



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

**CERTIFICATION TEST REPORT**

**FOR**

**802.11a/g/n 3x3 MIMO WLAN + BT Combo PCI-E Mini Card**

**MODEL NUMBER: BCM94331PCIEBT4**

**FCC ID: QDS-BRCM1055  
IC: 4324A-BRCM1055**

**REPORT NUMBER: 10U13492-1, Revision A**

**ISSUE DATE: JANUARY 21, 2011**

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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	01/20/2011	Initial Issue	T. Chan
A	01/21/2011	Added MPE Co-located	T. Chan

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, USA

**EUT DESCRIPTION:** 802.11a/g/n 3x3 MIMO WLAN + BT Combo PCI-E Mini Card

**MODEL:** BCM94331PCIEBT4

**SERIAL NUMBER:** 6

**DATE TESTED:** NOVEMBER 15, 2010 to JANUARY 20, 2011

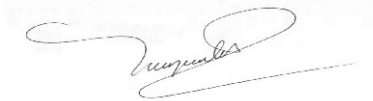
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

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

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

Approved & Released For UL CCS By:

Tested By:



THU CHAN  
ENGINEERING MANAGER  
UL CCS

VIEN TRAN  
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 802.11a/g/n 3x3 MIMO WLAN + BT Combo PCI-E Mini Card.

The radio module is manufactured by Broadcom

### 5.2. MAXIMUM OUTPUT POWER

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

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power Chain 1 (dBm)	Peak Power Chain 2 (dBm)	Peak Power Chain 3 (dBm)	Total Peak Power (dBm)	Output Power (mW)
2412 - 2462	802.11b Three Chains CDD Legacy	21.13	20.99	21.09	25.84	383.85
2412 - 2462	802.11g Legacy				27.79	601.17
2412 - 2462	802.11n 20MHz SISO	Covered by the worst case 802.11g Mode Legacy testing				
2412 - 2462	802.11g Three Chains CDD Legacy	Covered by the worst case 802.11n Three Chains 20MHz CDD				
2412 - 2462	802.11n Three Chain 20MHz CDD	21.36	21.23	21.3	26.07	404.41
2422 - 2452	802.11n 40MHz SISO	N/A, based on Broadcom's Test Plan				
2422 - 2452	802.11n Three Chain 40MHz CDD	N/A, based on Broadcom's Test Plan				

5725 to 5850 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power Chain 1 (dBm)	Peak Power Chain 2 (dBm)	Peak Power Chain 3 (dBm)	Total Peak Power (dBm)	Output Power (mW)
5745 - 5825	802.11a Legacy	N/A, based on Broadcom's Test Plan				
5745 - 5825	802.11n 20MHz SISO	N/A, based on Broadcom's Test Plan				
5745 - 5825	802.11a Three Chains CDD Legacy	Covered by the worst case 802.11n Three Chain 20MHz CDD				
5745 - 5825	802.11n Three Chains 20MHz CDD	20.36	20.31	20.52	25.17	328.76
5755 - 5795	802.11n 40MHz SISO	N/A, based on Broadcom's Test Plan				
5755 - 5795	802.11n Three Chains 40MHz CDD	15.39	16.34	16.26	20.79	119.91

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes three 802.11agn antennas, with a maximum gain as below table;

K91	Antenna Gain			Antenna Gain
	Ant 1 dBi	Ant 2 dBi	Ant 3 dBi	Combined dBi
2.4	5.65	5.23	3.57	9.68
K90	Antenna Gain			Antenna Gain
	Ant 1 dBi	Ant 2 dBi	Ant 3 dBi	Combined dBi
5.8	7.25	6.22	5.92	11.27

### 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 5.100.98.17  
 The test utility software used during testing was BCM Internal, rev. 5.100.RC98.17.



## 5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC.

Worst-Case data rates were utilized from preliminary testing of the Chipset, worst-case data rates used during the testing are as follows:

For 2.4GHz Band:

All final tests in the 802.11b Three Chains Mode (Legacy) were made at 1 Mb/s.

All final tests in the 802.11g Legacy mode were made at 6 Mb/s.

All final tests in the 802.11n Mode (20 MHz CDD/SDM) were made at MCS0.

All final tests in the 802.11n Mode (40 MHz CDD/SDM) were made at MCS0.

For 5.8GHz Band:

All final tests in the 802.11n Mode (20 MHz CDD/SDM) were made at MCS0

All final tests in the 802.11n Mode (40 MHz CDD/SDM) were made at MCS0

Worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was the mode and channel with the highest output power, that was determined to be 11n Three Chains HT20 mode, mid channel..

For MIMO conducted spurious measurement preliminary testing showed that combiner is worst-case compared to individual chains; therefore final measurements were performed using combiner for all channels and modes.

For 2.4GHz and 5GHz bands MIMO PSD measurement preliminary testing showed that combiner is worst-case compared to individual chains; therefore final measurements were performed using combiner for all channels and modes.

For Radiated Band Edge & Harmonic measurements preliminary testing showed that the worst case was vertical polarization, so final measurements were performed with vertical polarization.

All legacy/SISO modes were measured with the highest gain for each type of antenna.

All MIMO modes were measured with the highest combination of gains for each type of antenna. Note that this combination of antennas will not be implemented in the end product. This combination was selected for testing purposes only, to accommodate the highest gain of each antenna type in one single test configuration. The combined gain of this test configuration is higher than any combined gain that will be implemented in the end product.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Inspiron 0000	CN-9010003-70166-57K-01JS	DoC
AC Adapter	Dell	ADP-60NH B	MOW0528000191	DoC
Adapter Board	Catalyst	MINI2EXP	BRCM 07	N/A
Adapter Board	Broadcom	BCM94331PCIBT4HAD	241	N/A

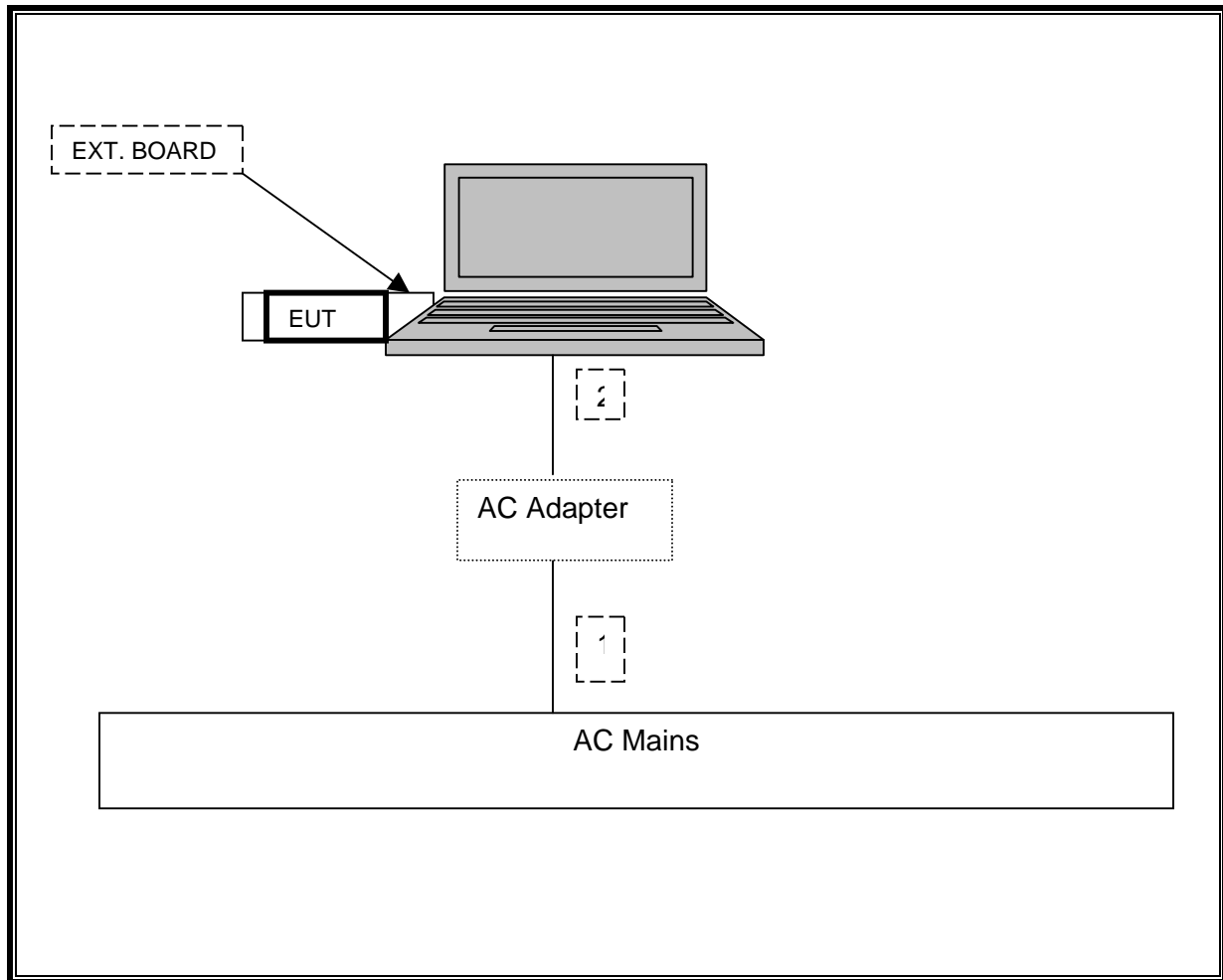
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Shielded	1.5m	NA
2	DC	1	DC	Un-shielded	1.5m	Ferrite at laptop's end

### TEST SETUP

The EUT is attached to a jig board which is installed in the PCMCIA slot of a host laptop computer during the tests. Test software exercised the radio card.

**SETUP DIAGRAM**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	07/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	07/29/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	07/06/11
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	08/04/11
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	10/29/11
Peak Power Meter	Agilent / HP	E9327A	C00964	12/04/11
Peak Power Sensor	Agilent / HP	E4416A	C00963	12/04/11
EMI Receiver, 6.5 GHz	Agilent / HP	8546A	1963	08/19/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-	N02481	11/05/11
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/12

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.11b THREE CHAINS LEGACY 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.

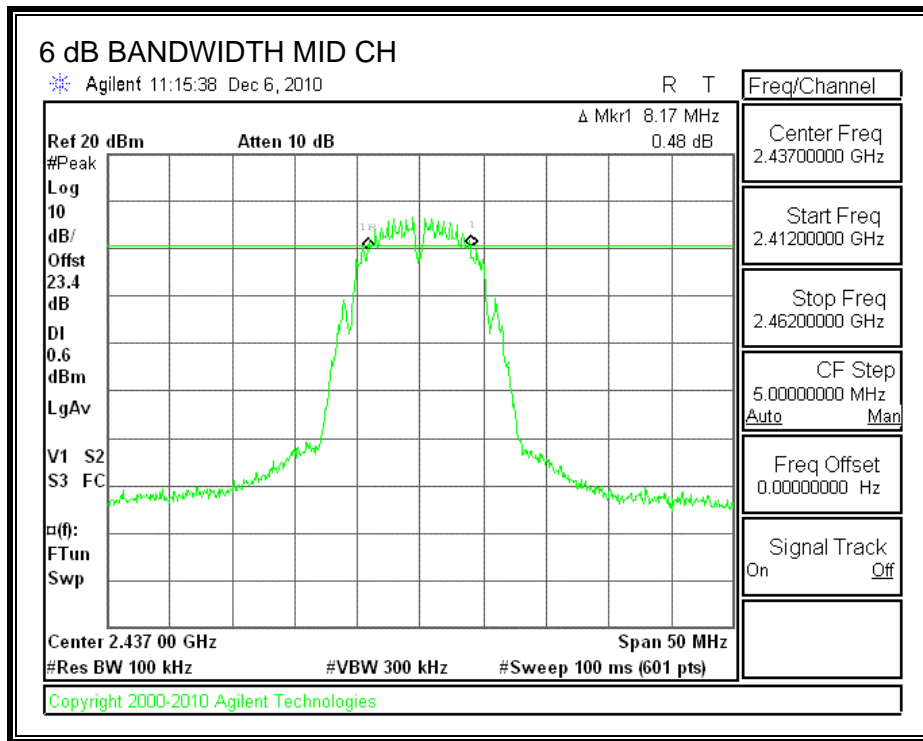
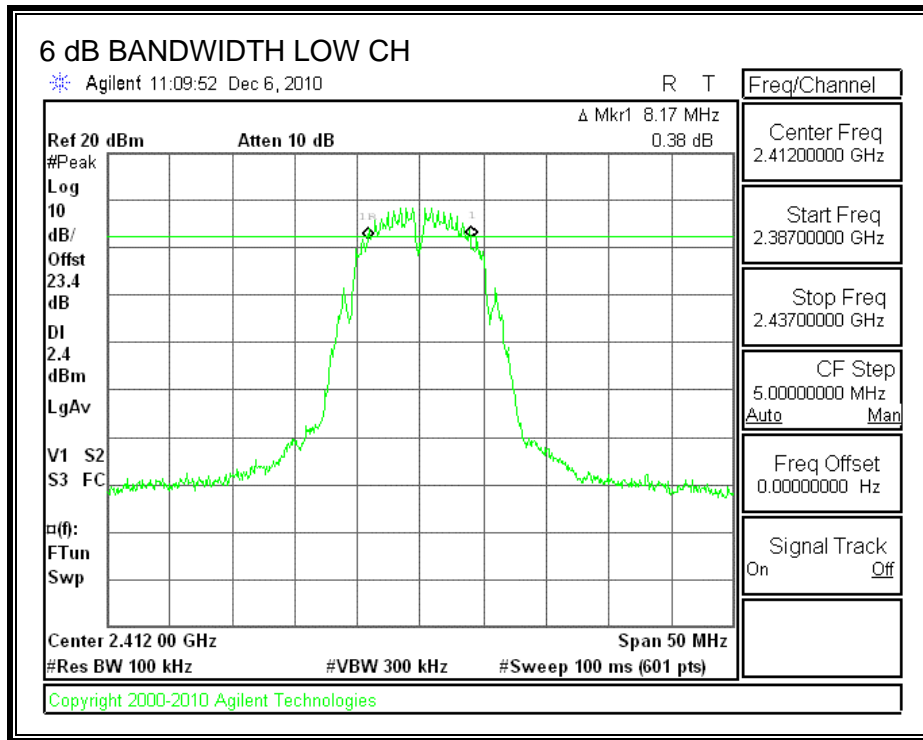
##### TEST PROCEDURE

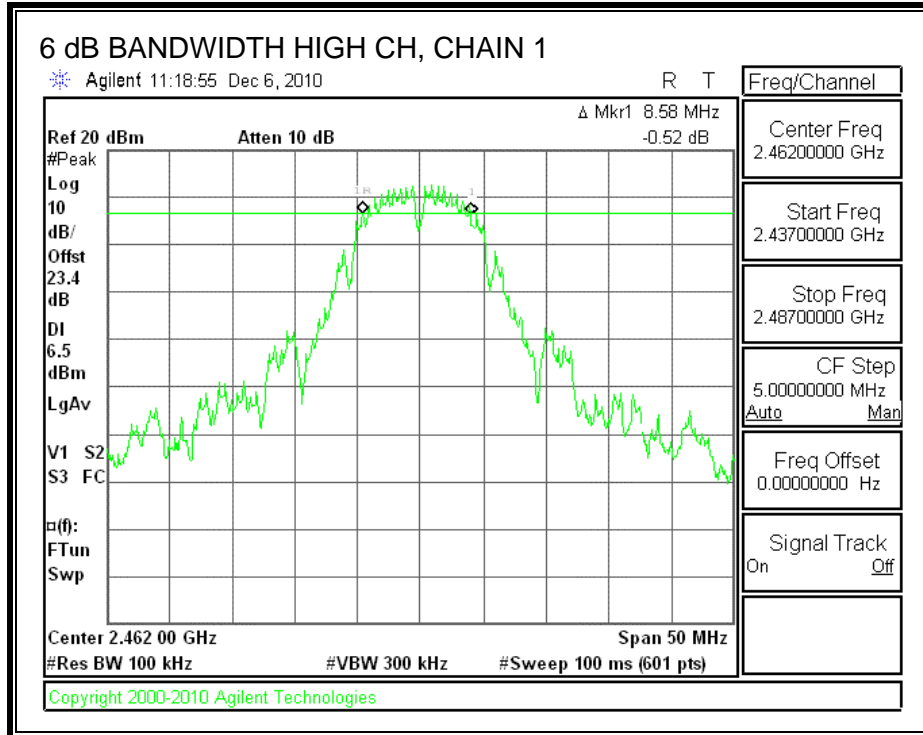
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

##### RESULTS

Channel	Frequency (MHz)	6 dB BW (MHz)	Minimum Limit (MHz)
Low	2412	8.17	0.5
Middle	2437	8.17	0.5
High	2462	8.58	0.5

**6 dB BANDWIDTH**





## 7.1.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

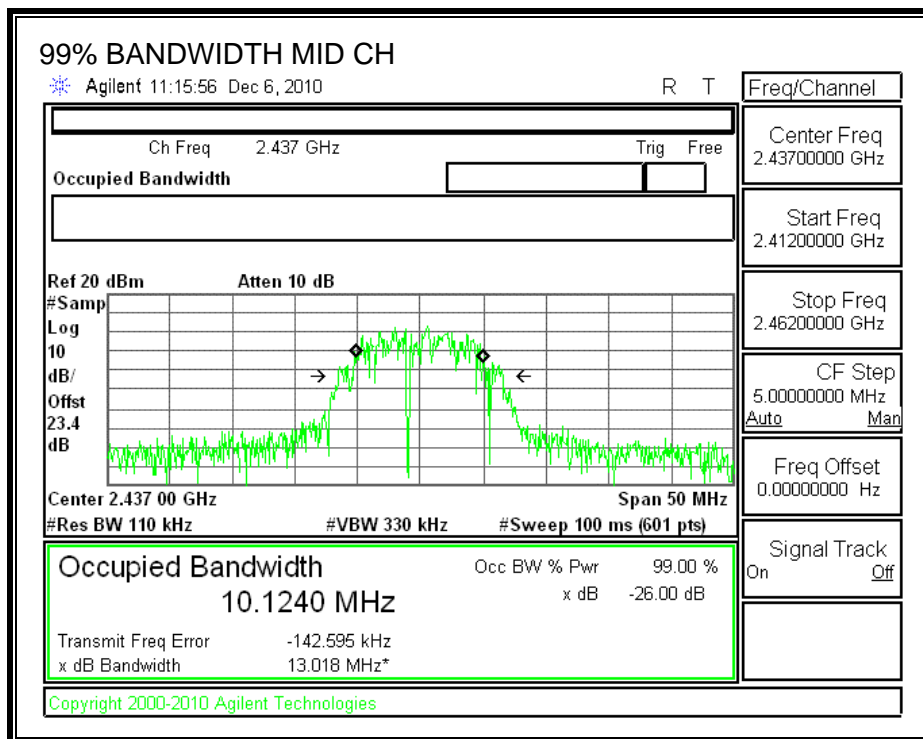
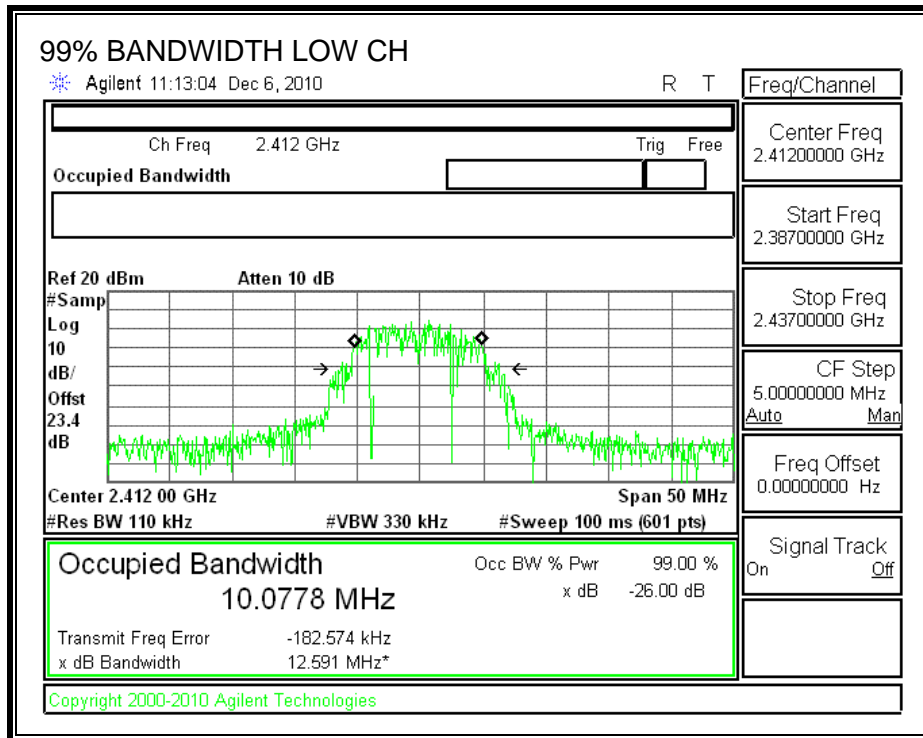
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

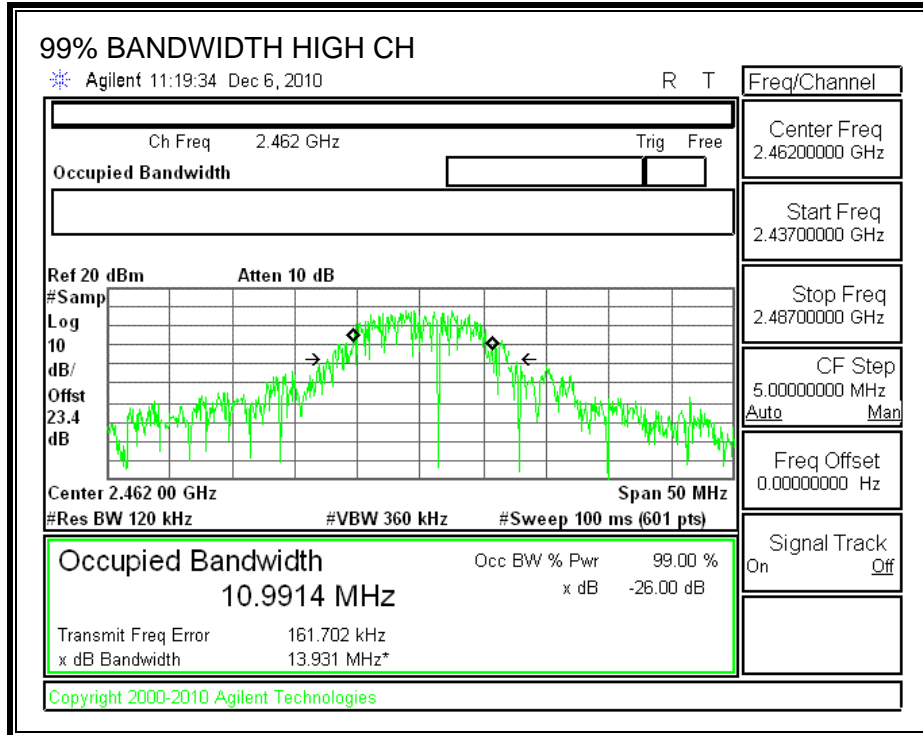
### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	10.0778
Middle	2437	10.1240
High	2462	10.9914



**99% BANDWIDTH**





### 7.1.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The composite antenna gain is equal to 9.68 dBi, therefore the limit is 26.32 dBm.

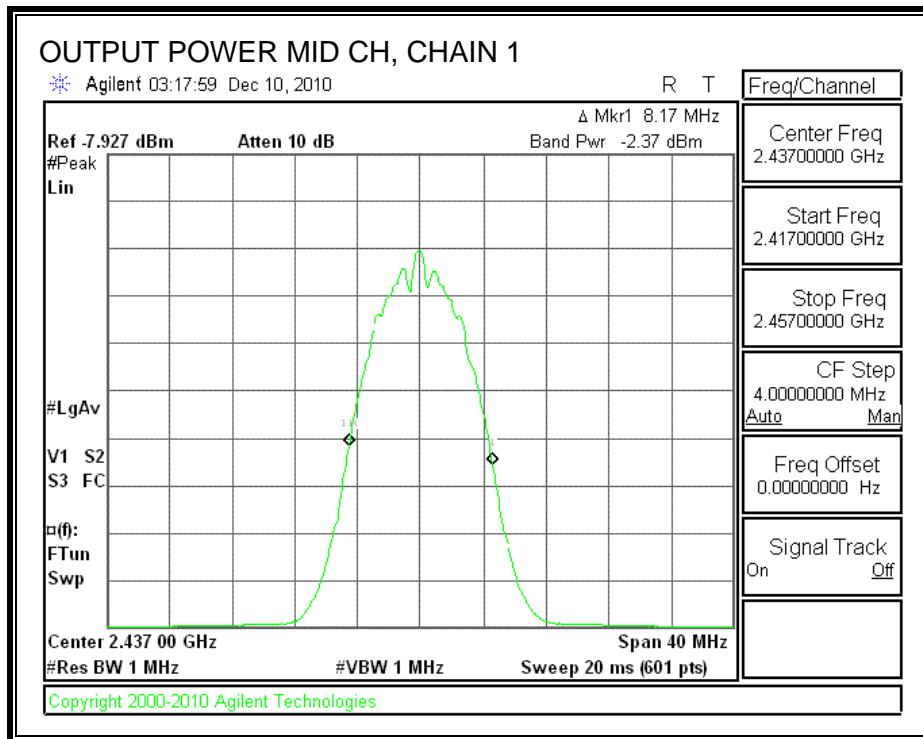
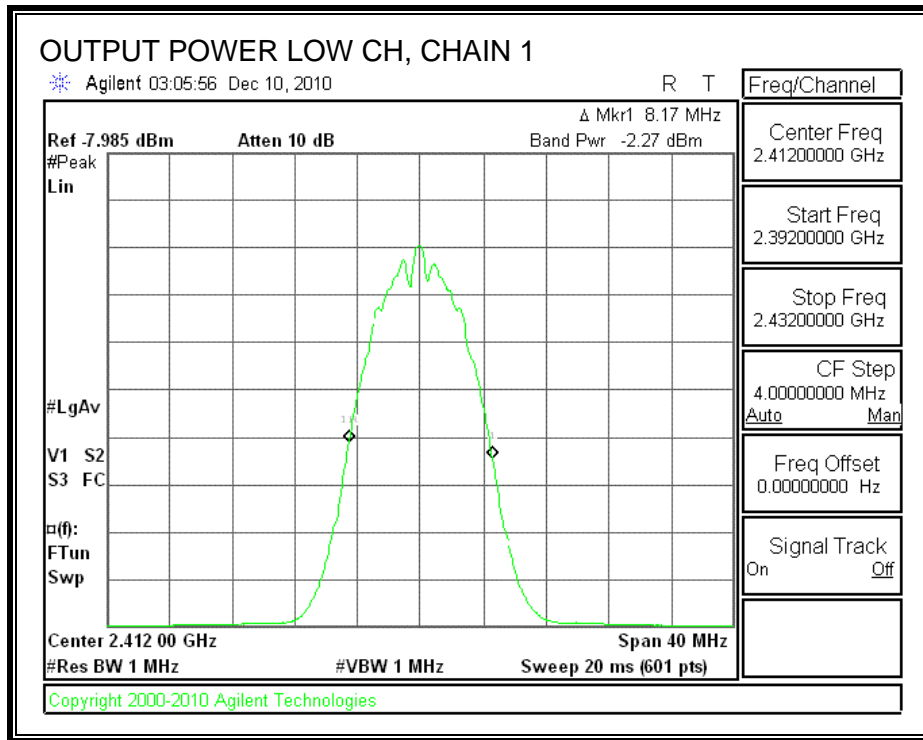
#### TEST PROCEDURE

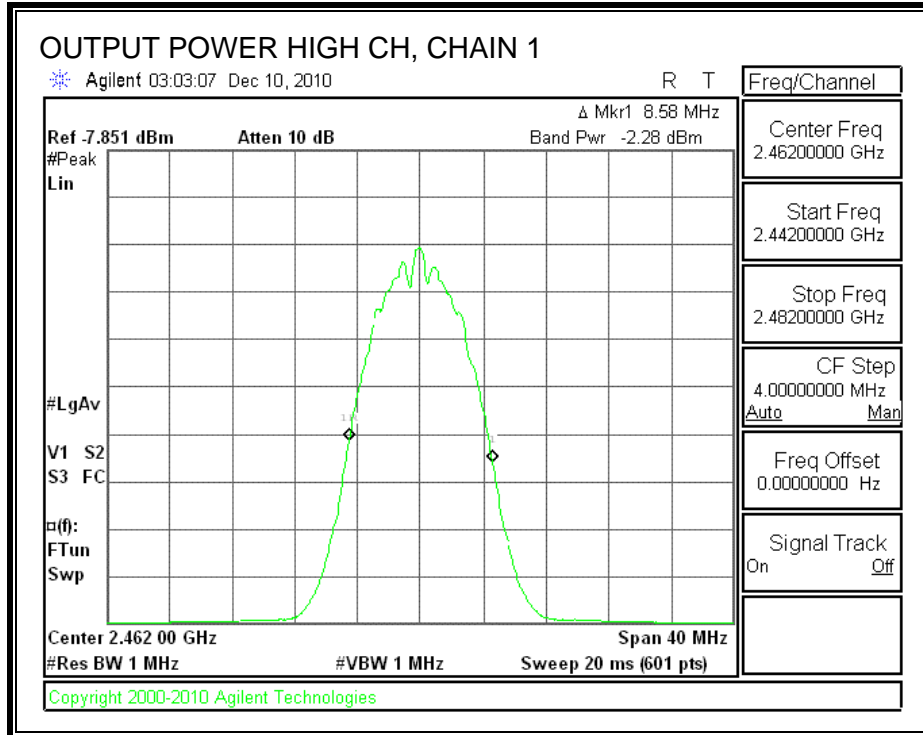
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

#### RESULTS

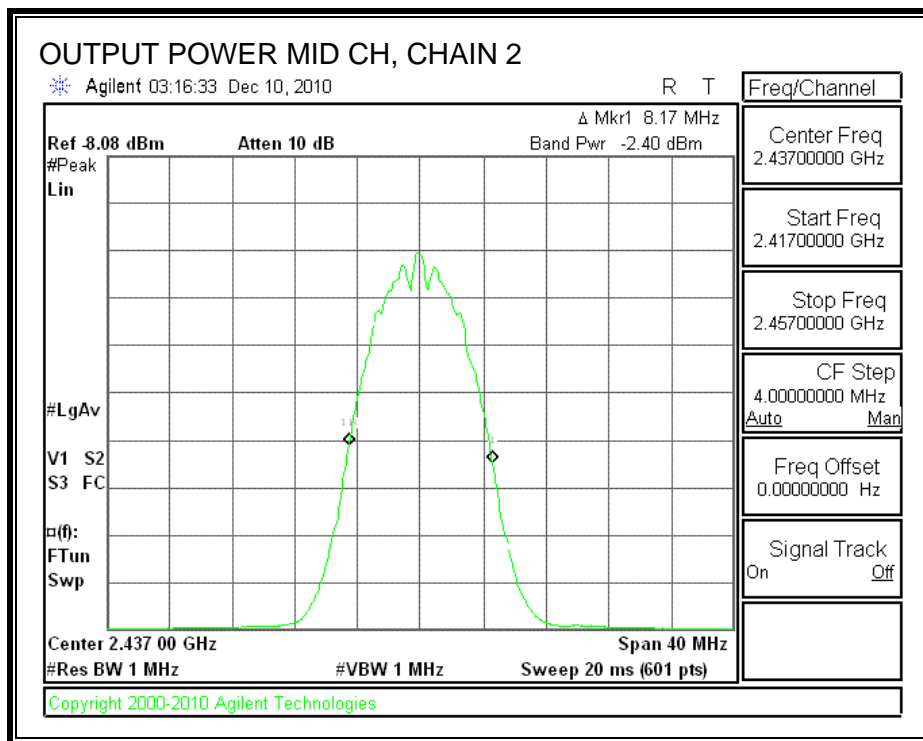
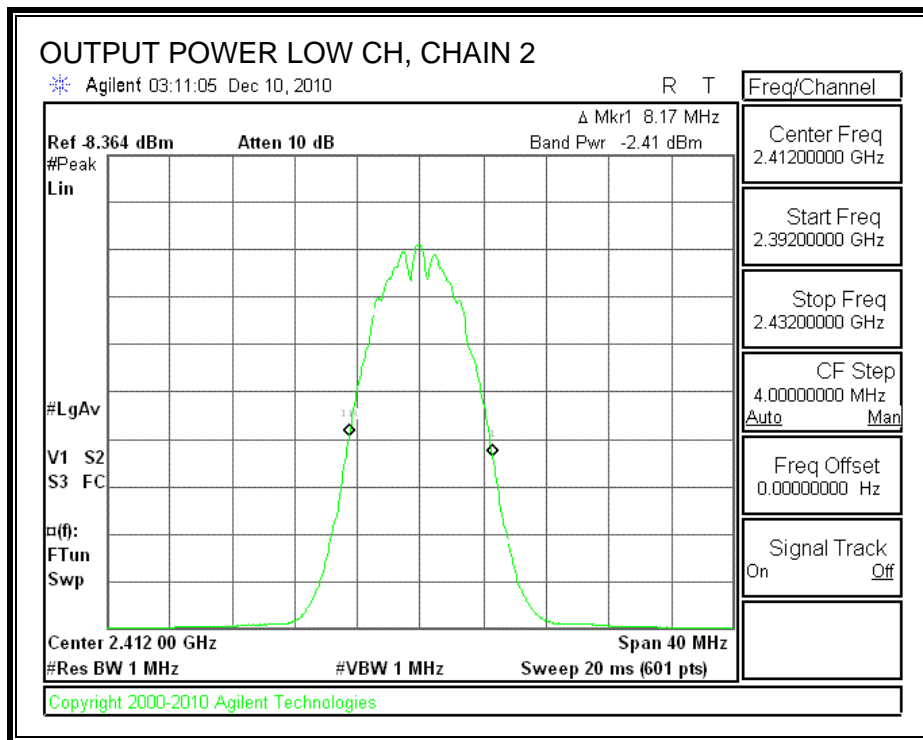
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Attenuator + Cable Loss (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-2.27	-2.41	-2.31	23.40	25.84	26.32	-0.48
Mid	2437	-2.37	-2.40	-2.53	23.40	25.74	26.32	-0.58
High	2462	-2.28	-2.49	-2.31	23.40	25.81	26.32	-0.51

