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

FOR

2X2 ACCESS POINT

MODEL NUMBER: A1264

FCC ID: BCGA1264

IC: 579C-A1264

REPORT NUMBER: 07U11408-2, REVISION A

ISSUE DATE: FEBRUARY 14, 2008

Prepared for

APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, USA

Prepared by

COMPLIANCE CERTIFICATION SERVICES
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	01/18/08	Initial Issue	F. Ibrahim
A	02/14/08	Revised the MPE section.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, USA

EUT DESCRIPTION: 2X2 Access Point

MODEL: A1264

SERIAL NUMBER: 02077

DATE TESTED: DECEMBER 21, 2007 – JANUARY 8, 2008

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

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

TOM CHEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC MO&O 06-96, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11 a/b/g/n Access Point.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Total Output Power (dBm)	Total Output Power (mW)
5180 - 5240	802.11a	12.83	19.19
5180 - 5240	802.11n HT20	13.57	22.75
5190 - 5230	802.11n HT40	16.16	41.30

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antennas:

1) PIFA, model: 056-2545 A, with the following gain:

Frequency	Max Gain
2440	-0.73
5150	-0.08
5350	1.53
5700	2.45
5800	3.42

2) PIFA, model: 056-2545 B, with the following gain:

Frequency	Max Gain
2440	-1.9
5150	-1.18
5350	1.44
5700	-0.08
5800	3.33

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 7.3d1 Auto20070907T0400.

The EUT driver software installed during testing was DutApiClient_UDP.exe, ver.031607.

The test utility software used during testing was m4tool.exe, rev 083107

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio.

All final tests in the 802.11a mode 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.

For radiated emissions below 1 GHz the worst-case configuration is determined to be the mode and channel with the highest output power.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Apple	MacBook Pro	AOU257941	DOC
AC Adapter	Apple	A52	NA	DOC
Mouse	Apple	A1152	KY5350QDTU3MA	DOC

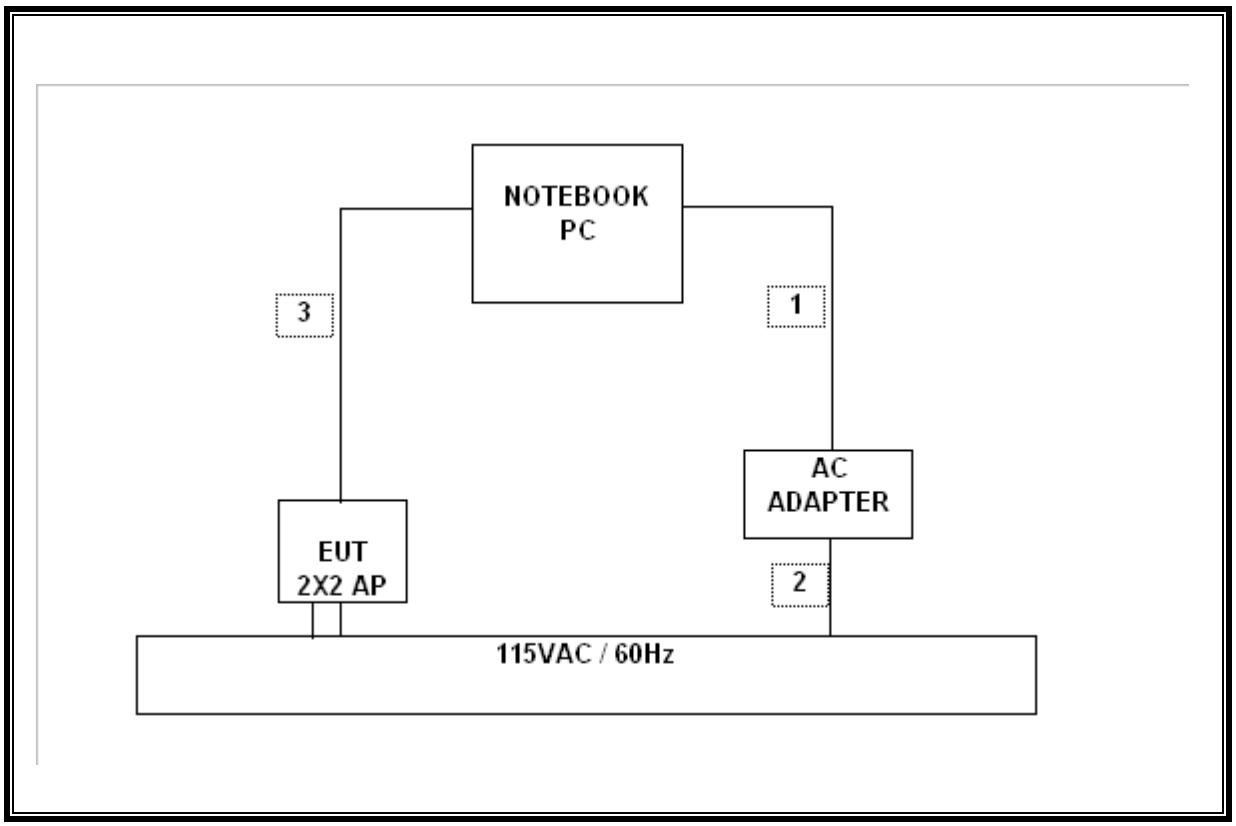
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	DC	1	DC	Unshielded	1.5 m	N/A
2	AC	1	AC	Unshielded	2.0 m	N/A
3	Ethernet	1	RJ45	Unshielded	1.5m	Connected to EUT

TEST SETUP

The EUT is connected to a host laptop computer during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Power Combiner	HP	11667B	N/A	05/24/07	05/24/08
Attenuators	Weinschel	56-10	N/A	N/A	N/A
Power Meter	Agilent / HP	438A	C01068	11/29/06	09/12/08
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/15/07	04/15/08
Preamp, 1000MHz	Sonoma	310N	N/A	01/20/07	01/20/08
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	08/03/07	08/03/08
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	09/28/07	09/28/08
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	02/06/07	06/12/08
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	02/06/07	06/12/08
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	05/02/06	08/07/08
Power Sensor, 18 GHz	Agilent / HP	8481A	N02784	01/12/07	04/22/08
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	09/15/06	09/15/07
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	10/16/06	01/27/08
Pre-amplifier	Miteq	NSP4000-SP2	C00990	10/11/07	10/11/08
Horn Antenna	ARA	MWH-1826/B	C00980	09/29/07	09/29/08
Horn Antenna	ARA	MWH-2640/B	C00981	04/11/07	04/11/08

7. ANTENNA PORT TEST RESULTS

7.1. 802.11a DUAL CHAIN LEGACY 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

26 dB Bandwidth

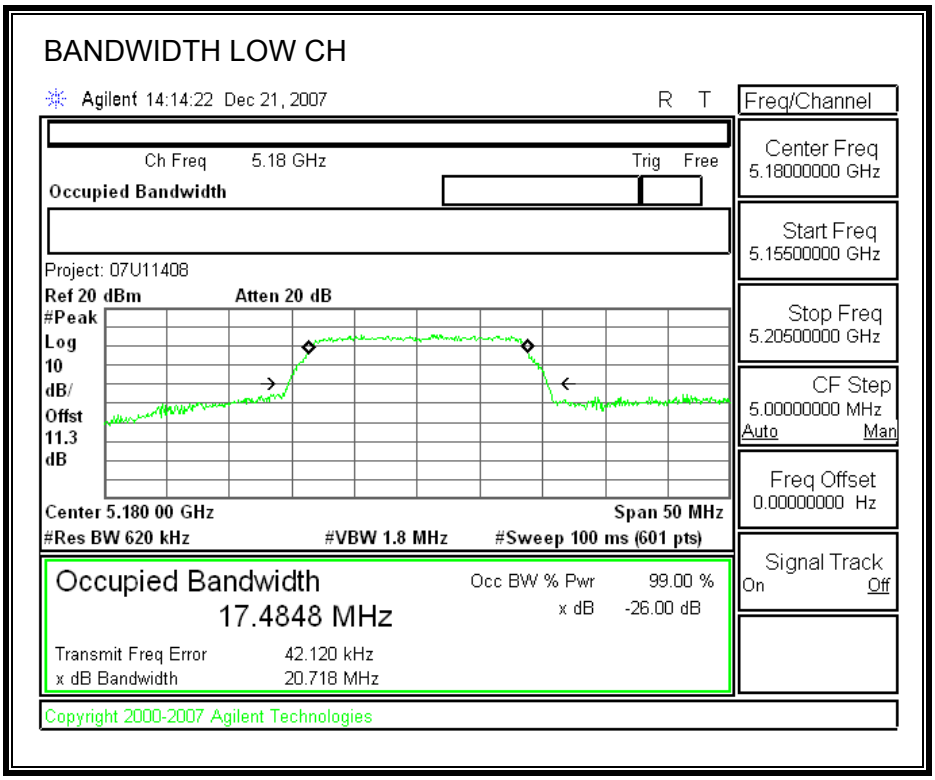
Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5180	20.718	20.707
Middle	5200	20.771	20.685
High	5240	20.809	20.633

99% Bandwidth

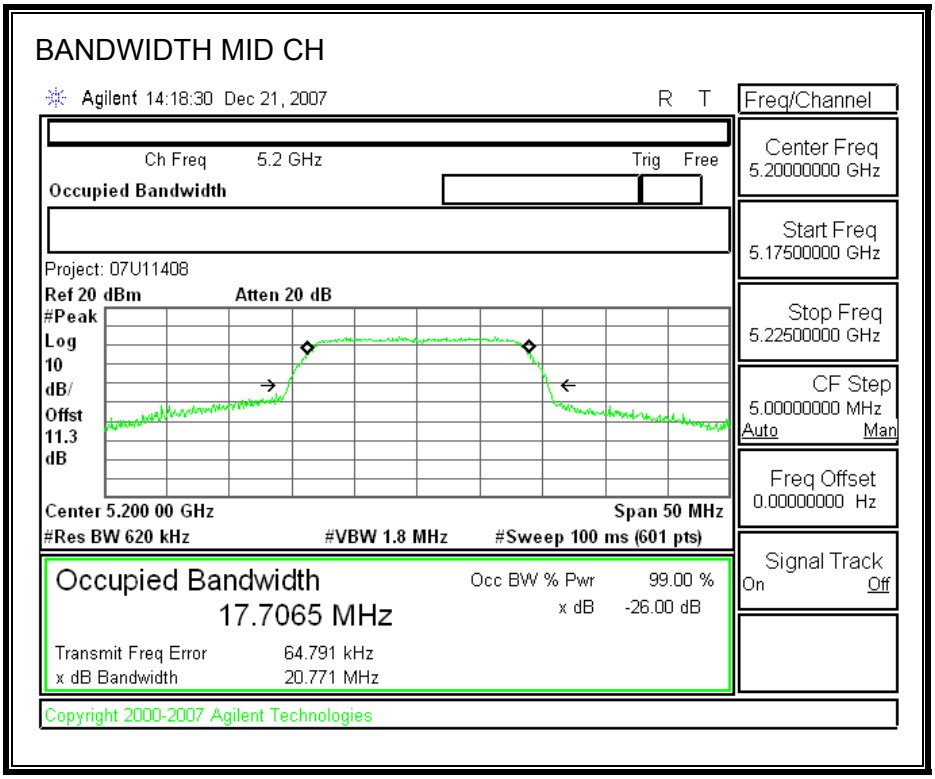
Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5180	16.5483	16.4132
Middle	5200	16.4419	16.5006
High	5240	16.5397	16.4418

