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

CERTIFICATION TEST REPORT

FOR

AR5BXB112 3x3 802.11n PCIe MODULE

MODEL NUMBER: AR5BXB112

FCC ID: PPD-AR5BXB112
IC: 4104A-AR5BXB112

REPORT NUMBER: 10U13467-2

ISSUE DATE: DECEMBER 16, 2010

Prepared for
ATHEROS COMMUNICATIONS, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
---	12/16/10	Initial Issue	T. Chan

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: ATHEROS COMMUNICATION, INC
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110

EUT DESCRIPTION: AR5BXB112 3x3 802.11n PCIe MODULE

MODEL: AR5BXB112

SERIAL NUMBER: CUS152-053-F0760

DATE TESTED: NOVEMBER 08 to DECEMBER 15, 2010

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 9	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 UL CCS By:

THU CHAN
ENGINEERING MANAGER
UL CCS

Tested By:

CHIN PANG
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, RSS-GEN Issue 3, 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.

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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 802.11abgn 3x3 product with the option of Beam Forming.

The radio module is manufactured by Atheros

5.2. MAXIMUM OUTPUT POWER

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

Non Beam-Forming

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz BAND, 1x3			
5180 - 5240	802.11a	15.17	32.89
5.2 GHz BAND, 3x3			
5180 - 5240	802.11a	10.63	11.56
5180 - 5240	802.11n HT20	15.70	37.15
5190 - 5230	802.11n HT40	16.86	48.53
5.3 GHz BAND			
5260 - 5320	802.11a	17.48	55.98
5260 - 5320	802.11n HT20	21.47	140.28
5270 - 5310	802.11n HT40	20.97	125.03
5.6 GHz BAND			
5500 - 5700	802.11a	18.28	67.30
5500 - 5700	802.11n HT20	20.50	112.20
5510 - 5670	802.11n HT40	20.70	117.49

Beam-Forming

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz BAND			
5180 - 5240	802.11n HT20	10.93	12.39
5190 - 5230	802.11n HT40	12.40	17.38
5.3 GHz BAND			
5260 - 5320	802.11n HT20	18.15	65.31
5270 - 5310	802.11n HT40	18.52	71.12
5.6 GHz BAND			
5500 - 5700	802.11n HT20	18.95	78.52
5510 - 5670	802.11n HT40	20.70	117.49

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

	WiFi 1	WiFI 2	WiFi 3		
Freq [GHz]	631-1330 (Black) Peak Gain dBi	631-1331 (Logo) Peak Gain dBi	631-1332 (Brown) Peak Gain dBi	Max Gain [dBi]	Array Gain [dBi]
2.4-2.484	4.84	2.9	4.02	**4.84**	**8.76**
5.15 - 5.25	5.28	5.97	5.25	**5.97**	**10.28**
5.25 - 5.35	5.21	6.07	4.82	**6.07**	10.17
5.47-5.725	4.02	4.78	4.51	4.78	**9.22**
5.725-5.85	3.12	4.73	4.87	**4.87**	**9.08**

	WiFi 1	WiFI 2	WiFi 3		
Freq [GHz]	631-1359 (Black) Peak Gain dBi	631-1357 (Logo) Peak Gain dBi	631-1358 (Brown) Peak Gain dBi	Max Gain [dBi]	Array Gain [dBi]
2.4-2.484	1.98	1.68	3.44	3.44	7.21
5.15 - 5.25	5.44	5.17	4.89	5.44	9.94
5.25 - 5.35	5.54	5.65	5.19	5.65	**10.24**
5.47-5.725	4.88	3.62	4.43	**4.88**	9.11
5.725-5.85	2.37	3.21	3.79	3.79	7.93

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Atheros AR93 Anwi Diagnostic Kernel Driver.

The test utility software used during testing was Atheros artgui ver_2.5.

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module connected to a host Laptop PC via a test fixture.

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

All final tests in the 802.11a Mode (Legacy) were made at 9 Mb/s.
All final tests in the 802.11n HT20 Mode were made at MCS0
All final tests in the 802.11n HT40 Mode were made at MCS0

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

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

For Legacy and MIMO PSD measurement, each individual chain is measured and total sum of three chains are calculated using the formula,

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	IBM Lenovo	T400	R8-NCKY4	DoC
AC Adapter	IBM Lenovo	DCWP CM-2	11S92P1156Z1ZDXN99HDSS	DoC

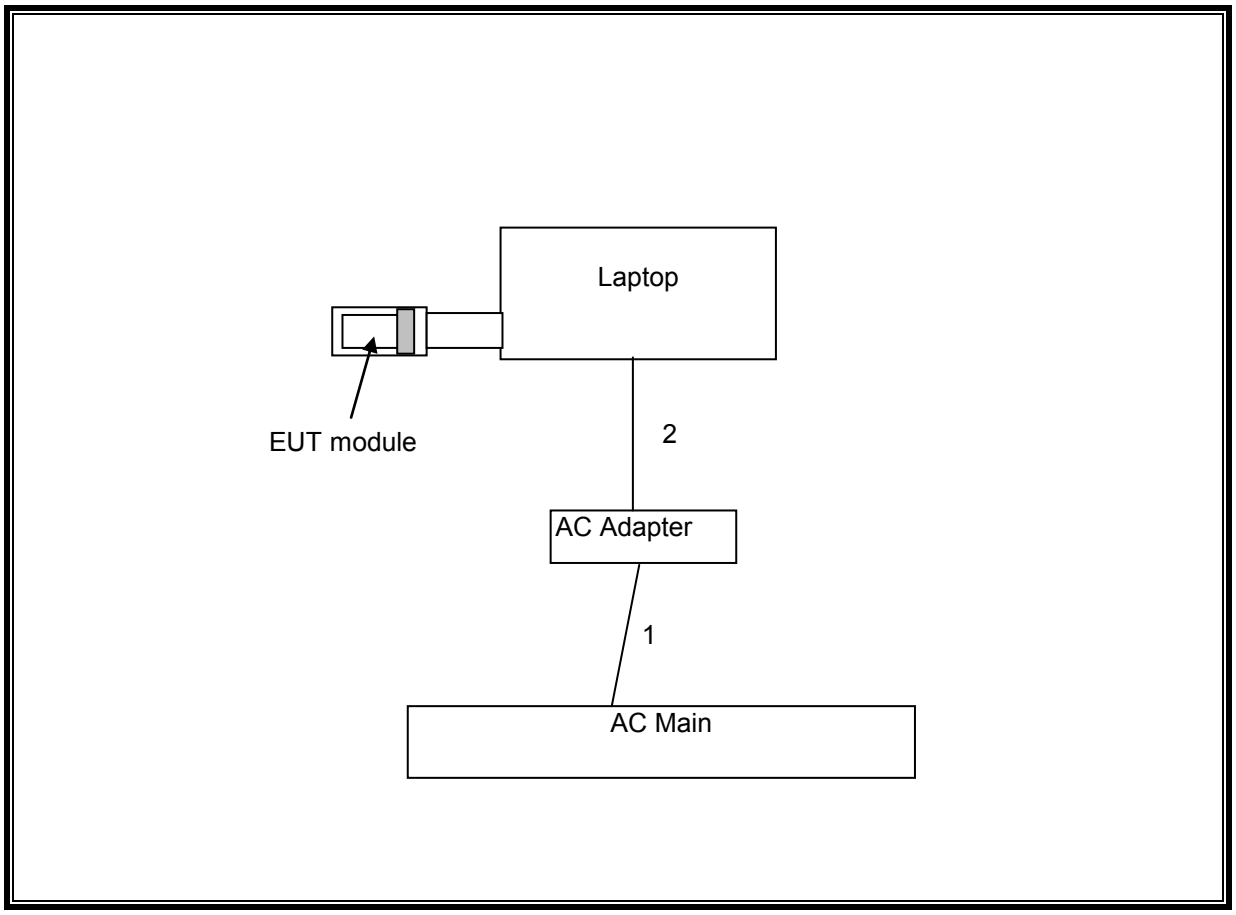
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115V	Unshielded	1m	N/A
2	DC	1	DC	Unshielded	2m	Ferrite on laptop's end

TEST SETUP

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

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	04/29/10	10/29/11
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	01/14/09	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	06/29/10	06/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	06/25/10	06/25/11
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/08/10	06/08/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	01/06/10	07/06/11
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/14/10	07/14/11
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	07/15/10	07/15/11
Peak Power Meter	Boonton	4541	C01186	03/01/10	03/01/11
Peak Power Sensor	Boonton	57318	0	02/24/10	02/24/11
EMI Receiver, 6.5 GHz	Agilent / HP	8546A	1963	05/19/10	08/19/11
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/06/09	05/06/11
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/06/09	02/06/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	01/00/00	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02601	CNR	CNR

7. ANTENNA PORT TEST RESULTS

7.1. 5.2 GHz BAND CHANNEL TESTS FOR 802.11a MODE

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

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	19.878	16.5039
Middle	5200	18.477	16.4523
High	5240	20.866	16.5148

CHAIN 1

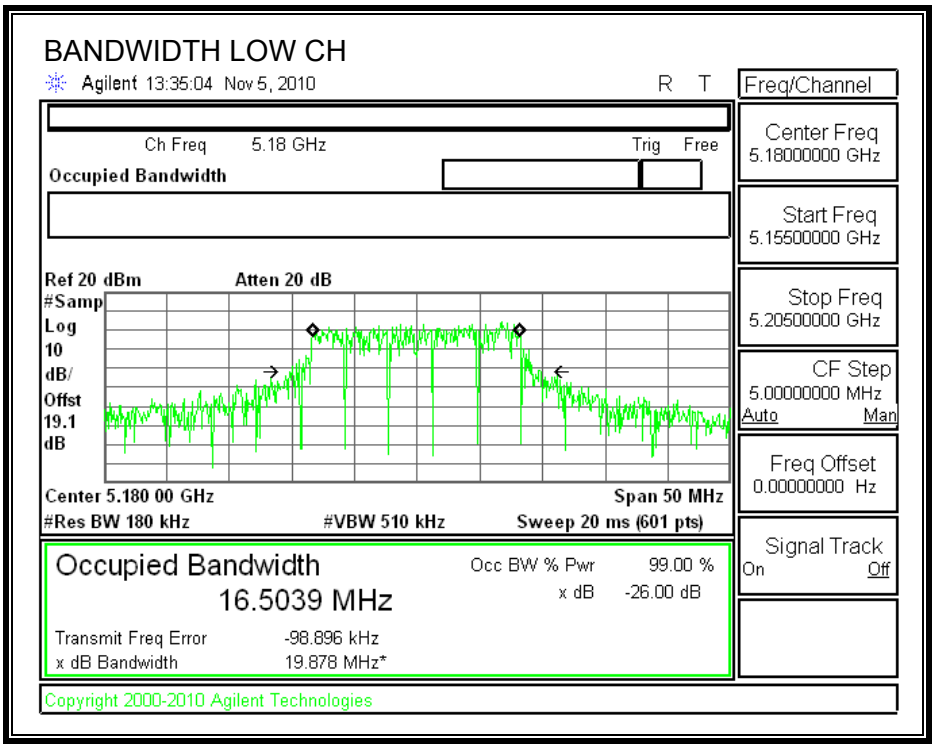
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	20.609	16.5293
Middle	5200	20.329	16.4458
High	5240	19.922	16.4741

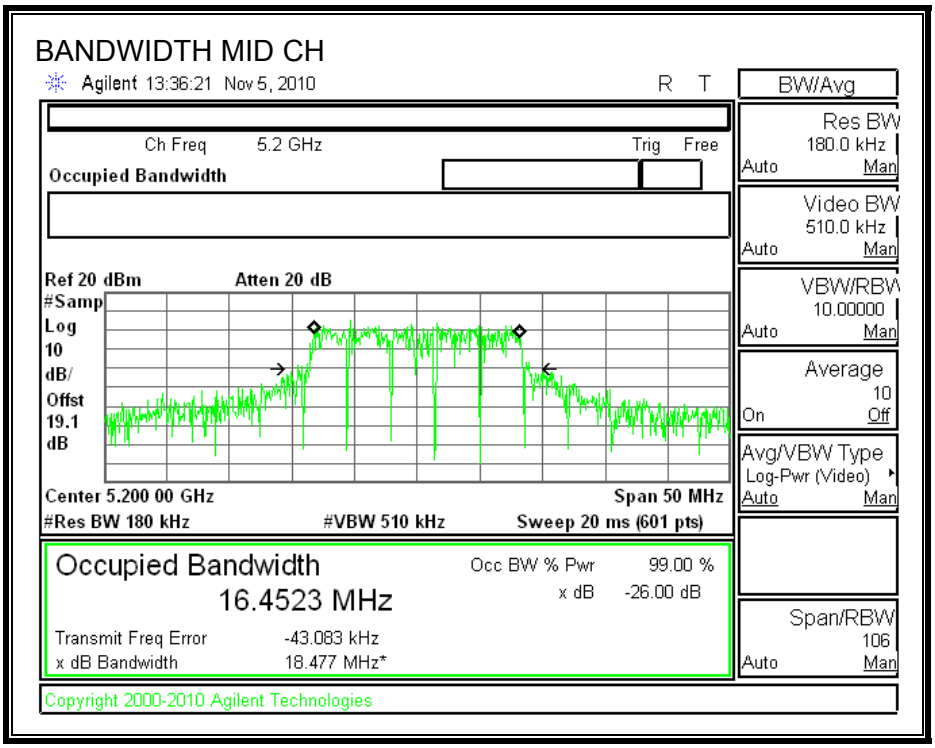
CHAIN 2

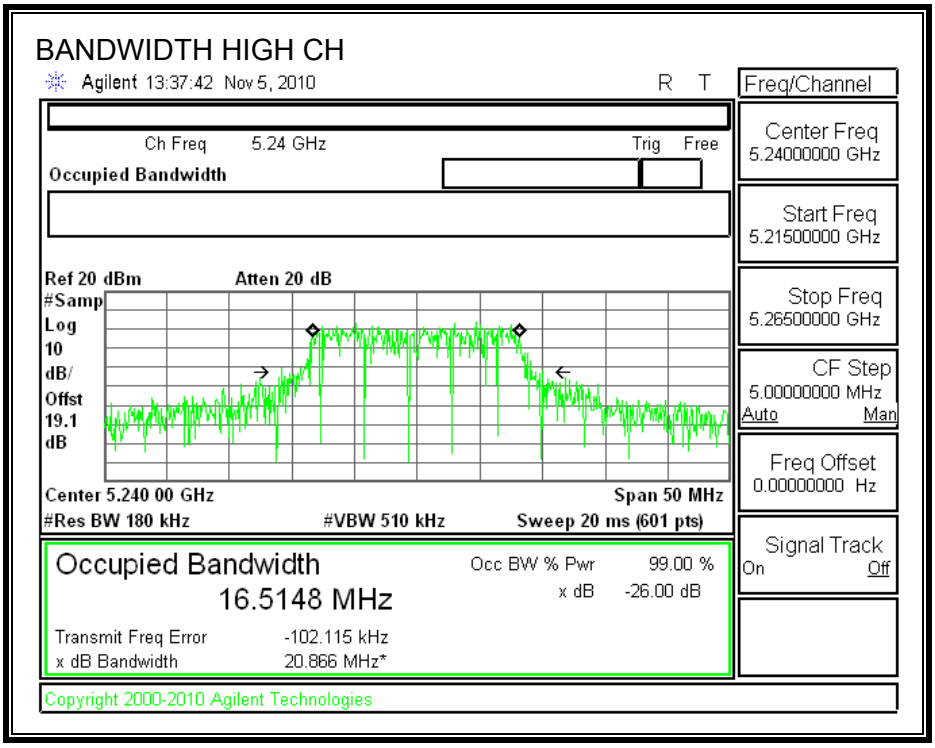
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	20.219	16.4173
Middle	5200	20.185	16.4876
High	5240	19.351	16.4042

CHAIN 0

26 dB and 99% BANDWIDTH

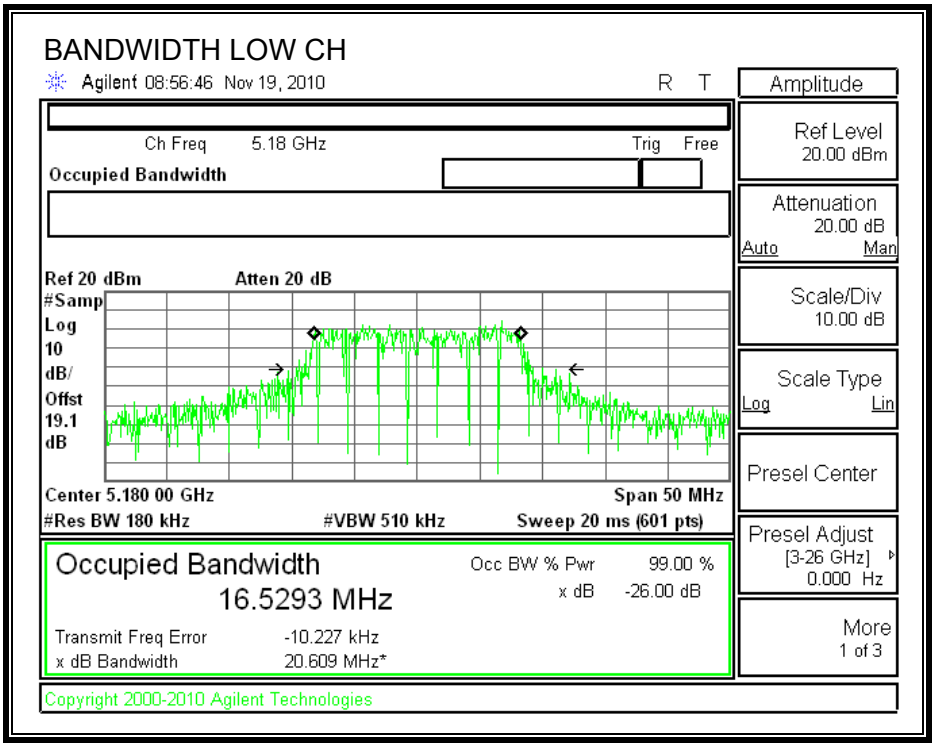


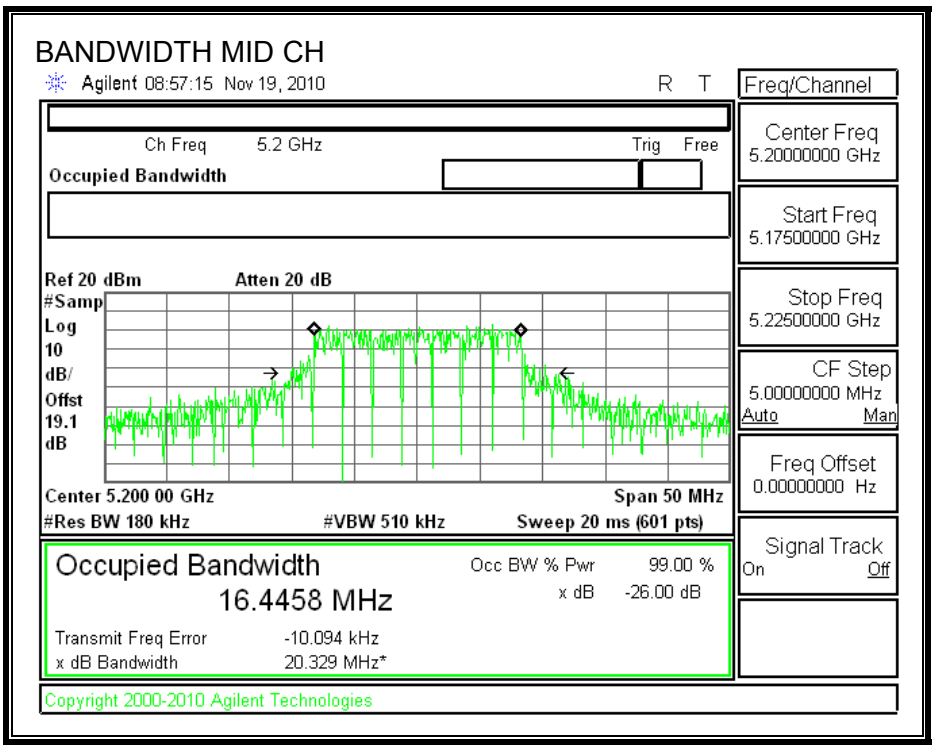


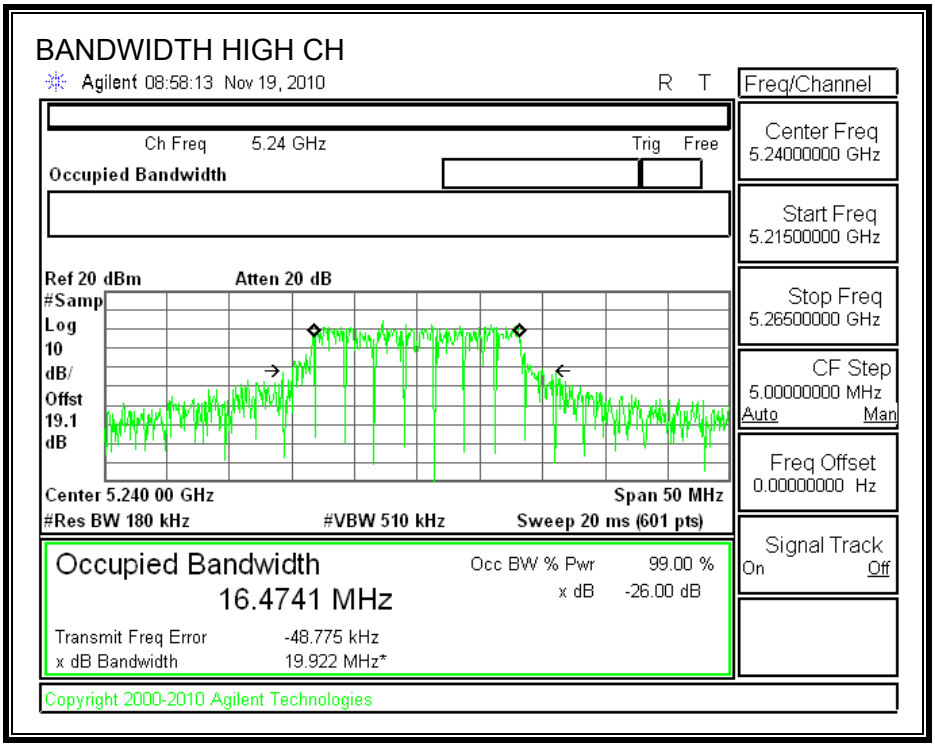


CHAIN 1

26 dB and 99% BANDWIDTH

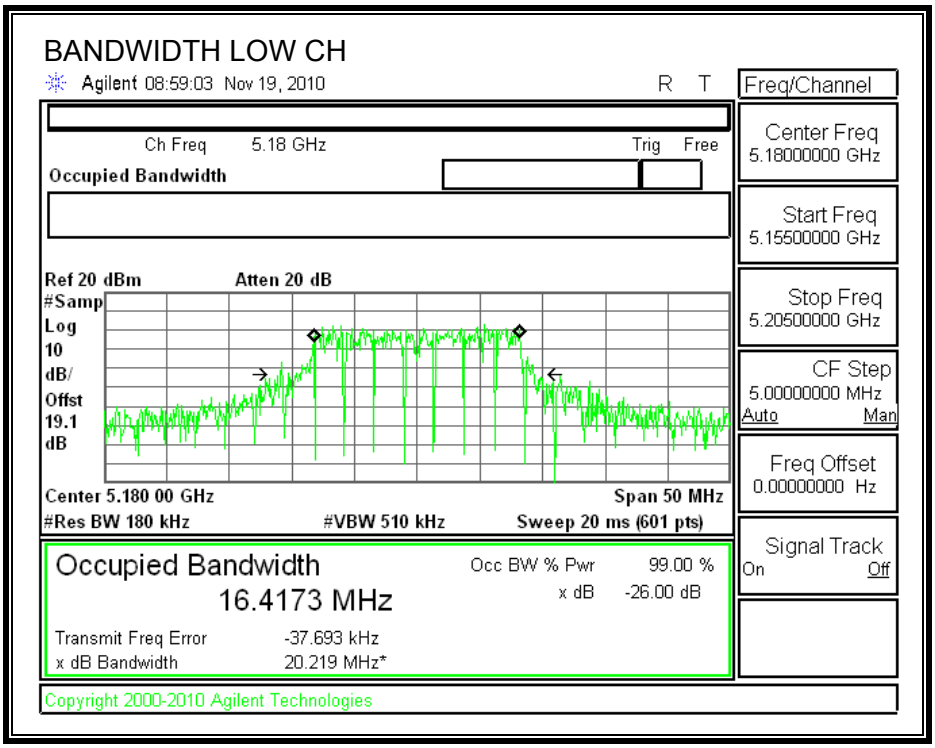


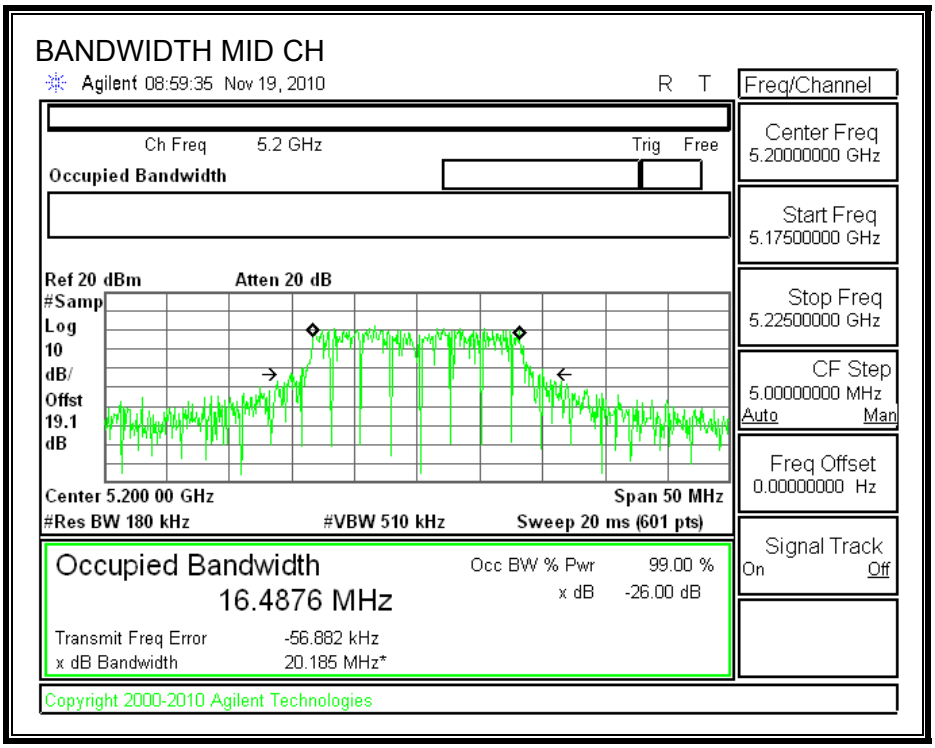


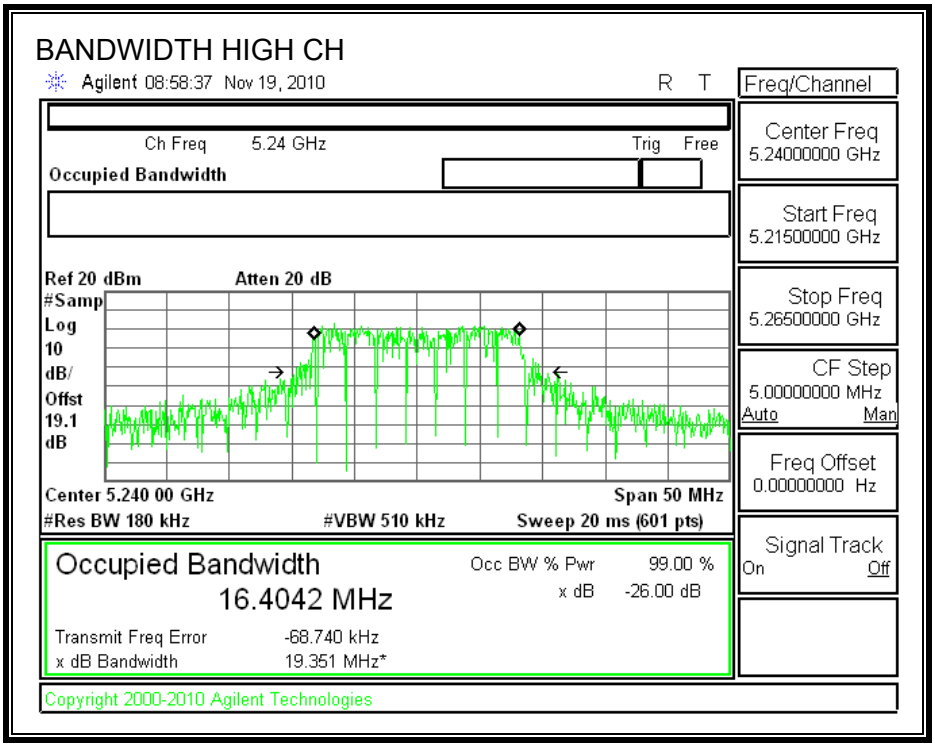


CHAIN 2

26 dB and 99% BANDWIDTH







7.1.2. 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.

The maximum of 1x3 antenna gain is less than 6 dBi, and the combination of 3x3 antennas gain is 10.28 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

1x3

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5180	16.99	19.878	16.98	5.97	16.98
Mid	5200	16.99	18.477	16.67	5.97	16.67
High	5240	16.99	20.866	17.19	5.97	16.99

Individual Chain Results

Channel	Frequency (MHz)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	15.16	16.98	-1.82
Mid	5200	15.17	16.67	-1.50
High	5240	14.89	16.99	-2.10

3x3

Limit

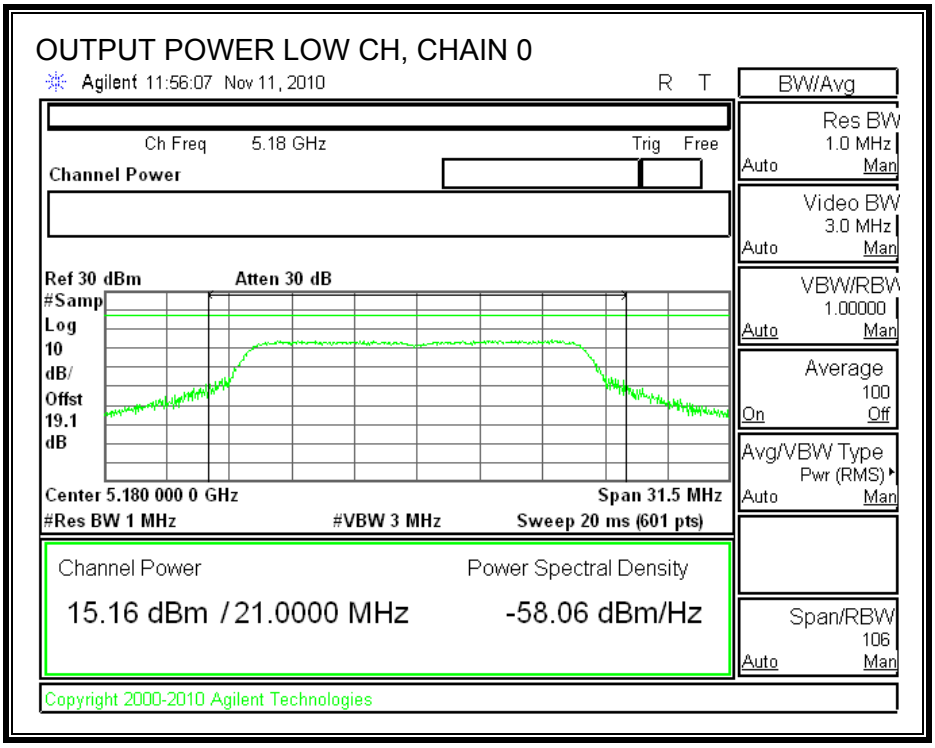
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5180	16.99	20.609	17.14	10.28	12.71
Mid	5200	16.99	20.329	17.08	10.28	12.71
High	5240	16.99	19.952	17.00	10.28	12.71

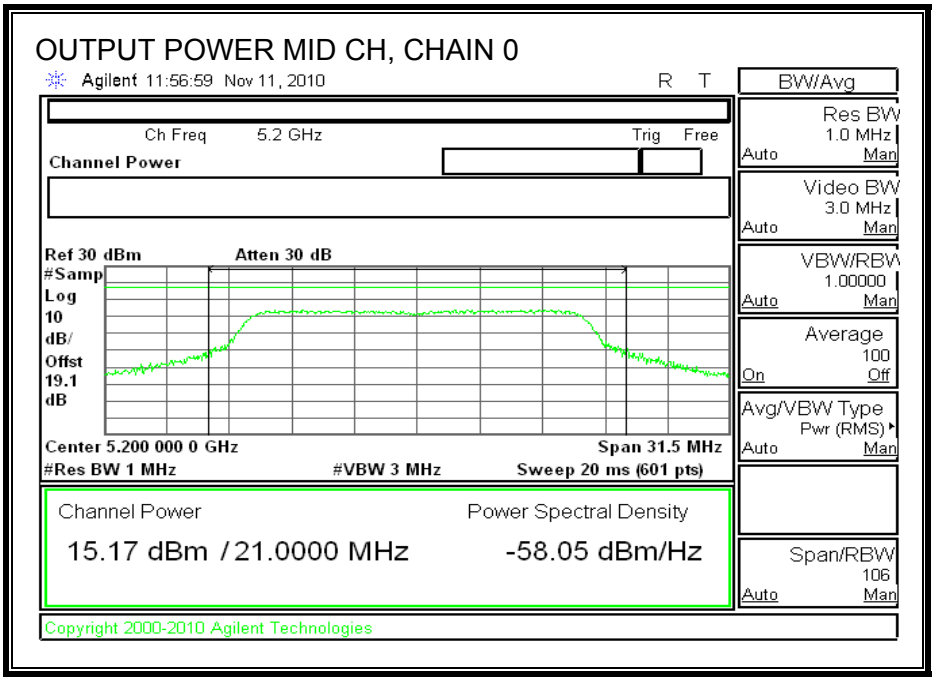
Individual Chain Results

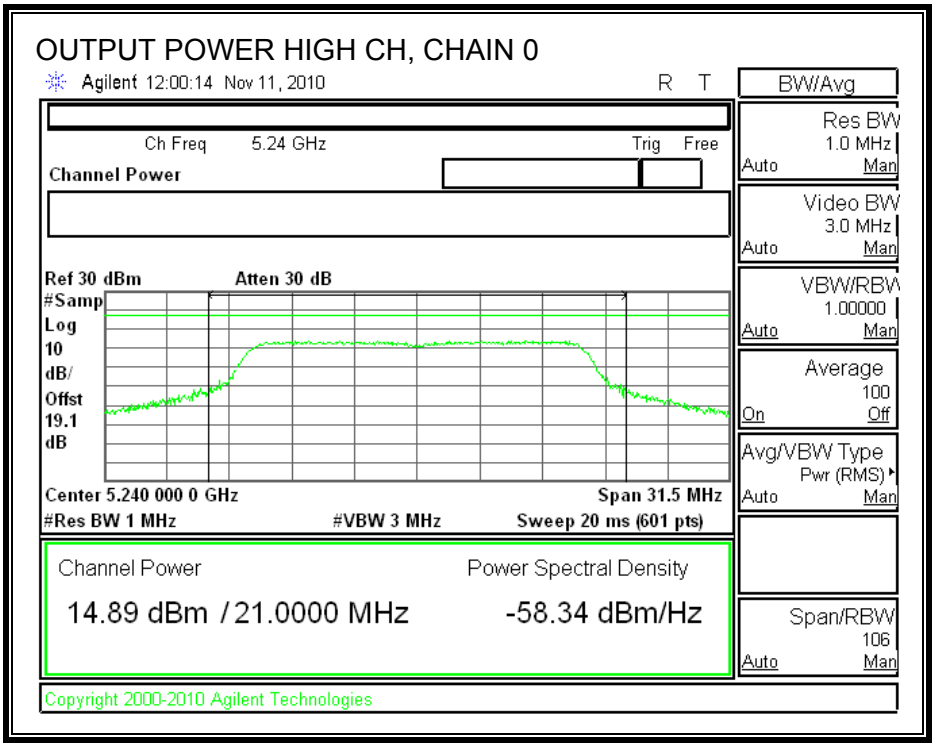
Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	6.73	5.72	4.93	10.63	12.71	-2.08
Mid	5200	5.62	5.62	5.17	10.25	12.71	-2.46
High	5240	6.30	5.71	4.80	10.42	12.71	-2.29

1x3

CHAIN 0 OUTPUT POWER

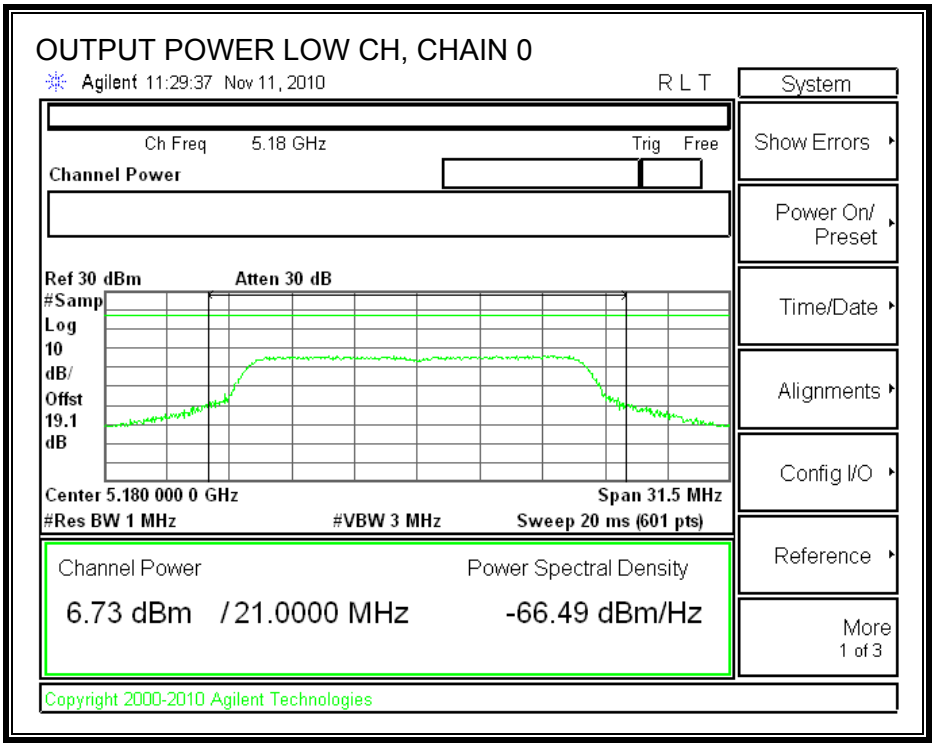


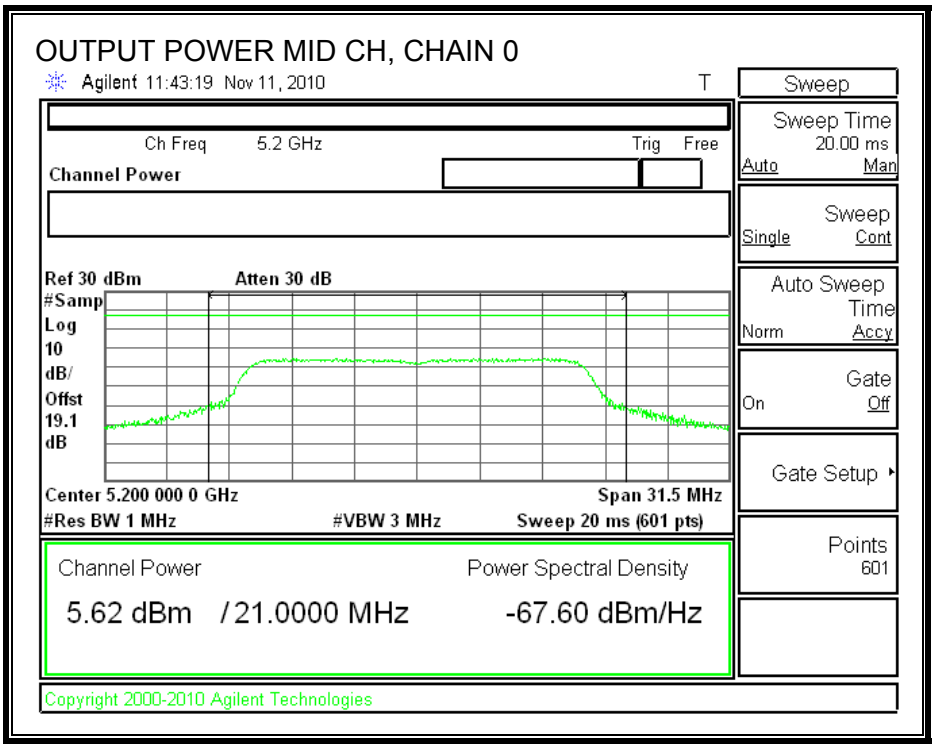


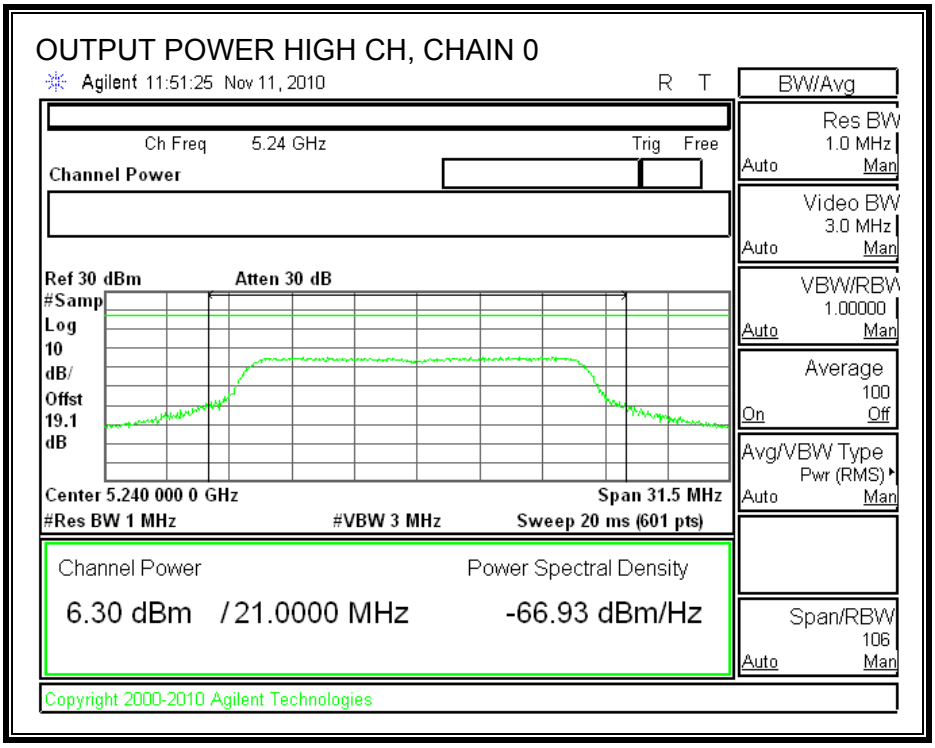


3x3

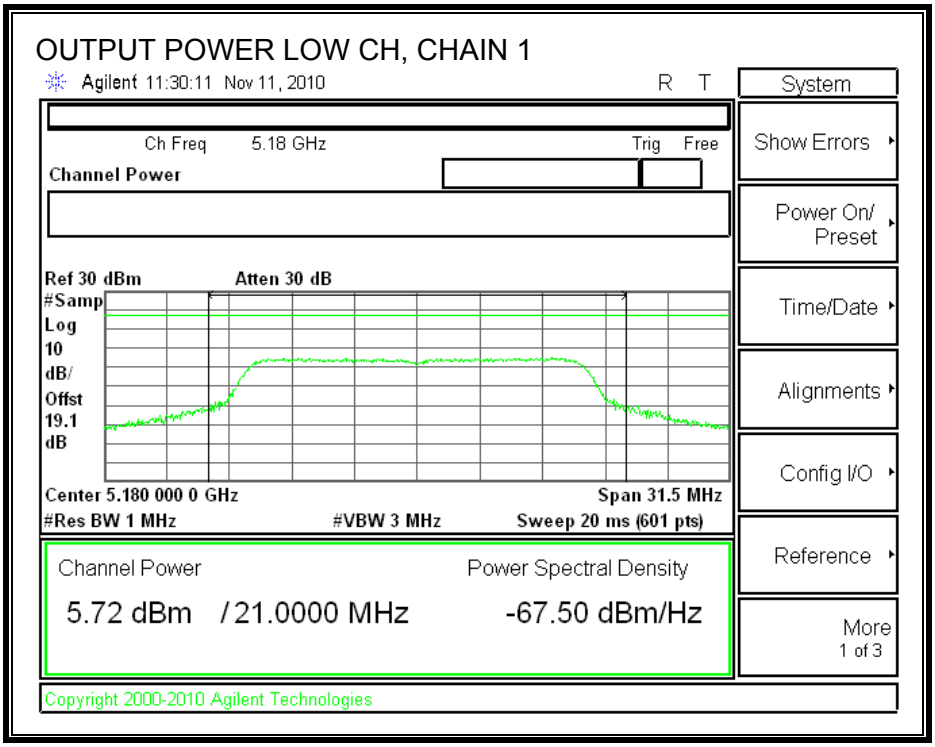
CHAIN 0 OUTPUT POWER

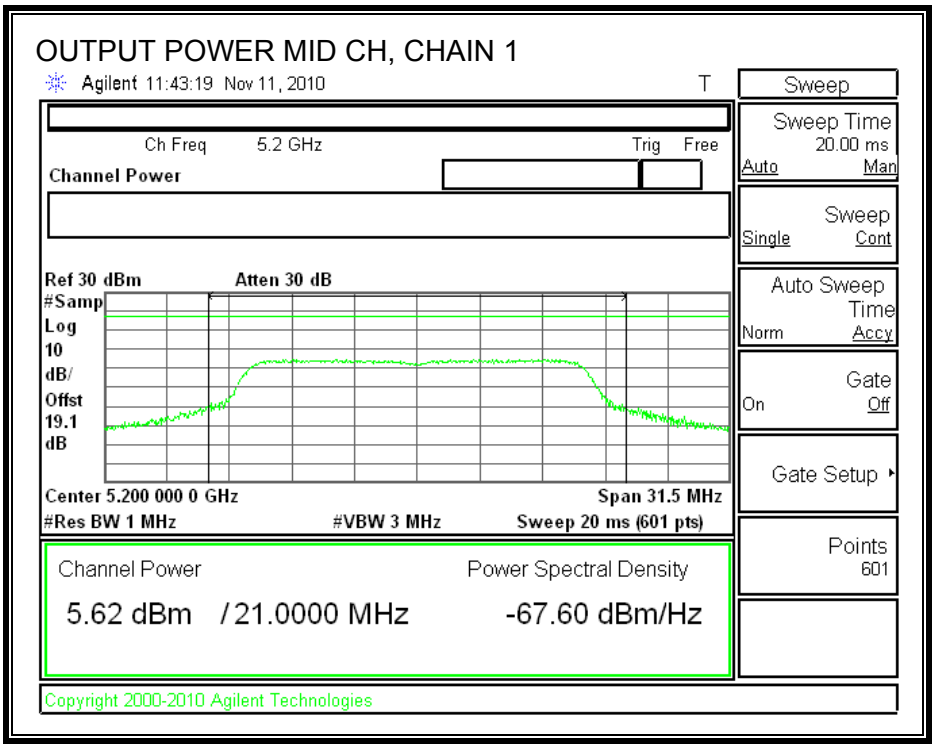


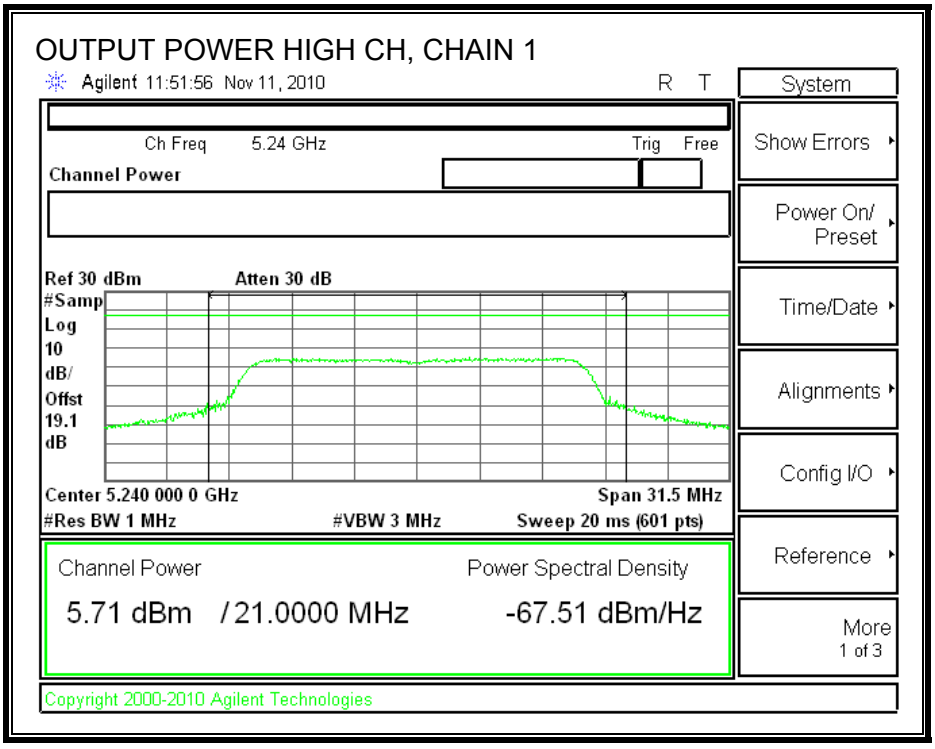




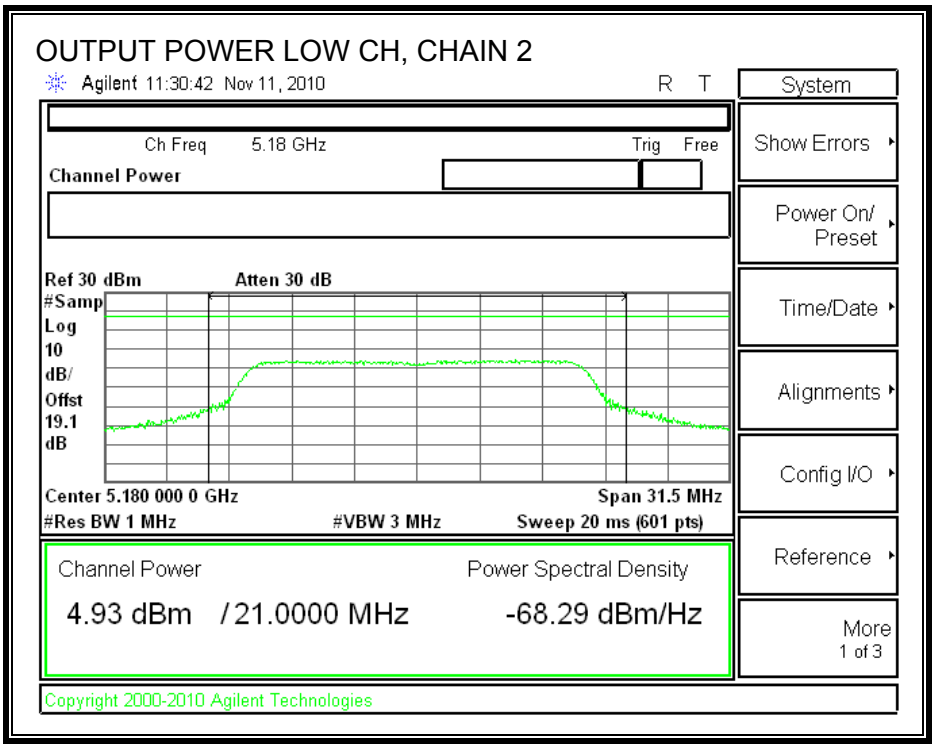
CHAIN 1 OUTPUT POWER

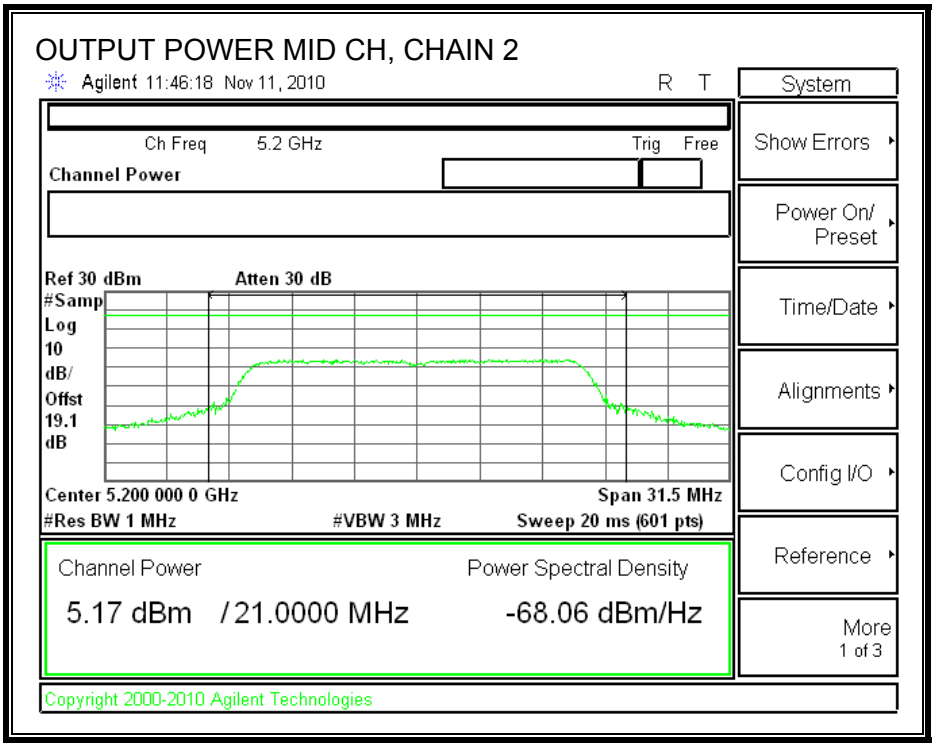


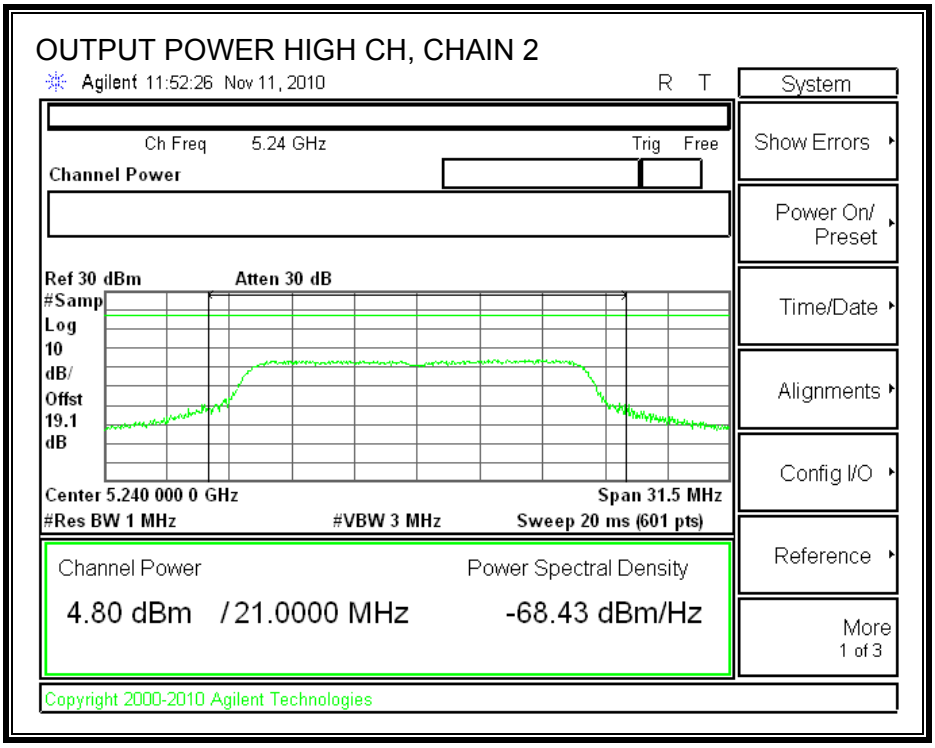




CHAIN 2 OUTPUT POWER







7.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

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

1x3

Channel	Frequency (MHz)	Power (dBm)
Low	5180	15.10
Middle	5200	15.12
High	5240	14.60

3x3

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	6.50	5.70	4.95	10.53
Middle	5200	5.50	5.52	5.10	10.15
High	5240	6.10	5.70	4.70	10.31

7.1.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (Chain 0) (dBi)	Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.28	5.97	5.25	10.28

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 combination antenna gain is 10.28 dBi, therefore the limit is -0.28 dBm.

TEST PROCEDURE

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

RESULTS

1x3 CHAIN 0

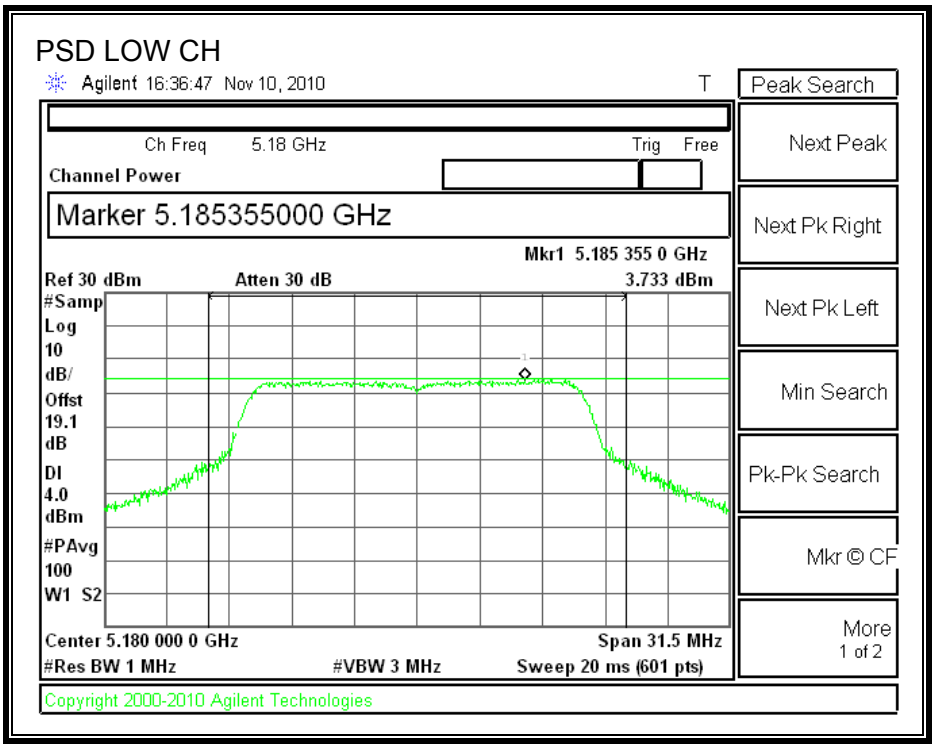
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.733	4.00	-0.27
Middle	5200	3.512	4.00	-0.49
High	5240	3.662	4.00	-0.34

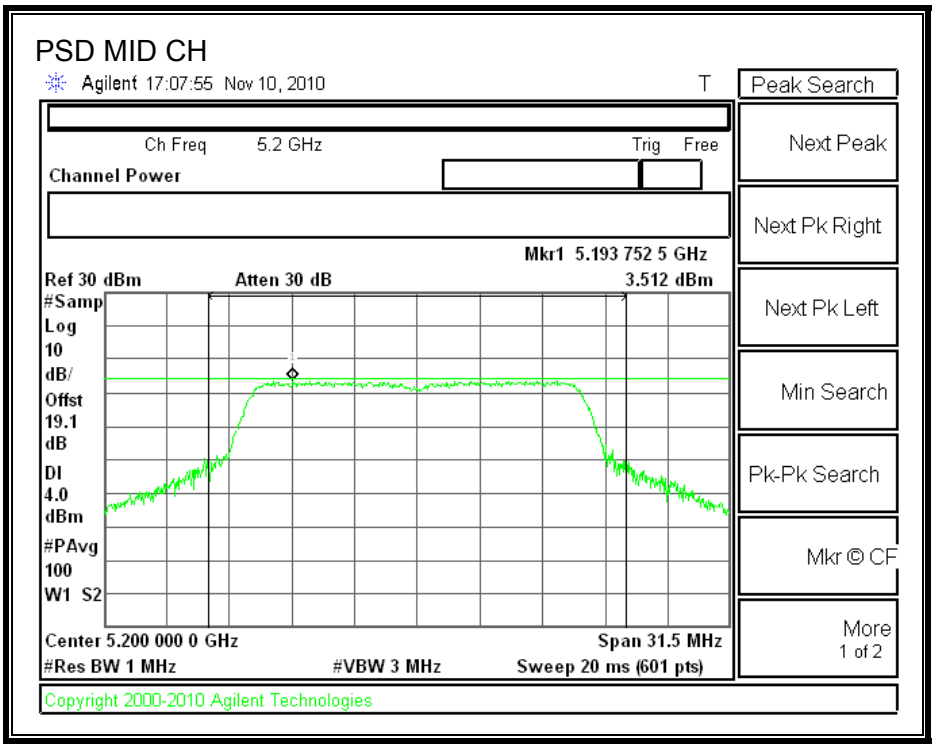
3x3

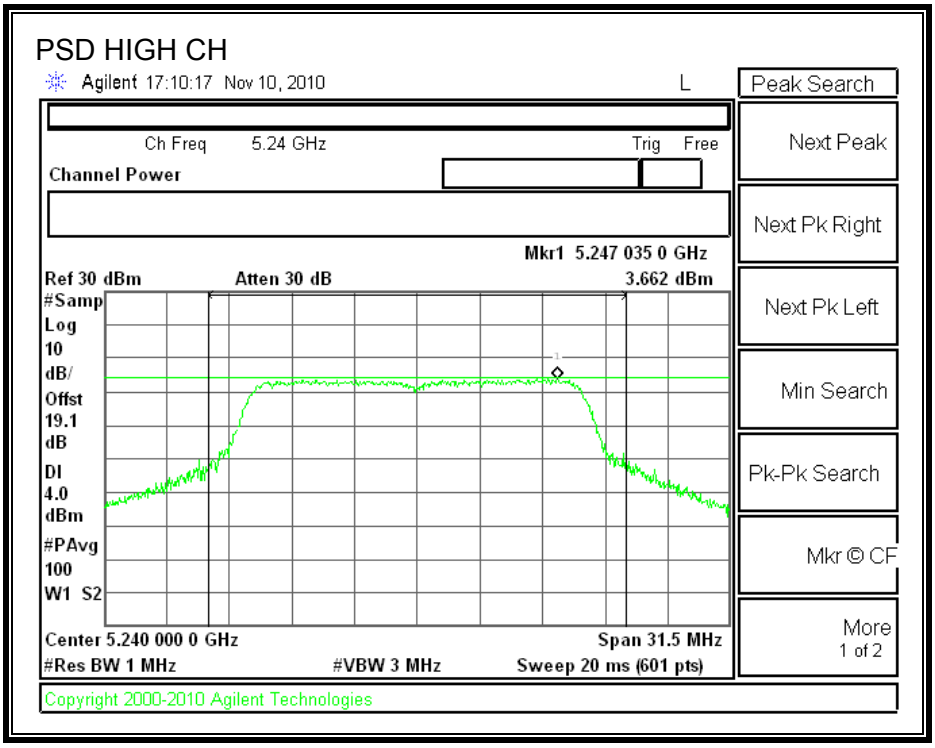
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-4.306	-5.387	-5.8	-0.35	-0.28	-0.07
Middle	5200	-4.245	-5.546	-6.147	-0.47	-0.28	-0.19
High	5240	-4.614	-5.23	-5.901	-0.45	-0.28	-0.17

1x3, POWER SPECTRAL DENSITY

CHAIN 0

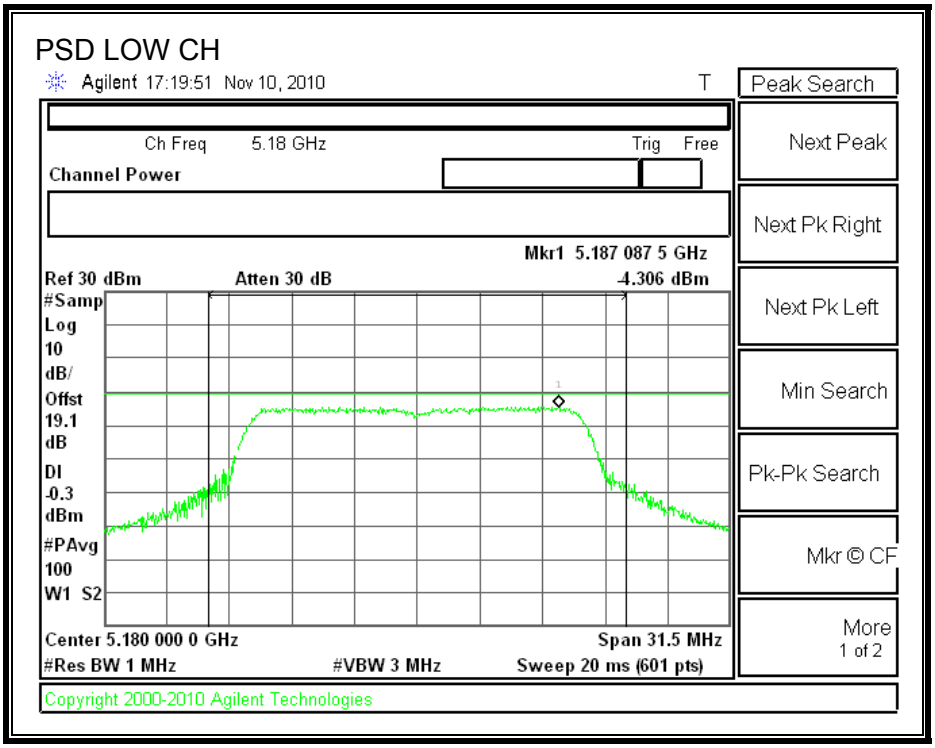




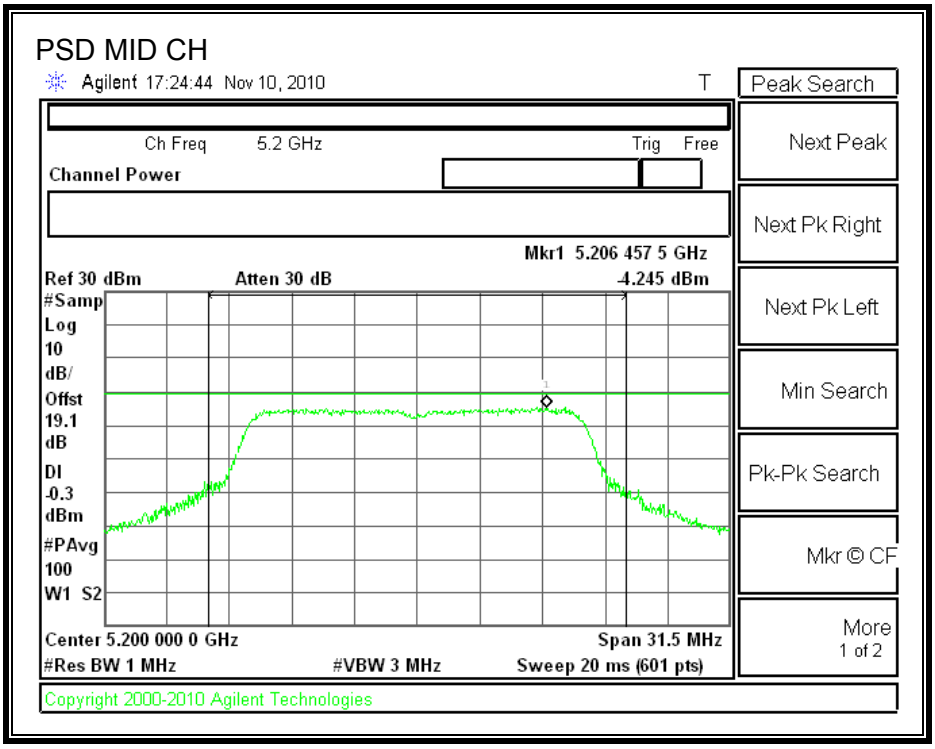


3x3, POWER SPECTRAL DENSITY

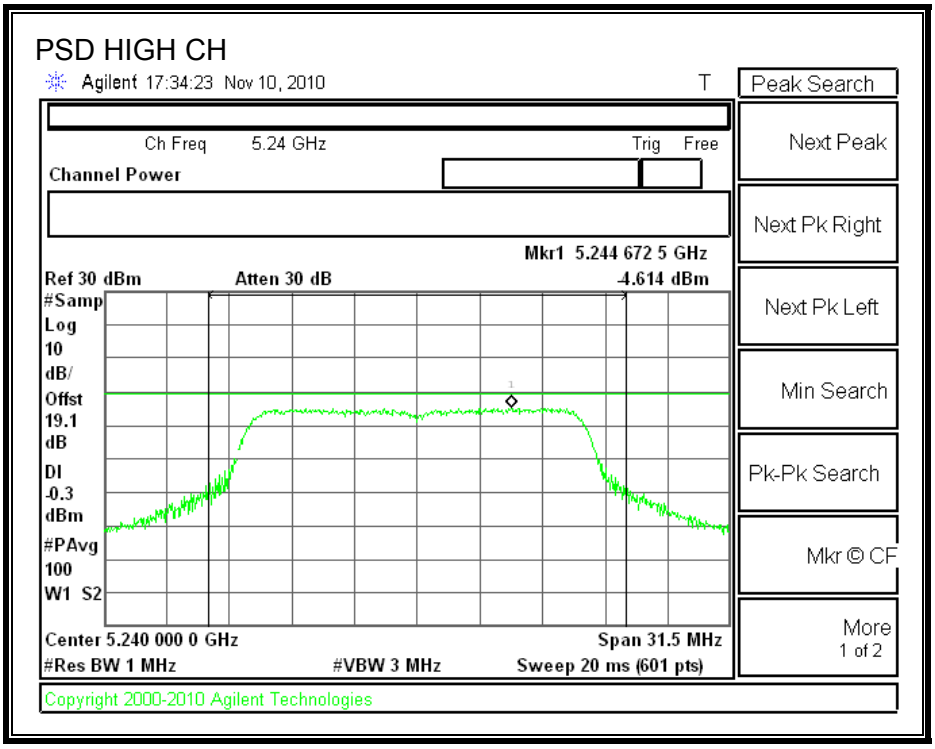
CHAIN 0



PSD MID CH



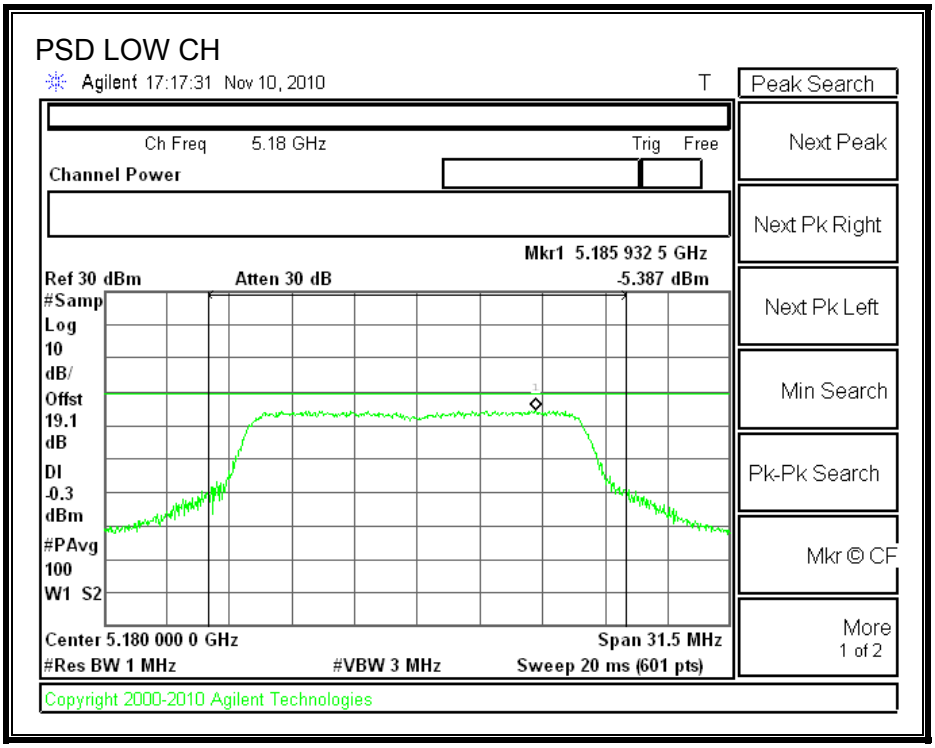
PSD HIGH CH



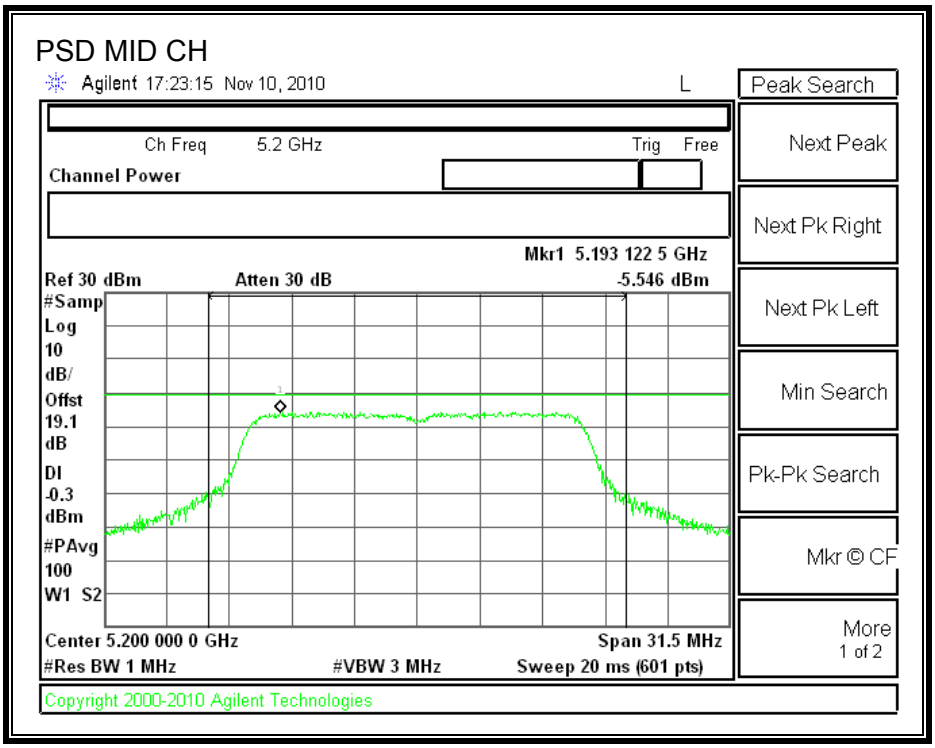
3x3, POWER SPECTRAL DENSITY

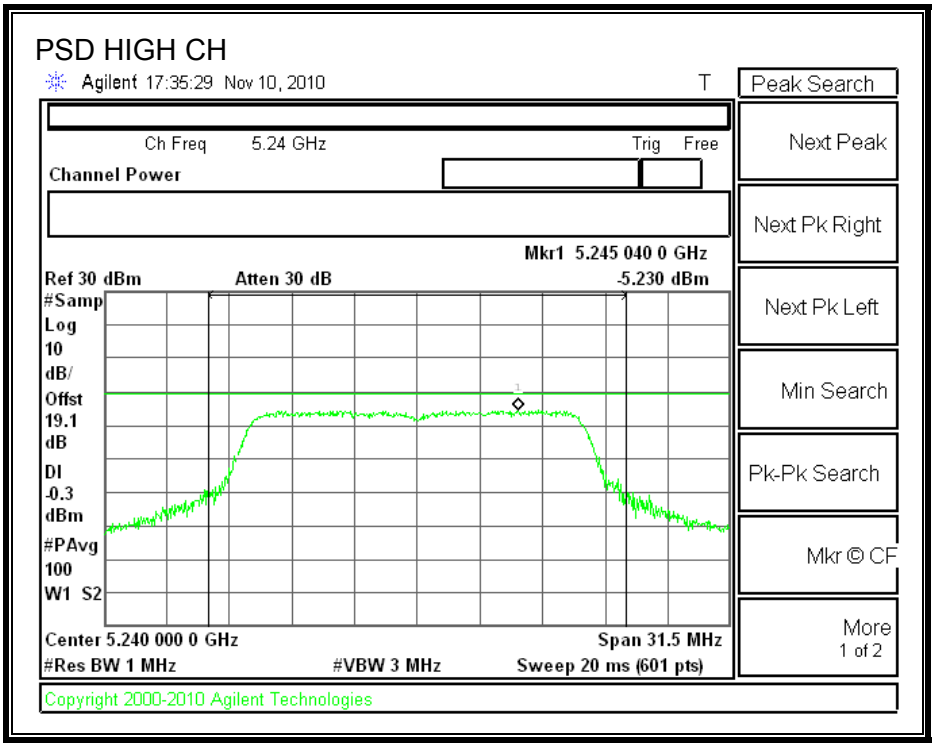
CHAIN 1

PSD LOW CH



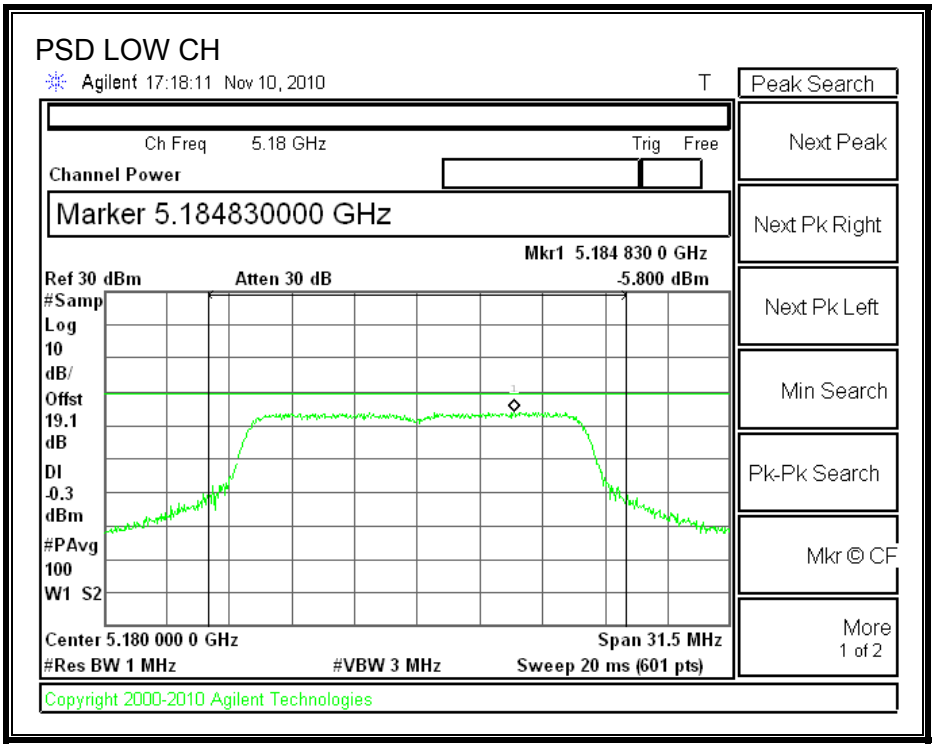
PSD MID CH

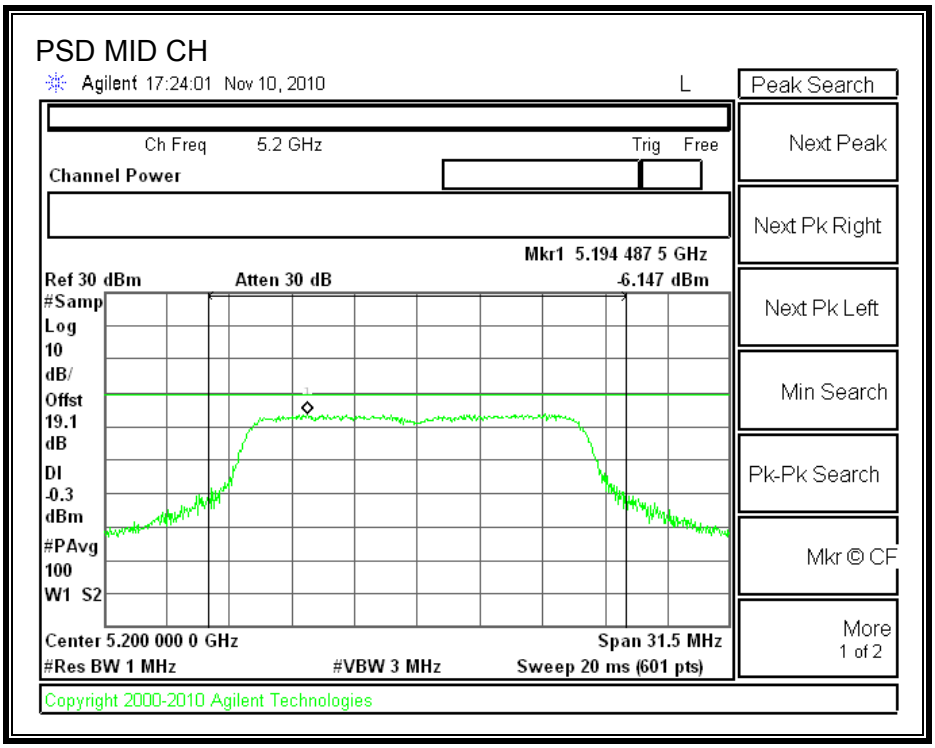


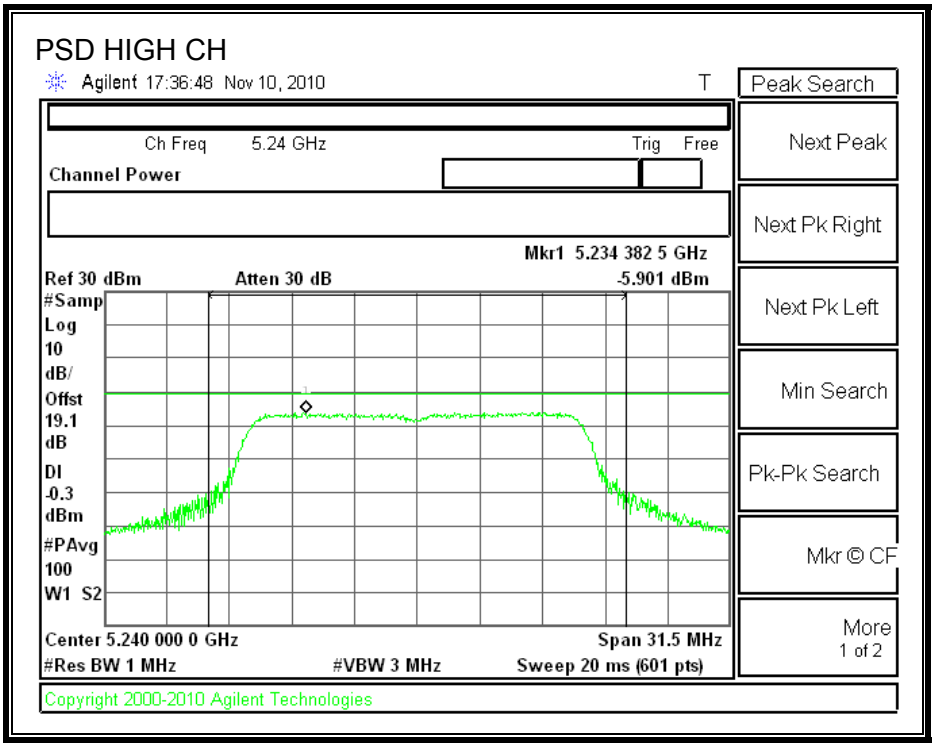


3x3, POWER SPECTRAL DENSITY

CHAIN 2







7.1.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.45	13	-3.55
Middle	5200	10.20	13	-2.80
High	5240	8.85	13	-4.15

