



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

**FOR**

**802.11n 2x2 PCIe MINICARD TRANSCEIVER  
MODEL NUMBER: AR5BXB92  
FCC ID: PPD-AR5BXB92  
IC: 4104A-AR5BXB92**

**REPORT NUMBER: 08U11572-3  
ISSUE DATE: MARCH 10, 2008**

*Prepared for*

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**NVLAP LAB CODE 200065-0**

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** ATHEROS COMMUNICATION, INC  
5480 GREAT AMERICA PARKWAY  
SANTA CLARA, CA 95054 USA

**EUT DESCRIPTION:** 802.11n 2x2 PCIe Minicard Transceiver

**MODEL:** AR5BXB92

**SERIAL NUMBER:** XB92-040-S0660 & XB92-040-S0579

**DATE TESTED:** MARCH 07, 2008

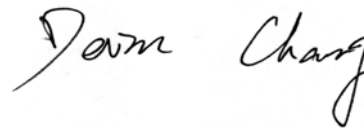
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	No Non-Compliance Noted
RSS-210 Issue 7 Annex 9 and RSS-GEN Issue 2	No Non-Compliance Noted

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:

Tested By:



THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

DEVIN CHANG  
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 MO&O 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. MEASUREMENT UNCERTAINTY

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

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

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



## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an 802.11n 2x2 PCIe minicard transceiver, model AR5BXB92. Two front-end module parts were evaluated; Vendors are SiGe (FEM1) and Hitachi (FEM2).

The radio module is manufactured by Atheros Communications, Inc.

### 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Chain 0 (dBm)	Chain 1 (dBm)	Total Power (dBm)	Total Power (mW)
5180 - 5240	802.11a	12.26	13.17	15.75	37.58
5180 - 5240	802.11n HT20	14.09	13.72	16.92	49.20
5190 - 5230	802.11n HT40	13.63	14.32	16.99	50.05
5260 - 5320	802.11a	17.98	17.90	20.95	124.47
5260 - 5320	802.11n HT20	20.36	20.95	23.68	233.09
5270 - 5310	802.11n HT40	20.30	21.35	23.87	243.61
5500 - 5700	802.11a	18.24	18.01	21.14	129.92
5500 - 5700	802.11n HT20	19.29	19.07	22.19	165.64
5510 - 5670	802.11n HT40	19.34	19.50	22.43	175.03

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The 2x2 configuration utilizes a set of PIFA antennas with maximum gain of 3.62 dBi from 2400 – 2483.5 MHz, 4.63 dBi from 5150 – 5350 MHz, 5.56 dBi from 5250 – 5350 MHz, 5.34 dBi from 5470 – 5725 MHz, and 4.76 dBi from 5725 - 5850 MHz.

### 5.4. SOFTWARE AND FIRMWARE

The test utility and driver software used during testing was Art ANWI 1.4 and Devlib Revision 0.6 Build #18 Art\_11n.

## 5.5. WORST-CASE CONFIGURATION AND MODE

The 2x2 configuration was used for all testing in this report.

Both FEM1 and FEM2 boards were evaluated on conducted and radiated emissions tests to find the worst case.

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

Thus all emissions tests were made with following data rates:

- 802.11b mode, 20 MHz Channel Bandwidth, 1 Mb/s, CCK Modulation, Spatial Stream 1.
- 802.11g mode, 20 MHz Channel Bandwidth, 9 Mb/s, OFDM Modulation, Spatial Stream 1.
- 802.11a mode, 20 MHz Channel Bandwidth, 9 Mb/s, OFDM Modulation, Spatial Stream 1.
- 802.11n HT20 mode, 20 MHz Channel Bandwidth, MCS0, 6.5 Mb/s, OFDM Modulation, Spatial Stream 1.
- 802.11n HT40 mode, 40 MHz Channel Bandwidth, MCS0, 13.5 Mb/s, OFDM Modulation, Spatial Stream 1.

Baseline testing demonstrated that the Power Spectral Density as measured through a combiner with both chains operating simultaneously is worst case.

For RF conducted emissions, all tests were performed on FEM2 board excepted conducted spurious to use FEM1 board.

For RF radiated emissions, all tests were performed on FEM1 boards.

For radiated emissions bandedge, both FEM1 and FEM2 boards were performed at both vertical and horizontal polarizations.

For radiated emissions TX below 1 GHz, RX spurious, and AC line conduction were performed at FEM1 board.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	IBM	ThinkPad T42	ZZ-27001	DoC
AC Adapter	IBM	02K6749	11S02K6749Z122OM2436ST	DoC

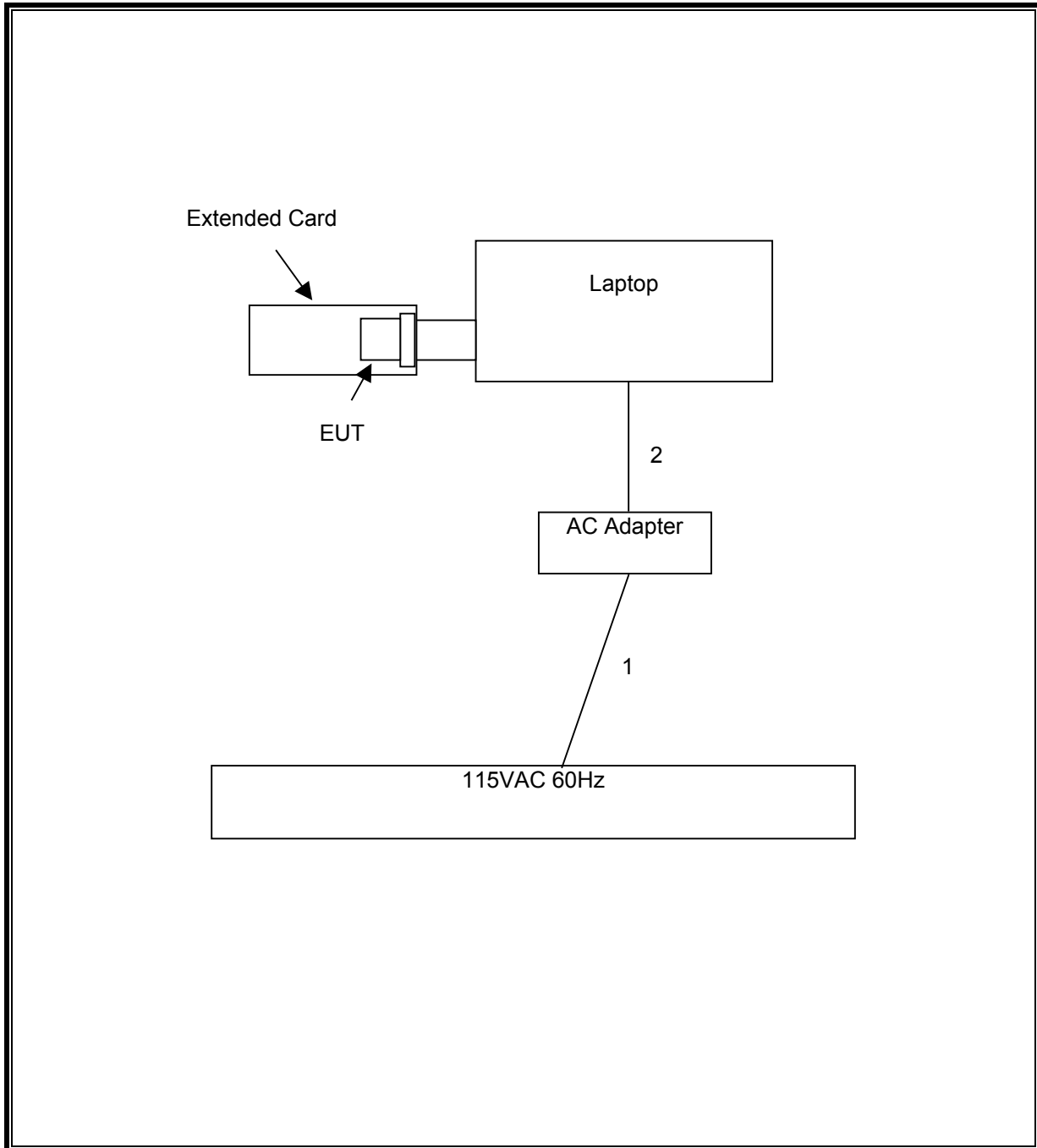
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	2m	One Ferrite at Laptop End
2	DC	1	DC	Un-shielded	2m	N/A

### TEST SETUP

The EUT is connected to a laptop PC via a PCI extension card 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	Asset	Cal Date	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	12/3/2007	3/3/2009
Peak Power Meter	Agilent / HP	E4416A	C00963	12/4/2007	12/4/2009
Peak / Average Power Sensor	Agilent	E9327A	C00964	12/7/2007	12/7/2009
Antenna, Bilog, 2 GHz	Sund Sciences	JB1	C01011	9/28/2007	9/28/2008
Antenna, Horn, 18 GHz	EMCO	3115	C00945	4/15/2007	4/15/2008
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	9/27/2007	9/27/2008
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	2/6/2007	6/12/2008
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	2/6/2007	6/12/2008
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	2/6/2008	8/6/2009
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/2007	10/25/2008
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	8/3/2007	9/27/2008
Antenna, Horn, 26.5 GHz	ARA	MMH-1826/B	C00589	9/29/2007	9/29/2008
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/2007	10/11/2008
2.4-2.5GHz Reject Filter	Micro Tronics	BRM50702	N02685	CNR	CNR
Reject Filter, 5.15-5.35 GHz	Micro-Tronics	BRC13190	N02679	CNR	CNR
Reject Filter, 5.47-5.725 GHz	Micro-Tronics	BRC13191	N02678	CNR	CNR
Reject Filter, 5.725-5.85 GHz	Micro-Tronics	BRC13192	N02676	CNR	CNR

## 7. ANTENNA PORT TEST RESULTS

### 7.1. 802.11a DUAL CHAIN LEGACY MODE IN THE LOWER 5.2 GHz BAND

#### 7.1.1. 26 dB and 99% BANDWIDTH

##### LIMITS

None; for reporting purposes only.

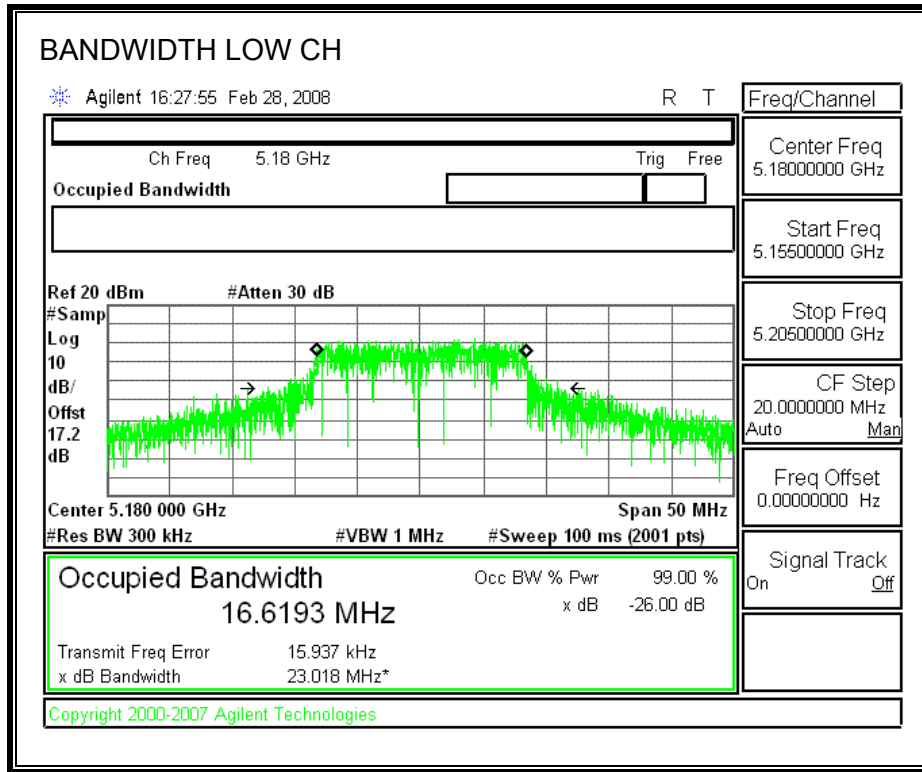
##### TEST PROCEDURE

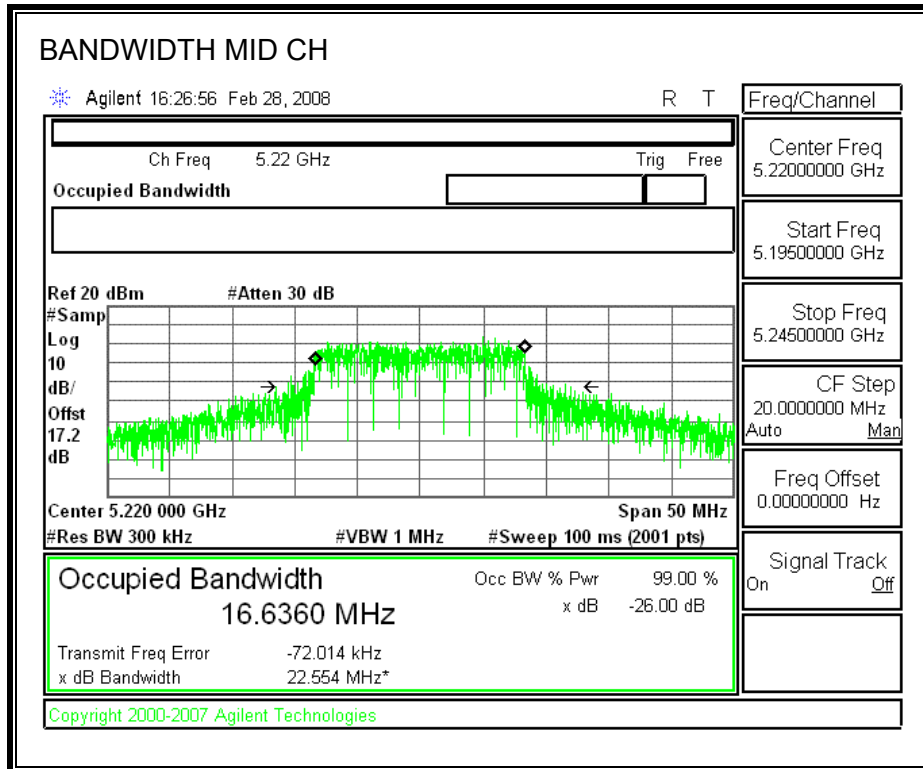
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

##### RESULTS

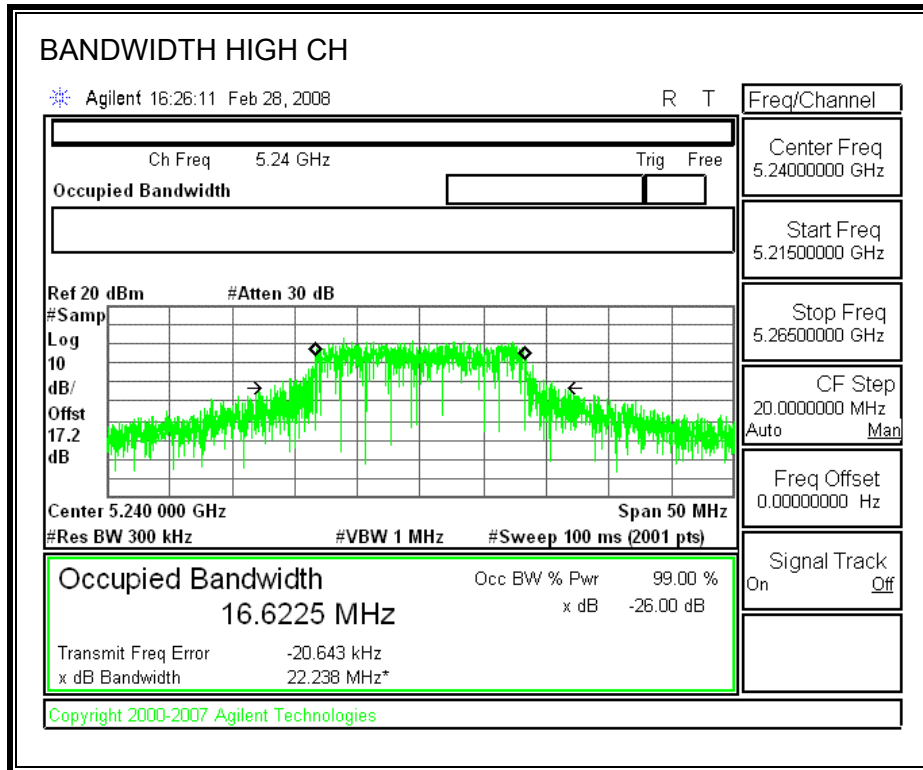
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	23.018	16.6190
Middle	5220	22.554	16.6360
High	5240	22.238	16.6225

**26 dB and 99% BANDWIDTH**









## 7.1.2. OUTPUT POWER

### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Directional gain = gain of antenna element + 10 log (# of TX antenna elements)

Effective Legacy Gain (dBi)
7.06

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.

### 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**

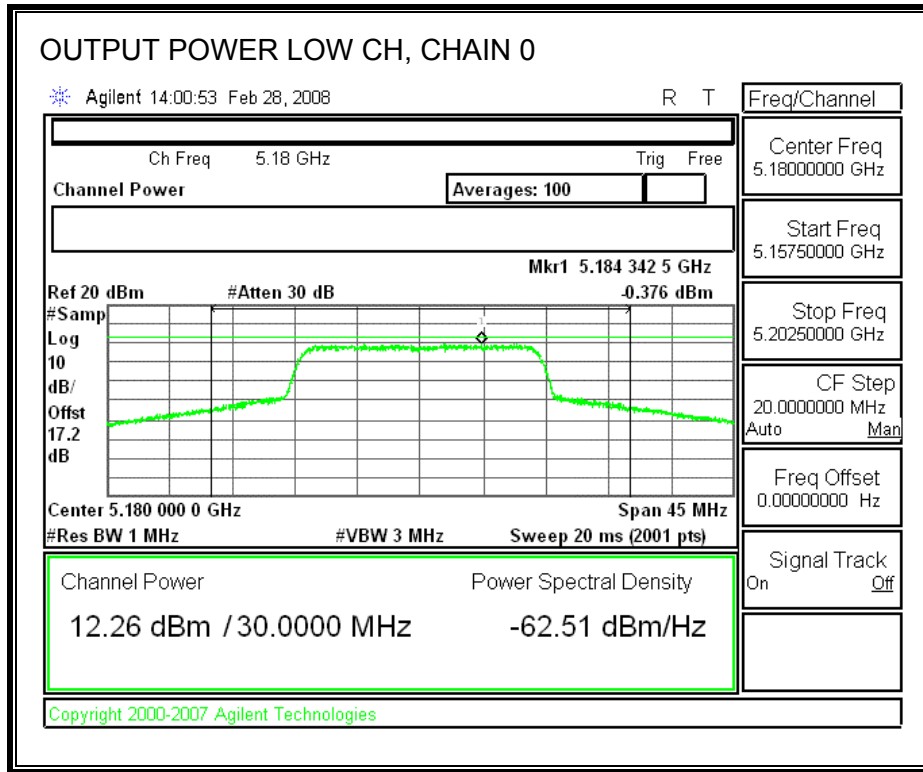
**Limit**

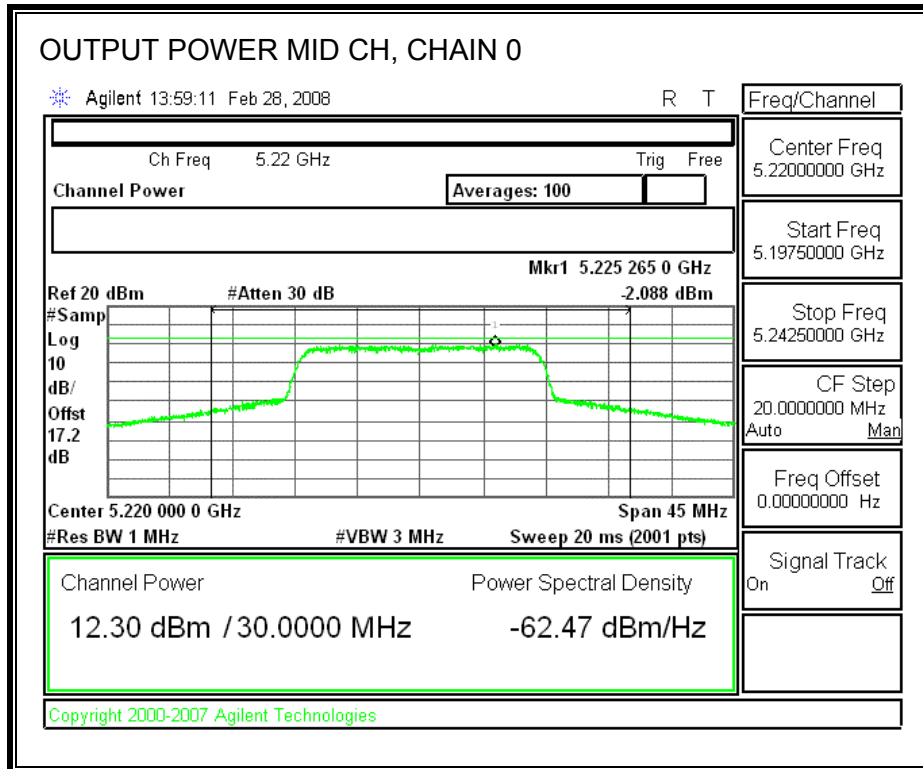
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17.00	23.018	17.62	7.06	15.94
Mid	5220	17.00	22.554	17.53	7.06	15.94
High	5240	17.00	22.238	17.47	7.06	15.94

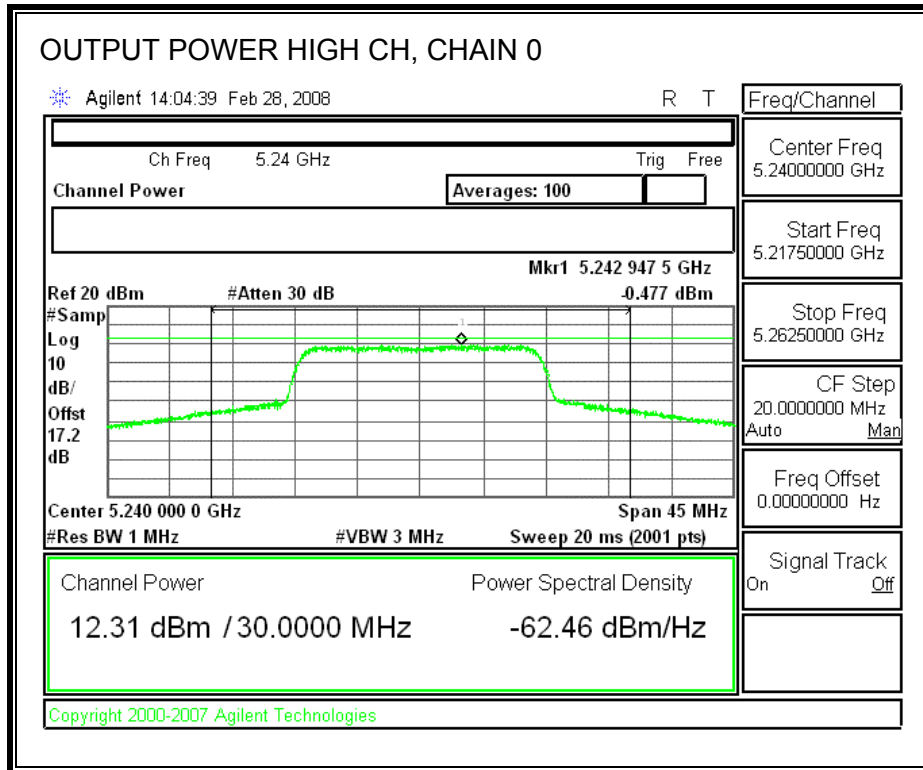
**Individual Chain Results**

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	12.26	13.17	15.75	15.94	-0.19
Mid	5220	12.30	12.45	15.39	15.94	-0.55
High	5240	12.31	12.34	15.34	15.94	-0.60

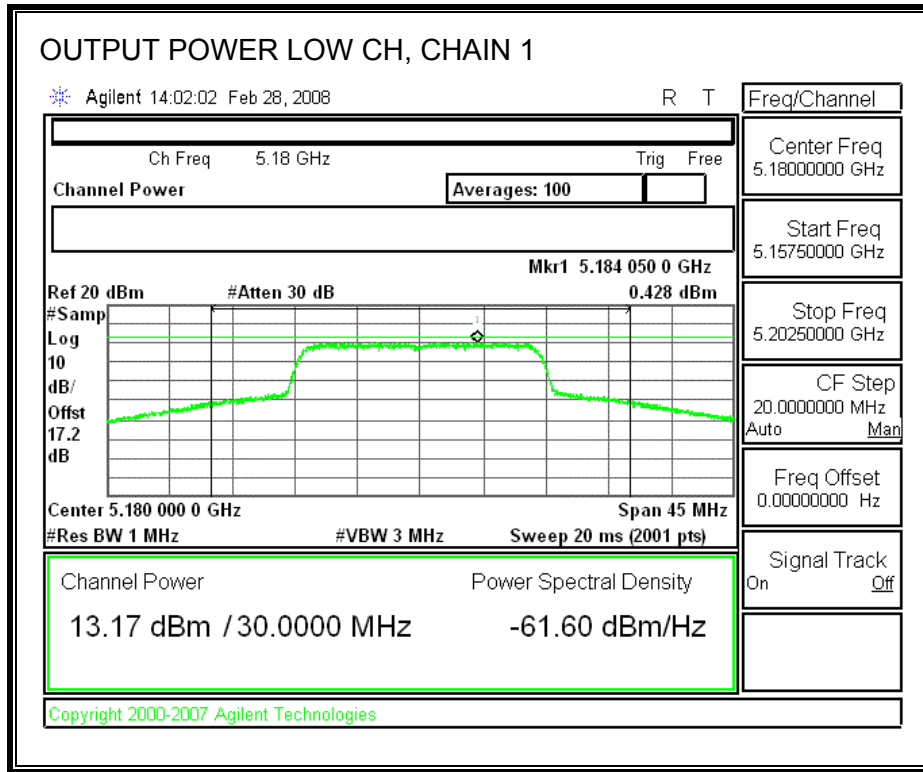
**CHAIN 0 OUTPUT POWER**

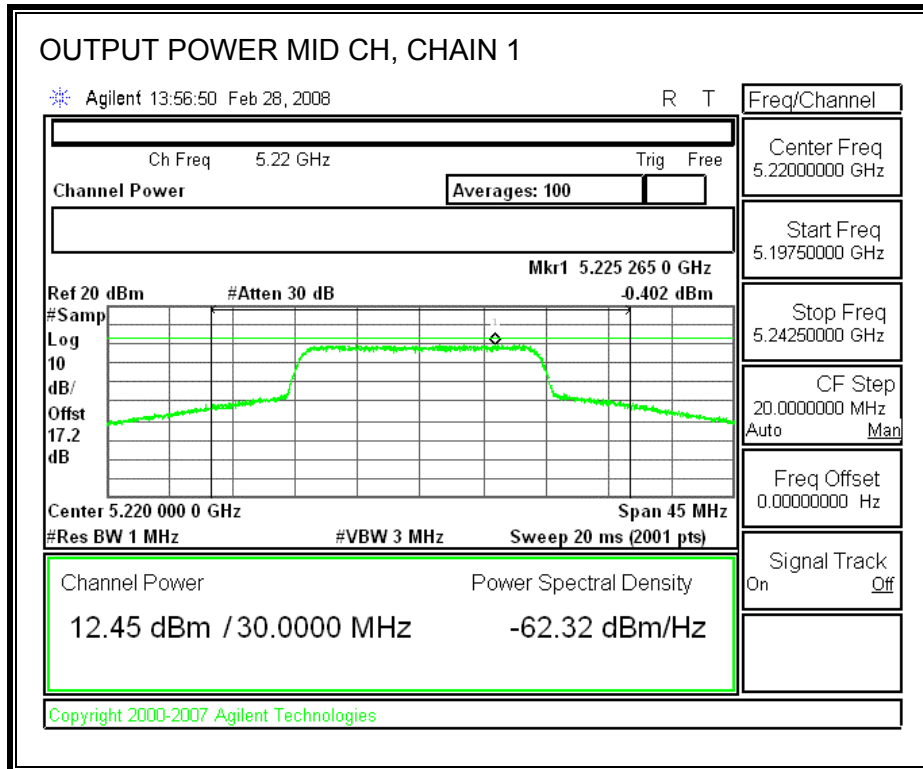




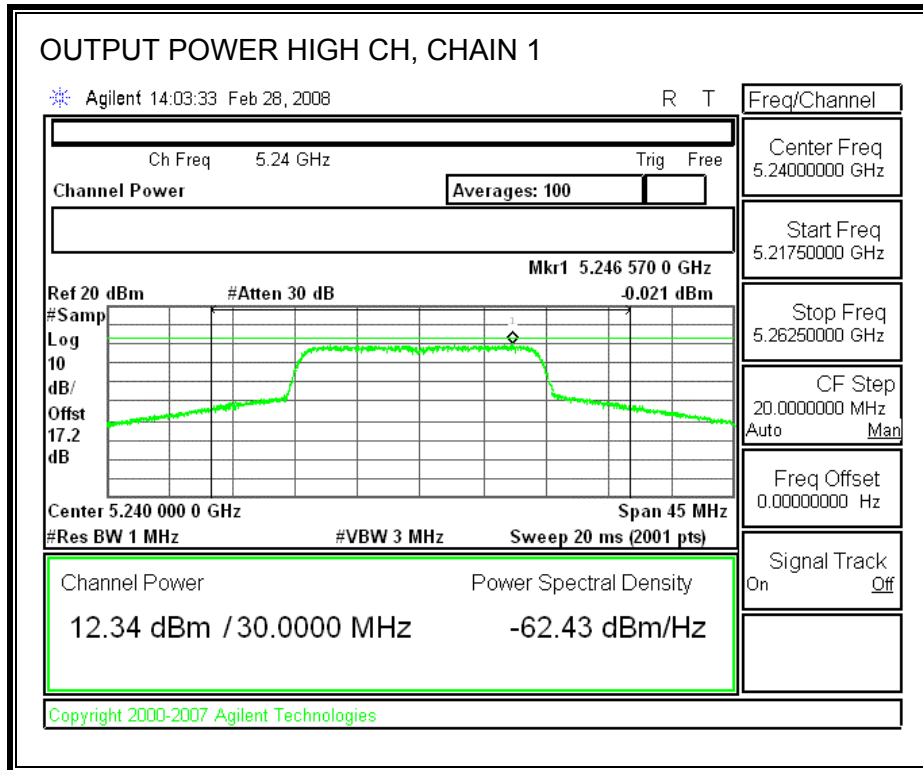


**CHAIN 1 OUTPUT POWER**









### 7.1.3. 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 17.2 dB (including 16 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5180	12.30	13.10	15.73
Middle	5220	12.16	12.33	15.26
High	5240	12.09	12.07	15.09

### 7.1.4. PEAK POWER SPECTRAL DENSITY

#### LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Directional gain = gain of antenna element + 10 log (# of TX antenna elements)

<b>Effective Legacy Gain (dBi)</b>
<b>7.06</b>

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 7.06 dBi, therefore the limit is 2.94 dBm.

