



**FCC CFR47 PART 15 SUBPART E  
INDUSTRY CANADA RSS-210 ISSUE 7  
CLASS II PERMISSIVE CHANGE**

**CERTIFICATION TEST REPORT**

**FOR**

**802.11ag / Draft 802.11n WLAN + BLUETOOTH PCI-E MINICARD**

**MODEL NUMBER: BCM943224PCIEBT**

**FCC ID: QDS-BRCM1047  
IC: 4324A-BRCM1047**

**REPORT NUMBER: 09U12954-2, Revision A**

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**NVLAP LAB CODE 200065-0**

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# 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** 802.11ag / Draft 802.11n WLAN + Bluetooth PCI-E Minicard

**MODEL:** BCM943224PCIEBT

**SERIAL NUMBER:** 8516097DA0EQC

**DATE TESTED:** DECEMBER 02 - 15, 2009

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 9	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

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

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

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC MANAGER  
COMPLIANCE CERTIFICATION SERVICES

VIEN TRAN  
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, FCC 06-96, 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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

### 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an 802.11ag / Draft 802.11n WLAN + Bluetooth PCI-E Minicard.  
 The radio module is manufactured by Broadcom.

### 5.2. MAXIMUM OUTPUT POWER

The test measurement passed within  $\pm 0.5$ dBm of the original output power.

In order to pass Peak Power, PPSD and Band edge measurements, some channels have to be reduced the output powers as table shown below:

MODE/ CHANNEL	Measured (dBm)_ Chain 1	Measured (dBm)_ Chain 2
<b>5.2GHz Band</b>		
<b>11a</b>		
Low ch, 5180MHz_36	13.06	
Mid ch, 5200MHz_40	13.10	
Hi ch, 5240MHz_48	13.03	
<b>11n HT20</b>		
Low ch, 5180MHz_36	6.97	7.18
Mid ch, 5200MHz_40	6.93	7.27
Hi ch, 5240MHz_48	6.52	7.47
<b>11n HT40 MIMO</b>		
Low ch, 5190MHz_38	8.72	9.56
Hi ch, 5230MHz_46	8.29	8.74
<b>5.3GHz Band</b>		
<b>11n HT20</b>		
Low ch, 5260MHz_52	13.10	13.56
Mid ch, 5300MHz_60	13.16	13.38
<b>11n HT40 SISO</b>		
Hi ch, 5310MHz_62	11.20	
<b>11n HT40 MIMO</b>		
Hi ch, 5310MHz_62	10.12	10.41
<b>5.5GHz Band</b>		
<b>11a</b>		
Low ch, 5500MHz_100	14.63	
<b>11n HT20</b>		
Mid ch, 5600MHz_120	14.42	14.82
<b>11n HT40 SISO</b>		
Hi ch, 5670MHz_134	15.31	

### 5.3. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 5.10.131.7  
 .The test utility software used during testing was BCM Internal, rev. 5.10.RC131.7.

### 5.4. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is adding higher antenna gains as showing in section below.

### 5.5. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes with two different types of antenna, with the maximum gain as table below:

Antenna Type	Model	Peak gain (dBi)		
		5150-5250MHz	5250-5350MHz	5740-5725MHz
802.11abgn WLAN Antenna	631-1235 WiFi1	5.93	6.98	6.02
802.11abgn WLAN Antenna	631-1235 WiFi2	6.62	6.82	6.15

The highest gains of each type of antennas for all legacy / SISO modes test.

Band	WiFi1 Ant Gain (dBi)	WiFi2 Ant Gain (dBi)
5150 – 5250 MHz	5.93	<b>6.62</b>
5250 – 5350 MHz	<b>6.98</b>	6.82
5470 – 5725 MHz	6.02	<b>6.15</b>

The antennas combinations for 2x2 (CCD) modes test.

Frequency Band	Antennas combination	WiFi1 Antenna Gain	WiFi2 Antenna gain	$10^{(Ant\ Main / 10)}$	$10^{(Ant\ Aux / 10)}$	$10^{(ant\ main / 10)} + 10^{(ant\ aux / 10)}$	$10 * \log[10^{(ant\ main / 10)} + 10^{(ant\ aux / 10)}]$ (dBi)
5.2 GHz HT20 & HT40	802.11abgn WLAN Antennas	5.93	6.62	3.917	4.592	8.509	<b>9.30</b>
5.3 GHz HT20 & HT40	802.11abgn WLAN Antennas	6.98	6.82	4.989	4.808	9.797	<b>9.91</b>
5.5 GHz HT20 & HT40	802.11abgn WLAN Antennas	6.02	6.15	3.999	4.121	8.120	<b>9.10</b>



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

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

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

802.11a Mode (20 MHz BW operation): 6 Mbps, OFDM.  
802.11n MIMO HT20 Mode: MCS0, 6.5 Mbps, 1 Spatial Stream.  
802.11n SISO HT40 Mode: MCS0, 13.5 Mbps, 1 Spatial Stream.  
802.11n MIMO HT40 Mode: MCS32, 6 Mbps, 1 Spatial Stream

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

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

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

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

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

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

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	4446	R8-CAC56 09/08	PD9LEN512ANMU
AC Adapter	Lenovo	ADP 65YB B	N/A	N/A
Adapter Board	Broadcom	BCRM943224PCI	1261490	N/A

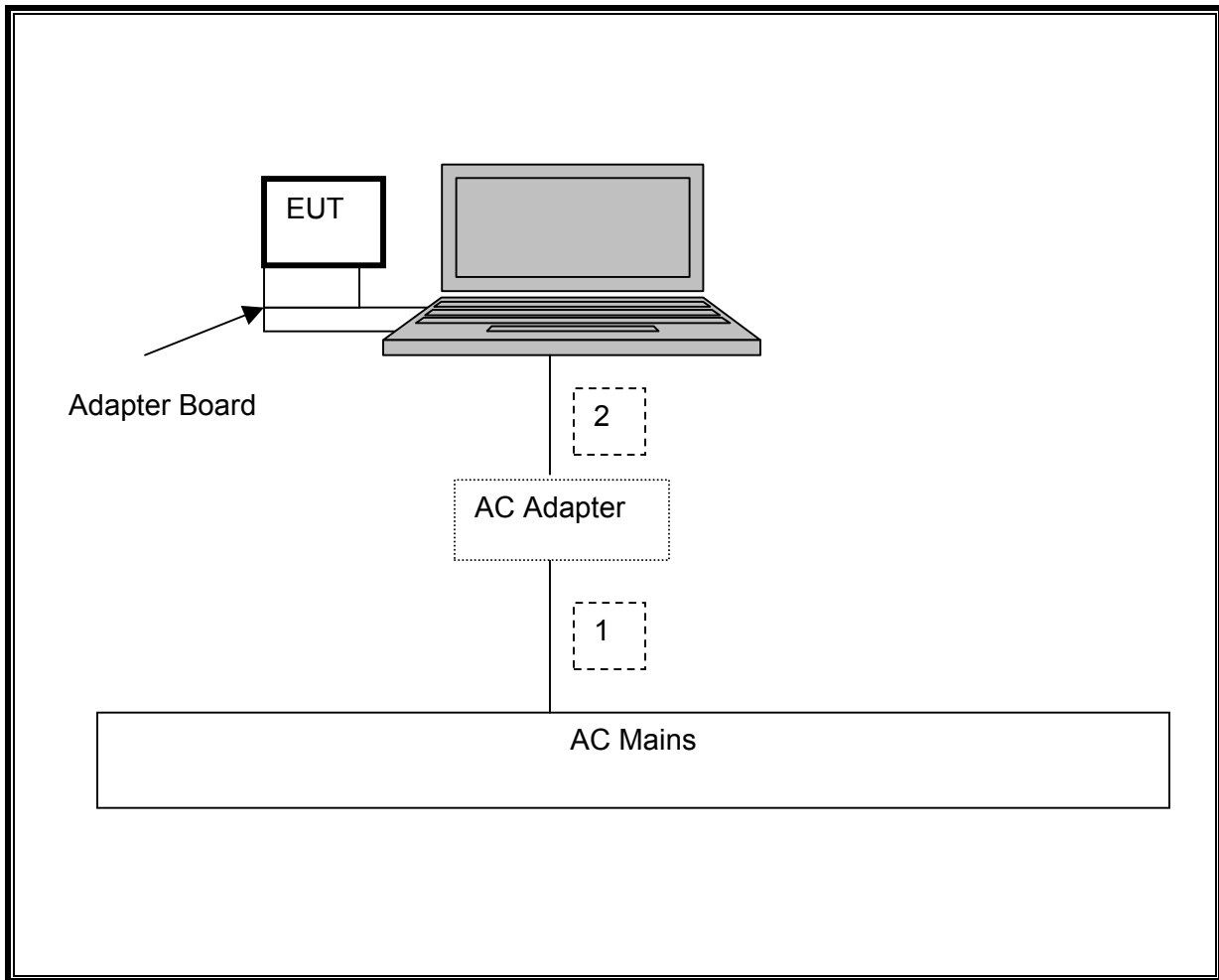
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.8 m	N/A
2	DC	1	DC	Unshielded	1.8 m	Ferrite on laptop's end

### TEST SETUP

The EUT is connected to a host laptop computer via Express card to MiniPCI-E adapter board during the test. Test software exercised the radio card.

**SETUP DIAGRAM**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/10
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/22/10
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	11/28/10
Antenna, Horn, 40 GHz	ARA	MWH-2640B	C00981	05/21/10
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/10
Preamplifier, 1-26GHz	Agilent / HP	8449B	C01052	08/05/10
Power Meter	Agilent / HP	437B	N02778	10/18/10
Power Sensor	Agilent / HP	8481A	N02784	10/22/10

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.11a MODE IN THE 5.2 GHz BAND

#### 7.1.1. OUTPUT POWER

##### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 6.62 dBi

##### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

##### RESULTS

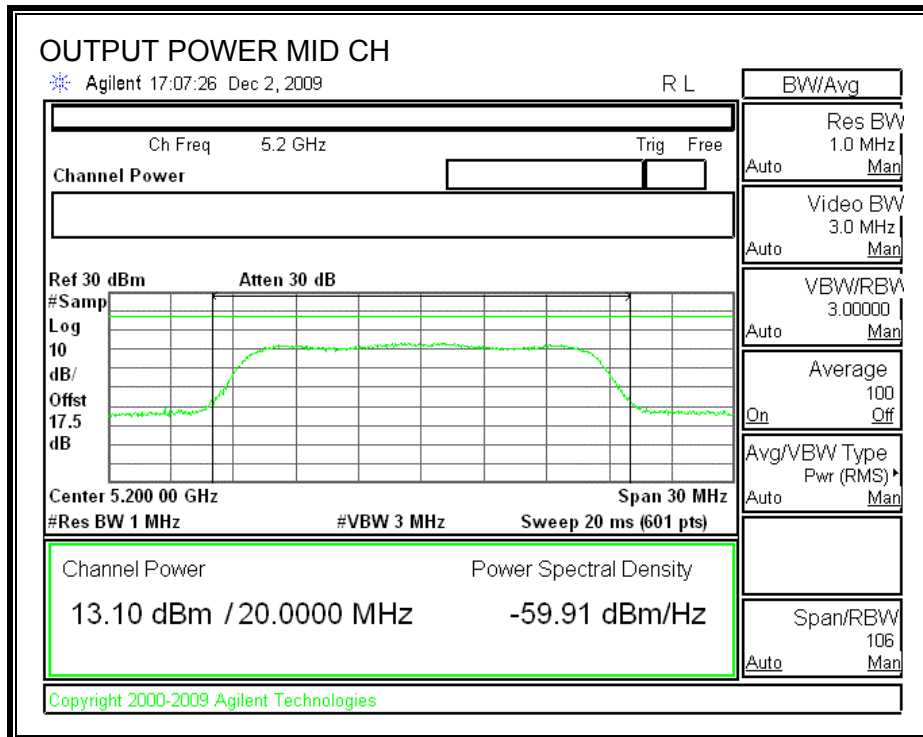
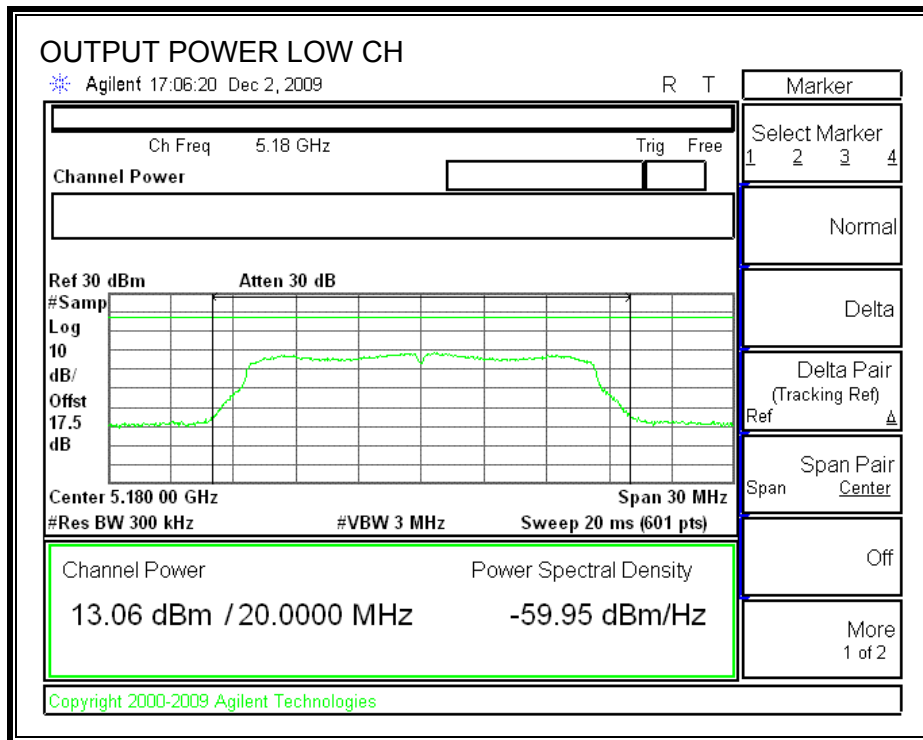
###### Limit

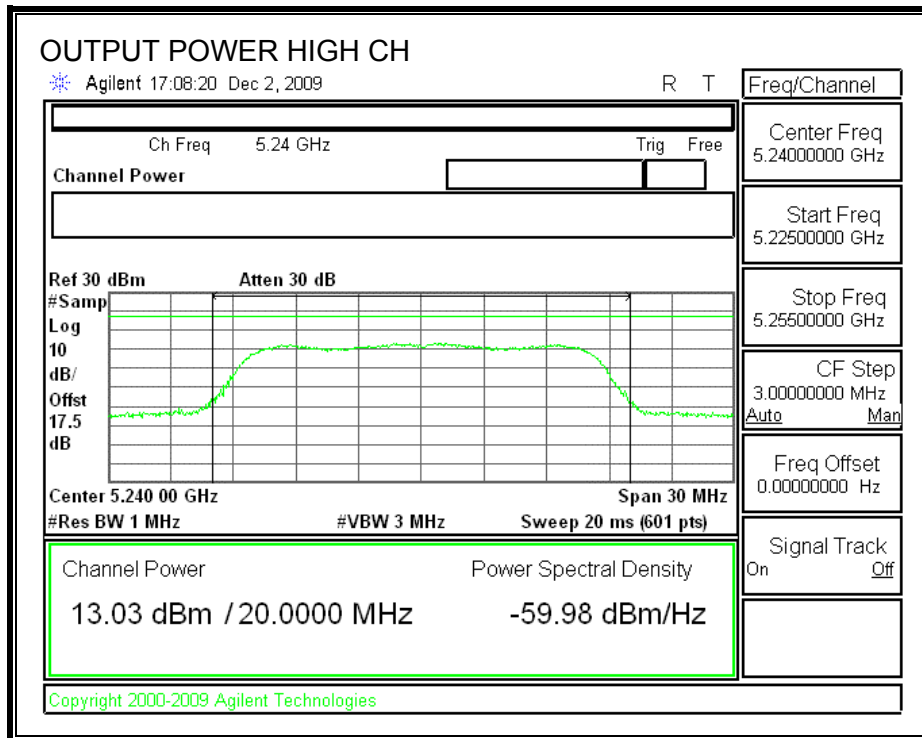
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	19.117	16.81	6.62	16.19
Mid	5200	17	18.949	16.78	6.62	16.16
High	5240	17	19.116	16.81	6.62	16.19

###### Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.06	16.19	-3.13
Mid	5200	13.10	16.16	-3.06
High	5240	13.03	16.19	-3.16

**OUTPUT POWER**





## 7.1.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is equal to 6.62 dBi, therefore the limit is 3.38 dBm.

### TEST PROCEDURE

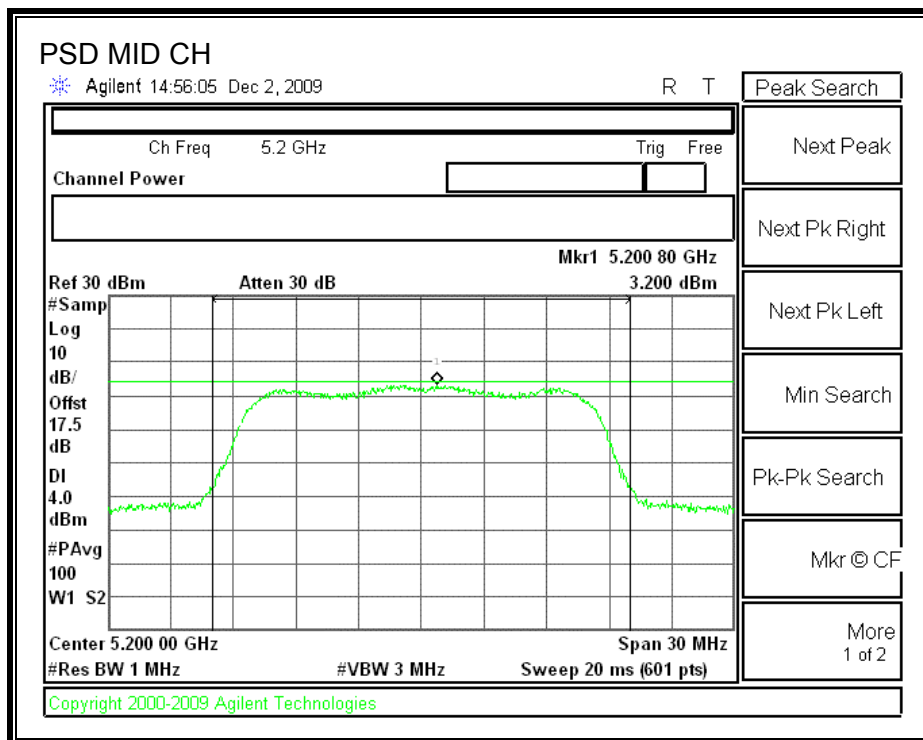
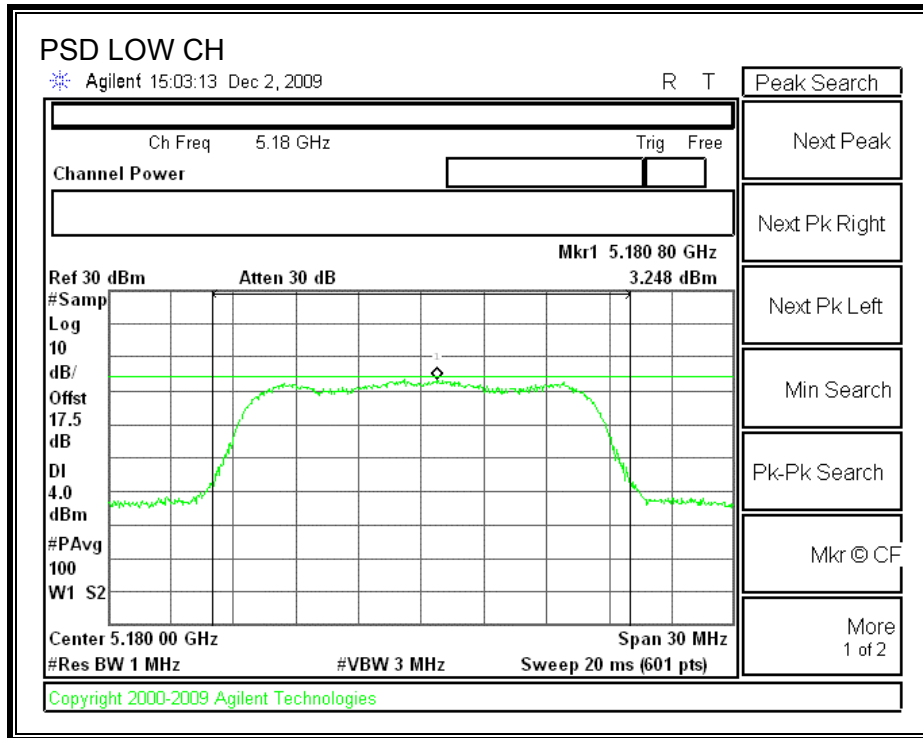
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

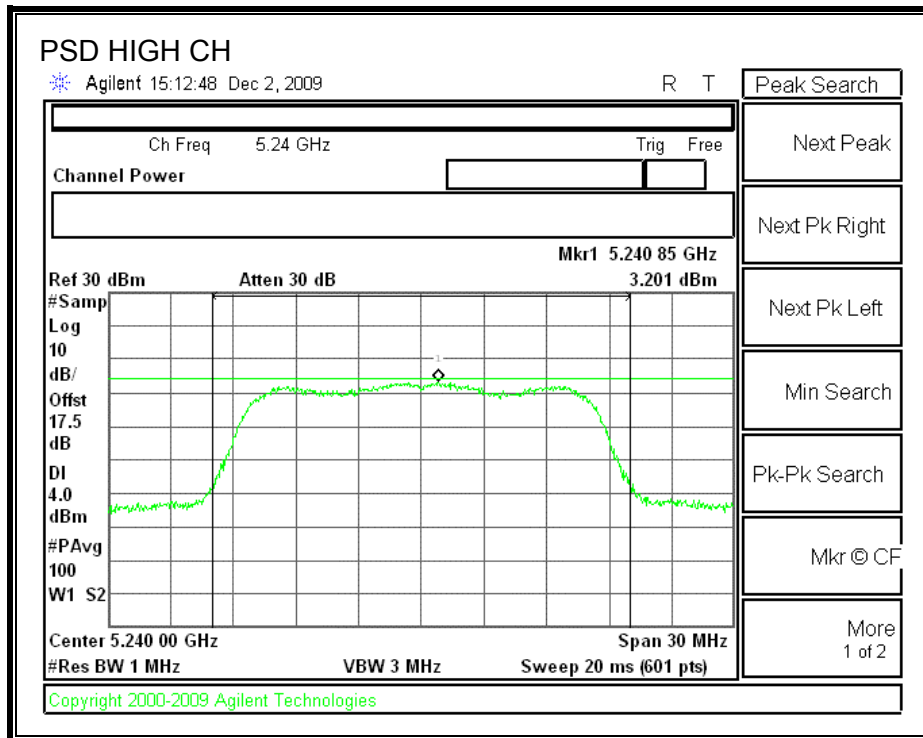
### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.248	3.38	-0.13
Middle	5200	3.200	3.38	-0.18
High	5240	3.201	3.38	-0.18



**POWER SPECTRAL DENSITY**





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## **7.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND**

### **7.2.1. OUTPUT POWER**

#### **LIMITS**

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $4 \text{ dBm} + 10 \log B$ , where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 9.30 dBi.

