



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

**CERTIFICATION TEST REPORT**

**FOR**

**ACCESS POINT**

**MODEL NUMBER: A1302**

**FCC ID: BCGA1302  
IC: 579C-A1302**

**REPORT NUMBER: 08U12087-1, Revision A**

**ISSUE DATE: FEBRUARY 06, 2009**

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**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
--	01/19/09	Initial Issue	F. Ibrahim
A	02/06/09	Revised Maximum Output Power section, revised section 7.5.2 for 99% plots, revised MPE section and antenna gains throughout the report	F. Ibrahim

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITY LOOP  
CUPERTINO, CALIFORNIA 95014, U.S.A.

**EUT DESCRIPTION:** ACCESS POINT

**MODEL:** A1302

**SERIAL NUMBER:** 6F83504X2UJ

**DATE TESTED:** SEPTEMBER 10 – JANUARY 15, 2009

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:



FRANK IBRAHIM  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

Tested By:



THANH NGUYEN  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

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

## 3. FACILITIES AND ACCREDITATION

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

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

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

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

### 4.2. MEASUREMENT UNCERTAINTY

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

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

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an 802.11a/b/g/n transceiver Access Point.

The radio module is manufactured by Ambit subsidiary of Foxconn, which is located in Hon Hai.

### 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	21.72	148.59
2412 - 2462	802.11g	22.24	167.49
2412 - 2462	802.11n HT20	22.37	172.58
5745 - 5825	802.11a	28.37	687.07
5745 - 5805	802.11n HT20	28.25	668.34
5755 - 5795	802.11n HT40	28.25	668.34

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following PIFA antennas:

Model 631-0878 used for AP1, with a maximum gain of 3.49 dBi in the 2.4 GHz band.

Model 631-0860 used for AP3, with a maximum gain of -0.04 dBi in the 2.4 GHz band.

Model 631-0861 used for AP2, with a maximum gain of 3.62 dBi in the 5.2 GHz band, 3.18 dBi in the 5.3 GHz band, 3.66 dBi in the 5.6 GHz band and 3.4 dBi in the 5.8 GHz band.

Model 631-0859 used for AP4, with a maximum gain of 4.21 dBi in the 5.2 GHz band, 3.78 dBi in the 5.3 GHz band, 3.67 dBi in the 5.6 GHz band, and 2.61 dBi in the 5.8 GHz band.

### 5.4. SOFTWARE AND FIRMWARE

Firmware: k10\_7.4d4auto20080826T0200

EUT Driver Software: ARTR07B13

The test utility software used during testing was ART Build #13, rev. 0.79

## **5.5. WORST-CASE CONFIGURATION AND MODE**

For Radiated Emissions and Power line Conducted Emissions, the channel with the highest conducted output power was selected.

Worst-case data rates as provided by the manufacturer are:

For 11b mode: 1Mbps

For 11g mode: 6Mbps

For 11n HT20 (2.4 GHz band): MCS1

For 11a mode: 6Mbps

For 11n HT20 (5.8 GHz band): MCS1

For 11n HT40 (5.8 GHz band): MCS0

Peak Power Spectral Density was investigated in the 11b mode at Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of PPSD in other channels and modes were performed using a combiner.

RF Conducted Spurious was investigated in the 11b mode for Low Channel, for individual chains versus combiner, and it was determined that the combiner is worst-case; therefore, all other measurements of RF conducted spurious were performed using a combiner.

RF Conducted Spurious was investigated in the 11a mode for Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of RF conducted spurious were performed with combiner in the 5.8 GHz band.



## 5.6. DESCRIPTION OF TEST SETUP

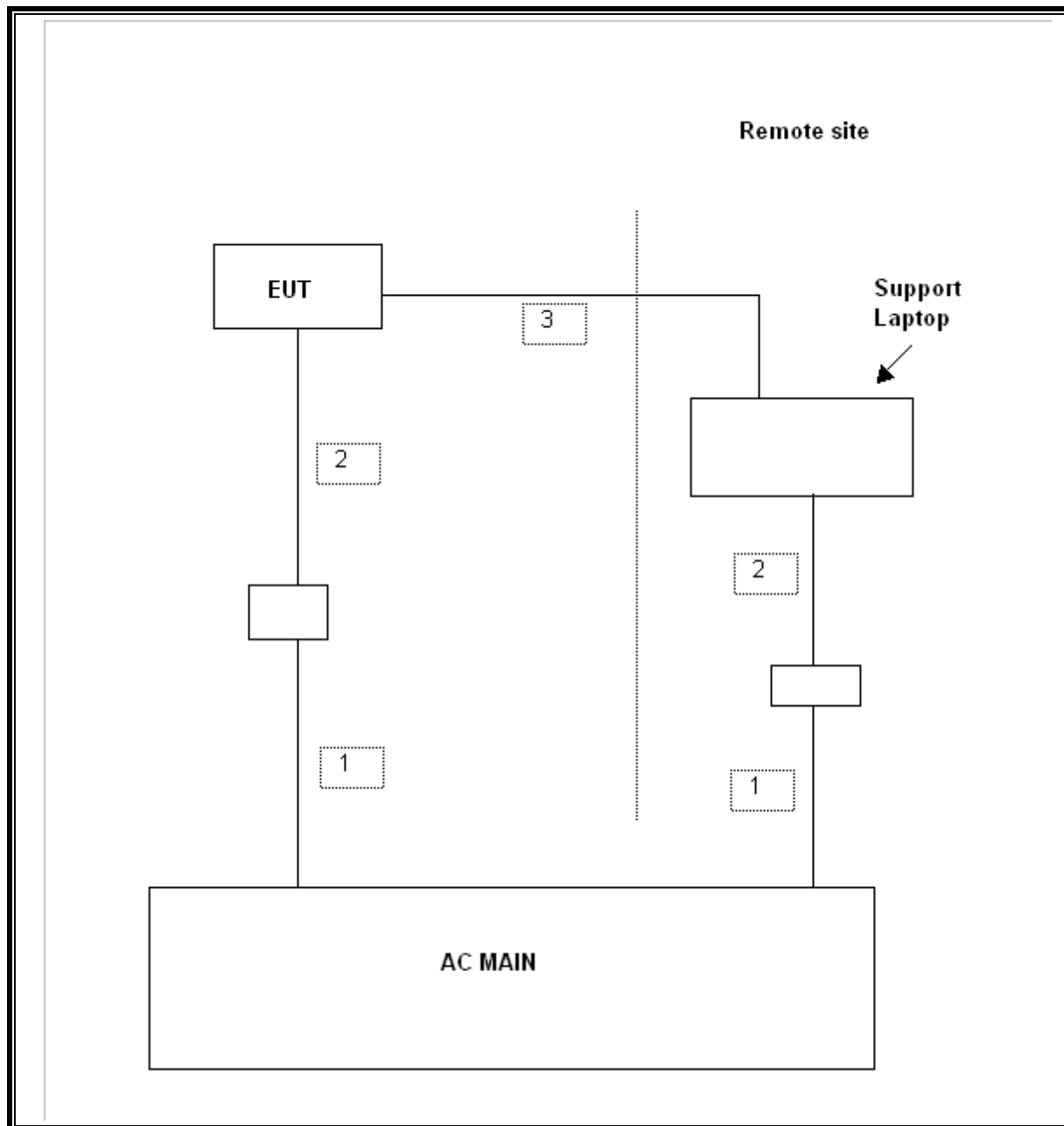
### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	Delta Elect., Inc.	611-0265	EH310BRPP5X	N/A
PowerBook	Apple	MediaMac G4	PT382989	DoC

### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US 115V	Un-shielded	2m	N/A
2	DC	2	DC Plug	Un-shielded	2m	N/A
3	WLAN	1	RJ45	Un-shielded	2m	N/A

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
EMI Test Receiver	Agilent / HP	8542E	C00957	09/12/09
RF Filter Section	Agilent / HP	85420E	C00958	09/12/09
Bilog Antenna	Sunol Sciences	JB1	C01011	01/14/10
Pre-amplifier	Agilent / HP	8447D	C00885	03/31/09
18 GHz Horn Antenna	ETS	3117	C01006	04/22/09
26.5 GHz Amplifier	Agilent / HP	8449B	C01063	09/27/09
4.0 GHz High Pass Filter	Micro-Tronics	HPM13351	N02708	C.N.R.
2.4-2.5 GHz Reject Filter	Micro-Tronics	BRM50702	N02685	C.N.R.
5.725-5.825 GHz Reject Filter	Micro-Tronics	BRC13192	N02676	C.N.R.
Peak Power Meter	Agilent / HP	E4416A	C00963	09/14/09
10 kHz - 30 MHz LISN	FCC	LISN-50/250-25-2	N02625	10/25/09
10 kHz - 30 MHz LISN	Solar	8012-50-R-24-BNC	N02481	10/25/09
EMI Test Receiver	R&S	ESHS 20	N02396	08/06/09
40 GHz Pre-amplifier	Miteq	NSP4000-SP2	C00990	02/04/10
26.5 GHz Horn Antenna	ARA	MWH-1826/B	C00589	01/29/10
40 GHz Horn Antenna	ARA	MWH-2640/B	C00981	04/29/09

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.11b DUAL CHAIN 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.

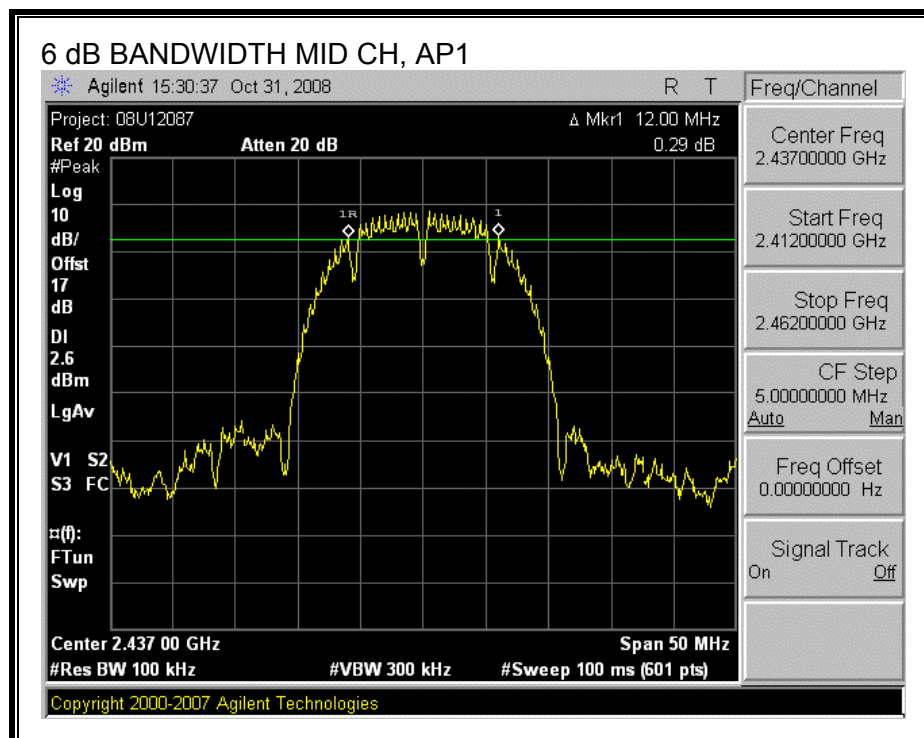
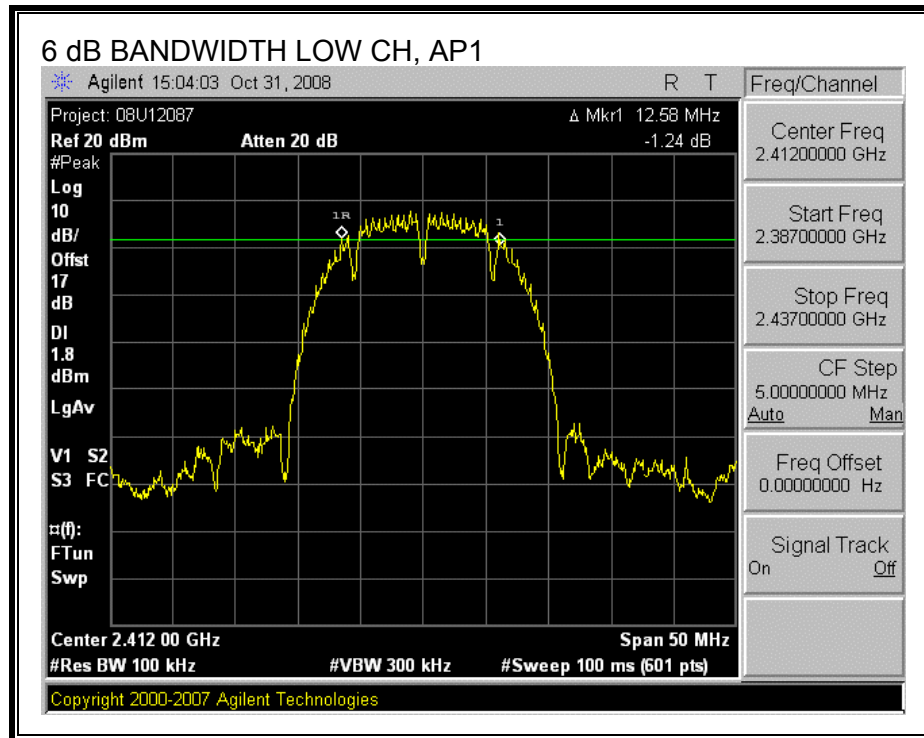
##### TEST PROCEDURE

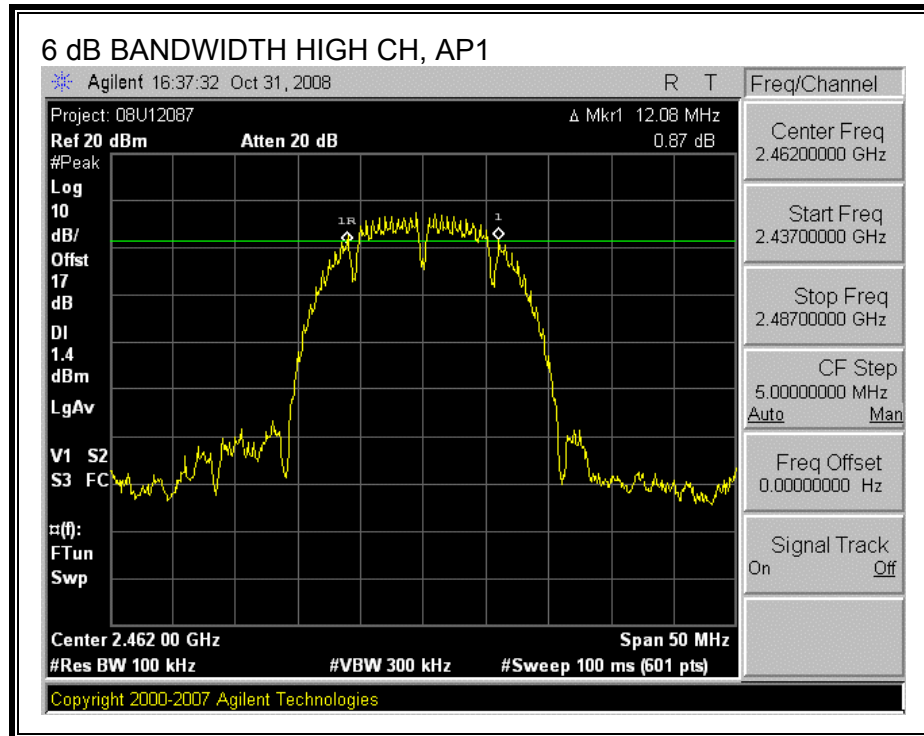
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

##### RESULTS

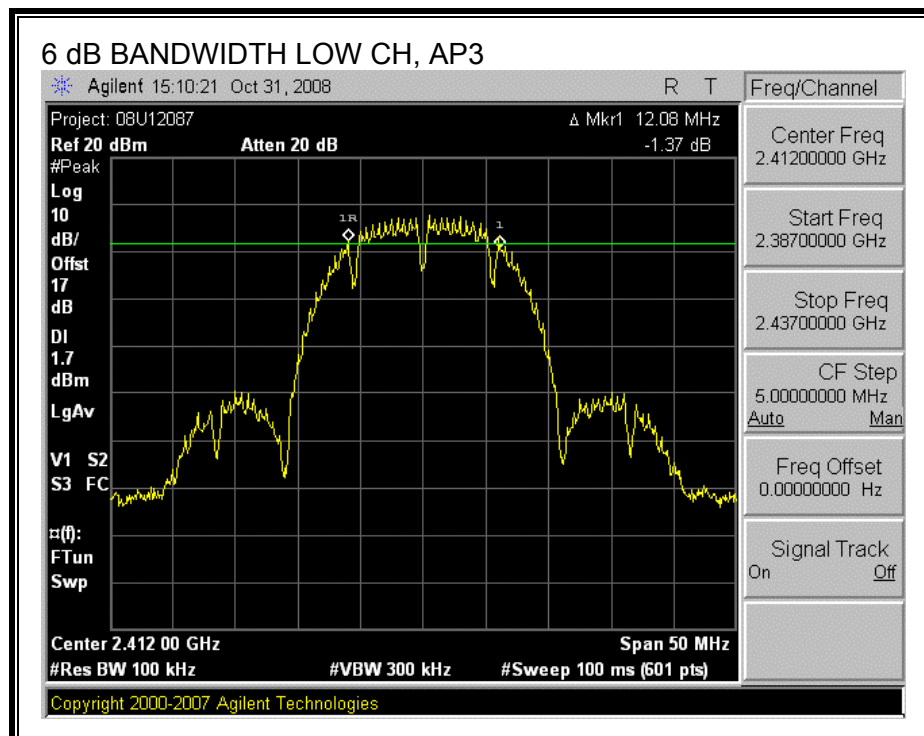
Channel	Frequency (MHz)	AP1 6 dB BW (MHz)	AP3 6 dB BW (MHz)	Minimum Limit (MHz)
Low	2412	12.58	12.08	0.5
Middle	2437	12.00	12.17	0.5
High	2462	12.08	12.08	0.5

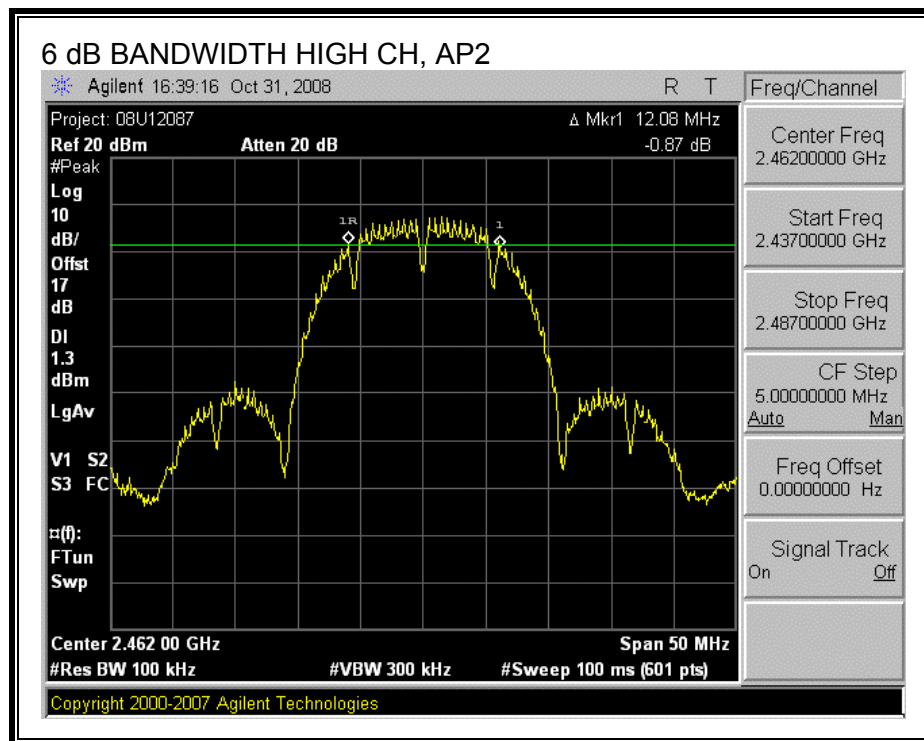
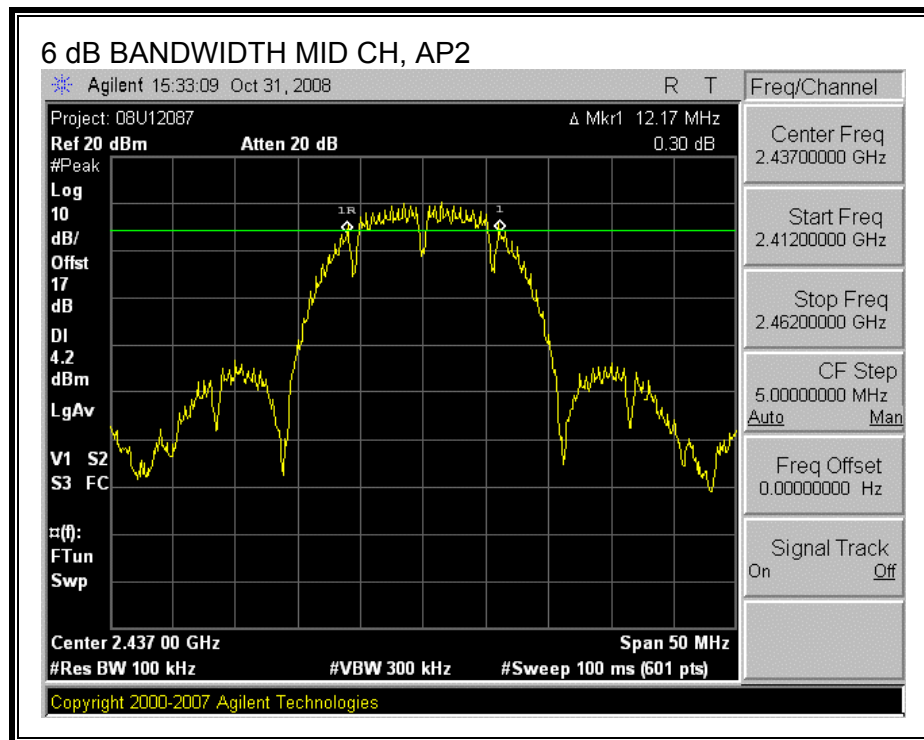
## 6 dB BANDWIDTH, AP1





**6 dB BANDWIDTH, AP3**





## 7.1.2. 26dB and 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 26dB (99 %) bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 26dB (99%) bandwidth function is utilized.

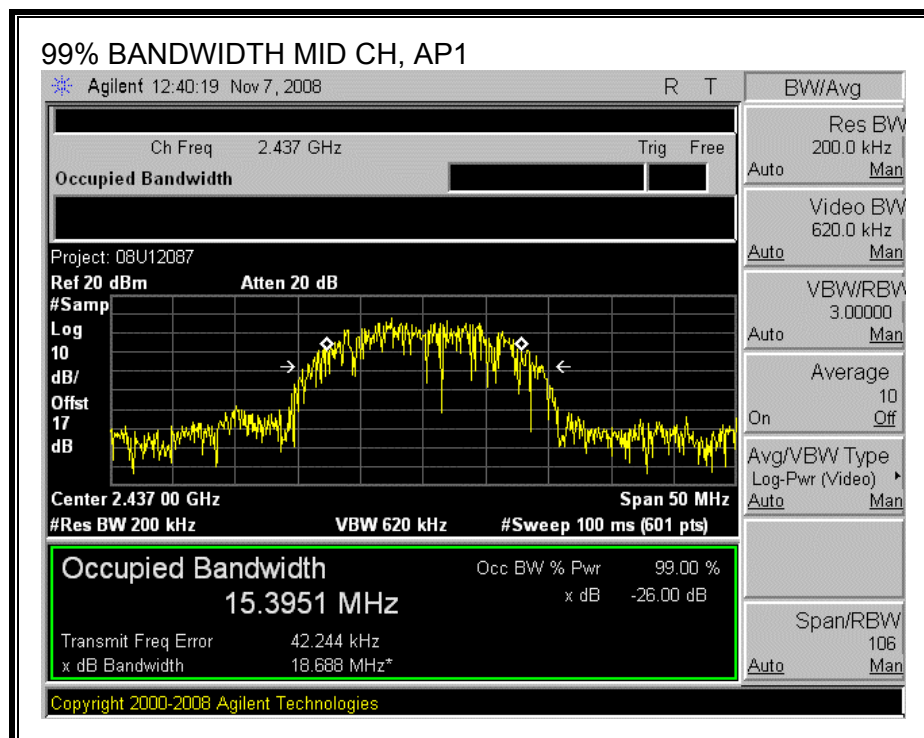
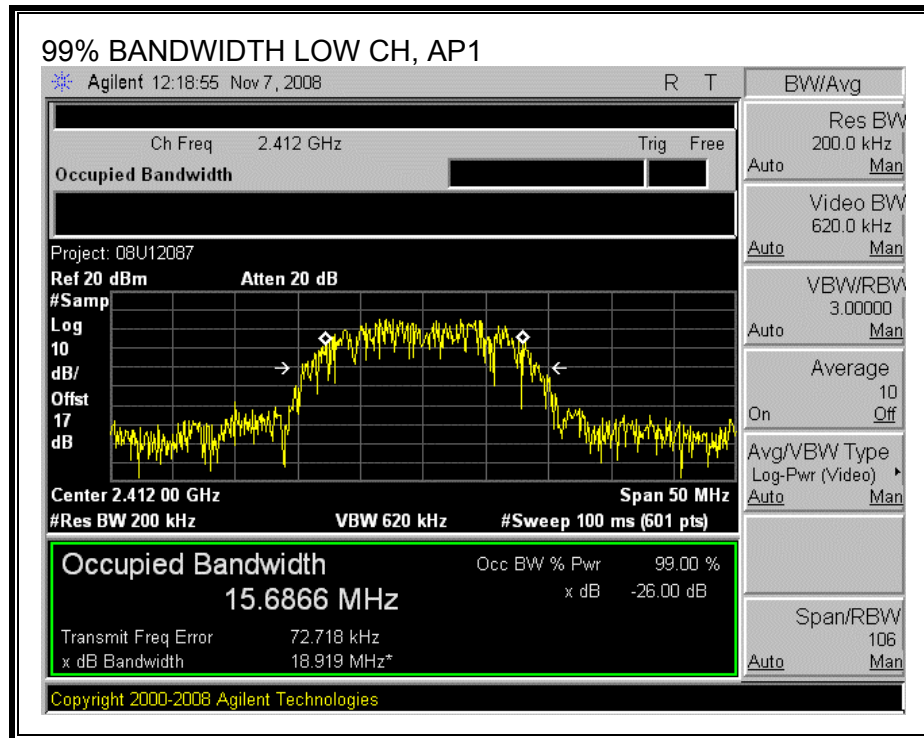
### RESULTS

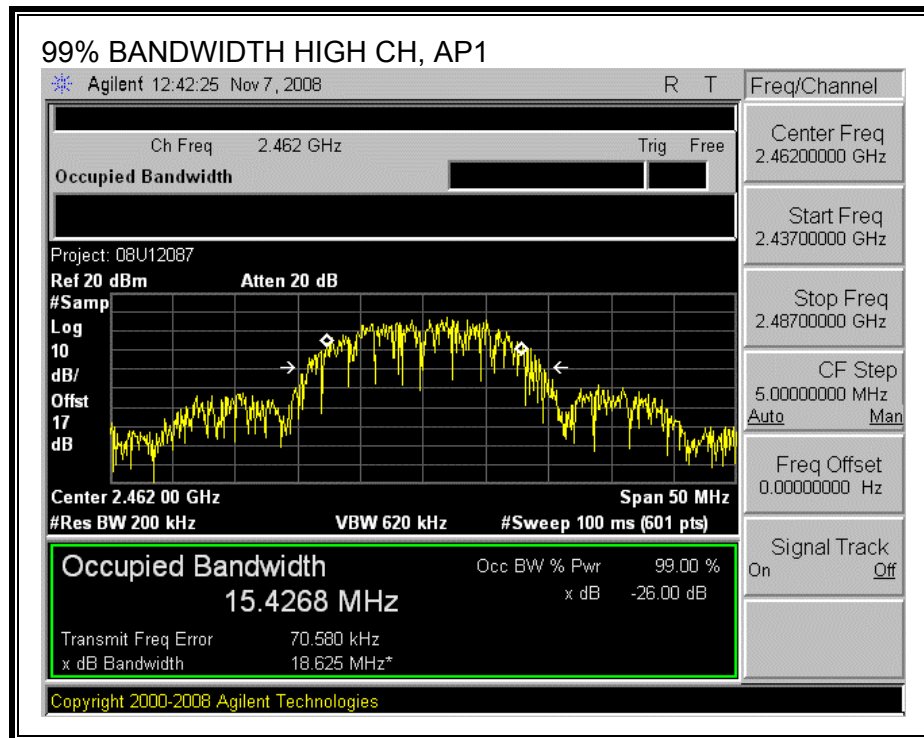
Channel	Frequency (MHz)	AP1 99% Bandwidth (MHz)	AP3 99% Bandwidth (MHz)
Low	2412	15.6866	15.5786
Middle	2437	15.3951	15.7698
High	2462	15.4268	15.4815

Channel	Frequency (MHz)	AP1 26dB Bandwidth (MHz)	AP3 26dB Bandwidth (MHz)
Low	2412	18.919	18.048
Middle	2437	18.688	18.616
High	2462	18.625	18.403

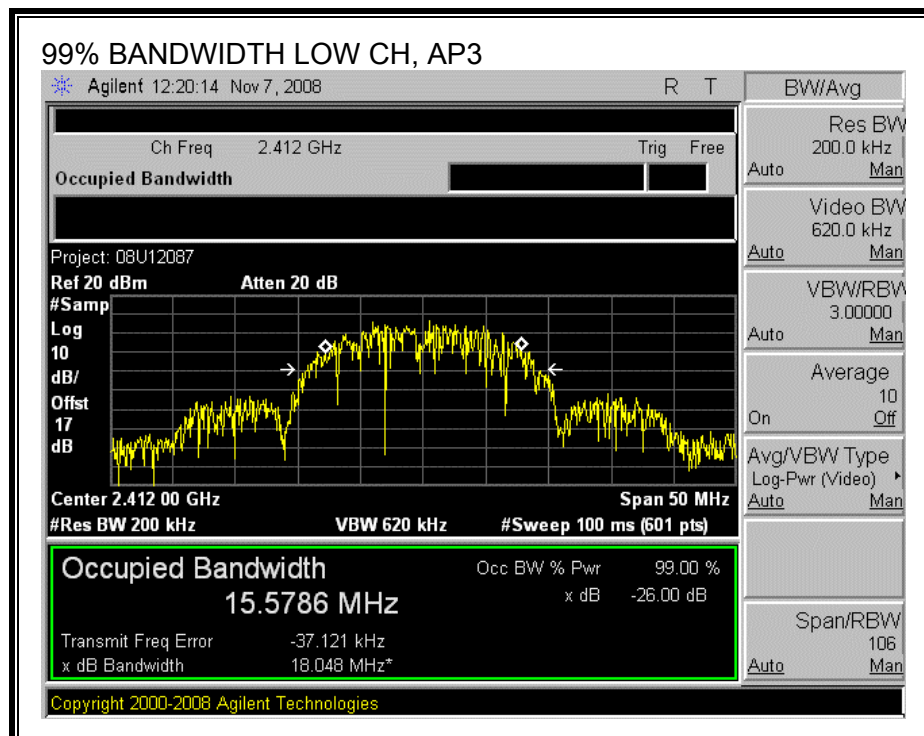


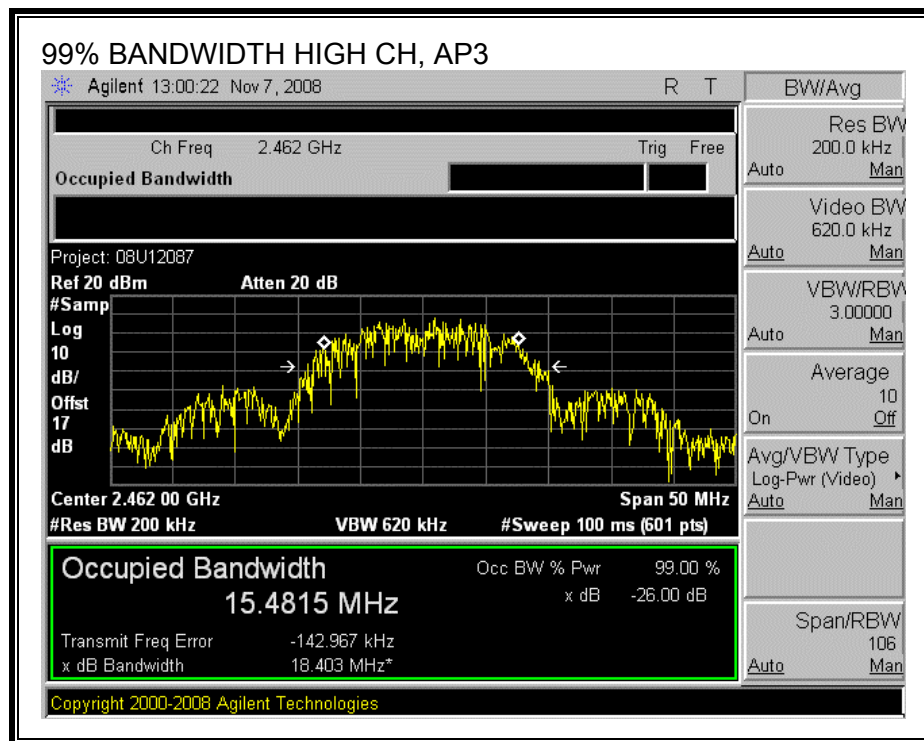
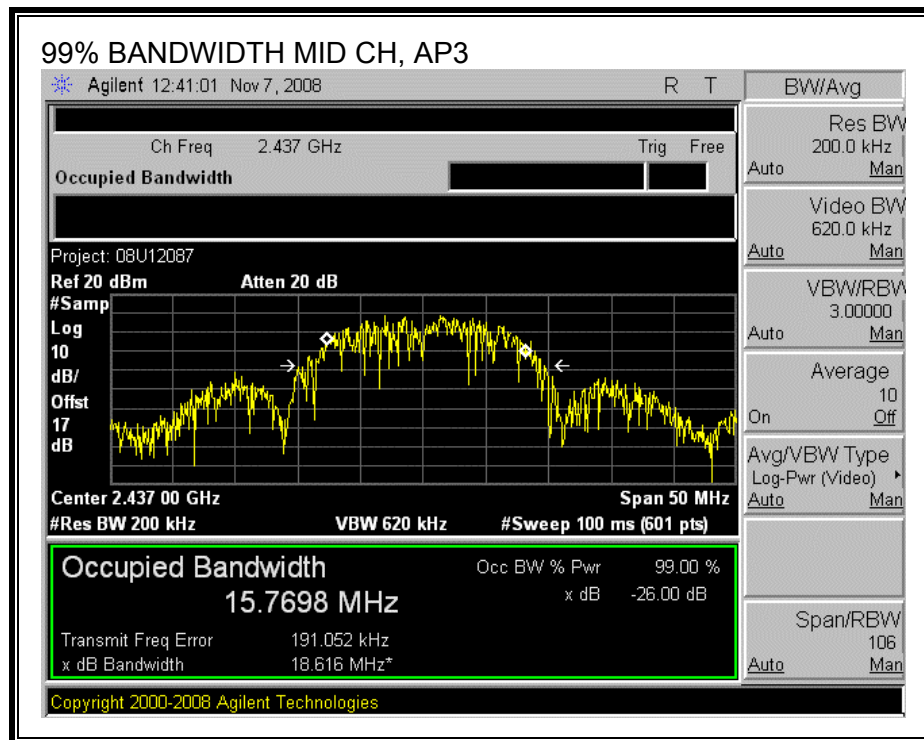
**26dB and 99% BANDWIDTH, AP1**





**26dB and 99% BANDWIDTH, AP3**





### 7.1.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The combined antenna gain =  $10 \log (10^{AG1/10} + 10^{AG2/10})$

The combined antenna gain = **5.08 dBi**

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

#### TEST PROCEDURE

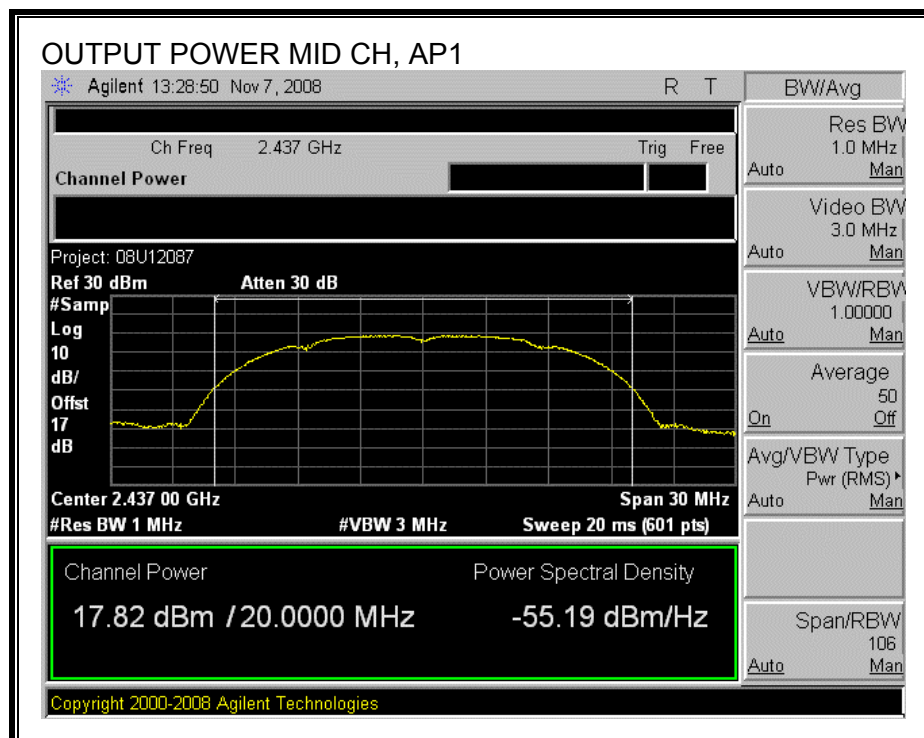
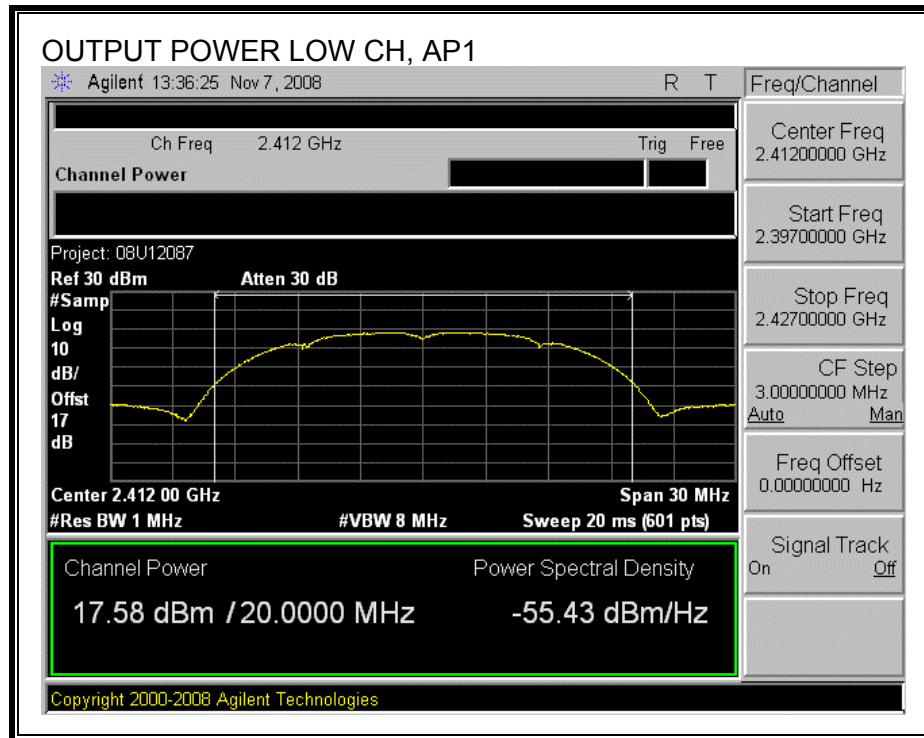
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

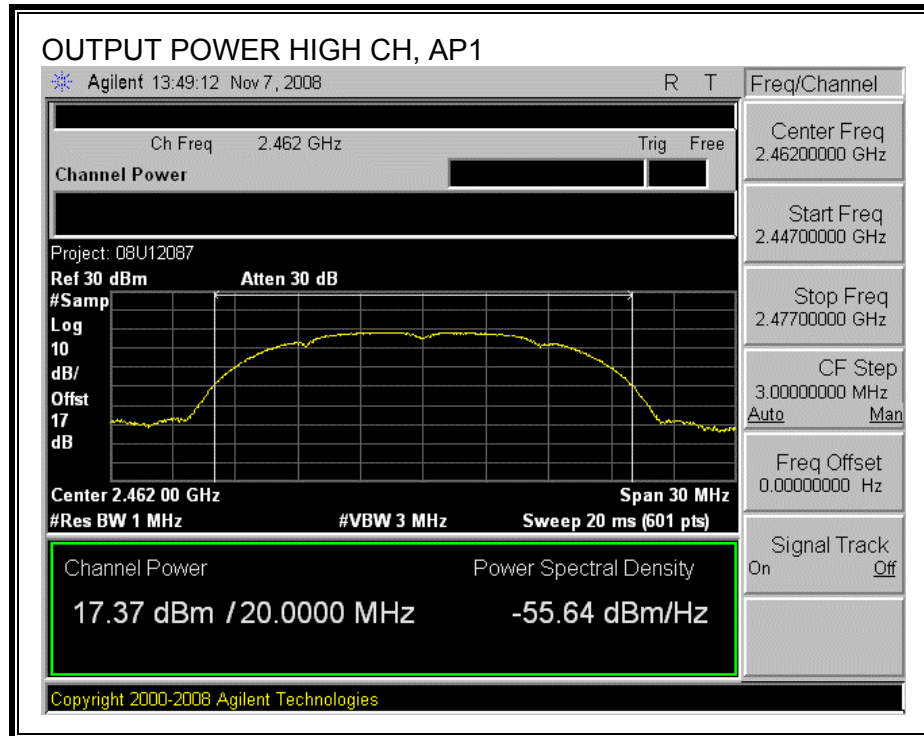
Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

#### RESULTS

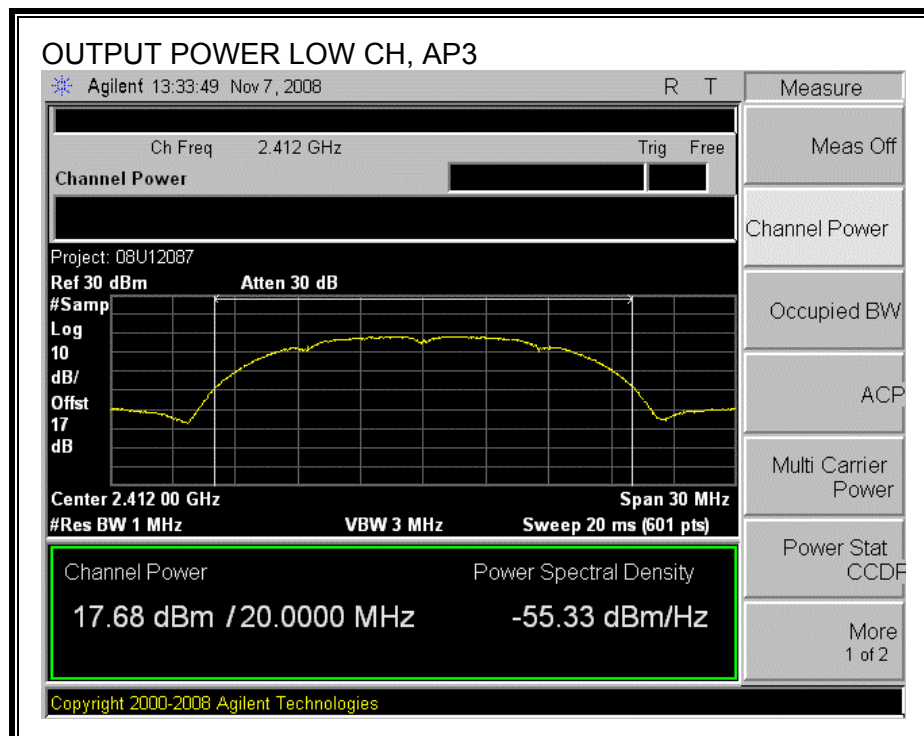
Channel	Frequency (MHz)	Limit (dBm)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	2412	30.00	17.58	17.68	20.64	-9.36
Mid	2437	30.00	17.82	19.45	21.72	-8.28
High	2462	30.00	17.37	17.59	20.49	-9.51

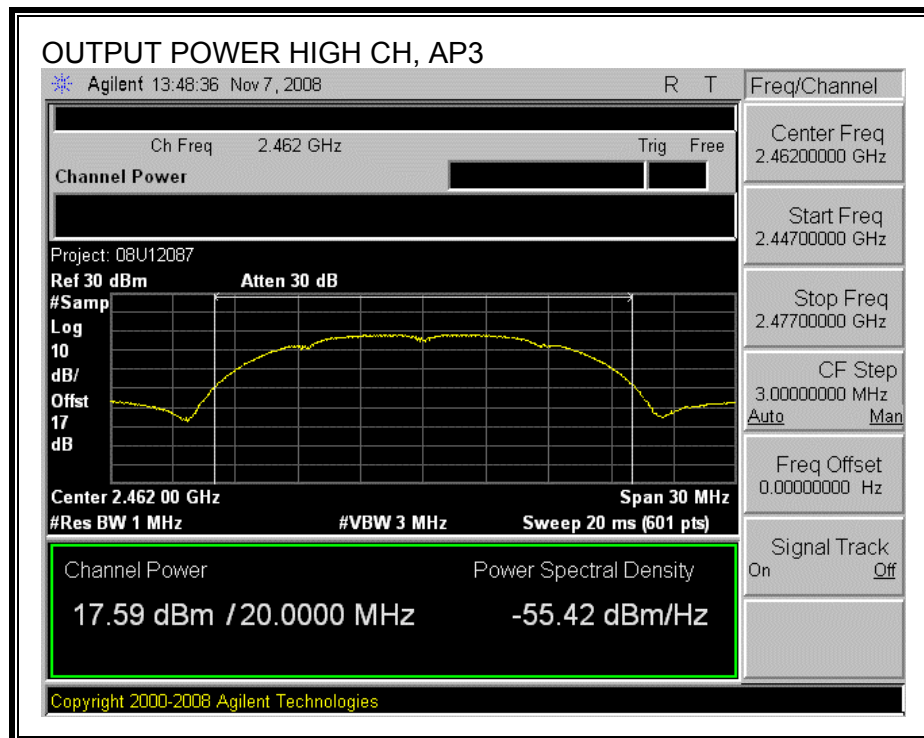
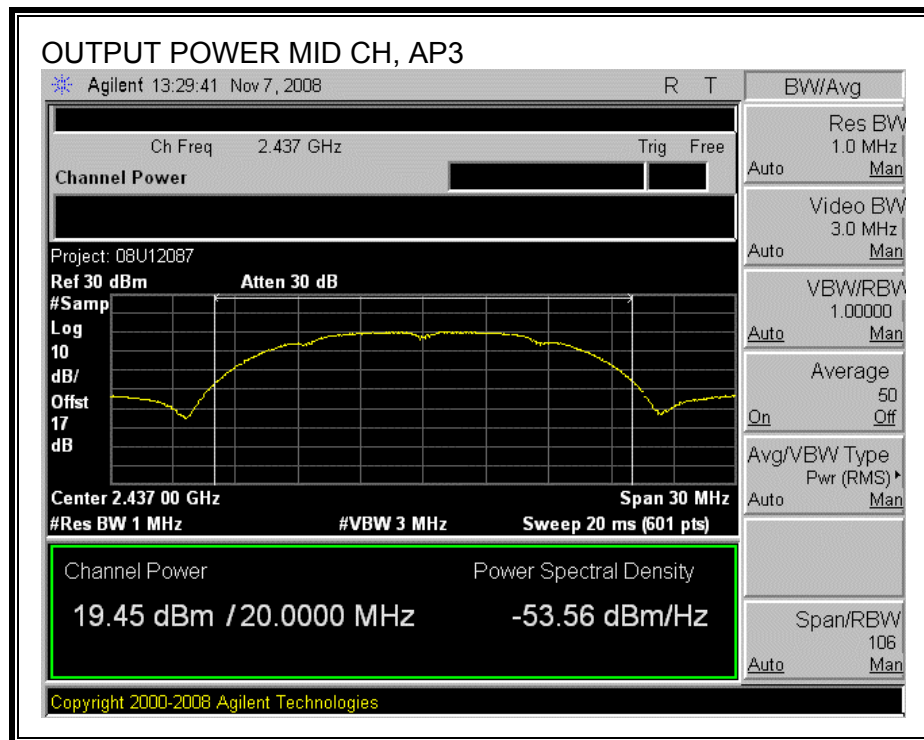
## AP1 OUTPUT POWER





### AP3 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

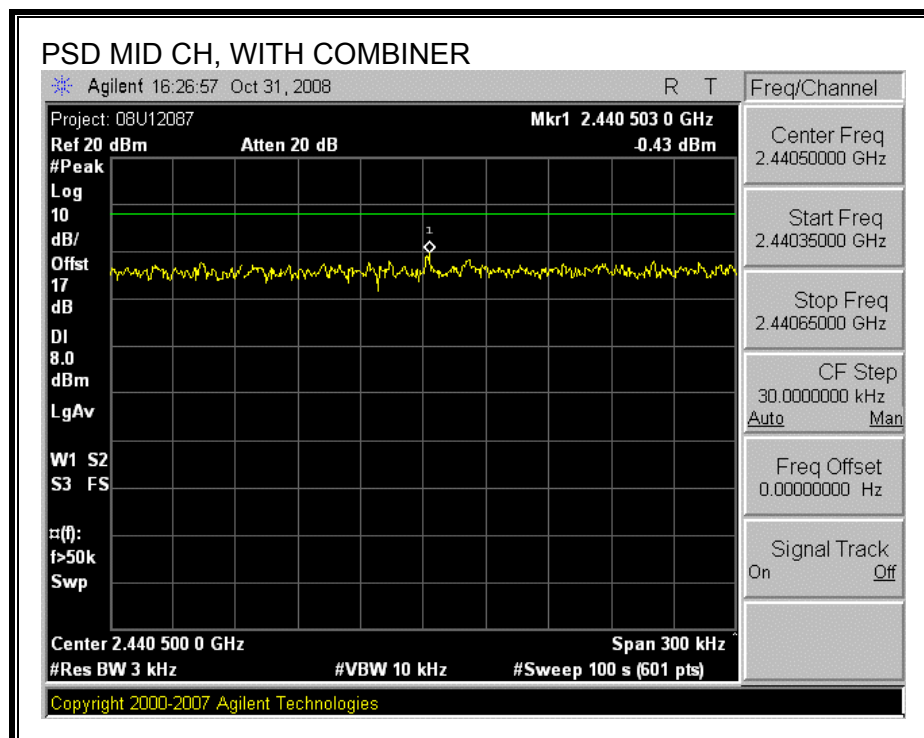
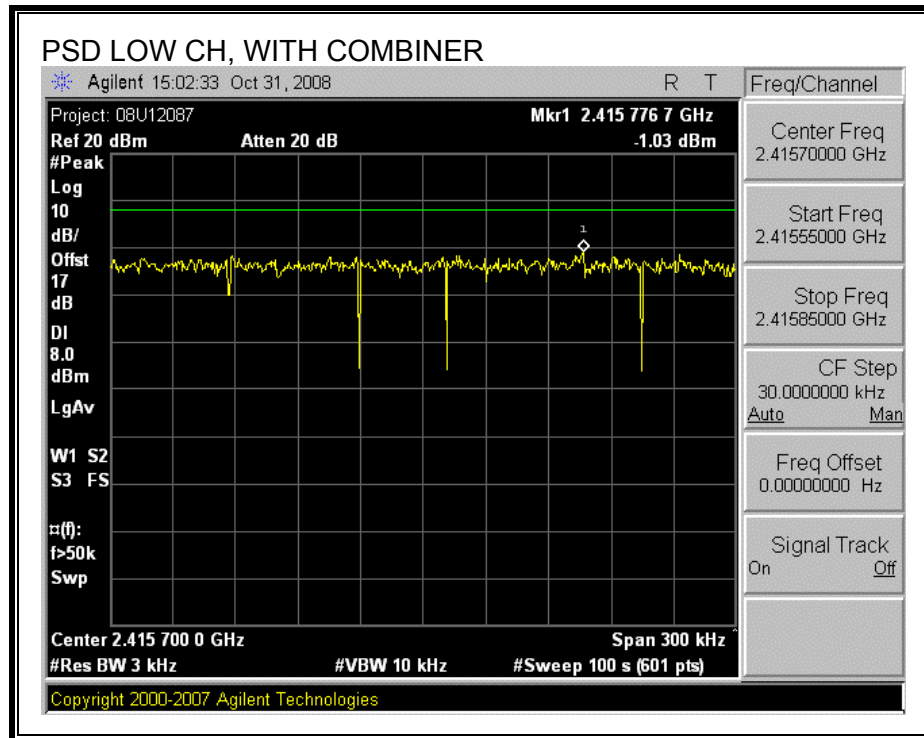
“Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

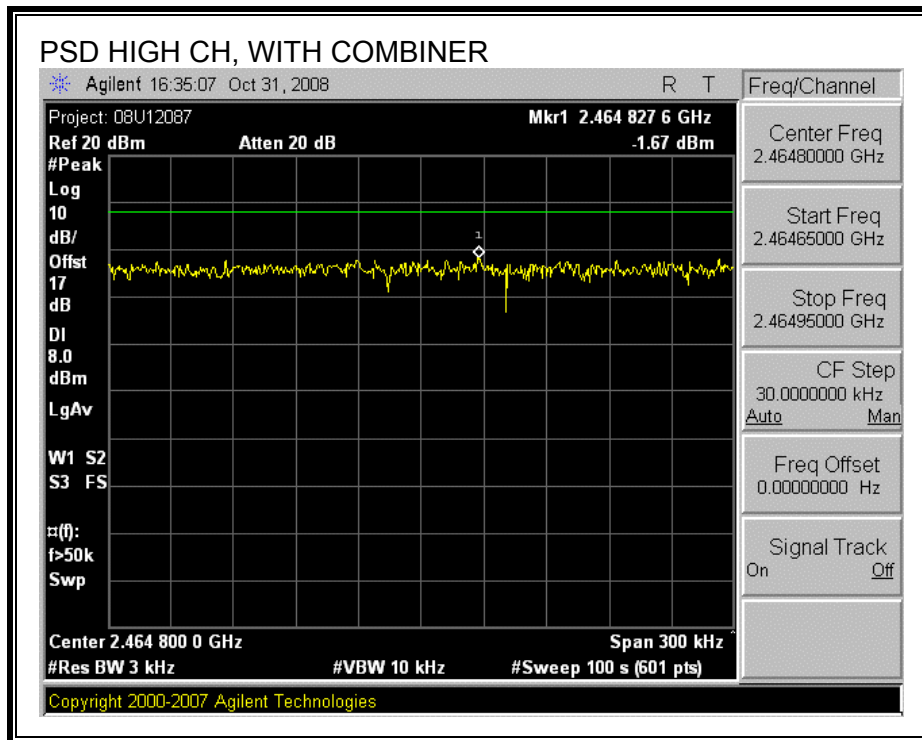
### RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-1.03	8	-9.03
Middle	2437	-0.43	8	-8.43
High	2462	-1.67	8	-9.67



## 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 RMS averaging over a time interval, therefore the required attenuation is 30 dB.