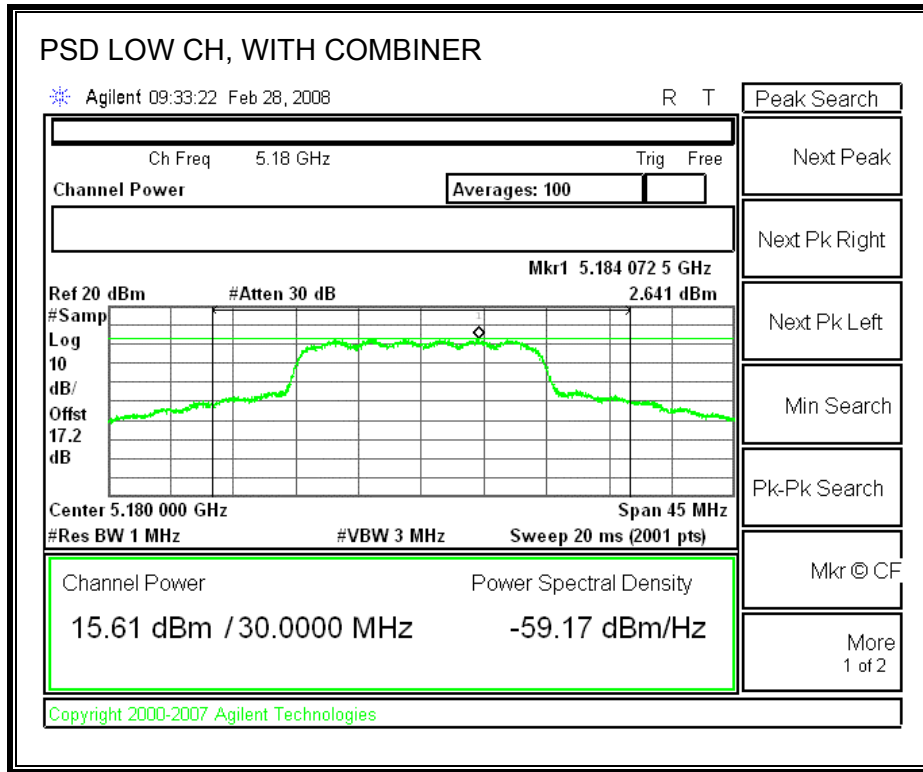
#### TEST PROCEDURE

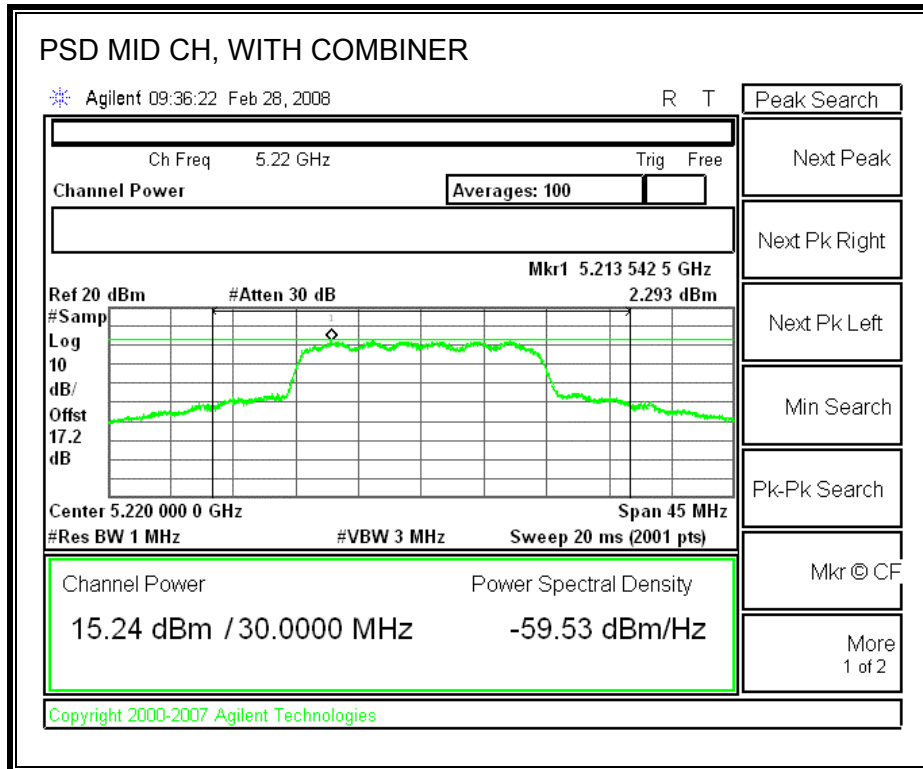
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

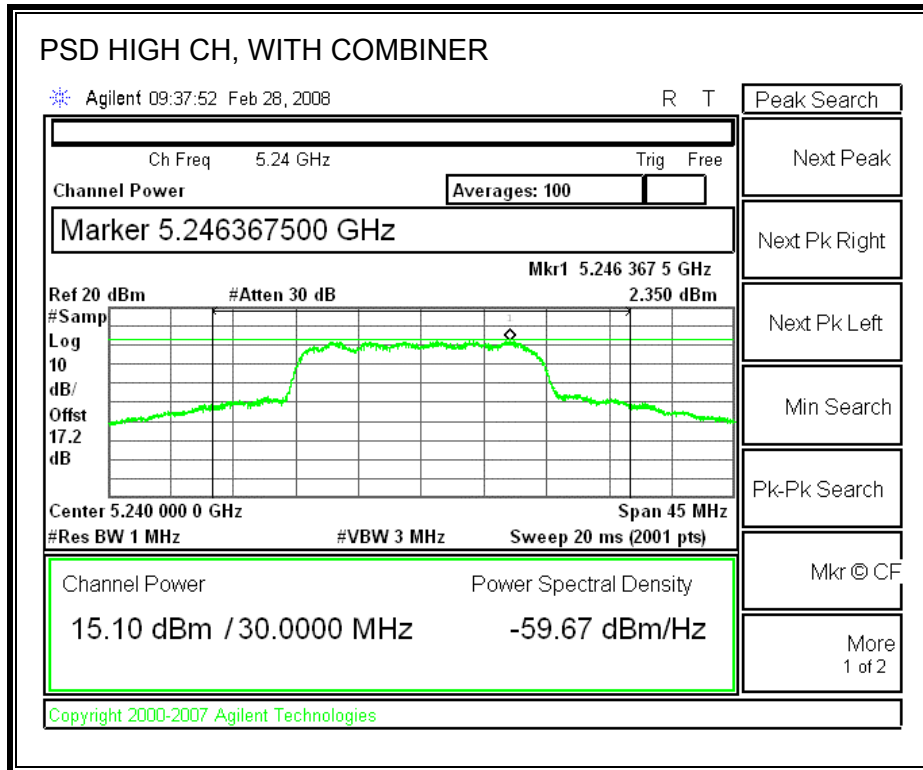
#### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	2.64	2.94	-0.30
Middle	5220	2.29	2.94	-0.65
High	5240	2.35	2.94	-0.59

**POWER SPECTRAL DENSITY WITH COMBINER**







### 7.1.5. PEAK EXCURSION

#### LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

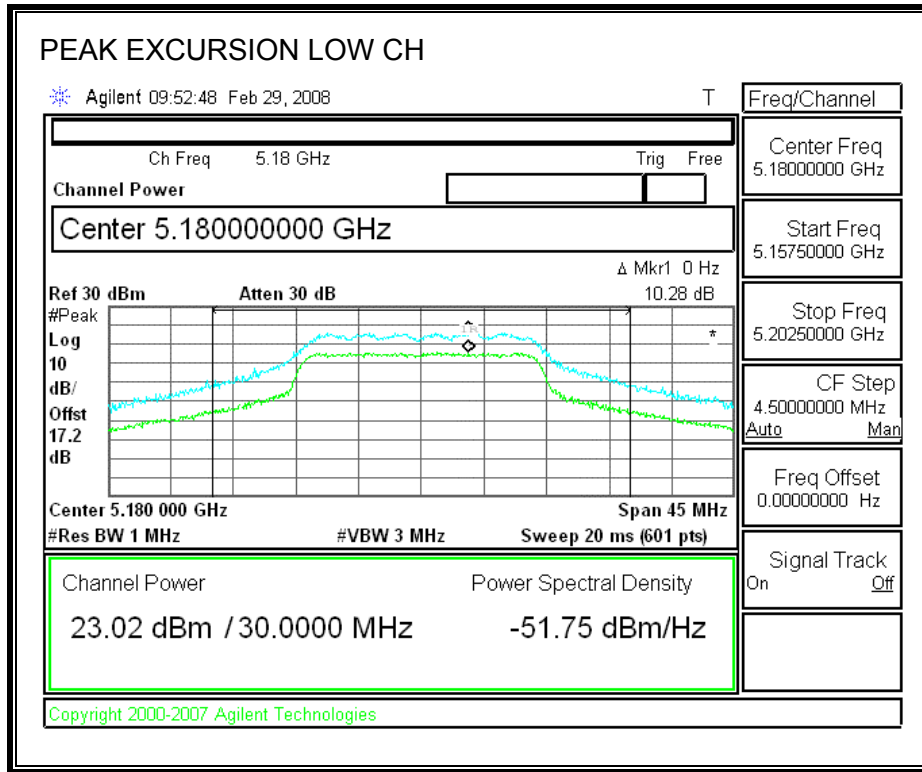
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

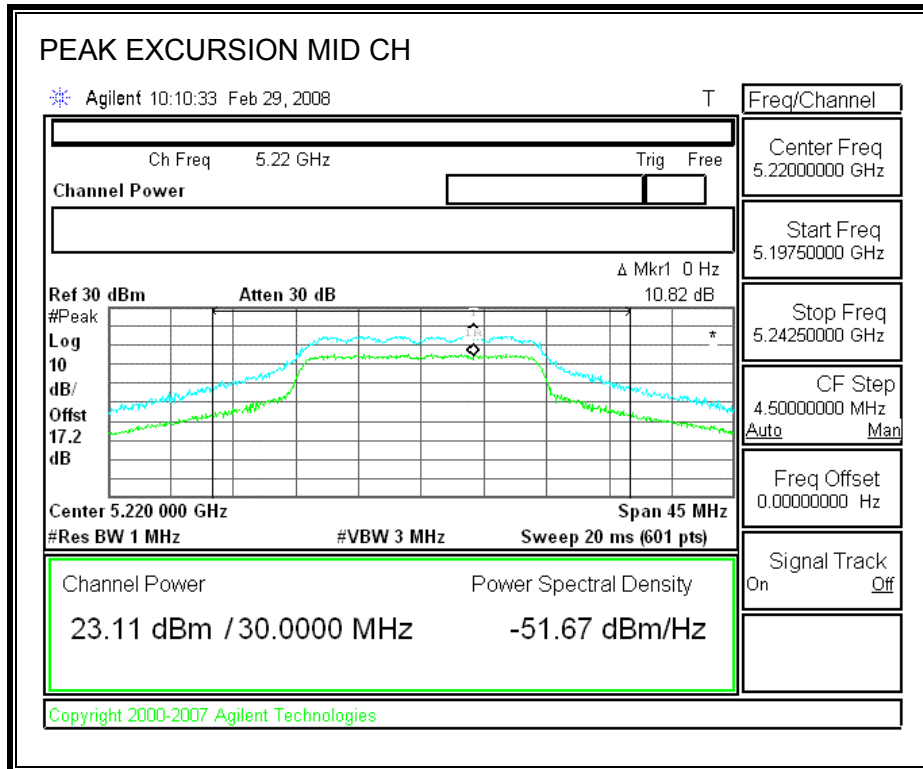
#### RESULTS

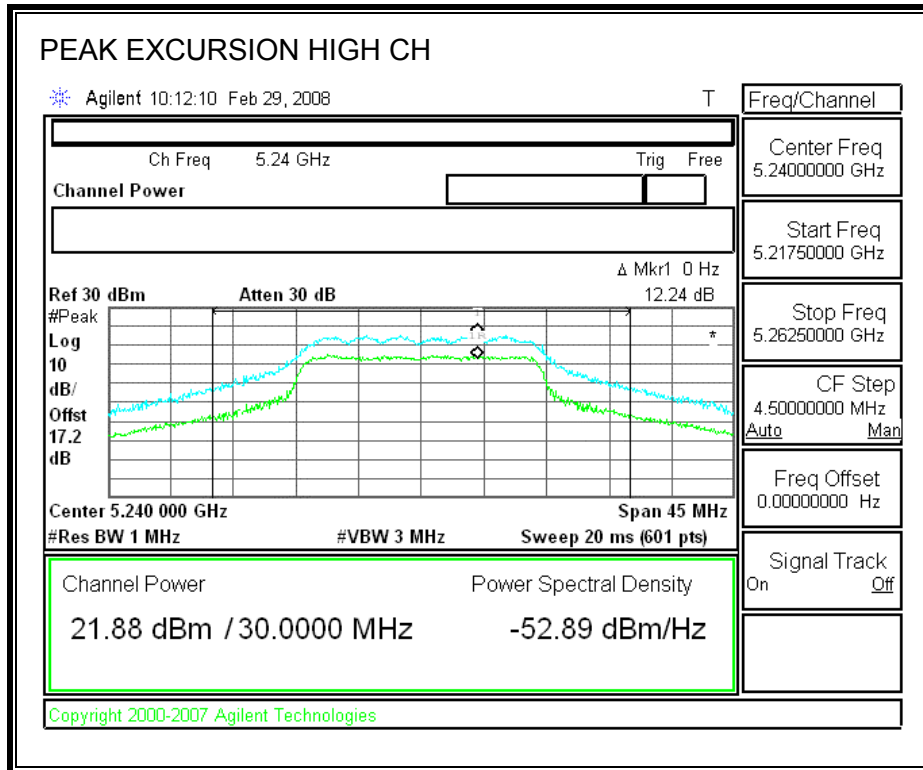
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	10.28	13	-2.72
Middle	5220	10.82	13	-2.18
High	5240	12.24	13	-0.76

**PEAK EXCURSION**









## **7.1.6. 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**

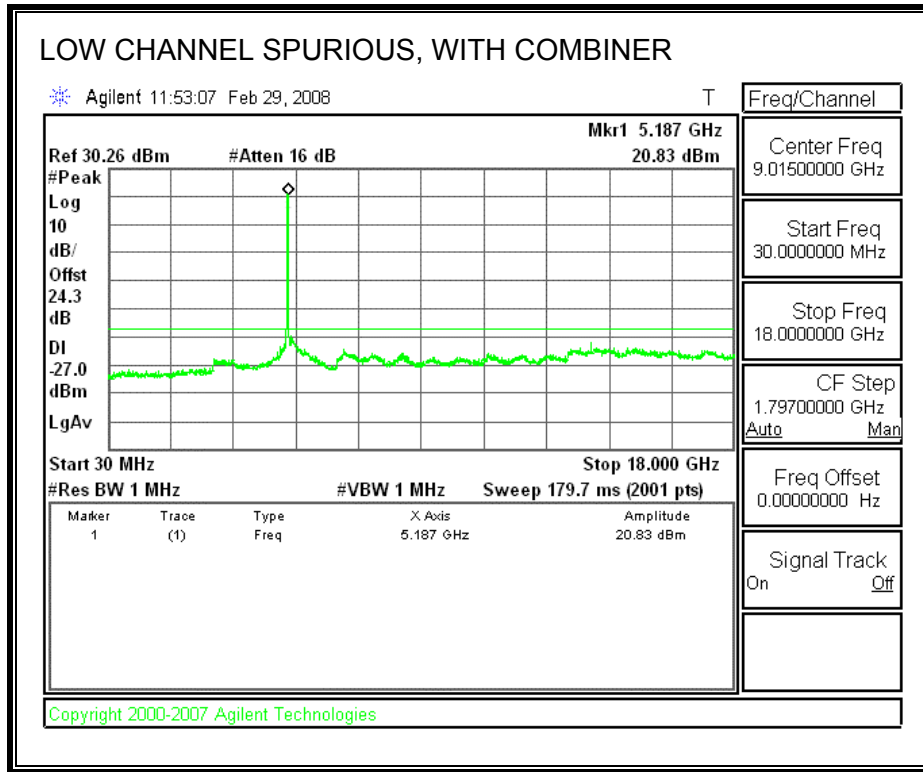
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

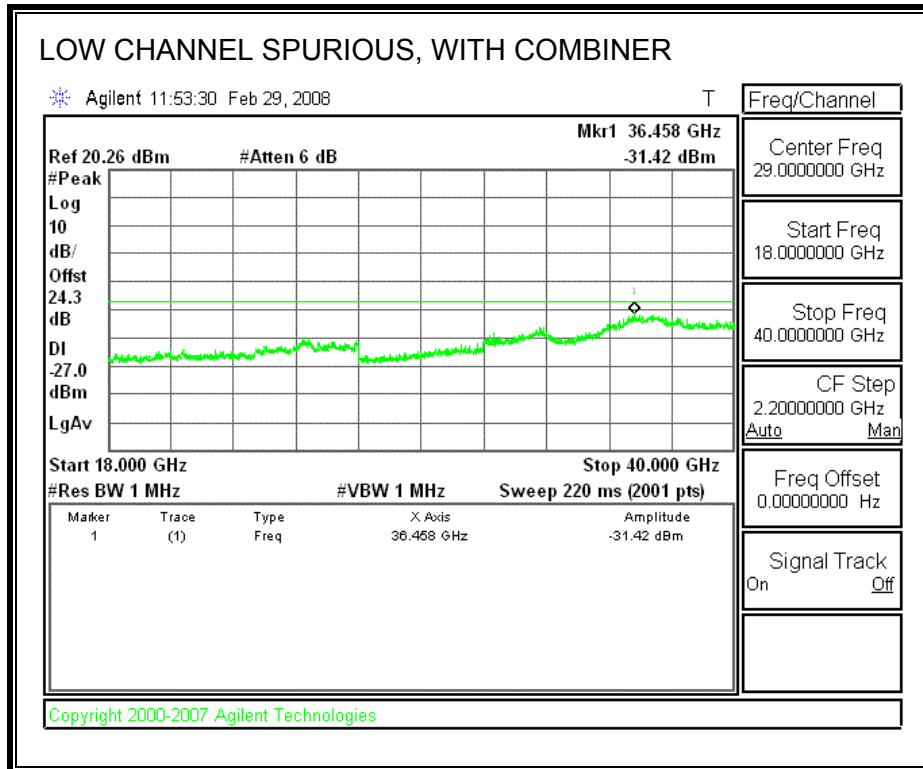
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

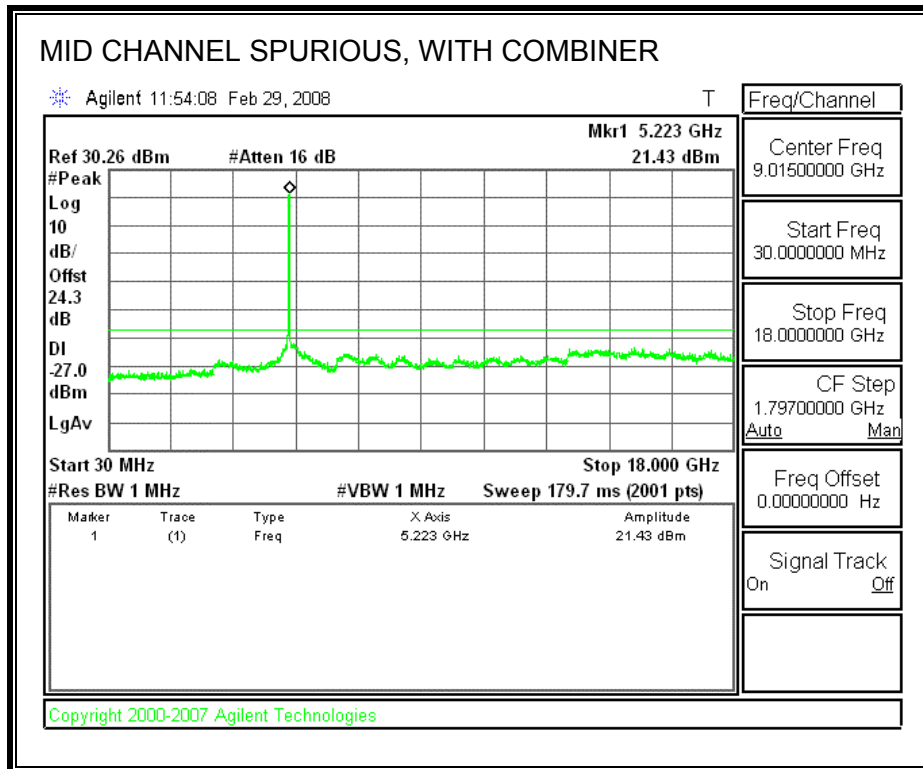
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

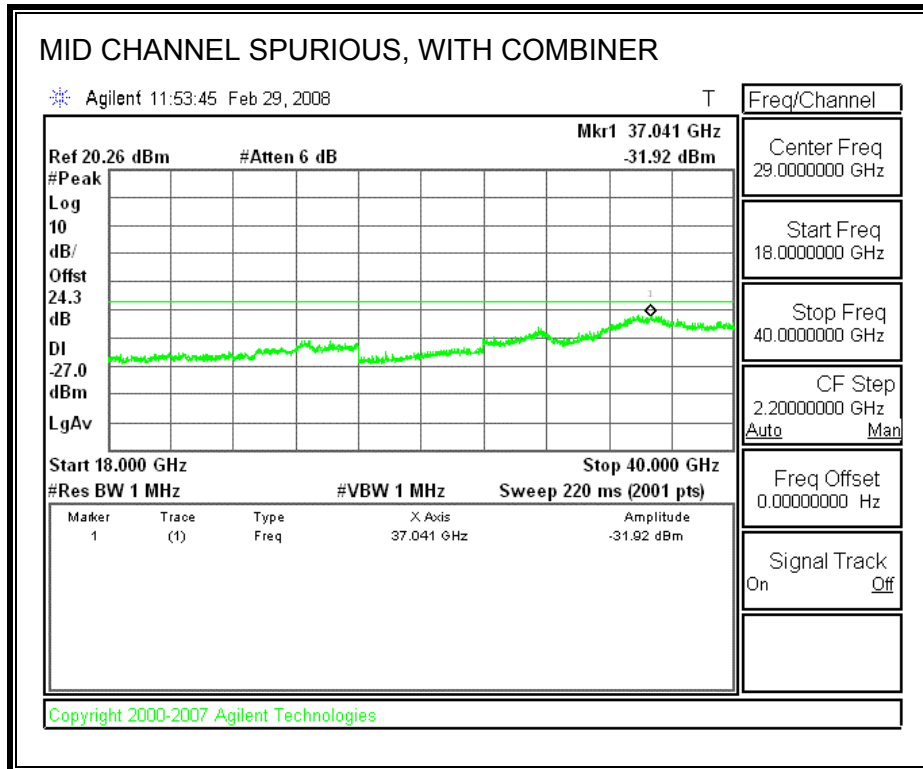
### **RESULTS**

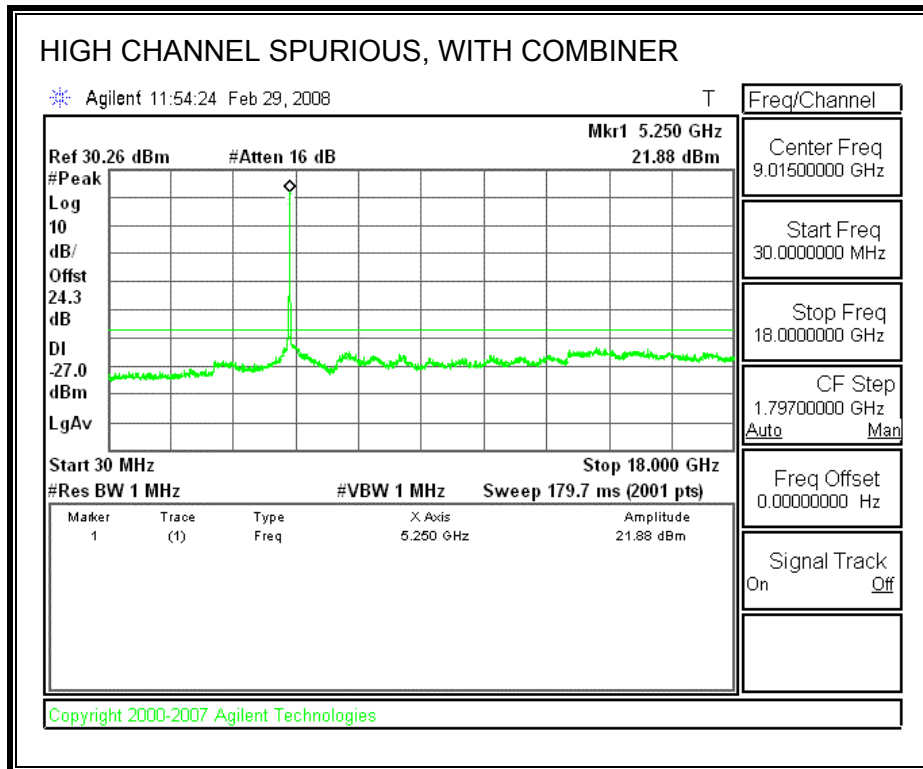
**SPURIOUS EMISSIONS WITH COMBINER**



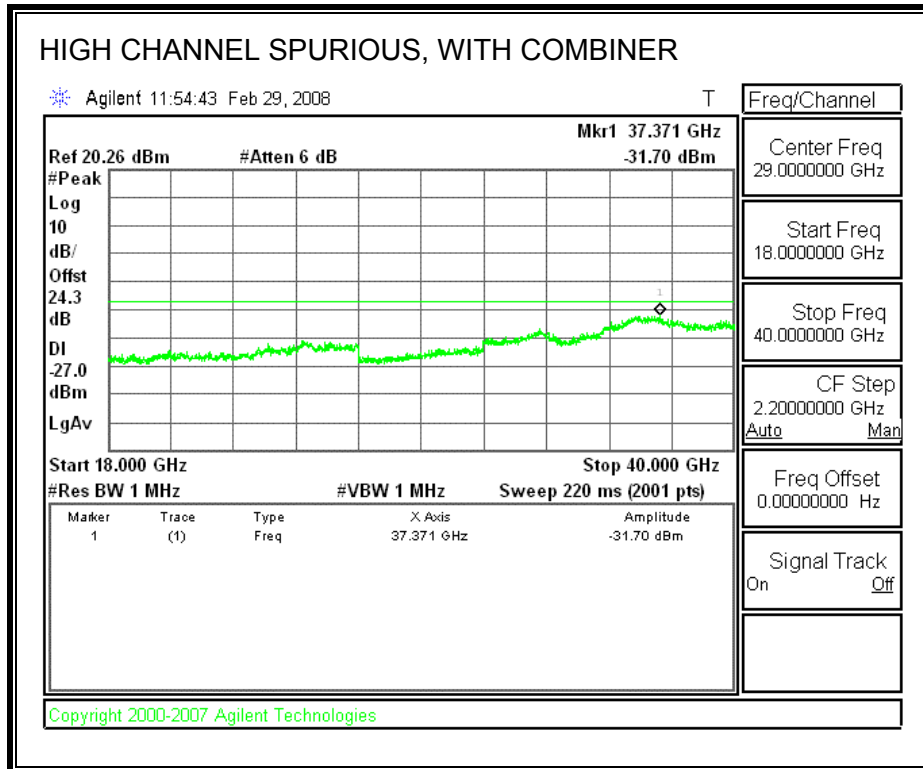












## 7.2. 802.11n HT20 MODE IN THE LOWER 5.2 GHz BAND

### 7.2.1. 26 dB and 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

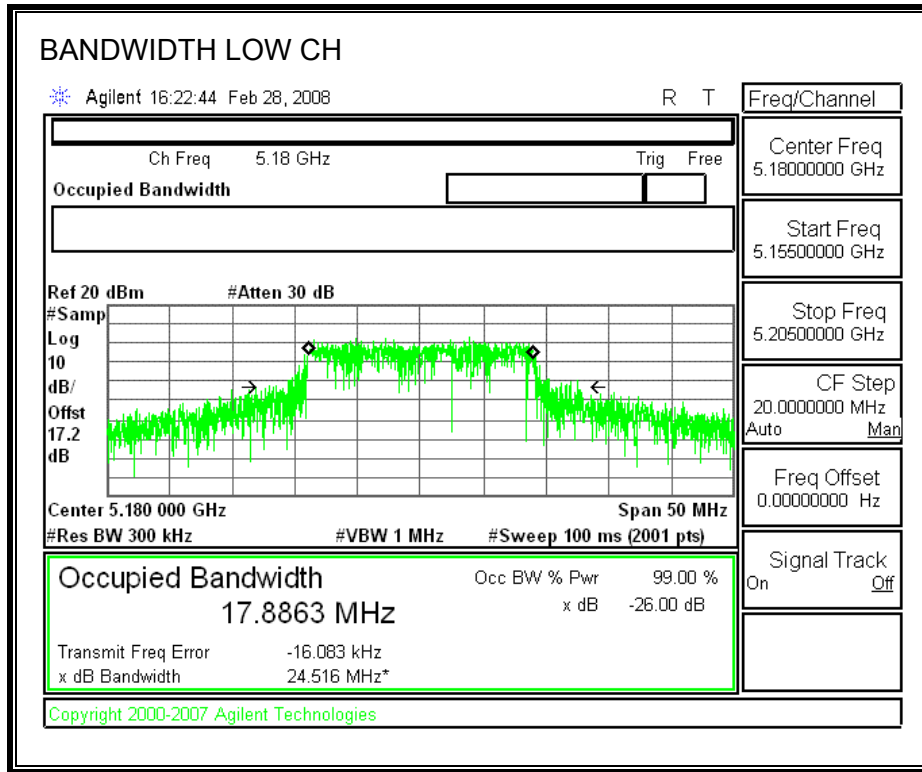
#### TEST PROCEDURE

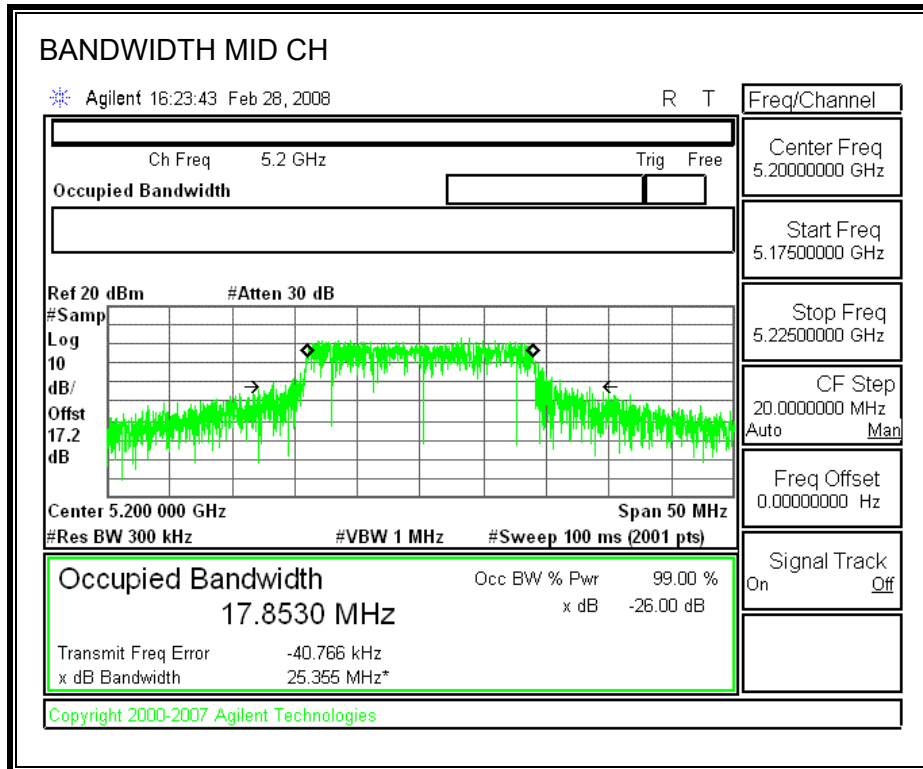
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

