



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

**CERTIFICATION TEST REPORT**

**FOR**

**Wi-Fi b/g/n Expansion Card  
(CONTAINED IN MODEM: GX400, GX440)**

**FCC ID: N7NEC4501**

**IC ID: 2417C- EC4501**

**MODEL NUMBER: EC4501**

**REPORT NUMBER: 12U14203-1, Revision C**

**ISSUE DATE: MARCH 23, 2012**

*Prepared for*  
**SIERRA WIRELESS, INC.  
13811 WIRELESS WAY  
RICHMOND, BC V6V 3A4, CANADA**

*Prepared by*  
**COMPLIANCE CERTIFICATION SERVICES (UL CCS)  
47173 BENICIA STREET  
FREMONT, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888**



**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	02/06/12	Initial Issue	F. Ibrahim
A	03/02/12	Revised report based on client's comments 1. Revised on page 7 the MC5728V module 2. Changed date of testing to Aug-26-Sept 6 on page 5. 3. Updated cover page to state "Certification Test Report"	A. Zaffar
B	03/14/12	Removed the "x, y, z Statement from section 5.5	A. Zaffar
C	03/23/12	Added the worst-case orientation to section 5.5	F. Ibrahim

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS</b>	<b>5</b>
<b>2. TEST METHODOLOGY</b>	<b>6</b>
<b>3. FACILITIES AND ACCREDITATION</b>	<b>6</b>
<b>4. CALIBRATION AND UNCERTAINTY</b>	<b>6</b>
4.1. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY	6
<b>5. EQUIPMENT UNDER TEST</b>	<b>7</b>
5.1. DESCRIPTION OF EUT	7
5.2. MAXIMUM OUTPUT POWER	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	7
5.4. SOFTWARE AND FIRMWARE	7
5.5. WORST-CASE CONFIGURATION AND MODE	7
<b>6. DESCRIPTION OF TEST SETUP</b>	<b>8</b>
<b>7. TEST AND MEASUREMENT EQUIPMENT</b>	<b>10</b>
<b>8. ANTENNA PORT TEST RESULTS</b>	<b>11</b>
8.1. 802.11b MODE IN THE 2.4 GHz BAND	11
8.1.1. 6 dB BANDWIDTH	11
8.1.2. 99% BANDWIDTH	15
8.1.3. OUTPUT POWER	19
8.1.4. AVERAGE POWER	23
8.1.5. POWER SPECTRAL DENSITY	24
8.1.6. CONDUCTED SPURIOUS EMISSIONS	28
8.2. 802.11g MODE IN THE 2.4 GHz BAND	35
8.2.1. 6 dB BANDWIDTH	35
8.2.2. 99% BANDWIDTH	39
8.2.3. OUTPUT POWER	43
8.2.4. AVERAGE POWER	47
8.2.5. POWER SPECTRAL DENSITY	48
8.2.6. CONDUCTED SPURIOUS EMISSIONS	52
8.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND	59
8.3.1. 6 dB BANDWIDTH	59
8.3.2. 99% BANDWIDTH	63
8.3.3. OUTPUT POWER	67
8.3.4. AVERAGE POWER	71
8.3.5. POWER SPECTRAL DENSITY	72
8.3.6. CONDUCTED SPURIOUS EMISSIONS	76
8.4. 802.11n HT40 MODE IN THE 2.4 GHz BAND	83

8.4.1.	6 dB BANDWIDTH .....	83
8.4.2.	99% BANDWIDTH .....	87
8.4.1.	OUTPUT POWER .....	91
8.4.2.	AVERAGE POWER .....	95
8.4.3.	POWER SPECTRAL DENSITY .....	96
8.4.4.	CONDUCTED SPURIOUS EMISSIONS.....	100
<b>9.</b>	<b>RADIATED TEST RESULTS .....</b>	<b>107</b>
9.1.	<i>LIMITS AND PROCEDURE .....</i>	<i>107</i>
9.2.	<i>TRANSMITTER ABOVE 1 GHz .....</i>	<i>108</i>
9.2.1.	TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND .....	108
9.2.2.	TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND .....	117
9.2.3.	TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 2.4 GHz BAND .....	126
9.2.4.	TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 2.4 GHz BAND .....	135
9.3.	<i>RECEIVER ABOVE 1 GHz.....</i>	<i>144</i>
9.3.1.	RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 2.4 GHz BAND .....	144
9.3.2.	RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH IN THE 2.4 GHz BAND .....	145
9.4.	<i>WORST-CASE BELOW 1 GHz.....</i>	<i>146</i>
<b>10.</b>	<b>AC POWER LINE CONDUCTED EMISSIONS .....</b>	<b>149</b>
<b>11.</b>	<b>MAXIMUM PERMISSIBLE EXPOSURE .....</b>	<b>153</b>
<b>12.</b>	<b>SETUP PHOTOS.....</b>	<b>157</b>

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SIERRA WIRELESS, INC.  
13811 WIRELESS WAY  
RICHMOND, BC V6V 3A4, CANADA

**EUT DESCRIPTION:** Wi-Fi b/g/n Expansion Card  
(CONTAINED IN MODEM: GX400, GX440)

**MODEL:** EC4501

**SERIAL NUMBER:** 353567040131022, and CA11981509810

**DATE TESTED:** AUGUST 26- SEPT 6, 2011, JANUARY 26 to FEBRUARY 3, 2012

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.

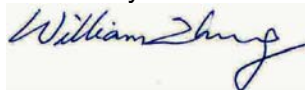
**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of 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:



FRANK IBRAHIM  
EMC SUPERVISOR  
UL CCS

Tested By:



WILLIAM ZHUANG  
EMC ENGINEER  
UL CCS

## 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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 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 a Wi-Fi b/g/n Expansion Card installed inside host Modems, m/n GX400 (co-located with MC8705 and MC5728V) or GX440 (co-located with MC7750).

The radio module is manufactured by Sierra Wireless, Inc.

### 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	17.53	56.62
2412 - 2462	802.11g	17.75	59.57
2412 - 2462	802.11n HT20	17.84	60.81
2422 - 2452	802.11n HT40	16.13	41.02

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a detachable dipole antenna, with a maximum gain of 2 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 4.2.3.007

The test utility software used during testing was 4.2.3.007

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is the channel with the highest output power; therefore, 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.

EUT is investigated at X, Y and Z orientations; X position was the worst case, so all final emission testing was performed at X position.

Worst-case data rates provided by the client which were used for the testing are as follows:

802.11b Mode: 1 Mbps

802.11g Mode: 6 Mbps

802.11n HT20 Mode: MCS0

802.11n HT40 Mode: MCS15

## 6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter 1	Sierra Wireless	S018EM1200150	02037	DoC
Notebook PC	Toshiba	Tecra A11-S3511	7A105324H	DoC
AC Adapter 2	Hipro Electronics	PA3755U-1ACA	Q71C000A5210	DoC
USB Memory Dongle	National Semiconductor	Power Wise 512Mb	02039	DoC

### I/O CABLES

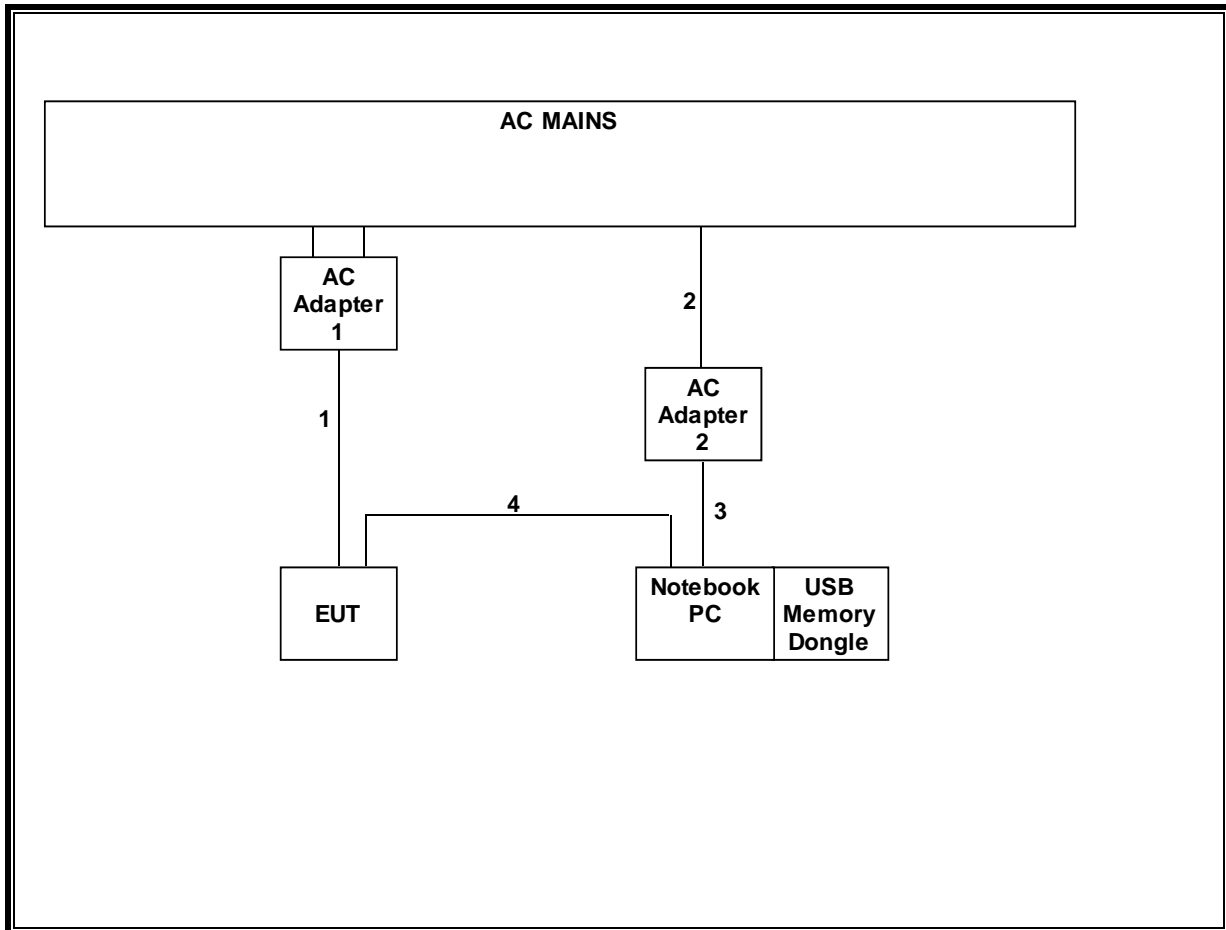
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	DC Power	1	2x2	Un-Shielded	1.75m	N/A
2	AC Power	1	3-Prong	Un-Shielded	1.5m	N/A
3	DC Power	1	Mini-Jack	Un-Shielded	1.75m	N/A
4	LAN	1	RJ-45	Un-Shielded	1m	N/A

### TEST SETUP

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



**SETUP DIAGRAM FOR TESTS**



## 7. 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
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01179	01/19/11	04/19/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	07/16/11	07/16/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01/27/11	02/27/12
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/11	06/29/12
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	07/28/11	07/28/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/12/11	07/12/12
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR	CNR
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/06/11	07/06/12
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/10/10	11/10/12
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	N02481	11/10/10	11/10/12
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	04/29/10	10/29/12
Power Meter	Agilent / HP	437B	None	07/28/11	07/28/12
Power Sensor, 18 GHz	Agilent / HP	8481A	None	07/28/11	10/28/12

## 8. ANTENNA PORT TEST RESULTS

### 8.1. 802.11b MODE IN THE 2.4 GHz BAND

#### 8.1.1. 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.

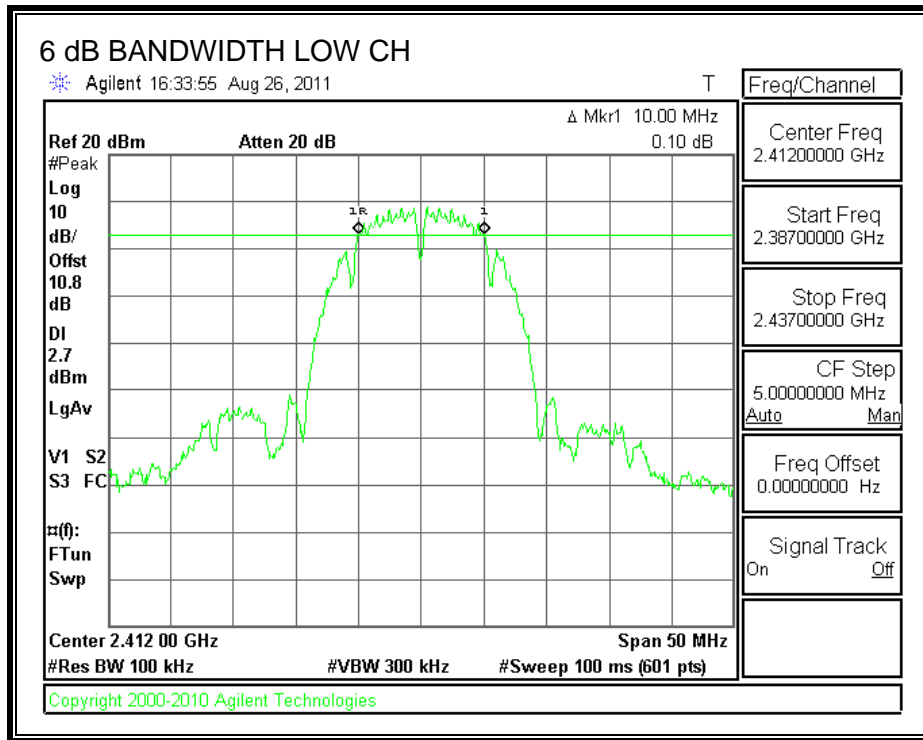
##### TEST PROCEDURE

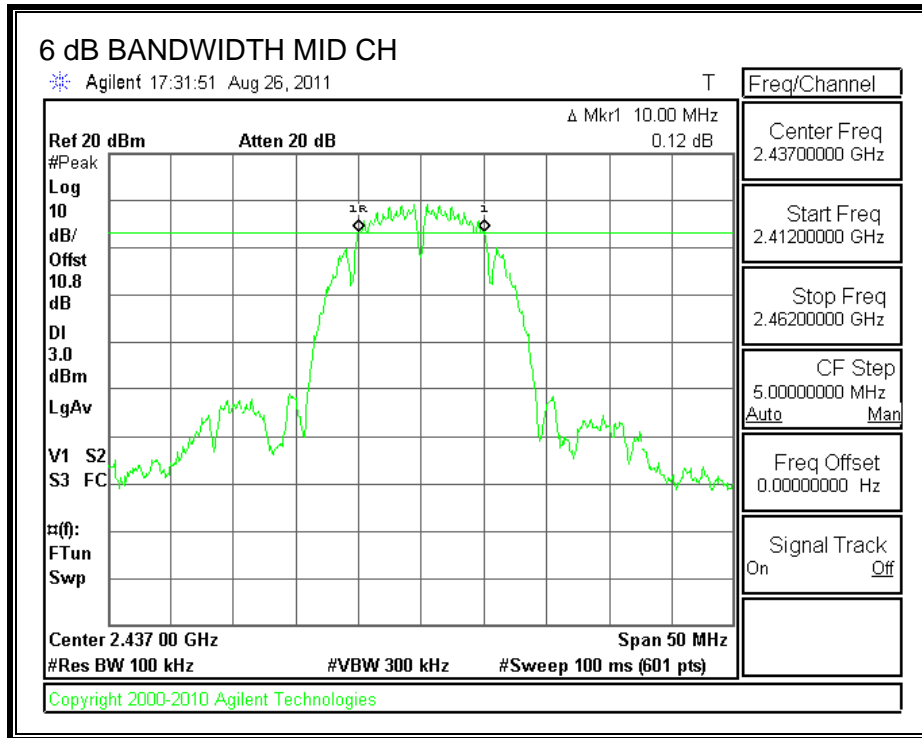
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

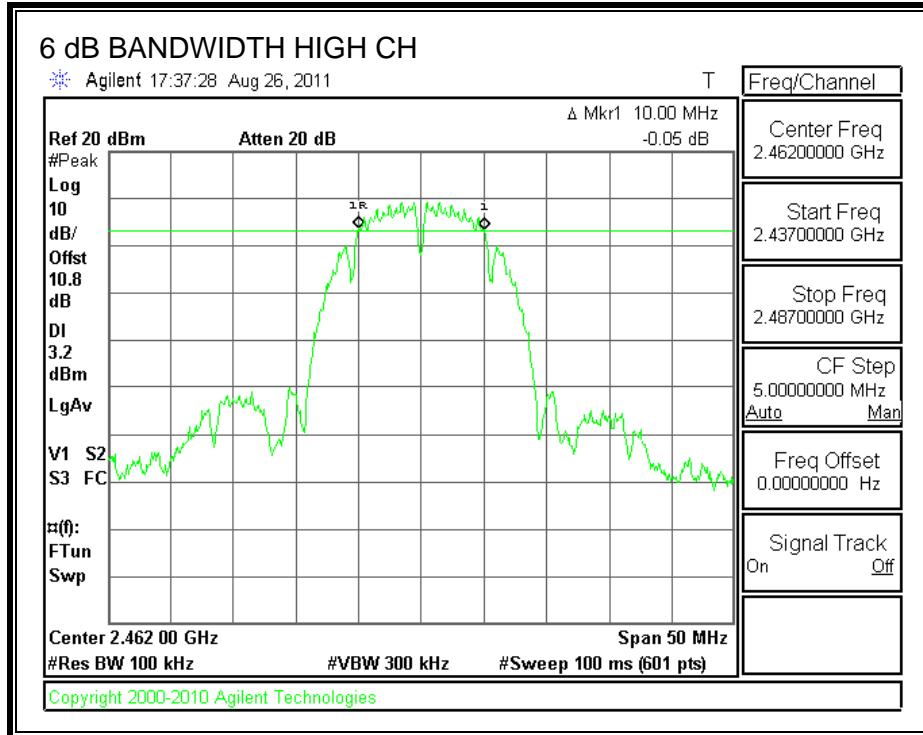
##### RESULTS

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

**6 dB BANDWIDTH**







### 8.1.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

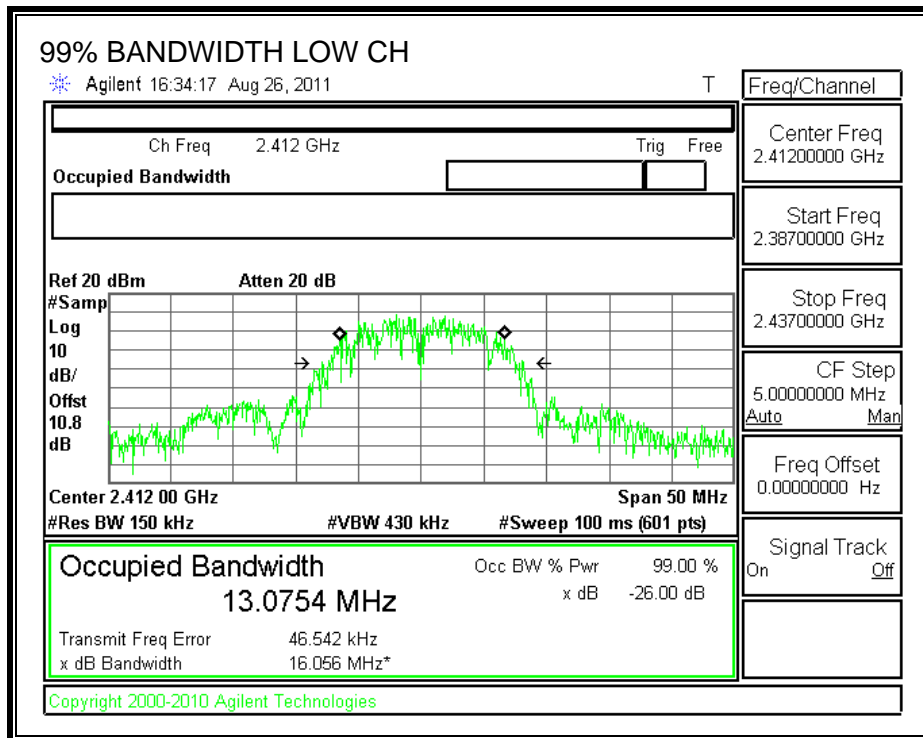
#### TEST PROCEDURE

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

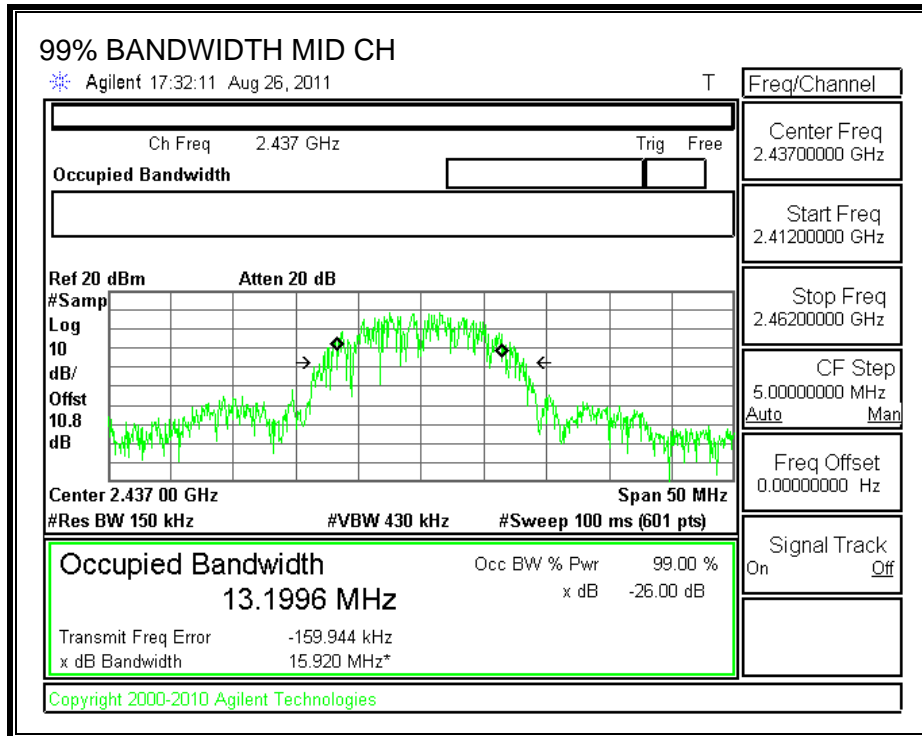
#### RESULTS

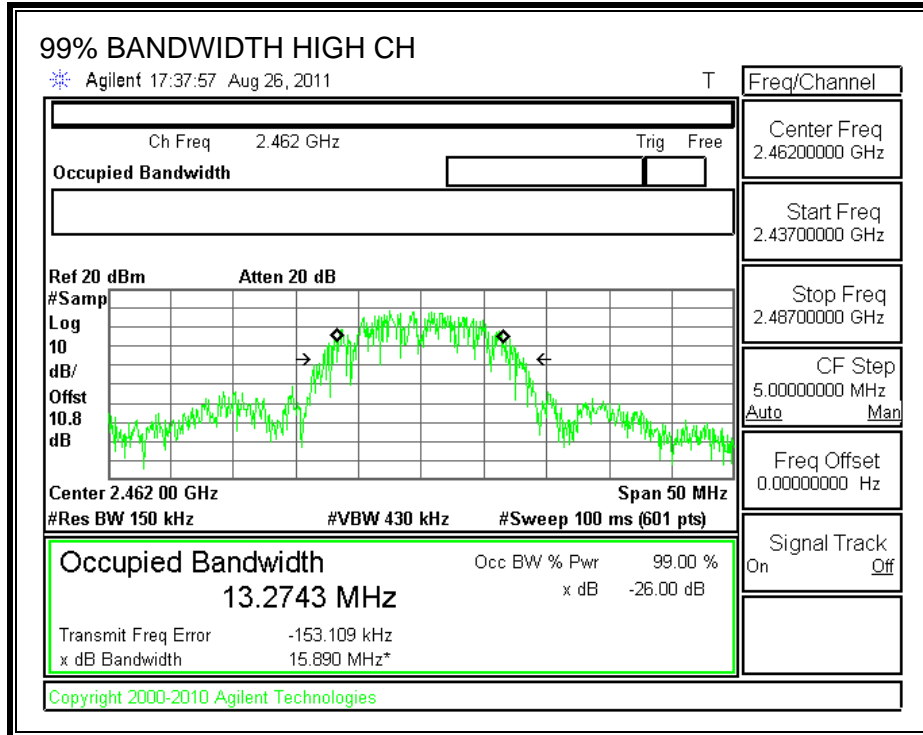
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	13.0754
Middle	2437	13.1996
High	2462	13.2743

**99% BANDWIDTH**









### 8.1.3. 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.

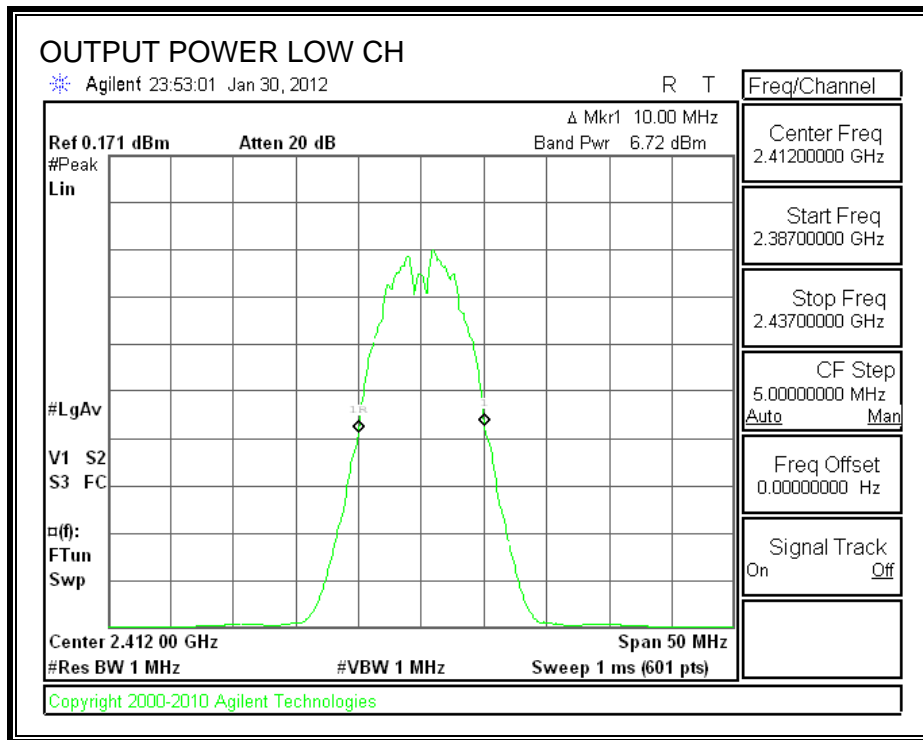
#### TEST PROCEDURE

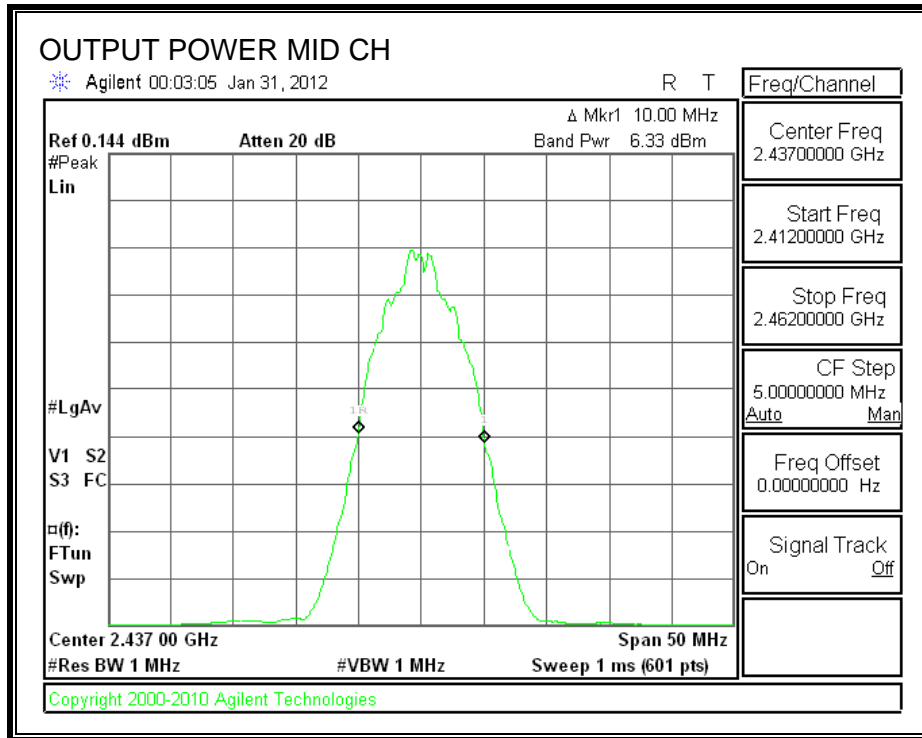
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

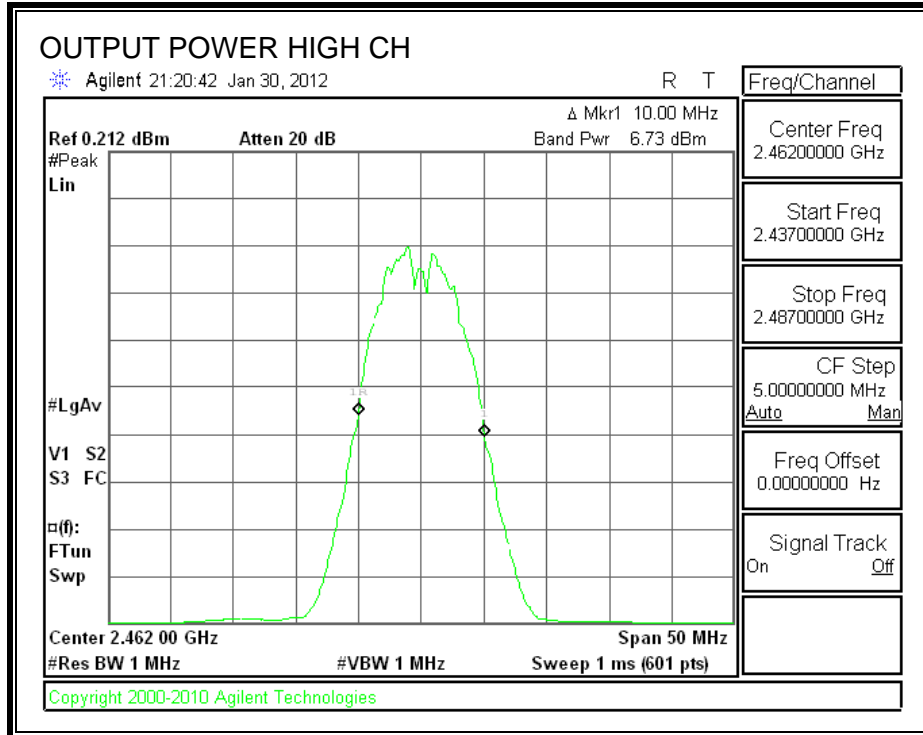
#### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	6.72	10.8	17.52	30	-12.48
Middle	2437	6.33	10.8	17.13	30	-12.87
High	2462	6.73	10.8	17.53	30	-12.47

**OUTPUT POWER**







### 8.1.4. 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 10.8 dB (including 10 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	15.35
Middle	2437	15.40
High	2462	15.50

### 8.1.5. 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

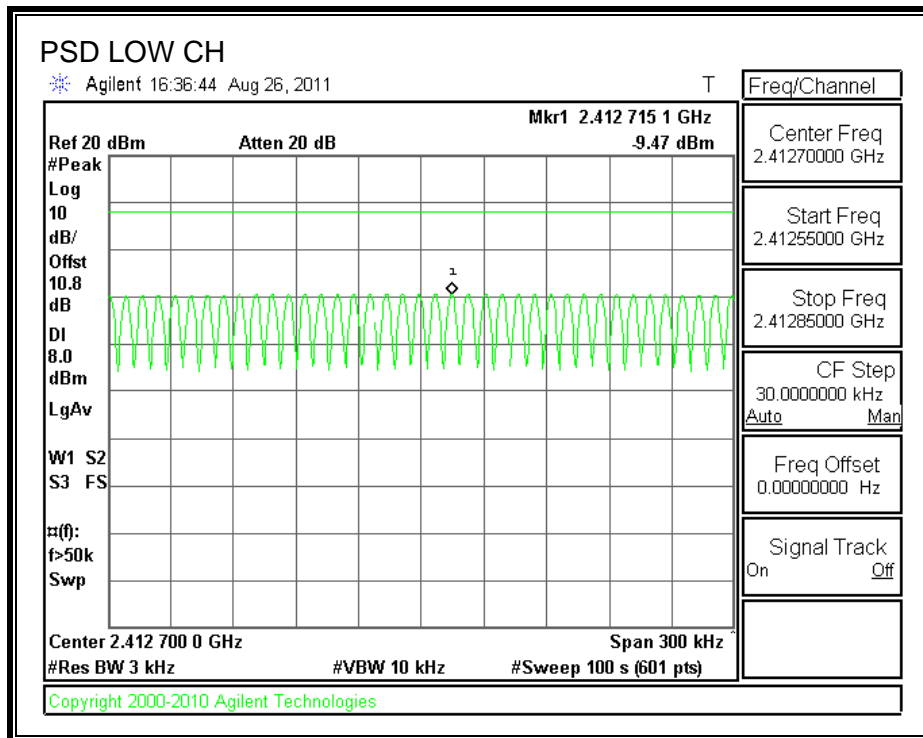
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