26 dB BANDWIDTH

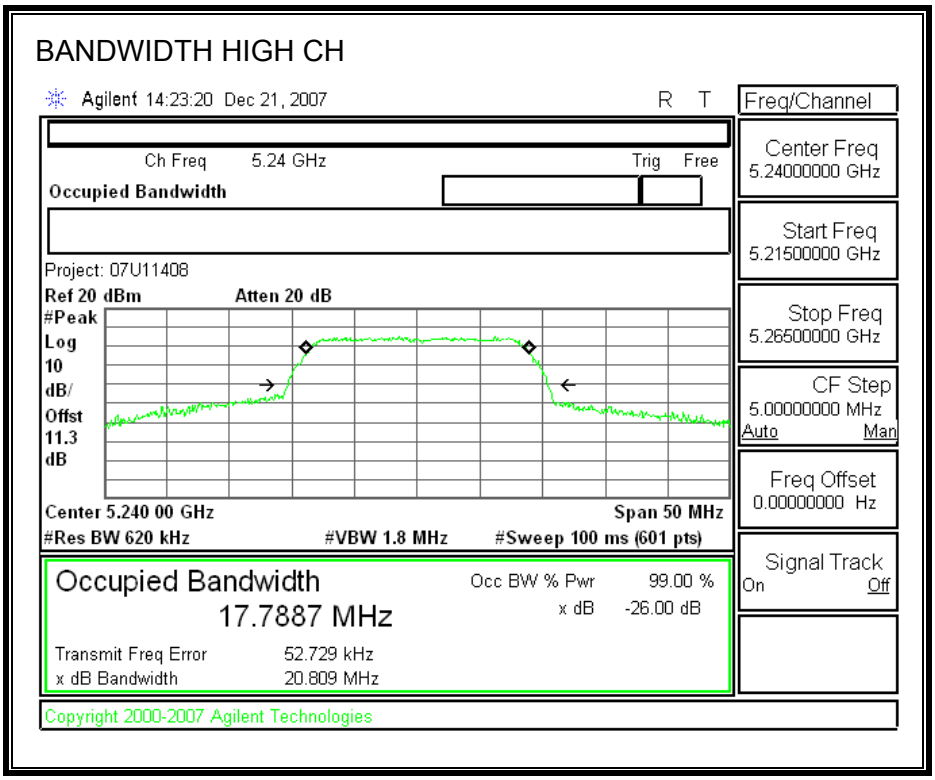
CHAIN A



BANDWIDTH MID CH

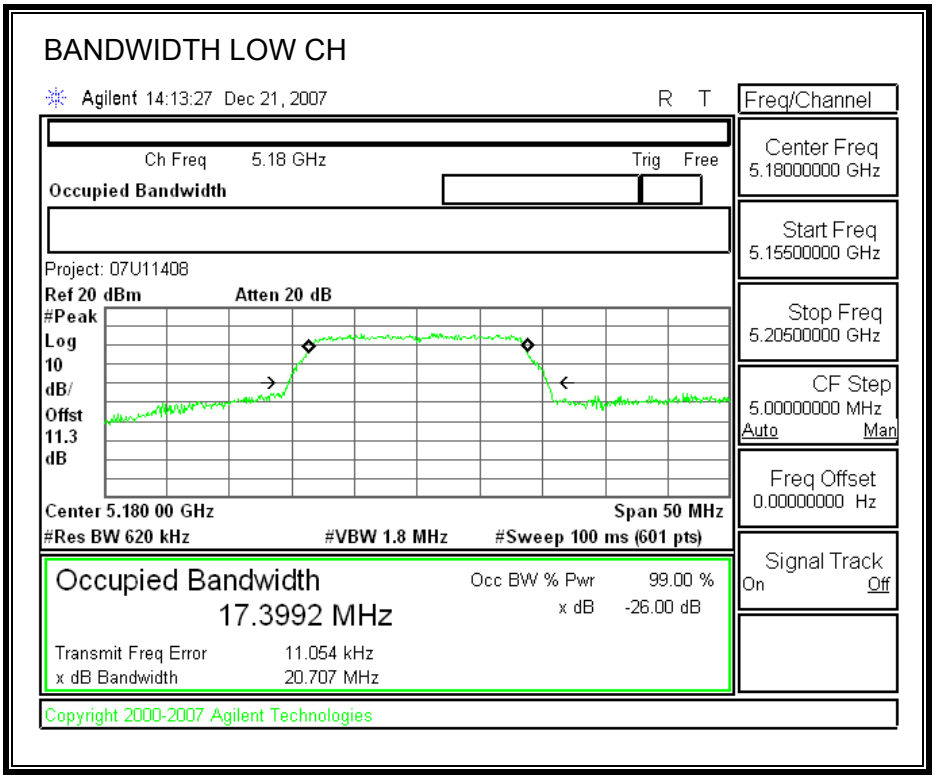


BANDWIDTH HIGH CH

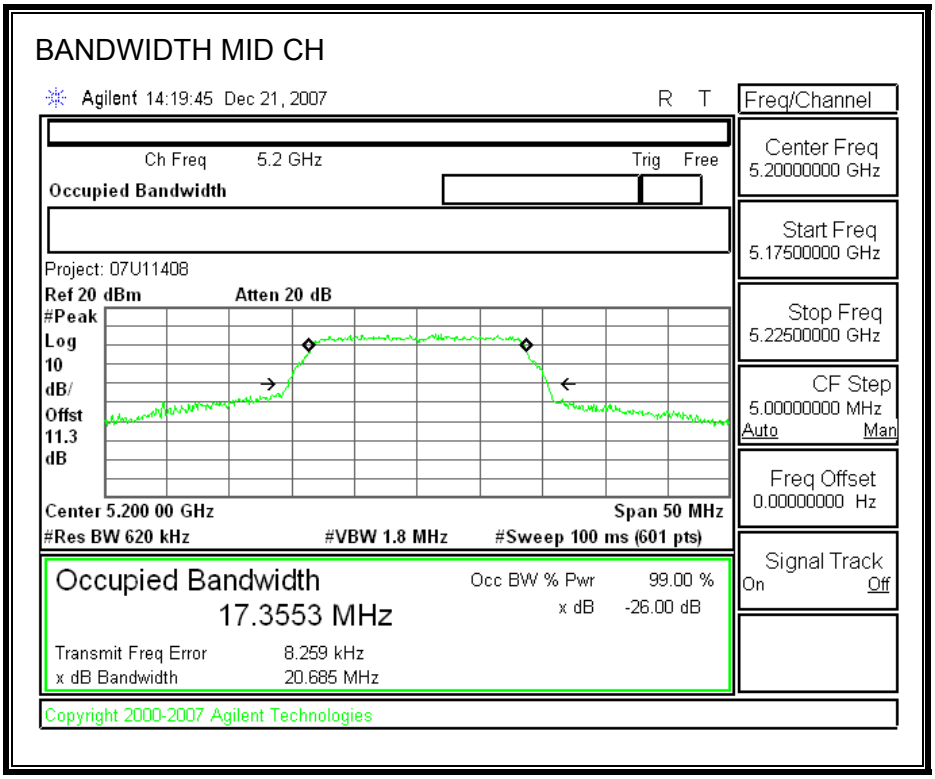


26 dB BANDWIDTH

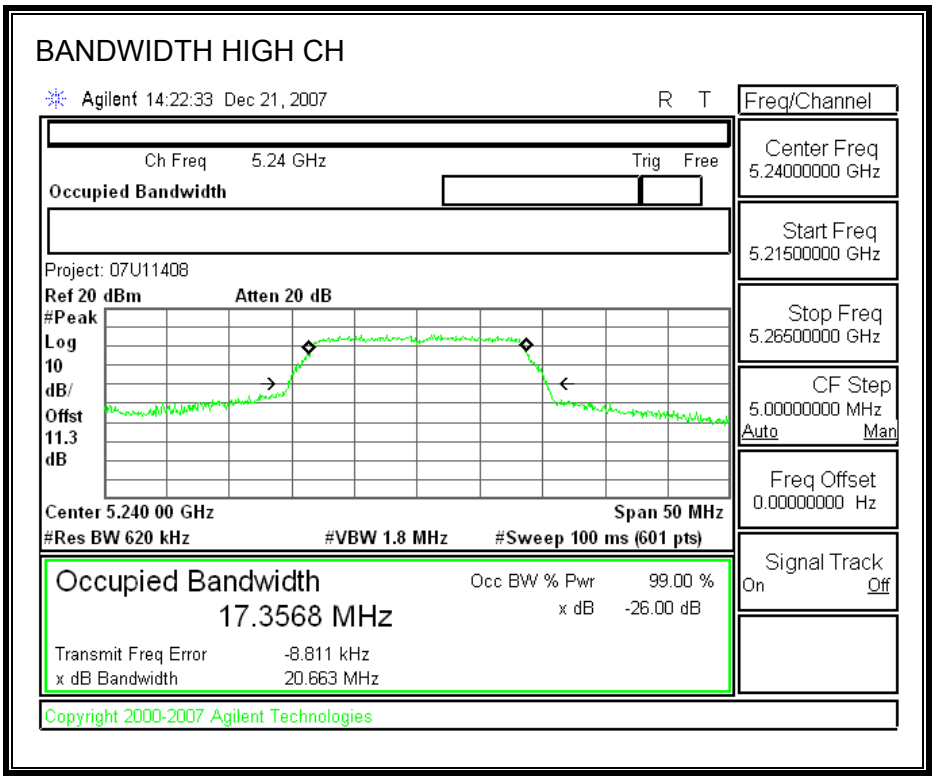
CHAIN B



BANDWIDTH MID CH

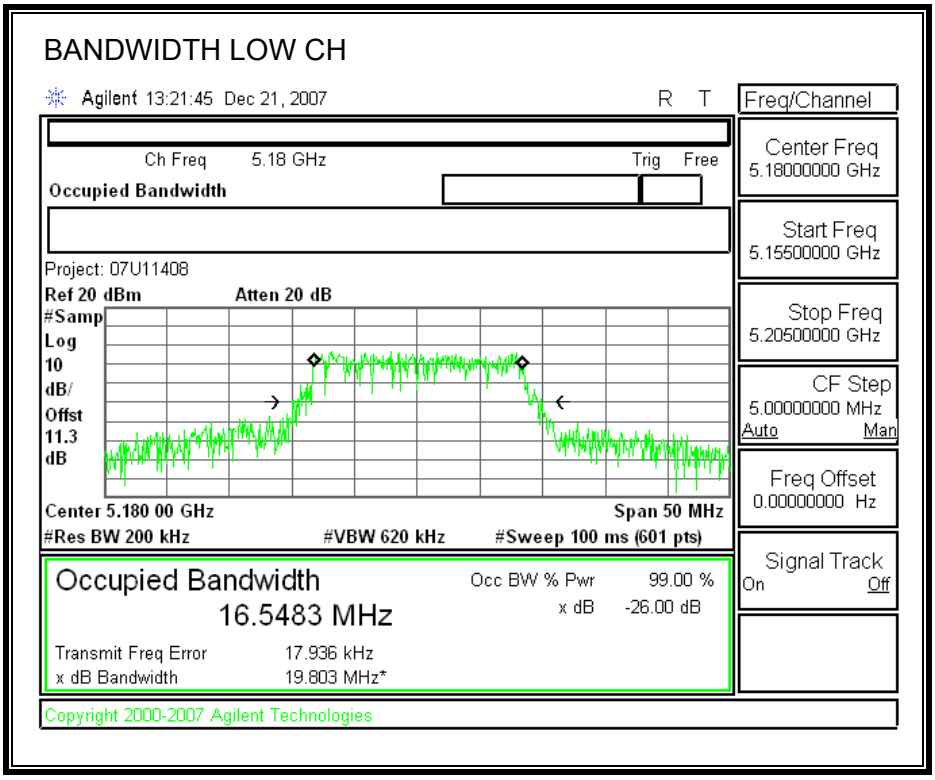


BANDWIDTH HIGH CH

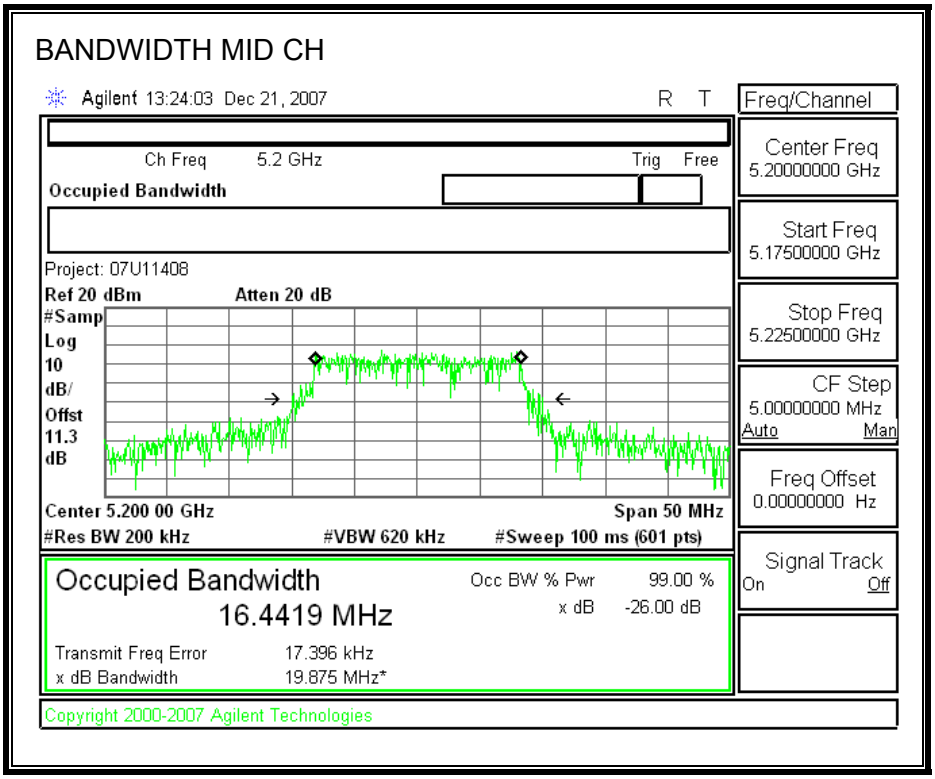


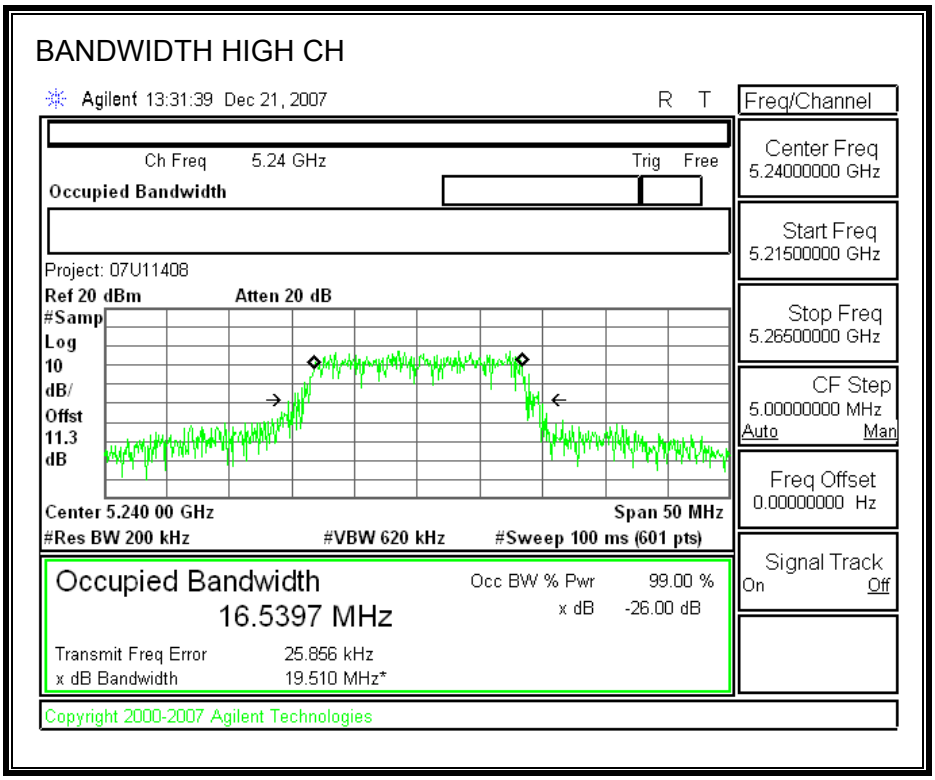
99% BANDWIDTH

CHAIN A



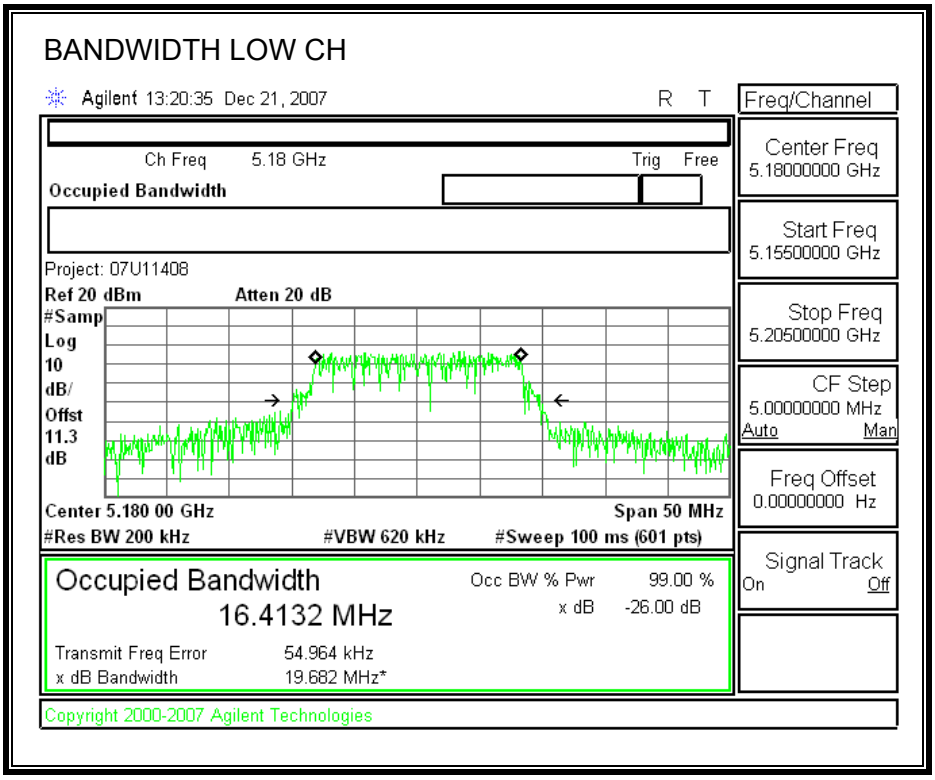
BANDWIDTH MID CH



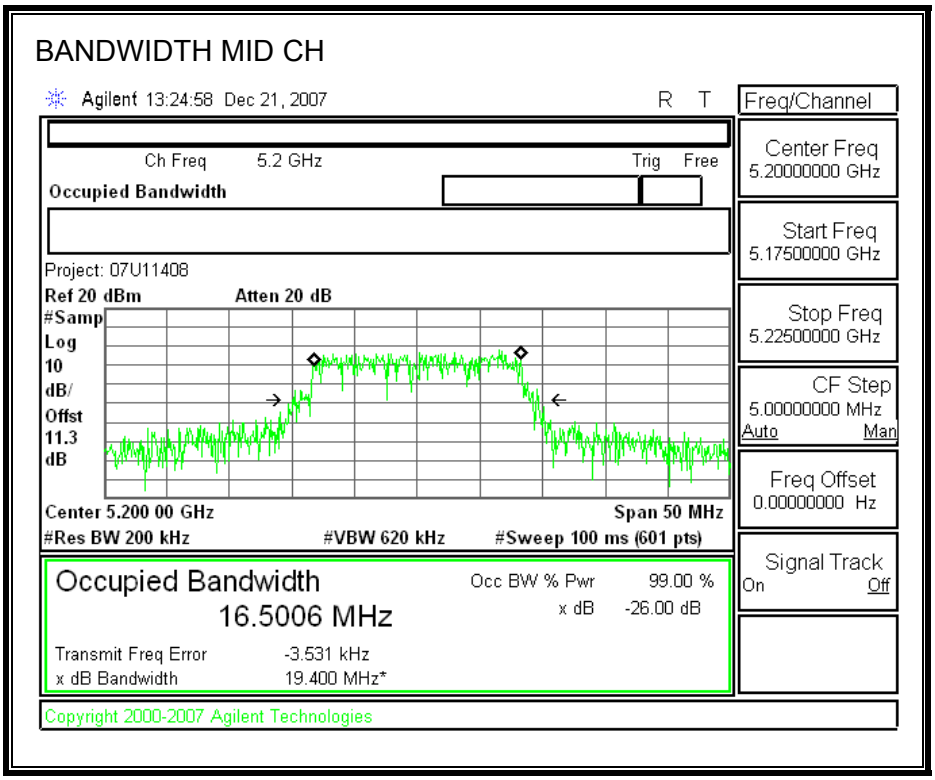


99% BANDWIDTH

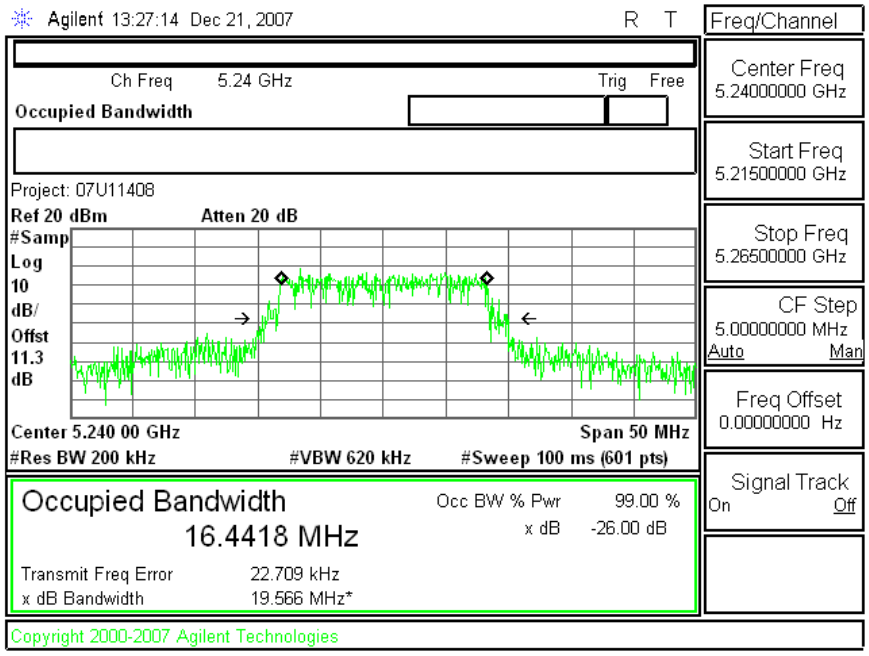
CHAIN B



BANDWIDTH MID CH



BANDWIDTH HIGH CH



7.1.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
-0.08	3.01	2.93

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

TEST PROCEDURE

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

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

RESULTS

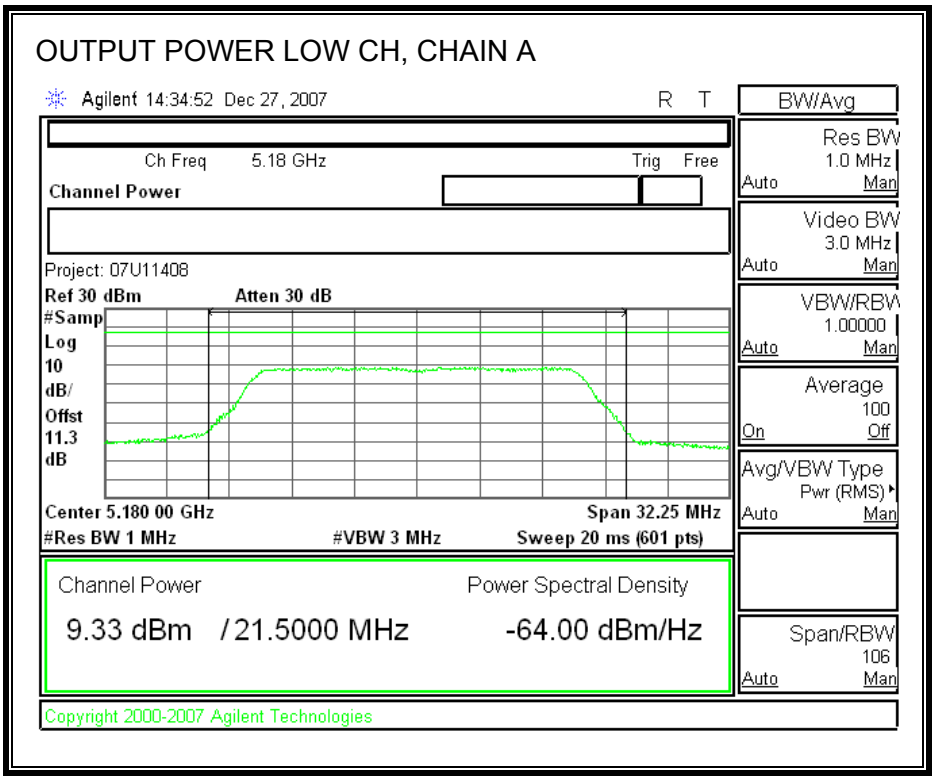
Limit

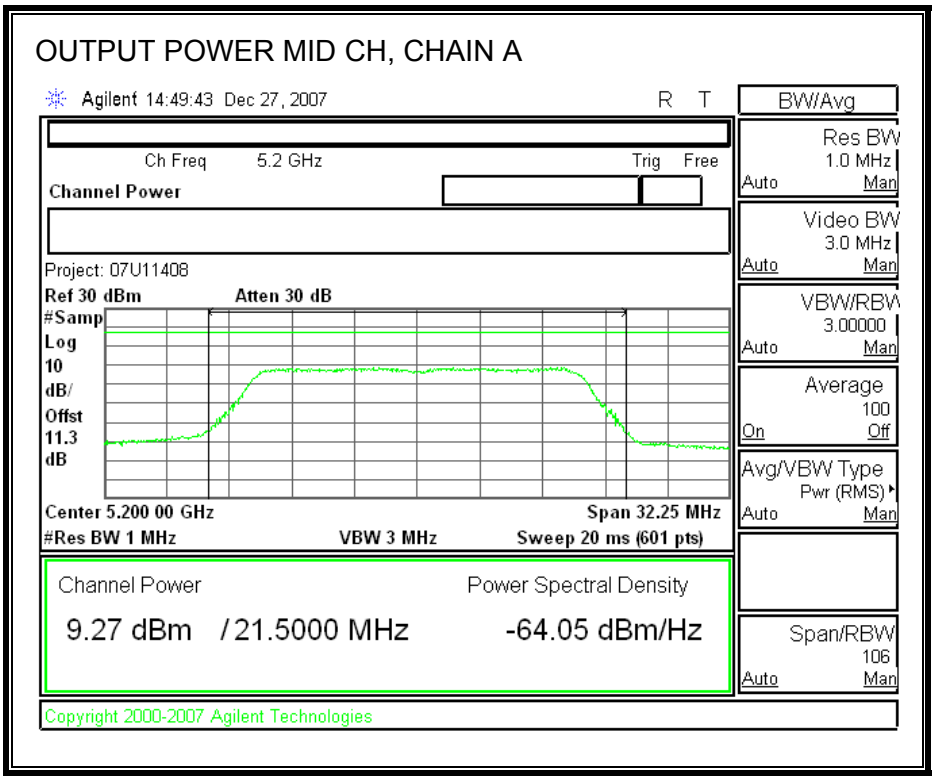
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	20.707	17.16	-0.08	17.00
Mid	5200	17	20.685	17.16	-0.08	17.00
High	5240	17	20.633	17.15	-0.08	17.00

Individual Chain Results

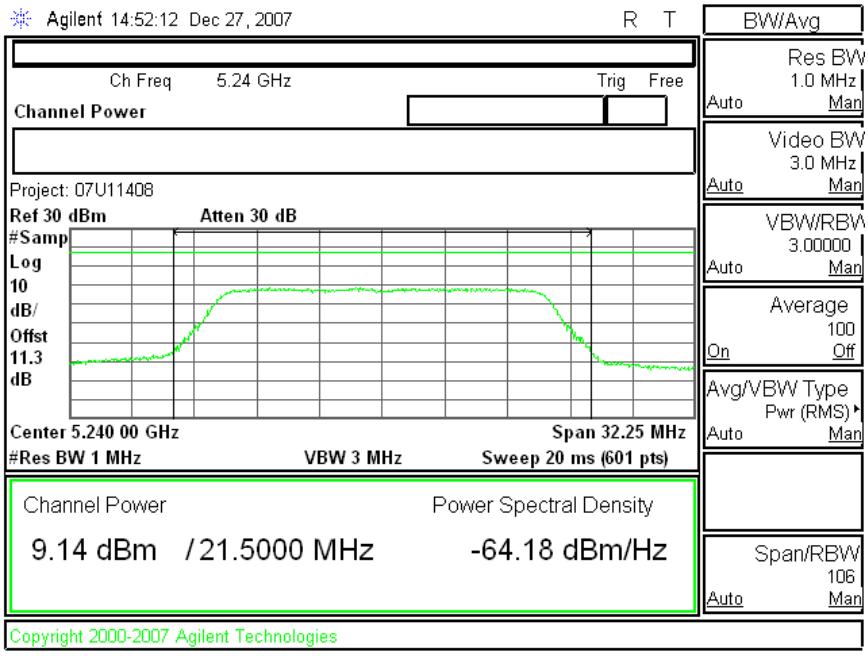
Channel	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.33	10.26	12.83	17.00	-4.17
Mid	5200	9.27	9.45	12.37	17.00	-4.63
High	5240	9.14	9.15	12.16	17.00	-4.84

CHAIN A OUTPUT POWER

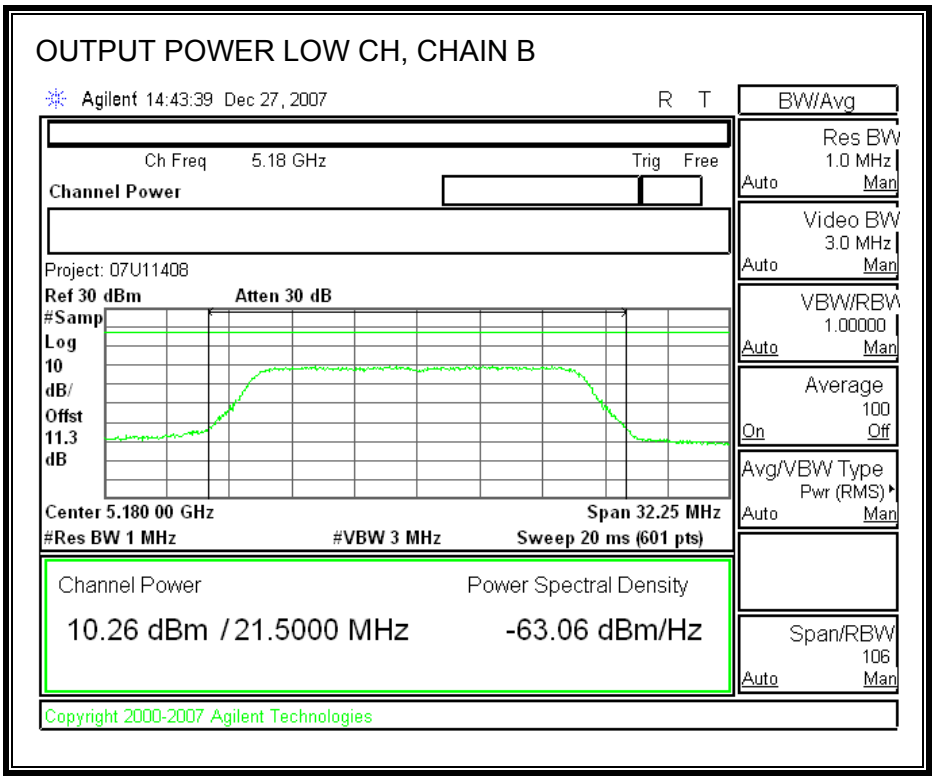




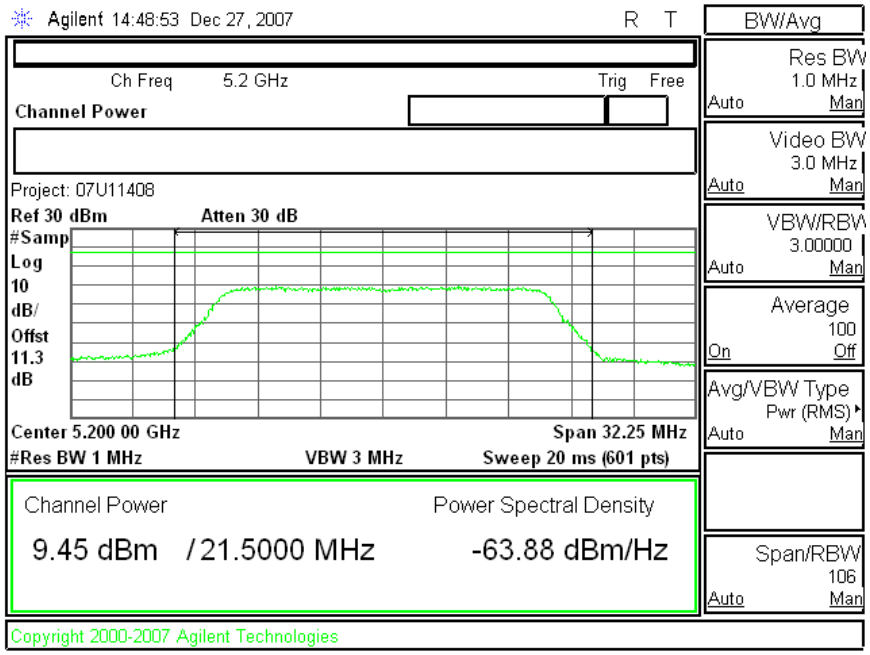
OUTPUT POWER HIGH CH, CHAIN A



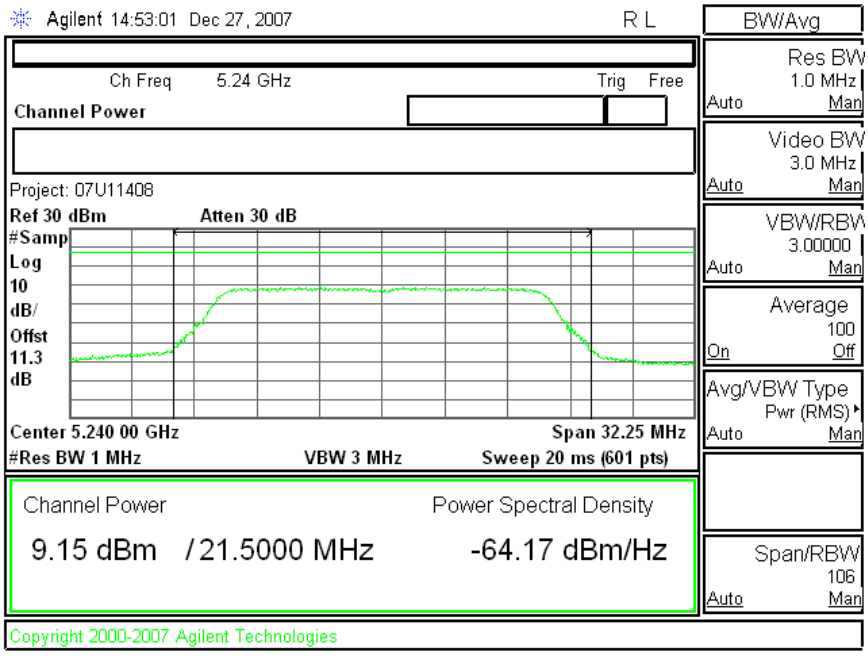
CHAIN B OUTPUT POWER



OUTPUT POWER MID CH, CHAIN B



OUTPUT POWER HIGH CH, CHAIN B



7.1.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
-0.08	3.01	2.93

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

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

TEST PROCEDURE

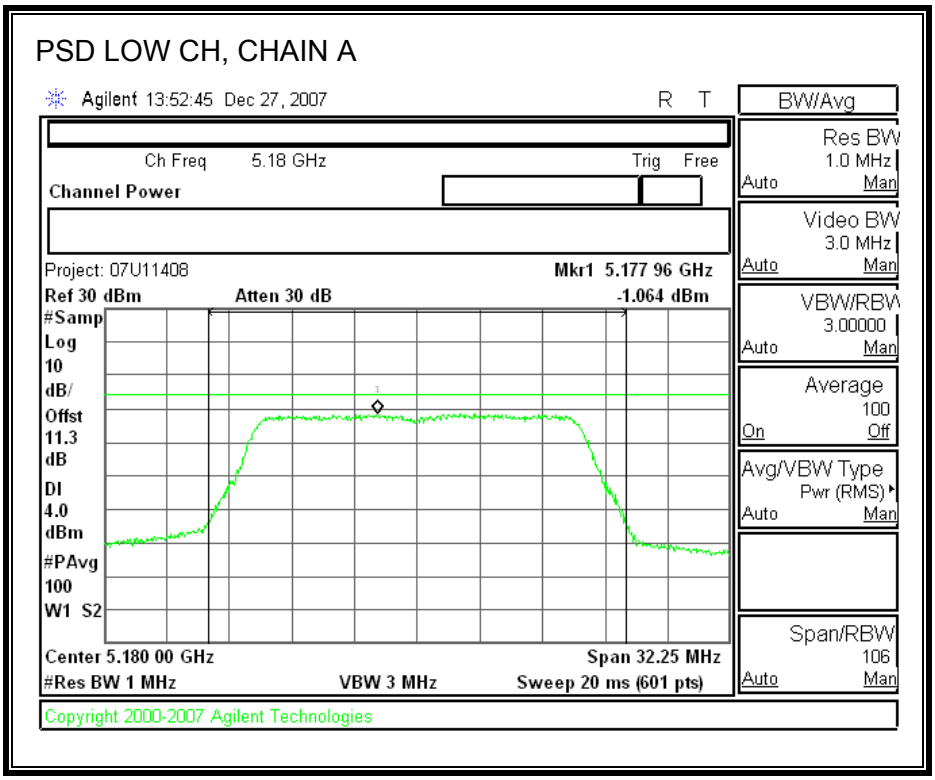
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

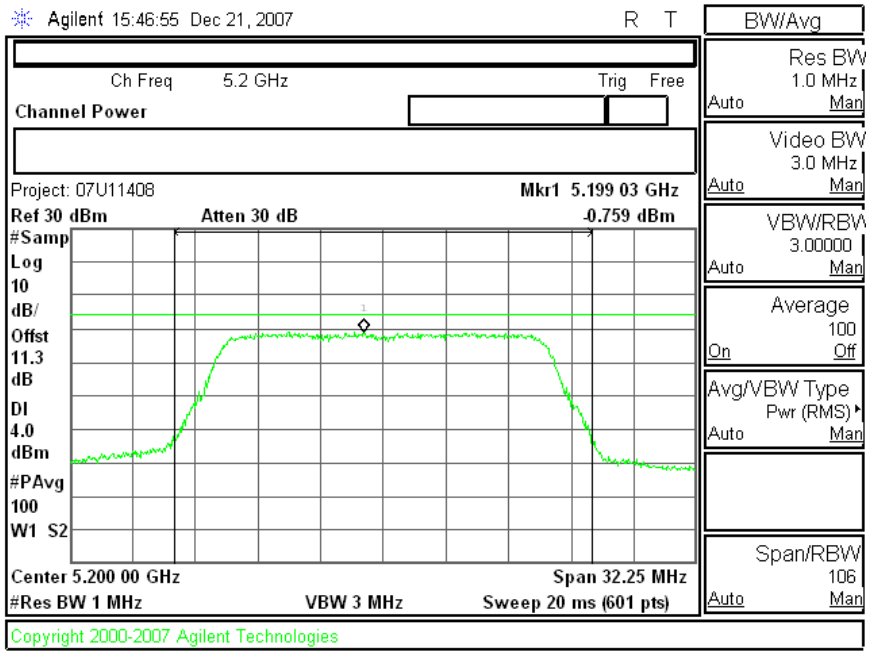
Channel	Frequency (MHz)	Chain A PPSD (dBm)	Chain B PPSD (dBm)	Limit (dBm)
Low	5180	-1.064	-0.485	4
Middle	5200	-0.759	-0.542	4
High	5240	-0.306	-0.457	4

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.676	4	-0.324
Middle	5200	3.787	4	-0.213
High	5240	3.915	4	-0.085

