



**FCC CFR47 PART 15 SUBPART E
CLASS II PERMISSIVE CHANGE**

CERTIFICATION TEST REPORT

FOR

802.11n 2x2 PCIe MINICARD TRANSCEIVER

MODEL NUMBER: AR5BXB92

FCC ID: PPD-AR5BXB92

REPORT NUMBER: 11U13650-3, Revision D

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Prepared for

**ATHEROS COMMUNICATIONS, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110, U.S.A.**

Prepared by

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



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	04/15/11	Initial Issue	T. Chan
A	05/09/11	Addressed TCB Reviewer's Questions	T. Chan
B	05/25/11	Revised Antenna's Description on Section 5.5 and Updated Setup Photo to Show only PIFA Antenna's Type	T. Chan
C	06/08/11	Re-measured With WIFI II Logo's Antenna	T. Chan
D	06/13/11	Revised Sections 5.6 and 9	T. Chan

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATIONS, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110, U.S.A.

EUT DESCRIPTION: 802.11n 2x2 PCIe MINICARD TRANSCEIVER

MODEL: AR5BxB92P

SERIAL NUMBER: 001F3A6CD9

DATE TESTED: MARCH 29-APRIL 8 AND MAY 09 & 31 AND JUNE 1-2, 2011

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

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

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

Approved & Released For UL CCS By:

Tested By:



THU CHAN
ENGINEERING MANAGER
UL CCS

CHIN PANG
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, and FCC 06-96.

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11n 2x2 PCIe minicard transceiver, model AR5BXB92.
The radio module is manufactured by Atheros. Communications Inc.

5.2. MAXIMUM OUTPUT POWER

Table shown below is the output power to pass limit due to the higher antenna gain.

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz BAND, 2x2			
5180 - 5240	802.11a	12.42	17.46
5180 - 5240	802.11n HT20	12.44	17.54
5190 - 5230	802.11n HT40	13.99	25.06
5.3 GHz BAND, 2x2			
5260 - 5320	802.11a	19.01	79.62
5260 - 5320	802.11n HT20	18.94	78.34
5270 - 5310	802.11n HT40	19.51	89.33
5.6 GHz BAND, 2x2			
5500 - 5700	802.11a	19.80	95.50
5500 - 5700	802.11n HT20	19.75	94.41
5510 - 5670	802.11n HT40	19.84	96.38

5.3. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Atheros Radio test Revision 0.6 Build #18 Art_11n.

5.4. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is adding higher antenna gains as shown (as showing in the report) in the section below.

5.5. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes same type of PIFA's antennas, with the maximum gain as table below:

Freq [GHz]	WiFi 1	WiFi 2	Combined Log Gain [dBi]
	(Black) Peak Gain dBi	(Logo) Peak Gain dBi	
2.4 - 2.484	4.84	2.90	6.99
5.15 - 5.25	5.28	5.97	8.65
5.25 - 5.35	5.21	6.07	8.67
5.47 - 5.725	4.02	4.78	7.43
5.725 - 5.85	3.12	4.73	7.01

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): 24 Mbps, OFDM.

802.11n MIMO HT20 Mode: MCS0, 6.5 Mbps, OFDM

802.11n MIMO HT40 Mode: MCS0, 13.5 Mbps, OFDM

Radiated emissions below and above 1 GHz tests were performed for all bands and all modes.

Worst-case mode and channel used for 30-1000 MHz radiated was the mode and channel with the highest output power.

All MIMO modes were measured with the highest combination of gains for each type of antenna.

For MIMO modes measurements were performed using individual chains for all channels and modes.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop PC	Lenovo	769	L3-BE291	DoC
AC Adapter	Lenovo	92P1105	11S92P11Z1ZBW9T1J5G1	N/A

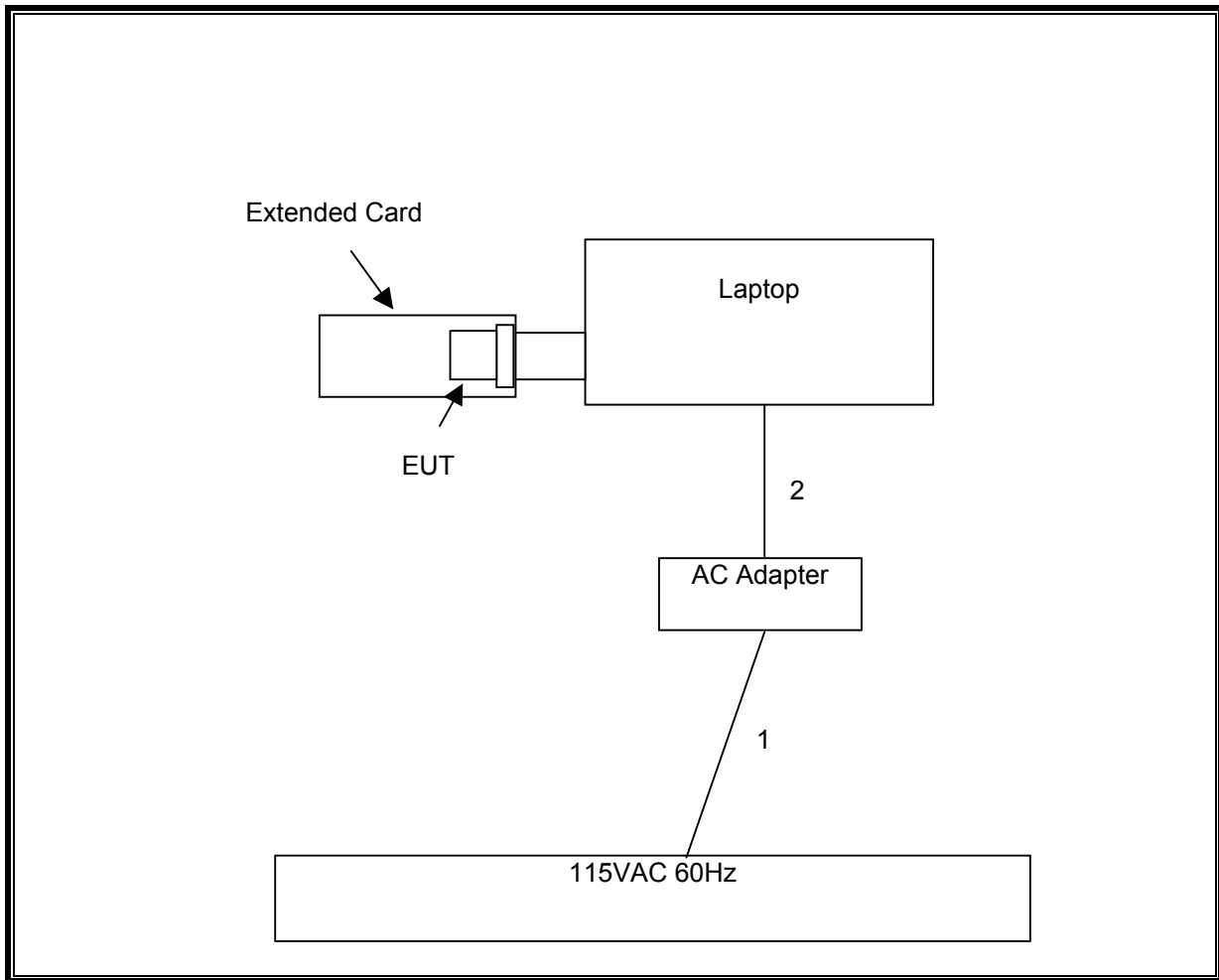
I/O CABLES

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	C01012	06-03-12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	07-14-11
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06-29-11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	11-28-11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01-27-12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	07-15-11
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06-08-11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	06-25-11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRC13192	N02683	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02601	CNR
Preamplifier, 1-26GHz	Agilent / HP	8449B	C01052	07-05-11
Peak Power Meter	Boonton	4541	C01186	03-14-12
Peak Power Sensor	Boonton	4541	C01189	03-15-12

7. ANTENNA PORT TEST RESULTS

7.1. 802.11a MODE IN THE 5.2 GHz BAND

7.1.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

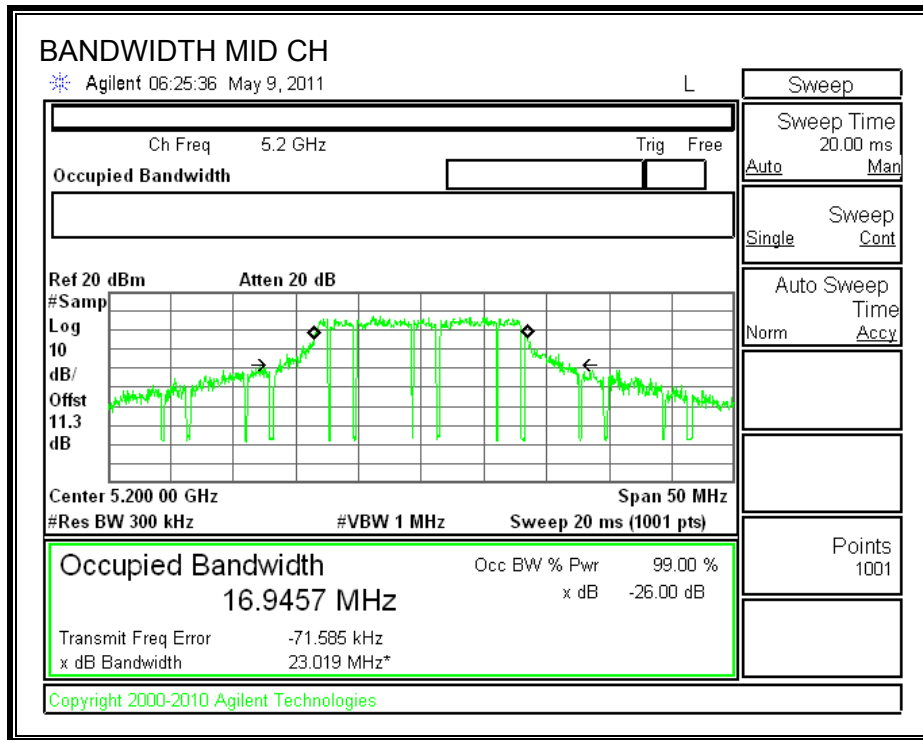
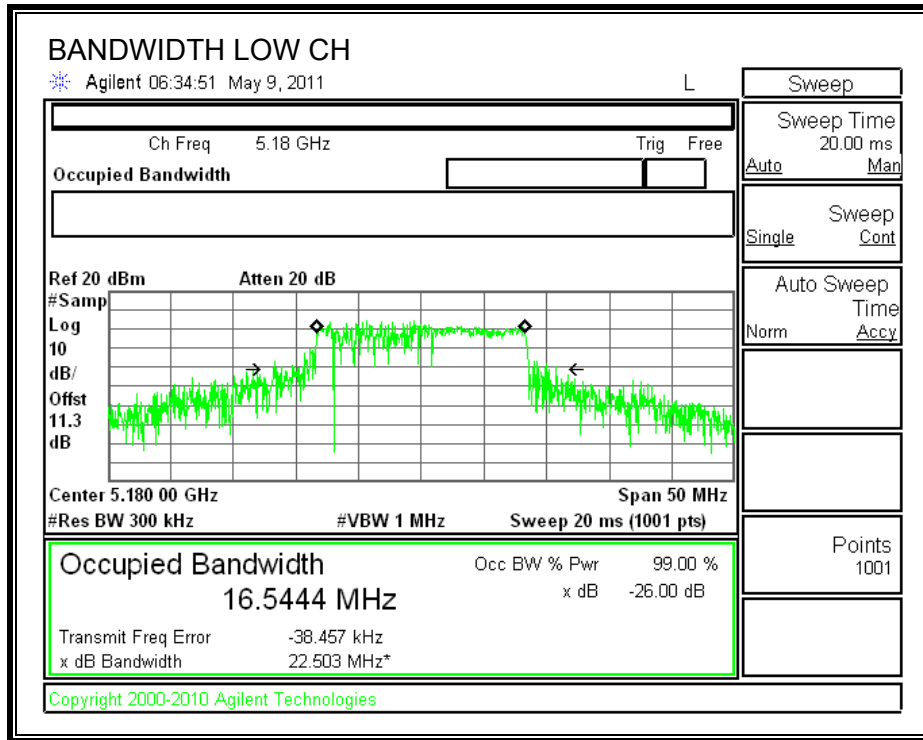
TEST PROCEDURE

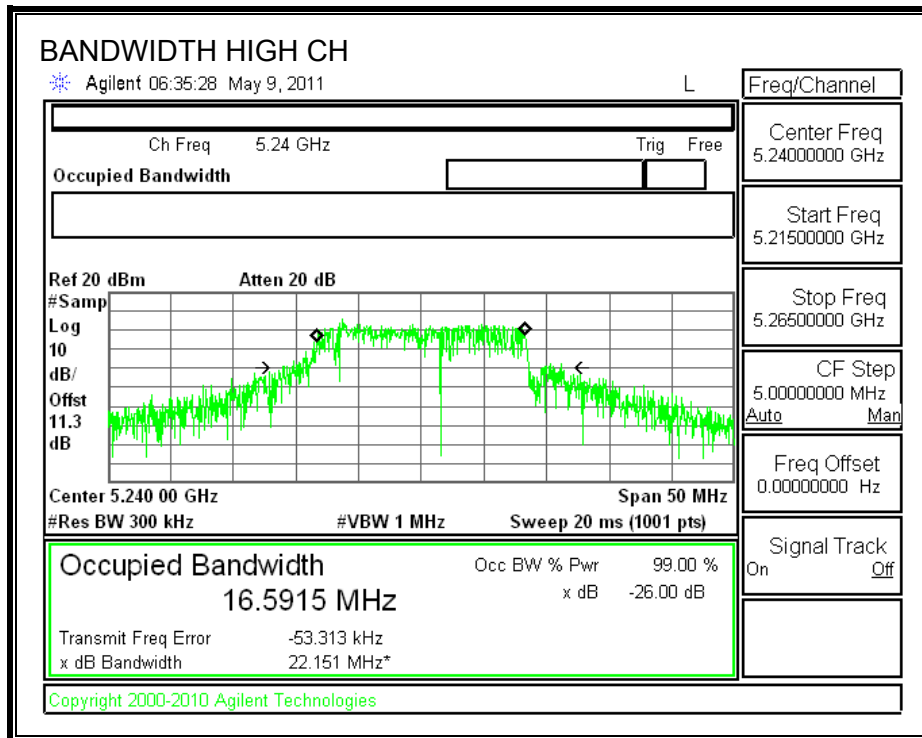
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.503
Middle	5200	23.019
High	5240	22.151

26 dB BANDWIDTH





7.1.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.28	5.97	8.65

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.

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

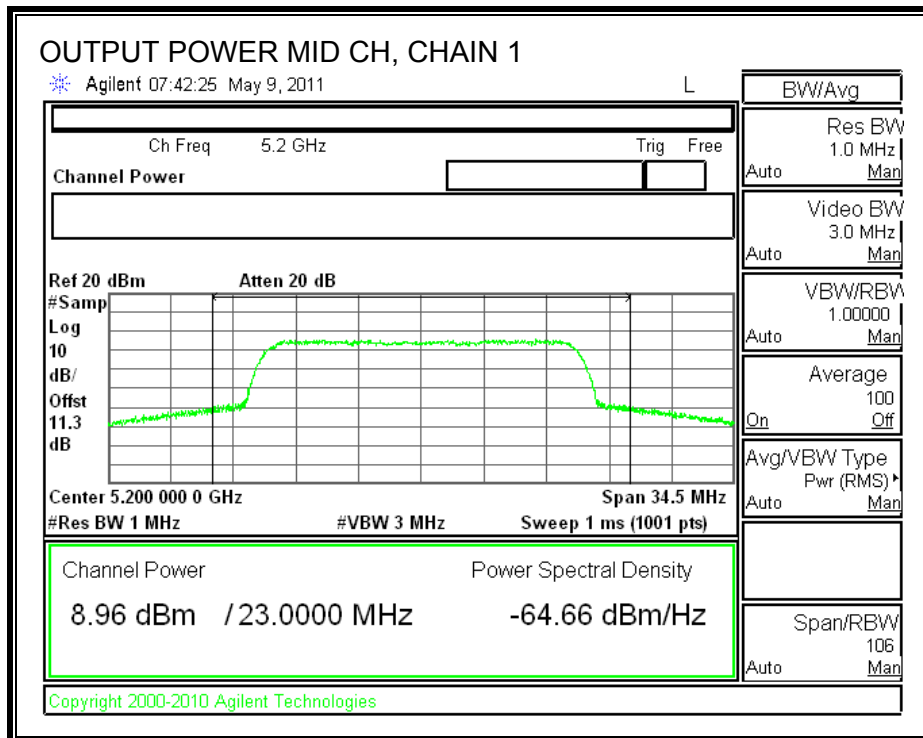
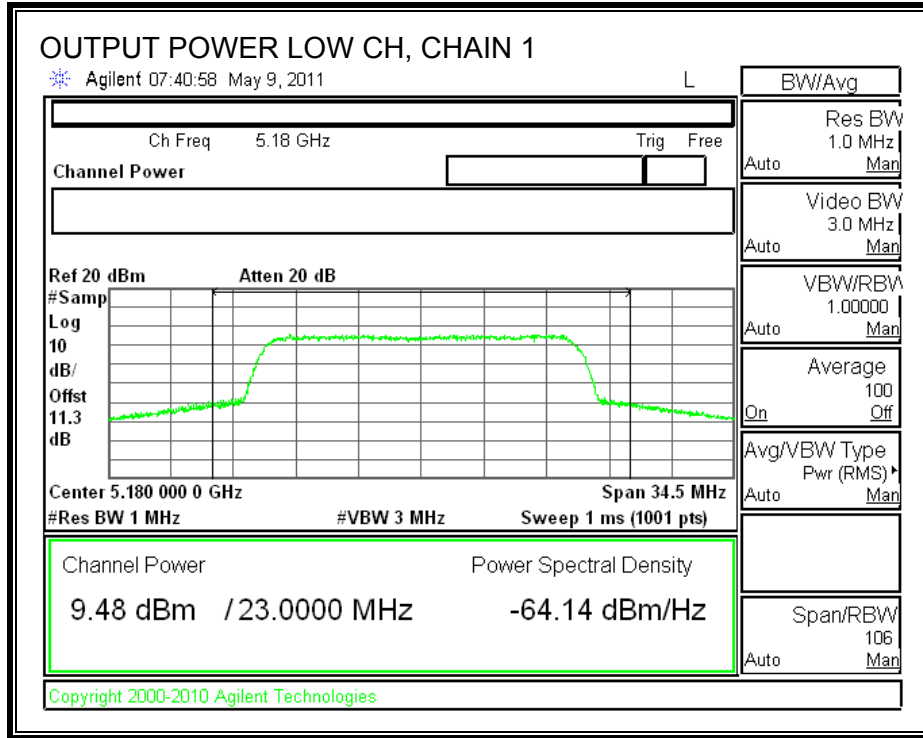
Limit

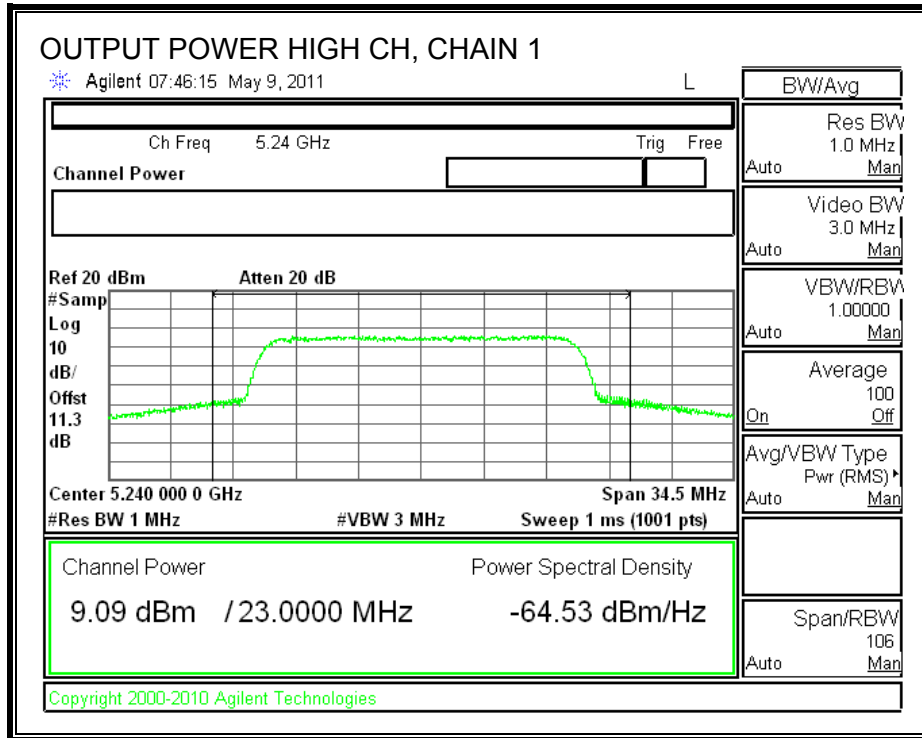
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	22.503	17.52	8.65	14.35
Mid	5200	17	23.219	17.66	8.65	14.35
High	5240	17	22.151	17.45	8.65	14.35

Individual Chain Results

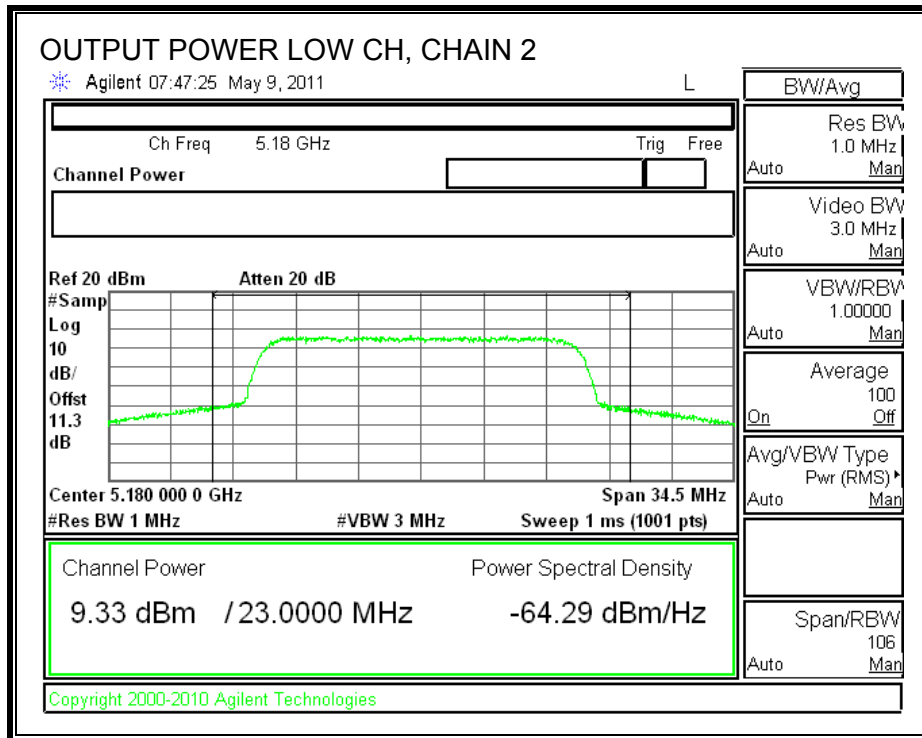
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.48	9.33	12.42	14.35	-1.93
Mid	5200	8.96	9.22	12.10	14.35	-2.25
High	5240	9.09	9.14	12.13	14.35	-2.22

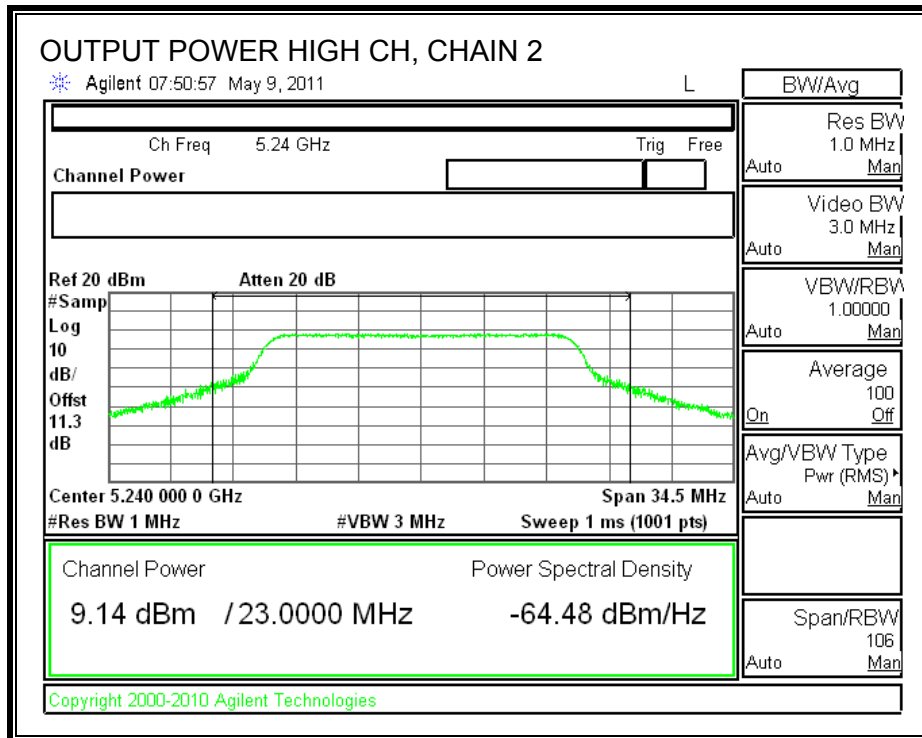
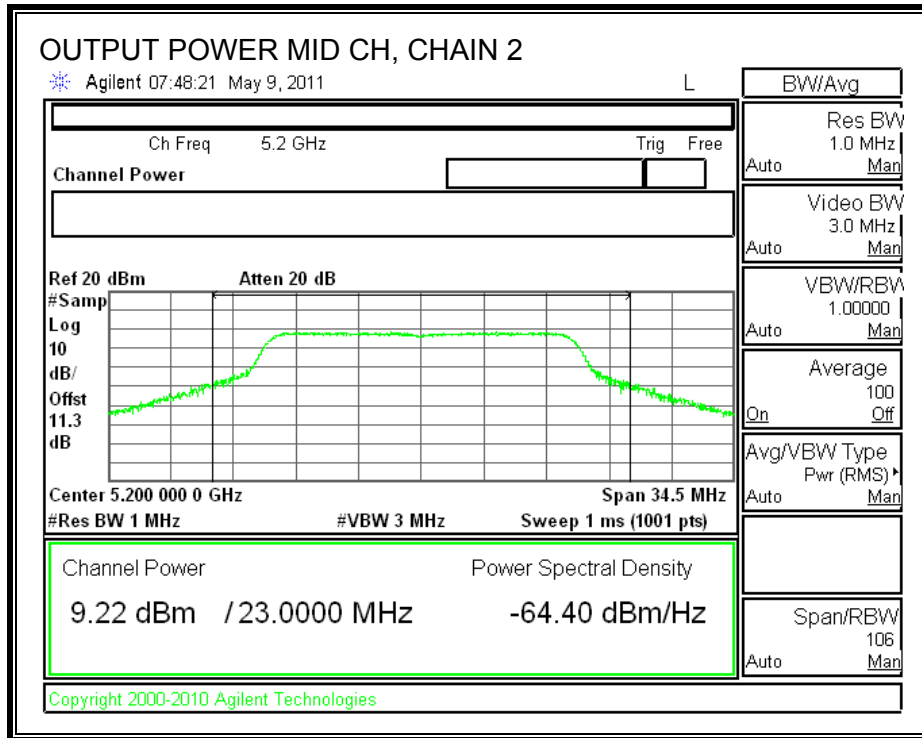
CHAIN 1 OUTPUT POWER





CHAIN 2 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 11 dB (including 10 dB pad and 1.3dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	9.15	9.26	12.22
Middle	5200	8.90	9.02	11.97
High	5240	8.80	9.10	11.96

7.1.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.28	5.97	8.65

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 effective antenna gain is 8.65dBi, therefore the limit is 1.35 dBm.

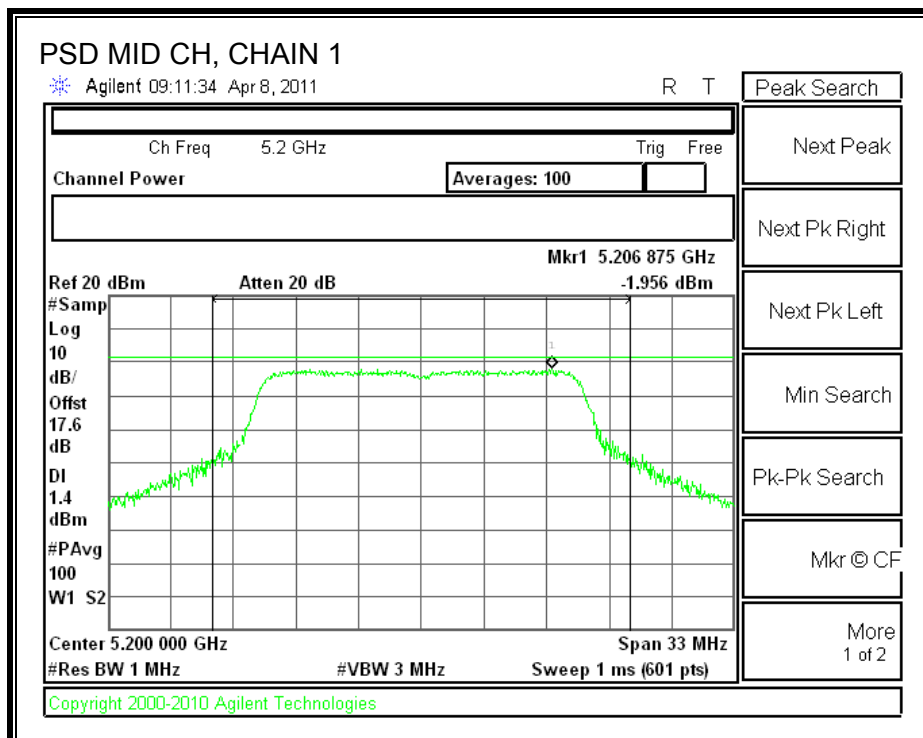
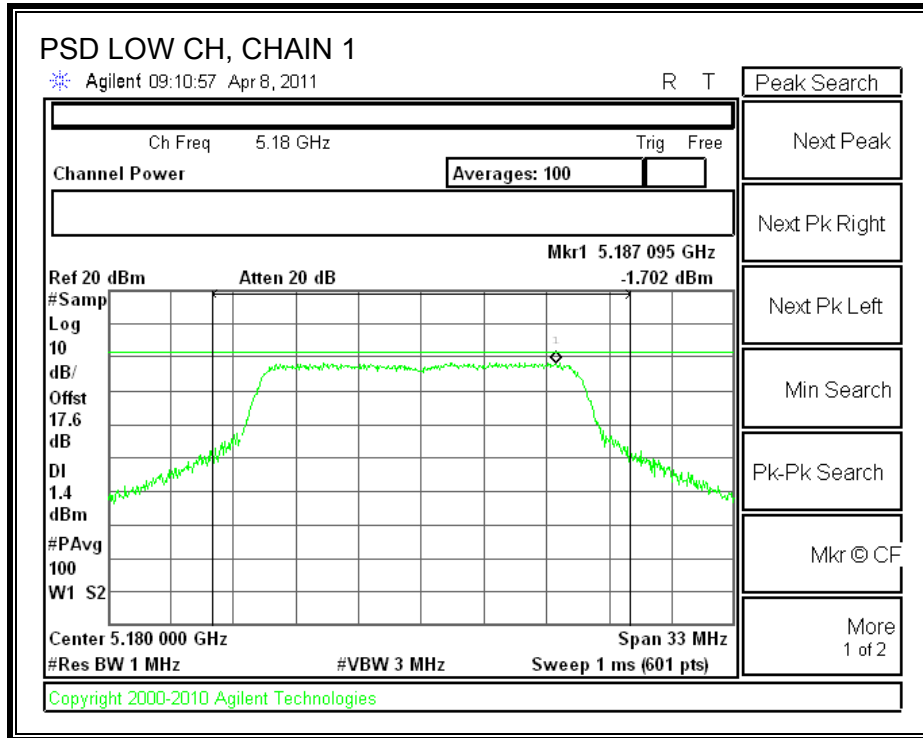
TEST PROCEDURE

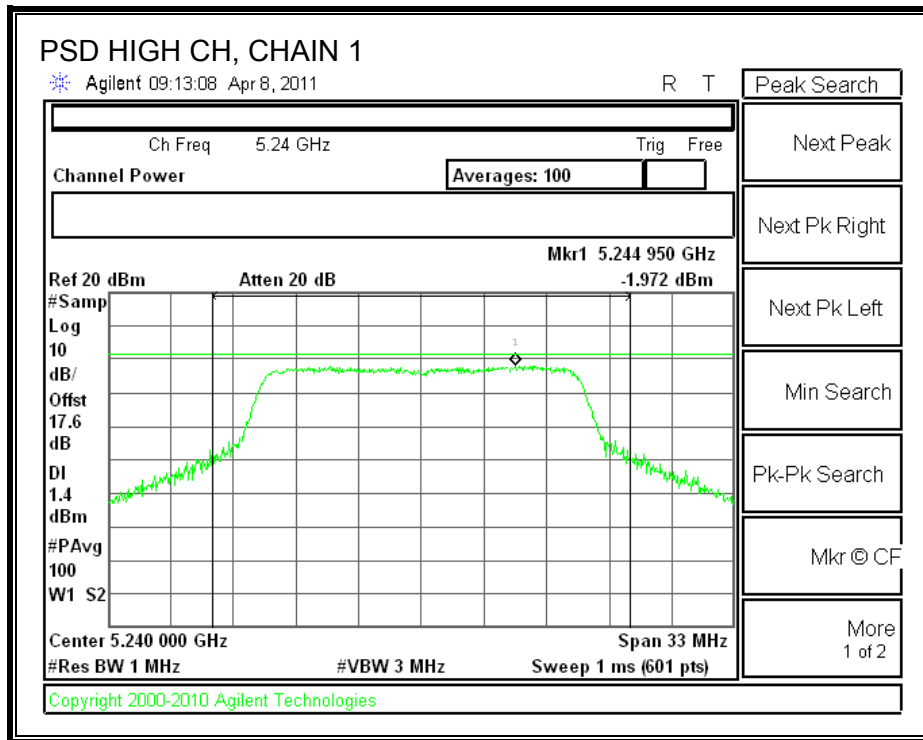
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

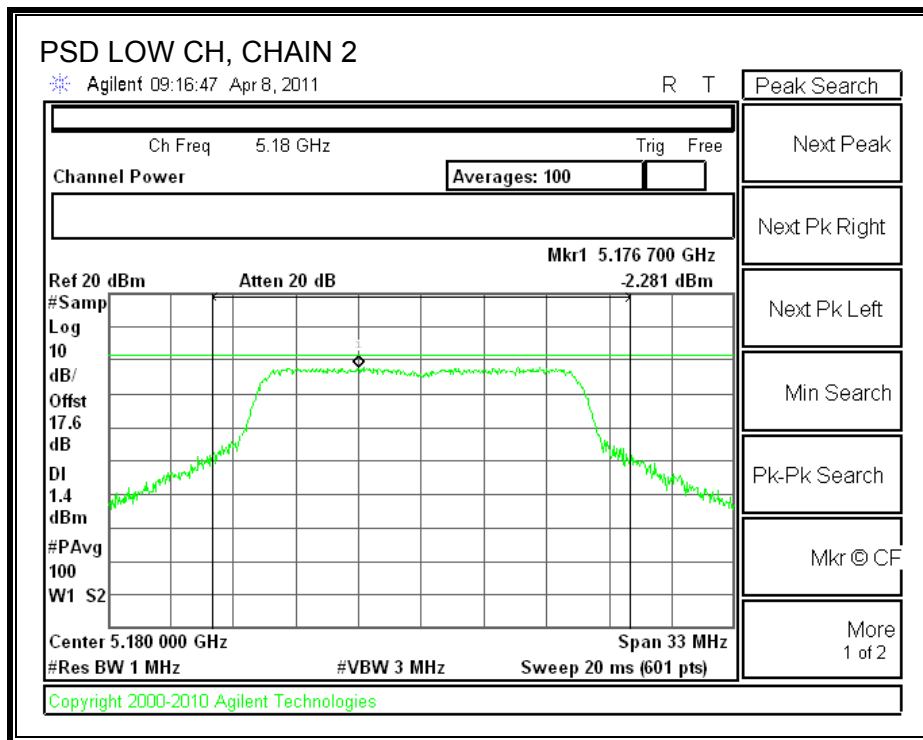
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-1.702	-2.281	1.03	1.35	-0.32
Middle	5200	-1.956	-2.477	0.80	1.35	-0.55
High	5240	-1.972	-1.882	1.08	1.35	-0.27

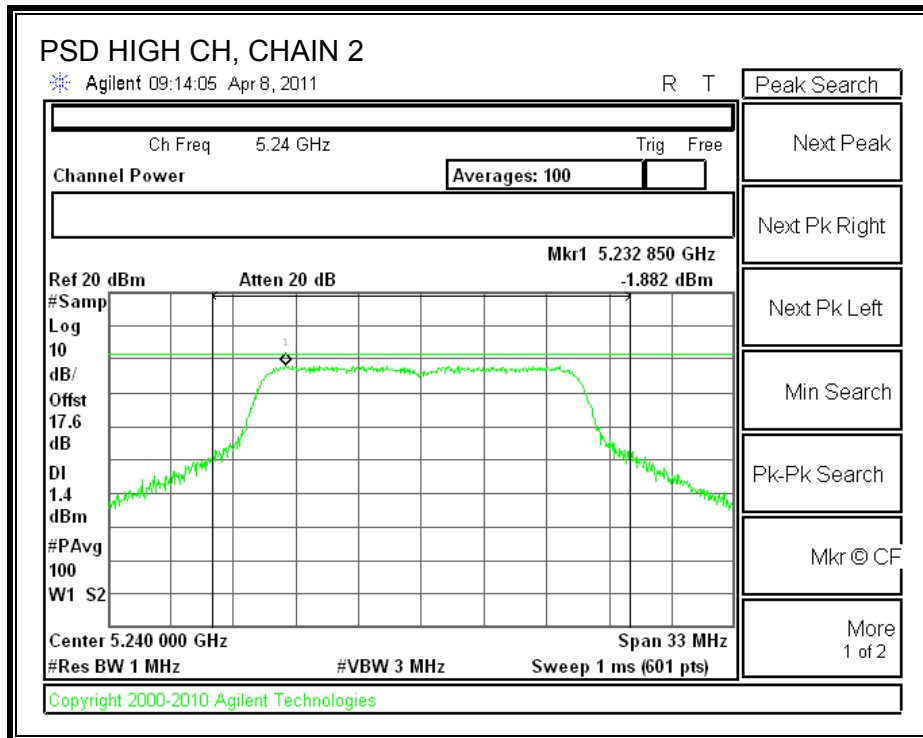
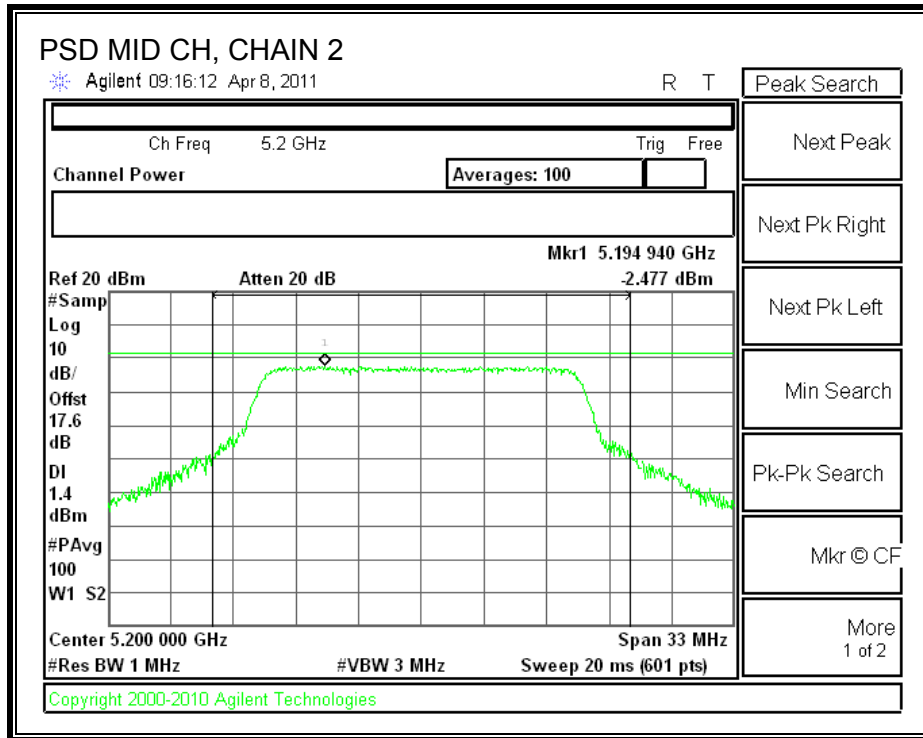
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.1.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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.

5.2GHz band, Antenna Gain, chain 1=5.28, chain 2=5.97

5.3GHz Band, antenna gain, chain 1=5.21, chain 2=6.07

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.

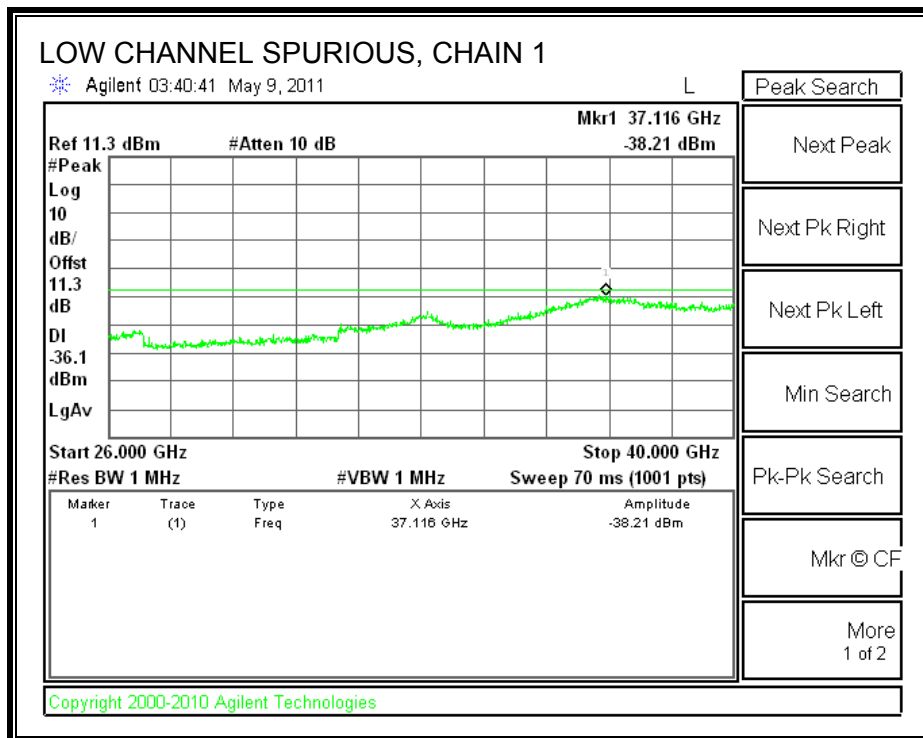
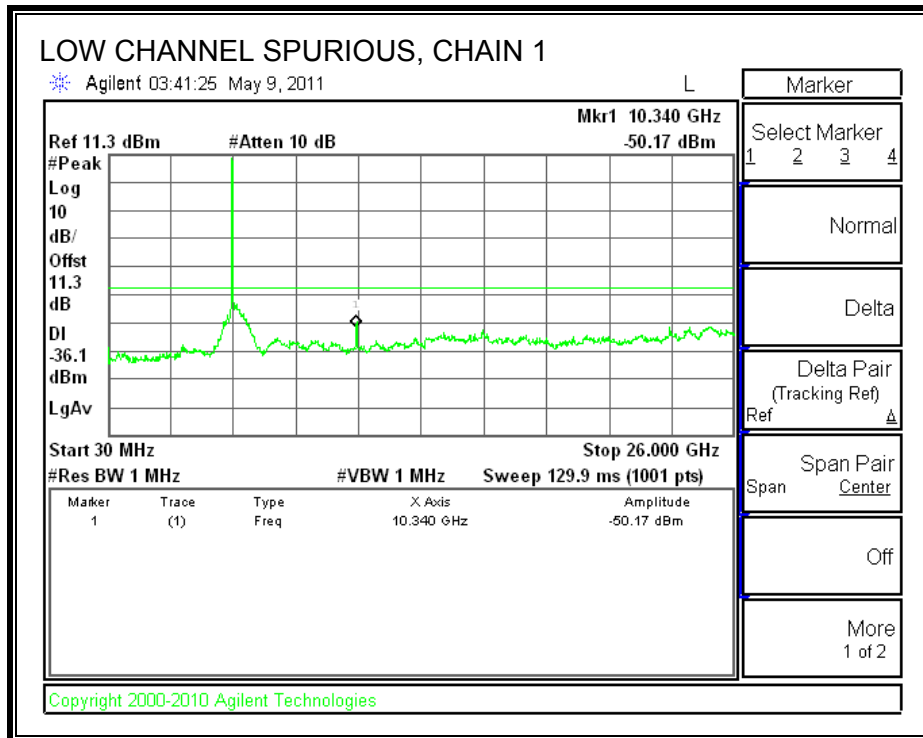
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

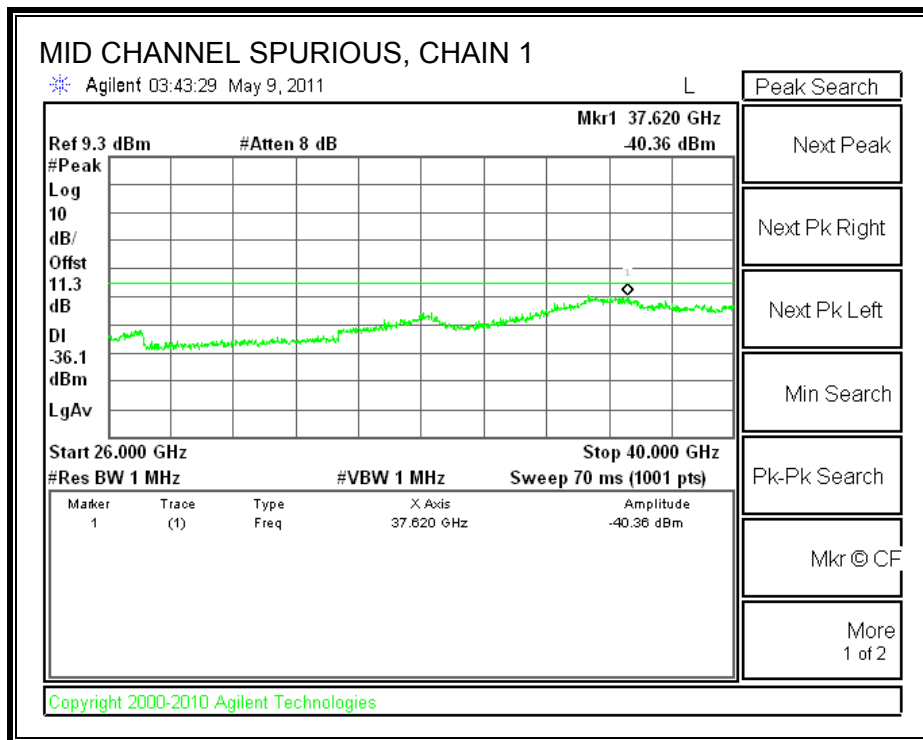
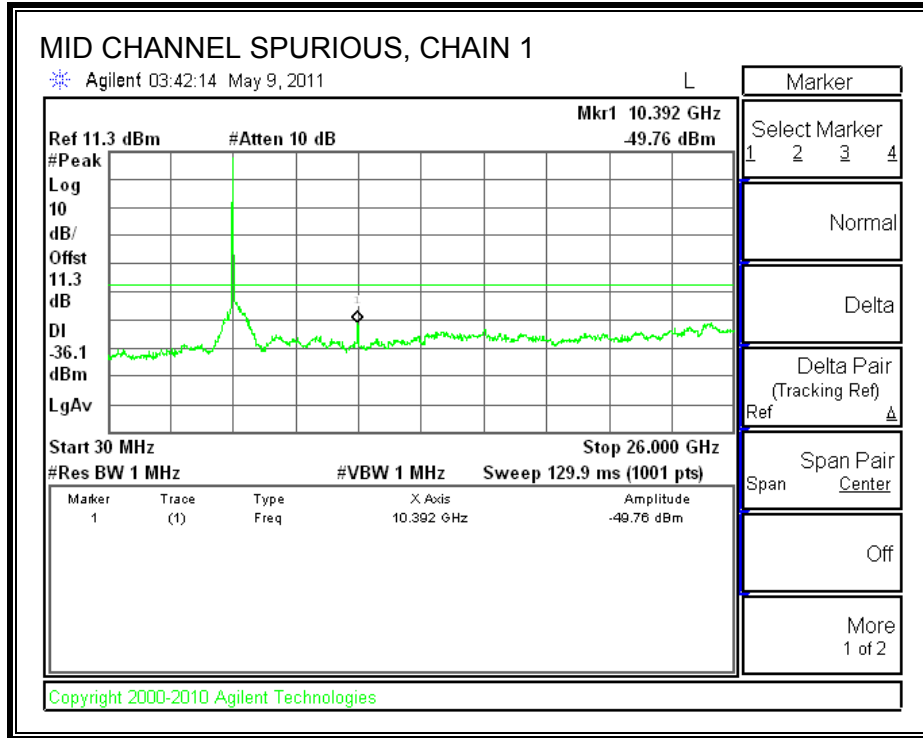
RESULTS:

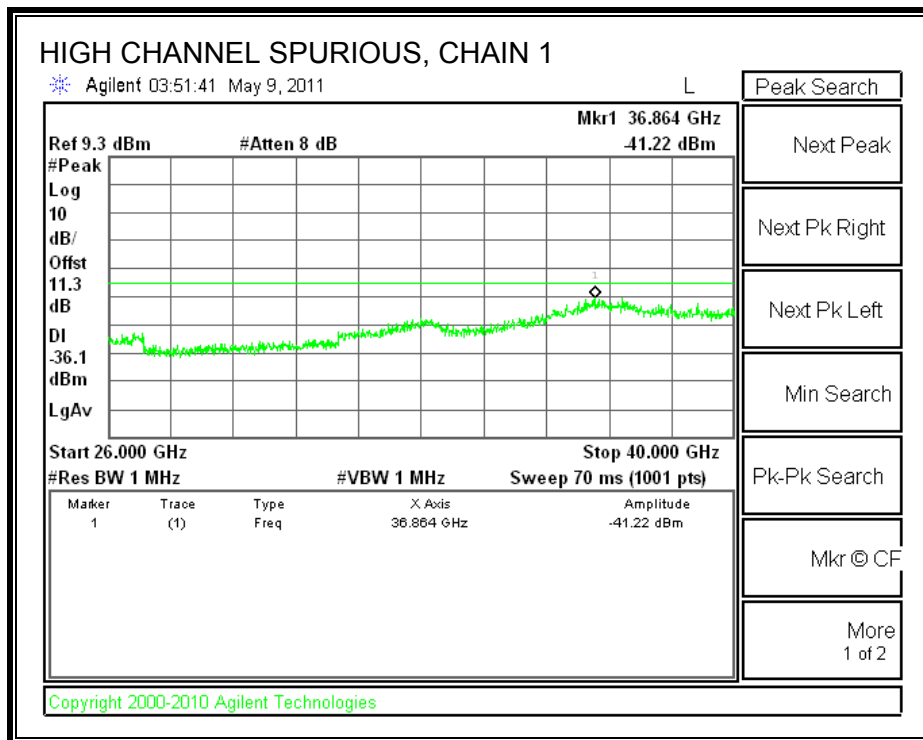
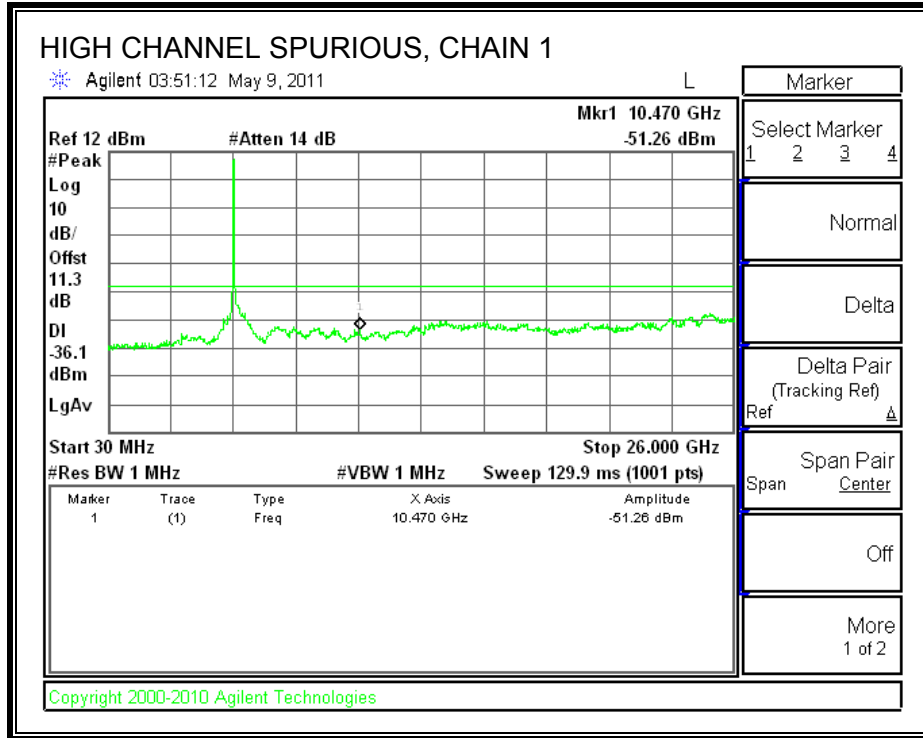
Limit=-27 dBm + Antenna Gain + 10Log (N) dB

RESULTS

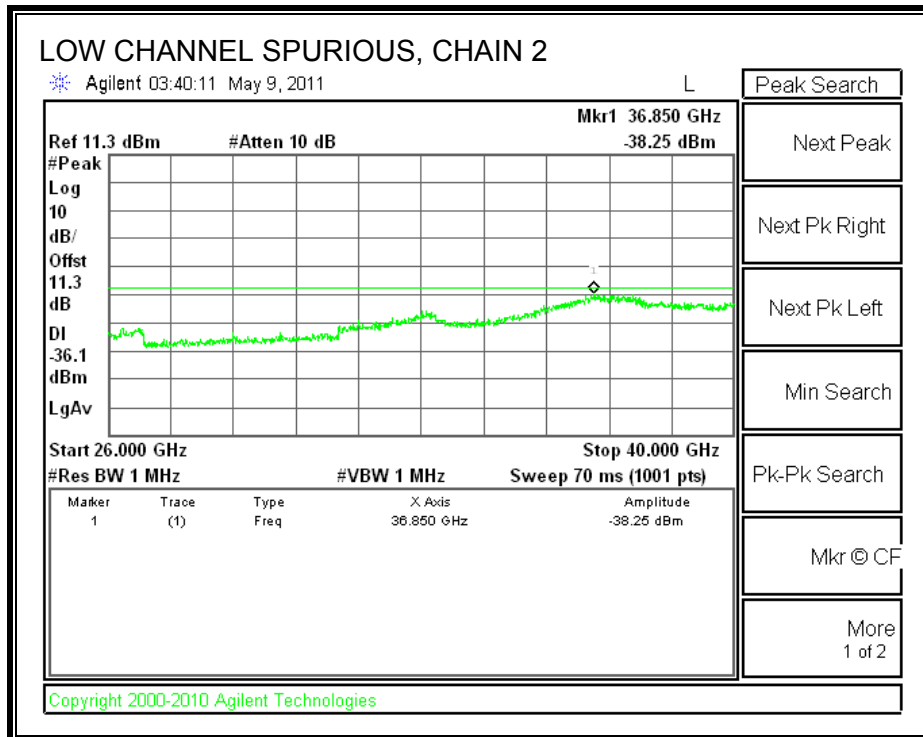
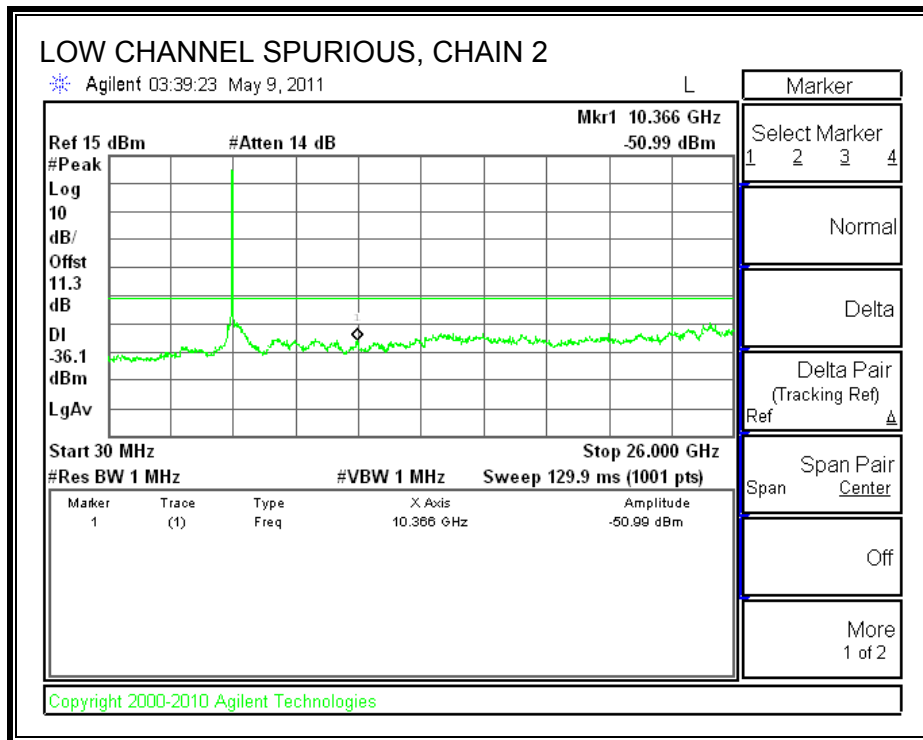
CHAIN 1 SPURIOUS EMISSIONS

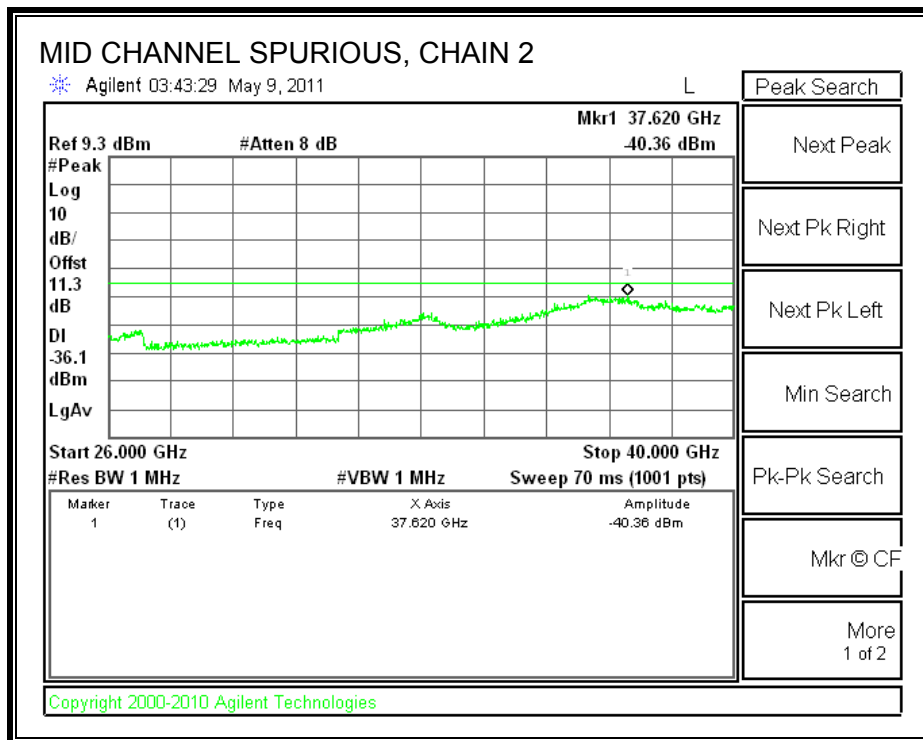
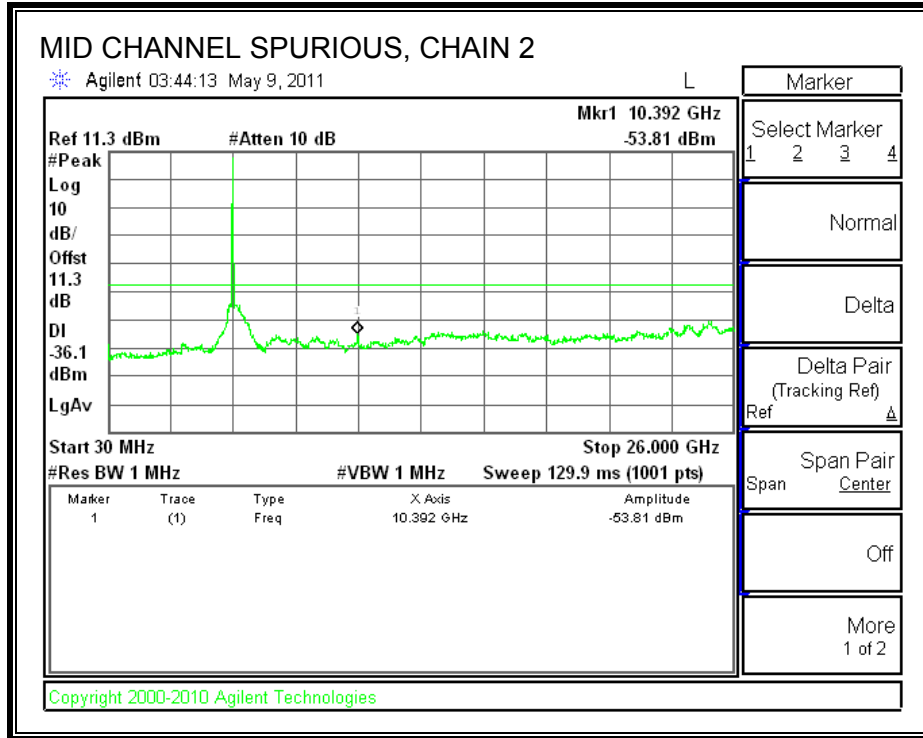


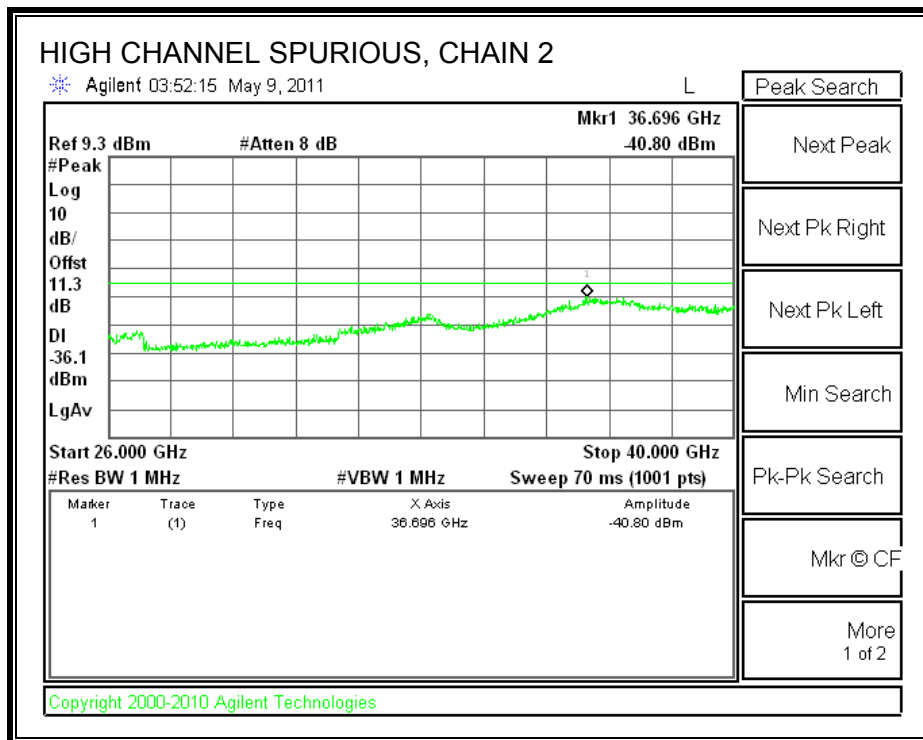
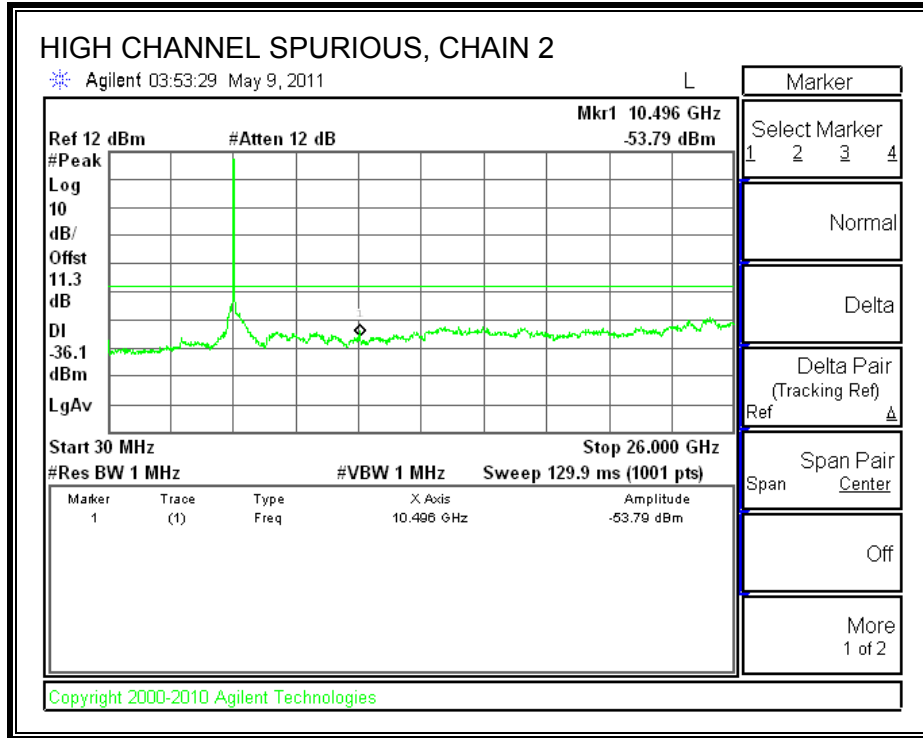




CHAIN 2 SPURIOUS EMISSIONS







7.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

7.2.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

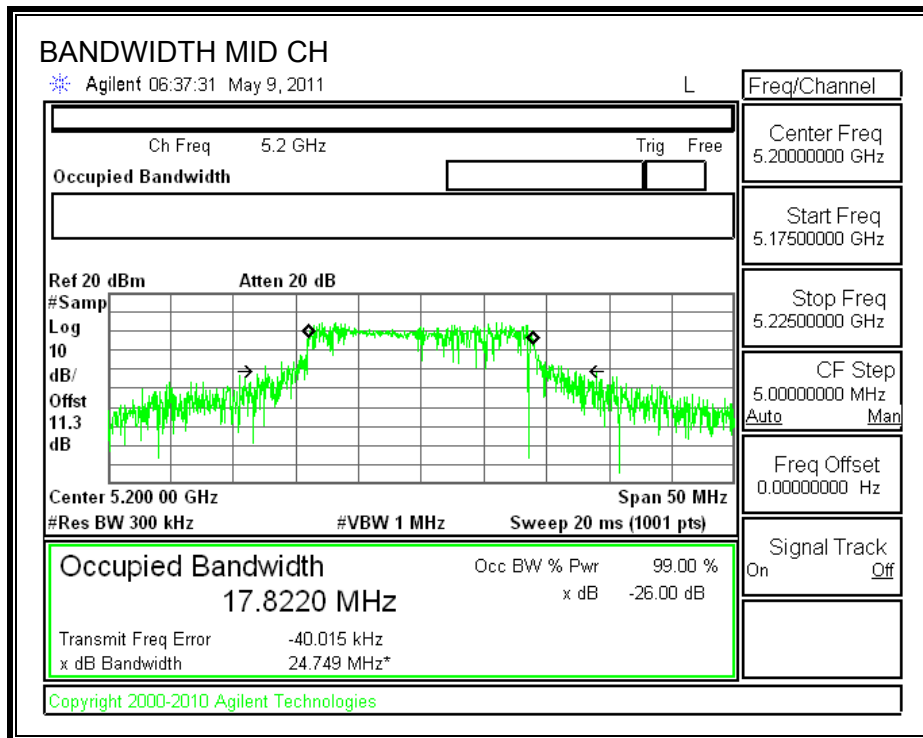
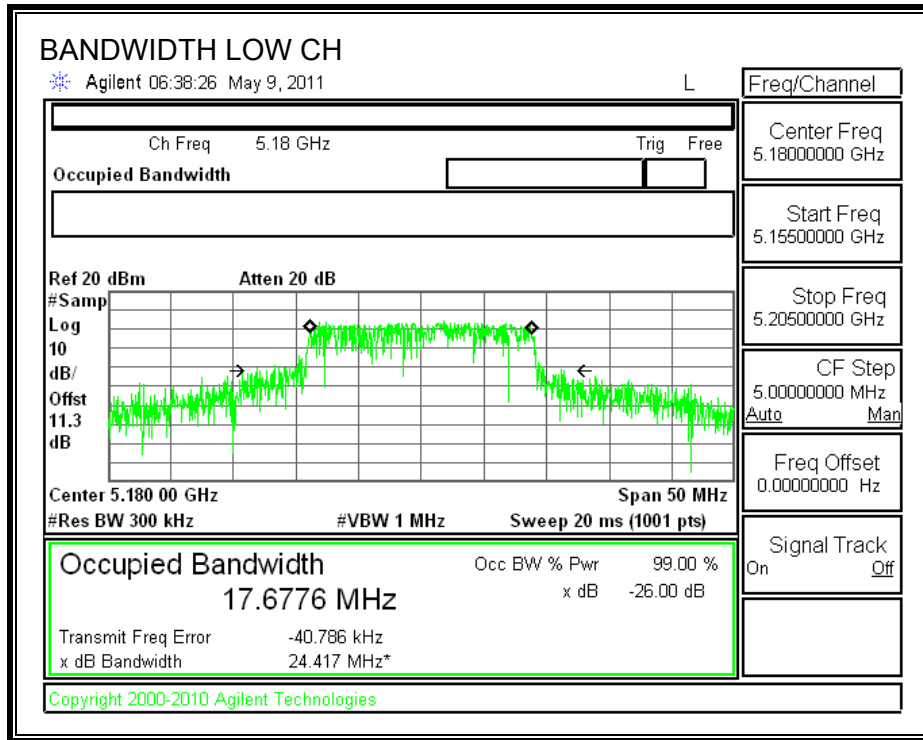
TEST PROCEDURE

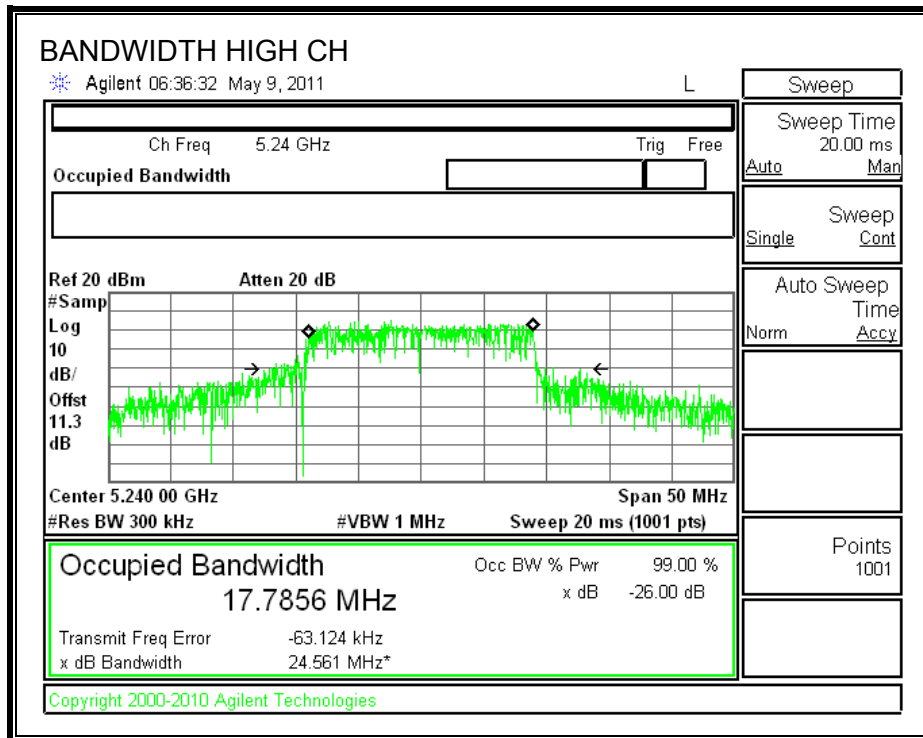
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	24.417
Middle	5200	24.749
High	5240	24.561

26 dB BANDWIDTH





7.2.2. OUTPUT POWER

FCC §15.407 (a) (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.

