FCC CFR47 PART 15 SUBPART E
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

802.11 a/b/g/n 3X3 ACCESS POINT

MODEL NUMBER: A1409

FCC ID: BCGA1409
IC: 579C-A1409

REPORT NUMBER: 11U13703-17, Revision B

ISSUE DATE: JUNE 03, 2011

Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA, 95014, U.S.A.

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/02/11	Initial Issue	F. Ibrahim
A	05/20/11	Revised all conducted spurious sections.	F. Ibrahim
B	06/01/11	Revised section 1, section 2, section 5.5, section 6 and section 7.5.	F. Ibrahim
C	06/03/11	Revised section 1.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA, 95014, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n 3X3 ACCESS POINT

MODEL: A1409

SERIAL NUMBER: C86F8006DM73

DATE TESTED: MARCH 2 – MARCH 25, 2011

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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 CCS By:

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

WILLIAM ZHUANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, ICES-003 ISSUE 4, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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 802.11 a/b/g/n transceiver Access Point.

5.2. MAXIMUM OUTPUT POWER

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

DUAL CHAIN CONFIGURATION

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	12.33	17.10
5180 - 5240	802.11n HT20	15.02	31.77
5190 -5230	802.11n HT40	16.87	48.64

THREE CHAIN CONFIGURATION

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	11.60	14.45
5180 - 5240	802.11n HT20	14.95	31.26
5190 -5230	802.11n HT40	16.59	45.60

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes 3 IFA integrated antennas, with the following peak gains:

Frequency Range (MHz)	AP1 Peak gain (dBi)	AP2 Peak gain (dBi)	AP3 Peak gain (dBi)
5.15 - 5.25	5.03	2.5	5.69

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was k30b_7.5.3d5auto20110307T0000-TOT_develop.basebinary.

The test utility is Terminal Version 2.1.1 (273).

5.5. WORST-CASE CONFIGURATION AND MODE

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

Worst-case data rates as provided by the manufacturer are:
For 11a mode: 6Mbps
For 11n HT20 (5.15-5.25 GHz band): MCS0
For 11n HT40 (5.15-5.25 GHz band): MCS0

Radiated Emissions and Bandedge for 11a mode was performed with three chains connected to the applicable antennas at the higher power values; therefore, this mode covers 11a two chains.

EUT only has one orientation (laid down on the desktop) and it was tested in that orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Apple	Mac Book	PT429161
AC Adaptor	Apple	A1344	N/A

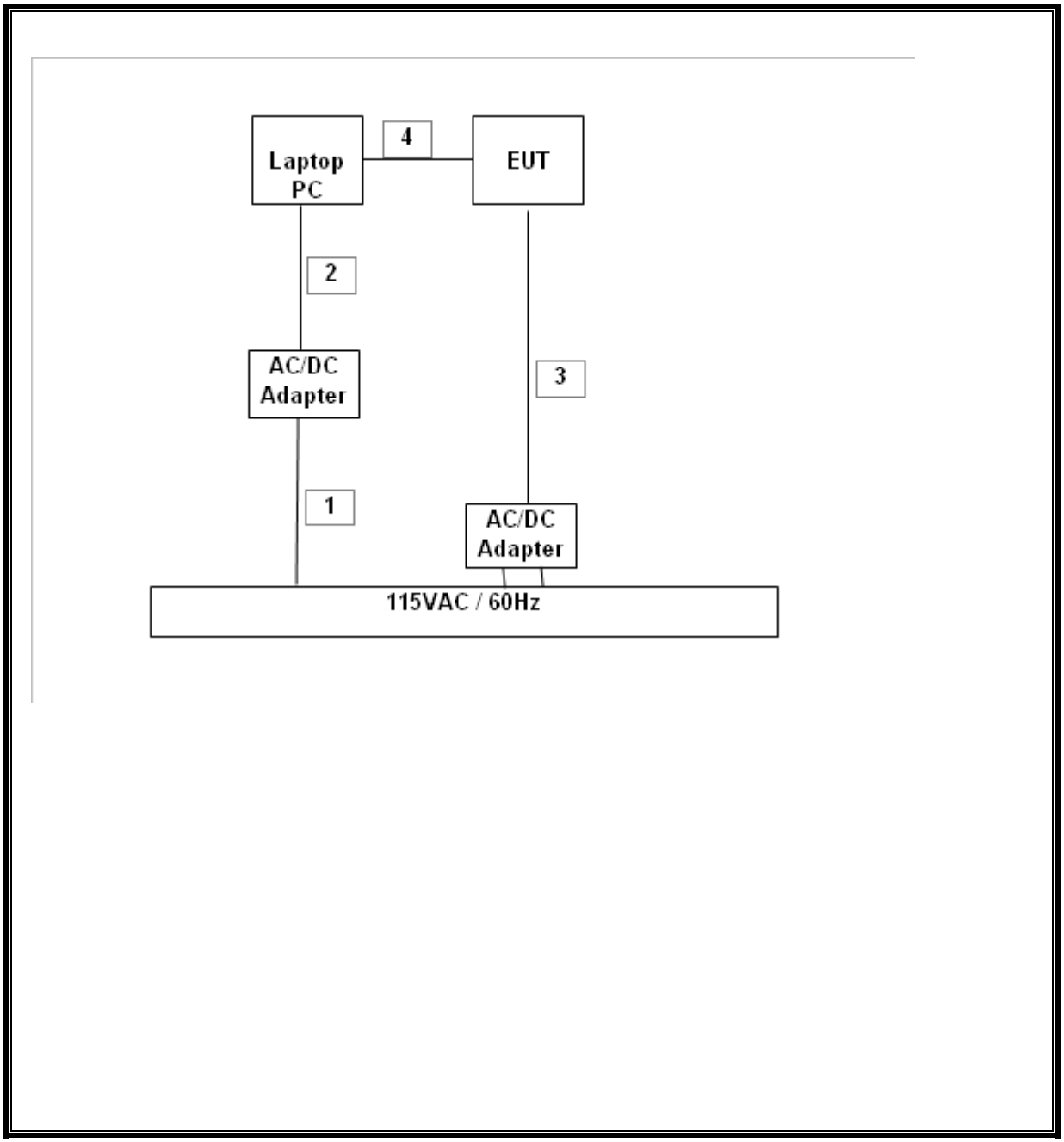
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	unshielded	2m	N/A
2	DC	1	DC	unshielded	2.5m	N/A
3	DC	1	DC	unshielded	2m	N/A
4	Ethernet	4	RJ45	Shielded	1.5m	N/A

TEST SETUP

The Access Point EUT is controlled externally with a laptop, via Ethernet.

SETUP DIAGRAM FOR RADIO TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01/27/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/12/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	06/25/11
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/08/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/06/11
Harmonic Mixer, 50 GHz	Agilent / HP	11970Q	C00769	05/05/11
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
Reject Filter, 2.0-2.9 GHz	Micro-Tronics	BRM50702	N02684	CNR
High Pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	05/11/12
Peak Power Meter	Boonton	4541	C01186	04/05/12
Peak Power Sensor	Boonton	57318	C01203	03/31/12
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/10/11

7. ANTENNA PORT TEST RESULTS

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

7.1.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

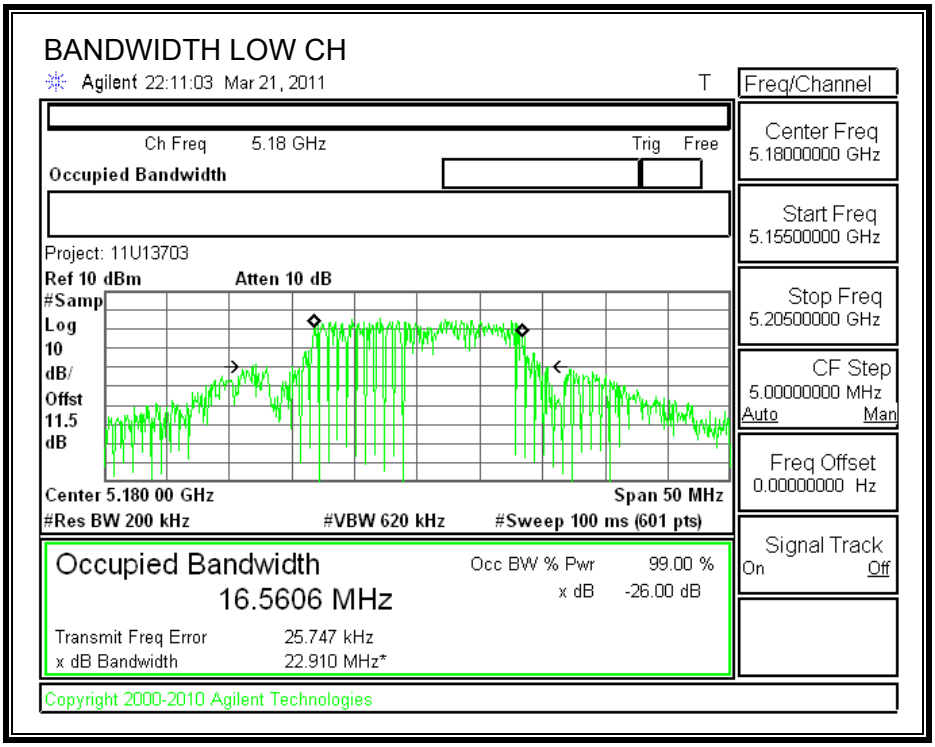
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.91	16.5606
Middle	5200	22.867	16.453
High	5240	22.853	16.5812

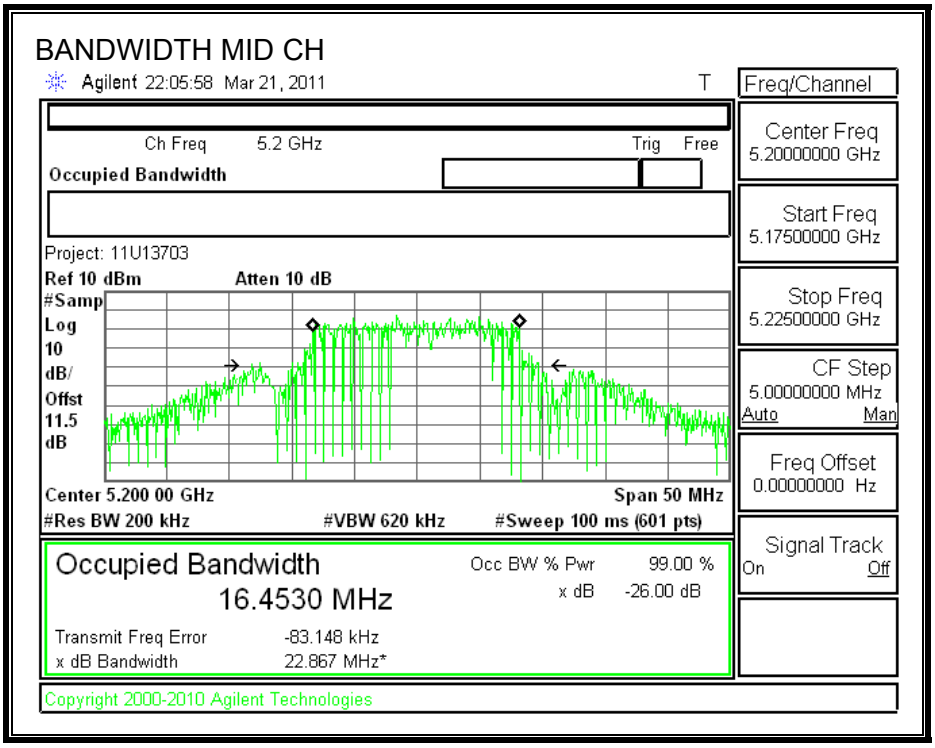
AP3

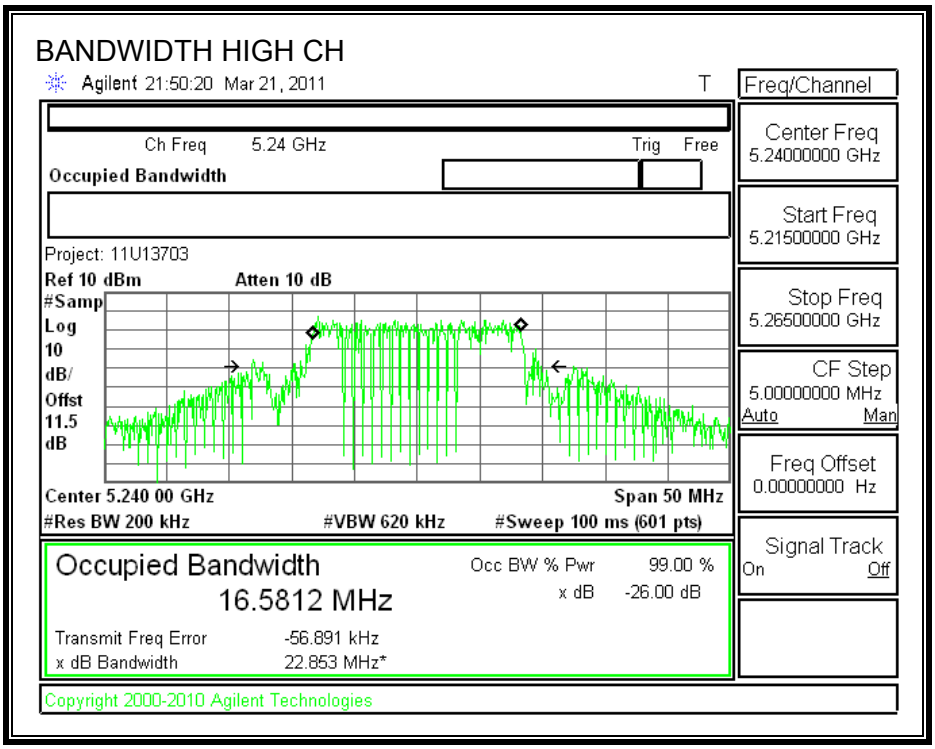
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.433	16.5884
Middle	5200	22.144	16.3719
High	5240	22.612	16.6131

AP1

26 dB and 99% BANDWIDTH

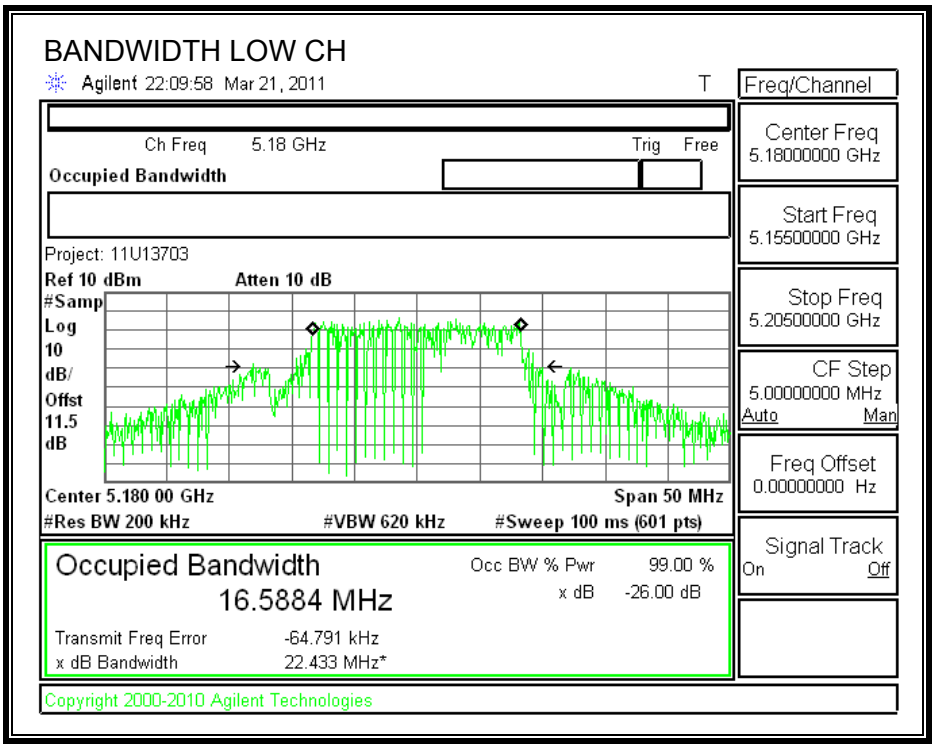


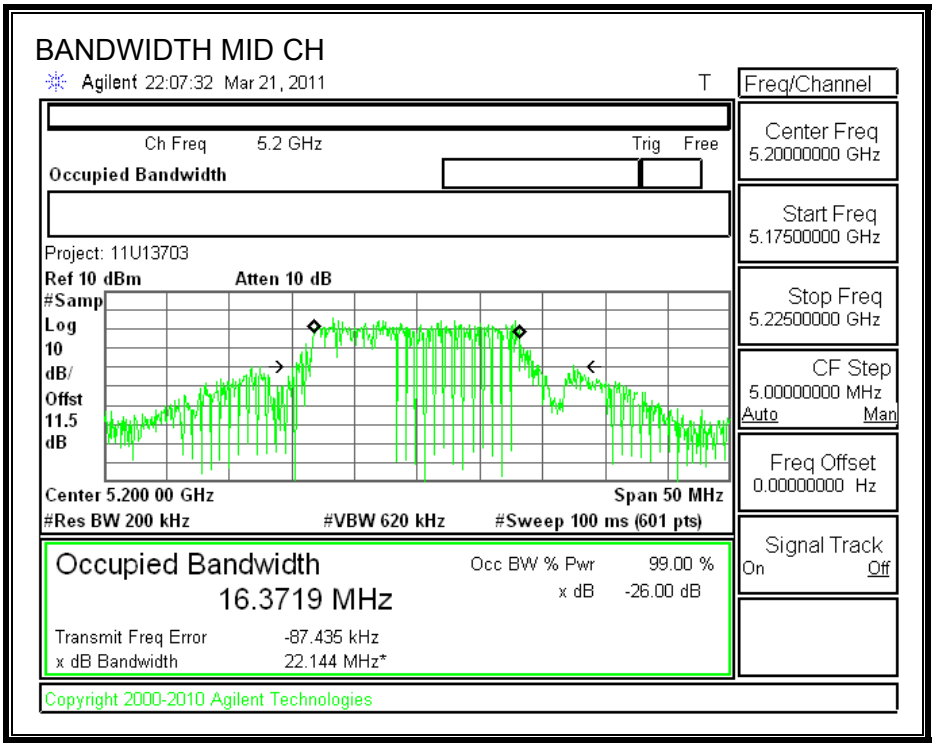


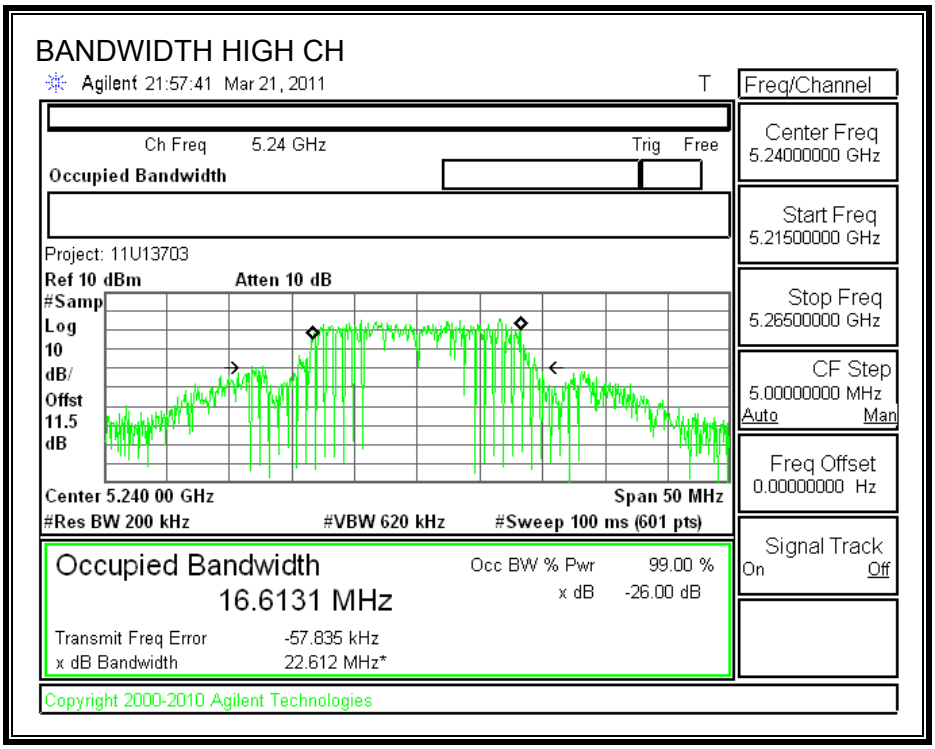


AP3

26 dB and 99% BANDWIDTH







7.1.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (Chain AP1) (dBi)	Antenna Gain (Chain AP3) (dBi)	Effective Legacy Gain (dBi)
5.03	5.69	8.38

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

The maximum effective legacy gain is **8.38 dBi** for other than fixed, point-to-point operations.

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

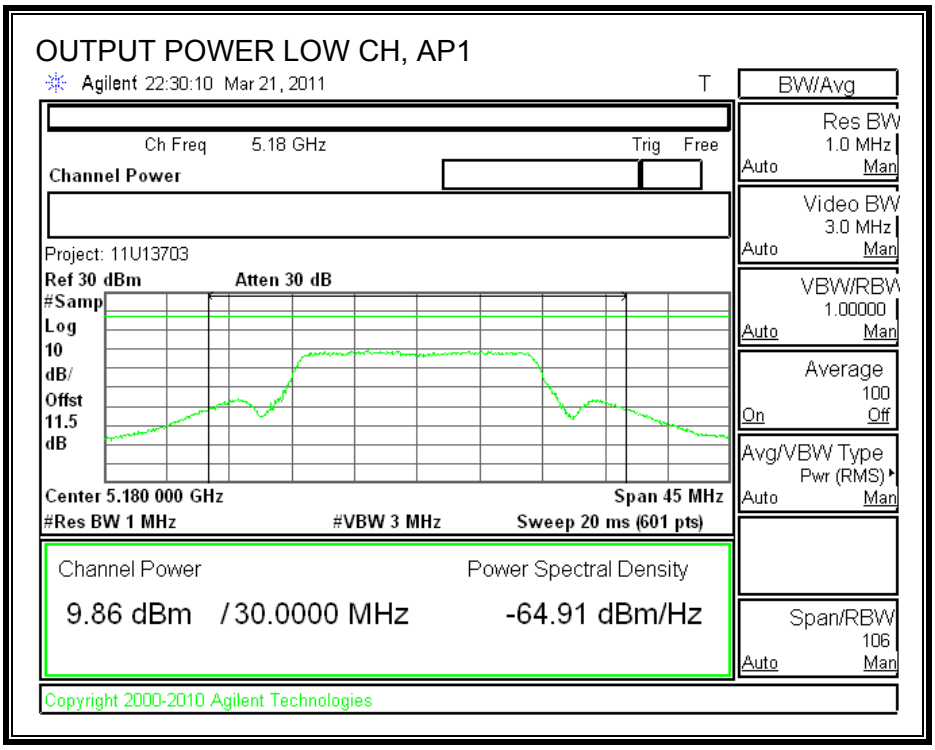
Limit

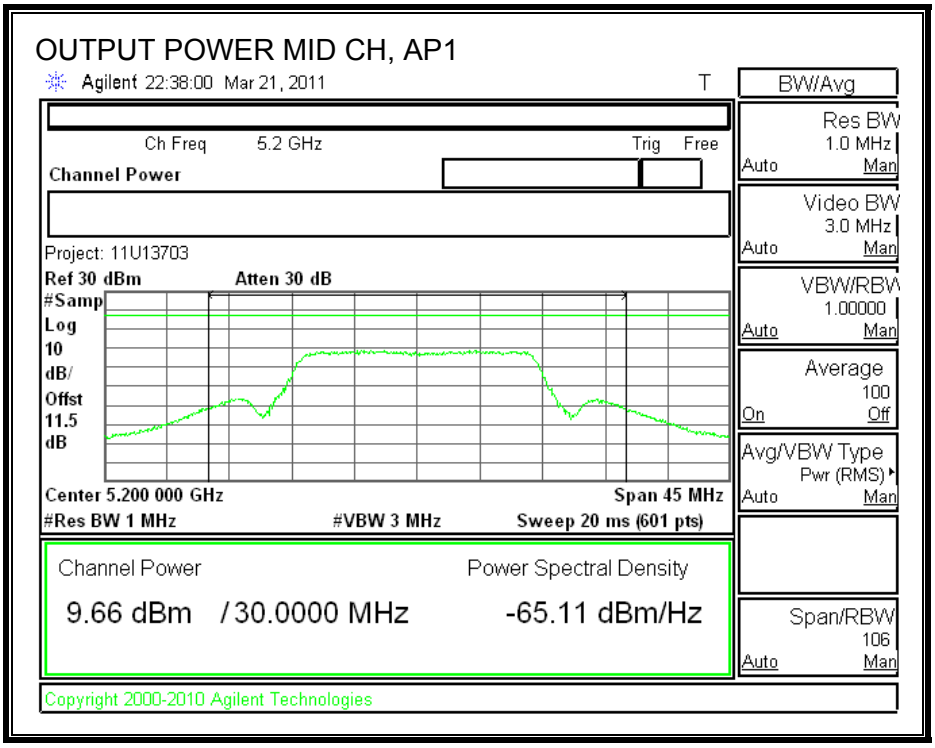
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	22.433	17.51	8.38	14.62
Mid	5200	17	22.144	17.45	8.38	14.62
High	5240	17	22.612	17.54	8.38	14.62

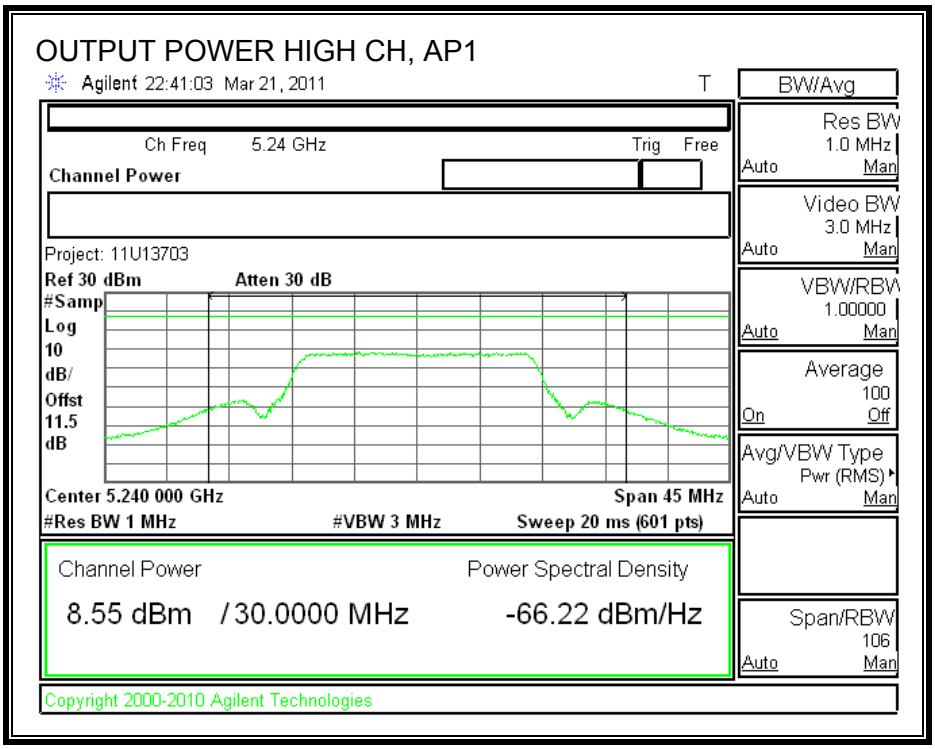
Individual Chain Results

Channel	Frequency (MHz)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.86	8.70	12.33	14.62	-2.29
Mid	5200	9.66	8.40	12.09	14.62	-2.53
High	5240	8.55	8.48	11.53	14.62	-3.09

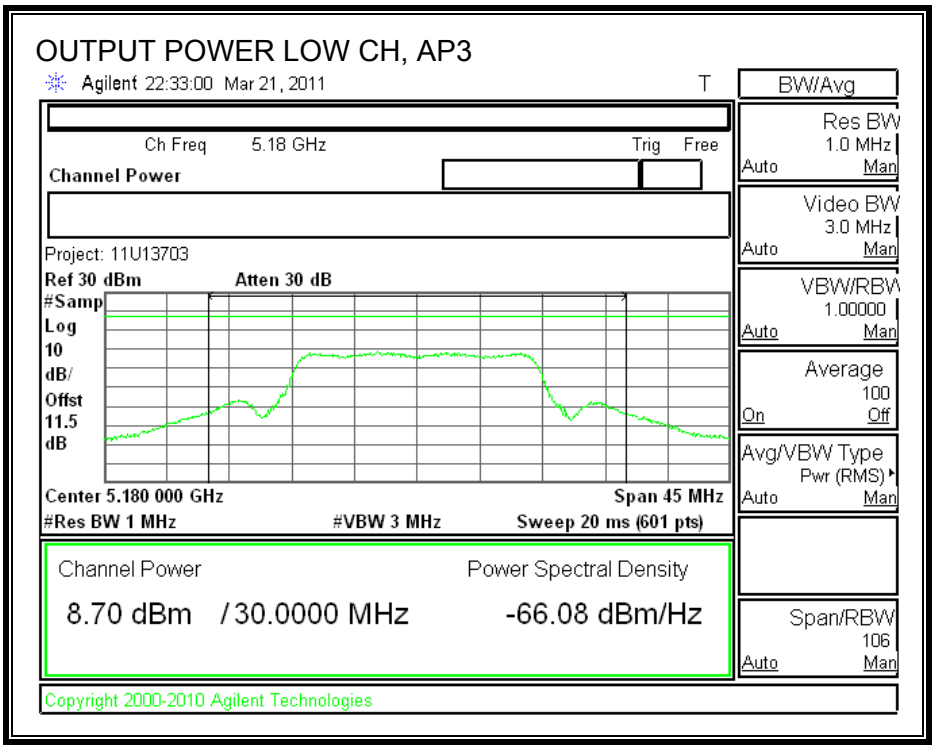
AP1 OUTPUT POWER

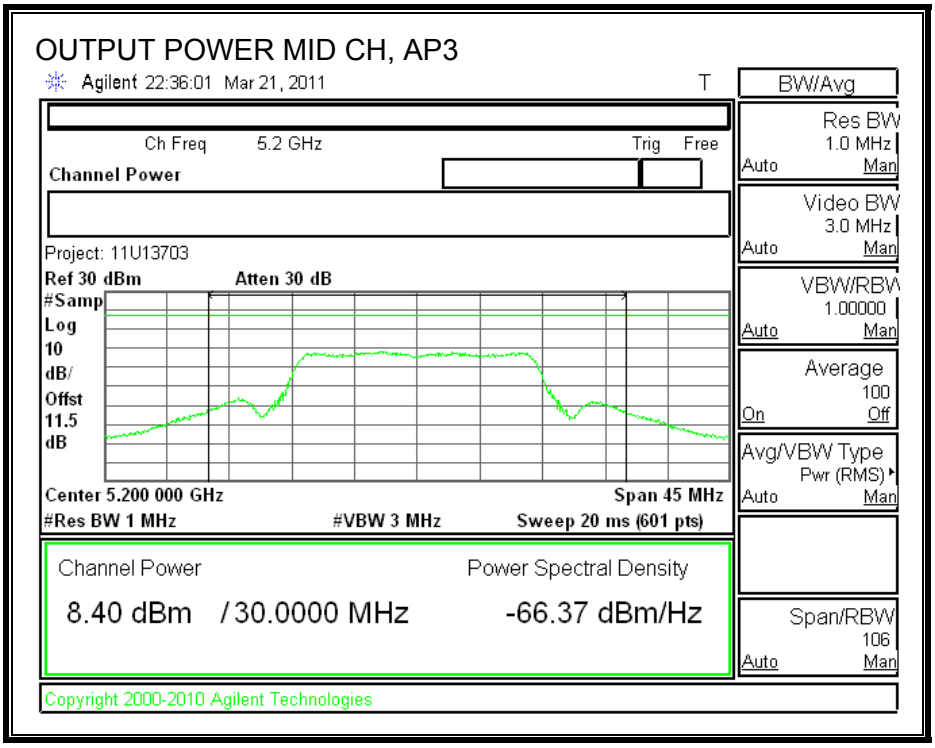


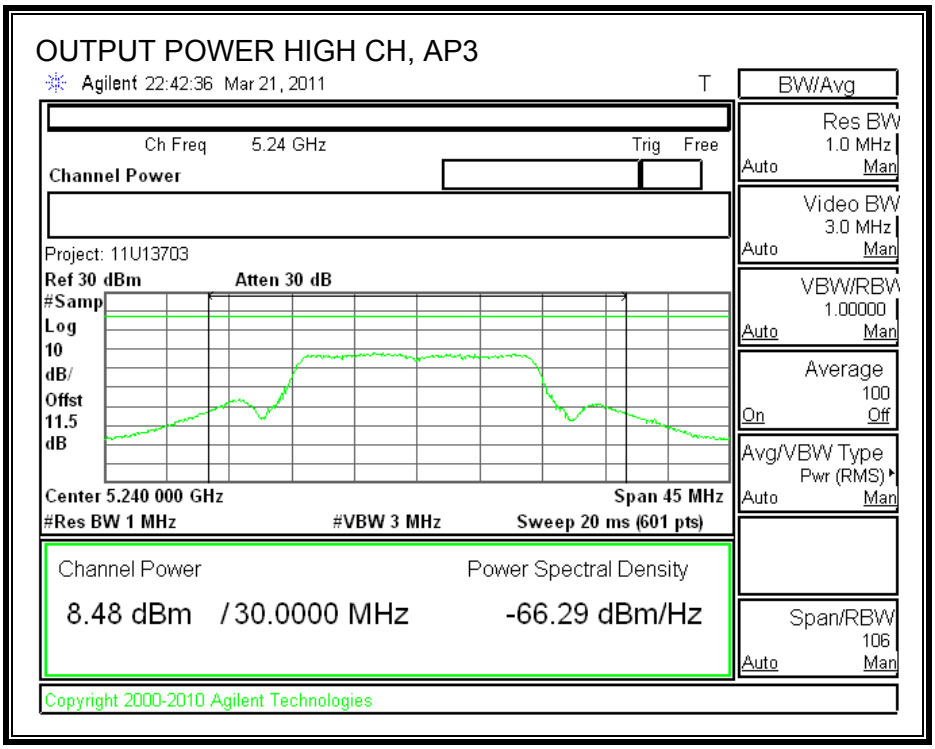




AP3 OUTPUT POWER







7.1.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (Chain AP1) (dBi)	Antenna Gain (Chain AP3) (dBi)	Effective Legacy Gain (dBi)
5.03	5.69	8.38

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 **8.38 dBi**, therefore the limit is **1.62 dBm**.

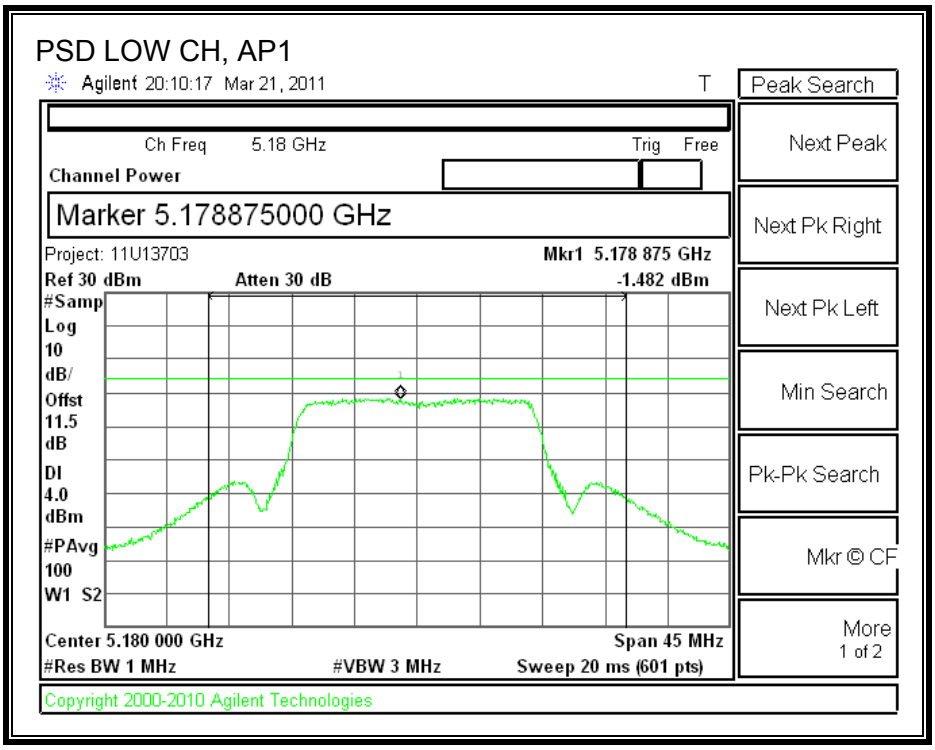
TEST PROCEDURE

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 #1 was used.

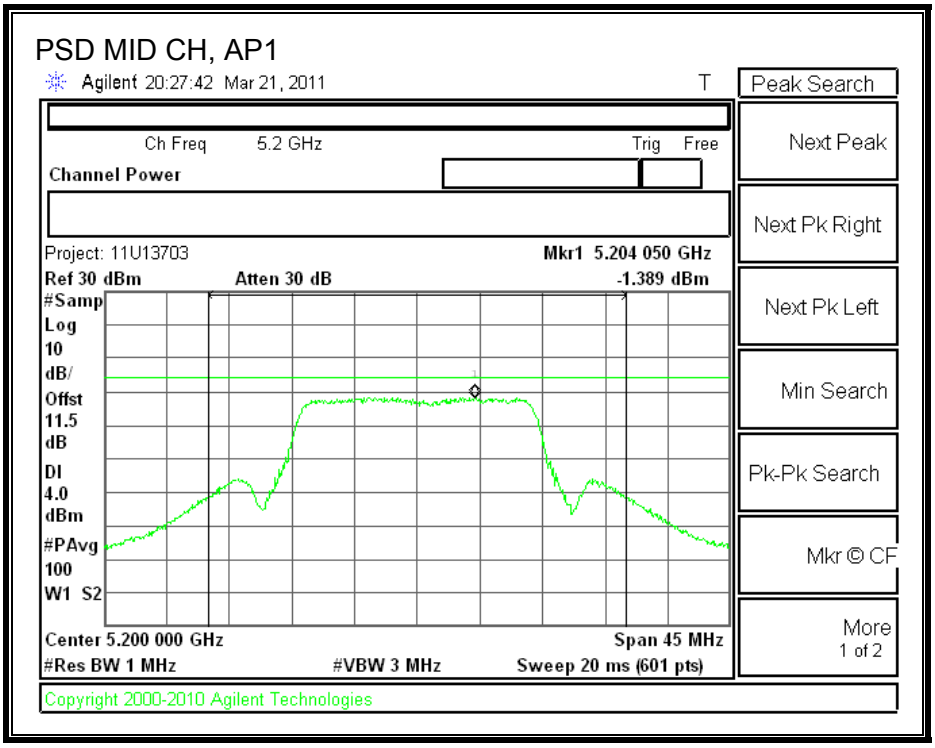
RESULTS

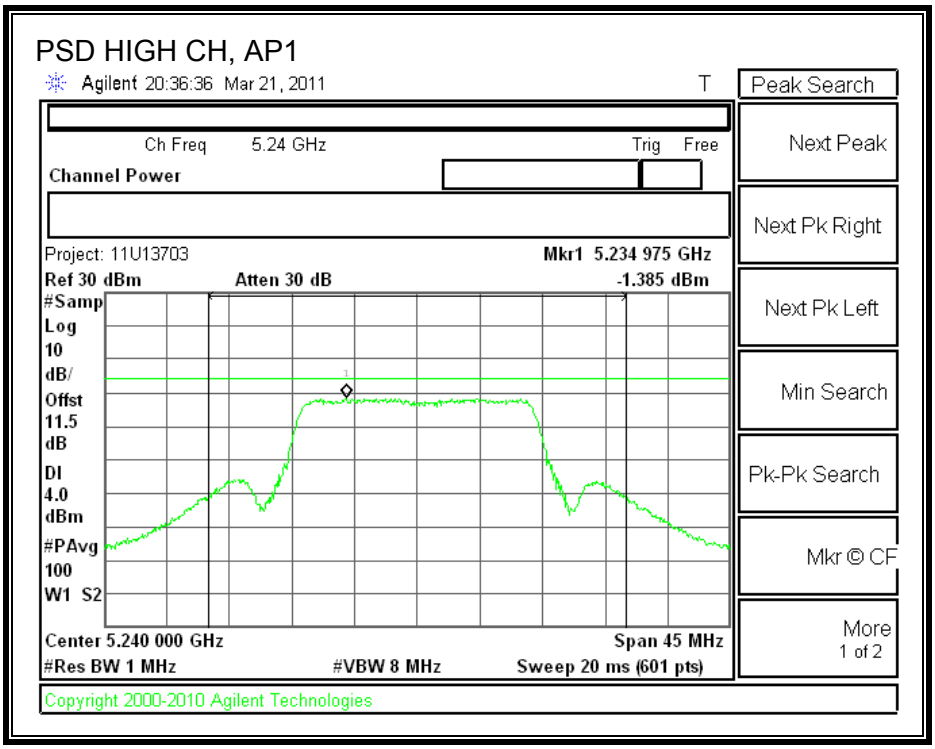
Channel	Frequency (MHz)	AP1 PPSD (dBm)	AP3 PPSD (dBm)	Total PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-1.482	-1.608	1.47	1.62	-0.15
Middle	5200	-1.389	-1.809	1.42	1.62	-0.20
High	5240	-1.385	-1.534	1.55	1.62	-0.07

AP1 POWER SPECTRAL DENSITY

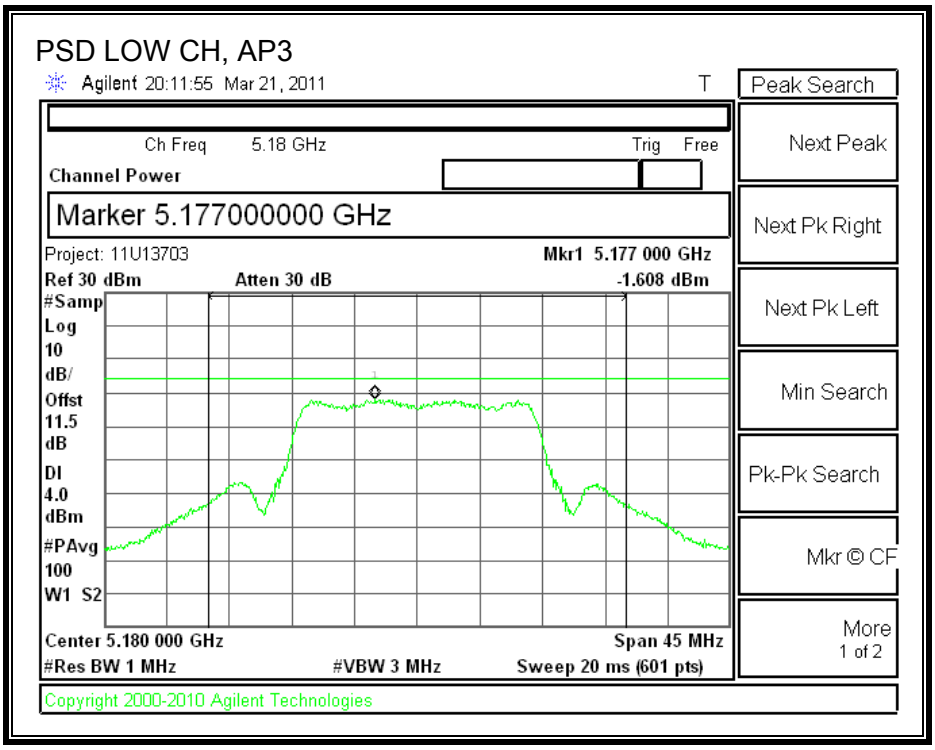


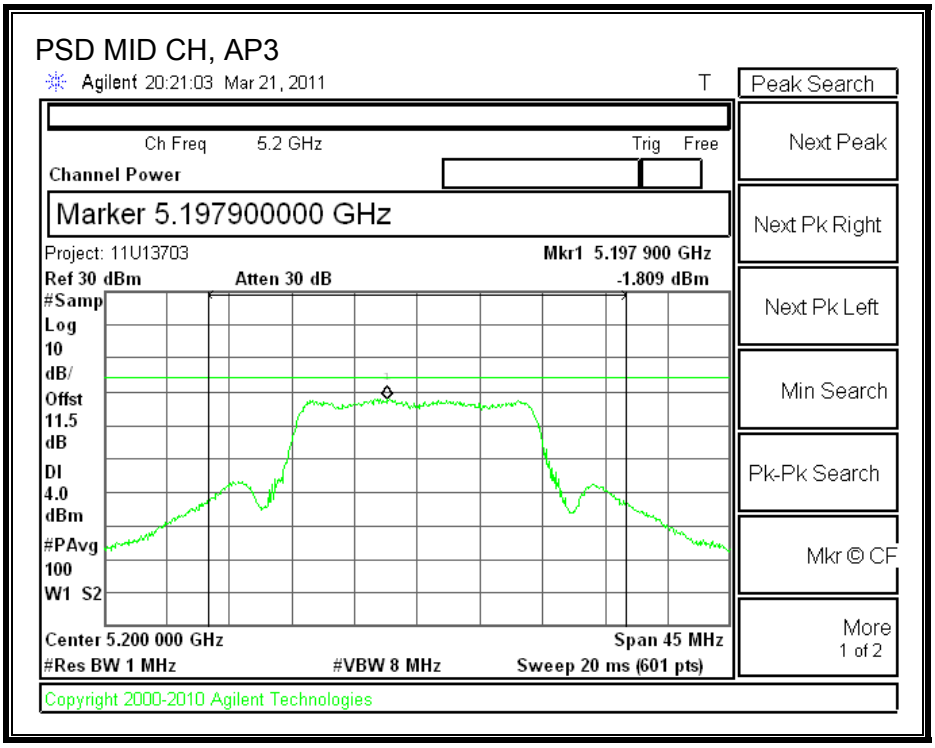
PSD MID CH, AP1

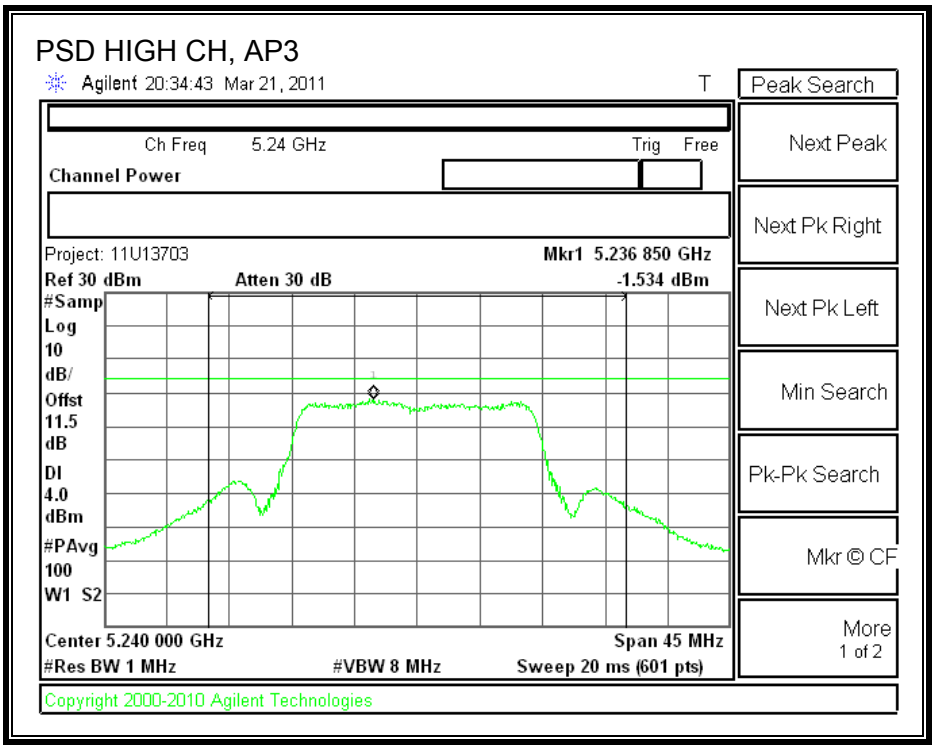




AP3 POWER SPECTRAL DENSITY







7.1.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

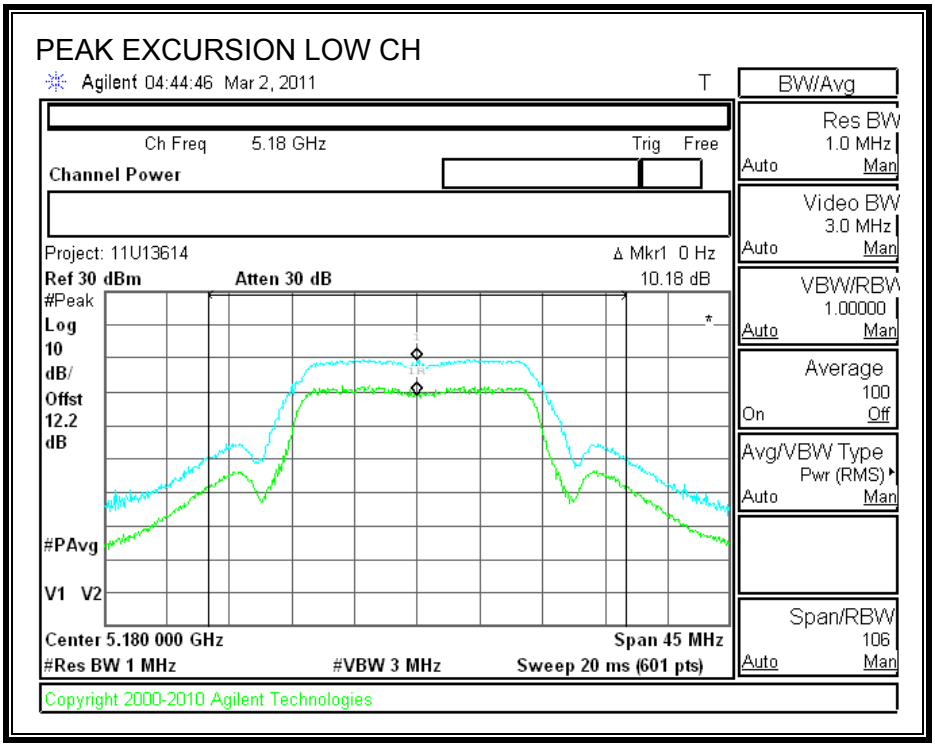
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	10.180	13	-2.82
Middle	5200	10.100	13	-2.90
High	5240	9.060	13	-3.94

AP3

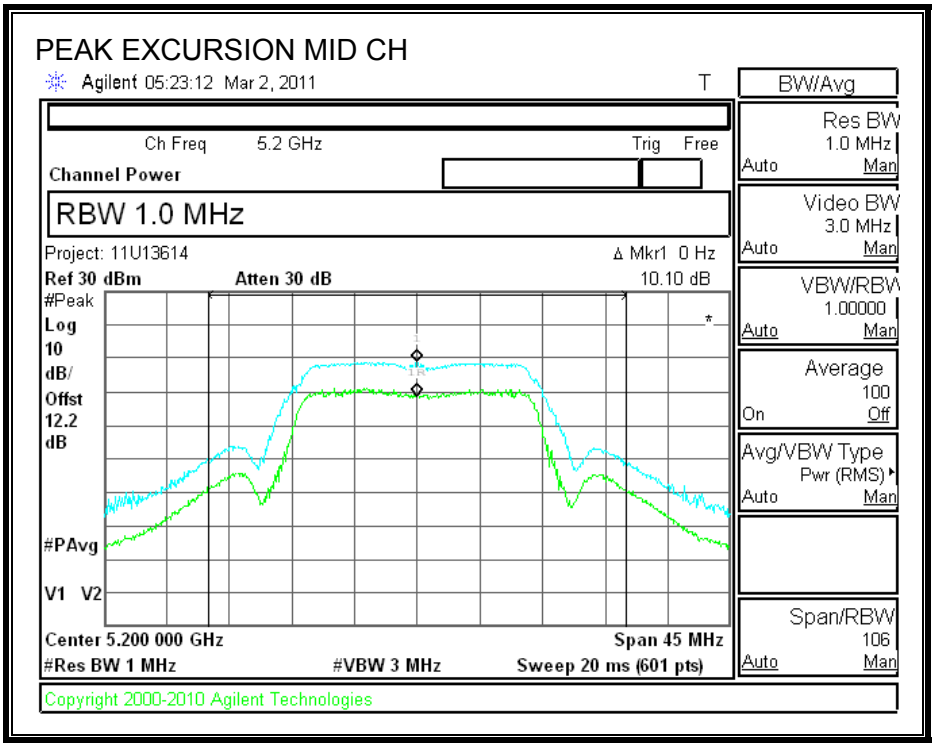
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.750	13	-3.25
Middle	5200	9.950	13	-3.05
High	5240	9.570	13	-3.43

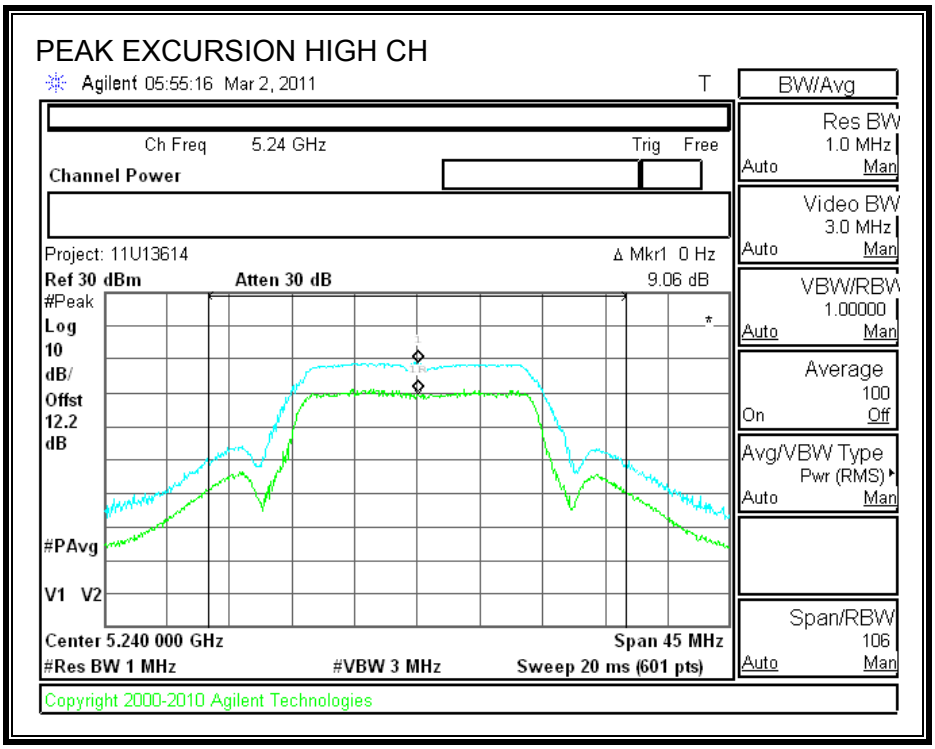
AP1

PEAK EXCURSION



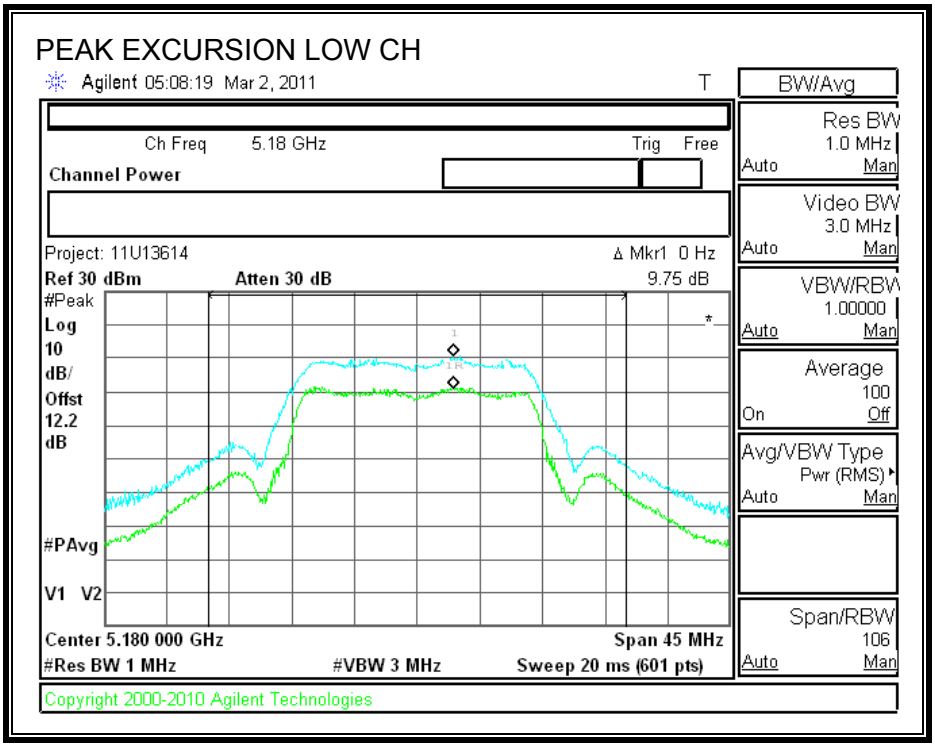
PEAK EXCURSION MID CH

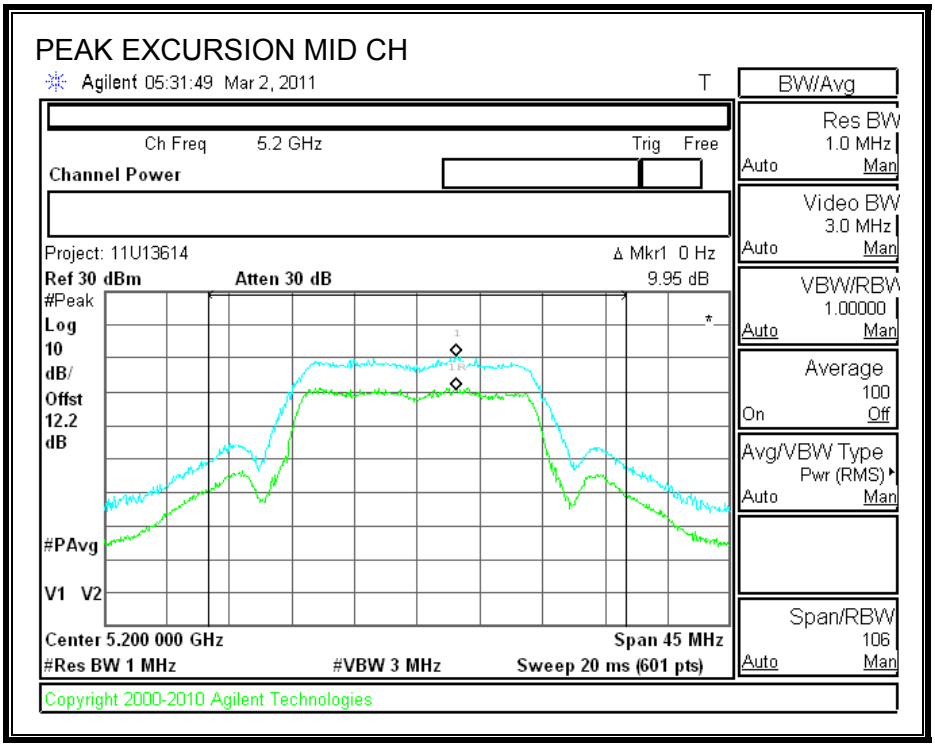


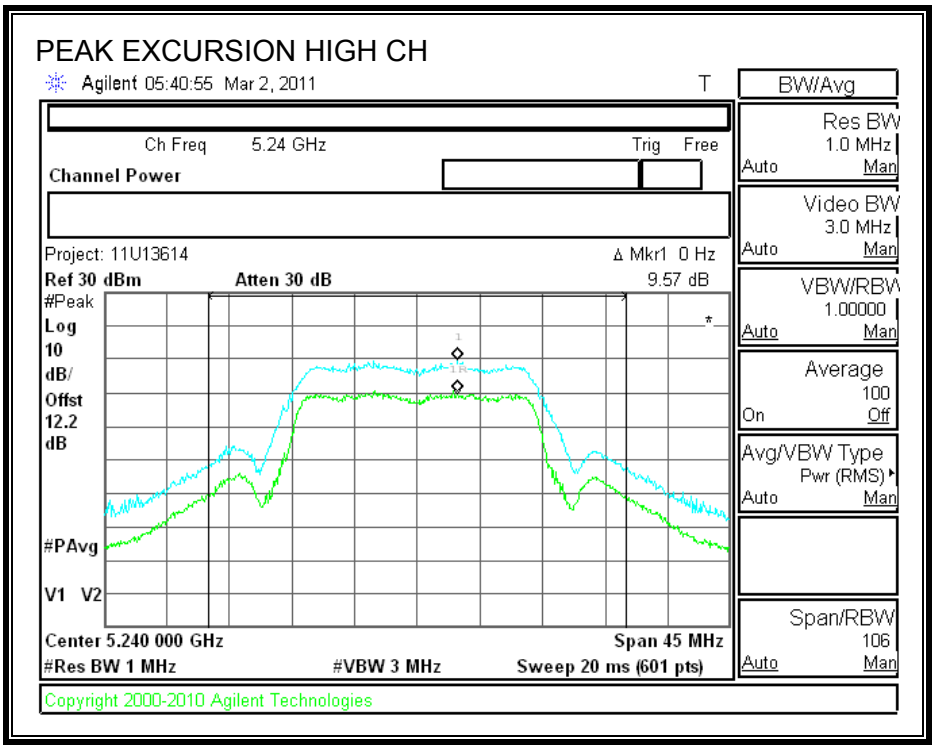


AP3

PEAK EXCURSION







7.1.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

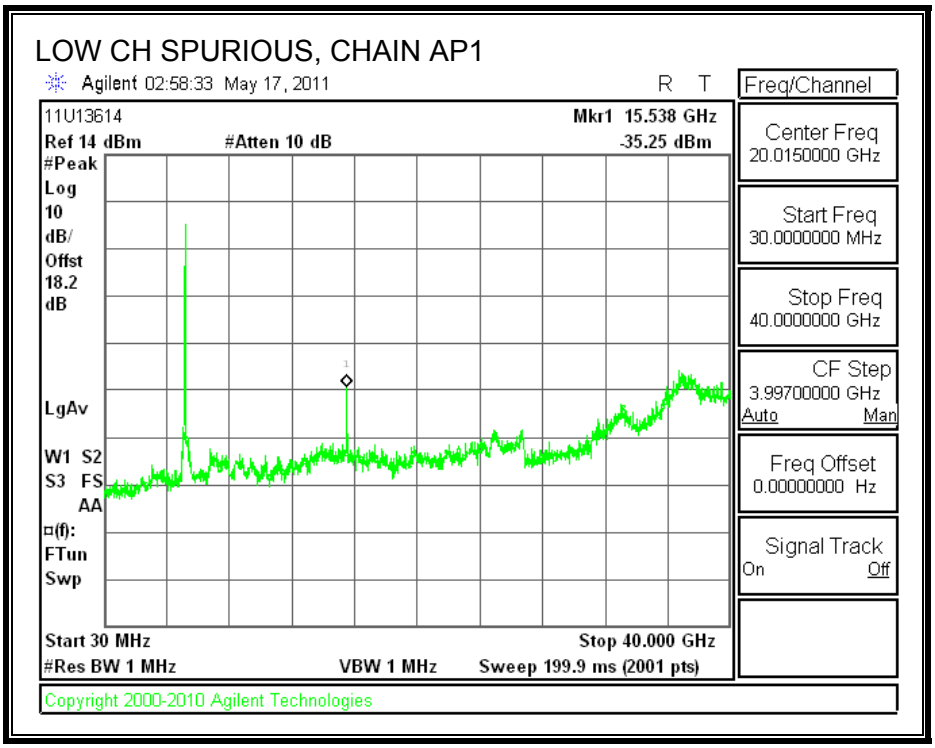
Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-35.25	5.03	3.01	-27.21	-27.00
Middle	15.598	-38.49	5.03	3.01	-30.45	-27.00
High	15.718	-35.79	5.03	3.01	-27.75	-27.00