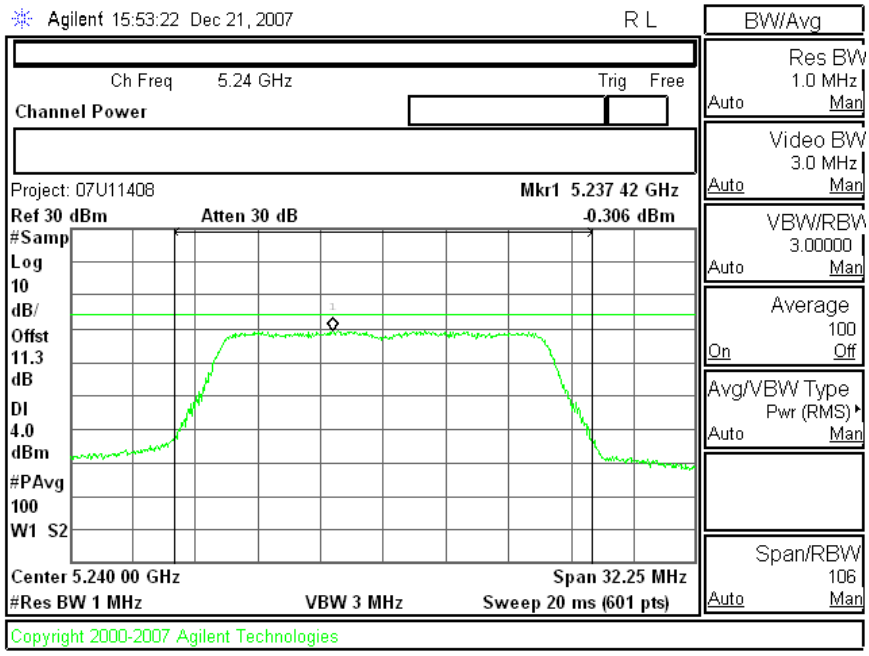
CHAIN A POWER SPECTRAL DENSITY



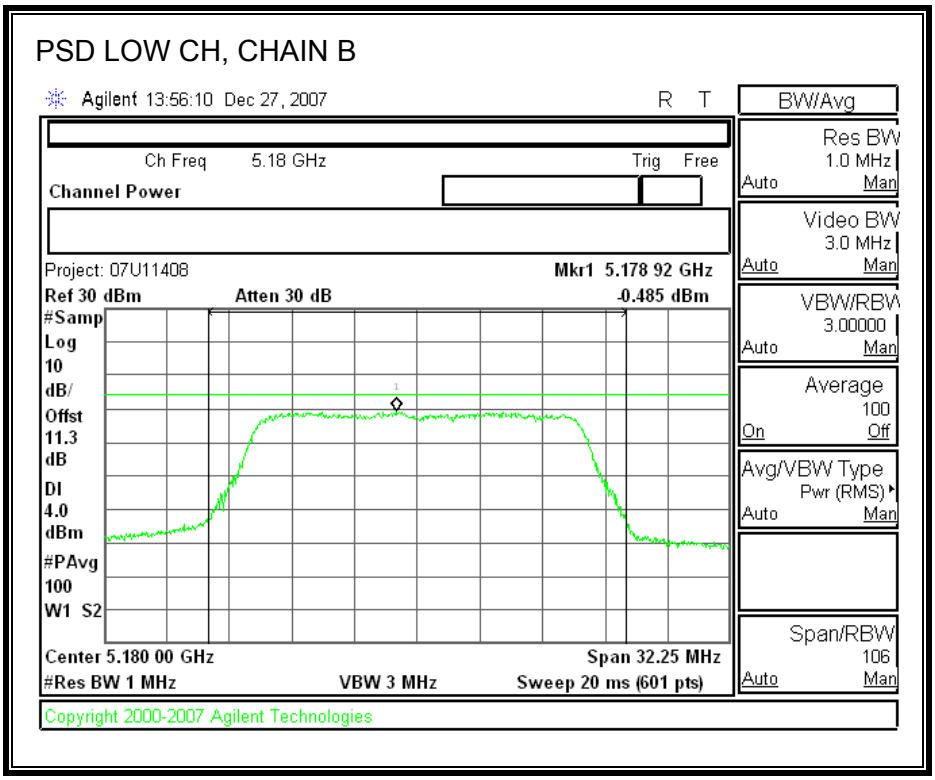
PSD MID CH, CHAIN A



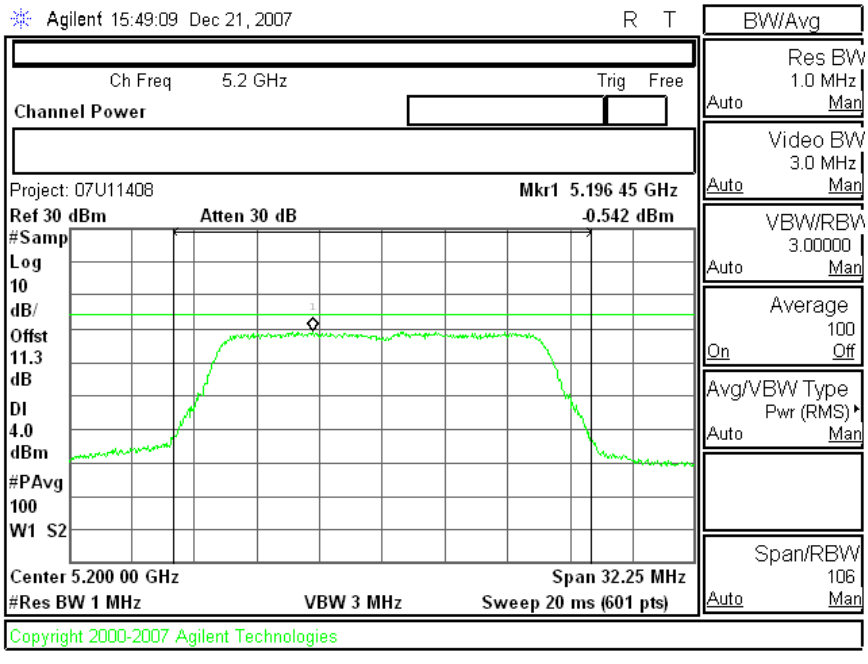
PSD HIGH CH, CHAIN A



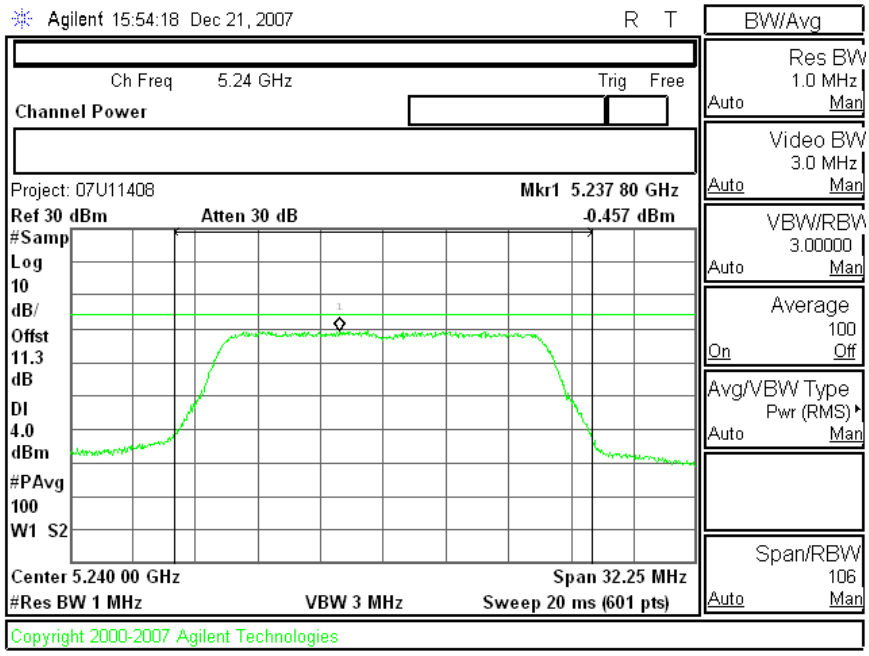
CHAIN B POWER SPECTRAL DENSITY



PSD MID CH, CHAIN B

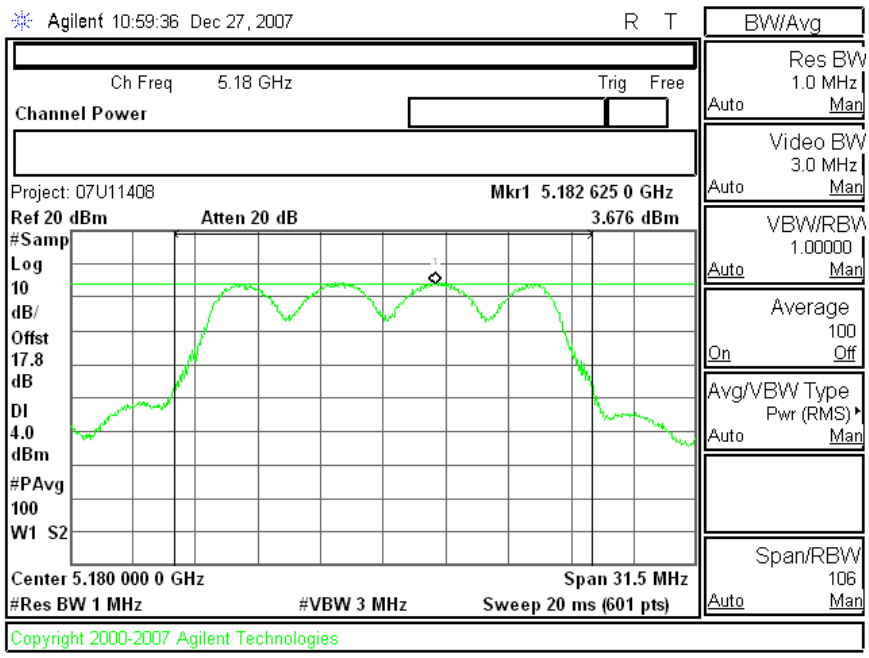


PSD HIGH CH, CHAIN B

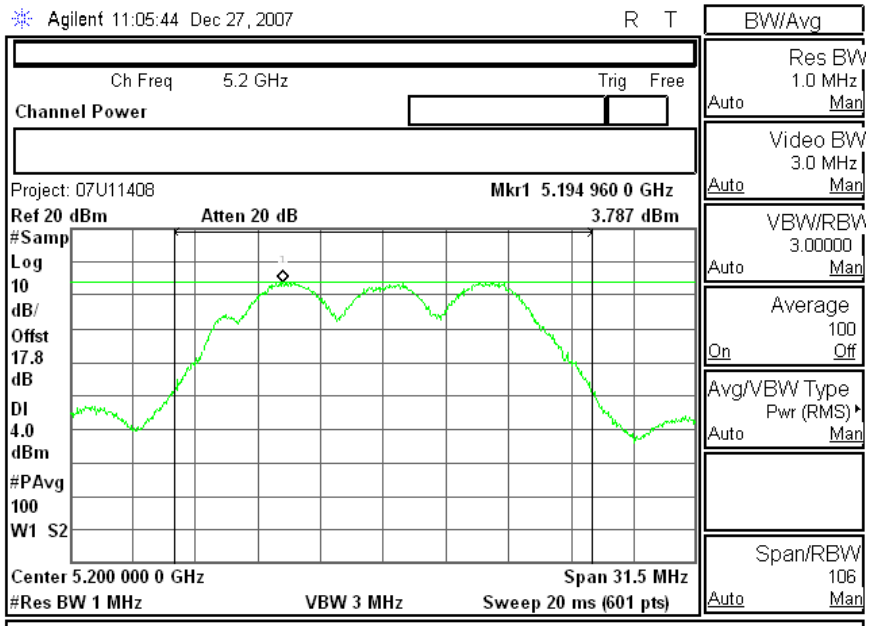


POWER SPECTRAL DENSITY WITH COMBINER

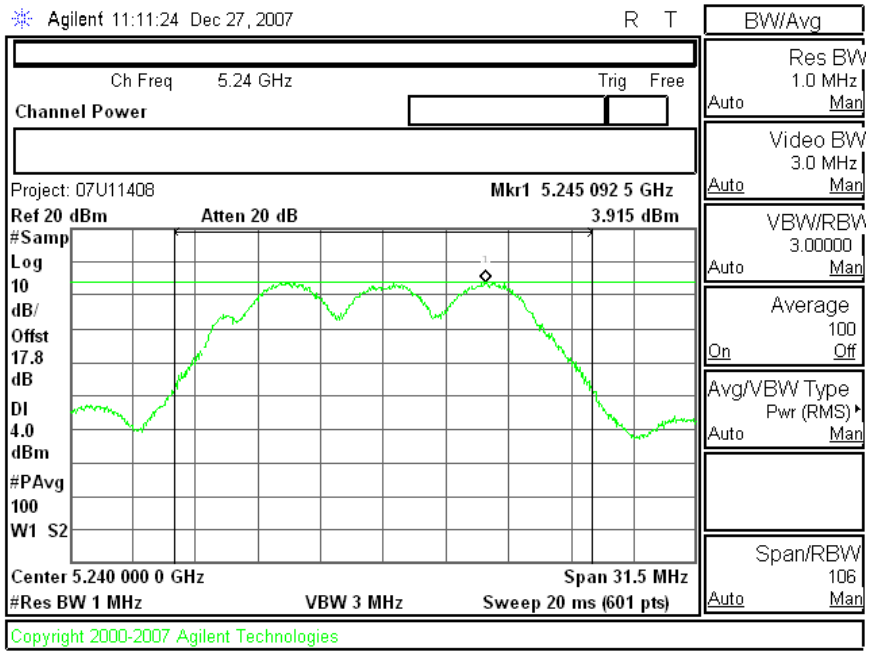
PSD LOW CH, WITH COMBINER



PSD MID CH, WITH COMBINER



PSD HIGH CH, WITH COMBINER



7.1.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

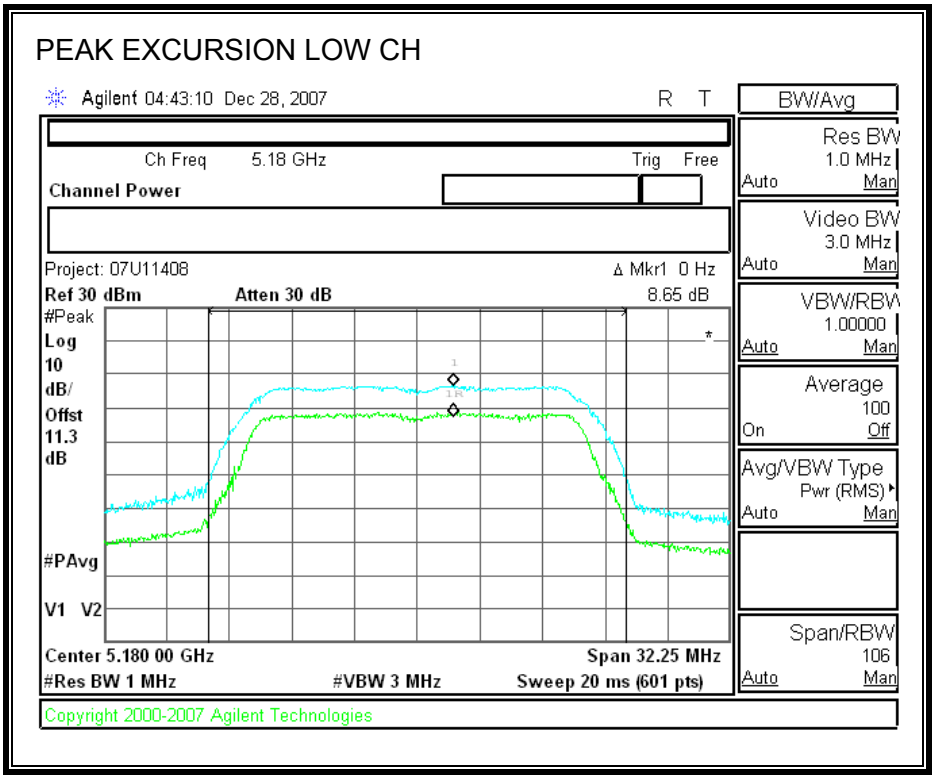
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

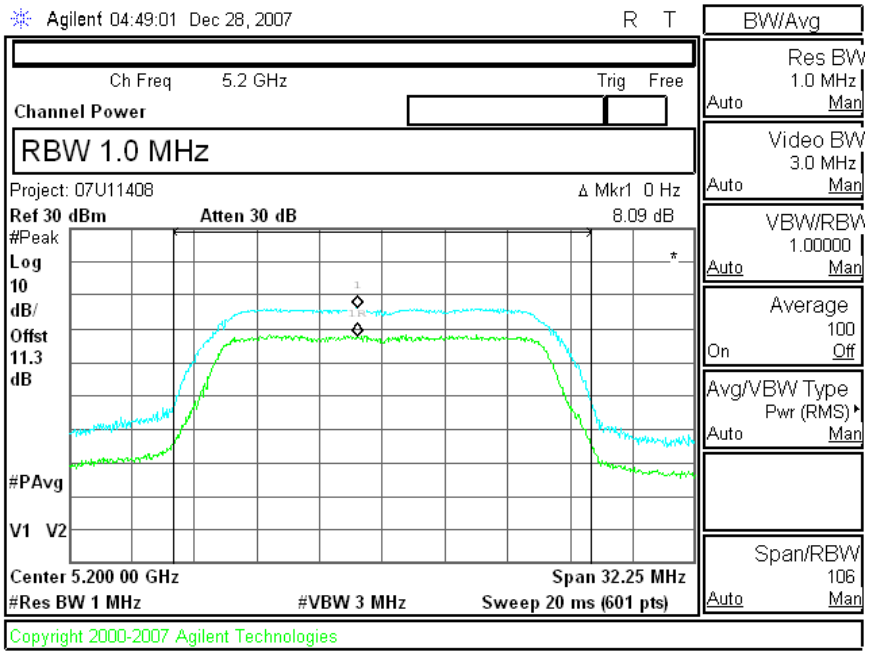
Channel	Frequency (MHz)	Peak Excursion Chain A (dB)	Peak Excursion Chain B (dB)	Limit (dB)	Margin (dB)
Low	5180	8.65	10.13	13	-2.87
Middle	5200	8.09	9.68	13	-3.32
High	5240	8.40	9.53	13	-3.47

PEAK EXCURSION

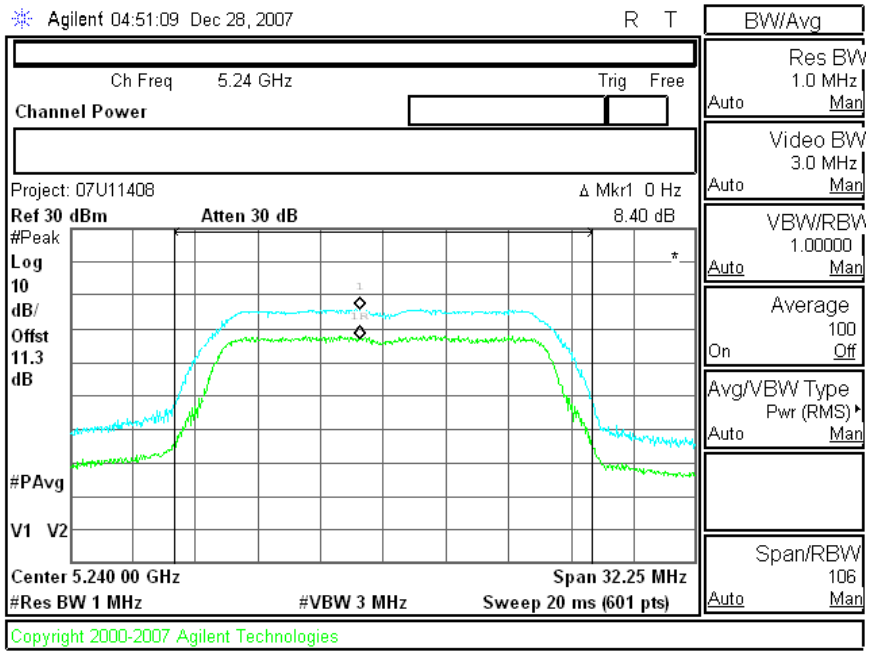
CHAIN A



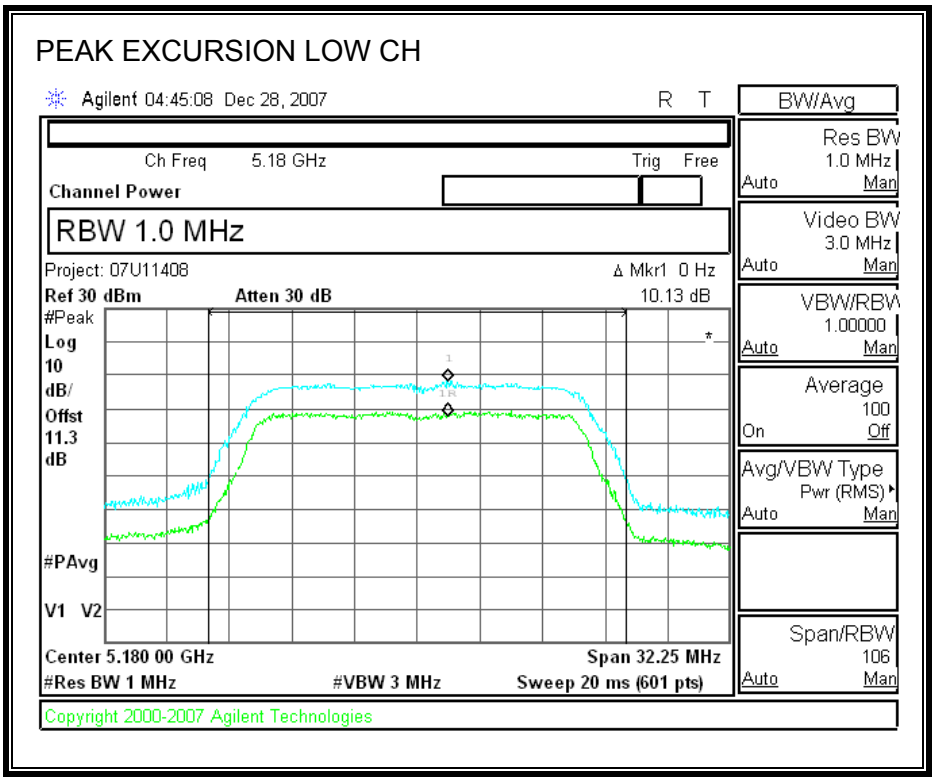
PEAK EXCURSION MID CH



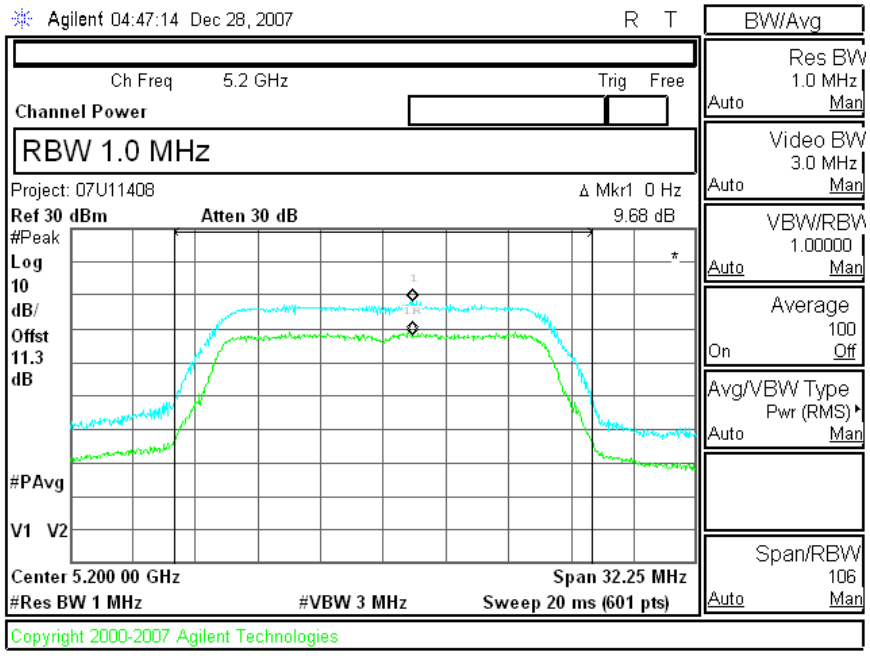
PEAK EXCURSION HIGH CH



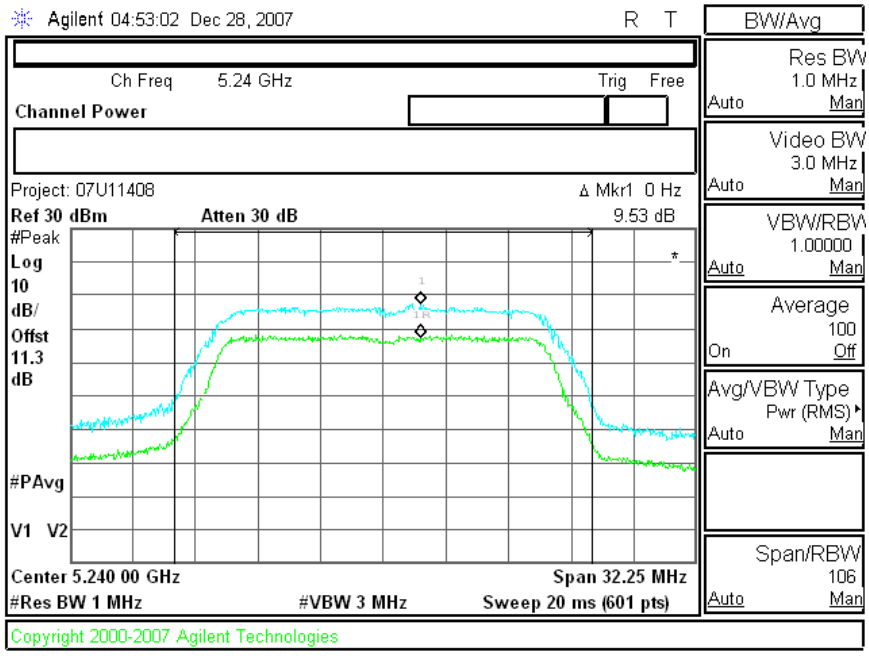
CHAIN B



PEAK EXCURSION MID CH



PEAK EXCURSION HIGH CH



7.1.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

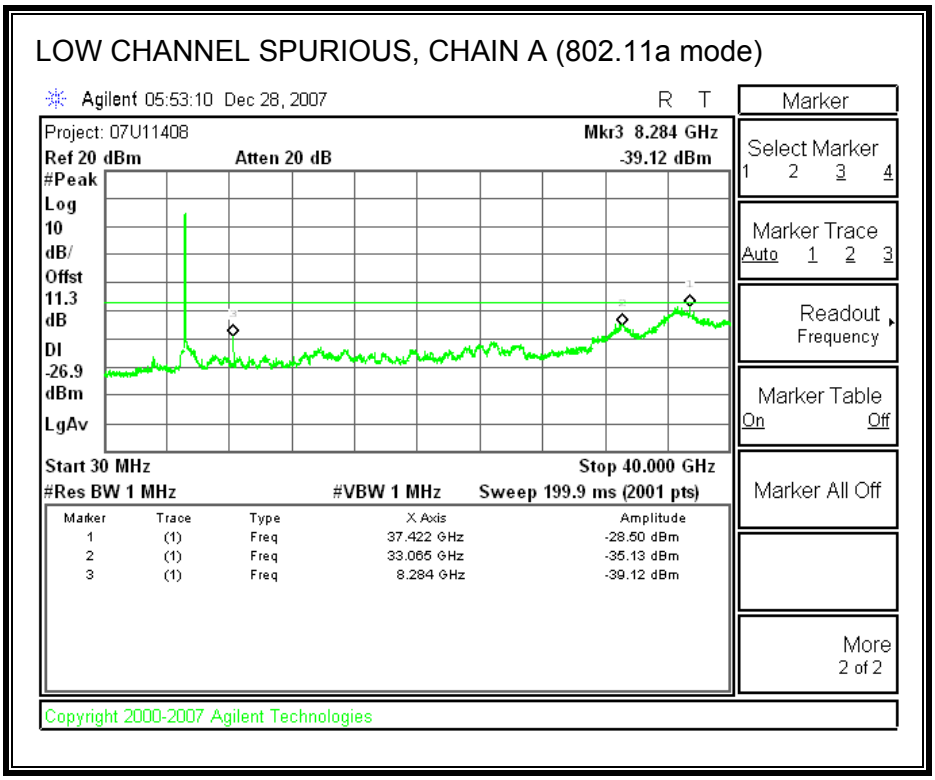
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

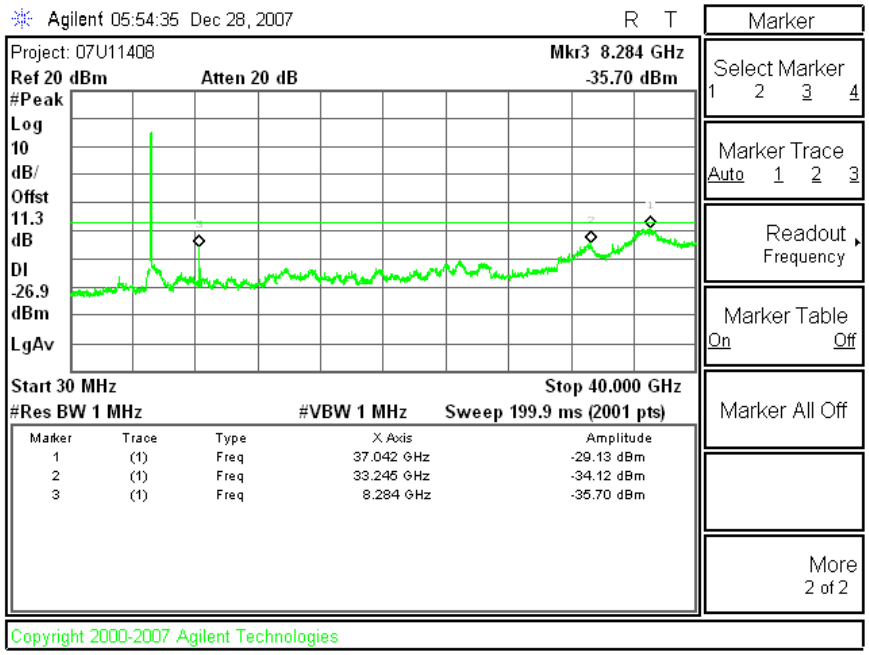
RESULTS

SPURIOUS EMISSIONS (802.11a Mode)

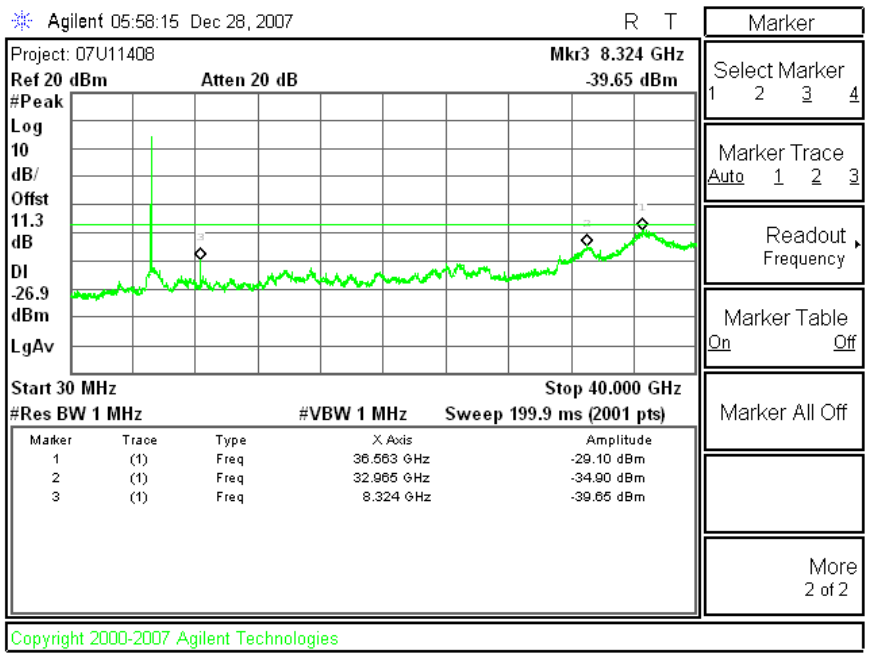
LOW CHANNEL SPURIOUS, CHAIN A (802.11a mode)



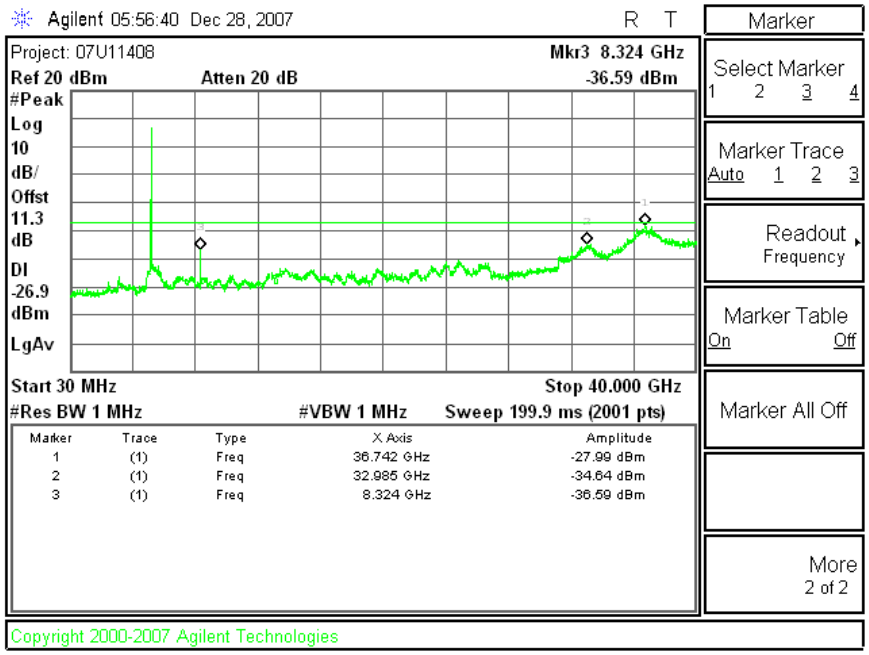
LOW CHANNEL SPURIOUS, CHAIN B (802.11a mode)



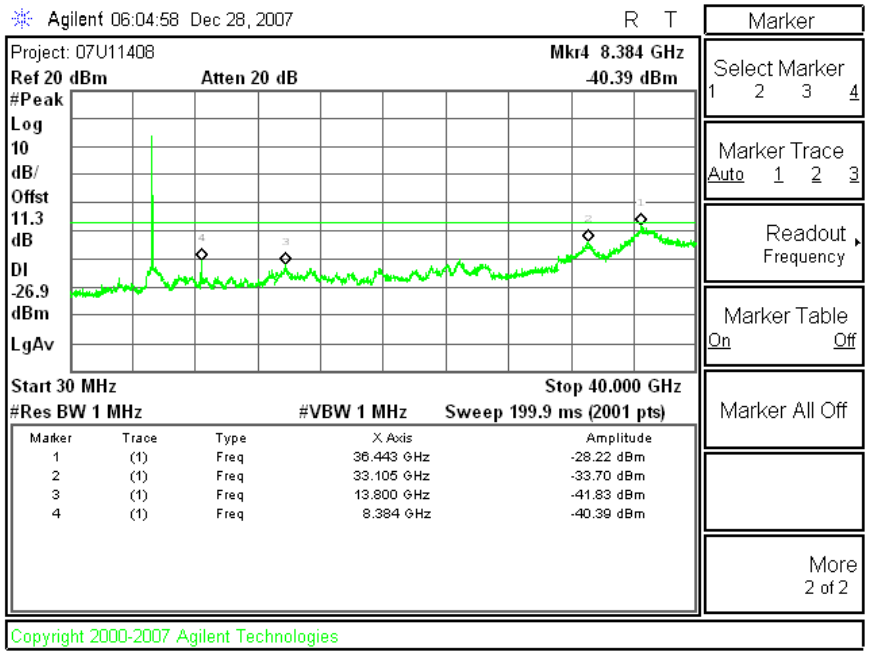
MID CHANNEL SPURIOUS, CHAIN A (802.11a mode)



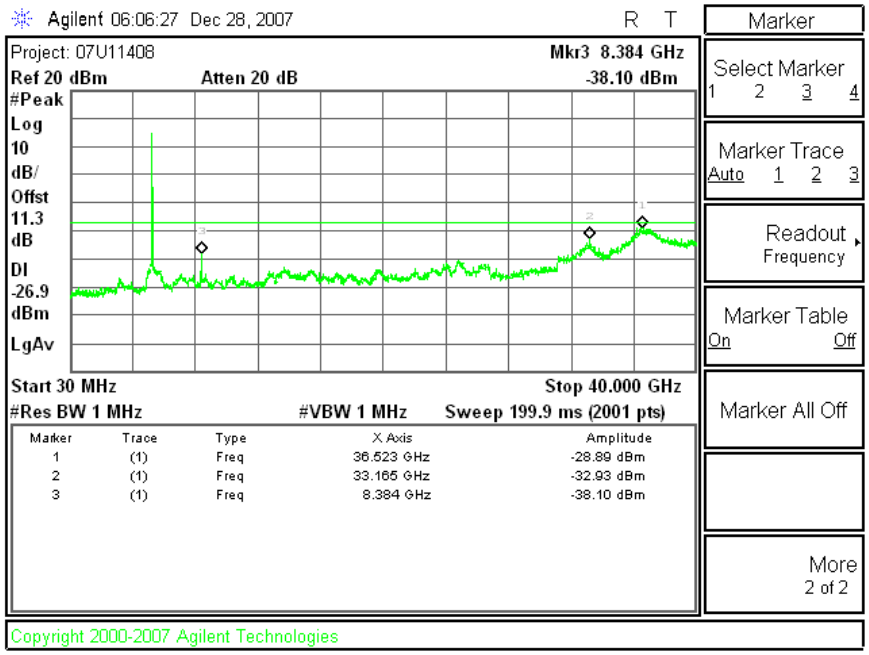
MID CHANNEL SPURIOUS, CHAIN B (802.11a mode)