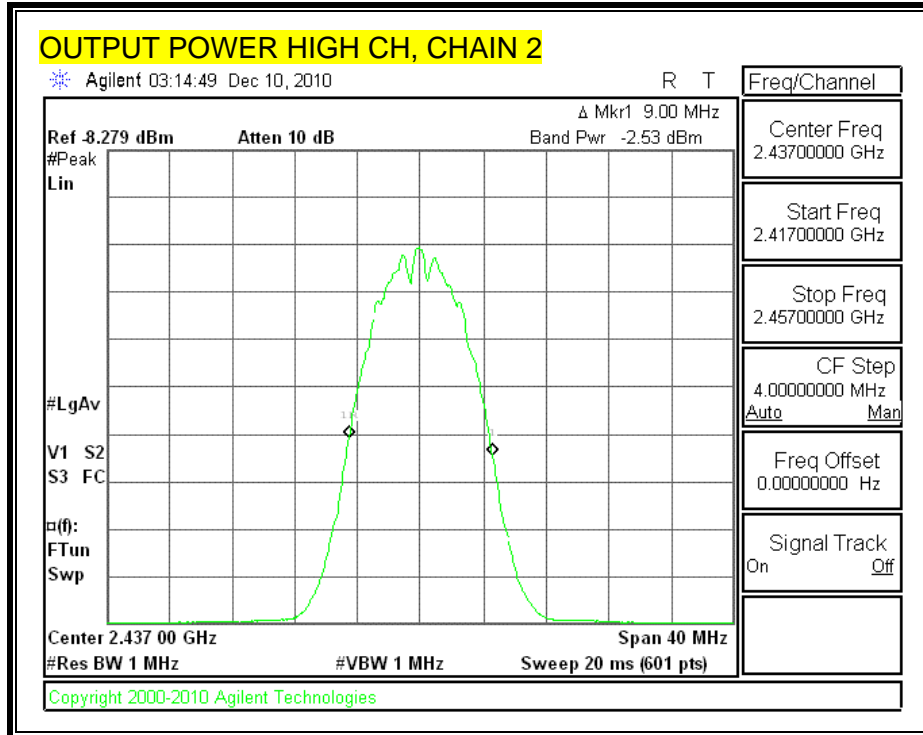
**CHAIN 1 OUTPUT POWER**



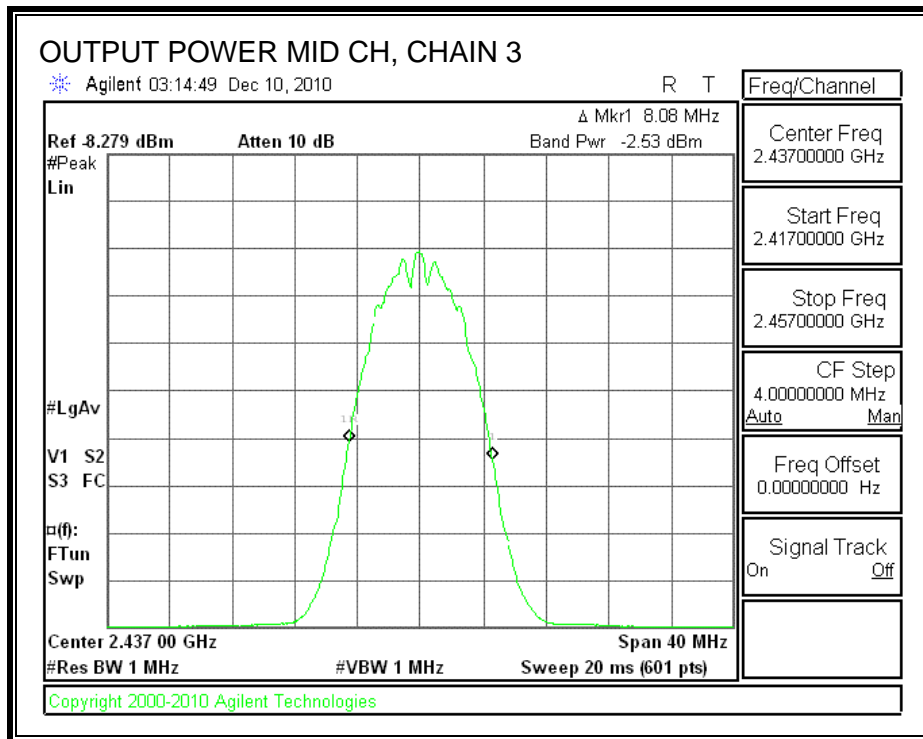
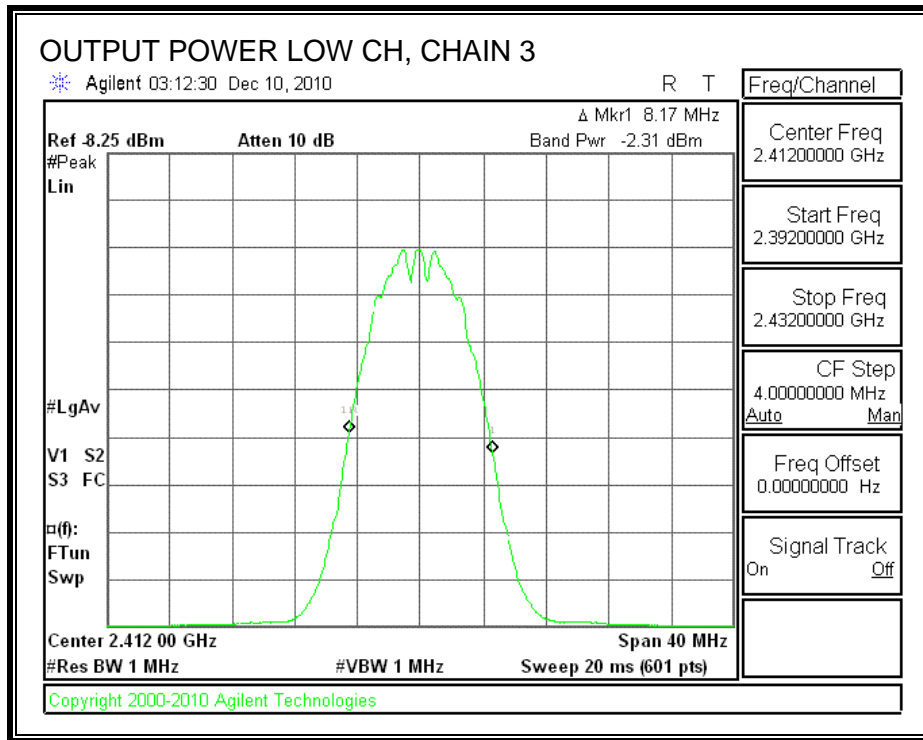


**CHAIN 2 OUTPUT POWER**

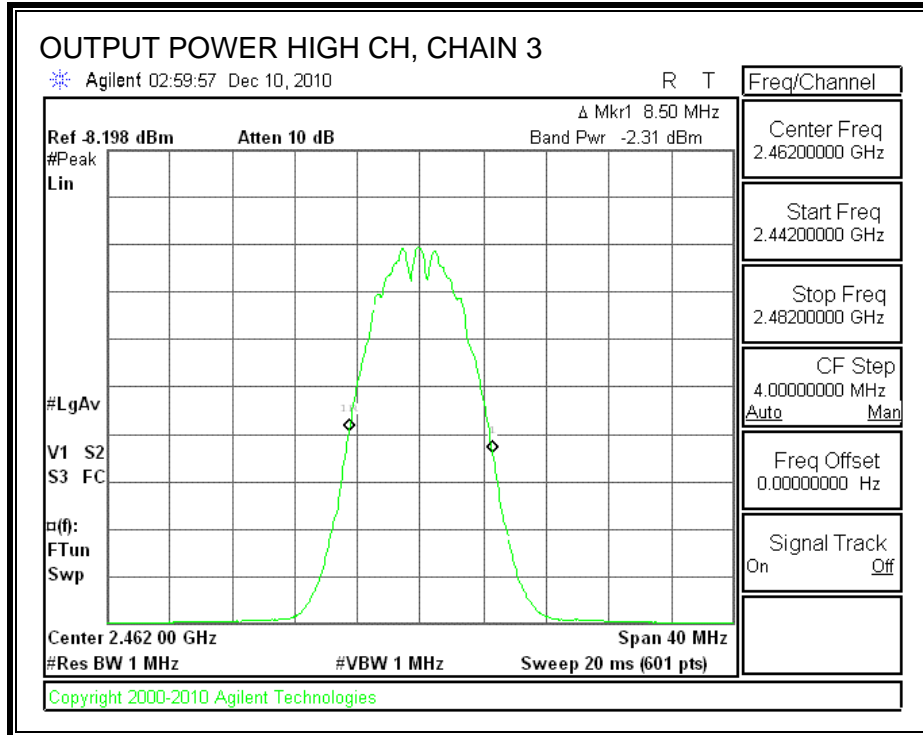




**CHAIN 3 OUTPUT POWER**







### 7.1.4. 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.

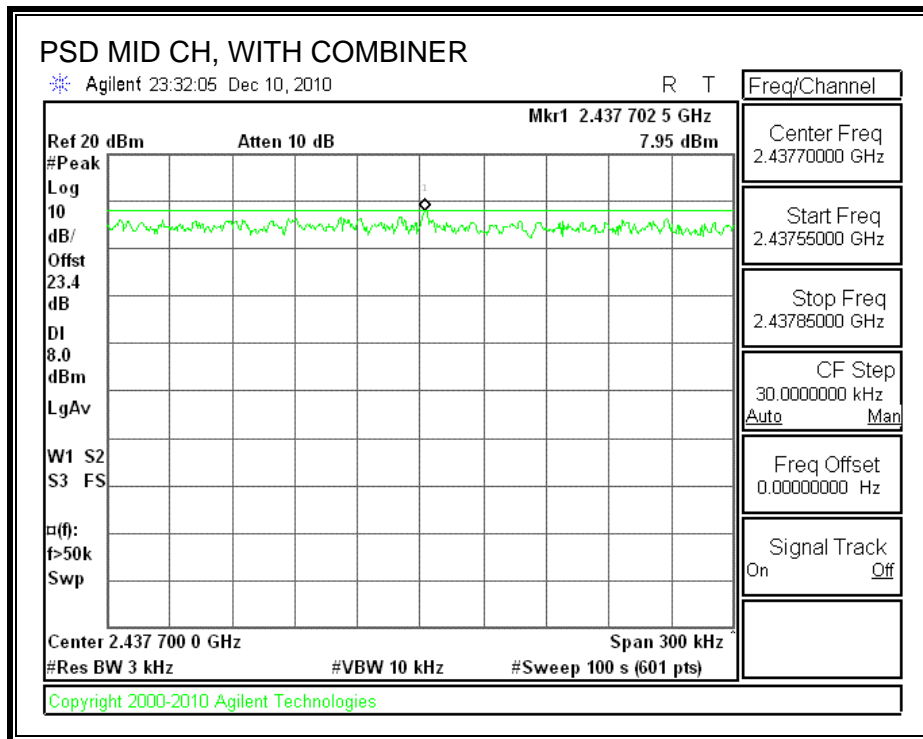
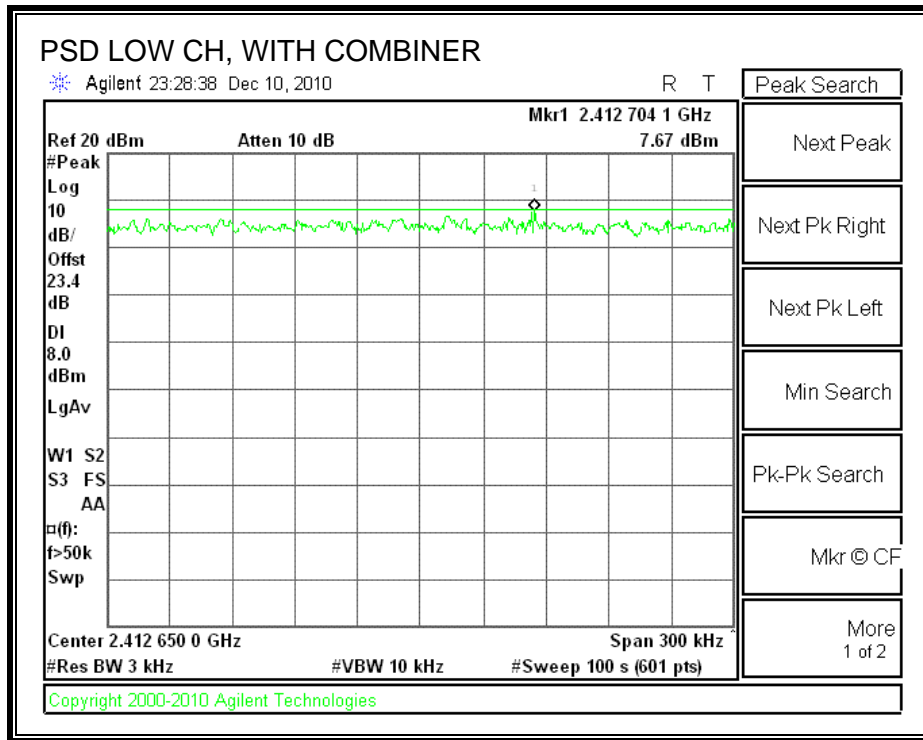
#### TEST PROCEDURE

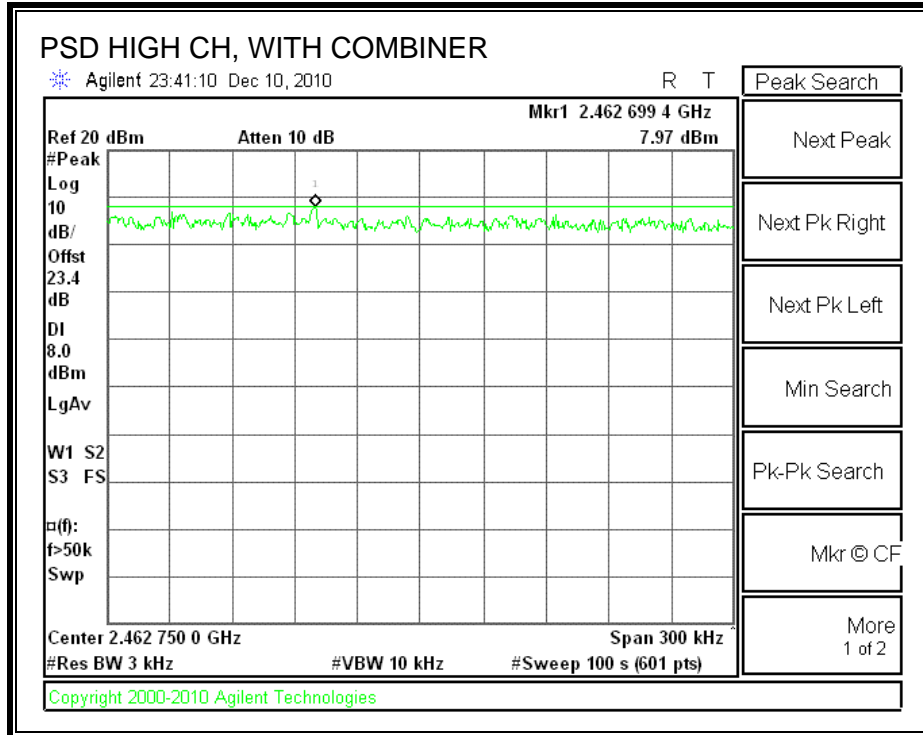
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

#### RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	2412	7.67	8	-0.33
Middle	2437	7.95	8	-0.05
High	2462	7.97	8	-0.03

**POWER SPECTRAL DENSITY, WITH COMBINER**





## **7.1.5. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

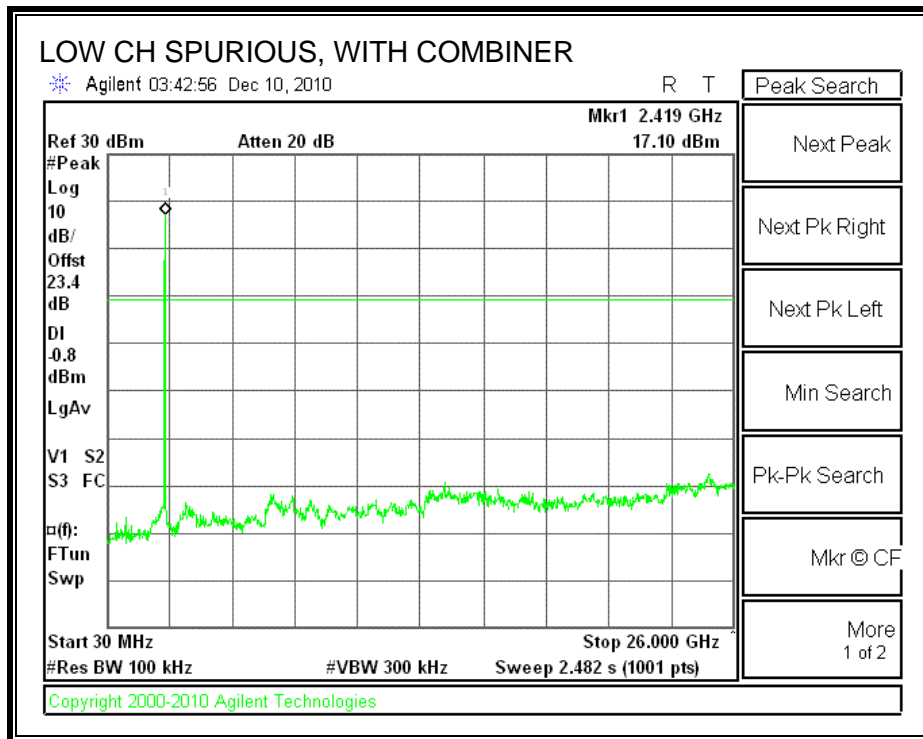
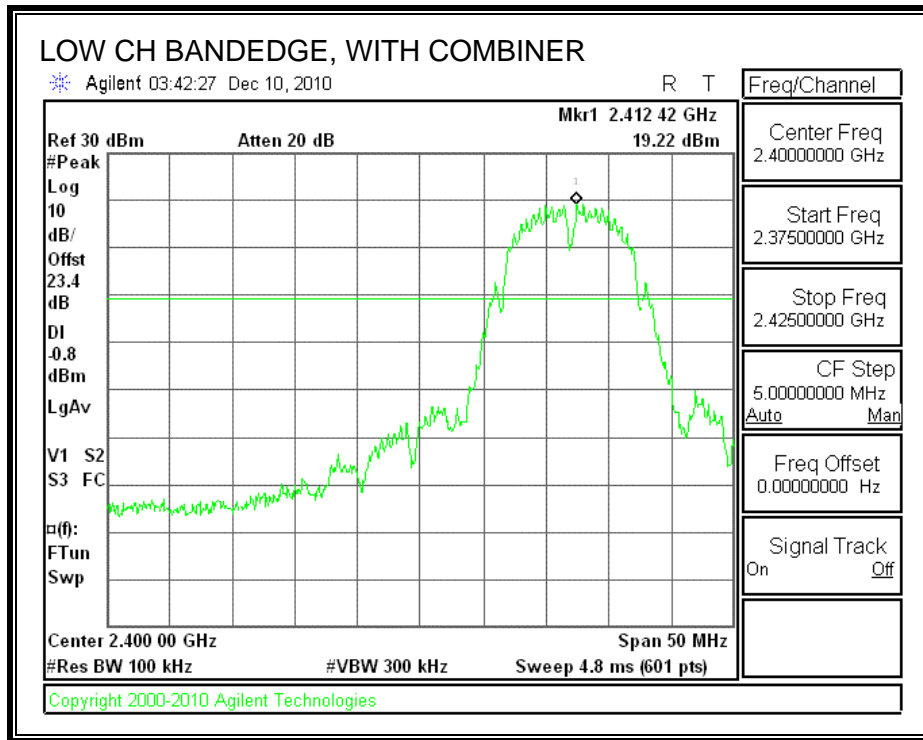
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

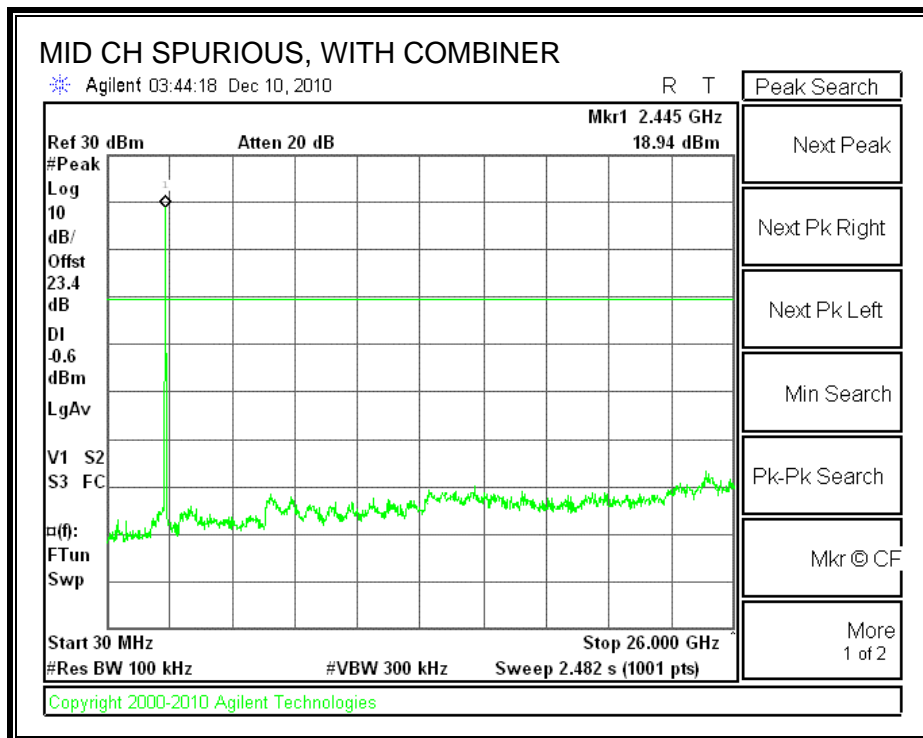
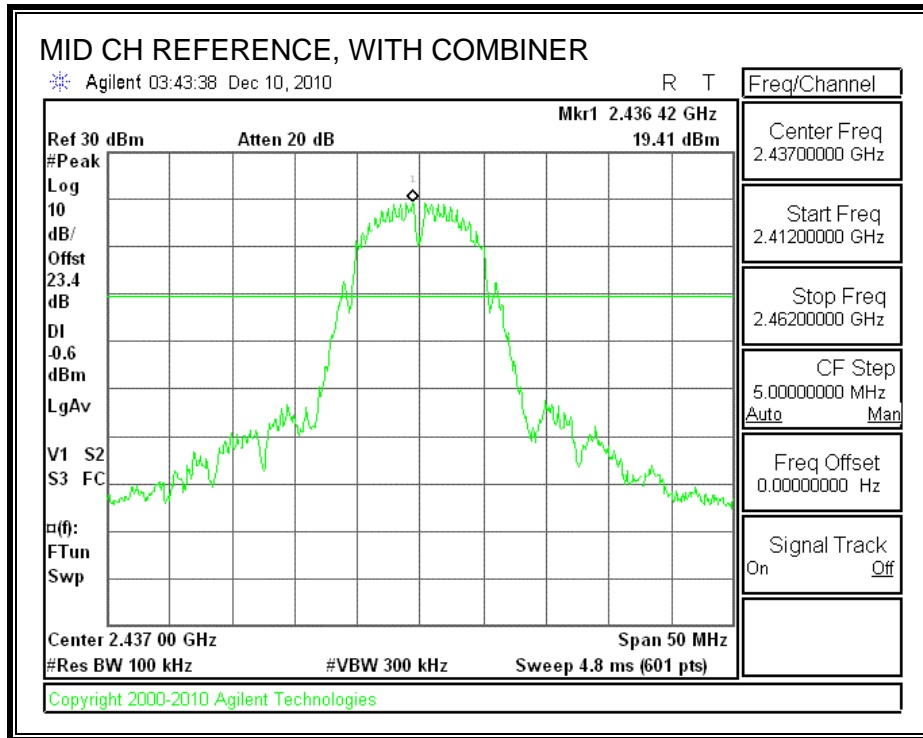
### **TEST PROCEDURE**

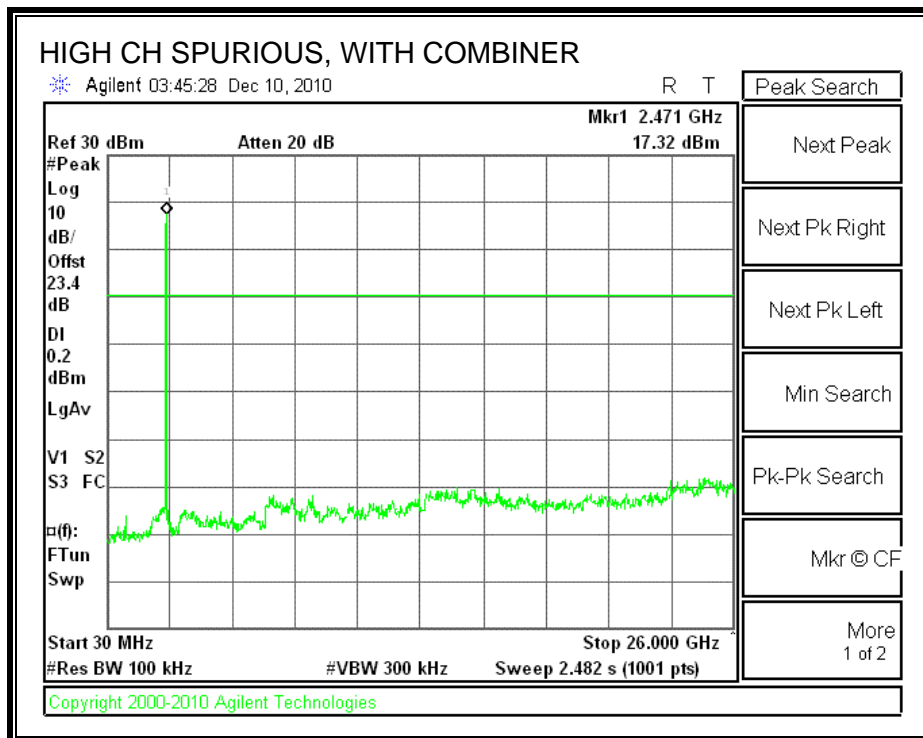
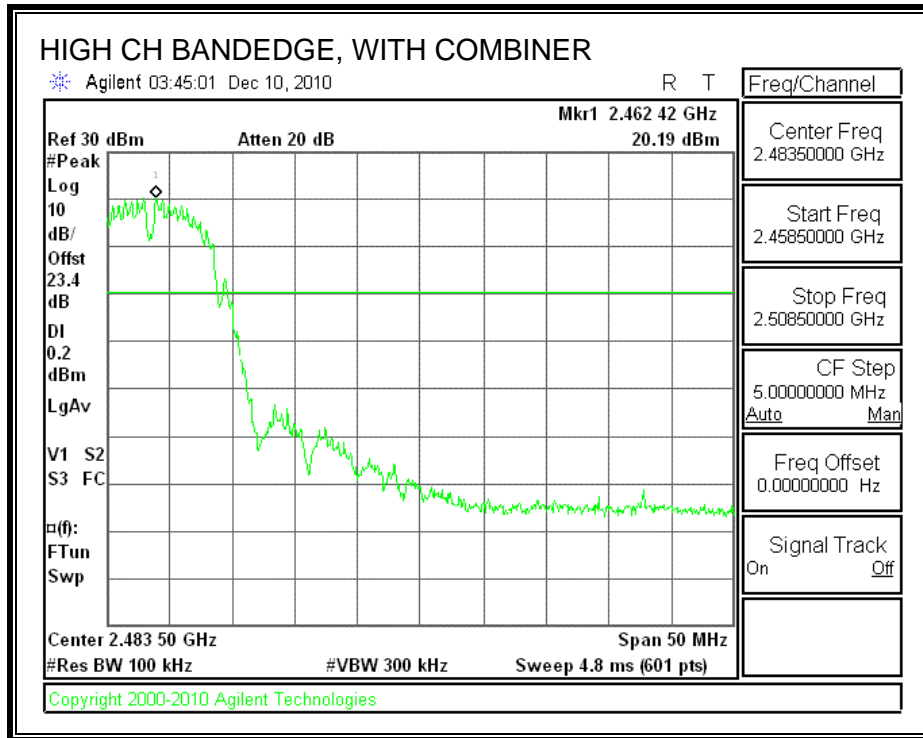
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

**SPURIOUS EMISSIONS WITH COMBINER**









## 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.

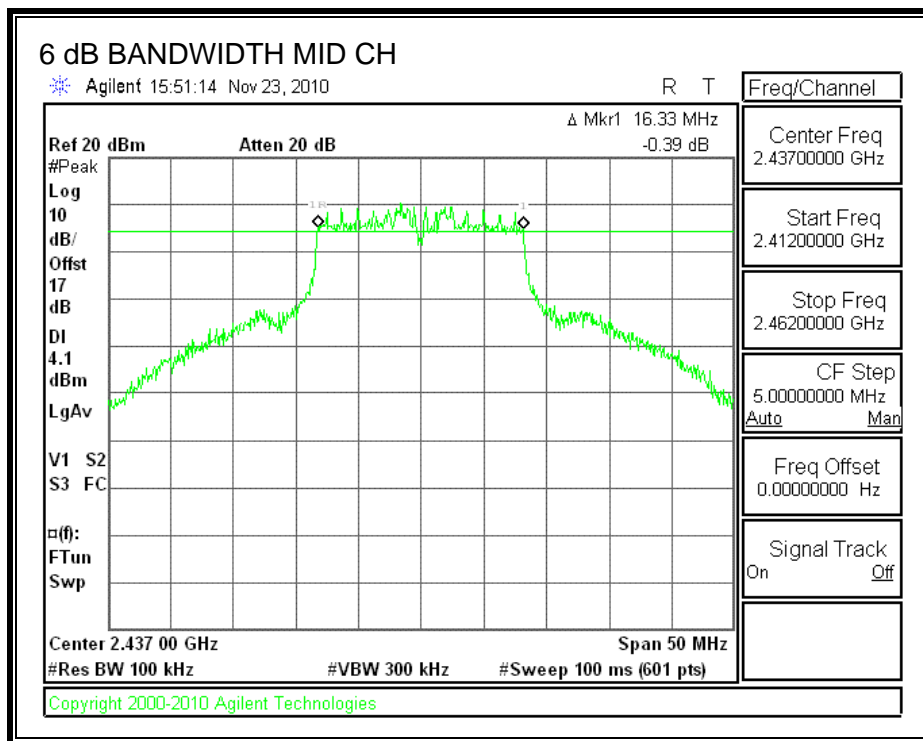
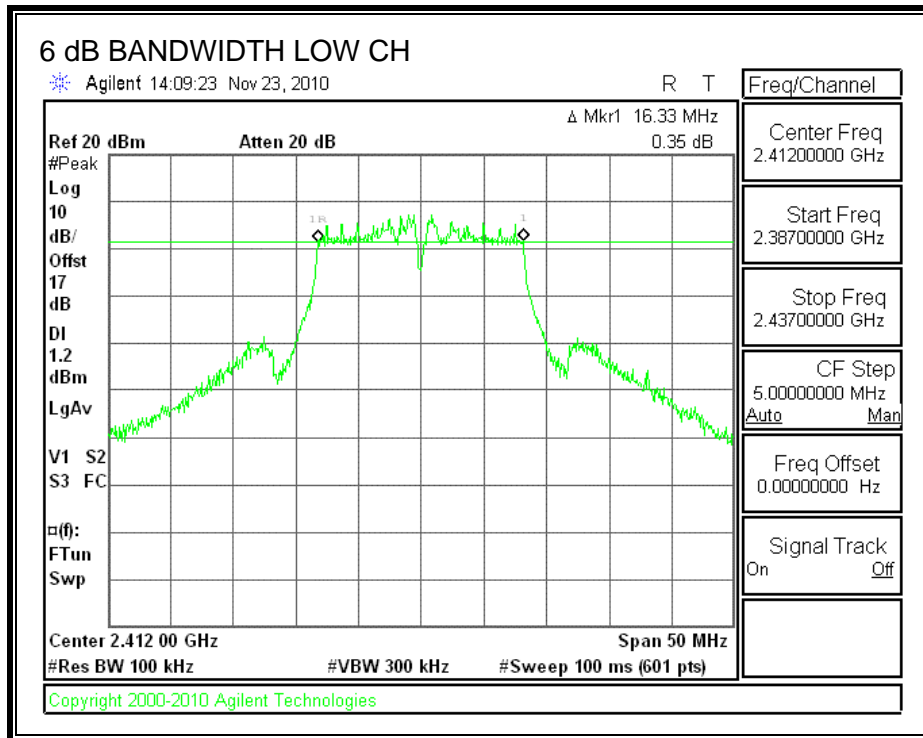
#### TEST PROCEDURE

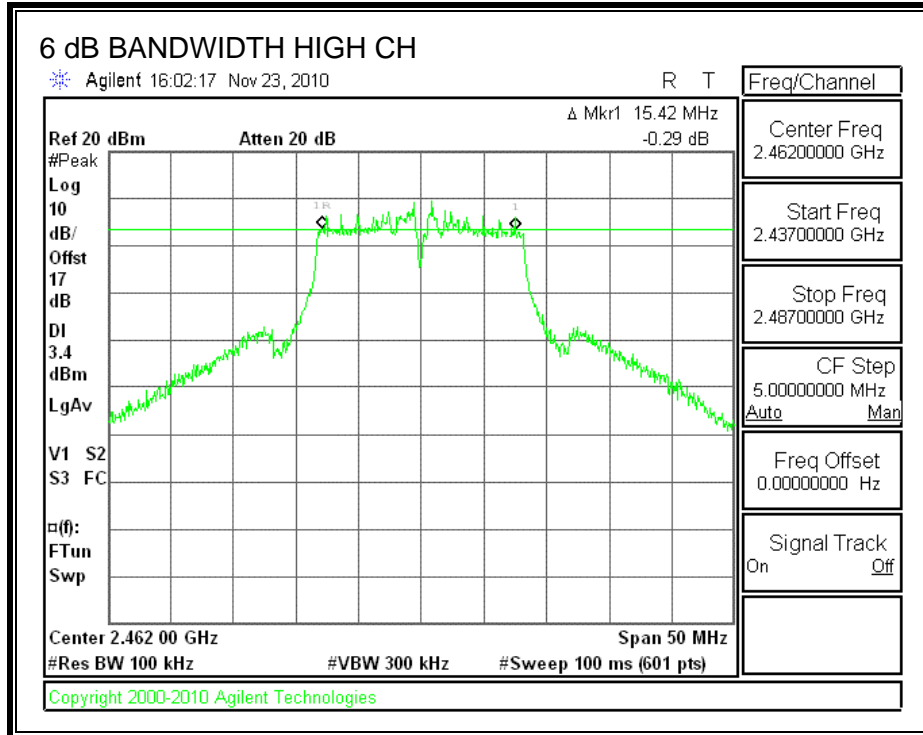
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	16.33	0.5
Middle	2437	16.33	0.5
High	2462	15.42	0.5

**6 dB BANDWIDTH**





## 7.2.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

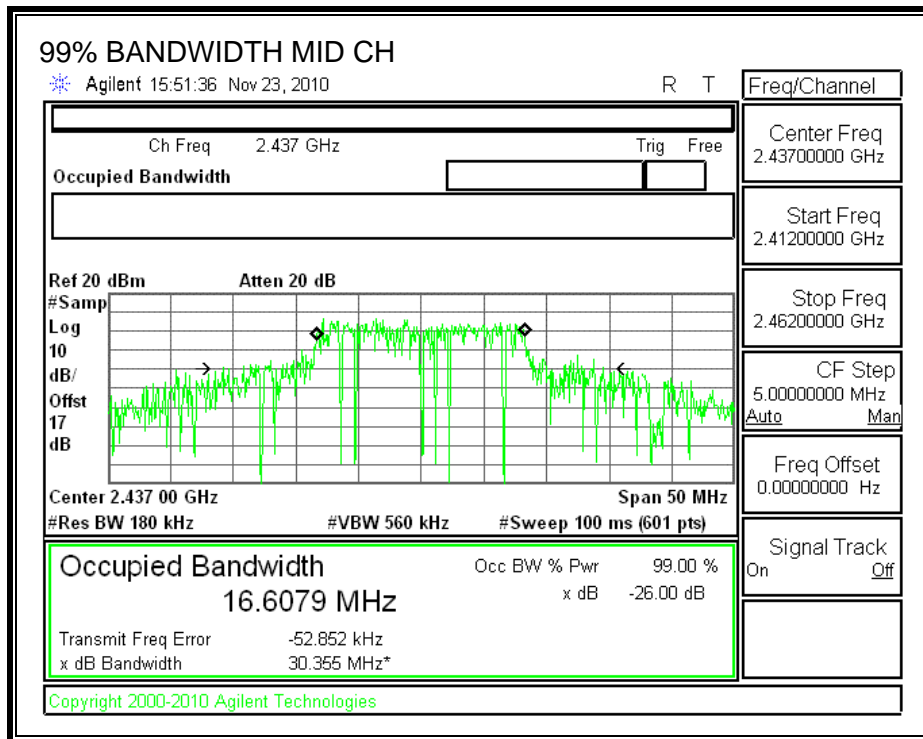
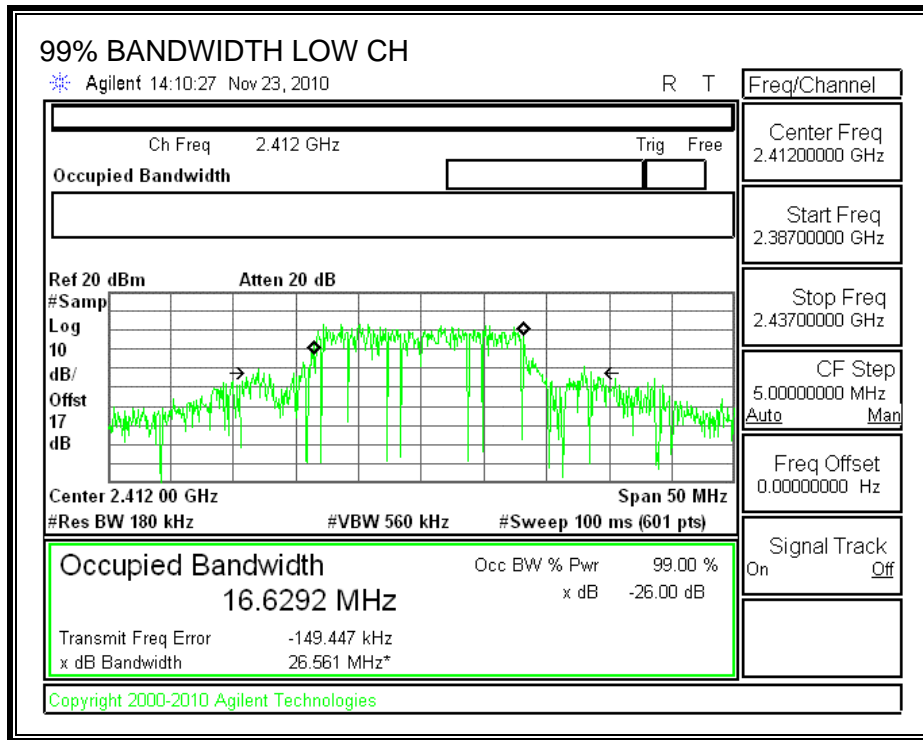
### TEST PROCEDURE