CHAIN 1

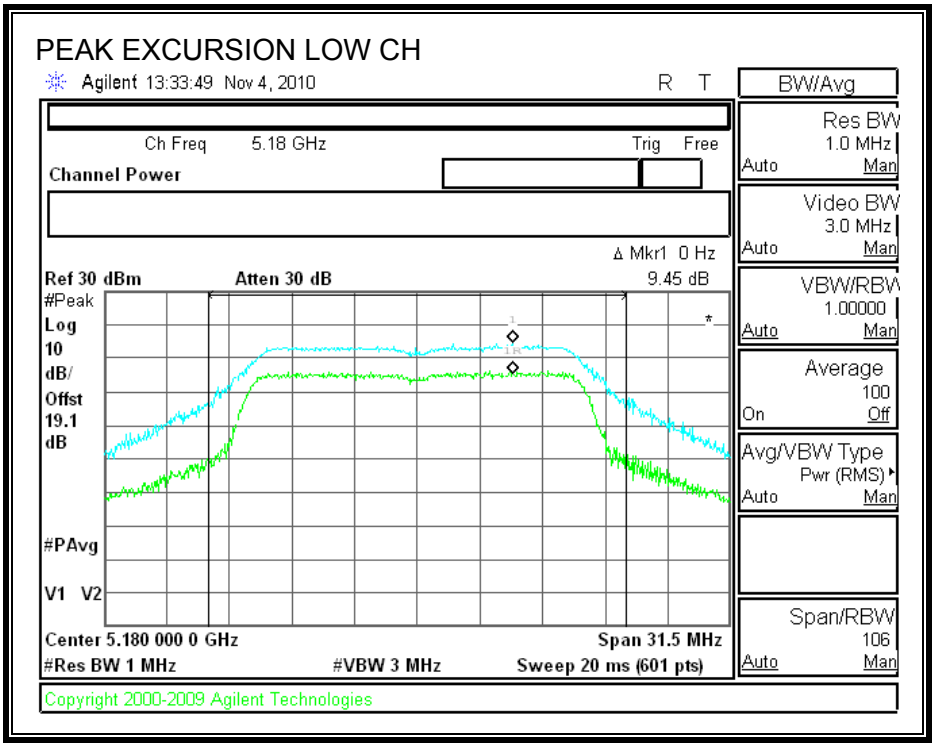
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.23	13	-3.77
Middle	5200	9.47	13	-3.53
High	5240	9.04	13	-3.96

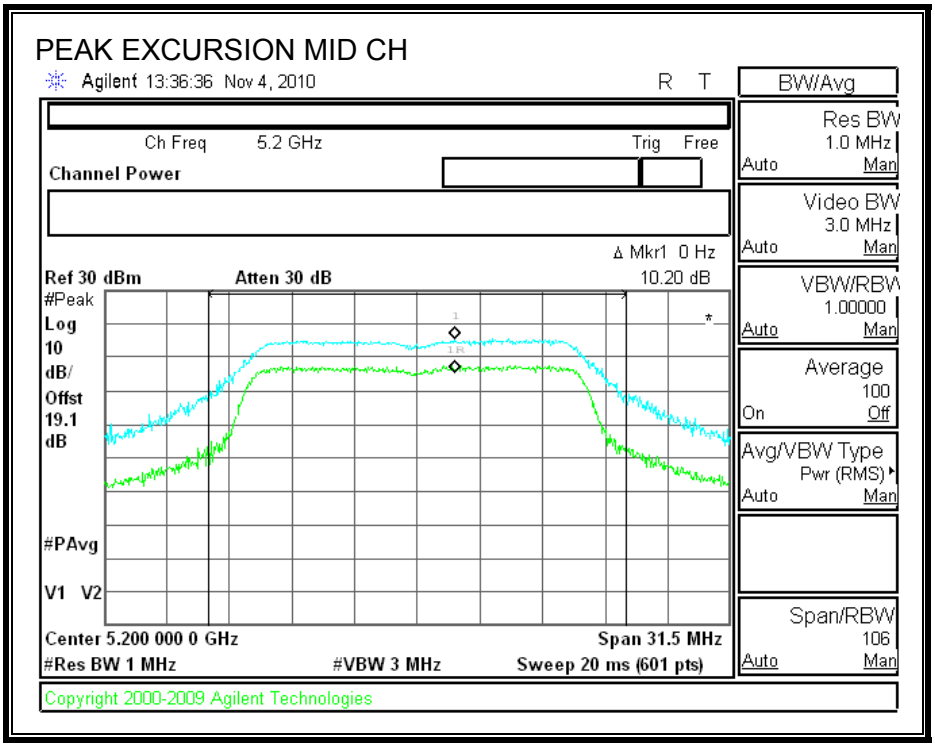
CHAIN 2

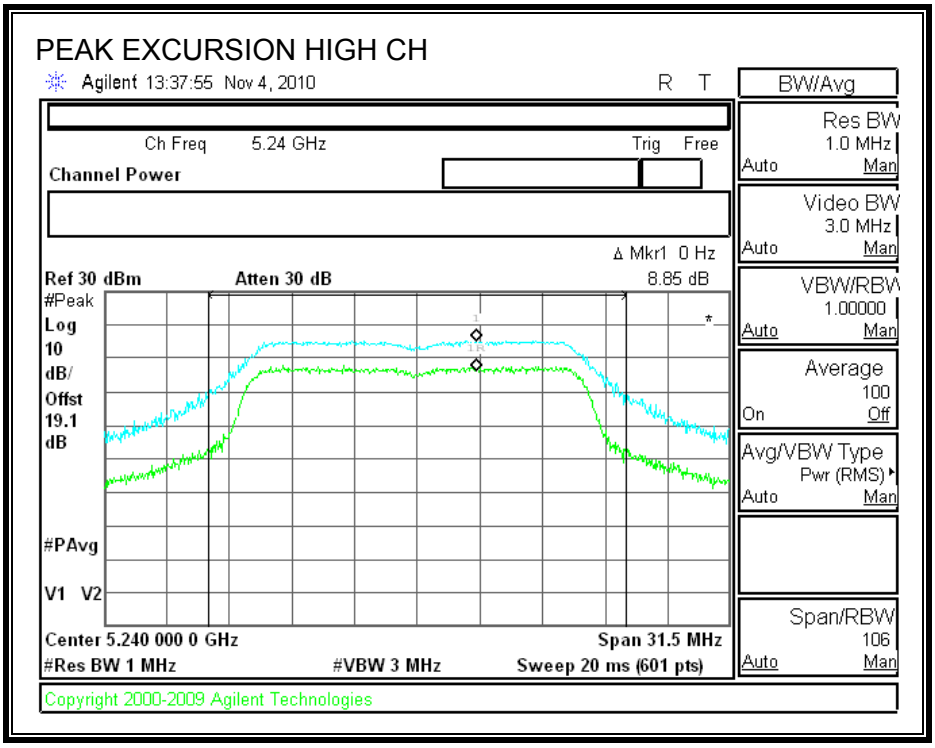
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.42	13	-4.58
Middle	5200	9.33	13	-3.67
High	5240	10.04	13	-2.96

CHAIN 0

PEAK EXCURSION

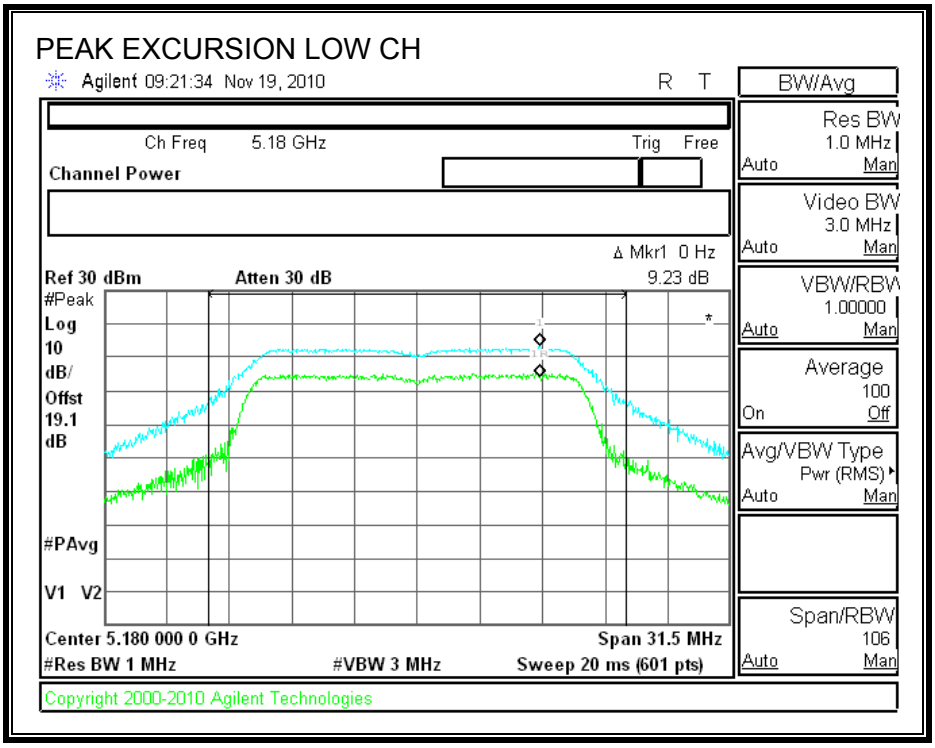




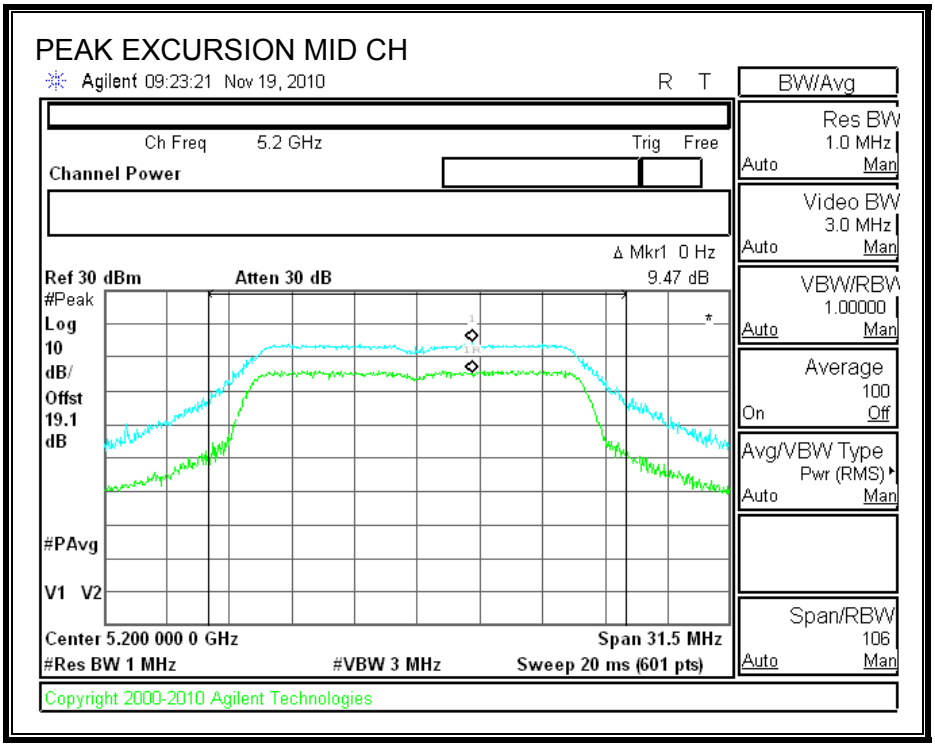


CHAIN 1

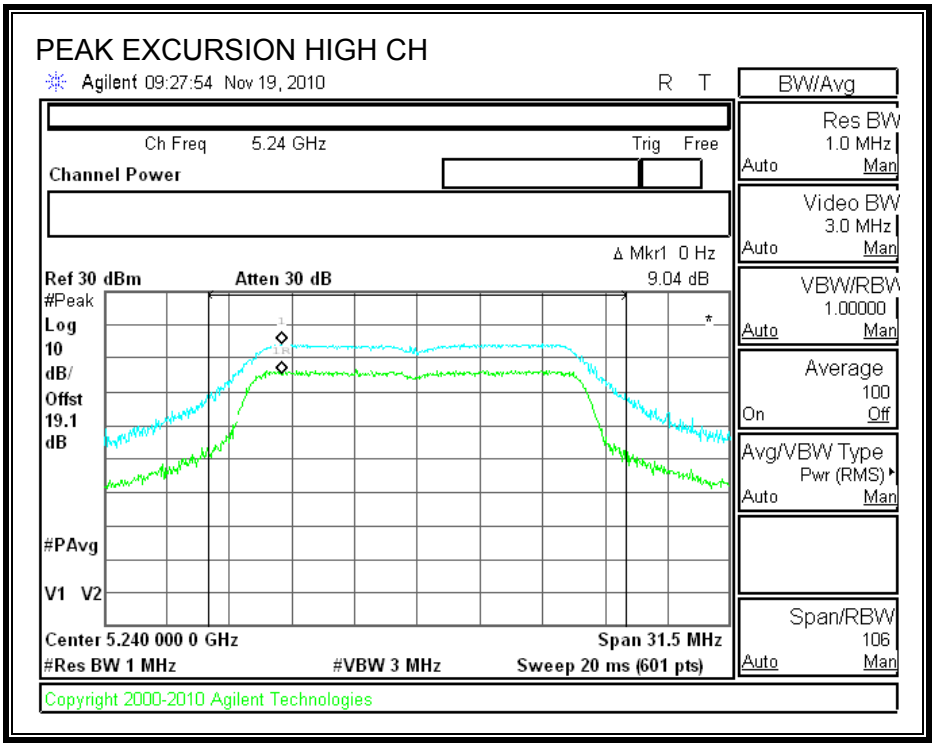
PEAK EXCURSION



PEAK EXCURSION MID CH

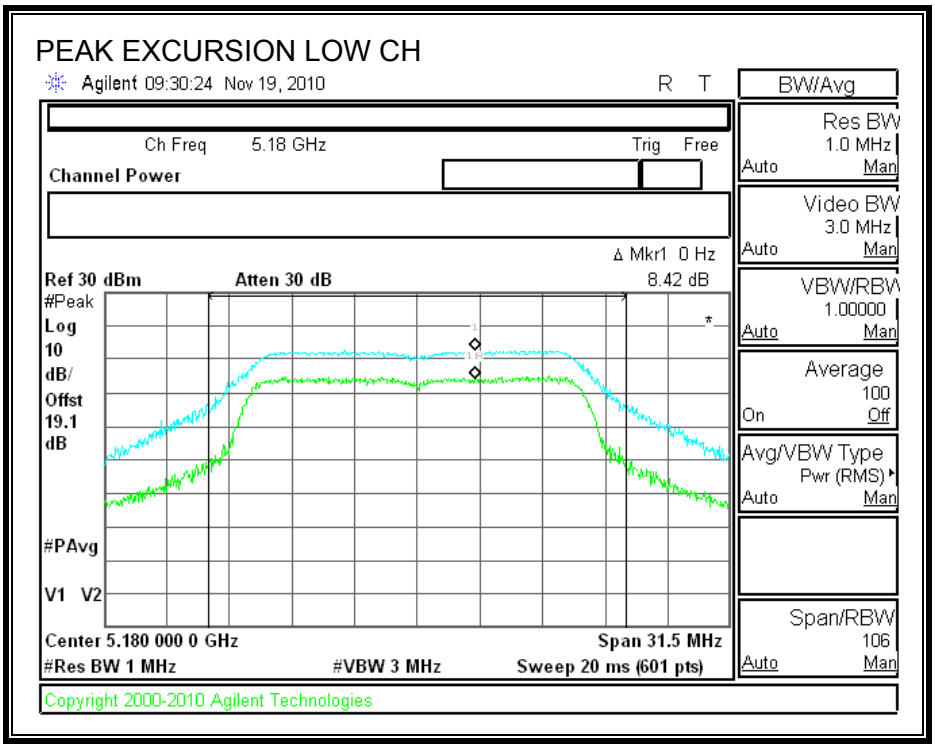


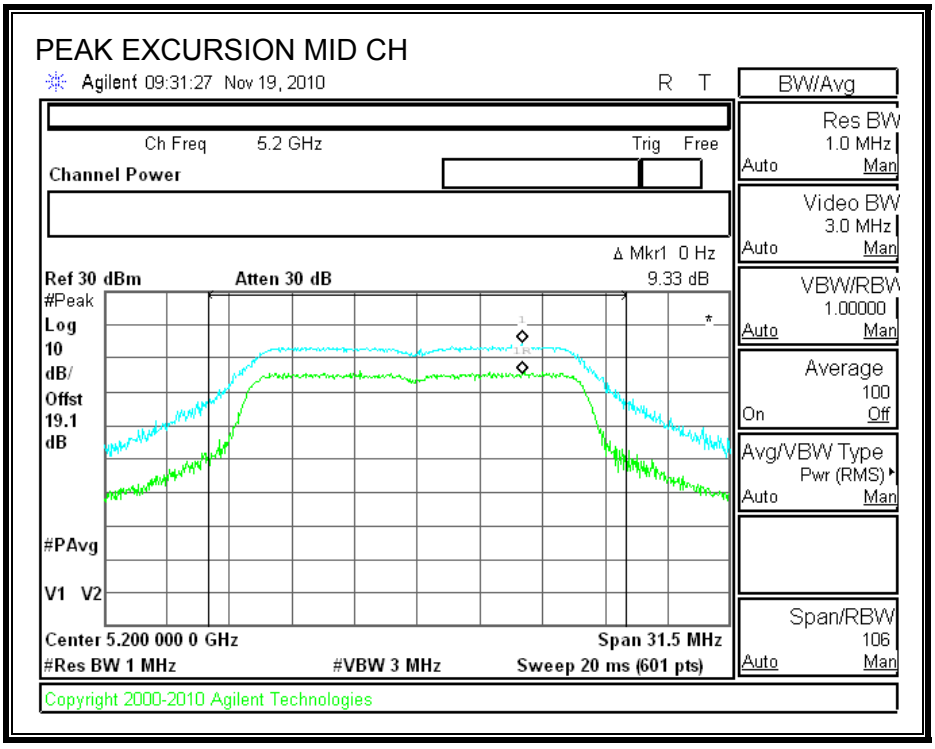
PEAK EXCURSION HIGH CH

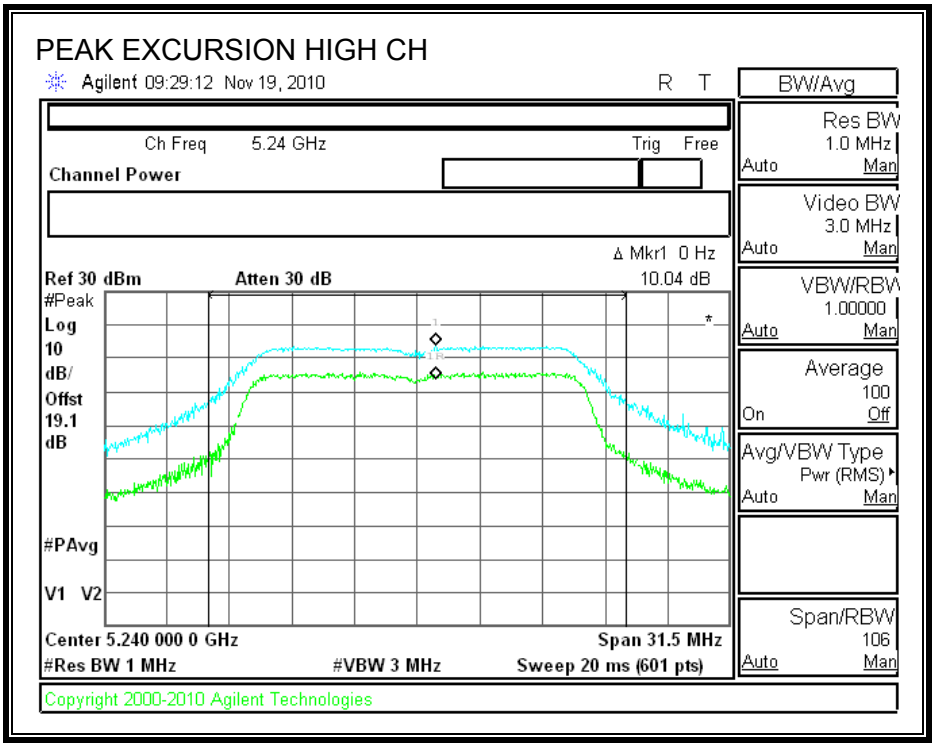


CHAIN 2

PEAK EXCURSION







7.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

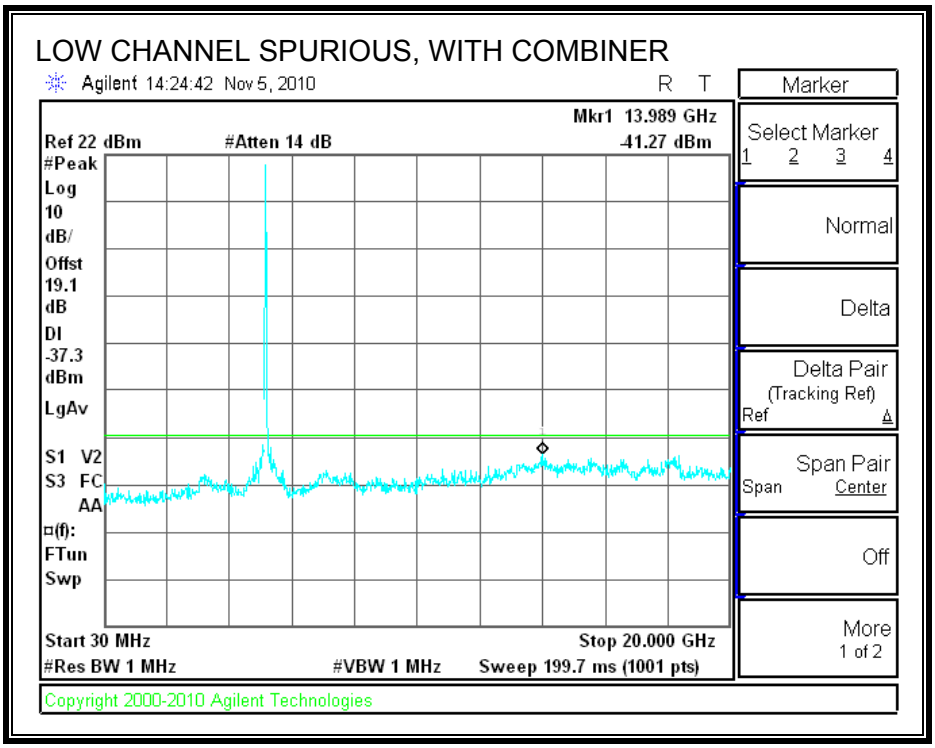
TEST PROCEDURE

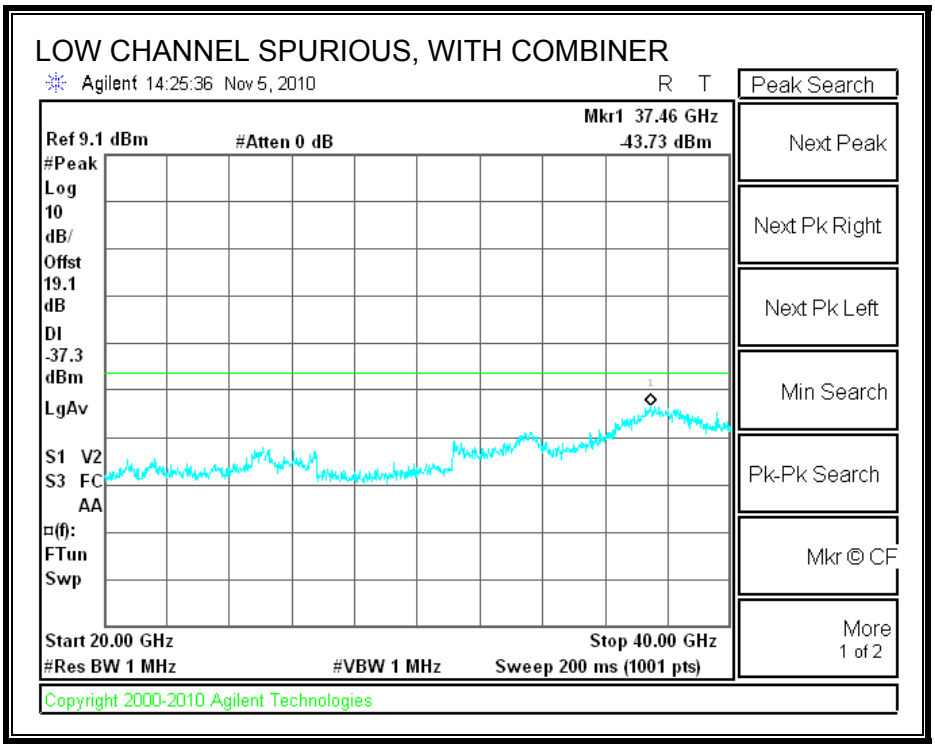
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

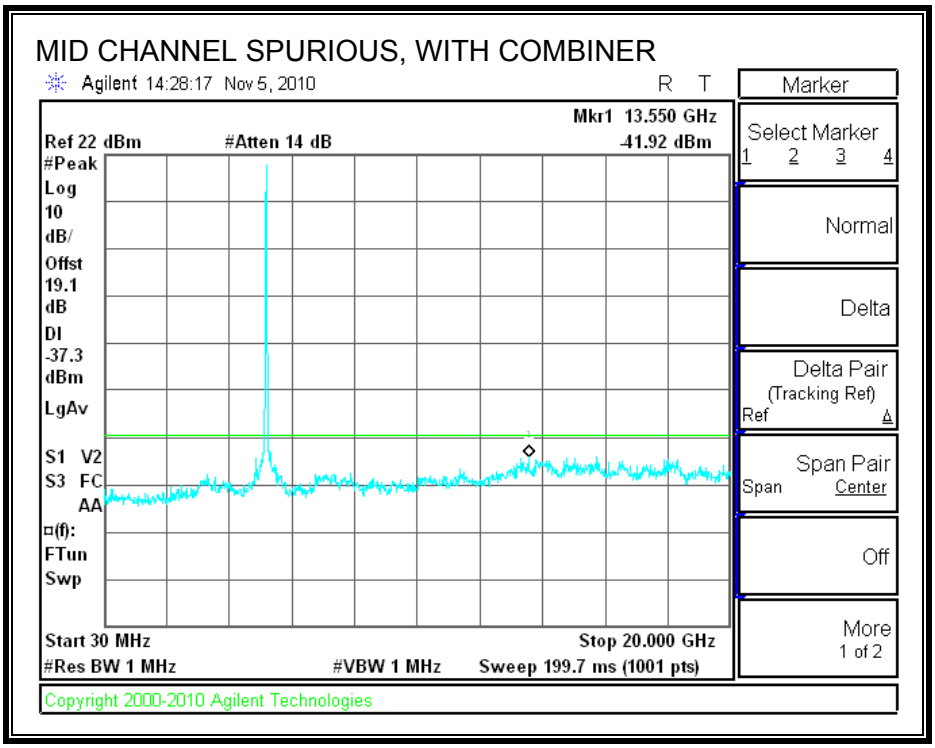
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

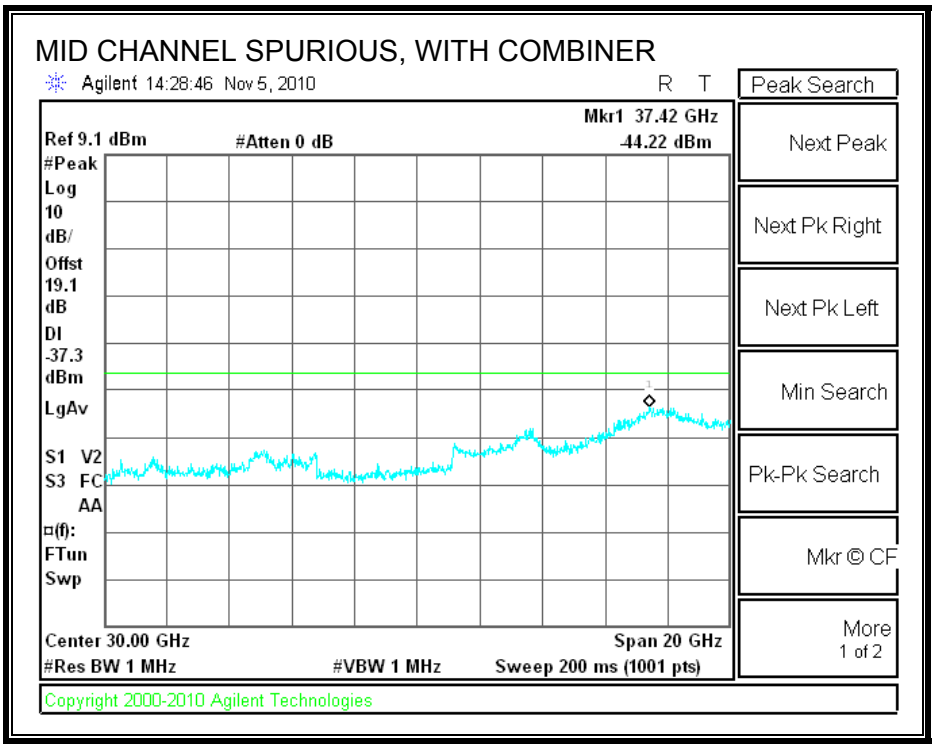
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

SPURIOUS EMISSIONS WITH COMBINER

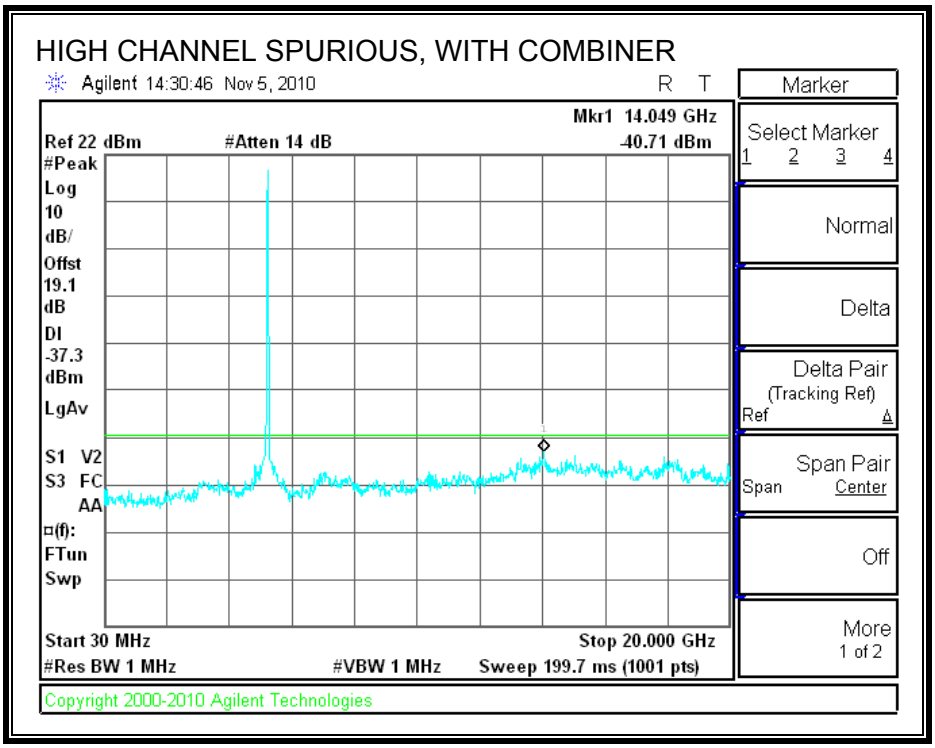




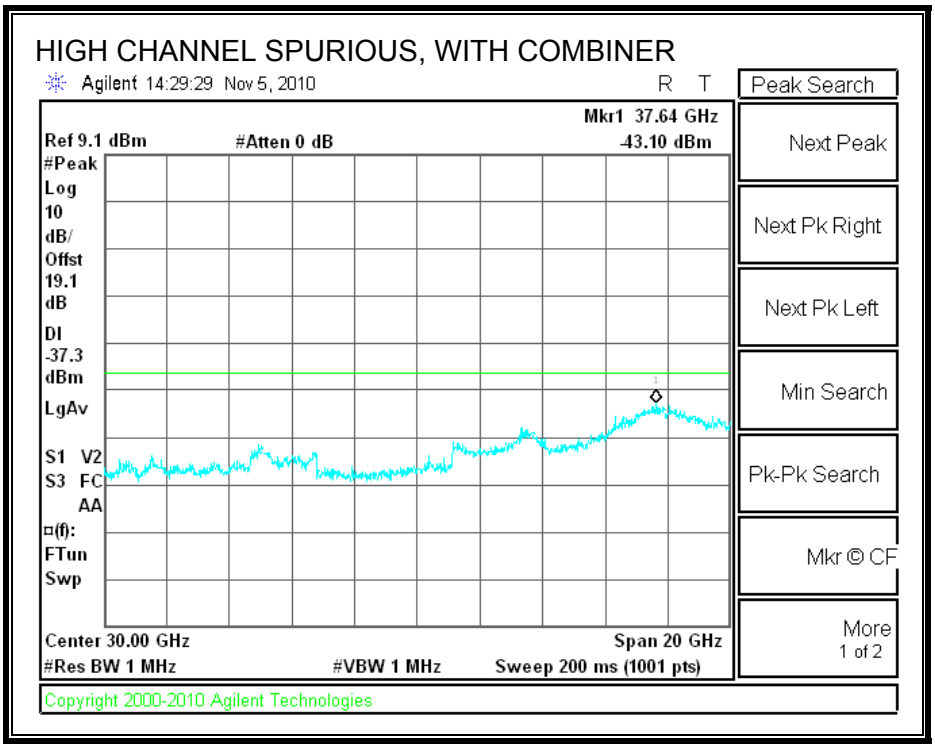




HIGH CHANNEL SPURIOUS, WITH COMBINER



HIGH CHANNEL SPURIOUS, WITH COMBINER



7.2. 5.2 GHz BAND CHANNEL TESTS FOR 802.11n HT20 MODE

7.2.1. 99% & 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	21.401	17.6546
Middle	5200	21.938	17.7308
High	5240	21.316	17.579

CHAIN 1

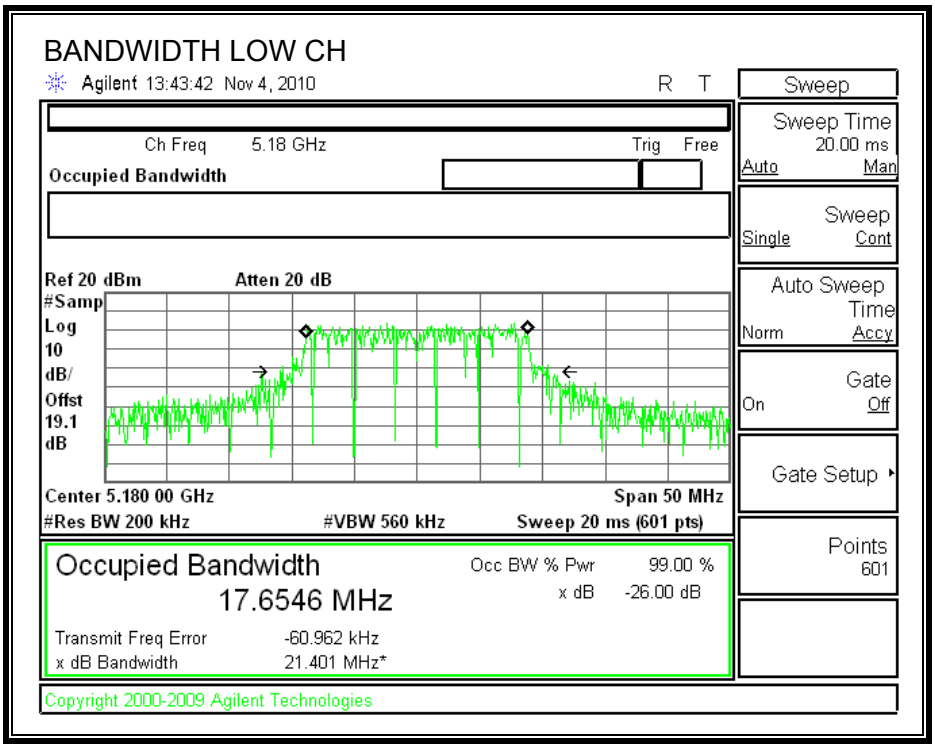
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	20.922	17.7172
Middle	5200	21.073	17.7417
High	5240	21.854	17.6851

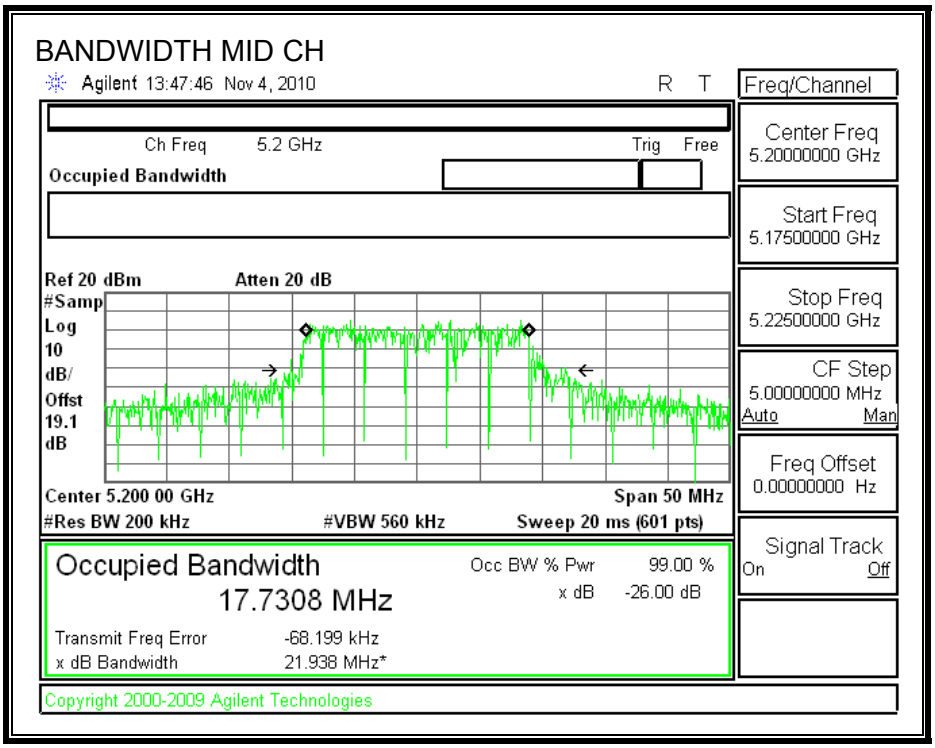
CHAIN 2

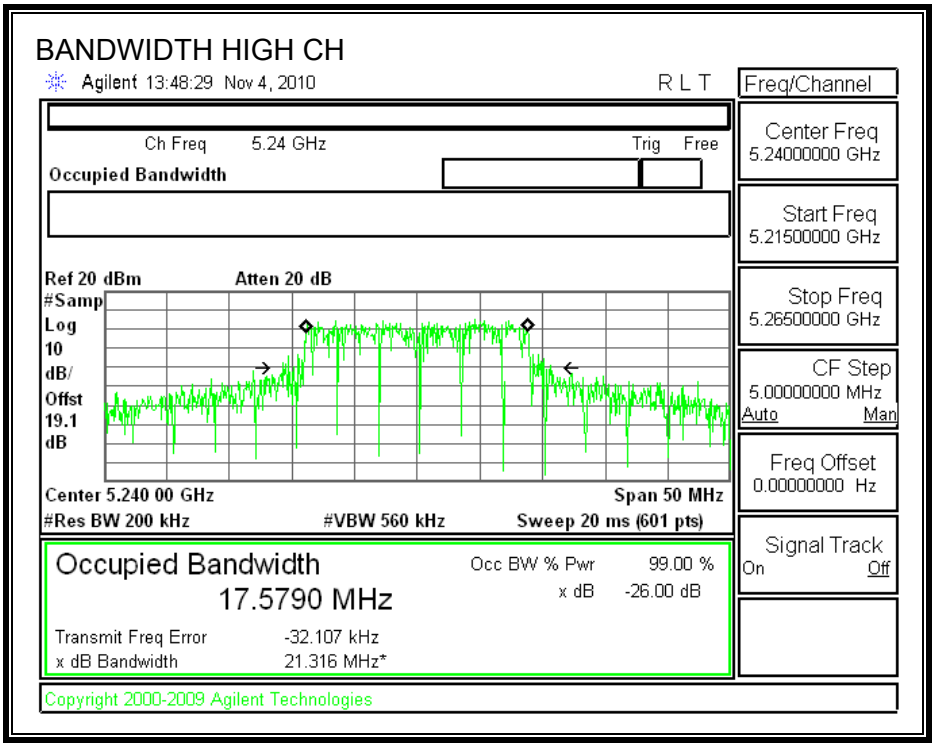
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	21.779	17.7233
Middle	5200	20.557	17.5999
High	5240	20.244	17.7311

CHAIN 0

26 dB and 99% BANDWIDTH

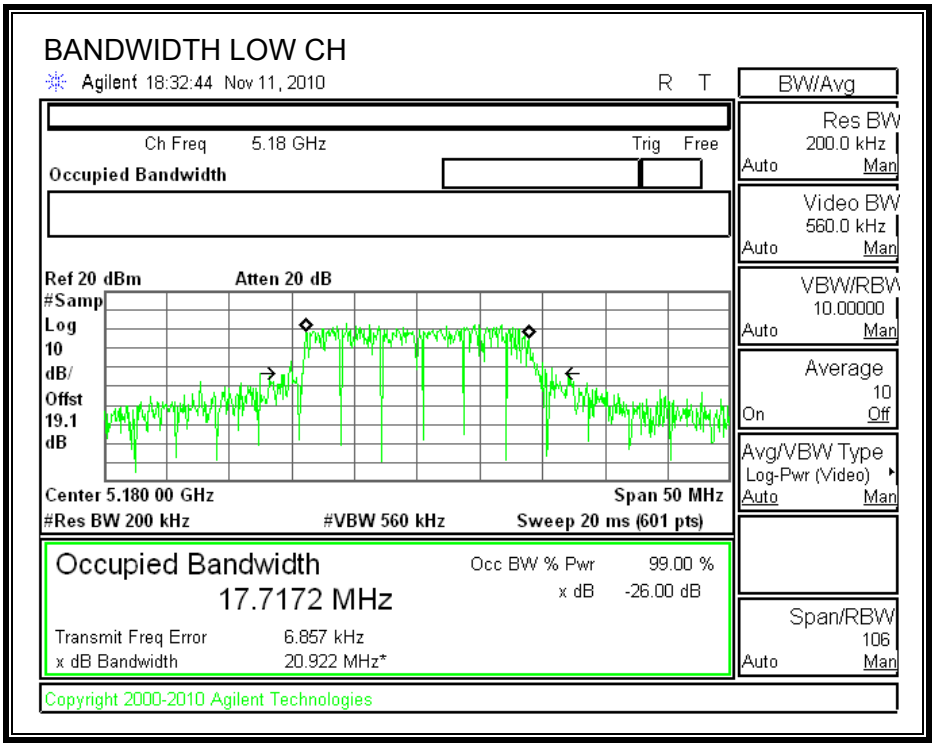




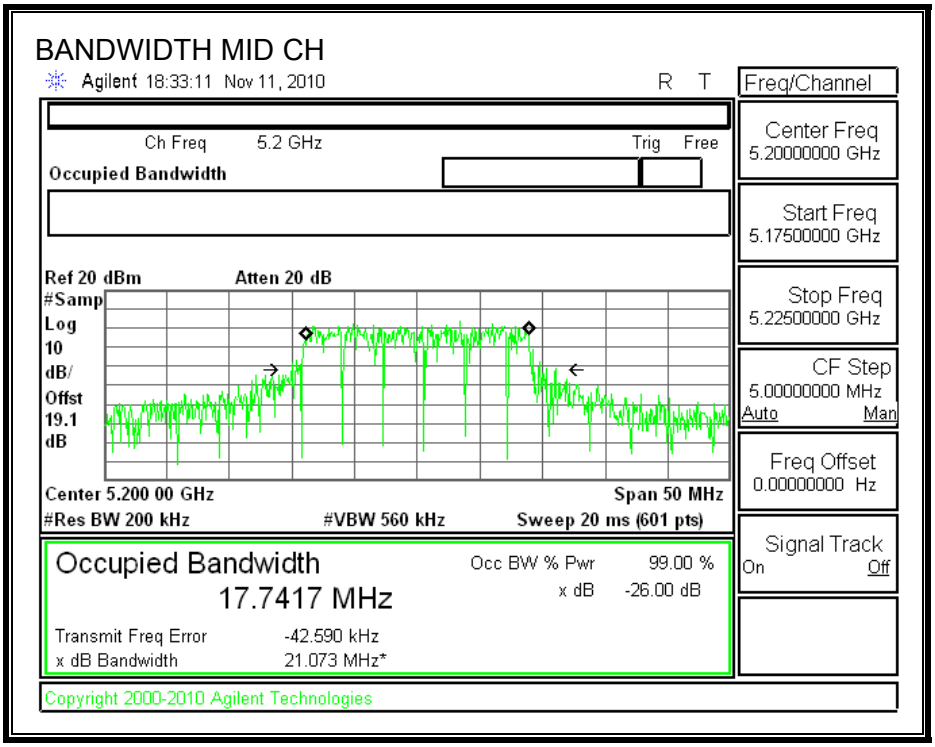


CHAIN 1

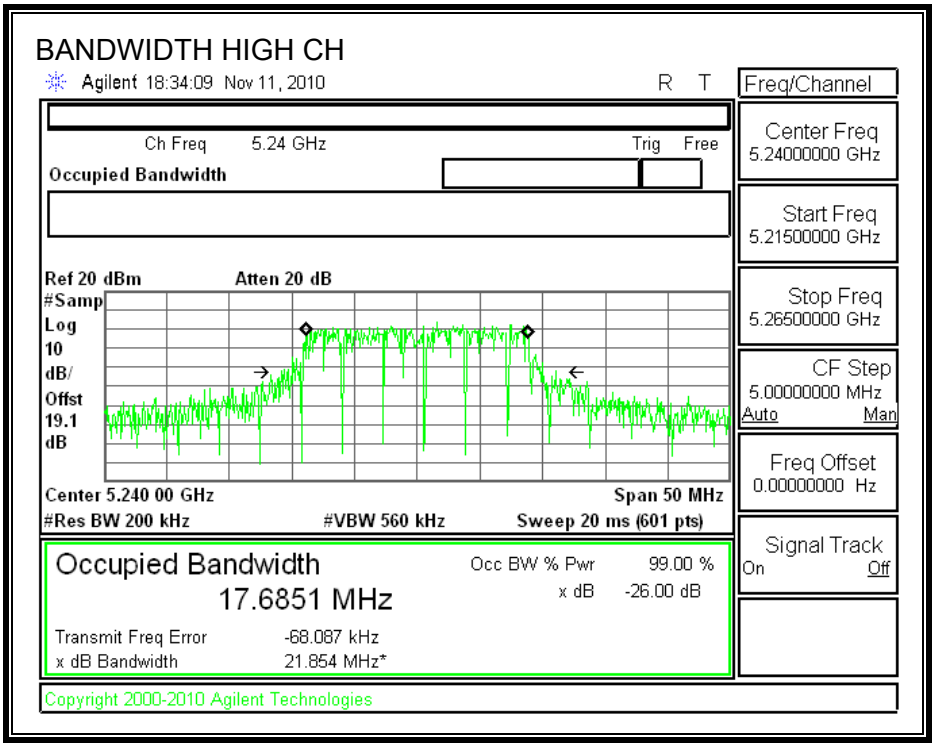
26 dB and 99% BANDWIDTH



BANDWIDTH MID CH

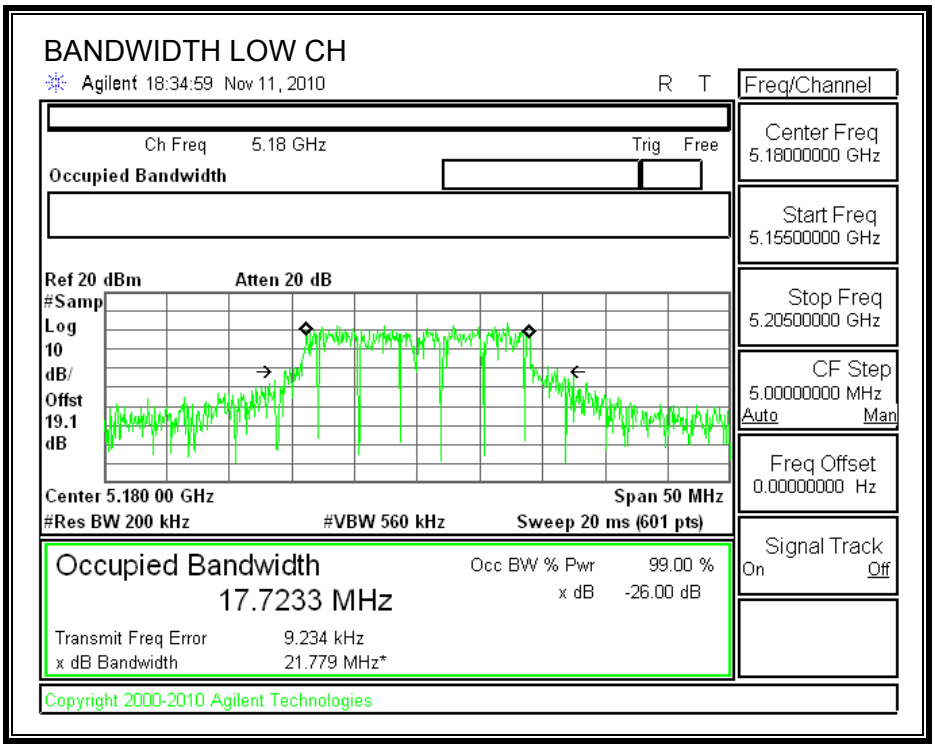


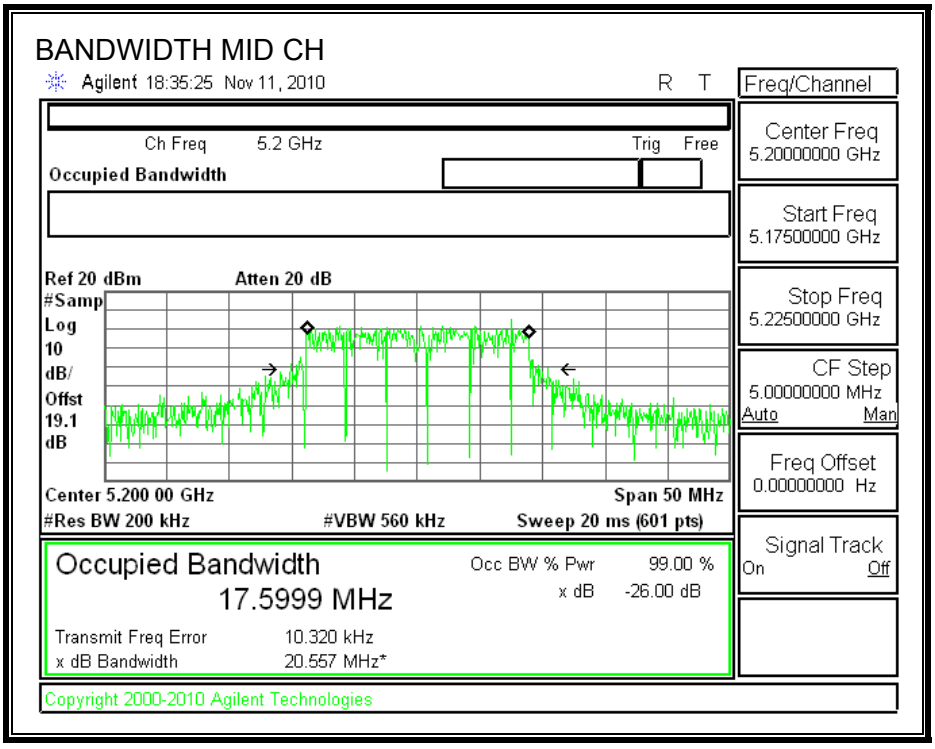
BANDWIDTH HIGH CH

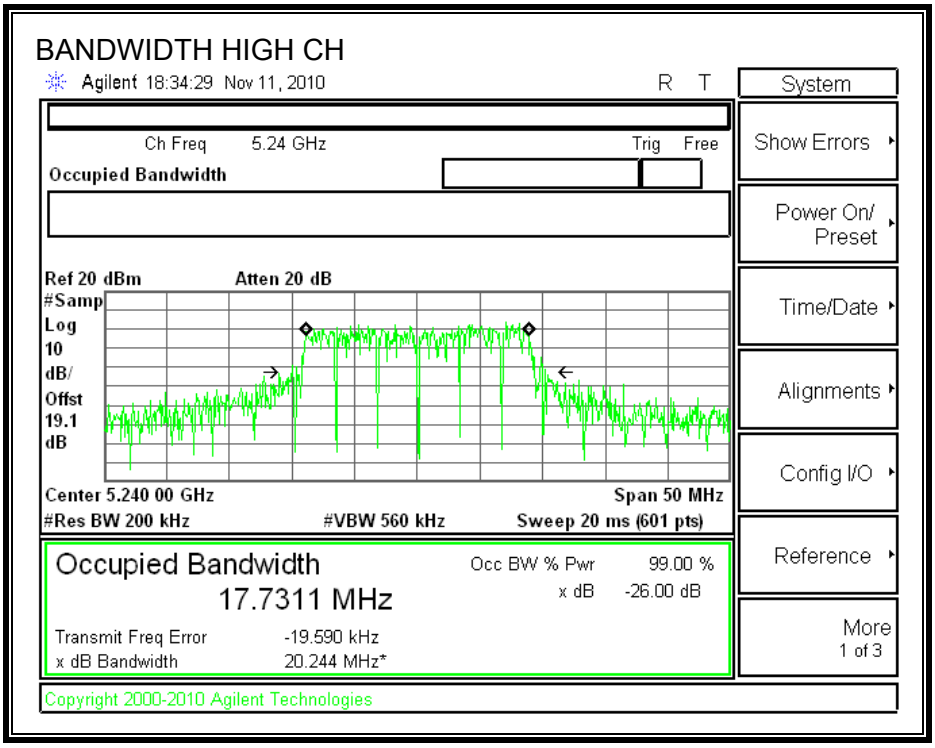


CHAIN 2

26 dB and 99% BANDWIDTH







7.2.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)
IC RSS-210 A9.2 (2)

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 of antenna gain is less than 6 dBi, and the combination antenna gain is 10.28 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

Non Beam-Forming

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	16.99	21.401	17.30	5.97	16.99
Mid	5200	16.99	21.938	17.41	5.97	16.99
High	5240	16.99	21.316	17.29	5.97	16.99

Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	11.32	10.78	10.65	15.70	16.99	-1.29
Mid	5200	10.64	10.35	9.68	15.01	16.99	-1.98
High	5240	10.99	10.70	10.22	15.42	16.99	-1.57

Beam-Forming

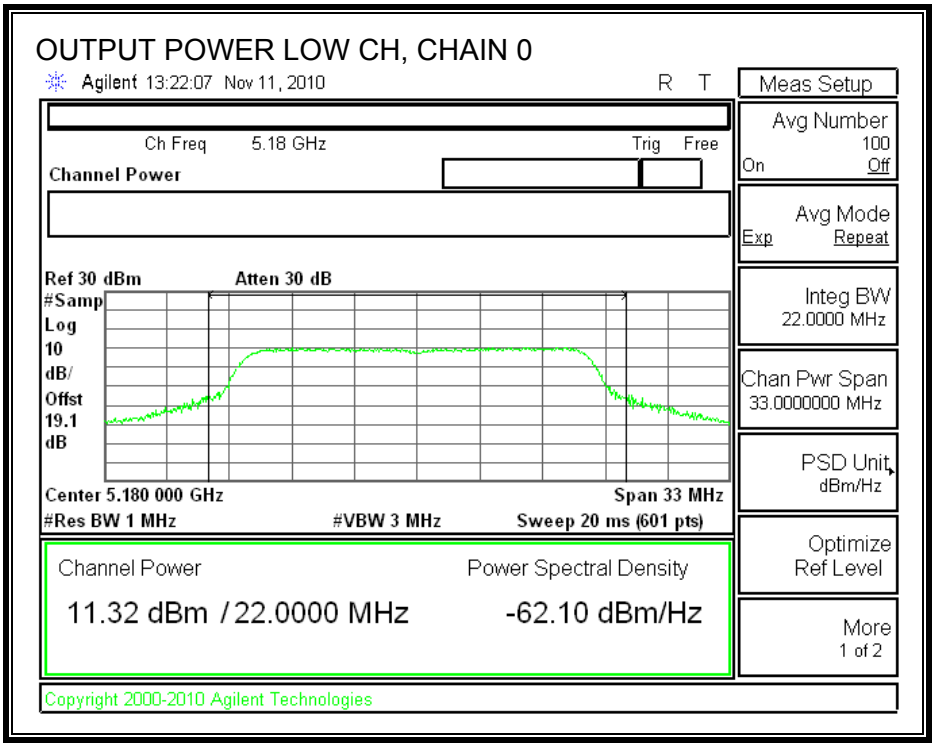
Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
5180	16.99	21.401	17.30	10.28	12.71
5200	16.99	21.938	17.41	10.28	12.71
5240	16.99	21.316	17.29	10.28	12.71

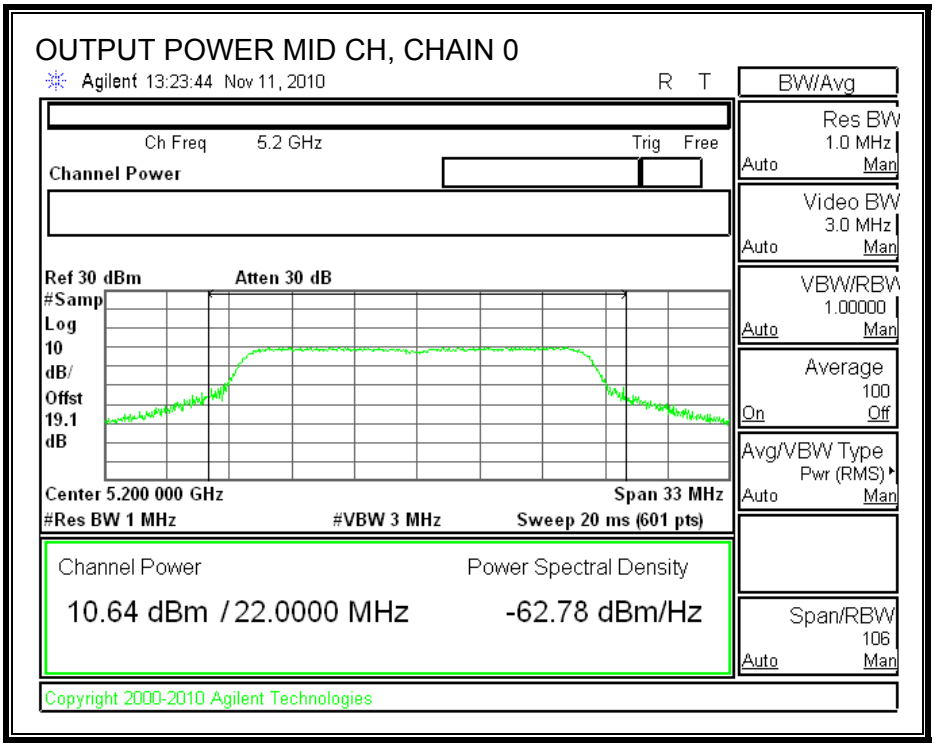
Chain Results

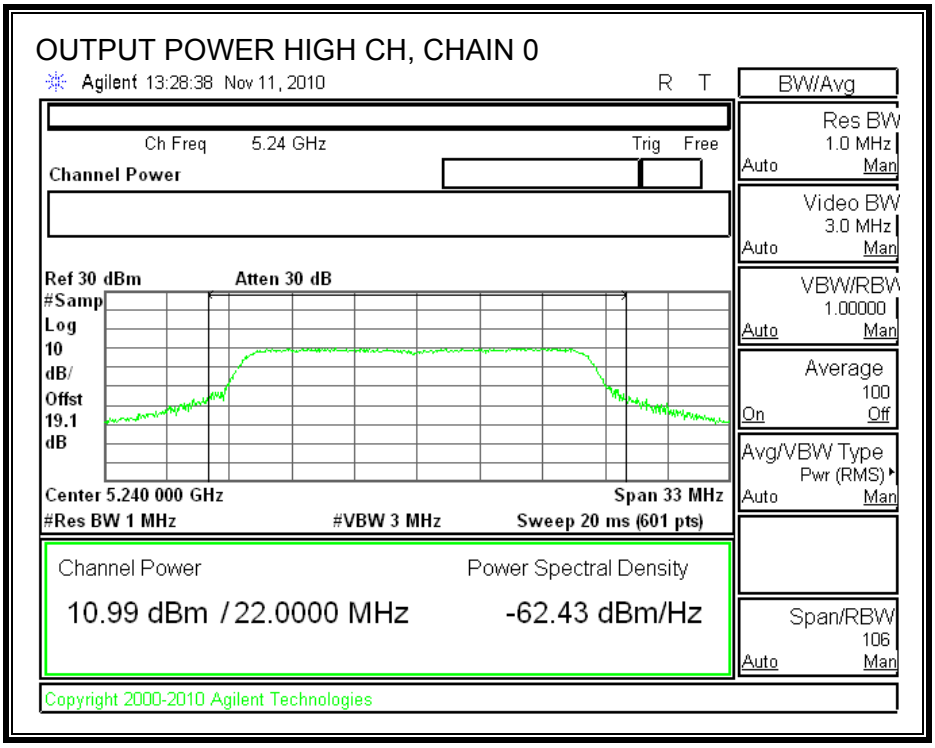
Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
5180	6.82	5.55	5.22	10.69	12.71	-2.02
5200	6.60	5.78	5.28	10.69	12.71	-2.02
5240	6.72	6.17	5.50	10.93	12.71	-1.78