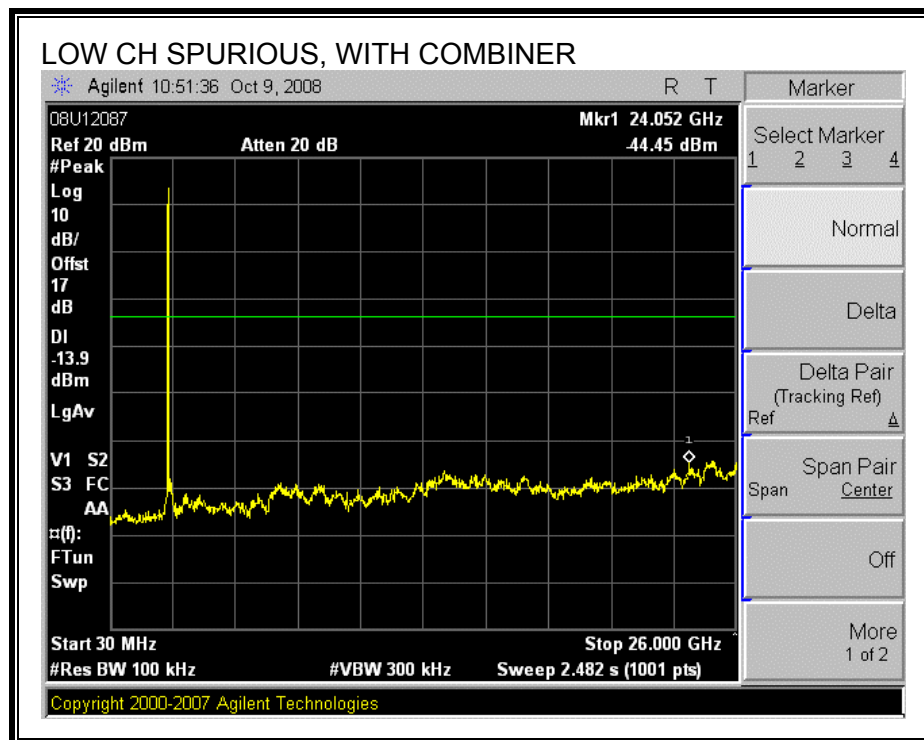
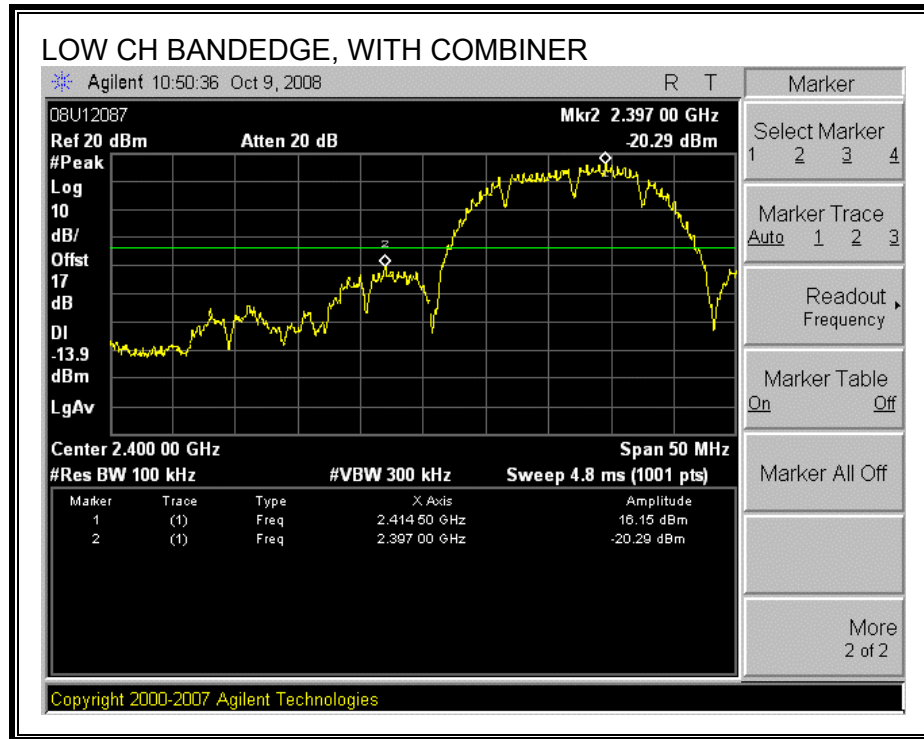
#### **TEST PROCEDURE**

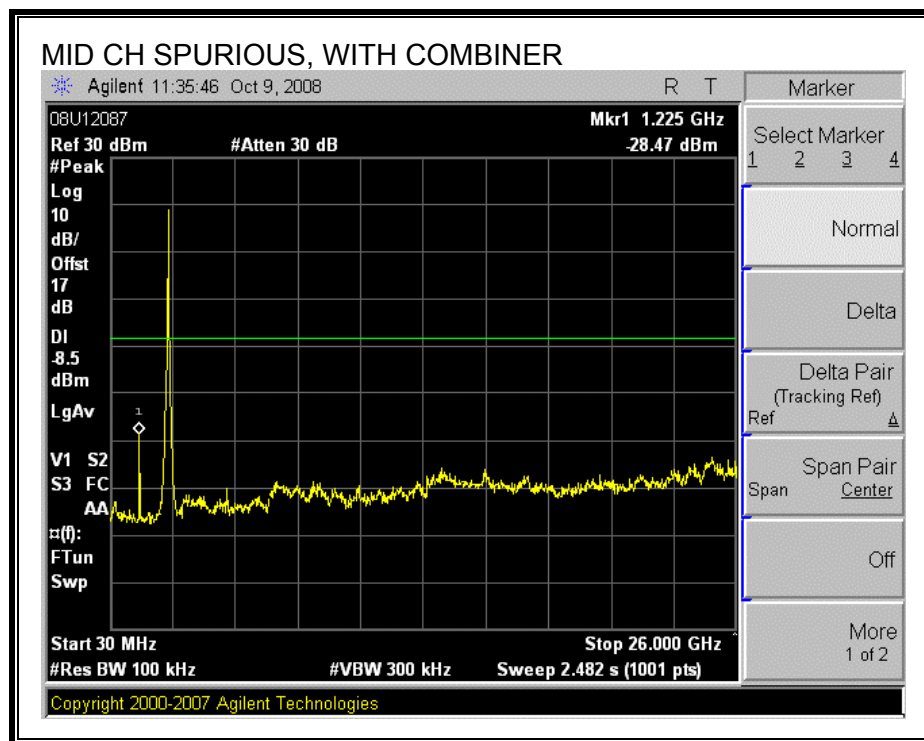
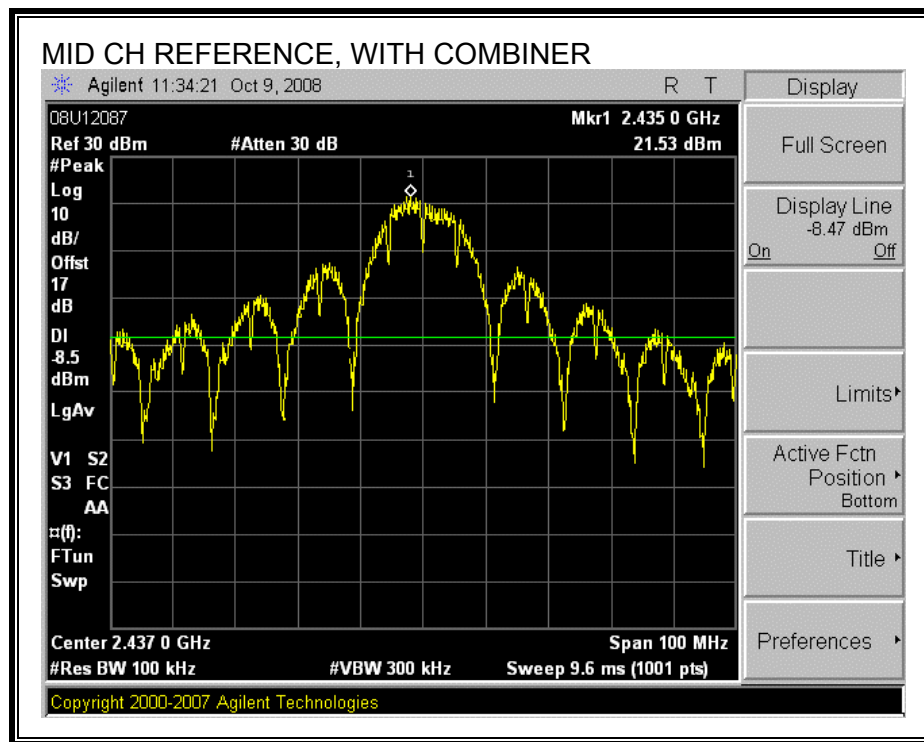
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

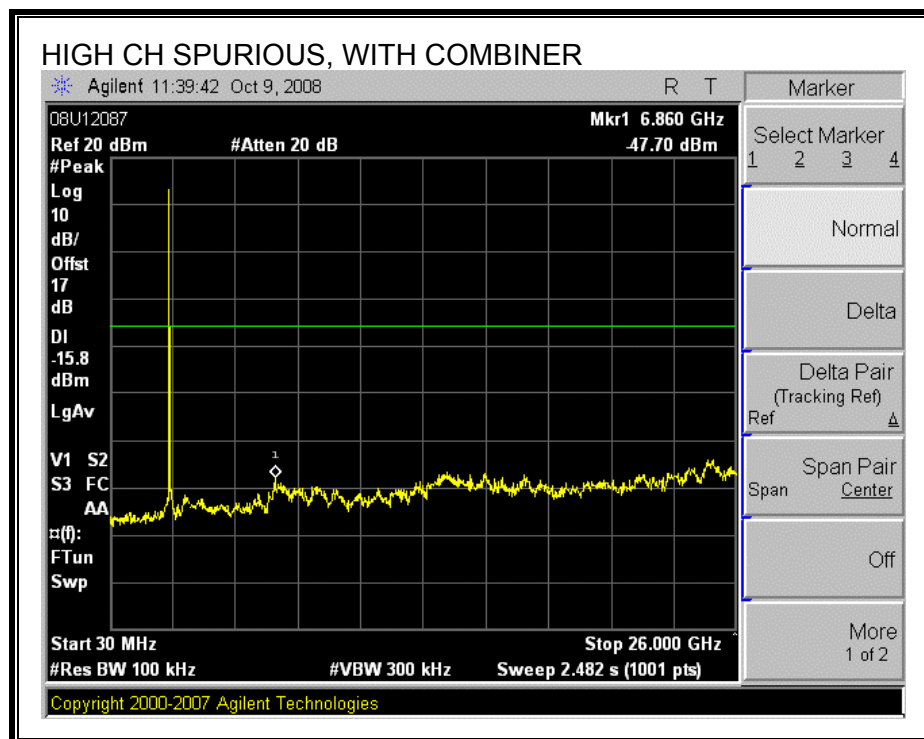
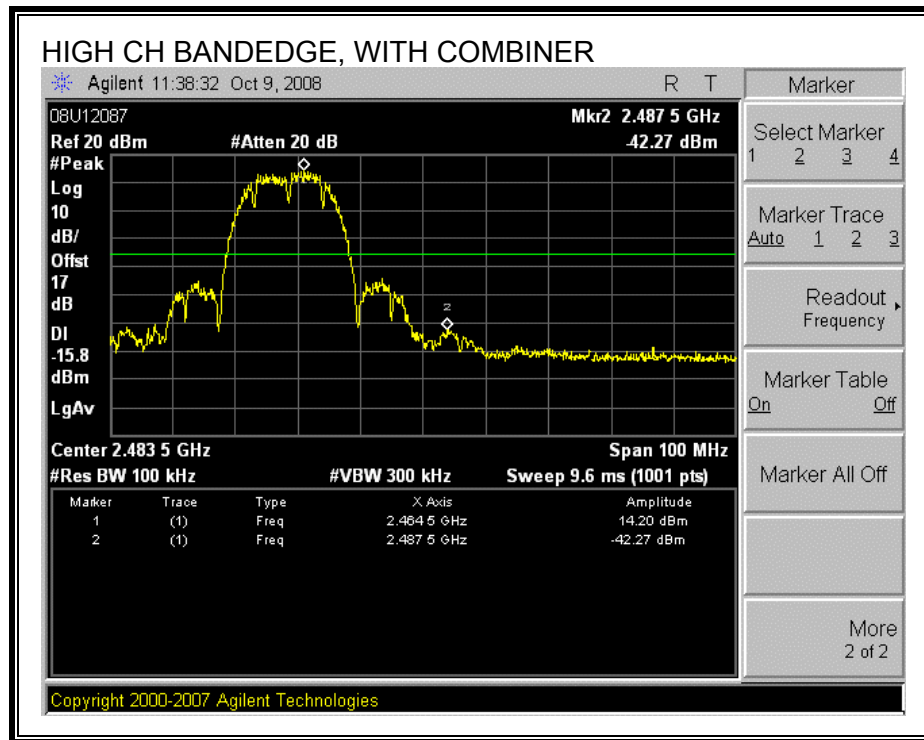
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

## RESULTS

### SPURIOUS EMISSIONS WITH COMBINER







## 7.2. 802.11g DUAL CHAIN LEGACY 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.

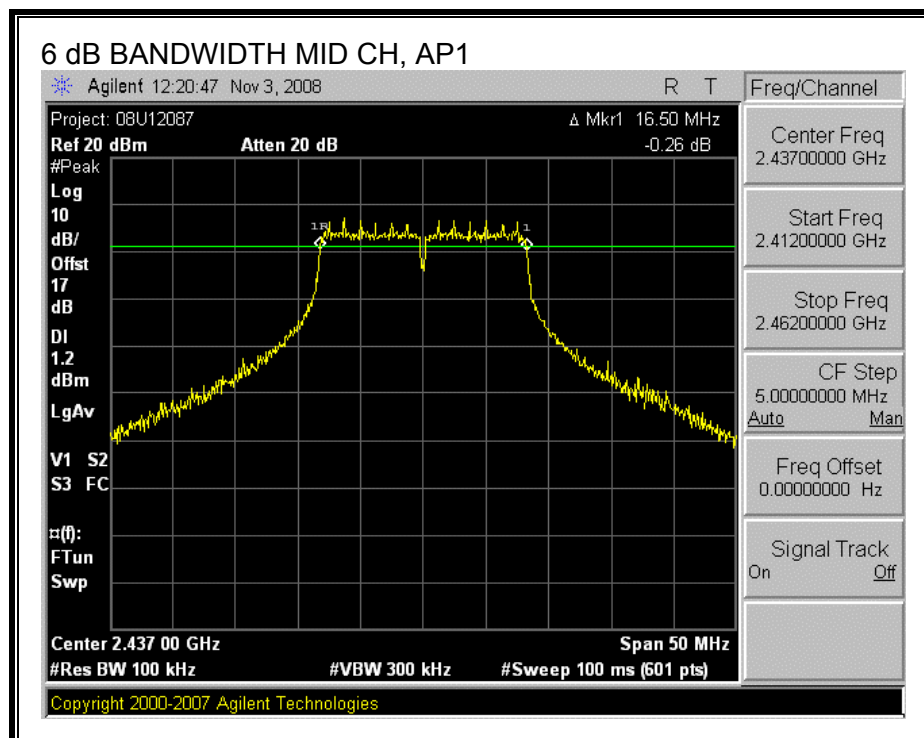
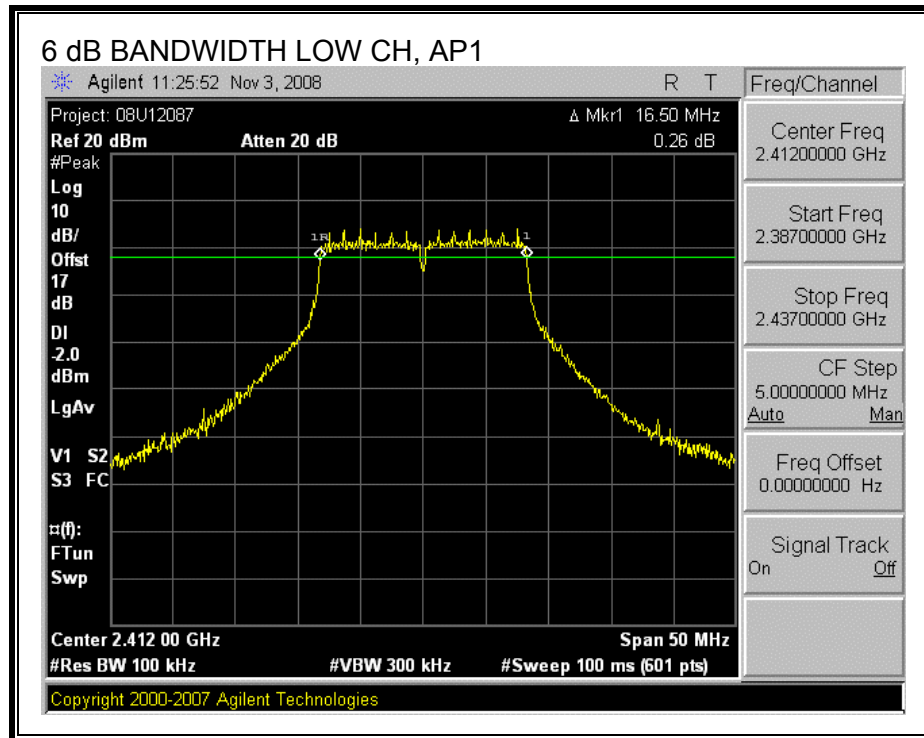
#### TEST PROCEDURE

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.

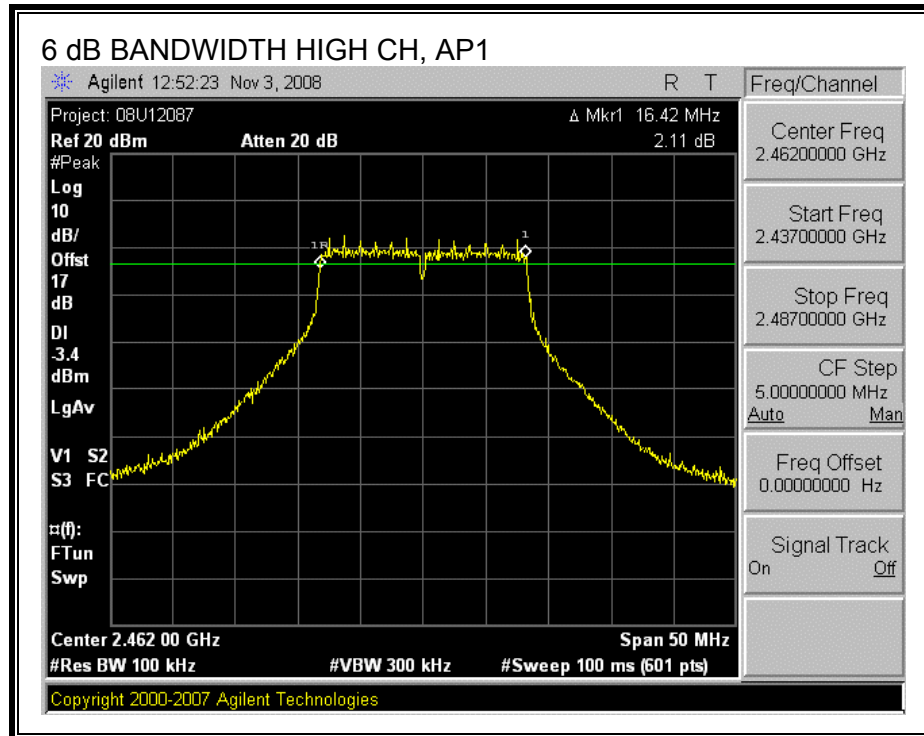
#### RESULTS

Channel	Frequency (MHz)	AP1 6 dB BW (MHz)	AP3 6 dB BW (MHz)	Minimum Limit (MHz)
Low	2412	16.5	16.5	0.5
Middle	2437	16.5	16.5	0.5
High	2462	16.42	16.42	0.5

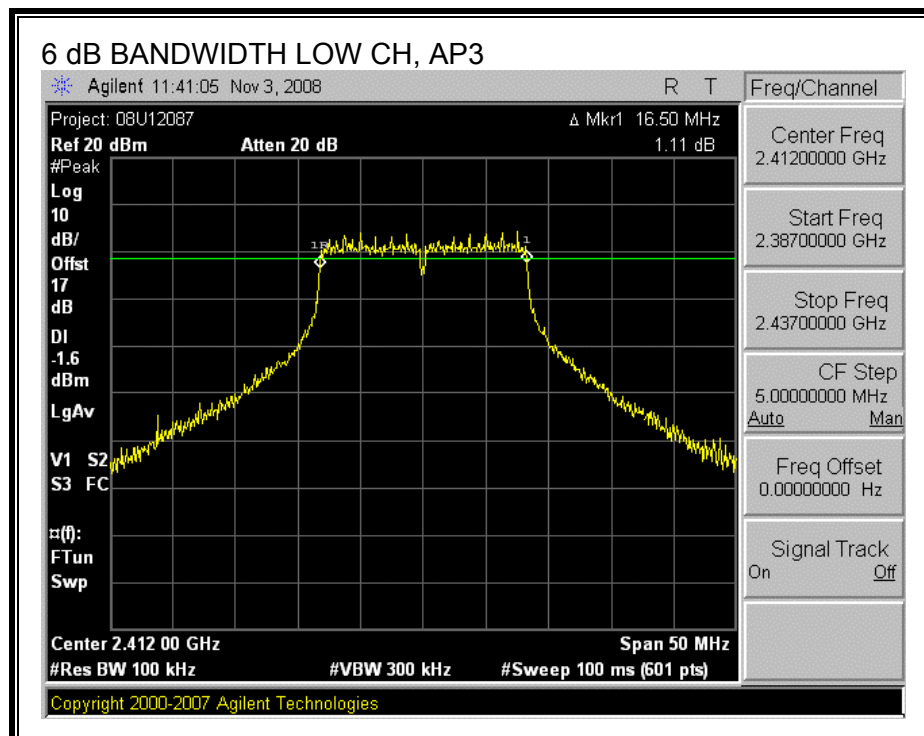
## 6 dB BANDWIDTH, AP1

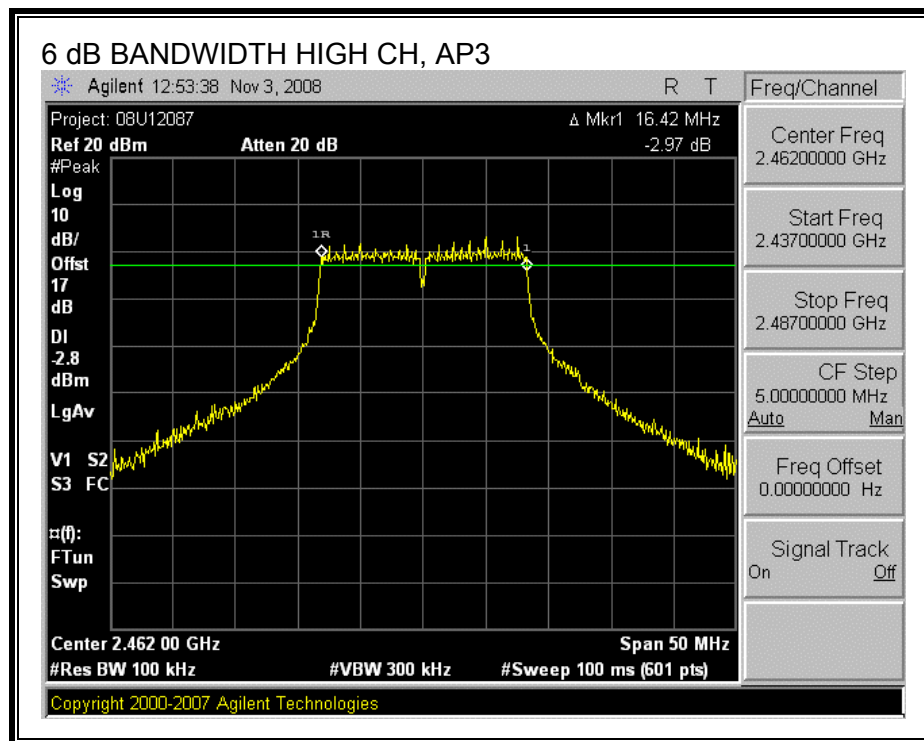
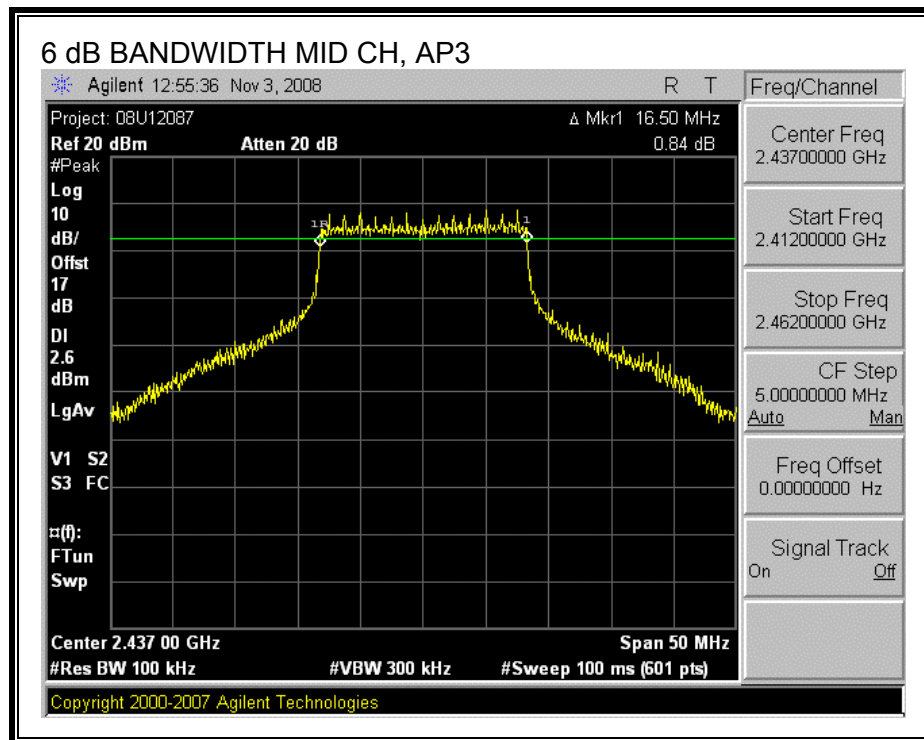






**6 dB BANDWIDTH, AP3**





## 7.2.2. 26dB and 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 26dB (99 %) bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 26dB (99%) bandwidth function is utilized.

### RESULTS

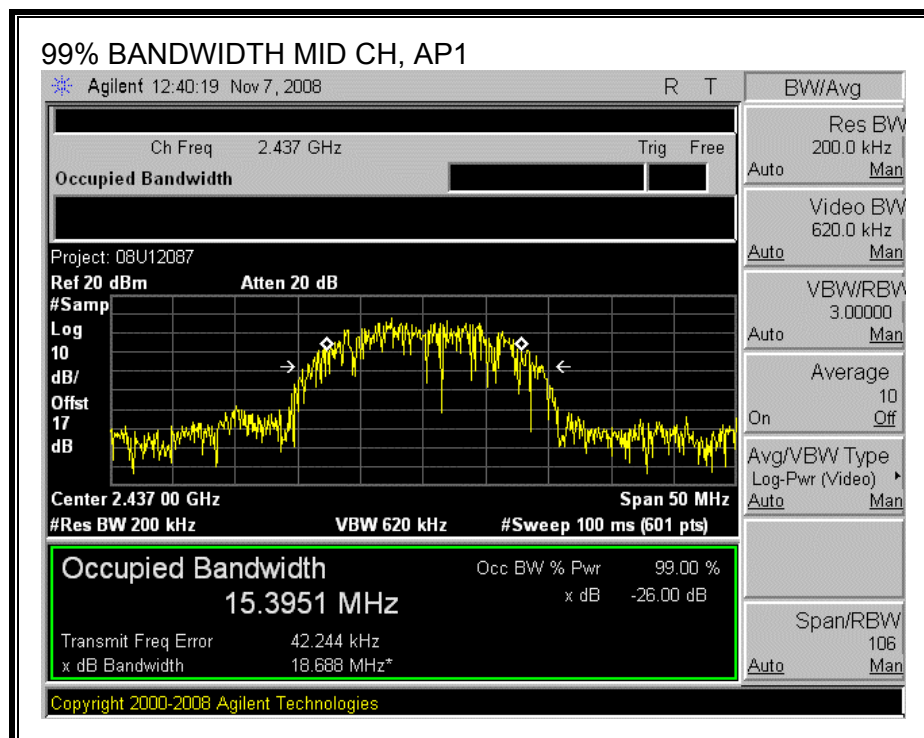
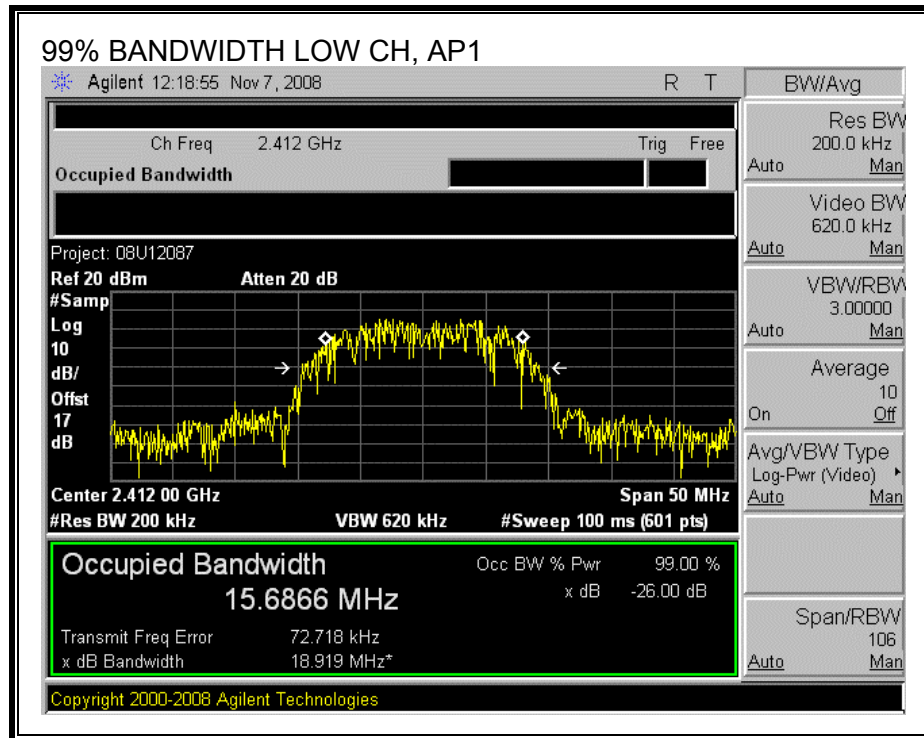
#### 99% BANDWIDTH

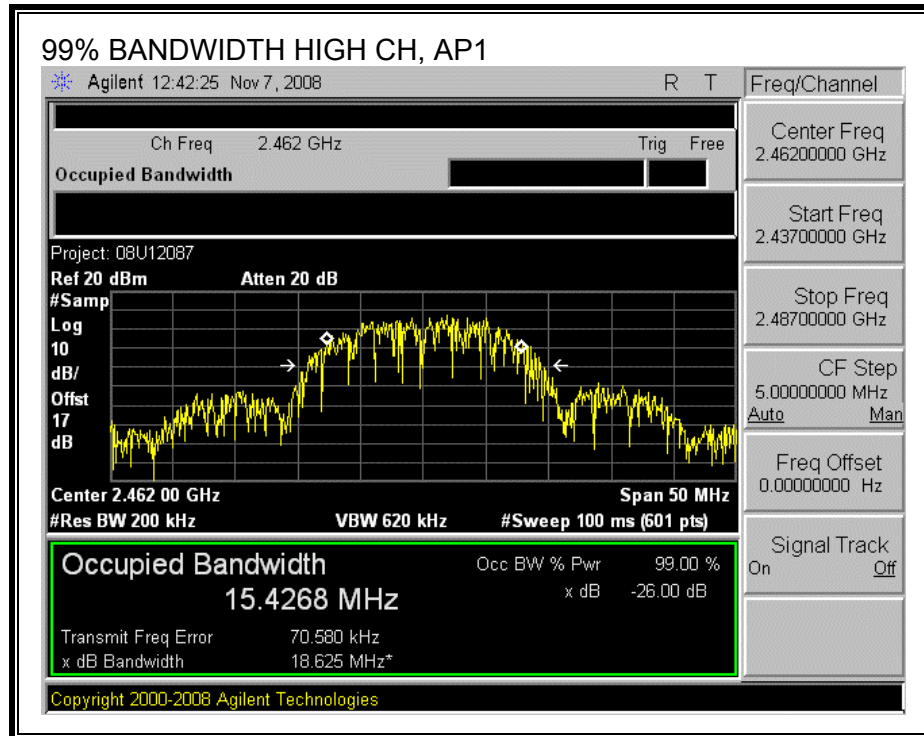
Channel	Frequency (MHz)	AP1 99% Bandwidth (MHz)	AP3 99% Bandwidth (MHz)
Low	2412	15.6866	15.5786
Middle	2437	15.3951	15.7698
High	2462	15.4268	15.4815

#### 26dB BANDWIDTH

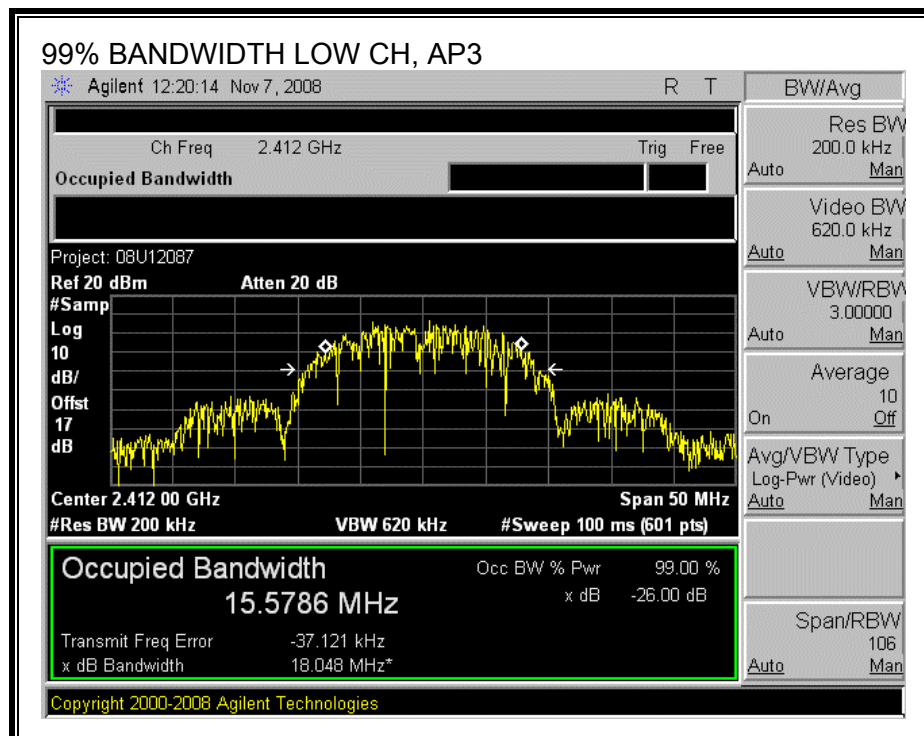
Channel	Frequency (MHz)	AP1 26dB Bandwidth (MHz)	AP3 26dB Bandwidth (MHz)
Low	2412	18.919	18.048
Middle	2437	18.688	18.616
High	2462	18.625	18.403

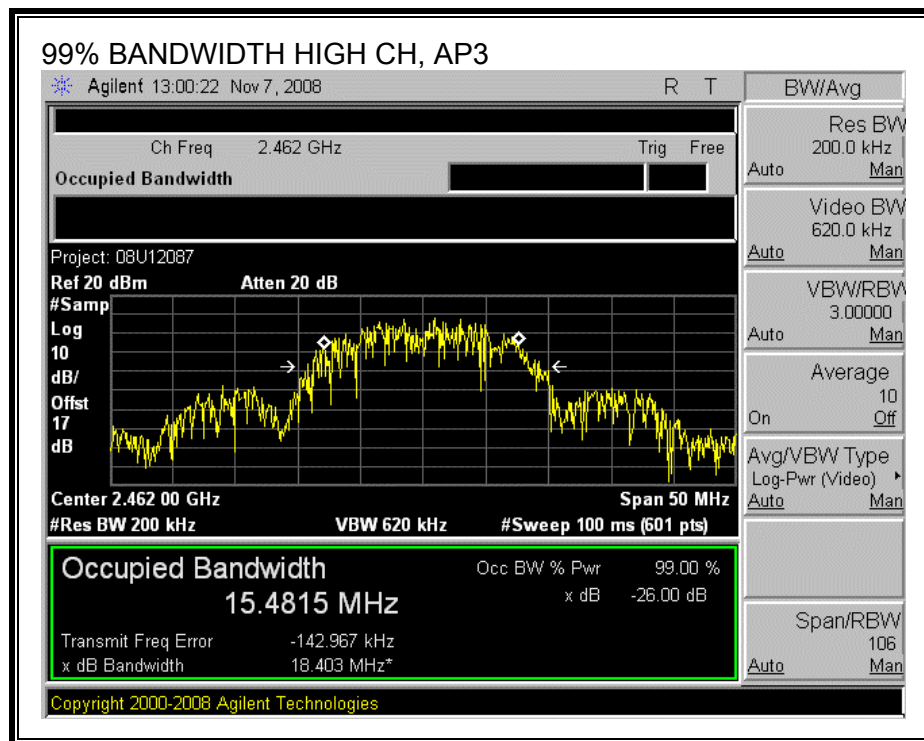
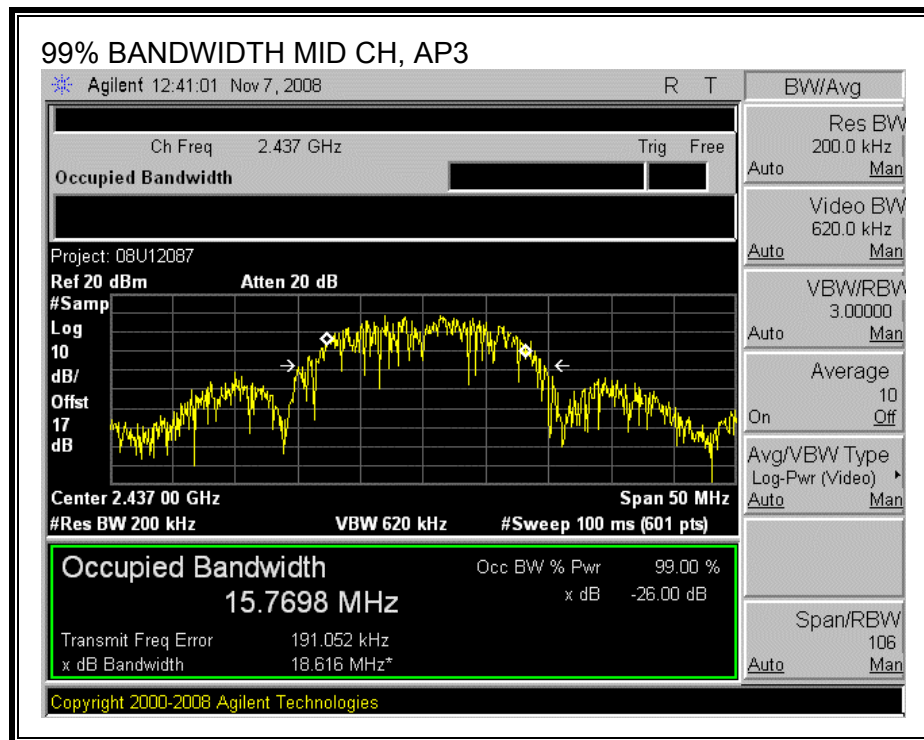
**26dB and 99% BANDWIDTH, AP1**





**26dB and 99% BANDWIDTH, AP3**





### 7.2.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The combined antenna gain =  $10 \log (10^{AG1/10} + 10^{AG2/10})$

The combined antenna gain = **5.08 dBi**

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

#### TEST PROCEDURE

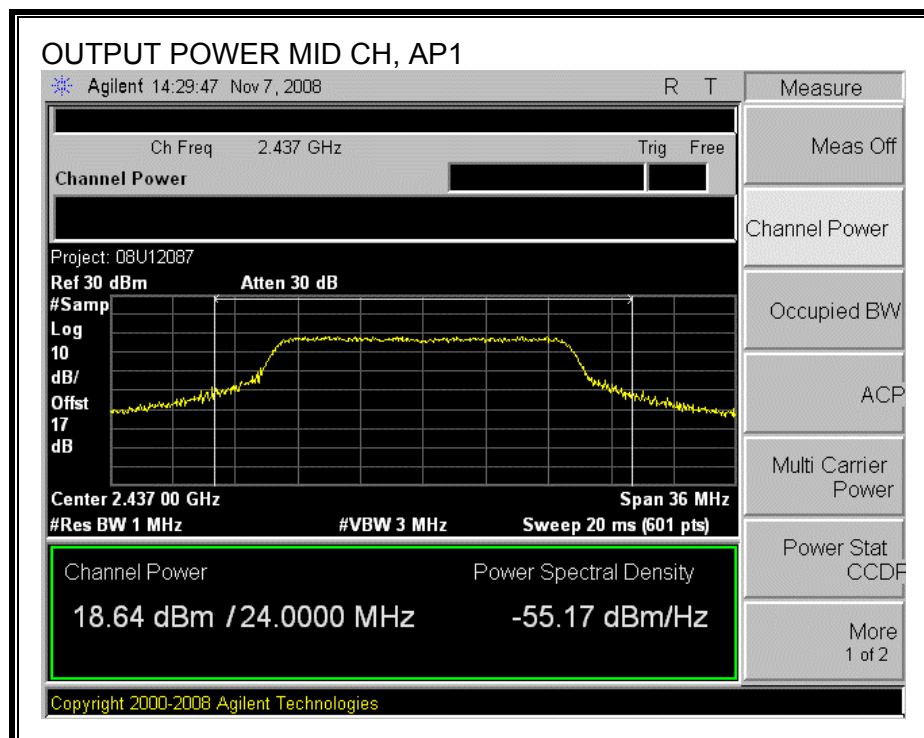
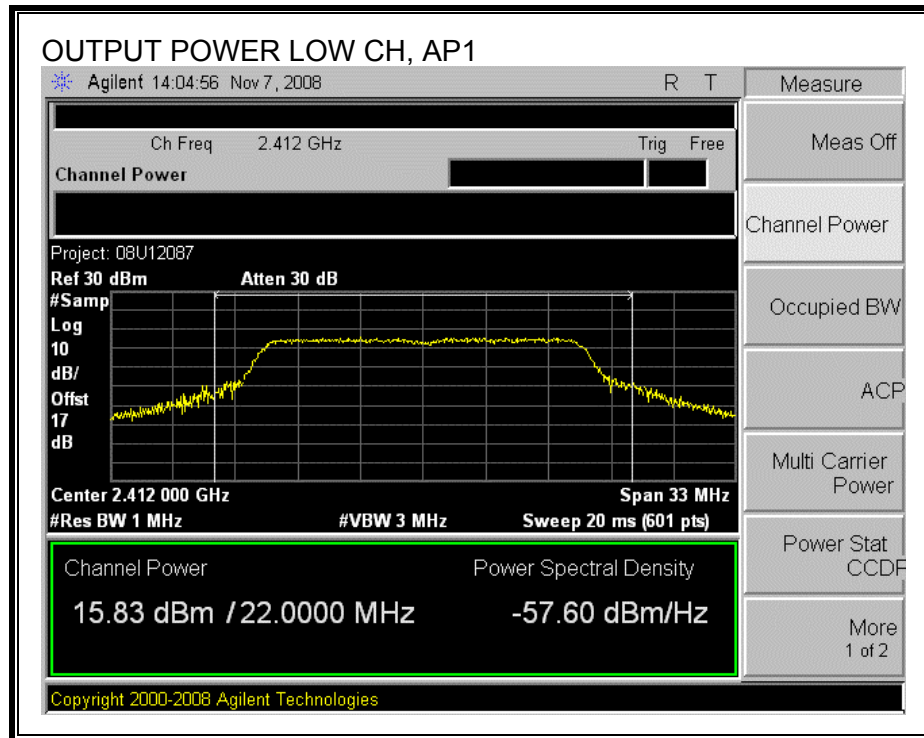
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

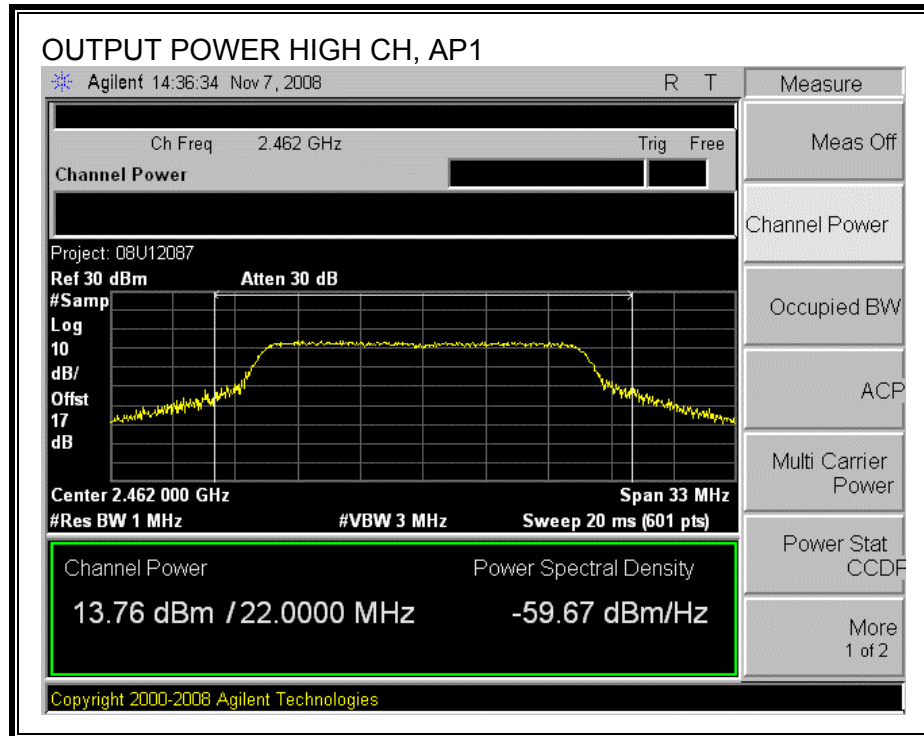
#### RESULTS

Channel	Frequency (MHz)	Limit (dBm)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	2412	30.00	15.83	15.86	18.86	-11.14
Mid	2437	30.00	18.64	19.75	22.24	-7.76
High	2462	30.00	13.76	14.40	17.10	-12.90

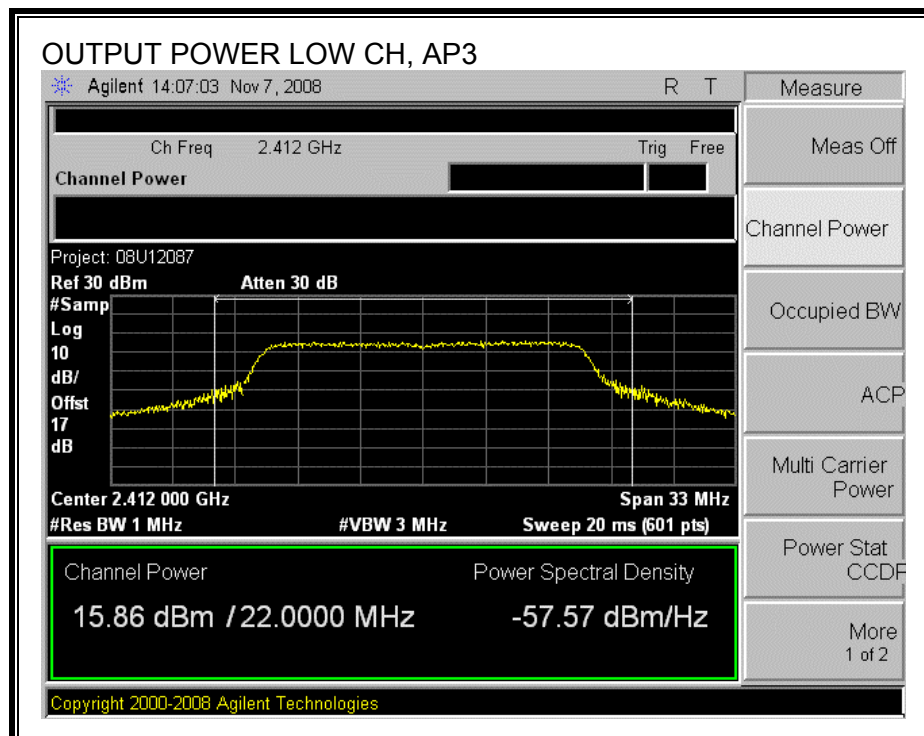
## AP1 OUTPUT POWER

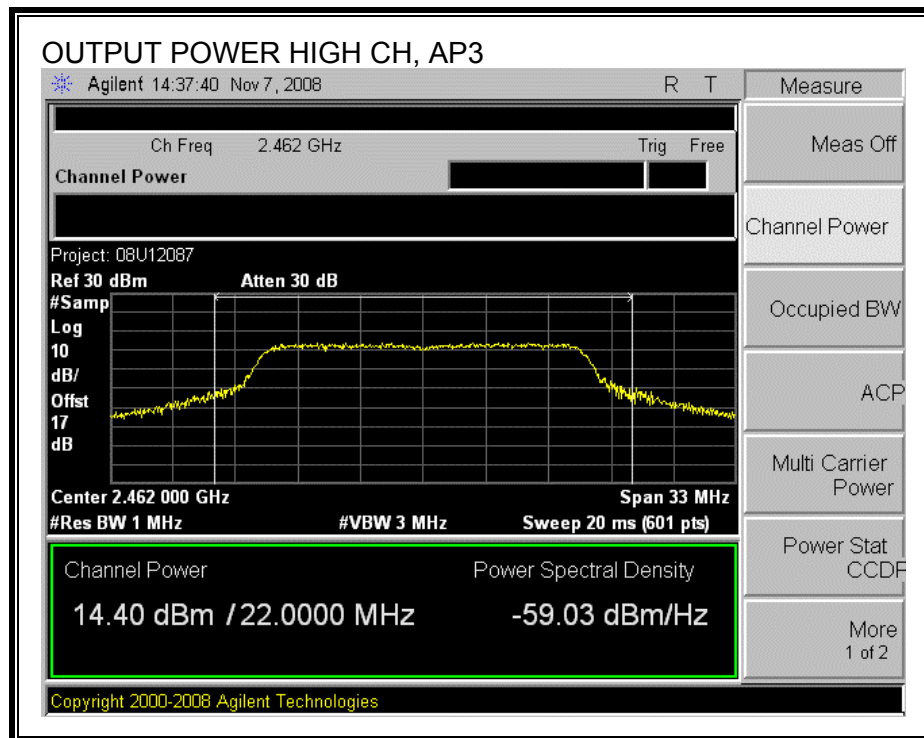
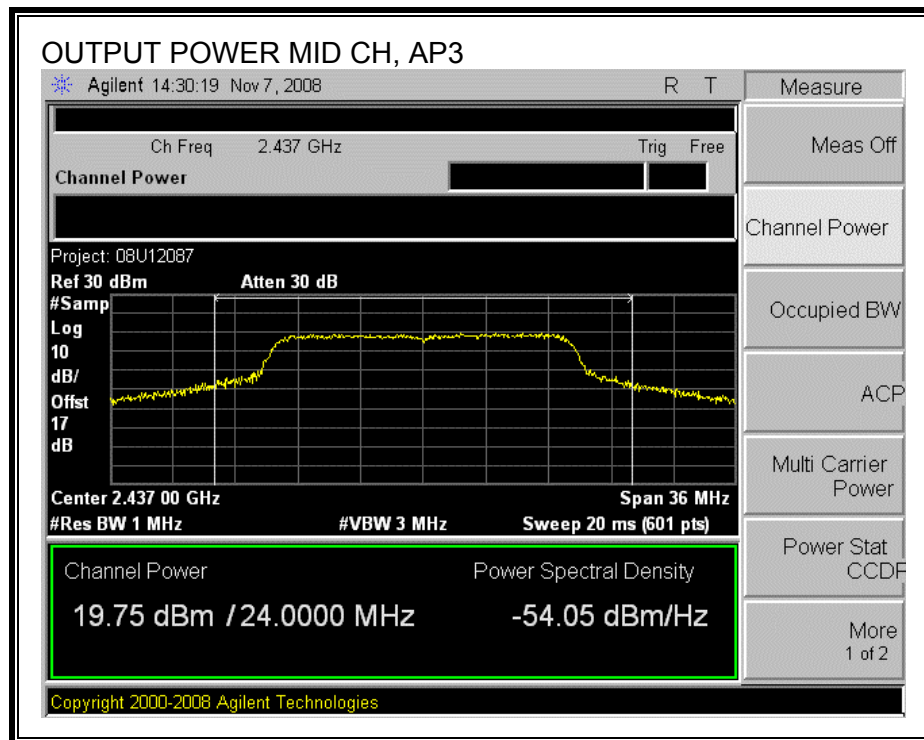






### AP3 OUTPUT POWER





## 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.

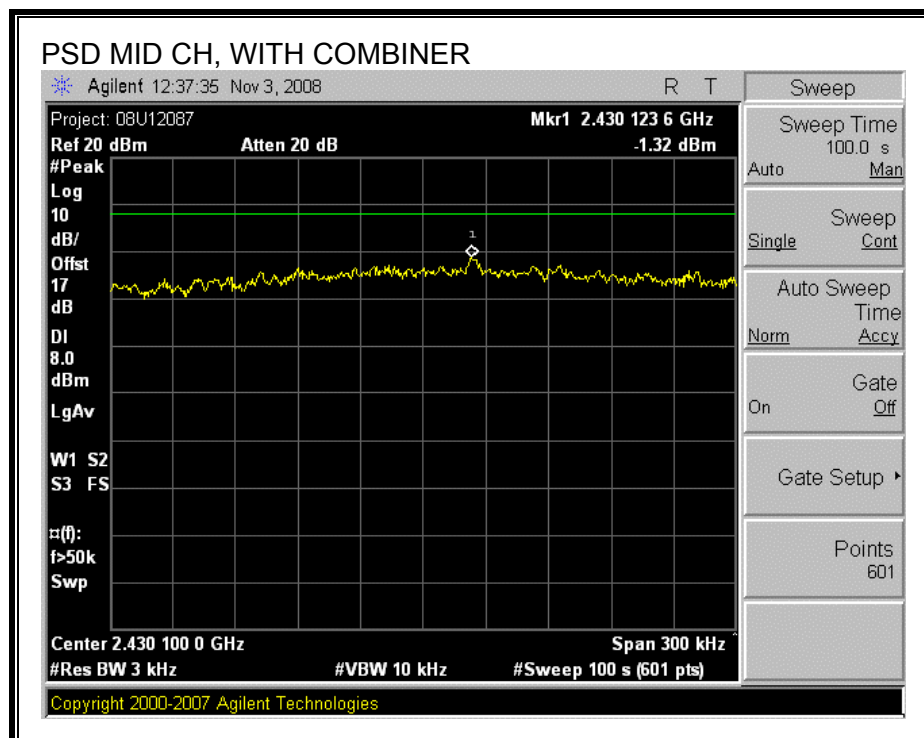
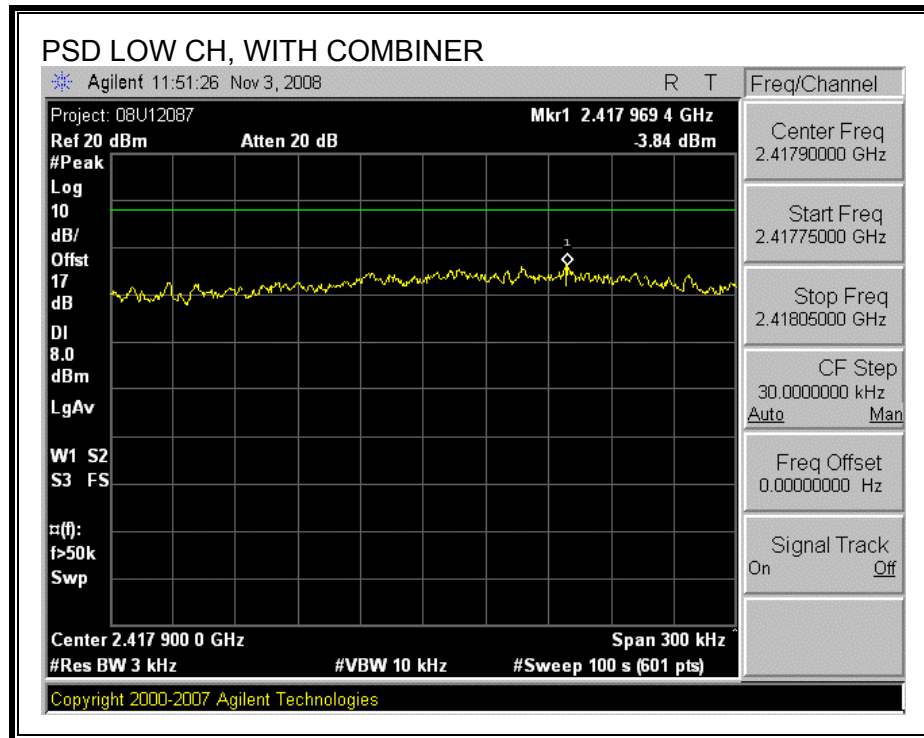
### TEST PROCEDURE

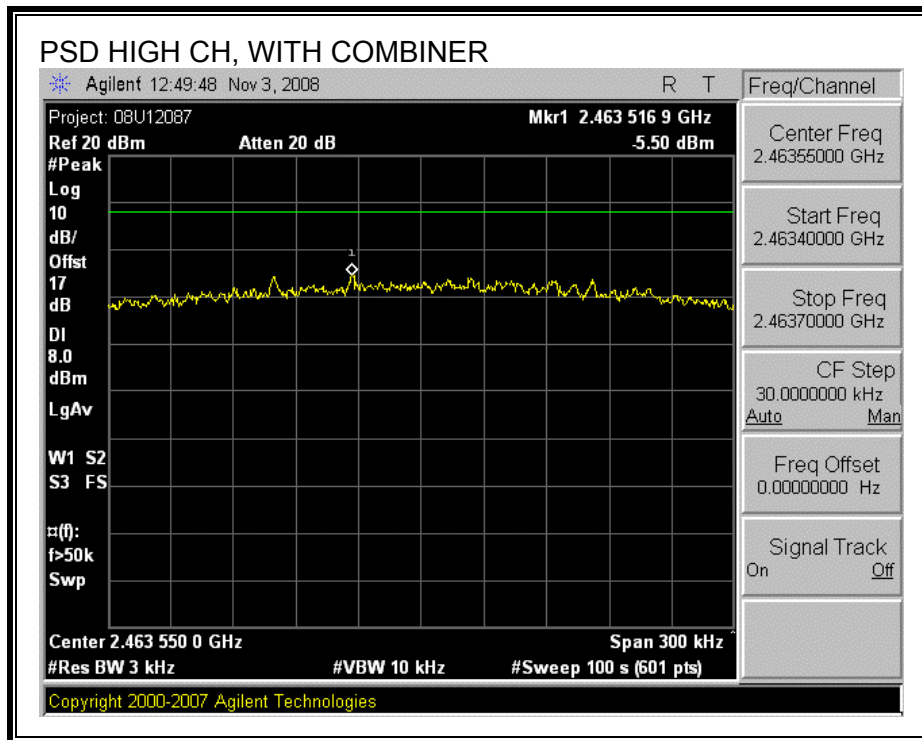
“Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

### RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-3.84	8	-11.84
Middle	2437	-1.32	8	-9.32
High	2462	-5.50	8	-13.50

## POWER SPECTRAL DENSITY, WITH COMBINER





## **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 RMS averaging over a time interval, therefore the required attenuation is 30 dB.