#### **TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

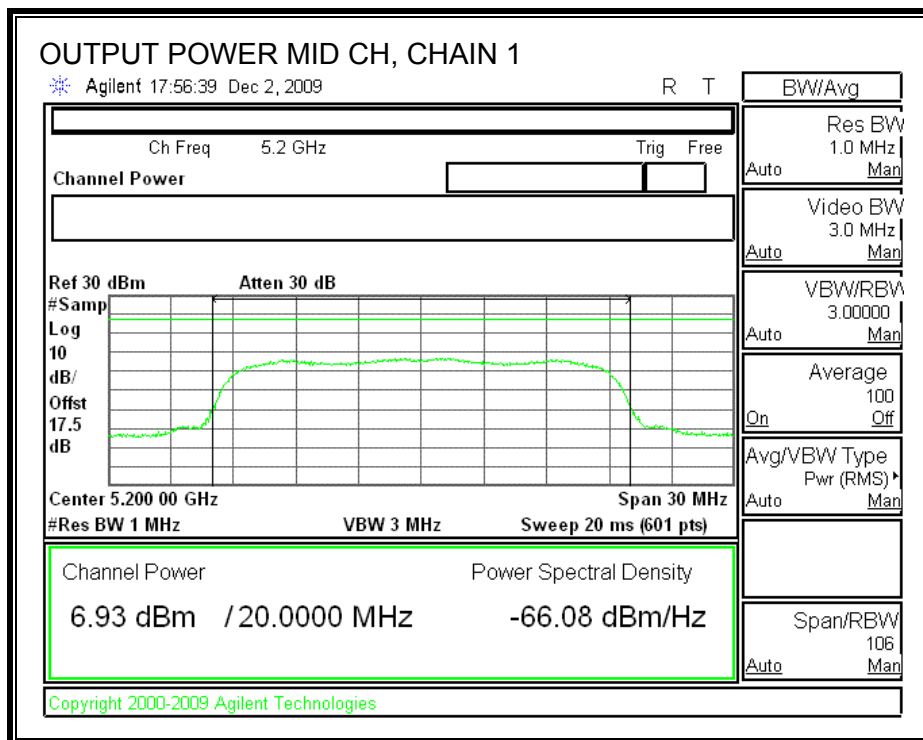
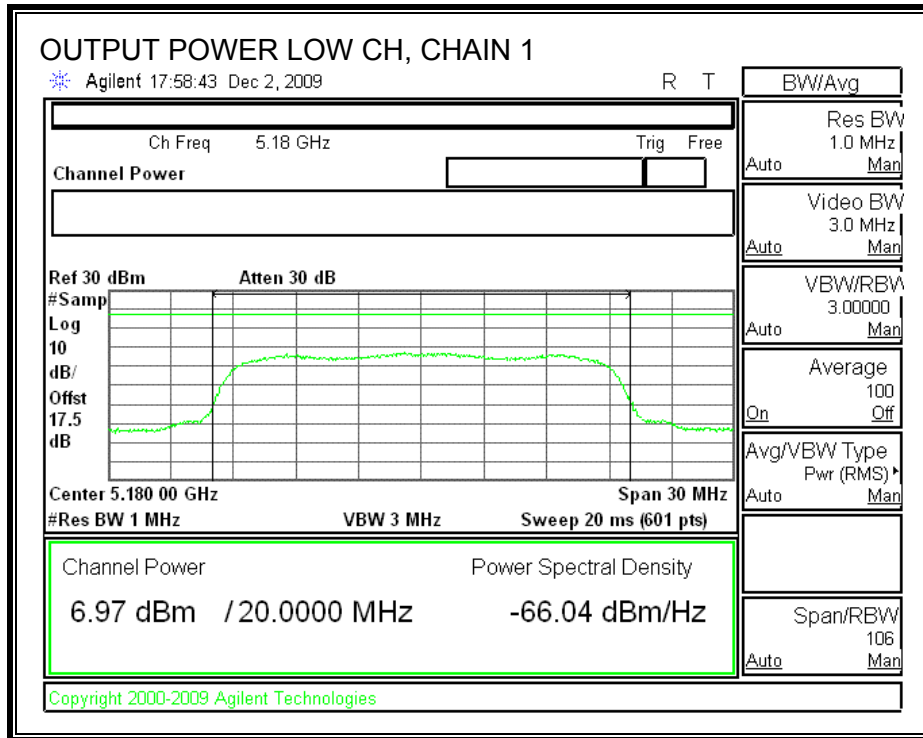
**Limit**

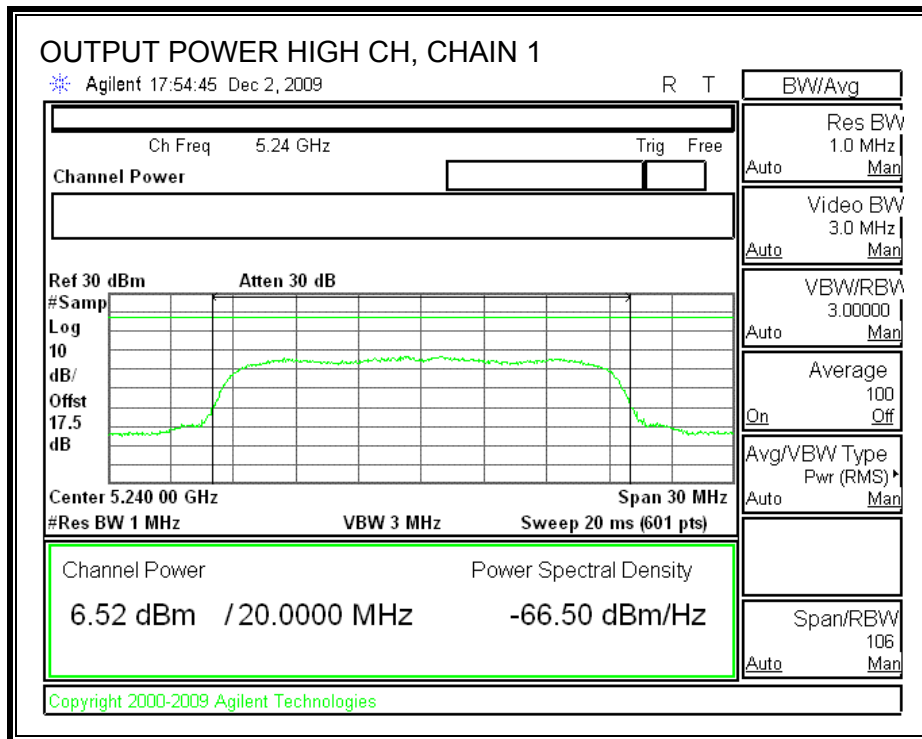
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	18.826	16.75	9.30	13.45
Mid	5200	17	19.162	16.82	9.30	13.52
High	5240	17	18.914	16.77	9.30	13.47

**Individual Chain Results**

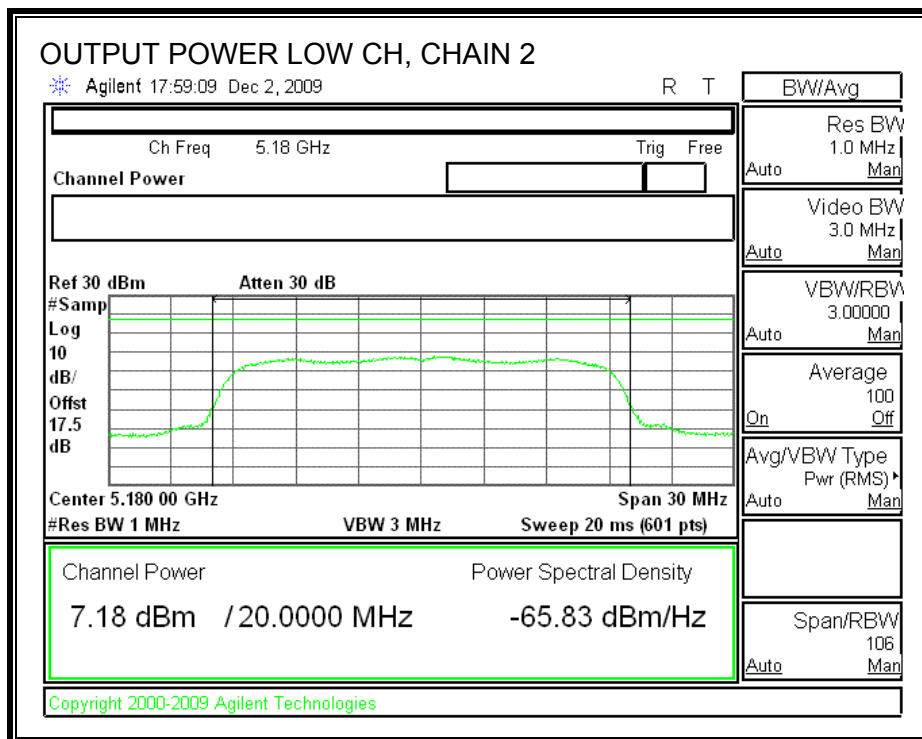
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	6.97	7.18	10.09	13.45	-3.36
Mid	5200	6.93	7.27	10.11	13.52	-3.41
High	5240	6.52	7.47	10.03	13.47	-3.44

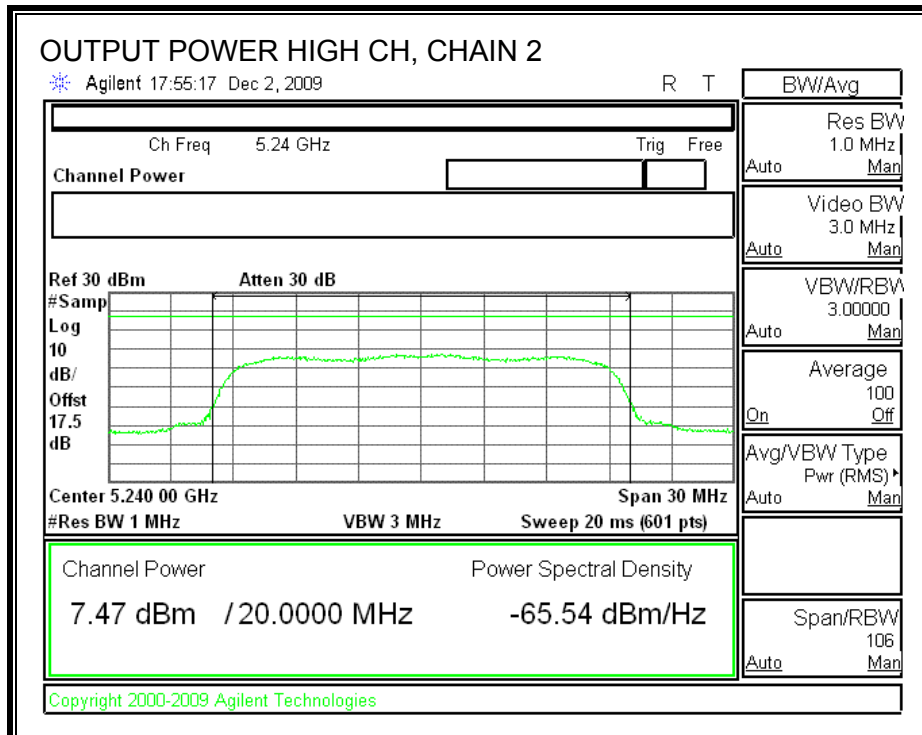
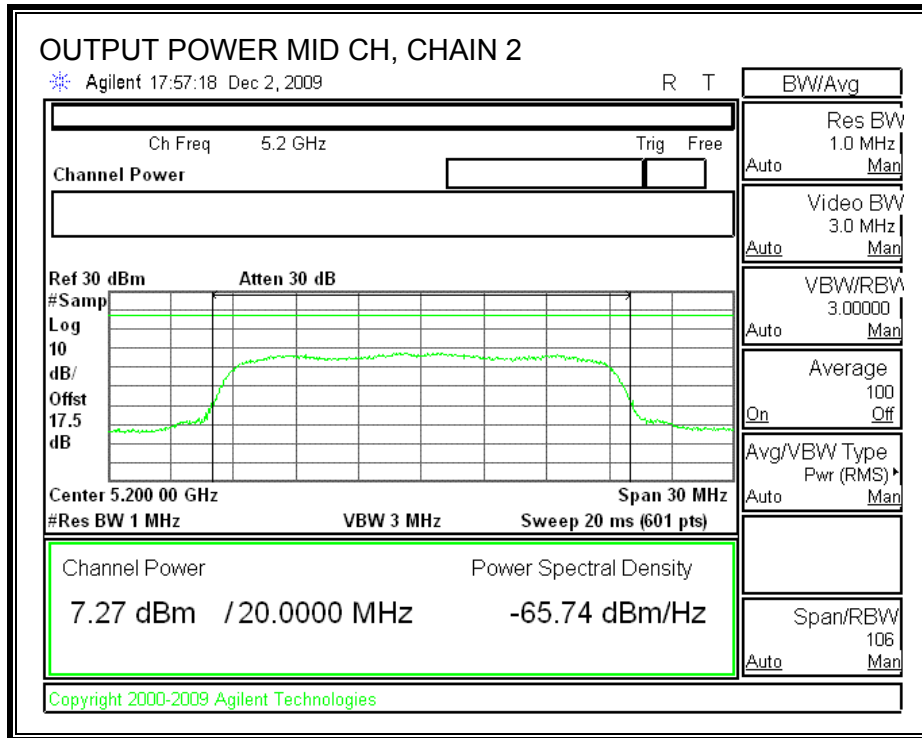
**CHAIN 1 OUTPUT POWER**





**CHAIN 2 OUTPUT POWER**





## 7.2.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 9.30 dBi, therefore the limit is .70 dBm.

### TEST PROCEDURE

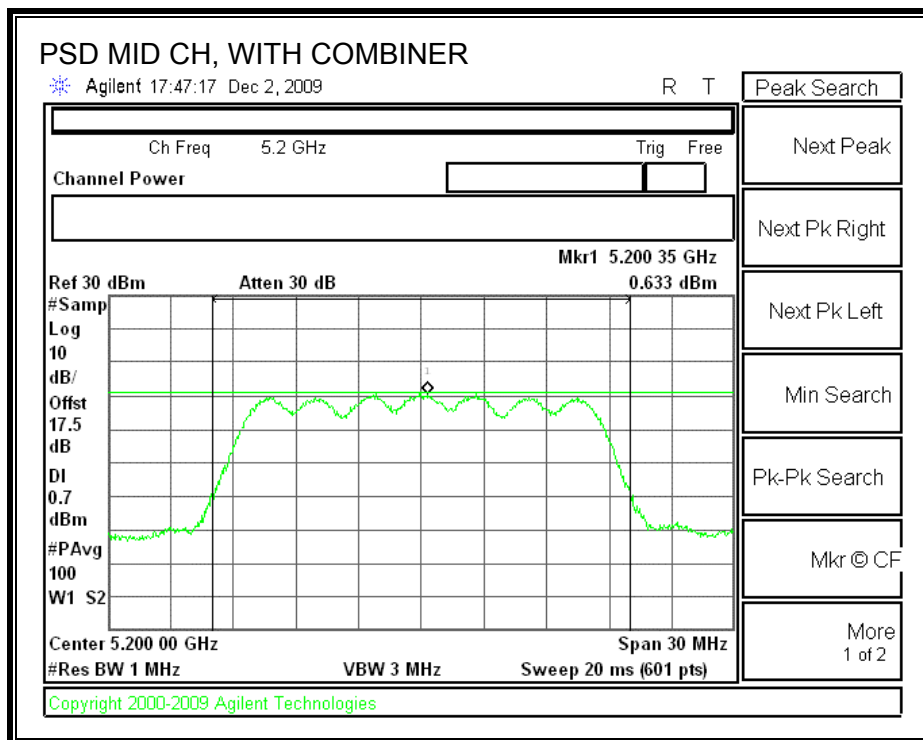
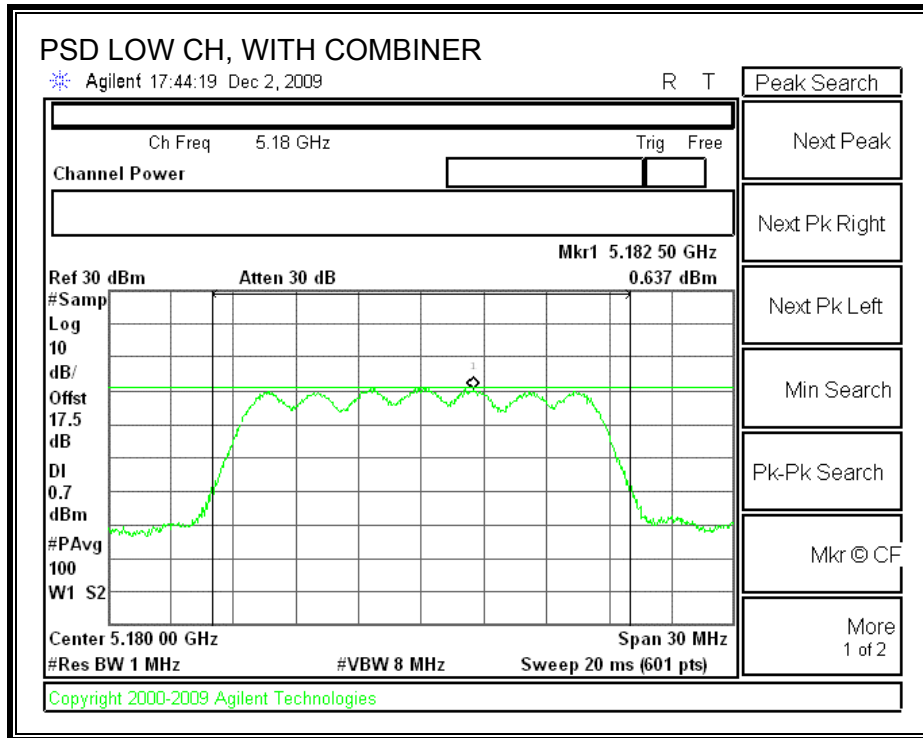
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

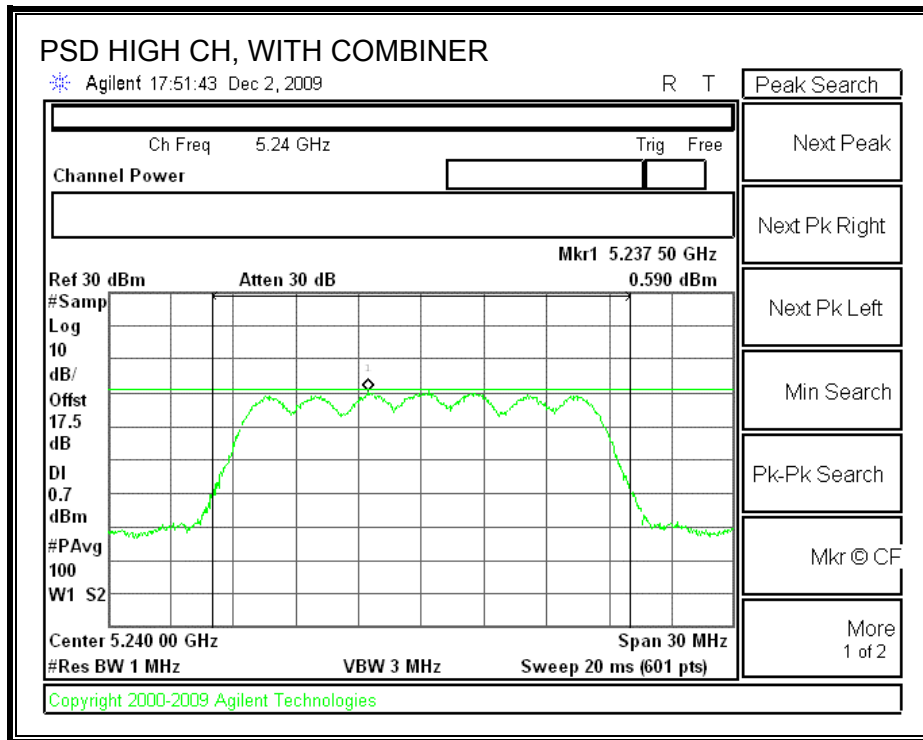
### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	0.64	0.70	-0.06
Middle	5200	0.63	0.70	-0.07
High	5240	0.59	0.70	-0.11