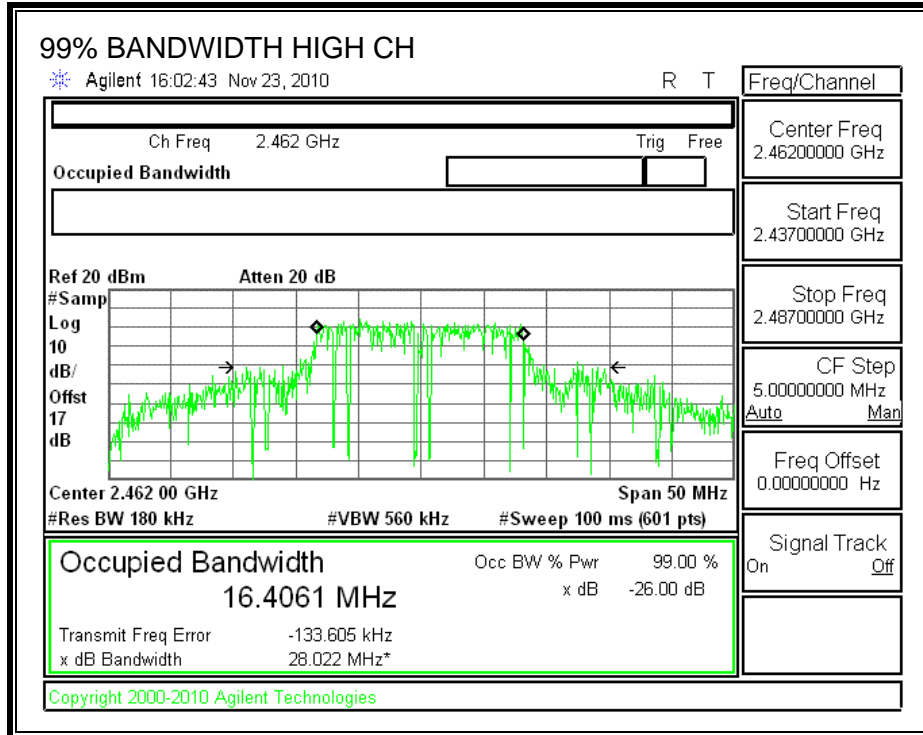
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.6292
Middle	2437	16.6079
High	2462	16.4061

**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.

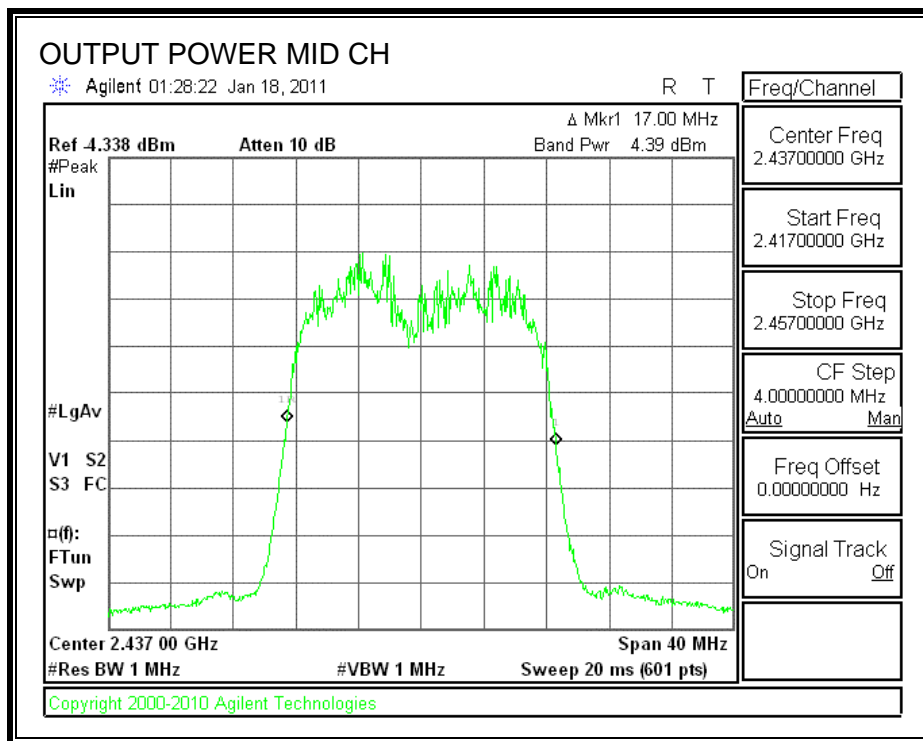
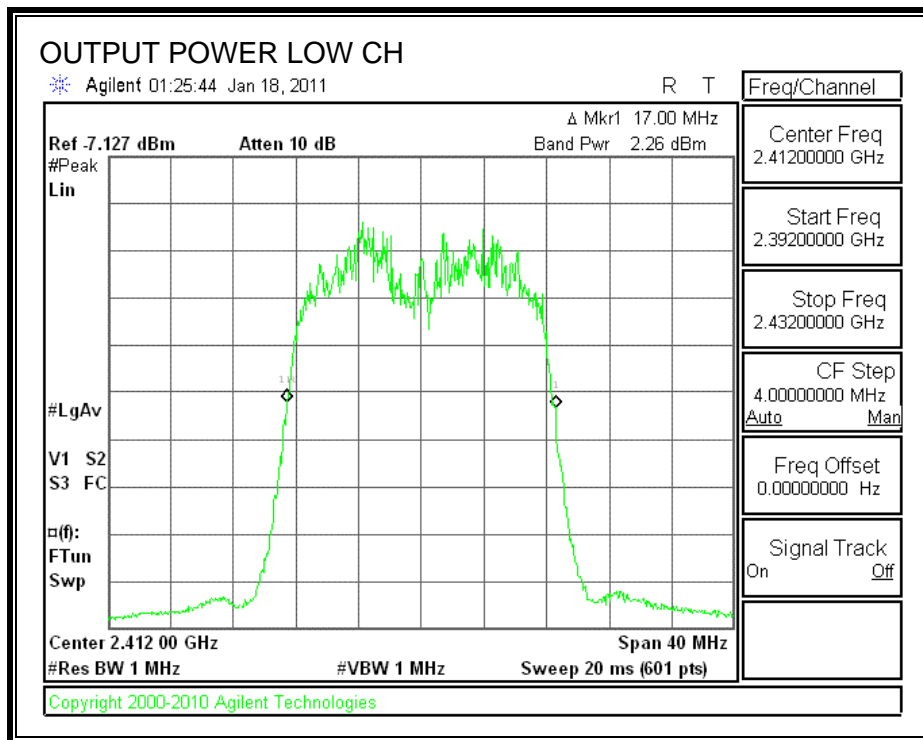
#### TEST PROCEDURE

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

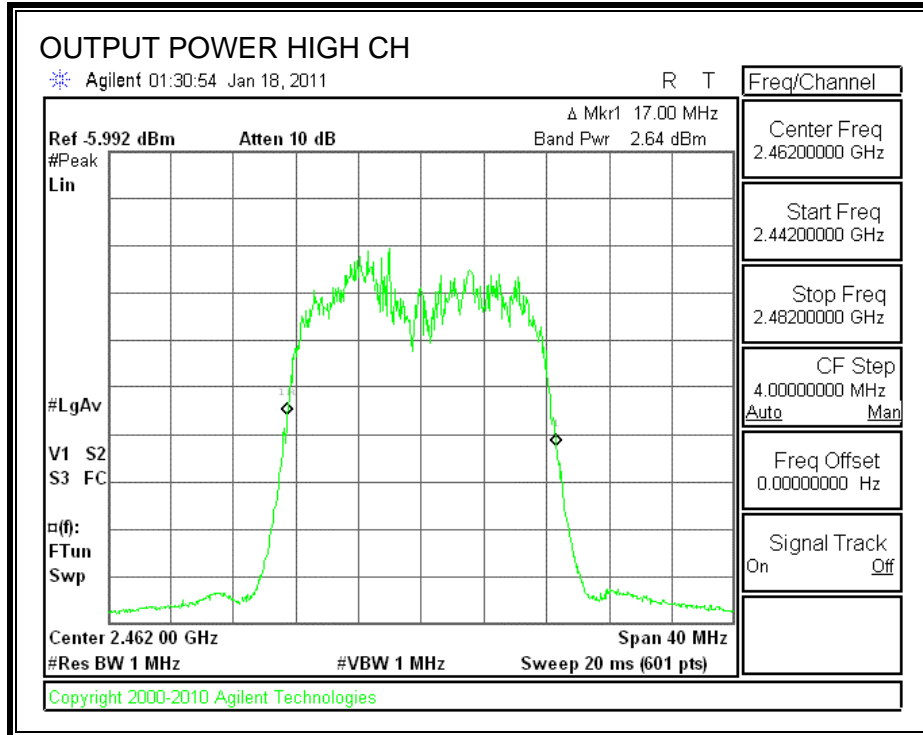
#### RESULTS

Channel	Frequency (MHz)	Spectrum Analyzer Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	2.26	23.4	25.66	30	-4.34
Middle	2437	4.39	23.4	27.79	30	-2.21
High	2462	2.64	23.4	26.04	30	-3.96

**OUTPUT POWER**







## 7.2.4. 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.

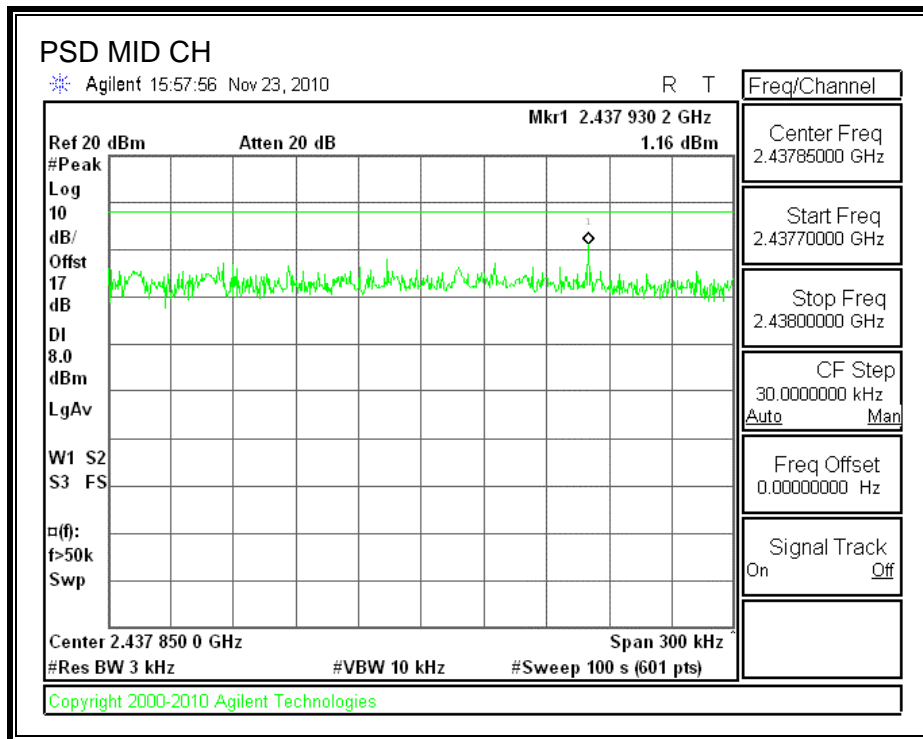
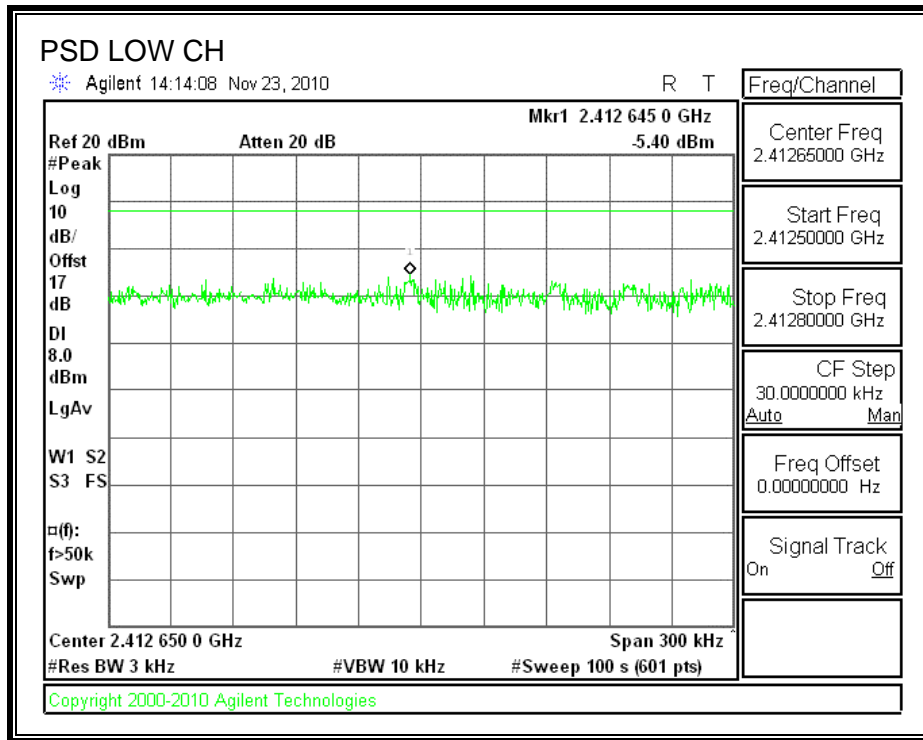
### TEST PROCEDURE

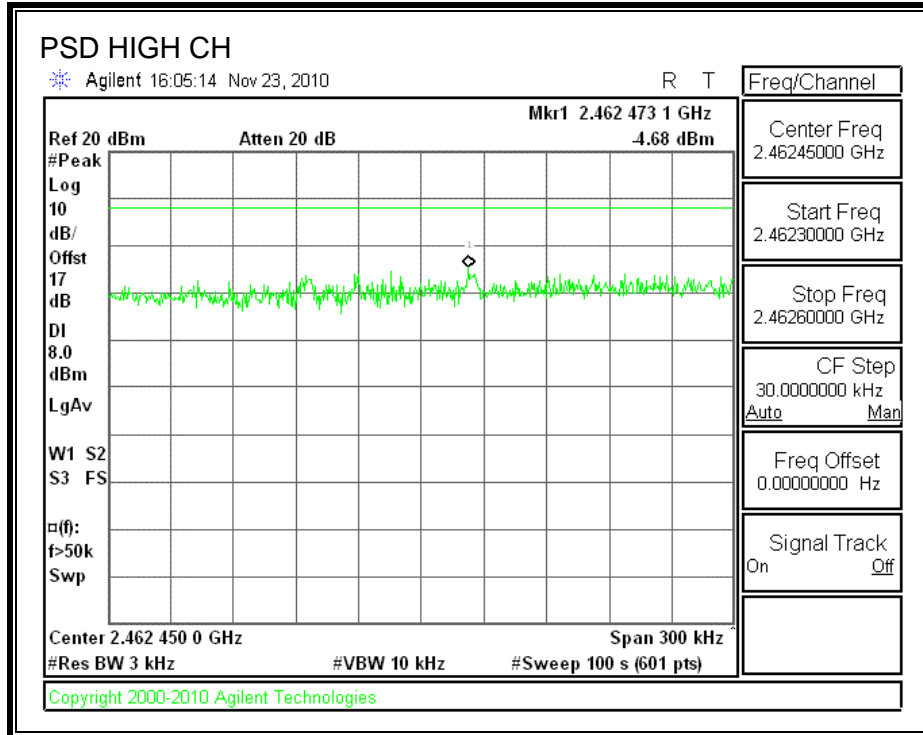
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.40	8	-13.40
Middle	2437	1.16	8	-6.84
High	2462	-4.68	8	-12.68

**POWER SPECTRAL DENSITY**





## **7.2.5. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

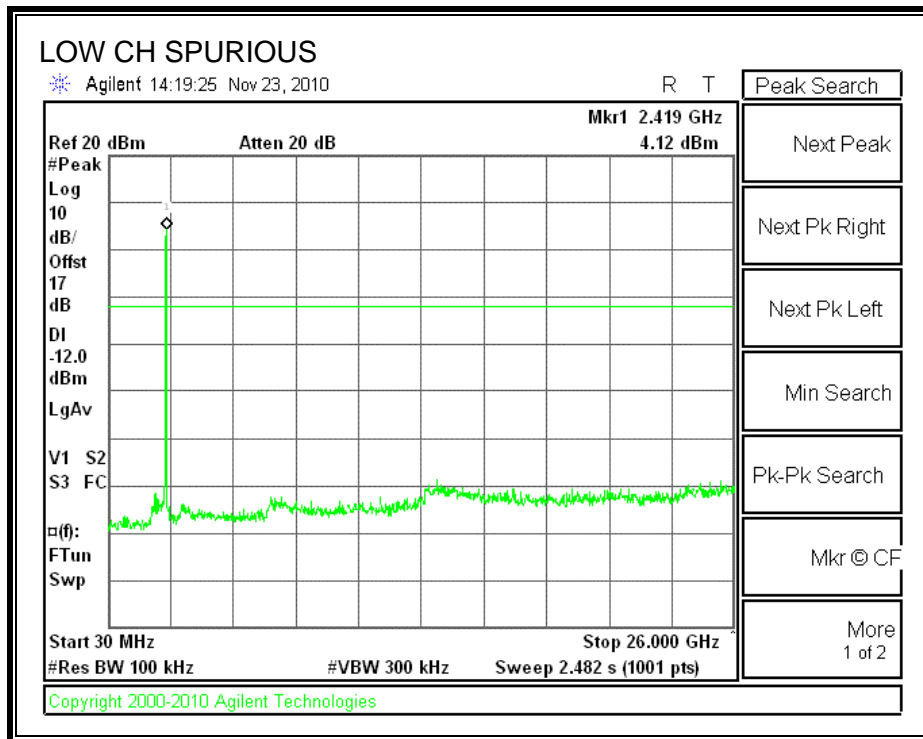
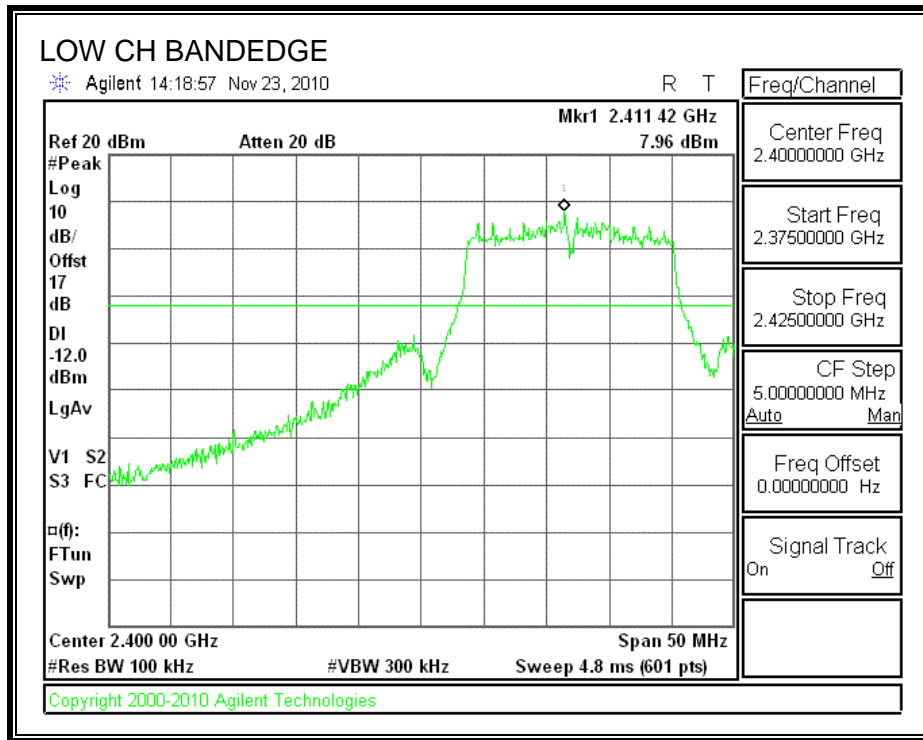
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

### **TEST PROCEDURE**

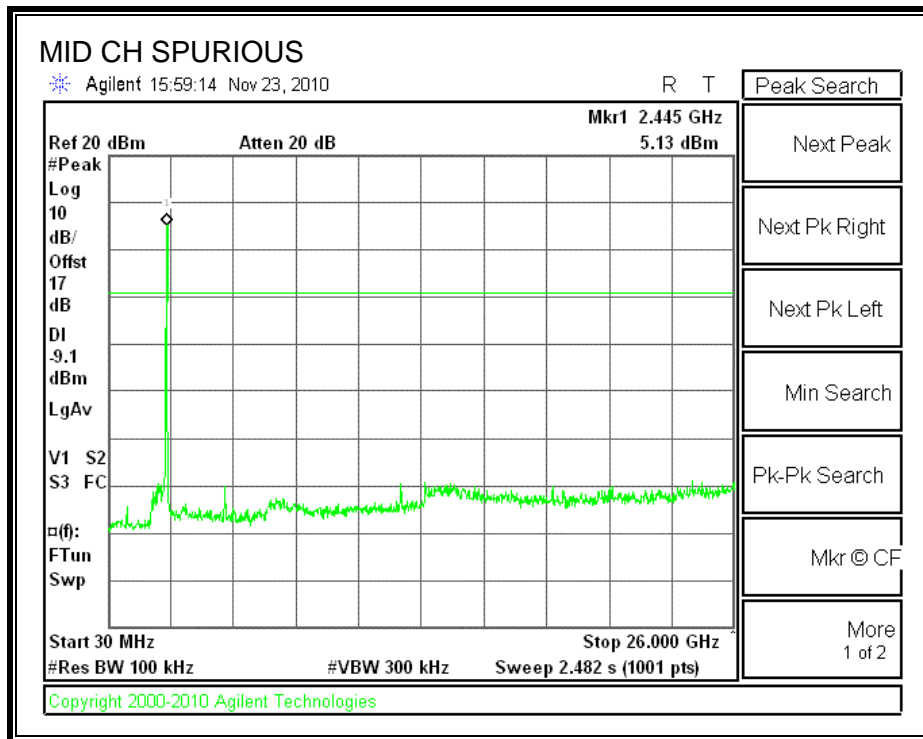
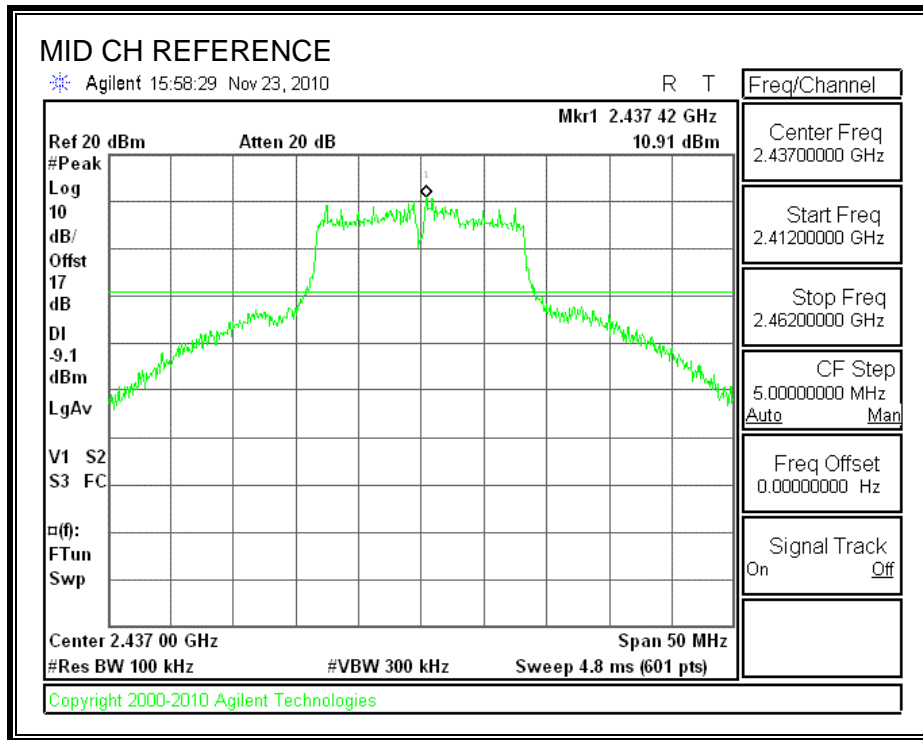
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

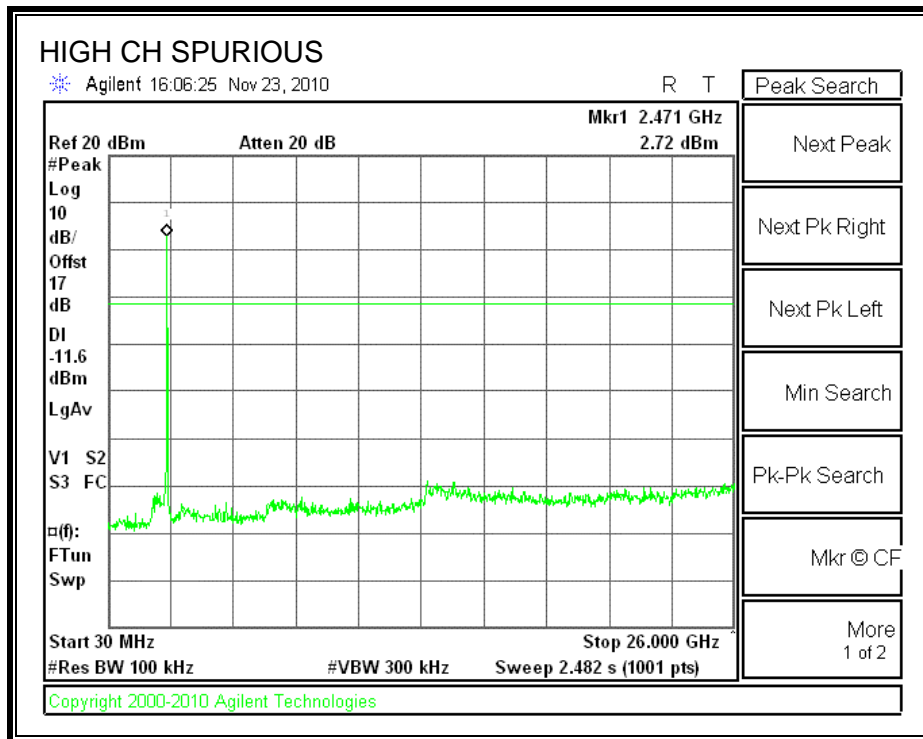
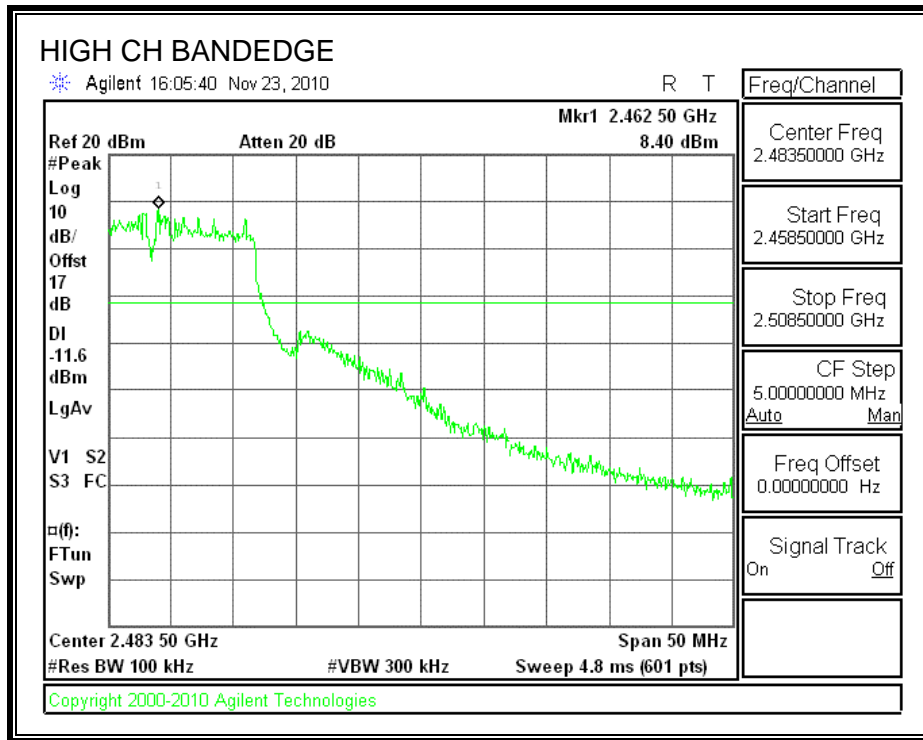
**SPURIOUS EMISSIONS, LOW CHANNEL**



**SPURIOUS EMISSIONS, MID CHANNEL**



**SPURIOUS EMISSIONS, HIGH CHANNEL**





### 7.3. 802.11n THREE CHAINS HT20 MODE IN THE 2.4 GHz BAND

#### 7.3.1. 6 dB BANDWIDTH

##### LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

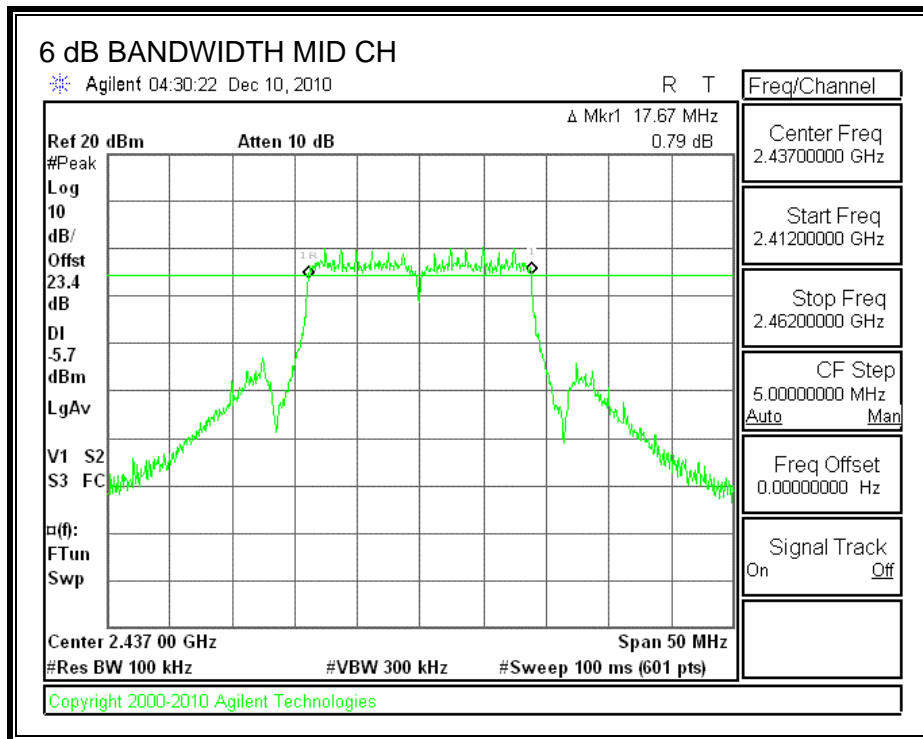
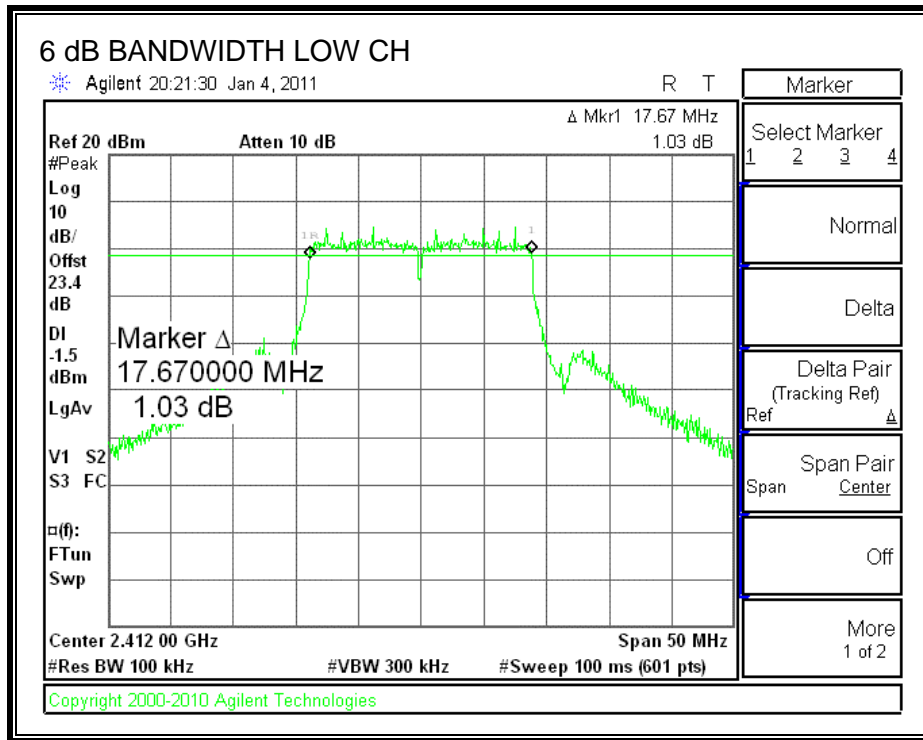
##### TEST PROCEDURE

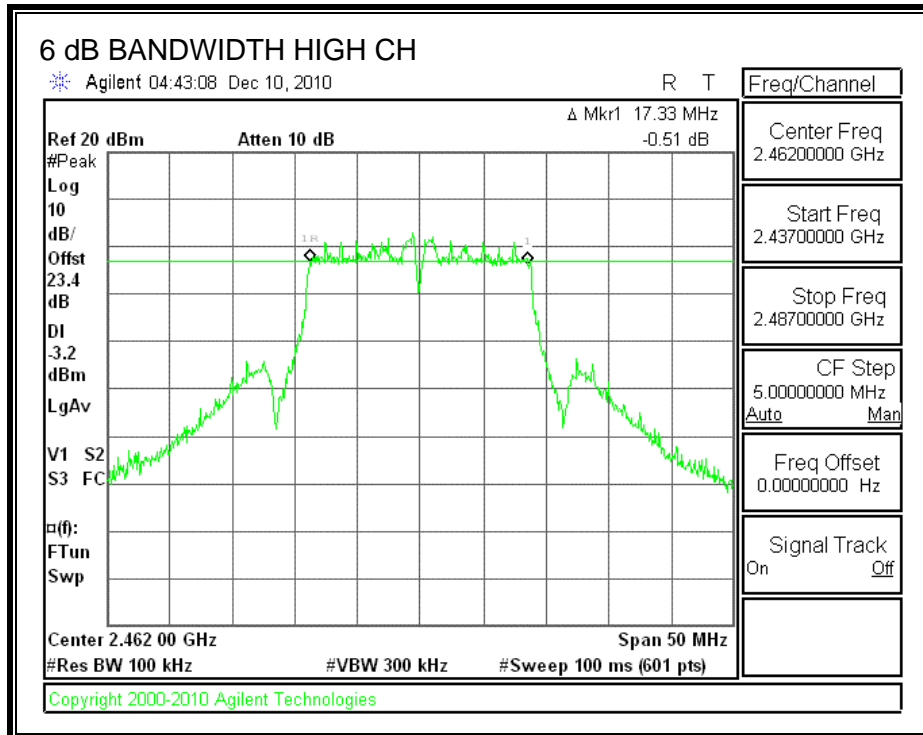
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

##### RESULTS

Channel	Frequency (MHz)	6 dB BW (MHz)	Minimum Limit (MHz)
Low	2412	17.67	0.5
Middle	2437	17.67	0.5
High	2462	17.33	0.5