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

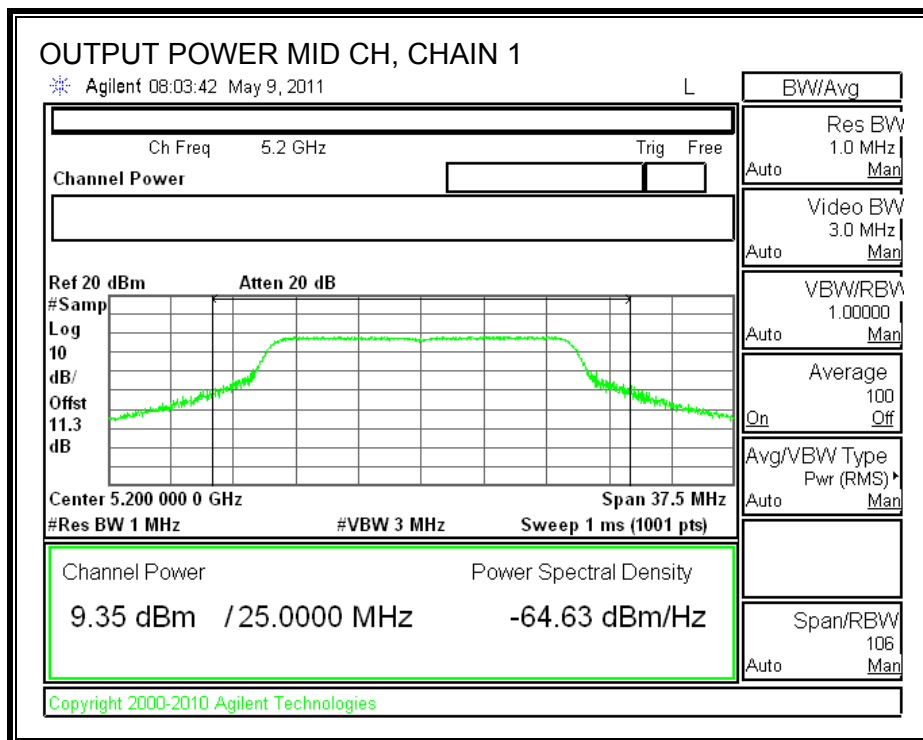
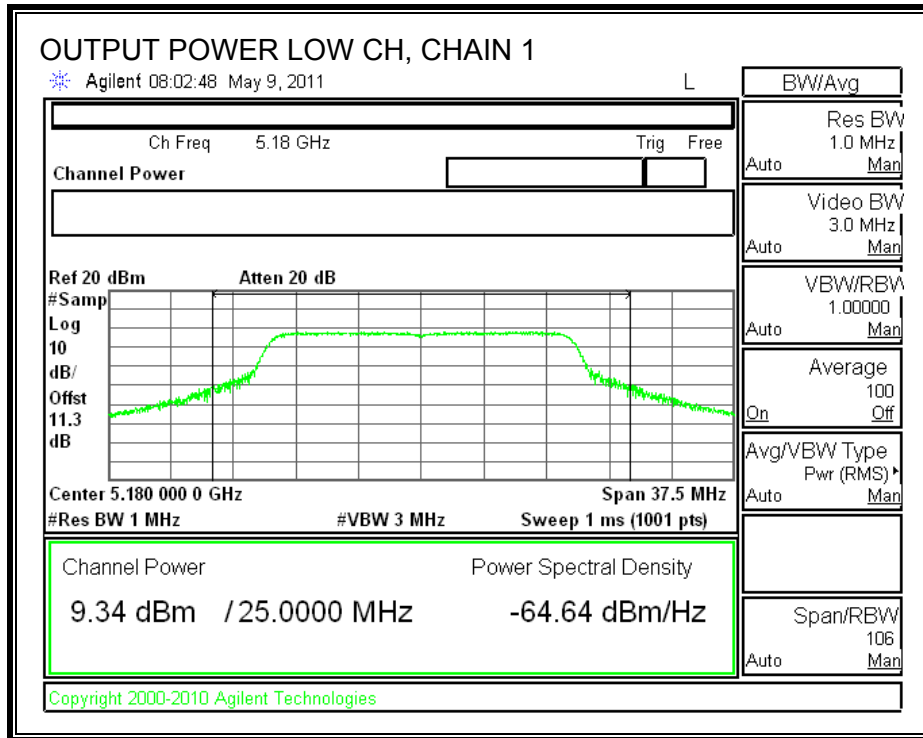
Limit

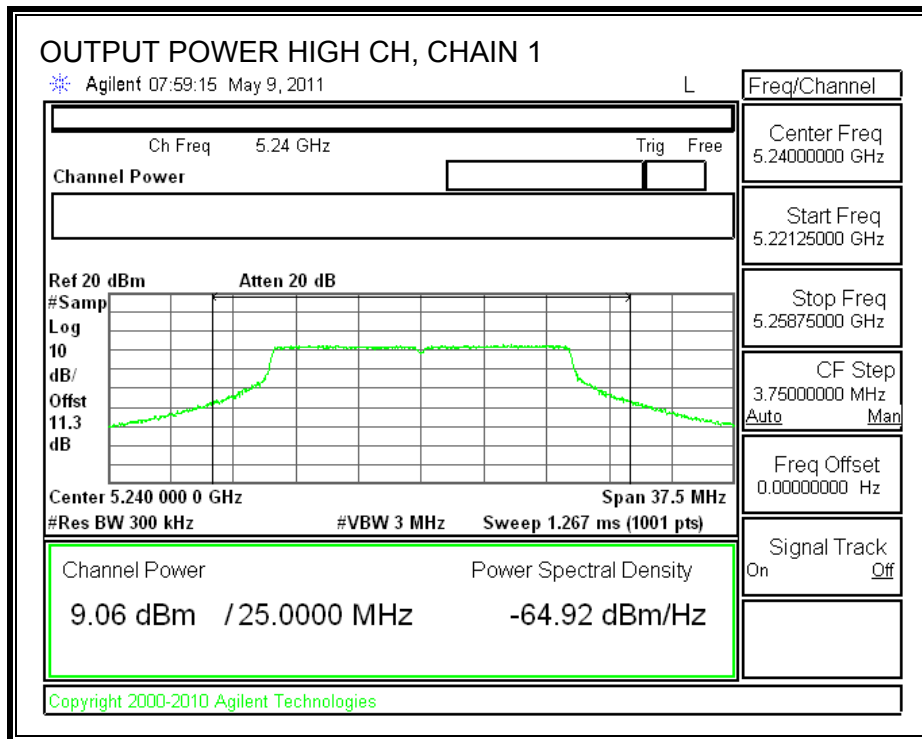
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	24.417	17.88	8.65	14.35
Mid	5200	17	24.749	17.94	8.65	14.35
High	5240	17	24.561	17.90	8.65	14.35

Individual Chain Results

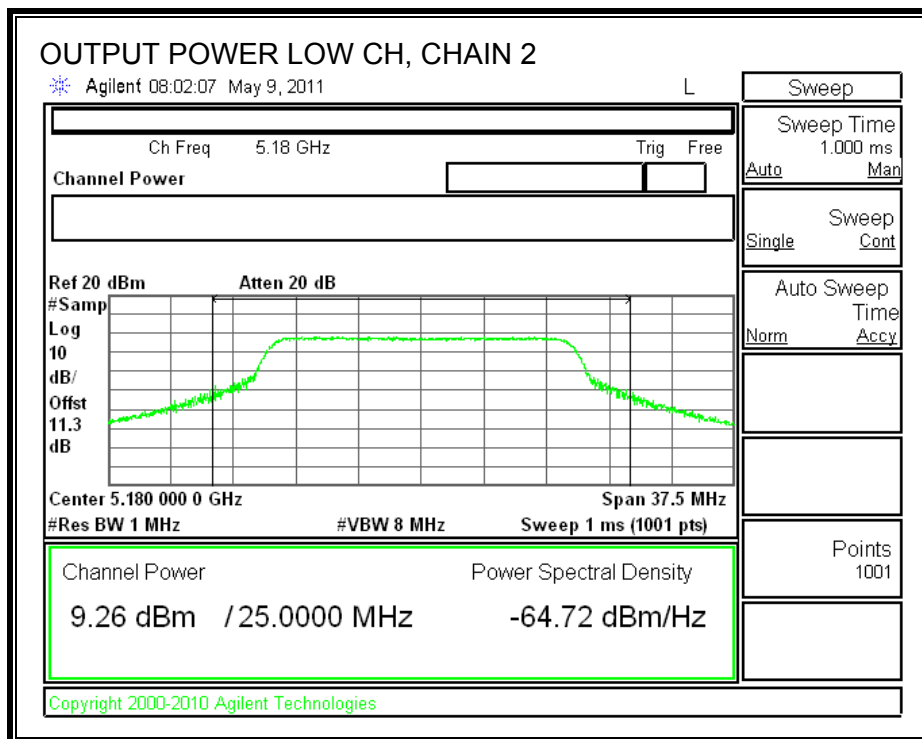
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.34	9.26	12.31	14.35	-2.04
Mid	5200	9.35	9.51	12.44	14.35	-1.91
High	5240	9.06	9.39	12.24	14.35	-2.11

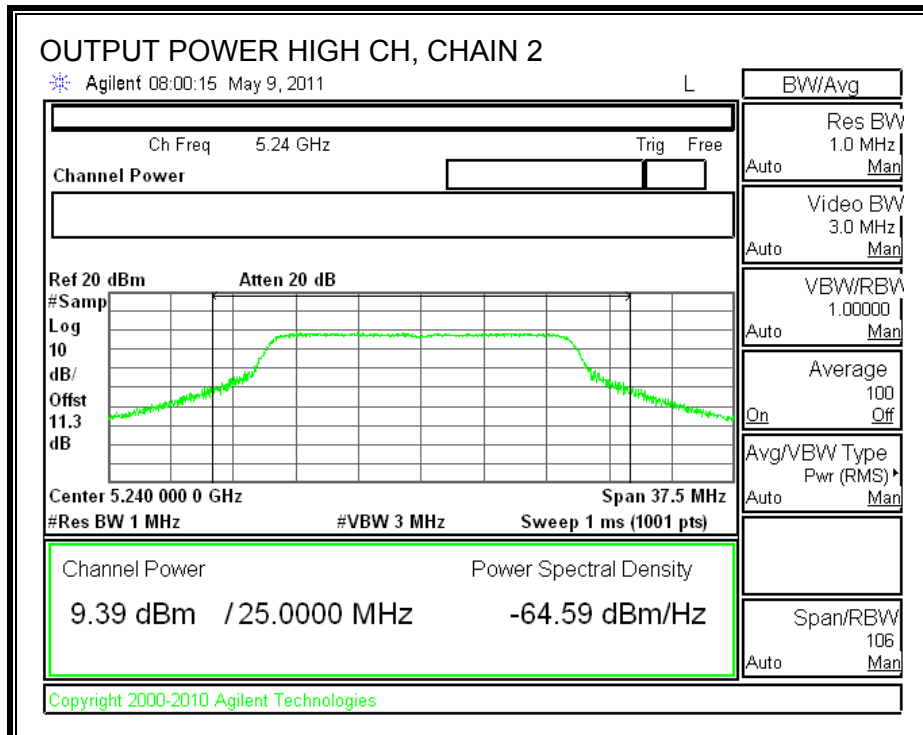
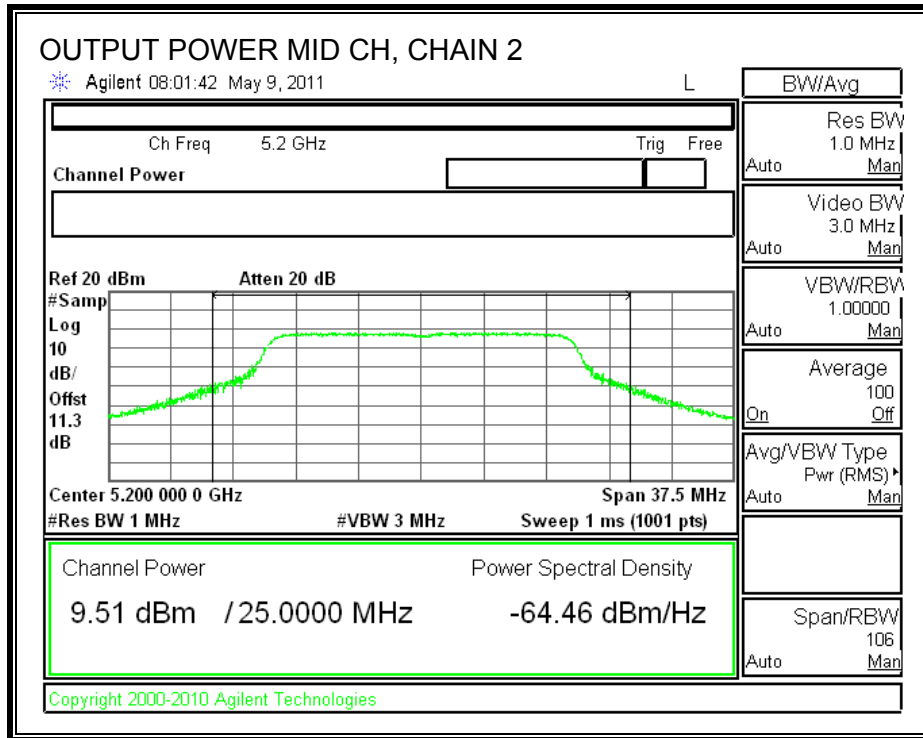
CHAIN 1 OUTPUT POWER





CHAIN 2 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 11.3dB (including 10 dB pad and 1.3dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	9.10	9.15	12.14
Middle	5200	9.22	9.40	12.32
High	5240	9.00	9.30	12.16

7.2.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (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 8.65 dBi, therefore the limit is 1.35 dBm.

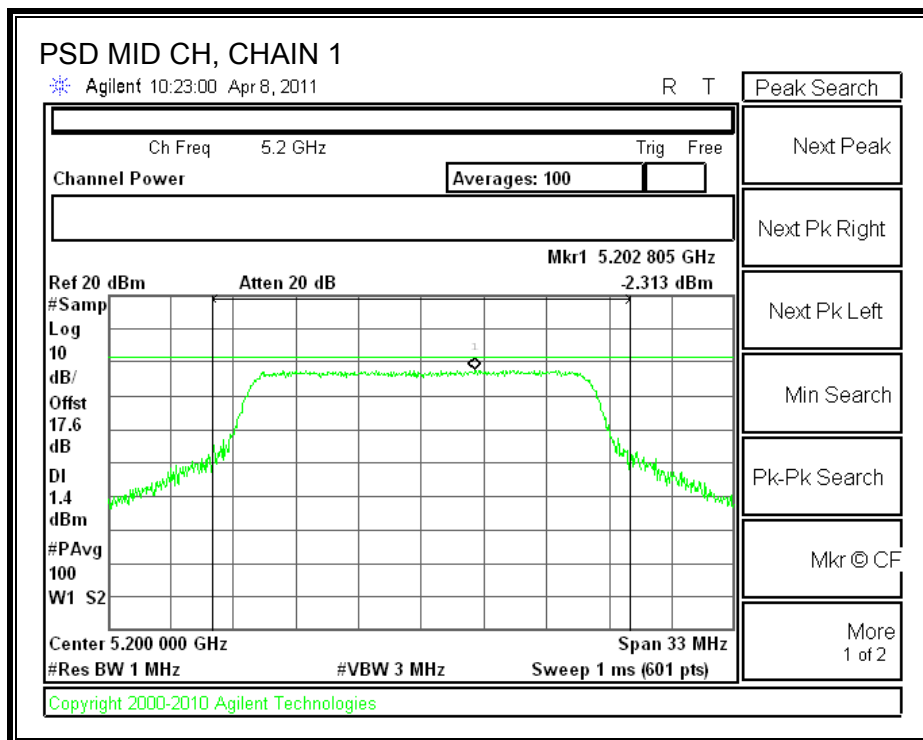
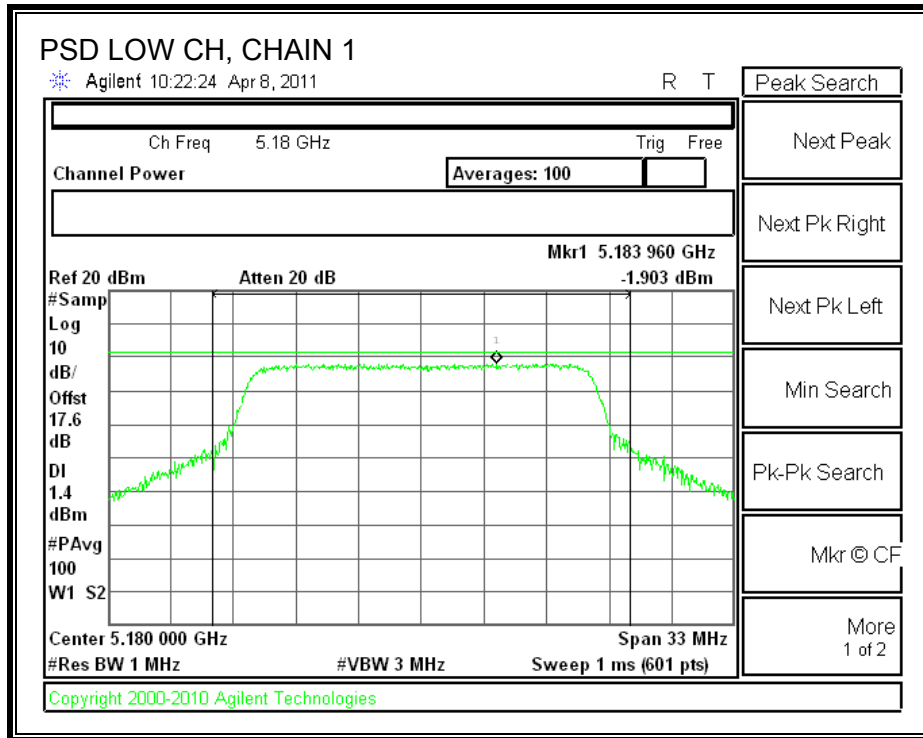
TEST PROCEDURE

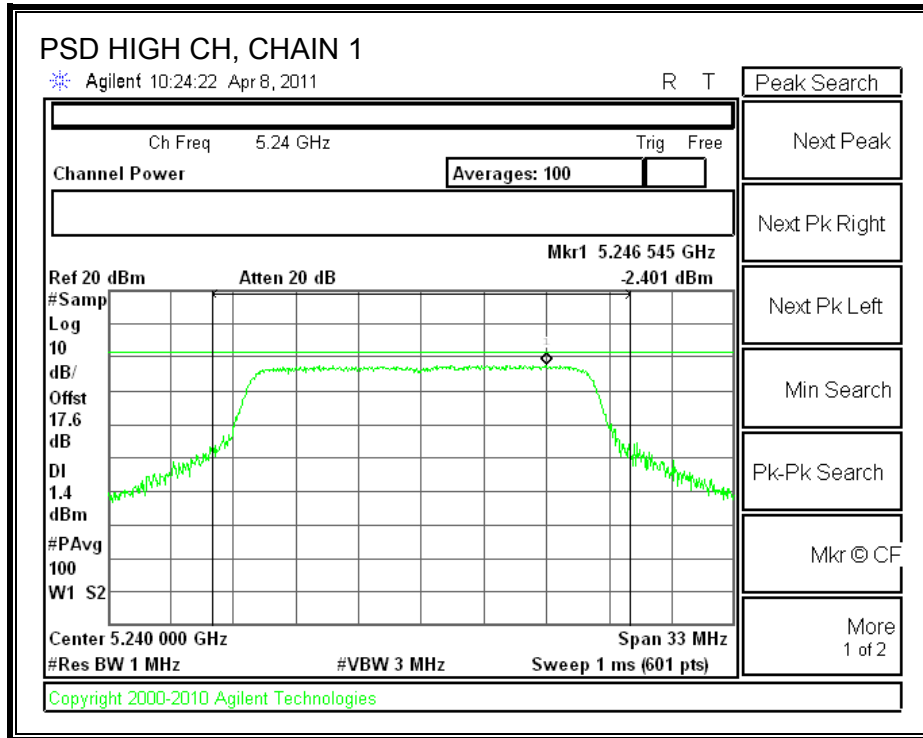
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

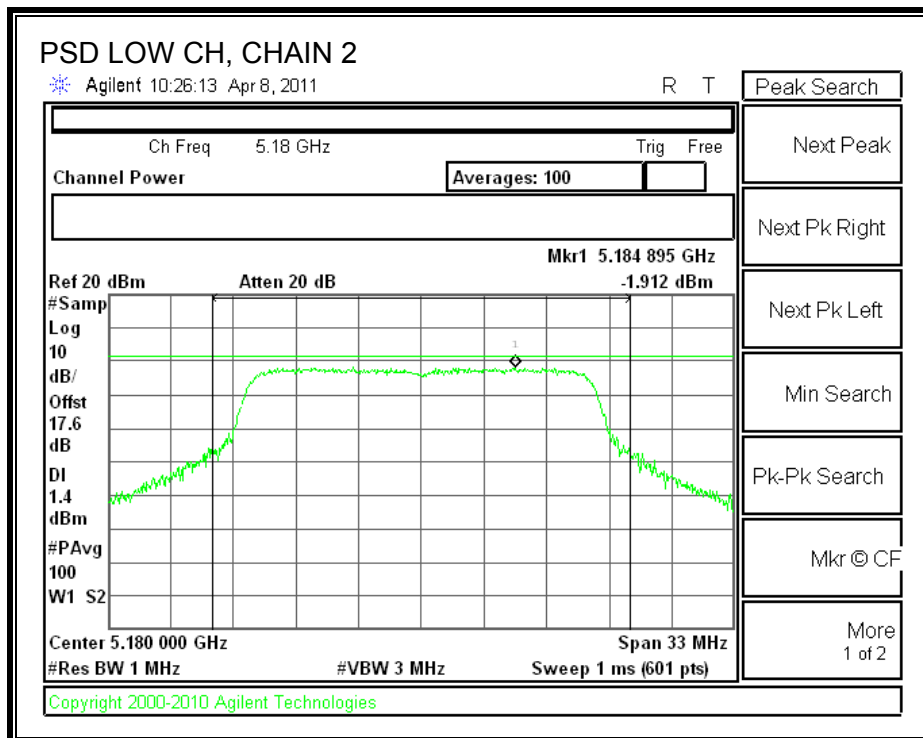
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-1.903	-1.912	1.10	1.35	-0.25
Middle	5200	-2.313	-2.014	0.85	1.35	-0.50
High	5240	-2.401	-2.461	0.58	1.35	-0.77

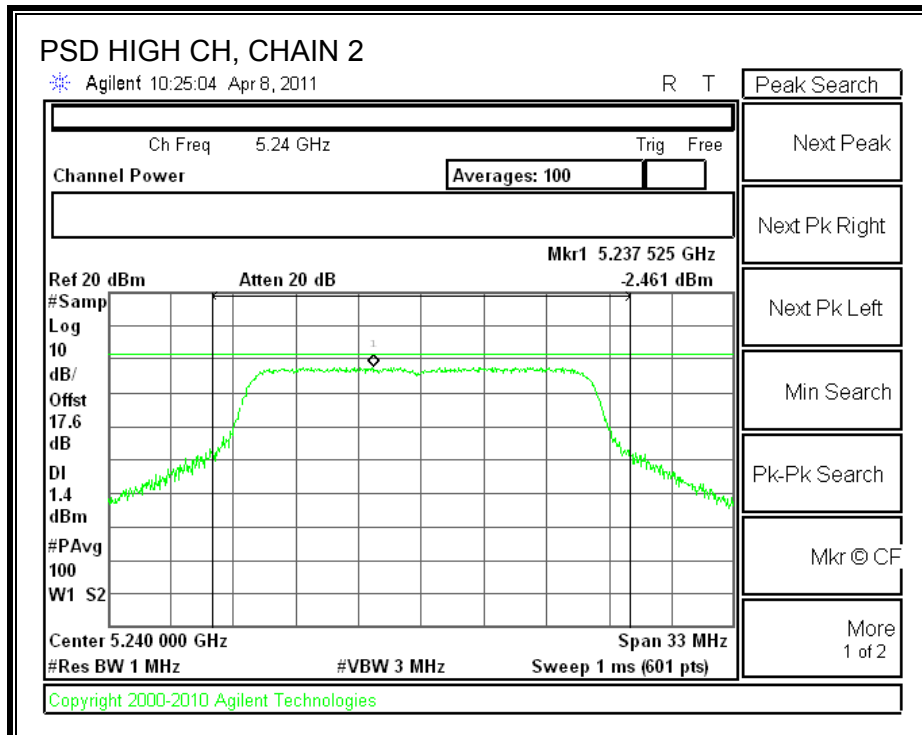
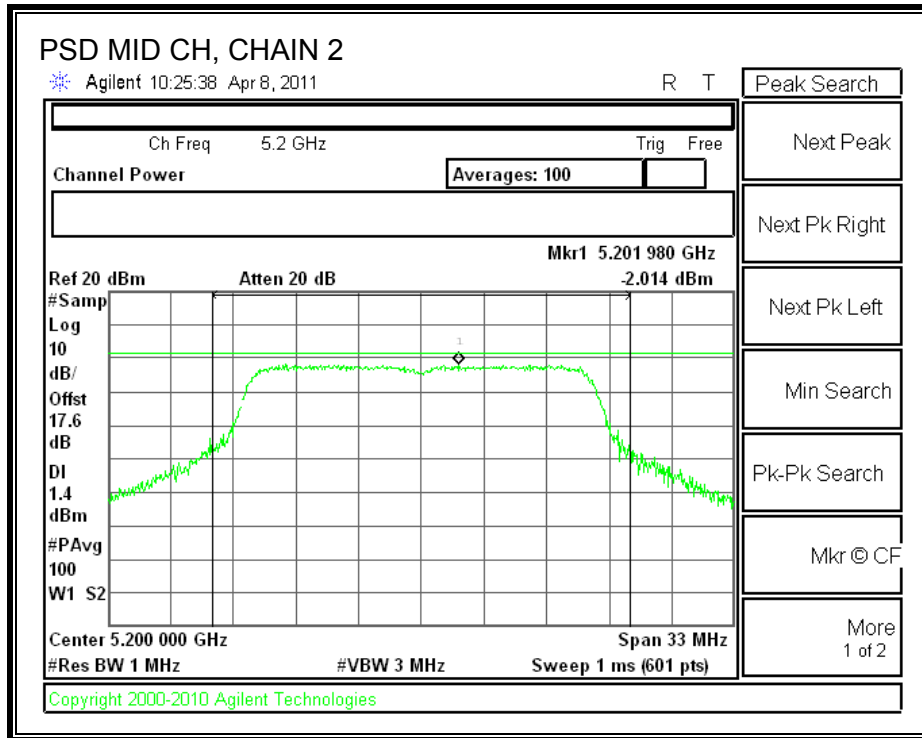
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.2.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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

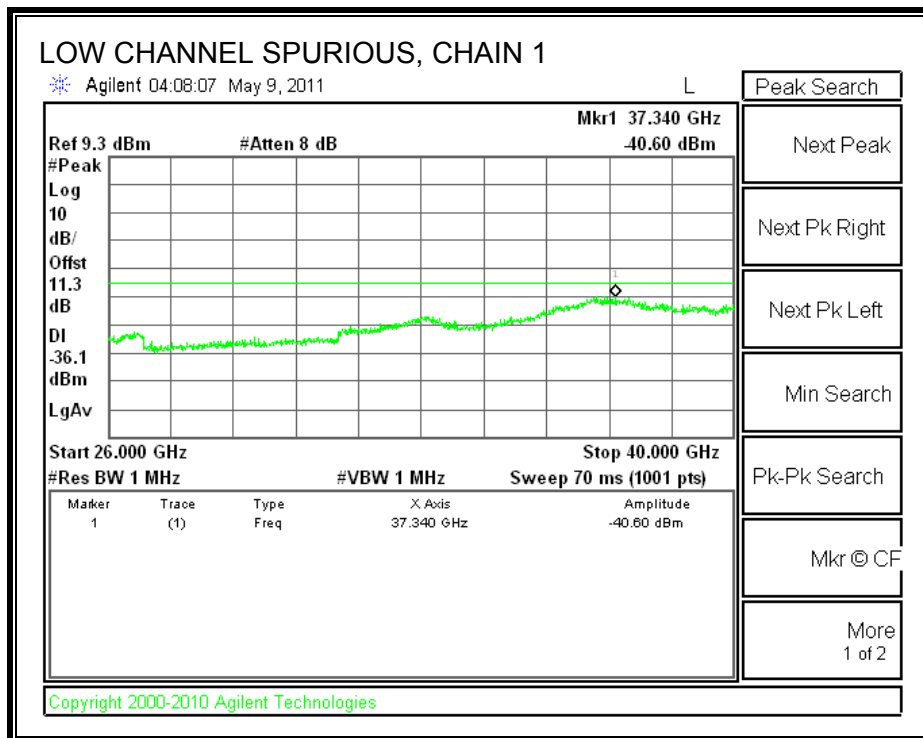
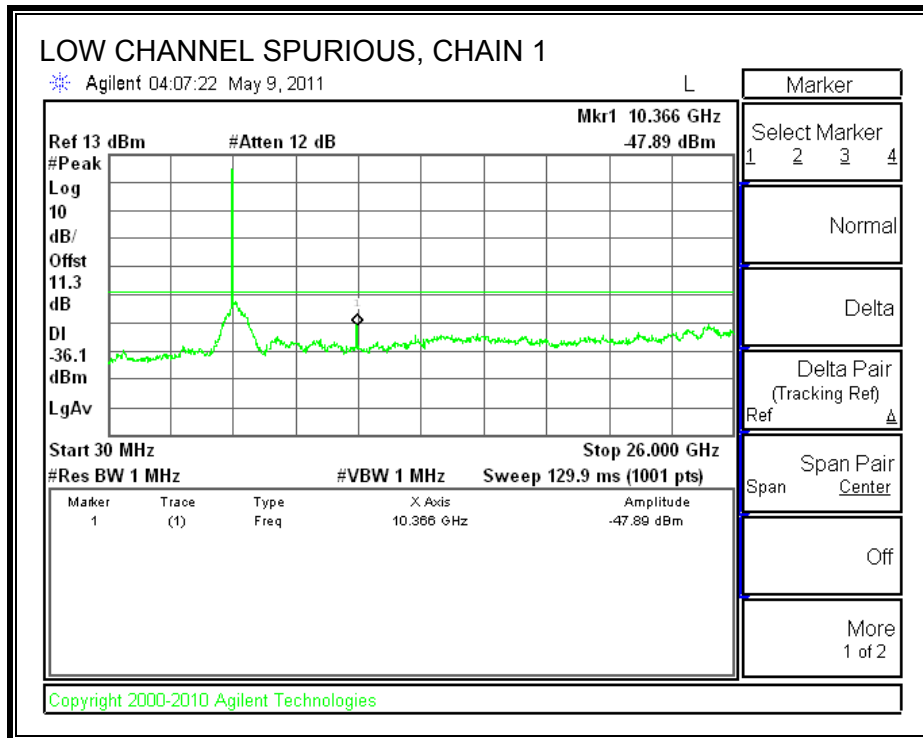
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

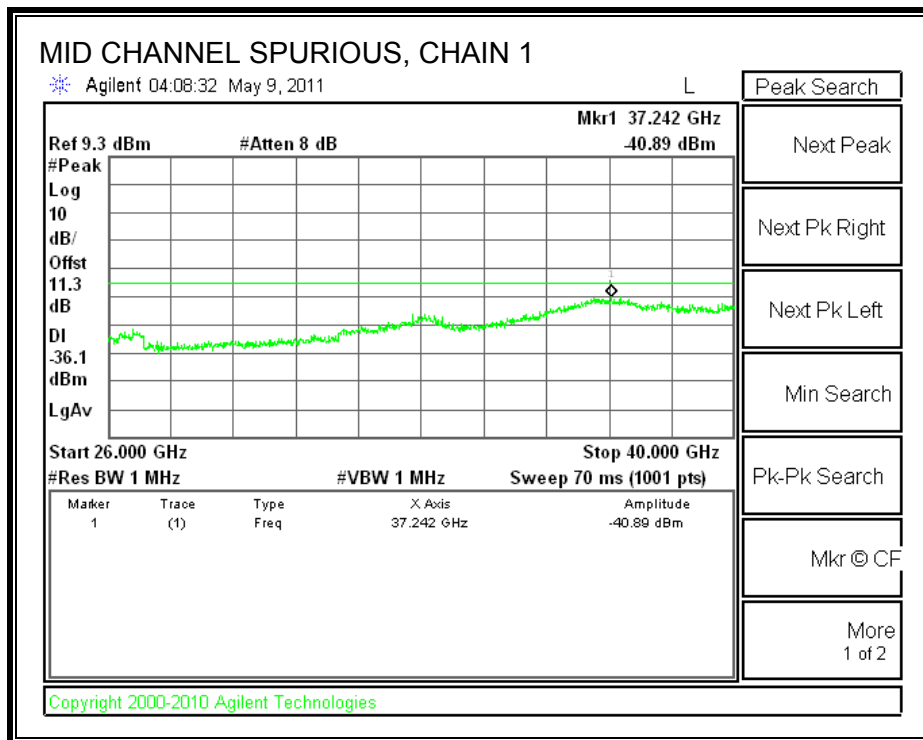
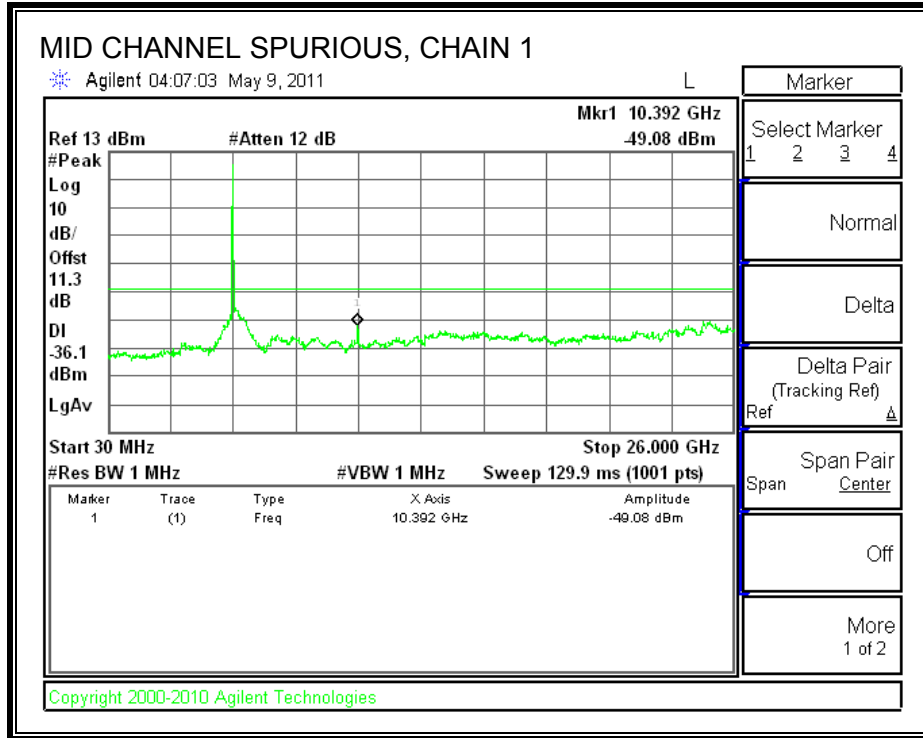
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

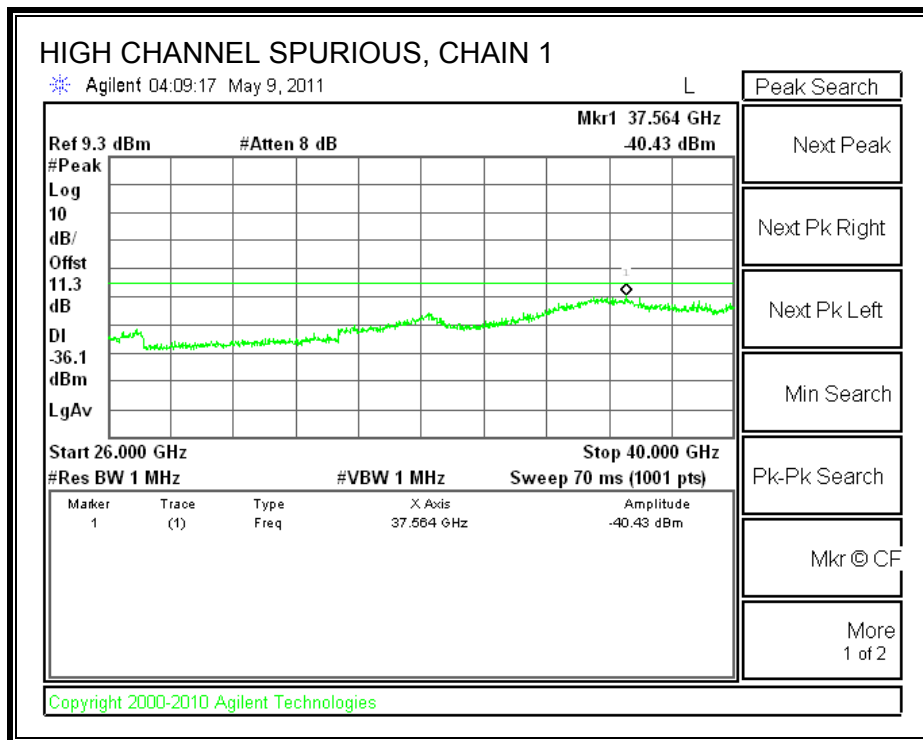
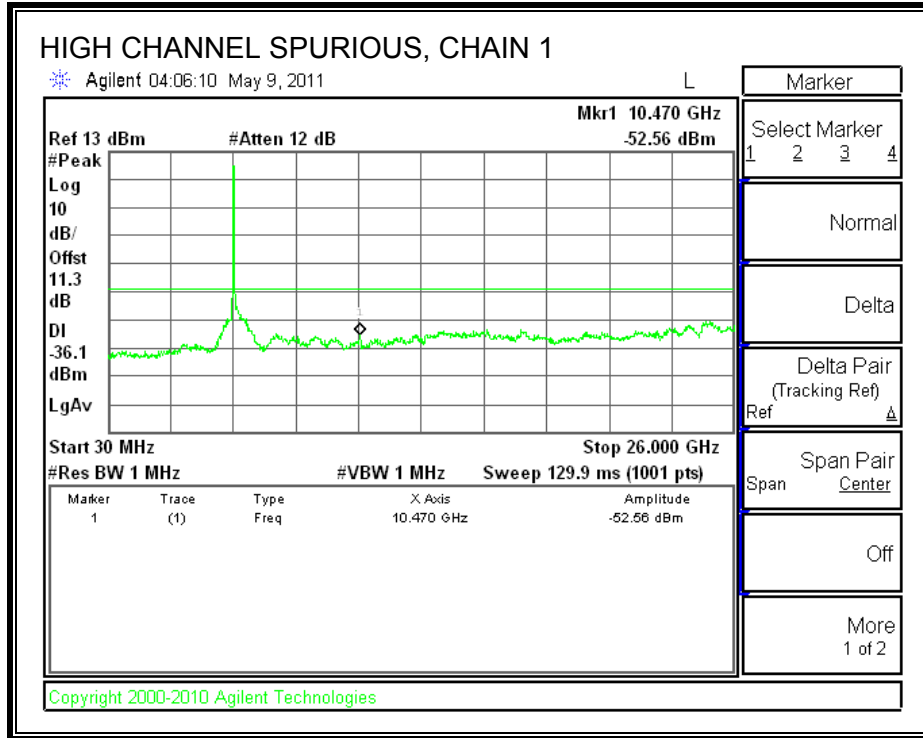
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

RESULTS

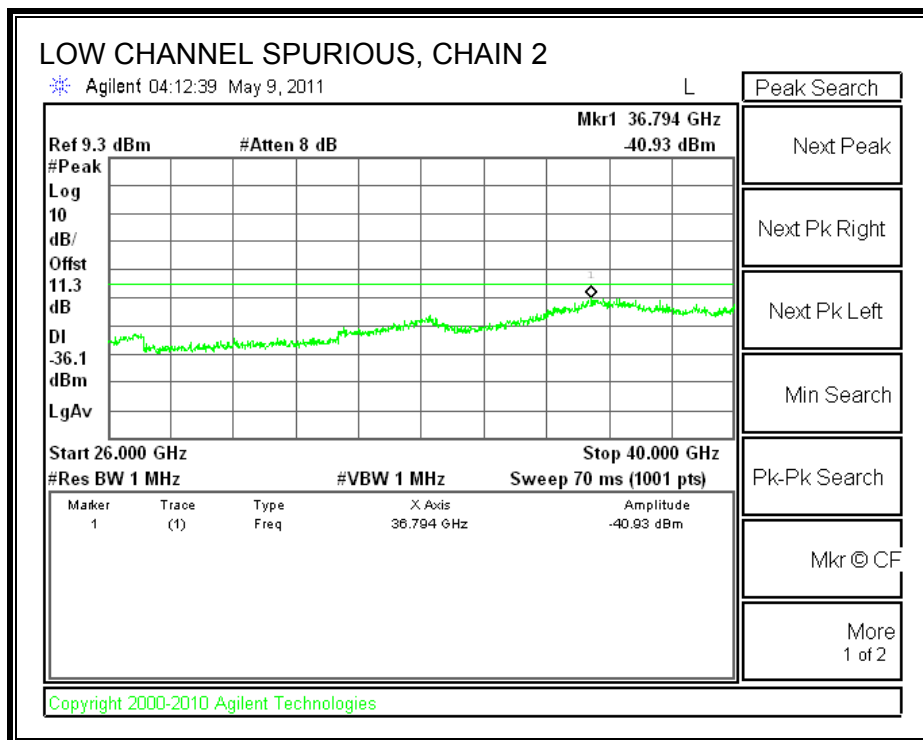
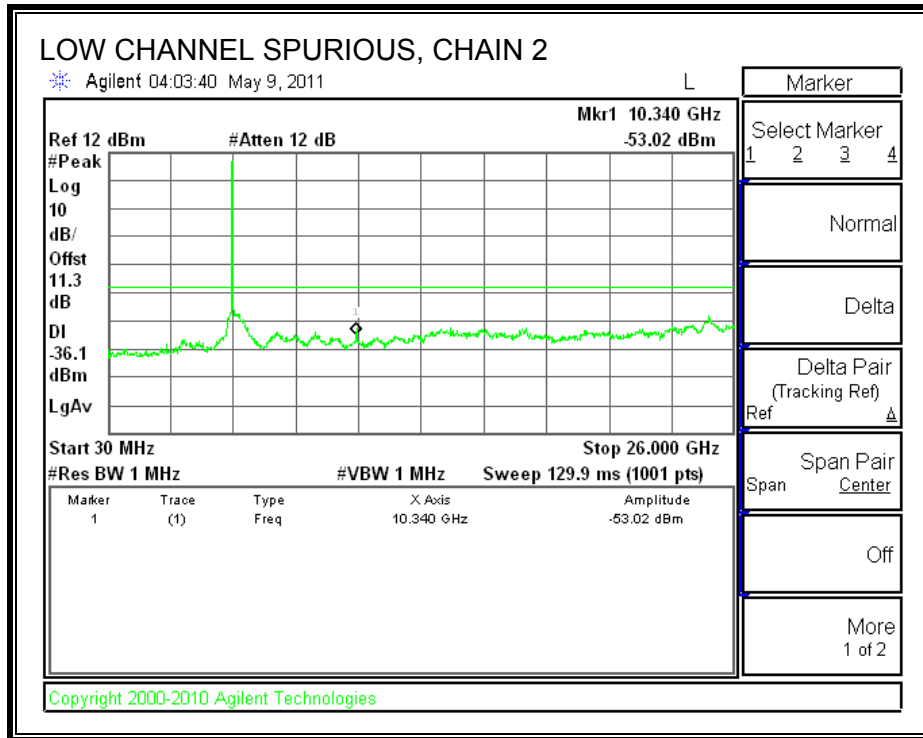
CHAIN 1 SPURIOUS EMISSIONS

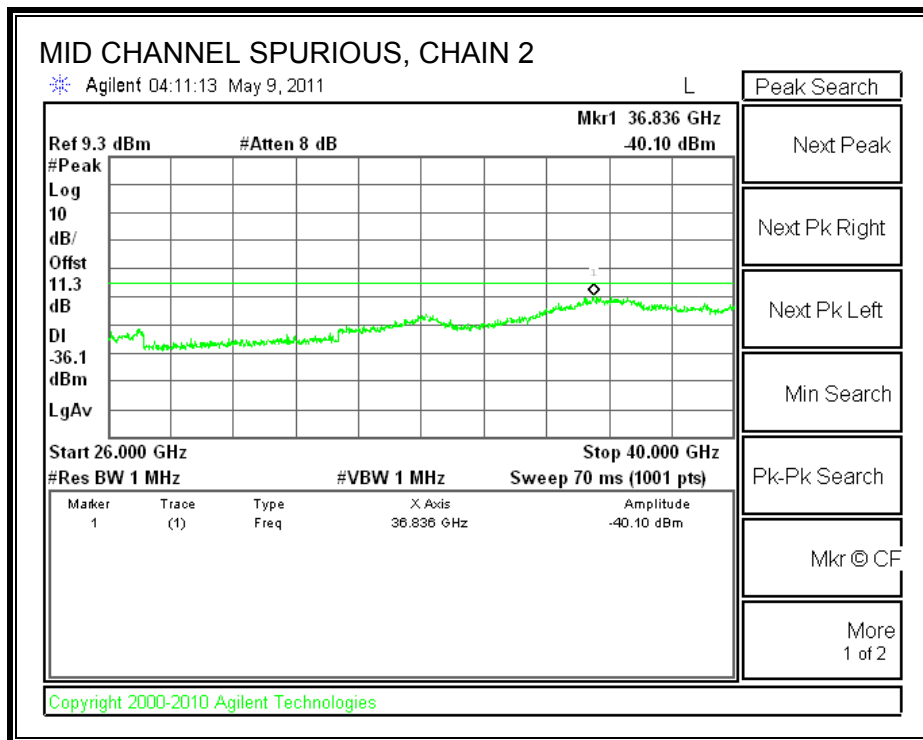
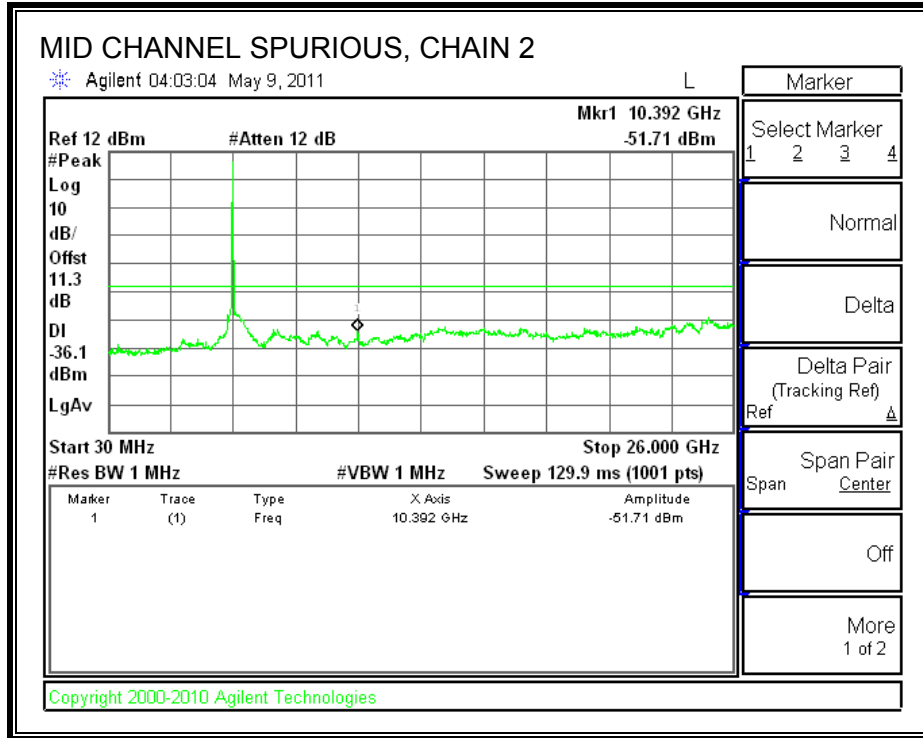


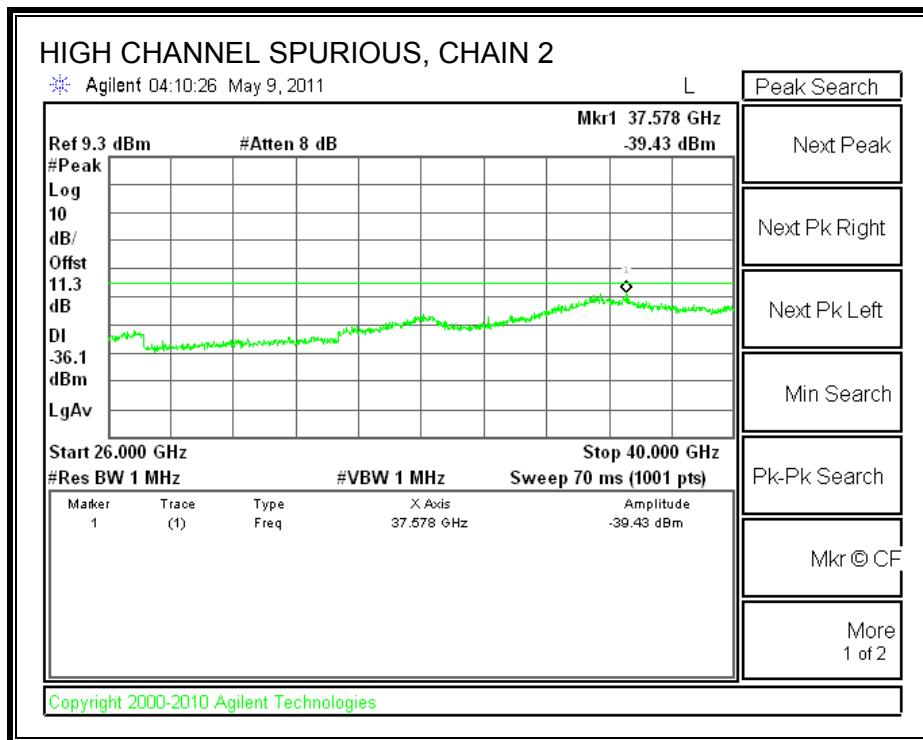
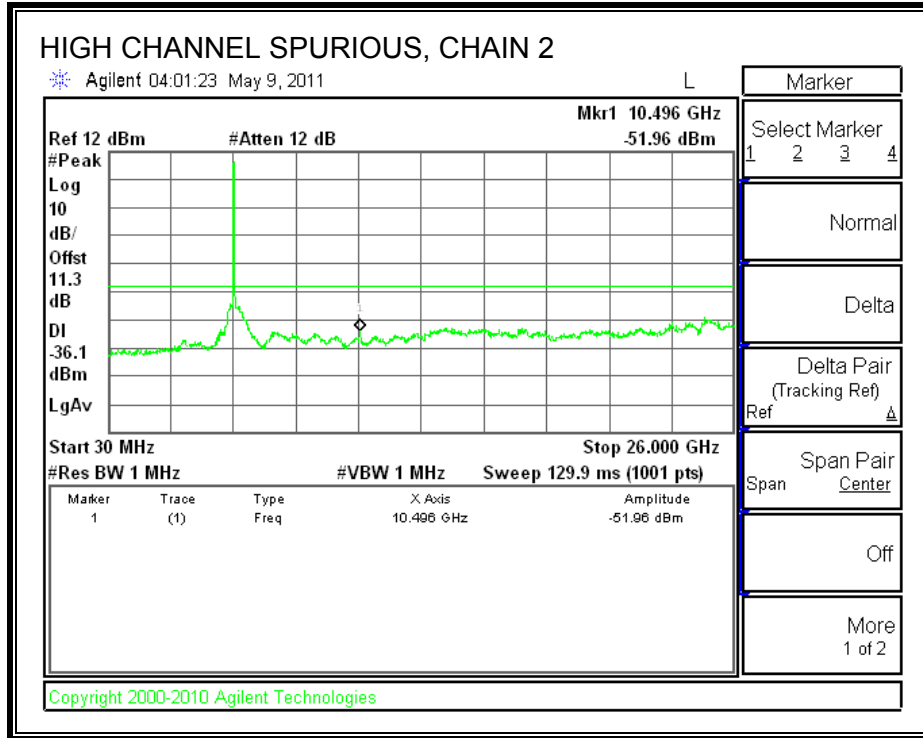




CHAIN 2 SPURIOUS EMISSIONS







7.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

7.3.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

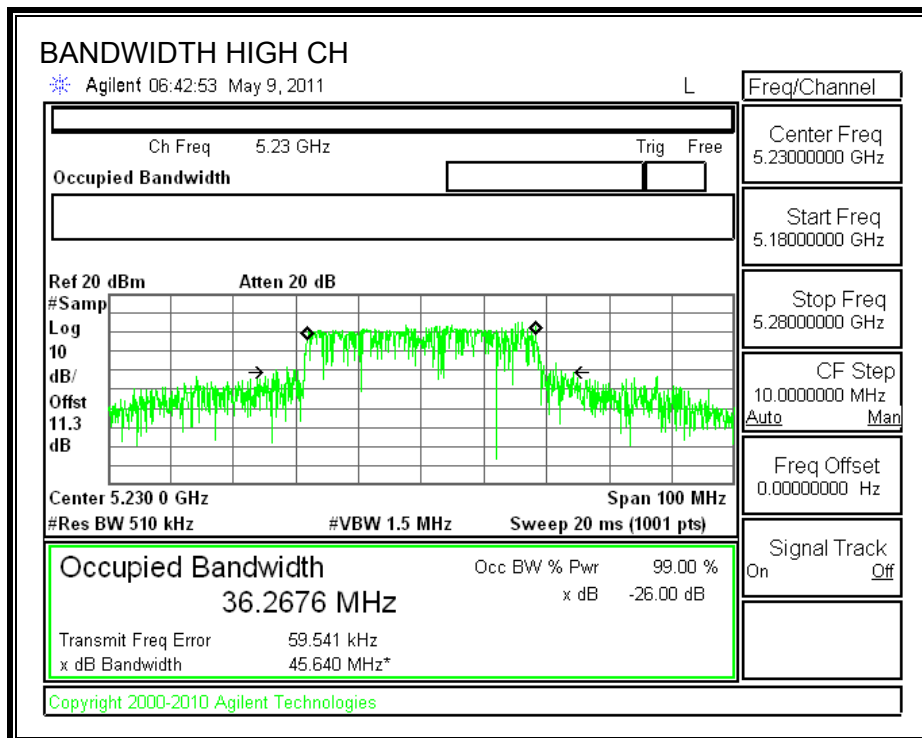
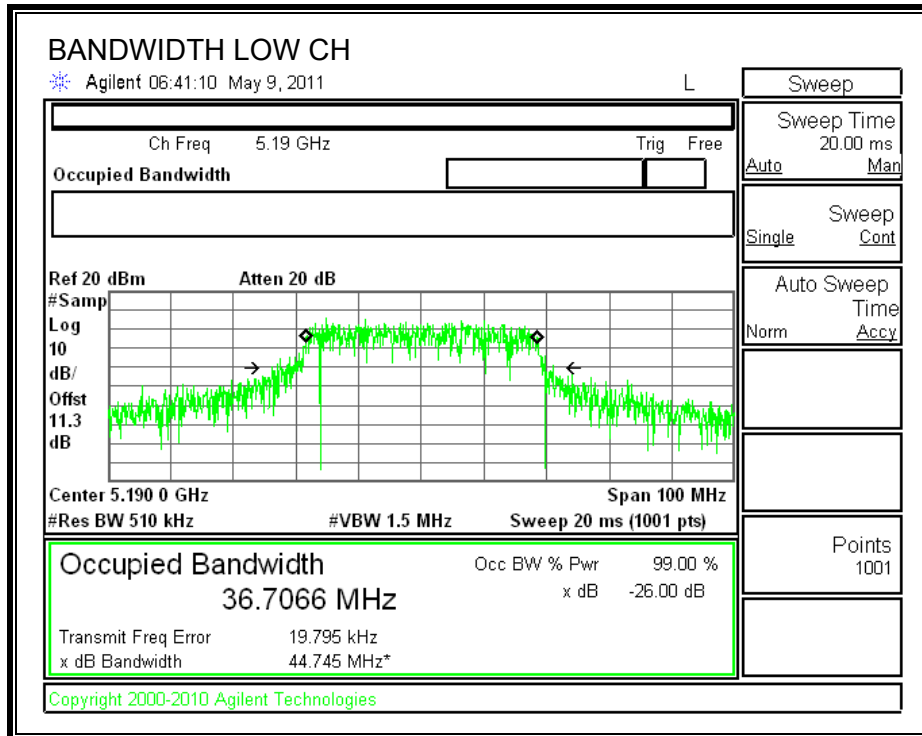
TEST PROCEDURE

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)
Low	5190	44.745
High	5230	45.640

26 dB BANDWIDTH



7.3.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (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 8.65 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

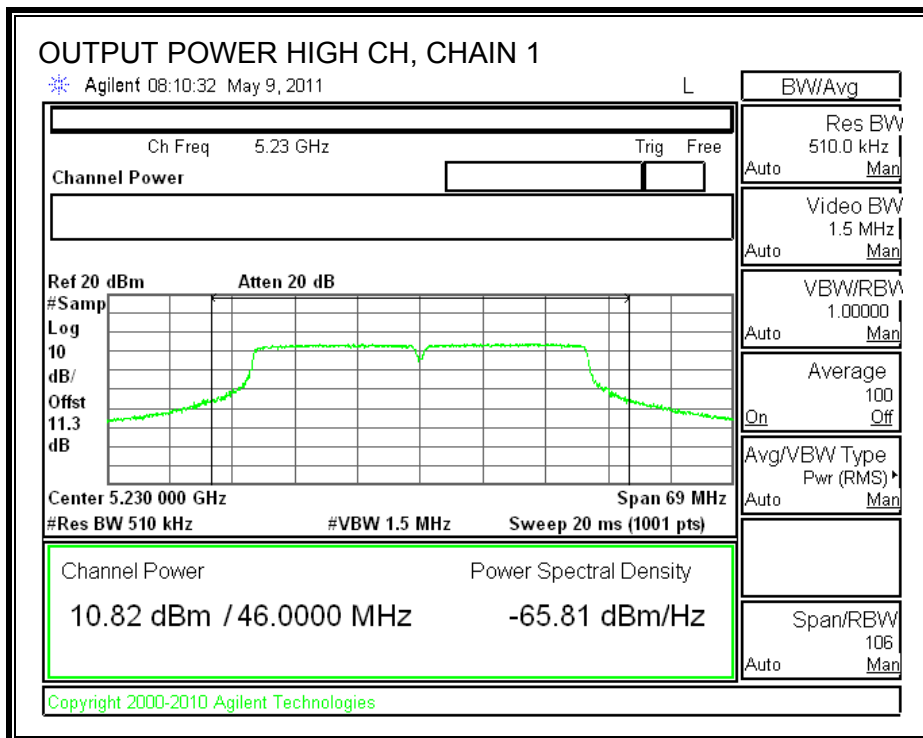
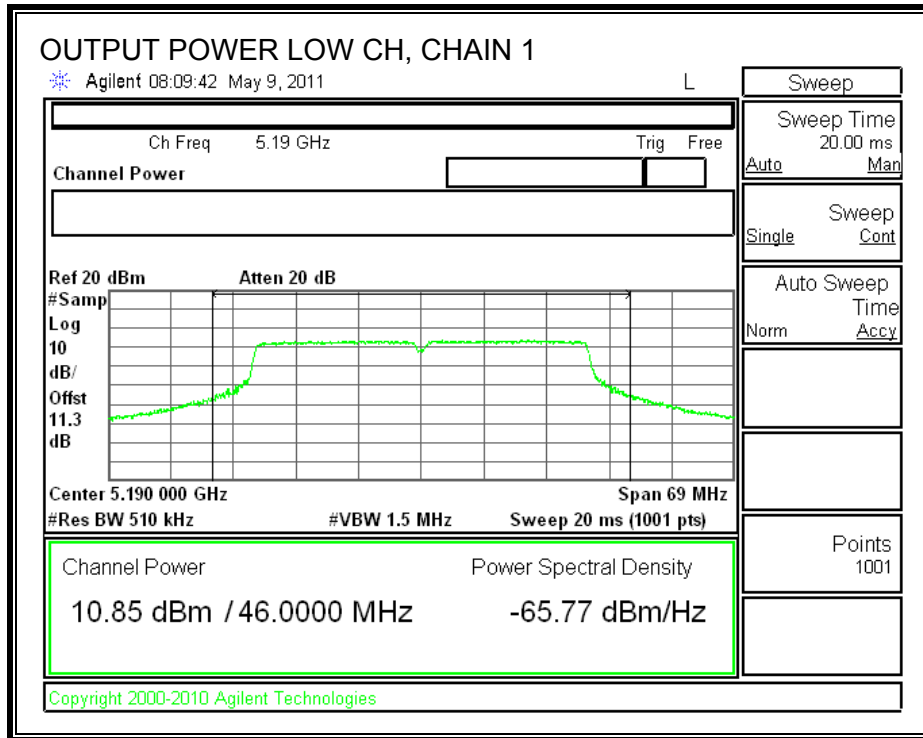
Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	44.745	20.51	8.65	14.35
High	5230	17	45.640	20.59	8.65	14.35

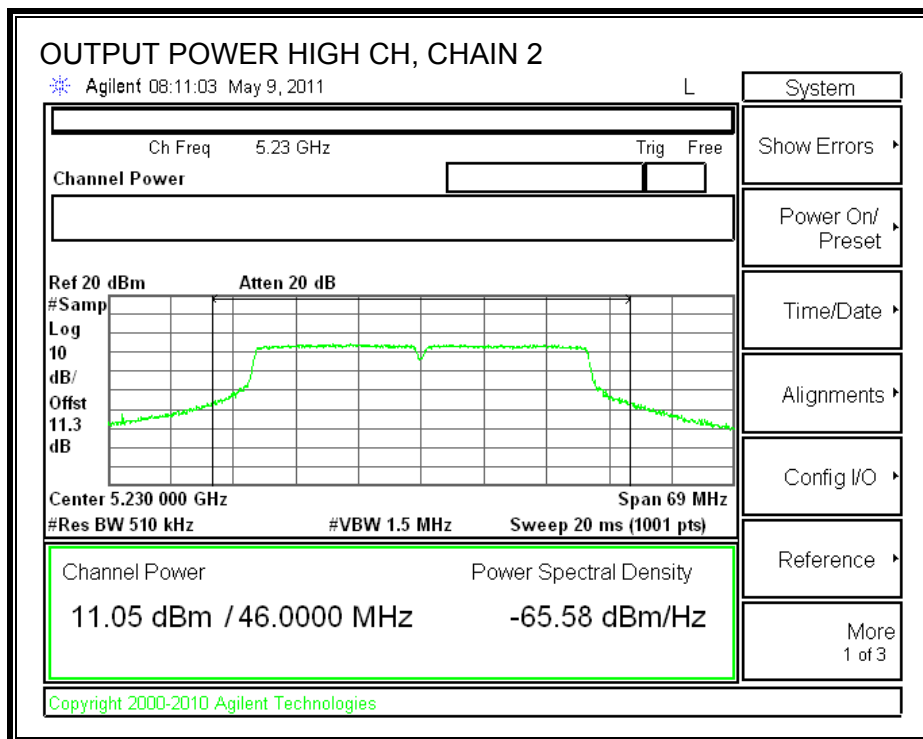
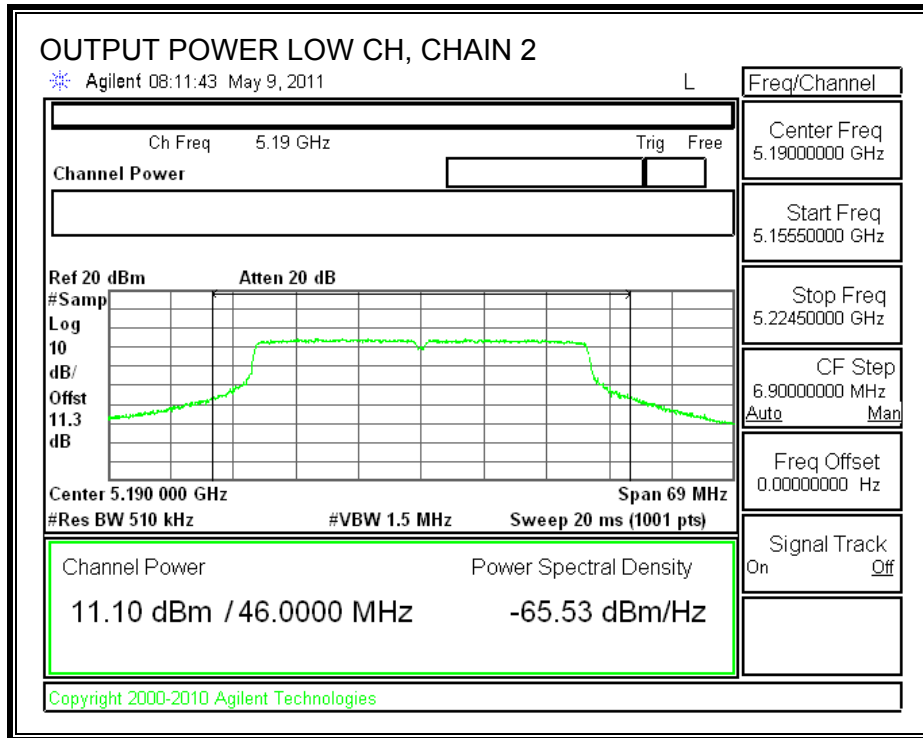
Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	10.85	11.10	13.99	14.35	-0.36
High	5230	10.82	11.05	13.95	14.35	-0.40

CHAIN 1 OUTPUT POWER



CHAIN 2 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 11.3dB (including 10 dB pad and 1.3dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5190	10.90	11.02	13.97
High	5230	10.70	11.05	13.89

7.3.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (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 8.65 dBi, therefore the limit is 1.35dBm.