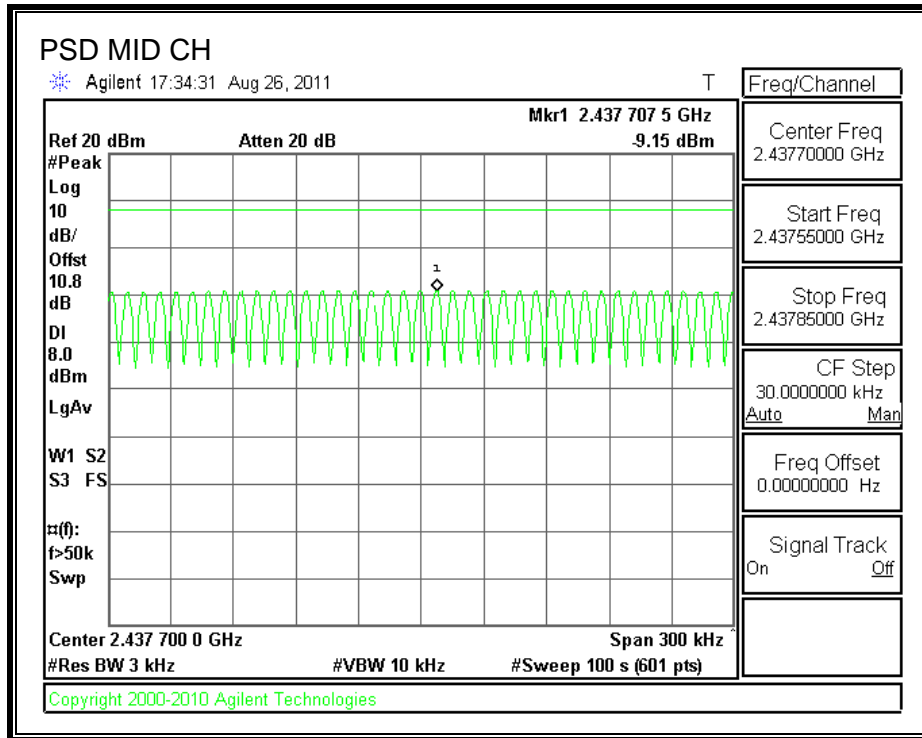
#### RESULTS

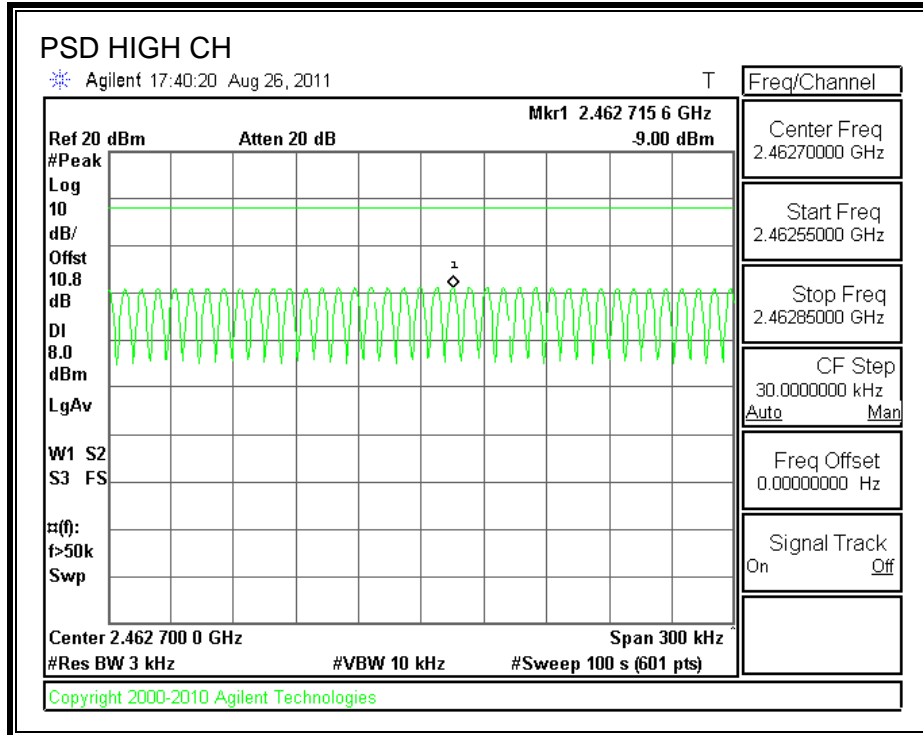
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-9.47	8	-17.47
Middle	2437	-9.15	8	-17.15
High	2462	-9.00	8	-17.00



**POWER SPECTRAL DENSITY**







## **8.1.6. 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.

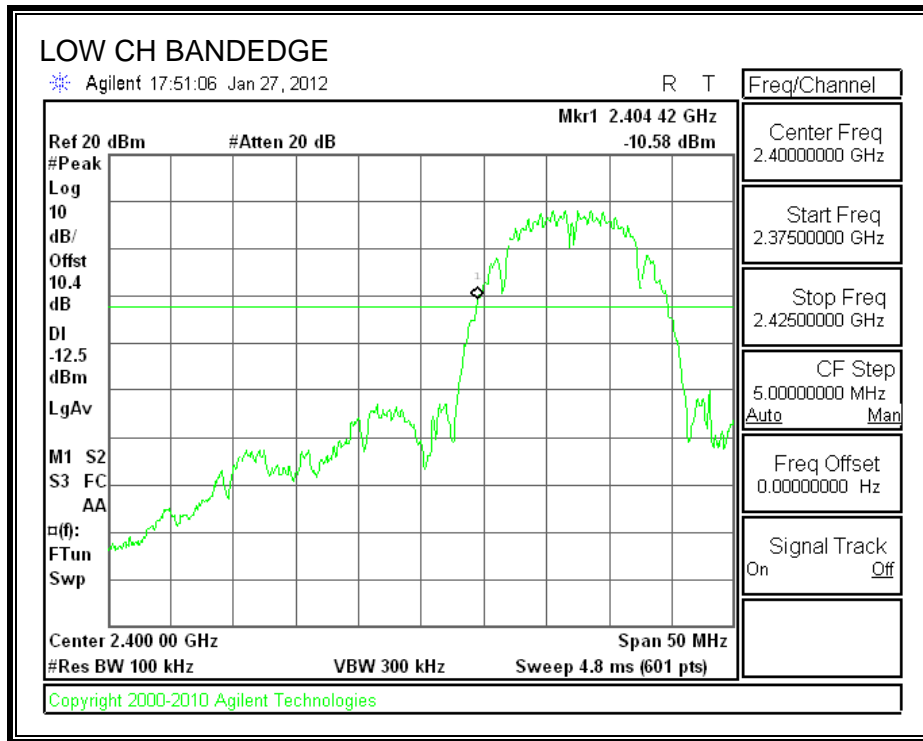
### **TEST PROCEDURE**

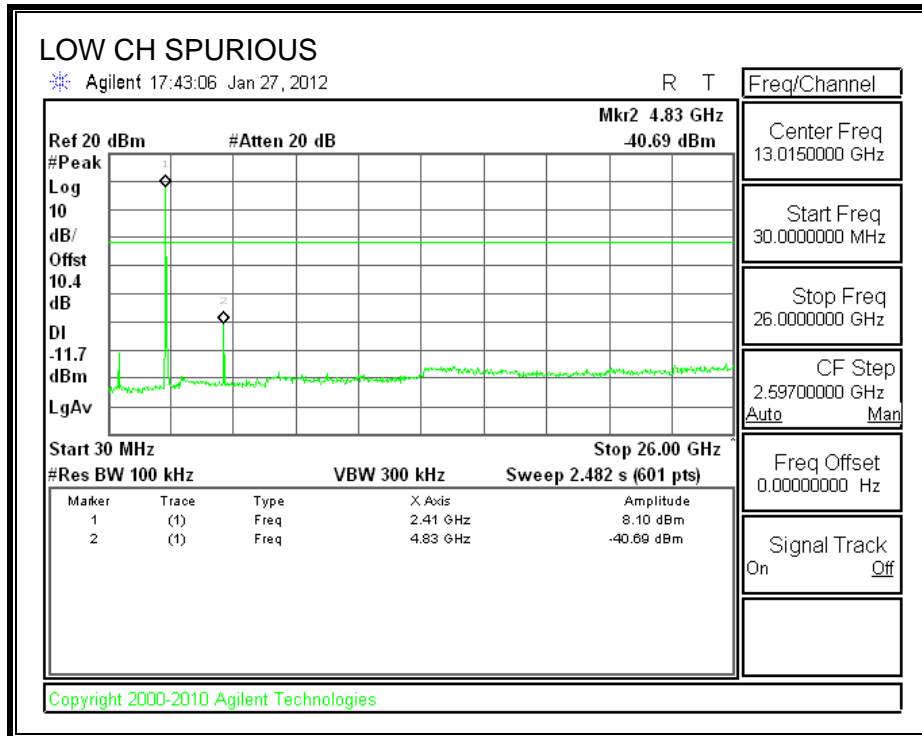
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

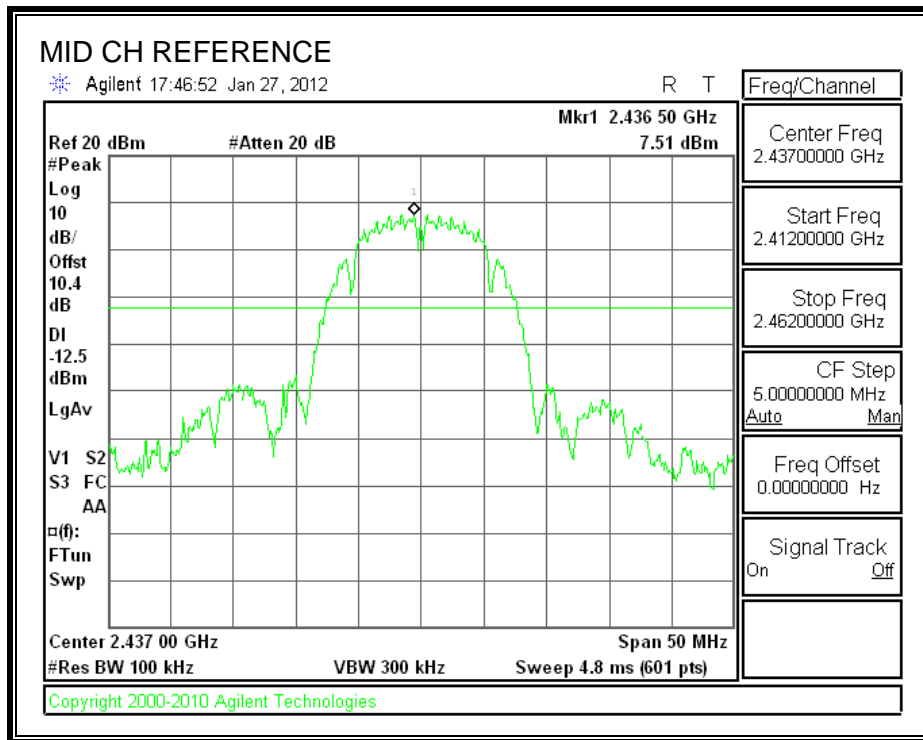
**RESULTS**

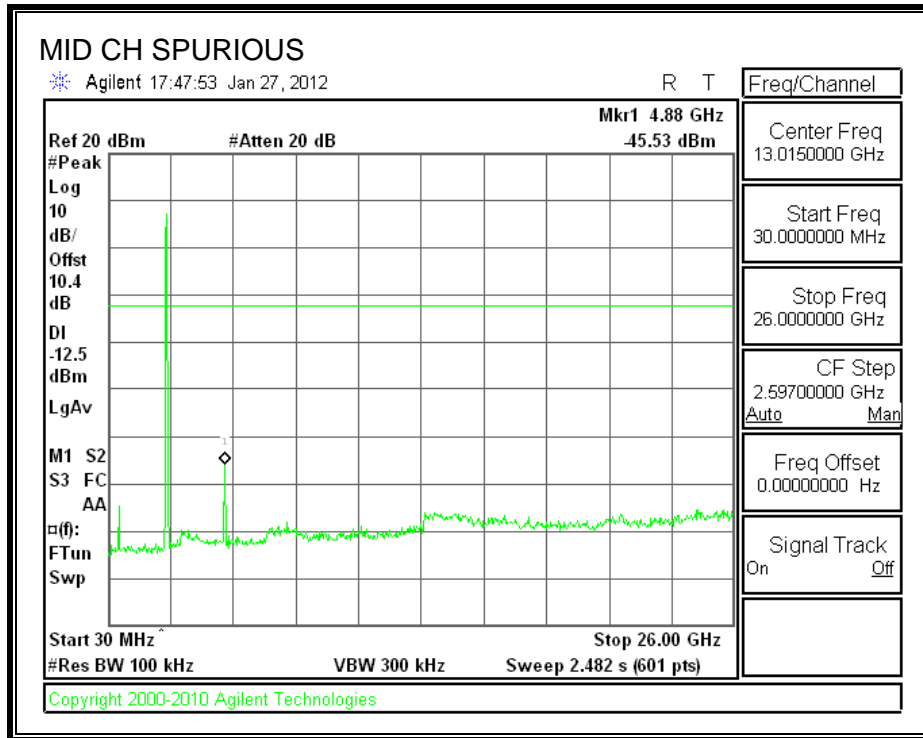
**SPURIOUS EMISSIONS, LOW CHANNEL**





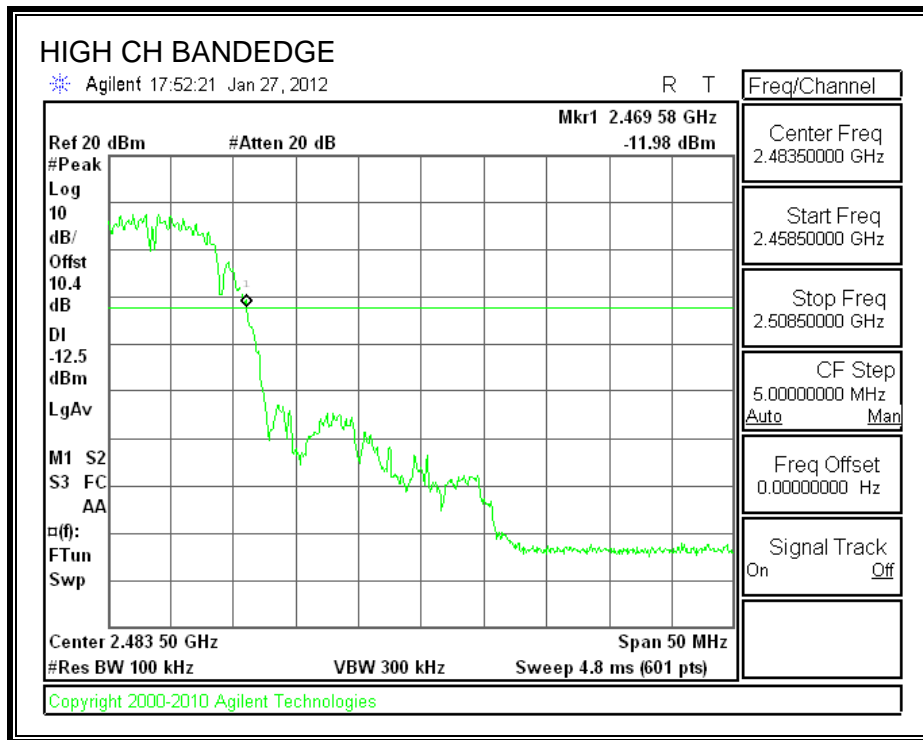
**SPURIOUS EMISSIONS, MID CHANNEL**

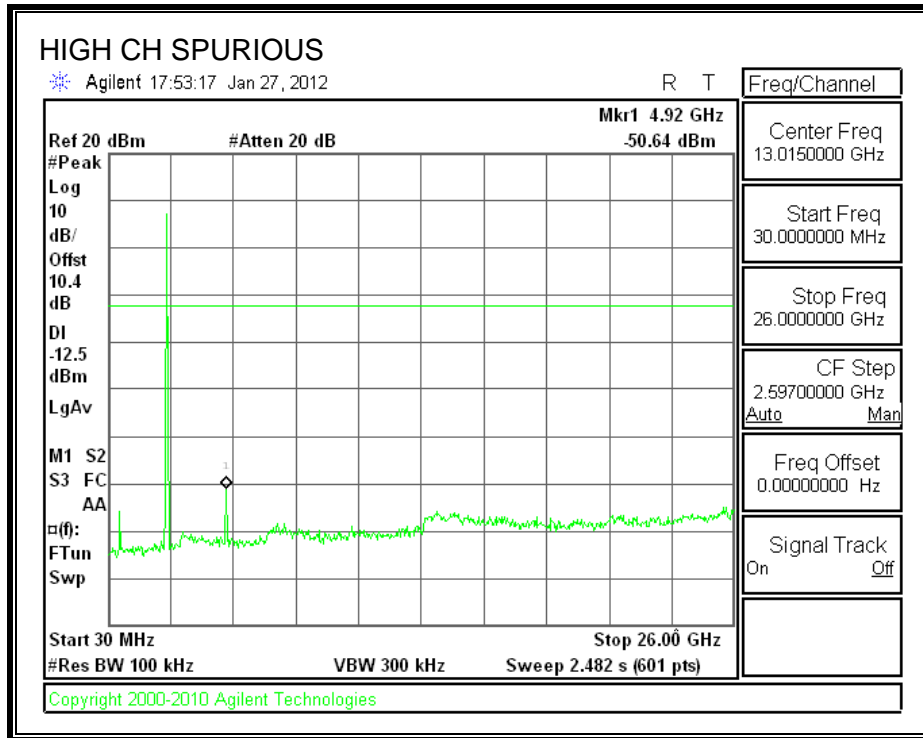






**SPURIOUS EMISSIONS, HIGH CHANNEL**





## 8.2. 802.11g MODE IN THE 2.4 GHz BAND

### 8.2.1. 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.

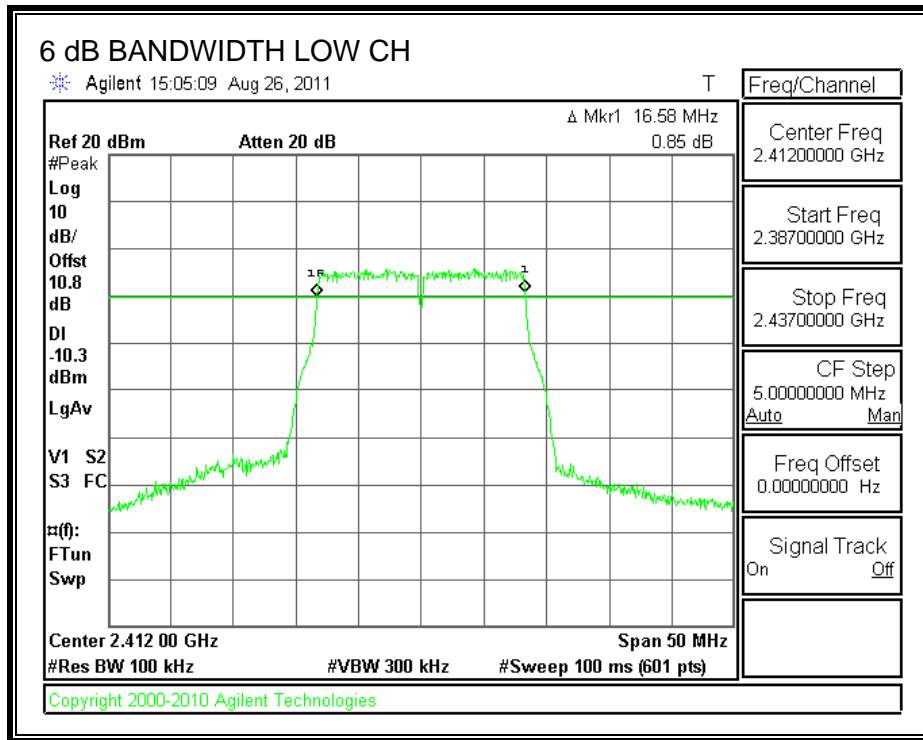
#### TEST PROCEDURE

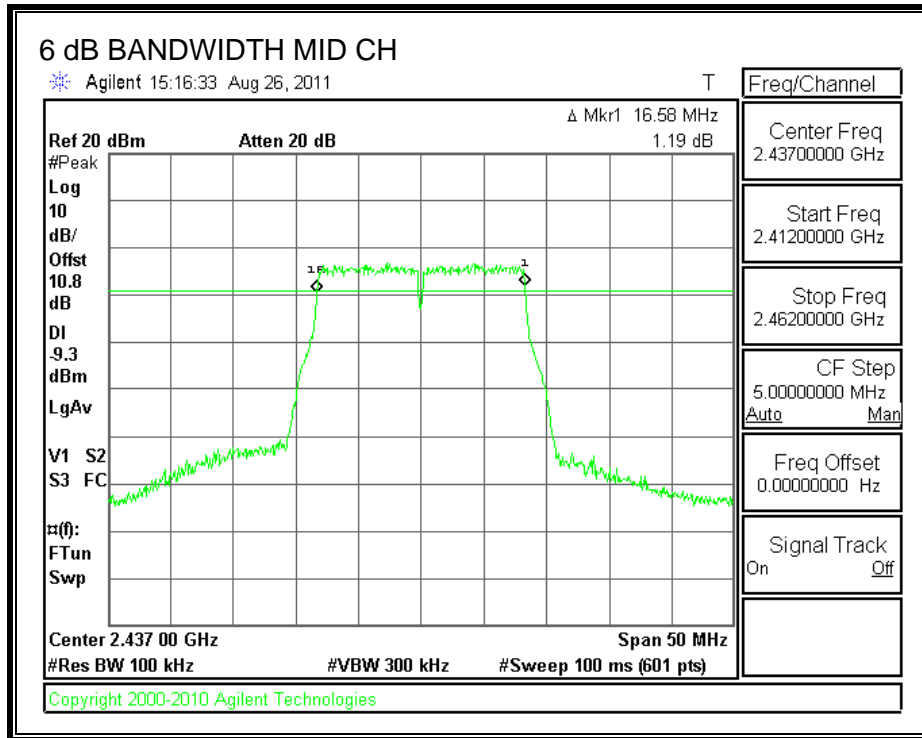
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

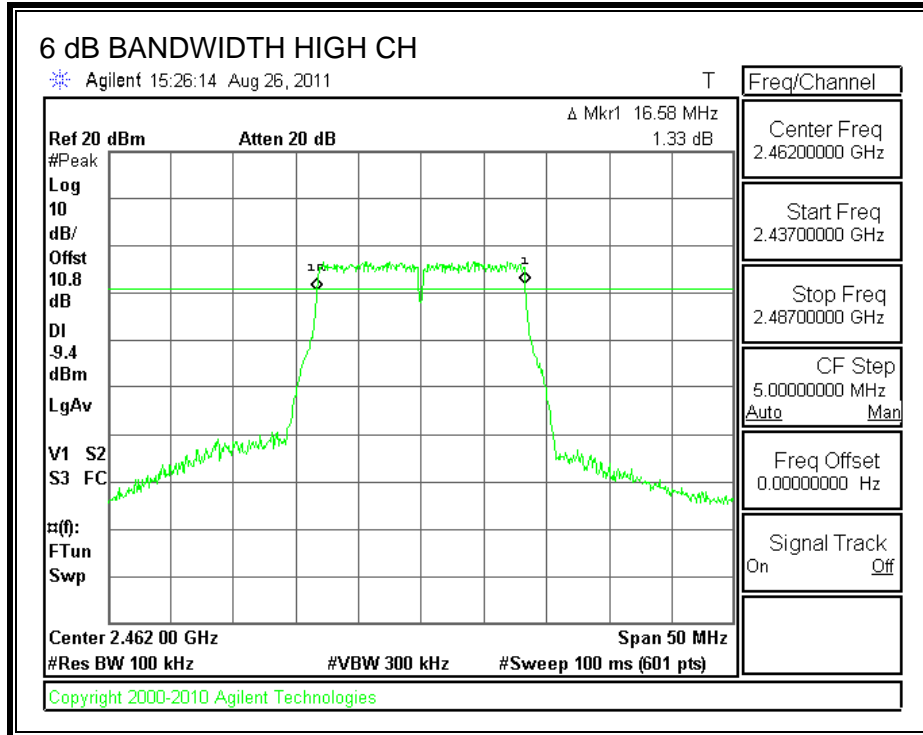
#### RESULTS

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

**6 dB BANDWIDTH**







## 8.2.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

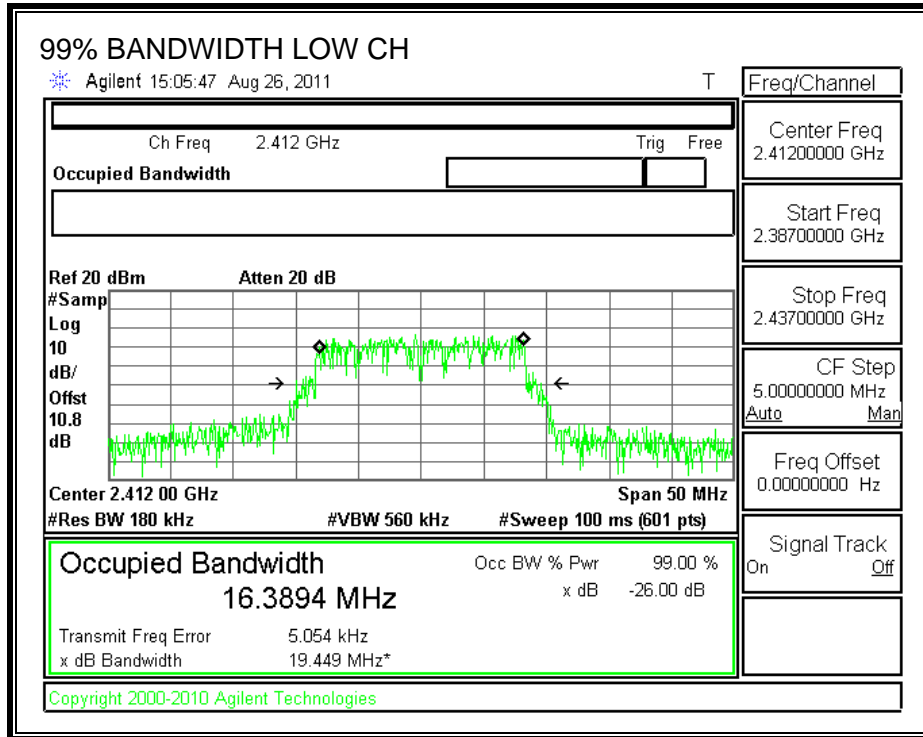
### TEST PROCEDURE

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.

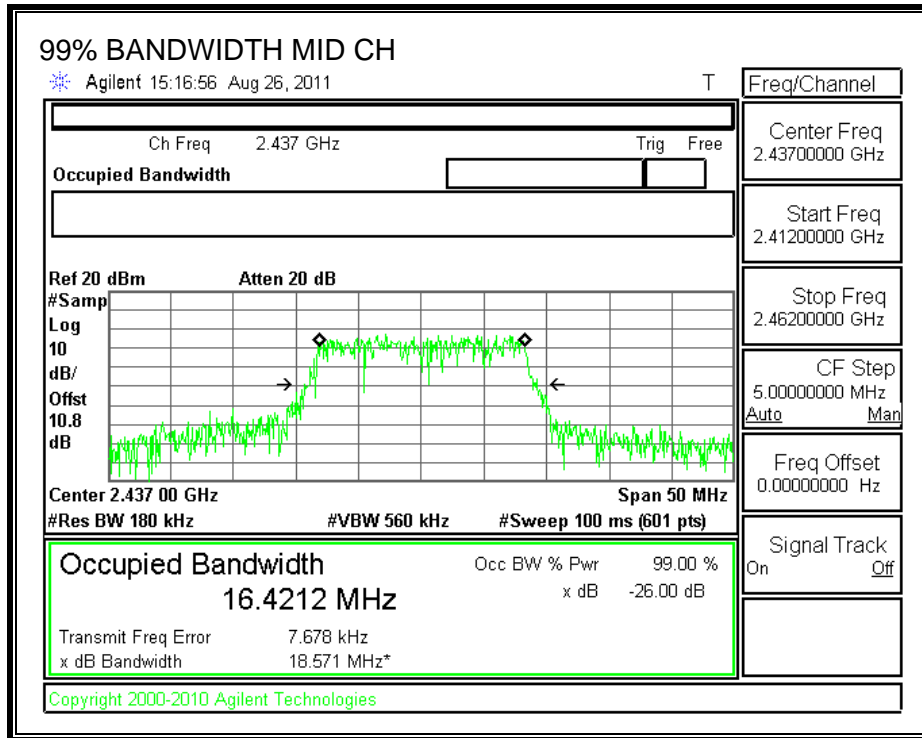
### RESULTS

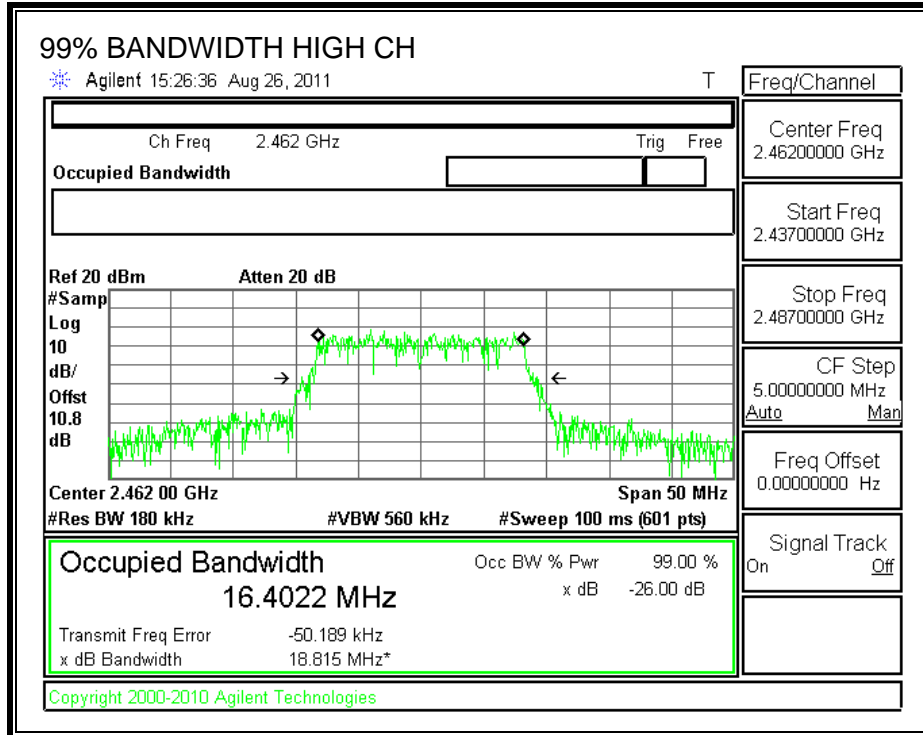
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.3894
Middle	2437	16.4212
High	2462	16.4022

**99% BANDWIDTH**









### 8.2.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

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

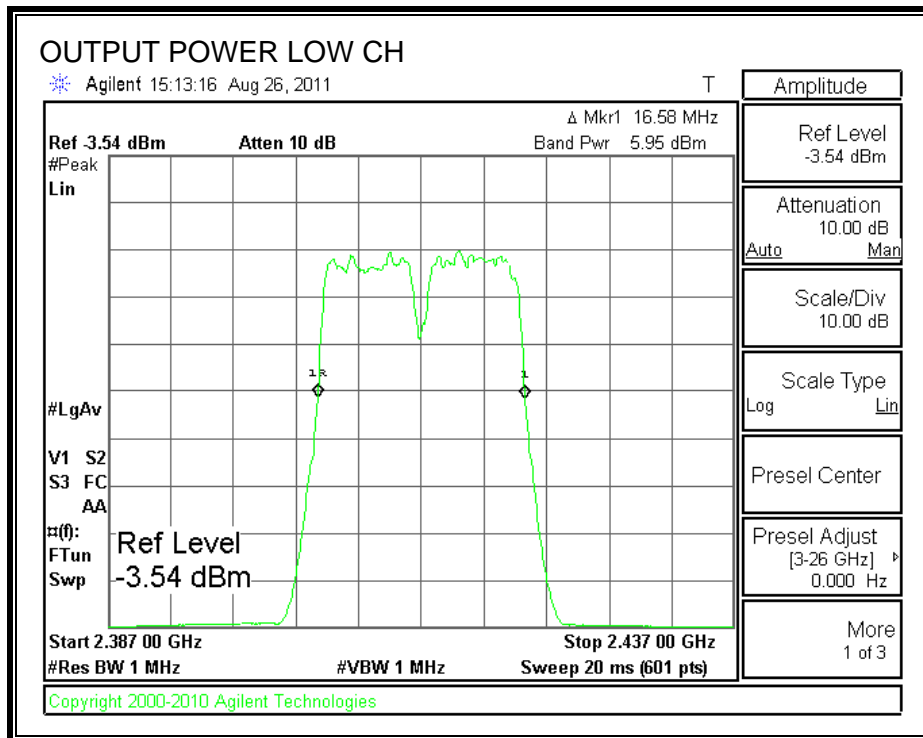
#### TEST PROCEDURE

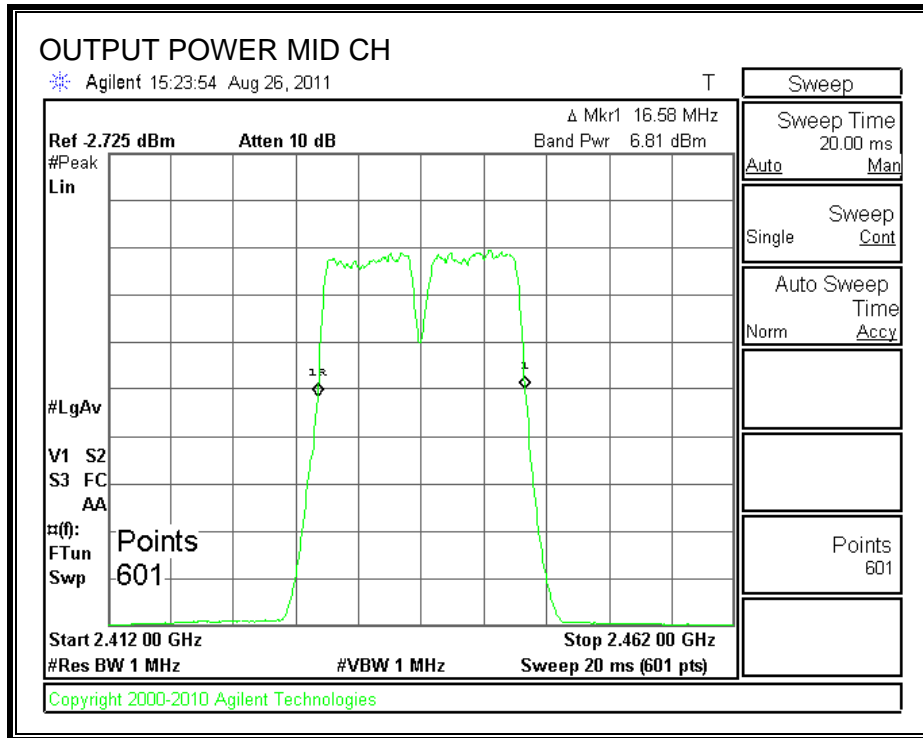
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