**6 dB BANDWIDTH**





### 7.3.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

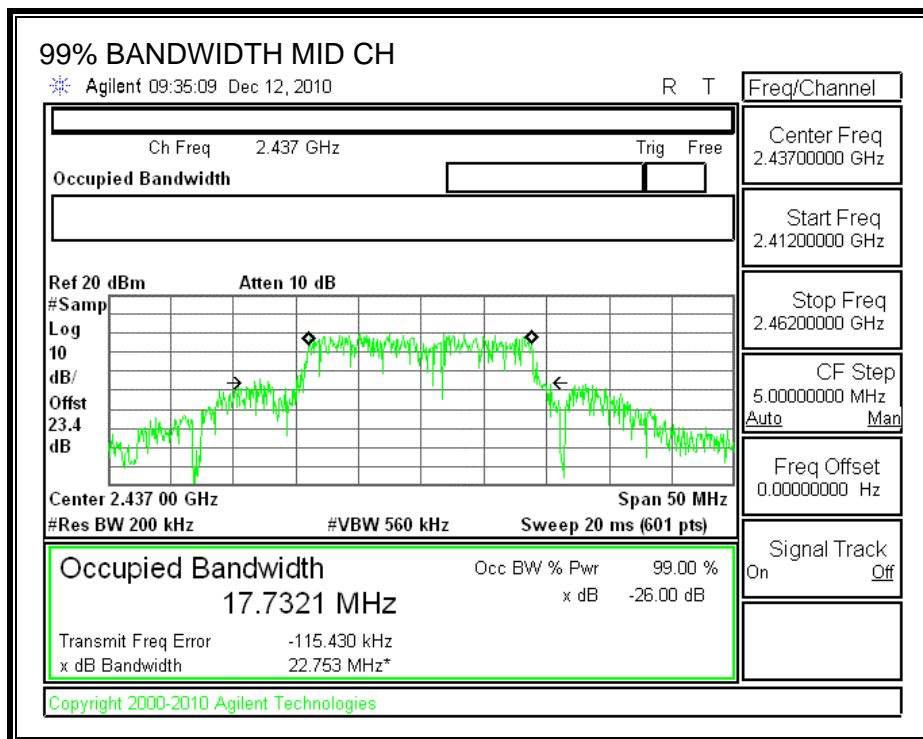
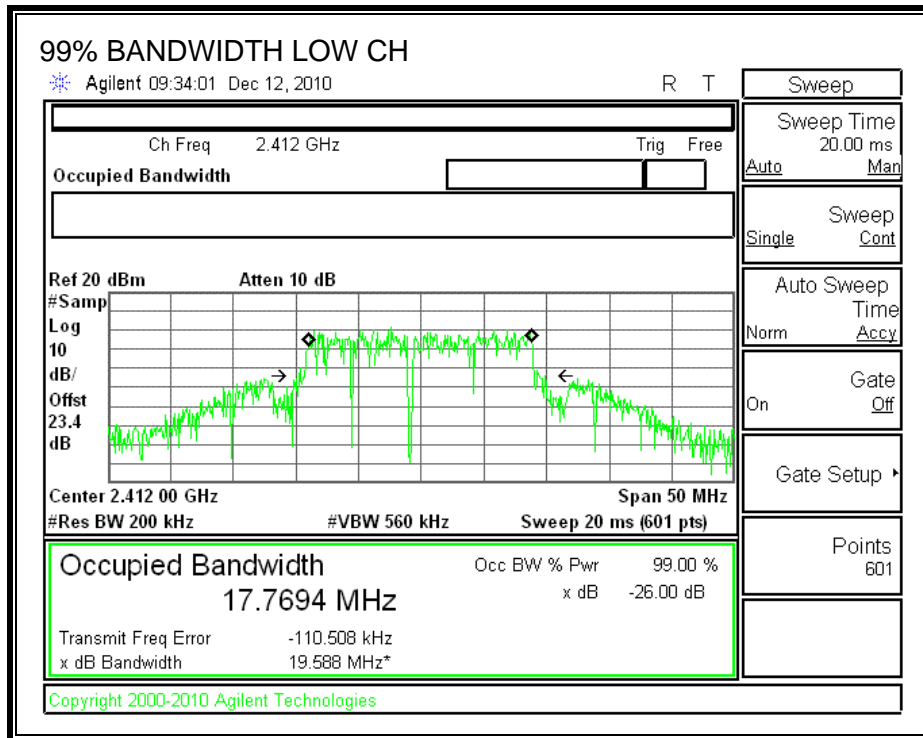
#### TEST PROCEDURE

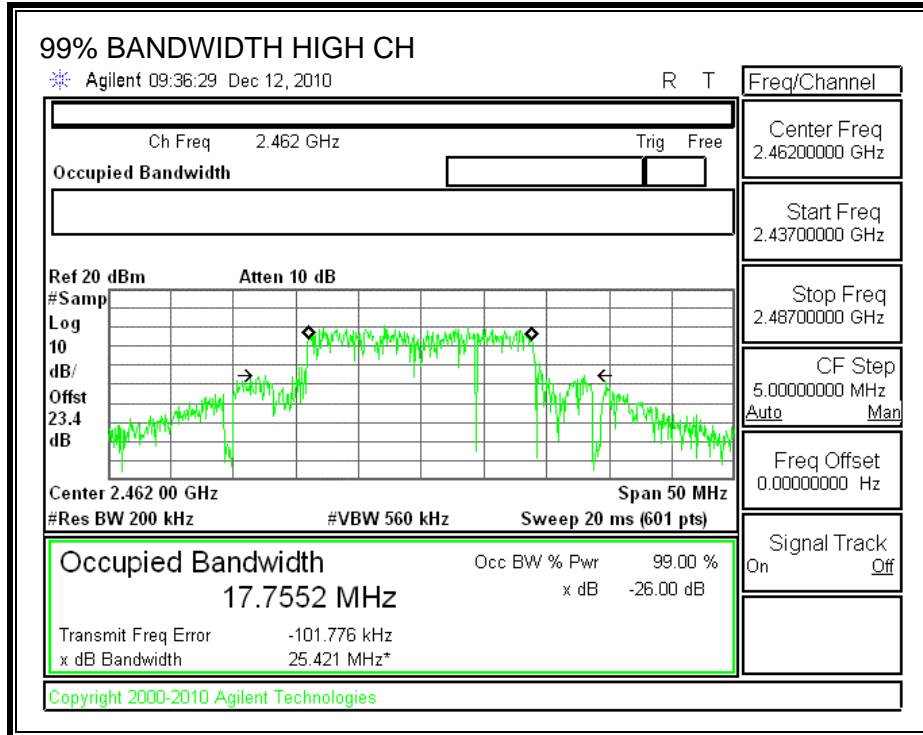
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	17.7694
Middle	2437	17.7321
High	2462	17.7552

**99% BANDWIDTH**





### 7.3.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The composite antenna gain is equal to 9.68 dBi, therefore the limit is 26.32 dBm.

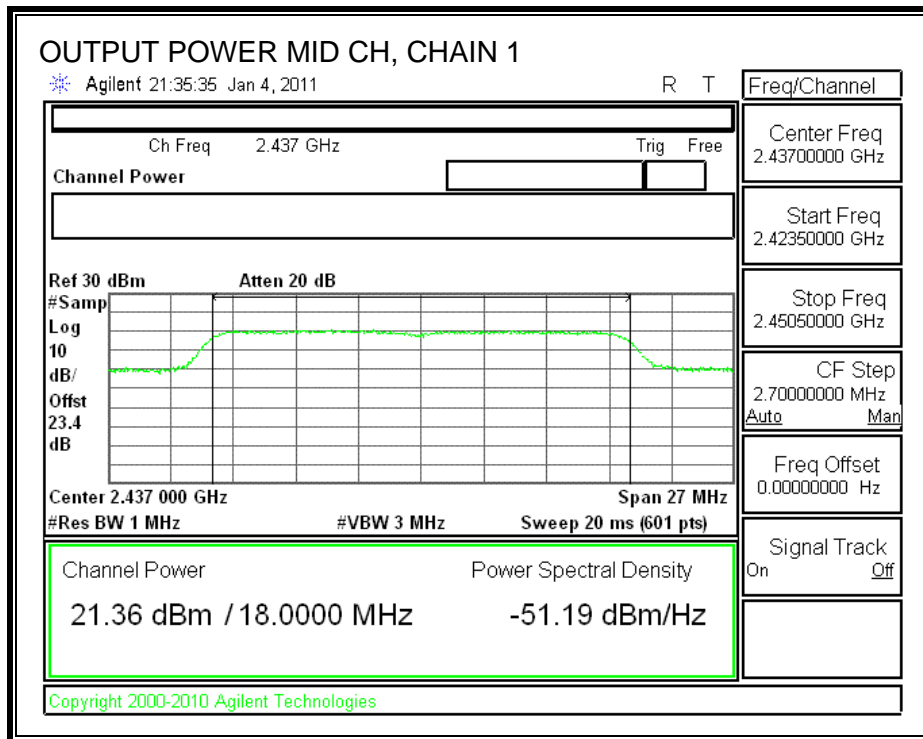
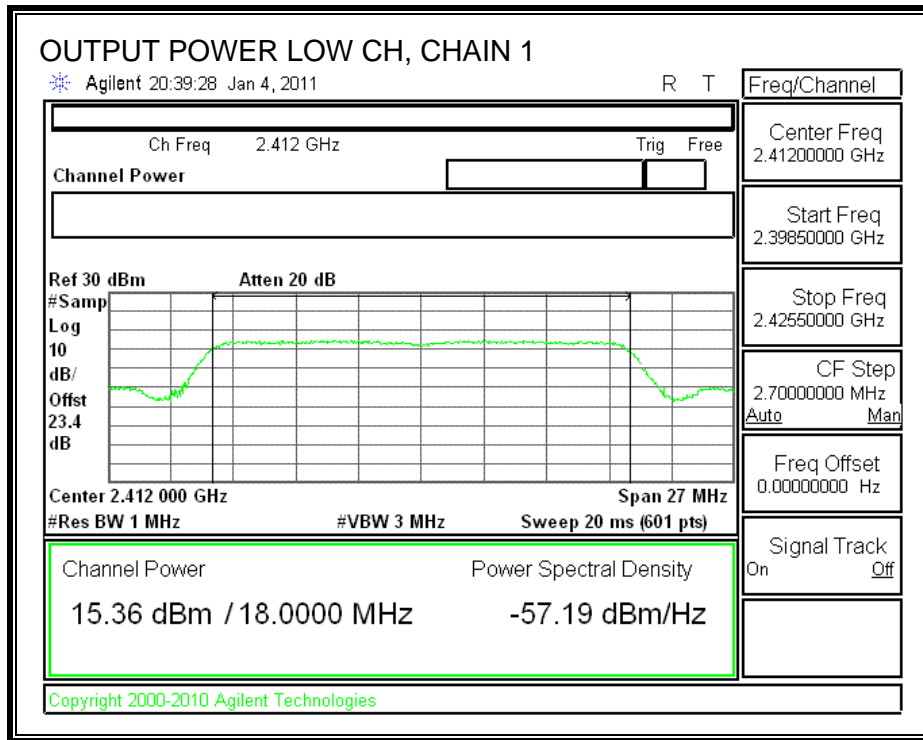
#### TEST PROCEDURE – UNII METHOD

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document “Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

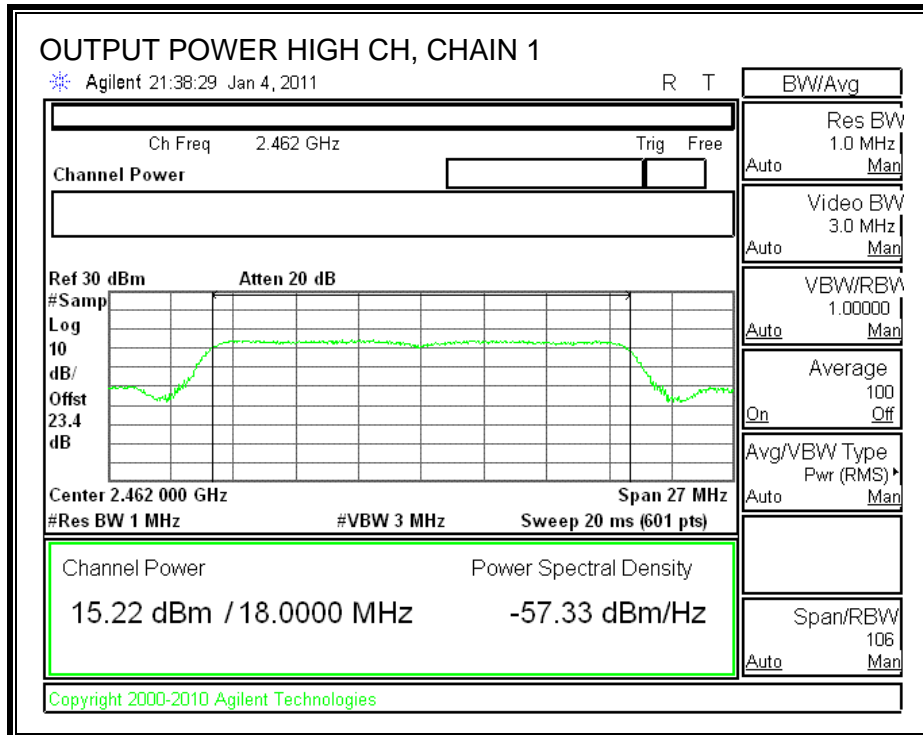
#### RESULTS

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	15.36	15.26	15.32	20.08	26.32	-6.24
Mid	2437	21.36	21.23	21.30	26.07	26.32	-0.25
High	2462	15.22	15.36	15.31	20.07	26.32	-6.25

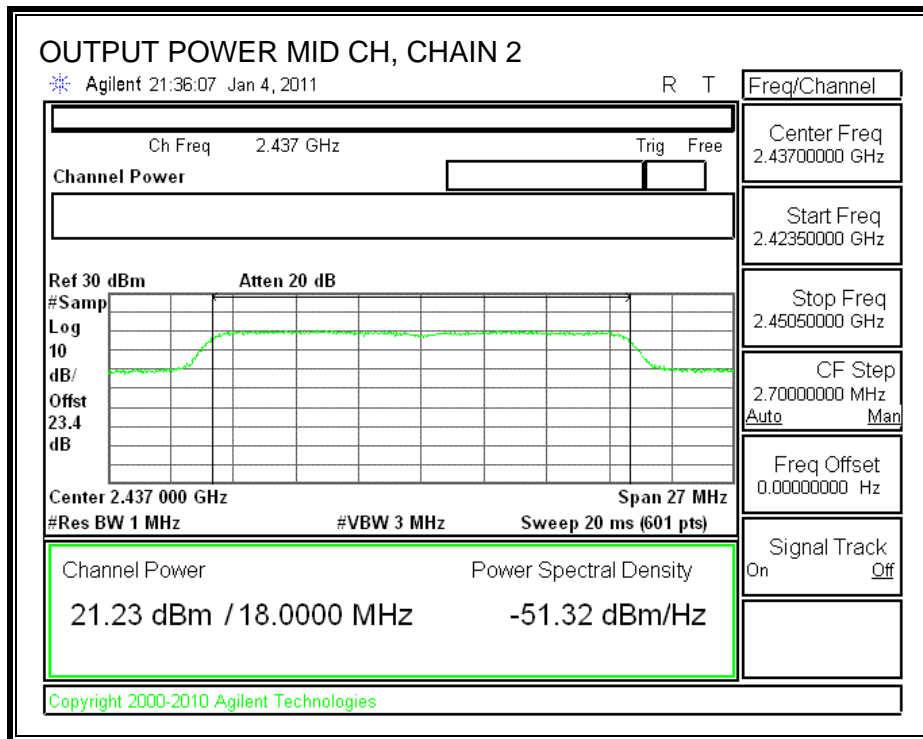
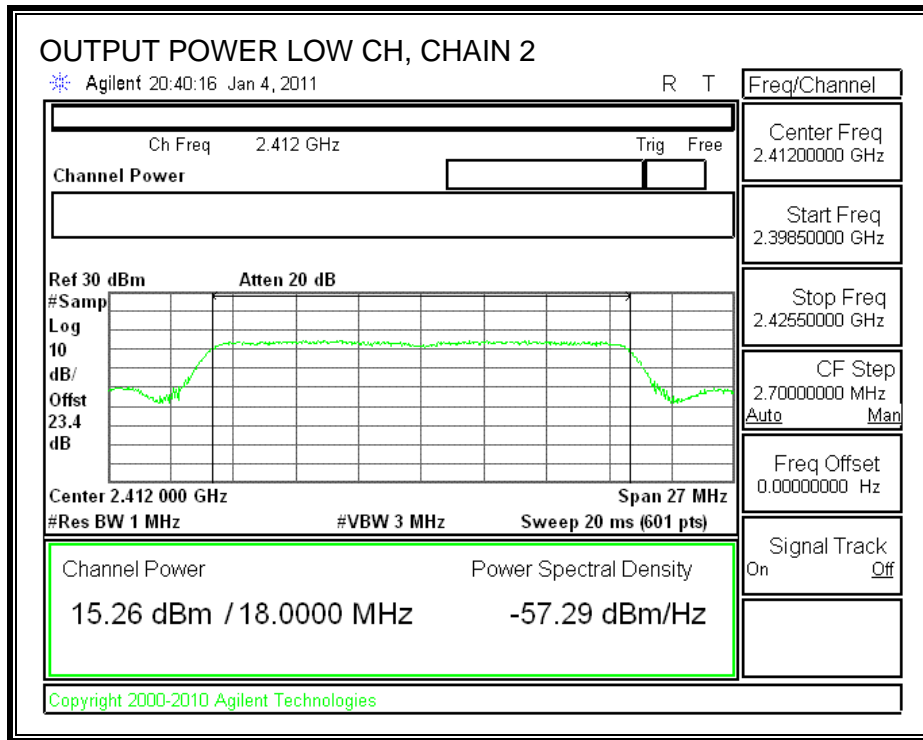
**CHAIN 1 OUTPUT POWER**

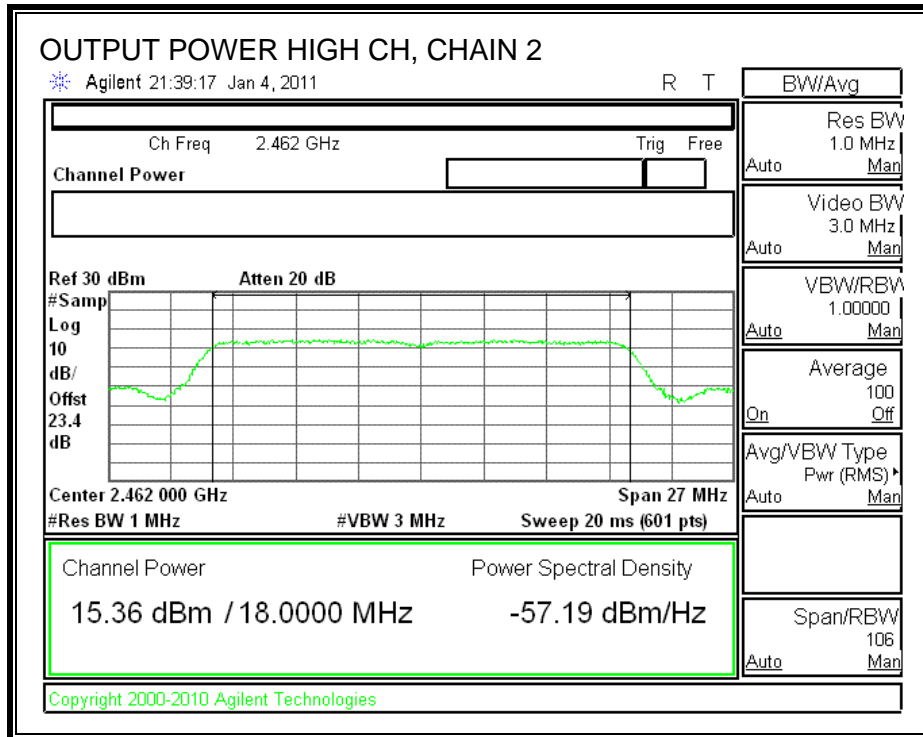




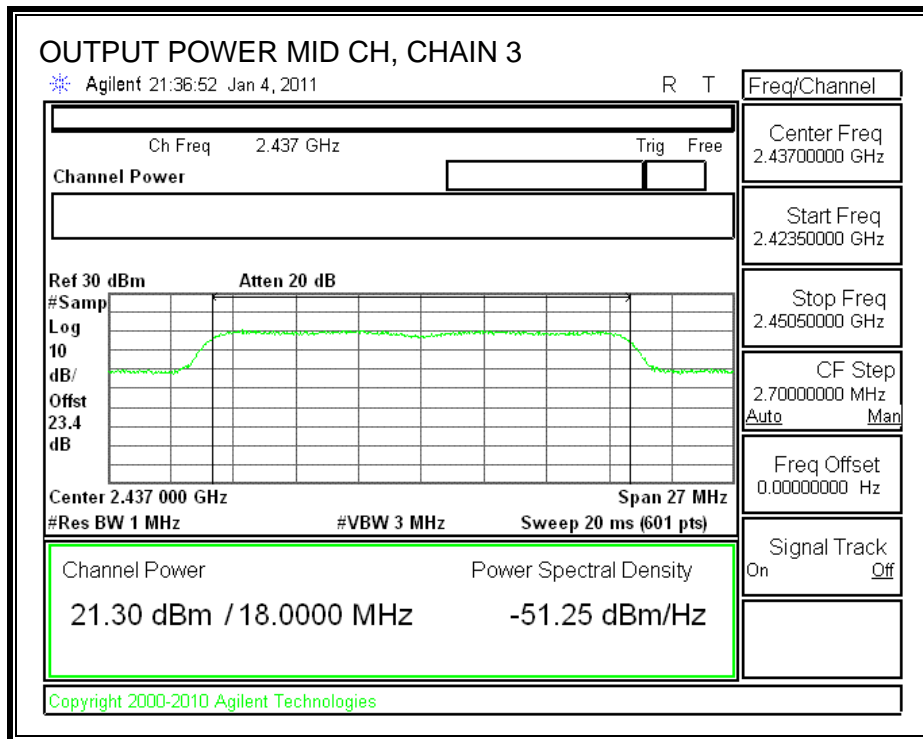
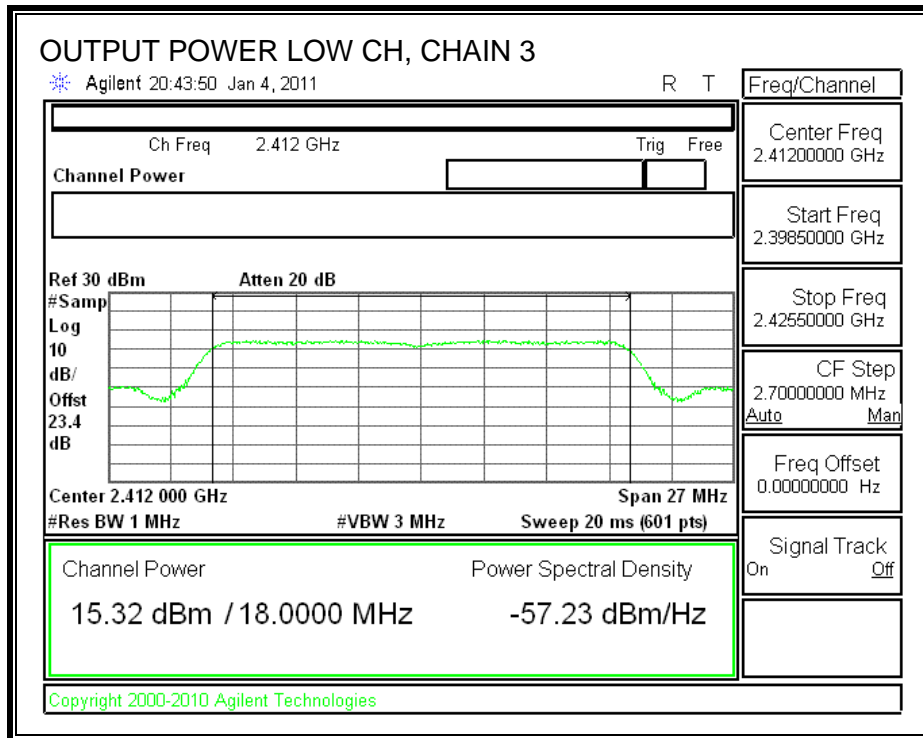


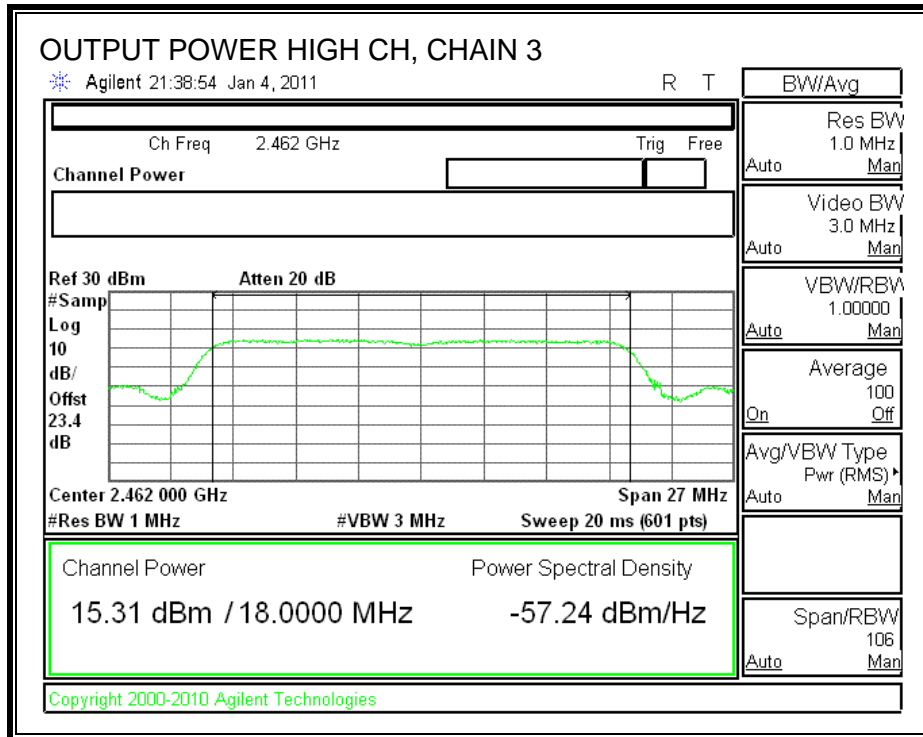
**CHAIN 2 OUTPUT POWER**





**CHAIN 3 OUTPUT POWER**





### 7.3.4. 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.

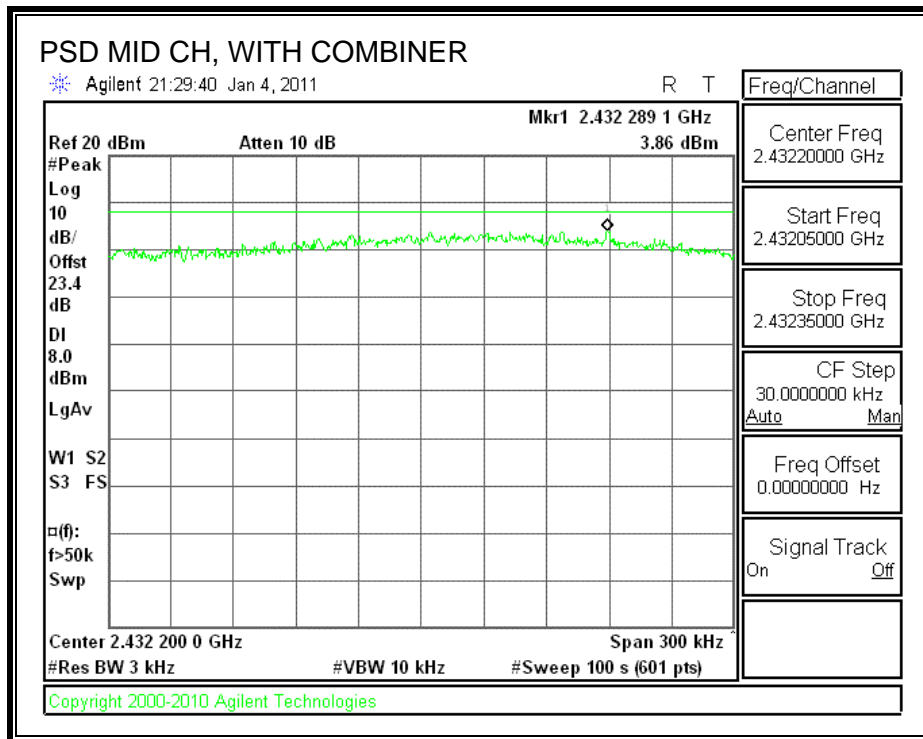
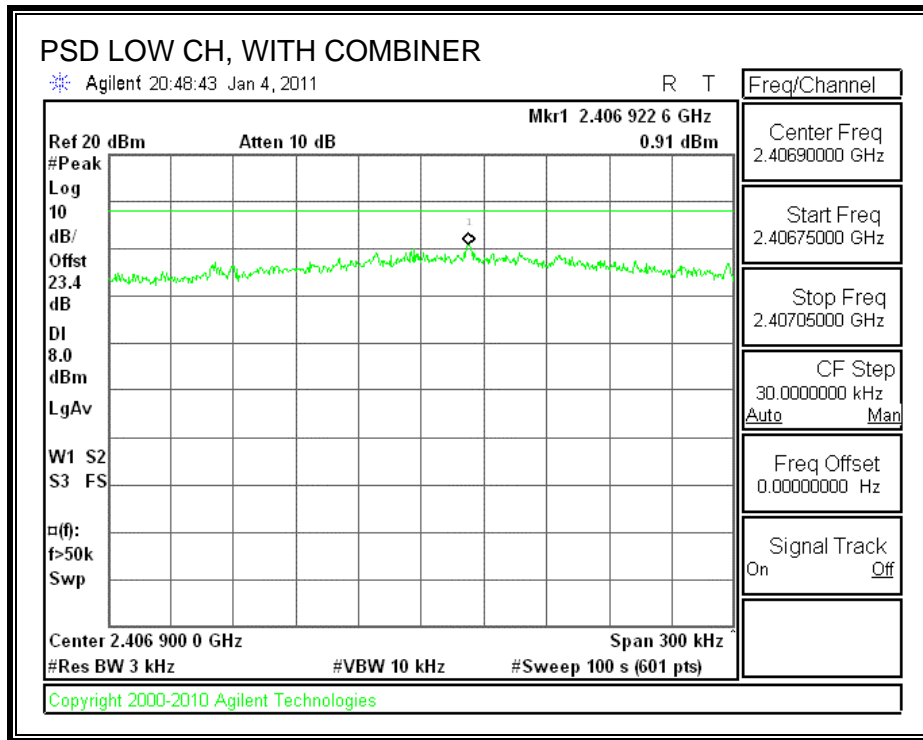
#### TEST PROCEDURE

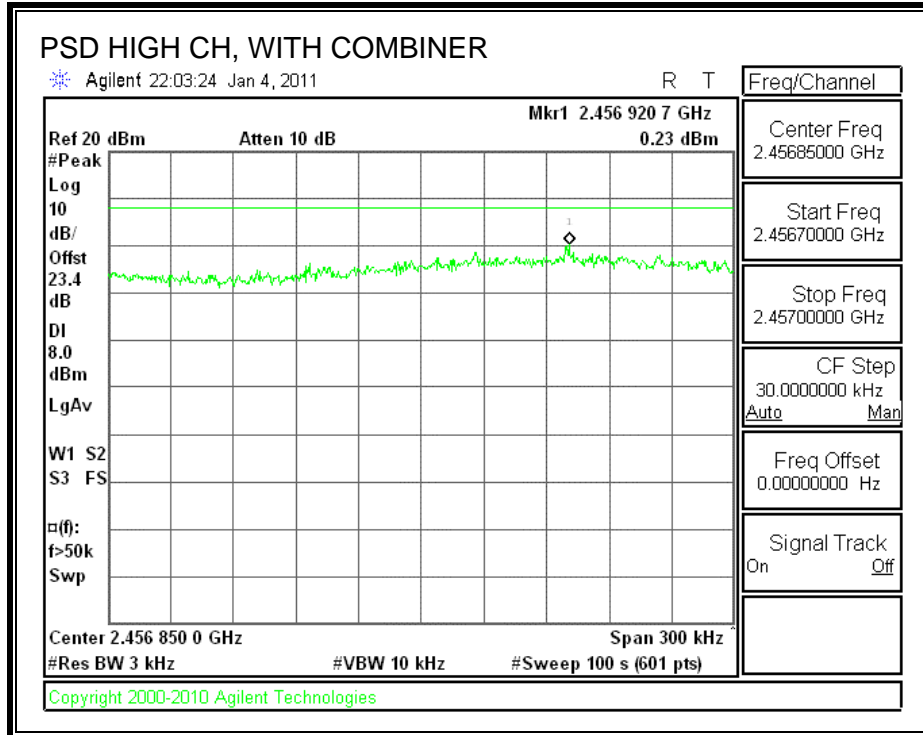
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

#### RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	2412	0.91	8	-7.09
Middle	2437	3.86	8	-4.14
High	2462	0.23	8	-7.77

**POWER SPECTRAL DENSITY, WITH COMBINER**







### **7.3.5. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of RMS averaging over a time interval, therefore the required attenuation is 30 dB.