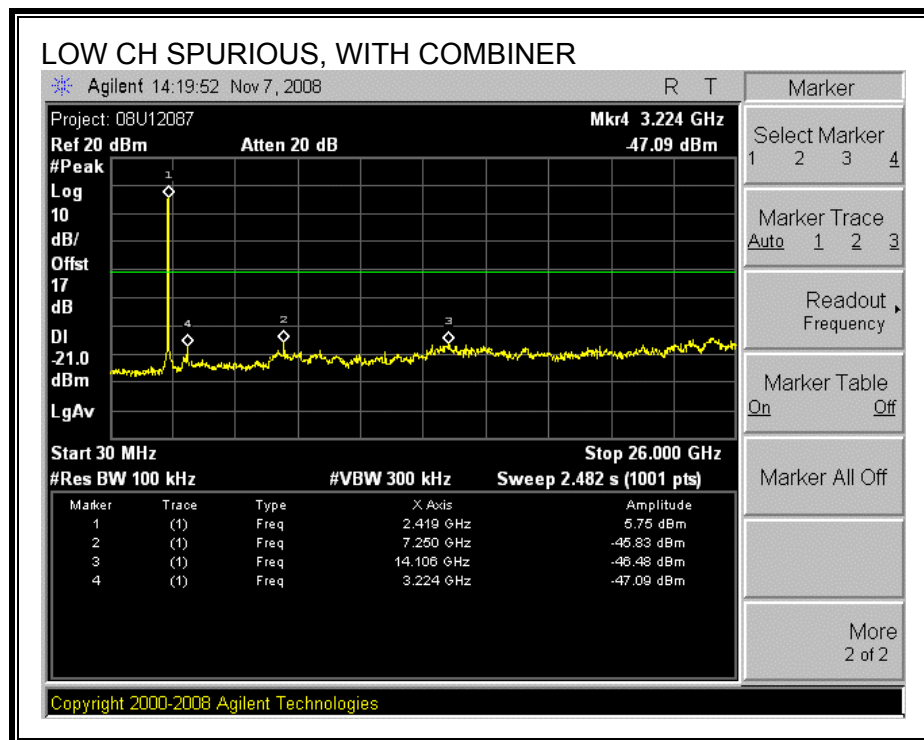
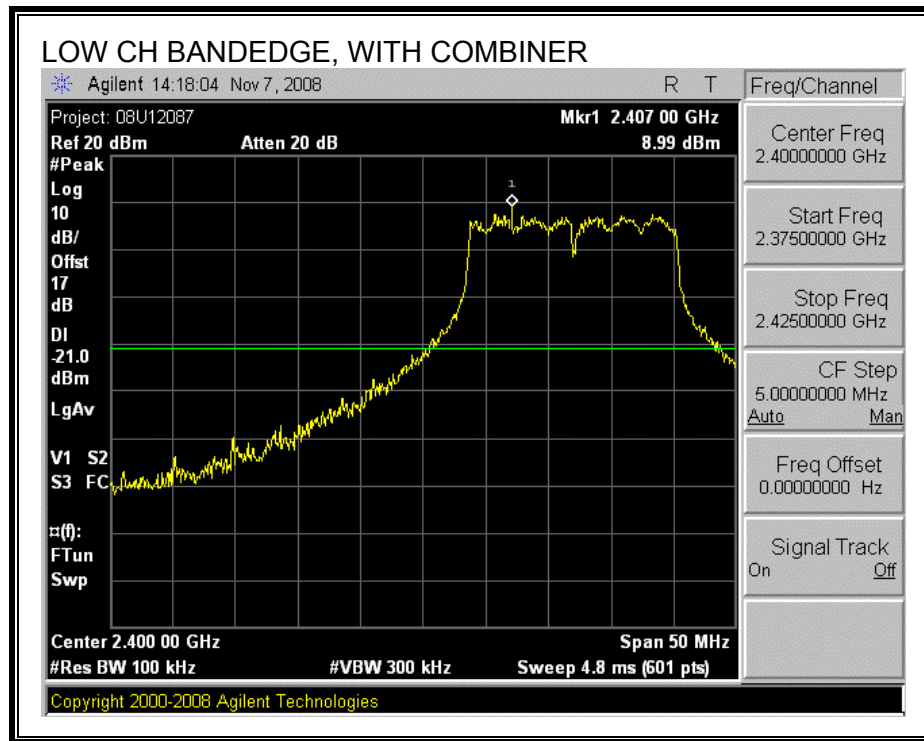
### **TEST PROCEDURE**

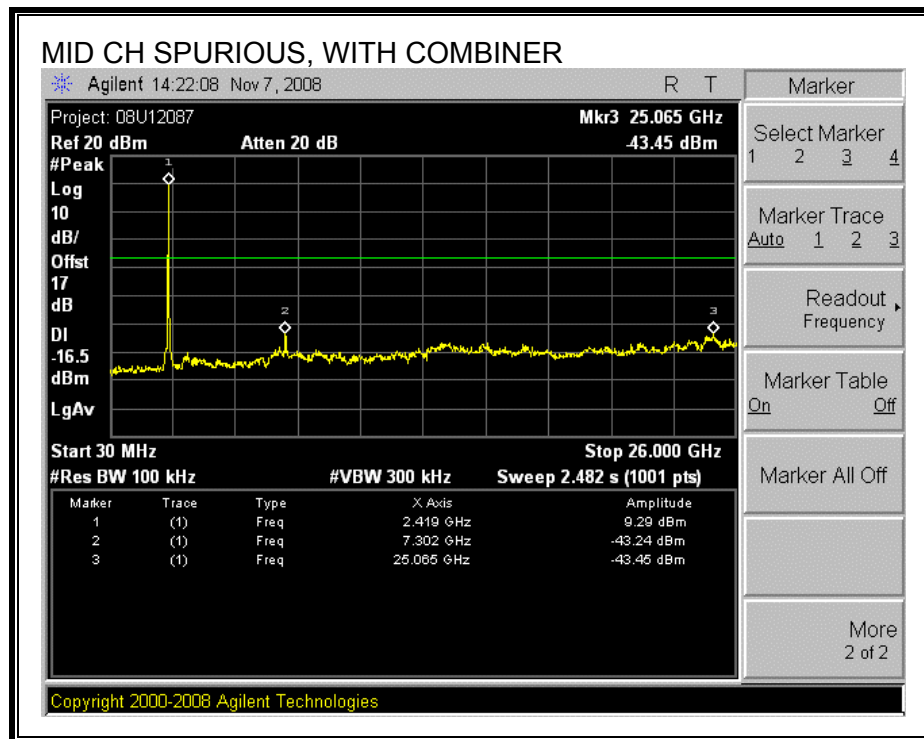
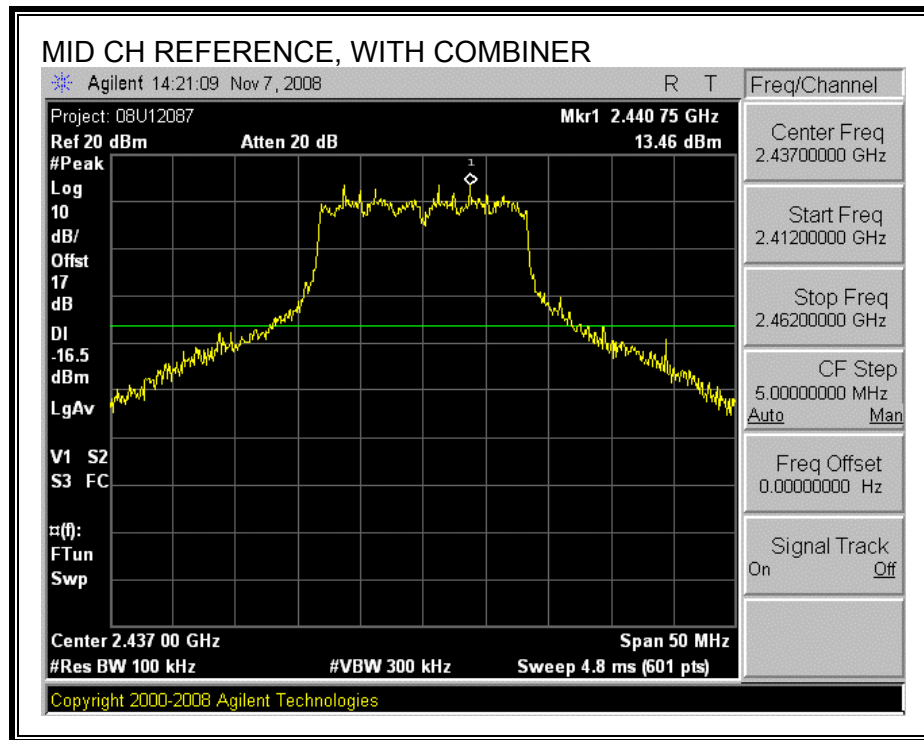
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

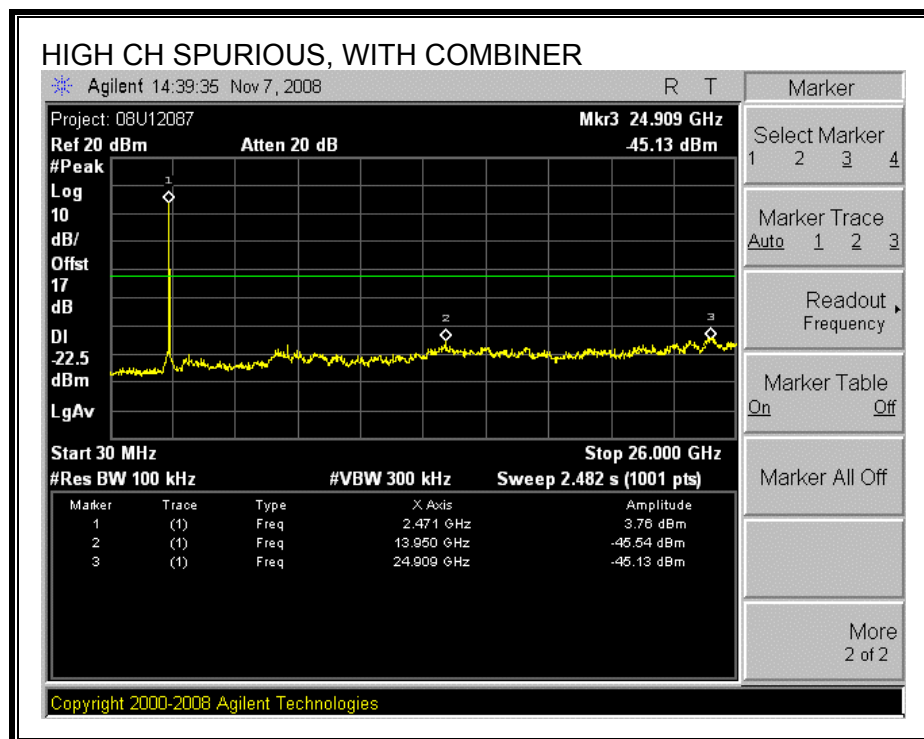
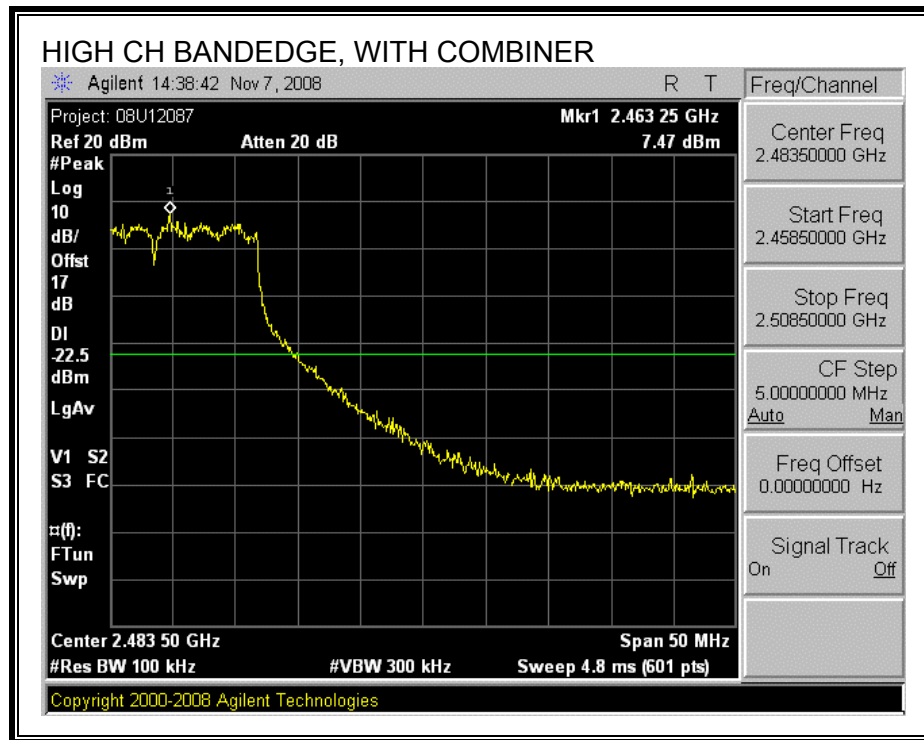
## RESULTS

### SPURIOUS EMISSIONS WITH COMBINER









### 7.3. 802.11n 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.

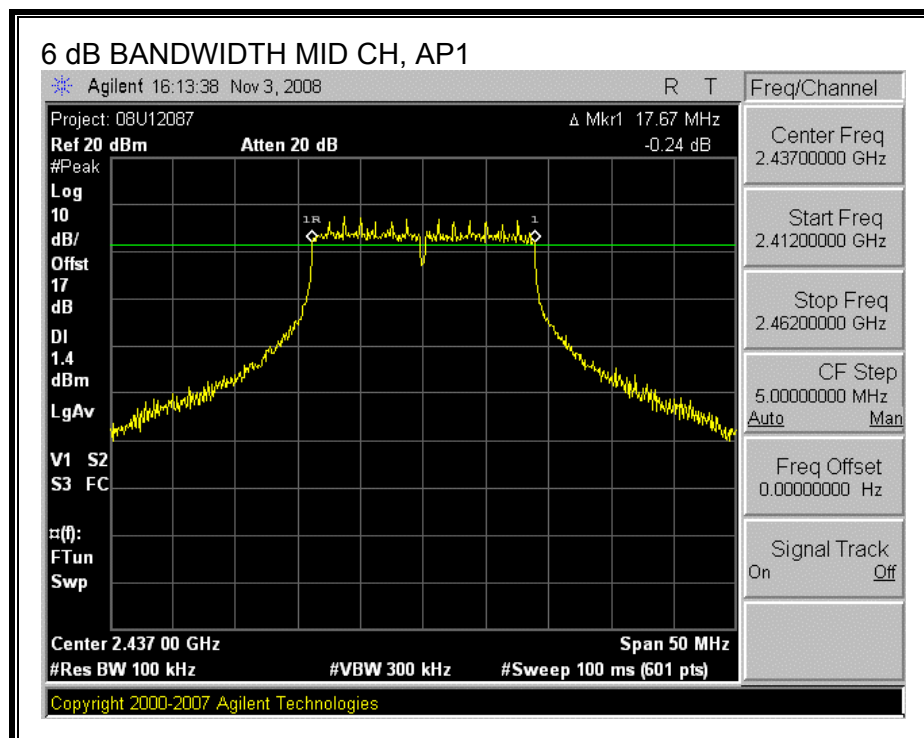
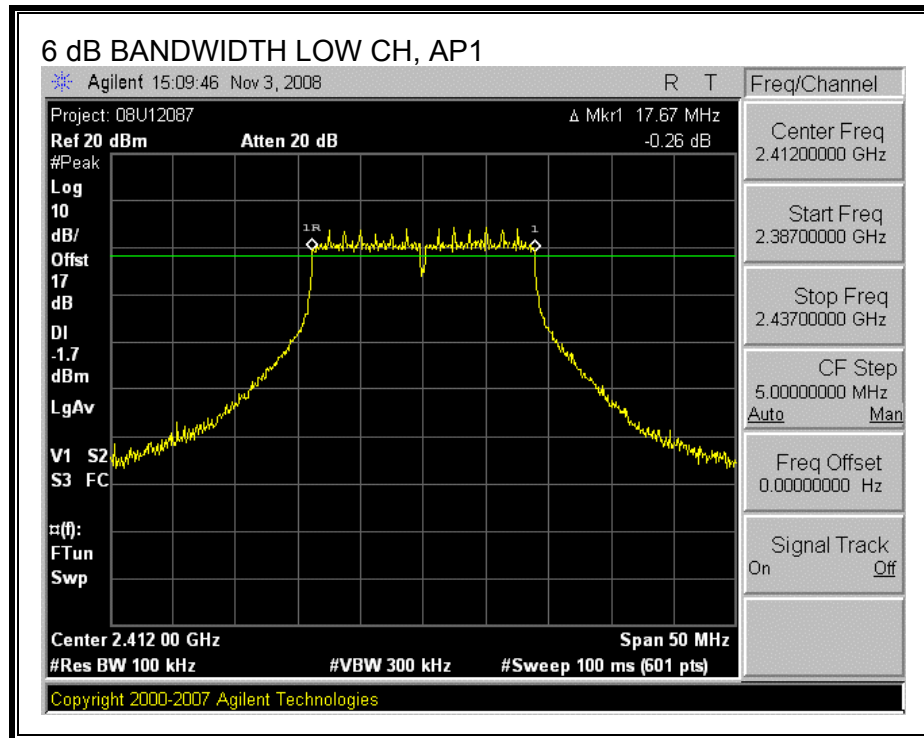
##### TEST PROCEDURE

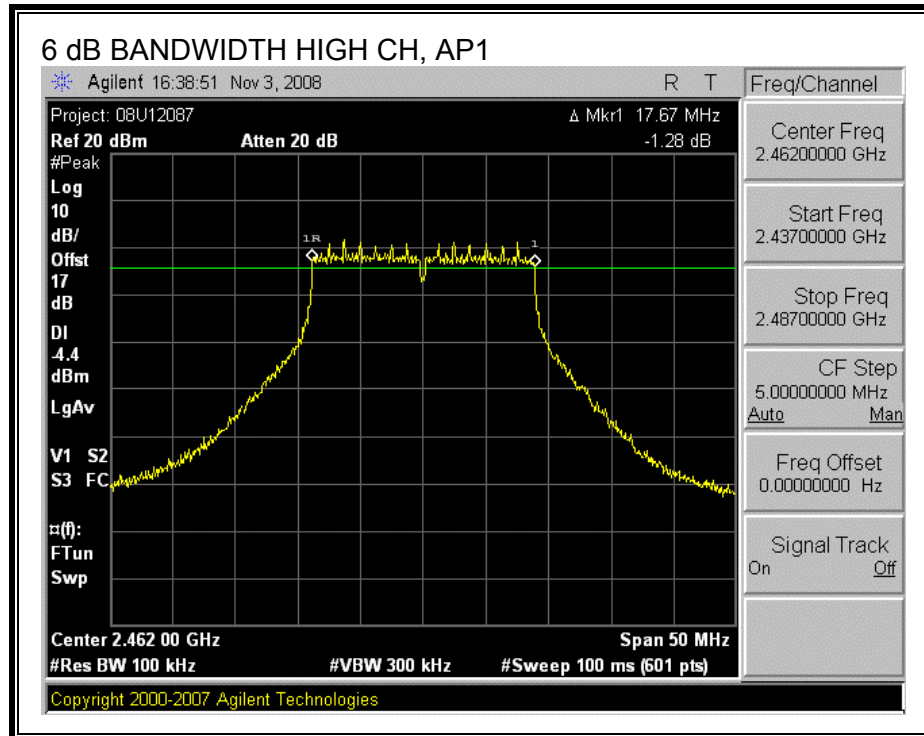
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

##### RESULTS

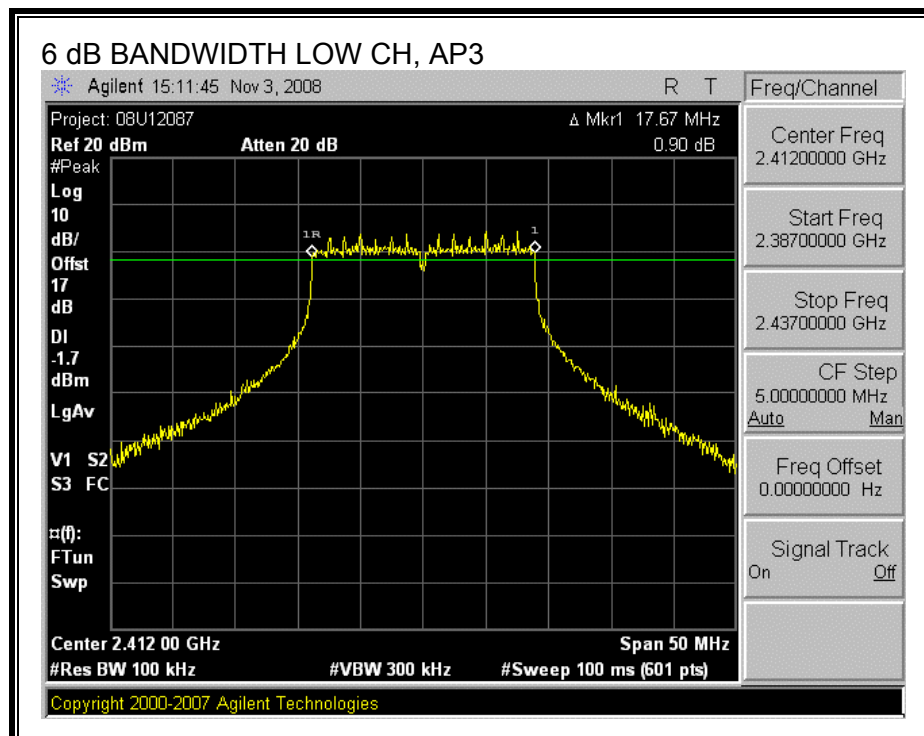
Channel	Frequency (MHz)	AP1 6 dB BW (MHz)	AP3 6 dB BW (MHz)	Minimum Limit (MHz)
Low	2412	17.67	17.67	0.5
Middle	2437	17.67	17.67	0.5
High	2462	17.67	17.67	0.5

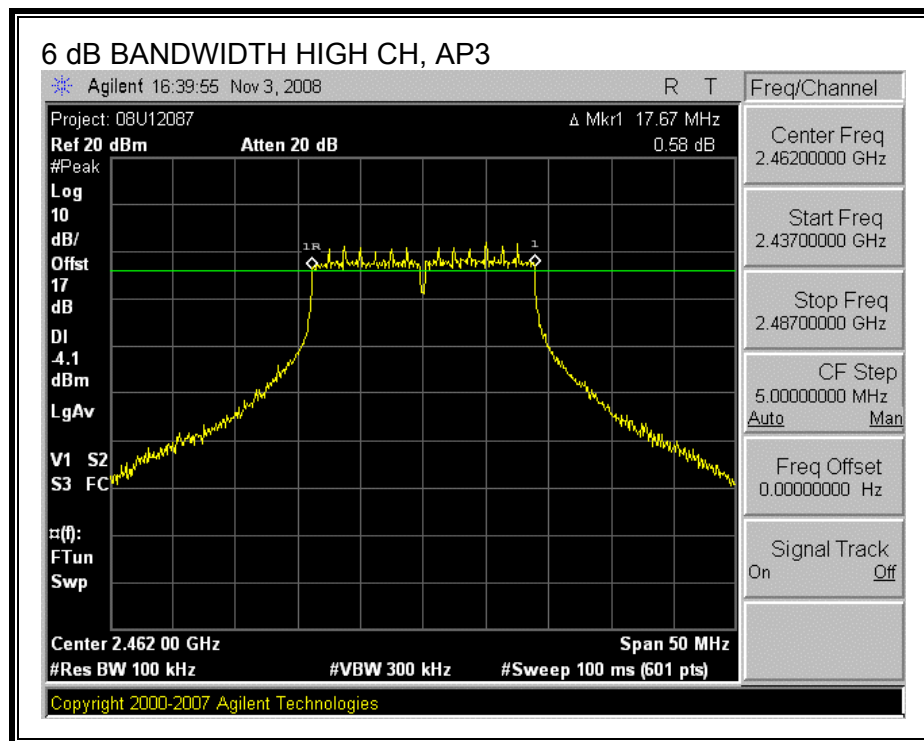
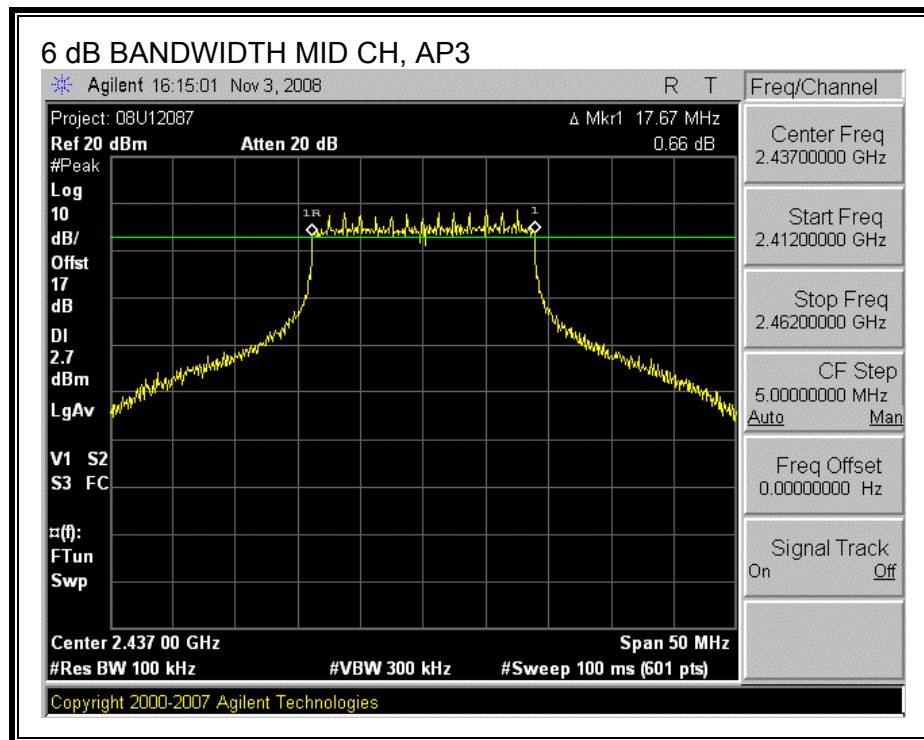
**6 dB BANDWIDTH, AP1**





**6 dB BANDWIDTH, AP3**





### 7.3.2. 26dB and 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 26dB (99 %) bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 26dB (99%) bandwidth function is utilized.

#### RESULTS

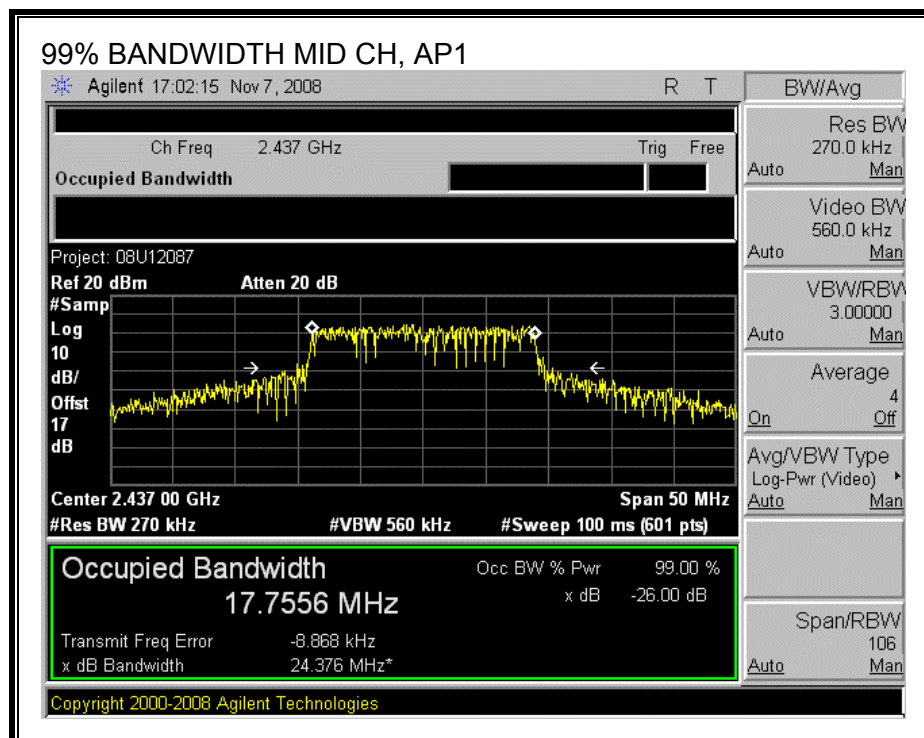
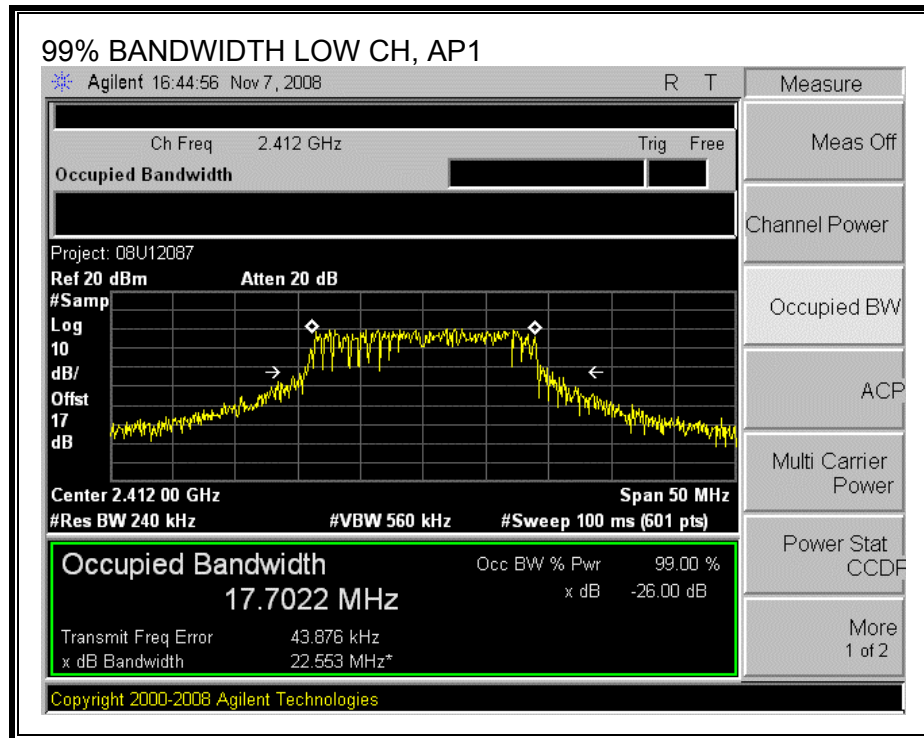
##### 99% BANDWIDTH

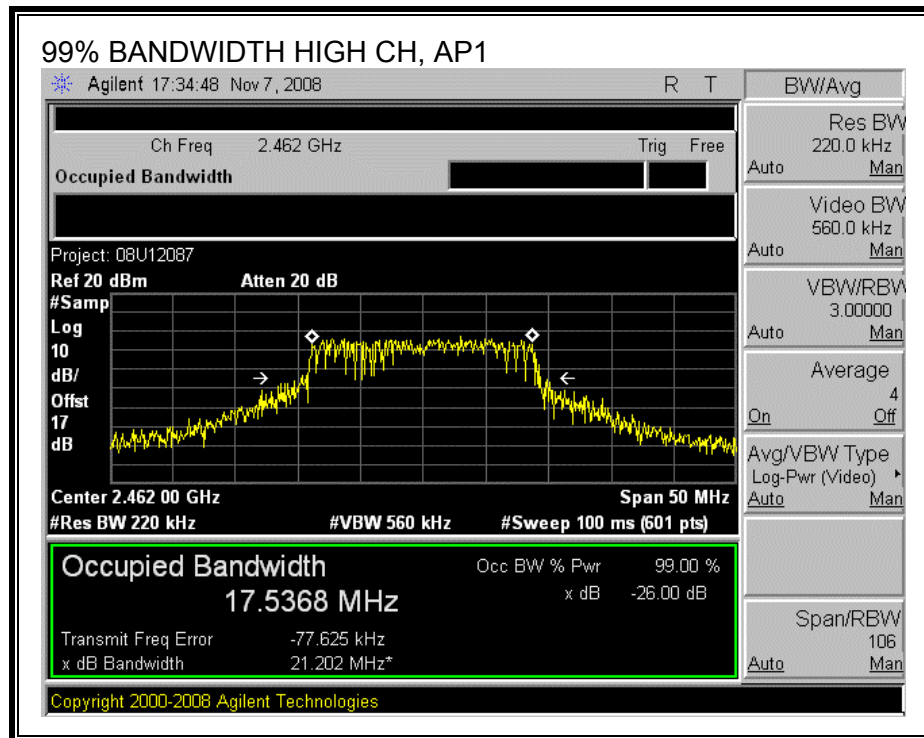
Channel	Frequency (MHz)	AP1 99% Bandwidth (MHz)	AP3 99% Bandwidth (MHz)
Low	2412	17.7022	17.6602
Middle	2437	17.7556	17.7974
High	2462	17.5368	17.7462

##### 26dB BANDWIDTH

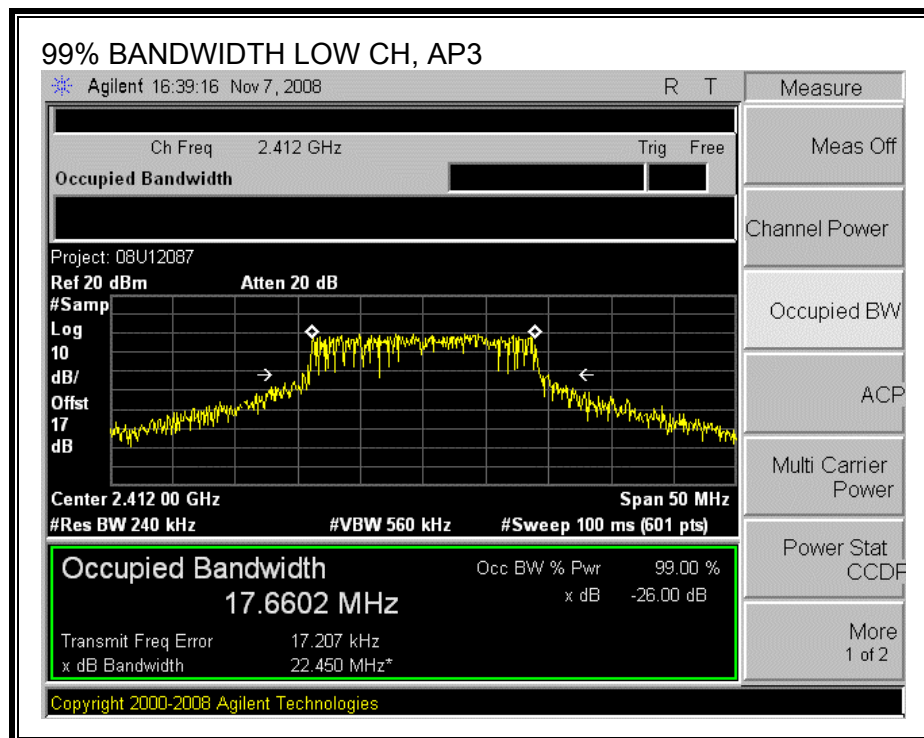
Channel	Frequency (MHz)	AP1 26dB Bandwidth (MHz)	AP3 26dB Bandwidth (MHz)
Low	2412	22.553	22.450
Middle	2437	24.376	24.413
High	2462	21.202	21.479

**26dB and 99% BANDWIDTH, AP1**

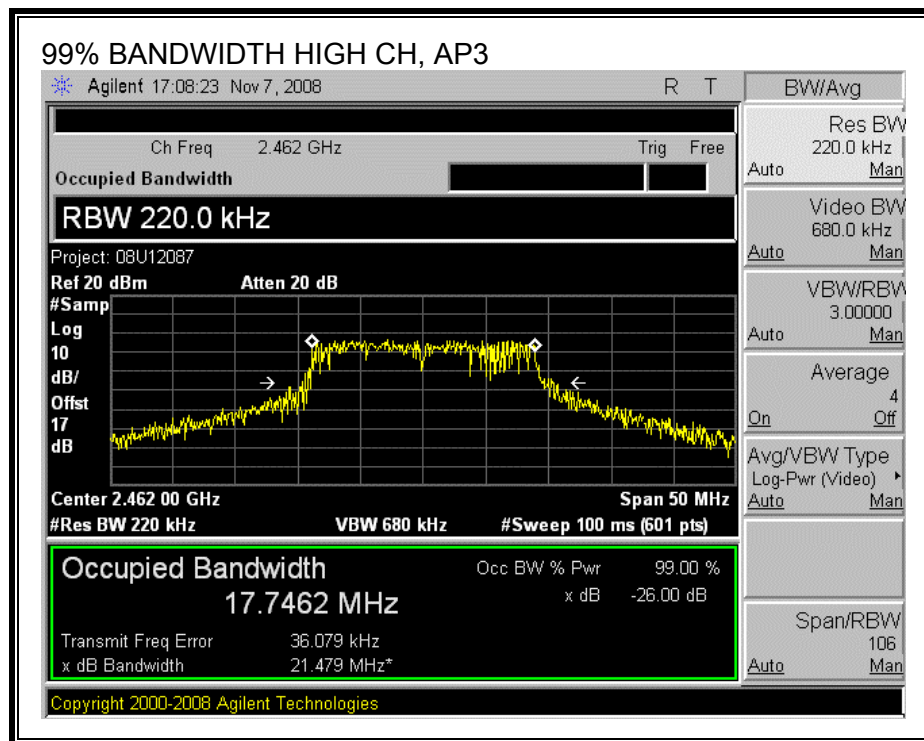
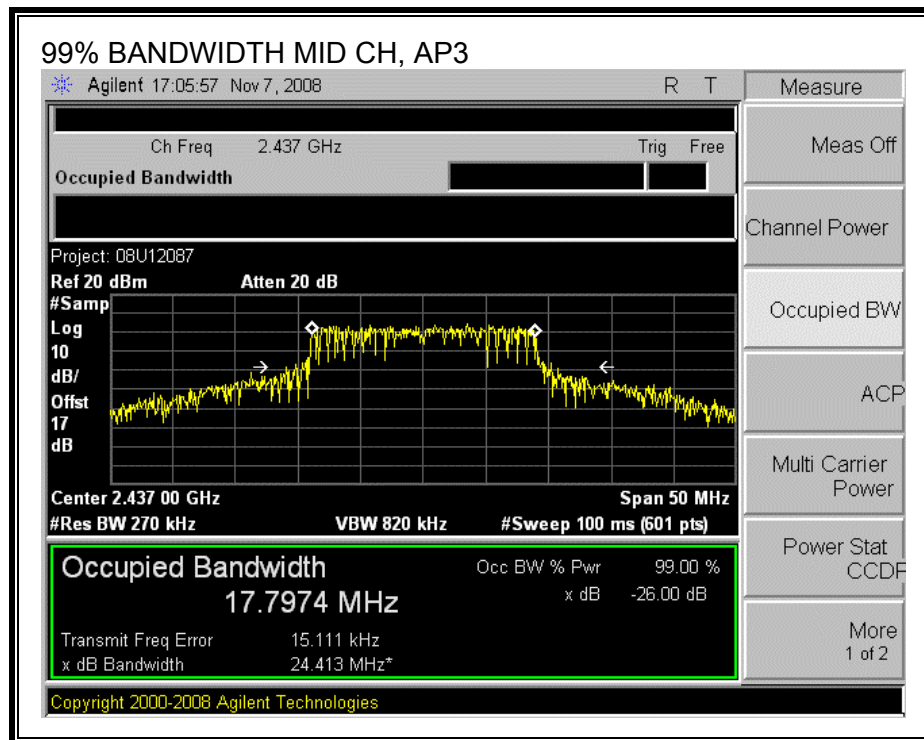




**26dB and 99% BANDWIDTH, AP3**







### 7.3.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain of **3.49 dBi** is less than or equal to 6 dBi, therefore the limit is 30 dBm.