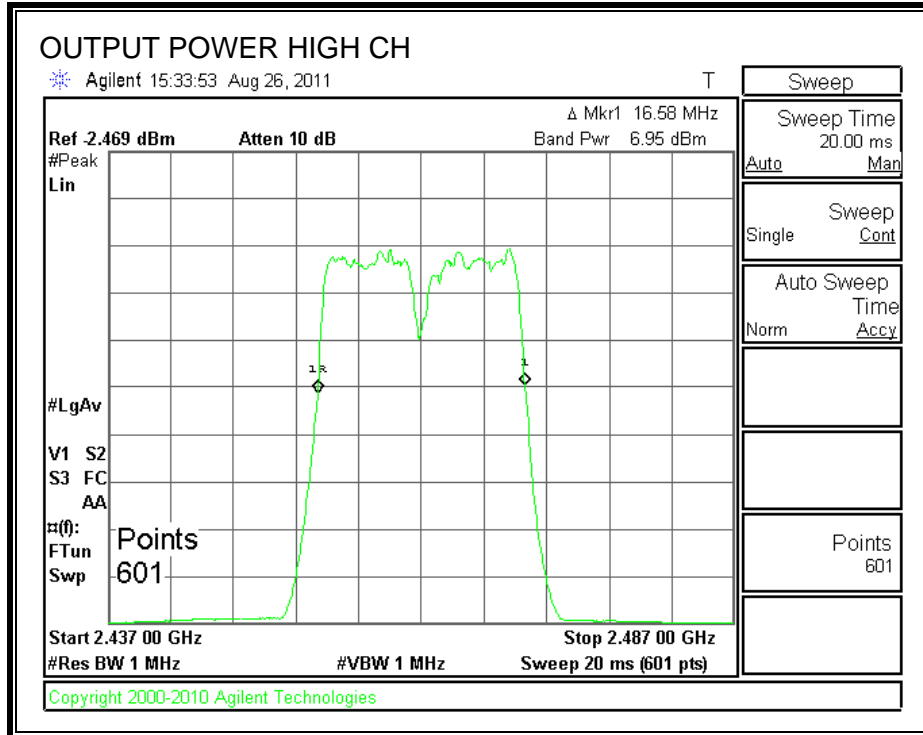
#### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	5.95	10.8	16.75	30	-13.25
Middle	2437	6.81	10.8	17.61	30	-12.39
High	2462	6.95	10.8	17.75	30	-12.25

**OUTPUT POWER**







## 8.2.4. 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 10.8 dB (including 10 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	14.58
Middle	2437	14.58
High	2462	14.25

## 8.2.5. 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

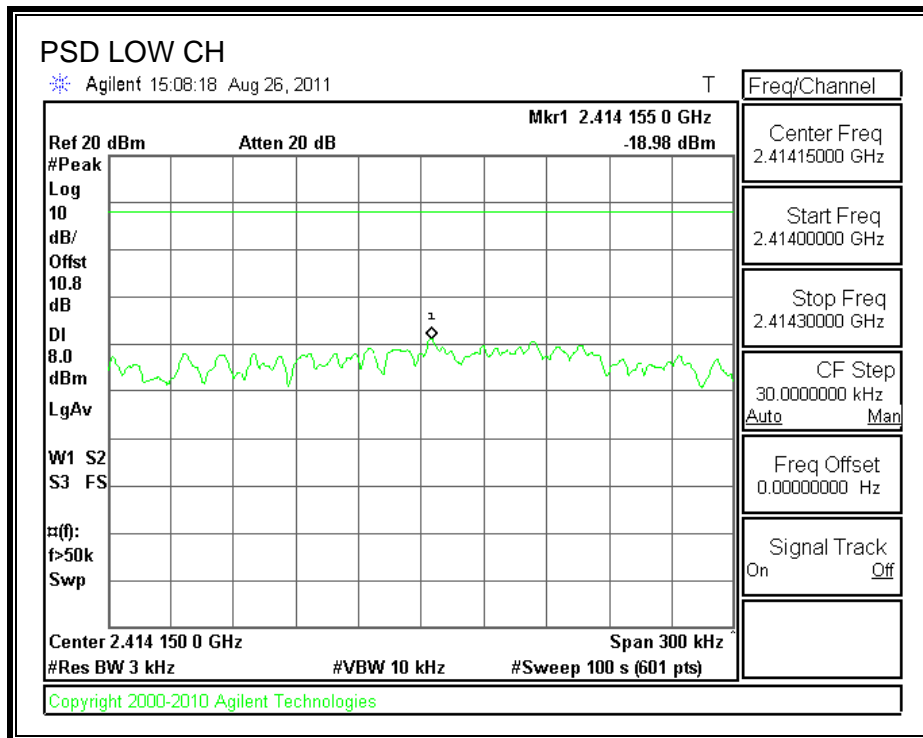
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

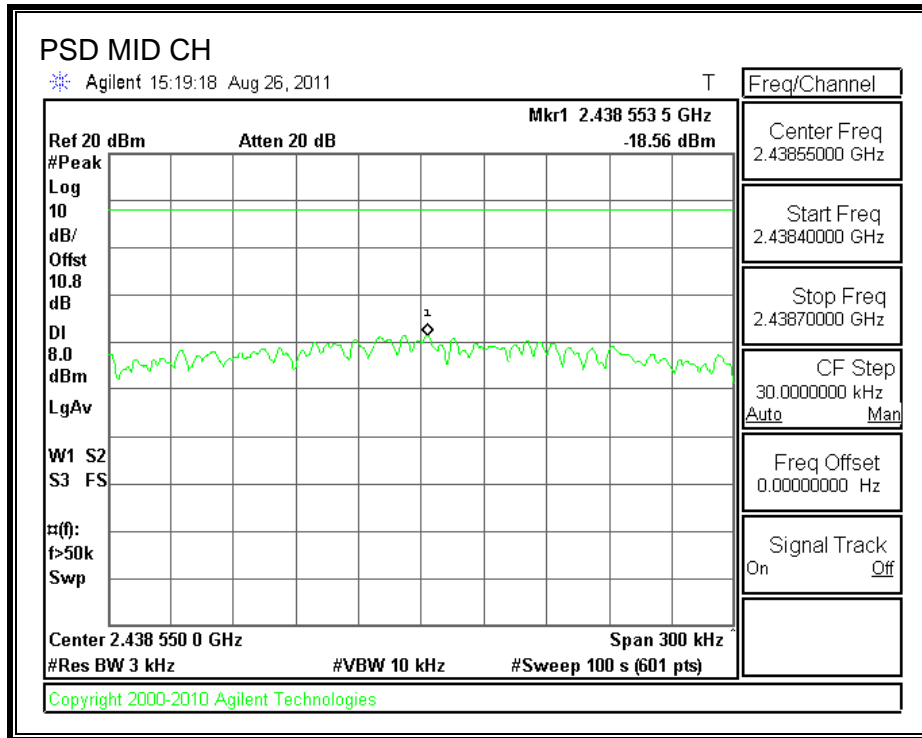
### RESULTS

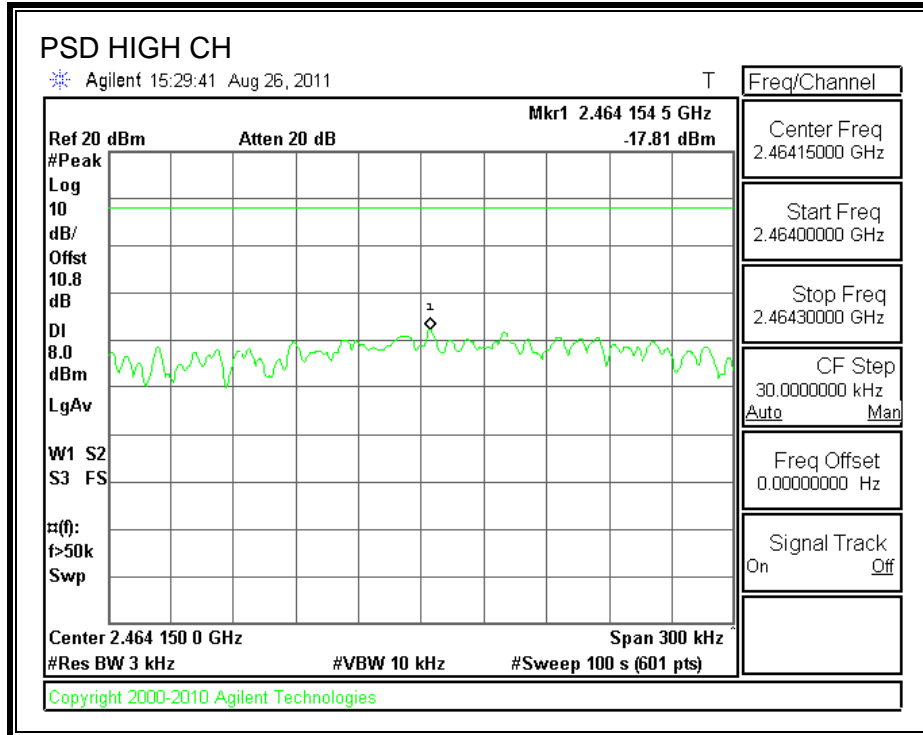
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-18.98	8	-26.98
Middle	2437	-18.56	8	-26.56
High	2462	-17.81	8	-25.81



**POWER SPECTRAL DENSITY**







## **8.2.6. 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.

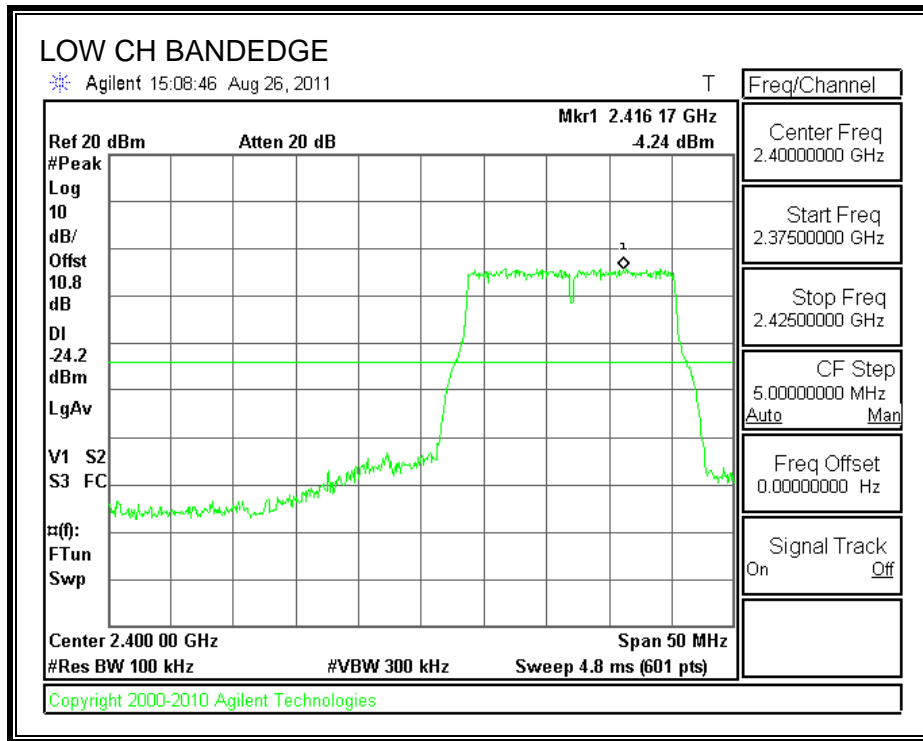
### **TEST PROCEDURE**

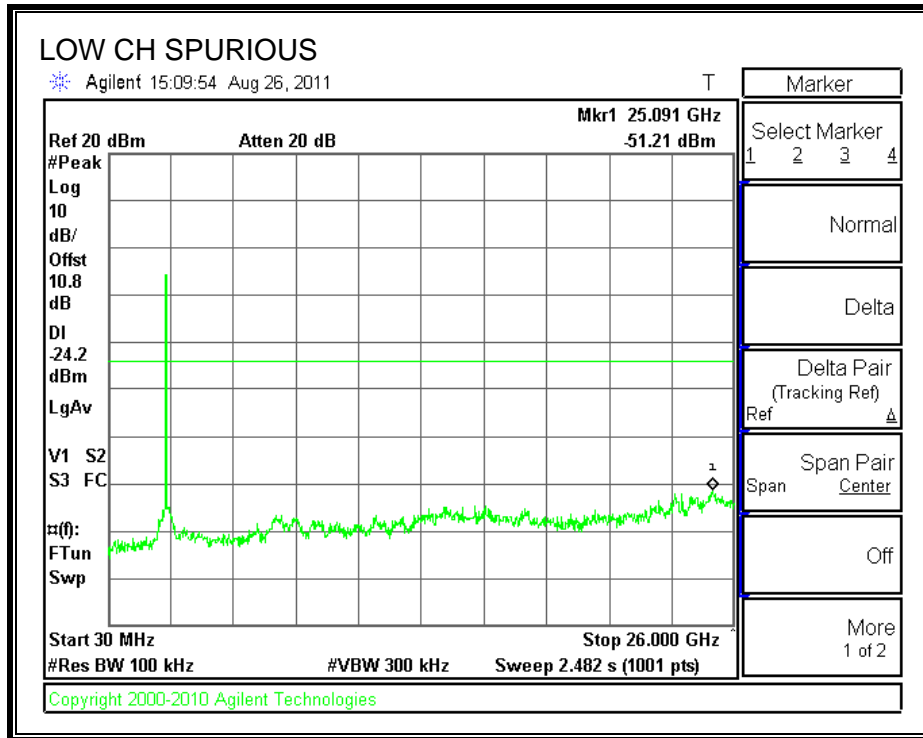
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

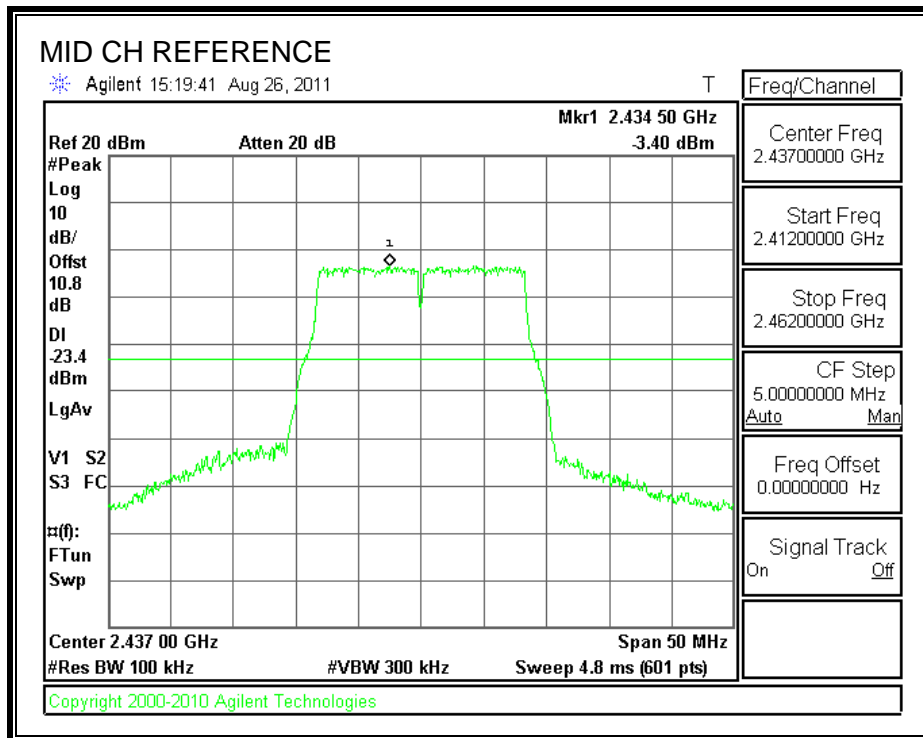
**RESULTS**

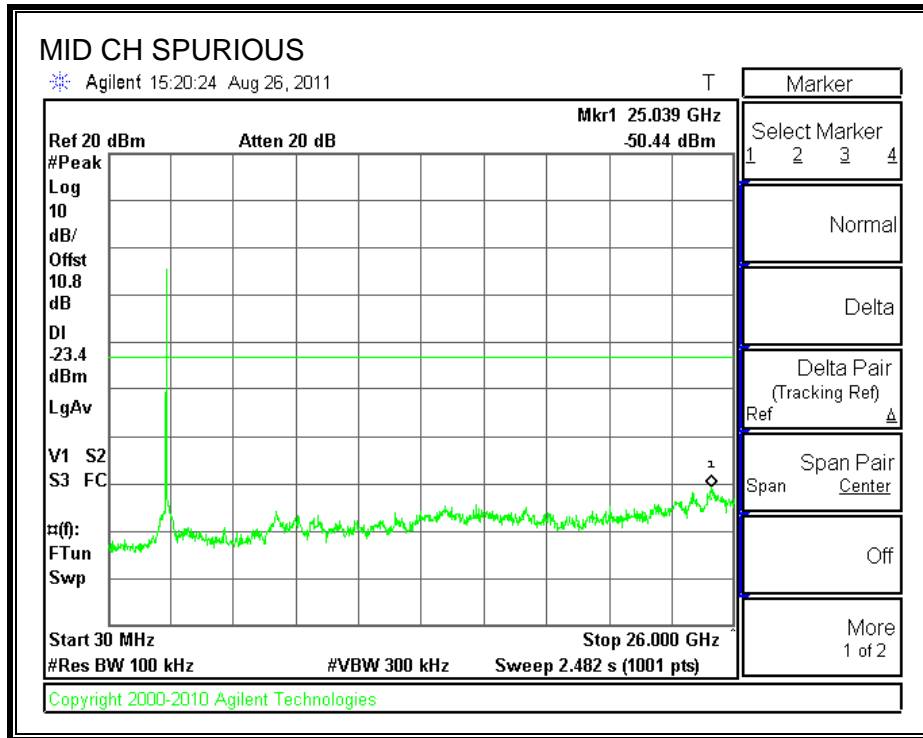
**SPURIOUS EMISSIONS, LOW CHANNEL**





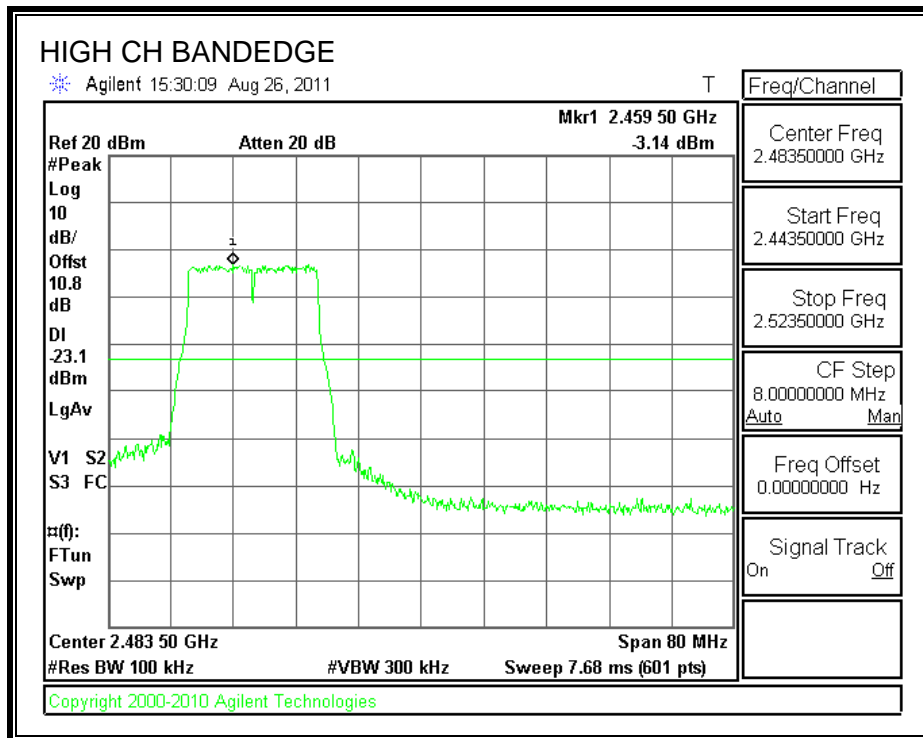
**SPURIOUS EMISSIONS, MID CHANNEL**

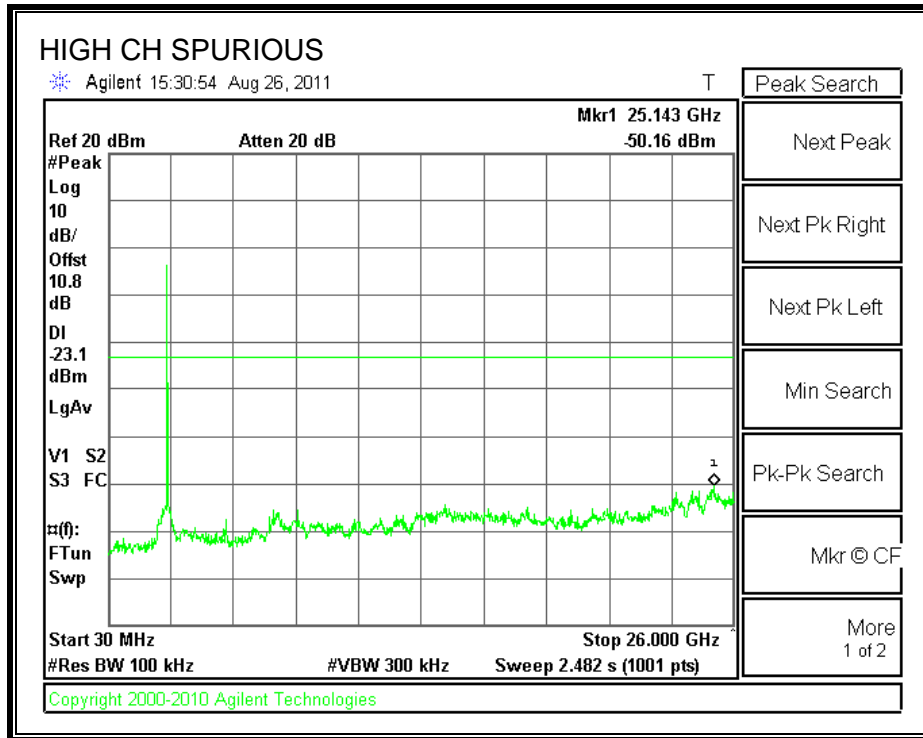






**SPURIOUS EMISSIONS, HIGH CHANNEL**





### 8.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

#### 8.3.1. 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.

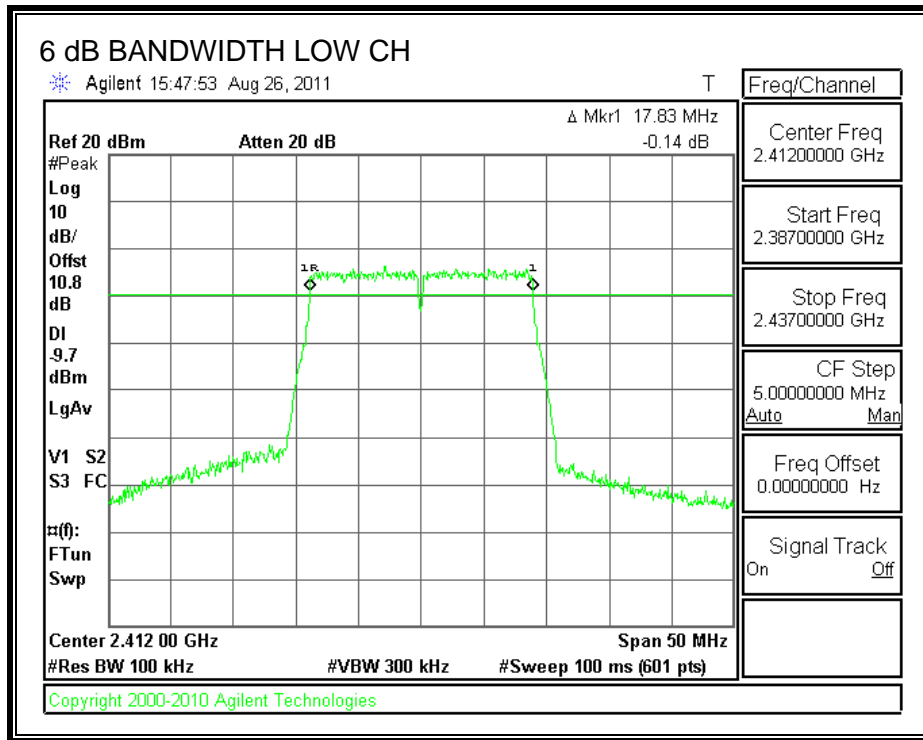
##### TEST PROCEDURE

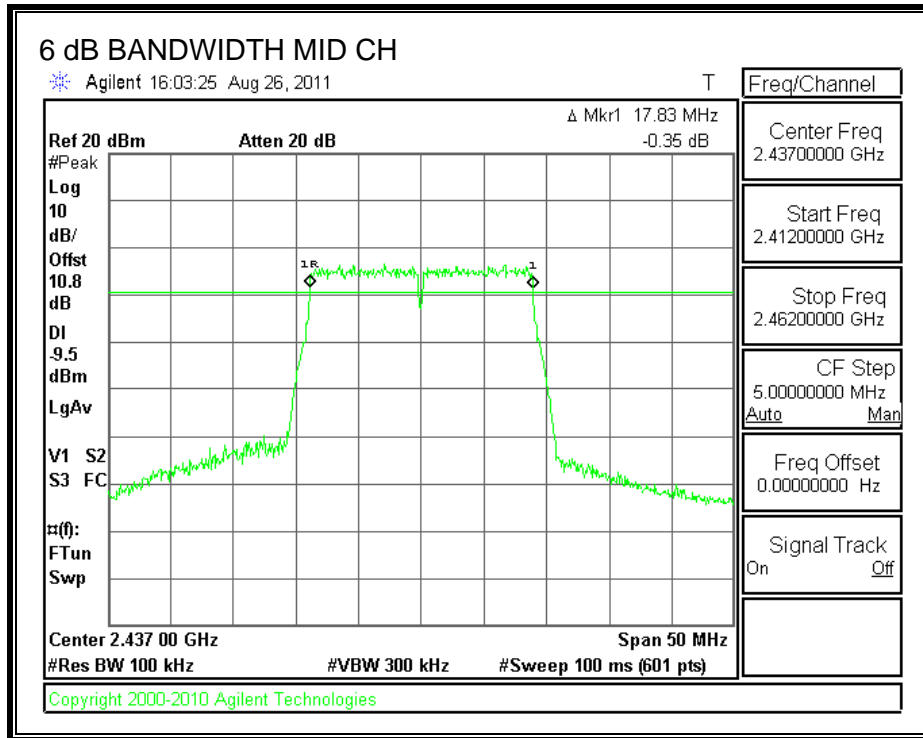
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

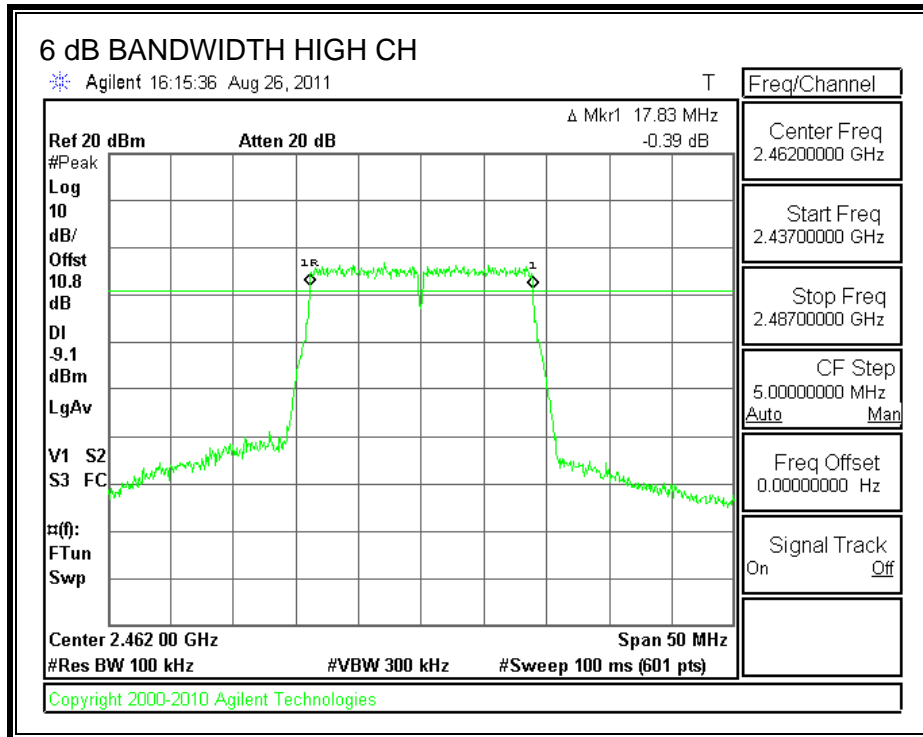
##### RESULTS

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

**6 dB BANDWIDTH**







### 8.3.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

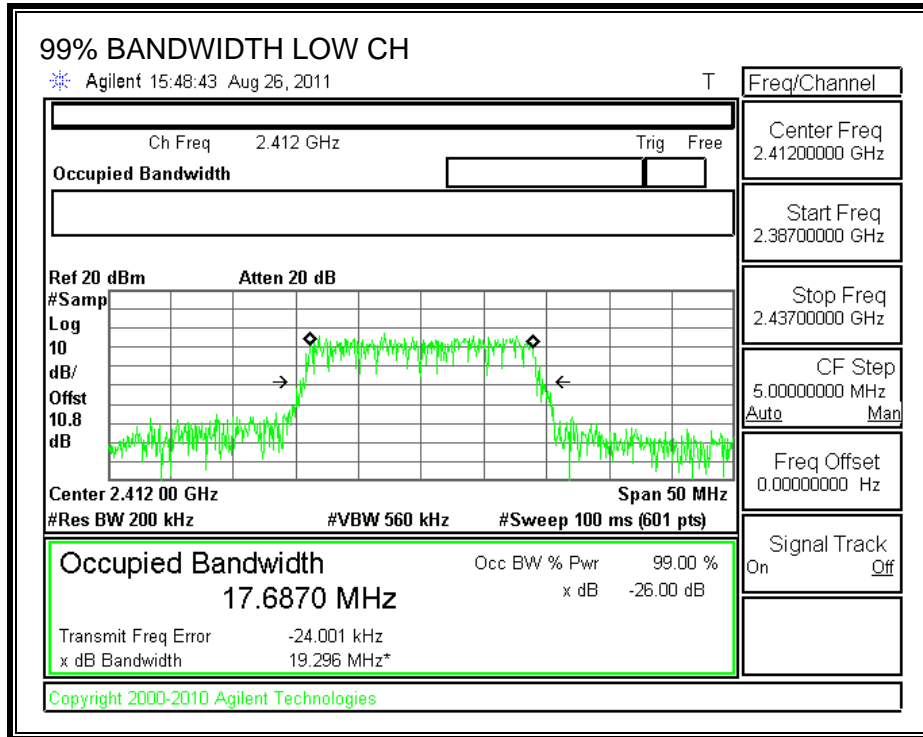
#### TEST PROCEDURE

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.

