



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

**FOR**

**2X3 ACCESS POINT W/ 802.11 a/b/g/n CARD**

**MODEL NUMBER: A1254**

**FCC ID: BCGA1254**

**IC: 579C-A1254**

**REPORT NUMBER: 07U11257-9**

**ISSUE DATE: OCTOBER 25, 2007**

*Prepared for*  
**APPLE, INC.**  
**1 INFINITE LOOP**  
**CUPERTINO, CA 95014, USA**

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

**NVLAP**<sup>®</sup>  
NVLAP LAB CODE 200065-0

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, USA

**EUT DESCRIPTION:** 2X3 Access Point w/ 802.11a/b/g/n Card

**MODEL:** A1254

**SERIAL NUMBER:** 6F73002JYZV

**DATE TESTED:** September 5 – October 15, 2007

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C and Subpart E	No Non-Compliance Noted
RSS-210 Issue 7 Annex 8 and RSS-GEN Issue 2	No Non-Compliance Noted

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. 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 Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services 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:



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HSIN FU SHIH  
ENGINEERING SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

Tested By:



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WILLIAM ZHUANG  
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
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a 2X3 Access point w/ 802.11a/b/g/n Card.

### 5.2. MAXIMUM OUTPUT POWER

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

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	25.45	350.75
2412 - 2462	802.11g	25.38	345.14
2412 - 2462	802.11n HT20	24.50	281.84
2422 - 2452	802.11n HT40	25.36	343.56

5725 to 5850 MHz Authorized Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11a	24.97	314.05
5745 - 5825	802.11n HT20	24.69	294.44
5755 - 5795	802.11n HT40	24.90	309.03

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA Antenna, with a maximum gain of 3.99 dBi @ 2.4 GHz band; 3.27 dBi @ 5.15-5.35 GHz band; 2.34 dBi @ 5.4-5.7 GHz band; and 2.16 dBi @ 5.8 GHz band.

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 7.3d1 Auto20070907T0400.

The EUT driver software installed during testing was DutApiClient\_UDP.exe, ver.031607.

The test utility software used during testing was m4tool.exe, rev 083107

## 5.5. WORST-CASE CONFIGURATION AND MODE

The 2x3 configuration was used for all testing in this report.

The worst- case data rates are determined to be as follows for each mode based on investigation by measuring the average power, peak power and PPSD across all data rates, bandwidths, and modulations.

The worst-case data rates for the 2 GHz bands are: 11 Mbps for 802.11b; 54Mbps for 802.11g; MCS11 for 802.11n HT20; MCS15 for 802.11n HT40. These are based on baseline testing with this chipset.

The worst-case data rates for the 5 GHz bands are: 9 Mbps for 802.11a 20MHz and 802.11a 40MHz; MCS0 for 802.11n HT20 and 802.11n HT40. These are based on baseline testing with this chipset.

All emissions tests were made with the worst-case data rates.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	MacBook Pro	AOU257941	DoC
AC Adapter	Apple	A52	611-0394	DoC
Mouse	Apple	A1152	KY5350QD7U3MA	DoC

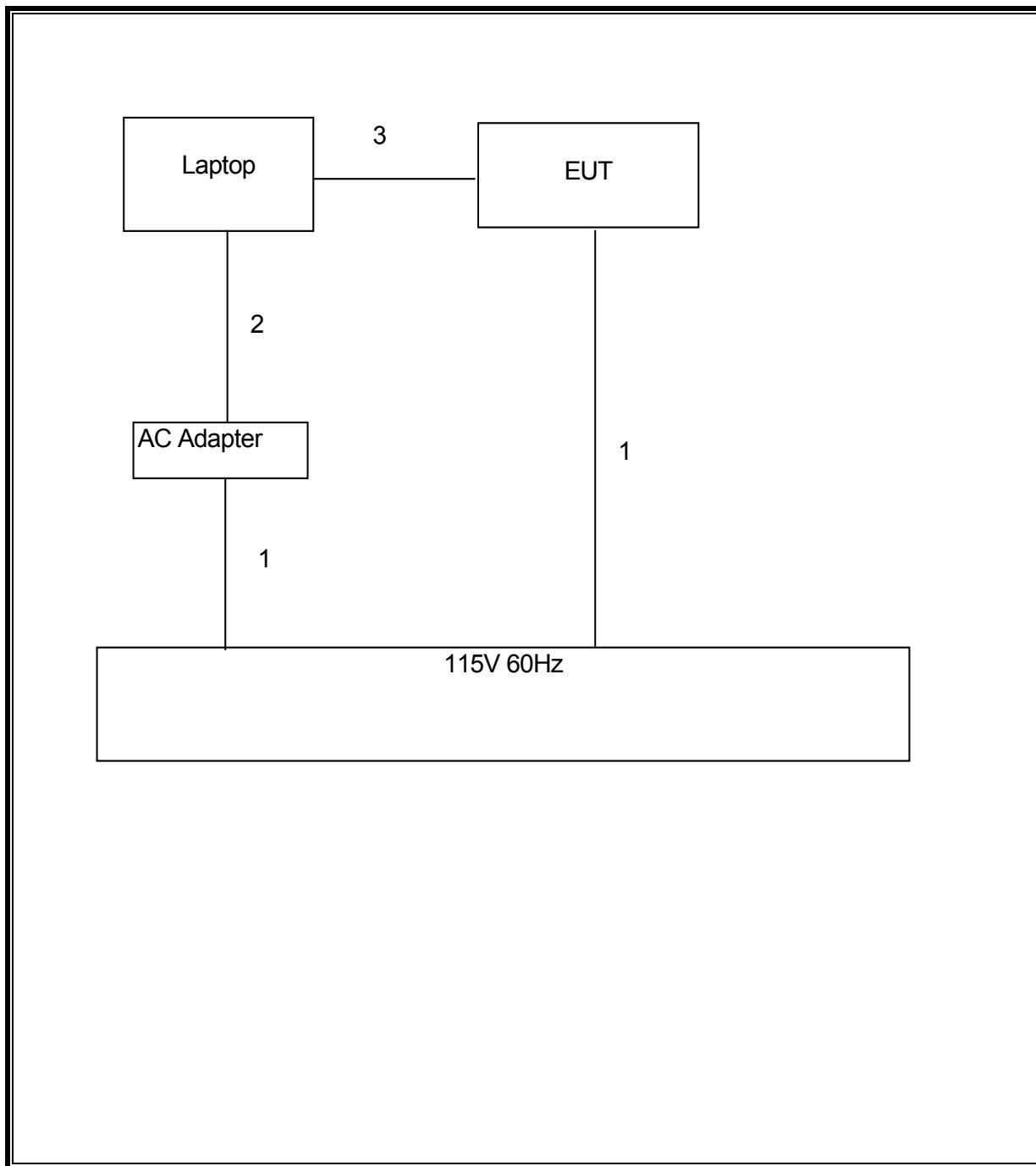
### I/O CABLES

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	1	DC	Un-shielded	2m	N/A
3	Ethernet	1	RJ45	Un-shielded	3m	N/A

### TEST SETUP

The EUT is installed in a host laptop computer during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/02/08
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/02/08
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	08/07/08
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	04/15/08
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	08/03/08
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	10/15/08
EMI Test Receiver	R & S	ESHS 20	827129/006	01/27/08
SA Display Section 2	Agilent / HP	85662A	2816A16696	04/07/08
SA RF Section, 1.5 GHz	Agilent / HP	85680B	2814A04227	01/07/08
Quasi-Peak Adaptor	Agilent / HP	85650A	3145A01654	01/21/08
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	09/28/08
Preamp 30-1000MHz	Sonoma	310N	185623	01/20/08

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.11 b/g/n MODE IN THE 2.4 GHz BAND

#### 7.1.1. 6 dB BANDWIDTH

##### LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

##### TEST PROCEDURE

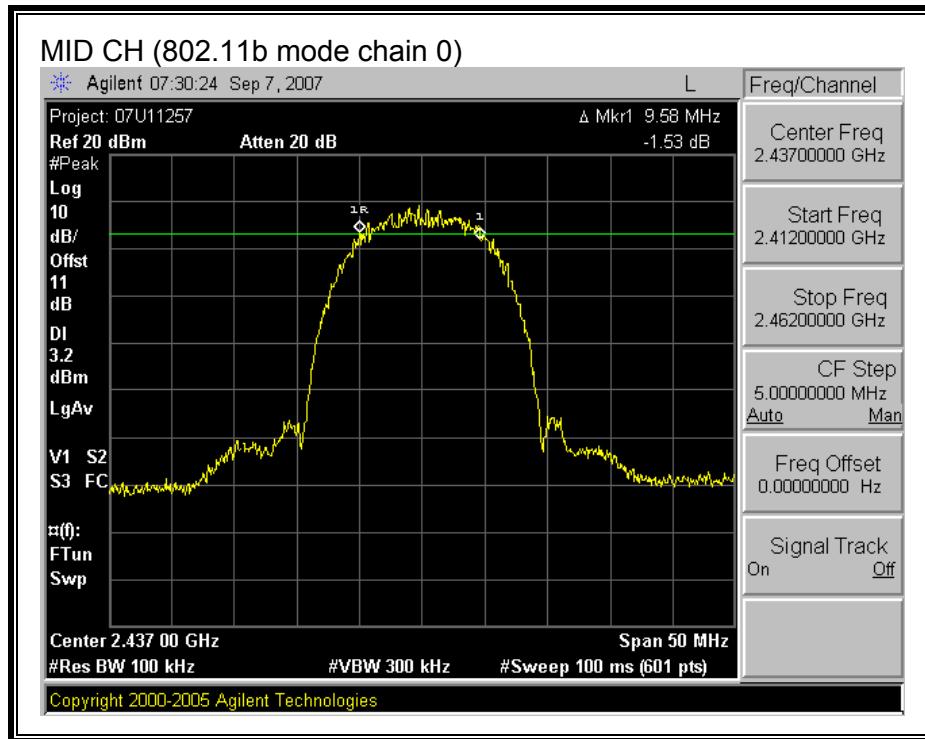
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

##### RESULTS

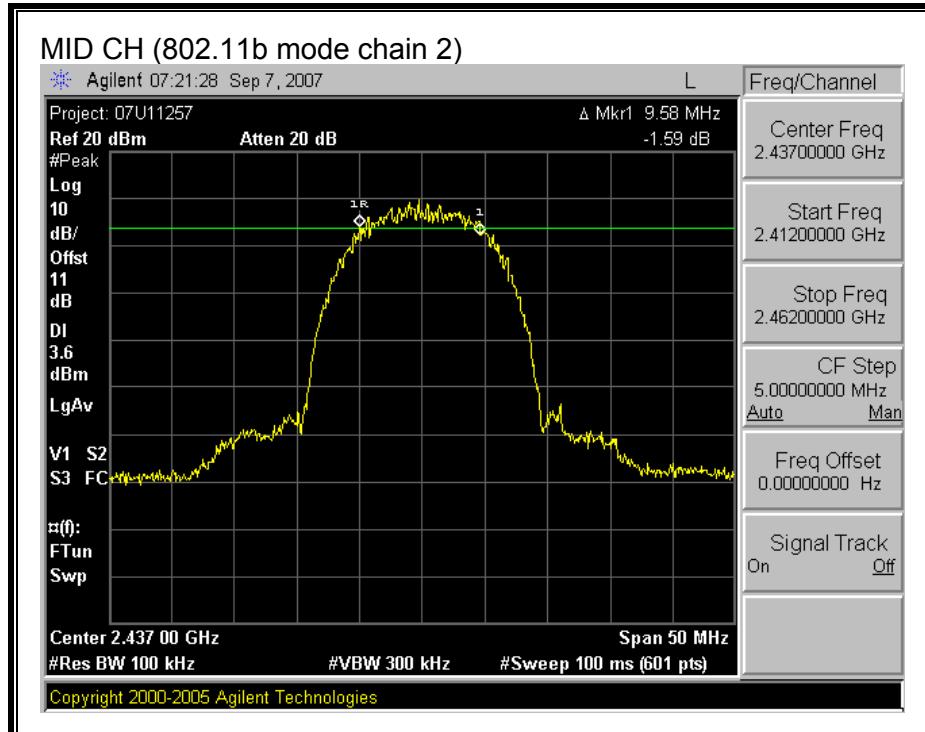
Channel	Frequency (MHz)	6 dB Bandwidth Chain 0 (MHz)	6 dB Bandwidth Chain 2 (MHz)	Minimum Limit (MHz)
802.11b Mode				
Low	2412	9.583	9.583	0.5
Middle	2437	9.583	9.583	0.5
High	2462	9.583	9.583	0.5
802.11g Mode				
Low	2412	16.500	16.583	0.5
Middle	2437	16.500	16.500	0.5
High	2462	16.500	16.583	0.5
802.11n HT20 Mode				
Low	2412	17.833	17.833	0.5
Middle	2437	17.833	17.833	0.5
High	2462	17.833	17.833	0.5
802.11n HT40 Mode				
Low	2422	36.667	36.667	0.5
Middle	2437	36.667	36.667	0.5
High	2452	36.667	36.667	0.5

Highlighted channel plots are included hereafter.

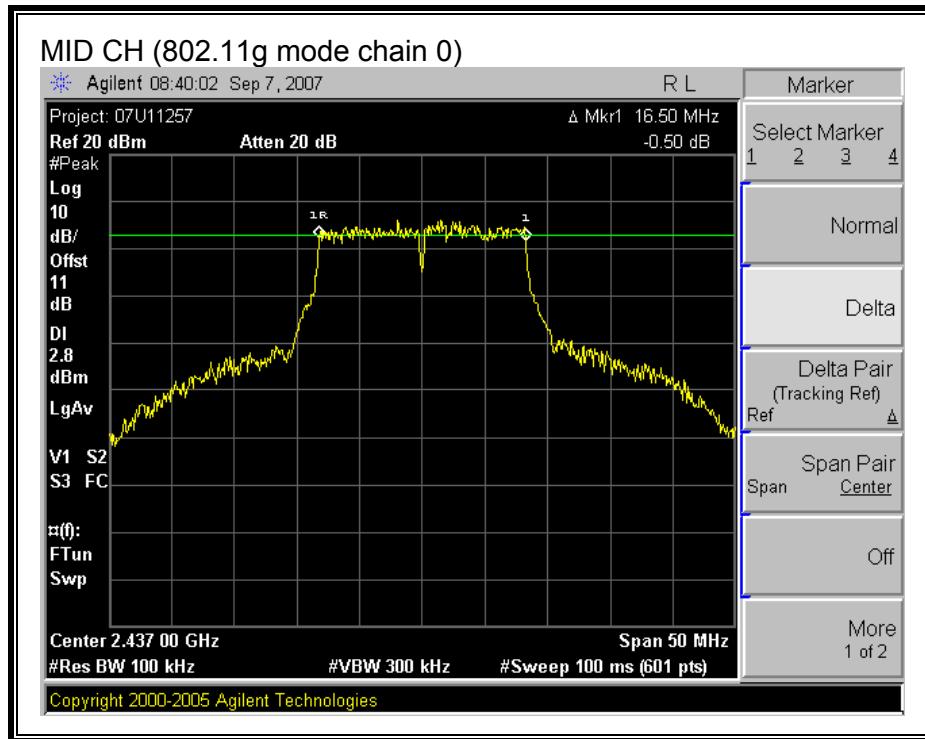
**(802.11b MODE CHAIN 0)**



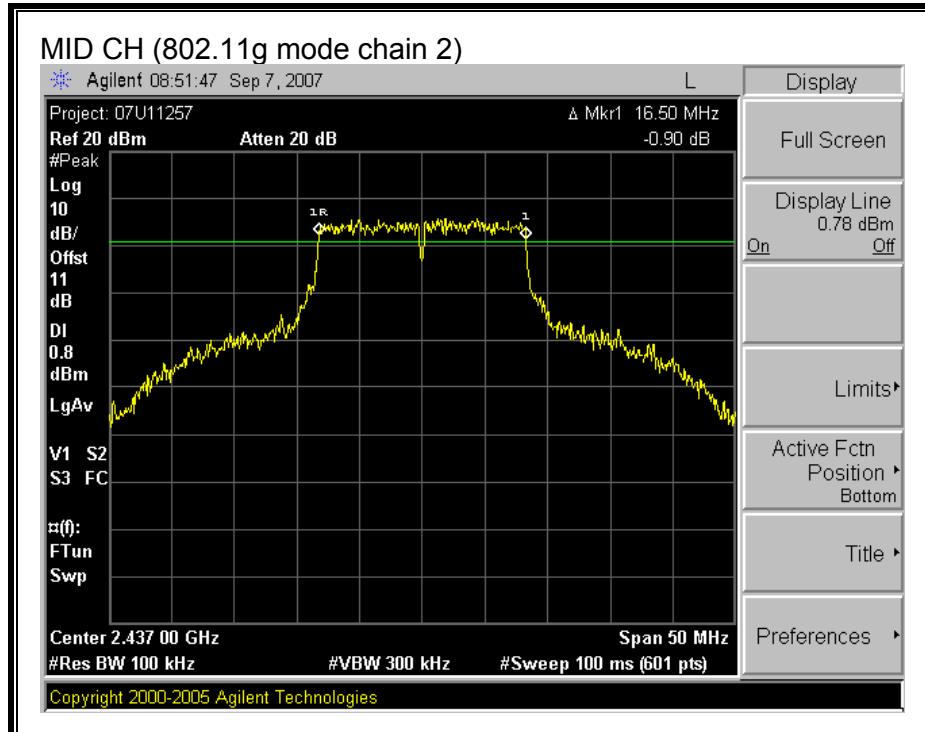
**(802.11b MODE CHAIN 2)**



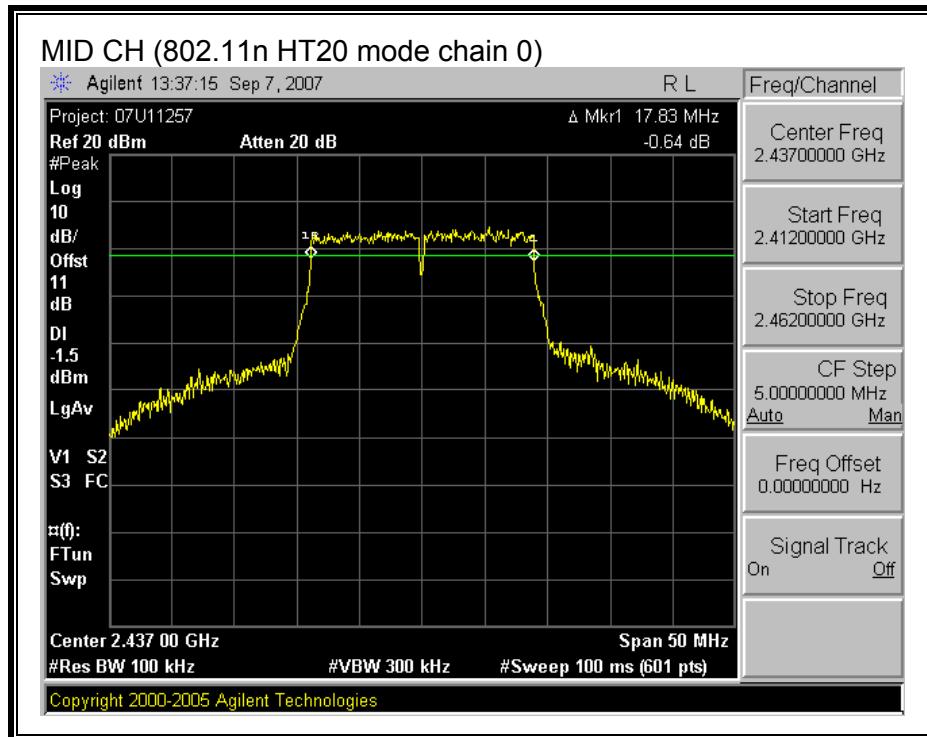
**(802.11g MODE CHAIN 0)**



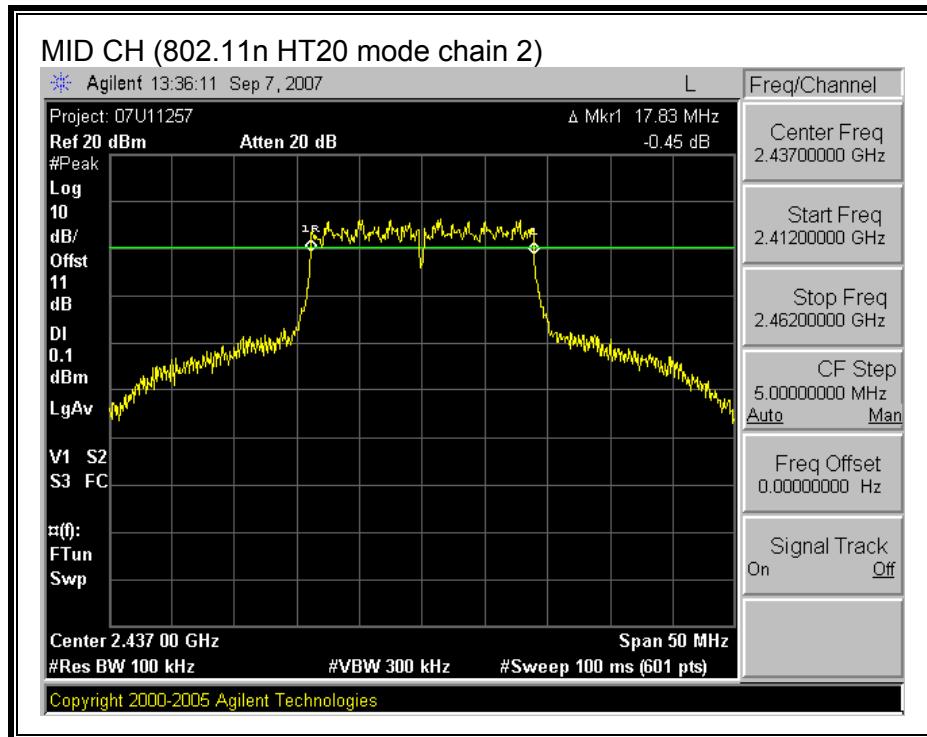
**(802.11g MODE CHAIN 2)**



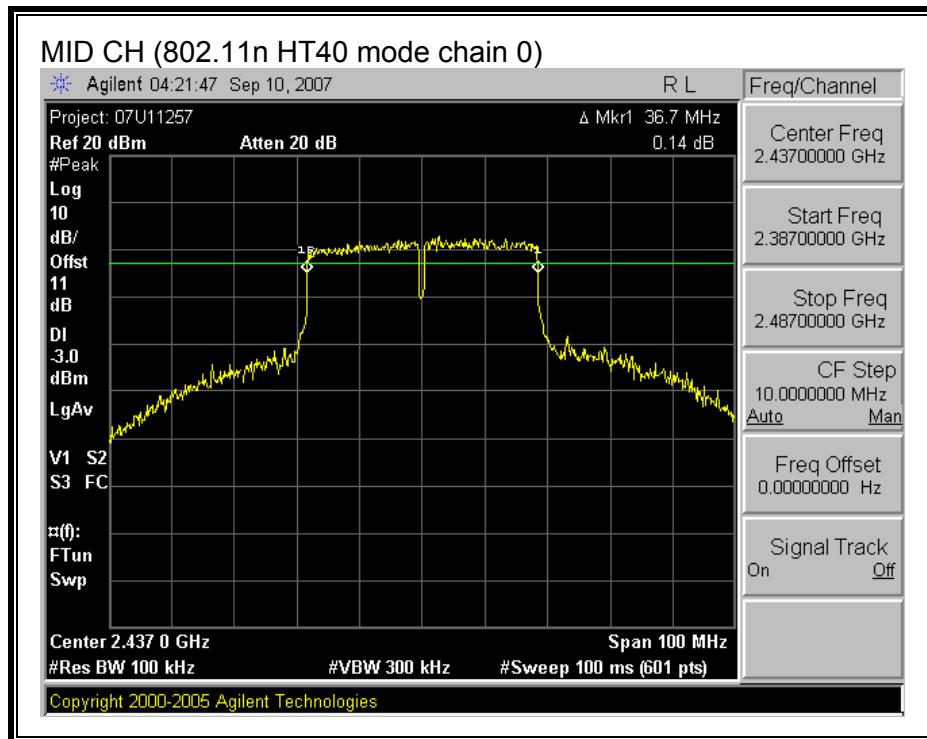
(802.11n HT20 MODE CHAIN 0)



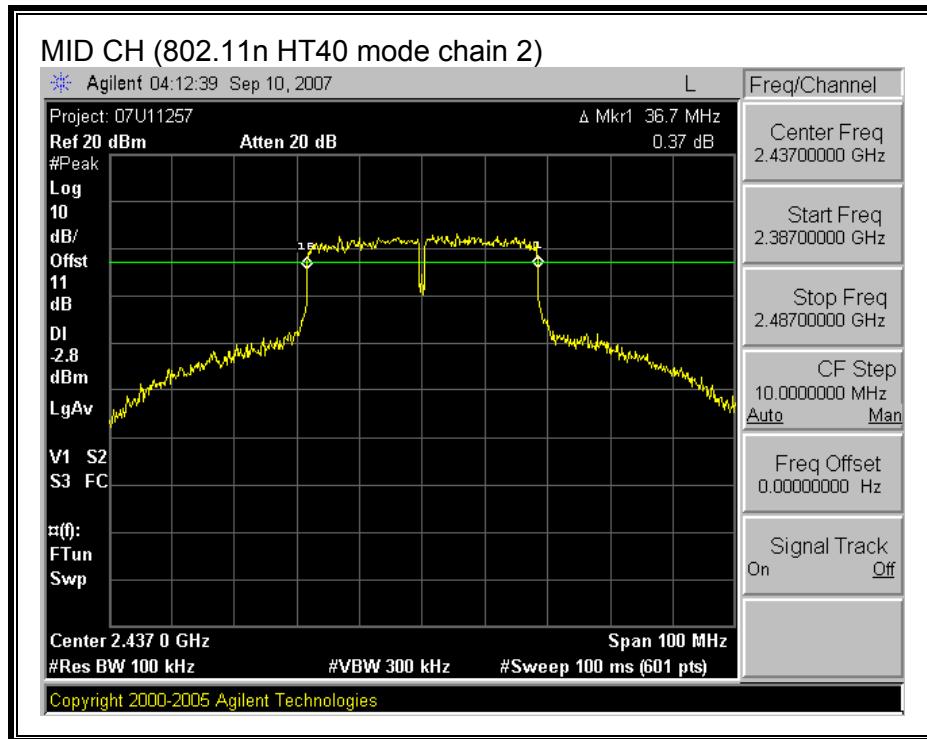
(802.11n HT20 MODE CHAIN 2)



**(802.11n HT40 MODE CHAIN 0)**



**(802.11n HT40 MODE CHAIN 2)**



### 7.1.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

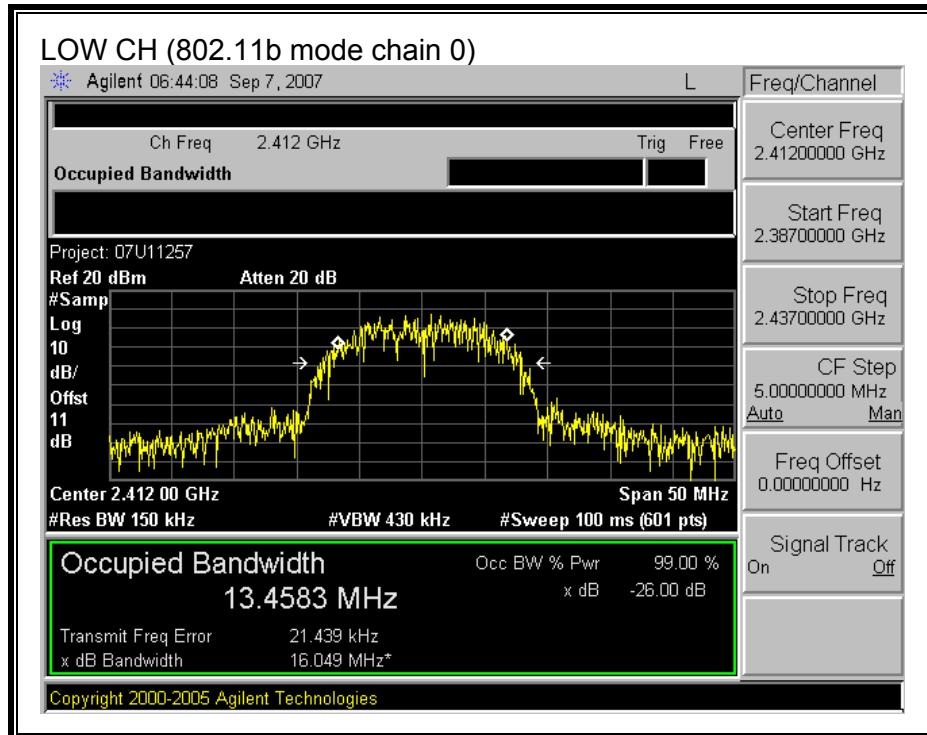
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### RESULTS

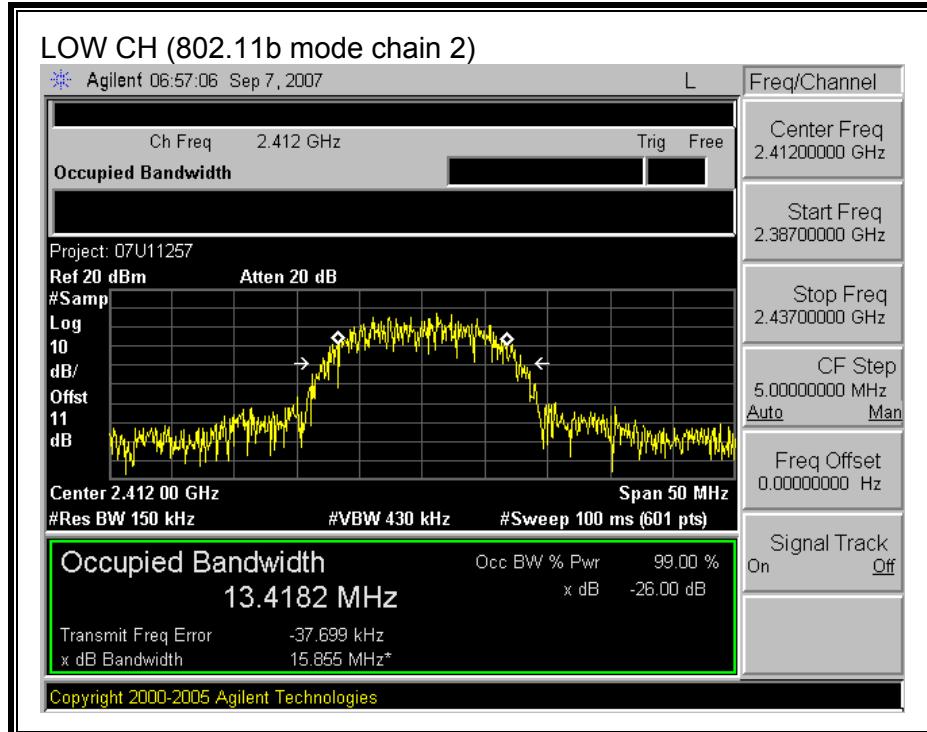
Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 2 (MHz)
802.11b Mode			
Low	2412	13.458	13.418
Middle	2437	13.078	13.462
High	2462	13.250	13.333
802.11g Mode			
Low	2412	16.594	16.599
Middle	2437	16.537	16.536
High	2462	16.421	16.495
802.11n HT20 Mode			
Low	2412	17.677	17.665
Mid	2437	17.735	17.699
High	2462	17.777	17.603
802.11n HT40 Mode			
Low	2422	36.087	36.052
Mid	2437	36.325	36.491
High	2452	36.089	36.324

Highlighted channel plots are included hereafter.

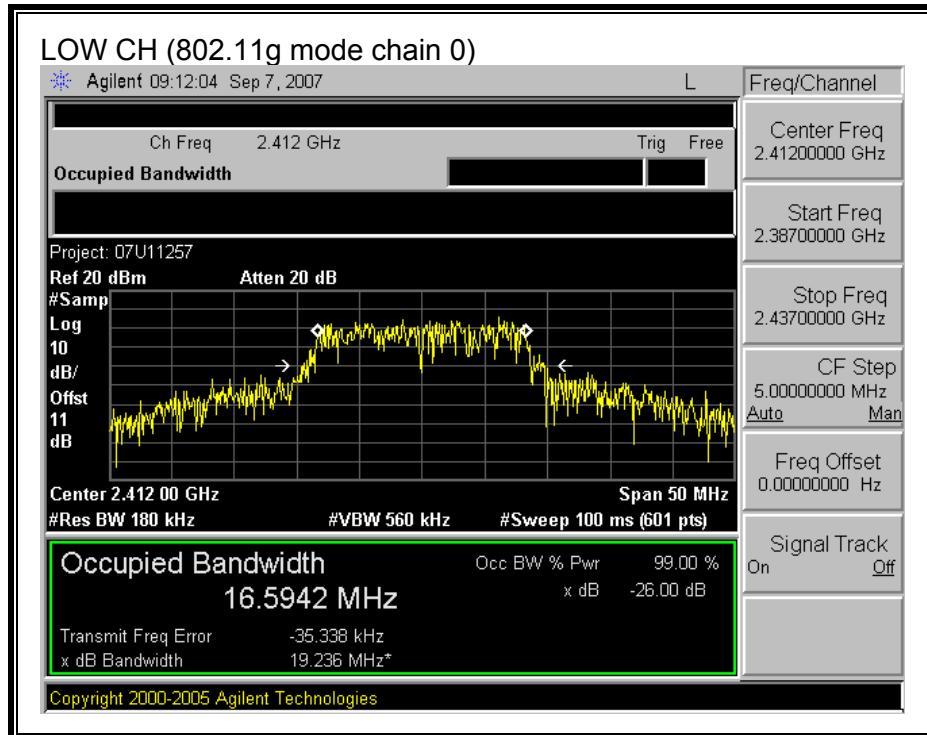
**(802.11b MODE CHAIN 0)**



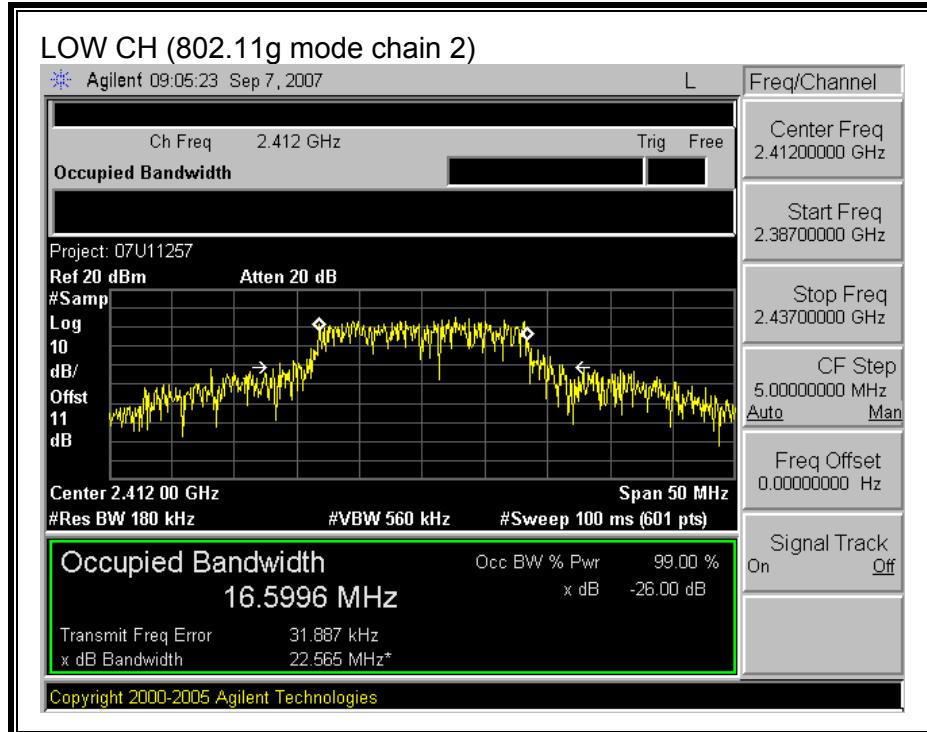
**(802.11b MODE CHAIN 2)**



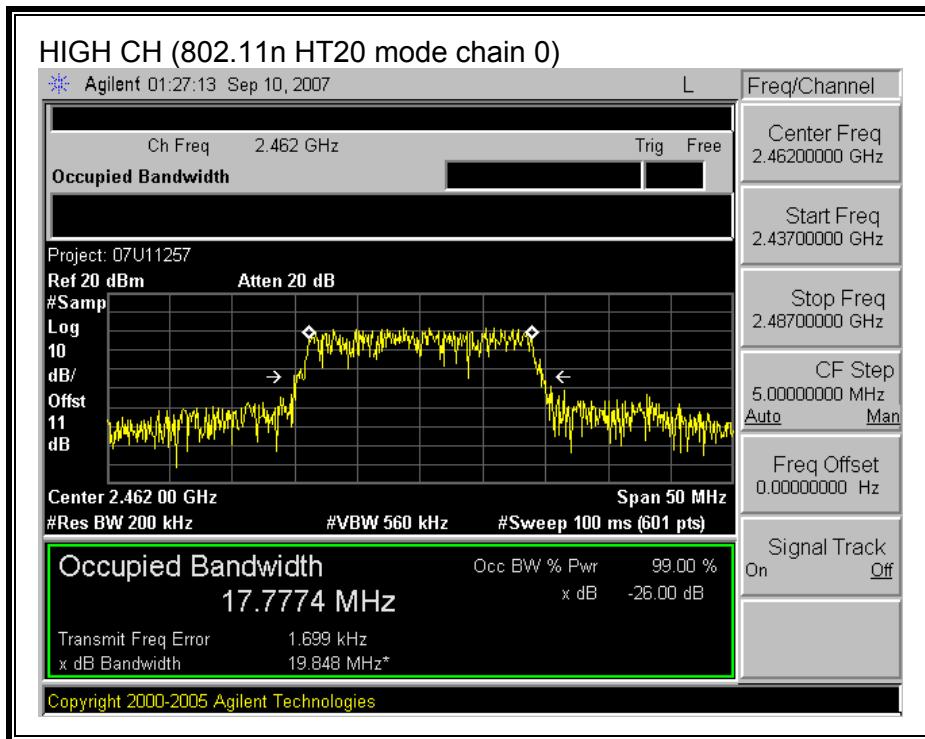
**(802.11g MODE CHAIN 0)**



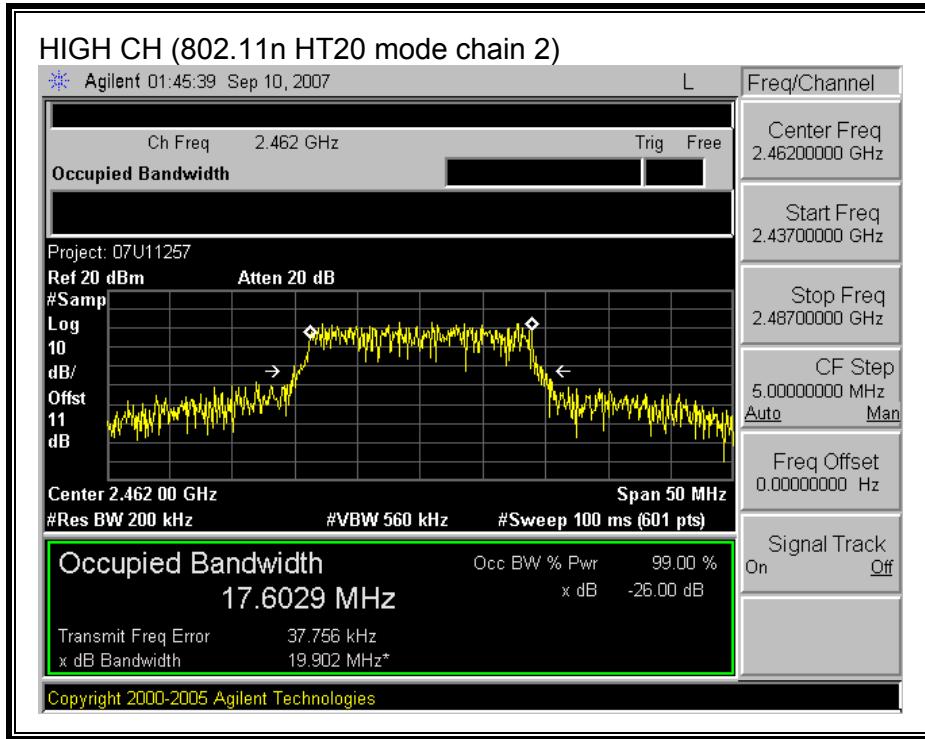
**(802.11g MODE CHAIN 2)**



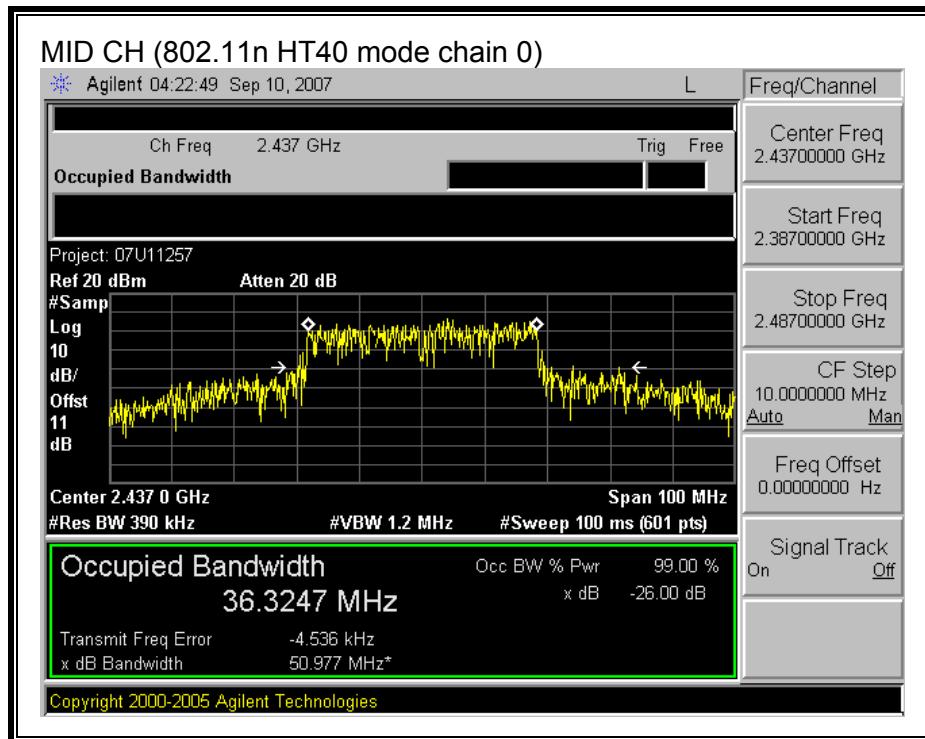
**(802.11n HT20 MODE CHAIN 0)**



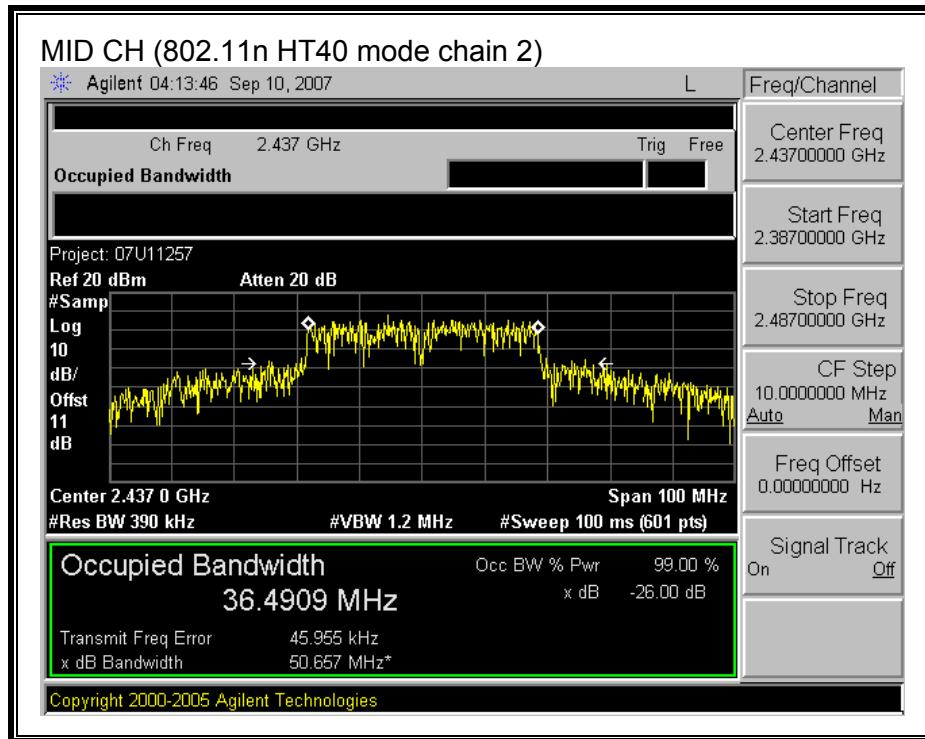
**(802.11n HT20 MODE CHAIN 2)**



**(802.11n HT40 MODE CHAIN 0)**



**(802.11n HT40 MODE CHAIN 2)**



### 7.1.3. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain of each transmitting chain is less than 6 dBi, therefore the limit is 30 dBm.