#### TEST PROCEDURE

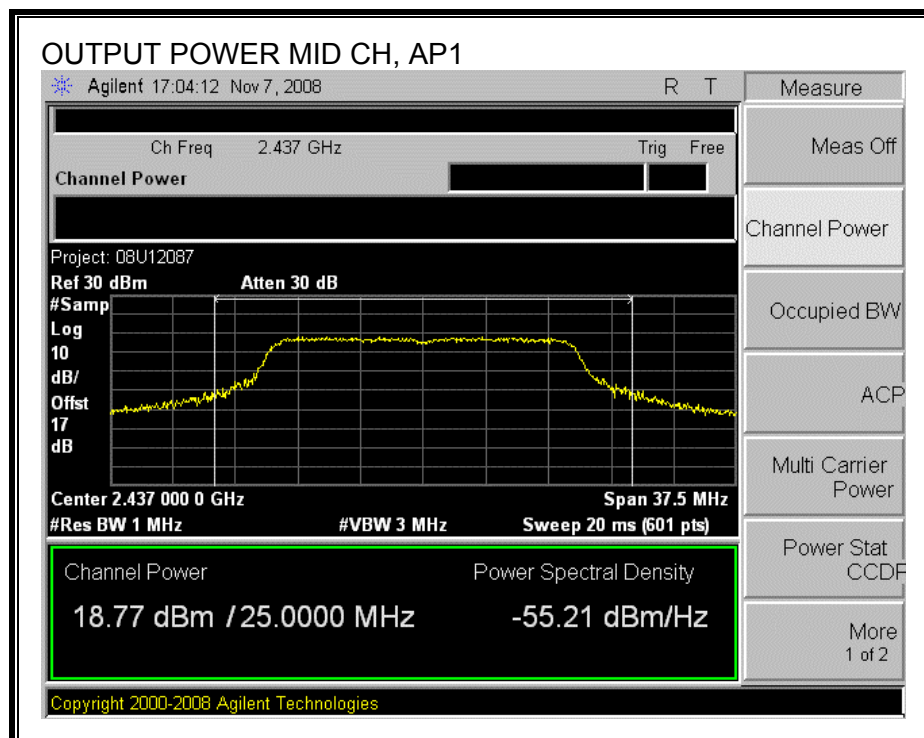
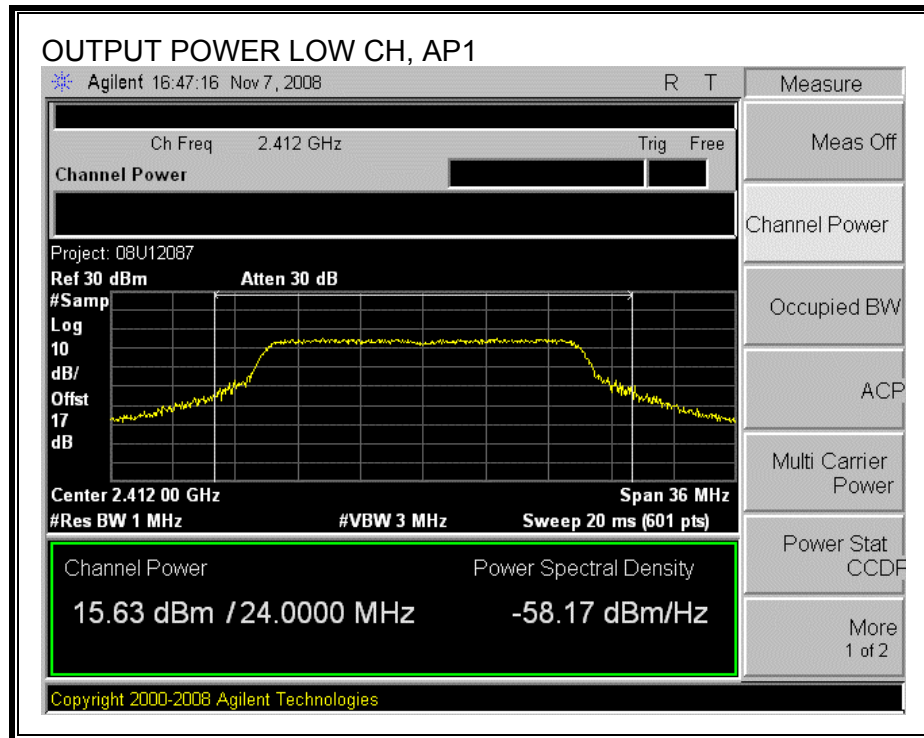
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

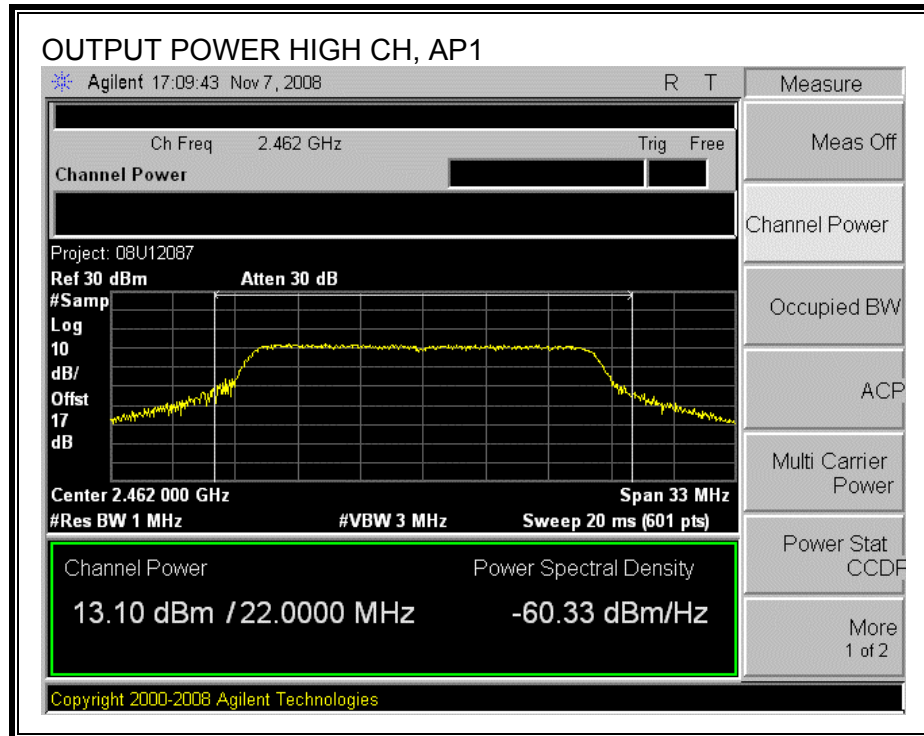
Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

#### RESULTS

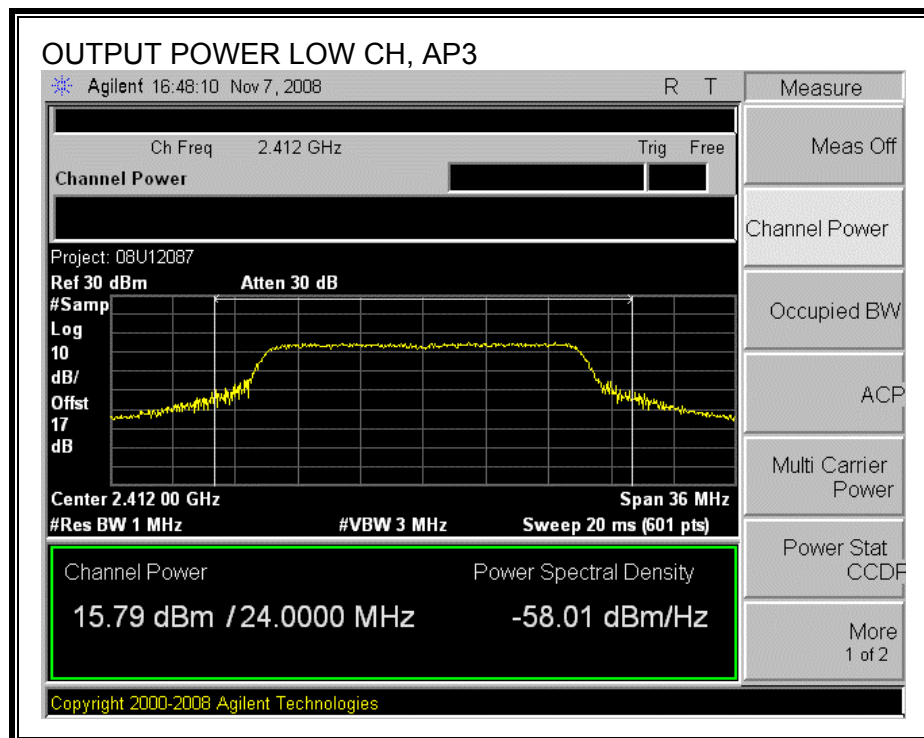
Channel	Frequency (MHz)	Limit (dBm)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	2412	30.00	15.63	15.79	18.72	-11.28
Mid	2437	30.00	18.77	19.88	22.37	-7.63
High	2462	30.00	13.10	12.75	15.94	-14.06

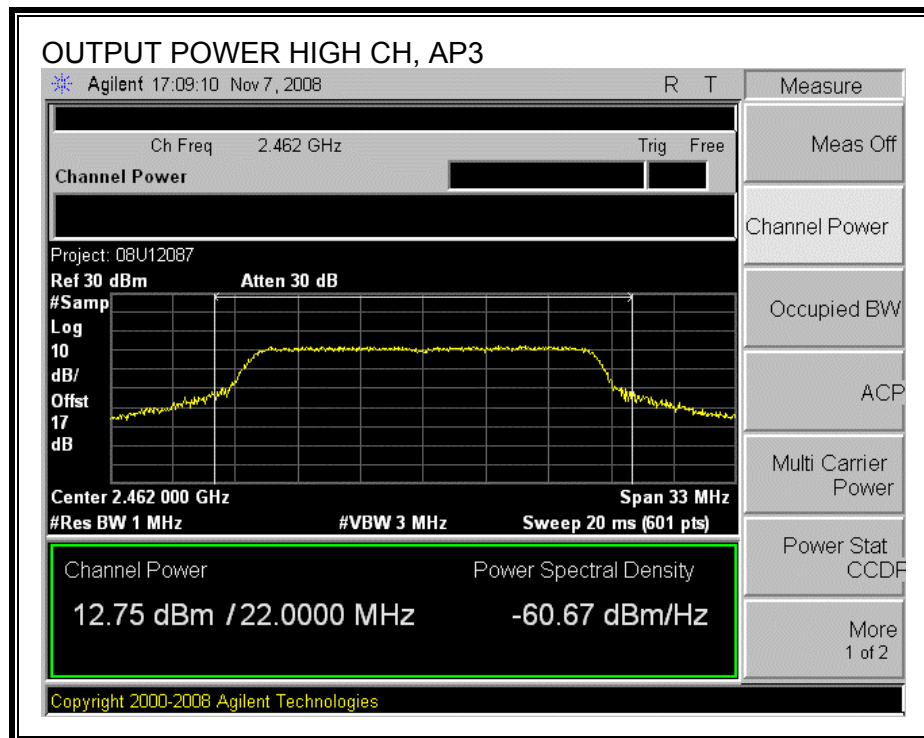
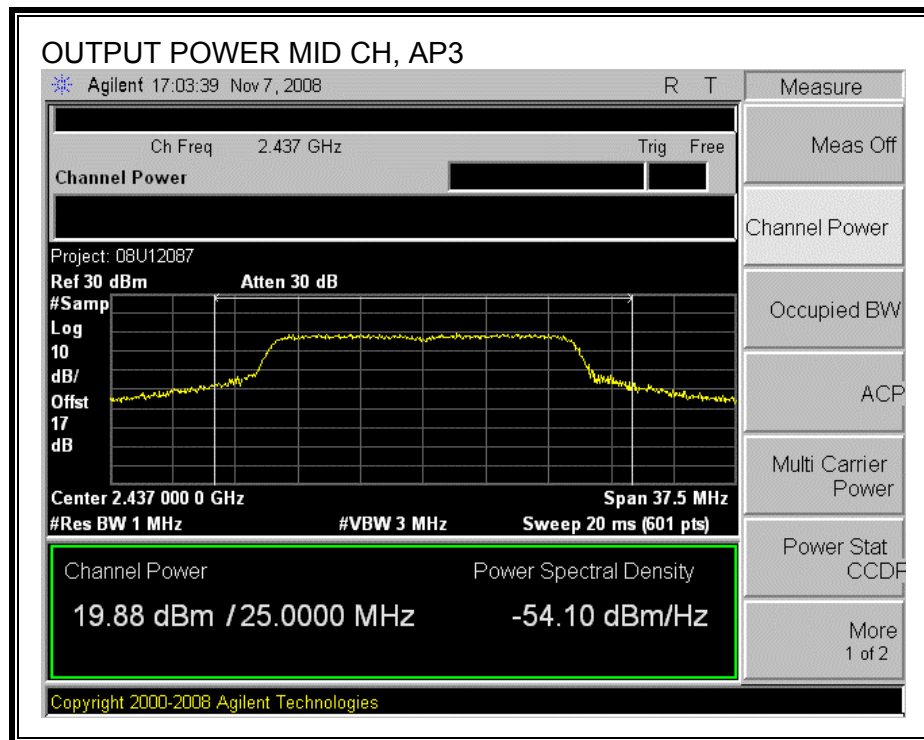
## AP1 OUTPUT POWER





**AP3 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.

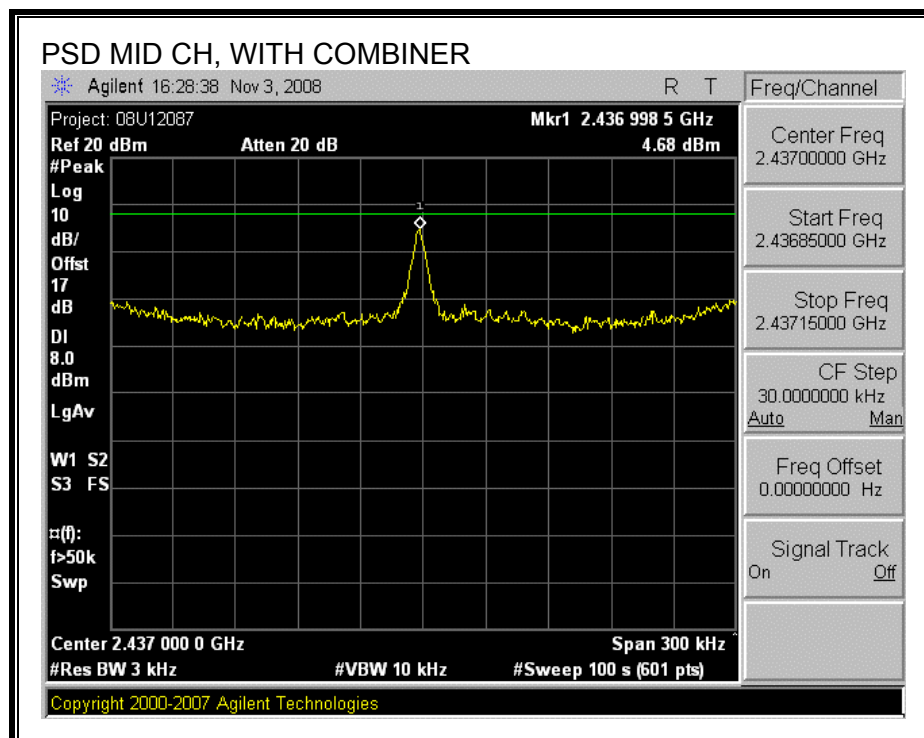
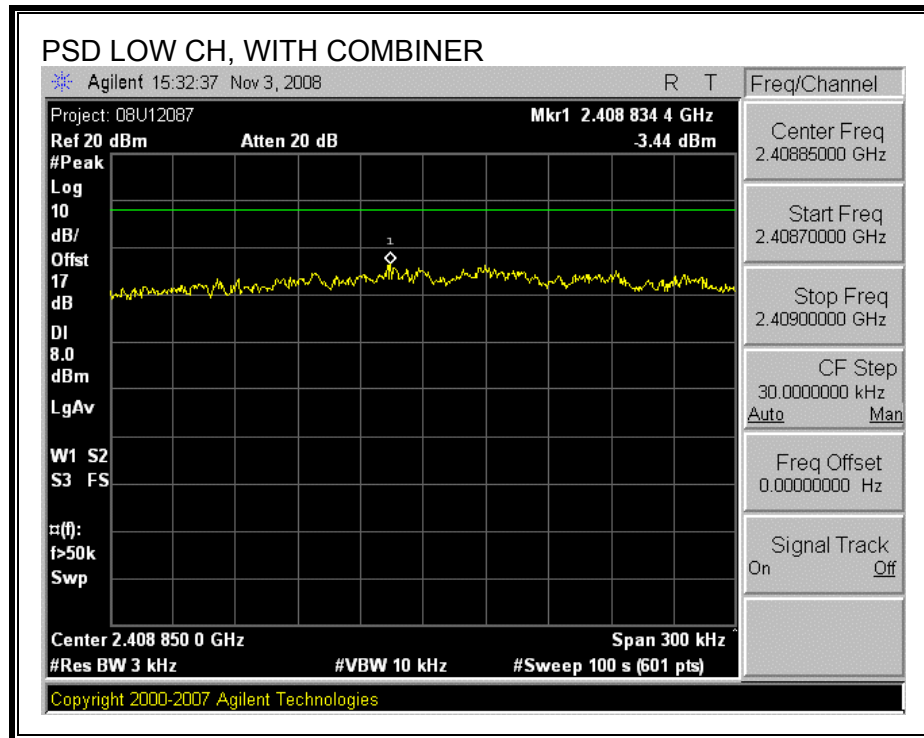
#### **TEST PROCEDURE**

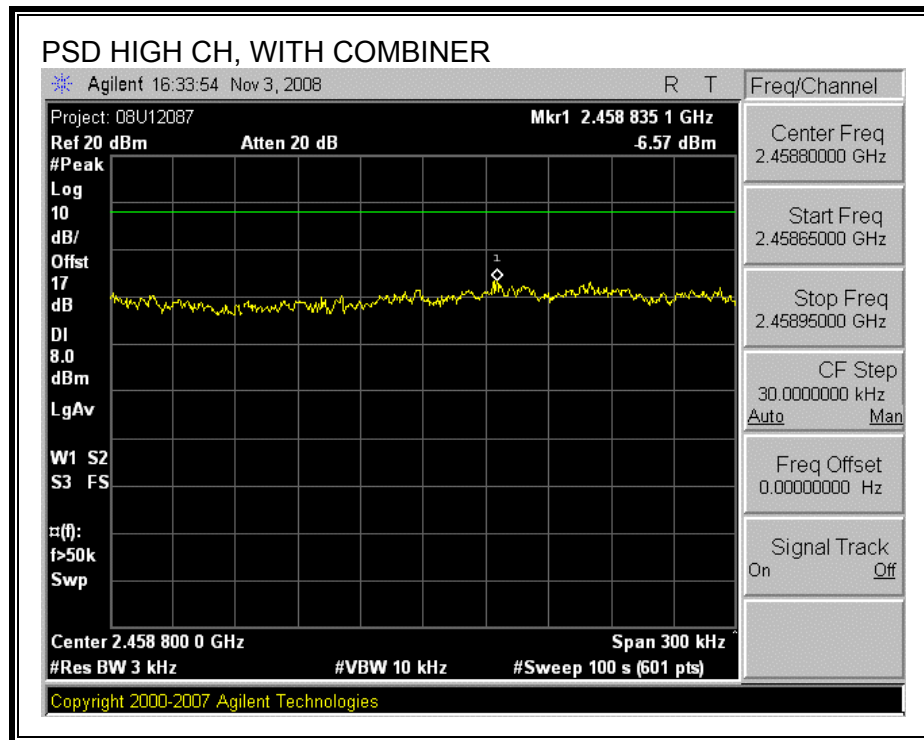
“Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

#### **RESULTS**

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-3.44	8	-11.44
Middle	2437	4.68	8	-3.32
High	2462	-6.57	8	-14.57

# **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.

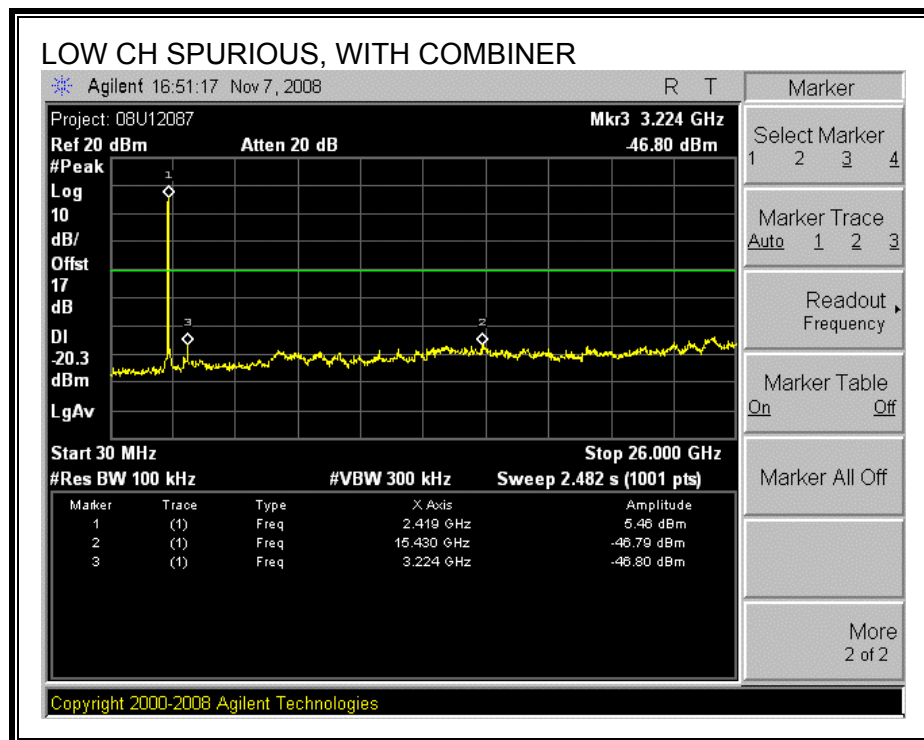
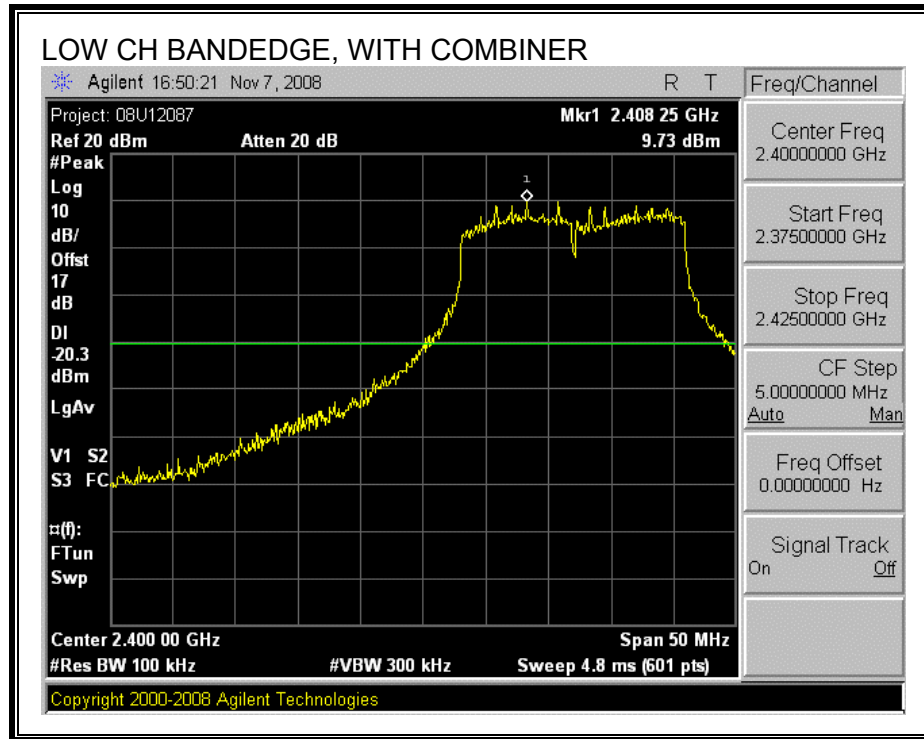
#### **TEST PROCEDURE**

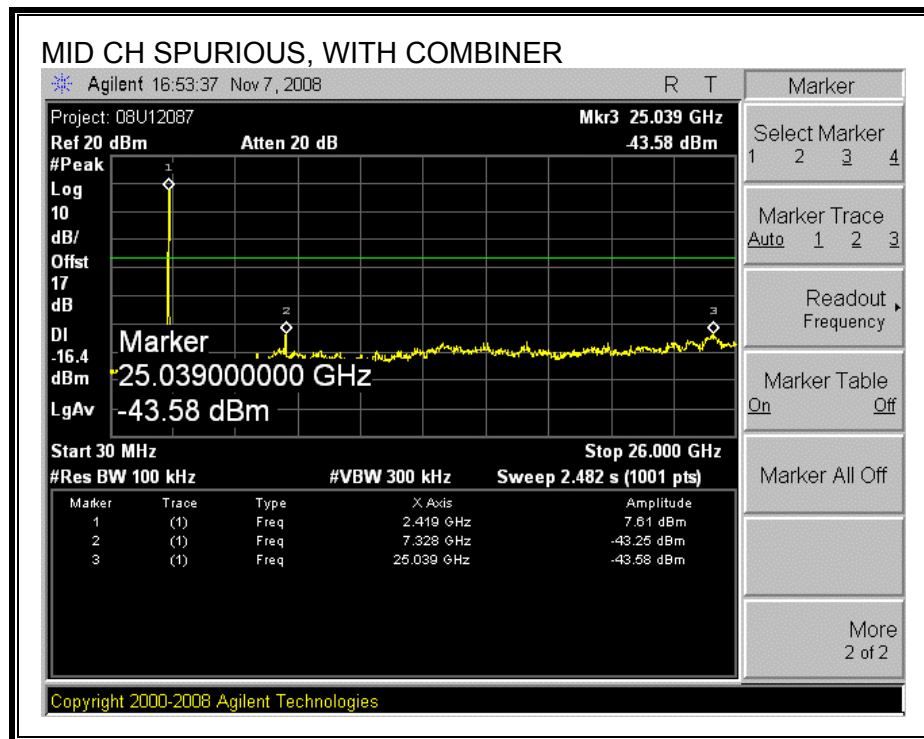
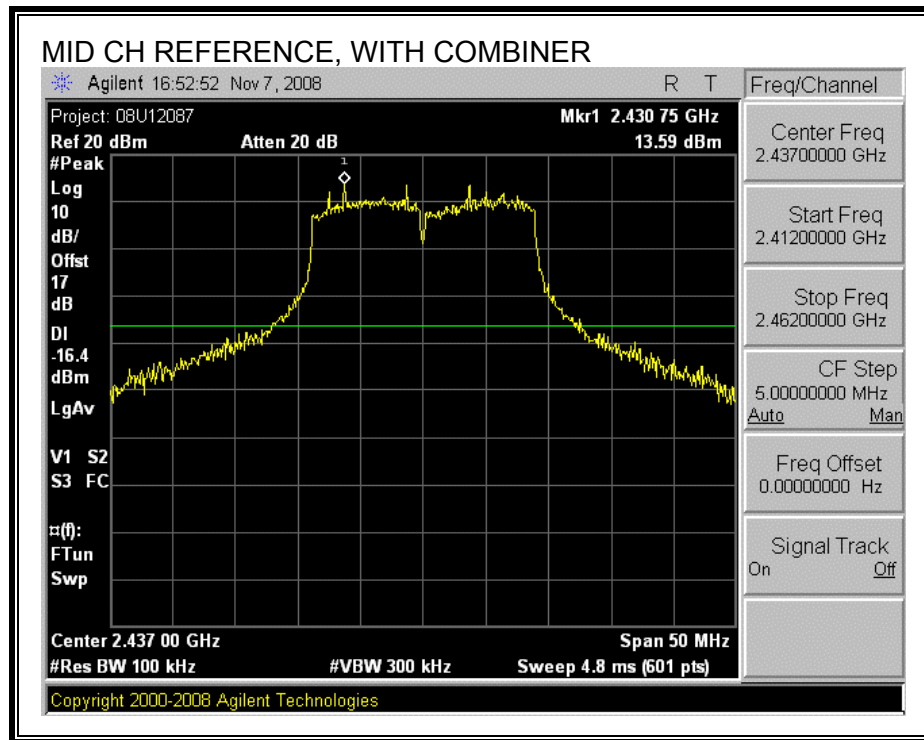
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

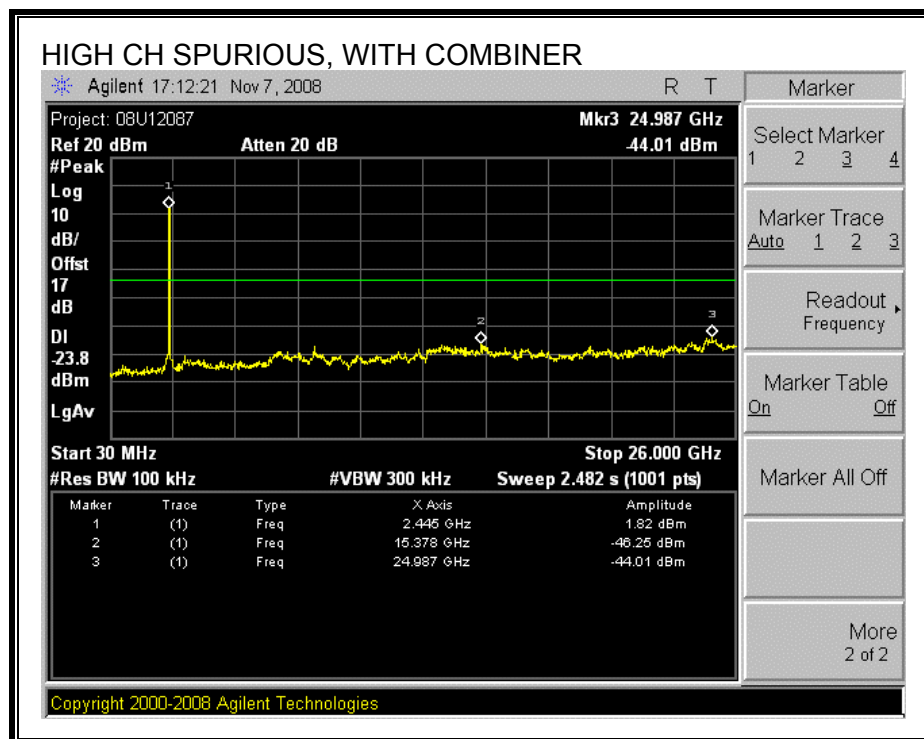
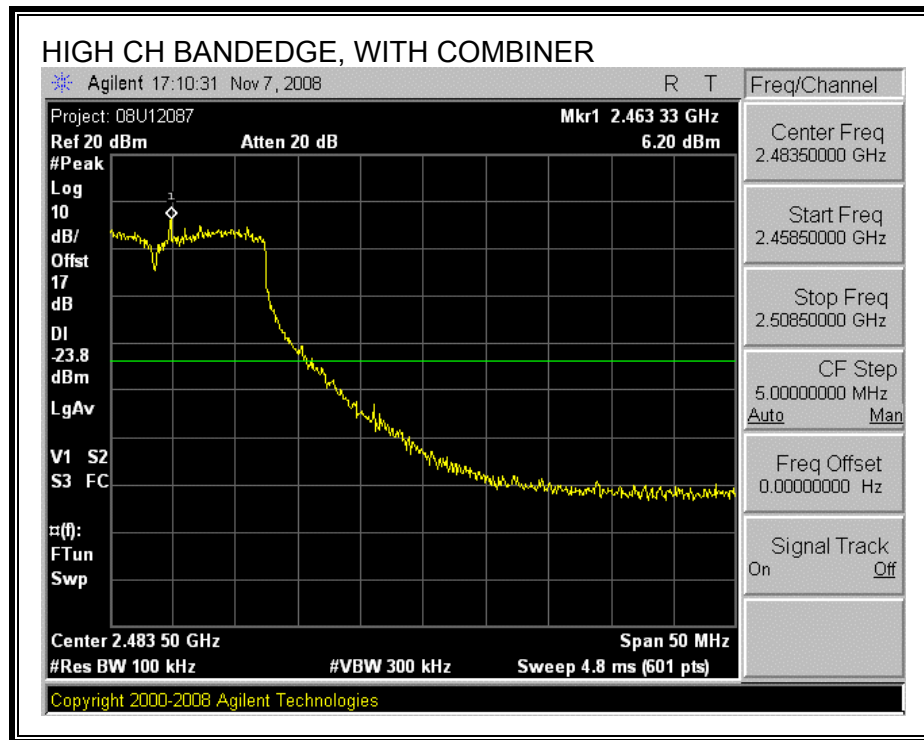
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

## RESULTS

### SPURIOUS EMISSIONS WITH COMBINER







## 7.4. 802.11a 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.

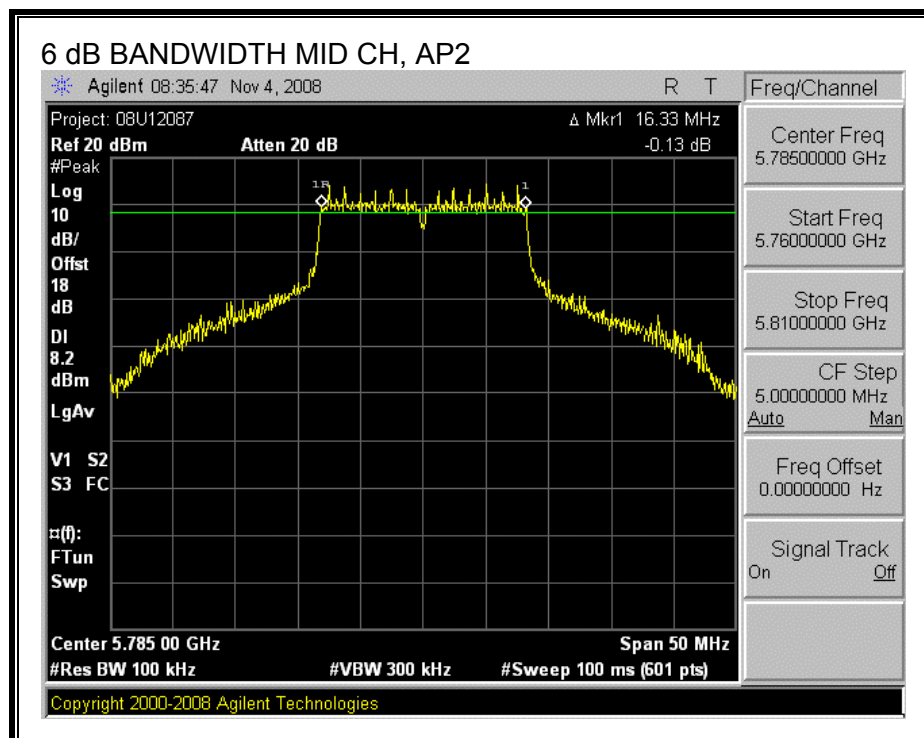
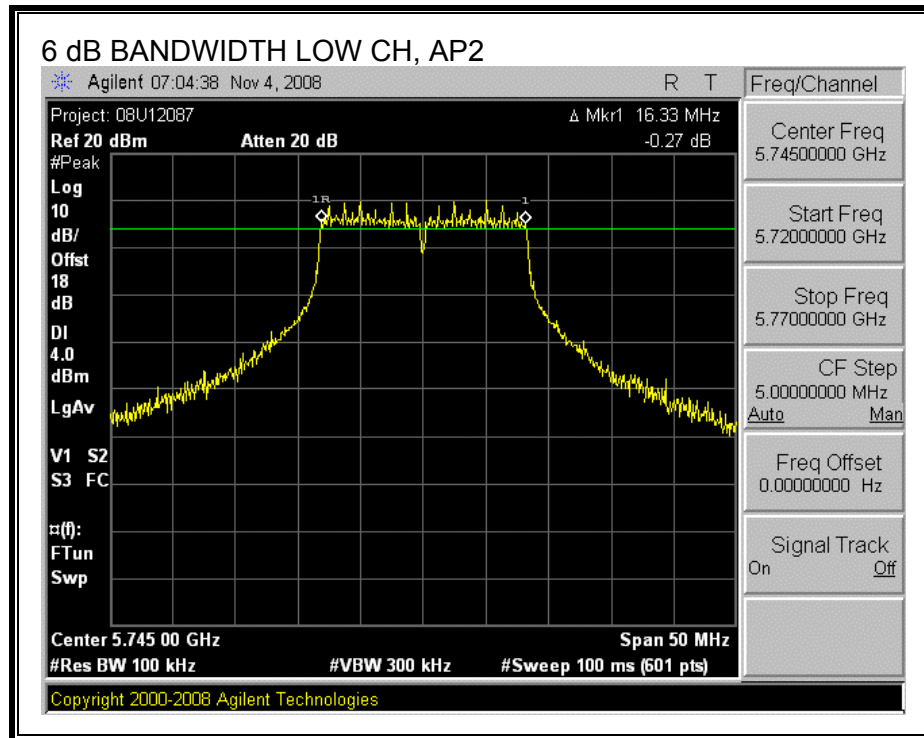
#### TEST PROCEDURE

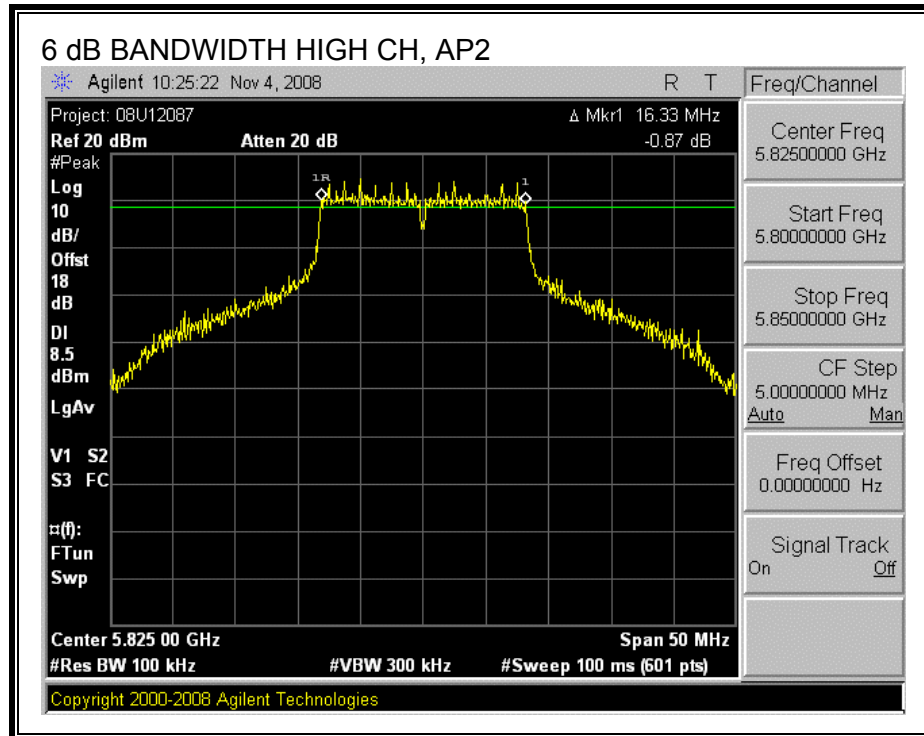
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### RESULTS

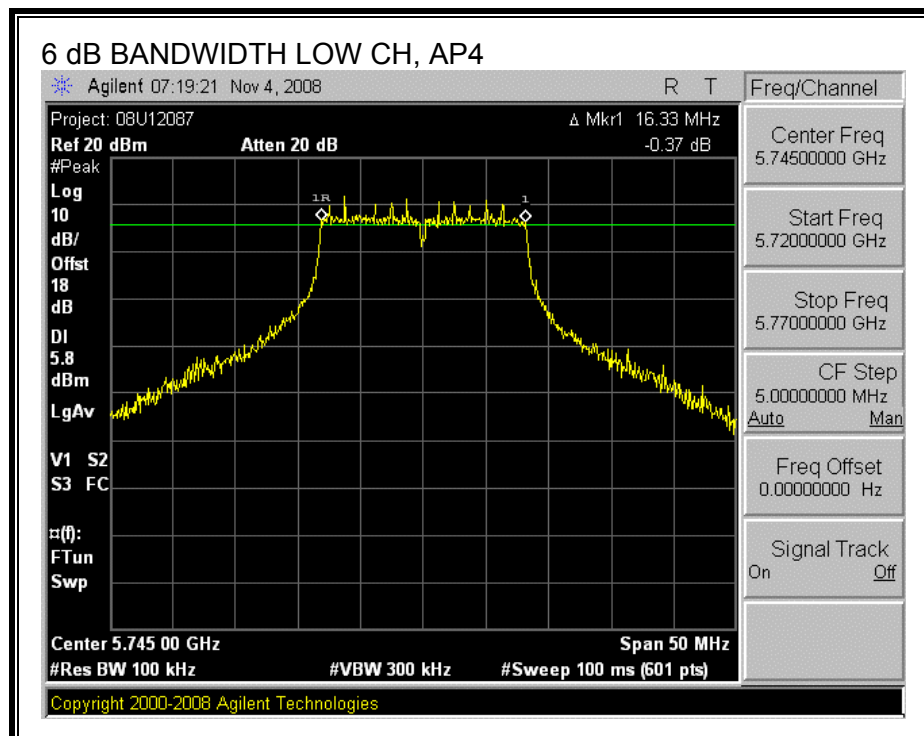
Channel	Frequency (MHz)	AP2 6 dB BW (MHz)	AP4 6 dB BW (MHz)	Minimum Limit (MHz)
Low	5745	16.33	16.33	0.5
Middle	5785	16.33	16.33	0.5
High	5825	16.33	16.42	0.5

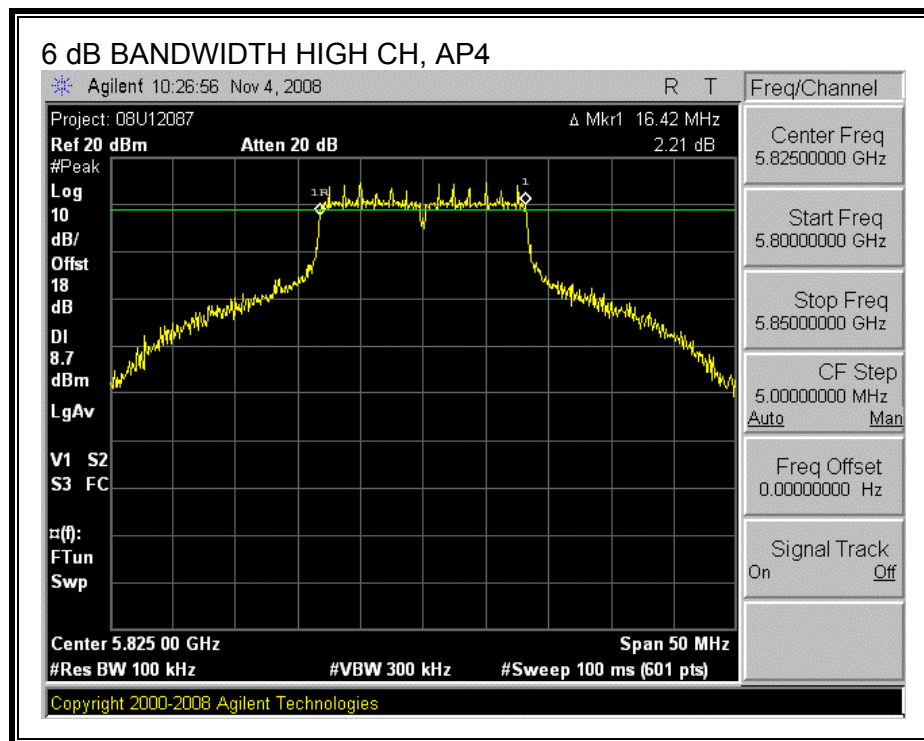
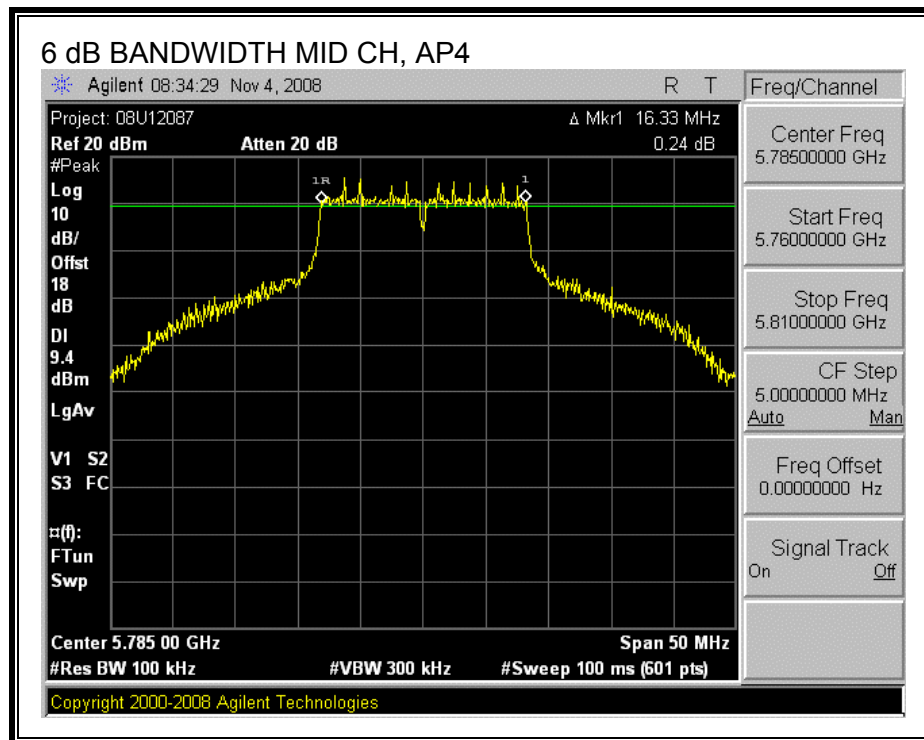
## 6 dB BANDWIDTH, AP2





**6 dB BANDWIDTH, AP4**







## 7.4.2. 26 and 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

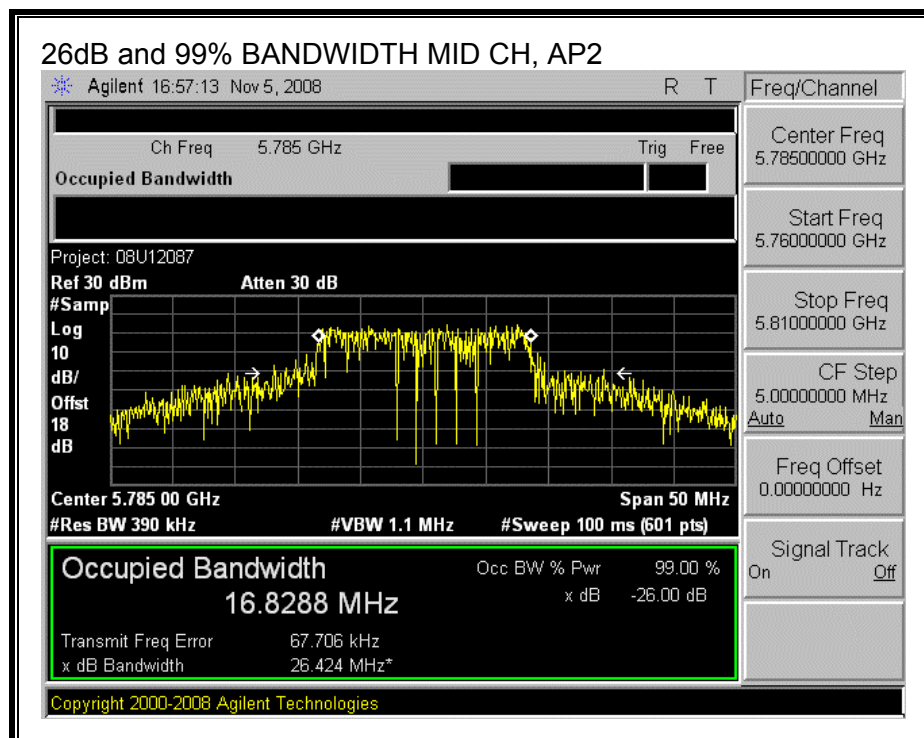
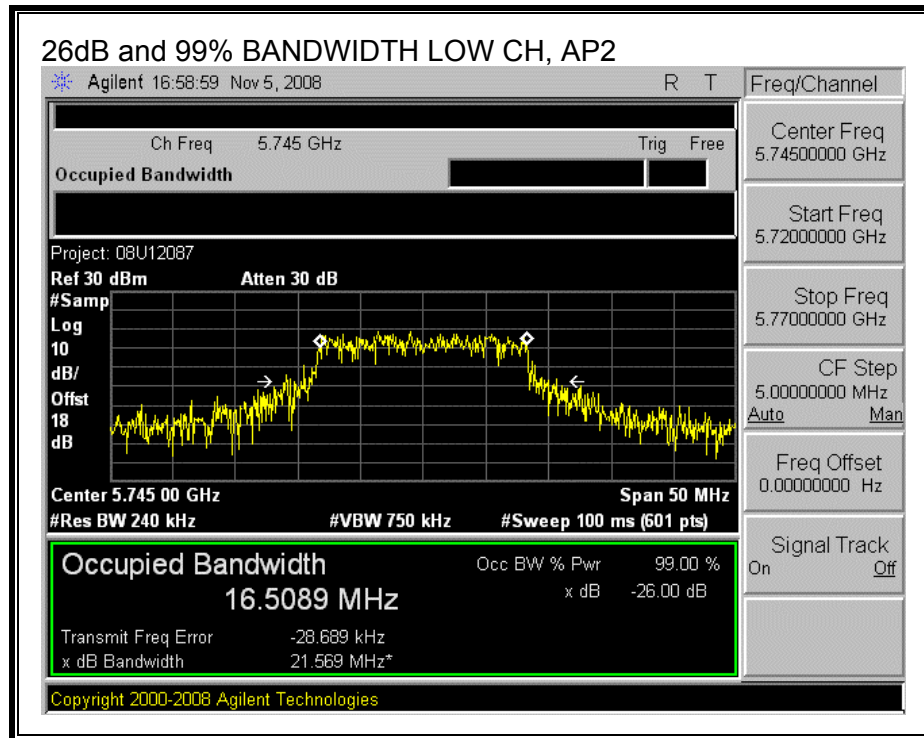
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

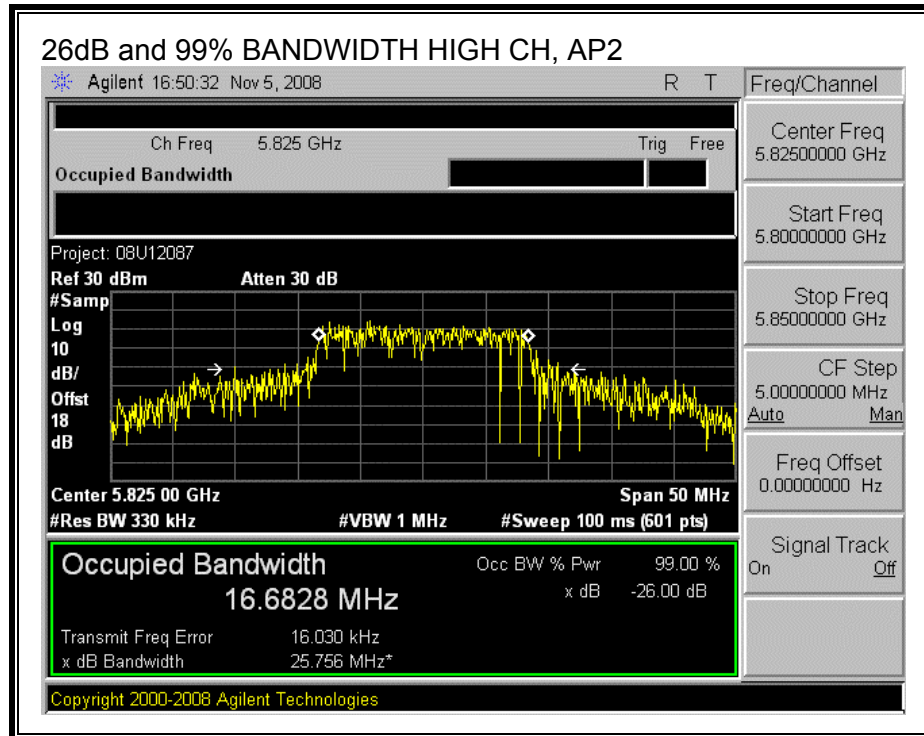
### RESULTS

Channel	Frequency (MHz)	AP2 99% Bandwidth (MHz)	AP4 99% Bandwidth (MHz)
Low	5745	16.5089	16.6189
Middle	5785	16.8288	16.8360
High	5825	16.6828	16.9876

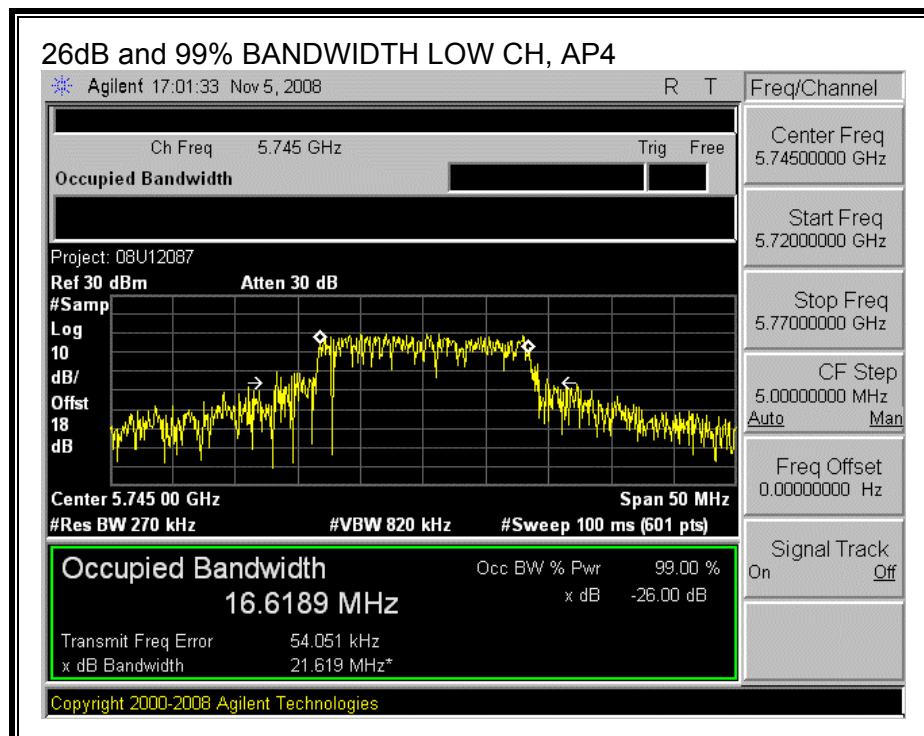
Channel	Frequency (MHz)	AP2 26 dB Bandwidth (MHz)	AP 4 26 dB Bandwidth (MHz)
Low	5745	21.569	21.619
Middle	5785	26.424	32.635
High	5825	25.756	33.414

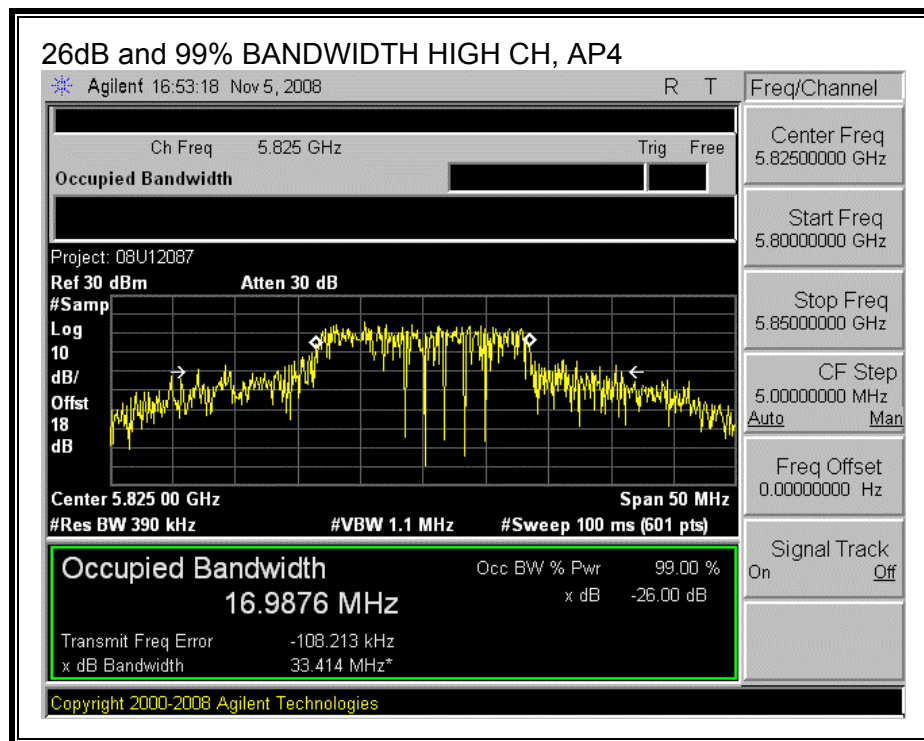
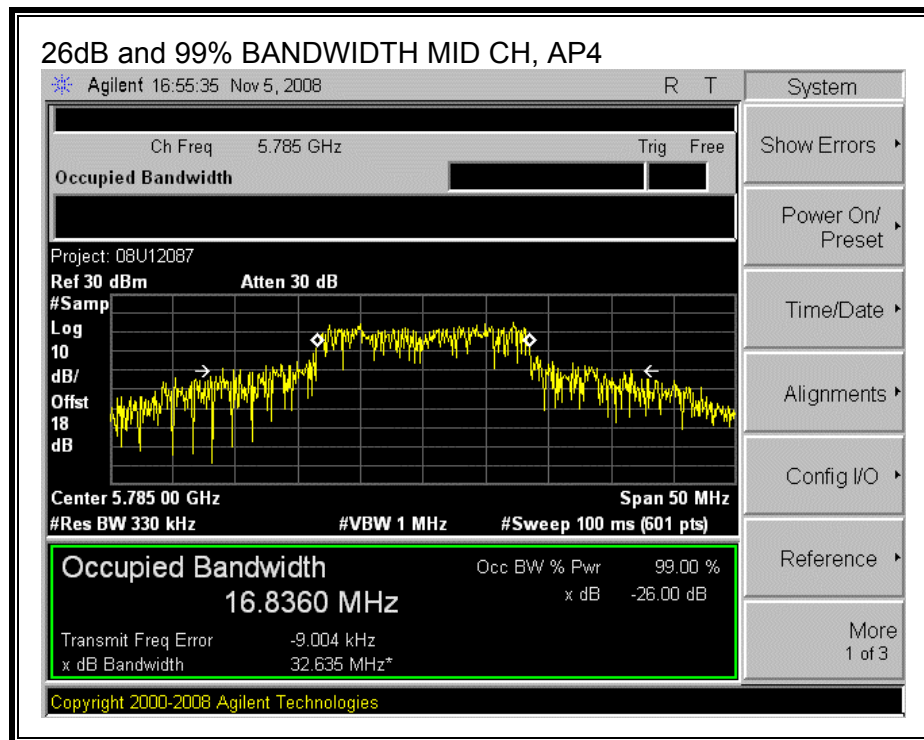
**26 dB and 26dB and 99% BANDWIDTH, AP2**





**26dB and 26dB and 99% BANDWIDTH, AP4**





### 7.4.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The combined antenna gain =  $10 \log (10^{AG1/10} + 10^{AG2/10})$

The combined antenna gain = **6.03 dBi**

The combined antenna gain is greater than 6 dBi by 0.03 dB, therefore the limit is 29.97 dBm.