**POWER SPECTRAL DENSITY WITH COMBINER**





**7.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND**

**7.3.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 9.30 dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

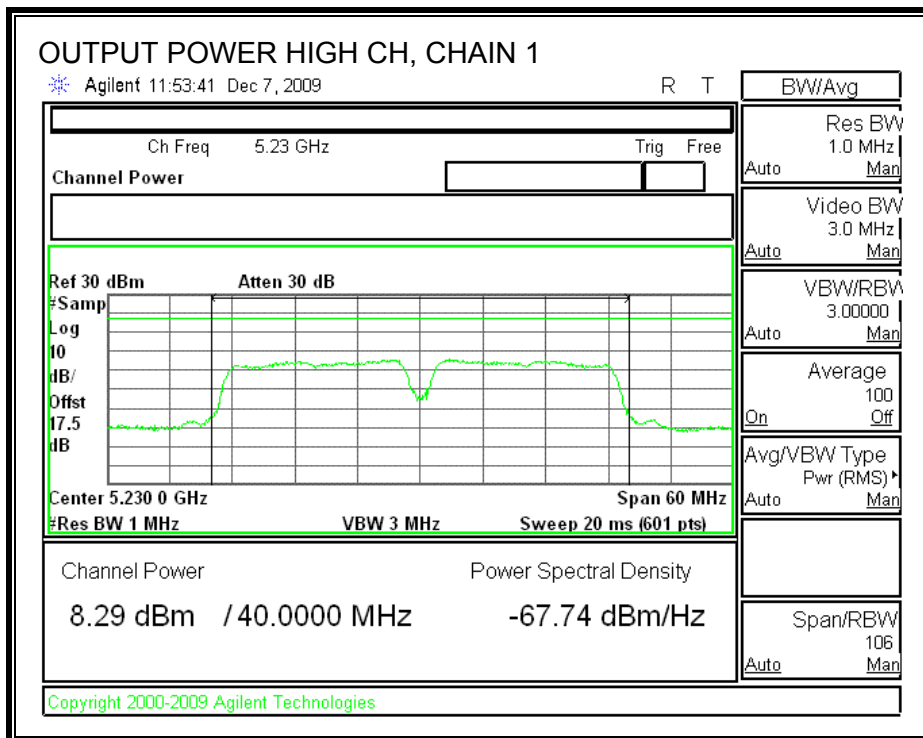
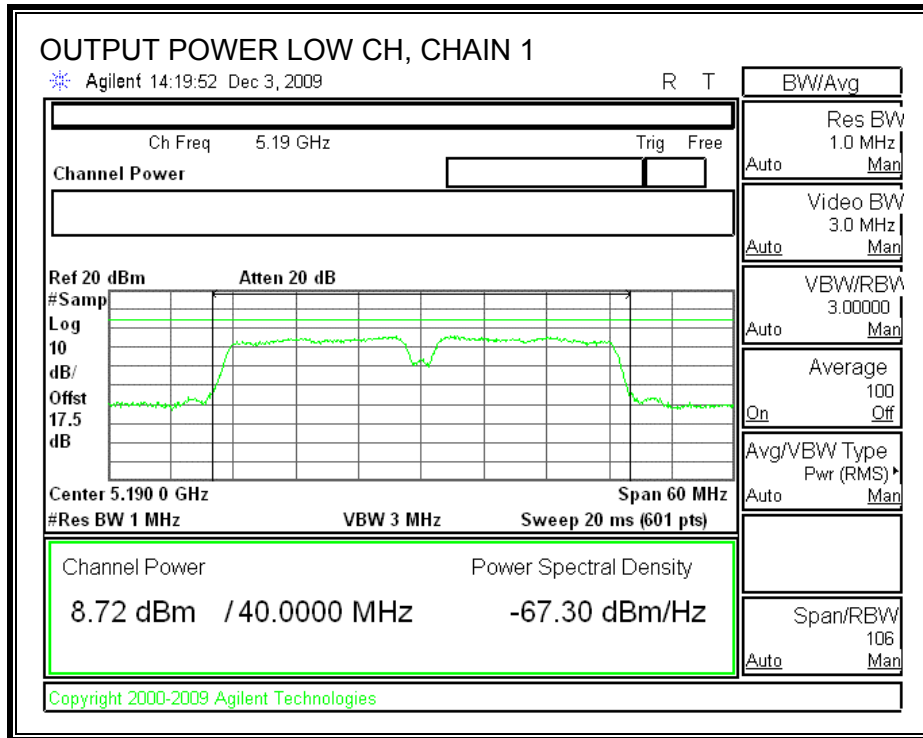
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	37.759	19.77	9.30	13.70
High	5230	17	37.678	19.76	9.30	13.70

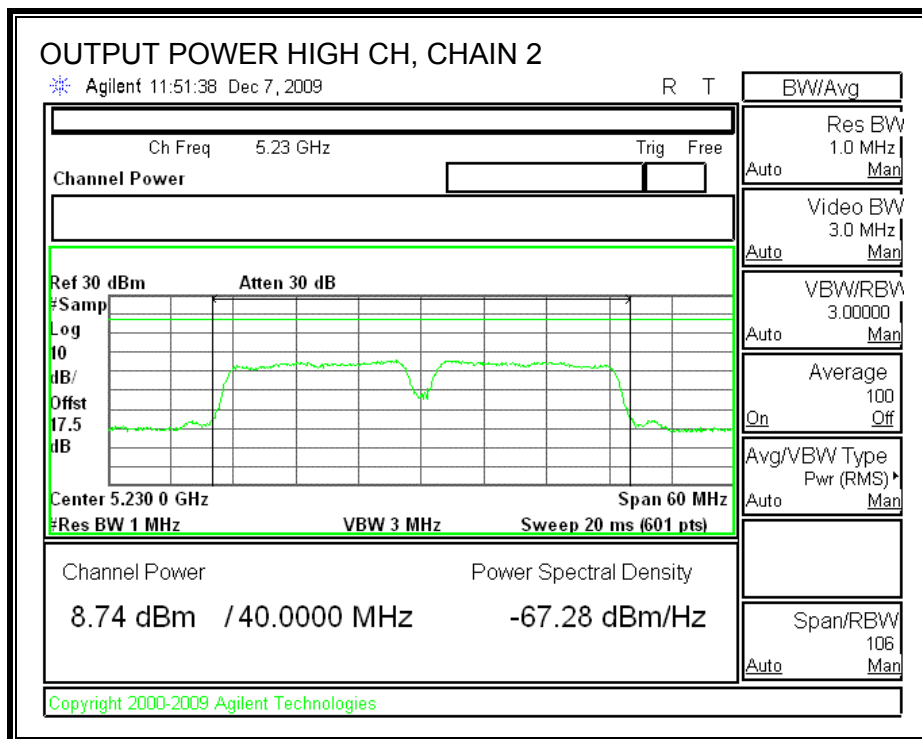
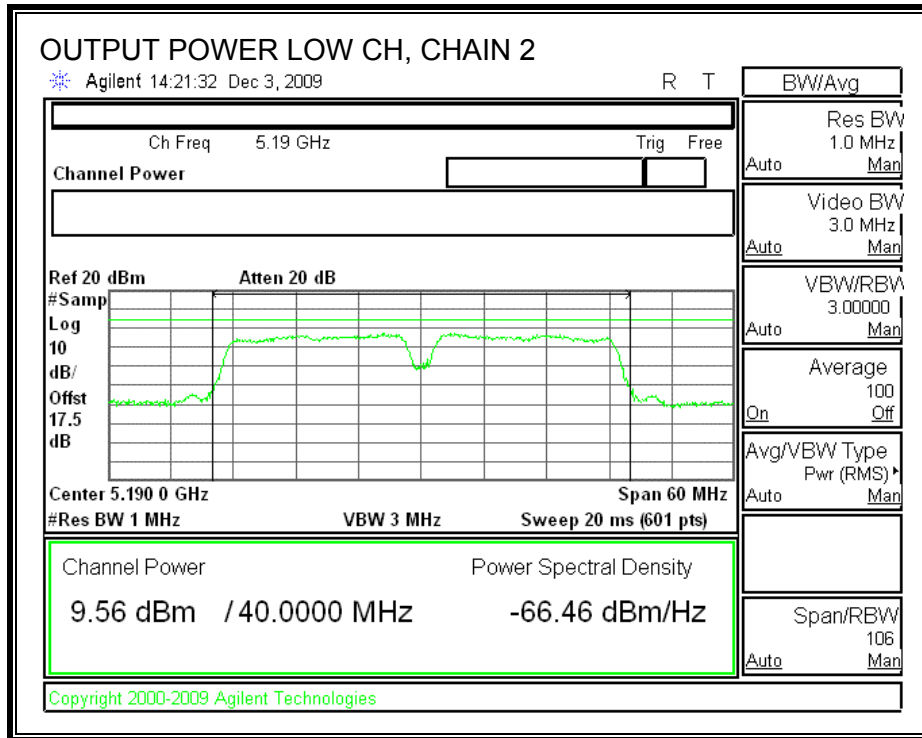
**Individual Chain Results**

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	8.72	9.56	12.17	13.70	-1.53
High	5230	8.29	8.74	11.53	13.70	-2.17

**CHAIN 1 OUTPUT POWER**



**CHAIN 2 OUTPUT POWER**



### 7.3.2. PEAK POWER SPECTRAL DENSITY

#### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 9.30 dBi, therefore the limit is 0.70 dBm.

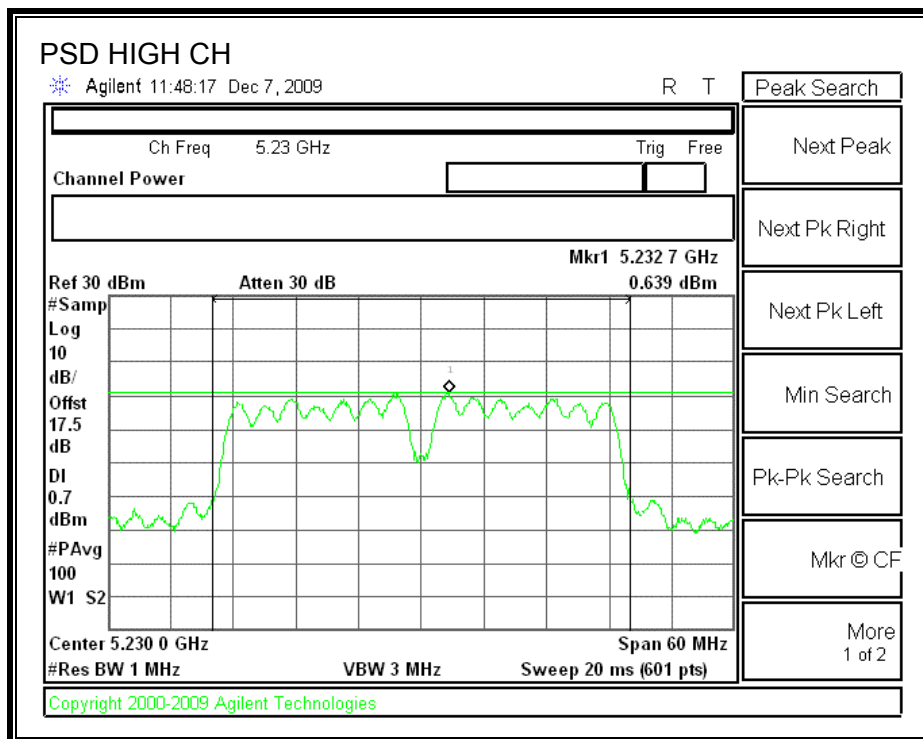
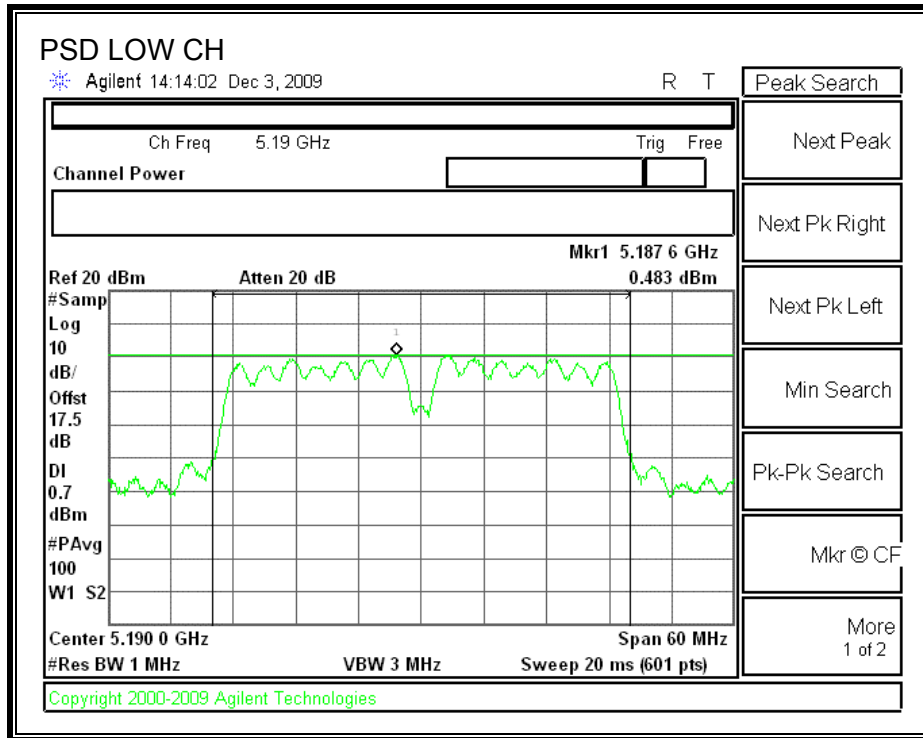
#### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

#### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5190	0.483	0.70	-0.22
High	5230	0.639	0.70	-0.06

**POWER SPECTRAL DENSITY**



### **7.3.3. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm / MHz.

#### **TEST PROCEDURE**

Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

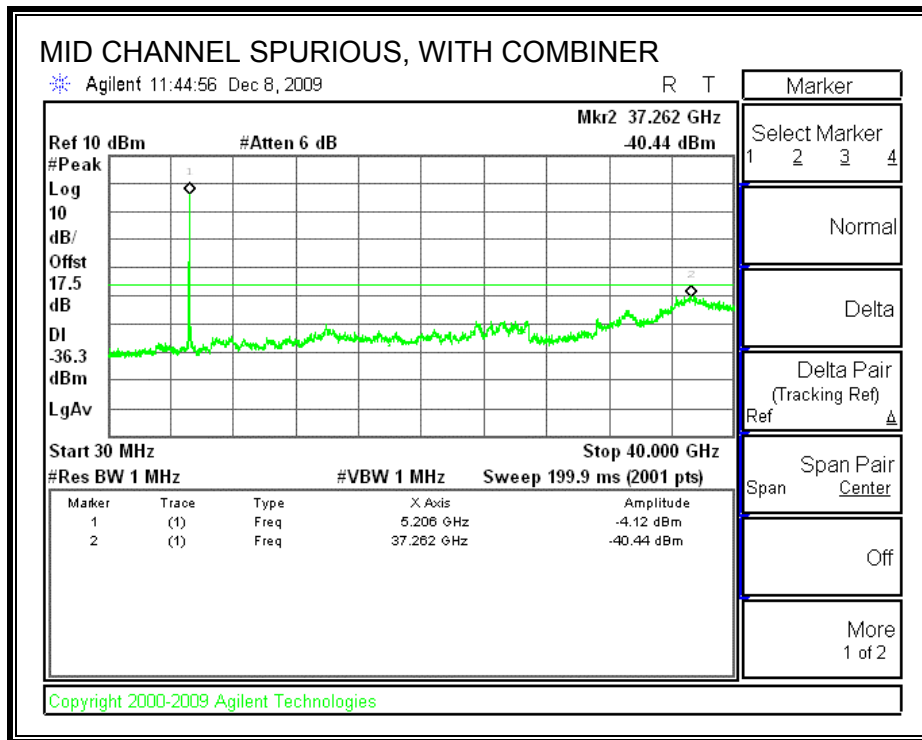
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.



**HT20 MODE, MID CHANNEL**

With combine antenna gain (9.30dBi) and highest power in 5.2GHz band (13dBm)



**7.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND**

**7.4.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 9.91 dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

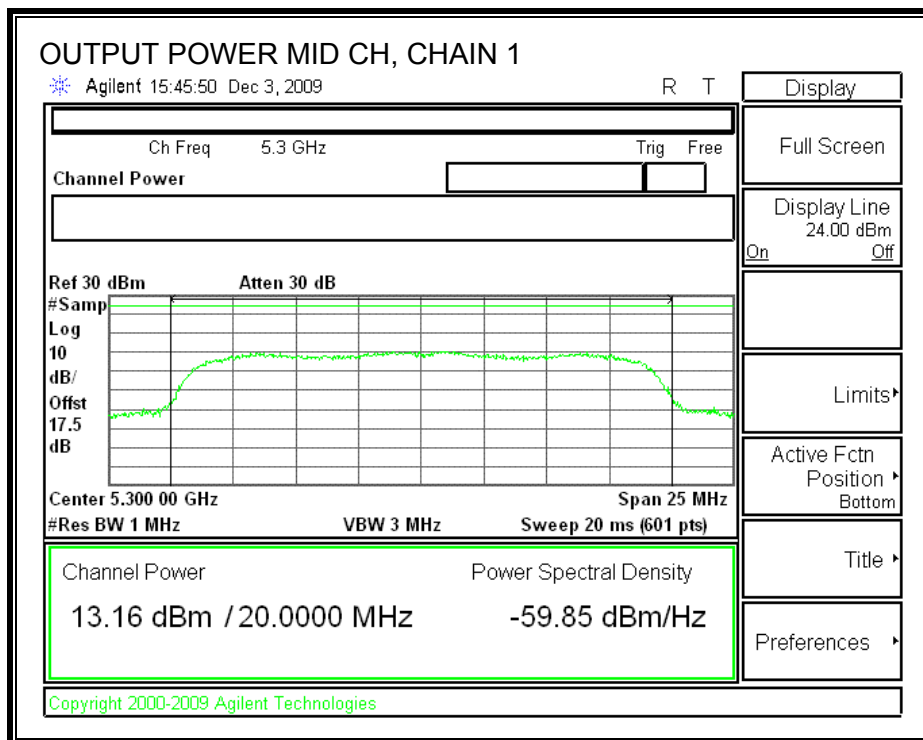
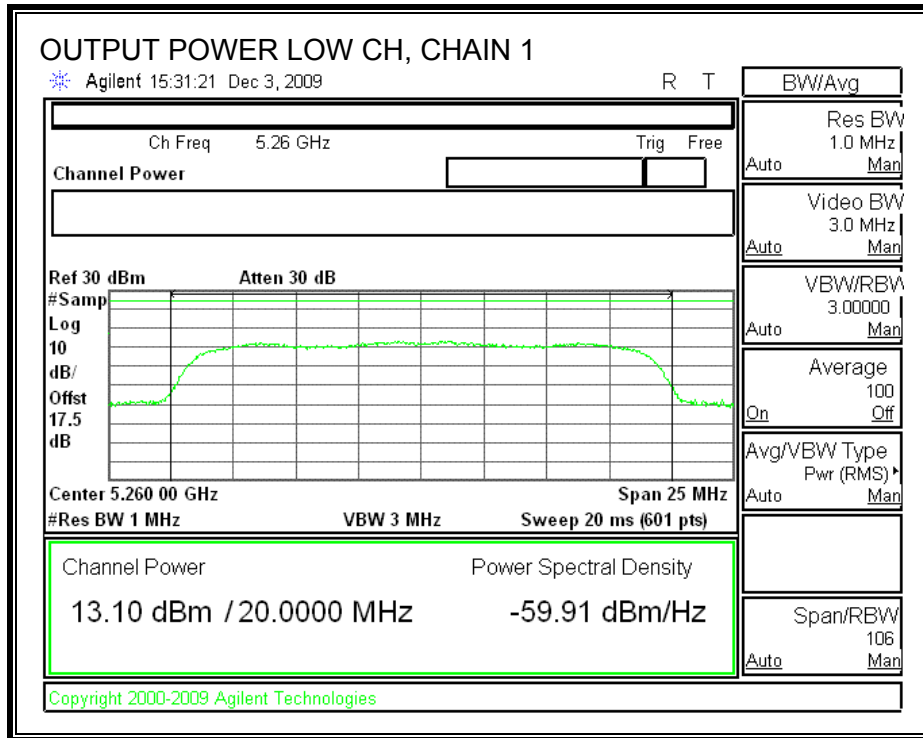
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24	19.011	23.79	9.91	19.88
Mid	5300	24	19.162	23.82	9.91	19.91

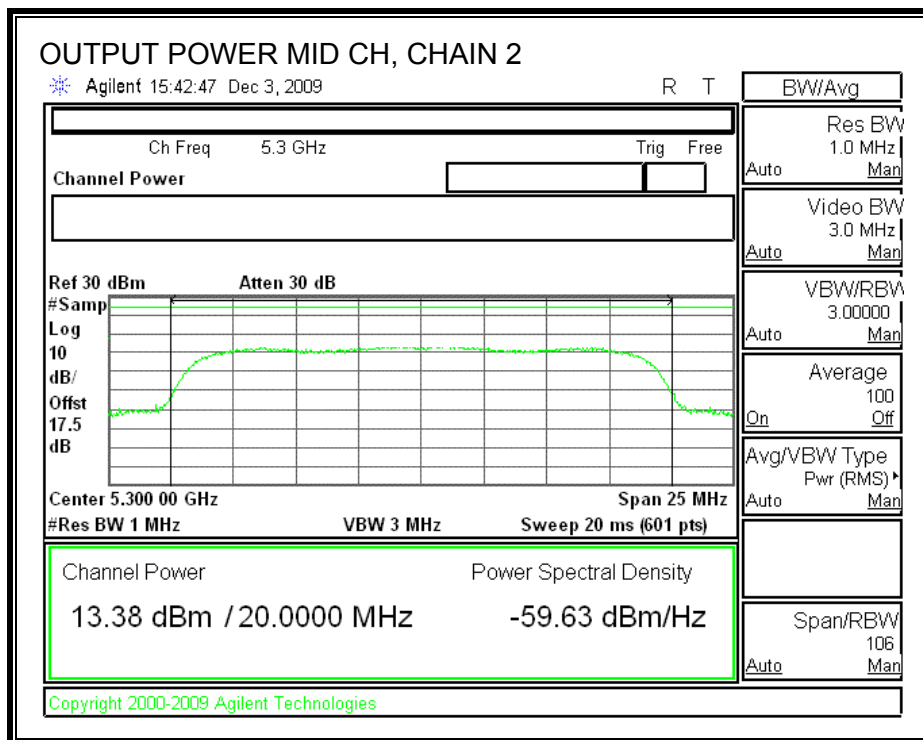
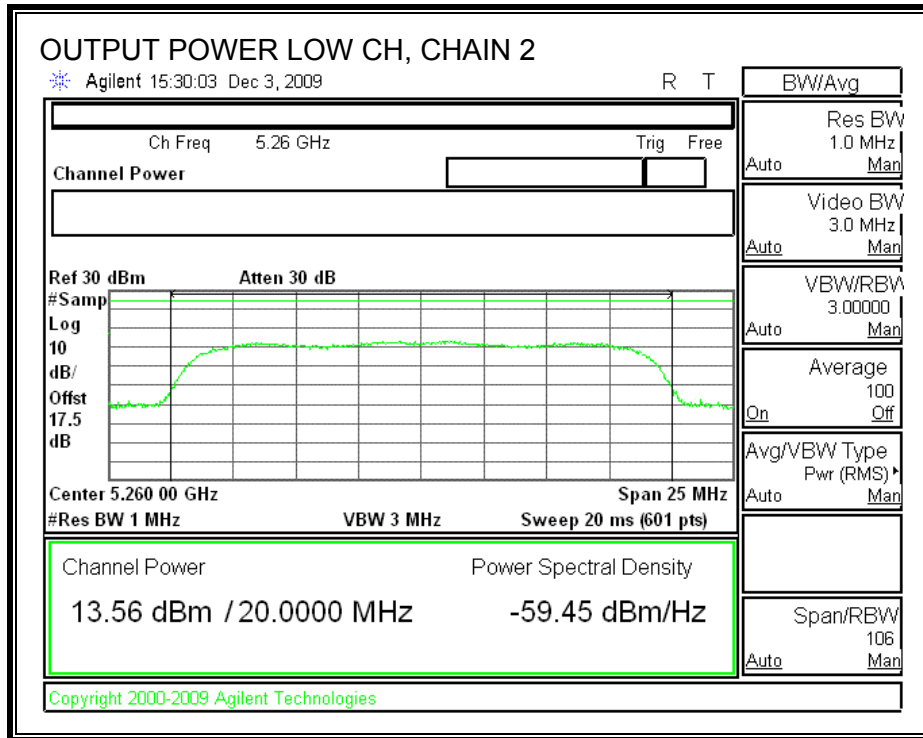
**Individual Chain Results**