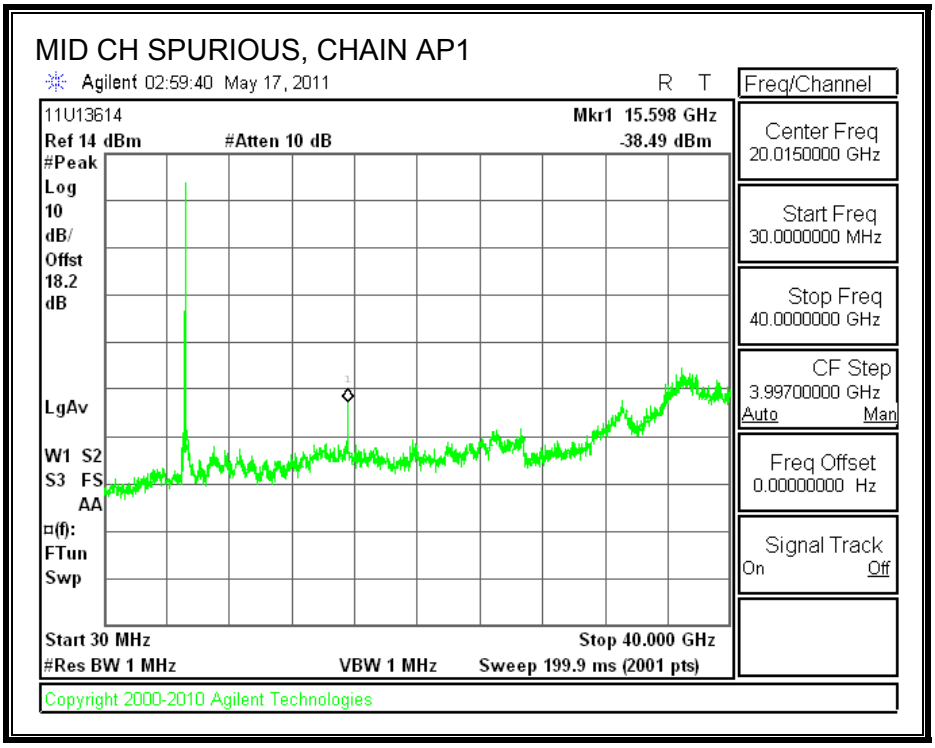
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-39.47	5.69	3.01	-30.77	-27.00
Middle	15.598	-40.25	5.69	3.01	-31.55	-27.00
High	15.718	-38.95	5.69	3.01	-30.25	-27.00

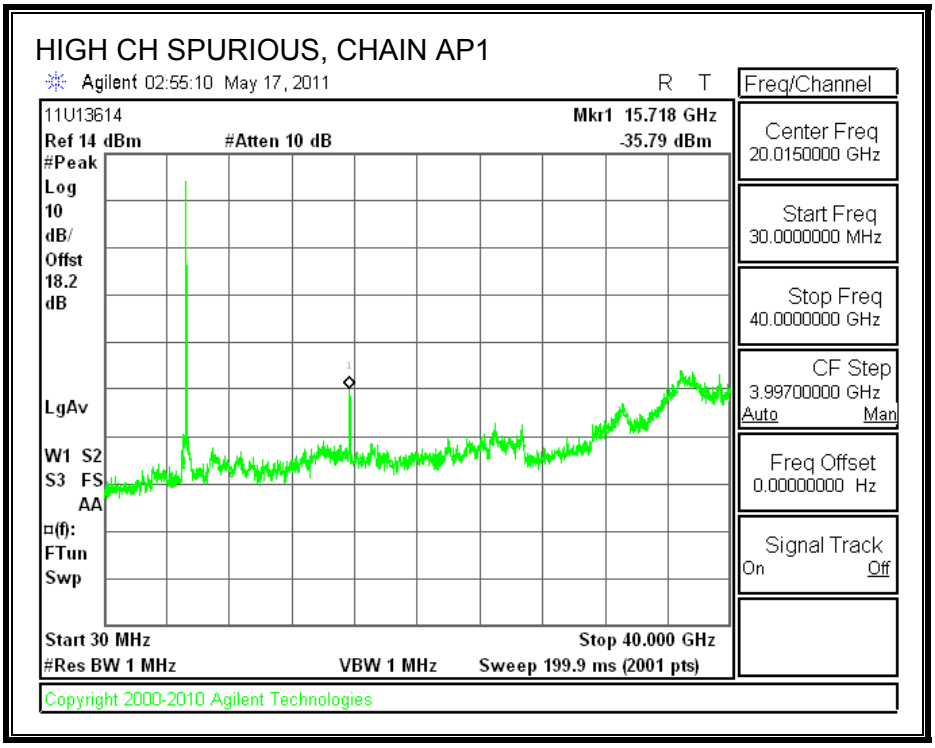
CHAIN AP1 SPURIOUS EMISSIONS



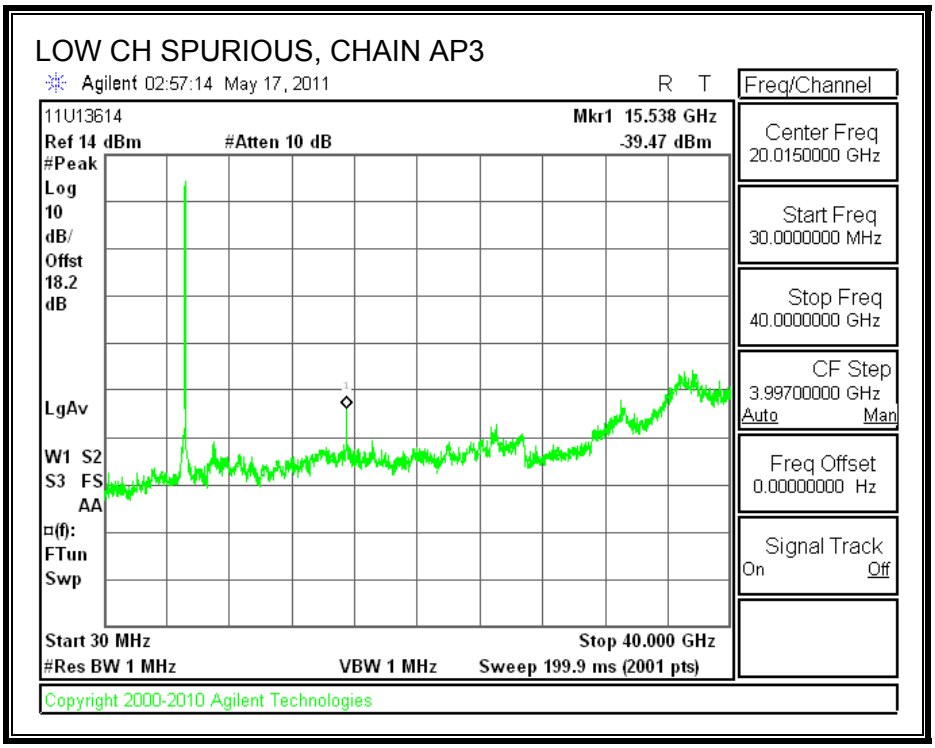
MID CH SPURIOUS, CHAIN AP1



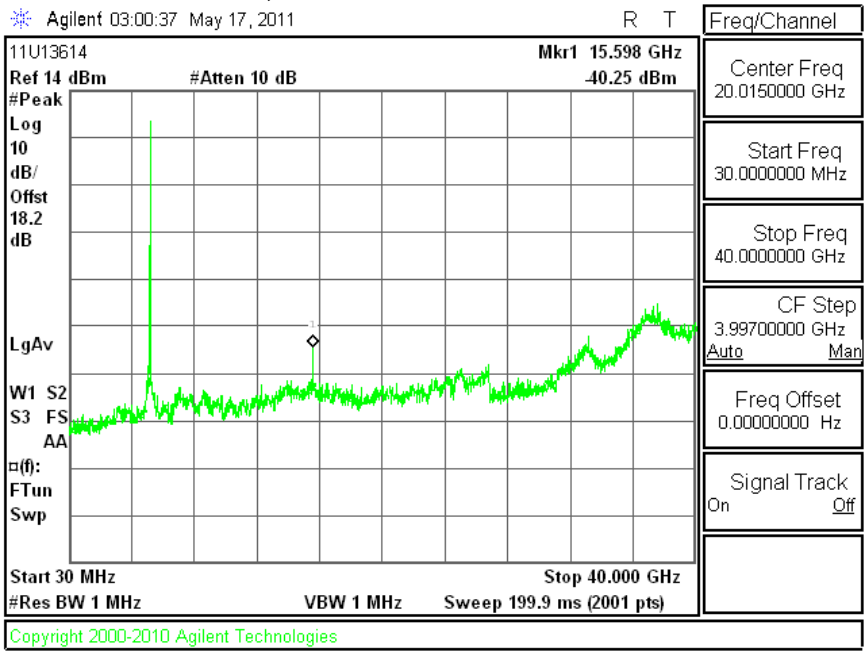
HIGH CH SPURIOUS, CHAIN AP1



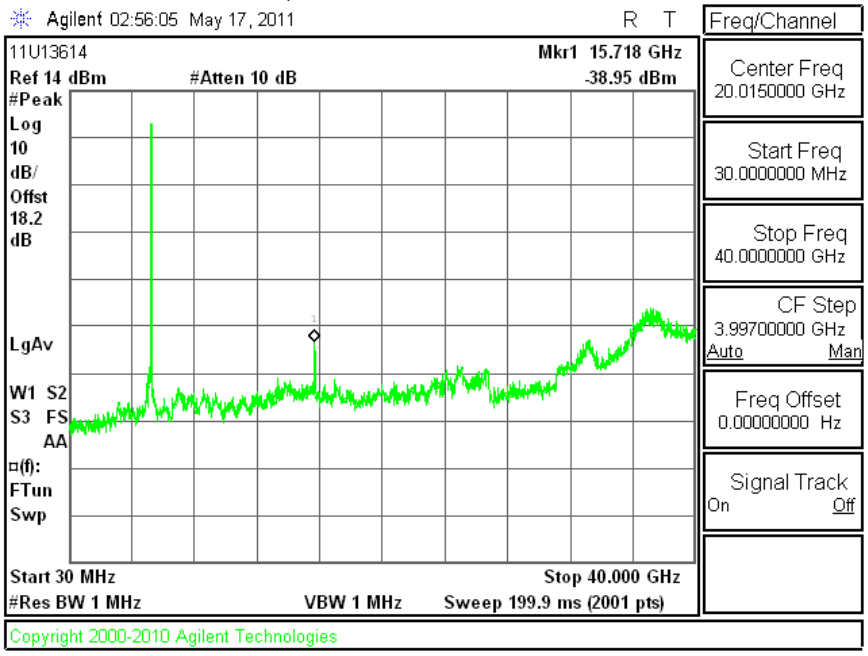
CHAIN AP3 SPURIOUS EMISSIONS



MID CH SPURIOUS, CHAIN AP3



HIGH CH SPURIOUS, CHAIN AP3



7.2. 802.11a THREE CHAINS LEGACY MODE IN THE 5.2 GHz BAND

7.2.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.703	16.5062
Middle	5200	22.605	16.5277
High	5240	23.375	16.5098

AP2

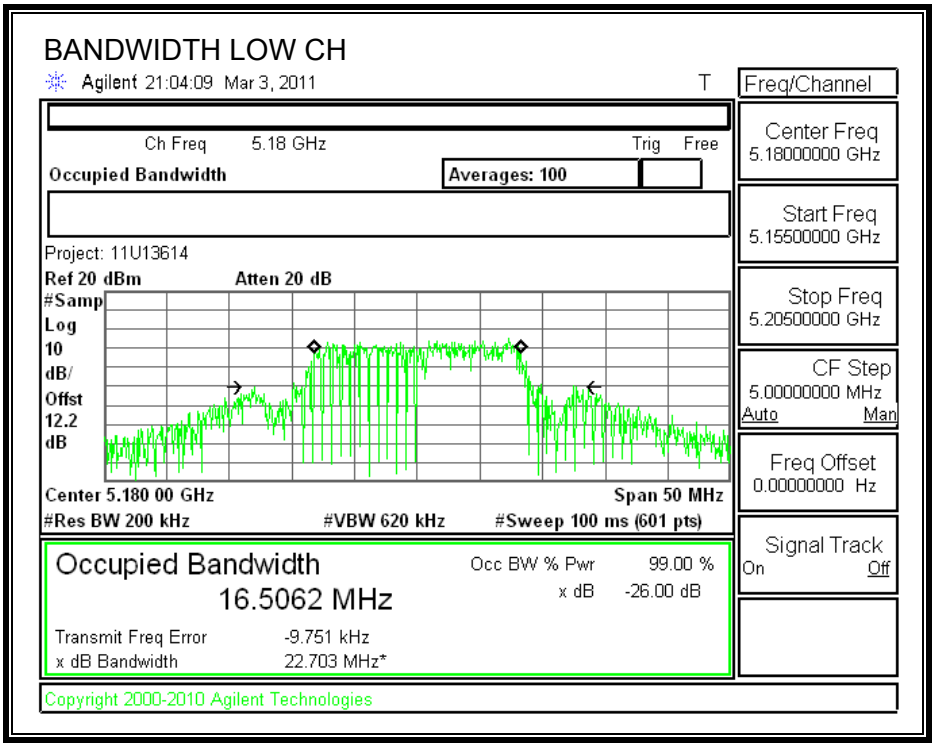
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.311	16.5070
Middle	5200	22.221	16.5090
High	5240	22.414	16.5207

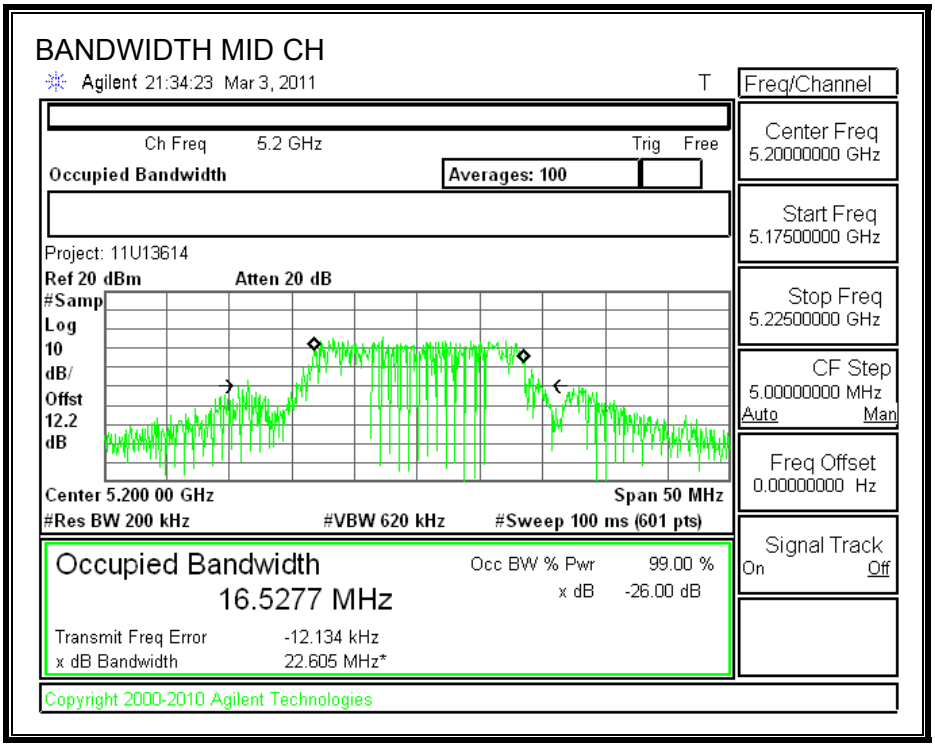
AP3

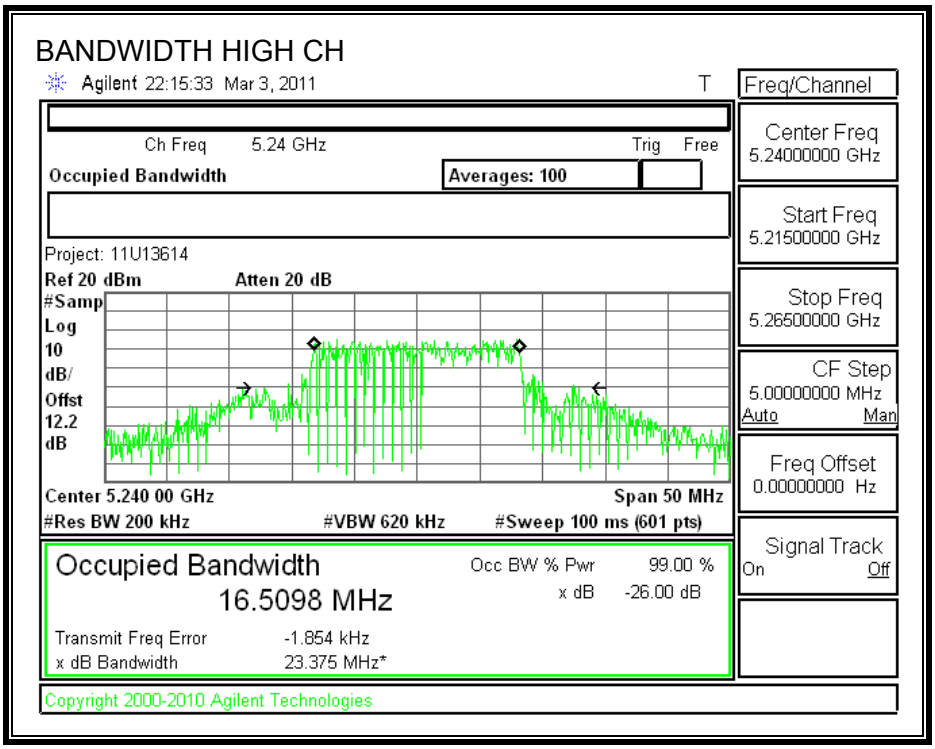
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.328	16.5297
Middle	5200	22.750	16.5231
High	5240	22.252	16.5150

AP1

26 dB and 99% BANDWIDTH

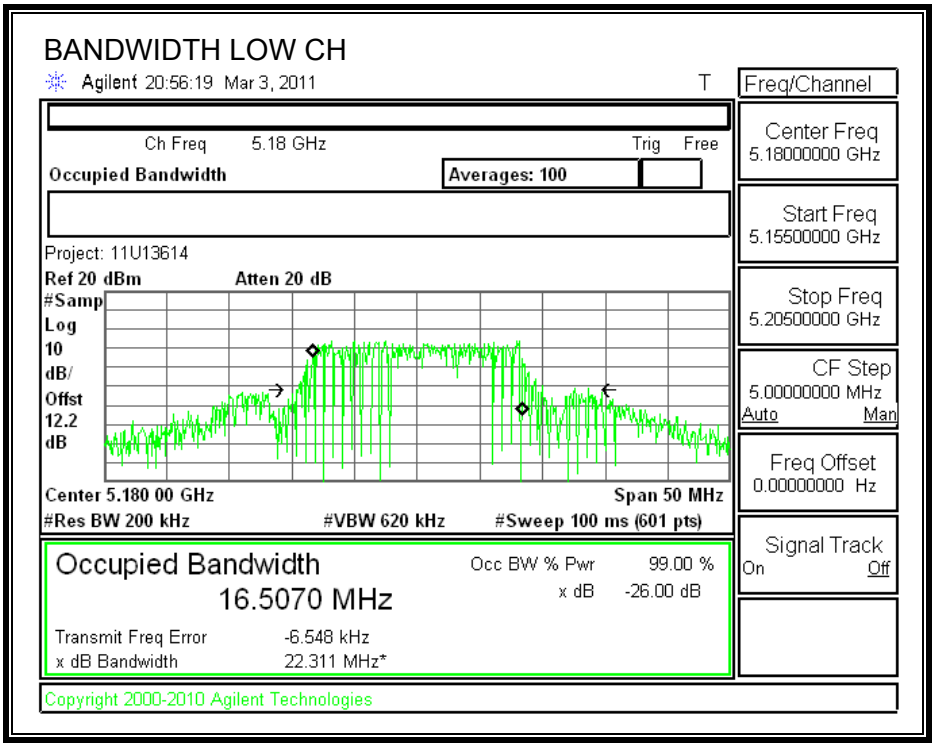


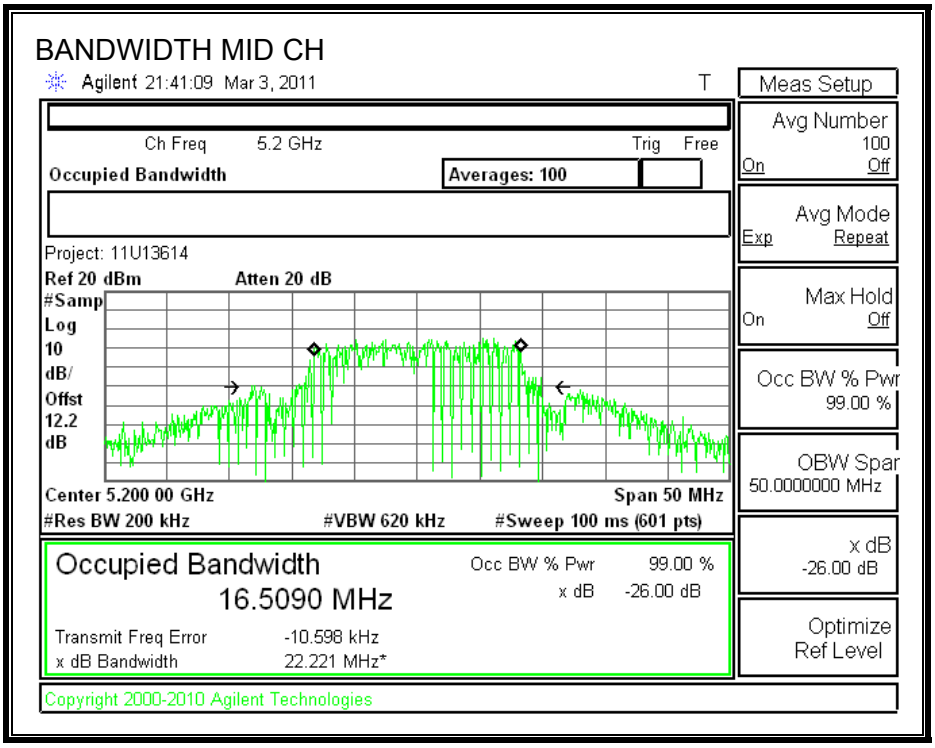


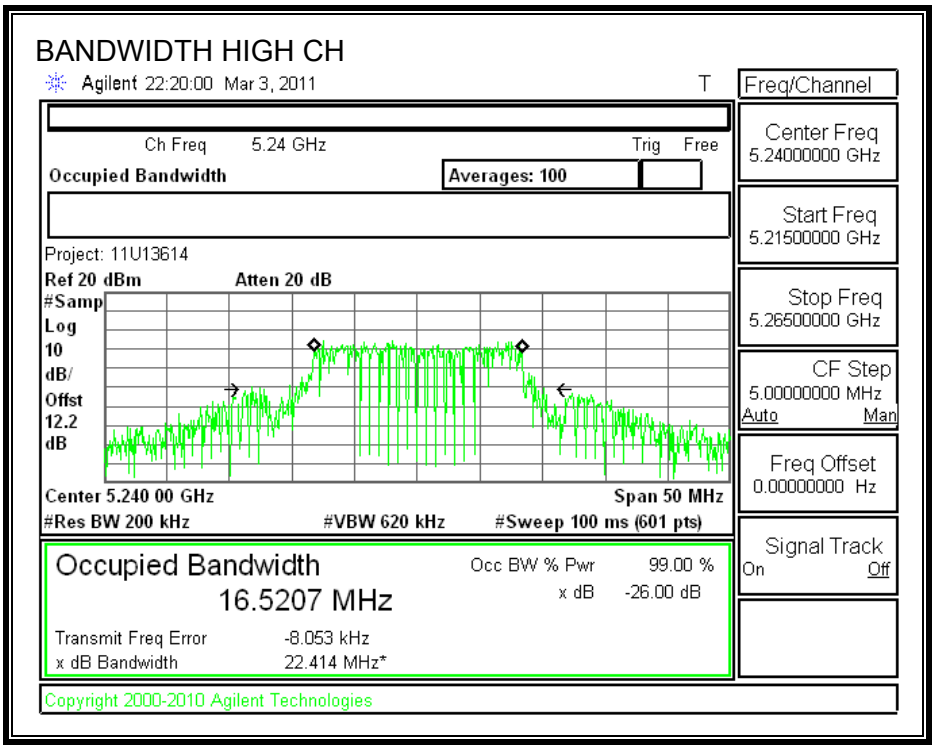


AP2

26 dB and 99% BANDWIDTH

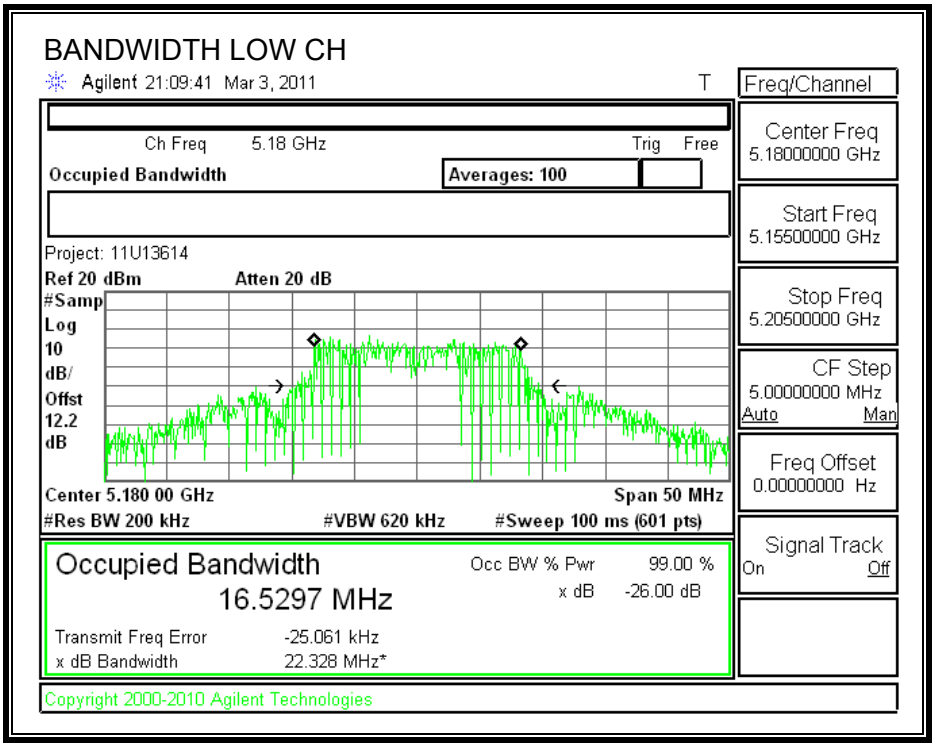


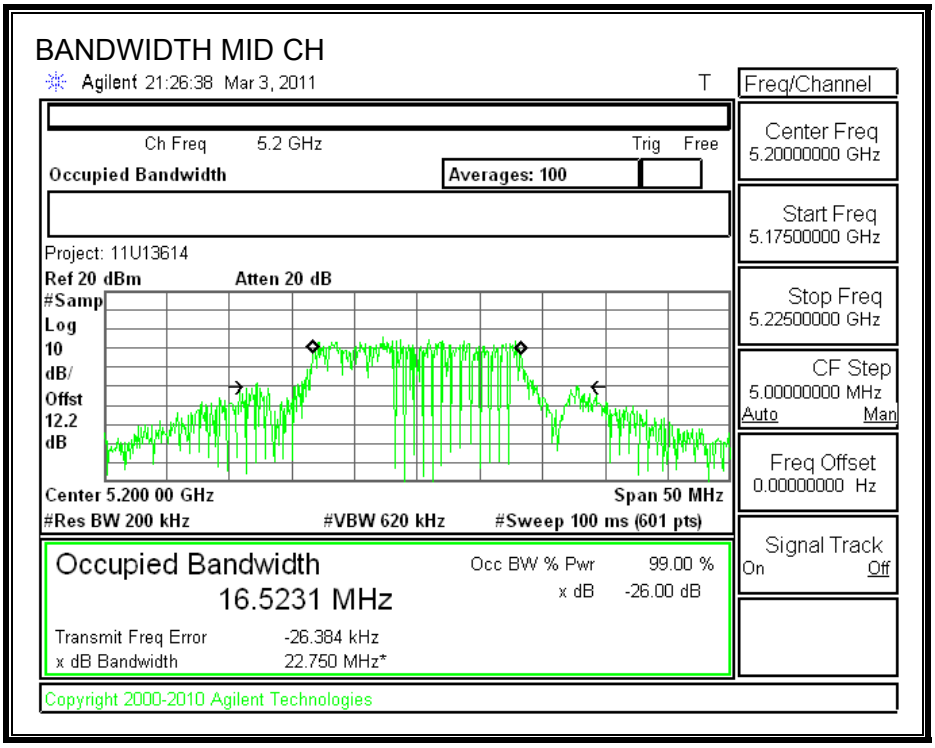


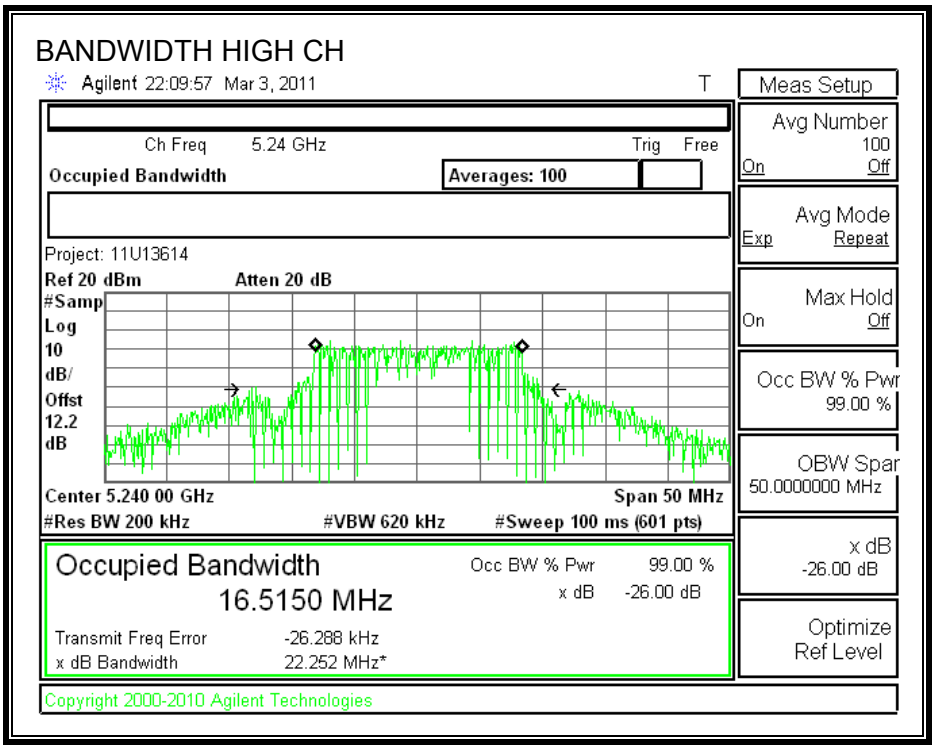


AP3

26 dB and 99% BANDWIDTH







7.2.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (AP1) (dBi)	Antenna Gain (AP2) (dBi)	Antenna Gain (AP3) (dBi)	Effective Legacy Gain (dBi)
5.03	2.5	5.69	9.38

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

The maximum effective legacy gain is **9.38 dBi** for other than fixed, point-to-point operations, therefore the limit shall be lowered by **3.38 dB**.

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

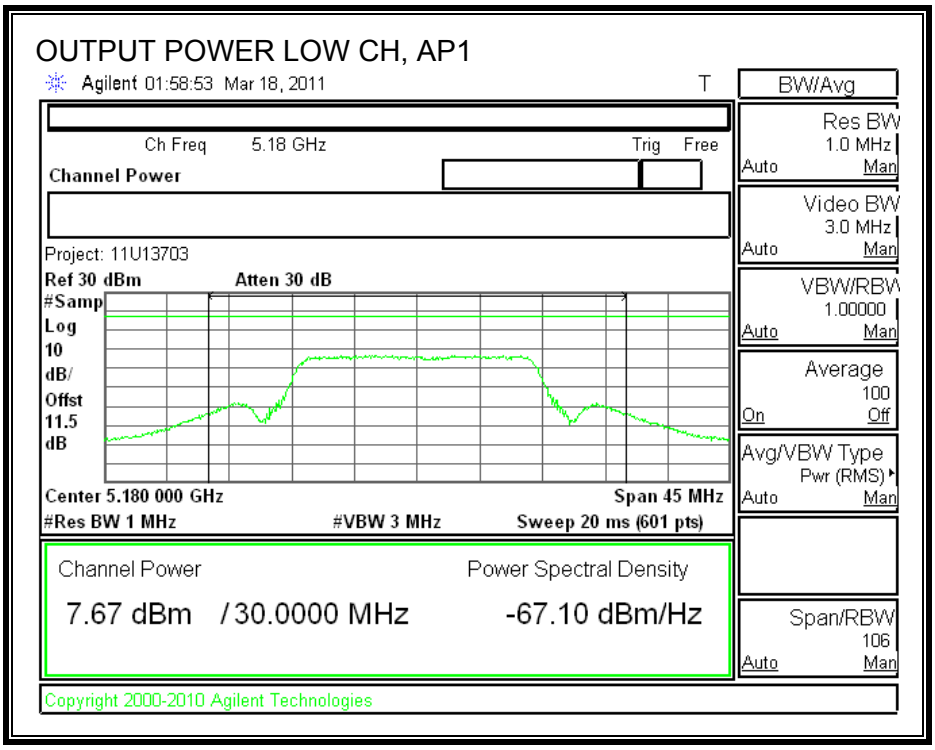
Limit

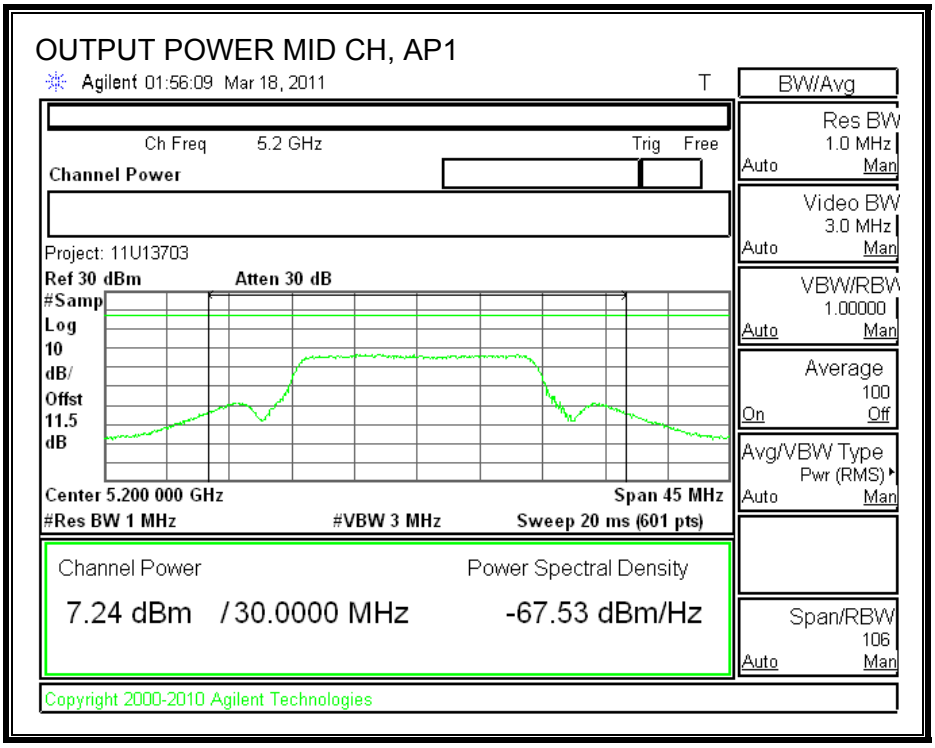
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5180	17.00	22.311	17.49	9.38	13.62
Mid	5200	17.00	22.221	17.47	9.38	13.62
High	5240	17.00	22.252	17.47	9.38	13.62

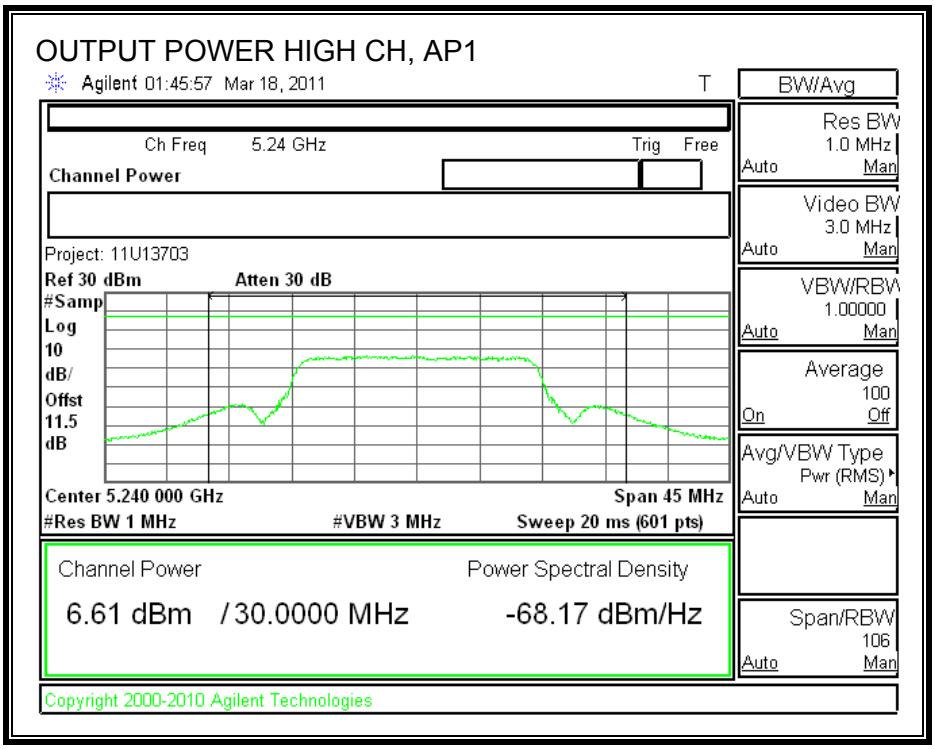
Individual Chain Results

Channel	Frequency (MHz)	AP1 Power (dBm)	AP2 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	7.67	6.14	6.54	11.60	13.62	-2.02
Mid	5200	7.24	6.27	6.61	11.50	13.62	-2.12
High	5240	6.61	5.54	5.97	10.83	13.62	-2.79

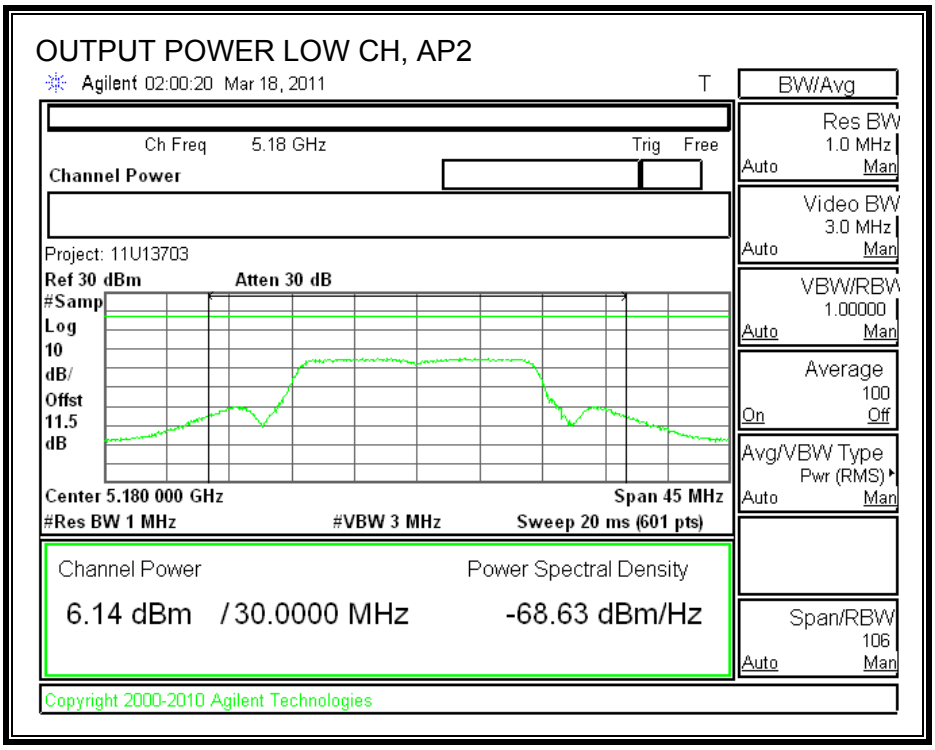
AP1 OUTPUT POWER

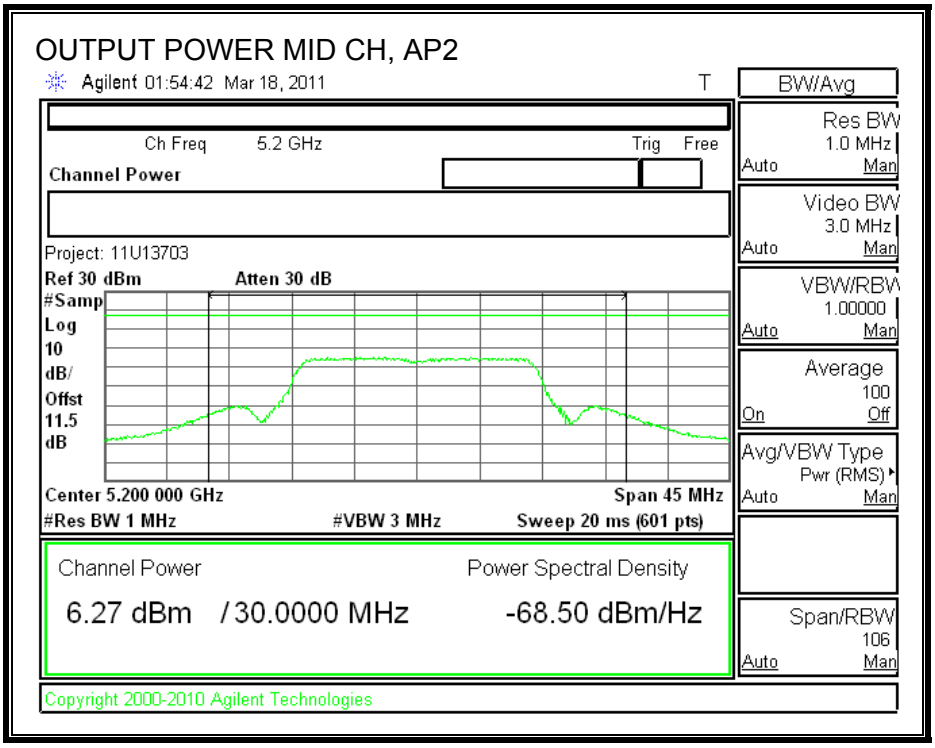


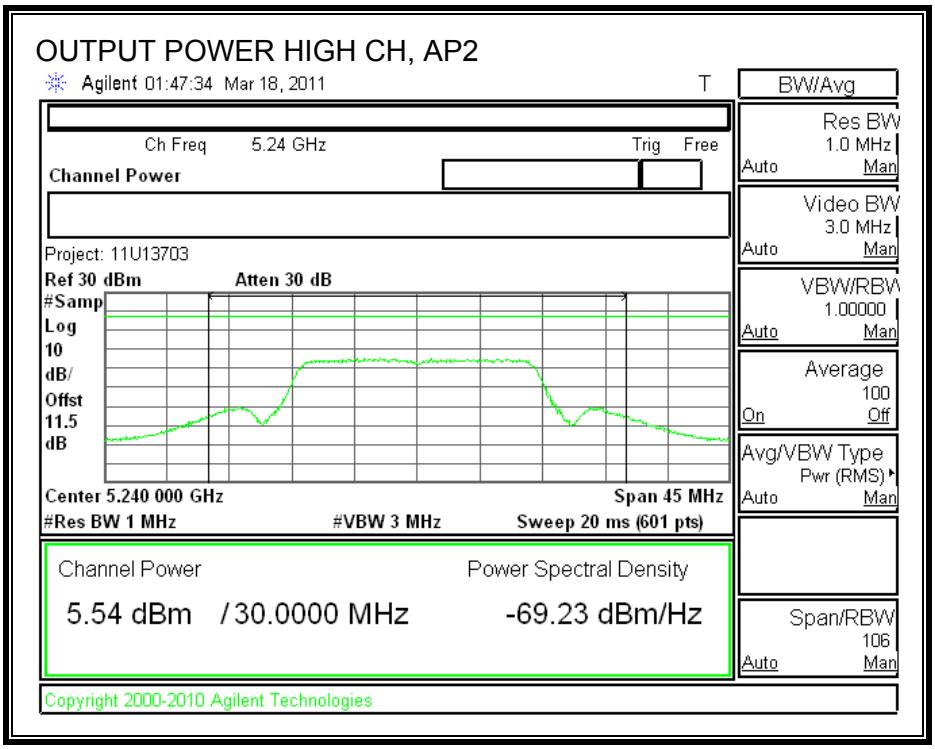




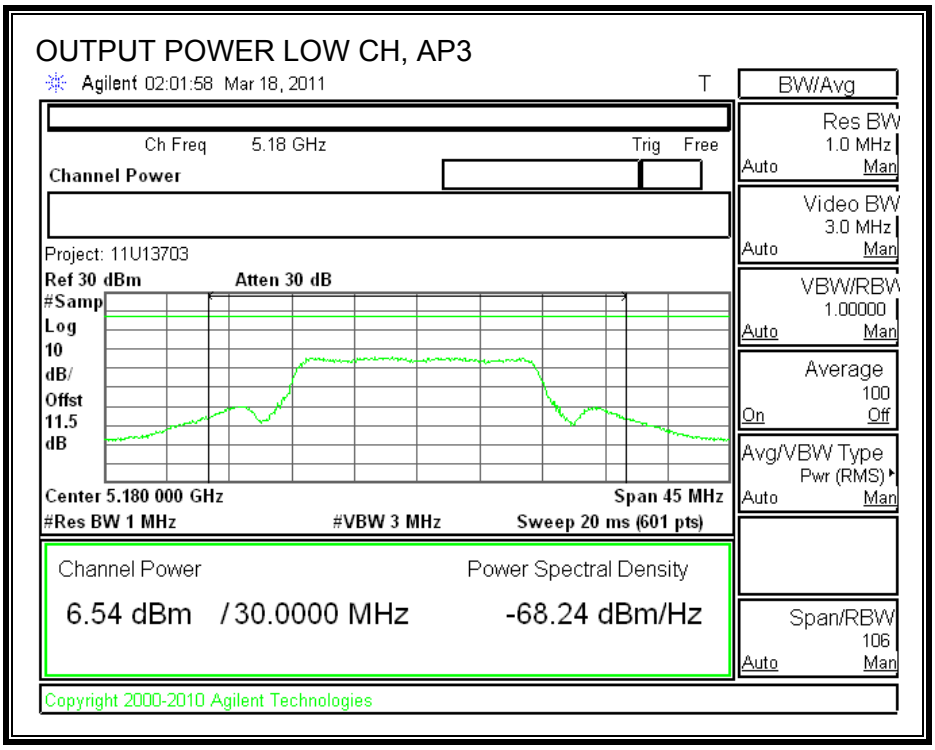
AP2 OUTPUT POWER

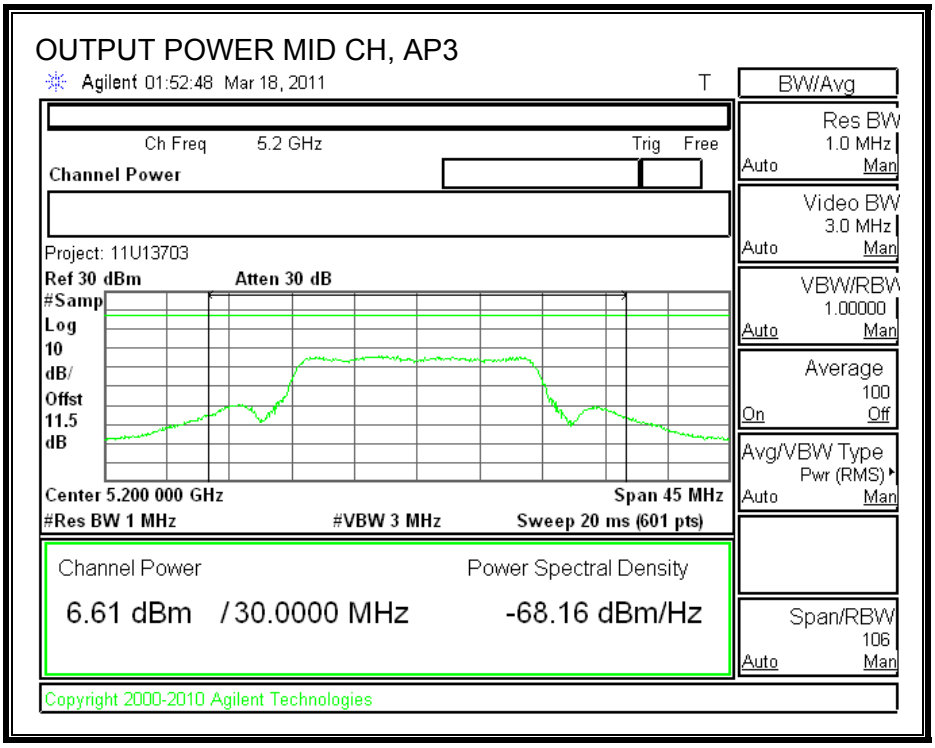


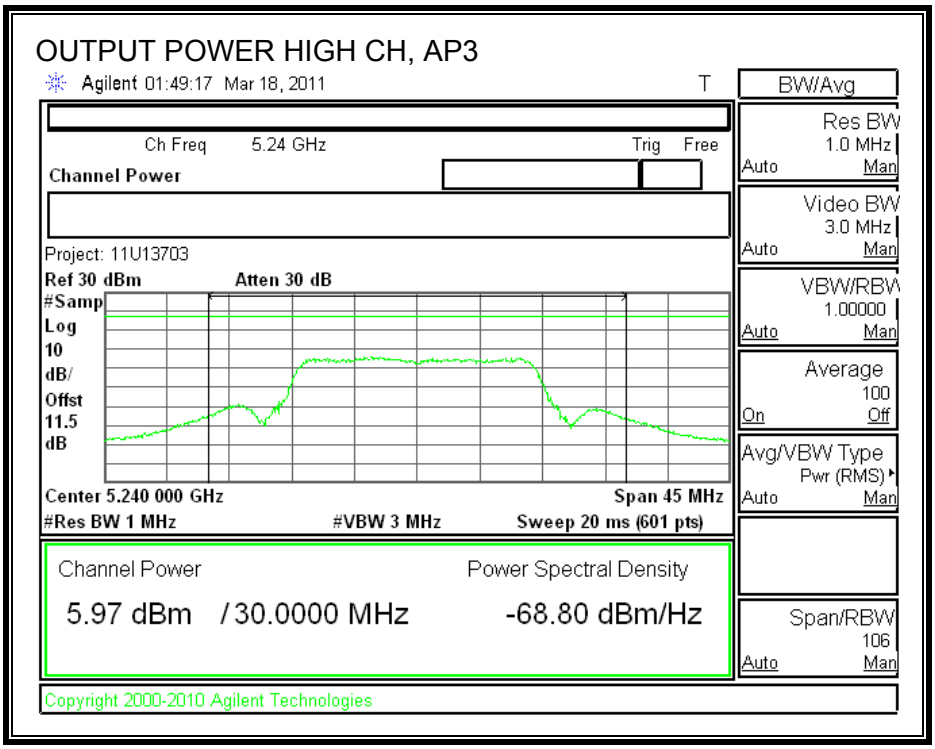




AP3 OUTPUT POWER







7.2.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (AP1) (dBi)	Antenna Gain (AP2) (dBi)	Antenna Gain (AP3) (dBi)	Effective Legacy Gain (dBi)
5.03	2.5	5.69	9.38

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 **9.38 dBi**, therefore the limit is **0.62 dBm**.

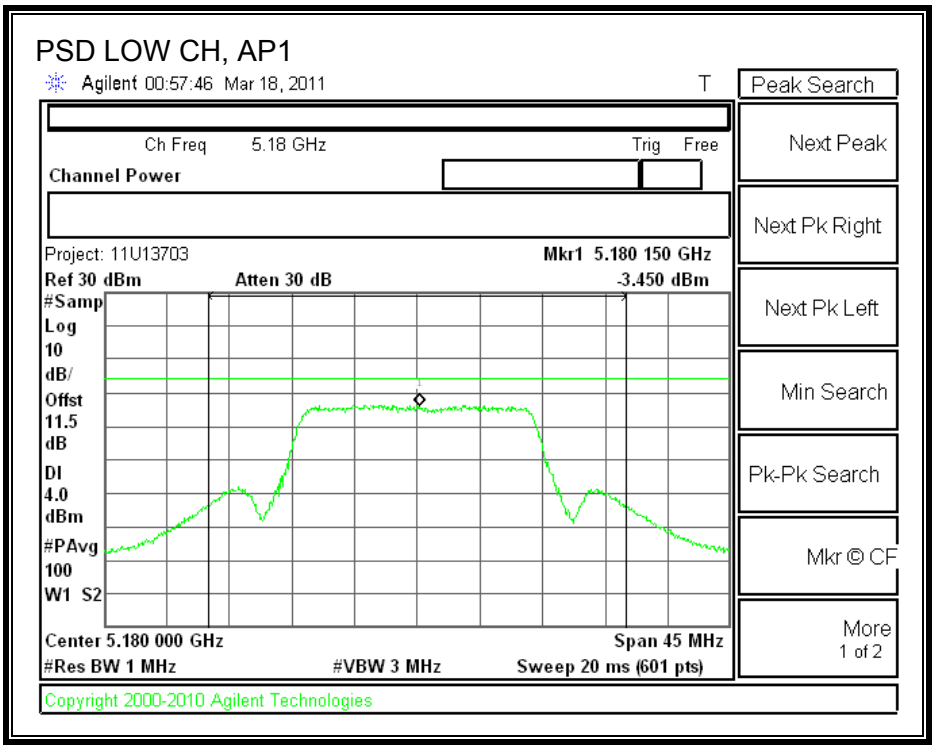
TEST PROCEDURE

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 #1 was used.