#### TEST PROCEDURE

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

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.

Each chain is measured separately and the total power is calculated using:

Total Power =  $10 \log (10^{\log(10^{\log(\text{antenna gain} \#1/10)} + 10^{\log(\text{antenna gain}\#2/10)}))$

Combined Antenna Gain in legacy and CCD mode:  $10^{\log(10^{\log(\text{antenna gain} \#1/10)} + 10^{\log(\text{antenna gain}\#2/10)}))$

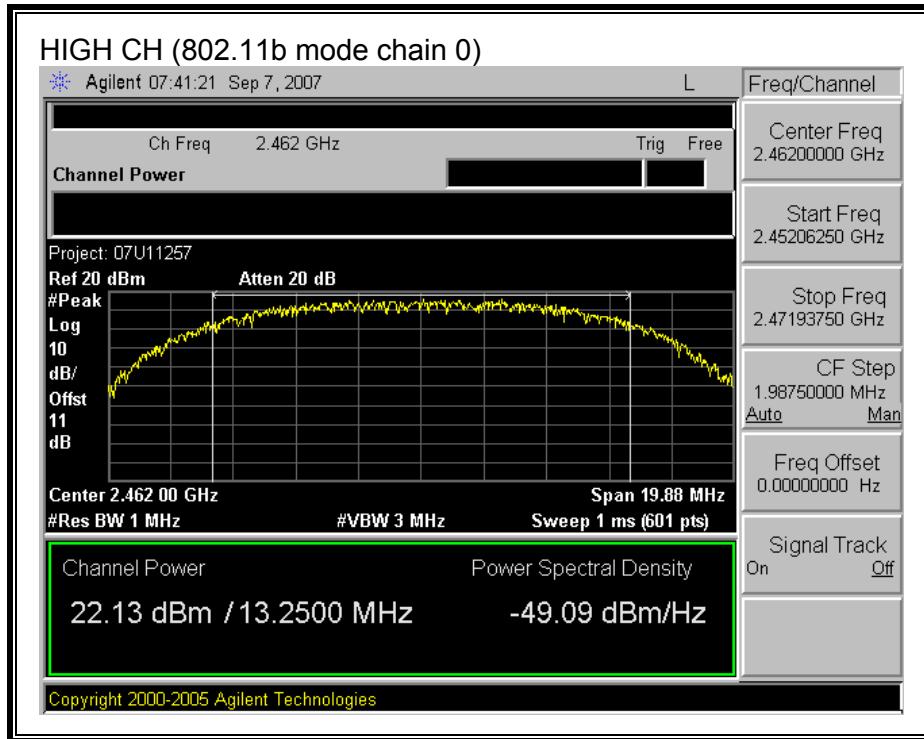
## RESULTS

Fixed Limit (dBm)	30
Antenna Gain (dBi) Chain 0@2.4GHz	3.99
Antenna Gain (dBi) Chain 2@2.4GHz	0.66
Effective Legacy Gain	5.65

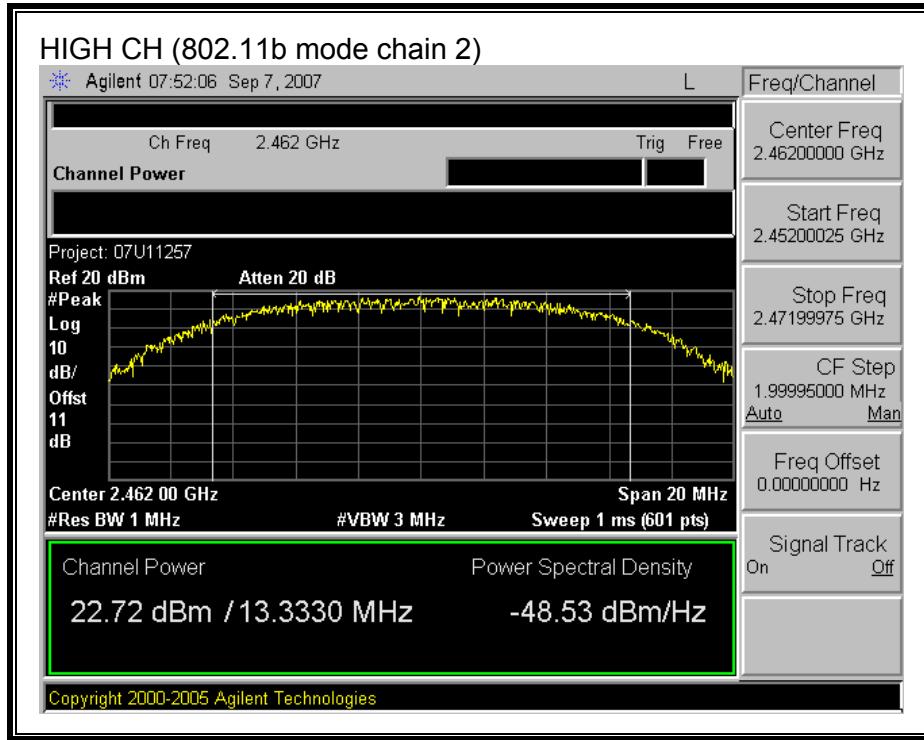
Modeb Channel	Frequency (MHz)	Max Power Chain 0 (dBm)	Max Power Chain 2 (dBm)	Max Power Total (dBm)	Limit (dBm)	Margin (dB)
802.11b Mode						
Low	2412	20.81	21.06	23.95	30.00	-6.05
Middle	2437	21.46	21.55	24.52	30.00	-5.48
High	2462	22.13	22.72	25.45	30.00	-4.55
802.11g Mode						
Low	2412	21.24	21.84	24.56	30.00	-5.44
Middle	2437	22.17	22.57	25.38	30.00	-4.62
High	2462	20.02	20.51	23.28	30.00	-6.72
802.11n HT20 Mode						
Low	2412	20.66	20.99	23.84	30.00	-6.16
Middle	2437	21.17	21.79	24.50	30.00	-5.50
High	2462	19.09	19.71	22.42	30.00	-7.58
802.11n HT40 Mode						
Low	2422	19.19	20.08	22.67	30.00	-7.33
Middle	2437	22.22	22.48	25.36	30.00	-4.64
High	2452	18.20	19.25	21.77	30.00	-8.23

Highlighted channel plots are included hereafter

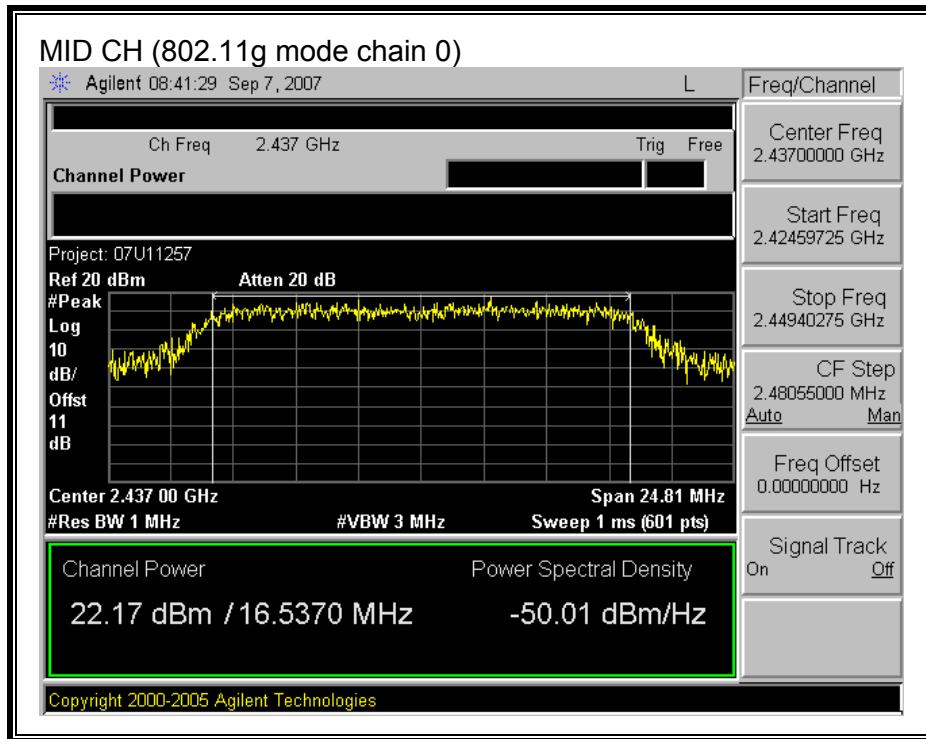
**(802.11b MODE CHAIN 0)**



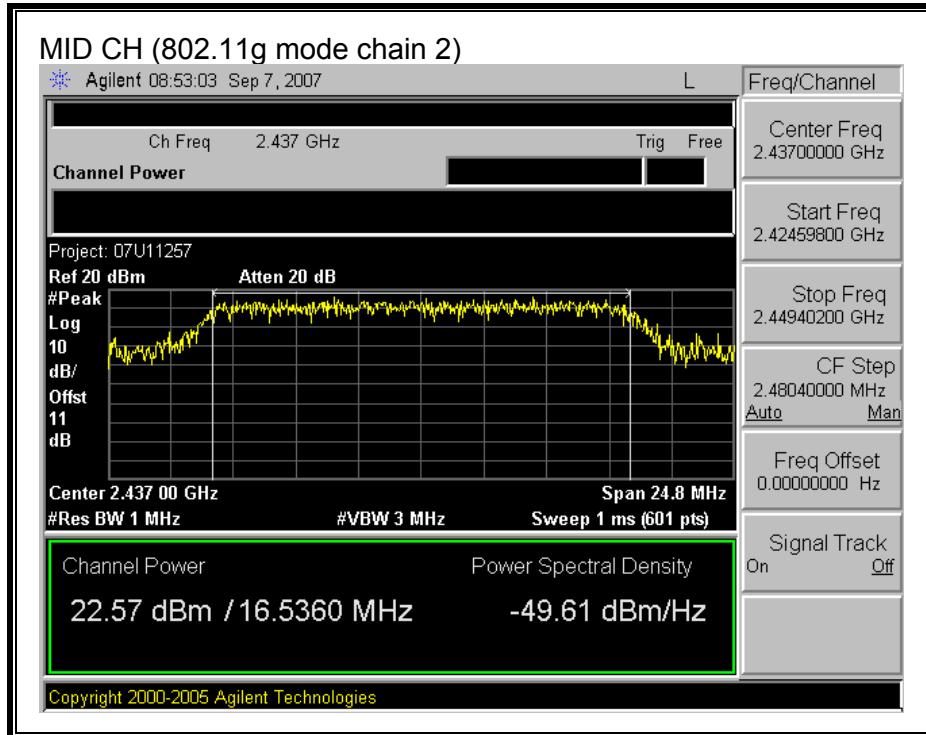
**(802.11b MODE CHAIN 2)**



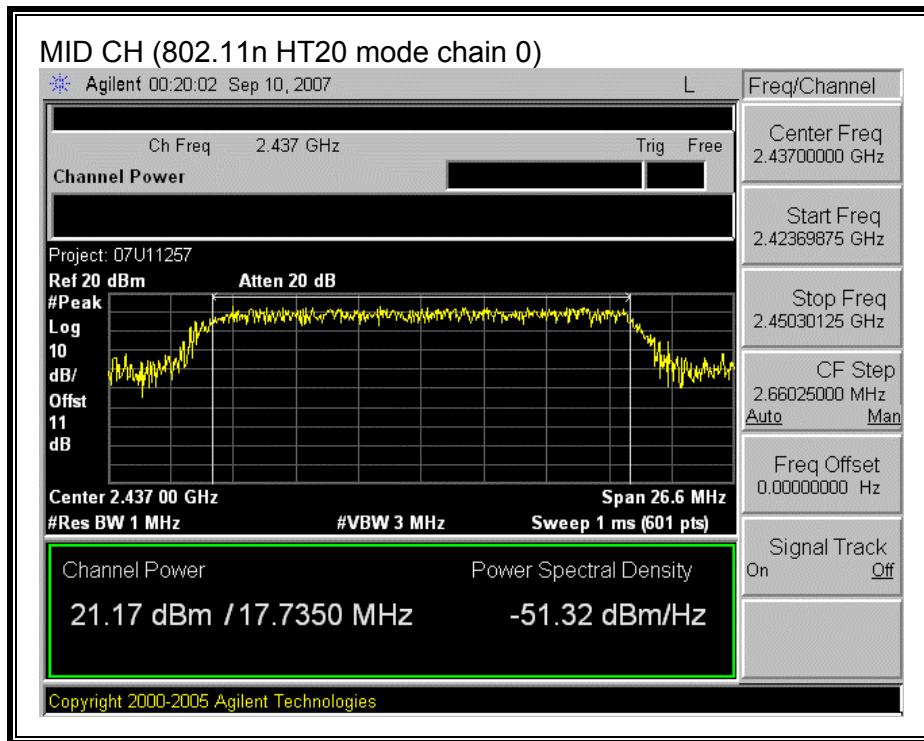
**(802.11g MODE CHAIN 0)**



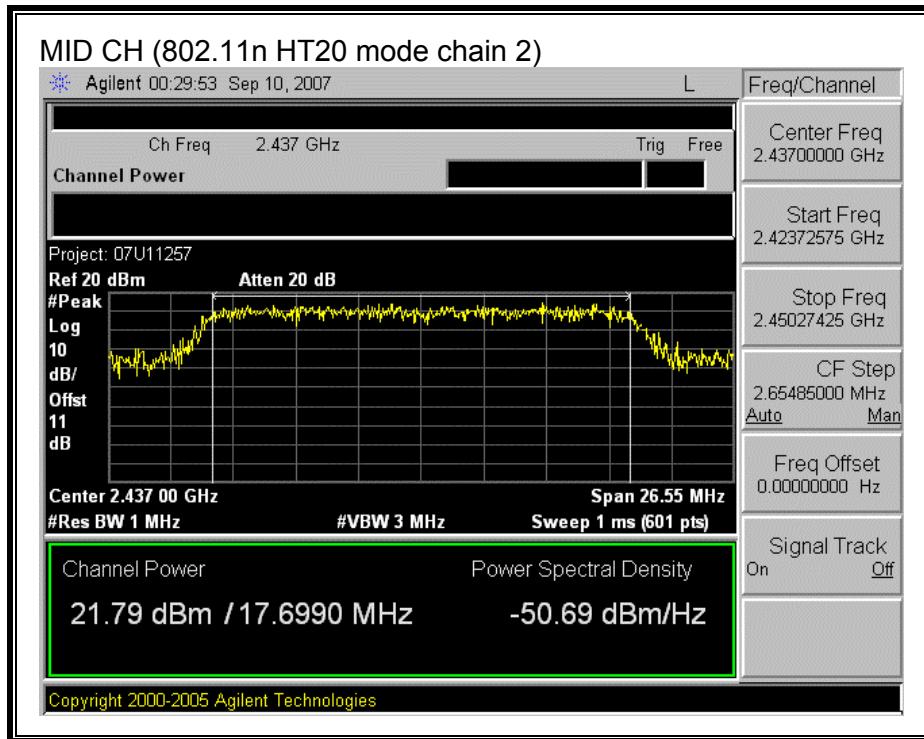
**(802.11g MODE CHAIN 2)**



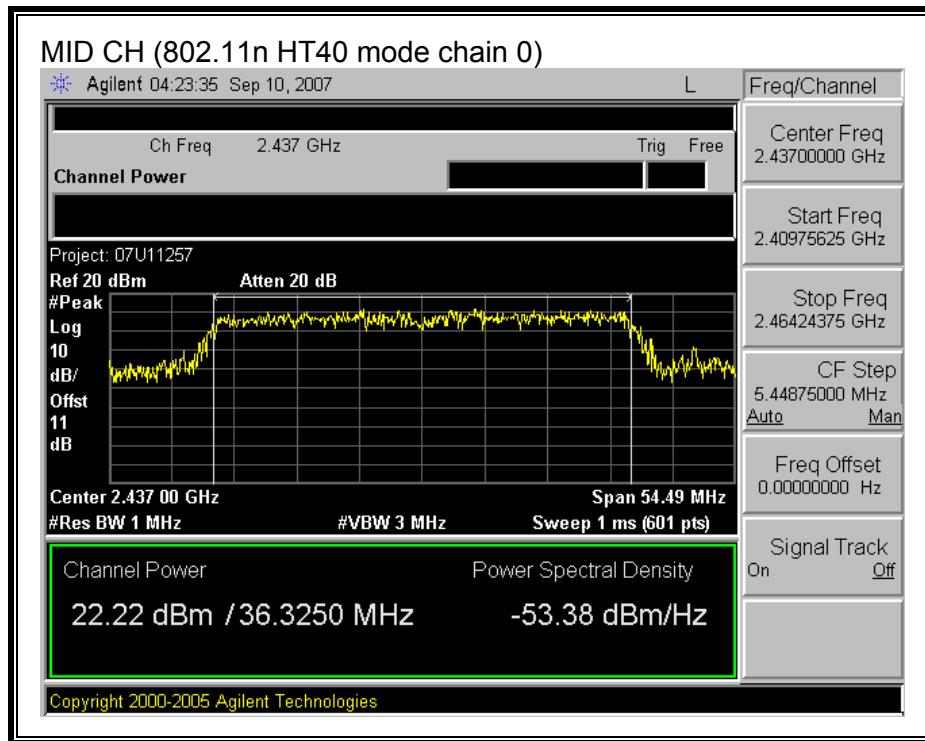
**(802.11n HT20 MODE CHAIN 0)**



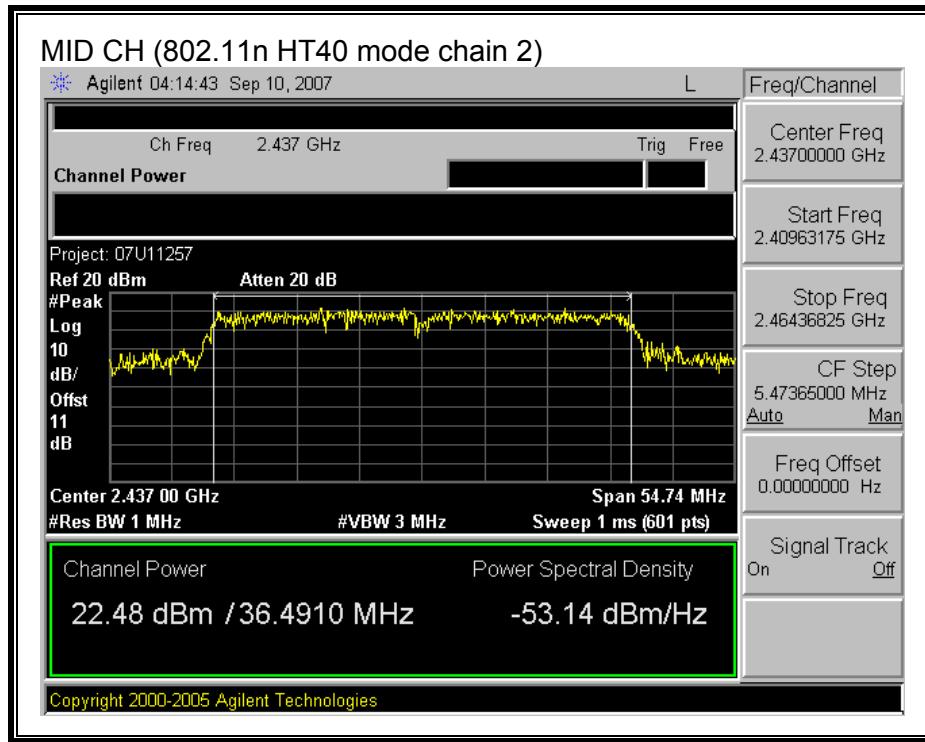
**(802.11n HT20 MODE CHAIN 2)**



**(802.11n HT40 MODE CHAIN 0)**



**(802.11n HT40 MODE CHAIN 2)**



## AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

Each chain is measured separately and the total power is calculated using:

$$\text{Total Power} = 10 \log (10^{\text{Chain 0 Power} / 10} + 10^{\text{Chain 2 Power} / 10})$$

### RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1.0 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

No non-compliance noted.

#### 7.1.4. POWER SPECTRAL DENSITY

##### LIMITS

FCC §15.247 (e); IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

##### TEST PROCEDURE

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

Each chain is measured separately and with combiner. Test result indicates combiner is the worse case.

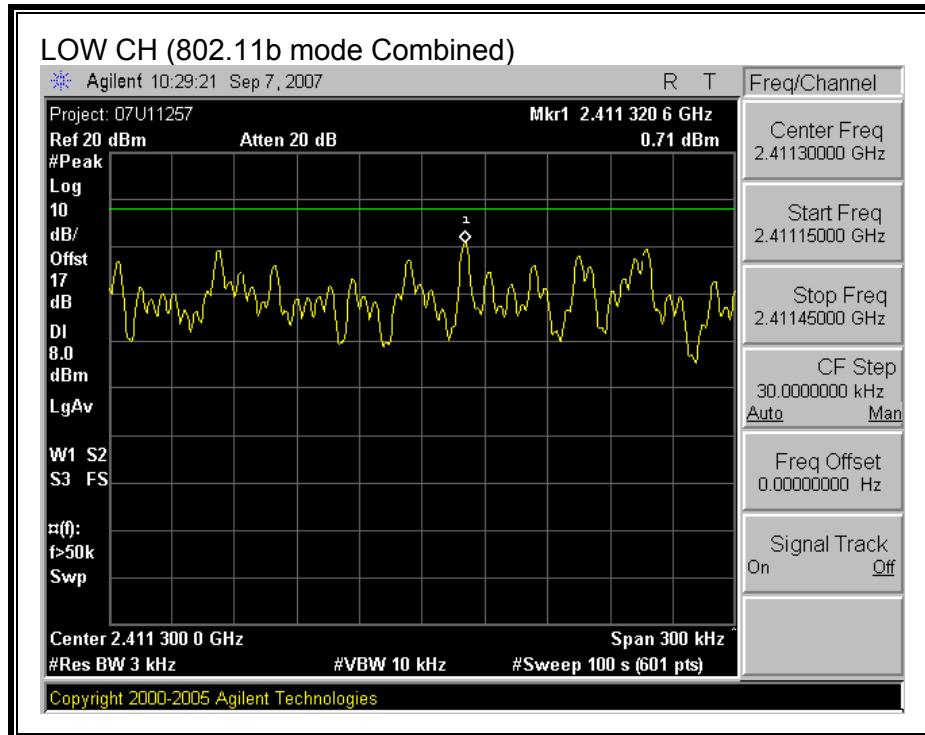
##### RESULTS WITH COMBINER

No non-compliance noted:

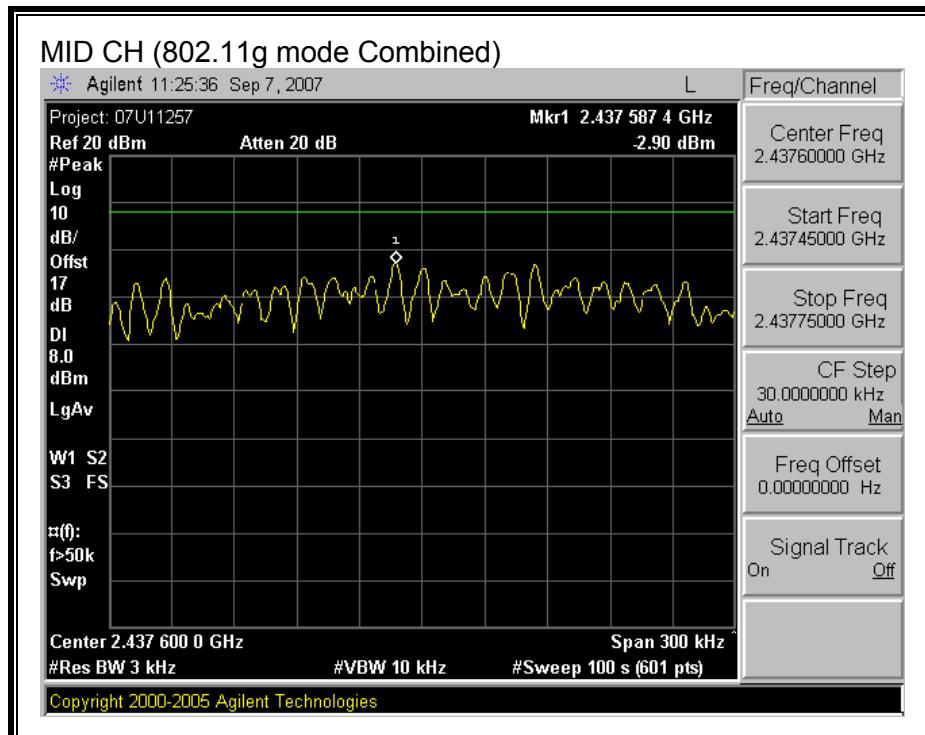
Mode Channel	Frequency (MHz)	PPSD Using Combiner (dBm)	Limit (dBm)	Margin (dB)
802.11b Mode				
Low	2412	0.71	8	-7.29
Middle	2437	0.48	8	-7.52
High	2462	-6.17	8	-14.17
802.11g Mode				
Low	2412	-3.60	8	-11.60
Middle	2437	-2.90	8	-10.90
High	2462	-4.95	8	-12.95
802.11n HT20 Mode				
Low	2412	-2.56	8	-10.56
Middle	2437	1.42	8	-6.58
High	2462	-3.14	8	-11.14
802.11n HT40 Mode				
Low	2422	-8.22	8	-16.22
Middle	2437	-5.46	8	-13.46
High	2452	-9.66	8	-17.66

Highlighted channel plots are included hereafter

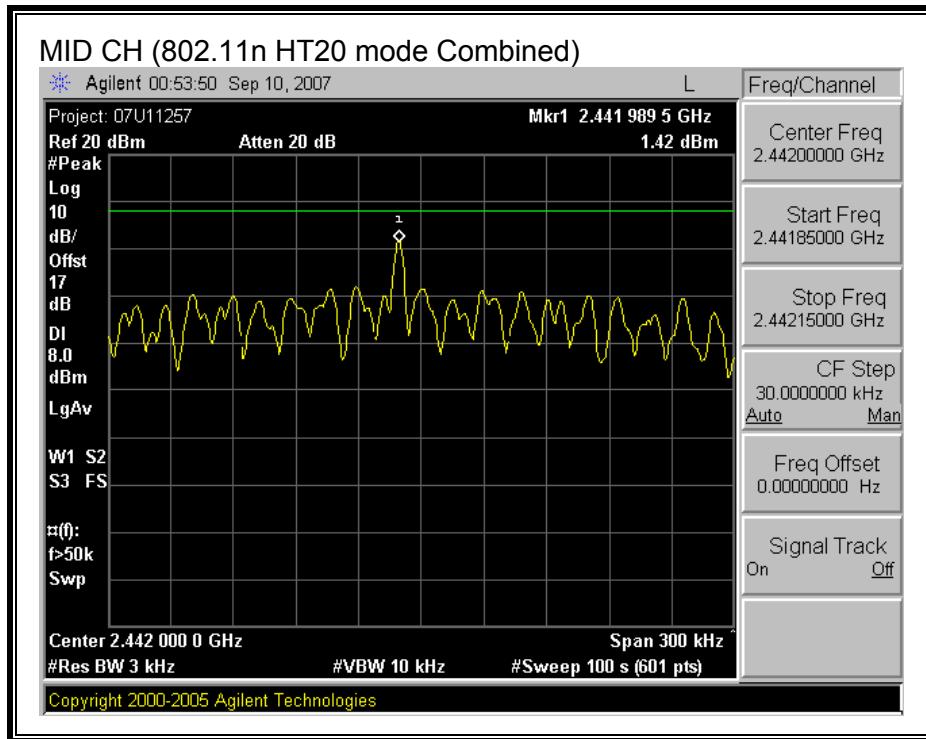
### COMBINED PEAK POWER DENSITY (802.11b MODE)



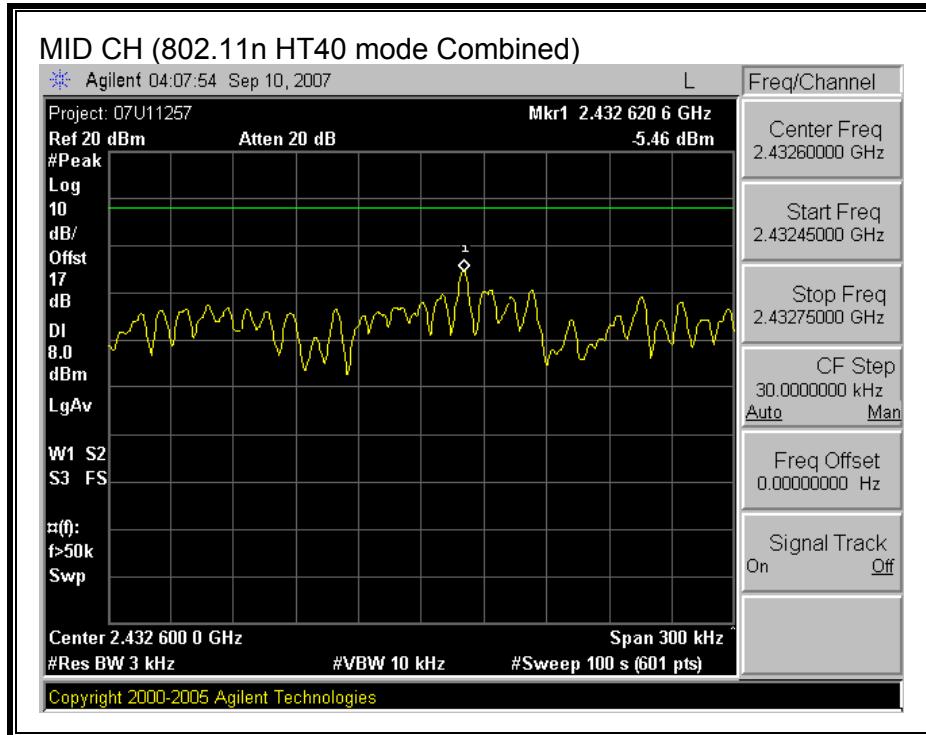
### COMBINED PEAK POWER DENSITY (802.11g MODE)



### COMBINED PEAK POWER DENSITY (802.11n HT20 MODE)



### COMBINED PEAK POWER DENSITY (802.11n HT40 MODE)



### 7.1.5. CONDUCTED SPURIOUS EMISSIONS

#### LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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

#### TEST PROCEDURE

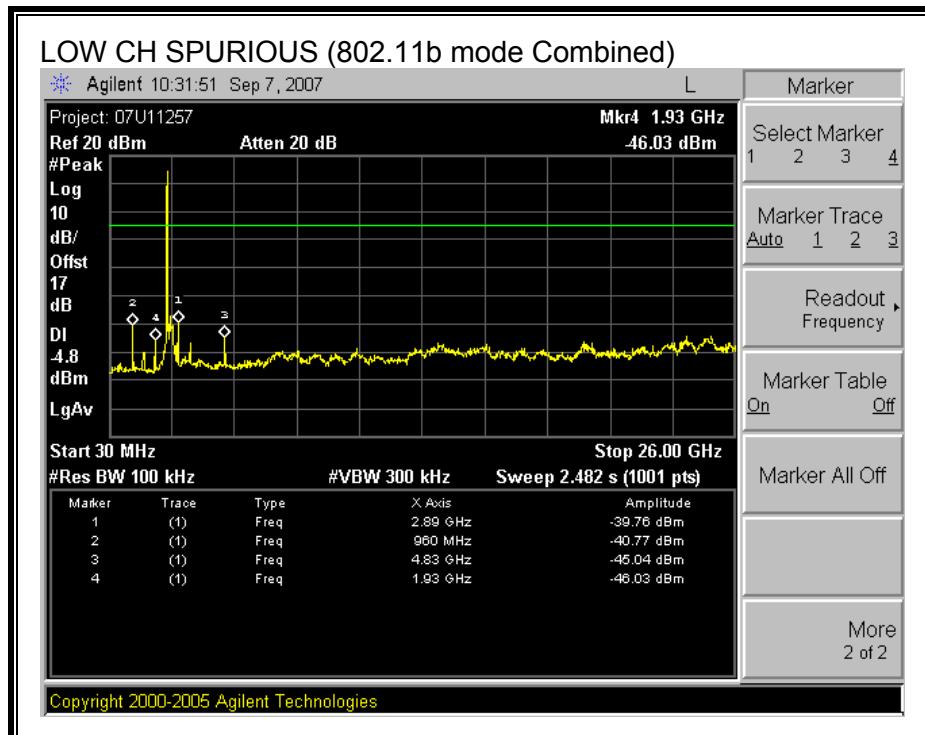
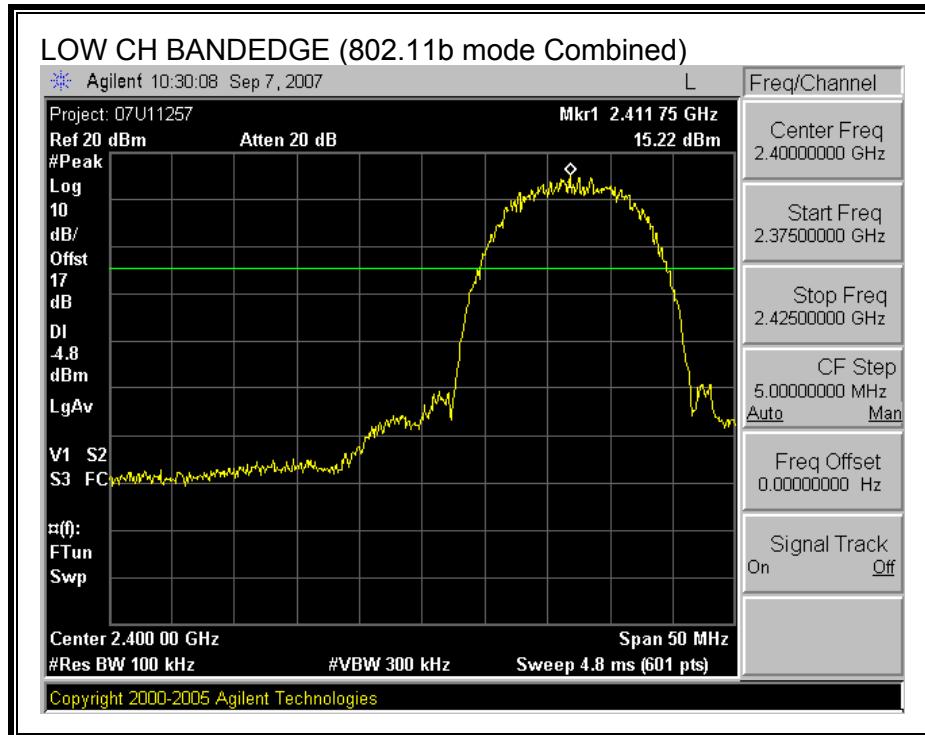
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

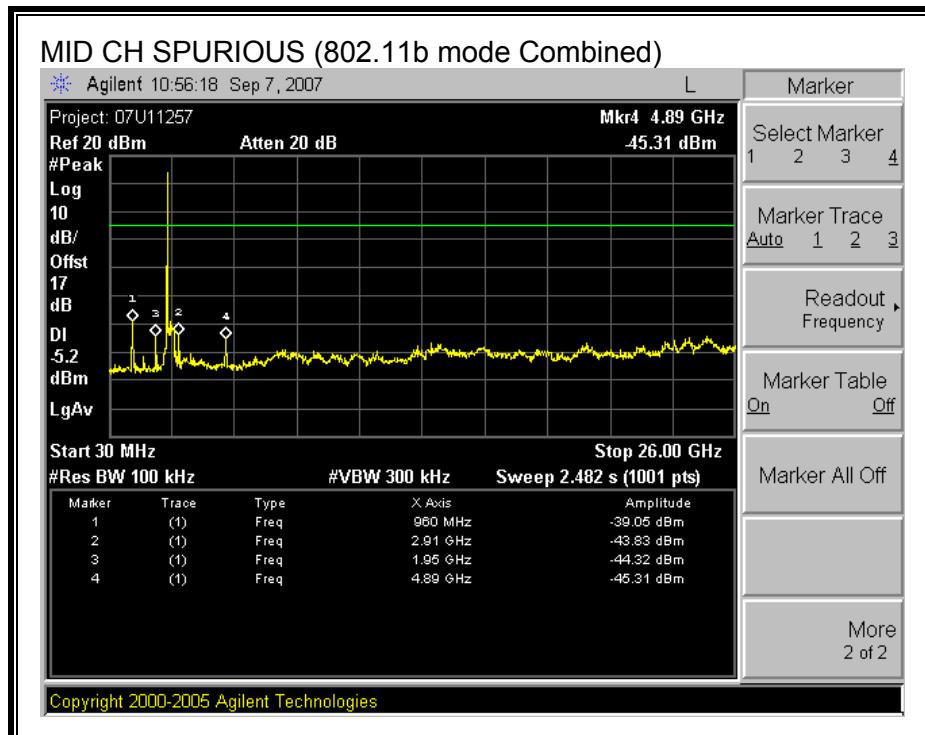
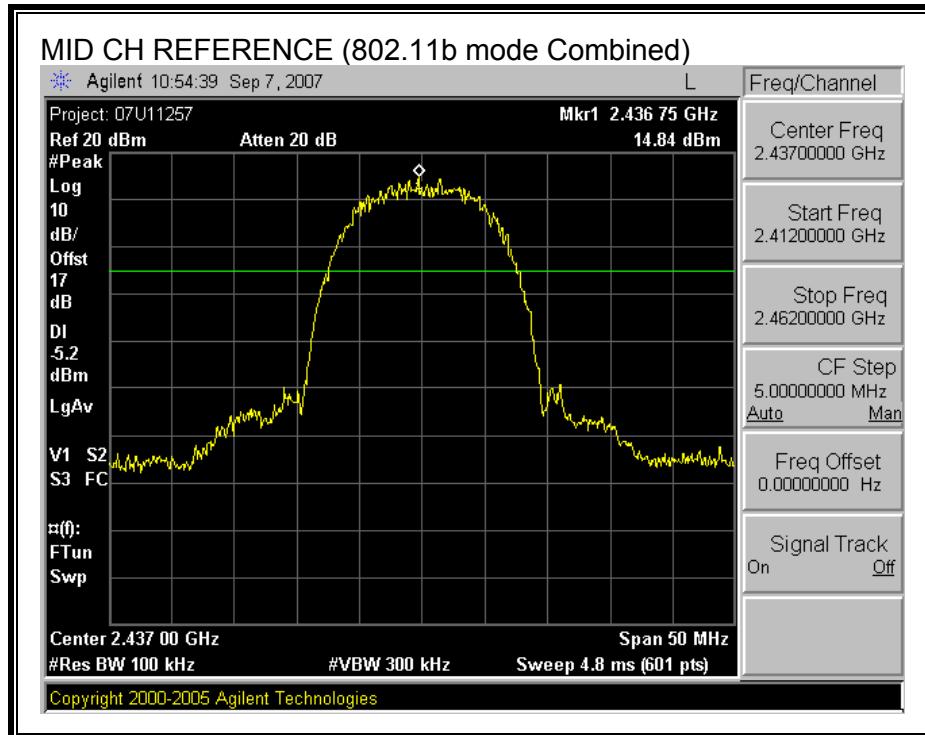
Each chain is measured separately and with combiner. Test result indicates combiner is the worse case.