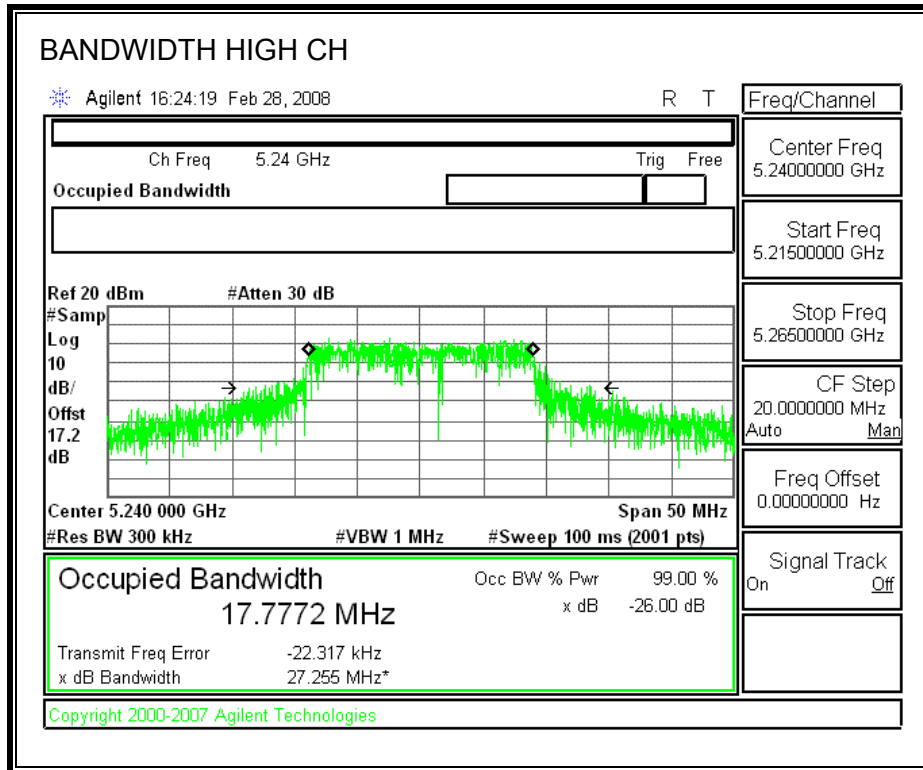
#### RESULTS

Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
5180	24.516	17.8863
5220	25.355	17.8530
5240	27.255	17.7772

**26 dB and 99% BANDWIDTH**







## 7.2.2. 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.

### 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

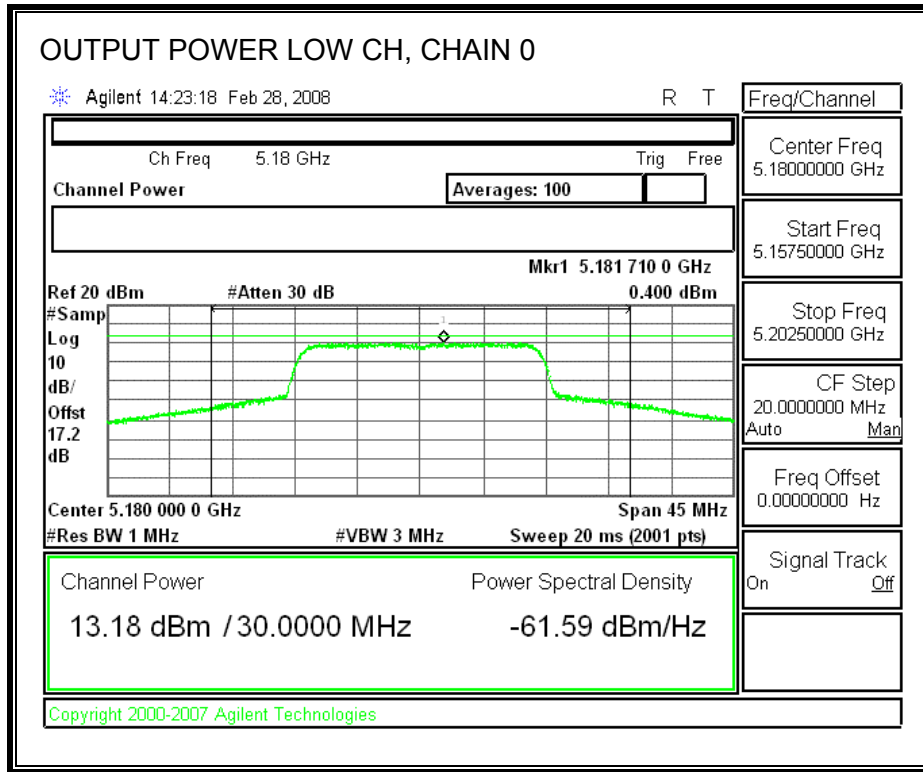
#### Limit

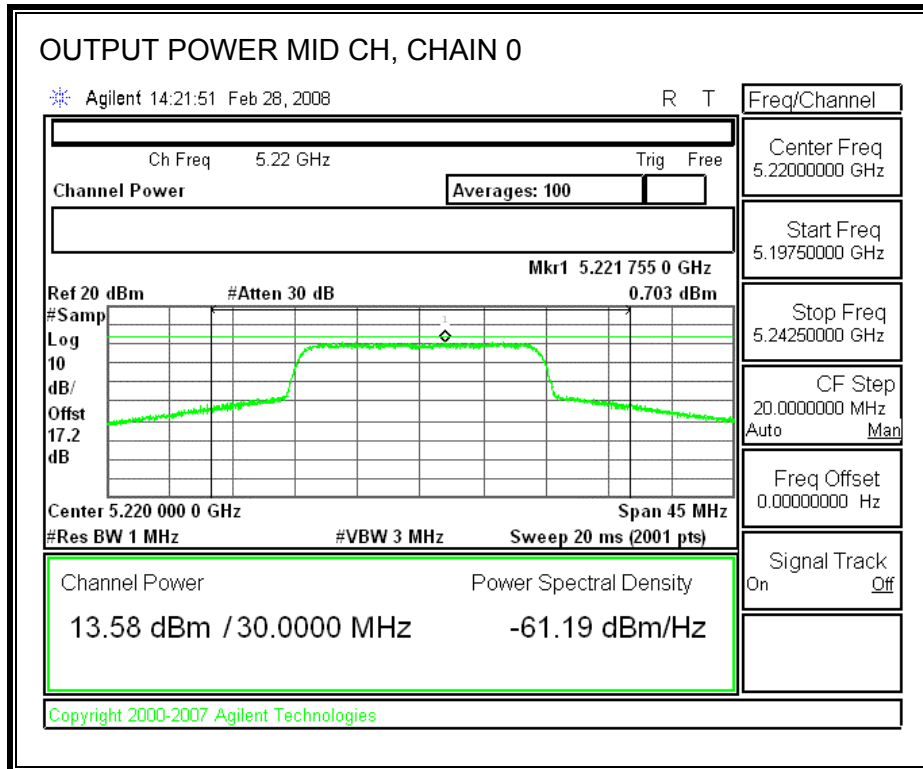
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17.00	24.516	17.89	4.63	17.00
Mid	5220	17.00	25.355	18.04	4.63	17.00
High	5240	17.00	27.255	18.35	4.63	17.00

#### Individual Chain Results

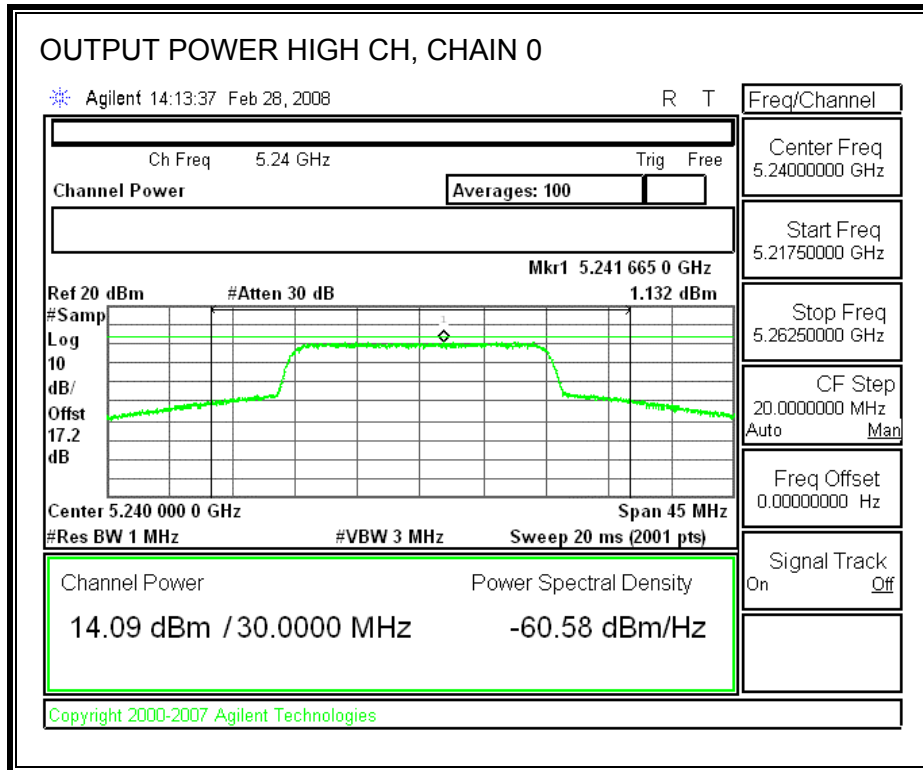
Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.18	14.08	16.66	17.00	-0.34
Mid	5220	13.58	14.13	16.87	17.00	-0.13
High	5240	14.09	13.72	16.92	17.00	-0.08

**CHAIN 0 OUTPUT POWER**

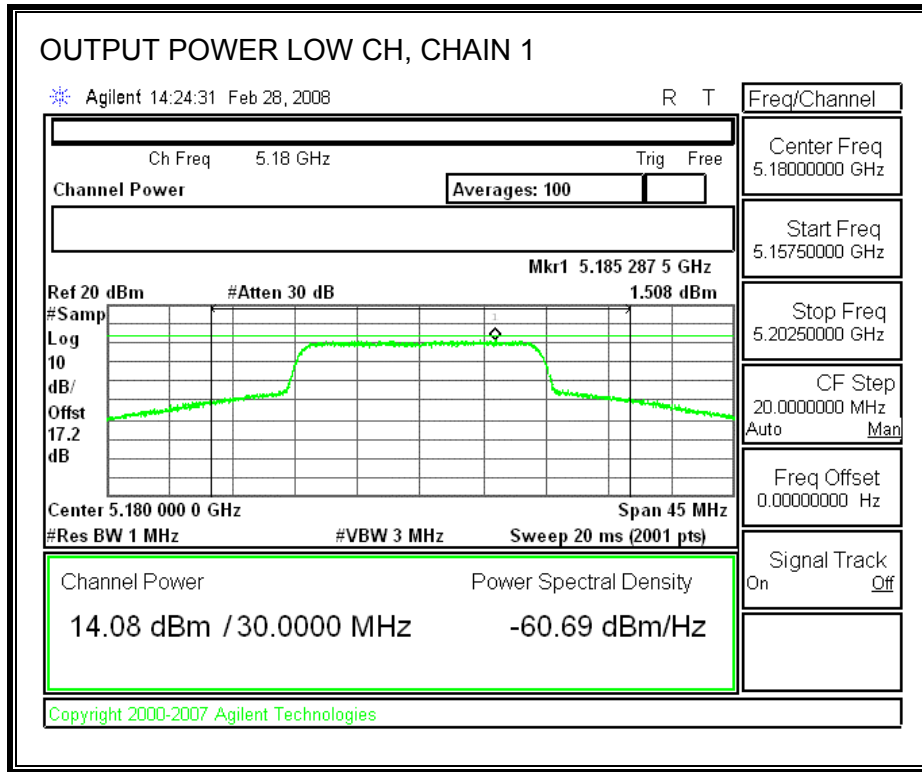


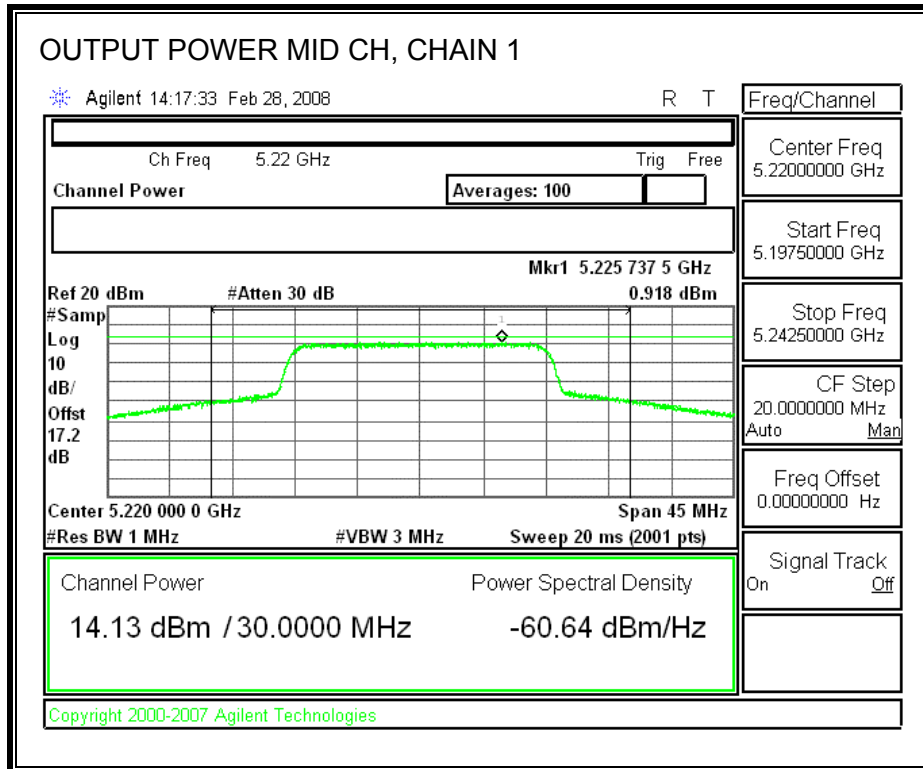


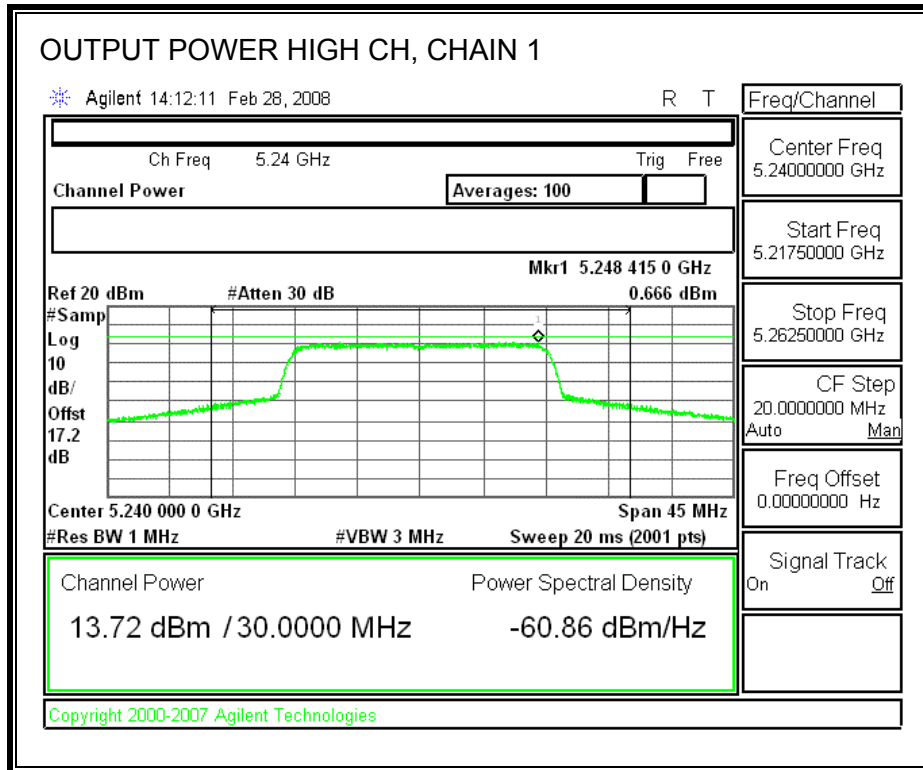




**CHAIN 1 OUTPUT POWER**







### 7.2.3. 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 17.2 dB (including 16 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
5180	13.15	14.03	16.62
5220	13.51	14.04	16.79
5240	13.96	13.70	16.84

## 7.2.4. 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 less than or equal to 6 dBi, therefore the limit is 4 dBm.

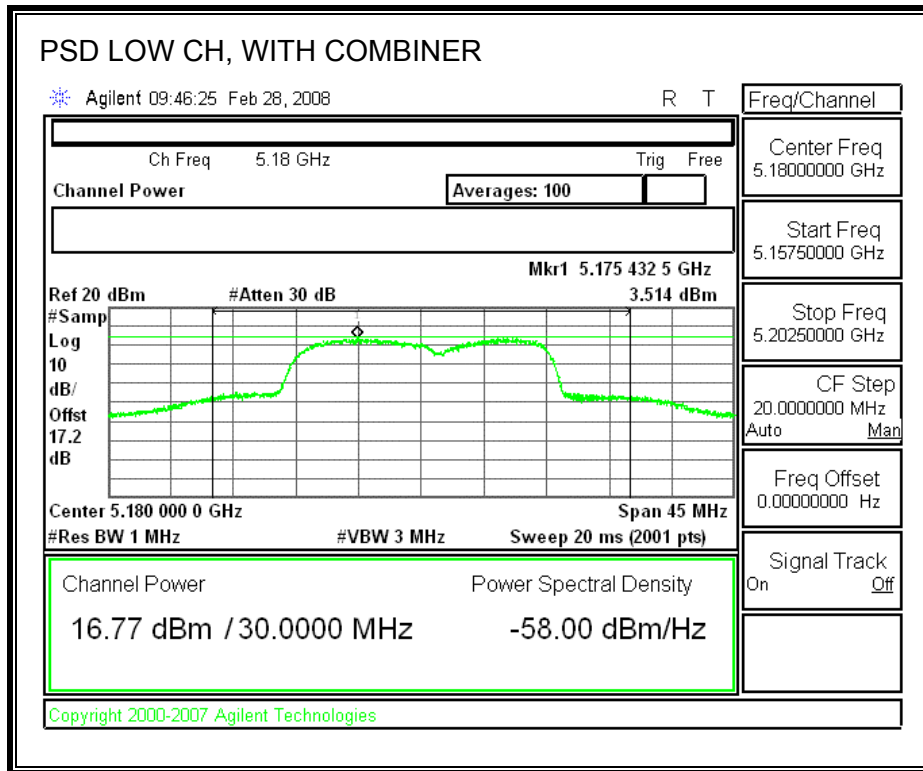
### TEST PROCEDURE

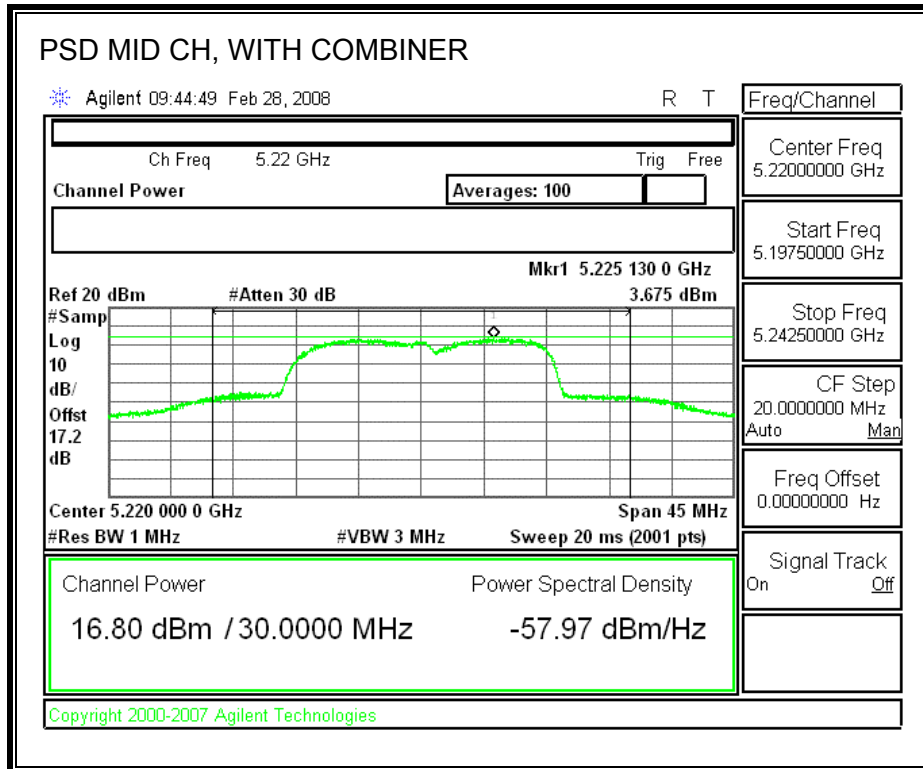
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

### RESULTS

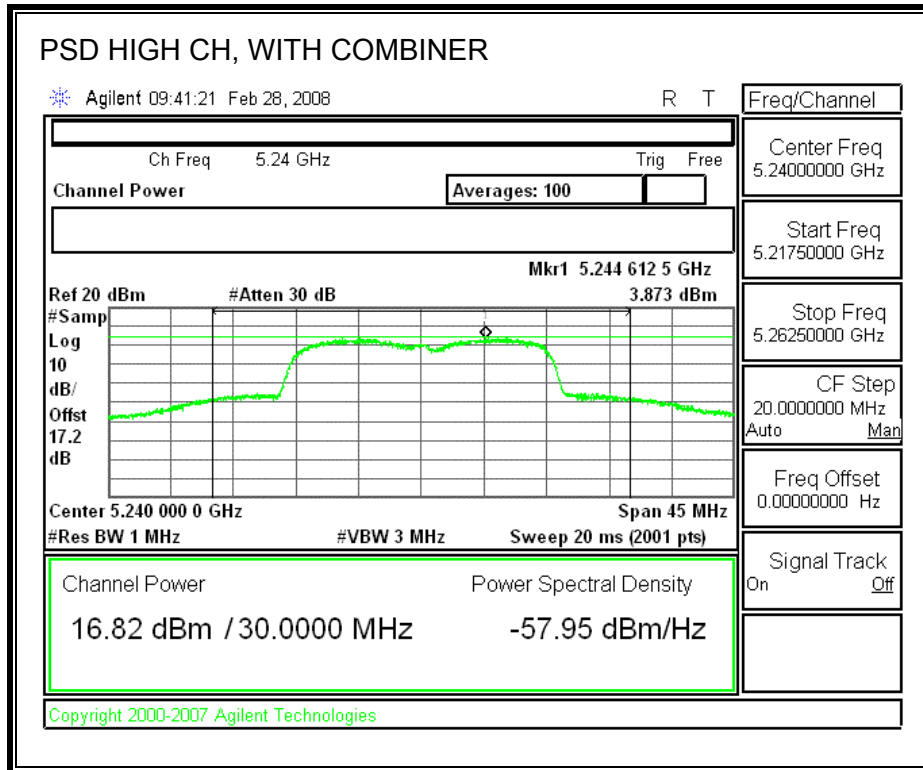
Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.51	4	-0.49
Middle	5220	3.68	4	-0.33
High	5240	3.87	4	-0.13

POWER SPECTRAL DENSITY WITH COMBINER









## 7.2.5. PEAK EXCURSION

### LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

### TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

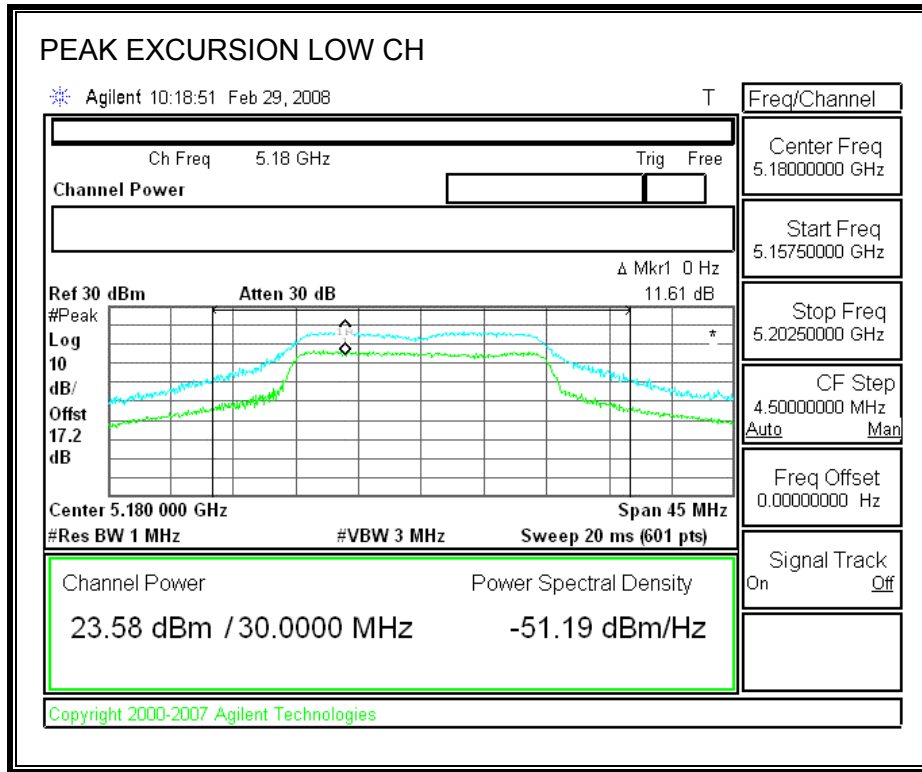
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

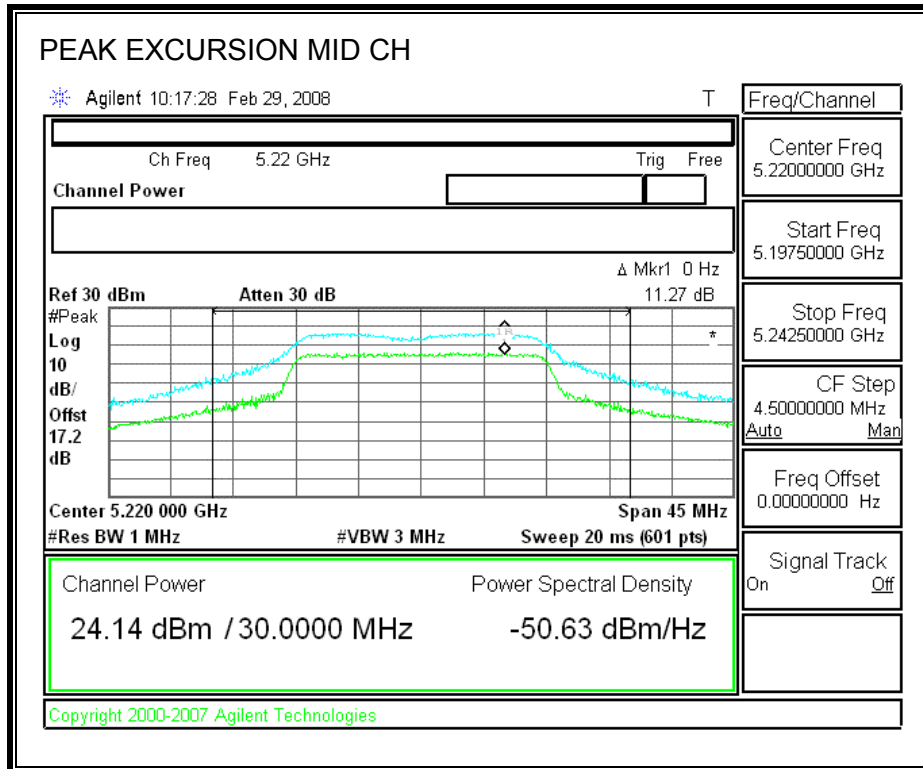
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