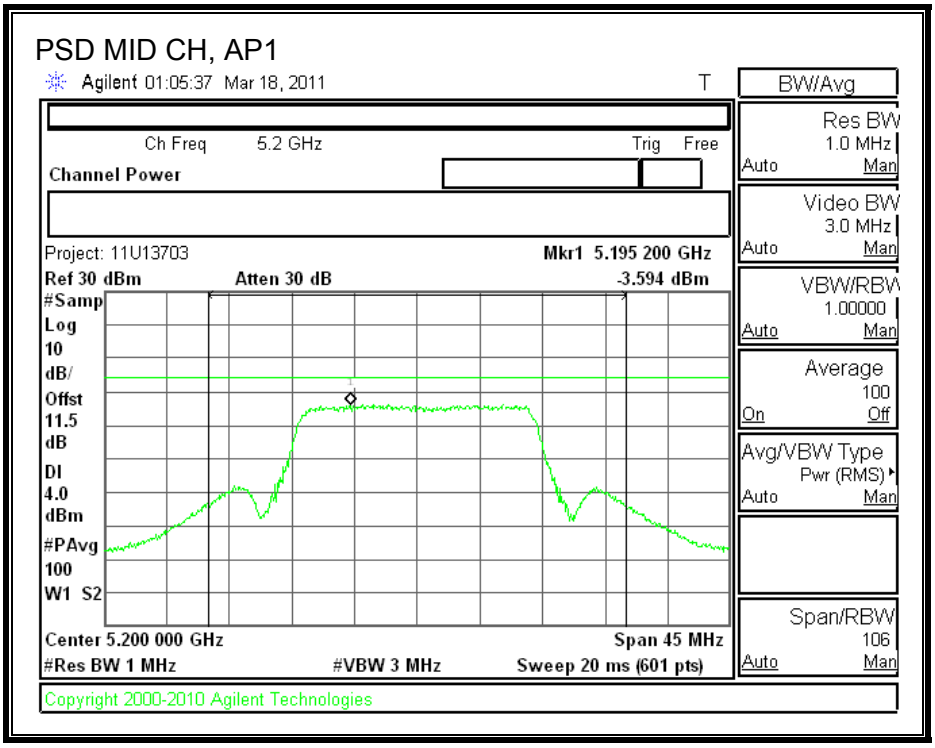
RESULTS

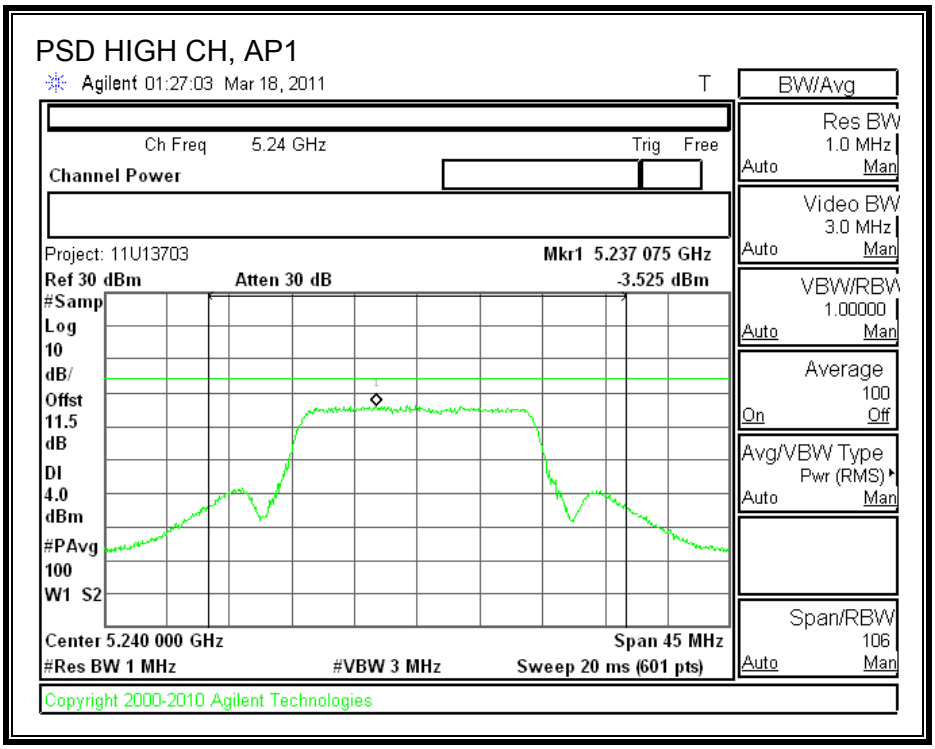
Channel	Frequency (MHz)	AP1 PPSD (dBm)	AP2 PPSD (dBm)	AP3 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-3.45	-4.727	-4.435	0.602	0.620	-0.018
Middle	5200	-3.594	-5.009	-4.232	0.531	0.620	-0.089
High	5240	-3.525	-5.042	-4.426	0.485	0.620	-0.135

AP1 POWER SPECTRAL DENSITY

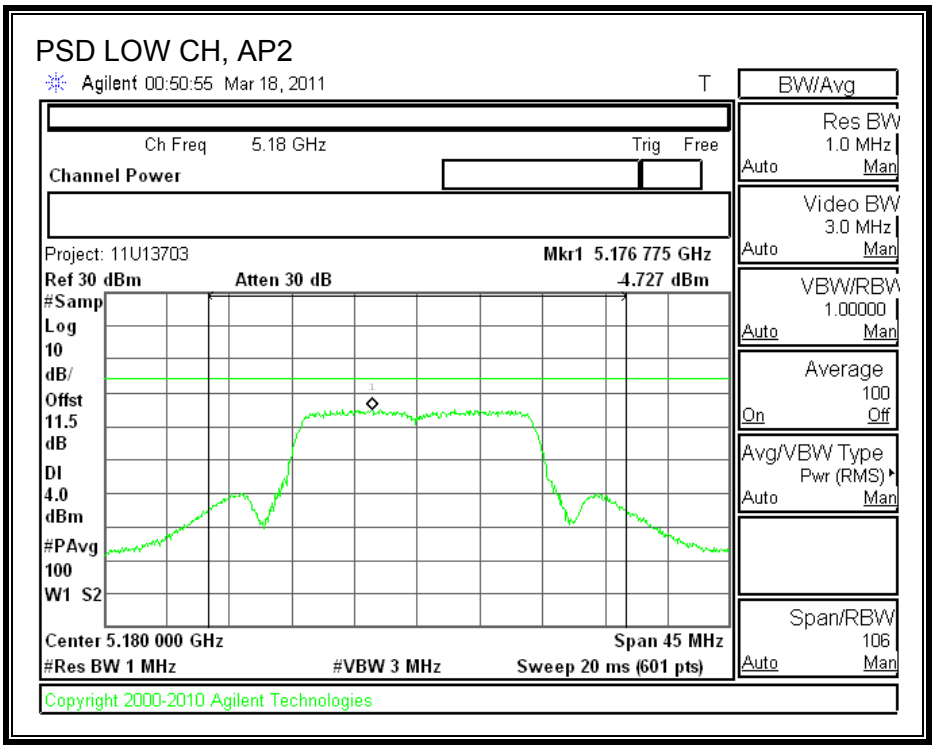


PSD MID CH, AP1

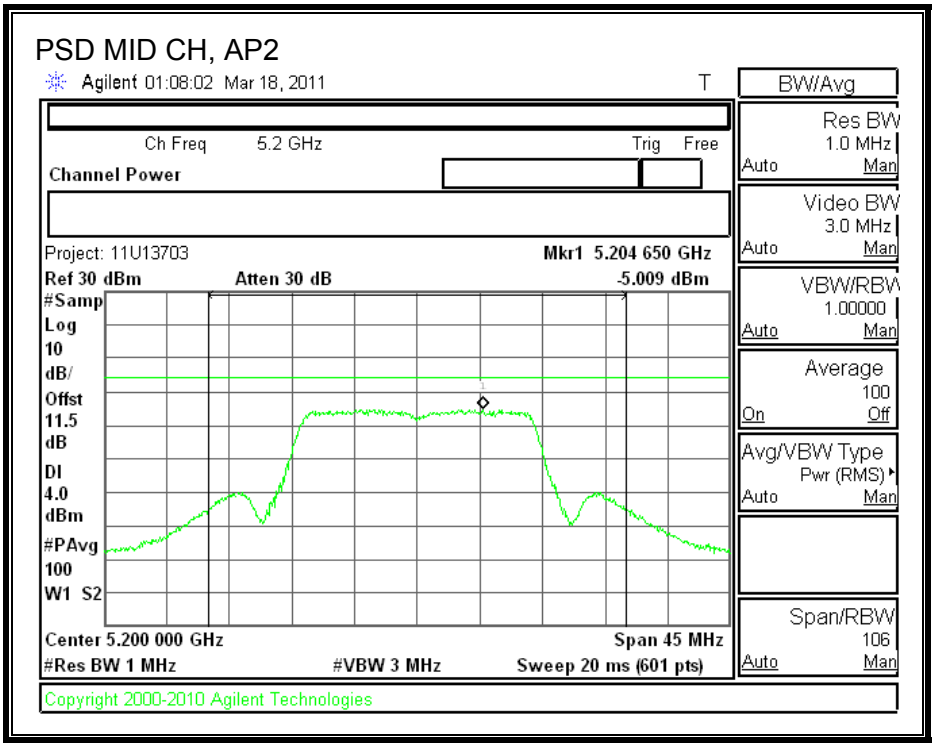


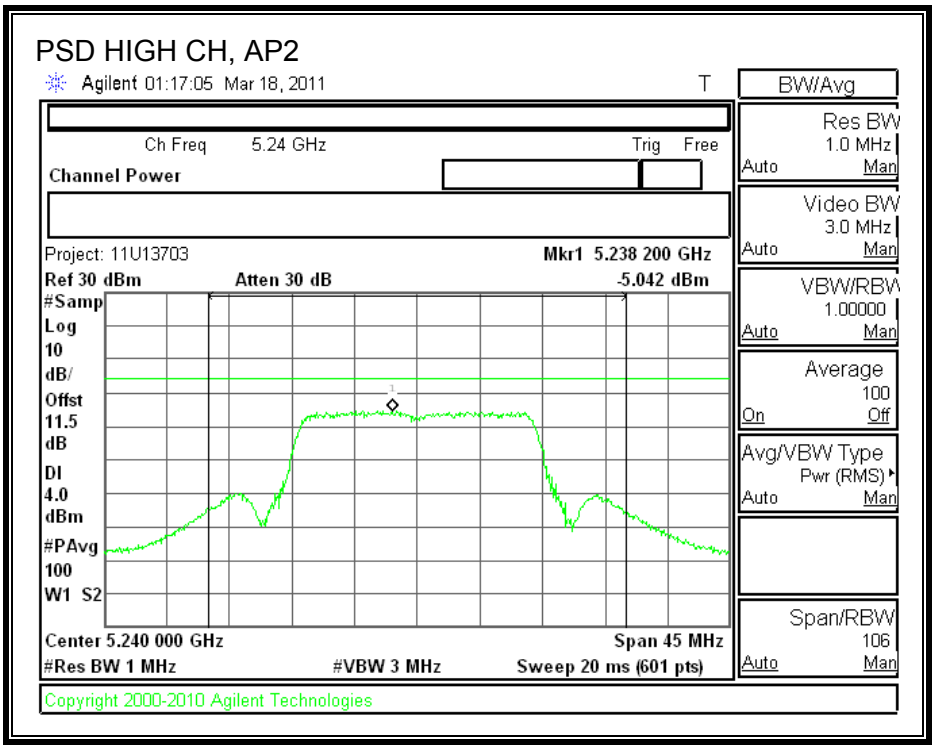


AP2 POWER SPECTRAL DENSITY

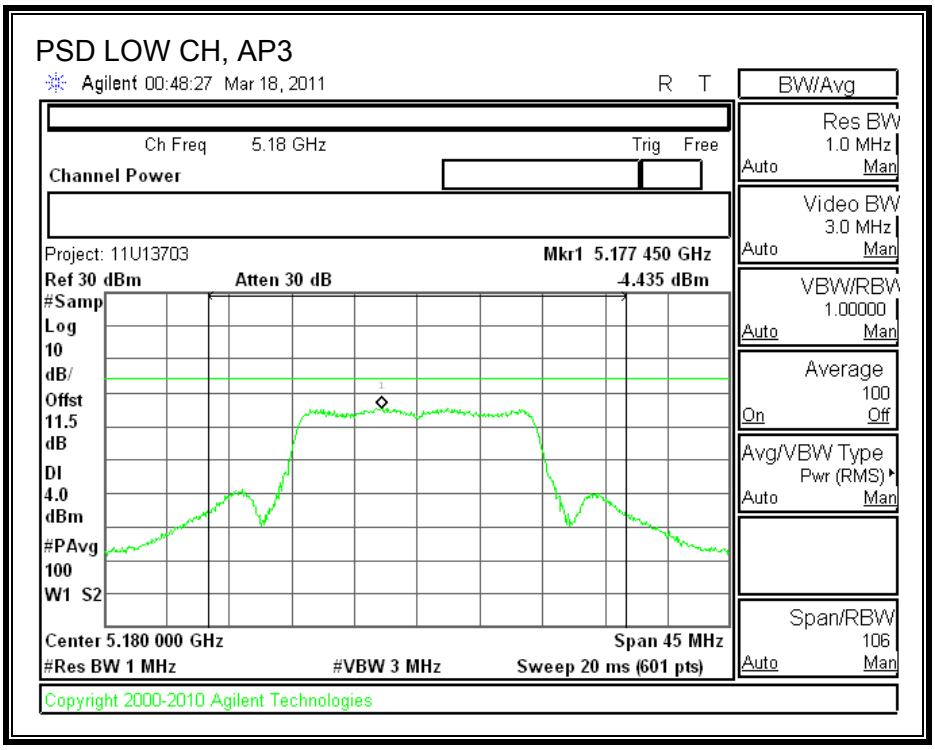


PSD MID CH, AP2

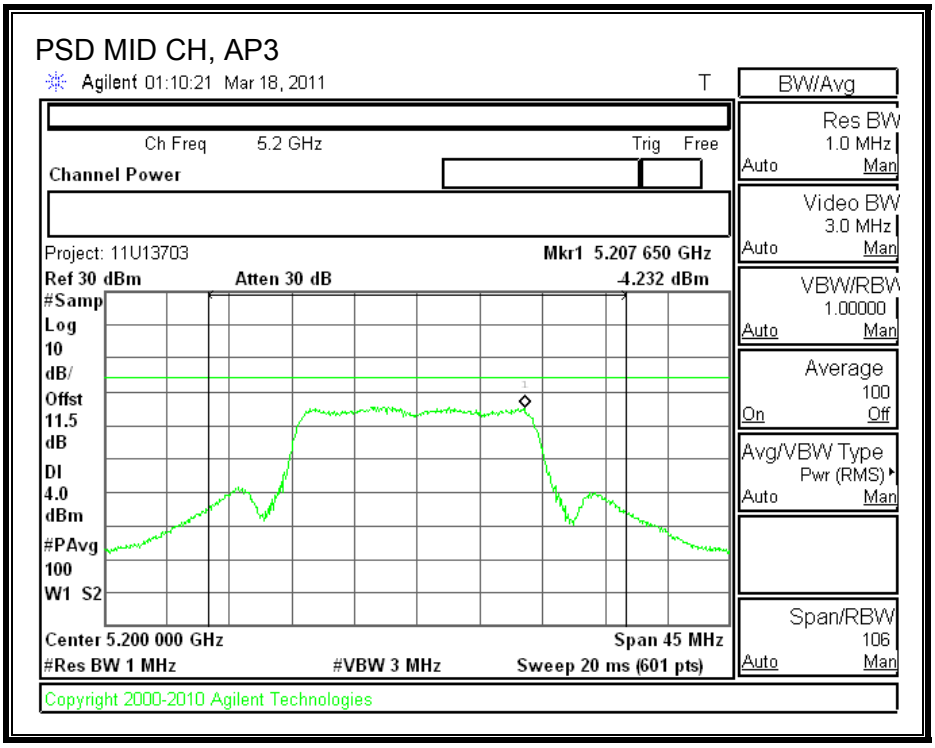


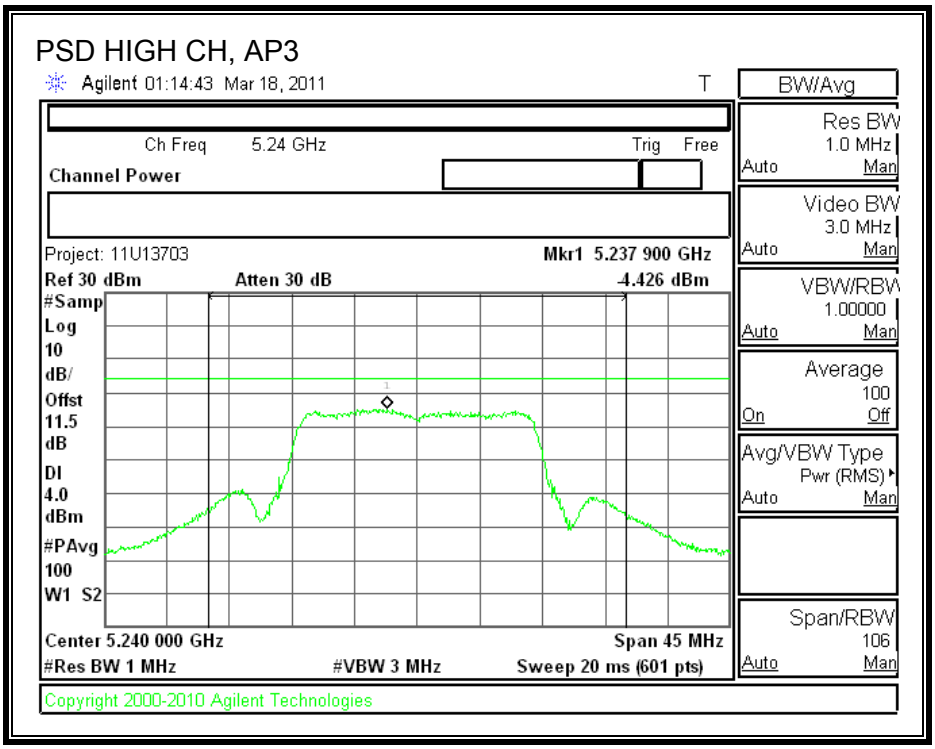


AP3 POWER SPECTRAL DENSITY



PSD MID CH, AP3





7.2.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.860	13	-4.14
Middle	5200	8.380	13	-4.62
High	5240	8.300	13	-4.70

AP2

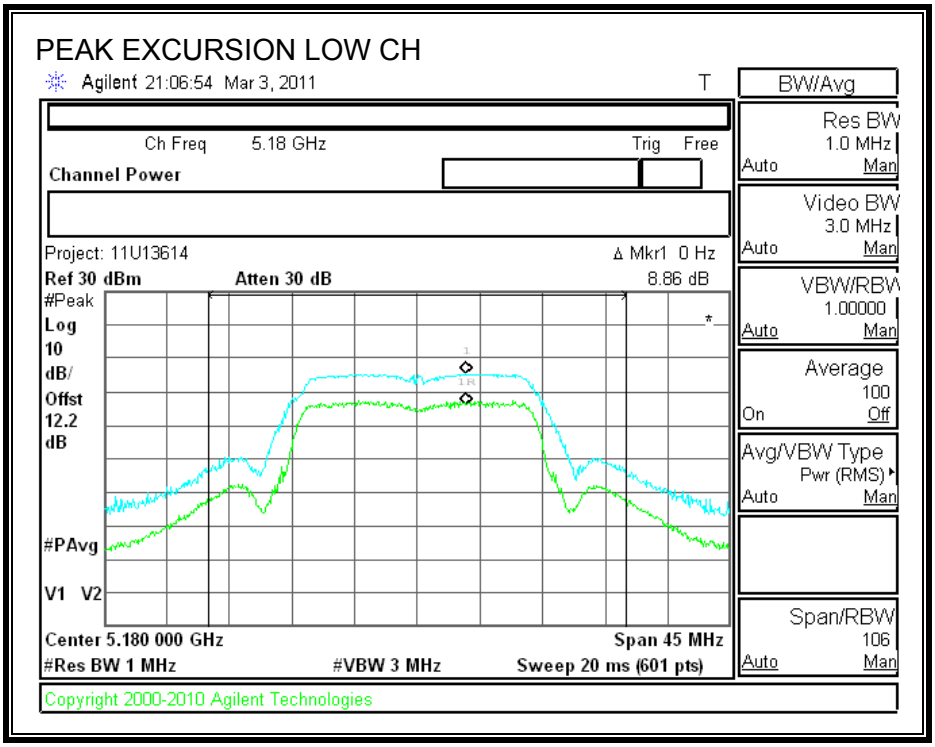
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.850	13	-3.15
Middle	5200	9.880	13	-3.12
High	5240	9.530	13	-3.47

AP3

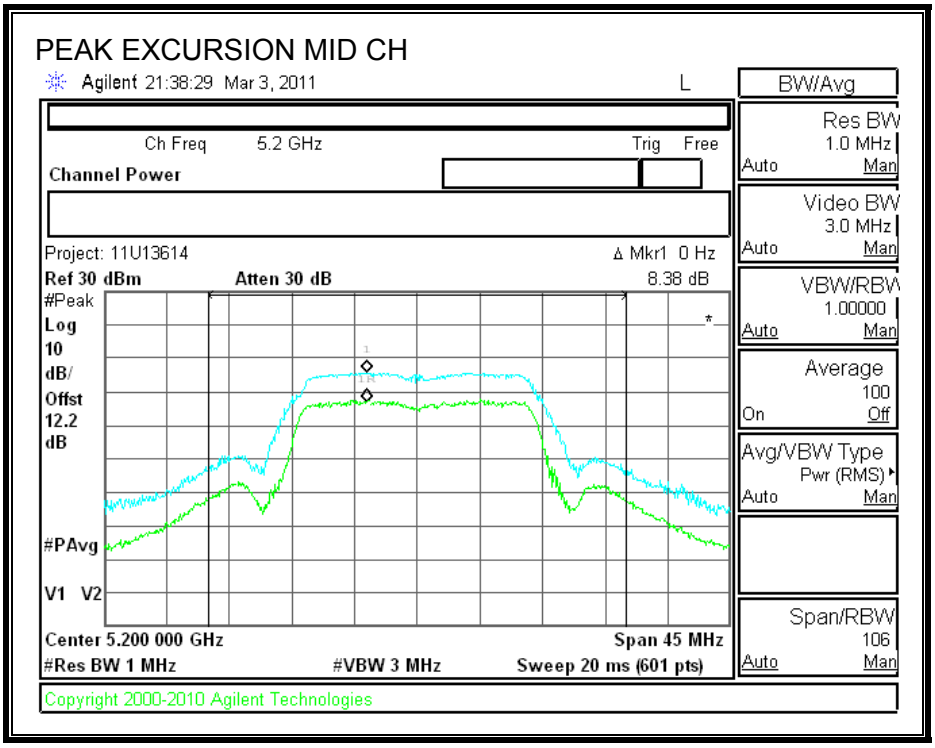
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.510	13	-3.49
Middle	5200	10.300	13	-2.70
High	5240	10.930	13	-2.07

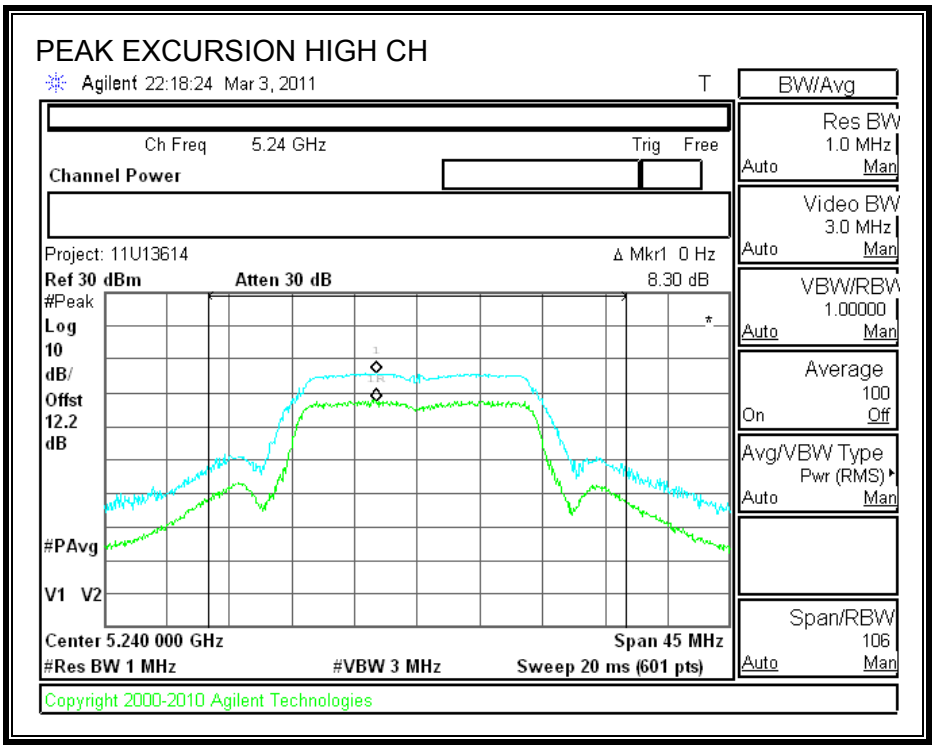
AP1

PEAK EXCURSION



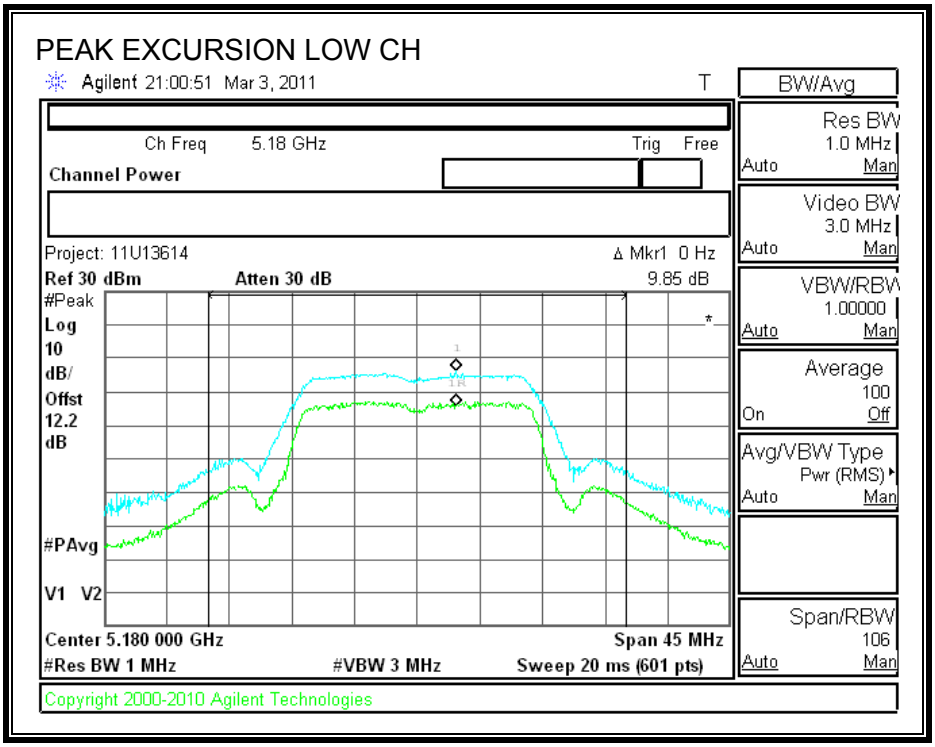
PEAK EXCURSION MID CH



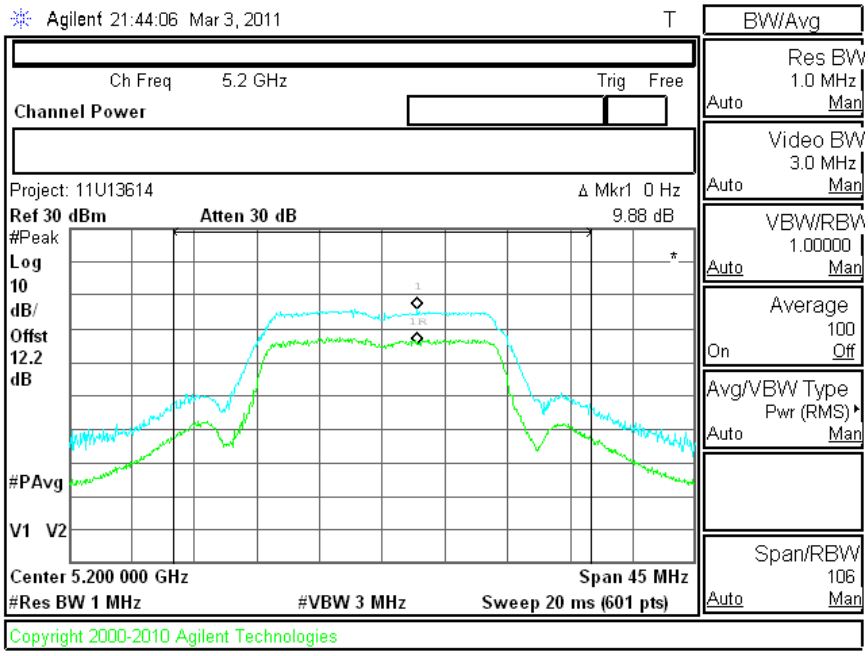


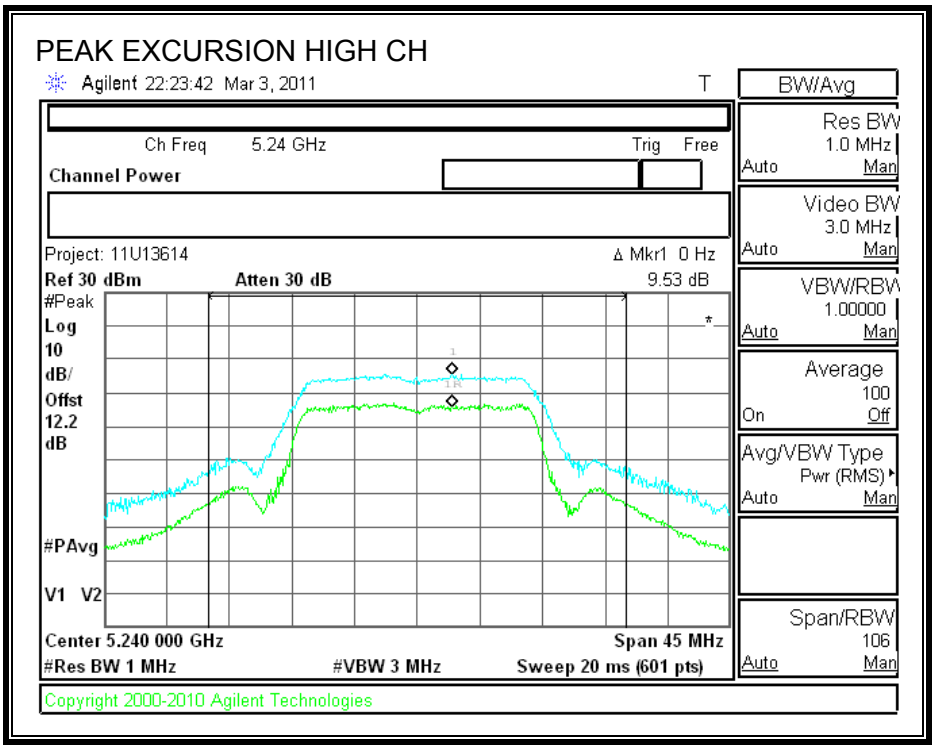
AP2

PEAK EXCURSION



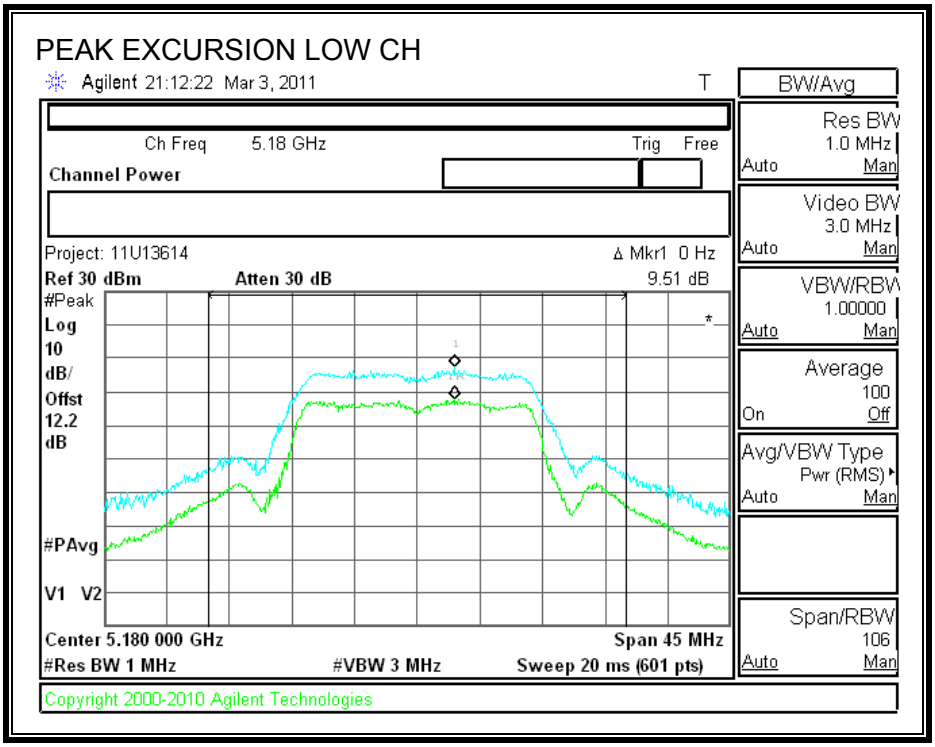
PEAK EXCURSION MID CH

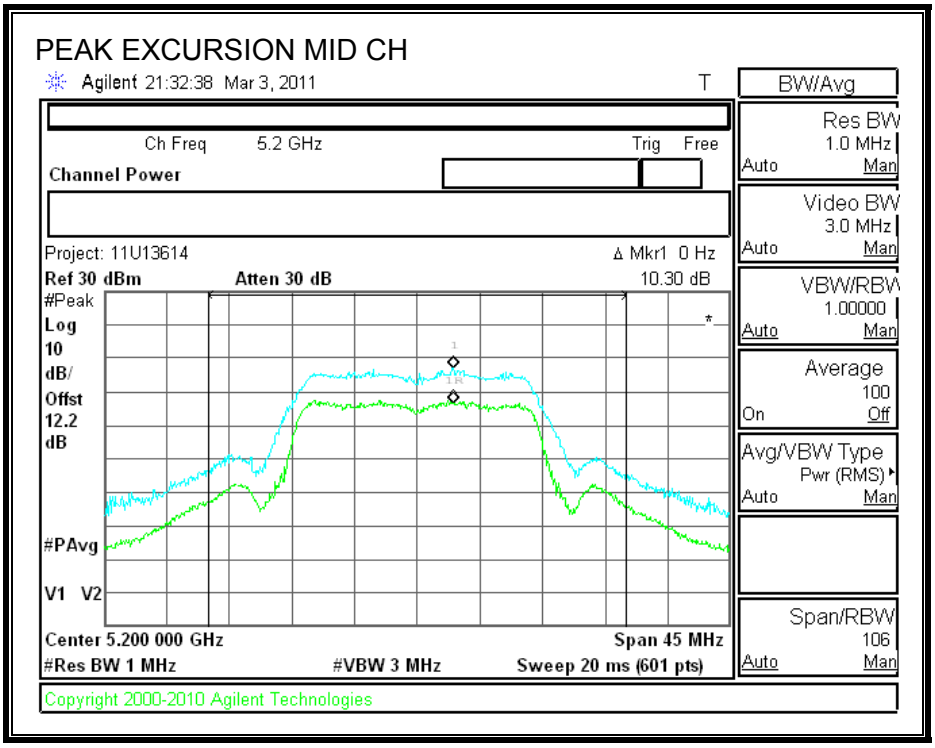


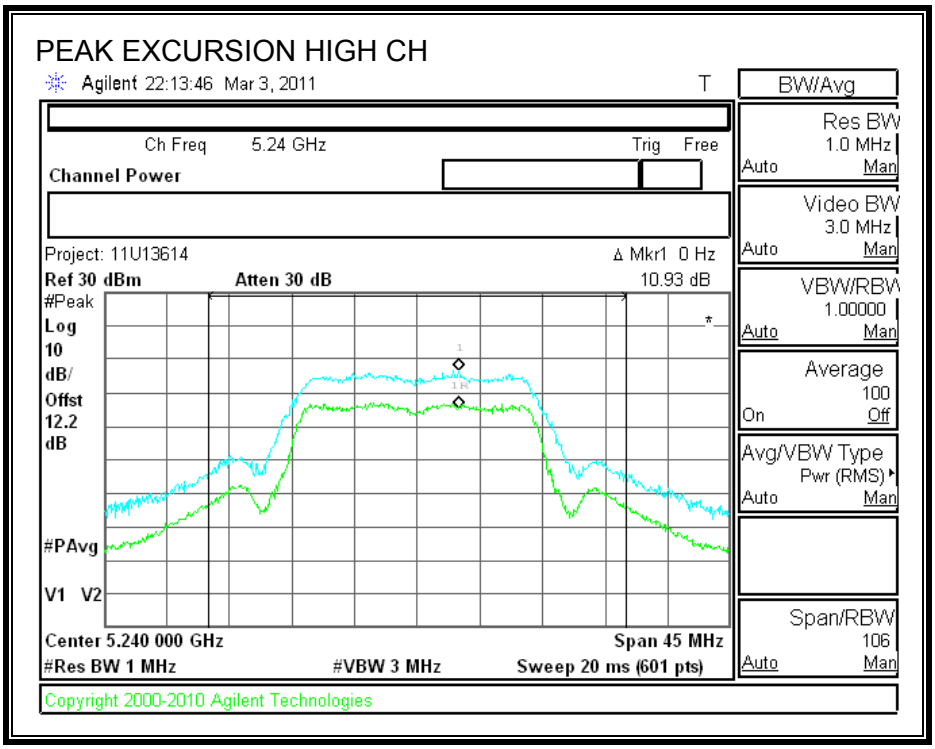


AP3

PEAK EXCURSION







7.2.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.95	5.03	4.77	-28.15	-27.00
Middle	15.598	-37.05	5.03	4.77	-27.25	-27.00
High	15.738	-37.42	5.03	4.77	-27.62	-27.00

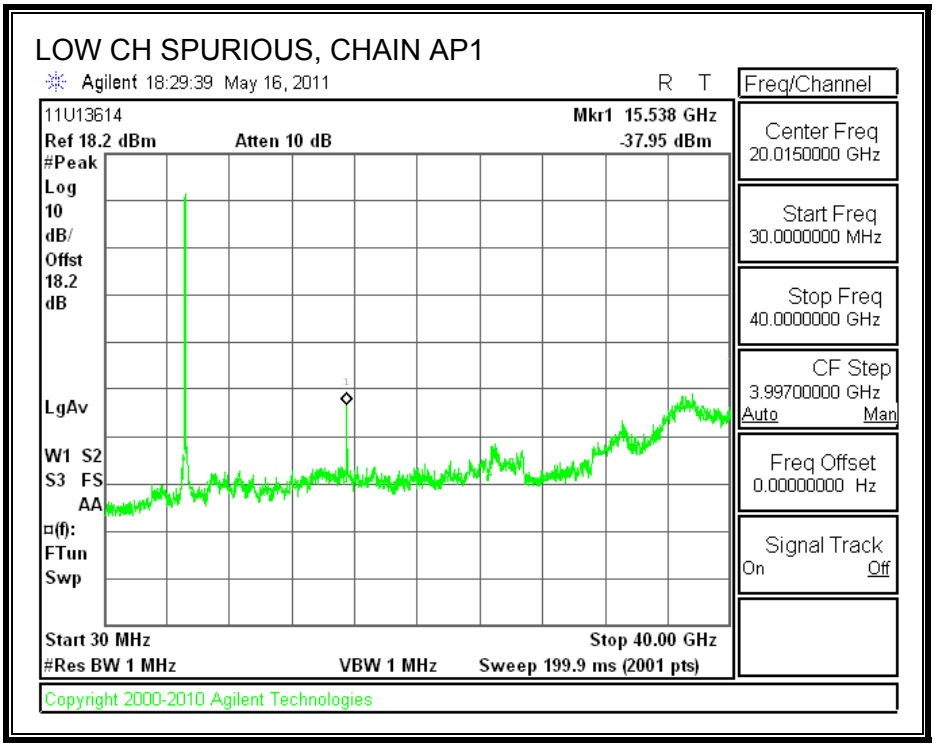
Chain AP2

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.58	2.50	4.77	-30.31	-27.00
Middle	15.598	-37.60	2.50	4.77	-30.33	-27.00
High	15.718	-37.75	2.50	4.77	-30.48	-27.00

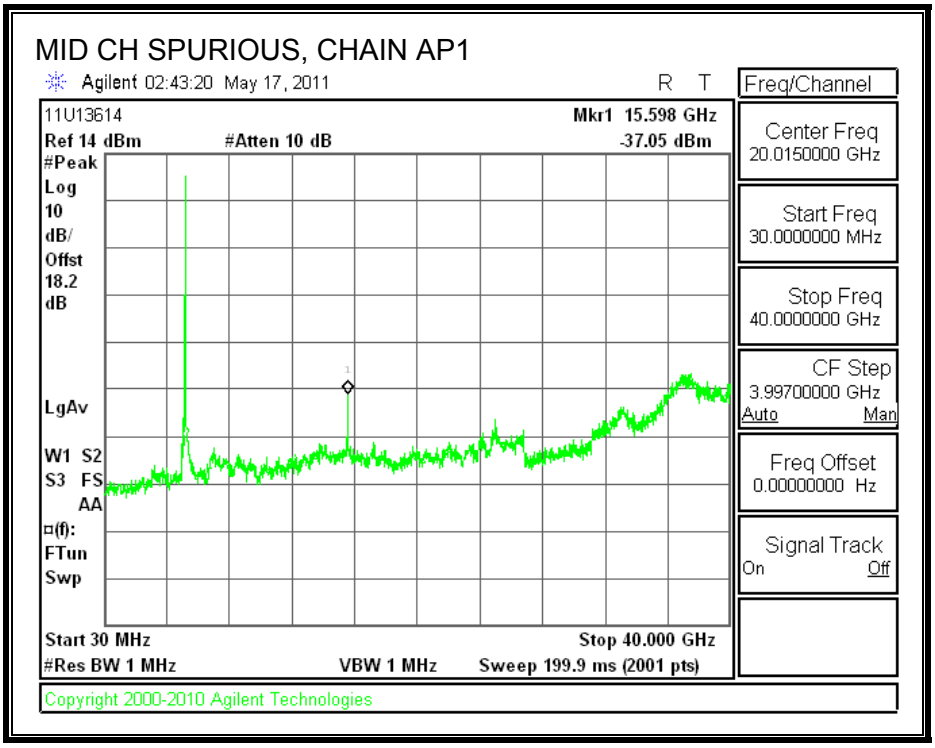
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.54	5.69	4.77	-27.08	-27.00
Middle	15.598	-40.42	5.69	4.77	-29.96	-27.00
High	15.718	-40.36	5.69	4.77	-29.90	-27.00

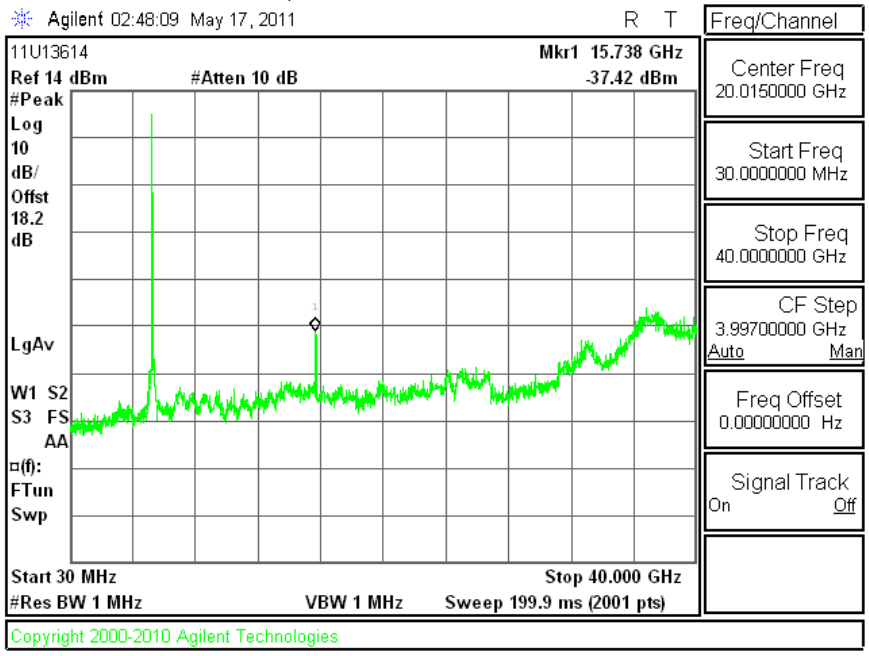
CHAIN AP1 SPURIOUS EMISSIONS



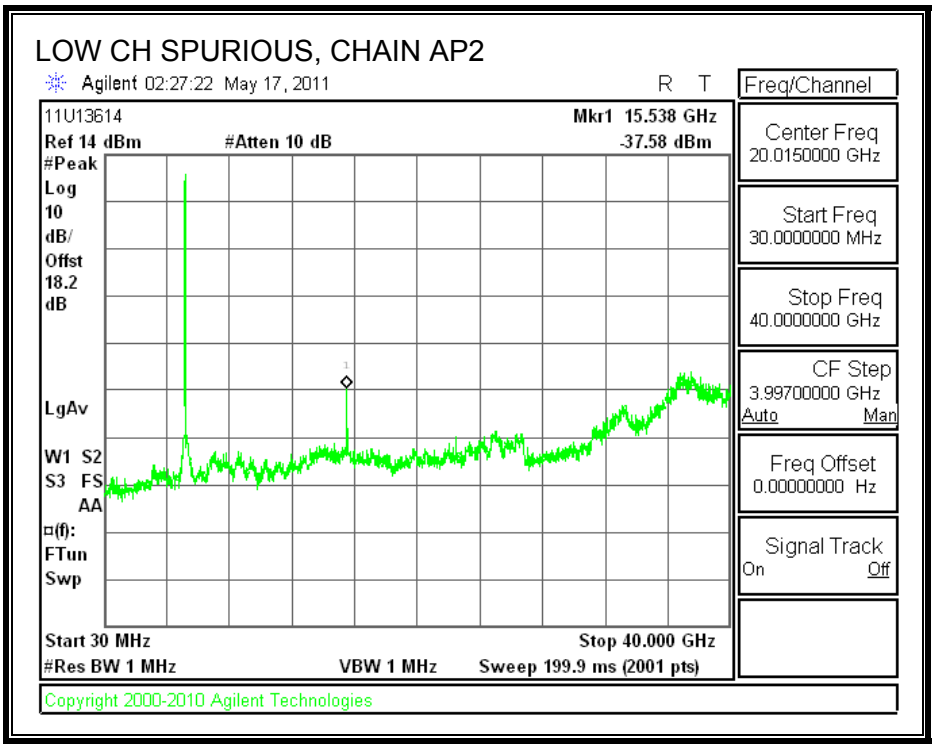
MID CH SPURIOUS, CHAIN AP1



HIGH CH SPURIOUS, CHAIN AP1



CHAIN AP2 SPURIOUS EMISSIONS



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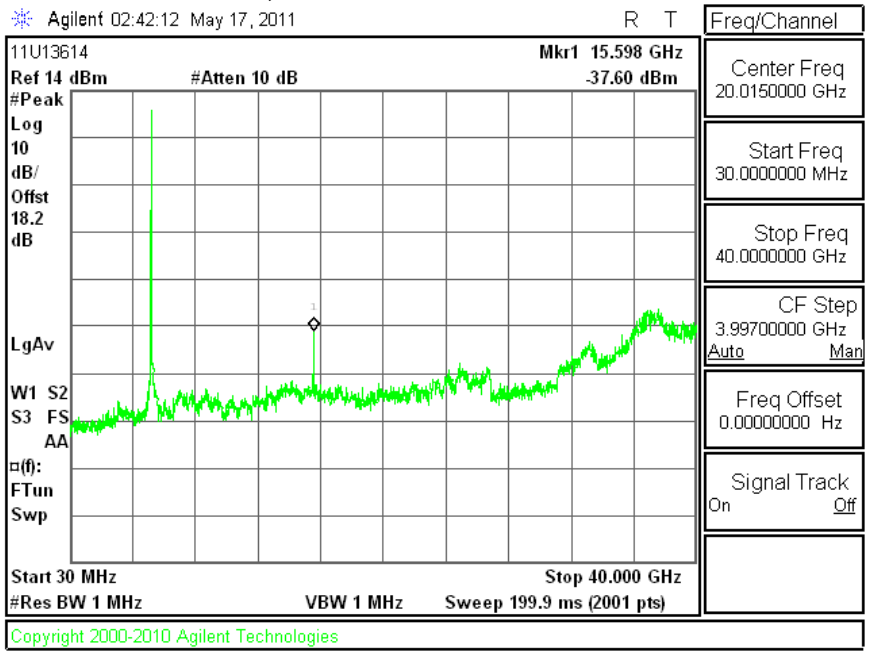
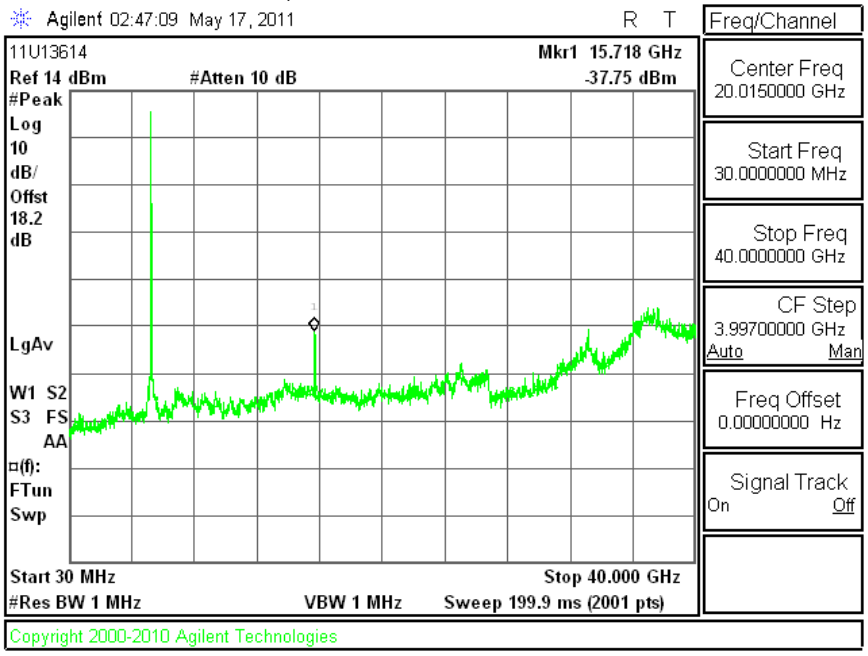
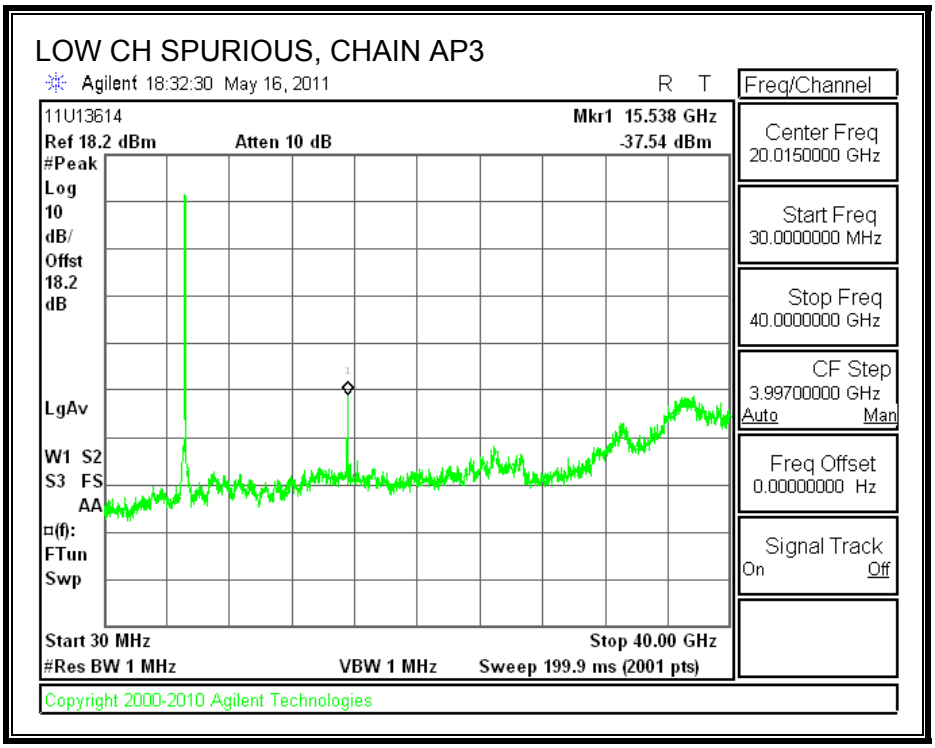


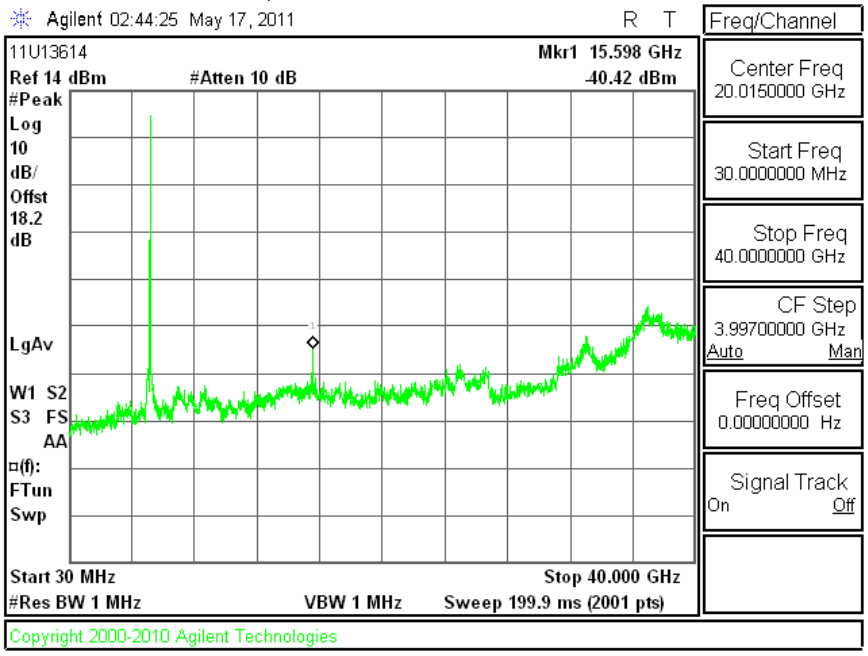
HIGH CH SPURIOUS, CHAIN AP2



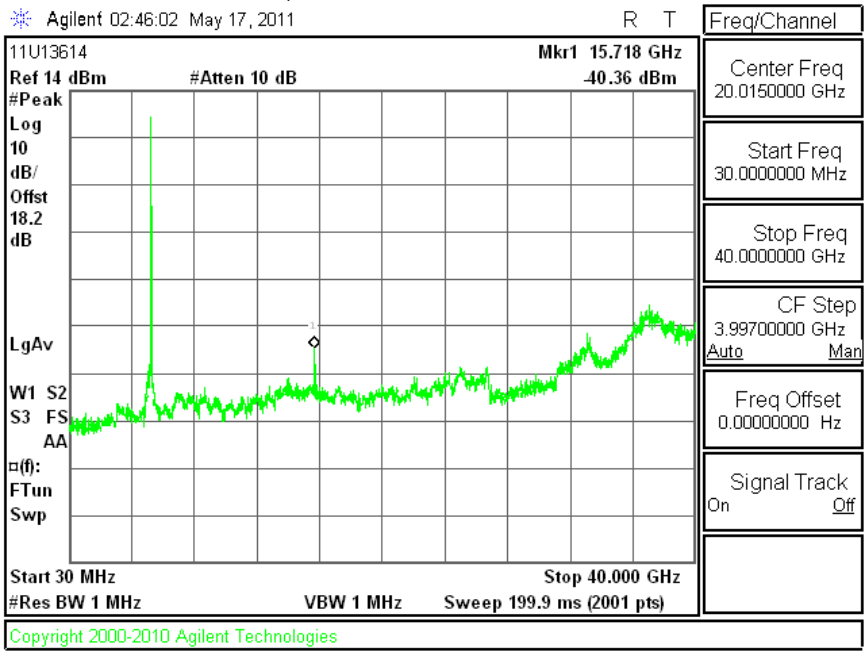
CHAIN AP3 SPURIOUS EMISSIONS



MID CH SPURIOUS, CHAIN AP3



HIGH CH SPURIOUS, CHAIN AP3



7.3. 802.11n TWO CHAINS HT20 MODE IN THE 5.2 GHz BAND

7.3.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

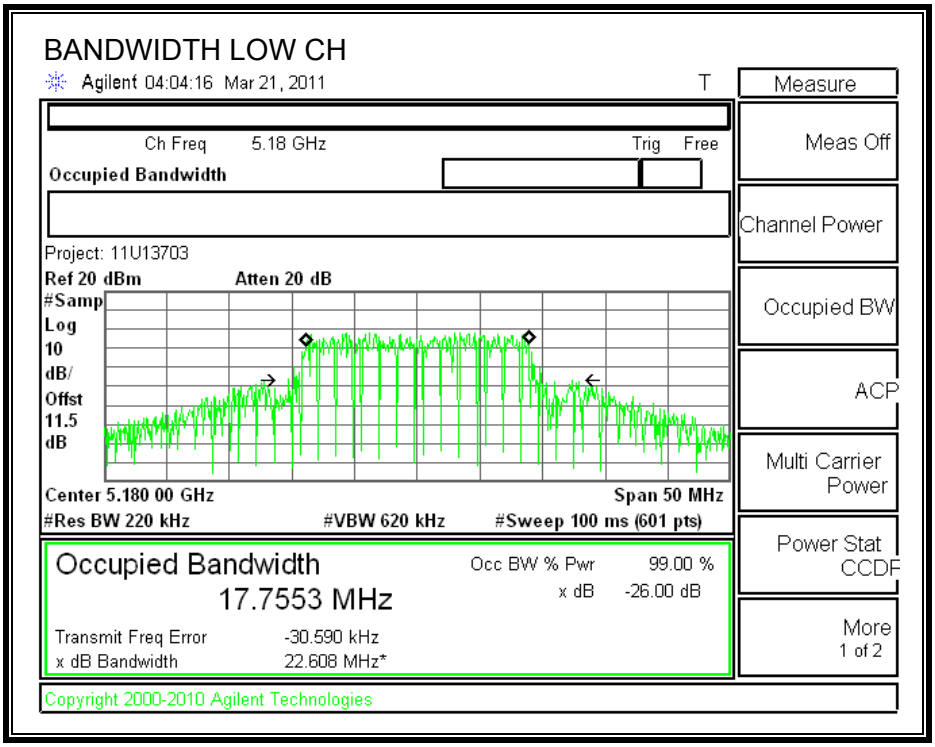
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.608	17.7553
Middle	5200	22.703	17.6422
High	5240	22.974	17.6662

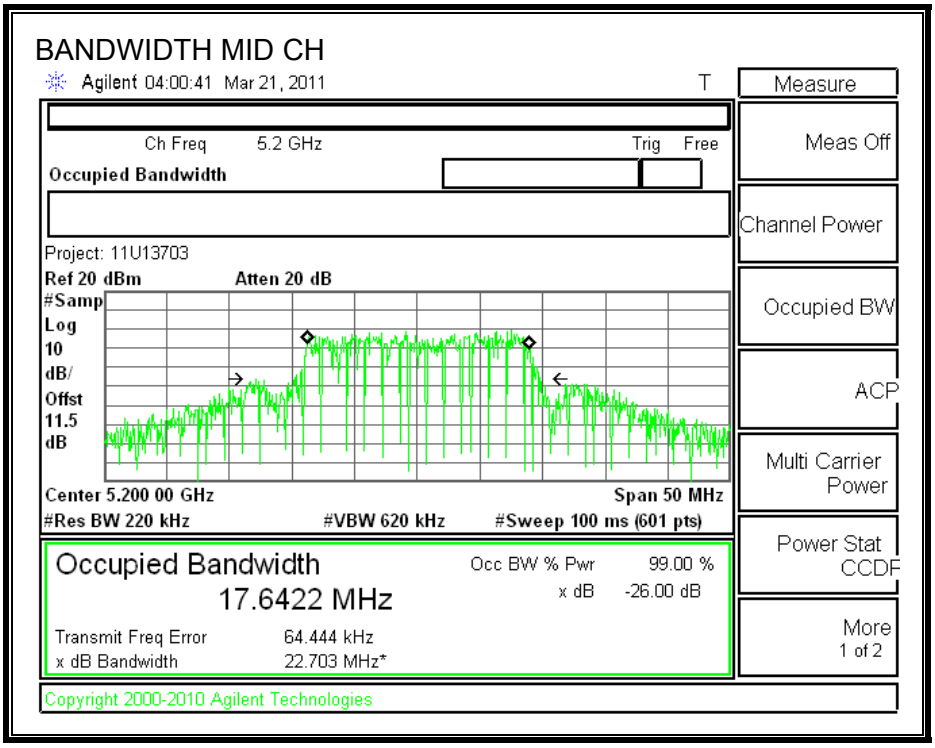
AP3

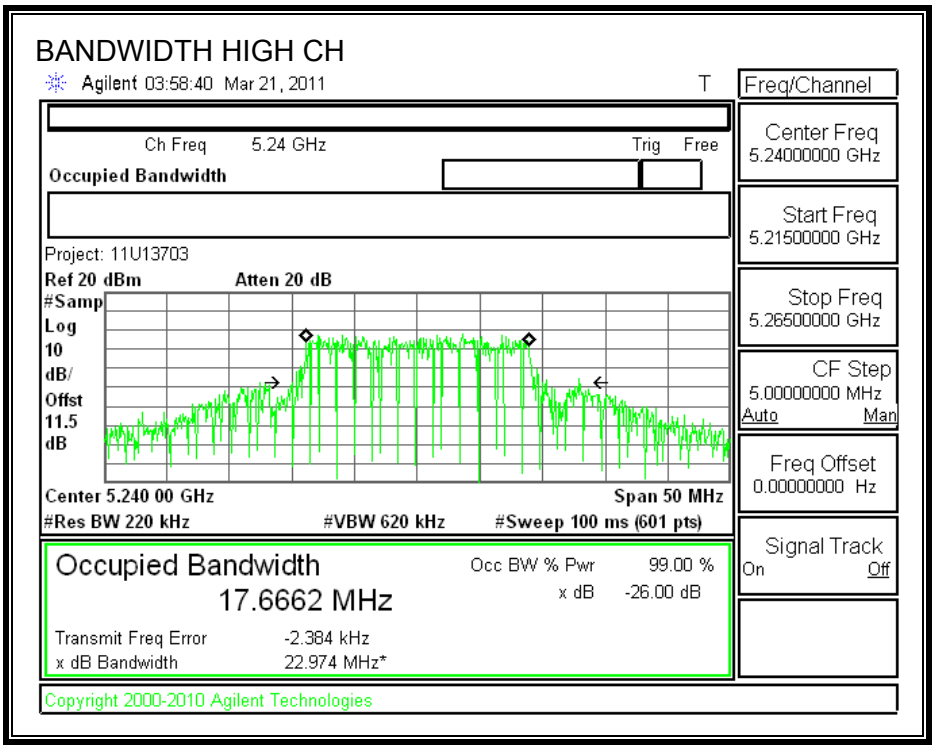
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.584	17.6236
Middle	5200	22.176	17.6500
High	5240	22.736	17.6331

AP1

26 dB and 99% BANDWIDTH

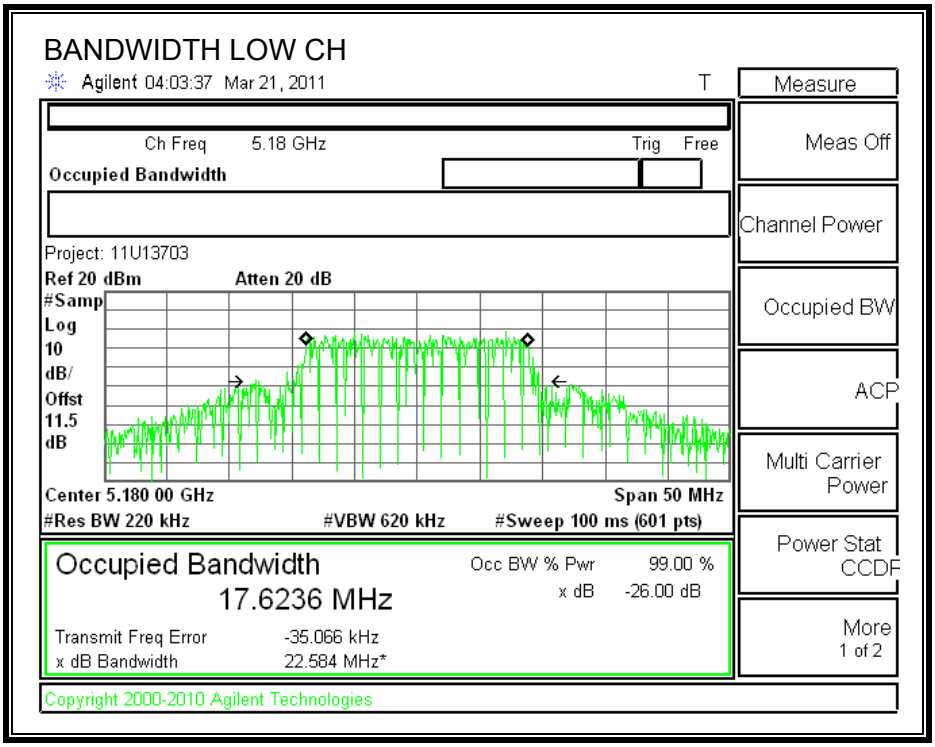


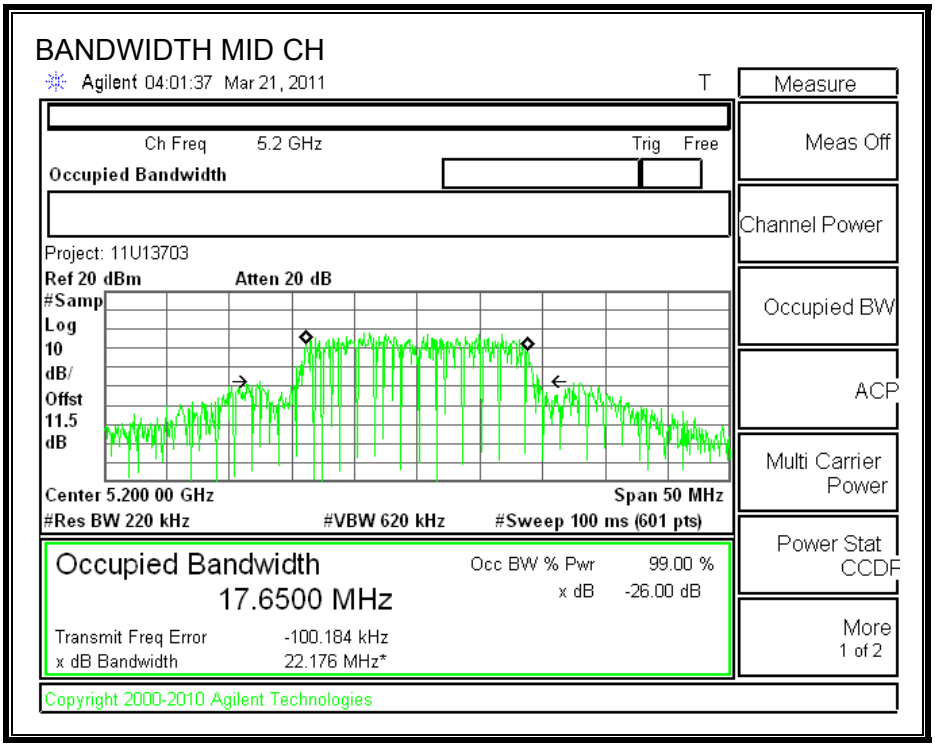


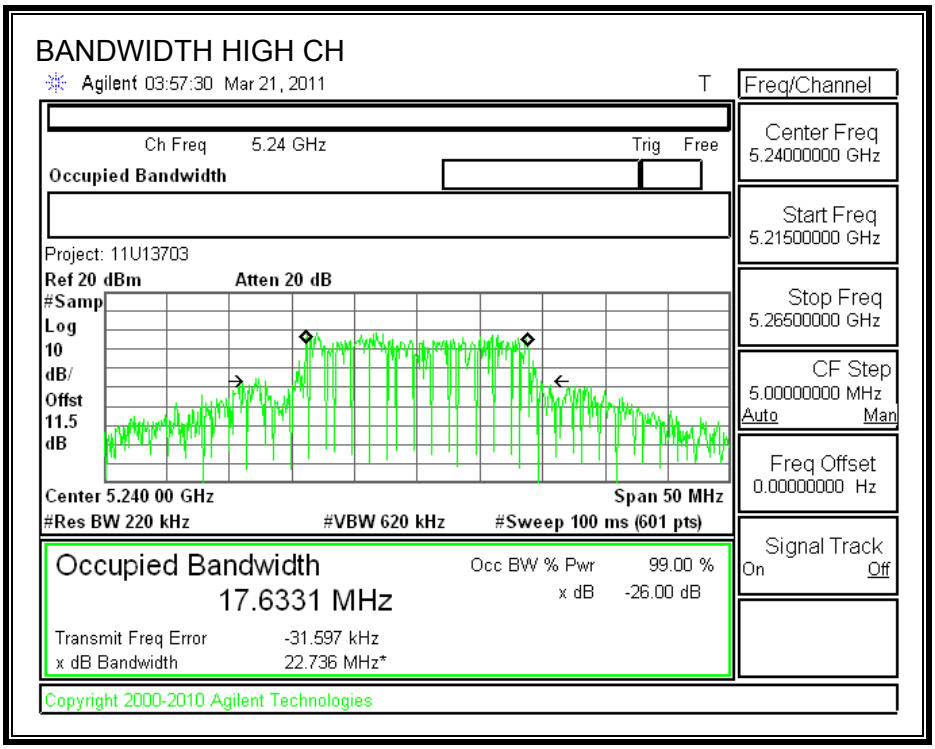


AP3

26 dB and 99% BANDWIDTH







7.3.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

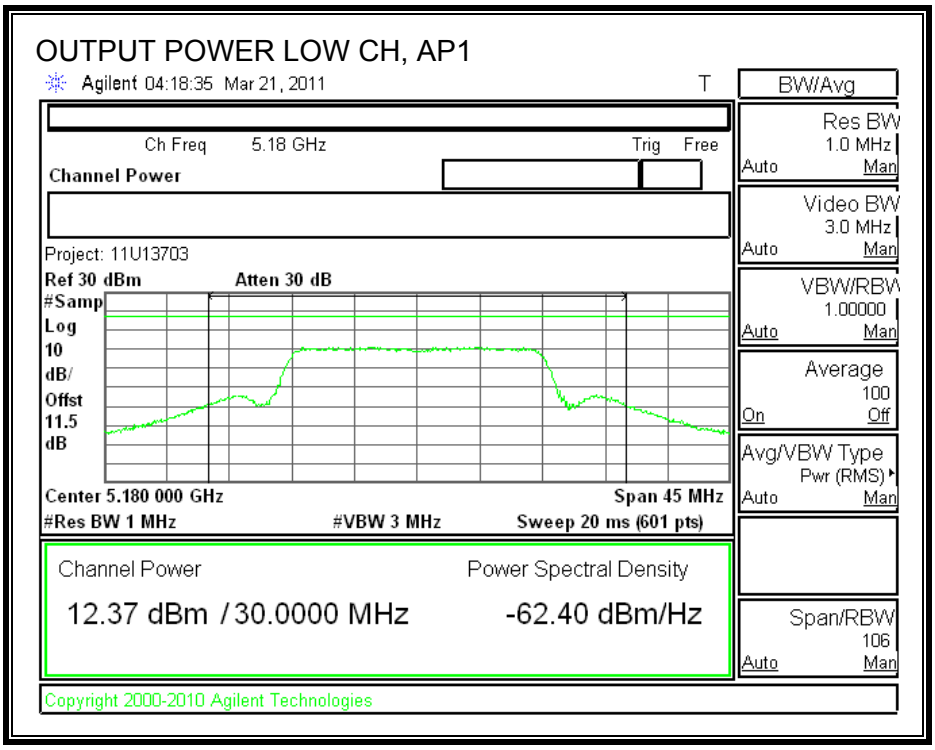
Limit

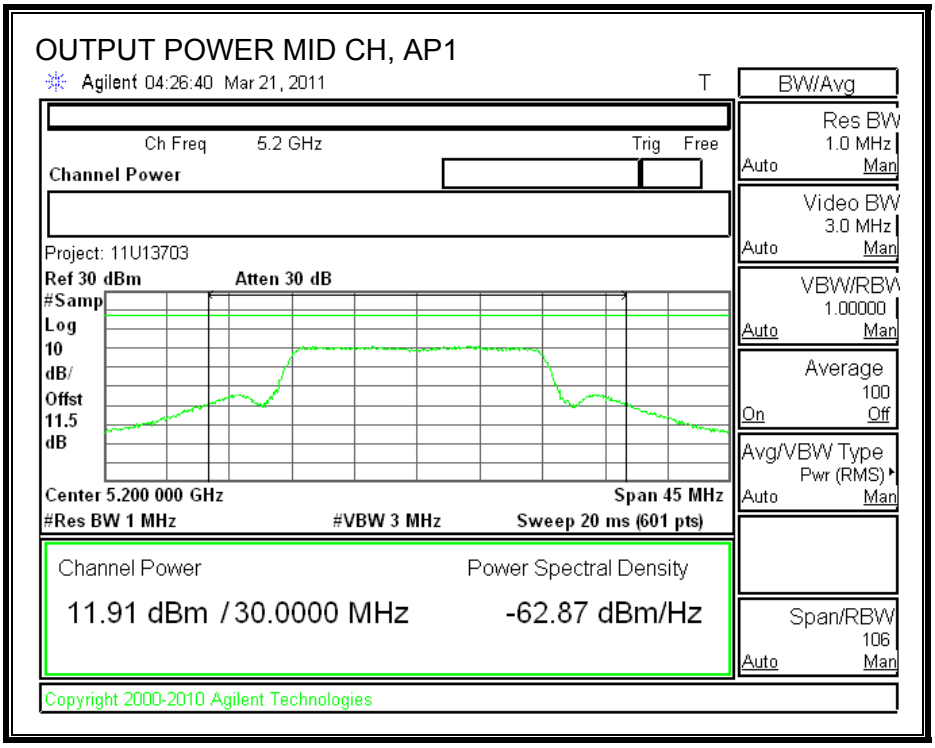
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17.00	22.584	17.54	5.69	17.00
Mid	5200	17.00	22.176	17.46	5.69	17.00
High	5240	17.00	22.736	17.57	5.69	17.00