#### RESULTS

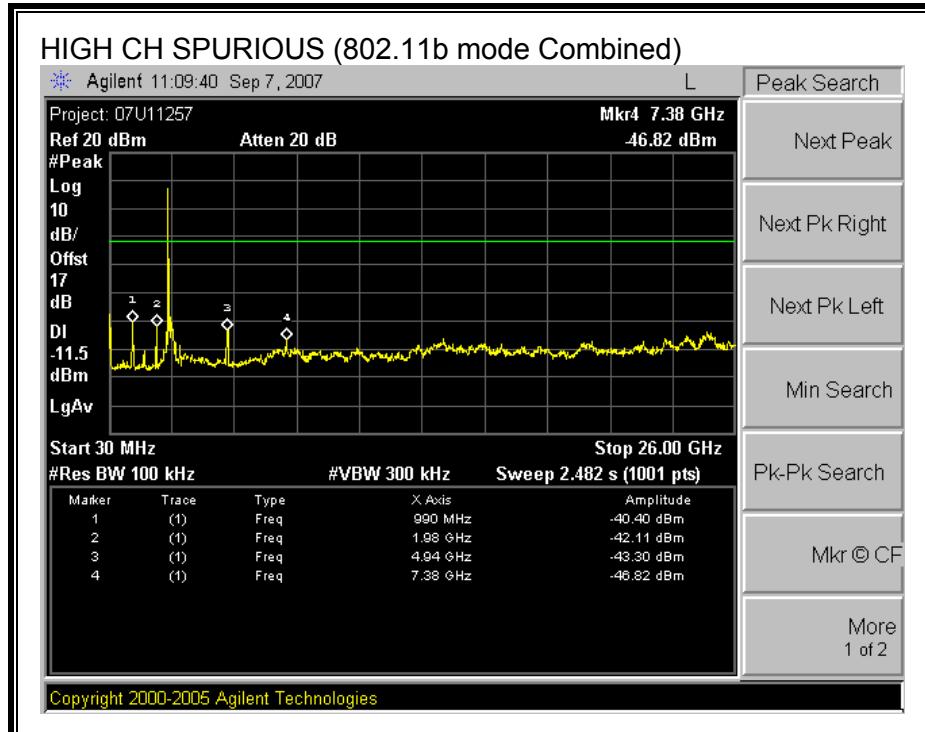
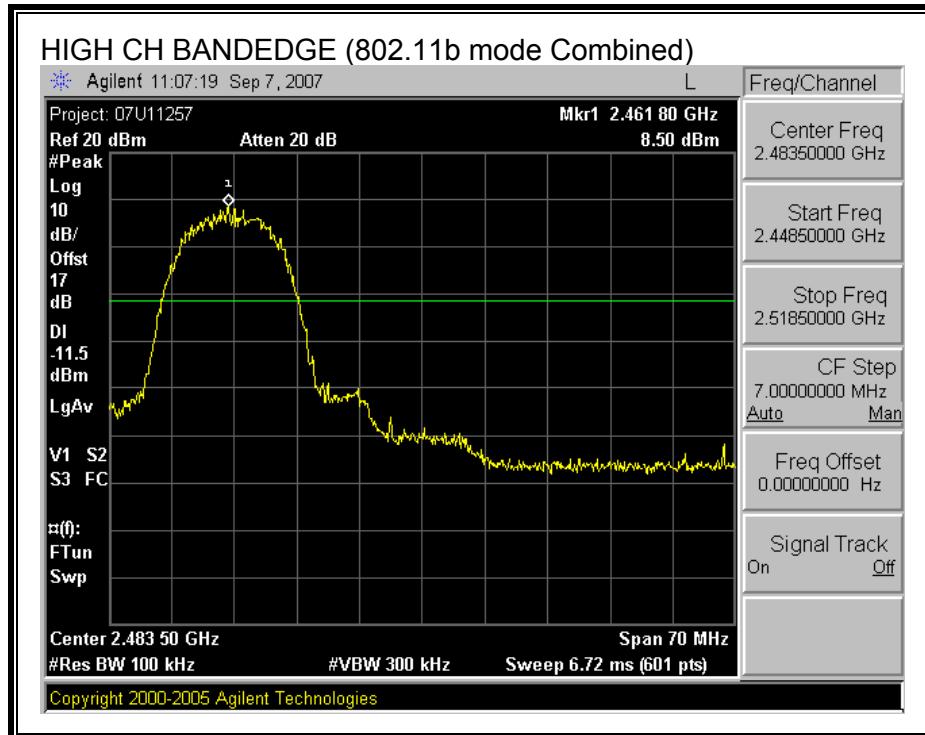
**COMBINED SPURIOUS EMISSIONS (802.11b MODE)**



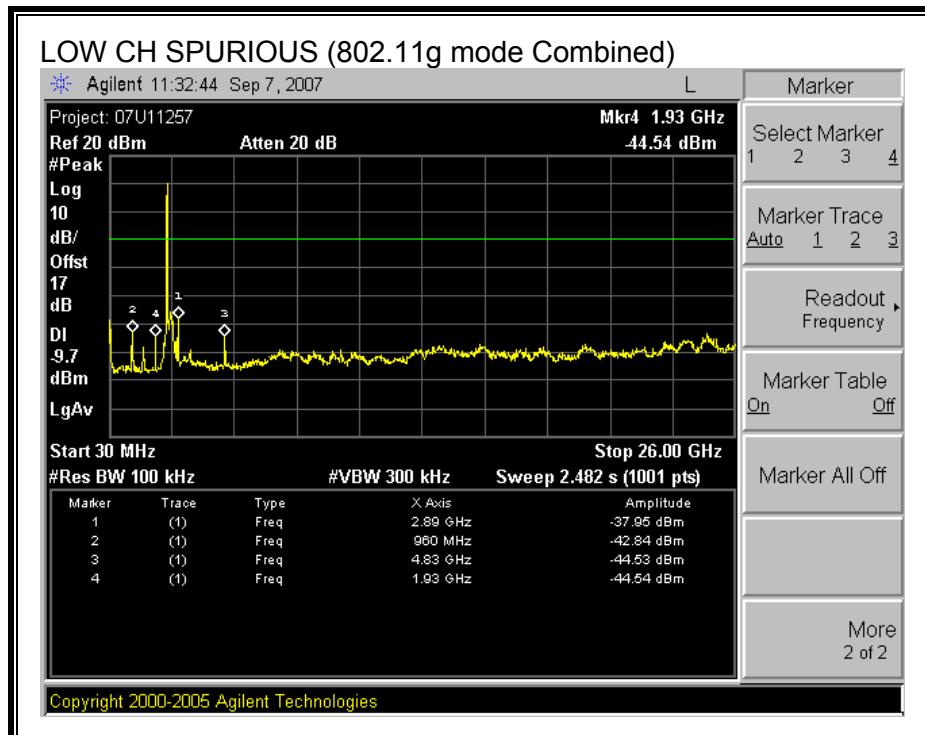
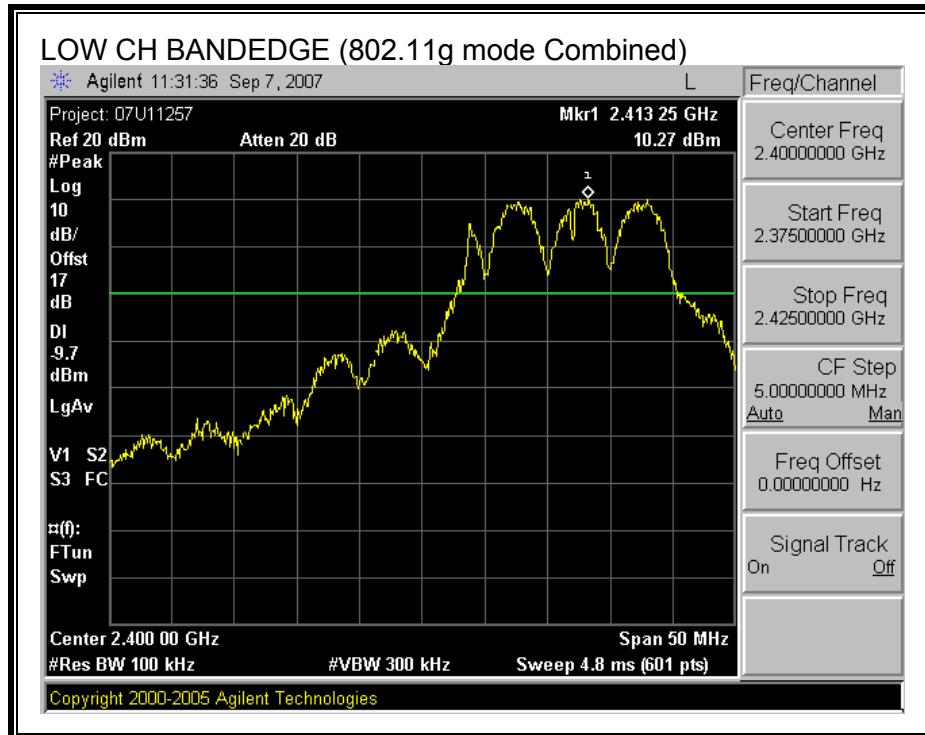
**COMBINED SPURIOUS EMISSIONS (802.11b MODE)**



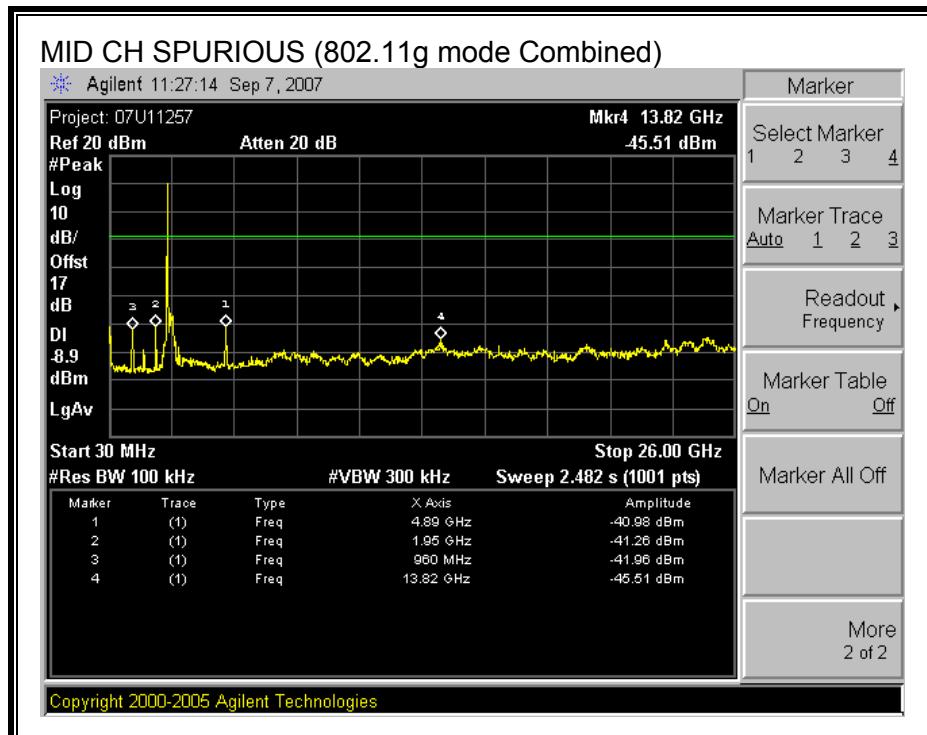
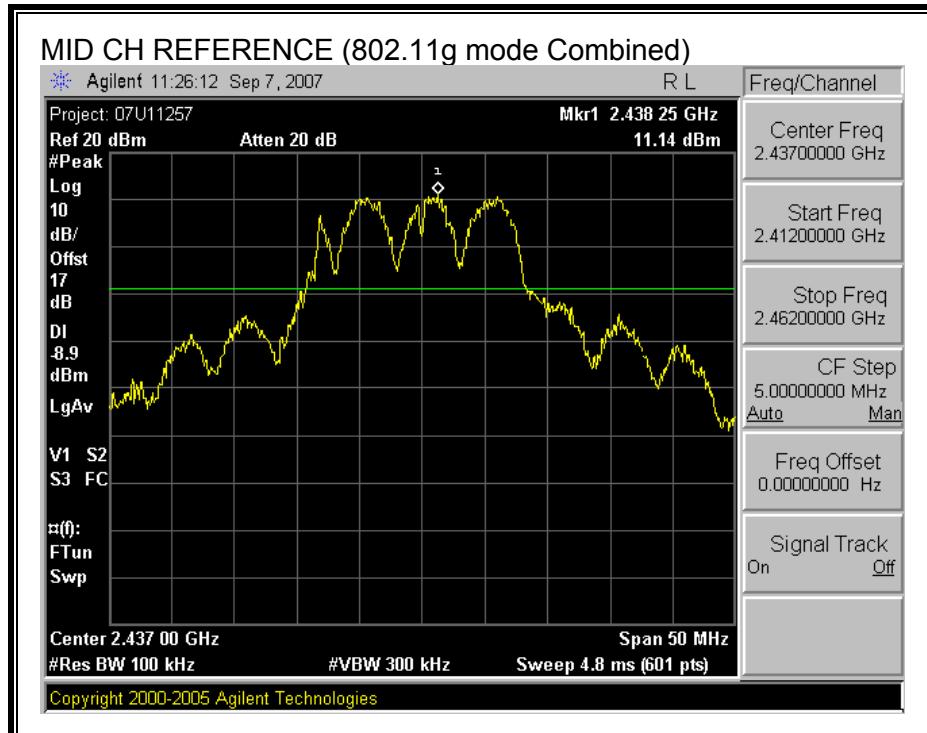
**COMBINED SPURIOUS EMISSIONS (802.11b MODE)**



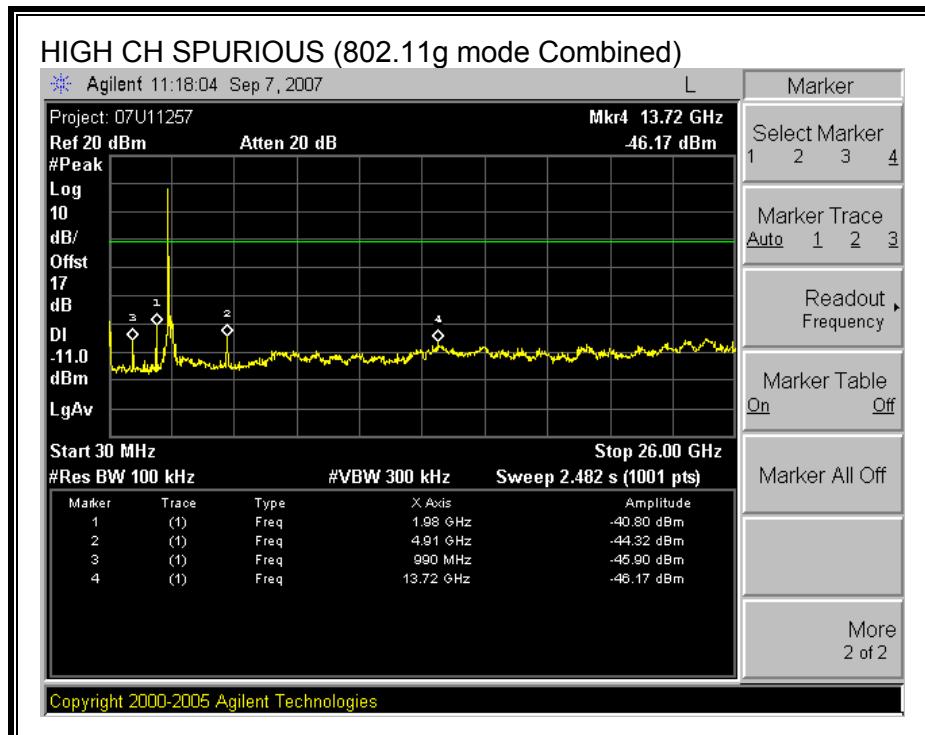
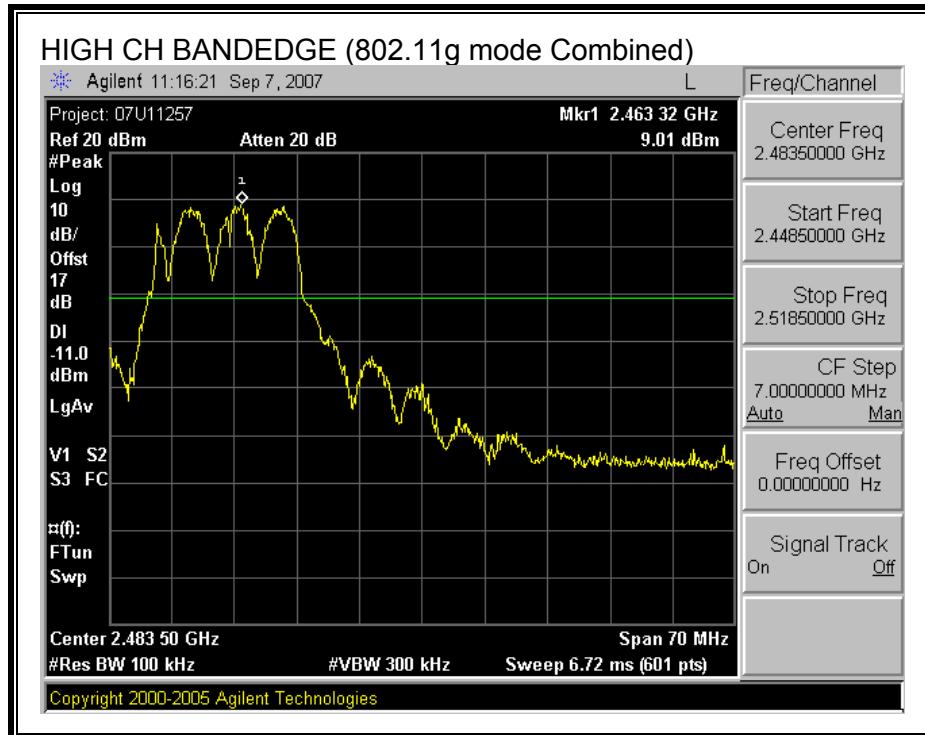
**COMBINED SPURIOUS EMISSIONS (802.11g MODE)**



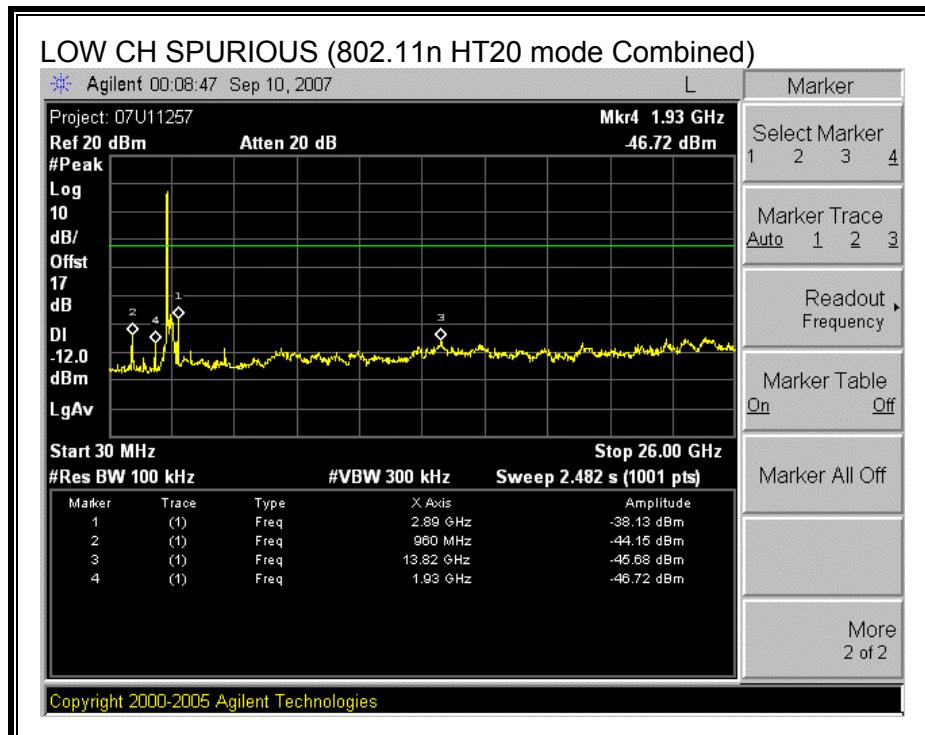
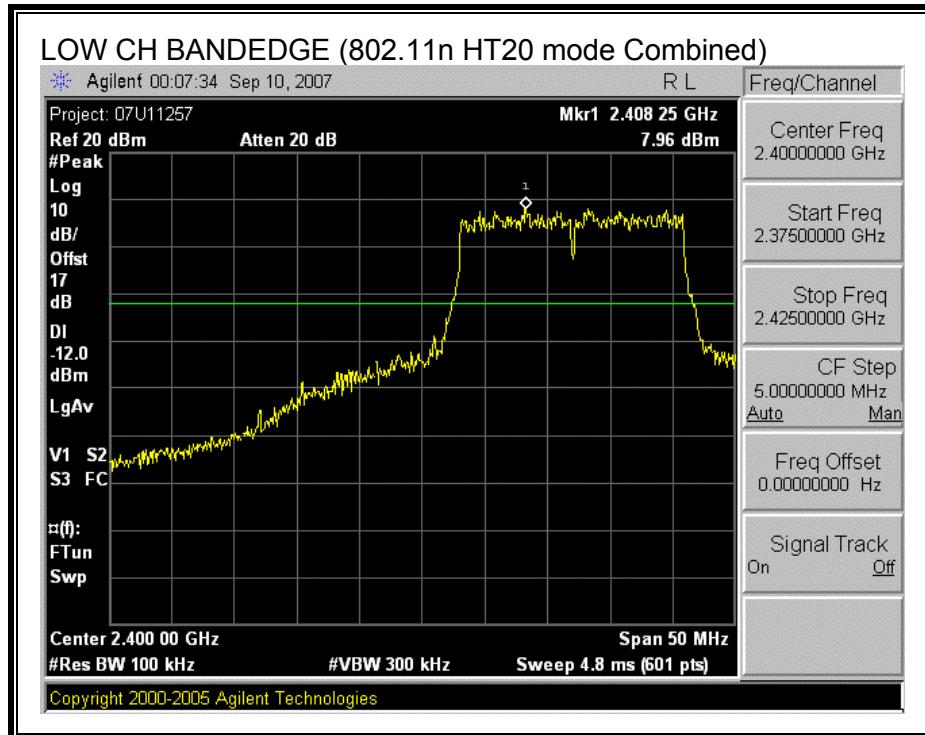
**COMBINED SPURIOUS EMISSIONS (802.11g MODE)**



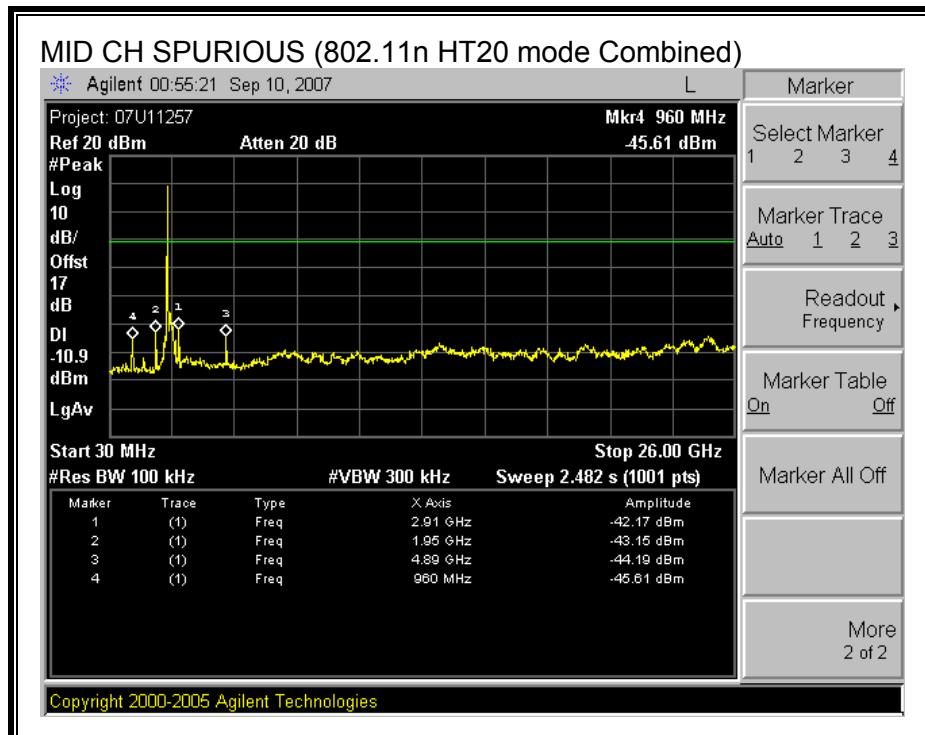
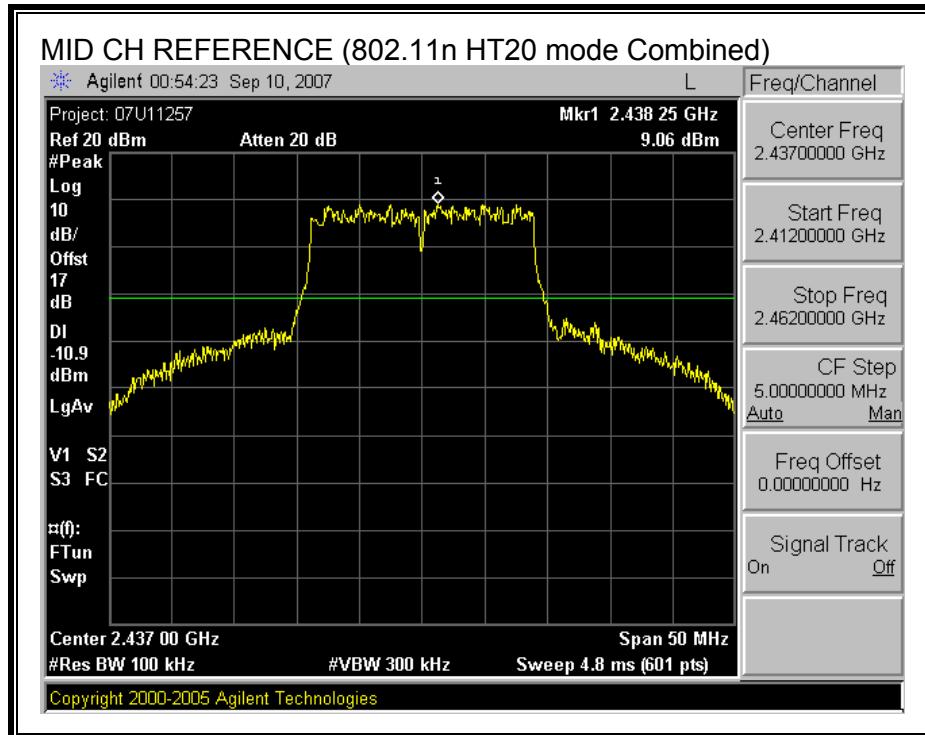
**COMBINED SPURIOUS EMISSIONS (802.11g MODE)**



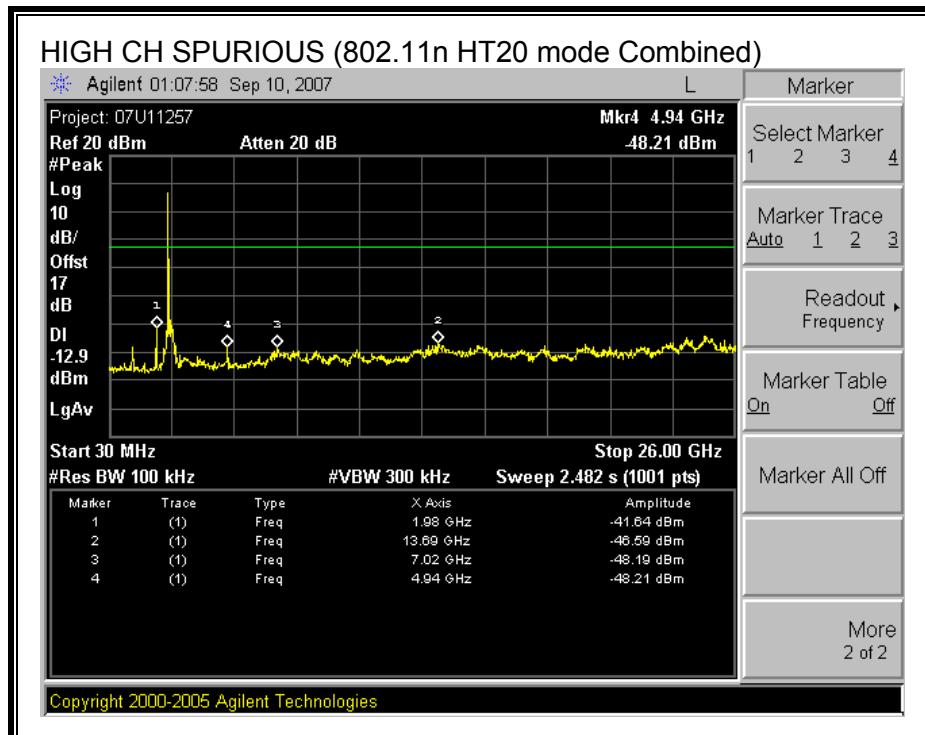
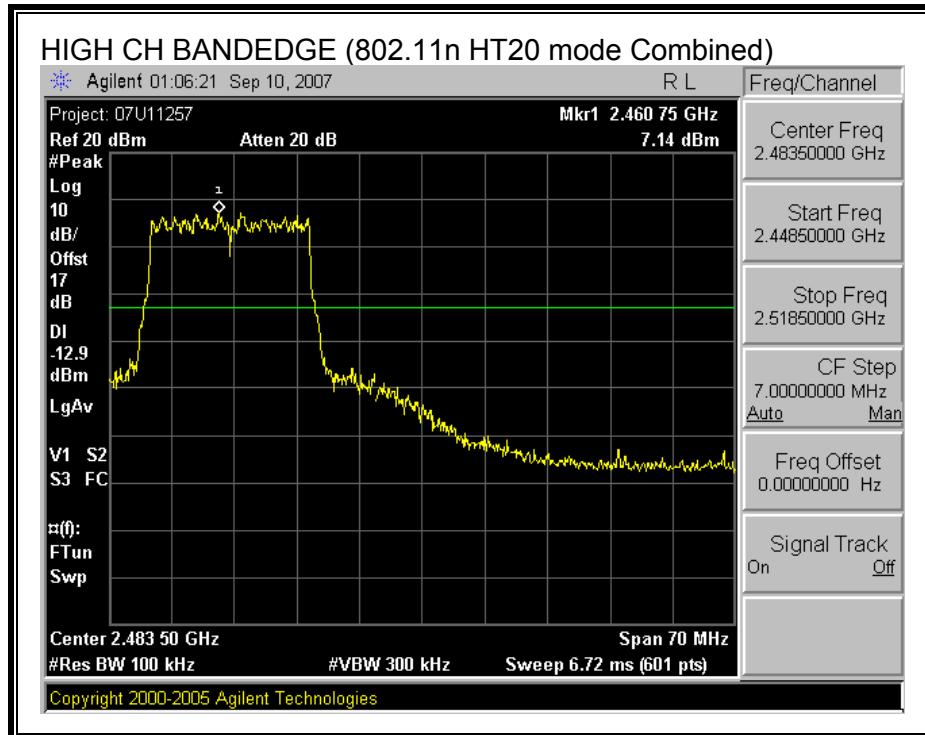
**COMBINED SPURIOUS EMISSIONS (802.11n HT20 MODE)**



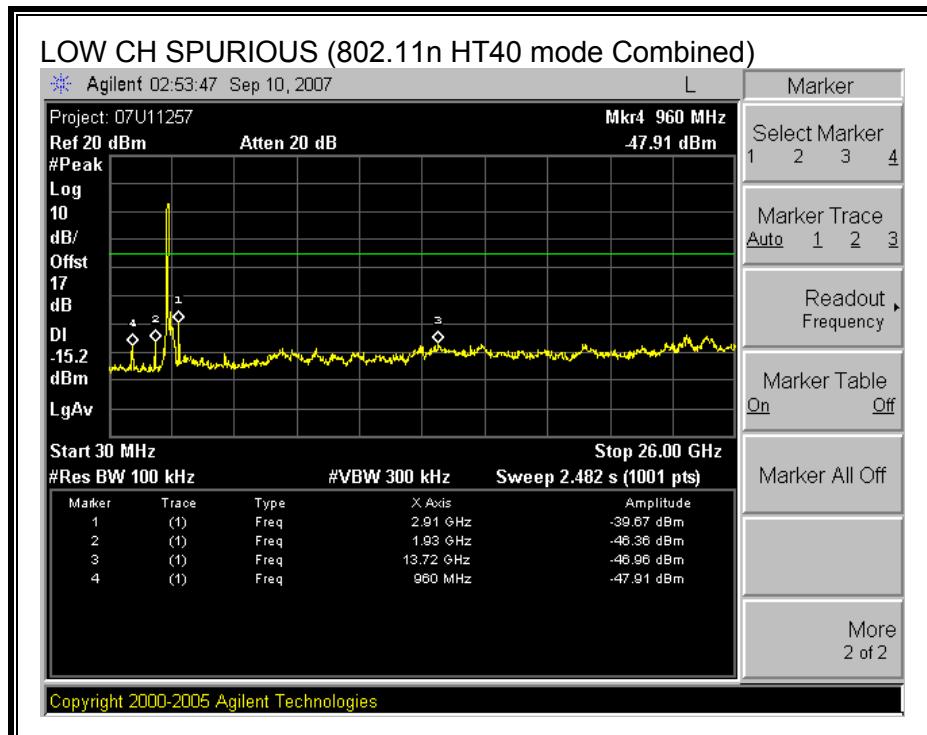
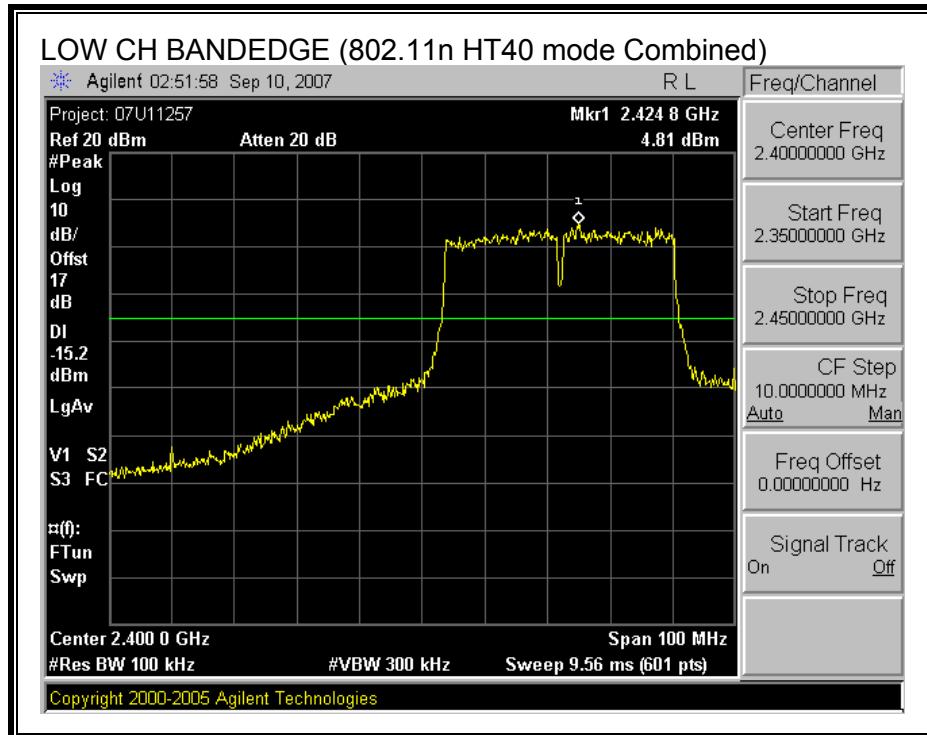
**COMBINED SPURIOUS EMISSIONS (802.11n HT20 MODE)**



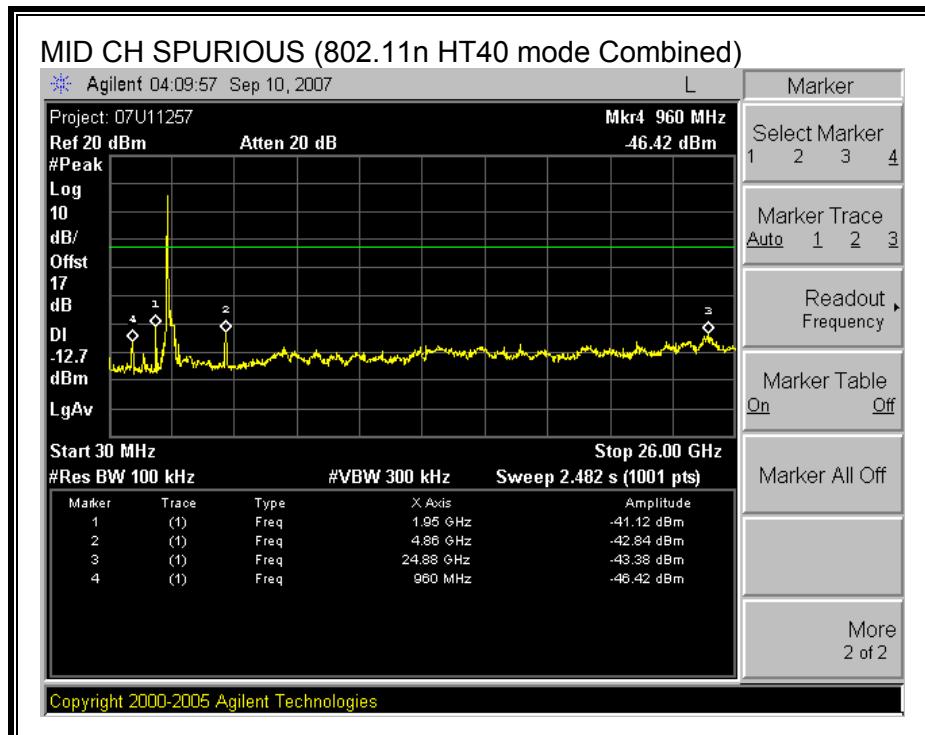
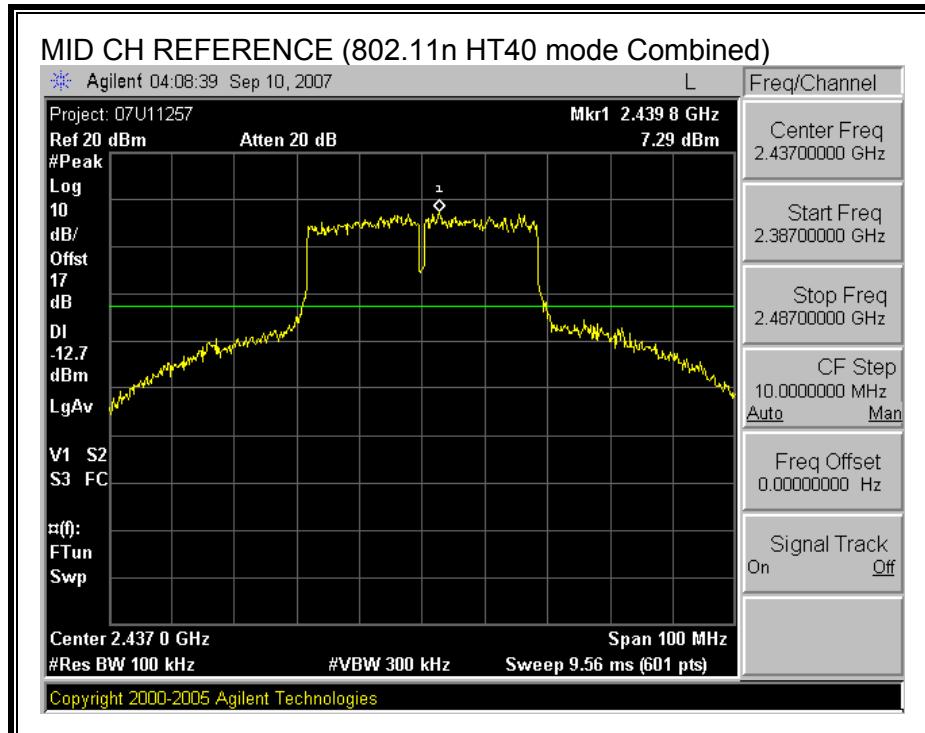
**COMBINED SPURIOUS EMISSIONS (802.11n HT20 MODE)**



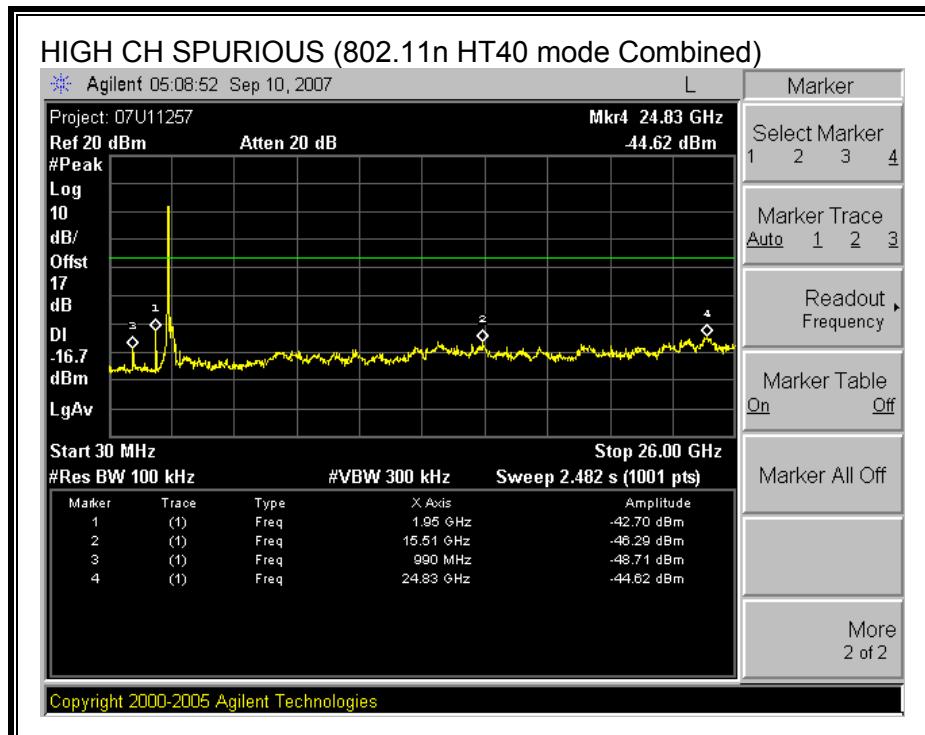
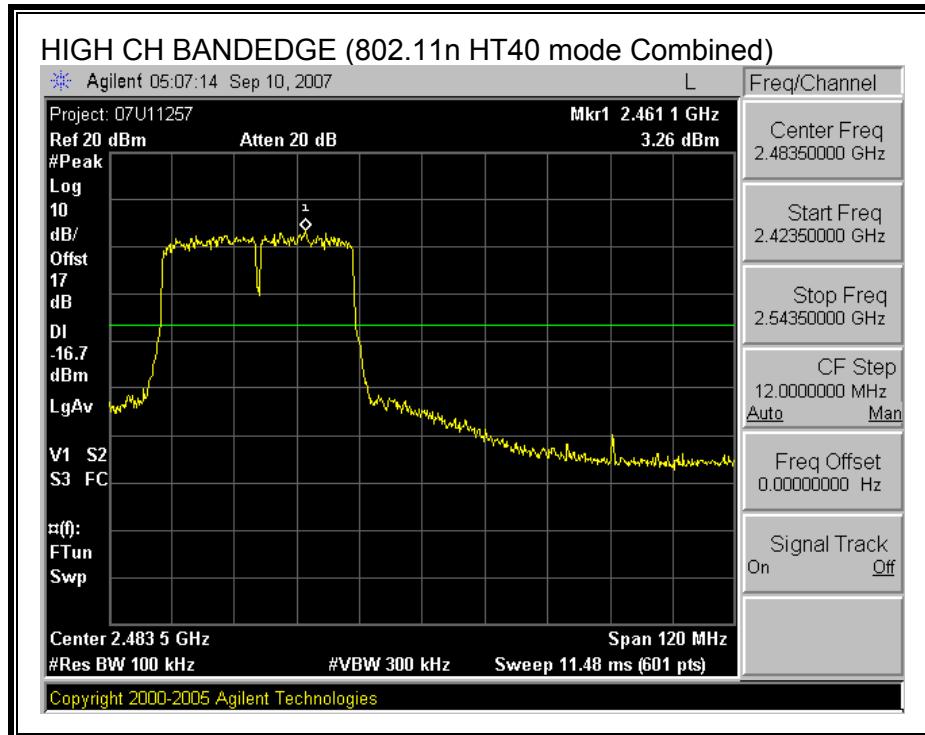
## COMBINED SPURIOUS EMISSIONS (802.11n HT40 MODE)