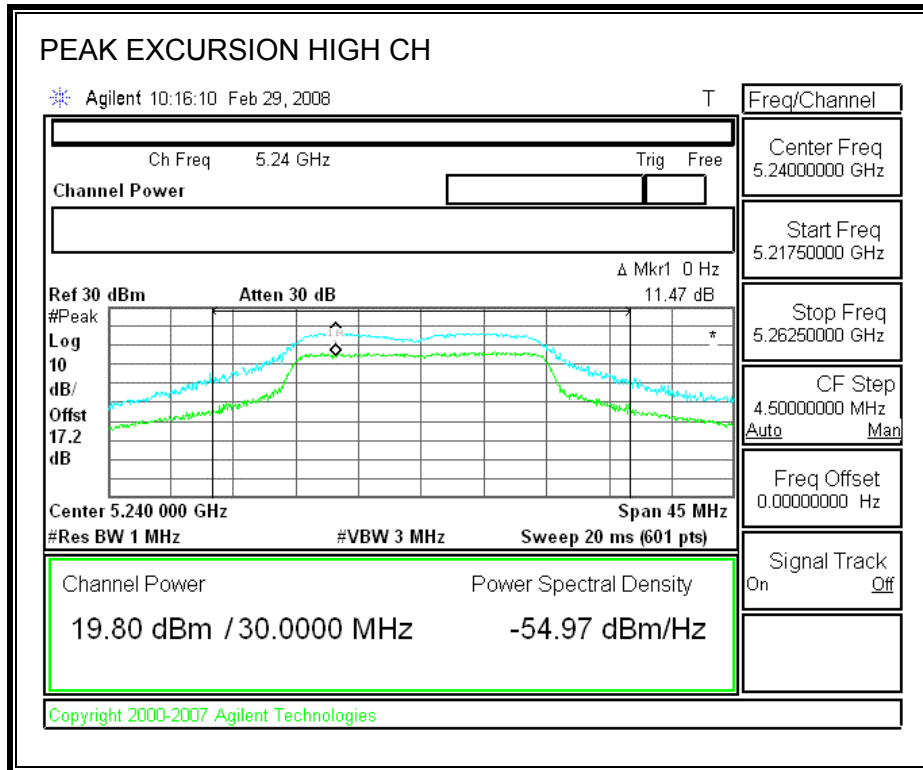
### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	11.61	13	-1.39
Middle	5220	11.27	13	-1.73
High	5240	11.47	13	-1.53

**PEAK EXCURSION**







## **7.2.6. 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**

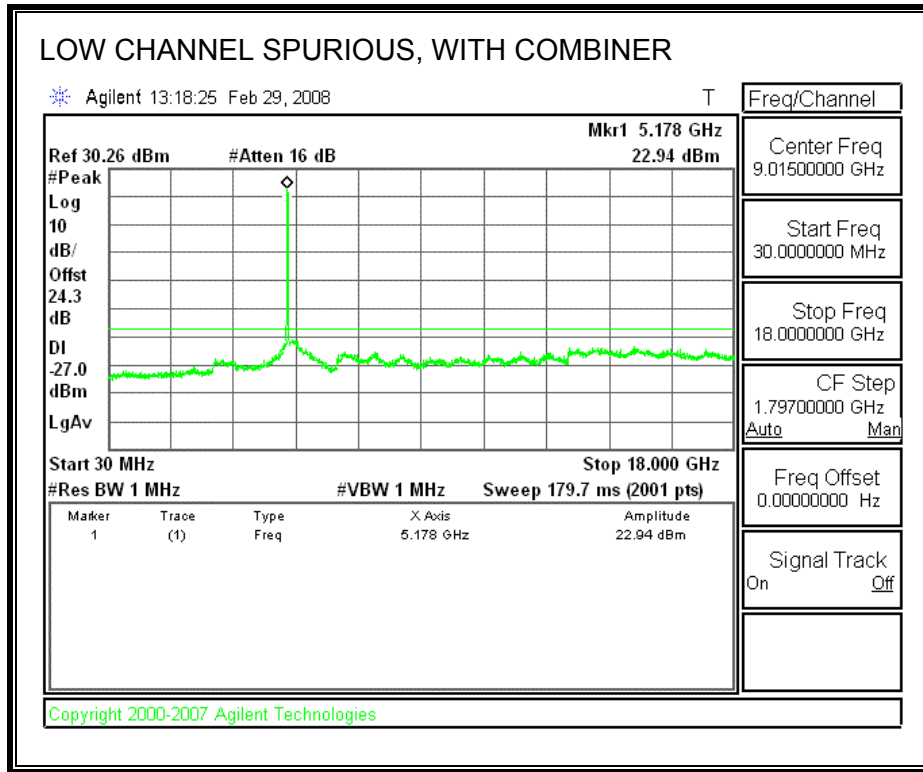
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

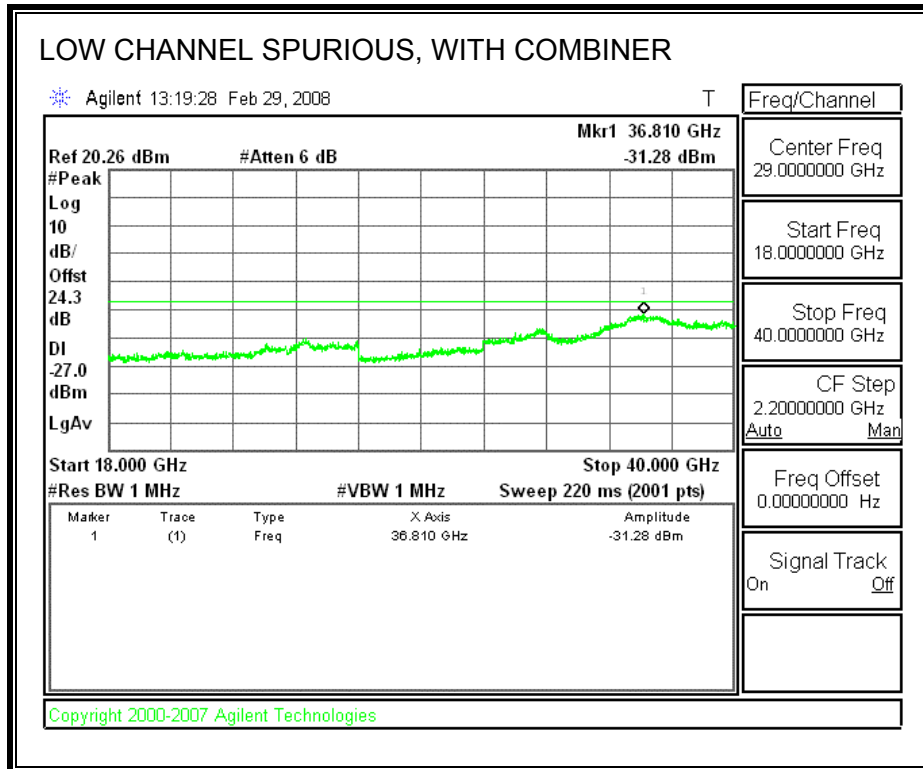
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

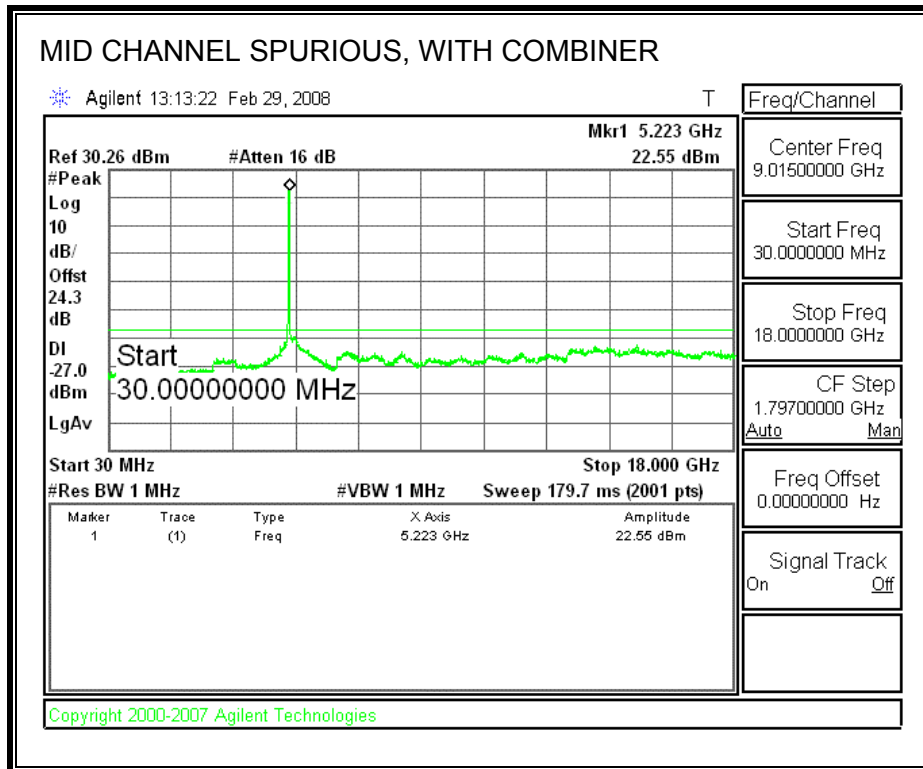
### **RESULTS**

**SPURIOUS EMISSIONS WITH COMBINER**

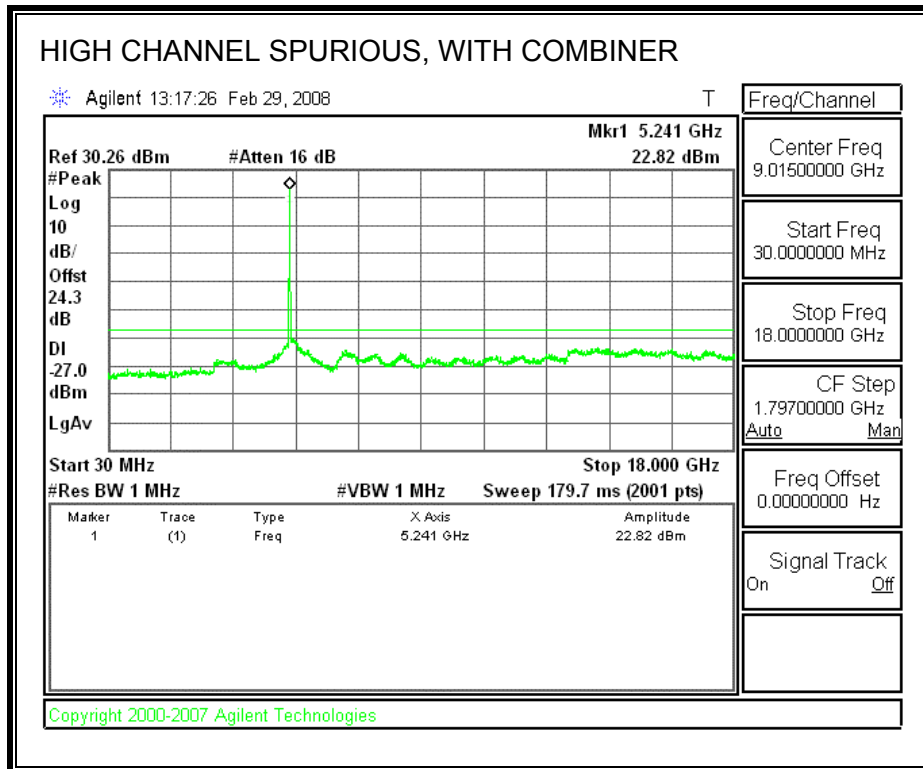


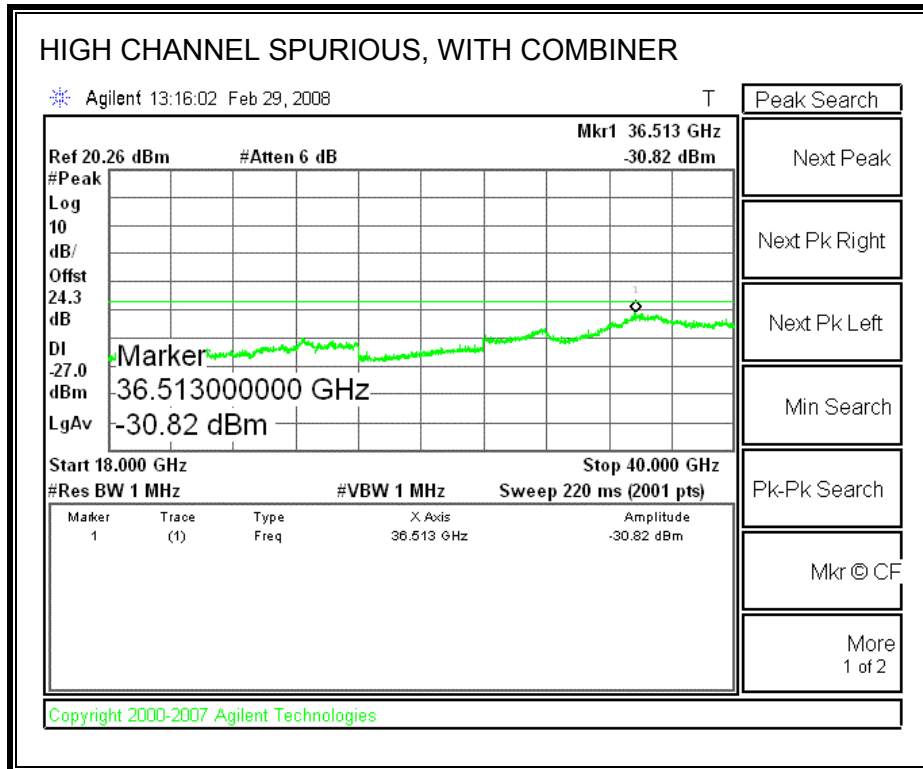












### 7.3. 802.11n HT40 MODE IN THE LOWER 5.2 GHz BAND

#### 7.3.1. 26 dB and 99% BANDWIDTH

##### LIMITS

None; for reporting purposes only.

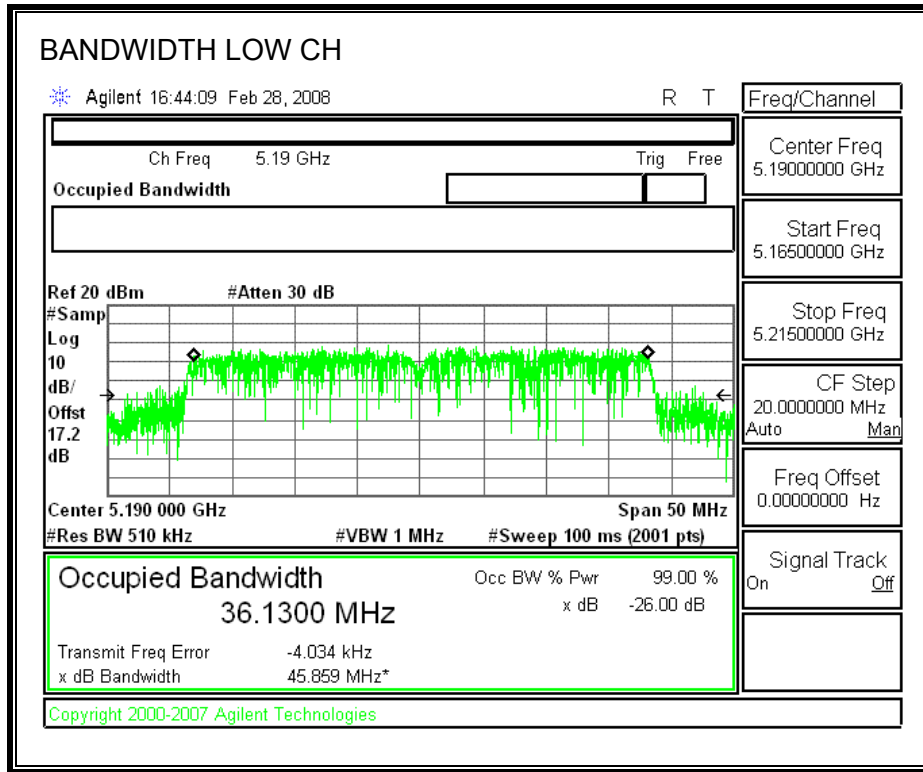
##### TEST PROCEDURE

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

##### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	45.859	36.1300
High	5230	45.791	36.3730

**26 dB and 99% BANDWIDTH**





### 7.3.2. 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.

#### 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

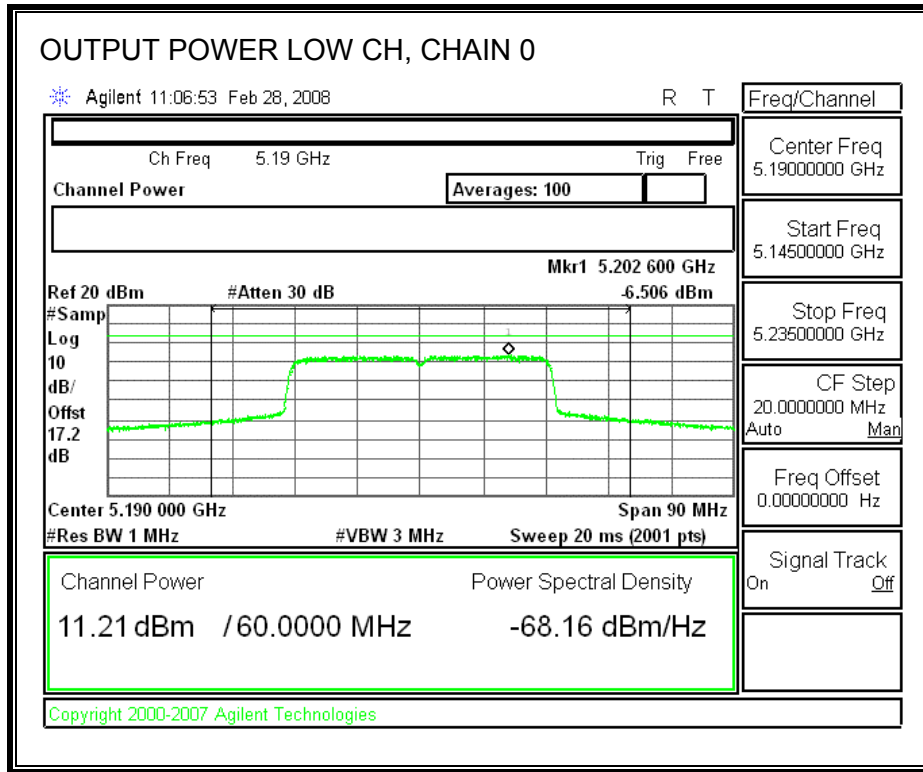
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17.00	45.859	20.61	4.63	17.00
High	5230	17.00	45.791	20.61	4.63	17.00

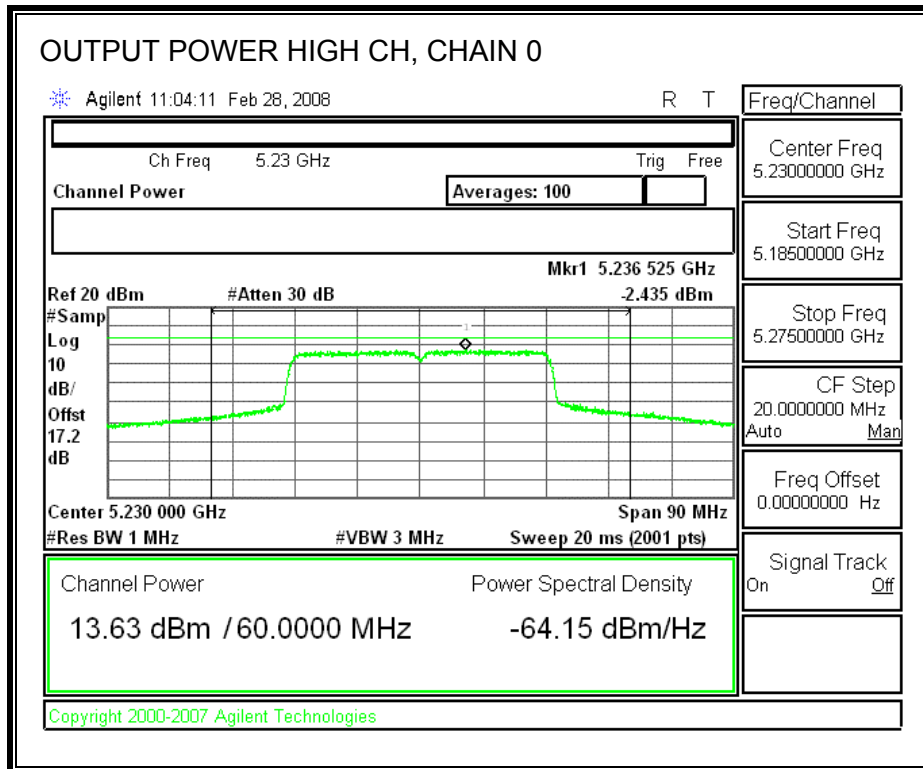
##### Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	11.21	11.22	14.23	17.00	-2.77
High	5230	13.63	14.32	16.99	17.00	-0.01

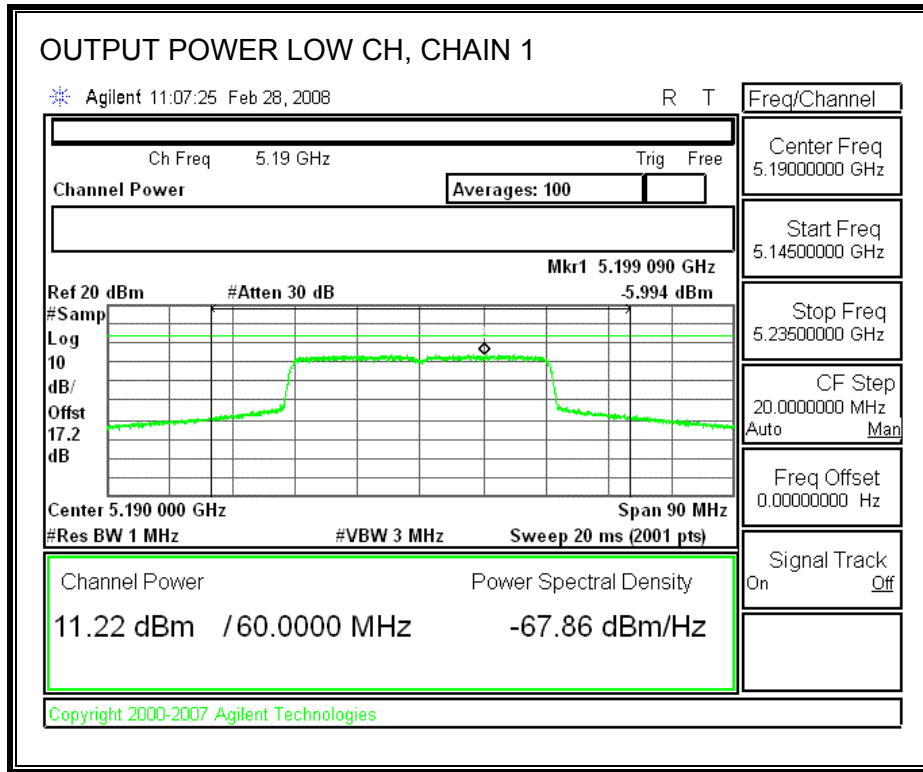


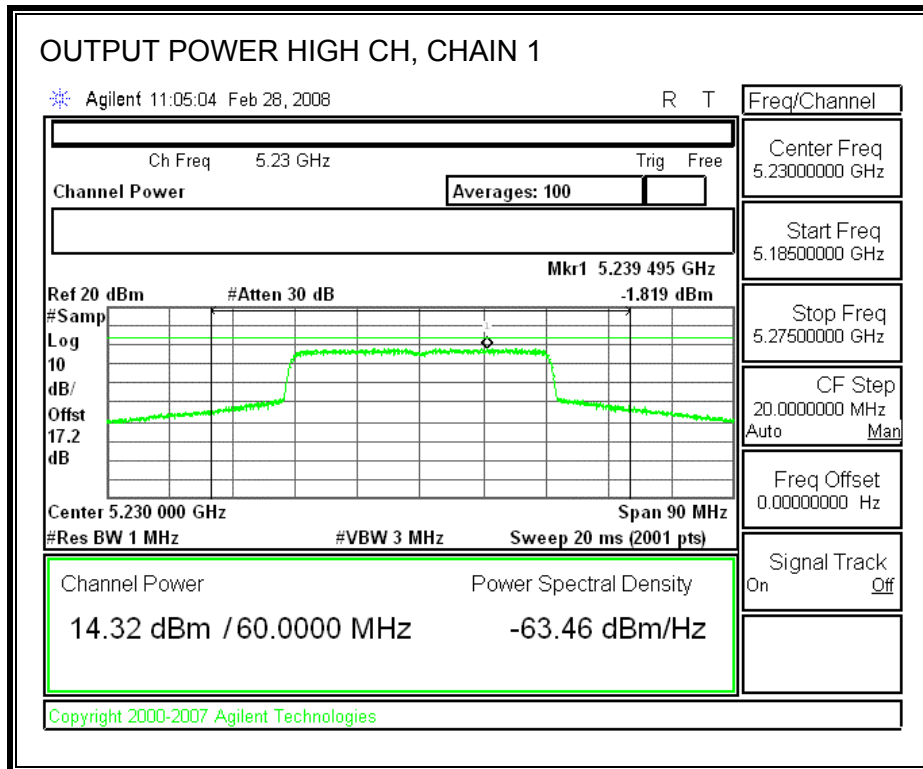
**CHAIN 0 OUTPUT POWER**





**CHAIN 1 OUTPUT POWER**





### 7.3.3. 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 17.2 dB (including 16 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5190	11.07	11.11	14.10
High	5230	13.50	14.11	16.83

### 7.3.4. 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 less than or equal to 6 dBi, therefore the limit is 4 dBm.