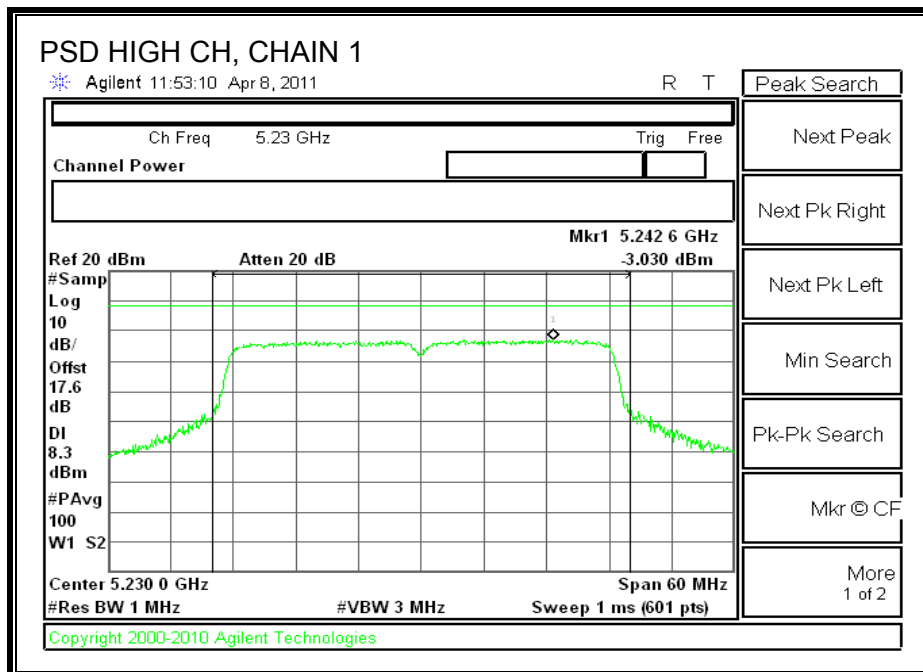
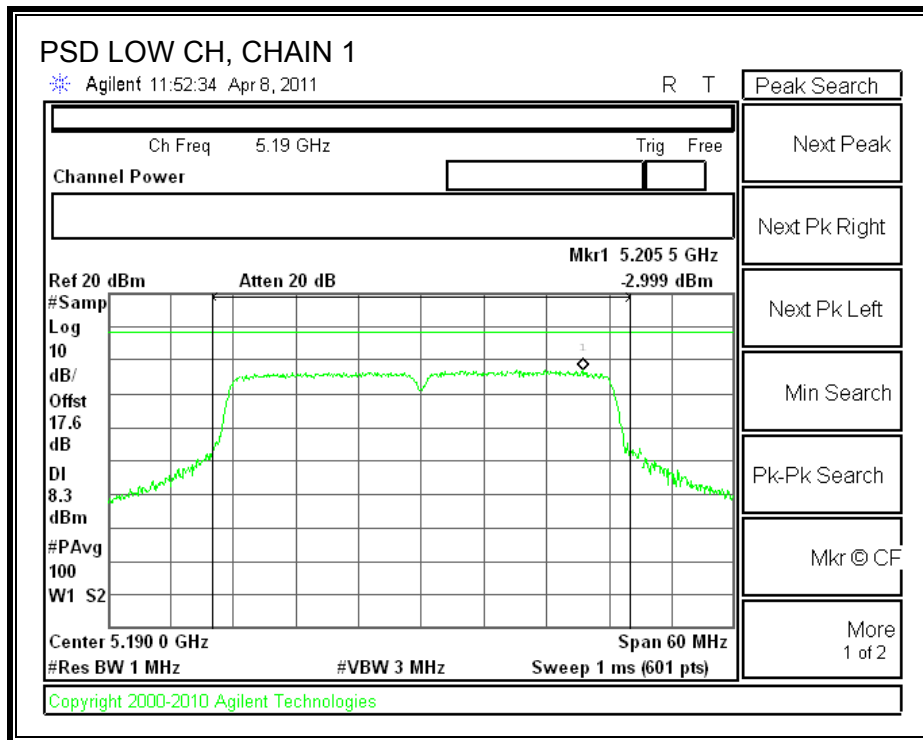
TEST PROCEDURE

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.

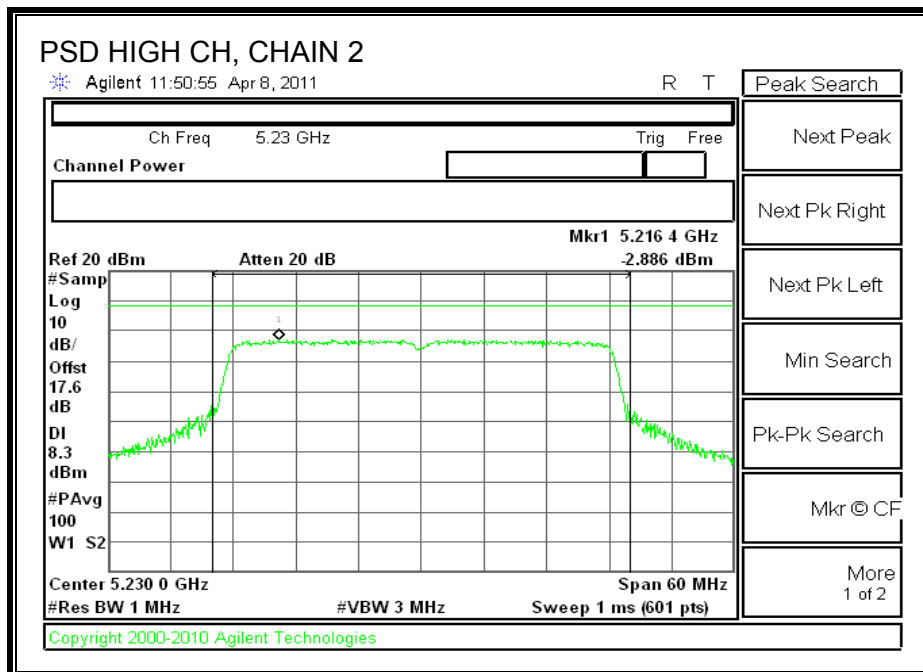
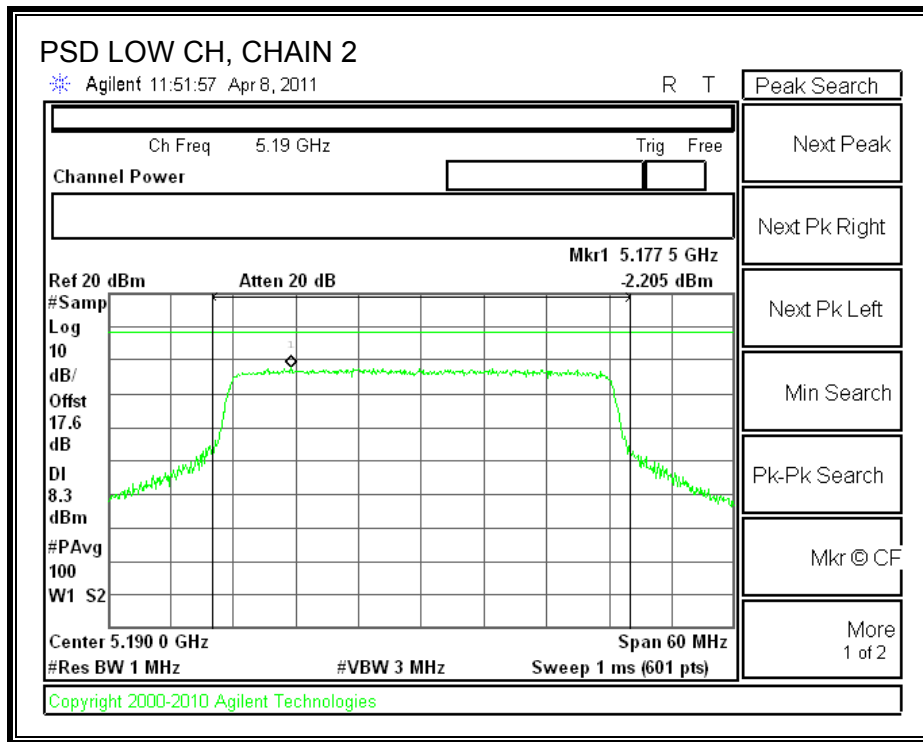
RESULTS

Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-2.999	-2.205	0.43	1.35	-0.92
High	5230	-3.03	-2.886	0.05	1.35	-1.30

CHAIN 1 POWER SPECTRAL DENSITY



CHAIN 2 POWER SPECTRAL DENSITY



7.3.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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.

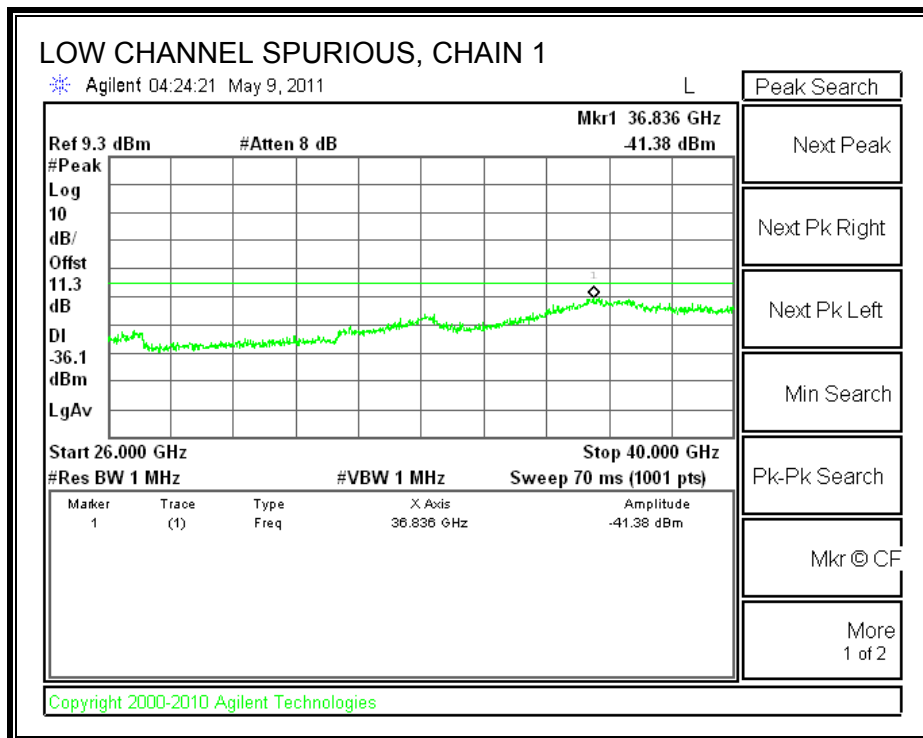
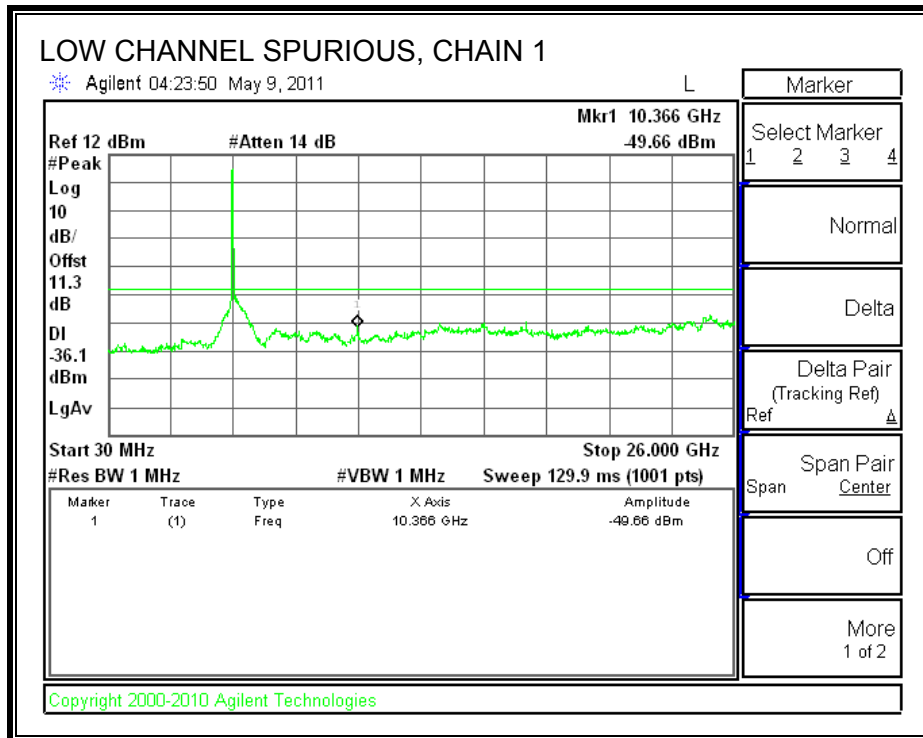
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

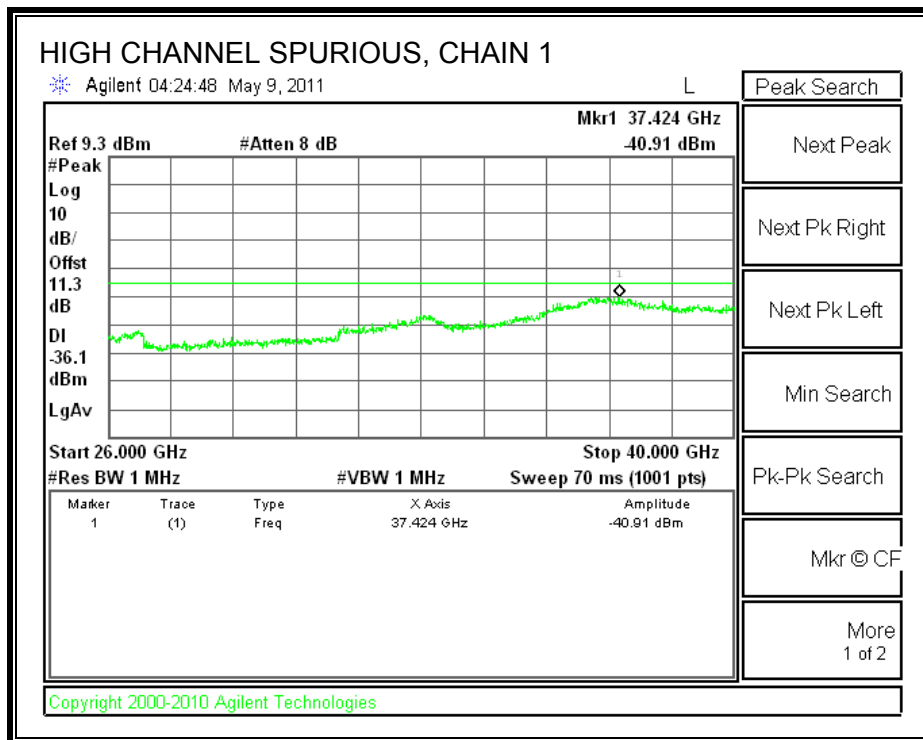
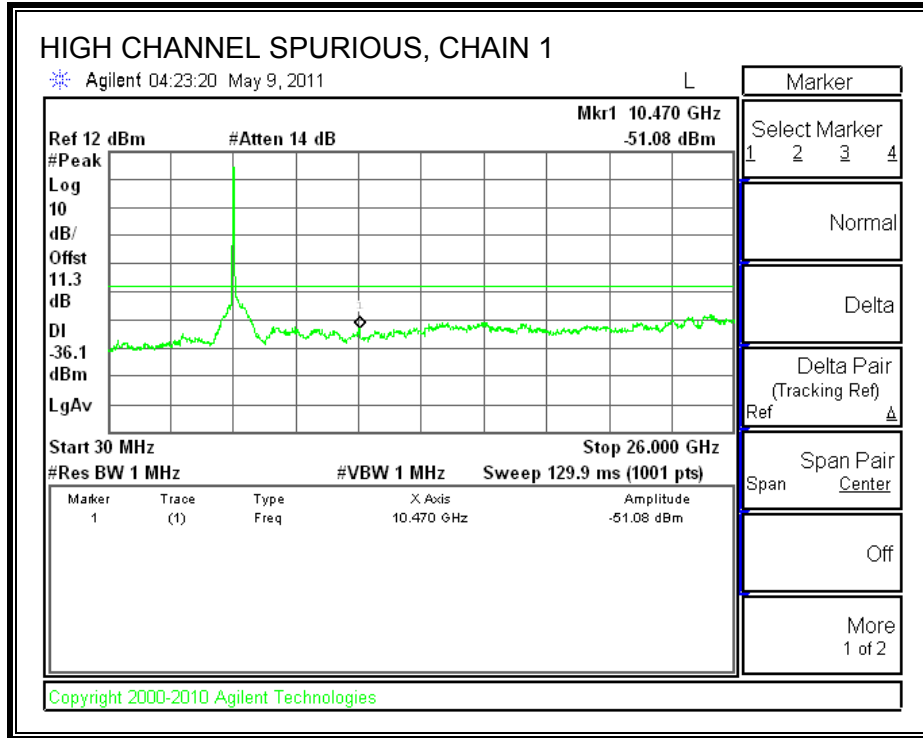
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

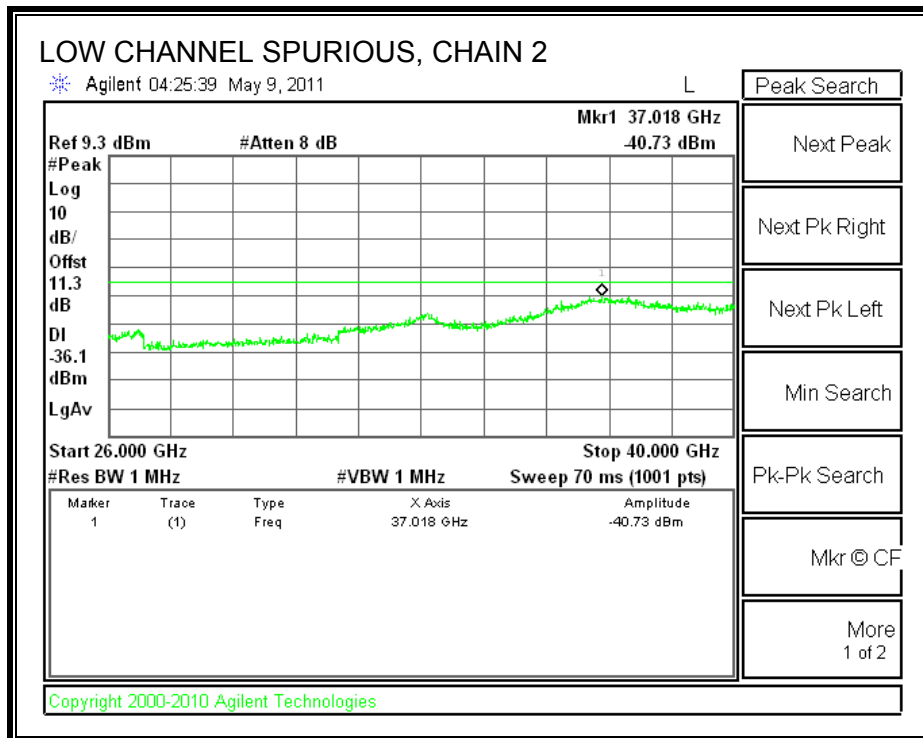
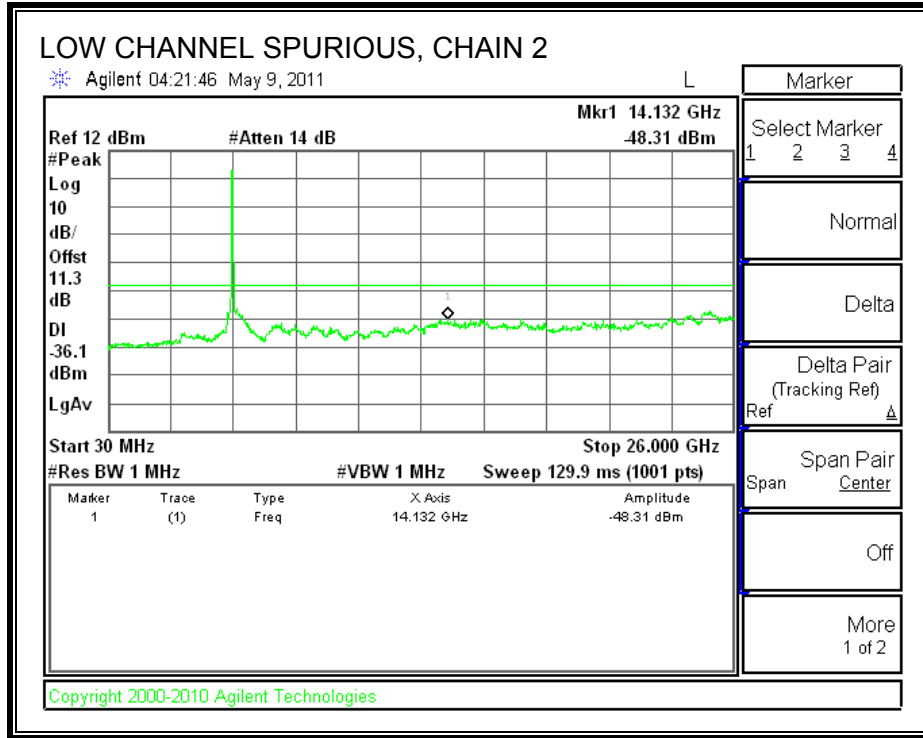
RESULTS

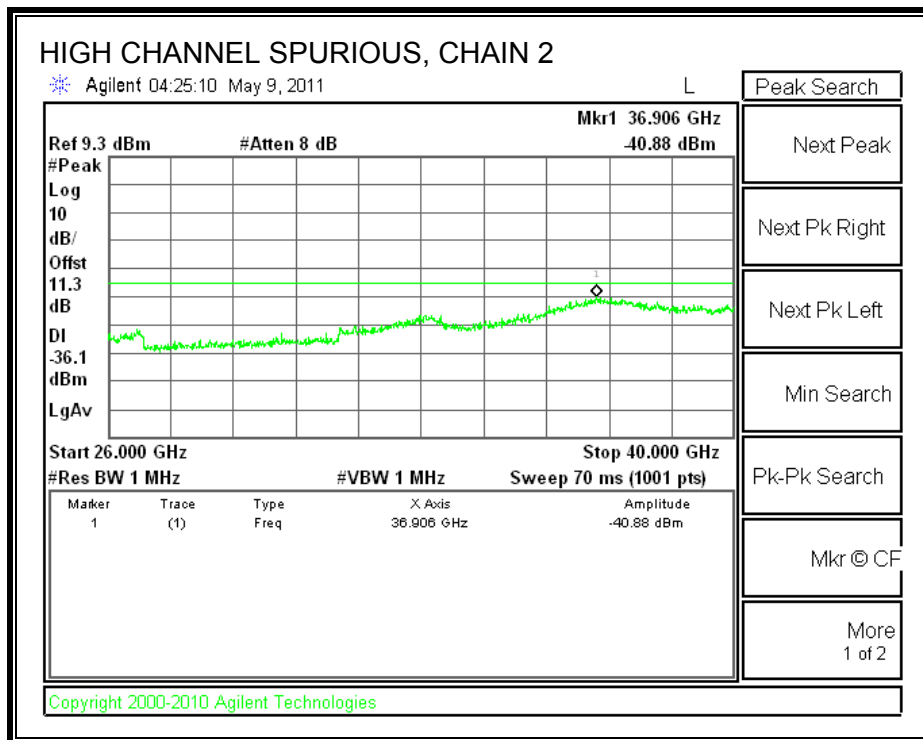
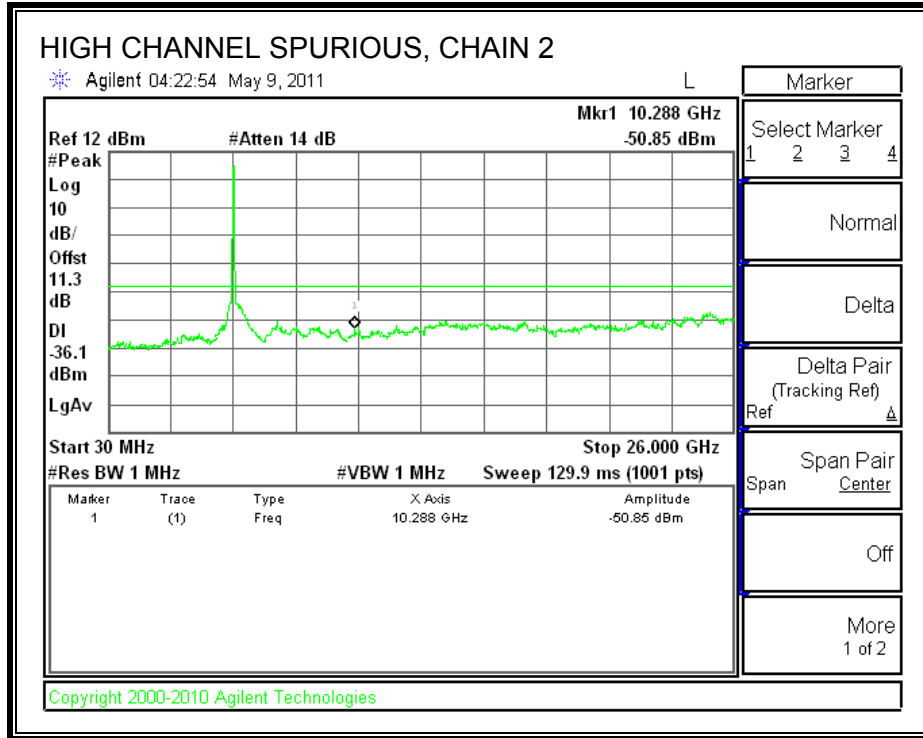
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.4. 802.11a DUAL CHAIN LEGACY MODE IN THE 5.3 GHz BAND

7.4.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

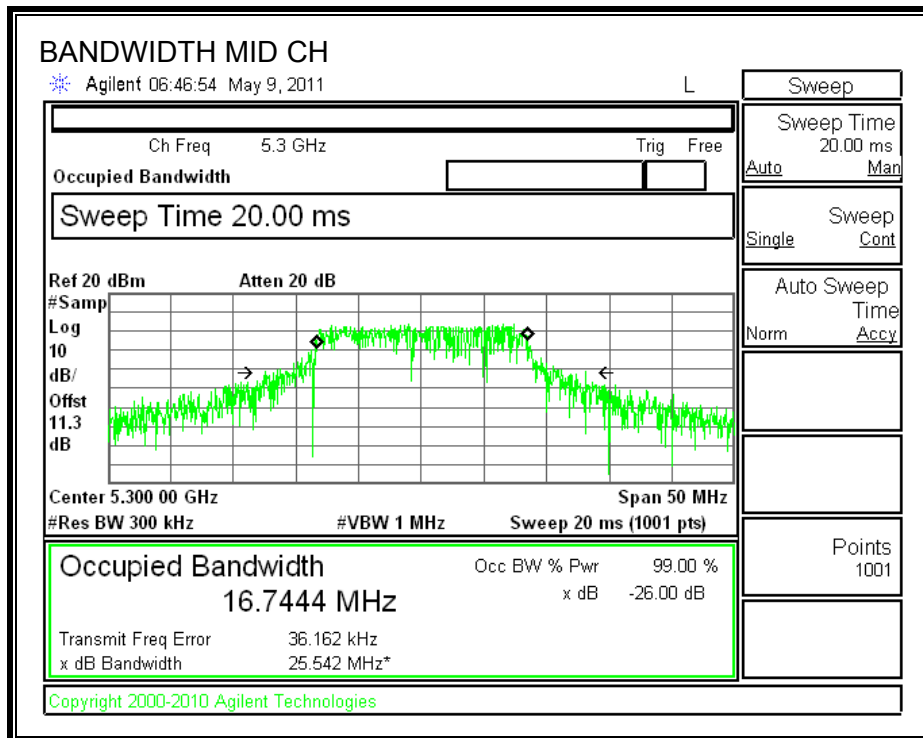
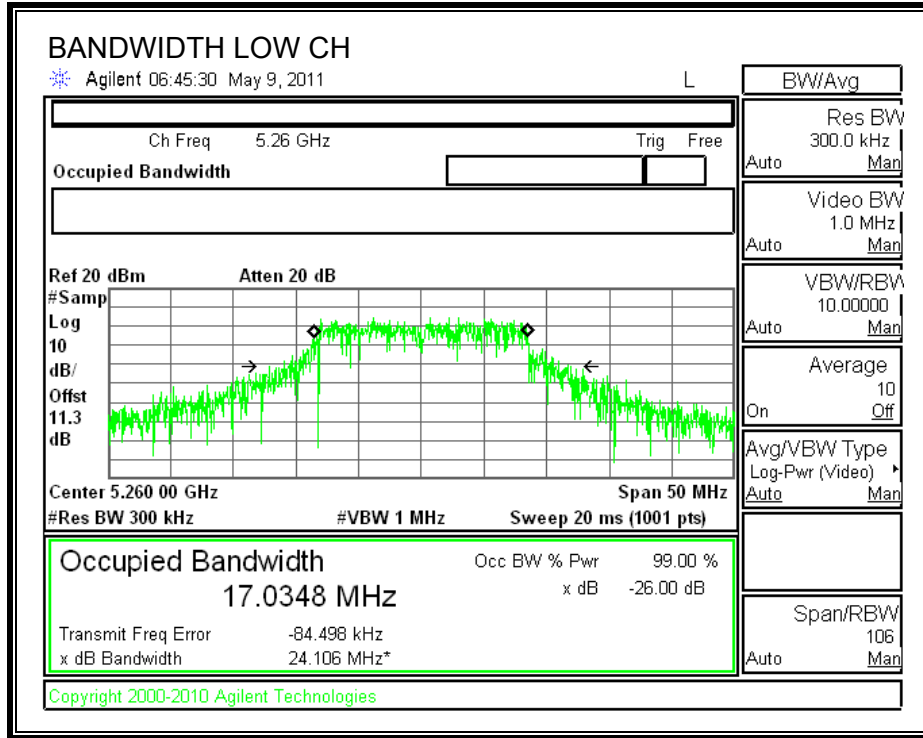
TEST PROCEDURE

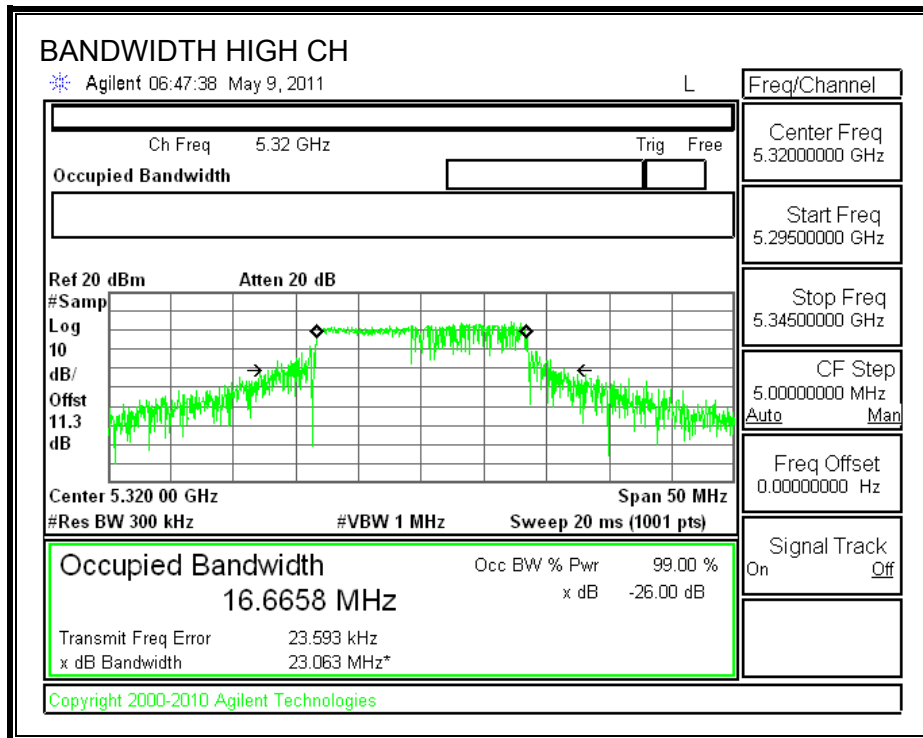
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	24.106
Middle	5300	25.542
High	5320	23.063

26 dB BANDWIDTH





7.4.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.21	6.07	8.67

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.

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

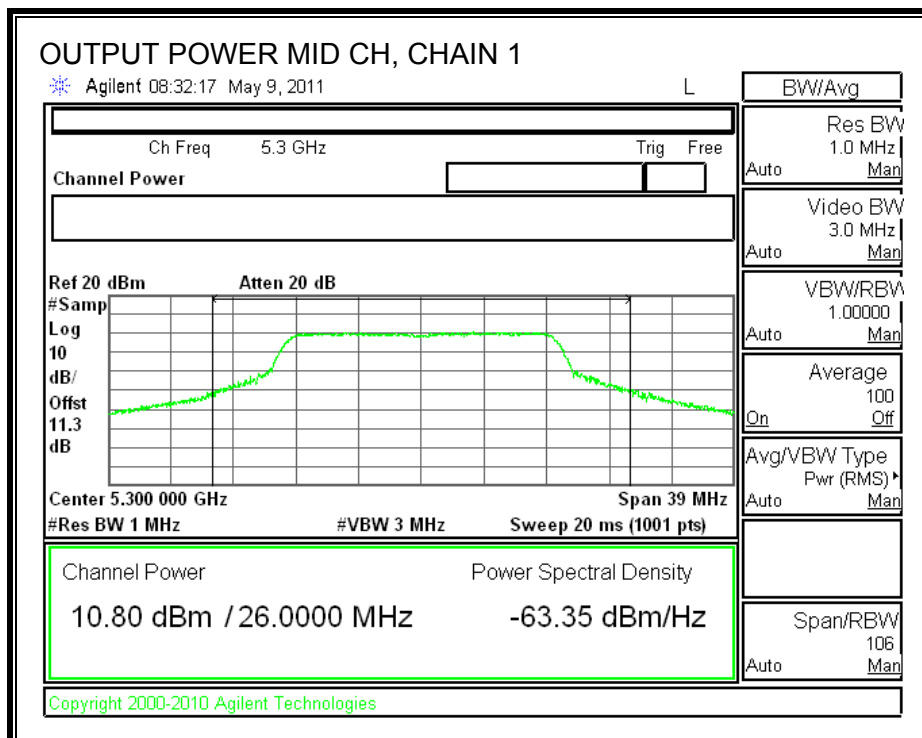
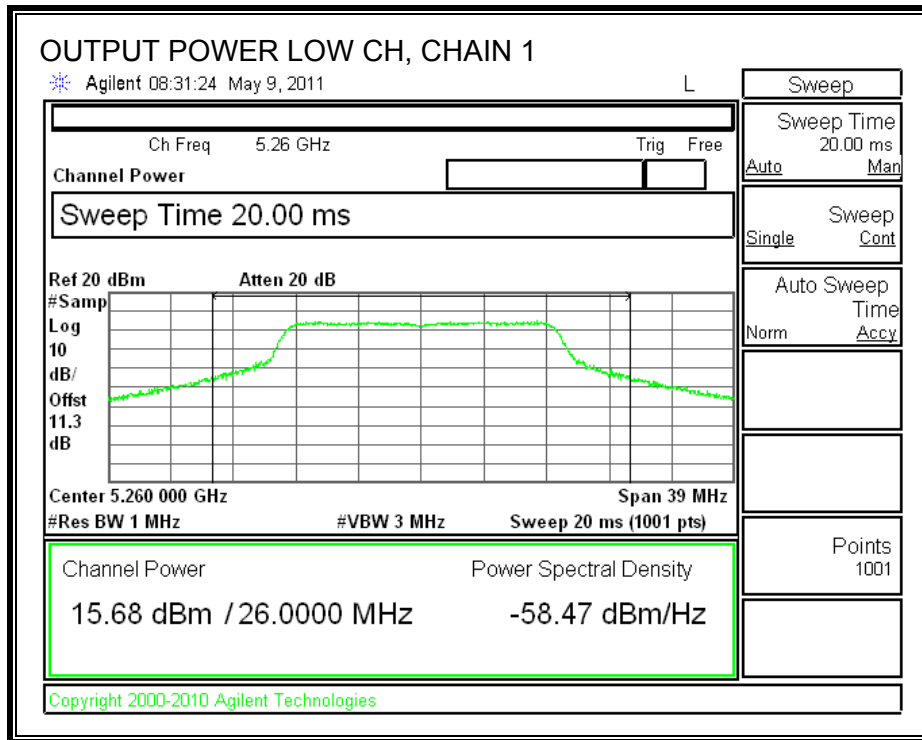
Limit

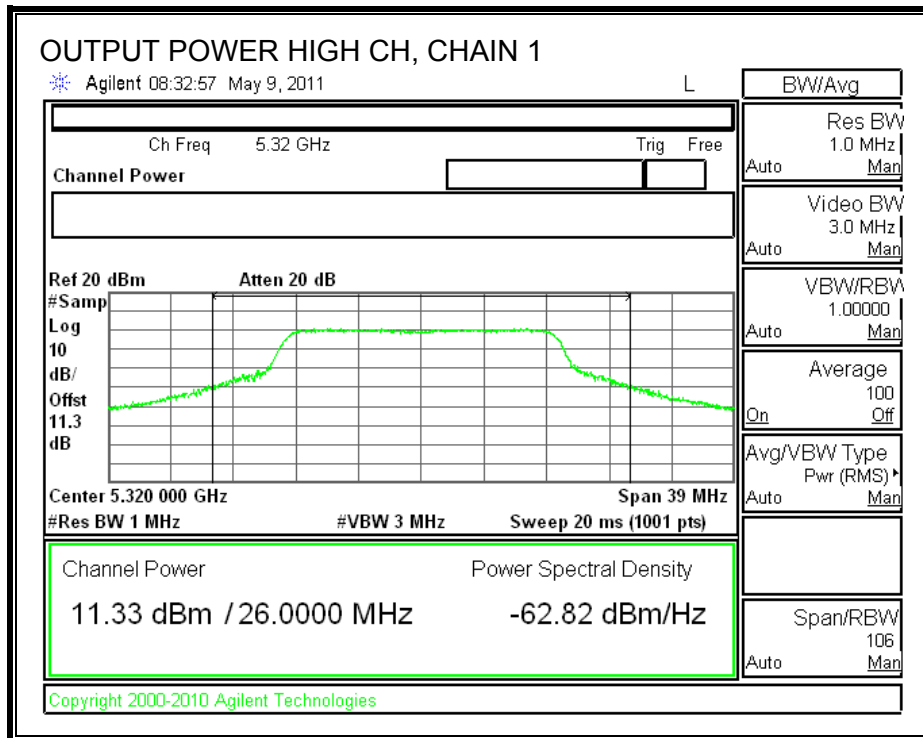
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Effective Ant Gain (dBi)	Limit (dBm)
Low	5260	24	24.106	24.82	8.67	21.33
Mid	5300	24	25.542	25.07	8.67	21.33
High	5320	24	23.063	24.63	8.67	21.33

Individual Chain Results

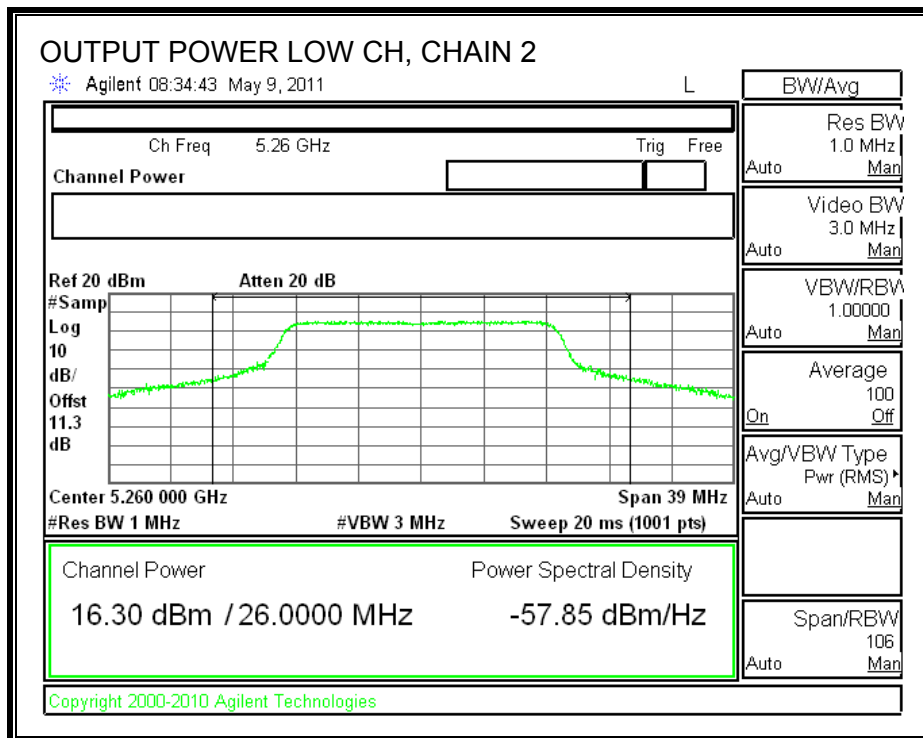
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	15.68	16.30	19.01	21.33	-2.32
Mid	5300	10.80	11.11	13.97	21.33	-7.36
High	5320	11.33	11.13	14.24	21.33	-7.09

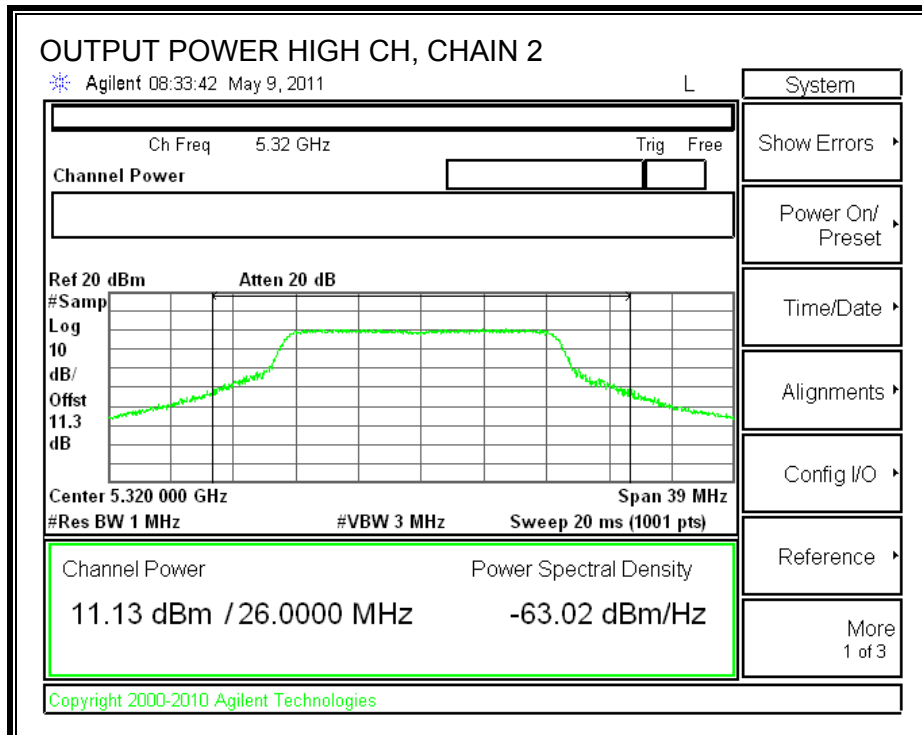
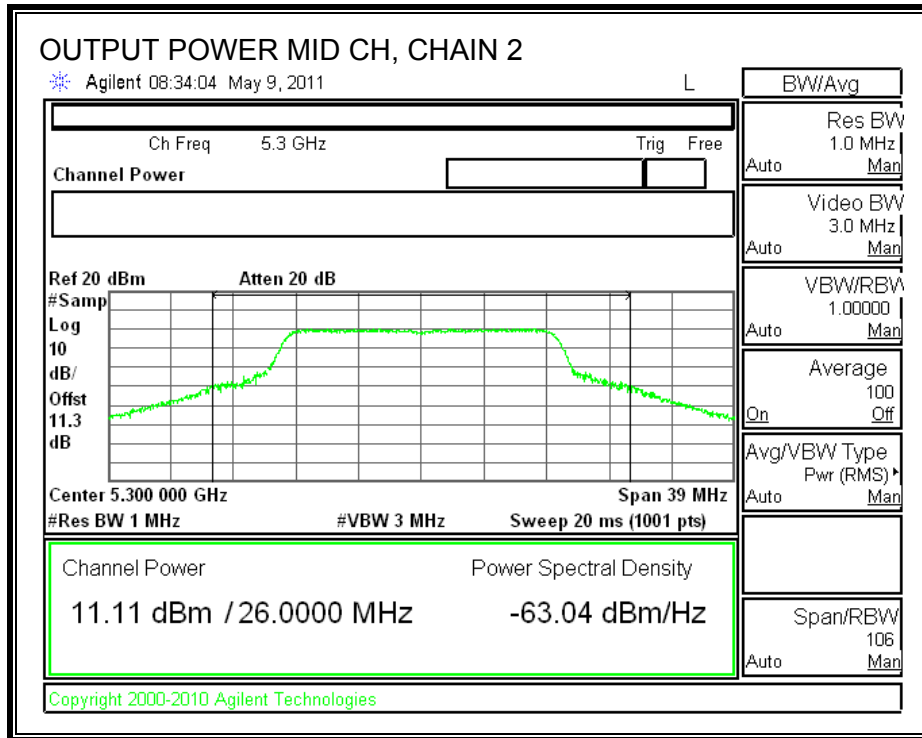
CHAIN 1 OUTPUT POWER





CHAIN 2 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 11.3dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5260	15.60	16.10	18.87
Middle	5300	10.78	10.70	13.75
High	5320	11.10	10.80	13.96

7.4.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.21	6.07	8.67

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 effective antenna gain is 8.67 dBi, therefore the limit is 8.33 dBm.

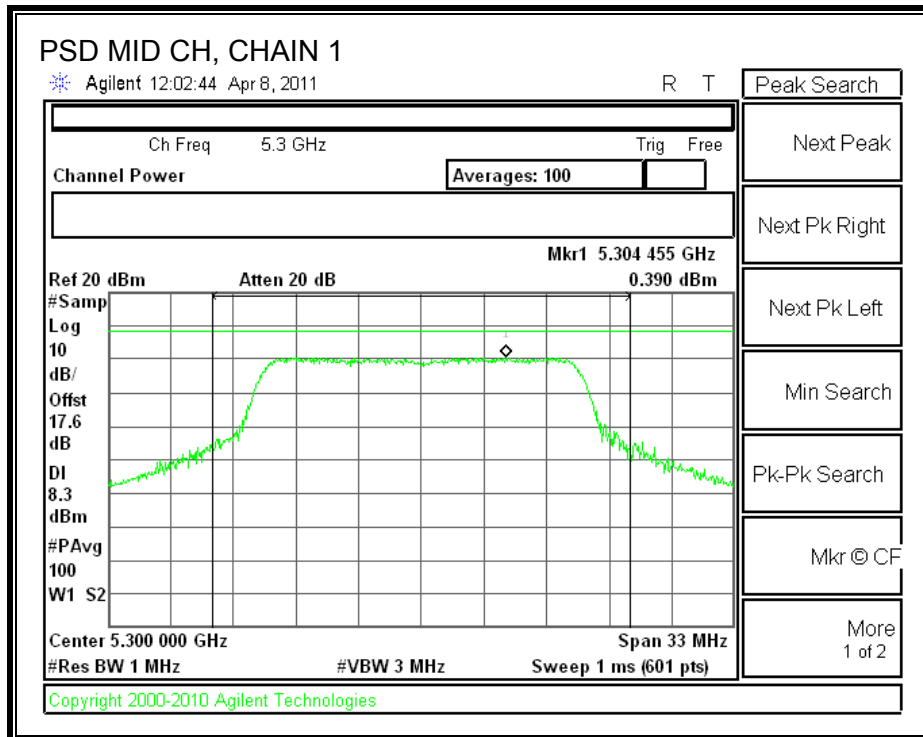
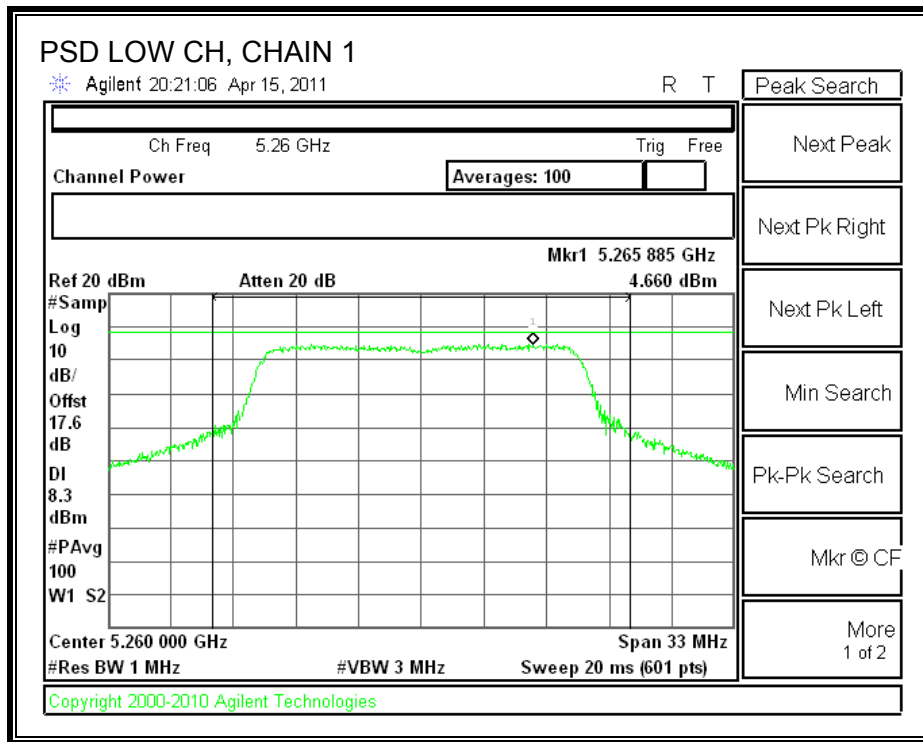
TEST PROCEDURE

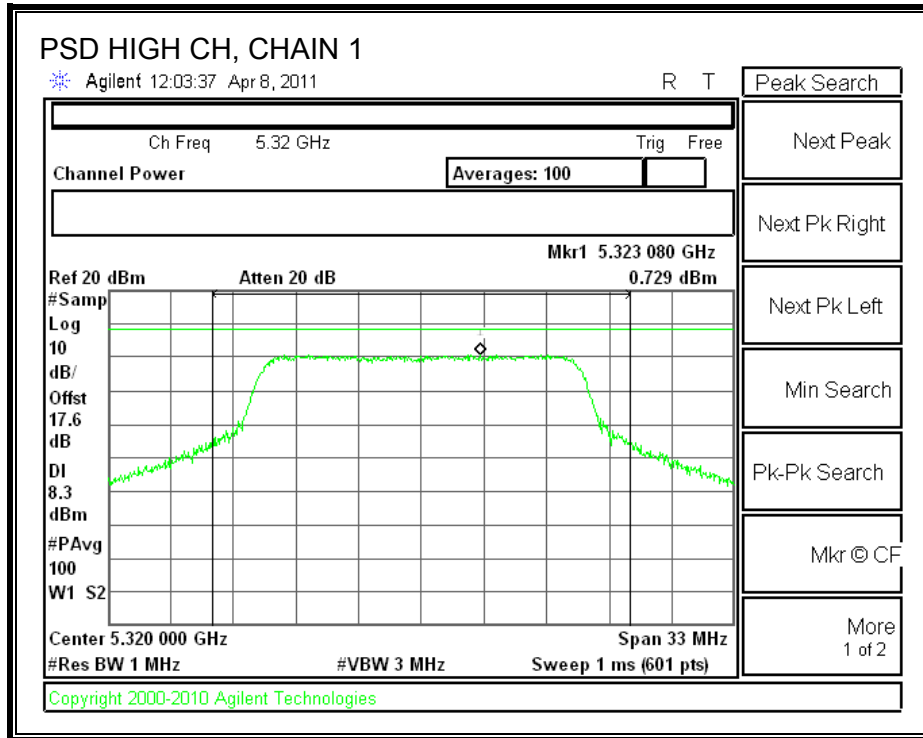
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

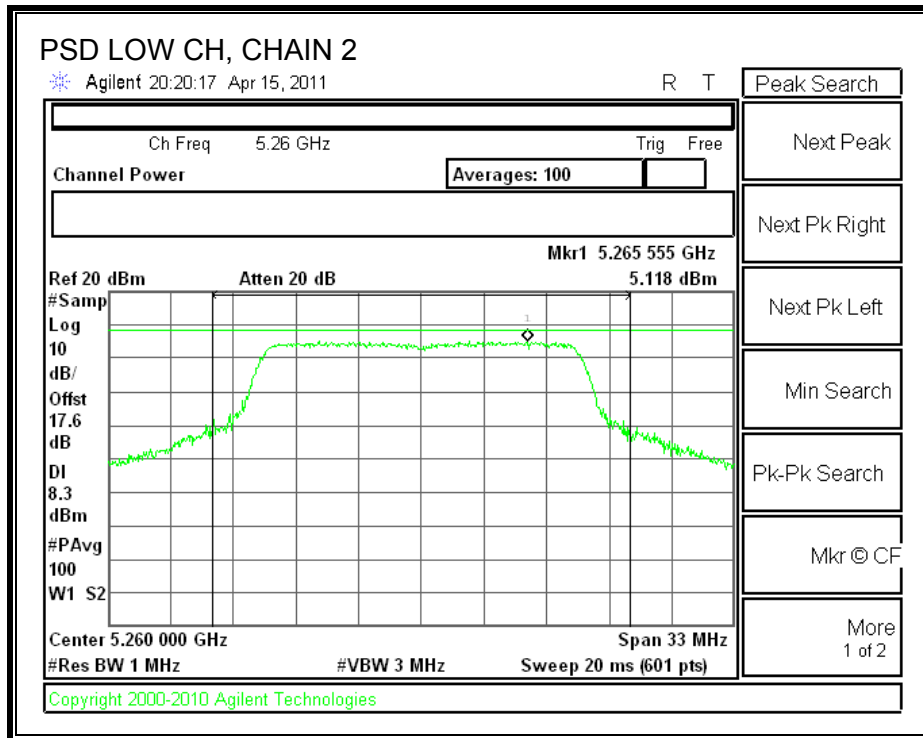
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5260	4.66	5.118	7.91	8.33	-0.42
Middle	5300	0.39	1.284	3.87	8.33	-4.46
High	5320	0.729	1.339	4.06	8.33	-4.27

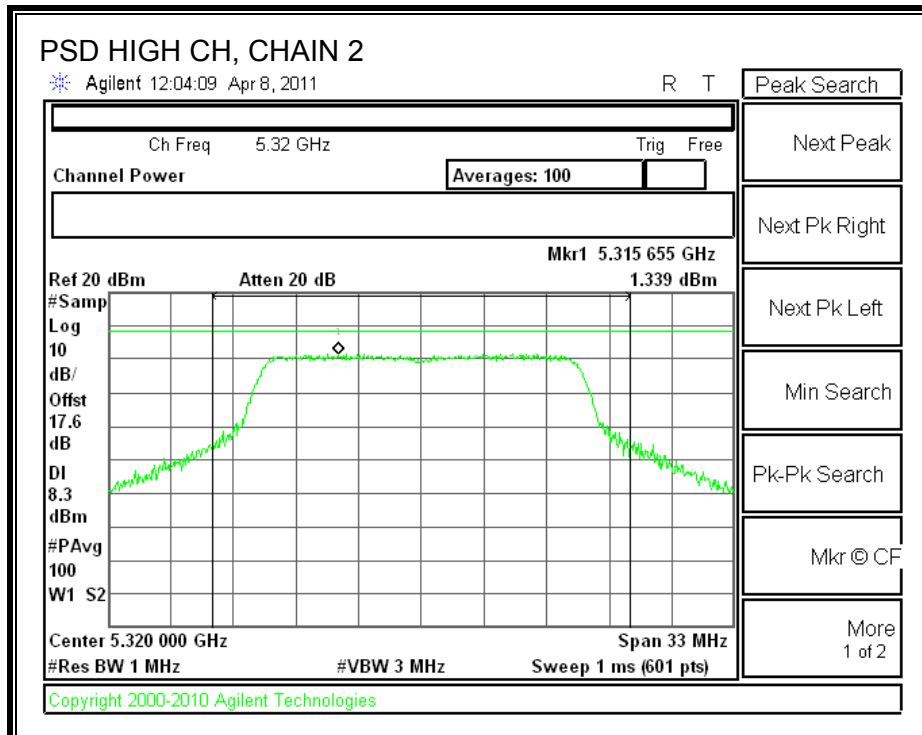
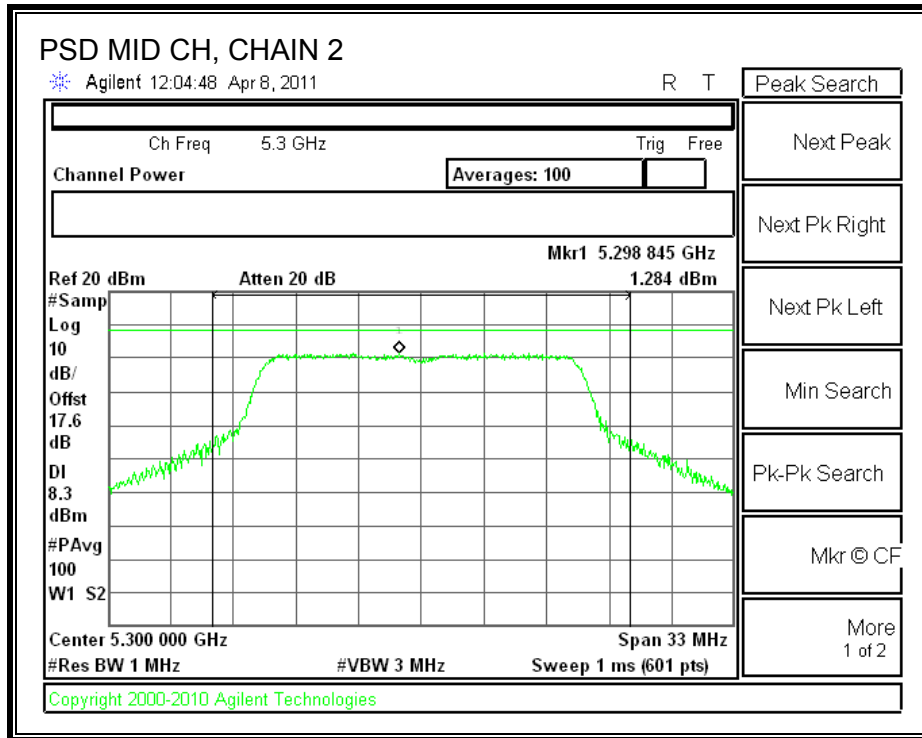
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.4.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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.

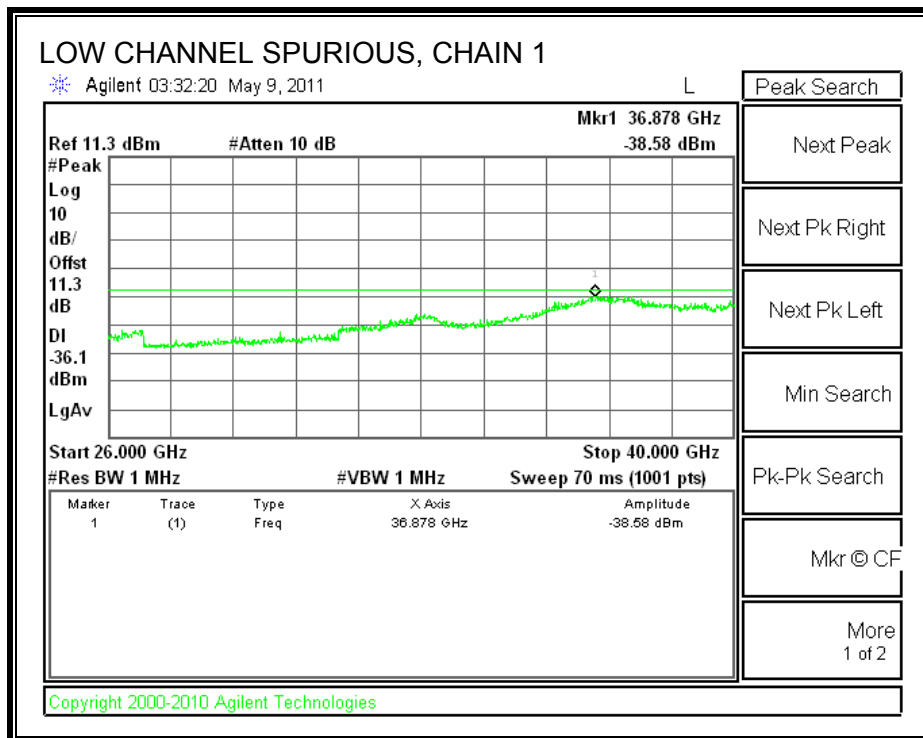
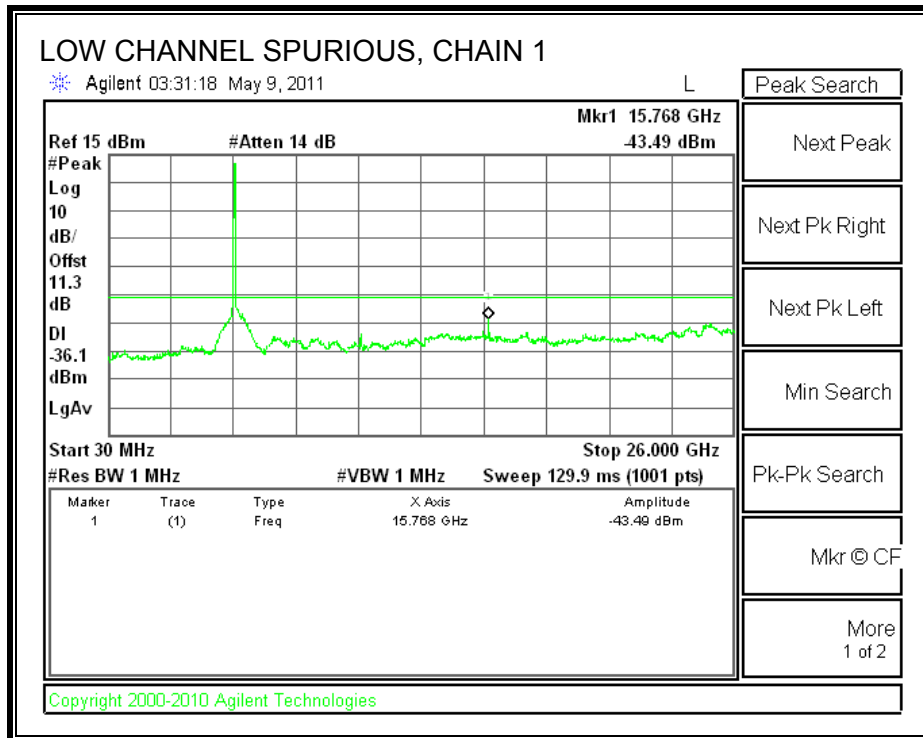
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

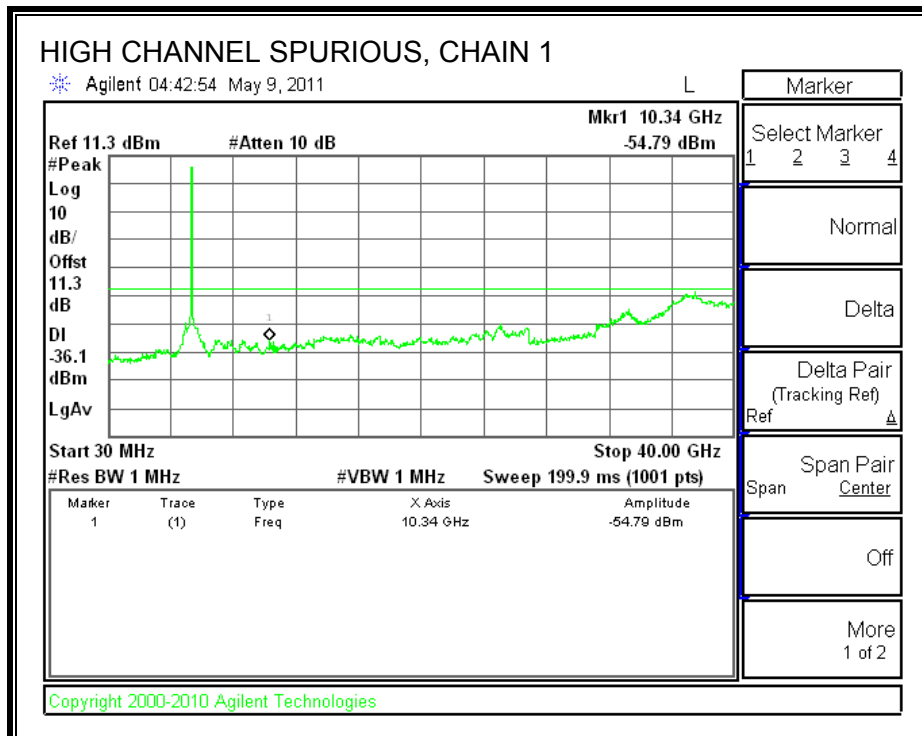
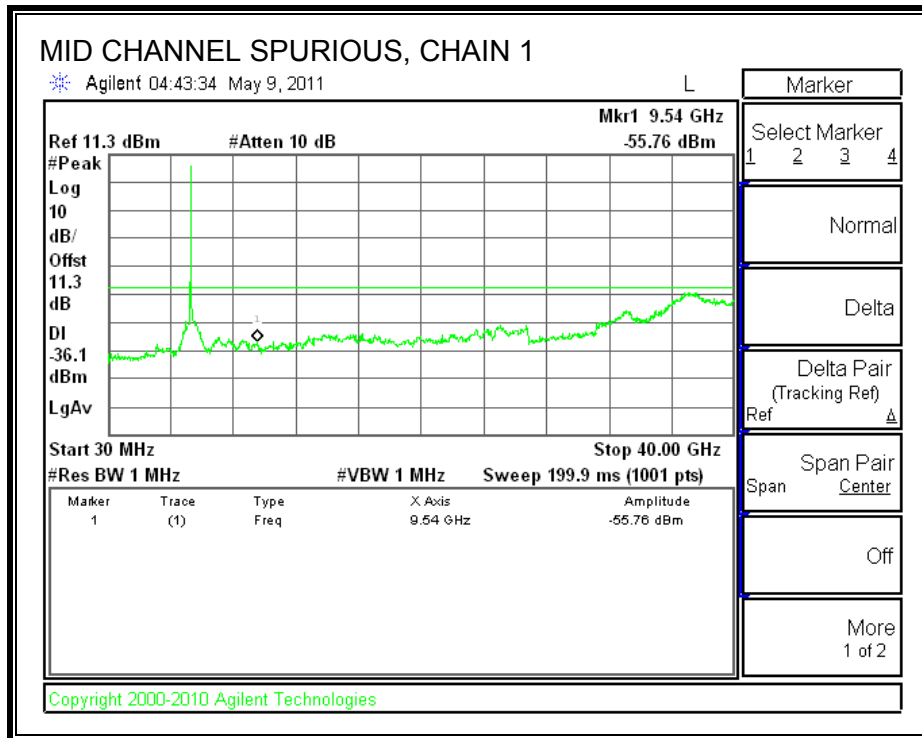
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

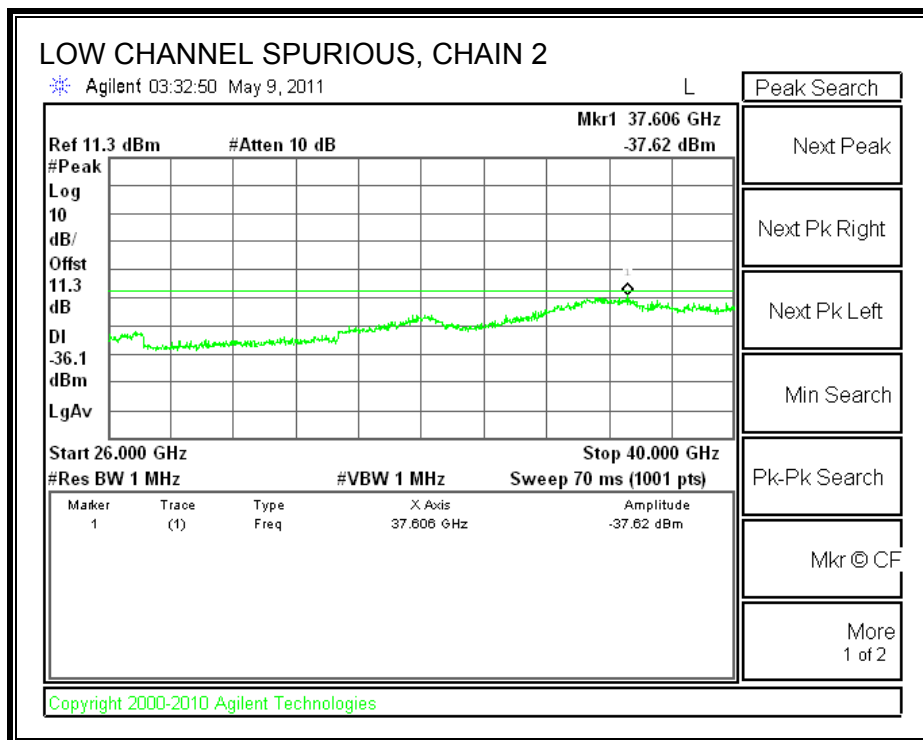
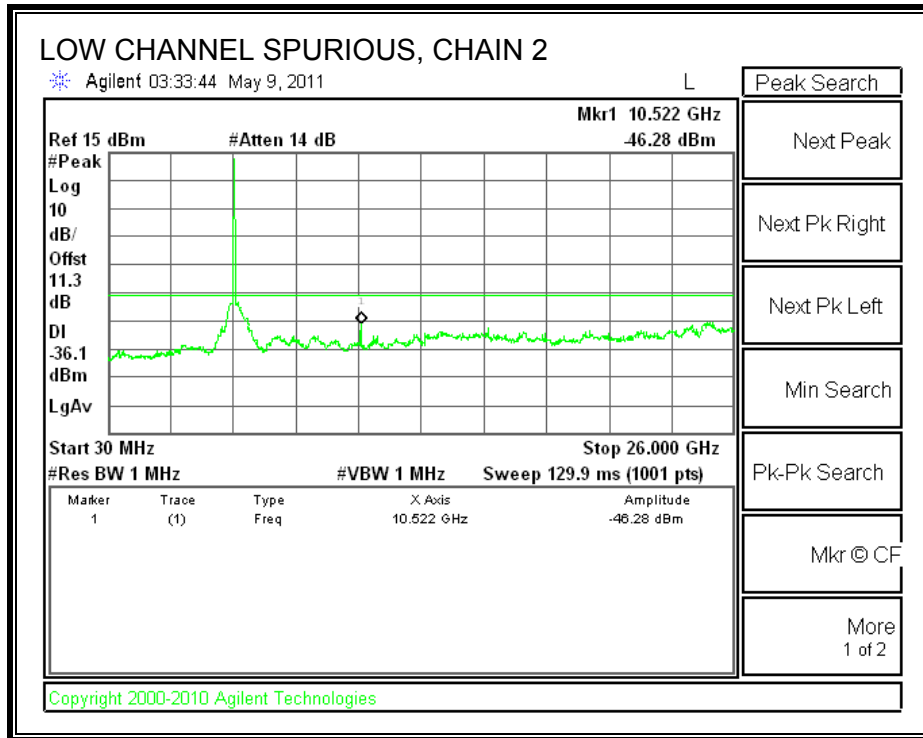
RESULTS

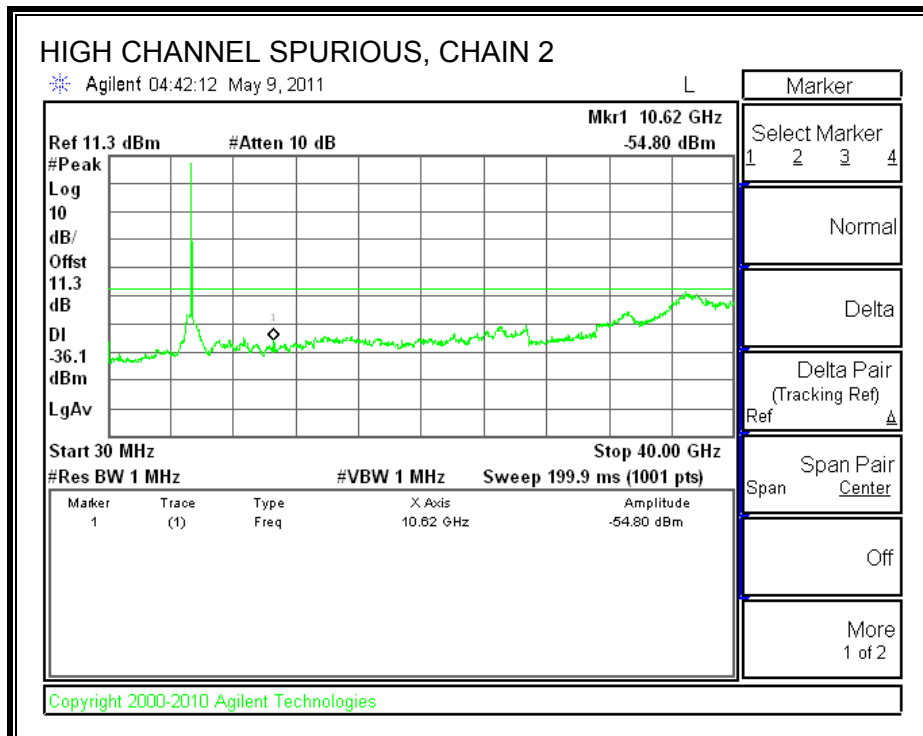
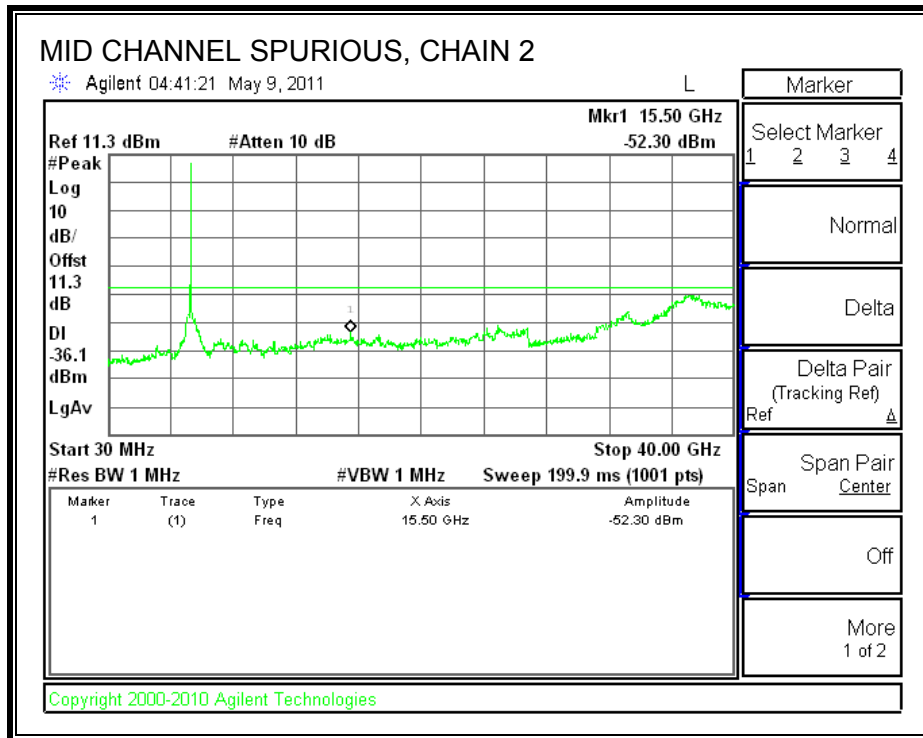
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

7.5.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

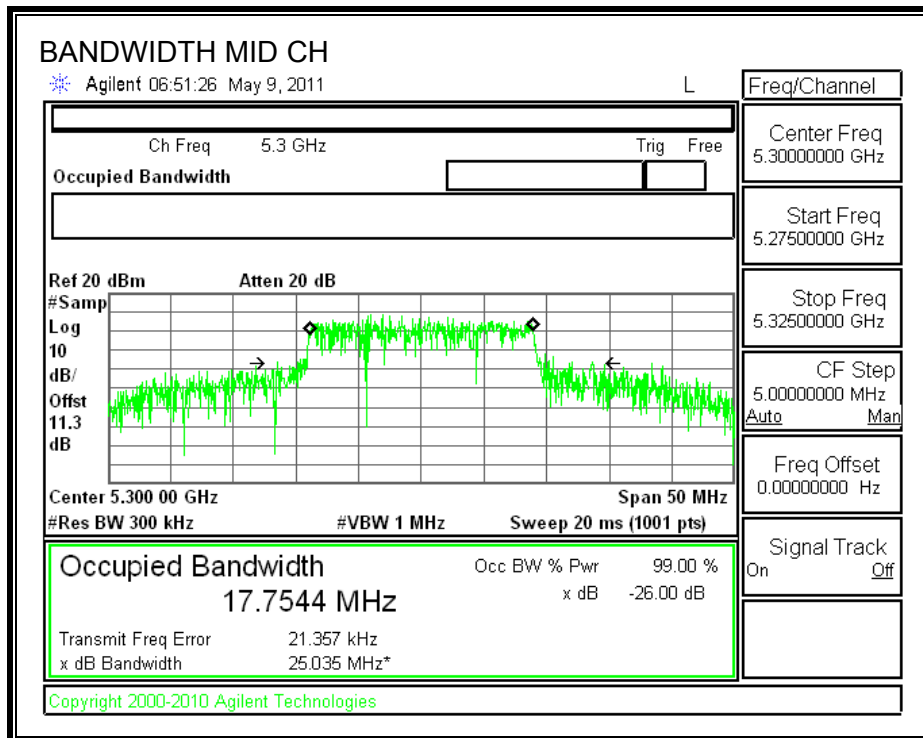
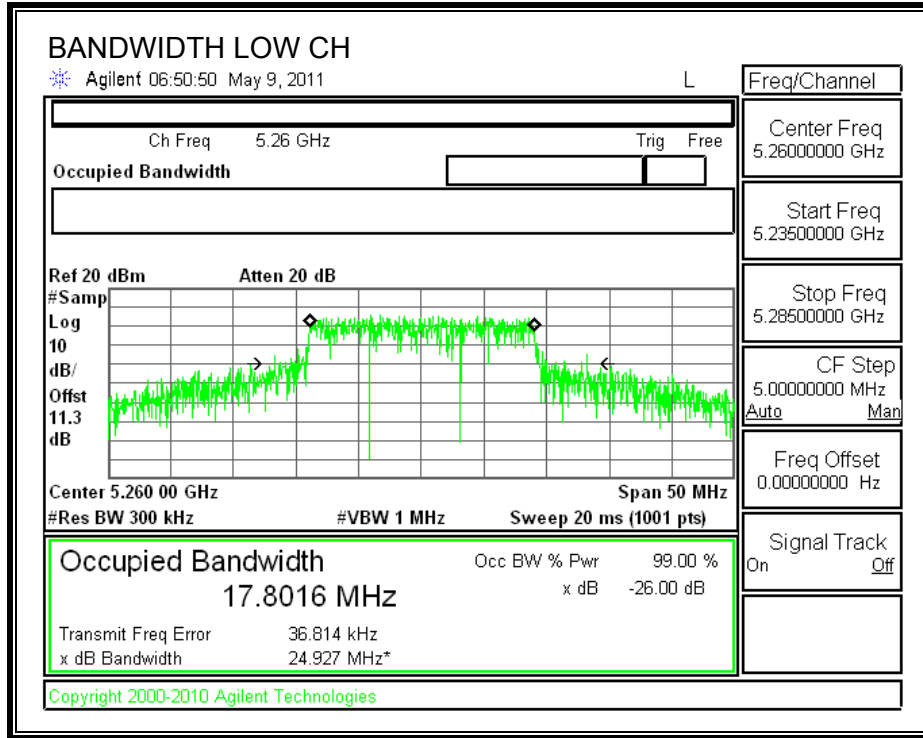
TEST PROCEDURE

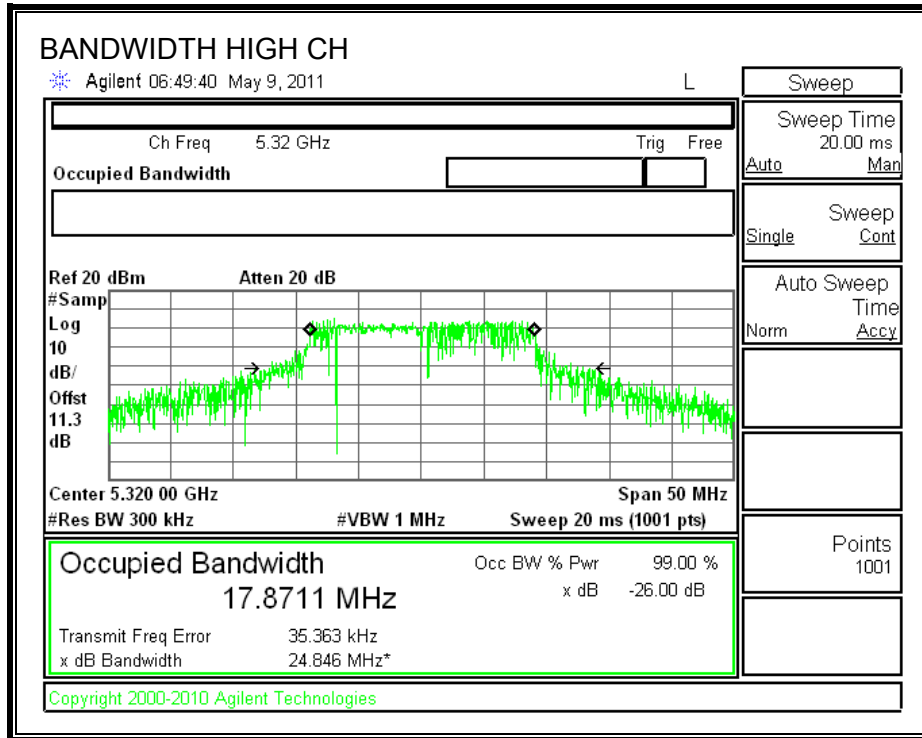
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	24.927
Middle	5300	25.035
High	5320	24.846

26 dB BANDWIDTH





7.5.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (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 $11 \text{ dBm} + 10 \log B$, 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.