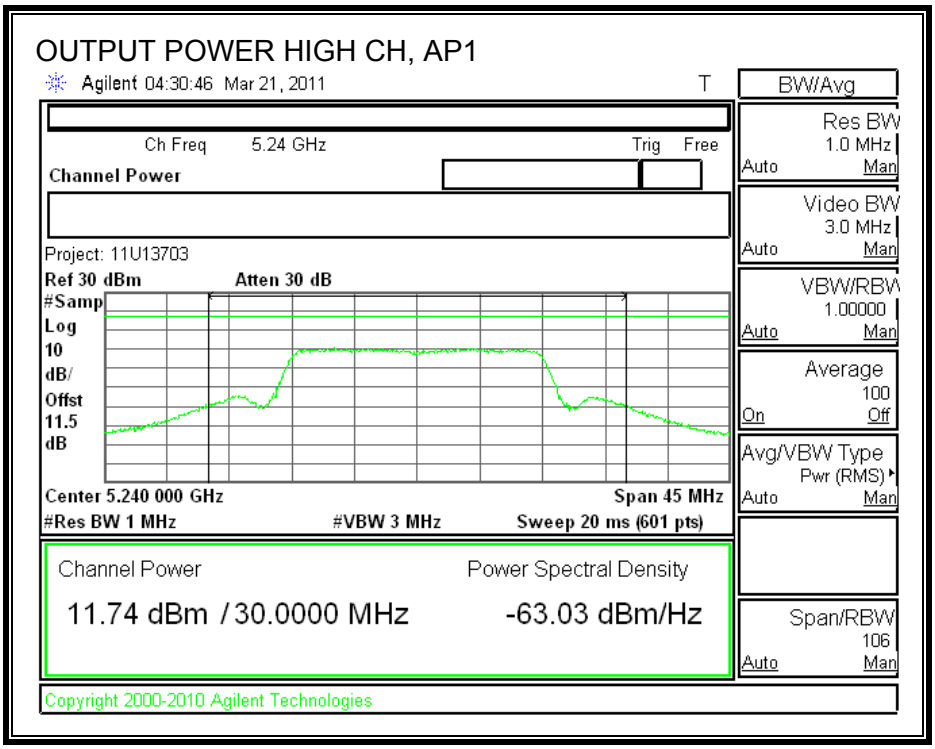
Individual Chain Results

Channel	Frequency (MHz)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	12.37	11.62	15.02	17.00	-1.98
Mid	5200	11.91	11.36	14.65	17.00	-2.35
High	5240	11.74	11.42	14.59	17.00	-2.41

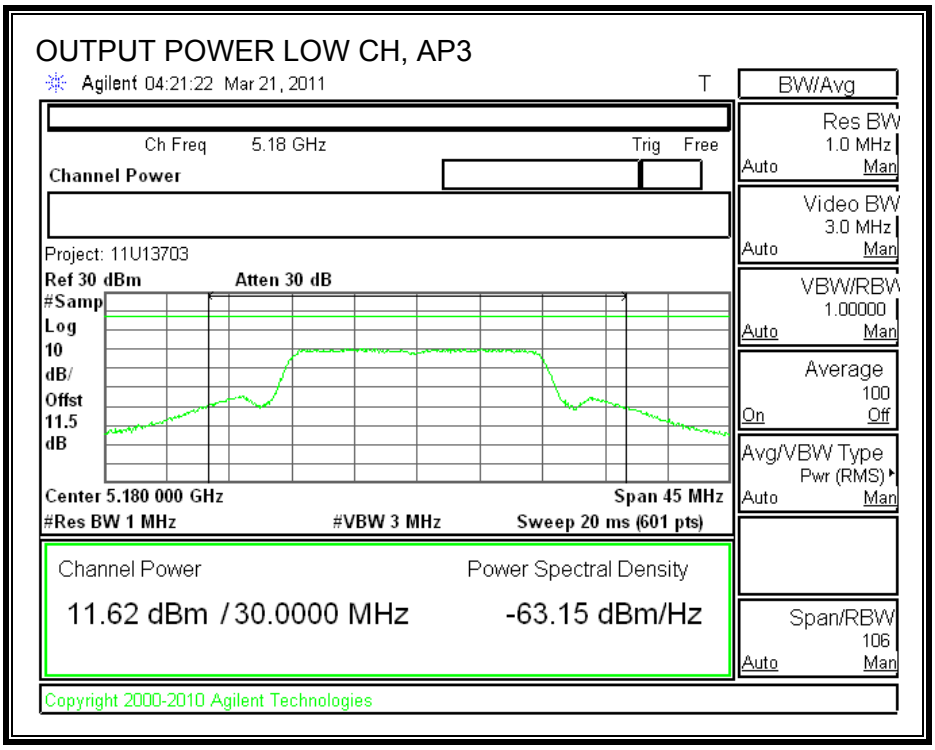
AP1 OUTPUT POWER

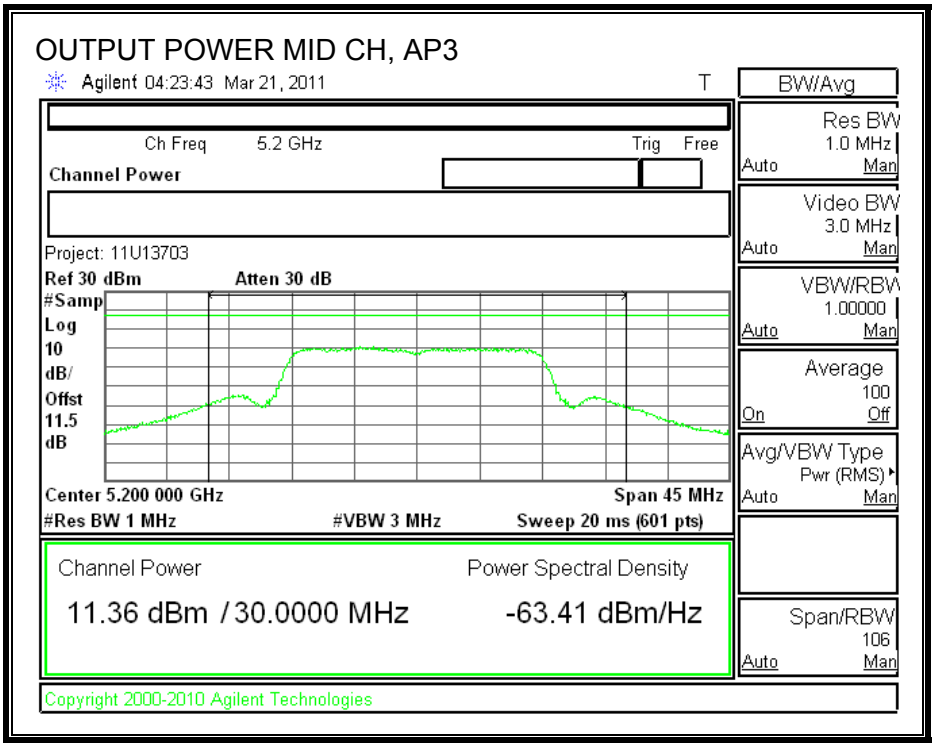


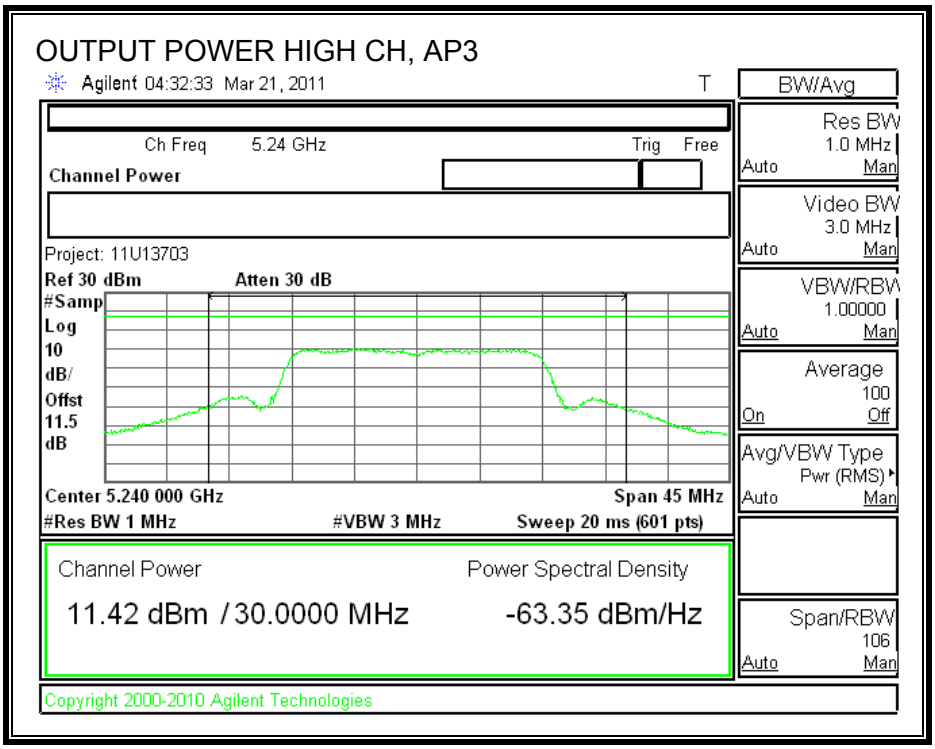




AP3 OUTPUT POWER







7.3.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

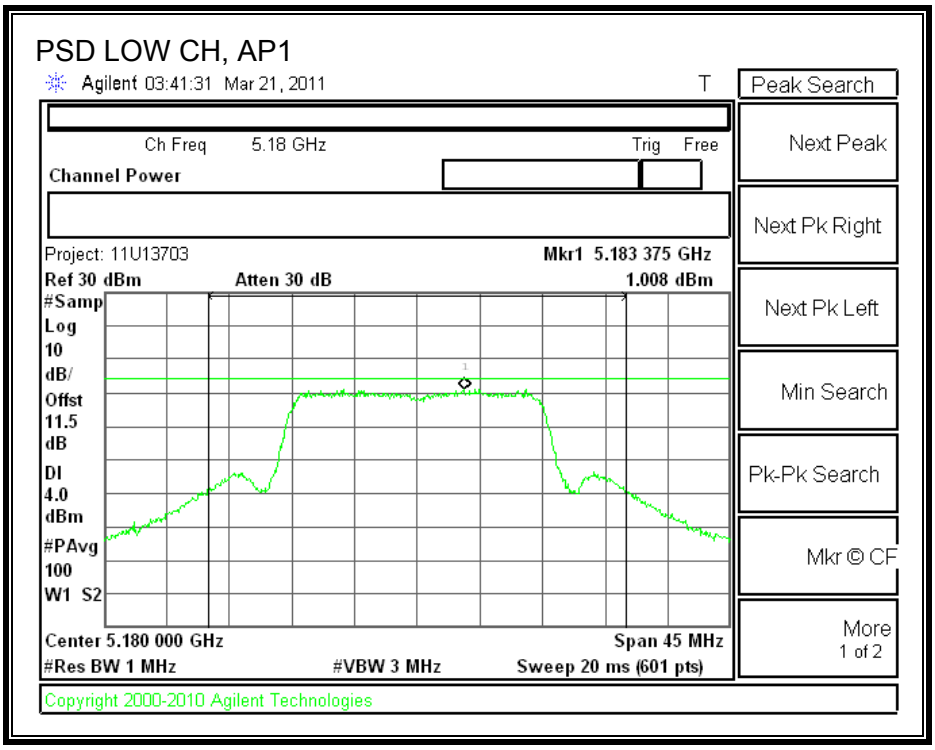
TEST PROCEDURE

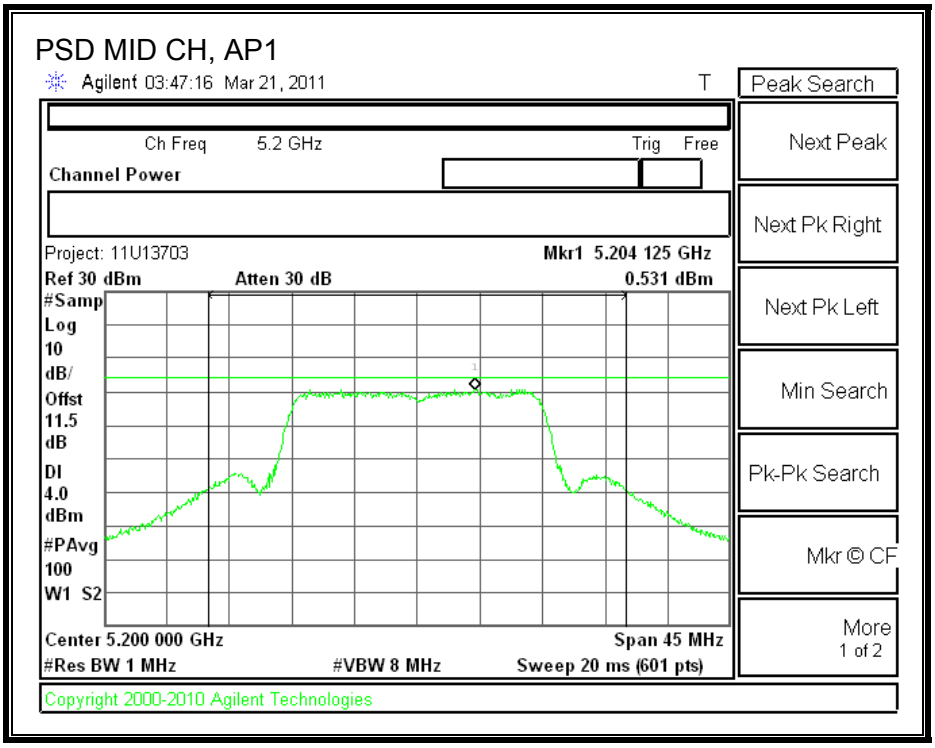
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #1 was used.

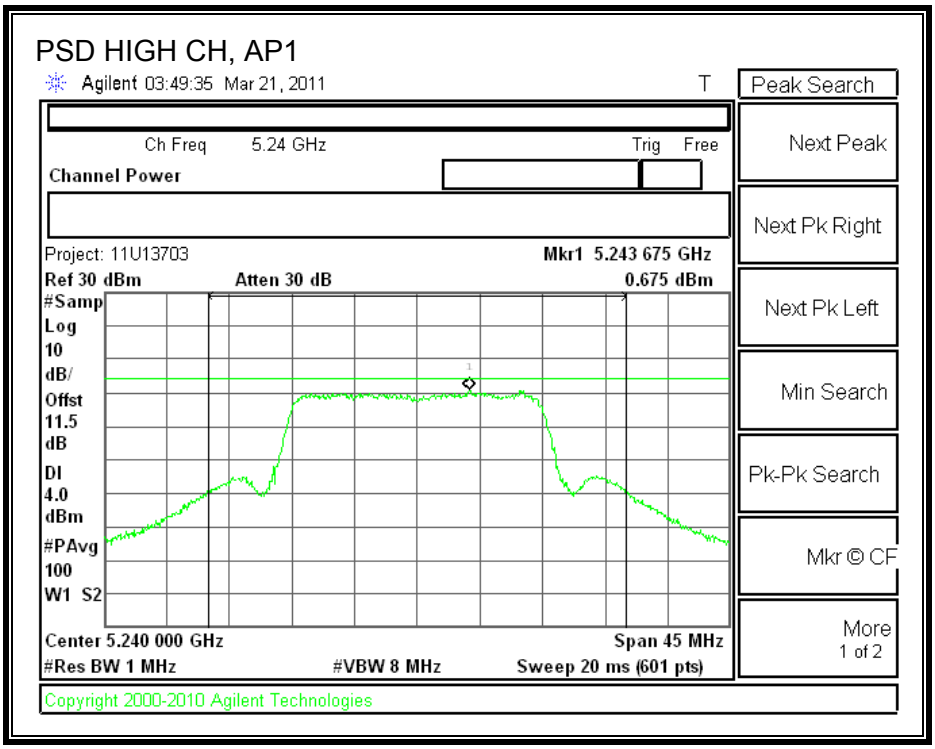
RESULTS

Channel	Frequency 80	Chain 1 PPSD (dBm)	Chain 3 PPSD (dBm)	Combined PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	1.008	0.294	3.676	4.000	-0.324
Middle	5200	0.531	0.817	3.687	4.000	-0.313
High	5240	0.675	0.686	3.691	4.000	-0.309

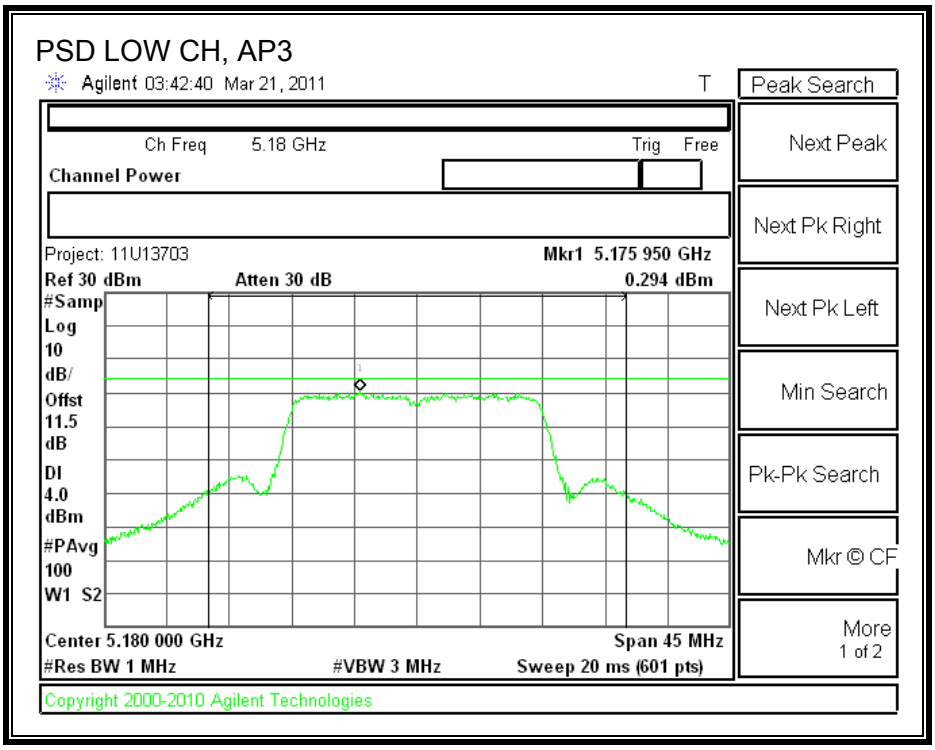
AP1 POWER SPECTRAL DENSITY

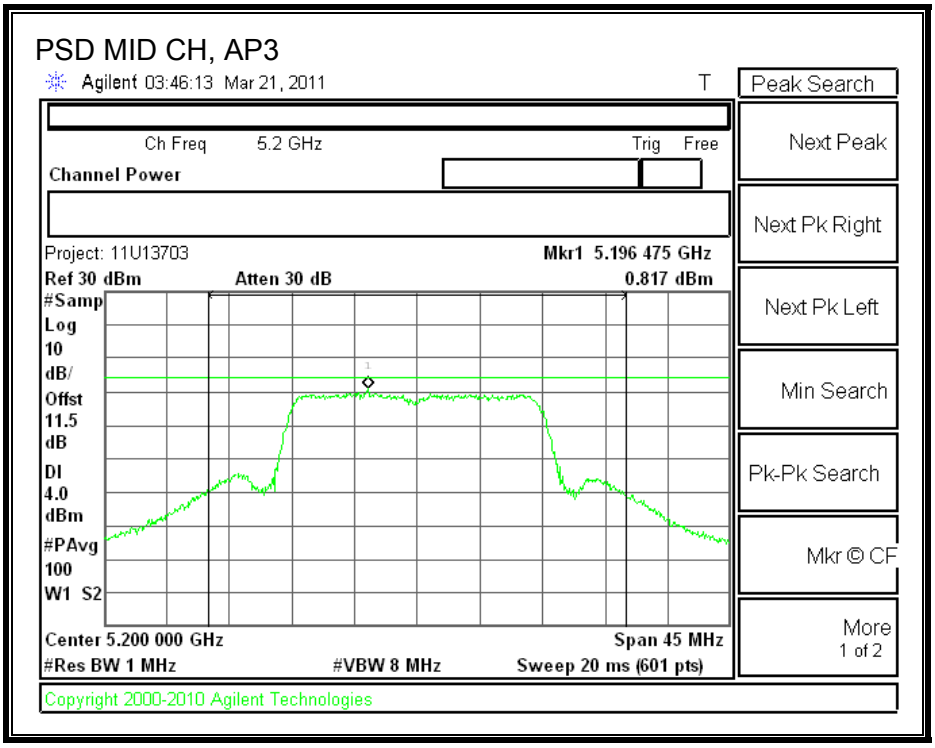


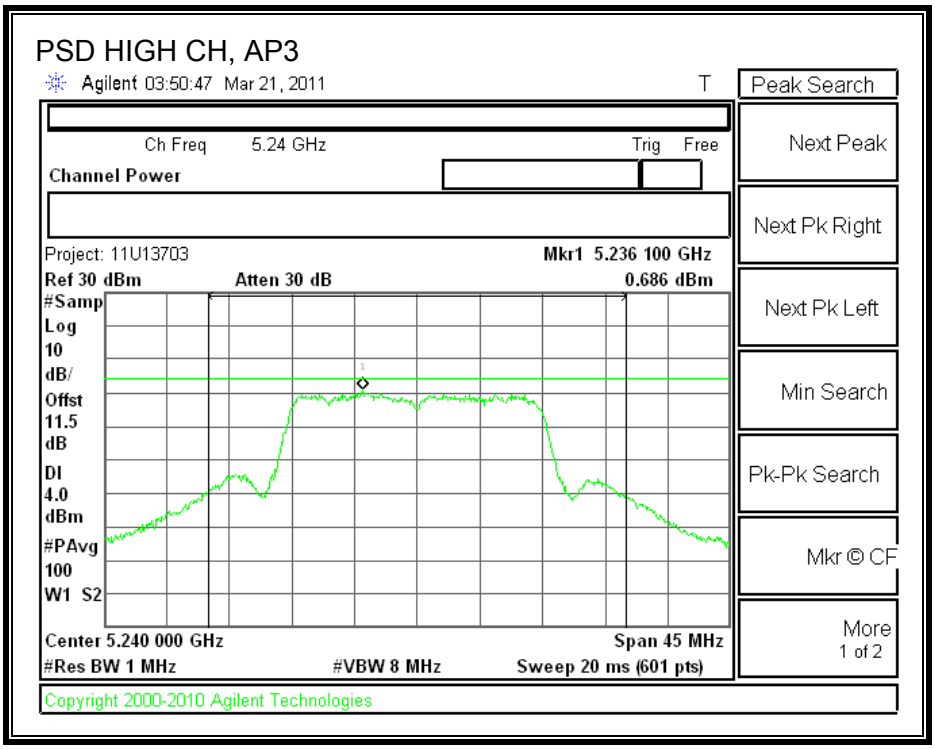




AP3 POWER SPECTRAL DENSITY







7.3.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

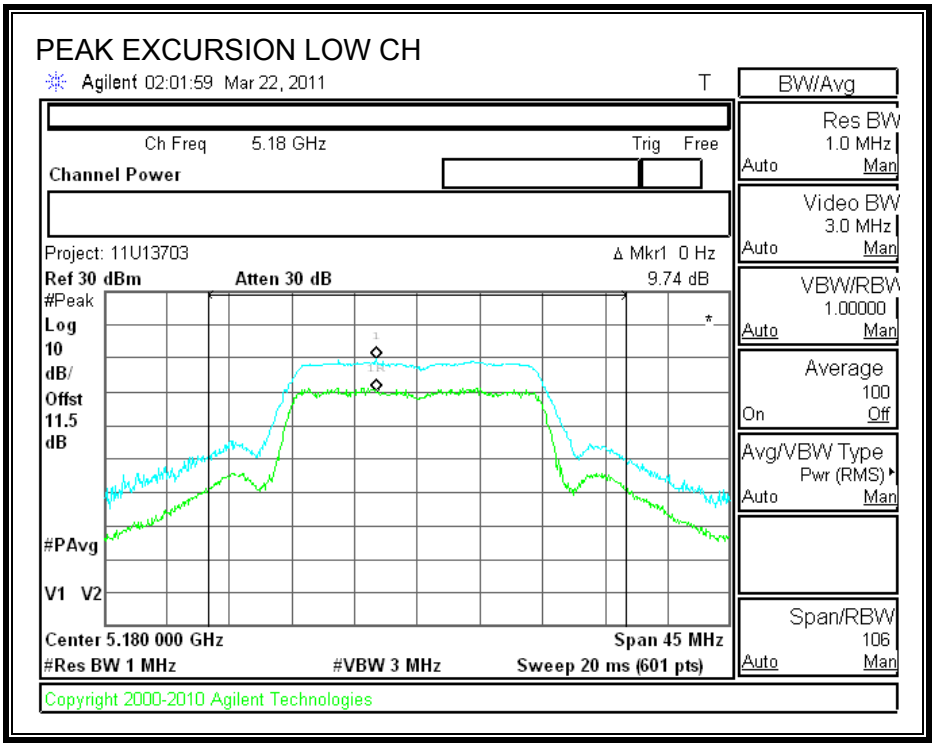
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.74	13	-3.26
Middle	5200	9.58	13	-3.42
High	5240	9.02	13	-3.98

AP3

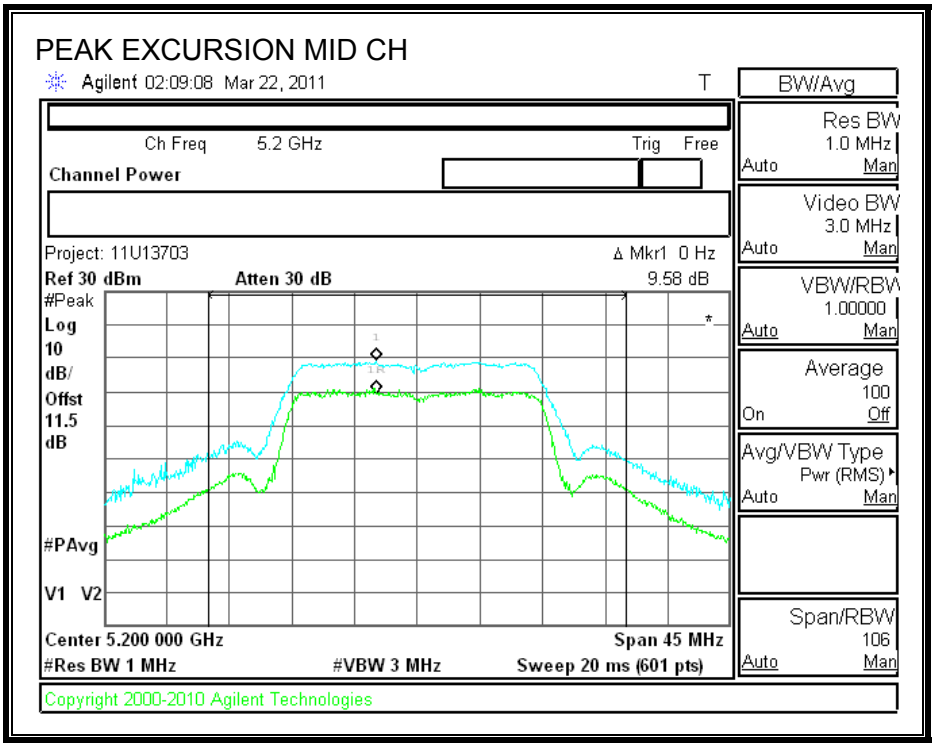
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.77	13	-3.23
Middle	5200	9.77	13	-3.23
High	5240	10.46	13	-2.54

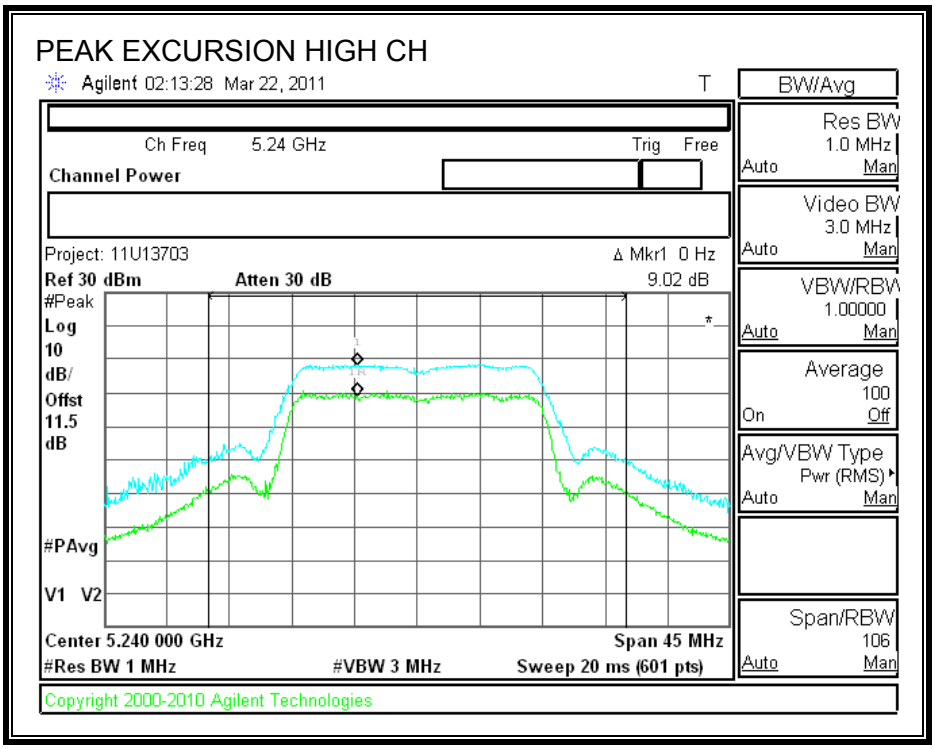
AP1

PEAK EXCURSION



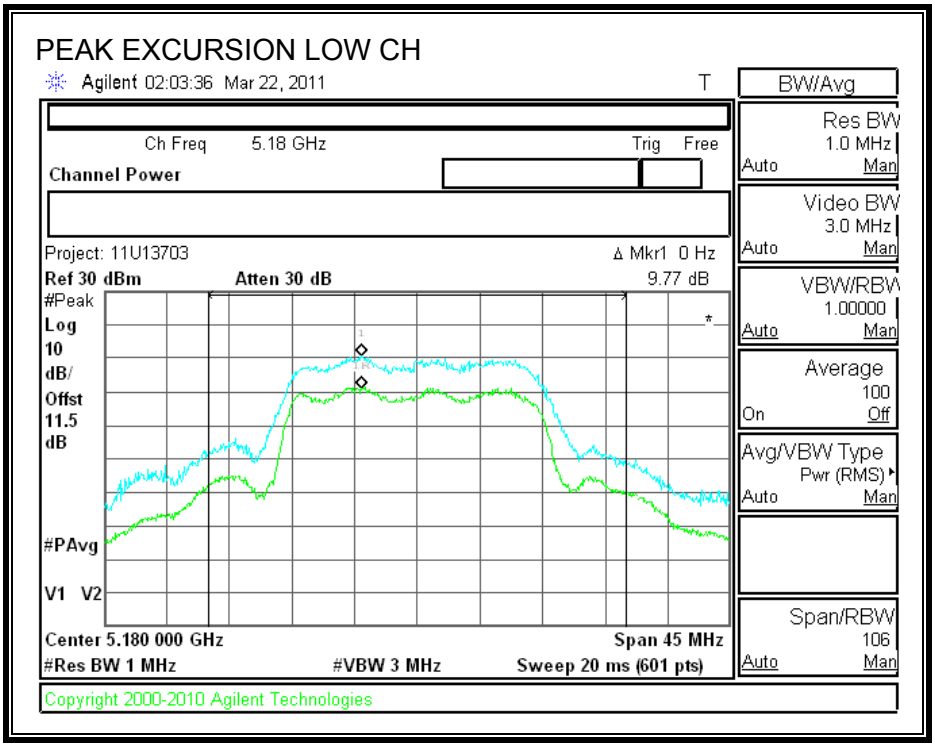
PEAK EXCURSION MID CH



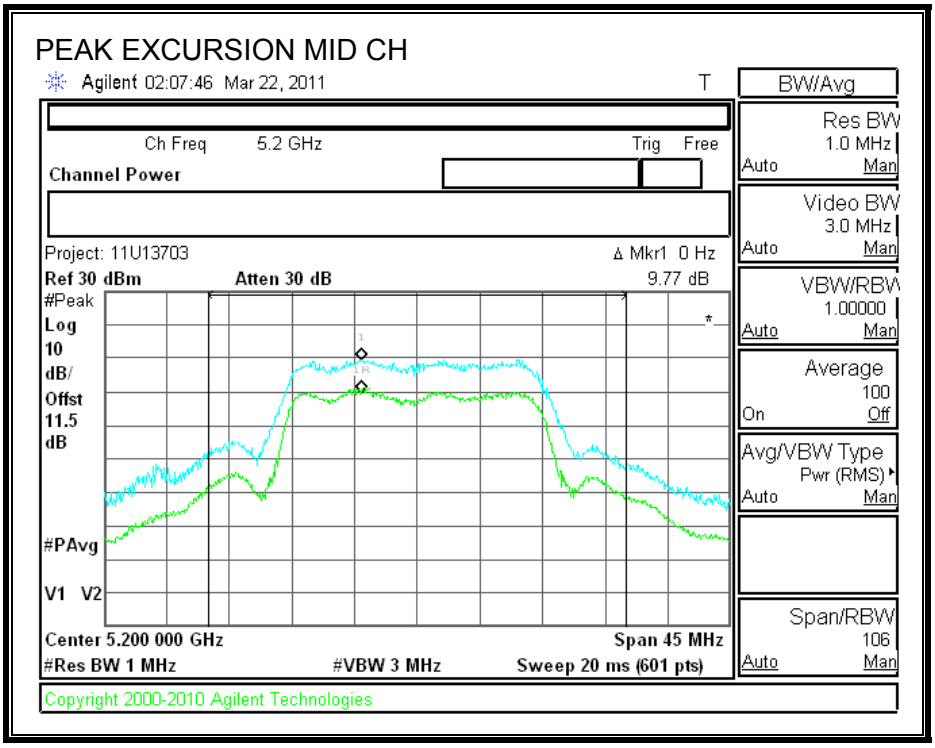


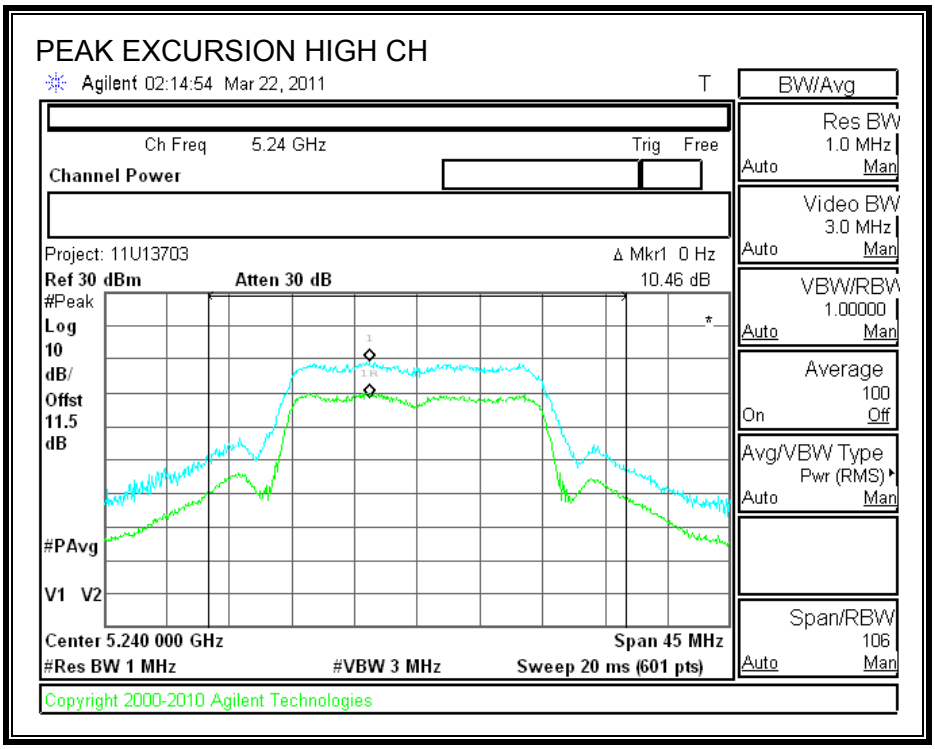
AP3

PEAK EXCURSION



PEAK EXCURSION MID CH





7.3.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

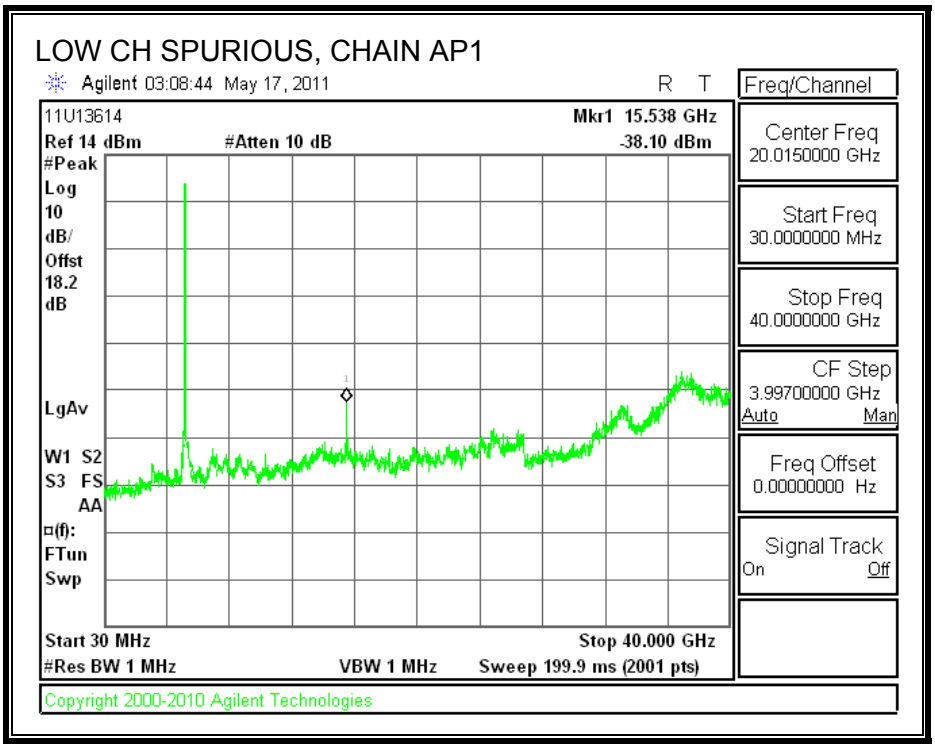
Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-38.10	5.03	3.01	-30.06	-27.00
Middle	15.598	-36.83	5.03	3.01	-28.79	-27.00
High	15.718	-37.14	5.03	3.01	-29.10	-27.00

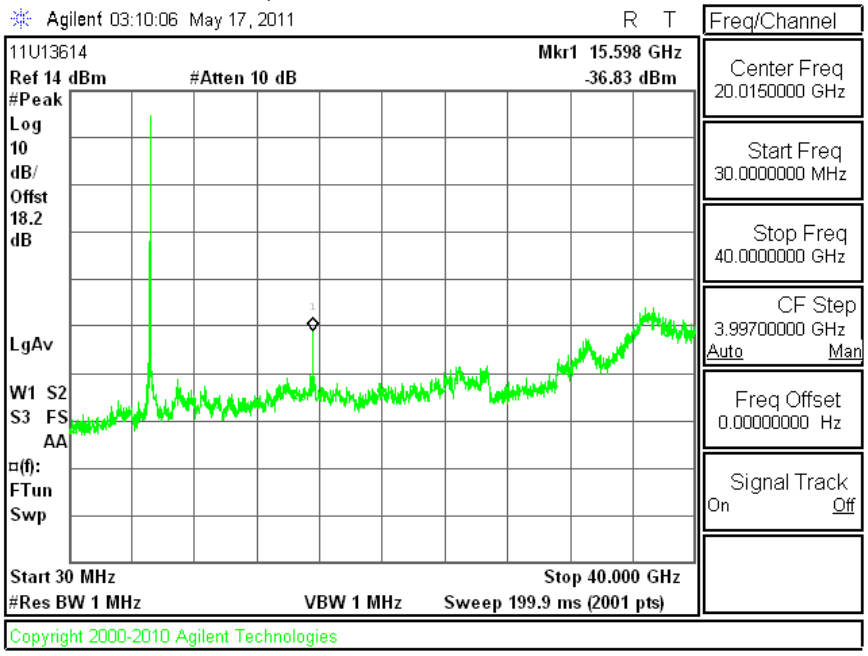
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.17	5.69	3.01	-28.47	-27.00
Middle	15.598	-37.34	5.69	3.01	-28.64	-27.00
High	15.738	-38.69	5.69	3.01	-29.99	-27.00

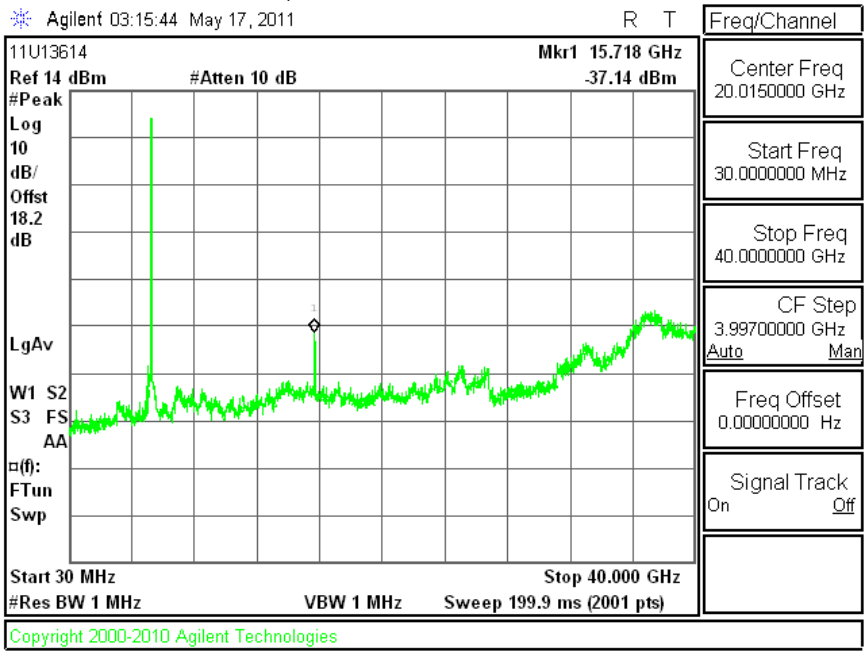
CHAIN AP1 SPURIOUS EMISSIONS



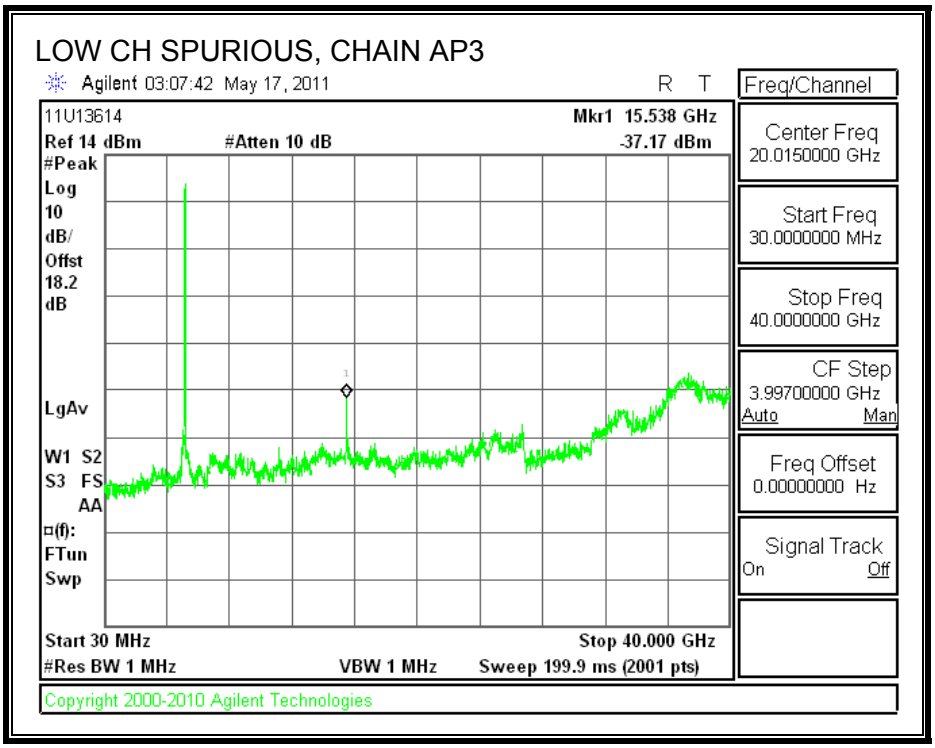
MID CH SPURIOUS, CHAIN AP1



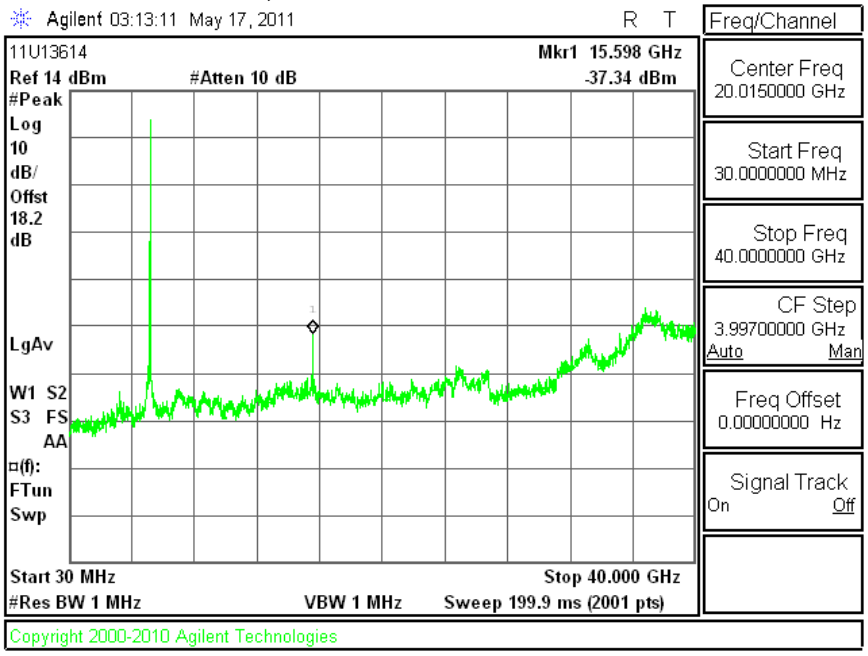
HIGH CH SPURIOUS, CHAIN AP1



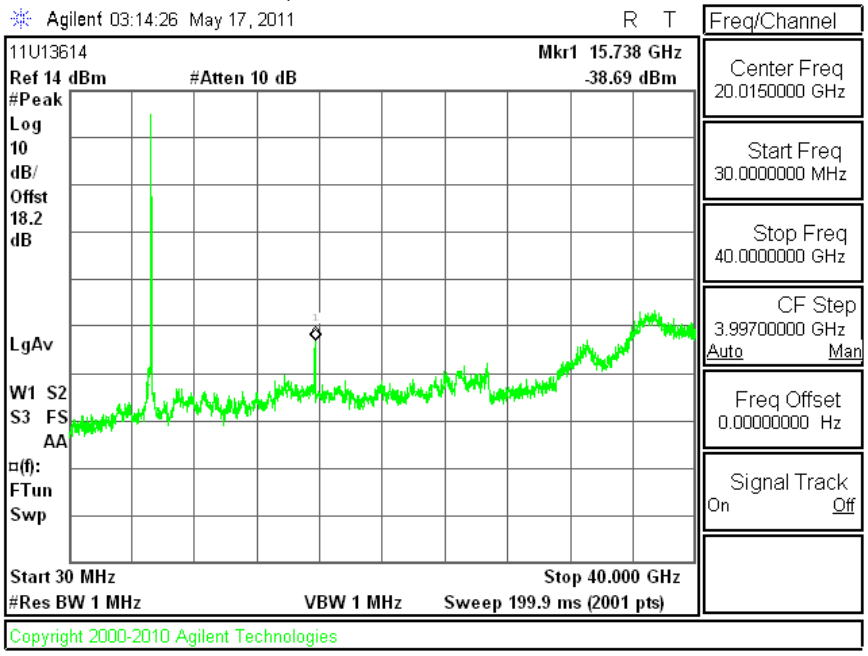
CHAIN AP3 SPURIOUS EMISSIONS



MID CH SPURIOUS, CHAIN AP3



HIGH CH SPURIOUS, CHAIN AP3



7.4. 802.11n THREE CHAINS HT20 MODE IN THE 5.2 GHz BAND

7.4.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.427	17.6833
Middle	5200	22.277	17.6620
High	5240	22.202	17.6767

AP2

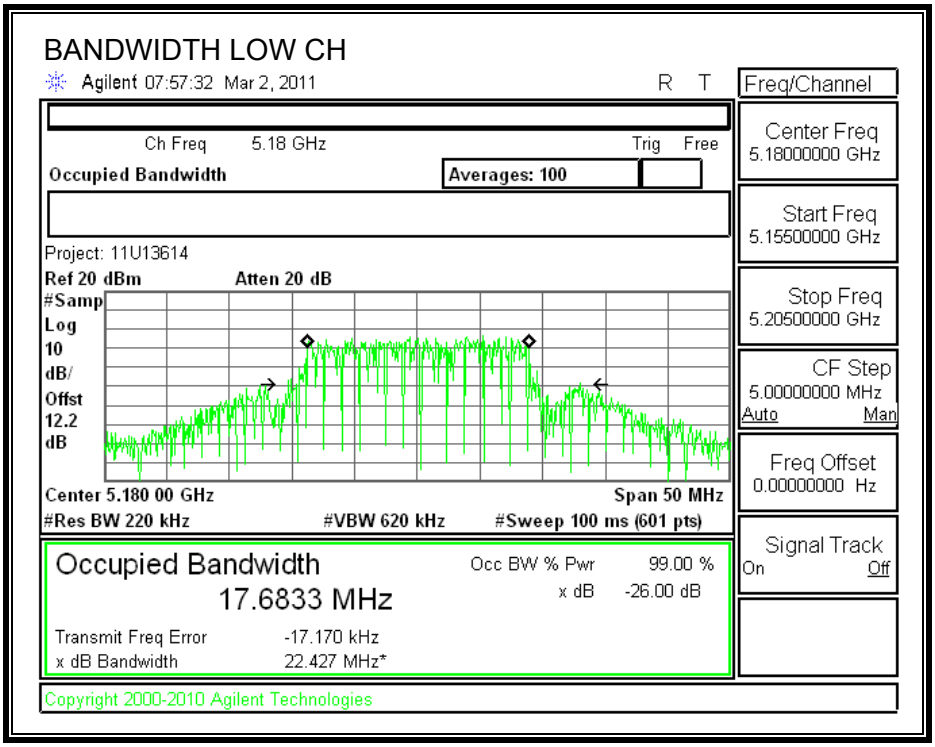
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.067	17.6494
Middle	5200	21.828	17.6441
High	5240	22.216	17.6395

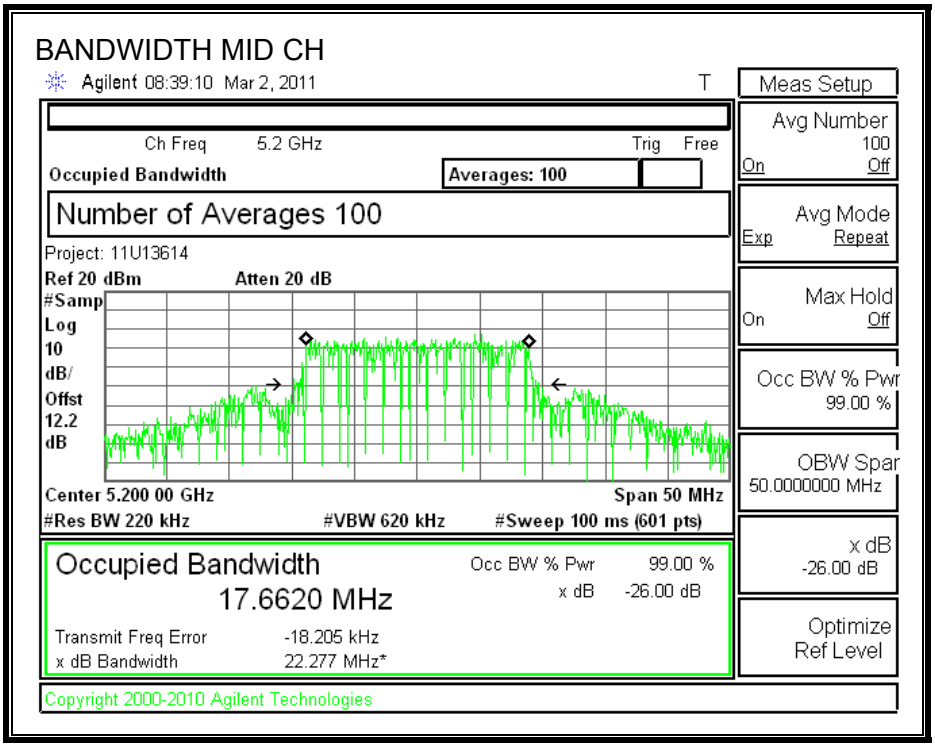
AP3

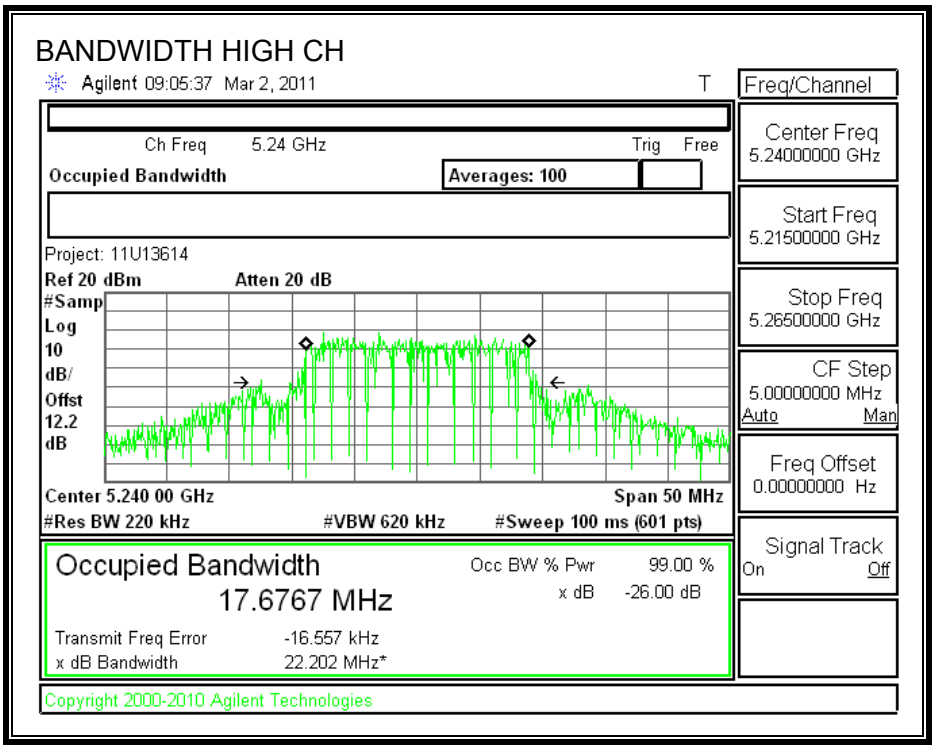
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	22.336	17.6818
Middle	5200	22.381	17.6577
High	5240	22.925	17.6638