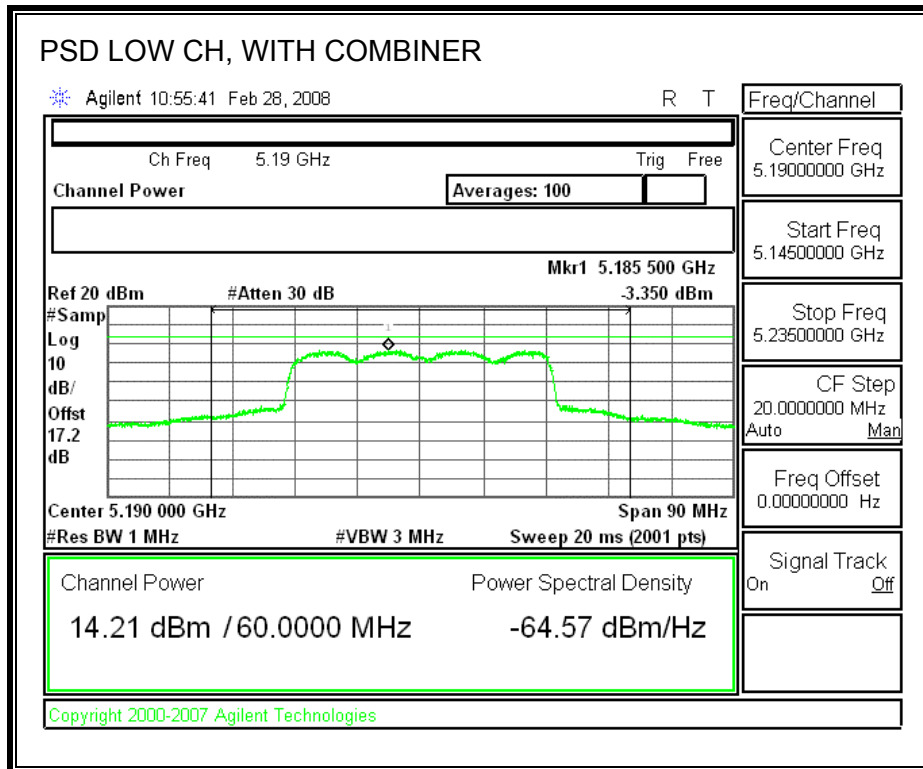
#### TEST PROCEDURE

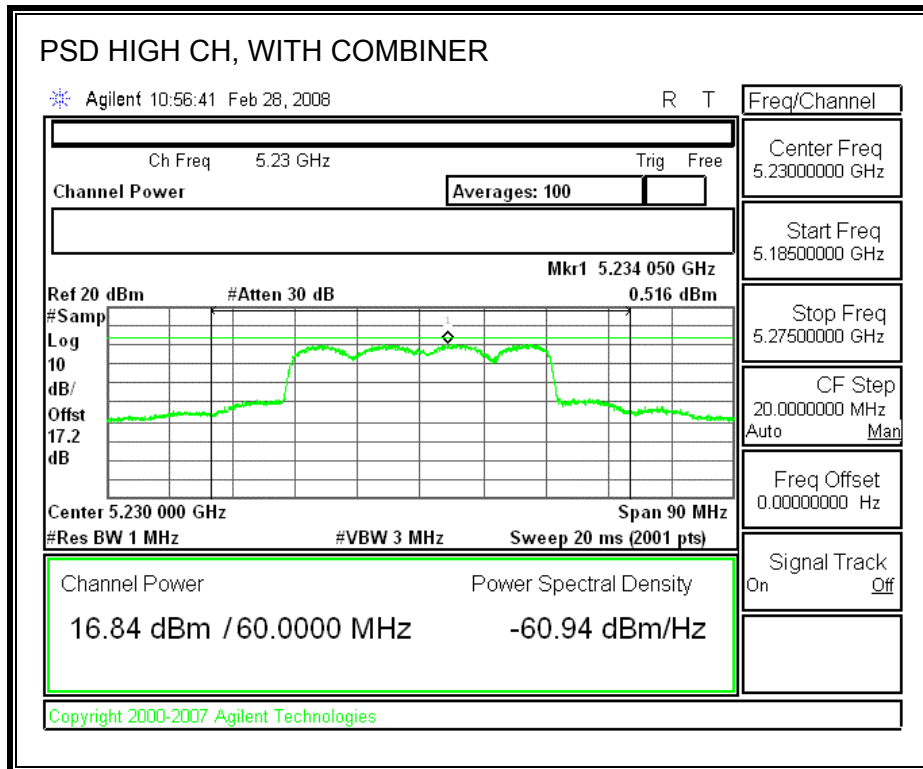
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

#### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-3.35	4	-7.35
High	5230	0.52	4	-3.48

POWER SPECTRAL DENSITY WITH COMBINER







### 7.3.5. PEAK EXCURSION

#### LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

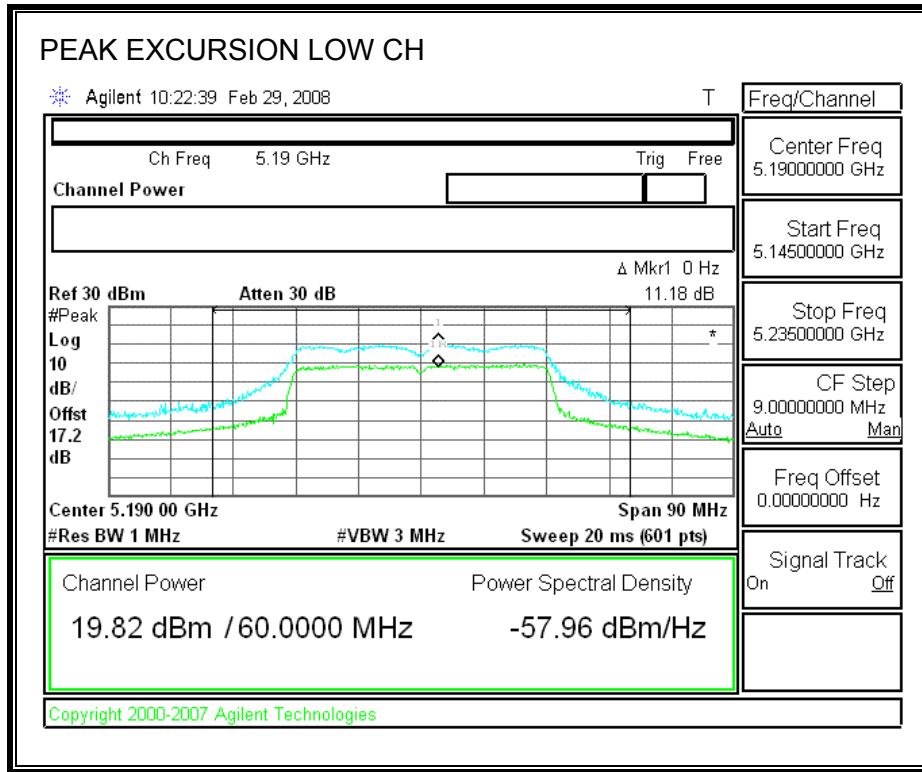
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

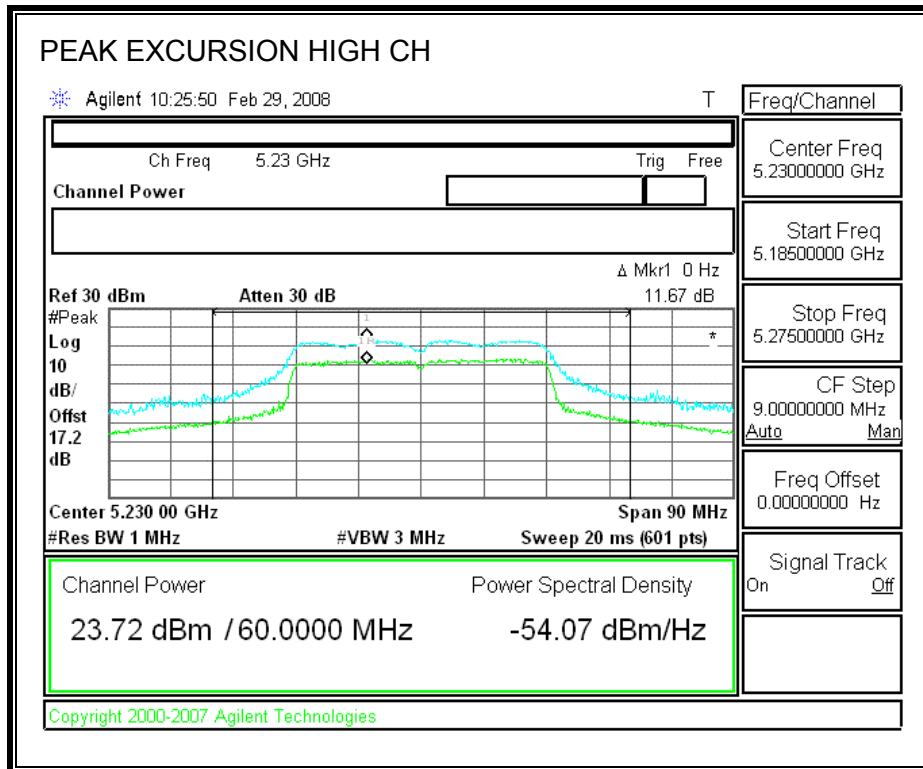
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	11.18	13	-1.82
High	5230	11.67	13	-1.33

**PEAK EXCURSION**





### **7.3.6. 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**

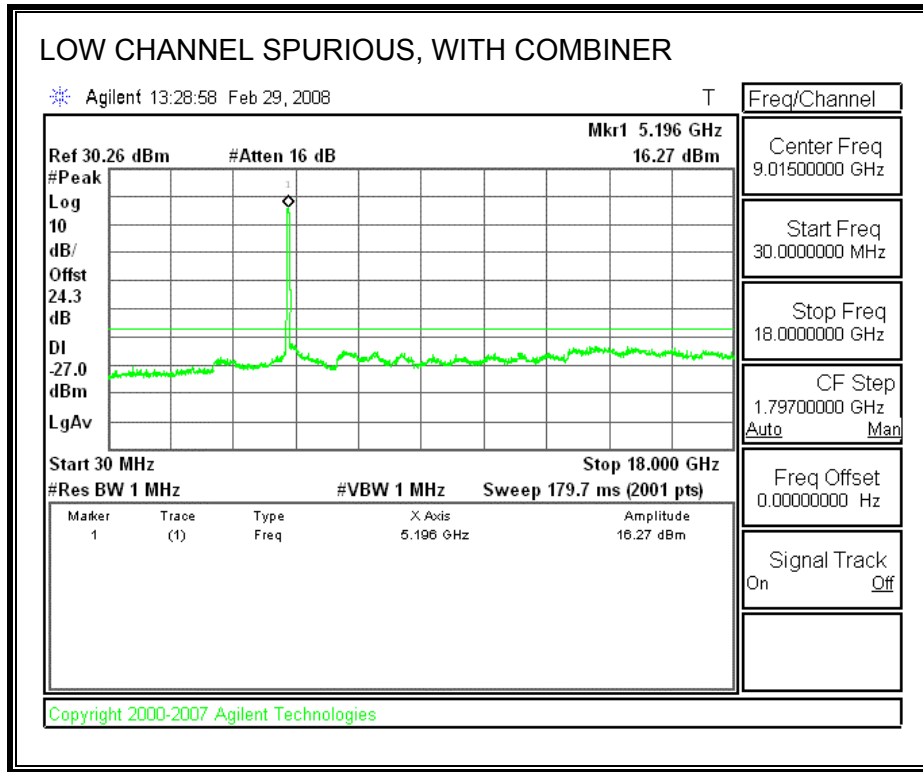
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

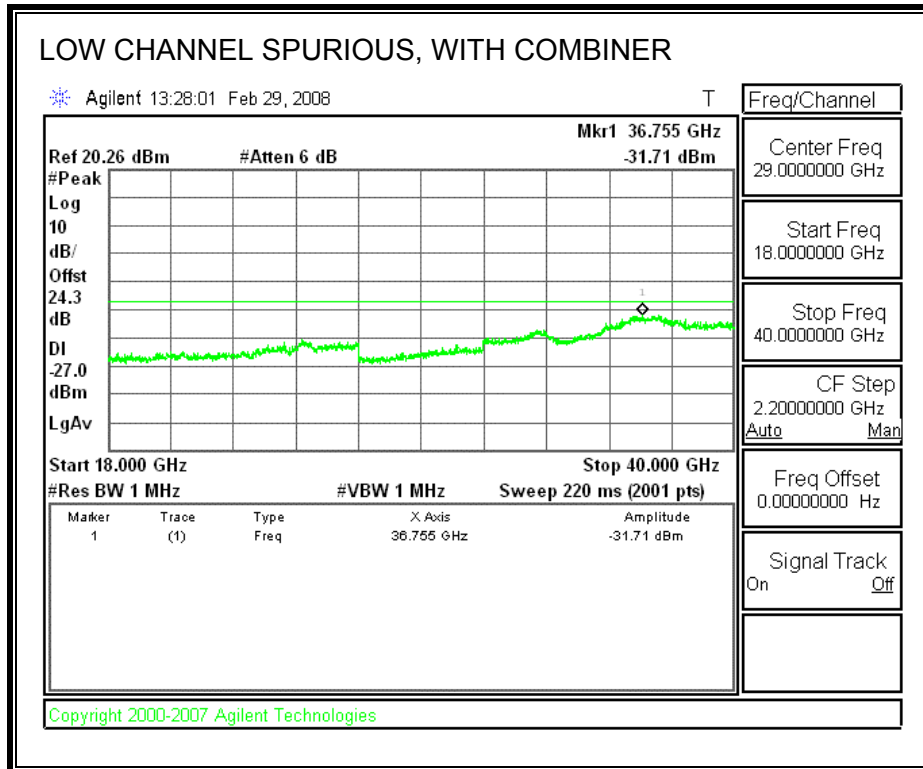
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

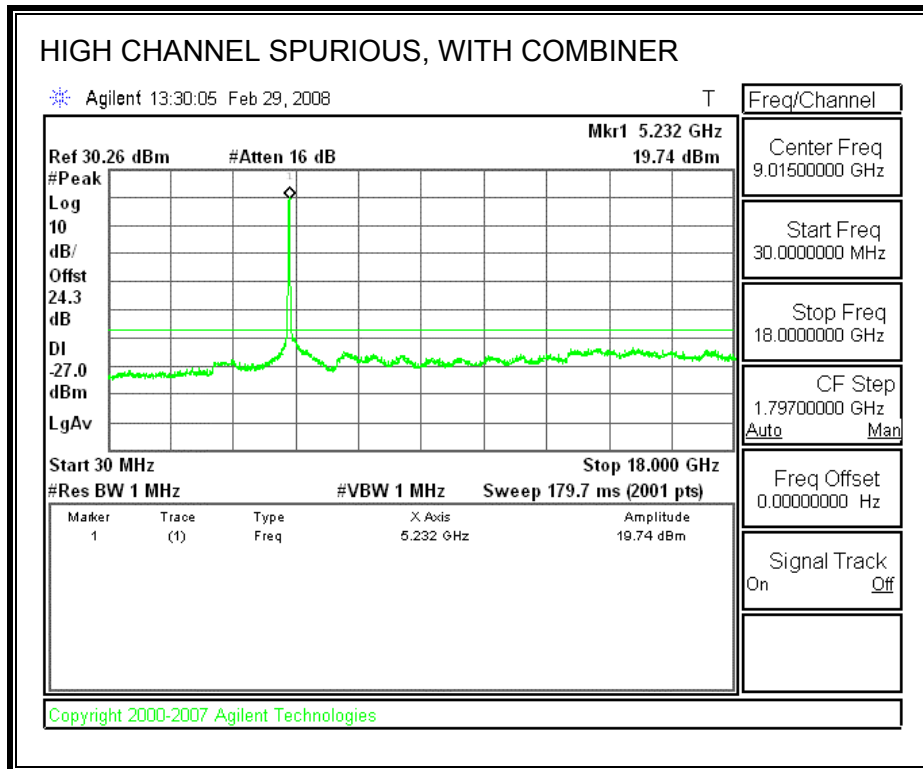
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

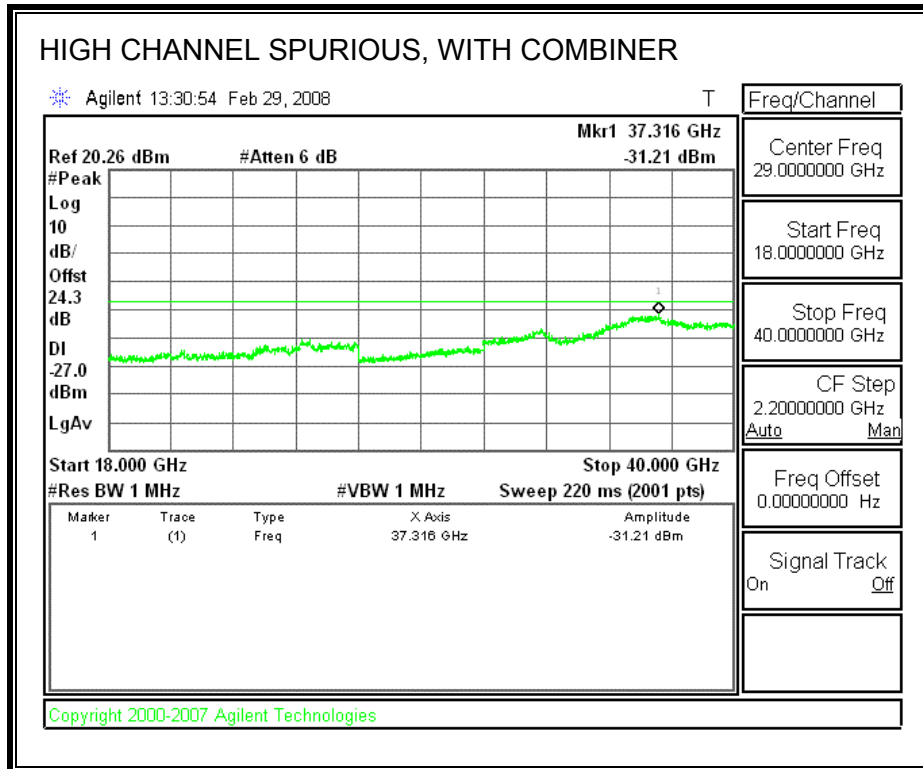
#### **RESULTS**

**SPURIOUS EMISSIONS WITH COMBINER**











## 7.4. 802.11a DUAL CHAIN LEGACY MODE IN THE UPPER 5.2 GHz BAND

### 7.4.1. 26 dB and 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

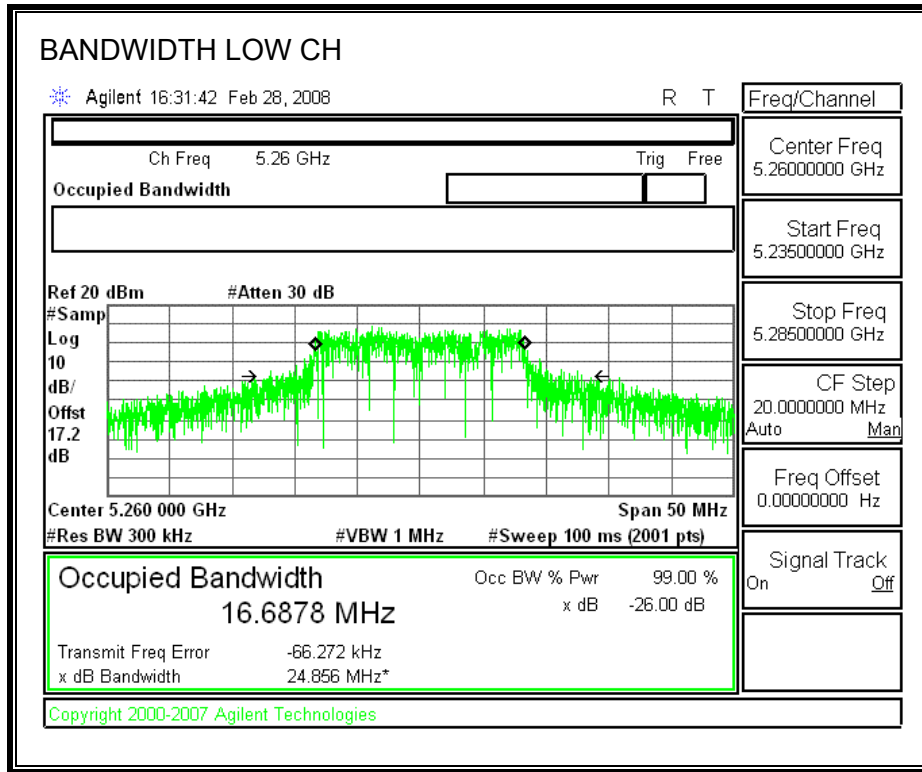
#### TEST PROCEDURE

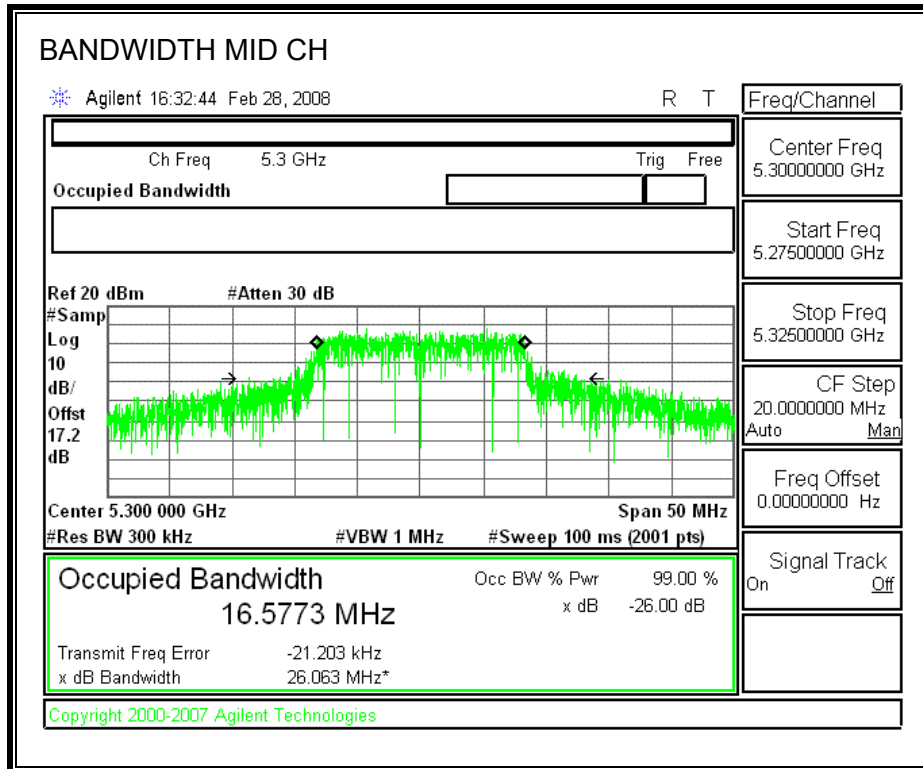
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

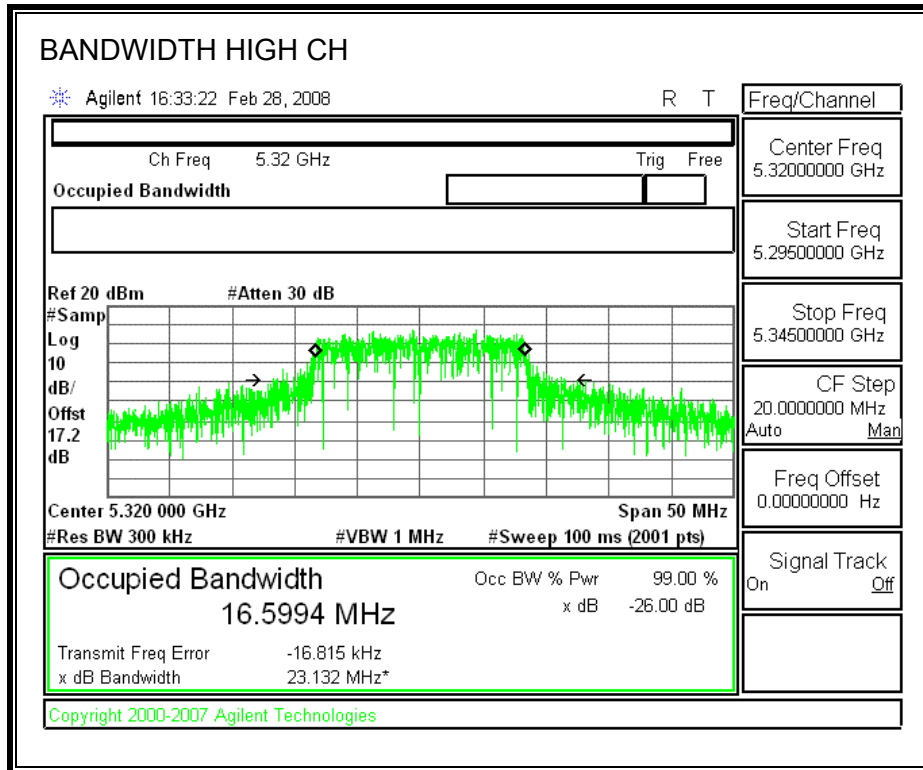
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	24.856	16.6878
Middle	5300	26.063	16.5773
High	5320	23.132	16.5994

**26 dB and 99% BANDWIDTH**







## 7.4.2. OUTPUT POWER

### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

Directional gain = gain of antenna element + 10 log (# of TX antenna elements)

<b>Effective Legacy Gain (dBi)</b>
<b>7.76</b>

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.

### 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

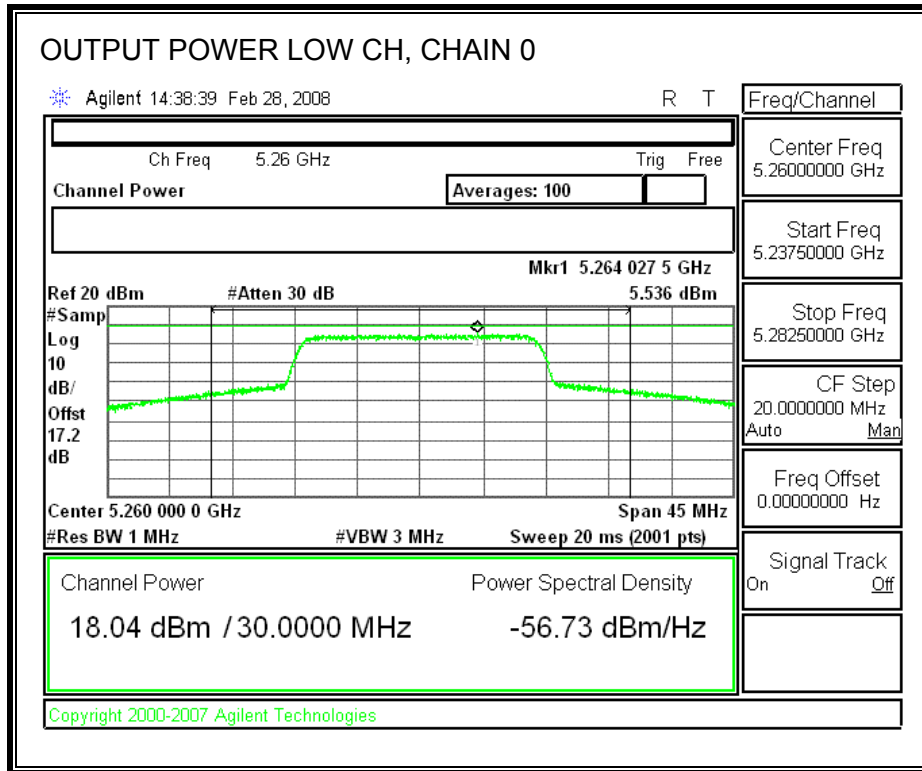
#### Limit

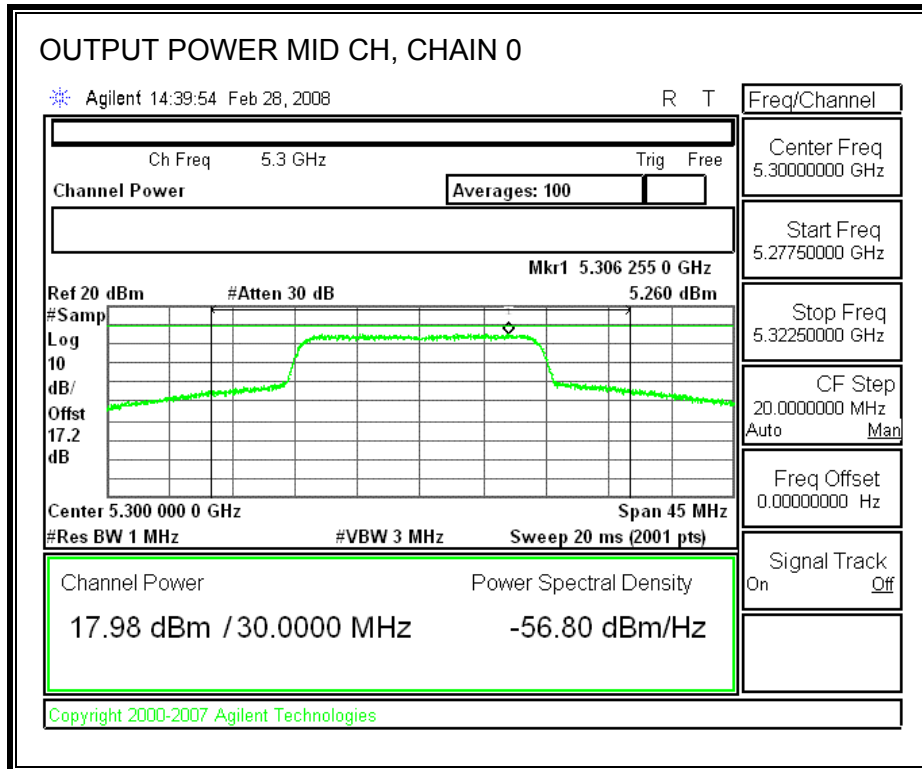
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24	24.856	24.95	7.76	22.24
Mid	5300	24	26.063	25.16	7.76	22.24
High	5320	24	23.132	24.64	7.76	22.24

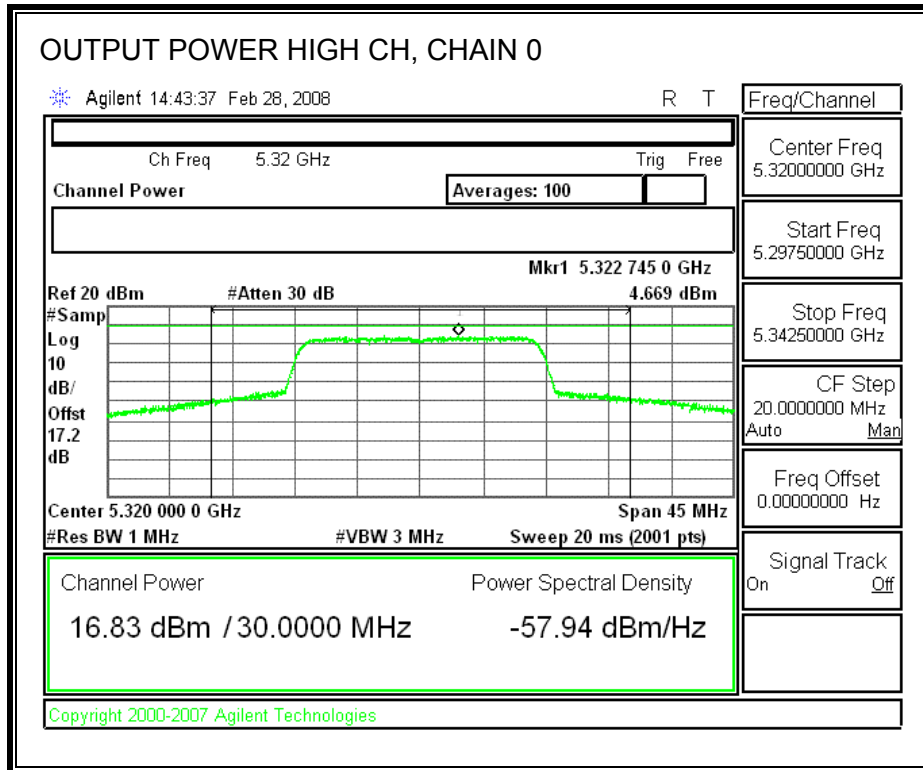
#### Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	18.04	17.77	20.92	22.24	-1.32
Mid	5300	17.98	17.90	20.95	22.24	-1.29
High	5320	16.83	16.91	19.88	22.24	-2.36