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

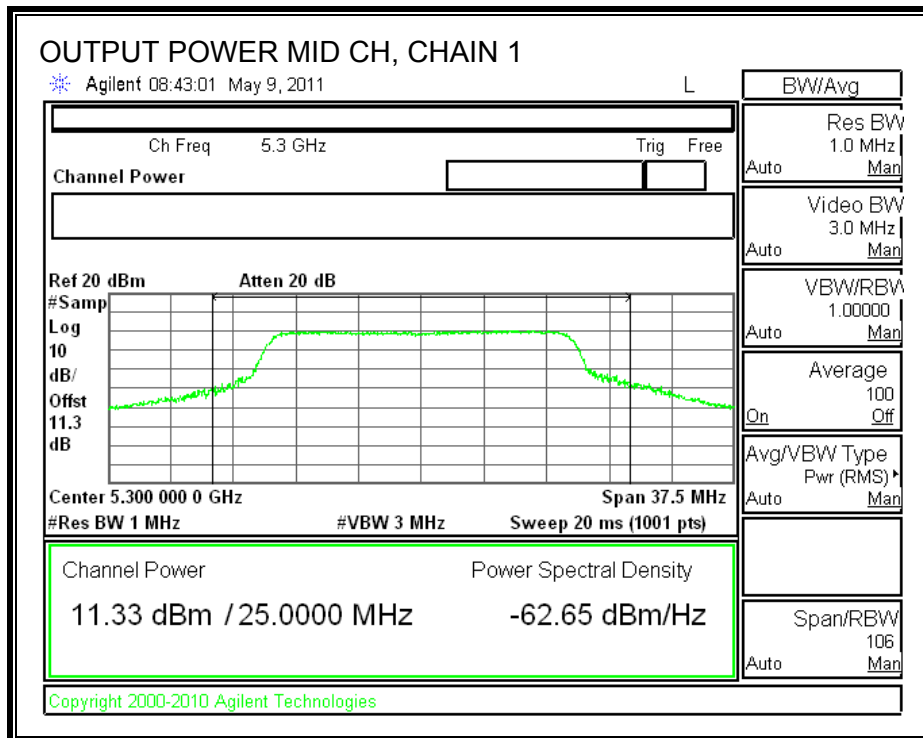
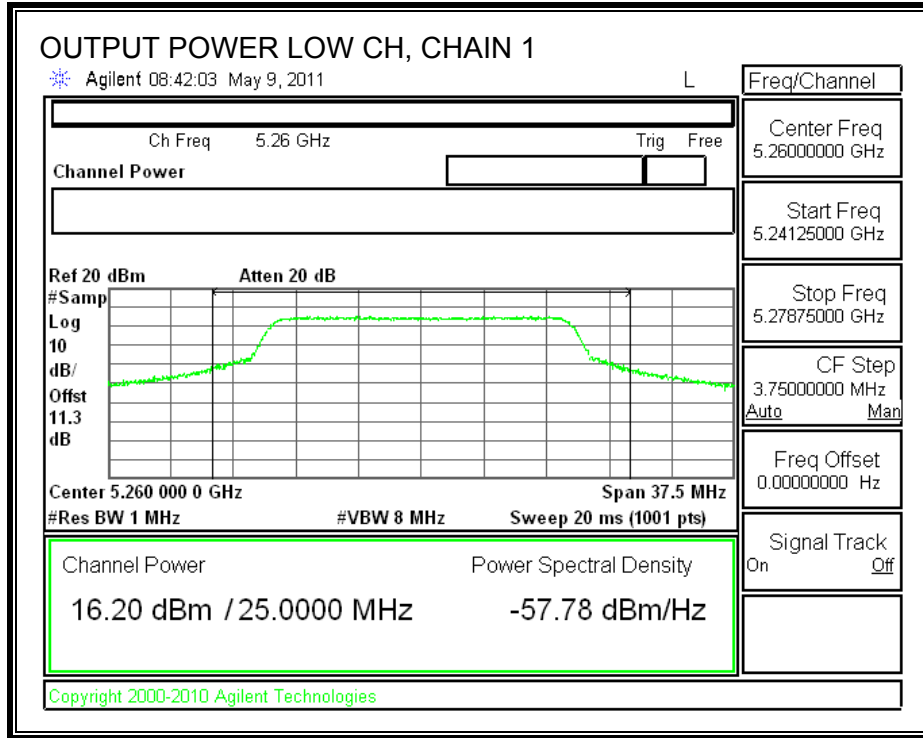
Limit

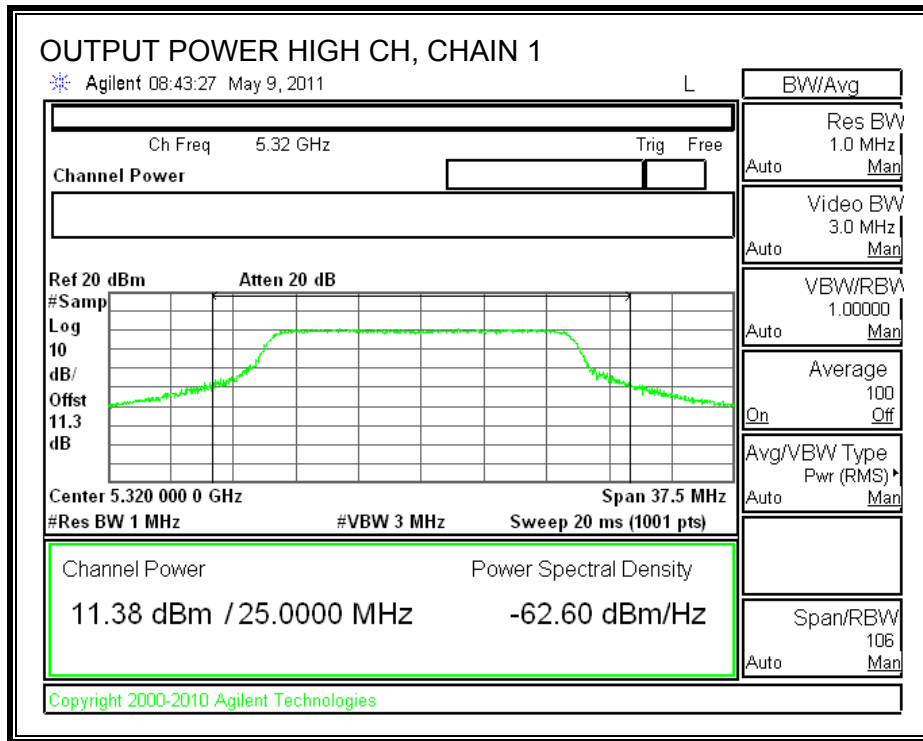
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	24	24.927	24.97	8.67	21.33
Mid	5300	24	25.035	24.99	8.67	21.33
High	5320	24	24.846	24.95	8.67	21.33

Individual Chain Results

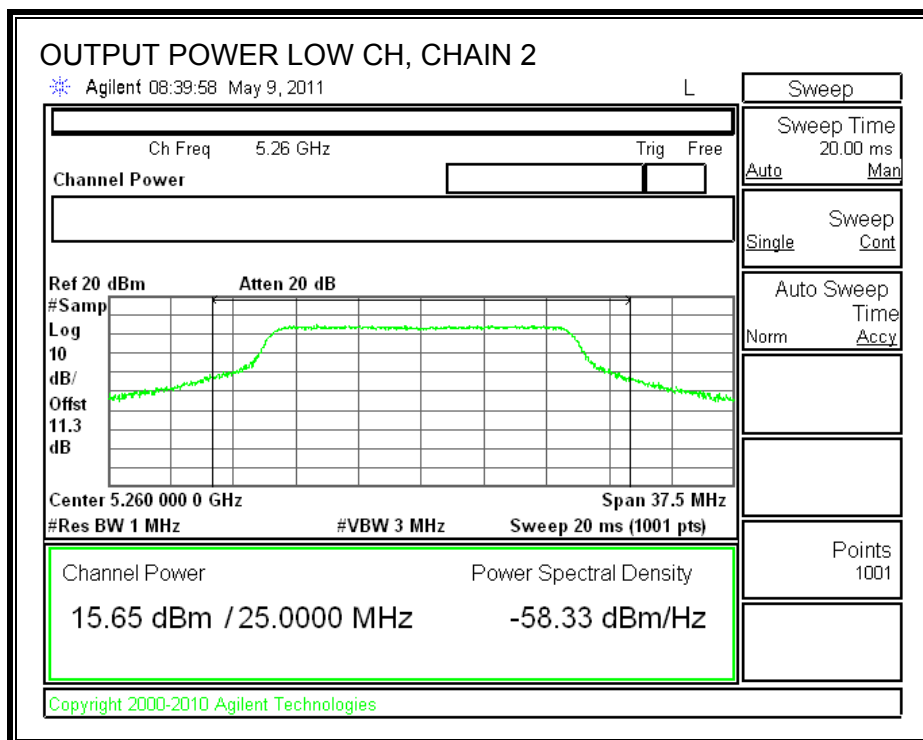
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	16.20	15.65	18.94	21.33	-2.39
Mid	5300	11.33	11.23	14.29	21.33	-7.04
High	5320	11.38	11.28	14.34	21.33	-6.99

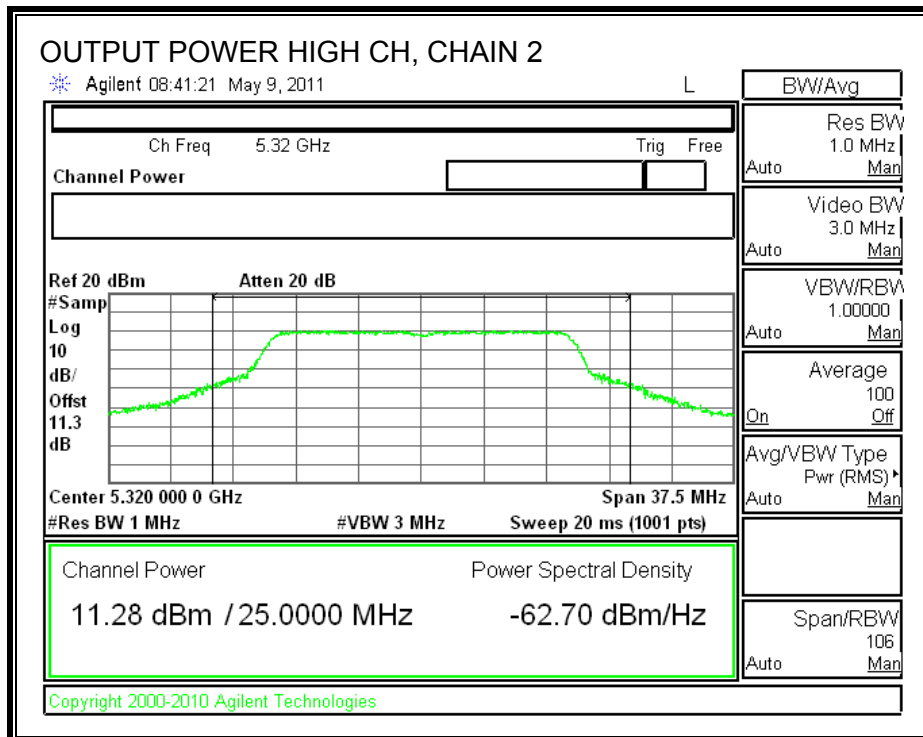
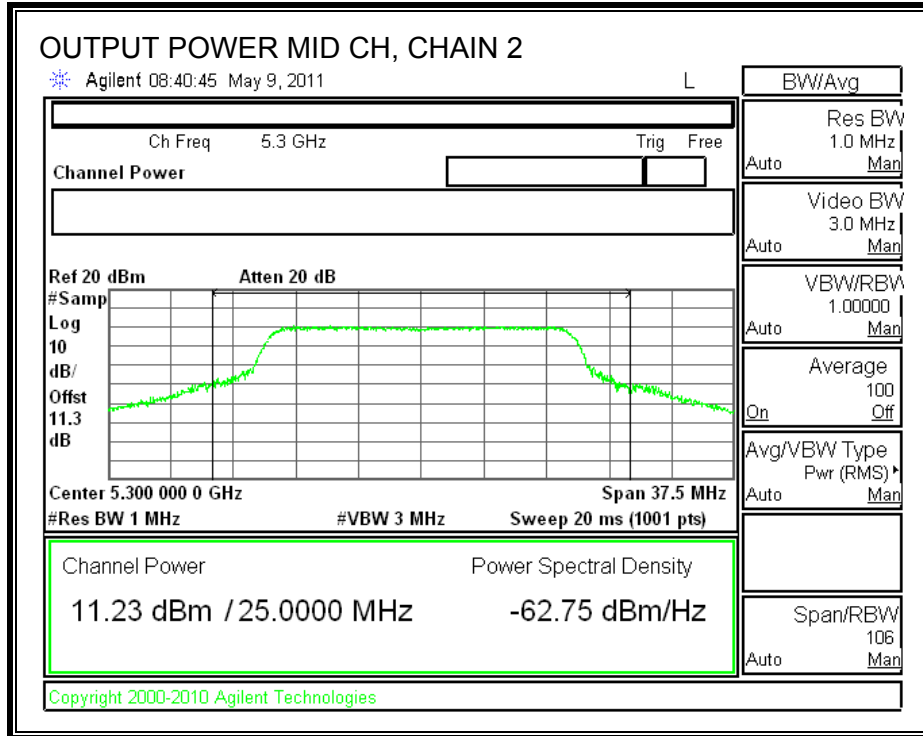
CHAIN 1 OUTPUT POWER





CHAIN 2 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 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5260	16.02	15.45	18.75
Middle	5300	11.00	11.10	14.06
High	5320	10.95	11.08	14.03

7.5.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.21	6.07	8.67

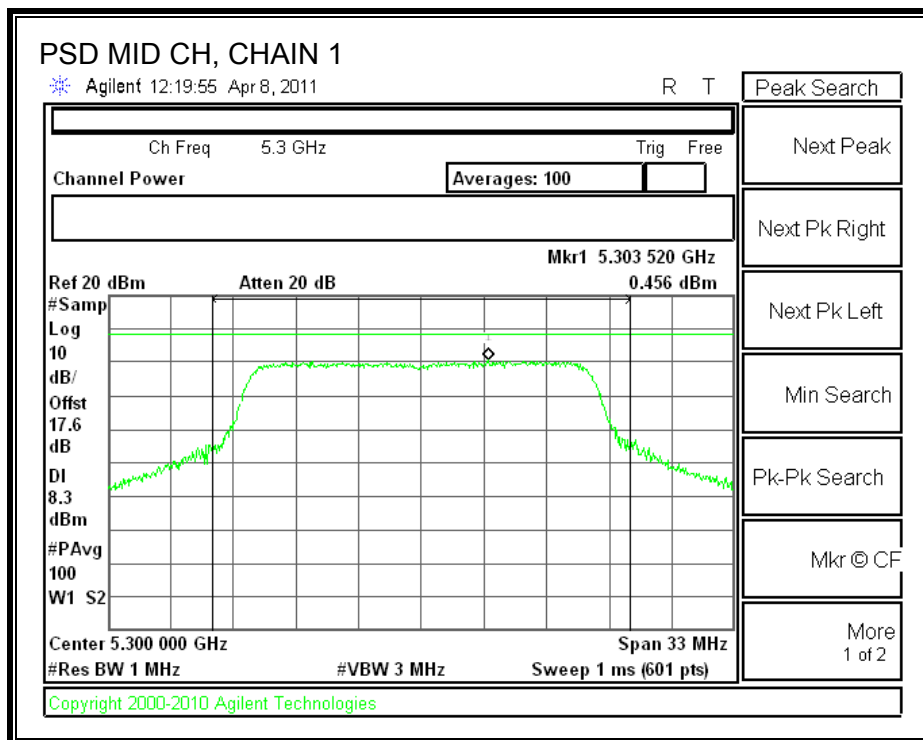
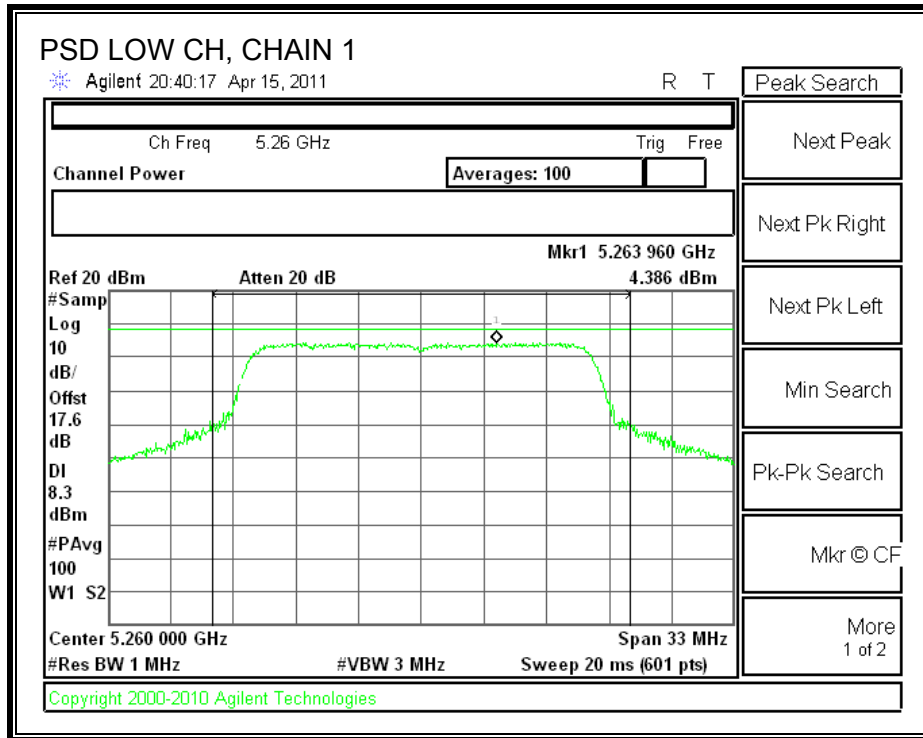
For the 5.25–5.35 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain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

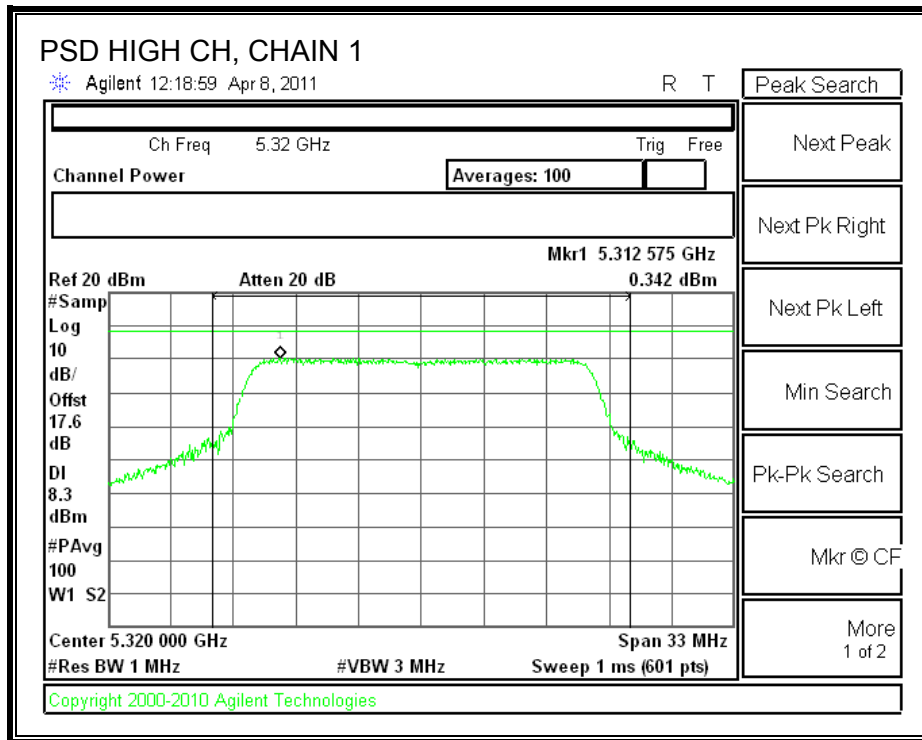
The maximum effective antenna gain is 8.67dBi, therefore the limit is 8.33 dBm.

RESULTS

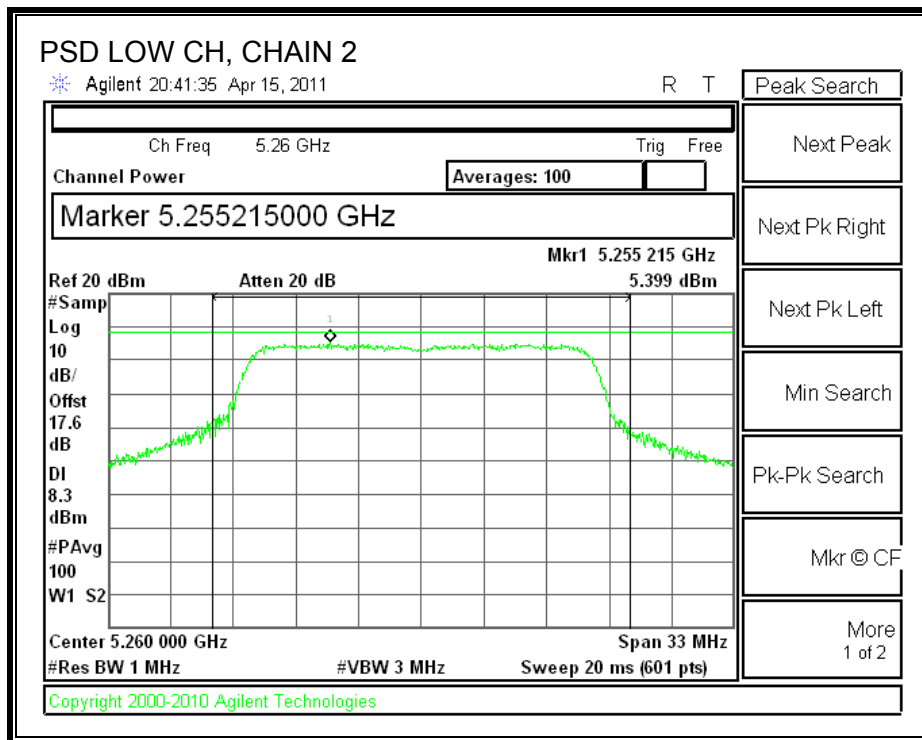
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5260	4.386	5.399	7.93	8.33	-0.40
Middle	5300	0.456	1.022	3.76	8.33	-4.57
High	5320	0.342	1.364	3.89	8.33	-4.44

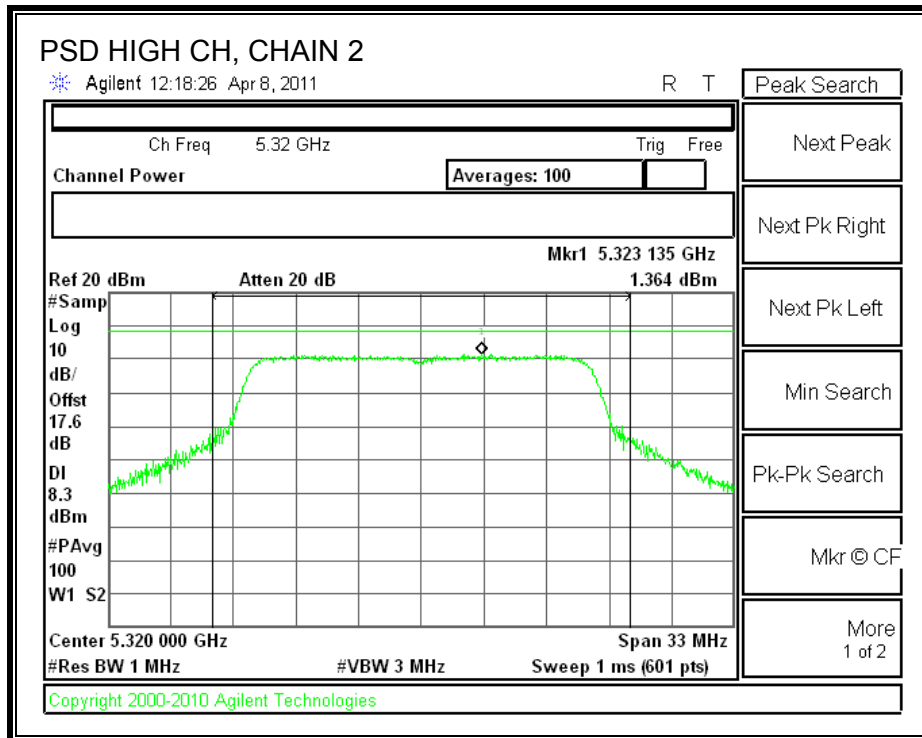
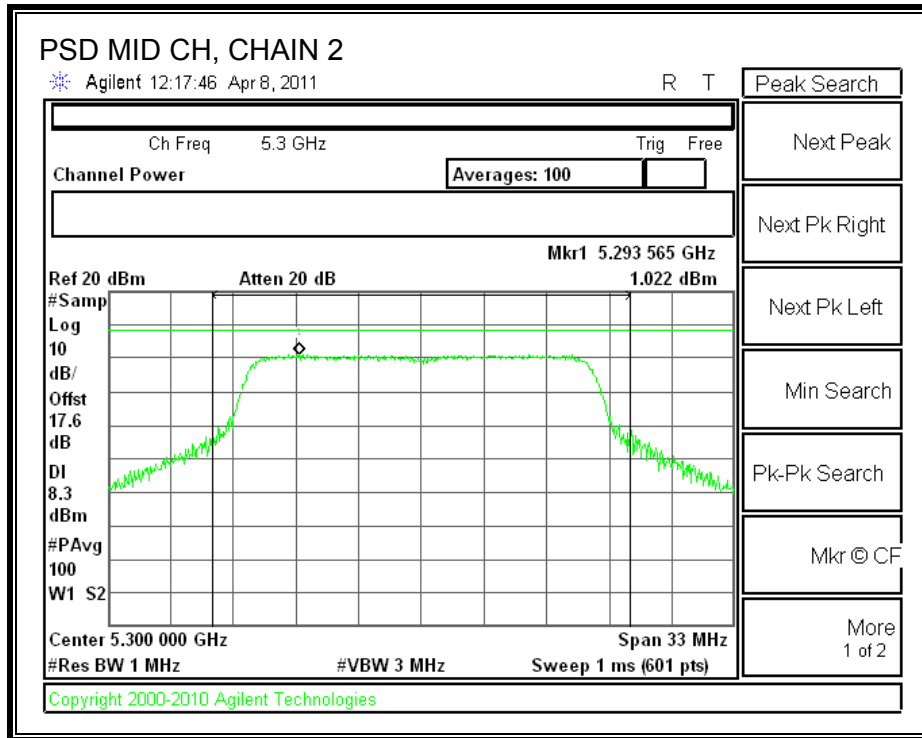
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.5.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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.

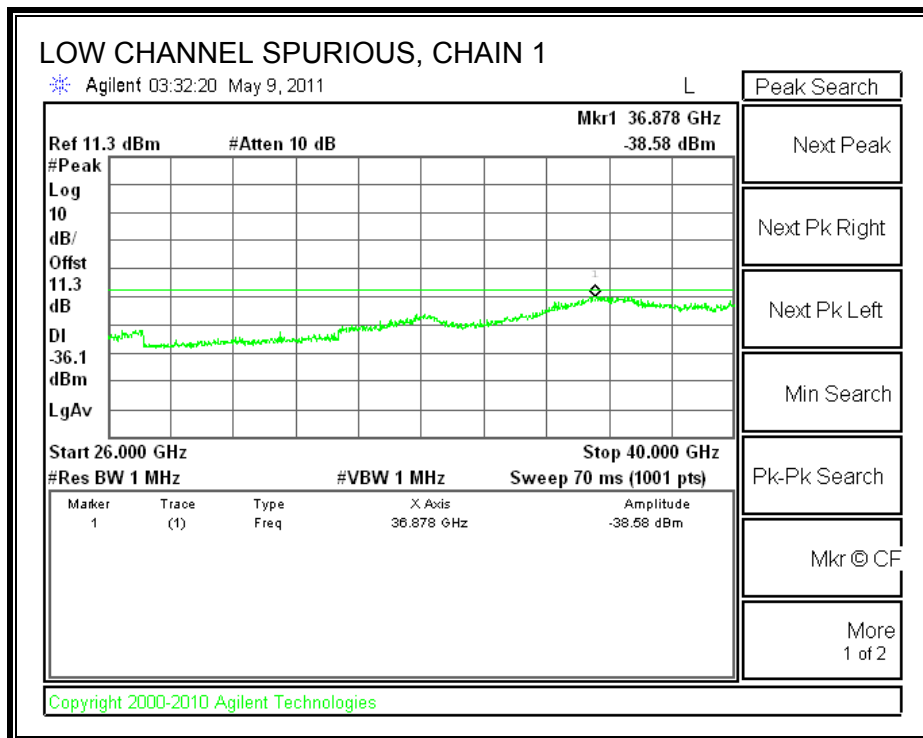
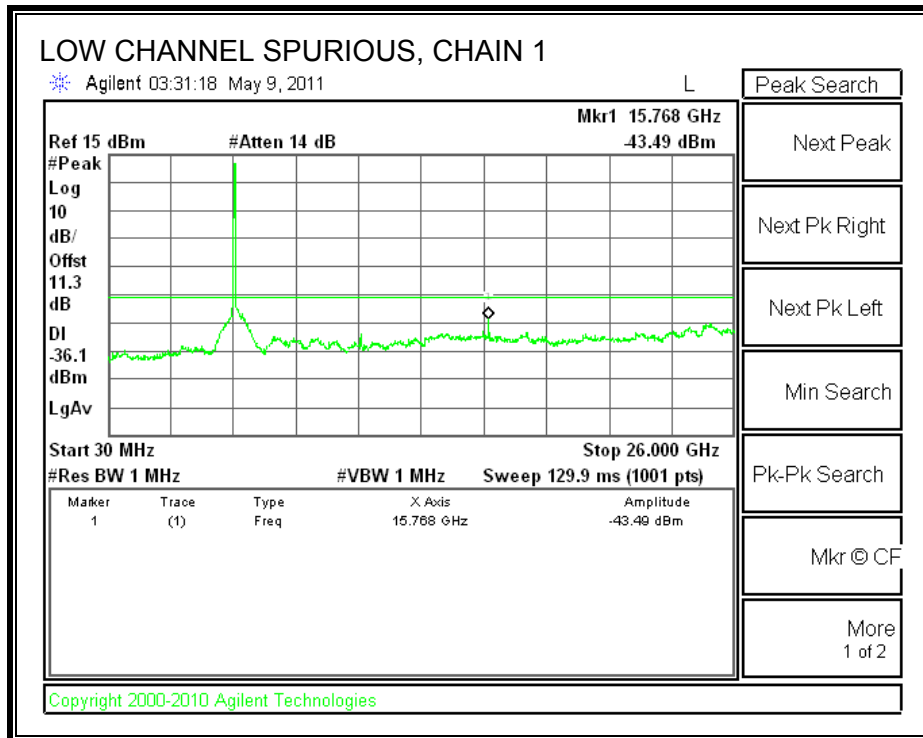
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

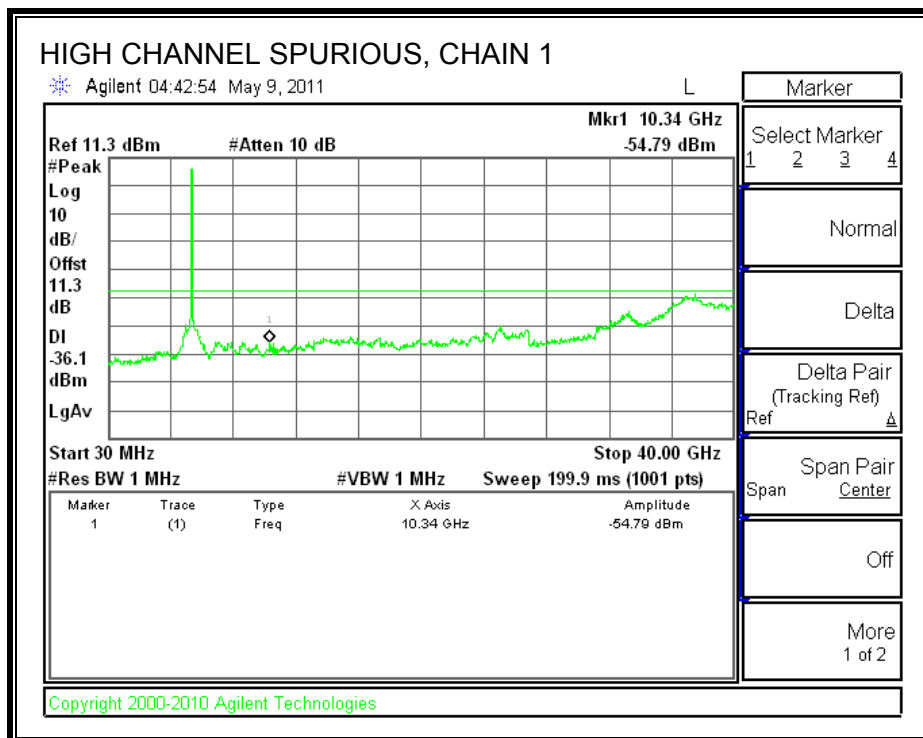
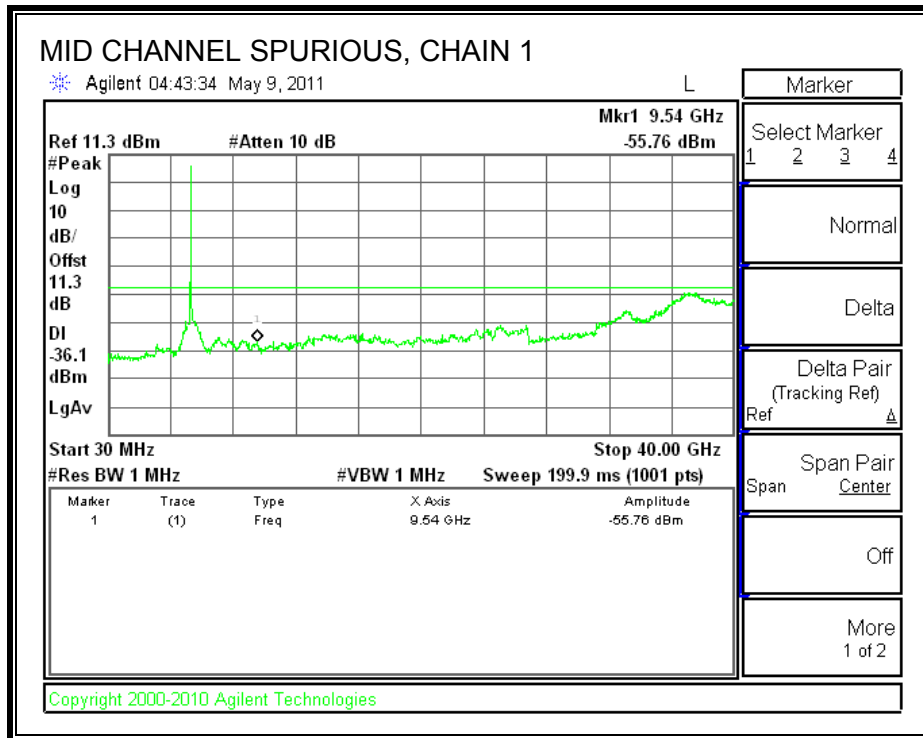
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

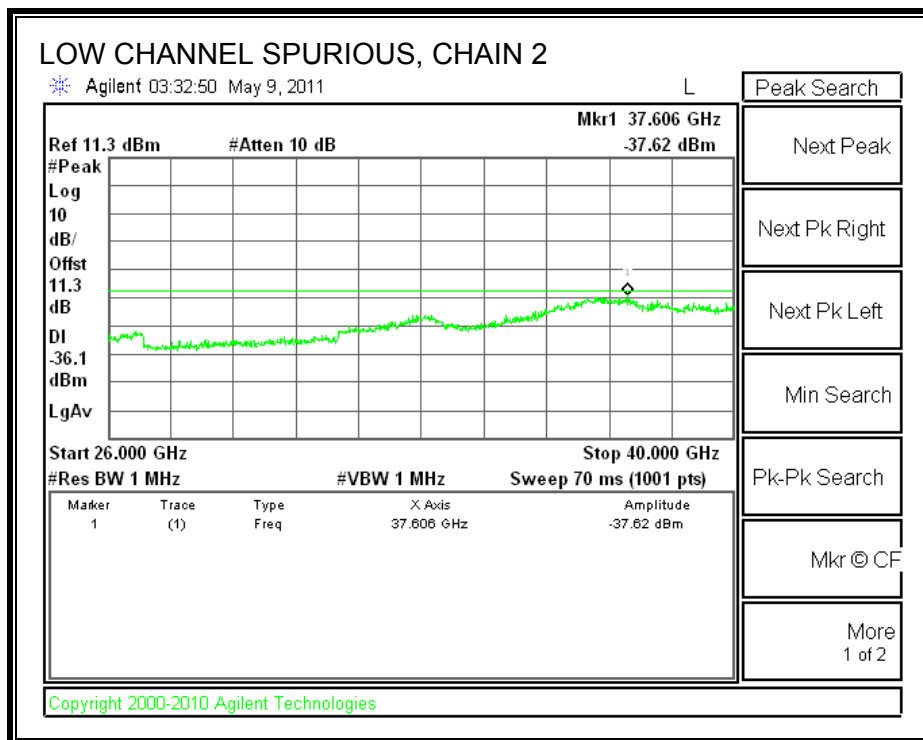
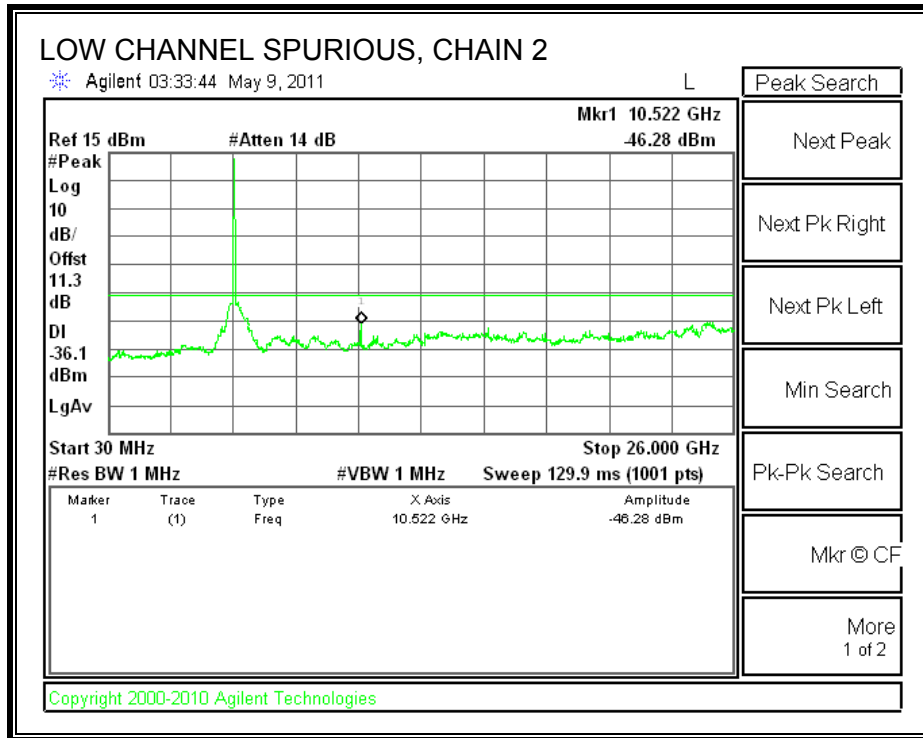
RESULTS

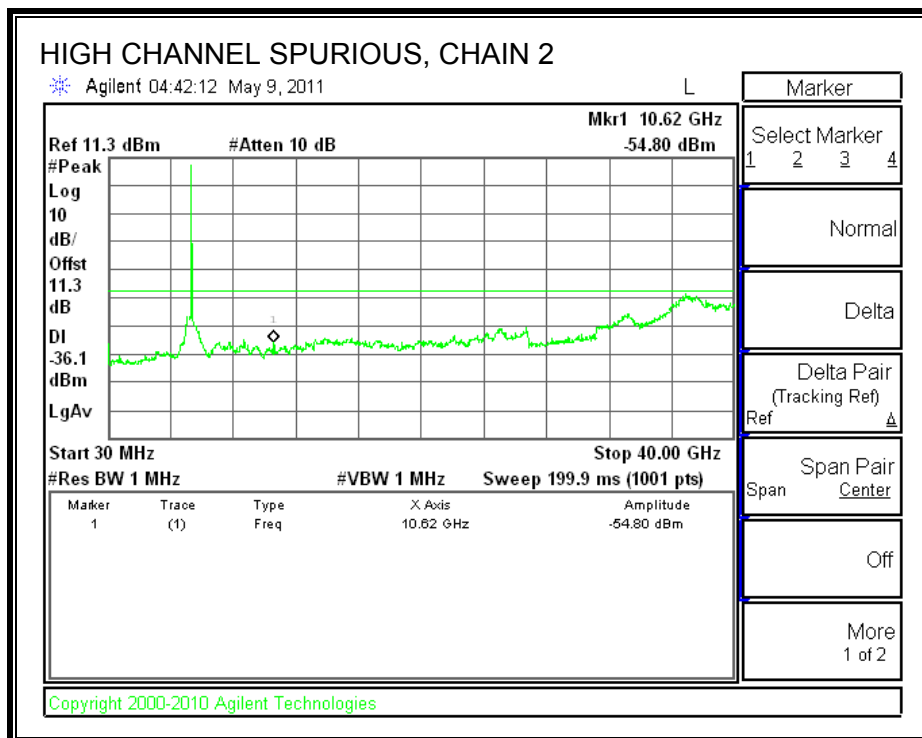
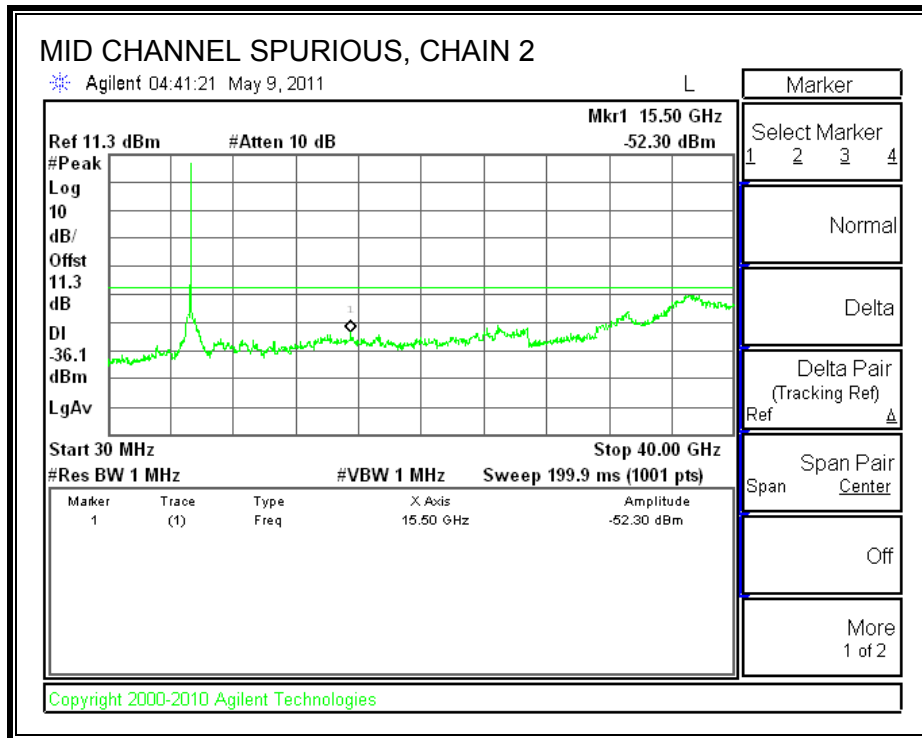
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.6. 802.11n HT40 MODE IN THE 5.3 GHz BAND

7.6.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

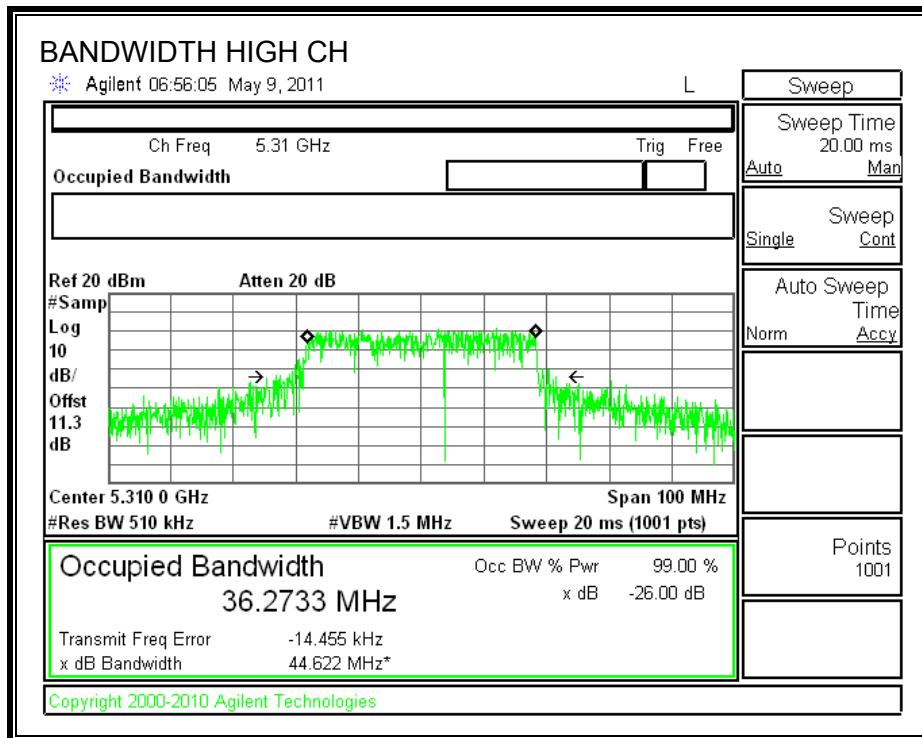
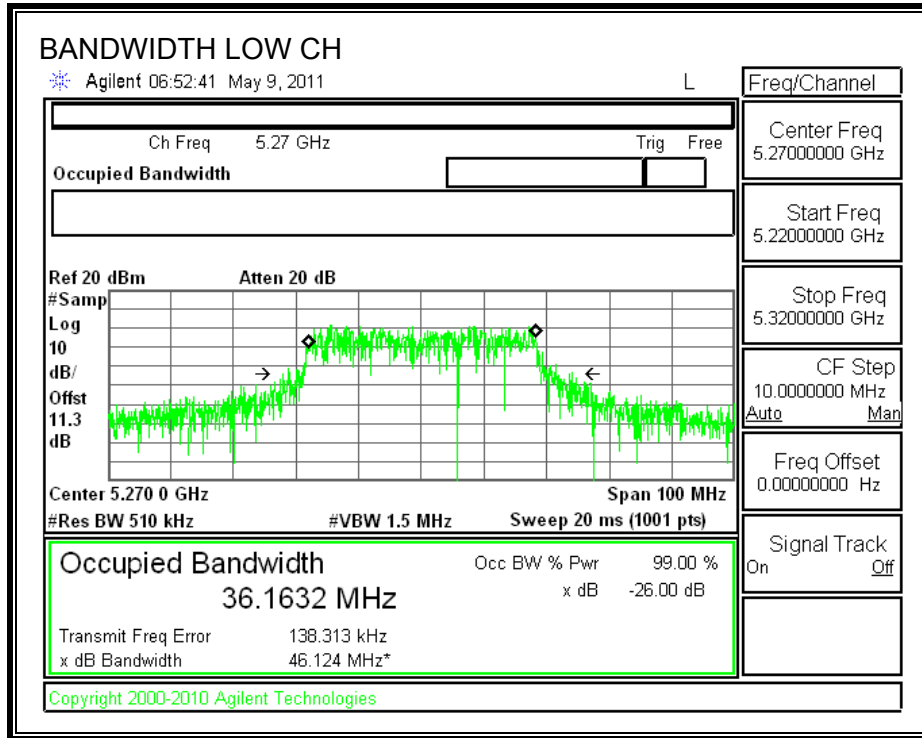
TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 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)
Low	5270	46.124
High	5310	44.622

26 dB BANDWIDTH



7.6.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (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 $11 \text{ dBm} + 10 \log B$, 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.

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

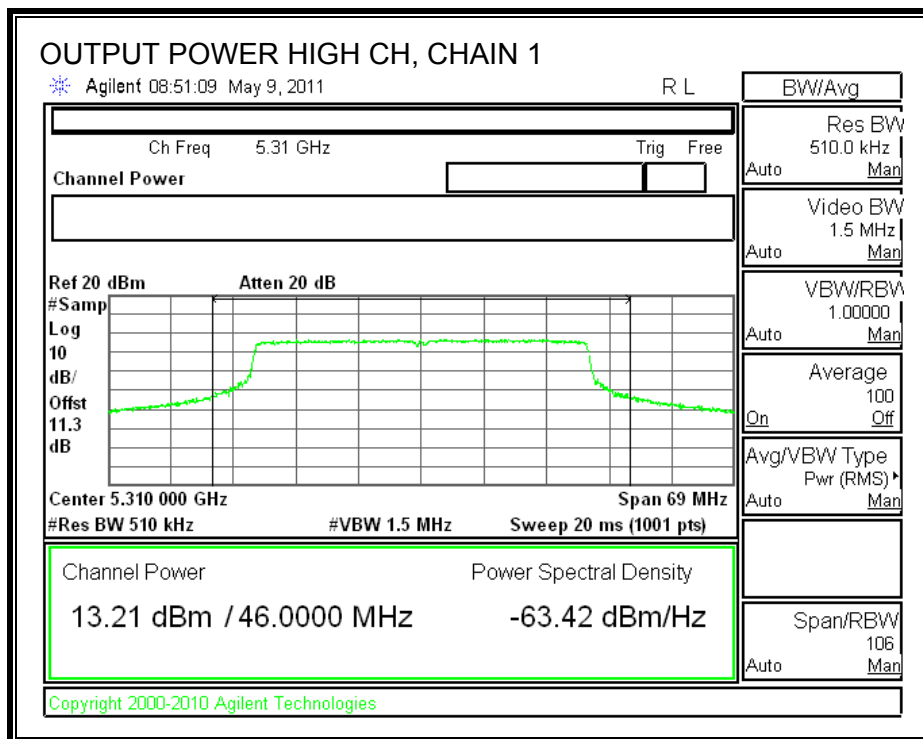
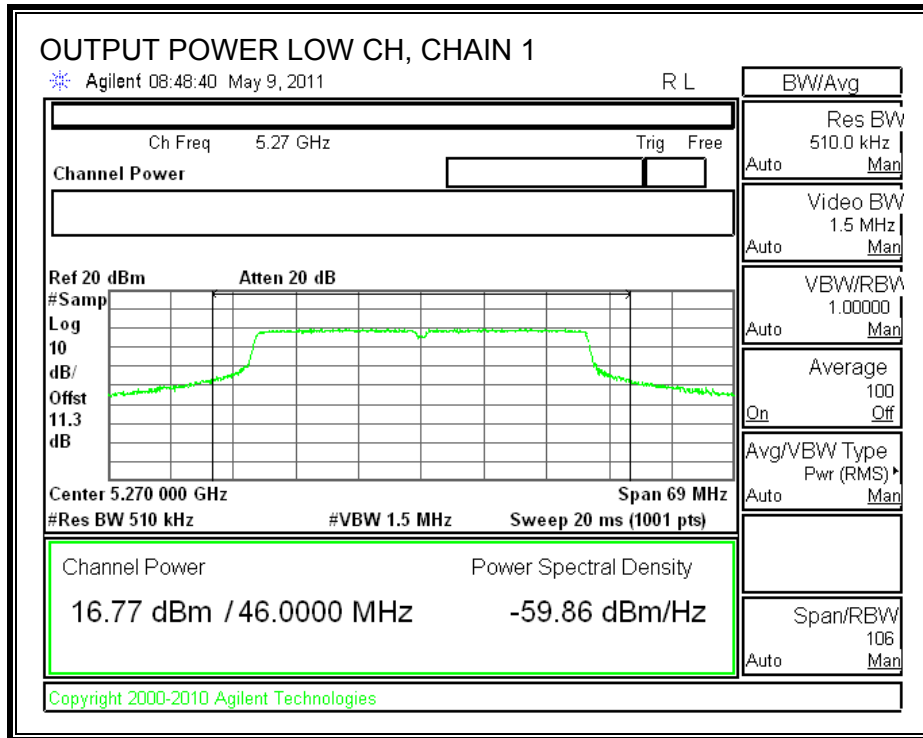
Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5270	24	46.124	27.64	8.67	21.33
High	5310	24	44.622	27.50	8.67	21.33

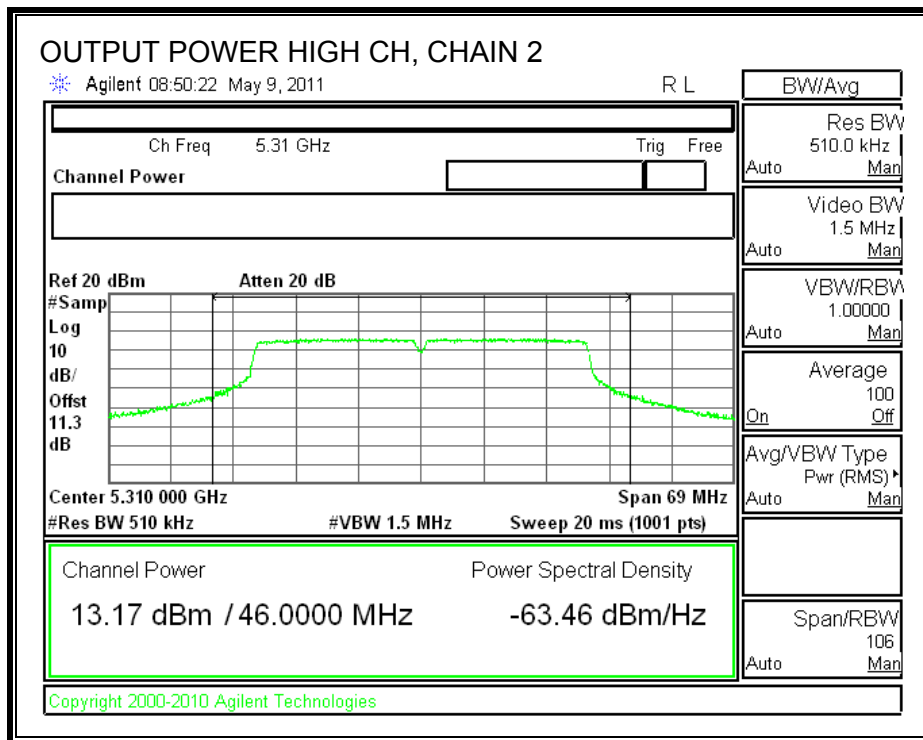
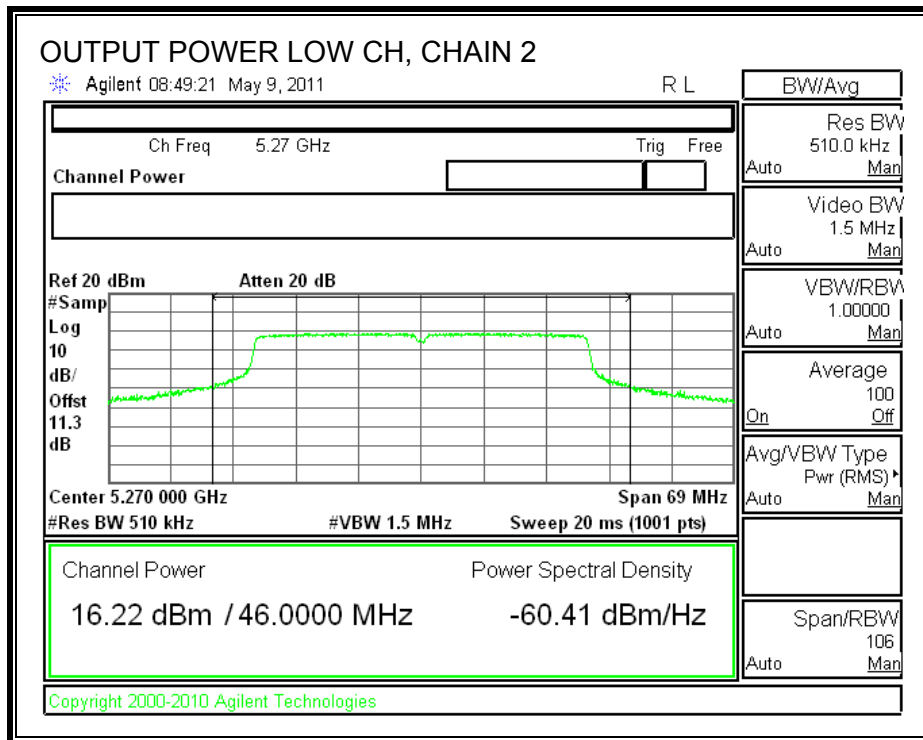
Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5270	16.77	16.22	19.51	21.33	-1.82
High	5310	13.21	13.17	16.20	21.33	-5.13

CHAIN 1 OUTPUT POWER



CHAIN 2 OUTPUT POWER



7.6.3. 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 11.3dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5270	16.60	16.23	19.43
High	5310	13.10	13.20	16.16

7.6.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (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 8.67 dBi, therefore the limit is 8.33 dBm.

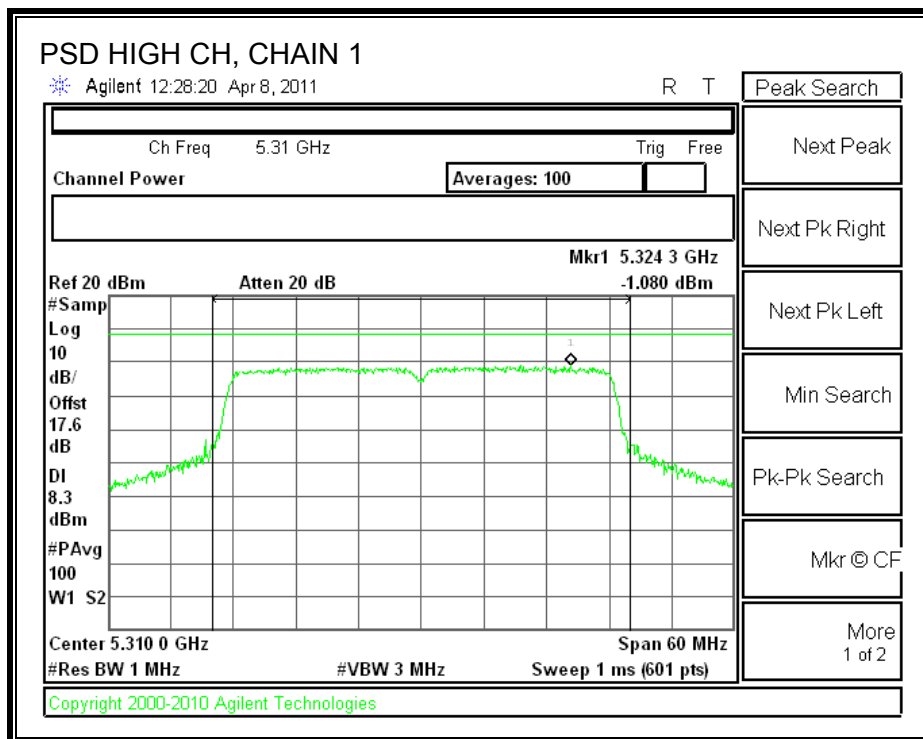
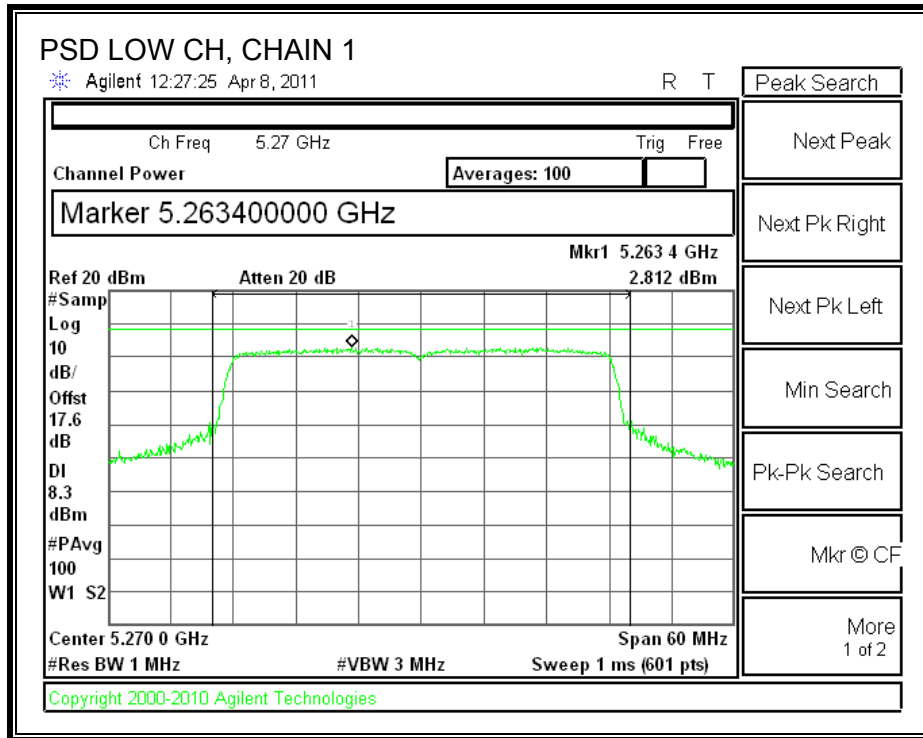
TEST PROCEDURE

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.