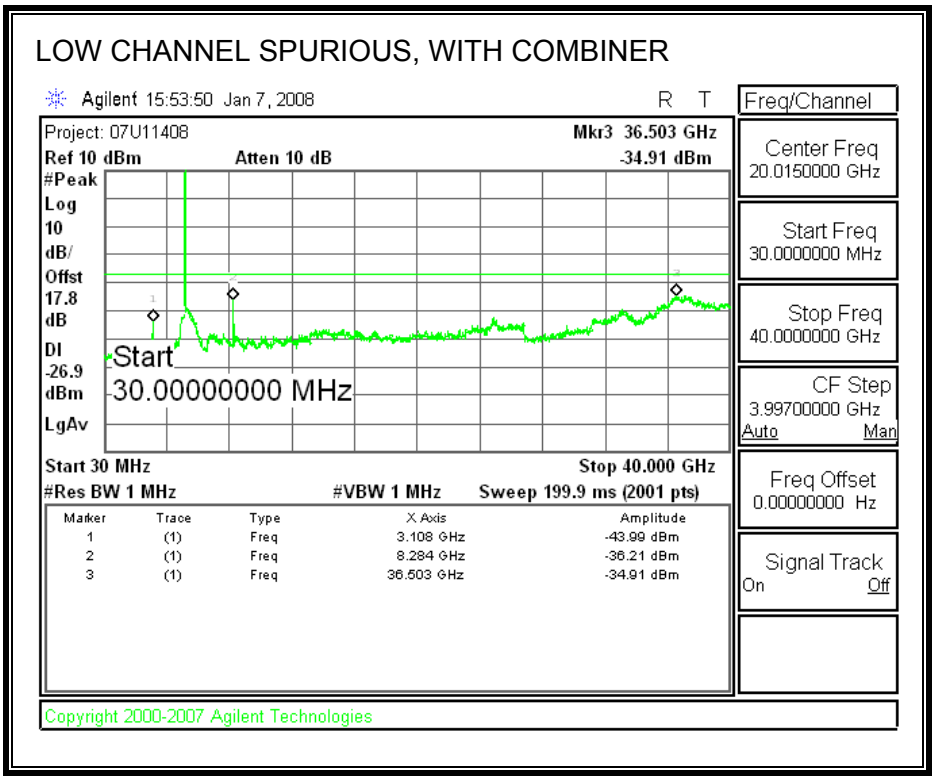
HIGH CHANNEL SPURIOUS, CHAIN A (802.11a mode)



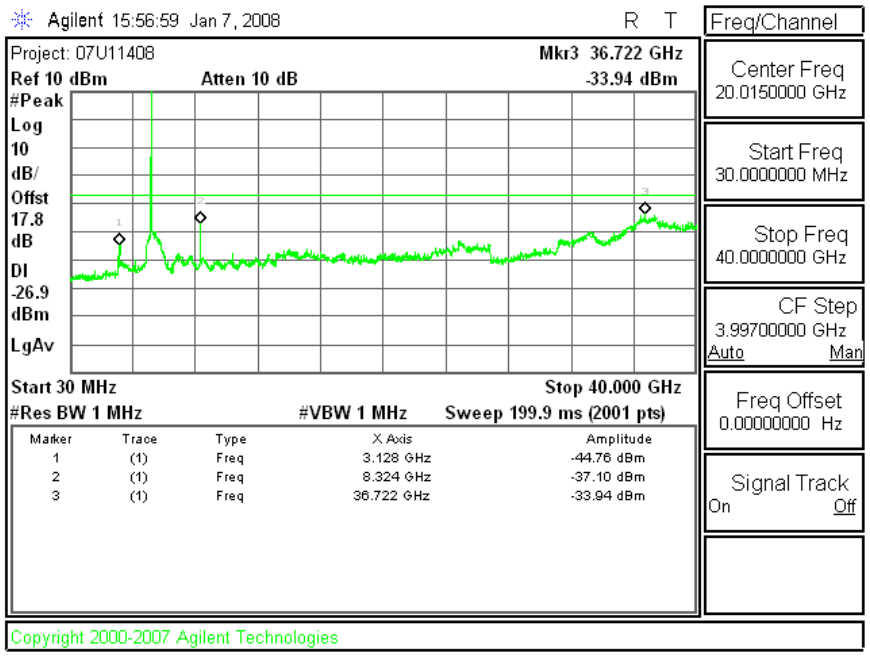
HIGH CHANNEL SPURIOUS, CHAIN B (802.11a mode)



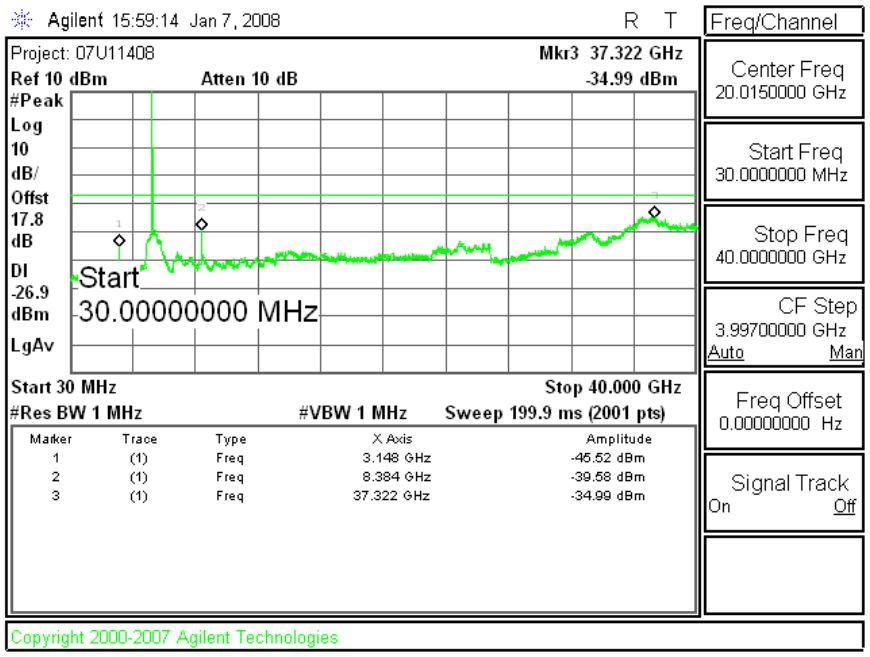
SPURIOUS EMISSIONS WITH COMBINER (802.11a Mode)



MID CHANNEL SPURIOUS, WITH COMBINER



HIGH CHANNEL SPURIOUS, WITH COMBINER



7.2. 802.11n HT20 MODE

7.2.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

26 dB Bandwidth

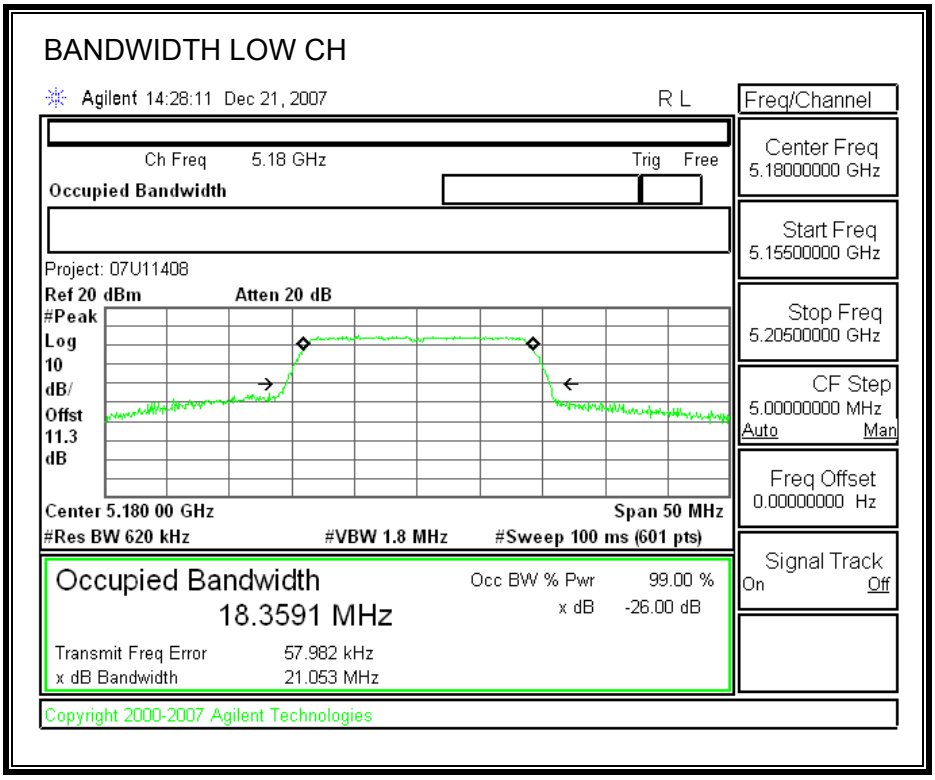
Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5180	21.053	20.722
Middle	5200	21.045	20.681
High	5240	21.001	20.698

Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5180	17.6177	17.7202
Middle	5200	17.6621	17.6390
High	5240	17.7371	17.6355