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	13.10	13.56	16.35	19.88	-3.53
Mid	5300	13.16	13.38	16.28	19.91	-3.63

**CHAIN 1 OUTPUT POWER**



**CHAIN 2 OUTPUT POWER**



## 7.4.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is equal to 9.91 dBi, therefore the limit is 7.09 dBm.

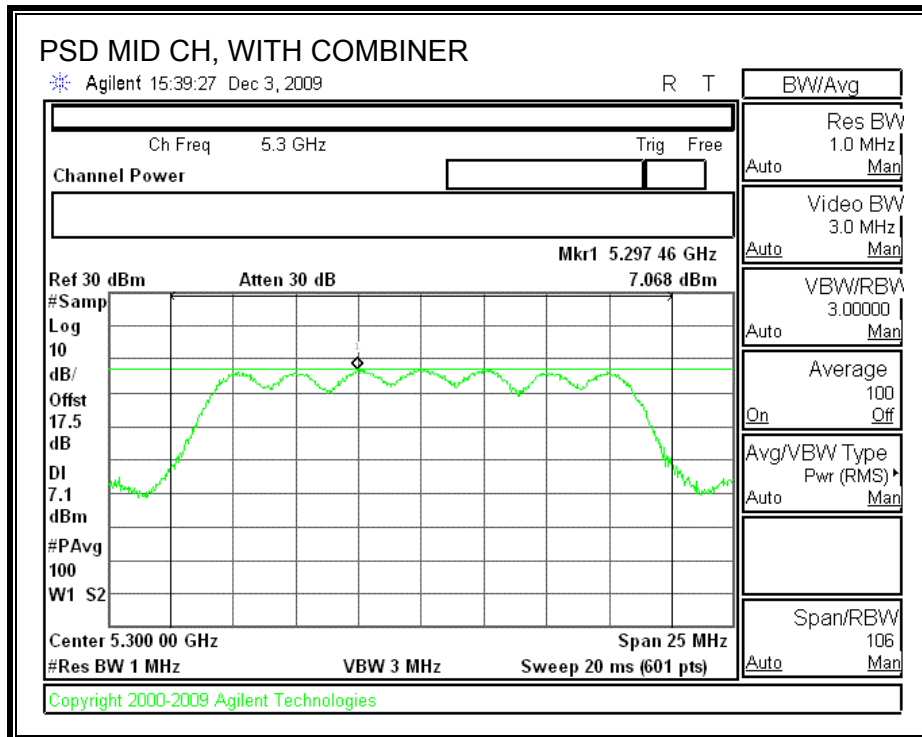
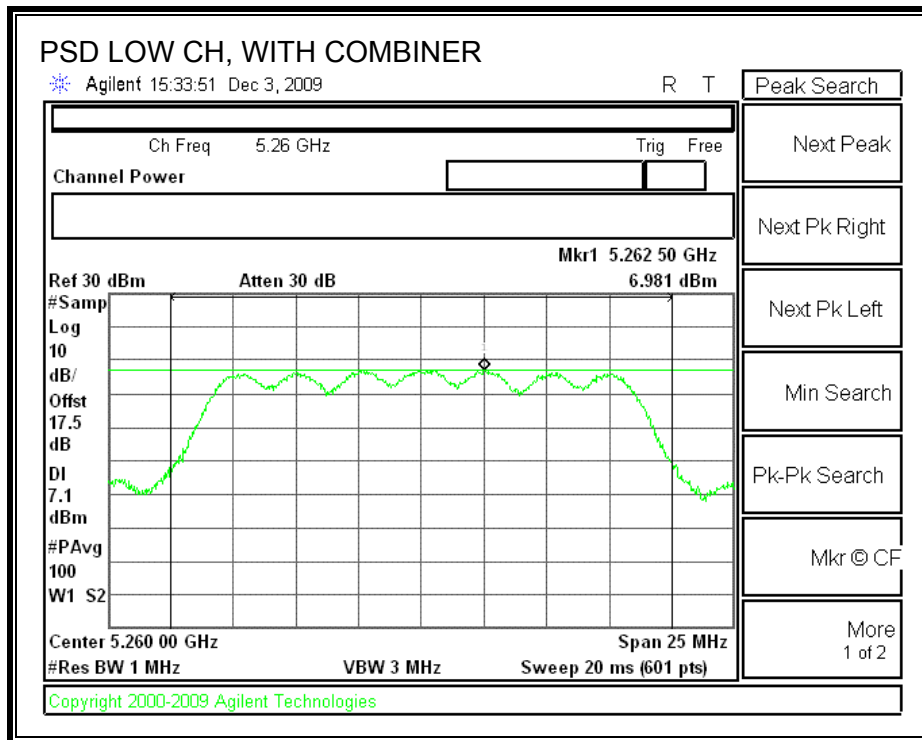
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5260	6.98	7.09	-0.11
Middle	5300	7.07	7.09	-0.02

**POWER SPECTRAL DENSITY WITH COMBINER**



**7.5. 802.11n HT40 SISO MODE IN THE 5.3 GHz BAND**

**7.5.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.25-5.35 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 6.98 dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

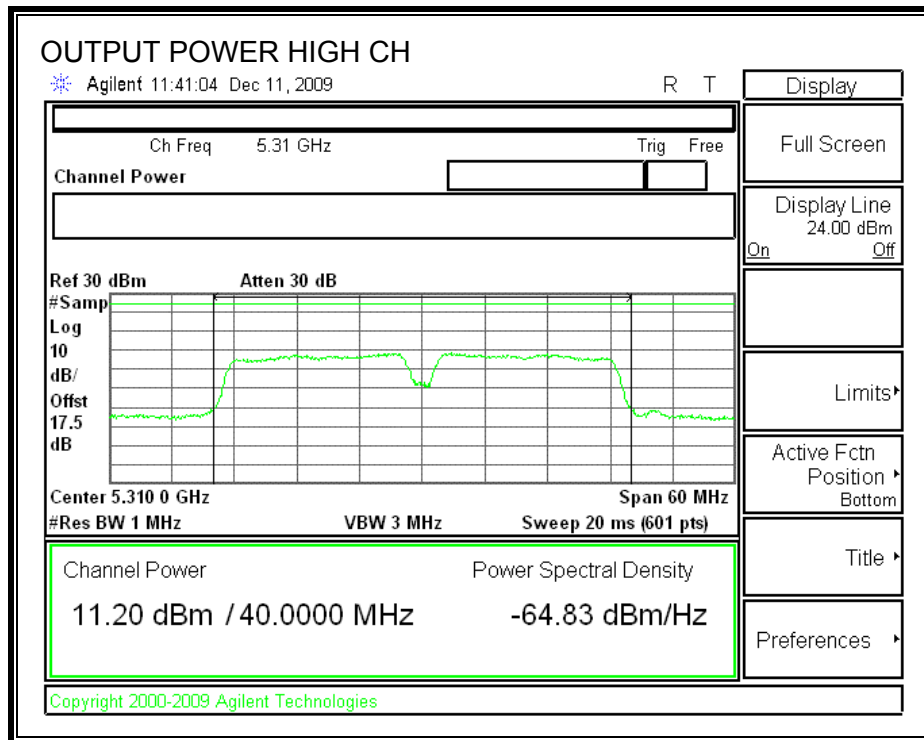
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
High	5310	24	37.897	19.79	6.98	18.81

**Results**

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
High	5310	11.20	18.81	-7.61

**OUTPUT POWER**





## 7.5.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.25-5.35 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 6.98 dBi; therefore the limit is 10.02 dBm.

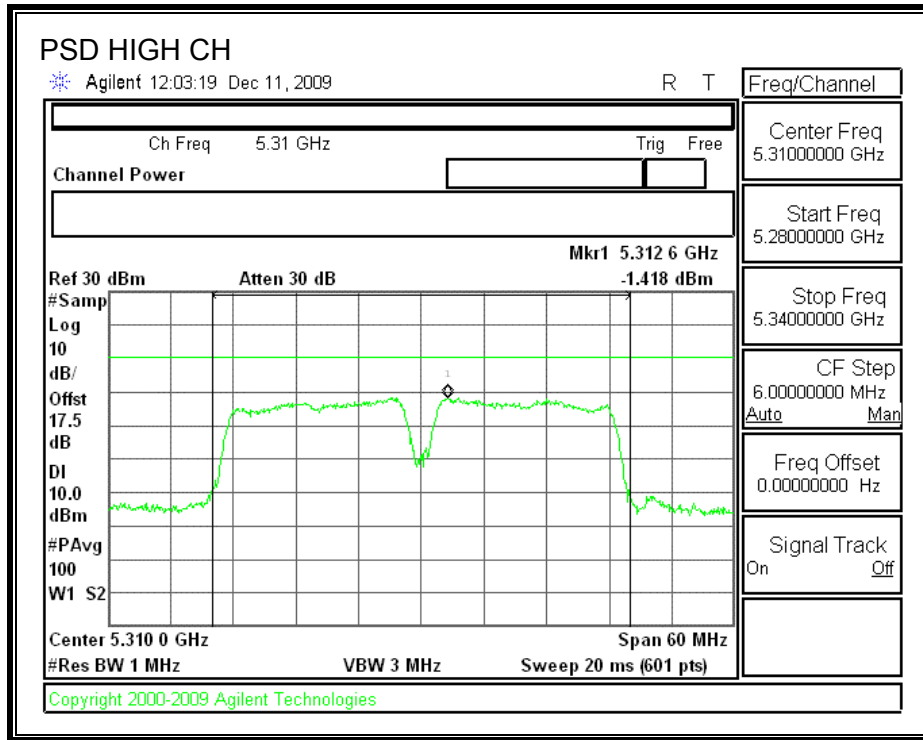
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
High	5310	-1.42	10.02	-11.44

**POWER SPECTRAL DENSITY**



**7.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND**

**7.6.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna is 9.91dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

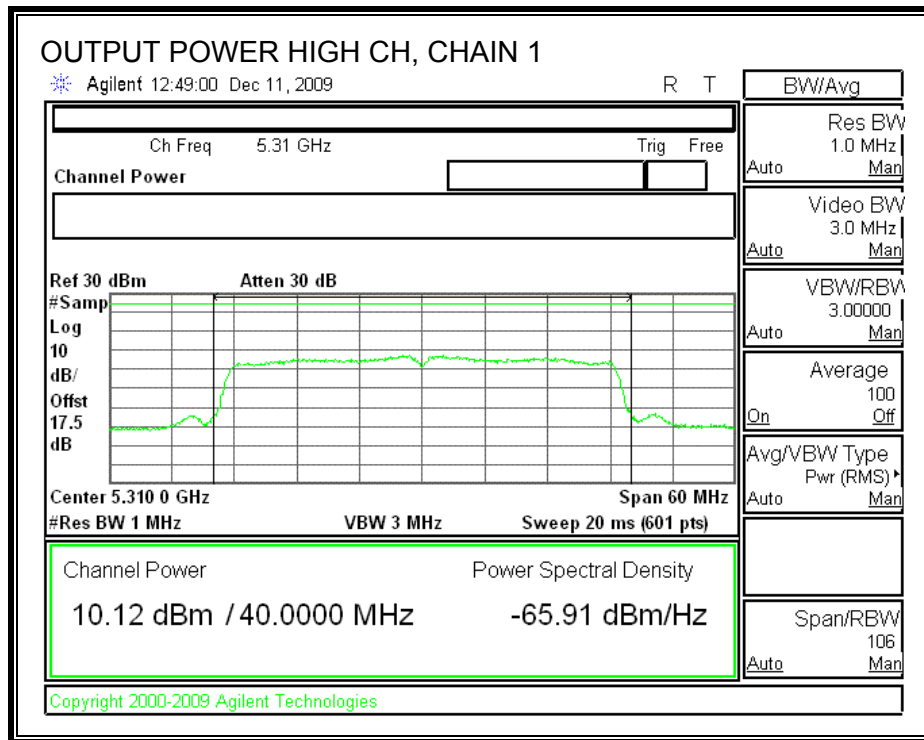
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
High	5310	24	38.499	26.85	9.91	20.09

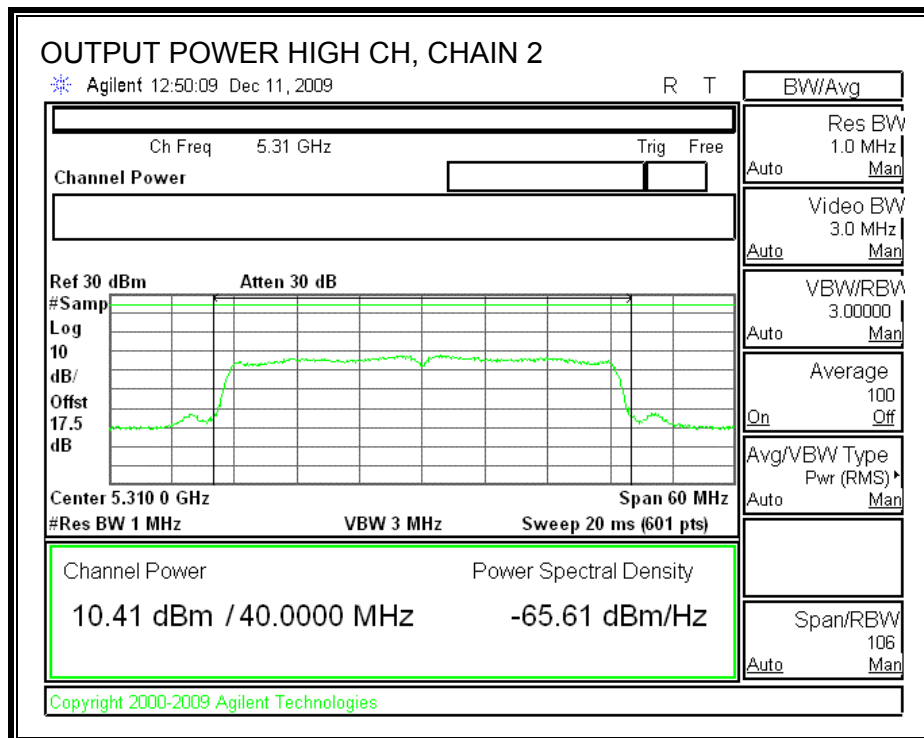
**Individual Chain Results**

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
High	5310	10.12	10.41	13.28	20.09	-6.81

**CHAIN 1 OUTPUT POWER**



**CHAIN 2 OUTPUT POWER**



## 7.6.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.25-5.35 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is equal to 9.91 dBi, therefore the limit is 7.09 dBm.

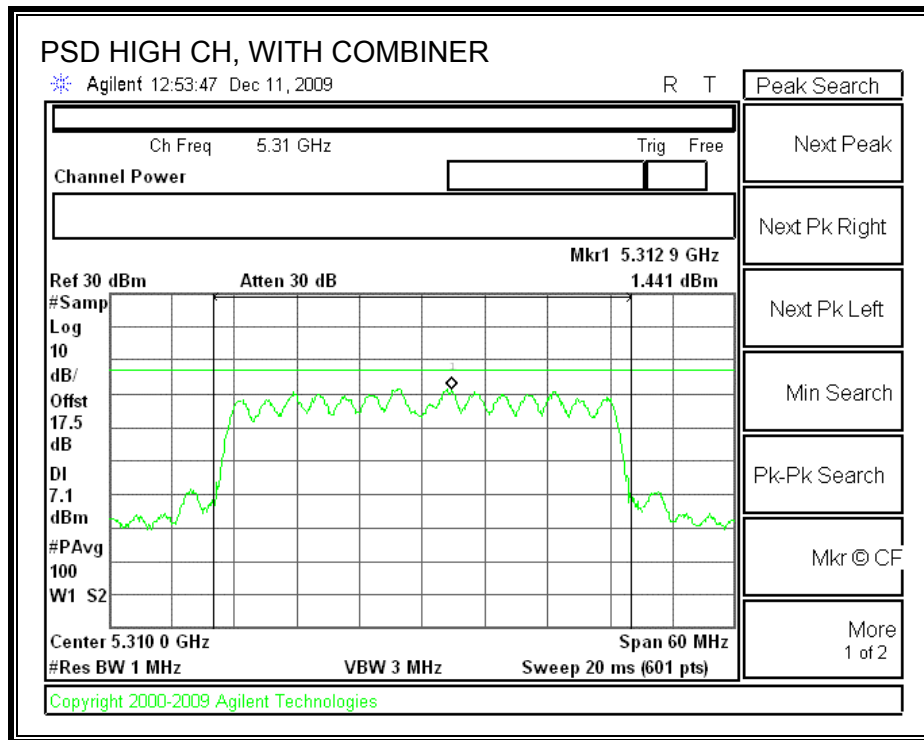
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
High	5310	1.44	7.09	-5.65

**POWER SPECTRAL DENSITY WITH COMBINER**



### **7.6.3. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.407 (b) (2)

IC RSS-210 A9.3 (2)

For transmitters operating in the 5.25-5.35 GHz band: all emissions outside of the 5.25-5.35 GHz band shall not exceed an EIRP of -27 dBm / MHz.

Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

#### **TEST PROCEDURE**

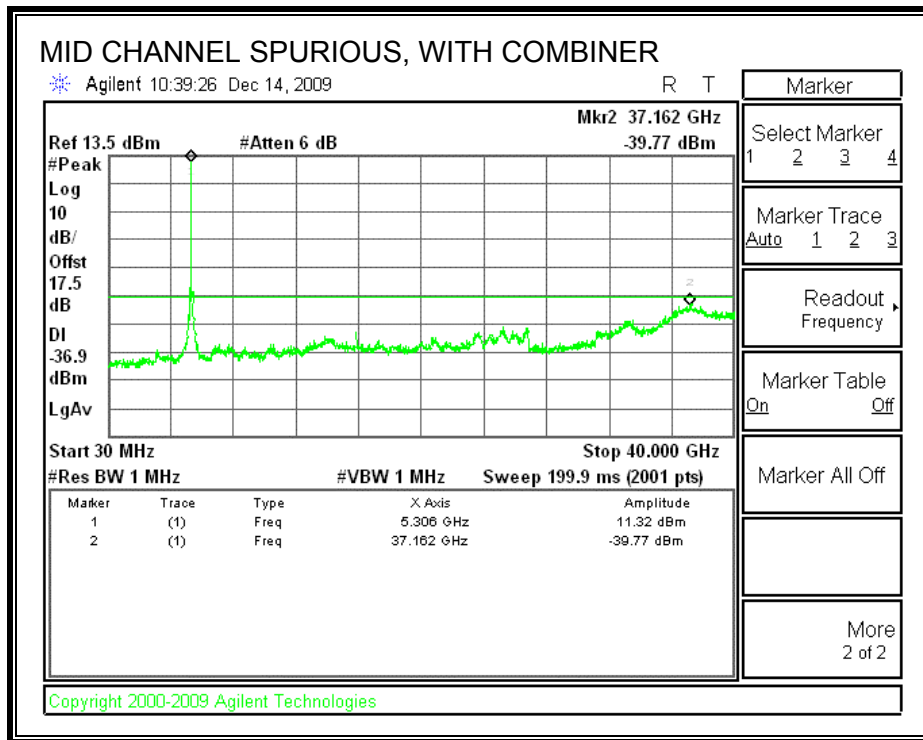
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

**HT20 MODE, MID CHANNEL**

With combine antenna gain (9.91dBi) and highest power in 5.3GHz band (13.5dBm)