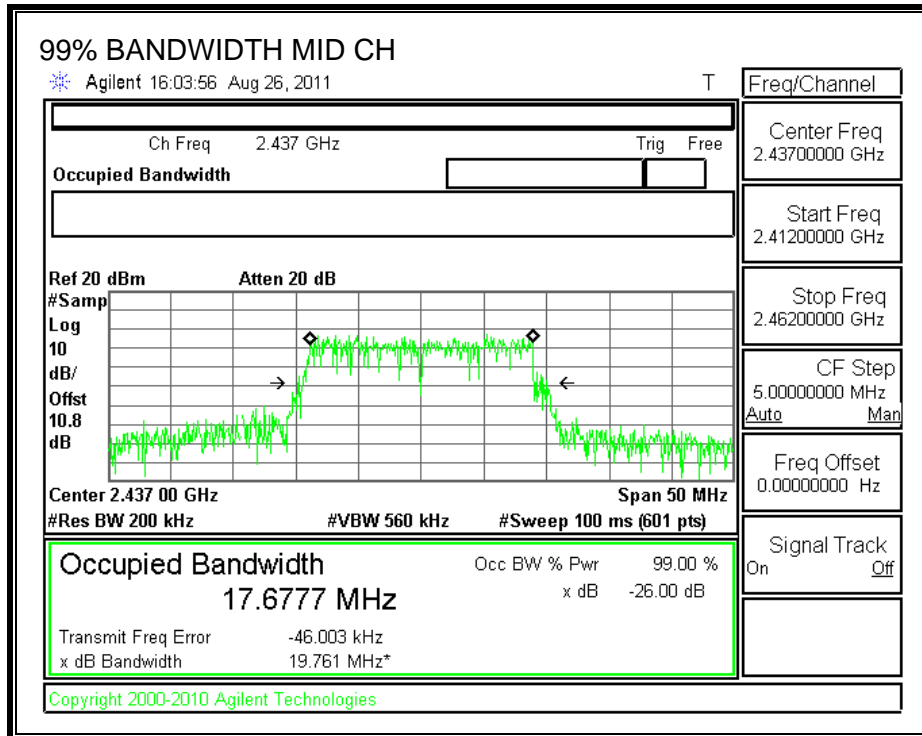
#### RESULTS

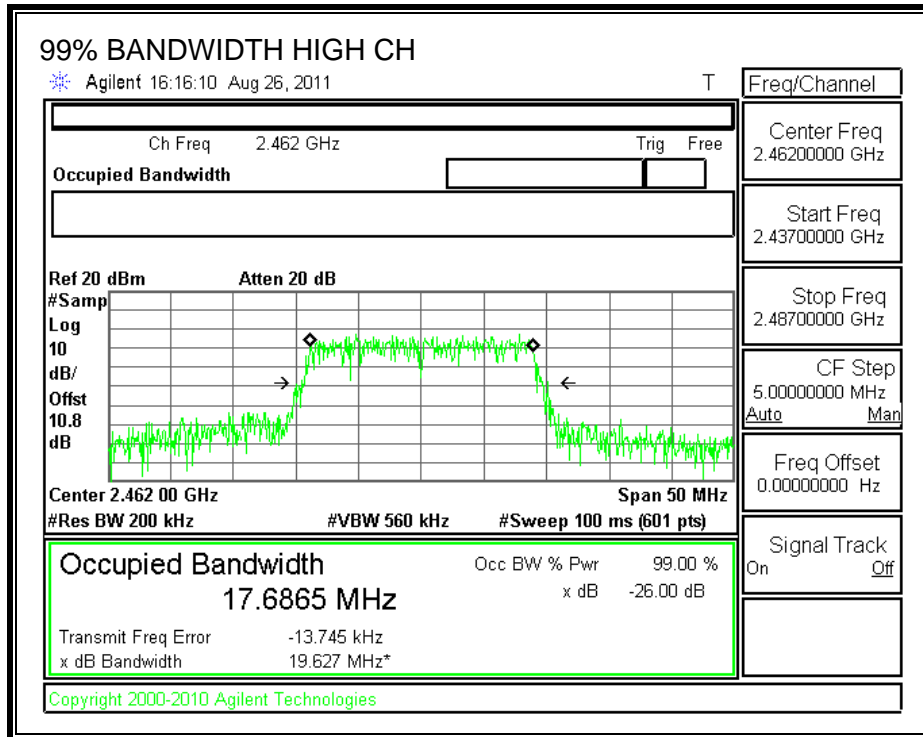
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	17.687
Middle	2437	17.6777
High	2462	17.6865

**99% BANDWIDTH**









### 8.3.3. 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.

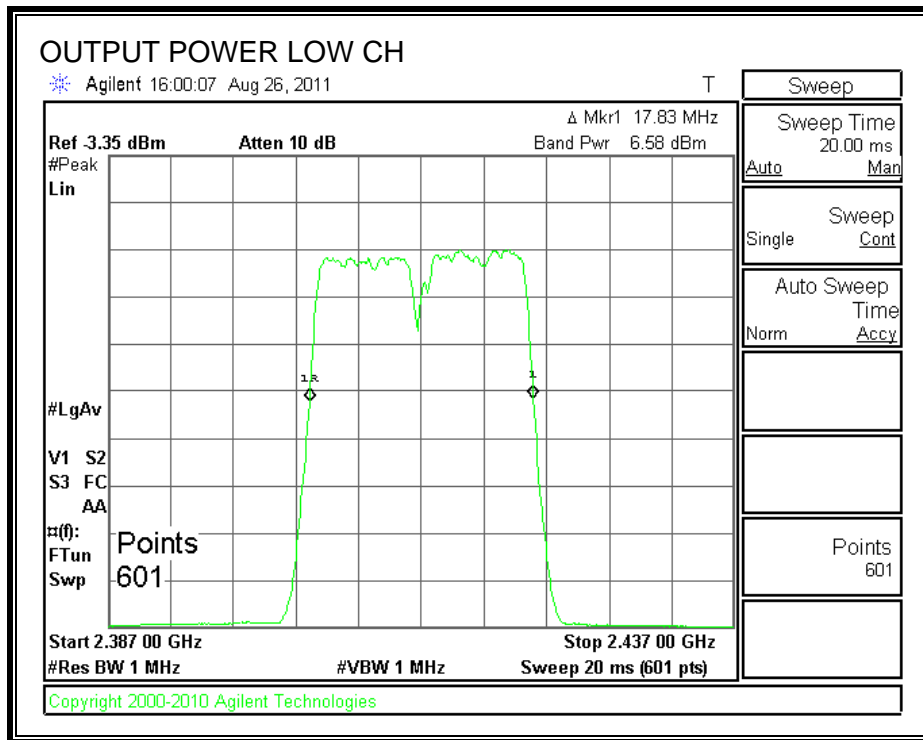
#### TEST PROCEDURE

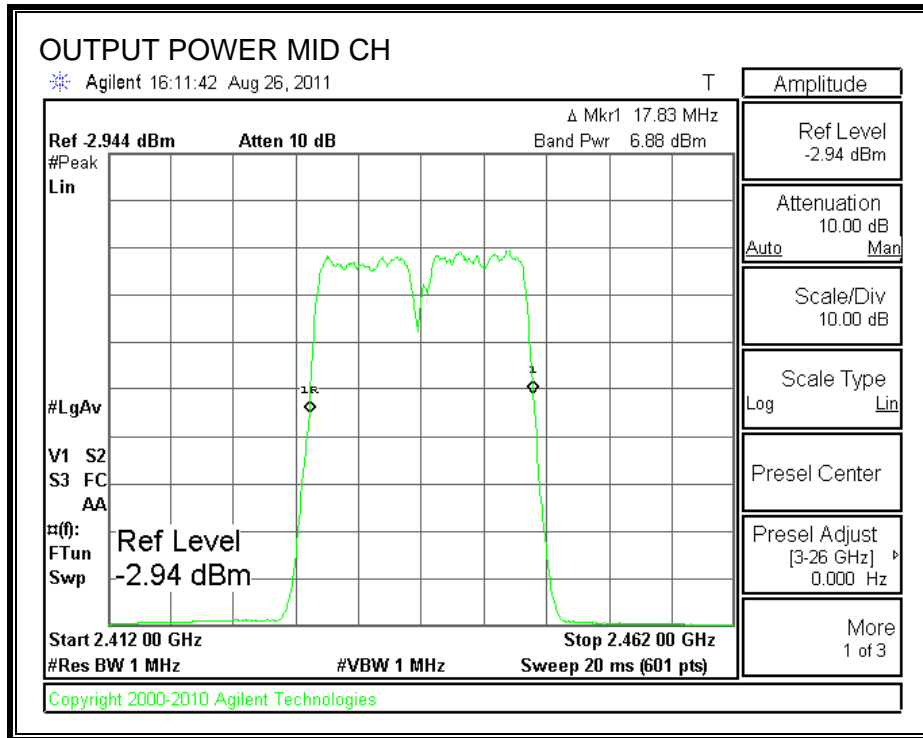
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

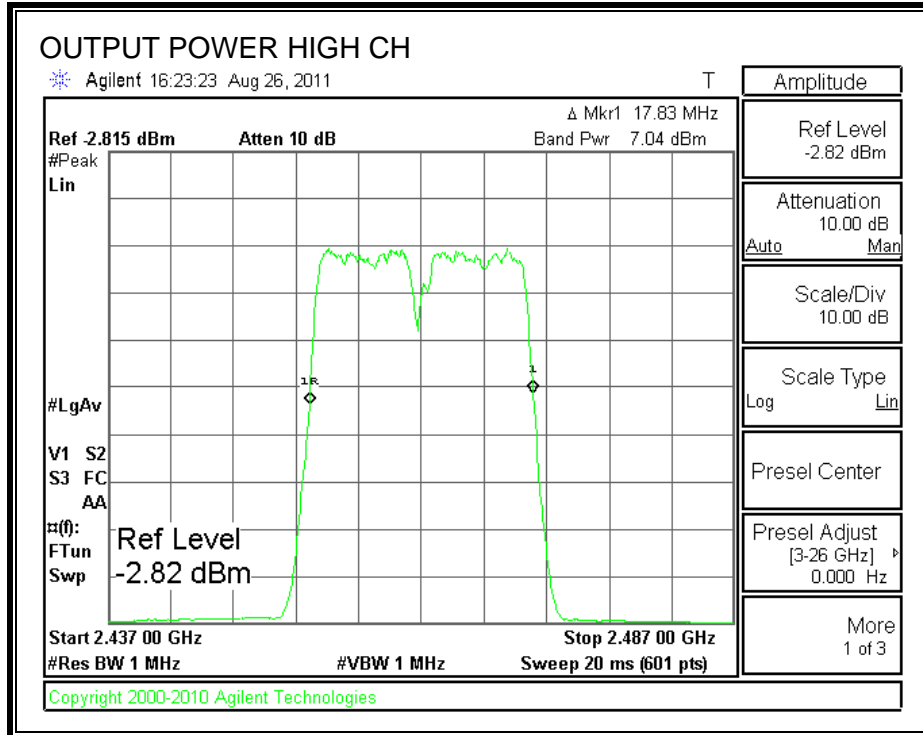
#### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	6.58	10.8	17.38	30	-12.62
Middle	2437	6.88	10.8	17.68	30	-12.32
High	2462	7.04	10.8	17.84	30	-12.16

**OUTPUT POWER**







### 8.3.4. 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 10.8 dB (including 10 dB pad and 0.8 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2412	14.23
Middle	2437	14.18
High	2462	13.85

### 8.3.5. 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

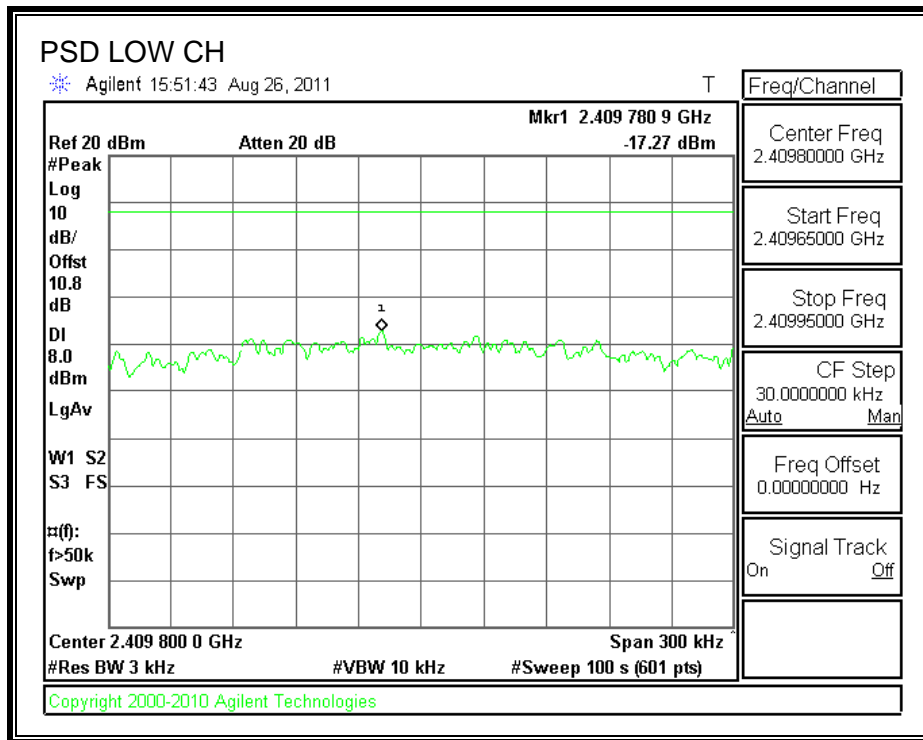
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

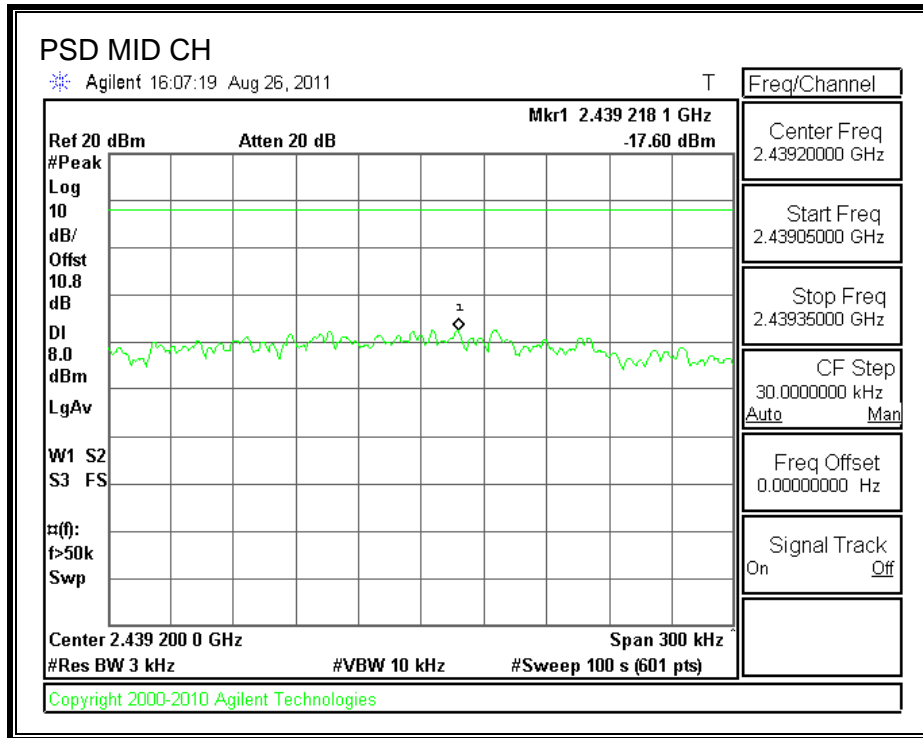
#### RESULTS

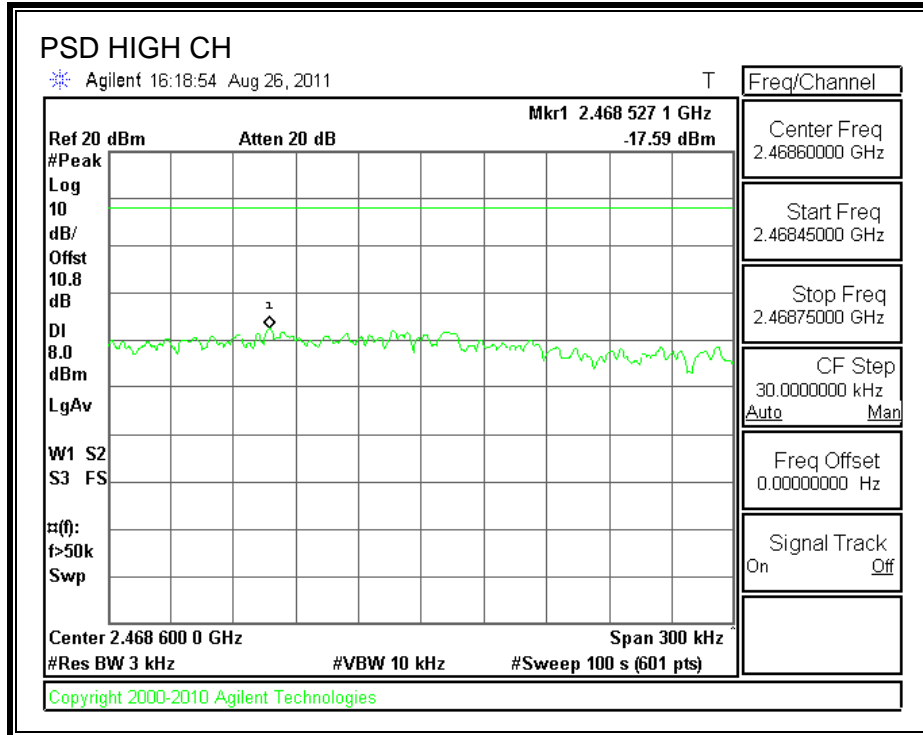
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-17.27	8	-25.27
Middle	2437	-17.60	8	-25.60
High	2462	-17.59	8	-25.59



**POWER SPECTRAL DENSITY**







### **8.3.6. 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.

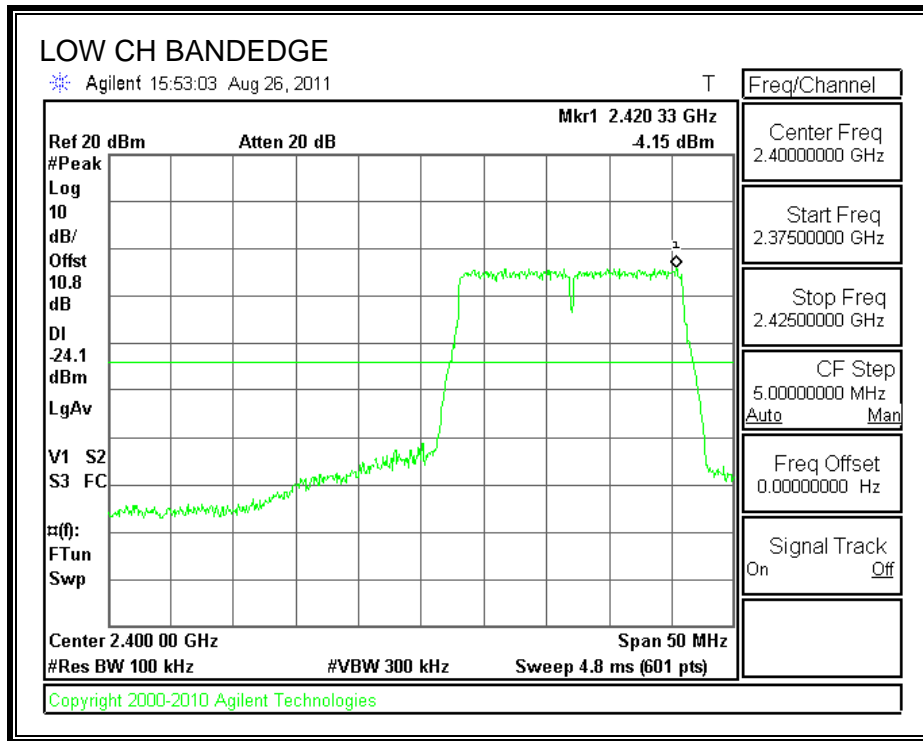
#### **TEST PROCEDURE**

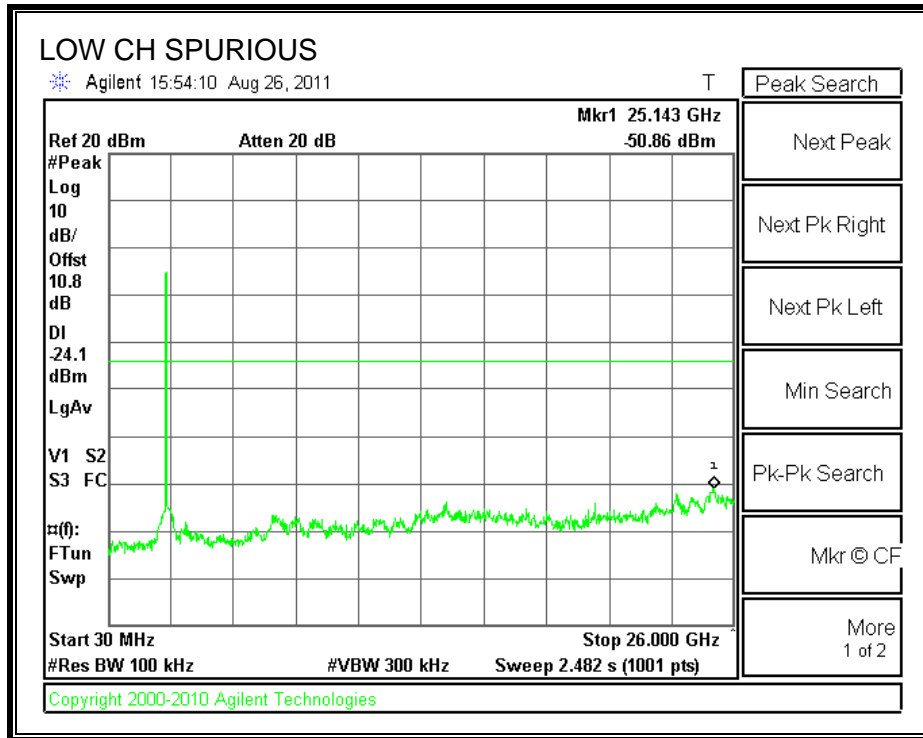
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

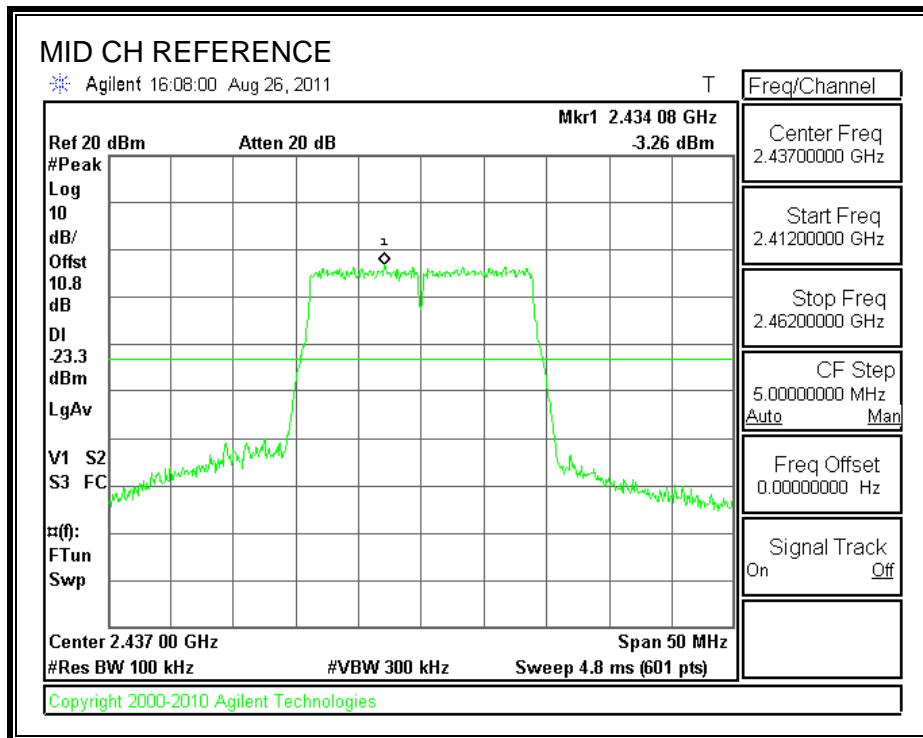
**RESULTS**

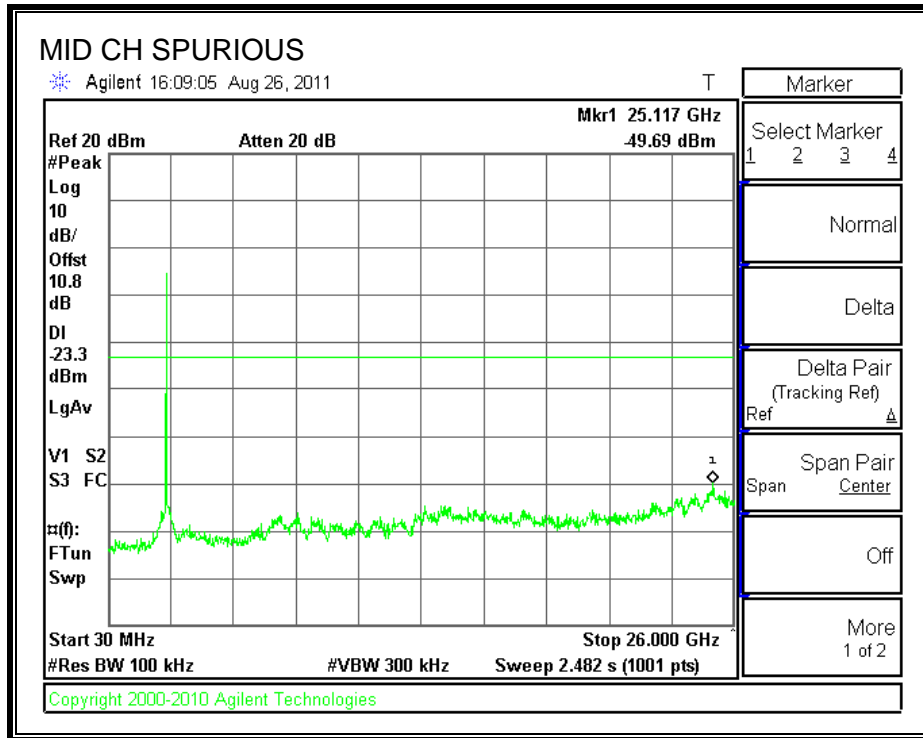
**SPURIOUS EMISSIONS, LOW CHANNEL**





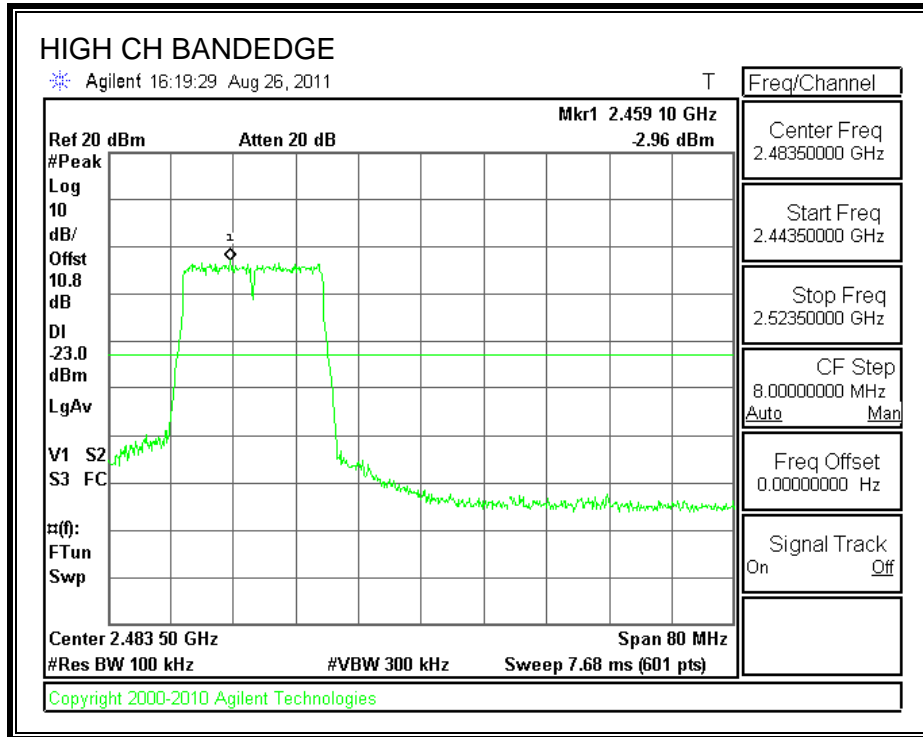
**SPURIOUS EMISSIONS, MID CHANNEL**

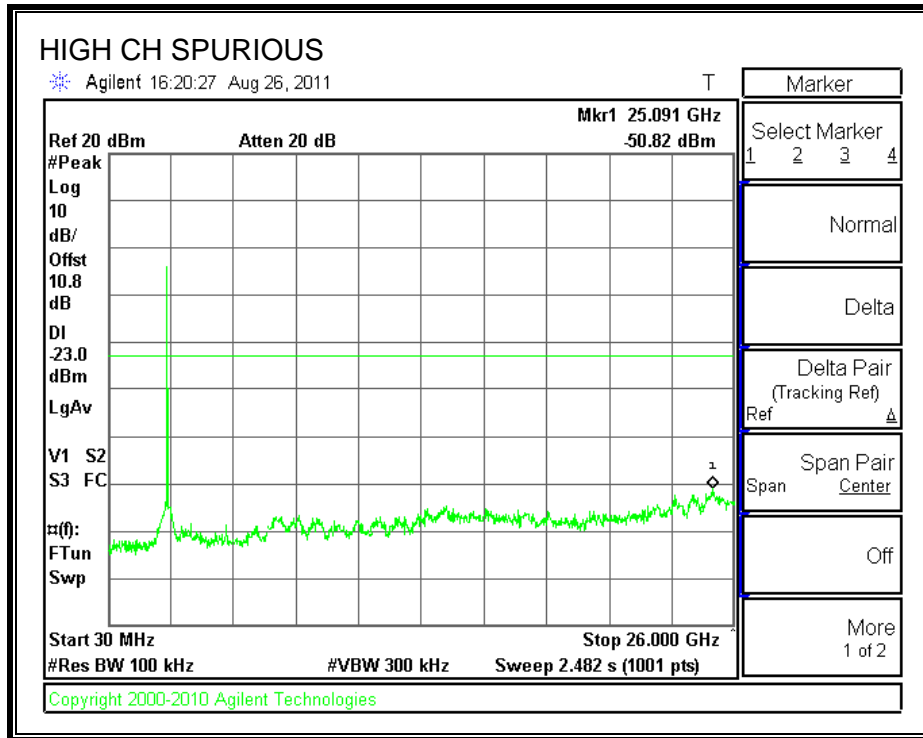






**SPURIOUS EMISSIONS, HIGH CHANNEL**





## 8.4. 802.11n HT40 MODE IN THE 2.4 GHz BAND

### 8.4.1. 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.

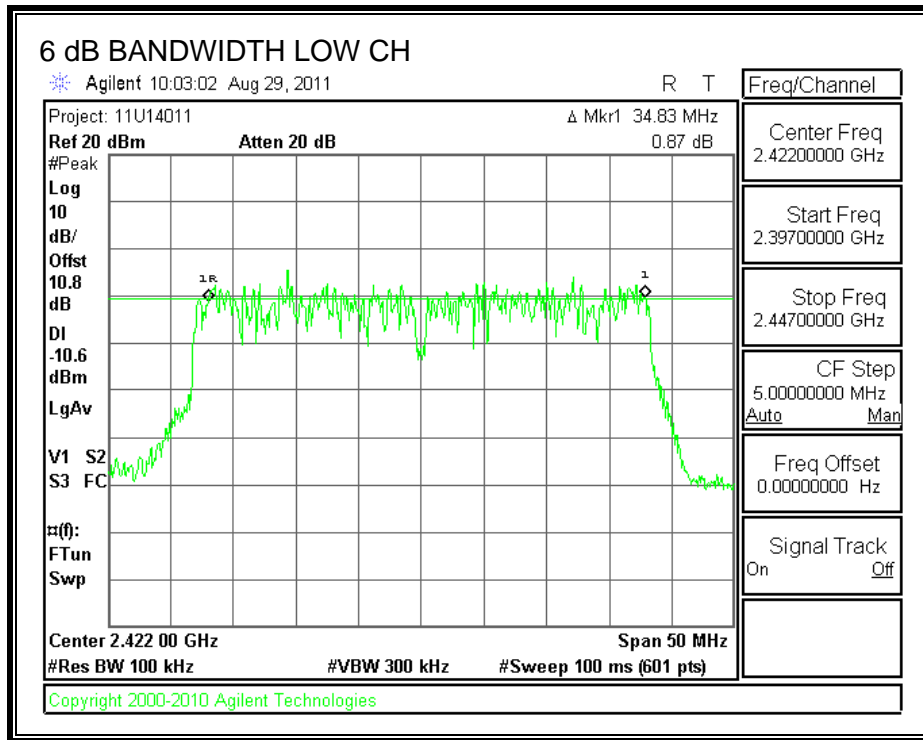
#### TEST PROCEDURE

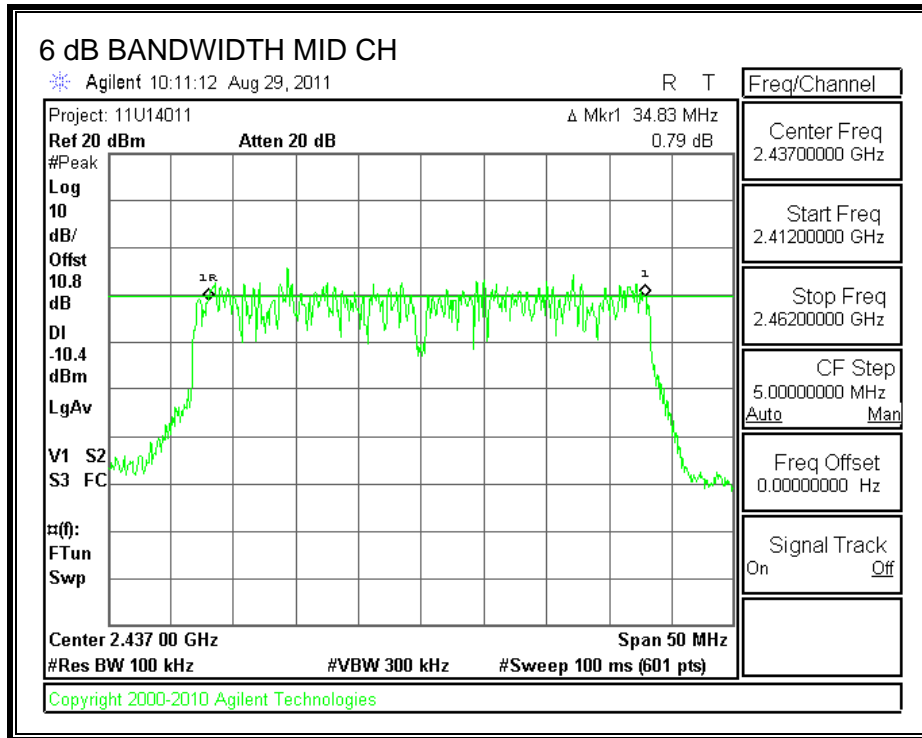
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

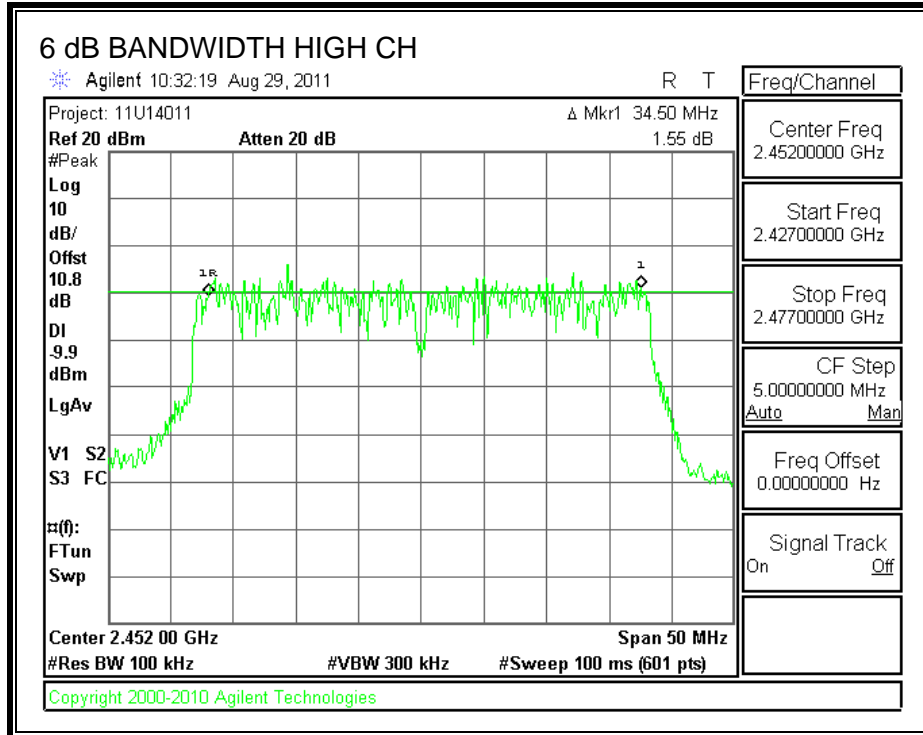
#### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2422	34.83	0.5
Middle	2437	34.83	0.5
High	2452	34.5	0.5

**6 dB BANDWIDTH**







## 8.4.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

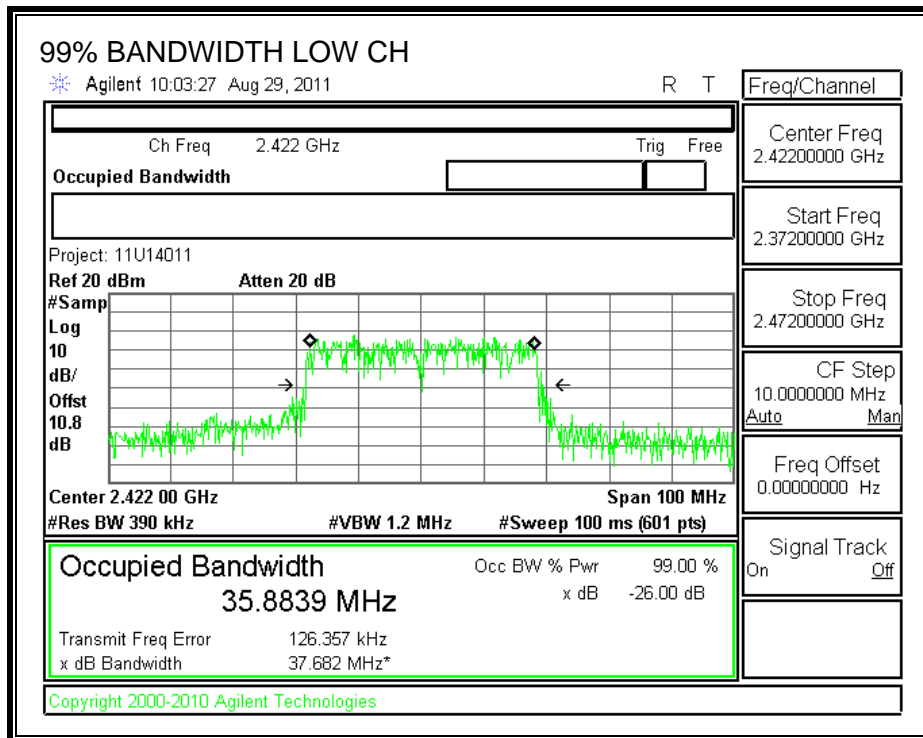
### TEST PROCEDURE

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.