**COMBINED SPURIOUS EMISSIONS (802.11n HT40 MODE)**



**COMBINED SPURIOUS EMISSIONS (802.11n HT40 MODE)**



## 7.2. 802.11a MODE IN THE 5.8 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

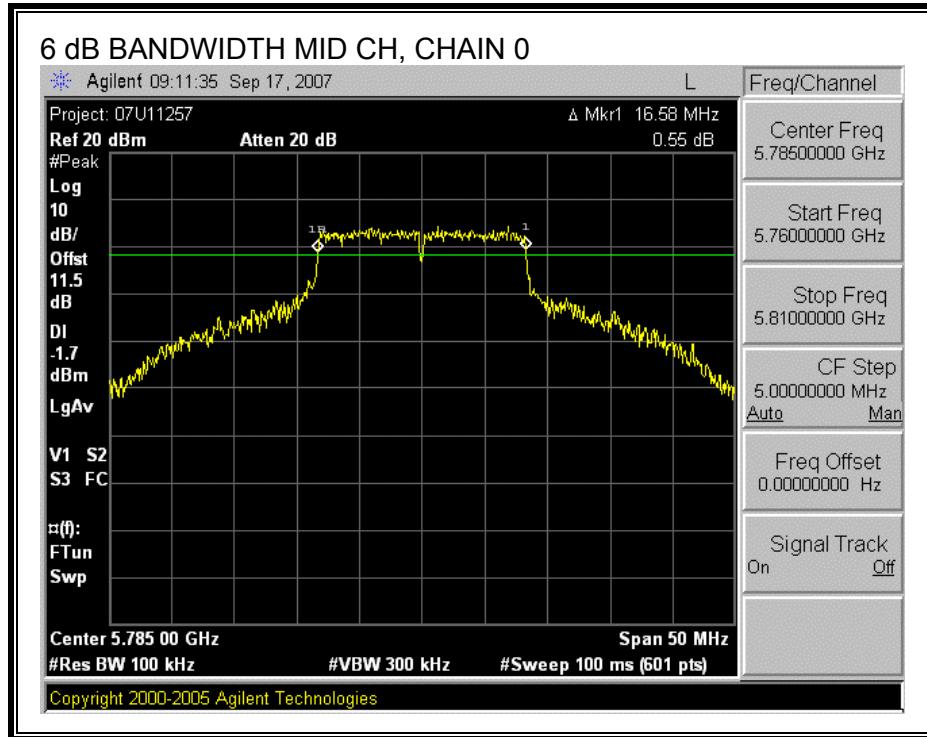
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

#### RESULTS

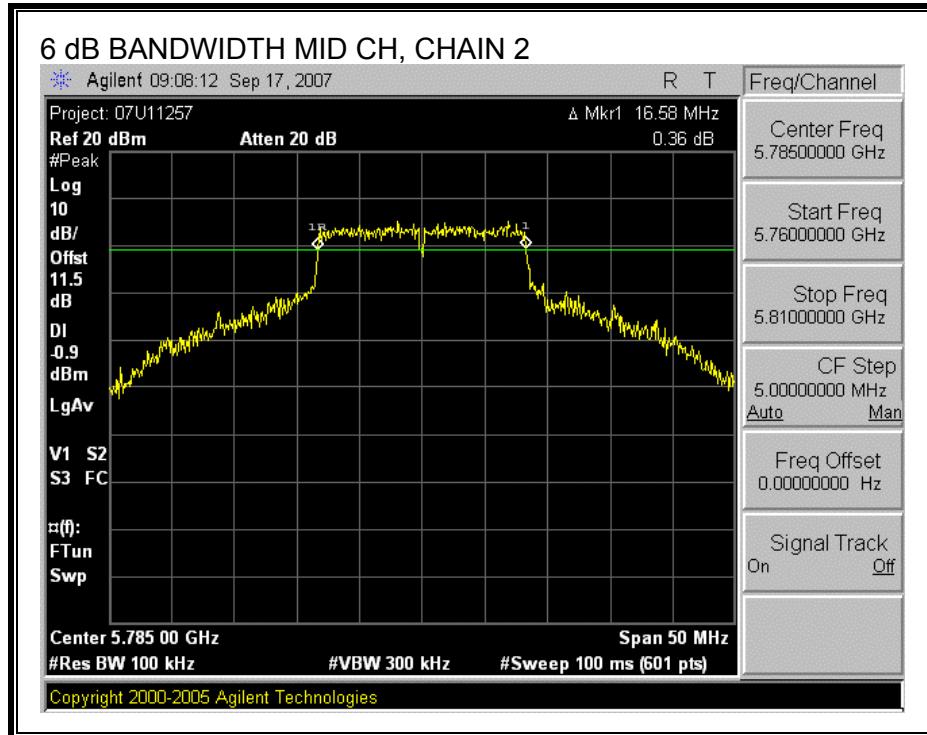
Channel	Frequency	Chain 0	Chain 2	Minimum Limit
	(MHz)	6 dB BW (MHz)	6 dB BW (MHz)	(MHz)
<b>802.11 a Legacy Mode</b>				
Low	5745	16.58	16.50	0.5
Middle	5785	16.58	16.58	0.5
High	5825	16.58	16.58	0.5
<b>802.11n HT20 Mode</b>				
Low	5745	17.83	17.75	0.5
Middle	5785	17.83	17.75	0.5
High	5825	17.92	17.75	0.5
<b>802.11n HT40 Mode</b>				
Low	5755	36.7	36.7	0.5
High	5795	36.7	36.7	0.5

Highlighted channel plots are included hereafter

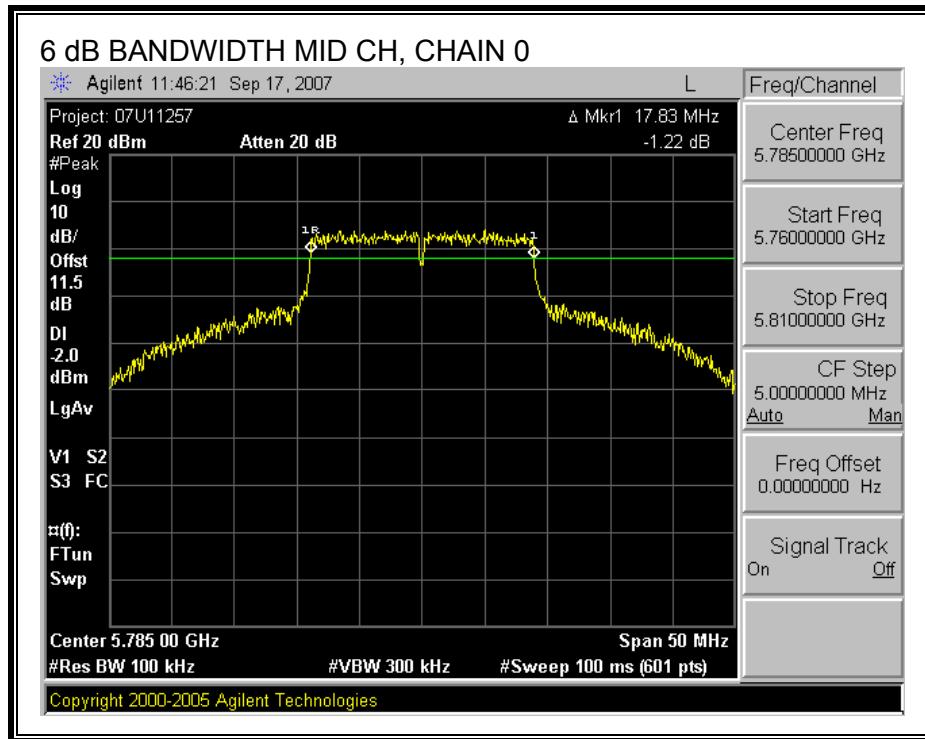
### 802.11a Mode - 6 dB BANDWIDTH, CHAIN 0



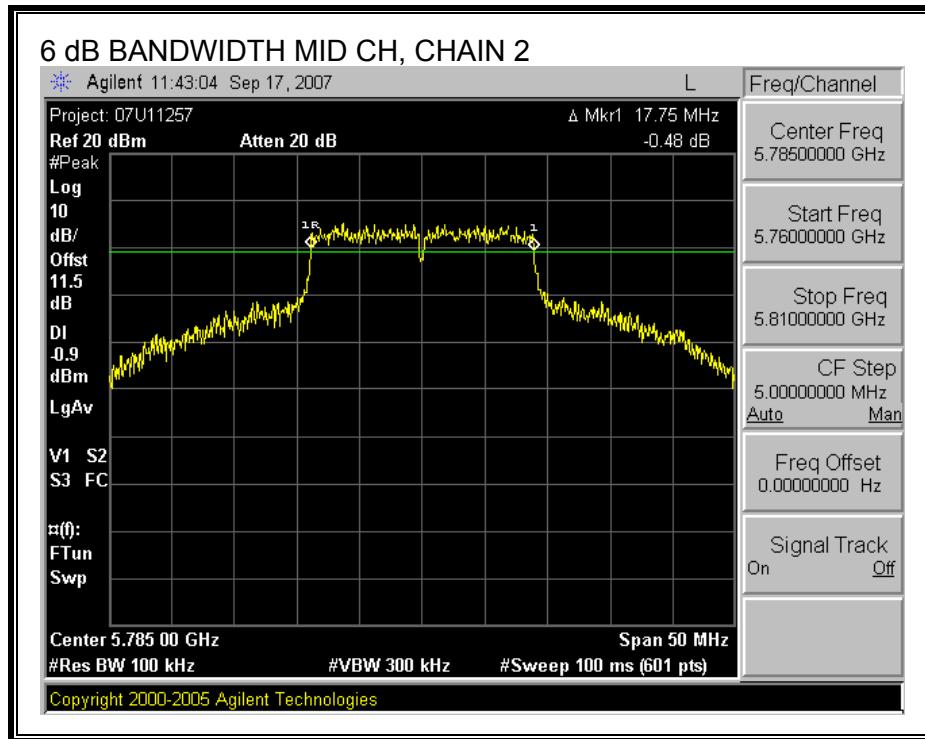
### 802.11a Mode - 6 dB BANDWIDTH, CHAIN 2



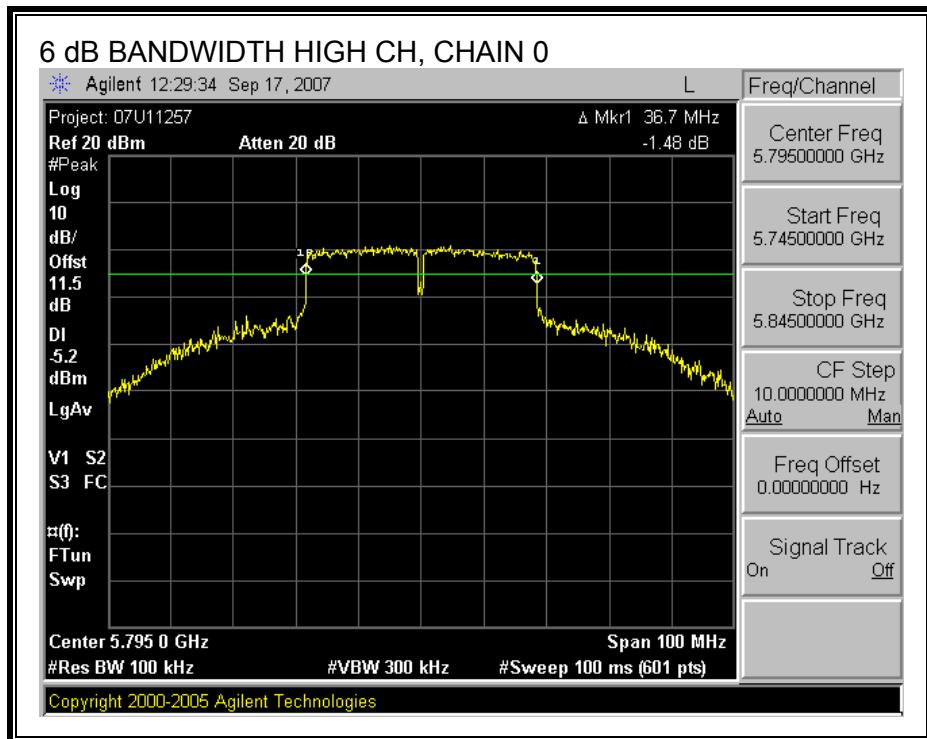
**802.11n HT20 Mode - 6 dB BANDWIDTH, CHAIN 0**



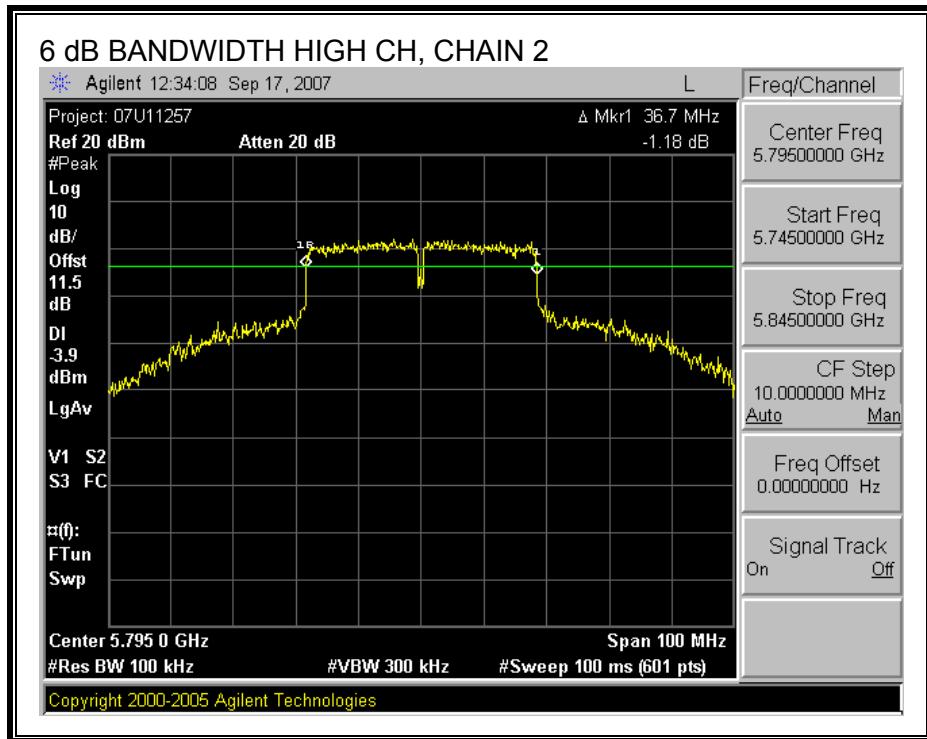
**802.11n HT20 Mode - 6 dB BANDWIDTH, CHAIN 2**



**802.11n HT40 Mode - 6 dB BANDWIDTH, CHAIN 0**



**802.11n HT40 Mode - 6 dB BANDWIDTH, CHAIN 2**



## 7.2.2. 99% BANDWIDTH

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

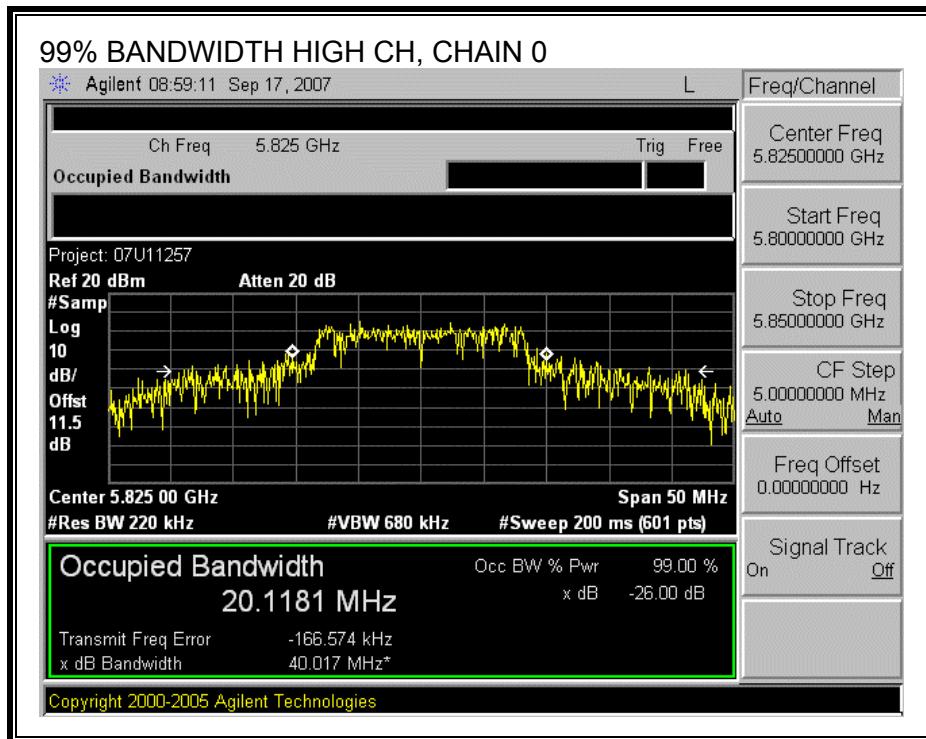
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

### RESULTS

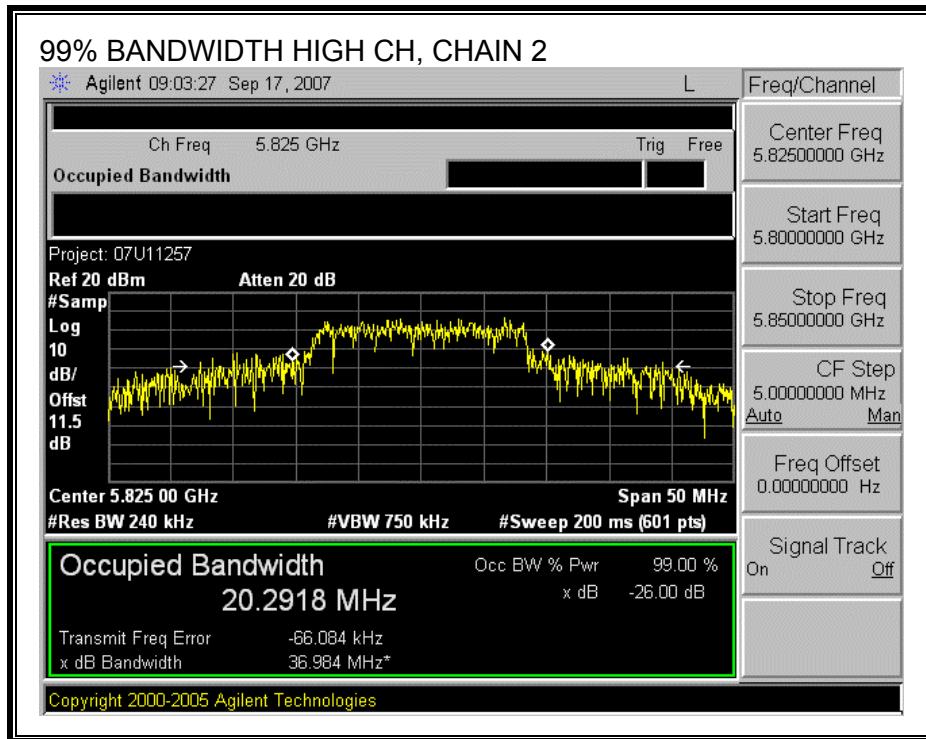
Channel	Frequency (MHz)	Chain 0 99% Bandwidth (MHz)	Chain 2 99% Bandwidth (MHz)
802.11 a Legacy Mode			
Low	5745	19.932	20.057
Middle	5785	19.997	20.258
High	5825	20.118	20.292
802.11n HT20 Mode			
Low	5745	20.502	20.553
Middle	5785	20.384	21.584
High	5825	21.966	22.774
802.11n HT40 Mode			
Low	5755	43.437	41.54
High	5795	43.108	43.545

Highlighted channel plots are included hereafter

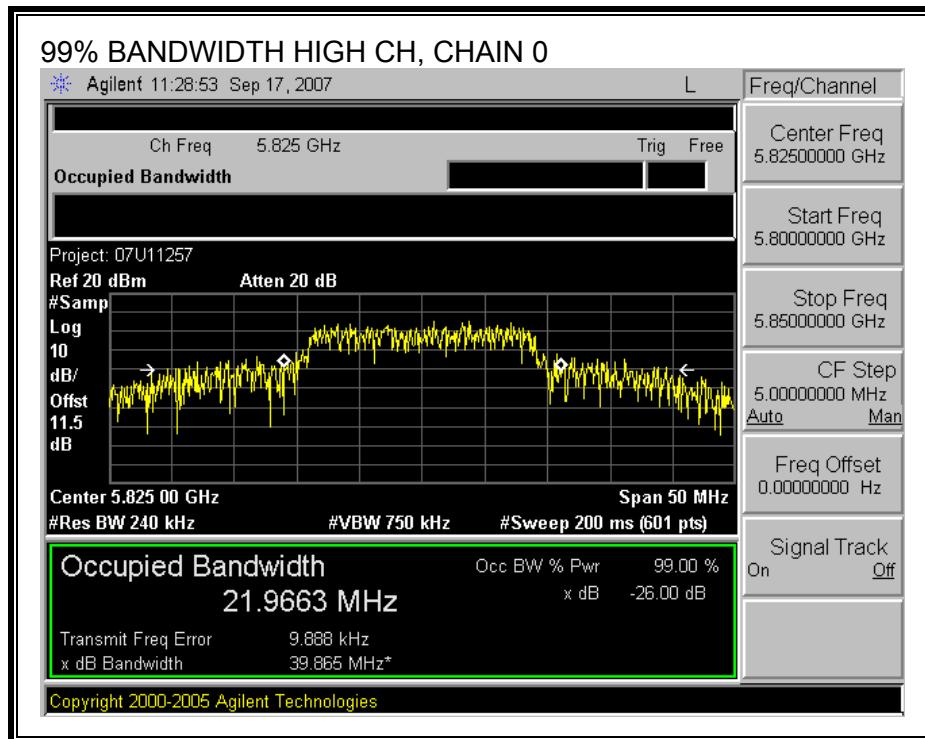
### 802.11 a Mode - 99% BANDWIDTH, CHAIN 0



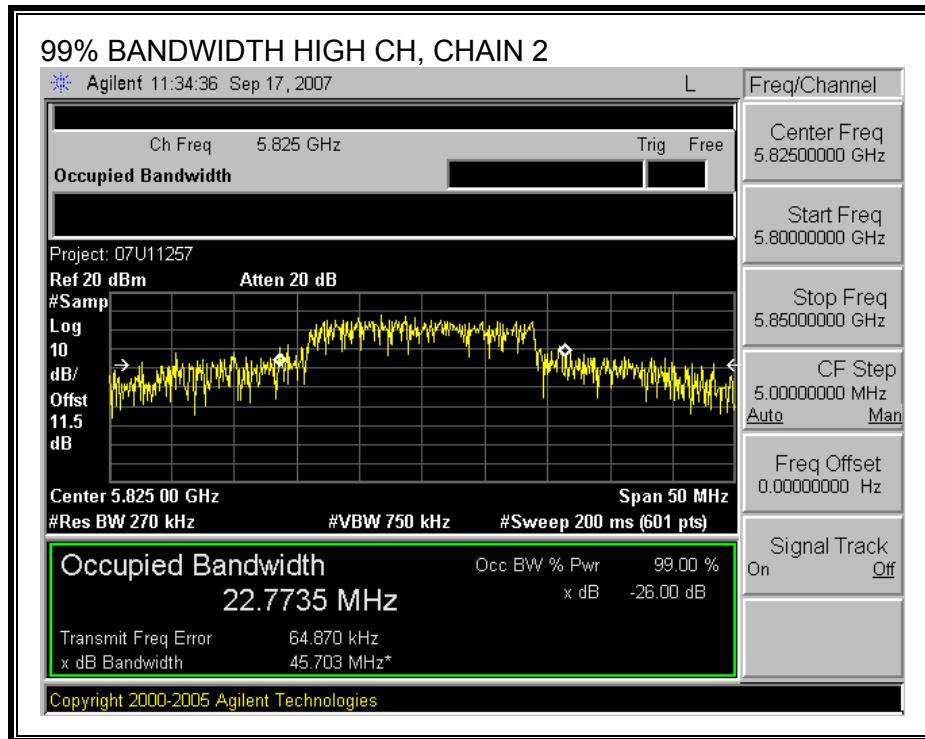
### 802.11 a Mode - 99% BANDWIDTH, CHAIN 2



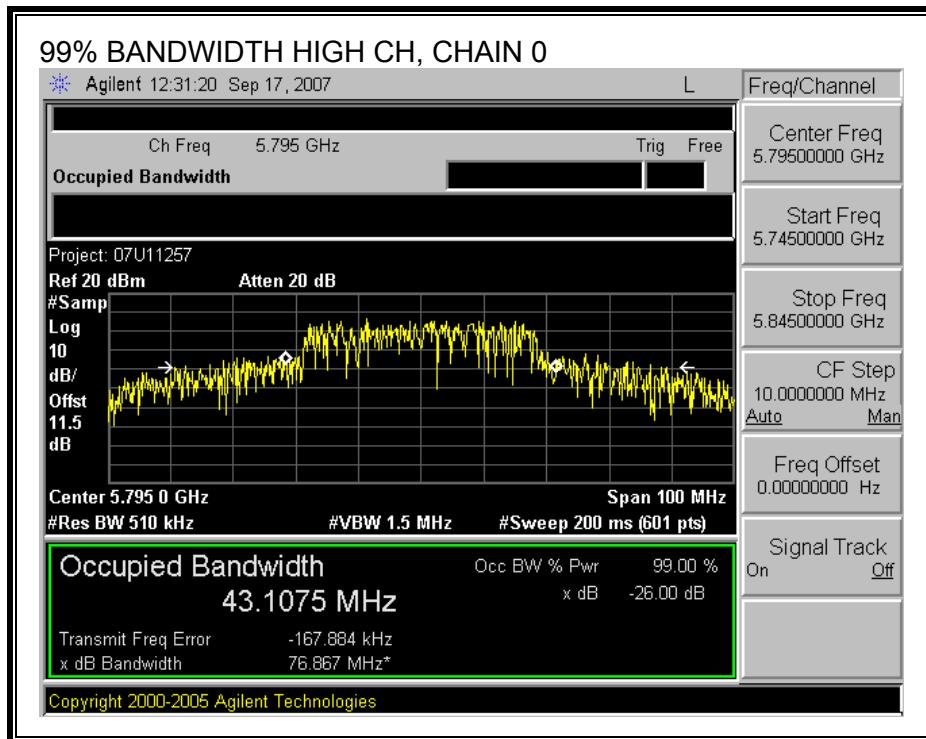
**802.11n HT20 Mode - 99% BANDWIDTH, CHAIN 0**



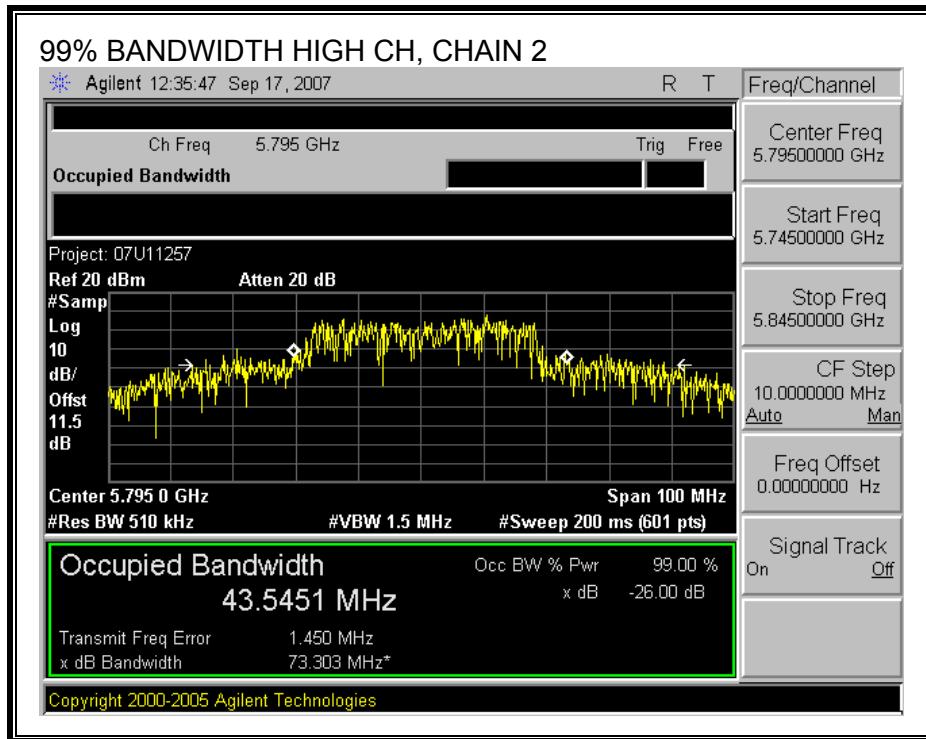
**802.11n HT20 Mode - 99% BANDWIDTH, CHAIN 2**



**802.11n HT40 Mode - 99% BANDWIDTH, CHAIN 0**



**802.11n HT40 Mode - 99% BANDWIDTH, CHAIN 2**



### 7.2.3. OUTPUT POWER

## **LIMITS**

FCC §15.247 (b)

IC RSS-210 A8.4

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

## **TEST PROCEDURE**

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

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.

Each chain is measured separately and the total power is calculated using:

Total Power =  $10 \log (10^4 (\text{Chain 0 Power} / 10) + 10^4 (\text{Chain 2 Power} / 10))$

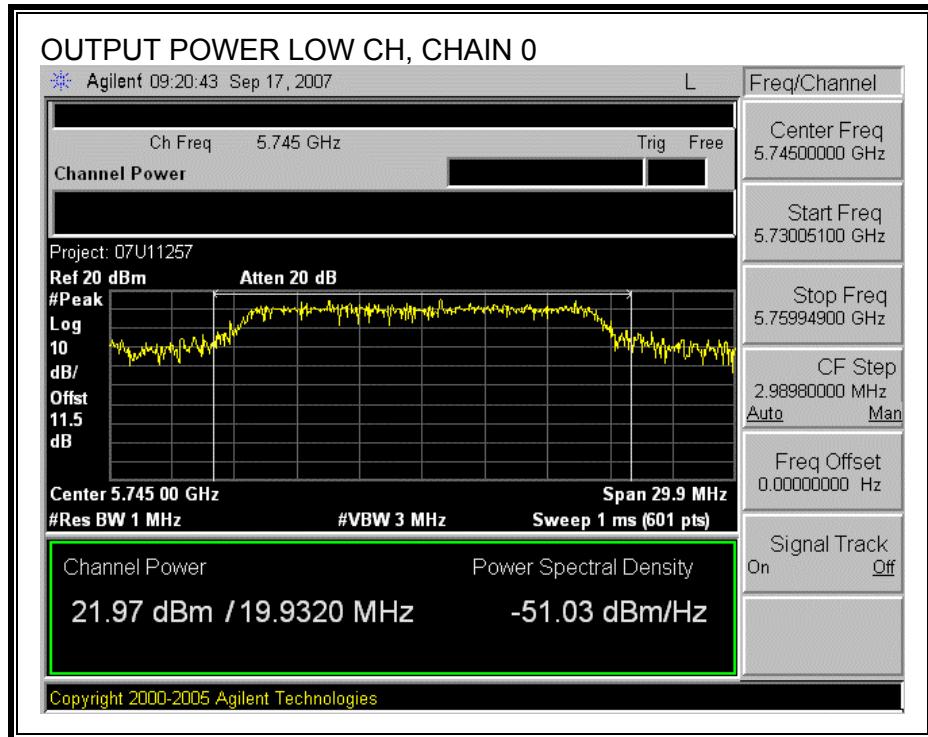
Combined Antenna Gain in legacy and CCD mode:  $10^{\log(10^{\log(\text{antenna gain } \#1/10)} + 10^{\log(\text{antenna gain } \#2/10)})}$

## RESULTS

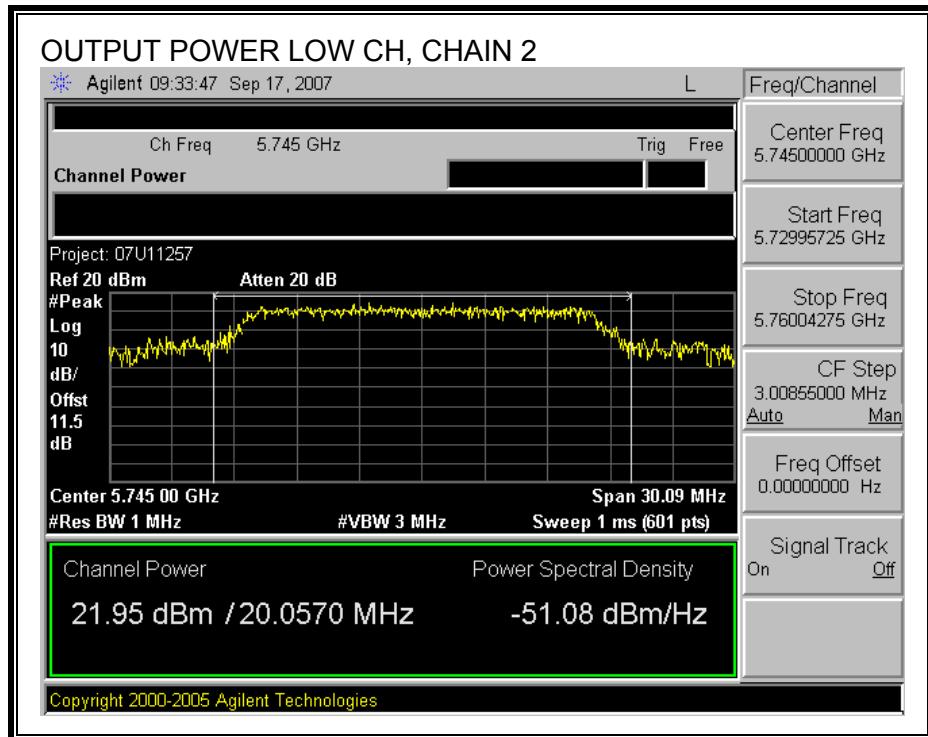
Antenna Gain (dBi) # 0	Antenna Gain (dBi) # 2	Effective Legacy Gain (dBi)
2.23	1.97	5.11

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
802.11 a Legacy Mode						
Low	5745	21.97	21.95	24.97	30.00	-5.03
Mid	5785	21.23	21.96	24.62	30.00	-5.38
High	5825	20.84	21.92	24.42	30.00	-5.58
802.11n HT20 Mode						
Low	5745	21.84	22.28	25.08	30.00	-4.92
Mid	5785	21.08	22.20	24.69	30.00	-5.31
High	5825	20.83	22.17	24.56	30.00	-5.44
802.11n HT40 Mode						
Low	5755	21.75	22.02	24.90	30.00	-5.10
High	5795	21.55	22.09	24.84	30.00	-5.16

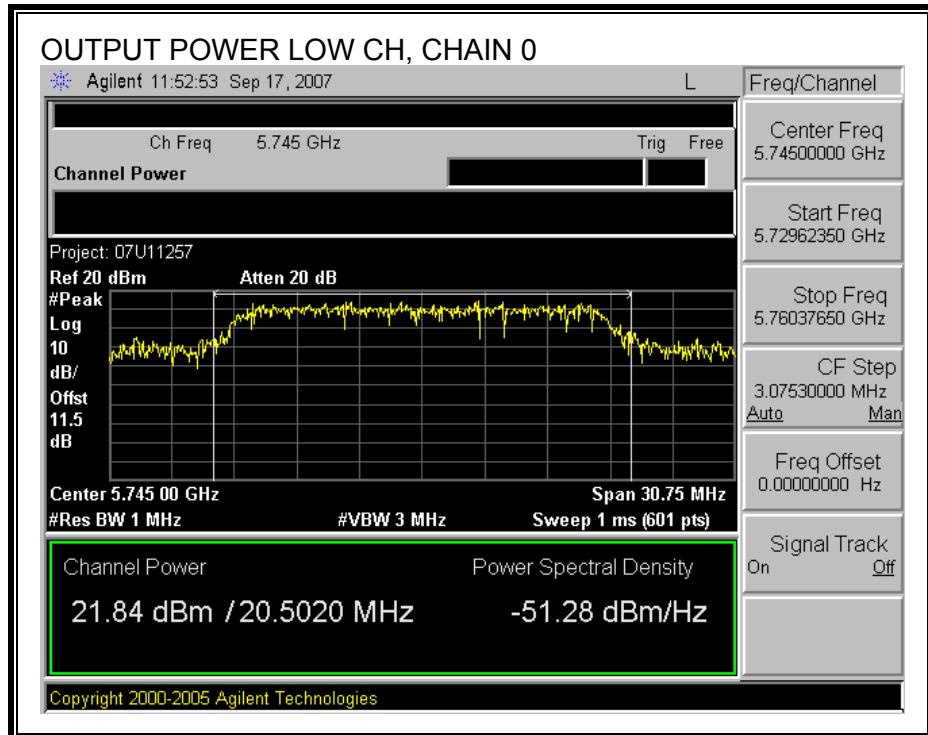
### 802.11 a Mode - CHAIN 0 OUTPUT POWER



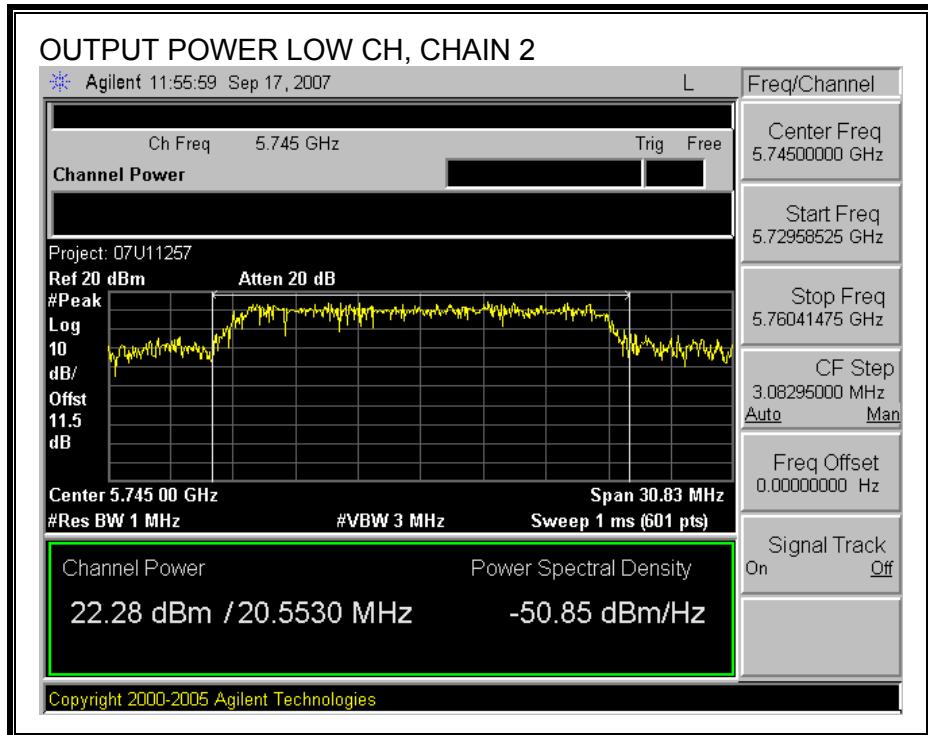
### 802.11 a Mode - CHAIN 2 OUTPUT POWER



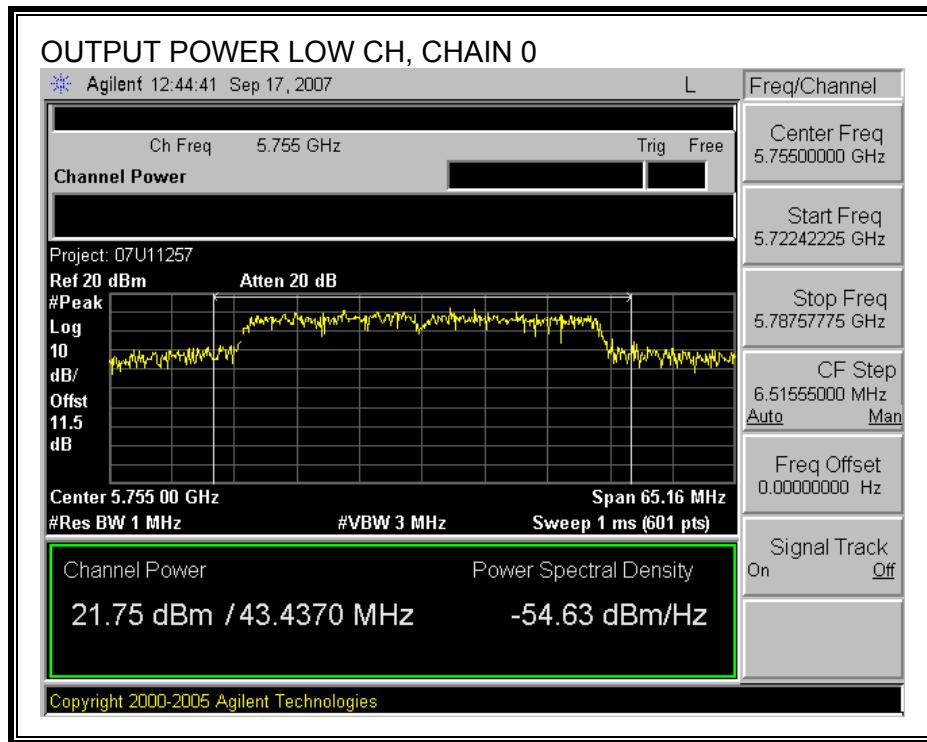
### 802.11n HT20 Mode - CHAIN 0 OUTPUT POWER



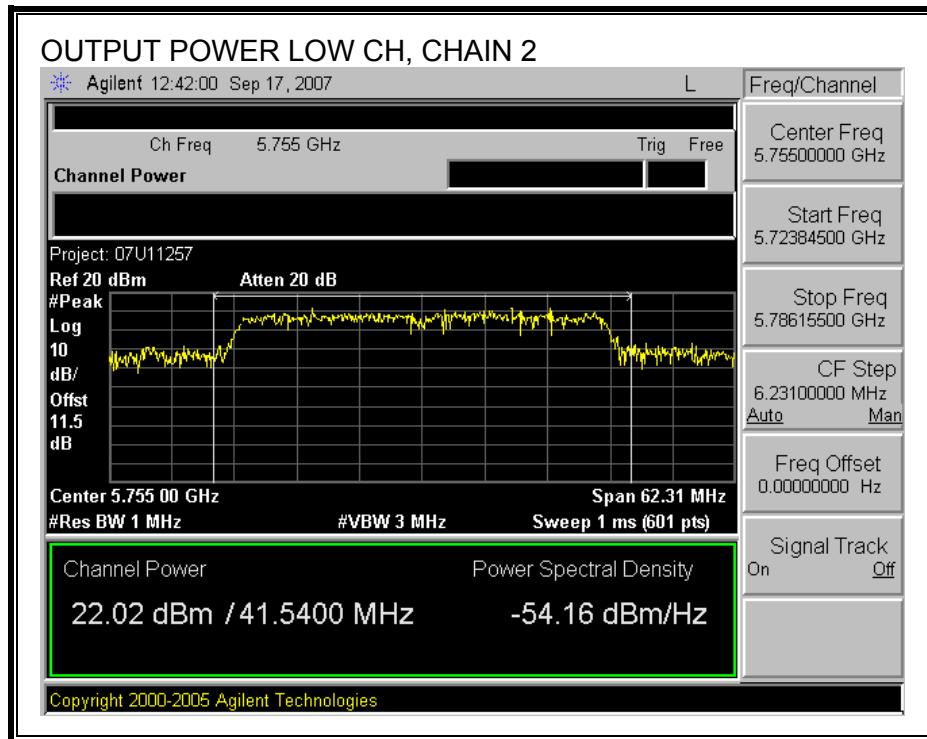
### 802.11n HT20 Mode - CHAIN 2 OUTPUT POWER



### 802.11n HT40 Mode - CHAIN 0 OUTPUT POWER



### 802.11n HT40 Mode - CHAIN 2 OUTPUT POWER



## 7.2.4. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

### RESULTS

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

## 7.2.5. POWER SPECTRAL DENSITY

### LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### TEST PROCEDURE

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

Each chain is measured separately and with combiner. Test result indicates combiner is the worse case.