**CHAIN 0 OUTPUT POWER**

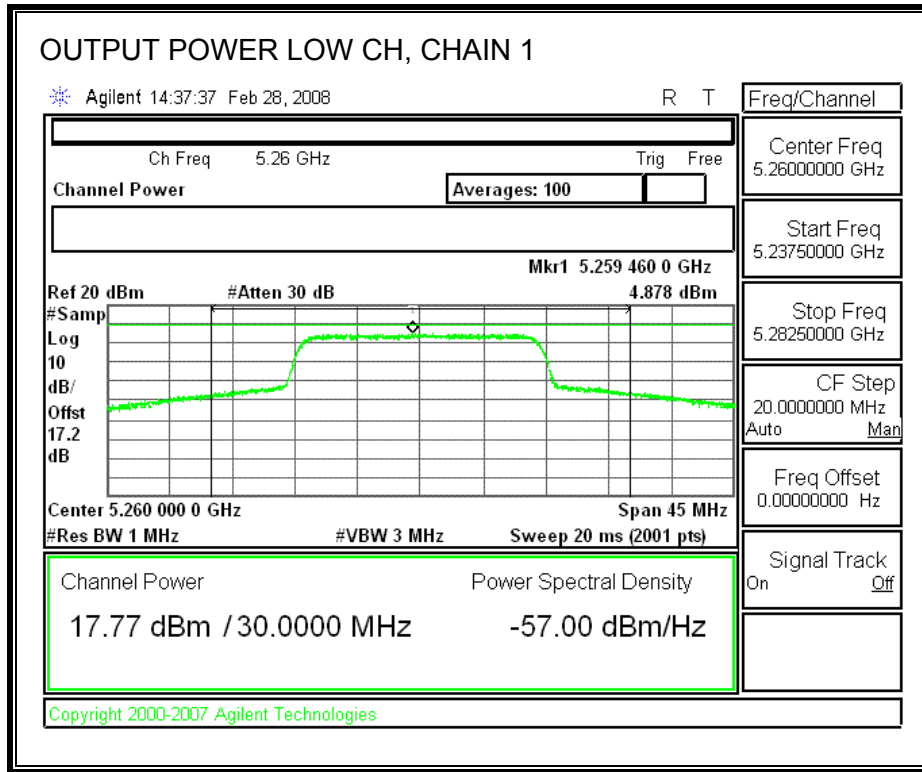


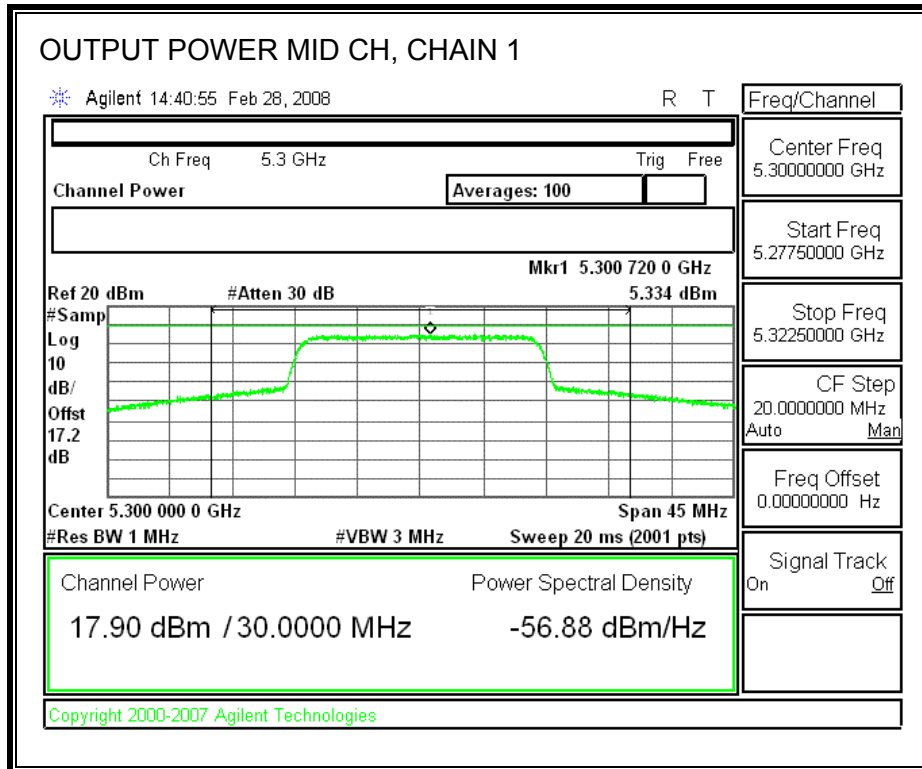


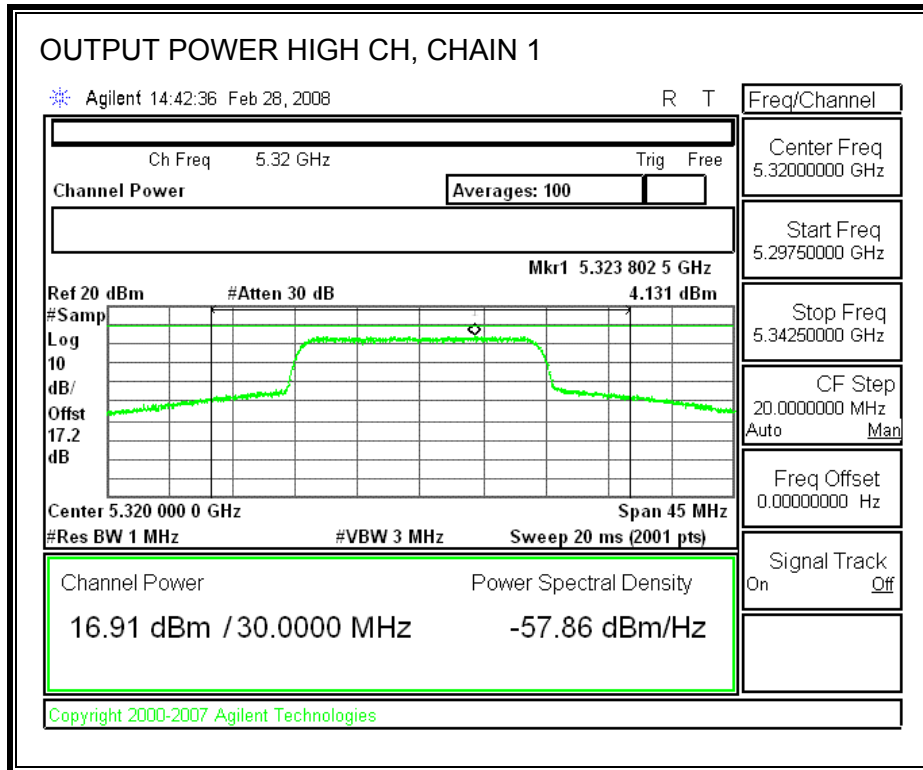




**CHAIN 1 OUTPUT POWER**







### 7.4.3. 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 17.2 dB (including 16 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
5260	17.80	17.48	20.65
5300	17.74	17.66	20.71
5320	16.57	16.62	19.61

#### 7.4.4. PEAK POWER SPECTRAL DENSITY

##### LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

Directional gain = gain of antenna element + 10 log (# of TX antenna elements)

<b>Effective Legacy Gain (dBi)</b>
<b>7.76</b>

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 7.76 dBi, therefore the limit is 9.24 dBm.

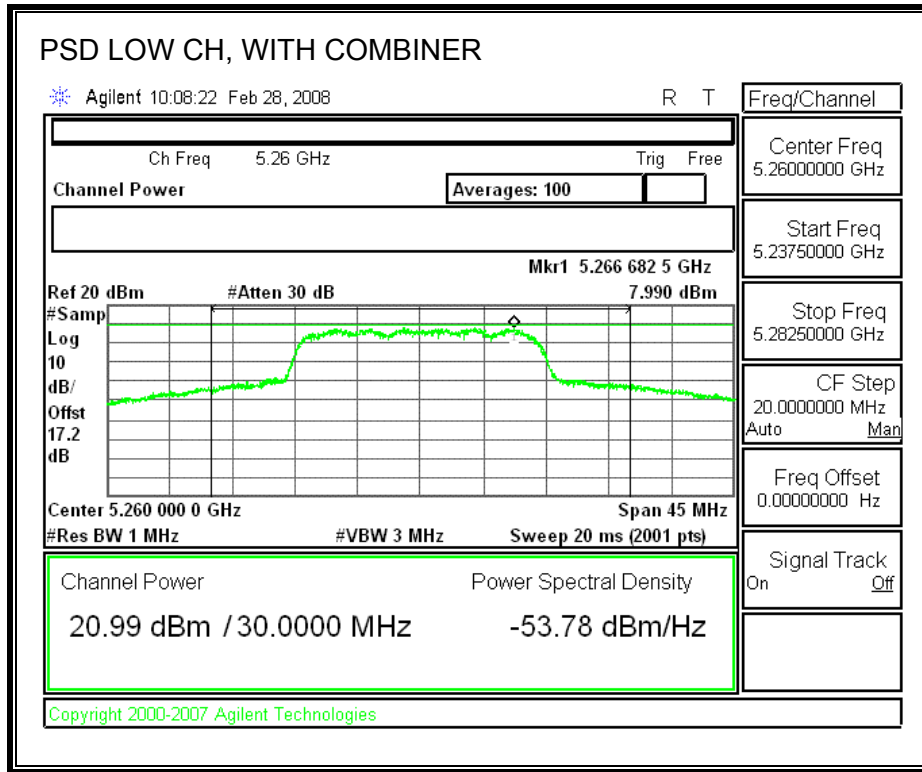
##### TEST PROCEDURE

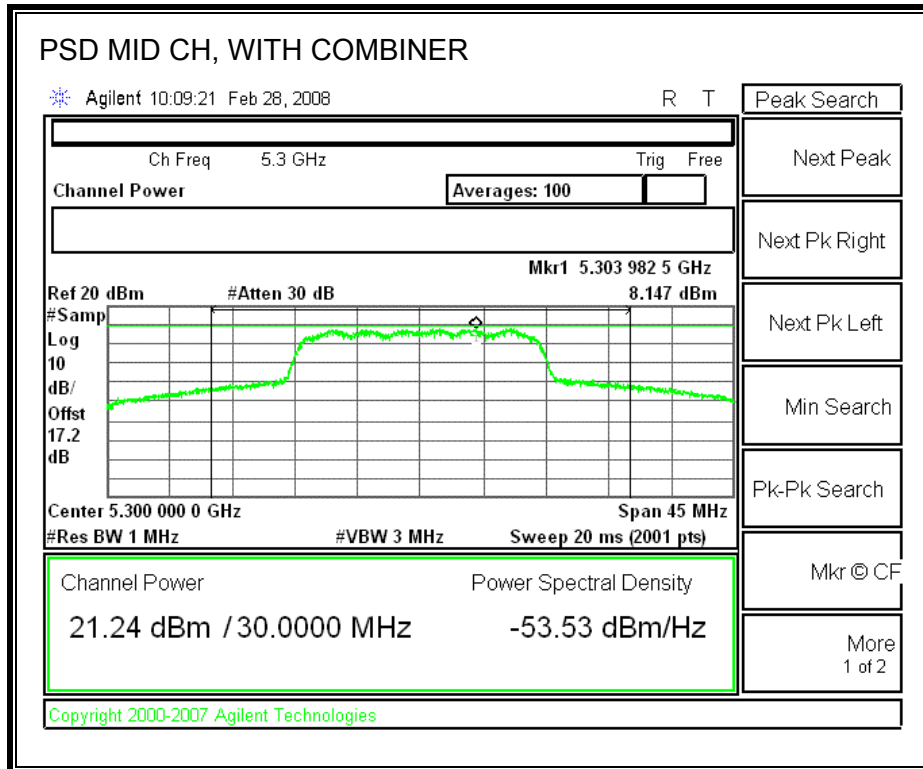
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

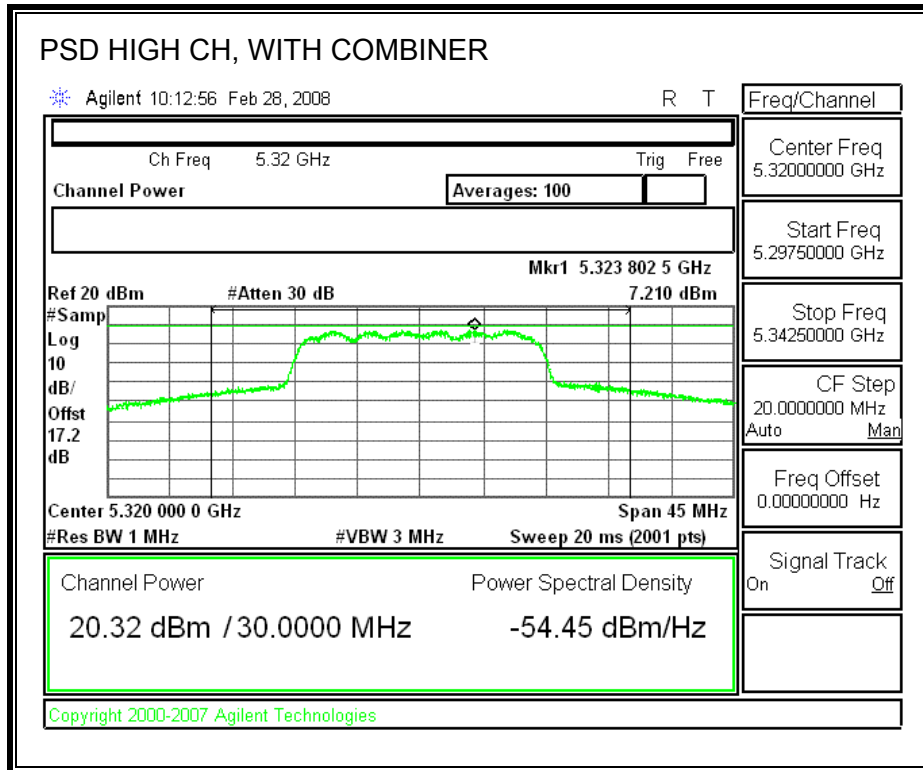
##### RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5260	7.99	9.24	-1.25
Middle	5300	8.15	9.24	-1.09
High	5320	7.21	9.24	-2.03

**POWER SPECTRAL DENSITY WITH COMBINER**









### 7.4.5. PEAK EXCURSION

#### LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

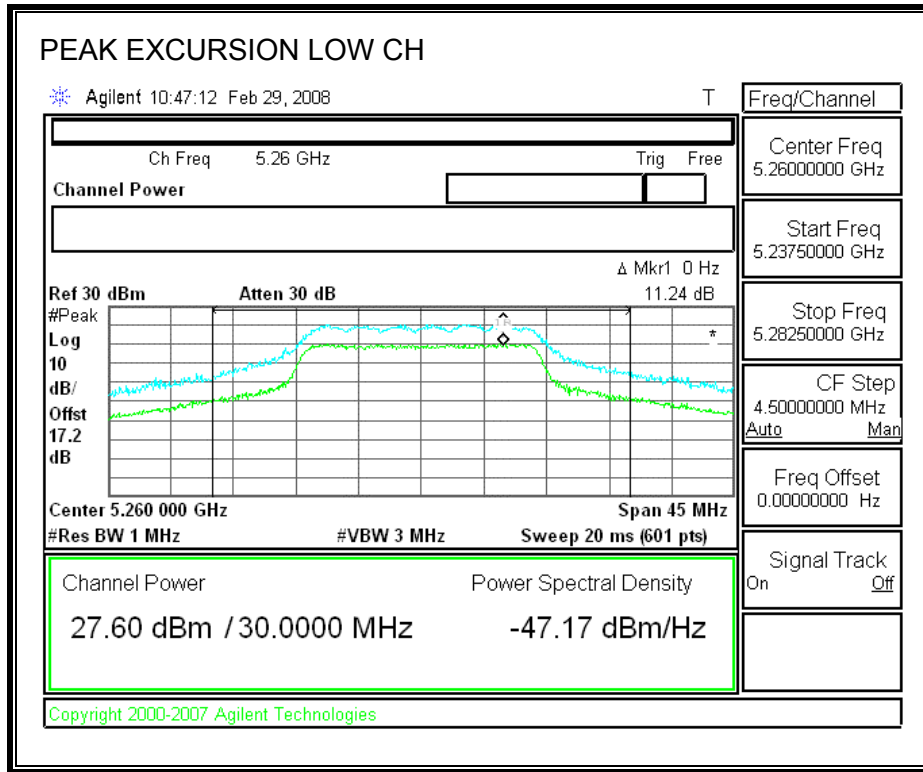
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

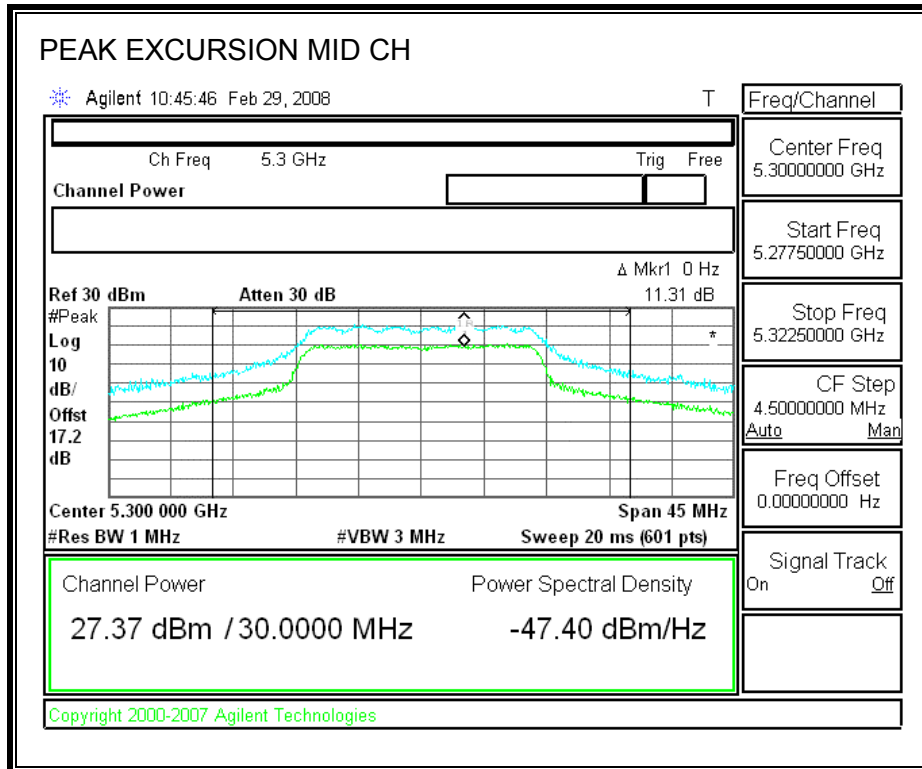
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

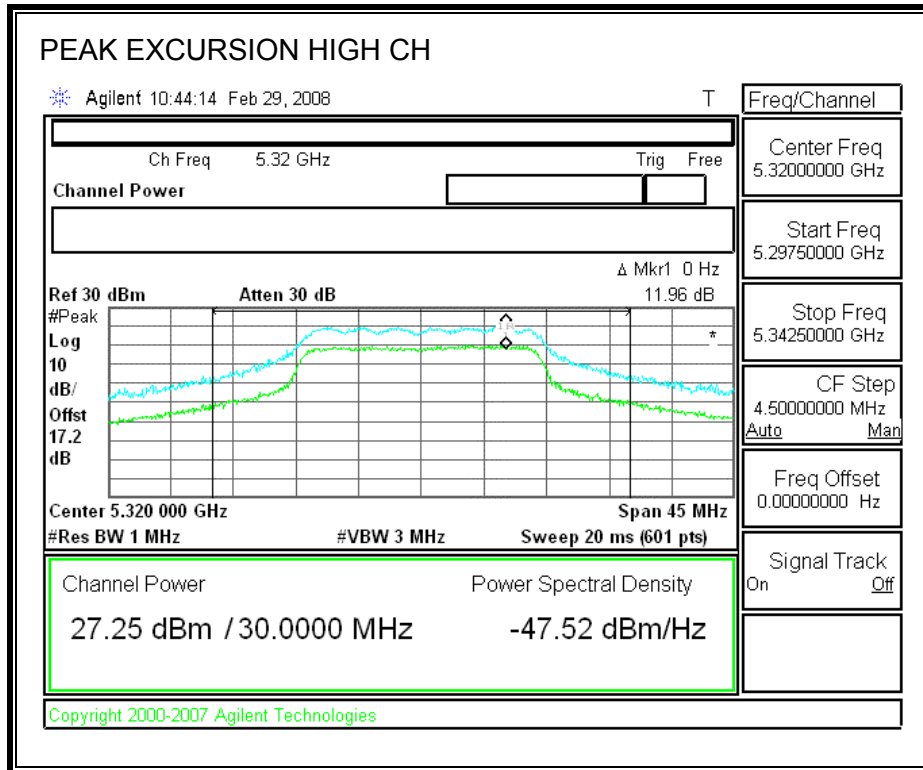
#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	11.24	13	-1.76
Middle	5300	11.31	13	-1.69
High	5320	11.96	13	-1.04

**PEAK EXCURSION**







## **7.4.6. 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**

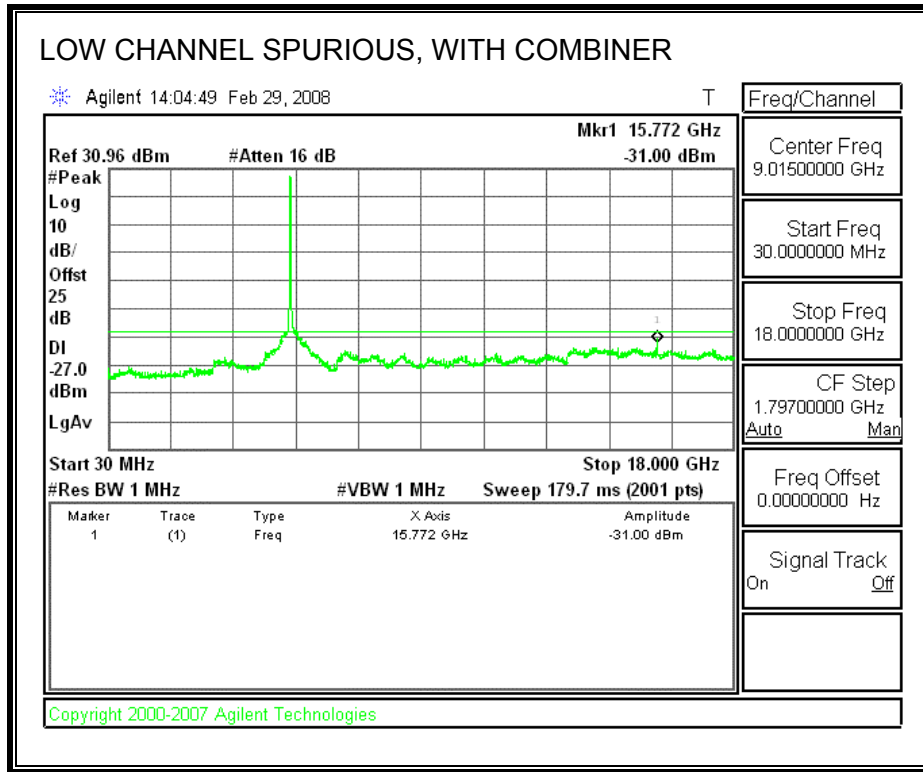
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

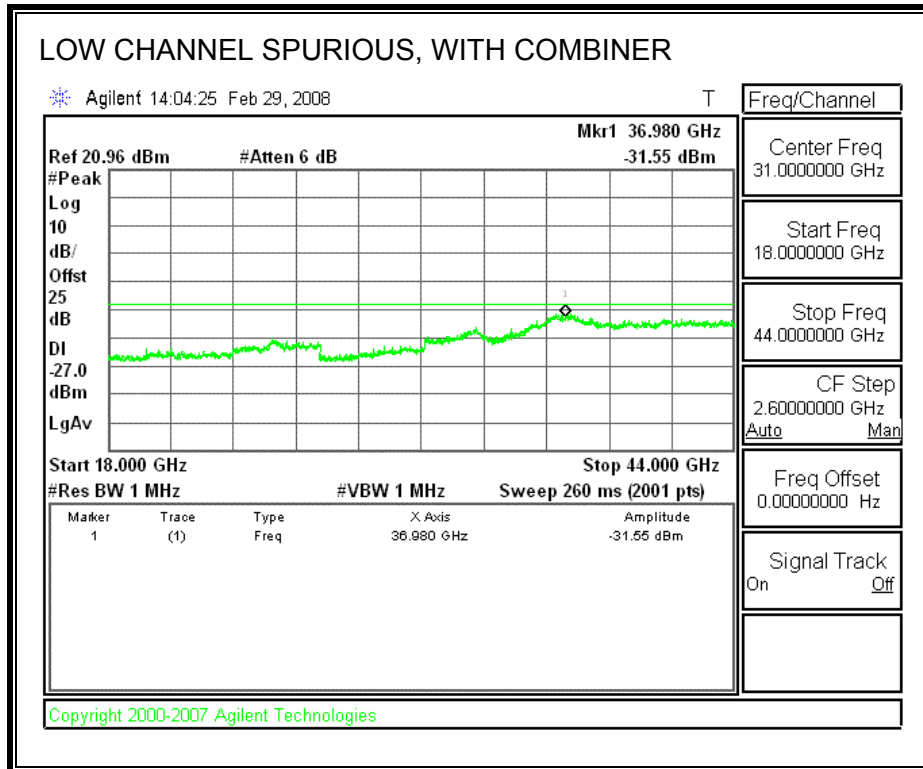
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

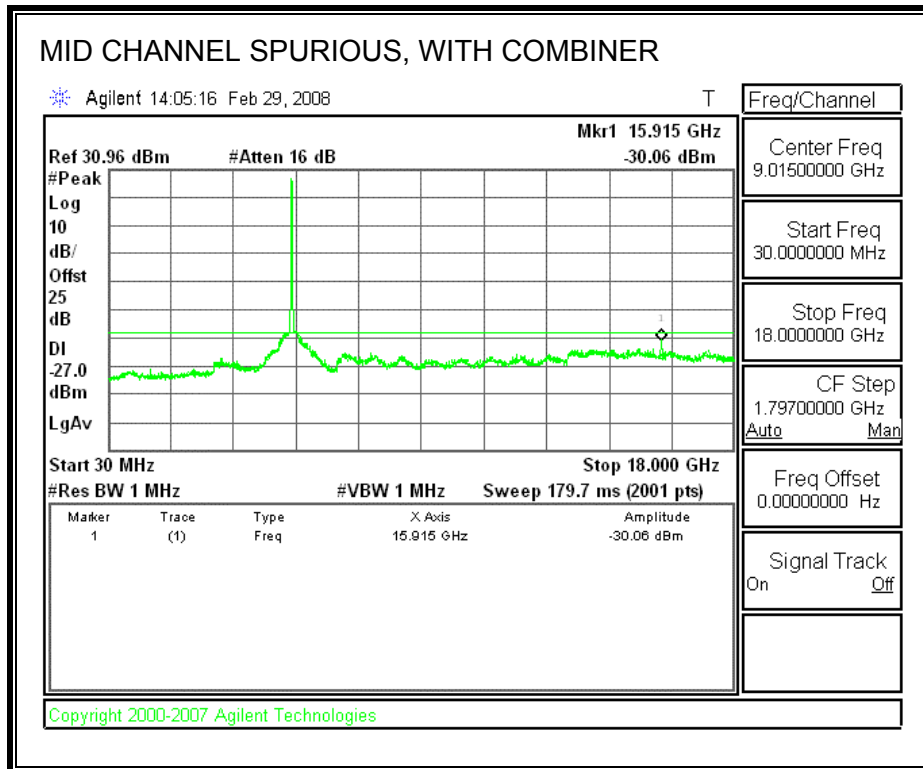
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