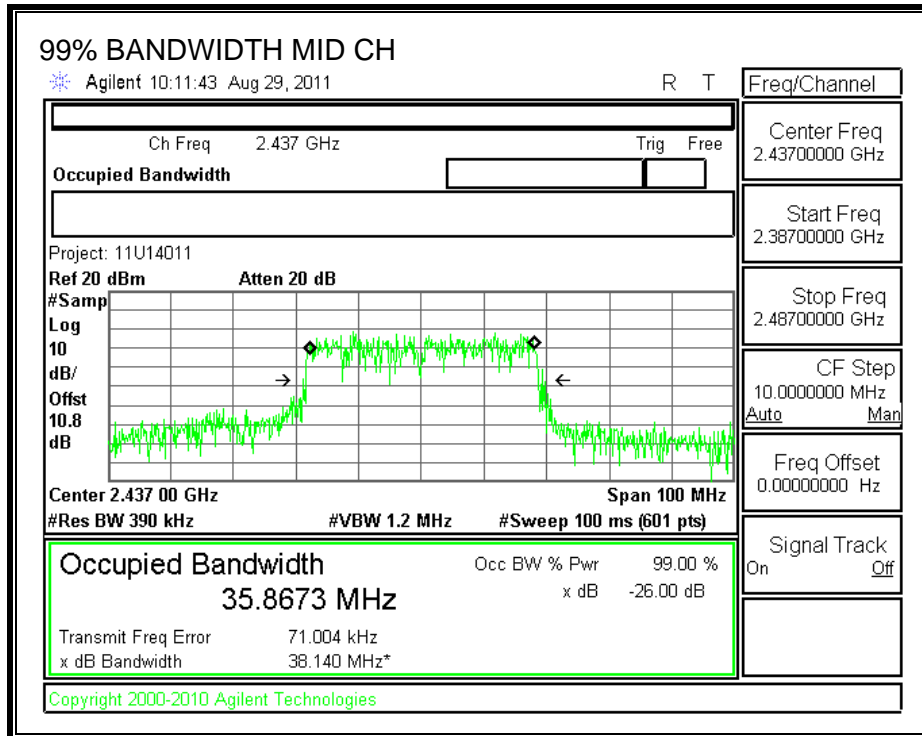
### RESULTS

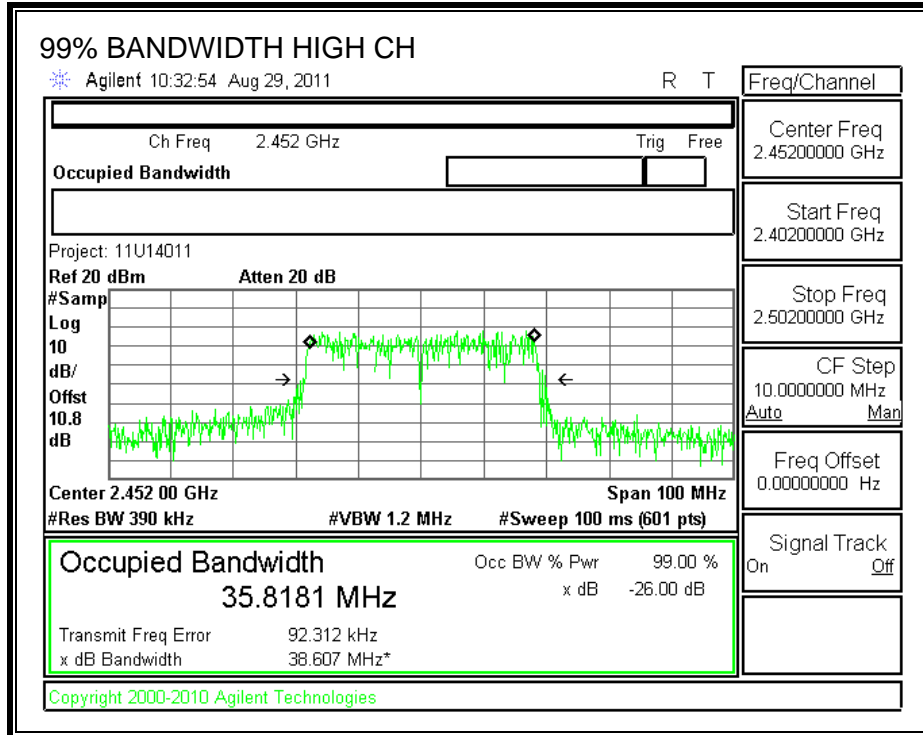
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2422	35.8839
Middle	2437	35.8673
High	2452	35.8181

**99% BANDWIDTH**









### 8.4.1. 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.

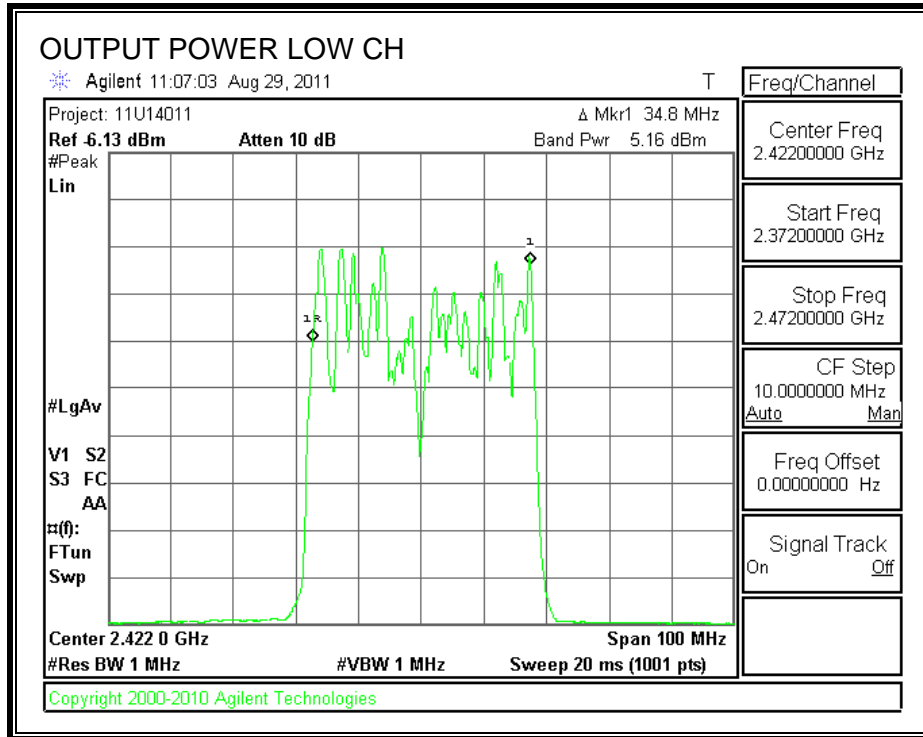
#### TEST PROCEDURE

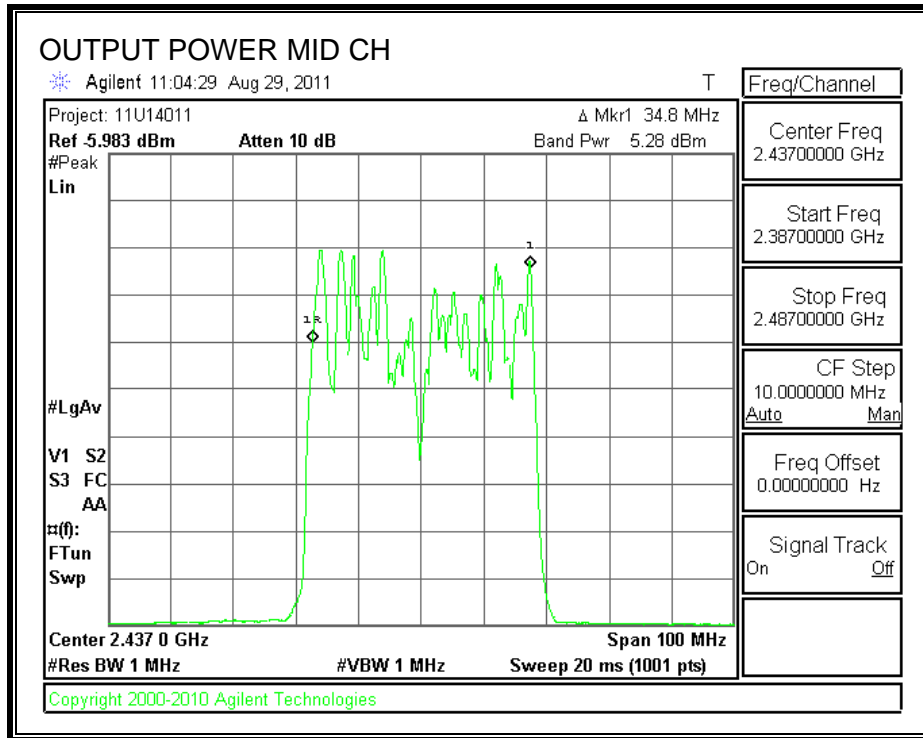
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

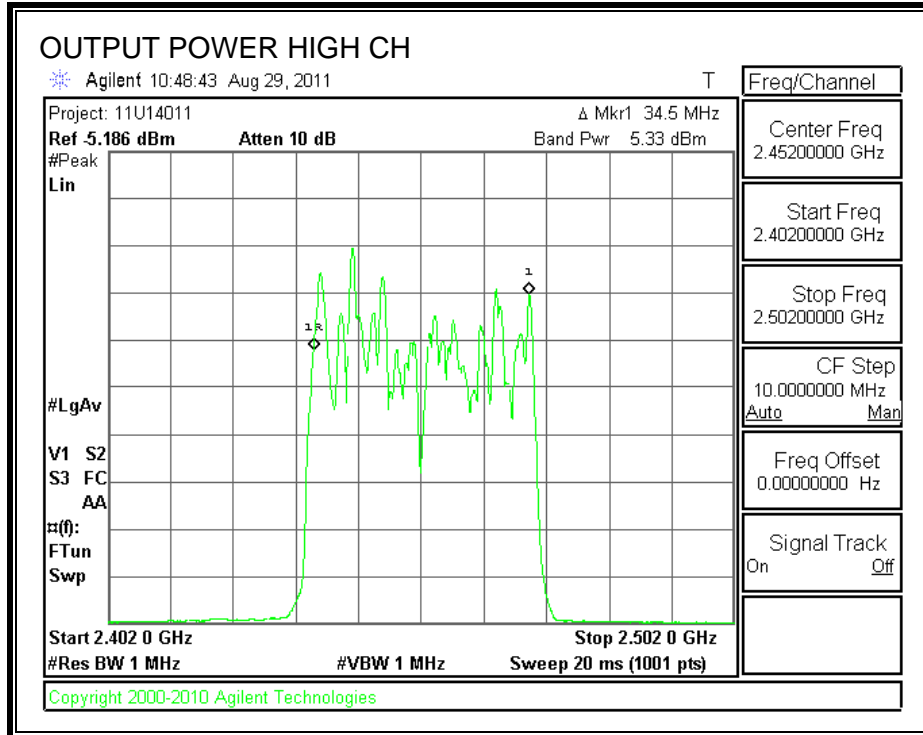
#### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2422	5.16	10.8	15.96	30	-14.04
Middle	2437	5.28	10.8	16.08	30	-13.92
High	2452	5.33	10.8	16.13	30	-13.87

**OUTPUT POWER**







## 8.4.2. 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 10.8 dB (including 10 dB pad and 0.80 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2422	14.55
Middle	2437	14.80
High	2452	14.98

### 8.4.3. 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

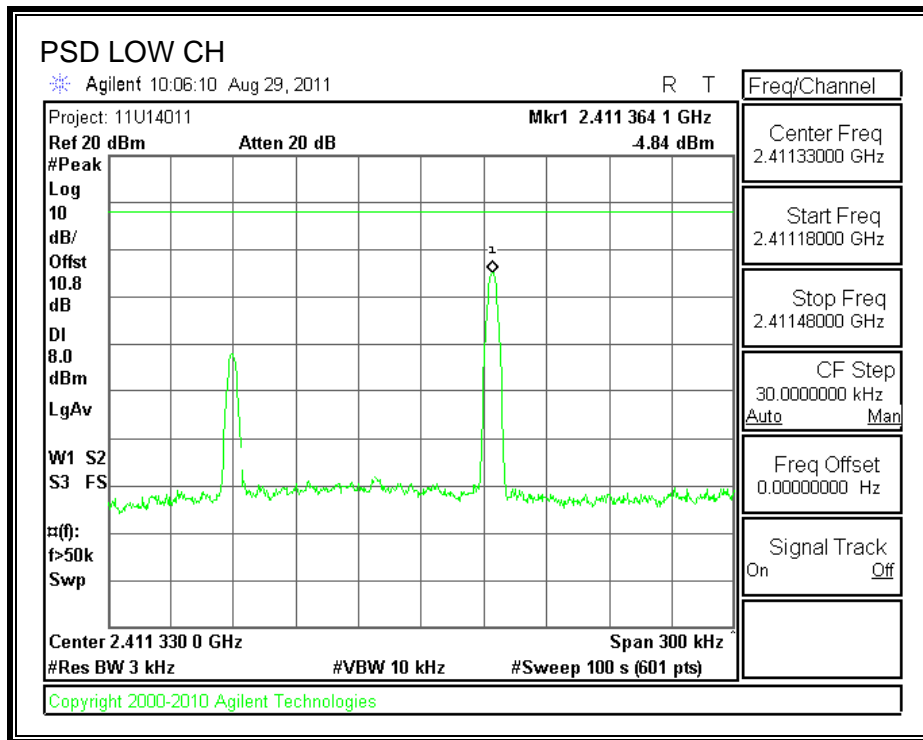
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

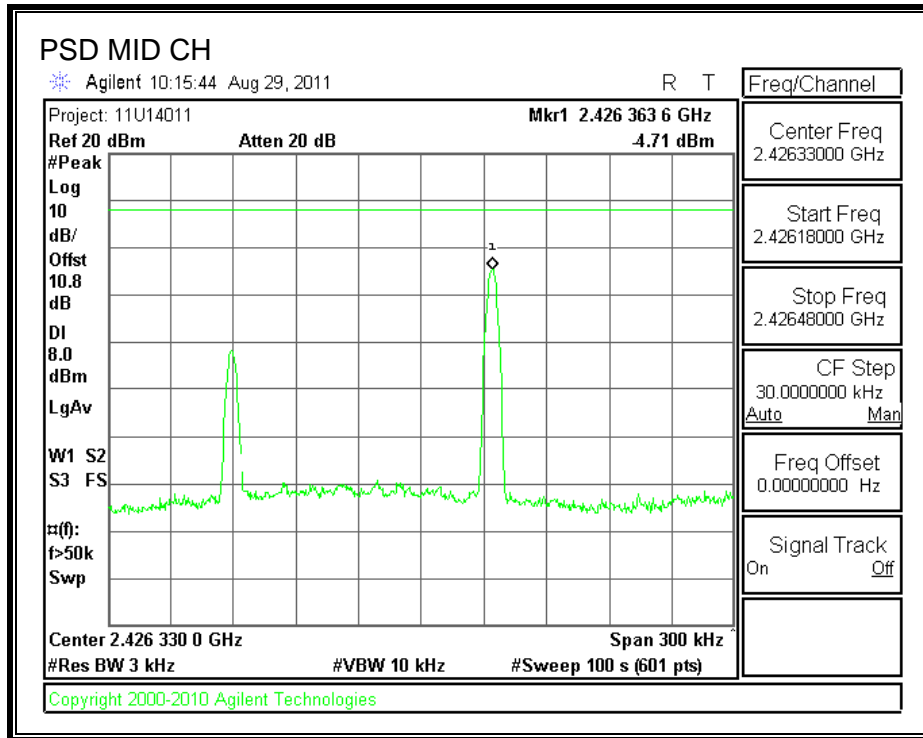
#### RESULTS

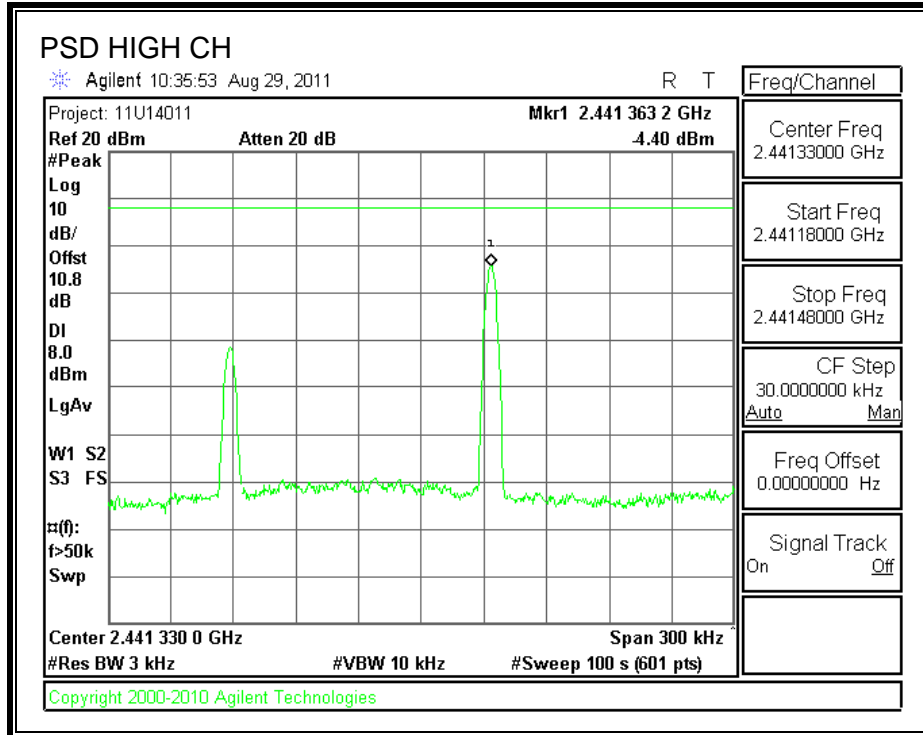
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2422	-4.84	8	-12.84
Middle	2437	-4.71	8	-12.71
High	2452	-4.40	8	-12.40



**POWER SPECTRAL DENSITY**







#### **8.4.4. 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.

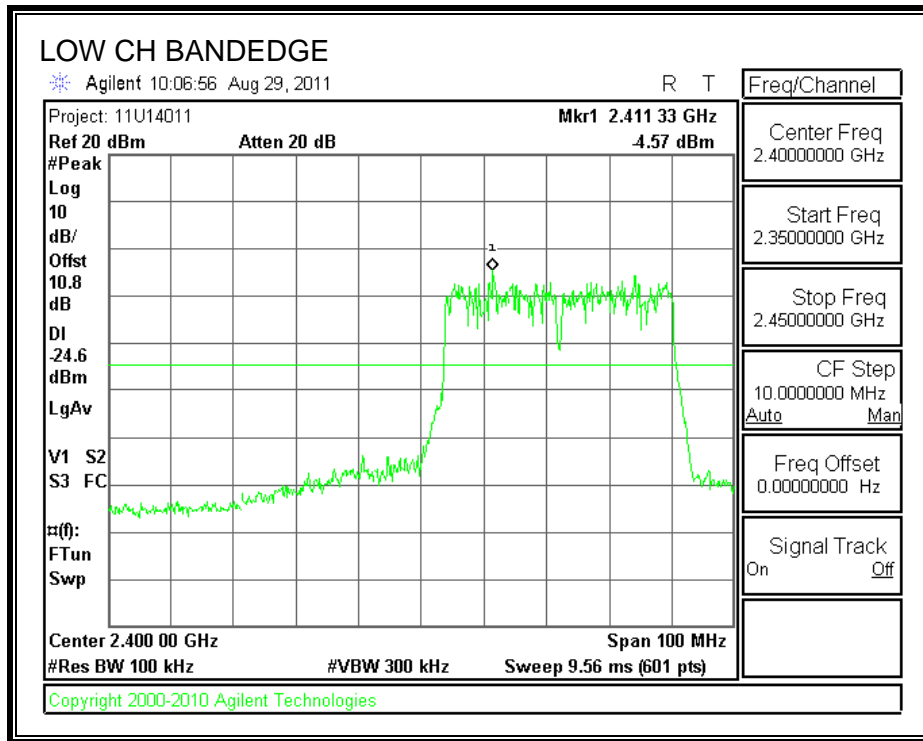
##### **TEST PROCEDURE**

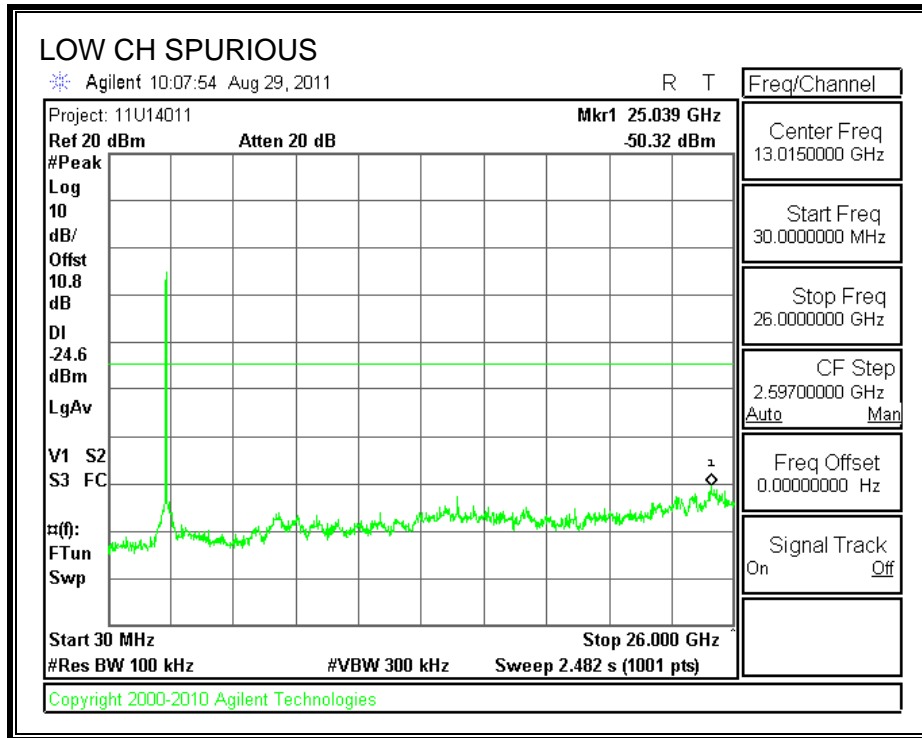
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

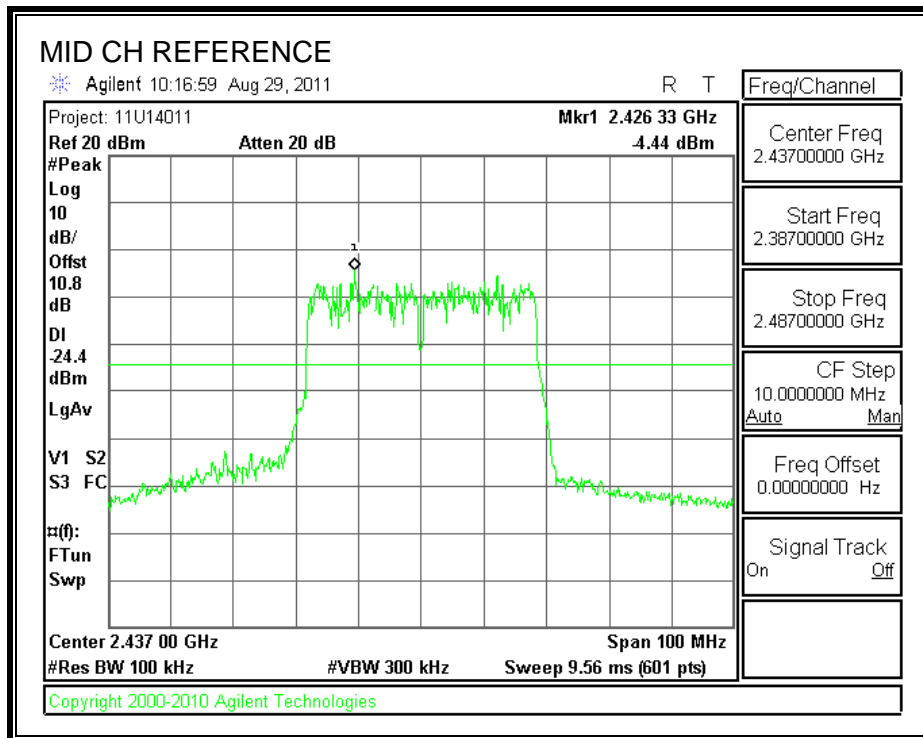
**RESULTS**

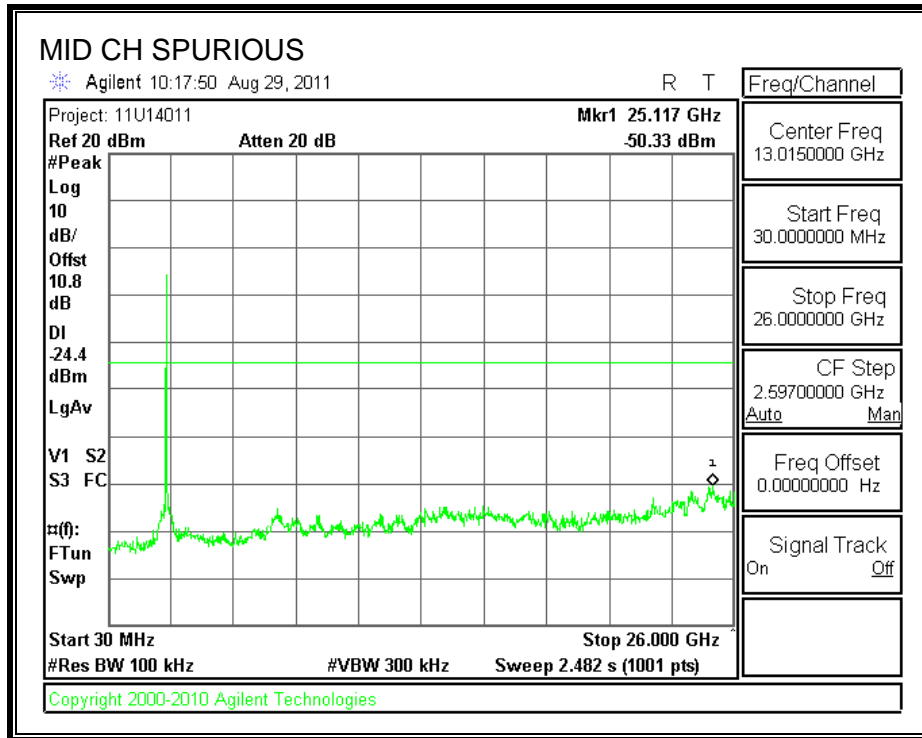
**SPURIOUS EMISSIONS, LOW CHANNEL**





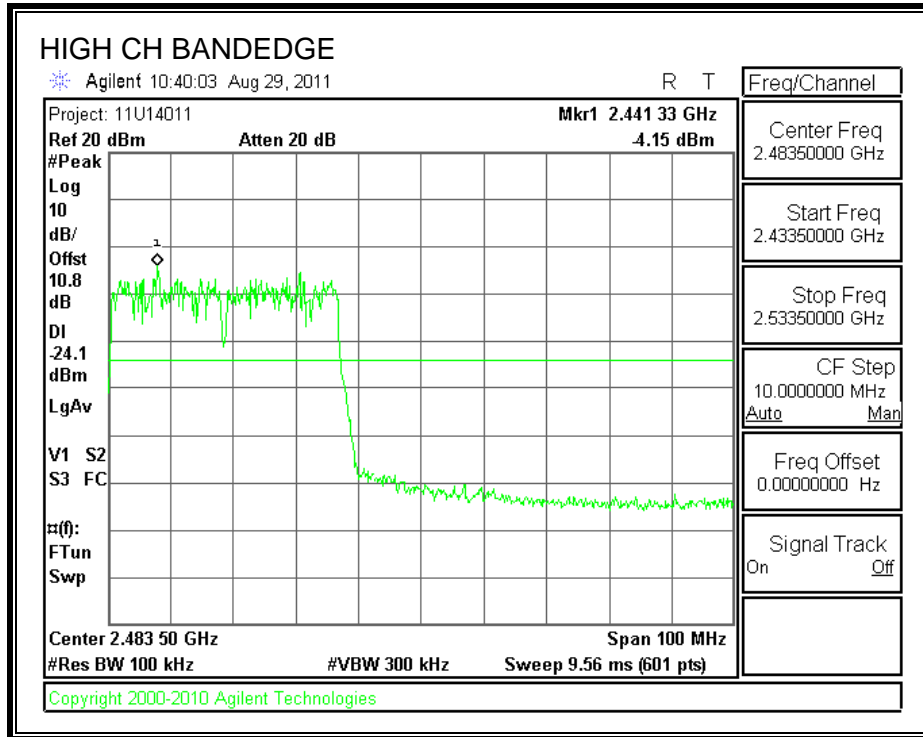
**SPURIOUS EMISSIONS, MID CHANNEL**

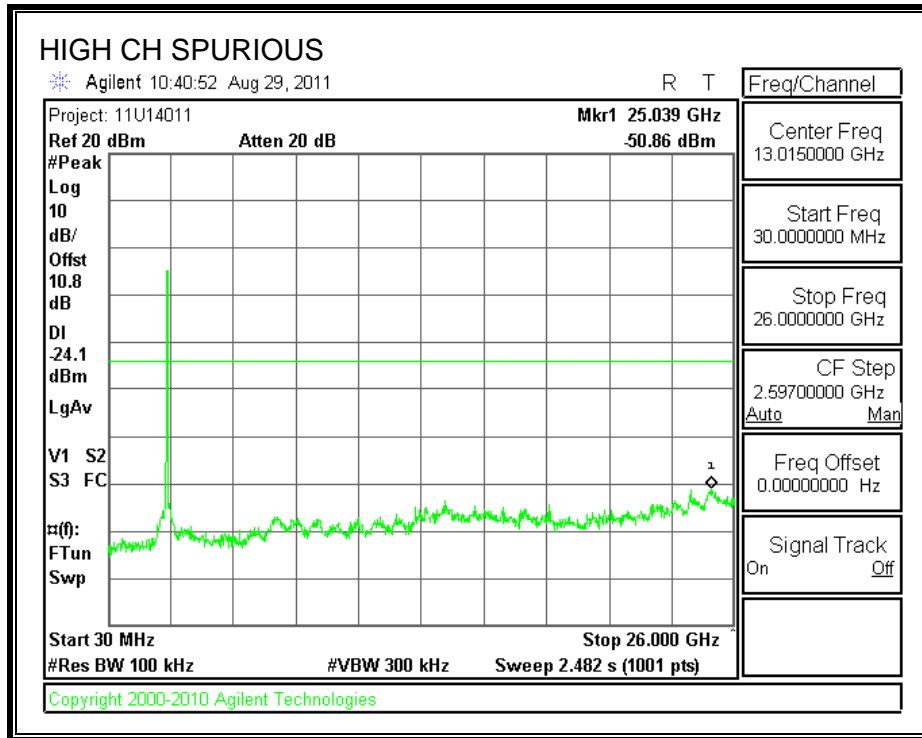






**SPURIOUS EMISSIONS, HIGH CHANNEL**





## 9. RADIATED TEST RESULTS

### 9.1. 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.

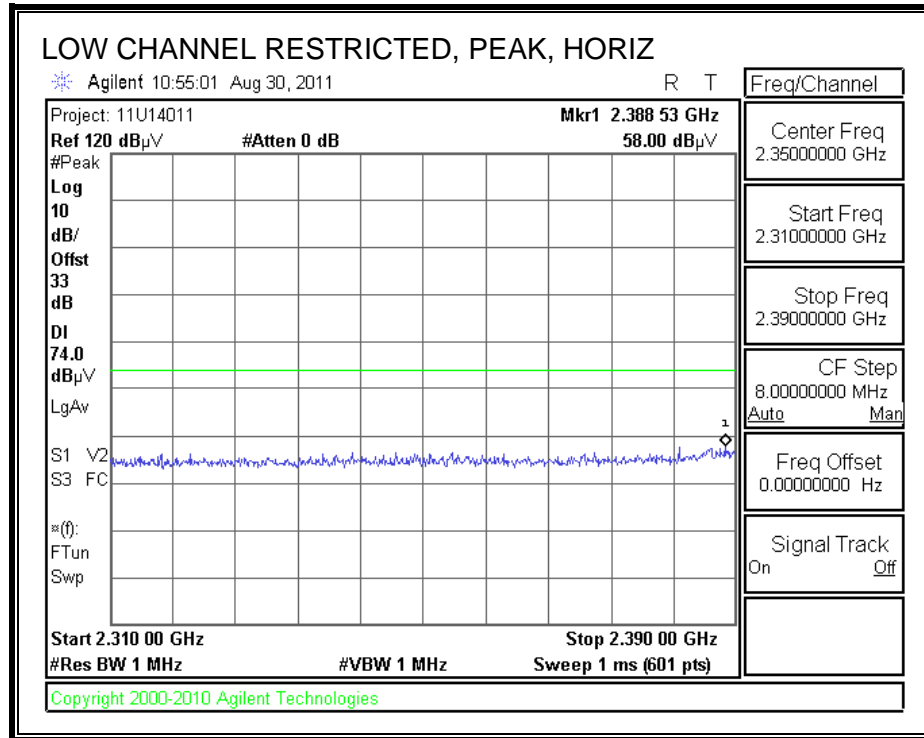
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