#### TEST PROCEDURE

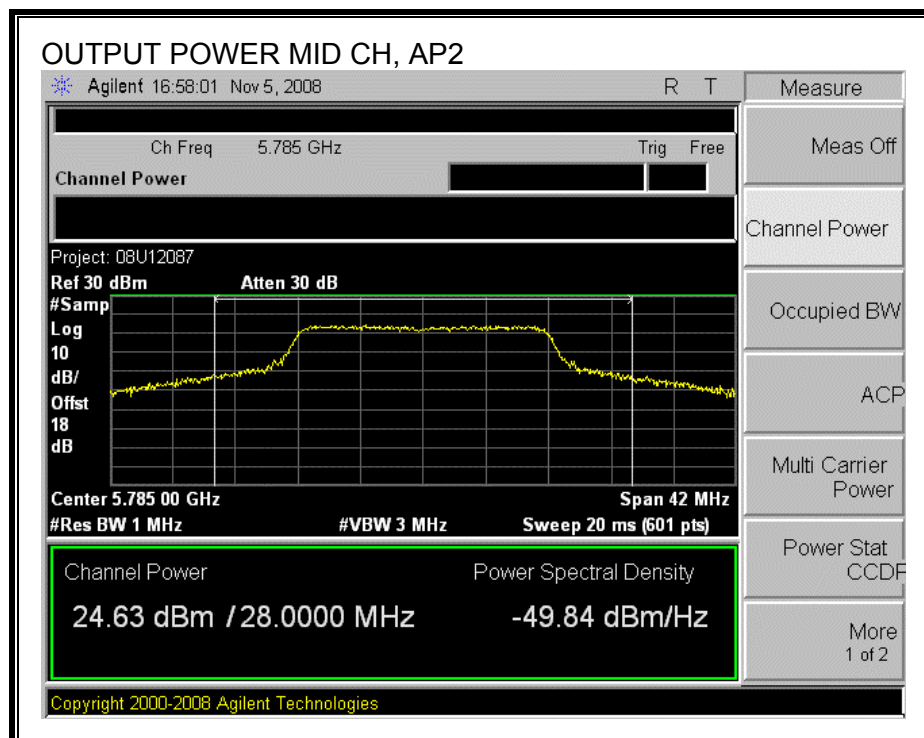
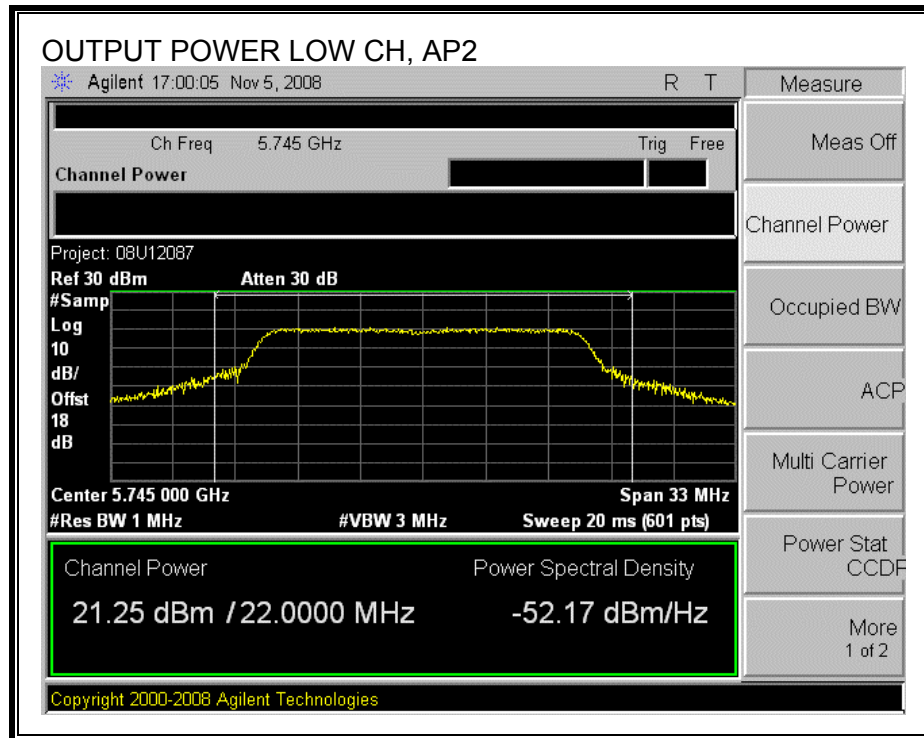
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

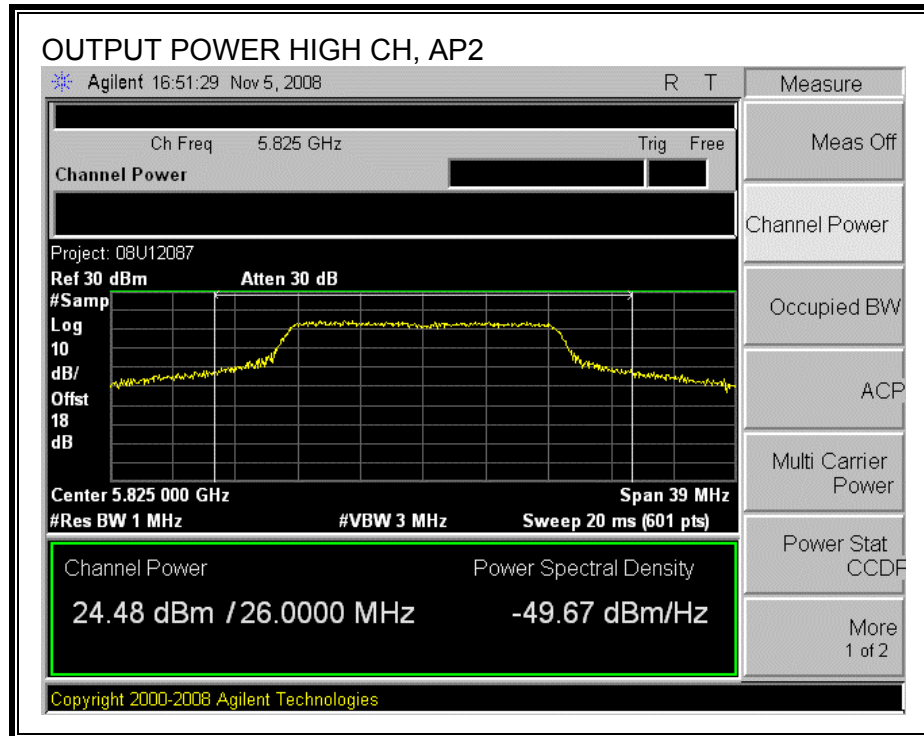
Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

#### RESULTS

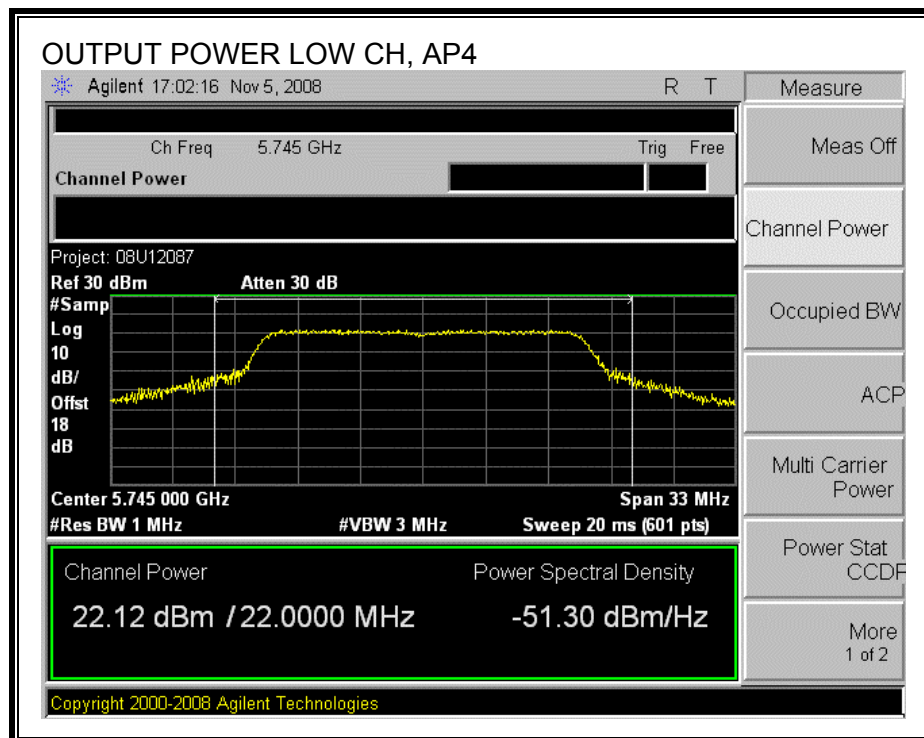
Channel	Frequency (MHz)	Limit (dBm)	AP2 Power (dBm)	AP4 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	5745	29.97	21.25	22.12	24.72	-5.25
Mid	5785	29.97	24.63	25.98	28.37	-1.60
High	5825	29.97	24.48	25.16	27.84	-2.13

## AP2 OUTPUT POWER

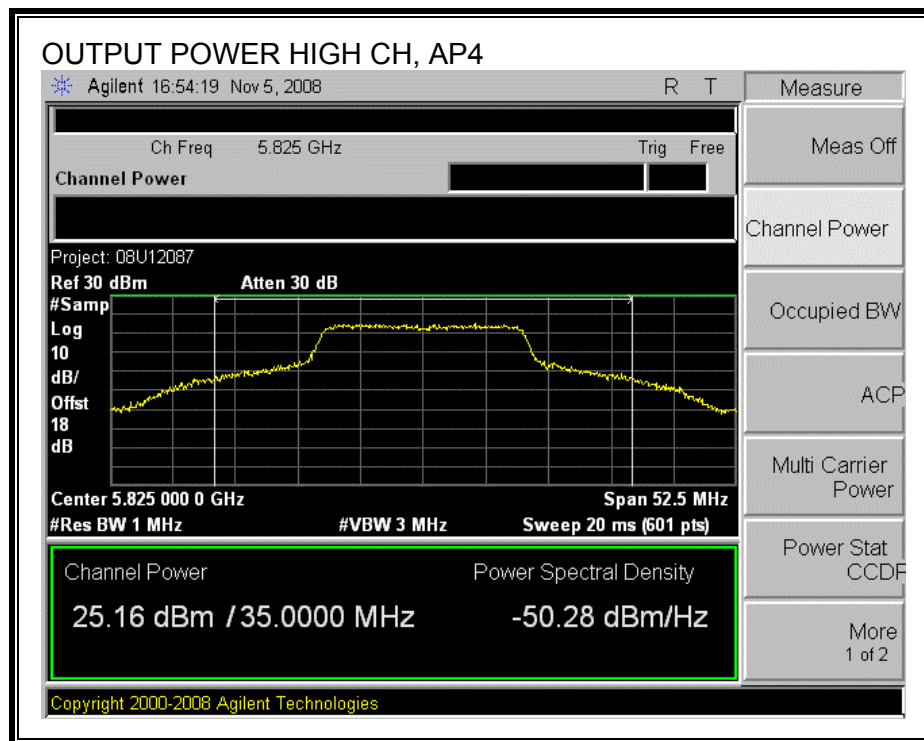
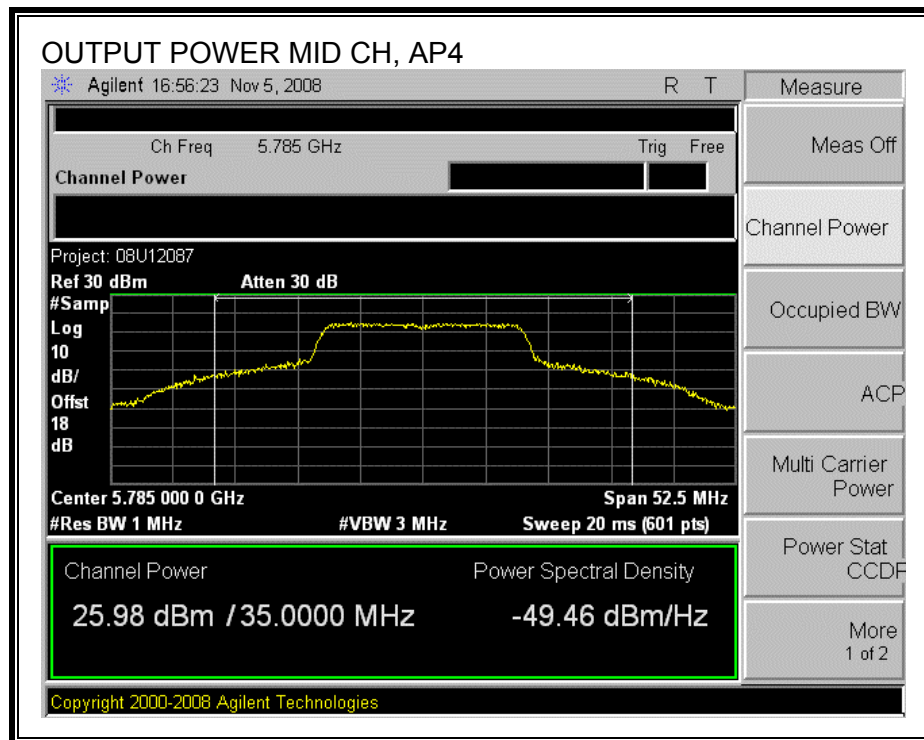




**AP4 OUTPUT POWER**









#### 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.

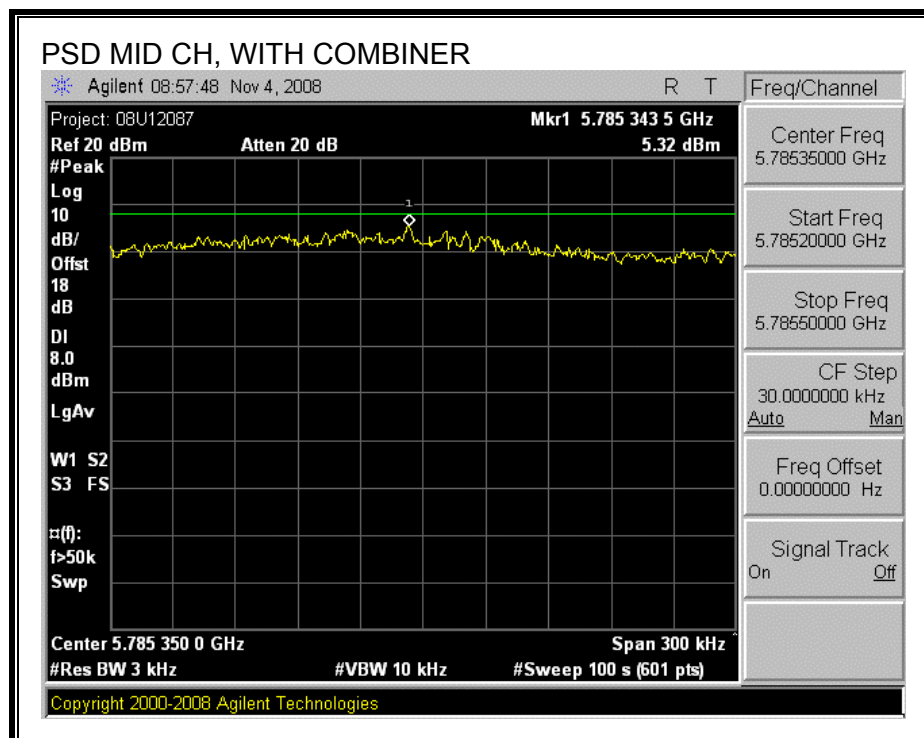
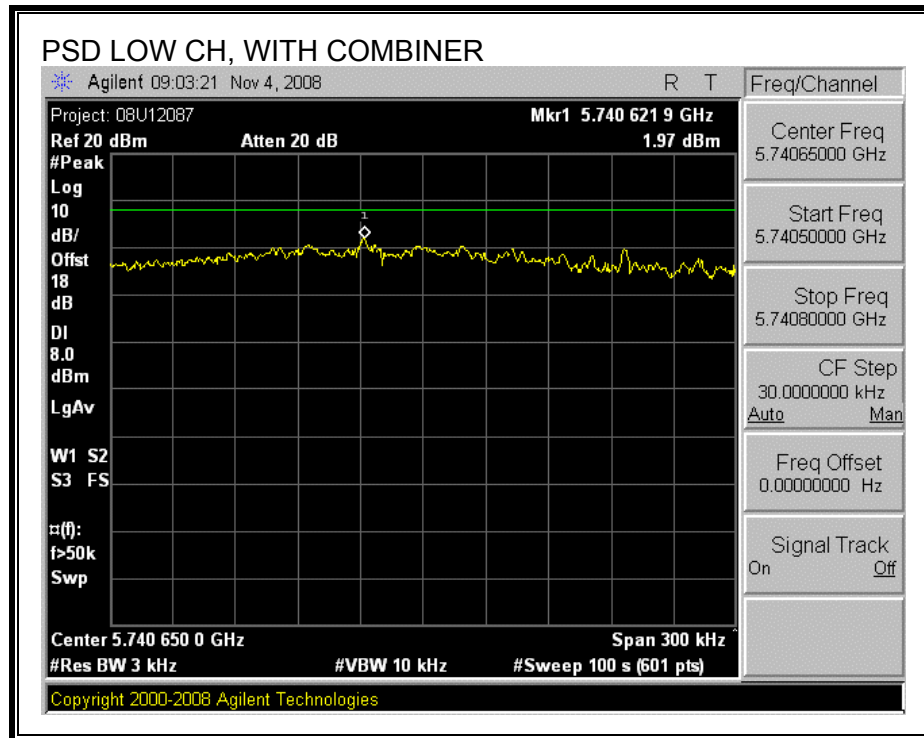
##### TEST PROCEDURE

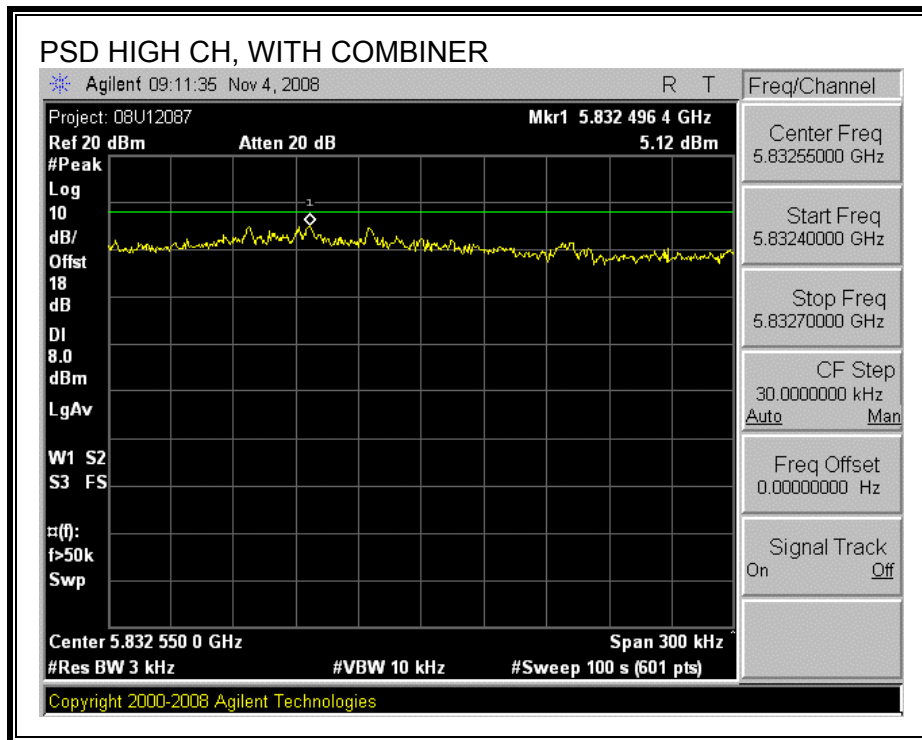
“Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

##### RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5745	1.97	8	-6.03
Middle	5785	5.32	8	-2.68
High	5825	5.12	8	-2.88

**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.

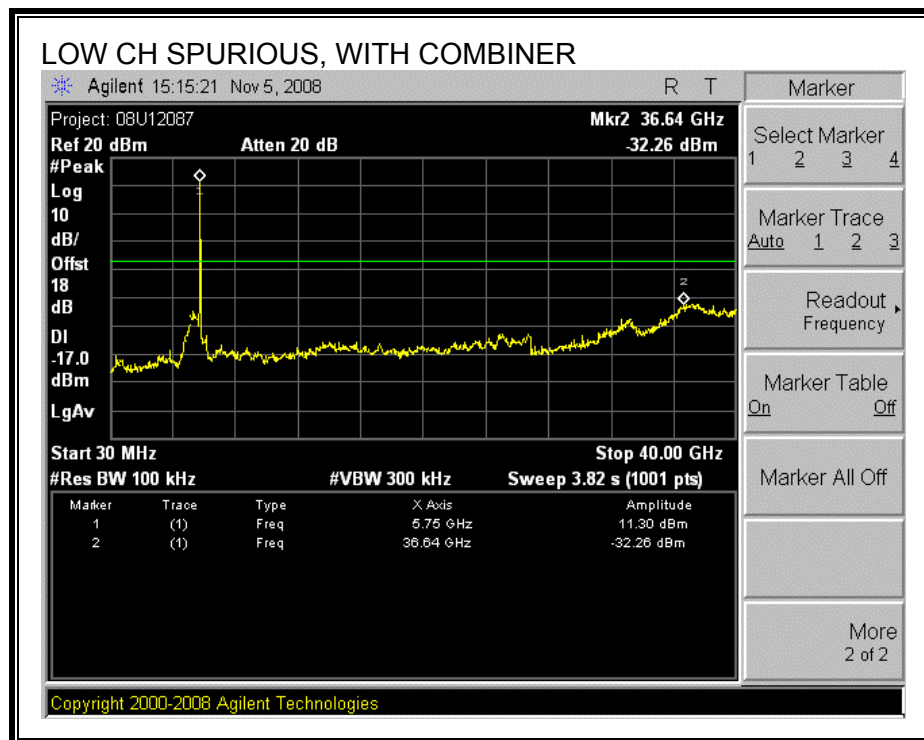
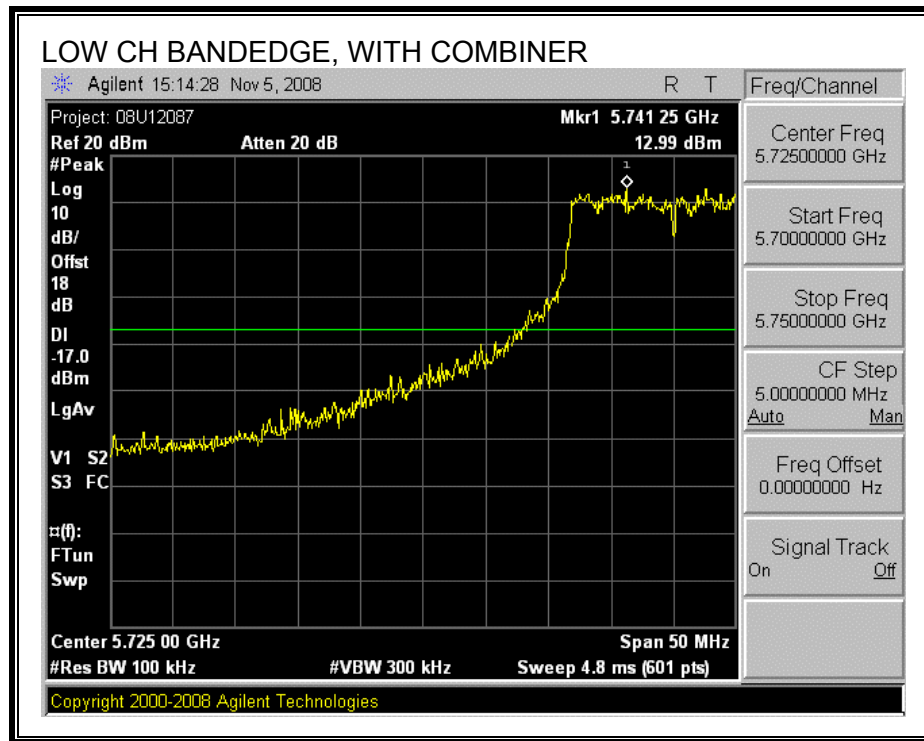
### **TEST PROCEDURE**

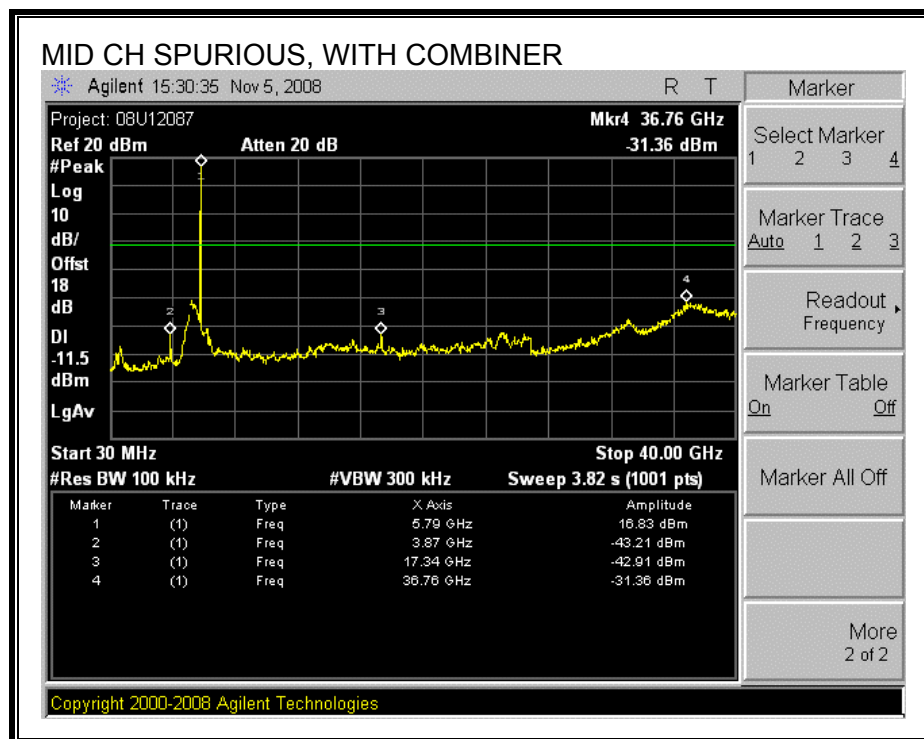
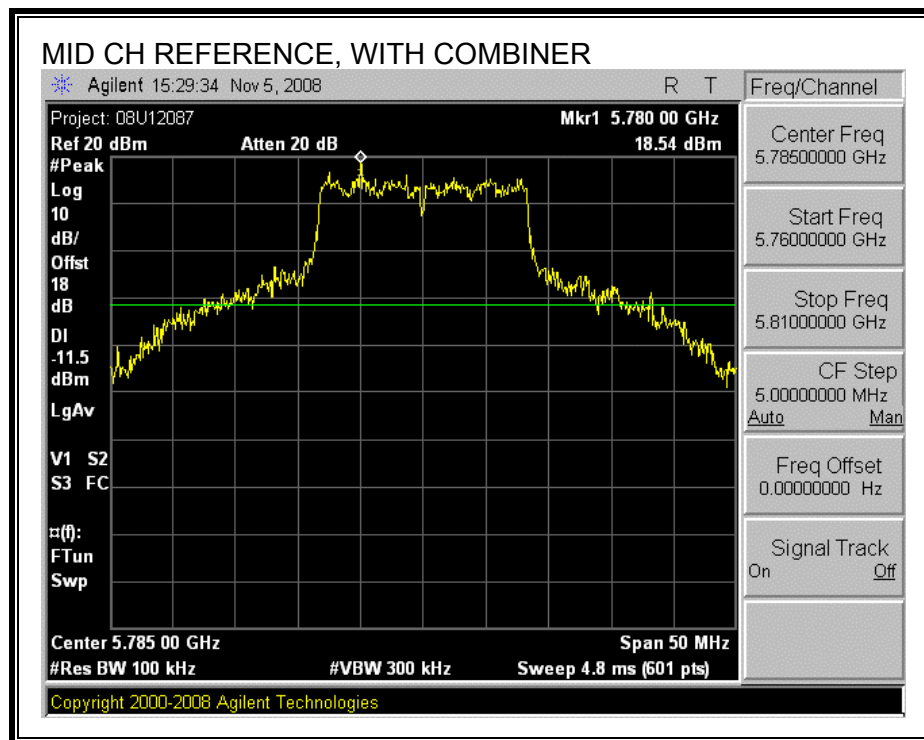
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

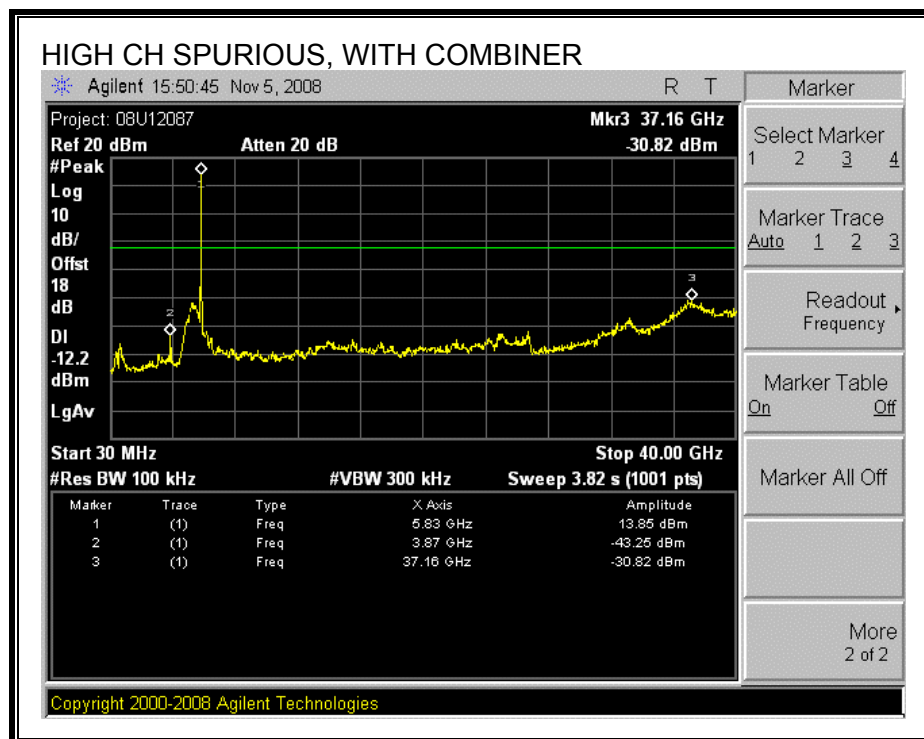
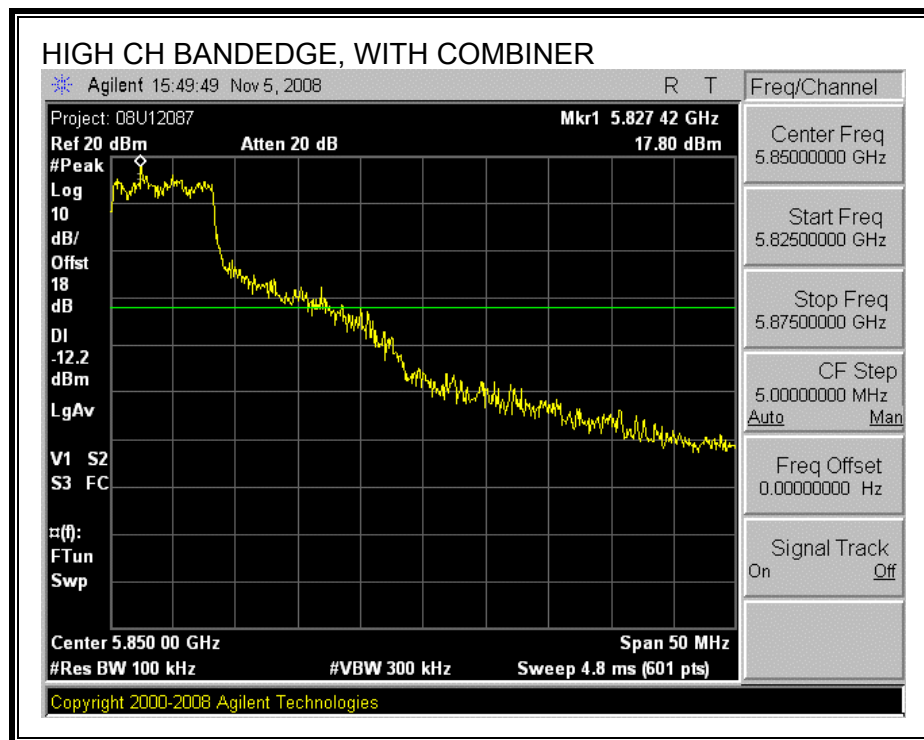
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

## RESULTS

### SPURIOUS EMISSIONS WITH COMBINER







## 7.5. 802.11n HT20 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

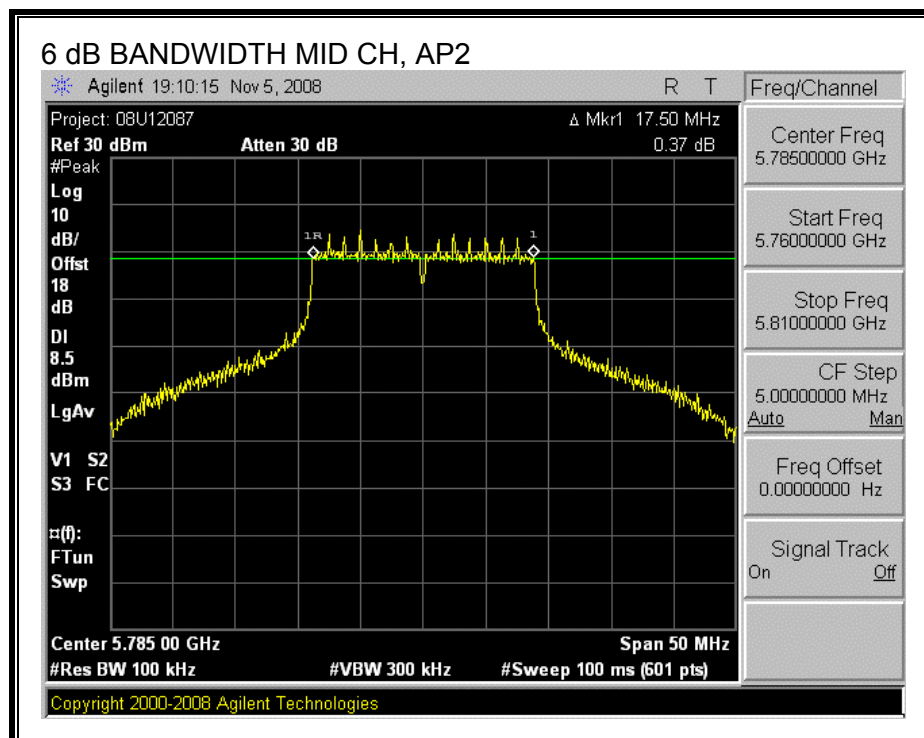
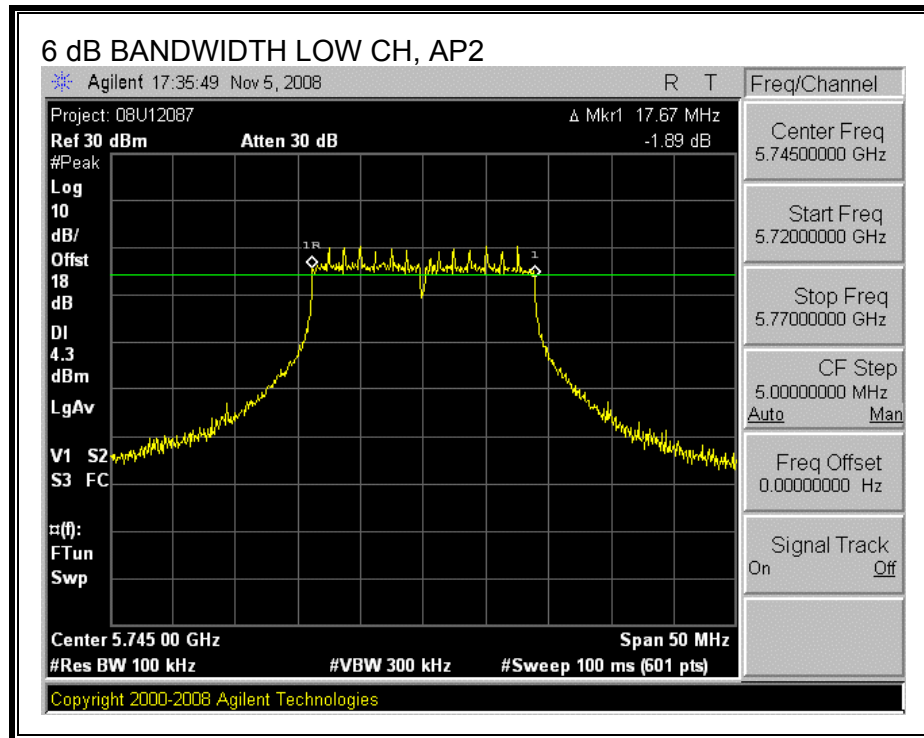
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

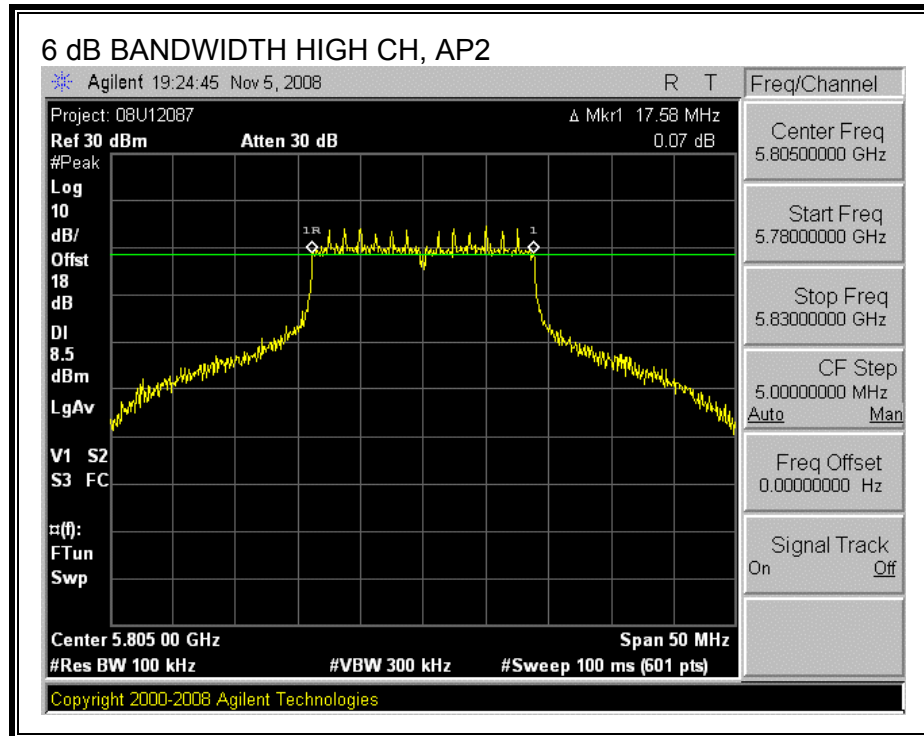
#### RESULTS

Channel	Frequency (MHz)	AP2 6 dB BW (MHz)	AP4 6 dB BW (MHz)	Minimum Limit (MHz)
Low	5745	17.67	17.33	0.5
Middle	5785	17.50	17.33	0.5
High	5805	17.58	17.58	0.5

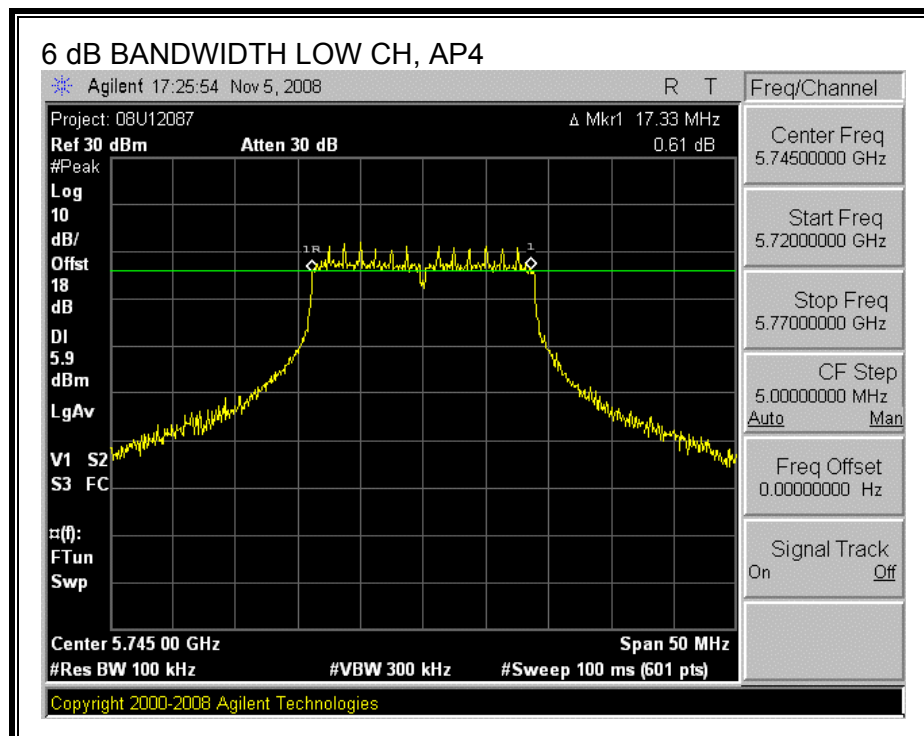


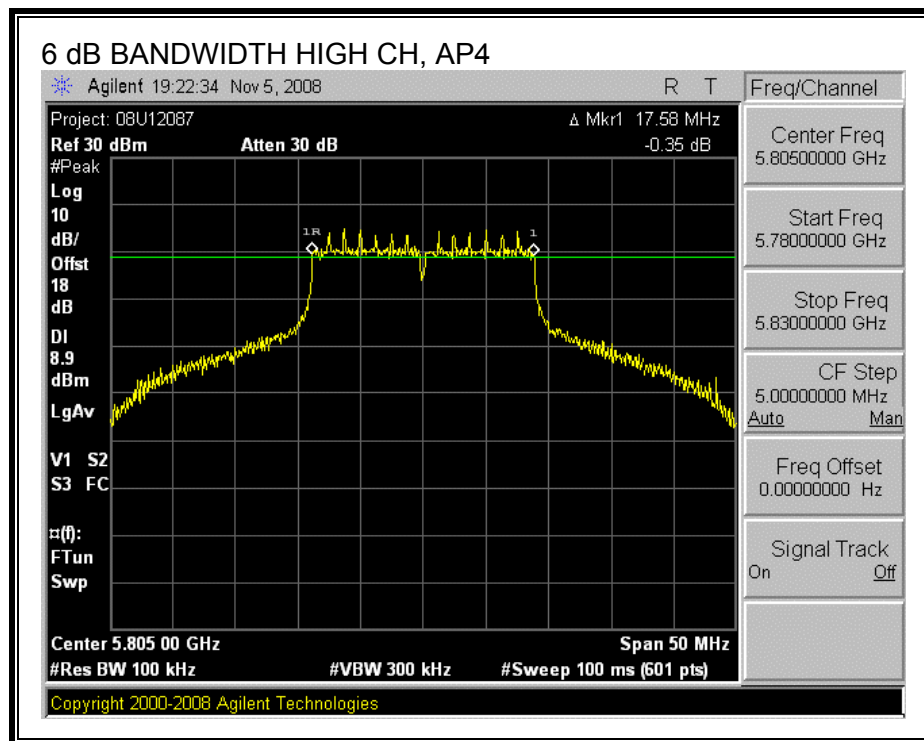
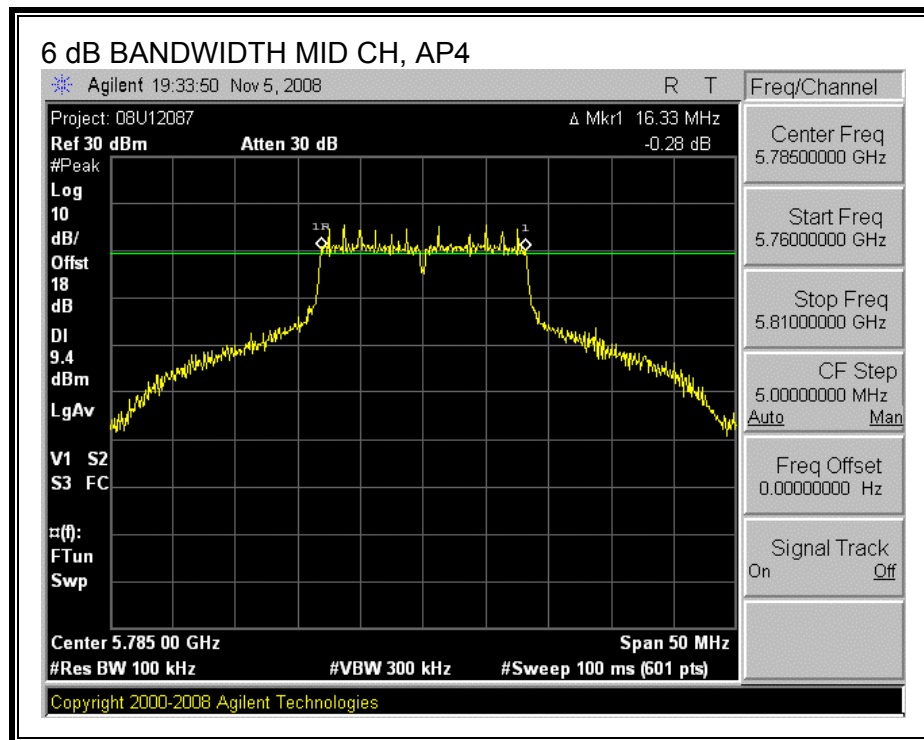
## 6 dB BANDWIDTH, AP2





**6 dB BANDWIDTH, AP4**





## 7.5.2. 26 and 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

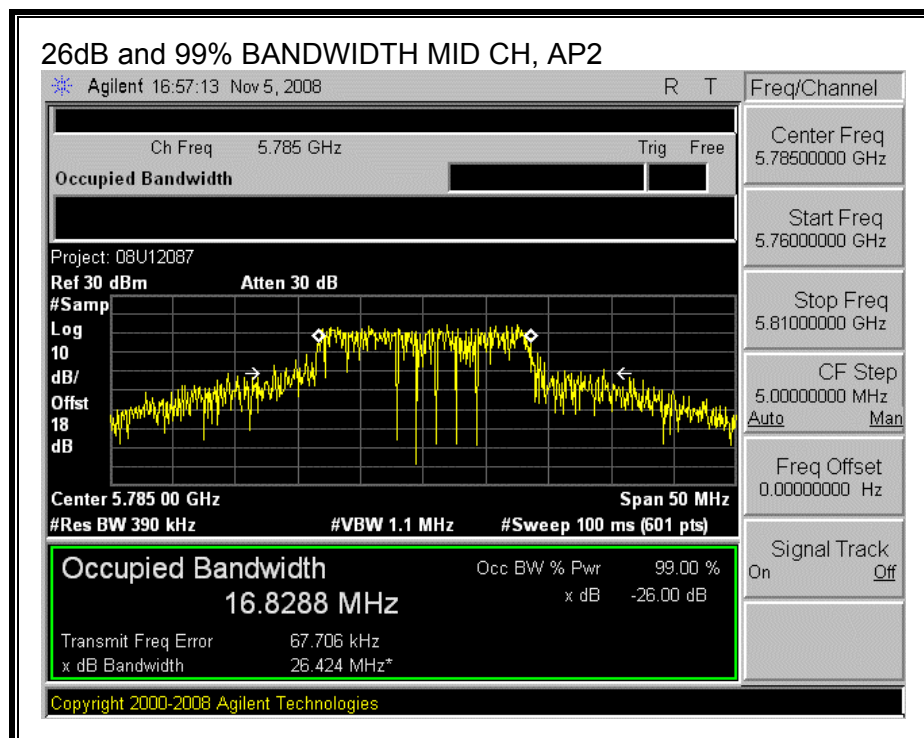
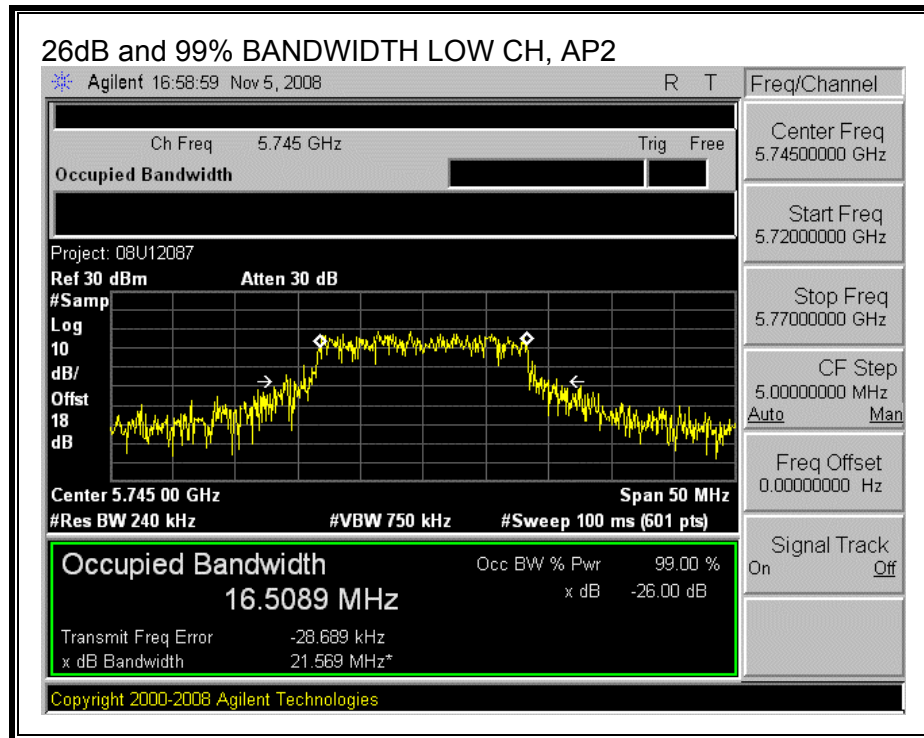
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

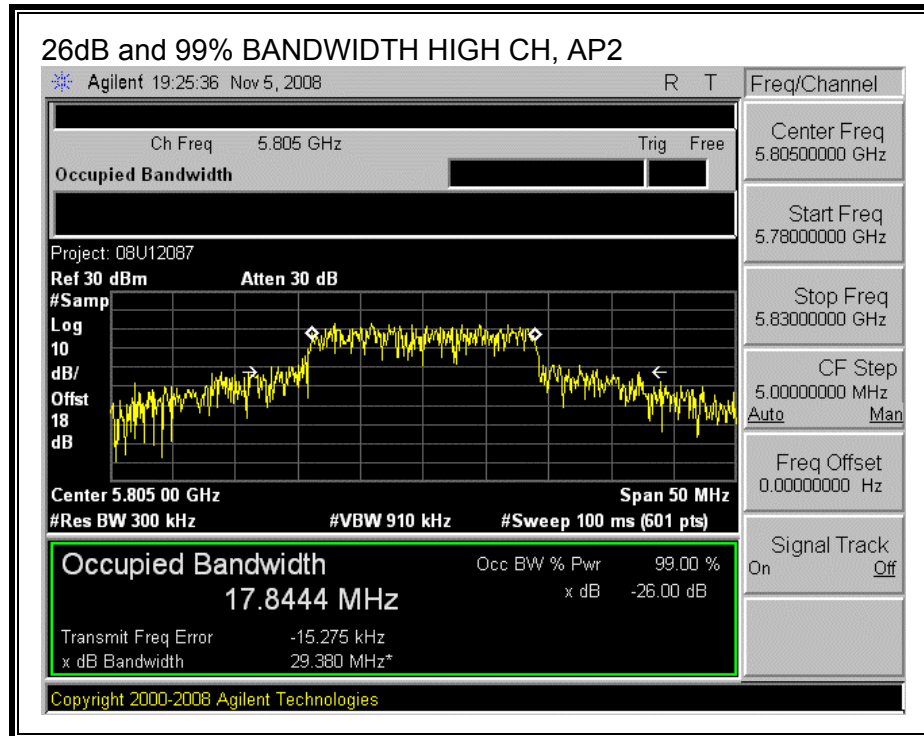
### RESULTS

Channel	Frequency (MHz)	AP2 99% Bandwidth (MHz)	AP4 99% Bandwidth (MHz)
Low	5745	16.5089	16.6189
Middle	5785	16.8288	16.8360
High	5805	17.8444	18.2779

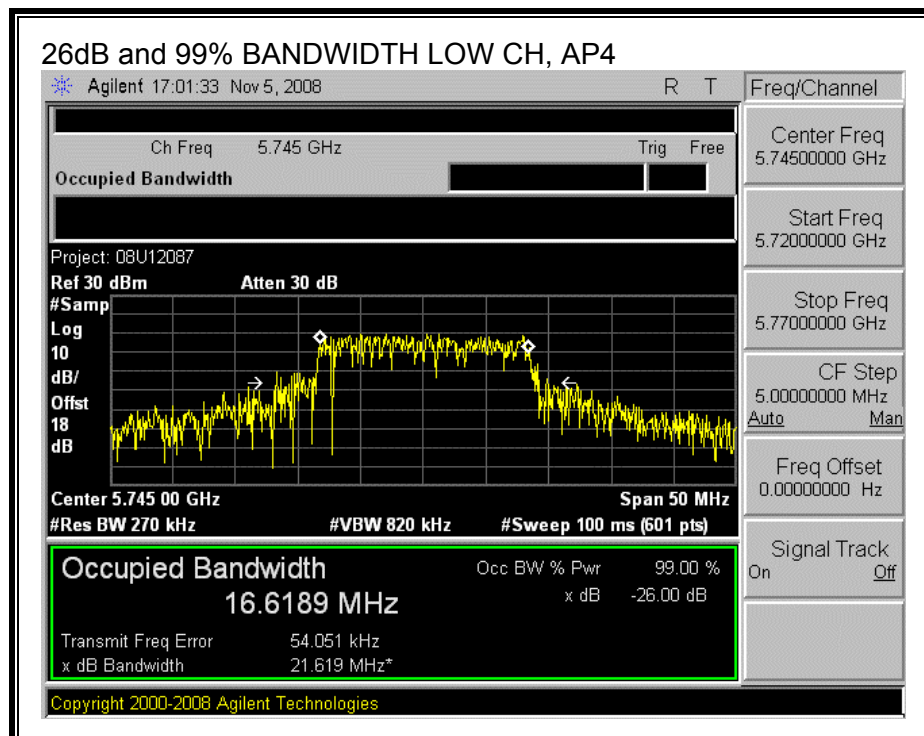
Channel	Frequency (MHz)	AP2 26 dB Bandwidth (MHz)	AP 4 26 dB Bandwidth (MHz)
Low	5745	21.569	21.619
Middle	5785	26.424	32.635
High	5805	29.38	34.037

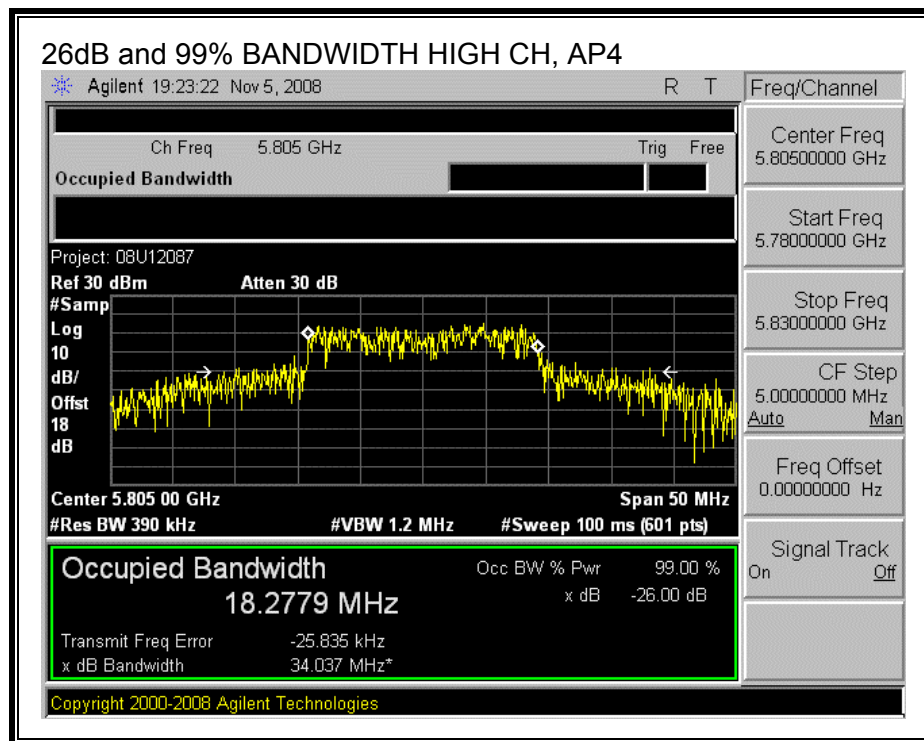
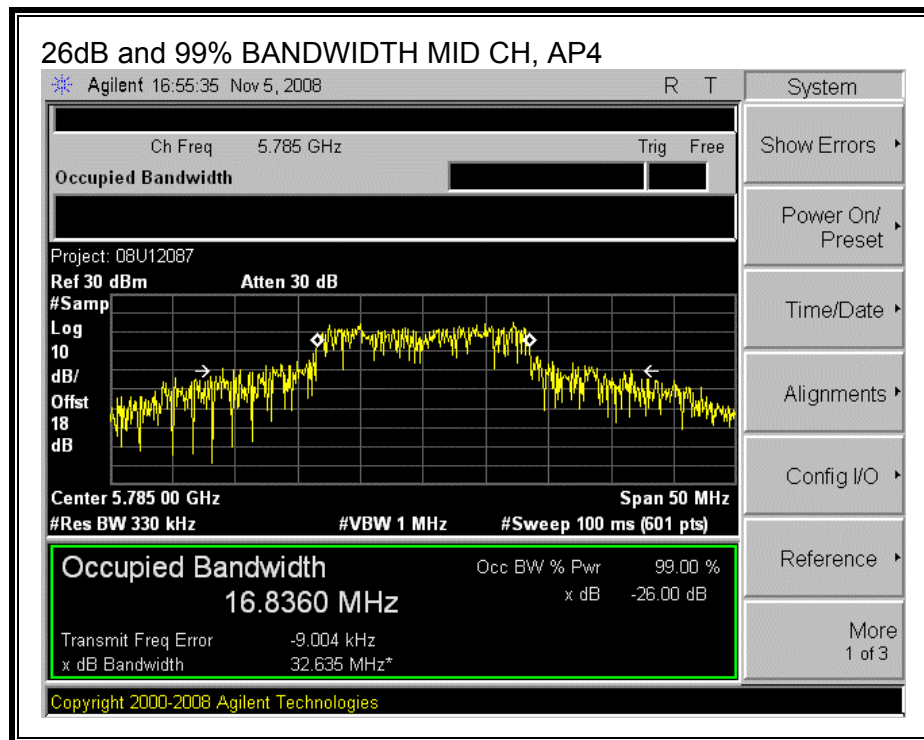
**26 dB and 26dB and 99% BANDWIDTH, AP2**





**26dB and 26dB and 99% BANDWIDTH, AP4**





### 7.5.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain of **3.4 dBi** is less than or equal to 6 dBi, therefore the limit is 30 dBm.