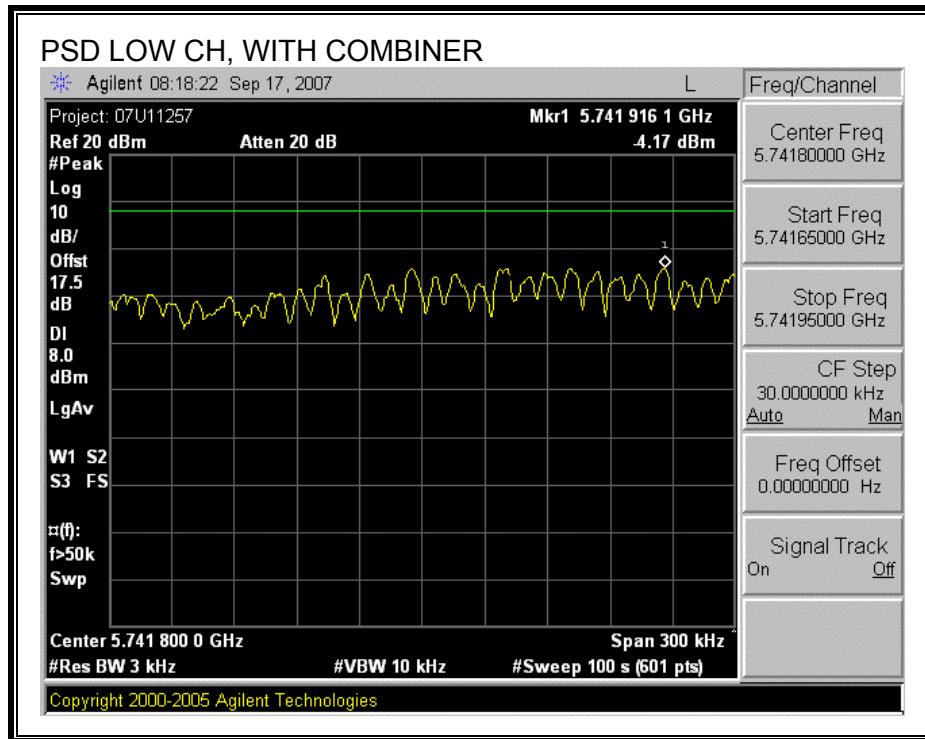
### RESULTS

#### POWER SPECTRAL DENSITY WITH COMBINER

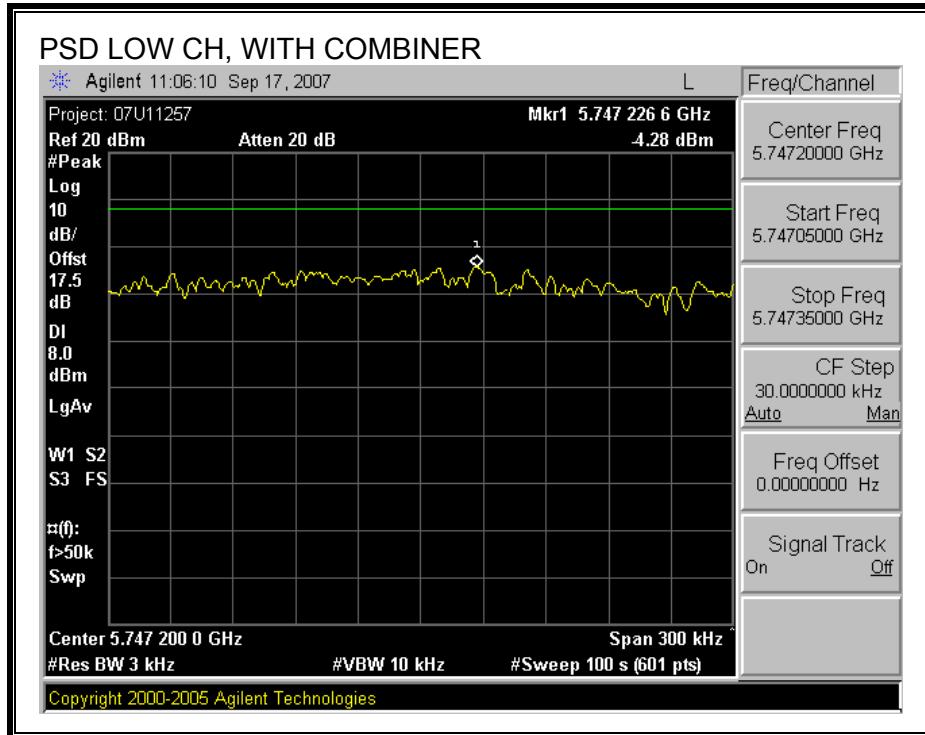
Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
<b>802.11 a Legacy Mode</b>				
Low	5745	-4.17	8	-12.17
Middle	5785	-4.51	8	-12.51
High	5825	-4.70	8	-12.70
<b>802.11n HT20 Mode</b>				
Low	5745	-4.28	8	-12.28
Middle	5785	-5.64	8	-13.64
High	5825	-4.63	8	-12.63
<b>802.11n HT40 Mode</b>				
Low	5755	-5.75	8	-13.75
High	5795	-6.04	8	-14.04

## POWER SPECTRAL DENSITY, WITH COMBINER

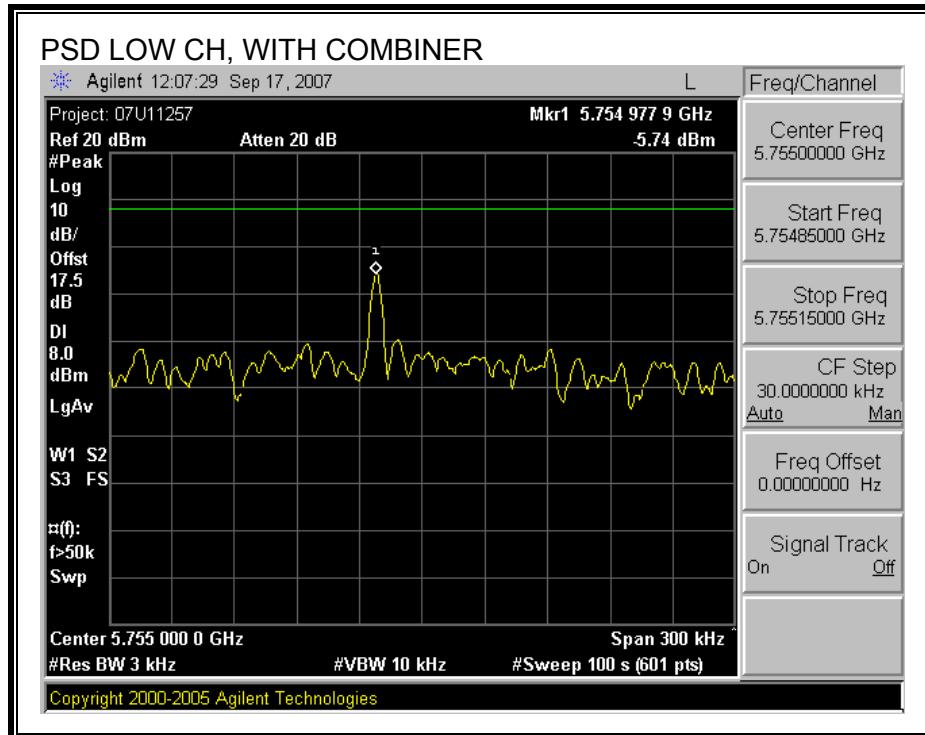
## 802.11 a Mode



## 802.11n HT20 Mode



**802.11n HT40 Mode**



## 7.2.6. CONDUCTED SPURIOUS EMISSIONS

### LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

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

### TEST PROCEDURE

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

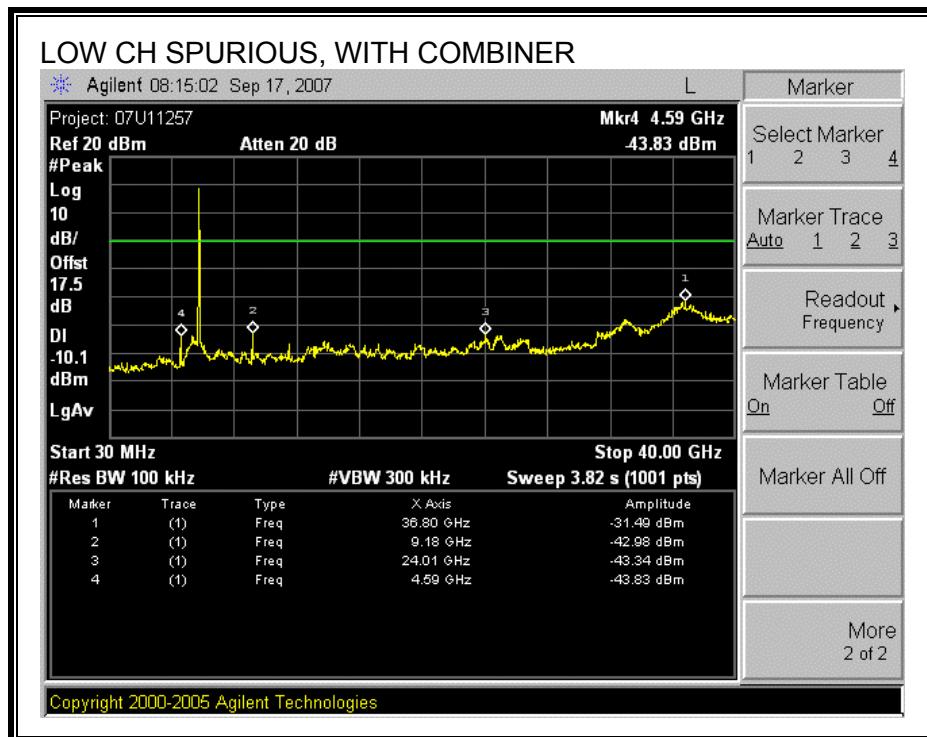
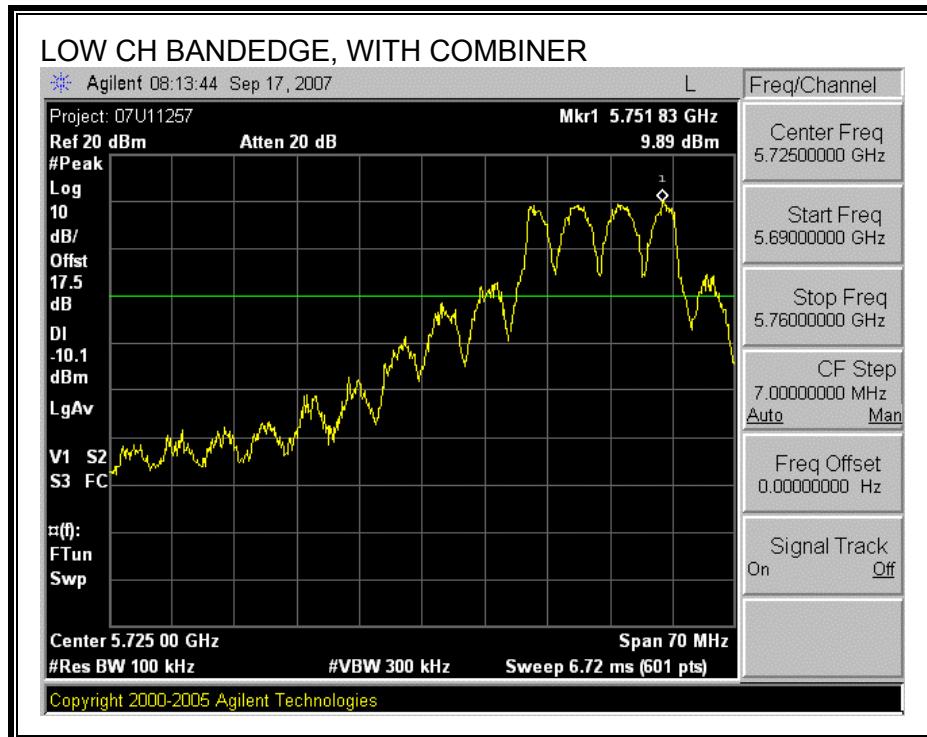
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

Each chain is measured separately and with combiner. Test result indicates combiner is the worse case.

### RESULTS

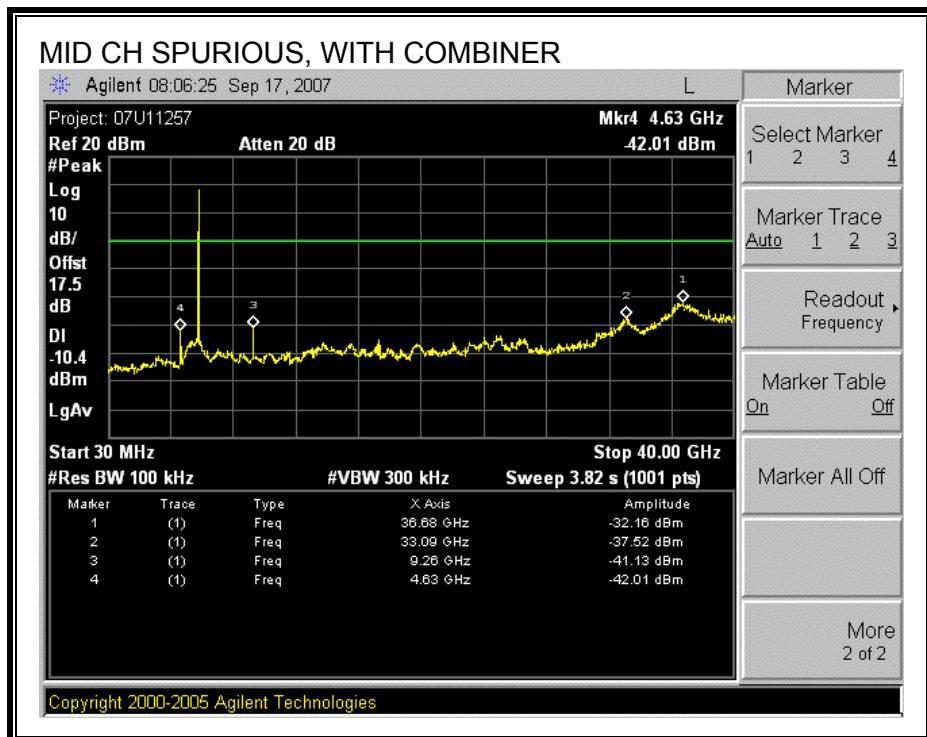
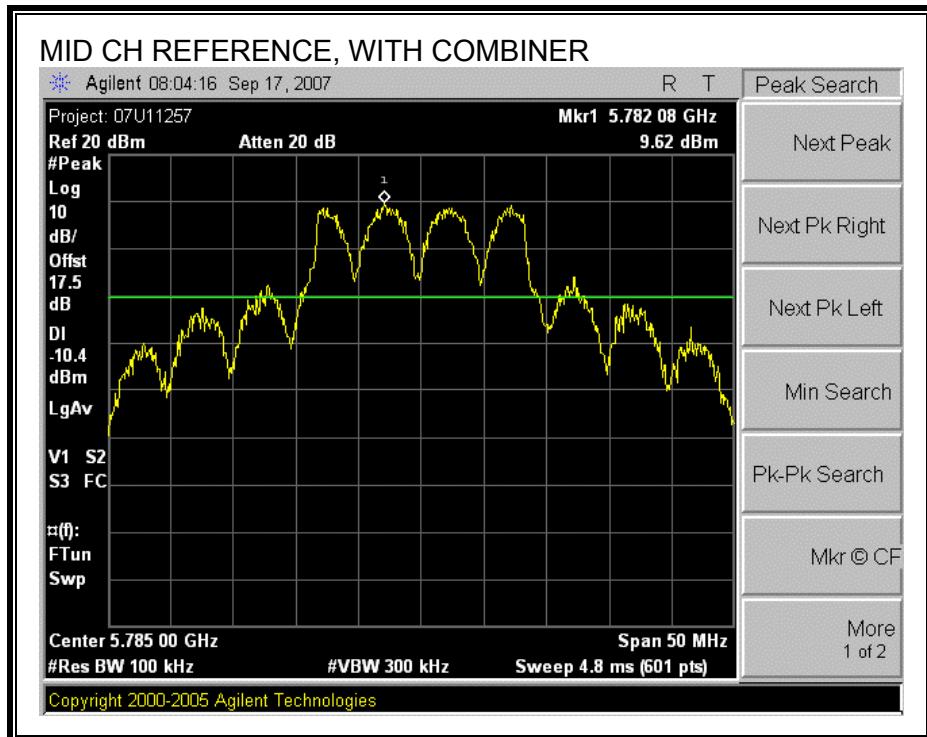
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11 a Mode



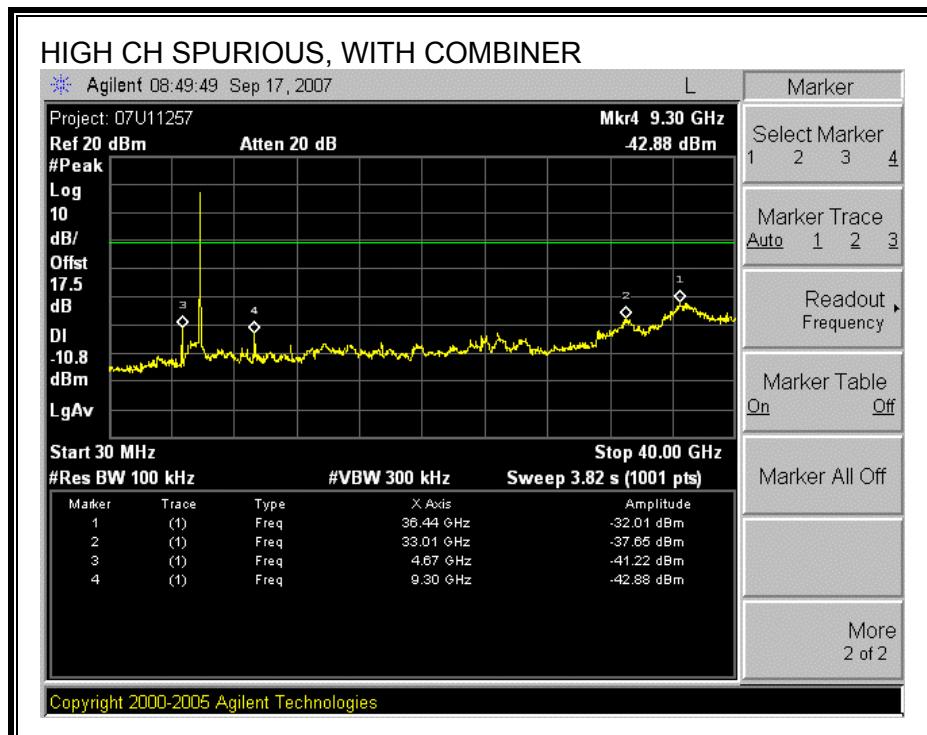
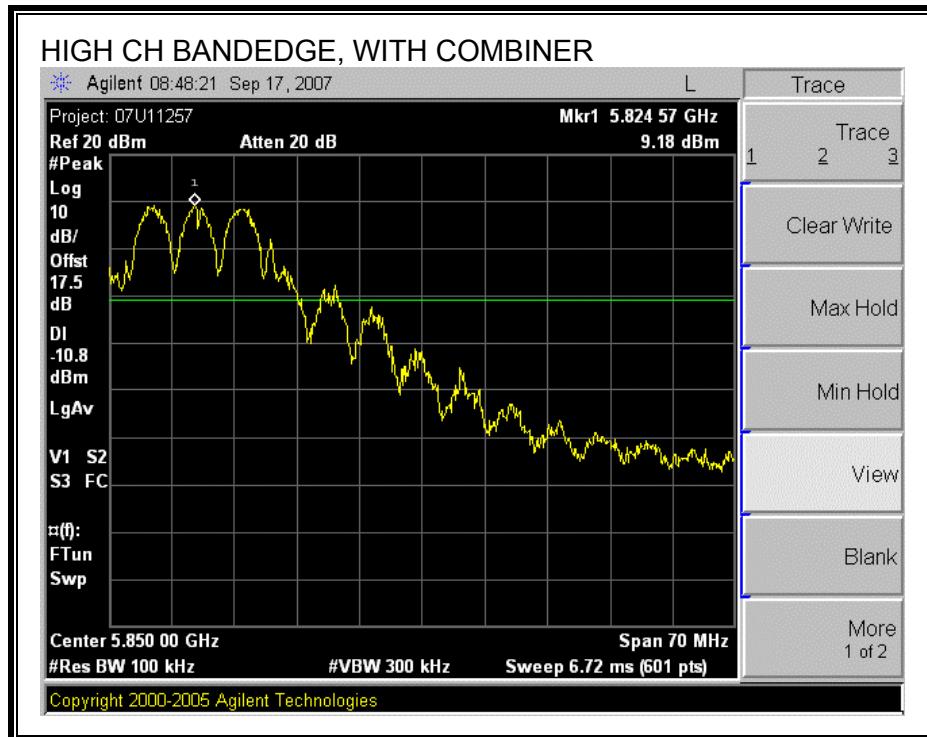
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11 a Mode



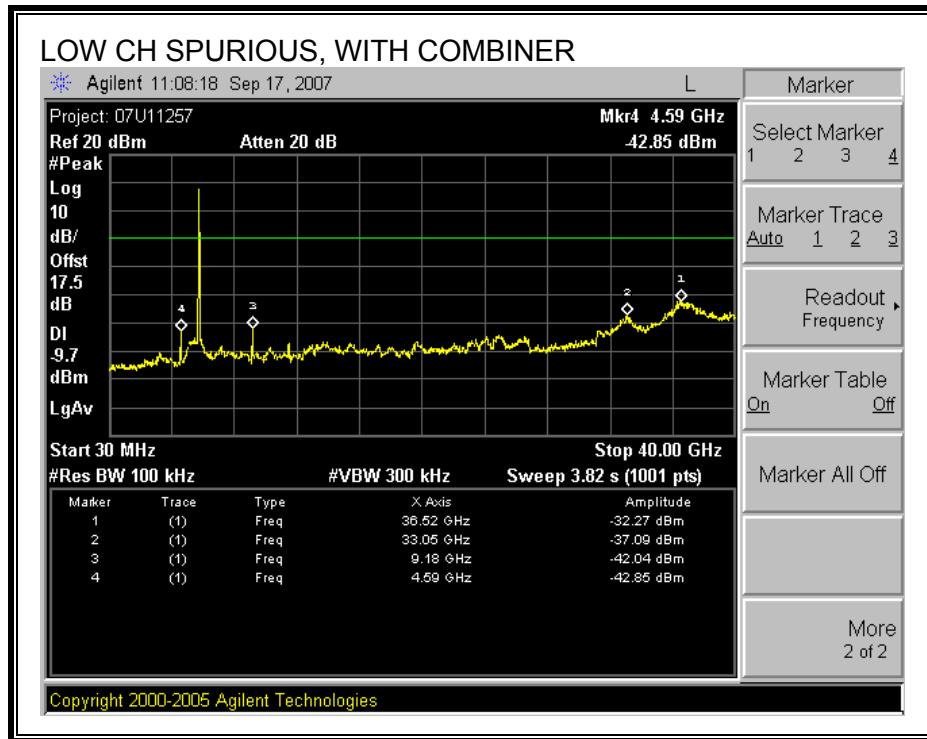
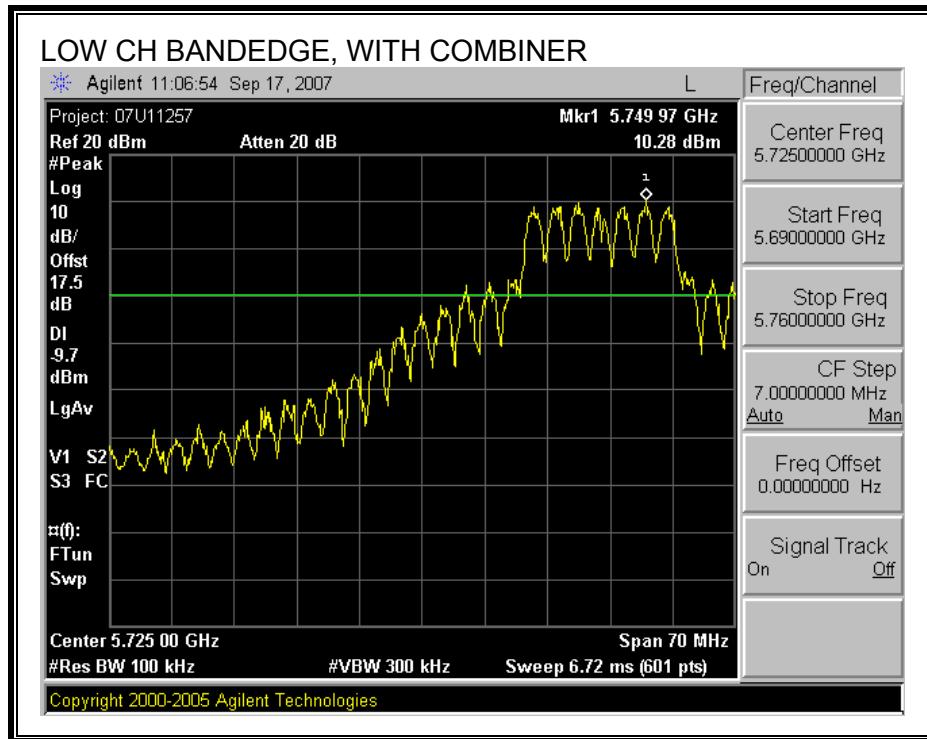
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11 a Mode



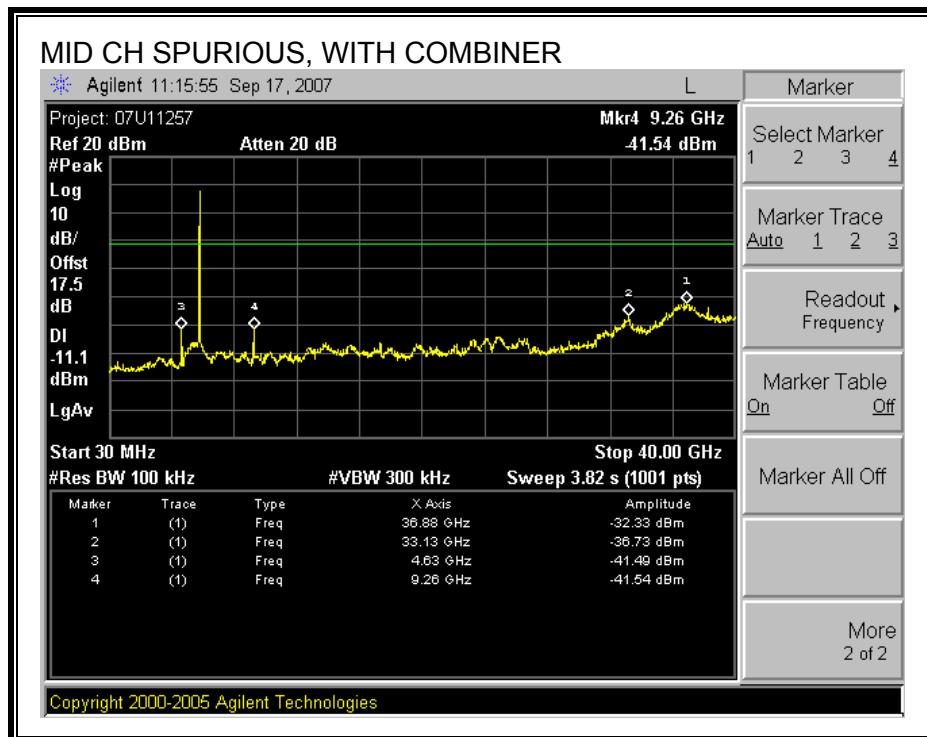
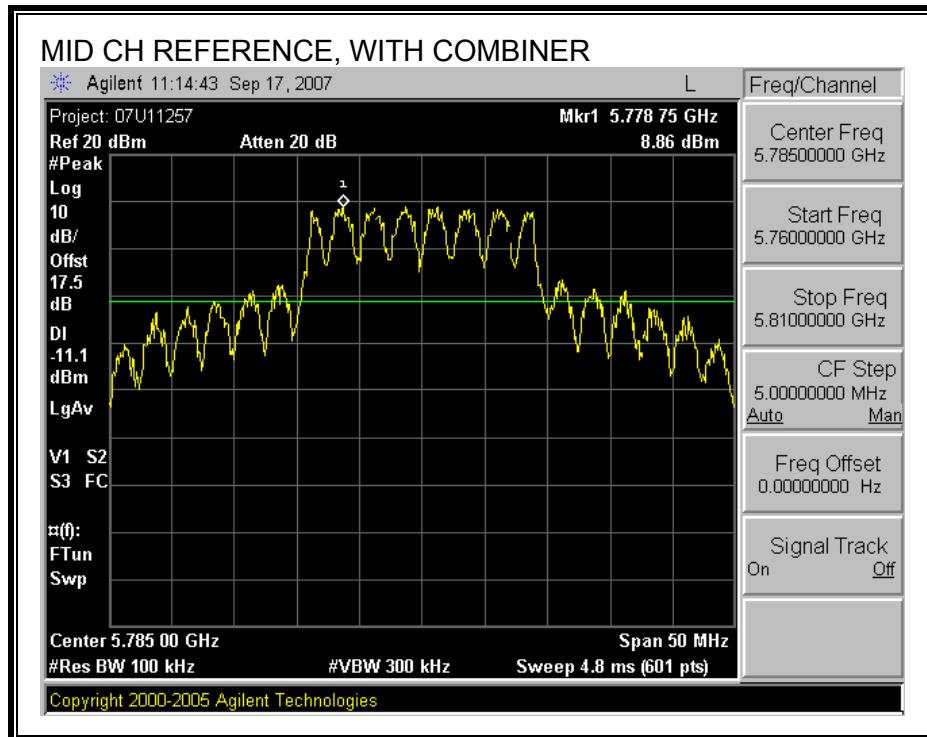
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11n HT20 Mode



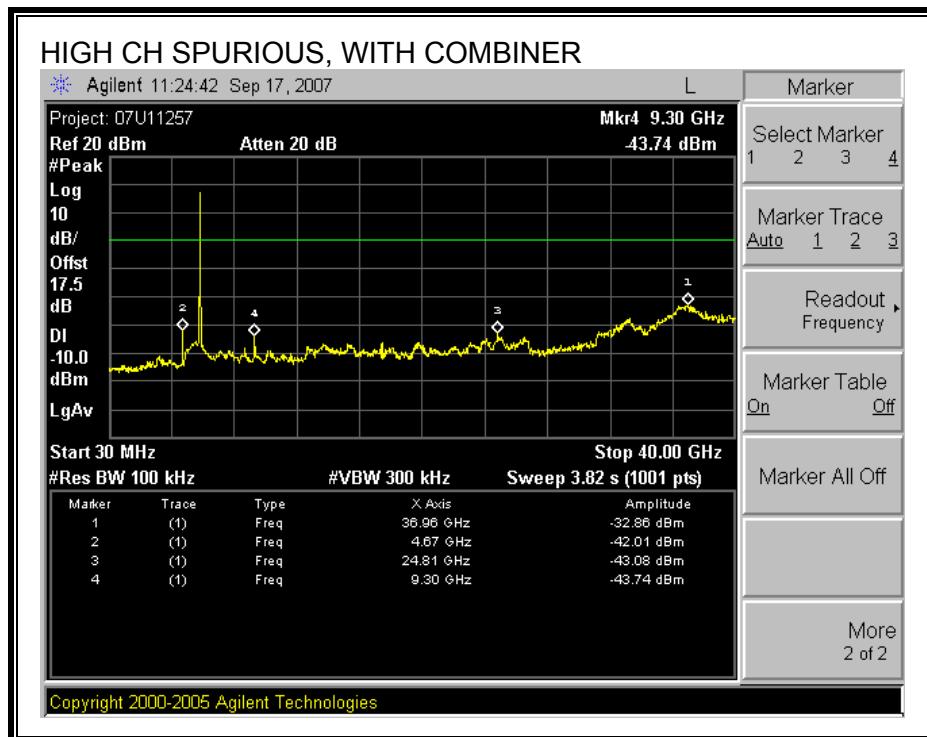
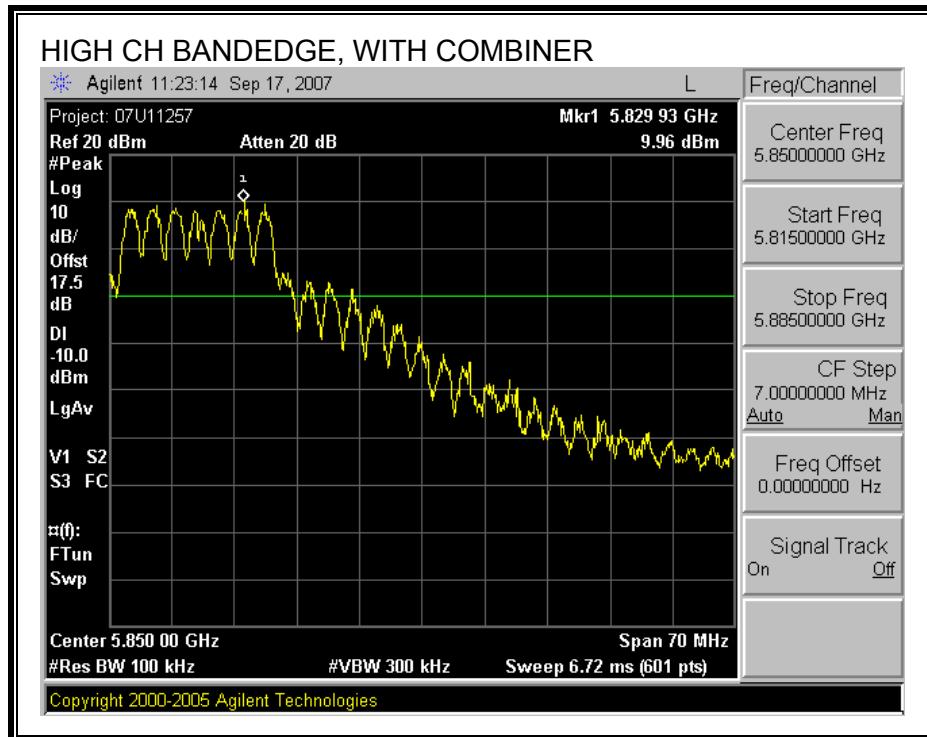
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11n HT20 Mode



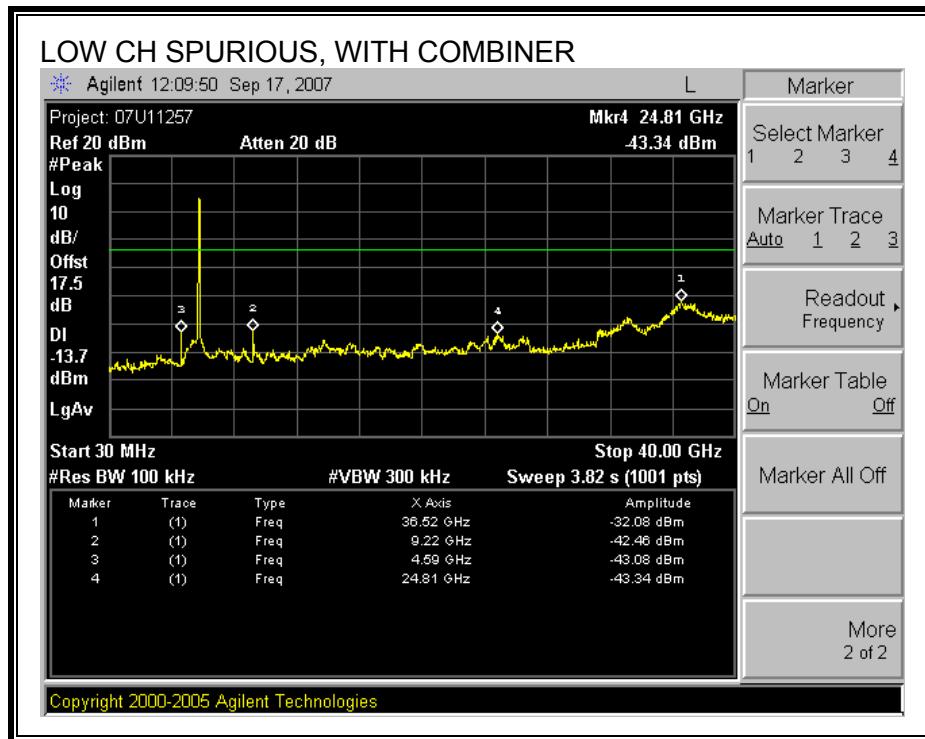
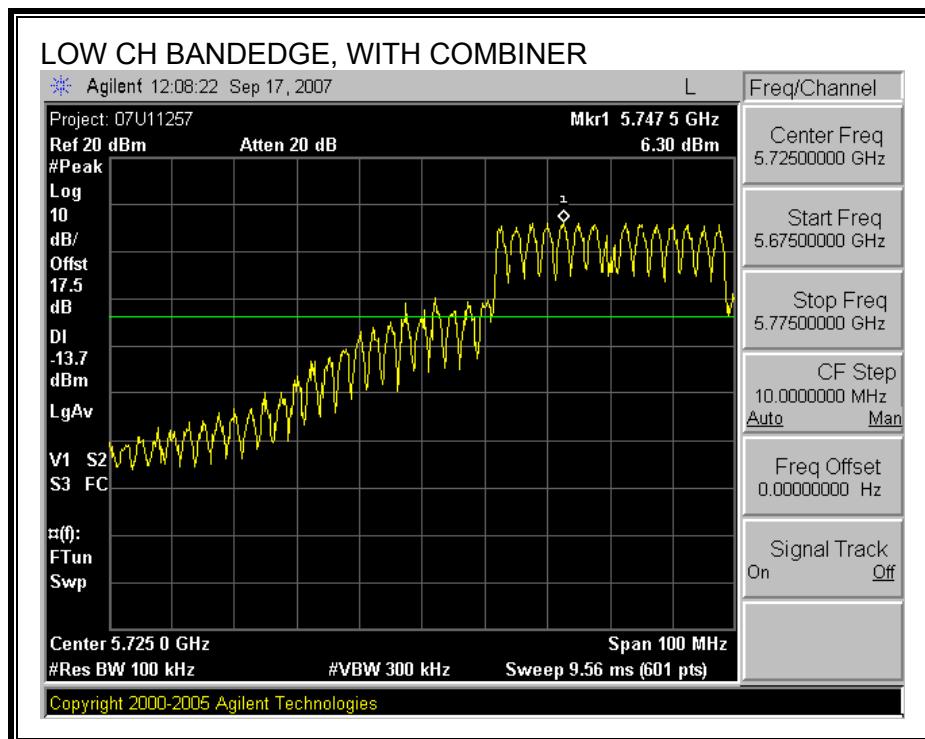
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11n HT20 Mode