AP1

26 dB and 99% BANDWIDTH

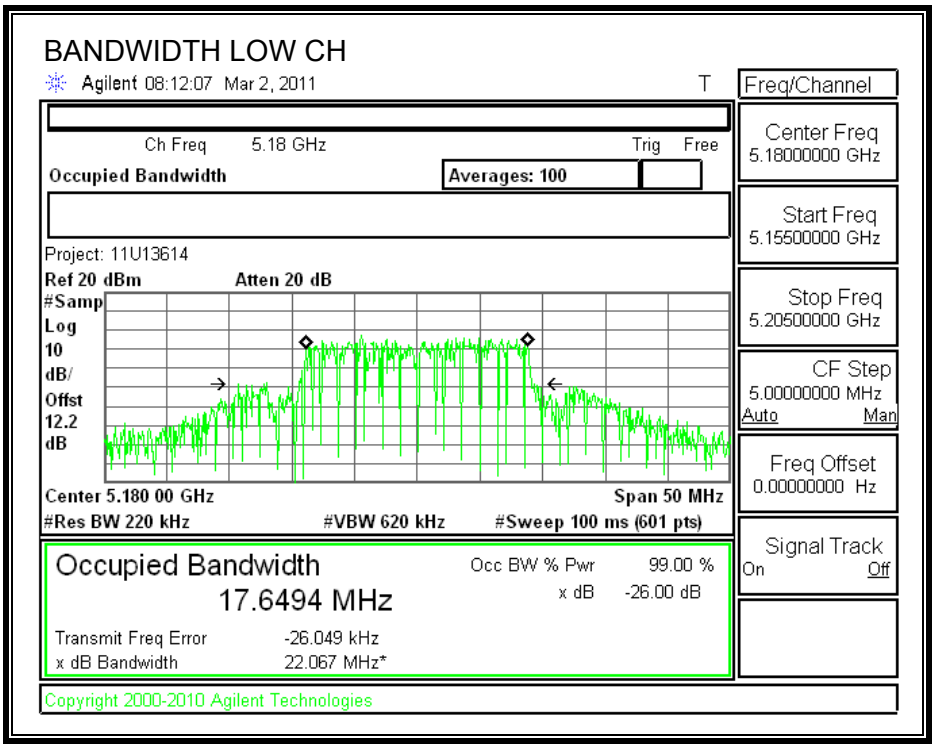


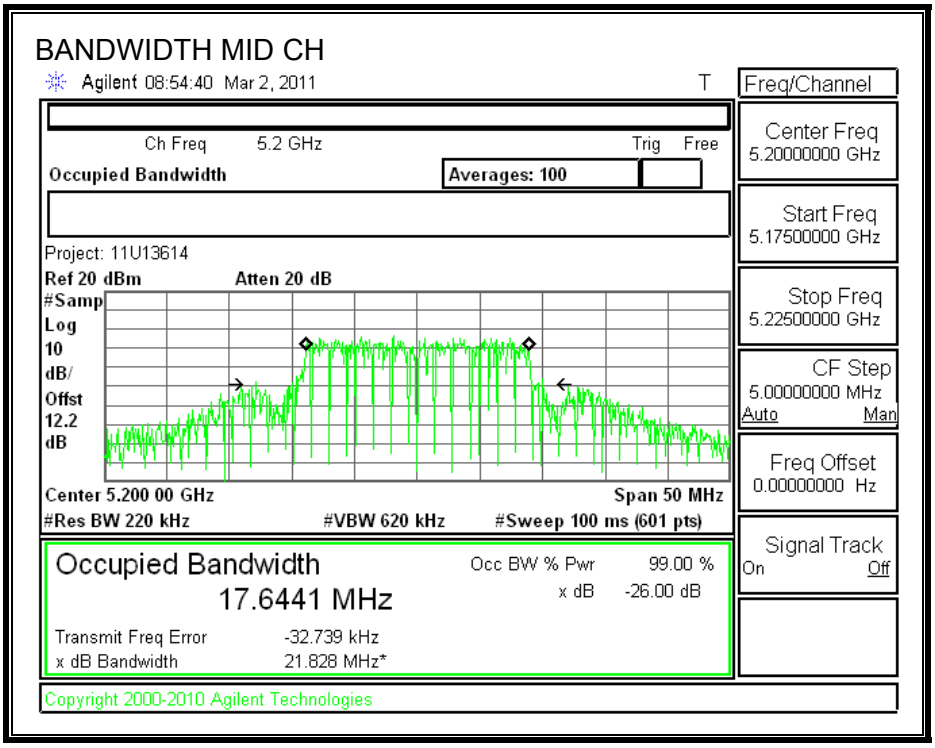


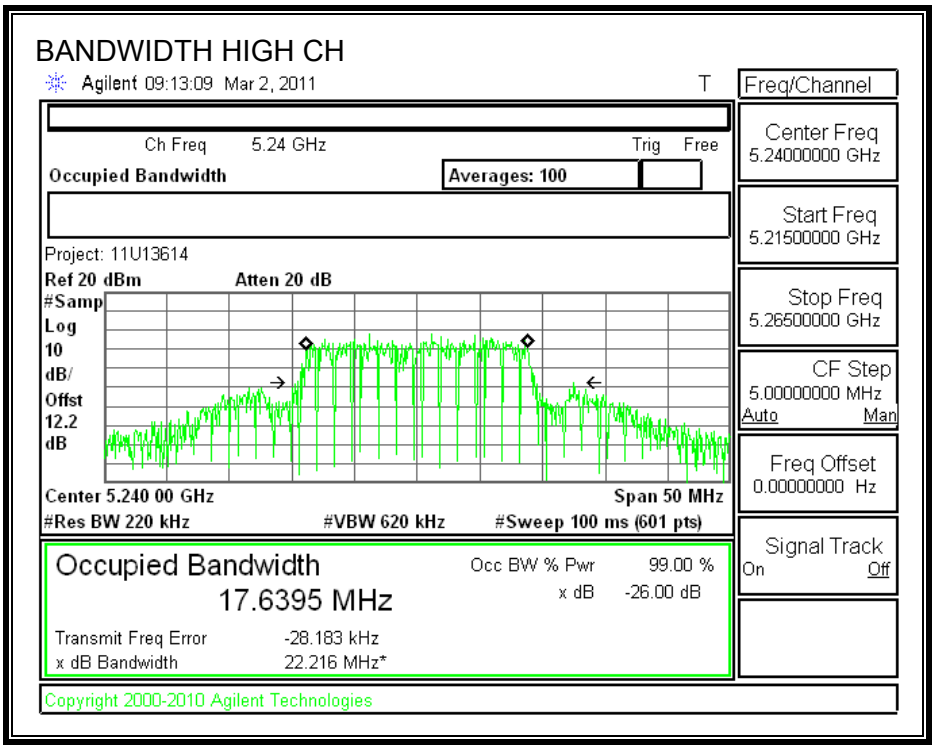


AP2

26 dB and 99% BANDWIDTH

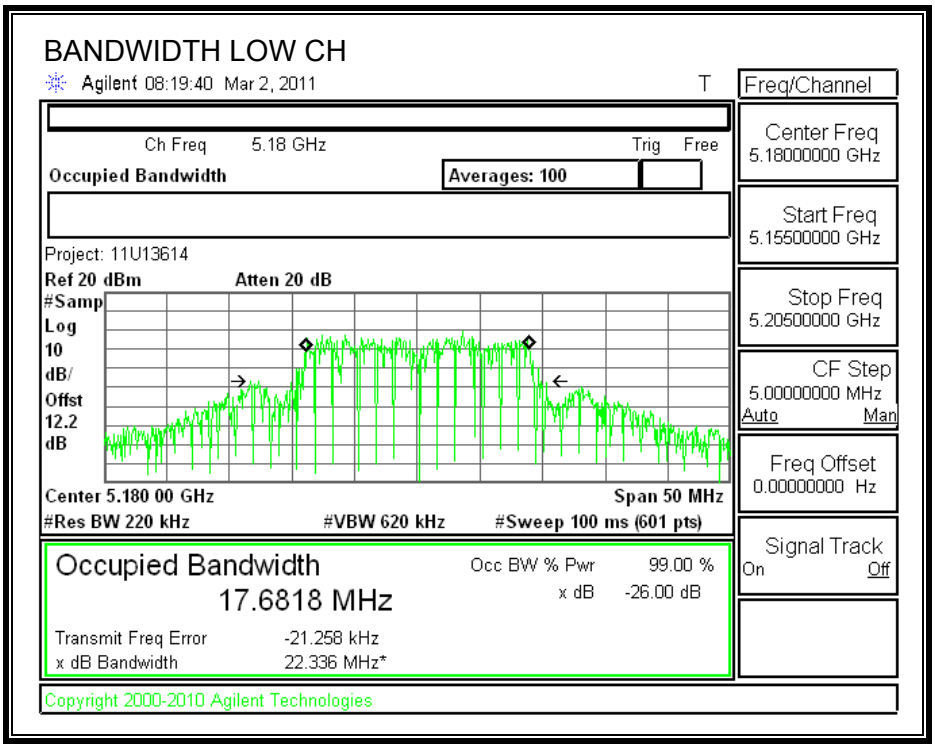


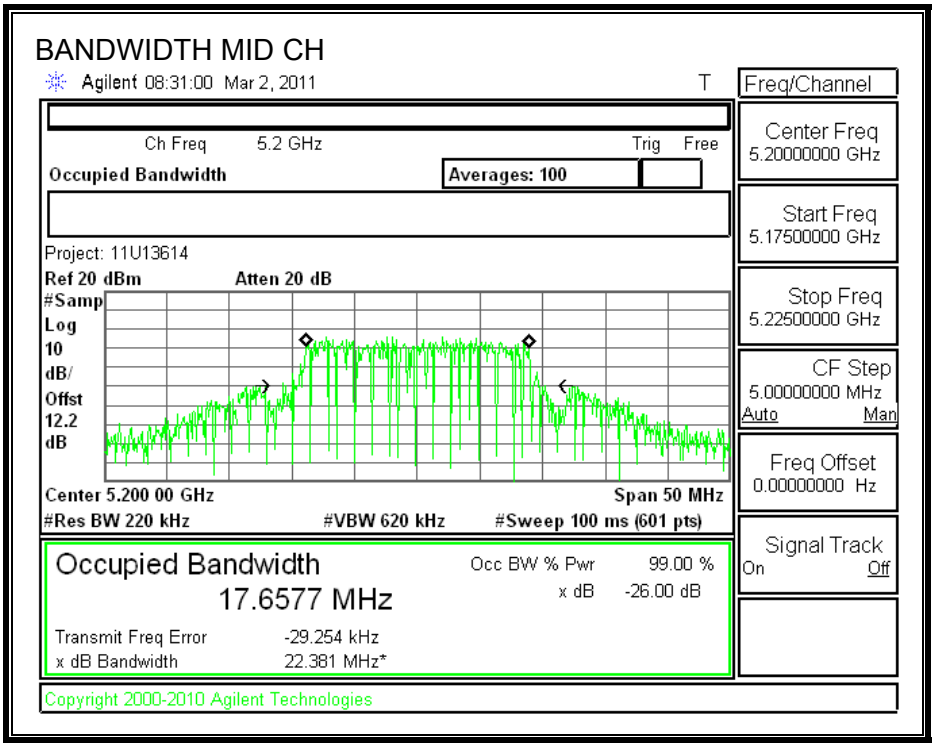


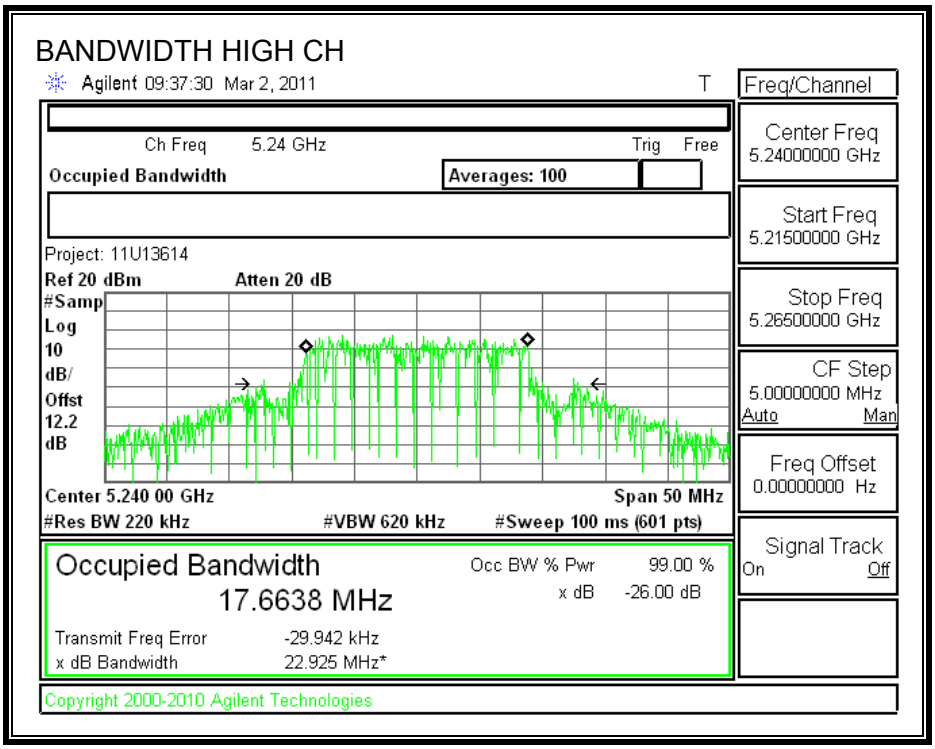


AP3

26 dB and 99% BANDWIDTH







7.4.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

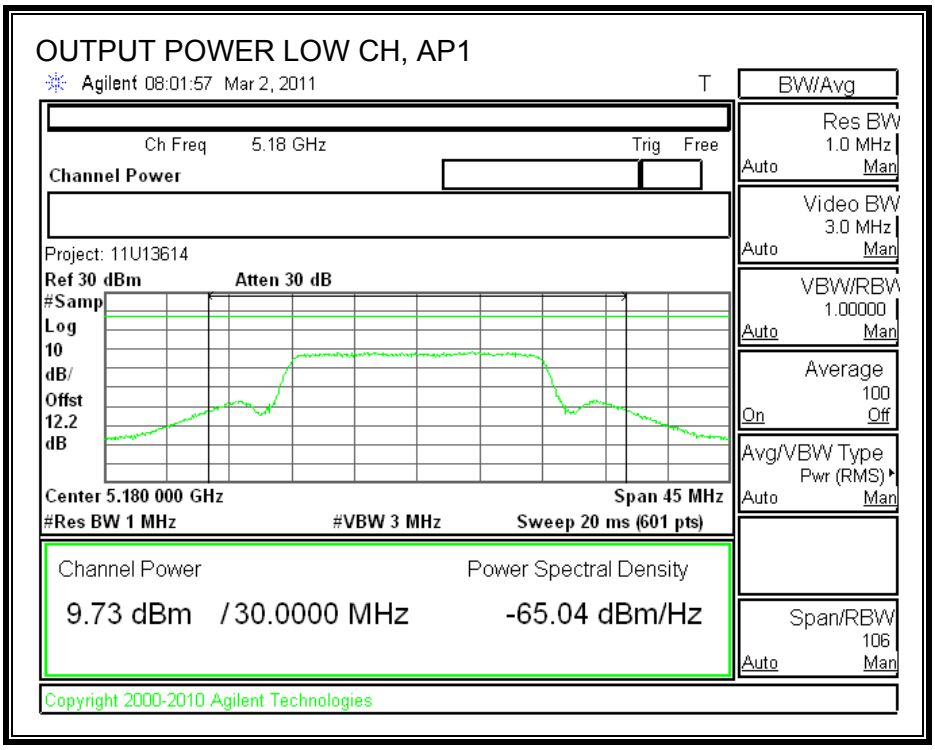
Limit

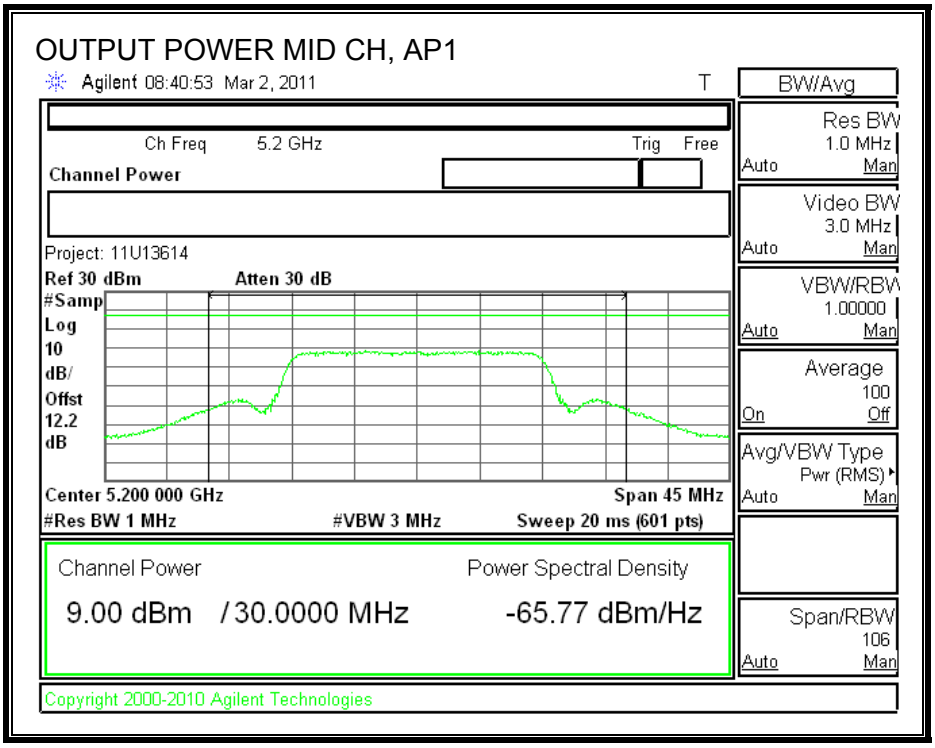
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17.00	22.067	17.44	5.69	17.00
Mid	5200	17.00	21.828	17.39	5.69	17.00
High	5240	17.00	22.202	17.46	5.69	17.00

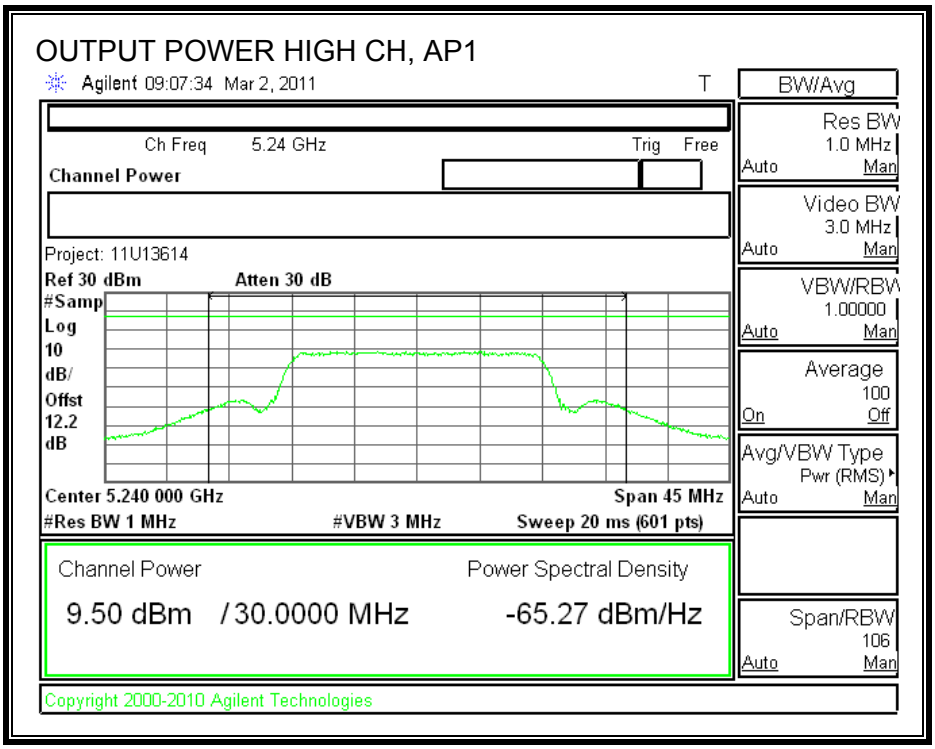
Individual Chain Results

Channel	Frequency (MHz)	AP1 Power (dBm)	AP2 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.73	9.84	10.88	14.95	17.00	-2.05
Mid	5200	9.00	9.42	9.00	13.92	17.00	-3.08
High	5240	9.50	9.47	9.66	14.32	17.00	-2.68

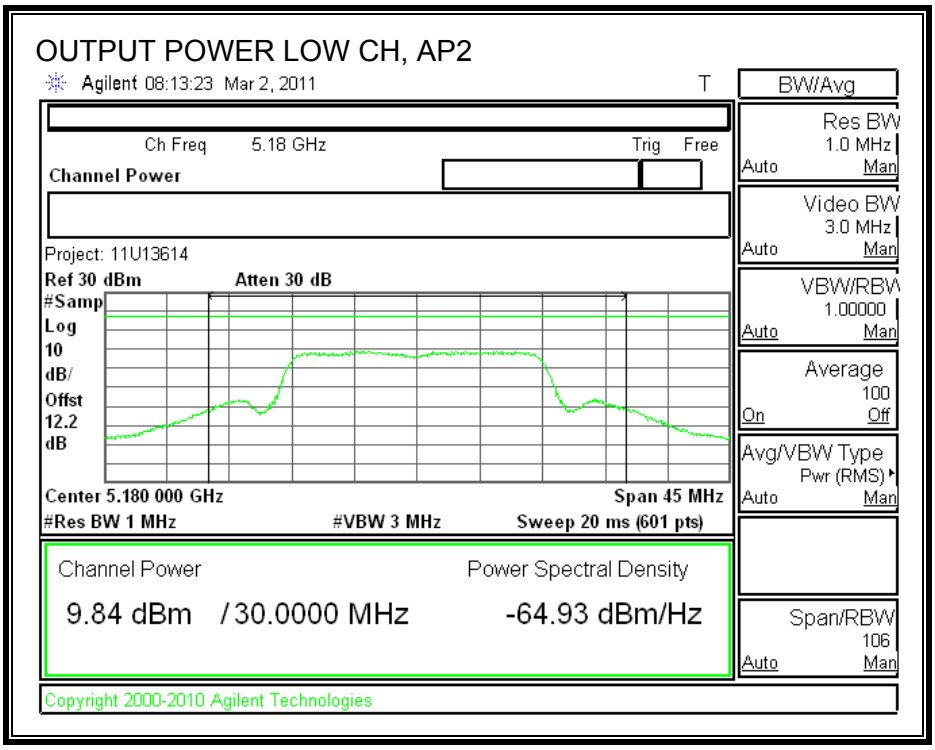
AP1 OUTPUT POWER

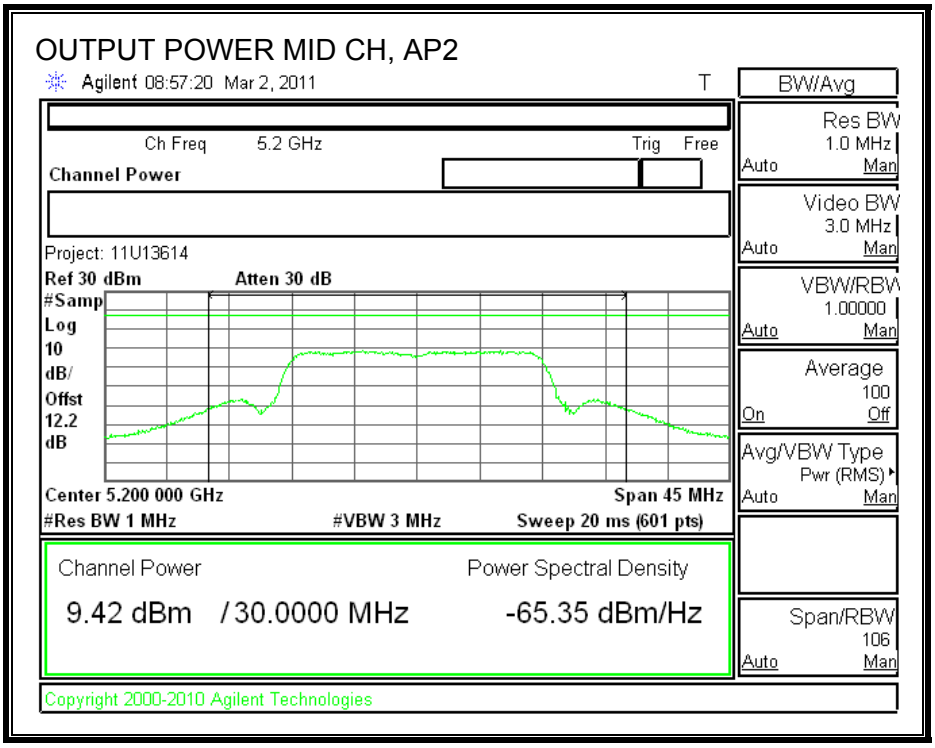


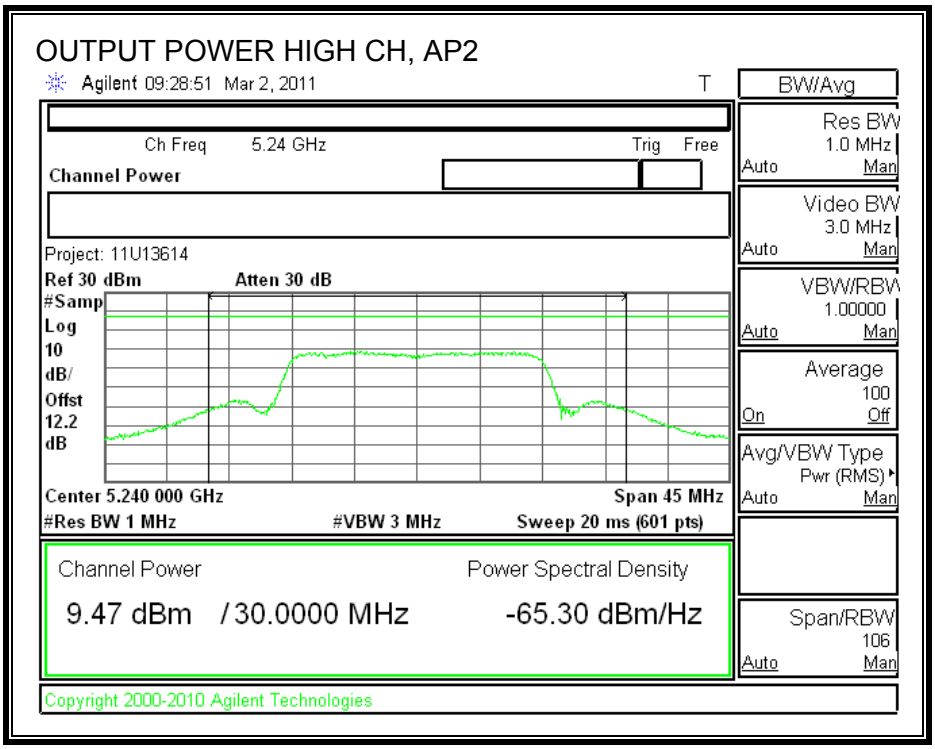




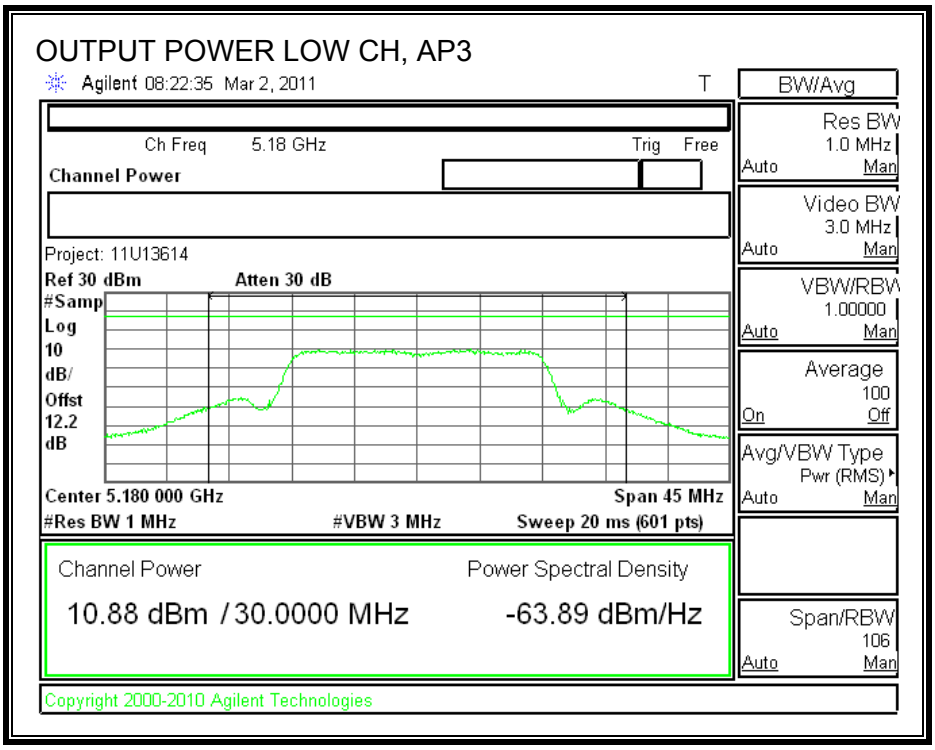
AP2 OUTPUT POWER

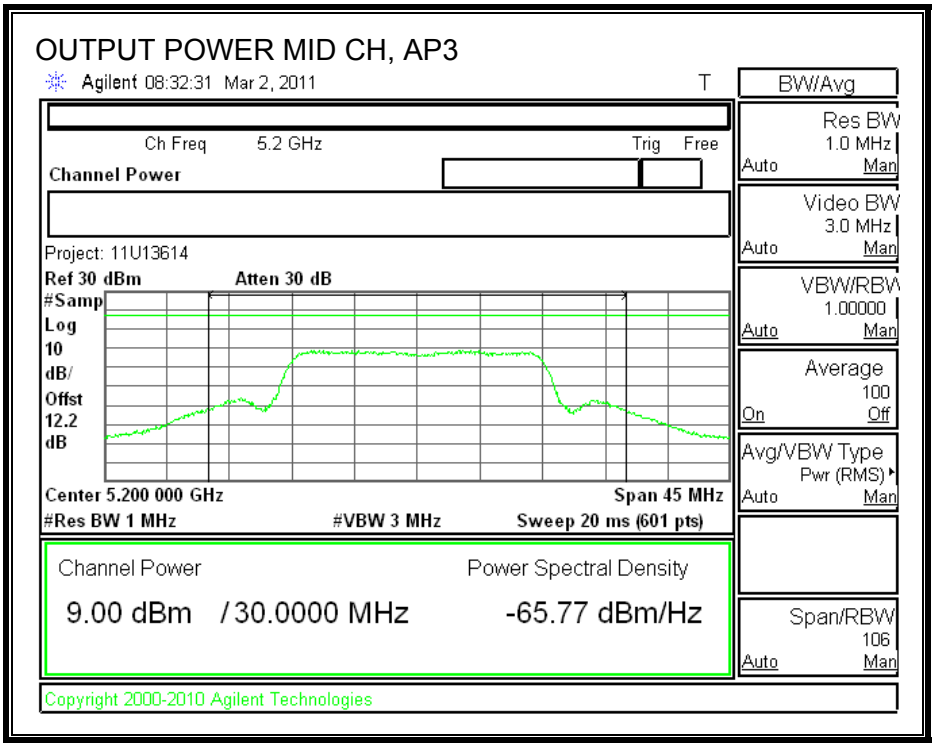


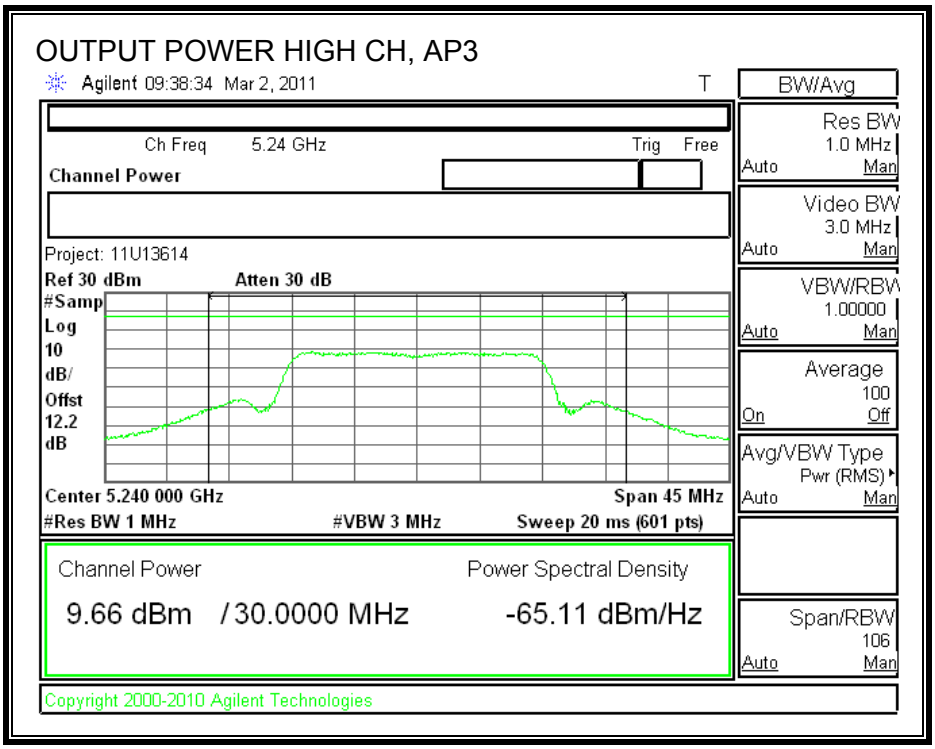




AP3 OUTPUT POWER







7.4.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

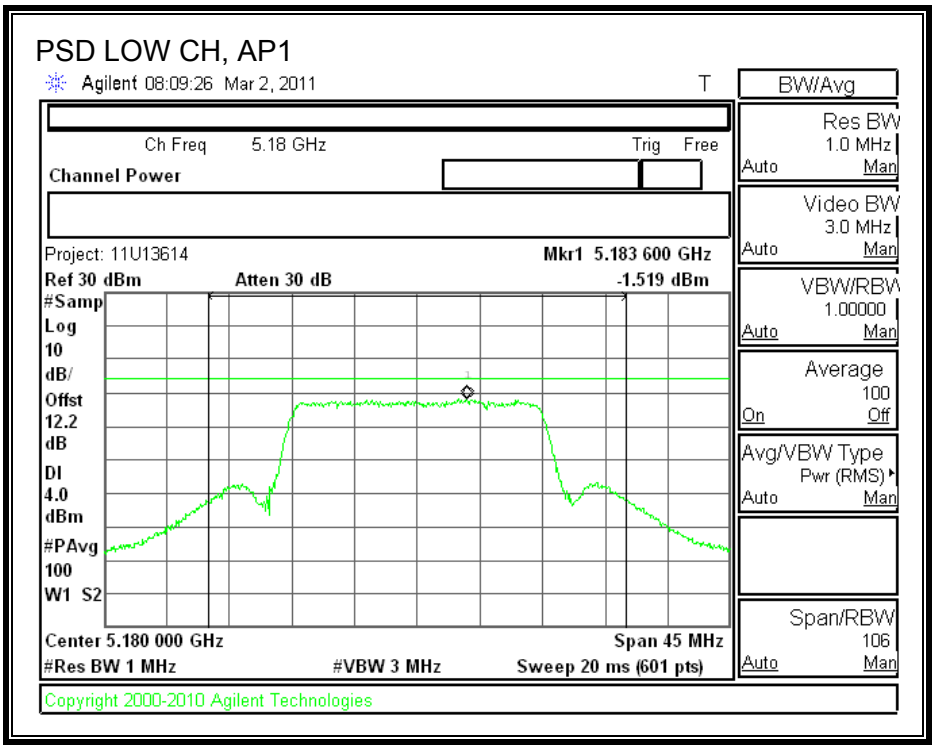
TEST PROCEDURE

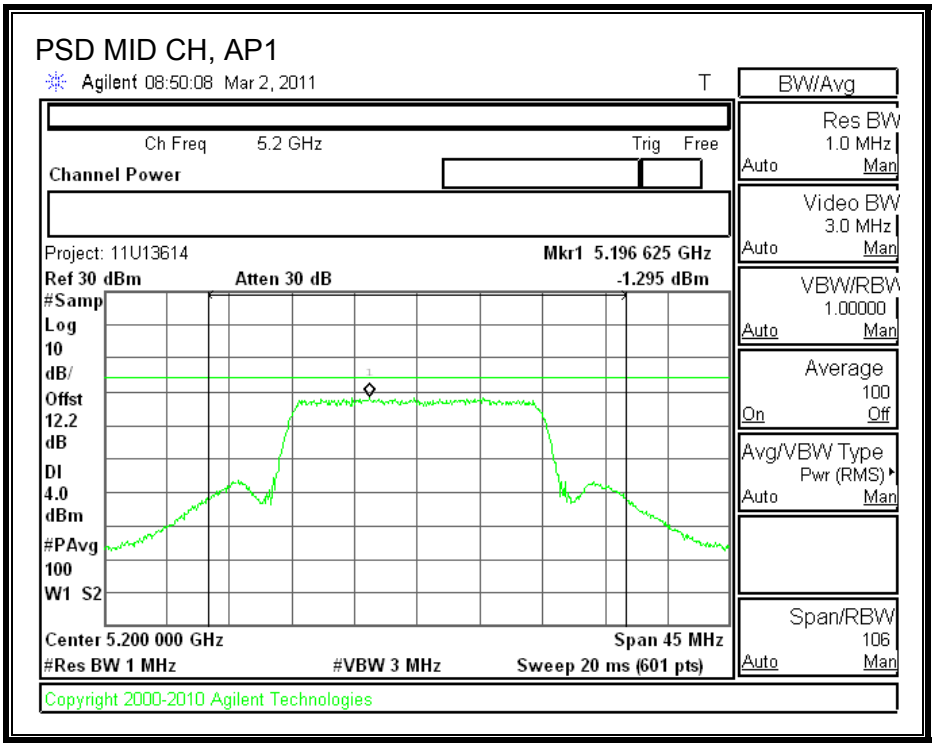
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #1 was used.

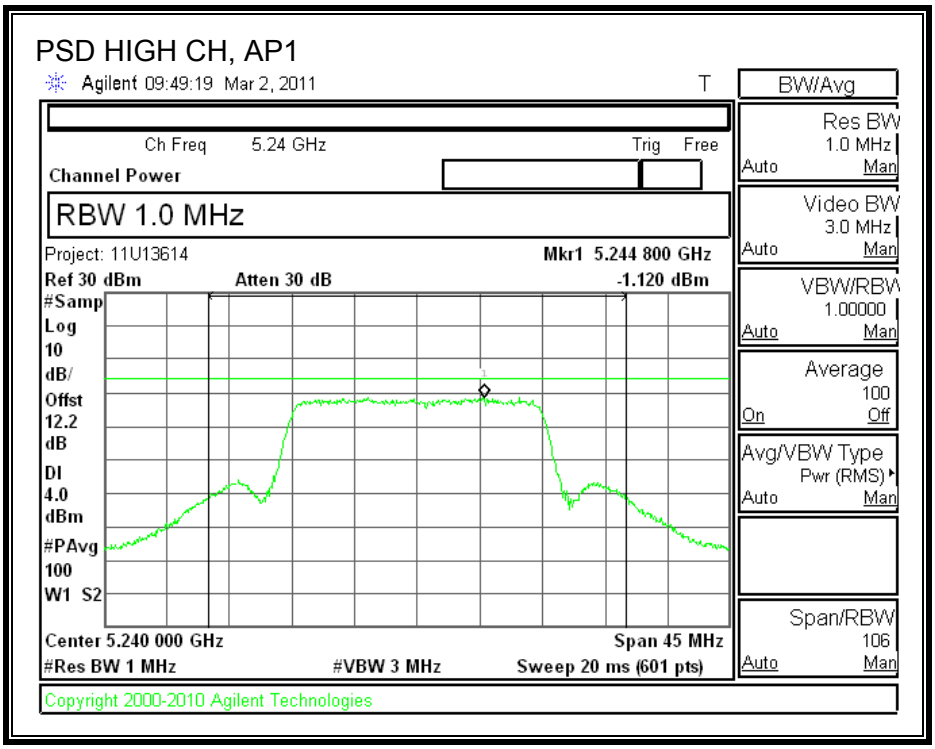
RESULTS

Channel	Frequency 80	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Chain 3 PPSD (dBm)	Combined PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-1.519	-1.009	-0.557	3.761	4.000	-0.239
Middle	5200	-1.295	-0.854	-1.362	3.607	4.000	-0.393
High	5240	-1.120	-1.140	-1.170	3.628	4.000	-0.372

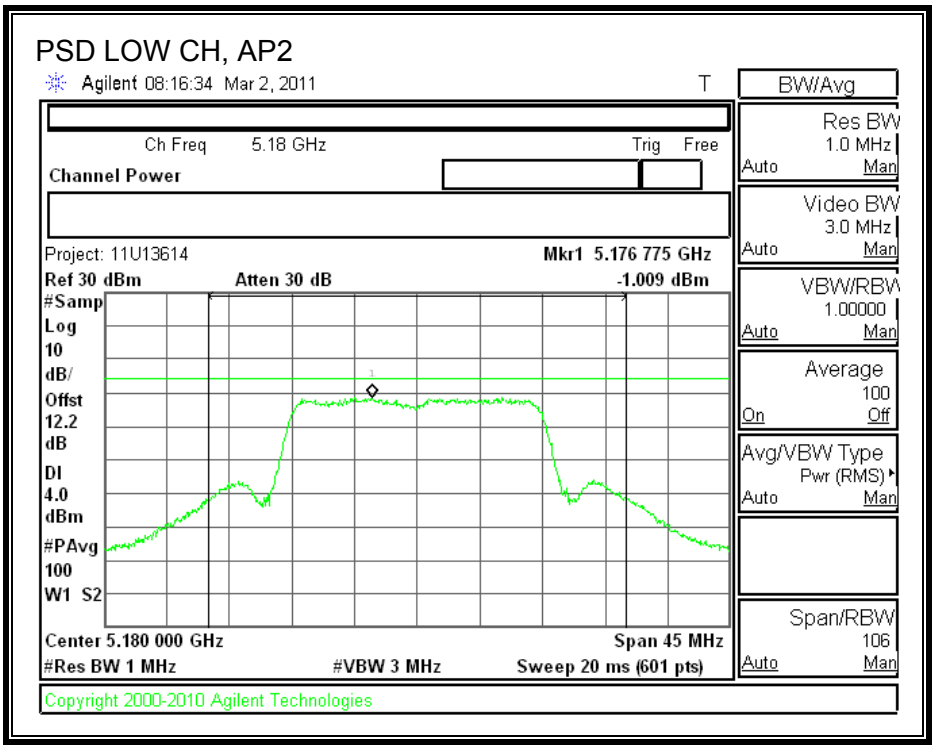
AP1 POWER SPECTRAL DENSITY

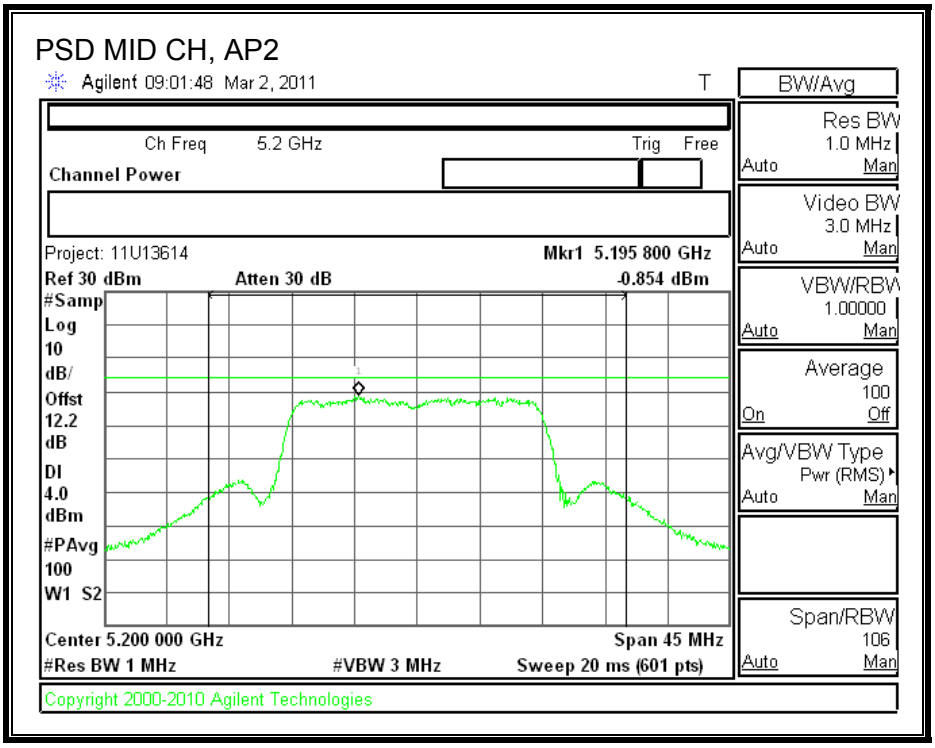


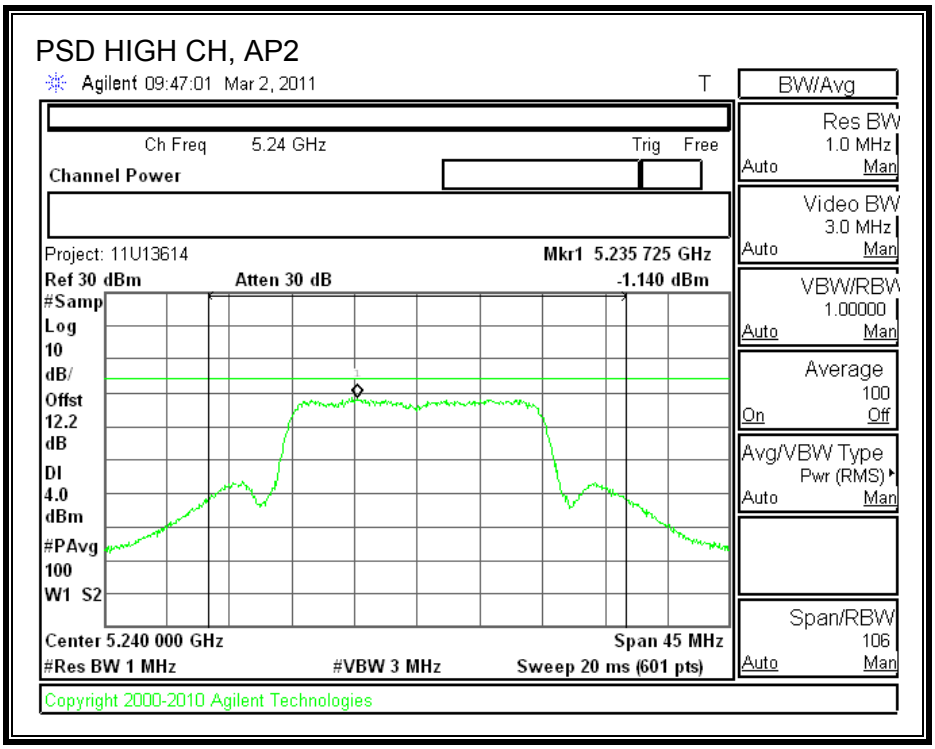




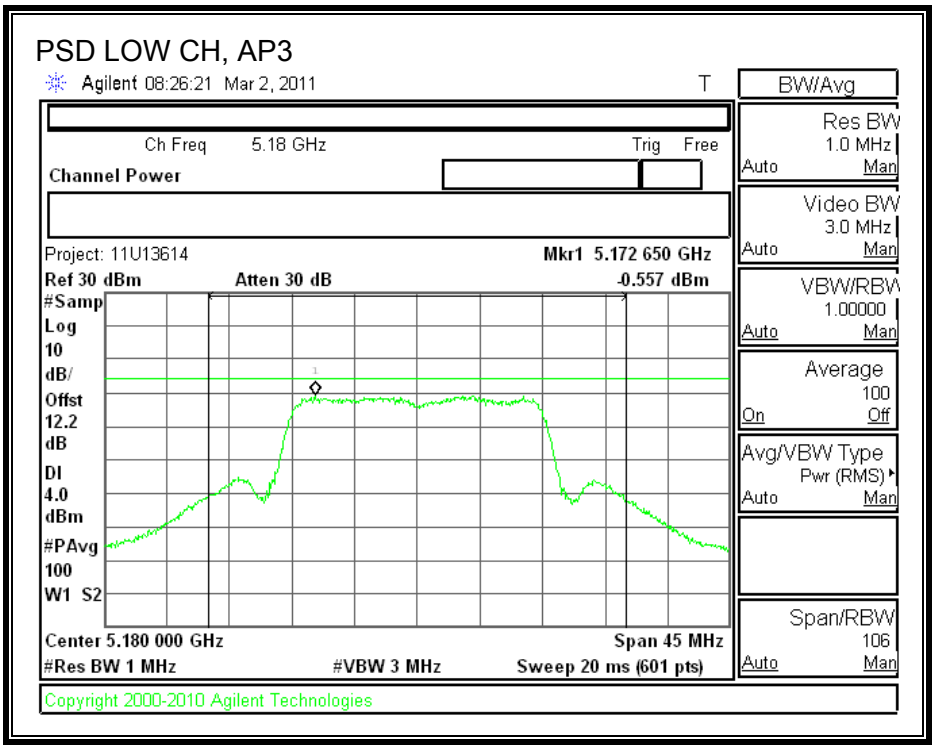
AP2 POWER SPECTRAL DENSITY

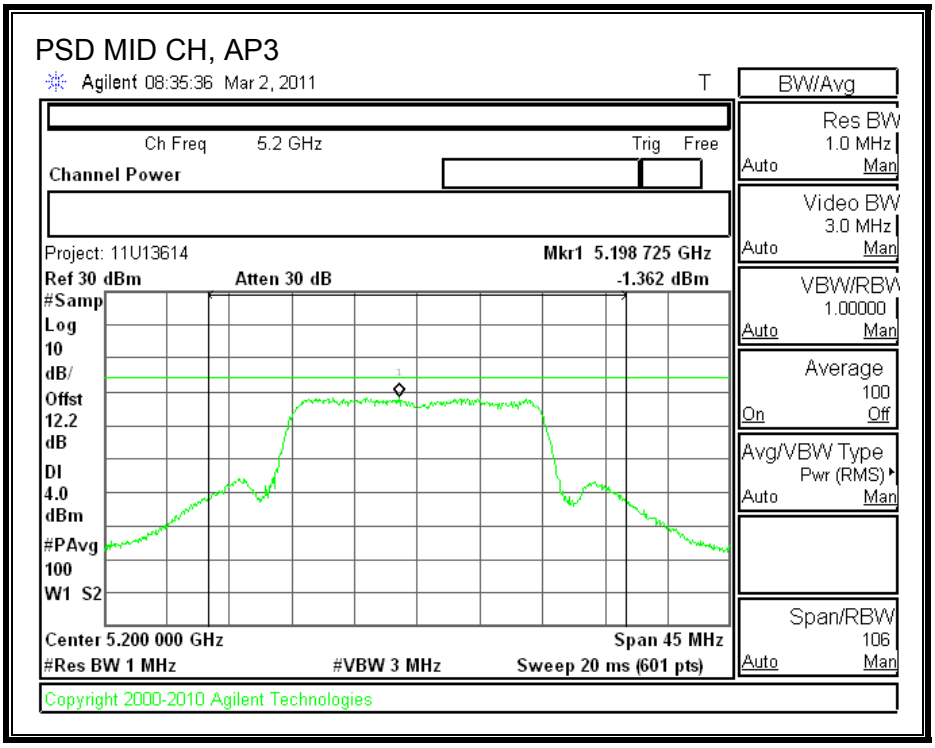


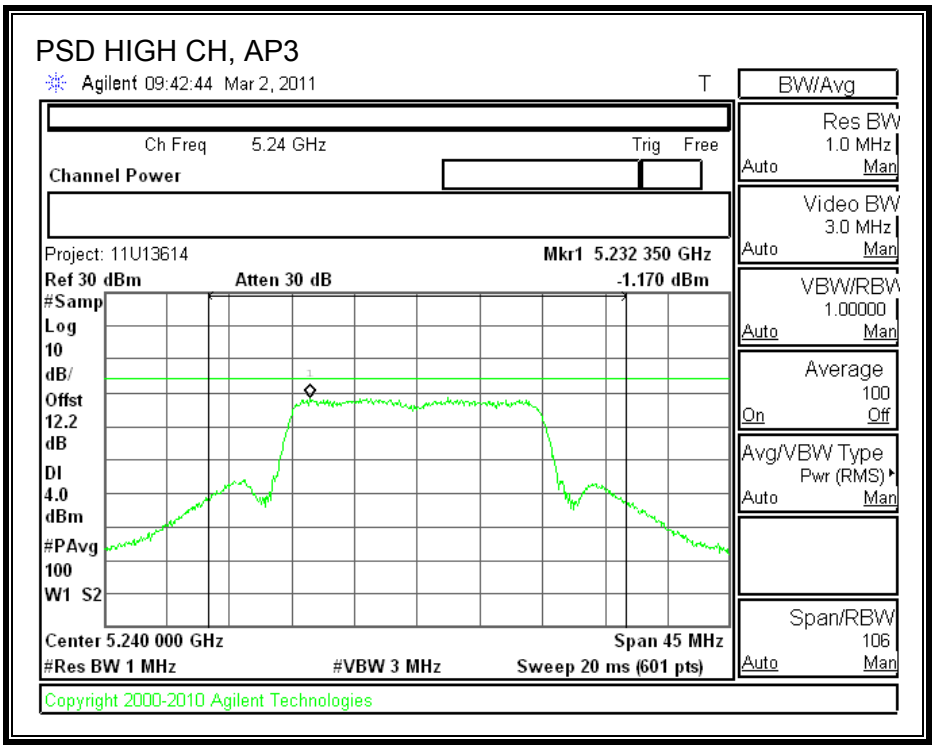




AP3 POWER SPECTRAL DENSITY







7.4.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.800	13	-4.20
Middle	5200	9.110	13	-3.89
High	5240	9.770	13	-3.23

AP2

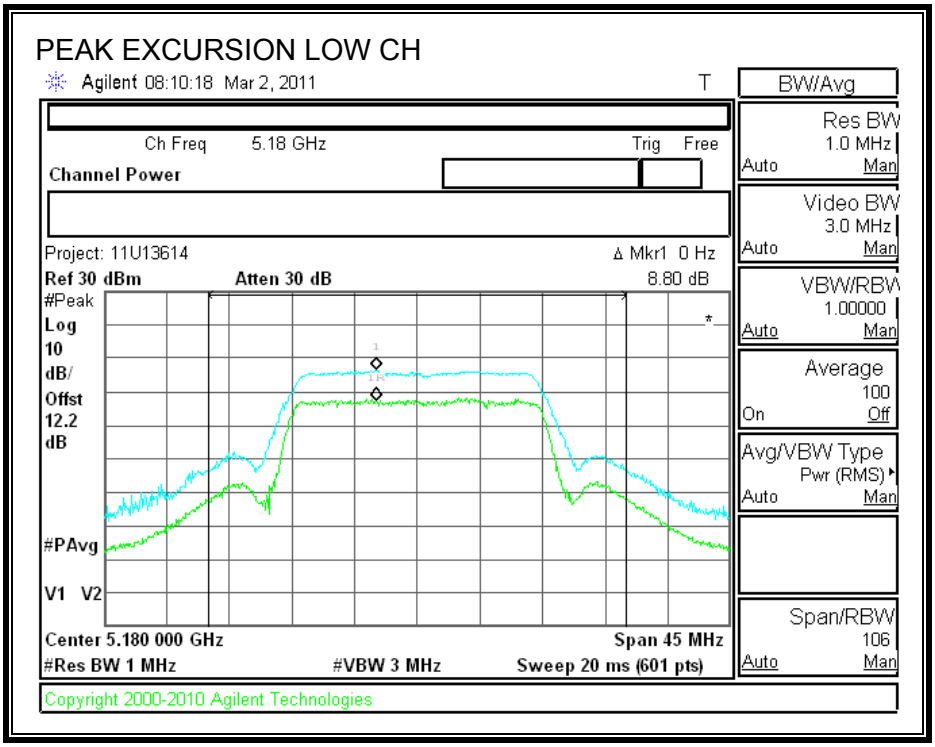
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.560	13	-3.44
Middle	5200	9.790	13	-3.21
High	5240	9.690	13	-3.31

AP3

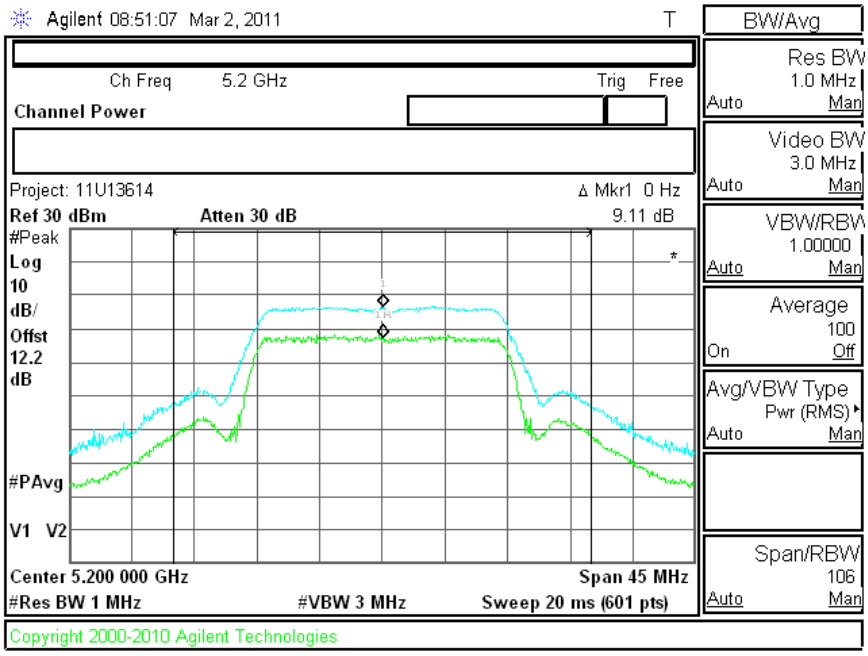
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	10.730	13	-2.27
Middle	5200	10.410	13	-2.59
High	5240	10.890	13	-2.11