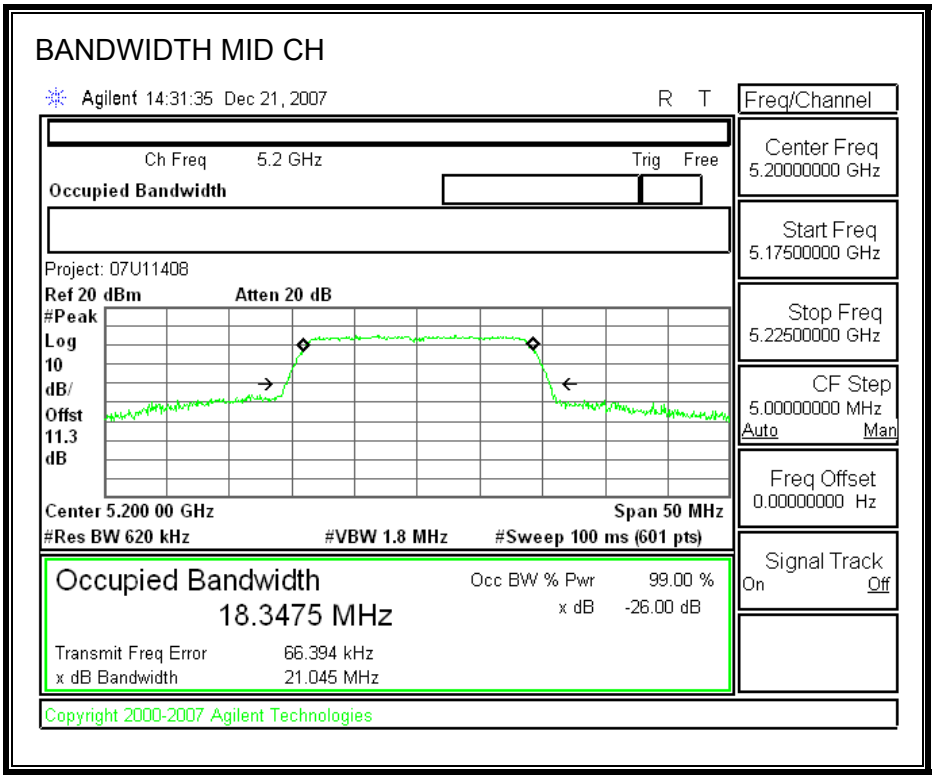
99% Bandwidth

26 dB BANDWIDTH

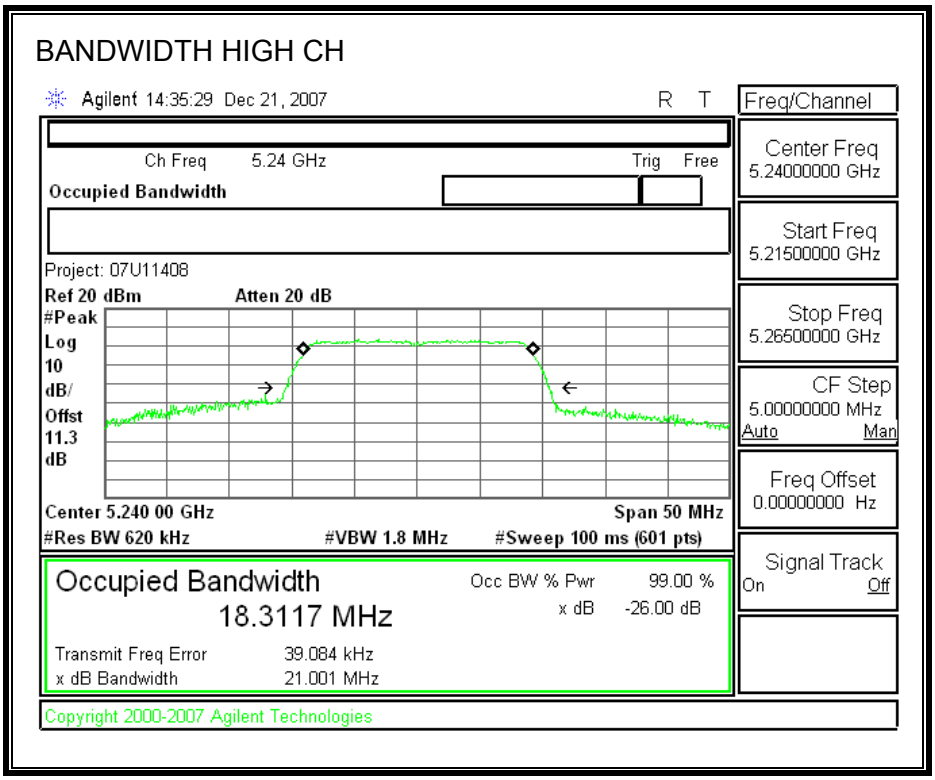
CHAIN A



BANDWIDTH MID CH

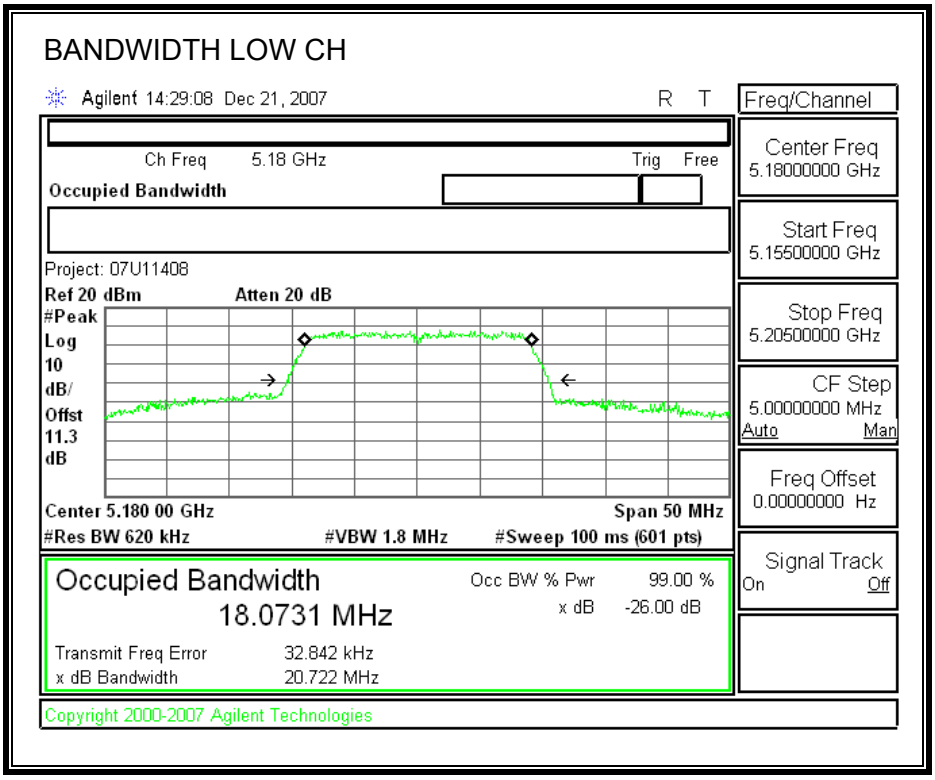


BANDWIDTH HIGH CH

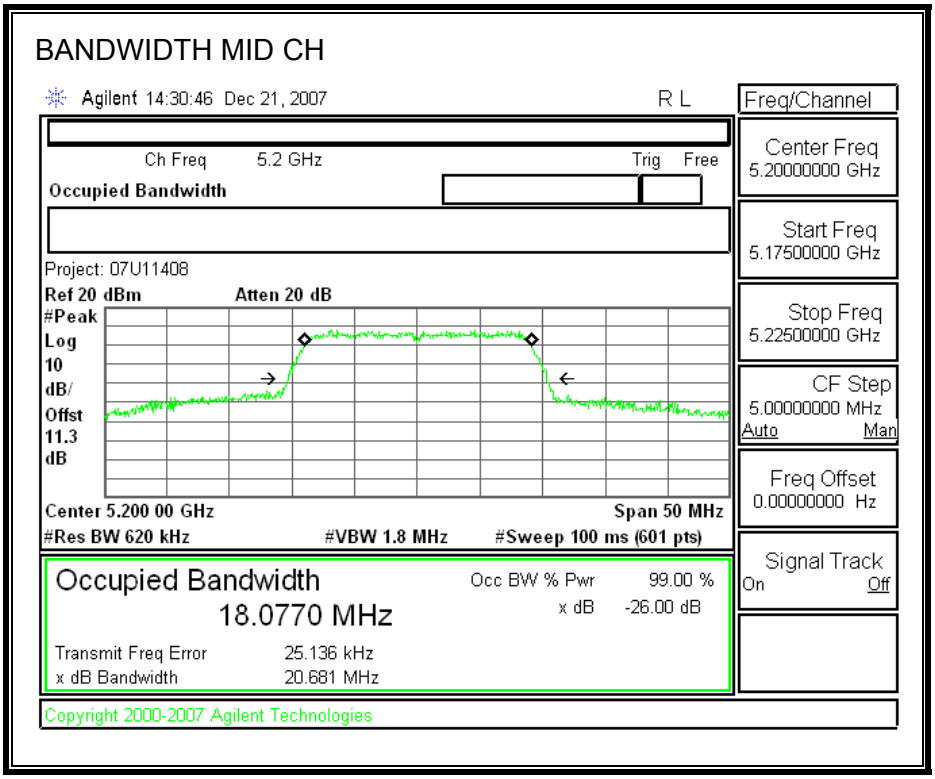


26 dB BANDWIDTH

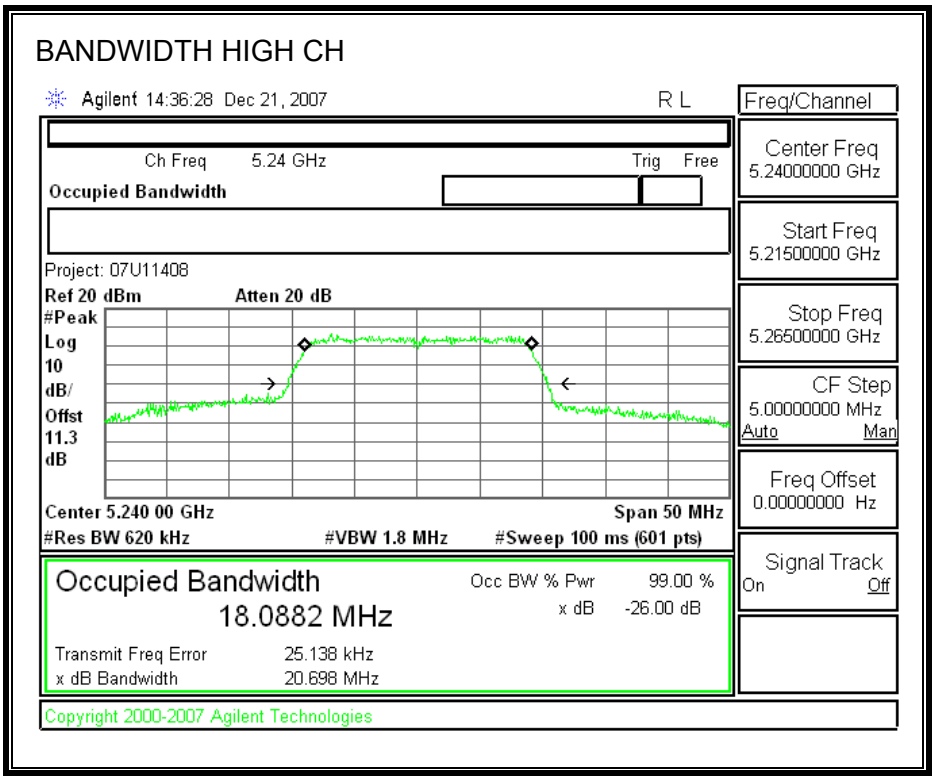
CHAIN B



BANDWIDTH MID CH

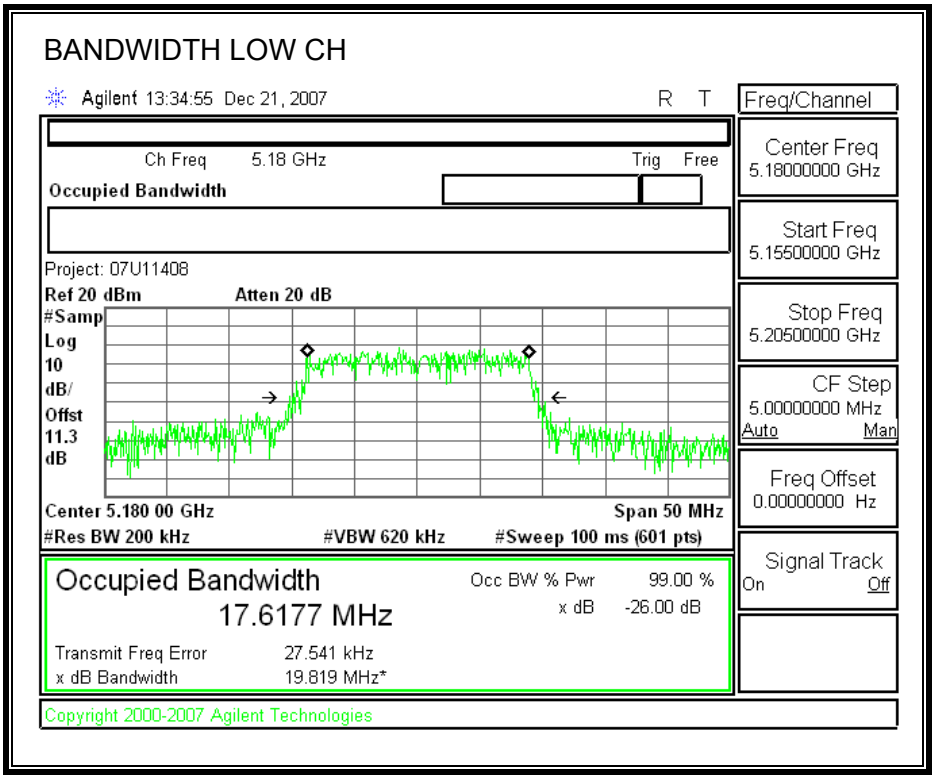


BANDWIDTH HIGH CH

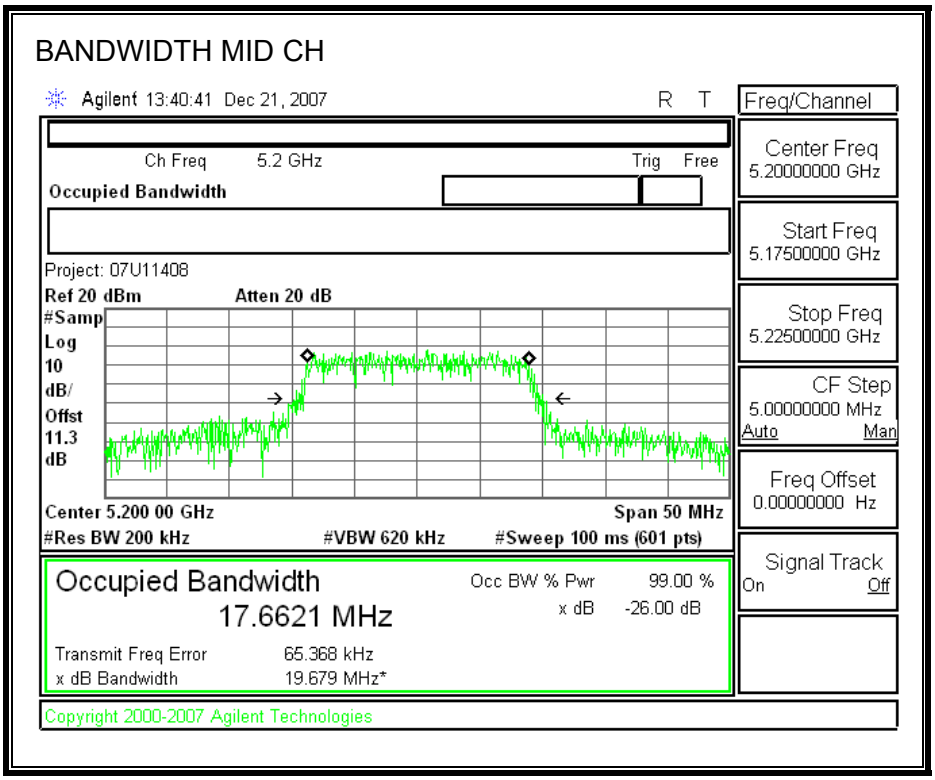


99% BANDWIDTH

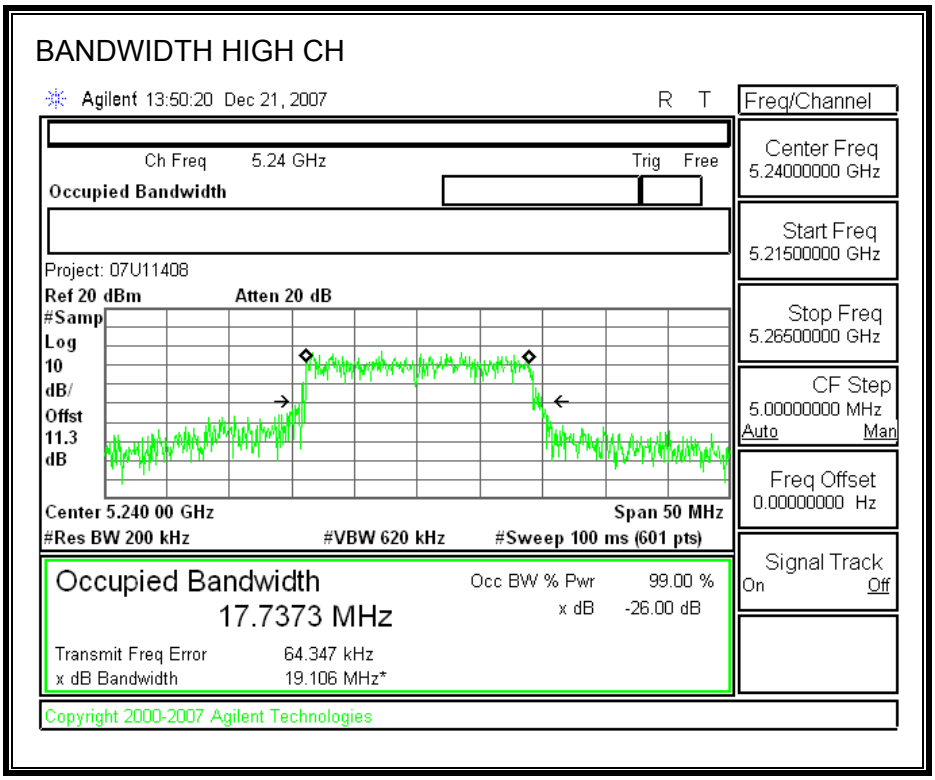
CHAIN A



BANDWIDTH MID CH

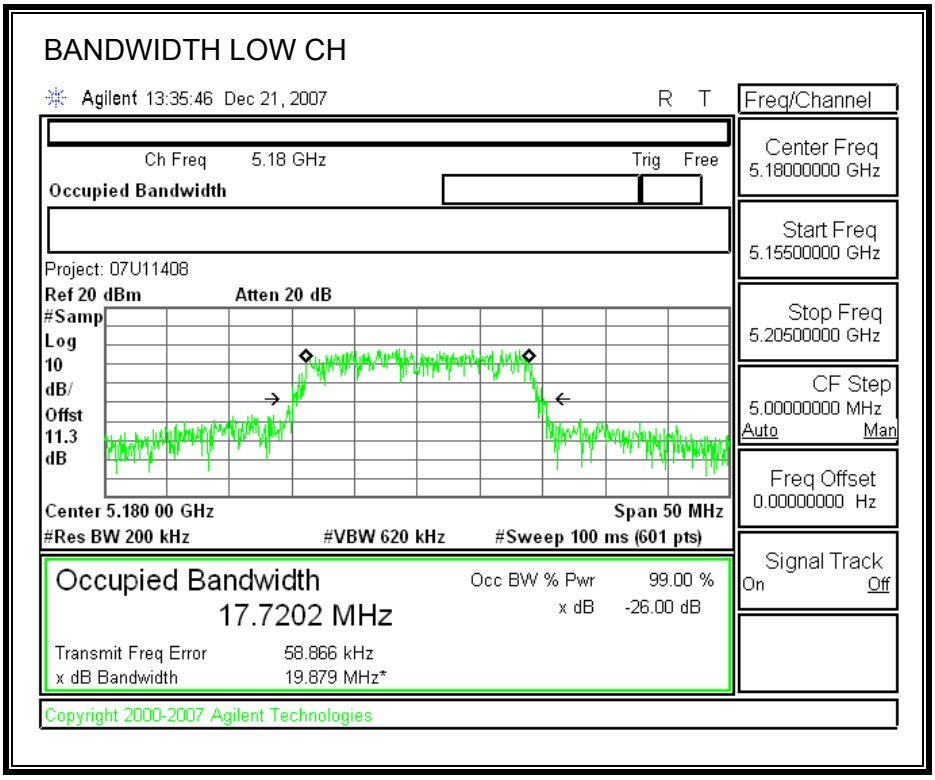


BANDWIDTH HIGH CH

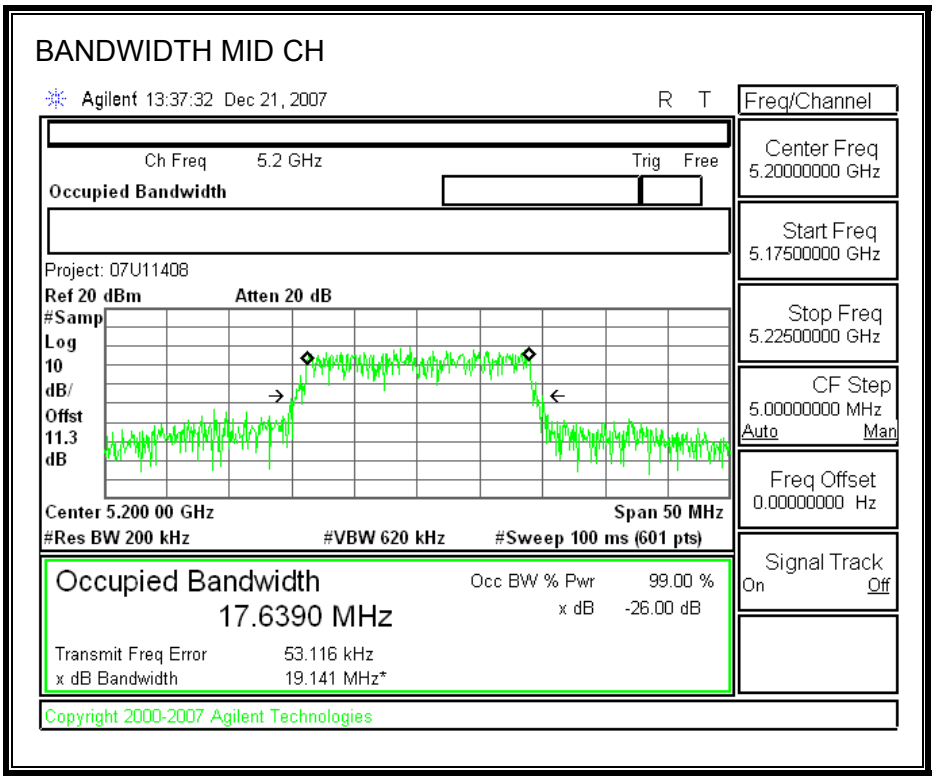


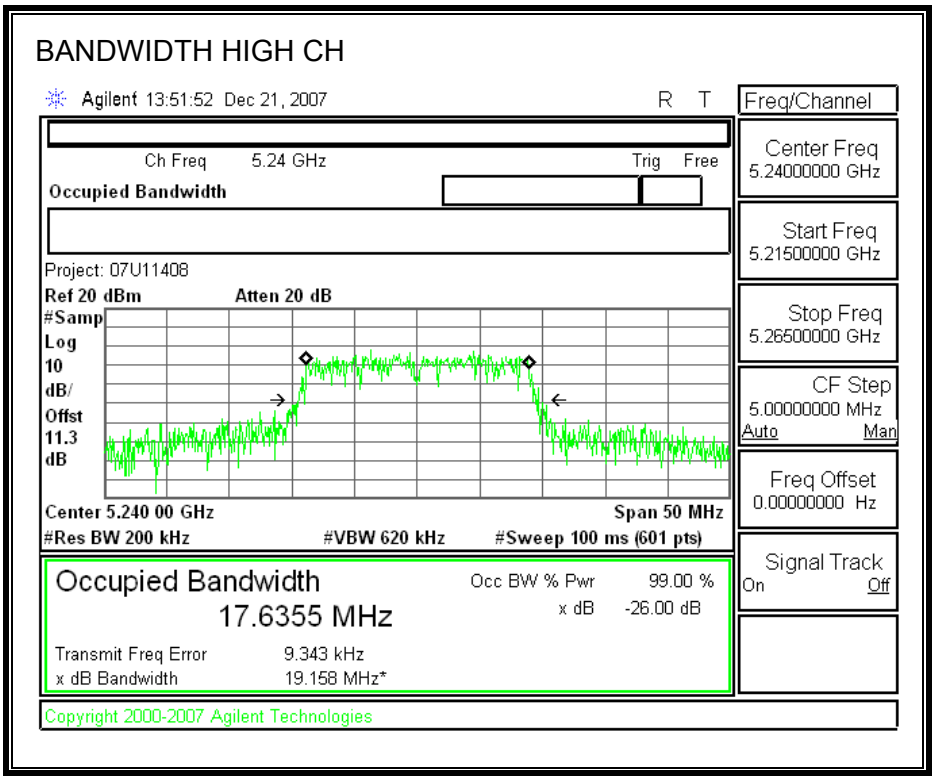
99% BANDWIDTH

CHAIN B



BANDWIDTH MID CH





7.2.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

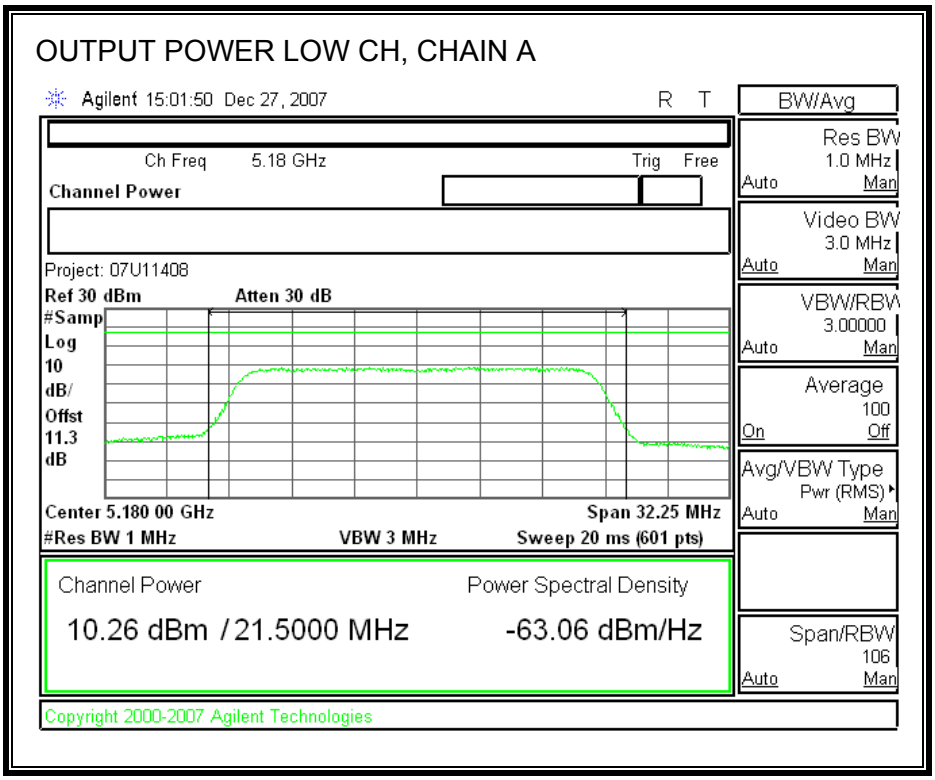
Limit

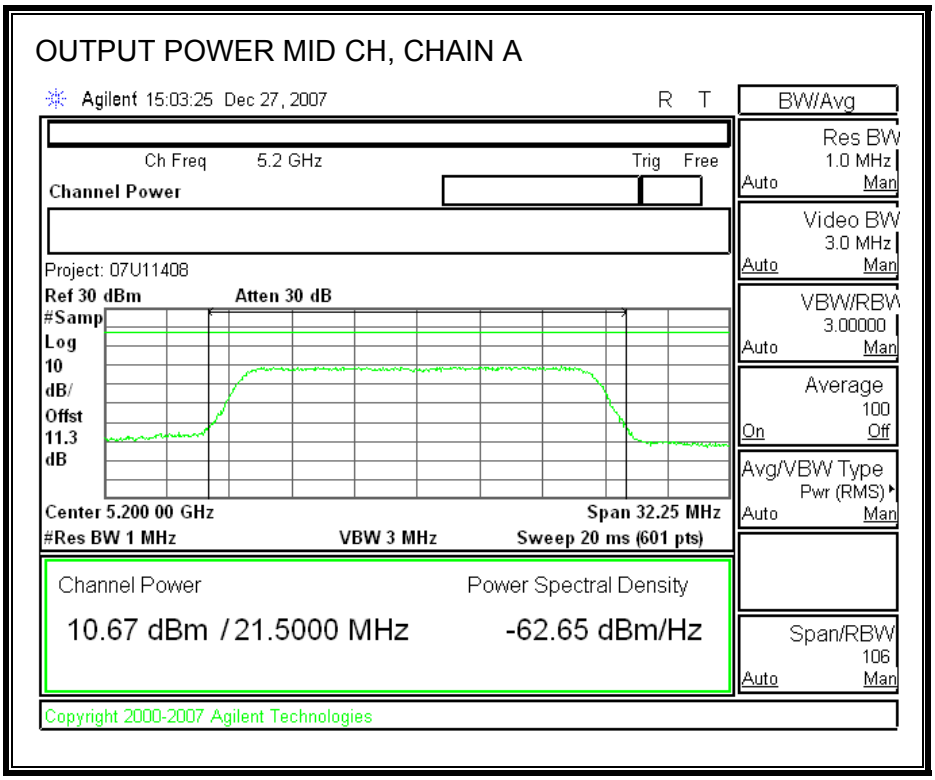
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	20.053	17.02	-0.08	17.00
Mid	5200	17	20.045	17.02	-0.08	17.00
High	5240	17	20.698	17.16	-0.08	17.00

Individual Chain Results

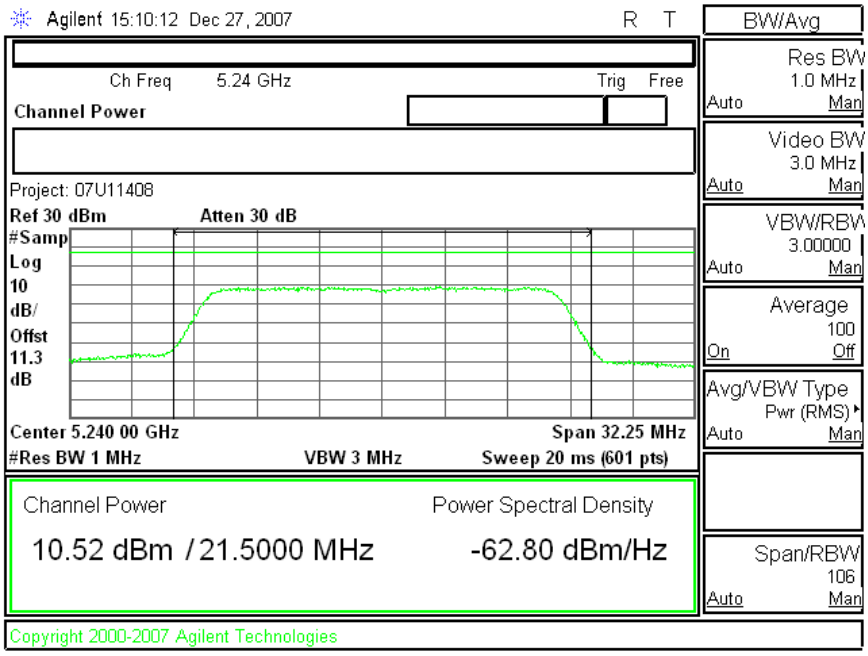
Channel	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	10.26	10.23	13.26	17.00	-6.74
Mid	5200	10.67	10.44	13.57	17.00	-6.33
High	5240	10.52	10.22	13.38	17.00	-6.48

CHAIN A OUTPUT POWER

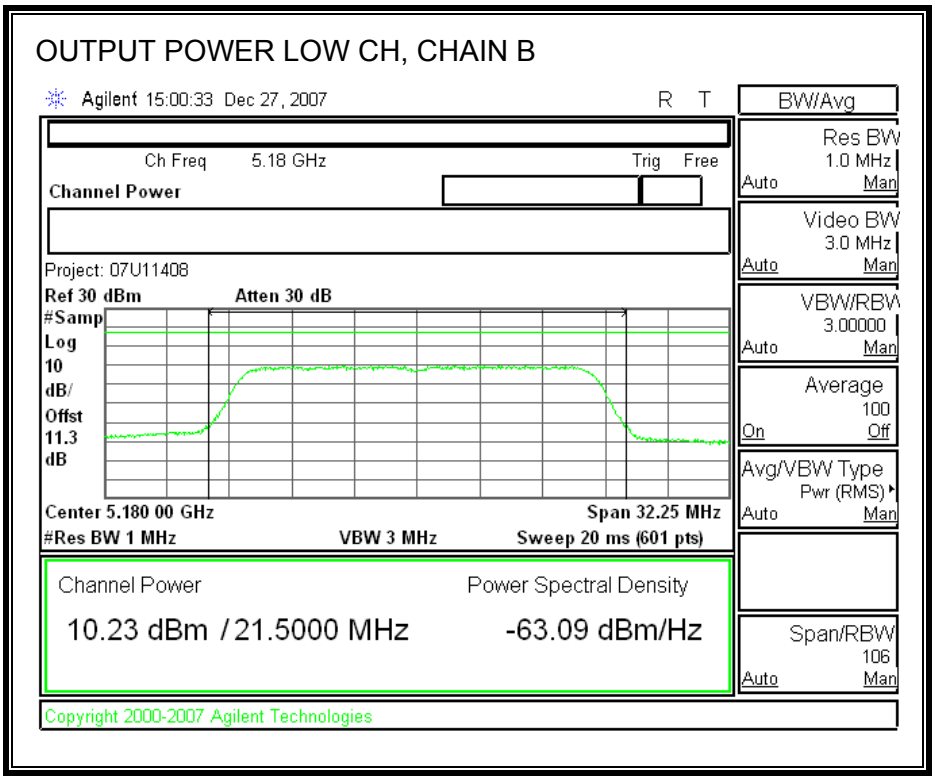




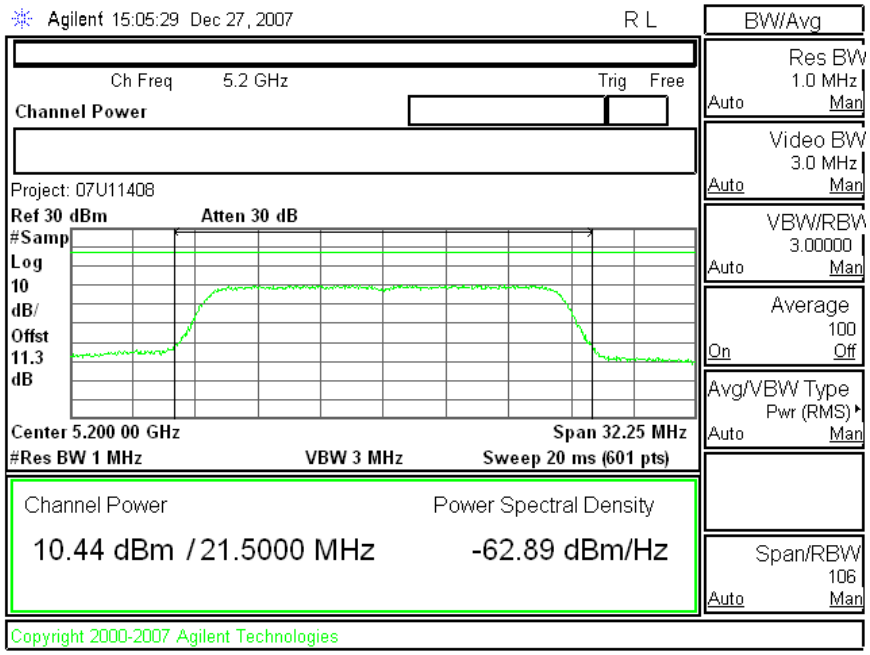
OUTPUT POWER HIGH CH, CHAIN A



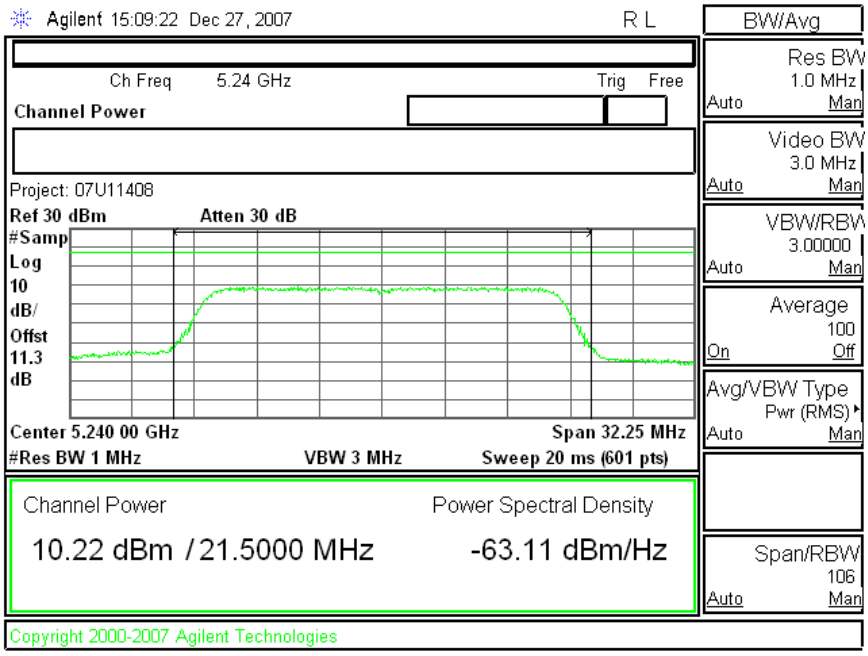
CHAIN B OUTPUT POWER



OUTPUT POWER MID CH, CHAIN B



OUTPUT POWER HIGH CH, CHAIN B



7.2.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

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

TEST PROCEDURE

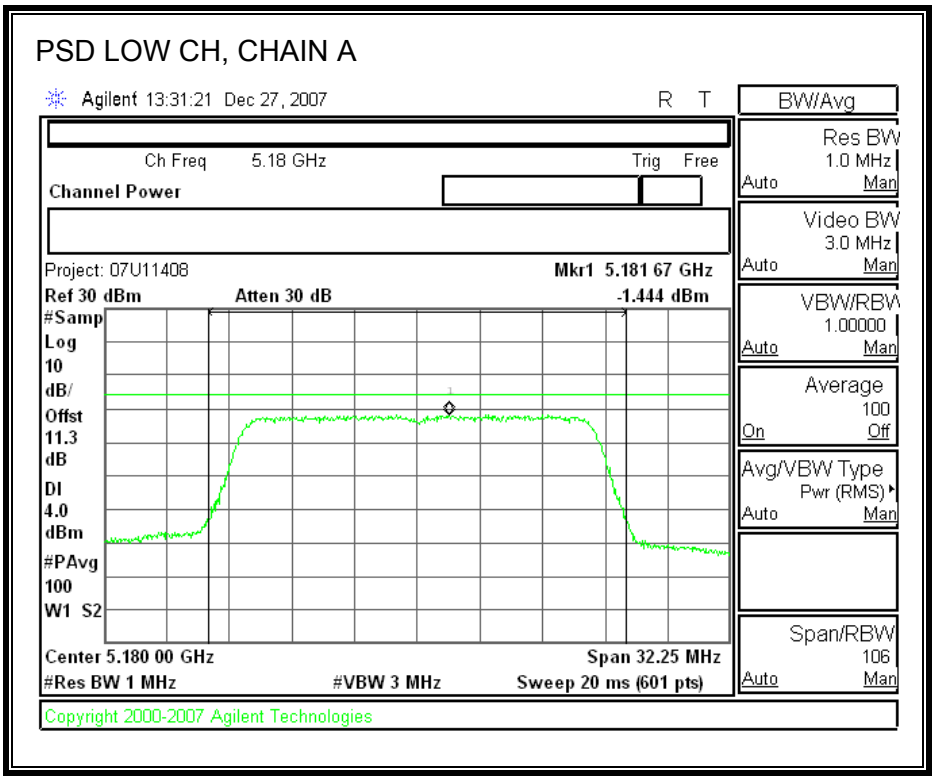
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

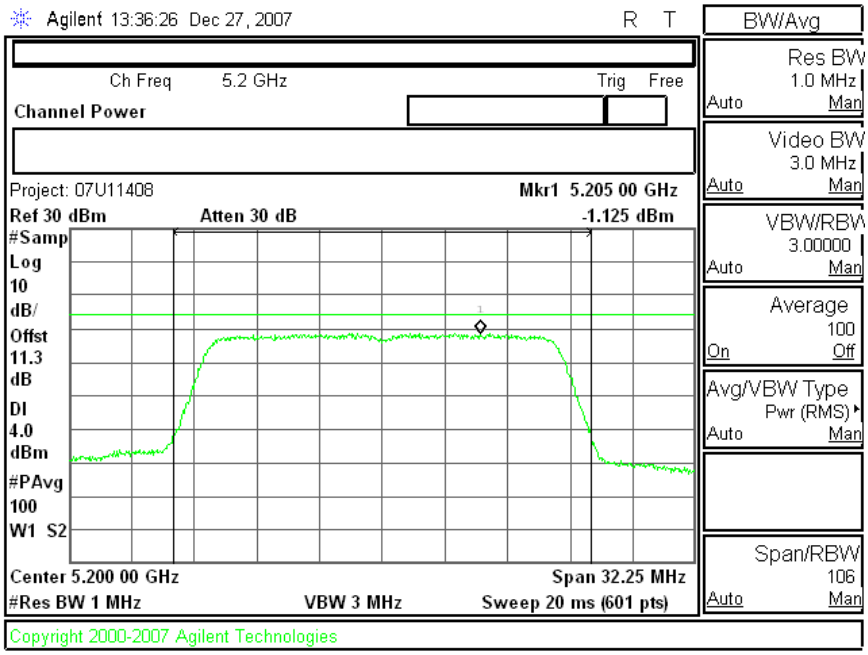
Channel	Frequency (MHz)	Chain A PPSD (dBm)	Chain B PPSD (dBm)	Limit (dBm)
Low	5180	-1.444	-0.258	4
Middle	5200	-1.125	-1.321	4
High	5240	-1.132	-0.799	4

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.443	4	-0.557
Middle	5200	3.844	4	-0.156
High	5240	3.675	4	-0.325