#### TEST PROCEDURE

Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

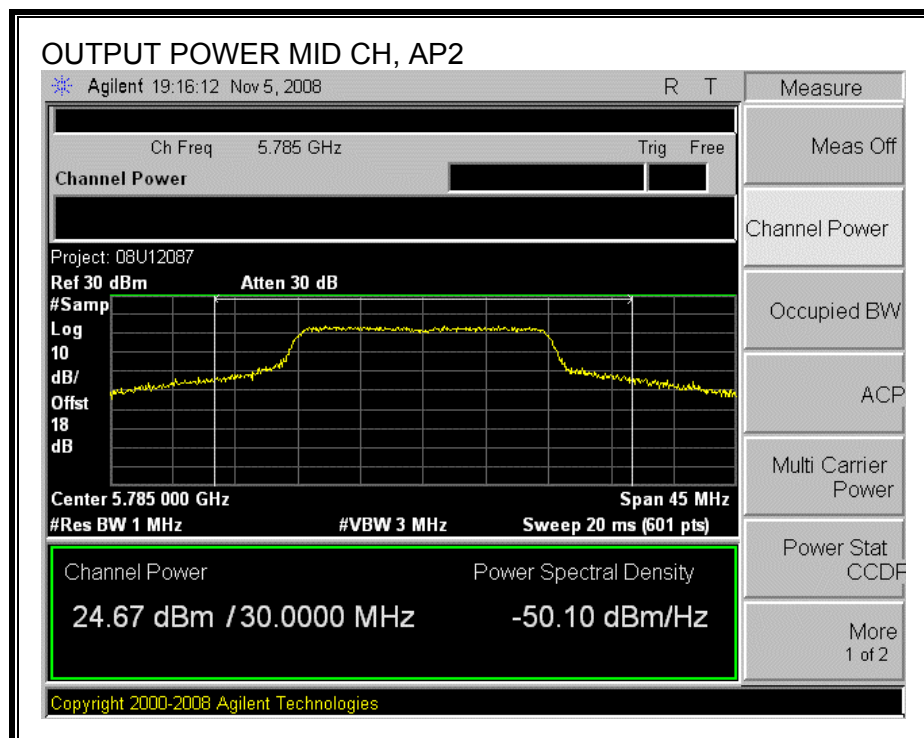
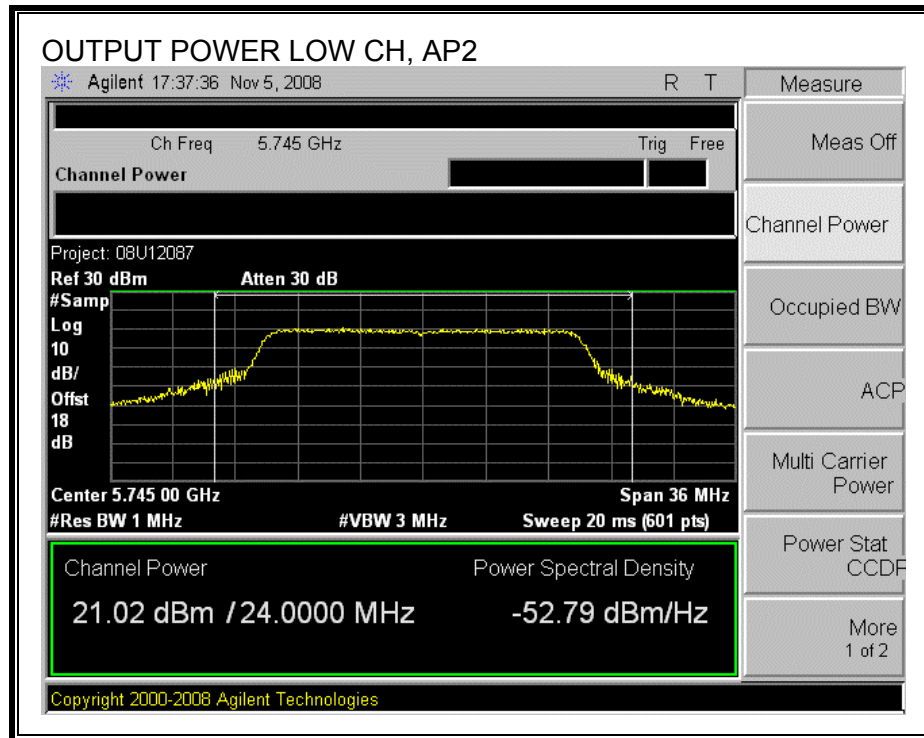
Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

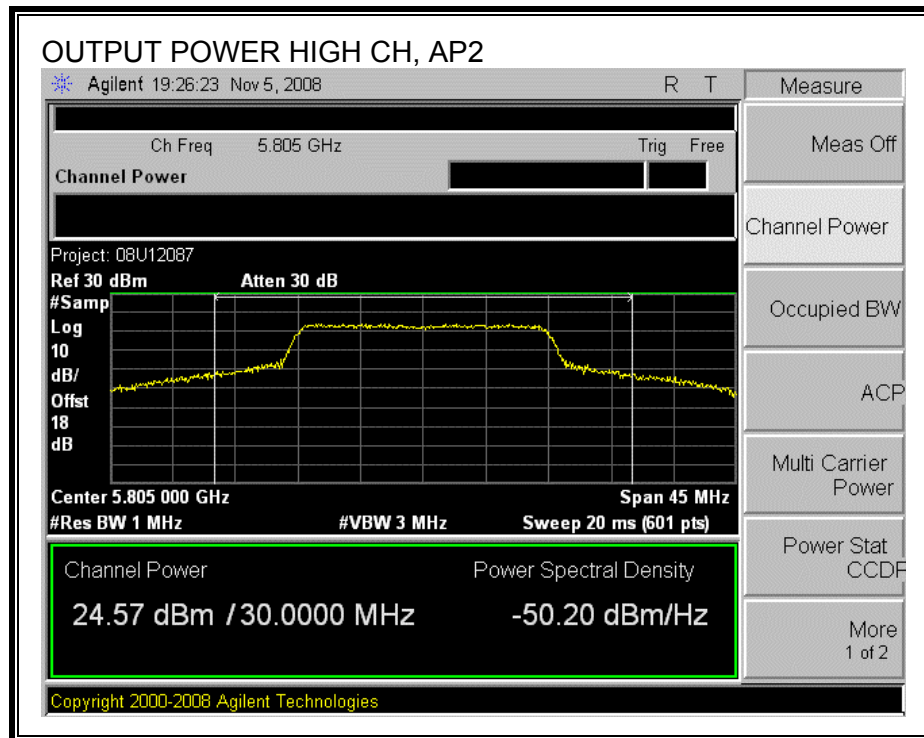
#### RESULTS

Channel	Frequency (MHz)	Limit (dBm)	AP2 Power (dBm)	AP4 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	5745	30.00	21.02	21.83	24.45	-5.55
Mid	5785	30.00	24.67	25.75	28.25	-1.75
High	5805	30.00	24.57	25.80	28.24	-1.76

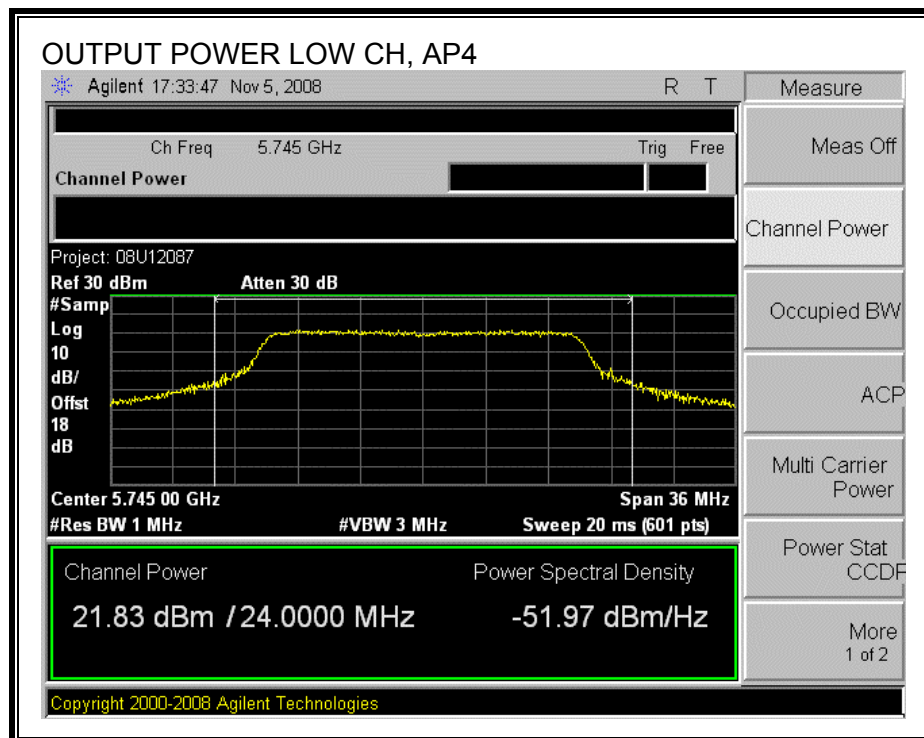


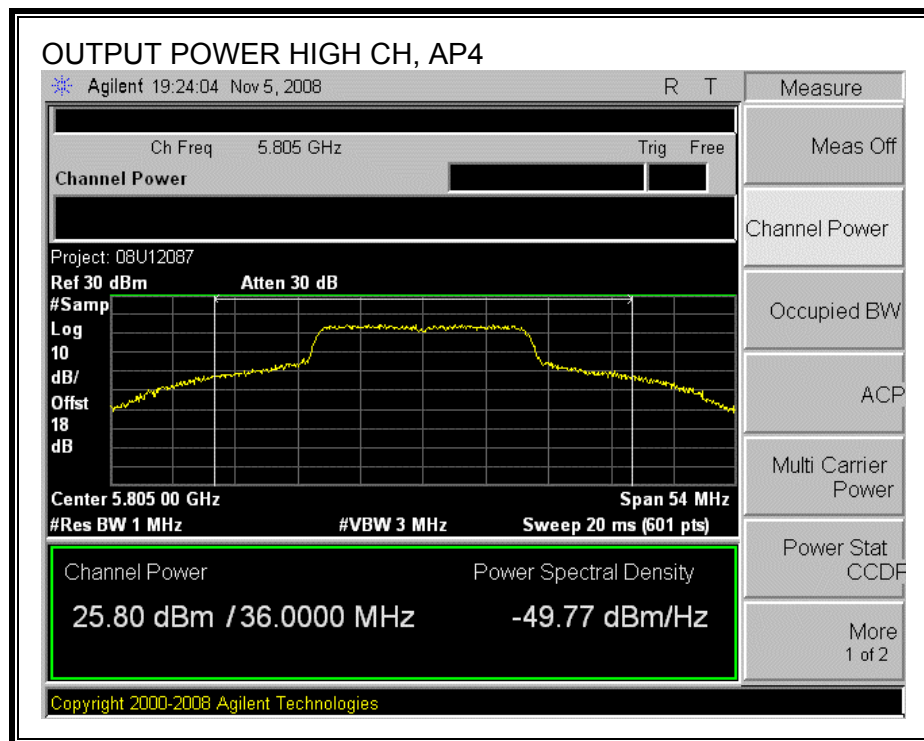
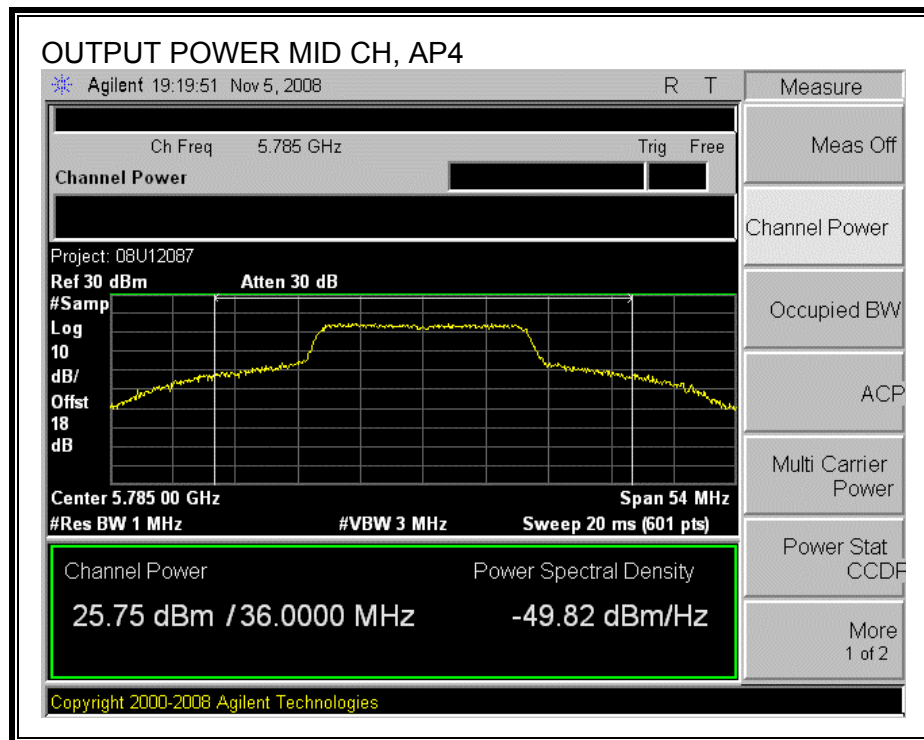
## AP2 OUTPUT POWER





**AP4 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.

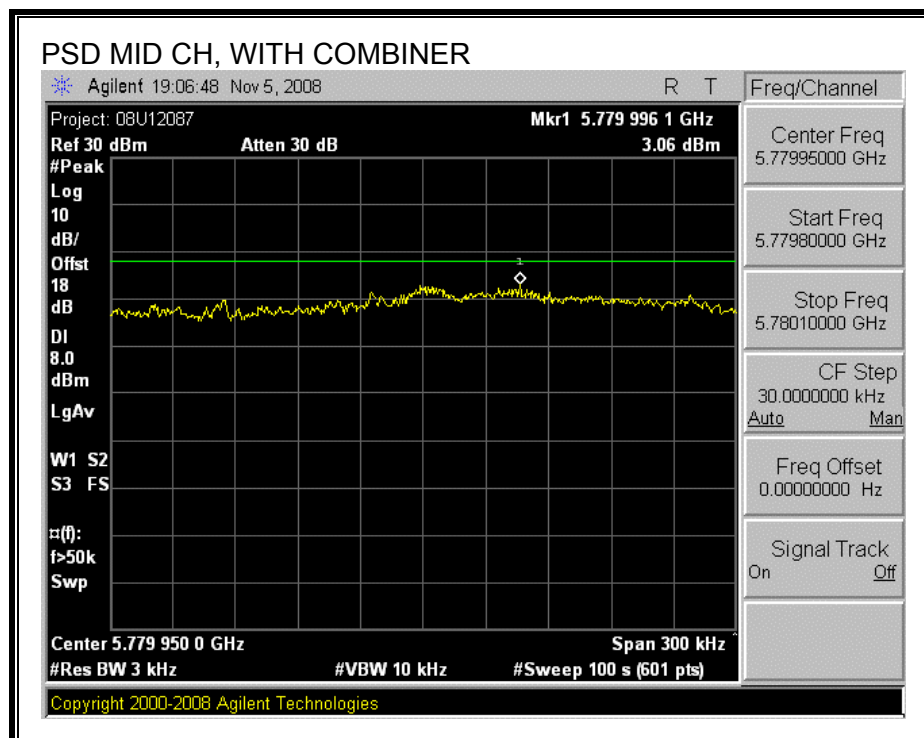
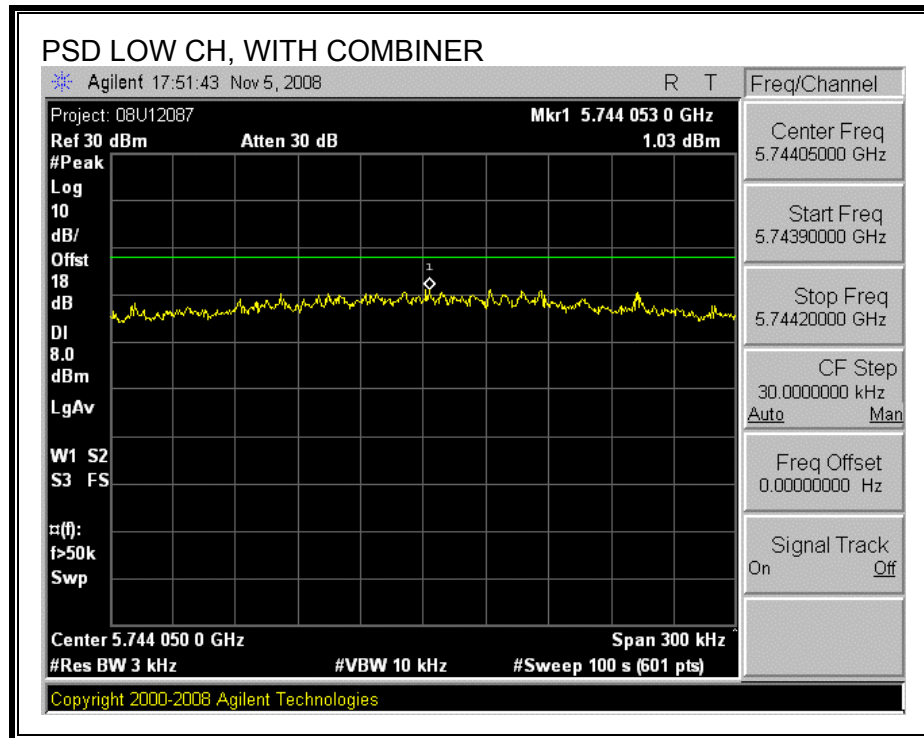
### TEST PROCEDURE

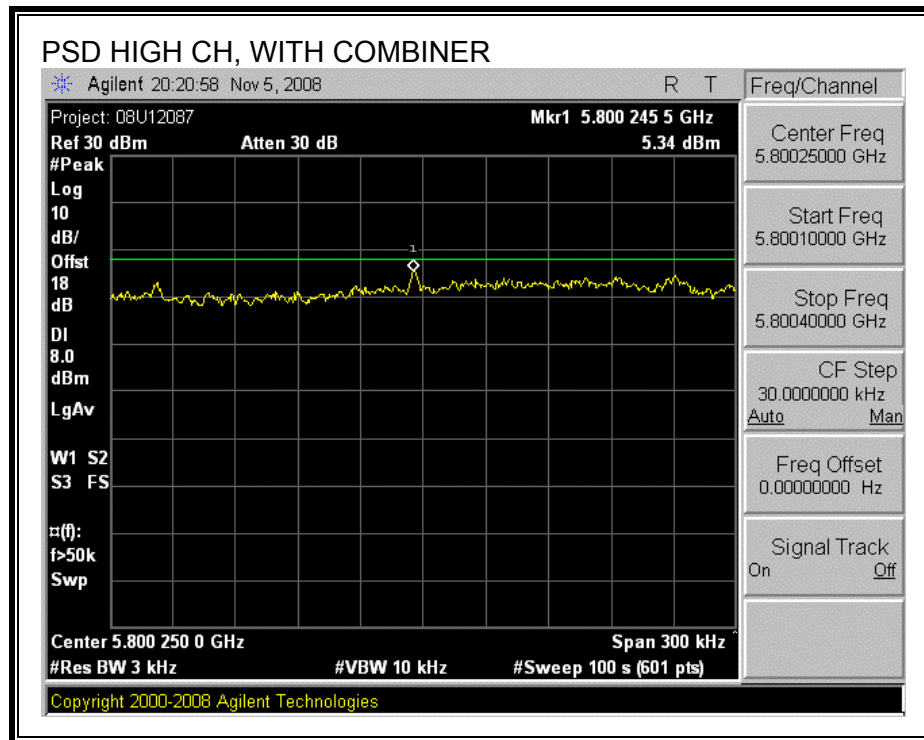
“Measurement of Digital Transmission Systems Operating under Section 15.247”, March 23, 2005.

### RESULTS:

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5745	1.03	8	-6.97
Middle	5785	3.06	8	-4.94
High	5805	5.34	8	-2.66

# **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.

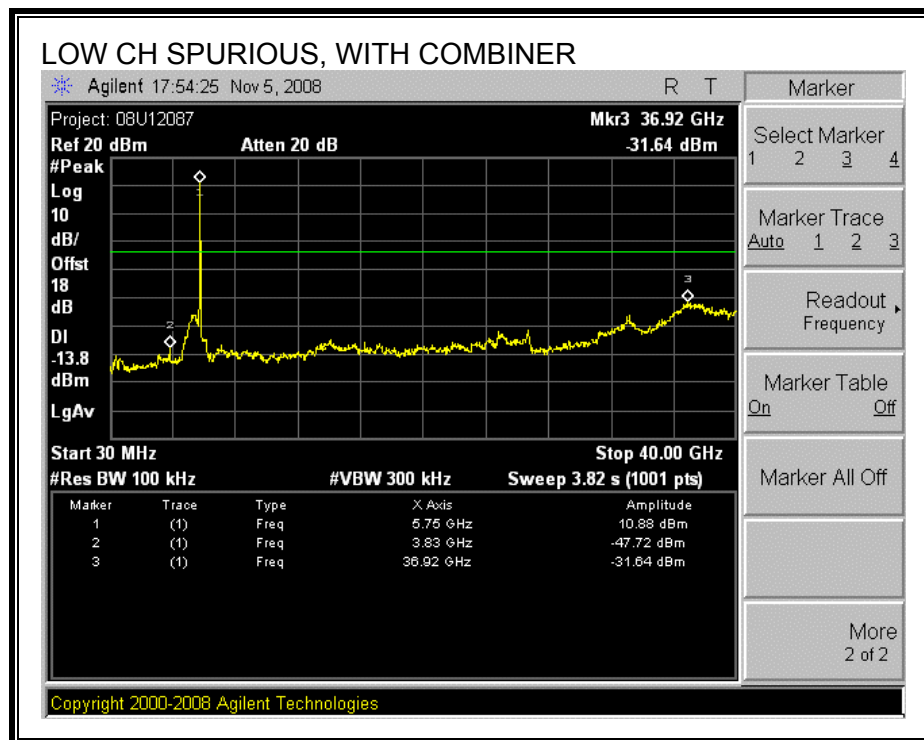
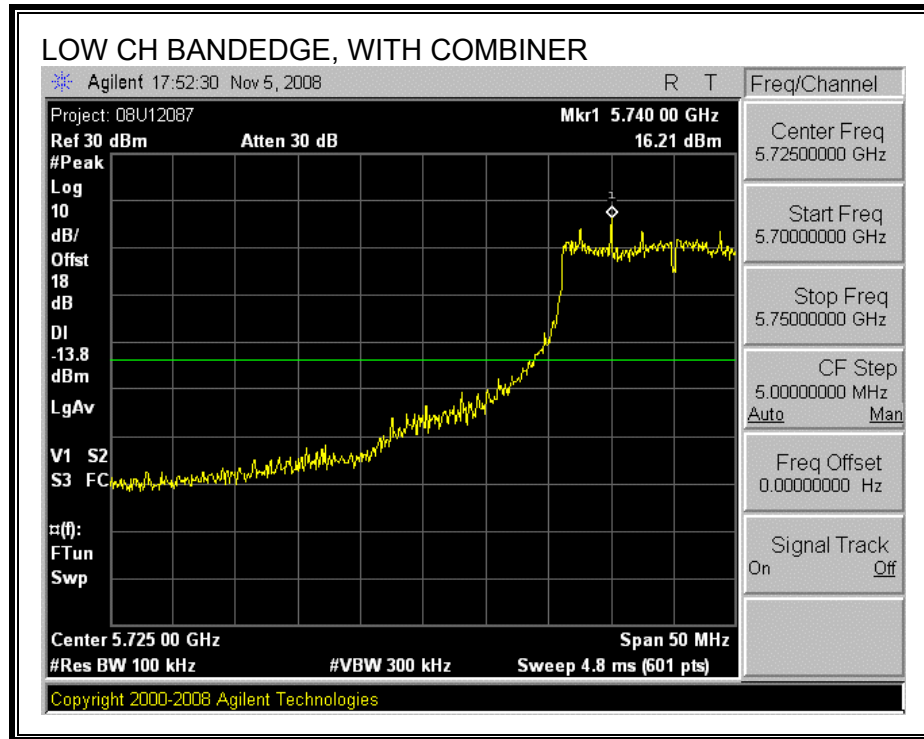
### **TEST PROCEDURE**

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.

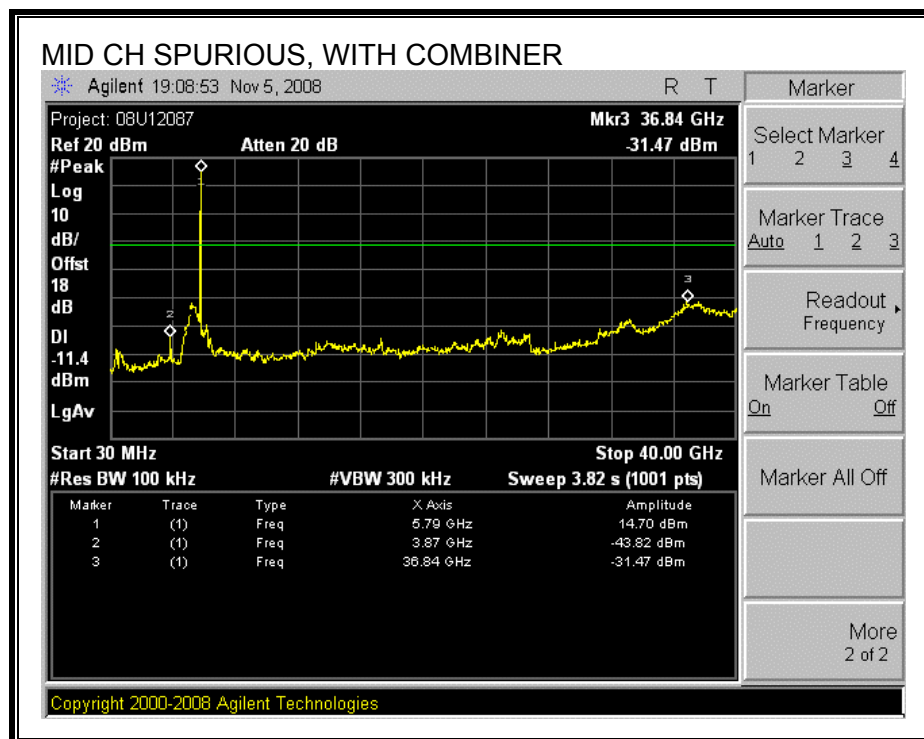
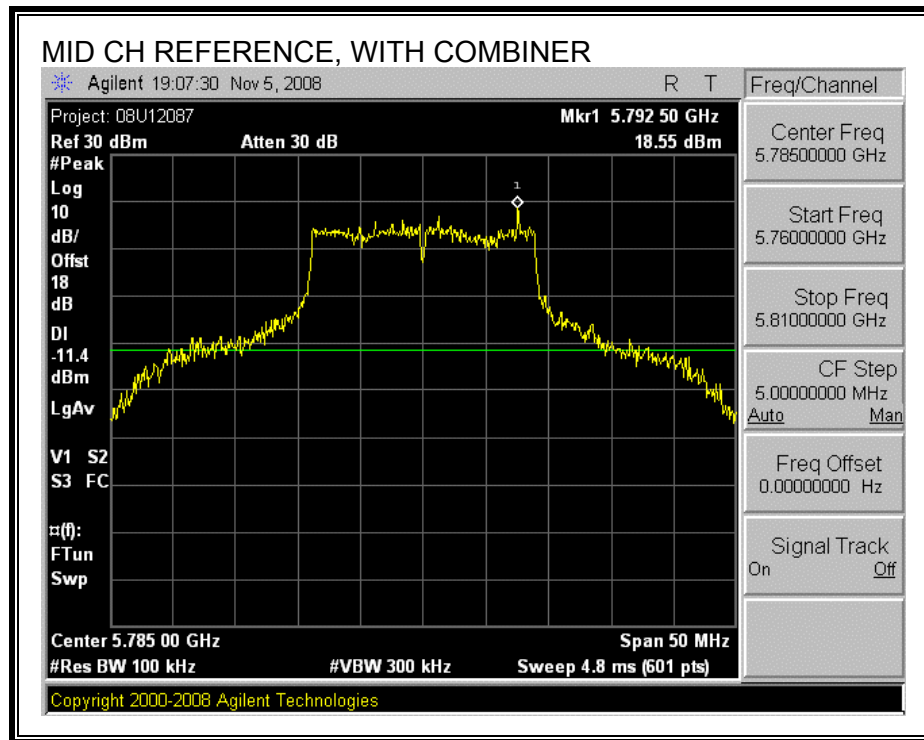
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

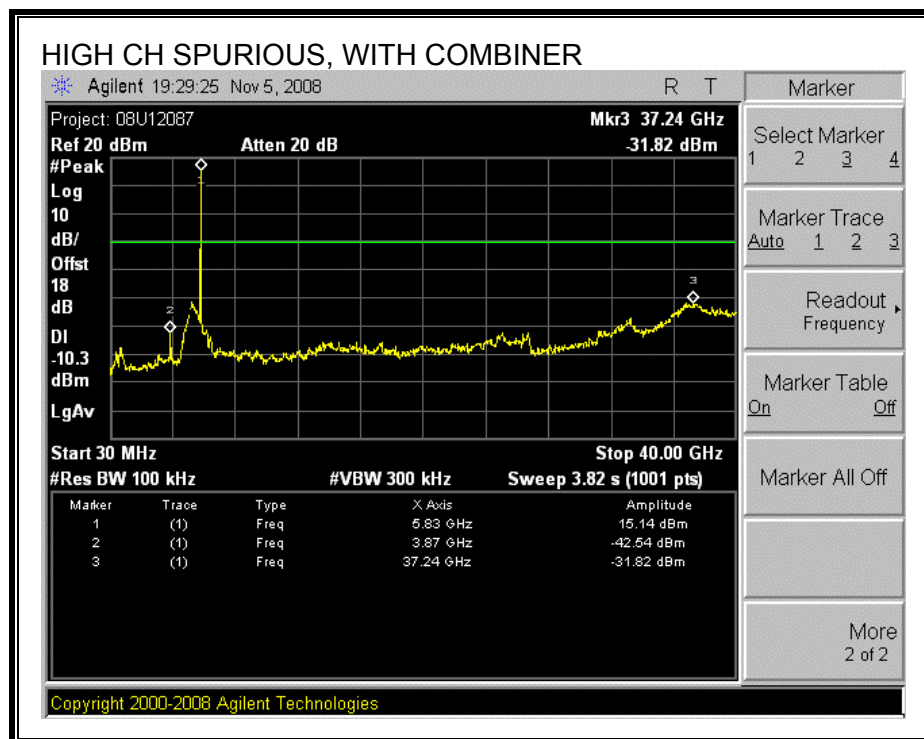
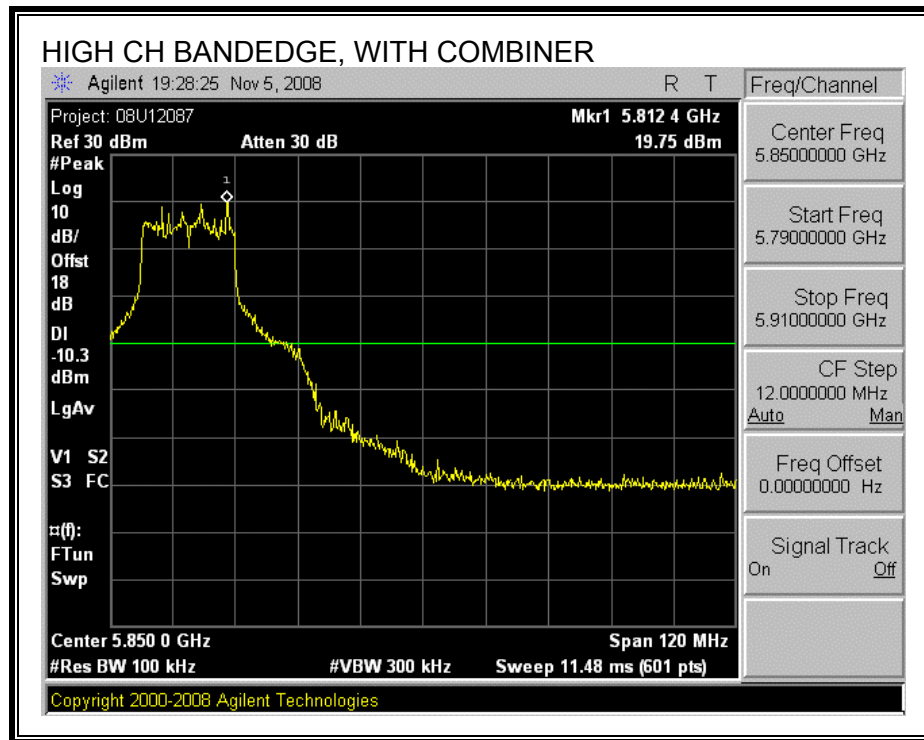
## RESULTS

### SPURIOUS EMISSIONS WITH COMBINER









## 7.6. 802.11n HT40 MODE IN THE 5.8 GHz BAND

### 7.6.1. 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.

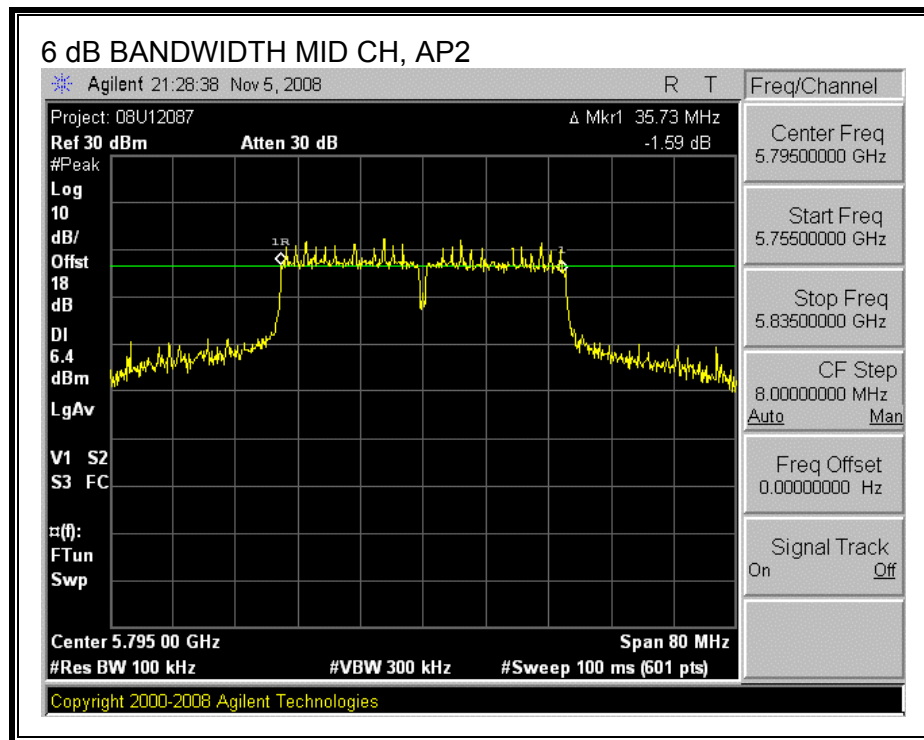
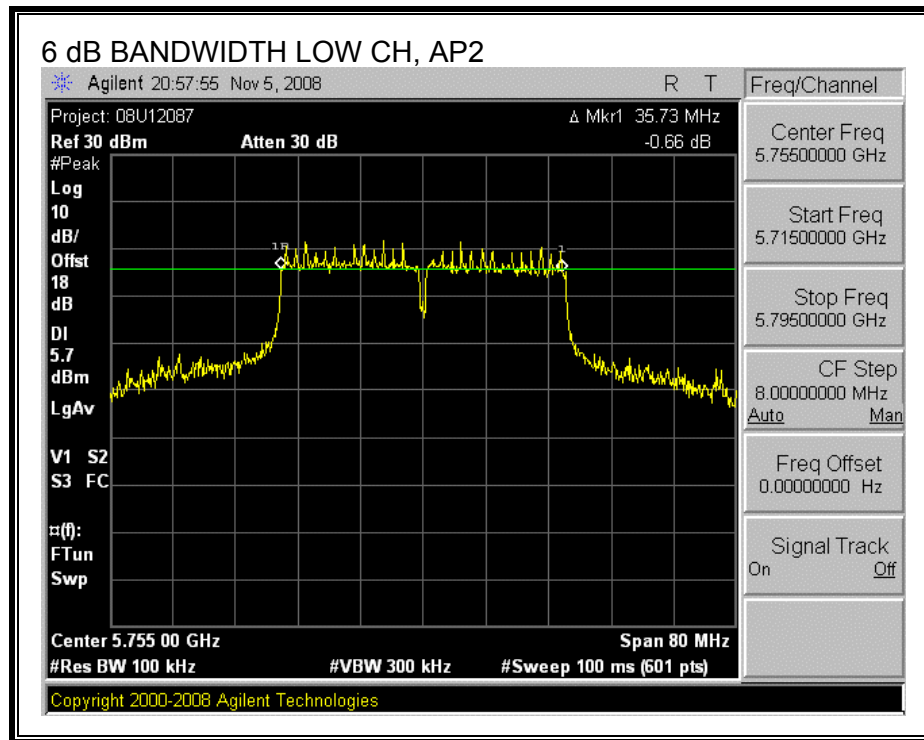
#### TEST PROCEDURE

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.

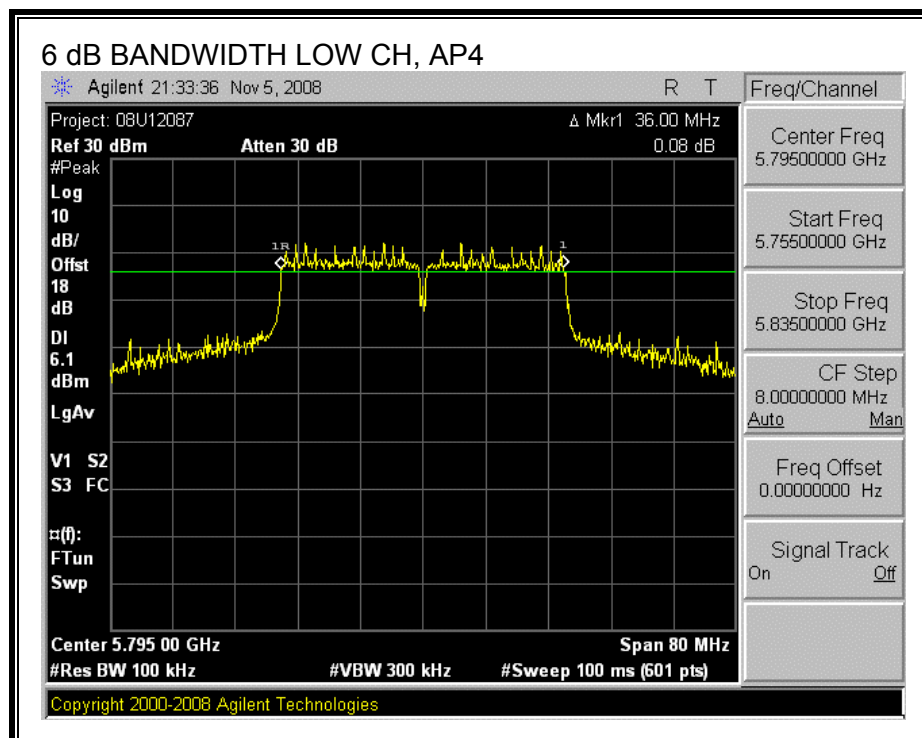
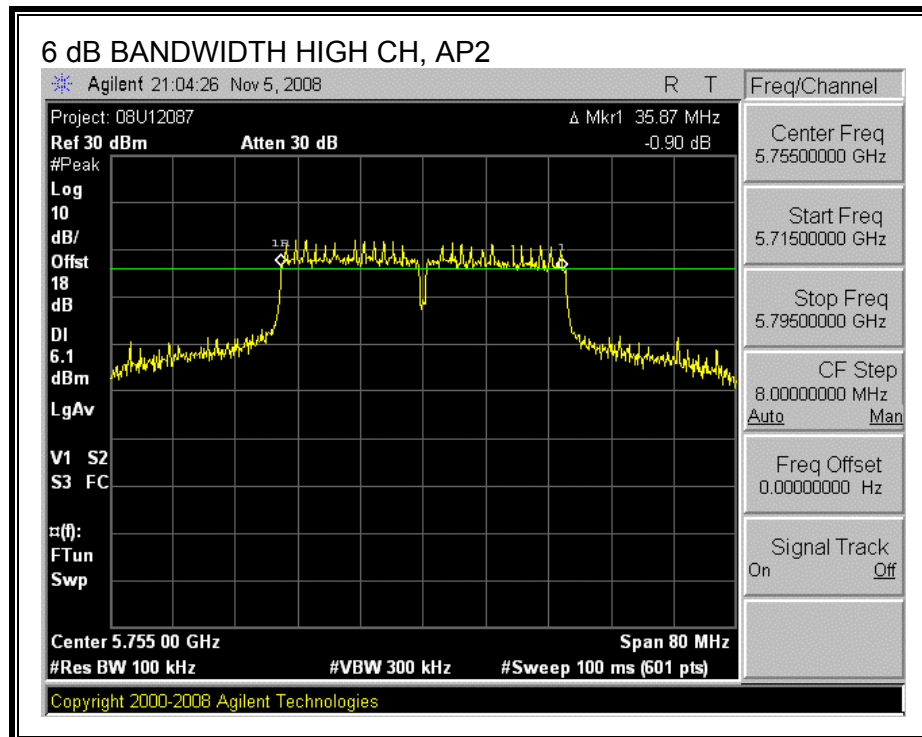
#### RESULTS

Channel	Frequency (MHz)	AP2 6 dB BW (MHz)	AP4 6 dB BW (MHz)	Minimum Limit (MHz)
Low	5755	35.73	35.87	0.5
High	5795	35.73	36.00	0.5

**6 dB BANDWIDTH, AP2**



## 6 dB BANDWIDTH, AP4



## 7.6.2. 26 dB and 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

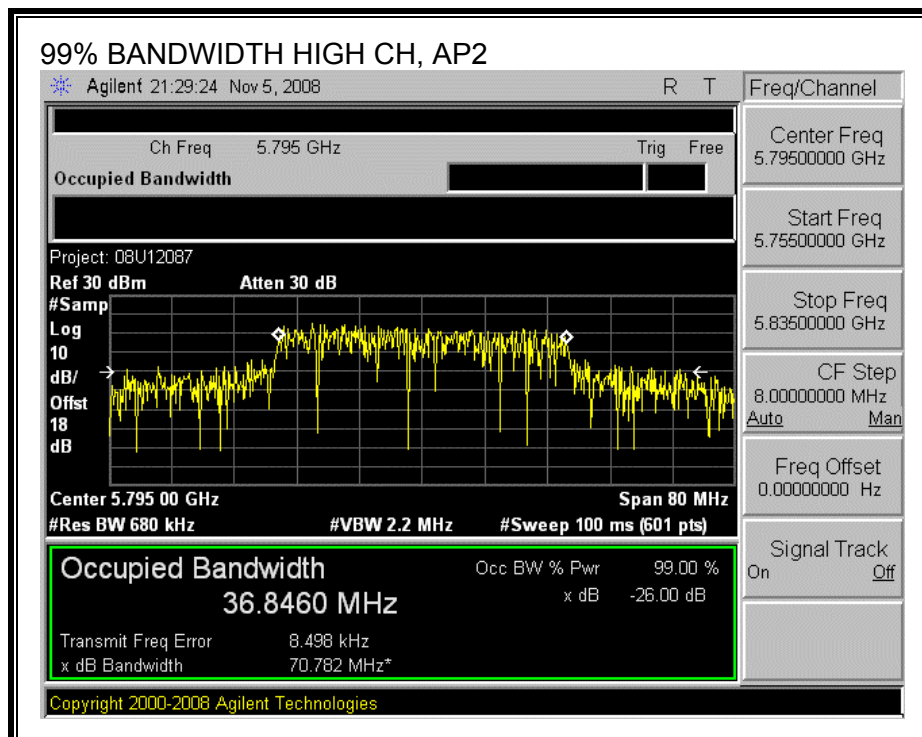
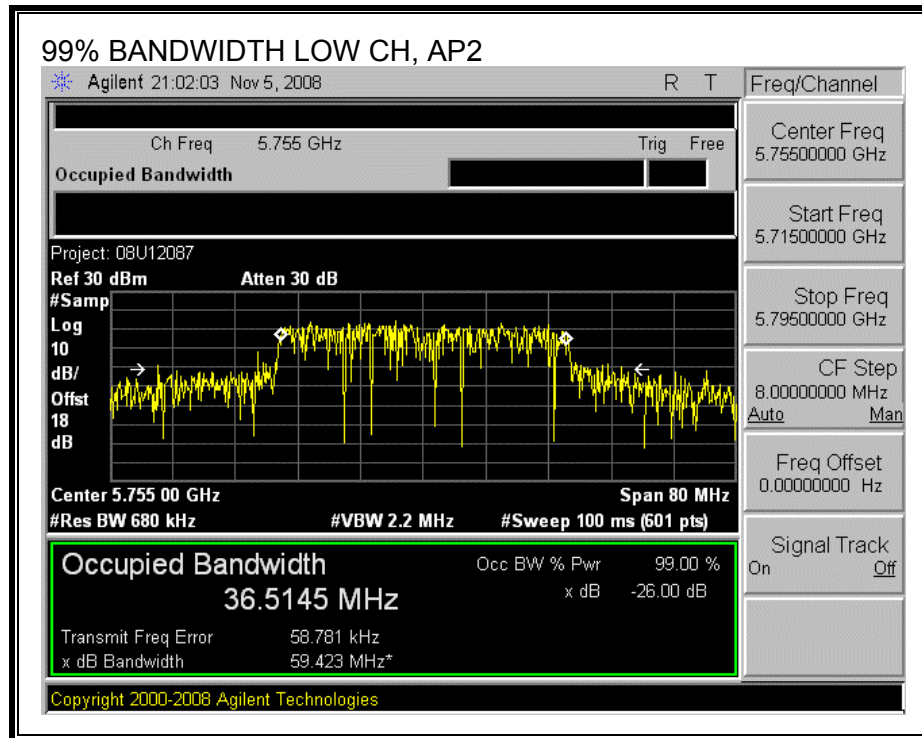
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % and 26dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 26% bandwidth function is utilized.

### RESULTS

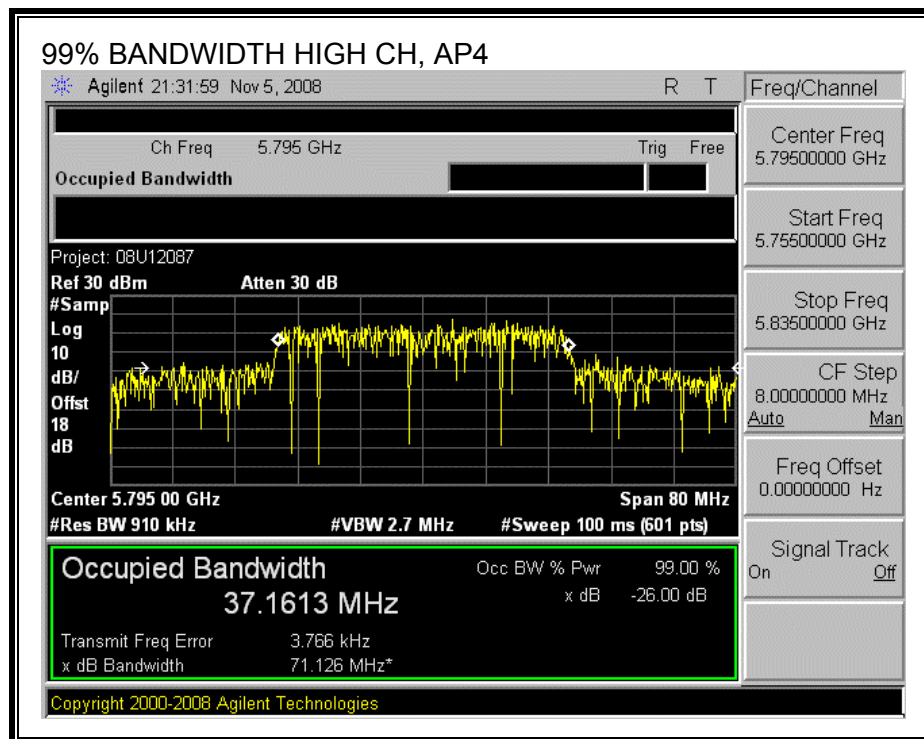
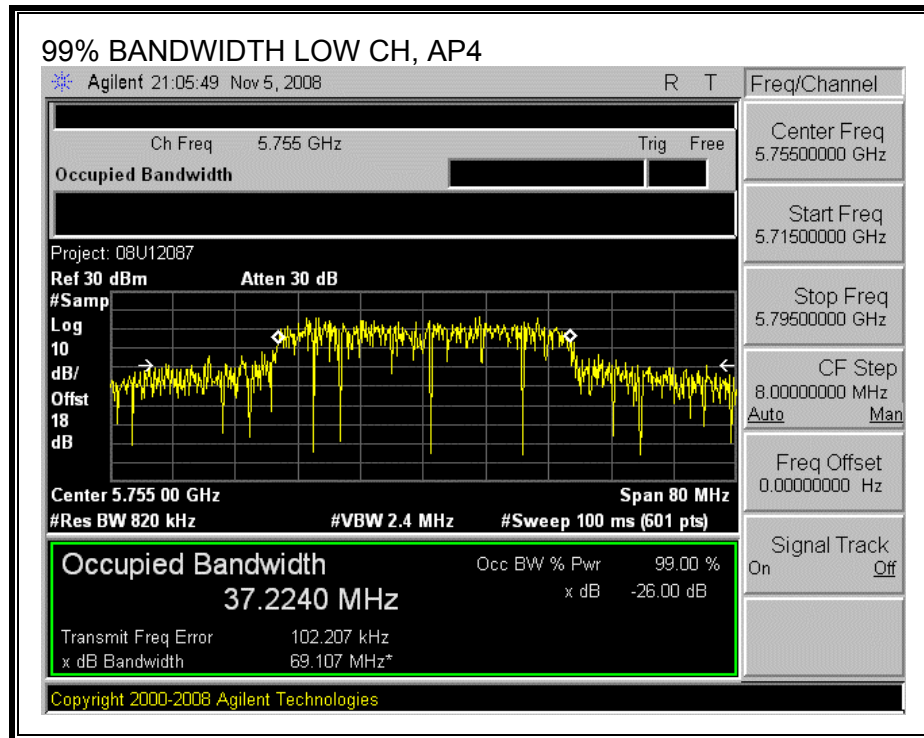
Channel	Frequency (MHz)	AP2 99% Bandwidth (MHz)	AP4 99% Bandwidth (MHz)
Low	5755	36.5145	37.2240
High	5795	36.8460	37.1613

Channel	Frequency (MHz)	AP2 26dB Bandwidth (MHz)	AP4 26dB Bandwidth (MHz)
Low	5755	59.423	69.107
High	5795	70.782	71.126

**26dB and 99% BANDWIDTH, AP2**



**26dB and 99% BANDWIDTH, AP4**





### 7.6.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain of **3.4 dBi** is less than or equal to 6 dBi, therefore the limit is 30 dBm.