#### **TEST PROCEDURE**

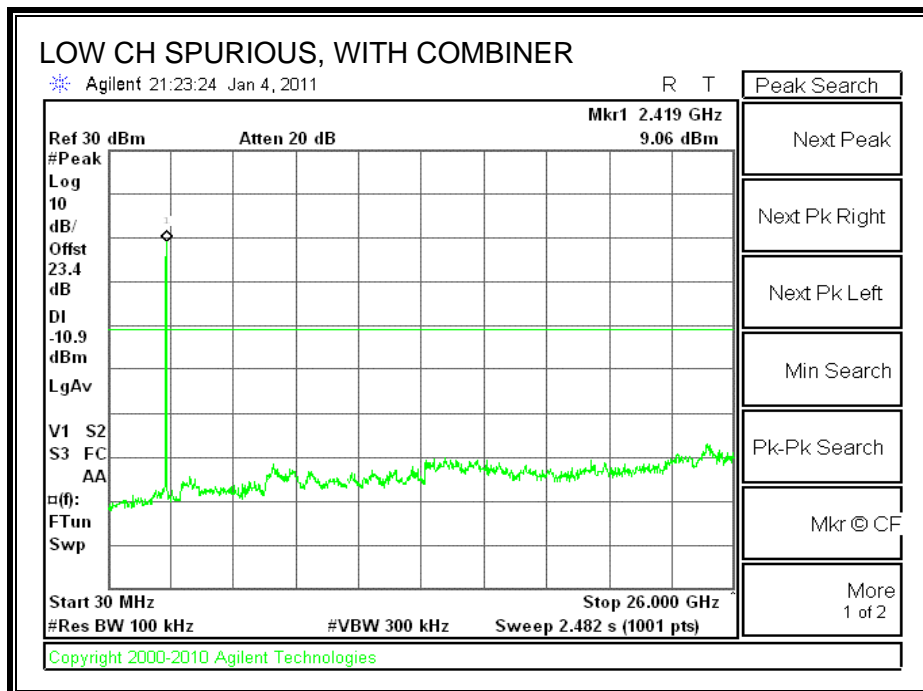
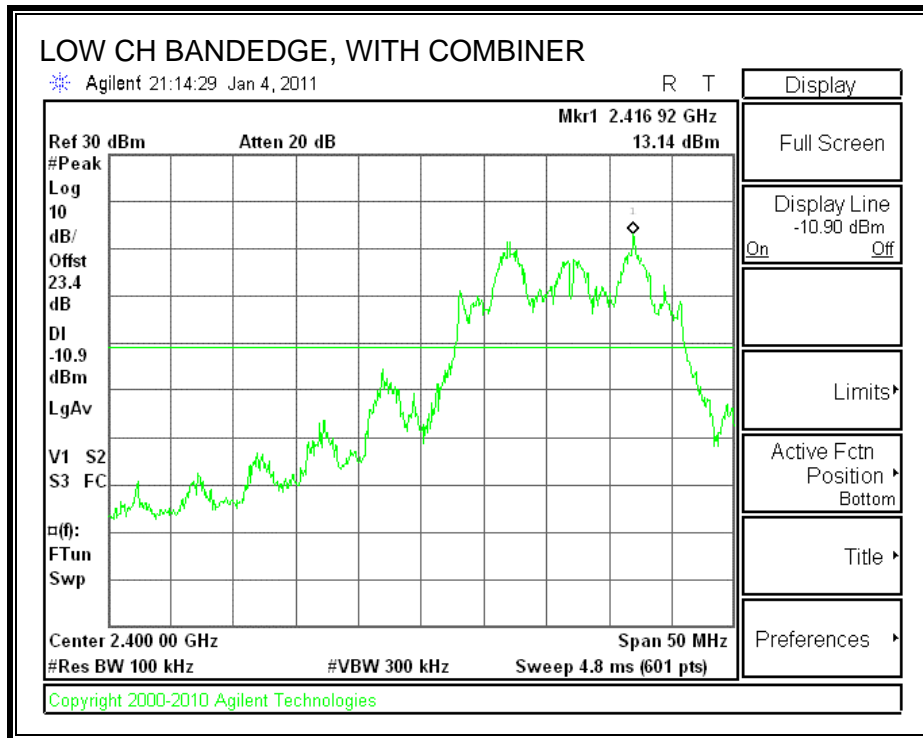
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

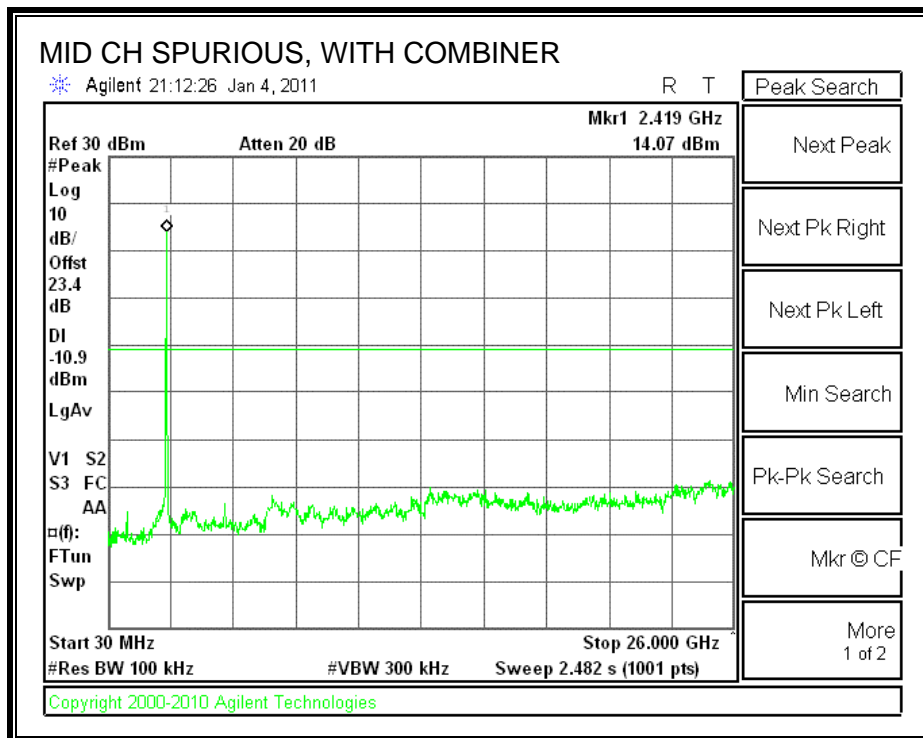
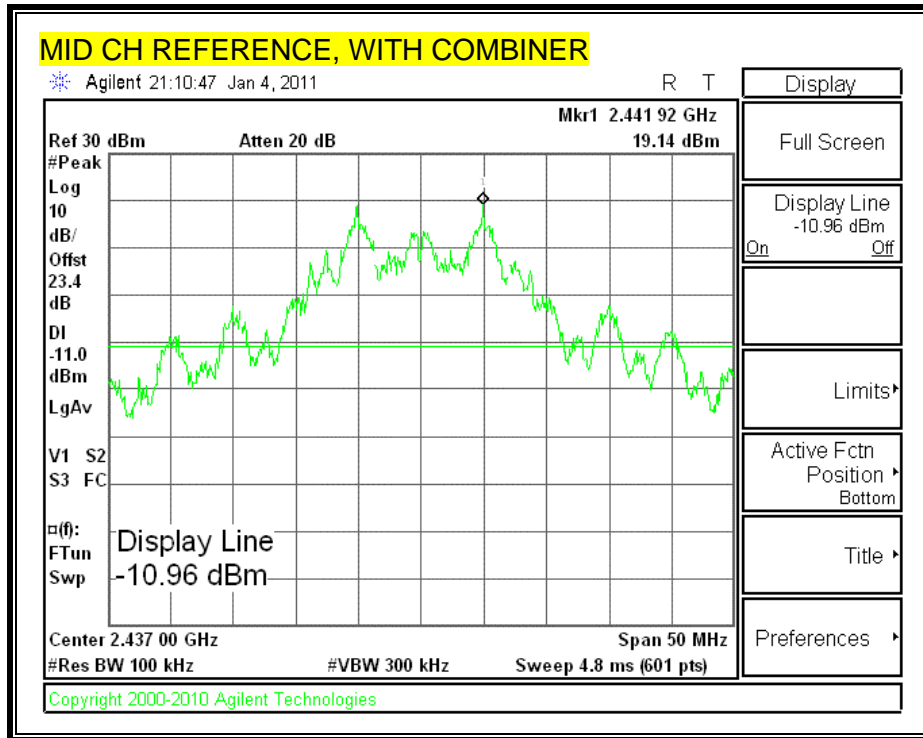
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

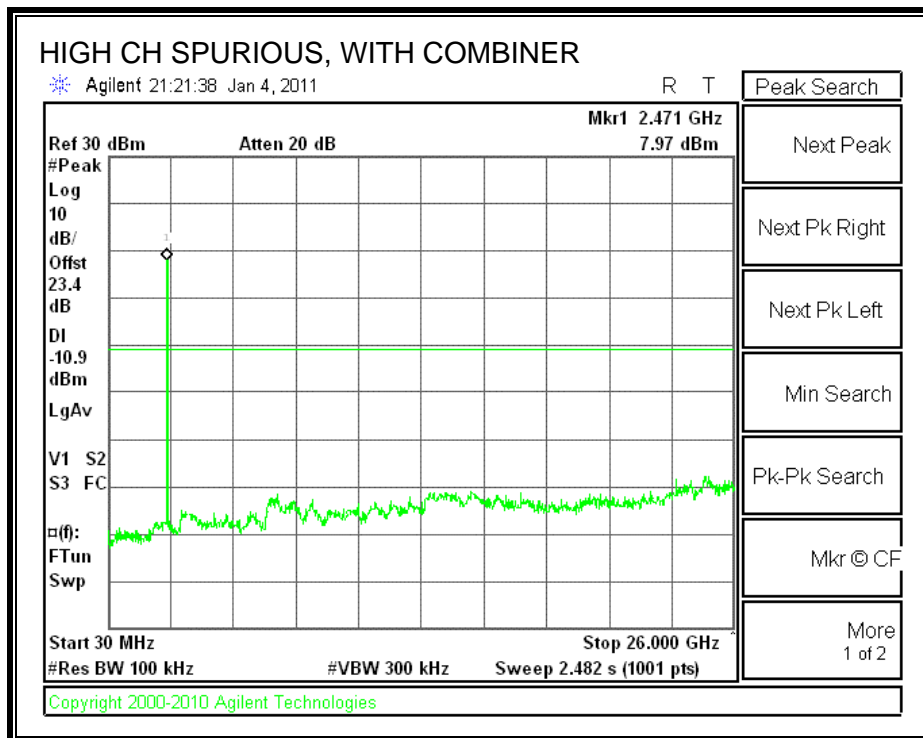
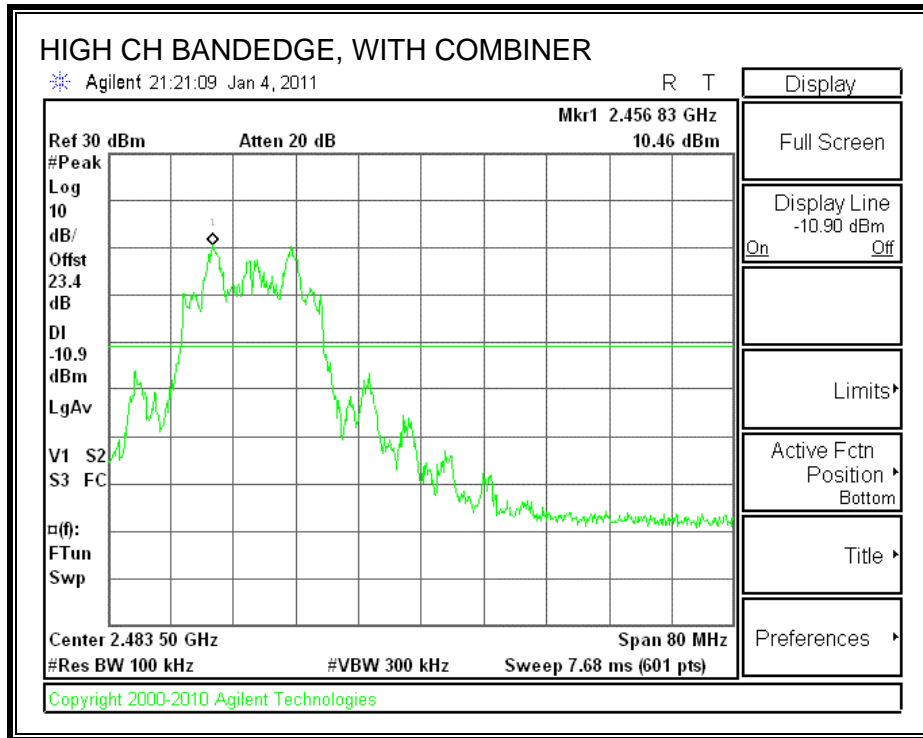
#### **RESULTS**

The -30dBc of low and high channels are based on mid channel reference point as highest output power.

**SPURIOUS EMISSIONS WITH COMBINER**







## 7.4. 802.11n THREE CHAINS HT20 MODE IN THE 5.8 GHz BAND

### 7.4.1. 6 dB BANDWIDTH

#### LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

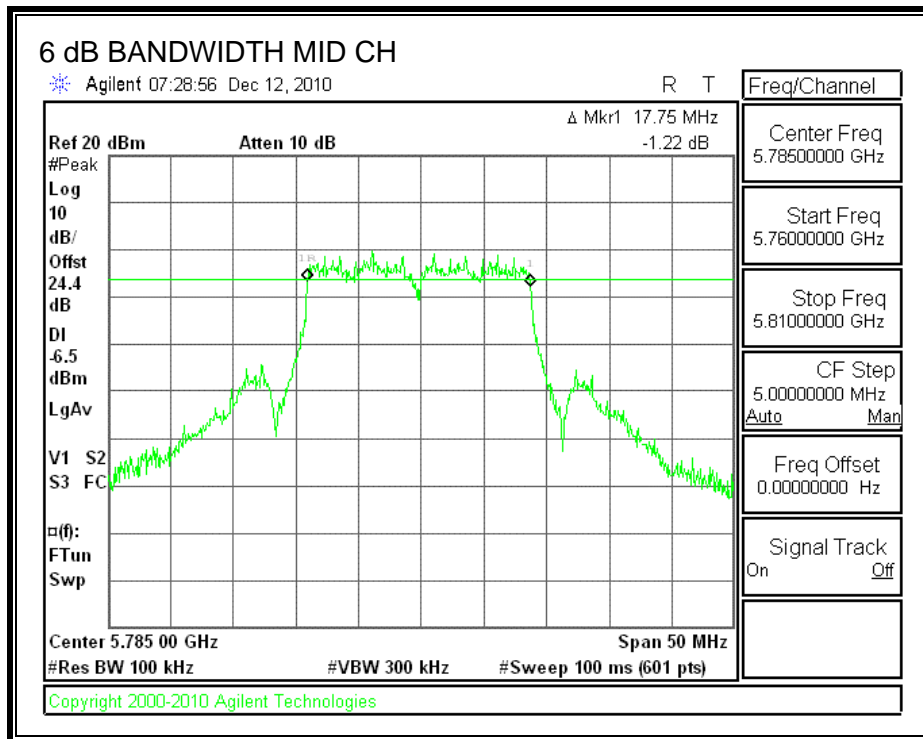
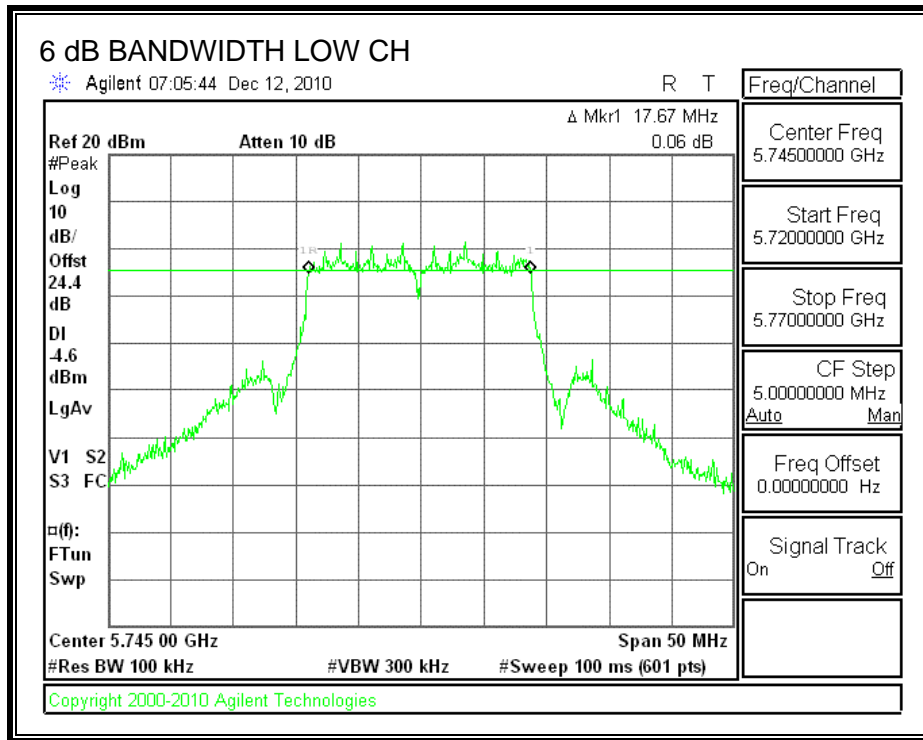
#### TEST PROCEDURE

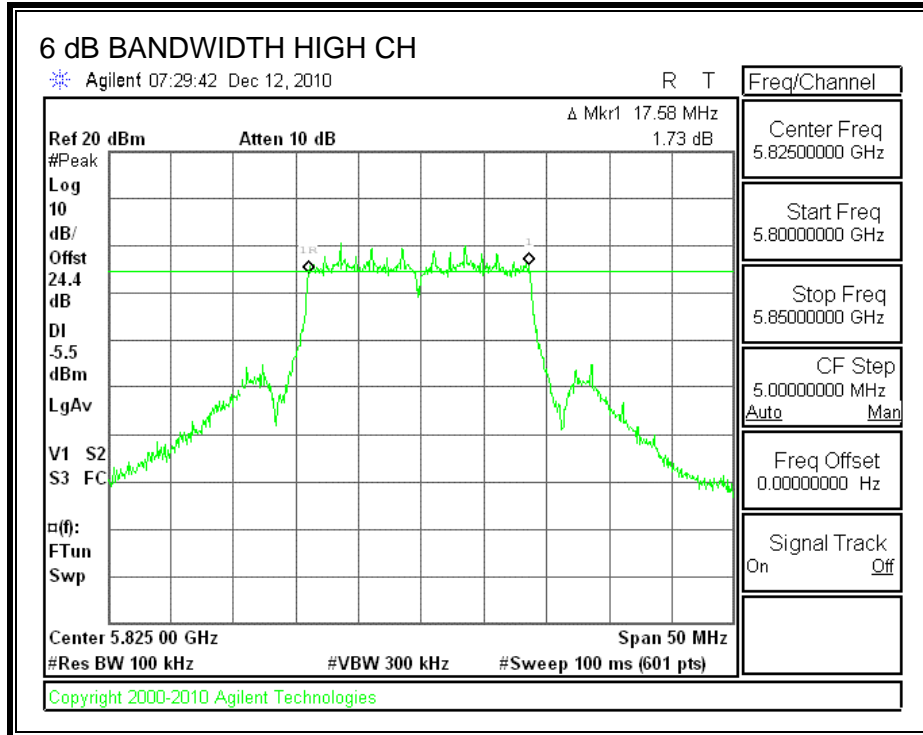
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	6 dB BW (MHz)	Minimum Limit (MHz)
Low	5745	17.67	0.5
Middle	5785	17.75	0.5
High	5825	17.58	0.5

**6 dB BANDWIDTH**





## 7.4.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

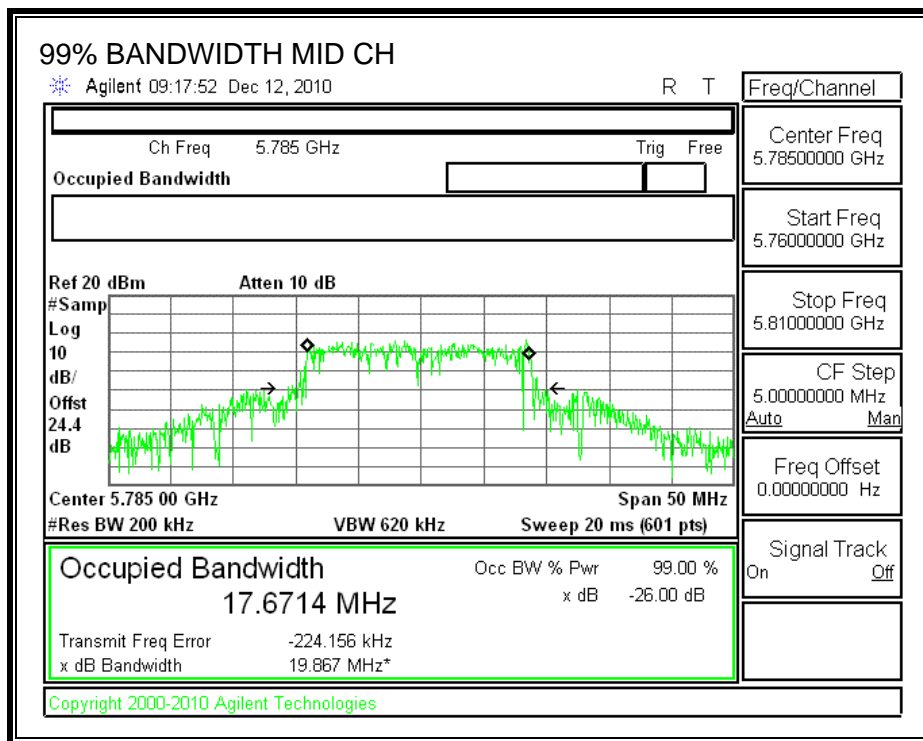
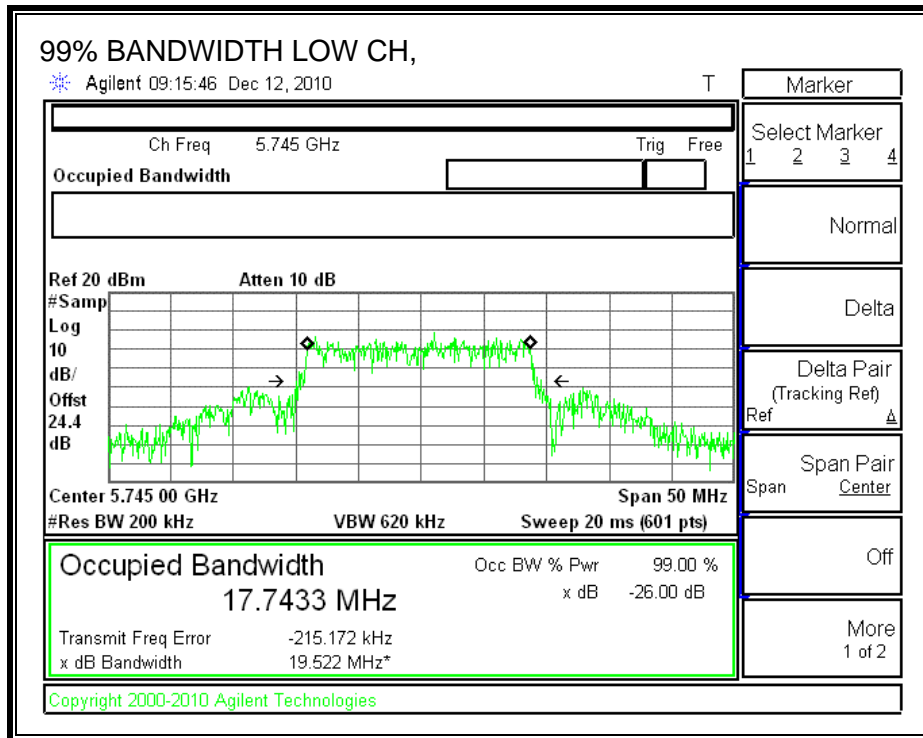
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

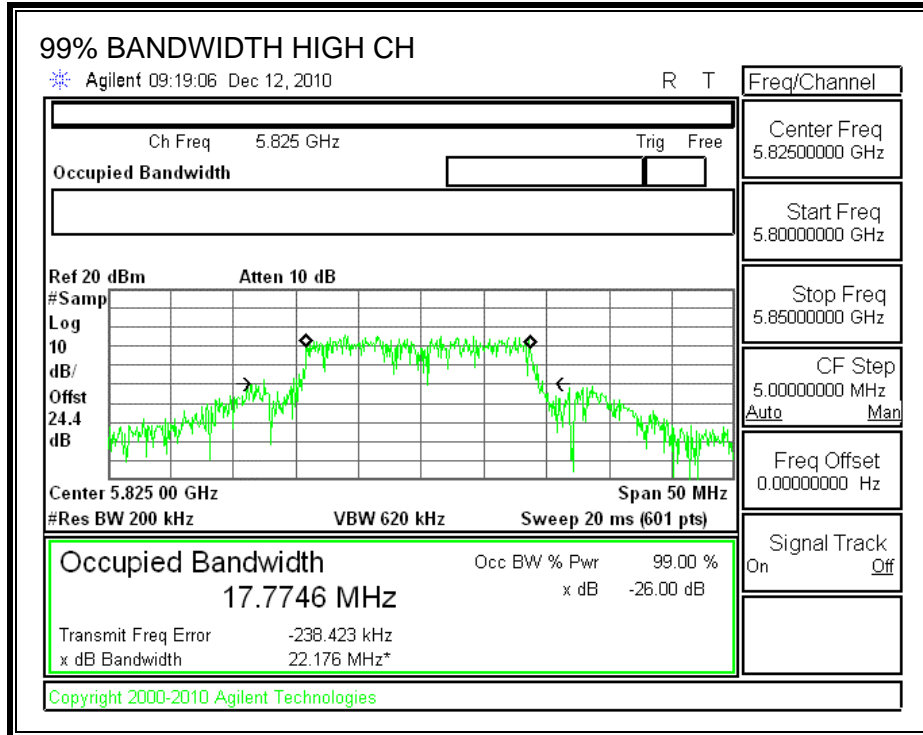
### RESULTS

Channel	Frequency (MHz)	Chain 1 99% Bandwidth (MHz)
Low	5745	17.7430
Middle	5785	17.6714
High	5825	17.7746



**99% BANDWIDTH**





### 7.4.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The composite antenna gain is equal to 11.27 dBi, therefore the limit is 24.73 dBm.

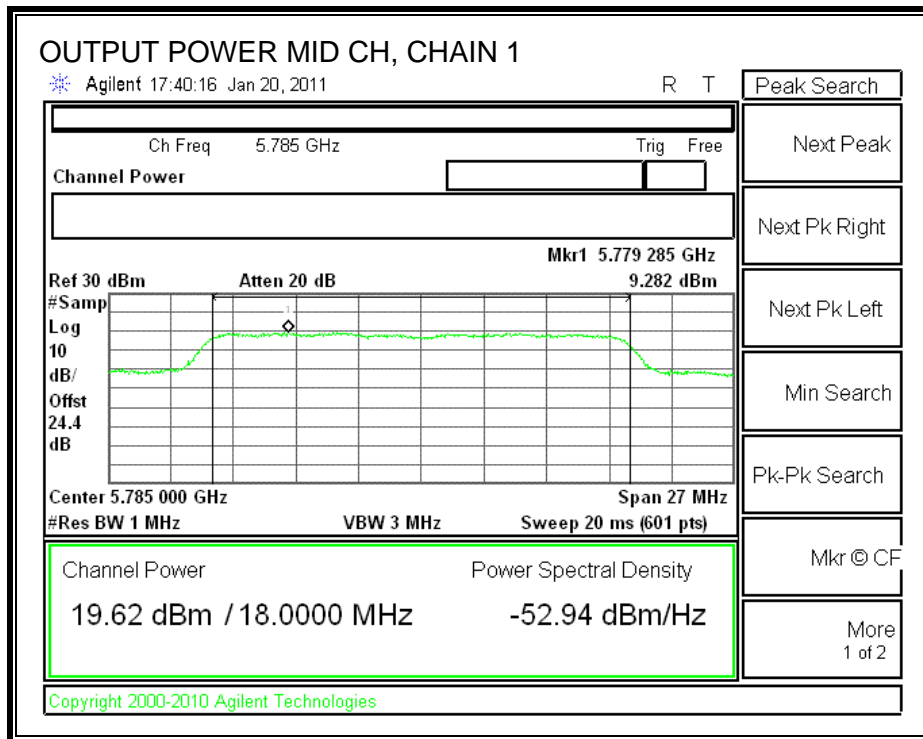
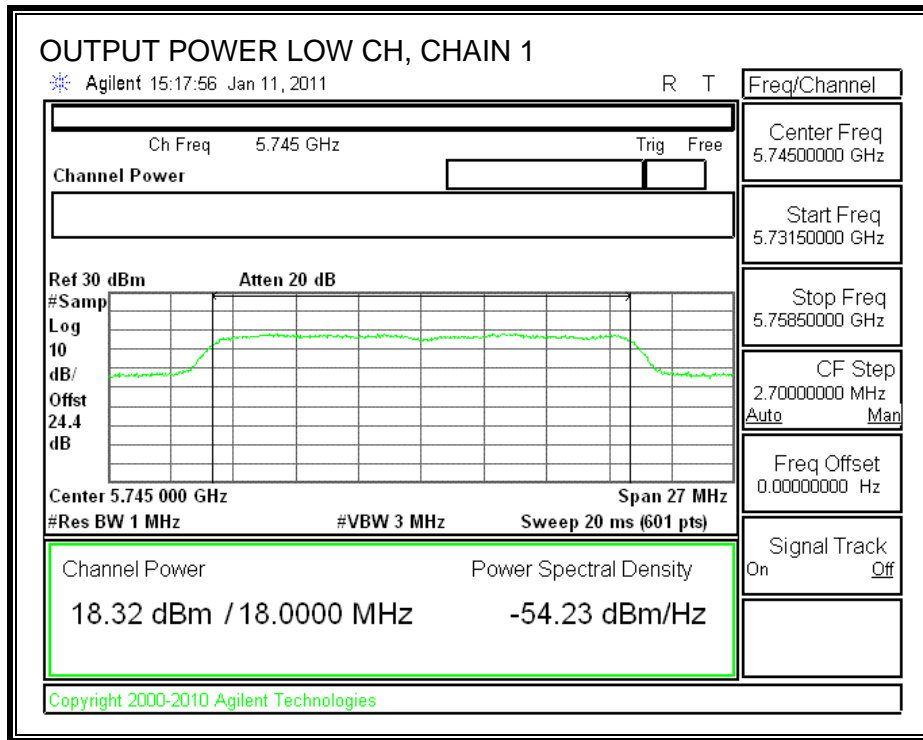
#### TEST PROCEDURE – UNII METHOD

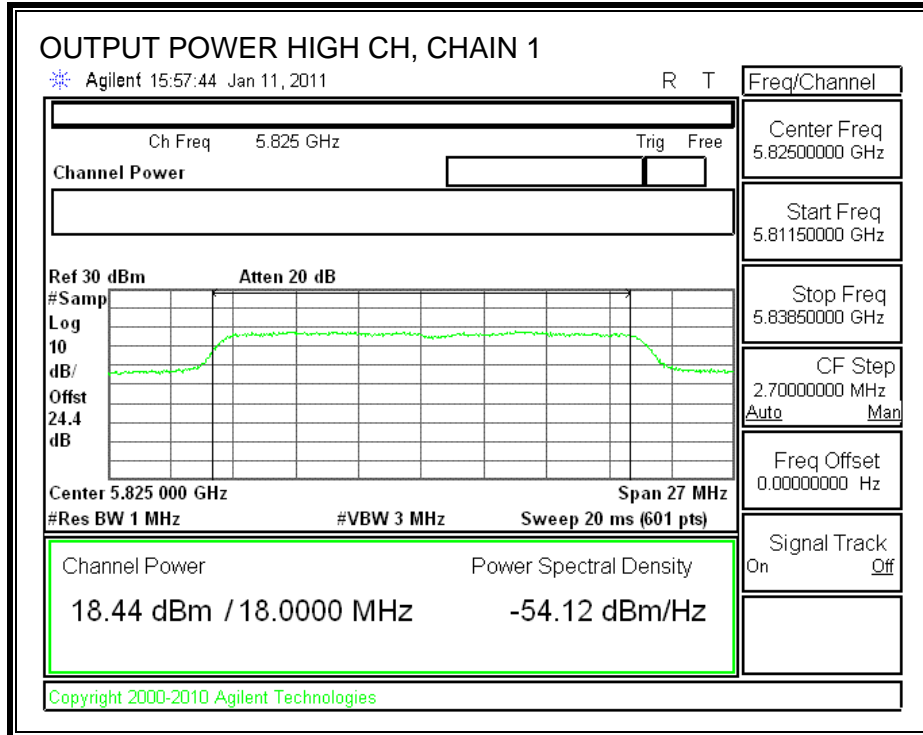
Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document “Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

#### RESULTS

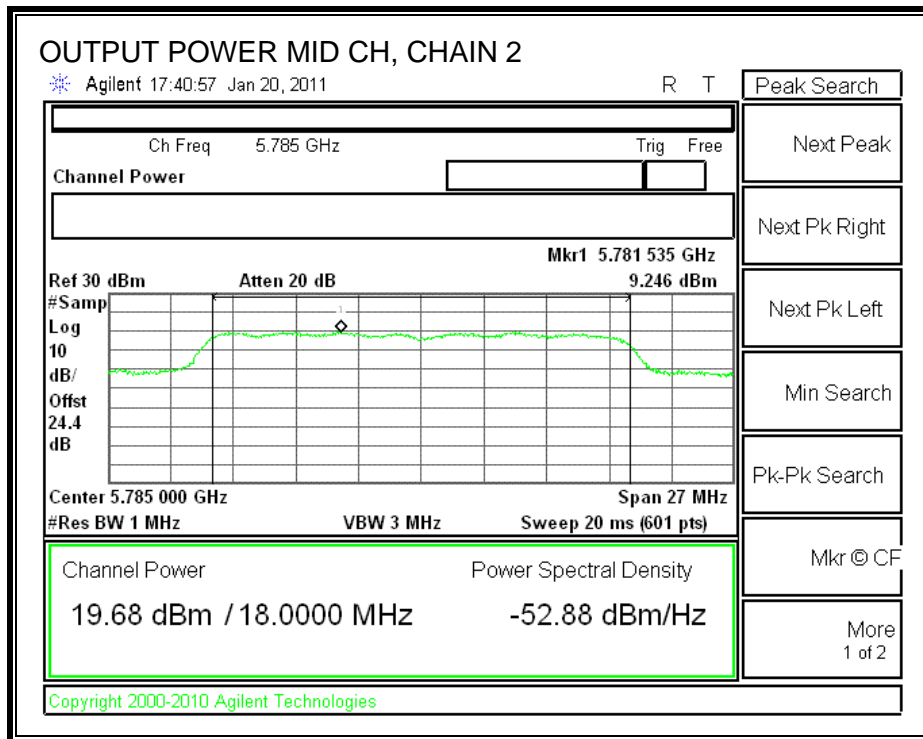
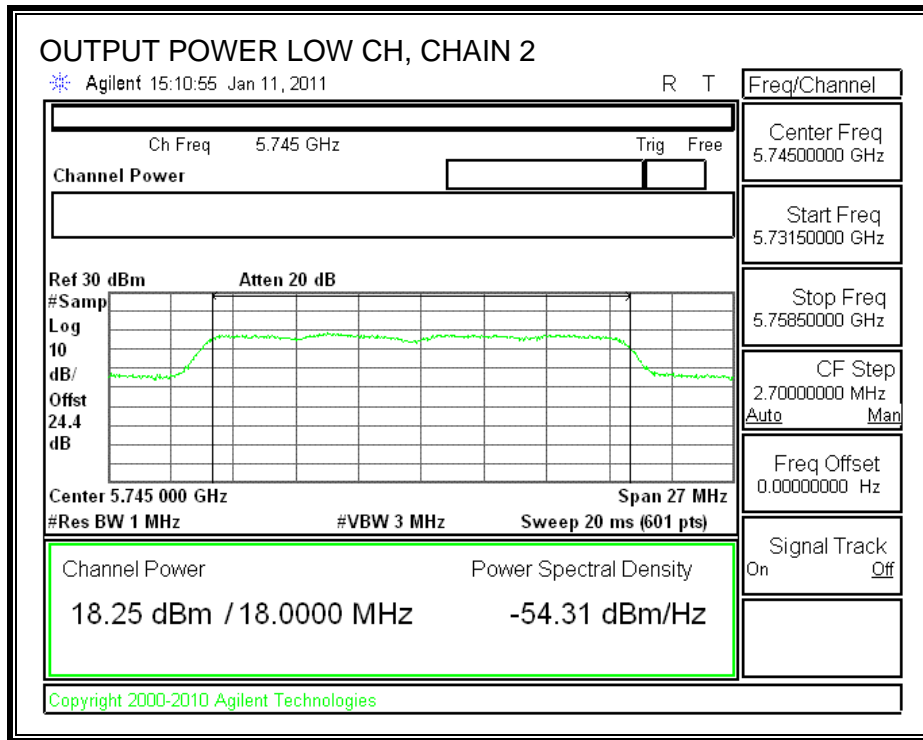
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	18.32	18.25	18.57	23.15	24.73	-1.58
Mid	5785	19.62	19.68	19.85	24.49	24.73	-0.24
High	5825	18.44	18.47	18.40	23.21	24.73	-1.52