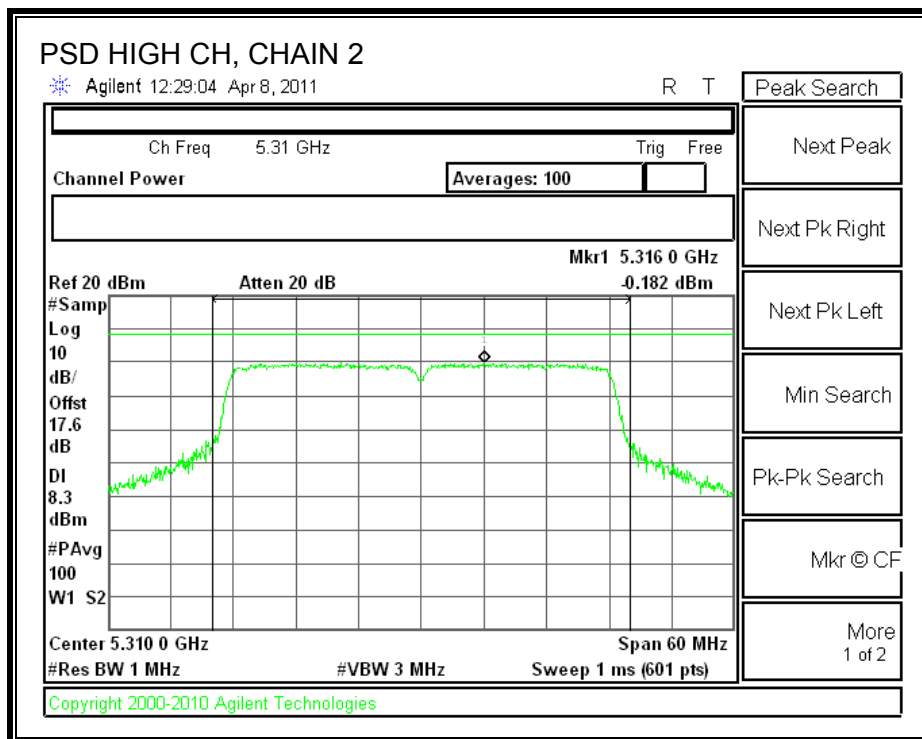
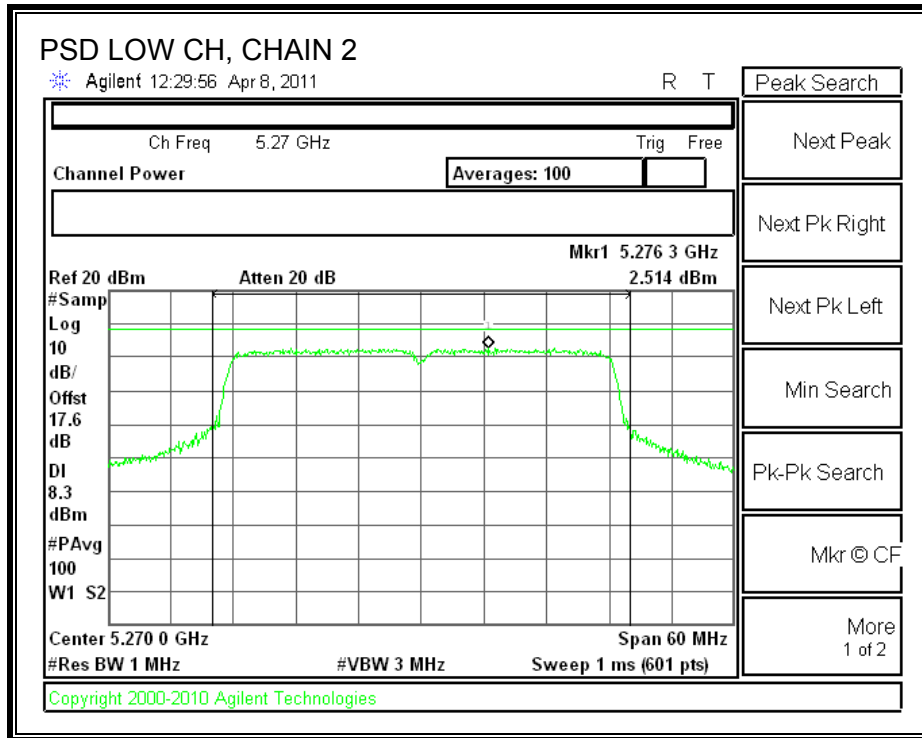
RESULTS

Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5270	2.812	2.514	5.68	8.33	-2.65
High	5310	-1.08	-0.182	2.40	8.33	-5.93

CHAIN 1 POWER SPECTRAL DENSITY



CHAIN 2 POWER SPECTRAL DENSITY



7.6.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (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.

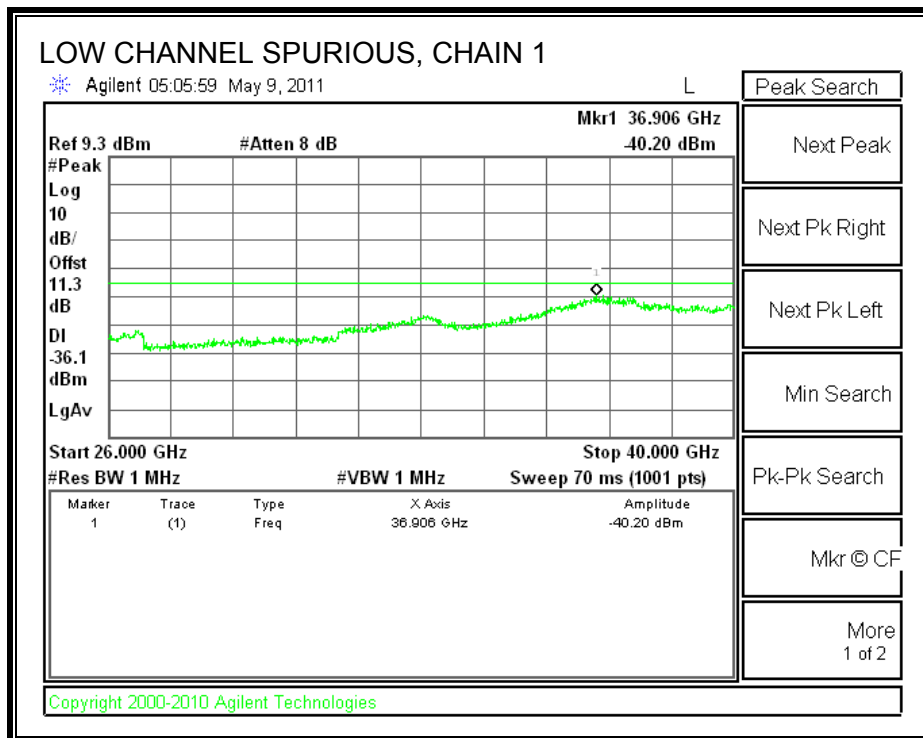
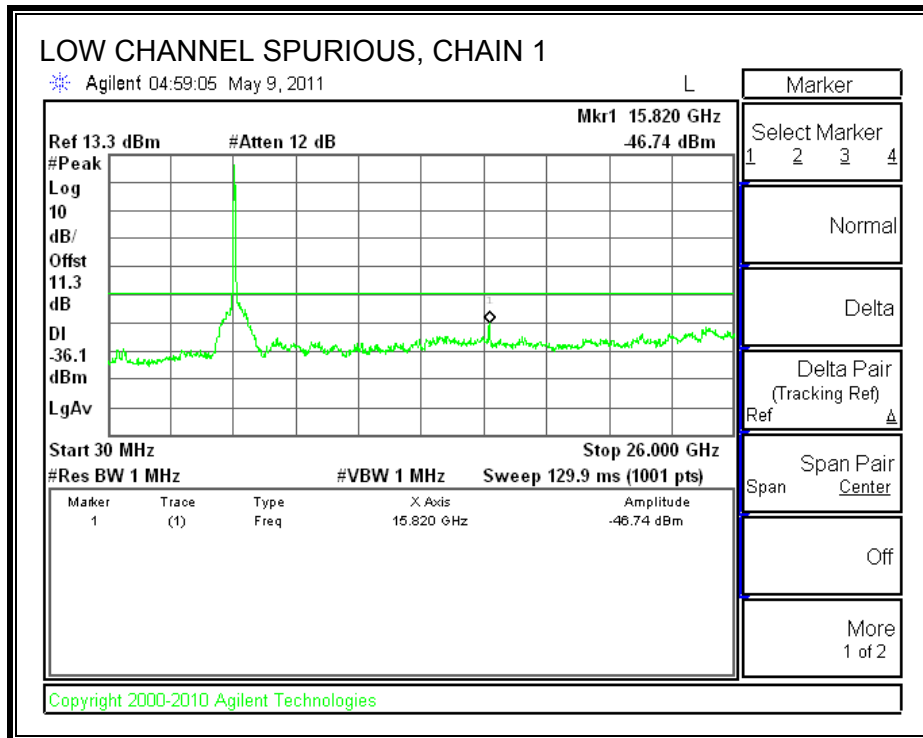
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

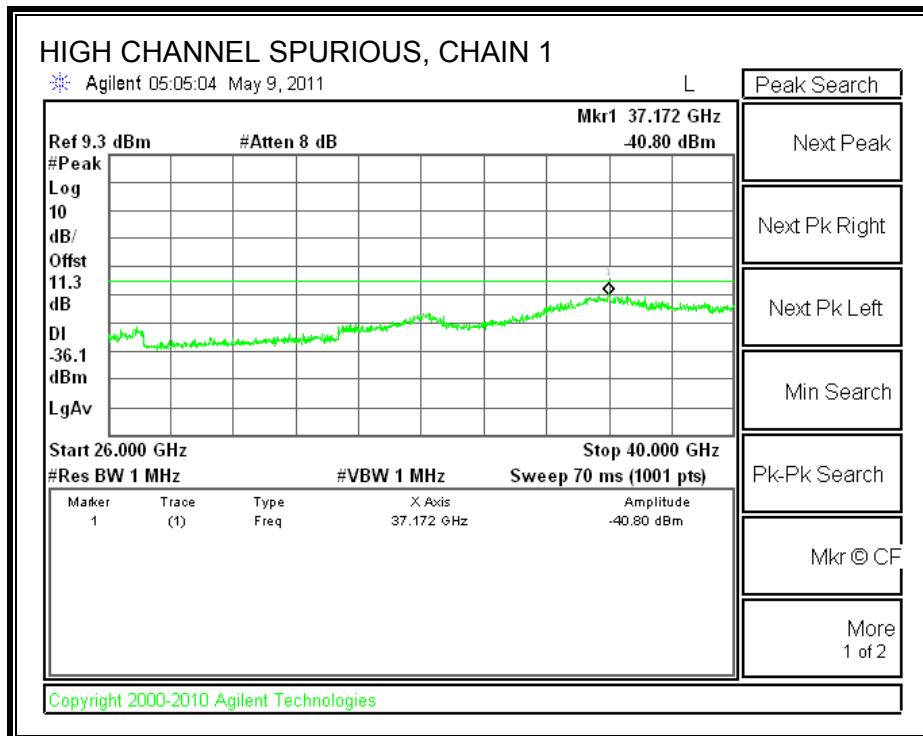
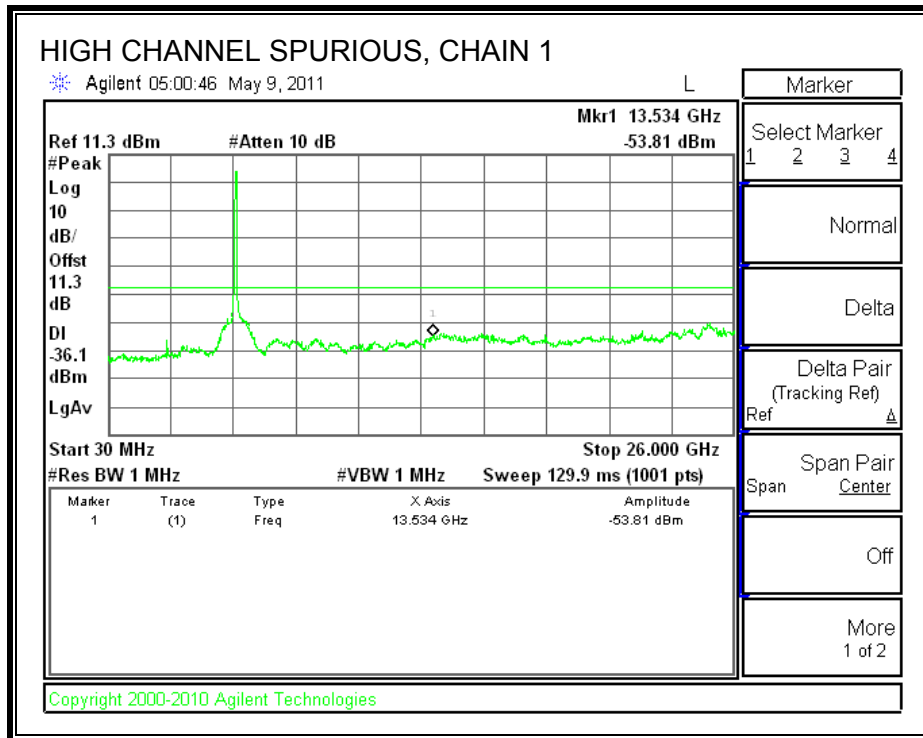
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

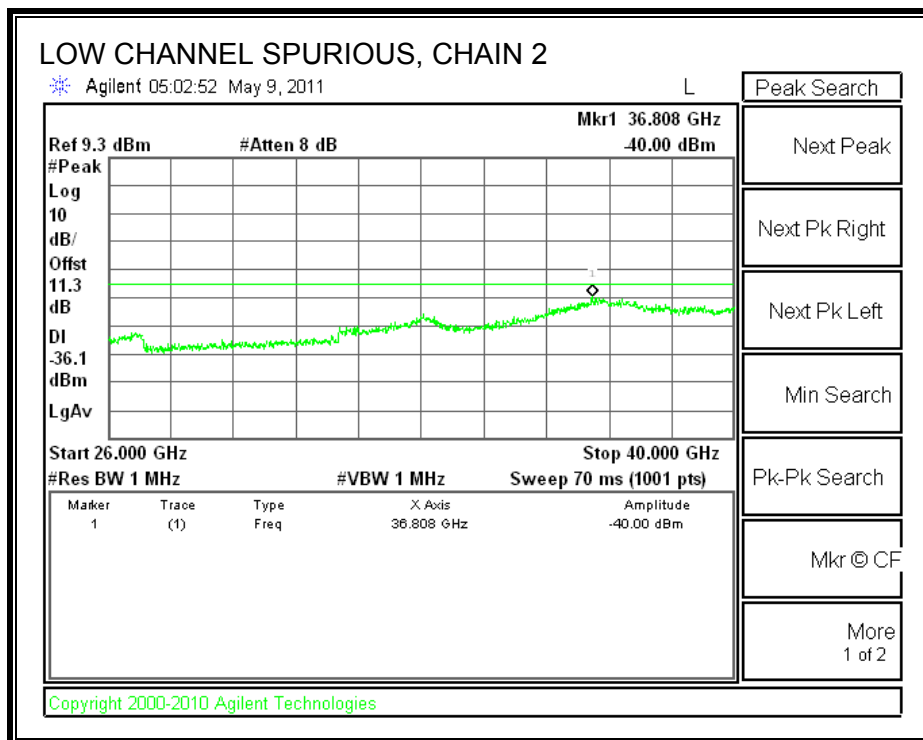
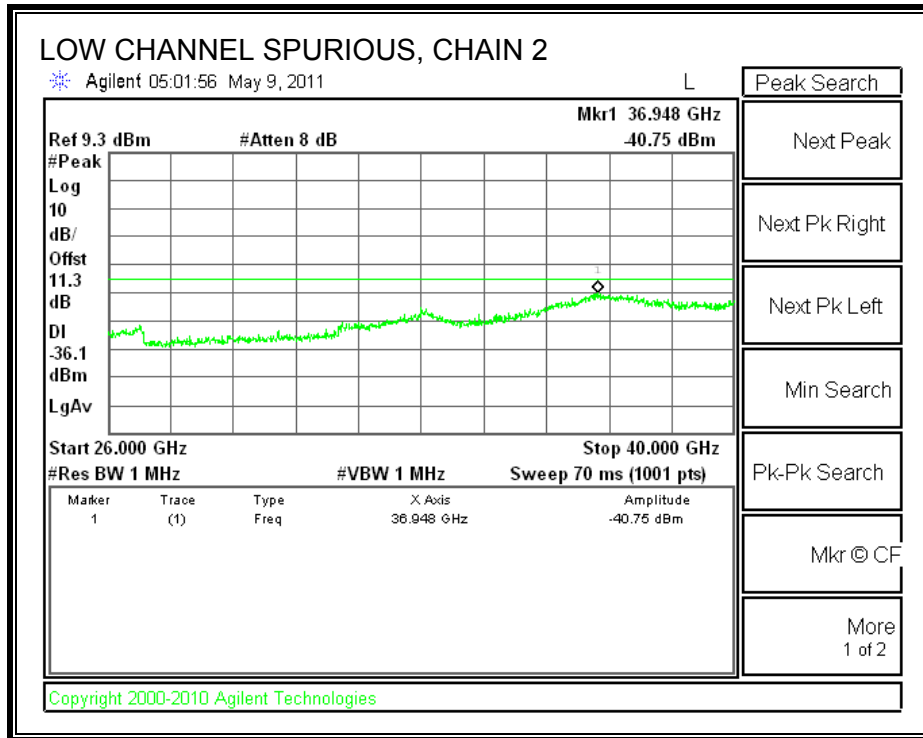
RESULTS

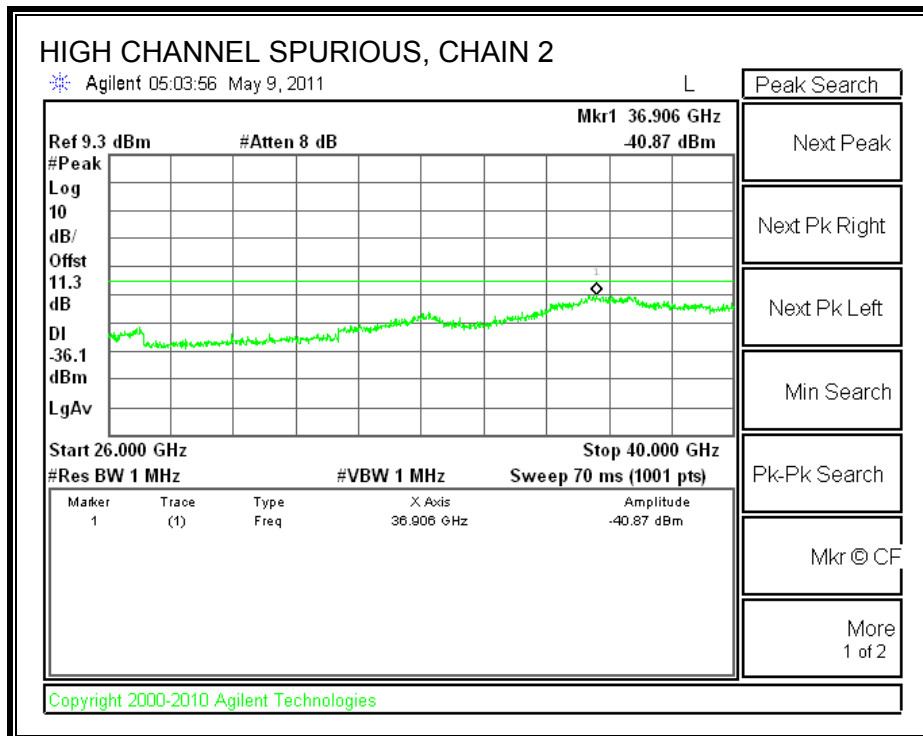
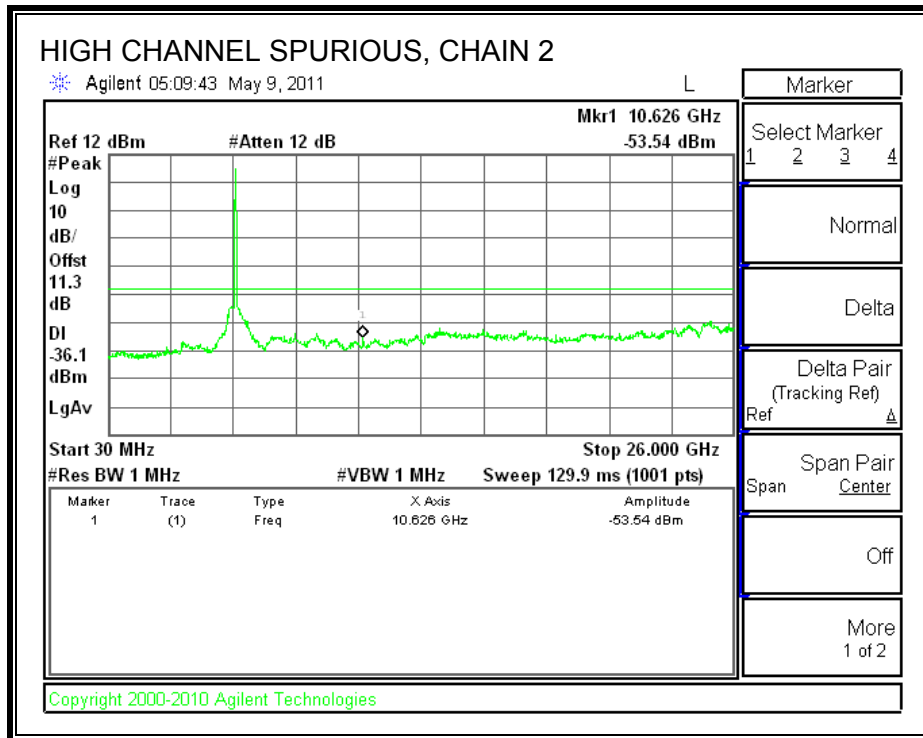
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.7. 802.11a DUAL CHAIN LEGACY MODE IN THE 5.6 GHz BAND

7.7.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

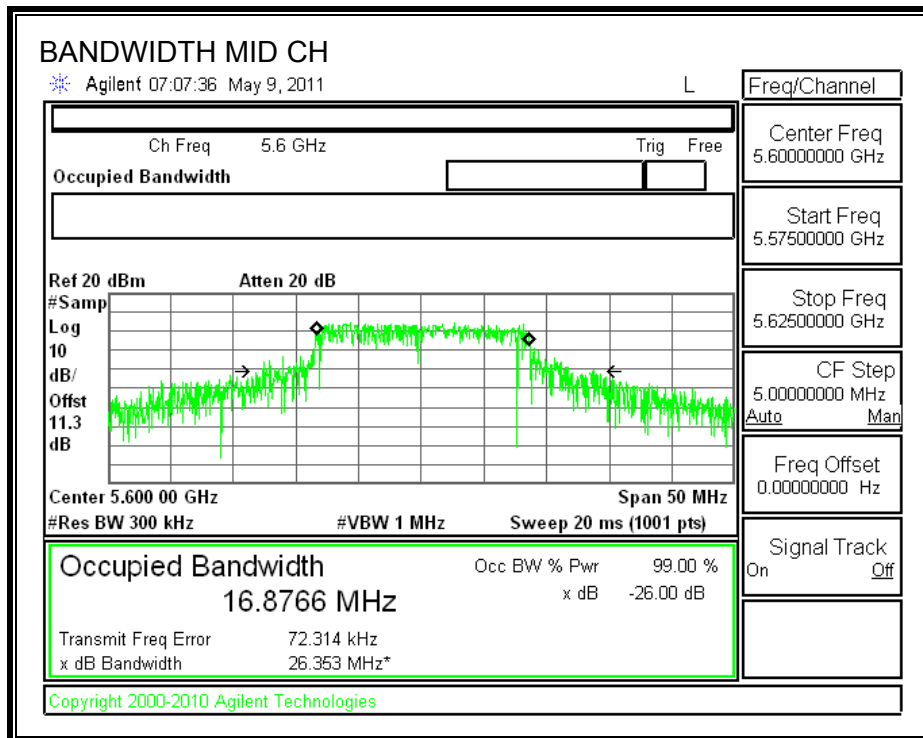
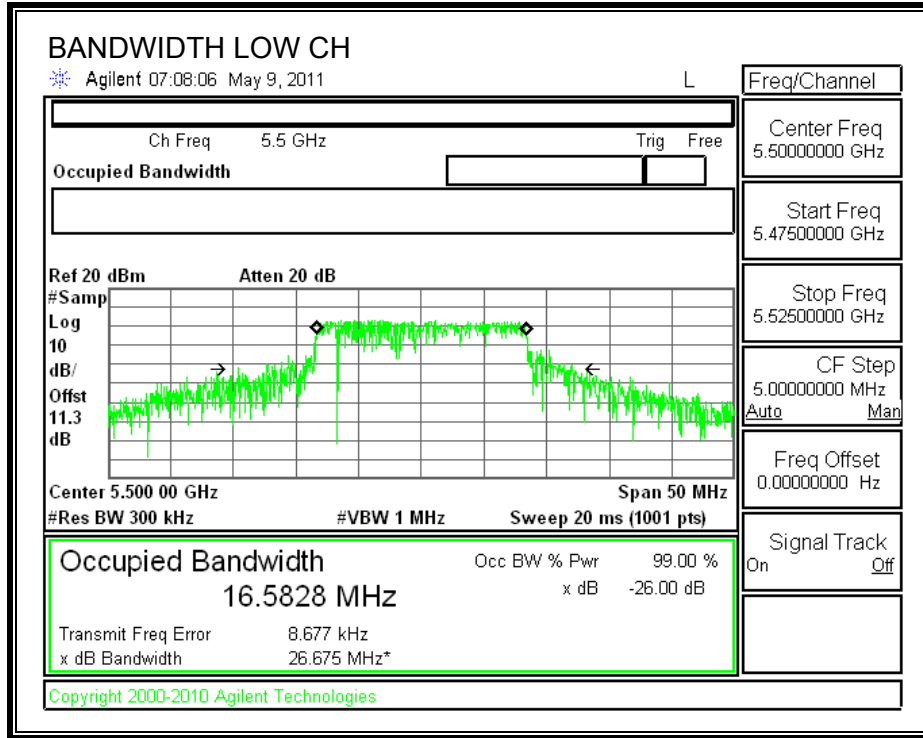
TEST PROCEDURE

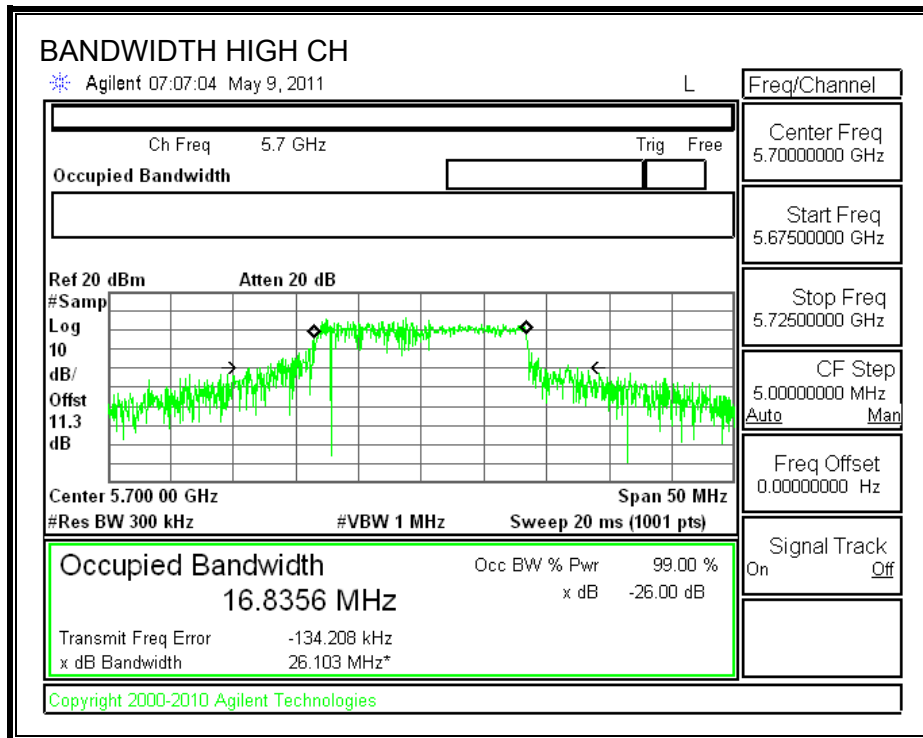
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	26.675
Middle	5600	26.353
High	5700	26.103

26 dB BANDWIDTH





7.7.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
4.02	4.78	7.43

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.

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

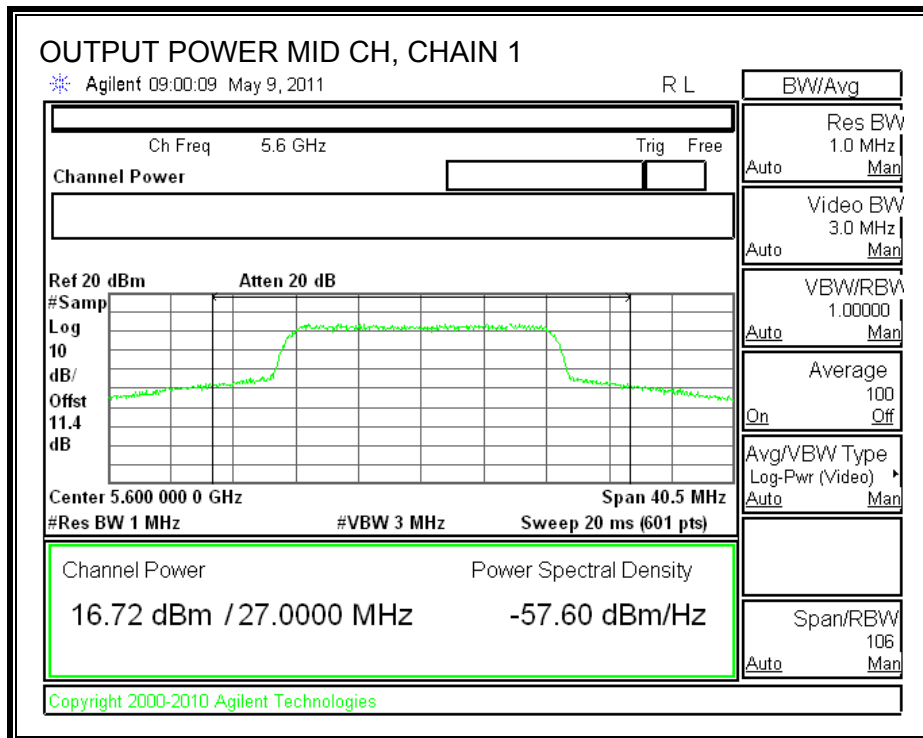
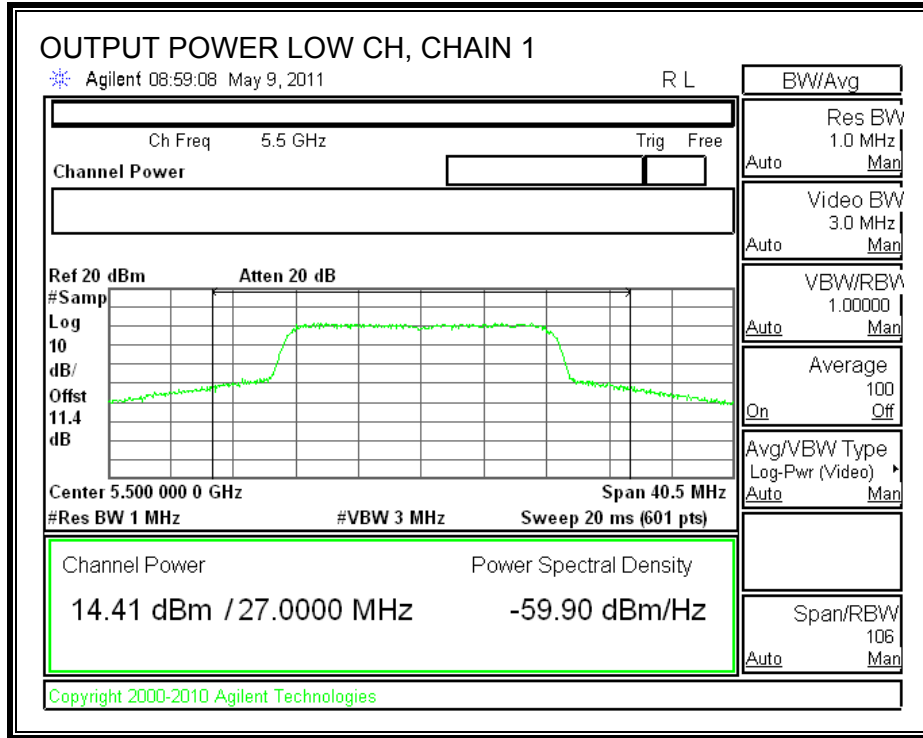
Limit

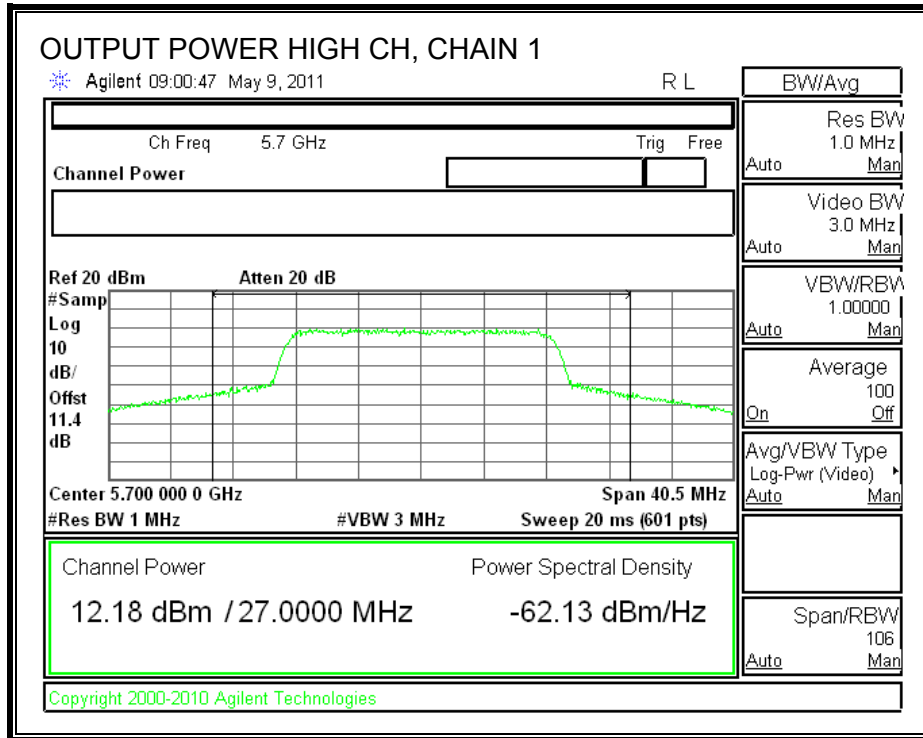
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Effective Ant Gain (dBi)	Limit (dBm)
Low	5500	24	26.675	25.26	7.43	22.57
Mid	5600	24	26.353	25.21	7.43	22.57
High	5700	24	26.103	25.17	7.43	22.57

Individual Chain Results

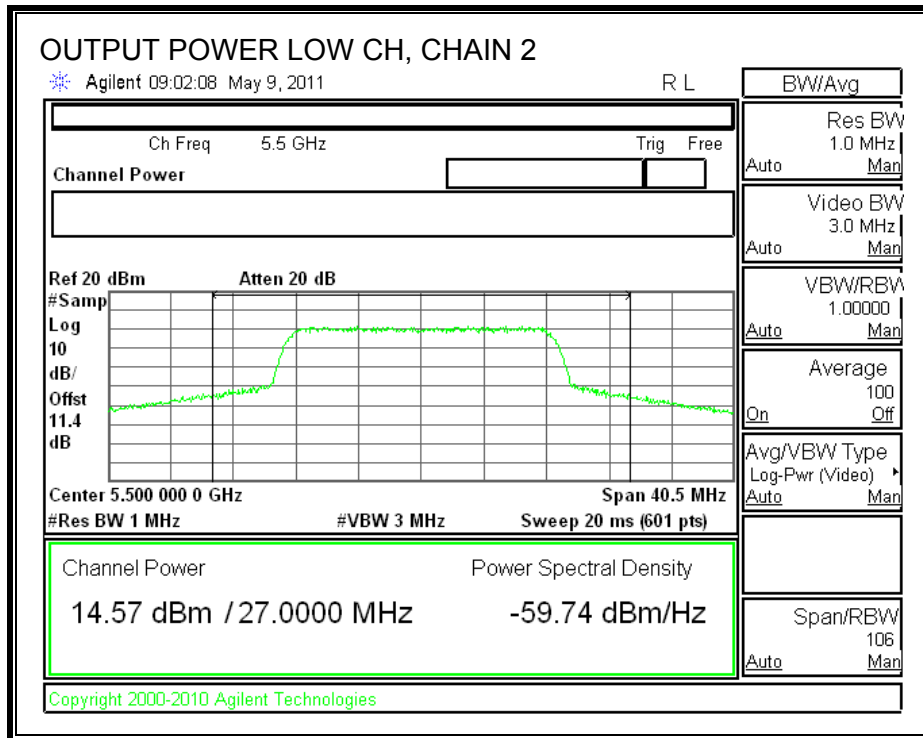
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	14.41	14.57	17.50	22.57	-5.07
Mid	5600	16.72	16.85	19.80	22.57	-2.77
High	5700	12.18	12.12	15.16	22.57	-7.41

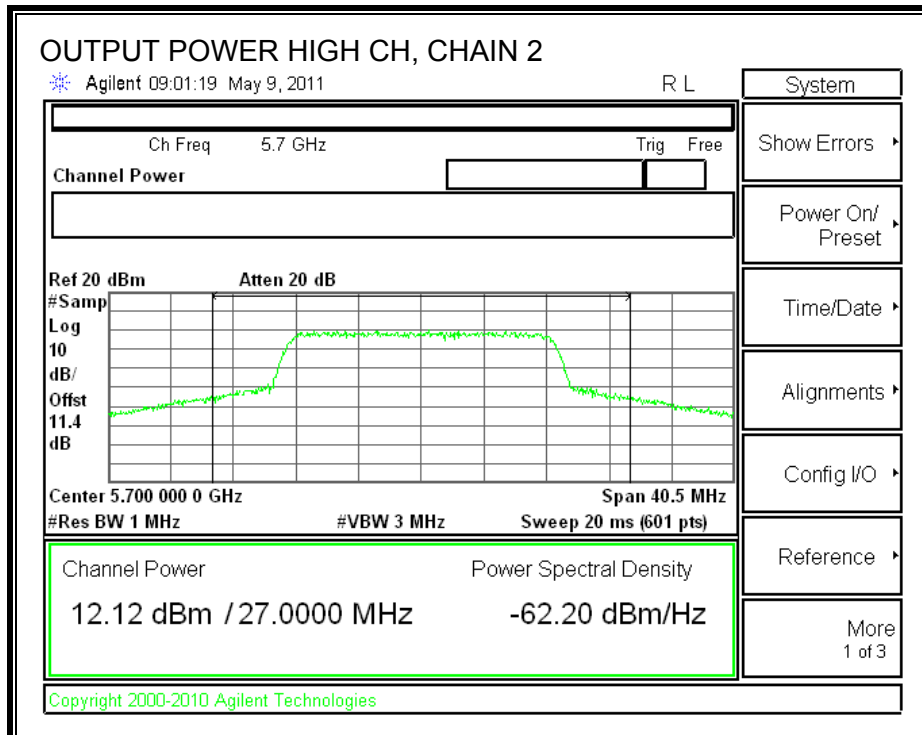
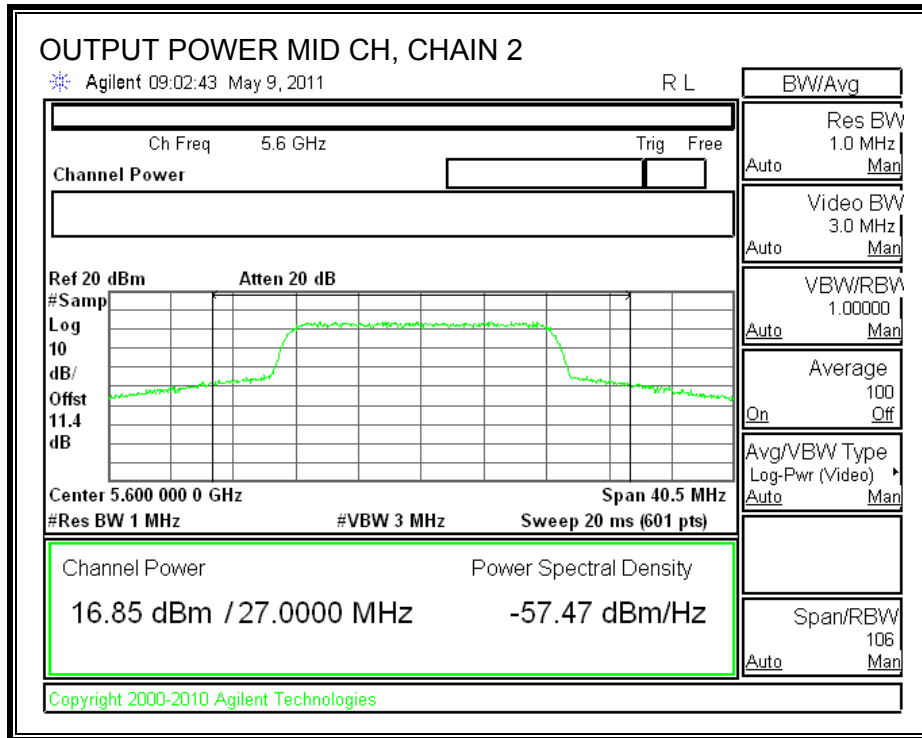
CHAIN 1 OUTPUT POWER





CHAIN 2 OUTPUT POWER





7.7.3. 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 11.3dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5500	14.25	14.30	17.29
Middle	5600	16.70	16.82	19.77
High	5700	12.08	11.70	14.90

7.7.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
4.02	4.78	7.43

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 effective antenna gain is 7.43 dBi, therefore the limit is 9.57dBm.

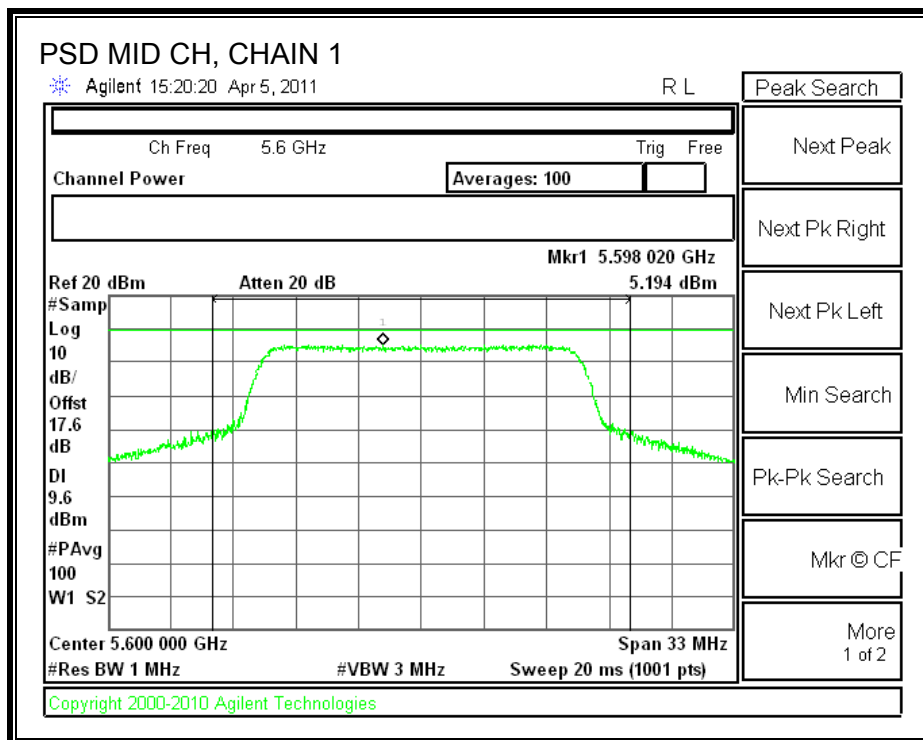
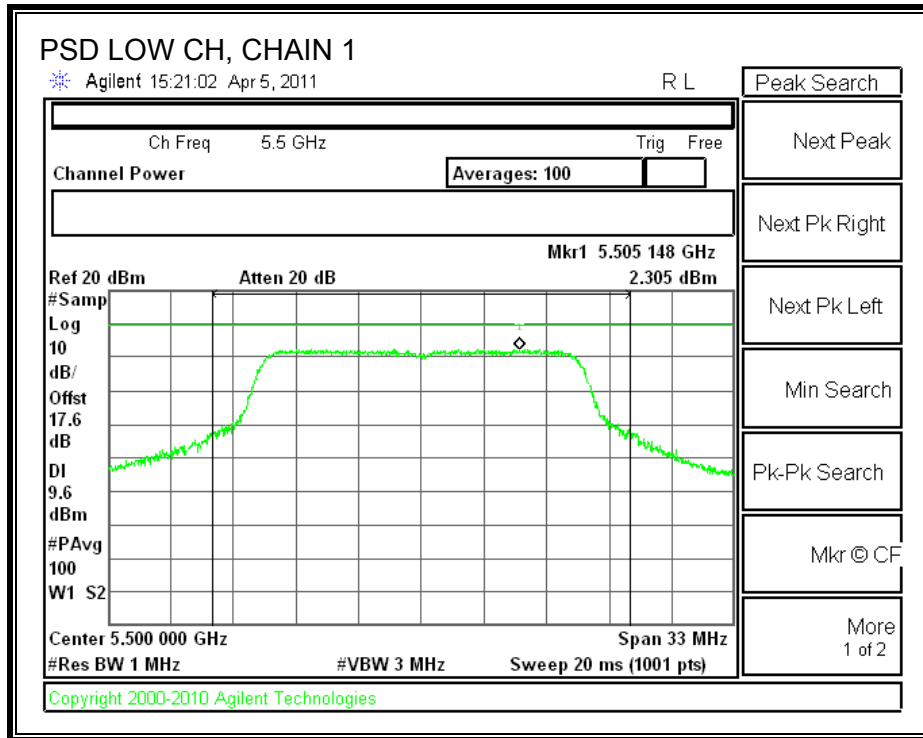
TEST PROCEDURE

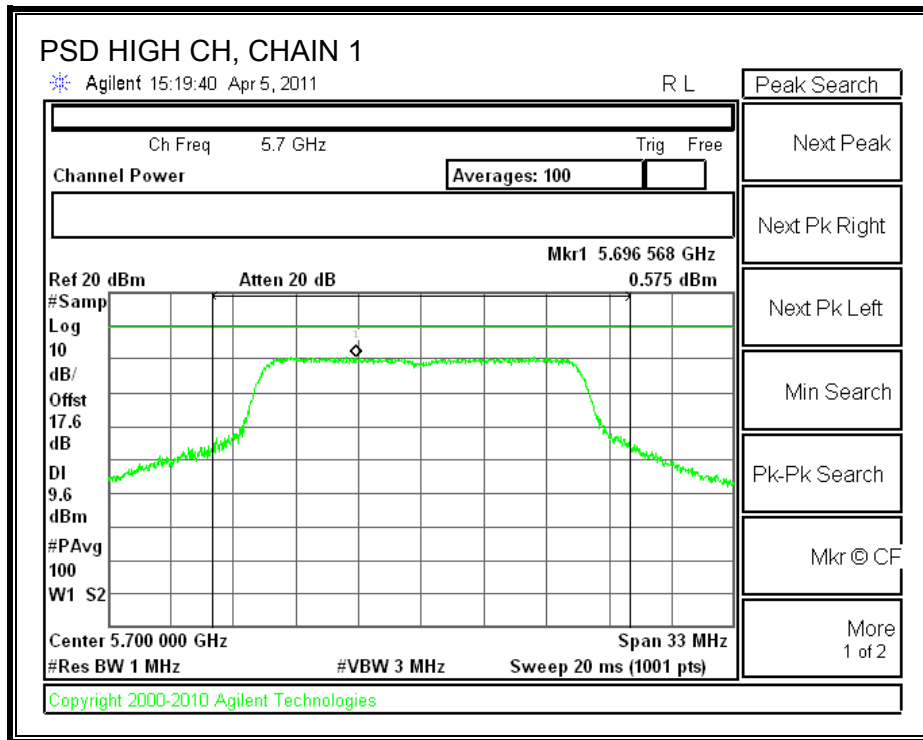
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

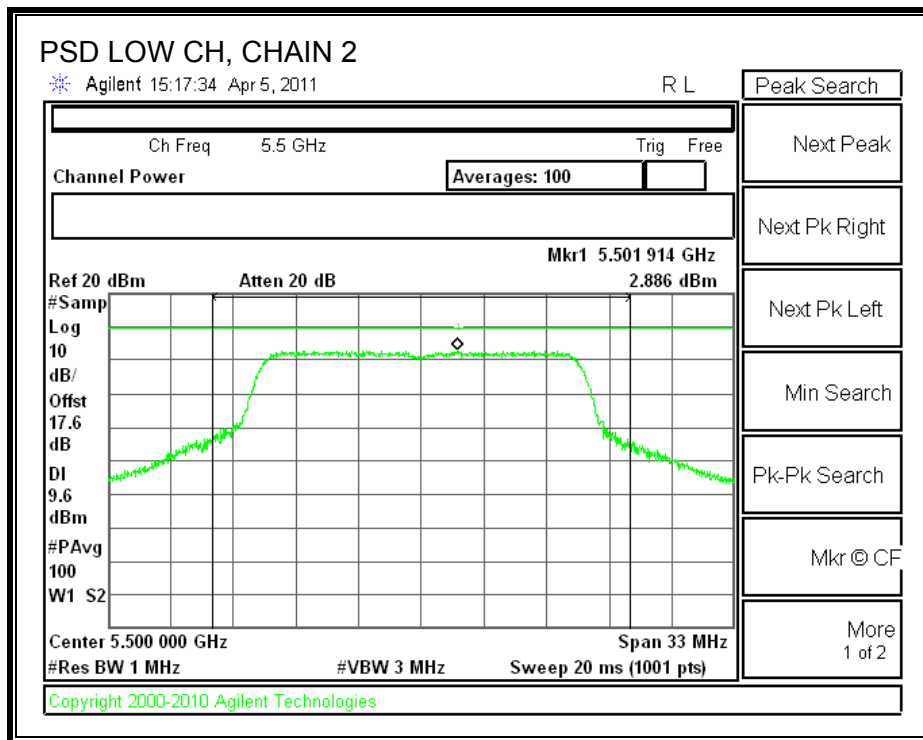
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	2.305	2.886	5.62	9.57	-3.95
Middle	5600	5.194	6.623	8.98	9.57	-0.59
High	5700	0.575	1.609	4.13	9.57	-5.44

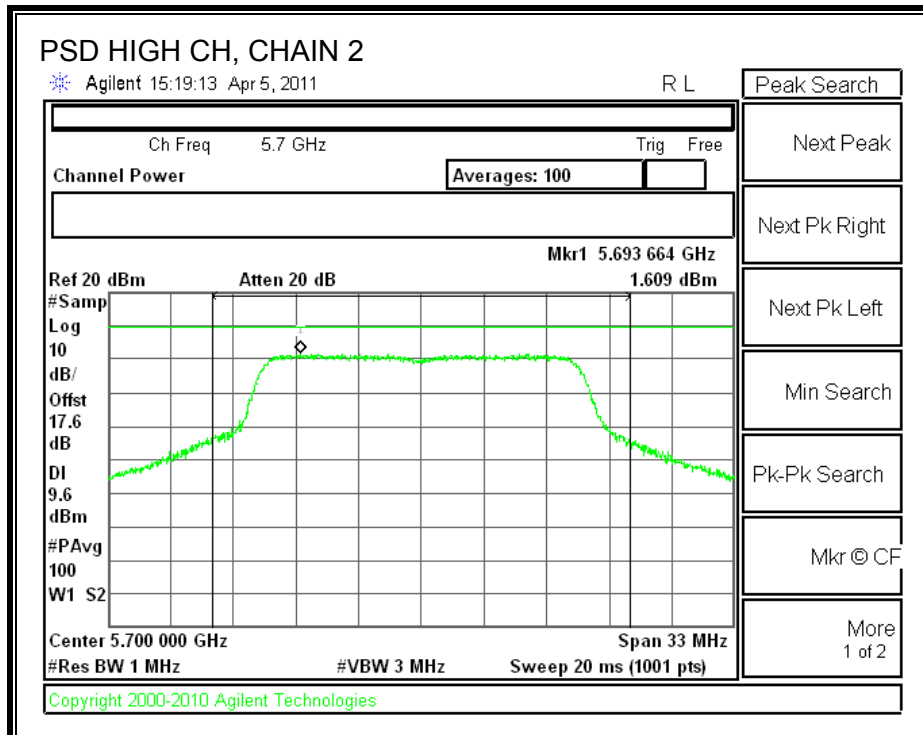
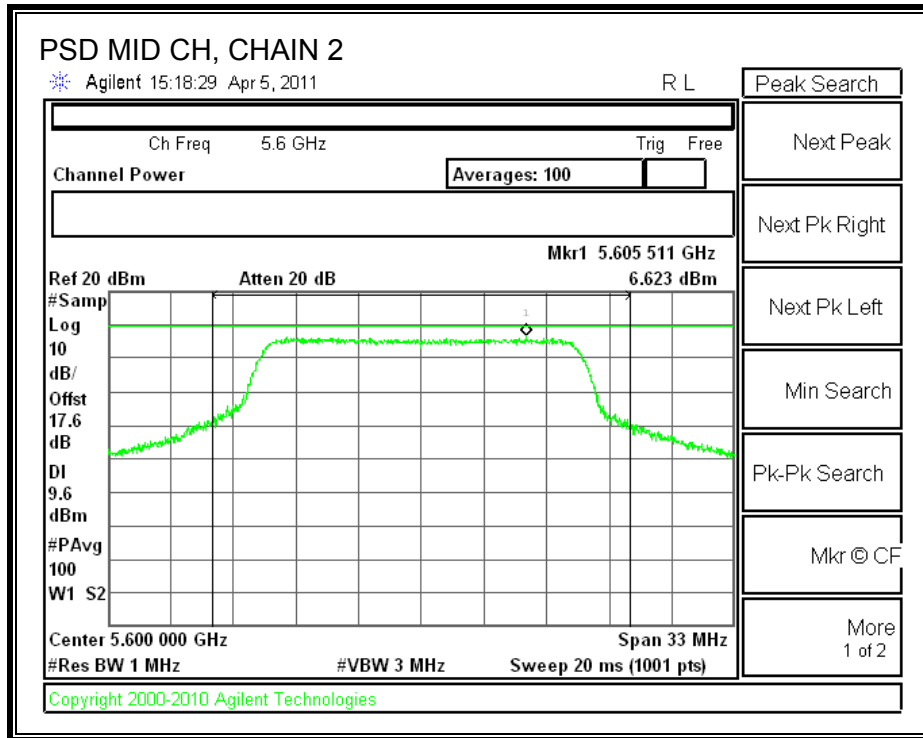
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.7.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

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.

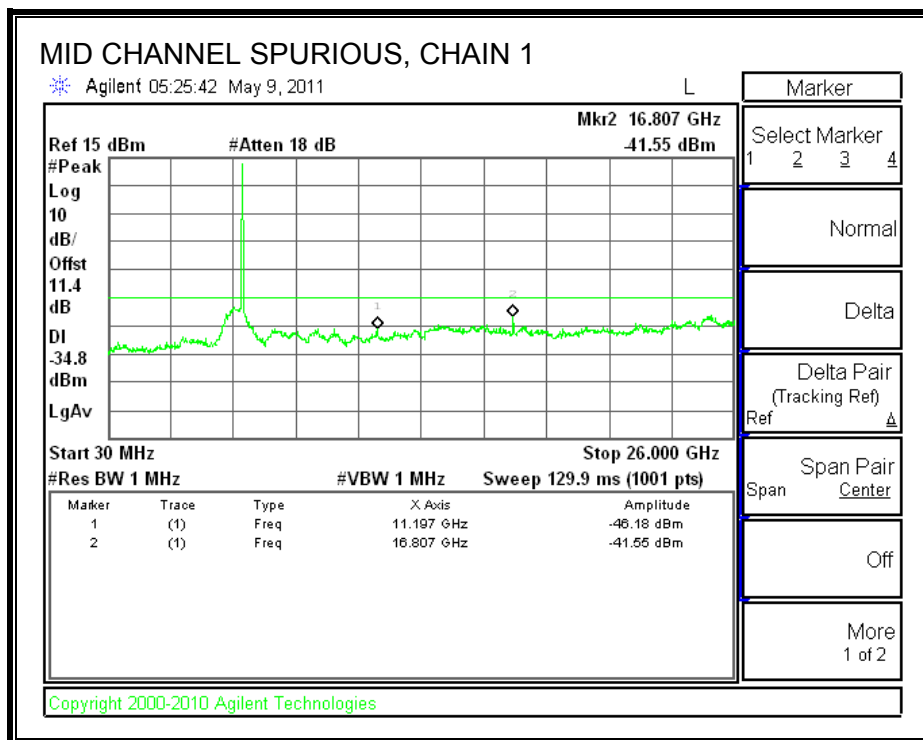
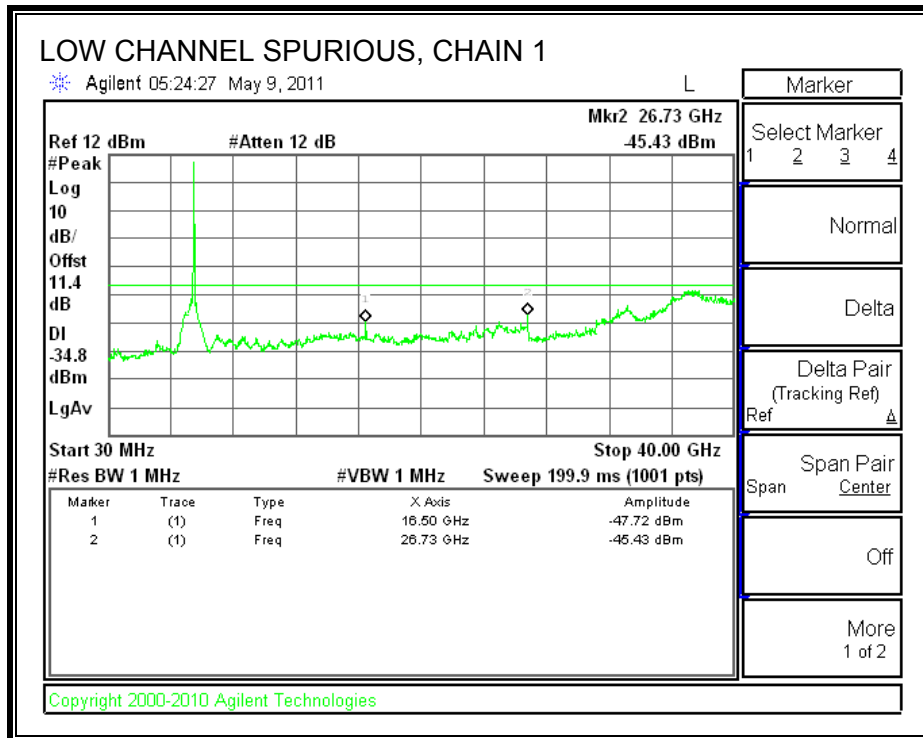
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

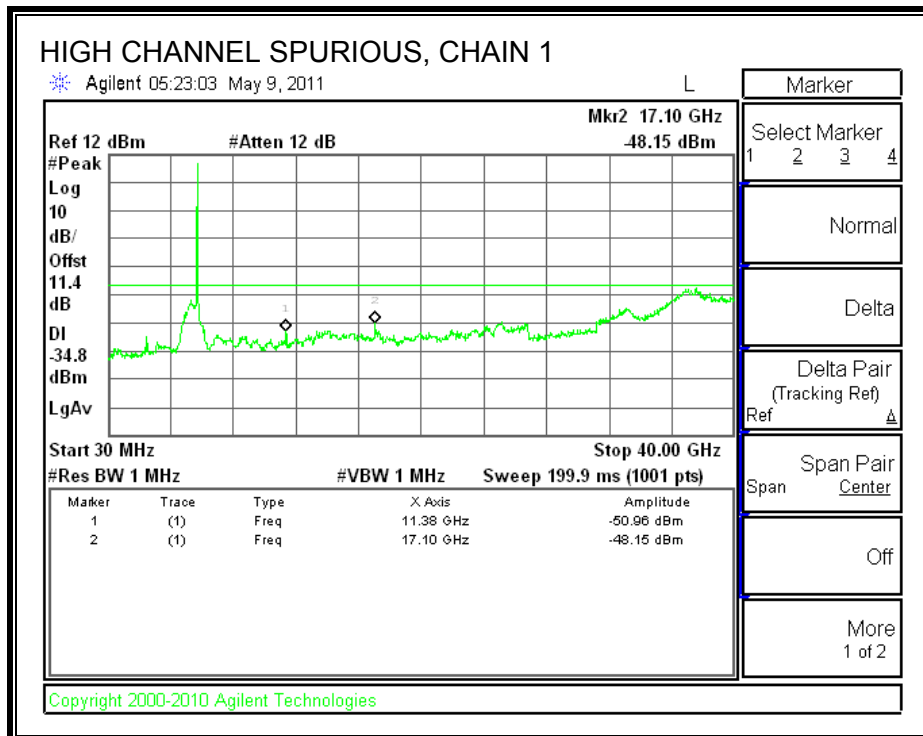
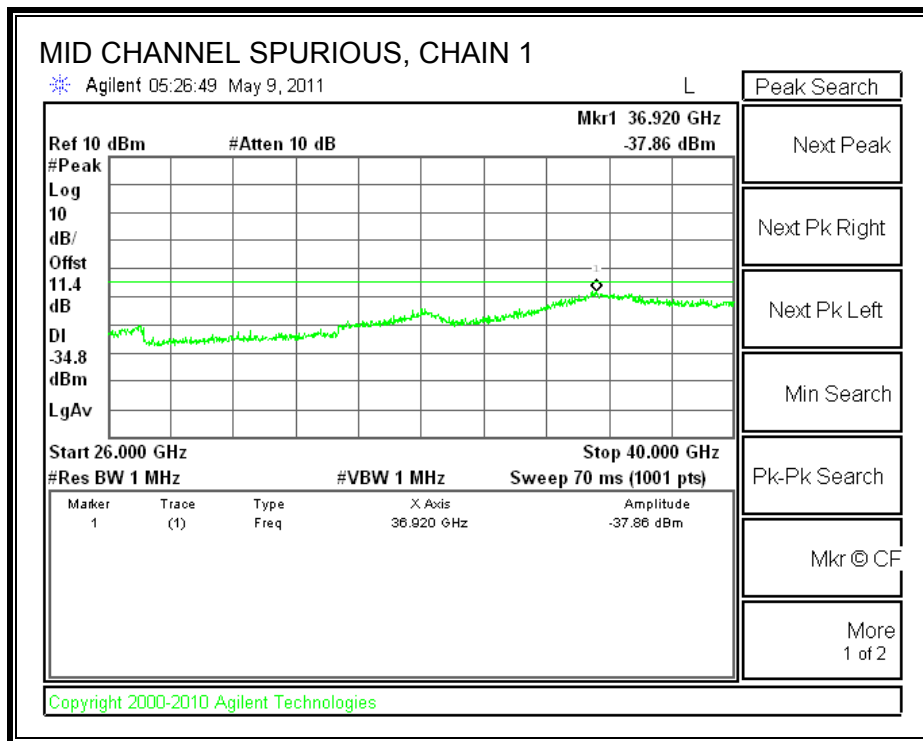
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

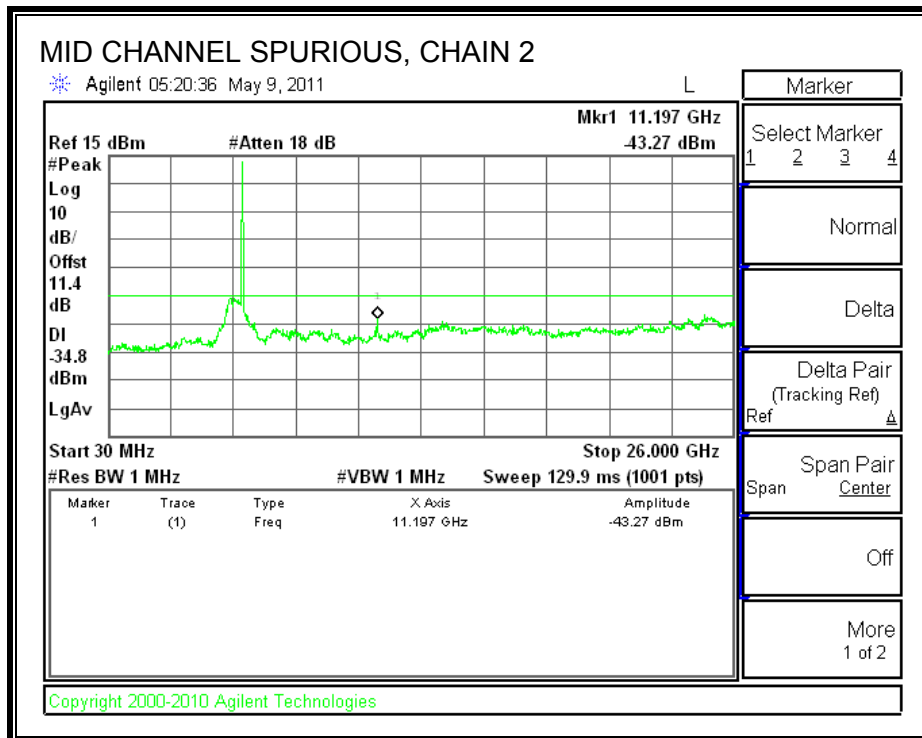
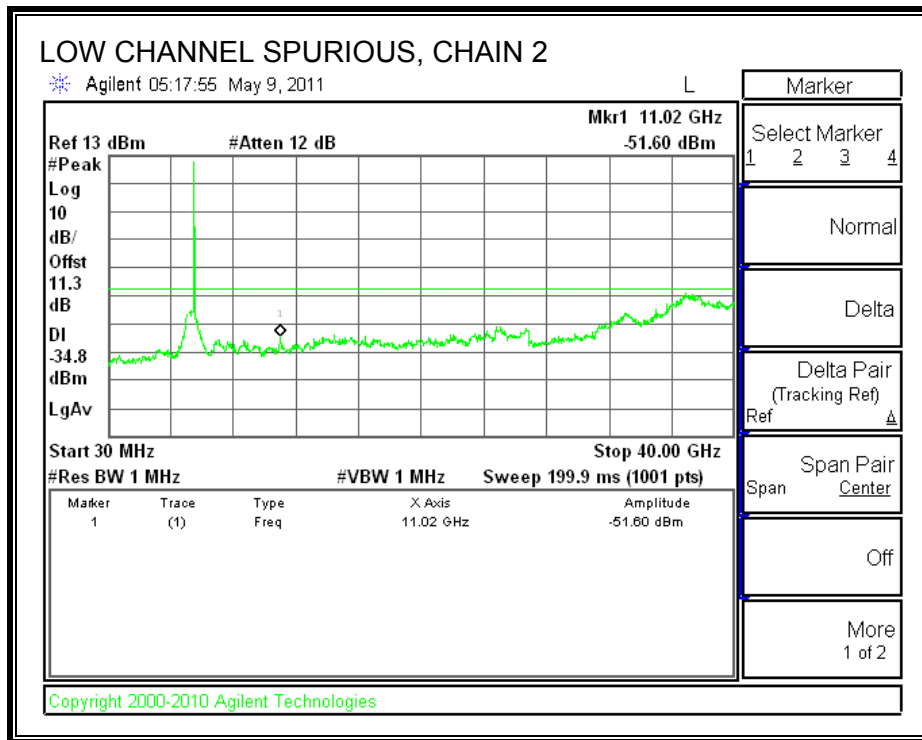
RESULTS

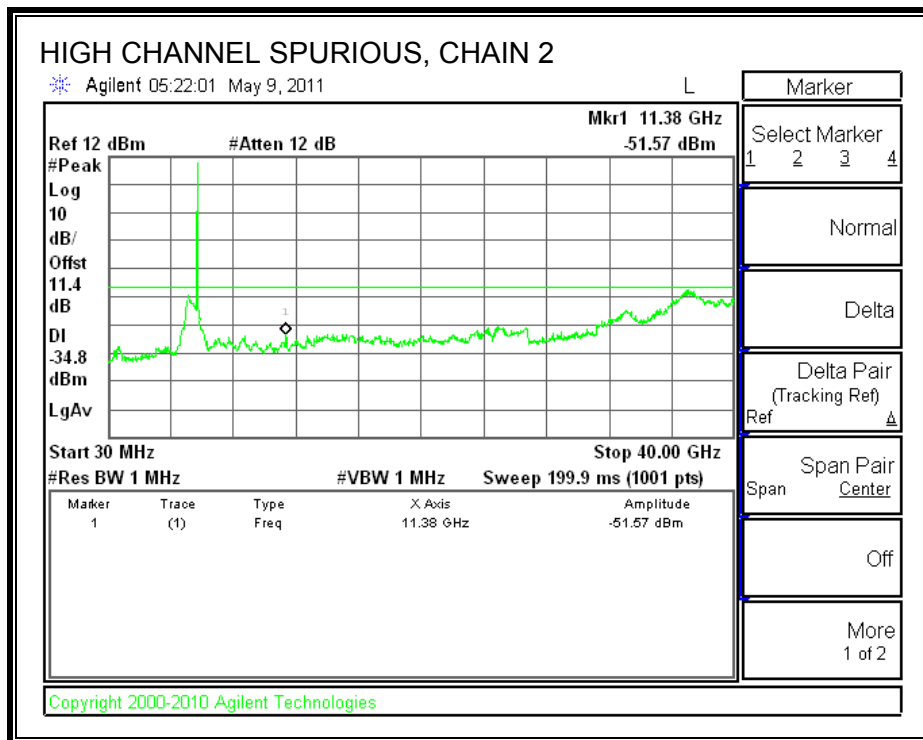
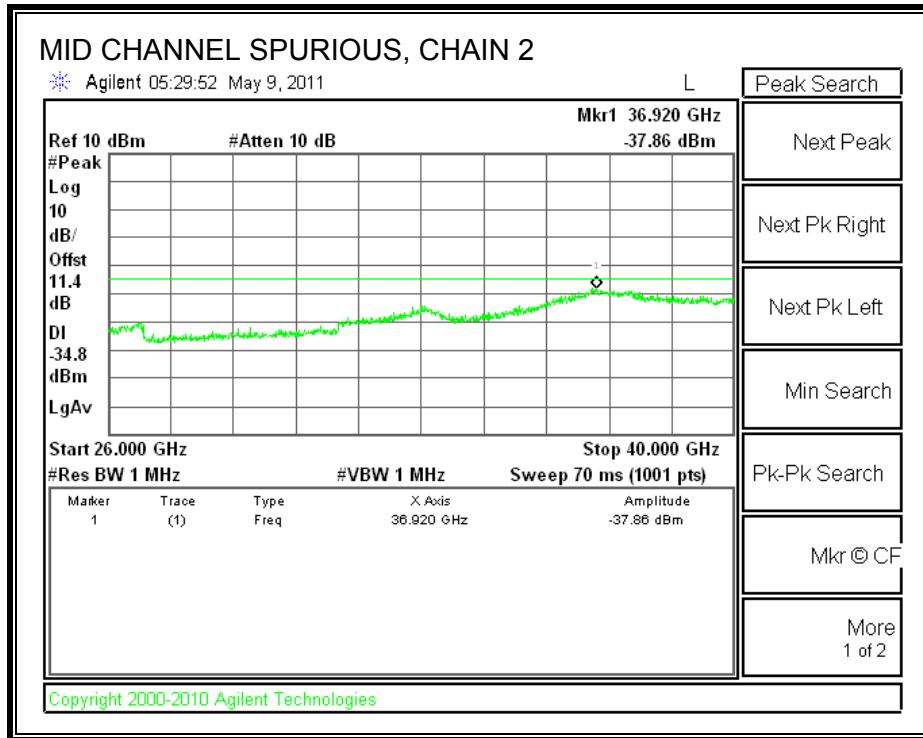
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.8. 802.11n HT20 MODE IN THE 5.6 GHz BAND

7.8.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

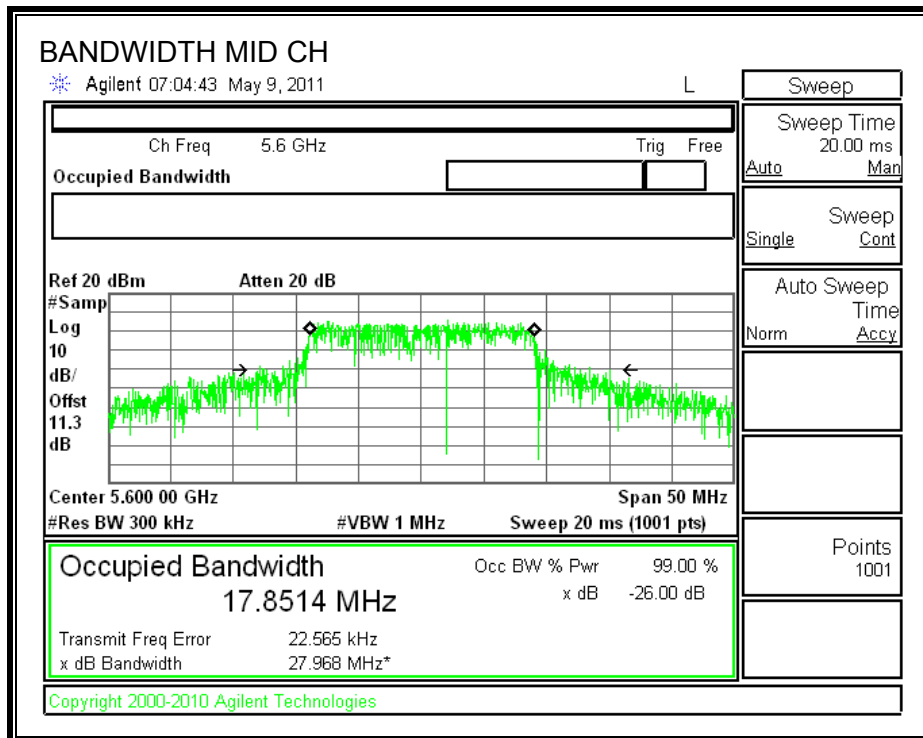
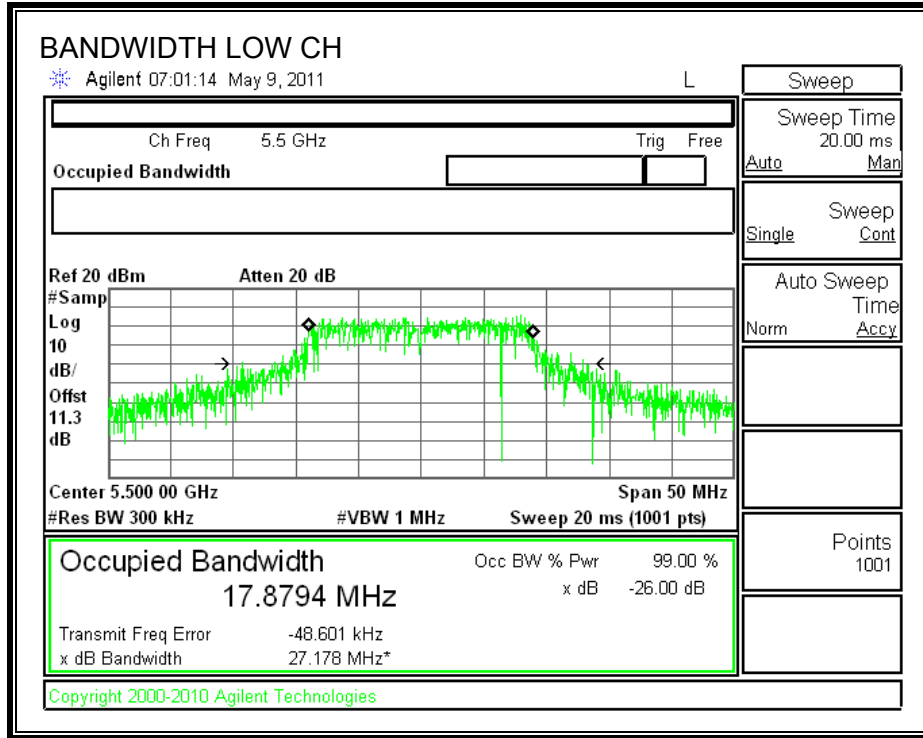
TEST PROCEDURE

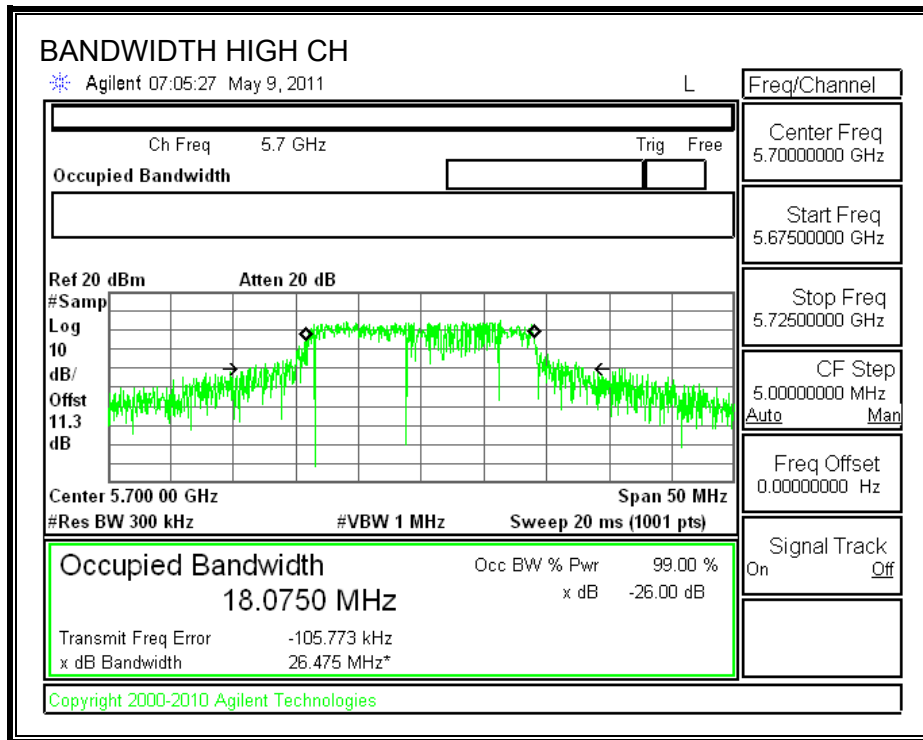
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	27.178
Middle	5600	27.968
High	5700	26.475

26 dB BADWIDTH





7.8.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (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.