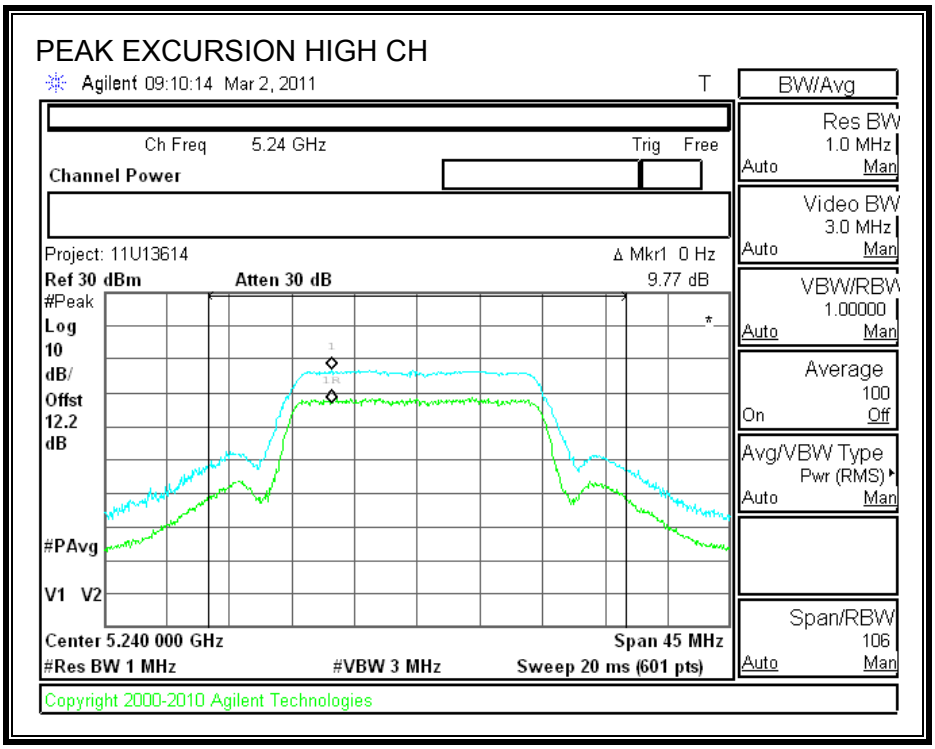
AP1

PEAK EXCURSION



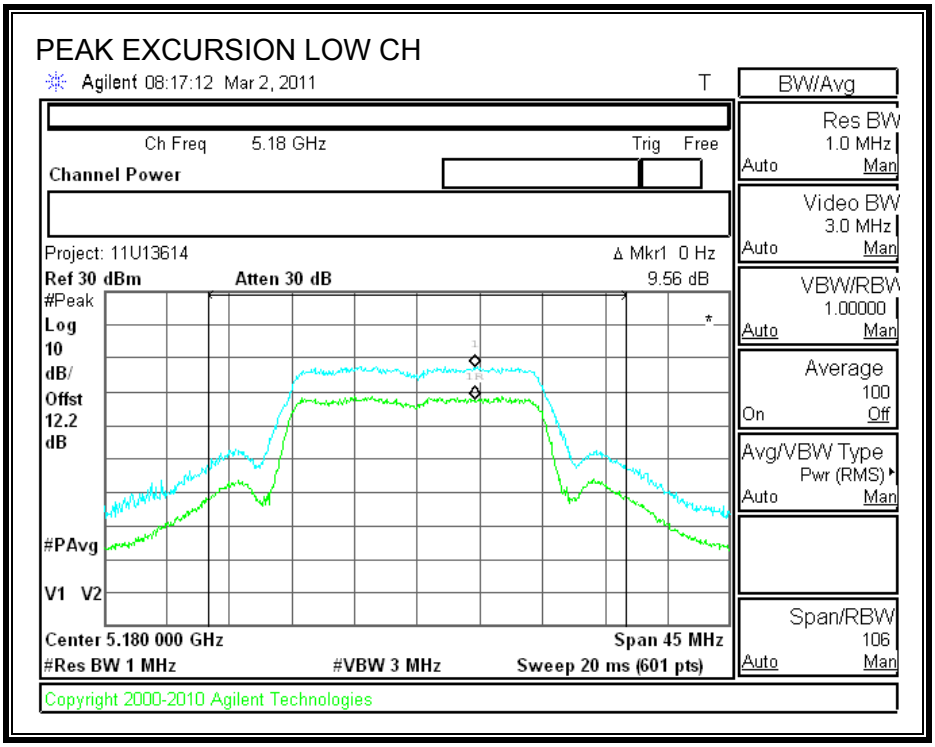
PEAK EXCURSION MID CH



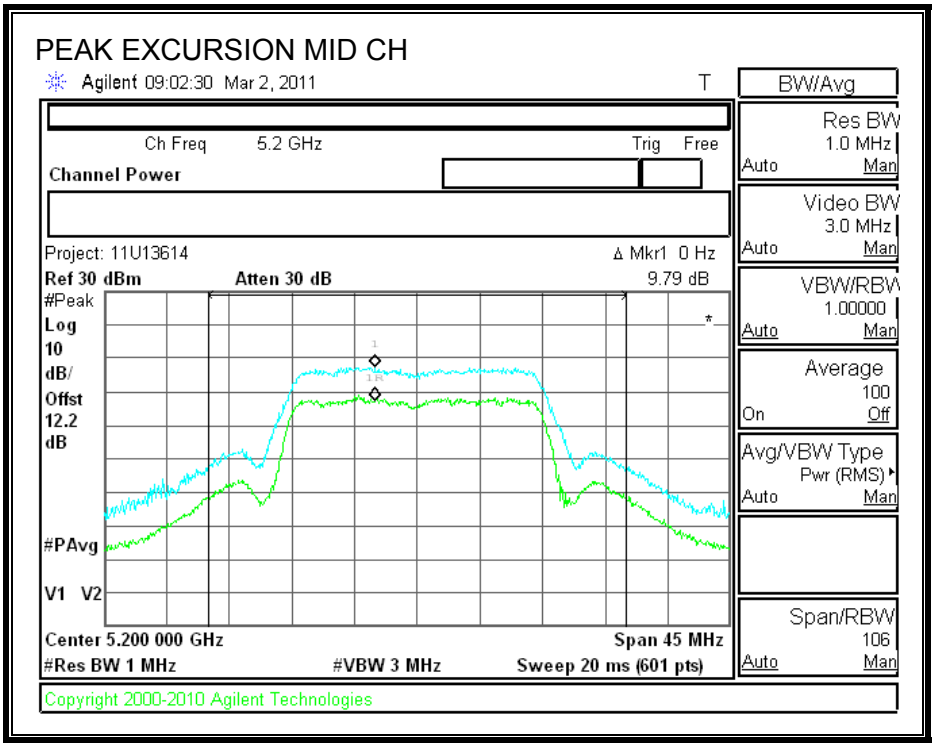


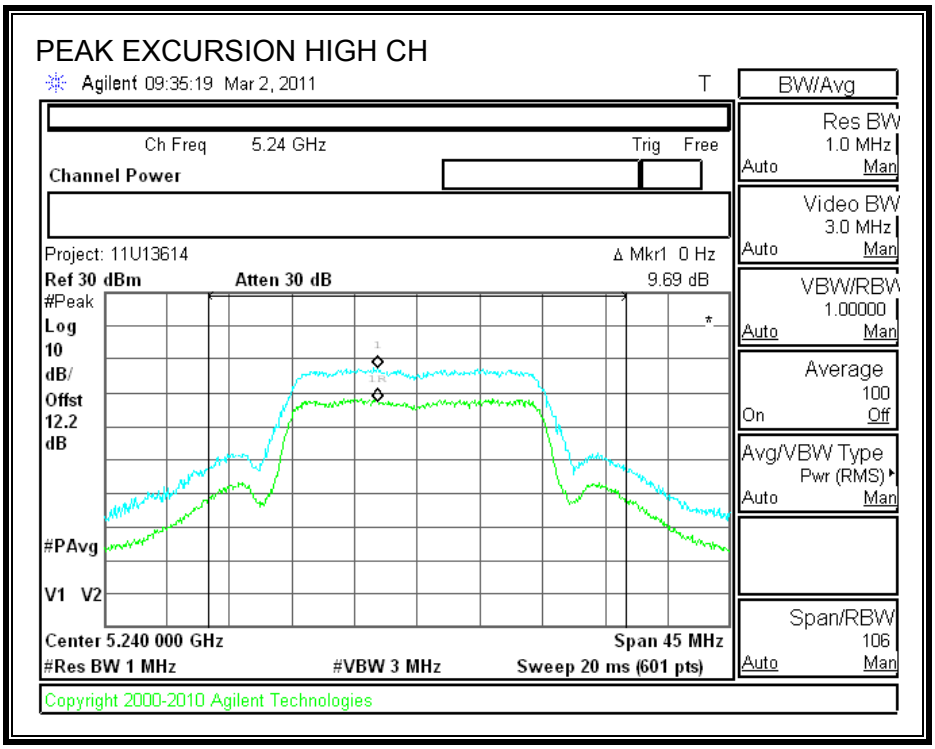
AP2

PEAK EXCURSION



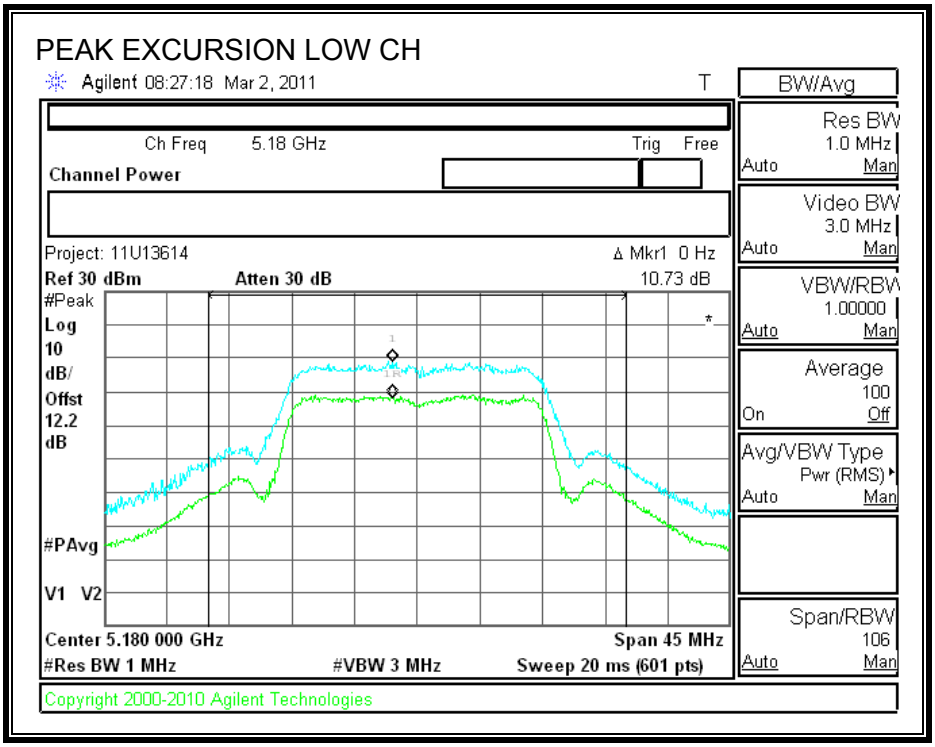
PEAK EXCURSION MID CH



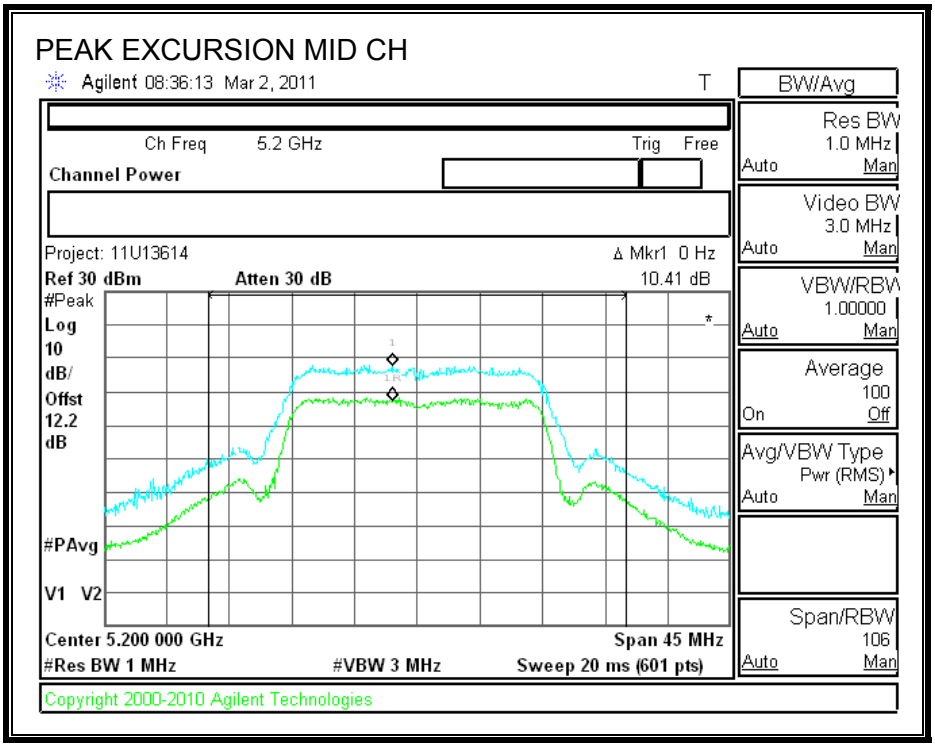


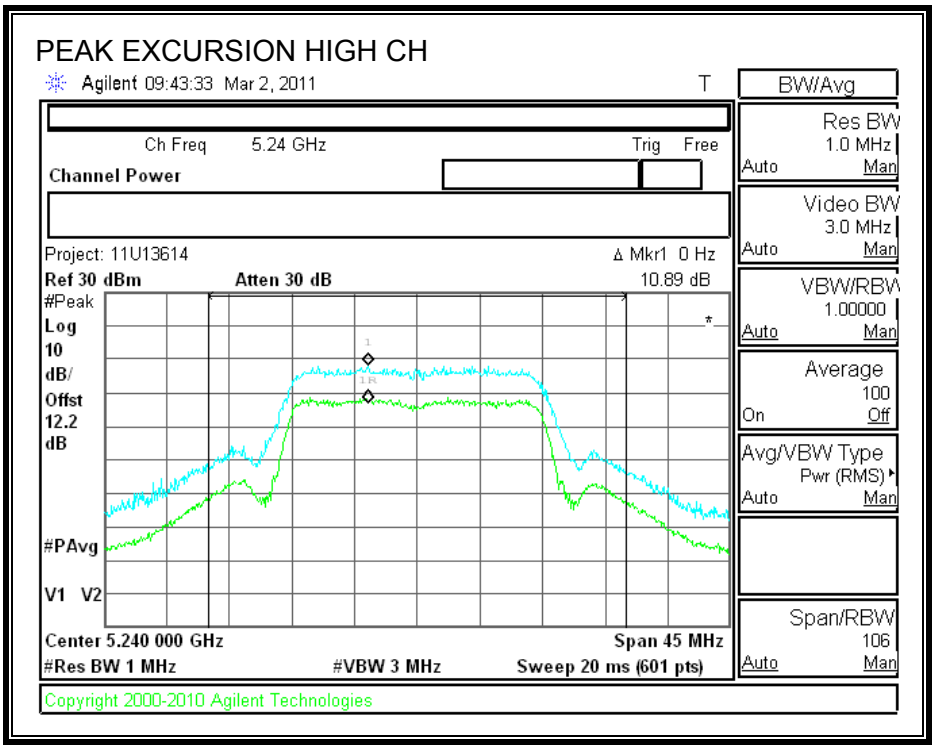
AP3

PEAK EXCURSION



PEAK EXCURSION MID CH





7.4.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.82	5.03	4.77	-28.02	-27.00
Middle	15.598	-39.65	5.03	4.77	-29.85	-27.00
High	15.738	-38.81	5.03	4.77	-29.01	-27.00

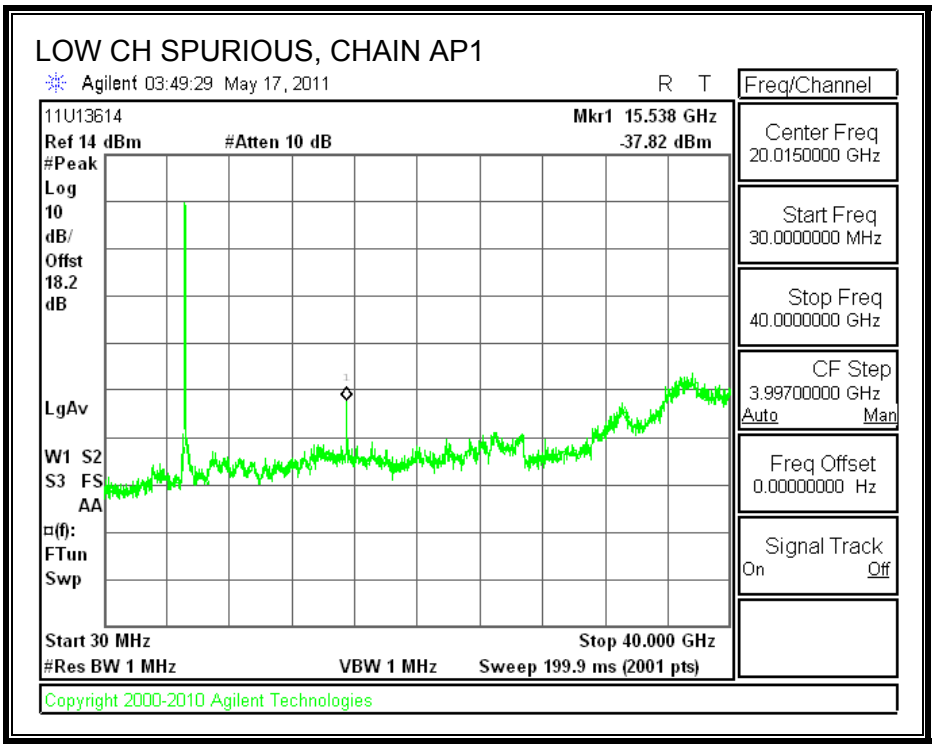
Chain AP2

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.01	2.50	4.77	-29.74	-27.00
Middle	15.598	-41.36	2.50	4.77	-34.09	-27.00
High	15.718	-39.94	2.50	4.77	-32.67	-27.00

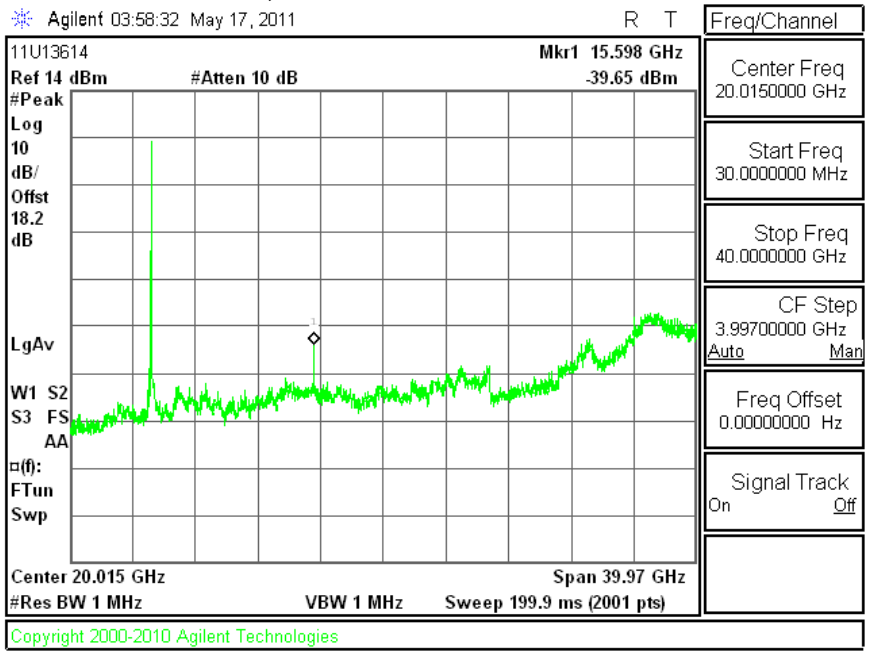
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-38.77	5.69	4.77	-28.31	-27.00
Middle	15.598	-40.23	5.69	4.77	-29.77	-27.00
High	15.718	-39.73	5.69	4.77	-29.27	-27.00

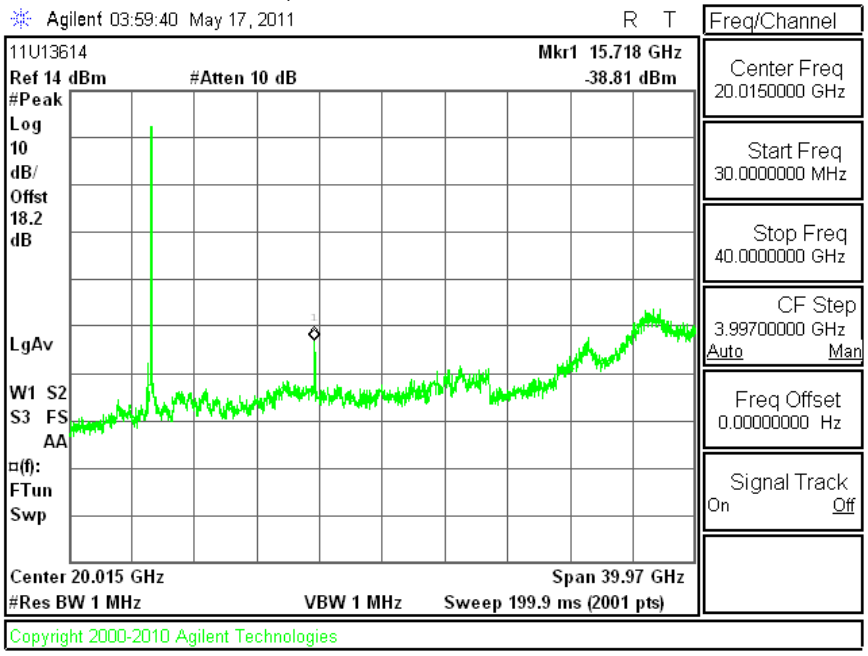
CHAIN AP1 SPURIOUS EMISSIONS



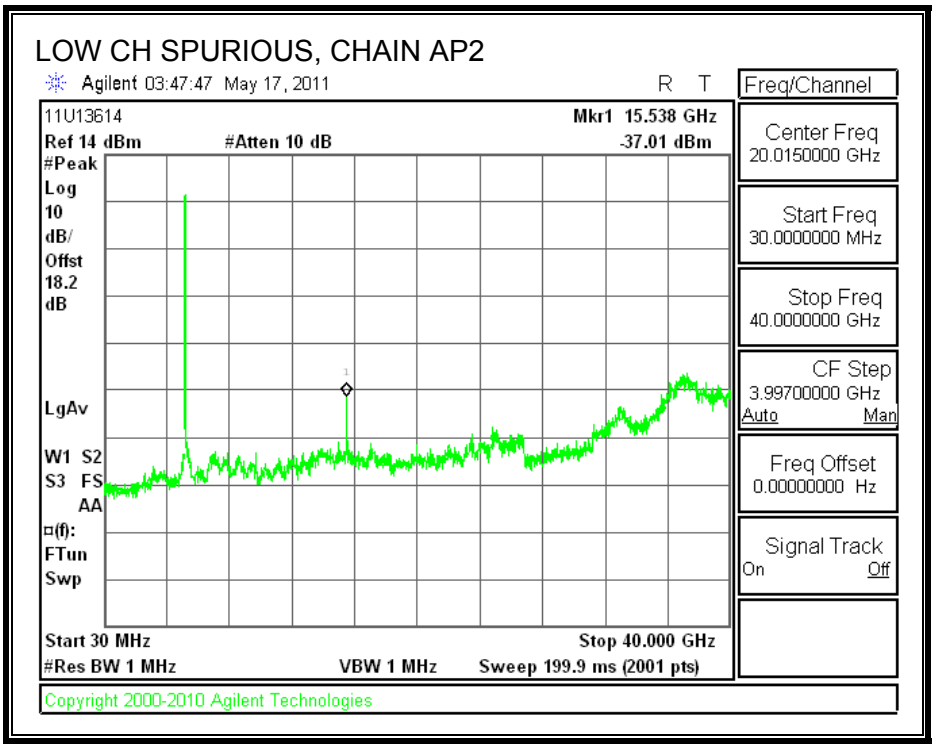
MID CH SPURIOUS, CHAIN AP1



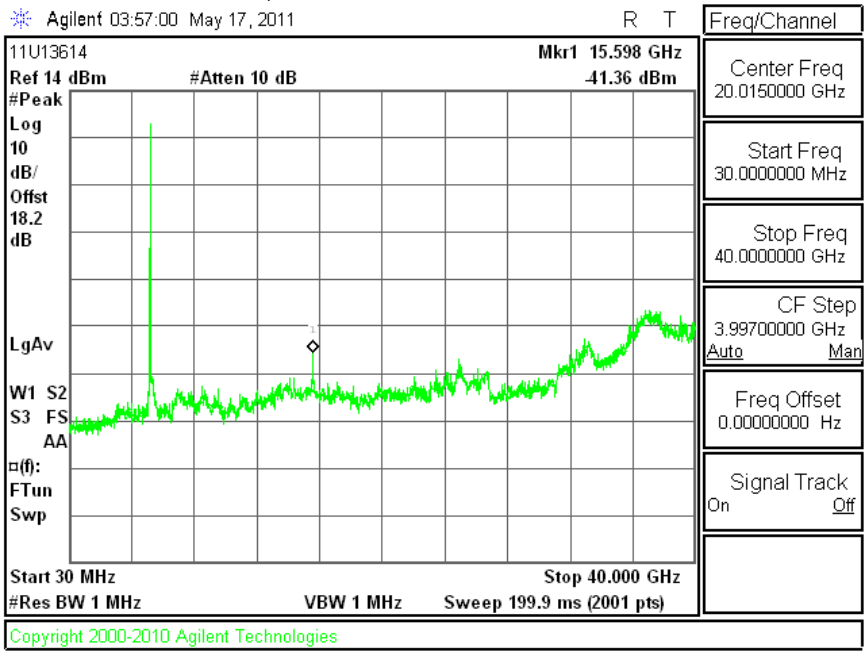
HIGH CH SPURIOUS, CHAIN AP1



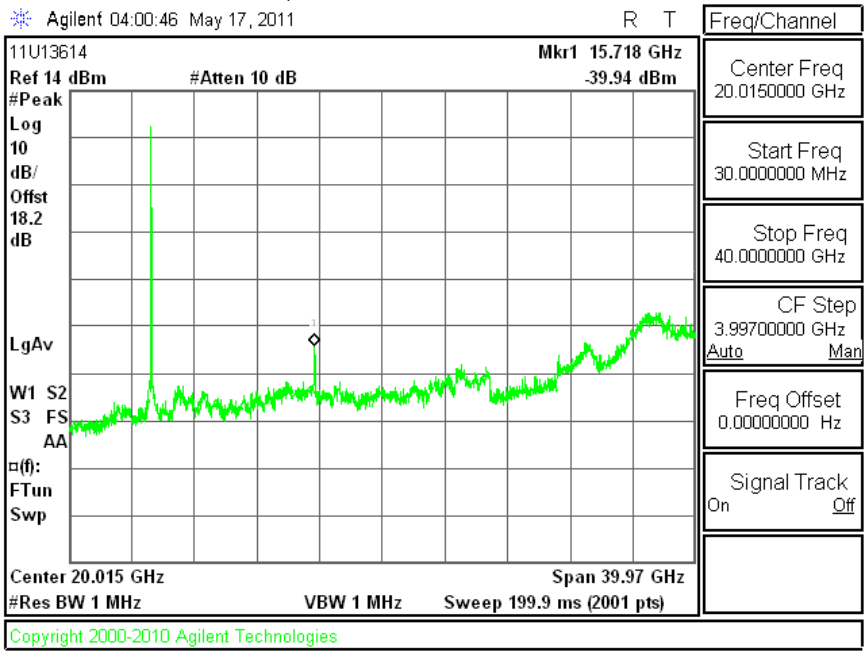
CHAIN AP2 SPURIOUS EMISSIONS



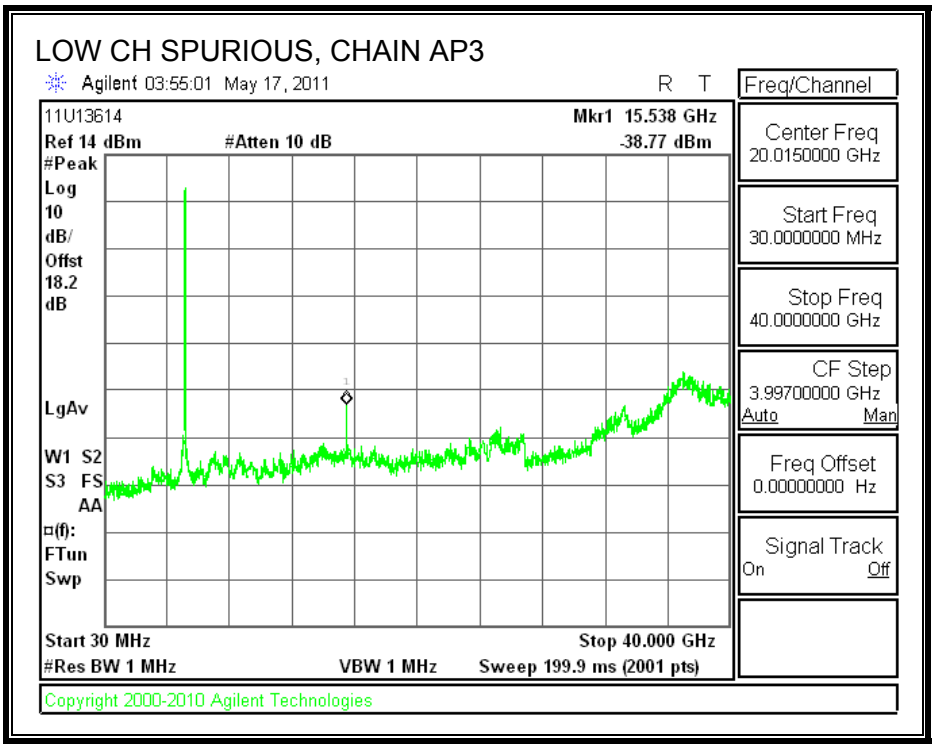
MID CH SPURIOUS, CHAIN AP2



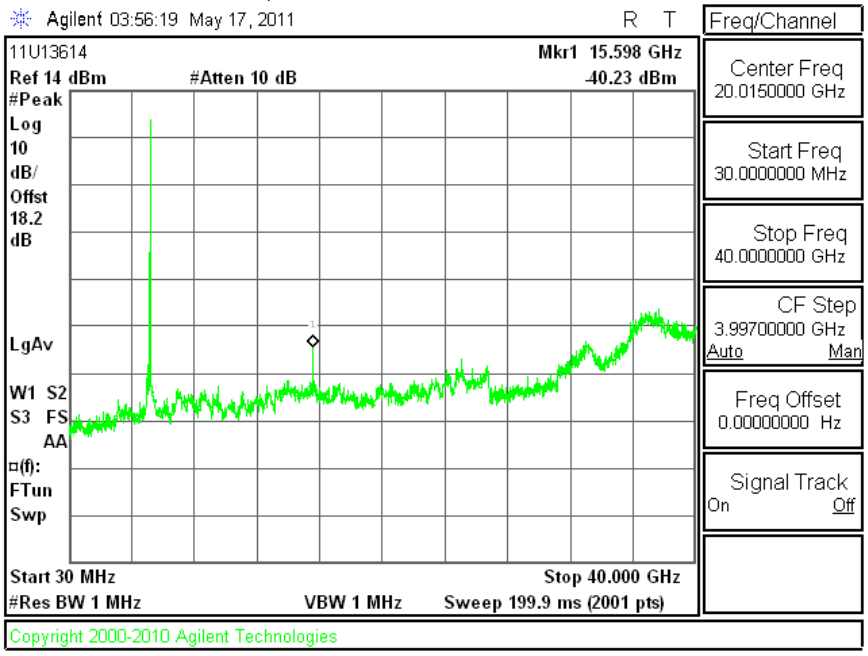
HIGH CH SPURIOUS, CHAIN AP2



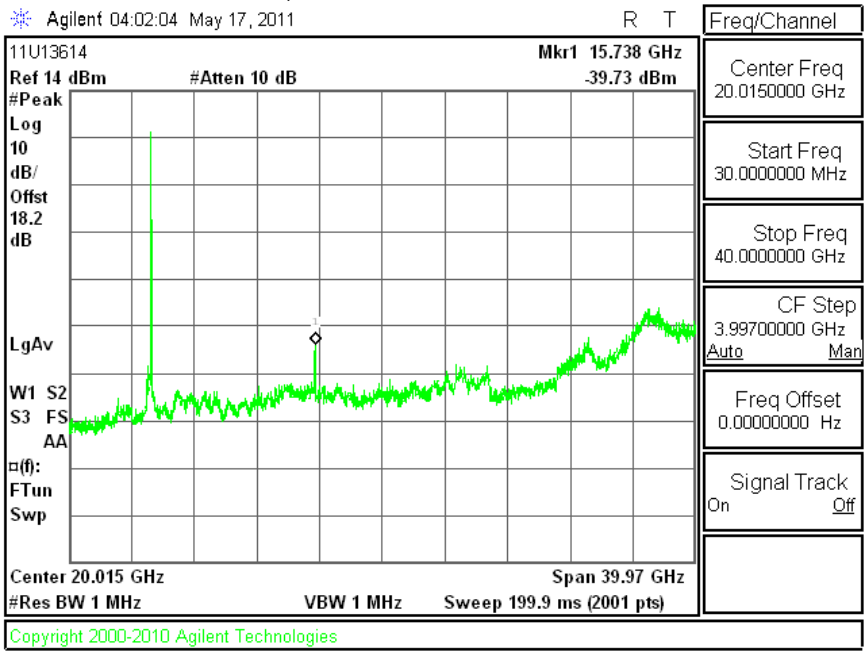
CHAIN AP3 SPURIOUS EMISSIONS



MID CH SPURIOUS, CHAIN AP3



HIGH CH SPURIOUS, CHAIN AP3



7.5. 802.11n TWO CHAINS HT40 MODE IN THE 5.2 GHz BAND

7.5.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

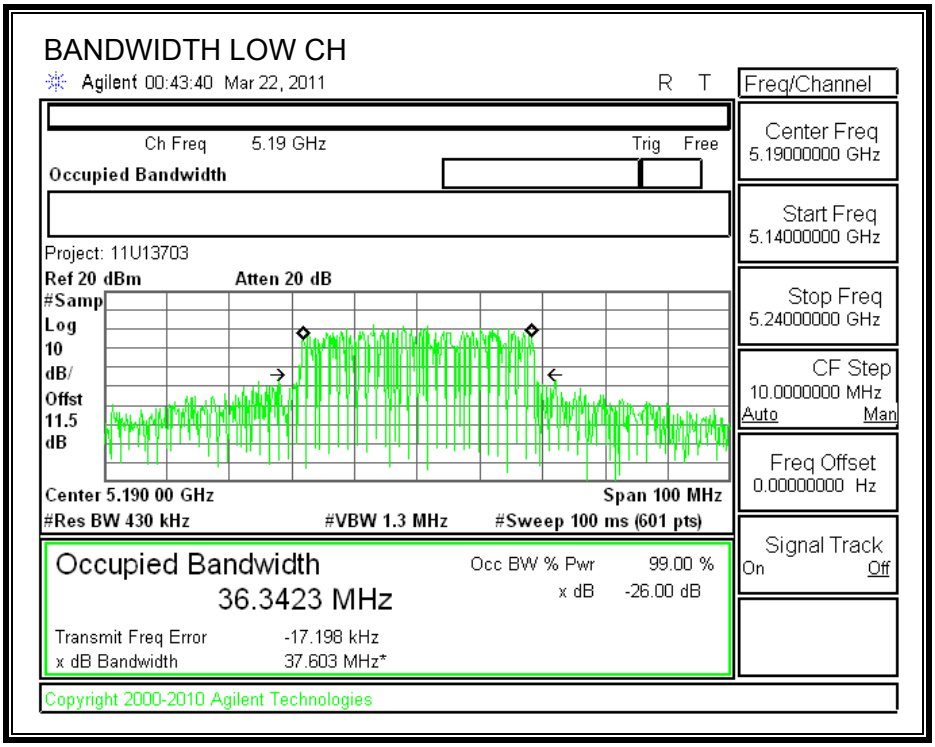
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	37.603	36.3423
High	5230	37.896	36.0782

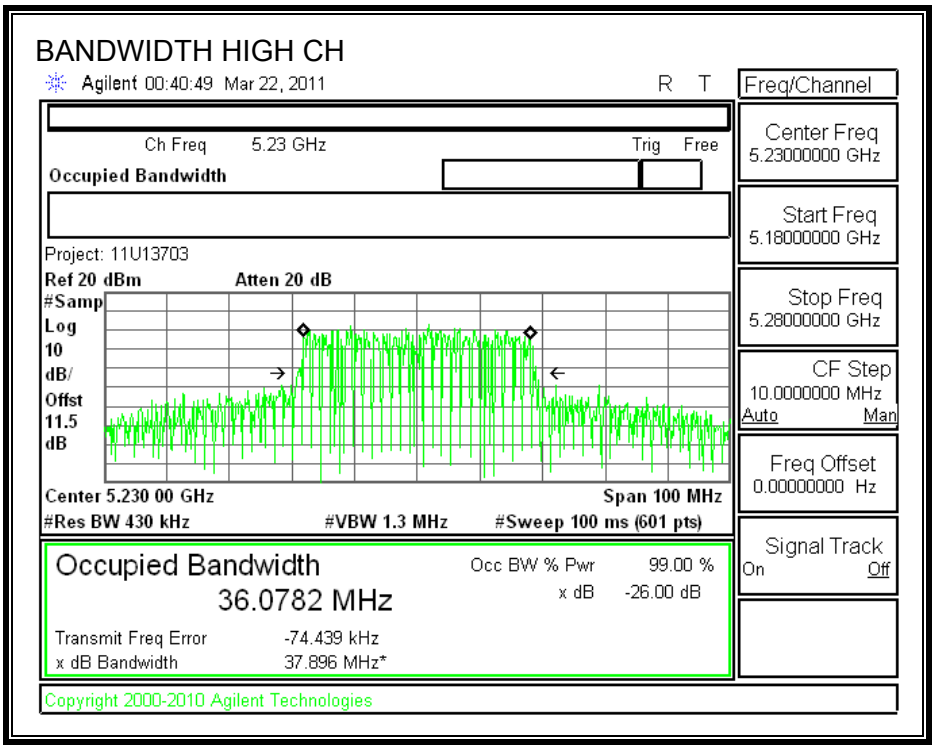
AP3

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	37.736	36.1768
High	5230	37.922	36.2925

AP1

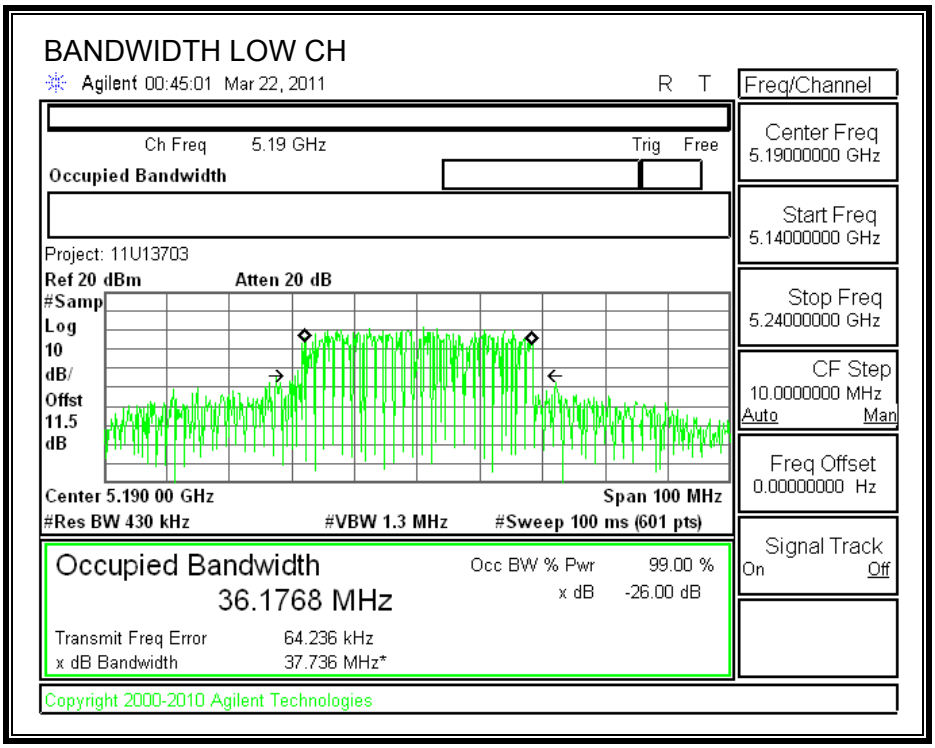
26 dB and 99% BANDWIDTH

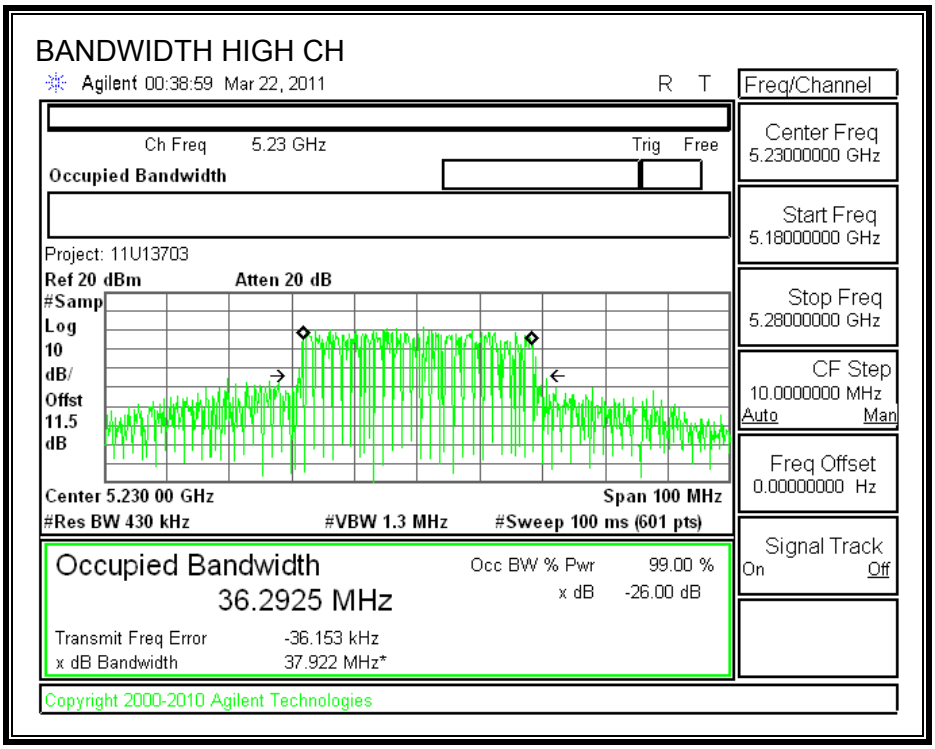




AP3

26 dB and 99% BANDWIDTH





7.5.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

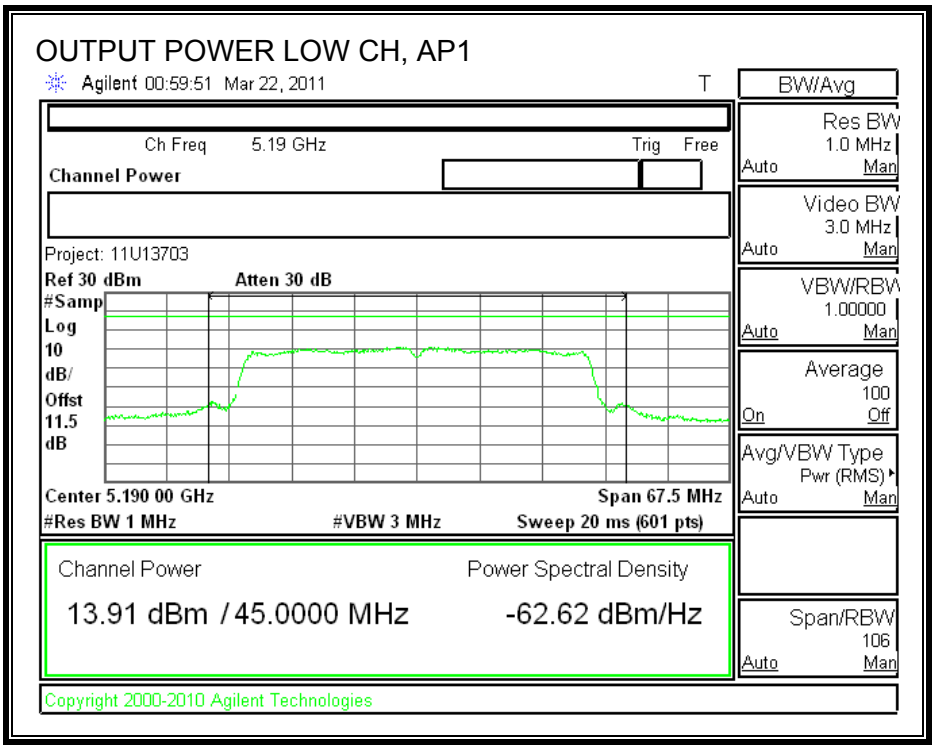
Limit

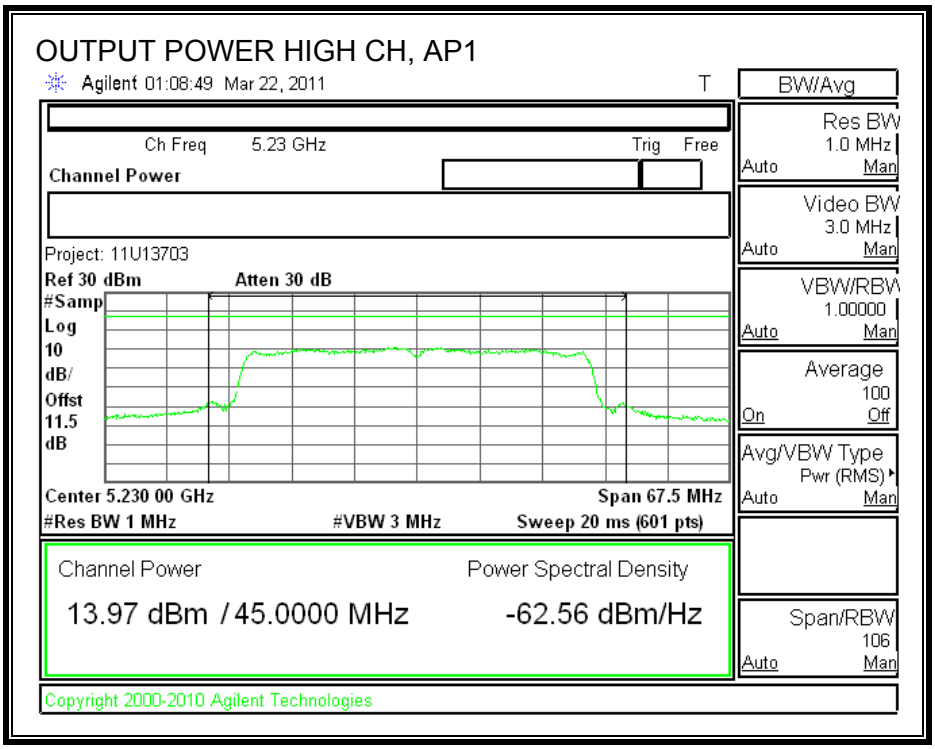
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17.00	37.603	19.75	5.69	17.00
High	5230	17.00	37.896	19.79	5.69	17.00

Individual Chain Results

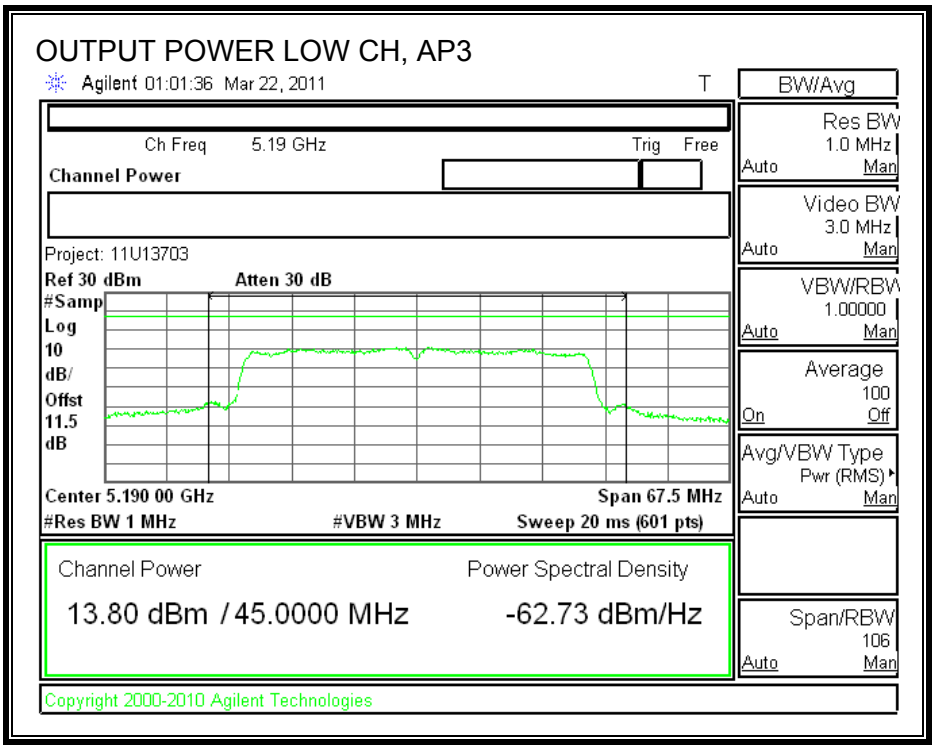
Channel	Frequency (MHz)	AP1 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	13.91	13.80	16.87	17.00	-0.13
High	5230	13.97	13.73	16.86	17.00	-0.14

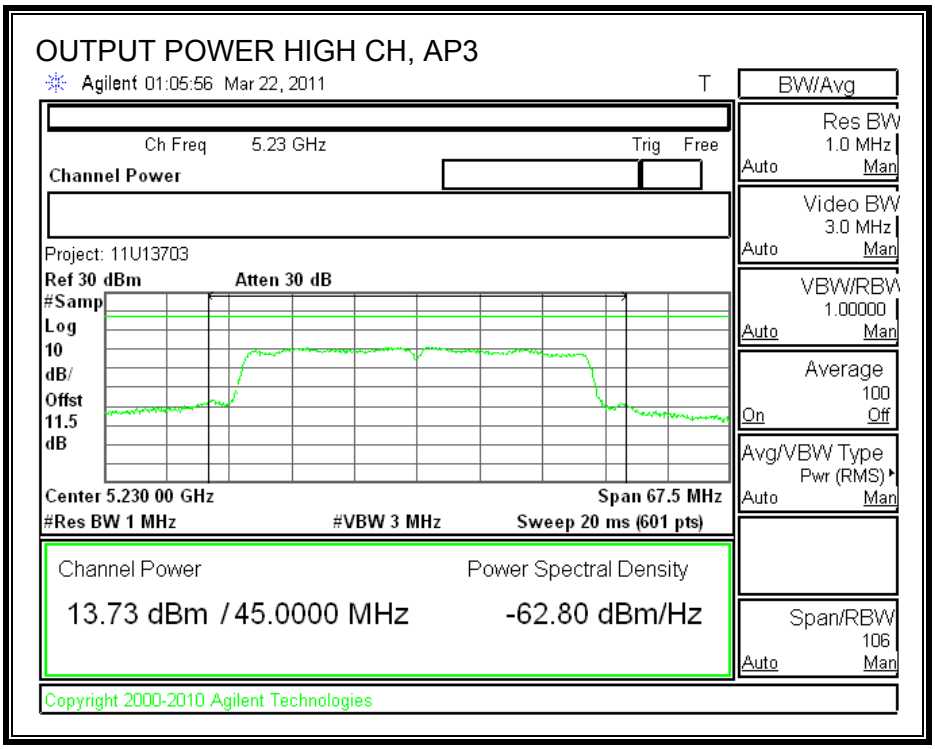
AP1 OUTPUT POWER





AP3 OUTPUT POWER





7.5.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

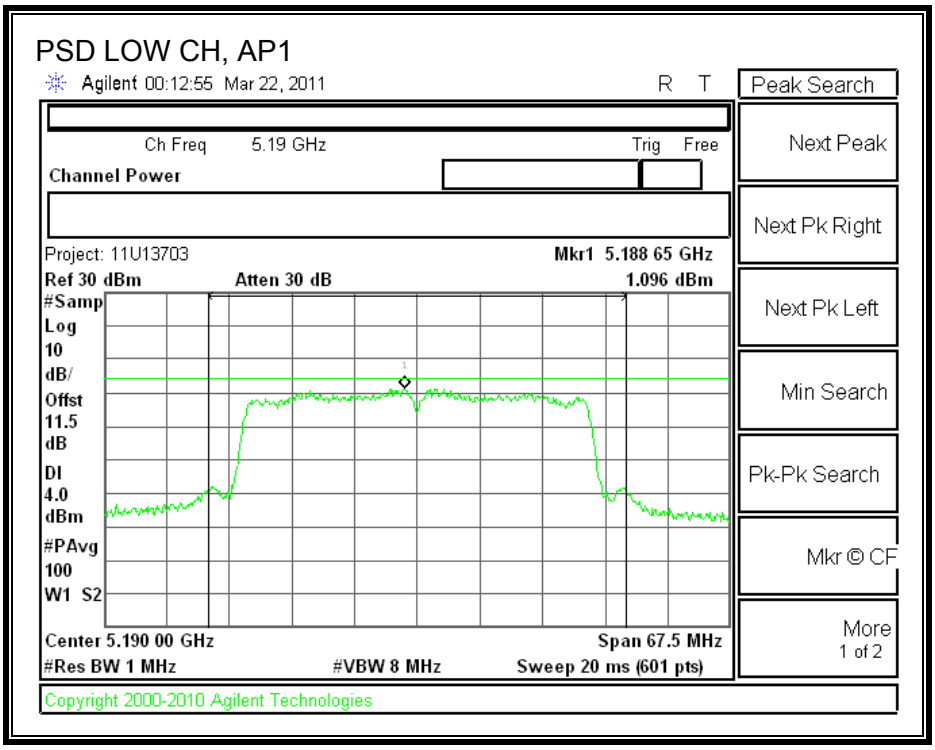
TEST PROCEDURE

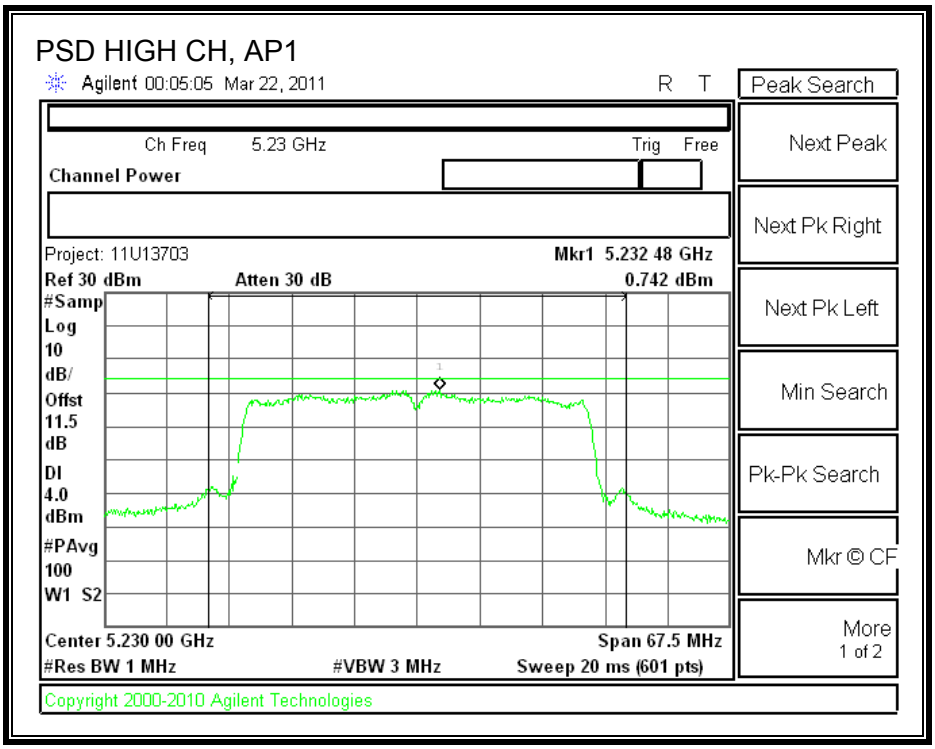
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #1 was used.

RESULTS

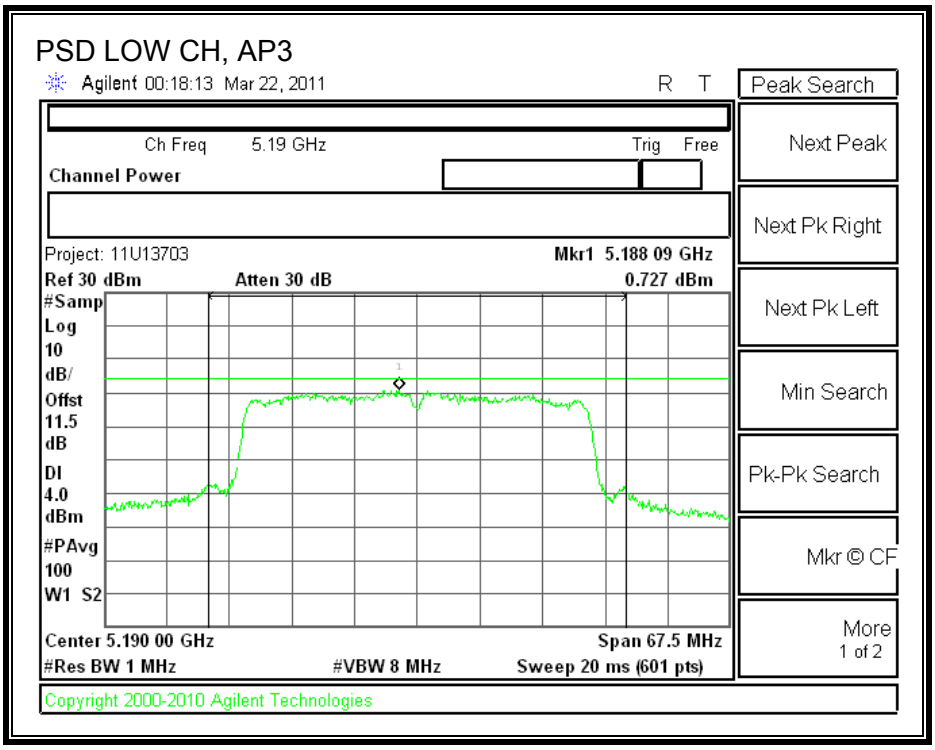
Channel	Frequency 80	Chain 1 PPSD (dBm)	Chain 3 PPSD (dBm)	Combined PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5190	1.096	0.727	3.926	4.000	-0.074
High	5230	0.742	1.074	3.921	4.000	-0.079

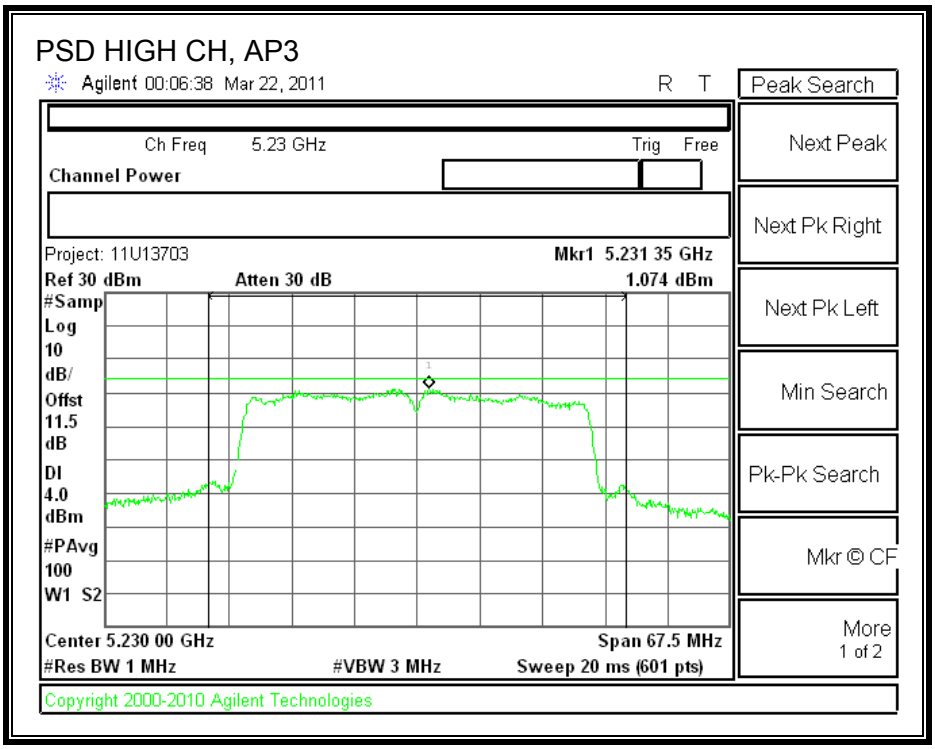
AP1 POWER SPECTRAL DENSITY





AP3 POWER SPECTRAL DENSITY





7.5.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

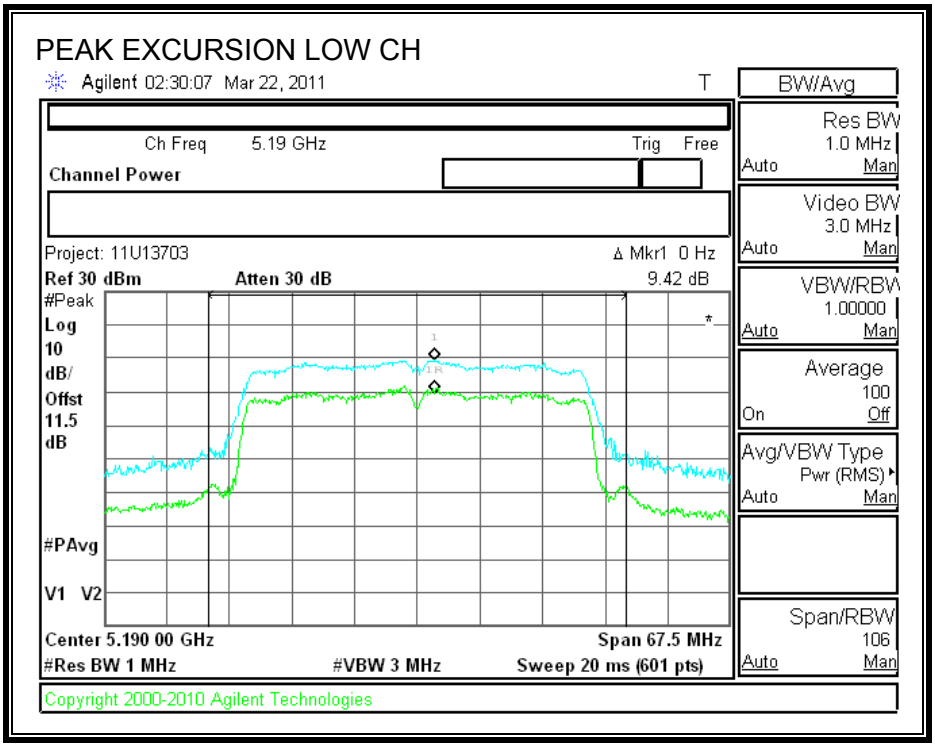
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	9.42	13	-3.58
High	5230	8.73	13	-4.27

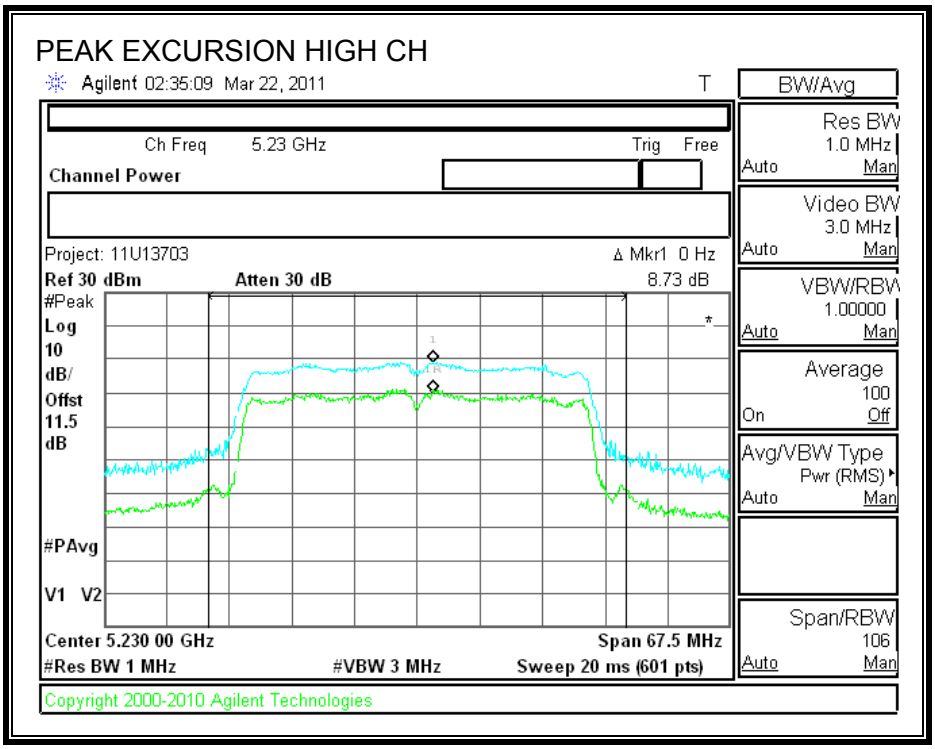
AP3

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	11.16	13	-1.84
High	5230	11.07	13	-1.93

AP1

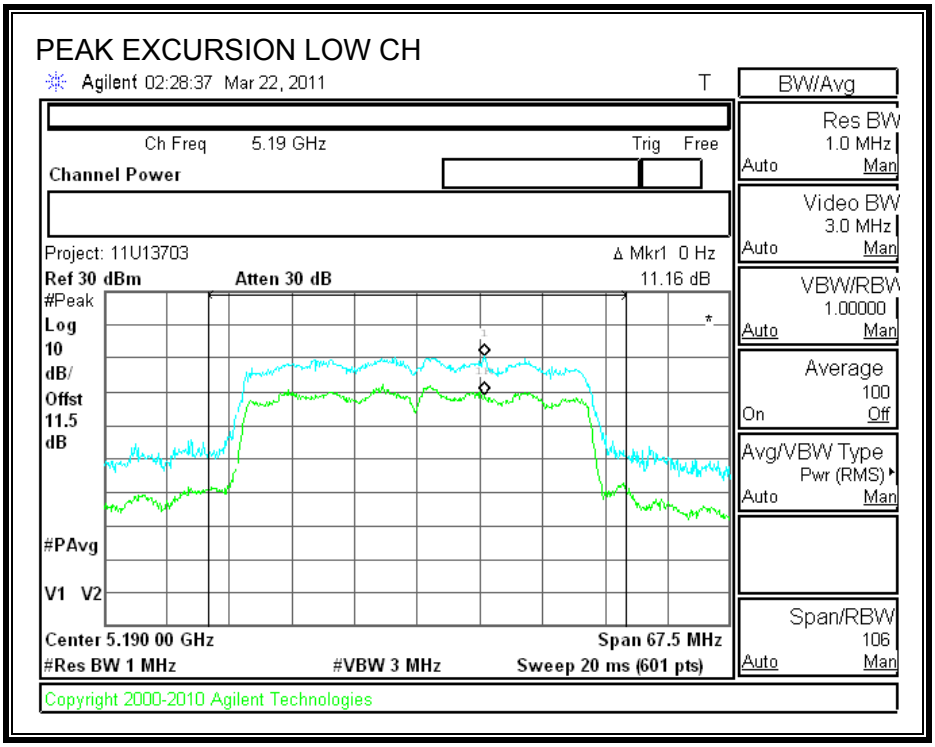
PEAK EXCURSION

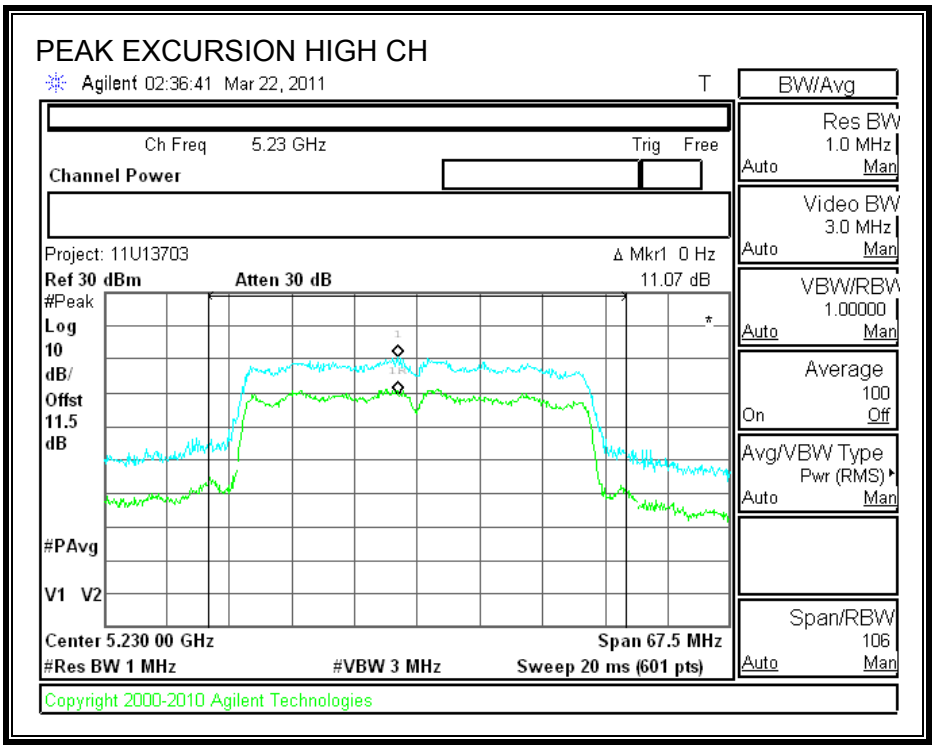




AP3

PEAK EXCURSION





7.5.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

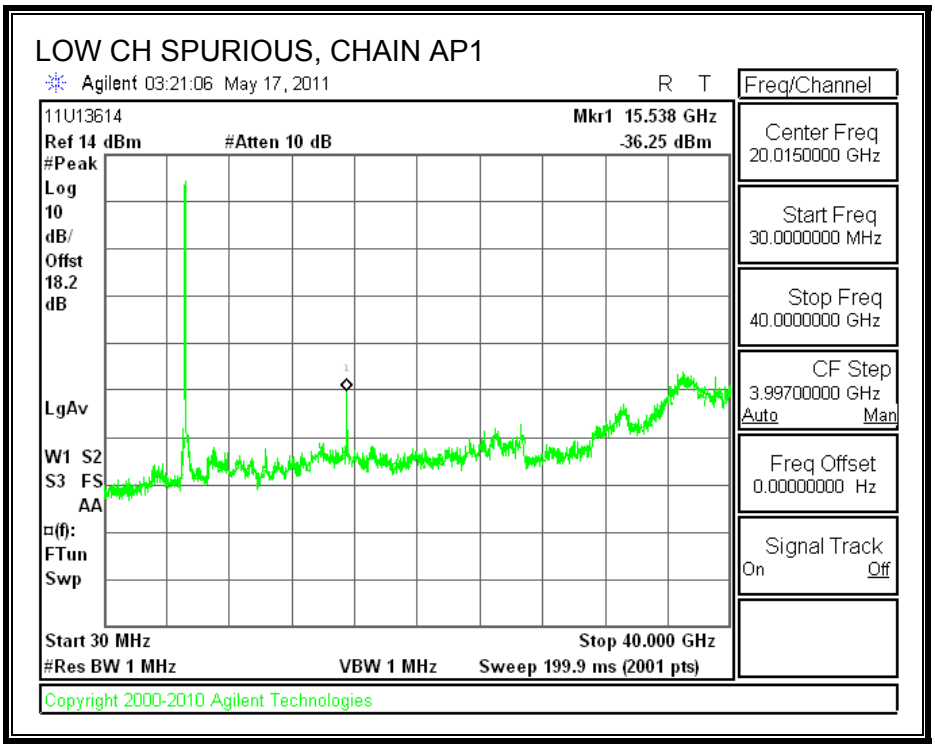
Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-36.25	5.03	3.01	-28.21	-27.00
High	15.718	-37.14	5.03	3.01	-29.10	-27.00