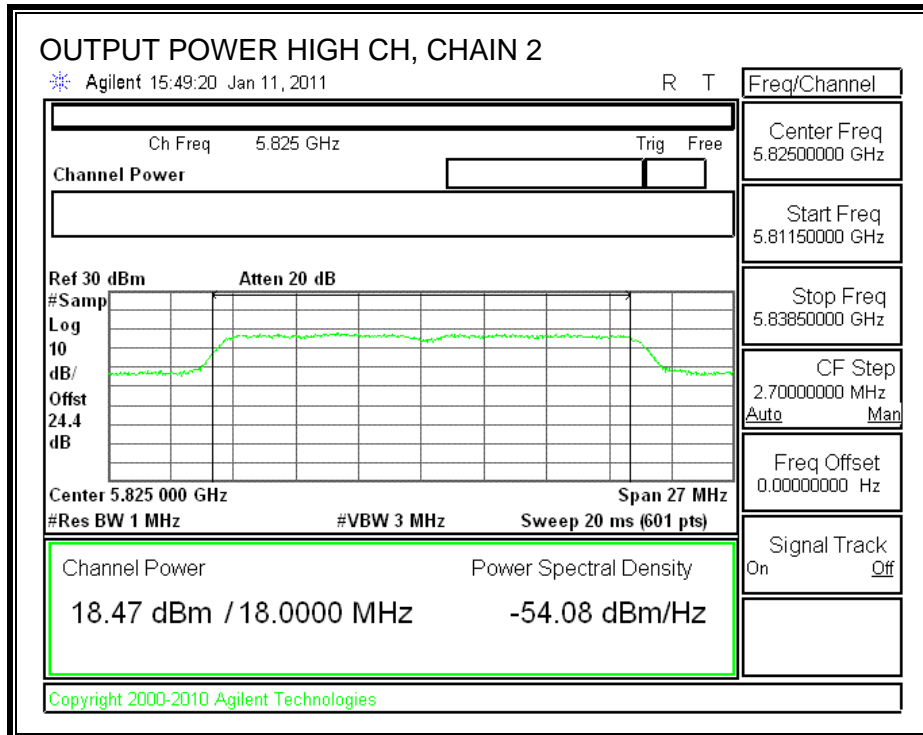
**CHAIN 1 OUTPUT POWER**



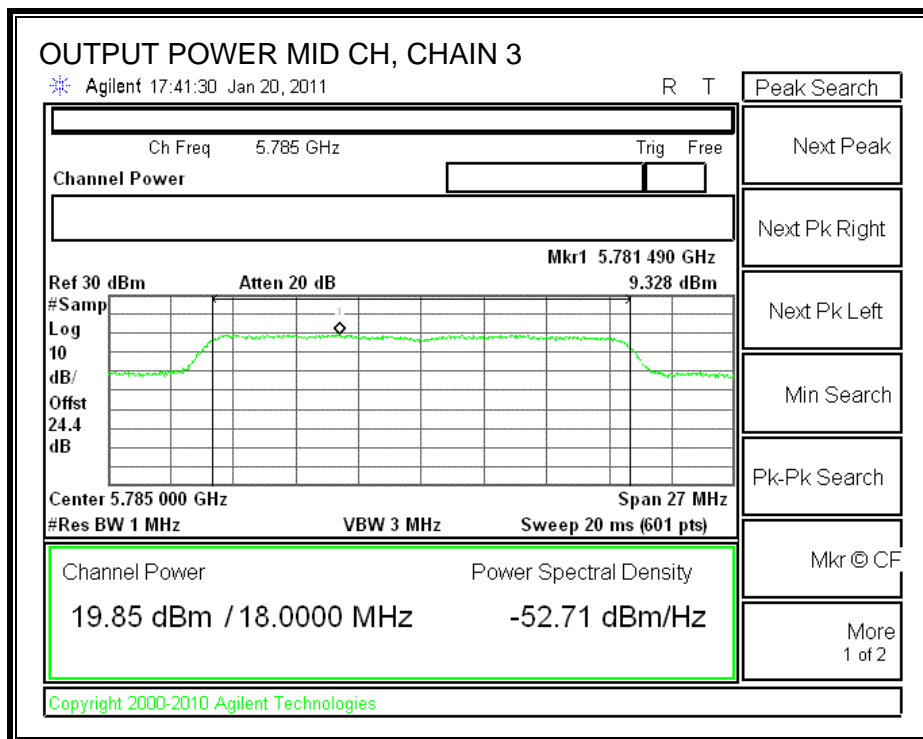
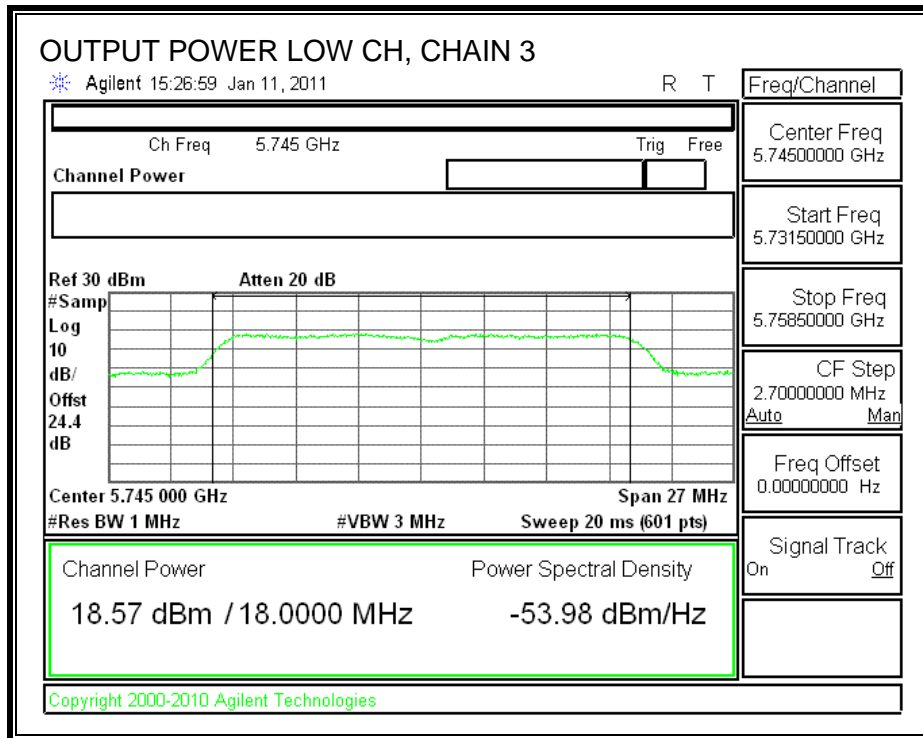


**CHAIN 2 OUTPUT POWER**

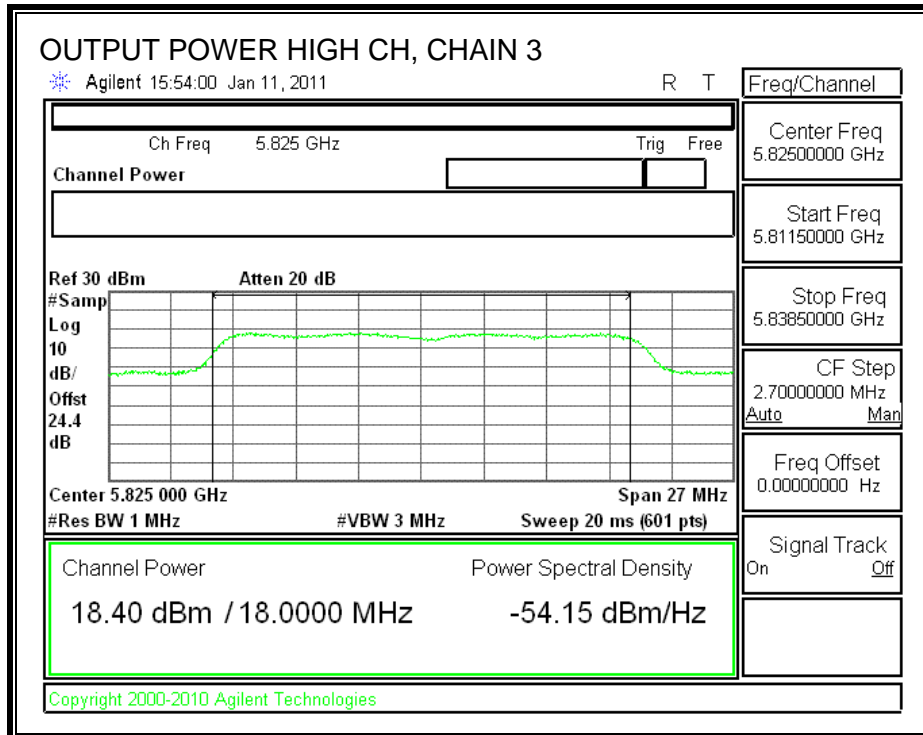




**CHAIN 3 OUTPUT POWER**







#### 7.4.4. 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.

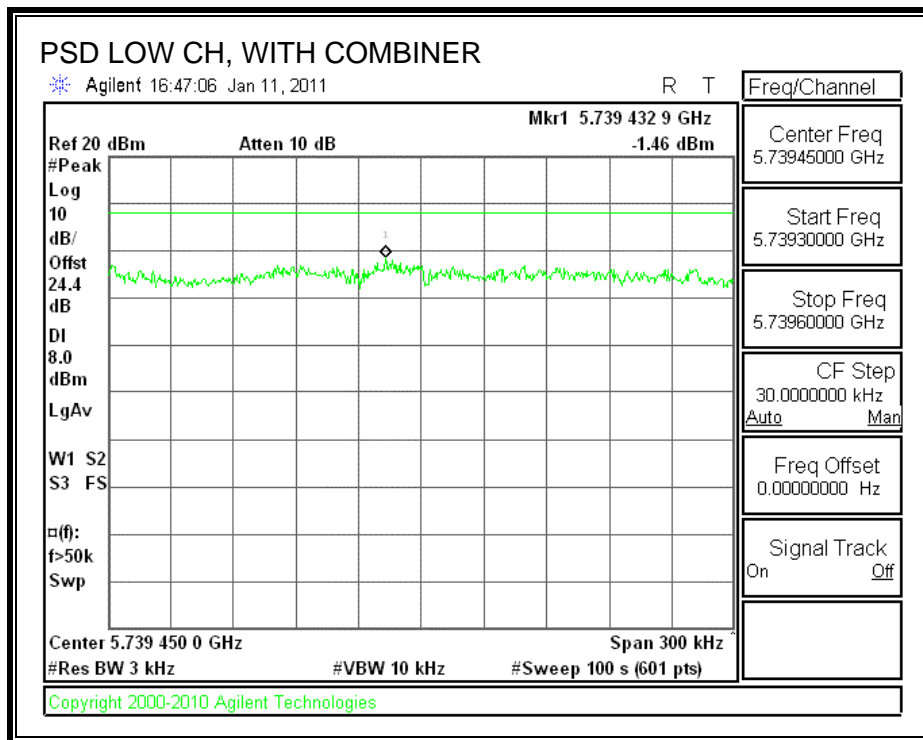
##### TEST PROCEDURE

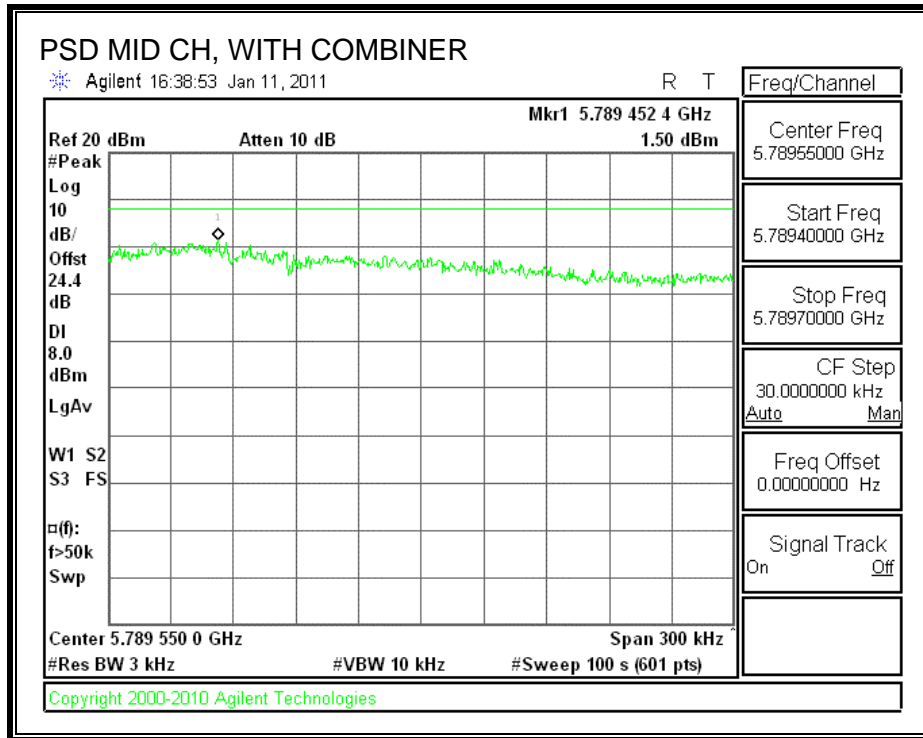
Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

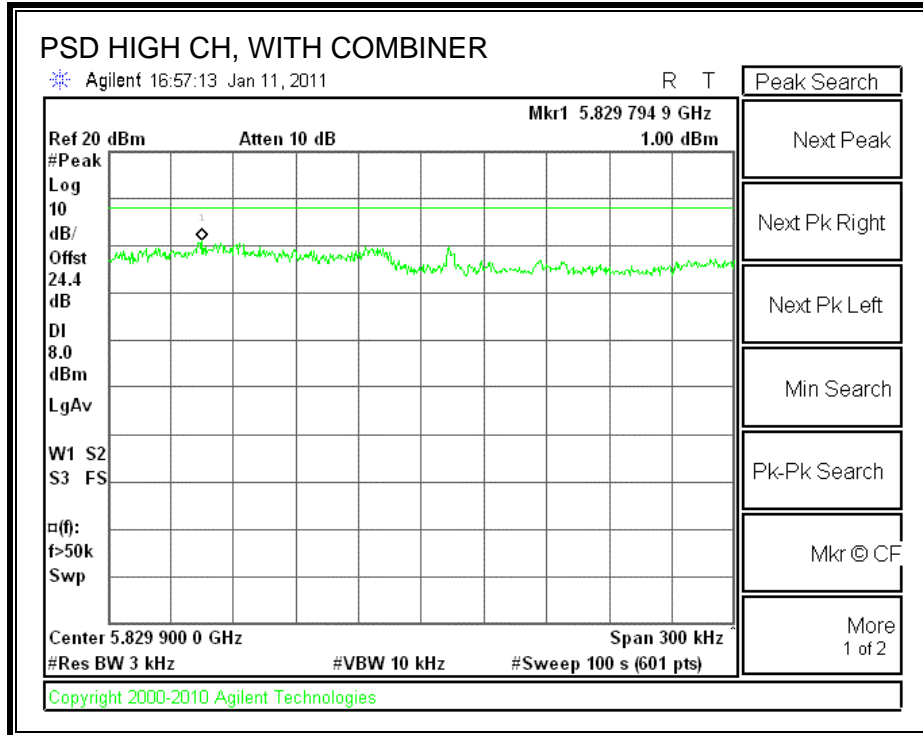
##### RESULTS:

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-1.46	8	-9.46
Middle	5785	1.50	8	-6.50
High	5825	1.00	8	-7.00

**POWER SPECTRAL DENSITY, WITH COMBINER**







## **7.4.5. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of RMS averaging over a time interval, therefore the required attenuation is 30 dB.

### **TEST PROCEDURE**

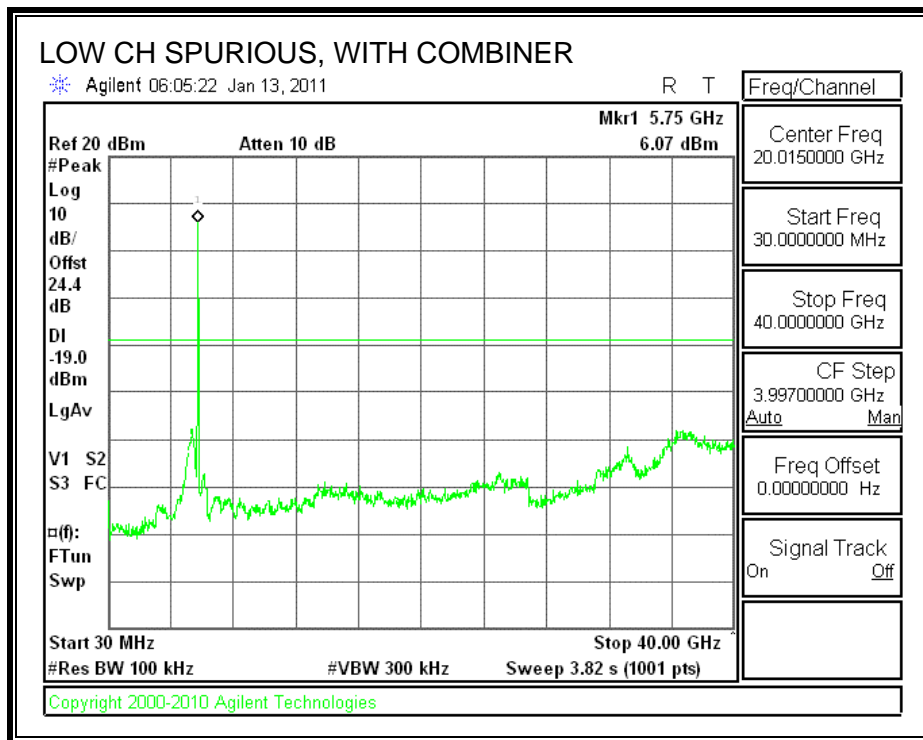
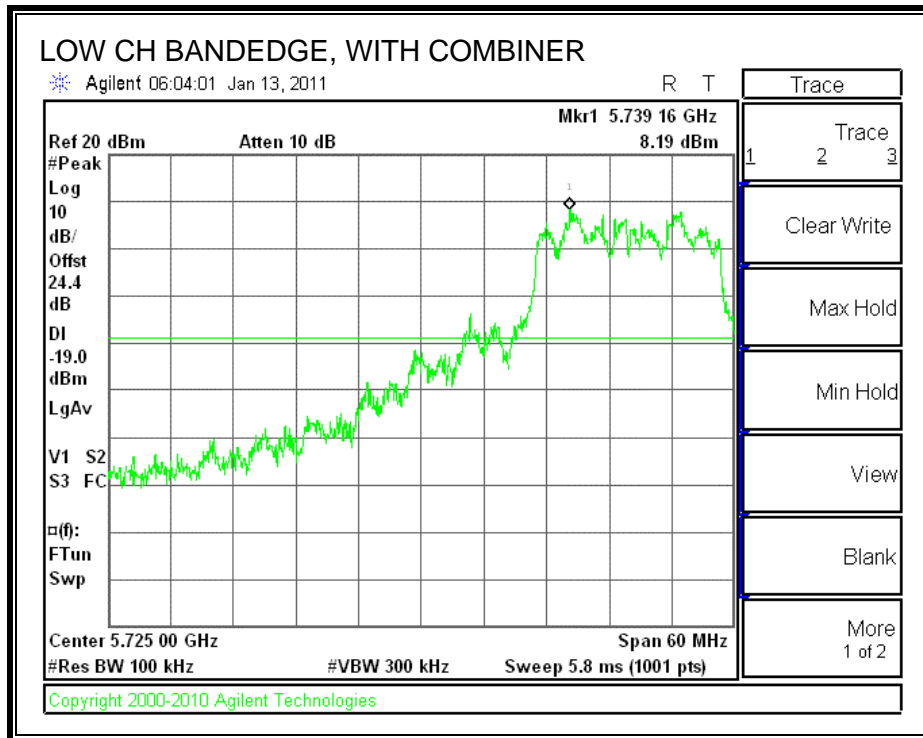
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

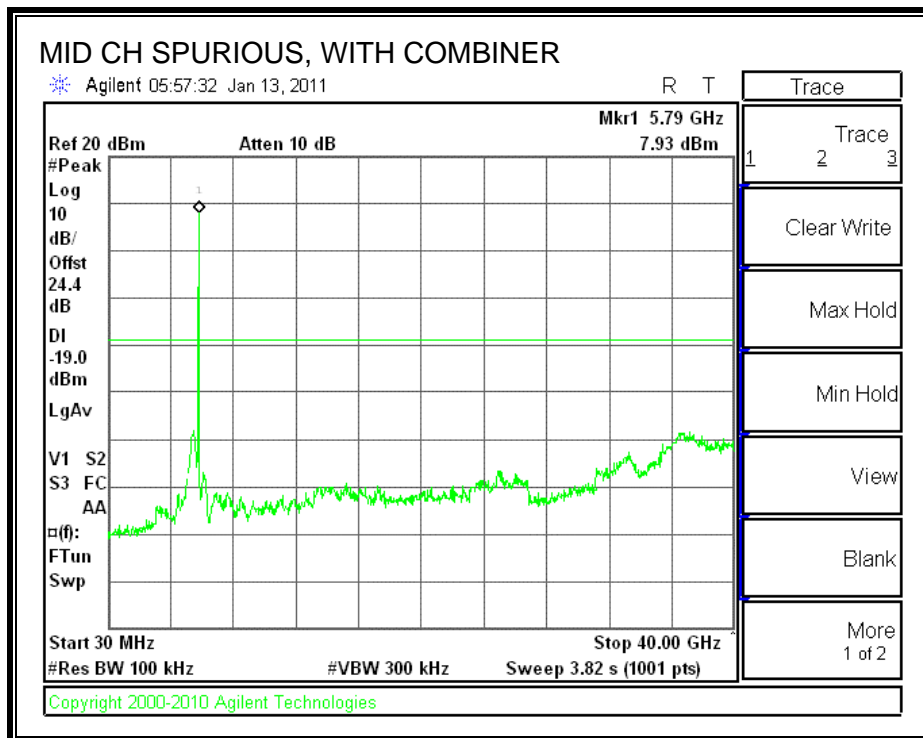
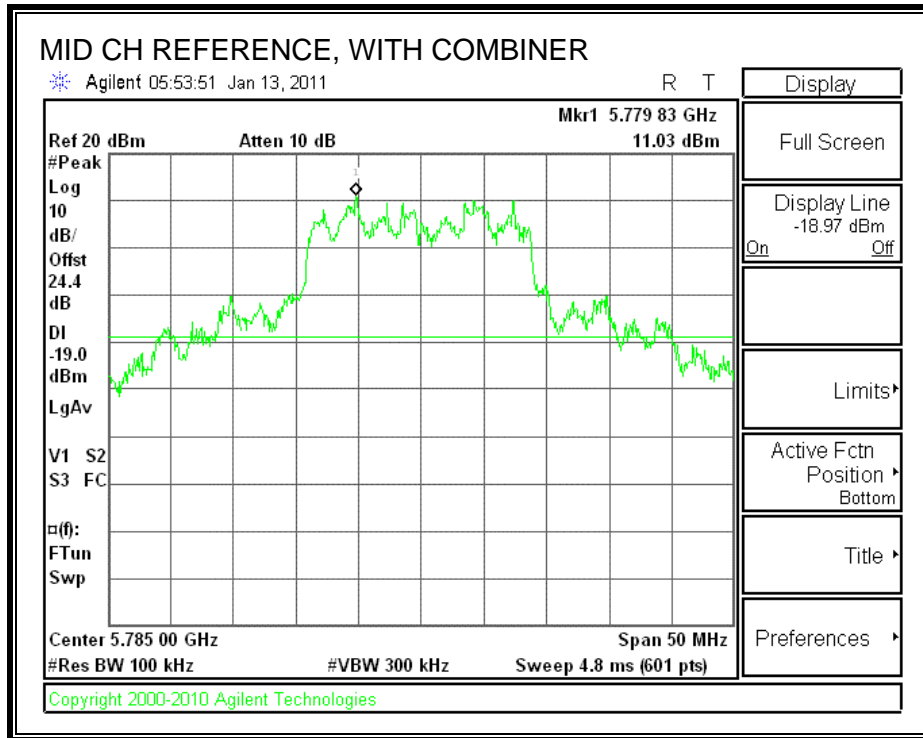
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

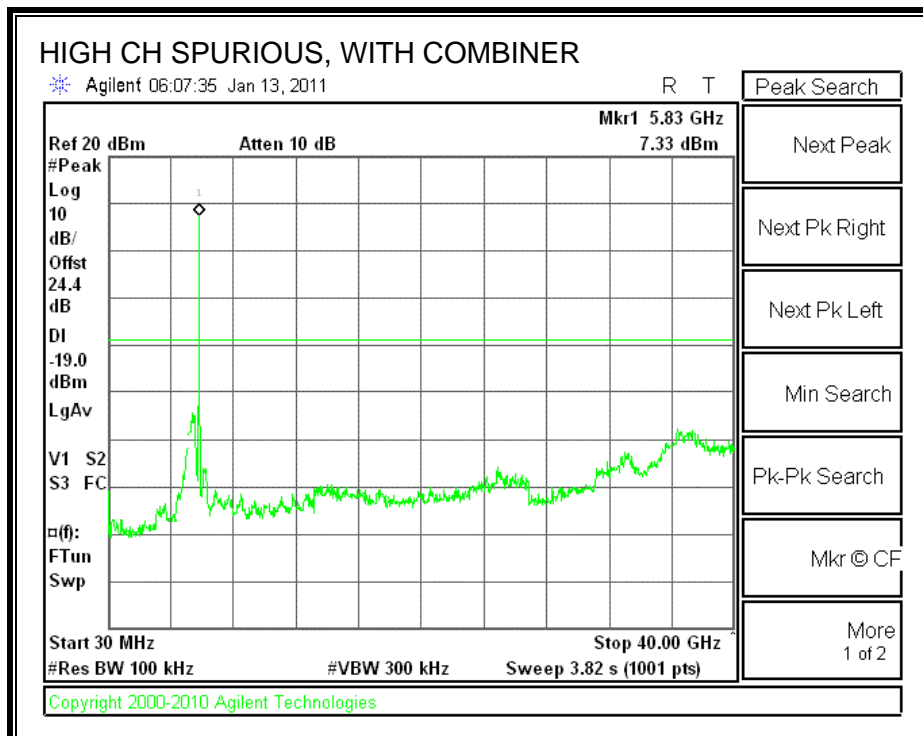
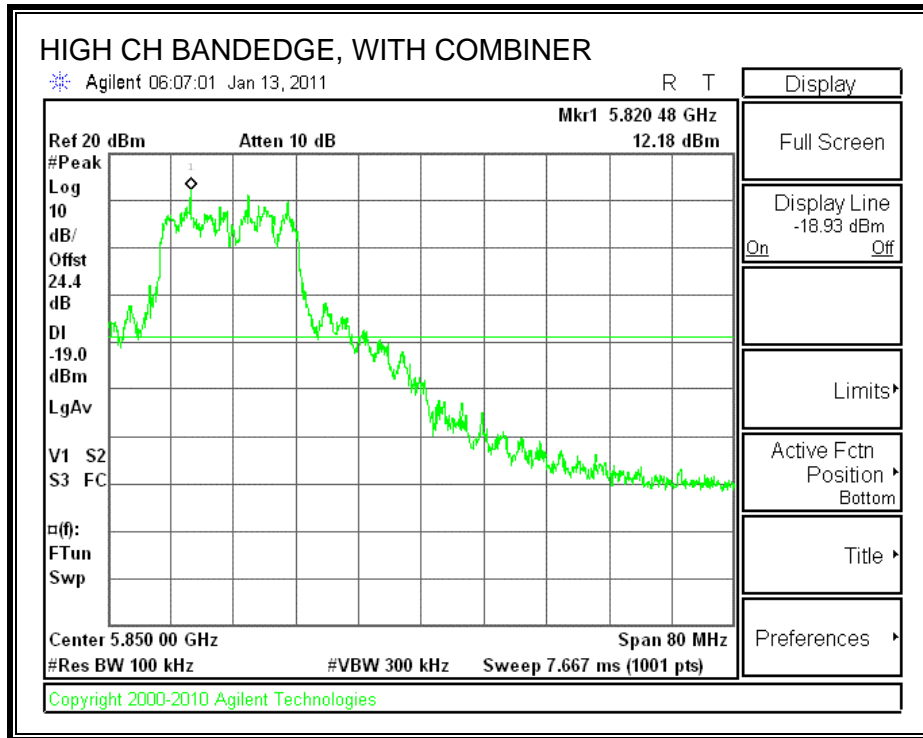
The -30dBc of low and high channels are based on mid channel reference point as highest output power.

**SPURIOUS EMISSIONS WITH COMBINER**









## 7.5. 802.11n THREE CHAINS HT40 MODE IN THE 5.8 GHz BAND

### 7.5.1. 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.

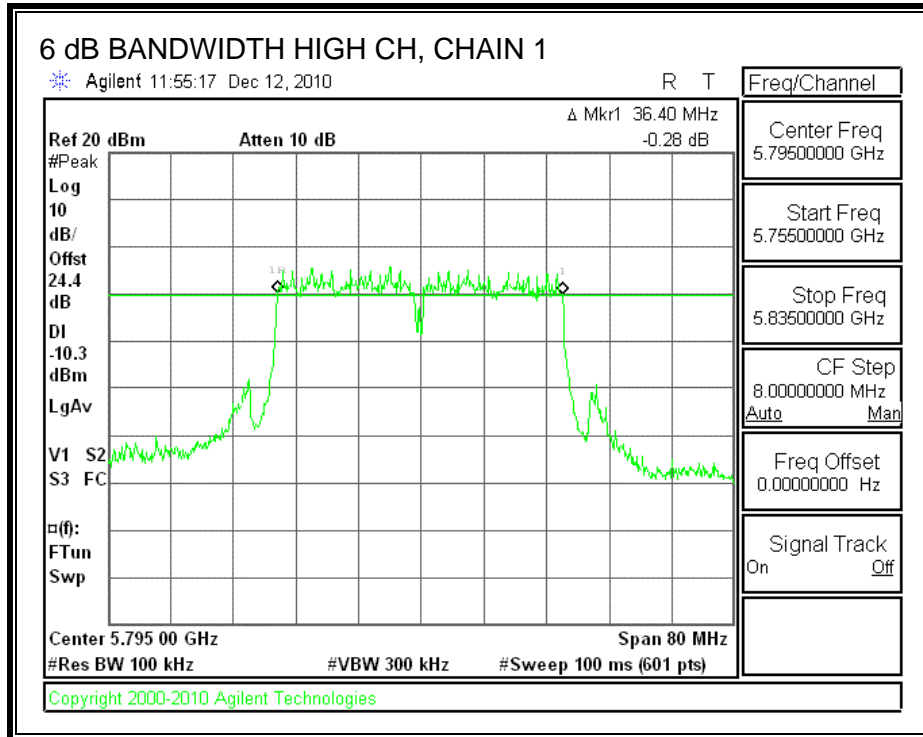
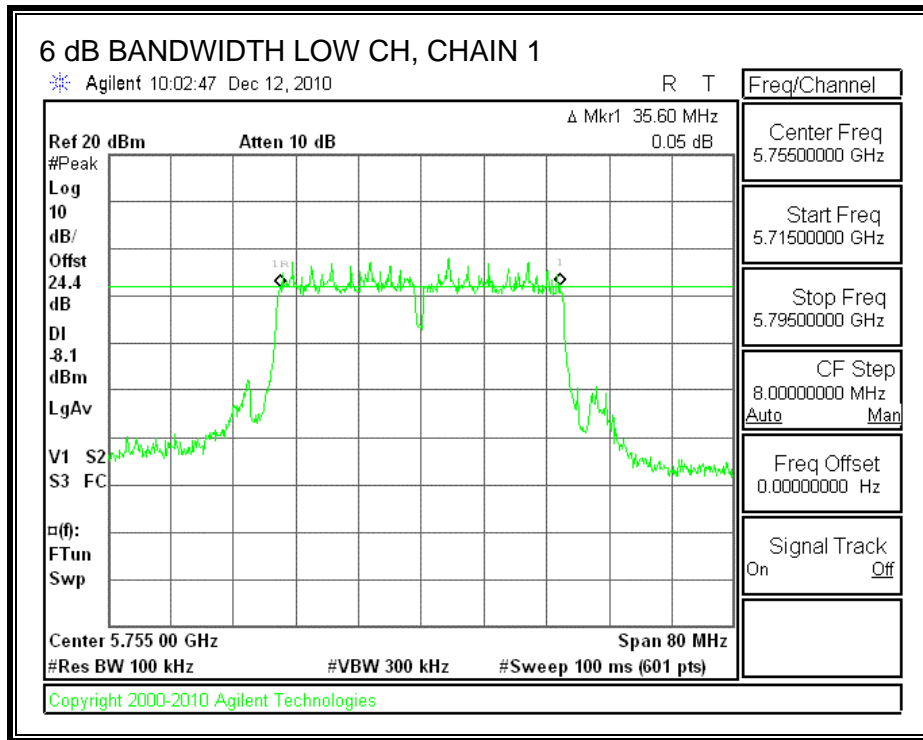
#### TEST PROCEDURE

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 BW (MHz)	Minimum Limit (MHz)
Low	5755	35.60	0.5
High	5795	36.40	0.5

**6 dB BANDWIDTH**



## 7.5.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

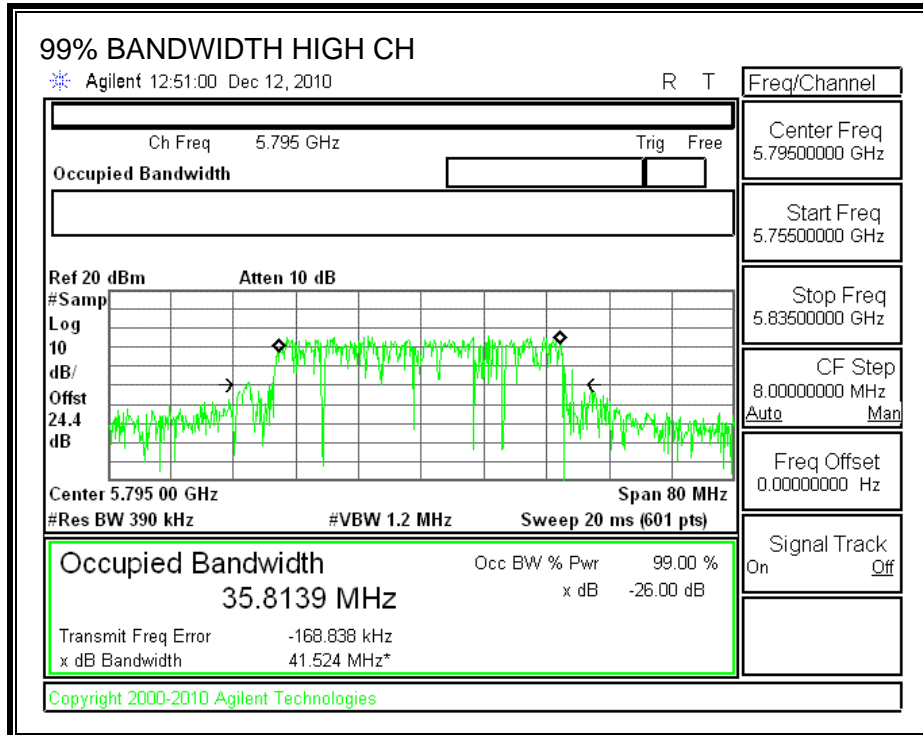
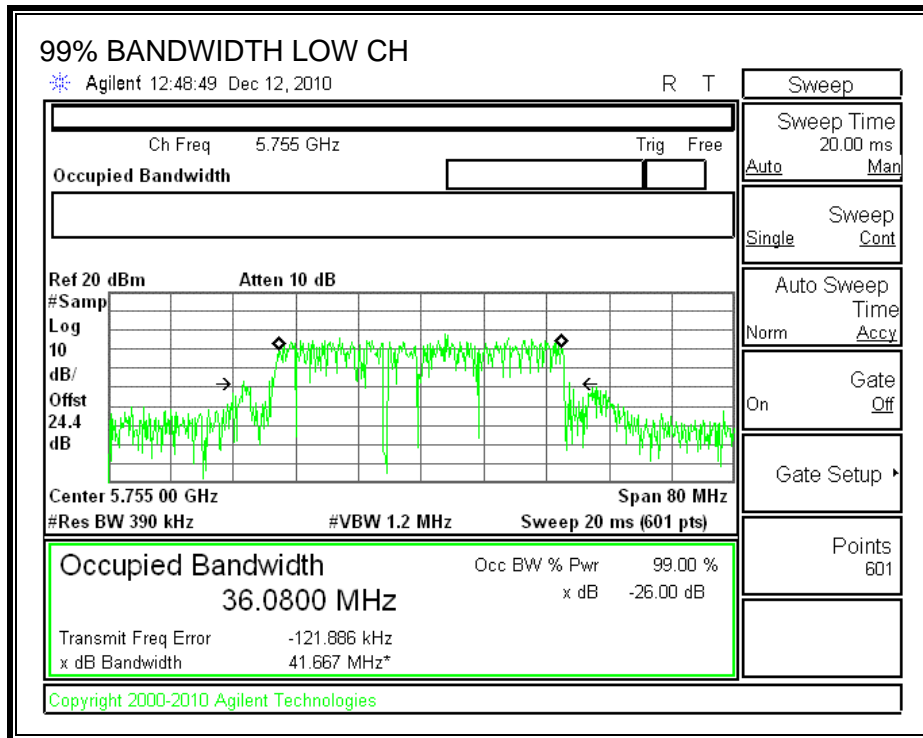
### TEST PROCEDURE

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

Frequency (MHz)	99% Bandwidth (MHz)
5755	36.0800
5795	35.8139

**99% BANDWIDTH**



### 7.5.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The composite antenna gain is equal to 11.27 dBi, therefore the limit is 24.73 dBm.