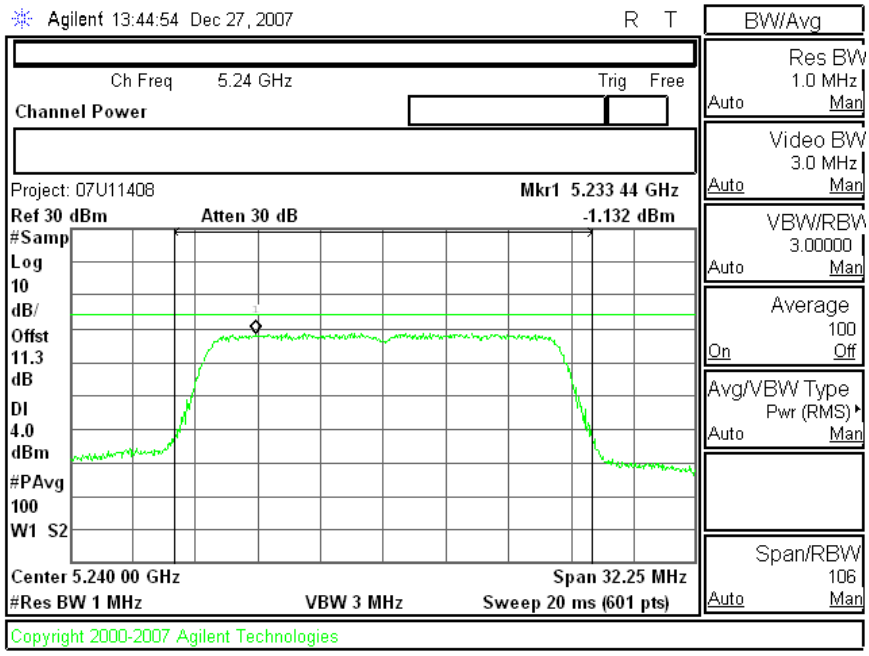
CHAIN A POWER SPECTRAL DENSITY



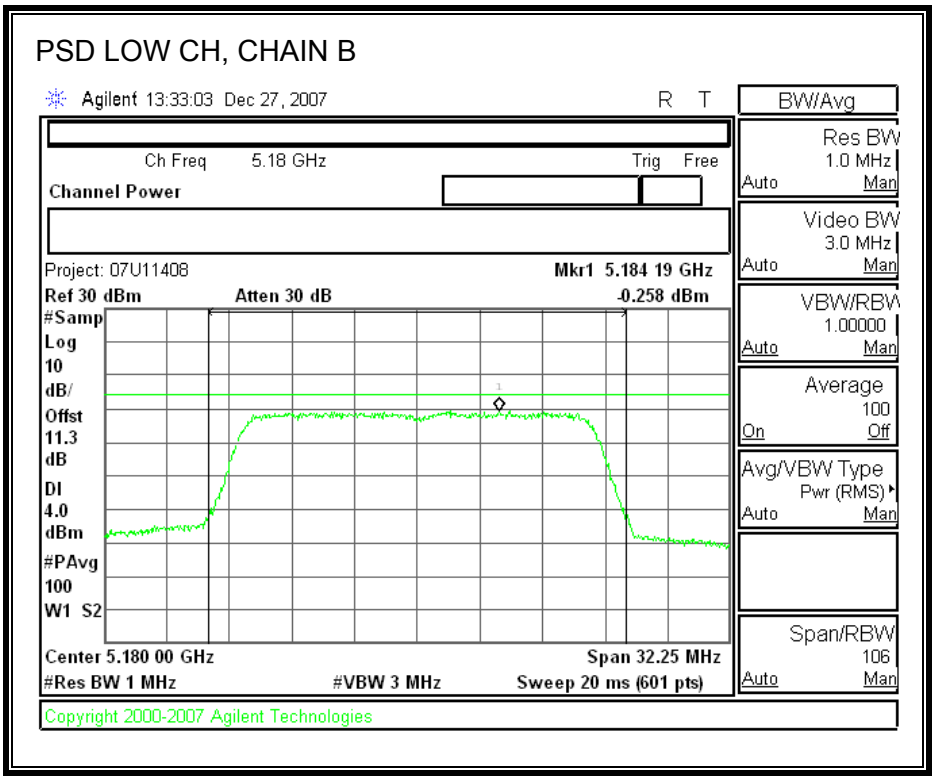
PSD MID CH, CHAIN A



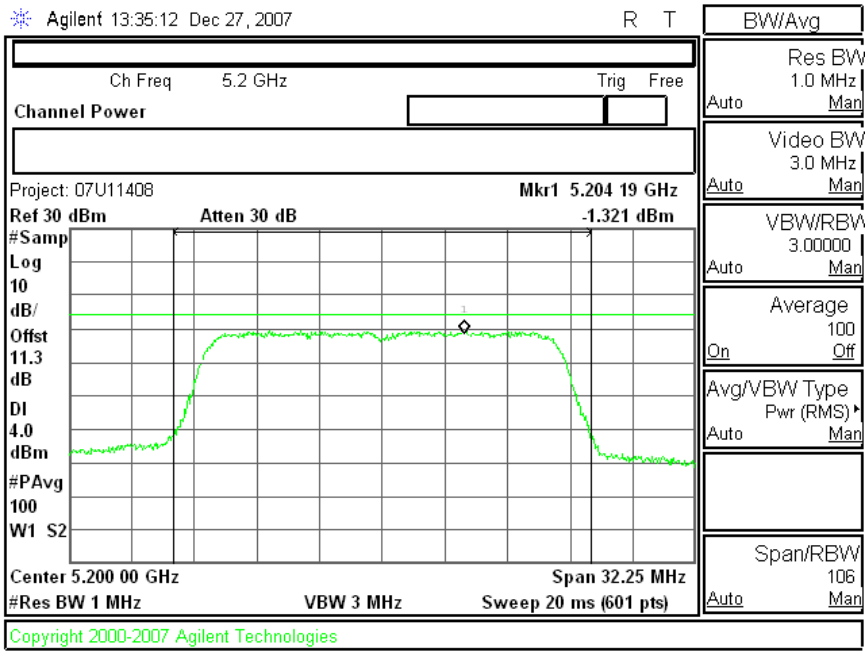
PSD HIGH CH, CHAIN A



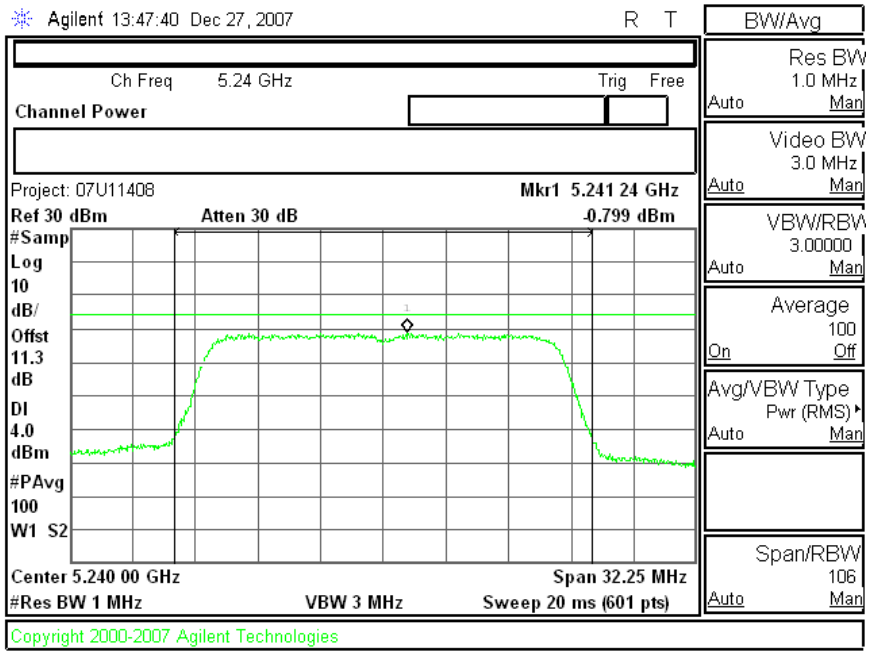
CHAIN B POWER SPECTRAL DENSITY



PSD MID CH, CHAIN B

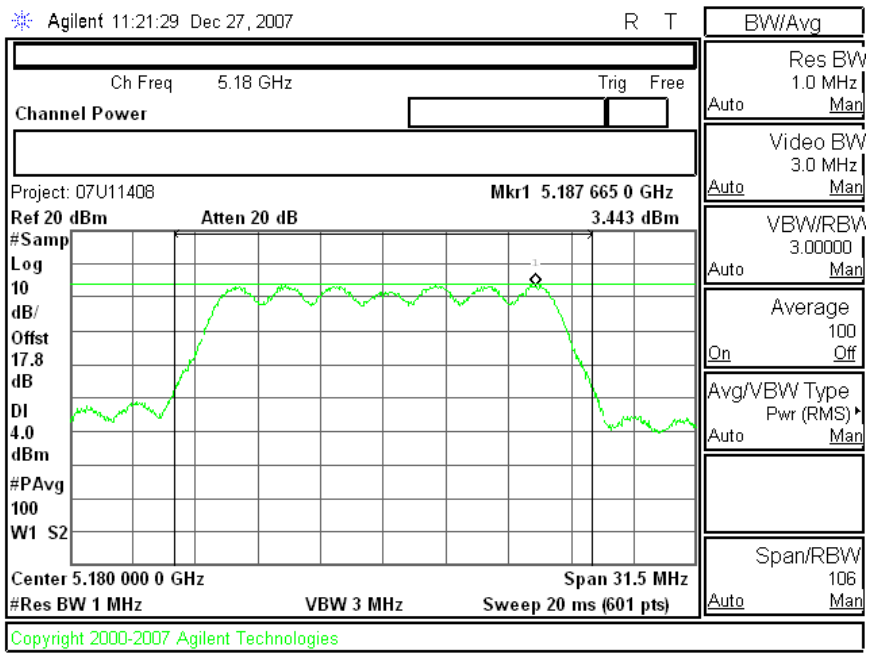


PSD HIGH CH, CHAIN B

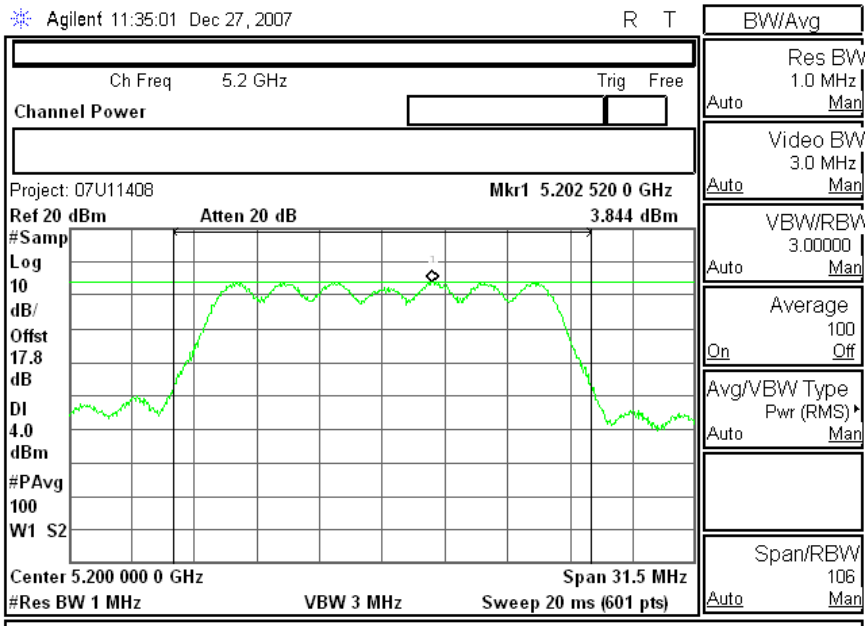


POWER SPECTRAL DENSITY WITH COMBINER

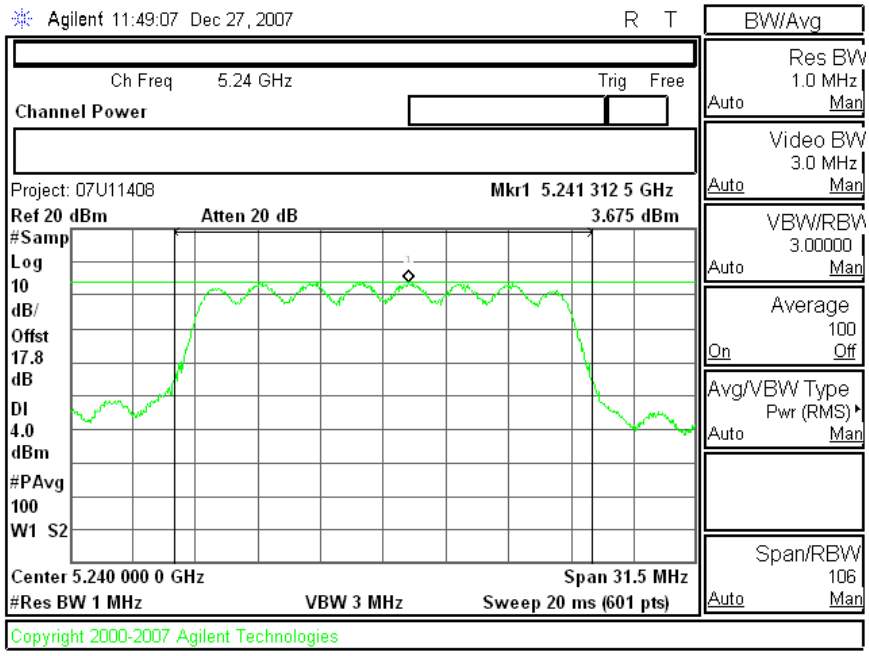
PSD LOW CH, WITH COMBINER



PSD MID CH, WITH COMBINER



PSD HIGH CH, WITH COMBINER



7.2.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

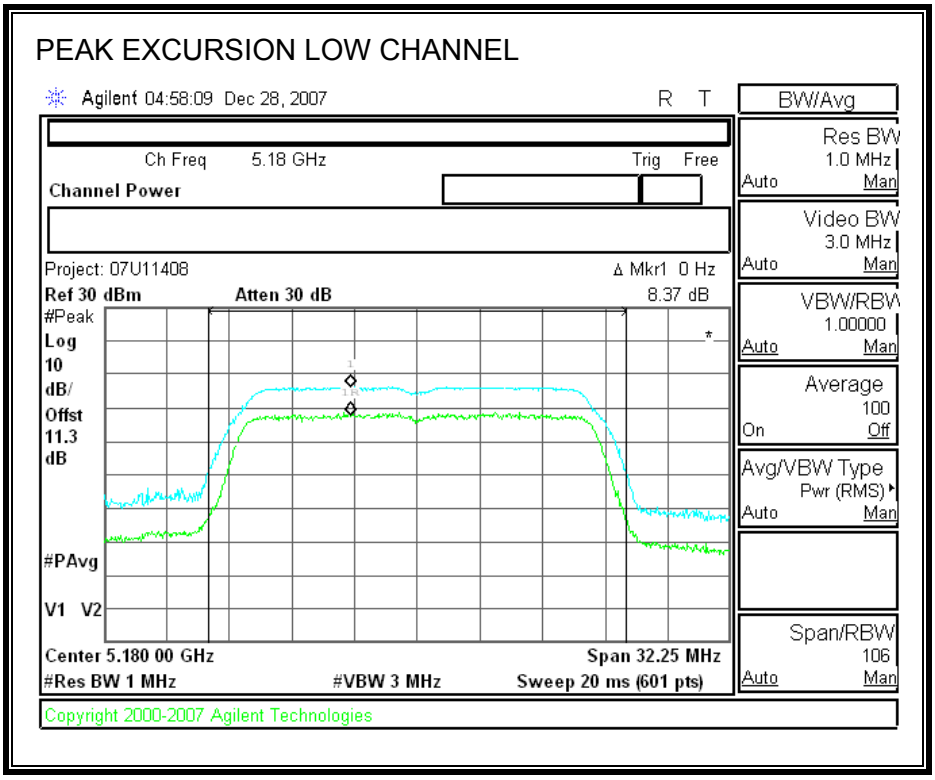
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

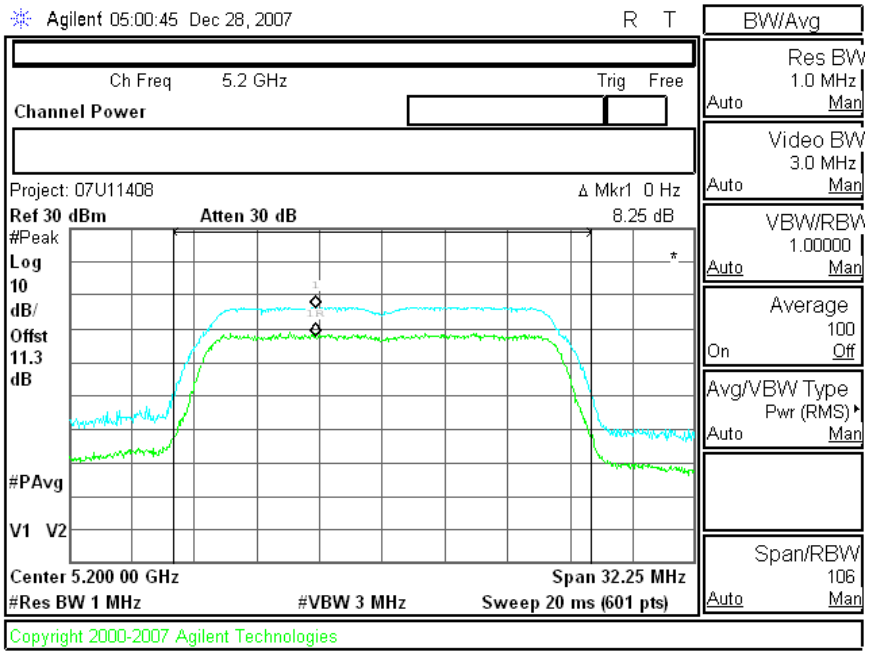
Mode Channel	Frequency (MHz)	Peak Excursion Chain A (dBm)	Peak Excursion Chain B (dBm)	Limit (dBm)	Worst Case Margin (dB)
802.11n HT20 Mode					
Low	5180	8.37	10.36	13	-2.64
Middle	5220	8.25	9.56	13	-3.44
High	5240	7.96	9.82	13	-3.18

PEAK EXCURSION

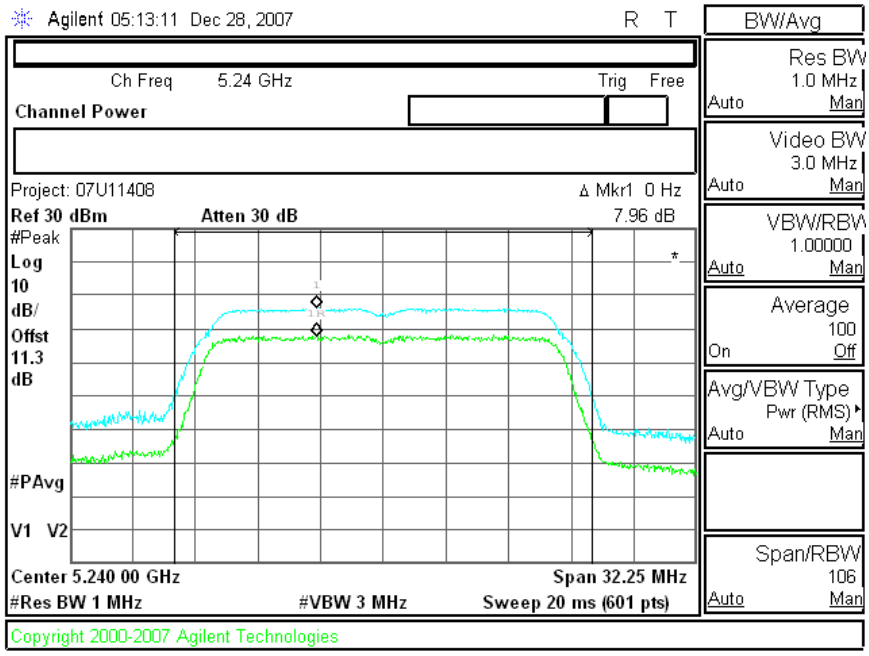
CHAIN A



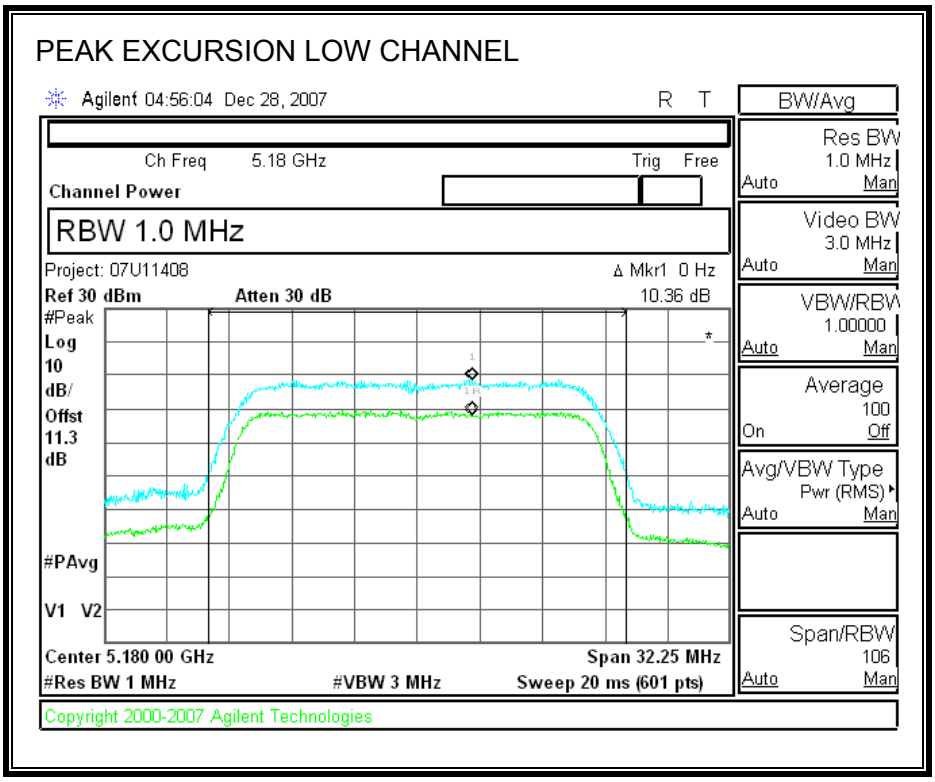
PEAK EXCURSION MID CHANNEL



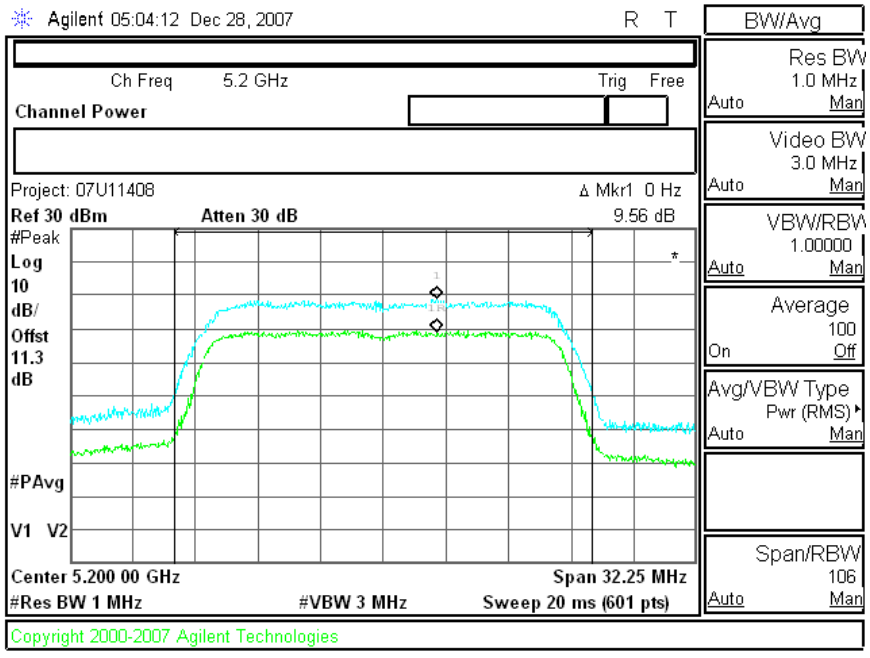
PEAK EXCURSION HIGH CHANNEL



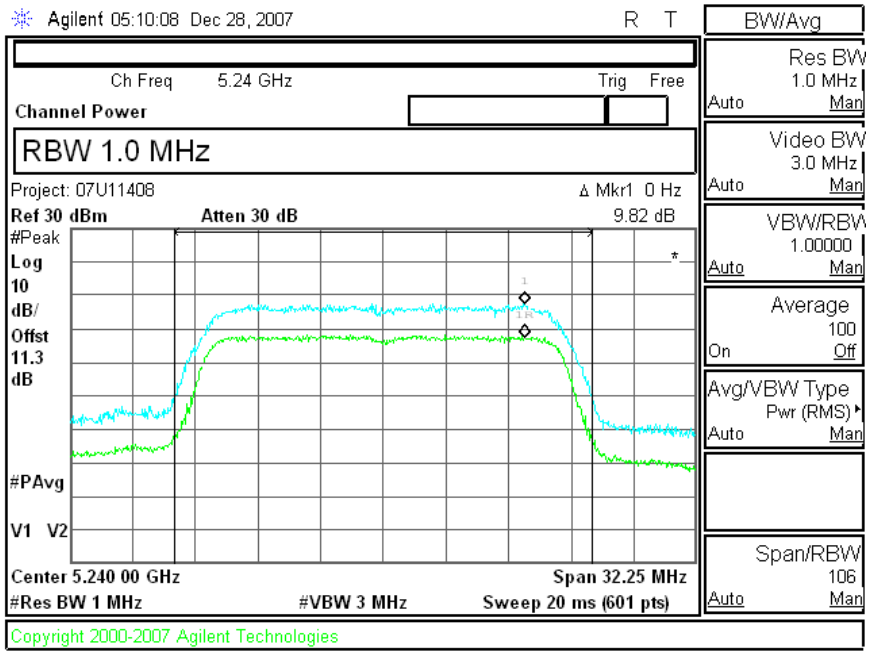
CHAIN B



PEAK EXCURSION MID CHANNEL



PEAK EXCURSION HIGH CHANNEL



7.2.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

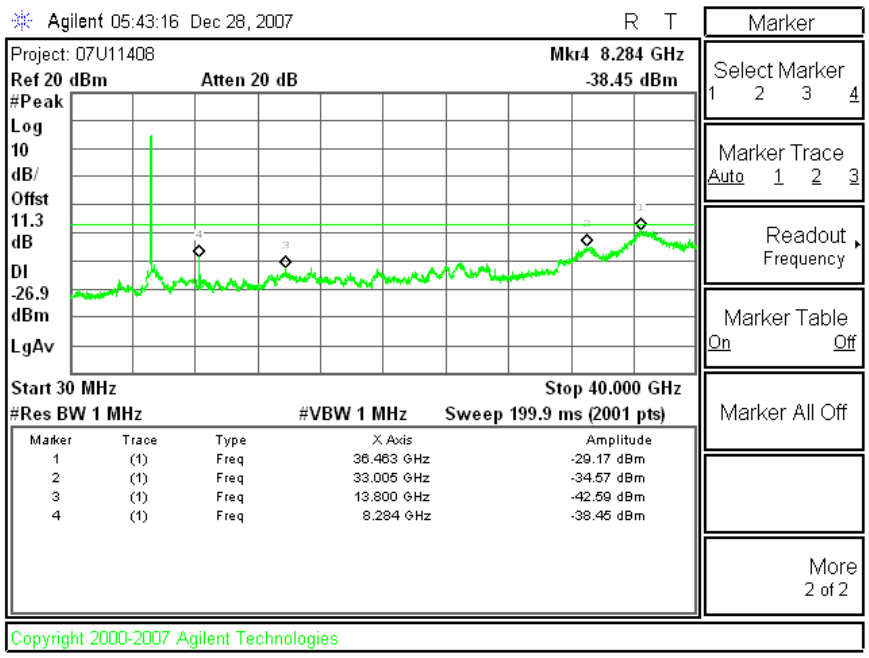
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