**7.7. 802.11a MODE IN THE 5.6 GHz BAND**

**7.7.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 6.15dBi

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

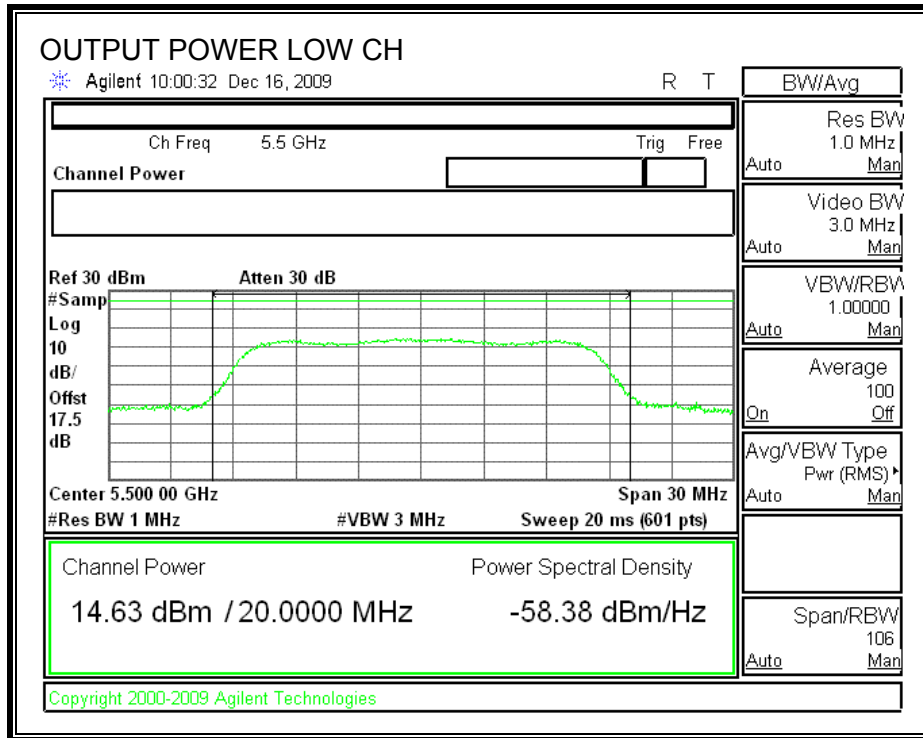
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	18.594	23.69	6.15	23.54

**Results**

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	14.63	23.54	-8.91

**OUTPUT POWER**



## 7.7.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is equal to 6.15 dBi, therefore the limit is 10.85 dBm.

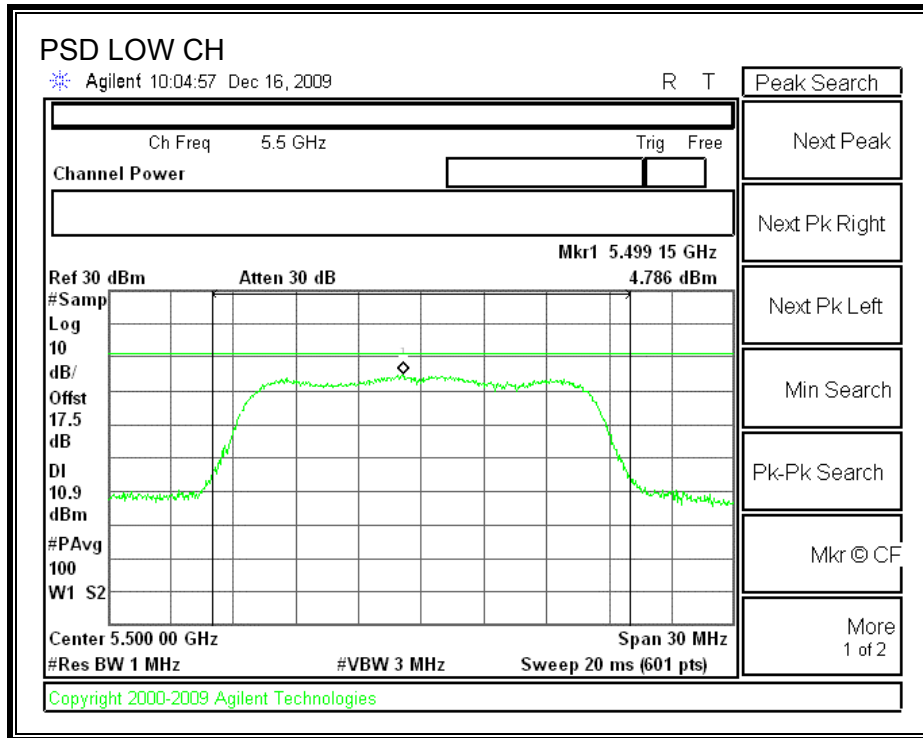
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	4.79	10.85	-6.06

**POWER SPECTRAL DENSITY**



**7.8. 802.11n HT20 MODE IN THE 5.6 GHz BAND**

**7.8.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 9.10dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

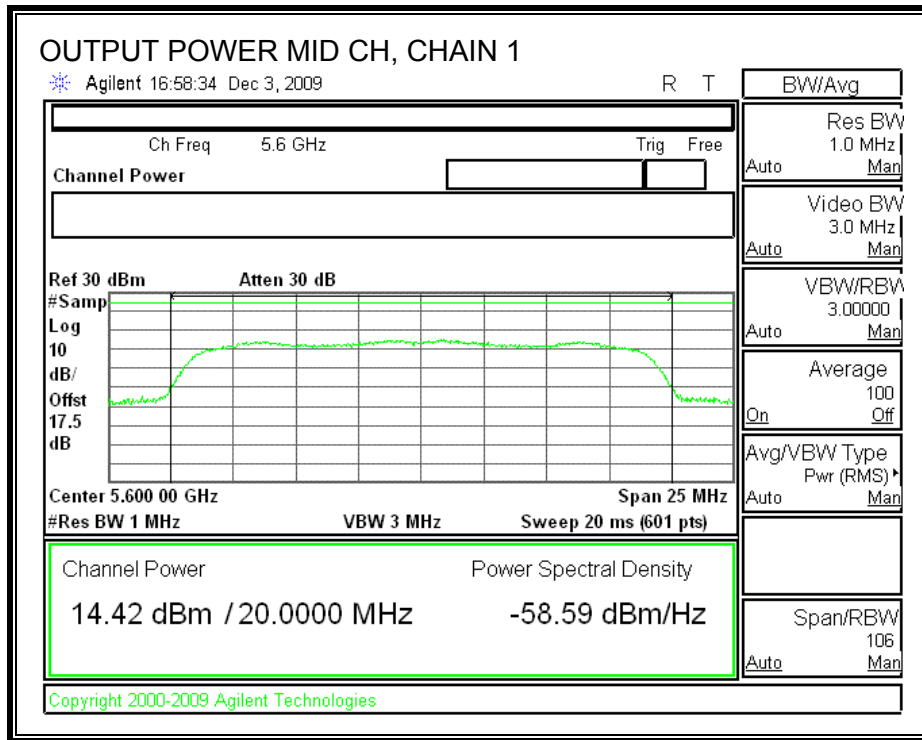
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5600	24	19.792	23.96	9.10	20.86

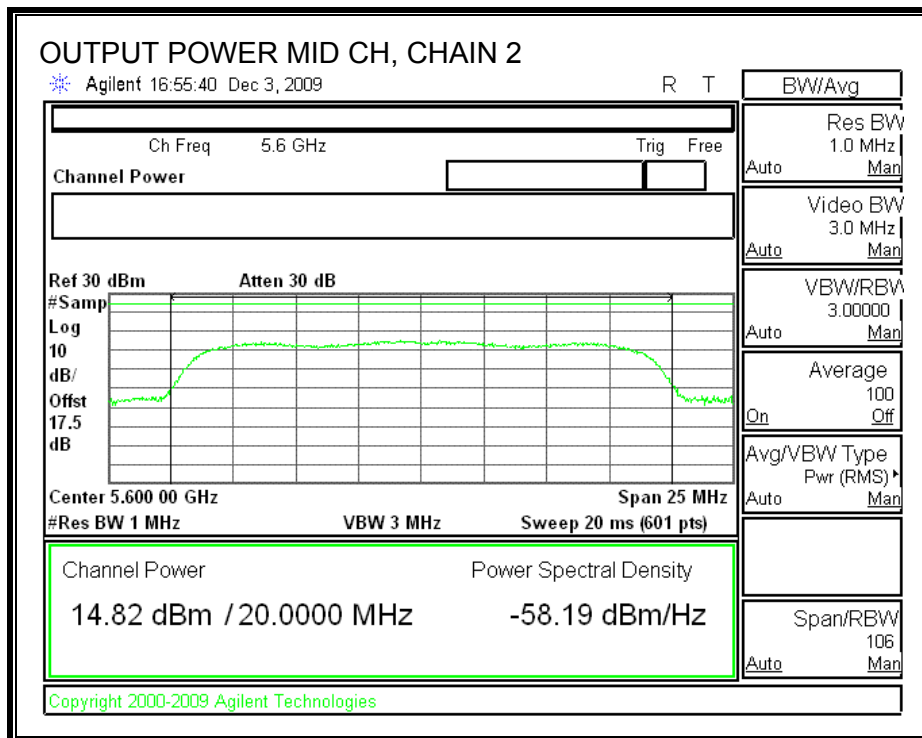
**Individual Chain Results**

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Mid	5600	14.42	14.82	17.63	20.86	-6.44

**CHAIN 1 OUTPUT POWER**



**CHAIN 2 OUTPUT POWER**



## 7.8.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is equal to 9.10 dBi, therefore the limit is 7.90 dBm.

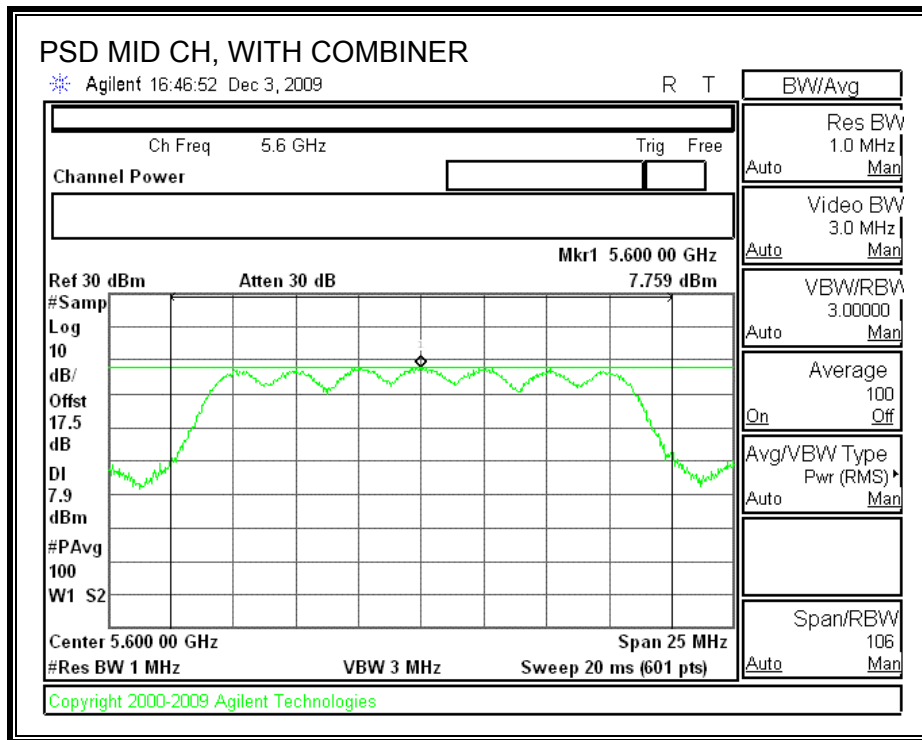
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Middle	5600	7.76	7.90	-0.14

**POWER SPECTRAL DENSITY WITH COMBINER**





**7.9. 802.11n HT40 SISO MODE IN THE 5.6 GHz BAND**

**7.9.1. OUTPUT POWER**

**LIMITS**

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.47-5.725 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 6.15 dBi.

**TEST PROCEDURE**

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

**RESULTS**

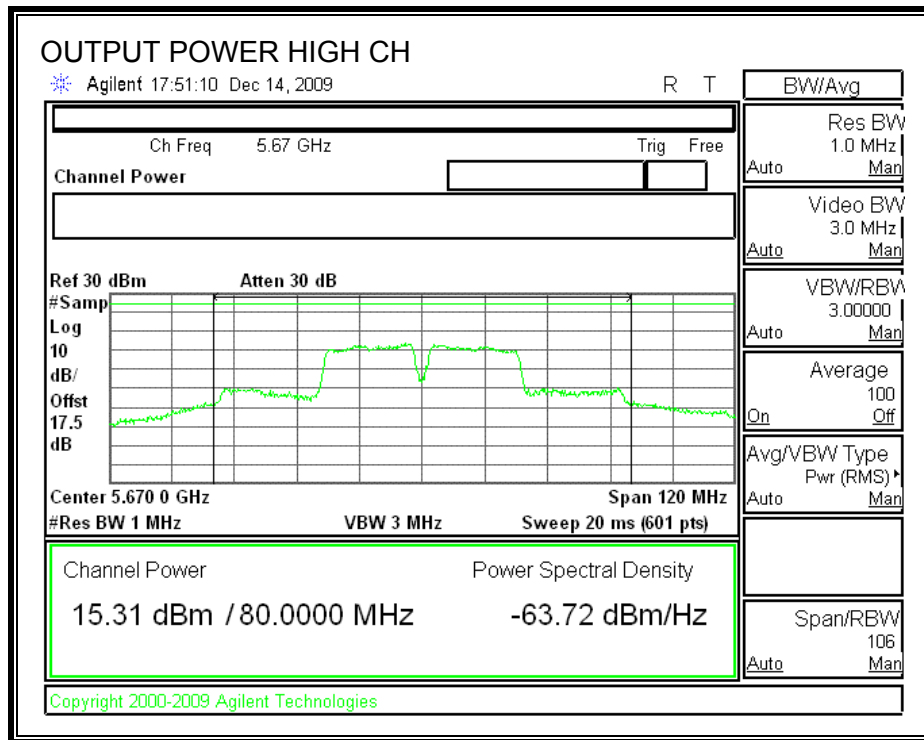
**Limit**

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
High	5670	24	75.895	22.80	6.15	22.65

**Results**

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
High	5670	15.31	22.65	-7.34

**OUTPUT POWER**



## 7.9.2. PEAK POWER SPECTRAL DENSITY

### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.47-5.725 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The composite antenna gain is 6.15 dBi, therefore the limit is 10.85 dBm.

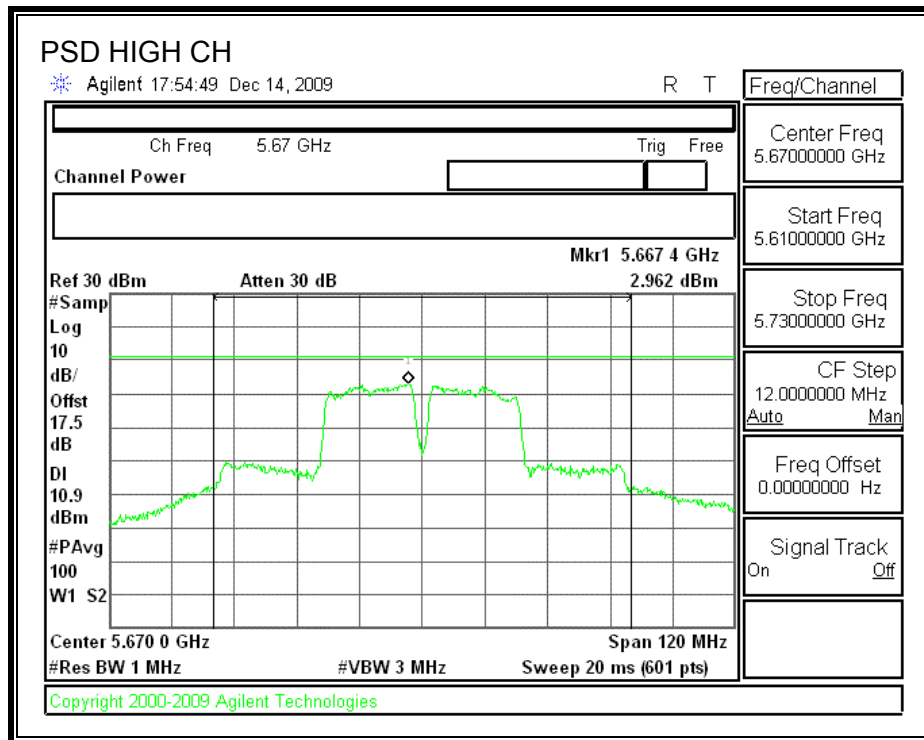
### TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
High	5670	2.96	10.85	-7.89

**POWER SPECTRAL DENSITY**



### **7.9.3. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm / MHz.

#### **TEST PROCEDURE**

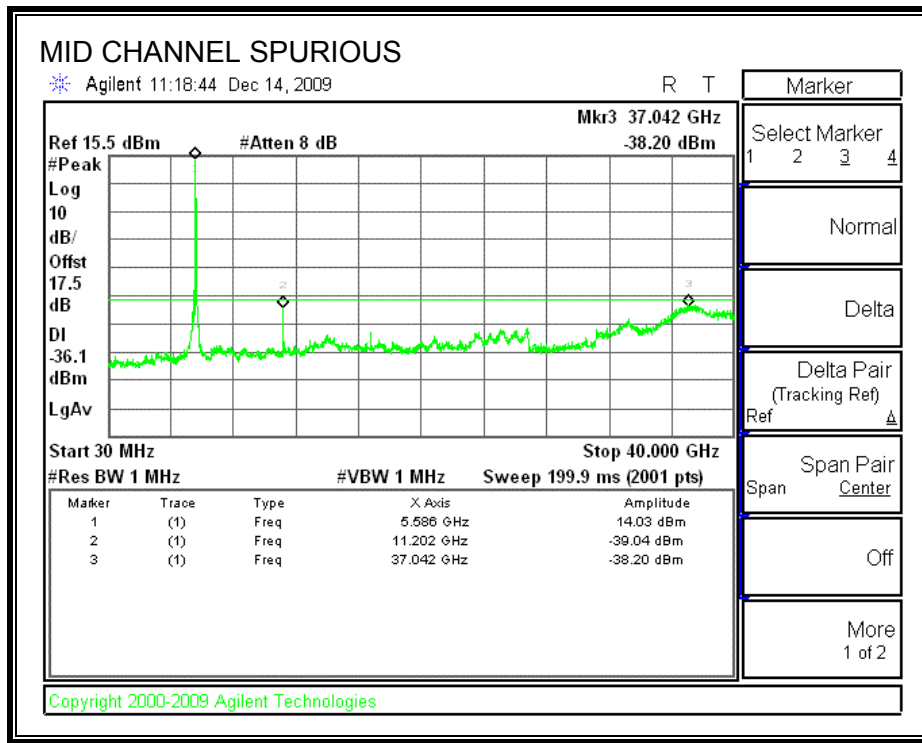
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

**HT20 MODE, MID CHANNEL**

With combine antenna gain (9.10dBi) and highest power in 5.6GHz band (15dBm)



## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

#### TEST PROCEDURE

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

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

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

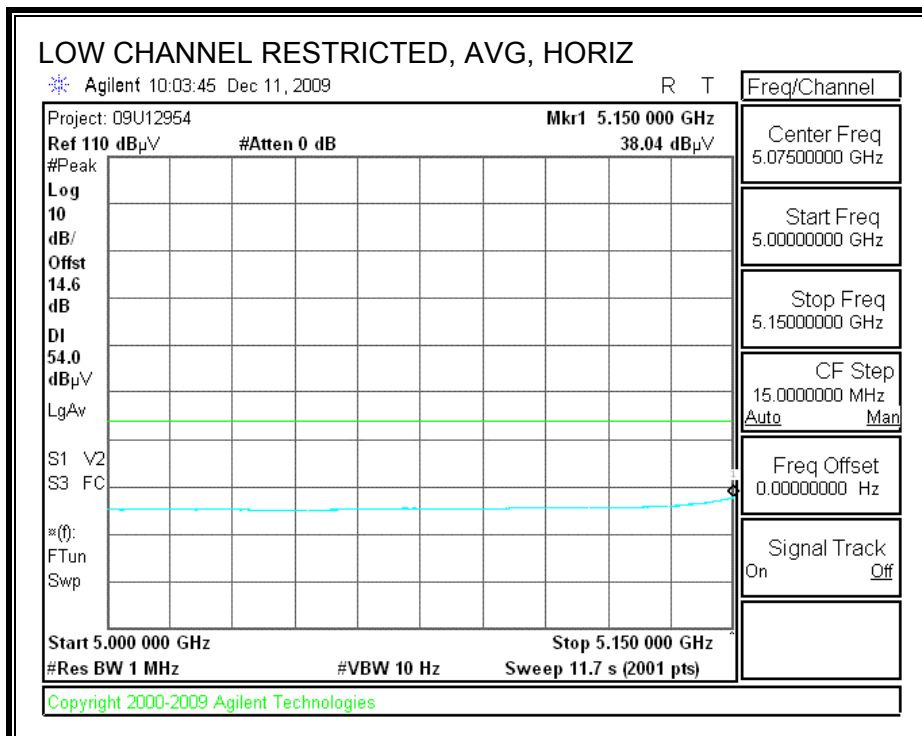
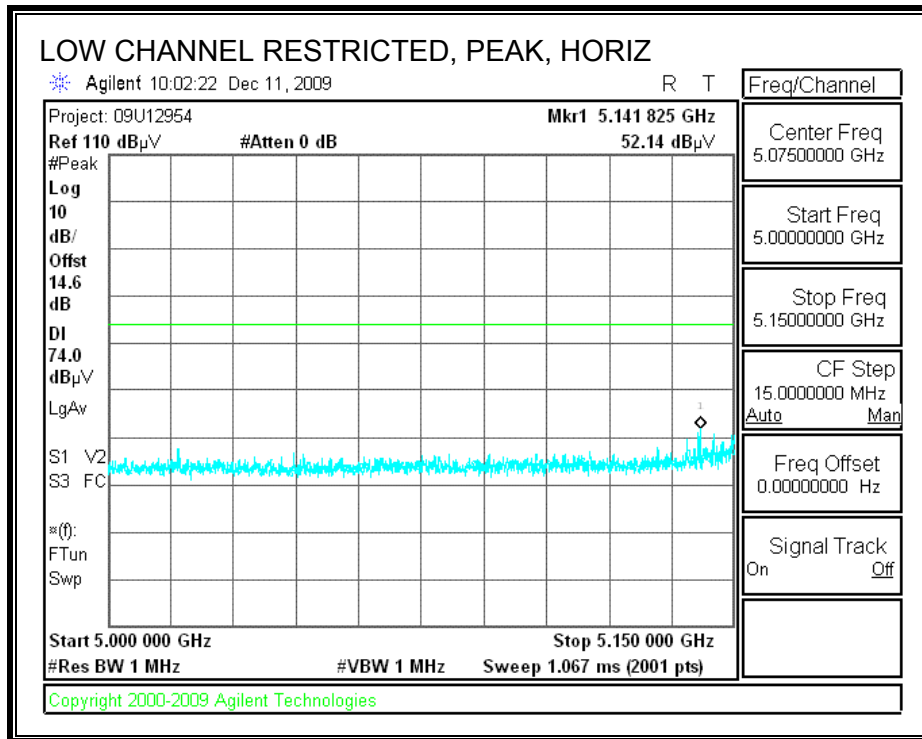
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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