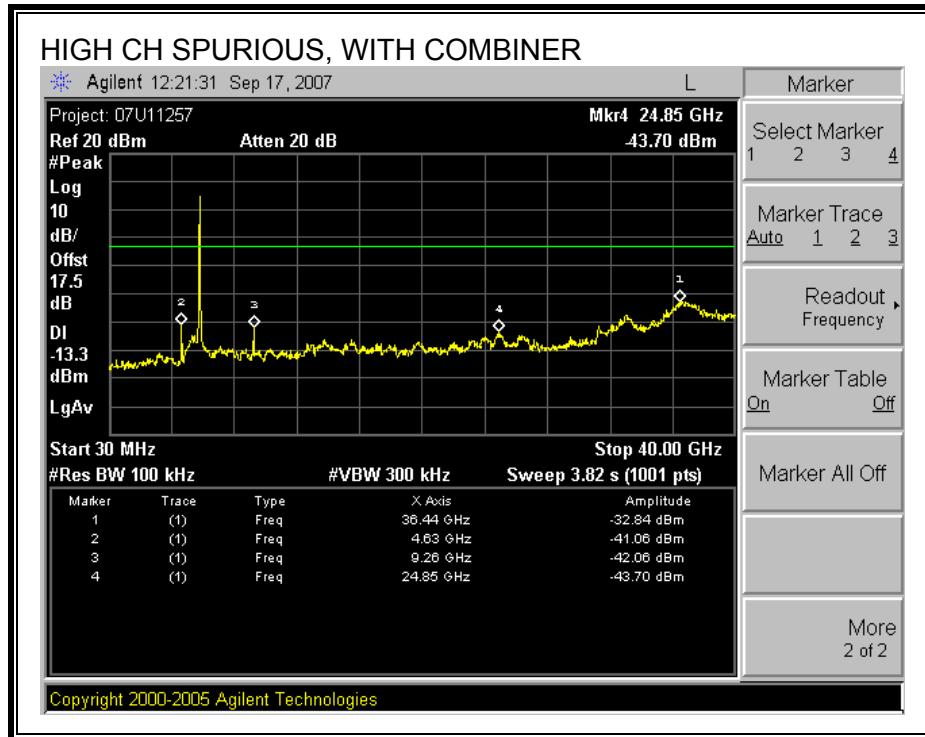
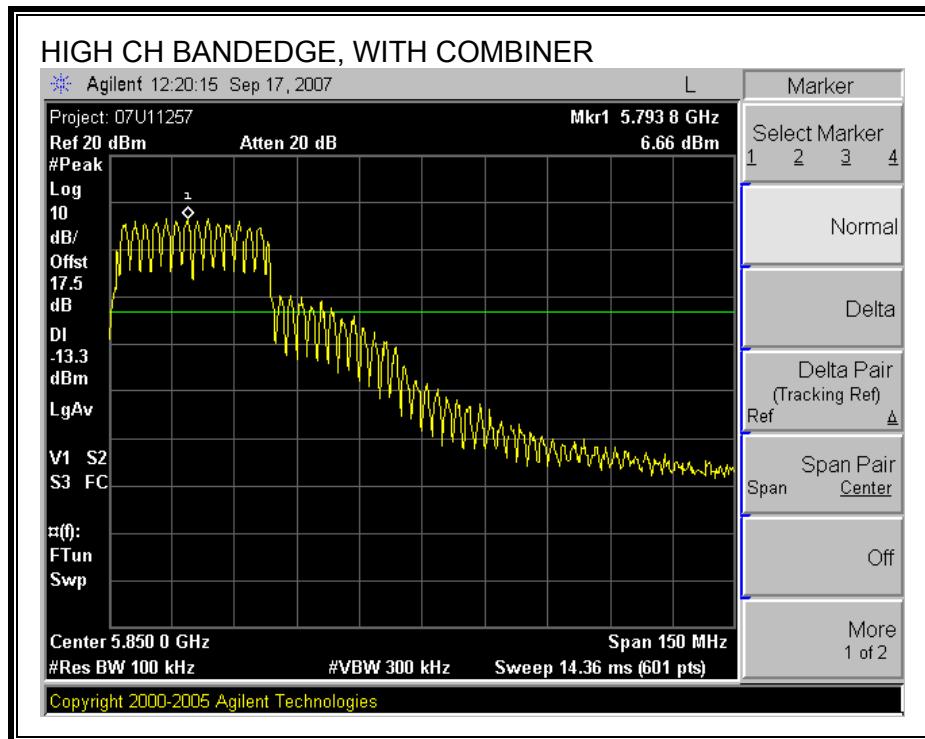
## SPURIOUS EMISSIONS WITH COMBINER

### 802.11n HT40 Mode



## SPURIOUS EMISSIONS WITH COMBINER

### 802.11n HT40 Mode



## 8. RADIATED TEST RESULTS

### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

### TEST PROCEDURE

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

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

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

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

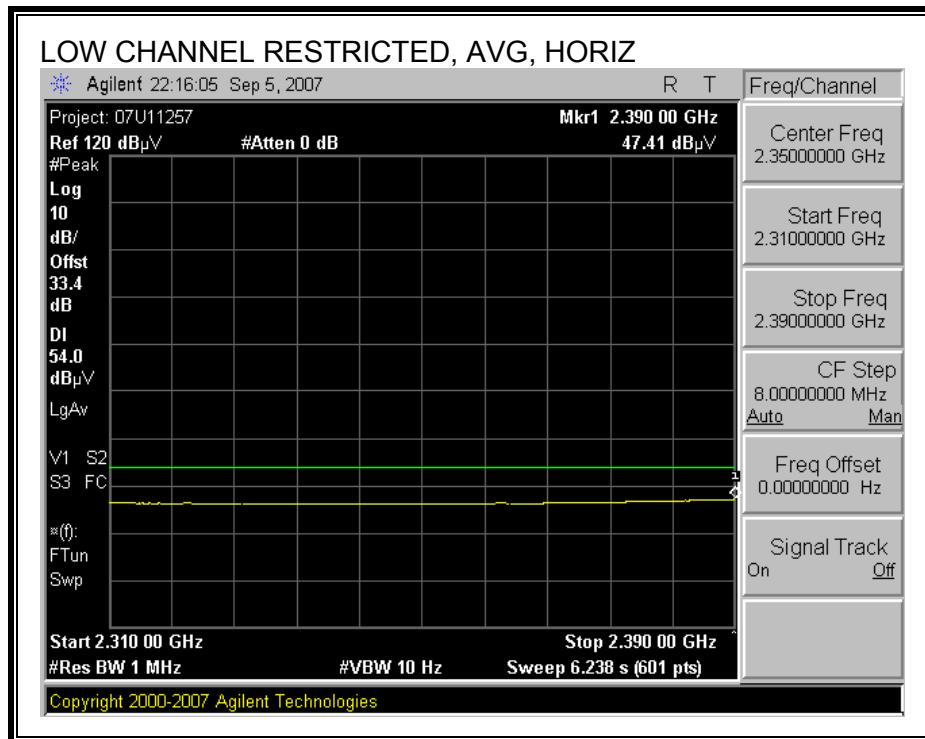
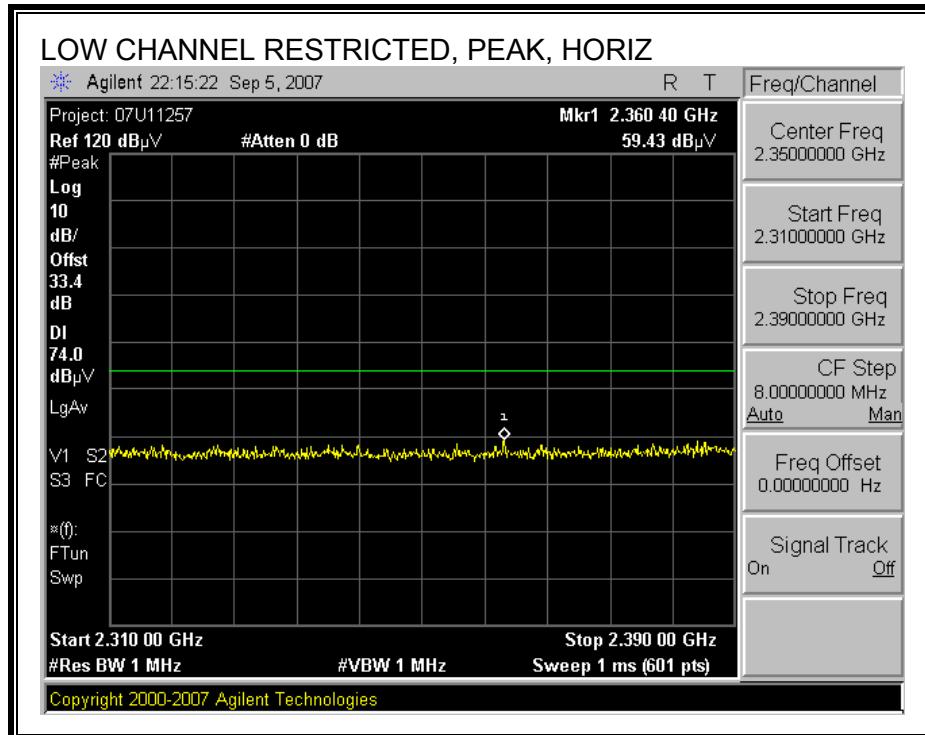
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

For 802.11b and 802.11g legacy mode, only one transmitting chain was activated during the radiated tests. For 802.11 H20 and H40 mode, chain 0 and chain 2 were activated simultaneously.

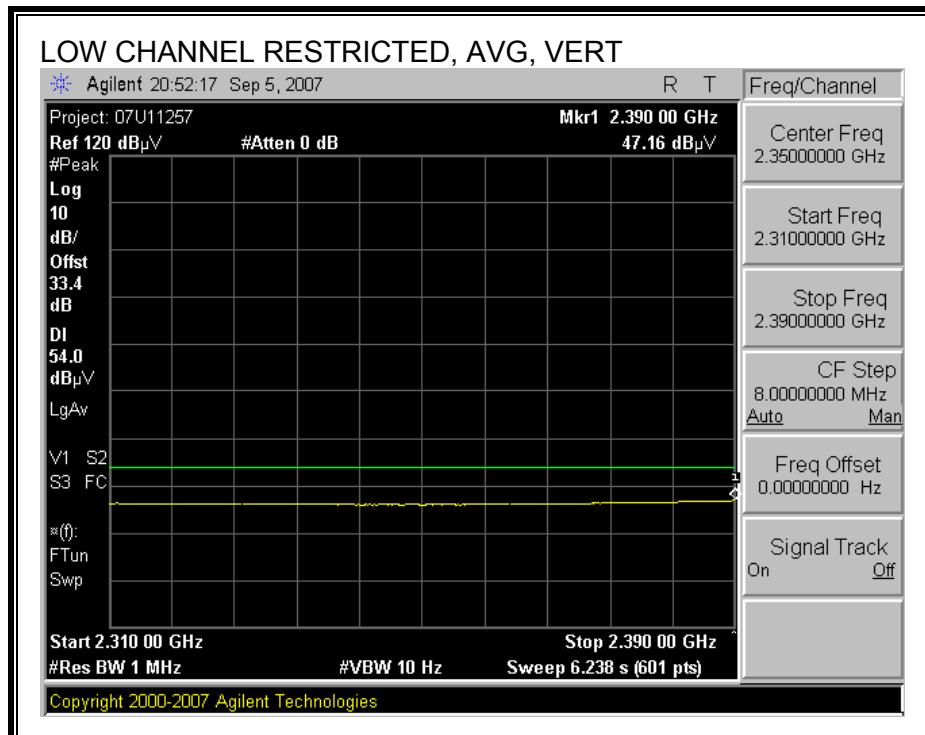
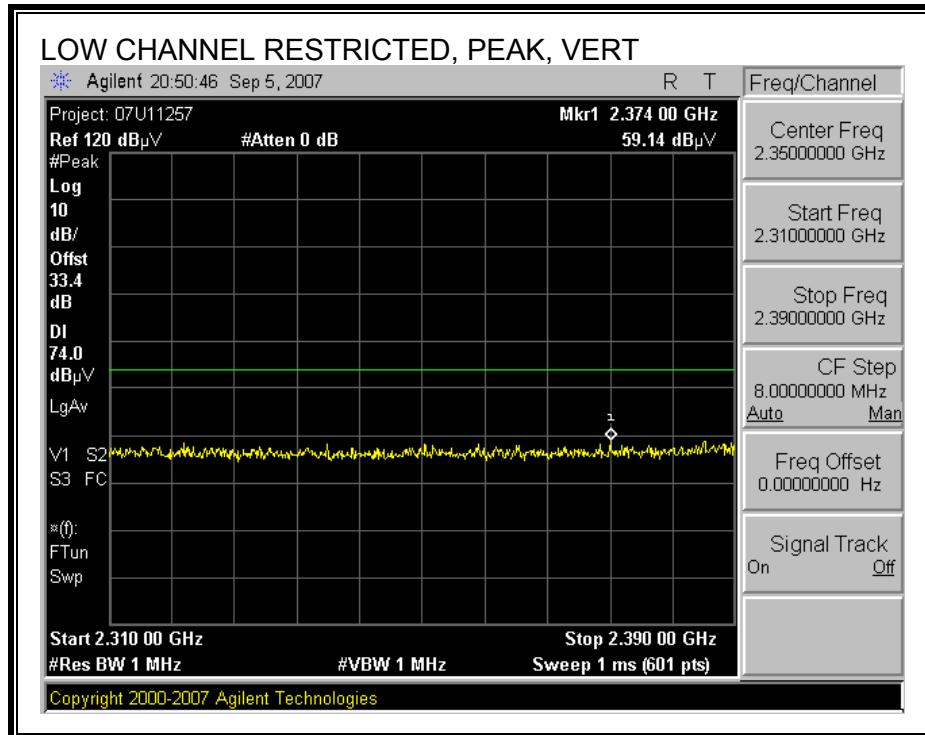
## 8.1. TRANSMITTER ABOVE 1 GHz

### 8.1.1. TRANSMITTER ABOVE 1 GHz FOR 2.4 GHz 802.11b MODE

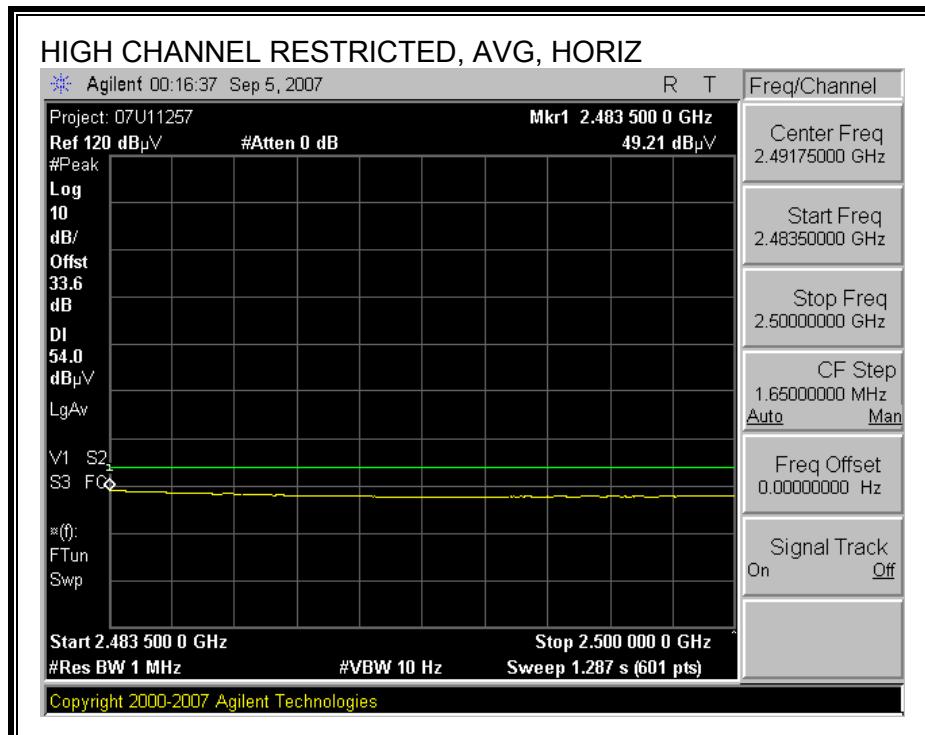
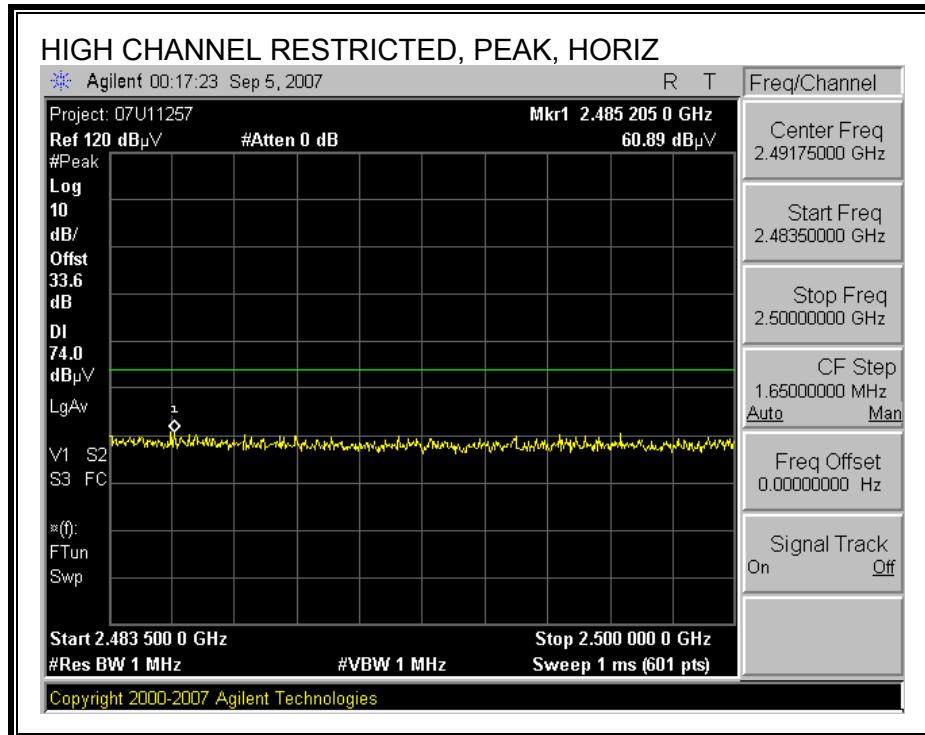
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



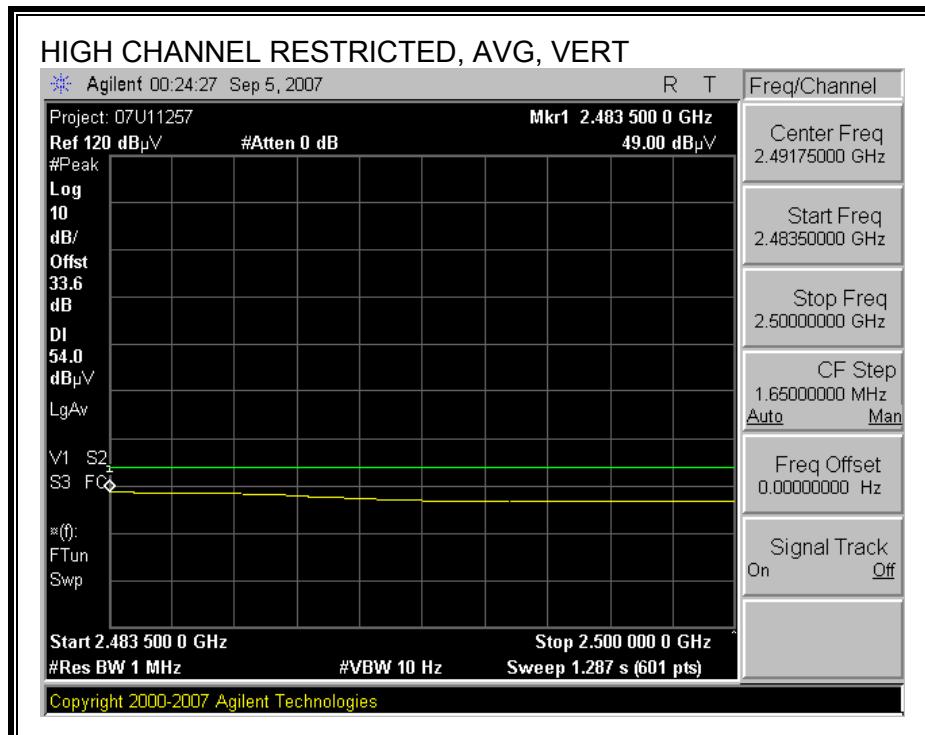
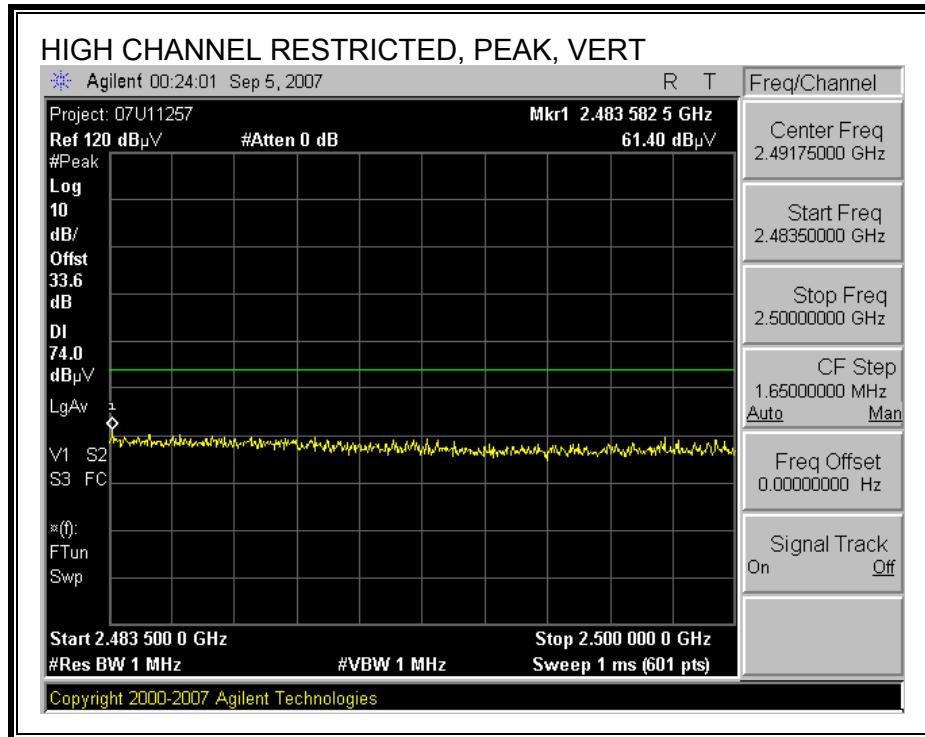
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



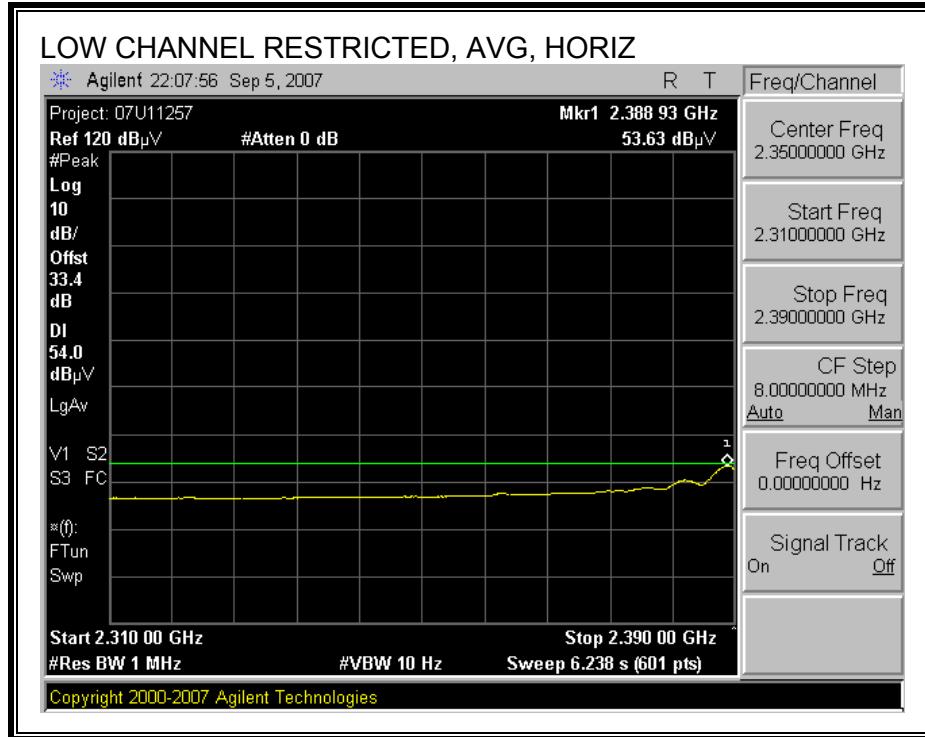
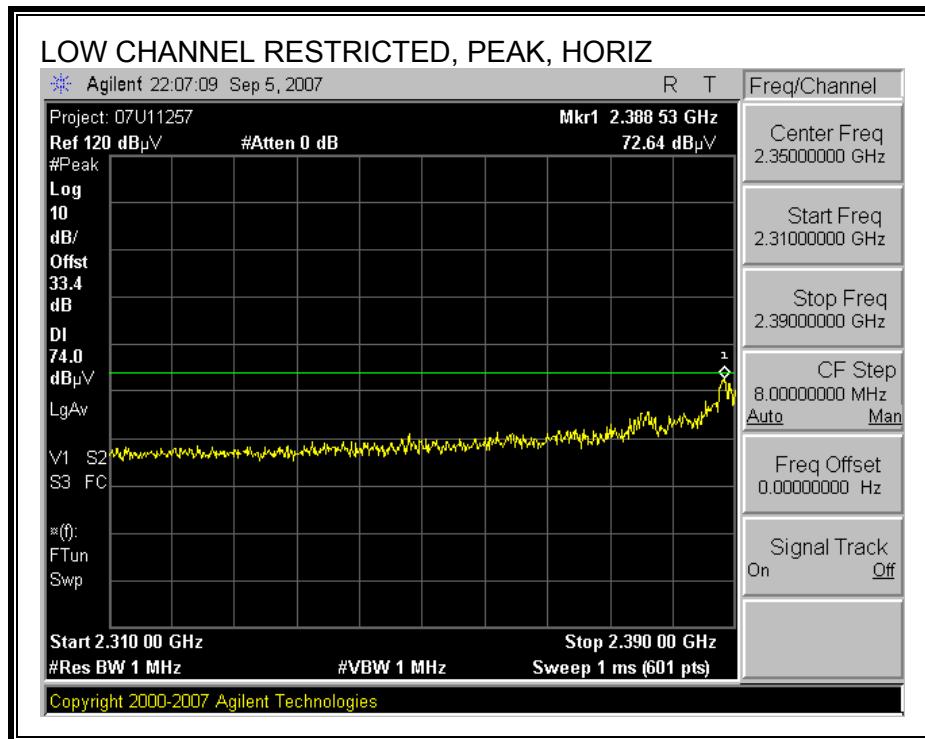
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



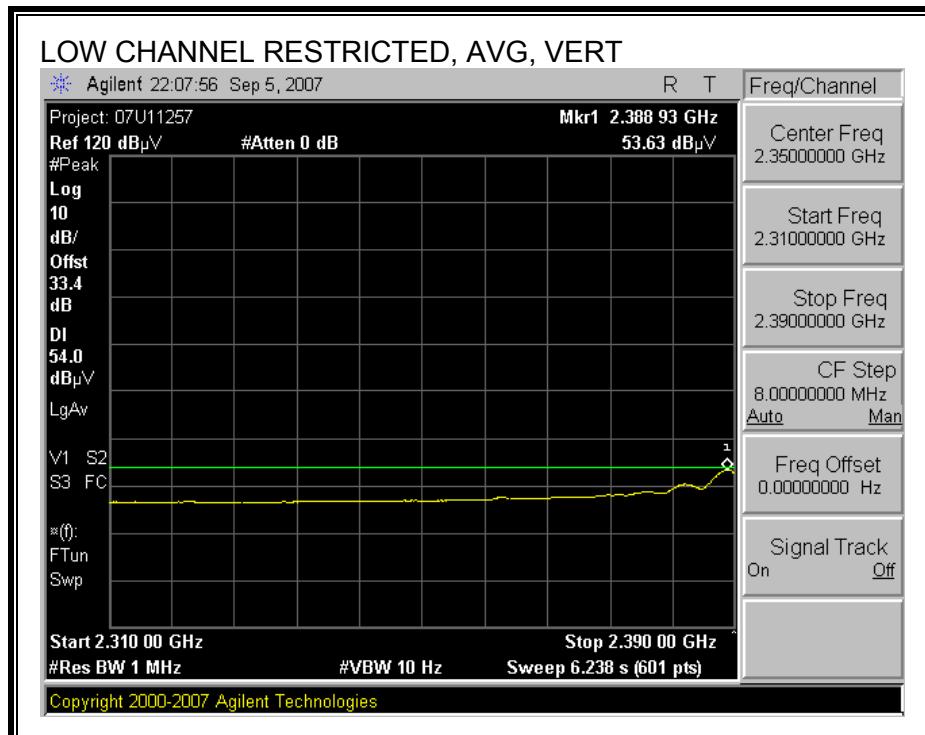
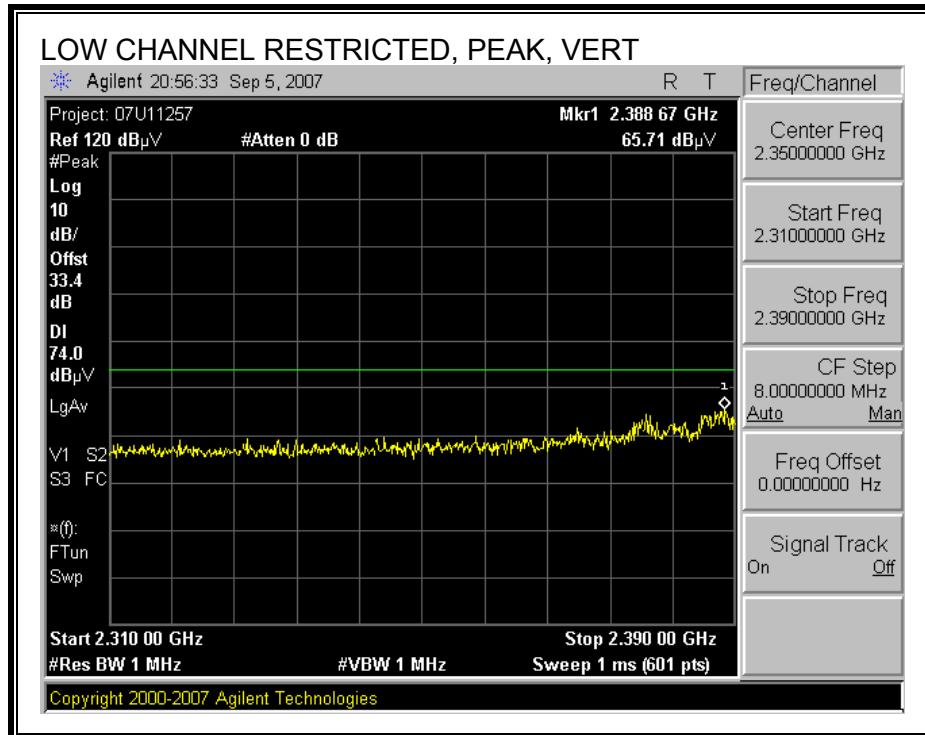
## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																											
<p>Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 5-6, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: b Mode, Tx On</p> <p><u>Test Equipment:</u></p> <table border="1"> <tr> <td>Horn 1-18GHz</td> <td>Pre-amplifier 1-26GHz</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="4">Horn &gt; 18GHz</td> <td>Limit</td> </tr> <tr> <td>T60; S/N: 2238 @3m</td> <td>T144 Miteq 3008A00931</td> <td></td> <td colspan="4"></td> <td>FCC 15.209</td> </tr> <tr> <td colspan="15">Hi Frequency Cables</td> </tr> <tr> <td>2 foot cable</td> <td>3 foot cable</td> <td>12 foot cable</td> <td colspan="2">HPF</td> <td>Reject Filter</td> <td colspan="9">Peak Measurements RBW=VBW=1MHz</td> </tr> <tr> <td>William 177079009</td> <td></td> <td>B-5m Chamber</td> <td colspan="2"></td> <td>R_001</td> <td colspan="9">Average Measurements RBW=1MHz ; VBW=10Hz</td> </tr> <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>Fltr 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> </table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz				Limit	T60; S/N: 2238 @3m	T144 Miteq 3008A00931						FCC 15.209	Hi Frequency Cables															2 foot cable	3 foot cable	12 foot cable	HPF		Reject Filter	Peak Measurements RBW=VBW=1MHz									William 177079009		B-5m Chamber			R_001	Average Measurements RBW=1MHz ; VBW=10Hz									f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
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<b>Low Ch. 2412 MHz, setting: 60-SE</b>																																																																																											
4.824	3.0	52.5	40.8	33.0	8.0	36.5	0.0	0.0	57.0	45.3	74	54	-17.0	-8.7	V																																																																												
7.236	3.0	41.6	29.4	35.4	9.6	36.2	0.0	0.0	50.4	38.2	74	54	-23.6	-15.8	V																																																																												
4.824	3.0	57.0	44.8	33.0	8.0	36.5	0.0	0.0	61.5	49.3	74	54	-12.5	-4.7	H																																																																												
7.236	3.0	39.4	26.0	35.4	9.6	36.2	0.0	0.0	48.2	34.8	74	54	-25.8	-19.2	H																																																																												
<b>Mid Ch. 2437 MHz, setting: 5F-5D</b>																																																																																											
4.874	3.0	46.8	34.7	33.1	8.0	36.5	0.0	0.0	51.4	39.3	74	54	-22.6	-14.7	V																																																																												
7.311	3.0	44.9	33.9	35.5	9.7	36.2	0.0	0.0	53.9	42.8	74	54	-20.1	-11.2	V																																																																												
4.874	3.0	54.1	41.7	33.1	8.0	36.5	0.0	0.0	58.7	46.3	74	54	-15.3	-7.7	H																																																																												
7.311	3.0	44.2	32.7	35.5	9.7	36.2	0.0	0.0	53.2	41.7	74	54	-20.8	-12.3	H																																																																												
<b>High Ch. 2462 MHz, setting: 5F-5E</b>																																																																																											
4.924	3.0	49.6	37.9	33.1	8.1	36.5	0.0	0.0	54.3	42.6	74	54	-19.7	-11.4	V																																																																												
7.386	3.0	47.6	34.2	35.6	9.7	36.2	0.0	0.0	56.6	43.2	74	54	-17.4	-10.8	V																																																																												
9.848	3.0	43.5	37.1	37.3	11.2	37.0	0.0	0.0	54.9	48.5	74	54	-19.1	-5.5	V																																																																												
4.924	3.0	57.6	46.4	33.1	8.1	36.5	0.0	0.0	62.3	51.0	74	54	-11.7	-3.0	H																																																																												
7.386	3.0	45.4	34.0	35.6	9.7	36.2	0.0	0.0	54.4	43.0	74	54	-19.6	-11.0	H																																																																												
9.848	3.0	45.5	39.0	37.3	11.2	37.0	0.0	0.0	56.9	50.4	74	54	-17.1	-3.6	H																																																																												
No more signal found																																																																																											
Rev. 4.12.7																																																																																											
<p>f Measurement Frequency Dist Distance to Antenna Read Analyzer Reading AF Antenna Factor CL Cable Loss</p>					<p>Amp Preamp Gain D Corr Distance Correct to 3 meters Avg Average Field Strength @ 3 m Peak Calculated Peak Field Strength HPF High Pass Filter</p>					<p>Avg Lim Average Field Strength Limit Pk Lim Peak Field Strength Limit Avg Mar Margin vs. Average Limit Pk Mar Margin vs. Peak Limit</p>																																																																																	

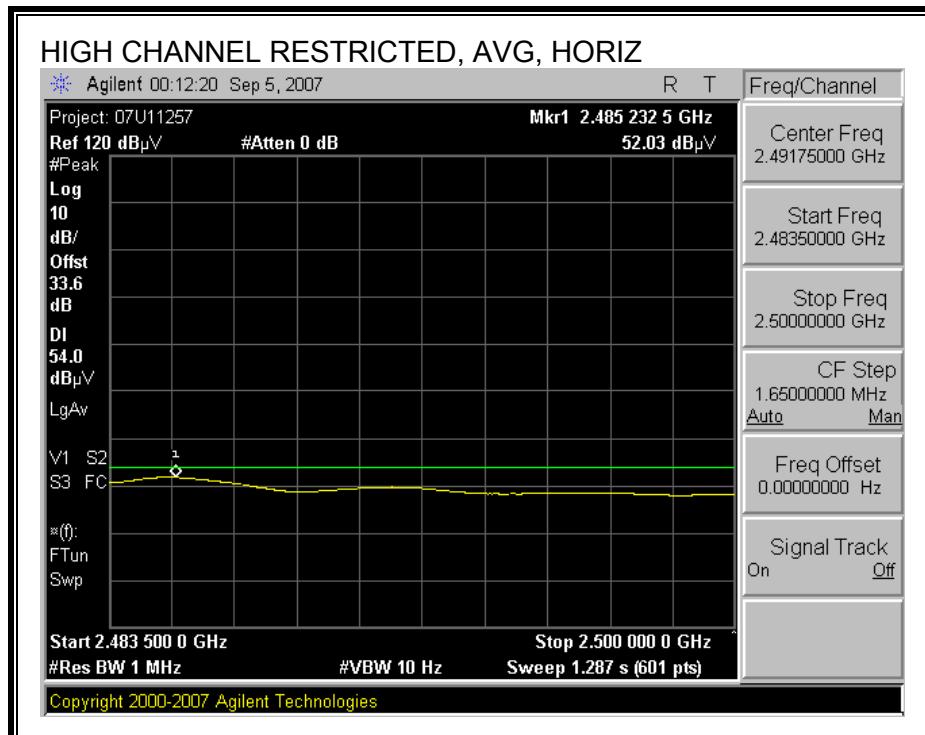
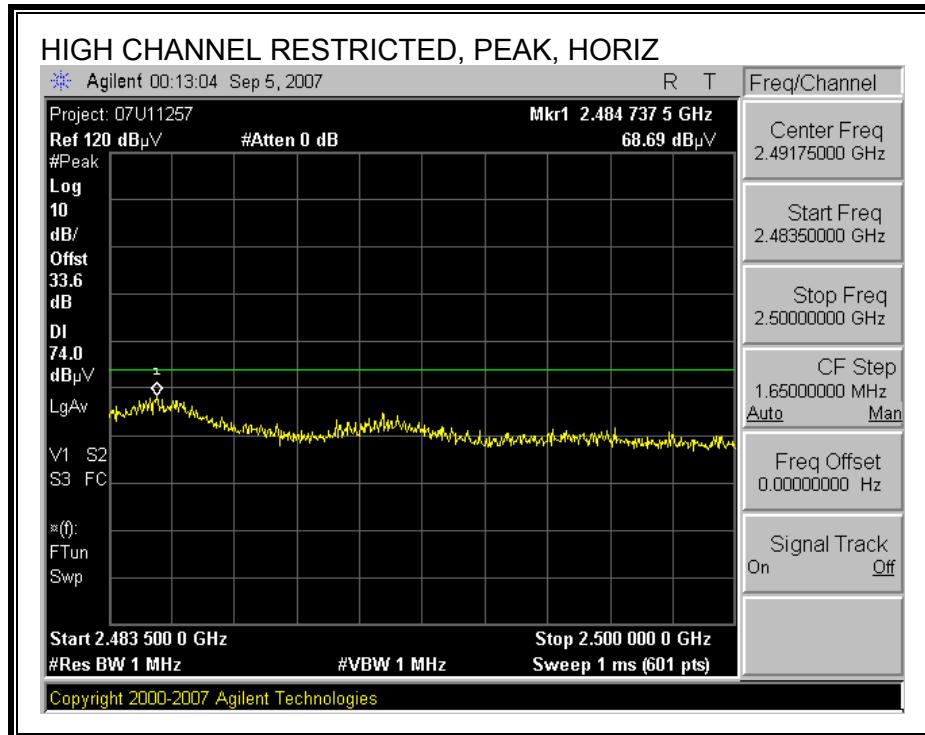
**8.1.2. TRANSMITTER ABOVE 1 GHz FOR 2.4 GHz 802.11g MODE  
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



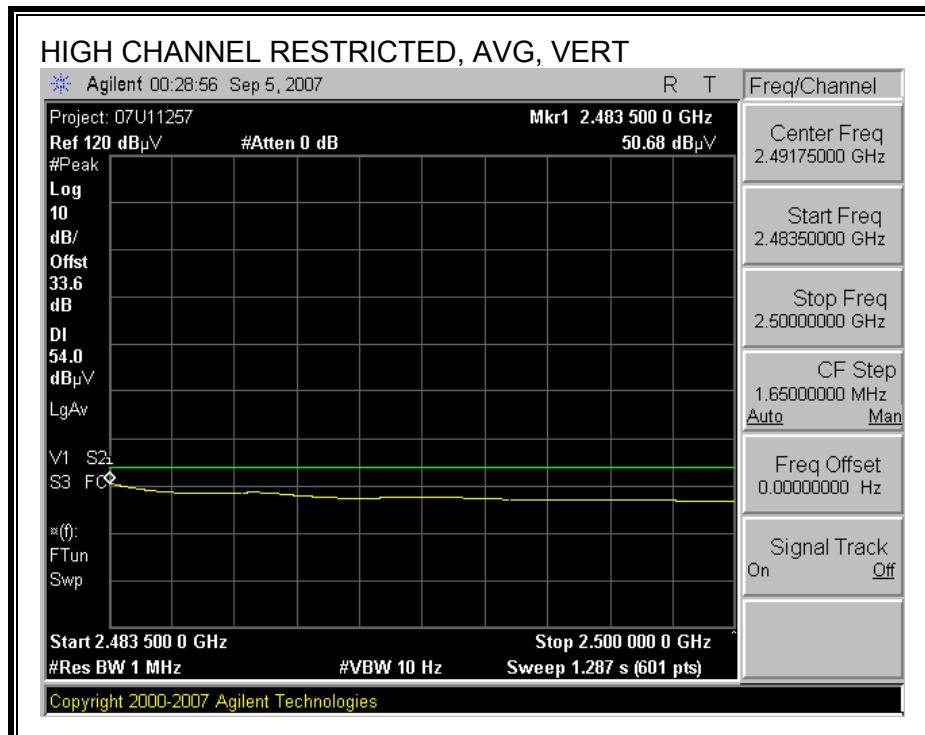
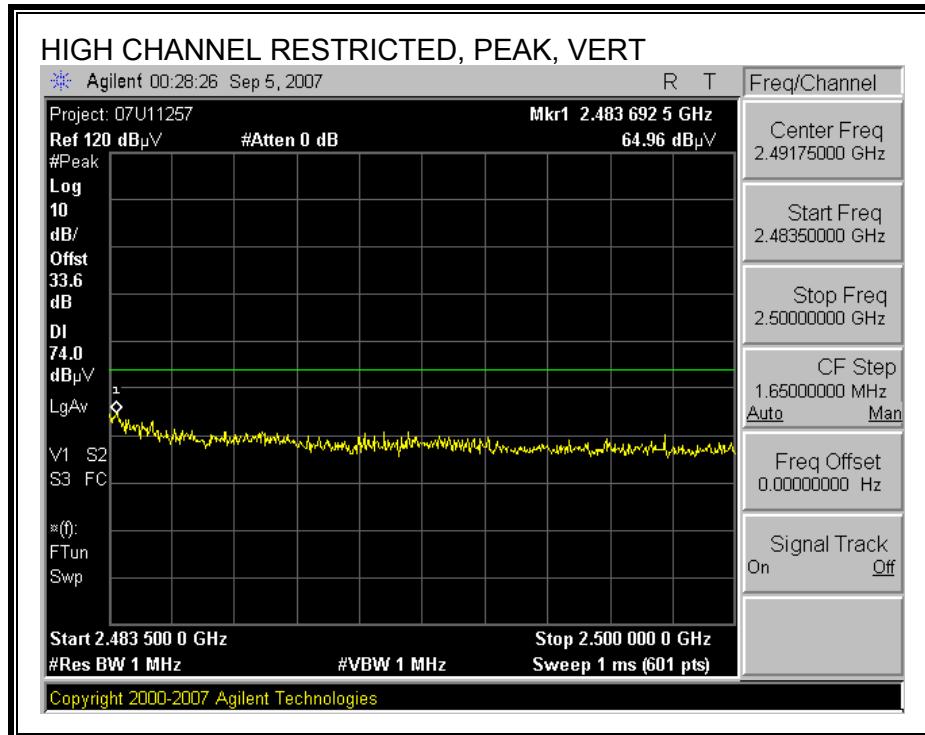
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