Non Beam-Forming

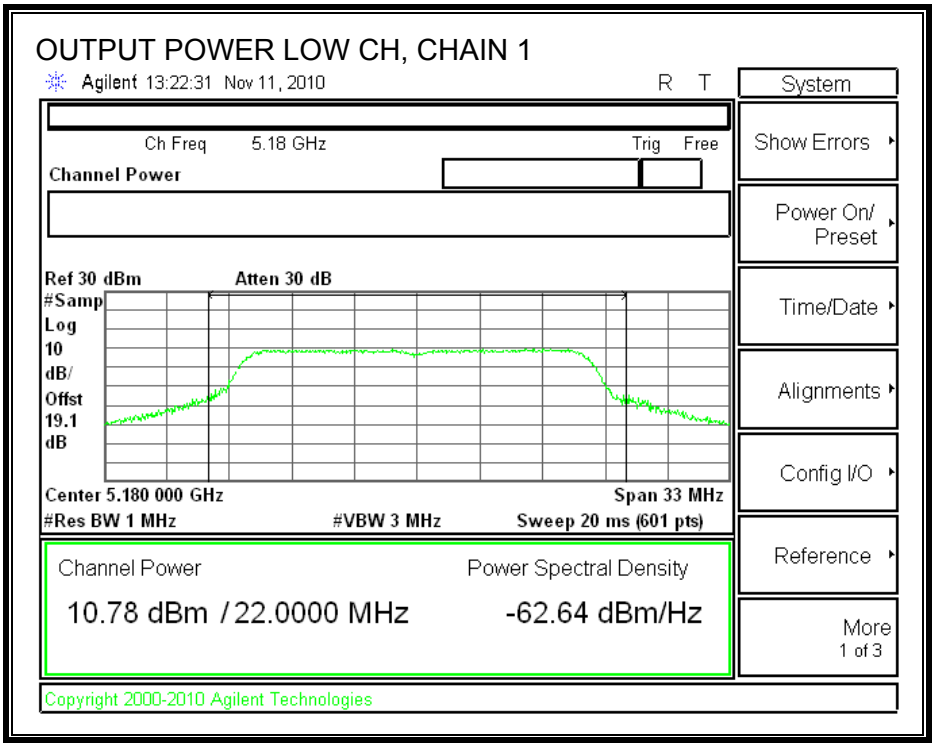
CHAIN 0 OUTPUT POWER

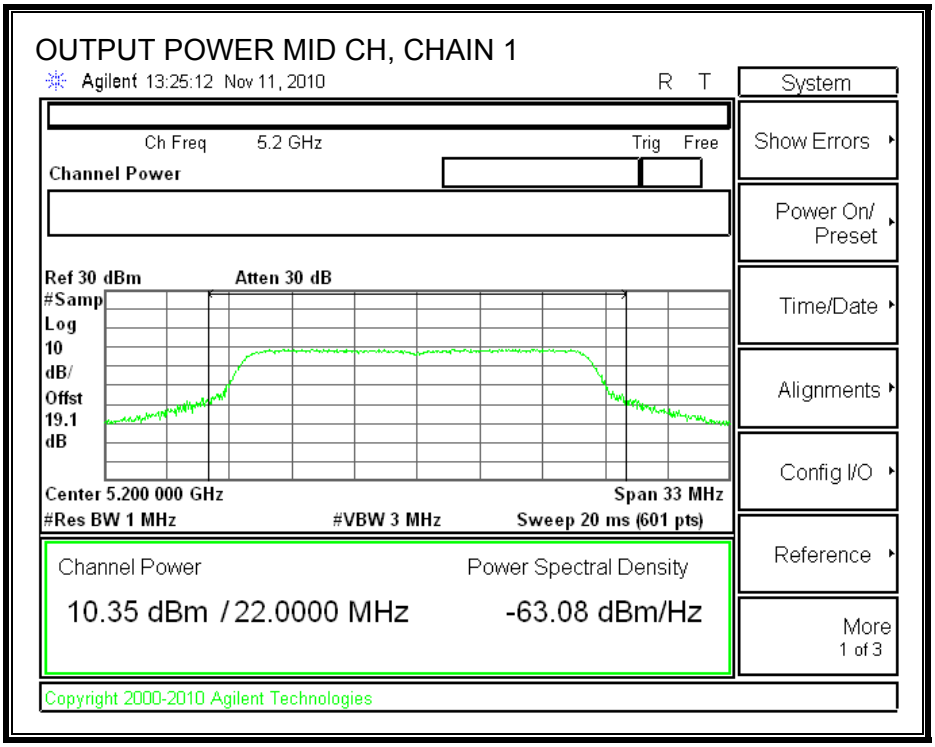


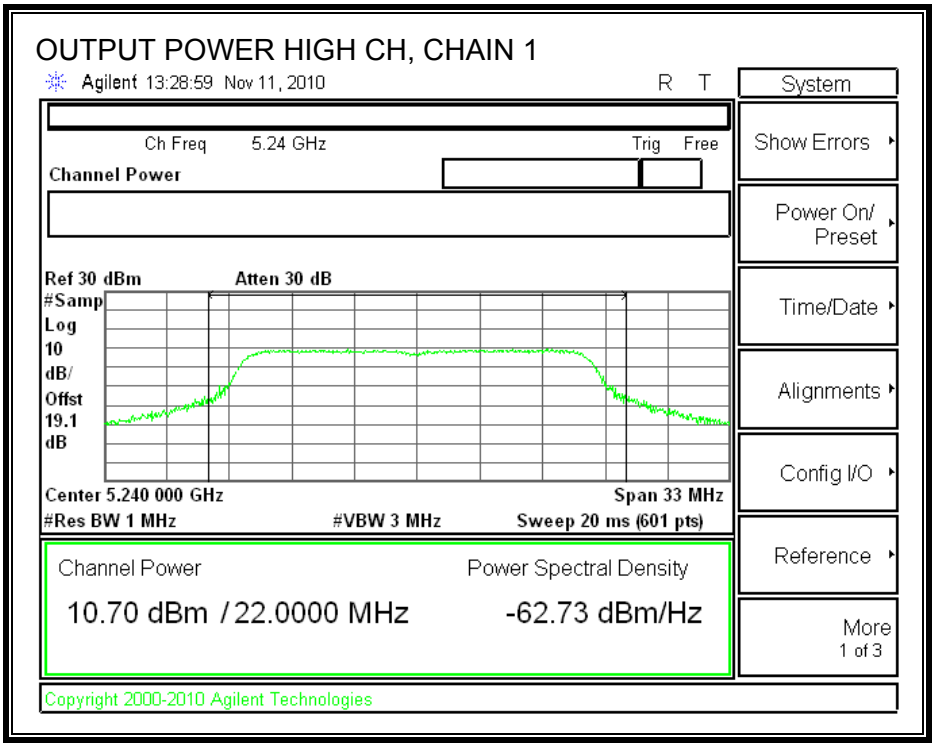




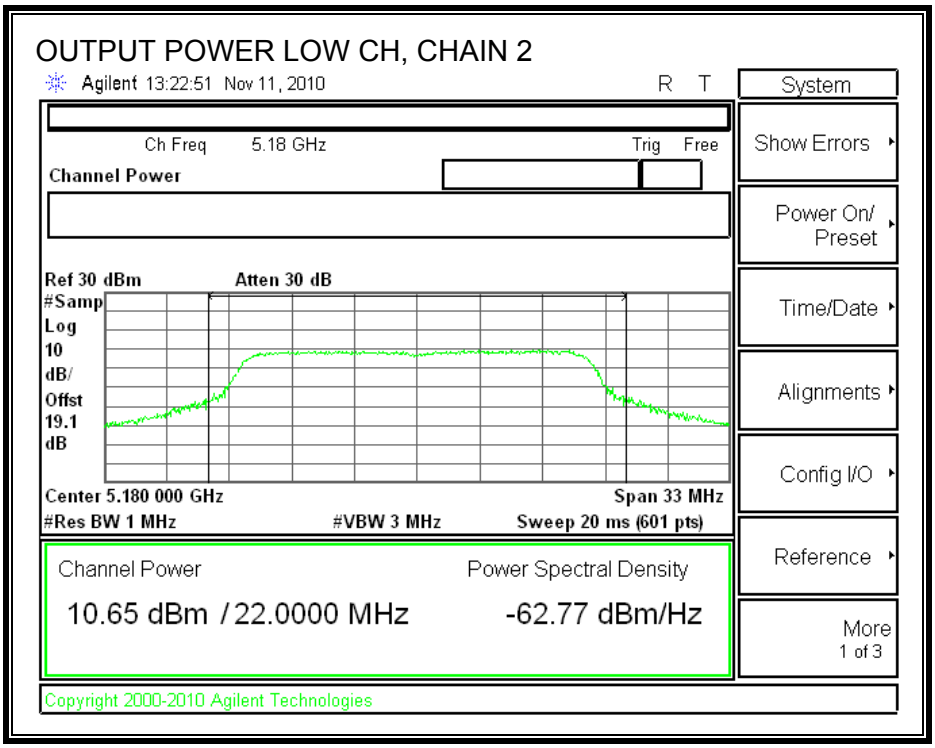
CHAIN 1 OUTPUT POWER

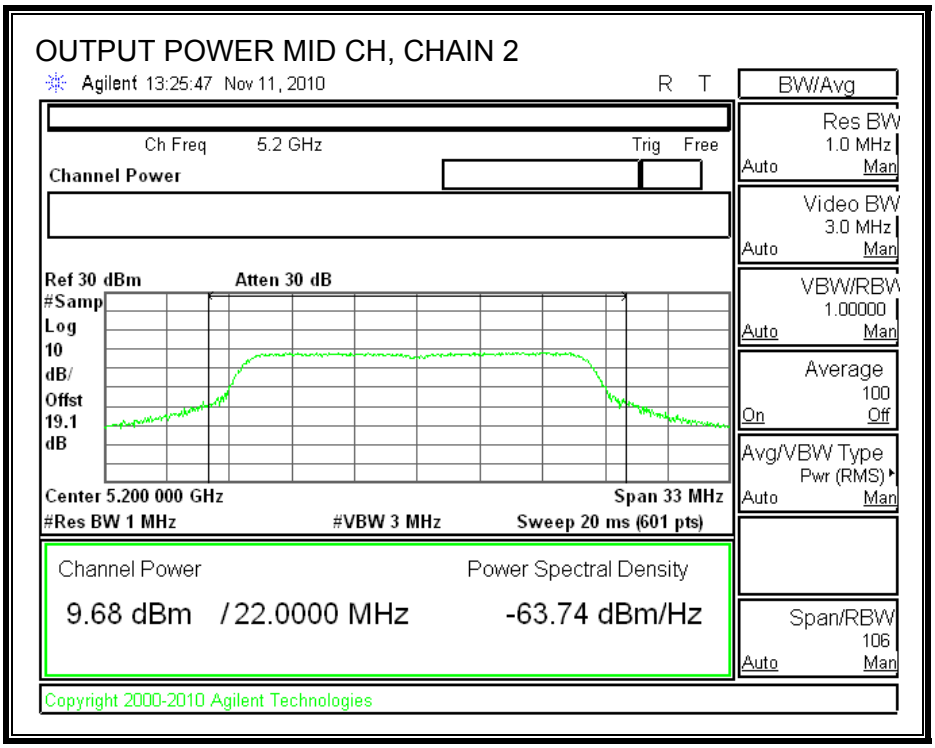


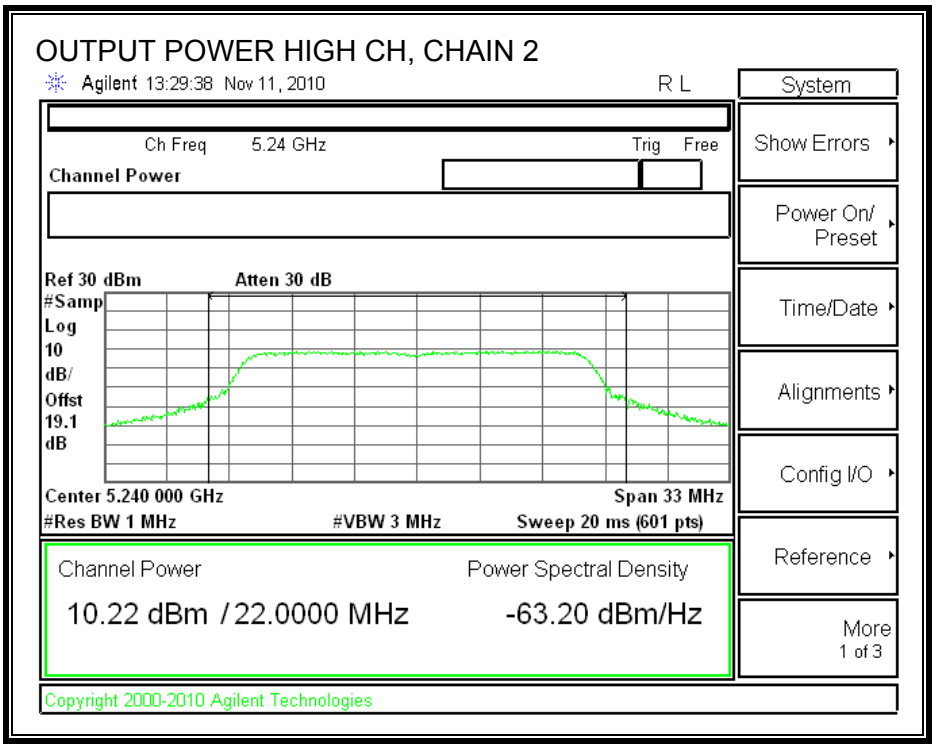




CHAIN 2 OUTPUT POWER

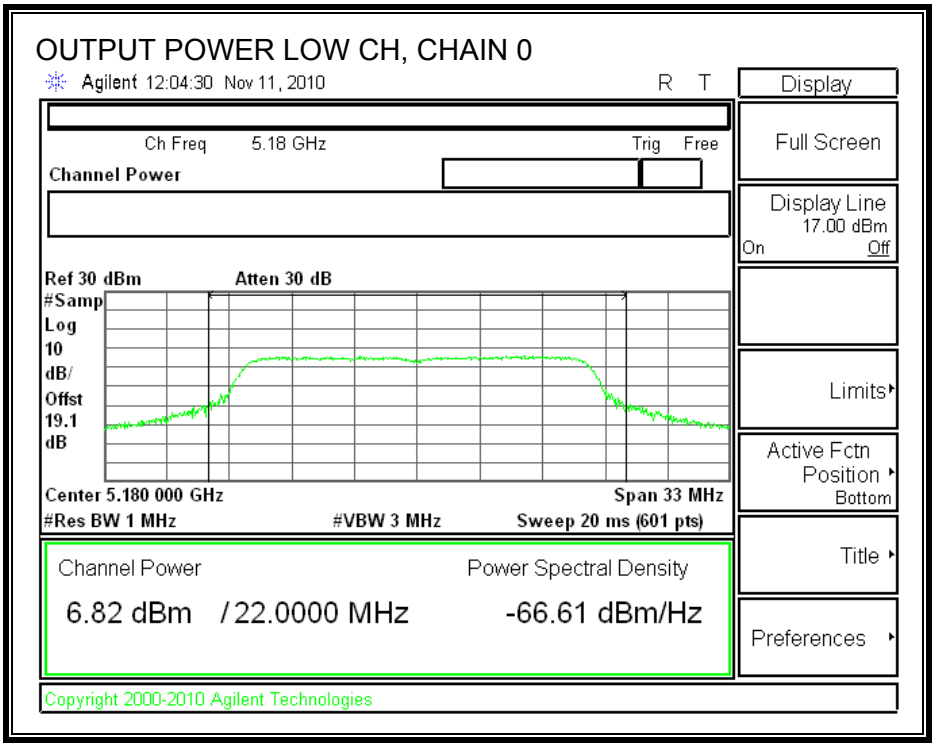


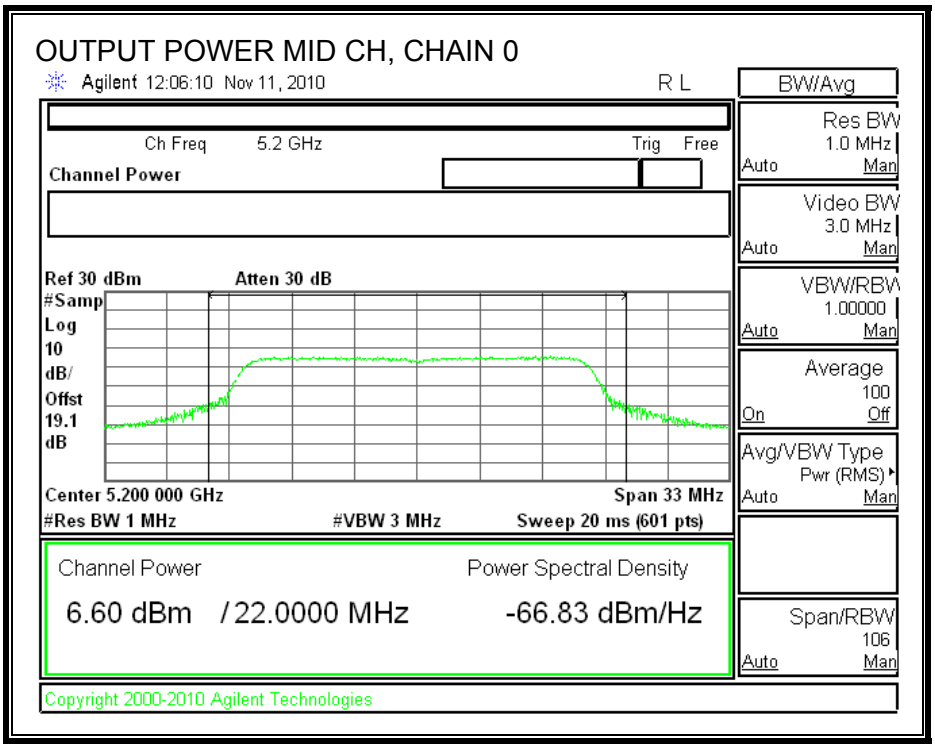


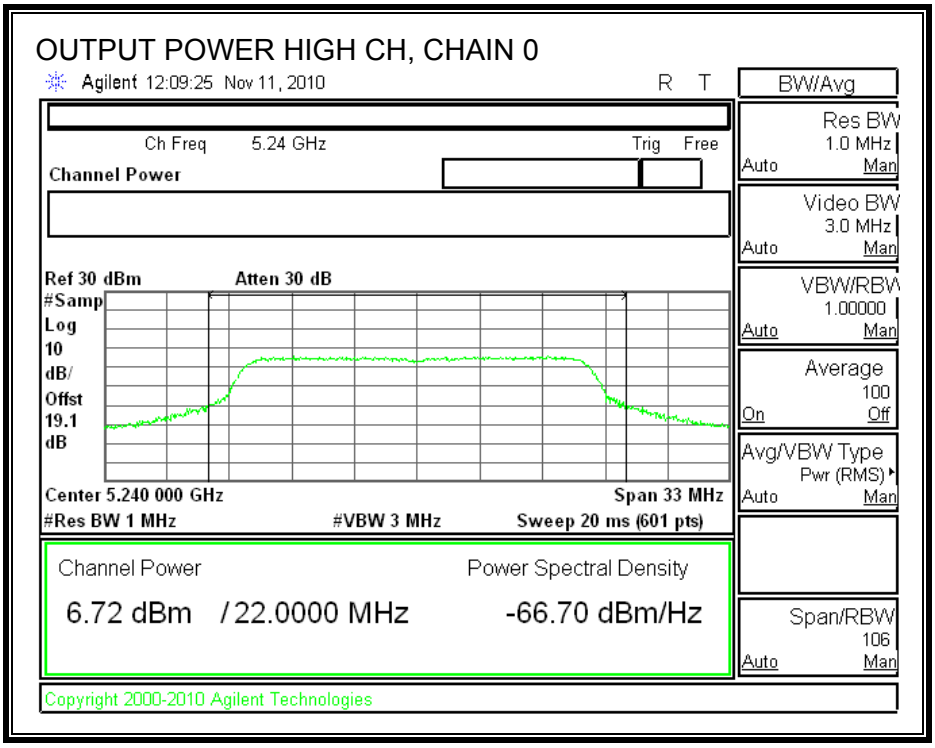


Beam-Forming

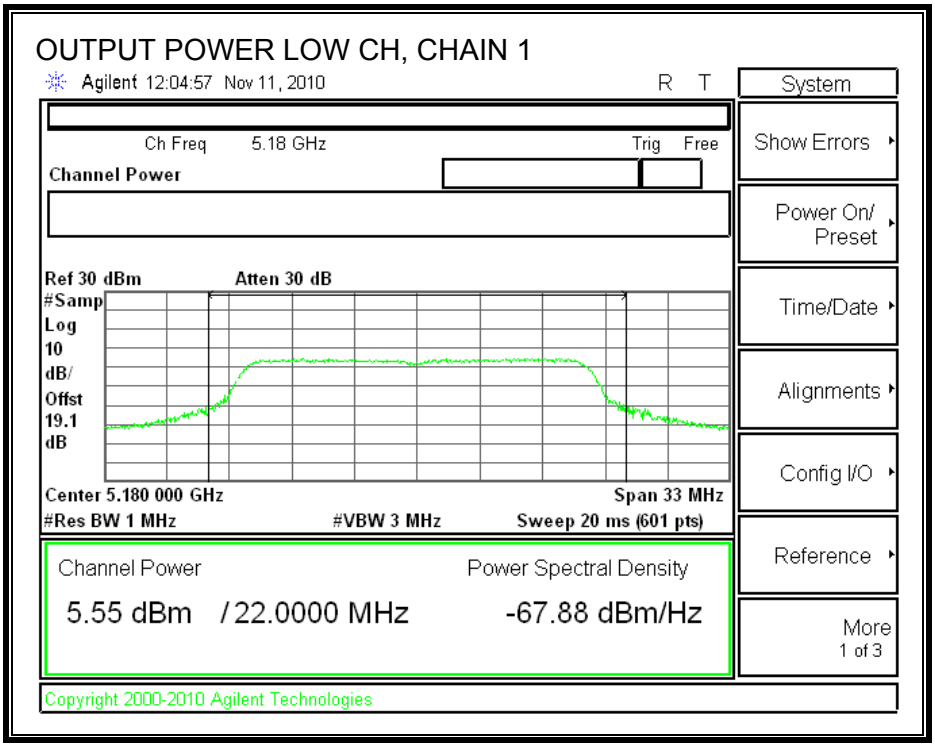
CHAIN 0 OUTPUT POWER



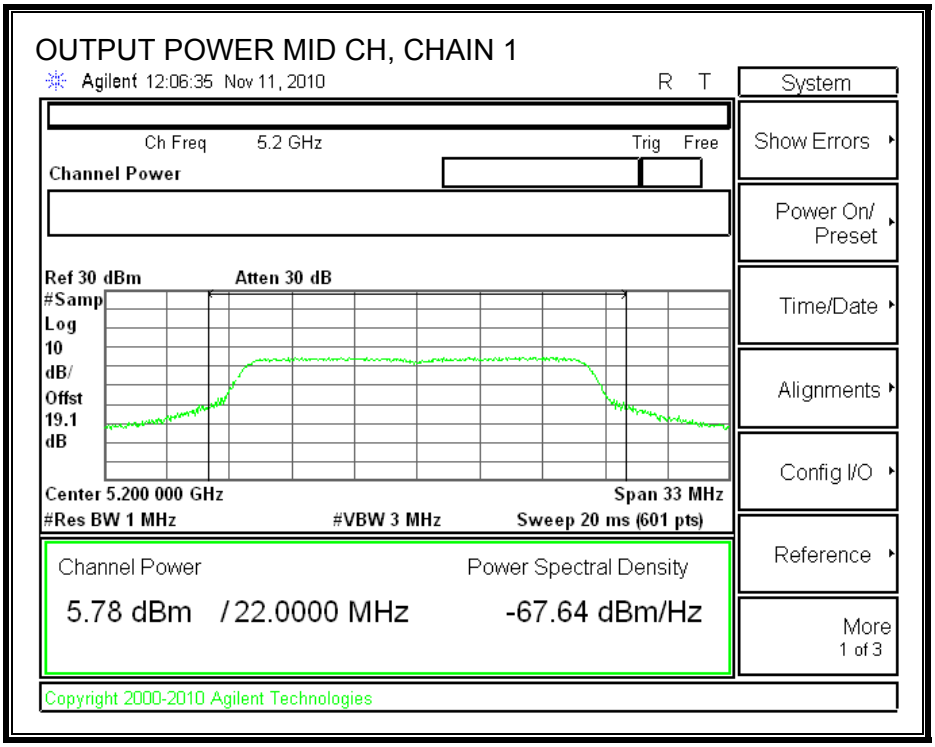




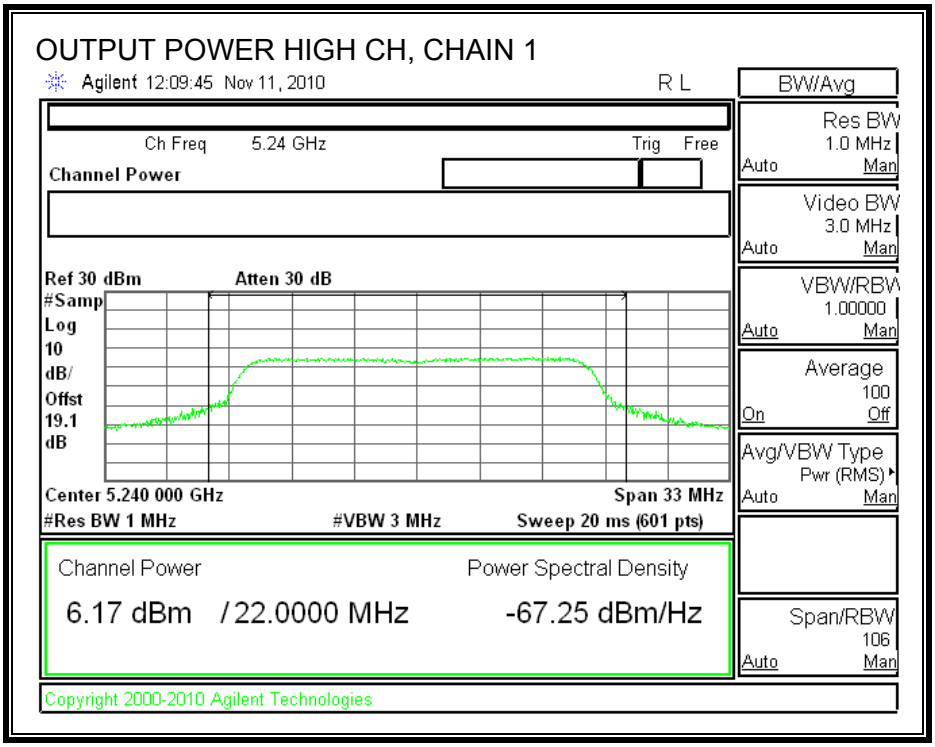
CHAIN 1 OUTPUT POWER



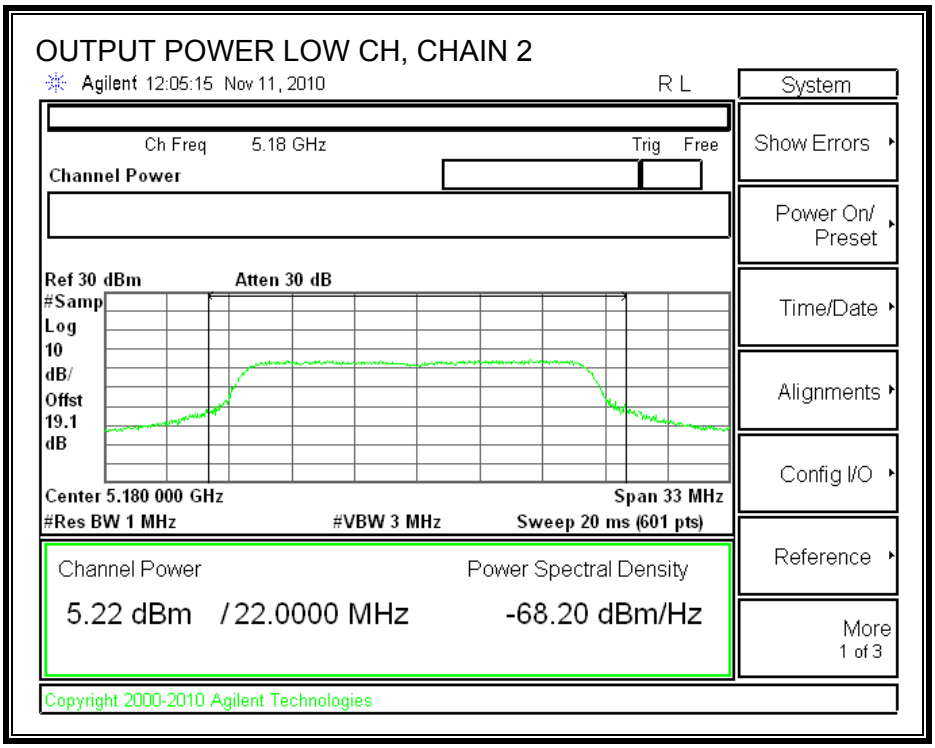
OUTPUT POWER MID CH, CHAIN 1

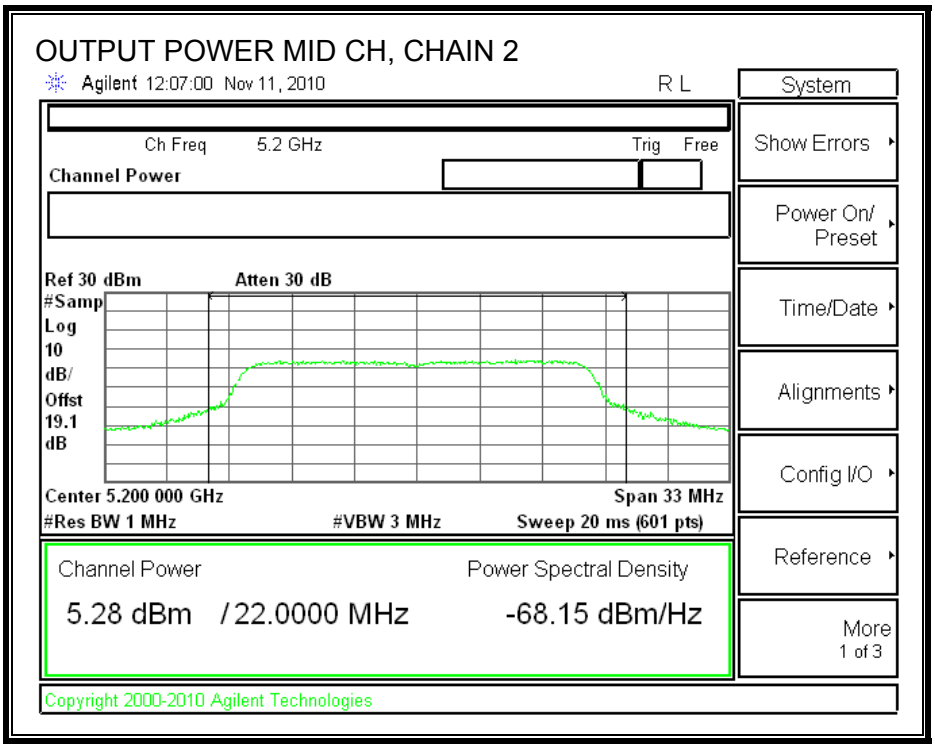


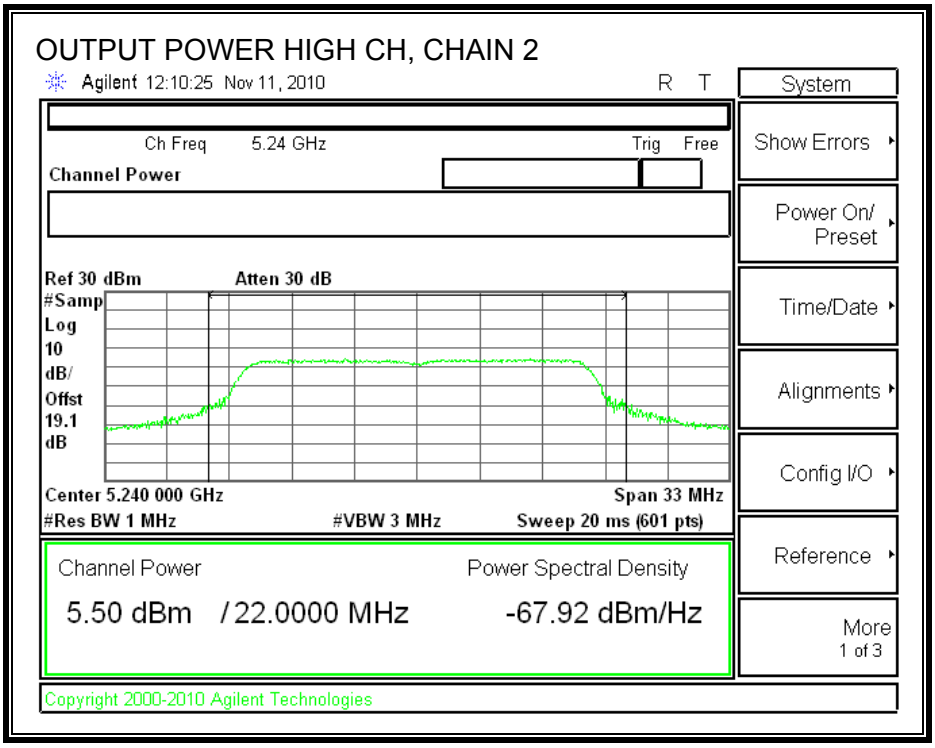
OUTPUT POWER HIGH CH, CHAIN 1



CHAIN 2 OUTPUT POWER







7.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 19.1 dB was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Non Beam-Forming

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	11.20	10.55	10.20	15.44
Middle	5200	10.50	10.15	9.50	14.84
High	5240	10.75	10.50	10.15	15.24

Beam-Forming

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	6.60	5.45	5.15	10.55
Middle	5200	6.20	5.60	5.20	10.46
High	5240	6.50	6.10	5.30	10.77

7.2.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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 6 dBi, therefore the limit is 4 dBm.

The combination antenna gain is 10.28 dBi, therefore the limit is -0.28 dBm.

TEST PROCEDURE

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

Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

RESULTS

Non Beam-Forming

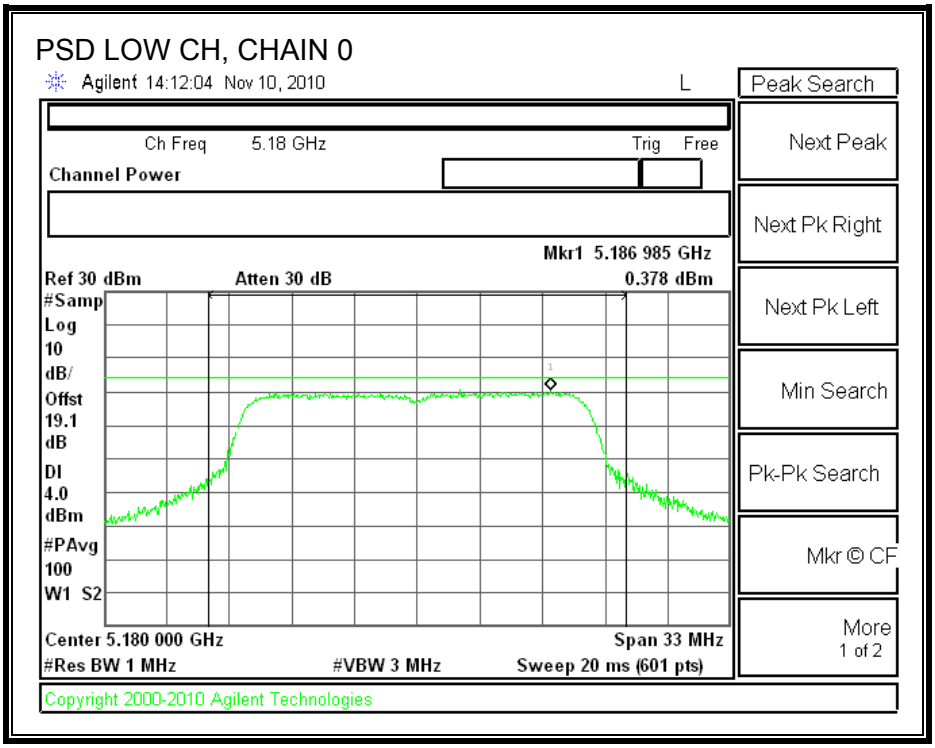
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	0.379	-1.305	-2.303	3.84	4.00	-0.16
Middle	5200	-0.364	-1.568	-2.178	3.47	4.00	-0.53
High	5240	-0.316	-1.703	-2.45	3.37	4.00	-0.63

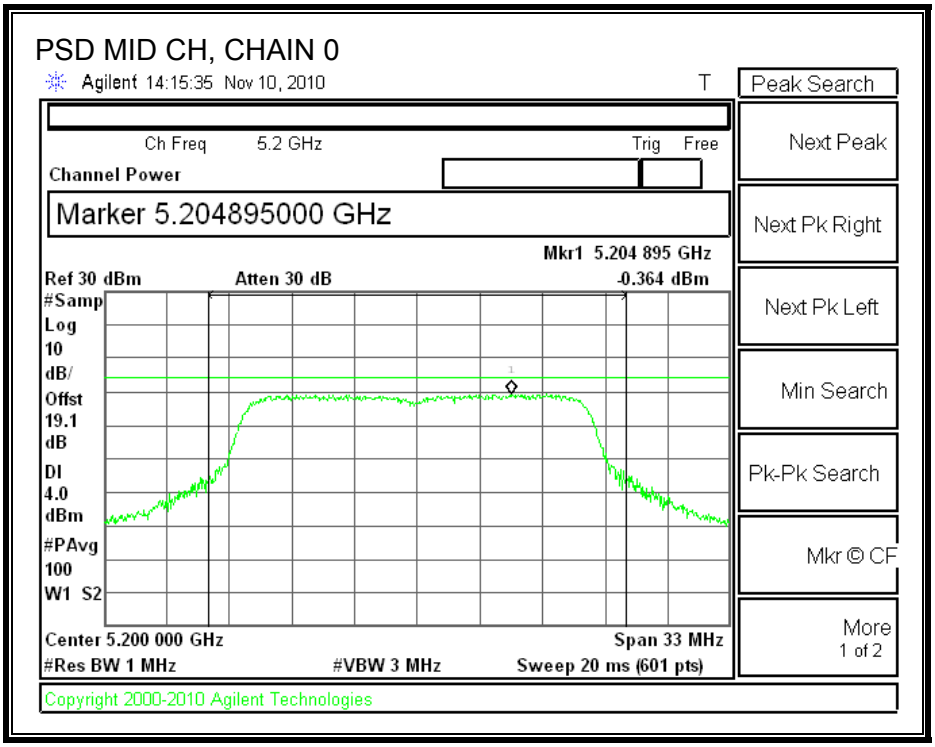
Beam-Forming

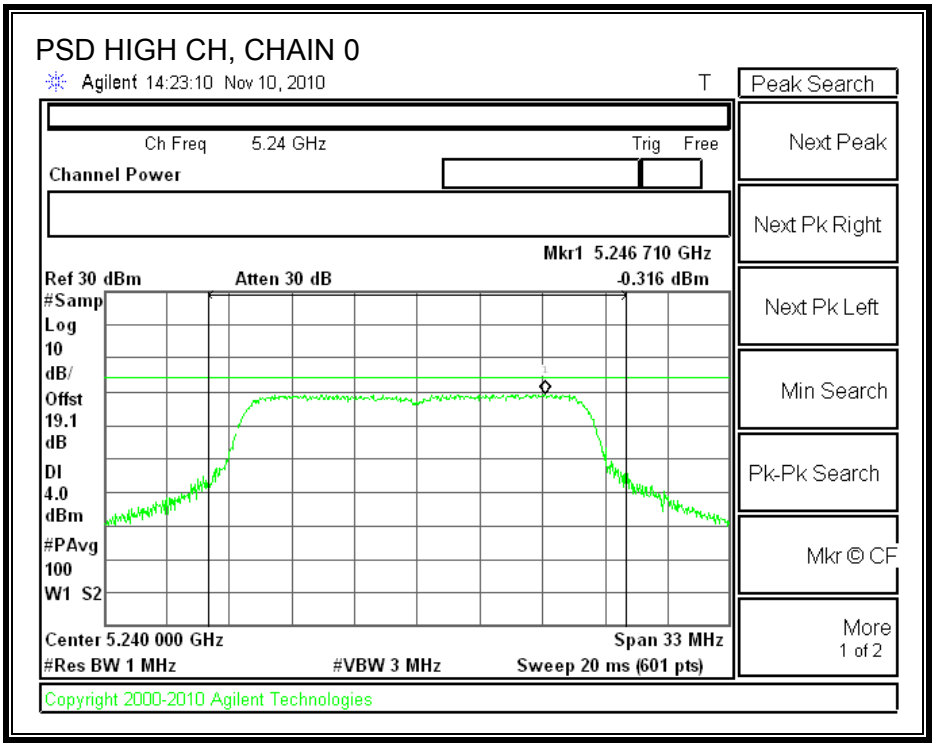
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-4.561	-5.402	-5.920	-0.49	-0.28	-0.21
Middle	5200	-4.428	-5.357	-5.951	-0.43	-0.28	-0.15
High	5240	-4.416	-5.382	-6.546	-0.59	-0.28	-0.31

Non Beam-Forming

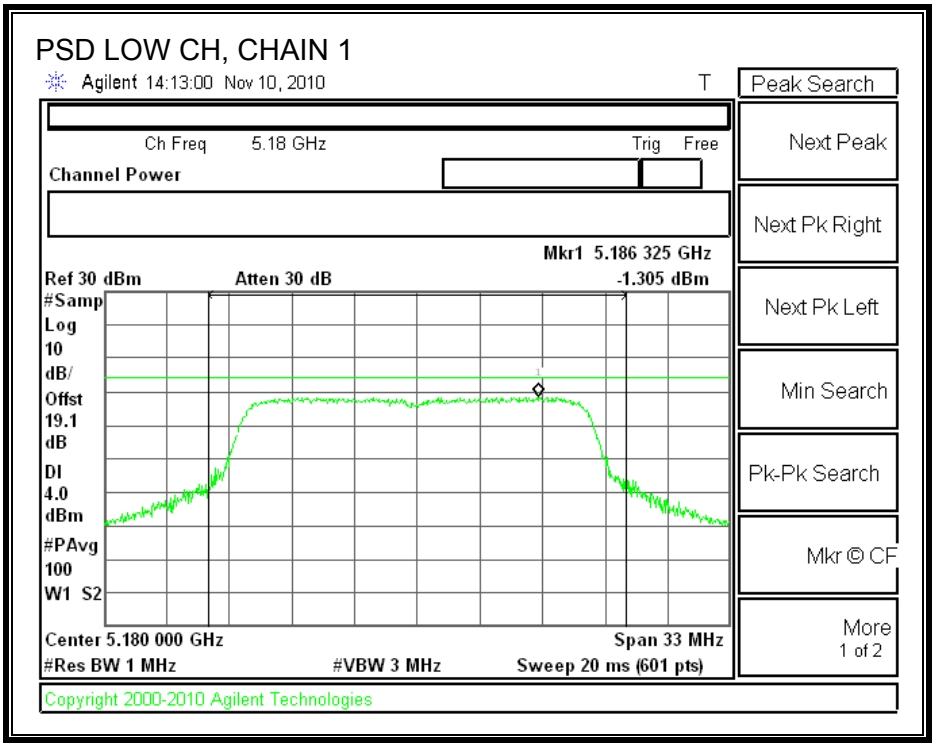
CHAIN 0 POWER SPECTRAL DENSITY



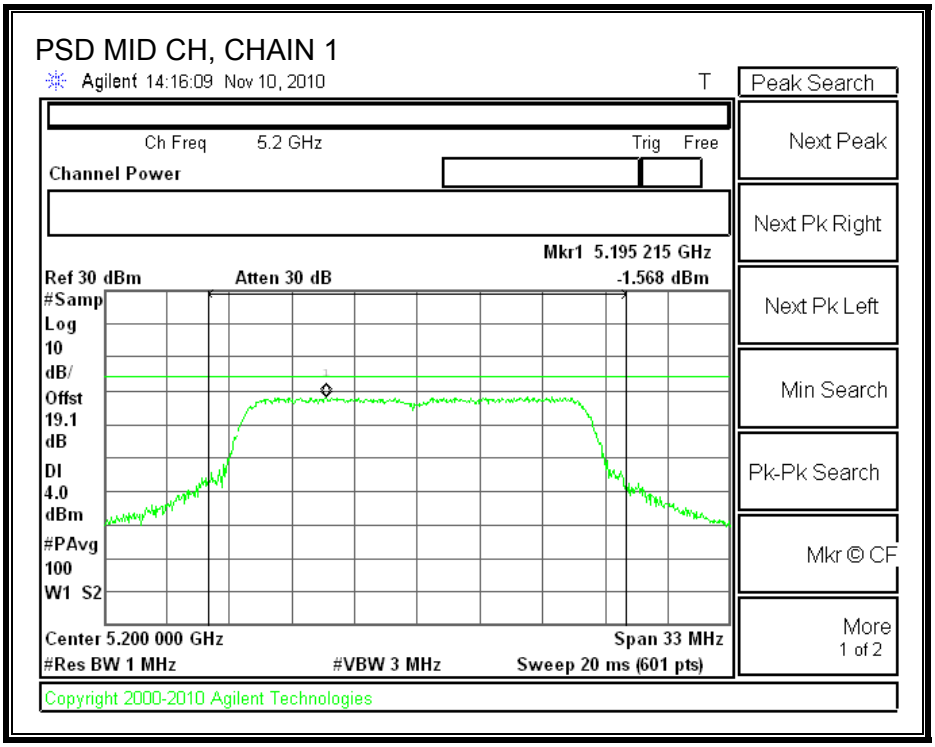




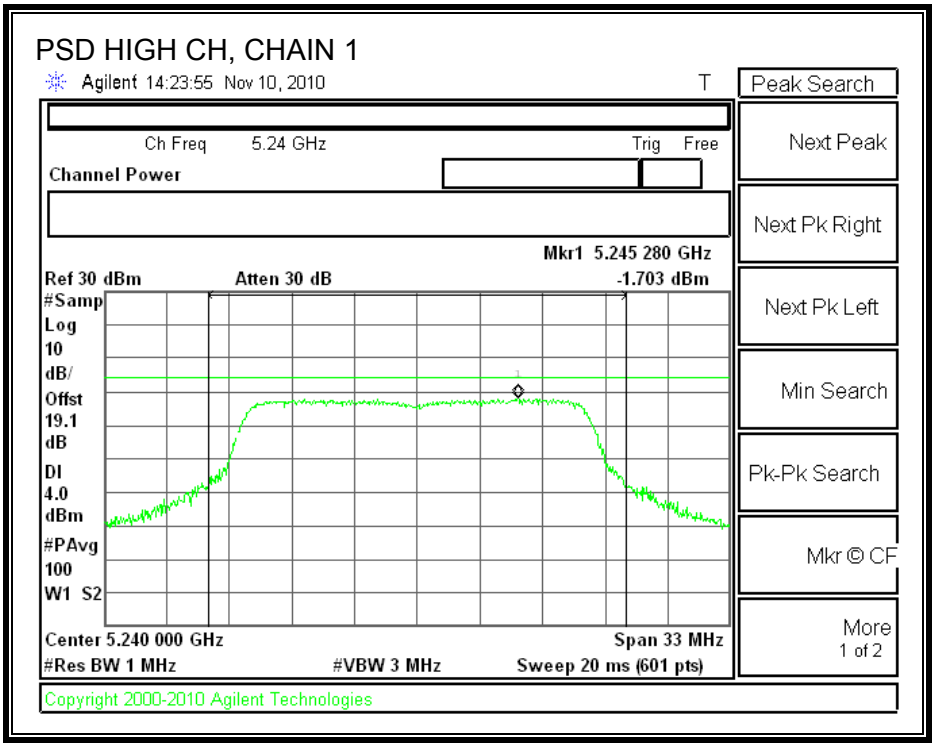
CHAIN 1 POWER SPECTRAL DENSITY



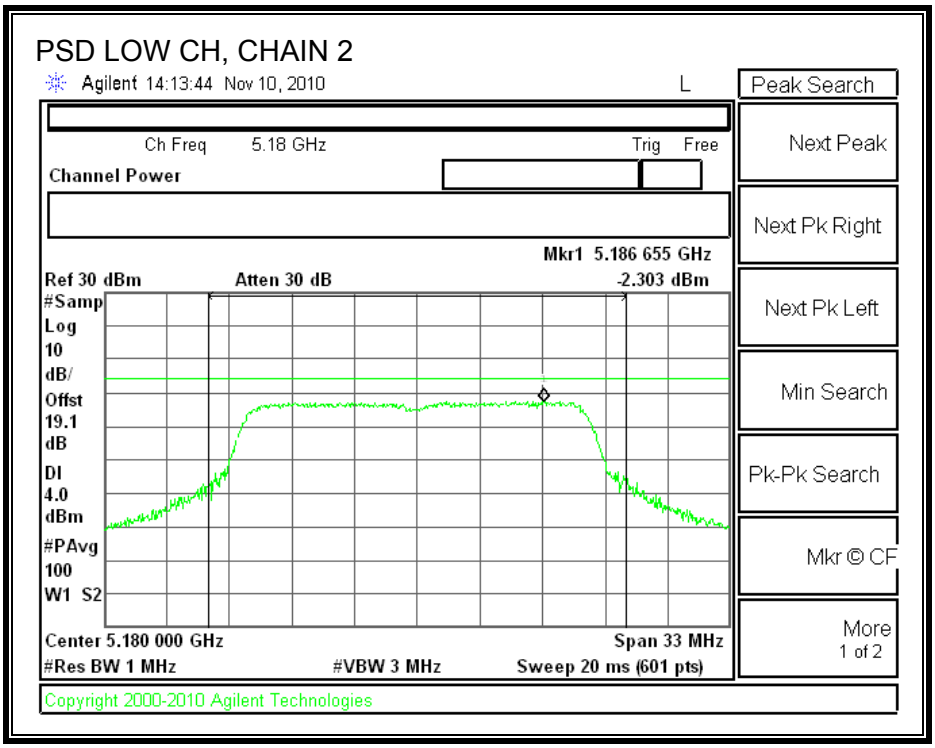
PSD MID CH, CHAIN 1

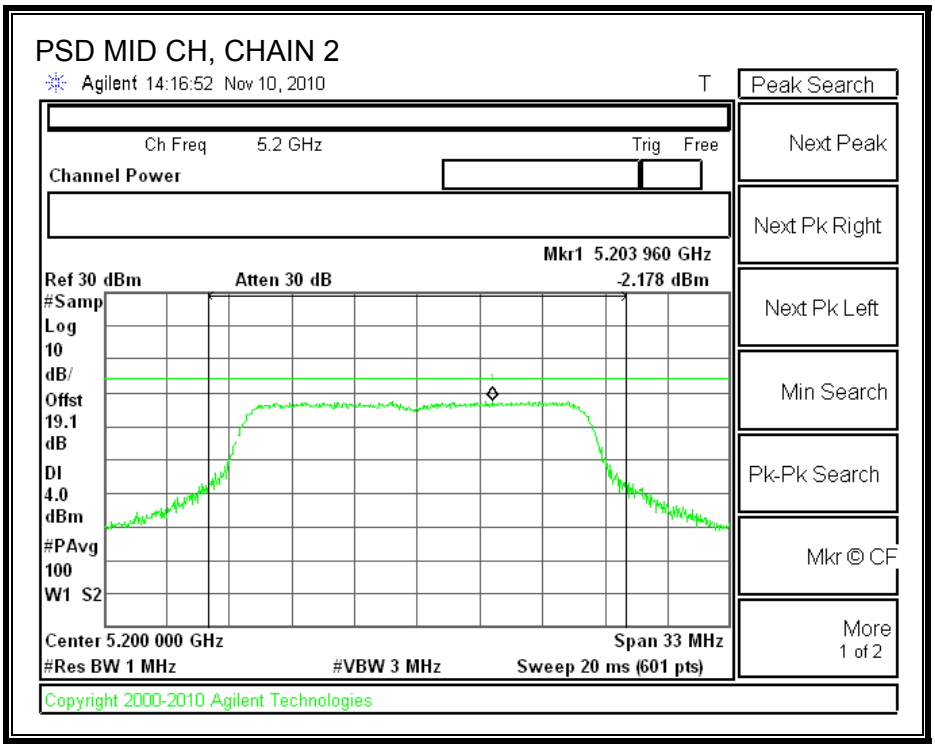


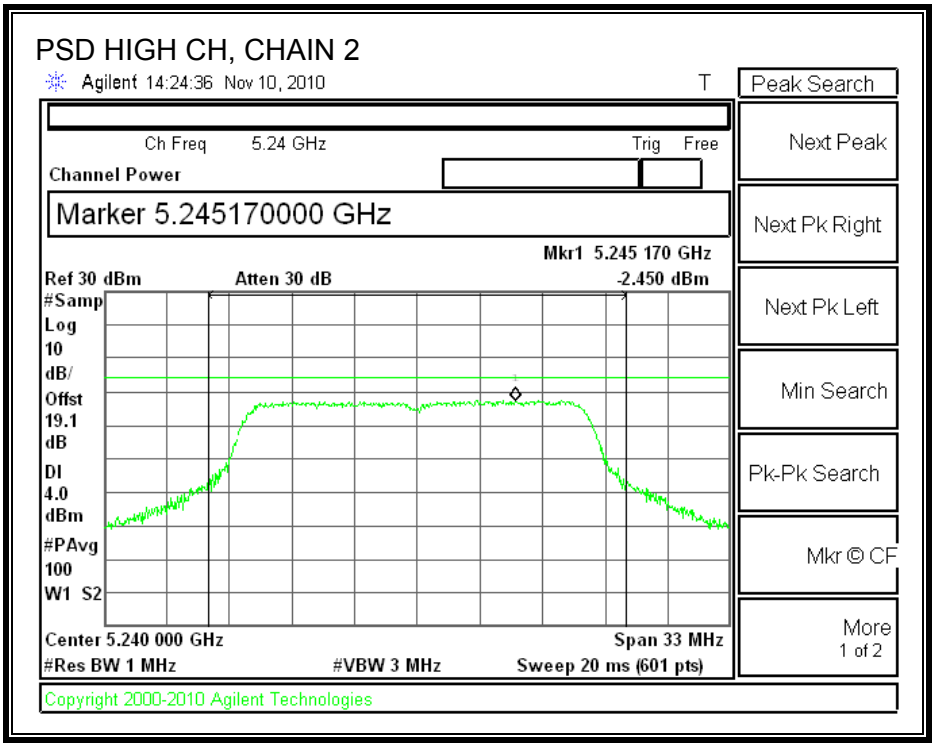
PSD HIGH CH, CHAIN 1



CHAIN 2 POWER SPECTRAL DENSITY

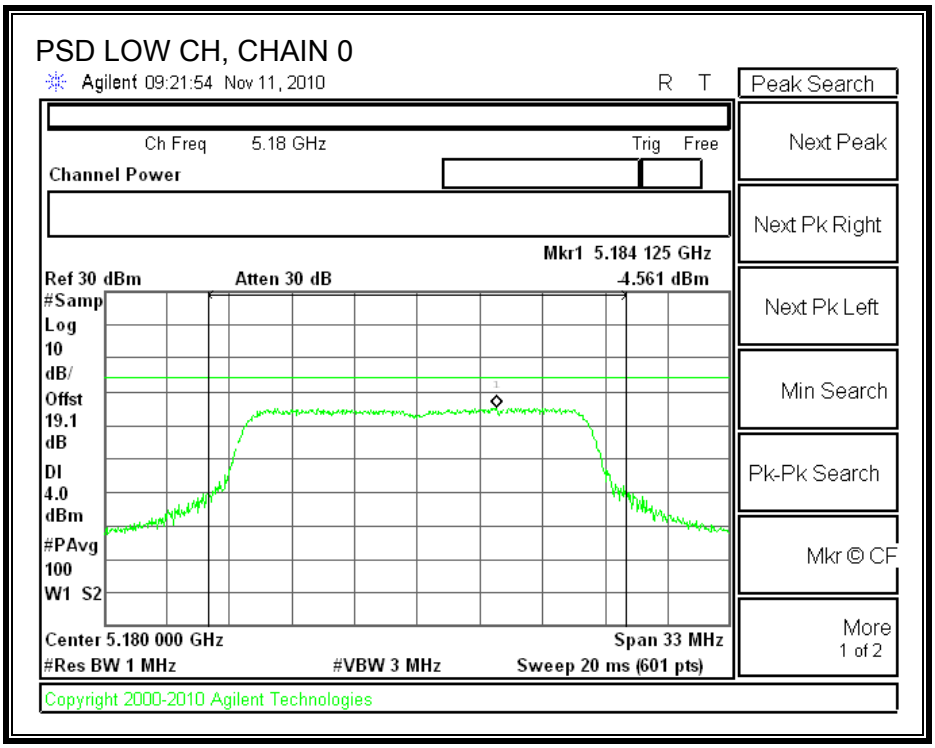


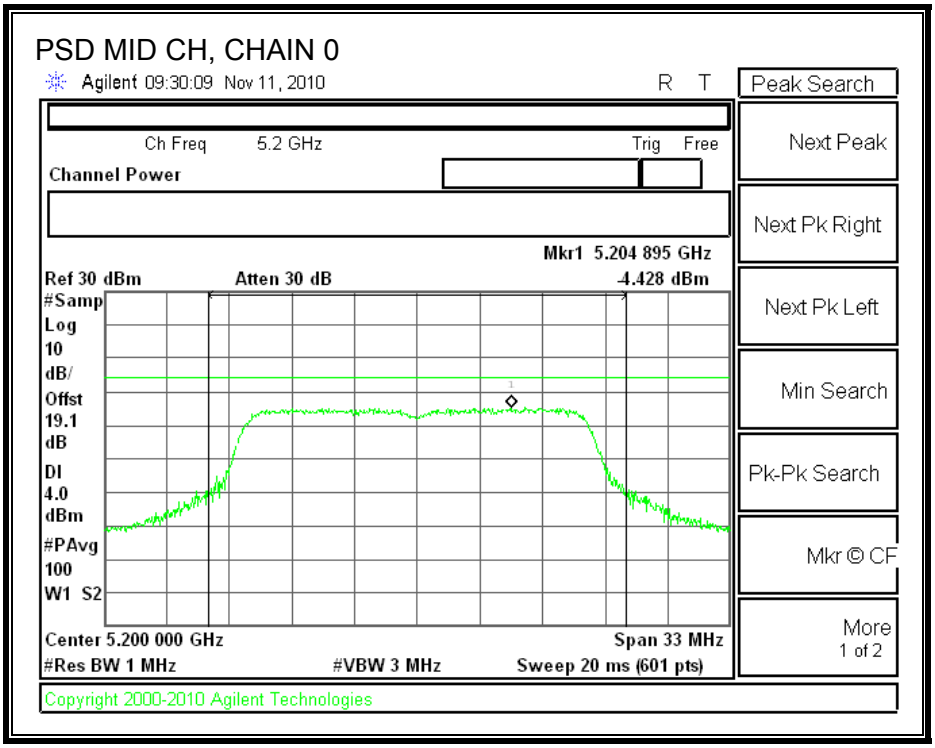


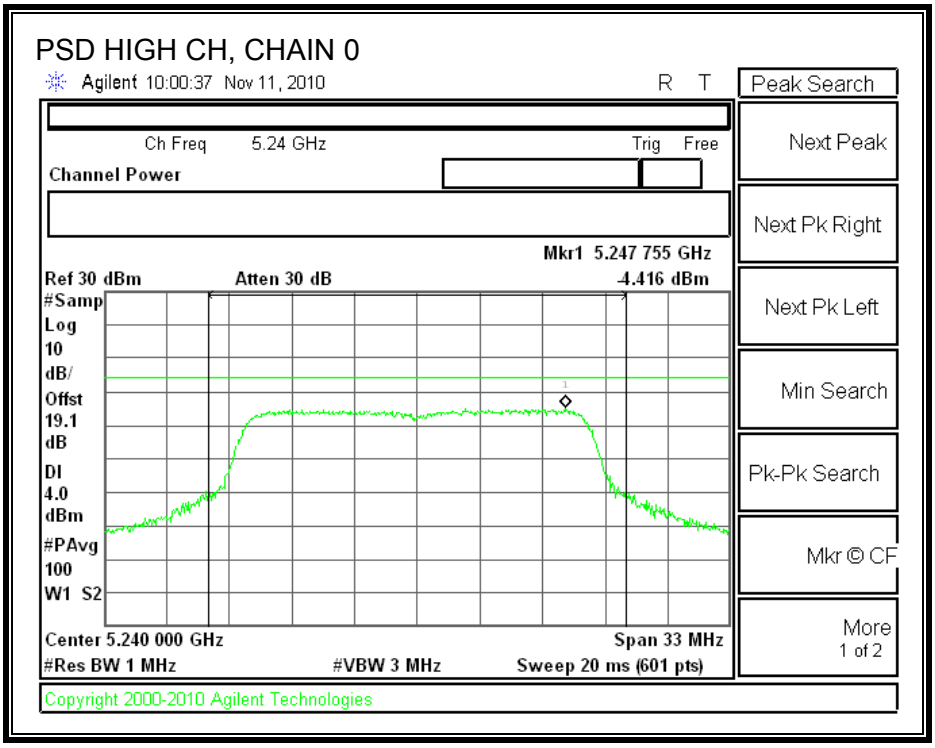


Beam-Forming

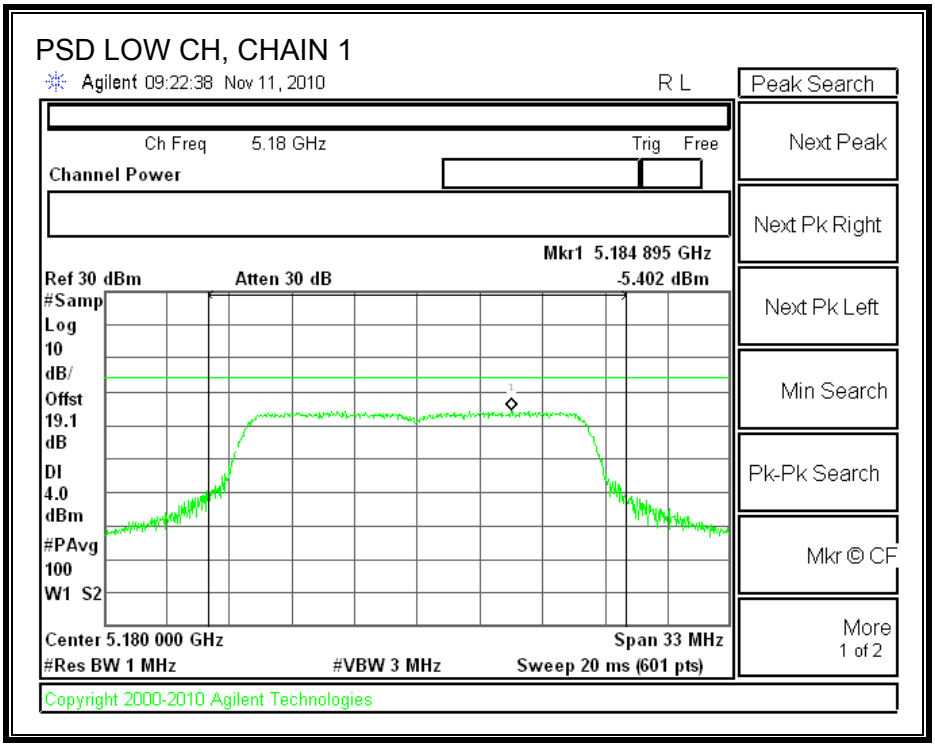
CHAIN 0 POWER SPECTRAL DENSITY

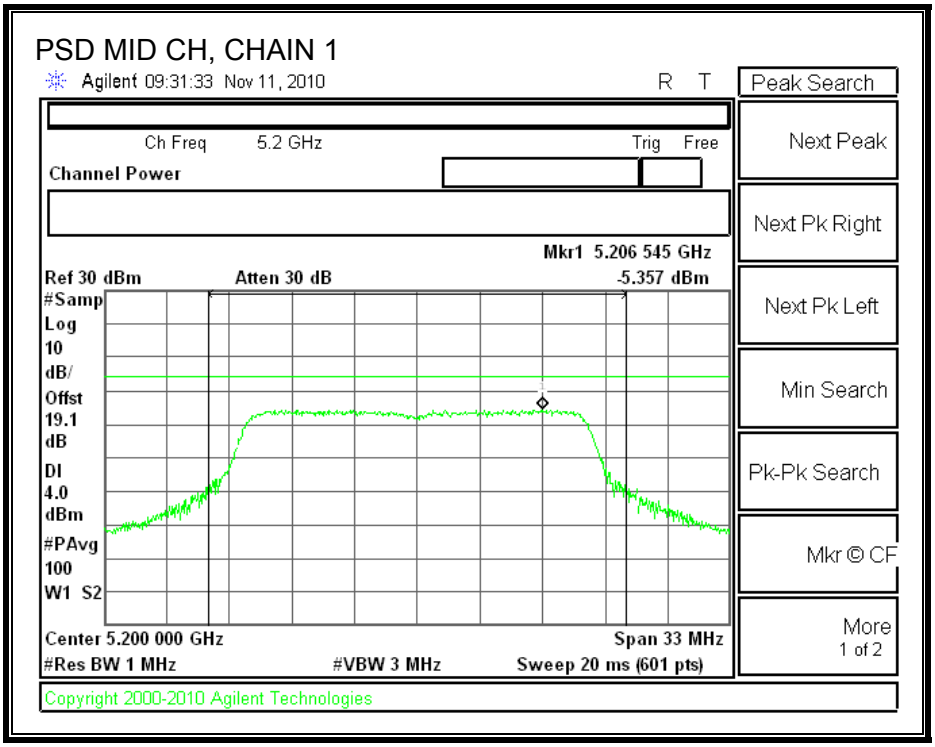


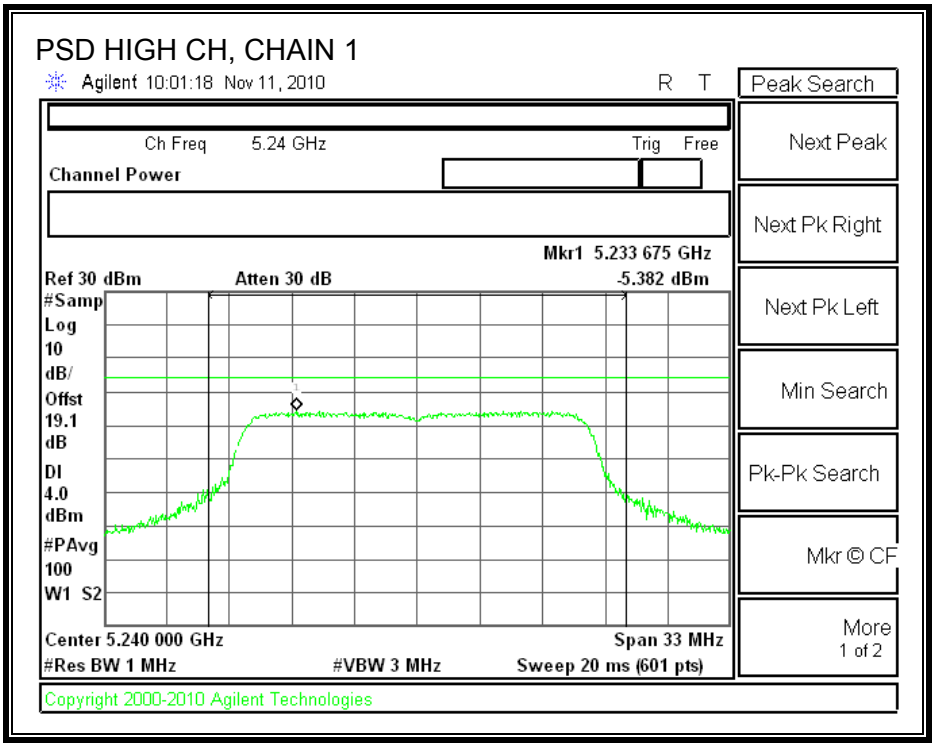




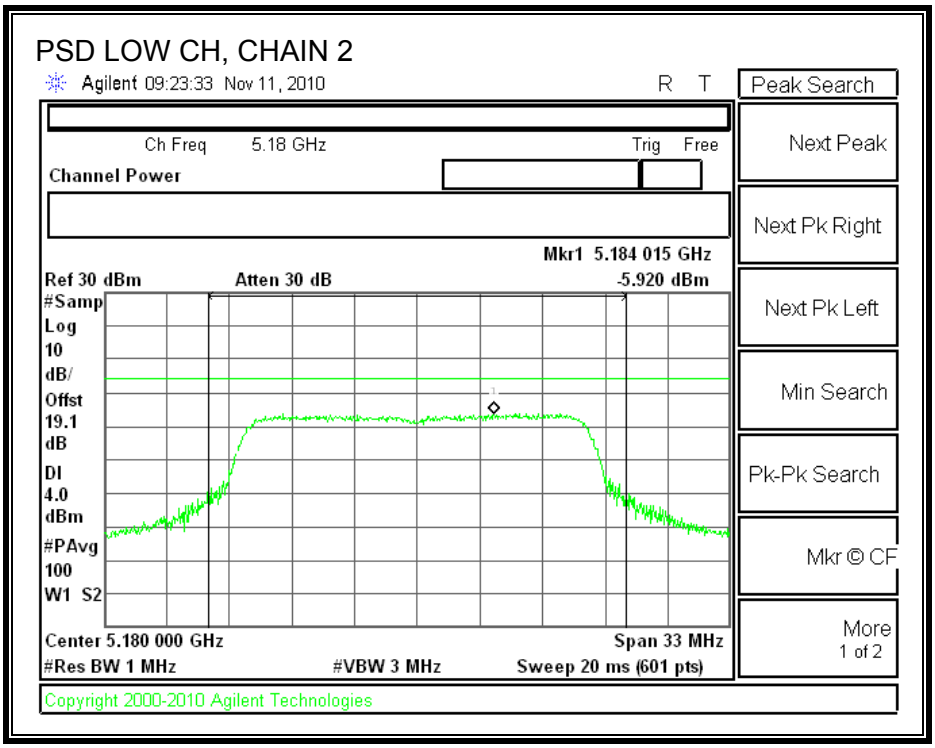
CHAIN 1 POWER SPECTRAL DENSITY

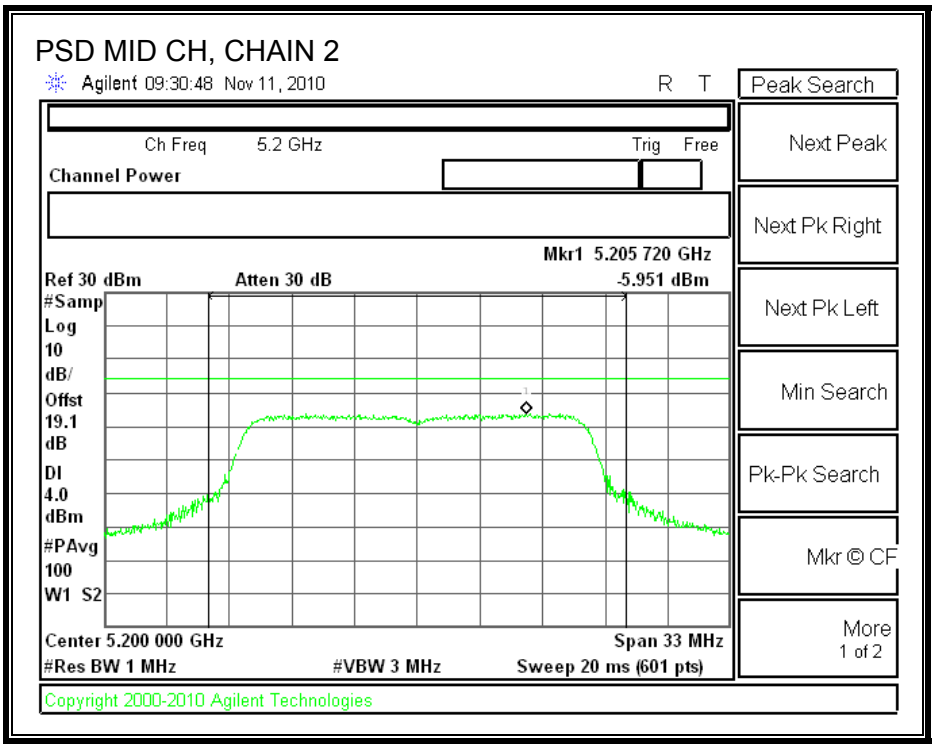


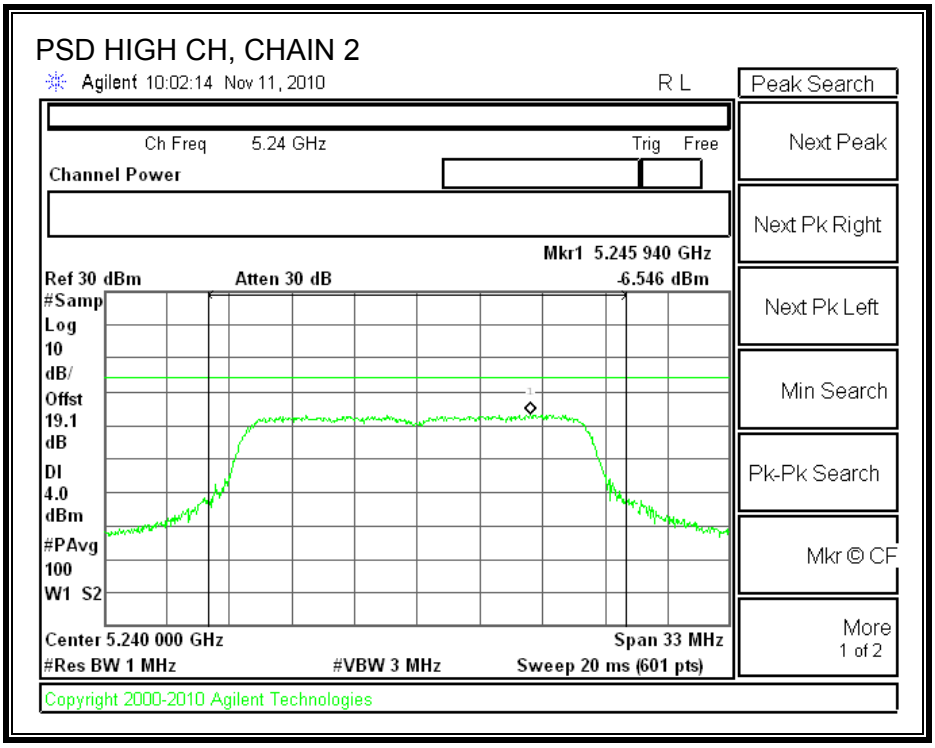




CHAIN 2 POWER SPECTRAL DENSITY







7.2.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)
The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less

TEST PROCEDURE

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

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

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.89	13	-4.11
Middle	5200	9.45	13	-3.55
High	5240	9.52	13	-3.48

CHAIN 1

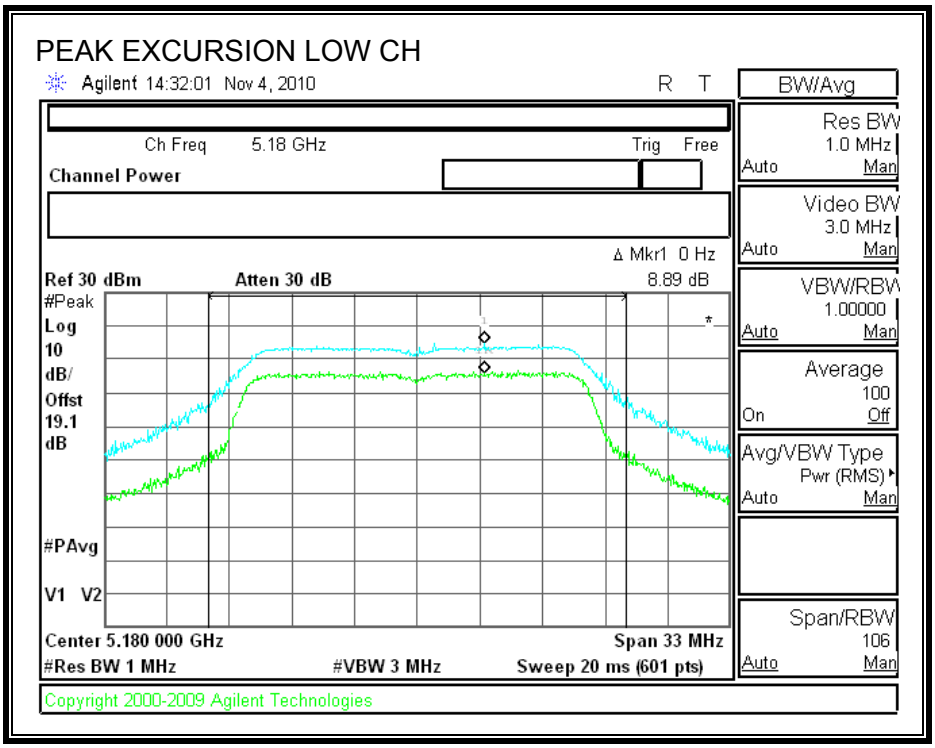
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.41	13	-3.59
Middle	5200	9.10	13	-3.90
High	5240	8.74	13	-4.26