## 8.2. TRANSMITTER ABOVE 1 GHz

### 8.2.1. 802.11a MODE IN THE LOWER 5.2 GHz BAND

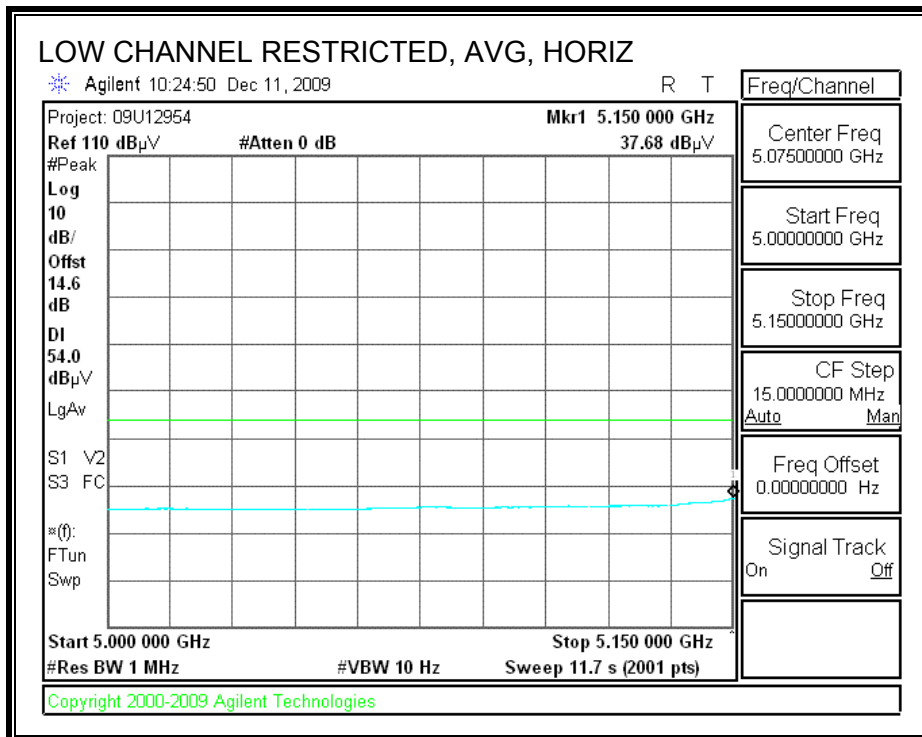
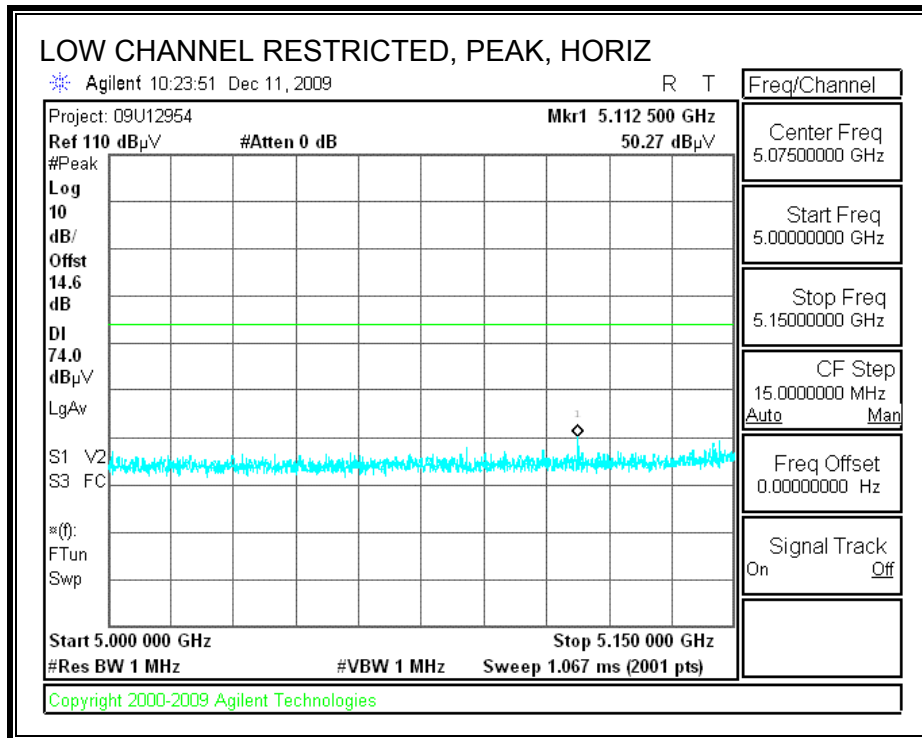
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





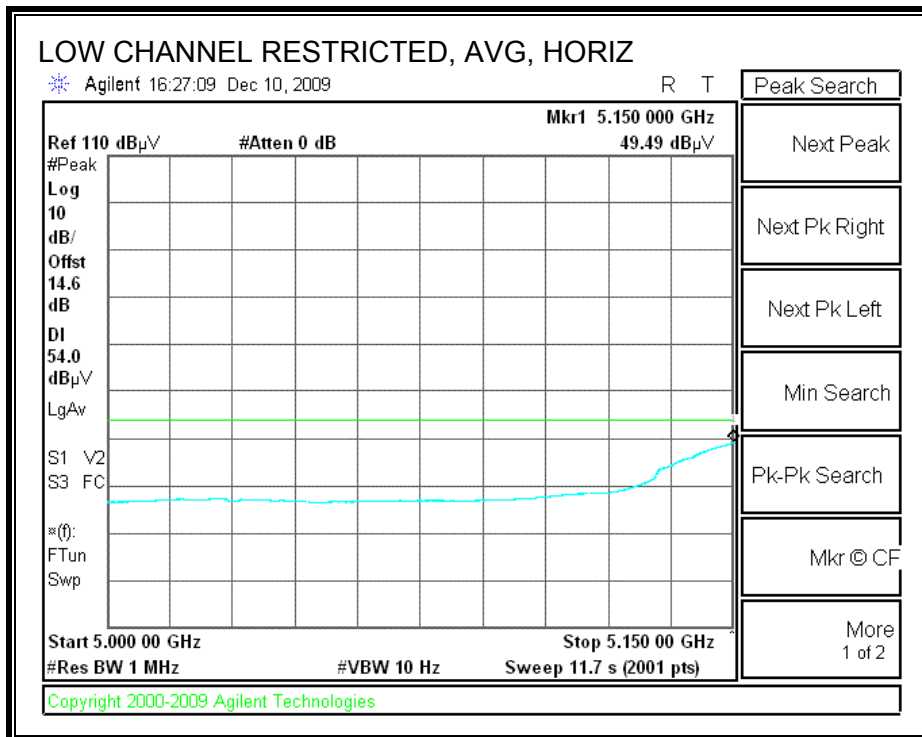
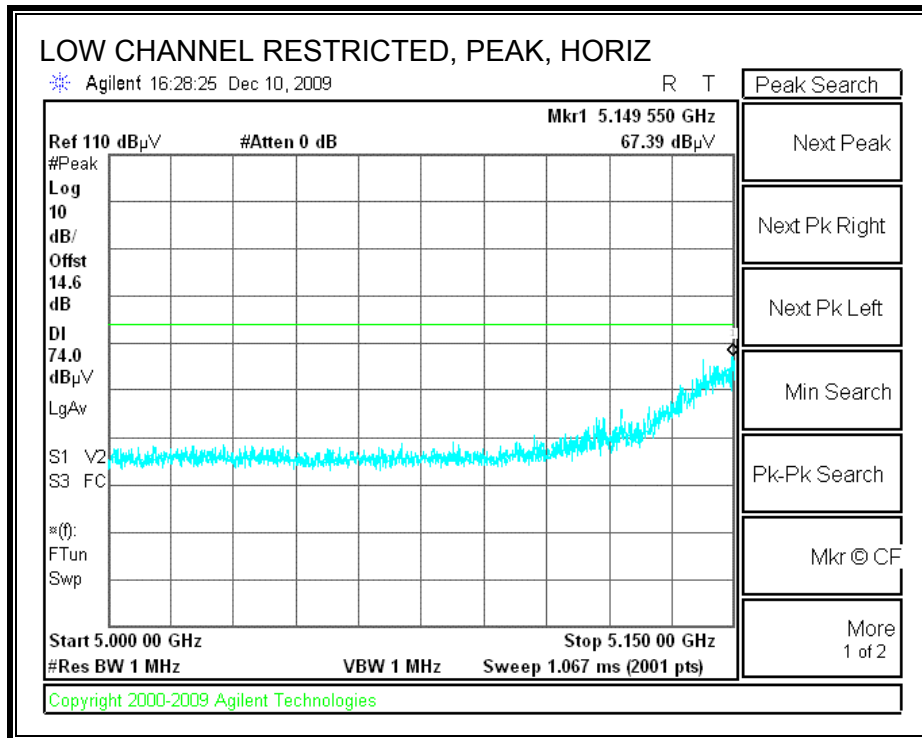
### 8.2.2. 802.11n HT20 MODE IN THE LOWER 5.2 GHz BAND

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



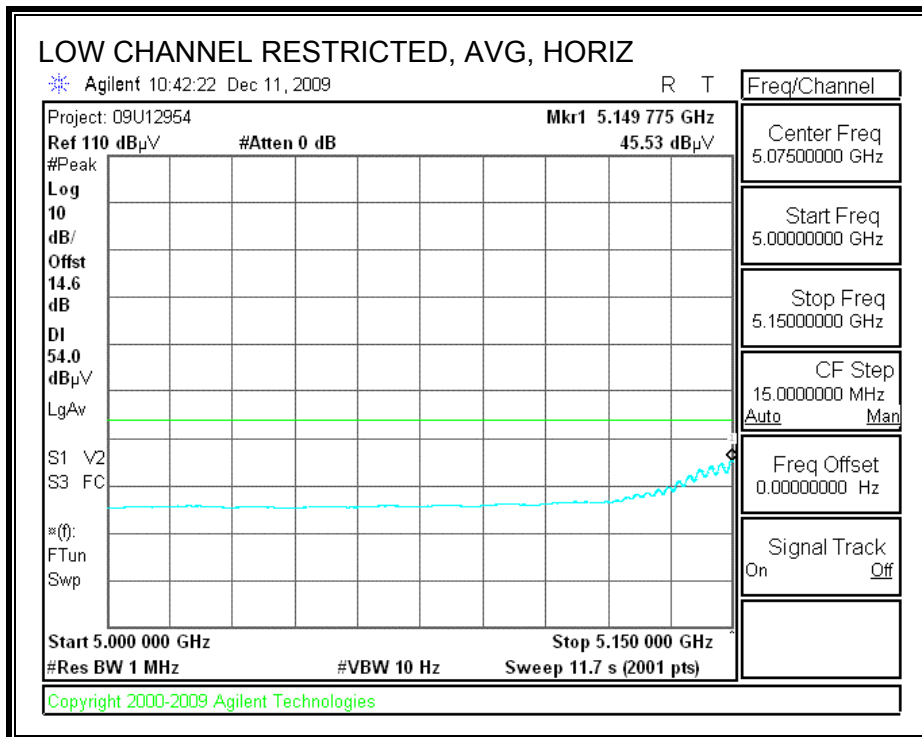
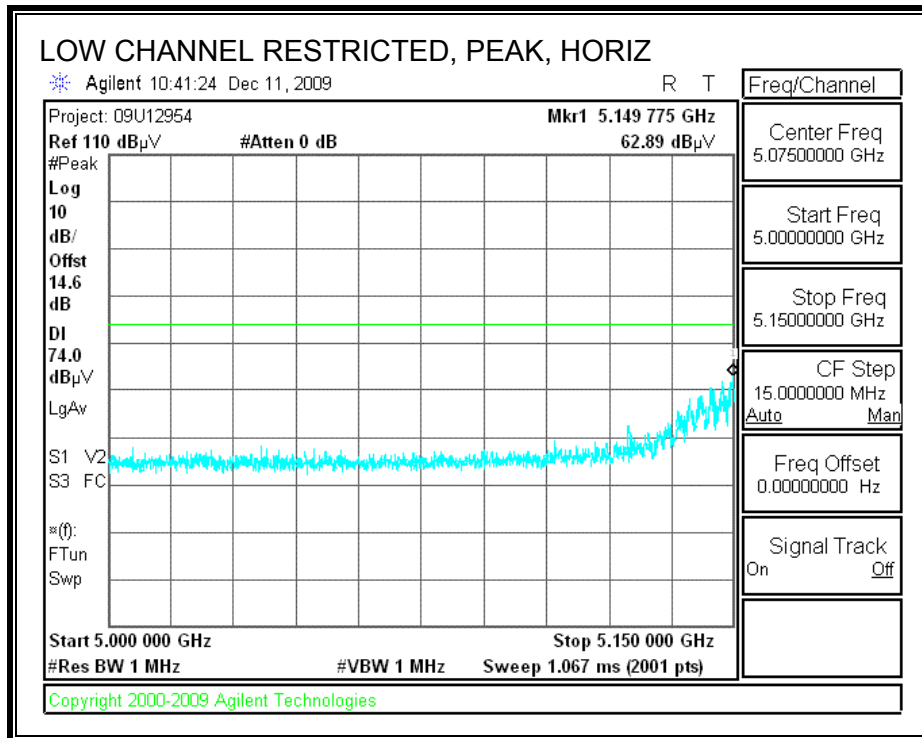
### 8.2.3. 802.11n HT40 SISO MODE IN THE LOWER 5.2 GHz BAND

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



### 8.2.4. 802.11n HT40 MIMO MCS0 MODE IN THE LOWER 5.2 GHz BAND

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



**5.2 GHz BAND - HARMONICS AND SPURIOUS EMISSIONS**

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

Company: Broadcom  
 Project #: 09U12954  
 Date: 12/14/09  
 Test Engineer: Thanh Nguyen  
 Configuration: EUT with support Laptop  
 Mode: Tx Worst Case in 5.2GHz Band - 11n HT 20

**Test Equipment:**

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

**Hi Frequency Cables**

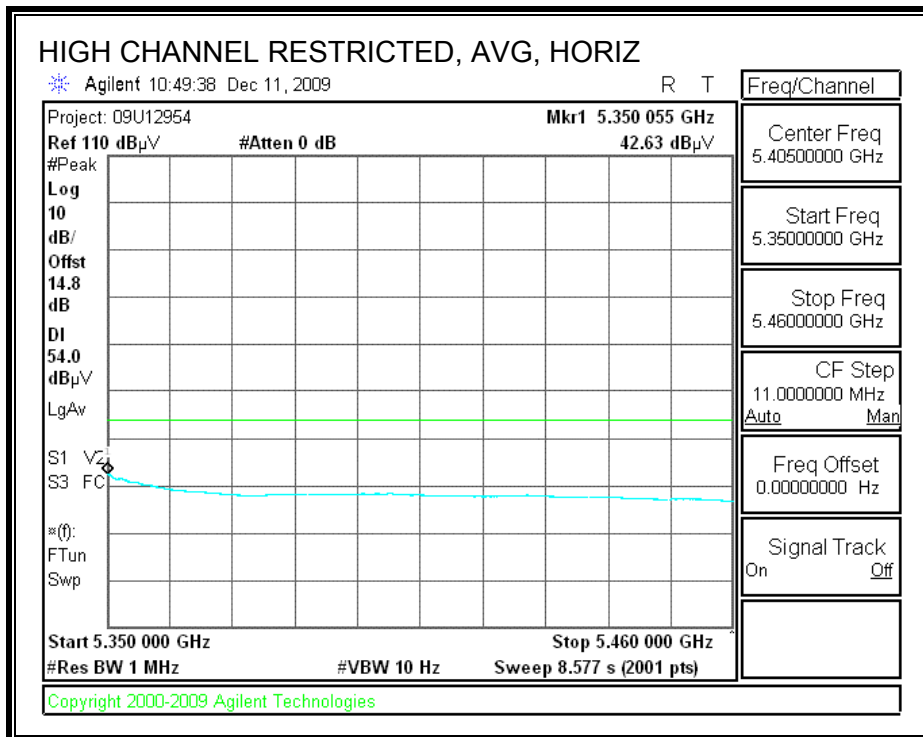
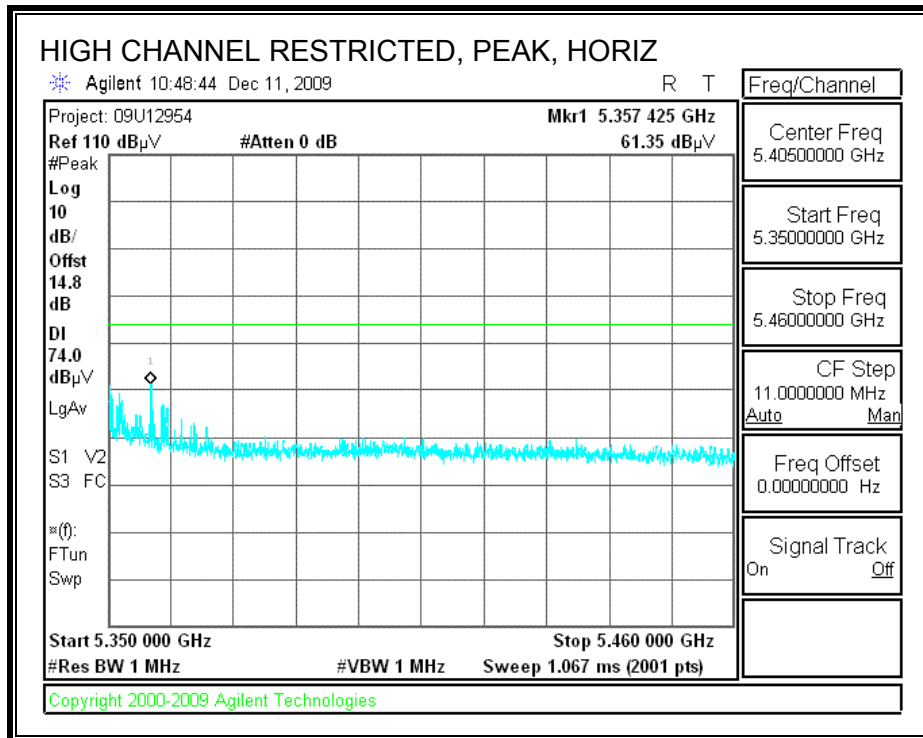
3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001	

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch 5180MHz</b>															
15.540	3.0	39.1	26.3	38.5	11.3	-32.2	0.0	0.0	56.7	44.0	74	54	-17.3	-10.0	Noise floor
<b>Mid Ch 5200MHz</b>															
15.600	3.0	38.6	26.3	38.3	11.4	-32.2	0.0	0.0	56.1	43.8	74	54	-17.9	-10.2	Noise floor
<b>High Ch 5240MHz</b>															
15.720	3.0	38.0	26.5	38.0	11.4	-32.2	0.0	0.0	55.2	43.8	74	54	-18.8	-10.2	Noise floor
<b>Spurious Emissions</b>															
1.000	3.0	64.4	42.6	24.5	2.4	-38.3	0.0	0.0	53.0	31.1	74	54	-21.0	-22.9	Noise floor
<b>No other emissions were detected above noise floor</b>															

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

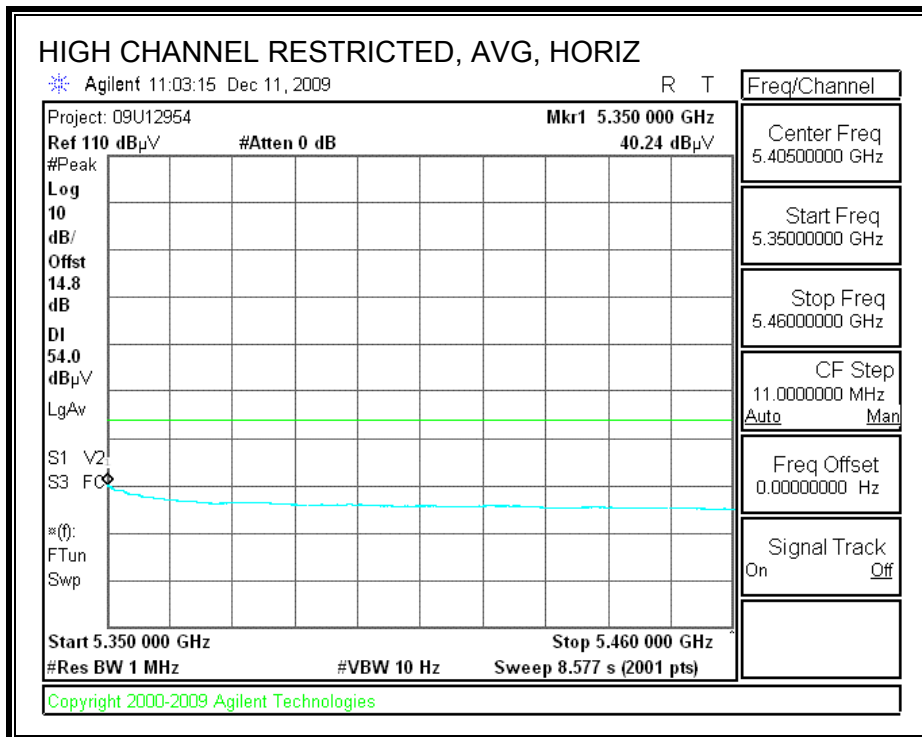
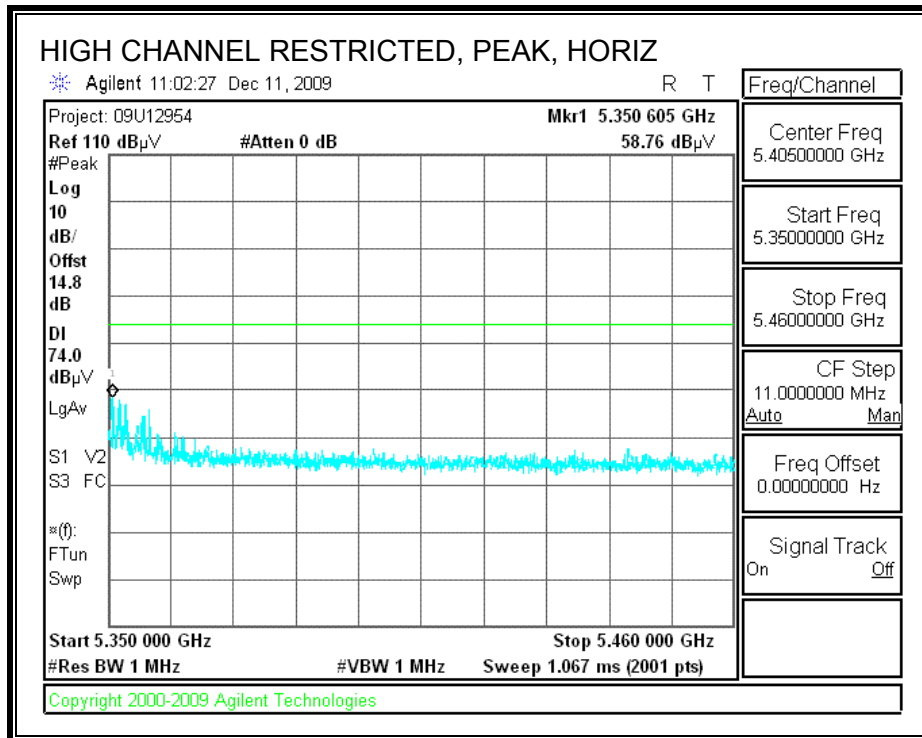
### 8.2.5. 802.11a MODE IN THE UPPER 5.3 GHz BAND