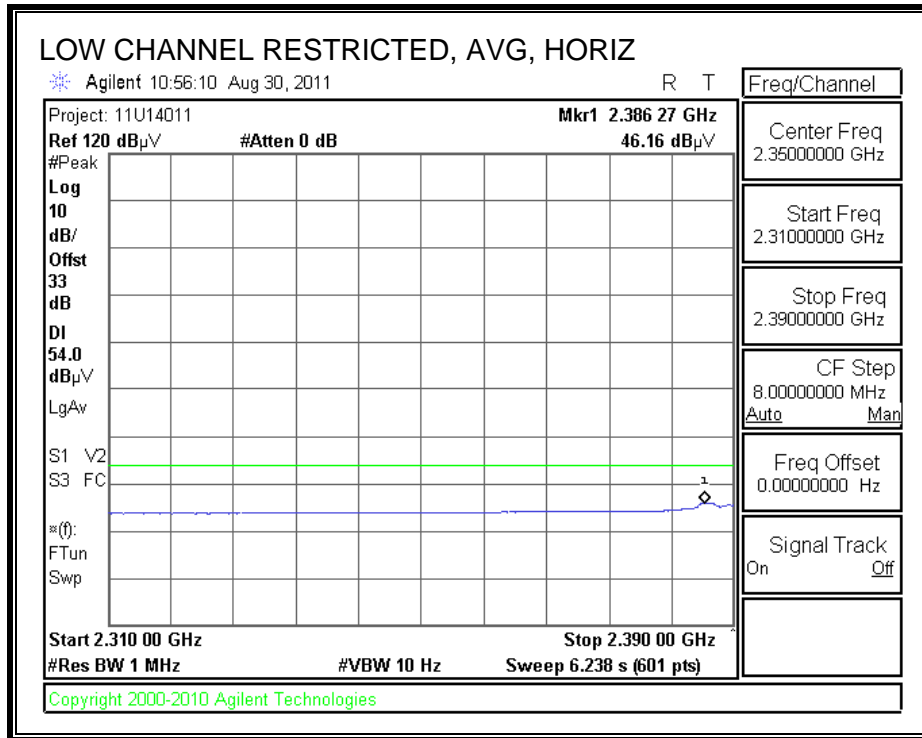
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

## 9.2. TRANSMITTER ABOVE 1 GHz

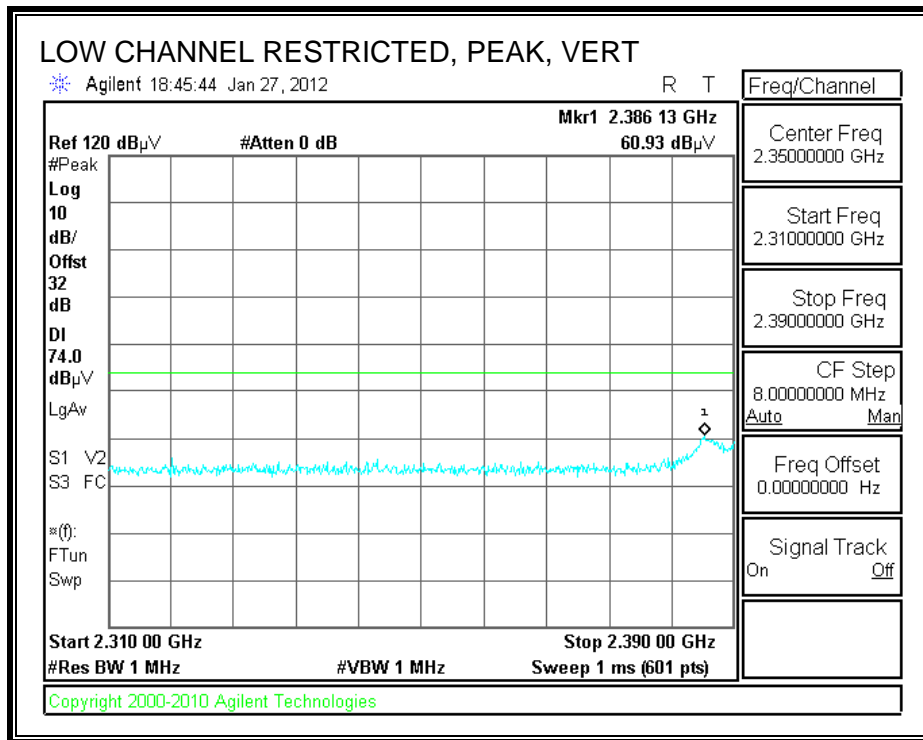
### 9.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND

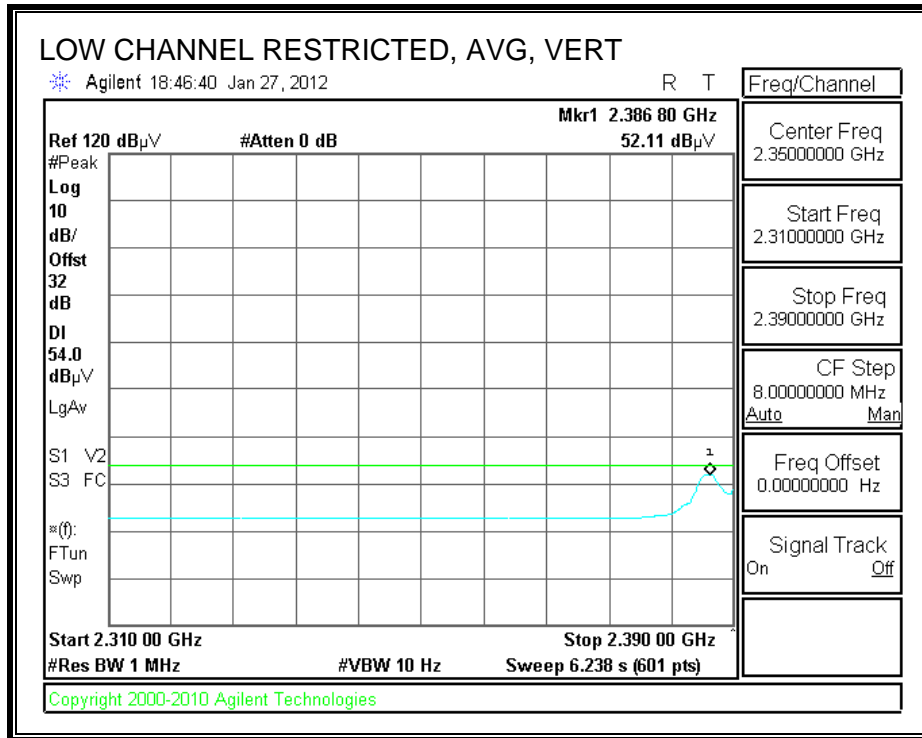
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



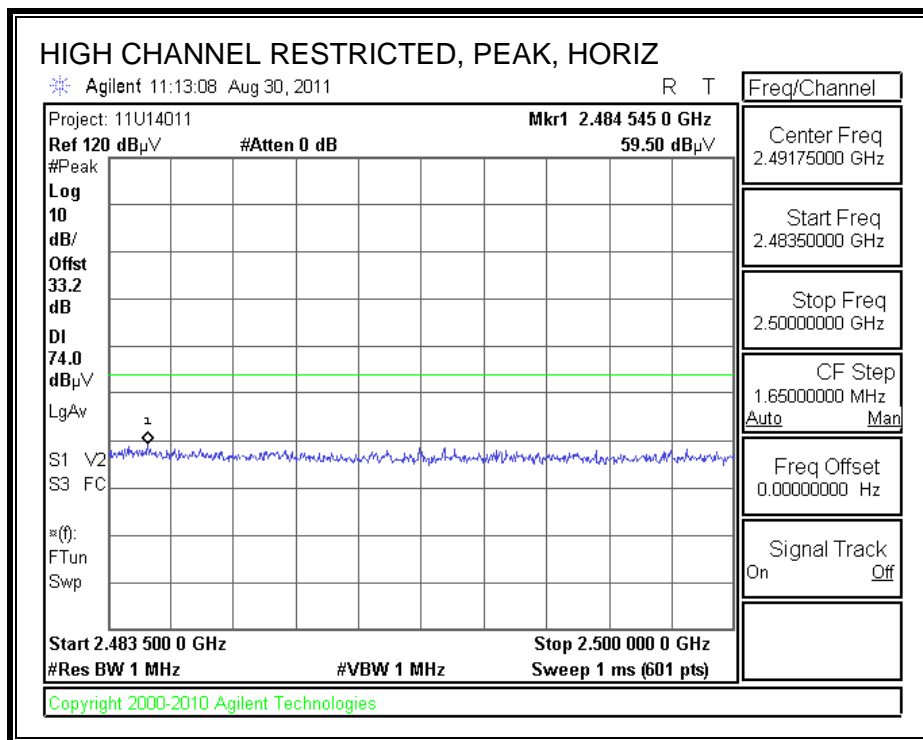


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

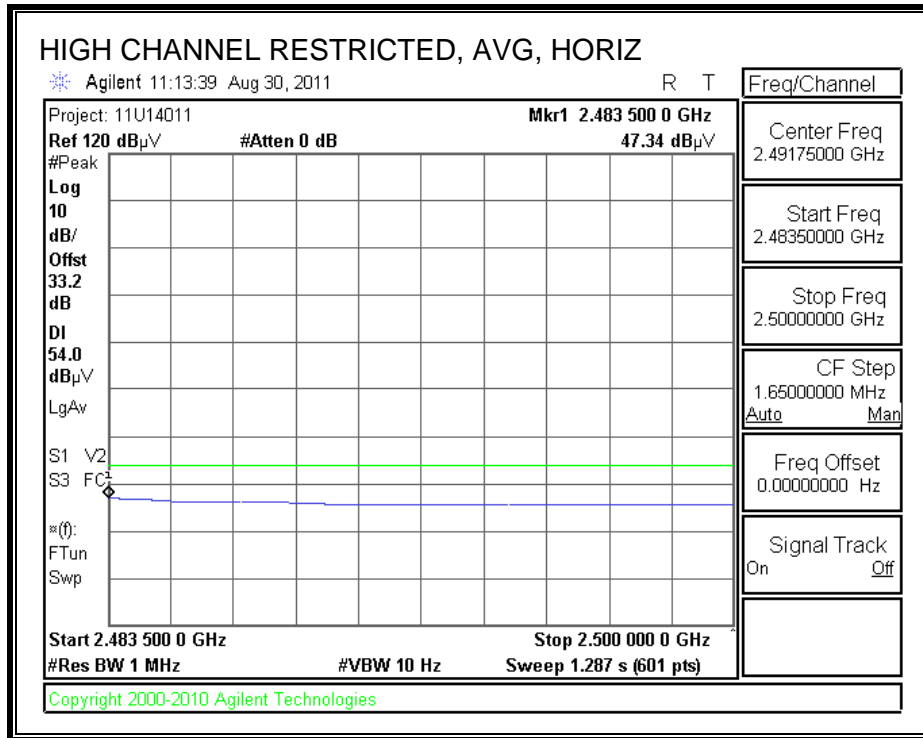




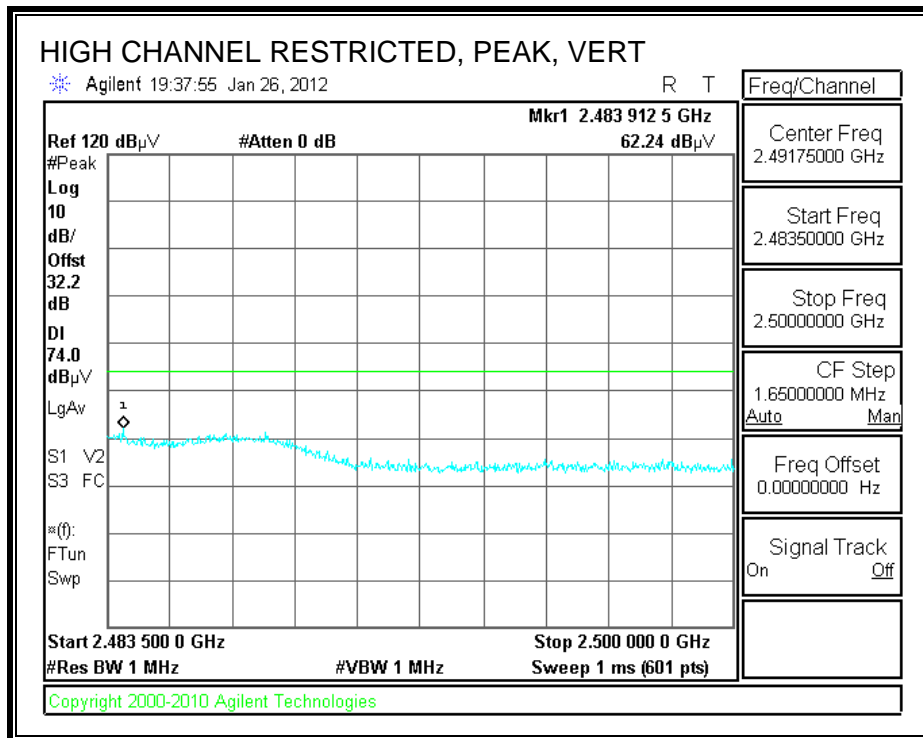
**RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)**

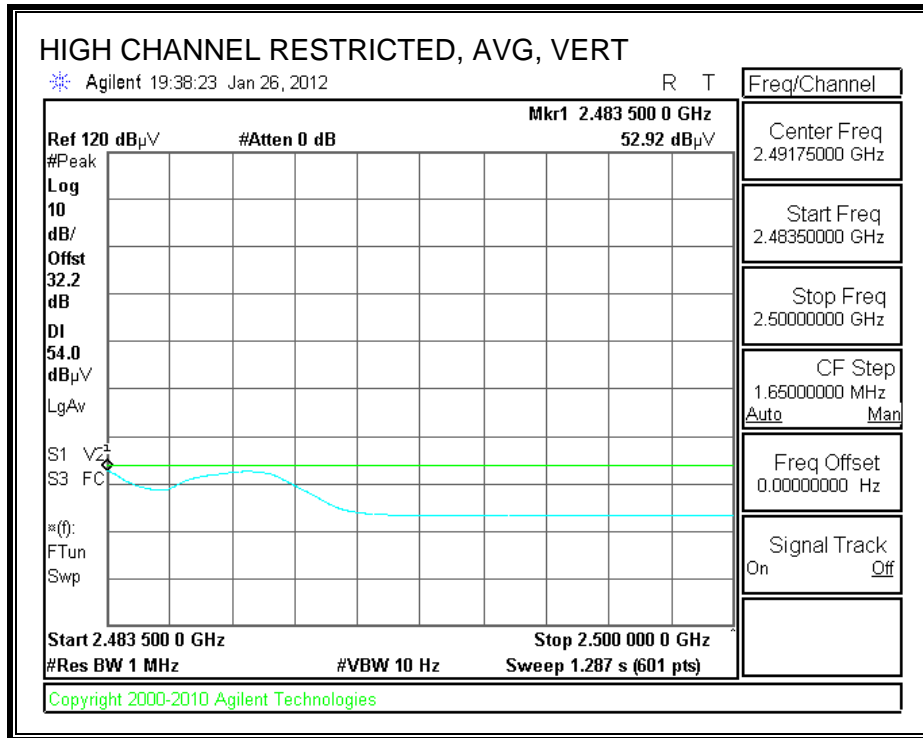






**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS**

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

Company: Sierra Wireless  
 Project #: 12U14203  
 Date: 1/26/2012  
 Test Engineer: Thanh Nguyen  
 Configuration: EUT and remote support laptop  
 Mode: Transmit b mode

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T59; S/N: 3245 @3m	T145 Agilent 3008A005c			FCC 15.205

Hi Frequency Cables

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

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)
Low ch															
4.824	3.0	45.8	42.1	33.2	6.3	-34.8	0.0	0.0	50.4	46.8	74	54	-23.6	-7.2	V
Mid ch															
4.874	3.0	46.0	42.2	33.2	6.3	-34.8	0.0	0.0	50.8	46.9	74	54	-23.2	-7.1	V
High Ch															
4.924	3.0	43.7	37.6	33.3	6.3	-34.8	0.0	0.0	48.6	42.4	74	54	-25.4	-11.6	V

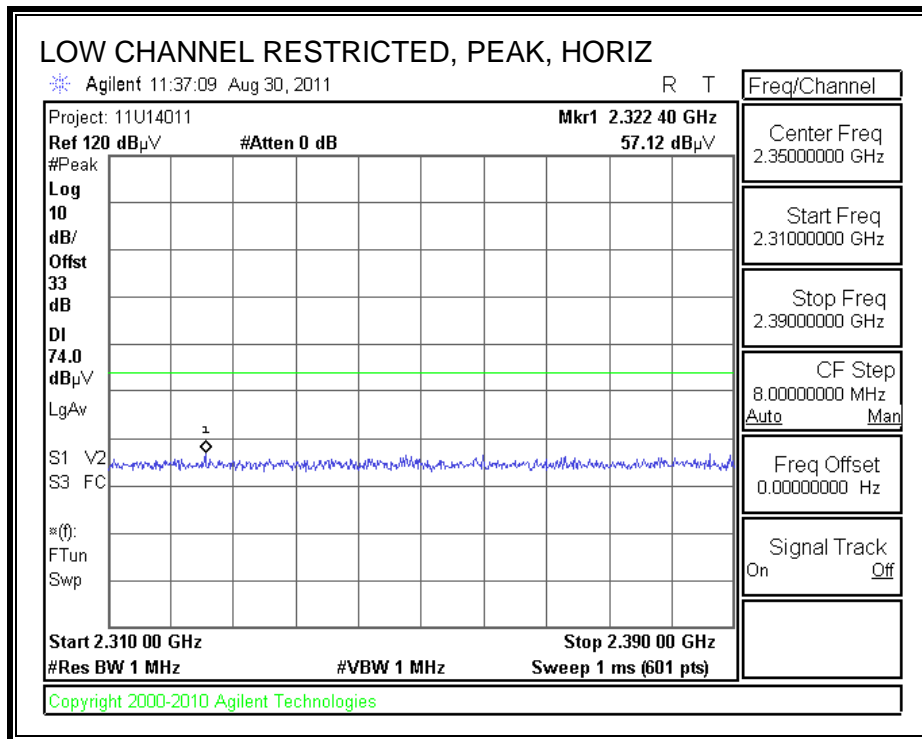
Rev. 07.08.11

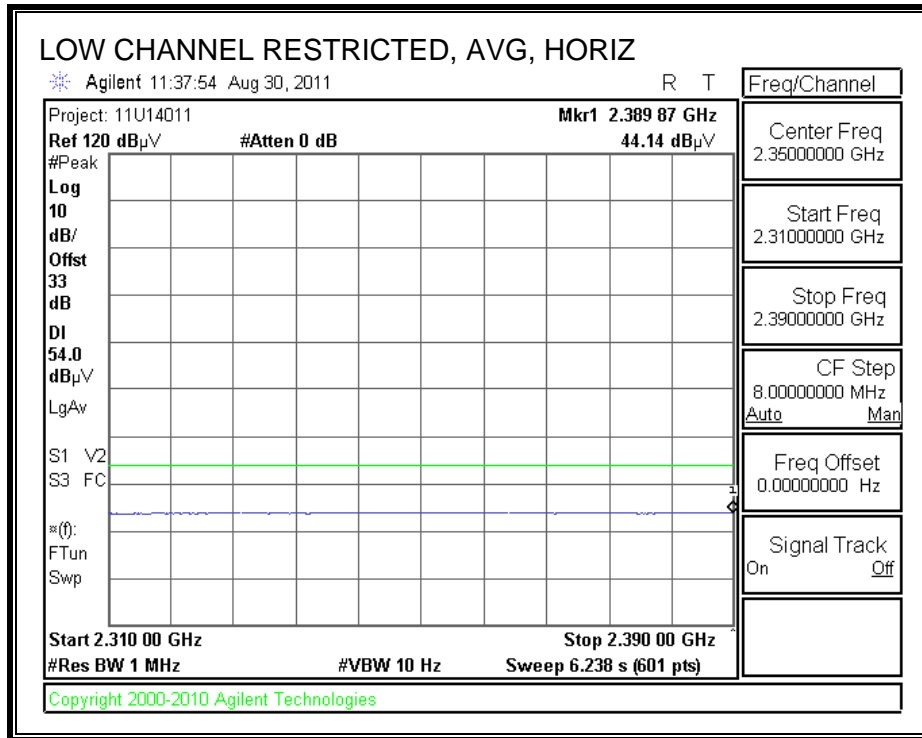
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

**Note:** there are no other signals above the noise floor level.

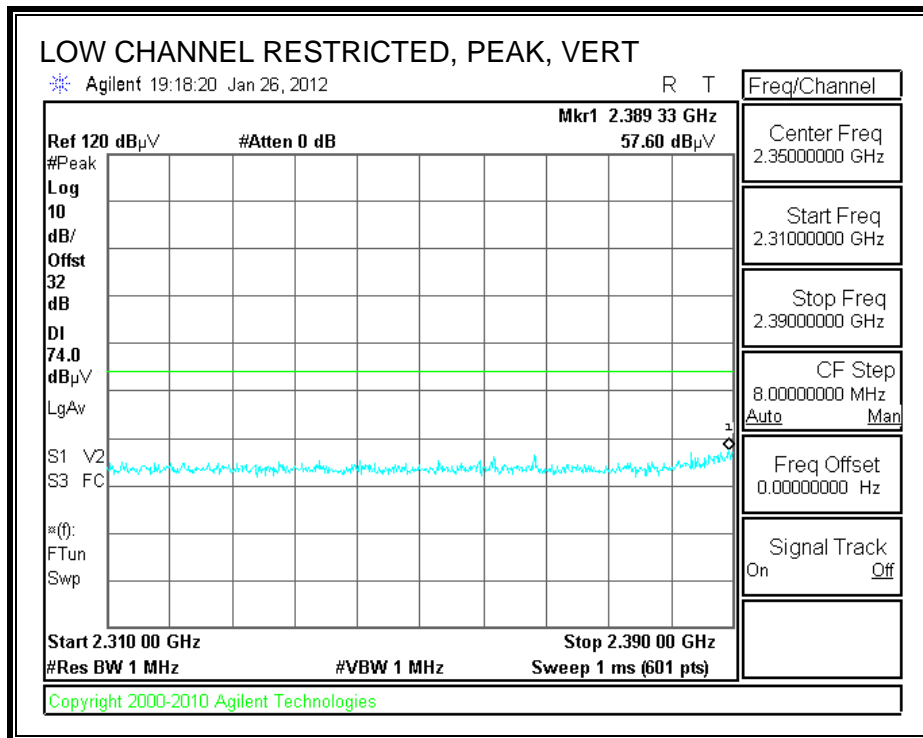
### 9.2.2. TX ABOVE 1 GHz FOR 802.11g MODE IN THE 2.4 GHz BAND

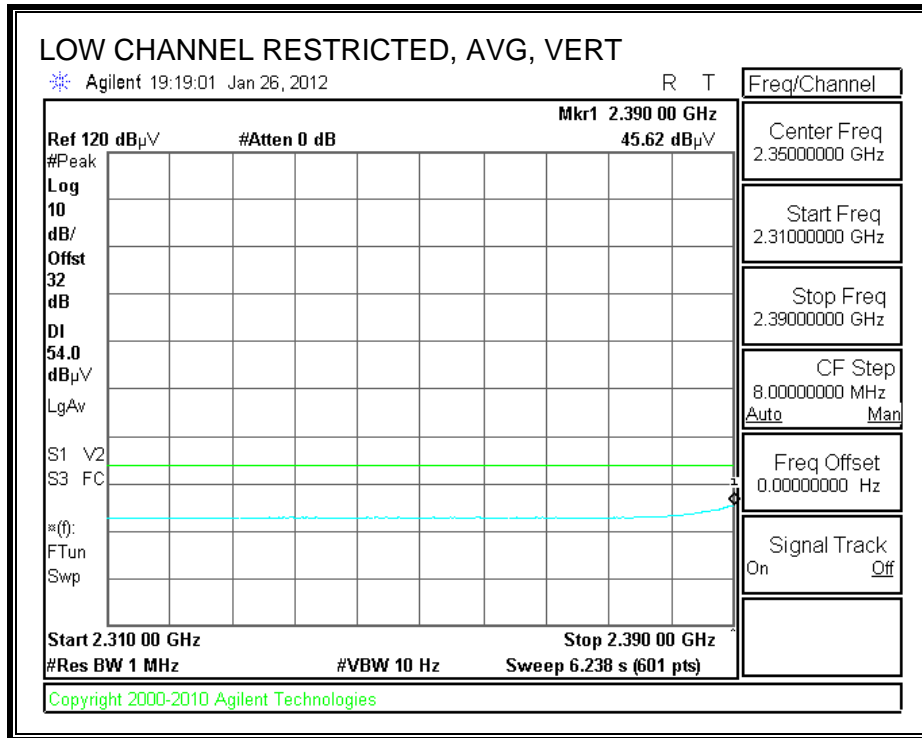
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





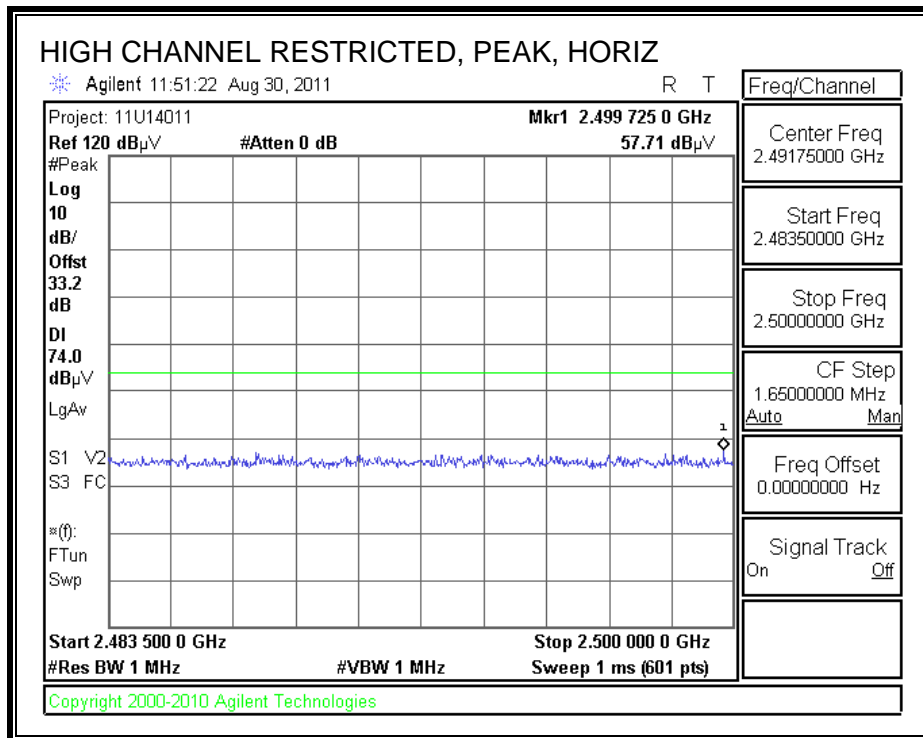
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

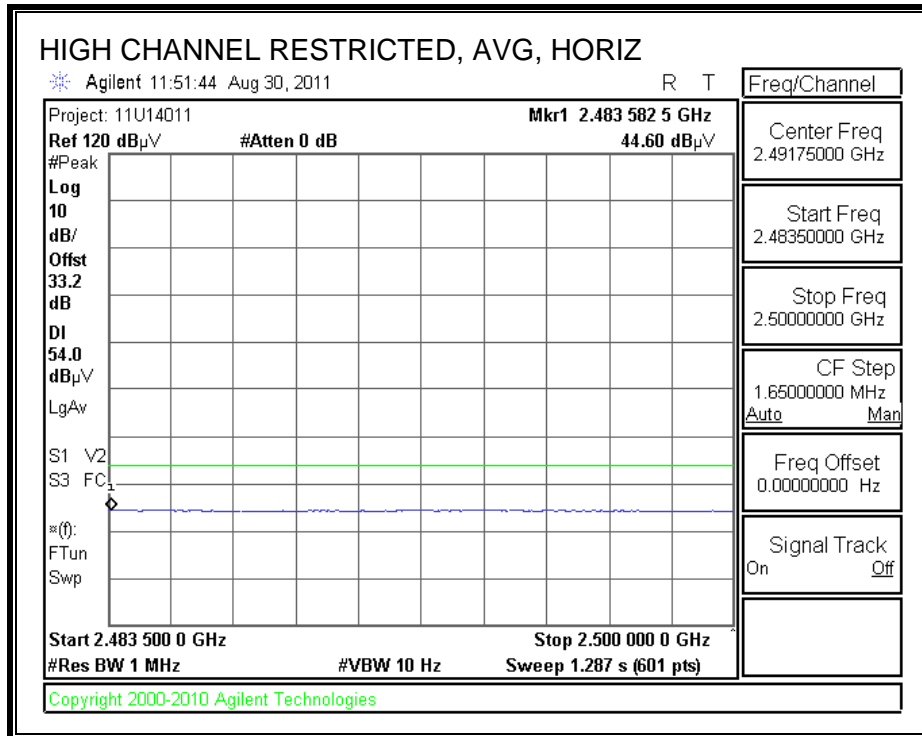




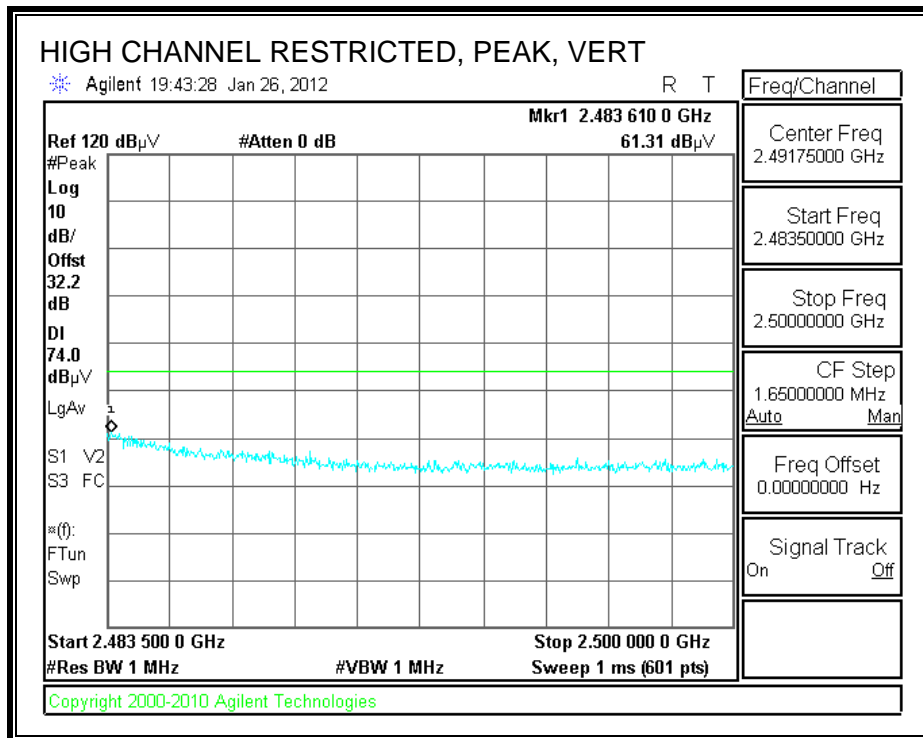


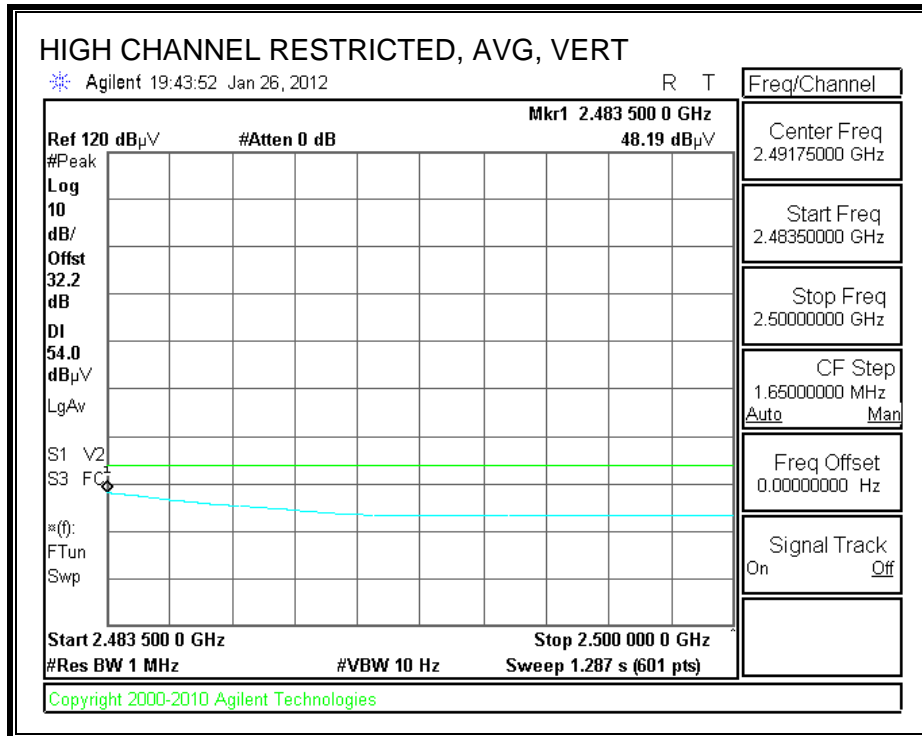
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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