#### TEST PROCEDURE

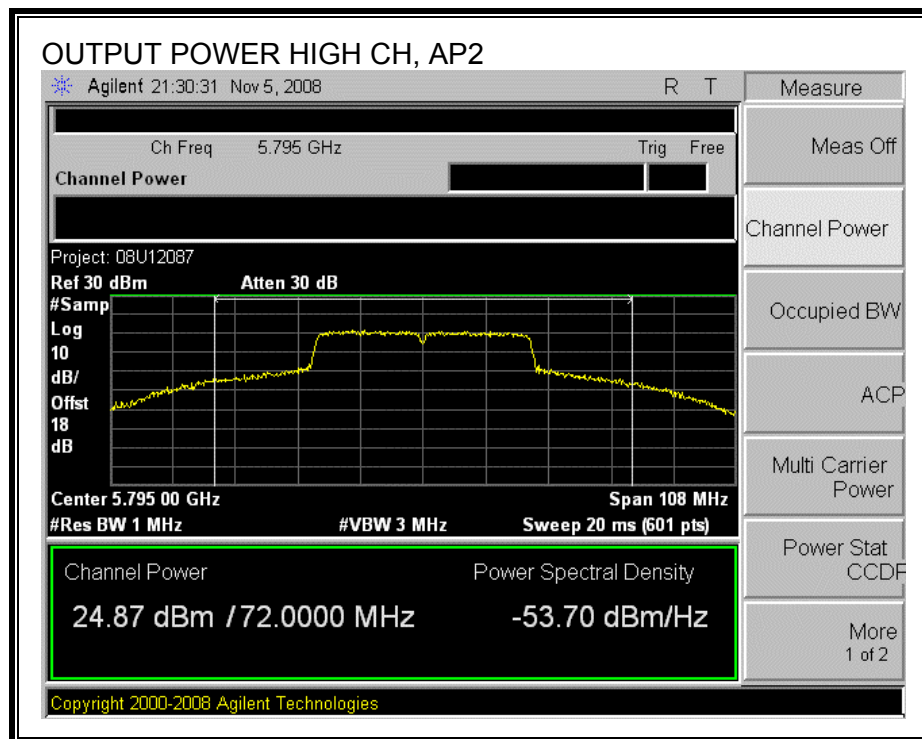
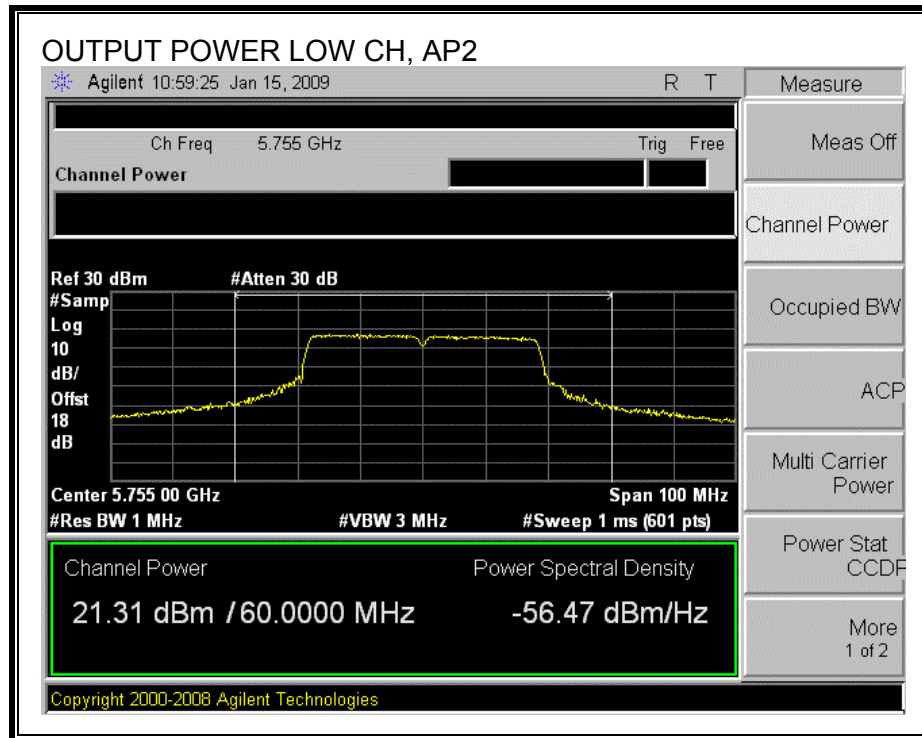
Peak power is measured using the spectrum analyzer's internal channel power integration function. Power is integrated over a bandwidth greater than or equal to the 26dB bandwidth.

Maximum Conducted Output Power based on RMS averaging over a time interval is measured in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

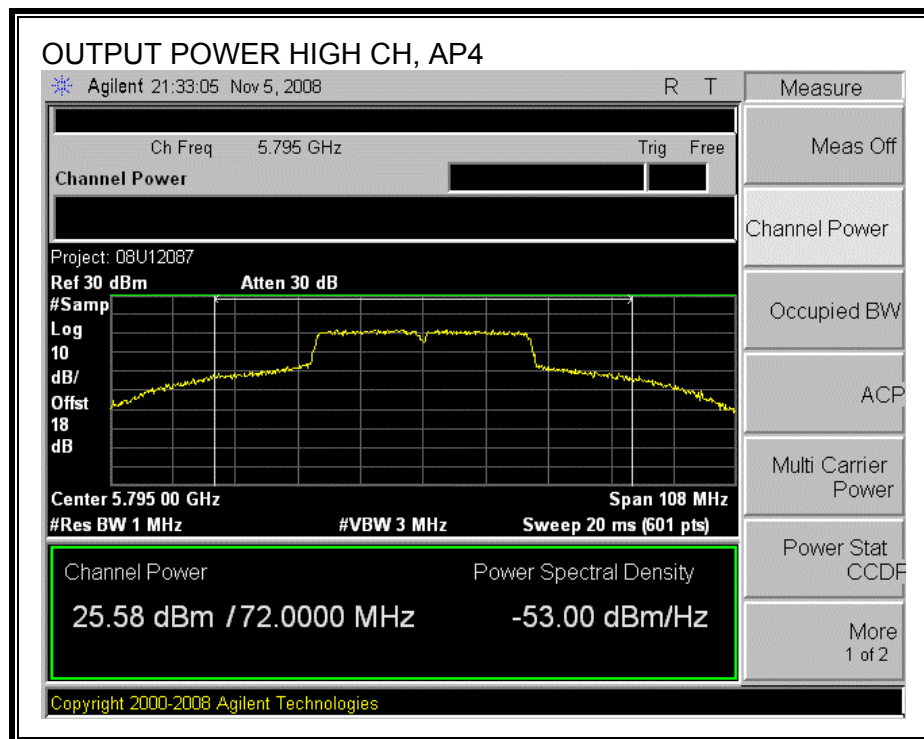
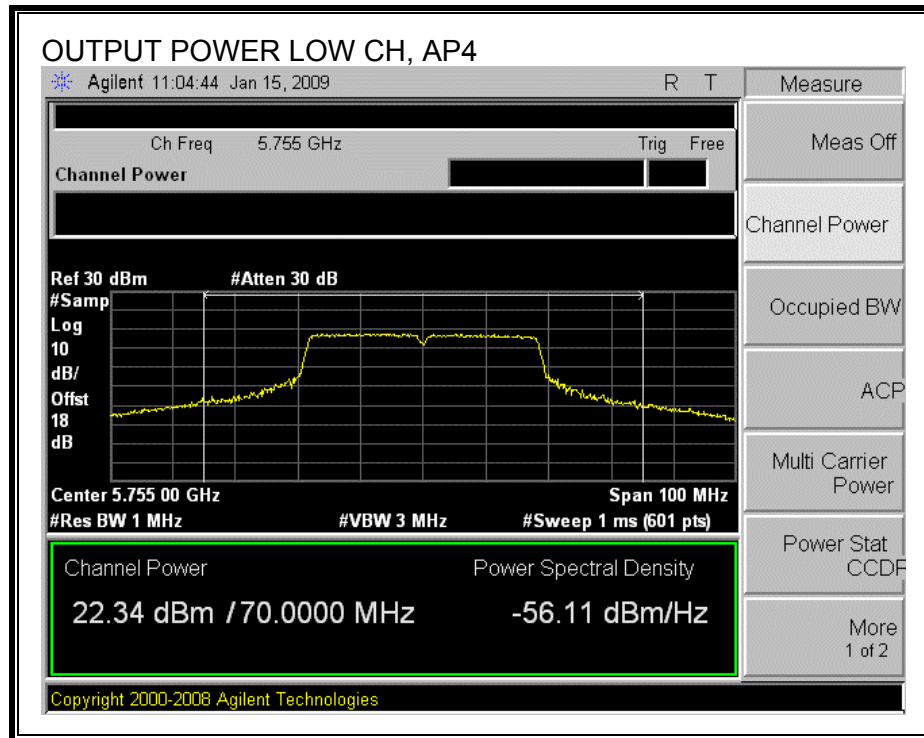
#### RESULTS

Channel	Frequency (MHz)	Limit (dBm)	AP2 Power (dBm)	AP4 Power (dBm)	Total Power (dBm)	Margin (dB)
Low	5755	30.00	21.31	22.34	24.87	-5.13
High	5795	30.00	24.87	25.58	28.25	-1.75

## AP2 OUTPUT POWER



## AP4 OUTPUT POWER



## 7.6.4. 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.

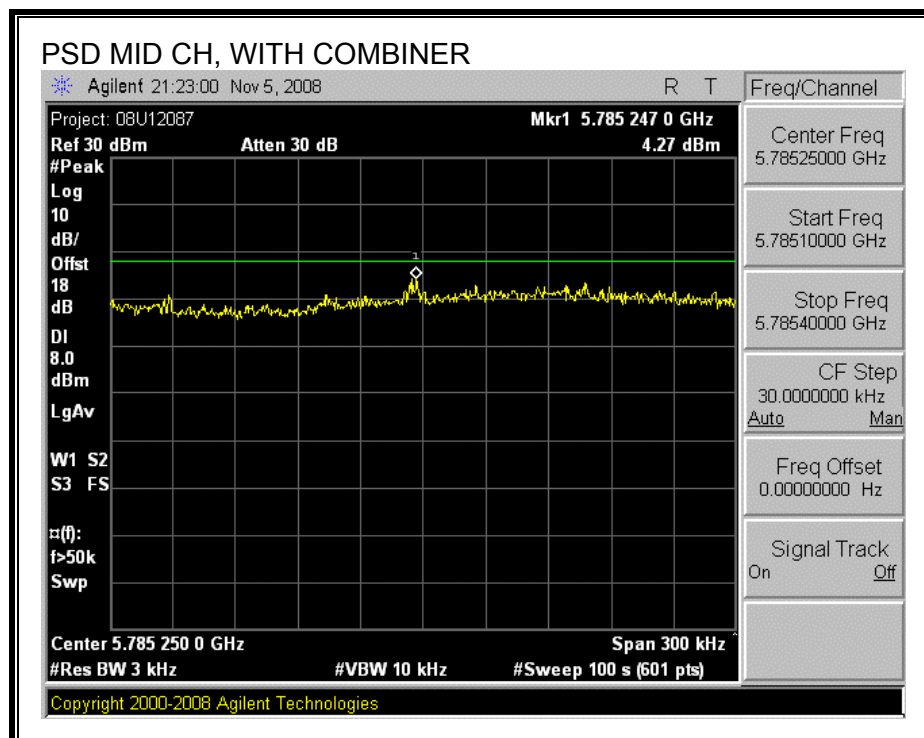
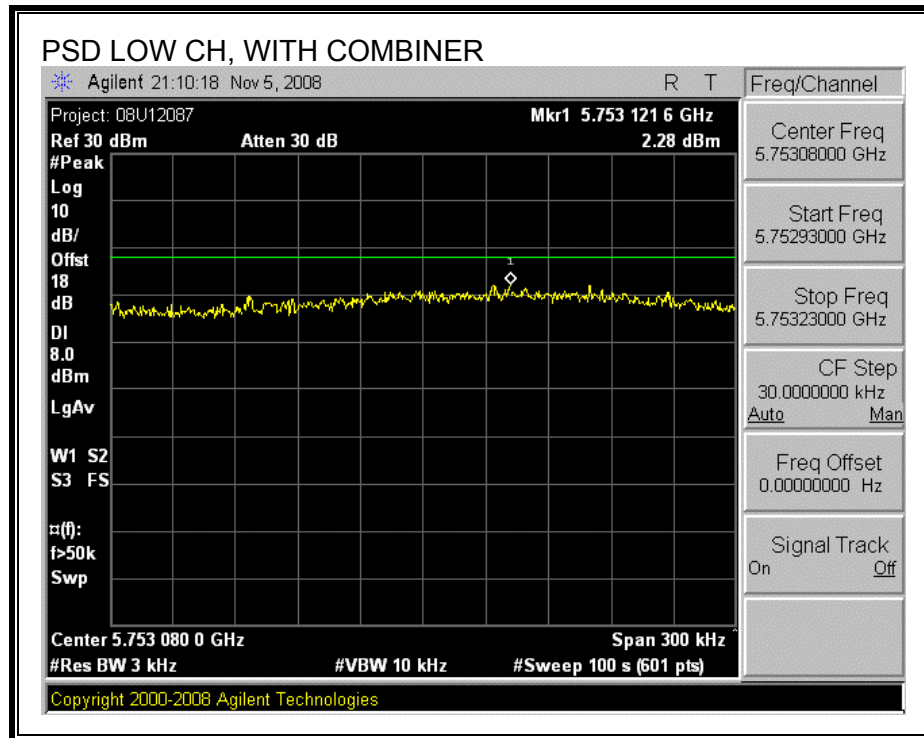
### TEST PROCEDURE

“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	2.28	8	-5.72
High	5795	4.27	8	-3.73

**POWER SPECTRAL DENSITY, WITH COMBINER**



## **7.6.5. 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.

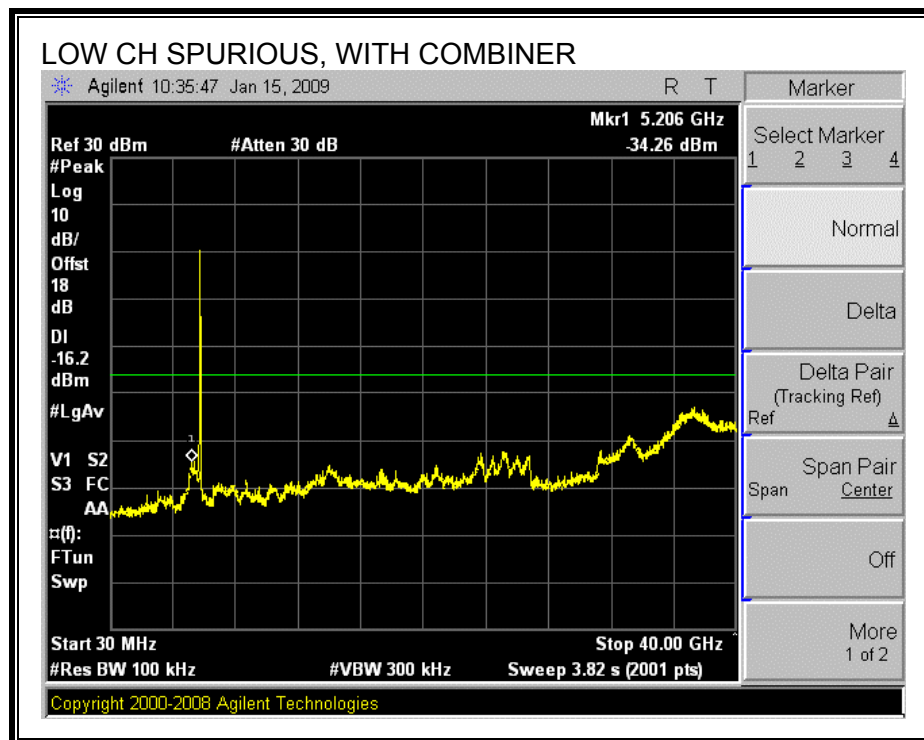
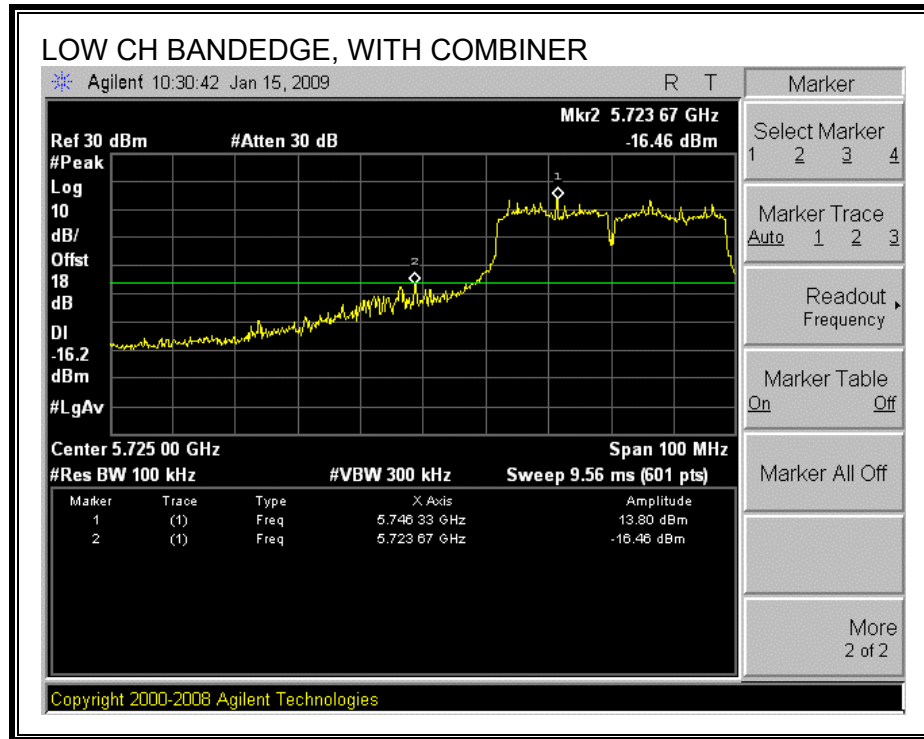
### **TEST PROCEDURE**

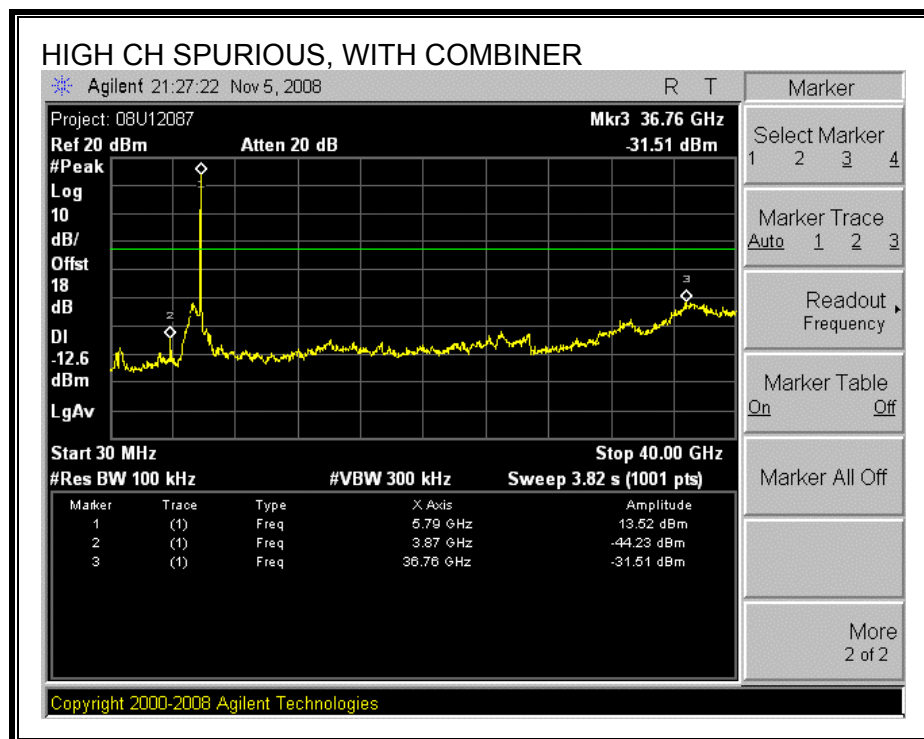
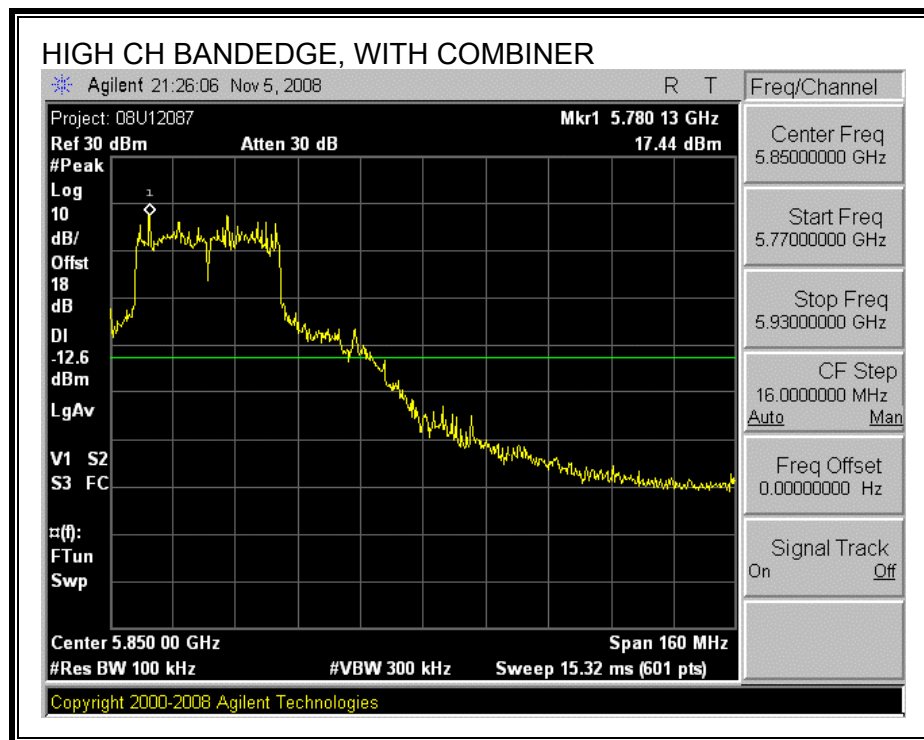
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

## RESULTS

### 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 ( $\mu\text{V/m}$ ) at 3 m	Field Strength Limit (dB $\mu\text{V/m}$ ) 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.

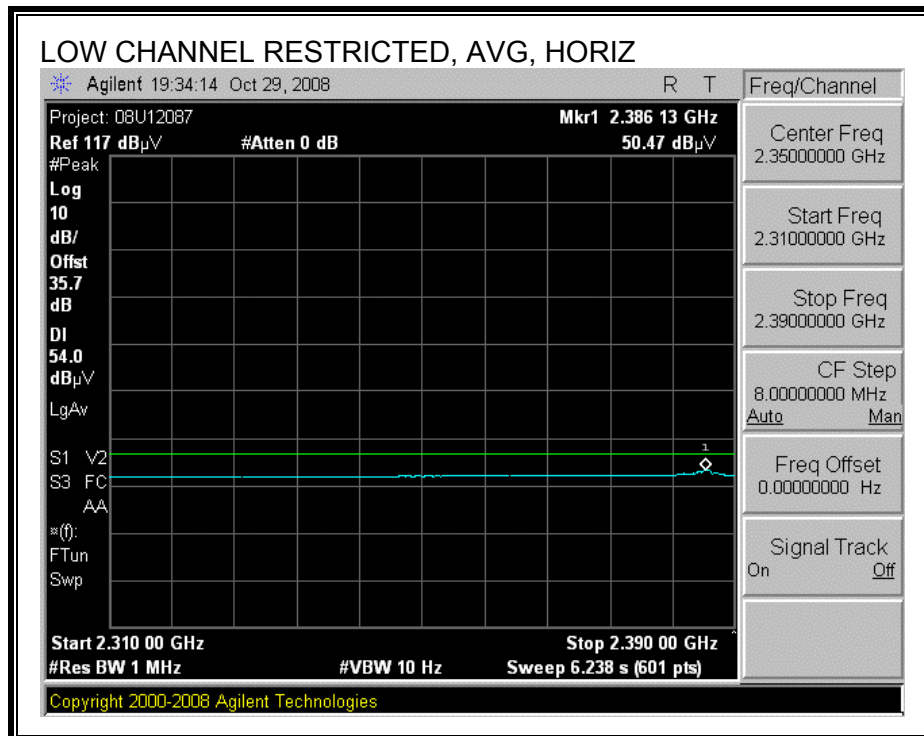
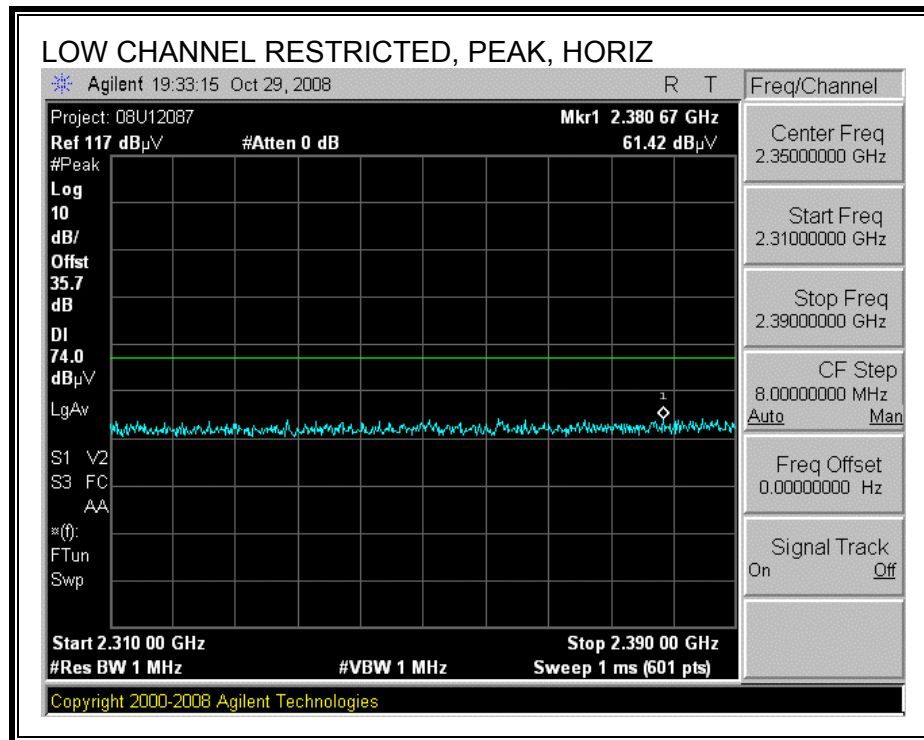
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

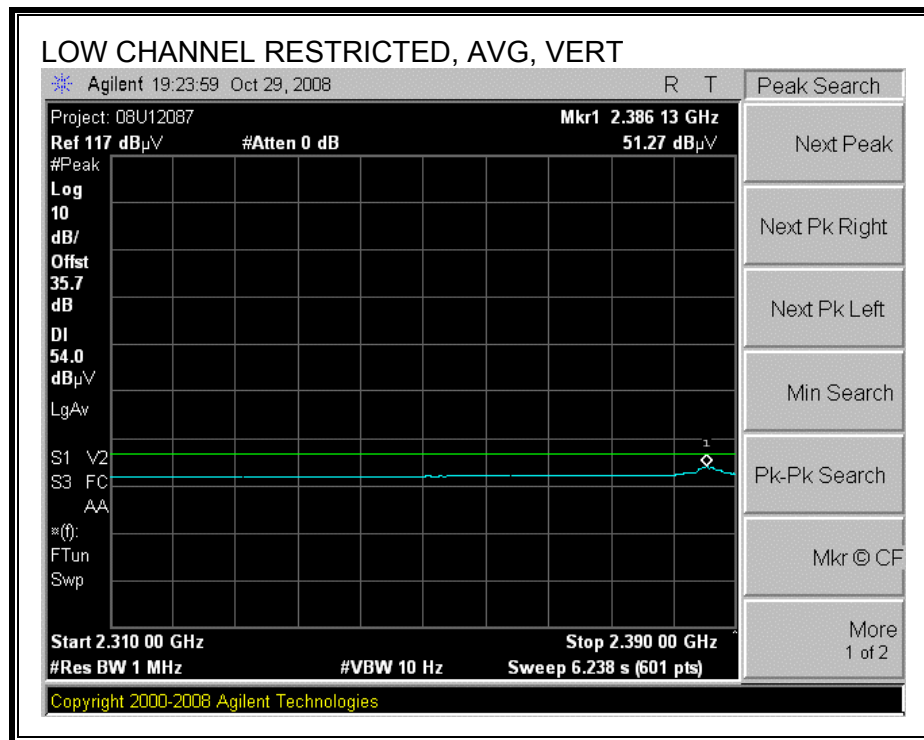
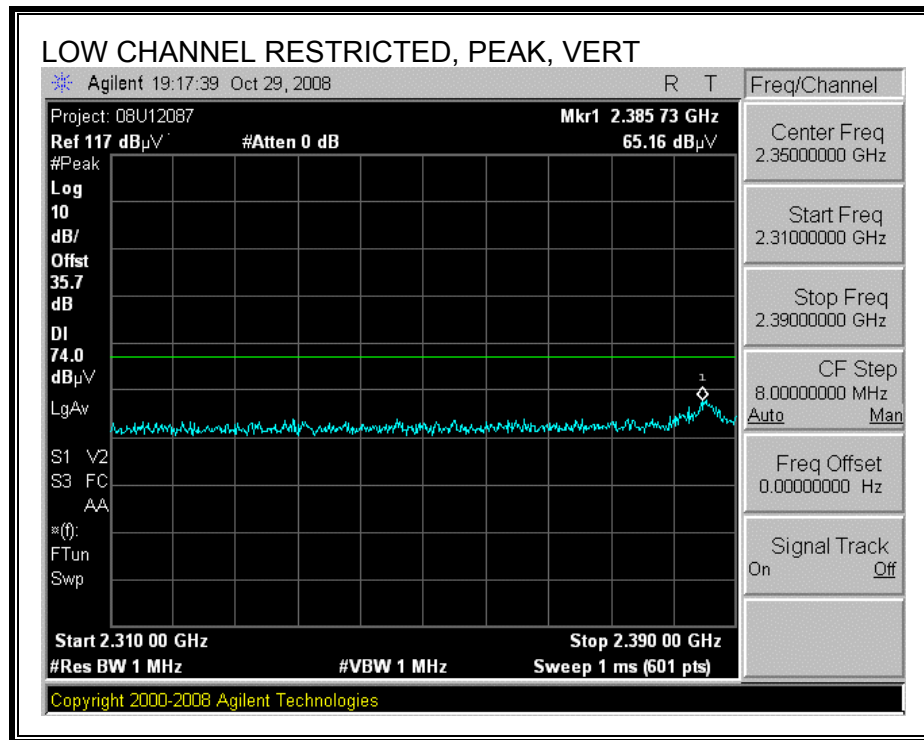
## 8.2. TRANSMITTER ABOVE 1 GHz

### 8.2.1. TRANSMITTER ABOVE 1 GHz FOR 802.11b MODE

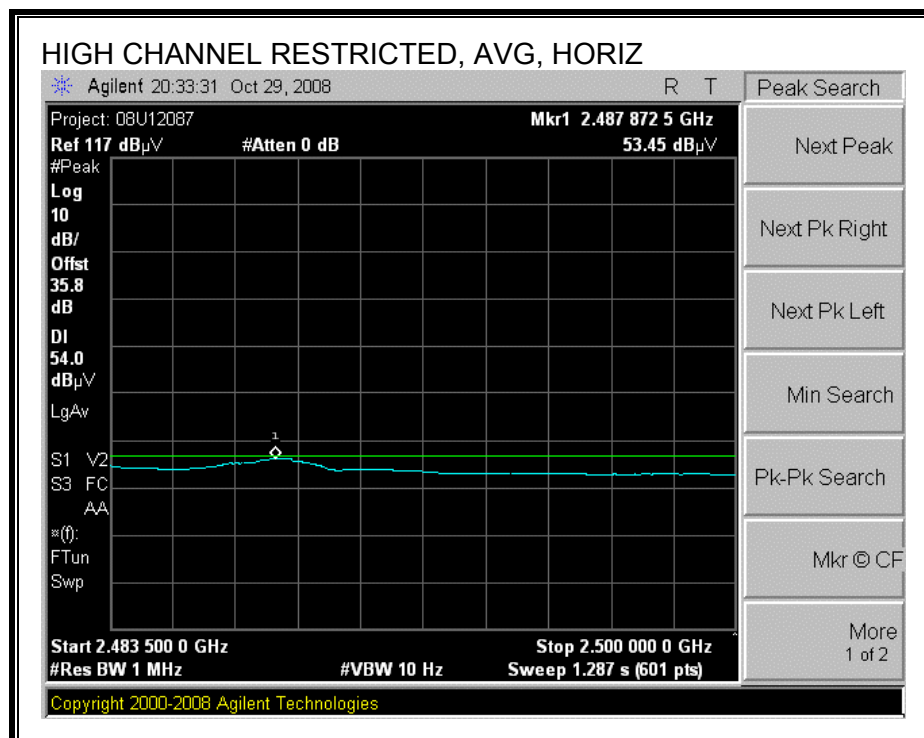
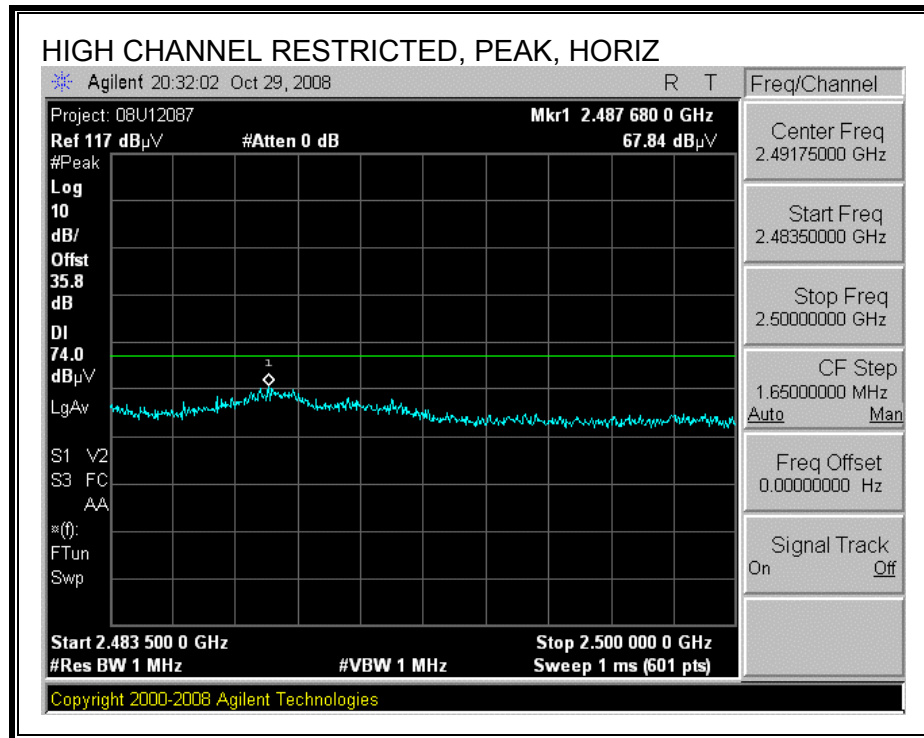
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



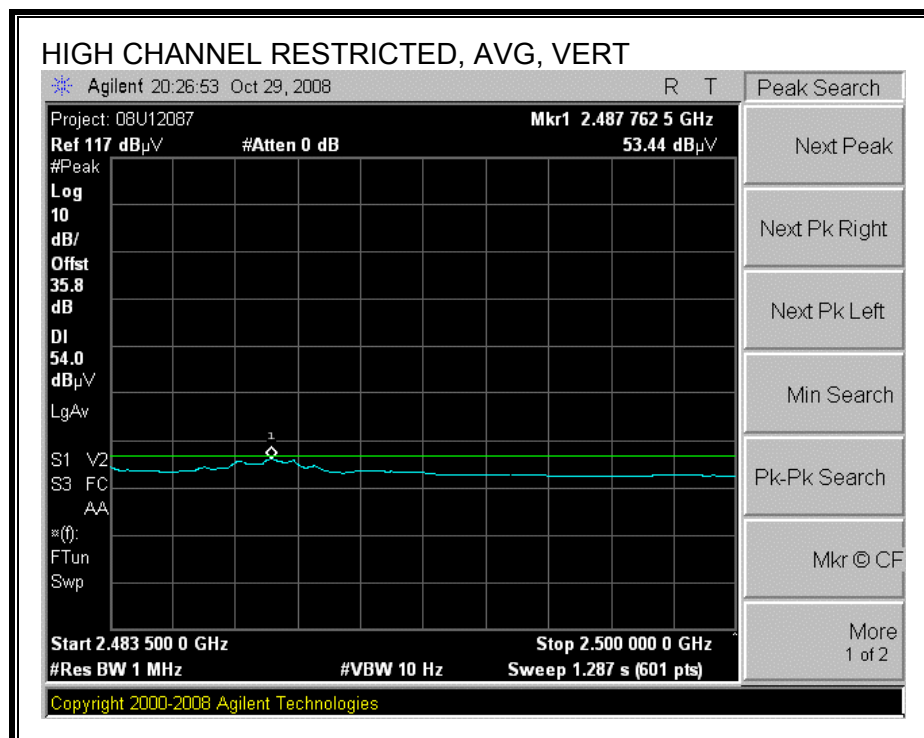
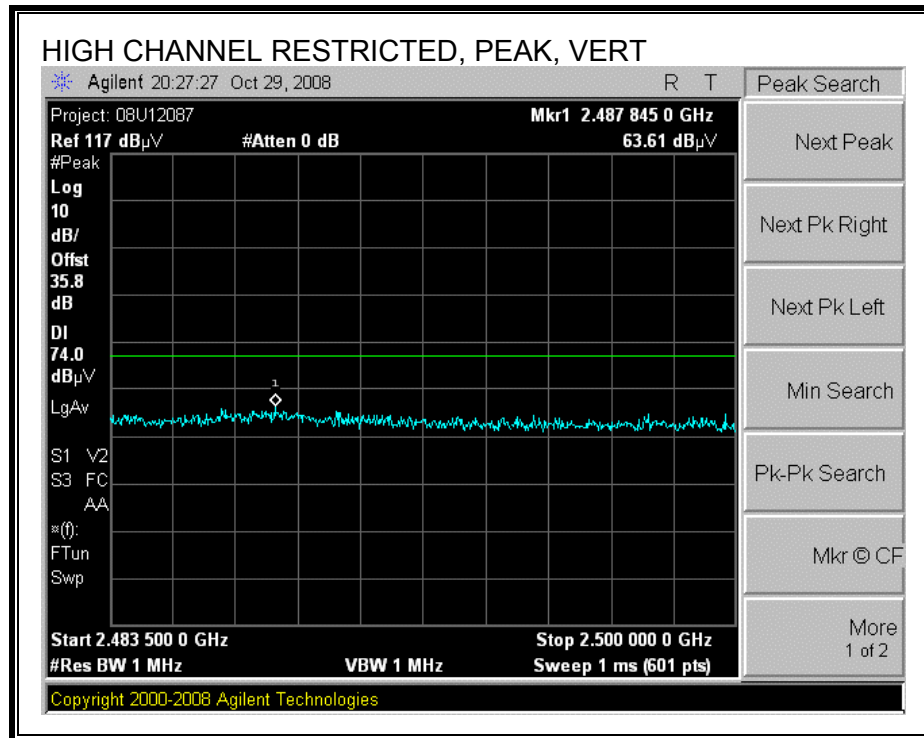
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



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

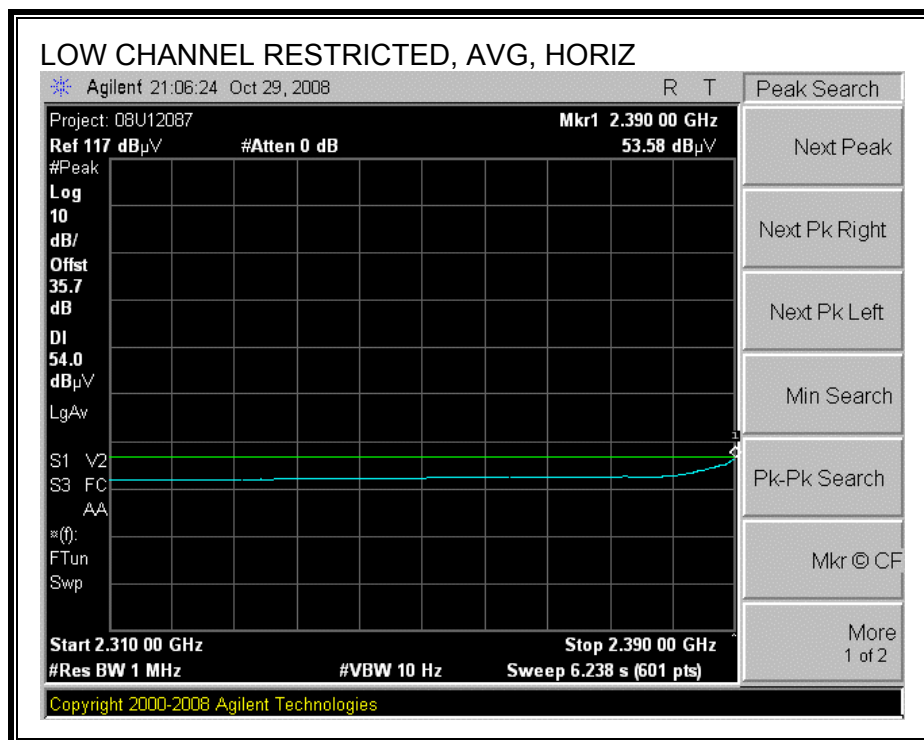
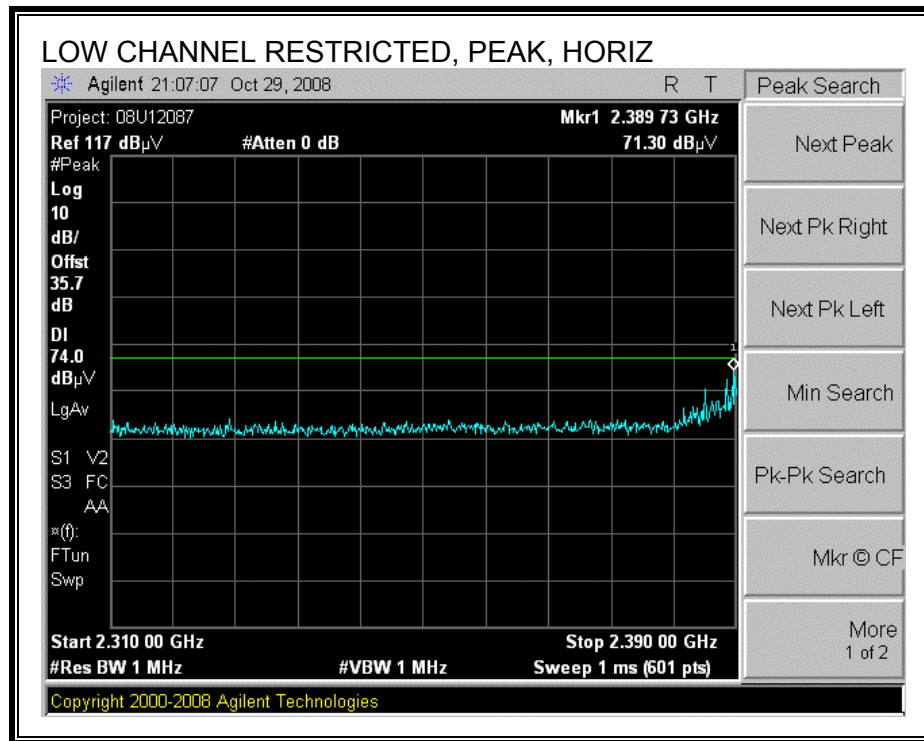


## HARMONICS AND SPURIOUS EMISSIONS

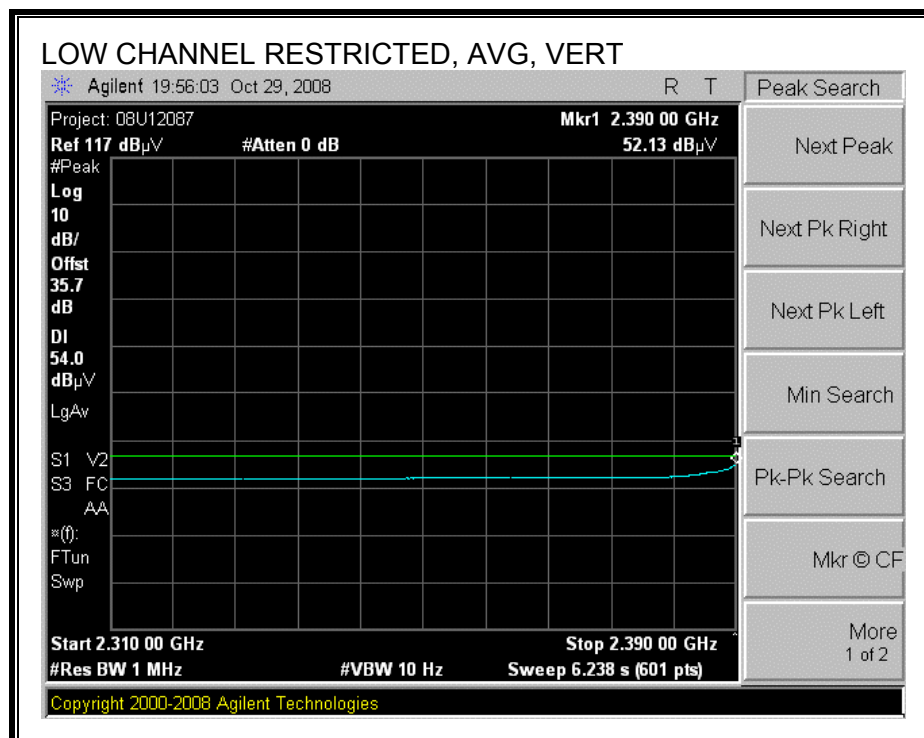
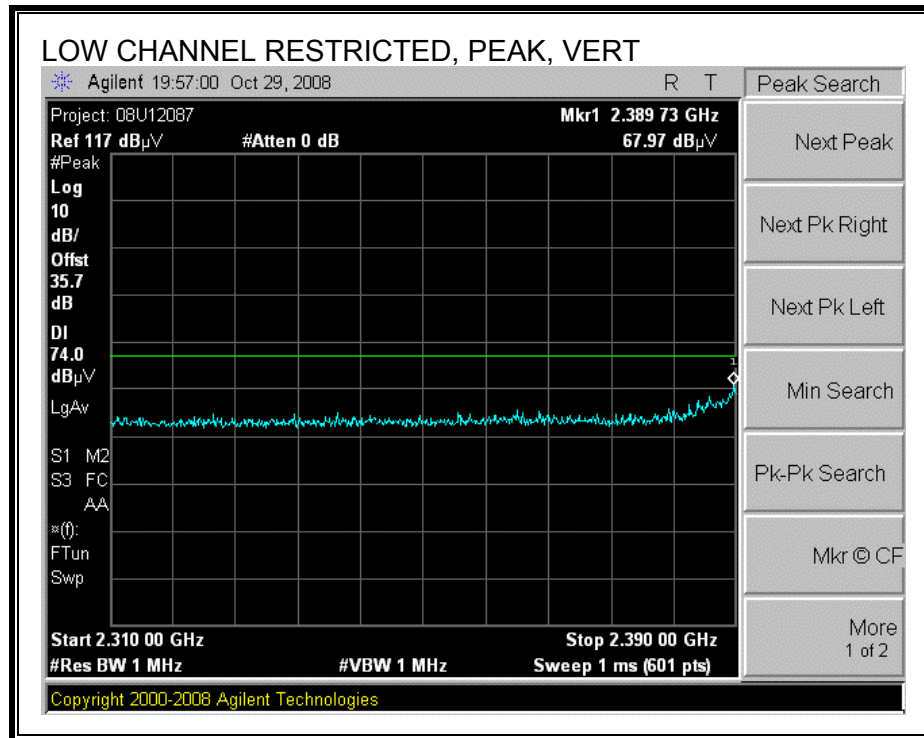
High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		Apple													
Project #:		08U12087													
Date:		10/29/08													
Test Engineer:		Vien Tran													
Configuration:		EUT / Laptop													
Mode:		Tx 11b Mode													
Test Equipment:															
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit							
T136; M/N: 3117 @3m		T34 HP 8449B		T88 Miteq 26-40GHz		T125; ARA 18-26GHz; S/N:1007		FCC 15.205							
Hi Frequency Cables															
2 foot cable		3 foot cable		Chamber Cables		HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz					
				C-5m Chamber		HPF_4.0GHz									
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
LOW CHANNEL, 2412 MHz															
4.824	3.0	40.9	31.2	32.6	5.3	-34.8	0.0	0.6	44.6	34.9	74	54	-29.4	-19.1	V
4.824	3.0	39.5	28.2	32.6	5.3	-34.8	0.0	0.6	43.2	31.9	74	54	-30.8	-22.1	H
MID CHANNEL, 2437 MHz															
4.874	3.0	49.1	44.9	32.6	5.4	-34.8	0.0	0.6	52.9	48.7	74	54	-21.1	-5.3	V
7.311	3.0	49.6	44.8	34.6	7.5	-34.1	0.0	0.6	58.2	53.4	74	54	-15.8	-0.6	V, Art-18
12.185	3.0	41.0	29.3	36.2	9.0	-32.5	0.0	0.9	54.7	43.0	74	54	-19.3	-11.0	V
4.874	3.0	41.2	32.1	32.6	5.4	-34.8	0.0	0.6	45.0	35.9	74	54	-29.0	-18.1	H
7.311	3.0	48.7	42.8	34.6	7.5	-34.1	0.0	0.6	57.3	51.4	74	54	-16.7	-2.6	H
12.185	3.0	40.1	29.1	36.2	9.0	-32.5	0.0	0.9	53.8	42.8	74	54	-20.2	-11.2	H
HI CHANNEL, 2462 MHz															
4.924	3.0	40.0	31.0	32.6	5.5	-34.8	0.0	0.6	43.9	34.9	74	54	-30.1	-19.1	V
7.386	3.0	47.1	40.2	34.6	7.6	-34.1	0.0	0.6	55.8	48.9	74	54	-18.2	-5.1	V
12.310	3.0	38.4	28.0	36.3	9.1	-32.5	0.0	0.9	52.2	41.8	74	54	-21.8	-12.2	V
4.924	3.0	42.8	35.5	32.6	5.5	-34.8	0.0	0.6	46.7	39.4	74	54	-27.3	-14.6	H
7.386	3.0	45.6	39.1	34.6	7.6	-34.1	0.0	0.6	54.3	47.8	74	54	-19.7	-6.2	H
12.310	3.0	39.2	28.3	36.3	9.1	-32.5	0.0	0.9	53.0	42.1	74	54	-21.0	-11.9	H
No other emissions were detected above system noise floor															
Rev. 10.15.08															
f	Measurement Frequency			Amp	Preamp Gain			Avg Lim		Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Pk Lim		Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Avg Mar		Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Pk Mar		Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter										

## 8.2.2. TRANSMITTER ABOVE 1 GHz FOR 802.11g MODE

### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

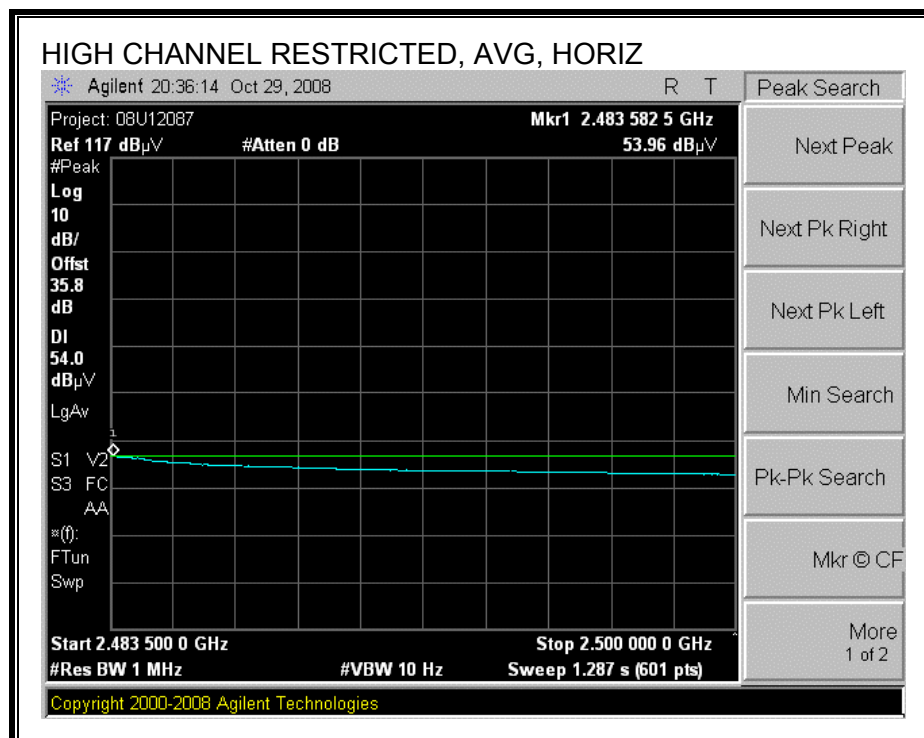
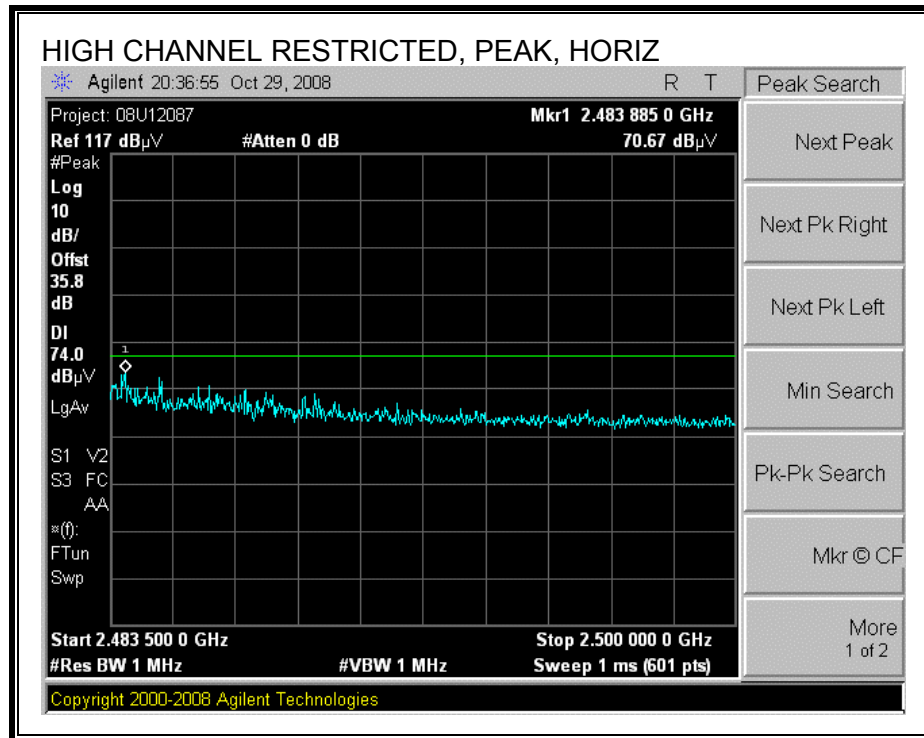