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



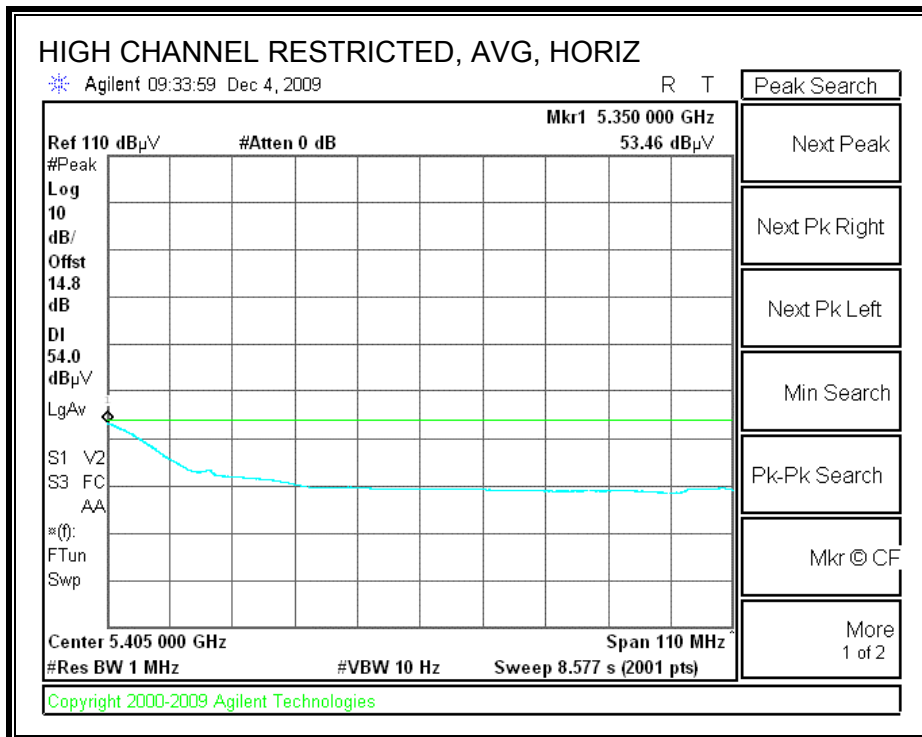
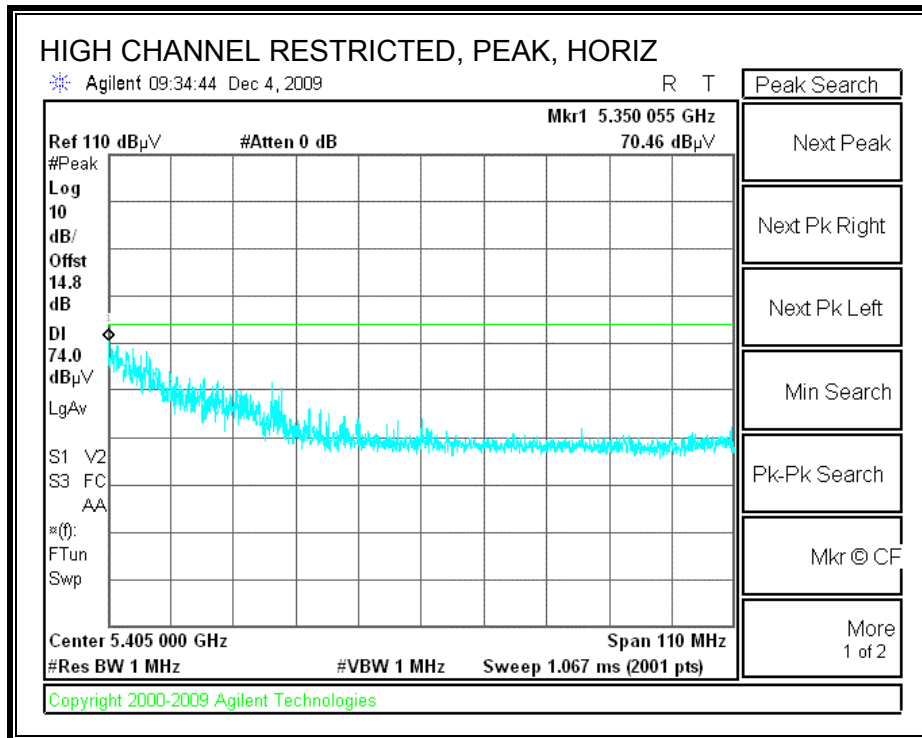
### 8.2.6. 802.11n HT20 MODE IN THE UPPER 5.3 GHz BAND

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



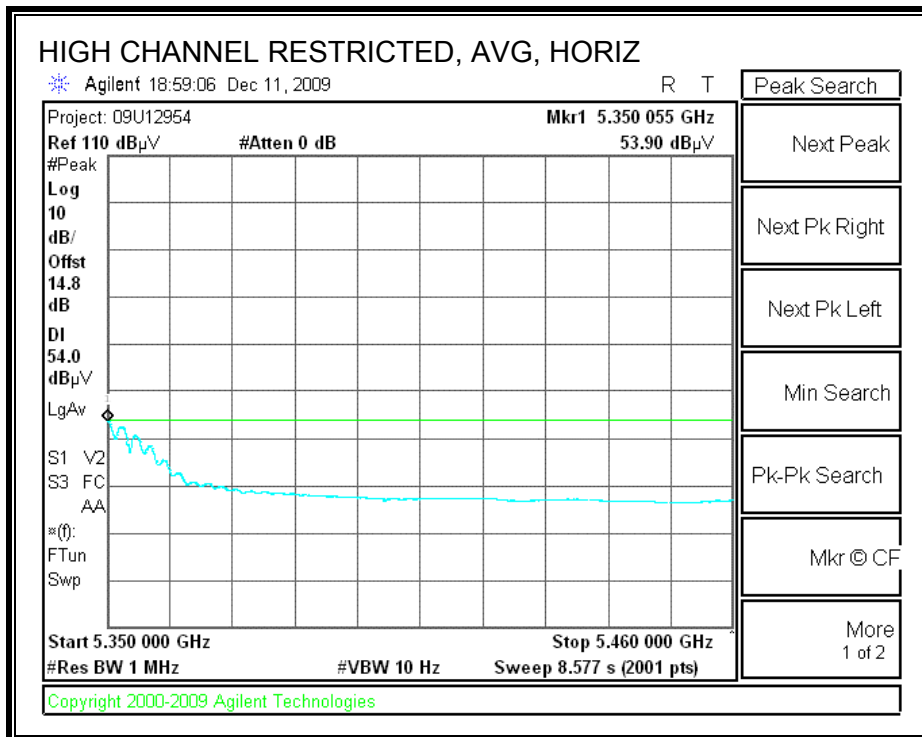
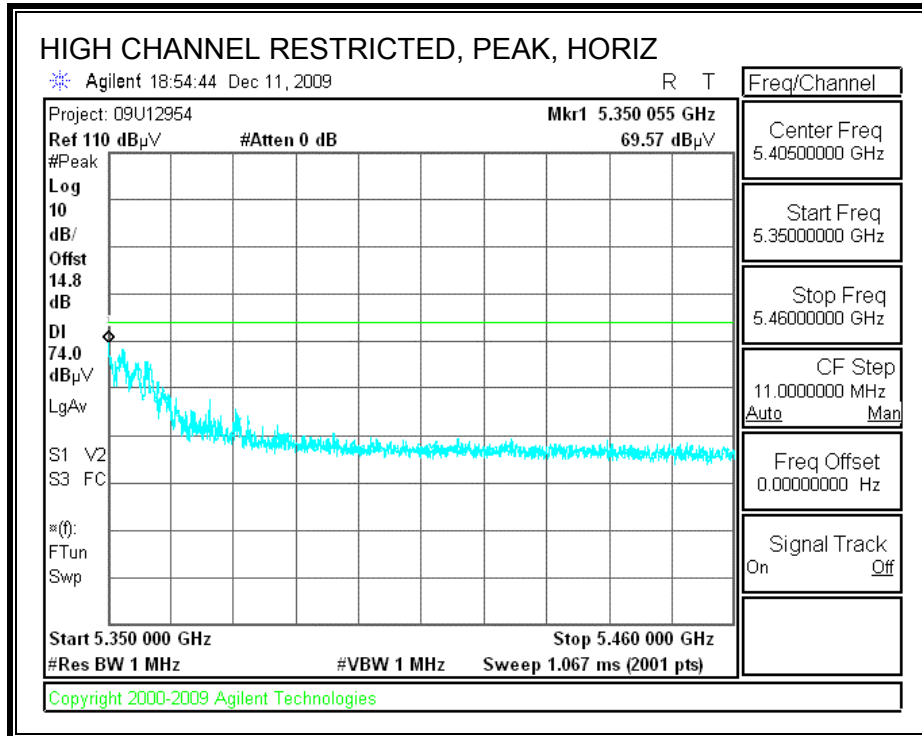
### 8.2.7. 802.11n HT40 SISO MODE IN THE UPPER 5.3 GHz BAND

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



### 8.2.8. 802.11n HT40 MIMO MCS0 MODE IN THE UPPER 5.3 GHz BAND

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



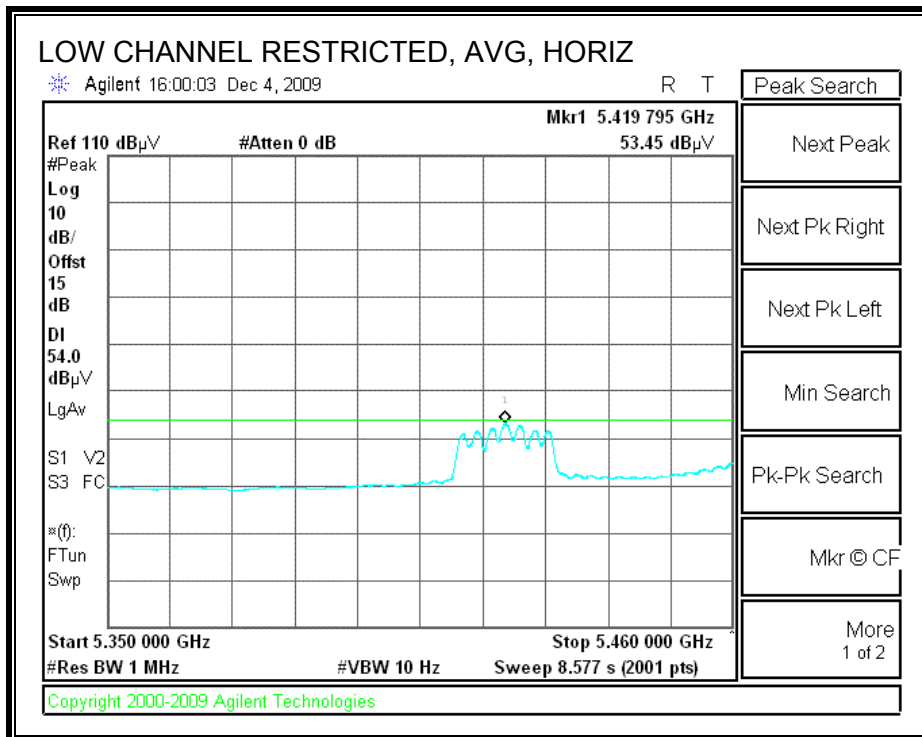
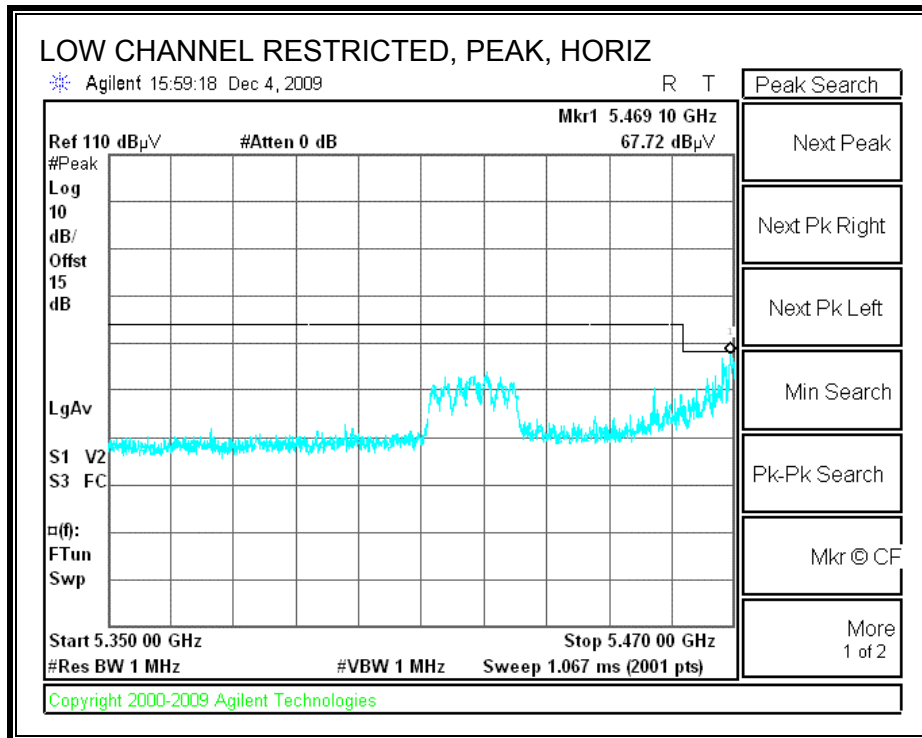


**5.3 GHz BAND - HARMONICS AND SPURIOUS EMISSIONS**

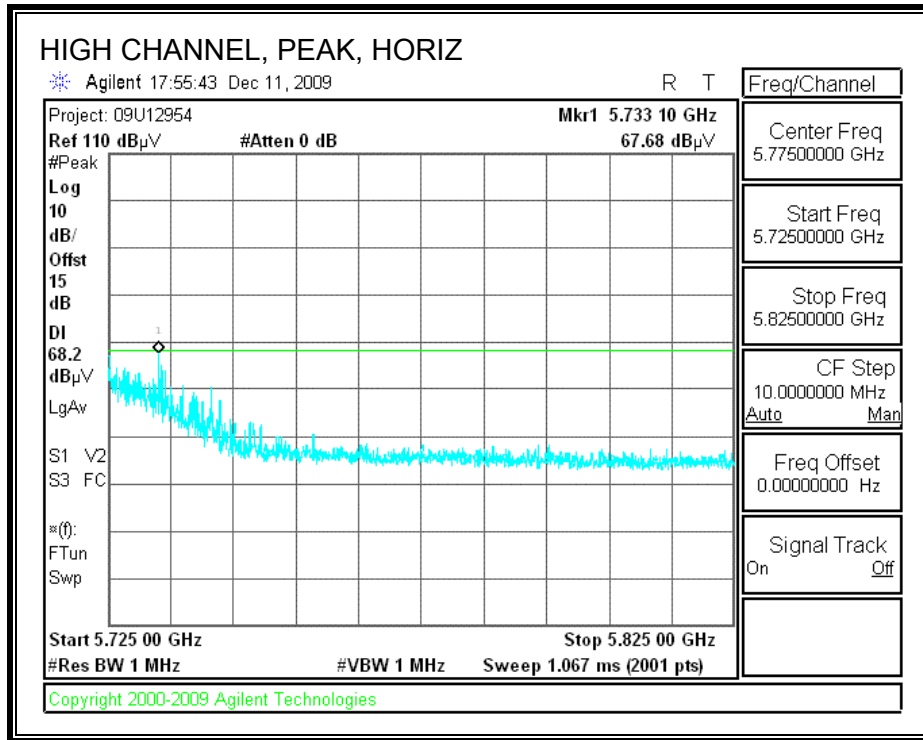
High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		Broadcom														
Project #:		09U12954														
Date:		12/14/09														
Test Engineer:		Thanh Nguyen														
Configuration:		EUT with support Laptop														
Mode:		Tx Worst Case in 5.3 GHz Band - 11n HT 20														
<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									FCC 15.205				
<b>Hi Frequency Cables</b>																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz			
3' cable 22807700			12' cable 22807600			20' cable 22807500					R_001		Average Measurements RBW=1MHz ; VBW=10Hz			
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
<b>Low Ch 5260MHz</b>																
15.780	3.0	39.6	26.5	37.8	11.5	-32.2	0.0	0.0	56.7	43.6	74	54	-17.3	-10.4	Noise floor	
<b>Mid Ch 5300MHz</b>																
10.600	3.0	40.0	24.9	37.6	9.0	-32.6	0.0	0.0	54.0	38.9	74	54	-20.0	-15.1	Noise floor	
<b>High Ch 5320MHz</b>																
10.640	3.0	37.3	24.9	37.6	9.1	-32.6	0.0	0.0	51.3	38.9	74	54	-22.7	-15.1	Noise floor	
No other emissions were detected above noise floor																
f	Measurement Frequency		Amp	Preamp Gain		Avg Lim	Average Field Strength Limit									
Dist	Distance to Antenna		D Corr	Distance Correct to 3 meters		Pk Lim	Peak Field Strength Limit									
Read	Analyzer Reading		Avg	Average Field Strength @ 3 m		Avg Mar	Margin vs. Average Limit									
AF	Antenna Factor		Peak	Calculated Peak Field Strength		Pk Mar	Margin vs. Peak Limit									
CL	Cable Loss		HPF	High Pass Filter												

### 8.2.9. 802.11a MODE IN THE 5.6 GHz BAND

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

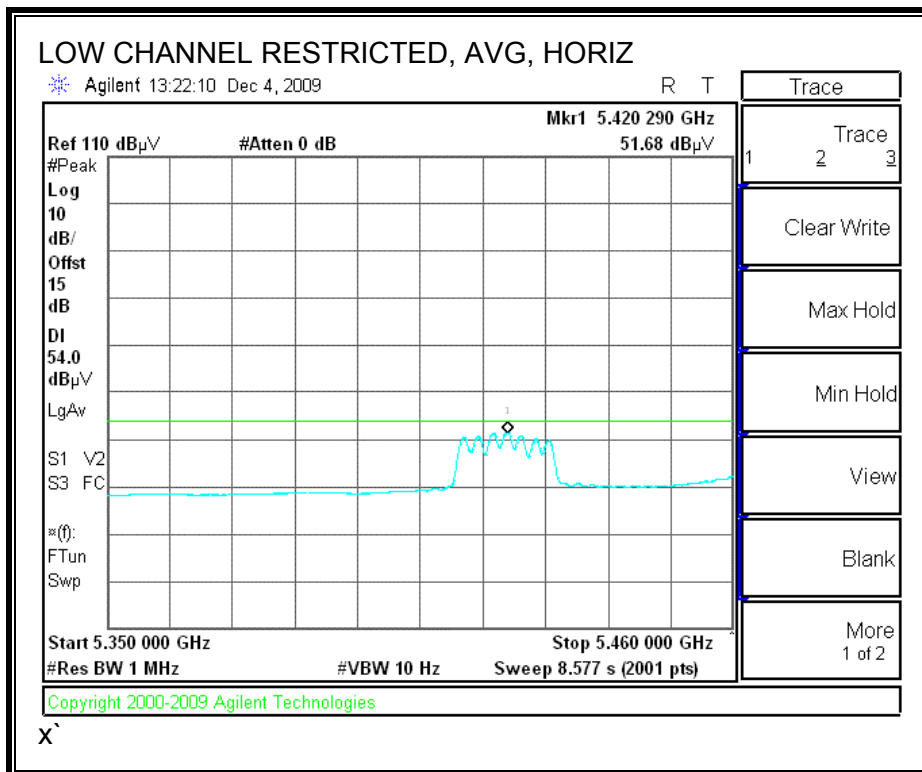
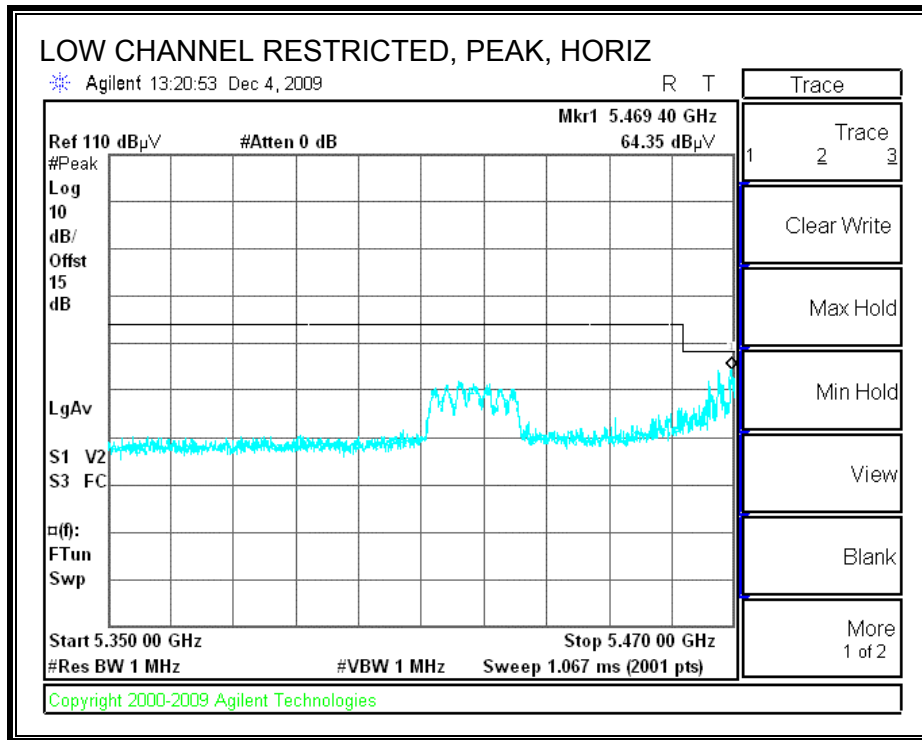