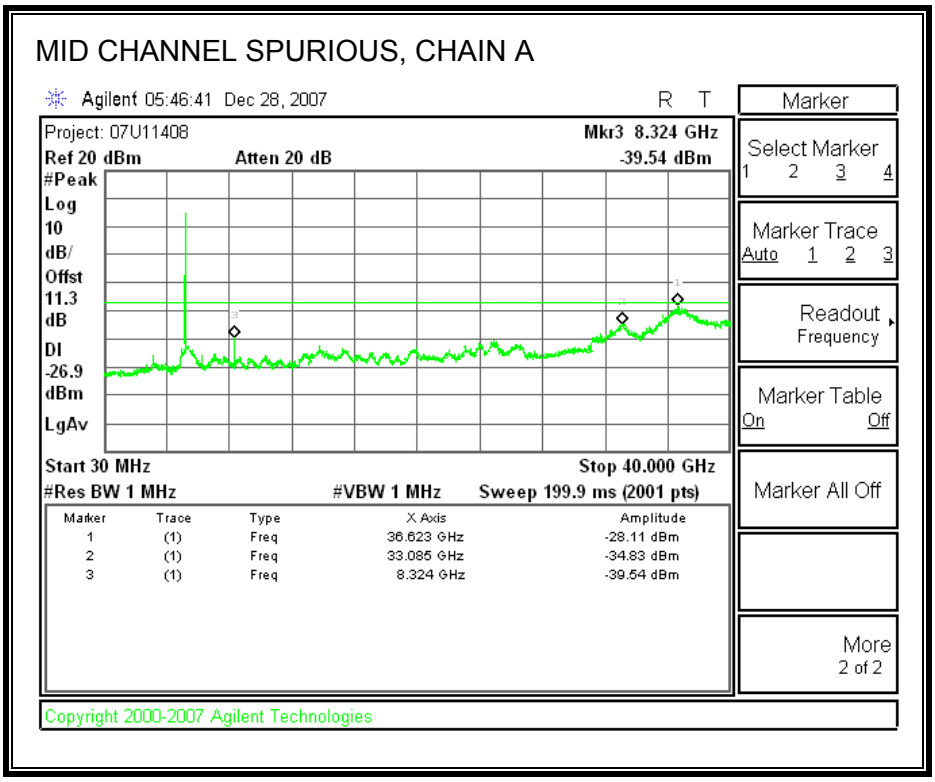
RESULTS

CHAIN A SPURIOUS EMISSIONS

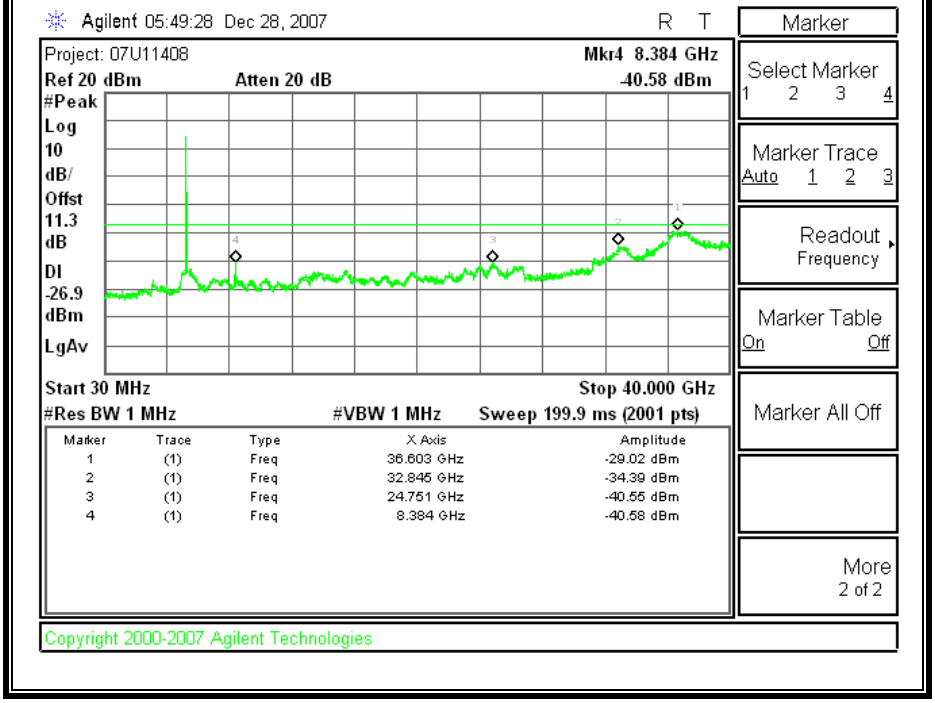
LOW CHANNEL SPURIOUS, CHAIN A



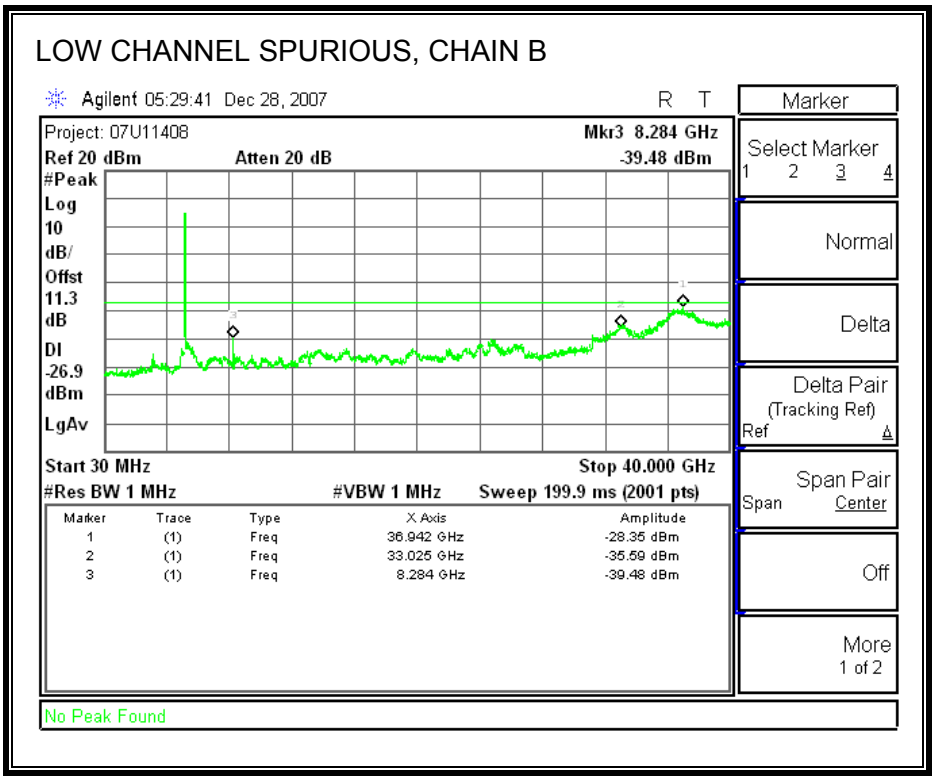
MID CHANNEL SPURIOUS, CHAIN A



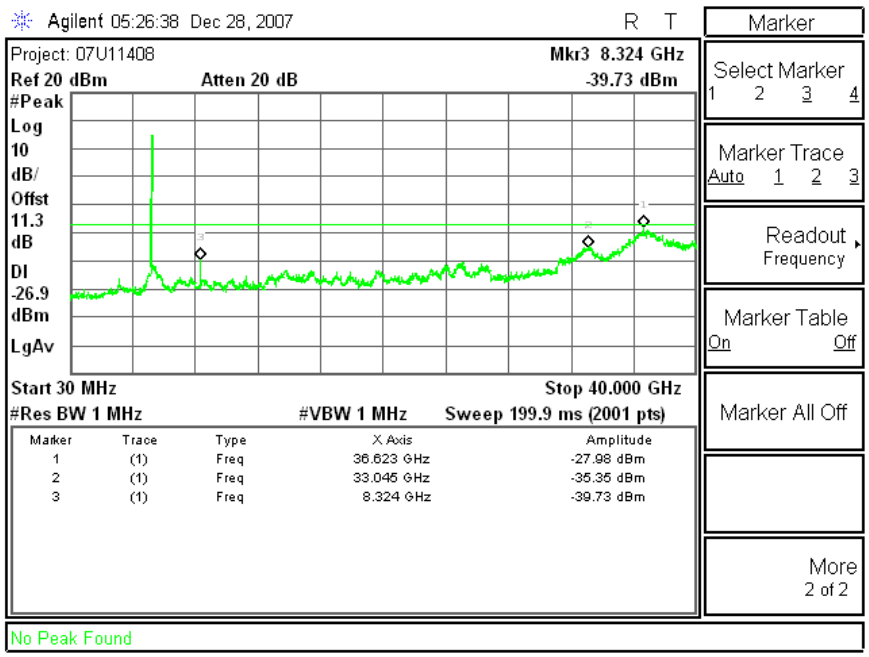
HIGH CHANNEL SPURIOUS, CHAIN A



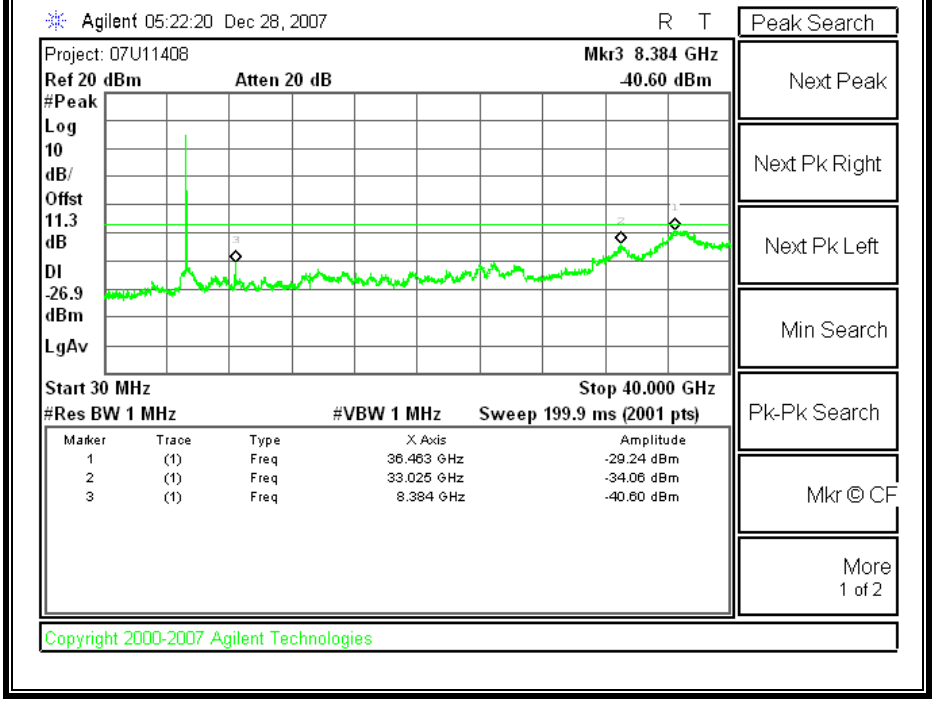
CHAIN B SPURIOUS EMISSIONS



MID CHANNEL SPURIOUS, CHAIN B

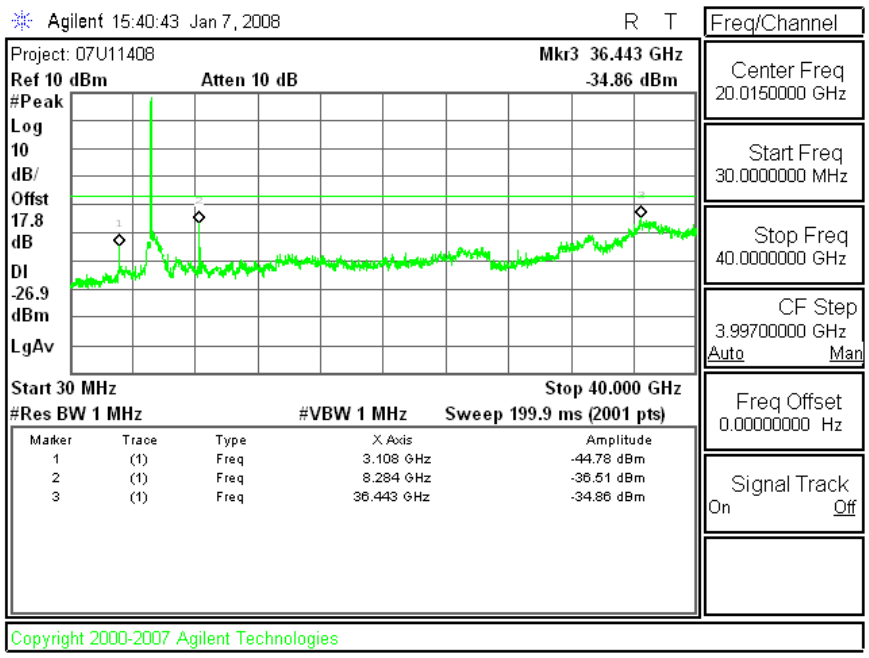


HIGH CHANNEL SPURIOUS, CHAIN B

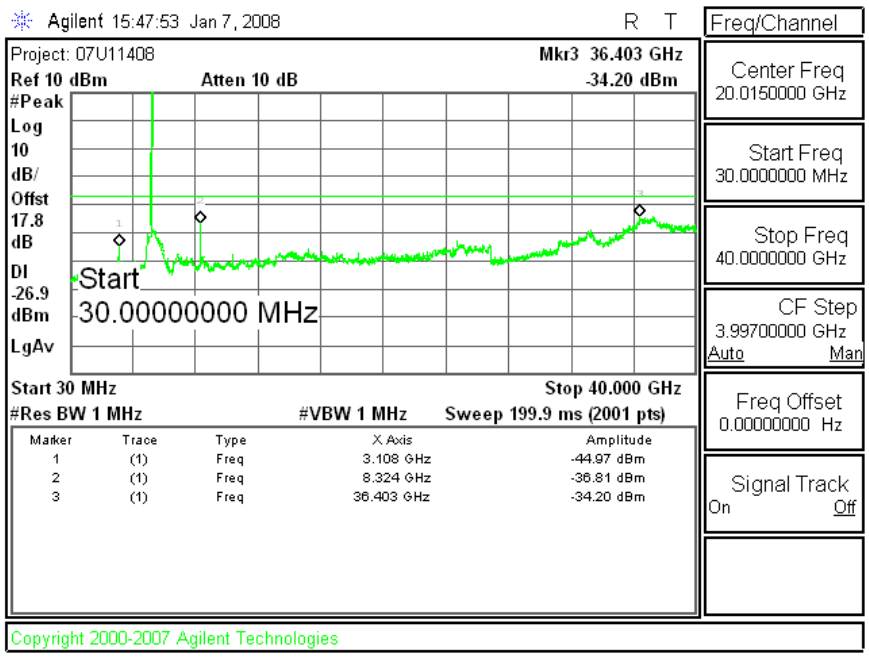


SPURIOUS EMISSIONS WITH COMBINER

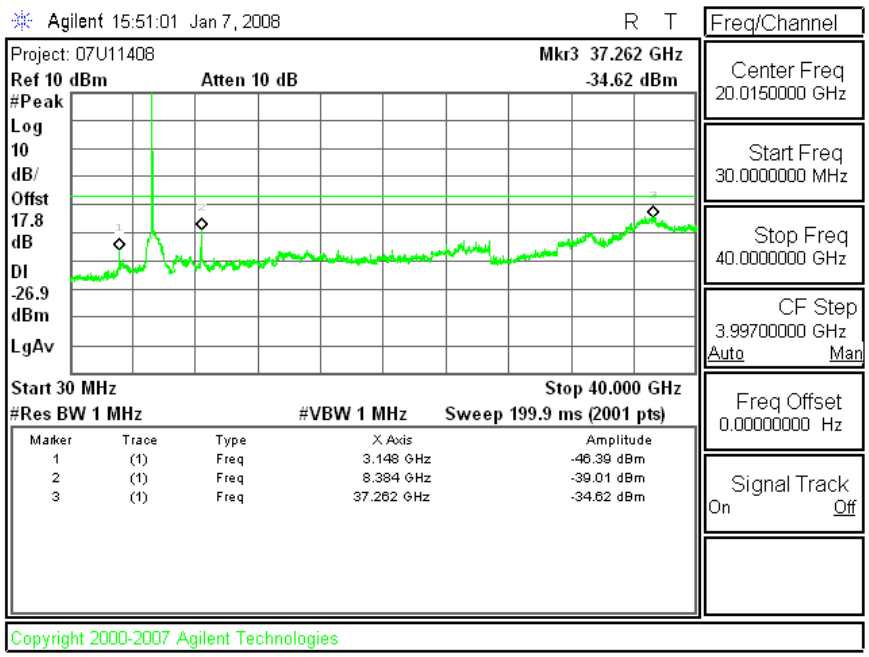
LOW CHANNEL SPURIOUS, WITH COMBINER



MID CHANNEL SPURIOUS, WITH COMBINER



HIGH CHANNEL SPURIOUS, WITH COMBINER



7.3. 802.11n HT40 MODE

7.3.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

26 dB Bandwidth

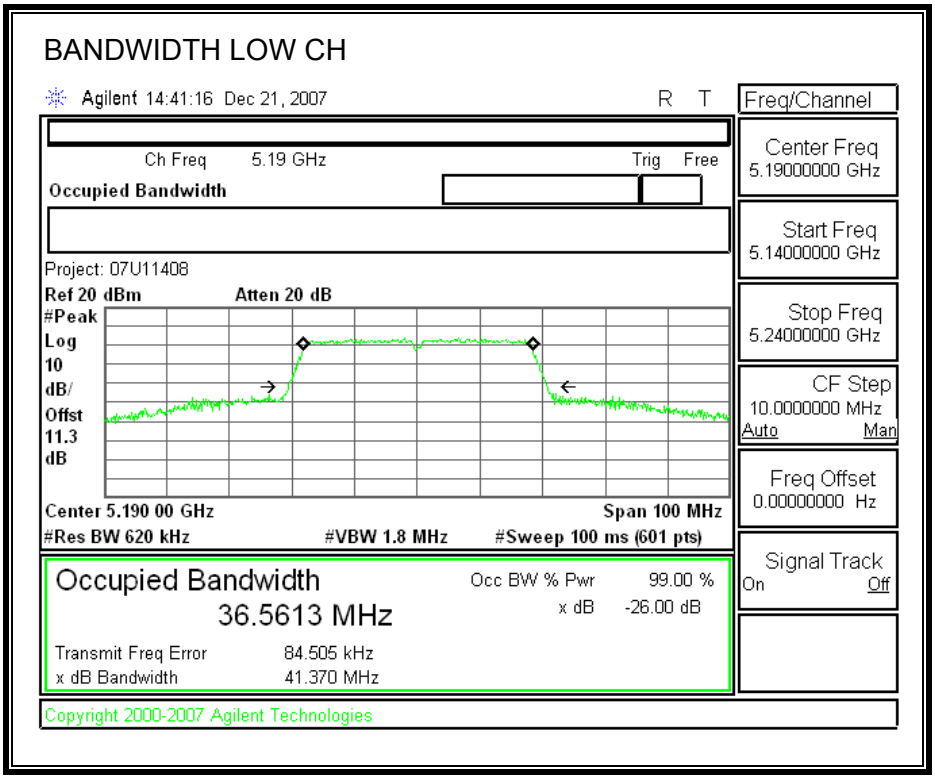
Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5190	41.370	41.093
High	5230	41.567	41.202

99% Bandwidth

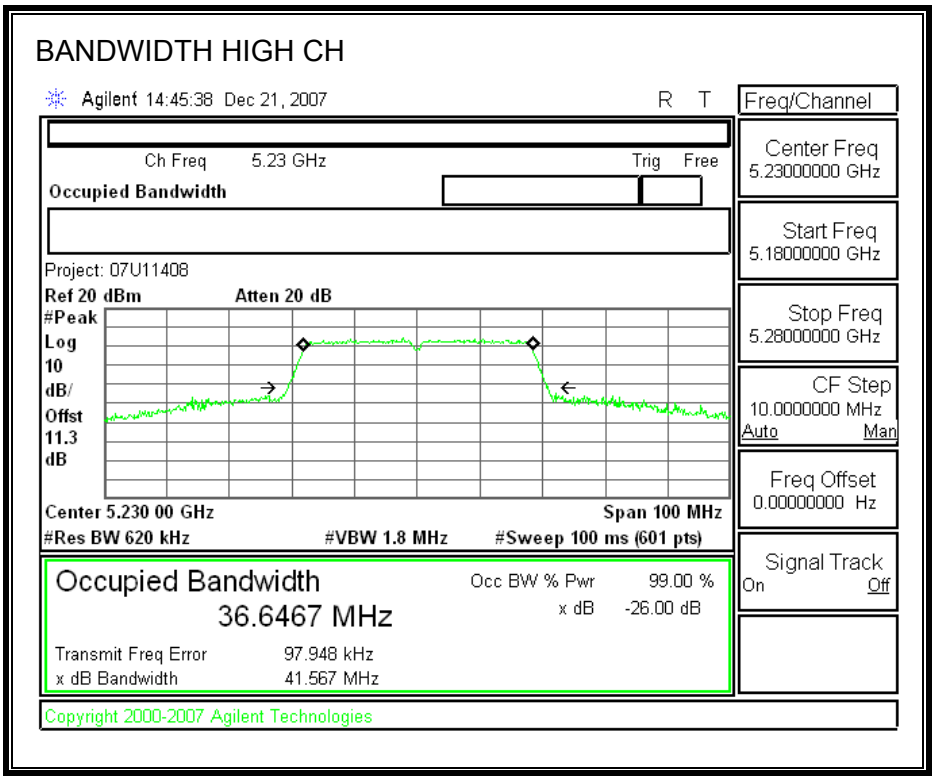
Channel	Frequency (MHz)	CHAIN A (MHz)	CHAIN B (MHz)
Low	5190	36.0877	36.1643
High	5230	36.0347	36.2374

26 dB BANDWIDTH

CHAIN A

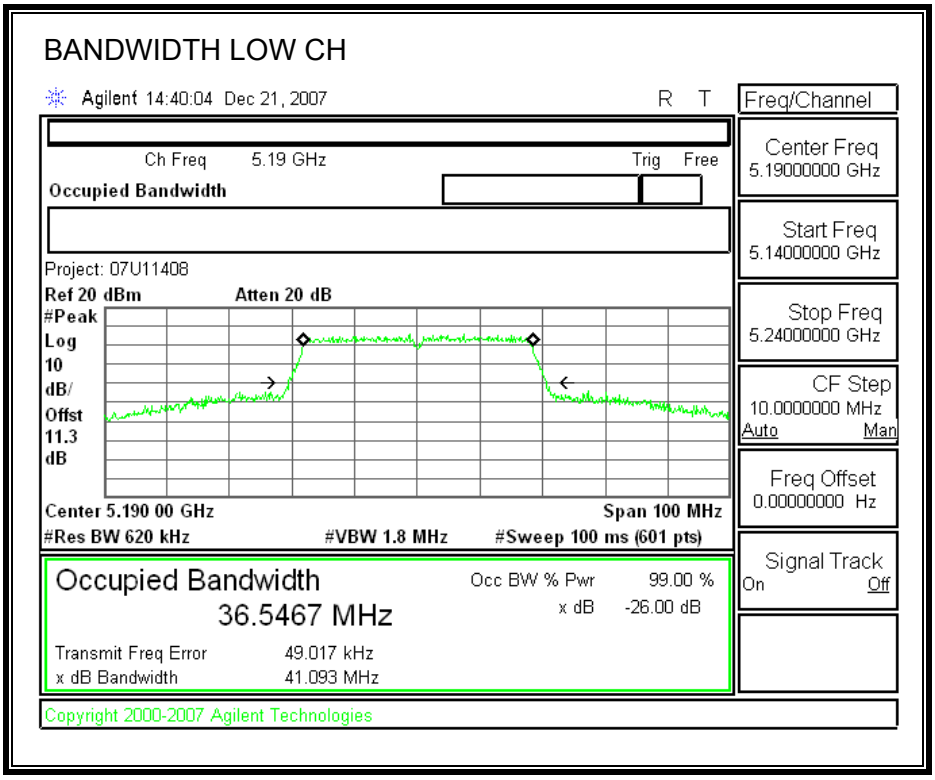


BANDWIDTH HIGH CH

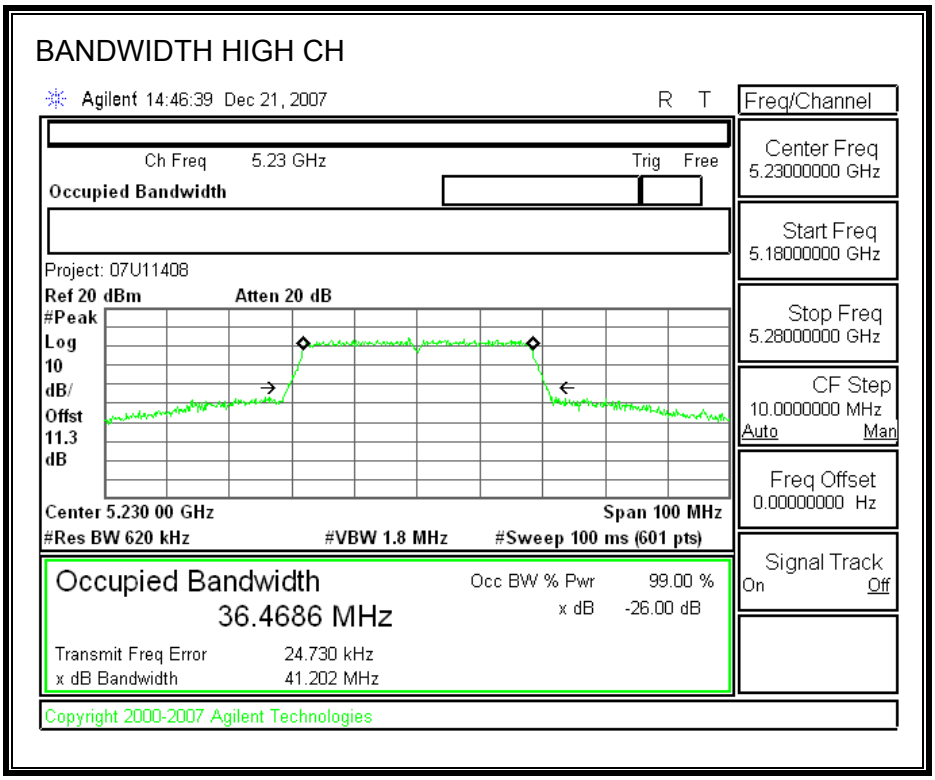


26 dB BANDWIDTH

CHAIN B

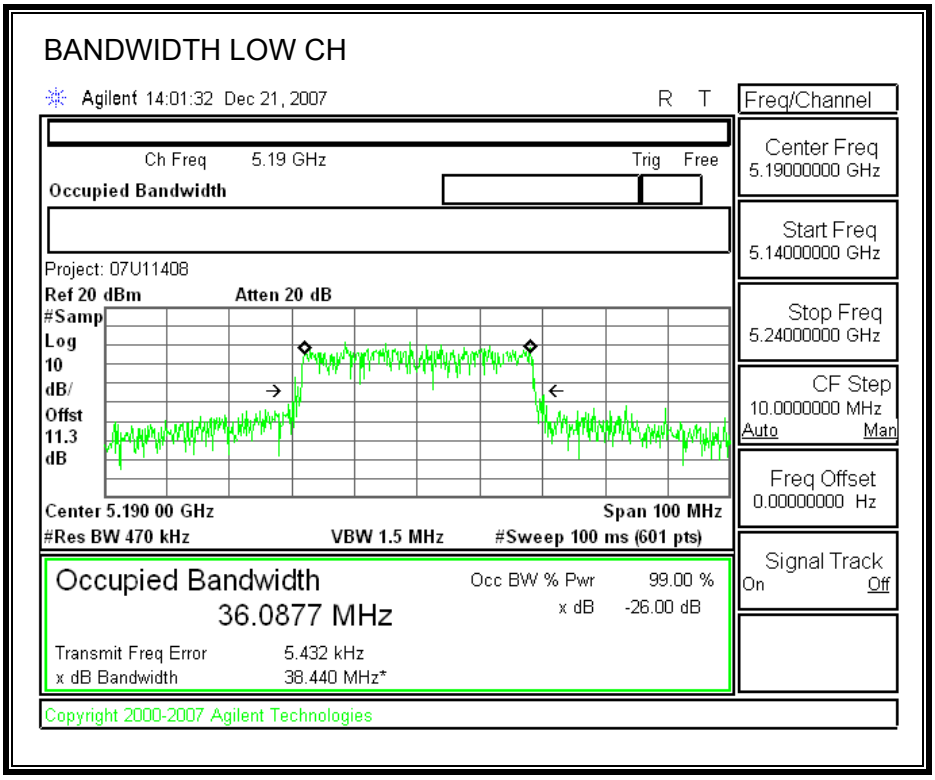


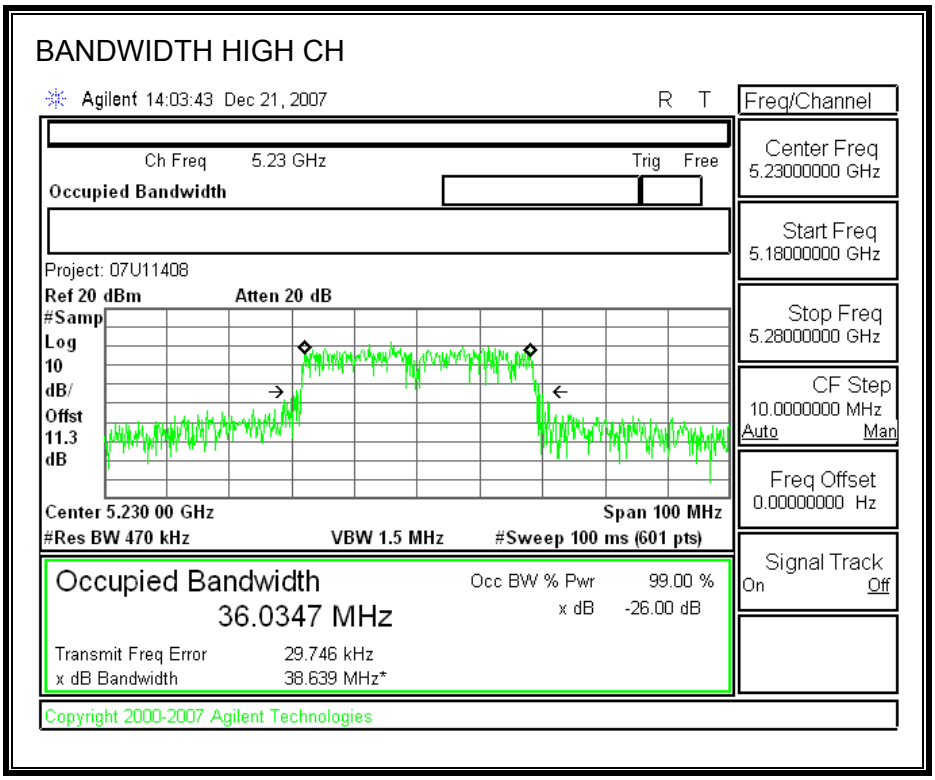
BANDWIDTH HIGH CH



99% BANDWIDTH

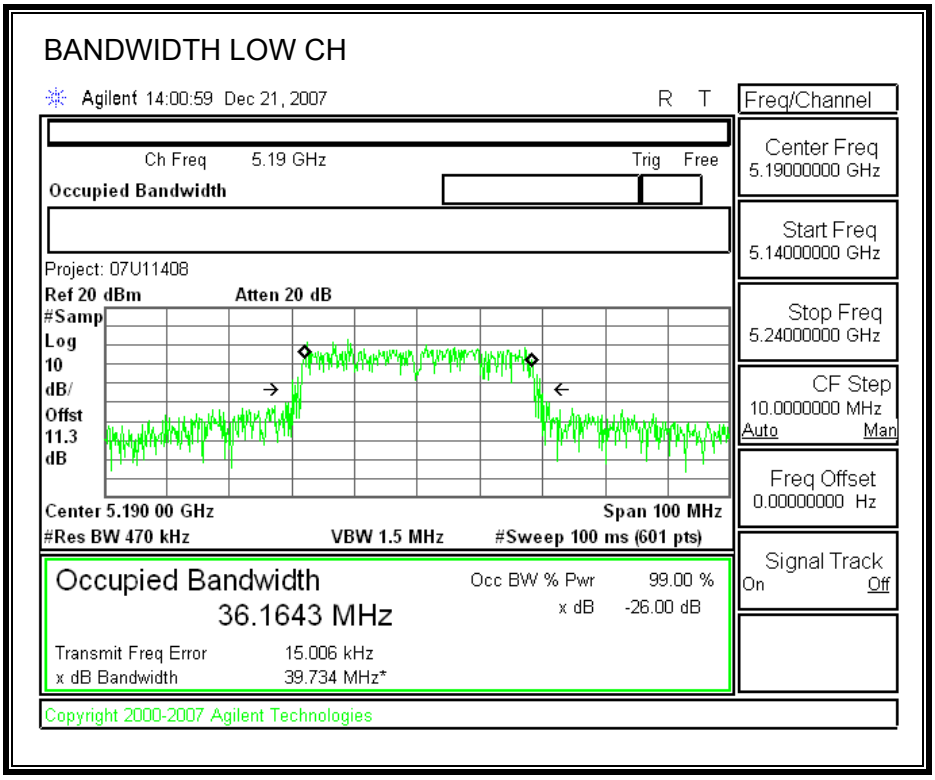
CHAIN A



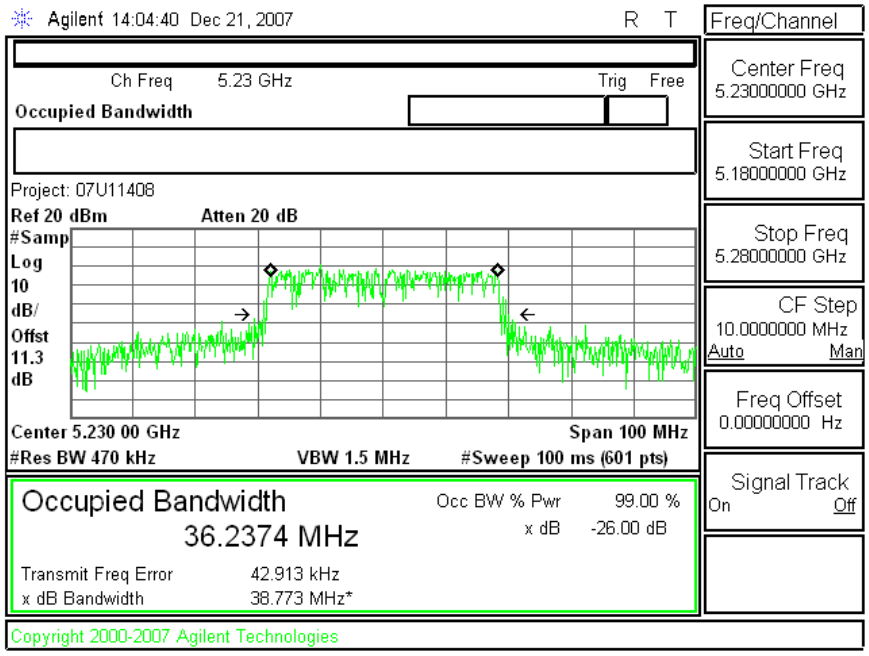


99% BANDWIDTH

CHAIN B



BANDWIDTH HIGH CH



7.3.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

TEST PROCEDURE

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

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

RESULTS

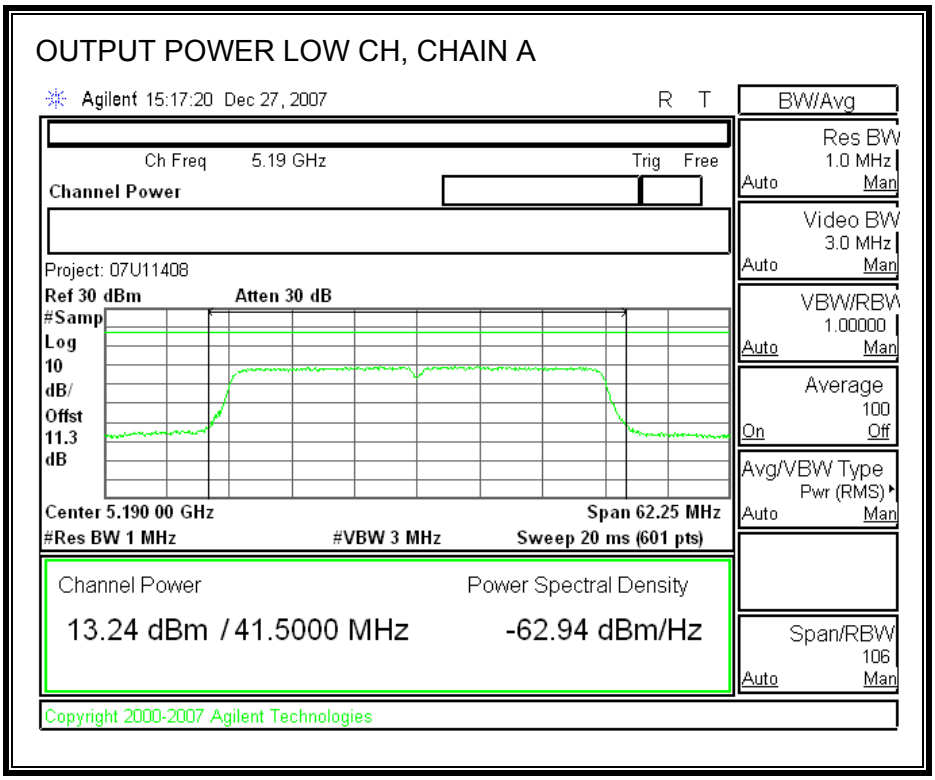
Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	41.093	20.14	-0.08	17.00
High	5230	17	41.202	20.15	-0.08	17.00

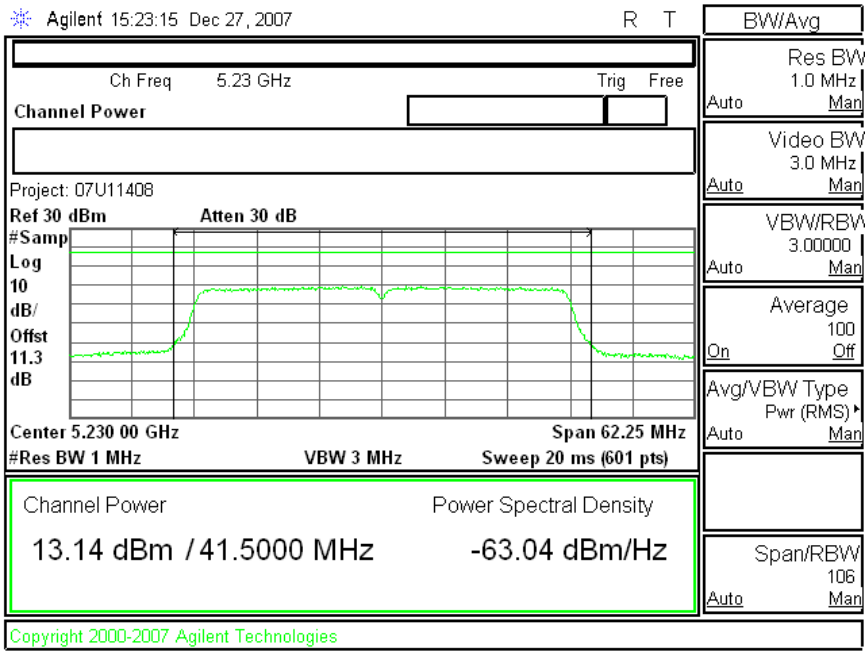
Individual Chain Results

Channel	Frequency (MHz)	Chain A Power (dBm)	Chain B Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	13.24	12.95	16.11	17.00	-3.76
High	5230	13.14	13.15	16.16	17.00	-3.86