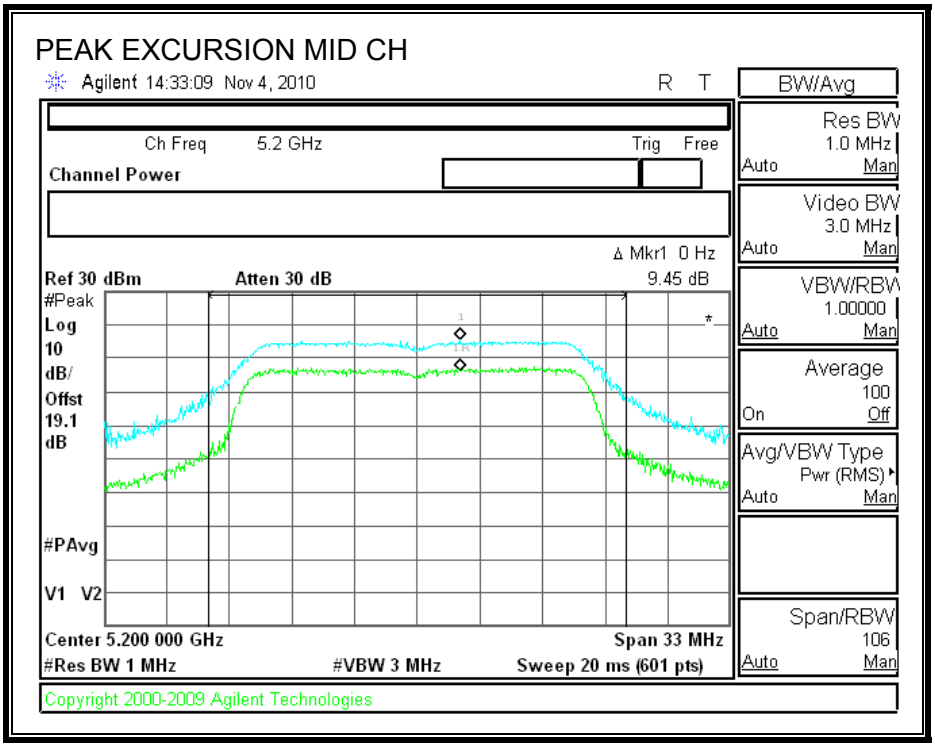
CHAIN 2

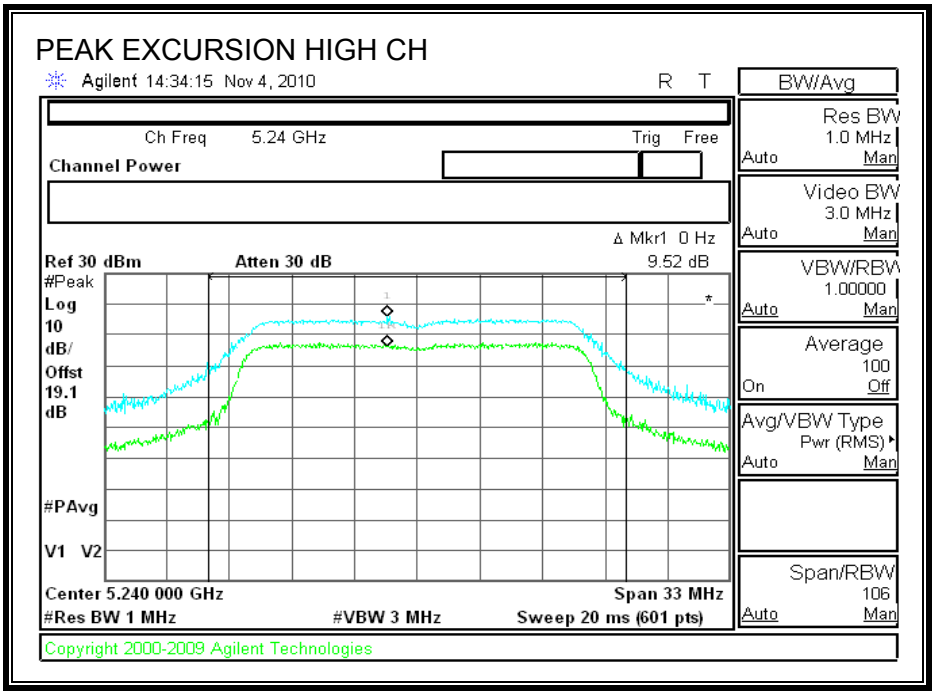
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	8.91	13	-4.09
Middle	5200	8.92	13	-4.08
High	5240	9.02	13	-3.98

CHAIN 0

PEAK EXCURSION

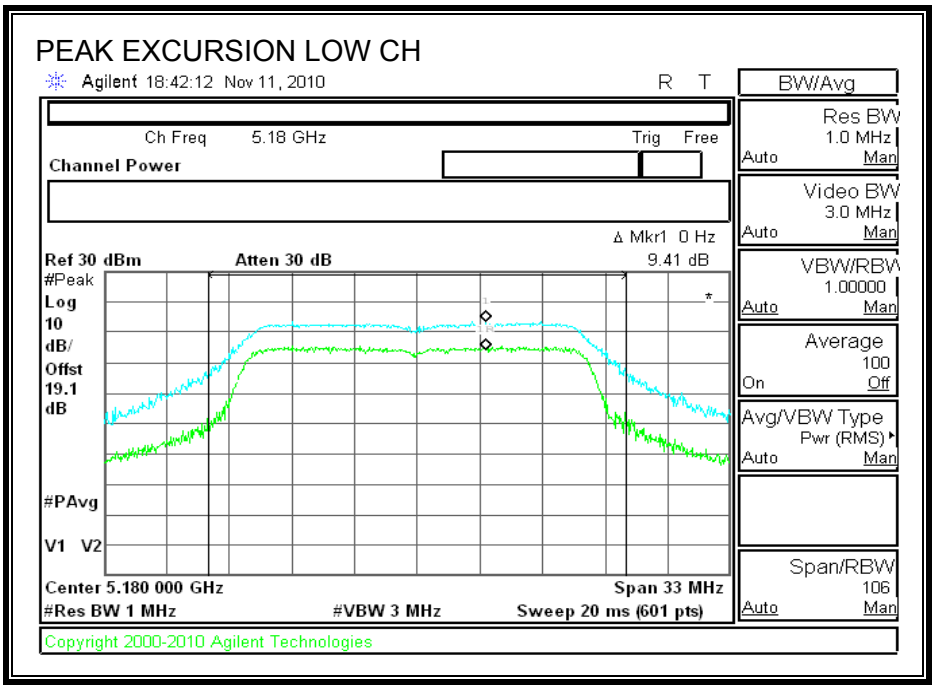




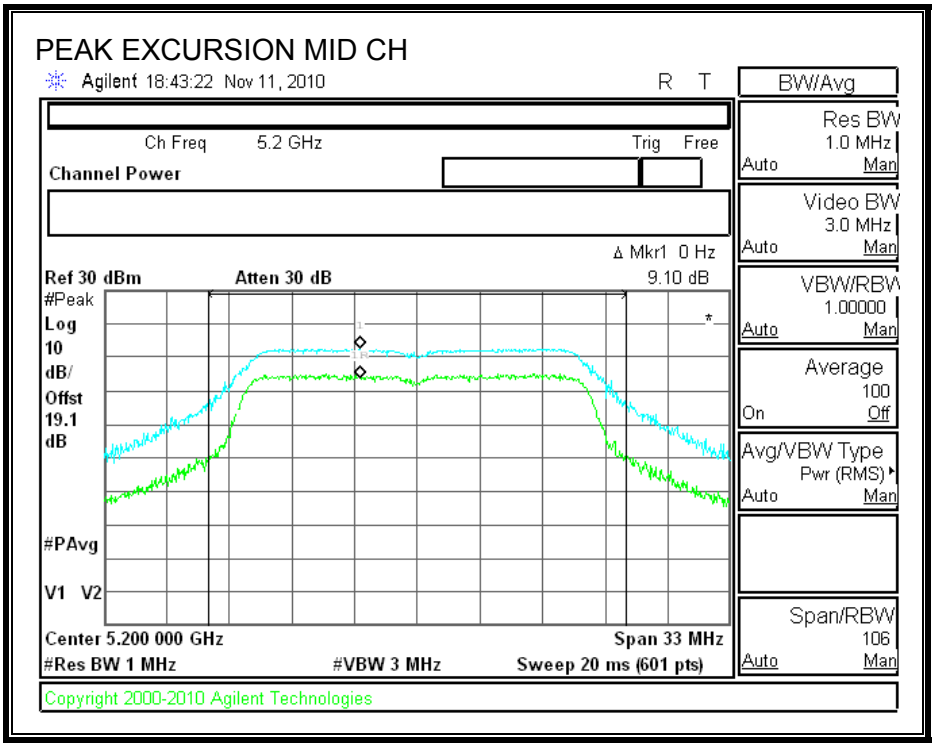


CHAIN 1

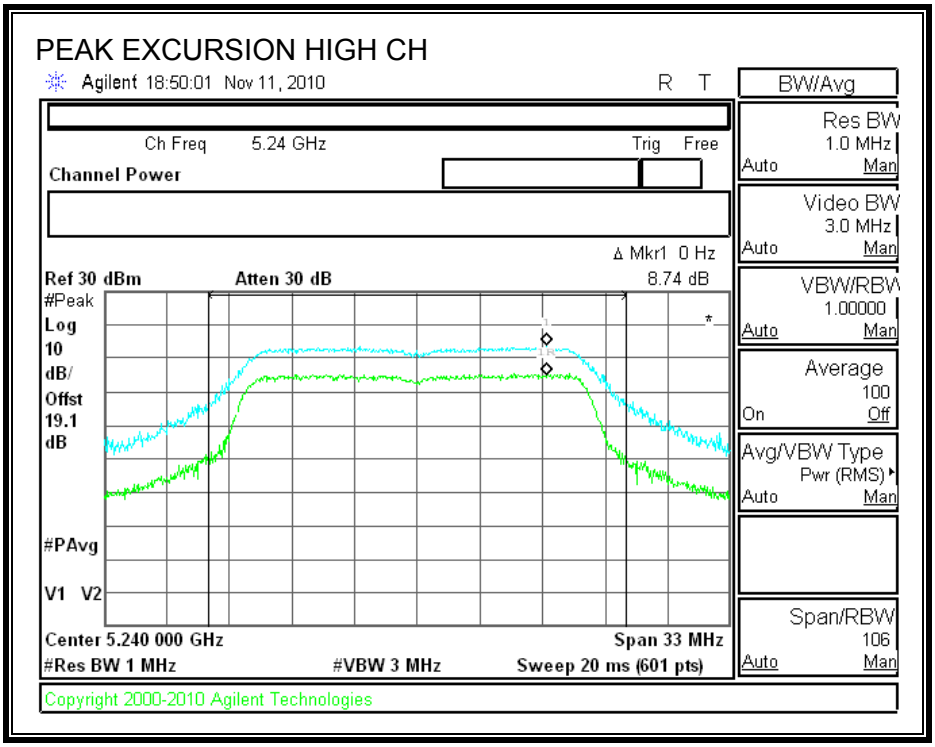
PEAK EXCURSION



PEAK EXCURSION MID CH

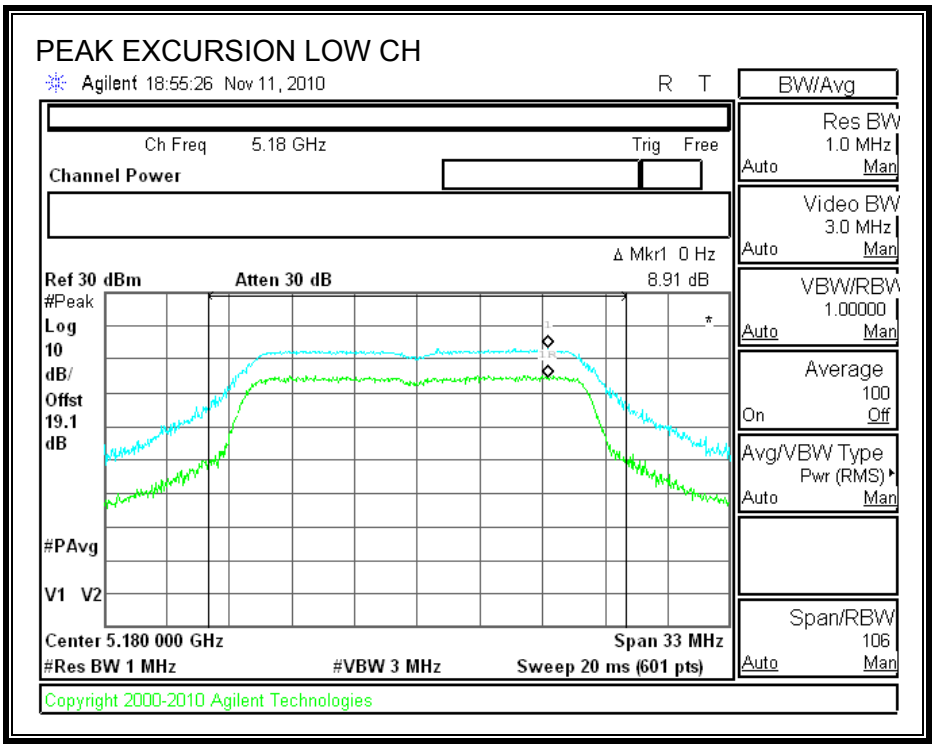


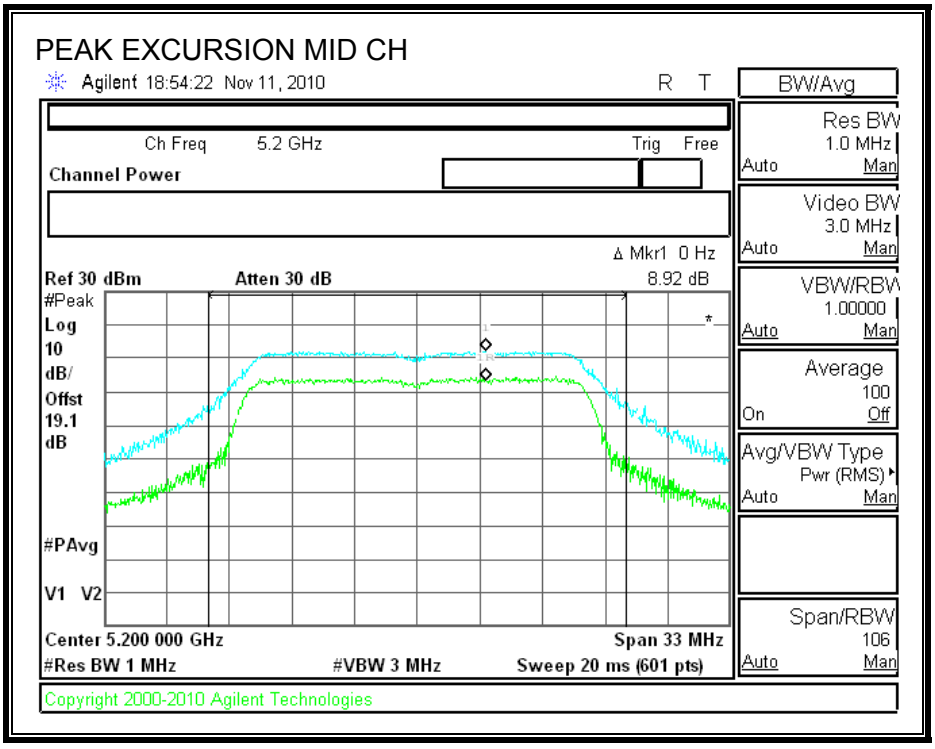
PEAK EXCURSION HIGH CH

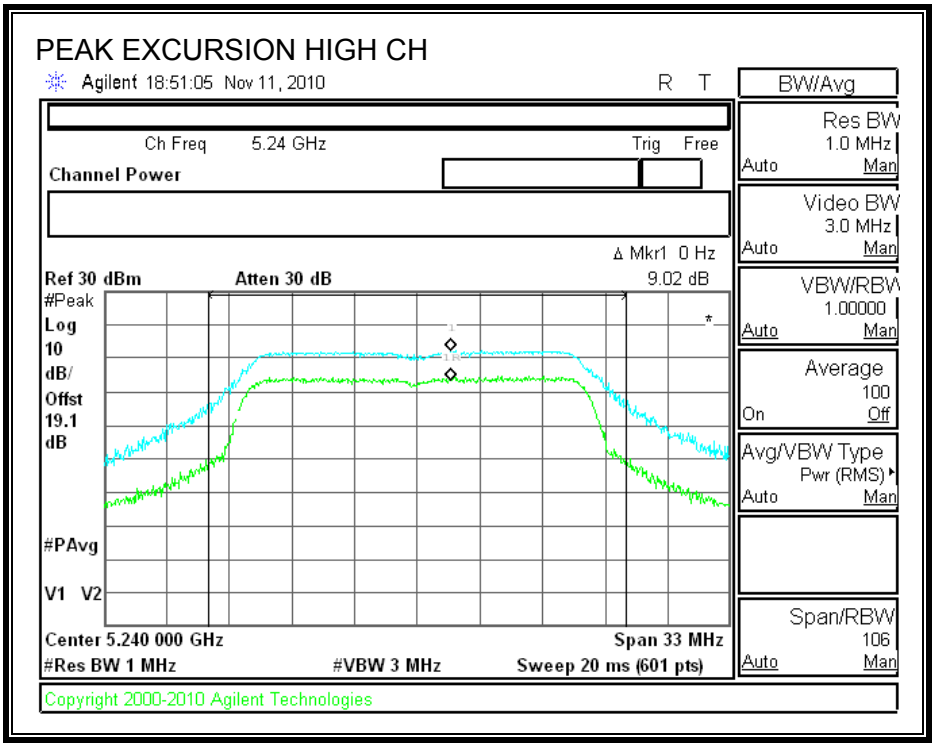


CHAIN 2

PEAK EXCURSION







7.2.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

IC RSS-210 A9.3 (3)

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

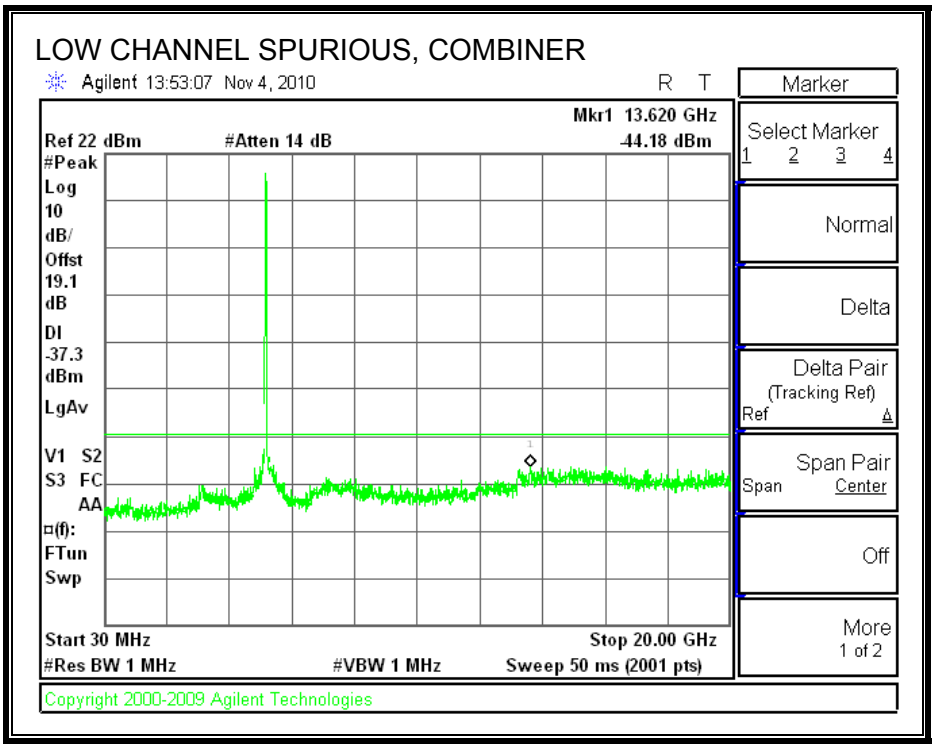
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

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.

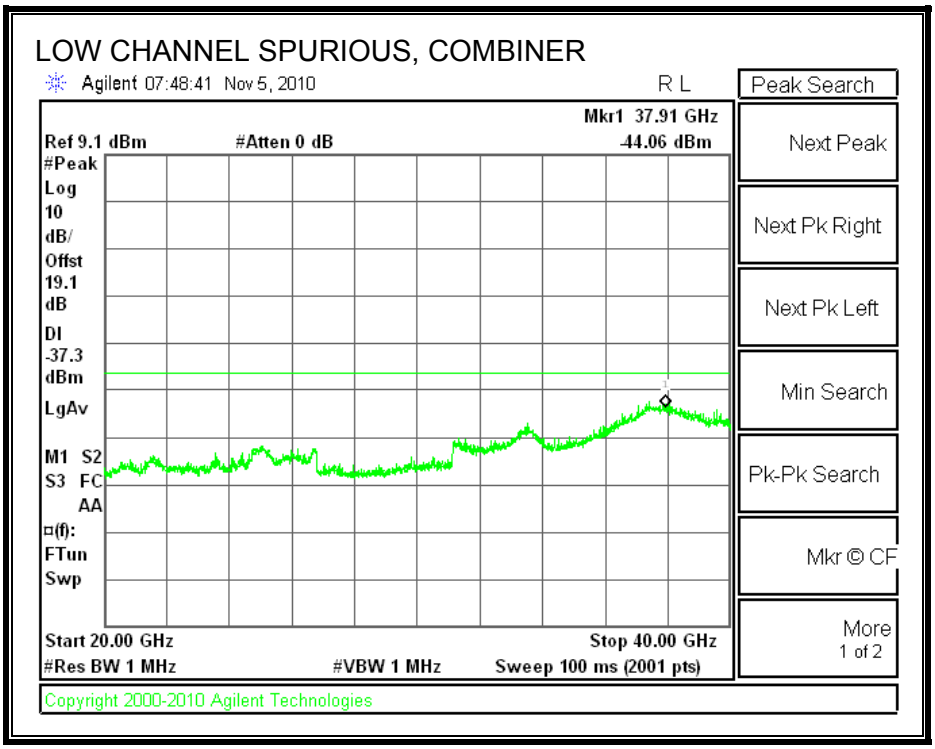
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

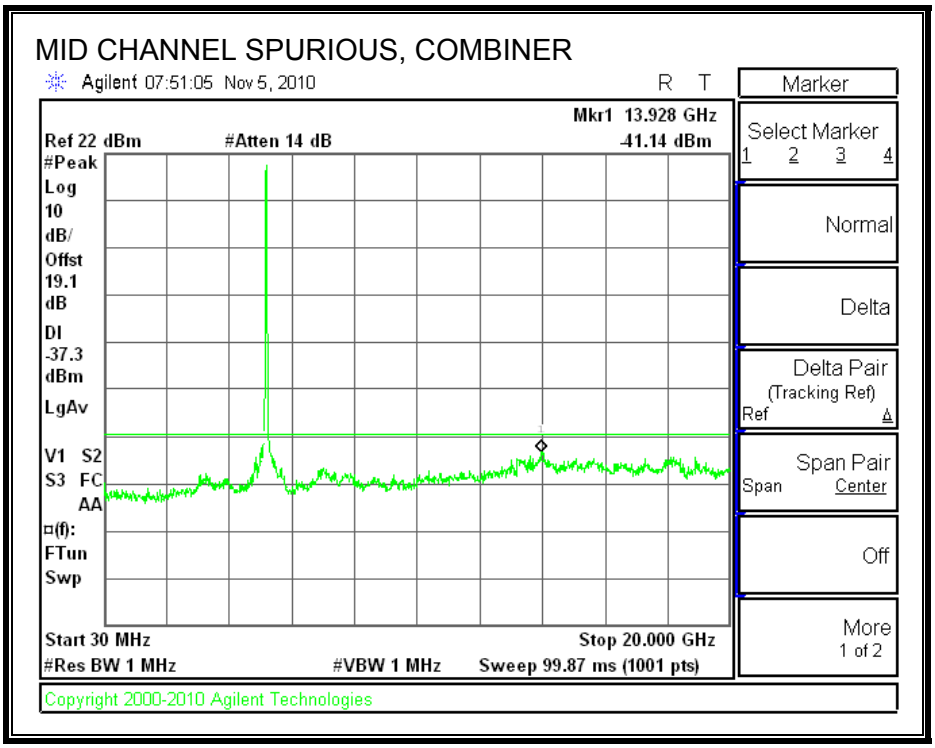
LOW CHANNEL SPURIOUS EMISSIONS



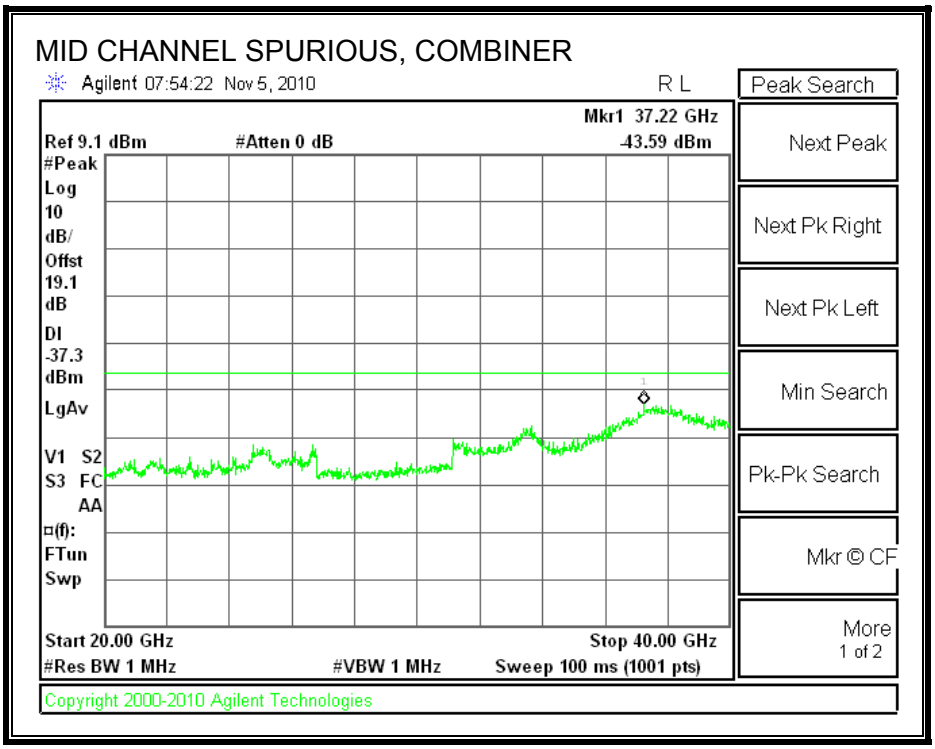
LOW CHANNEL SPURIOUS EMISSIONS



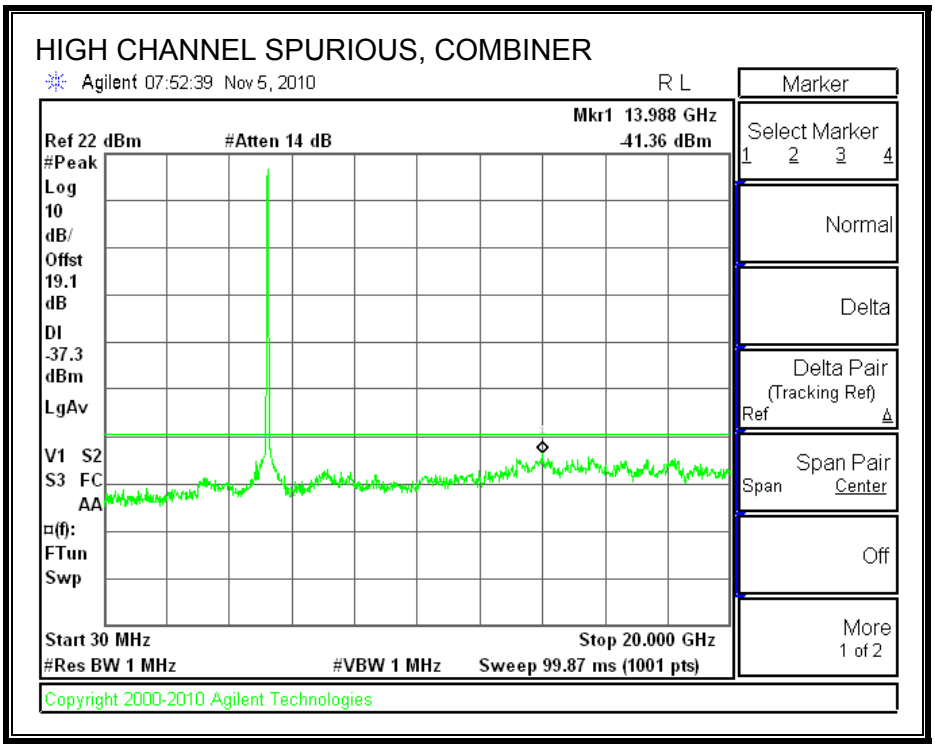
MID CHANNEL SPURIOUS EMISSIONS



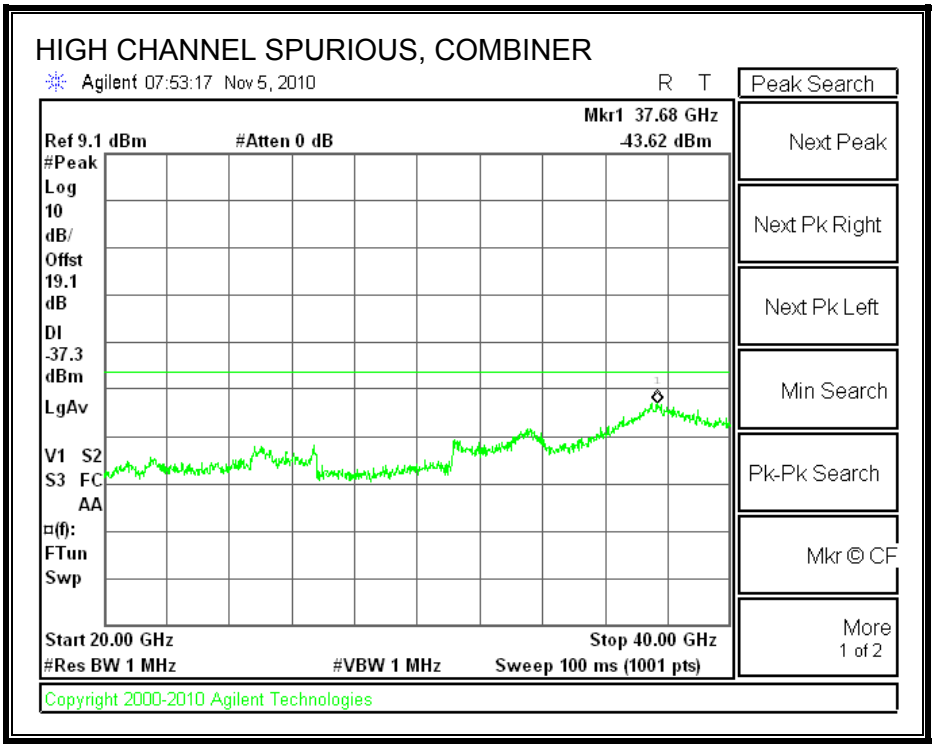
MID CHANNEL SPURIOUS EMISSIONS



HIGH CHANNEL SPURIOUS EMISSIONS



HIGH CHANNEL SPURIOUS EMISSIONS



7.3. 5.2 GHz BAND CHANNEL TESTS FOR 802.11n HT40 MODE

7.3.1. 99% & 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	41.939	36.0455
High	5230	40.069	36.2941

CHAIN 1

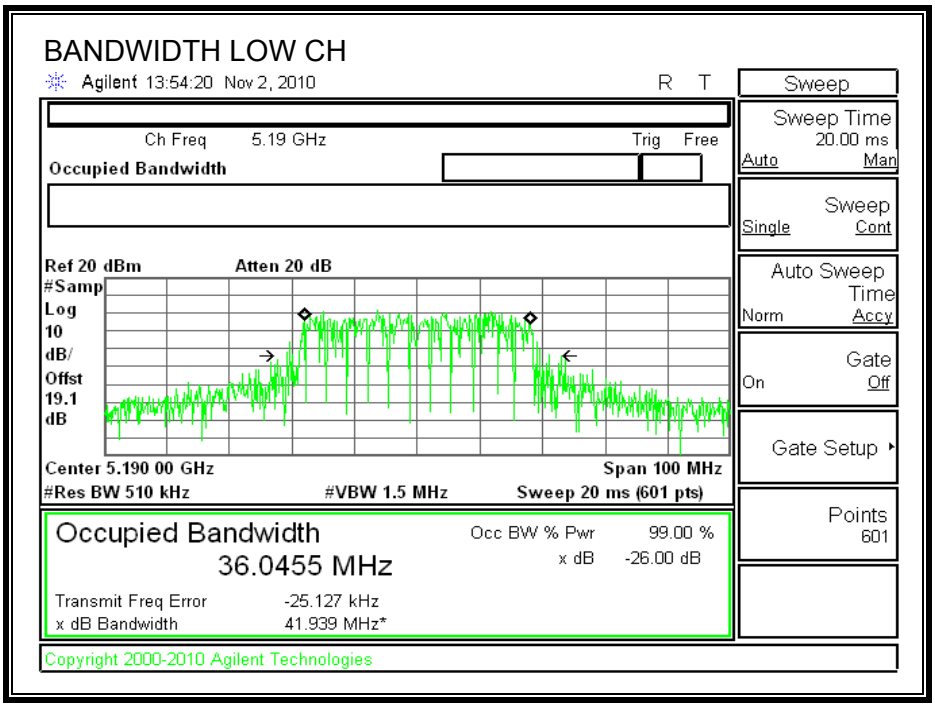
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	41.067	36.085
High	5230	40.894	36.4941

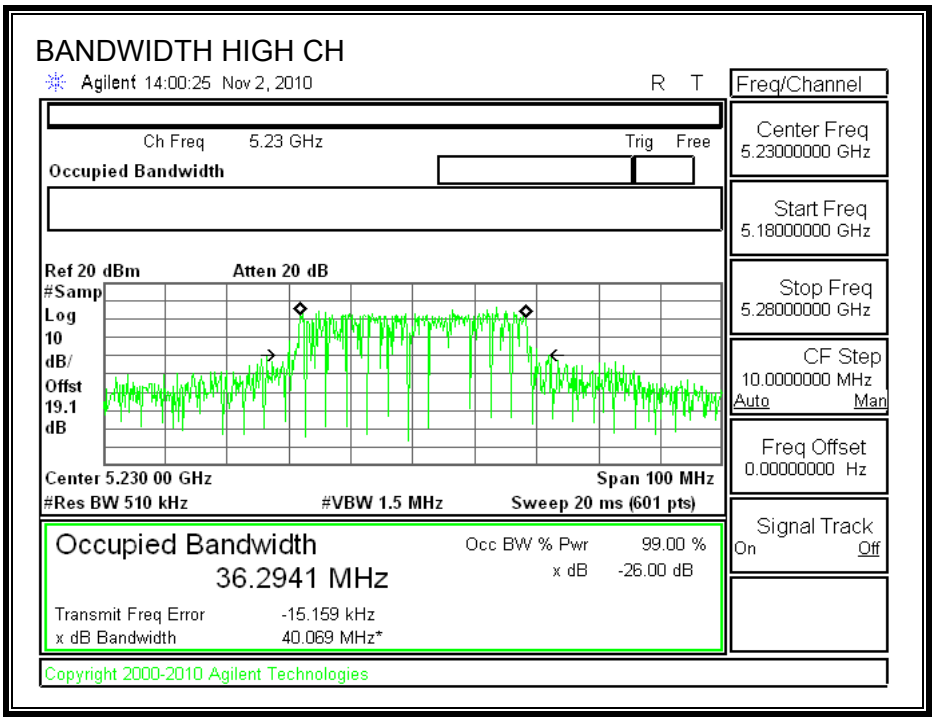
CHAIN 2

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5190	41.496	36.2223
High	5230	40.062	36.4637

CHAIN 0

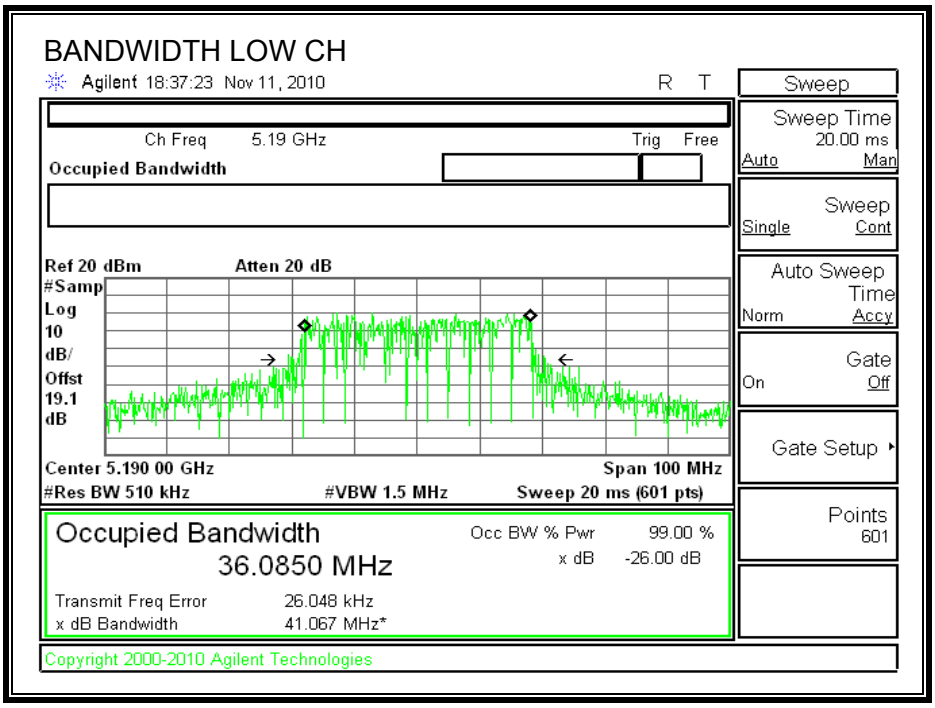
26 dB and 99% BANDWIDTH

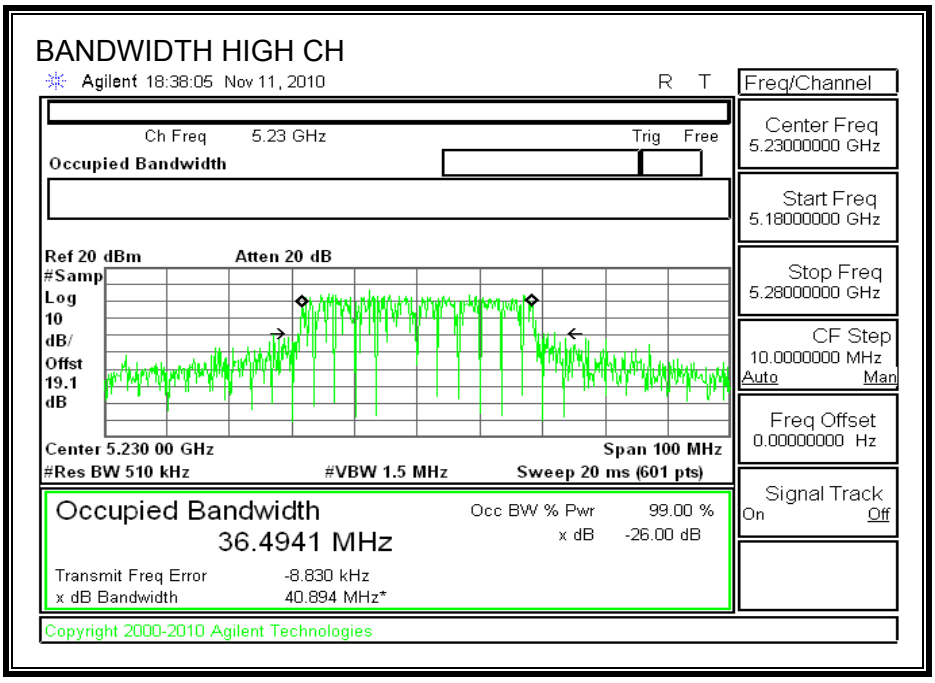




CHAIN 1

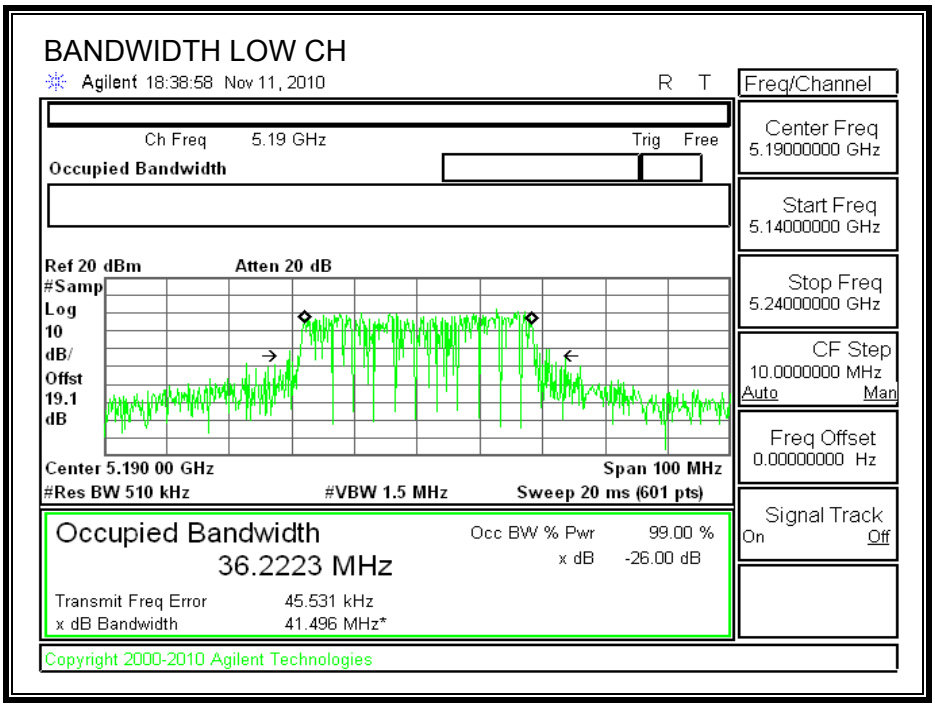
26 dB and 99% BANDWIDTH

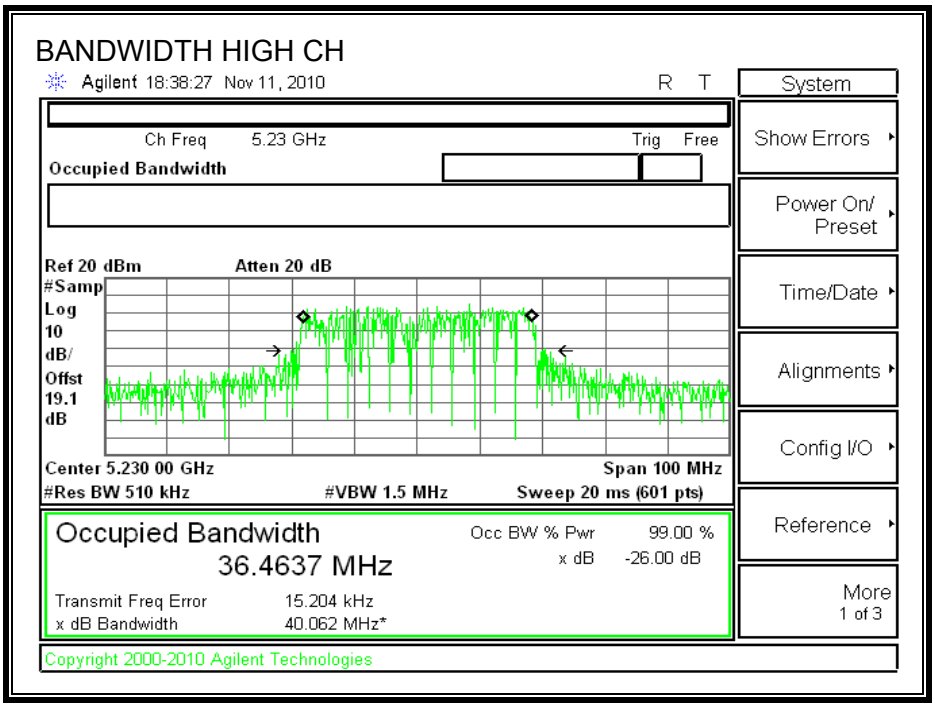




CHAIN 2

26 dB and 99% BANDWIDTH





7.3.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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 of antenna gain is less than 6 dBi, and the combination of antenna gain is 10.28 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

Non Beam-Forming

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5190	16.99	41.939	20.23	5.97	16.99
High	5230	16.99	40.069	20.03	5.97	16.99

Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	12.88	11.41	11.32	16.70	16.99	-0.29
High	5230	12.59	11.81	11.82	16.86	16.99	-0.13

Beam-Forming

Limit

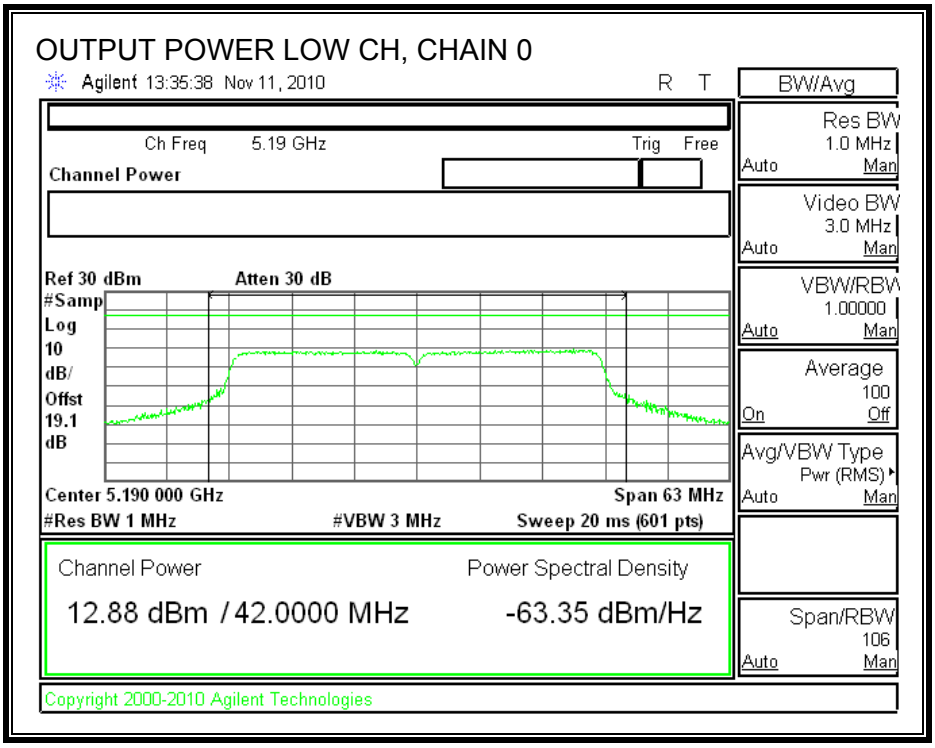
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5190	16.99	41.939	20.23	10.28	12.71
High	5230	16.99	40.069	20.03	10.28	12.71

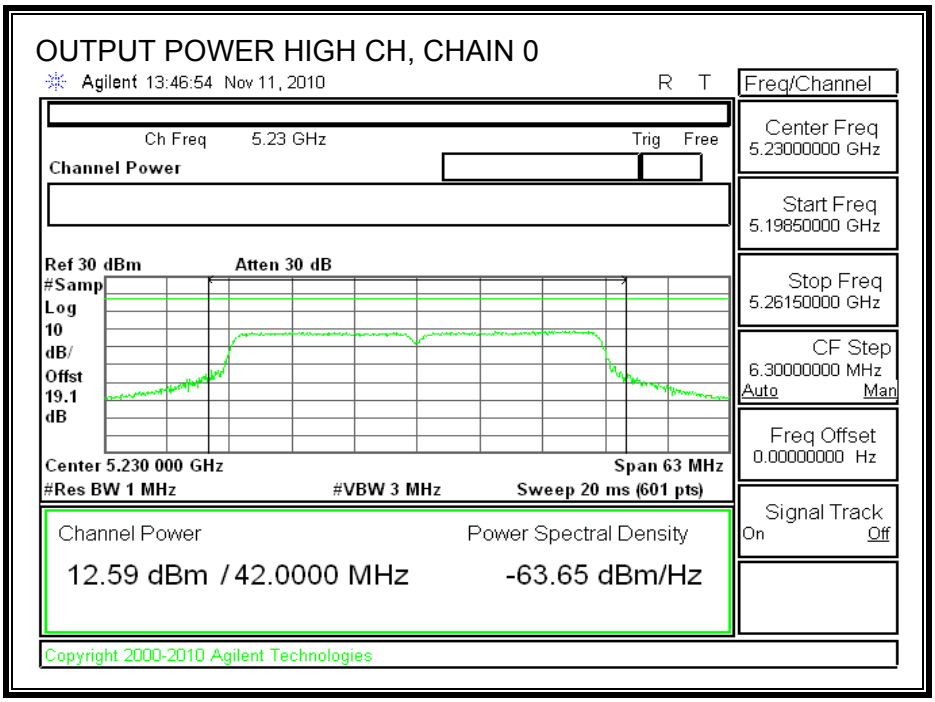
Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	8.36	7.30	7.11	12.40	12.71	-0.31
High	5230	8.22	7.54	7.06	12.40	12.71	-0.31

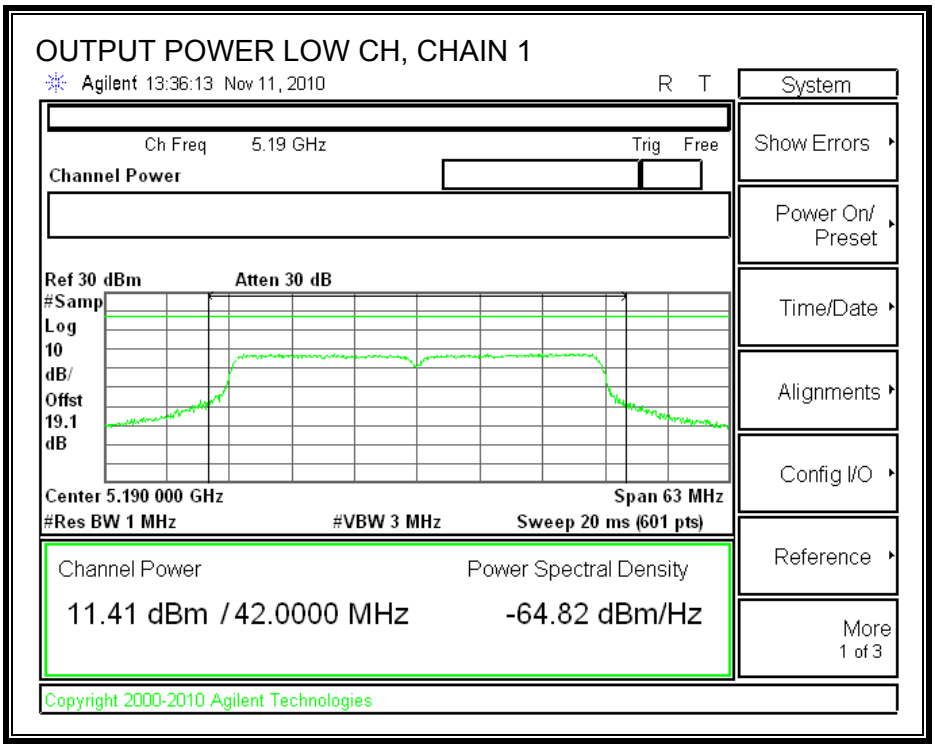
NBF

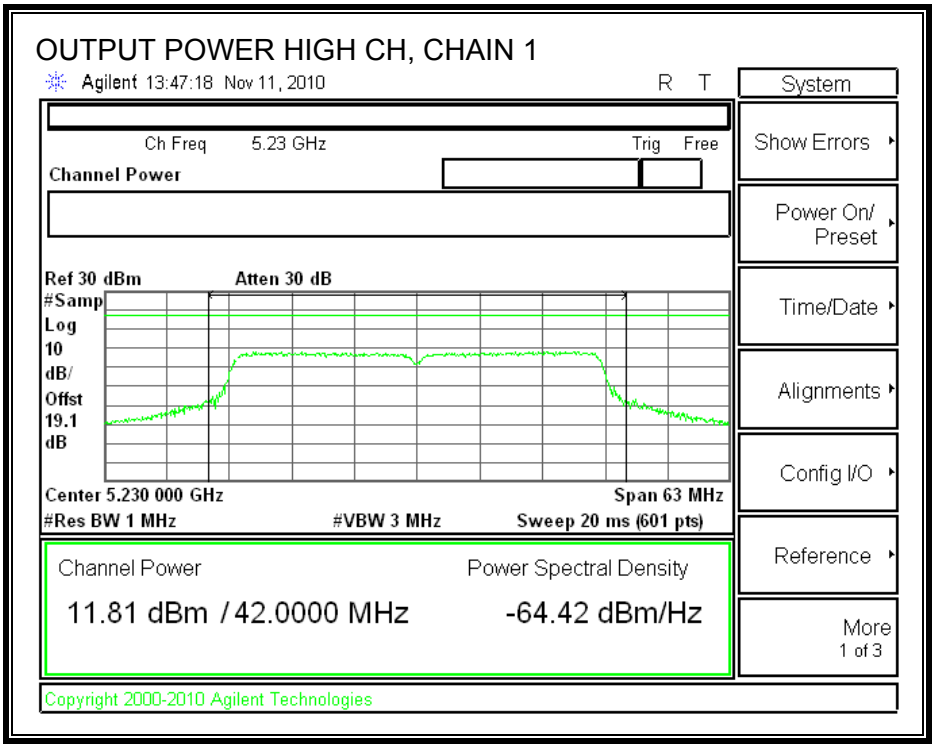
CHAIN 1 OUTPUT POWER



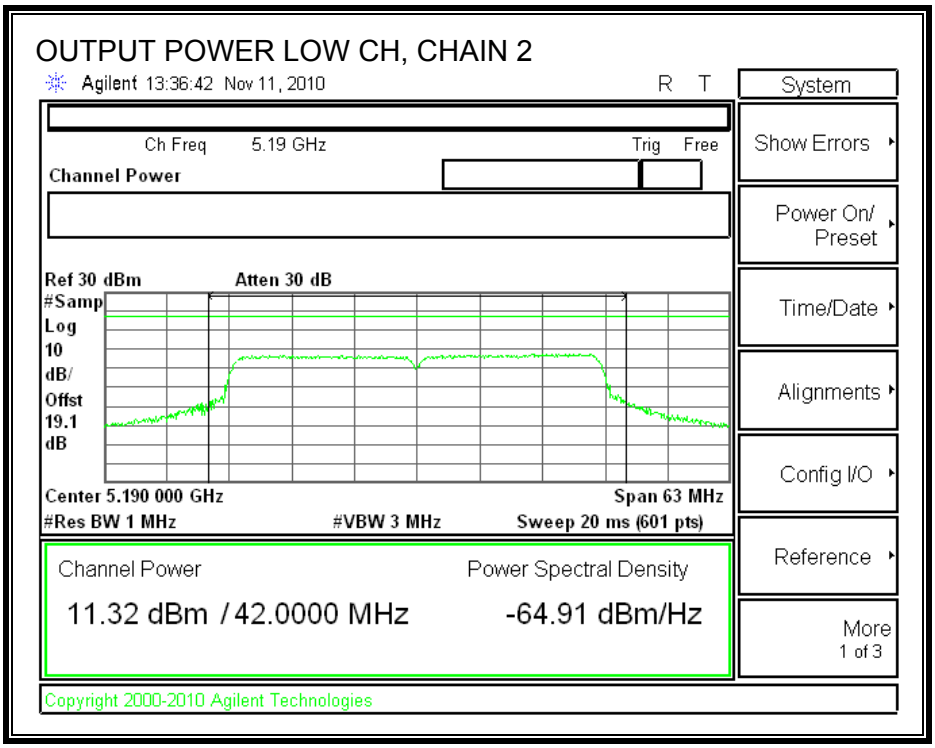


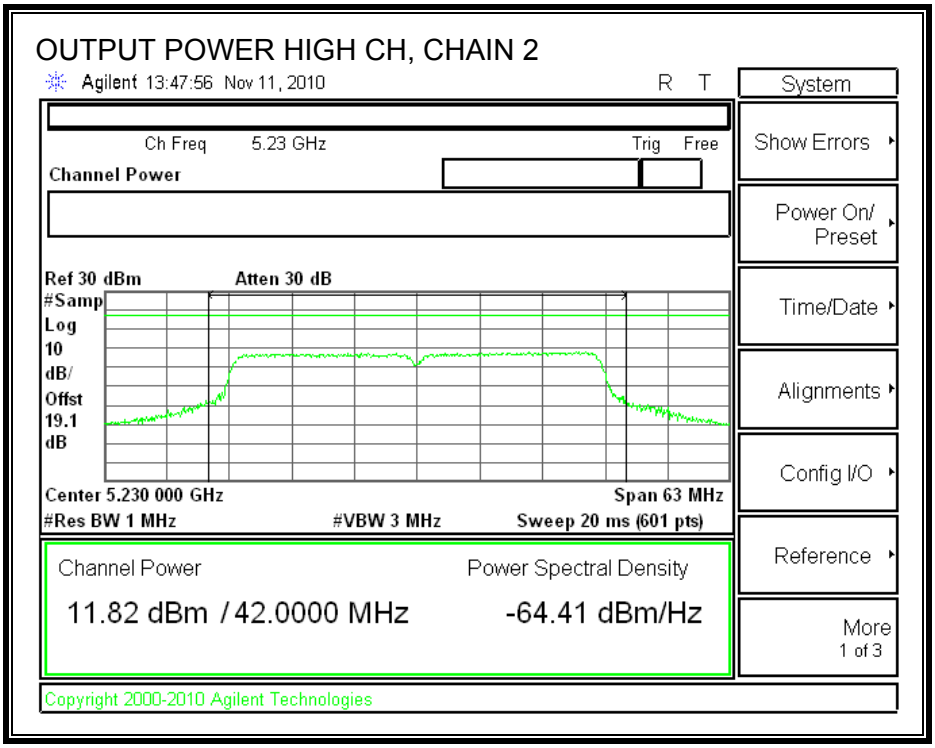
CHAIN 1 OUTPUT POWER





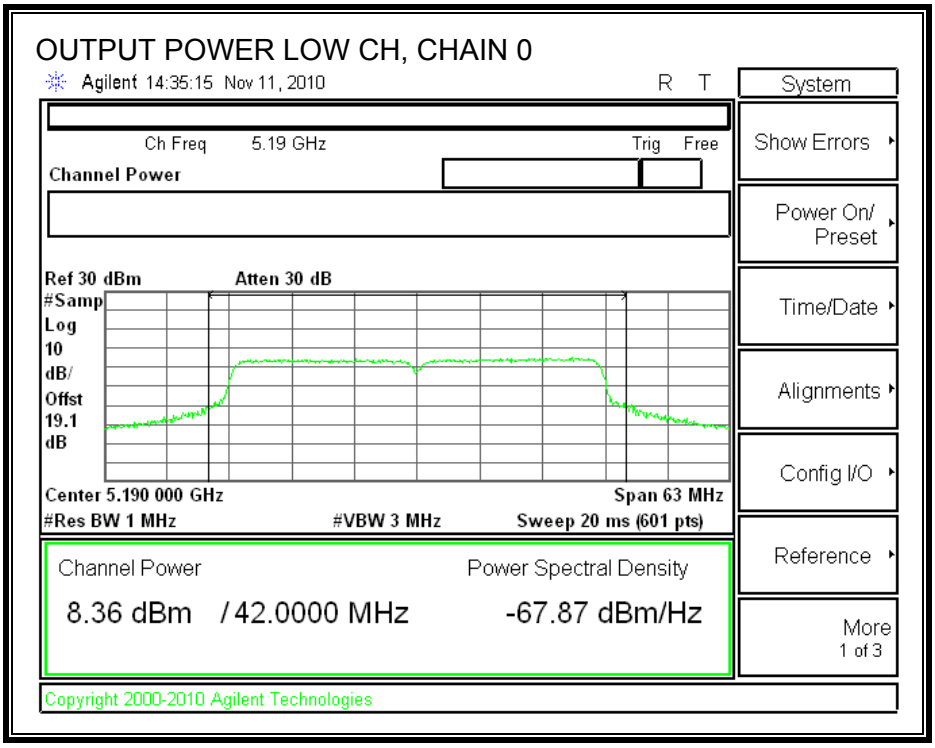
CHAIN 2 OUTPUT POWER

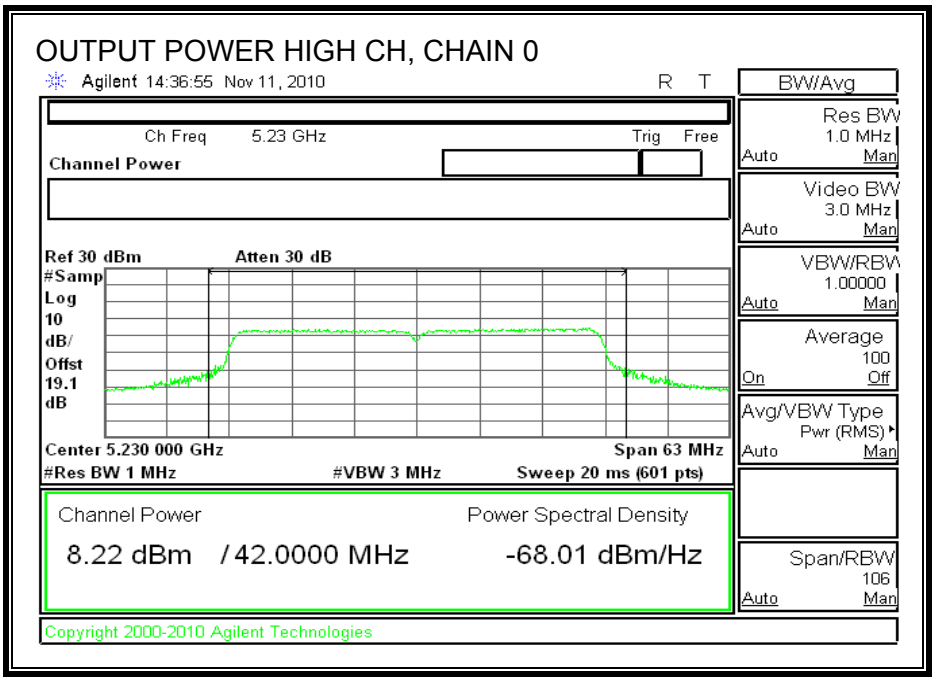




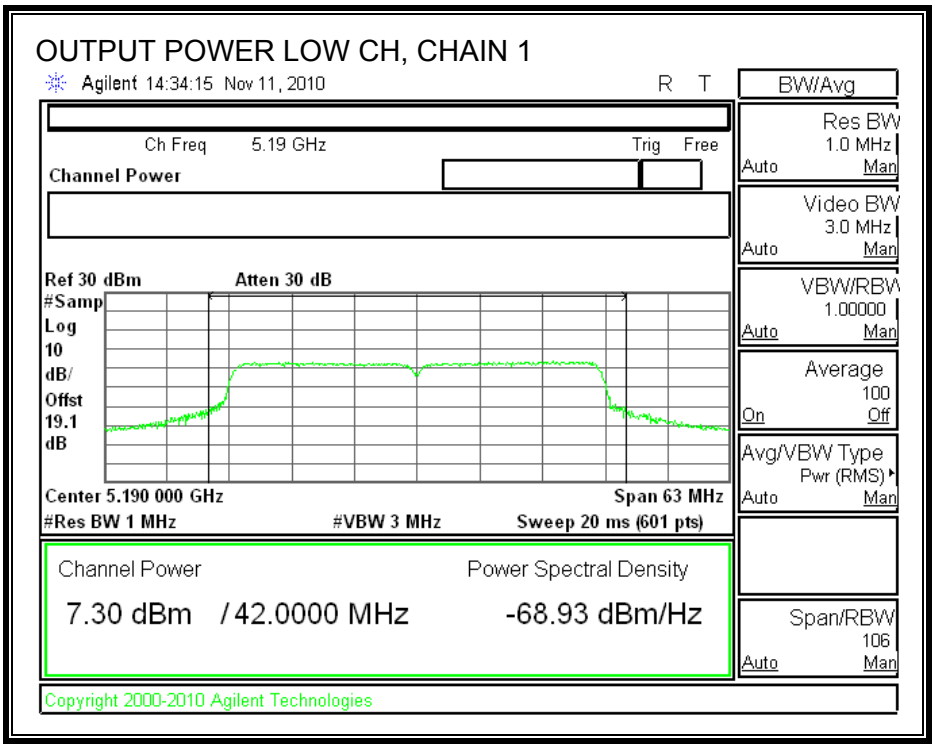
BF

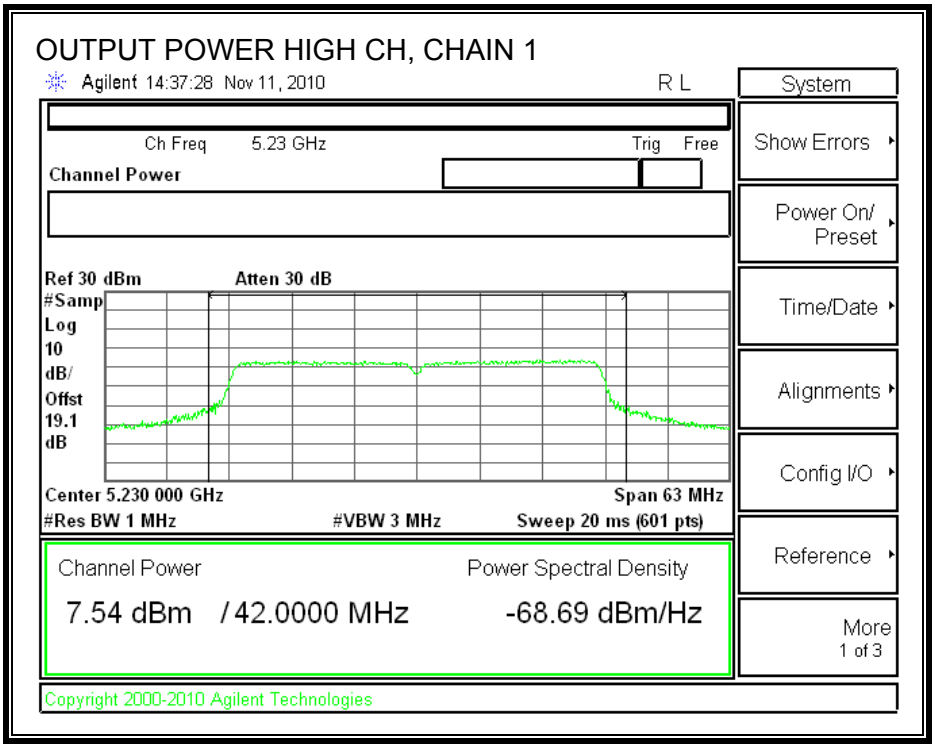
CHAIN 1 OUTPUT POWER



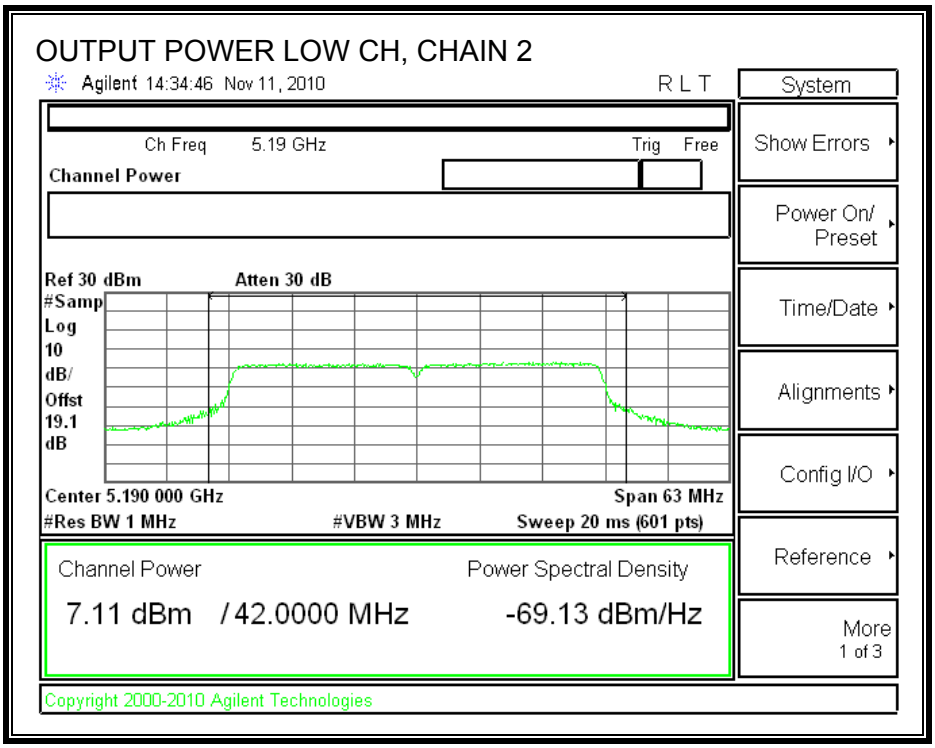


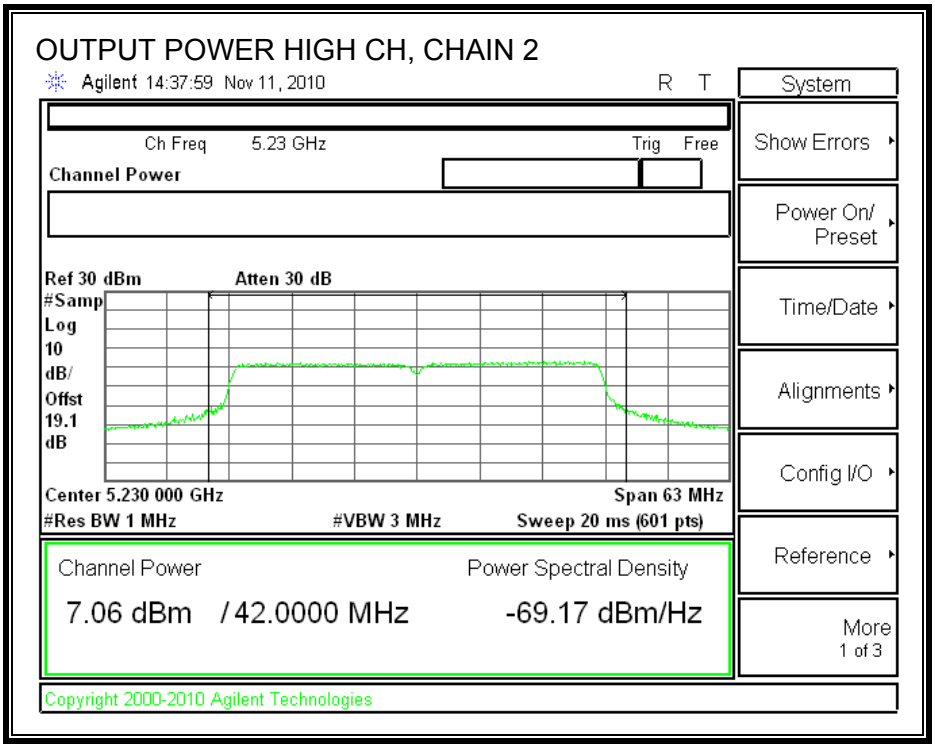
CHAIN 1 OUTPUT POWER





CHAIN 2 OUTPUT POWER





7.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

NBF

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5190	12.50	11.35	11.25	16.51
High	5230	12.30	11.70	11.70	16.68

BF

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5190	8.20	7.10	7.00	12.24
High	5230	8.15	7.25	6.90	12.24

7.3.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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 6 dBi, therefore the limit is 4 dBm.

The combination antenna gain is 10.28. dBi, therefore the limit is -0.28 dBm.