**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

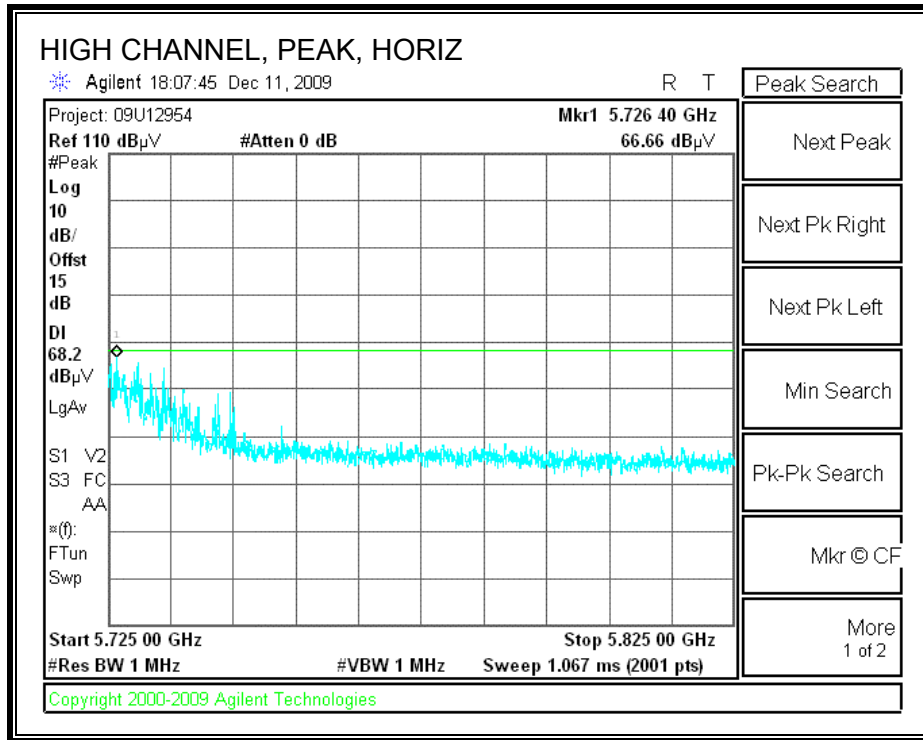


**8.2.10. 802.11n HT20 MODE IN THE 5.6 GHz BAND**

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

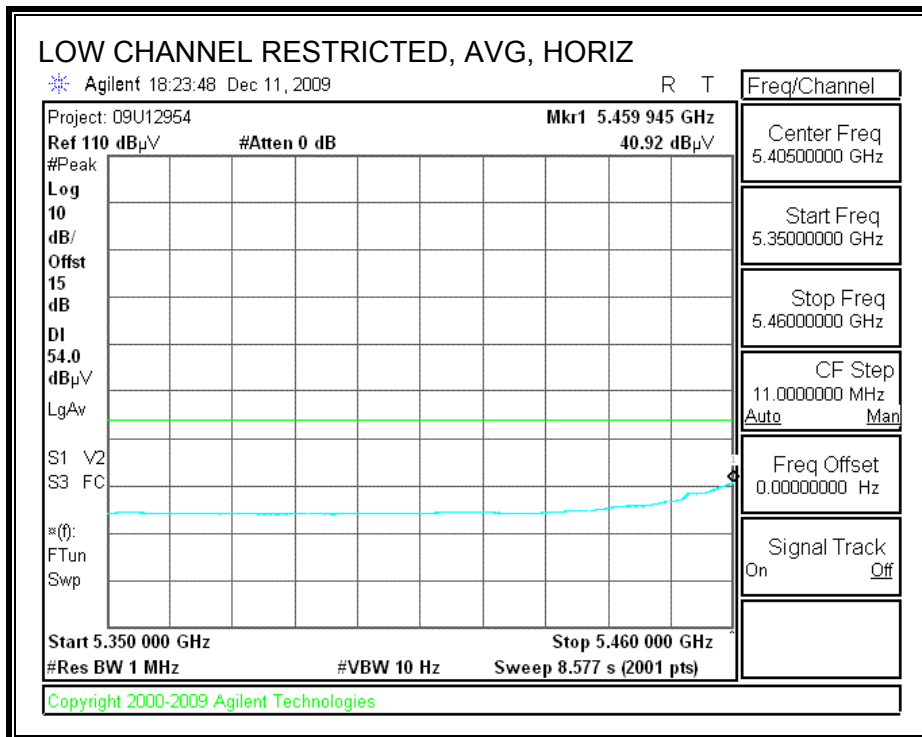
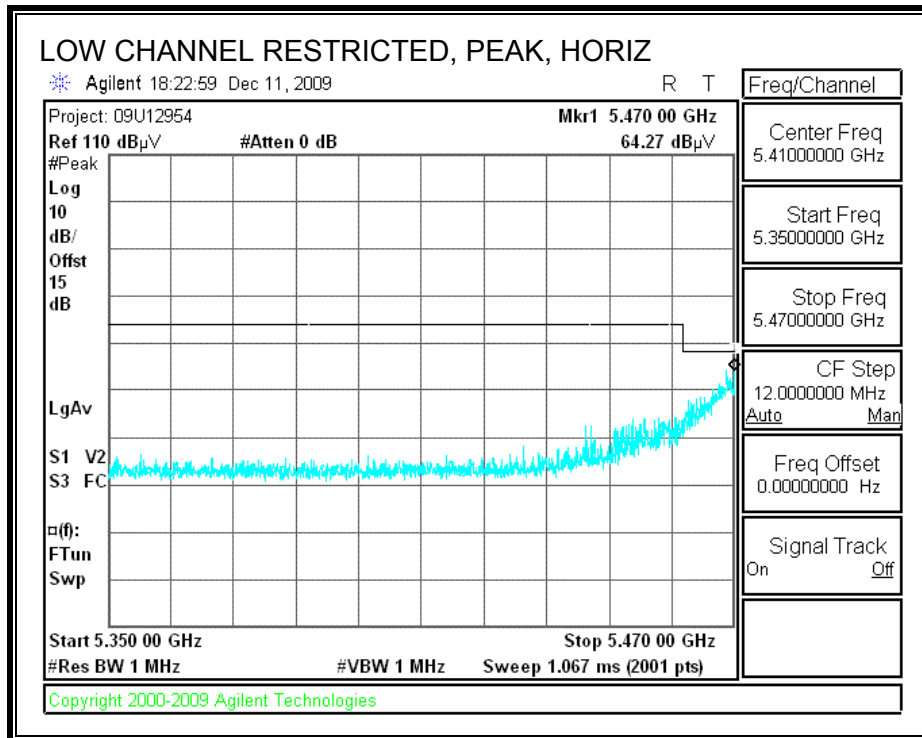


**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

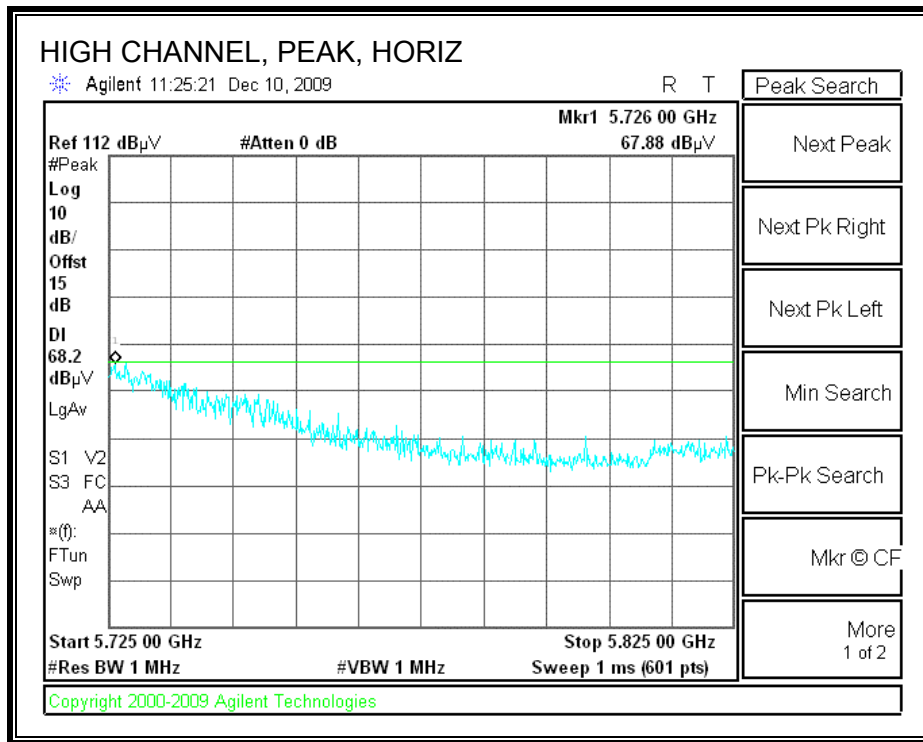


### 8.2.11. 802.11n HT40 SISO MODE IN THE 5.6 GHz BAND

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

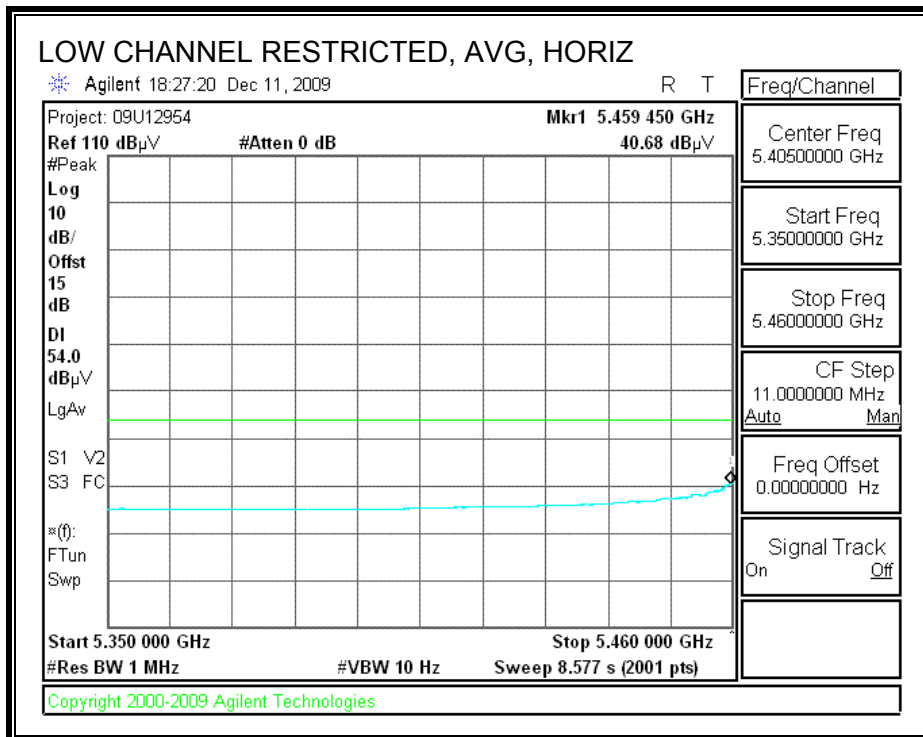
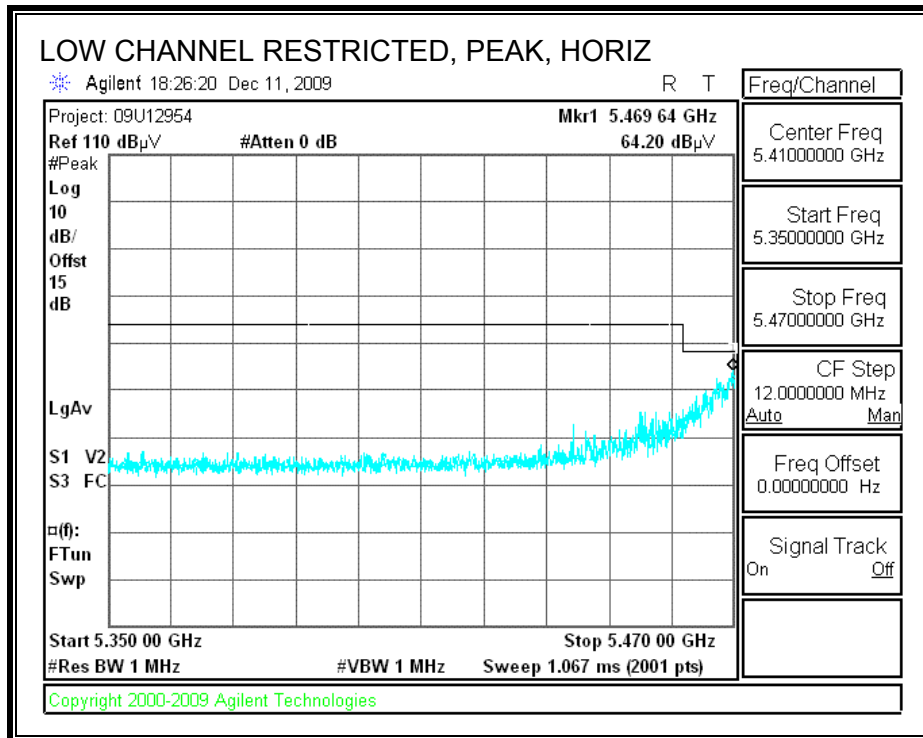


**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



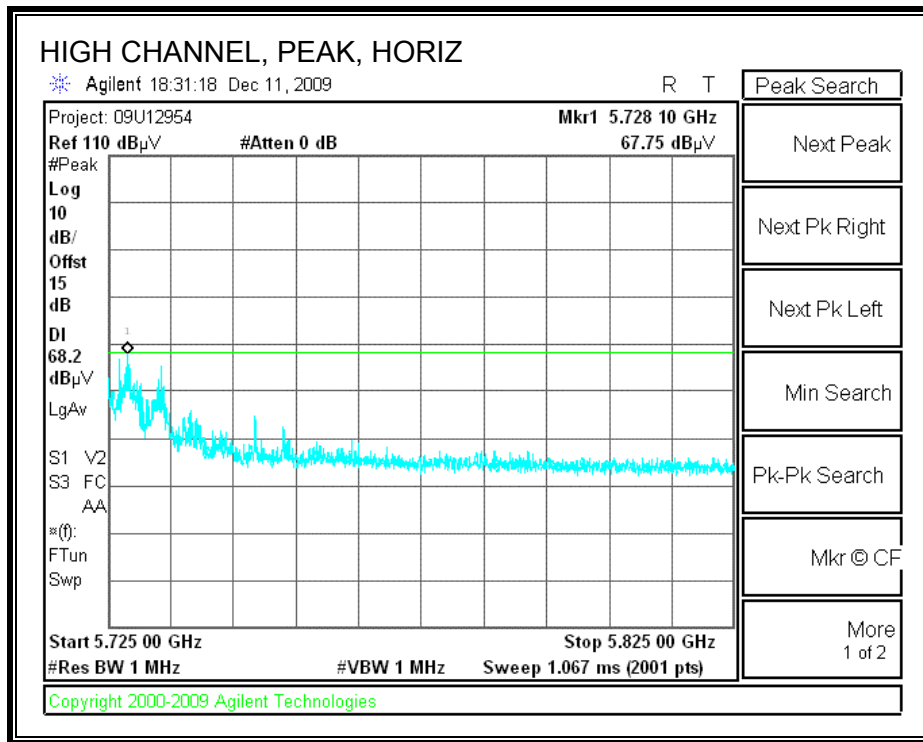
**8.2.12. 802.11n HT40 MIMO MCS0 MODE IN THE 5.6 GHz BAND**

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





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



**5.6 GHz BAND - HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement																	
Compliance Certification Services, Fremont 5m Chamber																	
Company:		Broadcom															
Project #:		09U12954															
Date:		12/14/09															
Test Engineer:		Thanh Nguyen															
Configuration:		EUT with support Laptop															
Mode:		Tx Worst Case in 5.6 GHz Band -11m HT 20															
<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									FCC 15.205					
<b>Hi Frequency Cables</b>																	
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz				
3' cable 22807700			12' cable 22807600			20' cable 22807500					R_001		Average Measurements RBW=1MHz; VBW=10Hz				
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
<b>Low Ch 5500MHz</b>																	
11.000	3.0	40.3	27.6	37.6	9.2	-32.6	0.0	0.0	54.5	41.9	74	54	-19.5	-12.1	Noise floor		
<b>Mid Ch 5600MHz</b>																	
11.200	3.0	40.3	25.3	37.8	9.3	-32.6	0.0	0.0	54.9	39.9	74	54	-19.1	-14.1	Noise floor		
<b>High Ch 5700MHz</b>																	
11.400	3.0	38.6	25.4	38.0	9.4	-32.5	0.0	0.0	53.4	40.2	74	54	-20.6	-13.8	Noise floor		
<b>No other emissions were detected above noise floor</b>																	
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										

### 8.3. RECEIVER ABOVE 1 GHz IN THE 5 GHz BAND

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

Company: Broadcom  
 Project #: 09U12954  
 Date: 12/9/09  
 Test Engineer: Chin Pang  
 Configuration:  
 Description: 802.11ag/Draft 802.11n Wlan+BT PCI\_E Minicard  
 Model: BCM943224PC1e1b  
 Mode: RX, 5GHz Band

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.209

Hi Frequency Cables

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
							0.0								
1.097	3.0	53.6	38.2	24.8	2.5	-38.1	0.0	0.0	42.7	27.3	74	54	-31.3	-26.7	H
1.331	3.0	52.0	43.8	25.6	2.7	-37.8	0.0	0.0	42.5	34.3	74	54	-31.5	-19.7	H
1.498	3.0	51.8	33.0	26.1	2.9	-37.6	0.0	0.0	43.3	24.5	74	54	-30.7	-29.5	H
1.098	3.0	53.7	36.8	24.8	2.5	-38.1	0.0	0.0	42.8	25.9	74	54	-31.2	-28.1	V
1.498	3.0	54.0	35.6	26.1	2.9	-37.6	0.0	0.0	45.5	27.1	74	54	-28.5	-26.9	V
1.596	3.0	50.0	35.8	26.5	3.0	-37.4	0.0	0.0	42.1	27.9	74	54	-31.9	-26.1	V

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

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

### 8.4. WORST-CASE BELOW 1 GHz

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

30-1000MHz Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Thanh Nguyen											
Date:		02/12/09											
Project #:		09U12954											
Company:		BroadCom											
EUT Description:		802.11a/b/g/n + Bluetooth PCI-E Mini card											
EUT M/N:		BCM943224PCIEBT											
Test Target:		FCC Class B											
Mode Oper:		Transmit worst Case											
f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit								
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters										
Read	Analyzer Reading	Filter	Filter Insert Loss										
AF	Antenna Factor	Corr.	Calculated Field Strength										
CL	Cable Loss	Limit	Field Strength Limit										
f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
43.201	3.0	47.3	12.3	0.6	28.4	0.0	0.0	31.9	40.0	-8.1	V	P	
144.005	3.0	47.2	12.9	1.0	27.9	0.0	0.0	33.3	43.5	-10.2	V	P	
336.013	3.0	45.7	14.0	1.6	27.6	0.0	0.0	33.7	46.0	-12.3	V	P	
414.976	3.0	44.5	15.3	1.8	28.1	0.0	0.0	33.5	46.0	-12.5	V	P	
830.433	3.0	35.6	21.2	2.6	28.1	0.0	0.0	31.3	46.0	-14.7	V	P	
933.277	3.0	36.0	22.3	2.8	27.8	0.0	0.0	33.3	46.0	-12.7	V	P	
92.163	3.0	55.5	7.8	0.8	28.2	0.0	0.0	35.8	43.5	-7.7	H	P	
184.566	3.0	50.7	11.0	1.1	27.5	0.0	0.0	35.4	43.5	-8.1	H	P	
415.216	3.0	49.3	15.3	1.8	28.1	0.0	0.0	38.3	46.0	-7.7	H	P	
528.021	3.0	48.1	17.3	2.0	28.6	0.0	0.0	38.8	46.0	-7.2	H	P	
899.316	3.0	41.8	22.1	2.7	27.9	0.0	0.0	38.7	46.0	-7.3	H	P	
995.800	3.0	44.6	22.7	2.9	27.6	0.0	0.0	42.5	54.0	-11.5	H	P	

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

## 9. MAXIMUM PERMISSIBLE EXPOSURE

### FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

**IC RULES**

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5  
 Exposure Limits for Persons Not Classified As RF and Microwave Exposed Workers (Including the General Public)**

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> <sup>0.5</sup>	0.0042 <i>f</i> <sup>0.5</sup>	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616 000 / <i>f</i> <sup>1.2</sup>

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

- Notes:**
1. Frequency, *f*, is in MHz.
  2. A power density of 10 W/m<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
  3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

**EQUATIONS**

Power density is given by:

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

where

- S = Power density in W/m<sup>2</sup>
- EIRP = Equivalent Isotropic Radiated Power in W
- D = Separation distance in m

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

Distance is given by:

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

where

- D = Separation distance in m
- EIRP = Equivalent Isotropic Radiated Power in W
- S = Power density in W/m<sup>2</sup>

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

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

where

- Px = Power of transmitter x
- Gx = Numeric gain of antenna x

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

**LIMITS**

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm<sup>2</sup>  
 From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m<sup>2</sup>

**RESULTS**

(MPE distance equals 20 cm)

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
WLAN	5 GHz	20.0	20.10	9.10	0.17	1.65