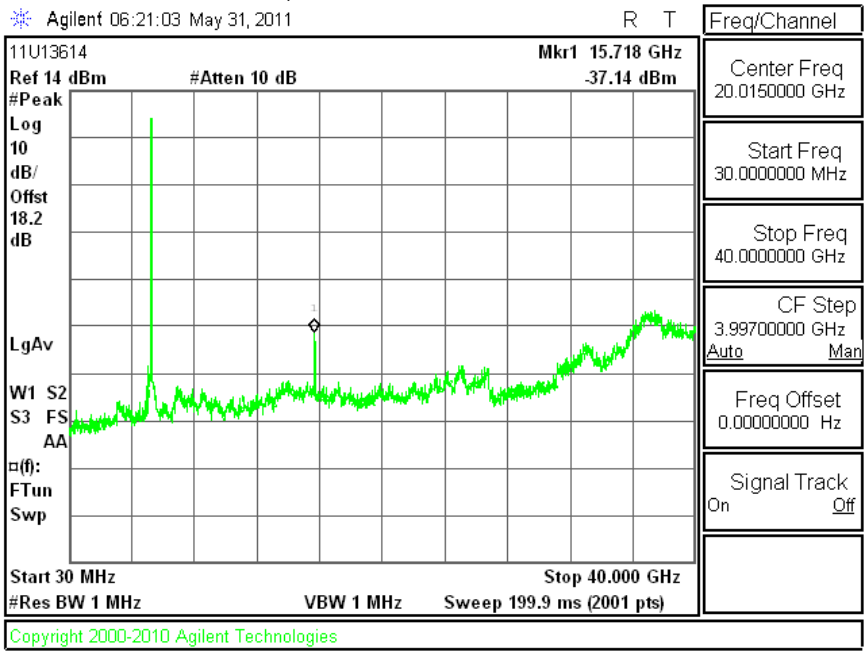
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-37.52	5.69	3.01	-28.82	-27.00
High	15.738	-36.78	5.69	3.01	-28.08	-27.00

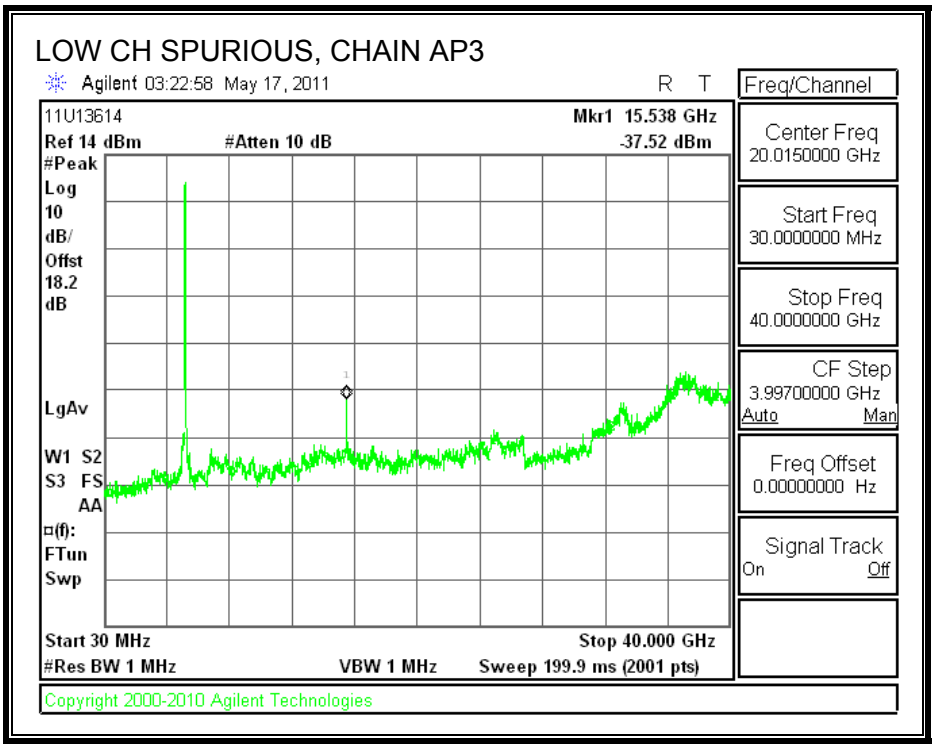
CHAIN AP1 SPURIOUS EMISSIONS



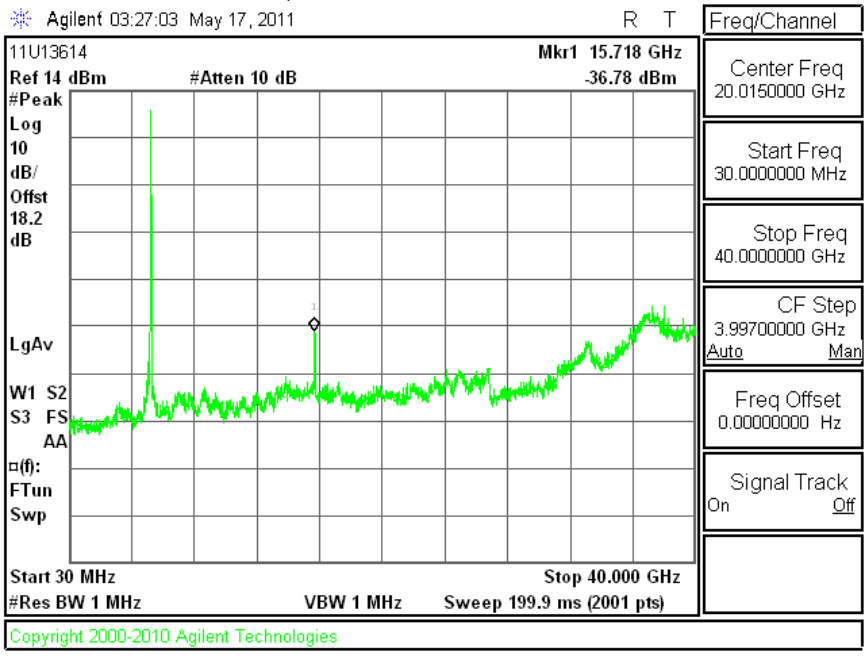
HIGH CH SPURIOUS, CHAIN AP1



CHAIN AP3 SPURIOUS EMISSIONS



HIGH CH SPURIOUS, CHAIN AP3



7.6. 802.11n THREE CHAINS HT40 MODE IN THE 5.2 GHz BAND

7.6.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

AP1

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	37.885	36.1170
High	5230	38.083	36.1500

AP2

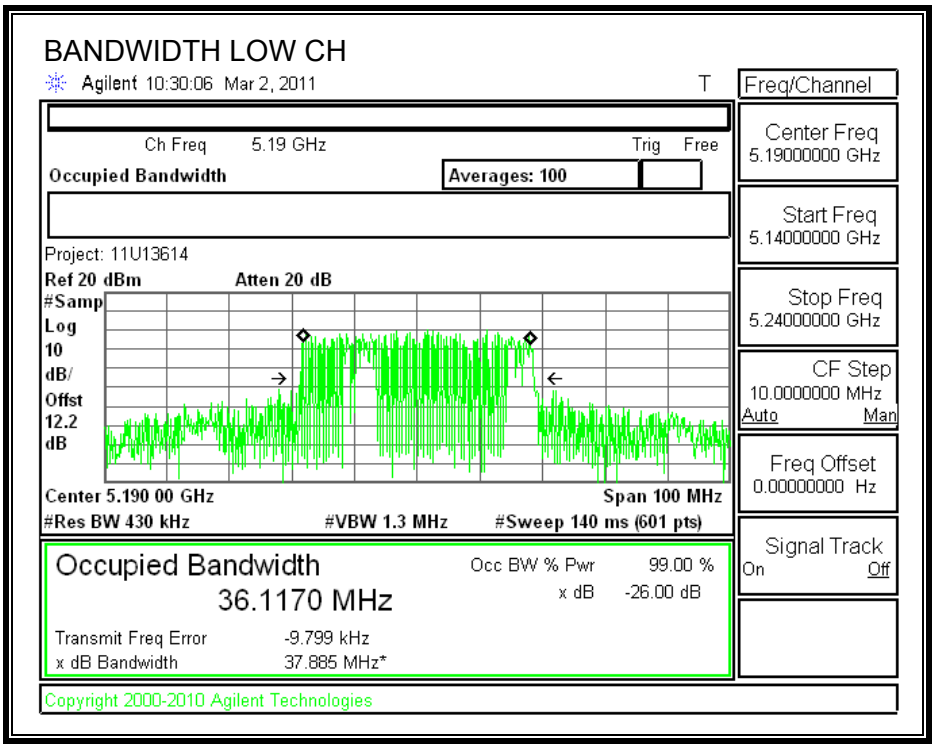
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	37.900	36.1195
High	5230	38.012	36.1428

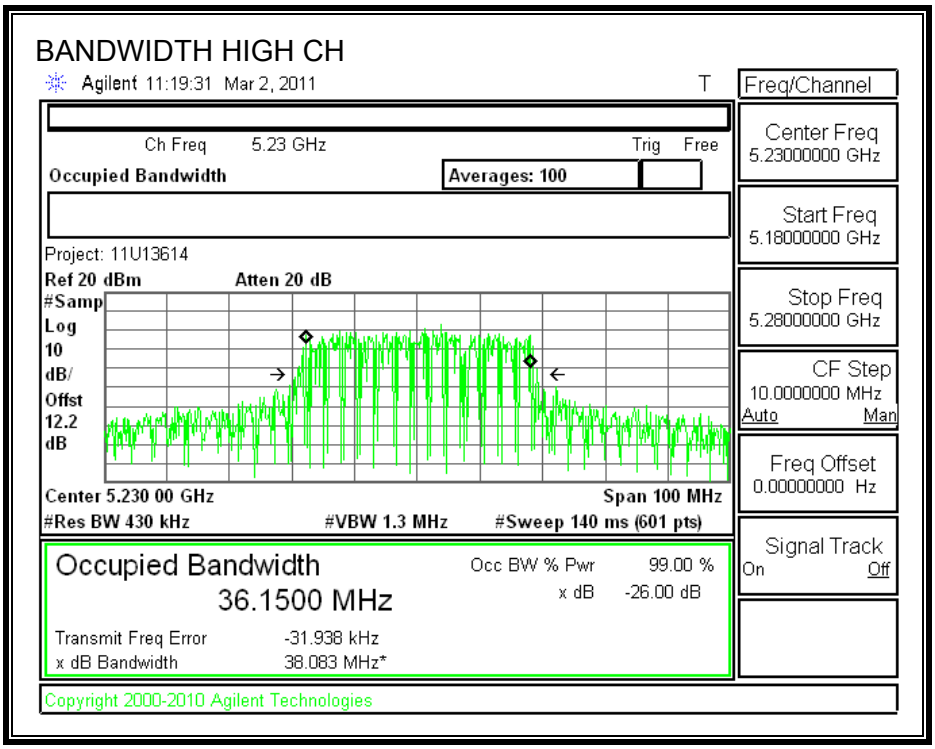
AP3

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	37.862	36.1005
High	5230	37.871	36.1380

AP1

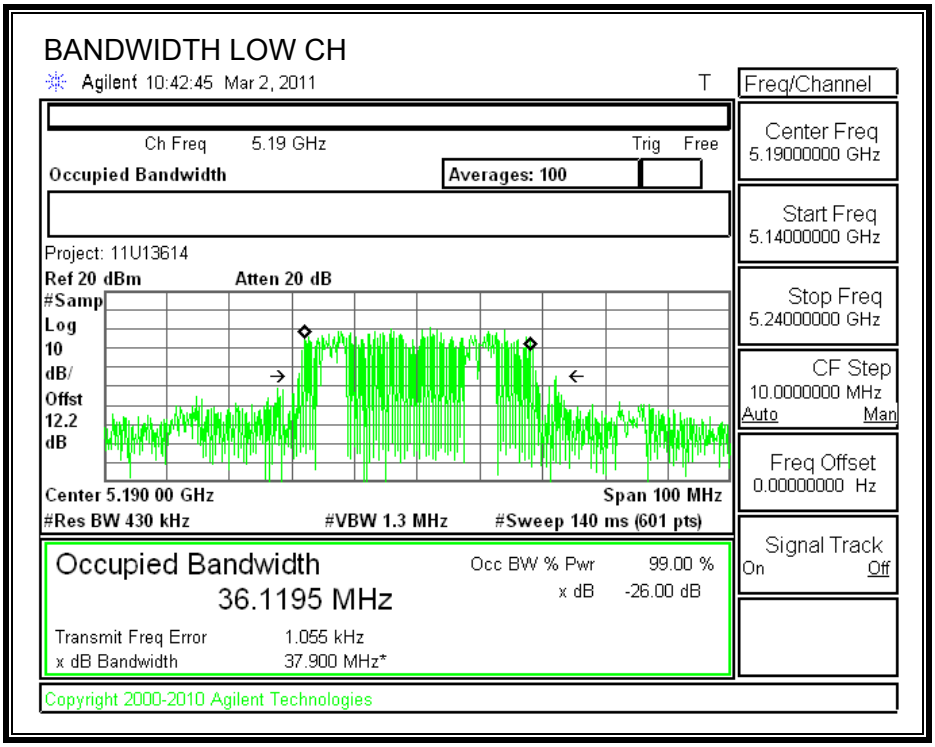
26 dB and 99% BANDWIDTH

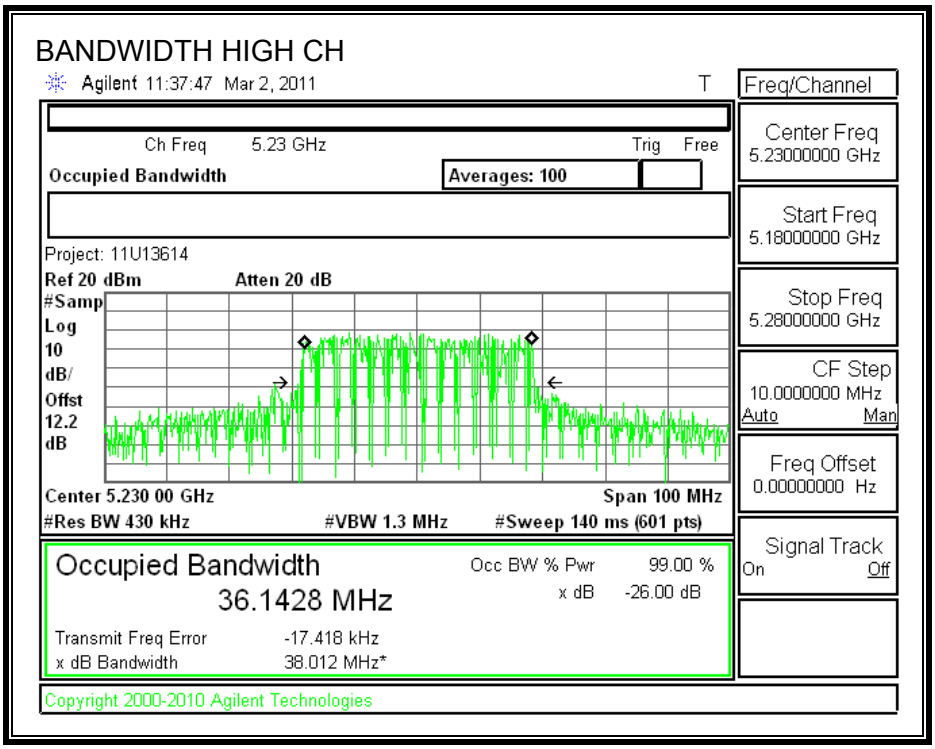




AP2

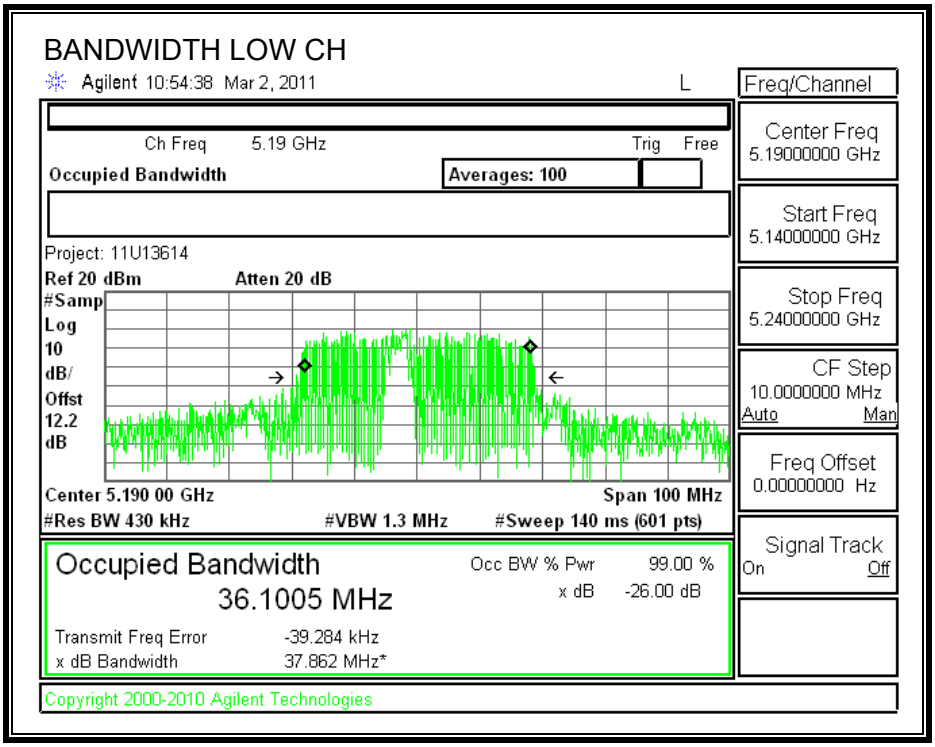
26 dB and 99% BANDWIDTH

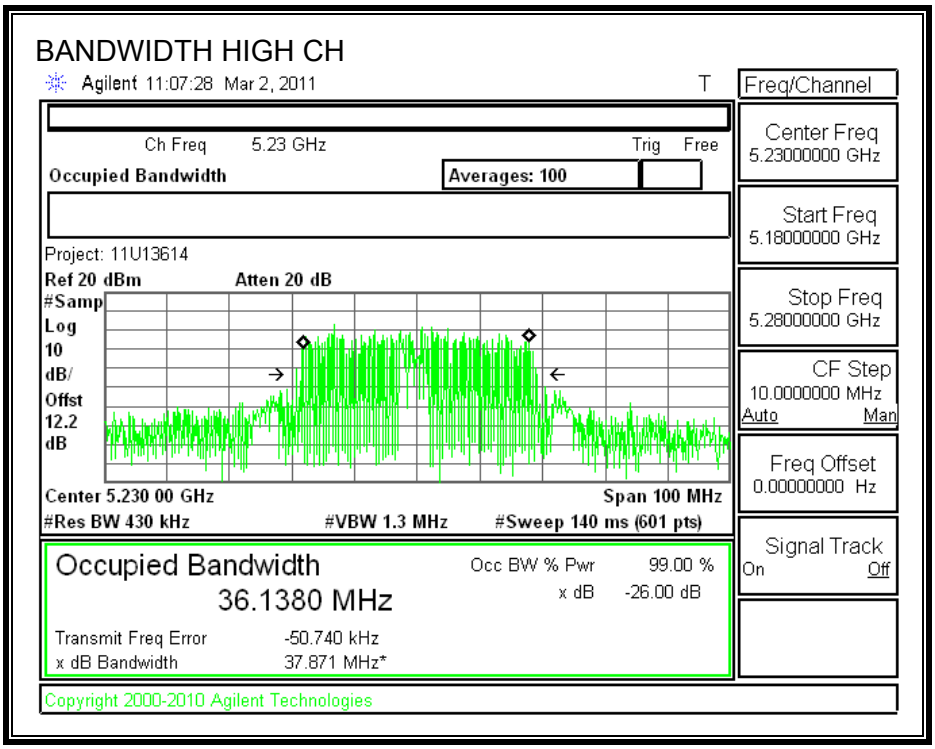




AP3

26 dB and 99% BANDWIDTH





7.6.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

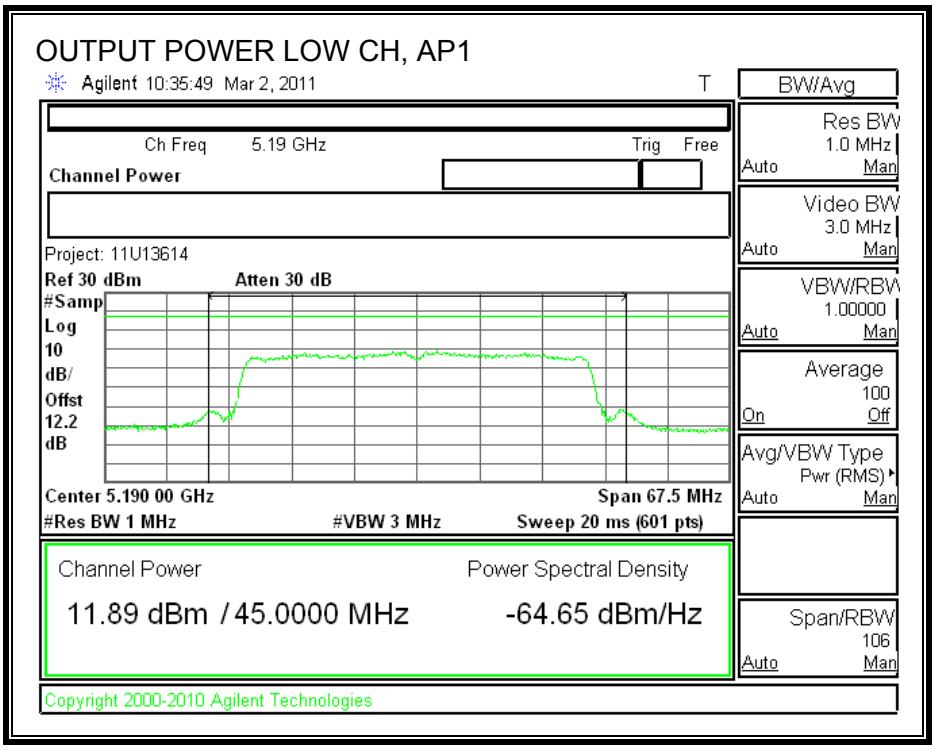
Limit

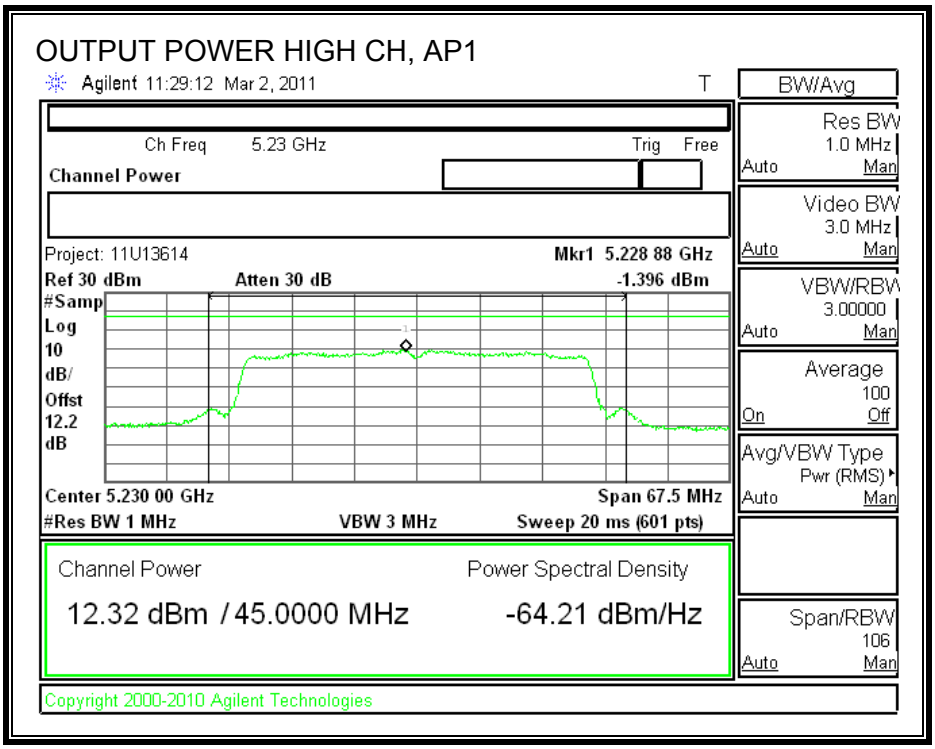
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17.00	37.862	19.78	5.69	17.00
High	5230	17.00	37.871	19.78	5.69	17.00

Individual Chain Results

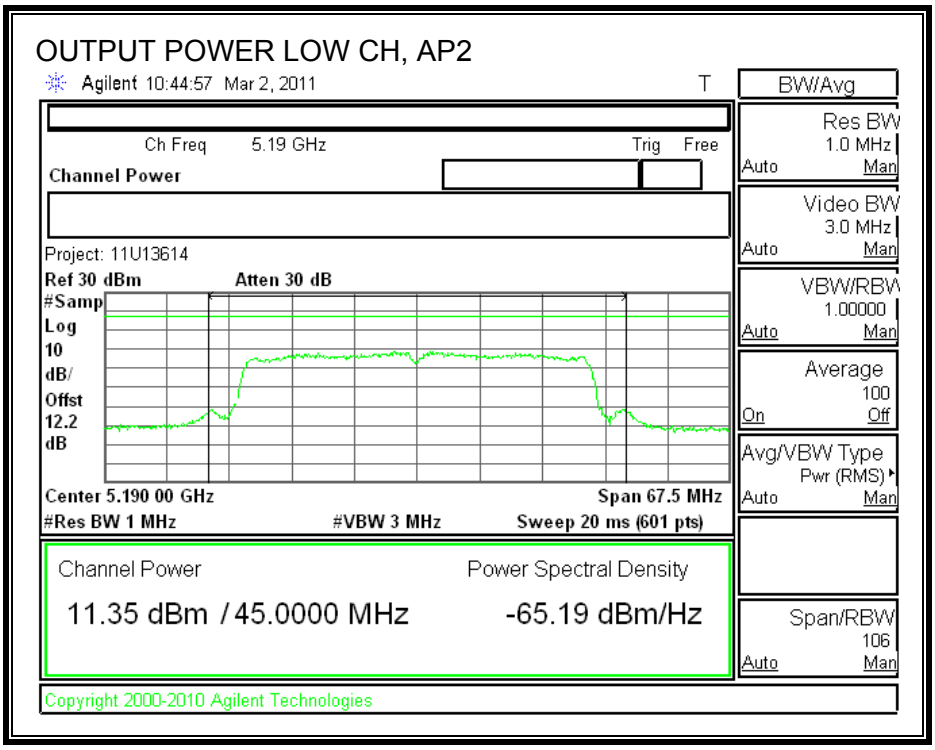
Channel	Frequency (MHz)	AP1 Power (dBm)	AP2 Power (dBm)	AP3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	11.89	11.35	11.43	16.33	17.00	-0.67
High	5230	12.32	11.78	11.29	16.59	17.00	-0.41

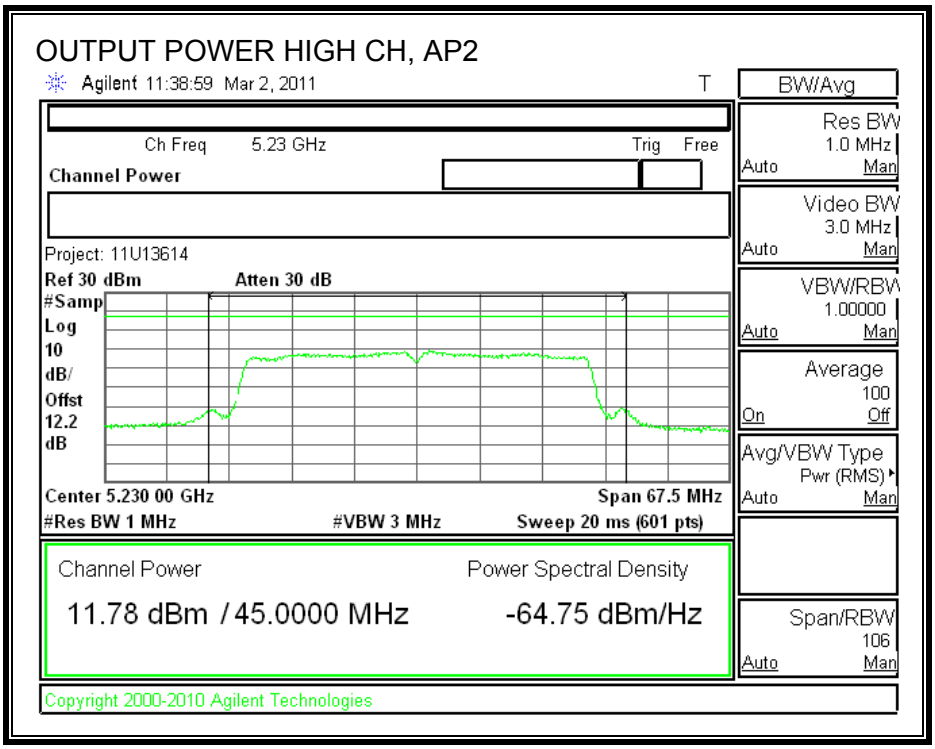
AP1 OUTPUT POWER



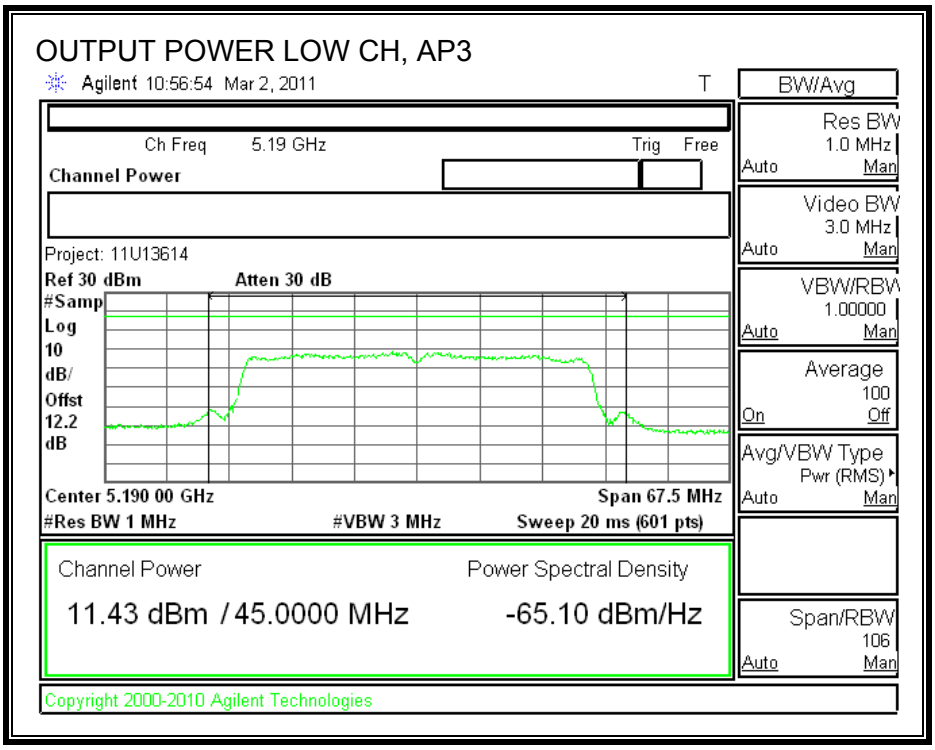


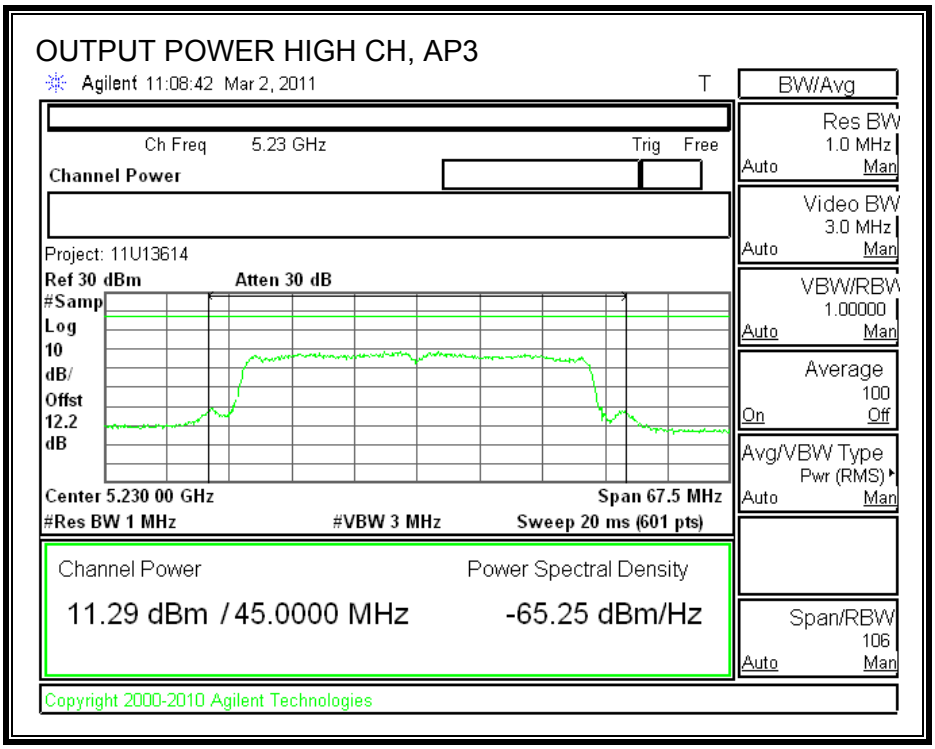
AP2 OUTPUT POWER





AP3 OUTPUT POWER





7.6.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

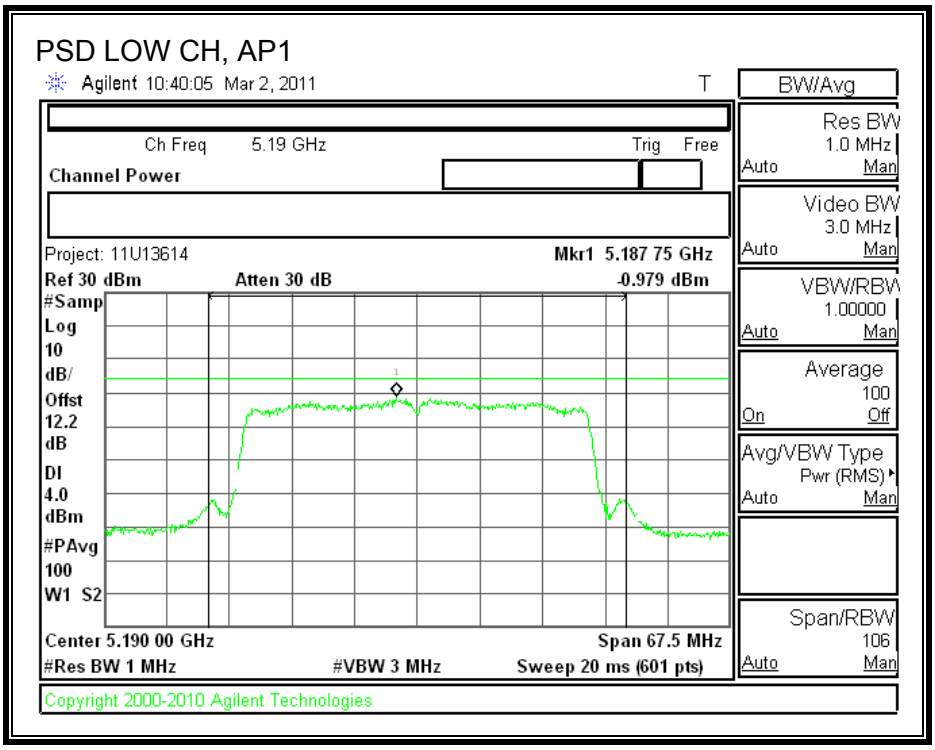
TEST PROCEDURE

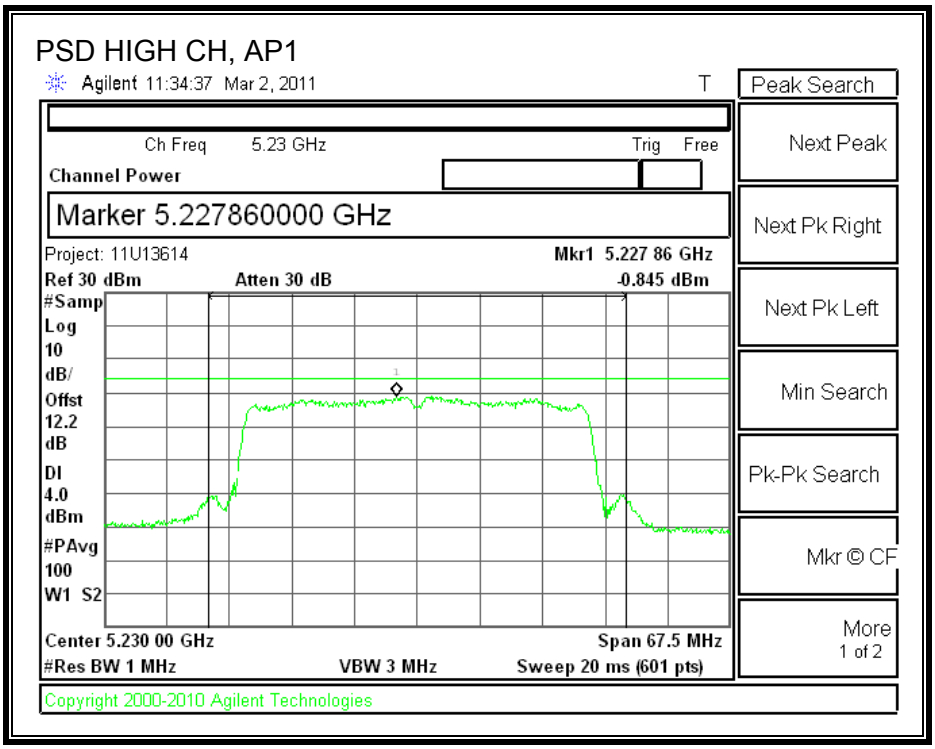
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #1 was used.

RESULTS

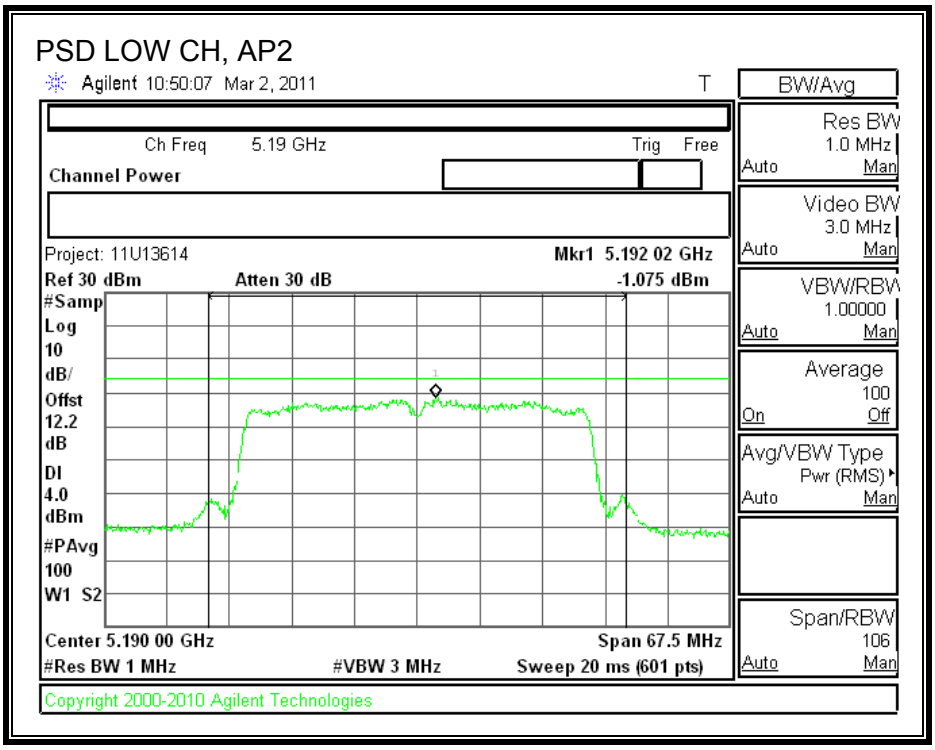
Channel	Frequency	Chain 1 PPSD	Chain 2 PPSD	Chain 3 PPSD	Combined PPSD	Limit	Margin
	80	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	(dB)
Low	5190	-0.979	-1.075	-1.320	3.649	4.000	-0.351
High	5230	-0.845	-1.235	-1.143	3.700	4.000	-0.300

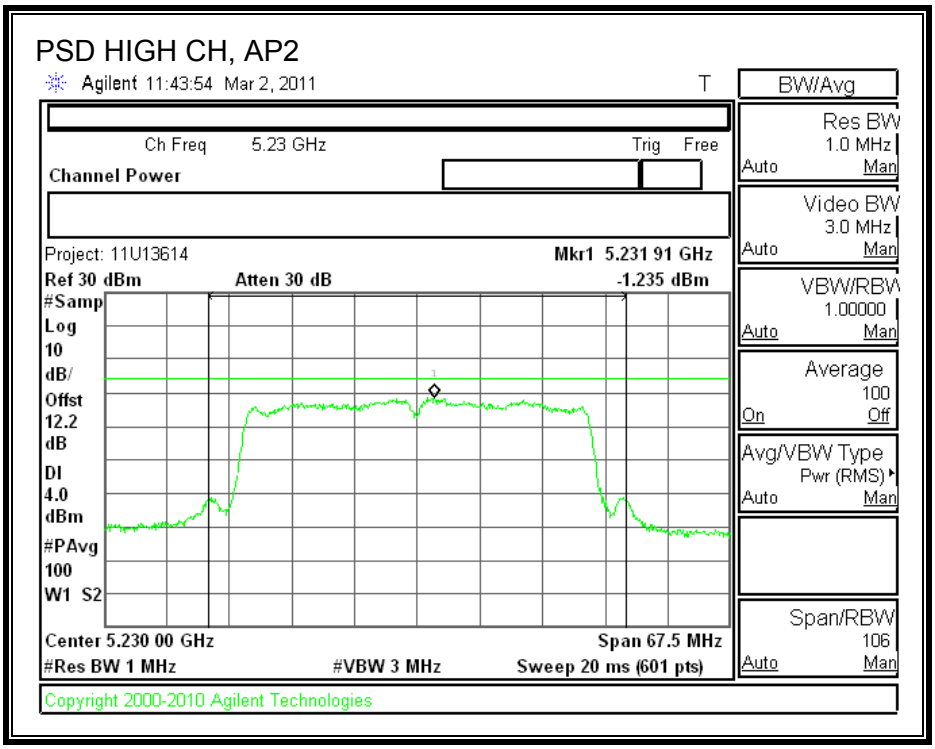
AP1 POWER SPECTRAL DENSITY



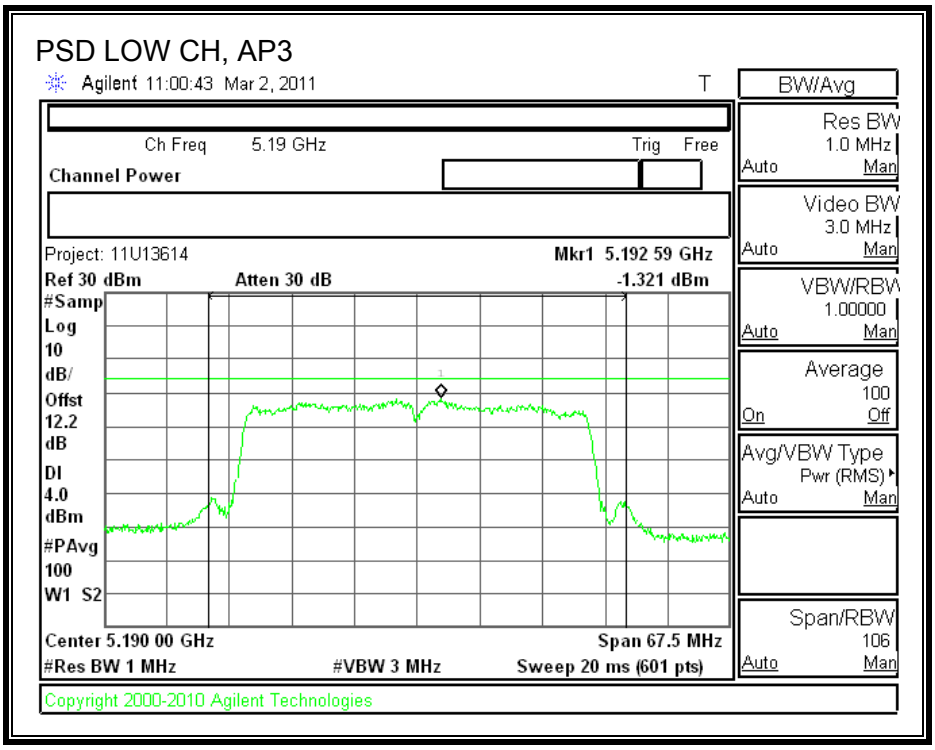


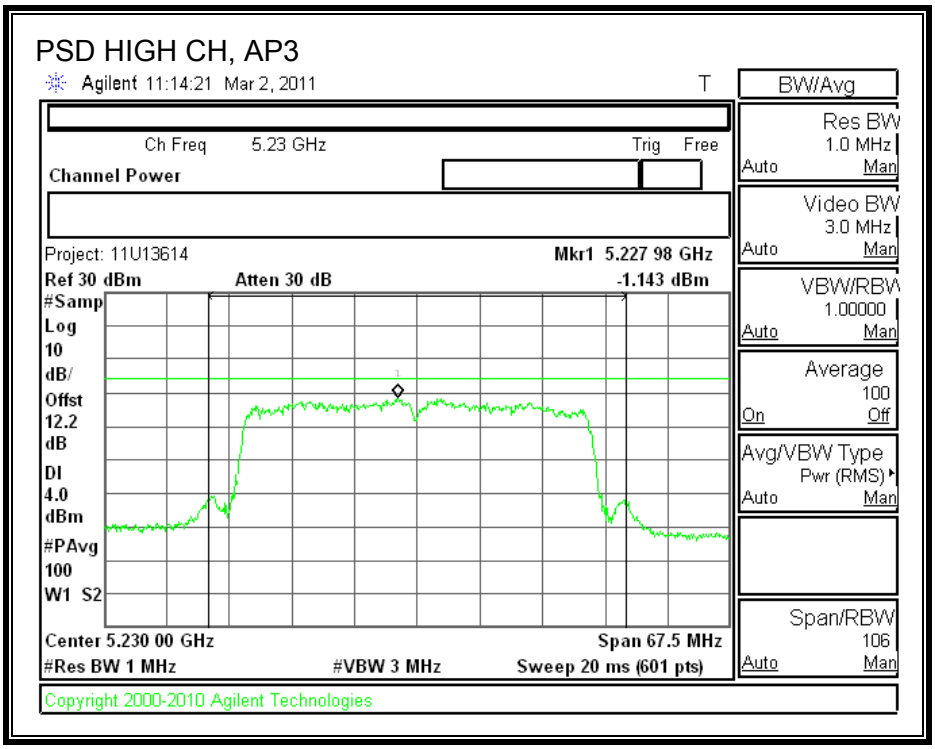
AP2 POWER SPECTRAL DENSITY





AP3 POWER SPECTRAL DENSITY





7.6.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

AP1

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	9.630	13	-3.37
High	5230	10.150	13	-2.85

AP2

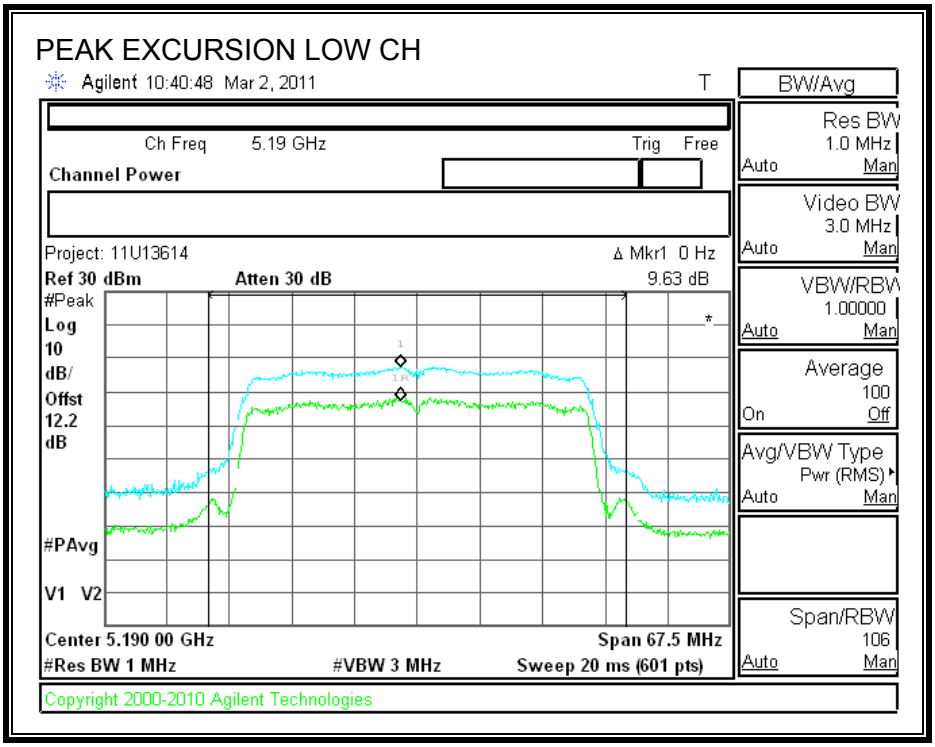
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	10.860	13	-2.14
High	5230	10.080	13	-2.92

AP3

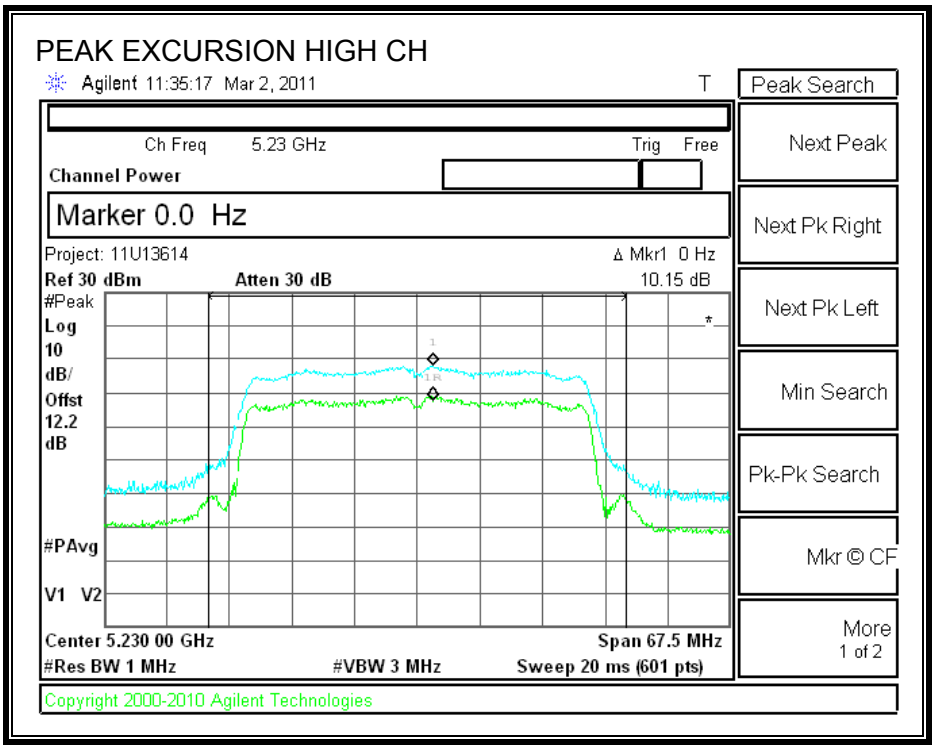
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	10.720	13	-2.28
High	5230	11.820	13	-1.18

AP1

PEAK EXCURSION

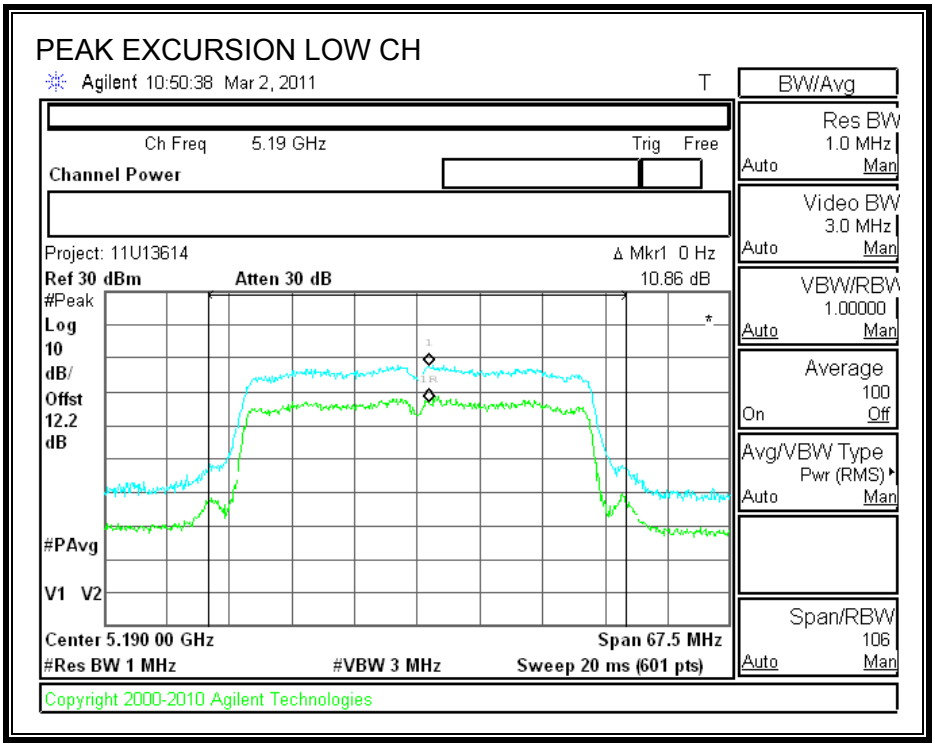


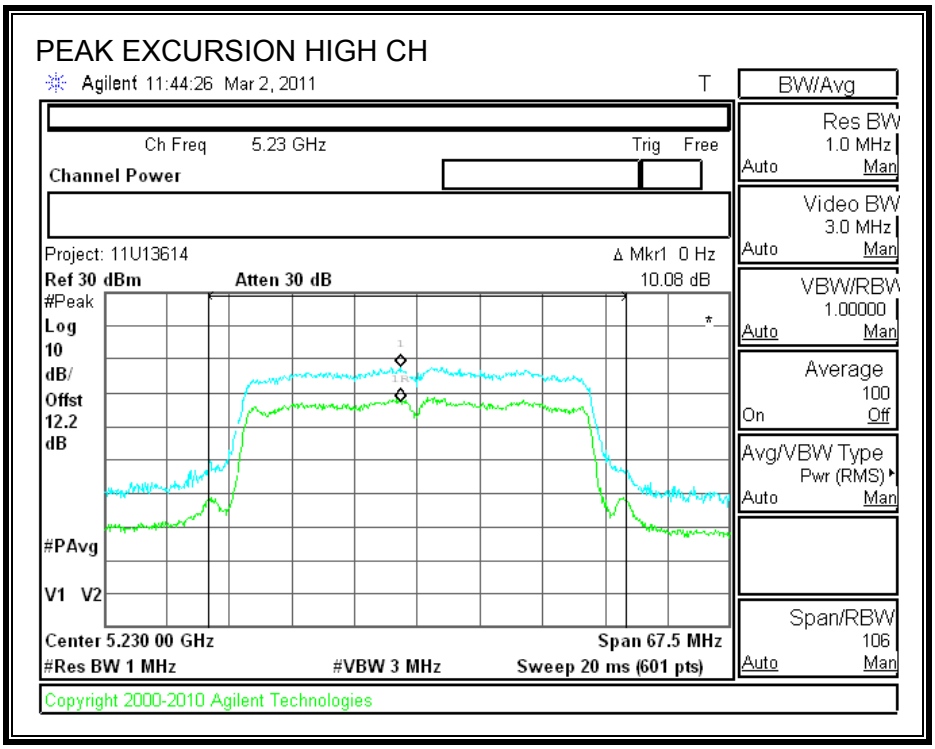
PEAK EXCURSION HIGH CH



AP2

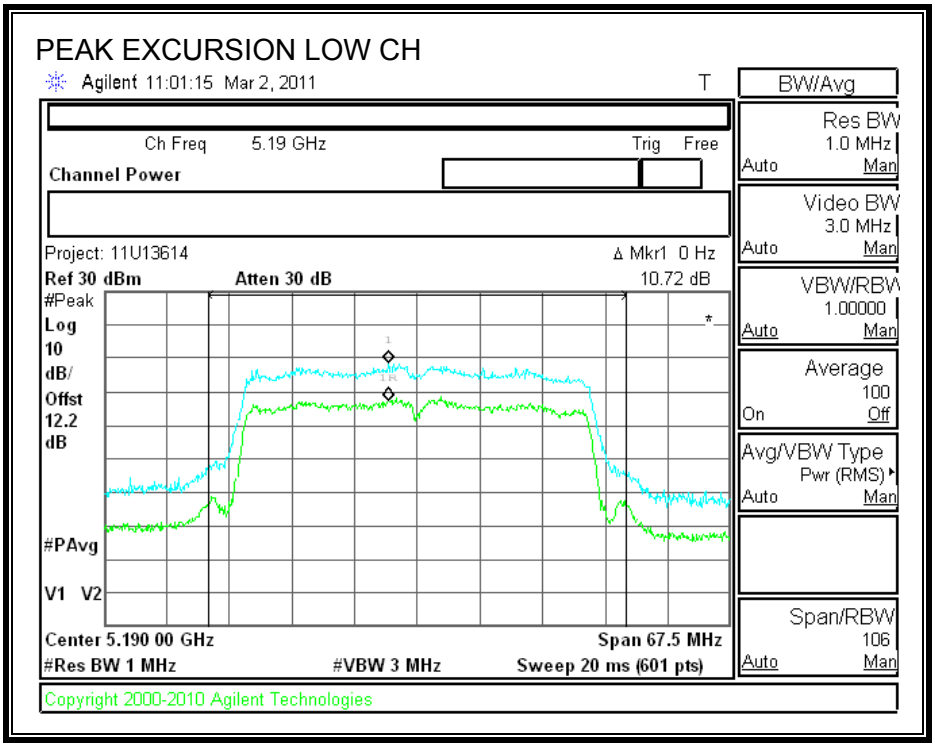
PEAK EXCURSION

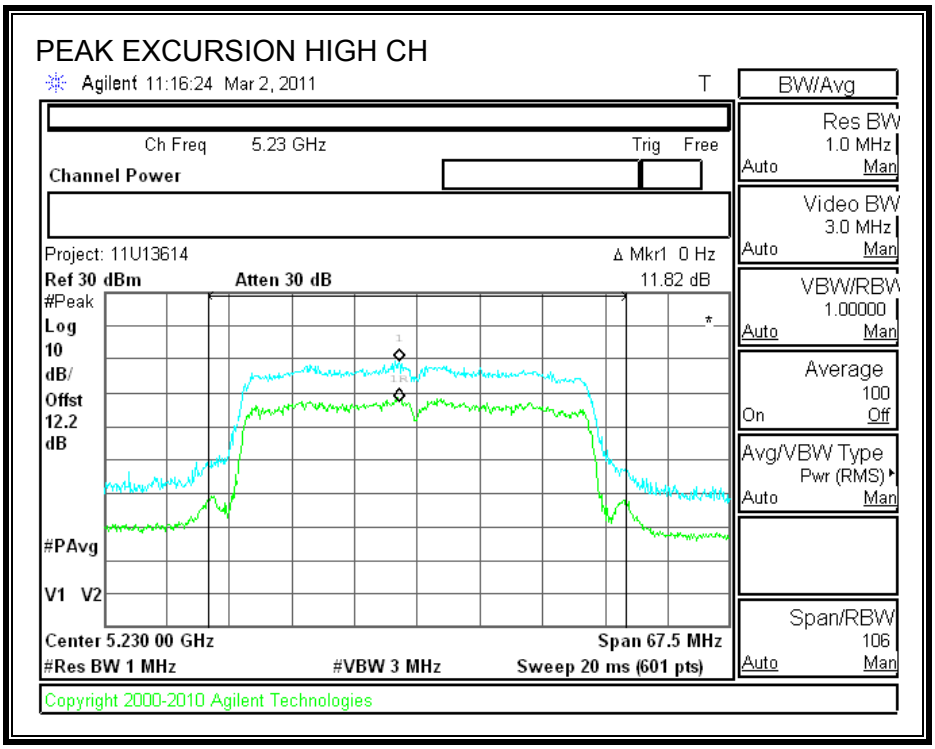




AP3

PEAK EXCURSION





7.6.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

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

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

RESULTS

Chain AP1

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-36.88	5.03	4.77	-27.08	-27.00
High	15.738	-40.07	5.03	4.77	-30.27	-27.00