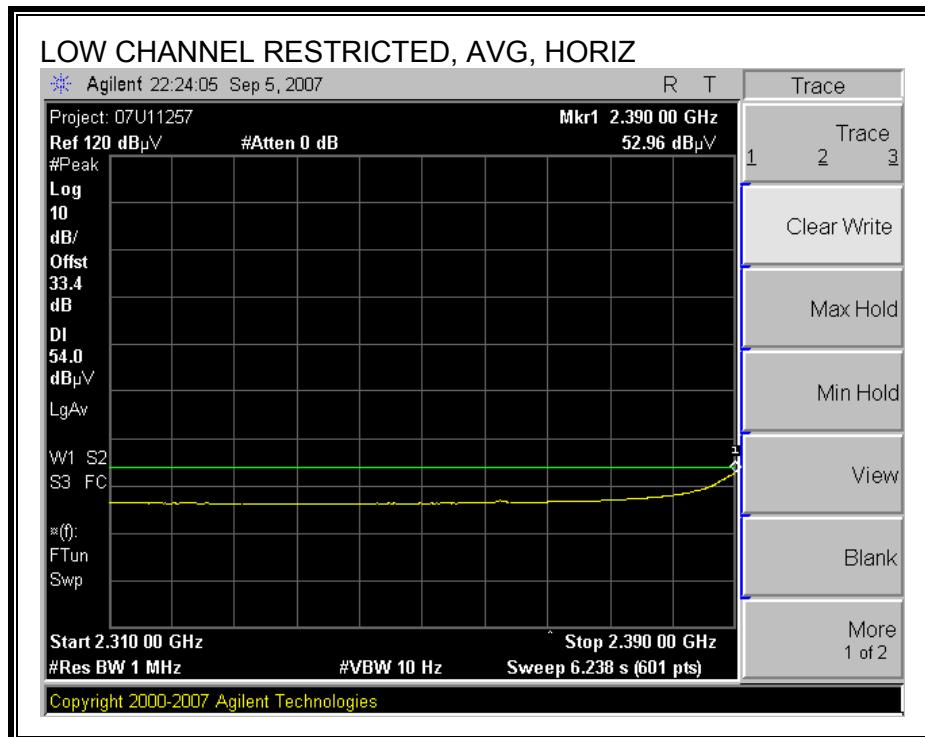
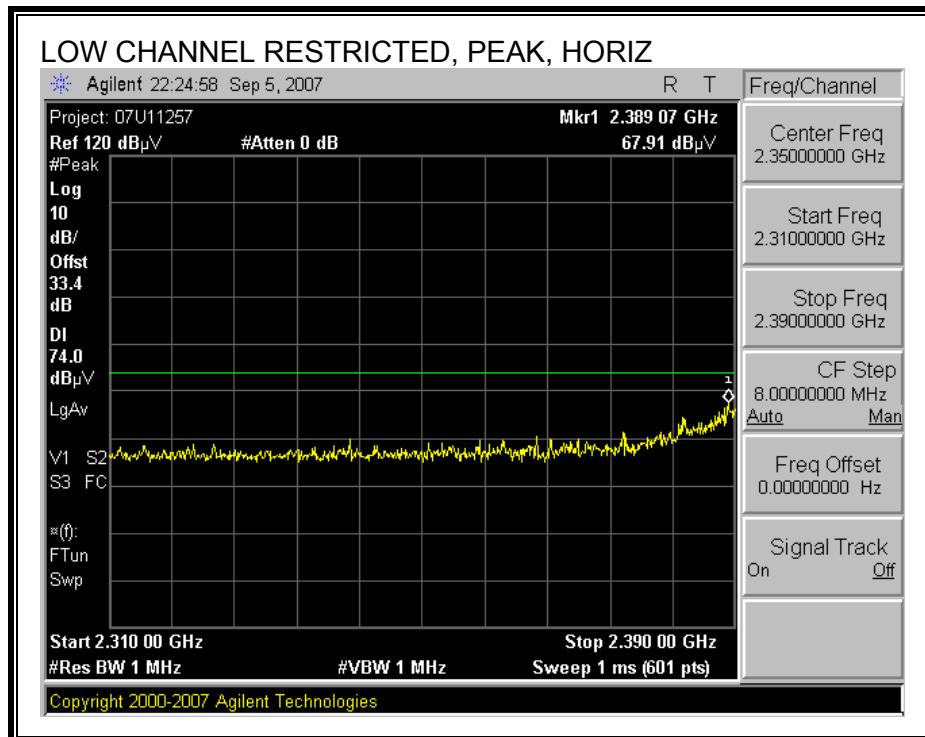
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



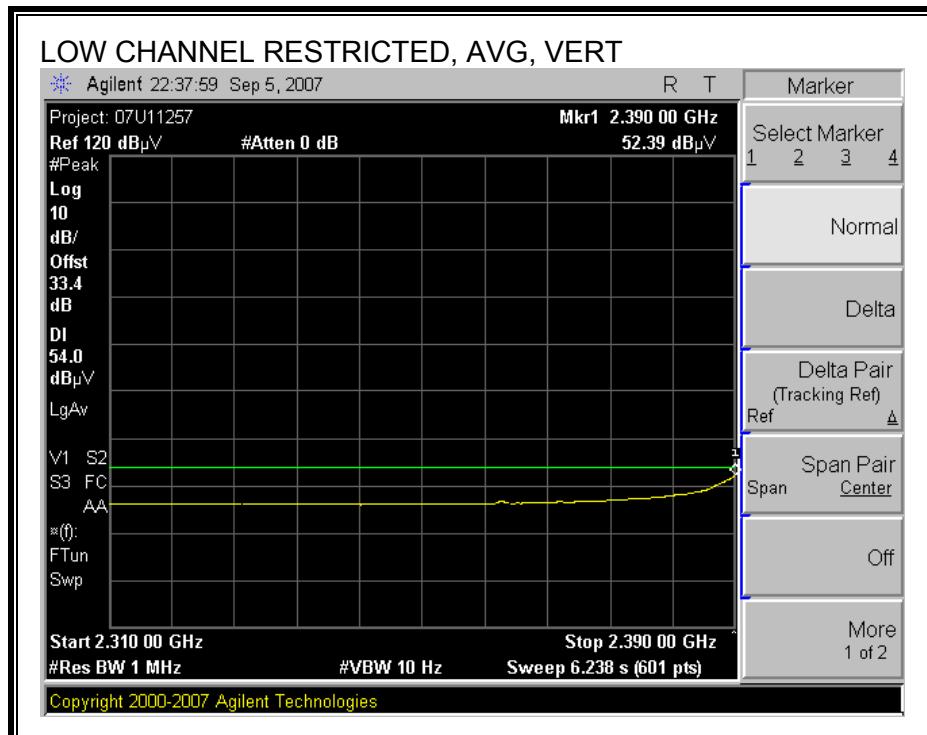
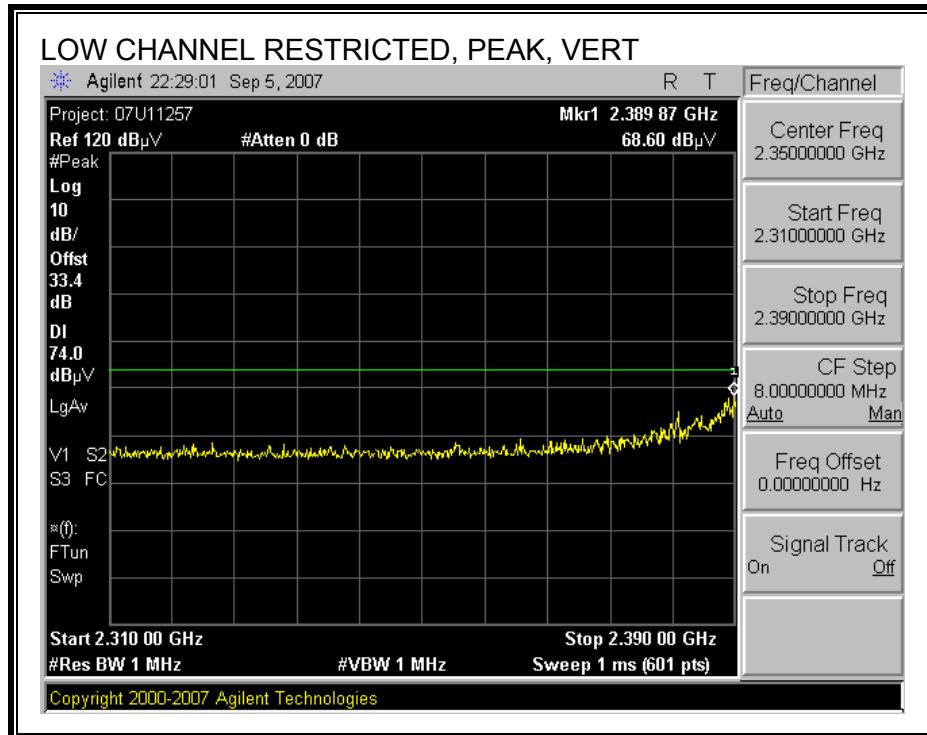
## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																
Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 6, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: g Mode, Tx On																
<b>Test Equipment:</b>																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T144 Miteq 3008A00931									FCC 15.209				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz	
William 177079009						B-5m Chamber						R_001			Average Measurements RBW=1MHz ; VBW=10Hz	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
Low Ch. 2412 MHz, setting: 66-65																
4.824	3.0	50.3	39.4	33.0	8.0	-36.5	0.0	0.0	54.8	43.9	74	54	-19.2	-10.1	V	
7.236	3.0	48.2	36.4	35.4	9.6	-36.2	0.0	0.0	57.0	45.2	74	54	-17.0	-8.8	V	
4.824	3.0	57.3	46.4	33.0	8.0	-36.5	0.0	0.0	61.8	50.9	74	54	-12.2	-3.1	H	
7.236	3.0	46.8	33.8	35.4	9.6	-36.2	0.0	0.0	55.6	42.6	74	54	-18.4	-11.4	H	
Mid Ch. 2437 MHz, setting: 66-65																
4.874	3.0	48.1	36.7	33.1	8.0	-36.5	0.0	0.0	52.7	41.3	74	54	-21.3	-12.7	V	
7.311	3.0	48.9	35.8	35.5	9.7	-36.2	0.0	0.0	57.9	44.7	74	54	-16.1	-9.3	V	
4.874	3.0	52.5	38.7	33.1	8.0	-36.5	0.0	0.0	57.1	43.3	74	54	-16.9	-10.7	H	
7.311	3.0	45.2	32.4	35.5	9.7	-36.2	0.0	0.0	54.2	41.3	74	54	-19.8	-12.7	H	
High Ch. 2462 MHz, setting: 60-5F																
4.924	3.0	48.1	34.9	33.1	8.1	-36.5	0.0	0.0	52.8	39.6	74	54	-21.2	-14.4	V	
7.386	3.0	46.0	32.1	35.6	9.7	-36.2	0.0	0.0	55.0	41.2	74	54	-19.0	-12.8	V	
4.924	3.0	54.6	41.4	33.1	8.1	-36.5	0.0	0.0	59.3	46.0	74	54	-14.7	-8.0	H	
7.386	3.0	43.4	29.6	35.6	9.7	-36.2	0.0	0.0	52.4	38.6	74	54	-21.6	-15.4	H	
No more signal found																
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											

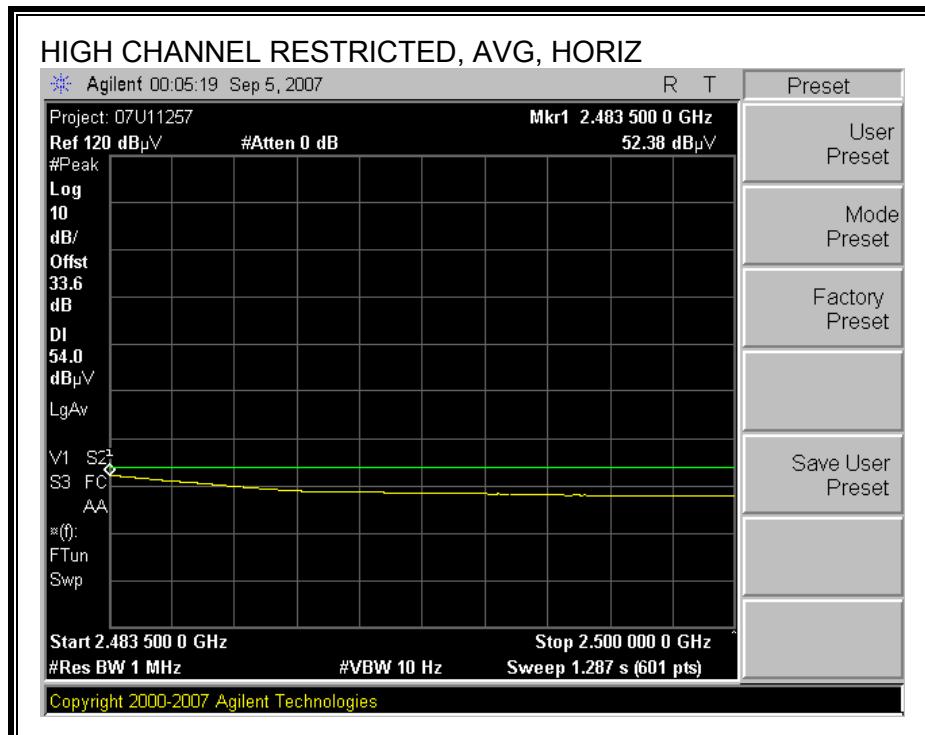
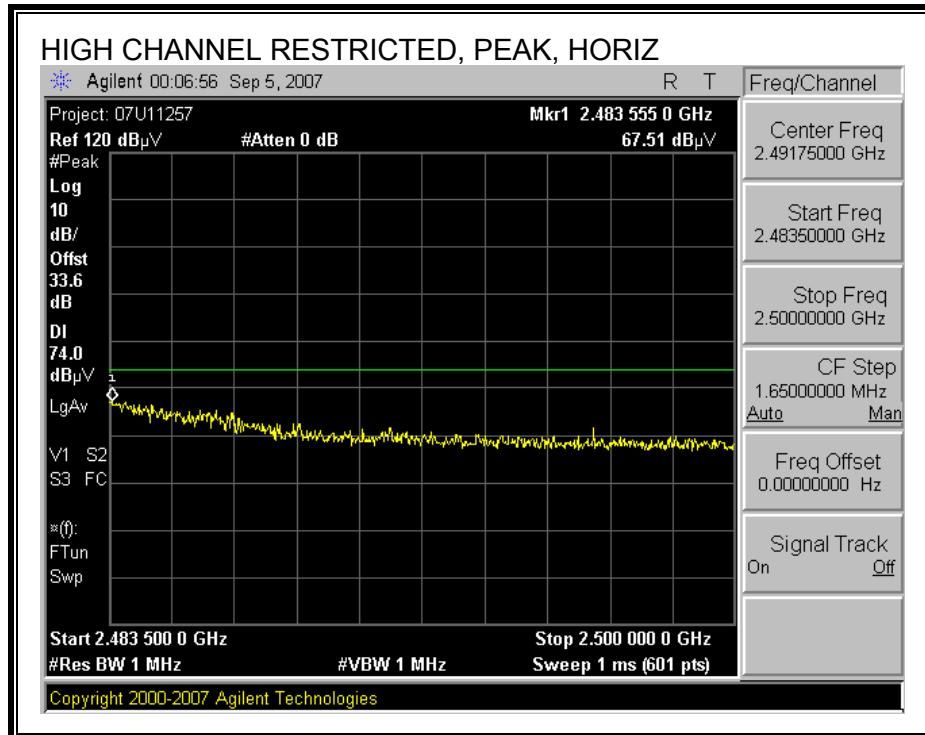
**8.1.3. TRANSMITTER ABOVE 1 GHz FOR 2.4 GHz 802.11g H20 MODE**  
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



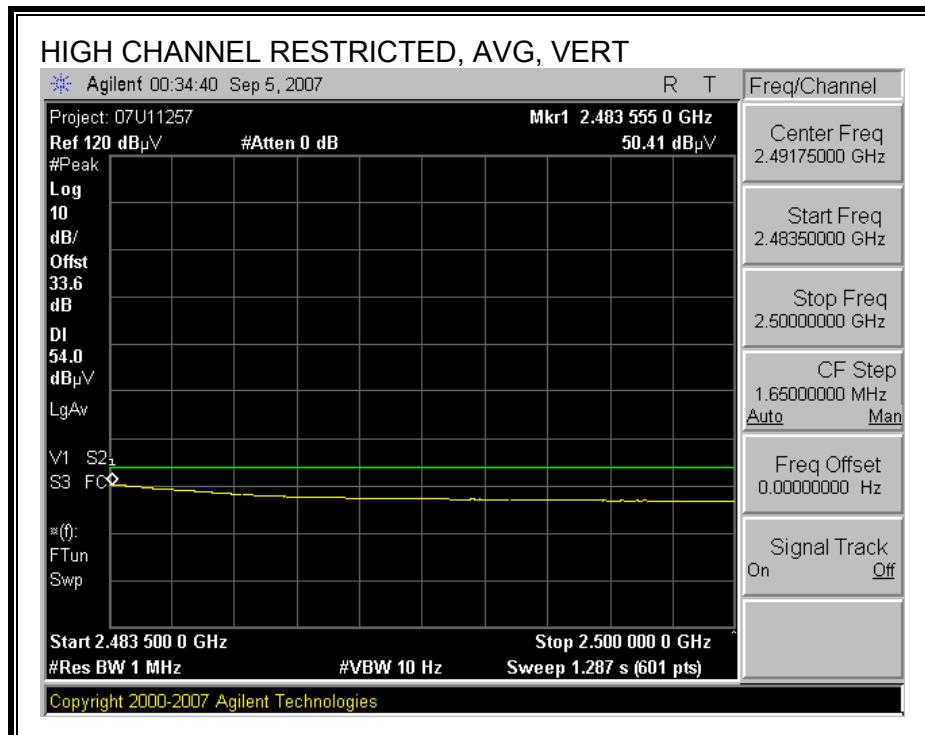
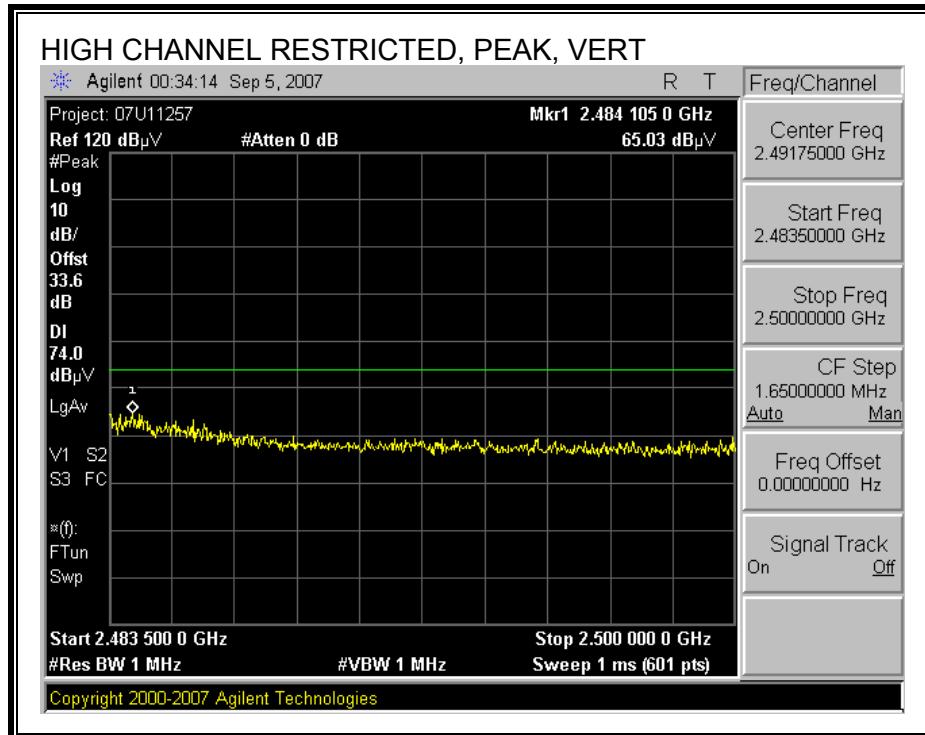
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



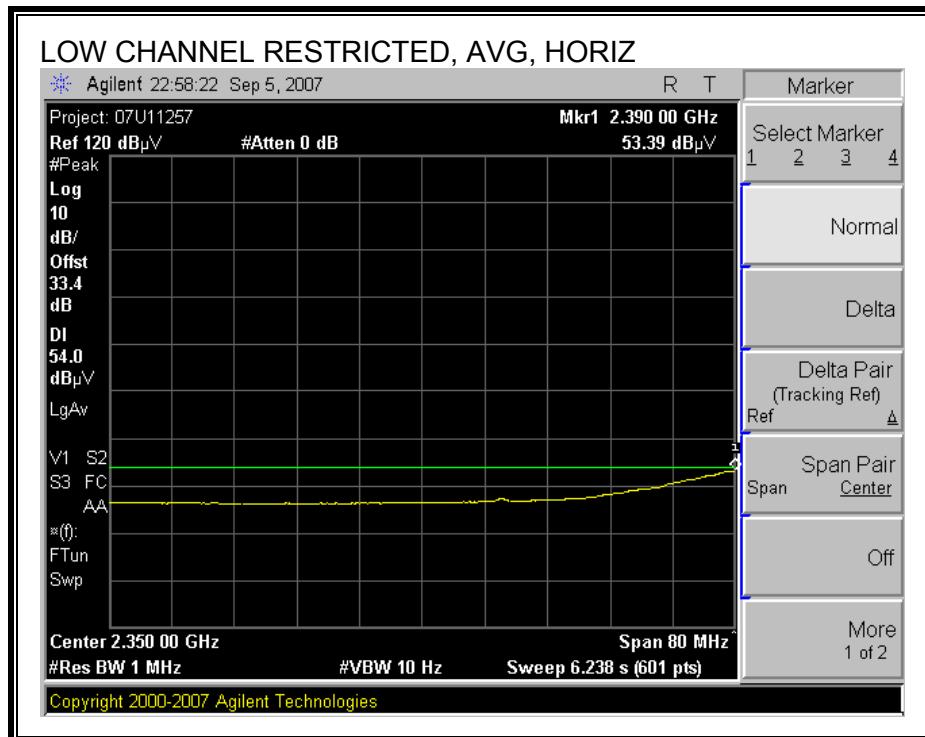
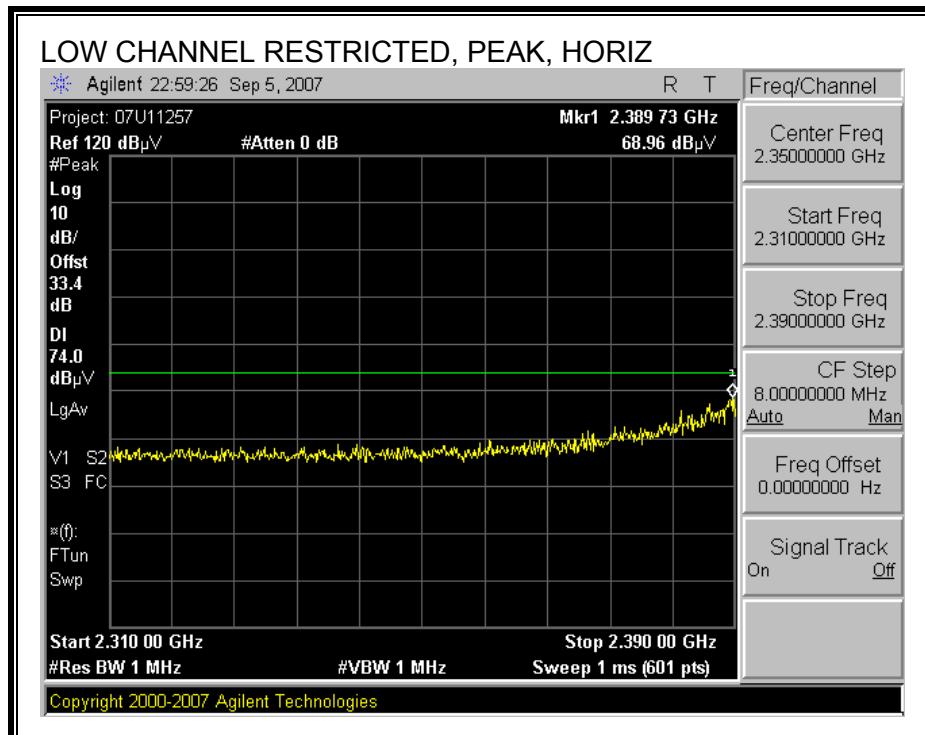
**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



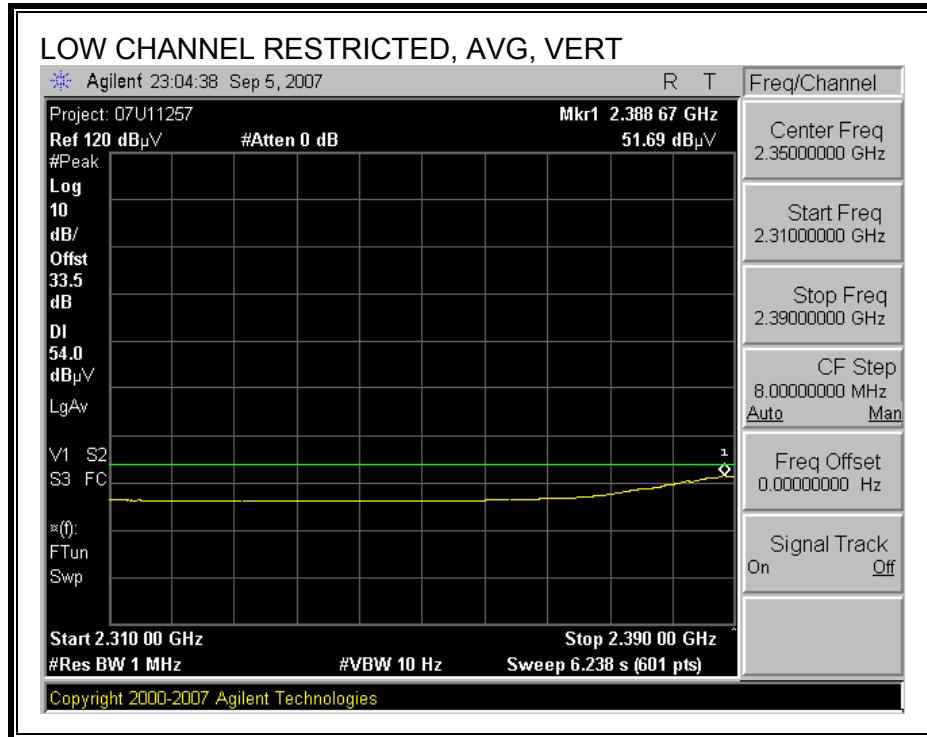
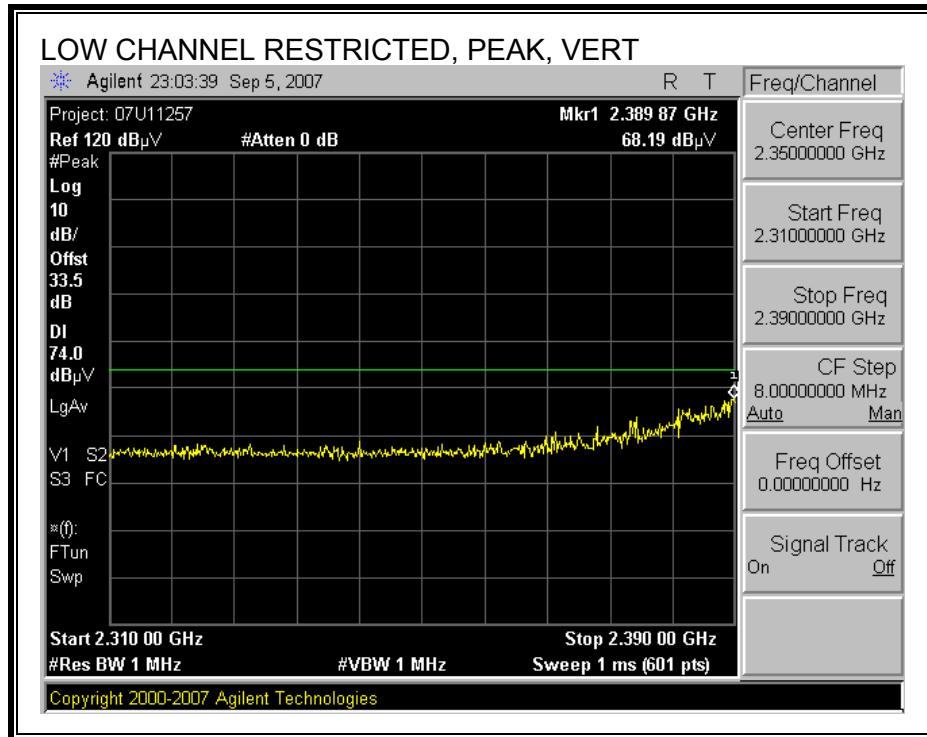
## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																
Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 6, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: HT20 Mode 2.4GHz Band, Tx On																
<b>Test Equipment:</b>																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T144 Miteq 3008A00931									FCC 15.209				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz	
William 177079009						B-5m Chamber						R_001			Average Measurements RBW=1MHz ; VBW=10Hz	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
Low Ch. 2412 MHz, setting: 64-62																
4.824	3.0	49.2	38.1	33.0	8.0	-36.5	0.0	0.0	53.7	42.6	74	54	-20.3	-11.4	V	
7.236	3.0	48.6	34.9	35.4	9.6	-36.2	0.0	0.0	57.4	43.7	74	54	-16.6	-10.3	V	
4.824	3.0	55.0	44.4	33.0	8.0	-36.5	0.0	0.0	59.5	48.9	74	54	-14.5	-5.1	H	
7.236	3.0	43.7	30.2	35.4	9.6	-36.2	0.0	0.0	52.5	39.0	74	54	-21.5	-15.0	H	
Mid Ch. 2437 MHz, setting: 64-63																
4.874	3.0	45.3	33.8	33.1	8.0	-36.5	0.0	0.0	49.9	38.3	74	54	-24.1	-15.7	V	
7.311	3.0	45.1	32.1	35.5	9.7	-36.2	0.0	0.0	54.0	41.0	74	54	-20.0	-13.0	V	
4.874	3.0	50.1	39.1	33.1	8.0	-36.5	0.0	0.0	54.7	43.7	74	54	-19.3	-10.3	H	
7.311	3.0	40.7	28.0	35.5	9.7	-36.2	0.0	0.0	49.6	37.0	74	54	-24.4	-17.0	H	
High Ch. 2462 MHz, setting: 5E-5D																
4.924	3.0	46.2	33.0	33.1	8.1	-36.5	0.0	0.0	50.9	37.6	74	54	-23.1	-16.4	V	
7.386	3.0	45.5	32.4	35.6	9.7	-36.2	0.0	0.0	54.5	41.4	74	54	-19.5	-12.6	V	
4.924	3.0	52.5	38.3	33.1	8.1	-36.5	0.0	0.0	57.2	43.0	74	54	-16.8	-11.0	H	
7.386	3.0	39.5	26.2	35.6	9.7	-36.2	0.0	0.0	48.6	35.2	74	54	-25.4	-18.8	H	
No more signal found																
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											

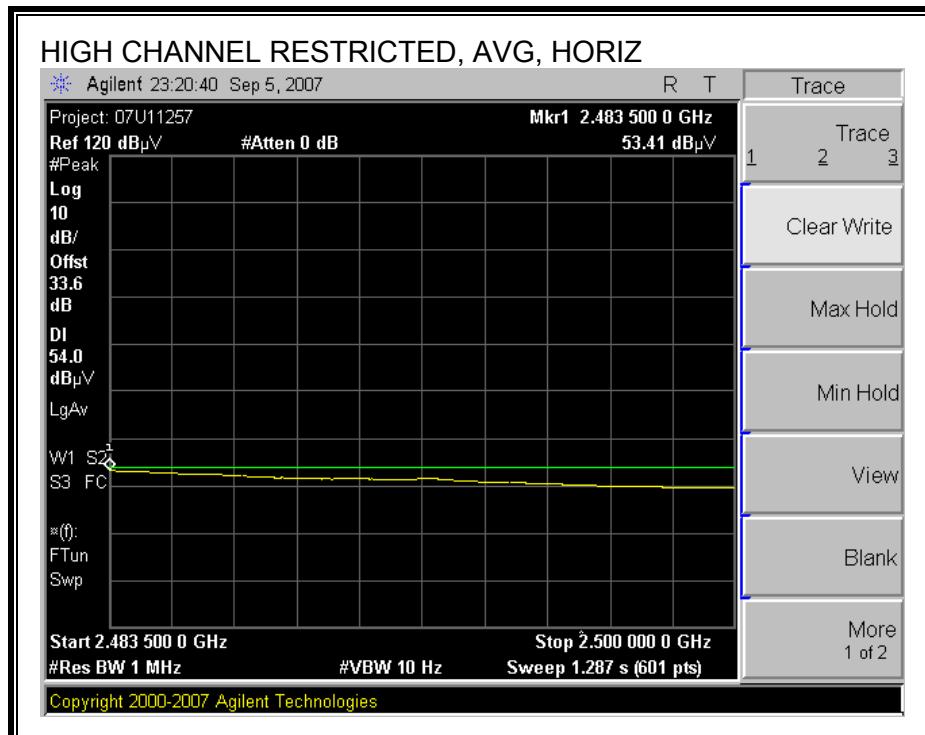
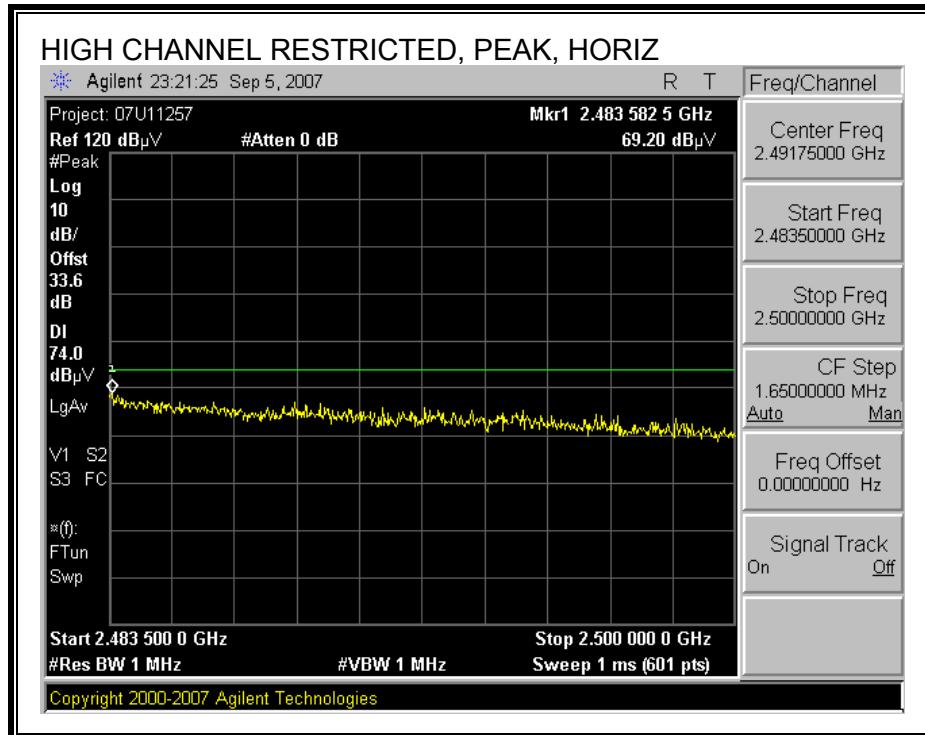
**8.1.4. TRANSMITTER ABOVE 1 GHz FOR 2.4 GHz 802.11g H40 MODE**  
**RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)**



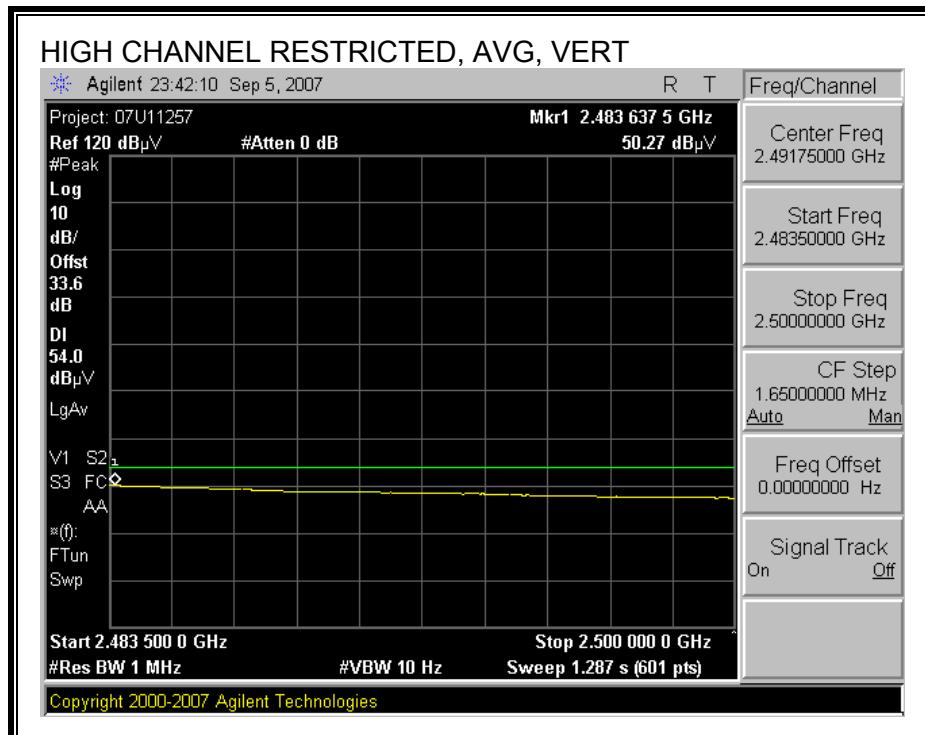
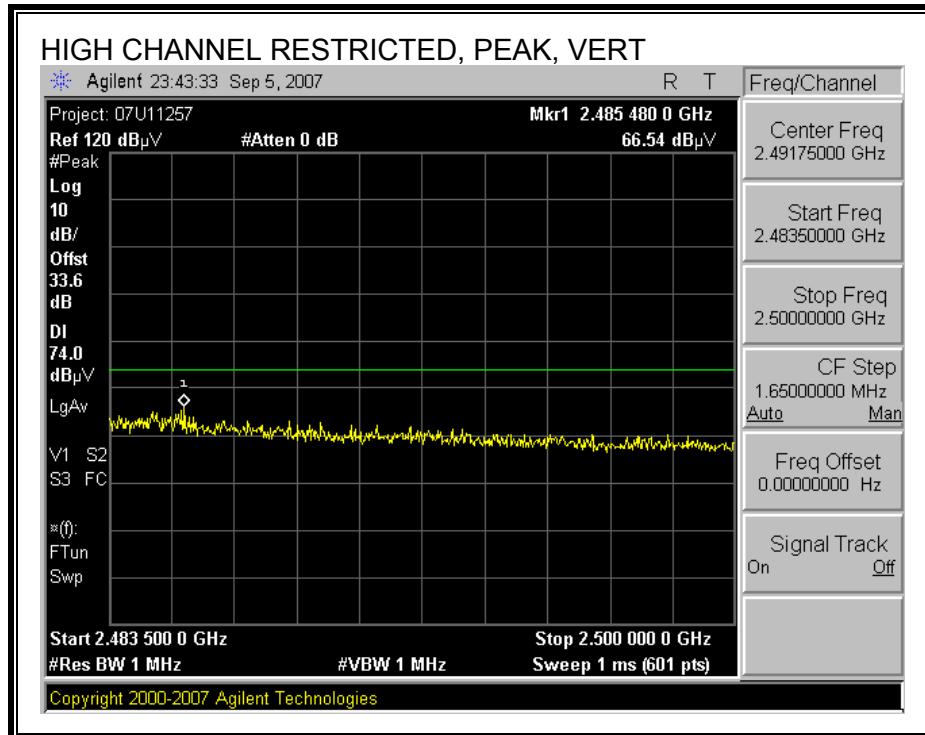
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



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



## HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																
<b>Company:</b> Apple Computer Inc. <b>Project #:</b> 07U11257 <b>Date:</b> Sept. 6, 2007 <b>Test Engineer:</b> William Zhuang <b>Configuration:</b> EUT with support equipment <b>Mode:</b> HT40 Mode 2.4GHz Band, Tx On																
<b>Test Equipment:</b>																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T144 Miteq 3008A00931									FCC 15.209				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			<b>Peak Measurements</b> RBW=VBW=1MHz	
William 177079009						B-5m Chamber						R_001			<b>Average Measurements</b> RBW=1MHz ; VBW=10Hz	
<b>f</b> GHz	<b>Dist</b> (m)	<b>Read Pk</b> dBuV	<b>Read Avg.</b> dBuV	<b>AF</b> dB/m	<b>CL</b> dB	<b>Amp</b> dB	<b>D Corr</b> dB	<b>Fltr</b> dB	<b>Peak</b> dBuV/m	<b>Avg</b> dBuV/m	<b>Pk Lim</b> dBuV/m	<b>Avg Lim</b> dBuV/m	<b>Pk Mar</b> dB	<b>Avg Mar</b> dB	<b>Notes</b> (V/H)	
<b>Low Ch. 2422 MHz, setting: 62-61</b>																
4.844	3.0	43.2	30.9	33.0	8.0	-36.5	0.0	0.0	47.8	35.5	74	54	-26.2	-18.5	V	
7.266	3.0	40.9	27.0	35.4	9.6	-36.2	0.0	0.0	49.8	35.8	74	54	-24.2	-18.2	V	
4.844	3.0	49.9	37.5	33.0	8.0	-36.5	0.0	0.0	54.5	42.0	74	54	-19.5	-12.0	H	
7.266	3.0	38.7	25.9	35.4	9.6	-36.2	0.0	0.0	47.6	34.7	74	54	-26.4	-19.3	H	
<b>Mid Ch. 2437 MHz, setting: 67-66</b>																
4.874	3.0	44.1	31.5	33.1	8.0	-36.5	0.0	0.0	48.6	36.1	74	54	-25.4	-17.9	V	
7.311	3.0	44.1	32.1	35.5	9.7	-36.2	0.0	0.0	53.0	41.1	74	54	-21.0	-12.9	V	
4.874	3.0	48.5	36.9	33.1	8.0	-36.5	0.0	0.0	53.1	41.5	74	54	-20.9	-12.5	H	
7.311	3.0	41.6	29.1	35.5	9.7	-36.2	0.0	0.0	50.5	38.0	74	54	-23.5	-16.0	H	
<b>High Ch. 2452 MHz, setting: 5E-5D</b>																
4.904	3.0	40.9	28.3	33.1	8.0	-36.5	0.0	0.0	45.6	33.0	74	54	-28.4	-21.0	V	
7.356	3.0	39.3	25.1	35.5	9.7	-36.2	0.0	0.0	48.3	34.1	74	54	-25.7	-19.9	V	
4.904	3.0	45.0	31.5	33.1	8.0	-36.5	0.0	0.0	49.6	36.1	74	54	-24.4	-17.9	H	
7.356	3.0	38.5	25.1	35.5	9.7	-36.2	0.0	0.0	47.5	34.1	74	54	-26.5	-19.9	H	
No more signal found																
Rev. 4.12.7																
<b>f</b> Measurement Frequency <b>Dist</b> Distance to Antenna <b>Read</b> Analyzer Reading <b>AF</b> Antenna Factor <b>CL</b> Cable Loss					<b>Amp</b> Preamp Gain <b>D Corr</b> Distance Correct to 3 meters <b>Avg</b> Average Field Strength @ 3 m <b>Peak</b> Calculated Peak Field Strength <b>HPF</b> High Pass Filter					<b>Avg Lim</b> Average Field Strength Limit <b>Pk Lim</b> Peak Field Strength Limit <b>Avg Mar</b> Margin vs. Average Limit <b>Pk Mar</b> Margin vs. Peak Limit						