TEST PROCEDURE

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

Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

RESULTS

NBF

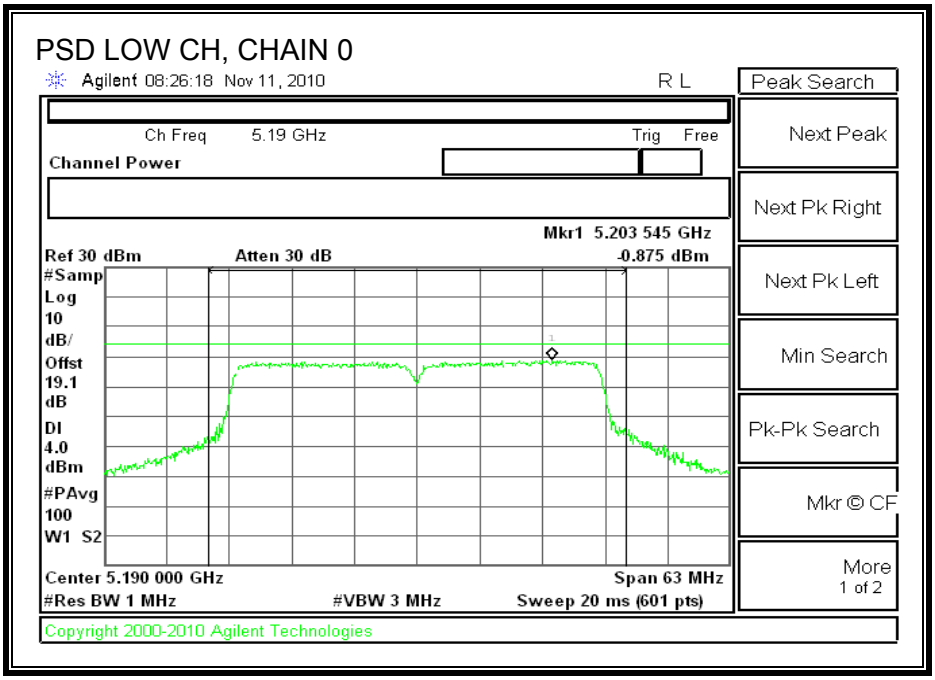
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-0.875	-2.406	-2.561	2.89	4.00	-1.11
High	5230	-1.348	-1.915	-2.231	2.96	4.00	-1.04

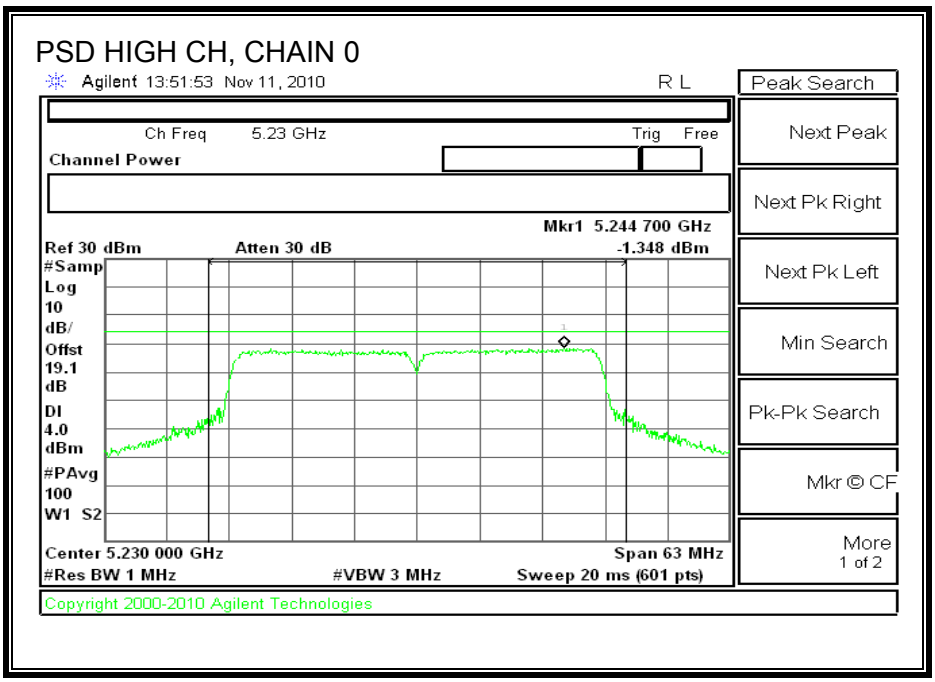
BF

Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-4.212	-5.751	-5.653	-0.38	-0.28	-0.10
High	5230	-4.606	-5.325	-5.628	-0.39	-0.28	-0.11

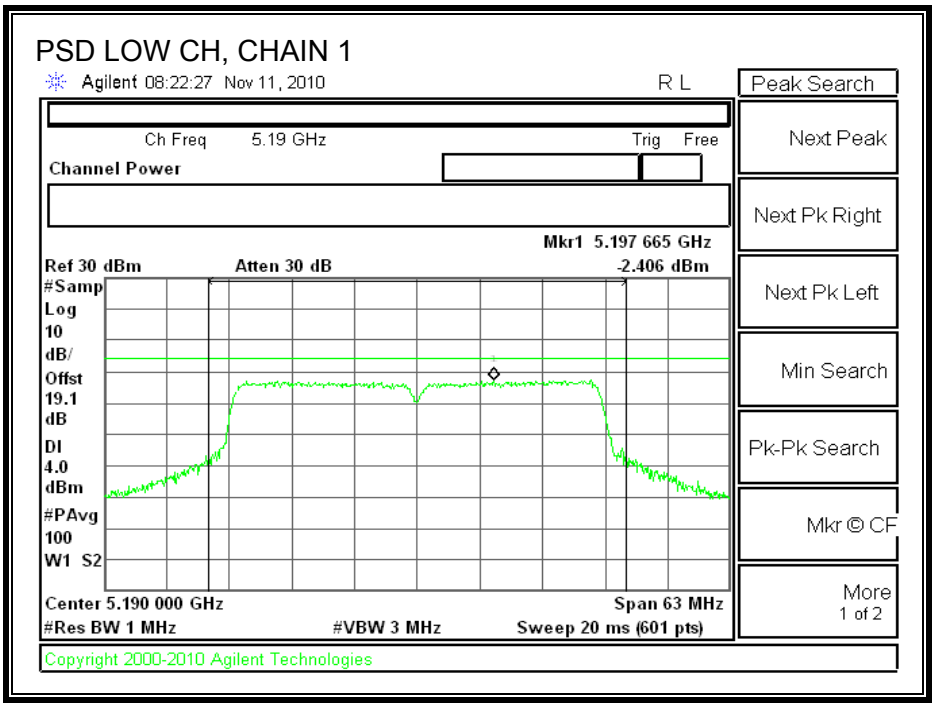
NBF

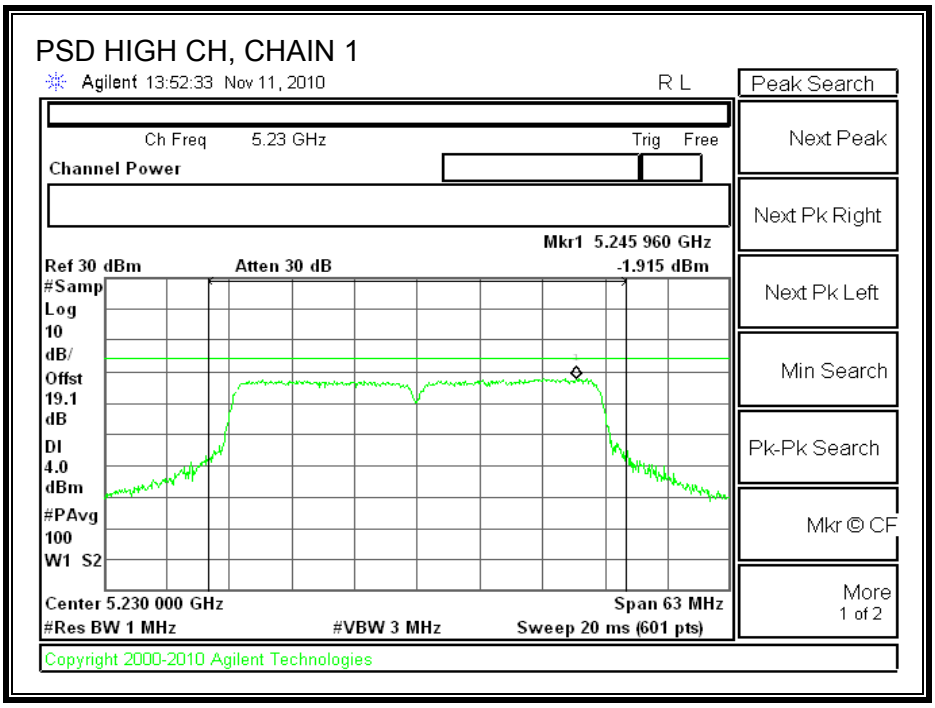
CHAIN 0 POWER SPECTRAL DENSITY



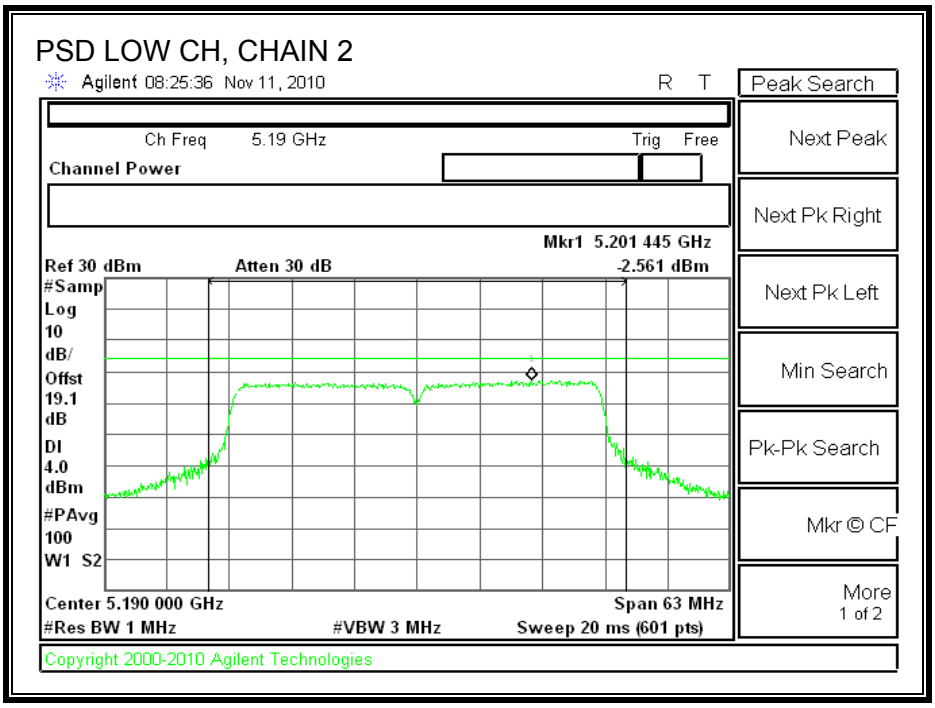


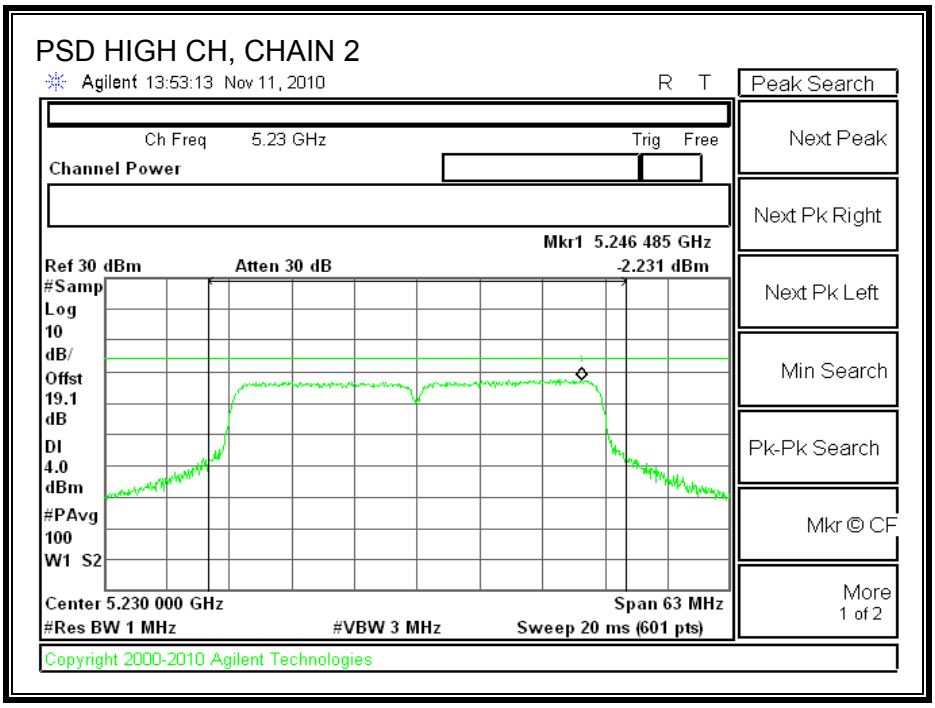
CHAIN 1 POWER SPECTRAL DENSITY





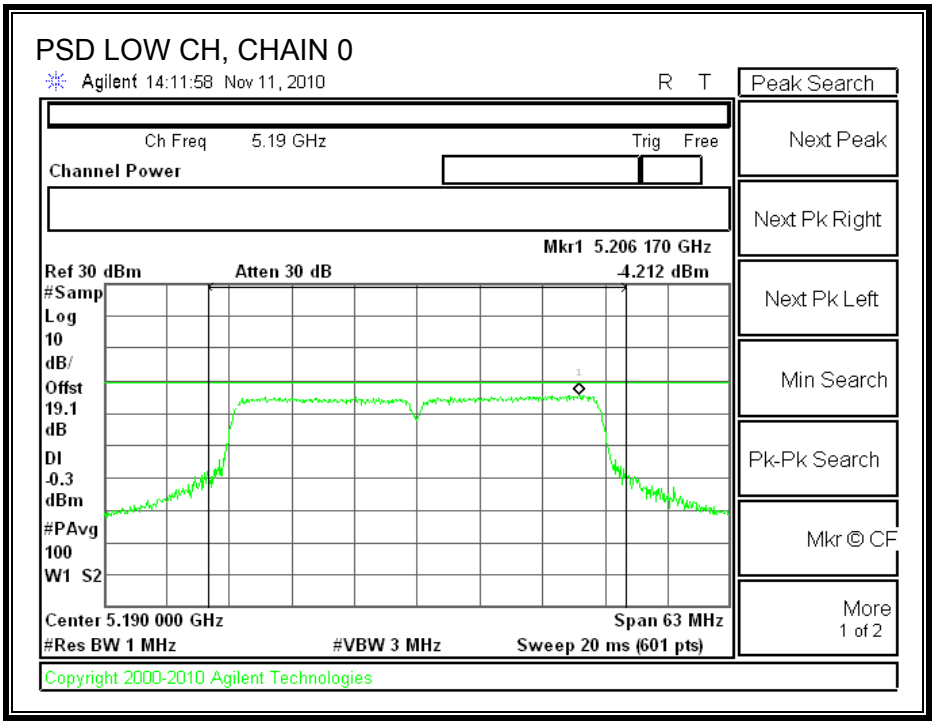
CHAIN 2 POWER SPECTRAL DENSITY

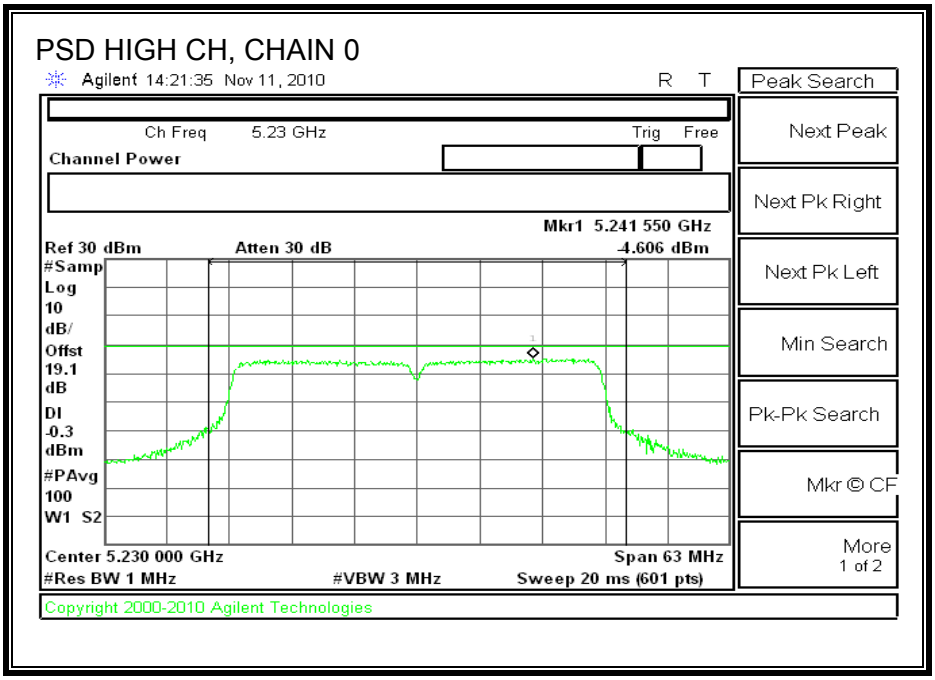




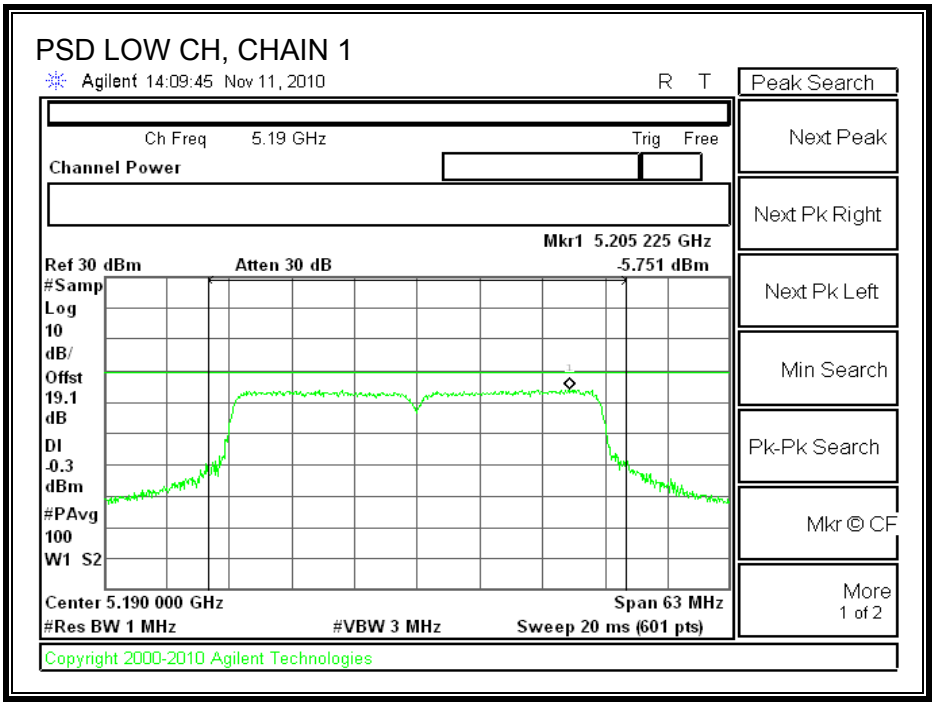
BF

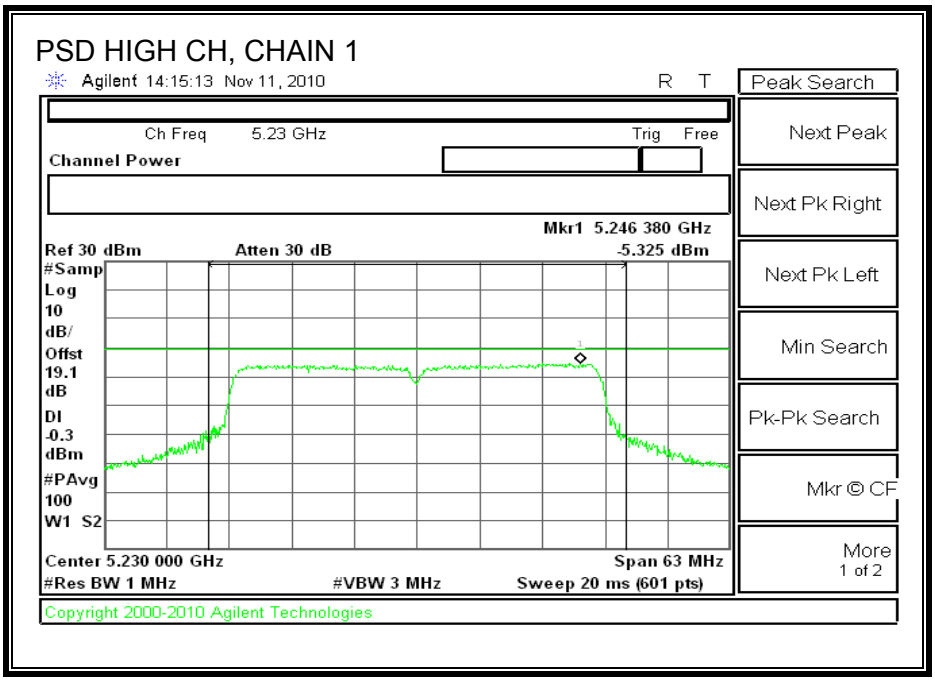
CHAIN 0 POWER SPECTRAL DENSITY



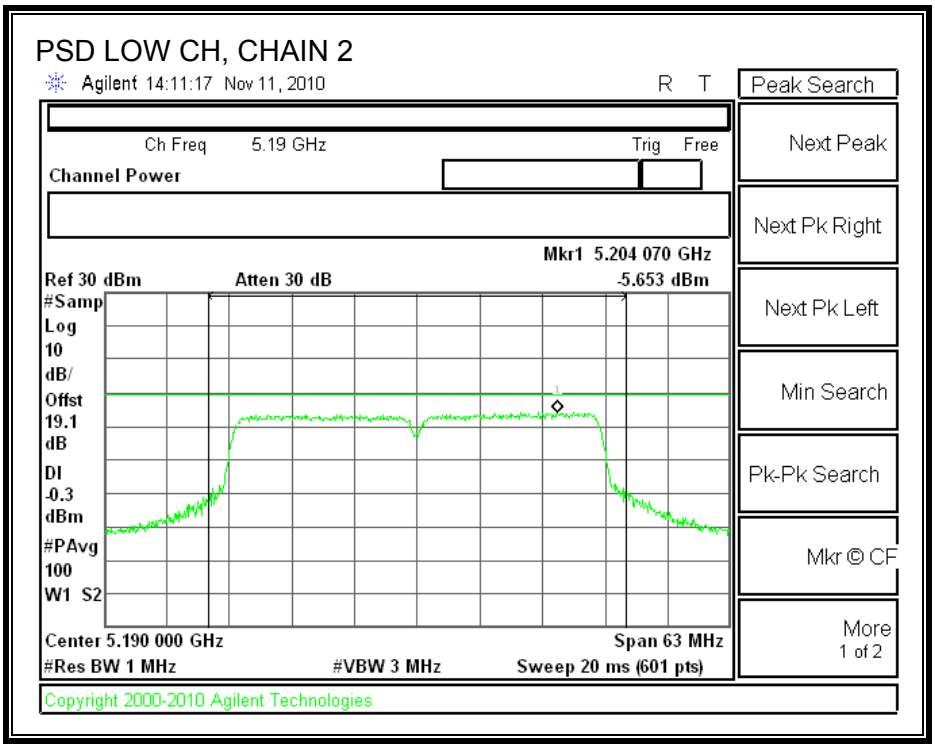


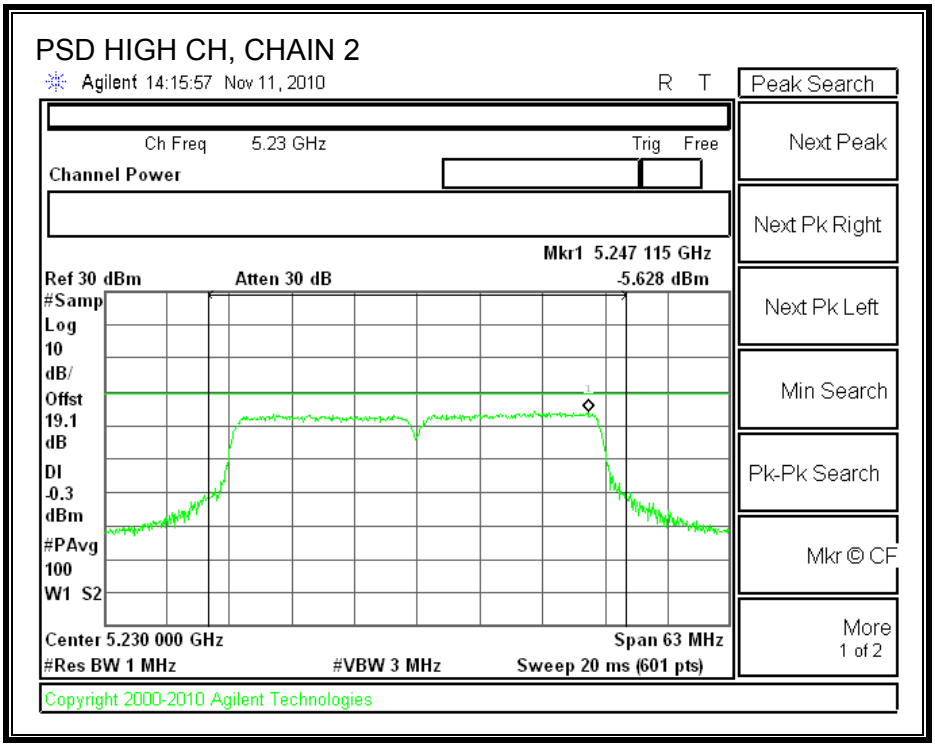
CHAIN 1 POWER SPECTRAL DENSITY





CHAIN 2 POWER SPECTRAL DENSITY





7.3.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	9.60	13	-3.40
High	5230	8.85	13	-4.15

CHAIN 1

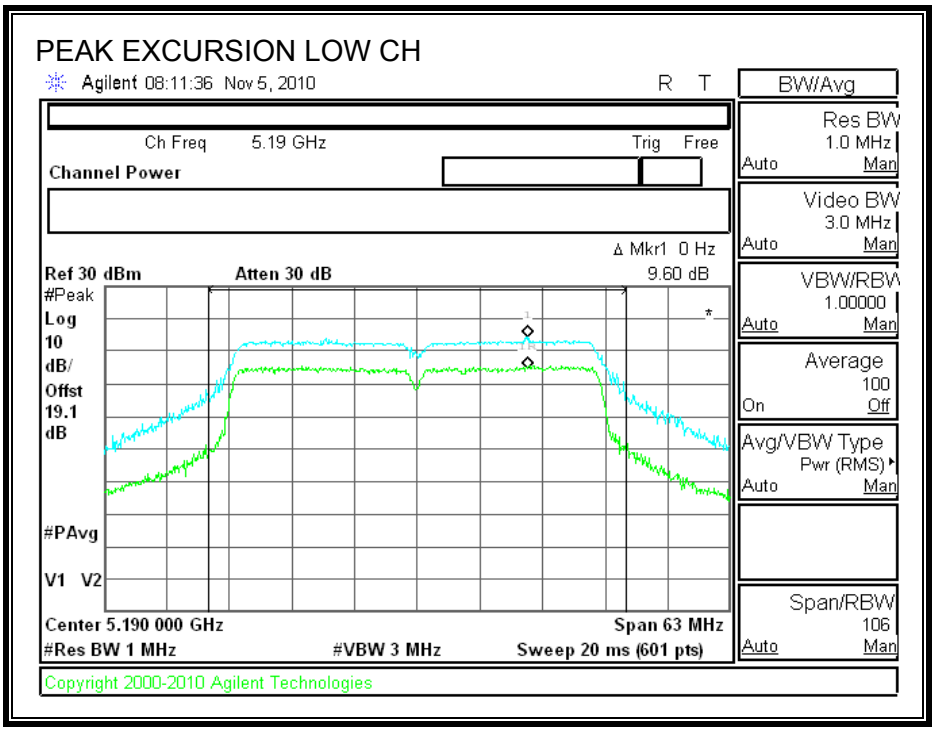
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	11.03	13	-1.97
High	5230	9.48	13	-3.52

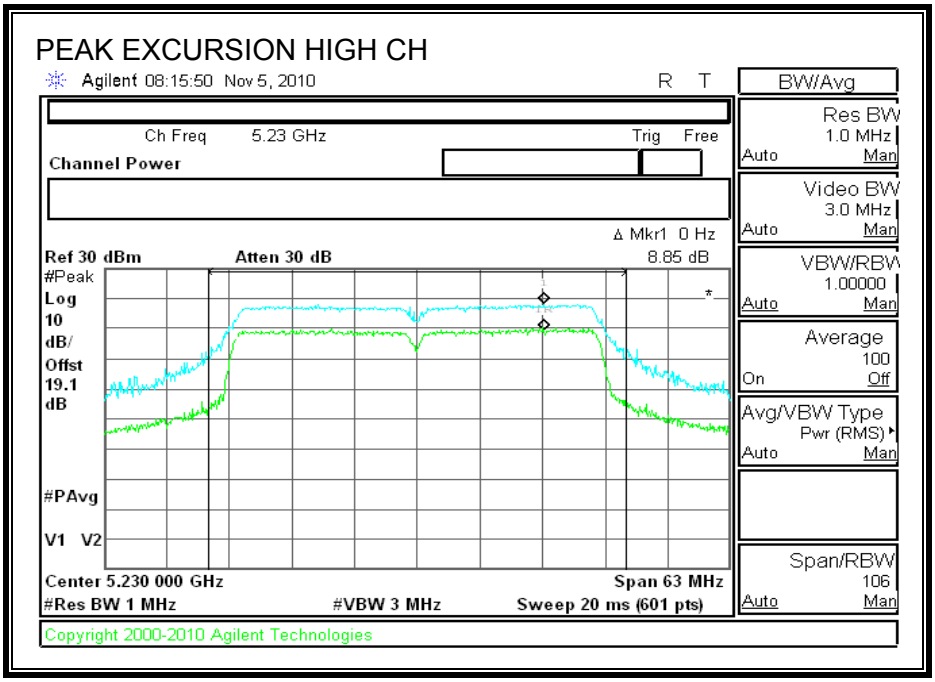
CHAIN 2

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	10.25	13	-2.75
High	5230	10.27	13	-2.73

CHAIN 0

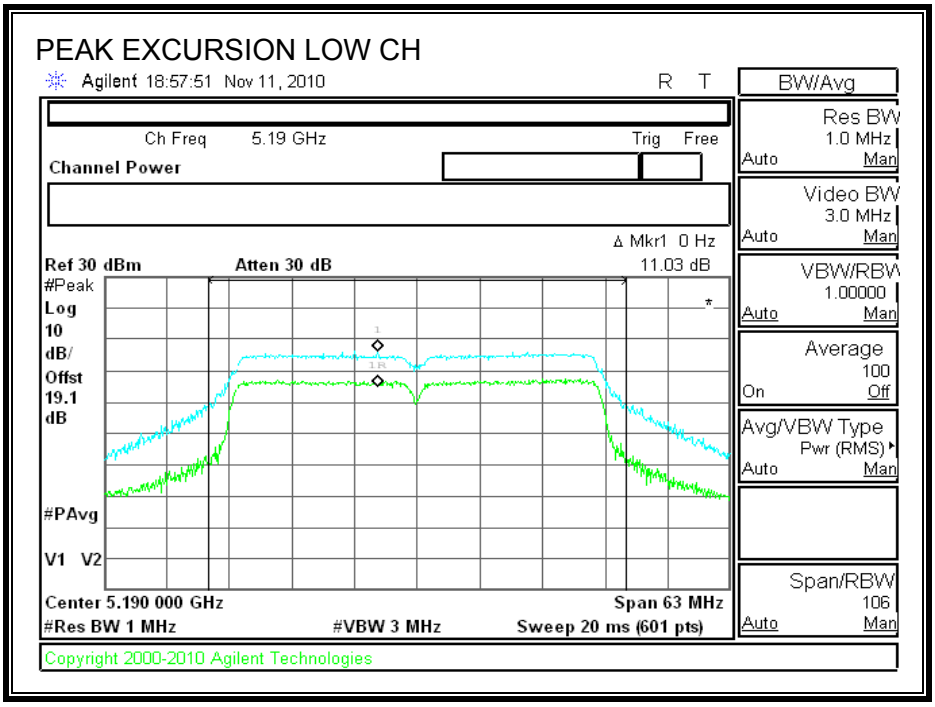
PEAK EXCURSION

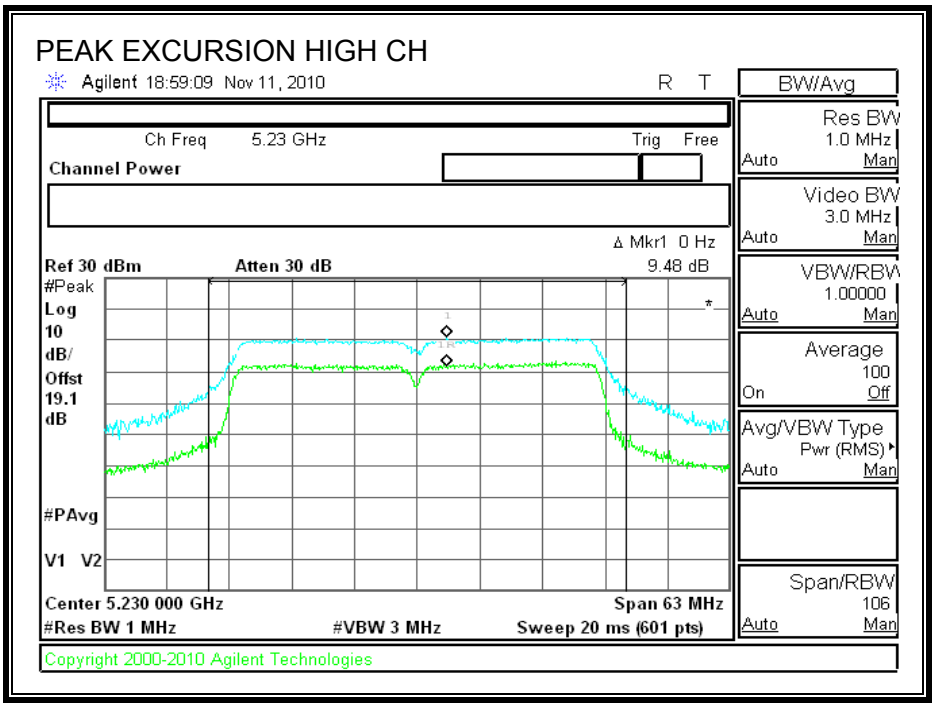




CHAIN 1

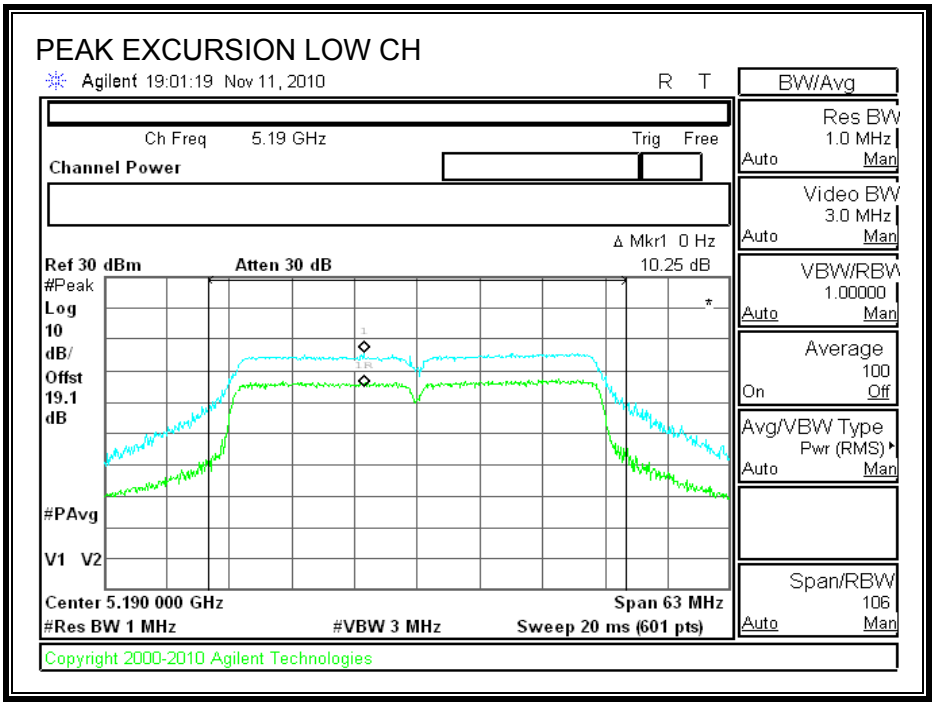
PEAK EXCURSION

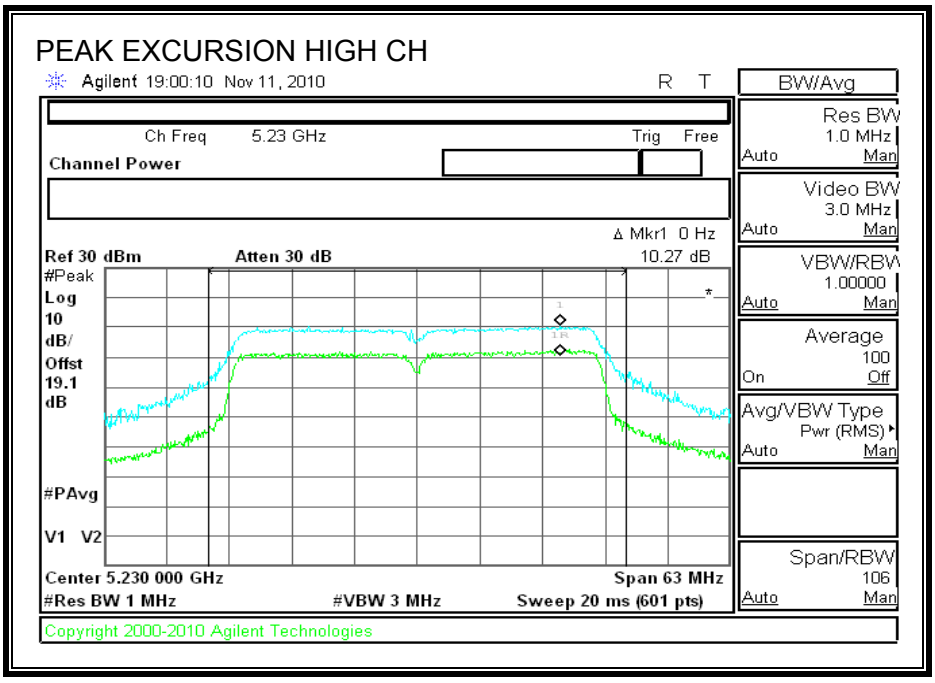




CHAIN 2

PEAK EXCURSION





7.3.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

IC RSS-210 A9.3 (3)

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

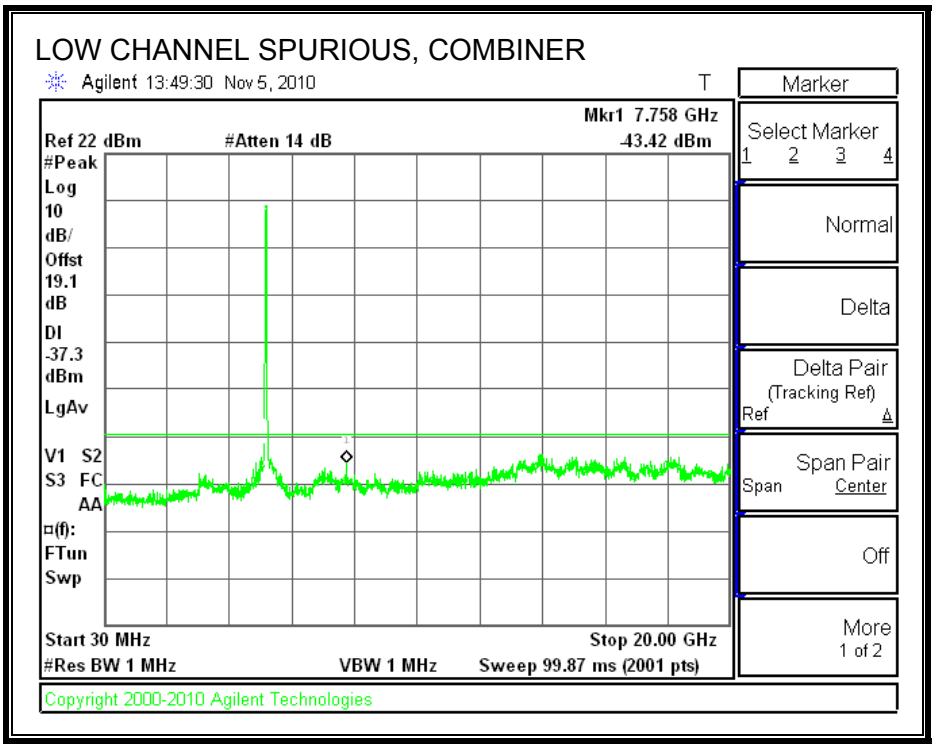
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

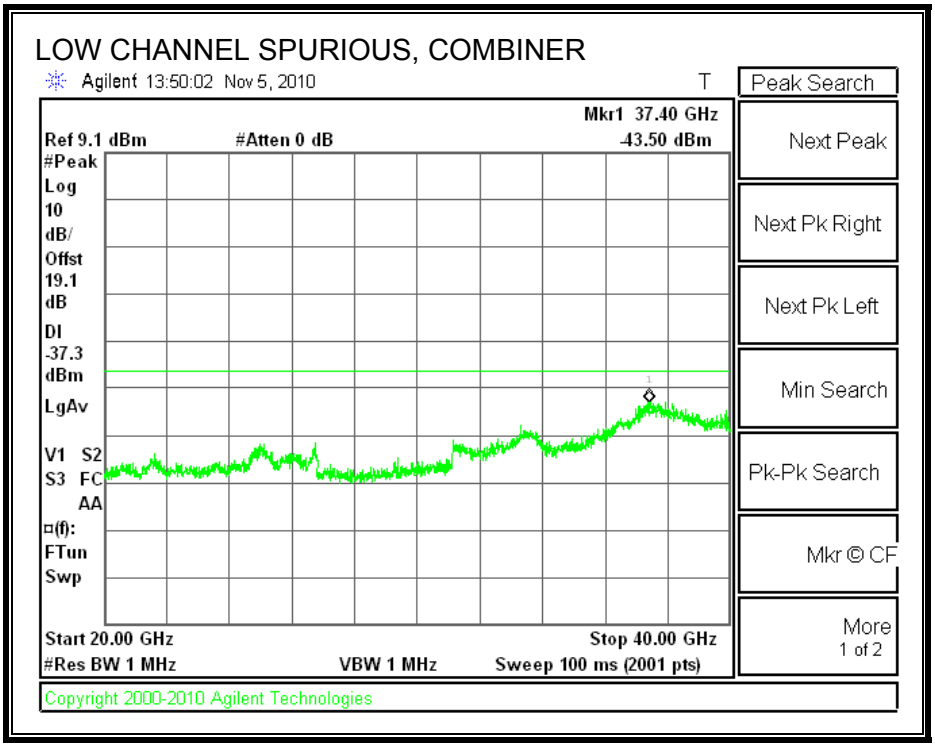
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

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

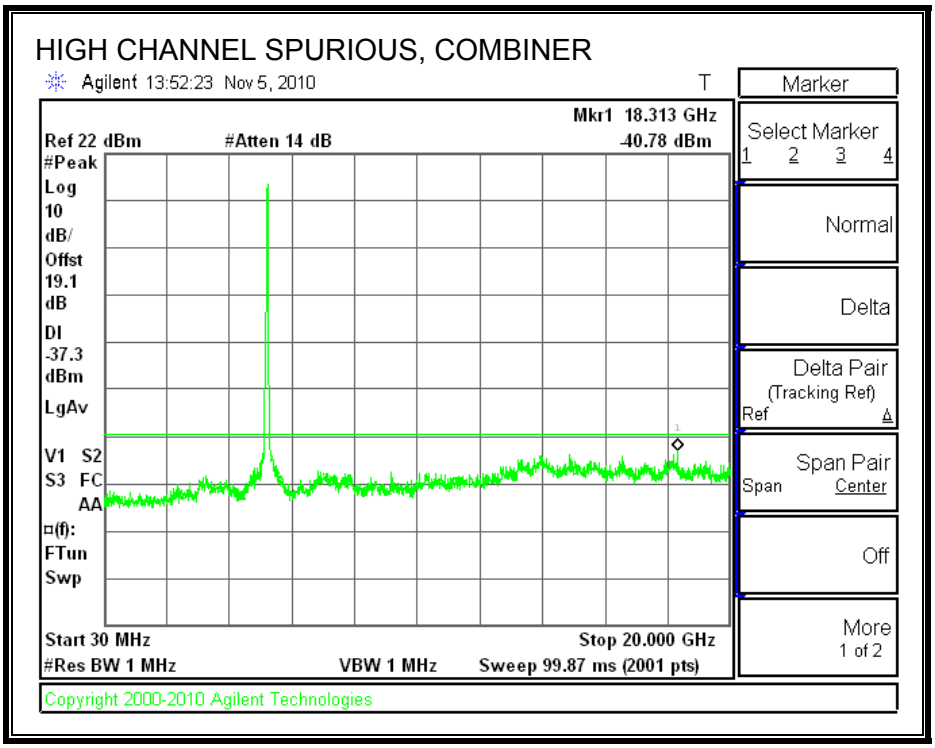
Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

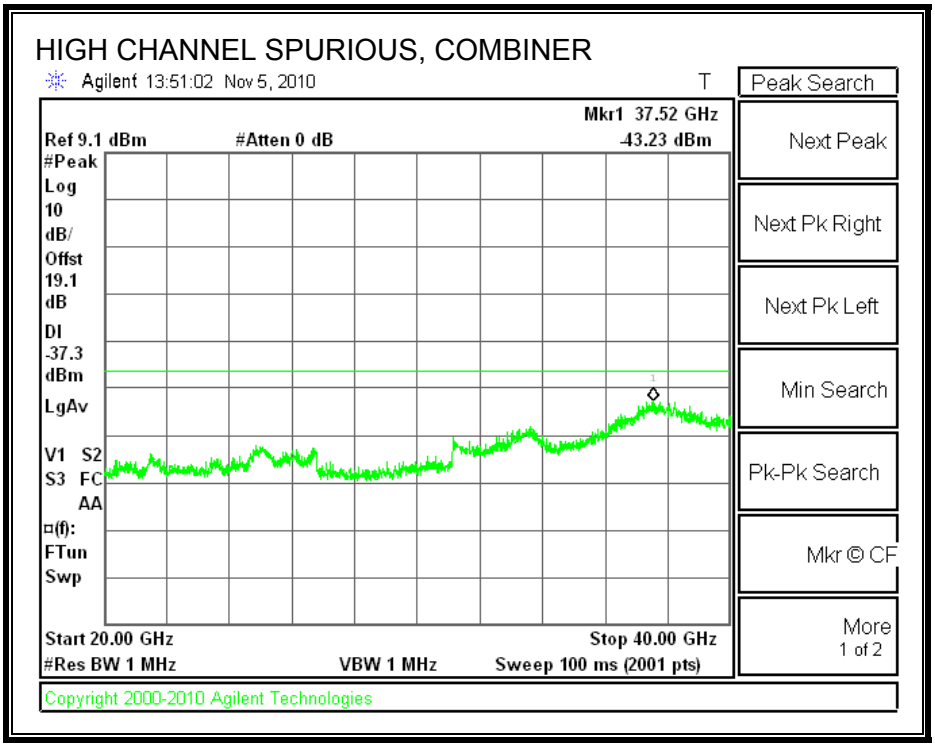
LOW CHANNEL SPURIOUS EMISSIONS





HIGH CHANNEL SPURIOUS EMISSIONS





7.4. 5.3 GHz BAND CHANNEL TESTS FOR 802.11a MODE

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

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	20.541	16.5241
Middle	5300	19.425	16.4905
High	5320	19.248	16.5298

CHAIN 1

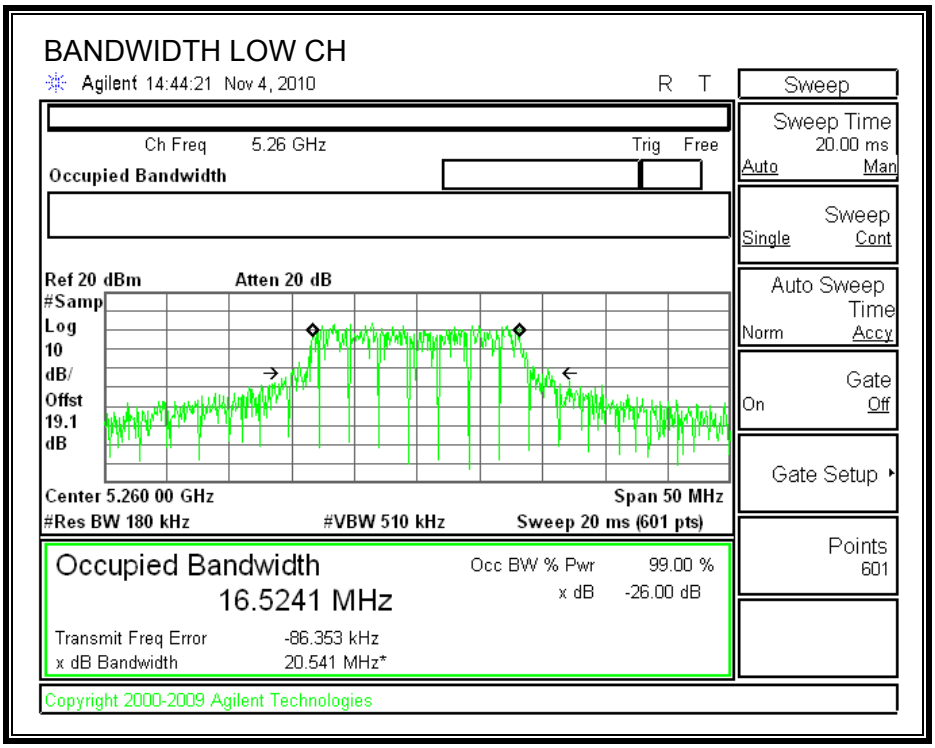
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	19.739	16.5148
Middle	5300	20.584	16.5197
High	5320	20.635	16.4405

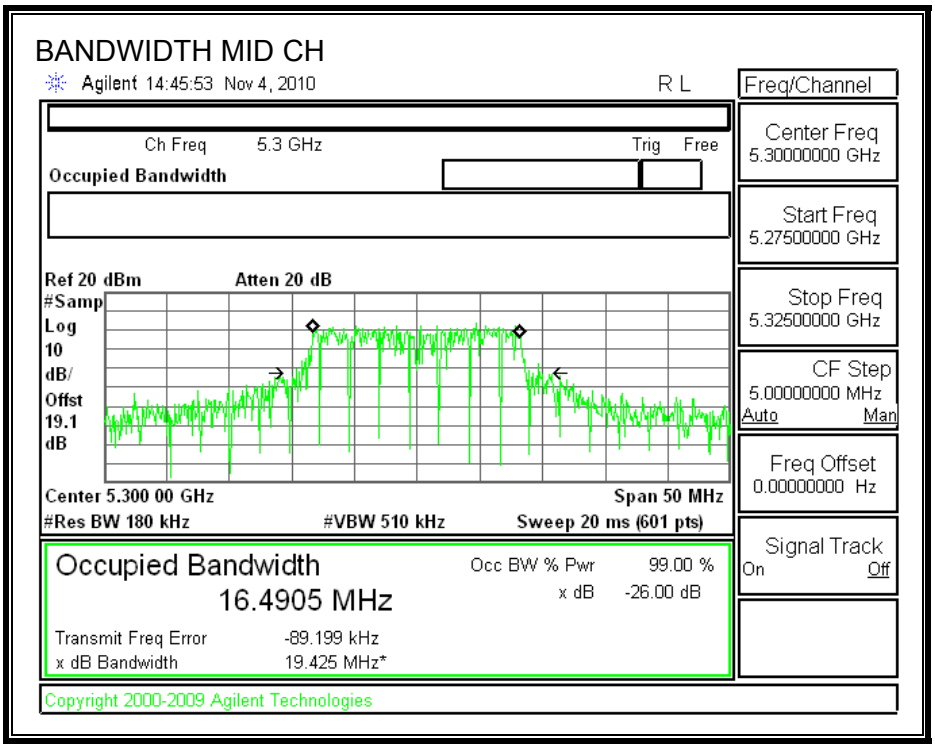
CHAIN 2

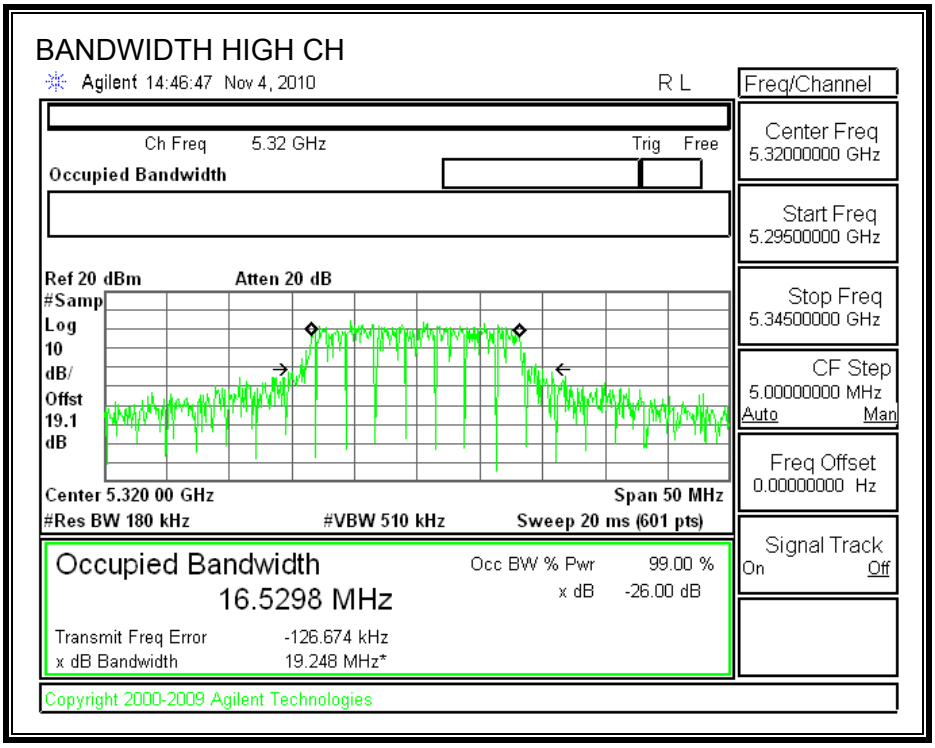
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	20.338	16.5326
Middle	5300	19.814	16.531
High	5320	20.141	16.4439

CHAIN 0

26 dB and 99% BANDWIDTH

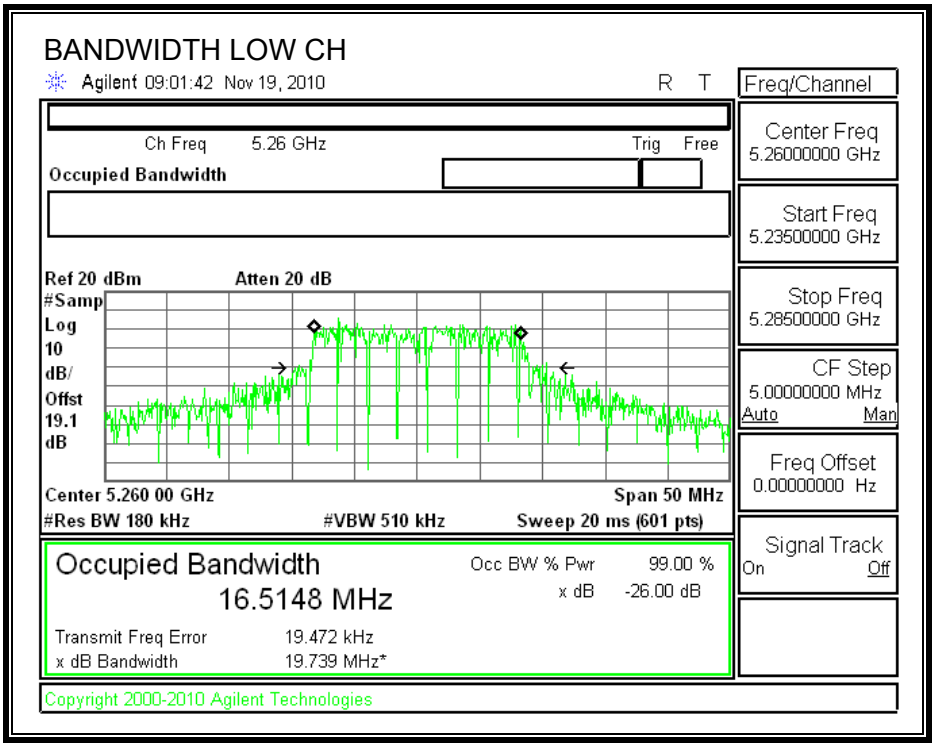


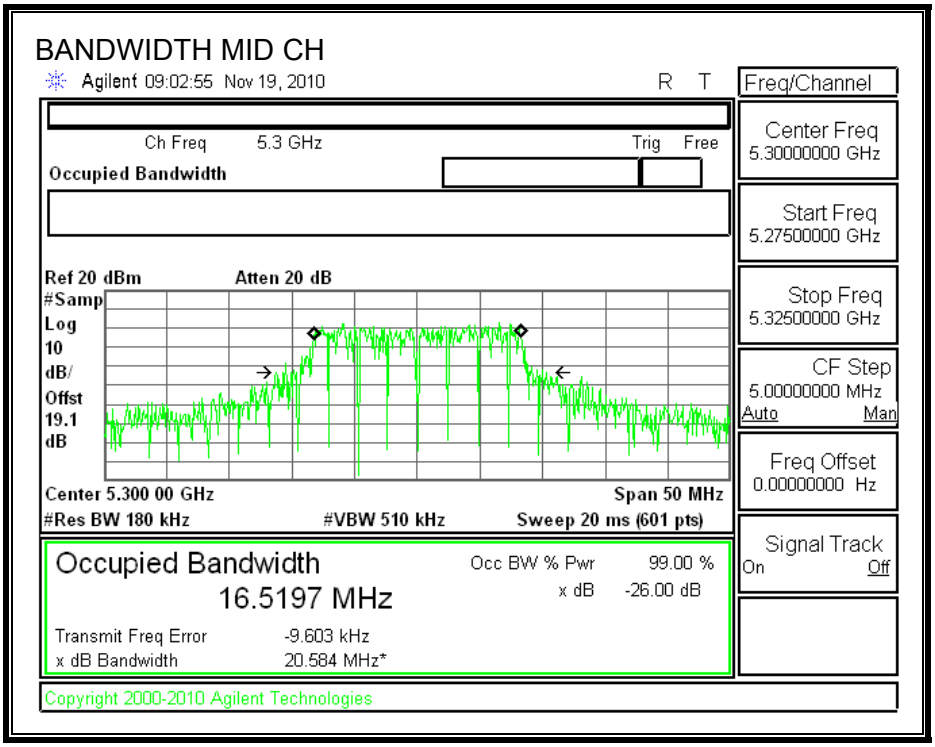


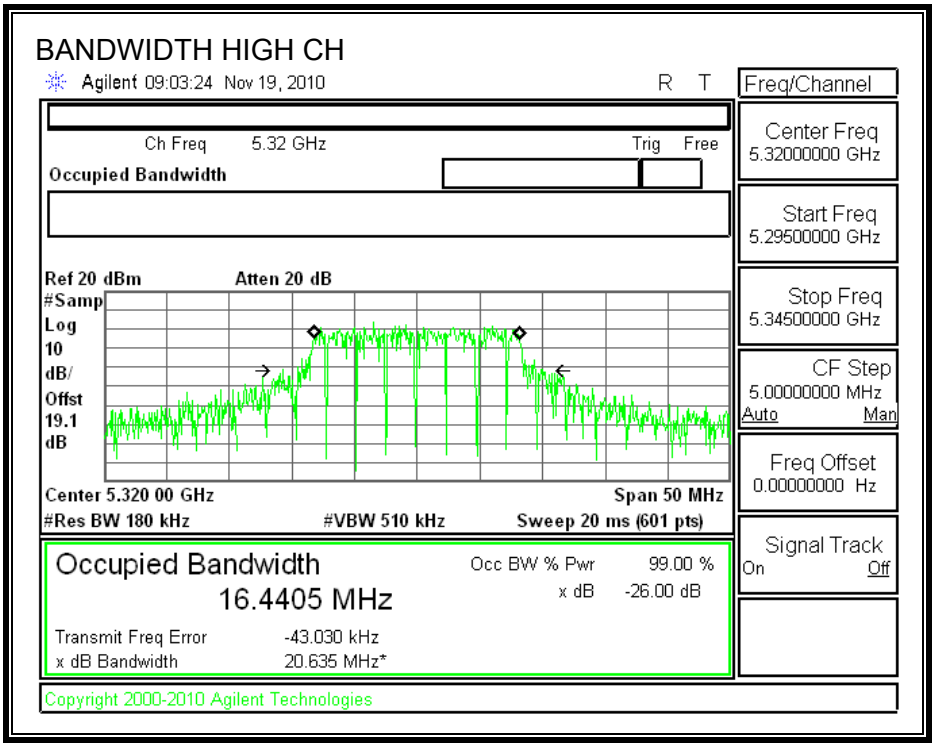


CHAIN 1

26 dB and 99% BANDWIDTH

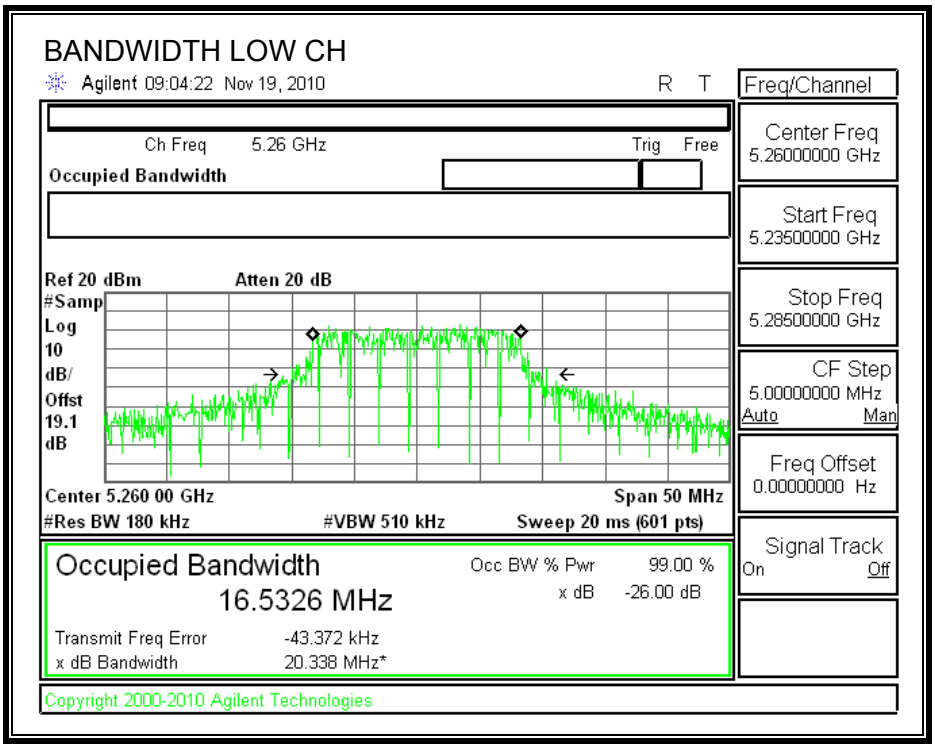


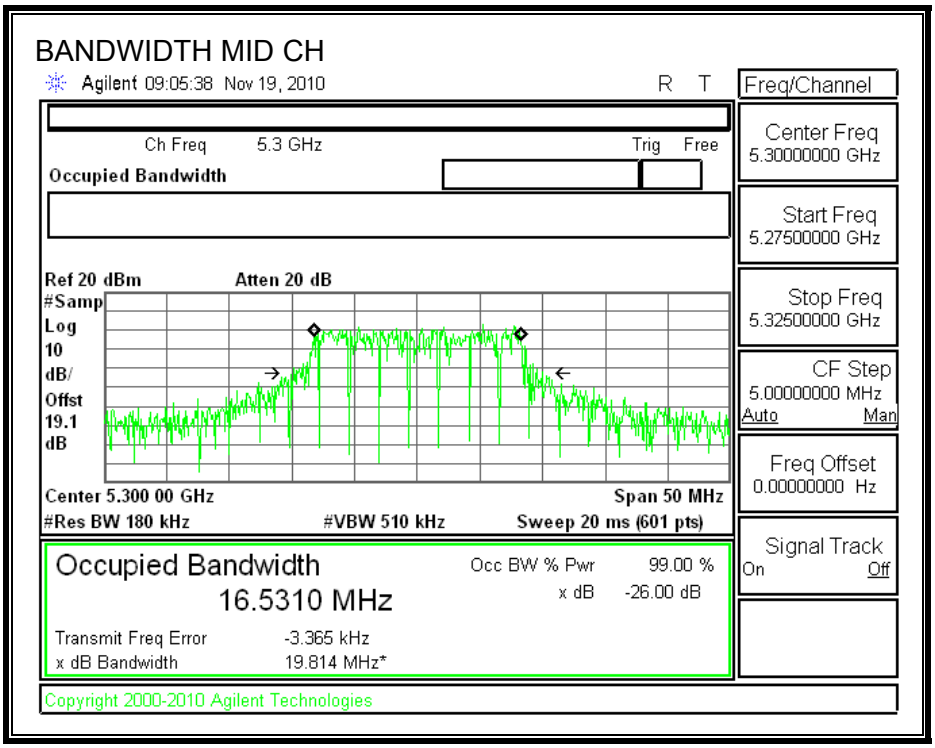


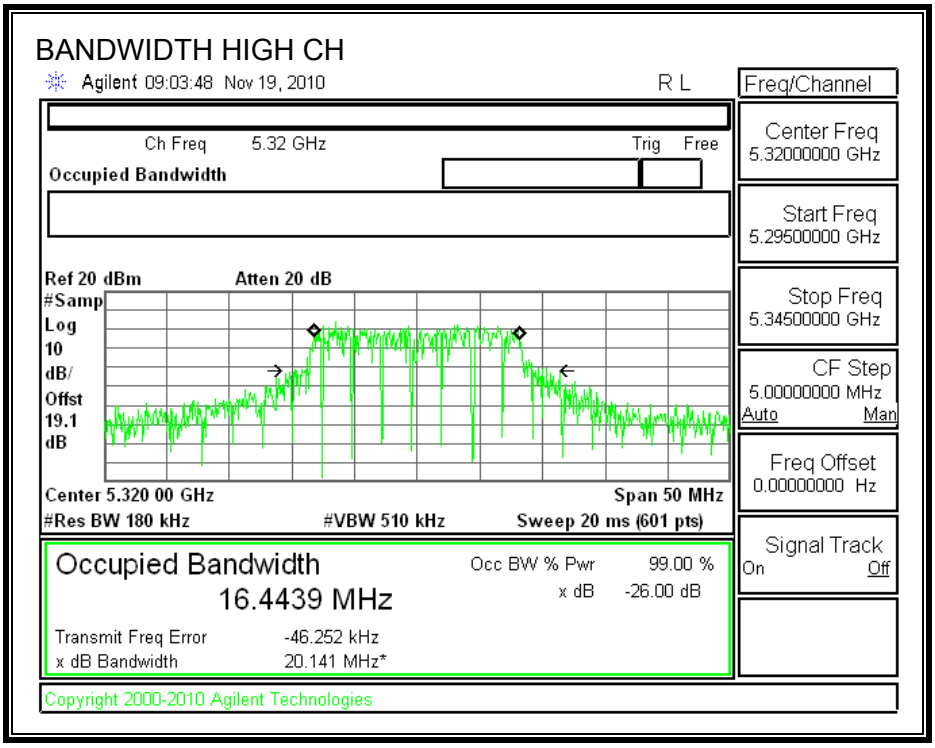


CHAIN 2

26 dB and 99% BANDWIDTH







7.4.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)
IC RSS-210 A9.2 (1)

Antenna Gain (Chain 0) (dBi)	Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.54	5.65	5.19	10.24

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

The combination antenna gain is 10.24dBi.