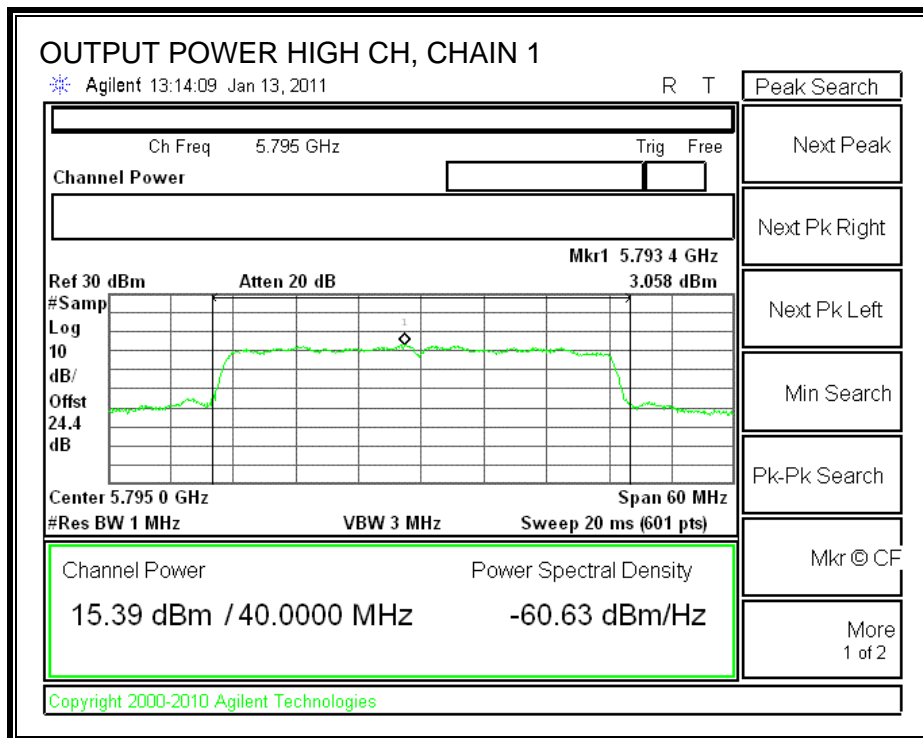
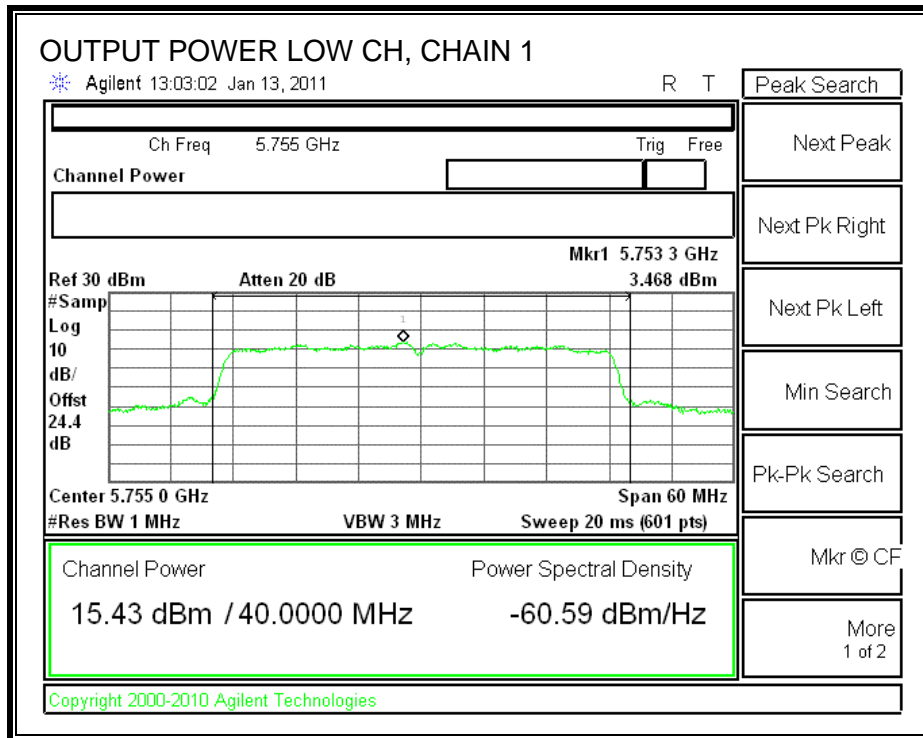
#### TEST PROCEDURE – UNII METHOD

Output power was measured based on the use of RMS averaging over a time interval in accordance with FCC document “Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

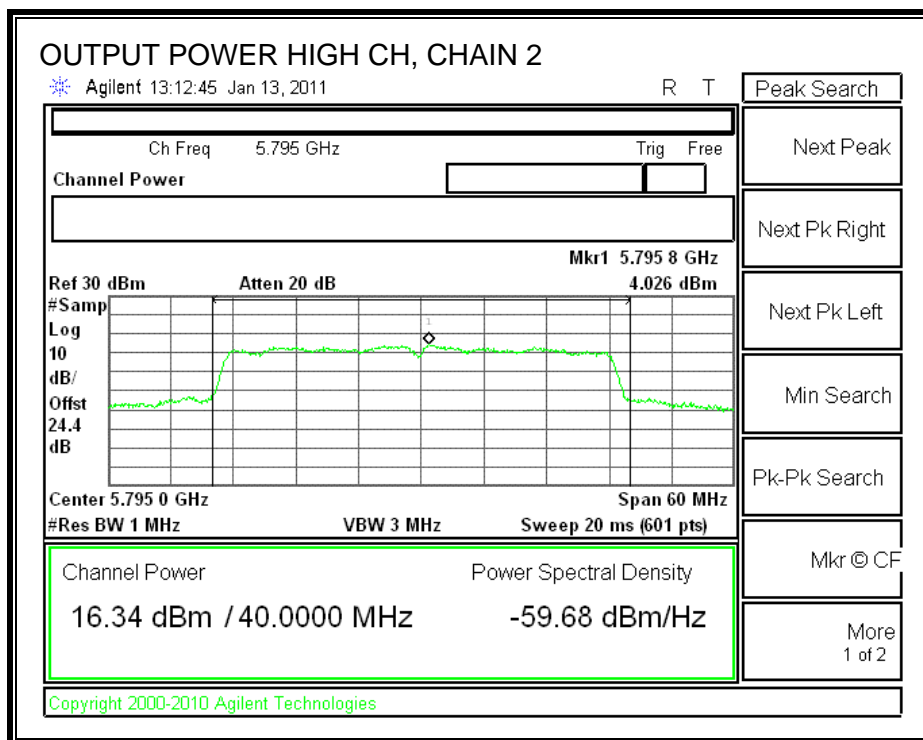
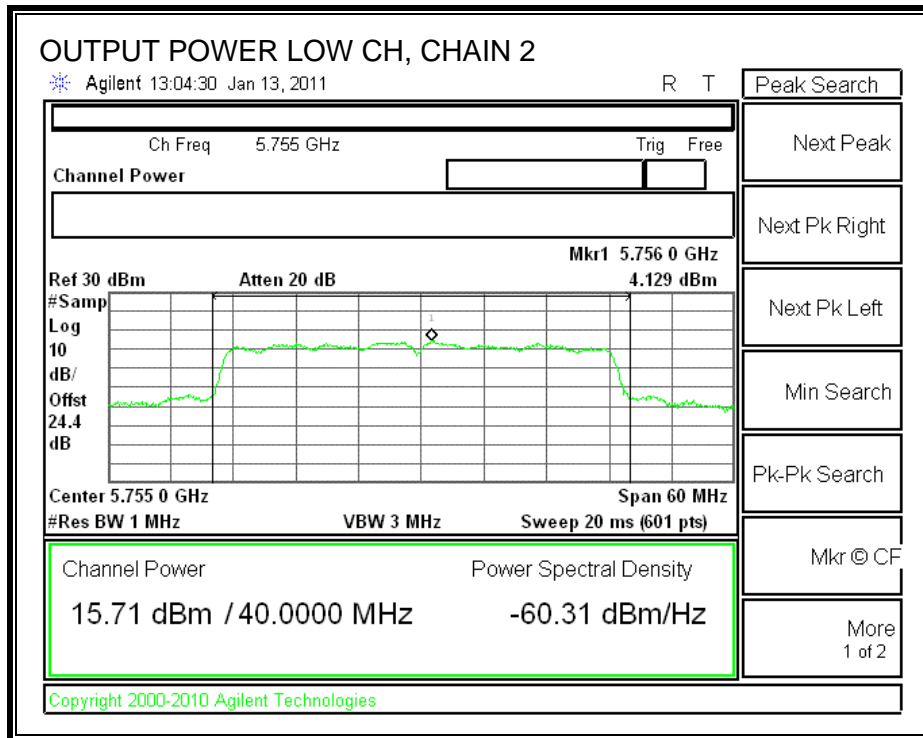
#### RESULTS

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5755	15.43	15.71	15.95	20.47	24.73	-4.26
High	5795	15.39	16.34	16.26	20.79	24.73	-3.94

**CHAIN 1 OUTPUT POWER**

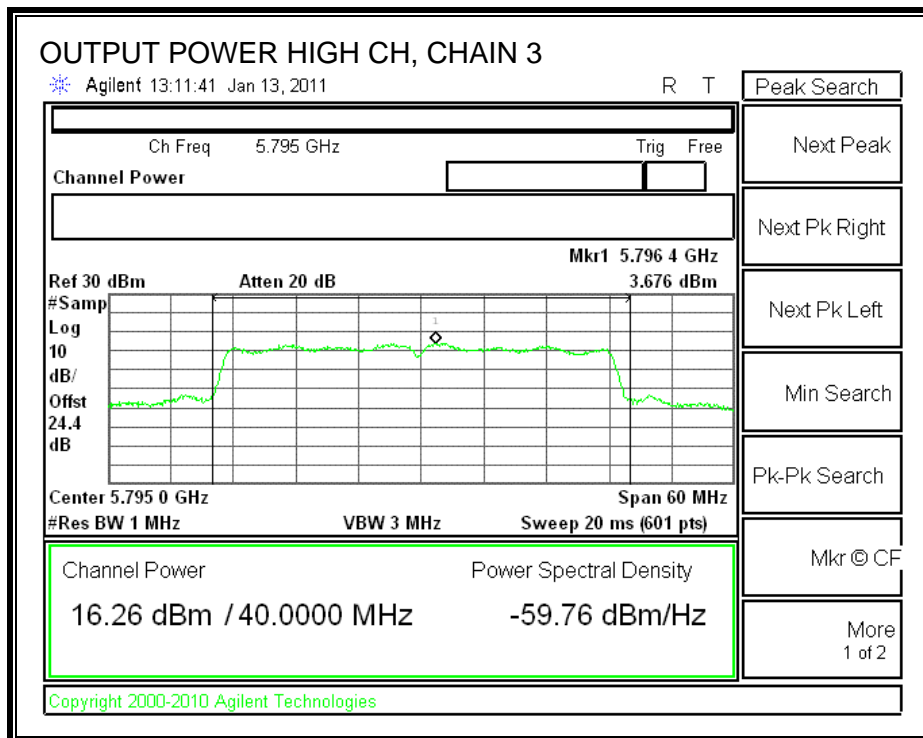
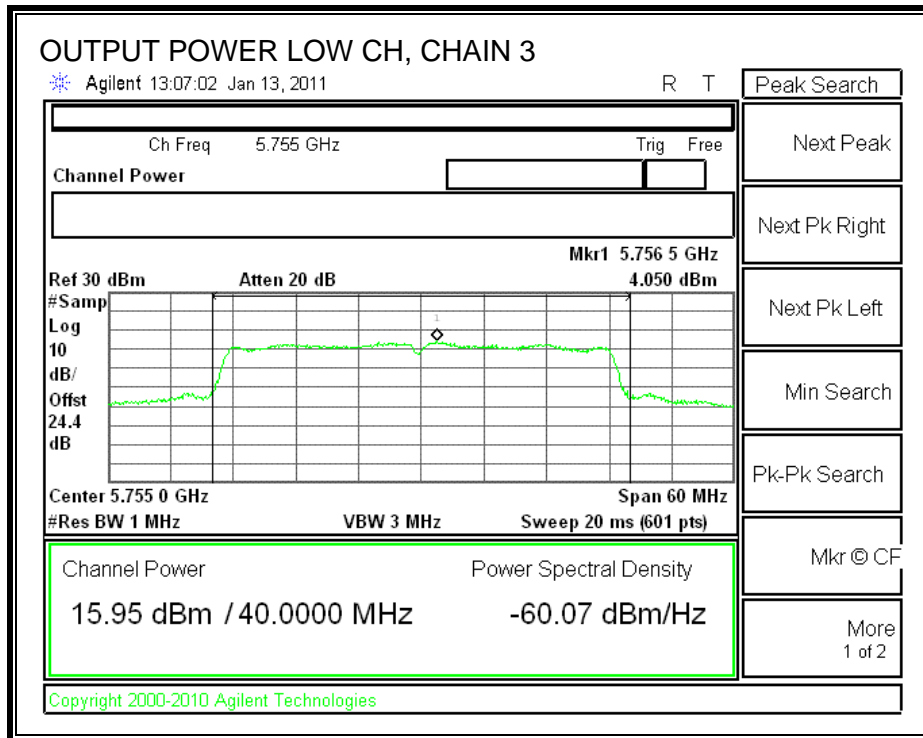


**CHAIN 2 OUTPUT POWER**





**CHAIN 3 OUTPUT POWER**



### 7.5.4. 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.

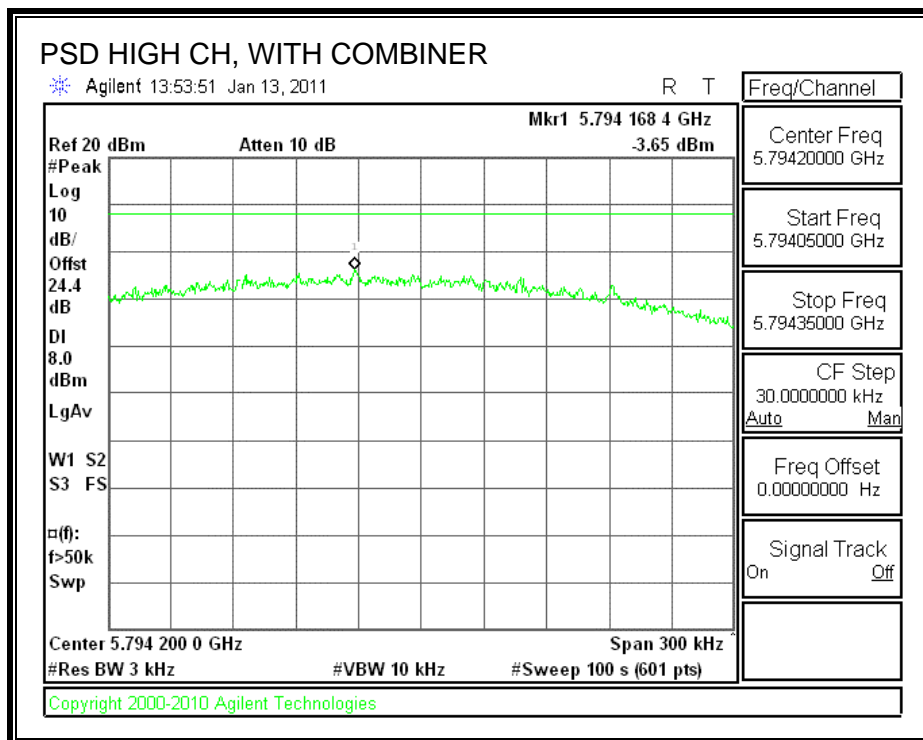
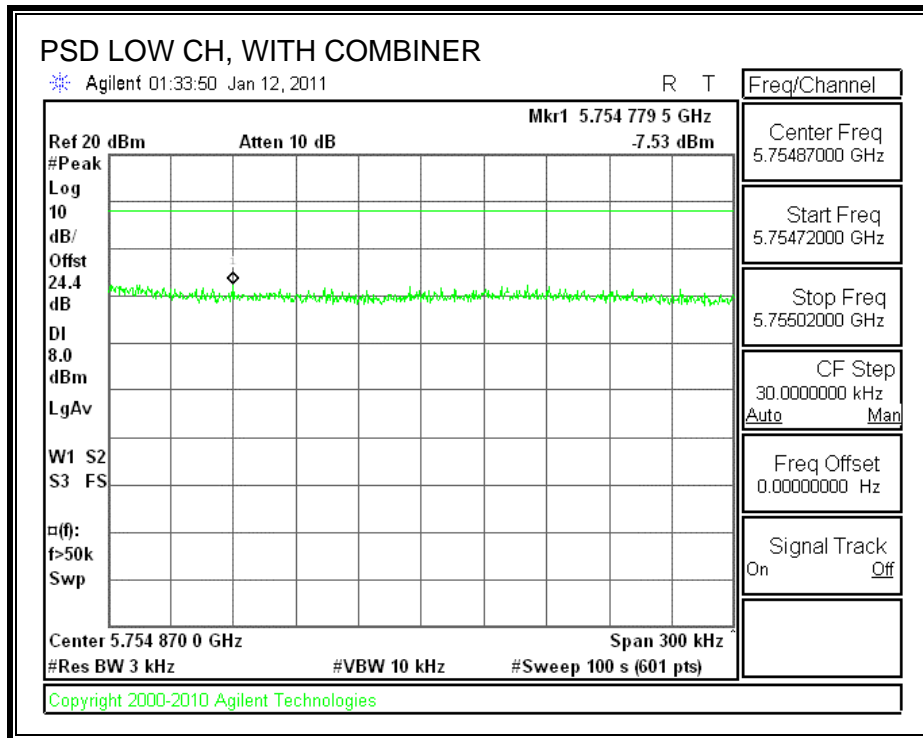
#### TEST PROCEDURE

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)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5755	-7.53	8	-15.53
High	5795	-3.65	8	-11.65

**POWER SPECTRAL DENSITY, WITH COMBINER**



## **7.5.5. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of RMS averaging over a time interval, therefore the required attenuation is 30 dB.

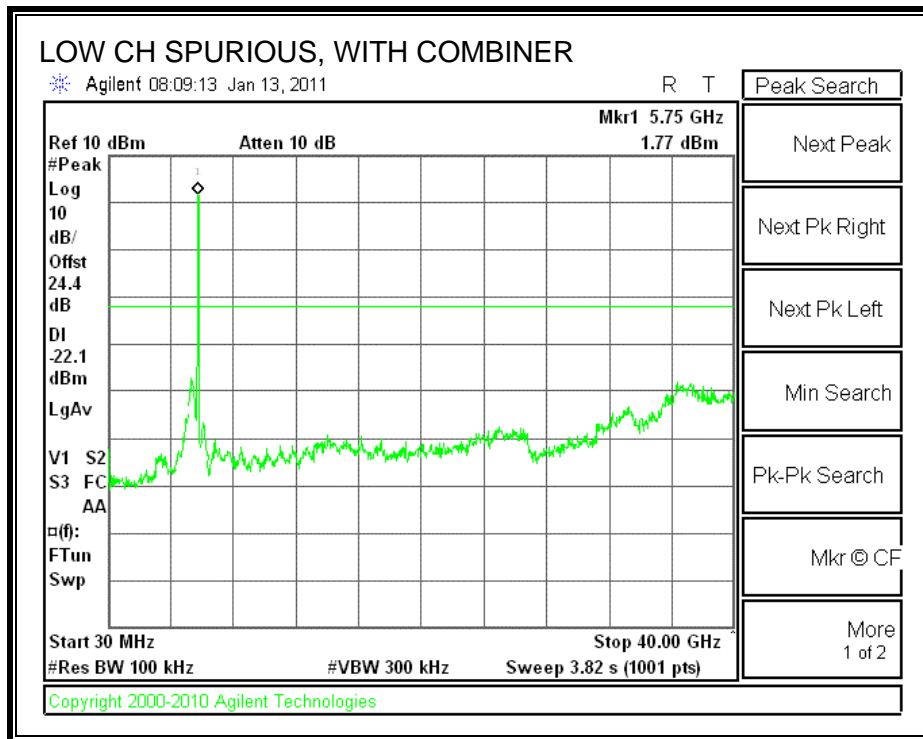
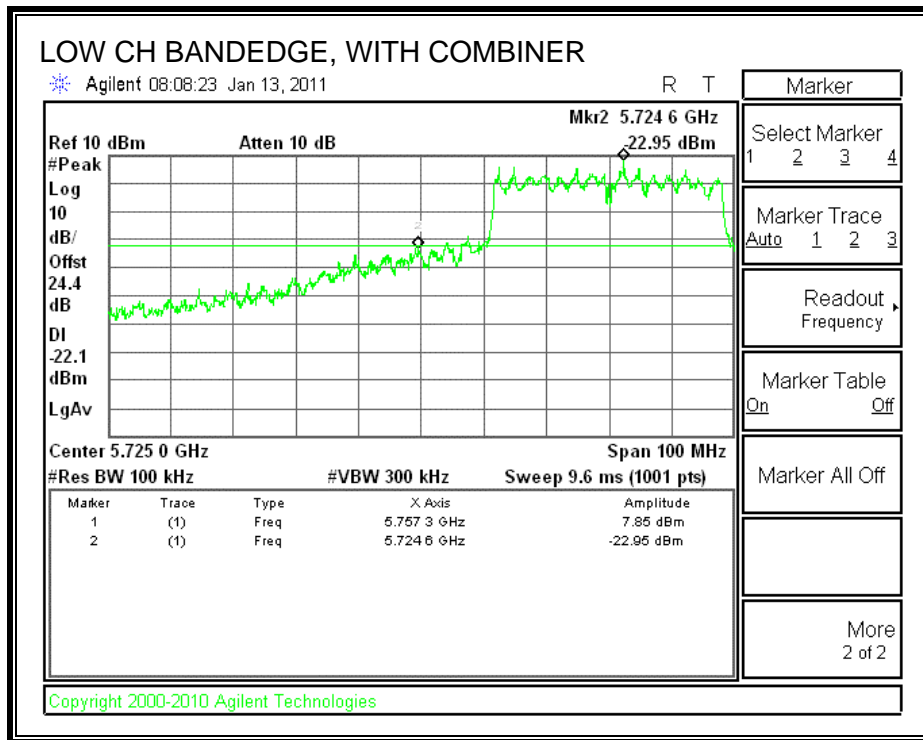
### **TEST PROCEDURE**

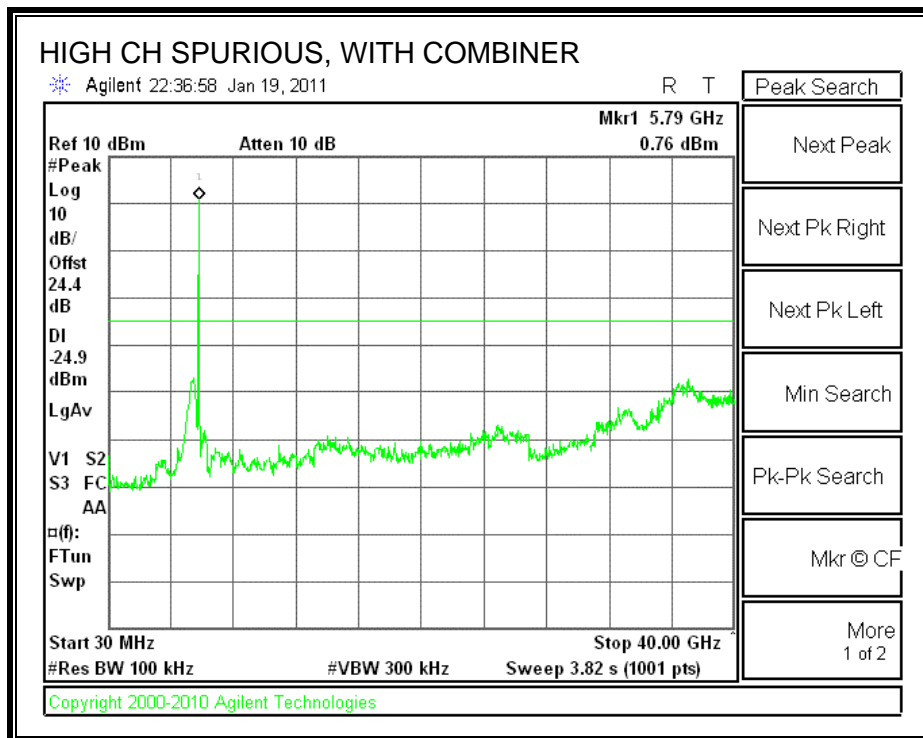
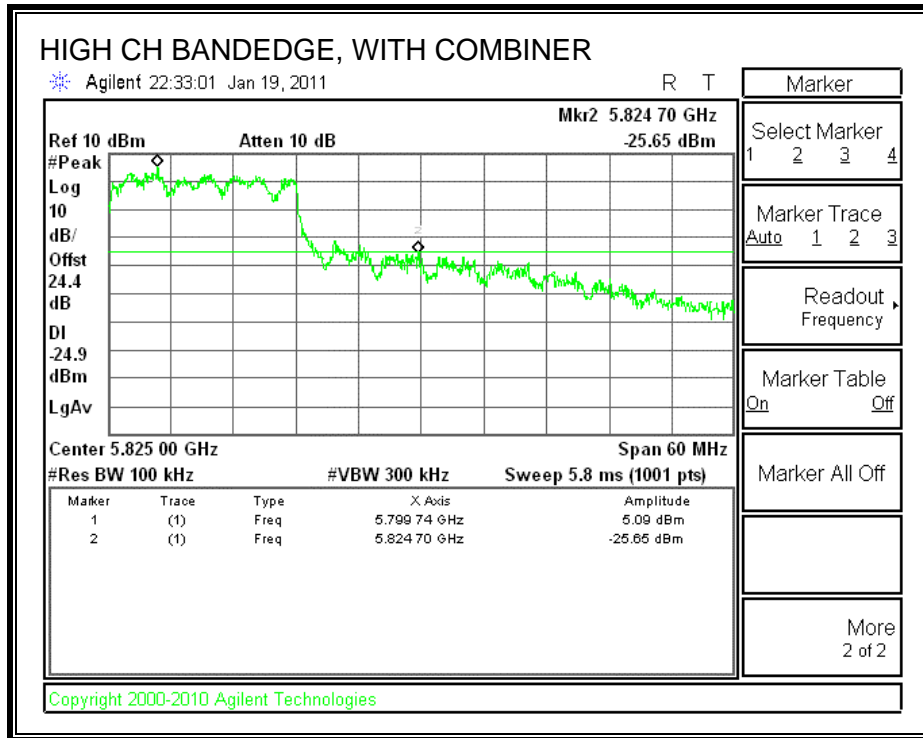
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

### **RESULT**

**SPURIOUS EMISSIONS WITH COMBINER**





## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

#### TEST PROCEDURE

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

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

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

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

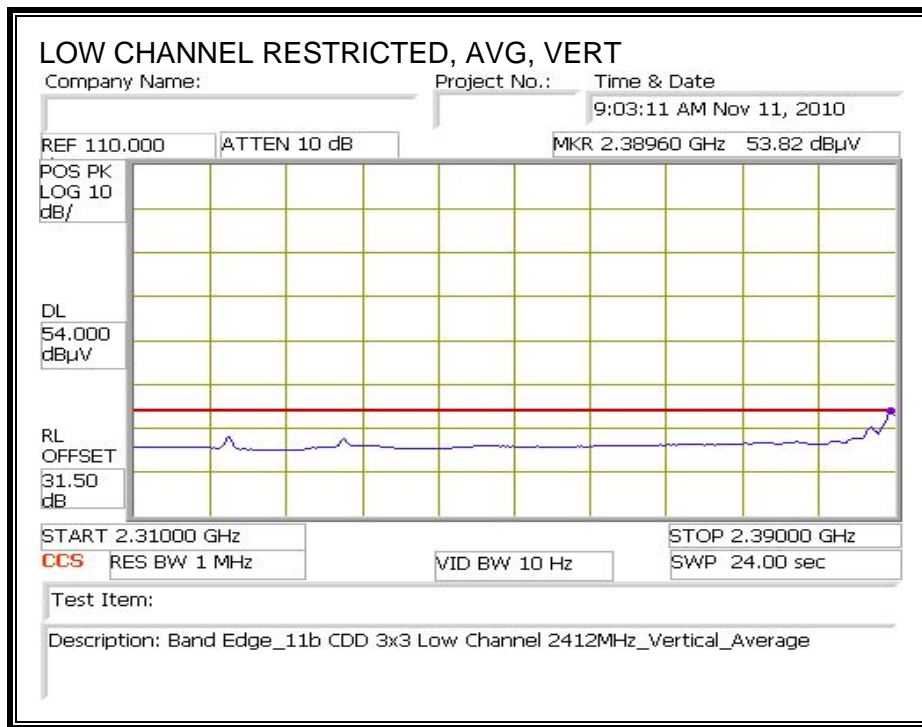
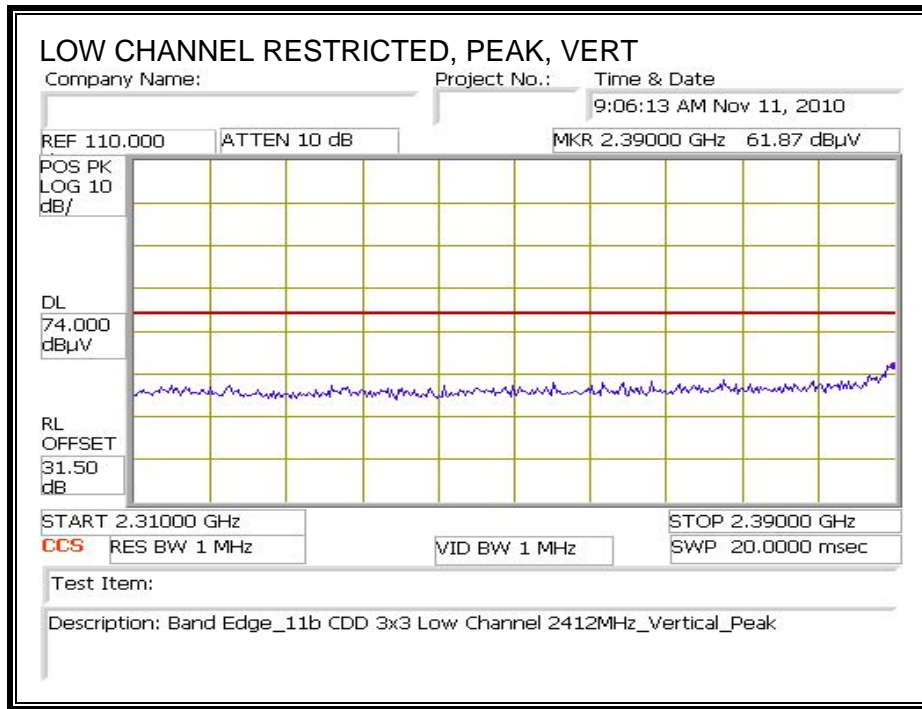
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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

## 8.2. TRANSMITTER ABOVE 1 GHz

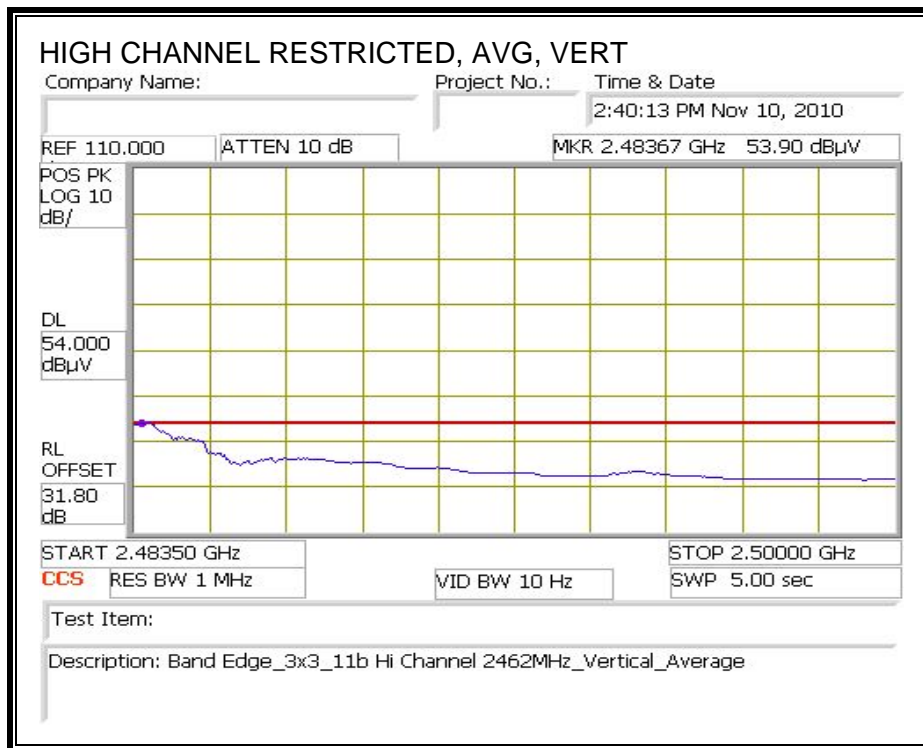
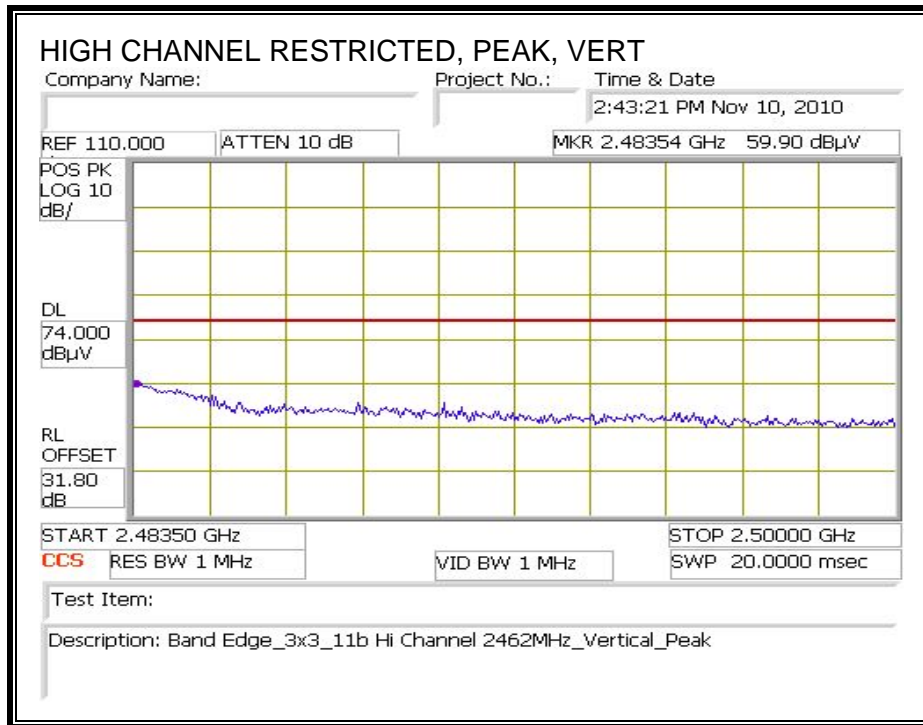
### 8.2.1. 802.11b THREE CHAINS LEGACY MODE IN THE 2.4 GHz BAND

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





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



**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 11/15/10  
 Test Engineer: Vien Tran  
 Configuration: EUT / Laptop / 2.4GHz Antenna  
 Mode: 11b 3x3 CDD