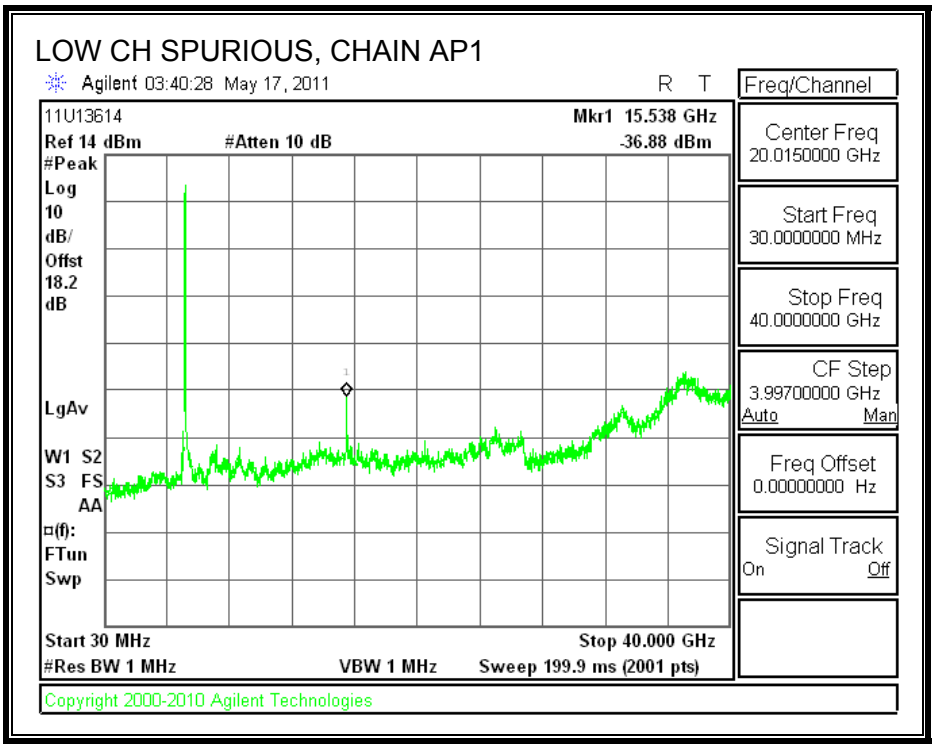
Chain AP2

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-36.88	2.50	4.77	-29.61	-27.00
High	15.718	-40.63	2.50	4.77	-33.36	-27.00

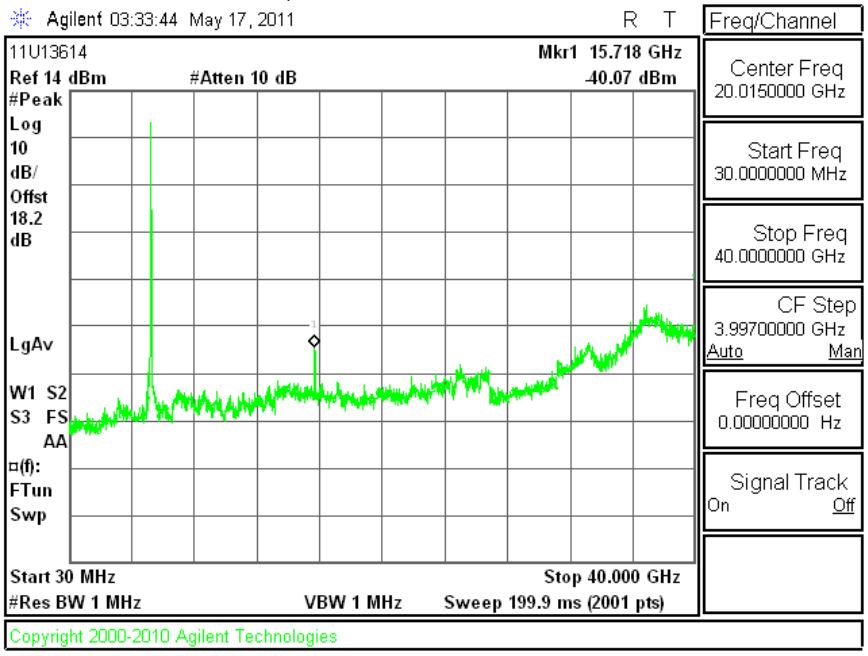
Chain AP3

Channel	Frequency (GHz)	Analyzer Reading (dBm)	AG (dBi)	Log (N)	Cond Spur Level (dBm)	Limit (dBm)
Low	15.538	-38.01	5.69	4.77	-27.55	-27.00
High	15.718	-41.72	5.69	4.77	-31.26	-27.00

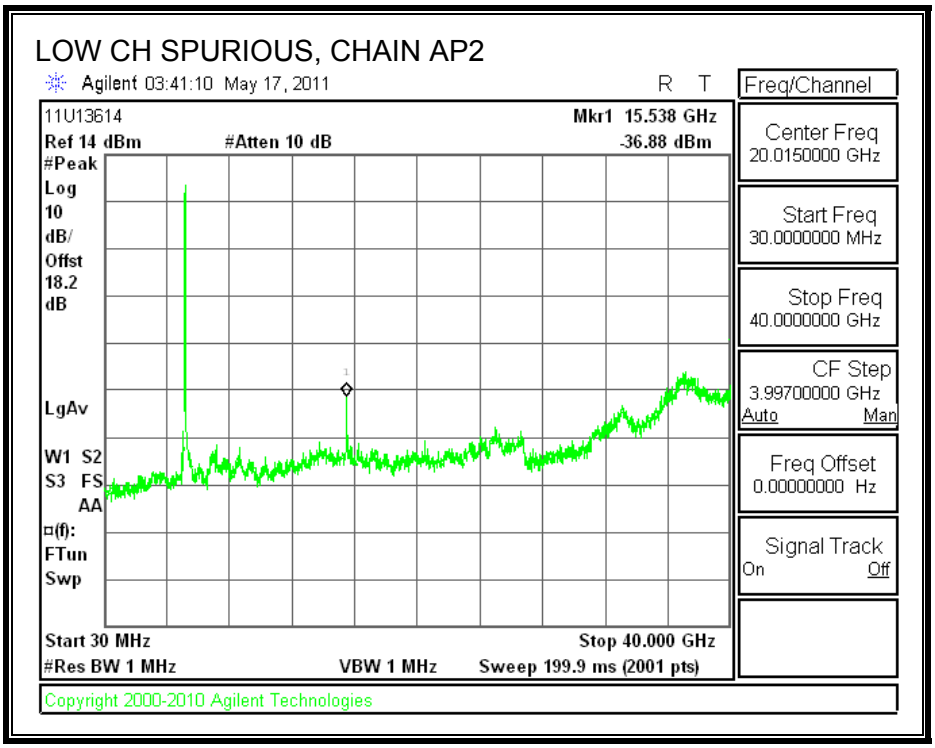
CHAIN AP1 SPURIOUS EMISSIONS



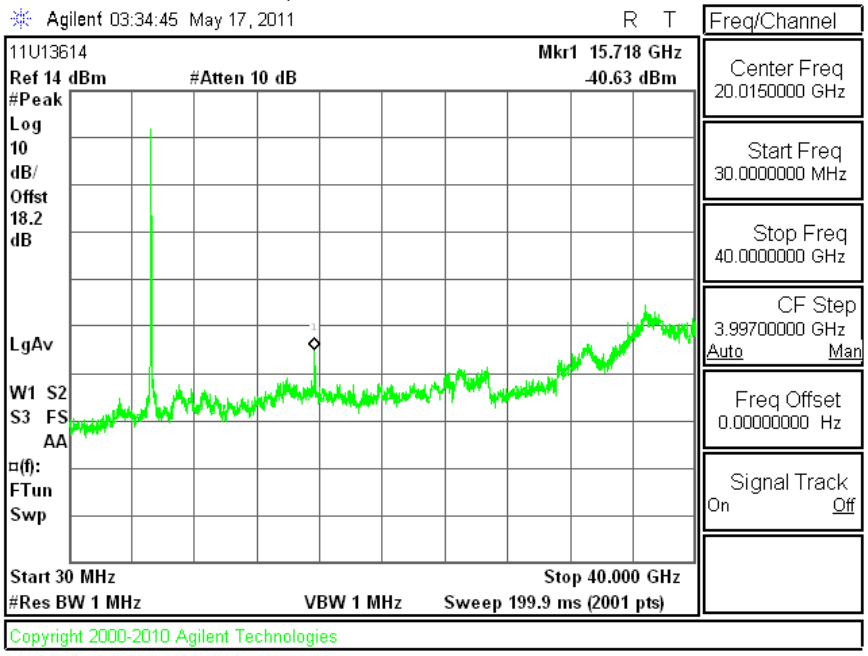
HIGH CH SPURIOUS, CHAIN AP1



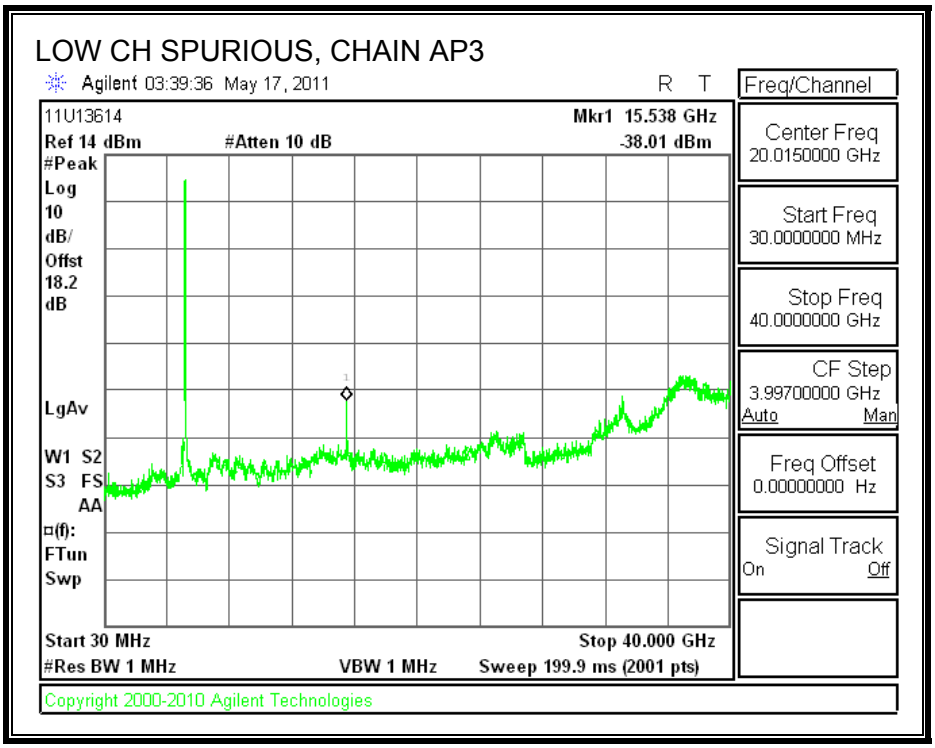
CHAIN AP2 SPURIOUS EMISSIONS



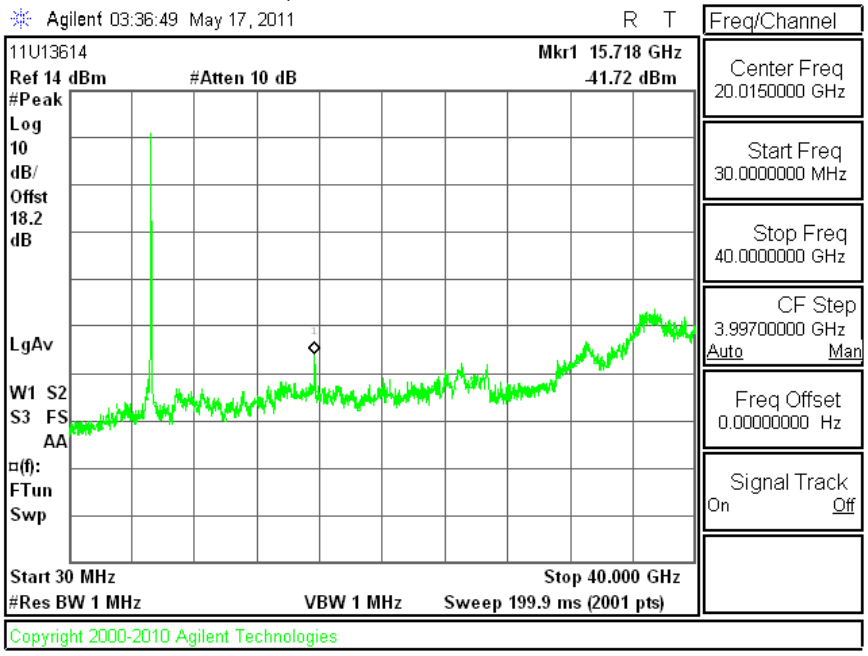
HIGH CH SPURIOUS, CHAIN AP2



CHAIN AP3 SPURIOUS EMISSIONS



HIGH CH SPURIOUS, CHAIN AP3



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

TEST PROCEDURE

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

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

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

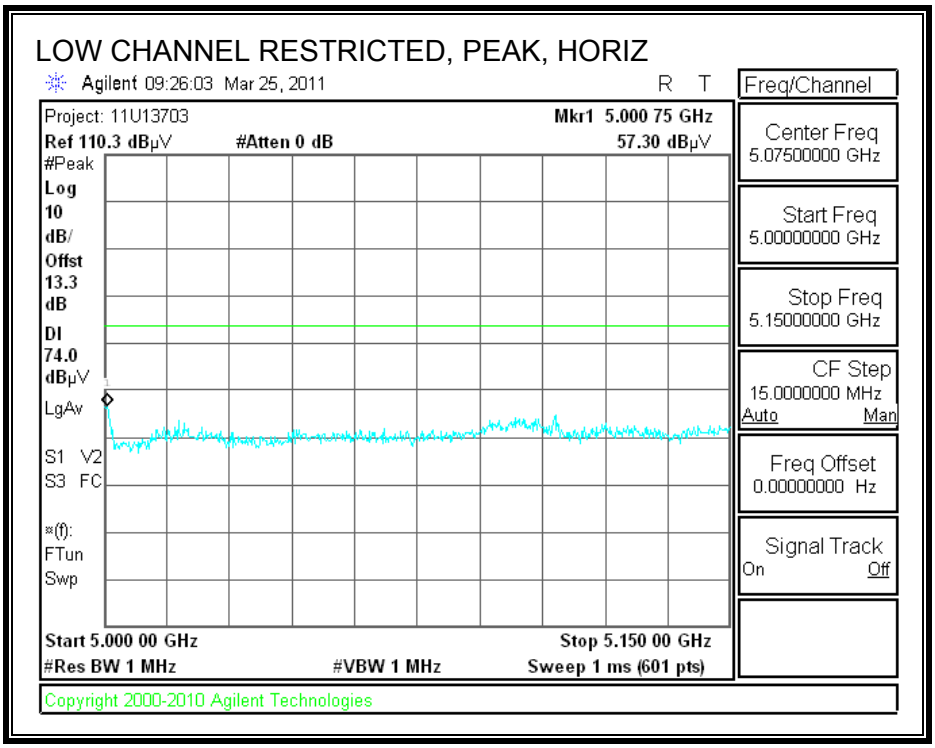
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

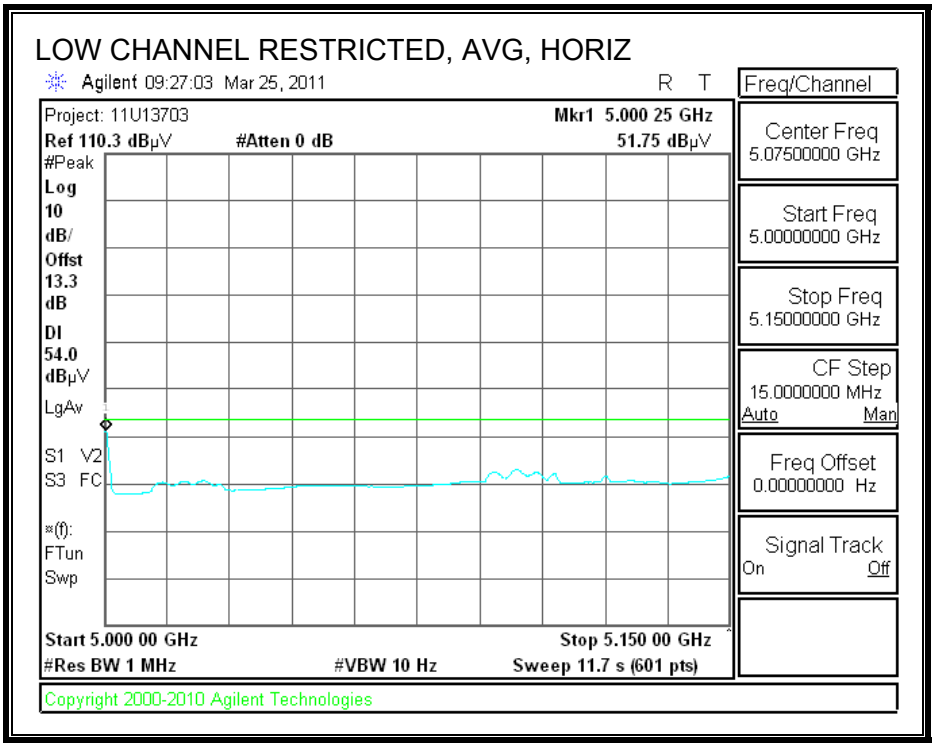
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

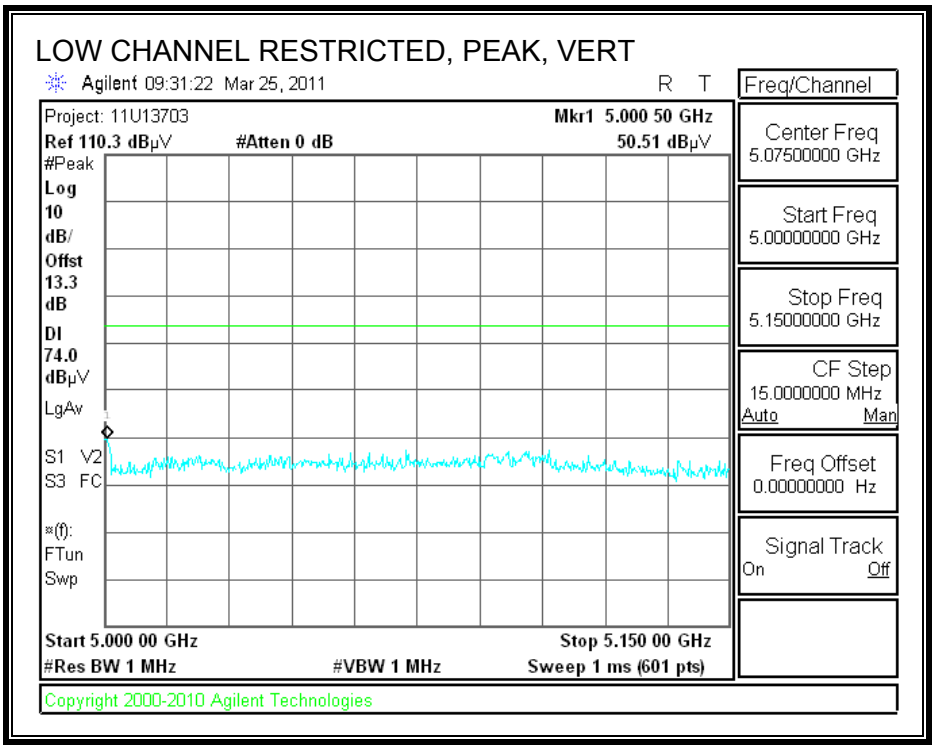
8.2.1. TX ABOVE 1 GHz FOR 802.11a MODE IN THE 5.2 GHz BAND

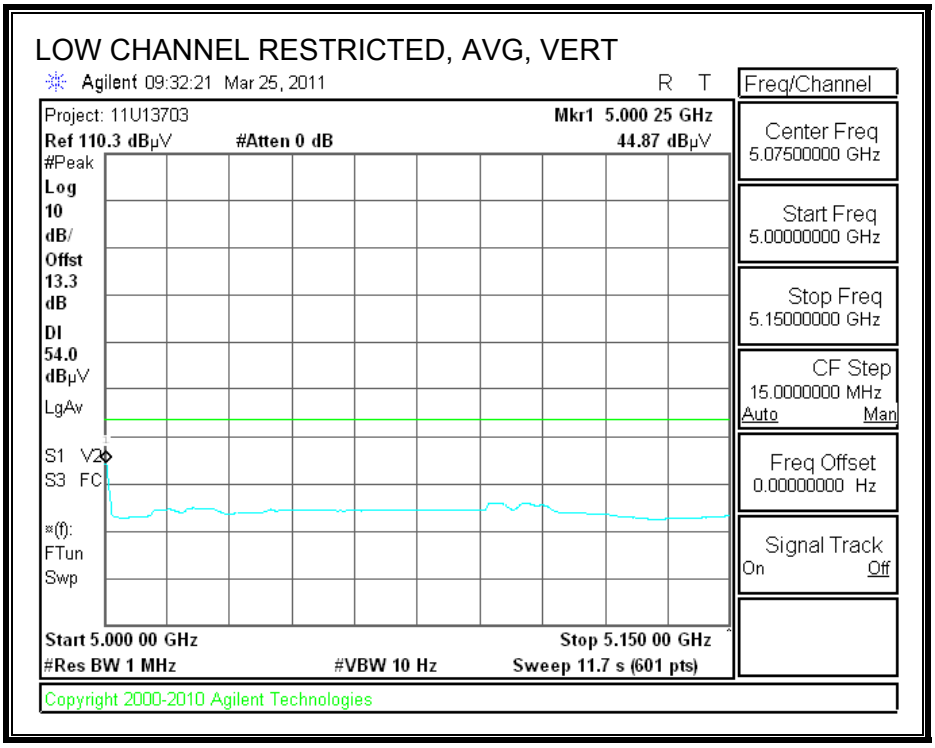
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 03/25/11
Project #: 11U13703
Company: Apple Inc.
Test Target: FCC 15.205
Mode Oper: 5.2 GHz band, a Mode, Tx On

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

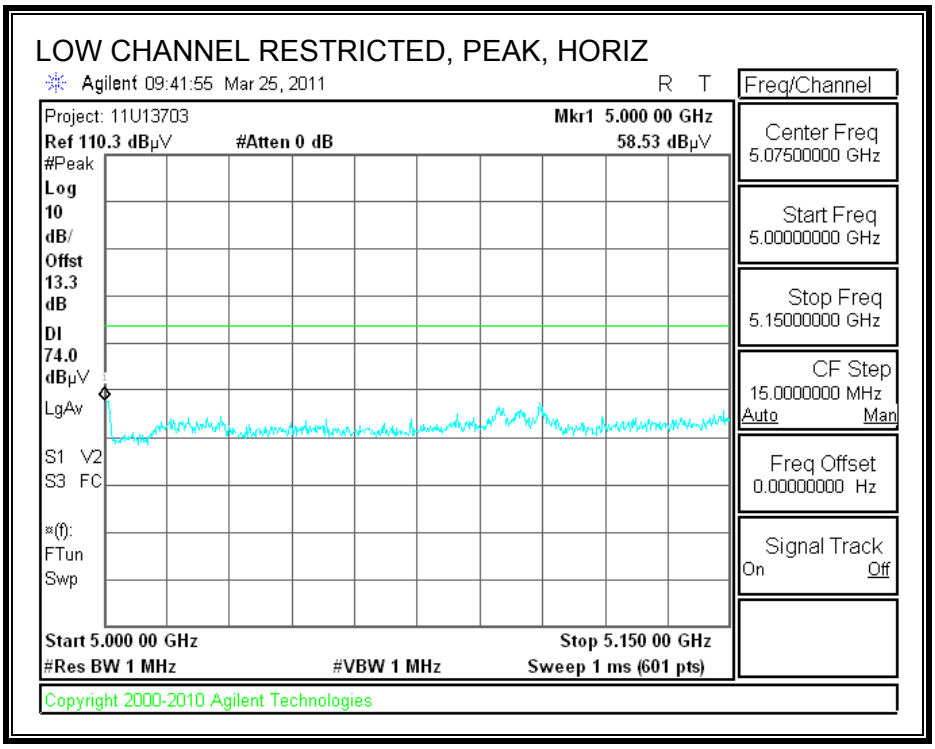
Average Field Strength Limit
Peak Field Strength Limit
Margin vs. Average Limit
Margin vs. Peak Limit

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	Ant.High cm	Table Angle Degree	Notes
Low Ch. 5180 MHz															
15.540	3.0	35.2	38.7	11.3	-34.8	0.0	0.0	50.3	74.0	-23.7	H	P	182.5	182.2	
15.540	3.0	22.5	38.7	11.3	-34.8	0.0	0.0	37.7	54.0	-16.3	H	A	182.5	182.2	
15.540	3.0	35.3	38.7	11.3	-34.8	0.0	0.0	50.5	74.0	-23.5	V	P	143.9	282.5	
15.540	3.0	22.5	38.7	11.3	-34.8	0.0	0.0	37.7	54.0	-16.3	V	A	143.9	282.5	
Mid Ch. 5200 MHz															
15.600	3.0	34.7	38.5	11.4	-34.8	0.0	0.0	49.8	74.0	-24.2	V	P	104.8	351.3	
15.600	3.0	22.4	38.5	11.4	-34.8	0.0	0.0	37.4	54.0	-16.6	V	A	104.8	351.3	
15.600	3.0	34.8	38.5	11.4	-34.8	0.0	0.0	49.9	74.0	-24.1	H	P	148.0	122.7	
15.600	3.0	22.4	38.5	11.4	-34.8	0.0	0.0	37.5	54.0	-16.5	H	A	148.0	122.7	
High Ch. 5240 MHz															
15.720	3.0	34.5	38.2	11.4	-34.7	0.0	0.0	49.4	74.0	-24.6	H	P	160.9	258.5	
15.720	3.0	22.0	38.2	11.4	-34.7	0.0	0.0	37.0	54.0	-17.0	H	A	160.9	258.5	
15.720	3.0	34.0	38.2	11.4	-34.7	0.0	0.0	48.9	74.0	-25.1	V	P	106.8	66.9	
15.720	3.0	22.1	38.2	11.4	-34.7	0.0	0.0	37.0	54.0	-17.0	V	A	106.8	66.9	

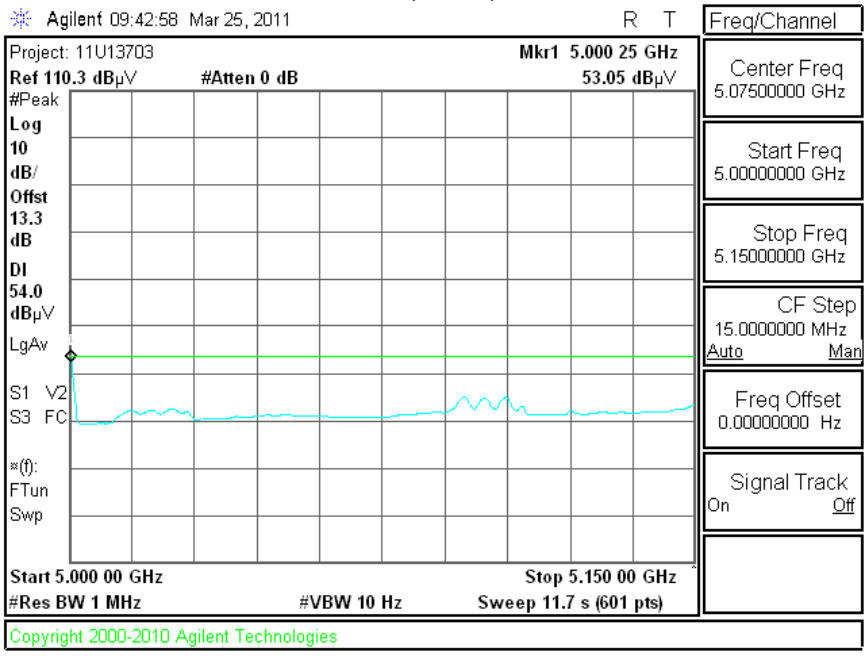
Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

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

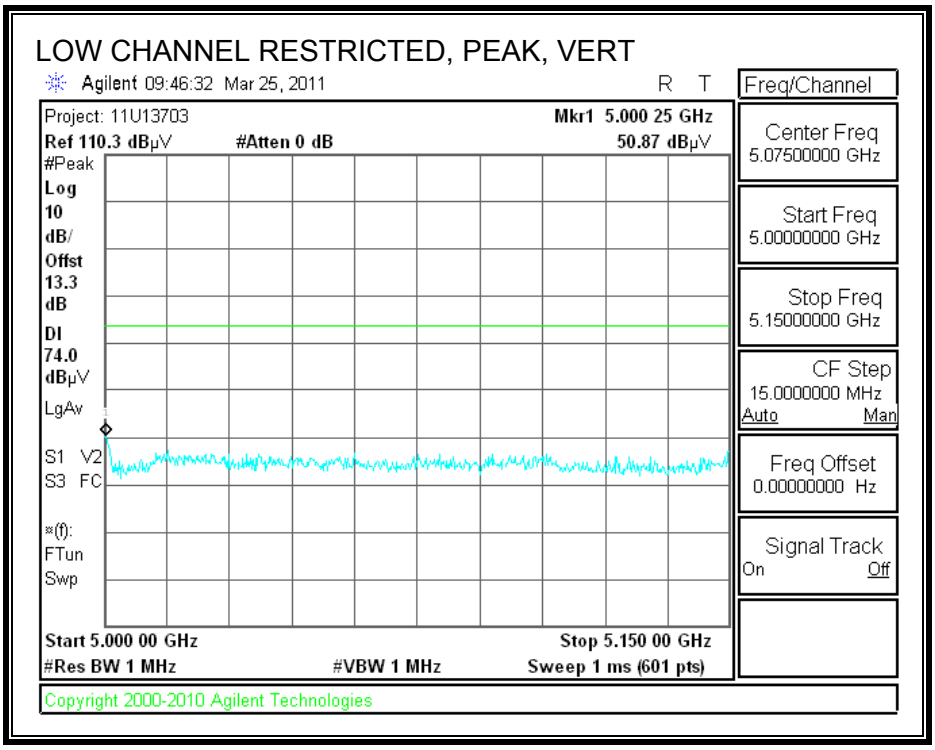
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

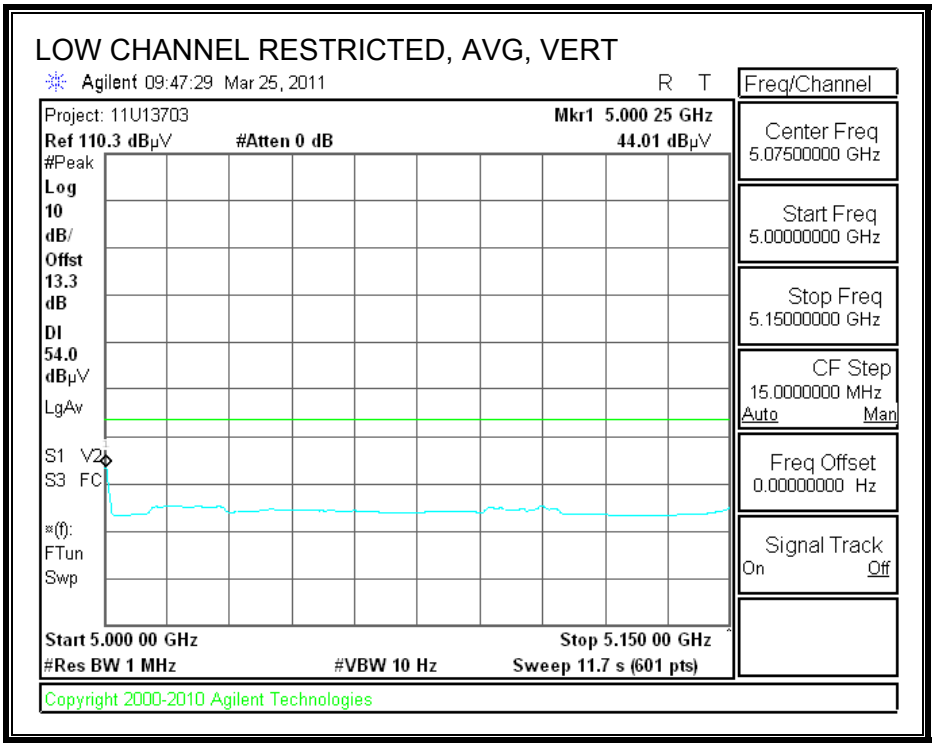


LOW CHANNEL RESTRICTED, AVG, HORIZ



RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 03/25/11
Project #: 11U13703
Company: Apple Inc.
Test Target: FCC 15.205
Mode Oper: 5.2 GHz band, HT20, Tx On

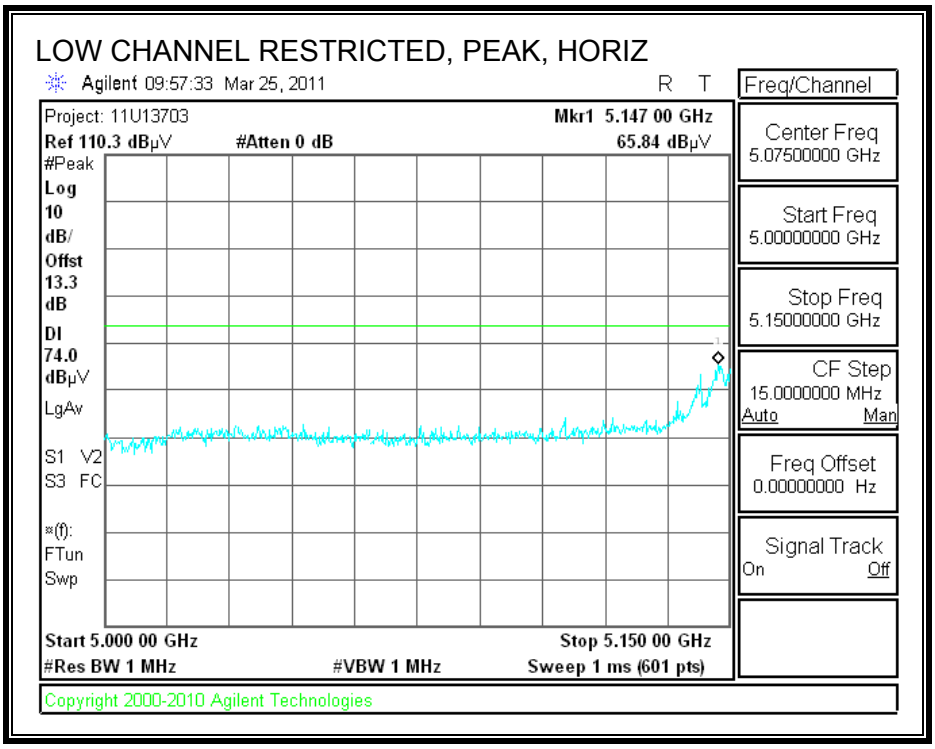
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

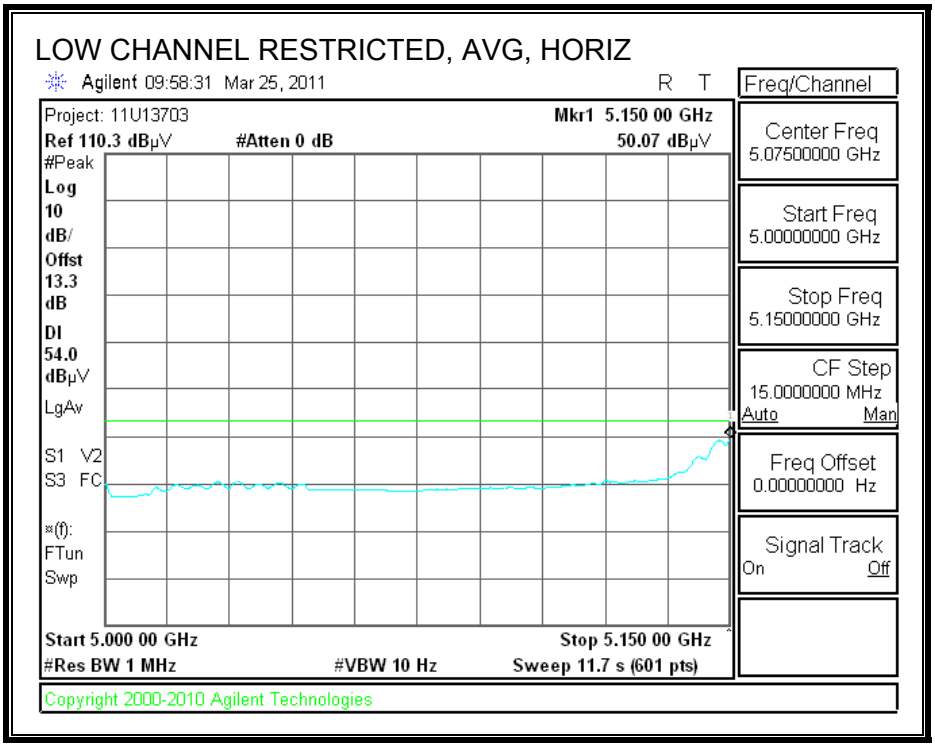
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch. 5180 MHz															
15.540	3.0	34.6	38.7	11.3	-34.8	0.0	0.0	49.7	74.0	-24.3	V	P	101.4	197.3	
15.540	3.0	22.5	38.7	11.3	-34.8	0.0	0.0	37.7	54.0	-16.3	V	A	101.4	197.3	
15.540	3.0	35.0	38.7	11.3	-34.8	0.0	0.0	50.2	74.0	-23.8	H	P	104.2	127.2	
15.540	3.0	22.5	38.7	11.3	-34.8	0.0	0.0	37.7	54.0	-16.3	H	A	104.2	127.2	
Mid Ch. 5200 MHz															
15.600	3.0	35.9	38.5	11.4	-34.8	0.0	0.0	51.0	74.0	-23.0	H	P	134.3	27.6	
15.600	3.0	22.4	38.5	11.4	-34.8	0.0	0.0	37.5	54.0	-16.5	H	A	134.3	27.6	
15.600	3.0	35.3	38.5	11.4	-34.8	0.0	0.0	50.4	74.0	-23.6	V	P	198.7	192.0	
15.600	3.0	22.5	38.5	11.4	-34.8	0.0	0.0	37.5	54.0	-16.5	V	A	198.7	192.0	
High Ch. 5240 MHz															
15.720	3.0	34.3	38.2	11.4	-34.7	0.0	0.0	49.2	74.0	-24.8	V	P	100.3	184.8	
15.720	3.0	22.1	38.2	11.4	-34.7	0.0	0.0	37.0	54.0	-17.0	V	A	100.3	184.8	
15.720	3.0	34.0	38.2	11.4	-34.7	0.0	0.0	48.9	74.0	-25.1	H	P	112.8	0.0	
15.720	3.0	22.1	38.2	11.4	-34.7	0.0	0.0	37.0	54.0	-17.0	H	A	112.8	0.0	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

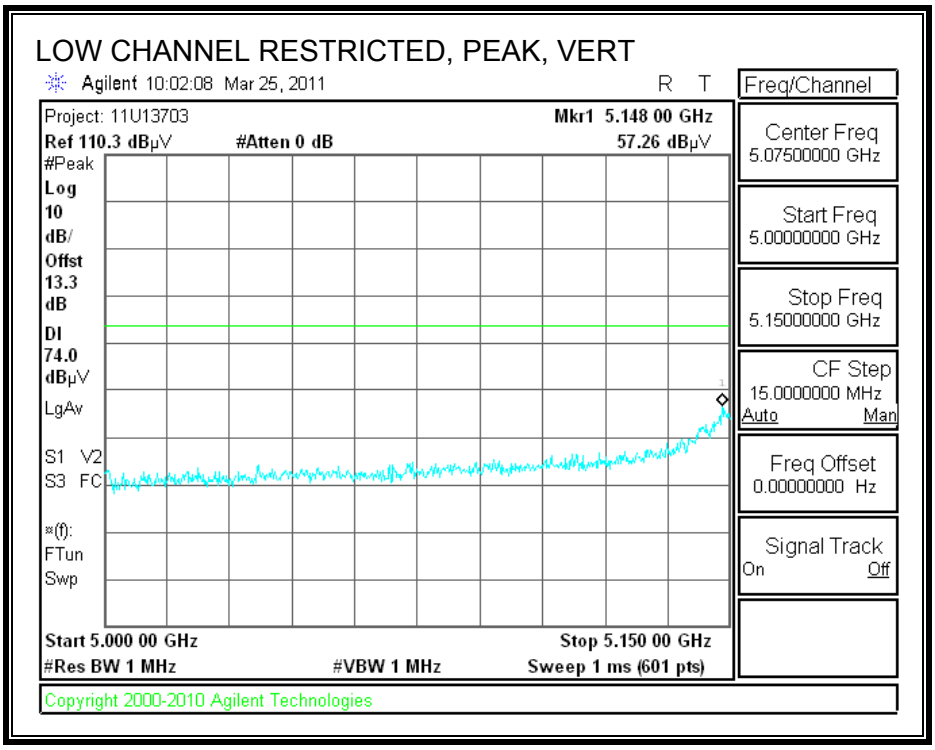
8.2.3. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 5.2 GHz BAND

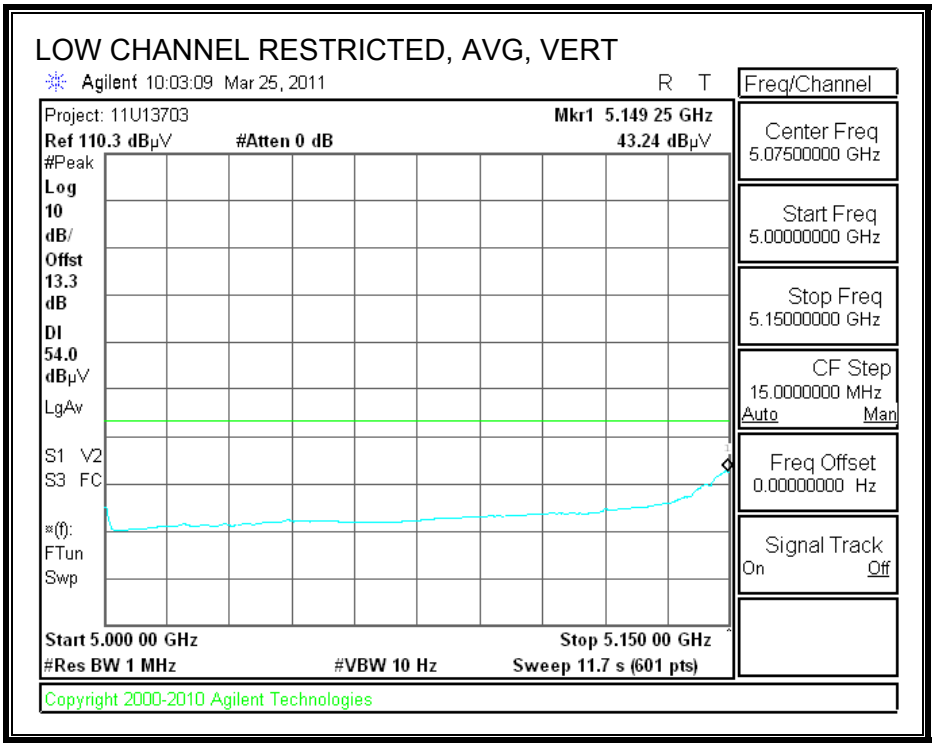
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 03/25/11
Project #: 11U13703
Company: Apple Inc.
Test Target: FCC 15.205
Mode Oper: 5.2 GHz band, HT40, Tx On

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	Ant.High cm	Table Angle Degree	Notes
Low Ch. 5190 MHz															
15.570	3.0	35.3	38.6	11.4	-34.8	0.0	0.0	50.4	74.0	-23.6	H	P	191.3	270.1	
15.570	3.0	22.5	38.6	11.4	-34.8	0.0	0.0	37.7	54.0	-16.3	H	A	191.3	270.1	
15.570	3.0	34.6	38.6	11.4	-34.8	0.0	0.0	49.7	74.0	-24.3	V	P	105.0	280.1	
15.570	3.0	22.5	38.6	11.4	-34.8	0.0	0.0	37.6	54.0	-16.4	V	A	105.0	280.1	
High Ch. 5230 MHz															
15.690	3.0	34.4	38.3	11.4	-34.7	0.0	0.0	49.3	74.0	-24.7	V	P	195.9	43.2	
15.690	3.0	22.2	38.3	11.4	-34.7	0.0	0.0	37.1	54.0	-16.9	V	A	195.9	43.2	
15.690	3.0	35.4	38.3	11.4	-34.7	0.0	0.0	50.4	74.0	-23.6	H	P	122.1	295.2	
15.690	3.0	22.2	38.3	11.4	-34.7	0.0	0.0	37.1	54.0	-16.9	H	A	122.1	295.2	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

8.3. RECEIVER ABOVE 1 GHz

8.3.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Inc.
Project #: 11U13703
Date: 3/25/2011
Test Engineer: William Zhuang
Configuration: EUT with Laptop
Mode: HT20 Mode, Mid Ch. Rx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.125	3.0	53.0	46.1	24.3	2.5	-39.3	0.0	0.0	40.5	33.6	74	54	-33.5	-20.4	H
1.190	3.0	53.1	32.7	24.5	2.6	-39.2	0.0	0.0	41.0	20.5	74	54	-33.0	-33.5	H
1.315	3.0	50.4	32.6	24.9	2.7	-39.0	0.0	0.0	39.0	21.2	74	54	-35.0	-32.8	H
1.590	3.0	50.3	32.5	25.8	3.0	-38.6	0.0	0.0	40.5	22.7	74	54	-33.5	-31.3	H
1.125	3.0	55.4	42.5	24.3	2.5	-39.3	0.0	0.0	42.8	30.0	74	54	-31.2	-24.0	V
1.190	3.0	56.8	33.0	24.5	2.6	-39.2	0.0	0.0	44.6	20.9	74	54	-29.4	-33.1	V
1.315	3.0	48.9	32.5	24.9	2.7	-39.0	0.0	0.0	37.5	21.1	74	54	-36.5	-32.9	V
1.590	3.0	51.4	32.3	25.8	3.0	-38.6	0.0	0.0	41.6	22.5	74	54	-32.4	-31.5	V

Rev. 07.22.09

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

8.3.2. RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Inc.
Project #: 11U13703
Date: 3/25/2011
Test Engineer: William Zhuang
Configuration: EUT with Laptop
Mode: HT40 Mode, High Ch. Rx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.149	3.0	57.8	38.3	24.4	2.5	-39.3	0.0	0.0	45.4	25.9	74	54	-28.6	-28.1	V
1.190	3.0	55.7	33.0	24.5	2.6	-39.2	0.0	0.0	43.6	20.9	74	54	-30.4	-33.1	V
1.510	3.0	54.5	32.7	25.6	3.0	-38.8	0.0	0.0	44.2	22.5	74	54	-29.8	-31.5	V
1.590	3.0	56.6	32.2	25.8	3.0	-38.6	0.0	0.0	46.8	22.4	74	54	-27.2	-31.6	V
1.149	3.0	50.9	44.0	24.4	2.5	-39.3	0.0	0.0	38.5	31.6	74	54	-35.5	-22.4	H
1.190	3.0	53.1	36.0	24.5	2.6	-39.2	0.0	0.0	41.0	23.9	74	54	-33.0	-30.1	H
1.510	3.0	51.5	33.1	25.6	3.0	-38.8	0.0	0.0	41.3	22.9	74	54	-32.7	-31.1	H
1.590	3.0	47.8	33.6	25.8	3.0	-38.6	0.0	0.0	38.0	23.8	74	54	-36.0	-30.2	H

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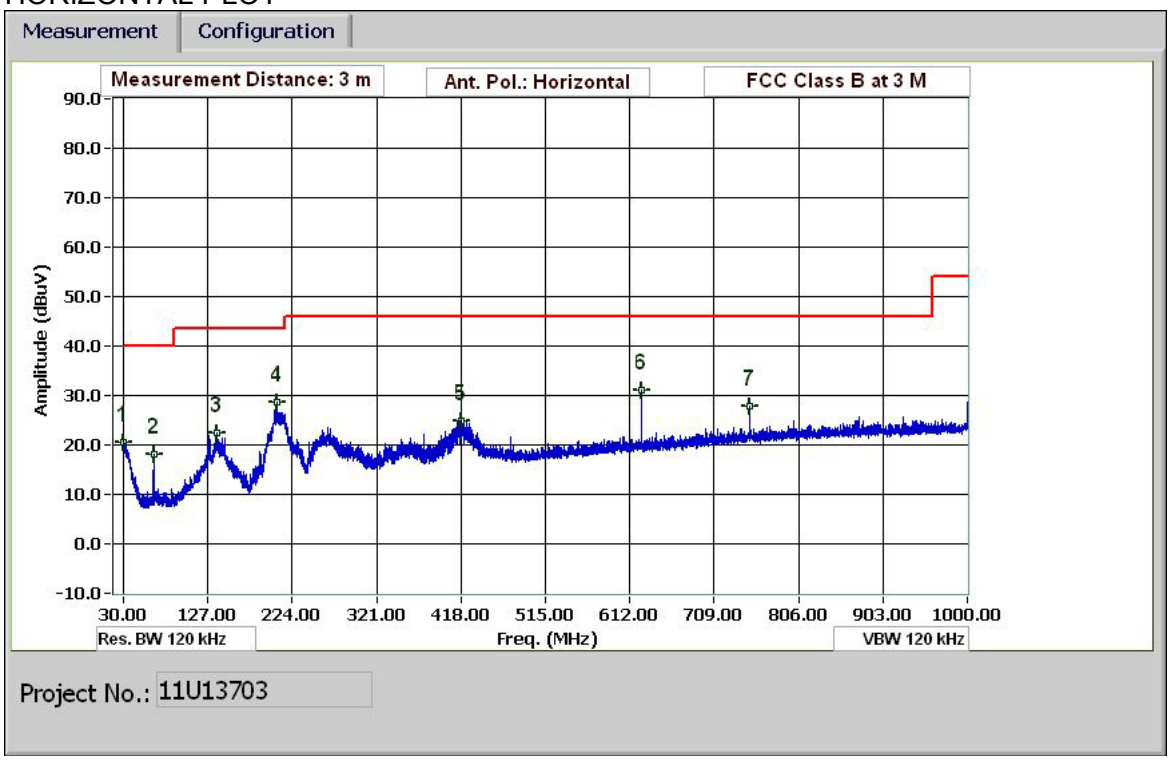
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

8.4. RADIATION BELOW 1 GHz

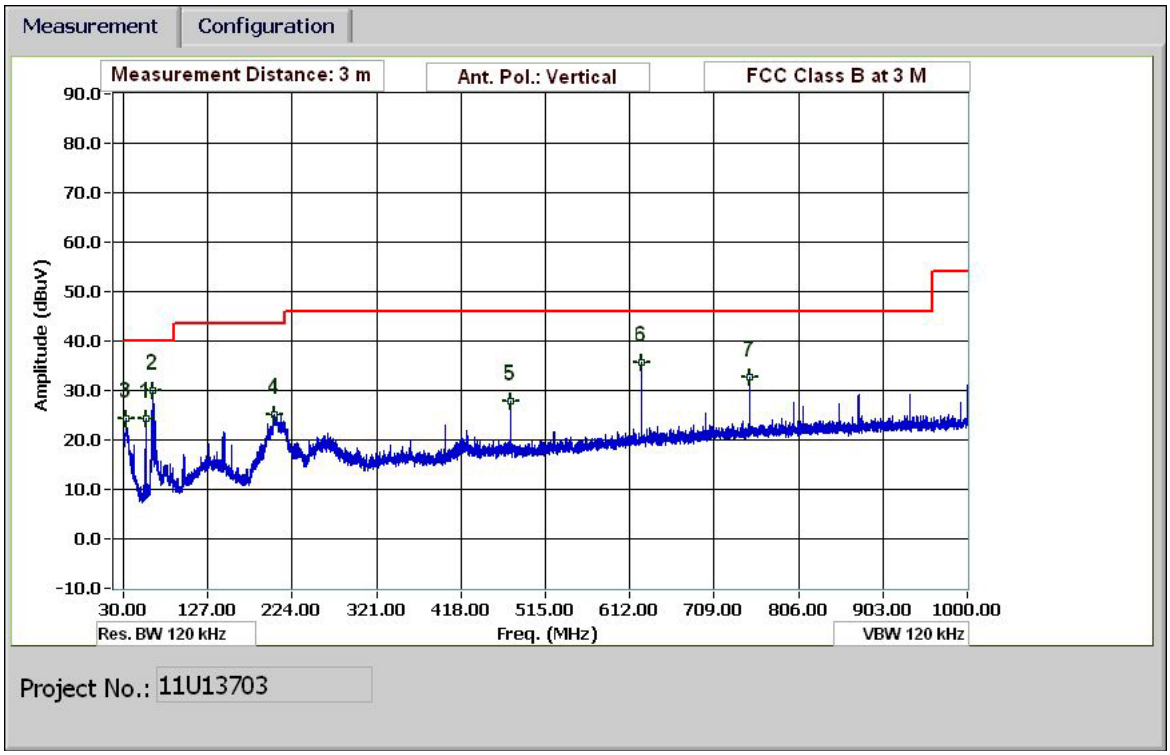
SPURIOUS EMISSIONS 30 TO 1000 MHz

HORIZONTAL PLOT



SPURIOUS EMISSIONS 30 TO 1000 MHz

VERTICAL PLOT



TABULATED DATA

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: William Zhuang
Date: 03/25/11
Project #: 11U13703
Company: Apple Inc.
Test Target: FCC 15.205
Mode Oper: 5.2 - 5.3 GHz band, Worst Case

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
Horizontal															
30.36	3.0	28.6	19.9	0.5	28.4	0.0	0.0	20.6	40.0	-19.4	H	P	100.0	0 - 360	
65.281	3.0	37.7	8.0	0.7	28.4	0.0	0.0	18.0	40.0	-22.0	H	P	100.0	0 - 360	
136.804	3.0	36.2	13.3	1.1	28.3	0.0	0.0	22.4	43.5	-21.1	H	P	100.0	0 - 360	
206.647	3.0	43.7	12.0	1.3	28.2	0.0	0.0	28.7	43.5	-14.8	H	P	100.0	0 - 360	
419.056	3.0	35.9	15.3	1.9	28.0	0.0	0.0	24.9	46.0	-21.1	H	P	100.0	0 - 360	
624.985	3.0	37.4	18.7	2.3	27.4	0.0	0.0	31.0	46.0	-15.0	H	P	100.0	0 - 360	
750.03	3.0	32.3	20.3	2.5	27.3	0.0	0.0	27.8	46.0	-18.2	H	P	100.0	0 - 360	
Vertical															
33	3.0	33.4	18.8	0.5	28.4	0.0	0.0	24.3	40.0	-15.7	V	P	100.0	0 - 360	
55.681	3.0	43.9	8.1	0.7	28.4	0.0	0.0	24.3	40.0	-15.7	V	P	100.0	0 - 360	
64.081	3.0	49.7	8.0	0.7	28.4	0.0	0.0	30.0	40.0	-10.0	V	P	100.0	0 - 360	
203.167	3.0	40.2	12.0	1.3	28.2	0.0	0.0	25.2	43.5	-18.3	V	P	100.0	0 - 360	
474.978	3.0	37.5	16.3	2.0	27.9	0.0	0.0	27.9	46.0	-18.1	V	P	100.0	0 - 360	
624.985	3.0	42.2	18.7	2.3	27.4	0.0	0.0	35.8	46.0	-10.2	V	P	100.0	0 - 360	
750.03	3.0	37.2	20.3	2.5	27.3	0.0	0.0	32.7	46.0	-13.3	V	P	100.0	0 - 360	

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

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

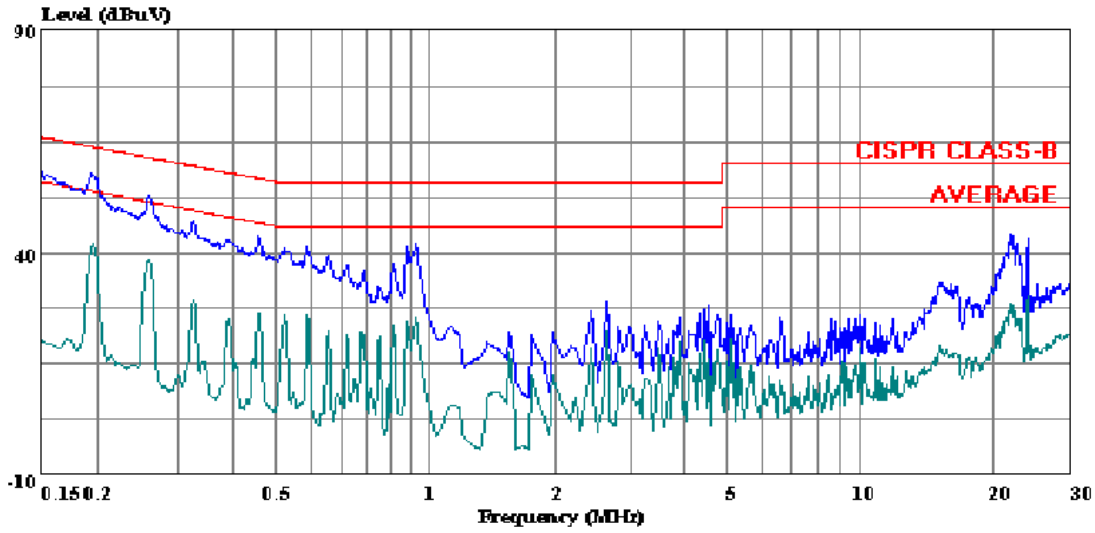
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA									
Freq.	Reading			Closs	Limit	FCC_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.19	57.88	--	41.81	0.00	63.91	53.91	-6.03	-12.10	L1
0.26	52.78	--	38.60	0.00	61.43	51.43	-8.65	-12.83	L1
1.03	42.02	--	25.70	0.00	56.00	46.00	-13.98	-20.30	L1
0.19	56.46	--	40.44	0.00	63.91	53.91	-7.45	-13.47	L2
0.26	51.80	--	37.05	0.00	61.43	51.43	-9.63	-14.38	L2
1.03	44.53	--	31.40	0.00	56.00	46.00	-11.47	-14.60	L2
6 Worst Data									

LINE 1 RESULTS

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

Data#: 7 File#: 11U13703-LC.EMI Date: 03-17-2011 Time: 11:02:24



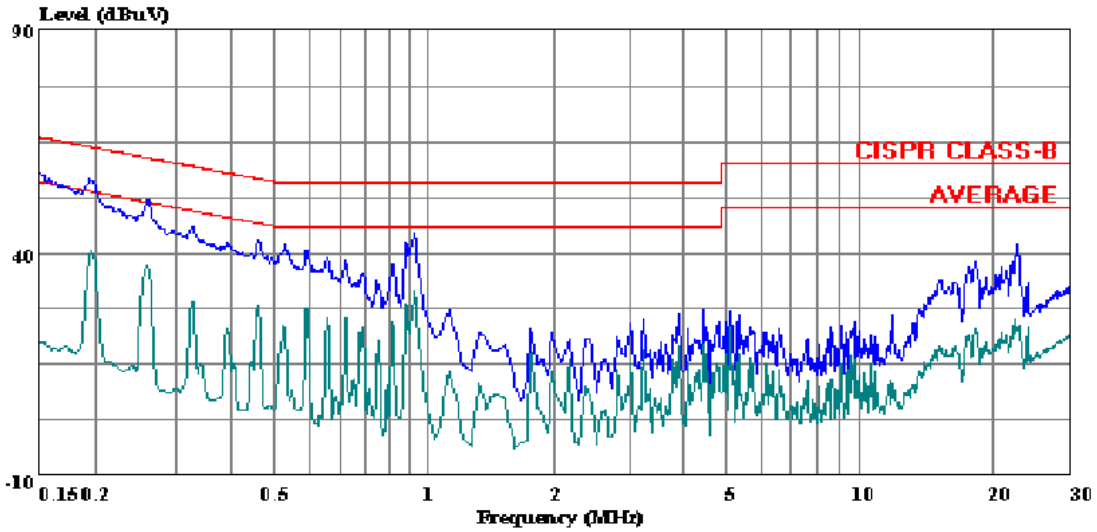
Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : William Zhuang
Project # : 11U13703
Company : Apple Inc.
Configuration : EUT with Laptop
EUT Description: 802.11 abgn; 3X3; AP
Mode : Normal, Worst case
Target : FCC Class B
Voltage : 115V / 60Hz
: L1: Blue (Peak), Green (Average)

LINE 2 RESULTS

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

Data#: 14 File#: 11U13703-LC.EMI Date: 03-17-2011 Time: 11:10:08



Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : William Zhuang
Project # : 11U13703
Company : Apple Inc.
Configuration : EUT with Laptop
EUT Description: 802.11 abgn; 3X3; AP
Mode : Normal, Worst case
Target : FCC Class B
Voltage : 115V / 60Hz
: L2: Blue (Peak), Green (Average)

10. 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.

IC RULES

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

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

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

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

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

EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

For multiple chain devices, and 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.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

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

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply, a fraction of the exposure limit is established for each band, such that the sum of the fractions is less than or equal to one.

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

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency, as 824 MHz / 1500 = 0.55 mW/cm^2 (FCC) and 824 MHz / 150 = 5.5 W/m^2 (IC).

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

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

RESULTS

Worst-case of 11a, HT20, HT40 (2 chains)

Multiple chain or colocated transmitters									
Band	**Mode**	**Chain for MIMO**	**Separation Distance (m)**	**Output AV Power (dBm)**	**Antenna Gain (dBi)**	**EIRP (dBm)**	**EIRP (W)**	**IC Power Density (W/m^2)**	**FCC Power Density (mW/cm^2)**
5 GHz	WLAN	1		15.00	5.03	20.03	0.10		
5 GHz	WLAN	2		16.80	5.69	22.49	0.18		
Combined			0.20				0.28	0.55	0.055

Worst-case of 11a, HT20, HT40 (3 chains)

Multiple chain or colocated transmitters									
Band	**Mode**	**Chain for MIMO**	**Separation Distance (m)**	**Output AV Power (dBm)**	**Antenna Gain (dBi)**	**EIRP (dBm)**	**EIRP (W)**	**IC Power Density (W/m^2)**	**FCC Power Density (mW/cm^2)**
5 GHz	WLAN	1		11.55	5.03	16.58	0.05		
5 GHz	WLAN	2		14.90	2.50	17.40	0.05		
5 GHz	WLAN	3		16.50	5.69	22.19	0.17		
Combined			0.20				0.27	0.53	0.053