**HARMONICS AND SPURIOUS EMISSIONS**

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

Company: Sierra Wireless  
 Project #: 11U14011  
 Date: 08/31/11  
 Test Engineer: Doug Anderson  
 Configuration: EUT with Support PC  
 Mode: Continuous Tx 11g Mode

**Test Equipment:**

<b>Horn 1-18GHz</b>	<b>Pre-amplifier 1-26GHz</b>	<b>Pre-amplifier 26-40GHz</b>	<b>Horn &gt; 18GHz</b>	<b>Limit</b>
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18-26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

<b>3' cable 22807700</b>	<b>12' cable 22807600</b>	<b>20' cable 22807500</b>	<b>HPF</b>	<b>Reject Filter</b>	<b>Peak Measurements</b> RBW=VBW=1MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001	<b>Average Measurements</b> RBW=1MHz; VBW=10Hz

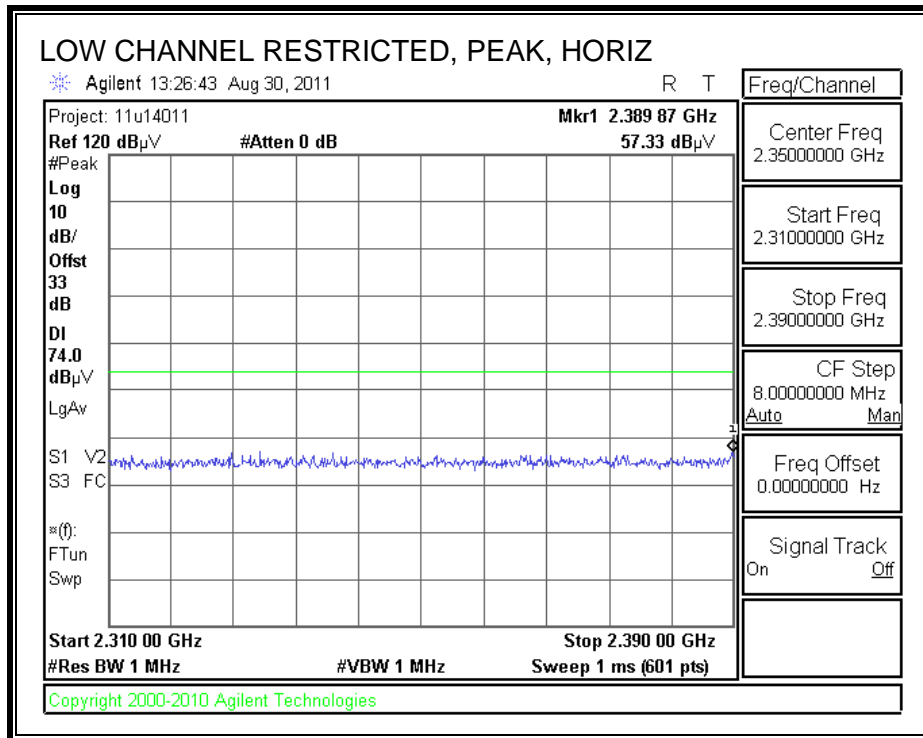
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Channel (2412 MHz): Vertical</b>															
4.824	3.0	39.1	25.5	34.6	6.2	-35.5	0.0	0.0	44.4	30.8	74	54	-29.6	-23.2	V, Noise Floor
<b>Low Channel (2412 MHz): Horizontal</b>															
4.824	3.0	39.5	25.4	34.6	6.2	-35.5	0.0	0.0	44.8	30.7	74	54	-29.2	-23.3	H, Noise Floor
<b>Mid Channel (2437 MHz): Vertical</b>															
4.874	3.0	39.5	25.6	34.7	6.2	-35.5	0.0	0.0	45.0	31.1	74	54	-29.0	-22.9	V, Noise Floor
<b>Mid Channel (2437 MHz): Horizontal</b>															
4.874	3.0	37.8	24.8	34.7	6.2	-35.5	0.0	0.0	43.2	30.2	74	54	-30.8	-23.8	H, Noise Floor
<b>High Channel (2462 MHz): Vertical</b>															
4.924	3.0	39.8	27.6	34.8	6.3	-35.5	0.0	0.0	45.3	33.2	74	54	-28.7	-20.8	V, Noise Floor
<b>High Channel (2462 MHz): Horizontal</b>															
4.924	3.0	40.2	27.0	34.8	6.3	-35.5	0.0	0.0	45.8	32.5	74	54	-28.2	-21.5	H, Noise Floor
<b>No Significant Emissions Found Above the Noise Floor</b>															

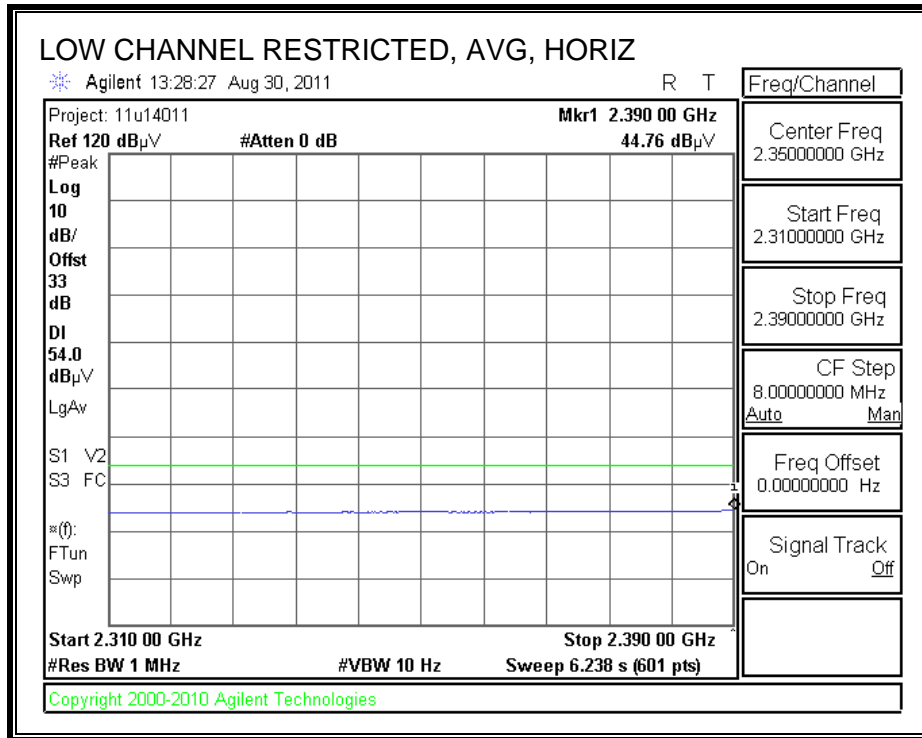
Rev. 07.08.11

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		

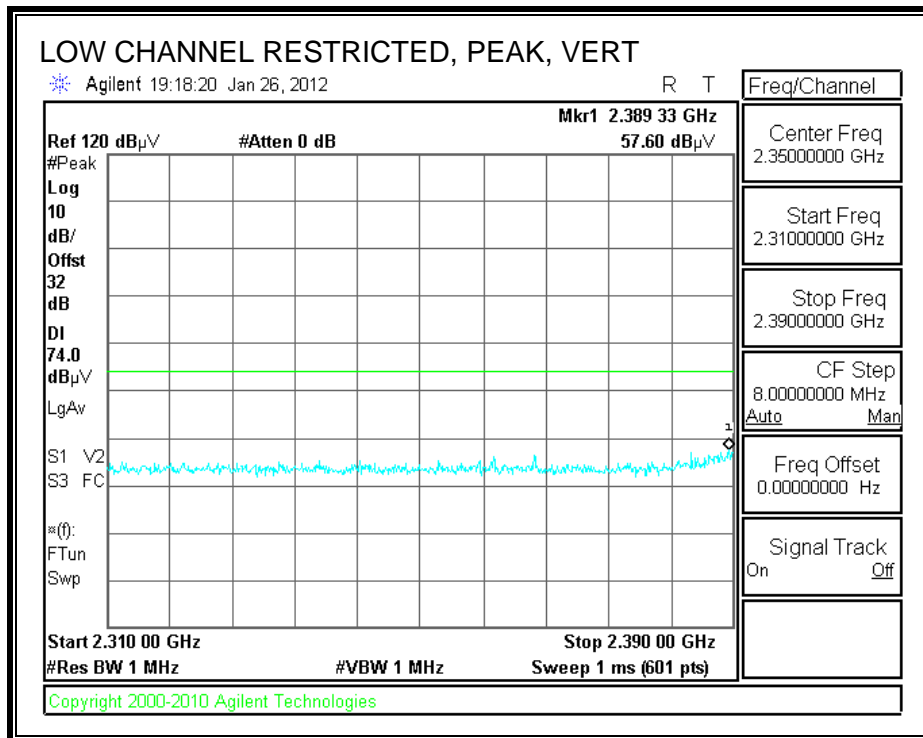
### 9.2.3. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 2.4 GHz BAND

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

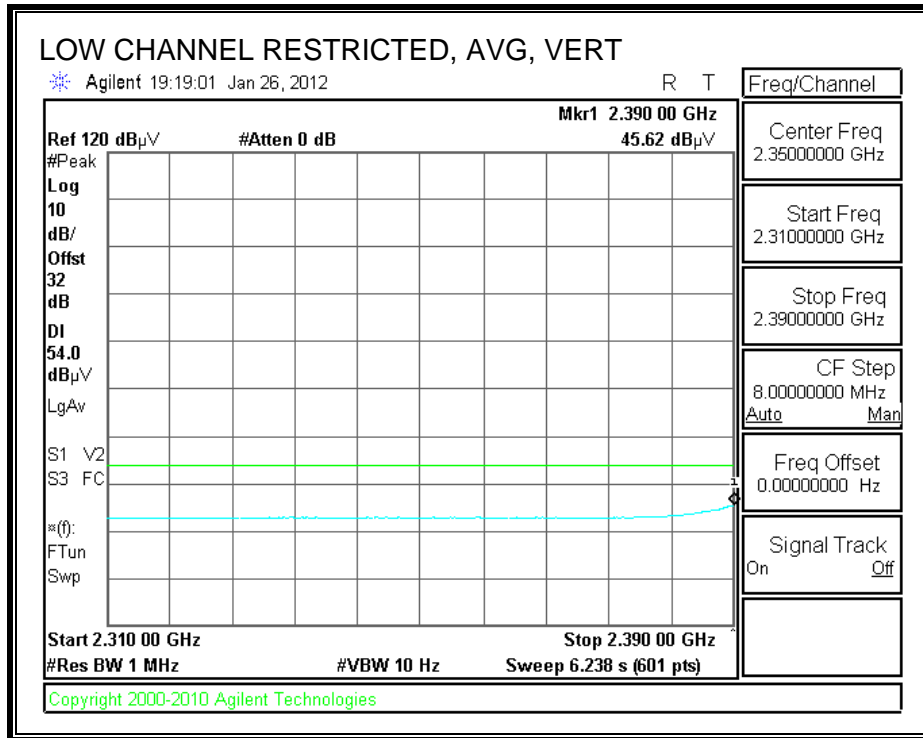




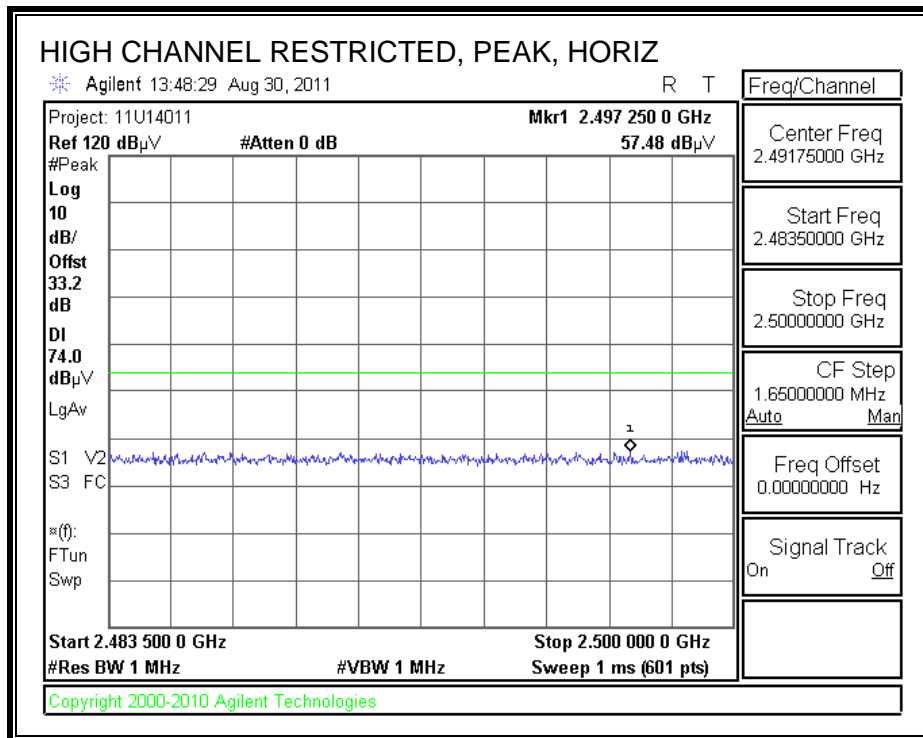
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

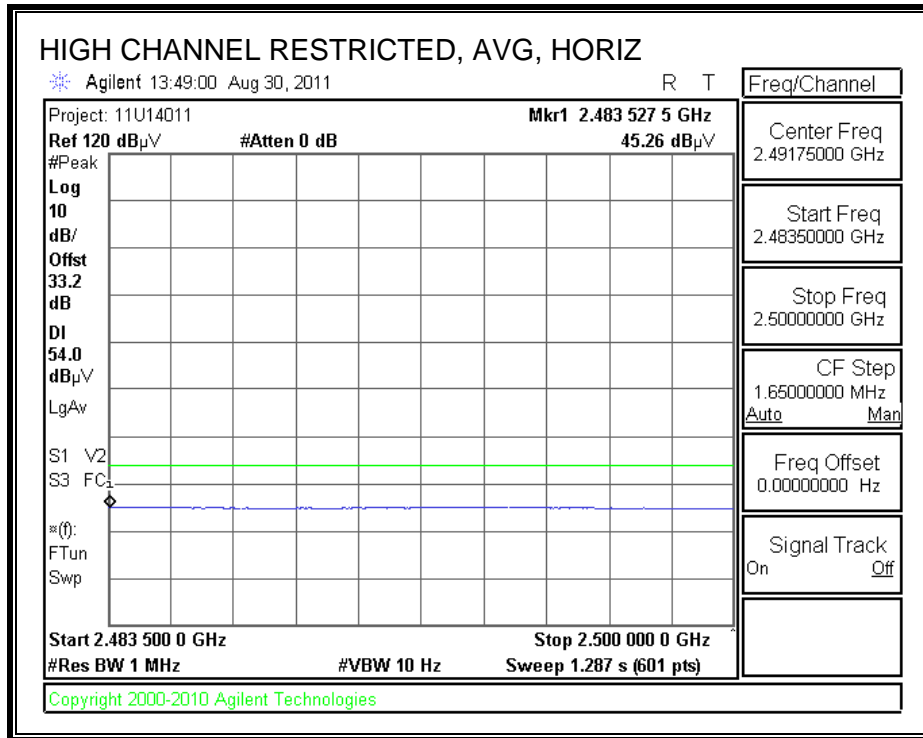




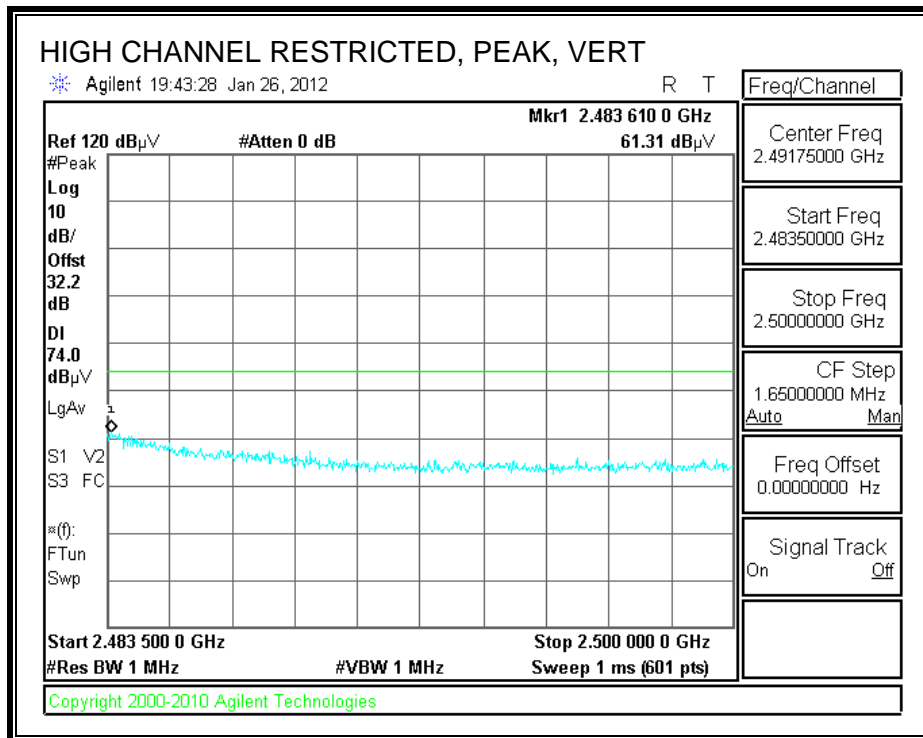


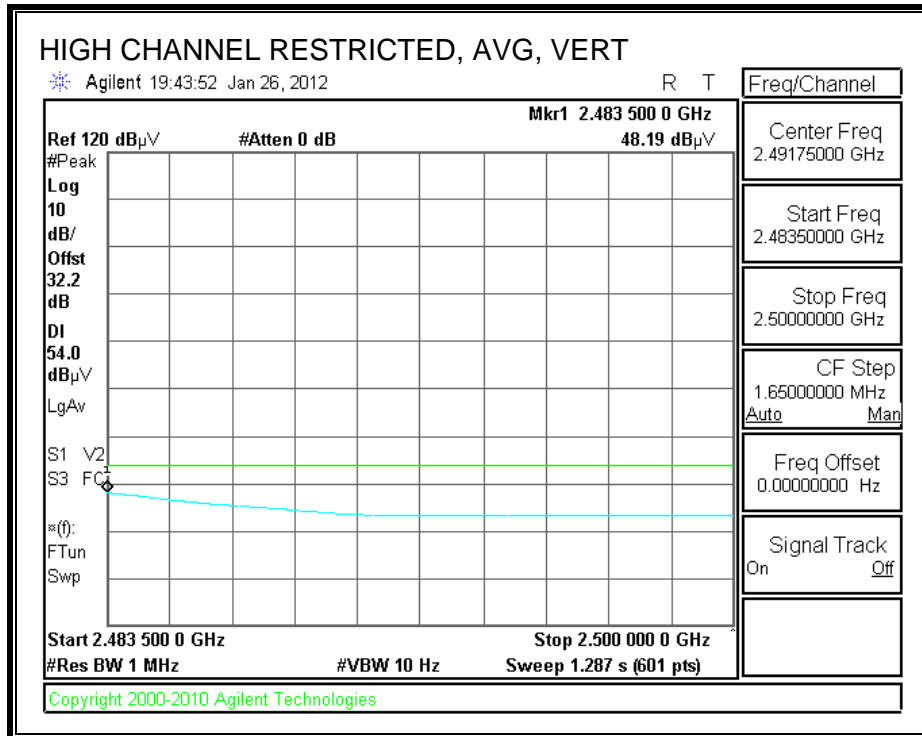
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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





**HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement  
 Compliance Certification Services, Fremont 5m Chamber-A

Company: Sierra Wireless  
 Project #: 11U14011  
 Date: 08/31/11  
 Test Engineer: Doug Anderson  
 Configuration: EUT with Support PC  
 Mode: Continuous Tx HT20 Mode

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18.26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

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

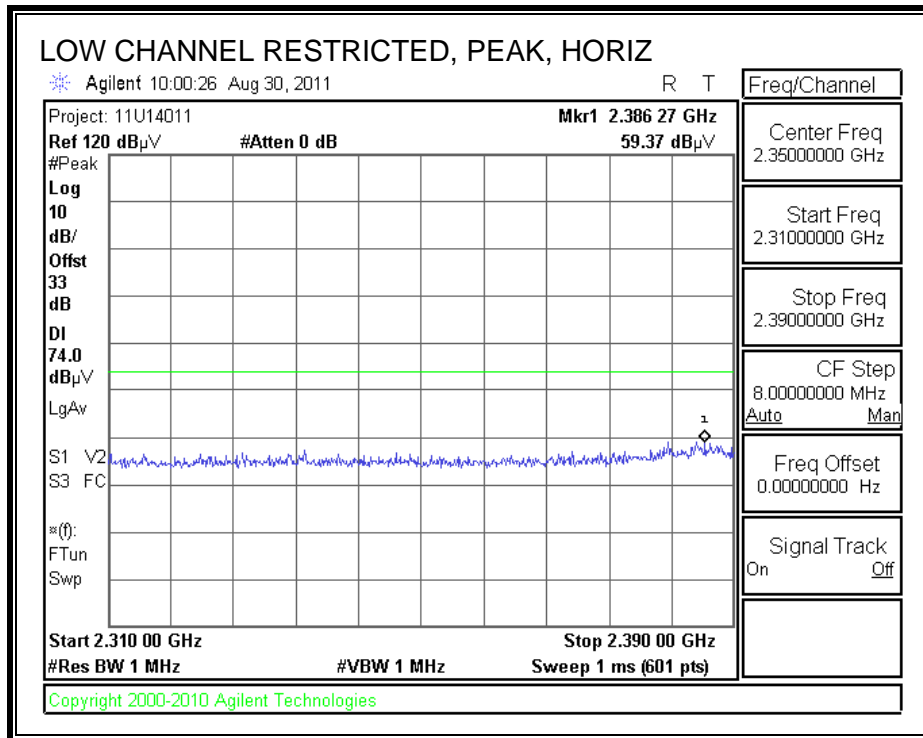
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Channel (2412 MHz): Vertical</b>															
4.824	3.0	40.7	27.0	34.6	6.2	-35.5	0.0	0.0	46.1	32.3	74	54	-27.9	-21.7	V, Noise Floor
<b>Low Channel (2412 MHz): Horizontal</b>															
4.824	3.0	40.4	27.0	34.6	6.2	-35.5	0.0	0.0	45.7	32.3	74	54	-28.3	-21.7	H, Noise Floor
<b>Mid Channel (2437 MHz): Vertical</b>															
4.874	3.0	40.4	26.8	34.7	6.2	-35.5	0.0	0.0	45.9	32.3	74	54	-28.1	-21.7	V, Noise Floor
<b>Mid Channel (2437 MHz): Horizontal</b>															
4.874	3.0	40.2	26.6	34.7	6.2	-35.5	0.0	0.0	45.6	32.1	74	54	-28.4	-21.9	H, Noise Floor
<b>High Channel (2462 MHz): Vertical</b>															
4.924	3.0	40.8	26.9	34.8	6.3	-35.5	0.0	0.0	46.4	32.5	74	54	-27.6	-21.5	V, Noise Floor
<b>High Channel (2462 MHz): Horizontal</b>															
4.924	3.0	40.1	26.9	34.8	6.3	-35.5	0.0	0.0	45.7	32.5	74	54	-28.3	-21.5	H, Noise Floor
No Significant Emissions Found Above the Noise Floor															

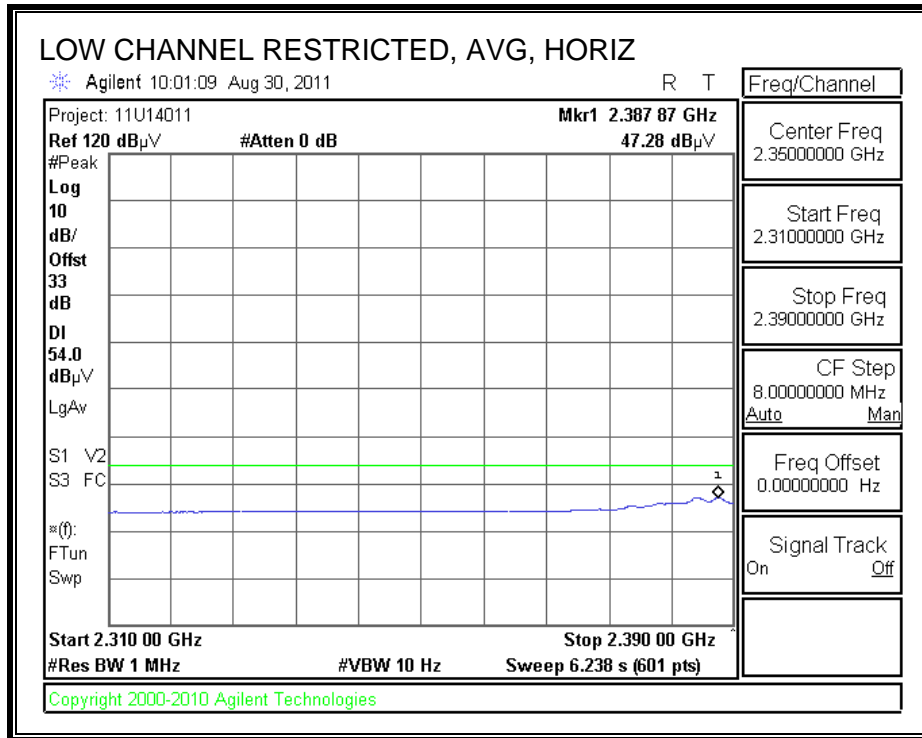
Rev. 07.08.11

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		

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

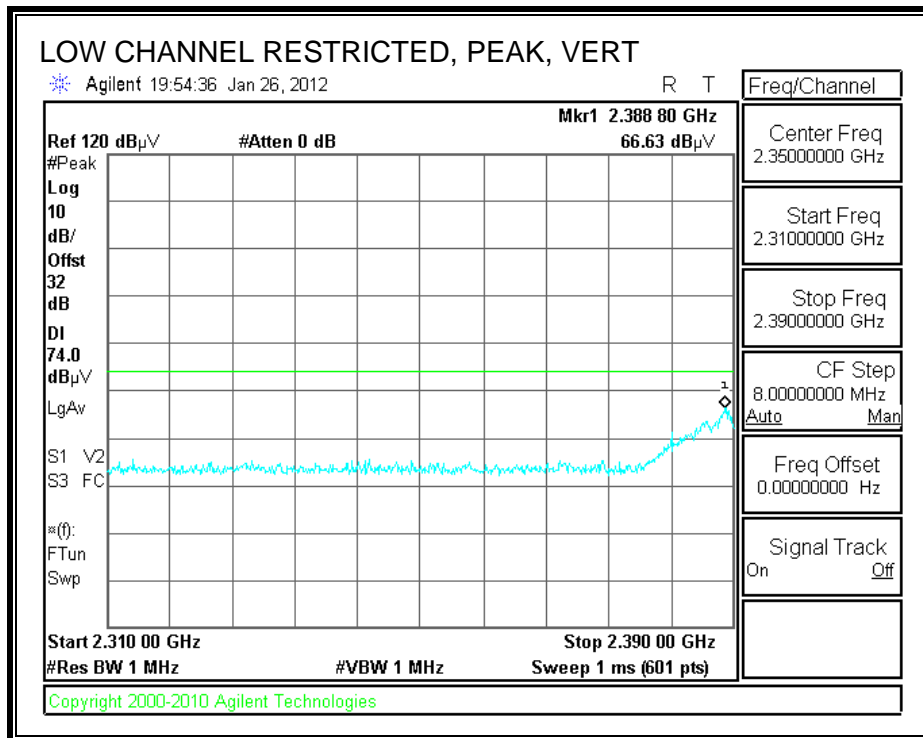
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

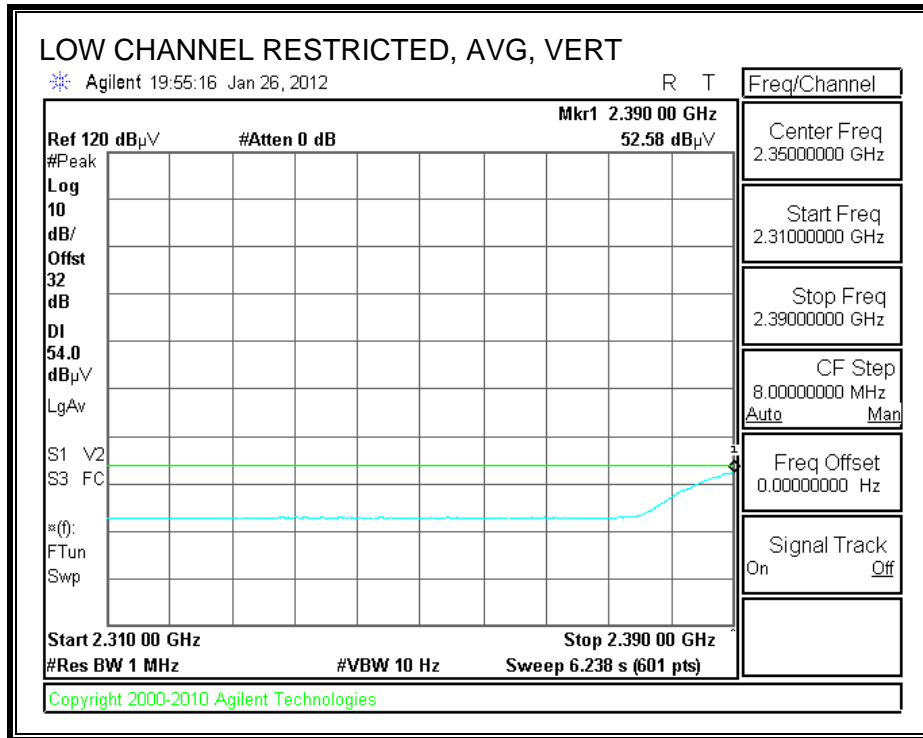




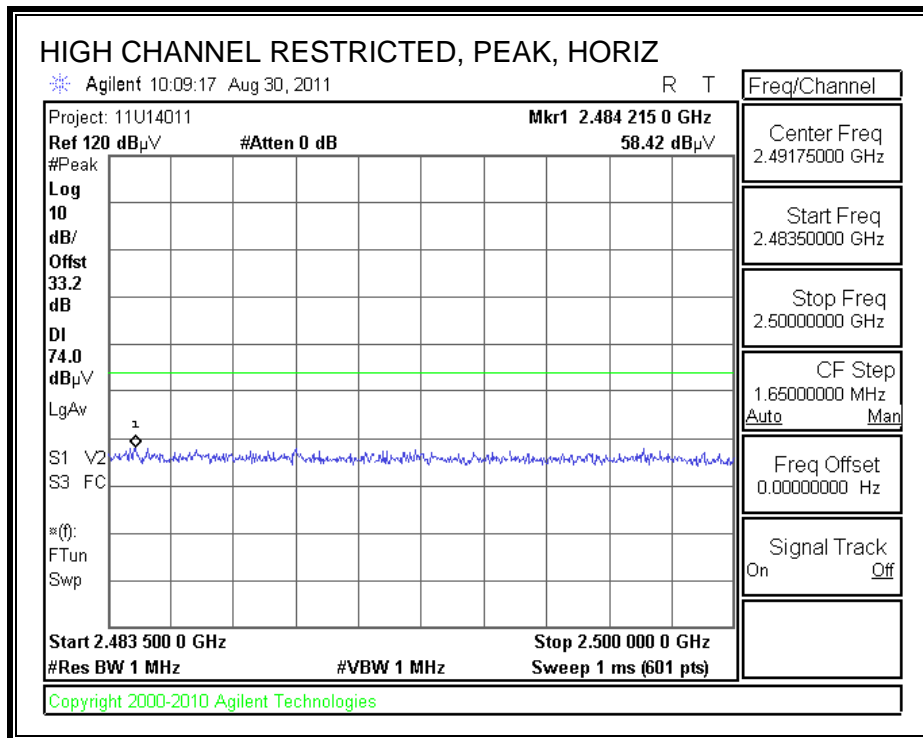


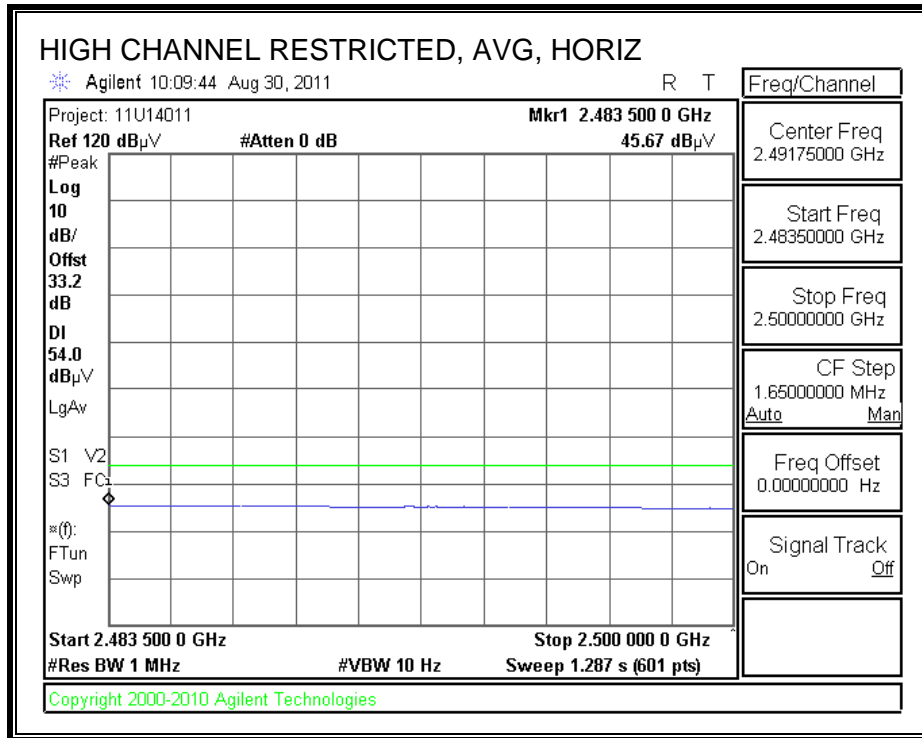
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