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

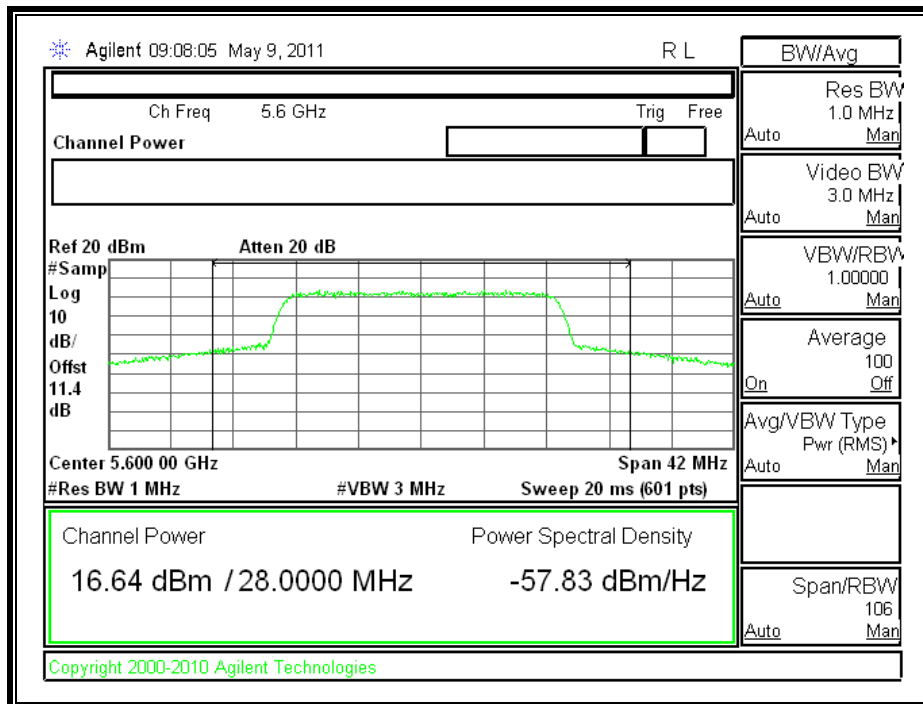
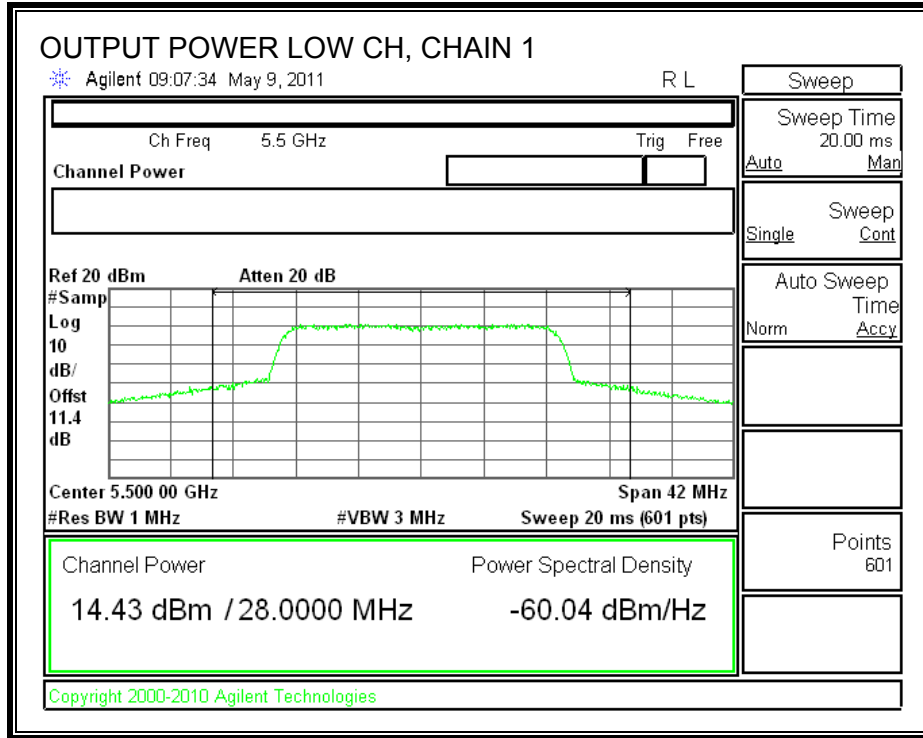
Limit

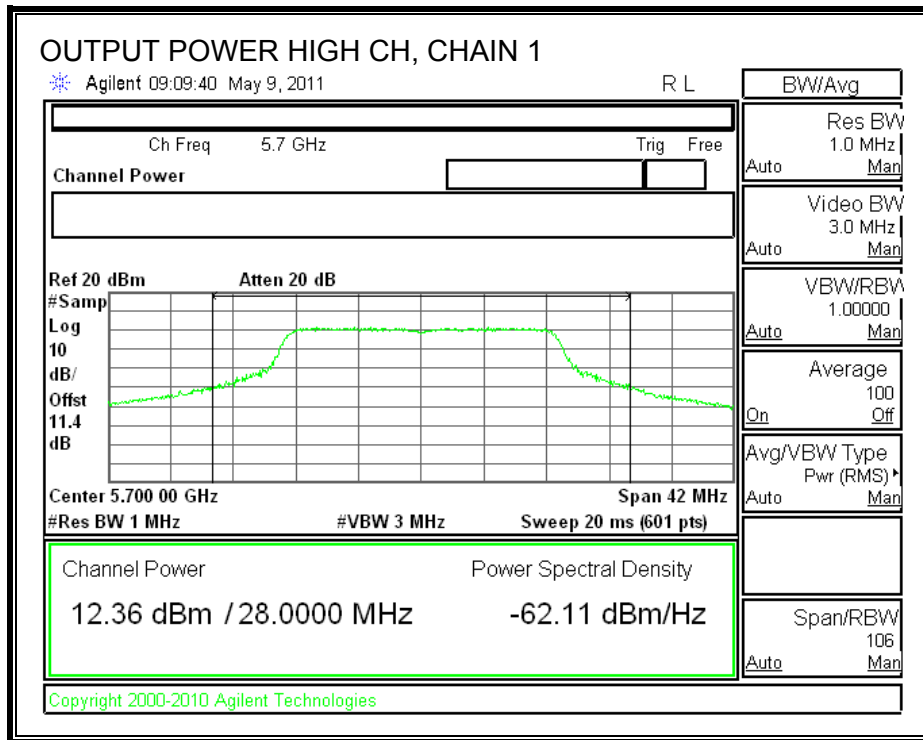
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	27.178	25.34	7.43	22.57
Mid	5600	24	27.968	25.47	7.43	22.57
High	5700	24	26.475	25.23	7.43	22.57

Individual Chain Results

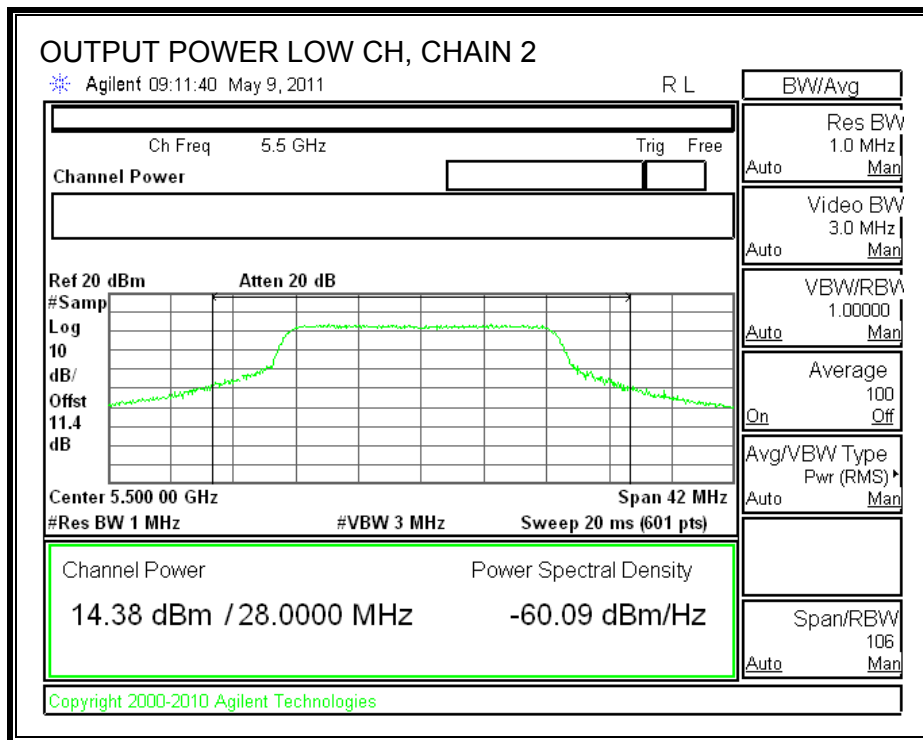
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	14.43	14.38	17.42	22.57	-5.15
Mid	5600	16.64	16.84	19.75	22.57	-2.82
High	5700	12.36	12.80	15.60	22.57	-6.97

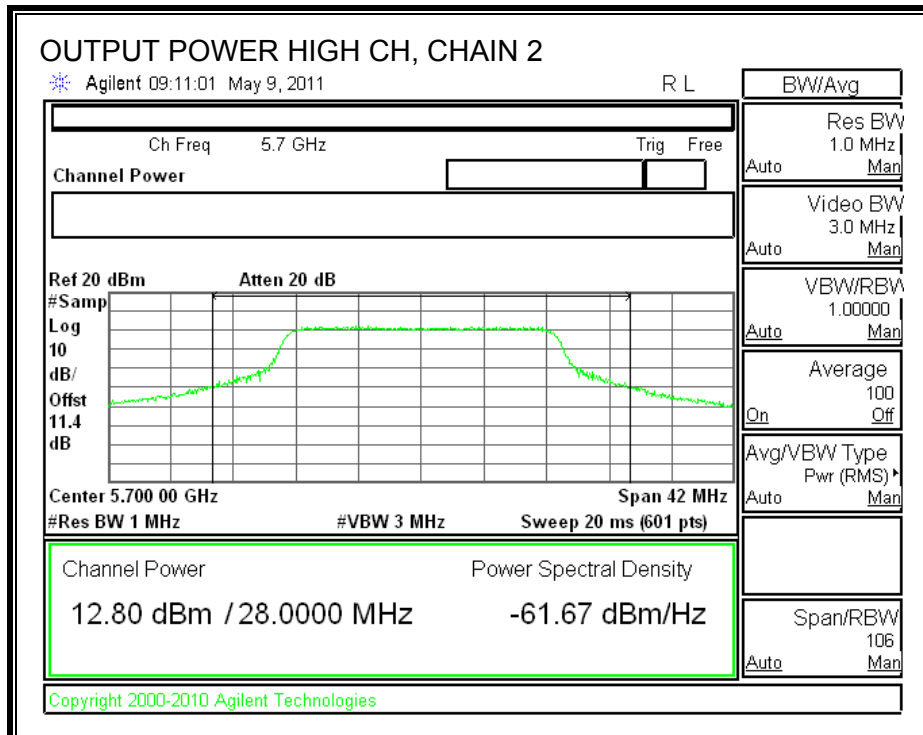
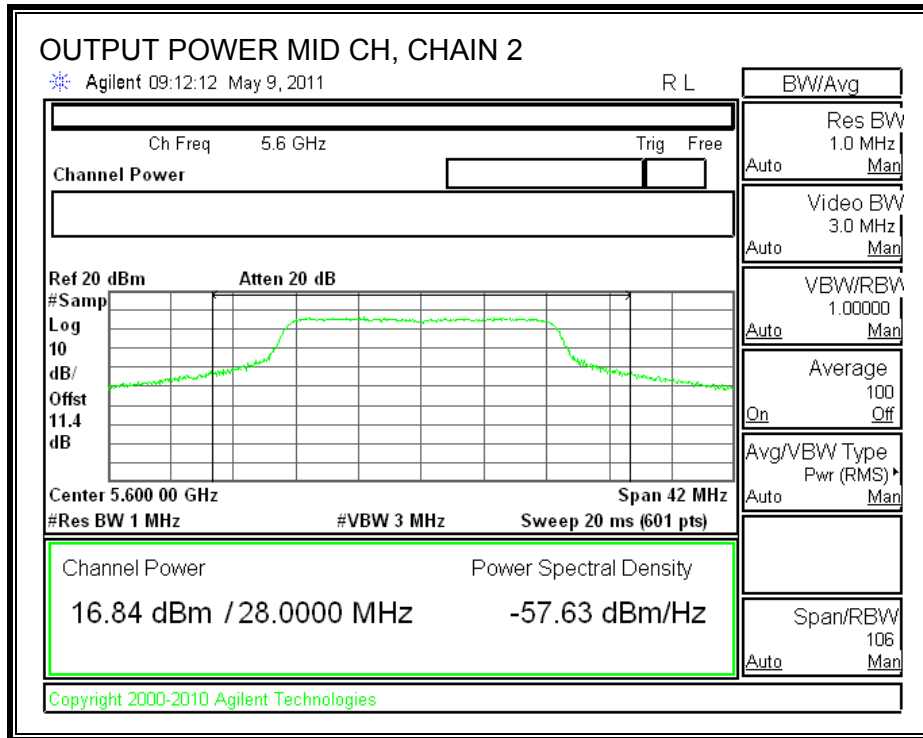
CHAIN 1 OUTPUT POWER





CHAIN 2 OUTPUT POWER





7.8.3. 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 11.3dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5500	14.27	14.20	17.25
Middle	5600	16.55	16.78	19.68
High	5700	12.20	12.50	15.36

7.8.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (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 7.43dBi, therefore the limit is 9.57 dBm.

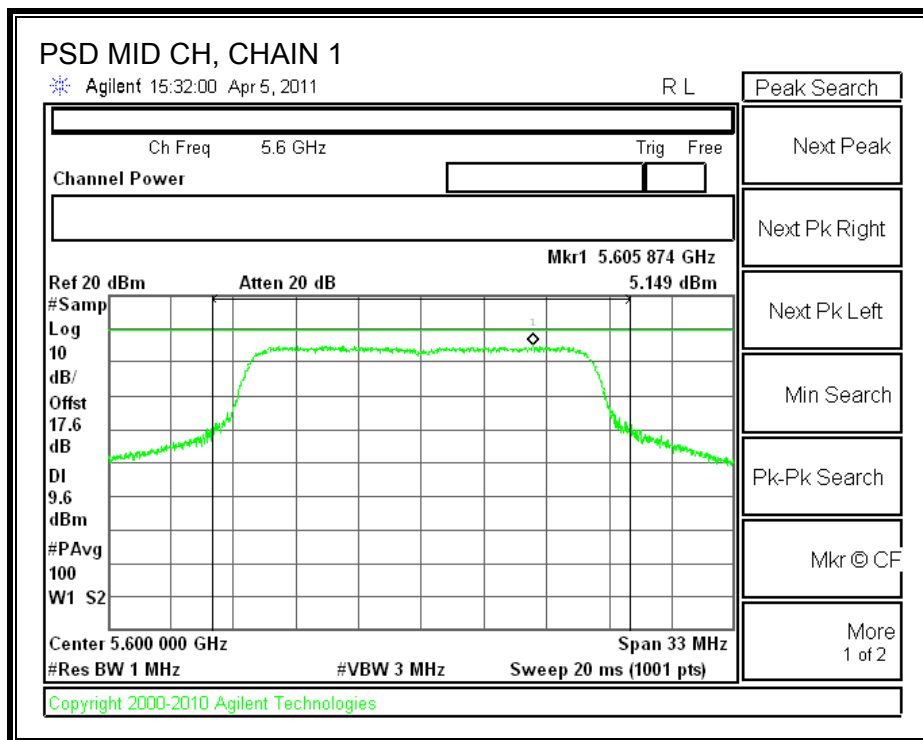
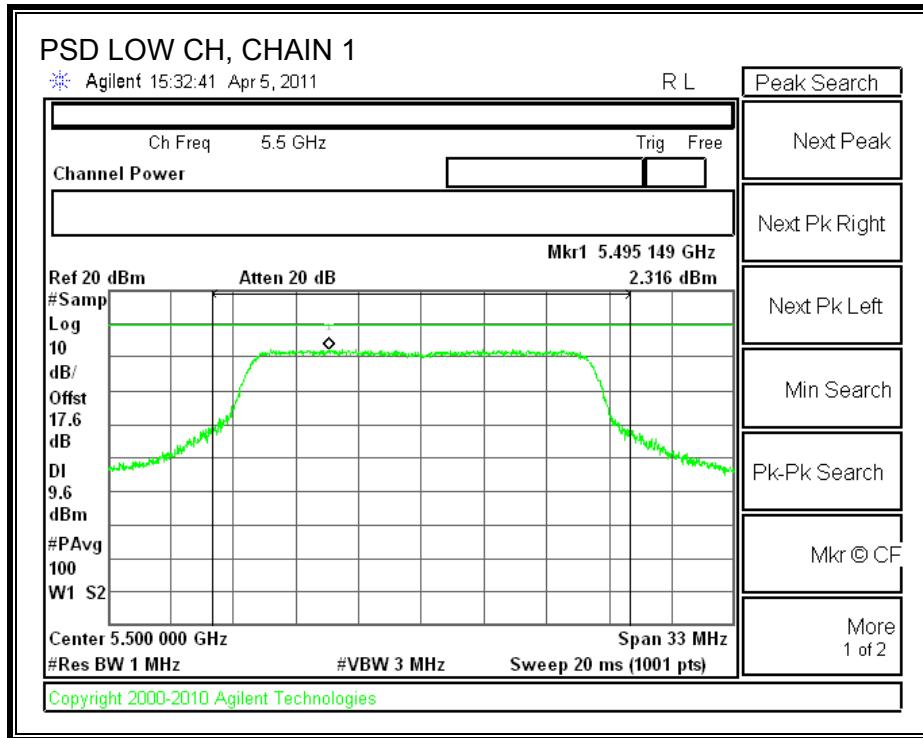
TEST PROCEDURE

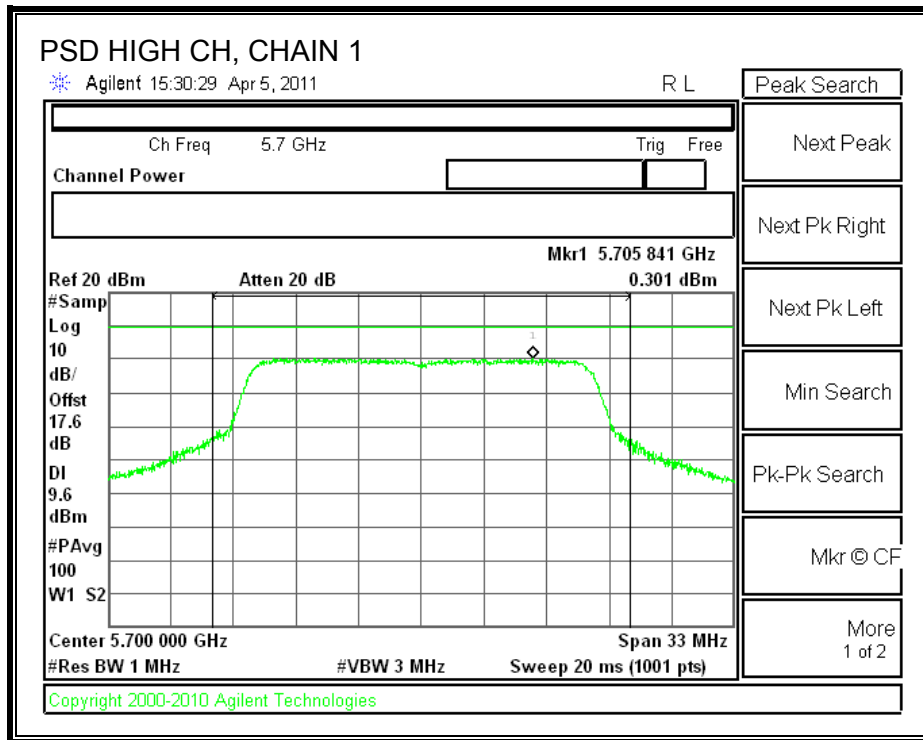
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

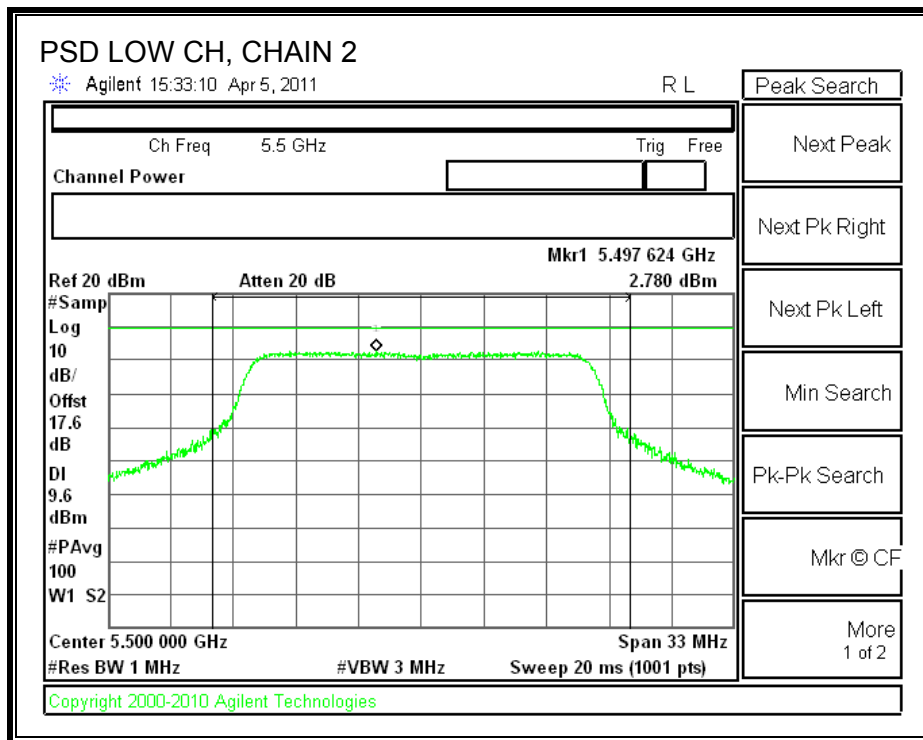
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5500	2.316	2.78	5.56	9.57	-4.01
Middle	5600	5.149	5.897	8.55	9.57	-1.02
High	5670	0.301	1.256	3.81	9.57	-5.76

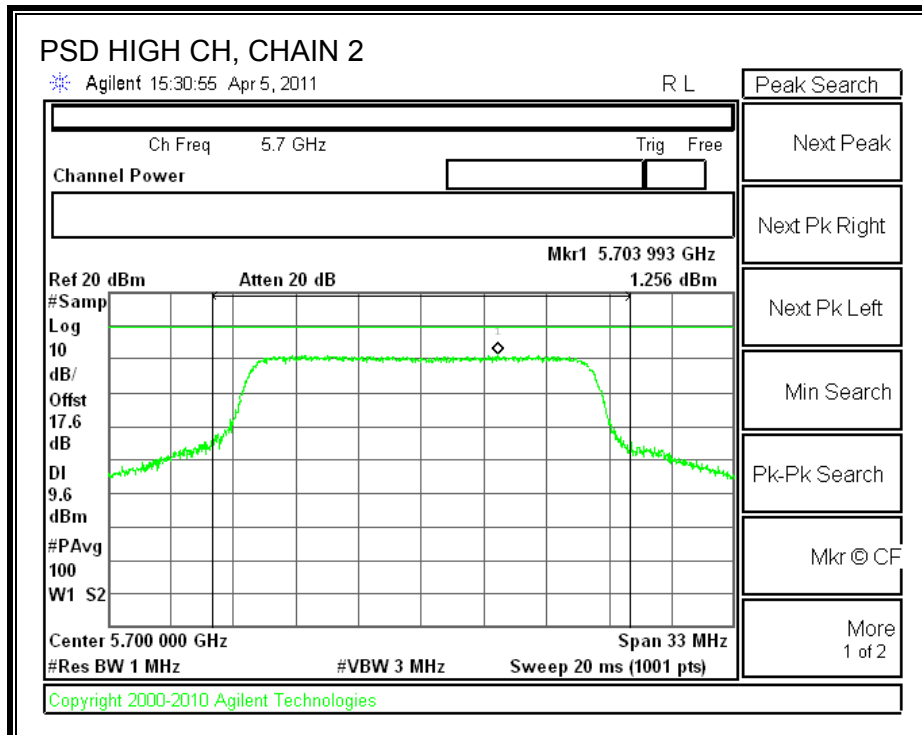
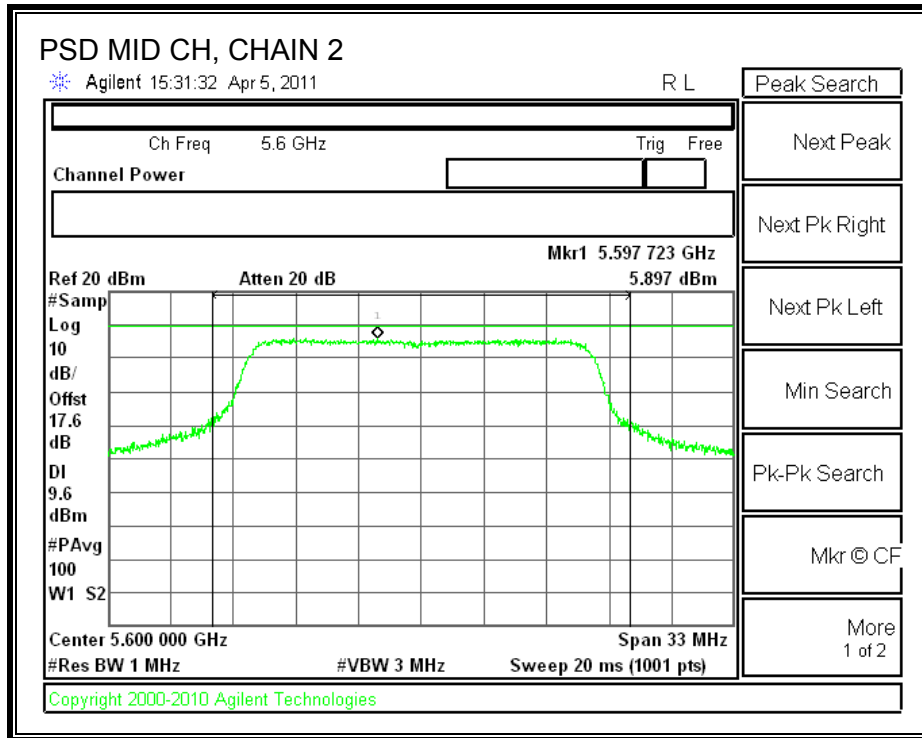
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.8.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

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.

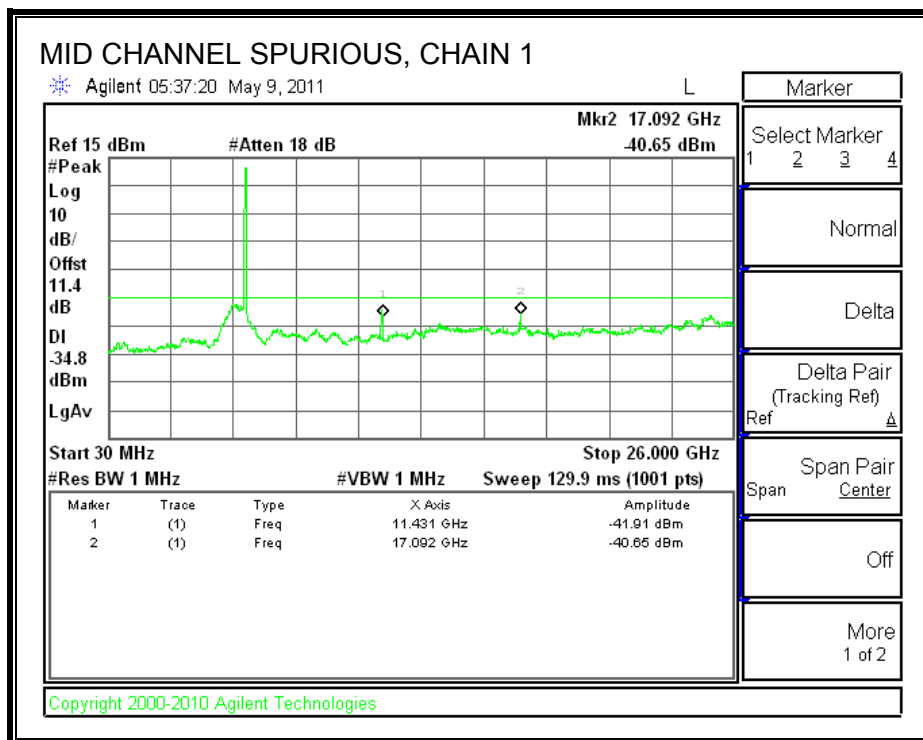
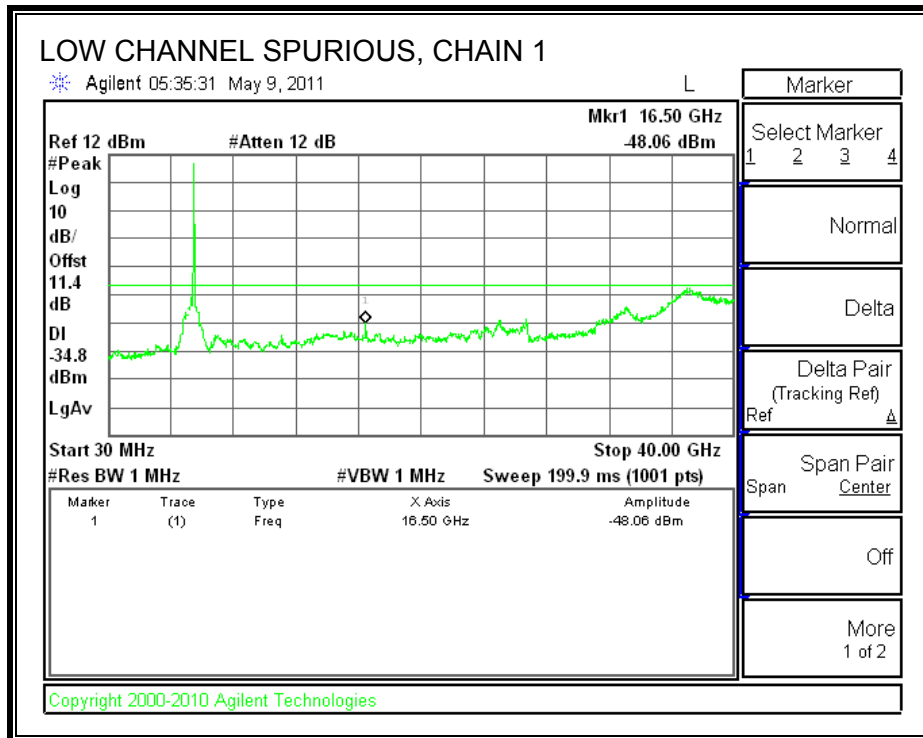
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

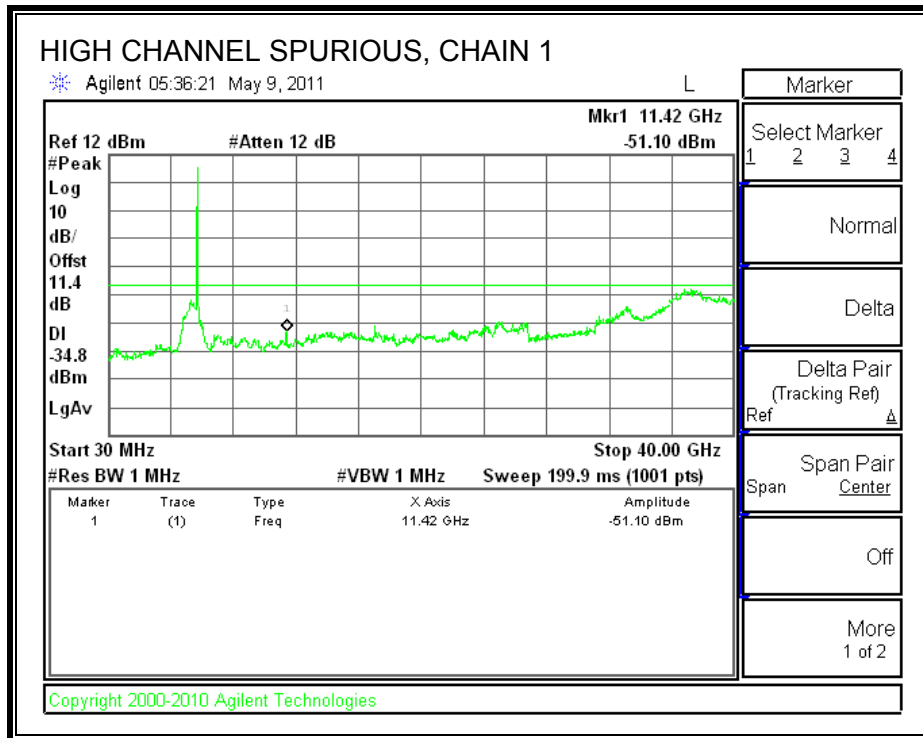
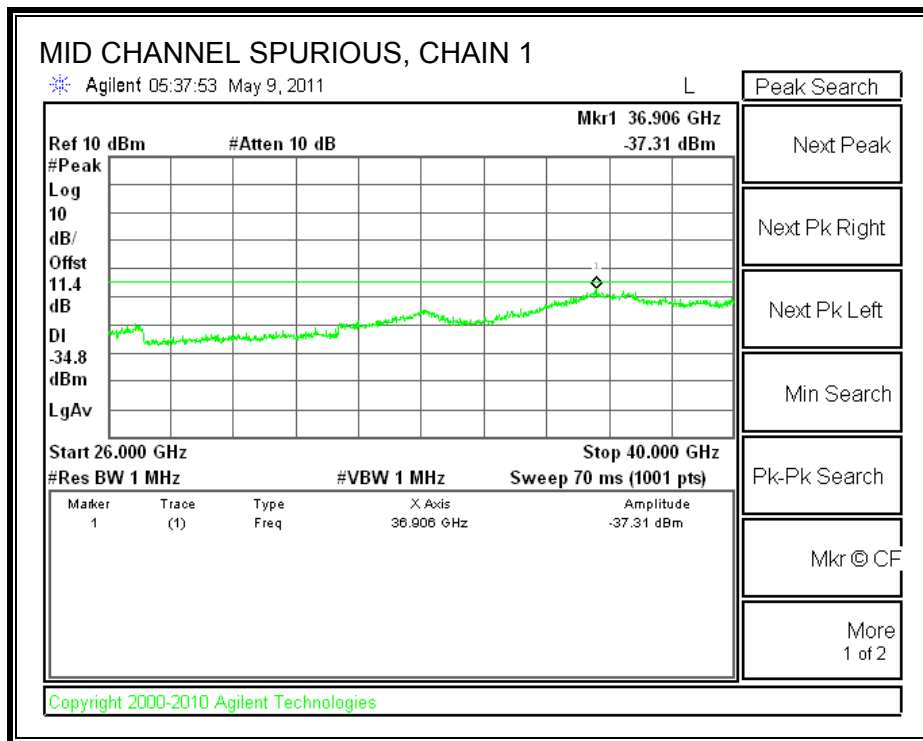
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

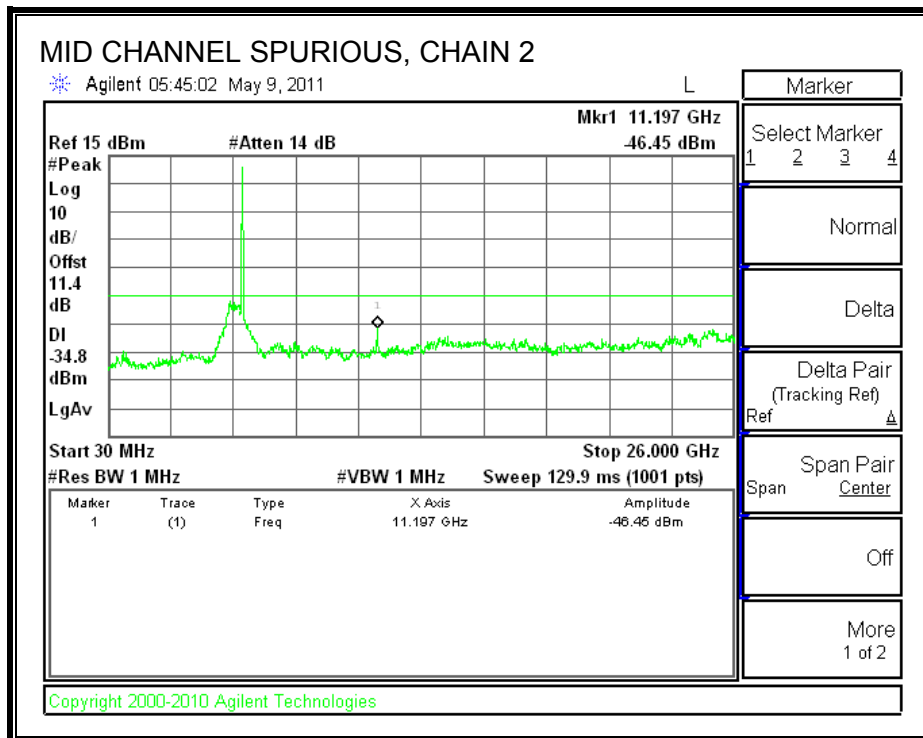
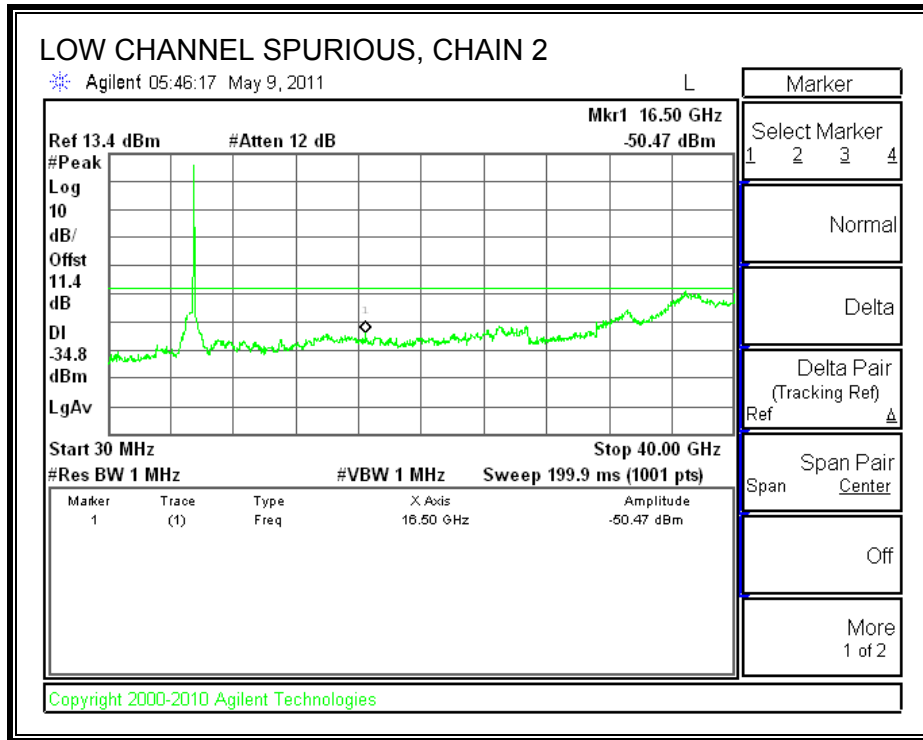
RESULTS

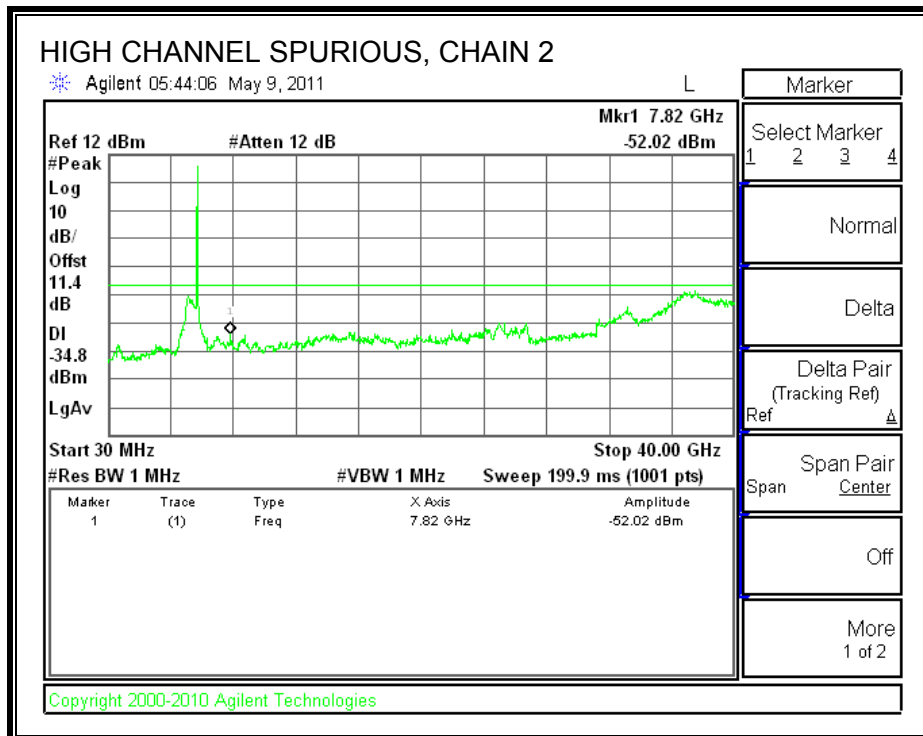
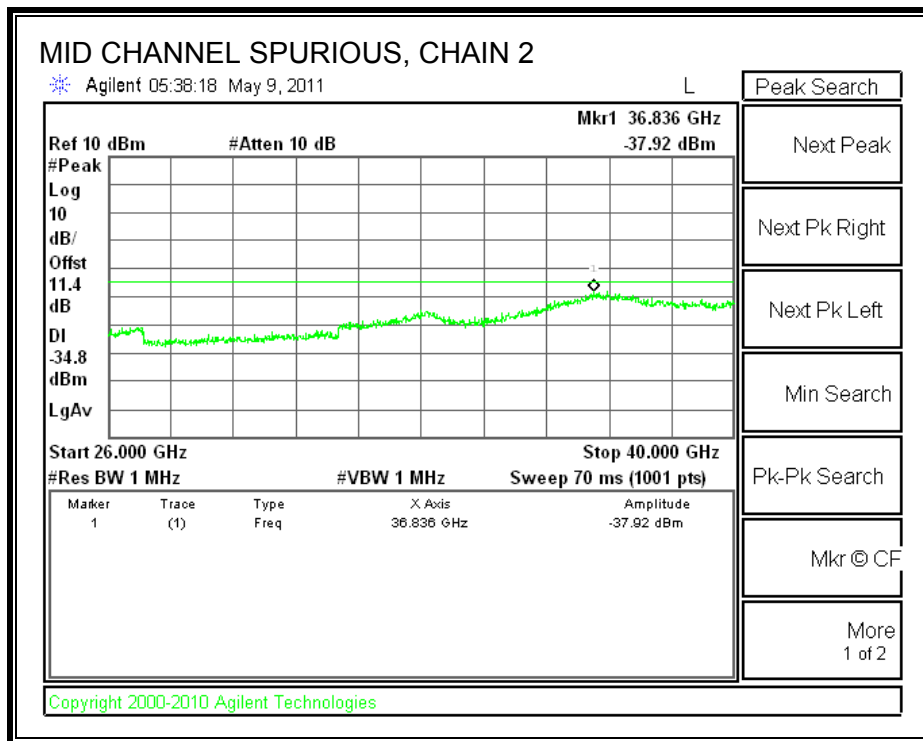
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





7.9. 802.11n HT40 MODE IN THE 5.6 GHz BAND

7.9.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

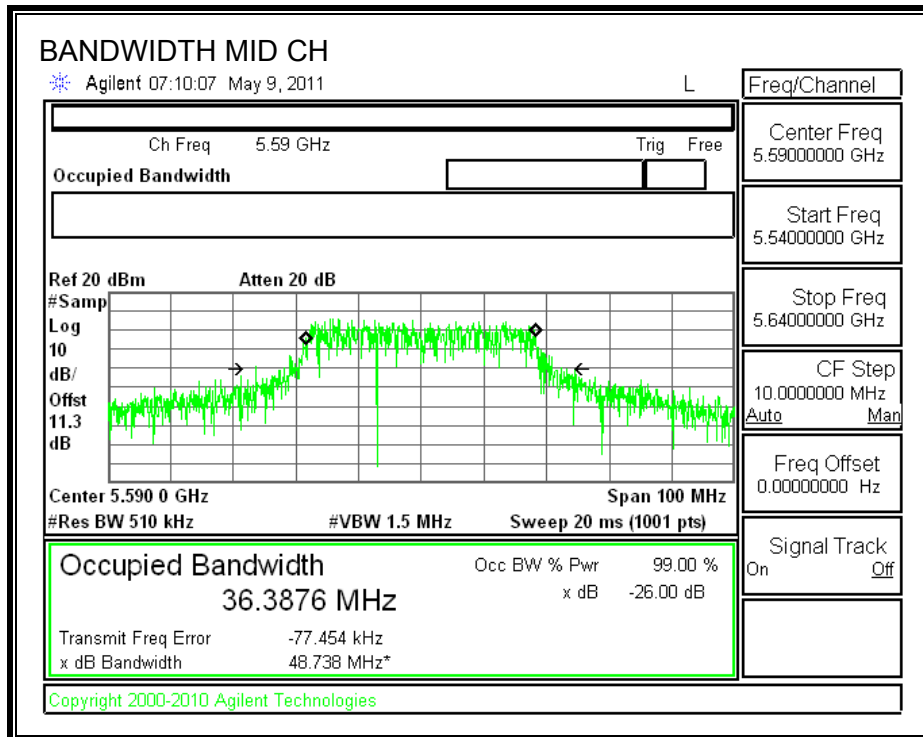
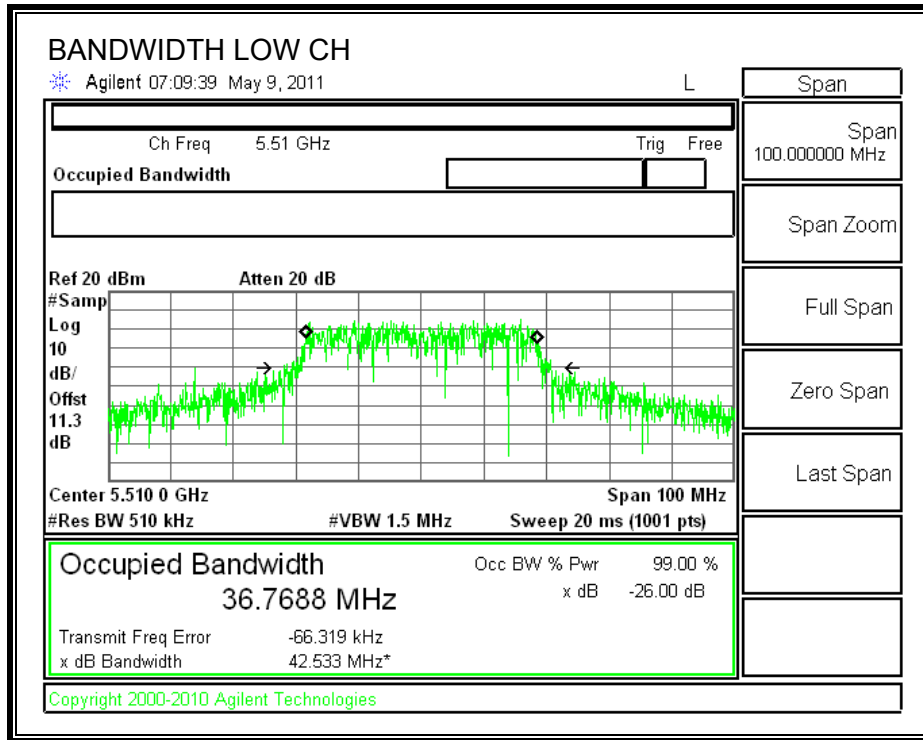
TEST PROCEDURE

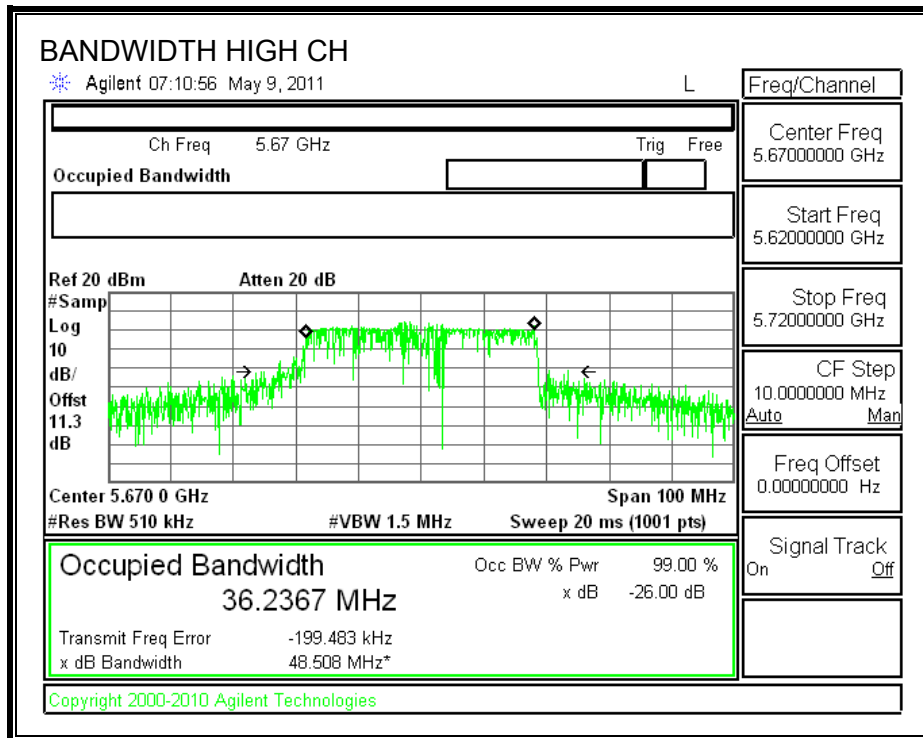
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	42.533
Middle	5590	48.738
High	5670	48.508

26 dB BANDWIDTH





7.9.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (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.

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

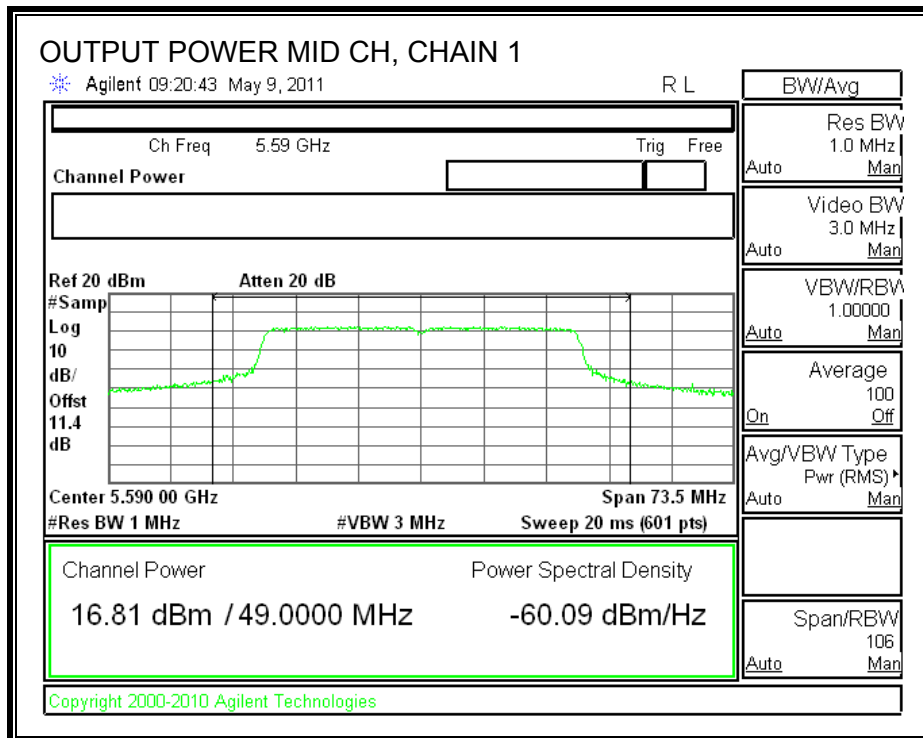
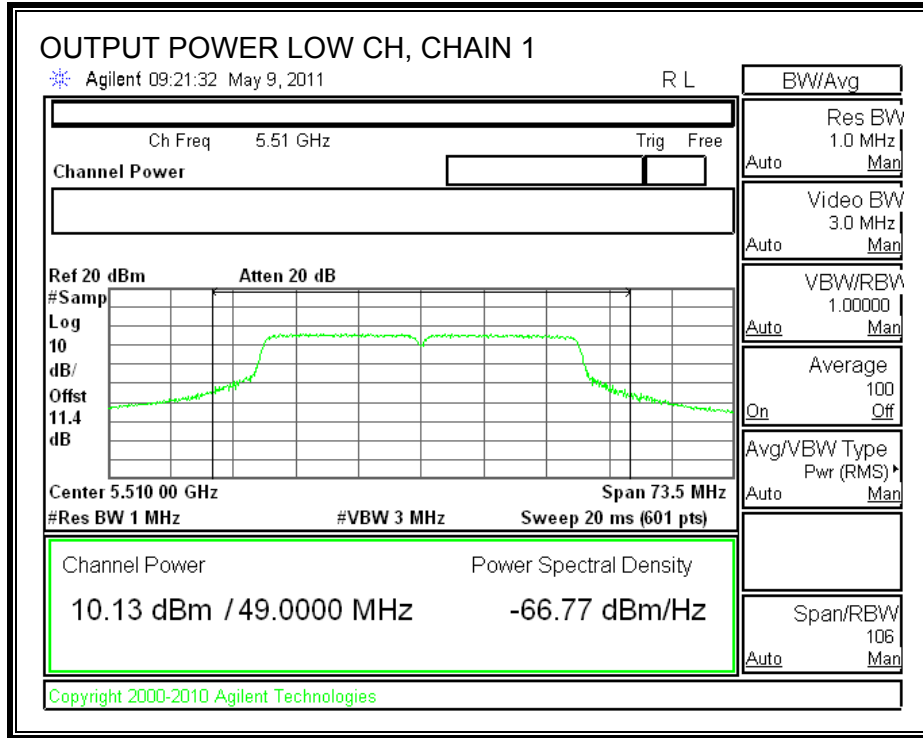
Limit

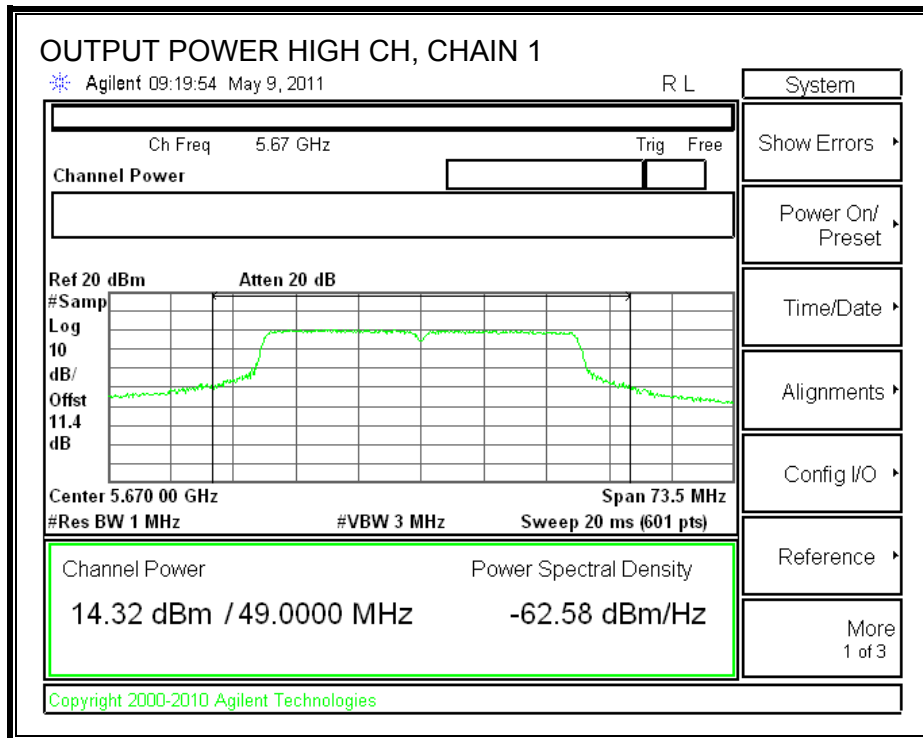
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5510	24	42.533	27.29	7.43	22.57
Mid	5550	24	48.738	27.88	7.43	22.57
High	5670	24	48.508	27.86	7.43	22.57

Individual Chain Results

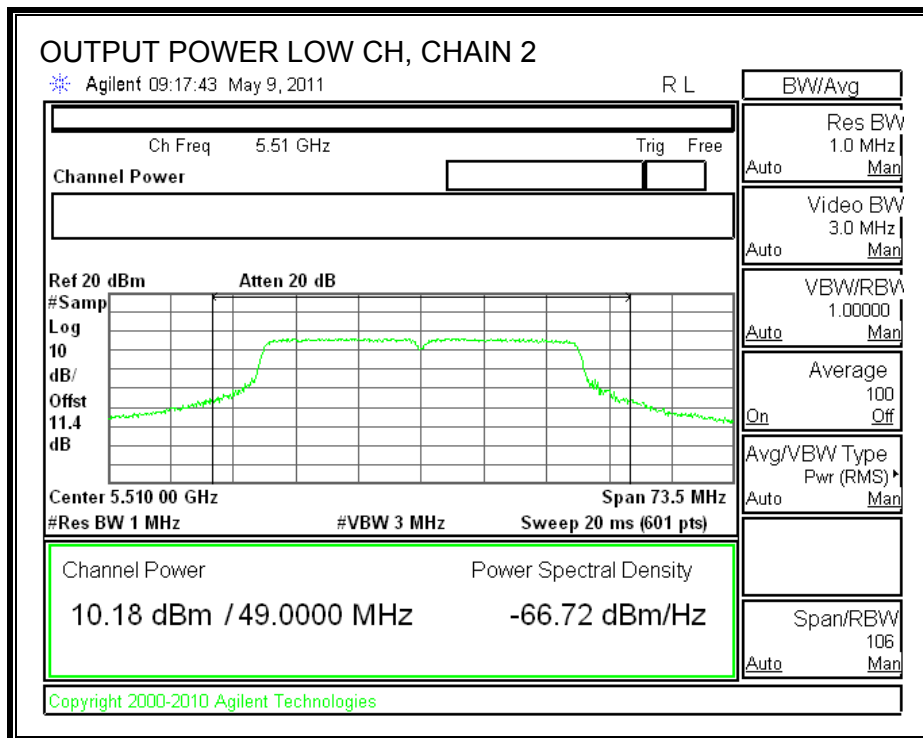
Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5510	10.13	10.18	13.17	22.57	-9.40
Mid	5590	16.81	16.84	19.84	22.57	-2.73
High	5670	14.32	14.50	17.42	22.57	-5.15

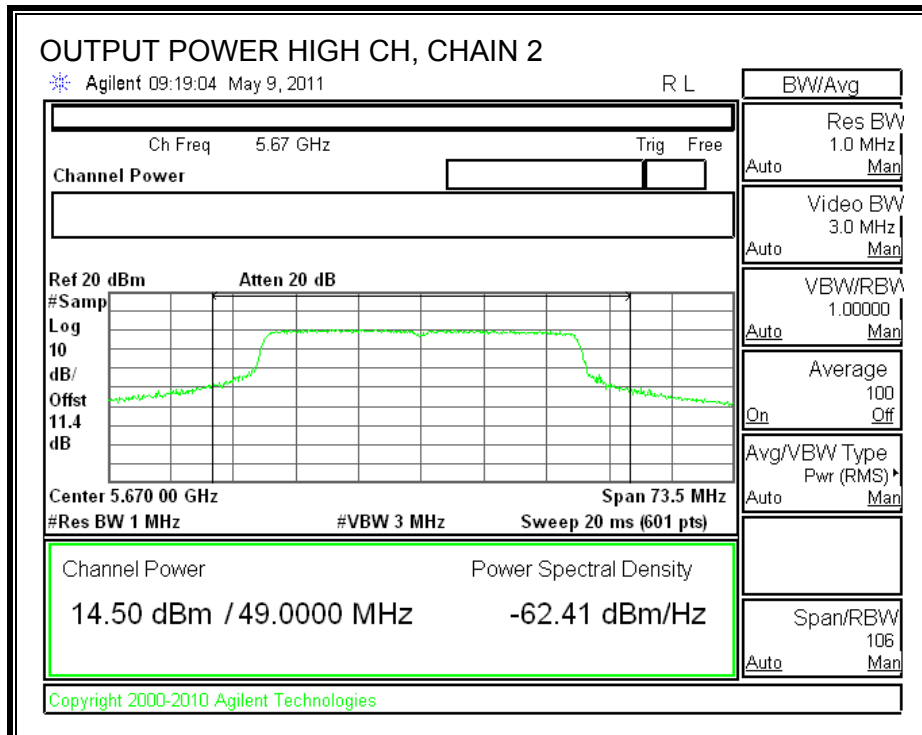
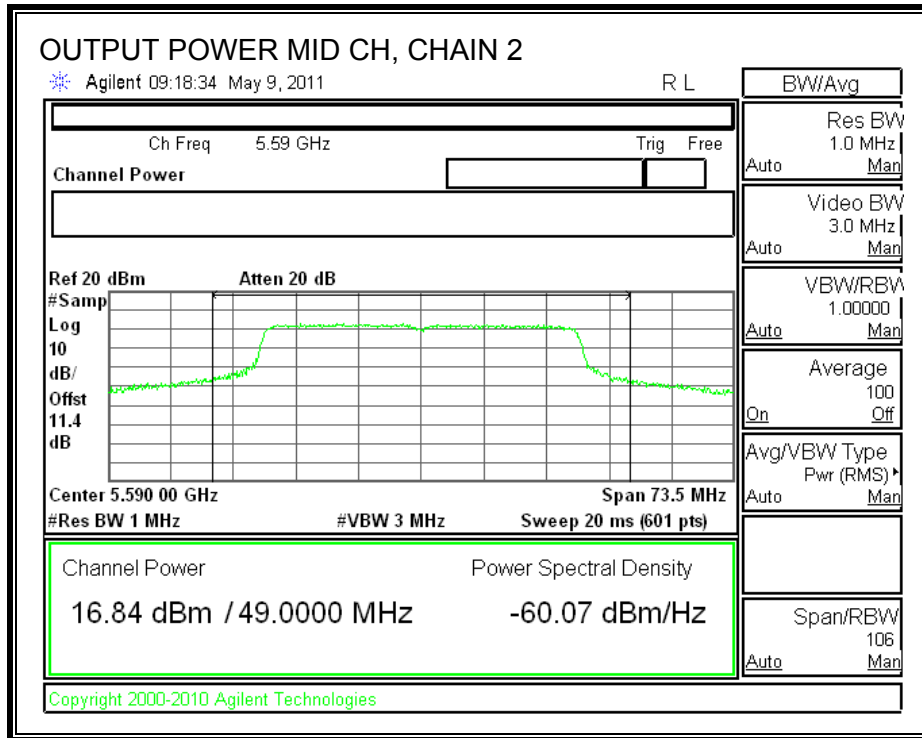
CHAIN 1 OUTPUT POWER





CHAIN 2 OUTPUT POWER





7.9.3. 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 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5510	9.95	10.00	12.99
Middle	5590	16.65	16.75	19.71
High	5670	14.25	14.37	17.32

7.9.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (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 7.43 dBi, therefore the limit is 9.57 dBm.