TEST PROCEDURE

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

RESULTS

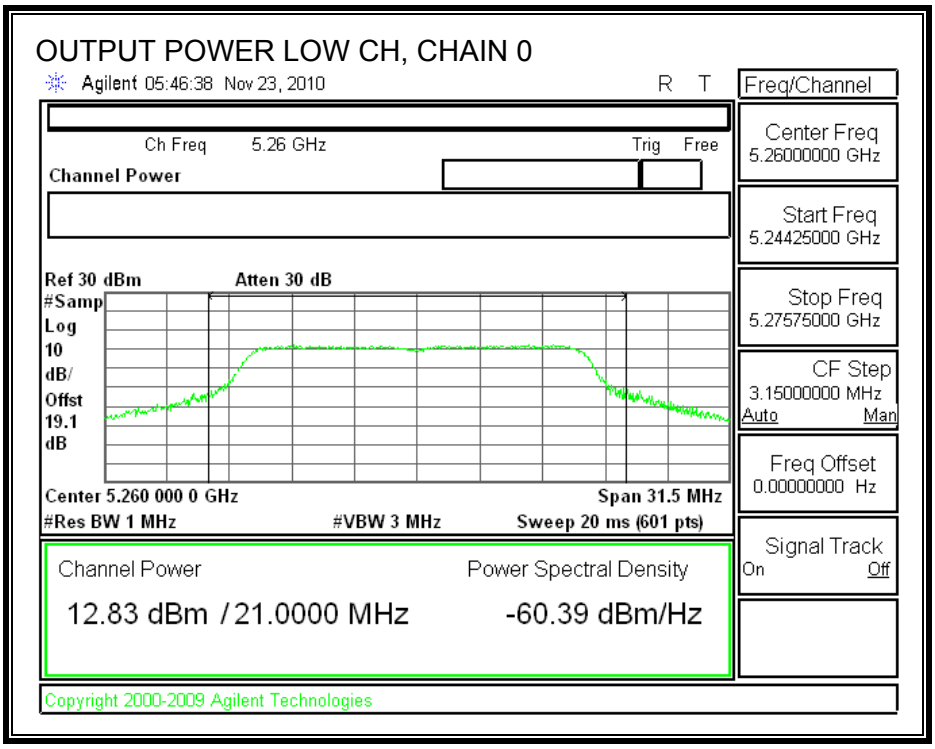
Limit

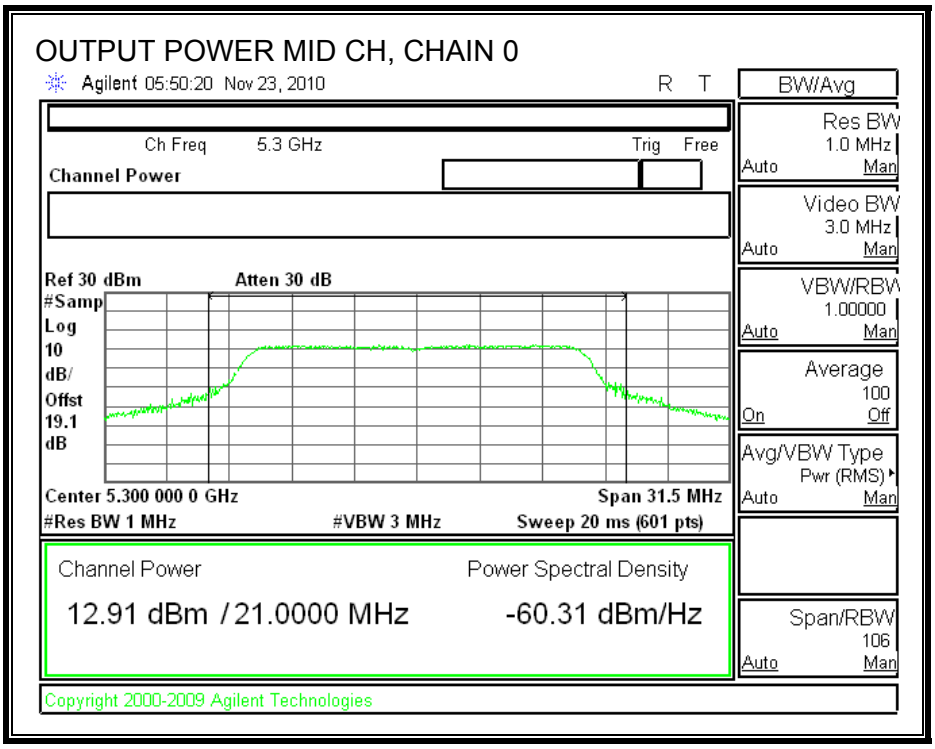
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Effective Ant. Gain (dBi)	Limit (dBm)
Low	5260	23.98	20.541	24.13	10.24	19.74
Mid	5300	23.98	19.425	23.88	10.24	19.64
High	5320	23.98	19.248	23.84	10.24	19.60

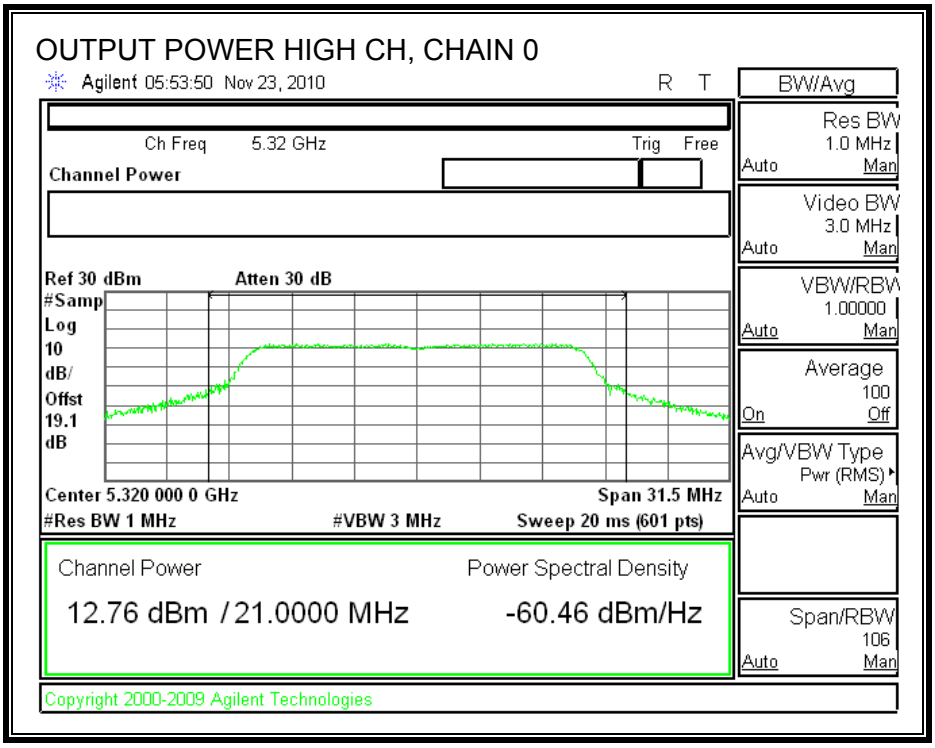
Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	12.83	12.05	12.94	17.40	19.74	-2.34
Mid	5300	12.91	12.66	12.55	17.48	19.64	-2.16
High	5320	12.76	12.10	12.44	17.21	19.60	-2.39

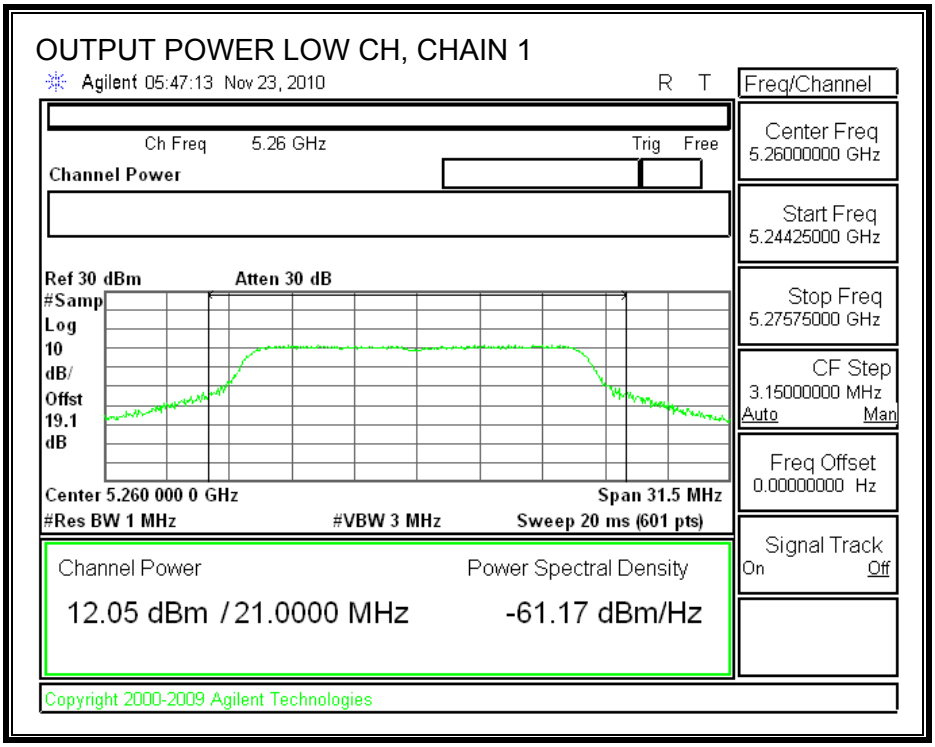
CHAIN 0 OUTPUT POWER



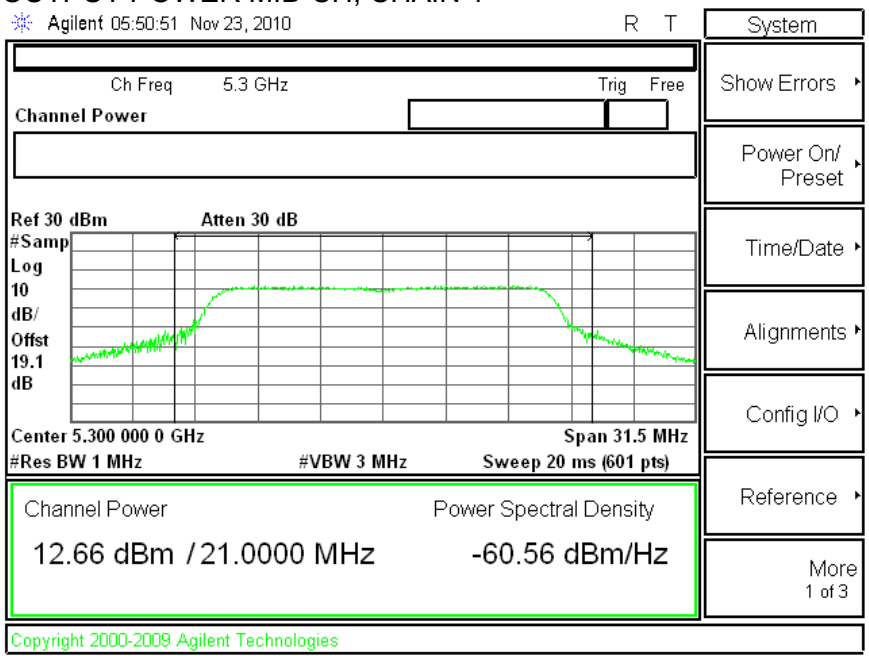




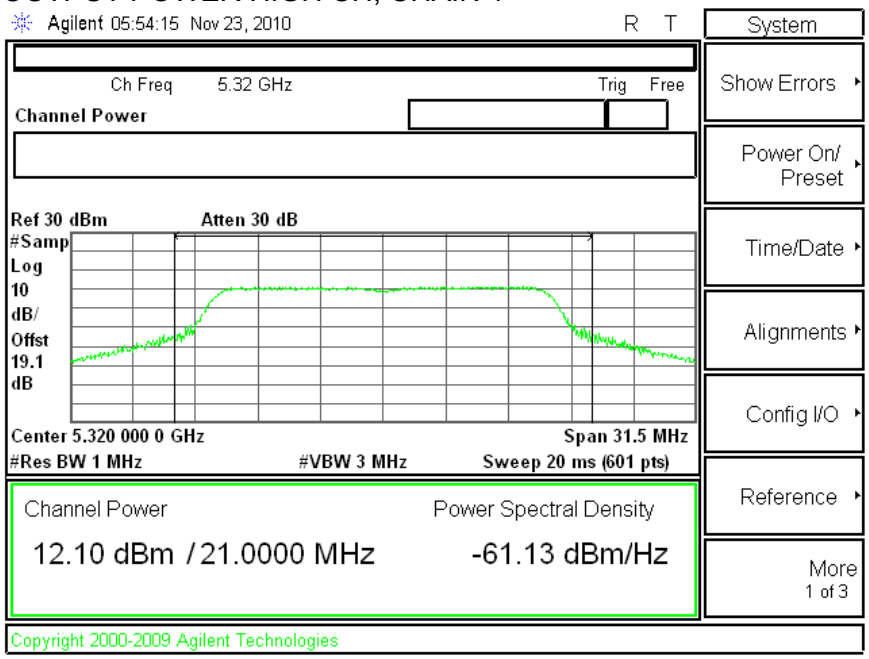
CHAIN 1 OUTPUT POWER



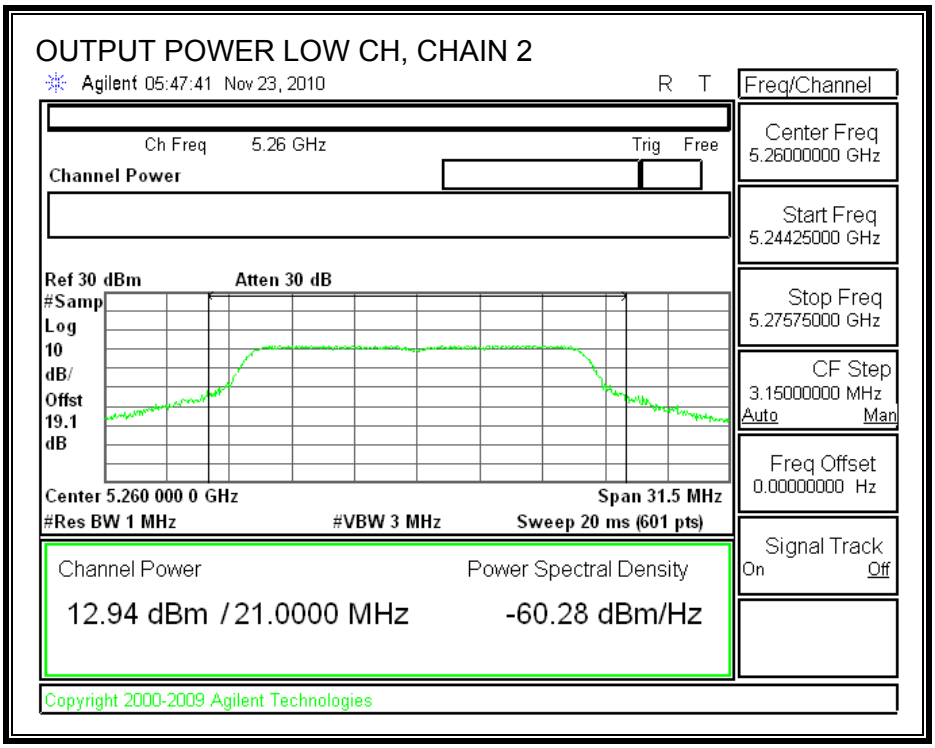
OUTPUT POWER MID CH, CHAIN 1

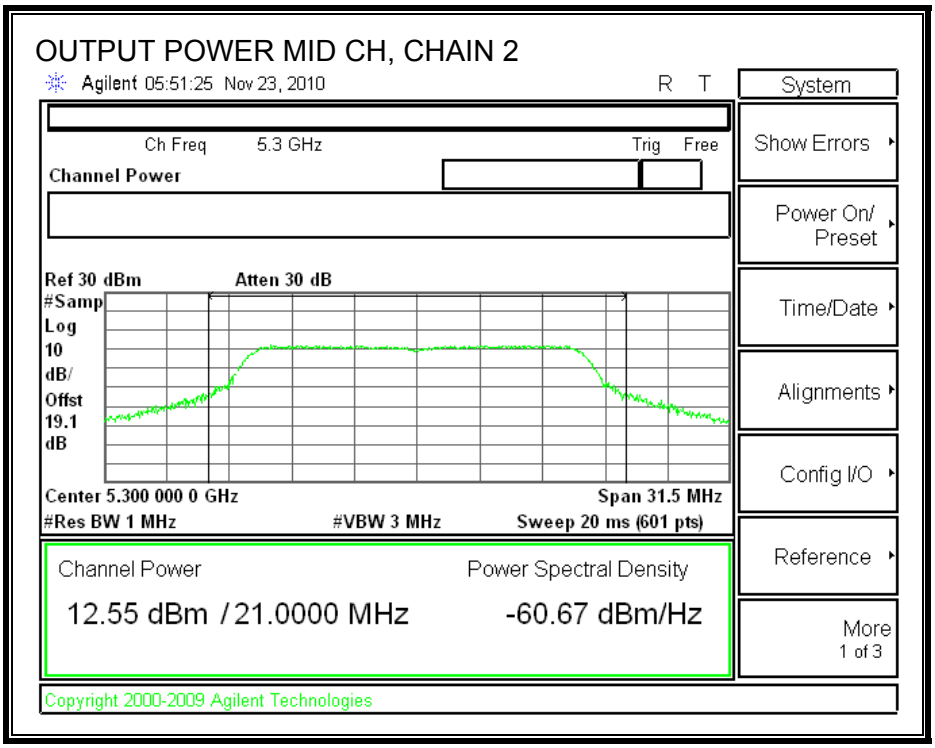


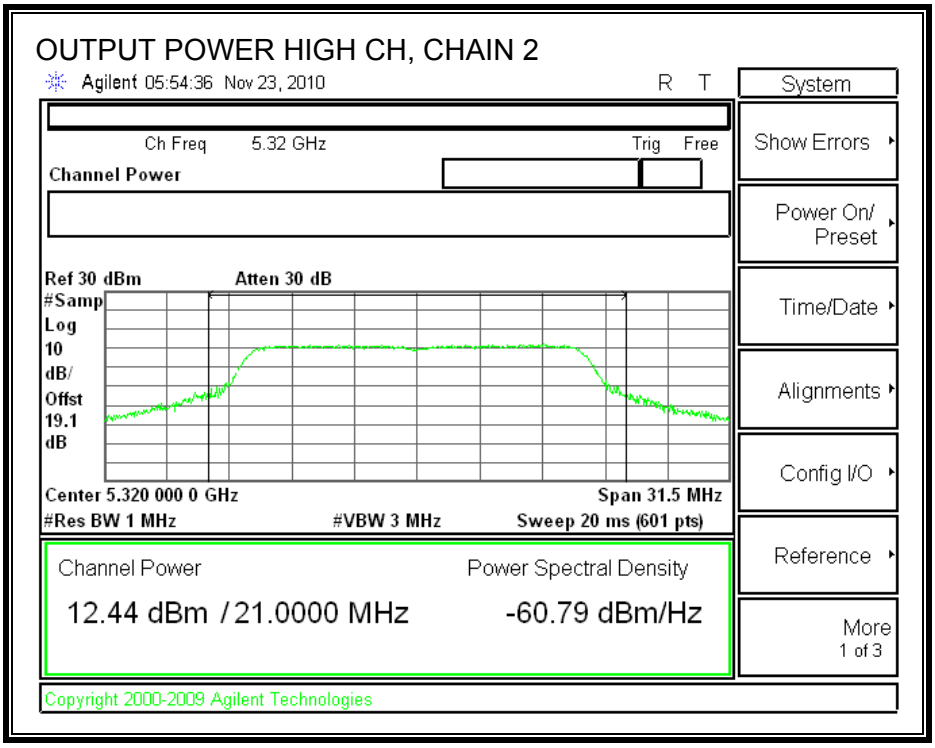
OUTPUT POWER HIGH CH, CHAIN 1



CHAIN 2 OUTPUT POWER







7.4.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 19.1 dB was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5260	12.70	12.00	12.85	17.30
Middle	5300	12.85	12.50	12.45	17.37
High	5320	12.70	12.00	12.40	17.15

7.4.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (Chain 0) (dBi)	Antenna Gain (Chain 1) (dBi)	Antenna Gain (Chain 2) (dBi)	Effective Legacy Gain (dBi)
5.54	5.65	5.19	10.24

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

The combined antenna gain is 10.24 dBi, therefore the limit is 6.76 dBm.

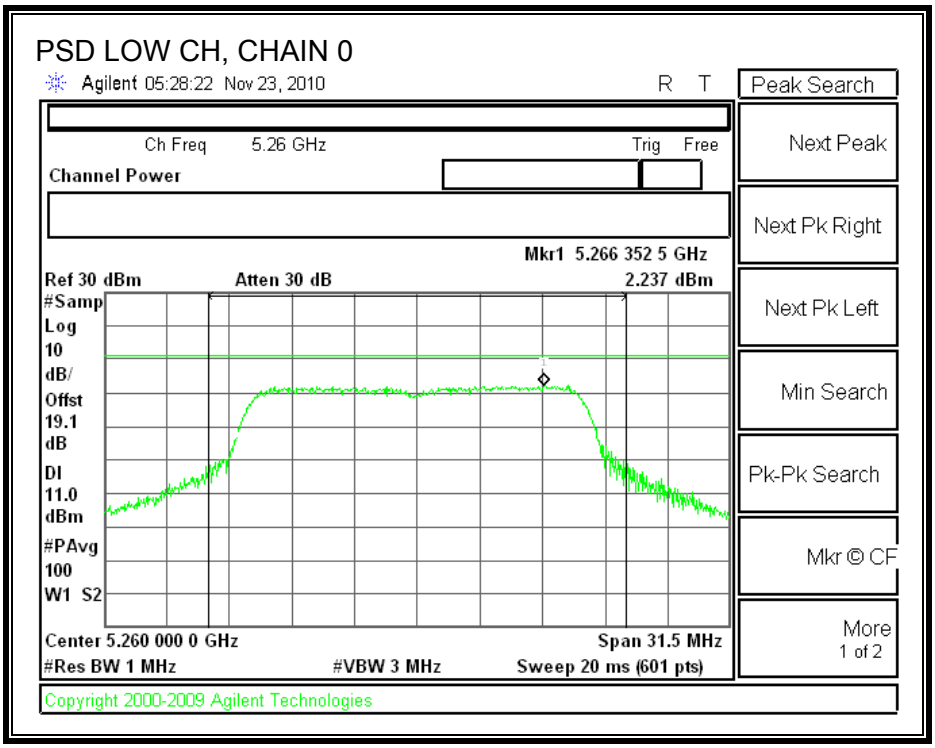
TEST PROCEDURE

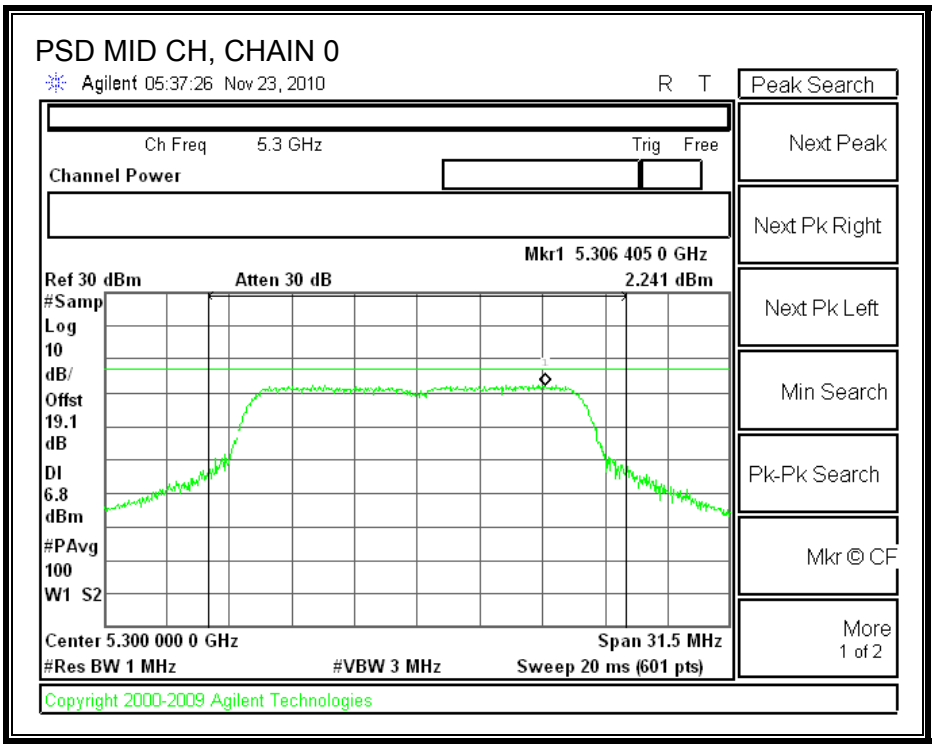
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

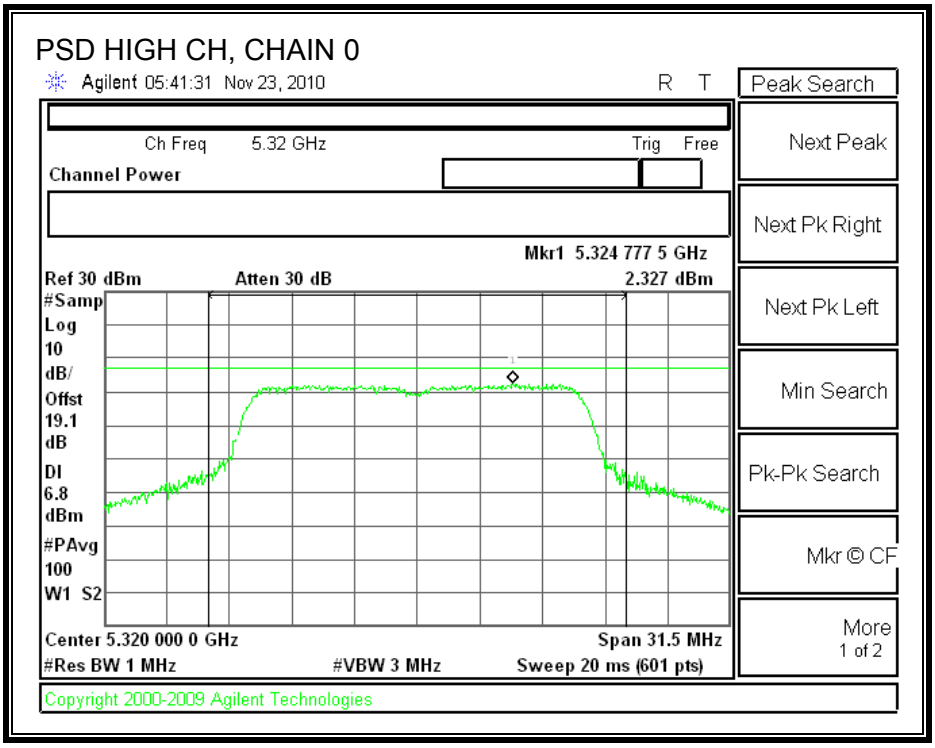
RESULTS

Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5260	2.237	1.231	1.836	6.56	6.76	-0.20
Middle	5300	2.241	1.564	1.717	6.62	6.76	-0.14
High	5320	2.327	1.364	1.728	6.60	6.76	-0.16

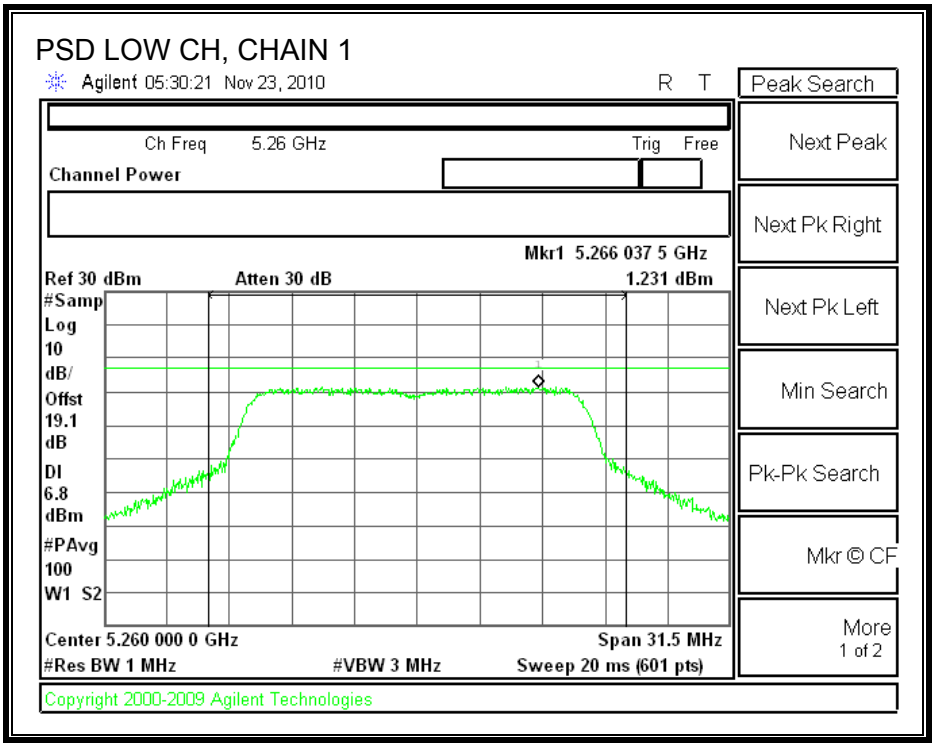
CHAIN 0 POWER SPECTRAL DENSITY

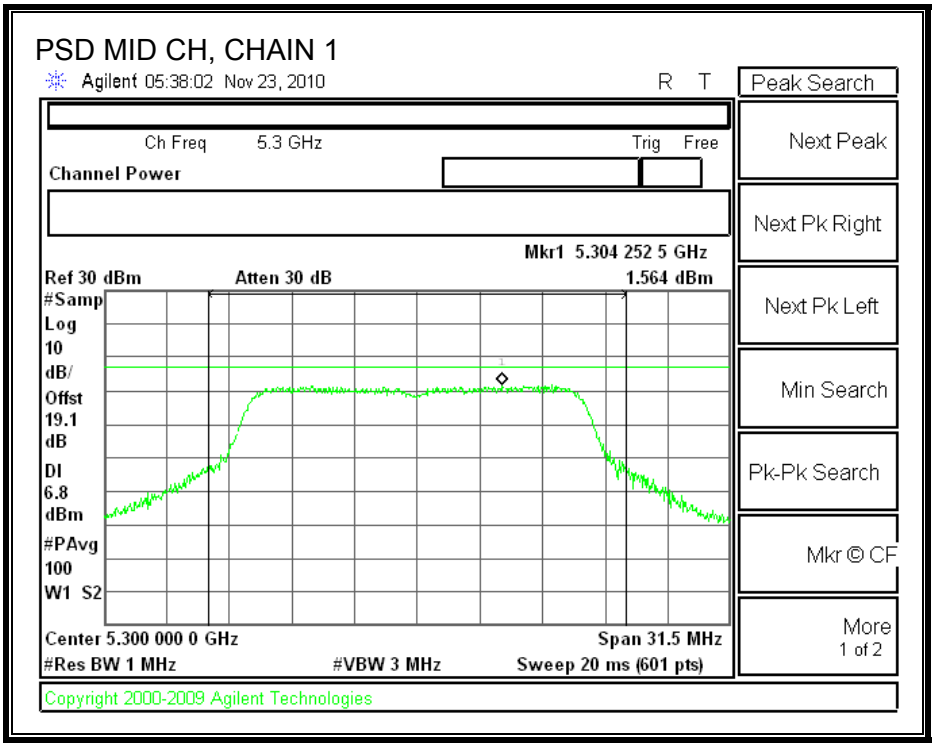


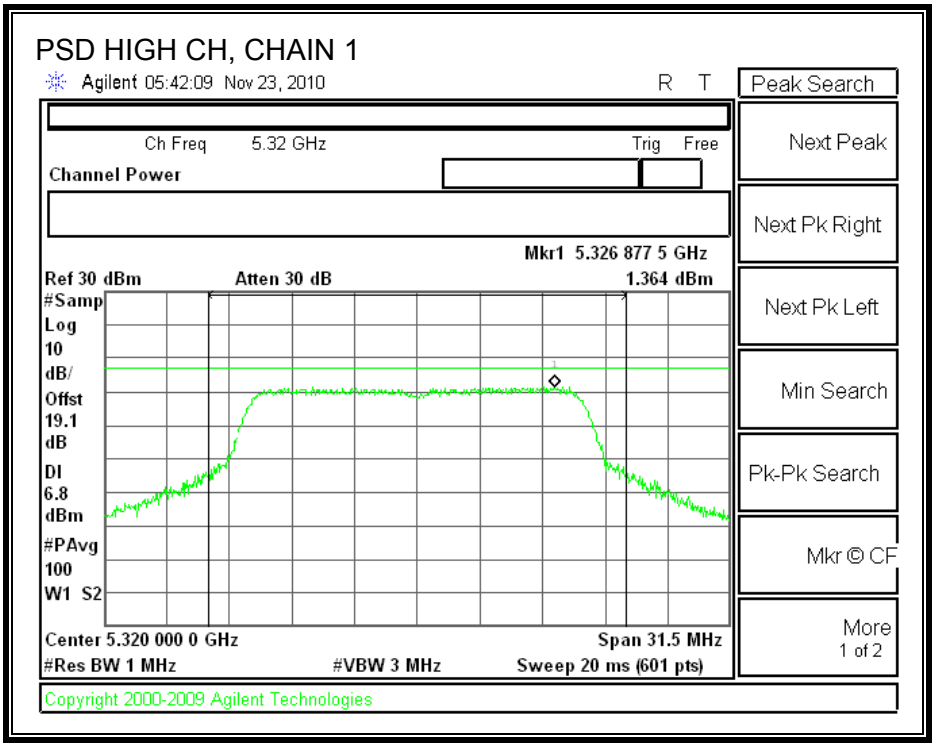




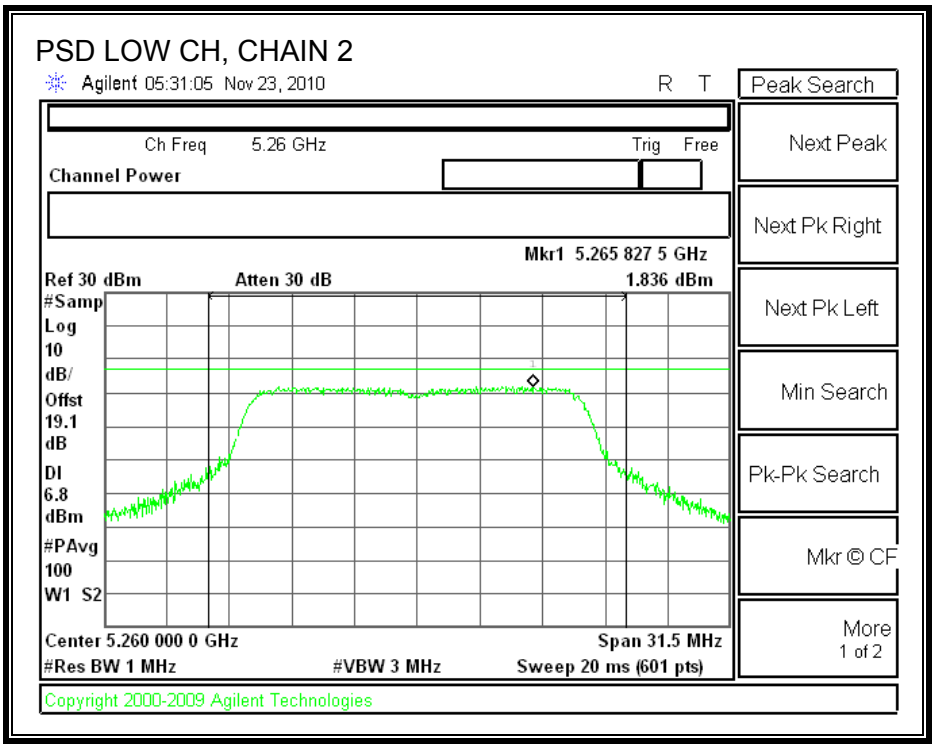
CHAIN 1 POWER SPECTRAL DENSITY

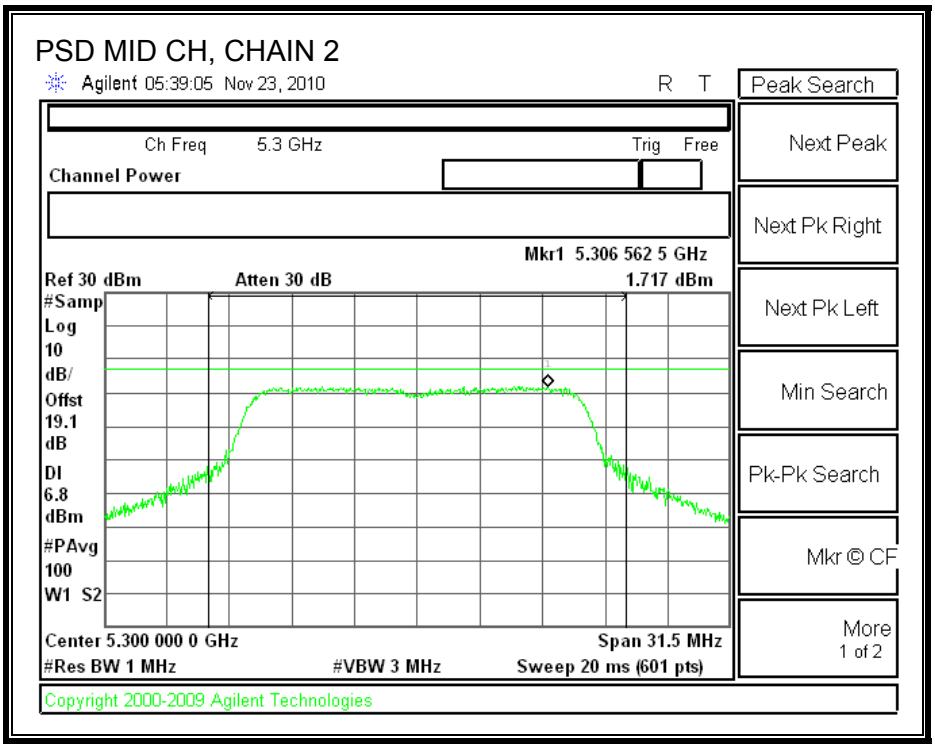


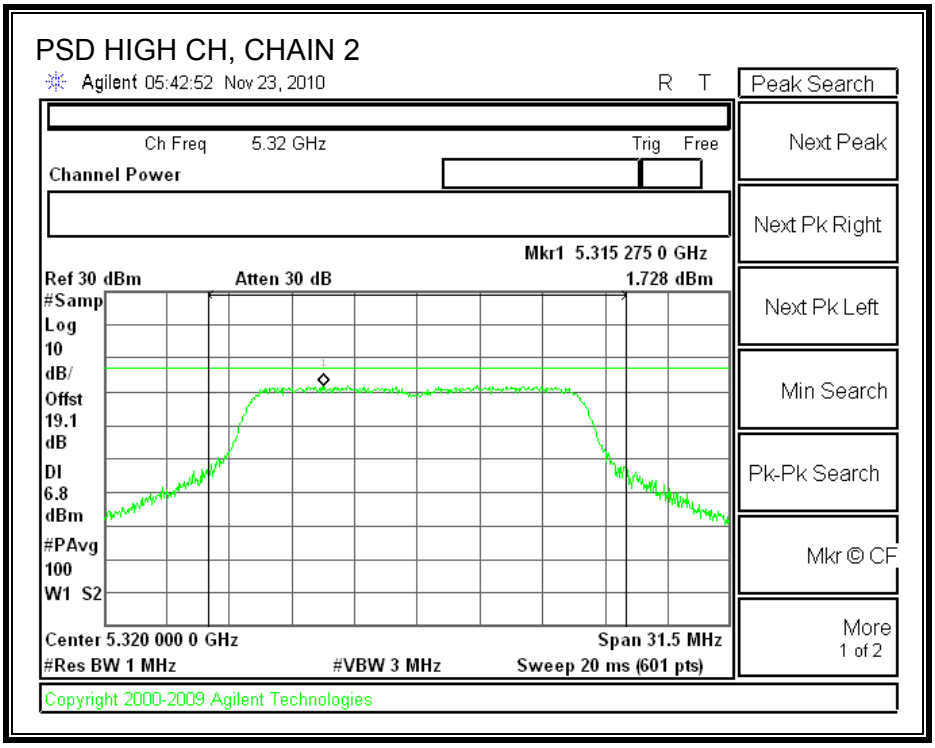




CHAIN 2 POWER SPECTRAL DENSITY







7.4.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	10.70	13	-2.30
Middle	5300	11.26	13	-1.74
High	5320	11.38	13	-1.62

CHAIN 1

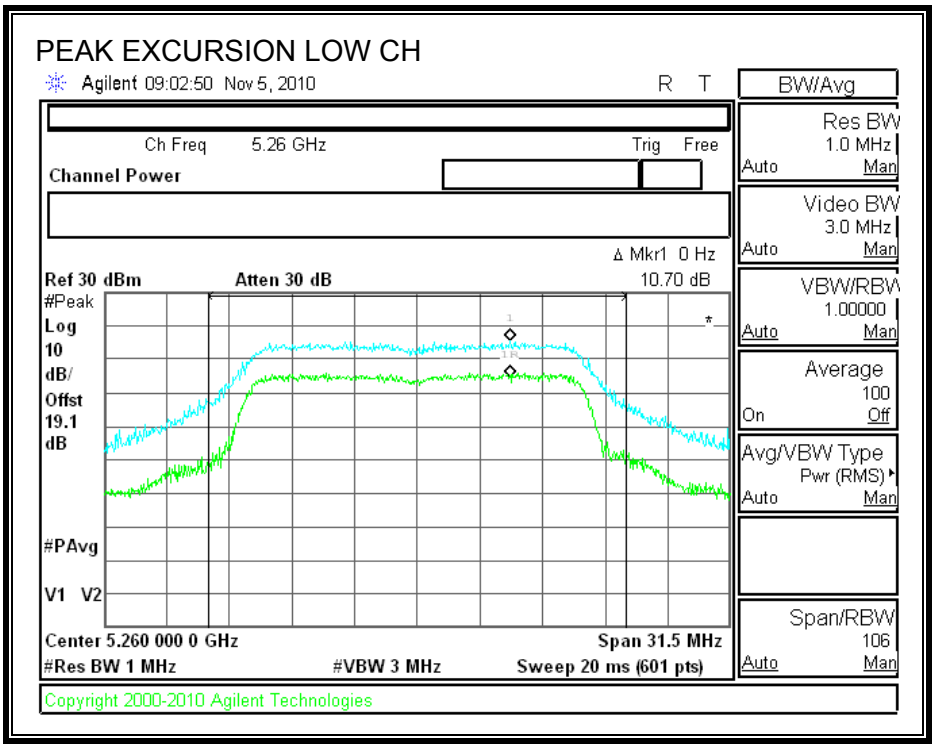
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	8.94	13	-4.06
Middle	5300	9.10	13	-3.90
High	5320	8.35	13	-4.65

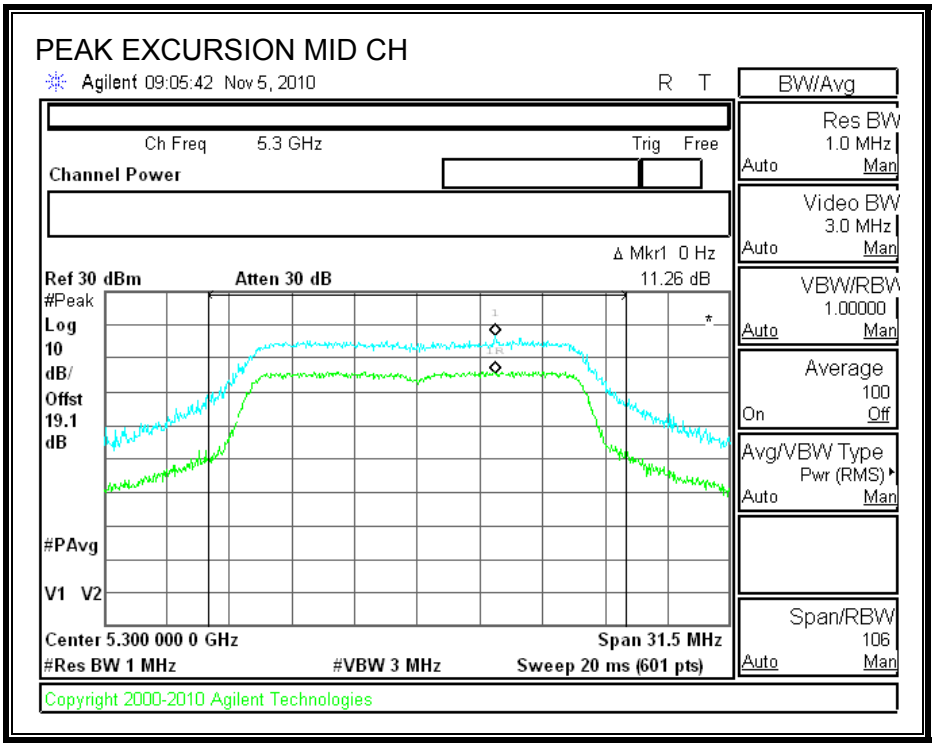
CHAIN 2

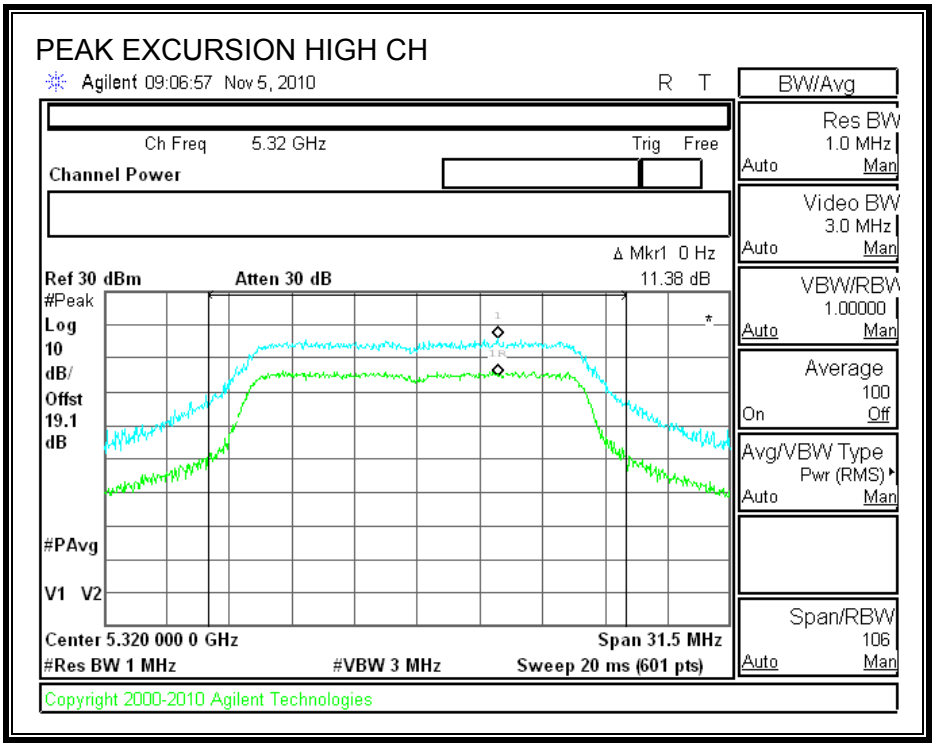
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	9.45	13	-3.55
Middle	5300	9.63	13	-3.37
High	5320	8.58	13	-4.42

CHAIN 0

PEAK EXCURSION

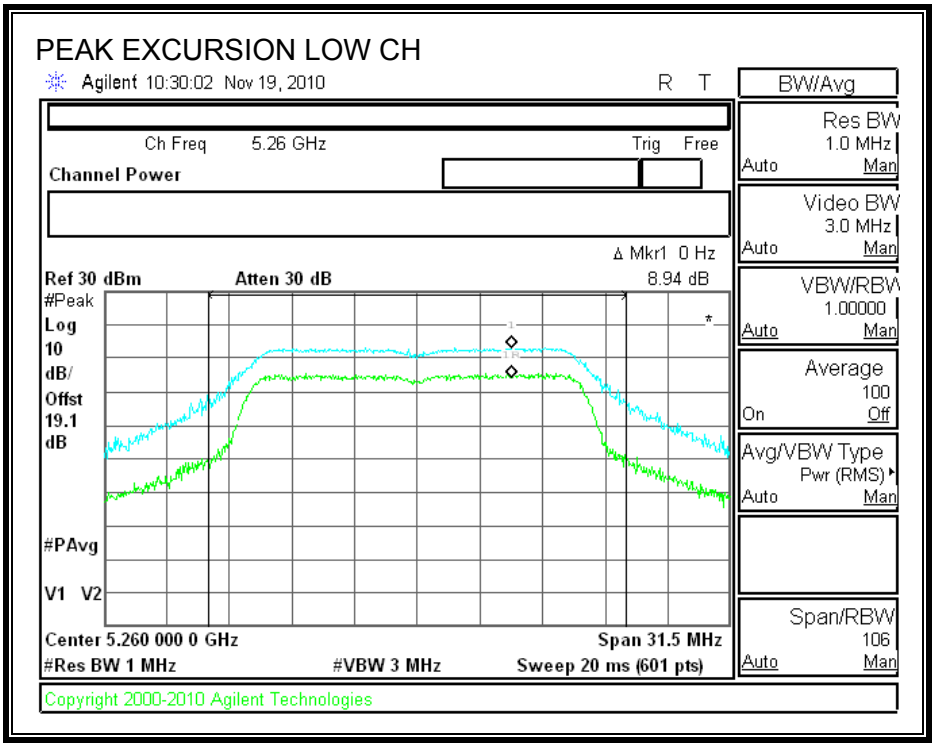




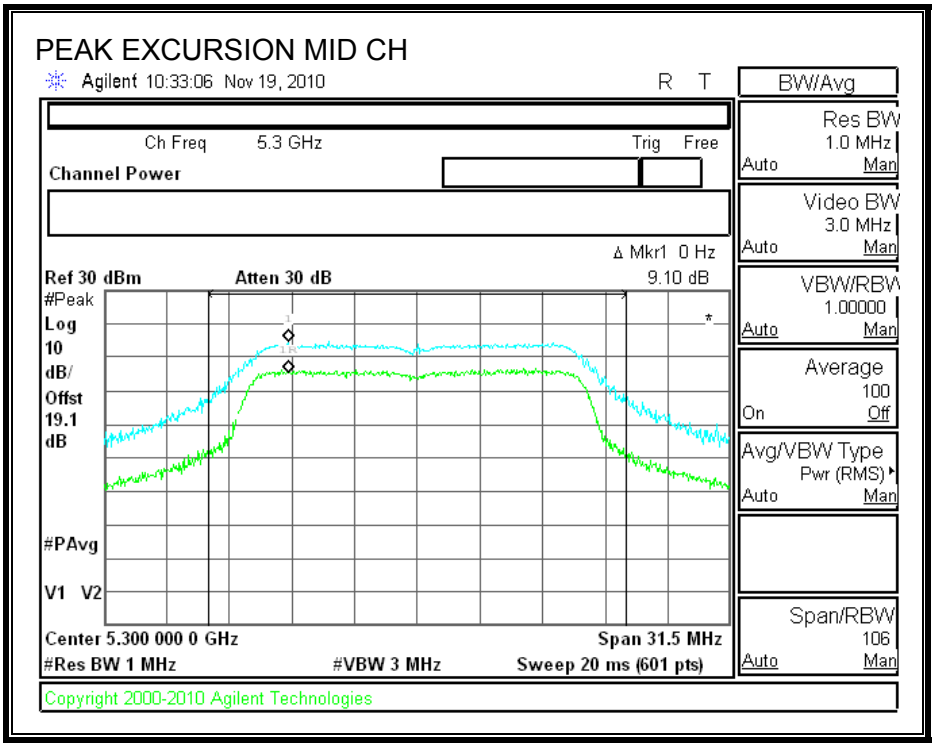


CHAIN 1

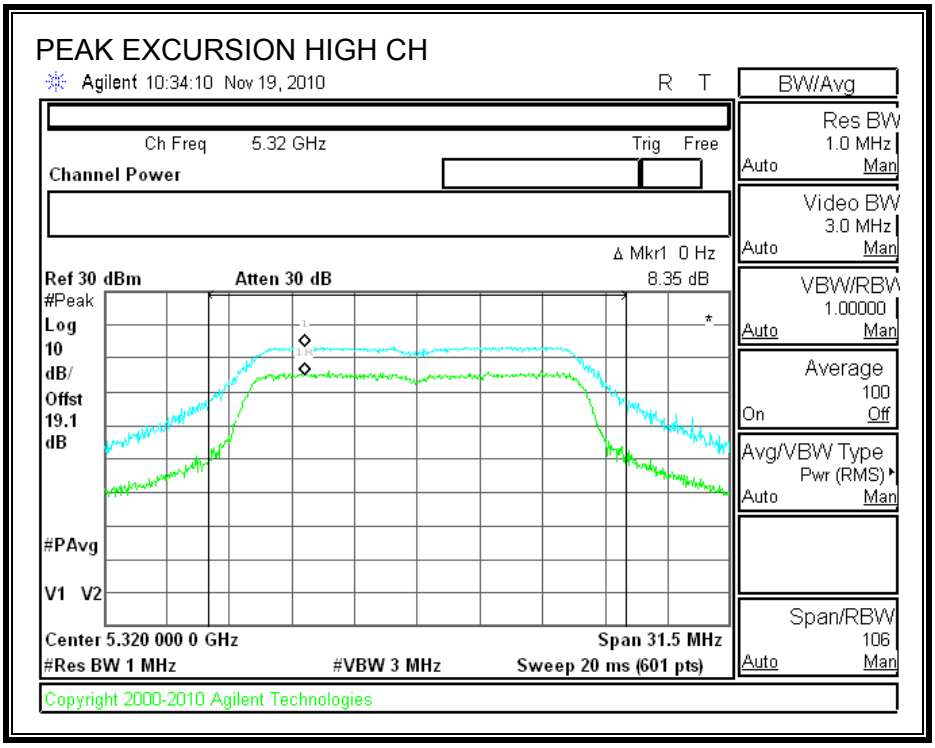
PEAK EXCURSION



PEAK EXCURSION MID CH

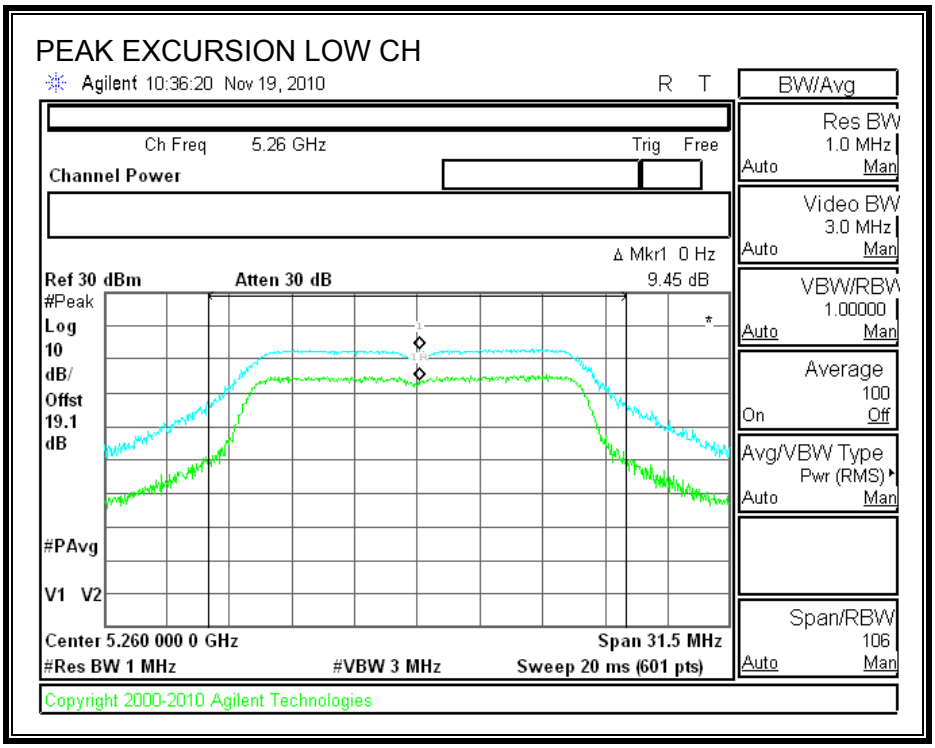


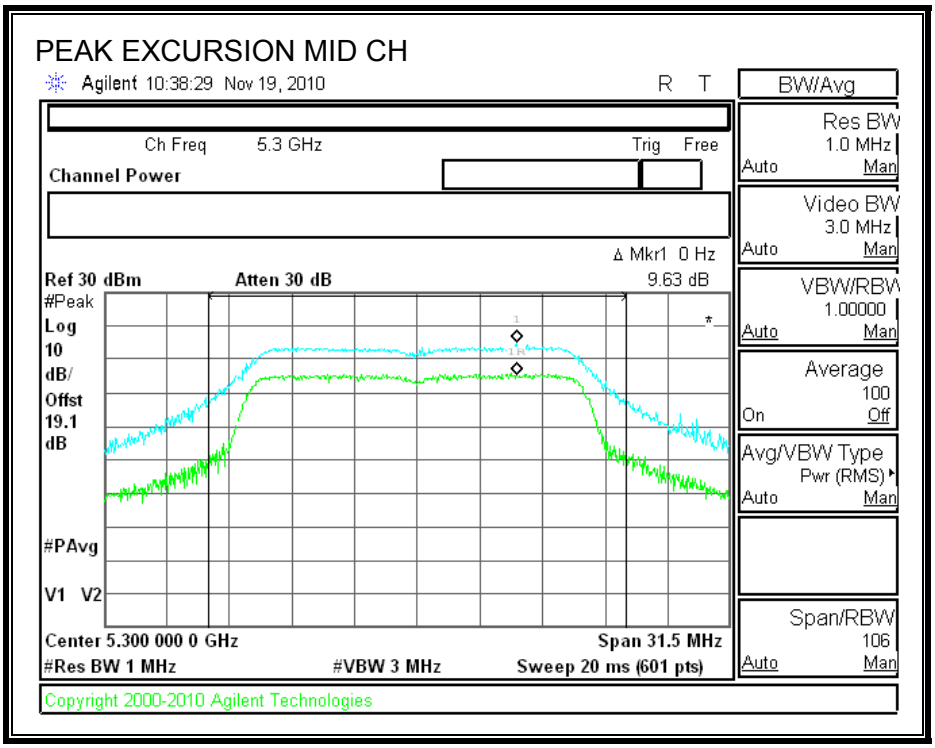
PEAK EXCURSION HIGH CH

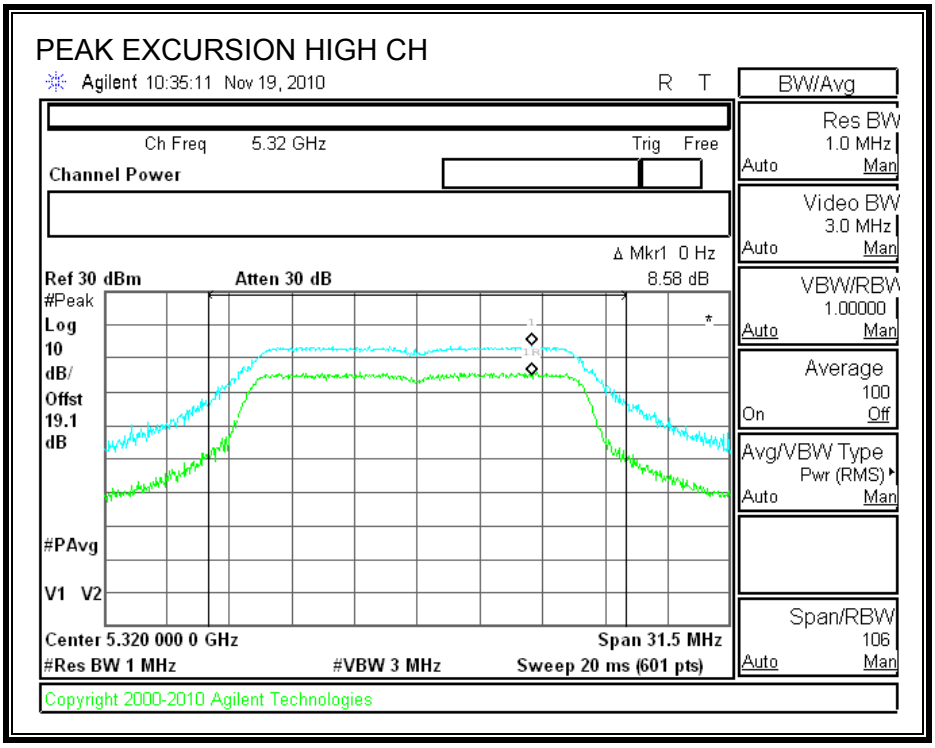


CHAIN 2

PEAK EXCURSION







7.4.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

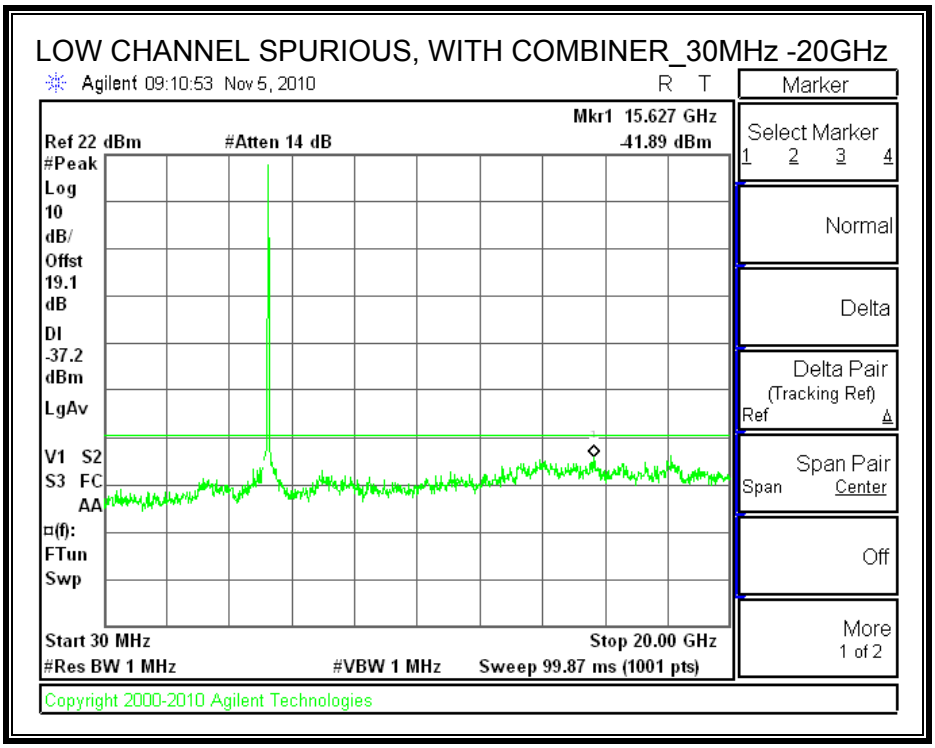
TEST PROCEDURE

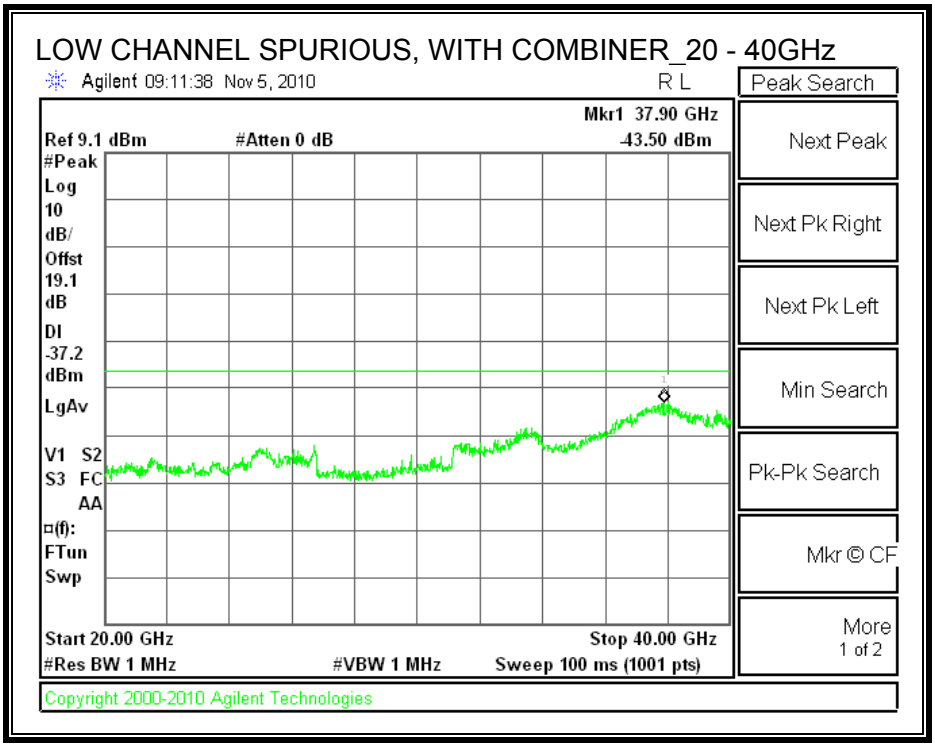
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

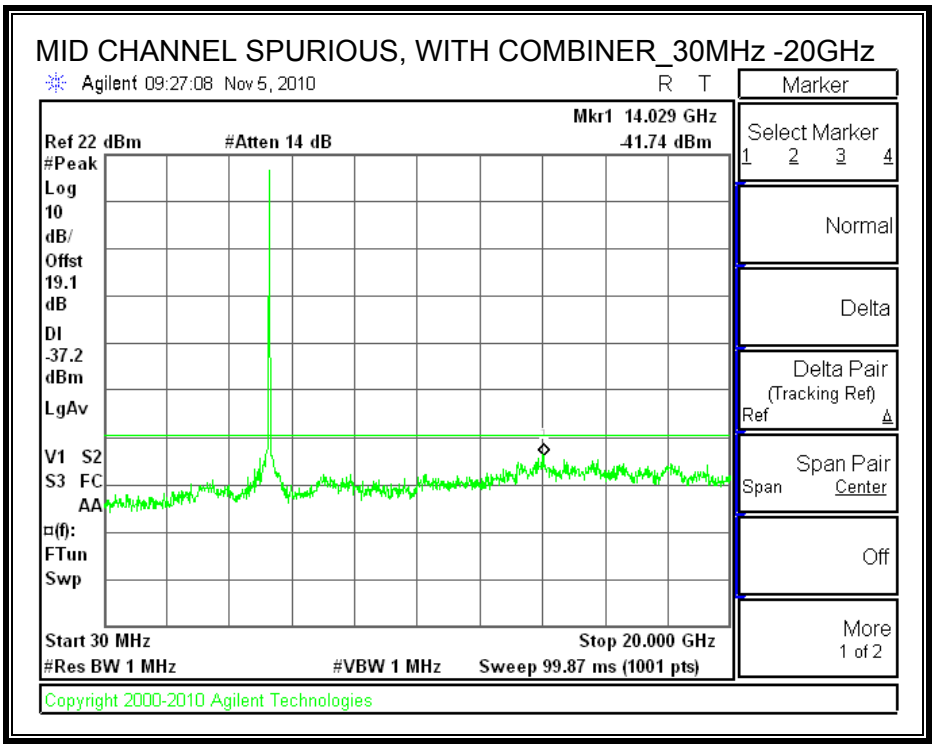
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

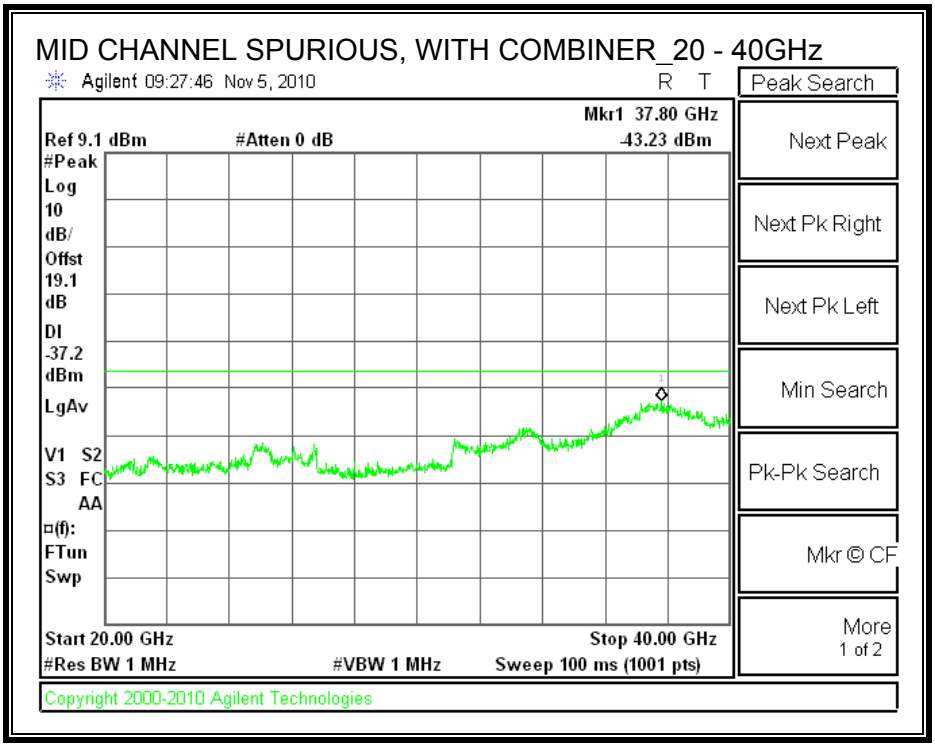
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

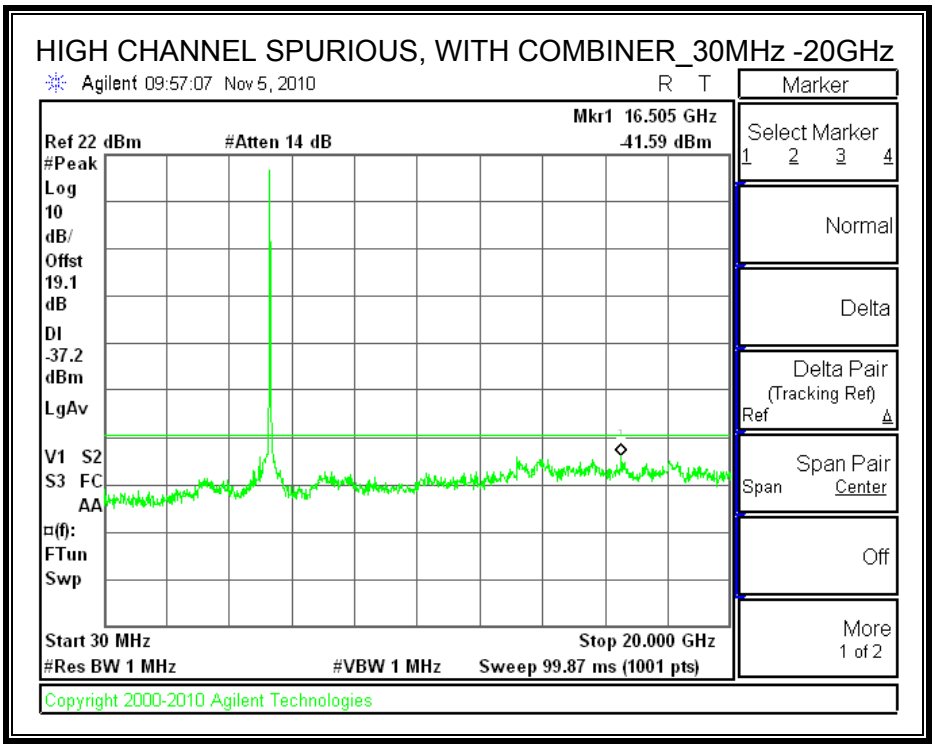
SPURIOUS EMISSIONS WITH COMBINER

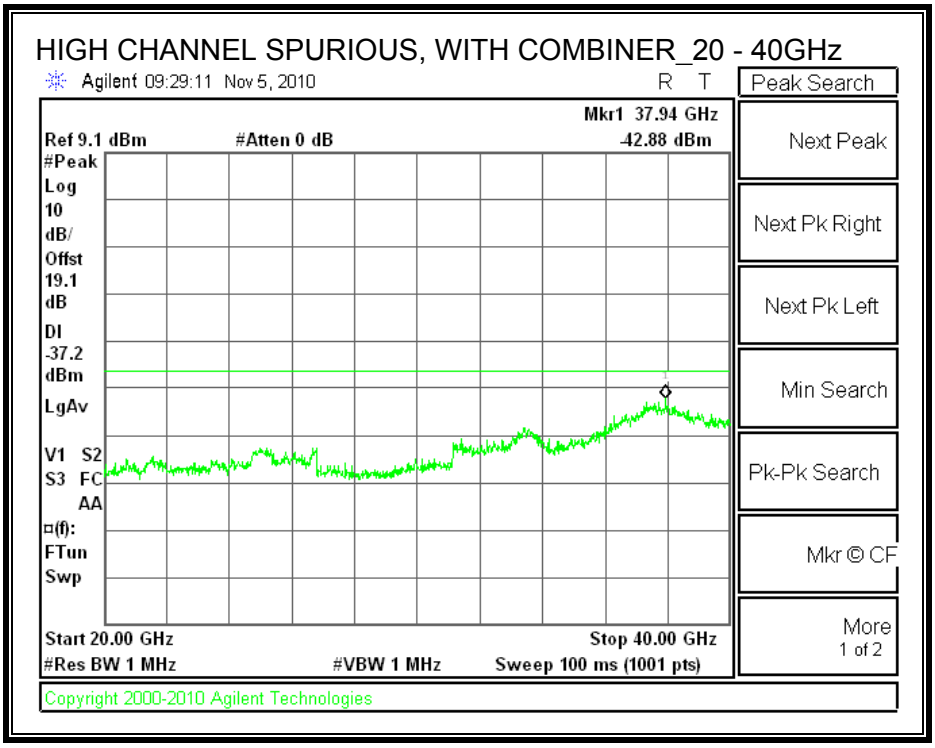












7.5. 5.3 GHz BAND CHANNEL TESTS FOR 802.11n HT20 MODE

7.5.1. 99% & 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	21.137	17.5914
Middle	5300	21.13	17.7285
High	5320	21.195	17.7101

CHAIN 1

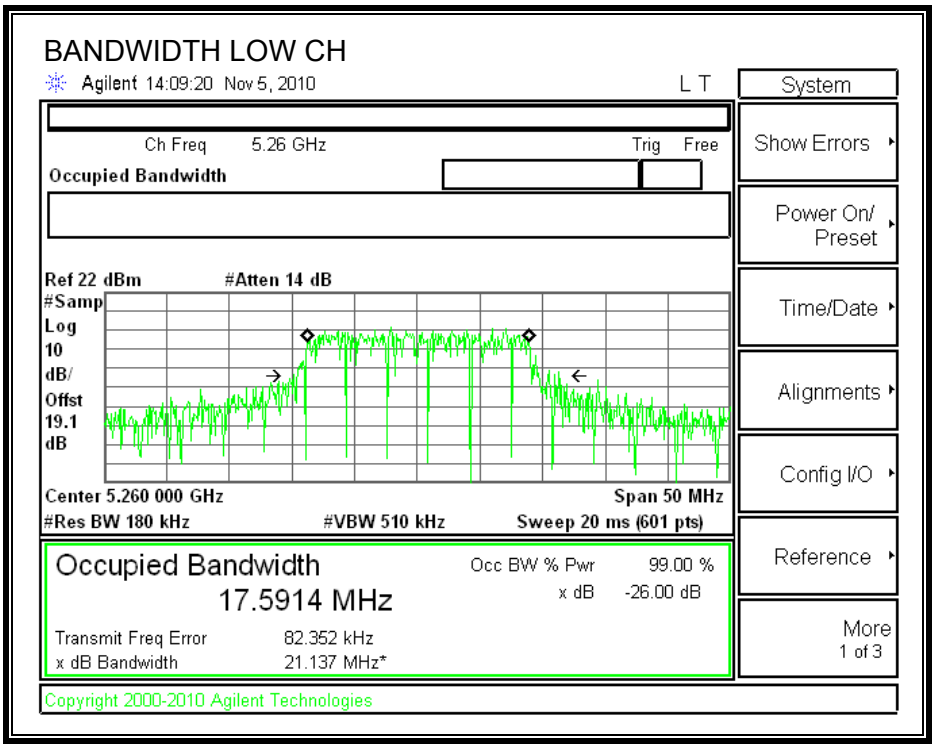
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	21.014	17.6115
Middle	5300	21.007	17.7105
High	5320	21.074	17.683

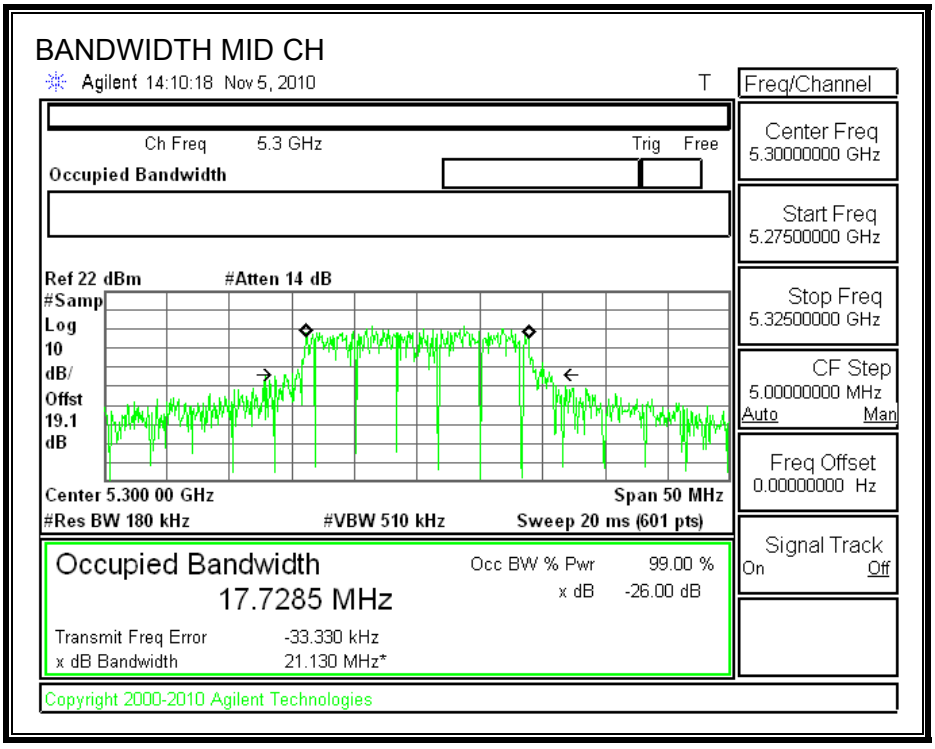
CHAIN 2

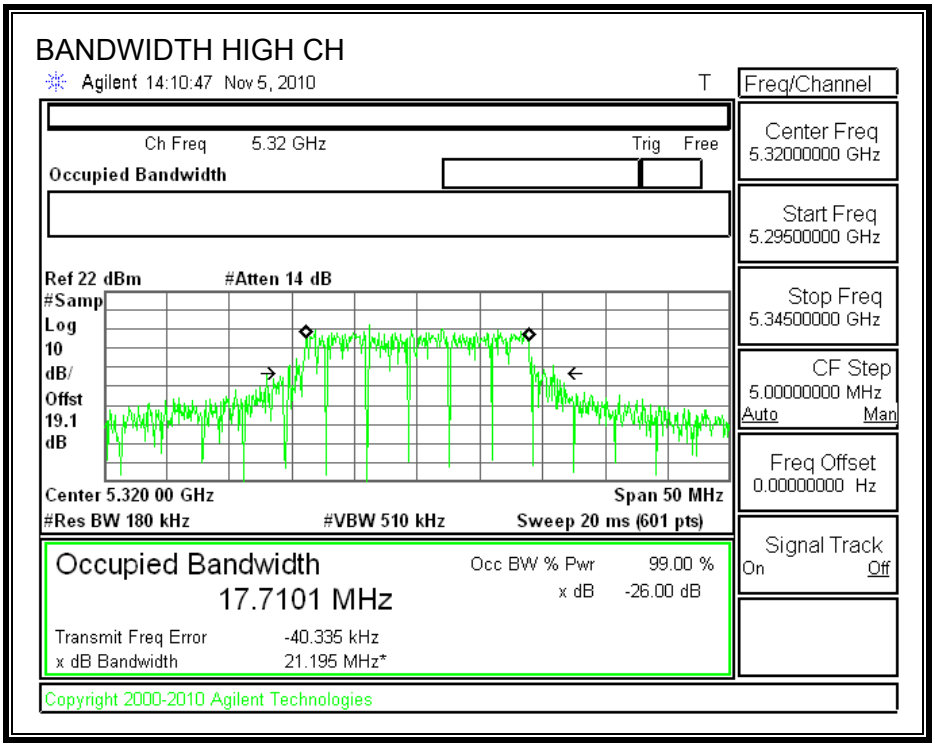
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5260	21.731	17.6659
Middle	5300	21.406	17.668
High	5320	21.176	17.6591