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

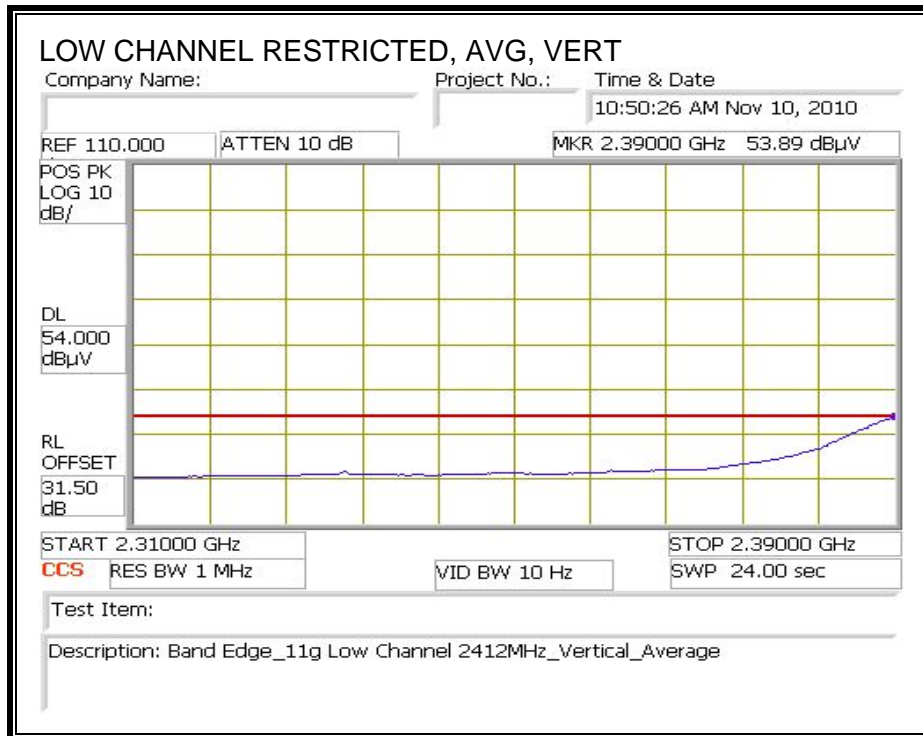
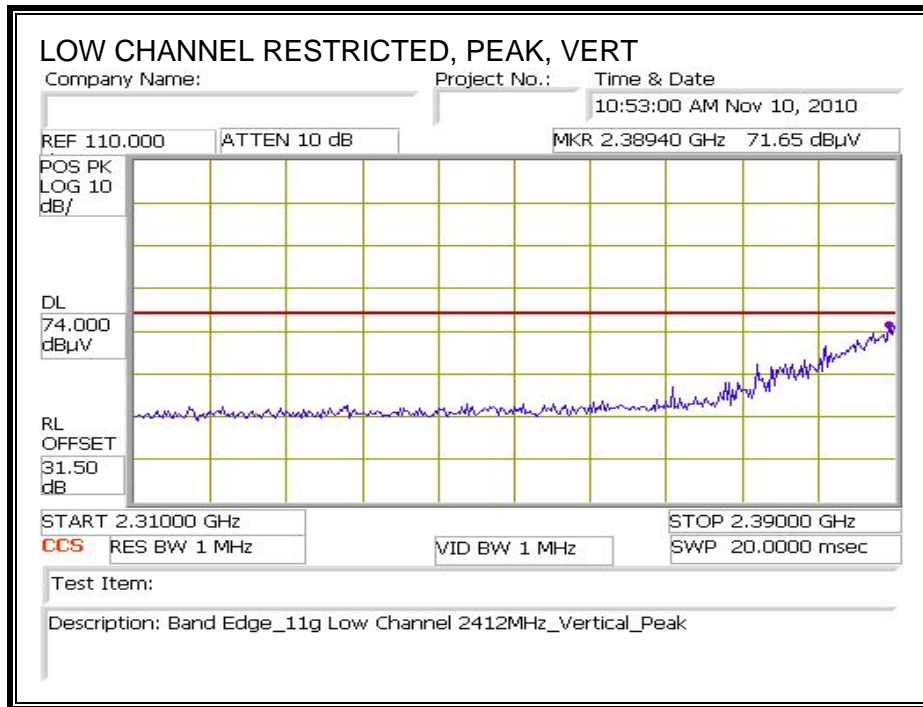
3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001	Average Measurements RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	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, 2412MHz</b>															
4.824	3.0	51.9	49.8	32.7	5.8	-34.8	0.0	0.0	55.5	53.4	74	54	-18.5	-0.6	V
4.824	3.0	49.0	43.0	32.7	5.8	-34.8	0.0	0.0	52.6	46.6	74	54	-21.4	-7.4	H
<b>MID CHANNEL, 2437MHz</b>															
4.874	3.0	48.4	44.1	32.7	5.8	-34.8	0.0	0.0	52.1	47.8	74	54	-21.9	-6.2	V
7.311	3.0	49.3	44.8	35.5	7.3	-34.1	0.0	0.0	58.0	53.4	74	54	-16.0	-0.6	V
4.874	3.0	45.4	41.1	32.7	5.8	-34.8	0.0	0.0	49.1	44.8	74	54	-24.9	-9.2	H
7.311	3.0	42.0	37.9	35.5	7.3	-34.1	0.0	0.0	50.6	46.5	74	54	-23.4	-7.5	H
<b>HIGH CHANNEL, 2462MHz</b>															
4.924	3.0	46.6	43.8	32.7	5.9	-34.8	0.0	0.0	50.4	47.6	74	54	-23.6	-6.4	V
7.386	3.0	49.0	44.9	35.6	7.3	-34.1	0.0	0.0	57.8	53.7	74	54	-16.2	-0.3	V
4.924	3.0	43.1	40.1	32.7	5.9	-34.8	0.0	0.0	46.9	43.9	74	54	-27.1	-10.1	H
7.386	3.0	45.9	39.2	35.6	7.3	-34.1	0.0	0.0	54.7	48.0	74	54	-19.3	-6.0	H

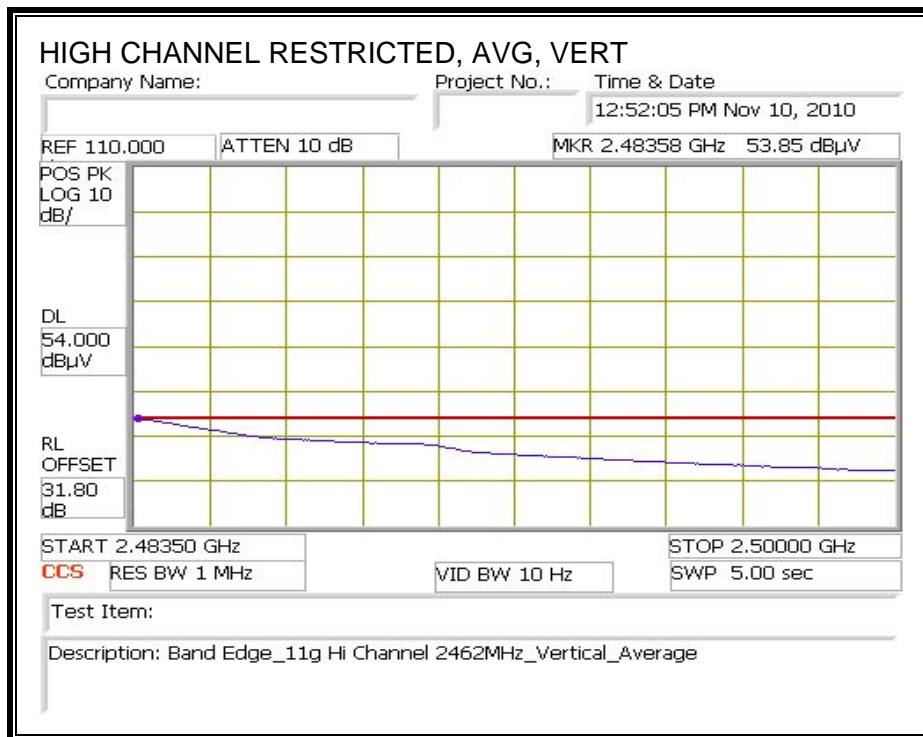
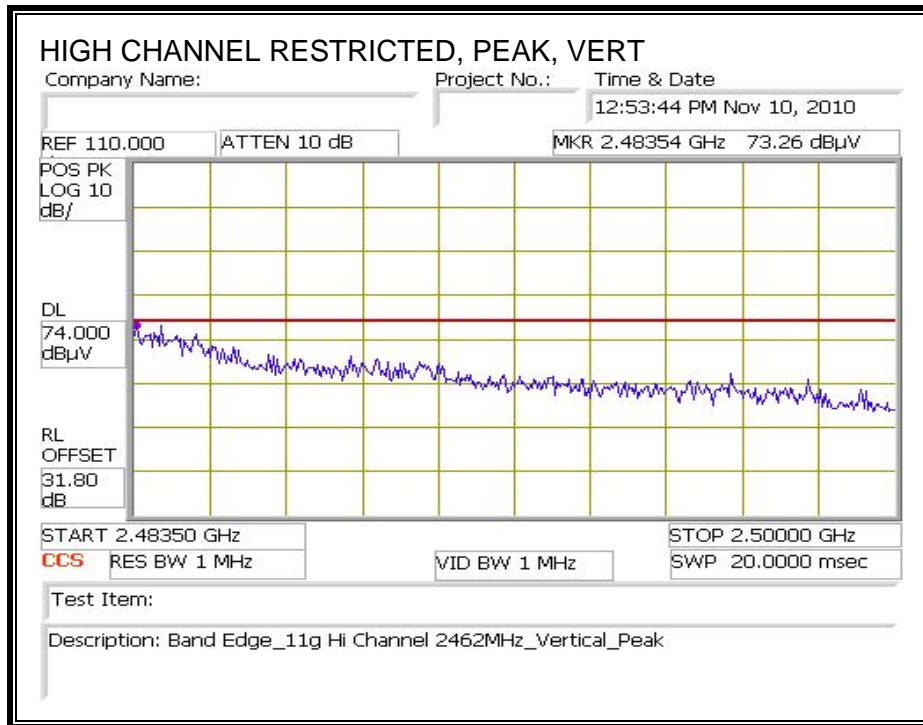
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

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

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



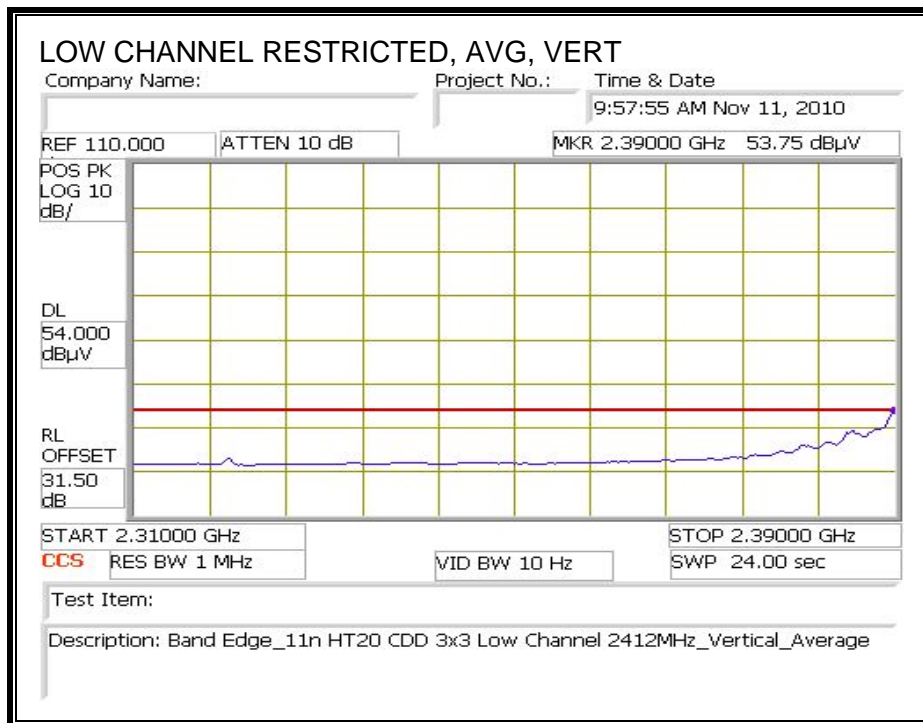
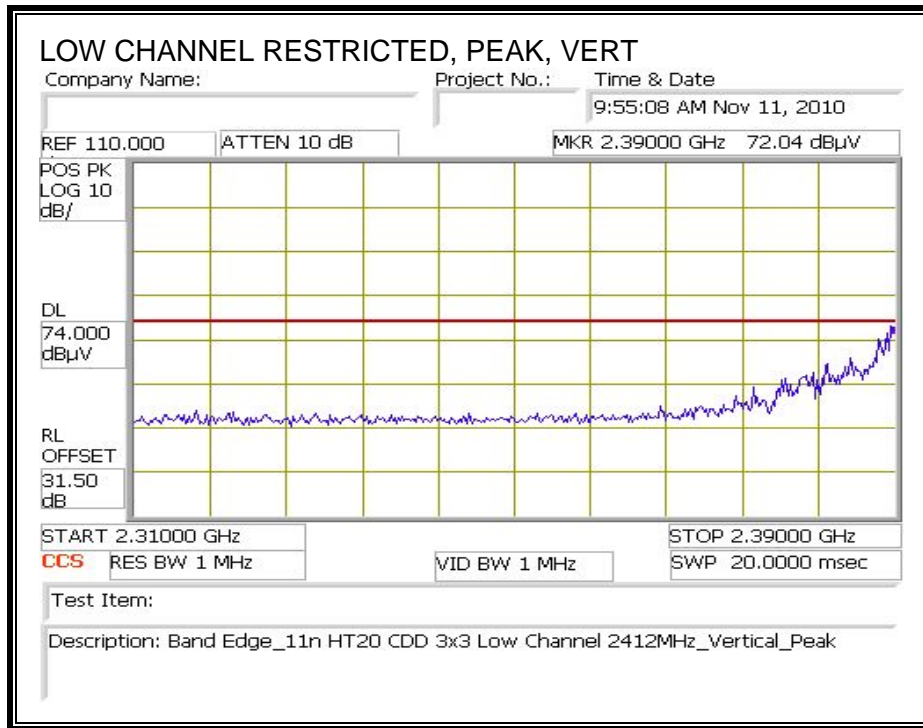
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



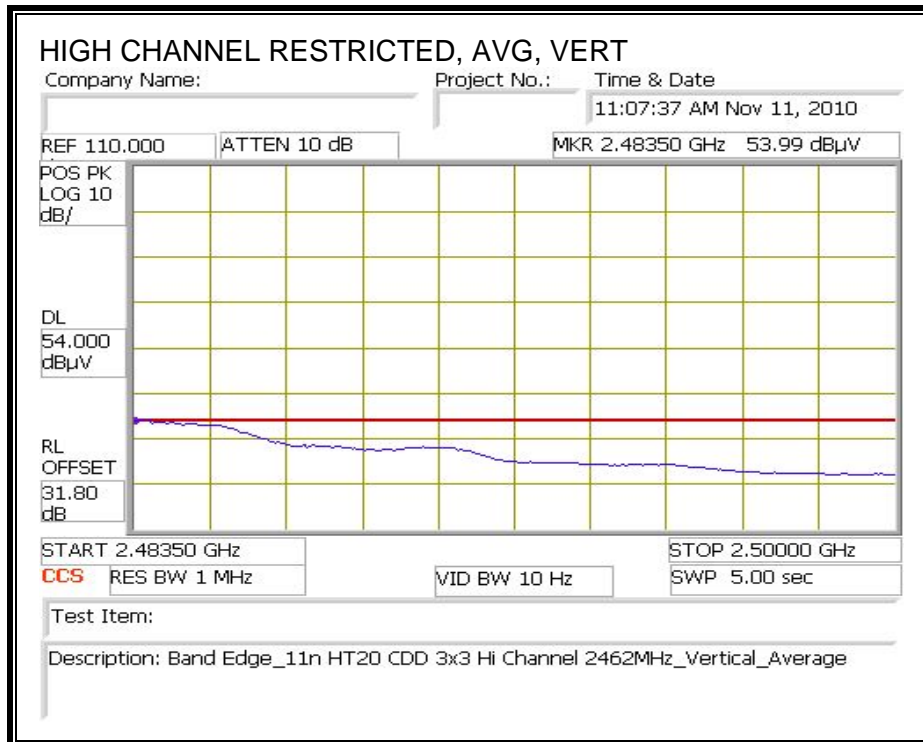
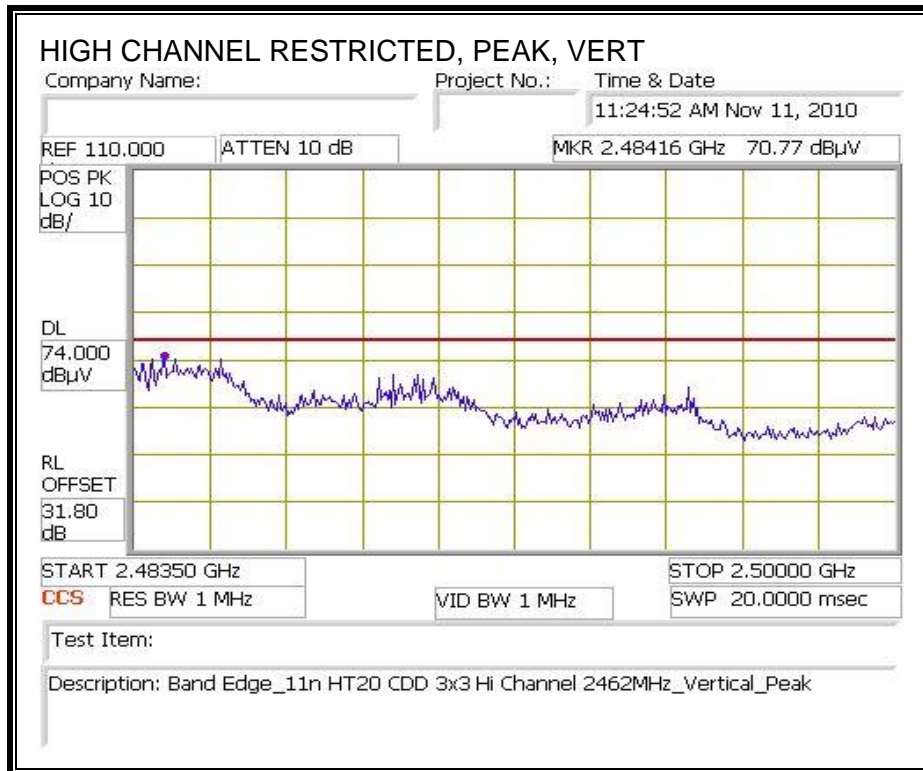
HARMONICS AND SPURIOUS EMISSIONS – Cover by 11n HT20 3x3 CDD which had tested at the worst case of g-mode mid channel output power.

### 8.2.3. 802.11n HT20 THREE CHAINS MIMO MODE IN THE 2.4 GHz BAND

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



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





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 11/15/10  
 Test Engineer: Vien Tran  
 Configuration: EUT / Laptop / 2.4GHz Antenna  
 Mode: 1In HT20 3x3 CDD

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			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	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, 2412MHz</b>															
4.824	3.0	54.5	44.2	32.7	5.8	-34.8	0.0	0.0	58.1	47.8	74	54	-15.9	-6.2	V
4.824	3.0	50.2	39.9	32.7	5.8	-34.8	0.0	0.0	53.8	43.5	74	54	-20.2	-10.5	H
<b>MID CHANNEL, 2437MHz</b>															
4.874	3.0	57.4	43.5	32.7	5.8	-34.8	0.0	0.0	61.1	47.2	74	54	-12.9	-6.8	V
7.311	3.0	56.0	43.6	35.5	7.3	-34.1	0.0	0.0	64.6	52.2	74	54	-9.4	-1.8	V
4.874	3.0	54.4	40.1	32.7	5.8	-34.8	0.0	0.0	58.1	43.8	74	54	-15.9	-10.2	H
7.311	3.0	51.2	38.1	35.5	7.3	-34.1	0.0	0.0	59.8	46.7	74	54	-14.2	-7.3	H
<b>HIGH CHANNEL, 2462MHz</b>															
4.924	3.0	54.3	43.3	32.7	5.9	-34.8	0.0	0.0	58.1	47.1	74	54	-15.9	-6.9	V
7.386	3.0	53.3	44.9	35.6	7.3	-34.1	0.0	0.0	62.1	53.7	74	54	-11.9	-0.3	V
4.924	3.0	50.8	40.2	32.7	5.9	-34.8	0.0	0.0	54.6	44.0	74	54	-19.4	-10.0	H
7.386	3.0	46.2	37.2	35.6	7.3	-34.1	0.0	0.0	55.0	46.0	74	54	-19.0	-8.0	H

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		

Test with the highest output power of g-mode mid channel as worst case for this mode HT20 3x3 CDD.

### 8.2.4. 802.11n HT20 THREE CHAINS MIMO MODE IN THE 5.8 GHz BAND

#### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 11/18/10  
 Test Engineer: Vien Tran  
 Configuration: EUT / Laptop / 5.8GHz Antenna  
 Mode: Tx 5.8GHz Band\_11n HT20 3x3 CDD

**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>
T60; S/N: 2238 @3m	T34 HP 8449B			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 (149), 5745MHz</b>															
11.490	3.0	43.5	32.7	38.0	9.5	-32.5	0.0	0.0	58.5	47.7	74	54	-15.5	-6.3	V
11.490	3.0	39.4	28.3	38.0	9.5	-32.5	0.0	0.0	54.4	43.3	74	54	-19.6	-10.7	H
<b>MID CHANNEL (157), 5785MHz</b>															
11.200	3.0	50.9	39.0	37.8	9.3	-32.6	0.0	0.0	65.4	53.5	74	54	-8.6	-0.5	V
11.200	3.0	45.2	34.4	37.8	9.3	-32.6	0.0	0.0	59.7	48.9	74	54	-14.3	-5.1	H
<b>HIGH CHANNEL (167), 5825MHz</b>															
11.400	3.0	44.8	32.6	38.0	9.4	-32.5	0.0	0.0	59.6	47.4	74	54	-14.4	-6.6	V
11.400	3.0	40.1	29.2	38.0	9.4	-32.5	0.0	0.0	54.9	44.0	74	54	-19.1	-10.0	H

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		



### 8.2.5. 802.11n HT40 THREE CHAINS MIMO MODE IN THE 5.8 GHz BAND

#### HARMONICS AND SPURIOUS EMISSIONS

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 12/22/10  
 Test Engineer: Vien Tran  
 Configuration: EUT / Laptop / 5.8GHz Antenna  
 Mode: Tx 5.8GHz Band\_11n HT40 3x3 CDD

**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>
T59; S/N: 3245 @3m	T145 Agilent 3008A005			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	HPF_7.6GHz		<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 (151), 5755MHz</b>															
11.510	3.0	42.8	30.4	38.1	9.5	-33.1	0.0	0.7	58.0	45.6	74	54	-16.0	-8.4	V
<b>HIGH CHANNEL (159), 5975MHz</b>															
11.590	3.0	48.8	37.3	38.2	9.5	-33.0	0.0	0.7	64.2	52.7	74	54	-9.8	-1.3	V

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. 20 MHz BANDWIDTH

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 12/23/10  
 Test Engineer: Mengistu Mekuria  
 Configuration: EUT / Laptop  
 Mode: Rx Mode\_20MHz Bandwidth

**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	T145 Agilent 3008A005			RX RSS 210

**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)
1.320	3.0	55.7	35.8	24.9	2.7	-35.9	0.0	0.0	47.4	27.6	74	54	-26.6	-26.4	H
1.595	3.0	53.4	37.8	25.9	3.0	-35.7	0.0	0.0	46.6	31.0	74	54	-27.4	-23.0	H
1.795	3.0	52.9	35.1	26.5	3.2	-35.5	0.0	0.0	47.1	29.3	74	54	-26.9	-24.7	H
2.500	3.0	53.8	33.0	28.5	3.9	-35.1	0.0	0.0	51.1	30.4	74	54	-22.9	-23.6	H
5.000	3.0	48.3	27.3	33.2	5.9	-34.9	0.0	0.0	52.6	31.6	74	54	-21.4	-22.4	H
1.035	3.0	55.6	38.7	24.0	2.4	-36.1	0.0	0.0	45.9	29.0	74	54	-28.1	-25.0	V
1.106	3.0	57.4	41.5	24.2	2.5	-36.1	0.0	0.0	48.0	32.2	74	54	-26.0	-21.8	V
1.795	3.0	53.3	34.9	26.5	3.2	-35.5	0.0	0.0	47.5	29.2	74	54	-26.5	-24.8	V
2.490	3.0	55.2	33.5	28.5	3.9	-35.1	0.0	0.0	52.5	30.8	74	54	-21.5	-23.2	V
5.000	3.0	51.5	27.9	33.2	5.9	-34.9	0.0	0.0	55.8	32.2	74	54	-18.2	-21.8	V

No other emissions were detected above system noise floor

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		

### 8.3.2. 40 MHz BANDWIDTH

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 3m Chamber

Company: Broadcom  
 Project #: 10U13492  
 Date: 12/23/10  
 Test Engineer: Mengistu Mekuria  
 Configuration: EUT / Laptop  
 Mode: Rx Mode\_40MHz Bandwidth

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @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)
1.395	3.0	56.0	34.4	25.8	2.8	-37.7	0.0	0.0	46.9	25.3	74	54	-27.1	-28.7	H
1.595	3.0	54.3	38.5	26.5	3.0	-37.4	0.0	0.0	46.3	30.5	74	54	-27.7	-23.5	H
1.795	3.0	53.8	35.7	27.1	3.2	-37.2	0.0	0.0	47.0	28.9	74	54	-27.0	-25.1	H
2.500	3.0	54.3	34.0	28.3	3.9	-36.3	0.0	0.0	50.3	30.0	74	54	-23.7	-24.0	H
5.000	3.0	47.2	28.1	32.8	5.9	-34.8	0.0	0.0	51.2	32.1	74	54	-22.8	-21.9	H
1.105	3.0	58.9	43.0	24.8	2.5	-38.1	0.0	0.0	48.1	32.2	74	54	-25.9	-21.8	V
1.655	3.0	55.4	38.2	26.7	3.1	-37.4	0.0	0.0	47.8	30.6	74	54	-26.2	-23.4	V
2.125	3.0	56.7	36.3	27.9	3.6	-36.7	0.0	0.0	51.5	31.1	74	54	-22.5	-22.9	V
2.490	3.0	55.9	34.2	28.3	3.9	-36.3	0.0	0.0	51.8	30.1	74	54	-22.2	-23.9	V
5.000	3.0	52.1	34.4	32.8	5.9	-34.8	0.0	0.0	56.0	38.4	74	54	-18.0	-15.6	V

No other emissions were detected above system noise floor

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 AND VERTICAL DATA

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

Test Engr: MENGISTU MEKURIA  
 Date: 12/23/10  
 Project #: 10U13492  
 Company: BROADCOM  
 Test Target: FCC CLASS B  
 Mode Oper: TX MODE

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

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
233.168	3.0	52.9	11.9	1.3	28.2	0.0	0.0	37.9	46.0	-8.1	H	P	
240.009	3.0	52.7	11.8	1.3	28.2	0.0	0.0	37.7	46.0	-8.3	H	P	
499.819	3.0	46.0	16.7	2.0	27.8	0.0	0.0	37.0	46.0	-9.0	H	P	
587.063	3.0	44.4	18.2	2.2	27.6	0.0	0.0	37.3	46.0	-8.7	H	P	
597.143	3.0	44.0	18.4	2.2	27.5	0.0	0.0	37.1	46.0	-8.9	H	P	
720.028	3.0	40.9	19.9	2.5	27.2	0.0	0.0	36.0	46.0	-10.0	H	P	
895.716	3.0	38.3	21.8	2.8	27.8	0.0	0.0	35.1	46.0	-10.9	H	P	
158.525	3.0	53.7	11.8	1.1	28.3	0.0	0.0	38.4	43.5	-5.1	V	P	
346.693	3.0	49.1	14.1	1.7	28.1	0.0	0.0	36.8	46.0	-9.2	V	P	
381.374	3.0	45.2	14.6	1.8	28.1	0.0	0.0	33.5	46.0	-12.5	V	P	
499.579	3.0	42.3	16.7	2.0	27.8	0.0	0.0	33.2	46.0	-12.8	V	P	
566.422	3.0	42.9	17.9	2.2	27.6	0.0	0.0	35.3	46.0	-10.7	V	P	
693.147	3.0	39.0	19.5	2.4	27.2	0.0	0.0	33.7	46.0	-12.3	V	P	

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

## 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

\* Decreases with the logarithm of the frequency.

### TEST PROCEDURE

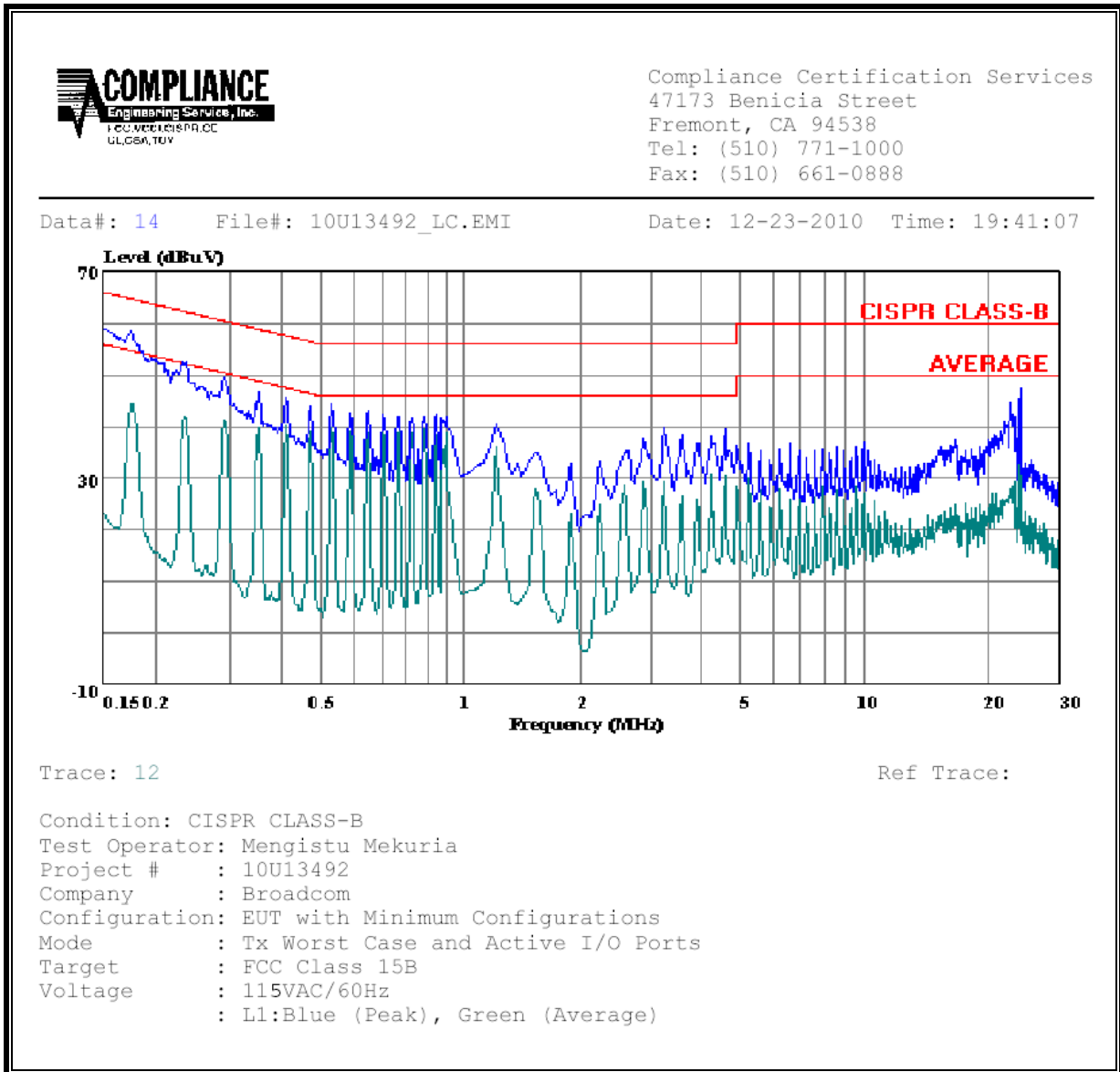
ANSI C63.4

### RESULTS

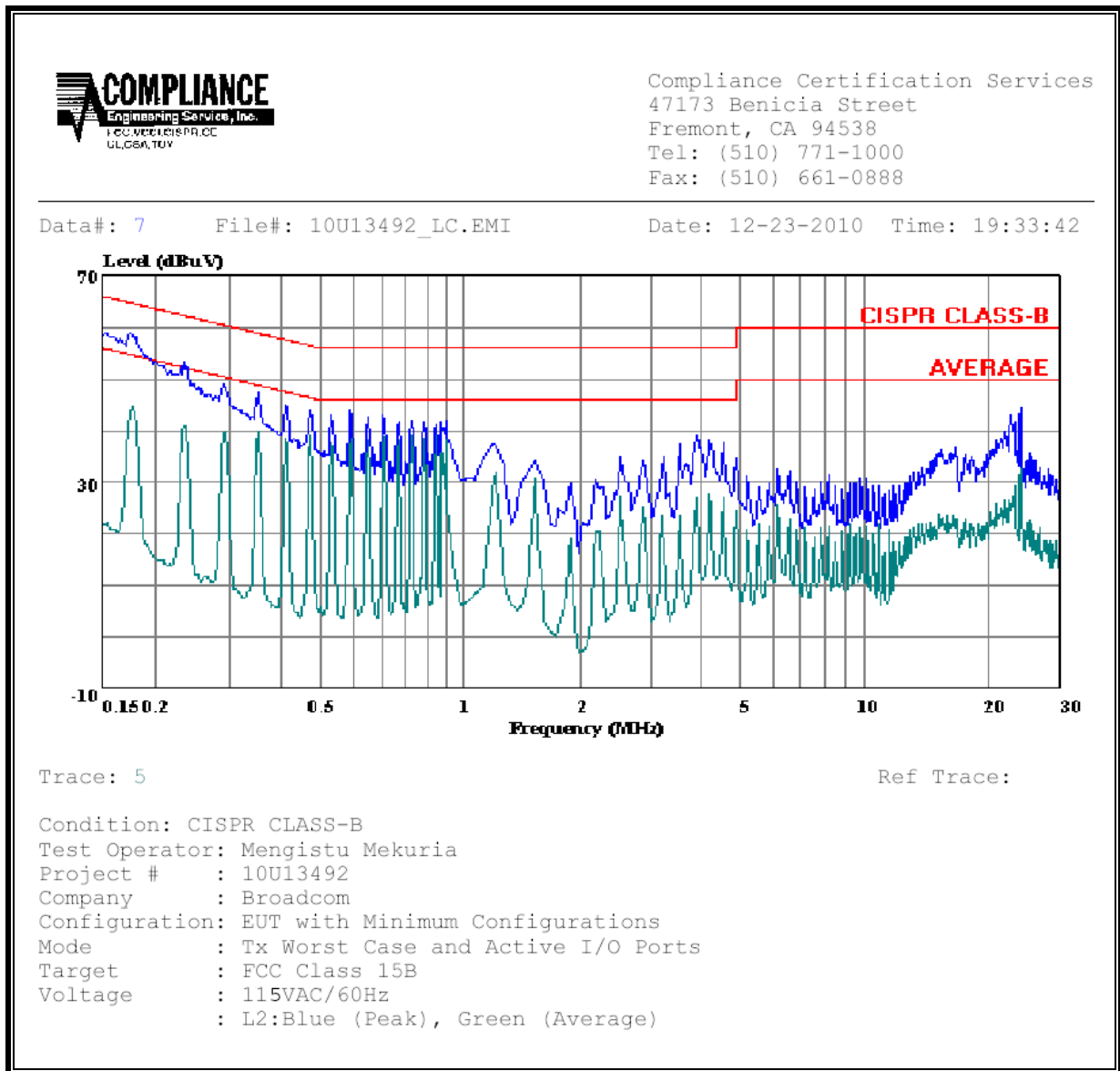
**6 WORST EMISSIONS**

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Class	Limit	EN B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.17	58.99	--	44.66	0.00	64.77	54.77	-5.78	-10.11	L1
0.23	53.31	--	40.82	0.00	62.31	52.31	-9.00	-11.49	L1
0.29	49.37	--	39.80	0.00	60.50	50.50	-11.13	-10.70	L1
0.17	58.41	--	44.41	0.00	64.77	54.77	-6.36	-10.36	L2
0.23	52.82	--	41.82	0.00	62.38	52.38	-9.56	-10.56	L2
0.29	49.57	--	41.22	0.00	60.50	50.50	-10.93	-9.28	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 <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>

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

where

DC = Duty Cycle in %, as applicable  
EIRP = Equivalent Isotropic Radiated Power in W

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.

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

where

P<sub>x</sub> = Power of transmitter x  
G<sub>x</sub> = Numeric gain of antenna x

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply, a fraction of the exposure limit is established for each band, such that the sum of the fractions is less than or equal to one.

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

## 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 (MHz)	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2400 to 2483.5 MHz Authorized Band						
2412 - 2462	802.11b Three Chains CDD Legacy	0.20	25.84	9.68	7.09	0.709
2412 - 2462	802.11g Legacy	0.20	27.79	5.65	4.39	0.439
2412 - 2462	802.11n Three Chains 20MHz CDD	0.20	26.07	9.68	7.48	0.748
5725 to 5850 MHz Authorized Band						
5745 - 5825	802.11n Three Chains 20MHz CDD	0.20	25.17	11.27	8.77	0.877
5755 - 5795	802.11n Three Chains 40MHz CDD	0.20	20.79	11.27	3.20	0.320

**CO-LOCATED RESULTS**

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	Bluetooth		-0.60	-2.95	100		
2.4 GHz	WLAN		26.07	9.68	100		
Combined		0.20				7.48	0.748

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	Bluetooth		-0.60	-2.95	100		
5 GHz	WLAN		25.17	11.27	100		
Combined		0.20				8.77	0.877