## 8.1.5. TRANSMITTER ABOVE 1 GHz FOR 5.8GHz 802.11a MODE

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																								
<p>Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 5.8 GHz Band a Mode, Tx On</p> <p><b>Test Equipment:</b></p> <table border="1"> <tr> <td>Horn 1-18GHz</td> <td>Pre-amplifier 1-26GHz</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="3">Horn &gt; 18GHz</td> <td>Limit</td> </tr> <tr> <td>T60; S/N: 2238 @3m</td> <td>T34 HP 8449B</td> <td></td> <td colspan="3"></td> <td>FCC 15.209</td> </tr> </table> <p>Hi Frequency Cables</p> <table border="1"> <tr> <td>2 foot cable</td> <td>3 foot cable</td> <td>12 foot cable</td> <td>HPF</td> <td>Reject Filter</td> <td>Peak Measurements RBW=VBW=1MHz</td> </tr> <tr> <td>William 177079009</td> <td></td> <td>B-5m Chamber</td> <td>HPF_7.6GHz</td> <td></td> <td>Average Measurements RBW=1MHz ; VBW=10Hz</td> </tr> </table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz			Limit	T60; S/N: 2238 @3m	T34 HP 8449B					FCC 15.209	2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz	William 177079009		B-5m Chamber	HPF_7.6GHz		Average Measurements RBW=1MHz ; VBW=10Hz
Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz			Limit																																		
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f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)																									
<b>Low Ch. 5745 MHz, setting: 67-66</b>																																								
11.490	3.0	47.6	34.9	37.4	12.8	-32.5	0.0	0.7	66.0	53.3	74	54	-8.0	-0.7	V																									
17.235	3.0	39.5	26.5	41.7	14.8	-32.0	0.0	0.6	64.5	51.6	74	54	-9.5	-2.4	V																									
11.490	3.0	43.4	30.0	37.4	12.8	-32.5	0.0	0.7	61.8	48.4	74	54	-12.2	-5.6	H																									
17.235	3.0	36.4	22.3	41.7	14.8	-32.0	0.0	0.6	61.5	47.4	74	54	-12.5	-6.6	H																									
<b>Mid Ch. 5785 MHz, setting: 67-65</b>																																								
11.570	3.0	46.3	34.3	37.4	12.9	-32.5	0.0	0.7	64.8	52.7	74	54	-9.2	-1.3	V																									
17.355	3.0	36.4	23.2	42.1	14.8	-32.1	0.0	0.6	62.0	48.7	74	54	-12.0	-5.3	V																									
11.570	3.0	40.3	26.9	37.4	12.9	-32.5	0.0	0.7	58.8	45.4	74	54	-15.2	-8.6	H																									
17.355	3.0	36.3	22.3	42.1	14.8	-32.1	0.0	0.6	61.8	47.8	74	54	-12.2	-6.2	H																									
<b>High Ch. 5825 MHz, setting: 67-66</b>																																								
11.650	3.0	44.7	31.1	37.4	13.0	-32.5	0.0	0.7	63.3	49.7	74	54	-10.7	-4.3	V																									
17.475	3.0	36.7	22.3	42.6	14.9	-32.1	0.0	0.6	62.7	48.2	74	54	-11.3	-5.8	V																									
11.650	3.0	40.5	27.8	37.4	13.0	-32.5	0.0	0.7	59.1	46.3	74	54	-14.9	-7.7	H																									
17.475	3.0	36.3	22.2	42.6	14.9	-32.1	0.0	0.6	62.2	48.1	74	54	-11.8	-5.9	H																									
No more signal found																																								
Rev. 4.12.7																																								
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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																																					

## 8.1.6. TRANSMITTER ABOVE 1 GHz FOR 5.8GHz 802.11n H20 MODE

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																																																																																																																																																																																																																																																																																							
<p>Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 5.8 GHz Band HT20 Mode, Tx On</p> <p><b>Test Equipment:</b></p> <table border="1"> <tr> <td>Horn 1-18GHz</td> <td>Pre-amplifier 1-26GHz</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="3">Horn &gt; 18GHz</td> <td>Limit</td> </tr> <tr> <td>T60; S/N: 2238 @3m</td> <td>T34 HP 8449B</td> <td></td> <td colspan="3"></td> <td>FCC 15.209</td> </tr> <tr> <td colspan="7">Hi Frequency Cables</td> </tr> <tr> <td>2 foot cable</td> <td>3 foot cable</td> <td>12 foot cable</td> <td>HPF</td> <td>Reject Filter</td> <td colspan="2"> <b>Peak Measurements</b> RBW=VBW=1MHz <b>Average Measurements</b> RBW=1MHz ; VBW=10Hz         </td> </tr> <tr> <td>William 177079009</td> <td></td> <td>B-5m Chamber</td> <td>HPF_7.6GHz</td> <td></td> <td colspan="2"></td> </tr> </table> <p><b>Measurement Data:</b></p> <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>Fltr 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="15"><b>Low Ch. 5745 MHz, setting: 66-65</b></td> </tr> <tr> <td>11.490</td> <td>3.0</td> <td>47.7</td> <td>35.4</td> <td>37.4</td> <td>12.8</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>66.1</td> <td>53.8</td> <td>74</td> <td>54</td> <td>-7.9</td> <td>-0.2</td> <td>V</td> </tr> <tr> <td>17.235</td> <td>3.0</td> <td>39.5</td> <td>25.8</td> <td>41.7</td> <td>14.8</td> <td>-32.0</td> <td>0.0</td> <td>0.6</td> <td>64.5</td> <td>50.9</td> <td>74</td> <td>54</td> <td>-9.5</td> <td>-3.1</td> <td>V</td> </tr> <tr> <td>11.490</td> <td>3.0</td> <td>40.2</td> <td>28.1</td> <td>37.4</td> <td>12.8</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>58.6</td> <td>46.5</td> <td>74</td> <td>54</td> <td>-15.4</td> <td>-7.5</td> <td>H</td> </tr> <tr> <td>17.235</td> <td>3.0</td> <td>38.0</td> <td>25.9</td> <td>41.7</td> <td>14.8</td> <td>-32.0</td> <td>0.0</td> <td>0.6</td> <td>63.0</td> <td>50.9</td> <td>74</td> <td>54</td> <td>-11.0</td> <td>-3.1</td> <td>H</td> </tr> <tr> <td colspan="15"><b>Mid Ch. 5785 MHz, setting: 66-64</b></td> </tr> <tr> <td>11.570</td> <td>3.0</td> <td>47.2</td> <td>33.9</td> <td>37.4</td> <td>12.9</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>65.7</td> <td>52.4</td> <td>74</td> <td>54</td> <td>-8.3</td> <td>-1.6</td> <td>V</td> </tr> <tr> <td>17.355</td> <td>3.0</td> <td>36.6</td> <td>23.6</td> <td>42.1</td> <td>14.8</td> <td>-32.1</td> <td>0.0</td> <td>0.6</td> <td>62.1</td> <td>49.1</td> <td>74</td> <td>54</td> <td>-11.9</td> <td>-4.9</td> <td>V</td> </tr> <tr> <td>11.570</td> <td>3.0</td> <td>39.6</td> <td>28.0</td> <td>37.4</td> <td>12.9</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>58.1</td> <td>46.5</td> <td>74</td> <td>54</td> <td>-15.9</td> <td>-7.5</td> <td>H</td> </tr> <tr> <td>17.355</td> <td>3.0</td> <td>38.1</td> <td>24.3</td> <td>42.1</td> <td>14.8</td> <td>-32.1</td> <td>0.0</td> <td>0.6</td> <td>63.6</td> <td>49.8</td> <td>74</td> <td>54</td> <td>-10.4</td> <td>-4.2</td> <td>H</td> </tr> <tr> <td colspan="15"><b>High Ch. 5825 MHz, setting: 67-66</b></td> </tr> <tr> <td>11.650</td> <td>3.0</td> <td>45.7</td> <td>33.2</td> <td>37.4</td> <td>13.0</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>64.2</td> <td>51.8</td> <td>74</td> <td>54</td> <td>-9.8</td> <td>-2.2</td> <td>V</td> </tr> <tr> <td>17.475</td> <td>3.0</td> <td>36.7</td> <td>22.8</td> <td>42.6</td> <td>14.9</td> <td>-32.1</td> <td>0.0</td> <td>0.6</td> <td>62.7</td> <td>48.7</td> <td>74</td> <td>54</td> <td>-11.3</td> <td>-5.3</td> <td>V</td> </tr> <tr> <td>11.650</td> <td>3.0</td> <td>38.5</td> <td>25.3</td> <td>37.4</td> <td>13.0</td> <td>-32.5</td> <td>0.0</td> <td>0.7</td> <td>57.1</td> <td>43.9</td> <td>74</td> <td>54</td> <td>-16.9</td> <td>-10.1</td> <td>H</td> </tr> <tr> <td>17.475</td> <td>3.0</td> <td>36.8</td> <td>24.3</td> <td>42.6</td> <td>14.9</td> <td>-32.1</td> <td>0.0</td> <td>0.6</td> <td>62.8</td> <td>50.2</td> <td>74</td> <td>54</td> <td>-11.2</td> <td>-3.8</td> <td>H</td> </tr> <tr> <td colspan="15">No more signal found</td> </tr> <tr> <td colspan="15">Rev. 4.12.7</td> </tr> <tr> <td colspan="5">         f Measurement Frequency          Dist Distance to Antenna          Read Analyzer Reading          AF Antenna Factor          CL Cable Loss       </td> <td>         Amp Preamp Gain          D Corr Distance Correct to 3 meters          Avg Average Field Strength @ 3 m          Peak Calculated Peak Field Strength          HPF High Pass Filter       </td> <td colspan="5">         Avg Lim Average Field Strength Limit          Pk Lim Peak Field Strength Limit          Avg Mar Margin vs. Average Limit          Pk Mar Margin vs. Peak Limit       </td> </tr> </tbody> </table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz			Limit	T60; S/N: 2238 @3m	T34 HP 8449B					FCC 15.209	Hi Frequency Cables							2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	<b>Peak Measurements</b> RBW=VBW=1MHz <b>Average Measurements</b> RBW=1MHz ; VBW=10Hz		William 177079009		B-5m Chamber	HPF_7.6GHz				f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	<b>Low Ch. 5745 MHz, setting: 66-65</b>															11.490	3.0	47.7	35.4	37.4	12.8	-32.5	0.0	0.7	66.1	53.8	74	54	-7.9	-0.2	V	17.235	3.0	39.5	25.8	41.7	14.8	-32.0	0.0	0.6	64.5	50.9	74	54	-9.5	-3.1	V	11.490	3.0	40.2	28.1	37.4	12.8	-32.5	0.0	0.7	58.6	46.5	74	54	-15.4	-7.5	H	17.235	3.0	38.0	25.9	41.7	14.8	-32.0	0.0	0.6	63.0	50.9	74	54	-11.0	-3.1	H	<b>Mid Ch. 5785 MHz, setting: 66-64</b>															11.570	3.0	47.2	33.9	37.4	12.9	-32.5	0.0	0.7	65.7	52.4	74	54	-8.3	-1.6	V	17.355	3.0	36.6	23.6	42.1	14.8	-32.1	0.0	0.6	62.1	49.1	74	54	-11.9	-4.9	V	11.570	3.0	39.6	28.0	37.4	12.9	-32.5	0.0	0.7	58.1	46.5	74	54	-15.9	-7.5	H	17.355	3.0	38.1	24.3	42.1	14.8	-32.1	0.0	0.6	63.6	49.8	74	54	-10.4	-4.2	H	<b>High Ch. 5825 MHz, setting: 67-66</b>															11.650	3.0	45.7	33.2	37.4	13.0	-32.5	0.0	0.7	64.2	51.8	74	54	-9.8	-2.2	V	17.475	3.0	36.7	22.8	42.6	14.9	-32.1	0.0	0.6	62.7	48.7	74	54	-11.3	-5.3	V	11.650	3.0	38.5	25.3	37.4	13.0	-32.5	0.0	0.7	57.1	43.9	74	54	-16.9	-10.1	H	17.475	3.0	36.8	24.3	42.6	14.9	-32.1	0.0	0.6	62.8	50.2	74	54	-11.2	-3.8	H	No more signal found															Rev. 4.12.7															f Measurement Frequency Dist Distance to Antenna Read Analyzer Reading AF Antenna Factor CL Cable Loss					Amp Preamp Gain D Corr Distance Correct to 3 meters Avg Average Field Strength @ 3 m Peak Calculated Peak Field Strength HPF High Pass Filter	Avg Lim Average 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17.235	3.0	39.5	25.8	41.7	14.8	-32.0	0.0	0.6	64.5	50.9	74	54	-9.5	-3.1	V																																																																																																																																																																																																																																																																																																																																								
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11.570	3.0	47.2	33.9	37.4	12.9	-32.5	0.0	0.7	65.7	52.4	74	54	-8.3	-1.6	V																																																																																																																																																																																																																																																																																																																																								
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## 8.1.7. TRANSMITTER ABOVE 1 GHz FOR 5.8GHz 802.11n H40 MODE

### HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																								
<p>Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 5.8 GHz Band HT40 Mode, Tx On</p> <p><b>Test Equipment:</b></p> <table border="1"> <tr> <td>Horn 1-18GHz</td> <td>Pre-amplifier 1-26GHz</td> <td>Pre-amplifier 26-40GHz</td> <td colspan="3">Horn &gt; 18GHz</td> <td>Limit</td> </tr> <tr> <td>T60; S/N: 2238 @3m</td> <td>T34 HP 8449B</td> <td></td> <td colspan="3"></td> <td>FCC 15.209</td> </tr> </table> <p>Hi Frequency Cables</p> <table border="1"> <tr> <td>2 foot cable</td> <td>3 foot cable</td> <td>12 foot cable</td> <td>HPF</td> <td>Reject Filter</td> <td>Peak Measurements RBW=VBW=1MHz</td> </tr> <tr> <td>William 177079009</td> <td></td> <td>B-5m Chamber</td> <td>HPF_7.6GHz</td> <td></td> <td>Average Measurements RBW=1MHz ; VBW=10Hz</td> </tr> </table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz			Limit	T60; S/N: 2238 @3m	T34 HP 8449B					FCC 15.209	2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz	William 177079009		B-5m Chamber	HPF_7.6GHz		Average Measurements RBW=1MHz ; VBW=10Hz
Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz			Limit																																		
T60; S/N: 2238 @3m	T34 HP 8449B					FCC 15.209																																		
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f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)																									
<b>Low Ch. 5755 MHz, setting: 67-66</b>																																								
11.510	3.0	42.8	32.6	37.4	12.9	-32.5	0.0	0.7	61.2	51.0	74	54	-12.8	-3.0	V																									
17.265	3.0	37.4	23.8	41.8	14.8	-32.0	0.0	0.6	62.5	49.0	74	54	-11.5	-5.0	V																									
11.510	3.0	35.3	22.9	37.4	12.9	-32.5	0.0	0.7	53.7	41.3	74	54	-20.3	-12.7	H																									
17.265	3.0	35.5	23.5	41.8	14.8	-32.0	0.0	0.6	60.6	48.6	74	54	-13.4	-5.4	H																									
<b>High Ch. 5795 MHz, setting: 68-66</b>																																								
11.590	3.0	41.7	29.6	37.4	12.9	-32.5	0.0	0.7	60.2	48.1	74	54	-13.8	-5.9	V																									
17.385	3.0	36.0	22.4	42.2	14.8	-32.1	0.0	0.6	61.7	48.0	74	54	-12.3	-6.0	V																									
11.590	3.0	36.4	23.3	37.4	12.9	-32.5	0.0	0.7	54.9	41.8	74	54	-19.1	-12.2	H																									
17.385	3.0	35.0	23.0	42.2	14.8	-32.1	0.0	0.6	60.7	48.6	74	54	-13.3	-5.4	H																									
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## 8.2. RECEIVER ABOVE 1 GHz

### 8.2.1. RECEIVER ABOVE 1 GHz FOR 2.4 GHz 802.11n H20 BAND

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																
Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 2.4GHz Band HT20 Mode, Mid Ch. Rx On																
<b>Test Equipment:</b>																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T34 HP 8449B									RX RSS 210				
Hi Frequency Cables																
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz	
William 177079009						B-5m Chamber									Average Measurements RBW=1MHz ; VBW=10Hz	
<b>f</b> GHz	<b>Dist</b> (m)	<b>Read Pk</b> dBuV	<b>Read Avg.</b> dBuV	<b>AF</b> dB/m	<b>CL</b> dB	<b>Amp</b> dB	<b>D Corr</b> dB	<b>Fltr</b> dB	<b>Peak</b> dBuV/m	<b>Avg</b> dBuV/m	<b>Pk Lim</b> dBuV/m	<b>Avg Lim</b> dBuV/m	<b>Pk Mar</b> dB	<b>Avg Mar</b> dB	<b>Notes</b> (V/H)	
1.127	3.0	55.4	45.0	25.7	4.1	-38.1	0.0	0.0	47.1	36.8	74	54	-26.9	-17.2	V	
1.837	3.0	56.2	42.1	27.5	5.1	-37.1	0.0	0.0	51.7	37.6	74	54	-22.3	-16.4	V	
1.127	3.0	50.3	38.7	25.7	4.1	-38.1	0.0	0.0	42.1	30.5	74	54	-31.9	-23.5	H	
1.807	3.0	50.4	37.6	27.5	5.0	-37.1	0.0	0.0	45.7	32.9	74	54	-28.3	-21.1	H	
No more signal found																
Rev. 4.12.7																
f Measurement Frequency Dist Distance to Antenna Read Analyzer Reading AF Antenna Factor CL Cable Loss					Amp Preamp Gain D Corr Distance Correct to 3 meters Avg Average Field Strength @ 3 m Peak Calculated Peak Field Strength HPF High Pass Filter					Avg Lim Average Field Strength Limit Pk Lim Peak Field Strength Limit Avg Mar Margin vs. Average Limit Pk Mar Margin vs. Peak Limit						

## 8.2.2. RECEIVER ABOVE 1 GHz FOR 2.4 GHz 802.11n H40 BAND

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																														
Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 2.4 GHz Band HT40 Mode, Mid Ch.Rx On																																																																																														
<b>Test Equipment:</b>																																																																																														
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit																																																																																		
T60; S/N: 2238 @3m			T34 HP 8449B									RX RSS 210																																																																																		
Hi Frequency Cables																																																																																														
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter																																																																																		
William 177079009						B-5m Chamber																																																																																								
Peak Measurements RBW=VBW=1MHz																																																																																														
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<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>Fltr 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>1.127</td><td>3.0</td><td>54.3</td><td>44.4</td><td>25.7</td><td>4.1</td><td>-38.1</td><td>0.0</td><td>0.0</td><td>46.1</td><td>36.2</td><td>74</td><td>54</td><td>-27.9</td><td>-17.8</td><td>V</td></tr><tr><td>1.833</td><td>3.0</td><td>56.2</td><td>41.7</td><td>27.5</td><td>5.1</td><td>-37.1</td><td>0.0</td><td>0.0</td><td>51.7</td><td>37.2</td><td>74</td><td>54</td><td>-22.3</td><td>-16.8</td><td>V</td></tr><tr><td>1.127</td><td>3.0</td><td>49.3</td><td>37.6</td><td>25.7</td><td>4.1</td><td>-38.1</td><td>0.0</td><td>0.0</td><td>41.1</td><td>29.4</td><td>74</td><td>54</td><td>-32.9</td><td>-24.6</td><td>H</td></tr><tr><td>1.833</td><td>3.0</td><td>50.2</td><td>37.4</td><td>27.5</td><td>5.1</td><td>-37.1</td><td>0.0</td><td>0.0</td><td>45.7</td><td>32.9</td><td>74</td><td>54</td><td>-28.3</td><td>-21.1</td><td>H</td></tr></tbody></table>															f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	1.127	3.0	54.3	44.4	25.7	4.1	-38.1	0.0	0.0	46.1	36.2	74	54	-27.9	-17.8	V	1.833	3.0	56.2	41.7	27.5	5.1	-37.1	0.0	0.0	51.7	37.2	74	54	-22.3	-16.8	V	1.127	3.0	49.3	37.6	25.7	4.1	-38.1	0.0	0.0	41.1	29.4	74	54	-32.9	-24.6	H	1.833	3.0	50.2	37.4	27.5	5.1	-37.1	0.0	0.0	45.7	32.9	74	54	-28.3	-21.1	H
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)																																																																															
1.127	3.0	54.3	44.4	25.7	4.1	-38.1	0.0	0.0	46.1	36.2	74	54	-27.9	-17.8	V																																																																															
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### 8.2.3. RECEIVER ABOVE 1 GHz FOR 5.8 GHz 802.11n H20 BAND

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																																																																																																																																								
<p>Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 5.8 GHz Band HT20 Mode, Mid Ch. Rx On</p>																																																																																																																																																																																																								
<p><b>Test Equipment:</b></p> <table border="1"><tr><td>Horn 1-18GHz</td><td>Pre-amplifier 1-26GHz</td><td>Pre-amplifier 26-40GHz</td><td colspan="4">Horn &gt; 18GHz</td><td>Limit</td></tr><tr><td>T60; S/N: 2238 @3m</td><td>T34 HP 8449B</td><td></td><td colspan="4"></td><td>RX RSS 210</td></tr><tr><td colspan="15">Hi Frequency Cables</td></tr><tr><td>2 foot cable</td><td>3 foot cable</td><td>12 foot cable</td><td colspan="4">HPF</td><td>Reject Filter</td><td colspan="7">Peak Measurements RBW=VBW=1MHz</td></tr><tr><td>William 177079009</td><td></td><td>B-5m Chamber</td><td colspan="4"></td><td></td><td colspan="7">Average Measurements RBW=1MHz ; VBW=10Hz</td></tr><tr><td><b>f</b> GHz</td><td><b>Dist</b> (m)</td><td><b>Read Pk</b> dBuV</td><td><b>Read Avg.</b> dBuV</td><td><b>AF</b> dB/m</td><td><b>CL</b> dB</td><td><b>Amp</b> dB</td><td><b>D Corr</b> dB</td><td><b>Fltr</b> dB</td><td><b>Peak</b> dBuV/m</td><td><b>Avg</b> dBuV/m</td><td><b>Pk Lim</b> dBuV/m</td><td><b>Avg Lim</b> dBuV/m</td><td><b>Pk Mar</b> dB</td><td><b>Avg Mar</b> dB</td><td><b>Notes</b> (V/H)</td></tr><tr><td>1.167</td><td>3.0</td><td>55.4</td><td>47.3</td><td>25.8</td><td>4.1</td><td>-38.0</td><td>0.0</td><td>0.0</td><td>47.3</td><td>39.3</td><td>74</td><td>54</td><td>-26.7</td><td>-14.7</td><td>V</td></tr><tr><td>1.823</td><td>3.0</td><td>56.5</td><td>40.0</td><td>27.5</td><td>5.0</td><td>-37.1</td><td>0.0</td><td>0.0</td><td>52.0</td><td>35.4</td><td>74</td><td>54</td><td>-22.0</td><td>-18.6</td><td>V</td></tr><tr><td>1.167</td><td>3.0</td><td>51.3</td><td>39.2</td><td>25.8</td><td>4.1</td><td>-38.0</td><td>0.0</td><td>0.0</td><td>43.3</td><td>31.1</td><td>74</td><td>54</td><td>-30.7</td><td>-22.9</td><td>H</td></tr><tr><td>1.823</td><td>3.0</td><td>52.0</td><td>40.2</td><td>27.5</td><td>5.0</td><td>-37.1</td><td>0.0</td><td>0.0</td><td>47.4</td><td>35.6</td><td>74</td><td>54</td><td>-26.6</td><td>-18.4</td><td>H</td></tr><tr><td colspan="15"><b>No more signal found</b></td></tr><tr><td colspan="15">Rev. 4.12.7</td></tr><tr><td colspan="5"><b>f</b> Measurement Frequency <b>Dist</b> Distance to Antenna <b>Read</b> Analyzer Reading <b>AF</b> Antenna Factor <b>CL</b> Cable Loss</td><td colspan="5"><b>Amp</b> Preamp Gain <b>D Corr</b> Distance Correct to 3 meters <b>Avg</b> Average Field Strength @ 3 m <b>Peak</b> Calculated Peak Field Strength <b>HPF</b> High Pass Filter</td><td colspan="5"><b>Avg Lim</b> Average Field Strength Limit <b>Pk Lim</b> Peak Field Strength Limit <b>Avg Mar</b> Margin vs. Average Limit <b>Pk Mar</b> Margin vs. Peak Limit</td></tr></table>															Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz				Limit	T60; S/N: 2238 @3m	T34 HP 8449B						RX RSS 210	Hi Frequency Cables															2 foot cable	3 foot cable	12 foot cable	HPF				Reject Filter	Peak Measurements RBW=VBW=1MHz							William 177079009		B-5m Chamber						Average Measurements RBW=1MHz ; VBW=10Hz							<b>f</b> GHz	<b>Dist</b> (m)	<b>Read Pk</b> dBuV	<b>Read Avg.</b> dBuV	<b>AF</b> dB/m	<b>CL</b> dB	<b>Amp</b> dB	<b>D Corr</b> dB	<b>Fltr</b> dB	<b>Peak</b> dBuV/m	<b>Avg</b> dBuV/m	<b>Pk Lim</b> dBuV/m	<b>Avg Lim</b> dBuV/m	<b>Pk Mar</b> dB	<b>Avg Mar</b> dB	<b>Notes</b> (V/H)	1.167	3.0	55.4	47.3	25.8	4.1	-38.0	0.0	0.0	47.3	39.3	74	54	-26.7	-14.7	V	1.823	3.0	56.5	40.0	27.5	5.0	-37.1	0.0	0.0	52.0	35.4	74	54	-22.0	-18.6	V	1.167	3.0	51.3	39.2	25.8	4.1	-38.0	0.0	0.0	43.3	31.1	74	54	-30.7	-22.9	H	1.823	3.0	52.0	40.2	27.5	5.0	-37.1	0.0	0.0	47.4	35.6	74	54	-26.6	-18.4	H	<b>No more signal found</b>															Rev. 4.12.7															<b>f</b> Measurement Frequency <b>Dist</b> Distance to Antenna <b>Read</b> Analyzer Reading <b>AF</b> Antenna Factor <b>CL</b> Cable Loss					<b>Amp</b> Preamp Gain <b>D Corr</b> Distance Correct to 3 meters <b>Avg</b> Average Field Strength @ 3 m <b>Peak</b> Calculated Peak Field Strength <b>HPF</b> High Pass Filter					<b>Avg Lim</b> Average Field Strength Limit <b>Pk Lim</b> Peak Field Strength Limit <b>Avg Mar</b> Margin vs. Average Limit <b>Pk Mar</b> Margin vs. Peak Limit				
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## 8.2.4. RECEIVER ABOVE 1 GHz FOR 5.8 GHz 802.11n H40 BAND

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber																																																																																														
Company: Apple Computer Inc. Project #: 07U11257 Date: Sept. 21, 2007 Test Engineer: William Zhuang Configuration: EUT with support equipment Mode: 5.8 GHz Band HT40 Mode, Rx On																																																																																														
<b>Test Equipment:</b>																																																																																														
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit																																																																																		
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### 8.3. WORST-CASE BELOW 1 GHz

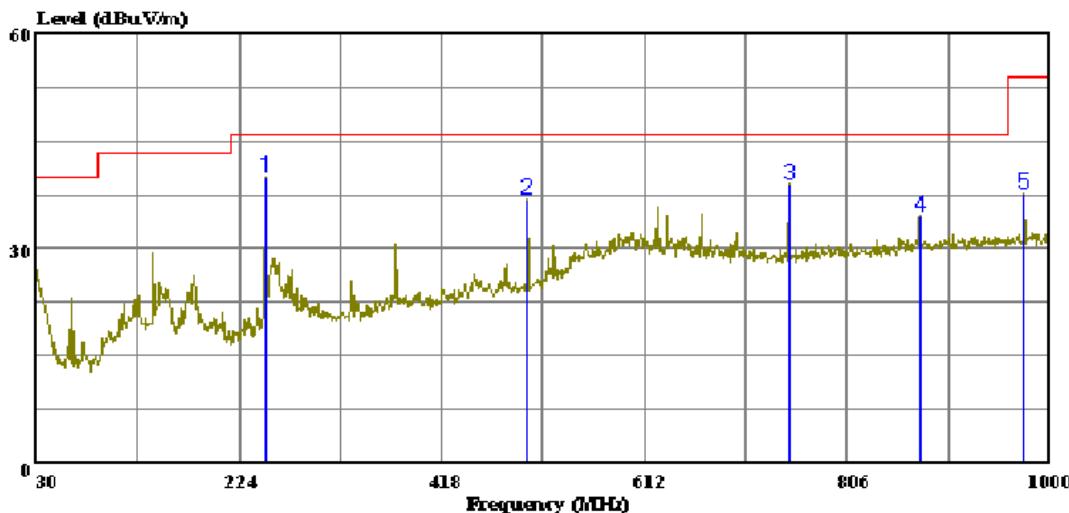
#### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

##### HORIZONTAL DATA



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

Data#: 12 File#: 07u11257.emi Date: 10-12-2007 Time: 10:23:12



Trace: 11

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL  
Engineer: : Thanh Nguyen  
Company: : Apple Computer Inc.  
Project #: : 07U11257  
Test Configuration: : EUT with Support Equipment  
Mode of operation: : Wireless link, play music and R/W to HD  
Test Target: : FCC Class B

Page: 1

Freq	Read	Over		Remark
	Level	Level	Limit	
MHz	dBuV	dBuV/m	dB	
1	249.220	54.10	39.91	-6.09 Peak
2	499.480	44.30	36.90	-9.10 Peak
3	750.710	41.70	38.93	-7.07 Peak
4	875.840	35.80	34.48	-11.52 Peak
5	975.750	38.40	37.65	-16.35 Peak

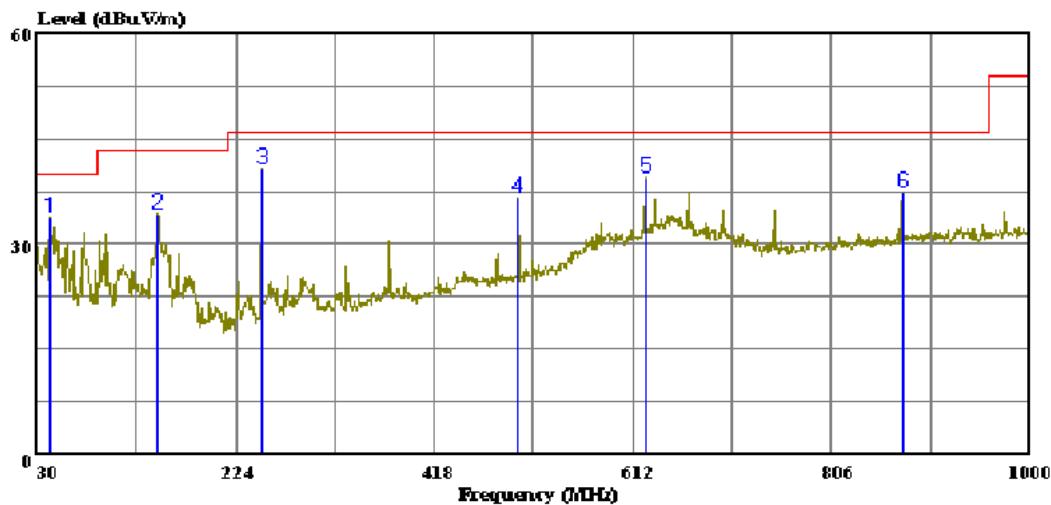
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

**VERTICAL DATA**



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

Data#: 10 File#: 07u11257.emi Date: 10-12-2007 Time: 10:11:37



Trace: 9

Ref Trace:

Condition: FCC CLASS-B 3m VERTICAL  
Engineer: : Thanh Nguyen  
Company: : Apple Computer Inc.  
Project #: : 07U11257  
Test Configuration: : EUT with Remote Support Laptop  
Mode of operation: : Wireless link, play music and R/W to HD  
Test Target: : FCC Class B

Page: 1

Freq	Read	Over		
	Level	Level	Limit	Remark
MHz	dBuV	dBuV/m	dB	
1	41.640	46.49	33.64	-6.36 Peak
2	148.340	47.93	34.19	-9.31 Peak
3	249.220	55.00	40.81	-5.19 Peak
4	499.480	44.00	36.60	-9.40 Peak
5	624.610	44.30	39.36	-6.64 Peak
6	875.840	38.60	37.28	-8.72 Peak

## 8.4. POWERLINE CONDUCTED EMISSIONS

### LIMIT

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

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

<sup>\*</sup> Decreases with the logarithm of the frequency.

### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

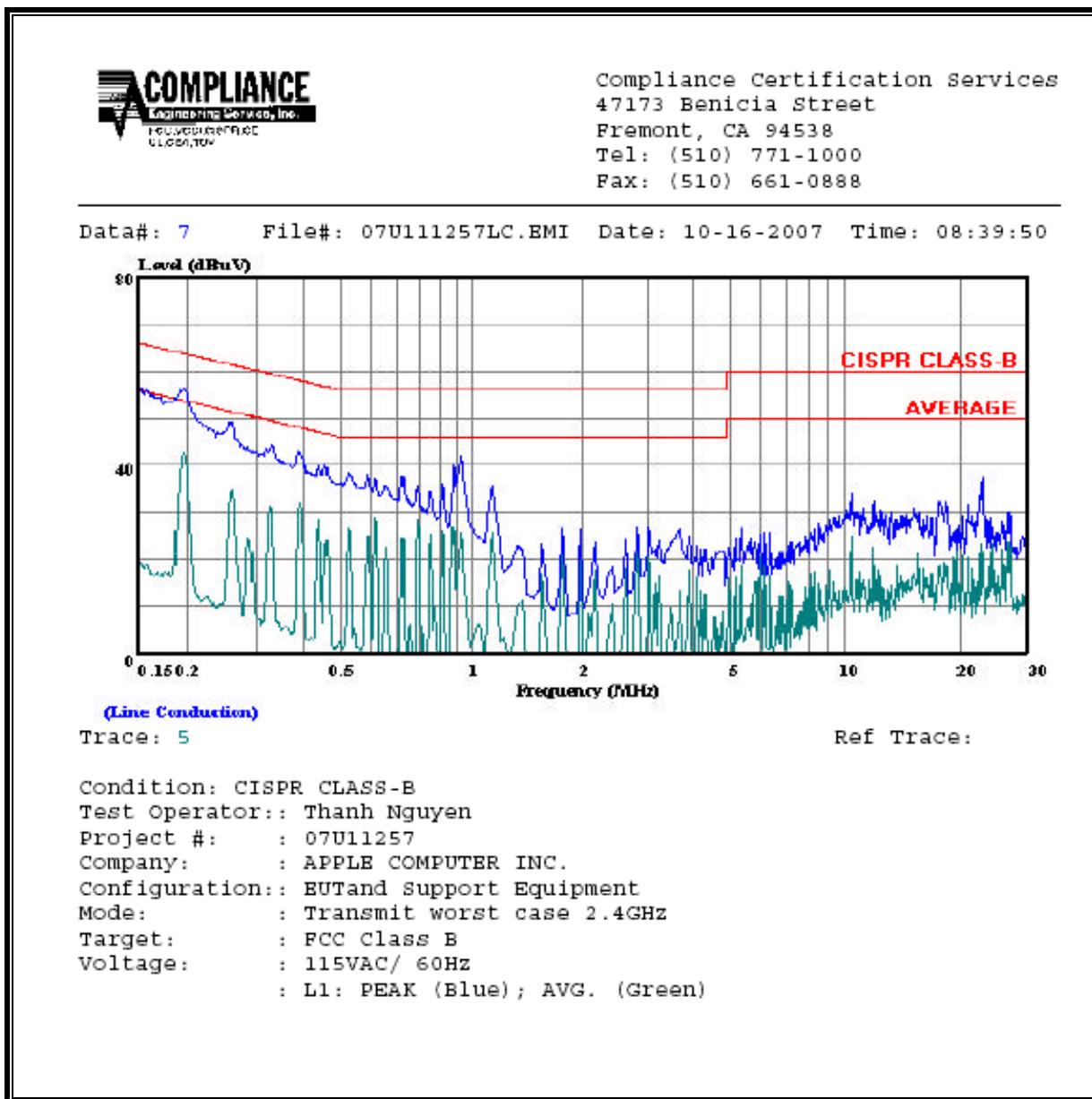
### RESULTS

No non-compliance noted:

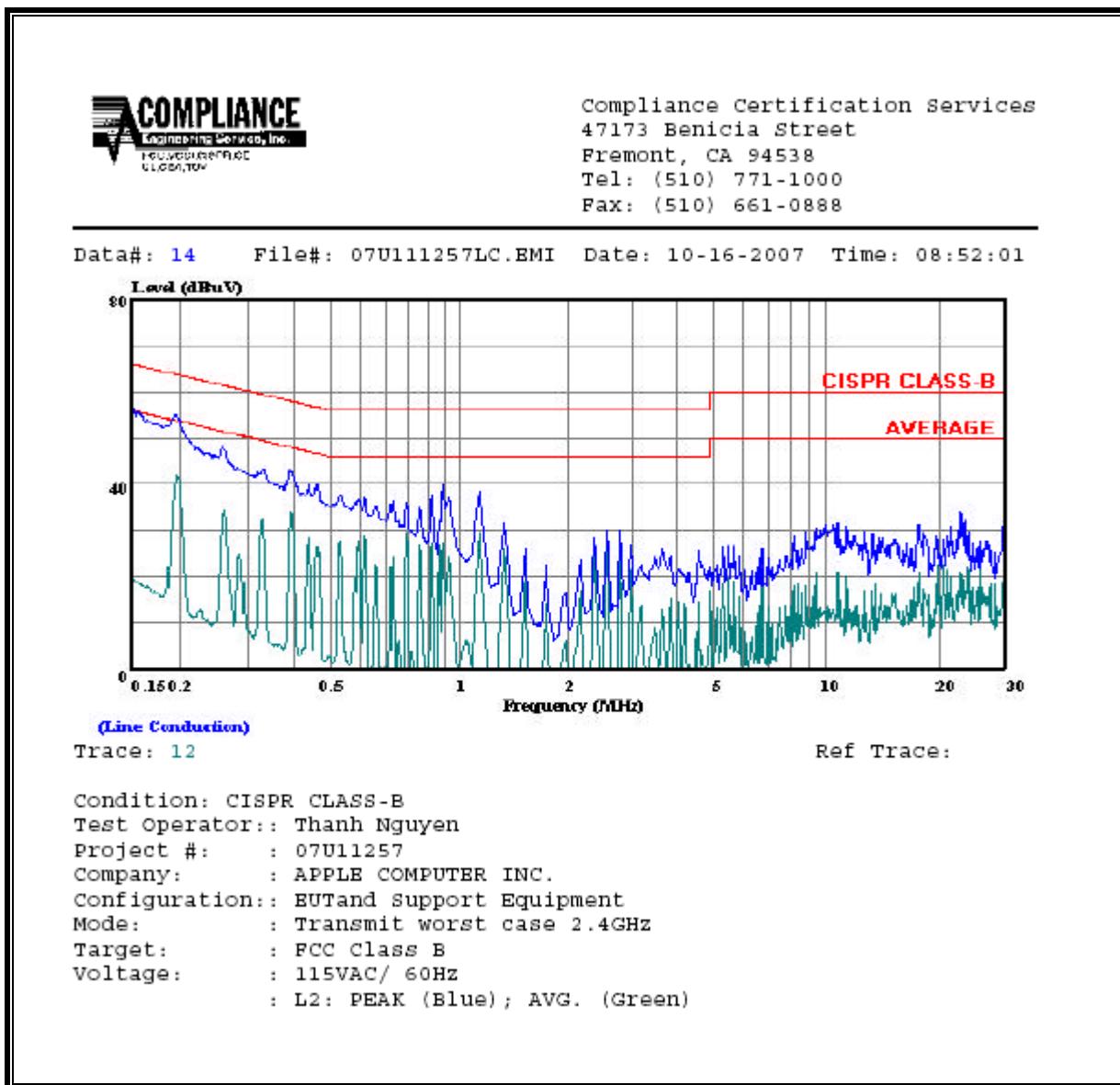
**6 WORST EMISSIONS**

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq. (MHz)	Reading			Closs (dB)	Limit		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)		QP	AV	QP (dB)	AV (dB)	
0.20	53.64	--	42.47	0.00	63.82	53.82	-10.18	-11.35	L1
1.03	41.90	--	25.71	0.00	56.00	46.00	-14.10	-20.29	L1
23.02	37.46	--	23.25	0.00	60.00	50.00	-22.54	-26.75	L1
0.20	54.88	--	41.58	0.00	63.82	53.82	-8.94	-12.24	L2
0.99	39.78	--	27.28	0.00	56.00	46.00	-16.22	-18.72	L2
23.02	33.60	--	22.22	0.00	60.00	50.00	-26.40	-27.78	L2
6 Worst Data									

**LINE 1 RESULTS**



## LINE 2 RESULTS



## 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 .....	1842f	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/f	2.19/f		6
10–30	28	2.19/f		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

\* Power density limit is applicable at frequencies greater than 100 MHz.

**Notes:**

1. Frequency,  $f$ , is in MHz.
2. A power density of 10 W/m<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 ( $\mu$ T) 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 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**

(MPE distance is greater than 20 cm)

Mode	Band	FCC Limit (mW/cm <sup>2</sup> )	IC Limit (W/m <sup>2</sup> )	Output (dBm)	Antenna (dBi)	MPE Distance (cm)
802.11b	2.4 GHz	1.0	10.0	22.5	5.65	7.20
802.11g	2.4 GHz	1.0	10.0	21.8	5.65	6.65
802.11n HT20	2.4 GHz	1.0	10.0	21.3	3.99	5.19
802.11n HT40	2.4 GHz	1.0	10.0	21.9	3.99	5.56
802.11a	5 GHz	1.0	10.0	20.61	5.11	5.45
802.11n HT20	5 GHz	1.0	10.0	20.61	2.23	3.91
802.11n HT40	5 GHz	1.0	10.0	20.90	2.23	4.04