### **RESULTS**

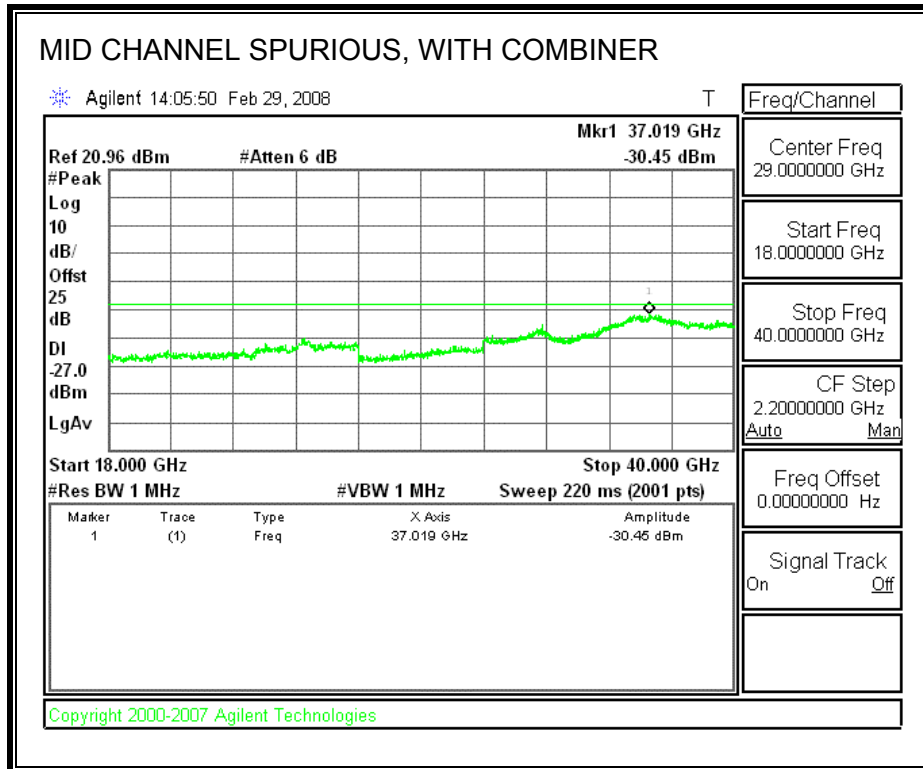
**SPURIOUS EMISSIONS WITH COMBINER**

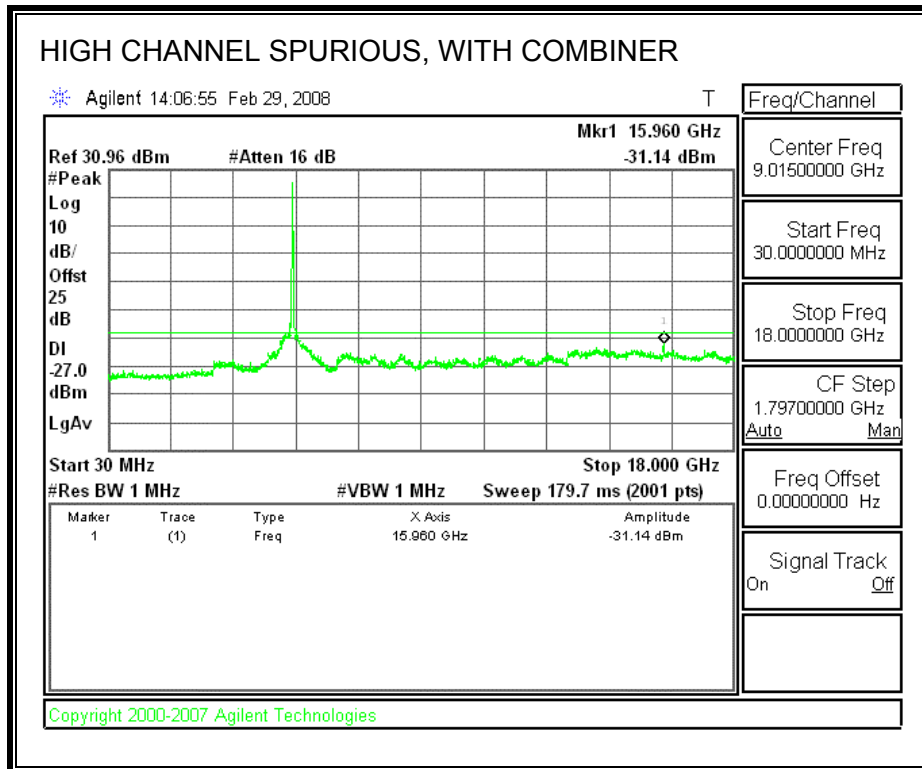


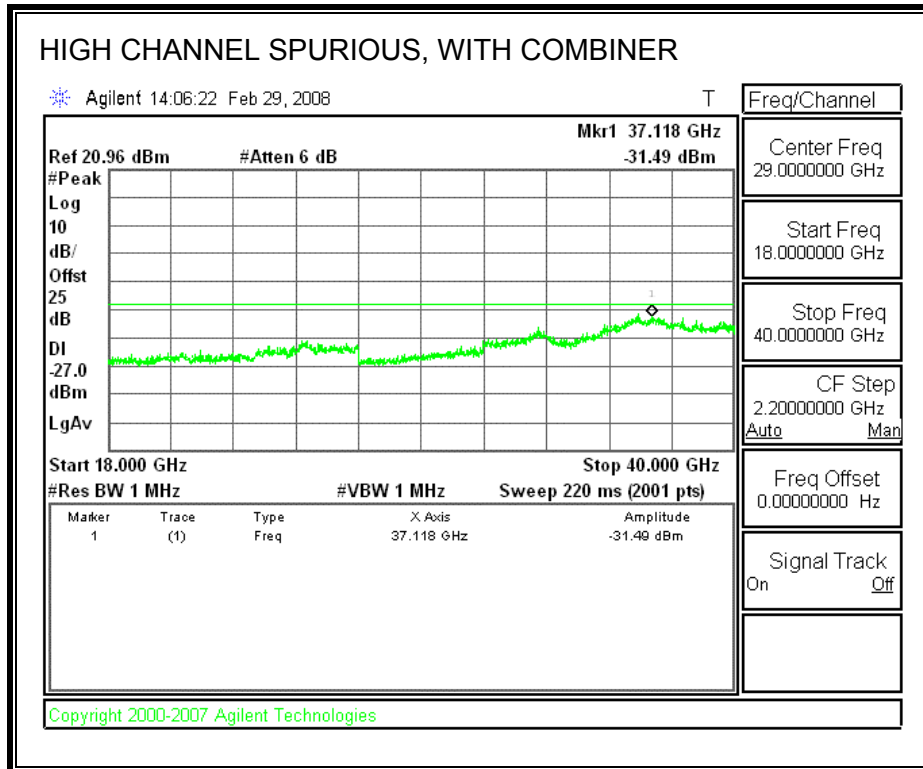












## 7.5. 802.11n HT20 MODE IN THE UPPER 5.2 GHz BAND

### 7.5.1. 26 dB and 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

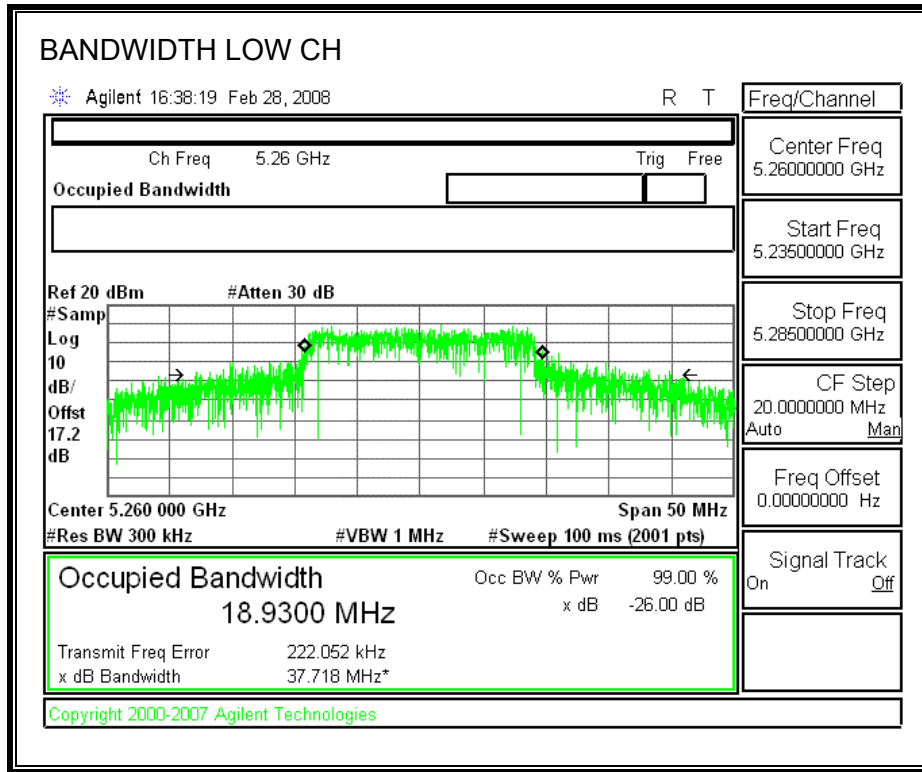
#### TEST PROCEDURE

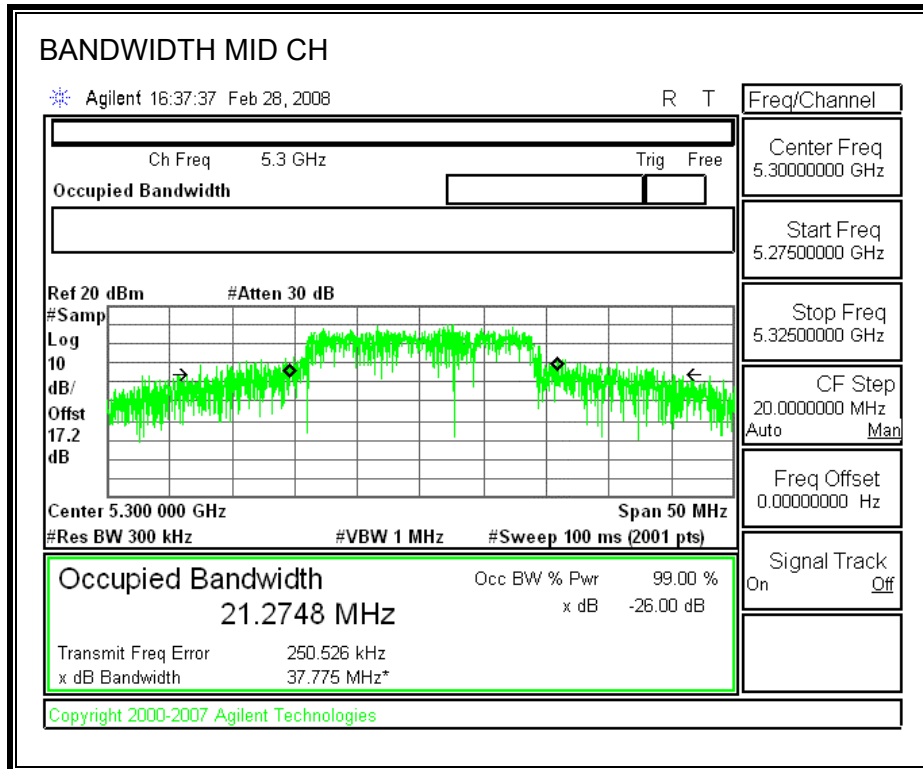
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

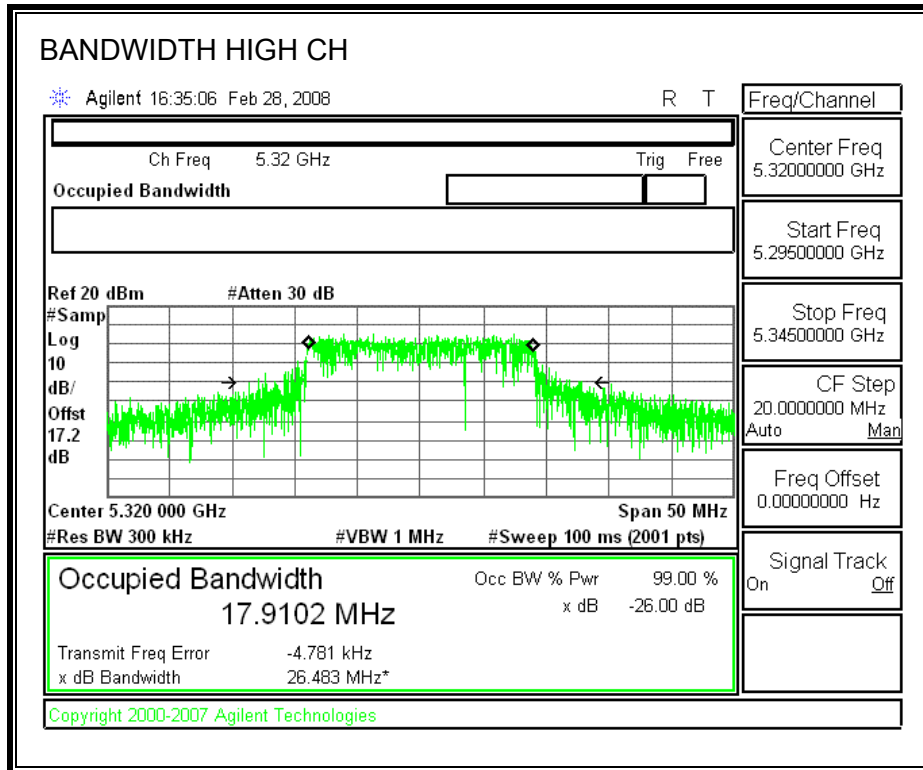
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	37.718	18.9300
Middle	5300	37.775	21.2748
High	5320	26.483	17.9102

**26 dB and 99% BANDWIDTH**







## 7.5.2. 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.

### 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

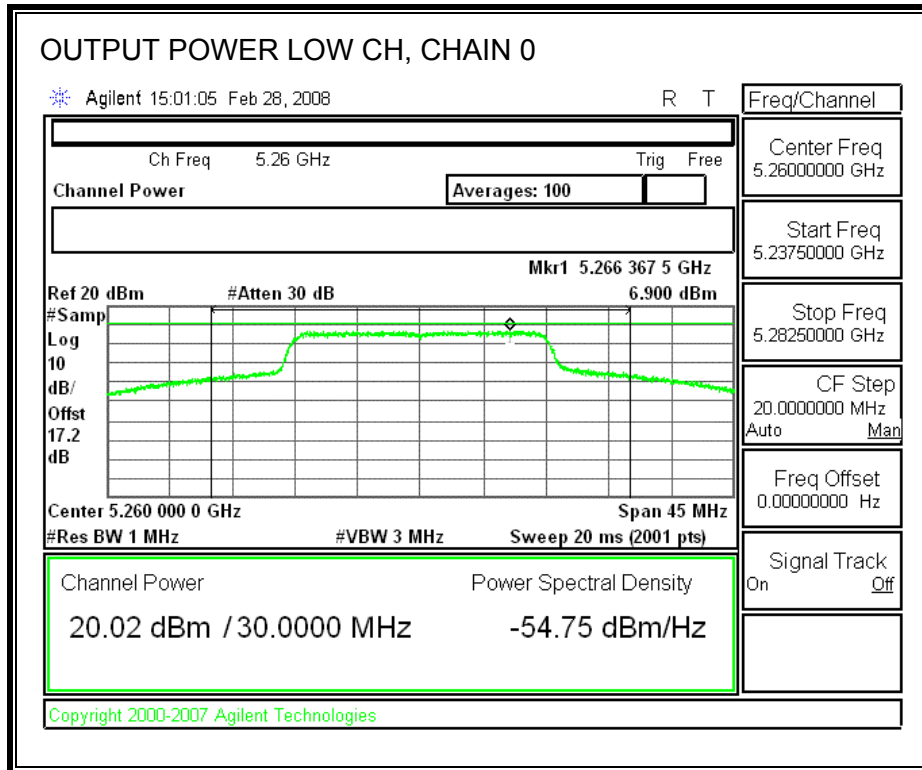
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24.00	37.718	26.77	5.56	24.00
Mid	5300	24.00	37.775	26.77	5.56	24.00
High	5320	24.00	26.483	25.23	5.56	24.00

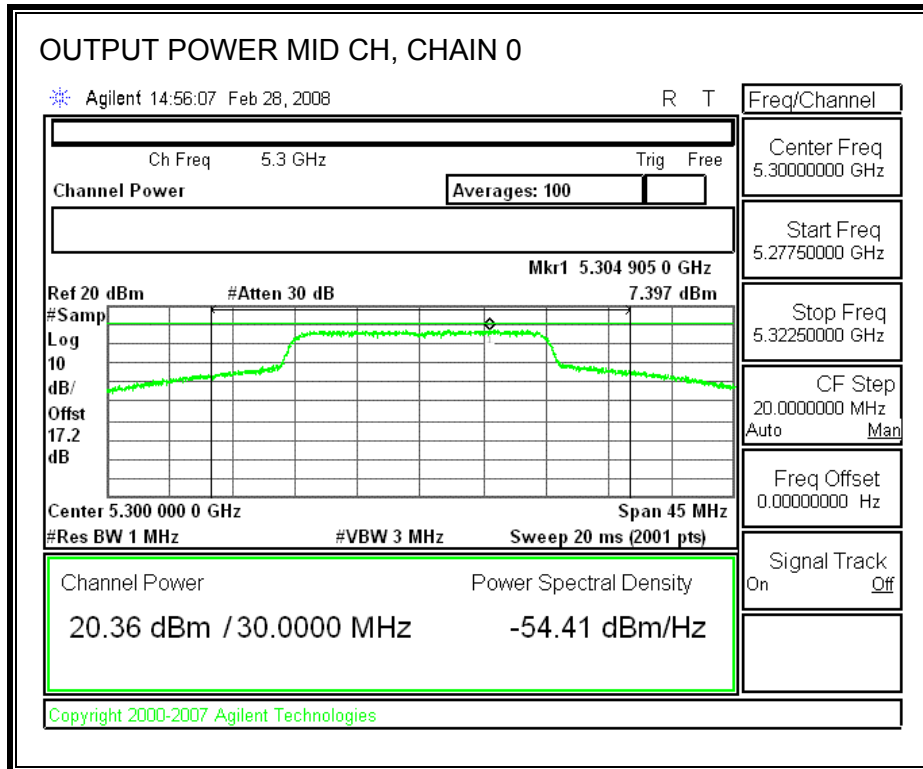
#### Individual Chain Results

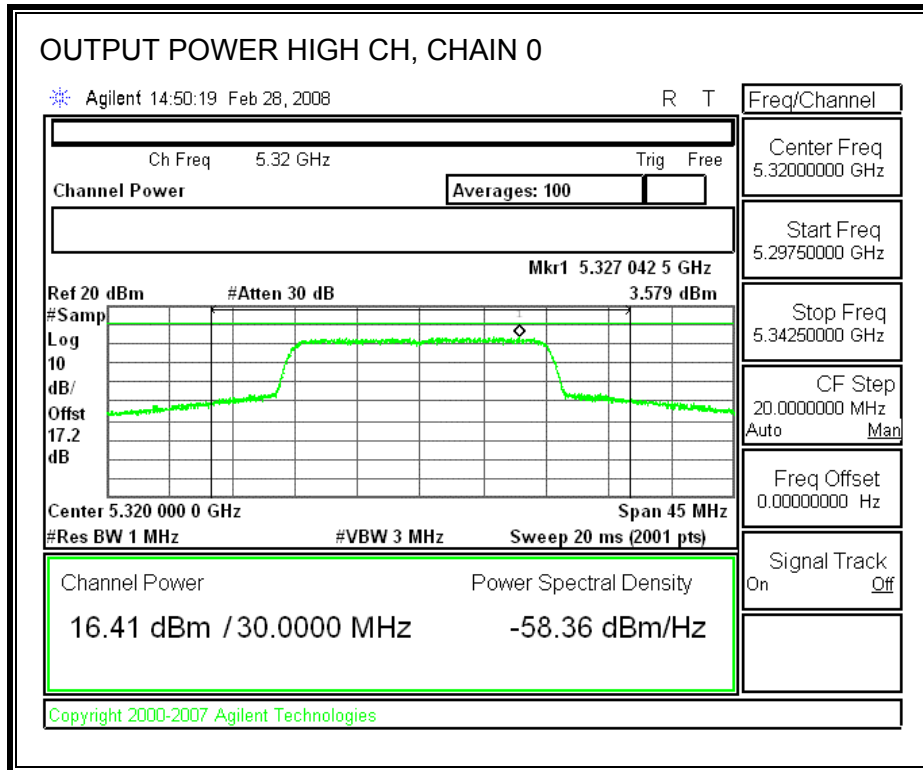
Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	20.02	20.88	23.48	24.00	-0.52
Mid	5300	20.36	20.95	23.68	24.00	-0.32
High	5320	16.41	16.37	19.40	24.00	-4.60



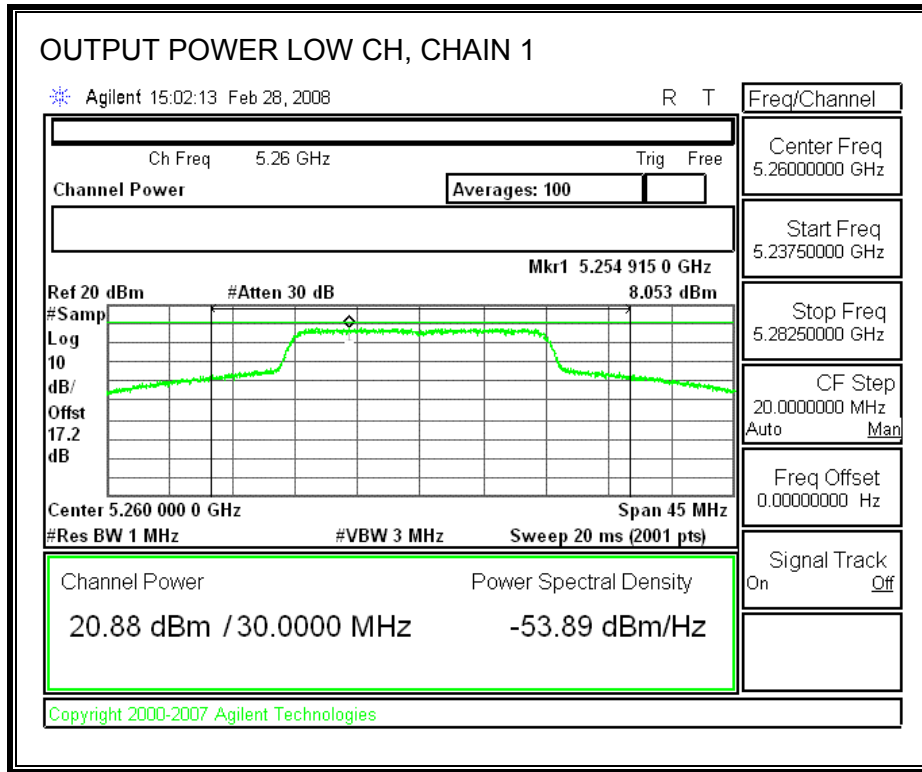
**CHAIN 0 OUTPUT POWER**

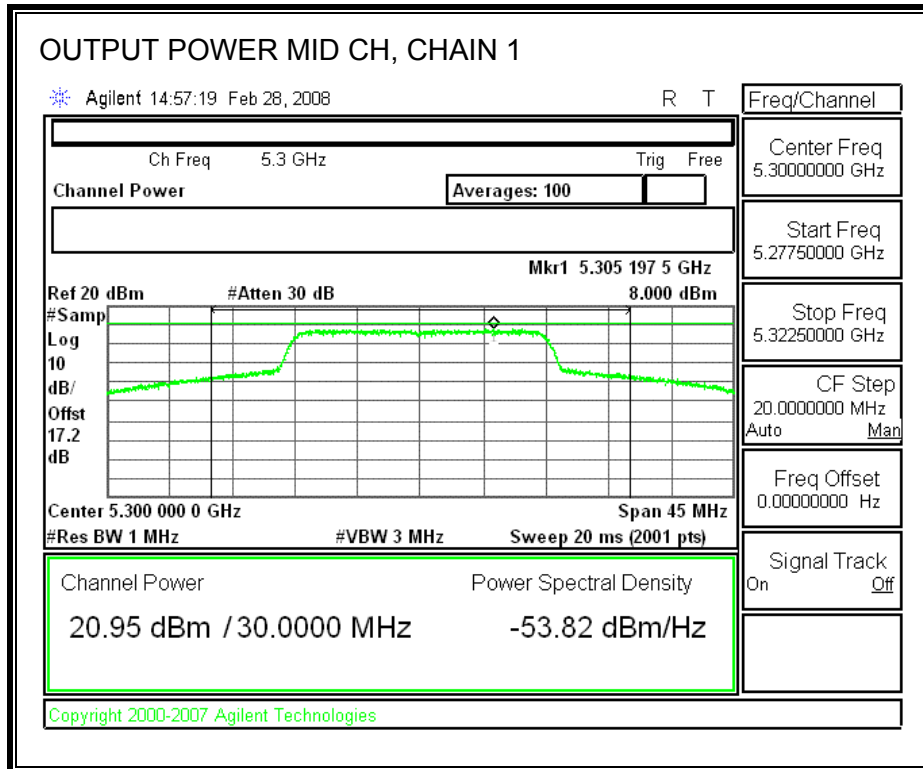


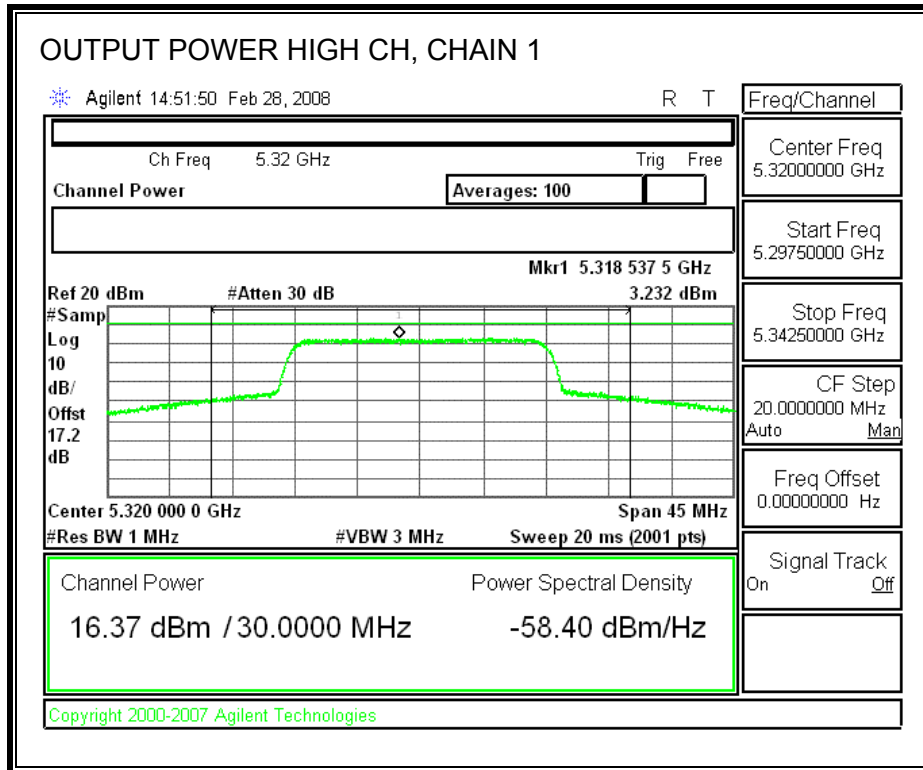




**CHAIN 1 OUTPUT POWER**







### 7.5.3. 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 17.2 dB (including 16 dB pad and 1.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
5260	19.78	20.64	23.24
5300	20.15	20.71	23.45
5320	16.20	16.12	19.17

### 7.5.4. 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 less than or equal to 6 dBi, therefore the limit is 11 dBm.

#### TEST PROCEDURE

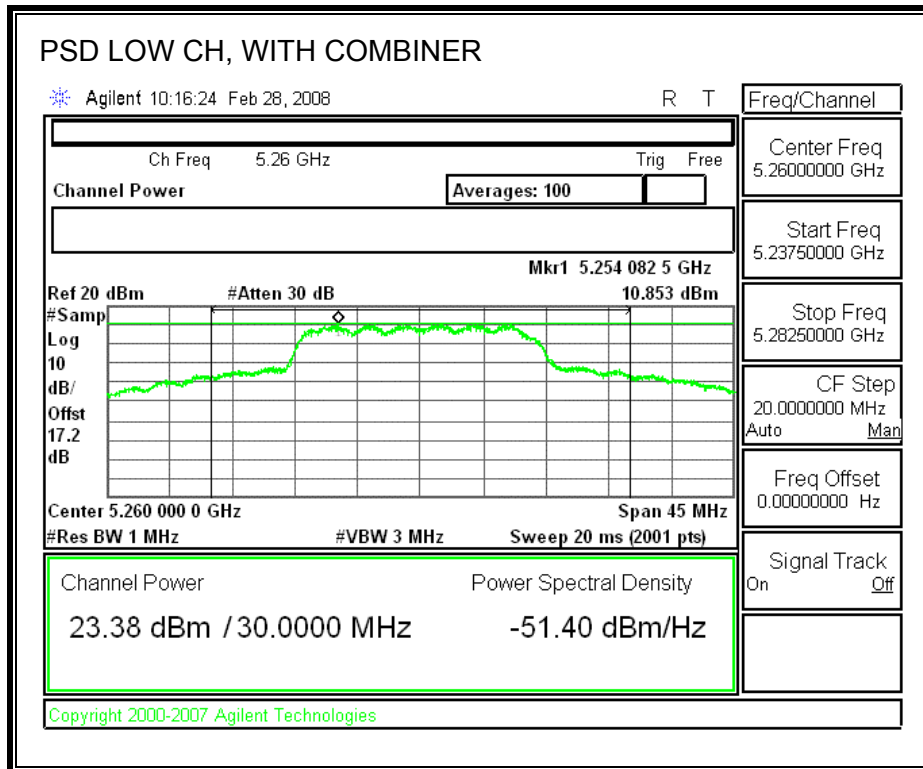
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

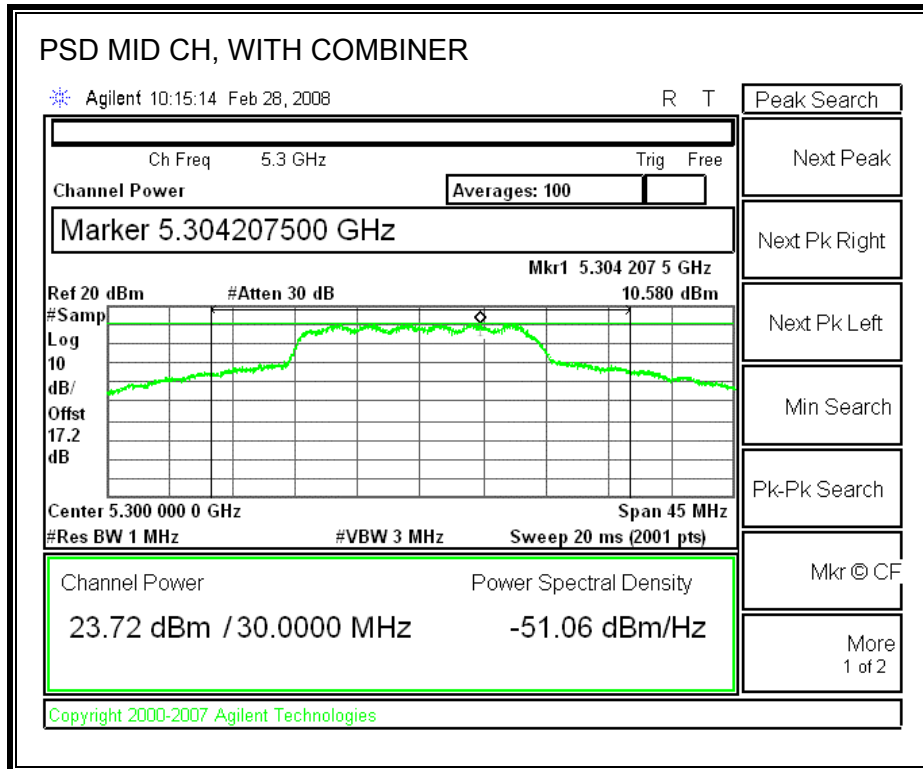
#### RESULTS

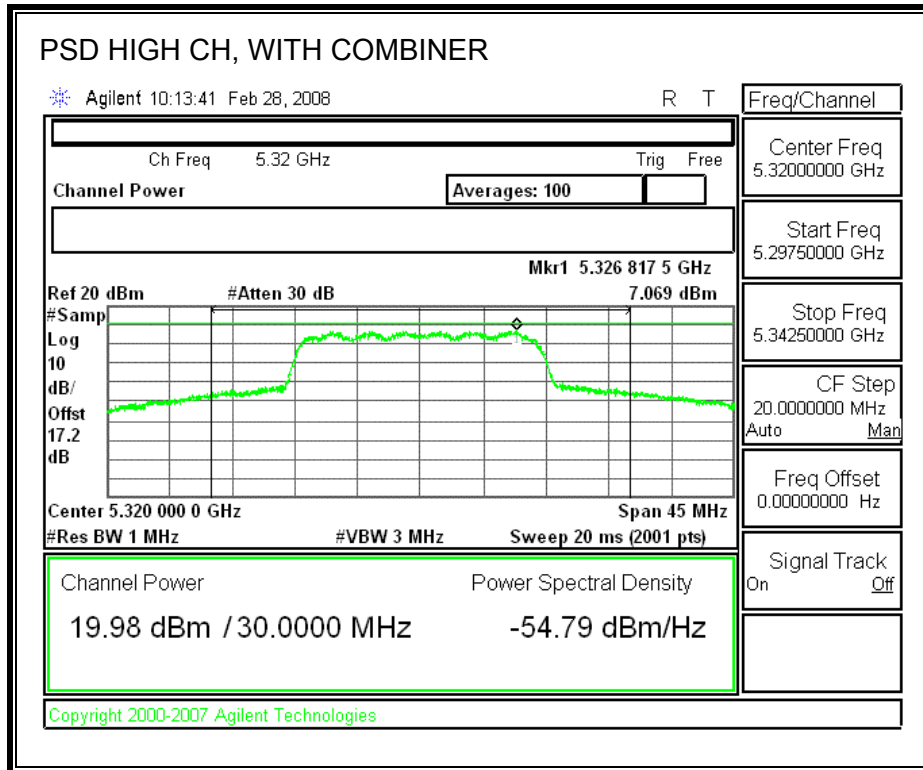
Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5260	10.85	11	-0.15
Middle	5300	10.58	11	-0.42
High	5320	7.07	11	-3.93