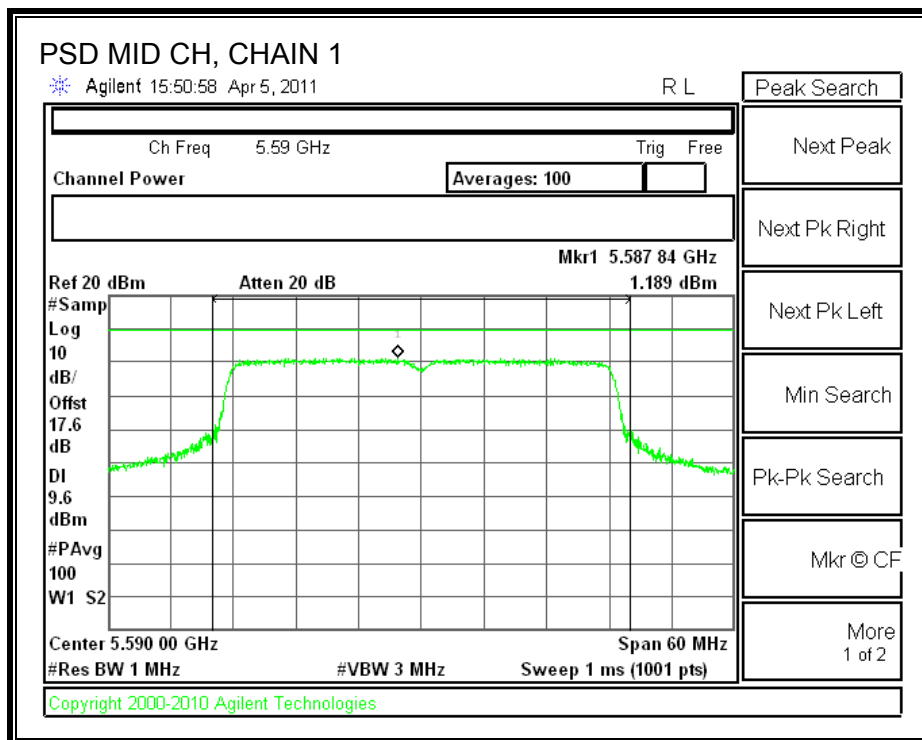
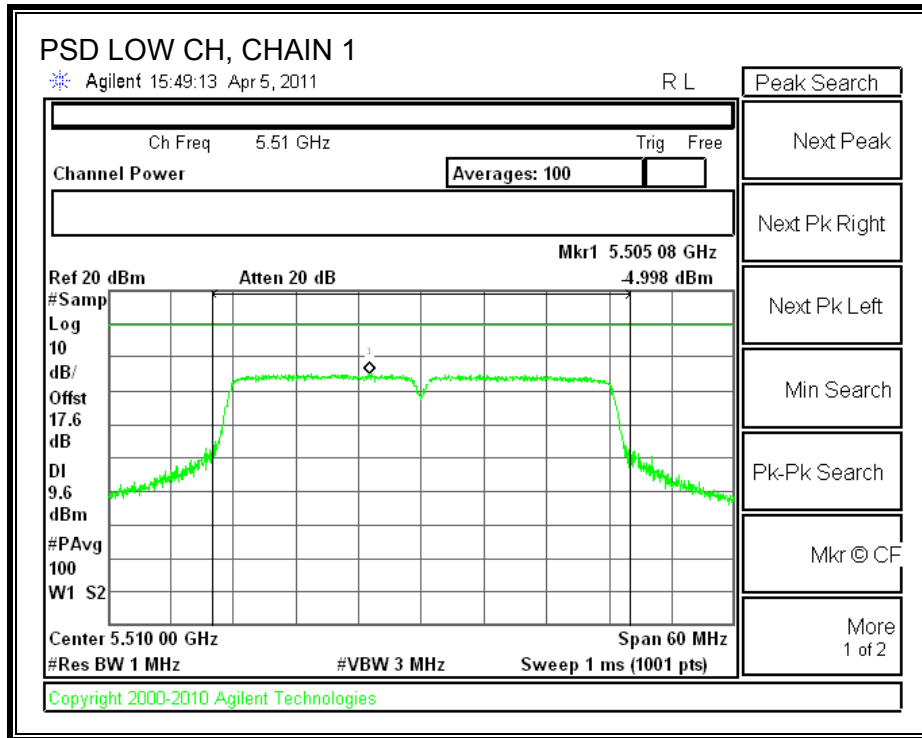
TEST PROCEDURE

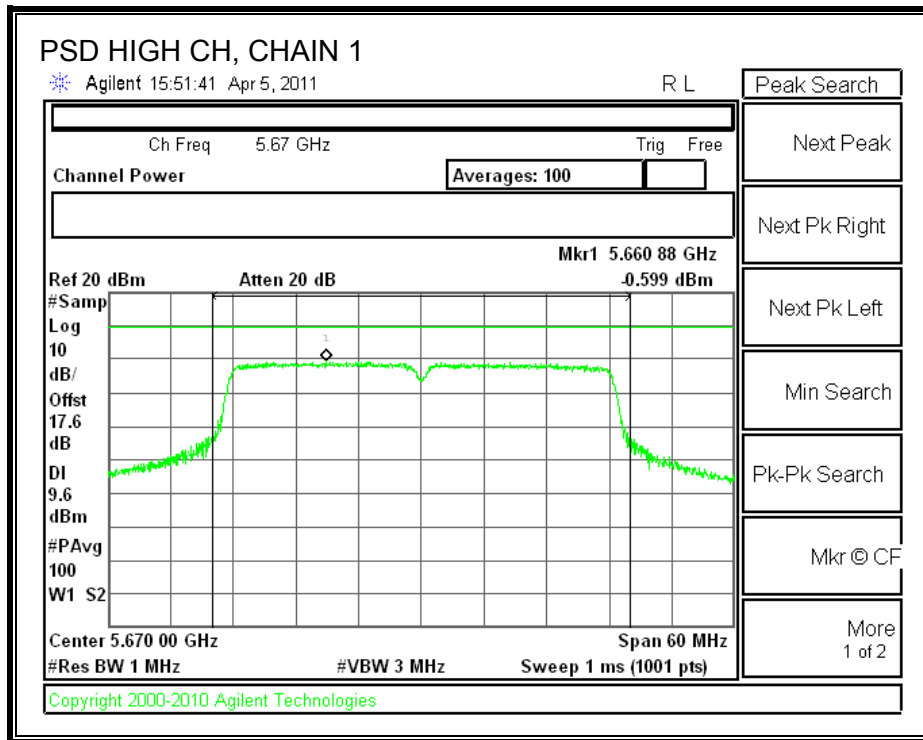
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

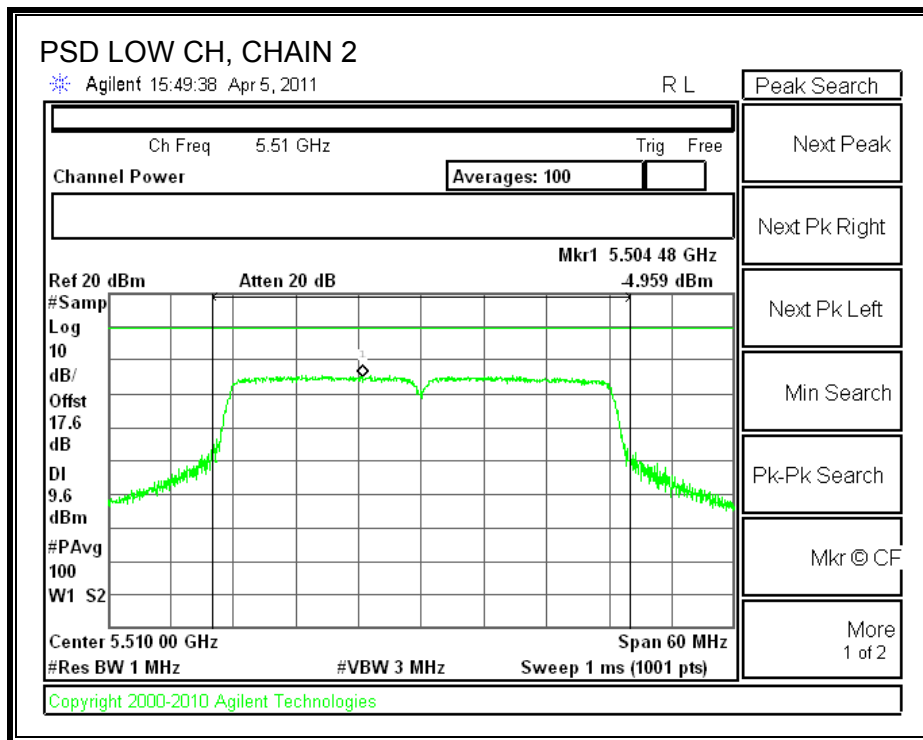
Channel	Frequency (MHz)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5510	-4.998	-4.959	-1.97	9.57	-11.54
Middle	5590	1.189	2.58	4.95	9.57	-4.62
High	5670	-0.599	0.112	2.78	9.57	-6.79

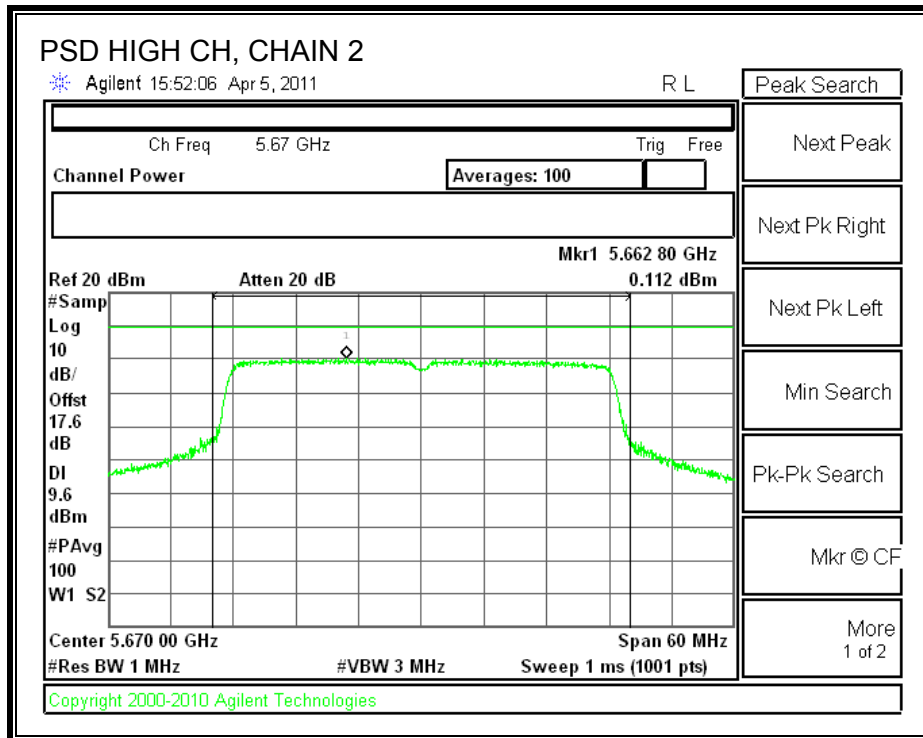
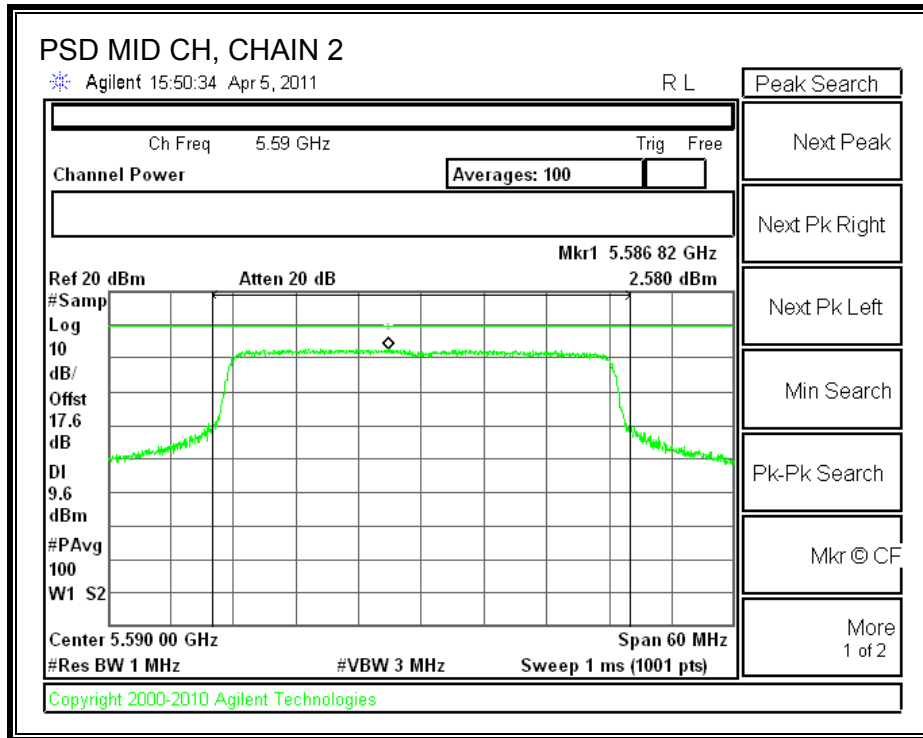
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.9.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

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.

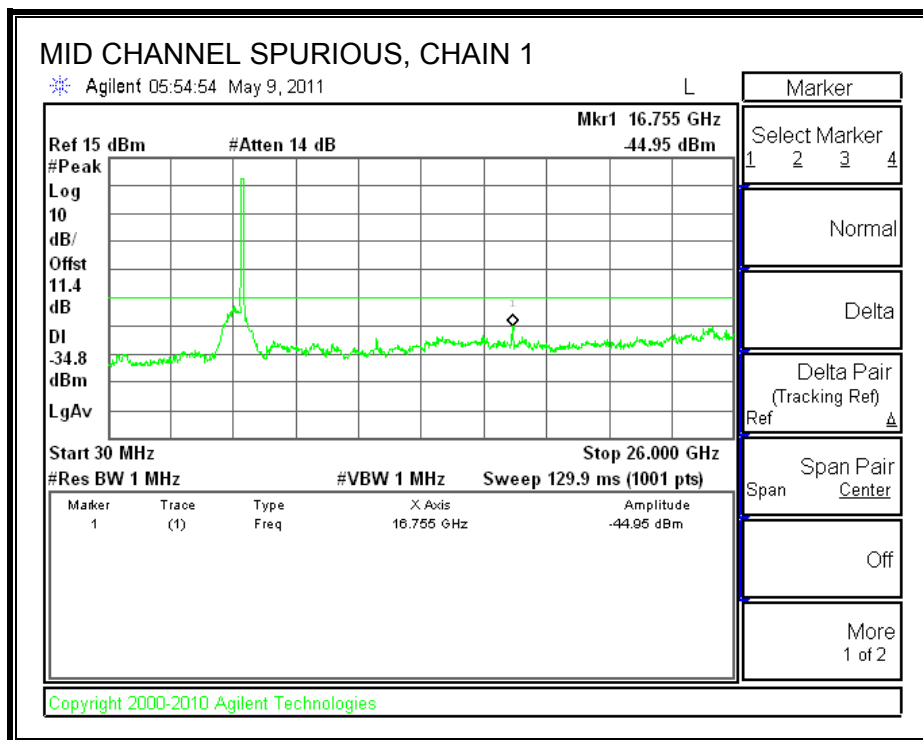
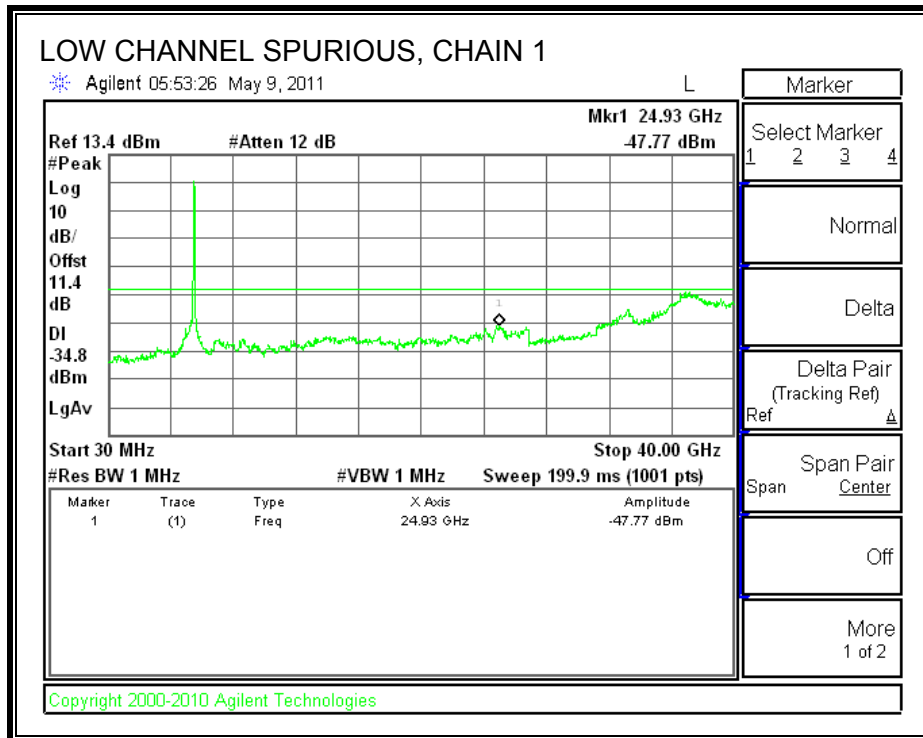
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

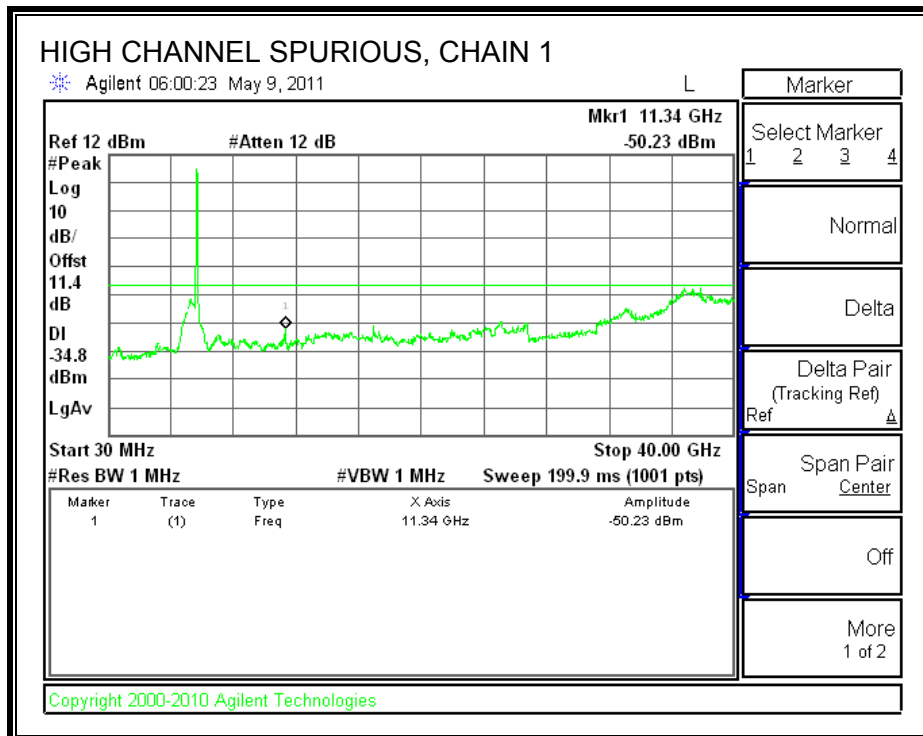
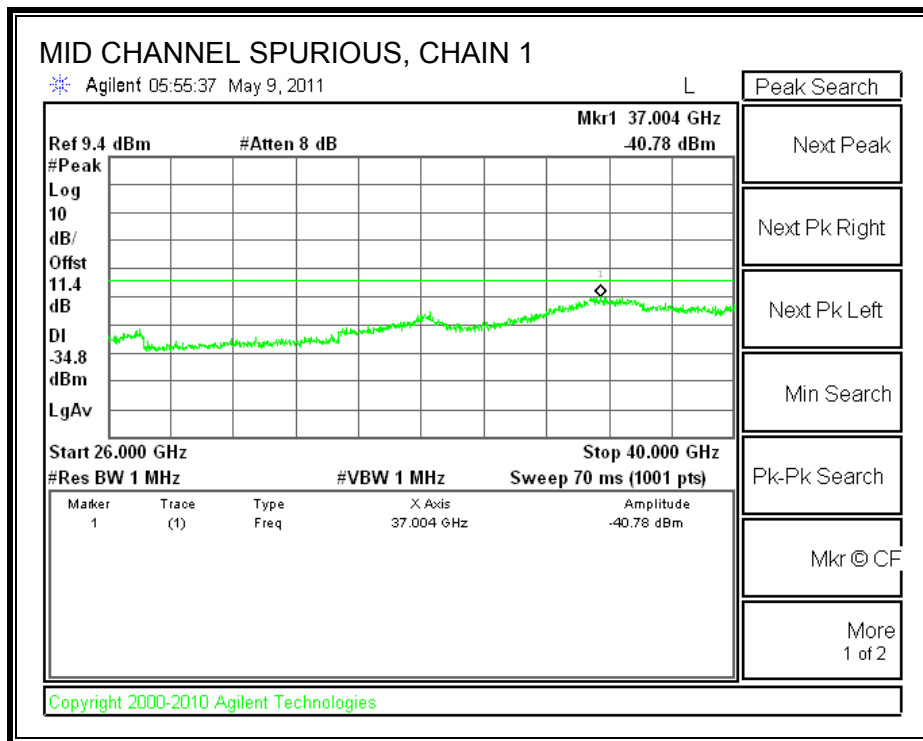
RESULTS:

Limit=-27 dBm + Antenna Gain + 10Log (N) dB

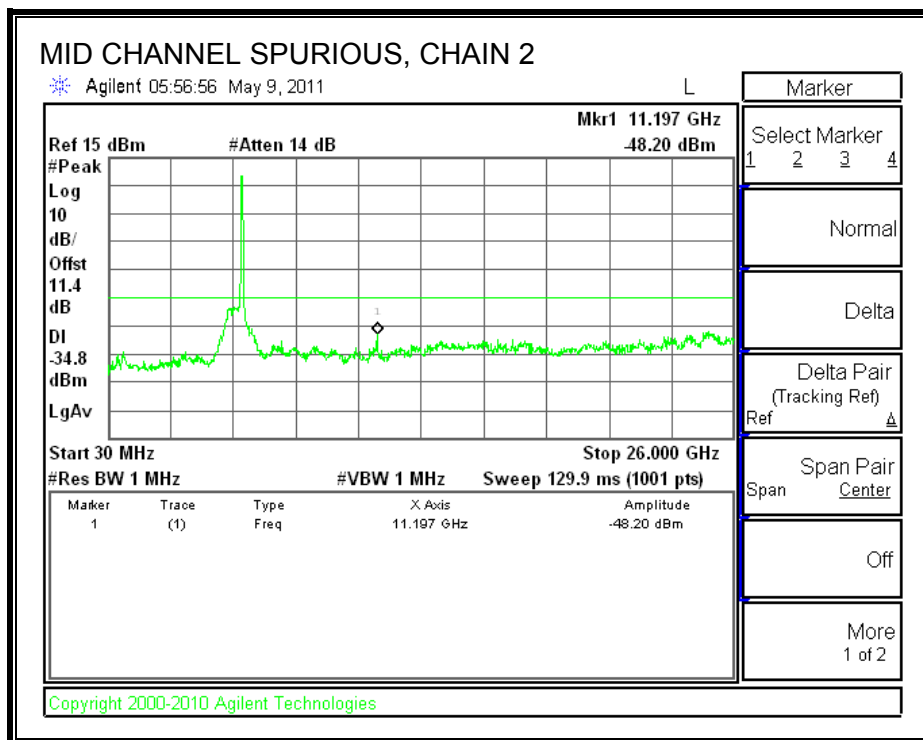
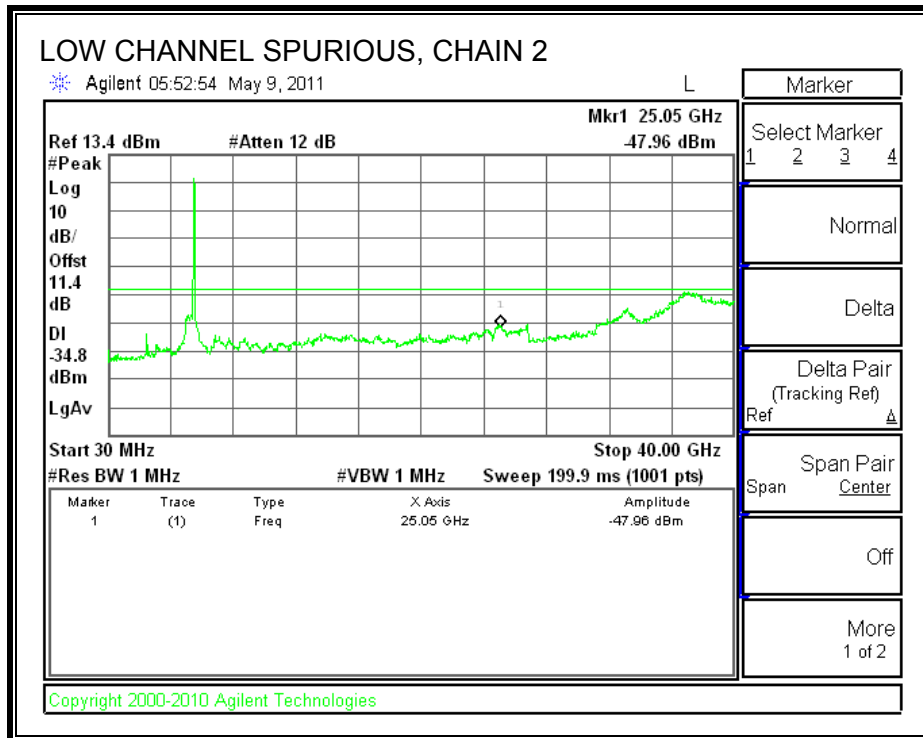
RESULTS

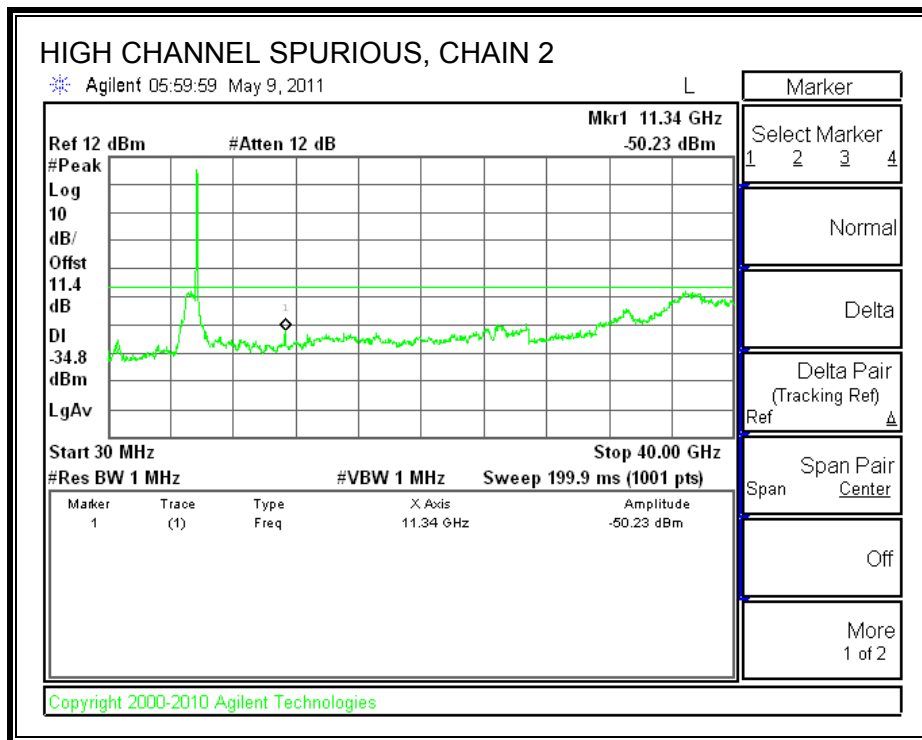
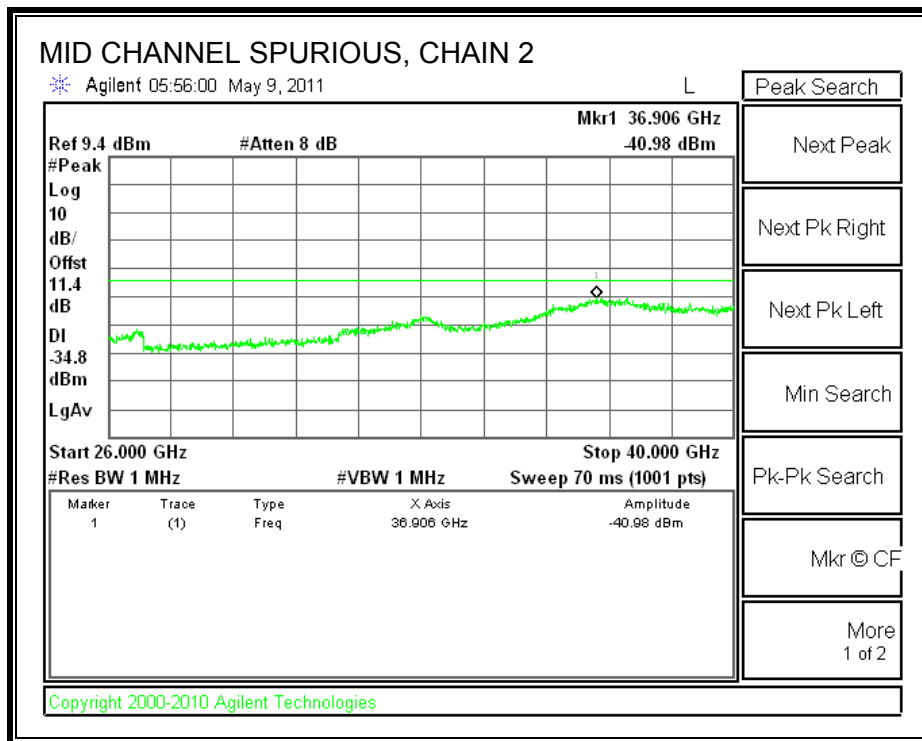
CHAIN 1 SPURIOUS EMISSIONS





CHAIN 2 SPURIOUS EMISSIONS





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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.

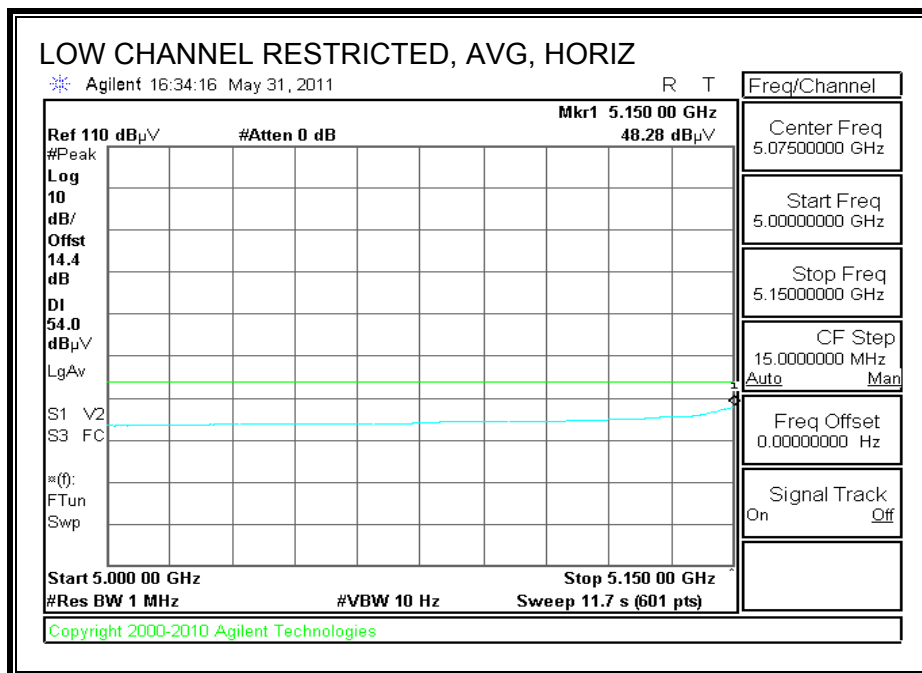
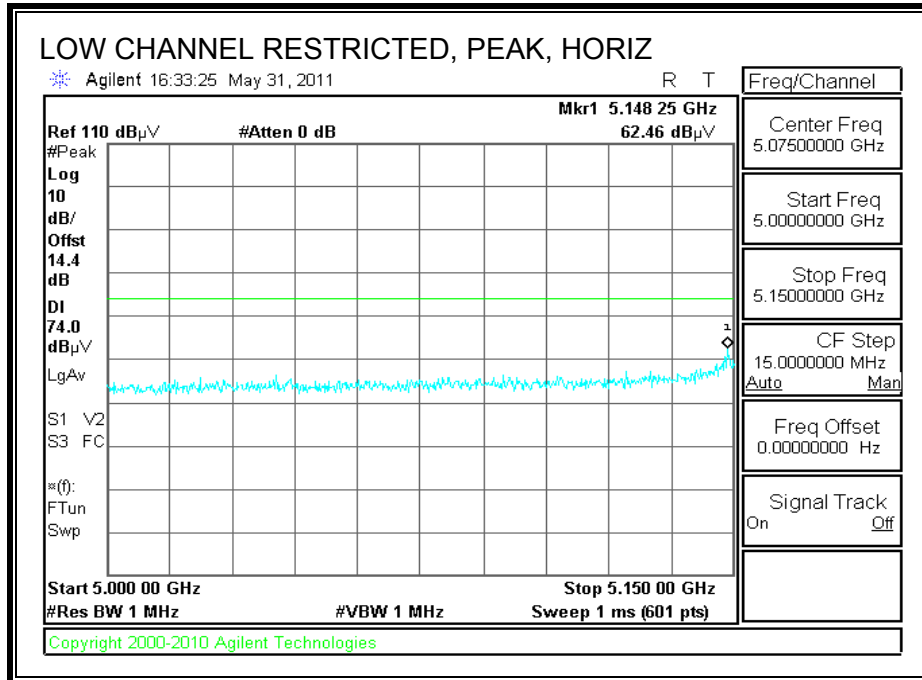
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

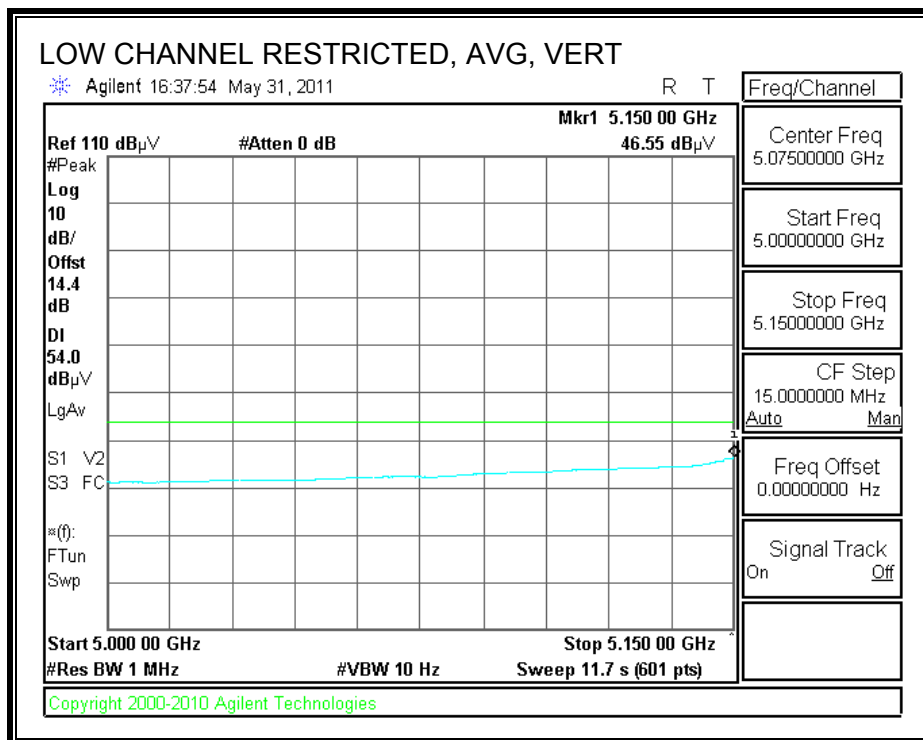
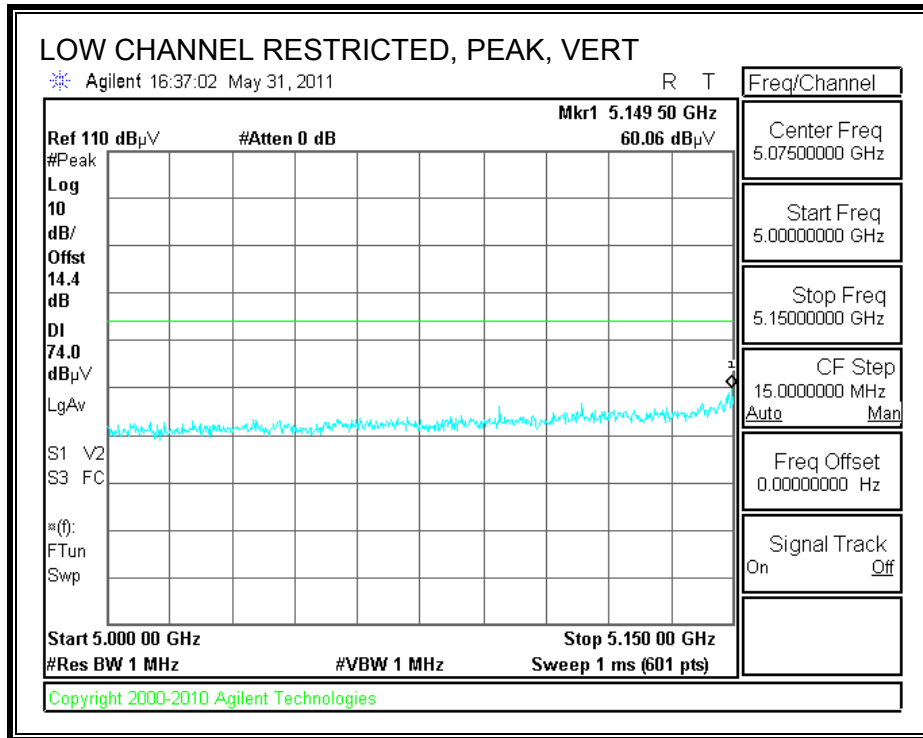
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. TX ABOVE 1 GHz FOR 802.11a DUAL CHAIN LEGACY MODE IN THE LOWER 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

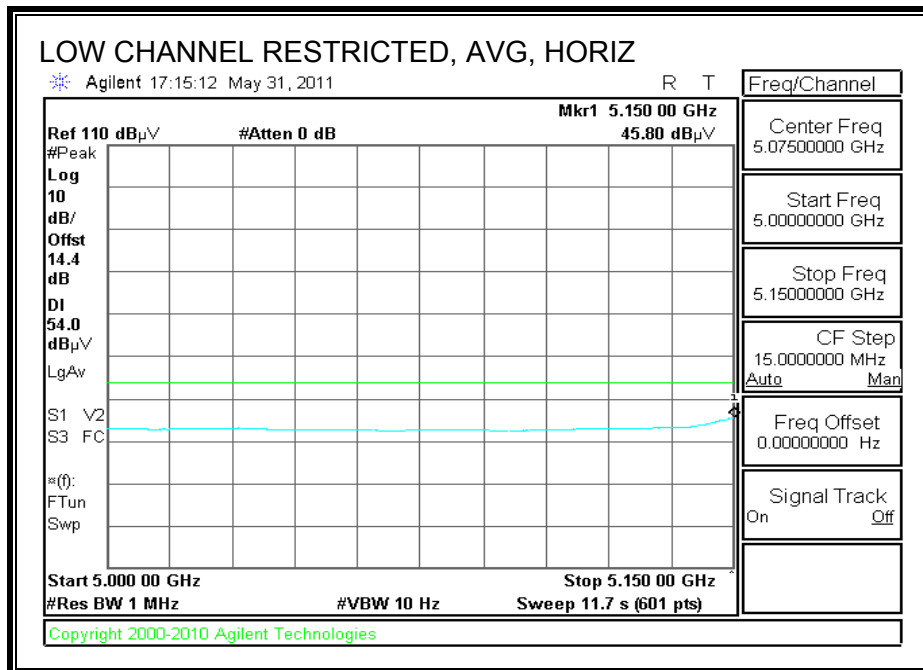
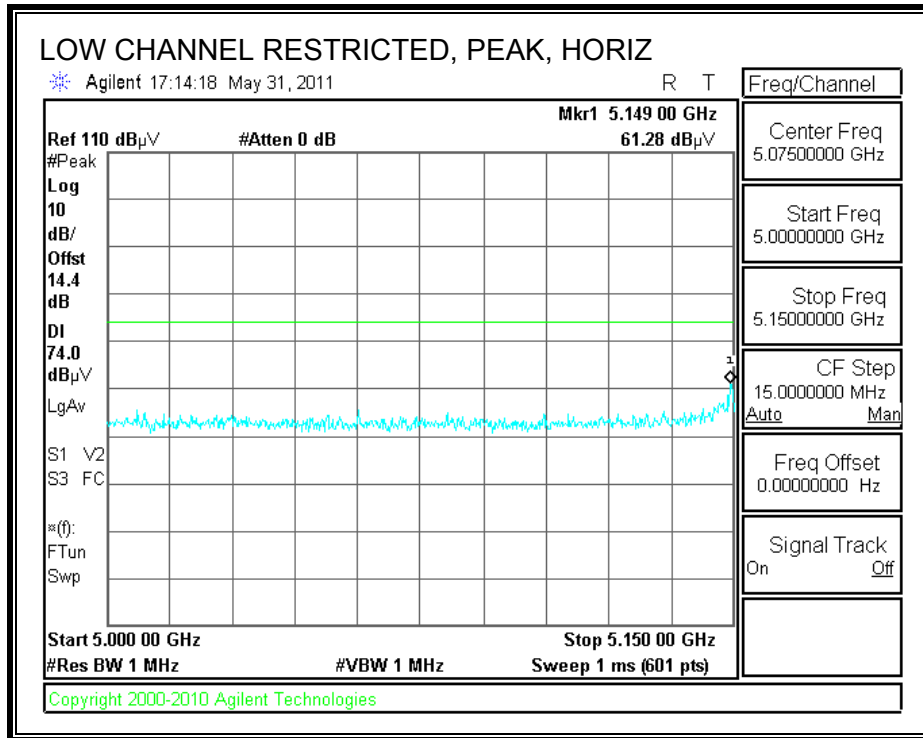


HARMONICS AND SPURIOUS EMISSIONS

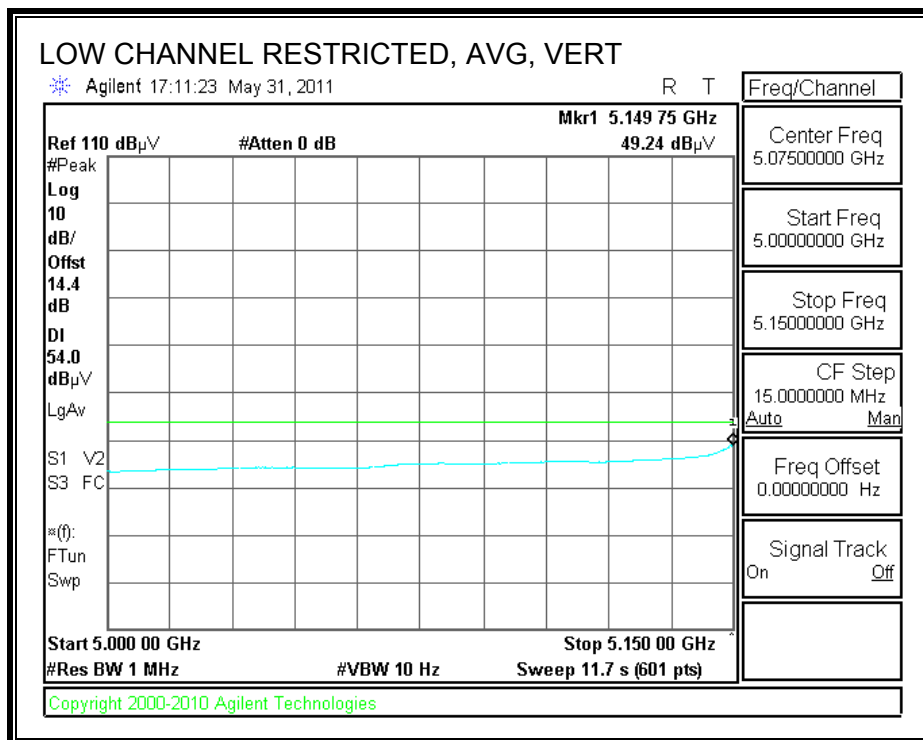
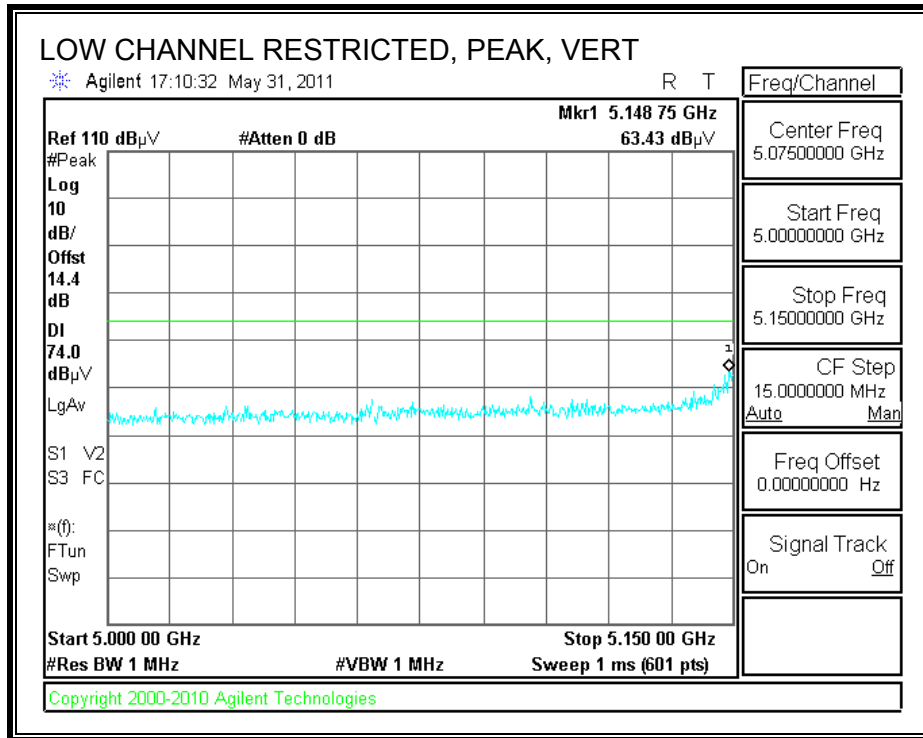
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		TX, 5.2GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5180MHz													
15.540	3.0	42.3	38.9	11.3	-32.3	0.0	0.7	61.0	74.0	-13.0	H	P	
15.540	3.0	27.0	38.9	11.3	-32.3	0.0	0.7	45.6	54.0	-8.4	H	A	
15.540	3.0	45.6	38.9	11.3	-32.3	0.0	0.7	64.2	74.0	-9.8	V	P	
15.540	3.0	30.0	38.9	11.3	-32.3	0.0	0.7	48.6	54.0	-5.4	V	A	
Mid Ch, 5200MHz													
15.600	3.0	41.9	38.7	11.4	-32.3	0.0	0.7	60.4	74.0	-13.6	H	P	
15.600	3.0	27.2	38.7	11.4	-32.3	0.0	0.7	45.7	54.0	-8.3	H	A	
15.600	3.0	44.2	38.7	11.4	-32.3	0.0	0.7	62.8	74.0	-11.2	V	P	
15.600	3.0	29.5	38.7	11.4	-32.3	0.0	0.7	48.1	54.0	-5.9	V	A	
High Ch, 5240MHz													
15.720	3.0	39.9	38.4	11.4	-32.3	0.0	0.7	58.2	74.0	-15.8	H	P	
15.720	3.0	26.5	38.4	11.4	-32.3	0.0	0.7	44.8	54.0	-9.2	H	A	
15.720	3.0	43.2	38.4	11.4	-32.3	0.0	0.7	61.5	74.0	-12.5	V	P	
15.720	3.0	28.8	38.4	11.4	-32.3	0.0	0.7	47.1	54.0	-6.9	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.2. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE LOWER 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber

Test Engr: Chin Pang
 Date: 06-02-11
 Project #: 11U13650
 Company: Apple
 Test Target: FCC 15.407
 Mode Oper: TX, HT20, 5.2GHz Band

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

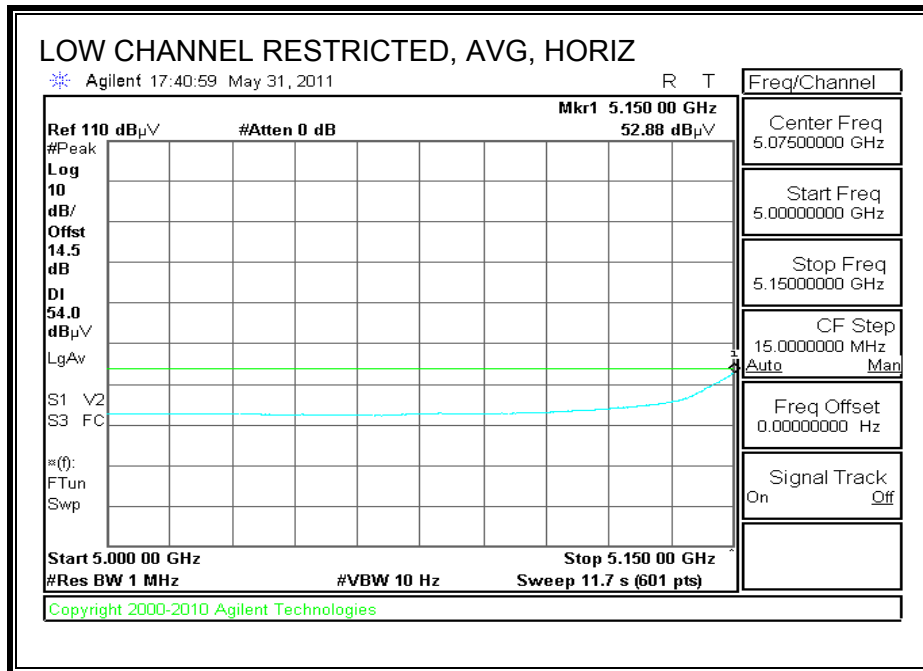
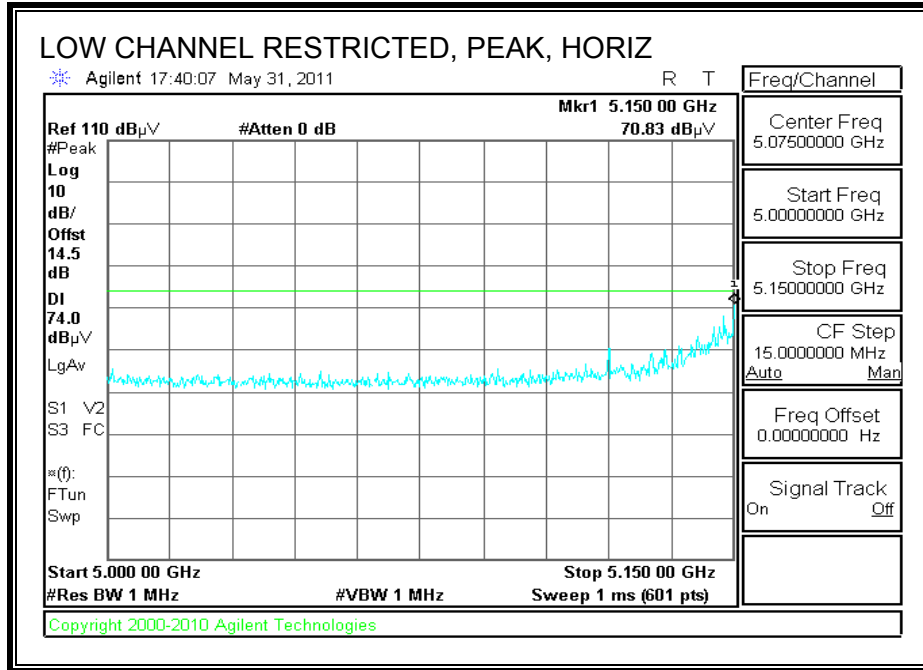
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5180MHz													
15.540	3.0	45.6	38.9	11.3	-32.3	0.0	0.7	64.3	74.0	-9.7	V	P	
15.540	3.0	30.3	38.9	11.3	-32.3	0.0	0.7	49.0	54.0	-5.0	V	A	
15.540	3.0	41.5	38.9	11.3	-32.3	0.0	0.7	60.1	74.0	-13.9	H	P	
15.540	3.0	27.4	38.9	11.3	-32.3	0.0	0.7	46.0	54.0	-8.0	H	A	
Mid Ch, 5200MHz													
15.600	3.0	47.1	38.7	11.4	-32.3	0.0	0.7	65.6	74.0	-8.4	V	P	
15.600	3.0	30.4	38.7	11.4	-32.3	0.0	0.7	49.0	54.0	-5.0	V	A	
15.600	3.0	42.6	38.7	11.4	-32.3	0.0	0.7	61.1	74.0	-12.9	H	P	
15.600	3.0	27.7	38.7	11.4	-32.3	0.0	0.7	46.3	54.0	-7.7	H	A	
High Ch, 5240MHz													
15.720	3.0	44.8	38.4	11.4	-32.3	0.0	0.7	63.1	74.0	-10.9	V	P	
15.720	3.0	30.2	38.4	11.4	-32.3	0.0	0.7	48.5	54.0	-5.5	V	A	
15.720	3.0	41.6	38.4	11.4	-32.3	0.0	0.7	59.9	74.0	-14.1	H	P	
15.720	3.0	26.8	38.4	11.4	-32.3	0.0	0.7	45.1	54.0	-8.9	H	A	

Rev. 4.1.2.7

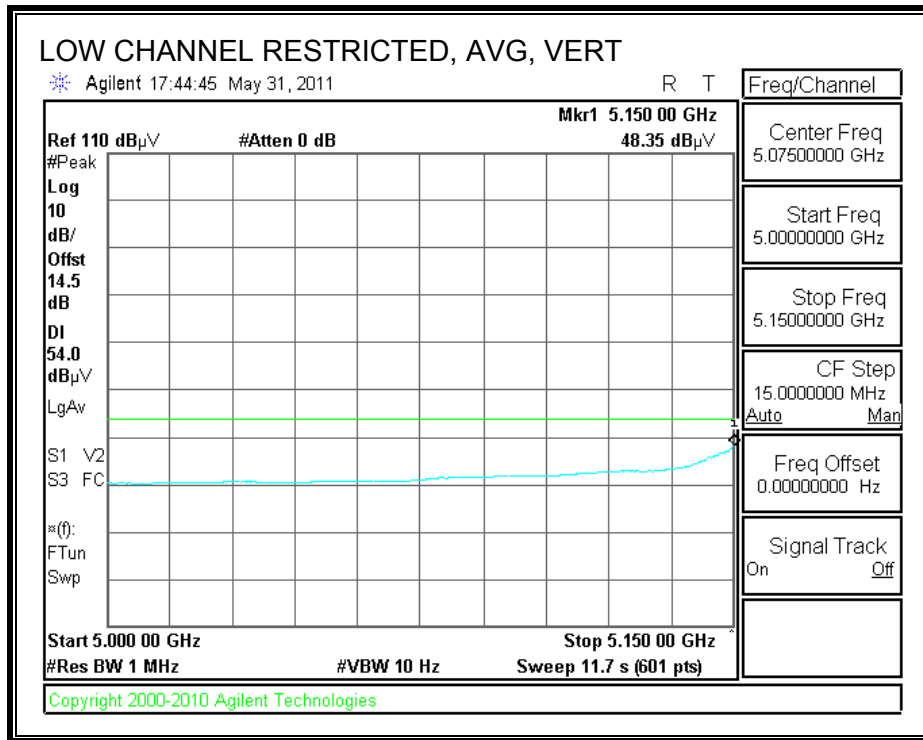
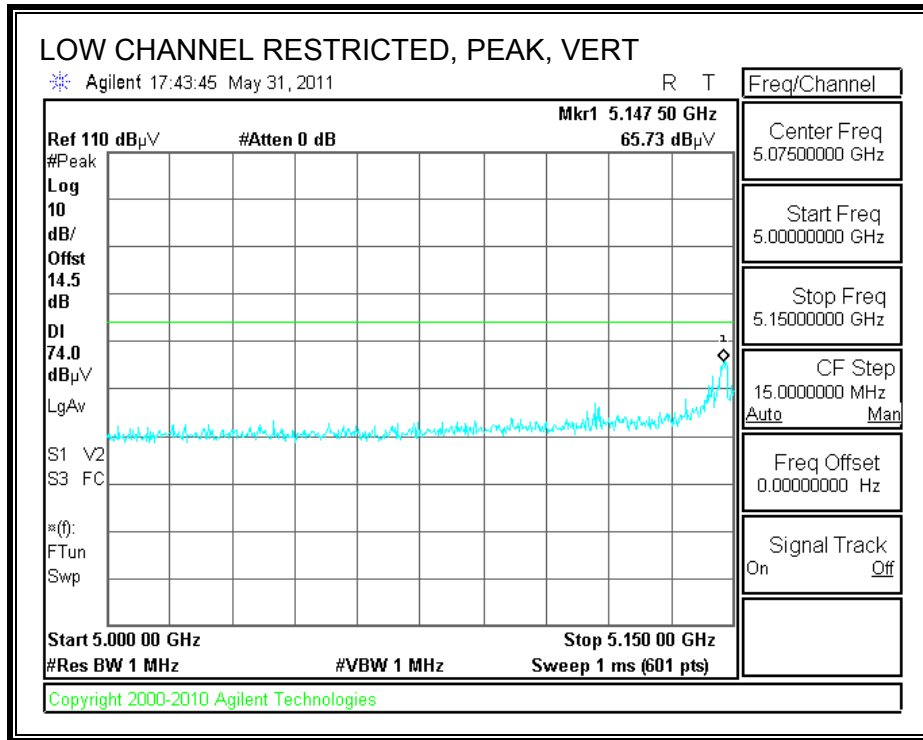
Note: No other emissions were detected above the system noise floor.