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

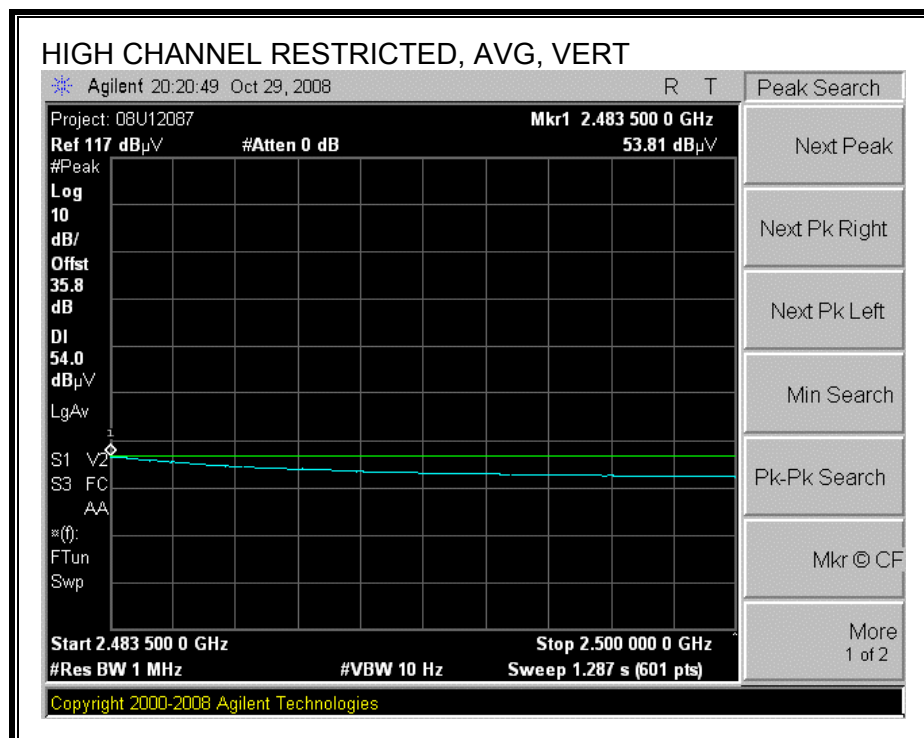
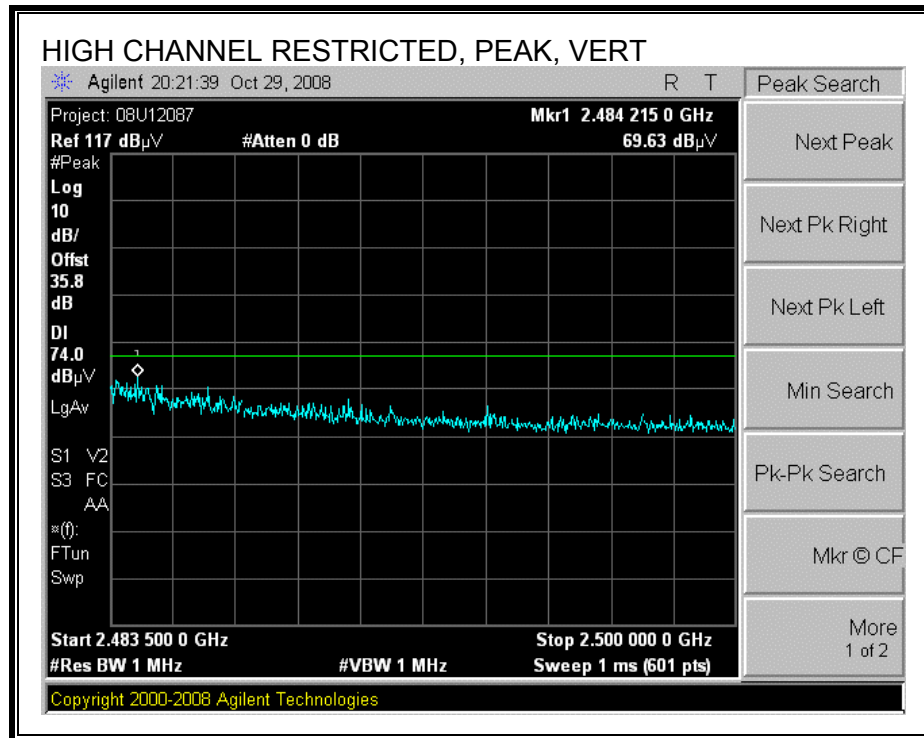




**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



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

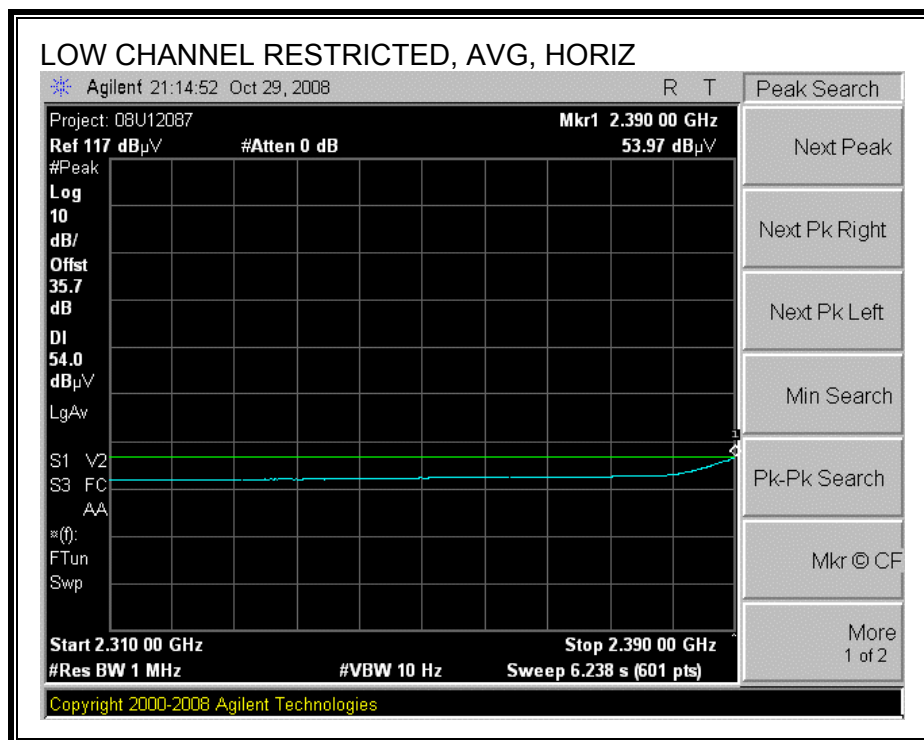
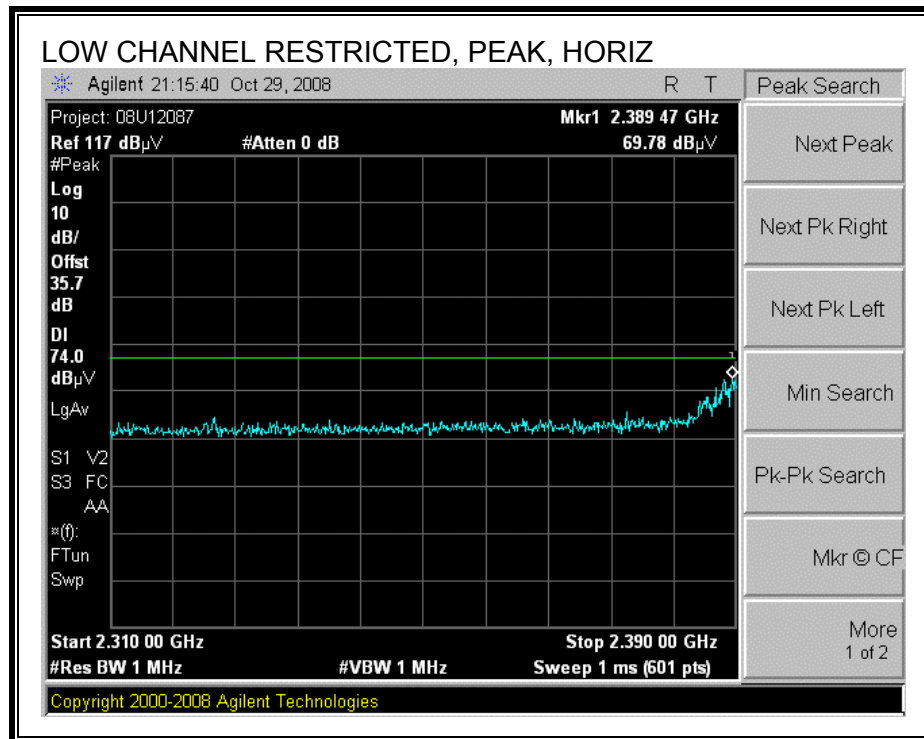


## HARMONICS AND SPURIOUS EMISSIONS

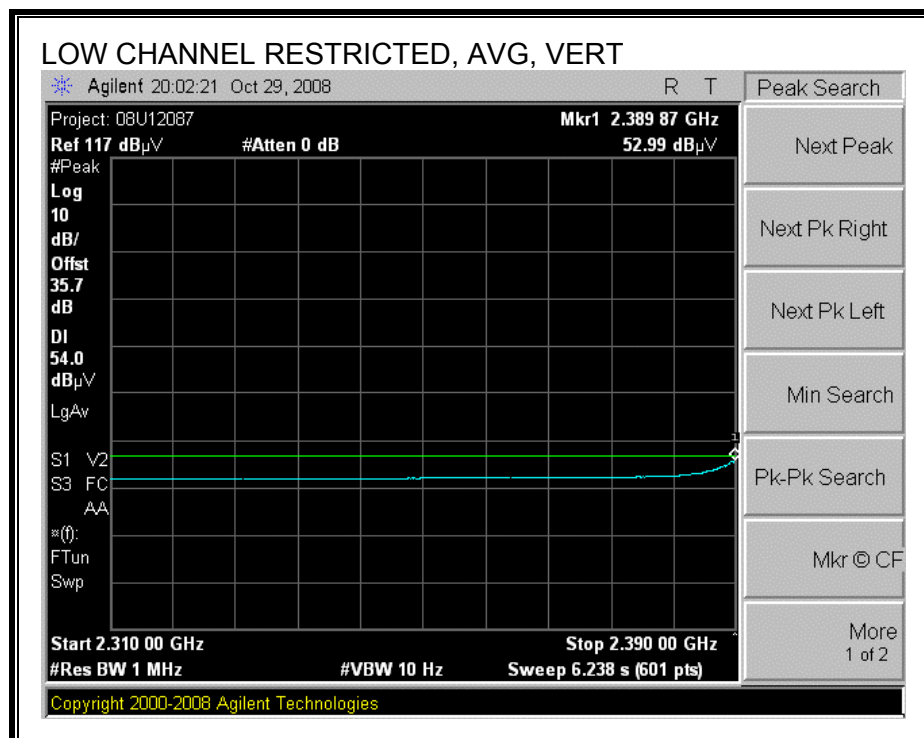
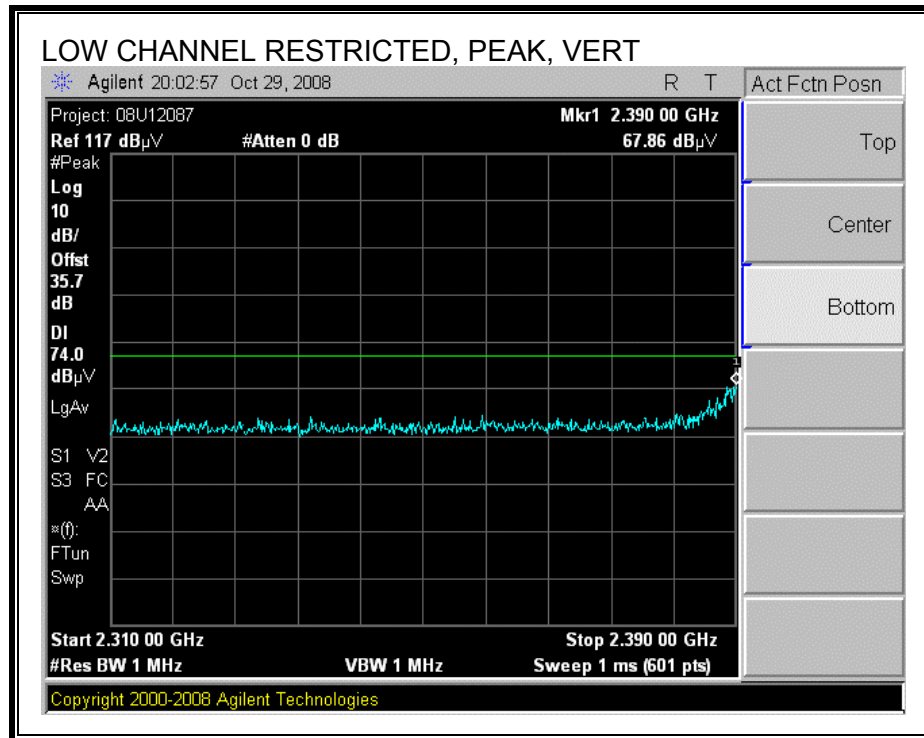
High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		Apple													
Project #:		08U12087													
Date:		10/30/08													
Test Engineer:		Vien Tran													
Configuration:		EUT / Laptop													
Mode:		Tx 11g Mode													
Test Equipment:															
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit			
T136; M/N: 3117 @3m			T34 HP 8449B			T88 Miteq 26-40GHz			T125; ARA 18-26GHz; S/N:1007			FCC 15.205			
Hi Frequency Cables															
2 foot cable			3 foot cable			Chamber Cables			HPF			Reject Filter			
						C-5m Chamber			HPF_4.0GHz						
<div style="display: flex; justify-content: space-between;"> <div> <b>Peak Measurements</b>  RBW=VBW=1MHz  <b>Average Measurements</b>  RBW=1MHz; VBW=10Hz </div> </div>															
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>LOW CHANNEL, 2412 MHz</b>															
4.824	3.0	39.5	28.3	32.6	5.3	-34.8	0.0	0.6	43.2	32.0	74	54	-30.8	-22.0	V
4.824	3.0	38.5	28.4	32.6	5.3	-34.8	0.0	0.6	42.2	32.1	74	54	-31.8	-21.9	H
<b>MID CHANNEL, 2437 MHz</b>															
4.874	3.0	39.6	27.8	32.6	5.4	-34.8	0.0	0.6	43.4	31.6	74	54	-30.6	-22.4	V
7.311	3.0	57.4	45.1	34.6	7.5	-34.1	0.0	0.6	66.0	53.7	74	54	-8.0	-0.3	V, Art=18.5
12.185	3.0	36.0	28.3	36.2	9.0	-32.5	0.0	0.9	49.7	42.0	74	54	-24.3	-12.0	V
4.874	3.0	39.9	28.5	32.6	5.4	-34.8	0.0	0.6	43.7	32.3	74	54	-30.3	-21.7	H
7.311	3.0	54.2	42.1	34.6	7.5	-34.1	0.0	0.6	62.8	50.7	74	54	-11.2	-3.3	H
12.185	3.0	39.2	28.7	36.2	9.0	-32.5	0.0	0.9	52.9	42.4	74	54	-21.1	-11.6	H
<b>HI CHANNEL, 2462 MHz</b>															
4.924	3.0	40.5	28.3	32.6	5.5	-34.8	0.0	0.6	44.4	32.2	74	54	-29.6	-21.8	V
7.386	3.0	46.8	33.8	34.6	7.6	-34.1	0.0	0.6	55.5	42.5	74	54	-18.5	-11.5	V
12.310	3.0	36.3	28.8	36.3	9.1	-32.5	0.0	0.9	50.1	42.6	74	54	-23.9	-11.4	V
4.924	3.0	41.8	28.8	32.6	5.5	-34.8	0.0	0.6	45.7	32.7	74	54	-28.3	-21.3	H
7.386	3.0	44.2	32.9	34.6	7.6	-34.1	0.0	0.6	52.9	41.6	74	54	-21.1	-12.4	H
12.310	3.0	39.7	28.8	36.3	9.1	-32.5	0.0	0.9	53.5	42.6	74	54	-20.5	-11.4	H
No other emissions were detected above suystem noise floor															
Rev. 10.15.08															
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit		
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit		
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit		
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit		
CL	Cable Loss					HPF	High Pass Filter								

### 8.2.3. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT20 MODE

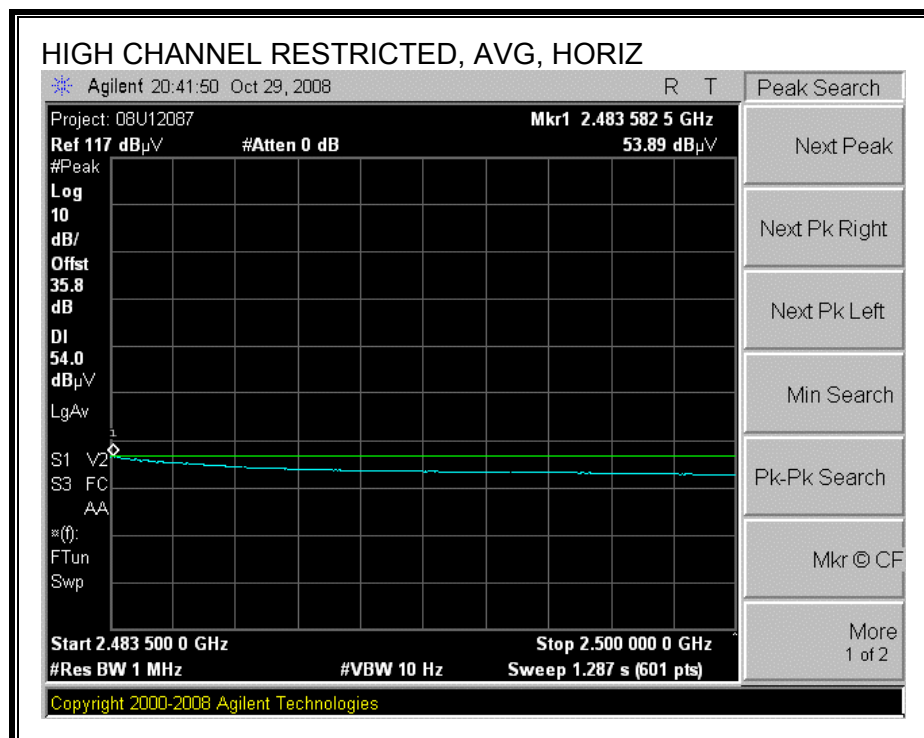
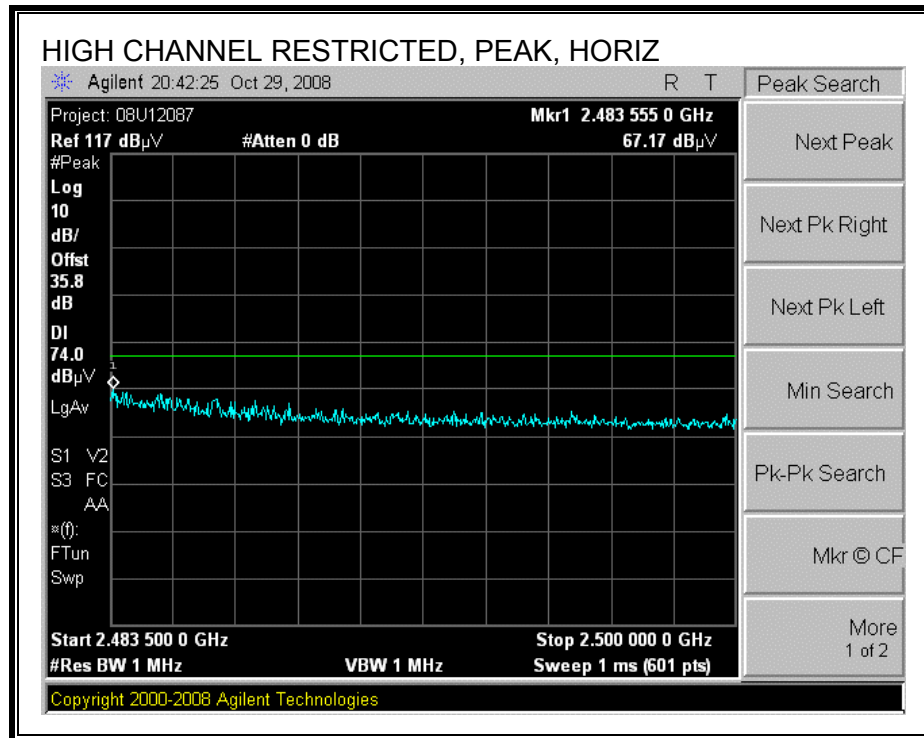
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



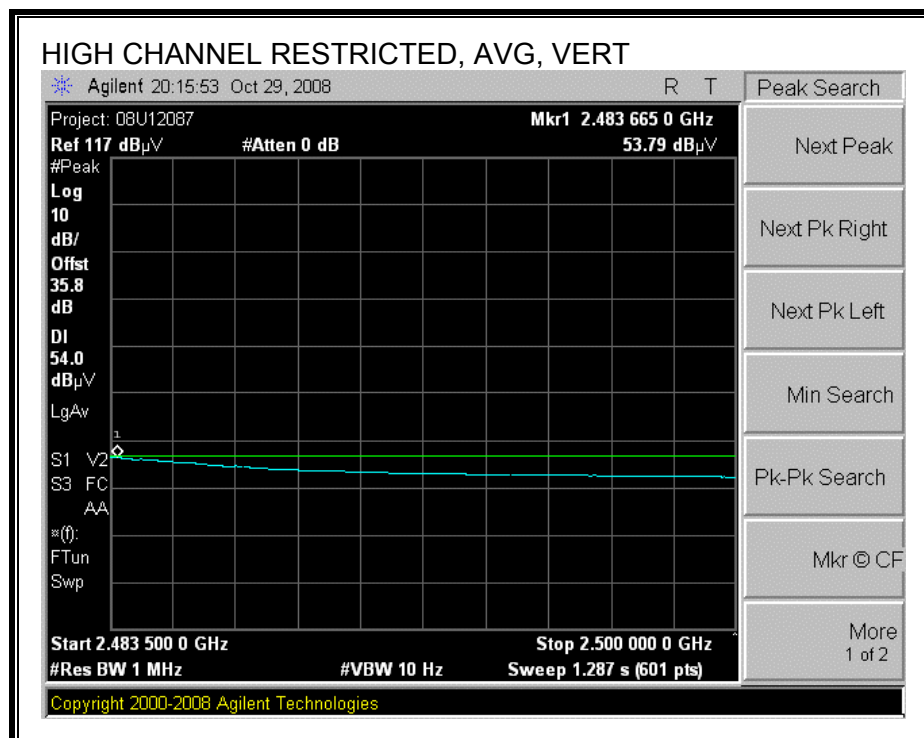
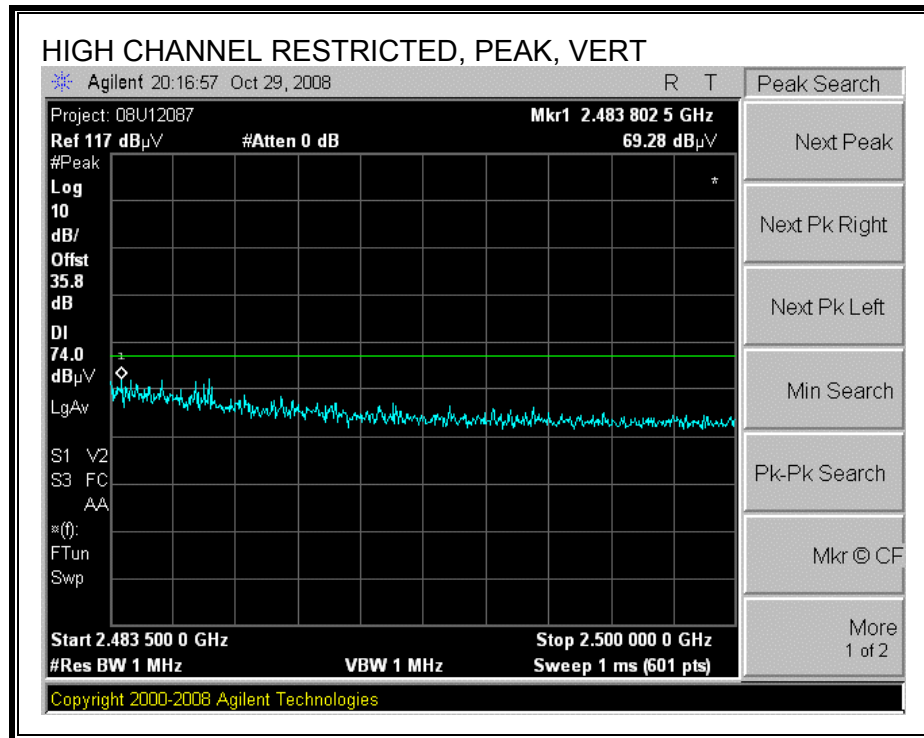
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



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



## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement																	
Compliance Certification Services, Fremont 5m Chamber																	
Company:		Apple															
Project #:		08U12087															
Date:		10/30/08															
Test Engineer:		Vien Tran															
Configuration:		EUT / Laptop															
Mode:		Tx 11n HT20 Mode															
Test Equipment:																	
Horn 1-18GHz T136; M/N: 3117 @3m				Pre-amplifier 1-26GHz T34 HP 8449B				Pre-amplifier 26-40GHz T88 Miteq 26-40GHz				Horn > 18GHz T125; ARA 18-26GHz; S/N:1007				Limit FCC 15.205	
Hi Frequency Cables																	
2 foot cable				3 foot cable				Chamber Cables C-5m Chamber				HPF HPF_4.0GHz		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
<b>LOW CHANNEL, 2412 MHz</b>																	
4.824	3.0	39.9	27.8	32.6	5.3	-34.8	0.0	0.6	43.6	31.5	74	54	-30.4	-22.5	V		
4.824	3.0	38.8	27.3	32.6	5.3	-34.8	0.0	0.6	42.5	31.0	74	54	-31.5	-23.0	H		
<b>MID CHANNEL, 2437 MHz</b>																	
4.874	3.0	40.2	28.3	32.6	5.4	-34.8	0.0	0.6	44.0	32.1	74	54	-30.0	-21.9	V		
7.311	3.0	57.3	45.3	34.6	7.5	-34.1	0.0	0.6	65.9	53.9	74	54	-8.1	-0.1	V, Art=18.5		
12.185	3.0	40.1	28.6	36.2	9.0	-32.5	0.0	0.9	53.8	42.3	74	54	-20.2	-11.7	V		
4.874	3.0	39.1	27.5	32.6	5.4	-34.8	0.0	0.6	42.9	31.3	74	54	-31.1	-22.7	H		
7.311	3.0	54.2	42.1	34.6	7.5	-34.1	0.0	0.6	62.8	50.7	74	54	-11.2	-3.3	H		
12.185	3.0	40.7	28.5	36.2	9.0	-32.5	0.0	0.9	54.4	42.2	74	54	-19.6	-11.8	H		
<b>HI CHANNEL, 2462 MHz</b>																	
4.924	3.0	39.3	28.1	32.6	5.5	-34.8	0.0	0.6	43.2	32.0	74	54	-30.8	-22.0	V		
7.386	3.0	45.7	32.8	34.6	7.6	-34.1	0.0	0.6	54.4	41.5	74	54	-19.6	-12.5	V		
12.310	3.0	39.2	28.5	36.3	9.1	-32.5	0.0	0.9	53.0	42.3	74	54	-21.0	-11.7	V		
4.924	3.0	38.6	27.8	32.6	5.5	-34.8	0.0	0.6	42.5	31.7	74	54	-31.5	-22.3	H		
7.386	3.0	42.6	31.2	34.6	7.6	-34.1	0.0	0.6	51.3	39.9	74	54	-22.7	-14.1	H		
12.310	3.0	38.9	28.0	36.3	9.1	-32.5	0.0	0.9	52.7	41.8	74	54	-21.3	-12.2	H		
No other emissions were detected above suystem noise floor																	
Rev. 10.15.08																	
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										



## 8.2.4. TX ABOVE 1 GHz FOR 802.11a LEGACY MODE IN THE 5.8 GHz BAND

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		Apple														
Project #:		08U12087														
Date:		10/29/08														
Test Engineer:		Vien Tran														
Configuration:		EUT / Laptop														
Mode:		Tx 11b Mode														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T136; M/N: 3117 @3m			T34 HP 8449B			T88 Miteq 26-40GHz			T125; ARA 18-26GHz; S/N:1007			FCC 15.205				
Hi Frequency Cables																
2 foot cable			3 foot cable			Chamber Cables			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz	
						C5m Chamber			HPF_4.0GHz							
f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
LOW CHANNEL, 2412 MHz																
4.824	3.0	40.9	31.2	32.6	5.3	-34.8	0.0	0.6	44.6	34.9	74	54	-29.4	-19.1	V	
4.824	3.0	39.5	28.2	32.6	5.3	-34.8	0.0	0.6	43.2	31.9	74	54	-30.8	-22.1	H	
MID CHANNEL, 2437 MHz																
4.874	3.0	49.1	44.9	32.6	5.4	-34.8	0.0	0.6	52.9	48.7	74	54	-21.1	-5.3	V	
7.311	3.0	49.6	44.8	34.6	7.5	-34.1	0.0	0.6	58.2	53.4	74	54	-15.8	-0.6	V, Art=18	
12.185	3.0	41.0	29.3	36.2	9.0	-32.5	0.0	0.9	54.7	43.0	74	54	-19.3	-11.0	V	
4.874	3.0	41.2	32.1	32.6	5.4	-34.8	0.0	0.6	45.0	35.9	74	54	-29.0	-18.1	H	
7.311	3.0	48.7	42.8	34.6	7.5	-34.1	0.0	0.6	57.3	51.4	74	54	-16.7	-2.6	H	
12.185	3.0	40.1	29.1	36.2	9.0	-32.5	0.0	0.9	53.8	42.8	74	54	-20.2	-11.2	H	
HI CHANNEL, 2462 MHz																
4.924	3.0	40.0	31.0	32.6	5.5	-34.8	0.0	0.6	43.9	34.9	74	54	-30.1	-19.1	V	
7.386	3.0	47.1	40.2	34.6	7.6	-34.1	0.0	0.6	55.8	48.9	74	54	-18.2	-5.1	V	
12.310	3.0	38.4	28.0	36.3	9.1	-32.5	0.0	0.9	52.2	41.8	74	54	-21.8	-12.2	V	
4.924	3.0	42.8	35.5	32.6	5.5	-34.8	0.0	0.6	46.7	39.4	74	54	-27.3	-14.6	H	
7.386	3.0	45.6	39.1	34.6	7.6	-34.1	0.0	0.6	54.3	47.8	74	54	-19.7	-6.2	H	
12.310	3.0	39.2	28.3	36.3	9.1	-32.5	0.0	0.9	53.0	42.1	74	54	-21.0	-11.9	H	
No other emissions were detected above system noise floor																
Rev. 10.15.08																
f	Measurement Frequency			Amp	Preamp Gain			Avg Lim	Average Field Strength Limit							
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Pk Lim	Peak Field Strength Limit							
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Avg Mar	Margin vs. Average Limit							
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Pk Mar	Margin vs. Peak Limit							
CL	Cable Loss			HPF	High Pass Filter											

## 8.2.5. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.8 GHz BAND

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		Apple													
Project #:		08U12087													
Date:		10/29/08													
Test Engineer:		Vien Tran													
Configuration:		EUT / Laptop													
Mode:		Tx 11b Mode													
Test Equipment:															
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit							
T136; M/N: 3117 @3m		T34 HP 8449B		T88 Miteq 26-40GHz		T125; ARA 18-26GHz; S/N:1007		FCC 15.205							
Hi Frequency Cables															
2 foot cable		3 foot cable		Chamber Cables		HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz, VBW=10Hz					
				C-5m Chamber		HPF_4.0GHz									
f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
LOW CHANNEL, 2412 MHz															
4.824	3.0	40.9	31.2	32.6	5.3	-34.8	0.0	0.6	44.6	34.9	74	54	-29.4	-19.1	V
4.824	3.0	39.5	28.2	32.6	5.3	-34.8	0.0	0.6	43.2	31.9	74	54	-30.8	-22.1	H
MID CHANNEL, 2437 MHz															
4.874	3.0	49.1	44.9	32.6	5.4	-34.8	0.0	0.6	52.9	48.7	74	54	-21.1	-5.3	V
7.311	3.0	49.6	44.8	34.6	7.5	-34.1	0.0	0.6	58.2	53.4	74	54	-15.8	-0.6	V, Art=18
12.185	3.0	41.0	29.3	36.2	9.0	-32.5	0.0	0.9	54.7	43.0	74	54	-19.3	-11.0	V
4.874	3.0	41.2	32.1	32.6	5.4	-34.8	0.0	0.6	45.0	35.9	74	54	-29.0	-18.1	H
7.311	3.0	48.7	42.8	34.6	7.5	-34.1	0.0	0.6	57.3	51.4	74	54	-16.7	-2.6	H
12.185	3.0	40.1	29.1	36.2	9.0	-32.5	0.0	0.9	53.8	42.8	74	54	-20.2	-11.2	H
HI CHANNEL, 2462 MHz															
4.924	3.0	40.0	31.0	32.6	5.5	-34.8	0.0	0.6	43.9	34.9	74	54	-30.1	-19.1	V
7.386	3.0	47.1	40.2	34.6	7.6	-34.1	0.0	0.6	55.8	48.9	74	54	-18.2	-5.1	V
12.310	3.0	38.4	28.0	36.3	9.1	-32.5	0.0	0.9	52.2	41.8	74	54	-21.8	-12.2	V
4.924	3.0	42.8	35.5	32.6	5.5	-34.8	0.0	0.6	46.7	39.4	74	54	-27.3	-14.6	H
7.386	3.0	45.6	39.1	34.6	7.6	-34.1	0.0	0.6	54.3	47.8	74	54	-19.7	-6.2	H
12.310	3.0	39.2	28.3	36.3	9.1	-32.5	0.0	0.9	53.0	42.1	74	54	-21.0	-11.9	H
No other emissions were detected above system noise floor															
Rev. 10.15.08															
f	Measurement Frequency		Amp	Preamp Gain		Avg Lim	Average Field Strength Limit								
Dist	Distance to Antenna		D Corr	Distance Correct to 3 meters		Pk Lim	Peak Field Strength Limit								
Read	Analyzer Reading		Avg	Average Field Strength @ 3 m		Avg Mar	Margin vs. Average Limit								
AF	Antenna Factor		Peak	Calculated Peak Field Strength		Pk Mar	Margin vs. Peak Limit								
CL	Cable Loss		HPF	High Pass Filter											

## 8.2.6. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 5.8 GHz BAND

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Company:		Apple													
Project #:		08U12087													
Date:		01/15/09													
Test Engineer:		Thanh Nguyen													
Configuration:		EUT / Laptop													
Mode:		Tx 11n HT40 Mode													
<b>Test Equipment:</b>															
Horn 1-18GHz		Pre-amplifier 1-26GHz		Pre-amplifier 26-40GHz		Horn > 18GHz		Limit							
T136; M/N: 3117 @3m		T34 HP 8449B		T88 Miteq 26-40GHz		T125; ARA 18-26GHz; S/N:1007		FCC 15.205							
<b>Hi Frequency Cables</b>															
2 foot cable		3 foot cable		Chamber Cables		HPF		Reject Filter		<b>Peak Measurements</b> RBW=VBW=1MHz <b>Average Measurements</b> RBW=1MHz, VBW=10Hz					
				C-5m Chamber		HPF_4.0GHz									
f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>LOW CHANNEL, 5755 MHz</b>															
11.510	3.0	48.3	37.0	35.9	9.0	-32.5	0.0	0.9	61.5	50.2	74	54	-12.5	-3.8	V, Art=19
11.510	3.0	46.9	34.3	35.9	9.0	-32.5	0.0	0.9	60.1	47.4	74	54	-13.9	-6.6	V, Art=19
<b>HI CHANNEL, 5795 MHz</b>															
11.590	3.0	50.5	39.2	35.9	9.0	-32.5	0.0	0.9	63.8	52.5	74	54	-10.2	-1.5	V, Art=23
11.590	3.0	48.8	37.8	35.9	9.0	-32.5	0.0	0.9	62.1	51.1	74	54	-11.9	-2.9	H, Art=23
No other emissions were detected above suystem noise floor															
Rev. 10.15.08															
f	Measurement Frequency			Amp	Preamp Gain			Avg Lim	Average Field Strength Limit						
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Pk Lim	Peak Field Strength Limit						
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Avg Mar	Margin vs. Average Limit						
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Pk Mar	Margin vs. Peak Limit						
CL	Cable Loss			HPF	High Pass Filter										

## 8.3. RECEIVER ABOVE 1 GHz

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

High Frequency Measurement																																																																																																																																																															
Compliance Certification Services, Fremont 5m Chamber																																																																																																																																																															
Company:		Apple Inc.																																																																																																																																																													
Project #:		08U12087-2																																																																																																																																																													
Date:		12/01/08																																																																																																																																																													
Test Engineer:		Thanh Nguyen																																																																																																																																																													
Configuration:		EUT and remote support Laptop																																																																																																																																																													
Mode:		Receive mode 20MHz, 2.4 GHz band																																																																																																																																																													
Test Equipment:																																																																																																																																																															
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit																																																																																																																																																			
T119; S/N: 29301 @3m			T145 Agilent 3008A005t			T88 Miteq 26-40GHz			T125; ARA 18-26GHz; S/N:1007			RX RSS 210																																																																																																																																																			
Hi Frequency Cables																																																																																																																																																															
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter																																																																																																																																																			
						B-5m Chamber																																																																																																																																																									
<table border="1"> <thead> <tr> <th>f GHz</th> <th>Dist (m)</th> <th>Read Pk dBuV</th> <th>Read Avg dBuV</th> <th>AF dB/m</th> <th>CL dB</th> <th>Amp dB</th> <th>D Corr dB</th> <th>Filt dB</th> <th>Peak dBuV/m</th> <th>Avg dBuV/m</th> <th>Pk Lim dBuV/m</th> <th>Avg Lim dBuV/m</th> <th>Pk Mar dB</th> <th>Avg Mar dB</th> <th>Notes (V/H)</th> </tr> </thead> <tbody> <tr> <td colspan="16"><b>Spurious emissions</b></td> </tr> <tr> <td>1.020</td> <td>3.0</td> <td>53.2</td> <td>43.5</td> <td>28.0</td> <td>3.3</td> <td>-36.1</td> <td>0.0</td> <td>0.0</td> <td>48.4</td> <td>38.6</td> <td>74</td> <td>54</td> <td>-25.6</td> <td>-15.4</td> <td>V</td> </tr> <tr> <td>1.066</td> <td>3.0</td> <td>51.4</td> <td>42.5</td> <td>28.2</td> <td>3.3</td> <td>-36.1</td> <td>0.0</td> <td>0.0</td> <td>46.8</td> <td>37.9</td> <td>74</td> <td>54</td> <td>-27.2</td> <td>-16.1</td> <td>V</td> </tr> <tr> <td>1.300</td> <td>3.0</td> <td>46.5</td> <td>42.4</td> <td>28.9</td> <td>3.6</td> <td>-35.9</td> <td>0.0</td> <td>0.0</td> <td>43.1</td> <td>39.0</td> <td>74</td> <td>54</td> <td>-30.9</td> <td>-15.0</td> <td>V</td> </tr> <tr> <td>1.385</td> <td>3.0</td> <td>47.5</td> <td>41.2</td> <td>29.2</td> <td>3.7</td> <td>-35.9</td> <td>0.0</td> <td>0.0</td> <td>44.5</td> <td>38.3</td> <td>74</td> <td>54</td> <td>-29.5</td> <td>-15.7</td> <td>V</td> </tr> <tr> <td>2.815</td> <td>3.0</td> <td>48.3</td> <td>41.3</td> <td>31.8</td> <td>5.4</td> <td>-35.2</td> <td>0.0</td> <td>0.0</td> <td>50.4</td> <td>43.3</td> <td>74</td> <td>54</td> <td>-23.6</td> <td>-10.7</td> <td>V</td> </tr> <tr> <td>1.375</td> <td>3.0</td> <td>48.2</td> <td>40.1</td> <td>29.2</td> <td>3.7</td> <td>-35.9</td> <td>0.0</td> <td>0.0</td> <td>45.3</td> <td>37.1</td> <td>74</td> <td>54</td> <td>-28.7</td> <td>-16.9</td> <td>H</td> </tr> <tr> <td colspan="16">No other emissions were detected above system noise floor</td> </tr> </tbody> </table>																f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	<b>Spurious emissions</b>																1.020	3.0	53.2	43.5	28.0	3.3	-36.1	0.0	0.0	48.4	38.6	74	54	-25.6	-15.4	V	1.066	3.0	51.4	42.5	28.2	3.3	-36.1	0.0	0.0	46.8	37.9	74	54	-27.2	-16.1	V	1.300	3.0	46.5	42.4	28.9	3.6	-35.9	0.0	0.0	43.1	39.0	74	54	-30.9	-15.0	V	1.385	3.0	47.5	41.2	29.2	3.7	-35.9	0.0	0.0	44.5	38.3	74	54	-29.5	-15.7	V	2.815	3.0	48.3	41.3	31.8	5.4	-35.2	0.0	0.0	50.4	43.3	74	54	-23.6	-10.7	V	1.375	3.0	48.2	40.1	29.2	3.7	-35.9	0.0	0.0	45.3	37.1	74	54	-28.7	-16.9	H	No other emissions were detected above system noise floor															
f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)																																																																																																																																																
<b>Spurious emissions</b>																																																																																																																																																															
1.020	3.0	53.2	43.5	28.0	3.3	-36.1	0.0	0.0	48.4	38.6	74	54	-25.6	-15.4	V																																																																																																																																																
1.066	3.0	51.4	42.5	28.2	3.3	-36.1	0.0	0.0	46.8	37.9	74	54	-27.2	-16.1	V																																																																																																																																																
1.300	3.0	46.5	42.4	28.9	3.6	-35.9	0.0	0.0	43.1	39.0	74	54	-30.9	-15.0	V																																																																																																																																																
1.385	3.0	47.5	41.2	29.2	3.7	-35.9	0.0	0.0	44.5	38.3	74	54	-29.5	-15.7	V																																																																																																																																																
2.815	3.0	48.3	41.3	31.8	5.4	-35.2	0.0	0.0	50.4	43.3	74	54	-23.6	-10.7	V																																																																																																																																																
1.375	3.0	48.2	40.1	29.2	3.7	-35.9	0.0	0.0	45.3	37.1	74	54	-28.7	-16.9	H																																																																																																																																																
No other emissions were detected above system noise floor																																																																																																																																																															
Rev. 4.12.7																																																																																																																																																															
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. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 5.8 GHz BAND

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		Apple Inc.														
Project #:		08U12087-2														
Date:		12/01/08														
Test Engineer:		Thanh Nguyen														
Configuration:		EUT and remote support Laptop														
Mode:		Receive mode 20MHz, 5.8GHz band.														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T73; S/N: 6717 @3m			T34 HP 8449B			T88 Miteq 26-40GHz			T125; ARA 18-26GHz; S/N:1007			RX RSS 210				
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	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
1.027	3.0	53.5	46.8	25.8	2.4	-38.2	0.0	0.0	43.5	36.8	74	54	-30.5	-17.2	H	
1.431	3.0	52.3	30.9	26.9	2.9	-37.7	0.0	0.0	44.3	23.0	74	54	-29.7	-31.0	H	
2.030	3.0	44.8	32.1	28.5	3.5	-36.8	0.0	0.0	39.9	27.3	74	54	-34.1	-26.7	H	
1.432	3.0	54.3	43.0	26.9	2.9	-37.7	0.0	0.0	46.3	35.1	74	54	-27.7	-18.9	V	
1.562	3.0	54.2	22.3	27.2	3.0	-37.5	0.0	0.0	46.9	15.0	74	54	-27.1	-39.0	V	
2.162	3.0	48.4	28.9	28.8	3.6	-36.6	0.0	0.0	44.1	24.6	74	54	-29.9	-29.4	V	
No other emissions were detected above system noise floor.																
Rev. 10.15.08																
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit			
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit			
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit			
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit			
CL	Cable Loss					HPF	High Pass Filter									

### 8.3.3. RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH IN THE 5.8 GHz BAND

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		Apple														
Project #:		08U12079														
Date:		11/10/2008														
Test Engineer:		Thanh Nguyen														
Configuration:		EUT and remote support laptop														
Mode:		Receive mode 40MHz at 5.8GHz band														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T119; S/N: 29301 @3m			T145 Agilent 3008A005t									RX RSS 210				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz	
						B-5m Chamber										
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
<b>Spurious emissions</b>																
1.110	3.0	51.5	41.5	28.3	3.4	-36.1	0.0	0.0	47.1	37.1	74	54	-26.9	-16.9	V	
1.100	3.0	48.6	39.4	28.3	3.4	-36.1	0.0	0.0	44.1	34.9	74	54	-29.9	-19.1	V	
1.330	3.0	48.8	42.5	29.0	3.7	-35.9	0.0	0.0	45.6	39.3	74	54	-28.4	-14.7	V	
2.810	3.0	46.7	38.6	31.8	5.4	-35.2	0.0	0.0	48.7	40.6	74	54	-25.3	-13.4	V	
1.100	3.0	49.9	40.1	28.3	3.4	-36.1	0.0	0.0	45.4	35.7	74	54	-28.6	-18.3	V	
1.110	3.0	50.2	39.2	28.3	3.4	-36.1	0.0	0.0	45.9	34.9	74	54	-28.1	-19.1	H	
1.375	3.0	48.6	40.3	29.2	3.7	-35.9	0.0	0.0	45.6	37.3	74	54	-28.4	-16.7	H	
No other emissions were detected above system noise floor																
Rev. 4.12.7																
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

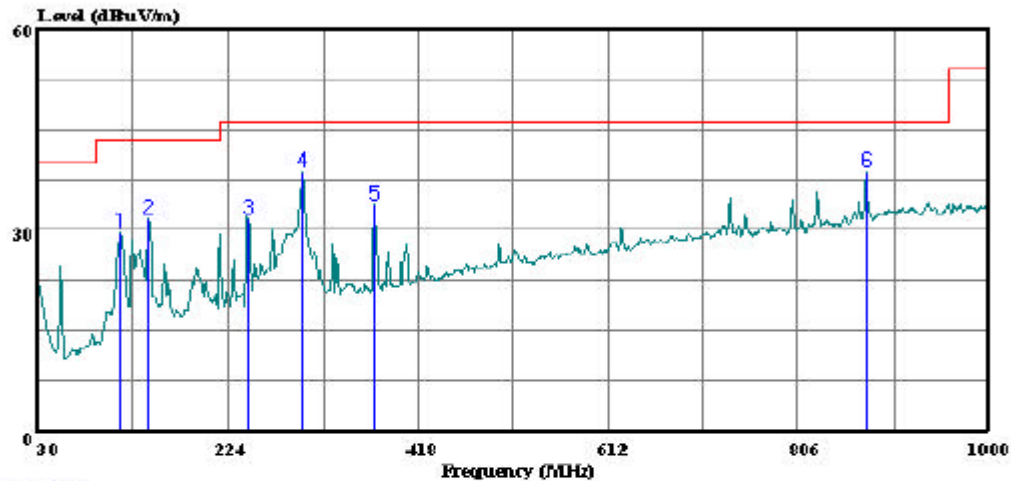
### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

#### HORIZONTAL PLOT& DATA



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

Data#: 4 File#: 08U12087EMI.EMI Date: 09-15-2008 Time: 10:27:04



(Fremont)

Trace: 3

Ref Trace:

Condition: FCC CLASS-B 3m ANTENNA B\_5M 021109 HORIZONTAL  
Test Operator:: Thanh Nguyen  
Project #: 08U12087  
Company: Apple Inc.  
Configuration:: BUT only  
Mode: Transmit worst case  
Target: FCC Class B

Page: 1

	Read		Limit	Over		
Freq	Level	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	114.390	43.30	-13.57	29.73	43.50	-13.77 Peak
2	143.490	45.29	-13.60	31.69	43.50	-11.81 Peak
3	243.400	44.88	-13.23	31.65	46.00	-14.35 Peak
4	300.630	49.88	-11.06	38.82	46.00	-7.18 Peak
5	373.380	42.76	-9.00	33.76	46.00	-12.24 Peak
6	875.840	36.39	2.38	38.77	46.00	-7.23 Peak

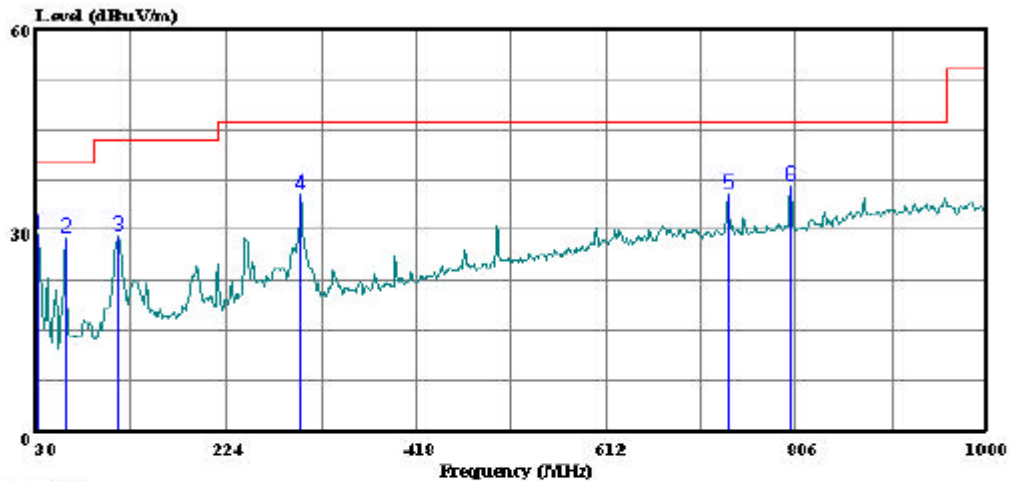
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

**VERTICAL PLOT& DATA**



Compliance Certification Services  
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Data#: 2 File#: 08U12087EMI.EMI Date: 09-15-2008 Time: 10:18:19



(Fremont)

Trace: 1

Ref Trace:

Condition: FCC CLASS-B 3m ANTENNA B\_5M 021109 VERTICAL  
Test Operator:: Thanh Nguyen  
Project #: 08U12087  
Company: Apple Inc.  
Configuration: BUT only  
Mode: Transmit worst case  
Target: FCC Class B

Page: 1

	Freq	Read		Limit	Over	
	MHz	Level	Factor	Level	Line	Limit Remark
		dBuV	dB	dBuV/m	dBuV/m	dB
1	31.940	38.45	-9.01	29.44	40.00	-10.56 Peak
2	61.040	48.64	-19.69	28.95	40.00	-11.05 Peak
3	114.390	42.72	-13.57	29.15	43.50	-14.35 Peak
4	300.630	46.30	-11.06	35.24	46.00	-10.76 Peak
5	735.190	35.33	0.03	35.36	46.00	-10.64 Peak
6	800.180	35.79	0.72	36.51	46.00	-9.49 Peak



## 9. 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).

## **CALCULATIONS**

Given

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

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

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

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

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

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

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

The power density in units of mW/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.

## **LIMITS**

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

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

## **RESULTS**

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
WLAN, 11b	2.4 GHz	20.0	21.72	5.08	0.10	0.95
WLAN, 11g	2.4 GHz	20.0	22.24	5.08	0.11	1.07
WLAN, HT20	2.4 GHz	20.0	22.37	3.49	0.08	0.77
WLAN, 11a	5.8 GHz	20.0	28.37	6.03	0.55	5.47
WLAN, HT20	5.8 GHz	20.0	28.25	3.40	0.29	2.91
WLAN, HT40	5.8 GHz	20.0	28.25	3.40	0.29	2.91
WLAN, 11a	5.2 GHz	20.0	14.12	6.94	0.03	0.25
WLAN, HT20	5.2 GHz	20.0	12.96	4.21	0.01	0.10
WLAN, HT40	5.2 GHz	20.0	16.10	4.21	0.02	0.21

### **Notes:**

Antenna Gain for 11b, 11g and 11a is the combined antenna gain for both chains.

Antenna gain for HT20 and HT40 is the maximum antenna gain of both chains.

Output power is the combined output power for both chains.

### **CO-LOCATED MPE CALCULATIONS**

For multiple colocated transmitters operating simultaneously the total power density can be calculated by summing the Power \* Gain product (in linear units) of each transmitter.

yields

$$d = 0.282 * \sqrt{((P1 * G1) + (P2 * G2) + \dots + (Pn * Gn)) / S}$$

where

d = distance in cm

Px = Power of transmitter x in mW

Gx = Numeric gain of antenna x

S = Power Density in mW/cm<sup>2</sup>

In the table below, Power and Gain are entered in units of dBm and dBi respectively, then converted to their linear forms for the purpose of 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**

Mode	Band	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
WLAN, 11g	2.4 GHz	22.24	5.08			
WLAN, 11a	5.8 GHz	28.37	6.03			
Combined				20.0	0.65	6.55