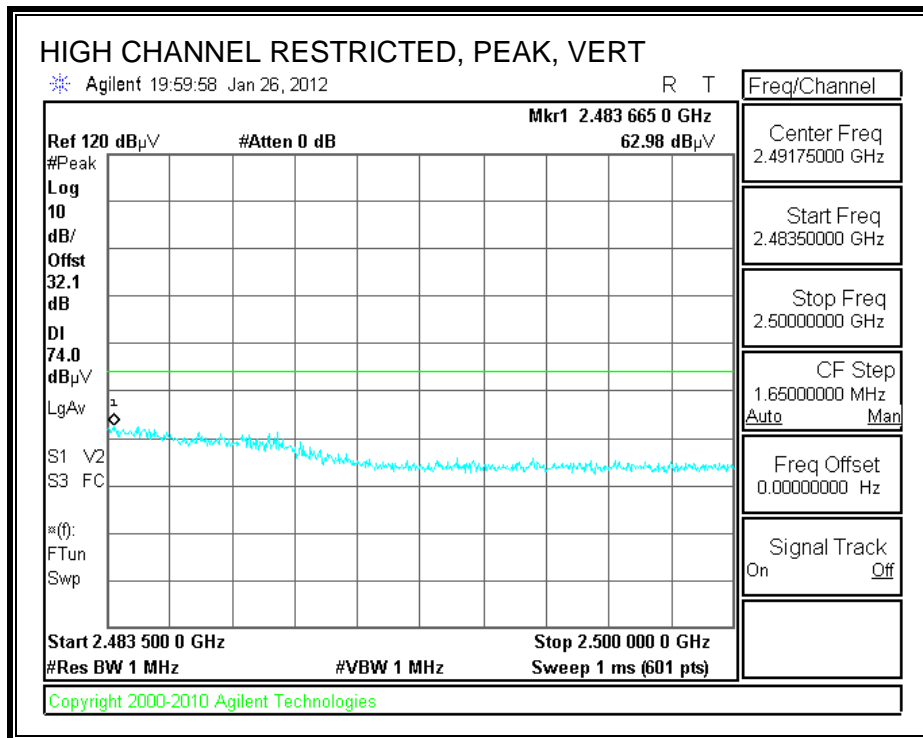


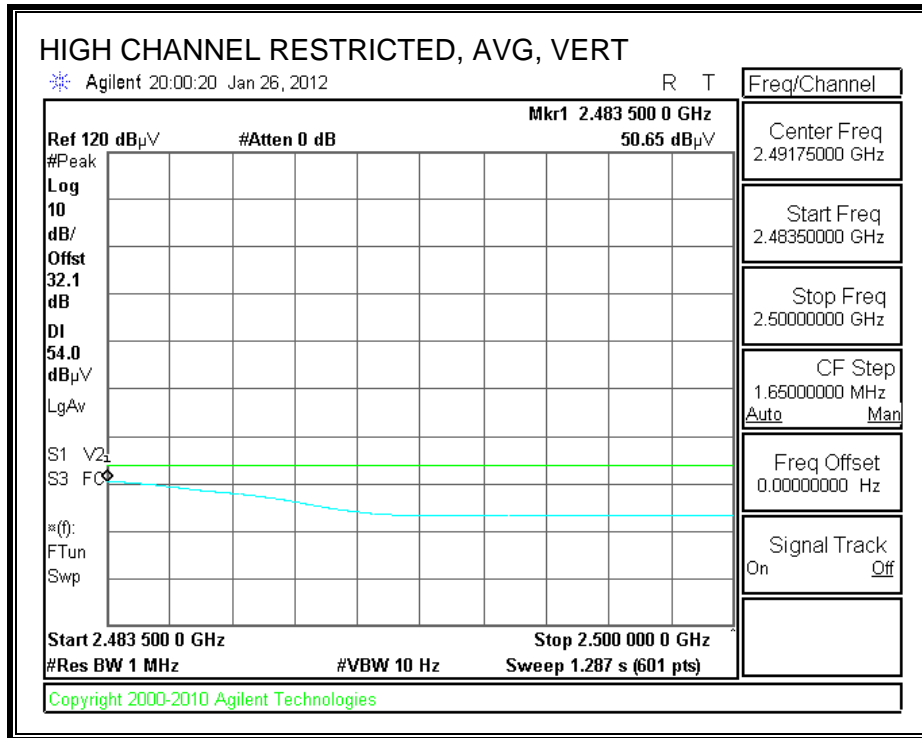
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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





**HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement  
 Compliance Certification Services, Fremont 5m Chamber-A

Company: Sierra Wireless  
 Project #: 11U14011  
 Date: 08/31/11  
 Test Engineer: Doug Anderson  
 Configuration: EUT with Support PC  
 Mode: Continuous Tx HT40 Mode

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18.26GHz; S/N:1049	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	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Channel (2422 MHz): Vertical</b>															
4.844	3.0	41.2	27.1	34.7	6.2	-35.5	0.0	0.0	46.6	32.5	74	54	-27.4	-21.5	V, Noise Floor
<b>Low Channel (2422 MHz): Horizontal</b>															
4.844	3.0	40.4	27.0	34.7	6.2	-35.5	0.0	0.0	45.8	32.4	74	54	-28.2	-21.6	H, Noise Floor
<b>Mid Channel (2437 MHz): Vertical</b>															
4.874	3.0	40.0	26.6	34.7	6.2	-35.5	0.0	0.0	45.5	32.0	74	54	-28.5	-22.0	V, Noise Floor
<b>Mid Channel (2437 MHz): Horizontal</b>															
4.874	3.0	39.7	26.6	34.7	6.2	-35.5	0.0	0.0	45.2	32.0	74	54	-28.8	-22.0	H, Noise Floor
<b>High Channel (2452 MHz): Vertical</b>															
4.904	3.0	40.3	26.7	34.8	6.3	-35.5	0.0	0.0	45.8	32.3	74	54	-28.2	-21.7	V, Noise Floor
<b>High Channel (2452 MHz): Horizontal</b>															
4.904	3.0	40.3	26.7	34.8	6.3	-35.5	0.0	0.0	45.9	32.2	74	54	-28.1	-21.8	H, Noise Floor
No Significant Emissions Found Above the Noise Floor															

Rev. 07.08.11

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		

### 9.3. RECEIVER ABOVE 1 GHz

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

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

Company: Sierra Wireless  
 Project #: 11U14011  
 Date: 08/31/11  
 Test Engineer: Doug Anderson  
 Configuration: EUT with Support PC  
 Mode: 20 MHz Channel BW Rx on Worst Case Channel and 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 15.209

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			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)
<b>Vertical:</b>															
2.000	3.0	56.3	52.1	27.9	3.9	-37.5	0.0	0.0	50.5	46.4	74	54	-23.5	-7.6	V
1.450	3.0	54.4	49.0	25.7	3.3	-38.2	0.0	0.0	45.2	39.8	74	54	-28.8	-14.2	V
1.196	3.0	62.6	50.2	24.8	3.0	-38.5	0.0	0.0	51.7	39.3	74	54	-22.3	-14.7	V
1.667	3.0	50.1	44.3	26.6	3.5	-37.9	0.0	0.0	42.3	36.5	74	54	-31.7	-17.5	V
1.350	3.0	49.4	40.0	25.4	3.1	-38.3	0.0	0.0	39.6	30.2	74	54	-34.4	-23.8	V
1.050	3.0	49.4	37.4	24.2	2.8	-38.7	0.0	0.0	37.6	25.6	74	54	-36.4	-28.4	V
<b>Horizontal:</b>															
1.960	3.0	64.5	50.5	27.7	3.8	-37.5	0.0	0.0	58.5	44.5	74	54	-15.5	-9.5	H
1.450	3.0	54.4	48.0	25.7	3.3	-38.2	0.0	0.0	45.2	38.8	74	54	-28.8	-15.2	H
2.000	3.0	48.9	42.3	27.9	3.9	-37.5	0.0	0.0	43.2	36.5	74	54	-30.8	-17.5	H
1.333	3.0	49.8	40.8	25.3	3.1	-38.4	0.0	0.0	39.9	30.8	74	54	-34.1	-23.2	H
1.599	3.0	50.6	36.5	26.3	3.4	-38.0	0.0	0.0	42.4	28.3	74	54	-31.6	-25.7	H
1.050	3.0	51.3	39.6	24.2	2.8	-38.7	0.0	0.0	39.4	27.8	74	54	-34.6	-26.2	H

Rev. 07.08.11

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		



### 9.3.2. RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH IN THE 2.4 GHz BAND

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

Company: Sierra Wireless  
 Project #: 11U14011  
 Date: 08/31/11  
 Test Engineer: Doug Anderson  
 Configuration: EUT with Support PC  
 Mode: 40 MHz Channel BW Rx on Worst Case Channel and Mode

**Test Equipment:**

<b>Horn 1-18GHz</b>	<b>Pre-amplifer 1-26GHz</b>	<b>Pre-amplifer 26-40GHz</b>	<b>Horn &gt; 18GHz</b>	<b>Limit</b>
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC 15.209

Hi Frequency Cables

<b>3' cable 22807700</b>	<b>12' cable 22807600</b>	<b>20' cable 22807500</b>	<b>HPF</b>	<b>Reject Filter</b>	<b>Peak Measurements</b> RBW=VBW=1MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500			<b>Average Measurements</b> RBW=1MHz ; VBW=10Hz

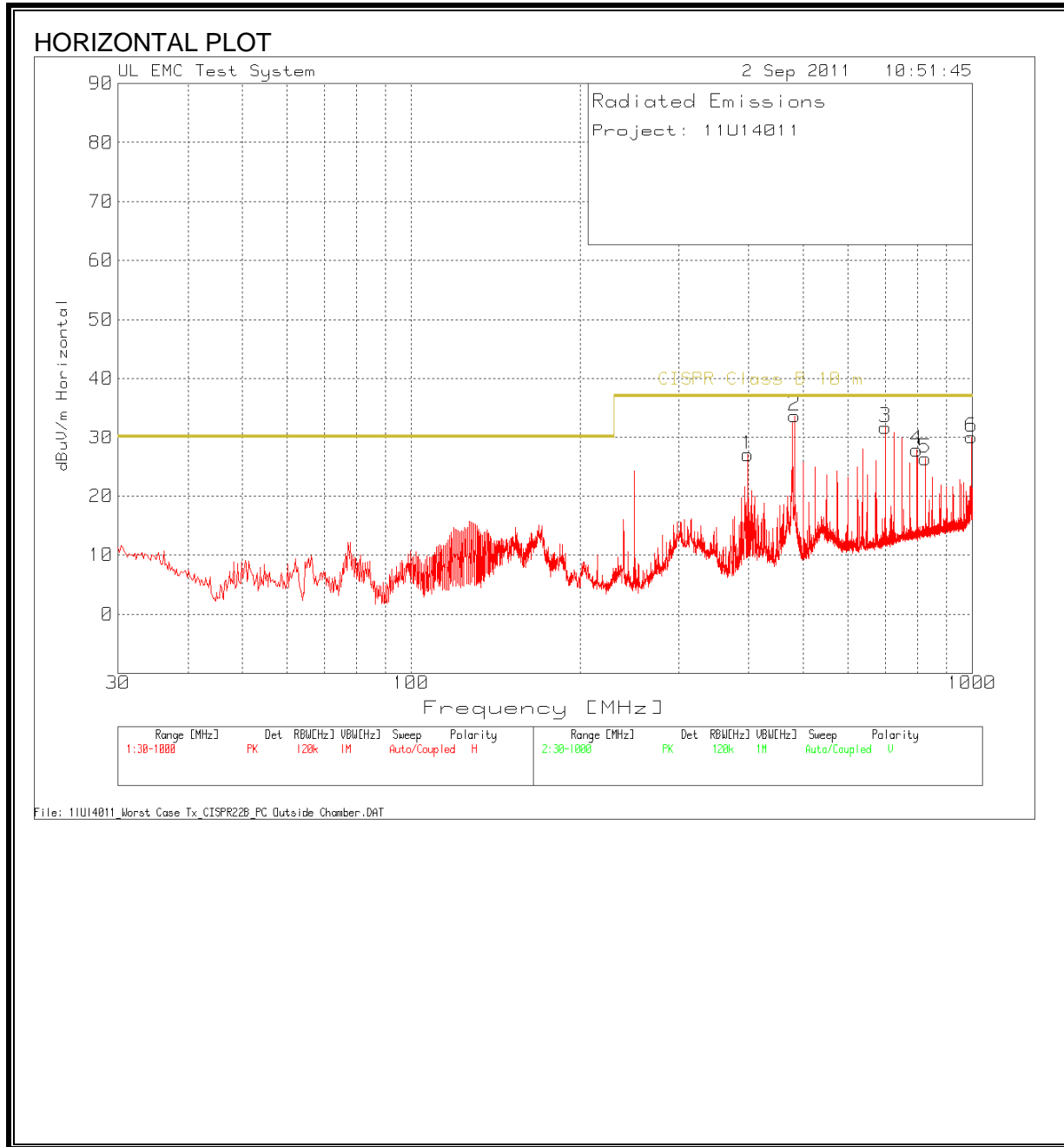
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Vertical:</b>															
2.000	3.0	55.8	51.6	27.9	3.9	-37.5	0.0	0.0	50.1	45.9	74	54	-23.9	-8.1	V
1.450	3.0	54.9	49.3	25.7	3.3	-38.2	0.0	0.0	45.7	40.1	74	54	-28.3	-13.9	V
1.196	3.0	62.3	50.0	24.8	3.0	-38.5	0.0	0.0	51.5	39.2	74	54	-22.5	-14.8	V
1.667	3.0	50.8	44.5	26.6	3.5	-37.9	0.0	0.0	43.0	36.7	74	54	-31.0	-17.3	V
1.350	3.0	49.1	39.8	25.4	3.1	-38.3	0.0	0.0	39.3	30.0	74	54	-34.7	-24.0	V
1.050	3.0	50.6	38.1	24.2	2.8	-38.7	0.0	0.0	38.8	26.3	74	54	-35.2	-27.7	V
<b>Horizontal:</b>															
1.960	3.0	63.4	49.3	27.7	3.8	-37.5	0.0	0.0	57.4	43.3	74	54	-16.6	-10.7	H
1.450	3.0	54.9	48.2	25.7	3.3	-38.2	0.0	0.0	45.7	39.0	74	54	-28.3	-15.0	H
2.000	3.0	49.9	42.6	27.9	3.9	-37.5	0.0	0.0	44.2	36.9	74	54	-29.8	-17.1	H
1.333	3.0	50.3	40.9	25.3	3.1	-38.4	0.0	0.0	40.3	30.9	74	54	-33.7	-23.1	H
1.050	3.0	52.0	39.8	24.2	2.8	-38.7	0.0	0.0	40.2	28.0	74	54	-33.8	-26.0	H
1.599	3.0	49.3	36.1	26.3	3.4	-38.0	0.0	0.0	41.1	27.9	74	54	-32.9	-26.1	H

Rev. 07.08.11

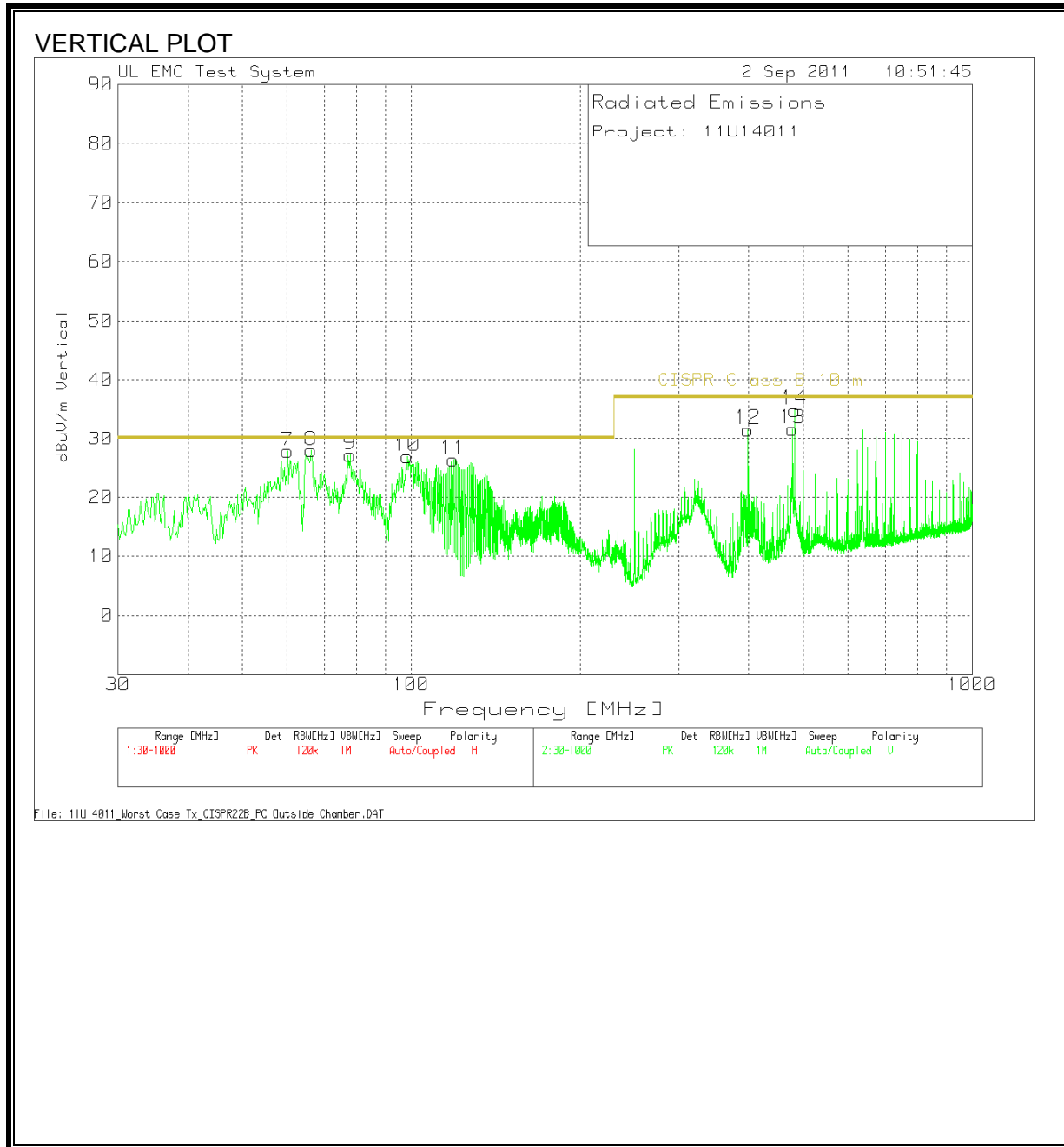
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

### 9.4. 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)**



**HORIZONTAL AND VERTICAL DATA**

Project: 11U14011											
Range 1 30 - 1000MHz											
Test Freq. (MHz)	Meter Reading (dBuV)	Detector	Cable Loss [dB]	Pre-Amp Gain [dB]	Antenna Factor [dB]	10m to 3m Conversion [dB]	dBuV/m	CISPR22 Class B 10 m Limit	Margin	Height [cm]	Polarity
398.4992	48.21	PK	2.2	-27.8	14.9	-10.5	27.01	37	-9.99	200	Horz
482.6279	53.1	PK	2.4	-27.7	16.4	-10.5	33.7	37	-3.3	200	Horz
699.9281	46.72	PK	2.9	-27	19.6	-10.5	31.72	37	-5.28	100	Horz
797.2382	41.43	PK	3.2	-27.2	20.9	-10.5	27.83	37	-9.17	100	Horz
825.1519	39.73	PK	3.2	-27.3	21.2	-10.5	26.33	37	-10.67	100	Horz
996.7046	42.36	PK	3.5	-27.7	22.4	-10.5	30.06	37	-6.94	100	Horz
Range 2 30 - 1000MHz											
Test Freq. (MHz)	Meter Reading (dBuV)	Detector	Cable Loss [dB]	Pre-Amp Gain [dB]	Antenna Factor [dB]	10m to 3m Conversion [dB]	dBuV/m	CISPR22 Class B 10 m Limit	Margin	Height [cm]	Polarity
60.2398	57.91	PK	0.8	-28.3	7.9	-10.5	27.81	30	-2.19	100	Vert
60.2398	55.15	QP	0.8	-28.3	7.9	-10.5	25.05	30	-4.95	100	Vert
66.249	57.69	PK	0.9	-28.2	8	-10.5	27.89	30	-2.11	100	Vert
66.249	55.22	QP	0.9	-28.2	8	-10.5	25.42	30	-4.58	100	Vert
77.8797	57.43	PK	0.9	-28.2	7.5	-10.5	27.13	30	-2.87	100	Vert
77.8797	54.38	QP	0.9	-28.2	7.5	-10.5	24.08	30	-5.92	100	Vert
98.4273	54.85	PK	1.1	-28.2	9.6	-10.5	26.85	30	-3.15	100	Vert
118.781	50.44	PK	1.2	-28.2	13.4	-10.5	26.34	30	-3.66	100	Vert
398.4992	52.75	PK	2.2	-27.8	14.9	-10.5	31.55	37	-5.45	200	Vert
478.5572	51.13	PK	2.4	-27.7	16.3	-10.5	31.63	37	-5.37	100	Vert
482.6279	54.27	PK	2.4	-27.7	16.4	-10.5	34.87	37	-2.13	100	Vert
482.6279	47.47	QP	2.4	-27.7	16.4	-10.5	28.07	37	-8.93	100	Vert
PK - Peak detector QP - Quasi-Peak detector LnAv - Linear Average detector LgAv - Log Average detector Av - Average detector CAV - CISPR Average detector RMS - RMS detection CRMS - CISPR RMS detection											

## 10. 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

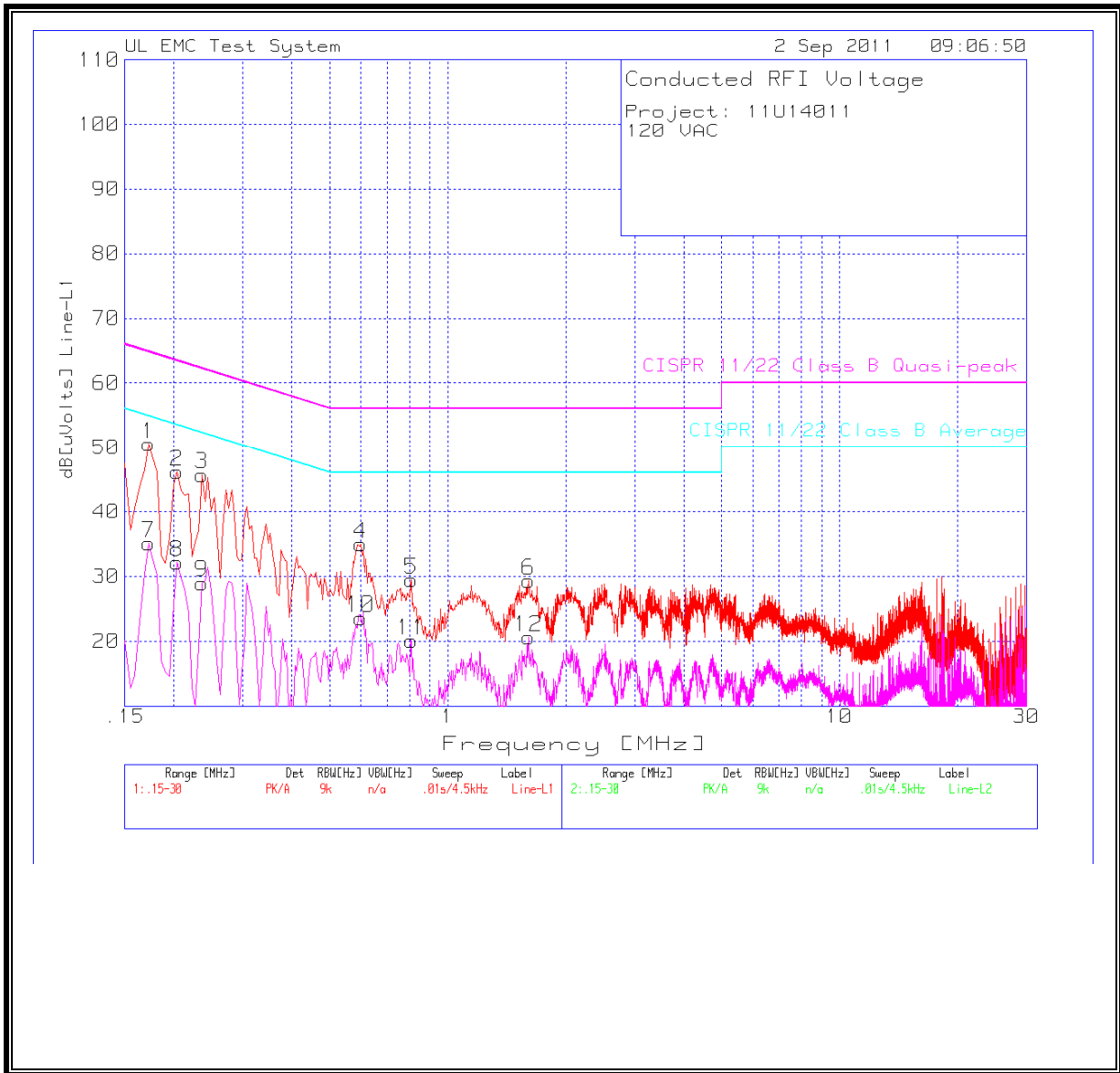
ANSI C63.4

### RESULTS

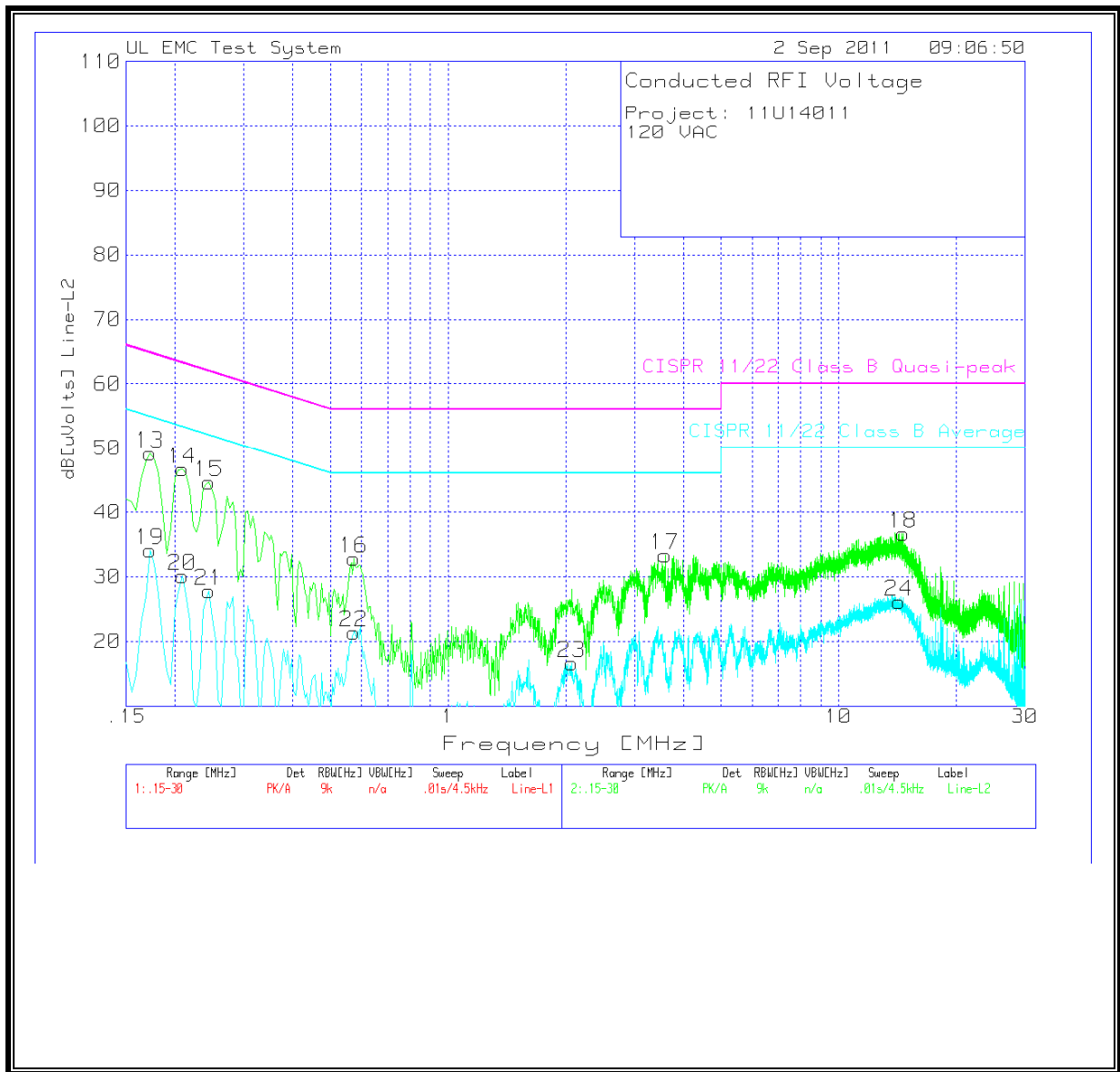
**6 WORST EMISSIONS**

Project: 11U14011									
120 VAC									
Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	LISN [dB]	Conducte d Emission Cable [dB]	dB[uVolts ]	CISPR 11/22 Class B Quasi- peak	Margin	CISPR 11/22 Class B Average	Margin
0.1725	50.48	PK	0	0	50.48	64.8	-14.32	54.8	-4.32
0.204	46.18	PK	0	0	46.18	63.4	-17.22	53.4	-7.22
0.2355	45.72	PK	0	0	45.72	62.3	-16.58	52.3	-6.58
0.6	34.97	PK	0	0	34.97	56	-21.03	46	-11.03
0.807	29.47	PK	0	0	29.47	56	-26.53	46	-16.53
1.608	29.36	PK	0	0	29.36	56	-26.64	46	-16.64
0.1725	35.08	Av	0	0	35.08	64.8	-29.72	54.8	-19.72
0.204	32.13	Av	0	0	32.13	63.4	-31.27	53.4	-21.27
0.2355	29.02	Av	0	0	29.02	62.3	-33.28	52.3	-23.28
0.6	23.62	Av	0	0	23.62	56	-32.38	46	-22.38
0.807	20.04	Av	0	0	20.04	56	-35.96	46	-25.96
1.608	20.6	Av	0	0	20.6	56	-35.4	46	-25.4
Line-L2 .15 - 30MHz									
0.1725	49.08	PK	0	0.1	49.18	64.8	-15.62	54.8	-5.62
0.2085	46.58	PK	0	0.1	46.68	63.3	-16.62	53.3	-6.62
0.2445	44.5	PK	0	0.1	44.6	61.9	-17.3	51.9	-7.3
0.573	32.69	PK	0	0.1	32.79	56	-23.21	46	-13.21
3.5925	33.24	PK	0	0.1	33.34	56	-22.66	46	-12.66
14.604	36.39	PK	0	0.3	36.69	60	-23.31	50	-13.31
0.1725	34.02	Av	0	0.1	34.12	64.8	-30.68	54.8	-20.68
0.2085	29.99	Av	0	0.1	30.09	63.3	-33.21	53.3	-23.21
0.2445	27.66	Av	0	0.1	27.76	61.9	-34.14	51.9	-24.14
0.573	21.27	Av	0	0.1	21.37	56	-34.63	46	-24.63
2.076	16.57	Av	0	0.1	16.67	56	-39.33	46	-29.33
14.2755	25.83	Av	0	0.3	26.13	60	-33.87	50	-23.87
PK - Peak detector									
QP - Quasi-Peak detector									
LnAv - Linear Average detector									
LgAv - Log Average detector									
Av - Average detector									
CAV - CISPR Average detector									
RMS - RMS detection									

**LINE 1 RESULTS**



**LINE 2 RESULTS**





# 11. 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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> <sup>0.5</sup>	0.0042 <i>f</i> <sup>0.5</sup>	<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> <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616 000 / <i>f</i> <sup>1.2</sup>

\* 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<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
  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:

$$S = \text{EIRP} / (4 * \text{Pi} * \text{D}^2)$$

where

S = Power density in W/m<sup>2</sup>

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mW/cm<sup>2</sup> by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m<sup>2</sup>

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

$$\text{Total EIRP} = (P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)$$

where

Px = Power of transmitter x

Gx = Numeric gain of antenna x

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<sup>2</sup>

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

**RESULTS**

Band	Mode	Separation Distance (m)	Output AV Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	WLAN	0.20	15.50	2.00	0.11	0.011