8.2.3. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE LOWER 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



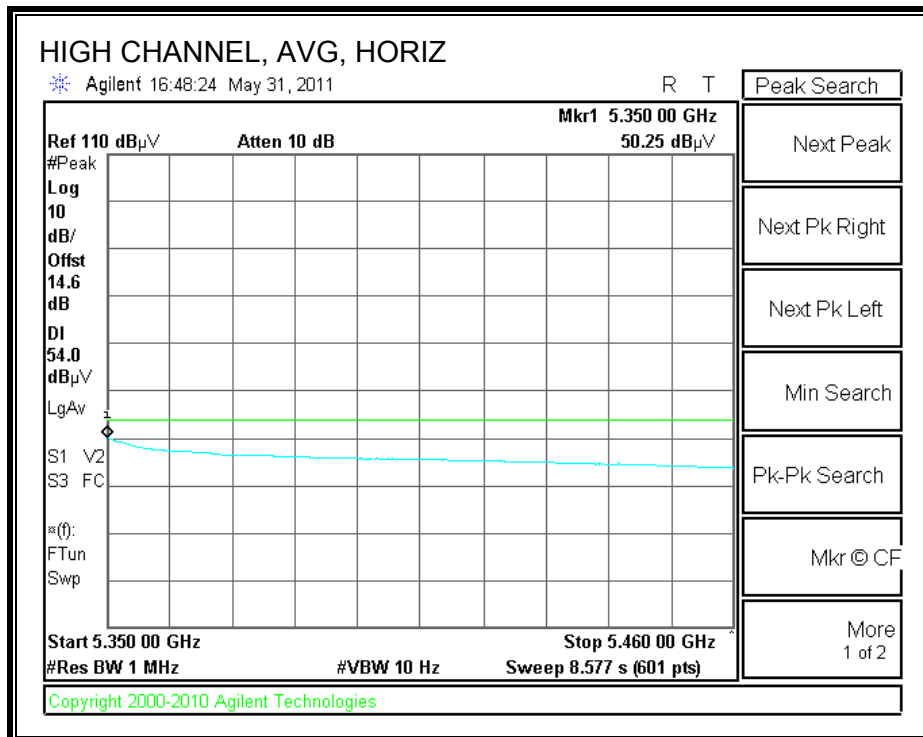
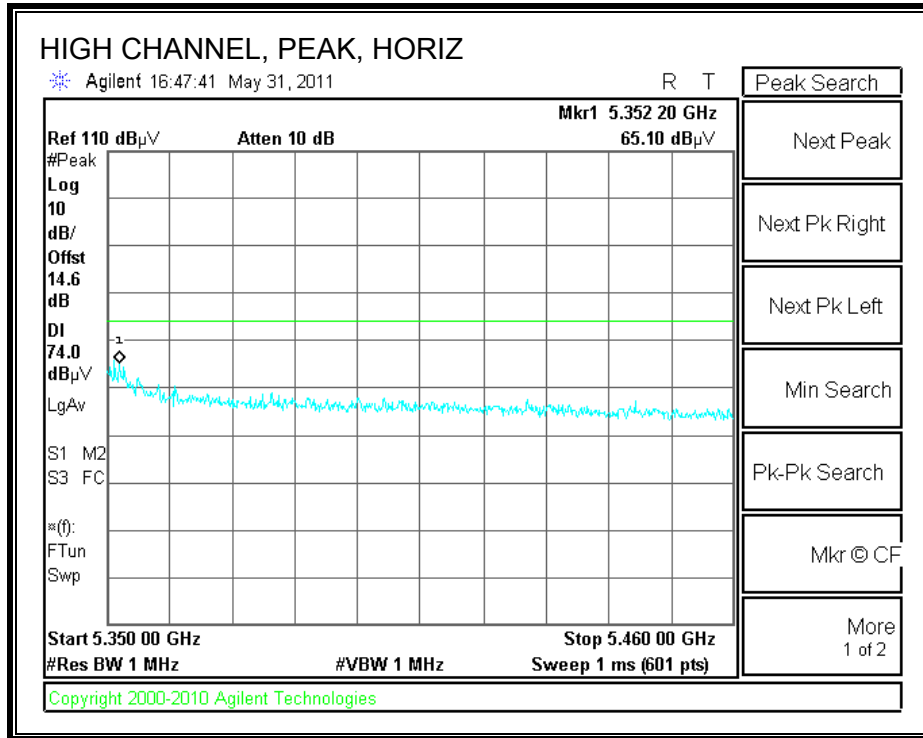
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

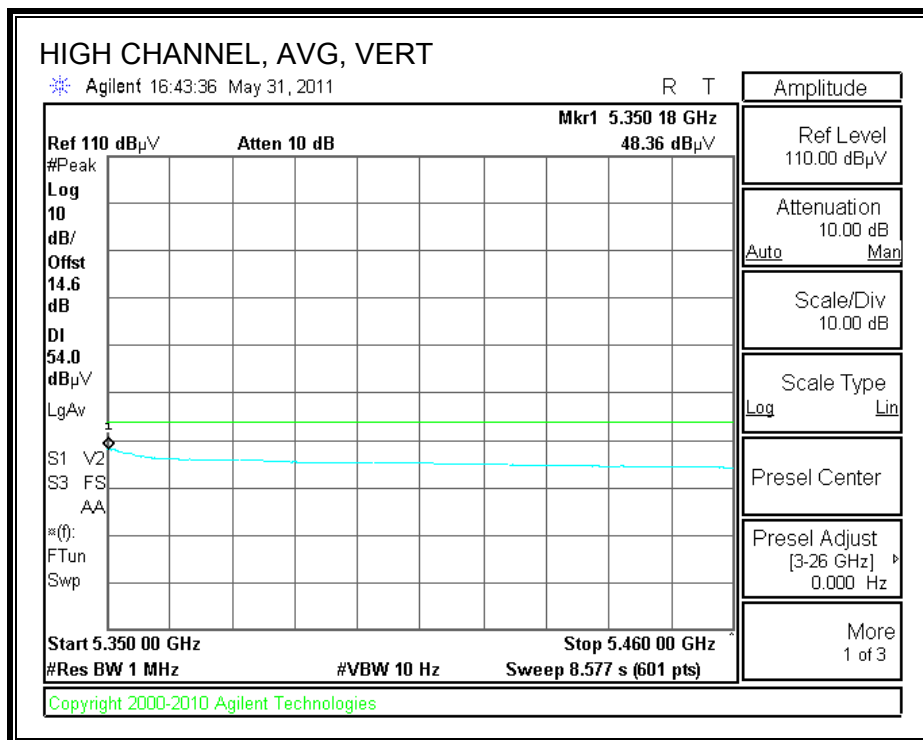
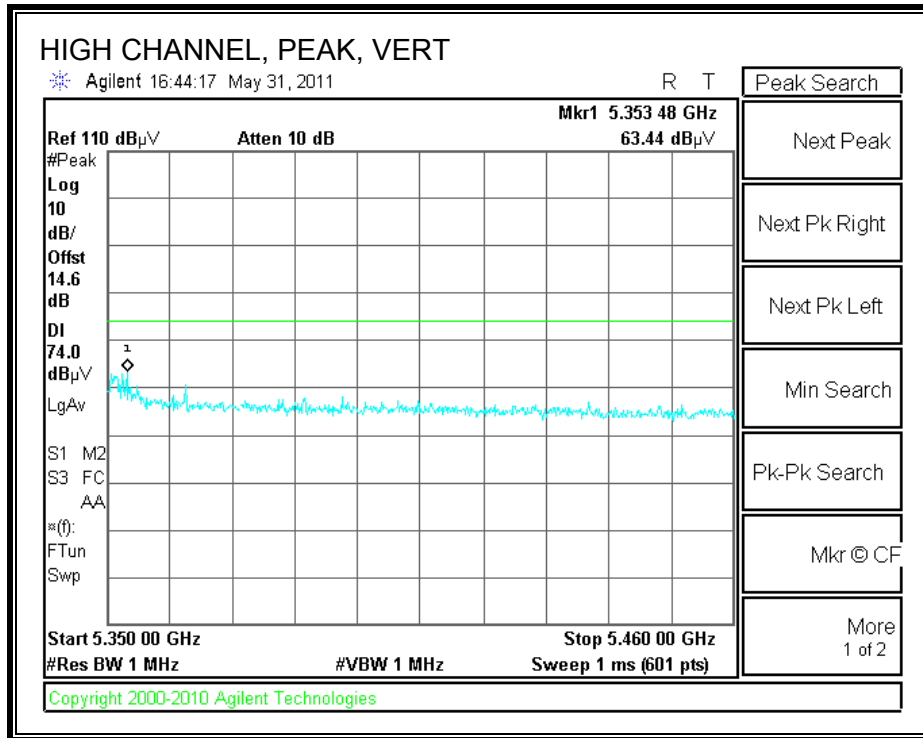


HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		HT40, TX, 5.2GHz Band											
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit									
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit									
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit									
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit									
CL	Cable Loss	HPF	High Pass Filter										
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5190MHz													
15.570	3.0	36.4	38.8	11.4	-32.3	0.0	0.7	55.0	74.0	-19.0	H	P	
15.570	3.0	24.1	38.8	11.4	-32.3	0.0	0.7	42.7	54.0	-11.3	H	A	
15.570	3.0	39.9	38.8	11.4	-32.3	0.0	0.7	58.5	74.0	-15.5	V	P	
15.570	3.0	25.7	38.8	11.4	-32.3	0.0	0.7	44.3	54.0	-9.7	V	A	
High Ch, 5230MHz													
15.690	3.0	36.8	38.5	11.4	-32.3	0.0	0.7	55.2	74.0	-18.8	H	P	
15.690	3.0	23.5	38.5	11.4	-32.3	0.0	0.7	41.9	54.0	-12.1	H	A	
15.690	3.0	39.9	38.5	11.4	-32.3	0.0	0.7	58.2	74.0	-15.8	V	P	
15.690	3.0	25.3	38.5	11.4	-32.3	0.0	0.7	43.6	54.0	-10.4	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.4. TX ABOVE 1 GHz FOR 802.11a DUAL CHAIN LEGACY MODE IN THE UPPER 5.2 GHz BAND



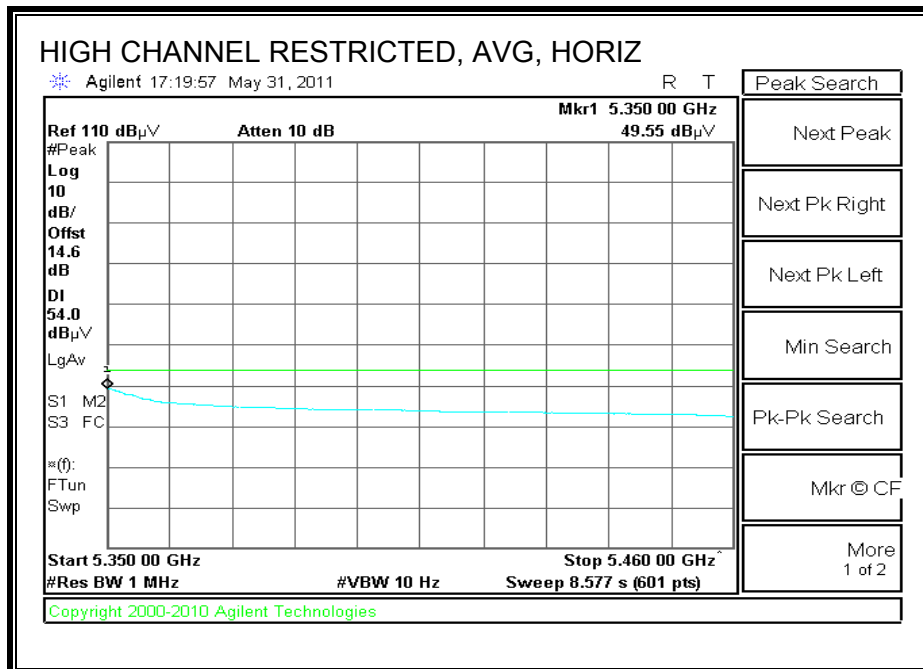
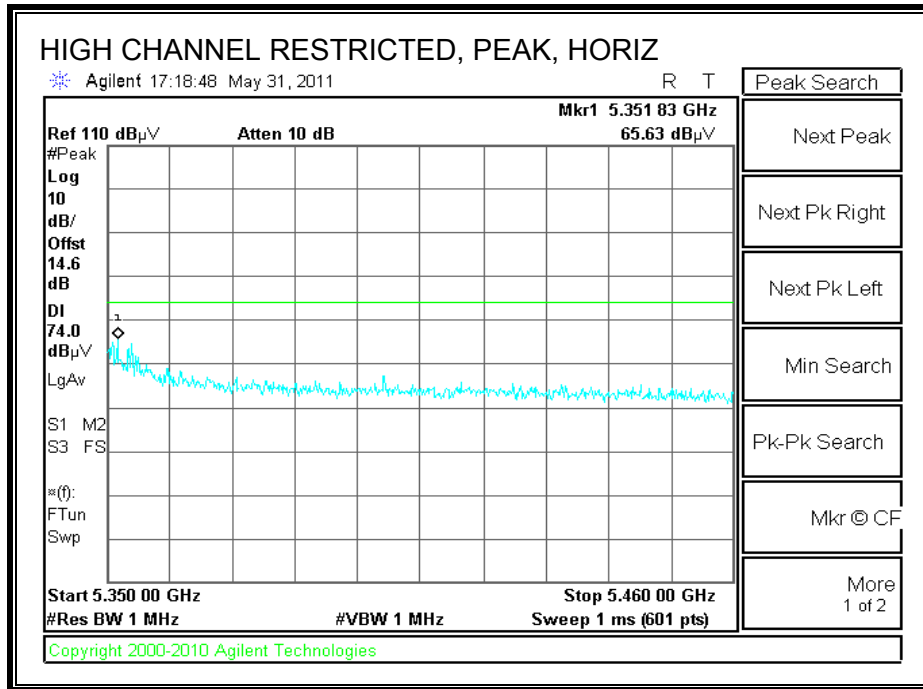


HARMONICS AND SPURIOUS EMISSIONS

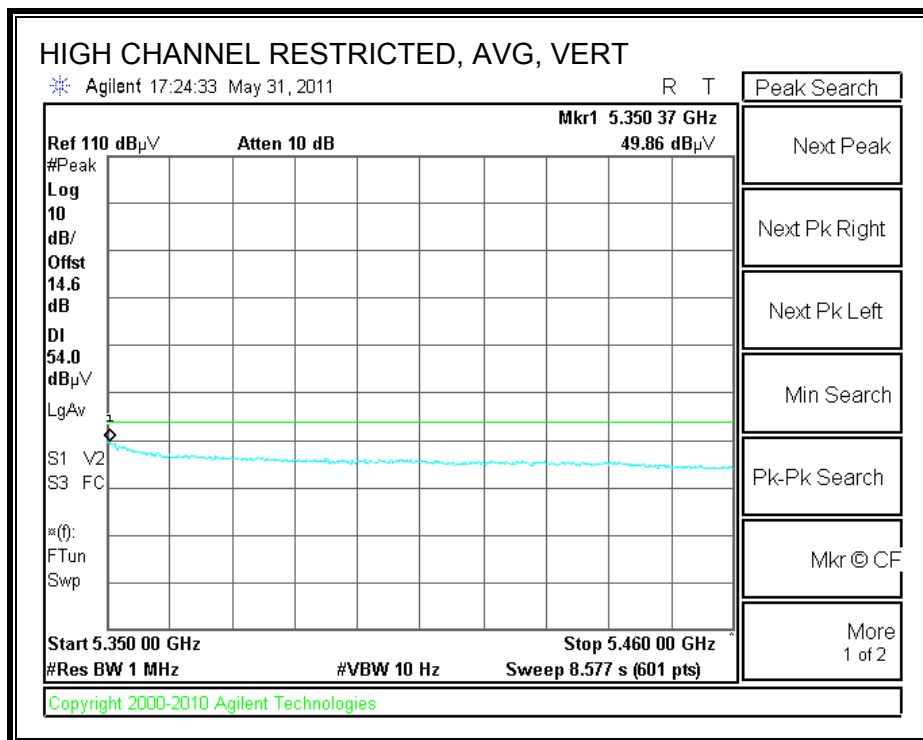
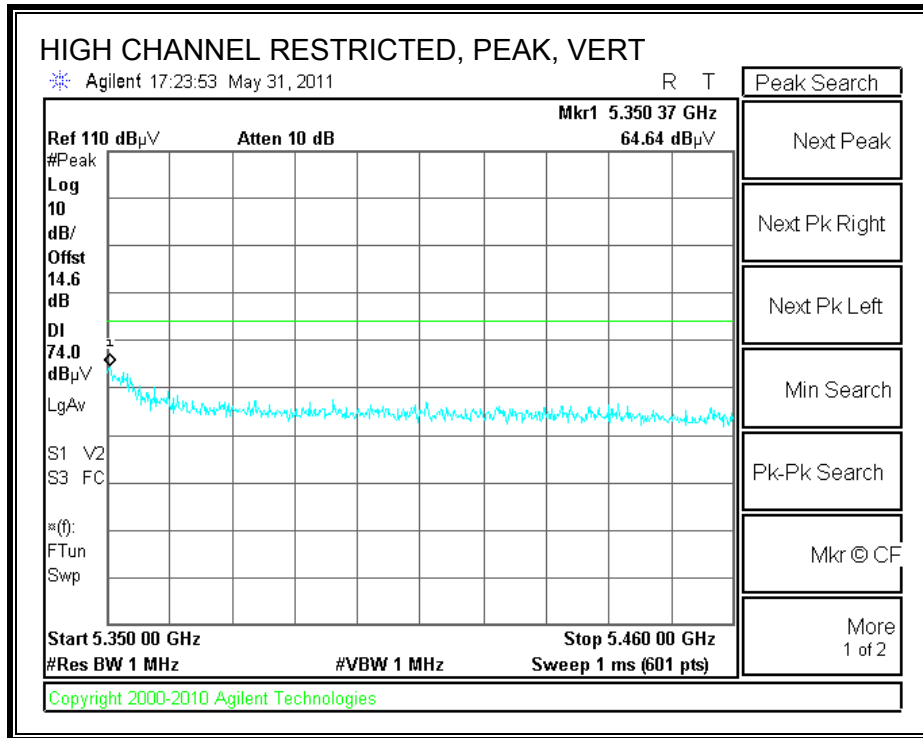
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		A mode, TX, 5.3GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
Low Ch, 5260MHz													
15.780	3.0	43.8	38.2	11.5	-32.2	0.0	0.7	61.9	74.0	-12.1	H	P	
15.780	3.0	29.8	38.2	11.5	-32.2	0.0	0.7	48.0	54.0	-6.0	H	A	
15.780	3.0	47.5	38.2	11.5	-32.2	0.0	0.7	65.6	74.0	-8.4	V	P	
15.780	3.0	33.0	38.2	11.5	-32.2	0.0	0.7	51.2	54.0	-2.8	V	A	
Mid ch, 5300MHz													
10.600	3.0	39.3	37.5	9.0	-34.3	0.0	0.8	52.4	74.0	-21.6	V	P	
10.600	3.0	27.6	37.5	9.0	-34.3	0.0	0.8	40.6	54.0	-13.4	V	A	
15.900	3.0	41.0	37.9	11.5	-32.2	0.0	0.7	58.9	74.0	-15.1	V	P	
15.900	3.0	25.5	37.9	11.5	-32.2	0.0	0.7	43.4	54.0	-10.6	V	A	
10.600	3.0	35.9	37.5	9.0	-34.3	0.0	0.8	48.9	74.0	-25.1	H	P	
10.600	3.0	24.7	37.5	9.0	-34.3	0.0	0.8	37.7	54.0	-16.3	H	A	
15.900	3.0	36.5	37.9	11.5	-32.2	0.0	0.7	54.5	74.0	-19.5	H	P	
15.900	3.0	23.5	37.9	11.5	-32.2	0.0	0.7	41.5	54.0	-12.5	H	A	
High Ch, 5320MHz													
10.640	3.0	38.6	37.6	9.1	-34.2	0.0	0.8	51.7	74.0	-22.3	V	P	
10.640	3.0	26.7	37.6	9.1	-34.2	0.0	0.8	39.8	54.0	-14.2	V	A	
15.960	3.0	38.9	37.7	11.5	-32.2	0.0	0.7	56.7	74.0	-17.3	V	P	
15.960	3.0	26.3	37.7	11.5	-32.2	0.0	0.7	44.1	54.0	-9.9	V	A	
10.640	3.0	36.4	37.6	9.1	-34.2	0.0	0.8	49.6	74.0	-24.4	H	P	
10.640	3.0	24.2	37.6	9.1	-34.2	0.0	0.8	37.4	54.0	-16.6	H	A	
15.960	3.0	35.4	37.7	11.5	-32.2	0.0	0.7	53.2	74.0	-20.8	H	P	
15.960	3.0	23.5	37.7	11.5	-32.2	0.0	0.7	41.3	54.0	-12.7	H	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.5. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE UPPER 5.2 GHz BAND

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

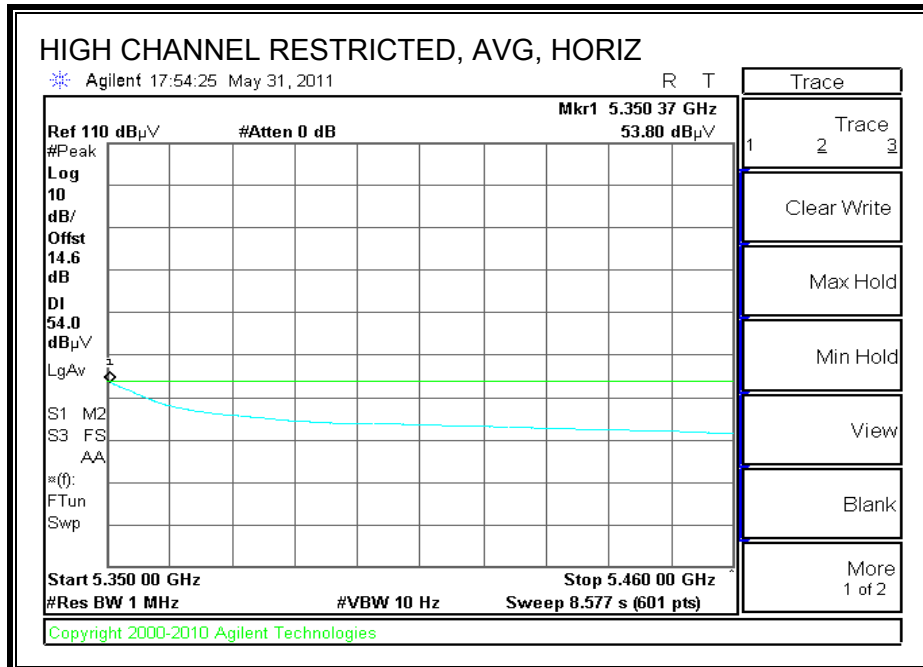
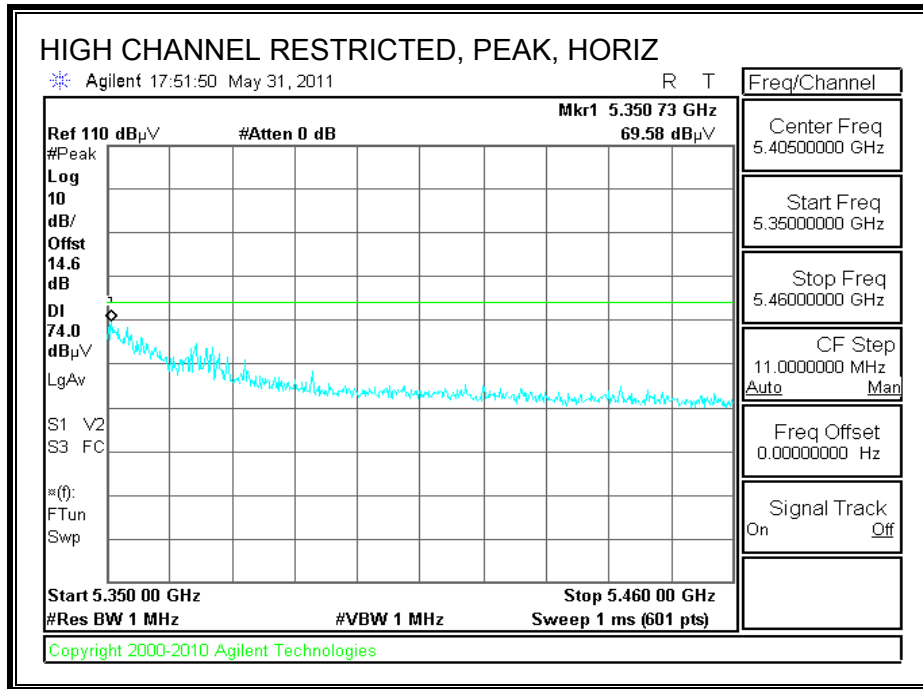


HARMONICS AND SPURIOUS EMISSIONS

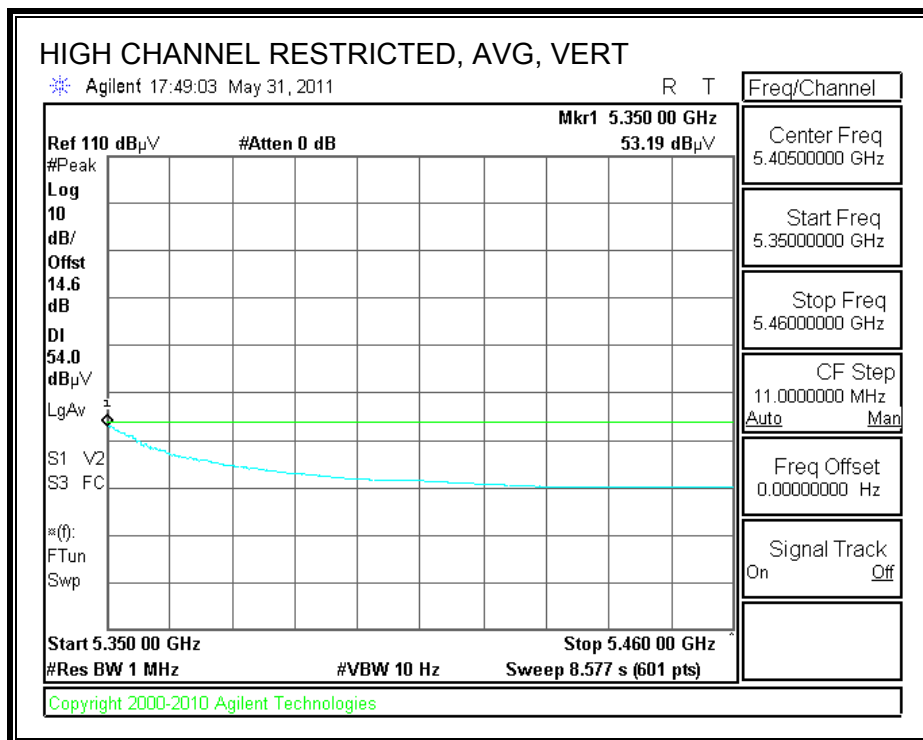
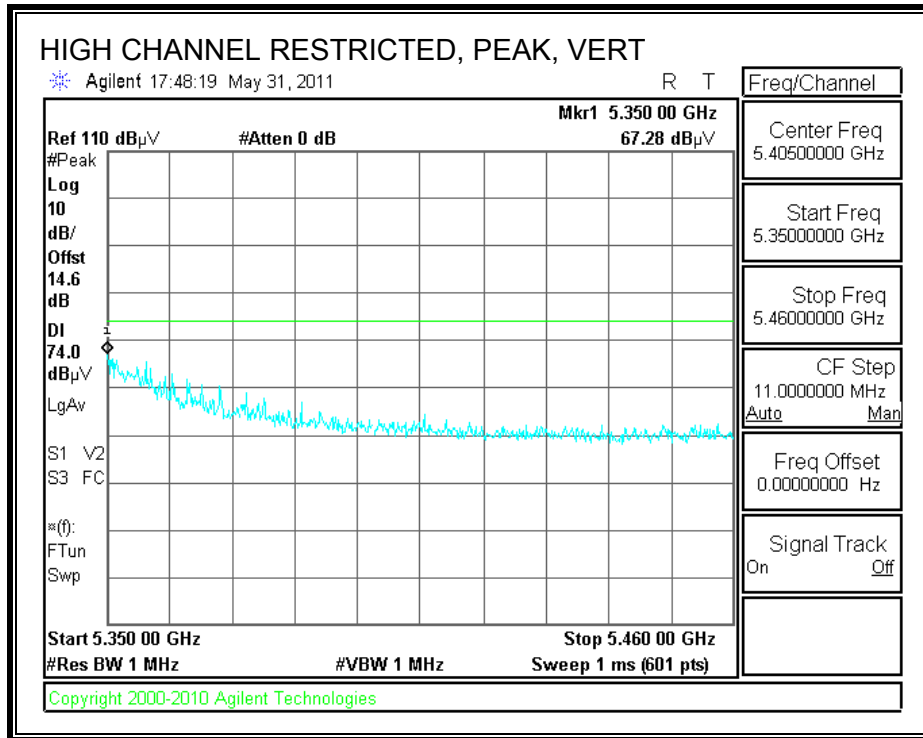
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		TX, HT20, 5.3GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
Low Ch, 5260MHz													
15.780	3.0	43.2	38.2	11.5	-32.2	0.0	0.7	61.4	74.0	-12.6	H	P	
15.780	3.0	30.2	38.2	11.5	-32.2	0.0	0.7	48.3	54.0	-5.7	H	A	
15.780	3.0	47.2	38.2	11.5	-32.2	0.0	0.7	65.4	74.0	-8.6	V	P	
15.780	3.0	33.4	38.2	11.5	-32.2	0.0	0.7	51.6	54.0	-2.4	V	A	
Mid Ch, 5300MHz													
10.600	3.0	38.7	37.5	9.0	-34.3	0.0	0.8	51.7	74.0	-22.3	H	P	
10.600	3.0	27.1	37.5	9.0	-34.3	0.0	0.8	40.2	54.0	-13.8	H	A	
15.900	3.0	38.1	37.9	11.5	-32.2	0.0	0.7	56.0	74.0	-18.0	H	P	
15.900	3.0	24.5	37.9	11.5	-32.2	0.0	0.7	42.4	54.0	-11.6	H	A	
10.600	3.0	39.8	37.5	9.0	-34.3	0.0	0.8	52.9	74.0	-21.1	V	P	
10.600	3.0	28.2	37.5	9.0	-34.3	0.0	0.8	41.3	54.0	-12.7	V	A	
15.900	3.0	36.0	37.9	11.5	-32.2	0.0	0.7	53.9	74.0	-20.1	V	P	
15.900	3.0	23.8	37.9	11.5	-32.2	0.0	0.7	41.7	54.0	-12.3	V	A	
High Ch, 5320MHz													
10.640	3.0	38.6	37.6	9.1	-34.2	0.0	0.8	51.7	74.0	-22.3	H	P	
10.640	3.0	26.7	37.6	9.1	-34.2	0.0	0.8	39.8	54.0	-14.2	H	A	
15.960	3.0	39.6	37.7	11.5	-32.2	0.0	0.7	57.4	74.0	-16.6	H	P	
15.960	3.0	24.5	37.7	11.5	-32.2	0.0	0.7	42.3	54.0	-11.7	H	A	
10.640	3.0	36.6	37.6	9.1	-34.2	0.0	0.8	49.7	74.0	-24.3	V	P	
10.640	3.0	25.0	37.6	9.1	-34.2	0.0	0.8	38.2	54.0	-15.8	V	A	
15.960	3.0	42.2	37.7	11.5	-32.2	0.0	0.7	60.0	74.0	-14.0	V	P	
15.960	3.0	27.3	37.7	11.5	-32.2	0.0	0.7	45.1	54.0	-8.9	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.6. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE UPPER 5.2 GHz BAND

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

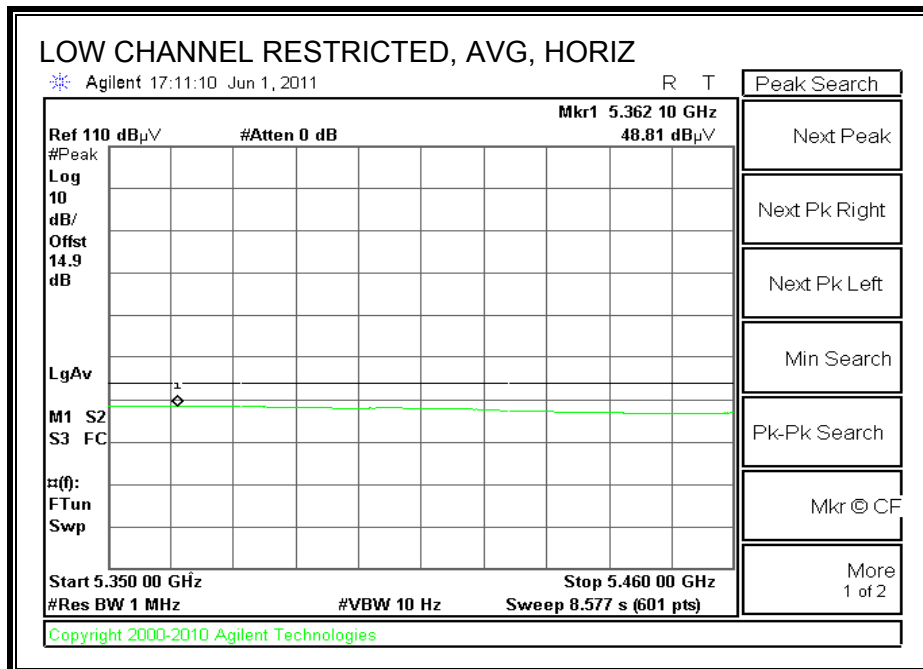
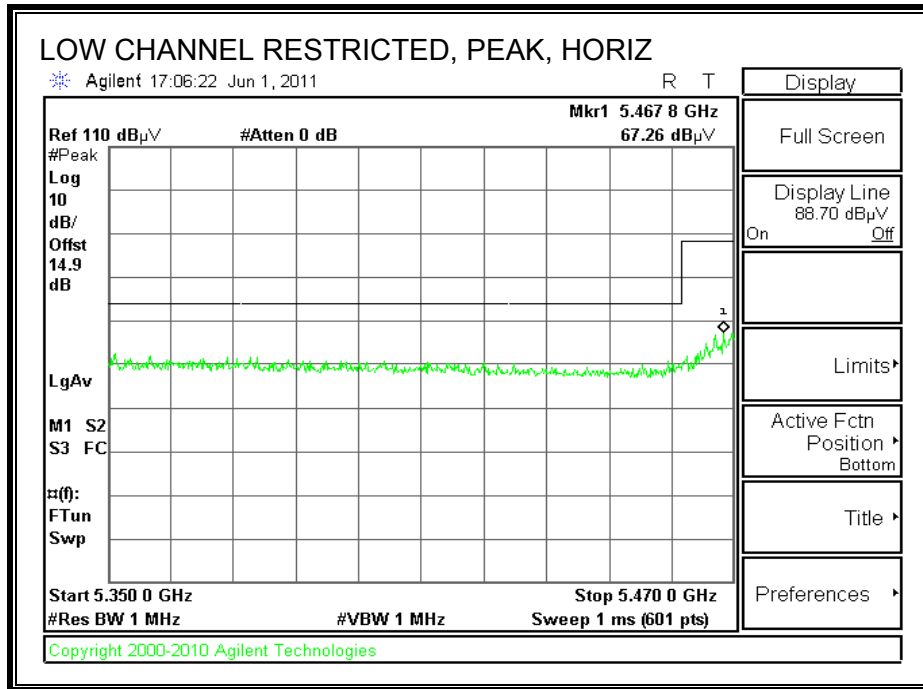


HARMONICS AND SPURIOUS EMISSIONS

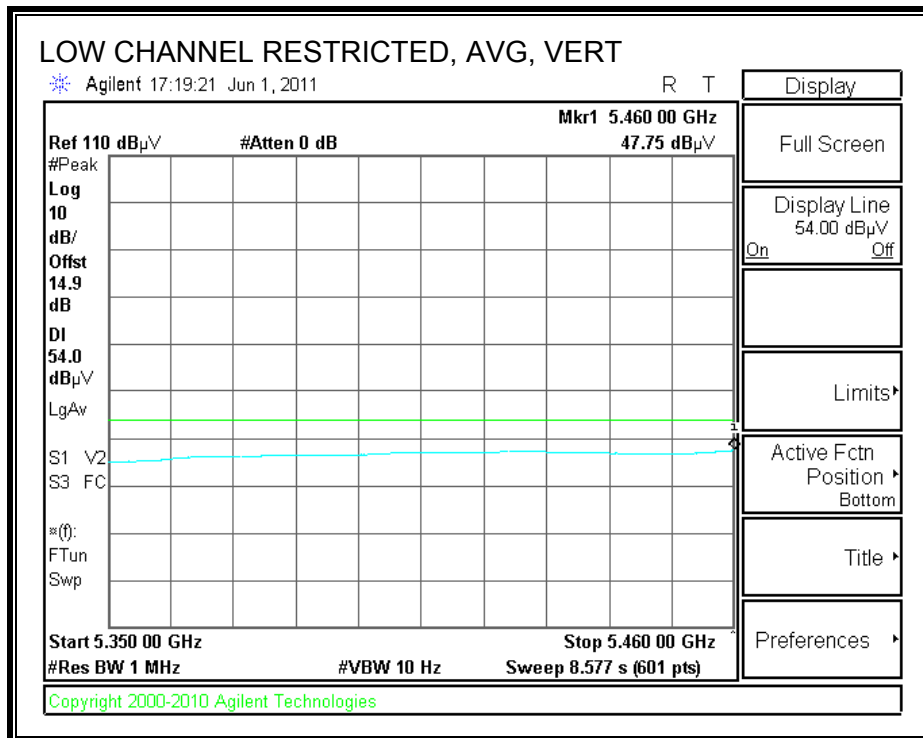
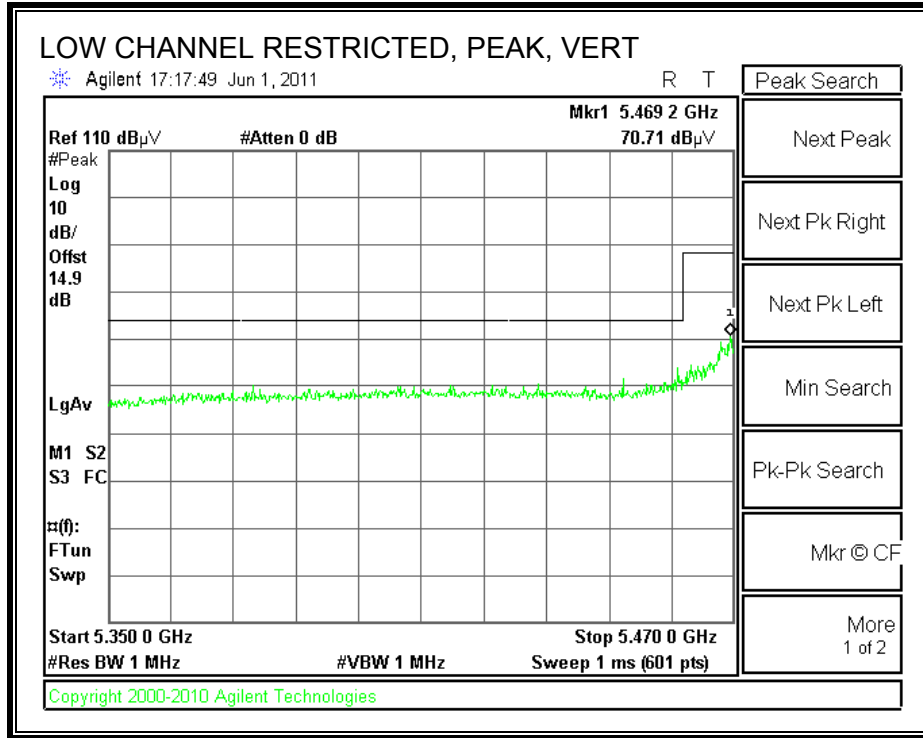
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		HT40, TX, 5.3GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Ch, 5270MHz													
15.810	3.0	41.6	38.2	11.5	-32.2	0.0	0.7	59.7	74.0	-14.3	H	P	
15.810	3.0	27.9	38.2	11.5	-32.2	0.0	0.7	46.0	54.0	-8.0	H	A	
15.810	3.0	43.2	38.2	11.5	-32.2	0.0	0.7	61.3	74.0	-12.7	V	P	
15.810	3.0	30.0	38.2	11.5	-32.2	0.0	0.7	48.1	54.0	-5.9	V	A	
High Ch, 5310MHz													
10.620	3.0	35.8	37.5	9.1	-34.3	0.0	0.8	48.9	74.0	-25.1	H	P	
10.620	3.0	23.1	37.5	9.1	-34.3	0.0	0.8	36.1	54.0	-17.9	H	A	
15.930	3.0	36.2	37.8	11.5	-32.2	0.0	0.7	54.0	74.0	-20.0	H	P	
15.930	3.0	23.2	37.8	11.5	-32.2	0.0	0.7	41.1	54.0	-12.9	H	A	
10.620	3.0	37.9	37.5	9.1	-34.3	0.0	0.8	51.0	74.0	-23.0	V	P	
10.620	3.0	25.8	37.5	9.1	-34.3	0.0	0.8	38.9	54.0	-15.1	V	A	
15.930	3.0	38.7	37.8	11.5	-32.2	0.0	0.7	56.5	74.0	-17.5	V	P	
15.930	3.0	25.2	37.8	11.5	-32.2	0.0	0.7	43.1	54.0	-10.9	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.7. TX ABOVE 1 GHz FOR 802.11a DUAL CHAIN LEGACY MODE IN THE 5.6 GHz BAND

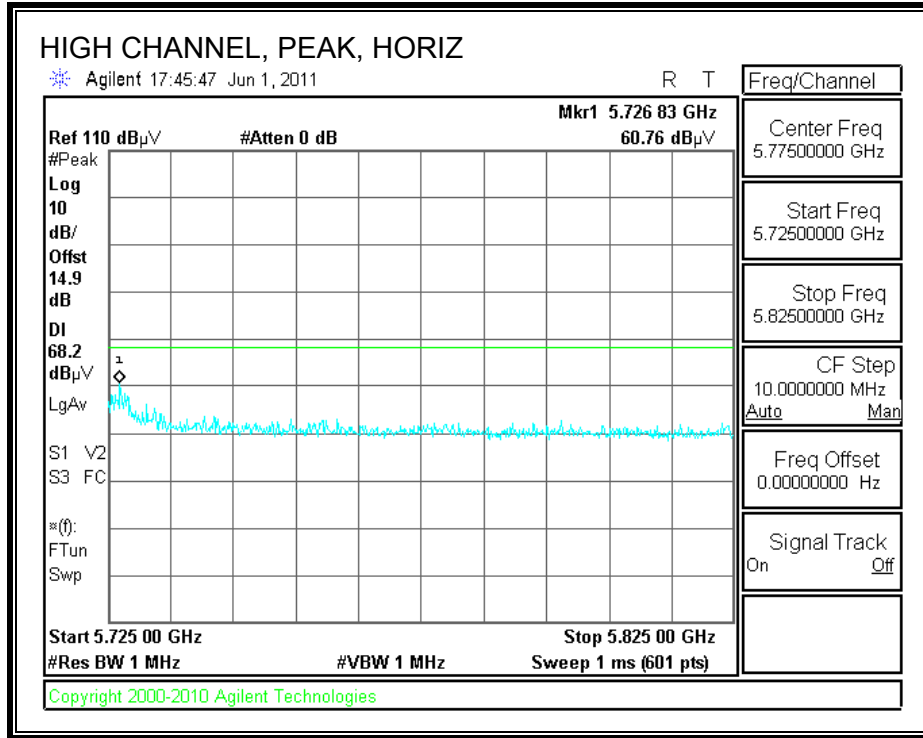
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



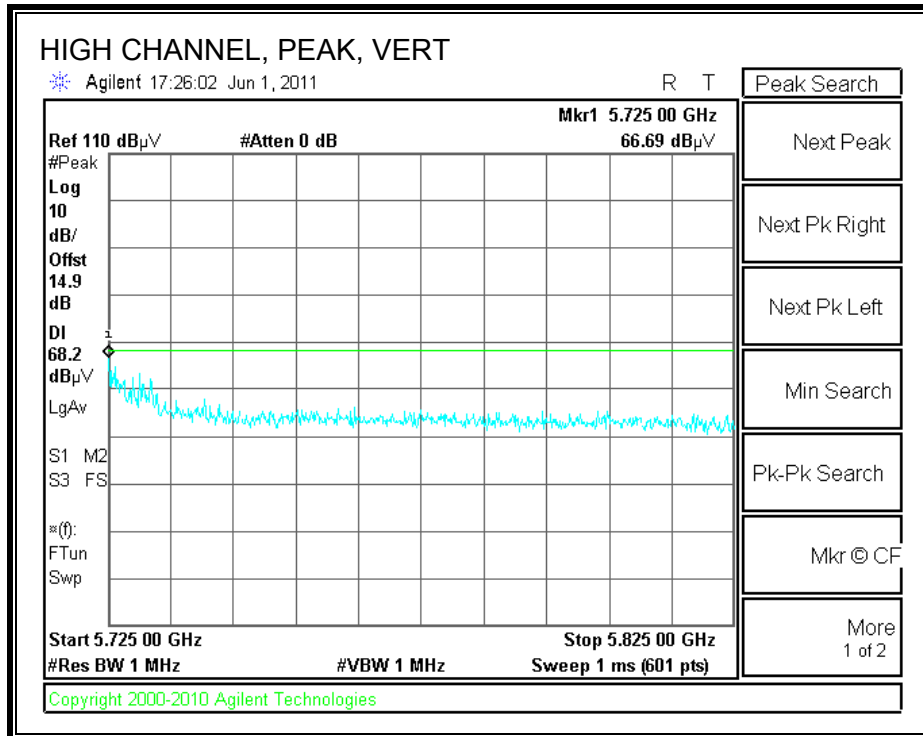
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)

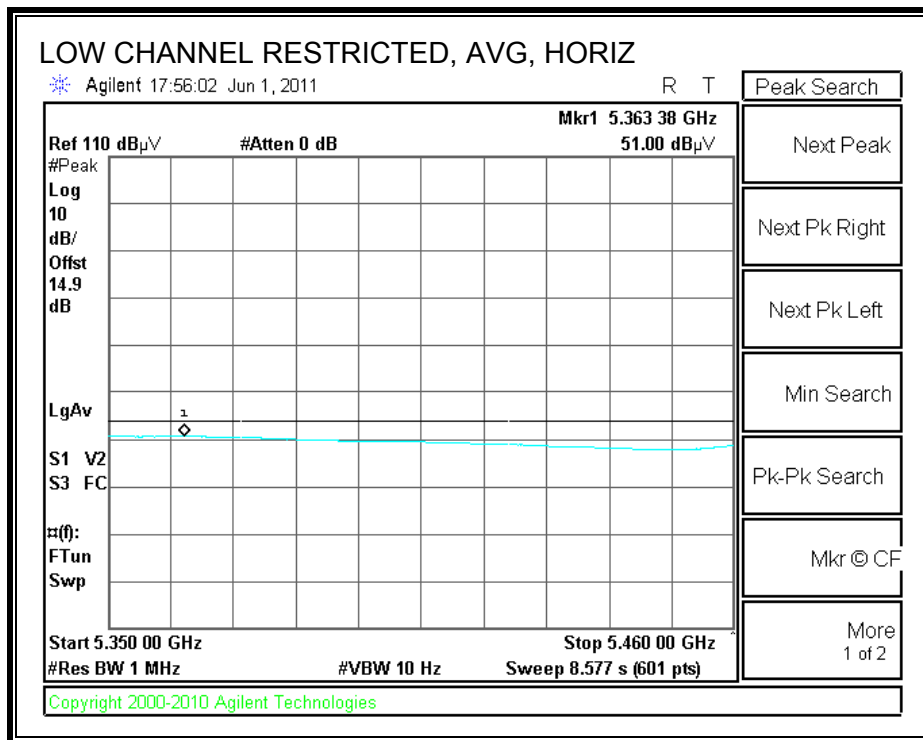
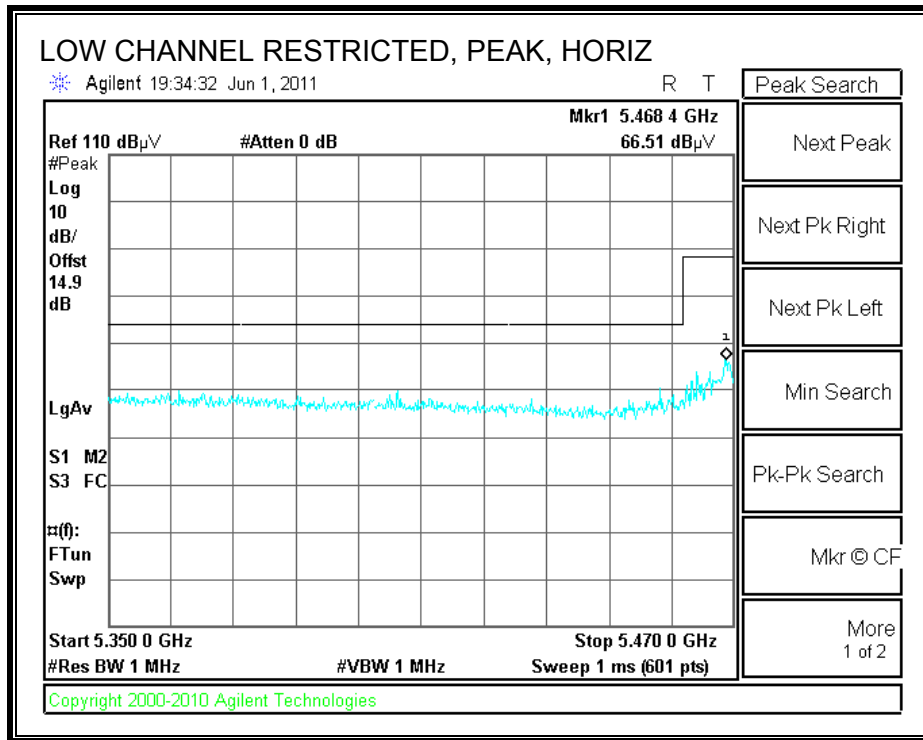


HARMONICS AND SPURIOUS EMISSIONS

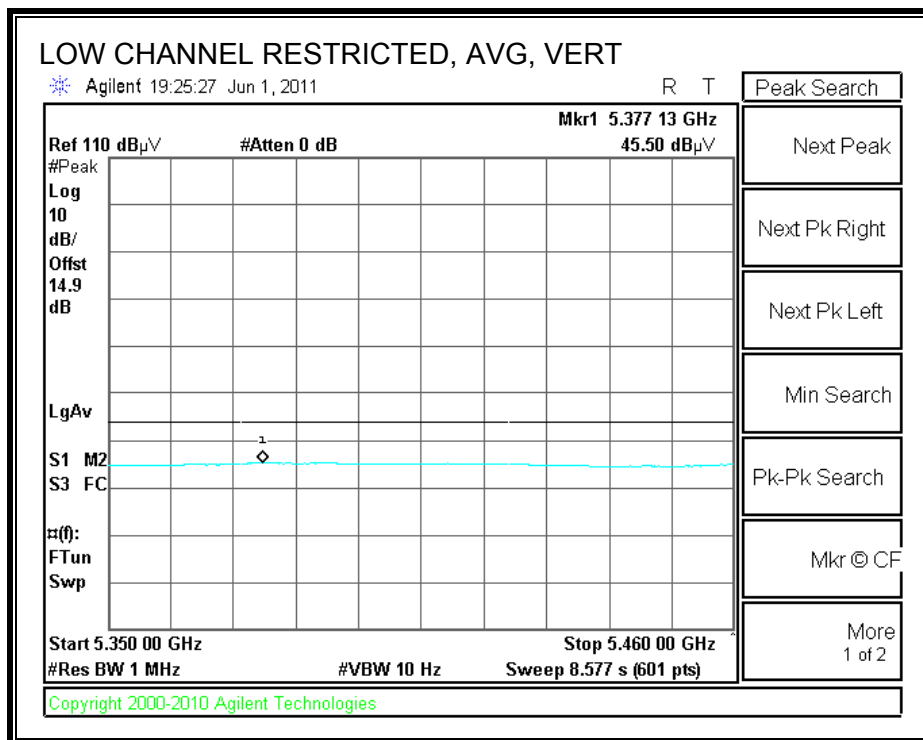
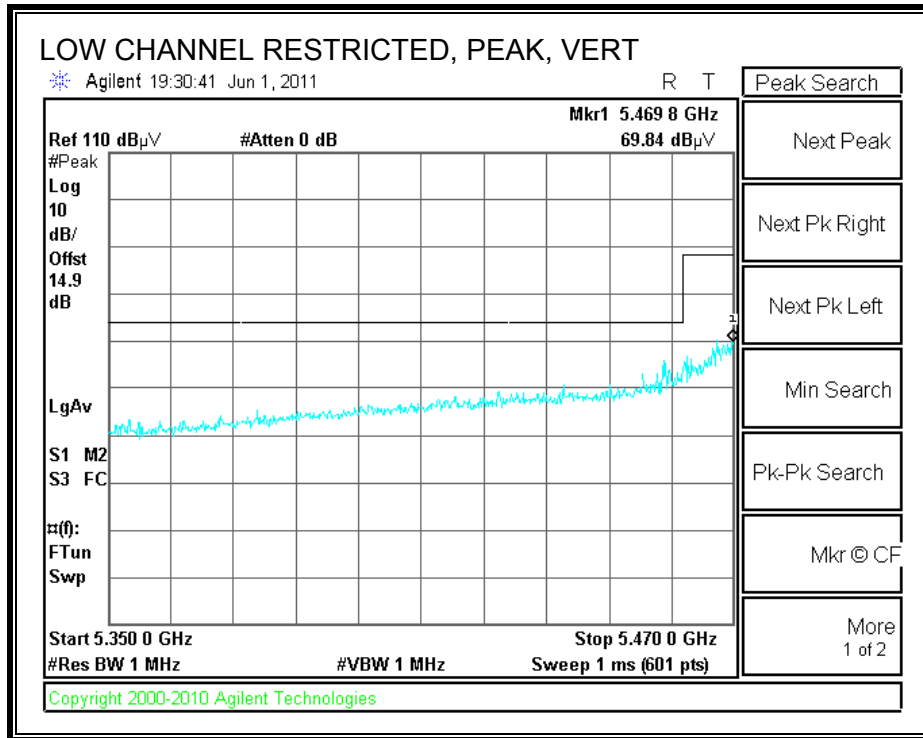
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		Legacy mode, TX, 5.6GHz Band											
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit									
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit									
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit									
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit									
CL	Cable Loss	HPF	High Pass Filter										
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
Low Ch, 5500MHz													
11.000	3.0	37.0	37.7	9.2	-33.8	0.0	0.7	50.9	74.0	-23.1	H	P	
11.000	3.0	24.7	37.7	9.2	-33.8	0.0	0.7	38.7	54.0	-15.3	H	A	
11.000	3.0	38.7	37.7	9.2	-33.8	0.0	0.7	52.7	74.0	-21.3	V	P	
11.000	3.0	26.9	37.7	9.2	-33.8	0.0	0.7	40.8	54.0	-13.2	V	A	
Mid Ch, 5600MHz													
11.200	3.0	44.7	37.9	9.3	-33.5	0.0	0.7	59.1	74.0	-14.9	H	P	
11.200	3.0	28.5	37.9	9.3	-33.5	0.0	0.7	42.9	54.0	-11.1	H	A	
11.200	3.0	43.1	37.9	9.3	-33.5	0.0	0.7	57.5	74.0	-16.5	V	P	
11.200	3.0	27.7	37.9	9.3	-33.5	0.0	0.7	42.1	54.0	-11.9	V	A	
High Ch, 5700MHz													
11.400	3.0	37.1	38.0	9.4	-33.2	0.0	0.7	52.0	74.0	-22.0	H	P	
11.400	3.0	24.7	38.0	9.4	-33.2	0.0	0.7	39.6	54.0	-14.4	H	A	
11.400	3.0	37.9	38.0	9.4	-33.2	0.0	0.7	52.8	74.0	-21.2	V	P	
11.400	3.0	26.1	38.0	9.4	-33.2	0.0	0.7	41.0	54.0	-13.0	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.8. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.6 GHz BAND

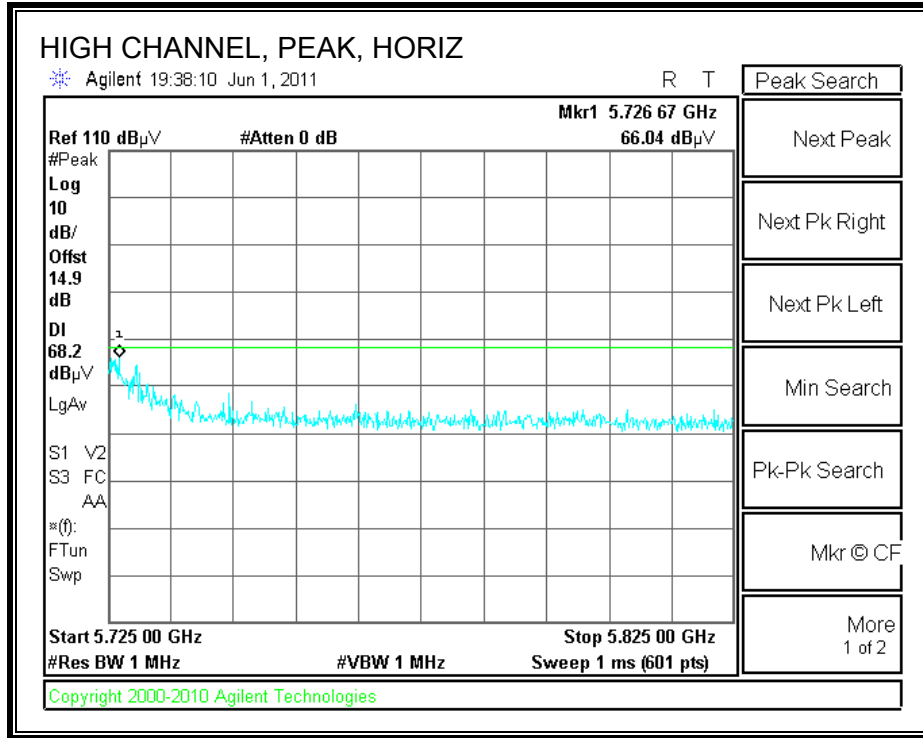
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



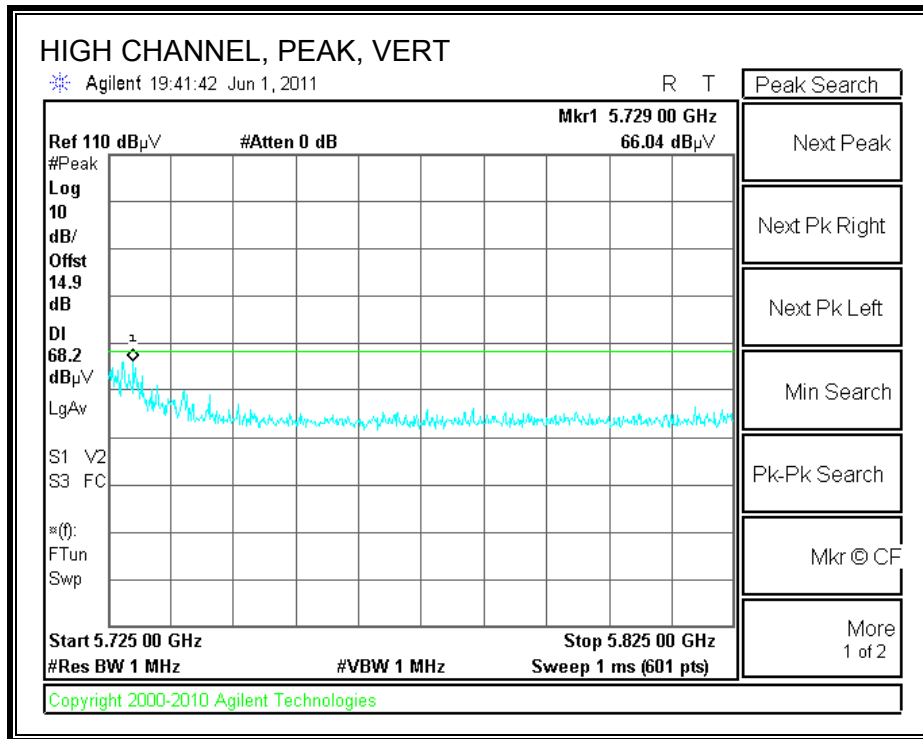
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)

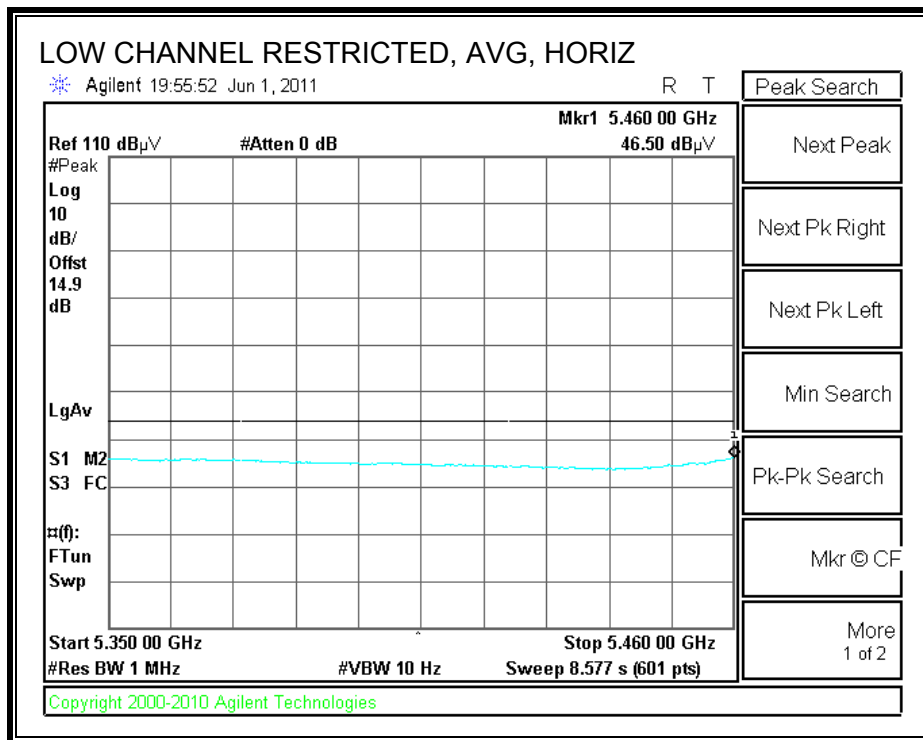
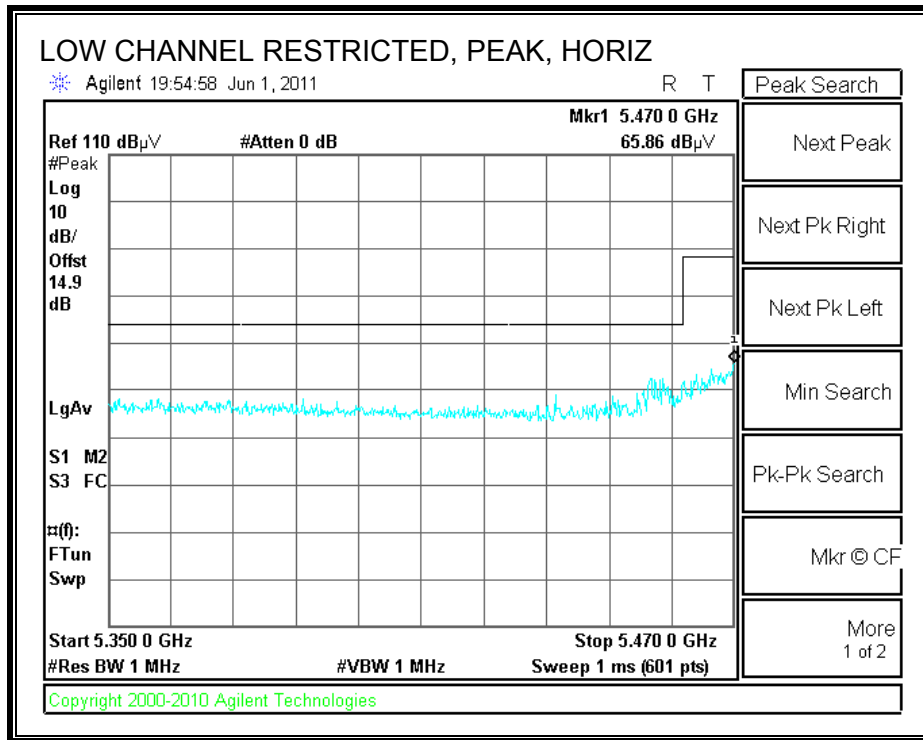


HARMONICS AND SPURIOUS EMISSIONS

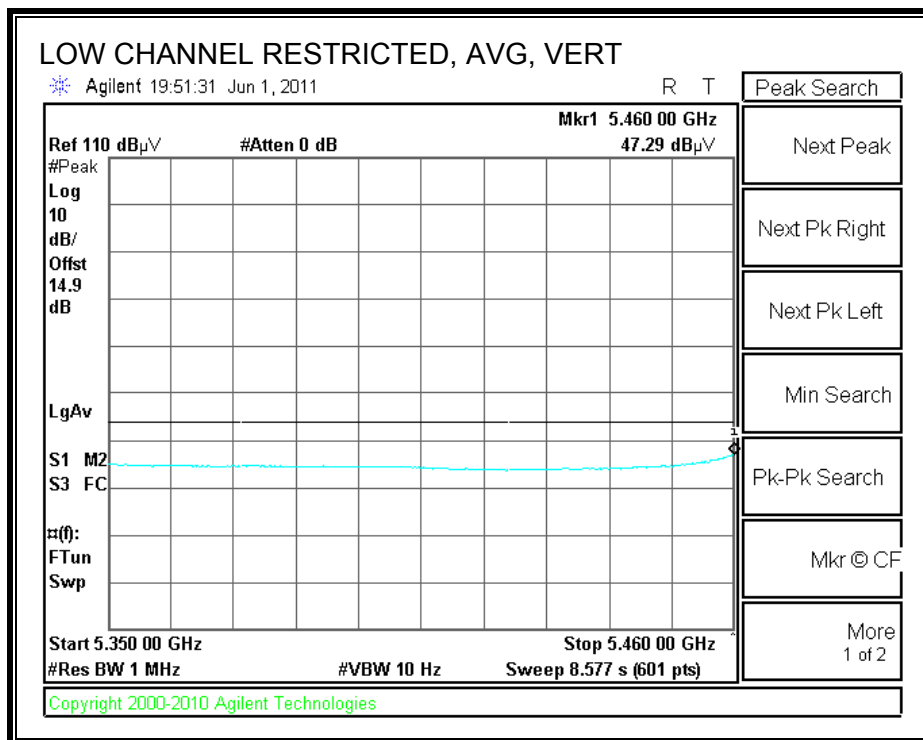
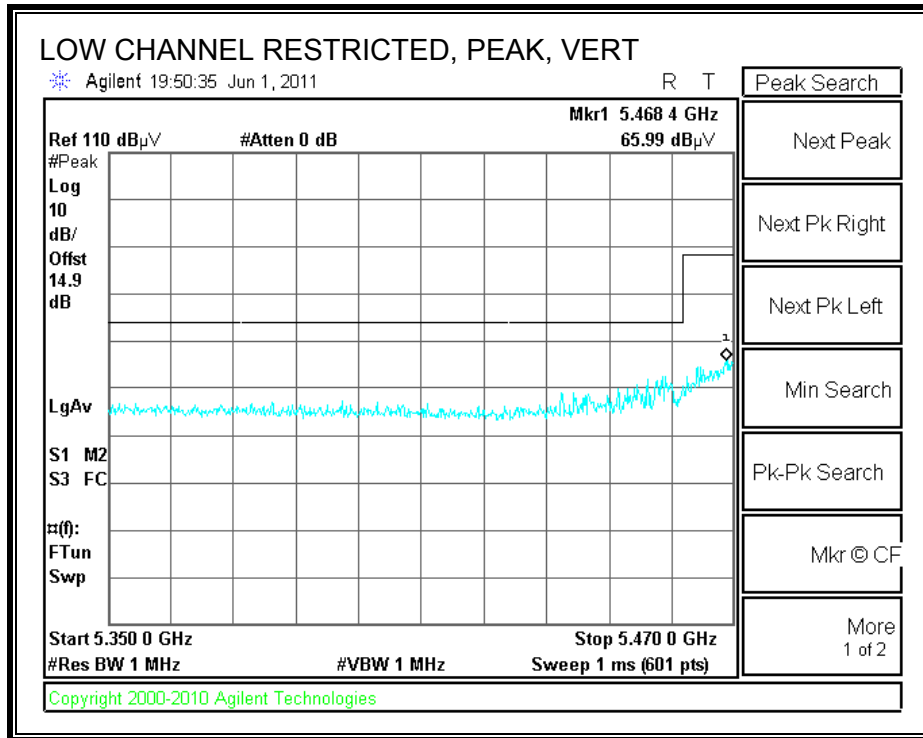
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		HT20, TX, 5.6 GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det P/A/QP	Notes
Low Ch, 5500MHz													
11.000	3.0	37.8	37.7	9.2	-33.8	0.0	0.7	51.7	74.0	-22.3	V	P	
11.000	3.0	25.1	37.7	9.2	-33.8	0.0	0.7	39.1	54.0	-14.9	V	A	
11.000	3.0	33.9	37.7	9.2	-33.8	0.0	0.7	47.8	74.0	-26.2	H	P	
11.000	3.0	21.9	37.7	9.2	-33.8	0.0	0.7	35.8	54.0	-18.2	H	A	
Mid Ch, 5600MHz													
11.200	3.0	46.3	37.9	9.3	-33.5	0.0	0.7	60.8	74.0	-13.2	V	P	
11.200	3.0	27.4	37.9	9.3	-33.5	0.0	0.7	41.8	54.0	-12.2	V	A	
11.200	3.0	46.6	37.9	9.3	-33.5	0.0	0.7	61.1	74.0	-12.9	H	P	
11.200	3.0	27.5	37.9	9.3	-33.5	0.0	0.7	41.9	54.0	-12.1	H	A	
High Ch, 5700MHz													
11.400	3.0	38.8	38.0	9.4	-33.2	0.0	0.7	53.7	74.0	-20.3	V	P	
11.400	3.0	25.4	38.0	9.4	-33.2	0.0	0.7	40.4	54.0	-13.6	V	A	
11.400	3.0	41.9	38.0	9.4	-33.2	0.0	0.7	56.8	74.0	-17.2	H	P	
11.400	3.0	25.5	38.0	9.4	-33.2	0.0	0.7	40.4	54.0	-13.6	H	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.2.9. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 5.6 GHz BAND

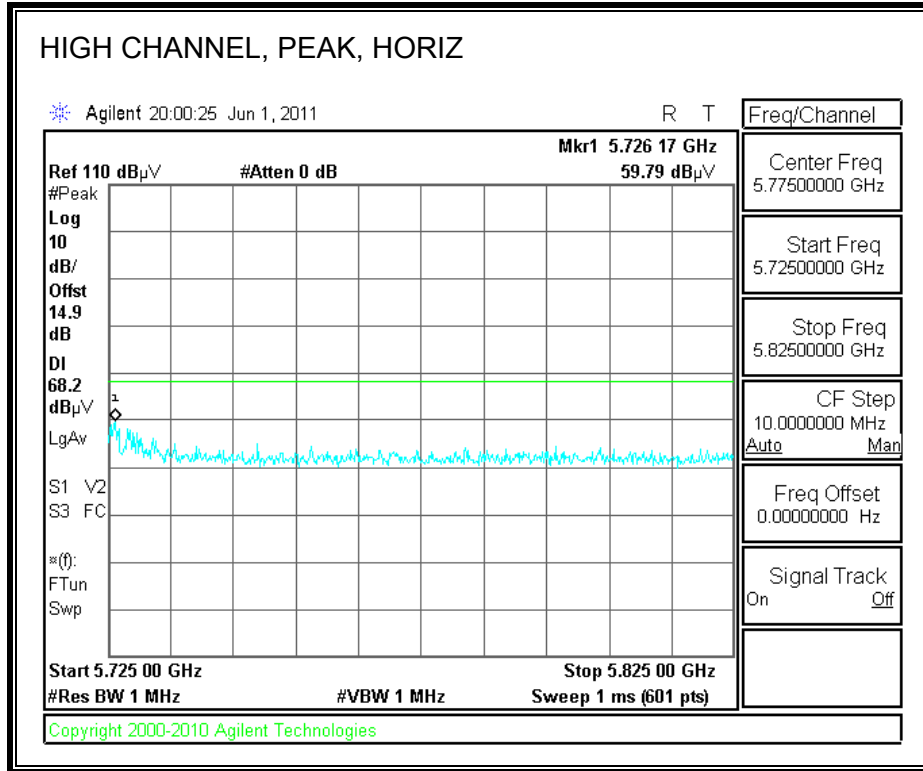
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



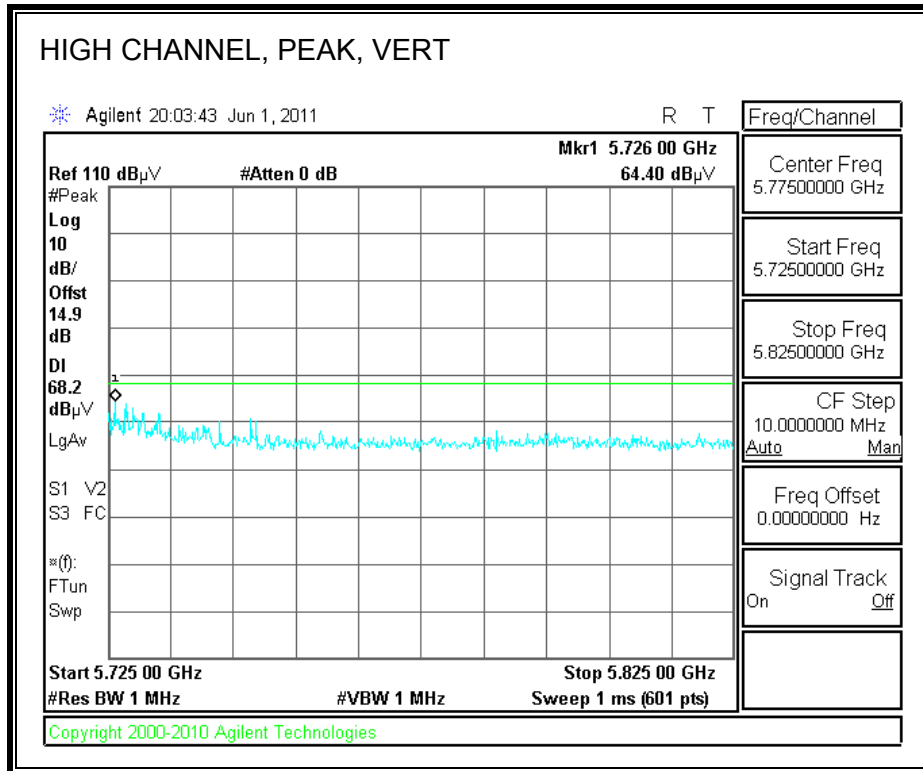
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



AUTHORIZED BANDEGE (HIGH CHANNEL, HORIZONTAL)



AUTHORIZED BANDEGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		06-02-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		HT40, TX, 5.6GHz Band											
f	Measurement Frequency			Amp	Preamp Gain			Average Field Strength Limit					
Dist	Distance to Antenna			D Corr	Distance Correct to 3 meters			Peak Field Strength Limit					
Read	Analyzer Reading			Avg	Average Field Strength @ 3 m			Margin vs. Average Limit					
AF	Antenna Factor			Peak	Calculated Peak Field Strength			Margin vs. Peak Limit					
CL	Cable Loss			HPF	High Pass Filter								
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
Low Ch, 5510MHz													
11.020	3.0	34.3	37.7	9.2	-33.7	0.0	0.7	48.3	74.0	-25.7	H	P	
11.020	3.0	22.0	37.7	9.2	-33.7	0.0	0.7	36.0	54.0	-18.0	H	A	
11.020	3.0	36.1	37.7	9.2	-33.7	0.0	0.7	50.1	74.0	-23.9	V	P	
11.020	3.0	23.8	37.7	9.2	-33.7	0.0	0.7	37.8	54.0	-16.2	V	A	
Mid Ch, 5590MHz													
11.180	3.0	39.9	37.8	9.3	-33.5	0.0	0.7	54.3	74.0	-19.7	H	P	
11.180	3.0	26.5	37.8	9.3	-33.5	0.0	0.7	40.9	54.0	-13.1	H	A	
11.180	3.0	39.2	37.8	9.3	-33.5	0.0	0.7	53.6	74.0	-20.4	V	P	
11.180	3.0	24.9	37.8	9.3	-33.5	0.0	0.7	39.2	54.0	-14.8	V	A	
High Ch, 5670MHz													
11.340	3.0	38.7	38.0	9.4	-33.3	0.0	0.7	53.5	74.0	-20.5	H	P	
11.340	3.0	25.0	38.0	9.4	-33.3	0.0	0.7	39.8	54.0	-14.2	H	A	
11.340	3.0	42.6	38.0	9.4	-33.3	0.0	0.7	57.4	74.0	-16.6	V	P	
11.340	3.0	25.7	38.0	9.4	-33.3	0.0	0.7	40.4	54.0	-13.6	V	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

8.3. 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:		Tom Chen											
Date:		03-31-11											
Project #:		11U13650											
Company:		Apple											
Test Target:		FCC Class B											
Mode Oper:		TX mode 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	Dist	Read	AF	CL	Amp	D Corr	Pad	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
MHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
148.565	3.0	45.8	12.7	1.1	29.3	0.0	0.0	30.3	43.5	-13.2	H	P	
166.566	3.0	52.9	10.4	1.2	29.3	0.0	0.0	35.2	43.5	-8.3	H	P	
384.015	3.0	44.8	14.8	1.9	29.2	0.0	0.0	32.2	46.0	-13.8	H	P	
443.897	3.0	45.0	15.8	2.0	29.5	0.0	0.0	33.3	46.0	-12.7	H	P	
517.7	3.0	46.6	17.1	2.2	29.7	0.0	0.0	36.1	46.0	-9.9	H	P	
796.592	3.0	42.3	21.0	2.8	29.2	0.0	0.0	36.9	46.0	-9.1	H	P	
39.36	3.0	48.7	14.6	0.5	29.6	0.0	0.0	34.2	40.0	-5.8	V	P	
99.723	3.0	46.4	10.0	0.9	29.5	0.0	0.0	27.8	43.5	-15.7	V	P	
384.015	3.0	44.4	14.8	1.9	29.2	0.0	0.0	31.8	46.0	-14.2	V	P	
398.295	3.0	49.1	15.0	1.9	29.3	0.0	0.0	36.7	46.0	-9.3	V	P	
585.983	3.0	41.5	18.0	2.4	29.6	0.0	0.0	32.3	46.0	-13.7	V	P	
779.551	3.0	33.0	20.6	2.8	29.2	0.0	0.0	27.2	46.0	-18.8	V	P	
Rev. 1.27.09													
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 ²)	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 ²)	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 ²)	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 ²)	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.

EQUATIONS

Power density is given by:

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

where

S = Power density in W/m²

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m² is converted to units of mWc/m² 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/m²

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/cm²

RESULTS

Band (MHz)	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m ²)	FCC Power Density (mW/cm ²)
5.2GHz Band, 2x2						
5180 - 5240	802.11a	0.20	12.42	8.65	0.25	0.025
5180 - 5240	HT20	0.20	12.44	8.65	0.26	0.026
5190 - 5230	HT40	0.20	13.99	8.65	0.37	0.037
5.3GHz Band, 2x2						
5260 - 5320	802.11a	0.20	19.01	8.67	1.17	0.117
5260 - 5320	HT20	0.20	18.94	8.67	1.15	0.115
5270 - 5310	HT40	0.20	19.51	8.67	1.31	0.131
5.6GHz Band, 2x2						
5500 - 5700	802.11a	0.20	19.80	7.43	1.05	0.105
5500 - 5700	HT20	0.20	19.75	7.43	1.04	0.104
5510 - 5670	HT40	0.20	19.84	7.43	1.06	0.106