POWER SPECTRAL DENSITY WITH COMBINER







### 7.5.5. PEAK EXCURSION

#### LIMITS

FCC §15.407 (a) (6)

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

#### TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

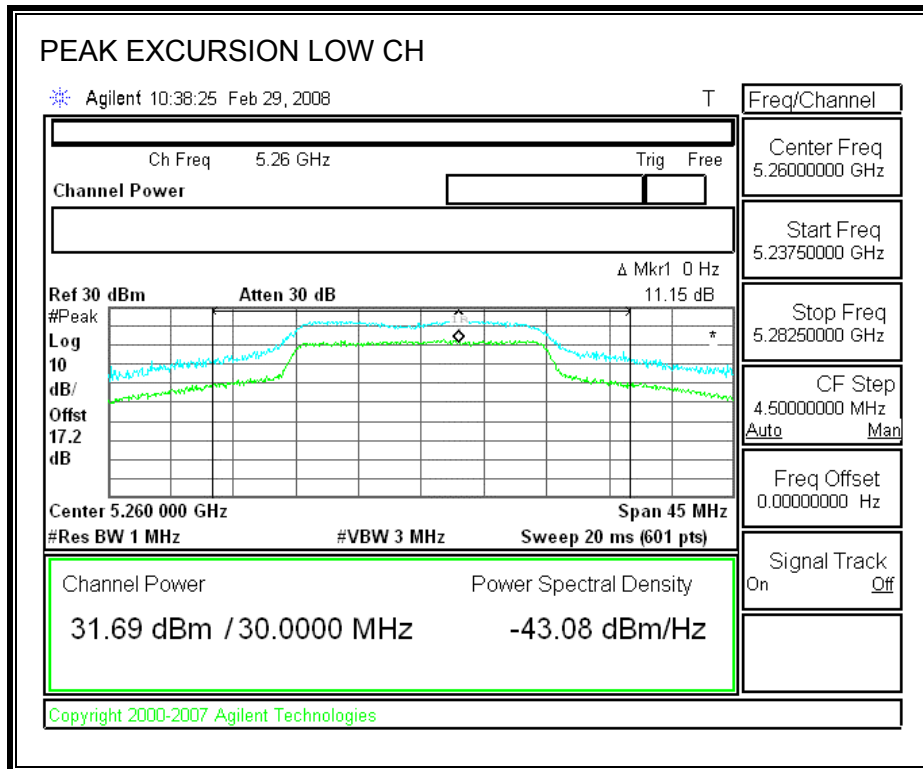
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

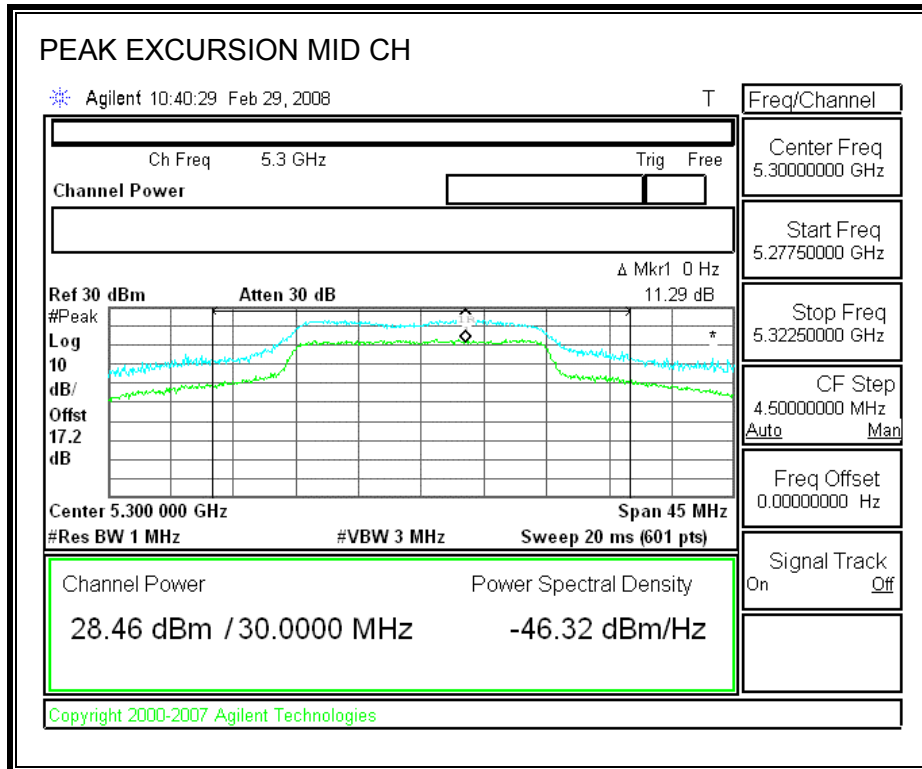
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

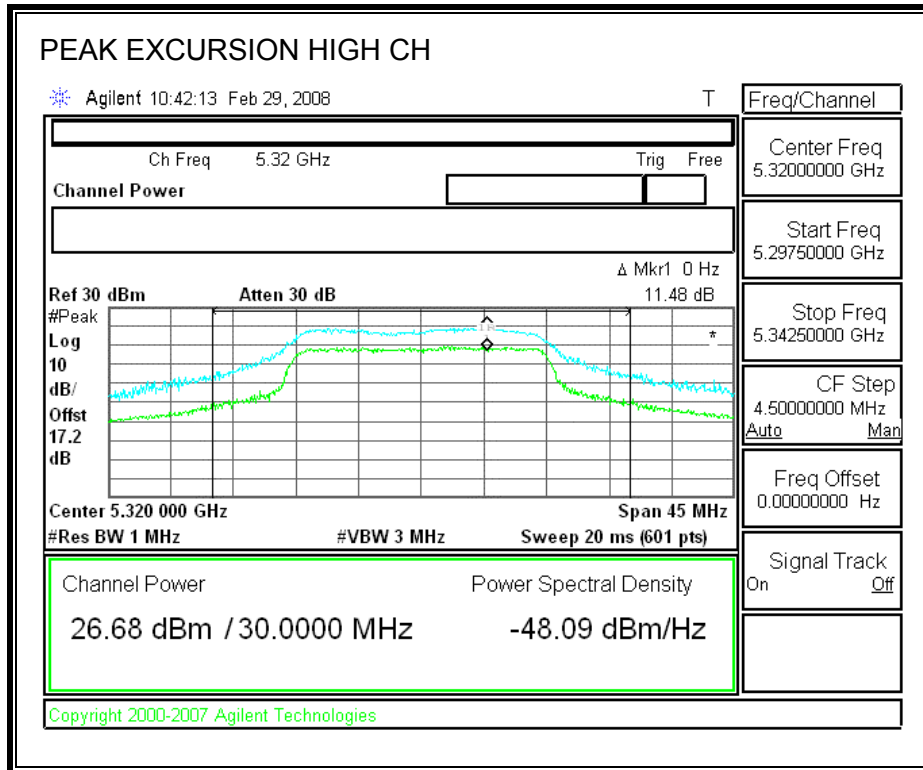
#### RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	11.15	13	-1.85
Middle	5300	11.29	13	-1.71
High	5320	11.48	13	-1.52

PEAK EXCURSION







## **7.5.6. 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.

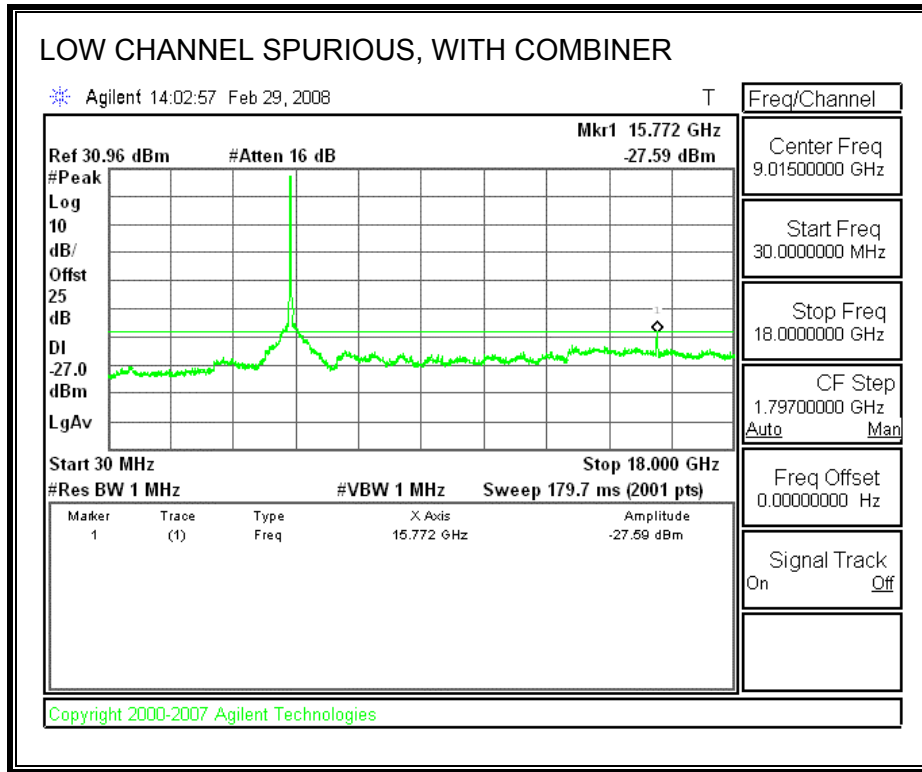
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

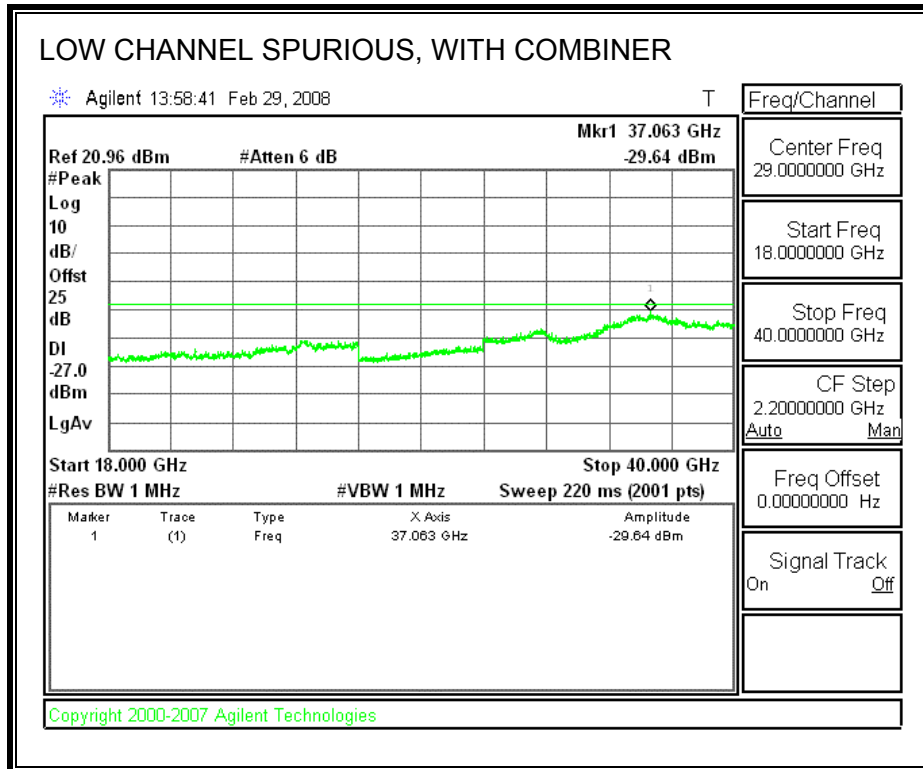
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

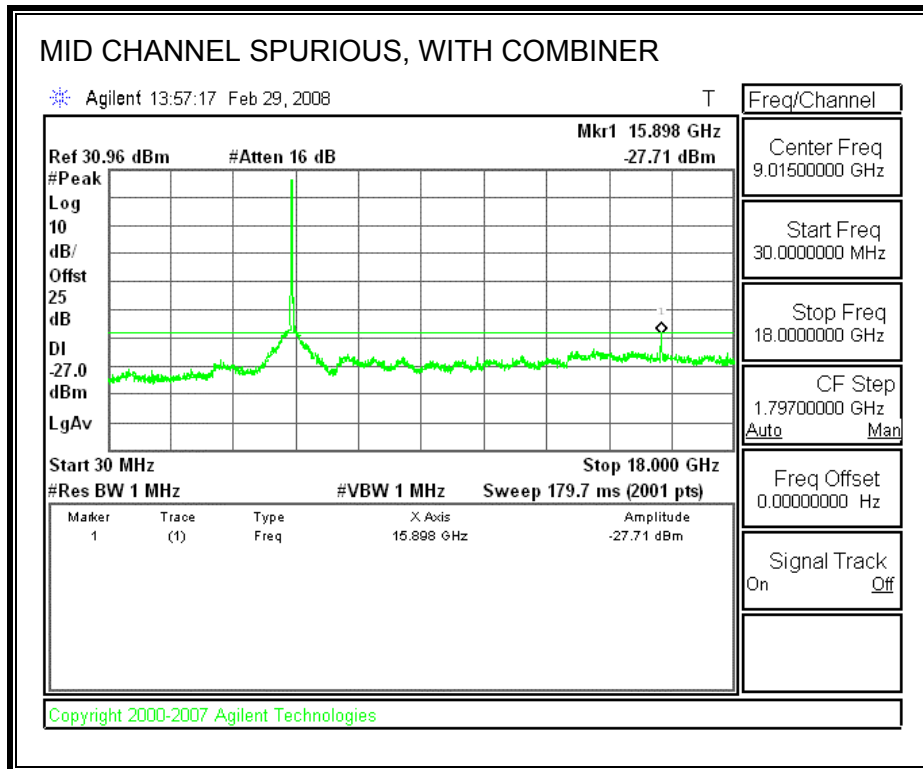
### **RESULTS**

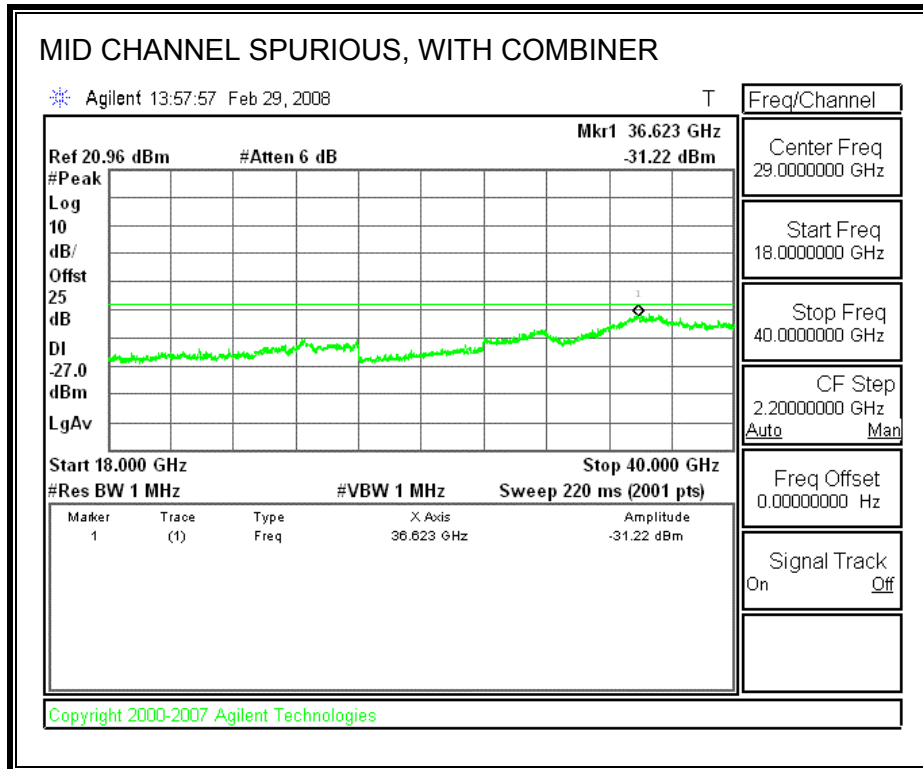


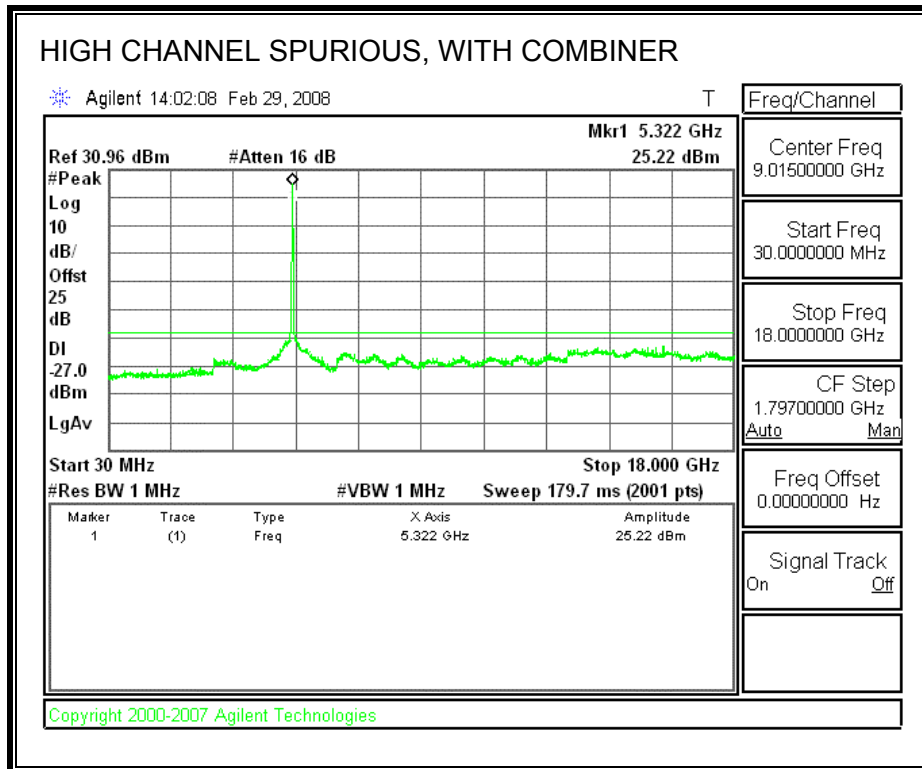
**SPURIOUS EMISSIONS WITH COMBINER**

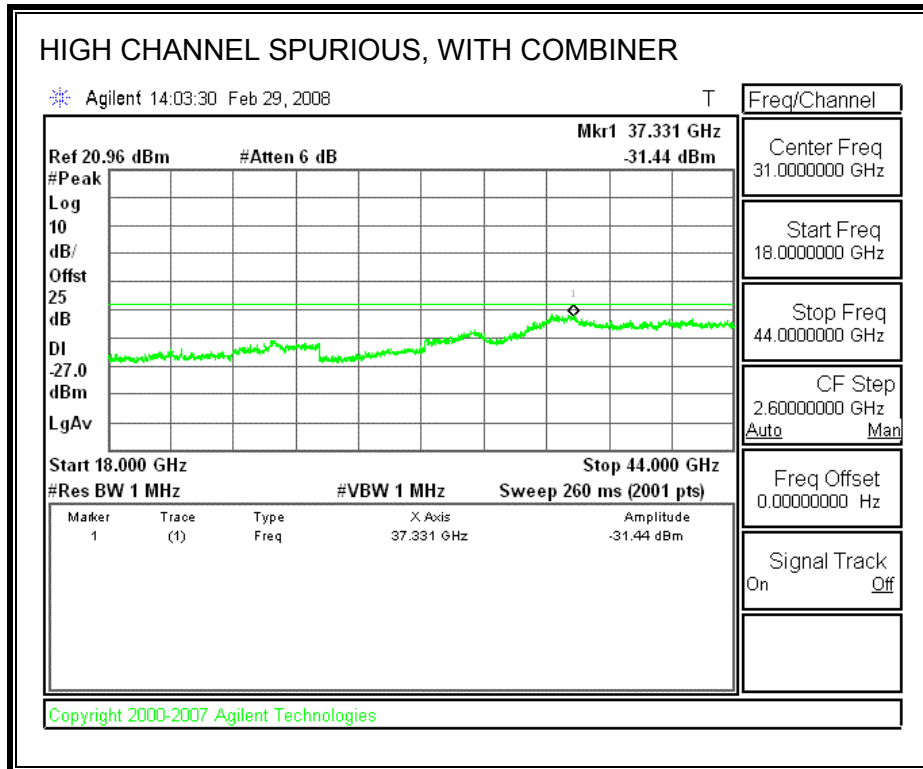












## 7.6. 802.11n HT40 MODE IN THE UPPER 5.2 GHz BAND

### 7.6.1. 26 dB and 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

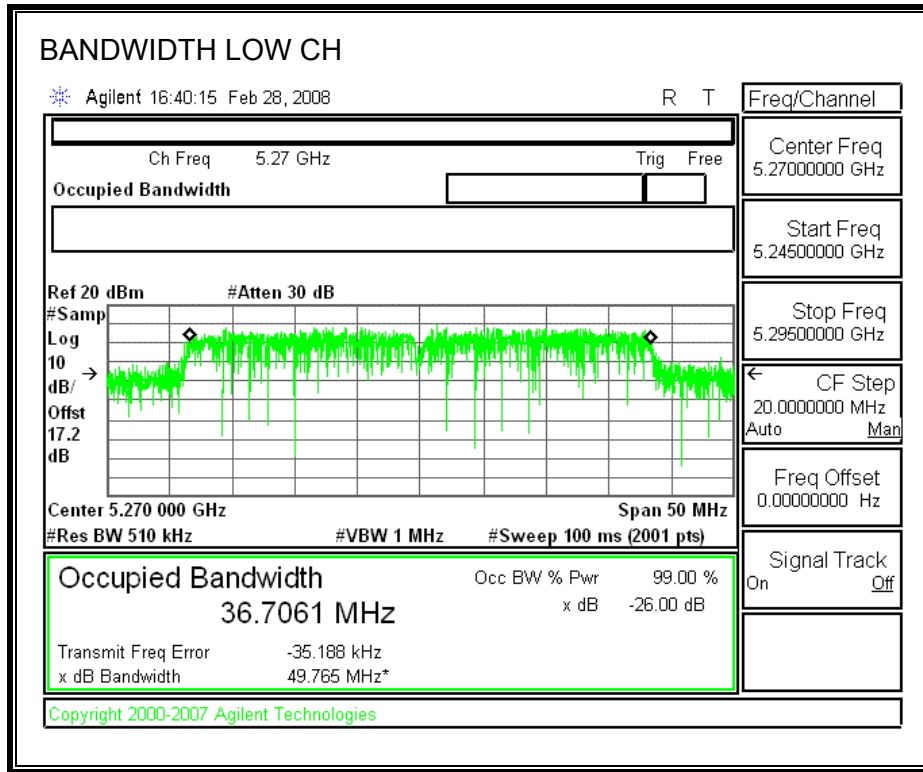
#### TEST PROCEDURE

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

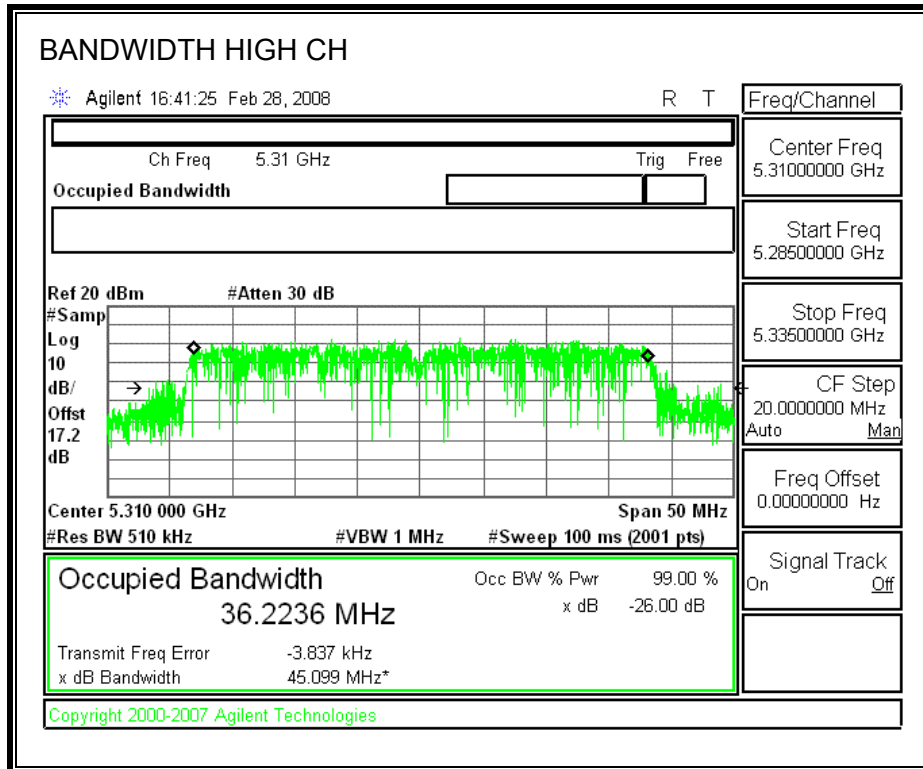
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5270	49.765	36.7061
High	5310	45.099	36.2236

**26 dB and 99% BANDWIDTH**







## 7.6.2. 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.

### 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

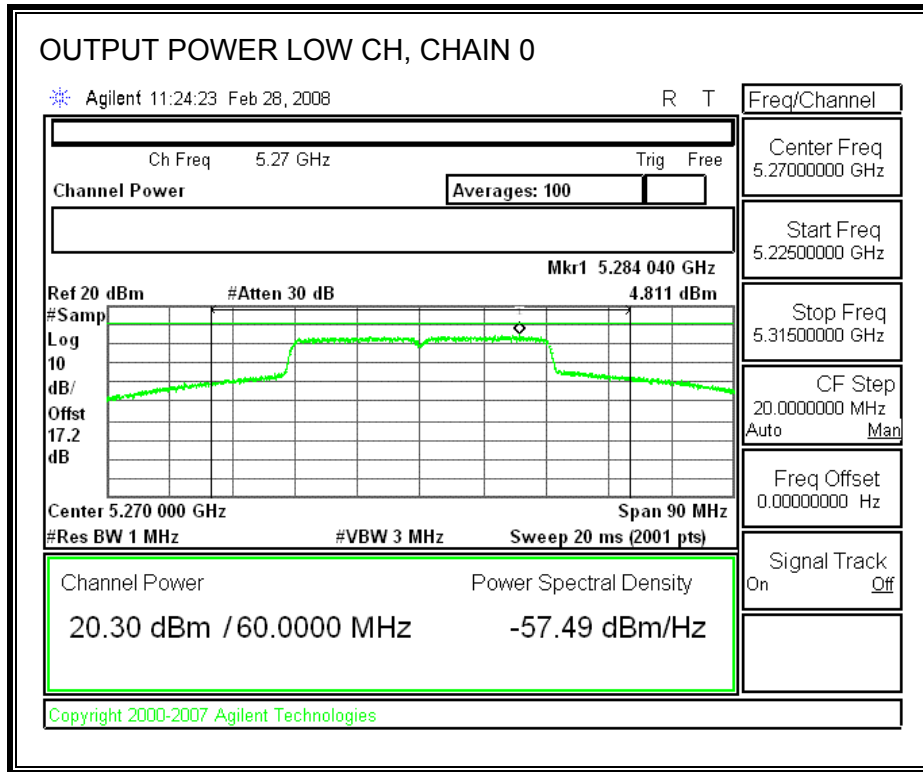
#### Limit

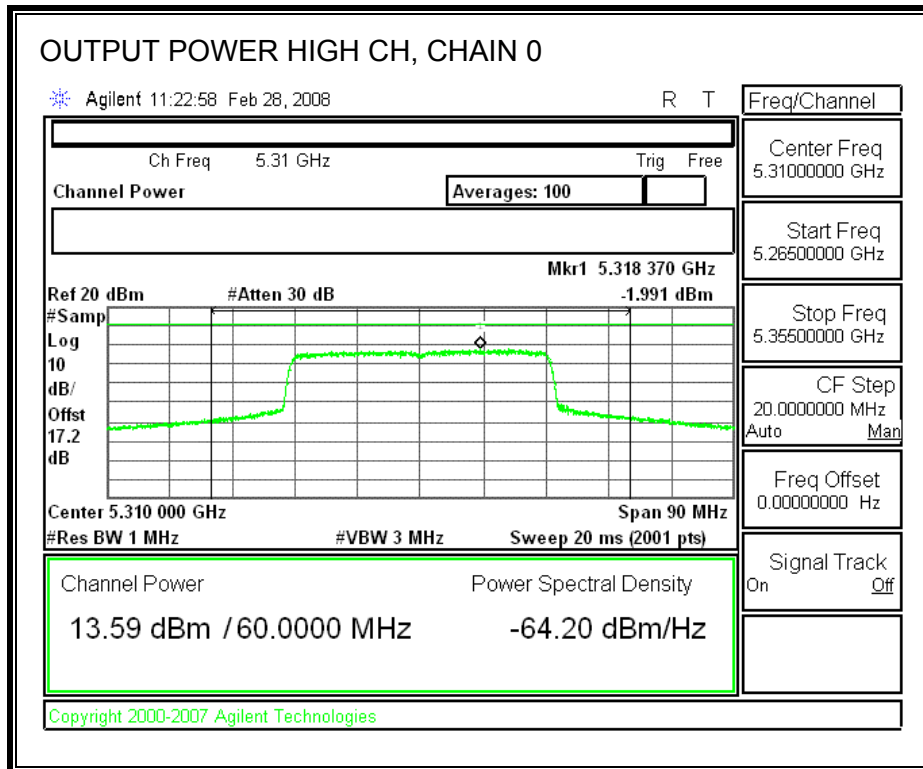
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5270	24.00	49.765	27.97	5.60	24.00
High	5310	24.00	45.099	27.54	5.56	24.00

#### Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5270	20.30	21.35	23.87	24.00	-0.13
High	5310	13.59	13.64	16.63	24.00	-7.37

**CHAIN 0 OUTPUT POWER**





**CHAIN 1 OUTPUT POWER**