CHAIN 1

26 dB and 99% BANDWIDTH

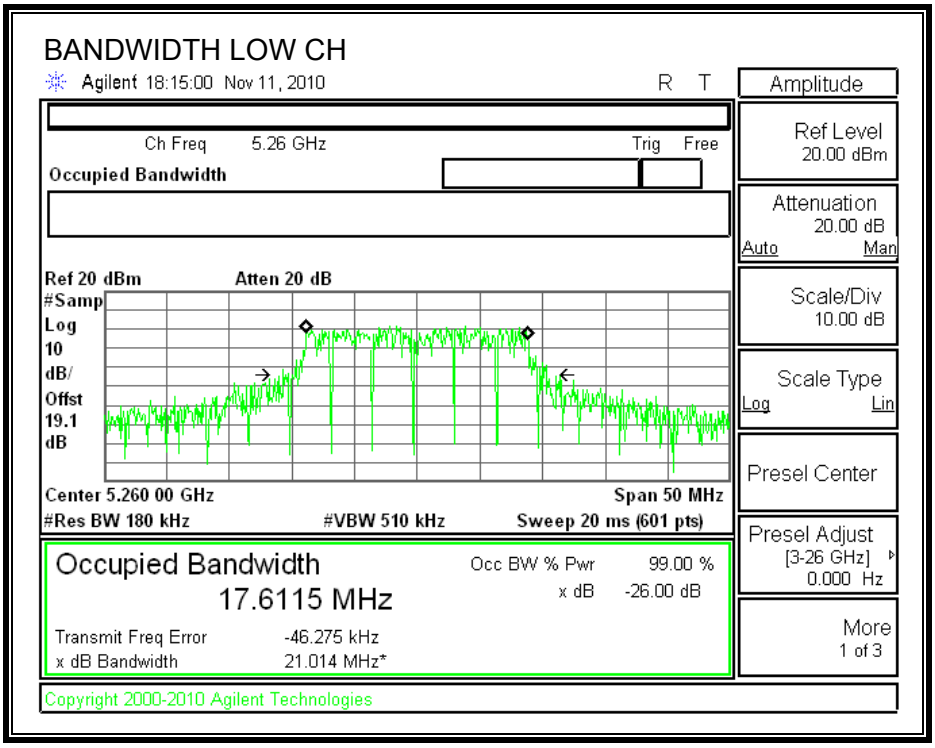




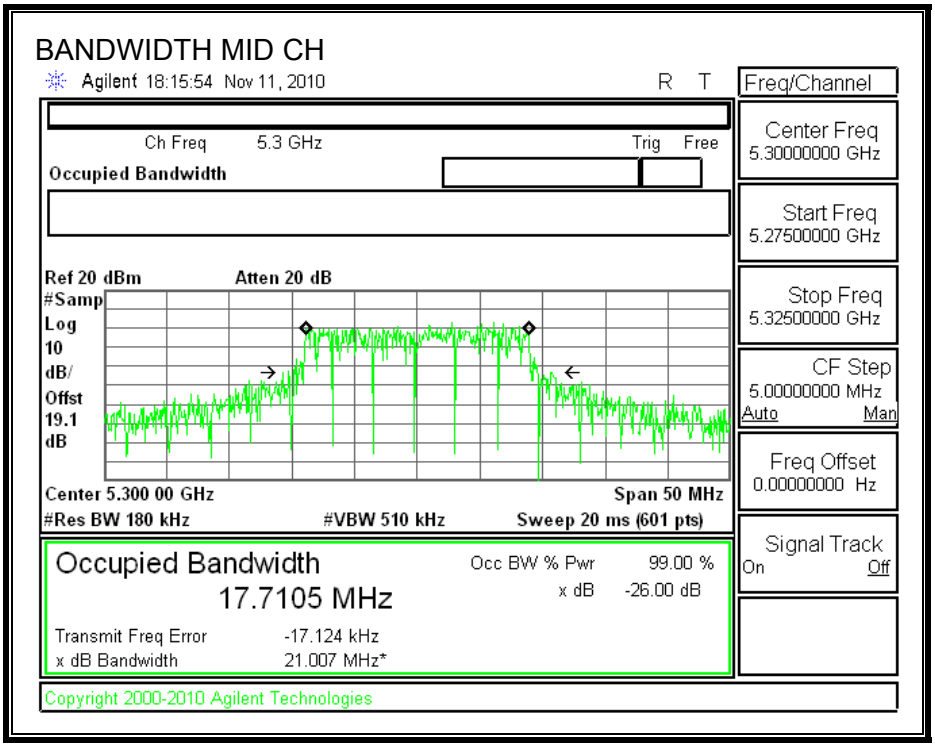


CHAIN 1

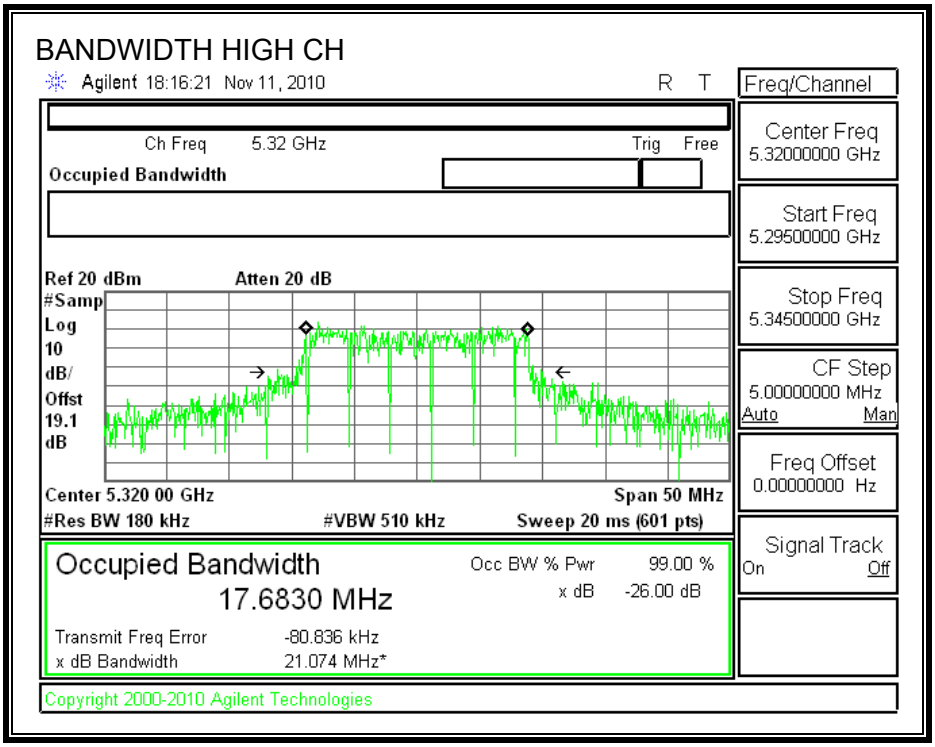
26 dB and 99% BANDWIDTH



BANDWIDTH MID CH

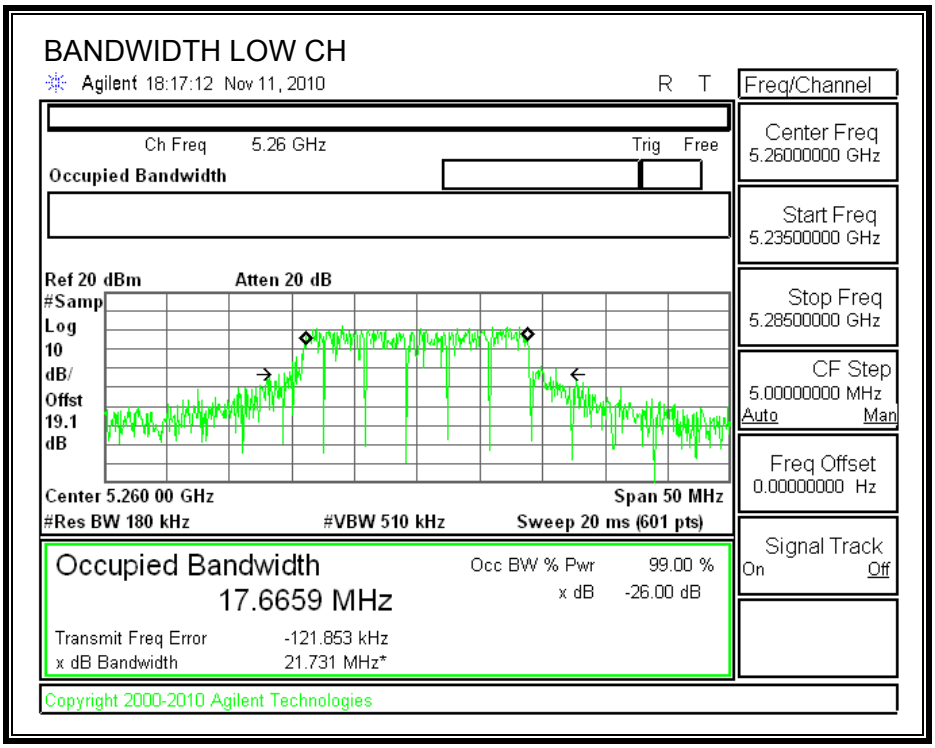


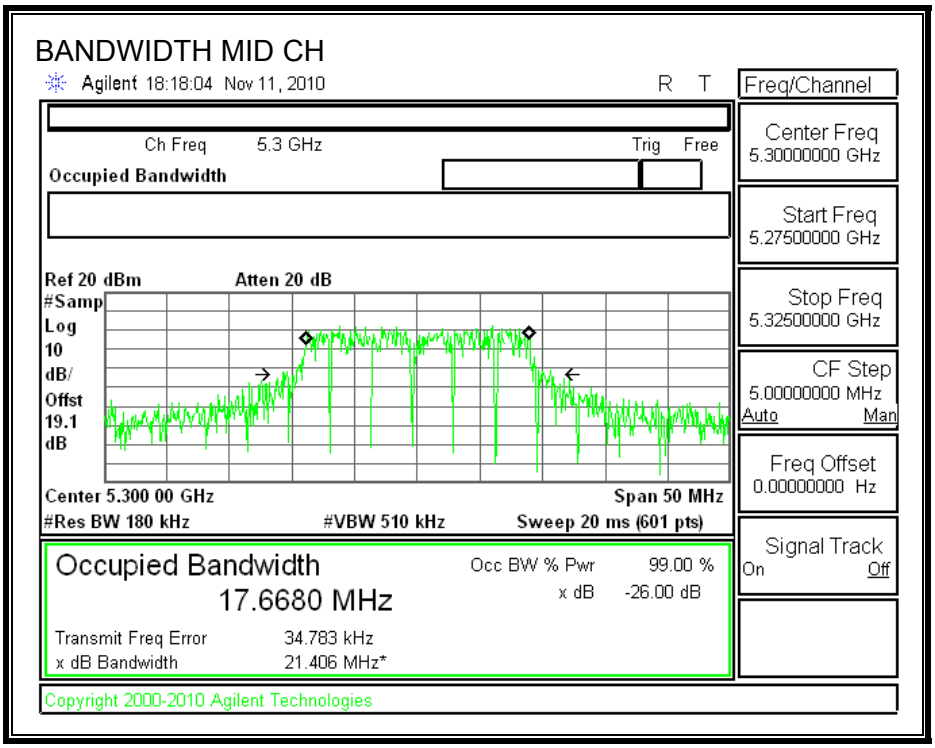
BANDWIDTH HIGH CH

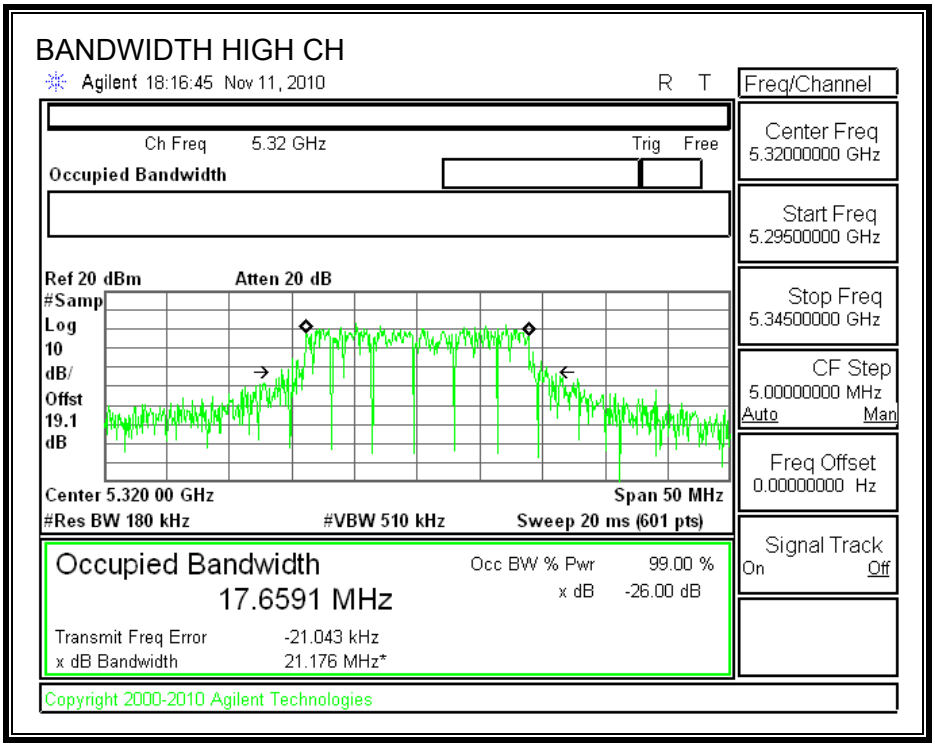


CHAIN 2

26 dB and 99% BANDWIDTH







7.5.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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

The maximum antenna gain is 6.07 dBi, and the combination antenna gain is 10.24 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

Non Beam-Forming

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	23.98	21.137	24.25	6.07	23.91
Mid	5300	23.98	21.13	24.25	6.07	23.91
High	5320	23.98	21.195	24.26	6.07	23.91

Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	16.55	16.07	15.46	20.82	23.91	-3.09
Mid	5300	17.42	16.74	15.78	21.47	23.91	-2.44
High	5320	16.24	16.34	15.06	20.69	23.91	-3.22

Beam-Forming

Limit

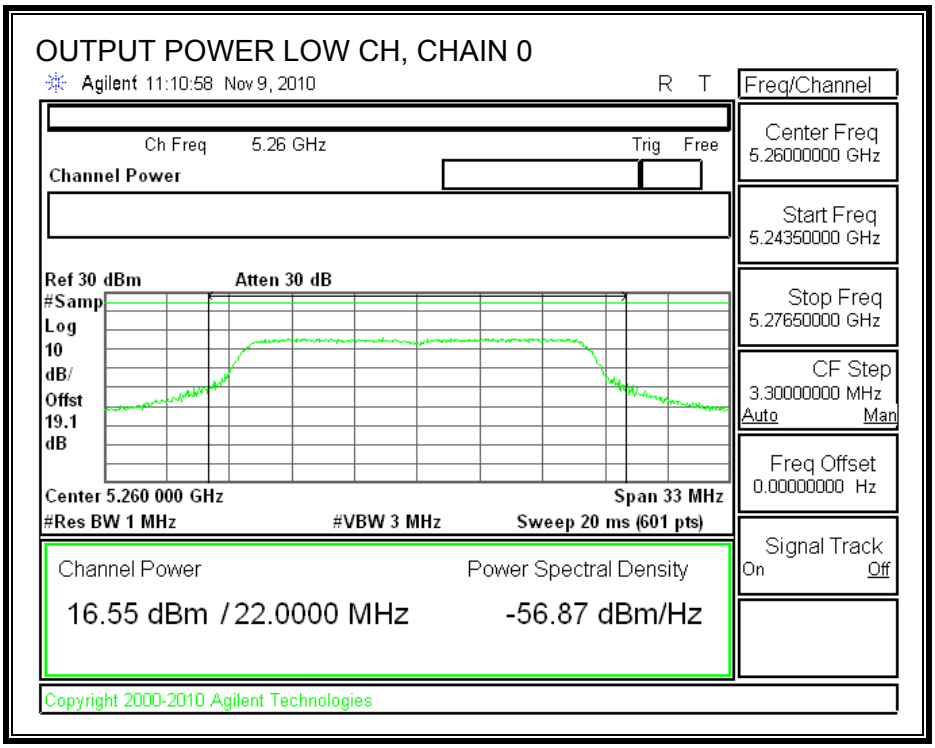
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5260	23.98	21.137	24.25	10.24	19.74
Mid	5300	23.98	21.13	24.25	10.24	19.74
High	5320	23.98	21.195	24.26	10.24	19.74

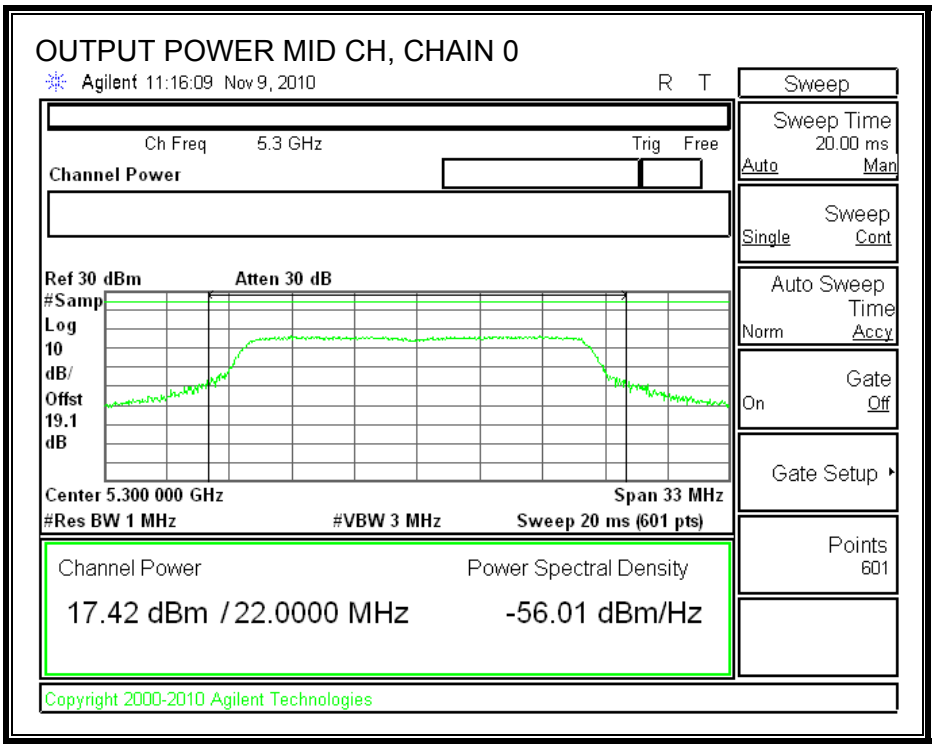
Individual Chain Results

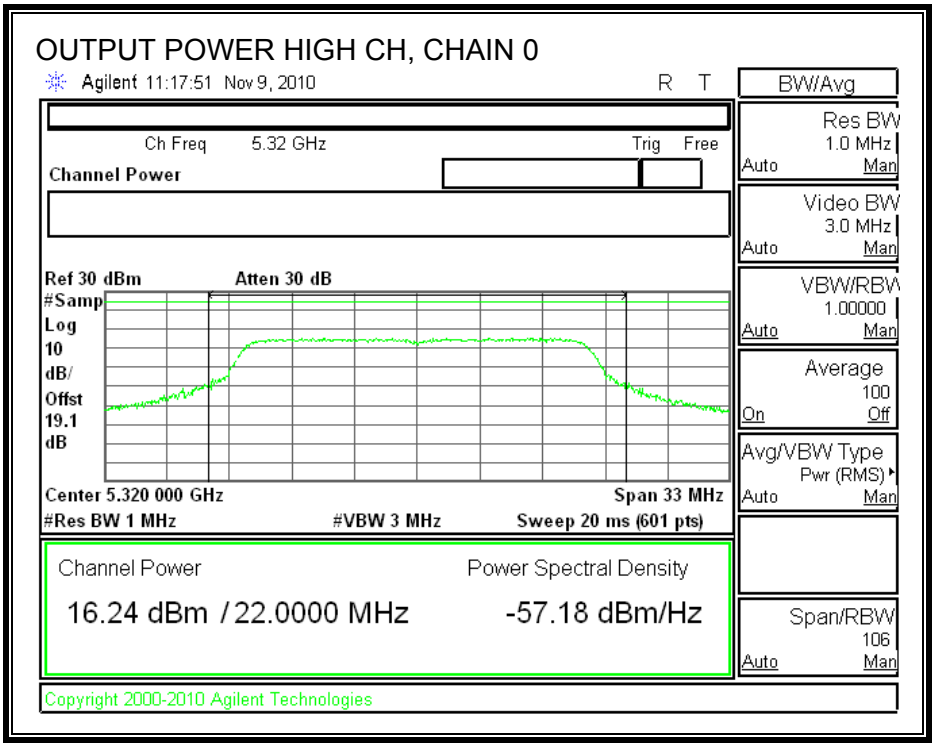
Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5260	14.31	12.96	12.22	18.02	19.74	-1.72
Mid	5300	13.56	12.52	12.49	17.66	19.74	-2.08
High	5320	14.11	13.26	12.63	18.15	19.74	-1.59

NBF

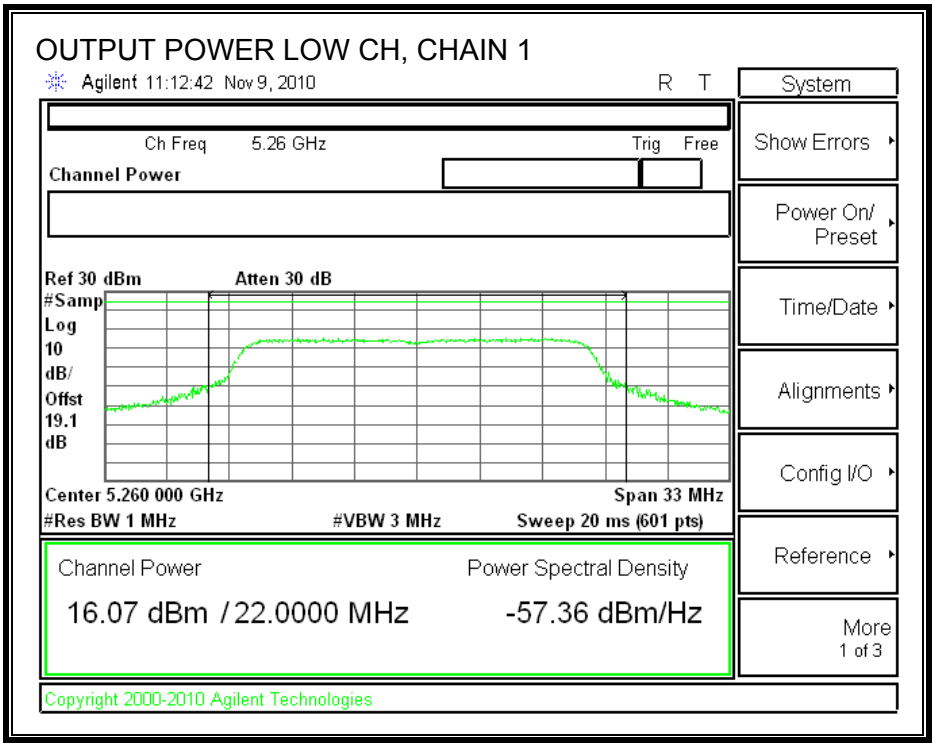
CHAIN 0 OUTPUT POWER

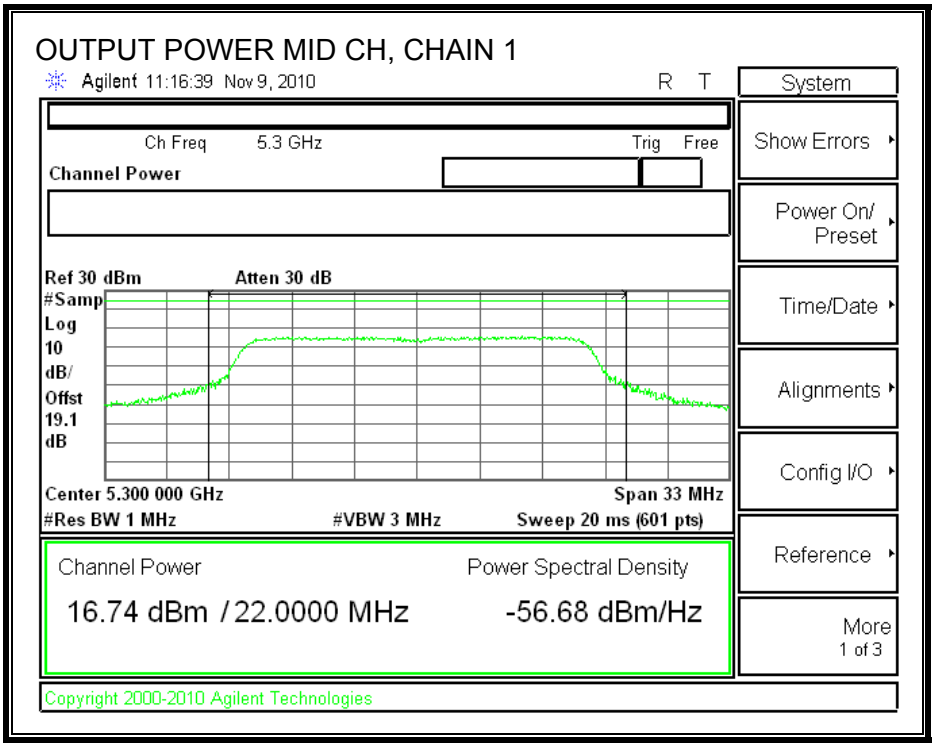


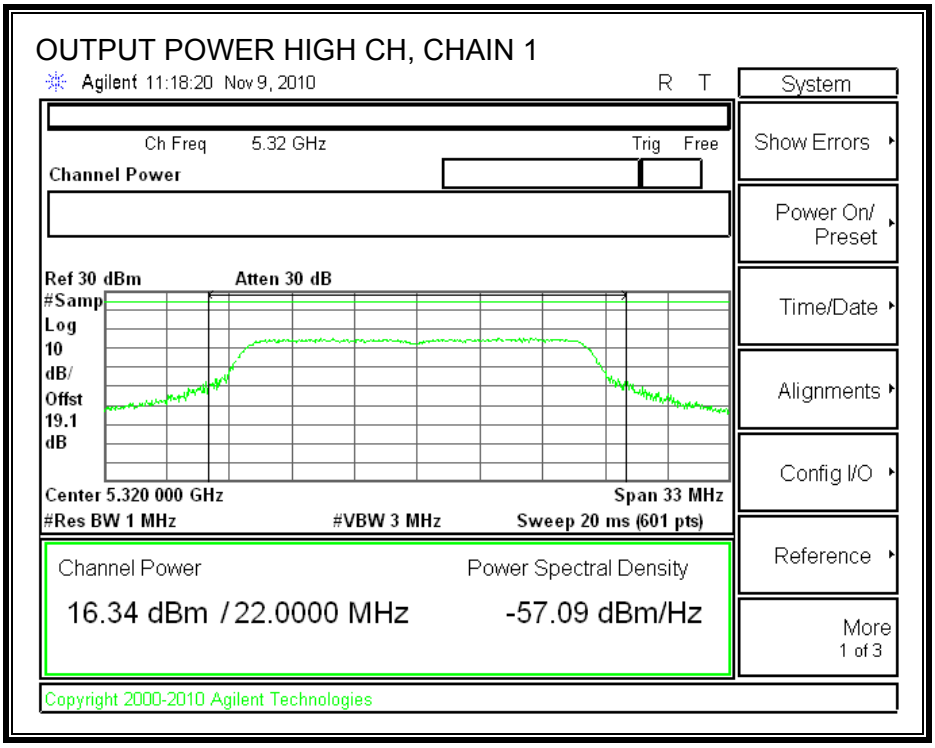




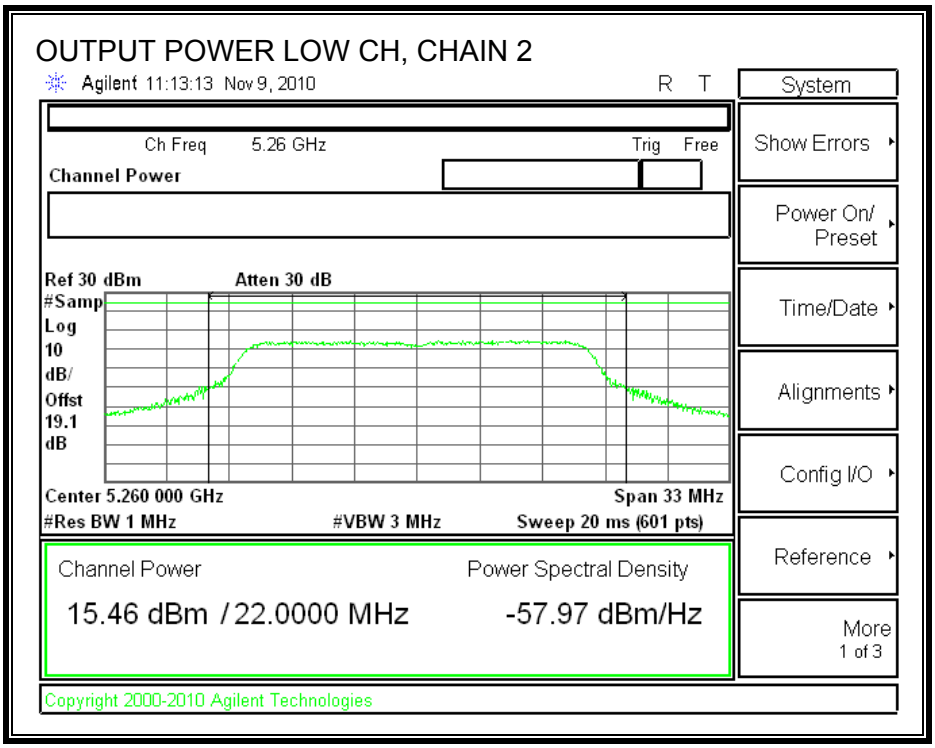
CHAIN 1 OUTPUT POWER

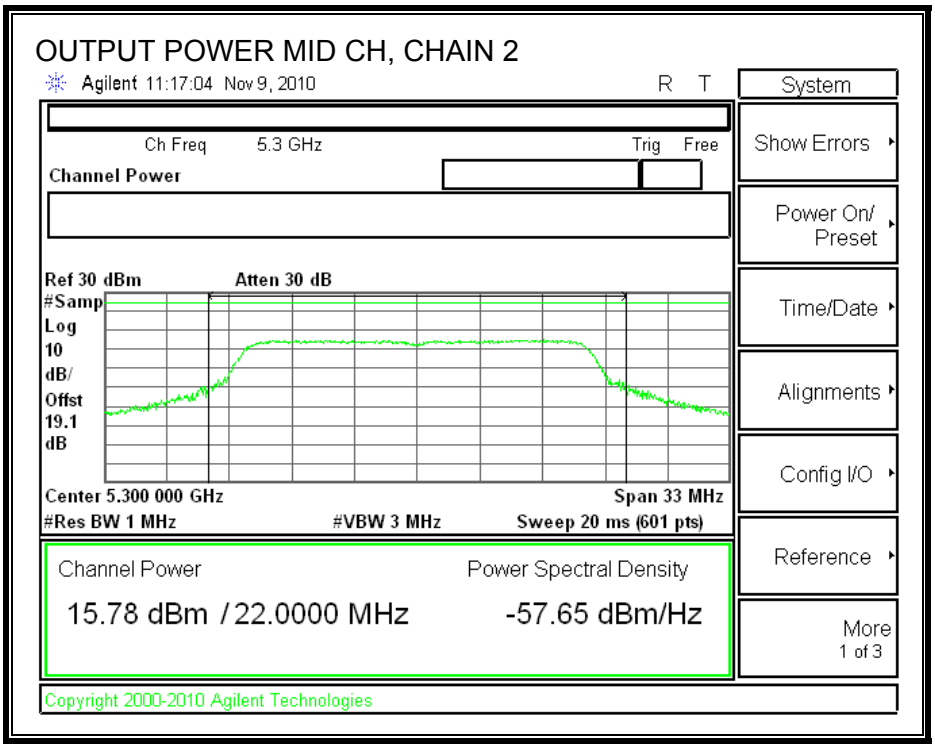


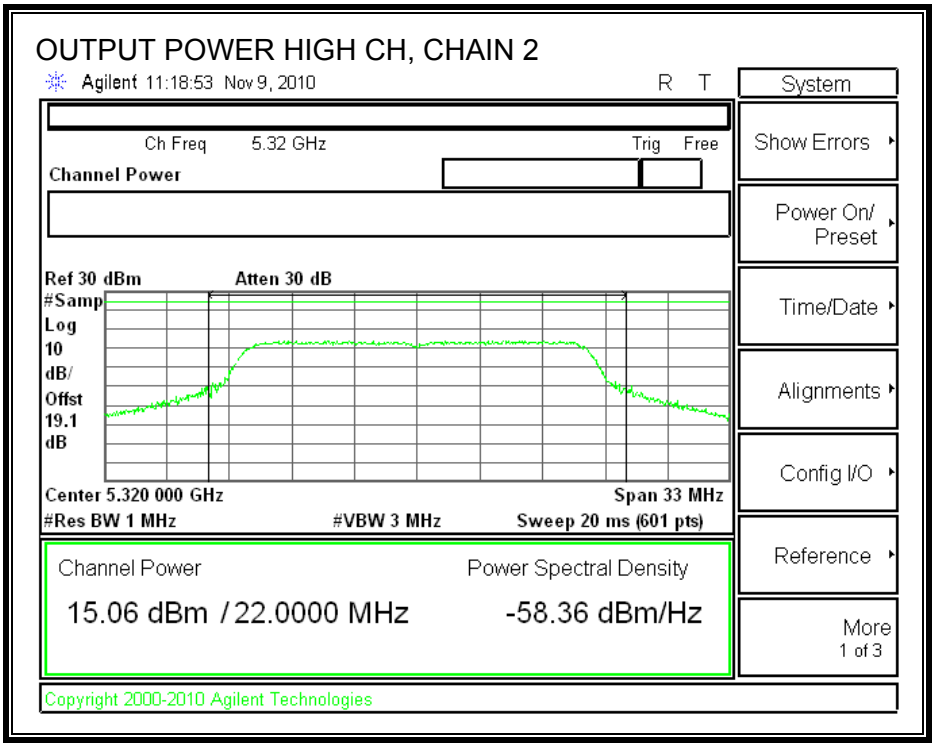




CHAIN 2 OUTPUT POWER

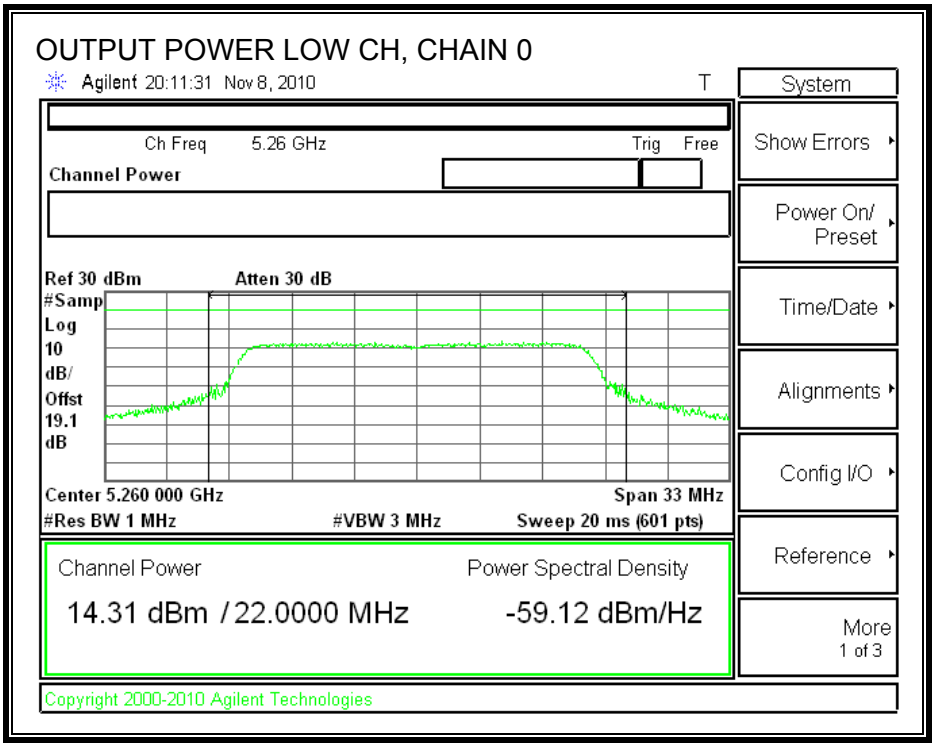


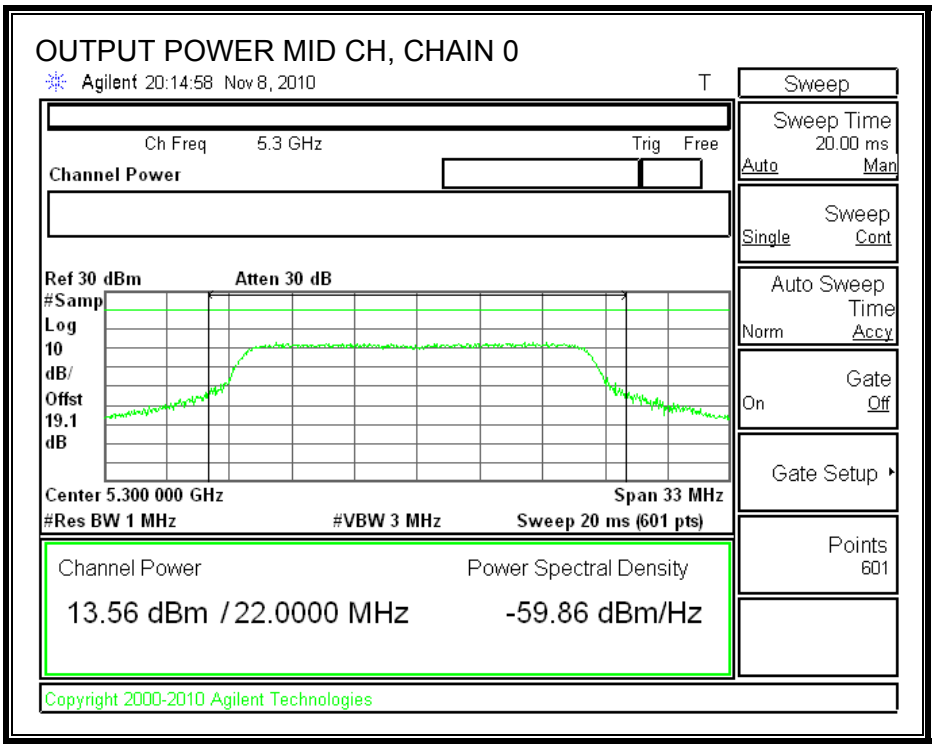


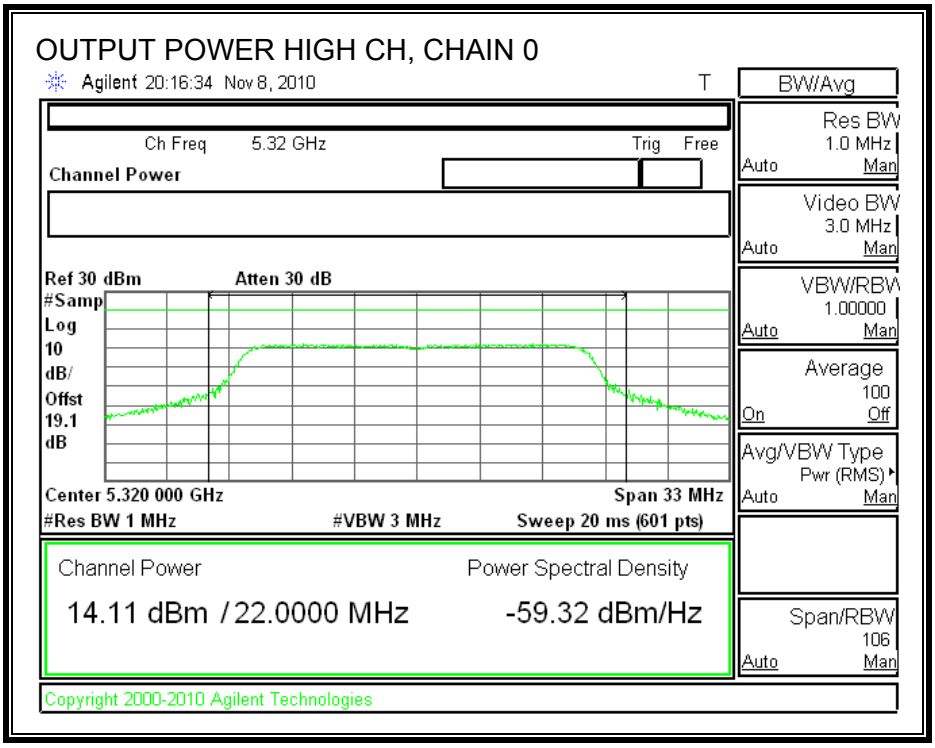


BF

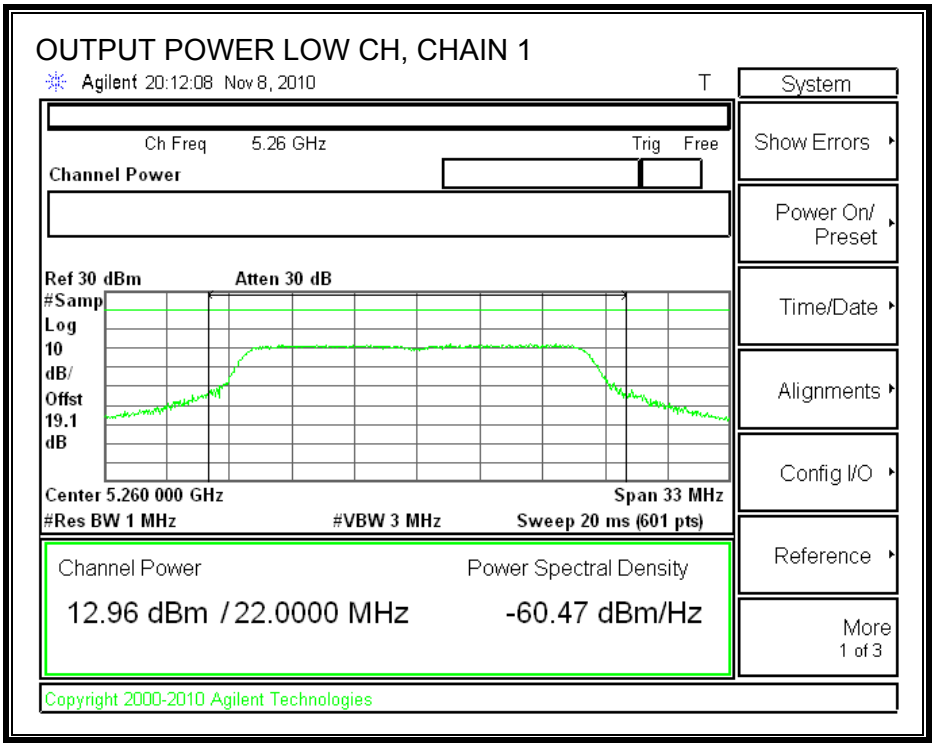
CHAIN 0 OUTPUT POWER

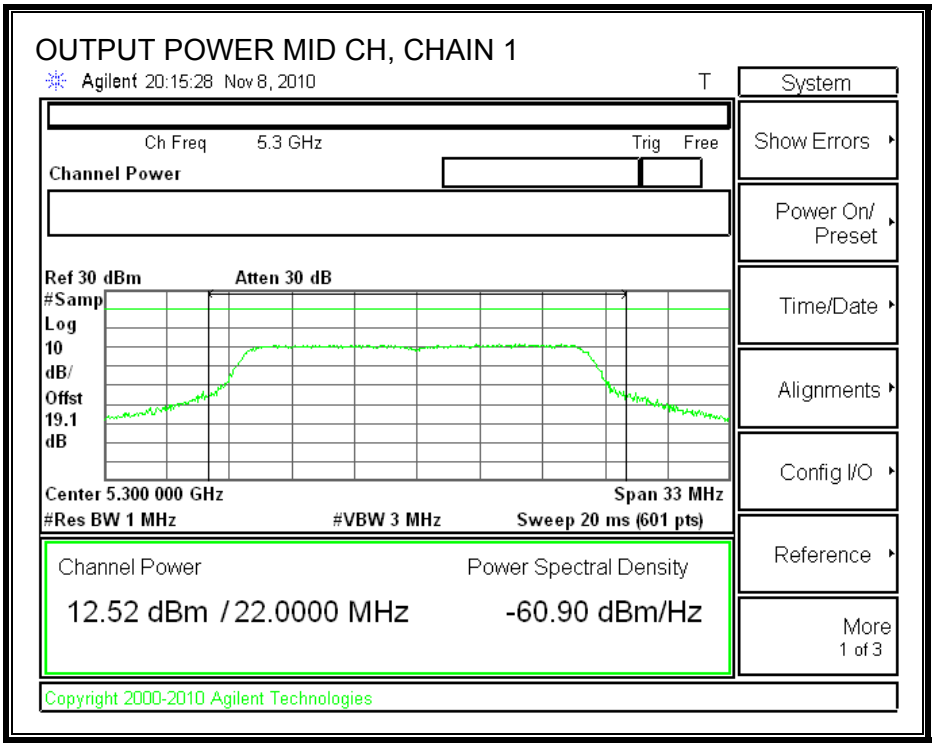


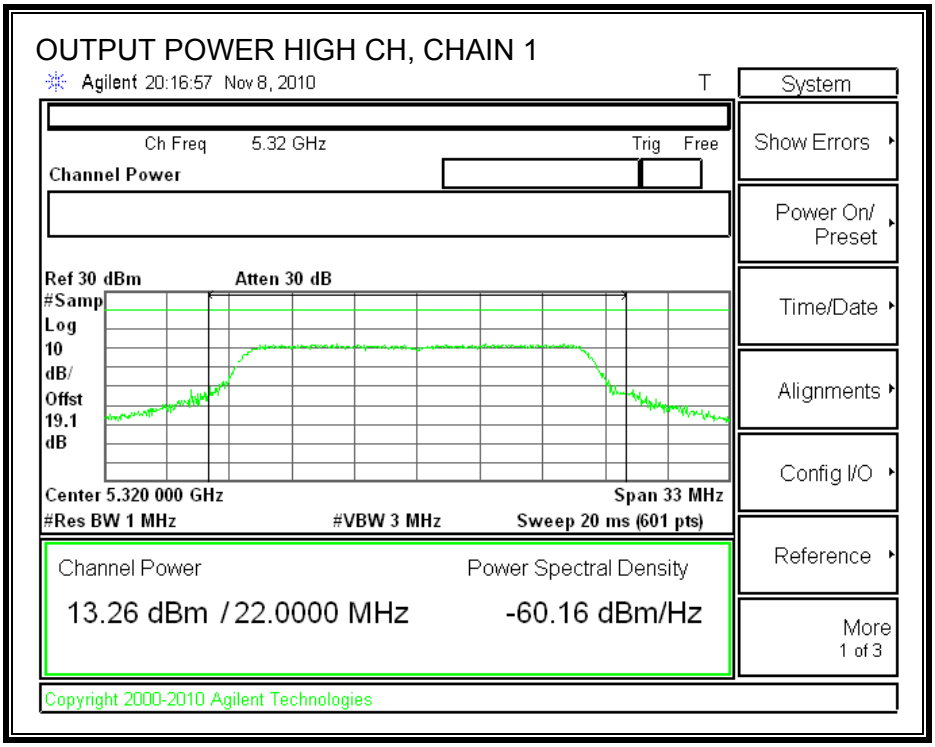




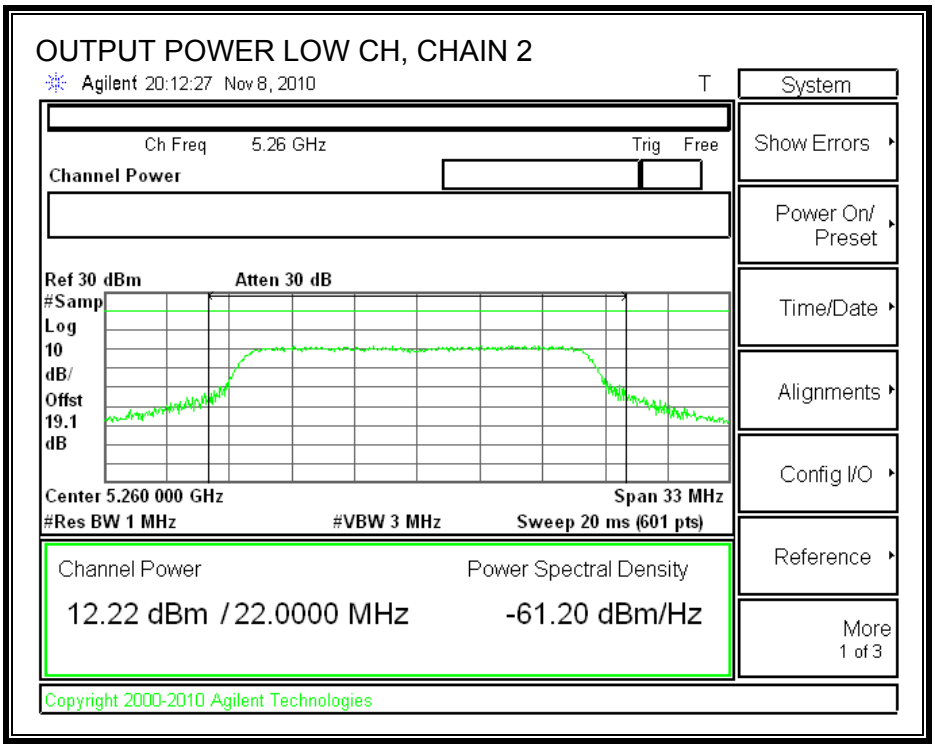
CHAIN 1 OUTPUT POWER

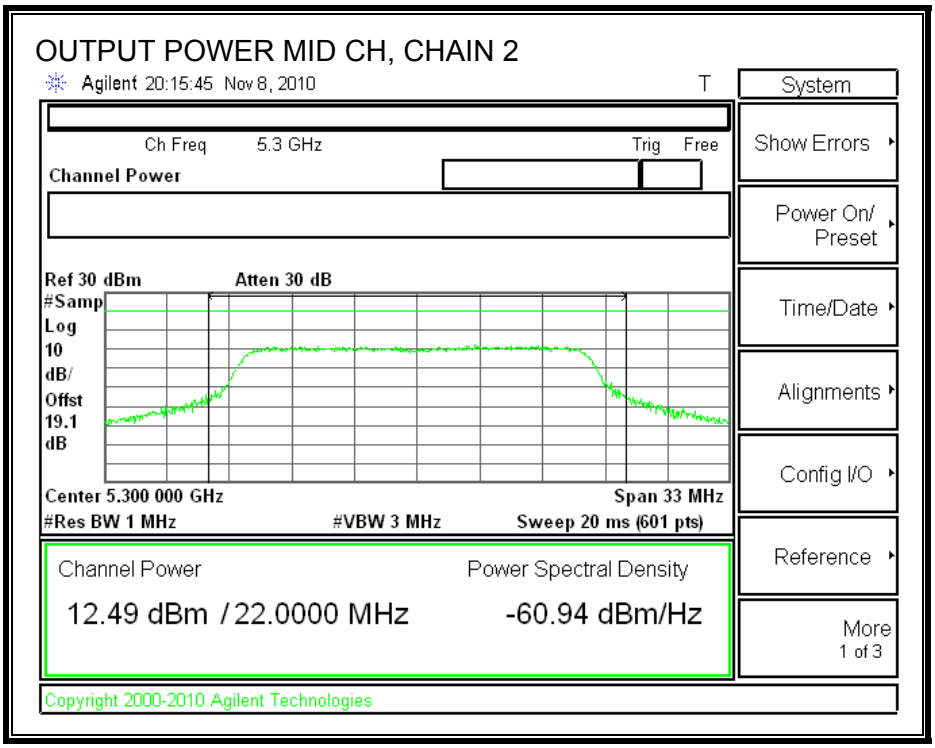


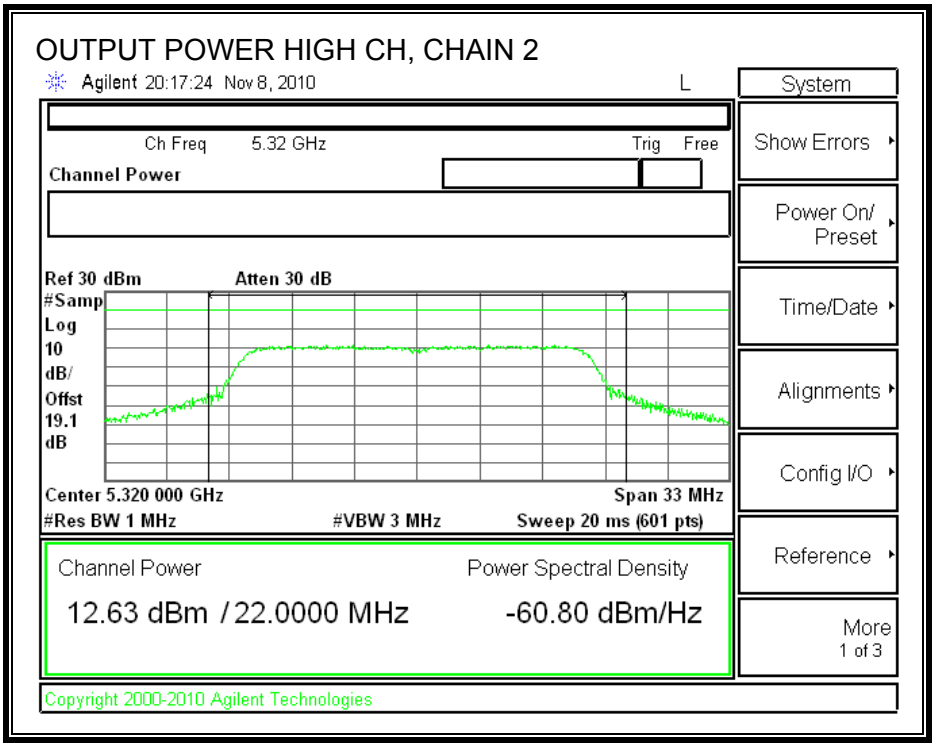




CHAIN 2 OUTPUT POWER







7.5.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

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

RESULTS

NBF

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5260	16.50	16.00	15.40	20.76
Middle	5300	17.40	16.65	15.70	21.41
High	5320	16.15	16.20	15.00	20.59

BF

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5260	14.25	12.85	12.20	17.96
Middle	5300	13.45	12.45	12.45	17.58
High	5320	14.00	13.25	12.50	18.06

7.5.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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

The maximum antenna gain is 6.07 dBi, therefore the limit is 10.93 dBm.

The combination antenna gain is 10.24 dBi, therefore the limit is 6.76 dBm.

TEST PROCEDURE

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

Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

RESULTS

Non Beam-Forming

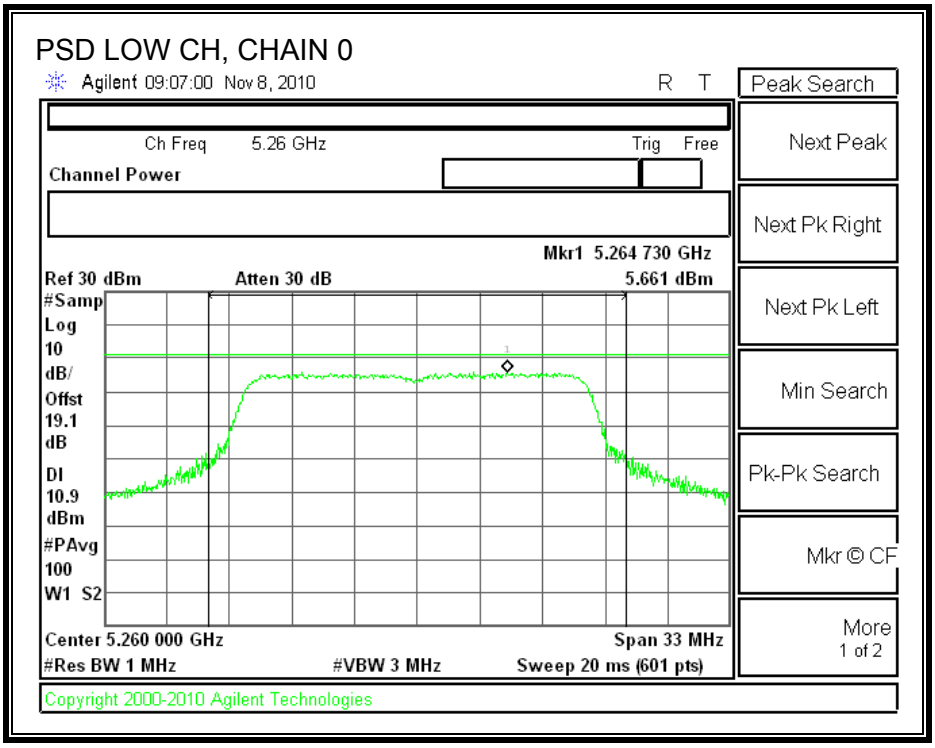
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5260	5.661	4.712	4.176	9.7	10.93	-1.27
Middle	5300	5.77	4.898	4.092	9.7	10.93	-1.18
High	5320	5.392	5.02	3.785	9.6	10.93	-1.37

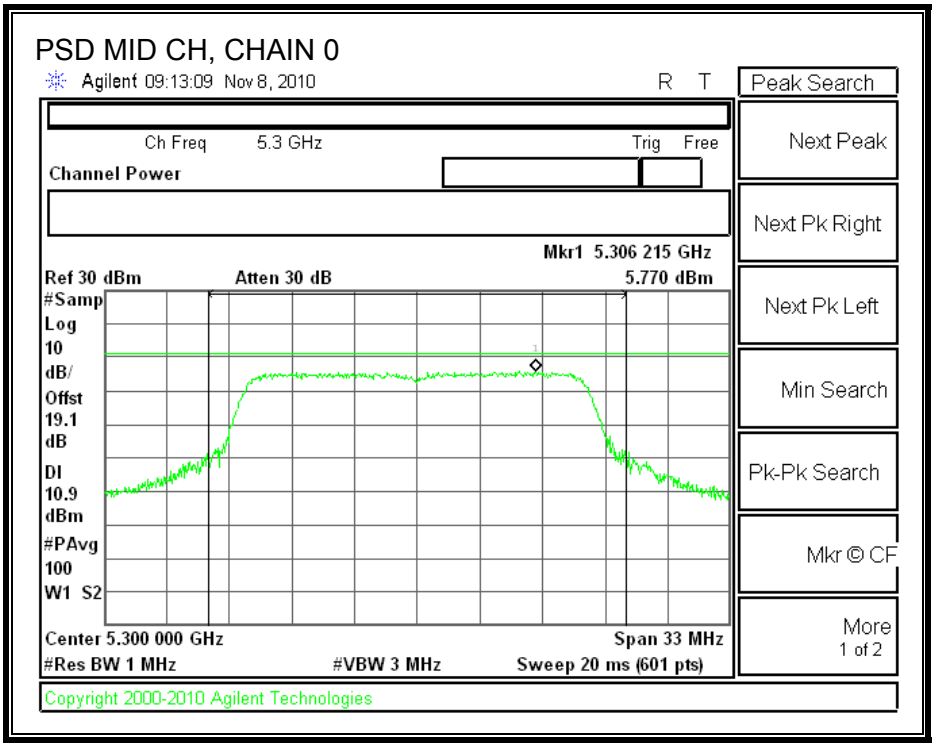
Beam-Forming

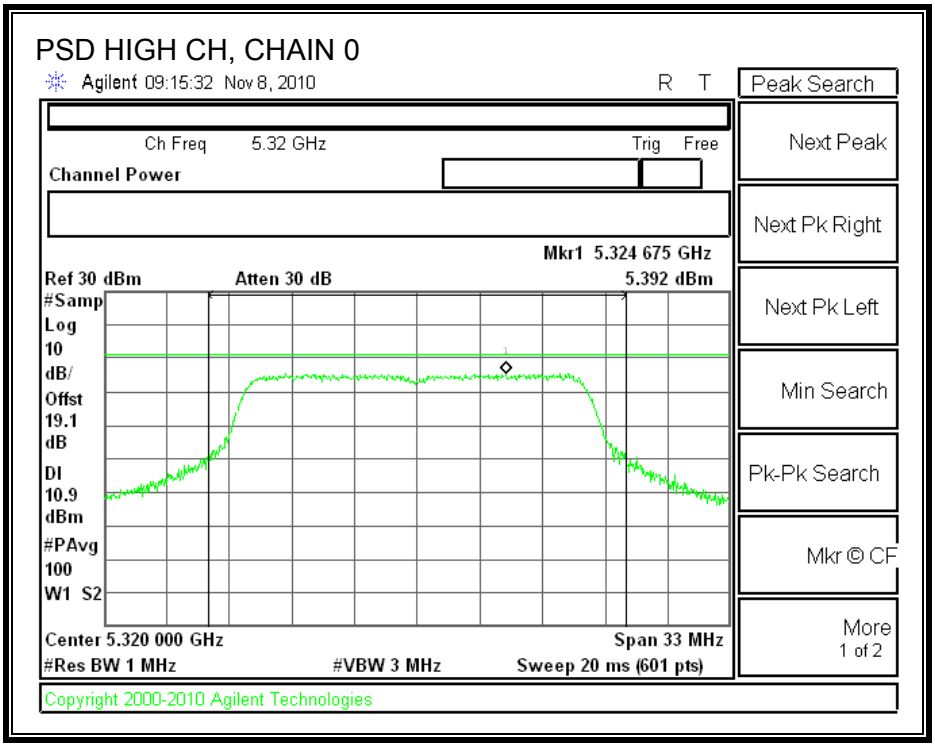
Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 1 PPSD (dBm)	Chain 2 PPSD (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5260	2.547	1.808	1.124	6.6	6.76	-0.12
Middle	5300	2.671	1.748	0.929	6.6	6.76	-0.15
High	5320	2.473	2.013	0.947	6.6	6.76	-0.13

NBF

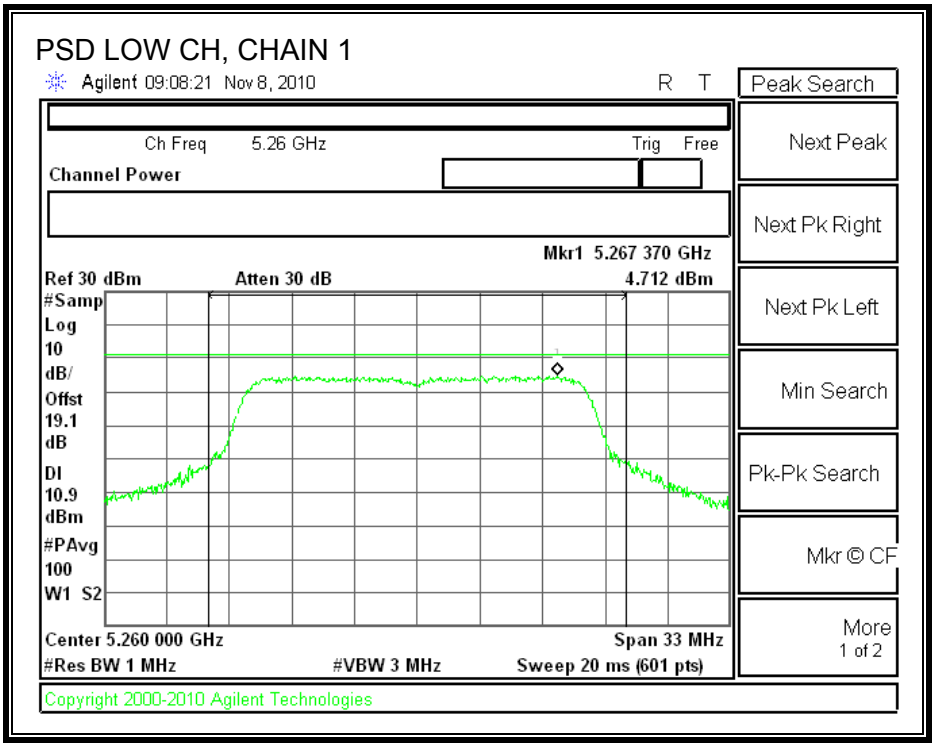
CHAIN 0 POWER SPECTRAL DENSITY

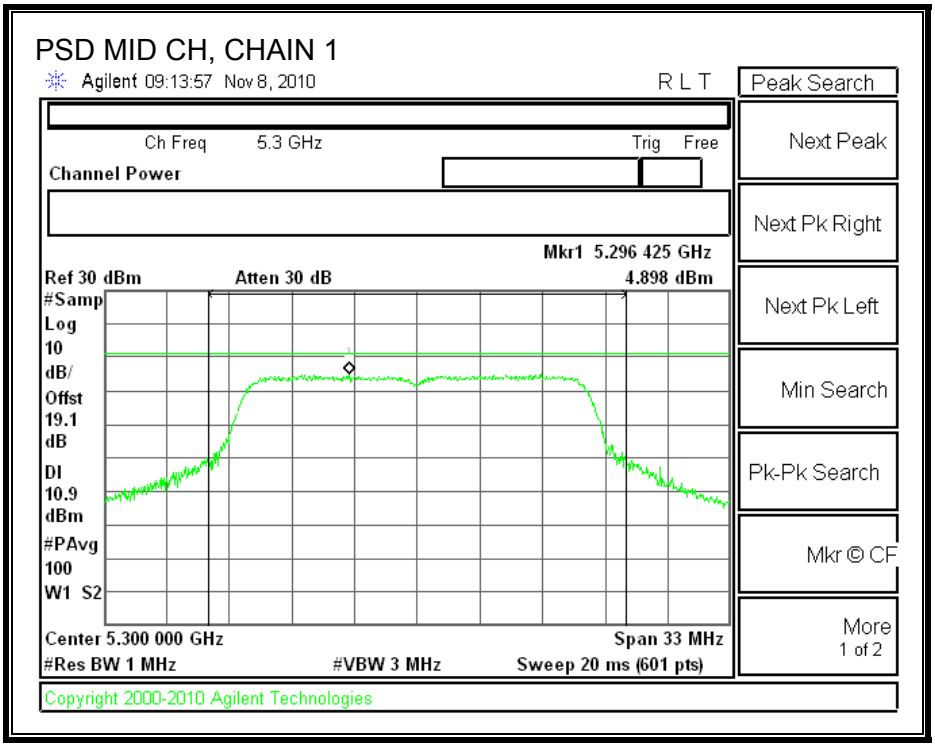


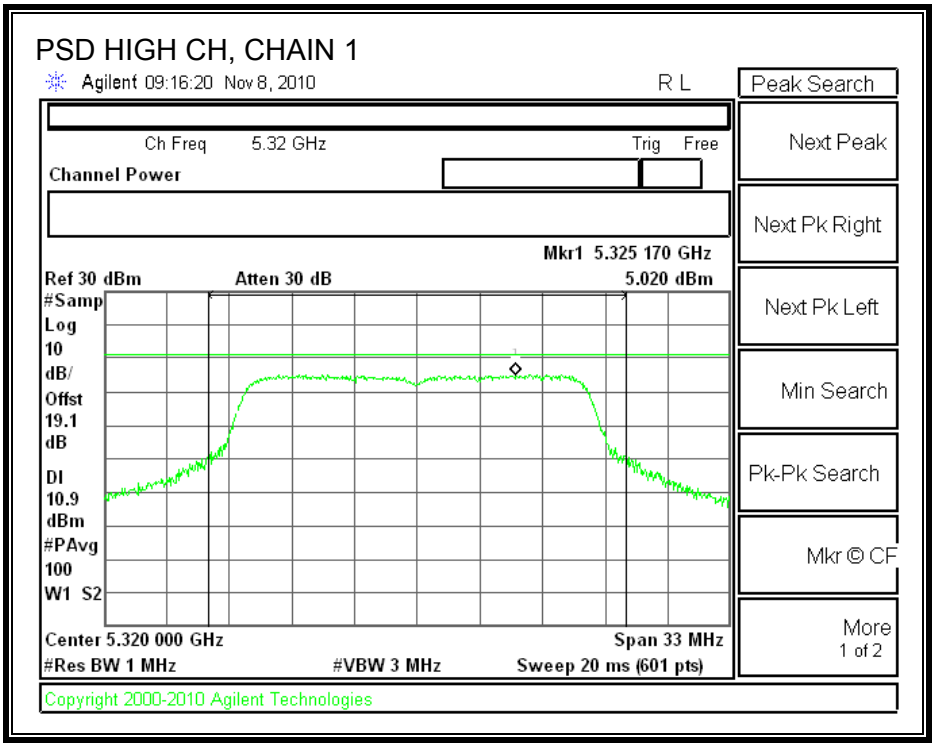




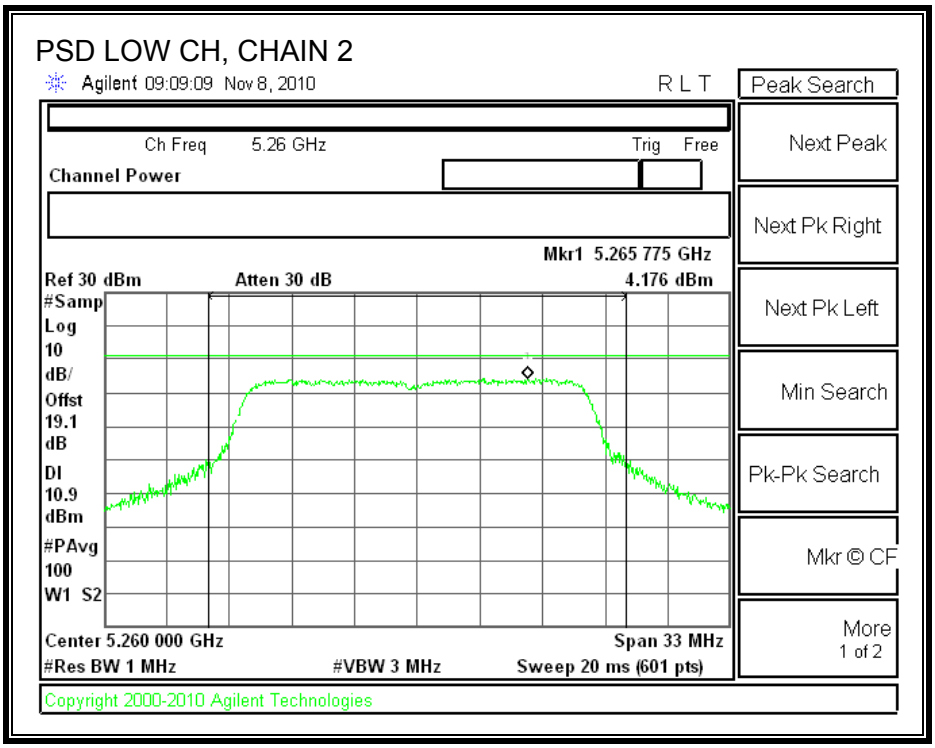
CHAIN 1 POWER SPECTRAL DENSITY

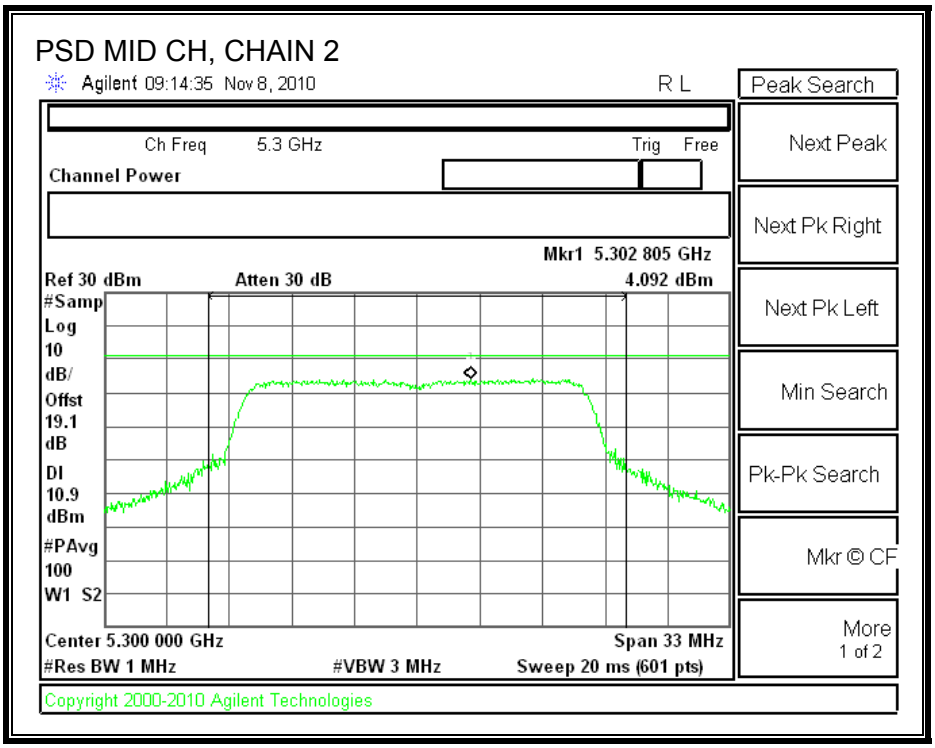


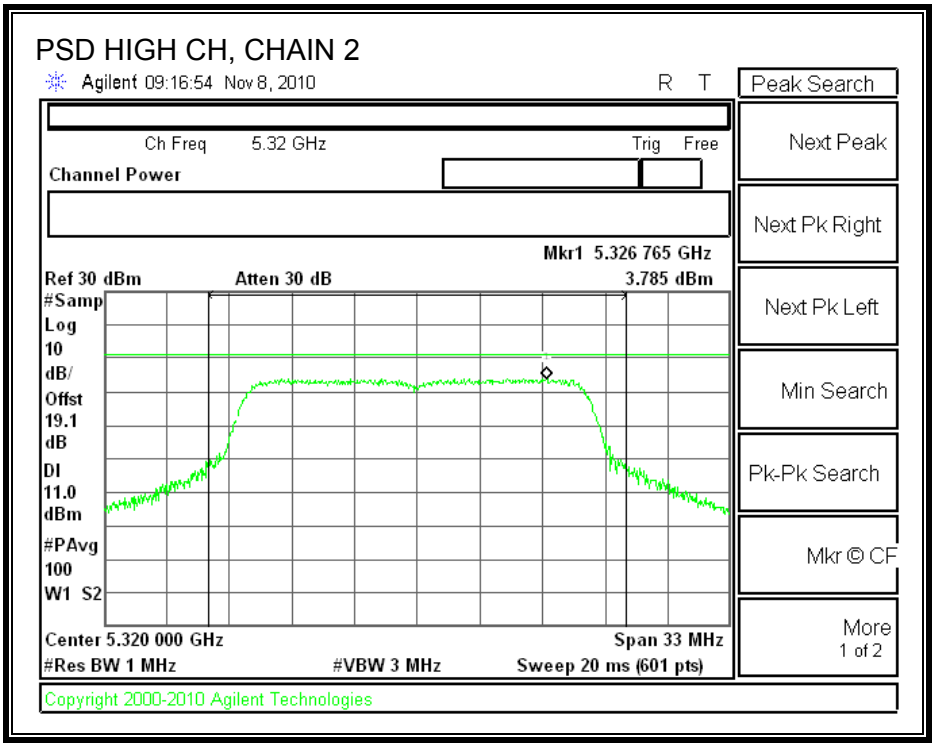




CHAIN 2 POWER SPECTRAL DENSITY

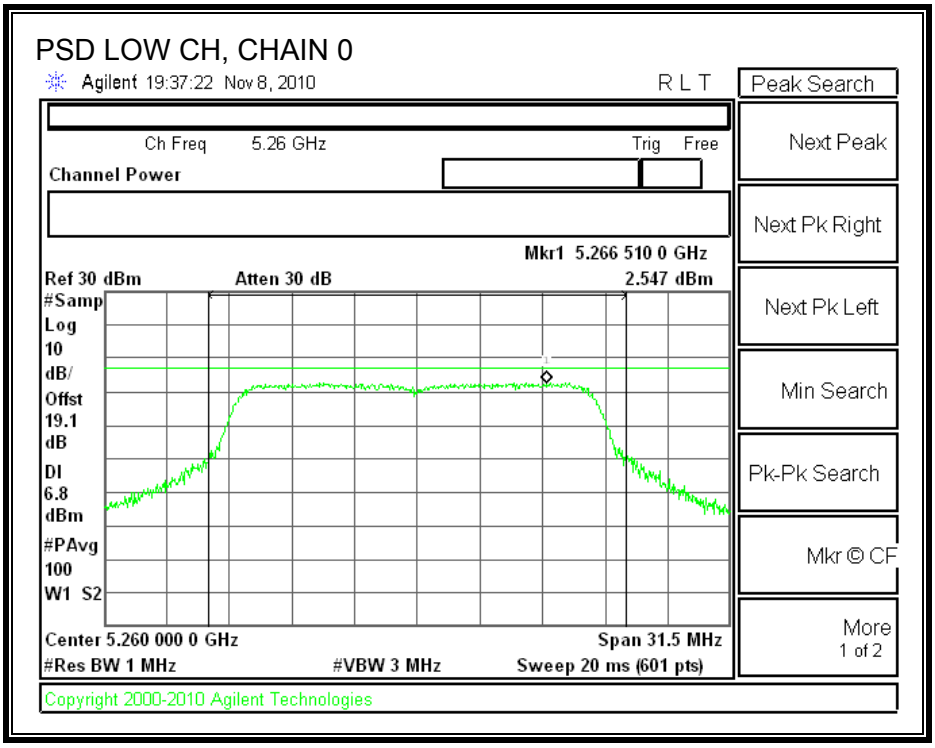


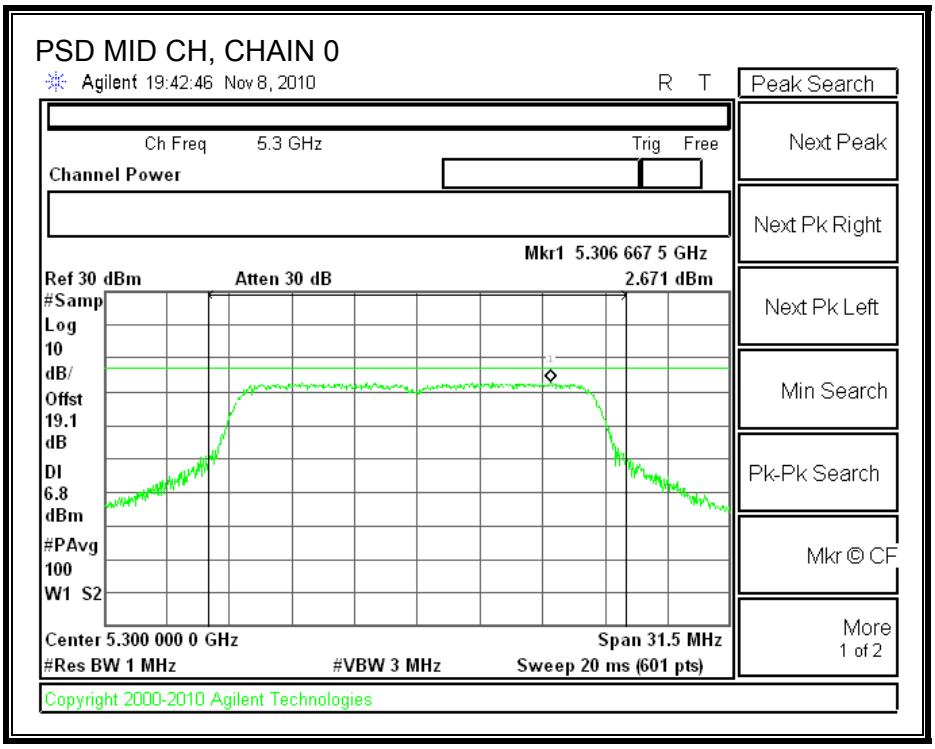


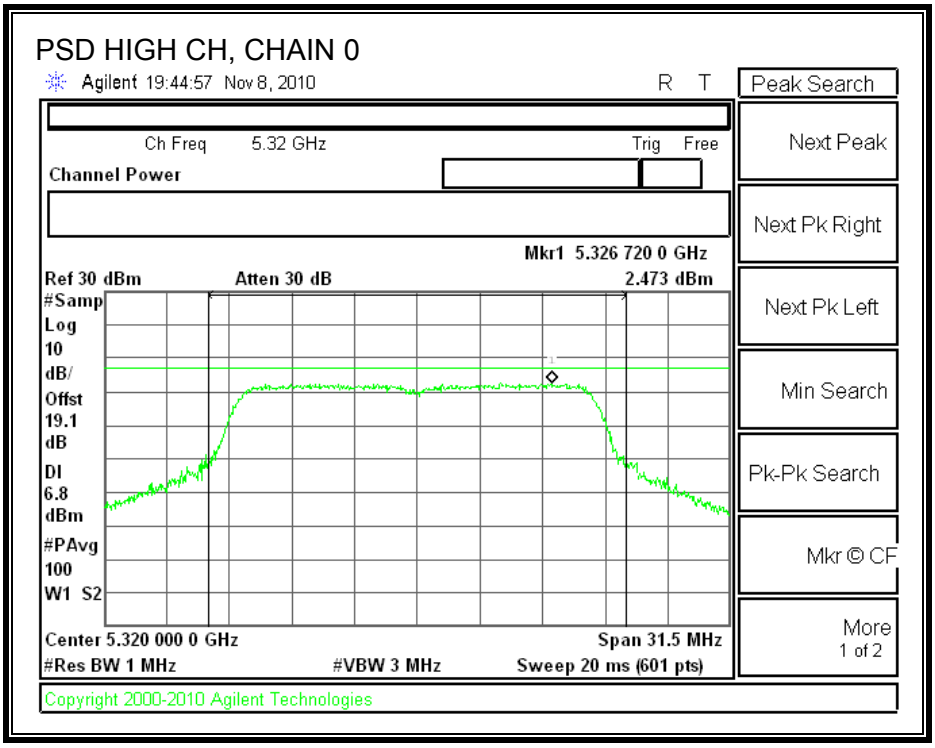


BF

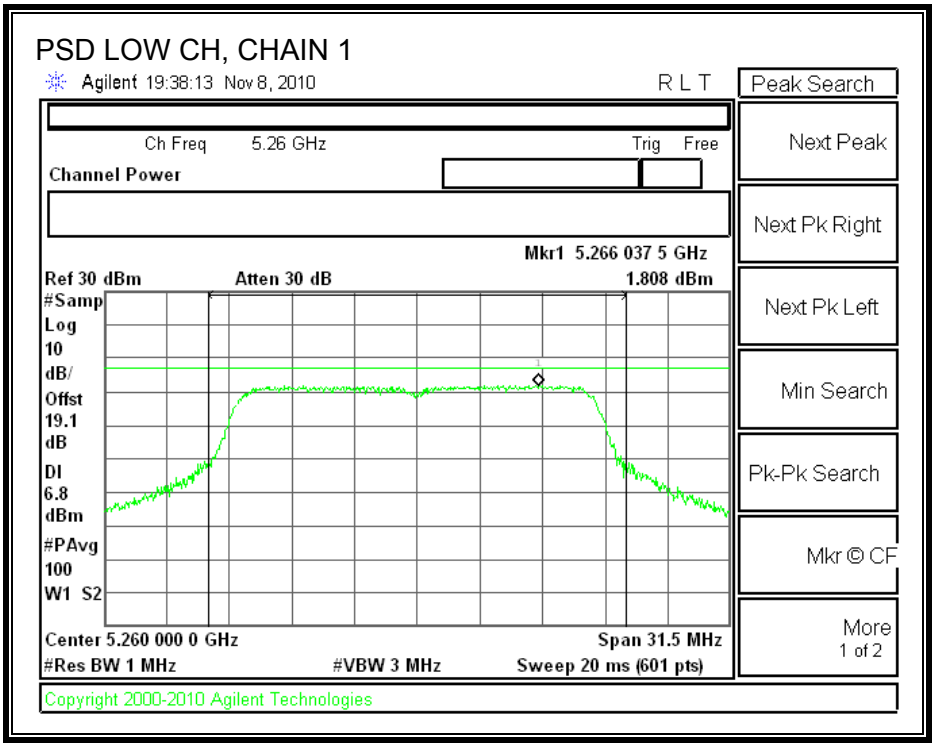
CHAIN 0 POWER SPECTRAL DENSITY

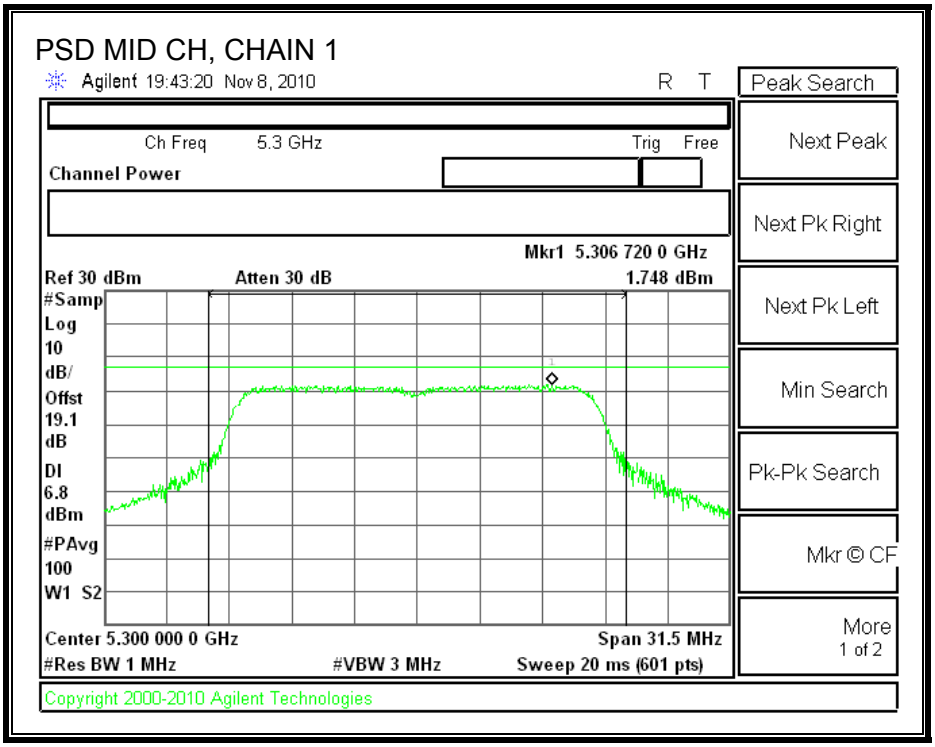


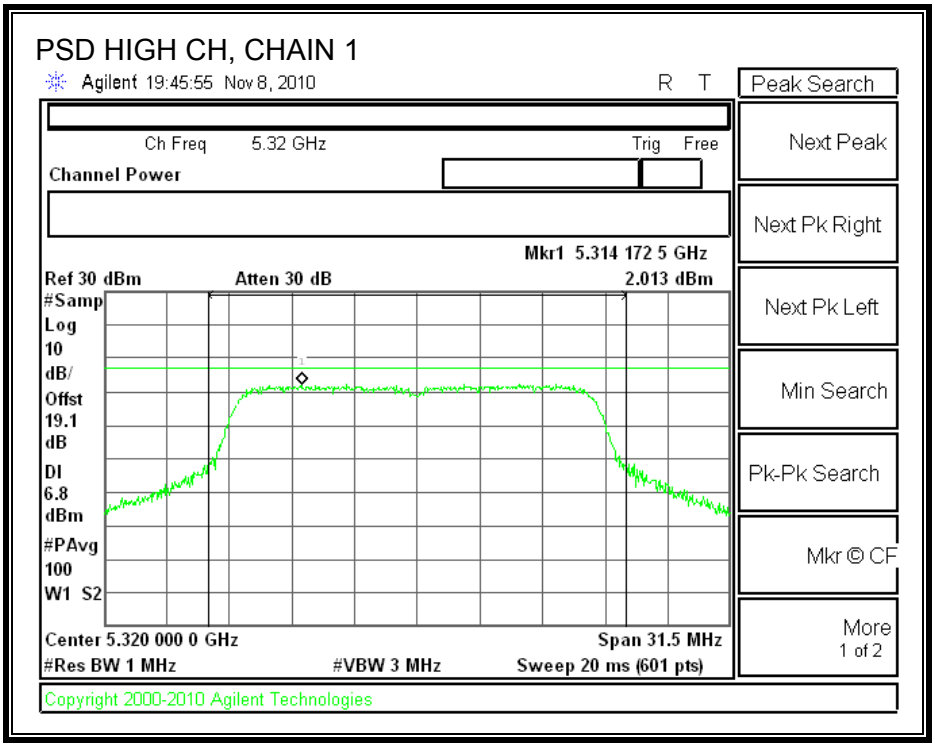




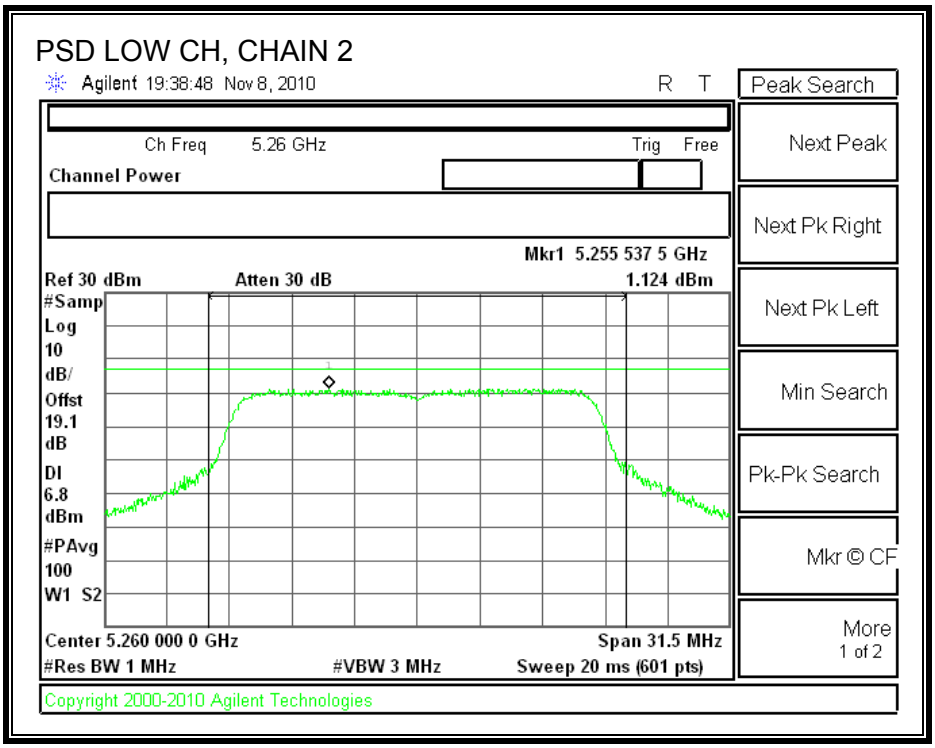
CHAIN 1 POWER SPECTRAL DENSITY

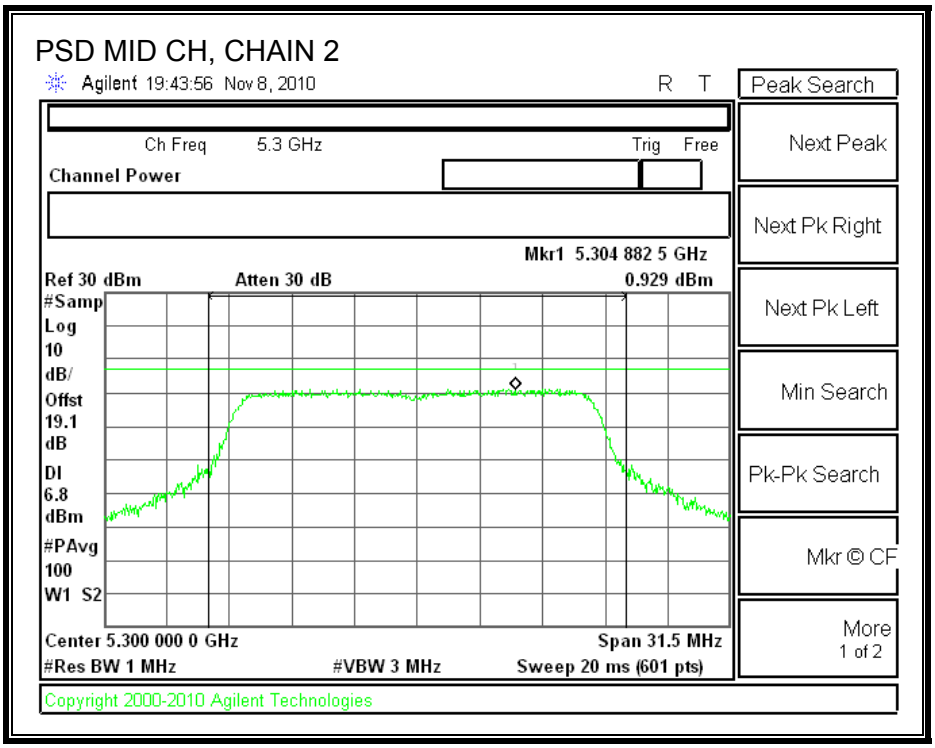


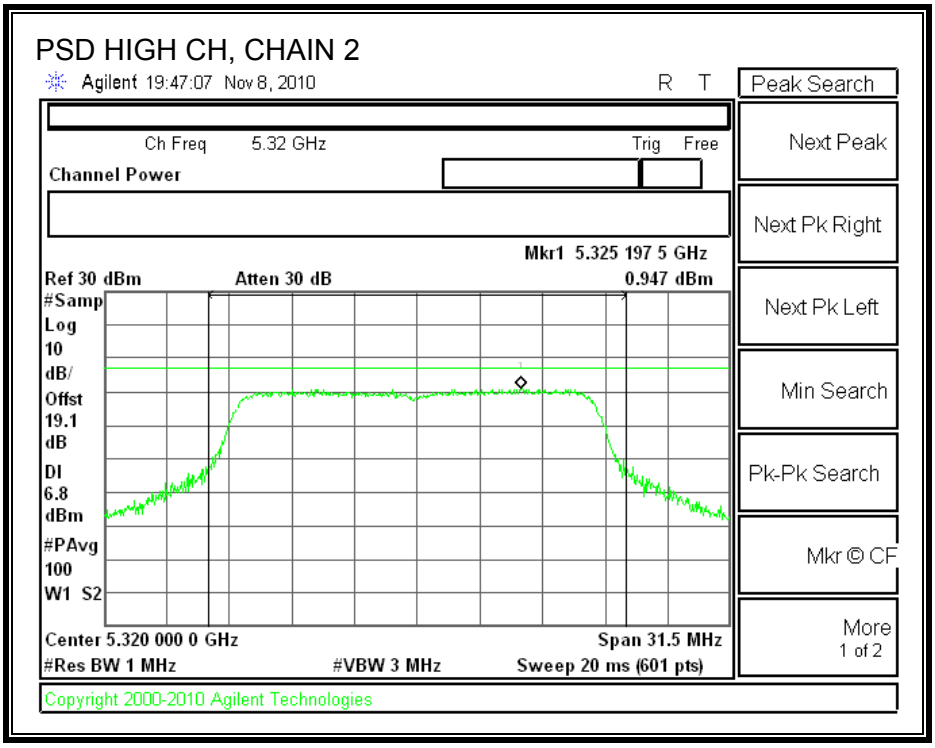




CHAIN 2 POWER SPECTRAL DENSITY







7.5.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	8.67	13	-4.33
Middle	5300	8.78	13	-4.22
High	5320	8.71	13	-4.29

CHAIN 1

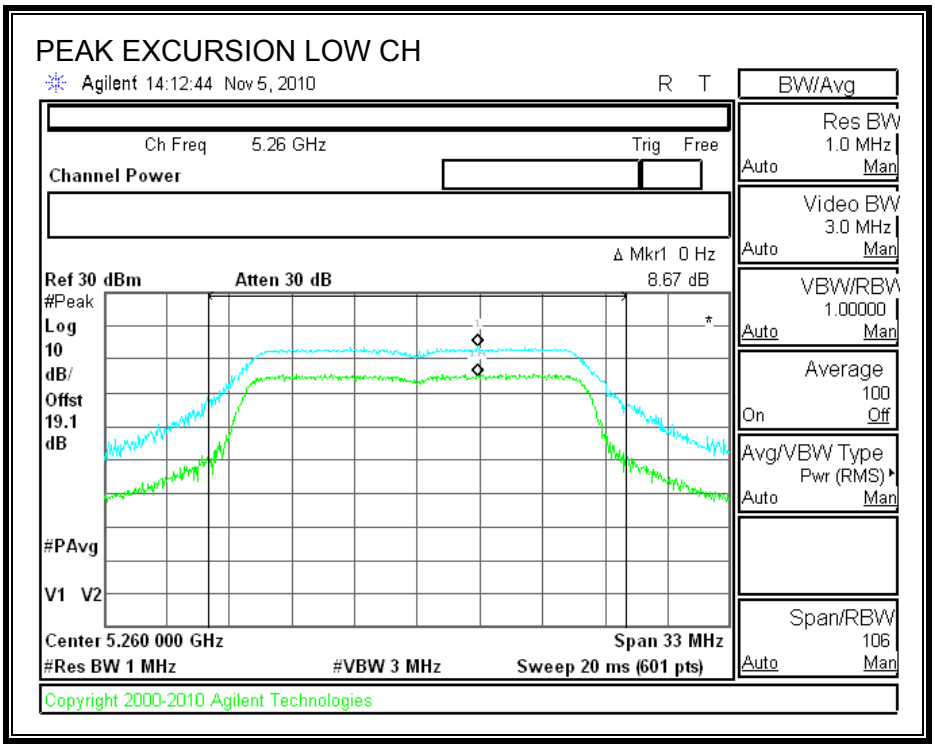
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	9.06	13	-3.94
Middle	5300	8.86	13	-4.14
High	5320	8.71	13	-4.29

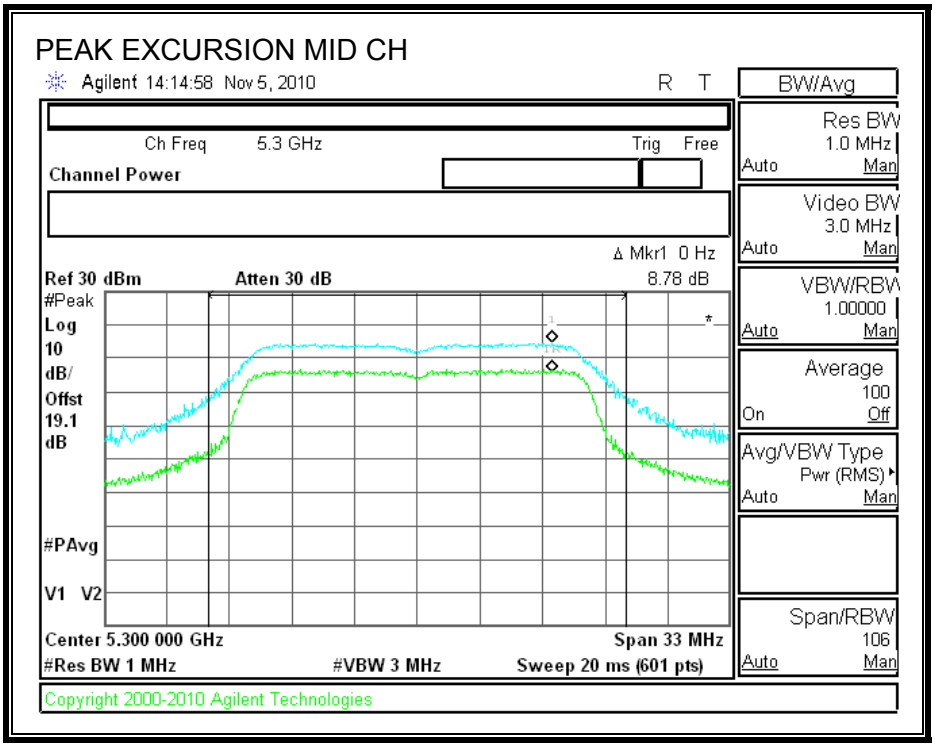
CHAIN 2

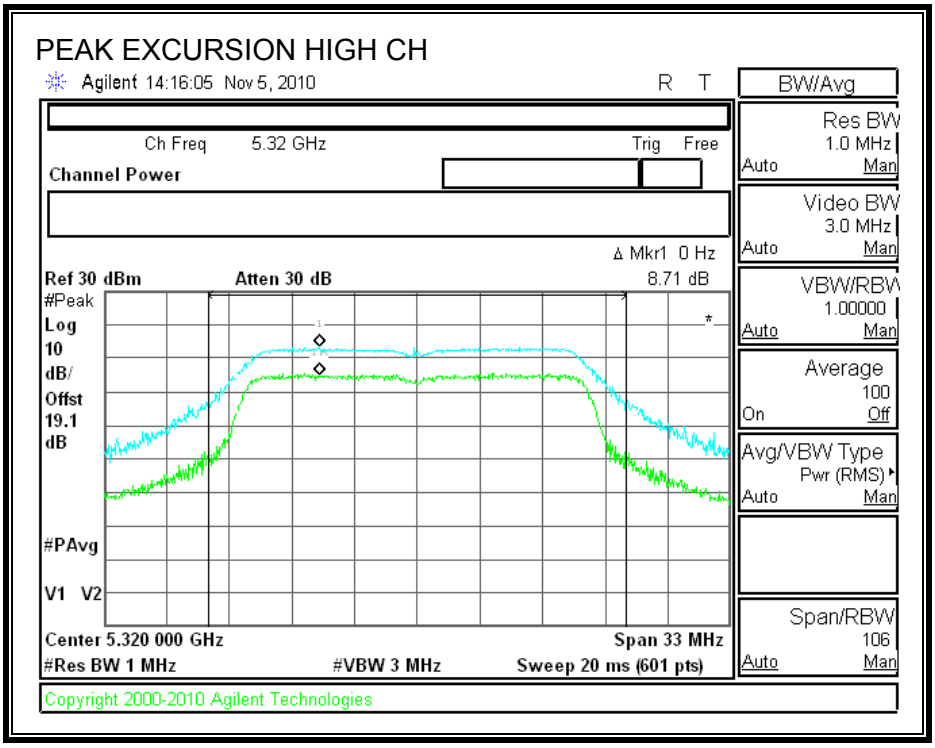
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5260	9.40	13	-3.60
Middle	5300	9.39	13	-3.61
High	5320	9.68	13	-3.32

CHAIN 0

PEAK EXCURSION

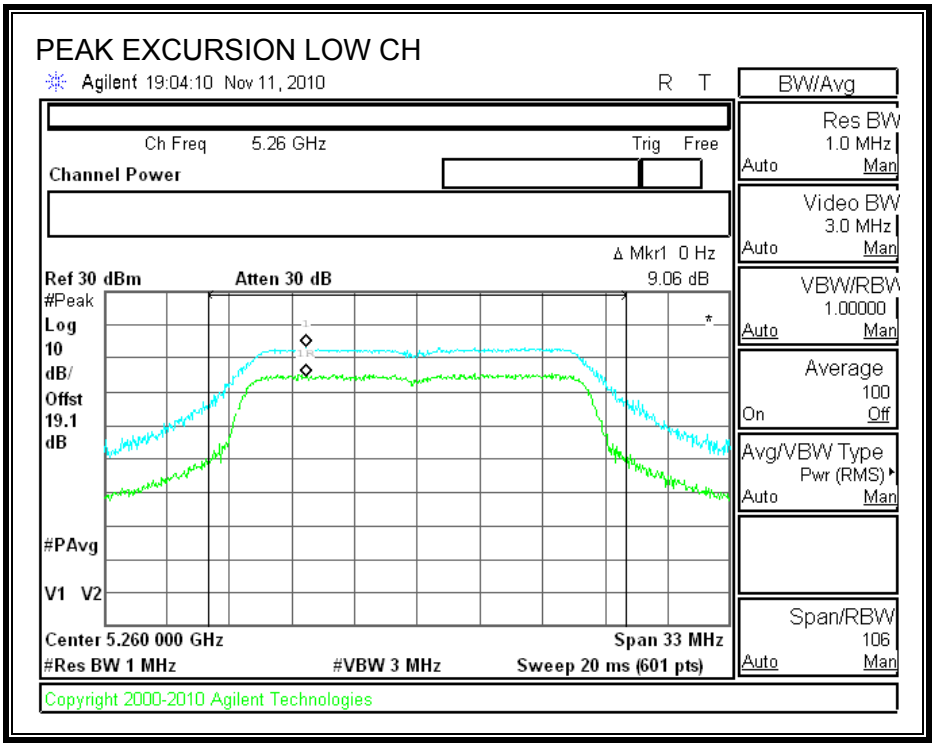




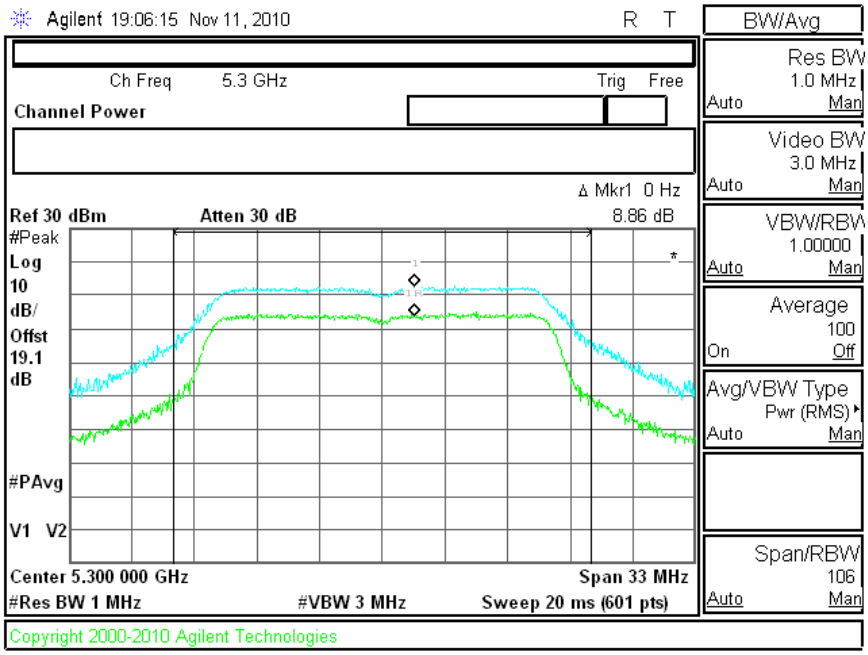


CHAIN 1

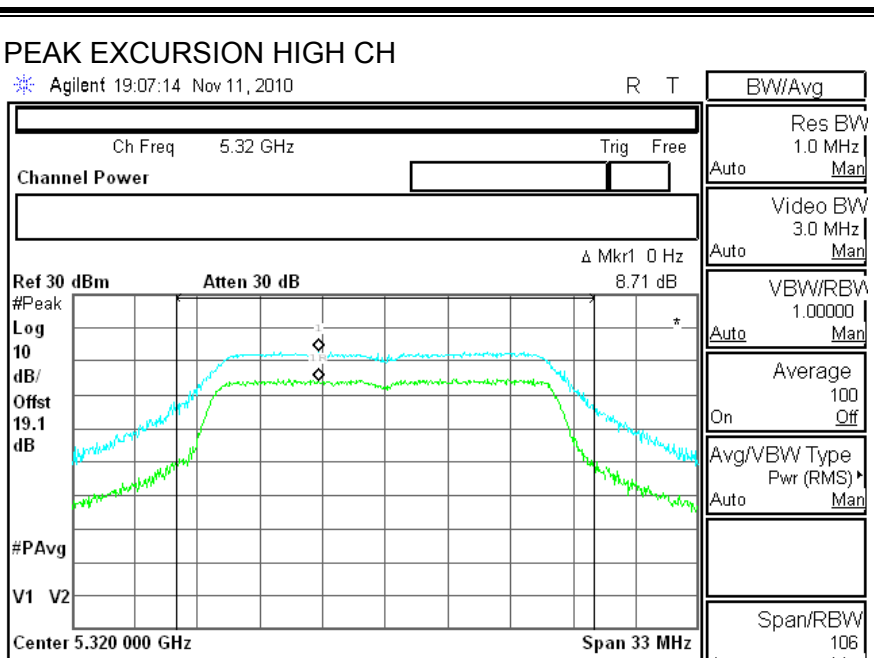
PEAK EXCURSION



PEAK EXCURSION MID CH

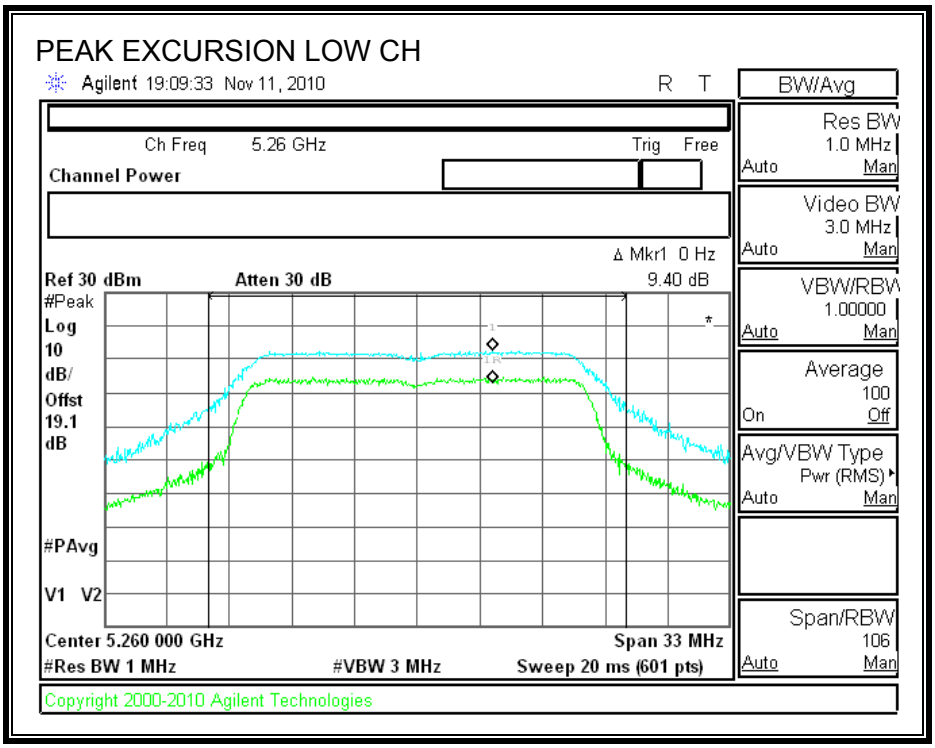


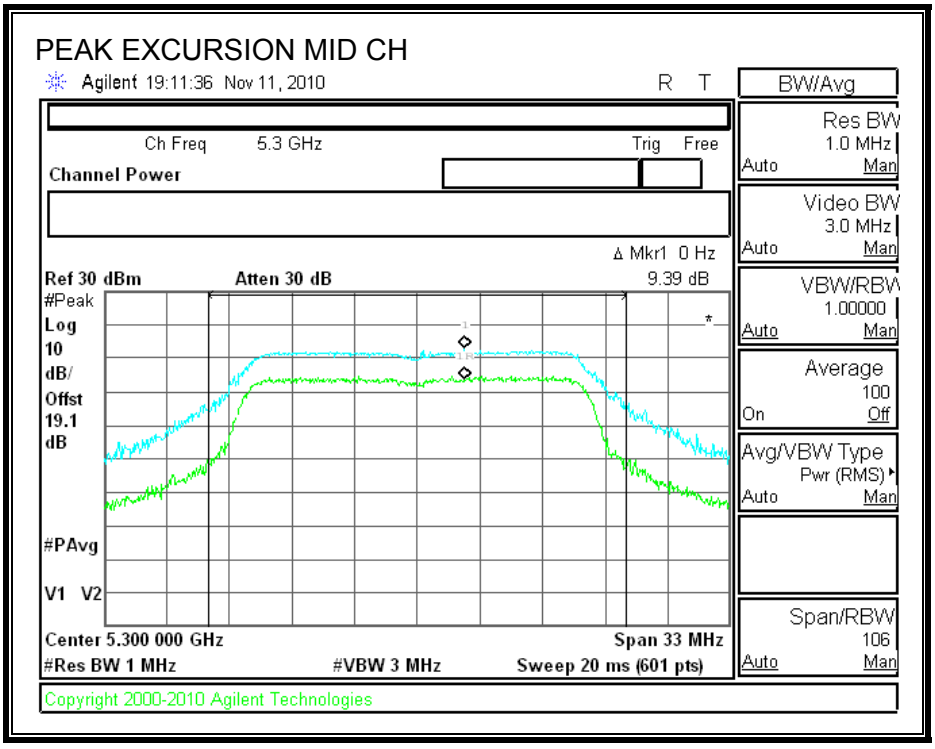
PEAK EXCURSION HIGH CH

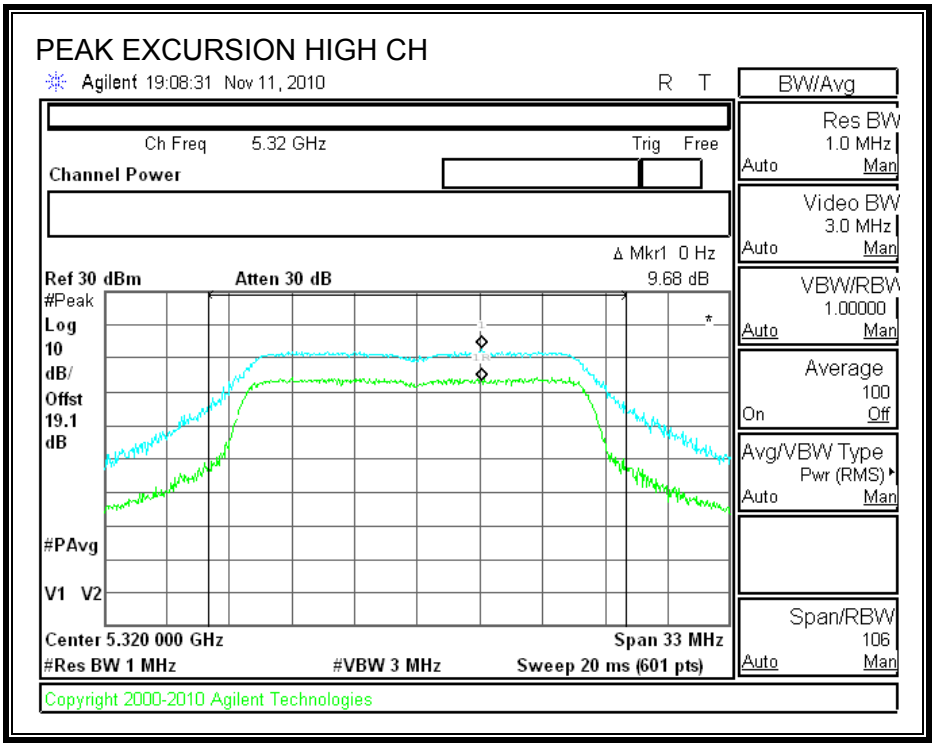


CHAIN 2

PEAK EXCURSION







7.5.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (3)

IC RSS-210 A9.3 (3)

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

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

TEST PROCEDURE

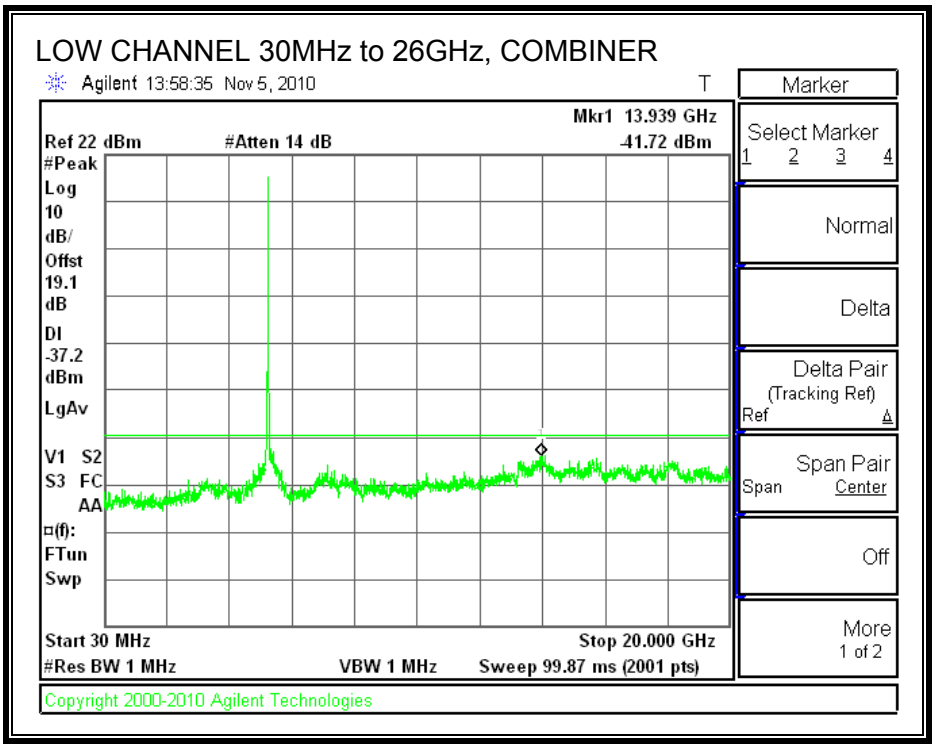
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

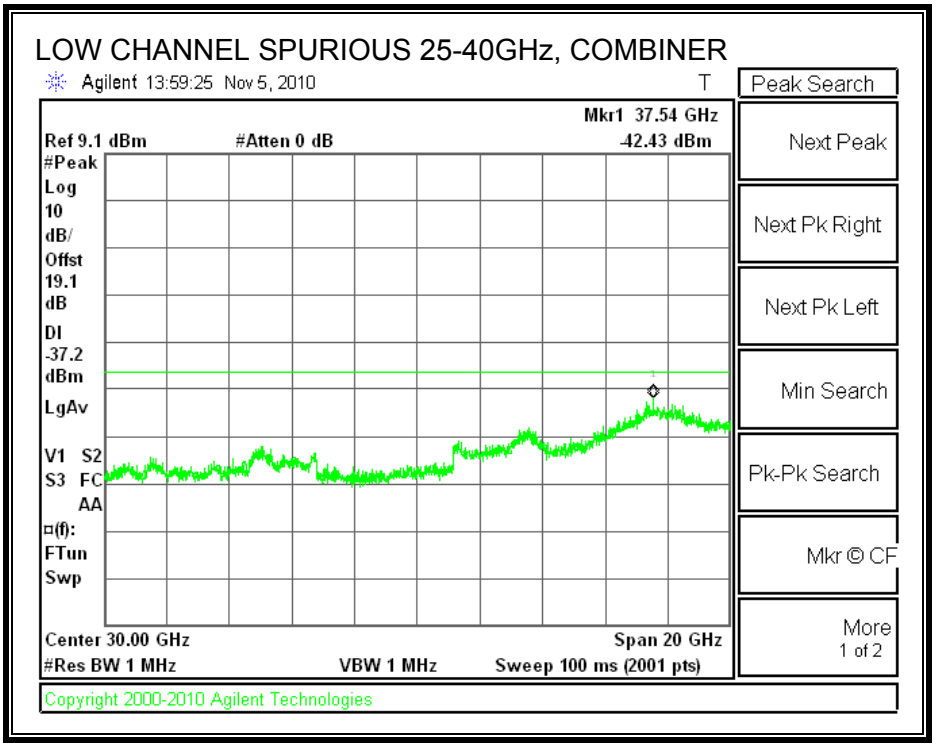
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

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

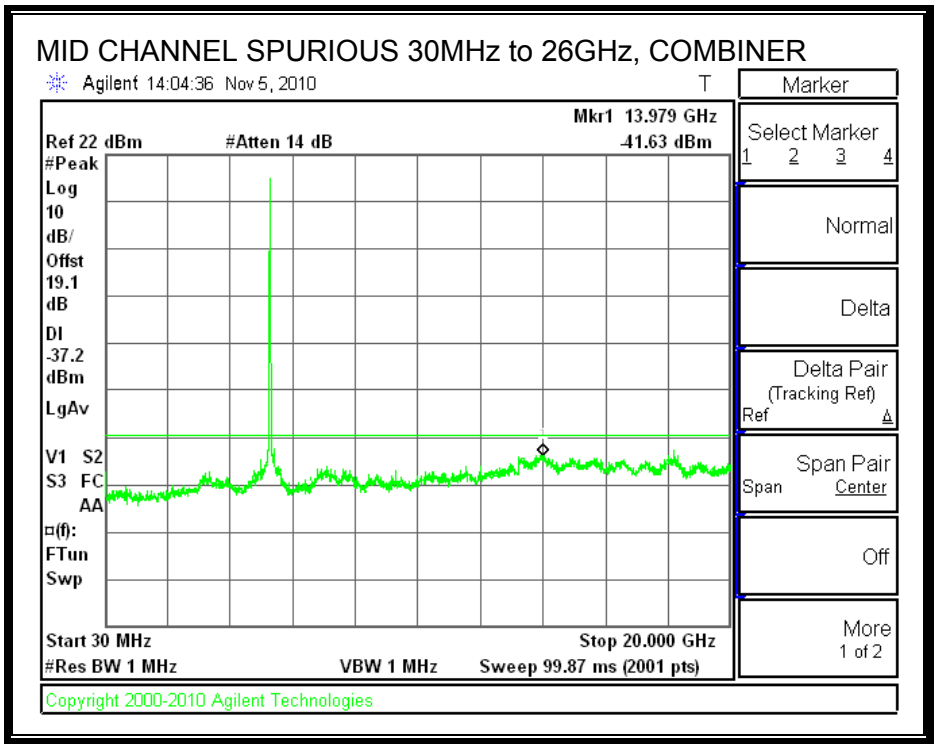
Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

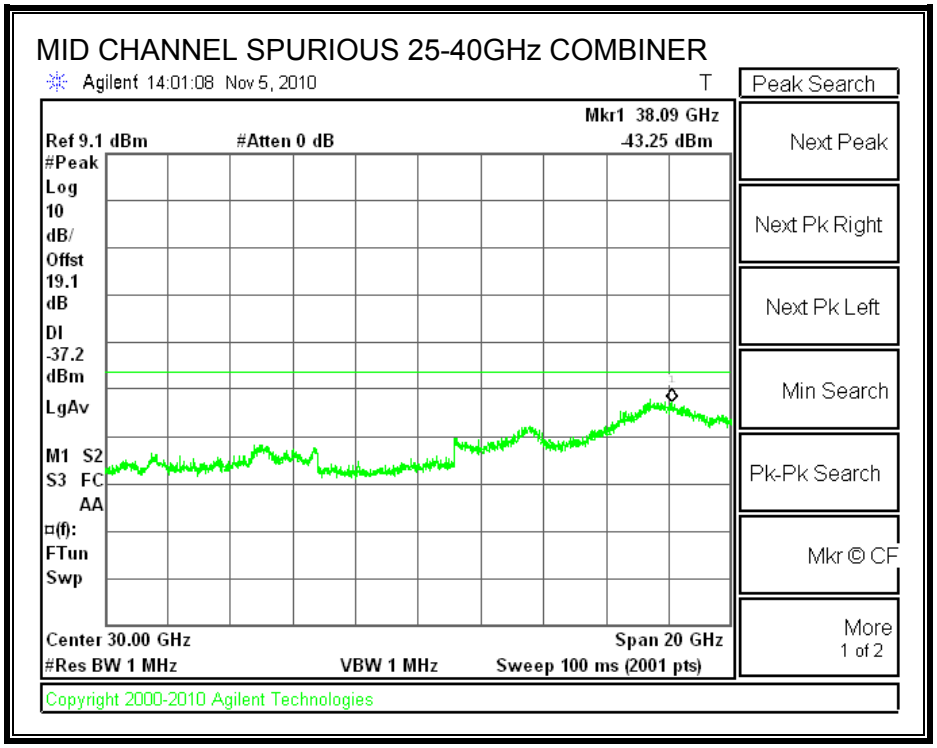
LOW CHANNEL SPURIOUS EMISSIONS



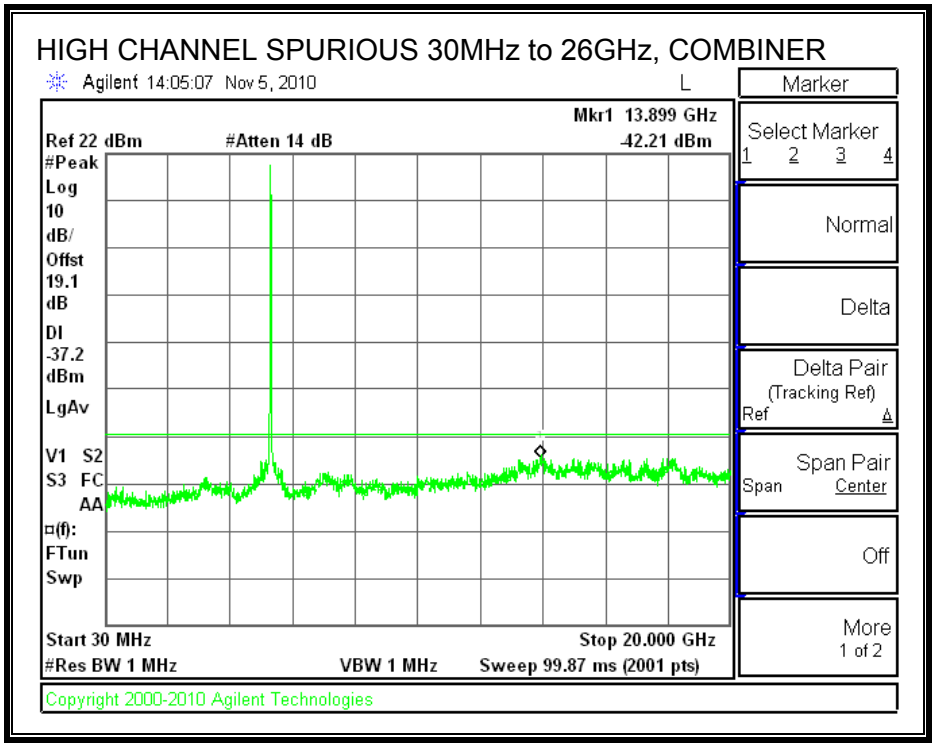


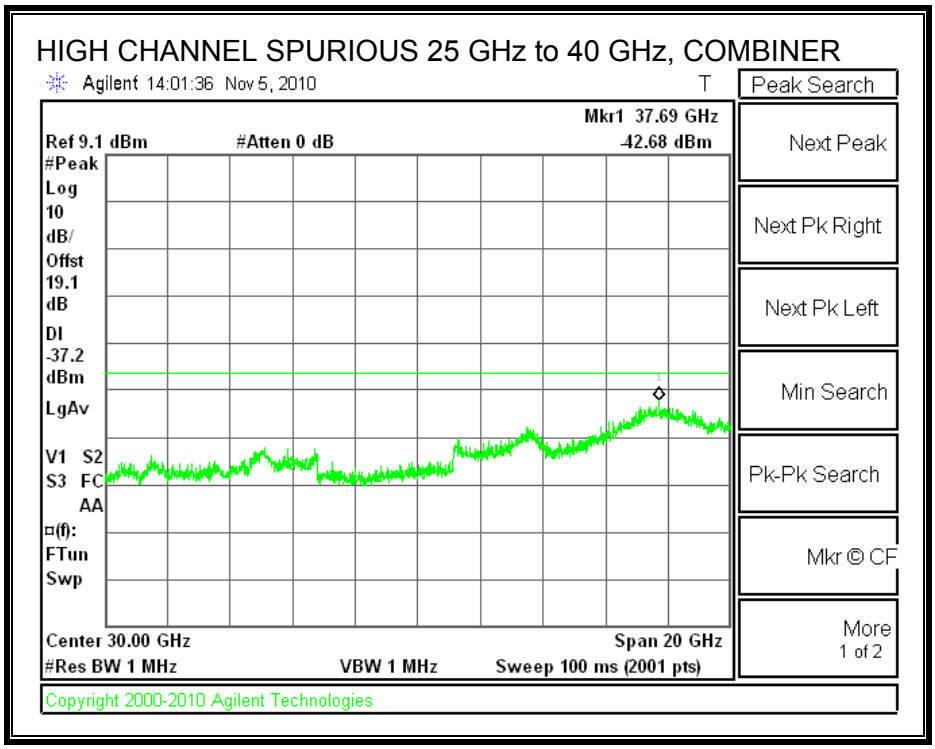
MID CHANNEL SPURIOUS EMISSIONS





HIGH CHANNEL SPURIOUS EMISSIONS





7.6. 5.3 GHz BAND CHANNEL TESTS FOR 802.11n HT40 MODE

7.6.1. 99% & 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

CHAIN 0

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5270	41.499	36.4651
High	5310	40.503	36.4423

CHAIN 1

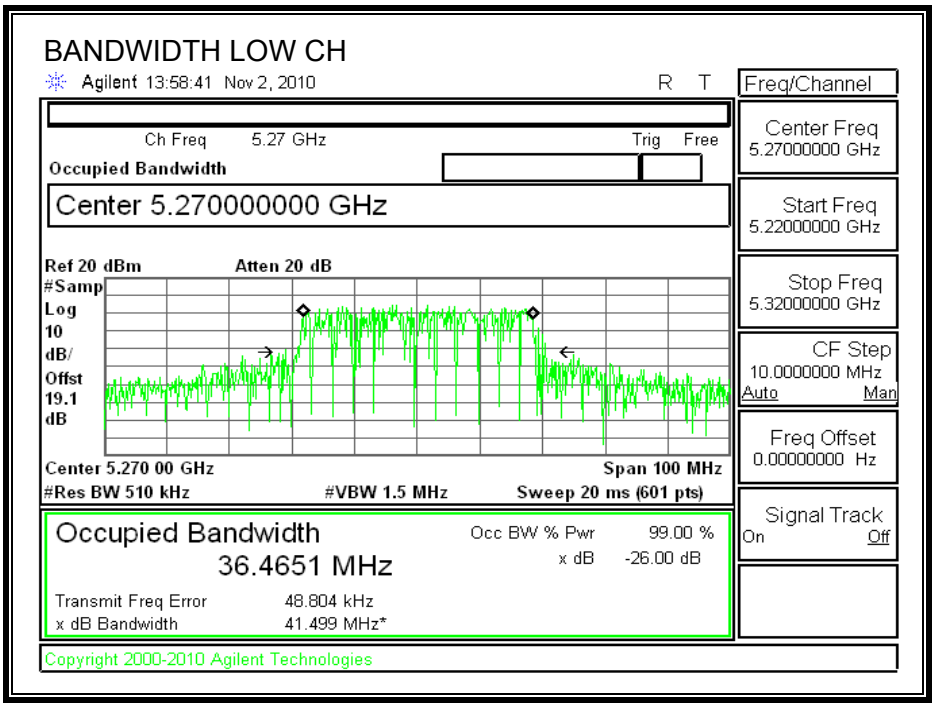
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5270	40.553	36.402
High	5310	41.033	36.4014

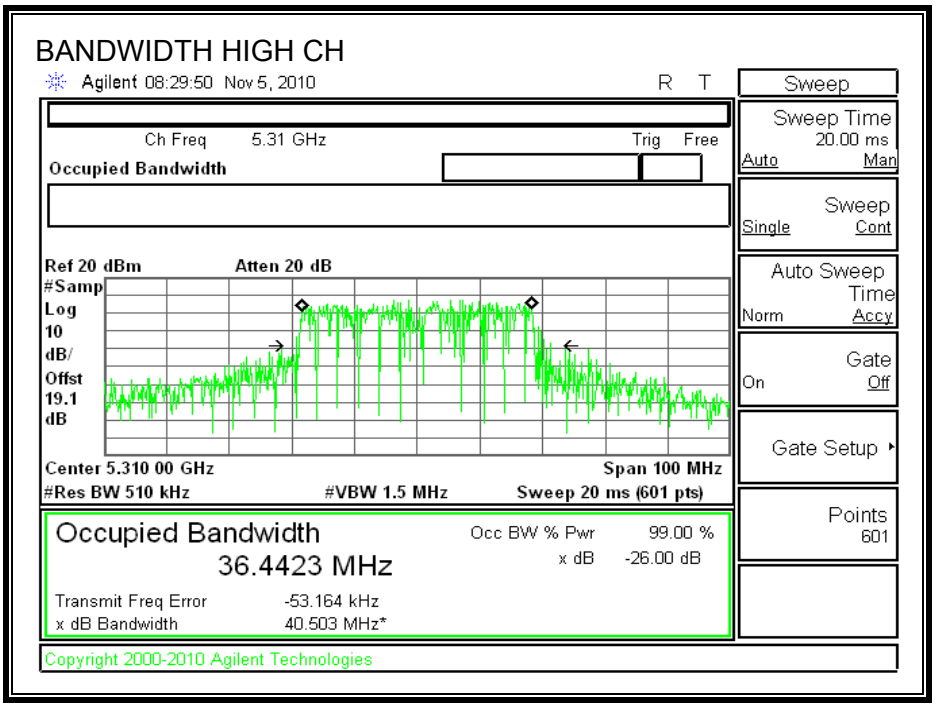
CHAIN 2

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5270	41.175	36.4013
High	5310	40.523	36.2646

CHAIN 0

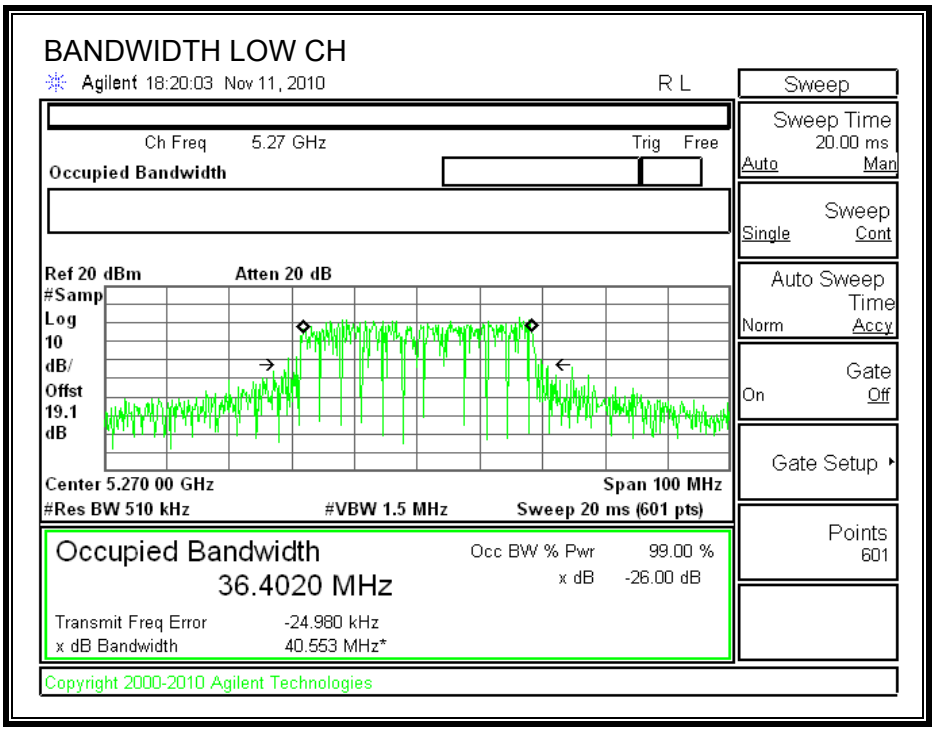
26 dB and 99% BANDWIDTH

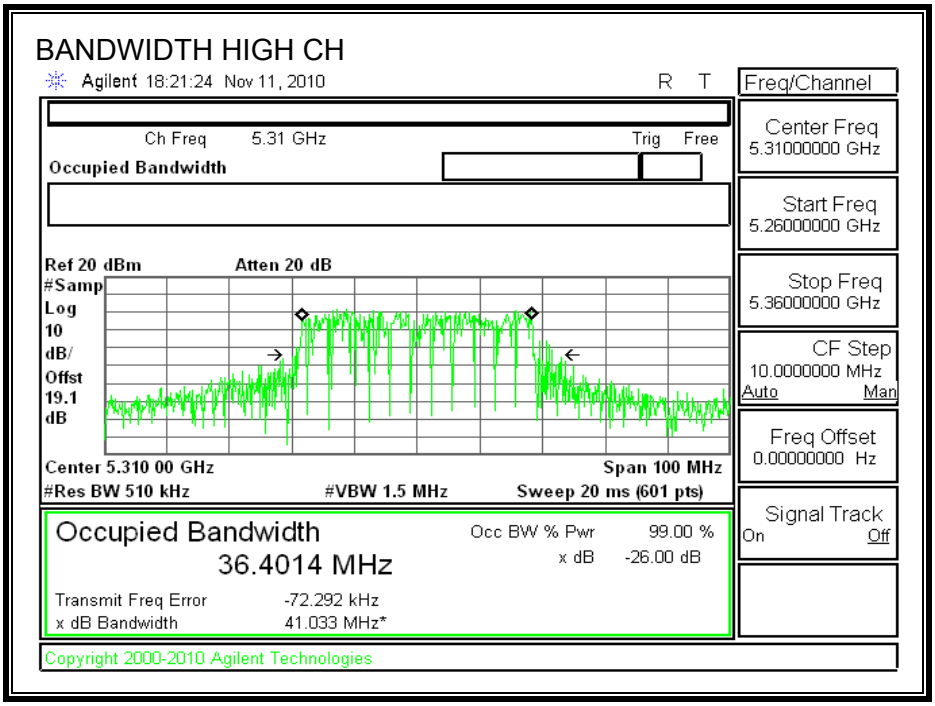




CHAIN 1

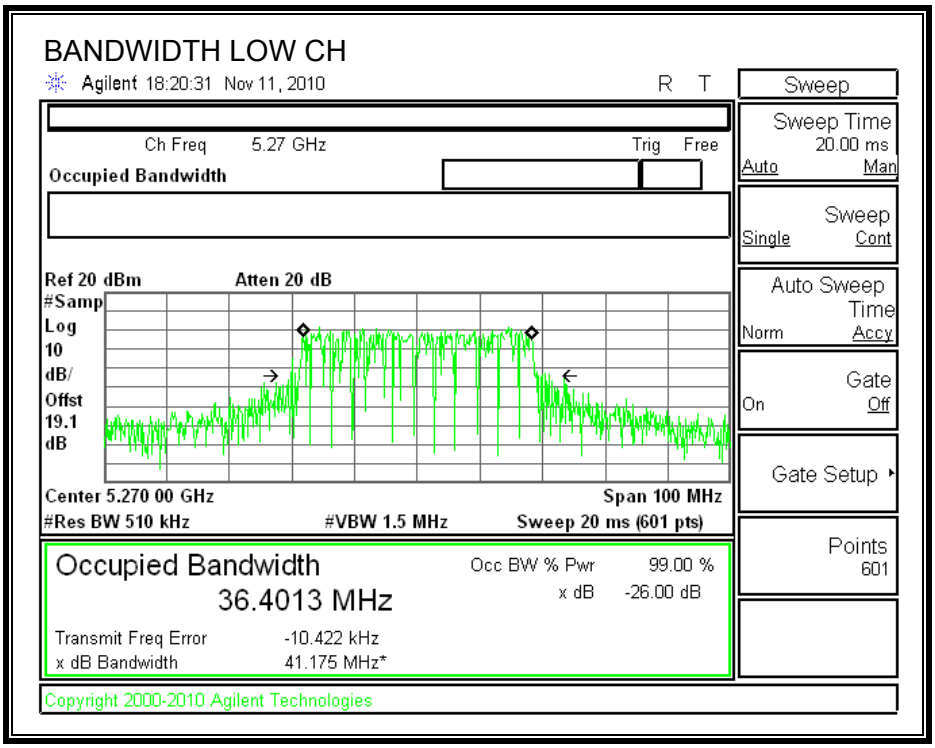
26 dB and 99% BANDWIDTH

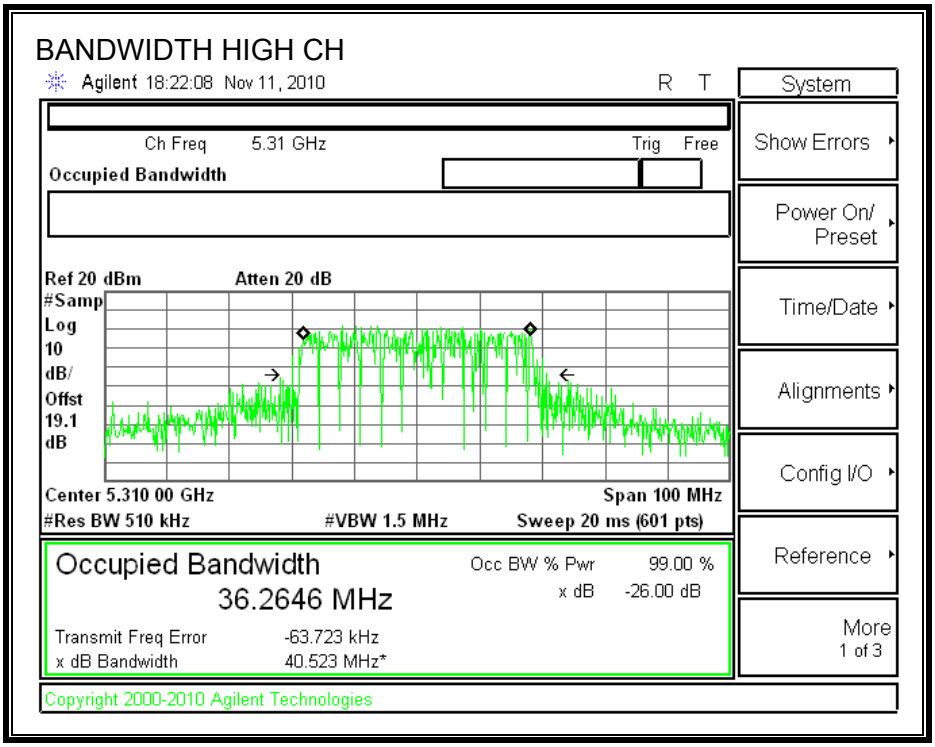




CHAIN 2

26 dB and 99% BANDWIDTH





7.6.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (2)

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

The maximum antenna gain is 6.07 dBi, and the combination antenna gain is 10.24 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

Non Beam-Forming

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5270	23.98	41.499	27.18	6.07	23.91
High	5310	23.98	40.503	27.07	6.07	23.91

Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5270	16.73	15.96	15.86	20.97	23.91	-2.94
High	5310	14.61	13.38	13.09	18.52	23.91	-5.39

Beam-Forming

Limit

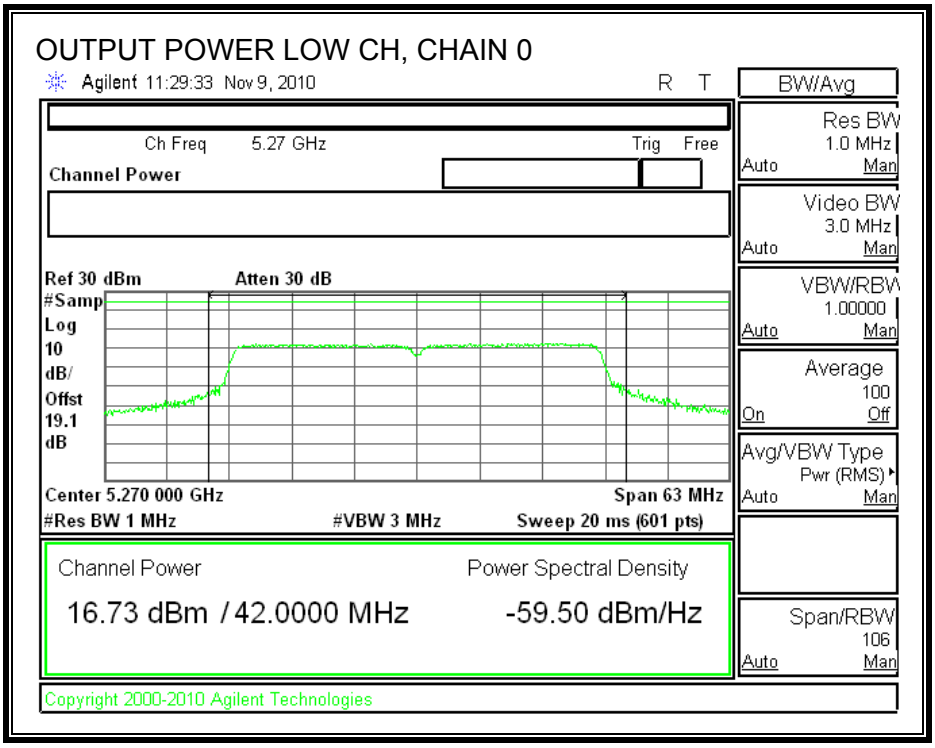
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5270	23.98	41.499	27.18	10.24	19.74
High	5310	23.98	40.503	27.07	10.24	19.74

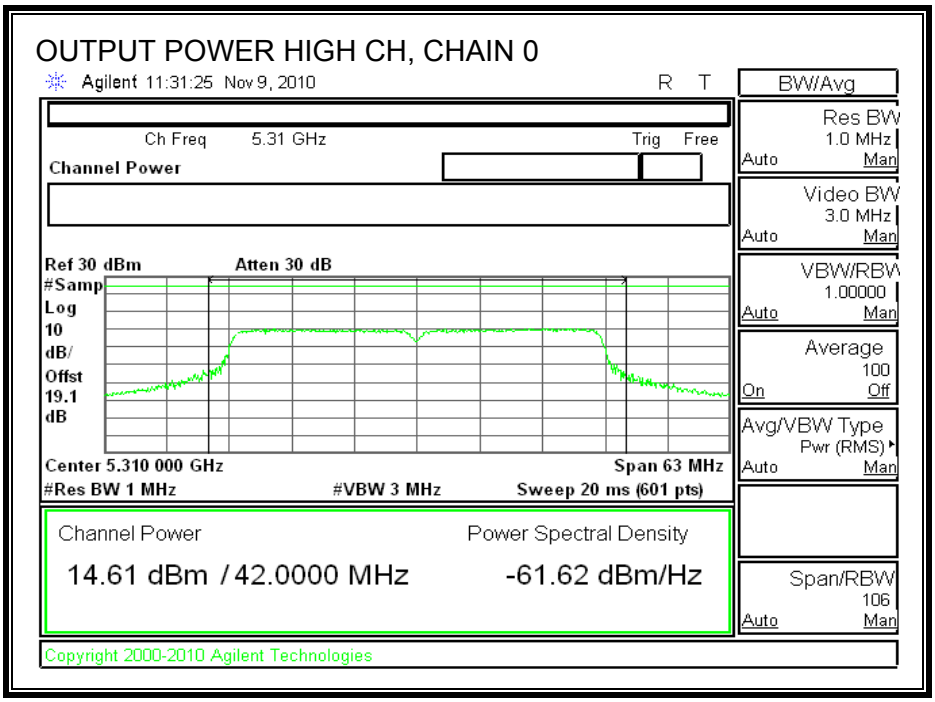
Individual Chain Results

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5270	14.25	13.57	12.51	18.27	19.74	-1.47
High	5310	14.61	13.38	13.09	18.52	19.74	-1.22

NBF

CHAIN 0 OUTPUT POWER





CHAIN 1 OUTPUT POWER