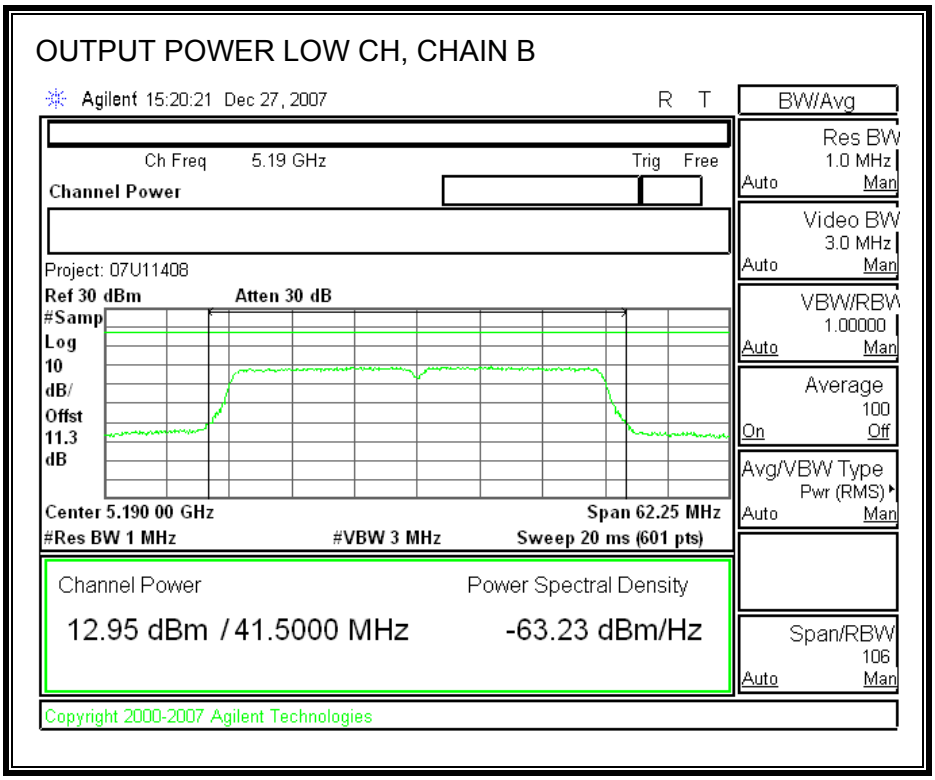
CHAIN A OUTPUT POWER



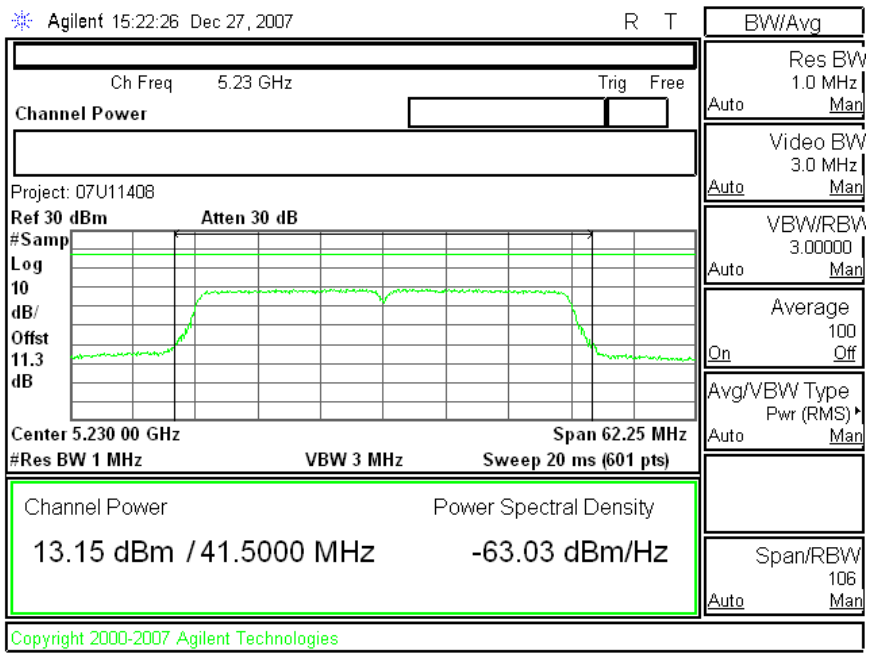
OUTPUT POWER HIGH CH, CHAIN A



CHAIN B OUTPUT POWER



OUTPUT POWER HIGH CH, CHAIN B



7.3.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

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

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

TEST PROCEDURE

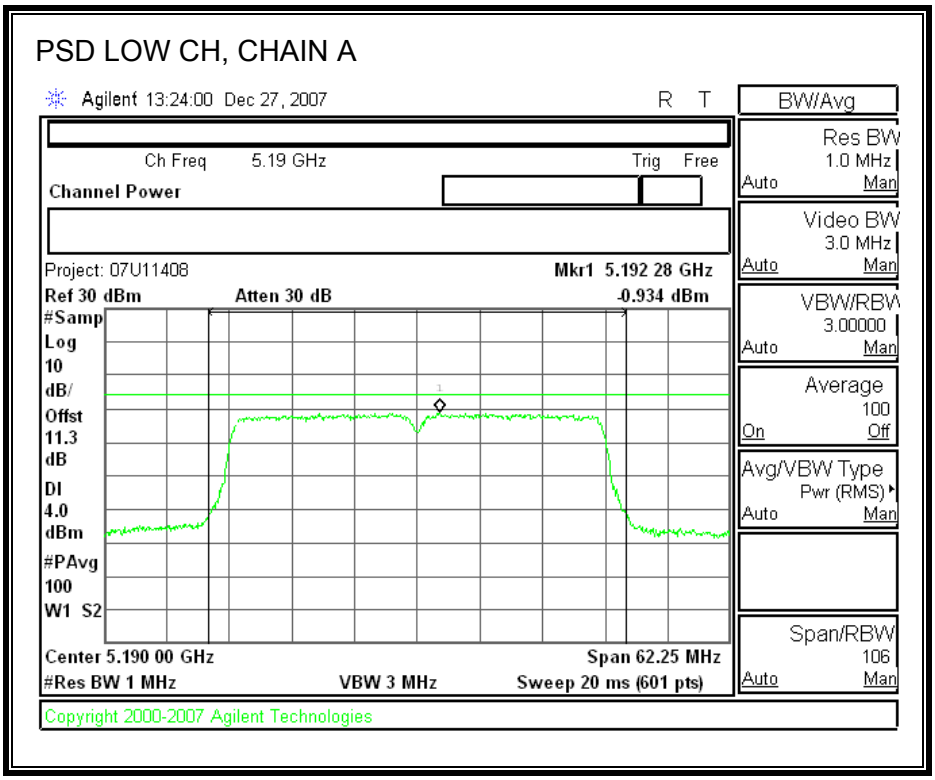
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

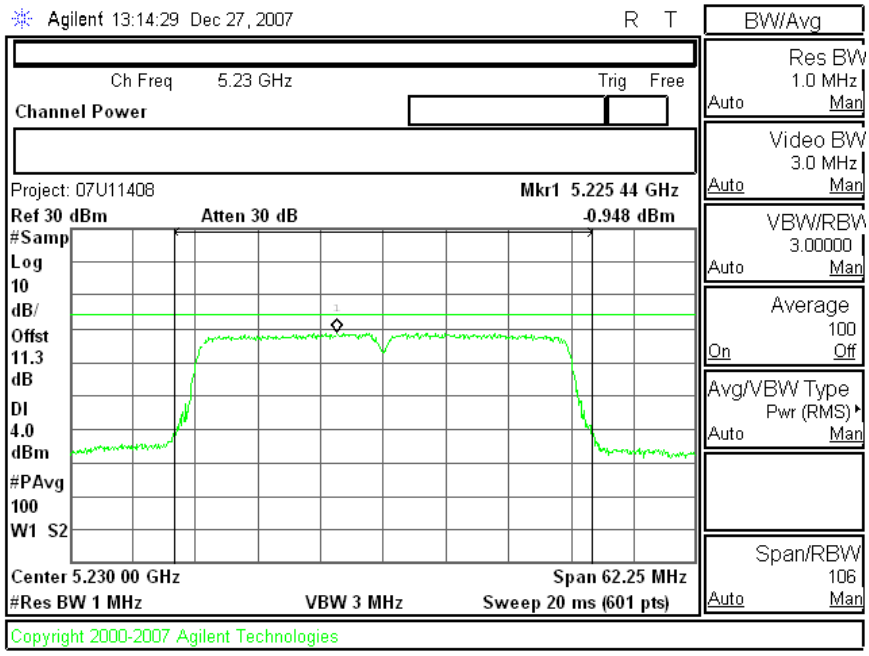
Channel	Frequency (MHz)	Chain A PPSD (dBm)	Chain B PPSD (dBm)	Limit (dBm)
Low	5190	-0.934	-1.128	4
High	5330	-0.948	-0.992	4

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5190	3.863	4	-0.137
High	5330	3.825	4	-0.175

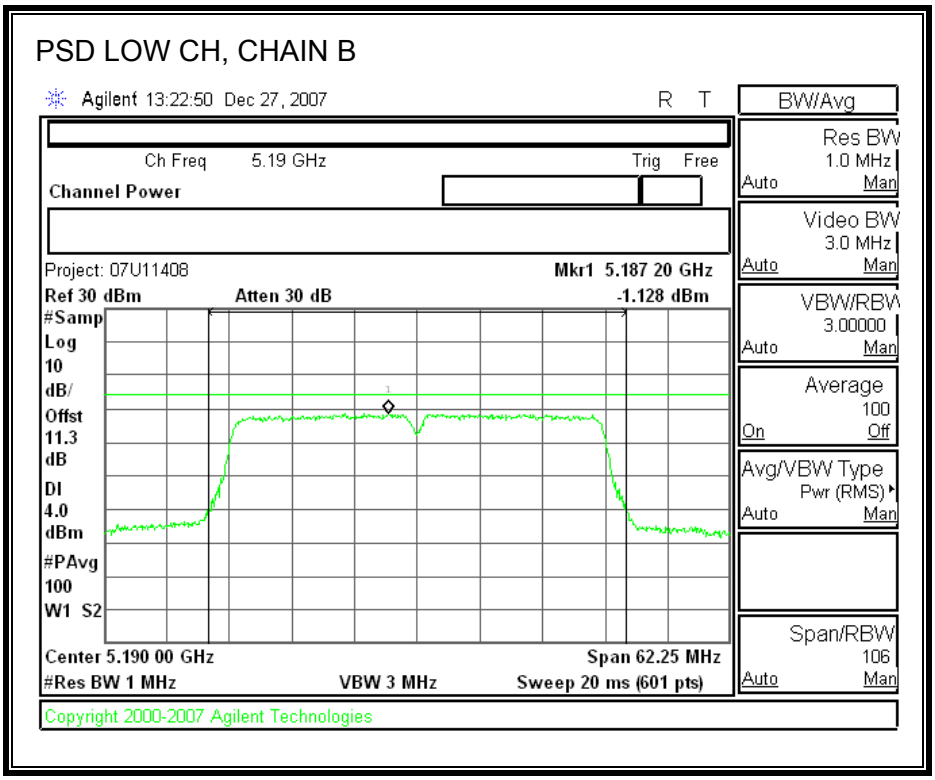
CHAIN A POWER SPECTRAL DENSITY



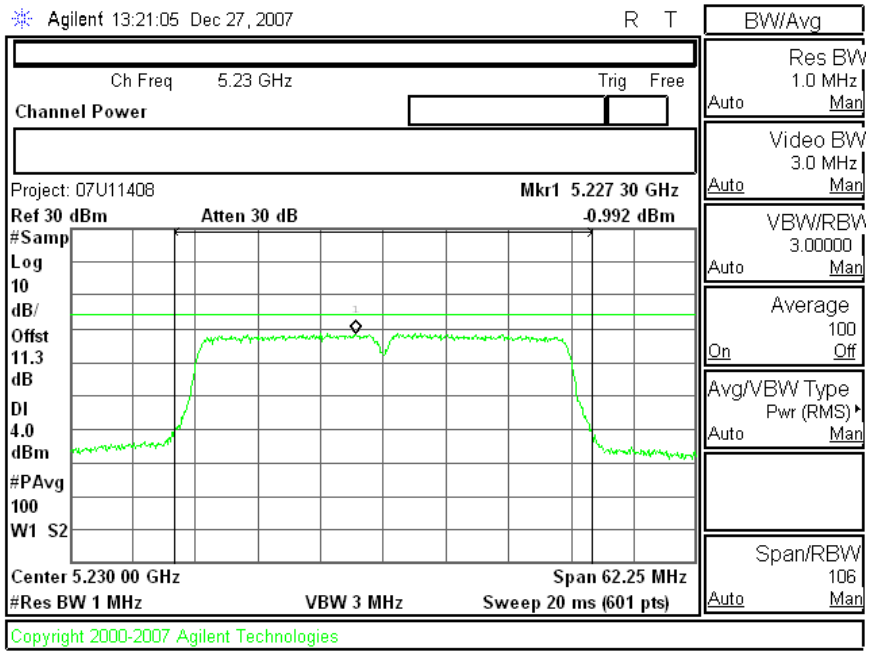
PSD HIGH CH, CHAIN A



CHAIN B POWER SPECTRAL DENSITY

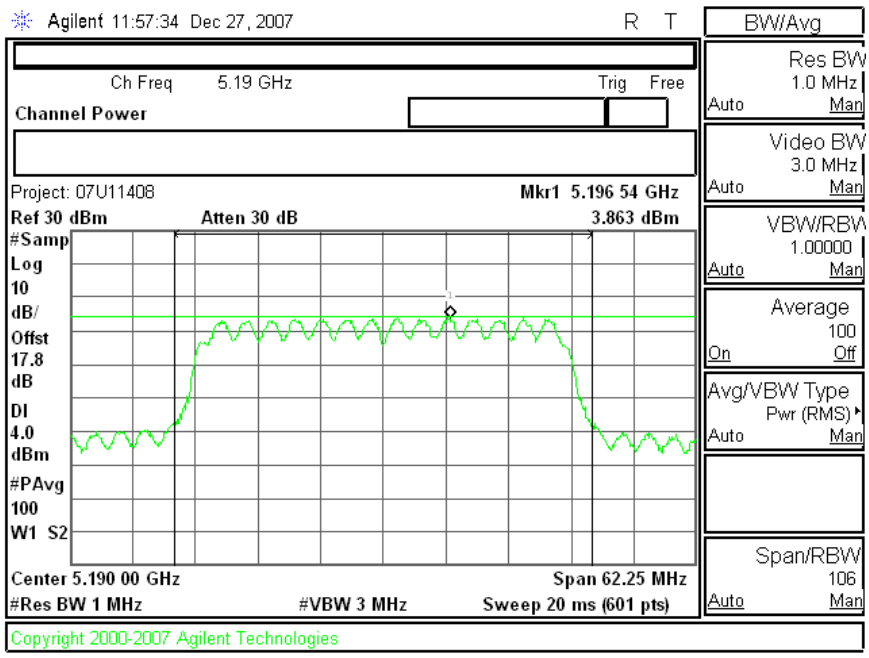


PSD HIGH CH, CHAIN B

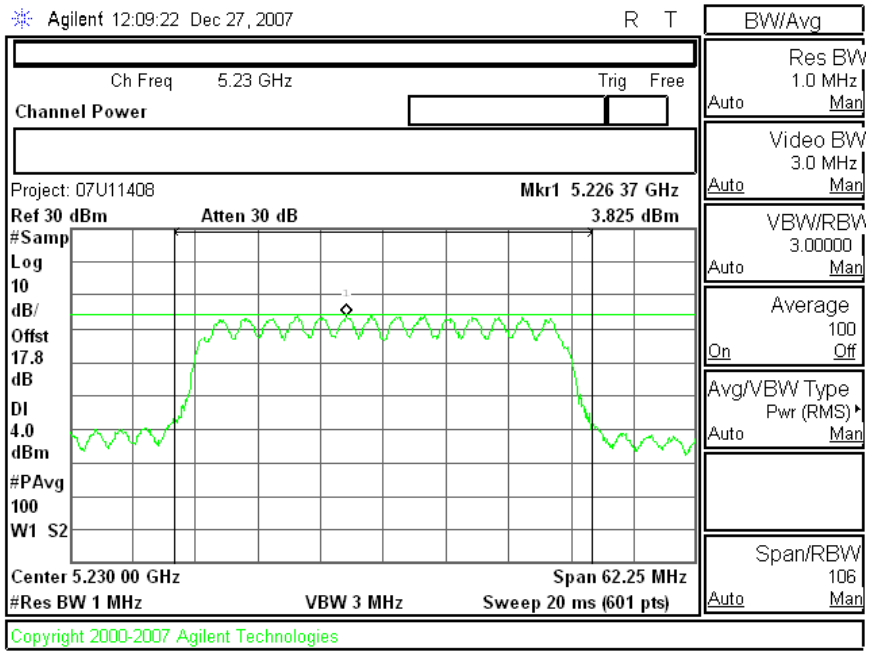


POWER SPECTRAL DENSITY WITH COMBINER

PSD LOW CH, WITH COMBINER



PSD HIGH CH, WITH COMBINER



7.3.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

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

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

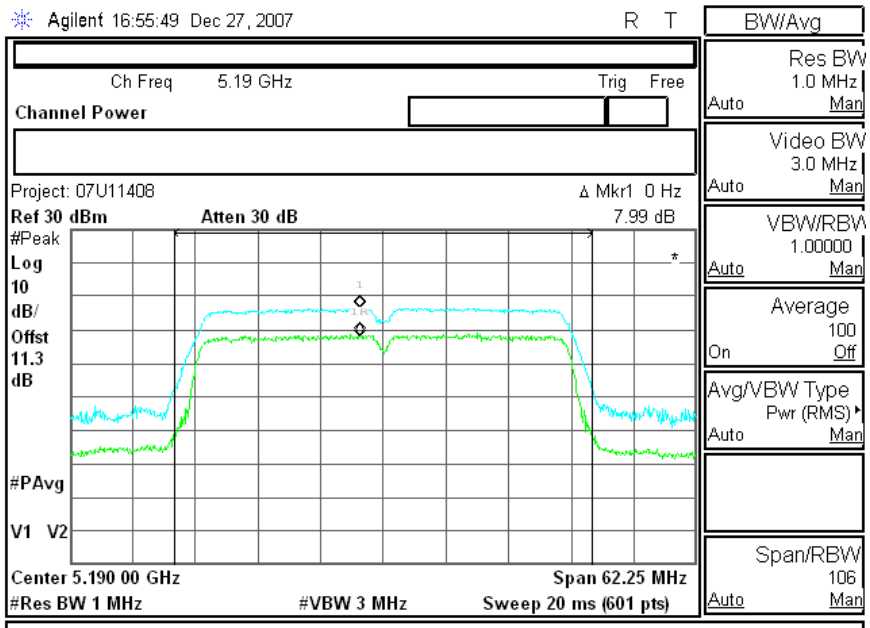
RESULTS

Mode Channel	Frequency (MHz)	Peak Excursion Chain A (dBm)	Peak Excursion Chain B (dBm)	Limit (dBm)	Worst Case Margin (dB)
802.11n HT40 Mode					
Low	5190	7.99	8.82	13	-4.18
High	5230	7.91	9.68	13	-3.32

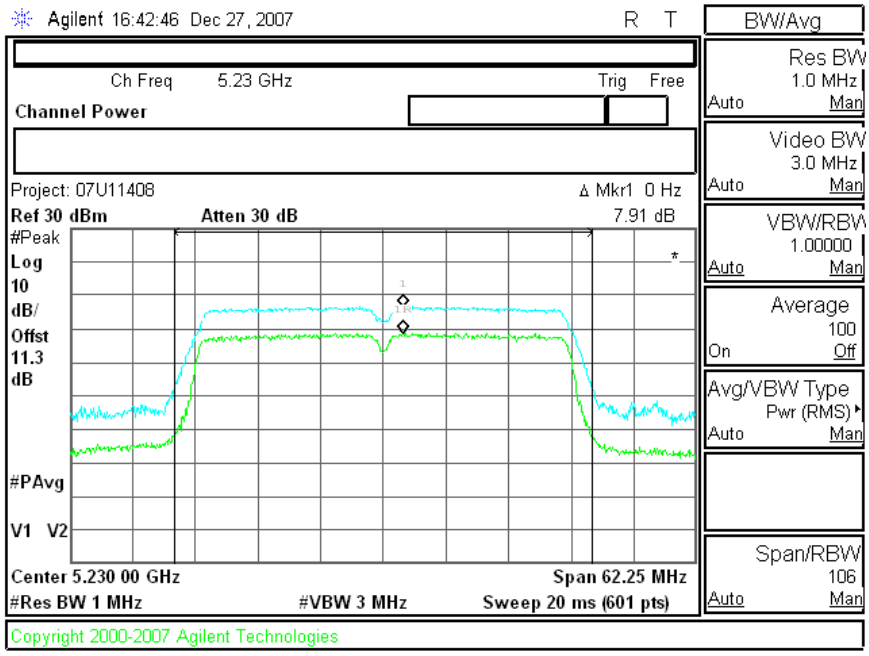
PEAK EXCURSION

CHAIN A

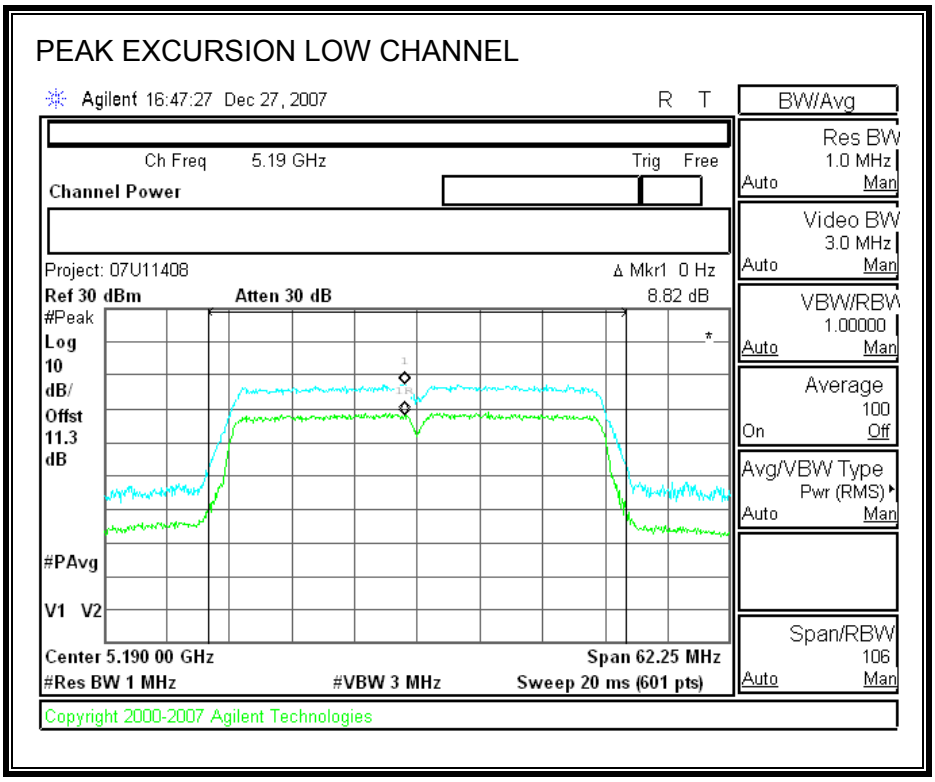
PEAK EXCURSION LOW CHANNEL



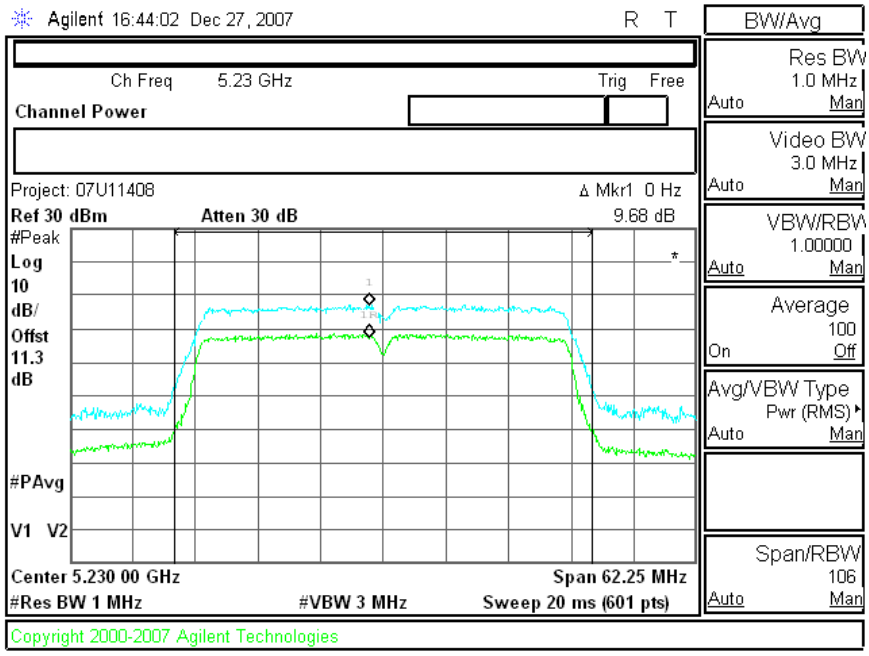
PEAK EXCURSION HIGH CHANNEL



CHAIN B



PEAK EXCURSION HIGH CHANNEL



7.3.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

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

TEST PROCEDURE

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

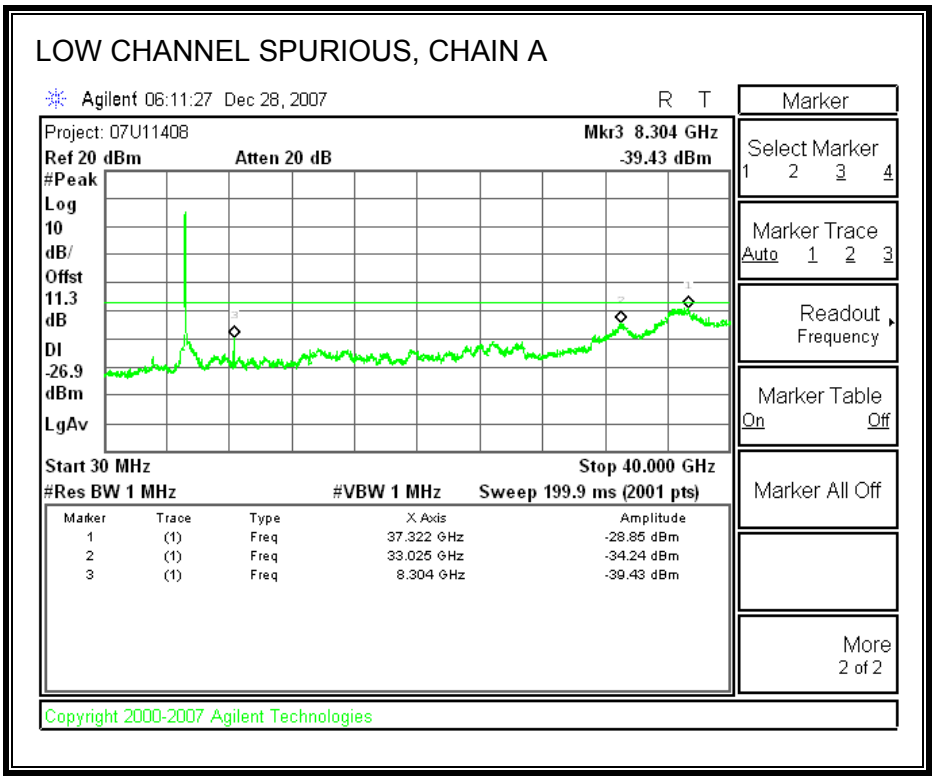
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

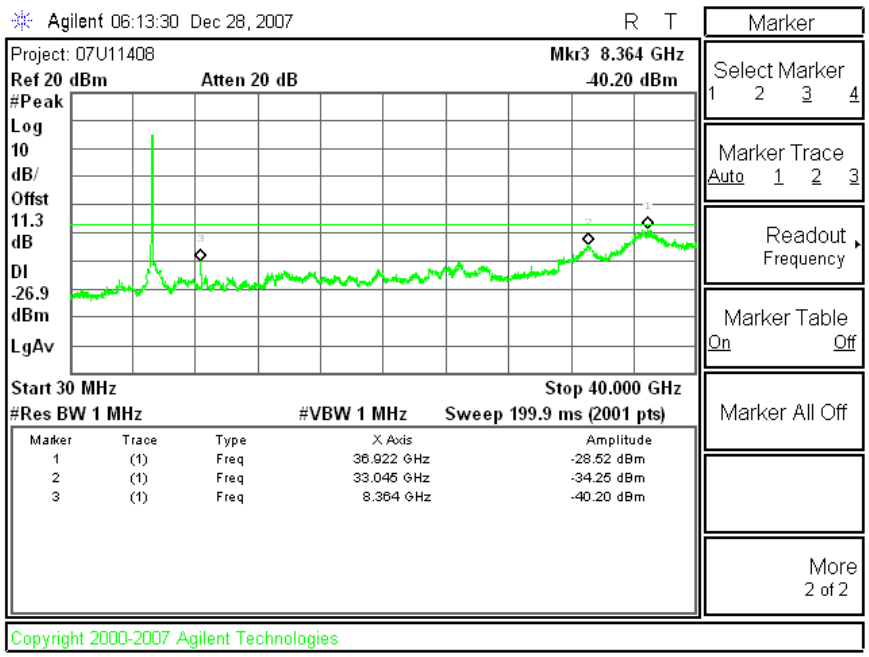
RESULTS

CHAIN A SPURIOUS EMISSIONS

LOW CHANNEL SPURIOUS, CHAIN A

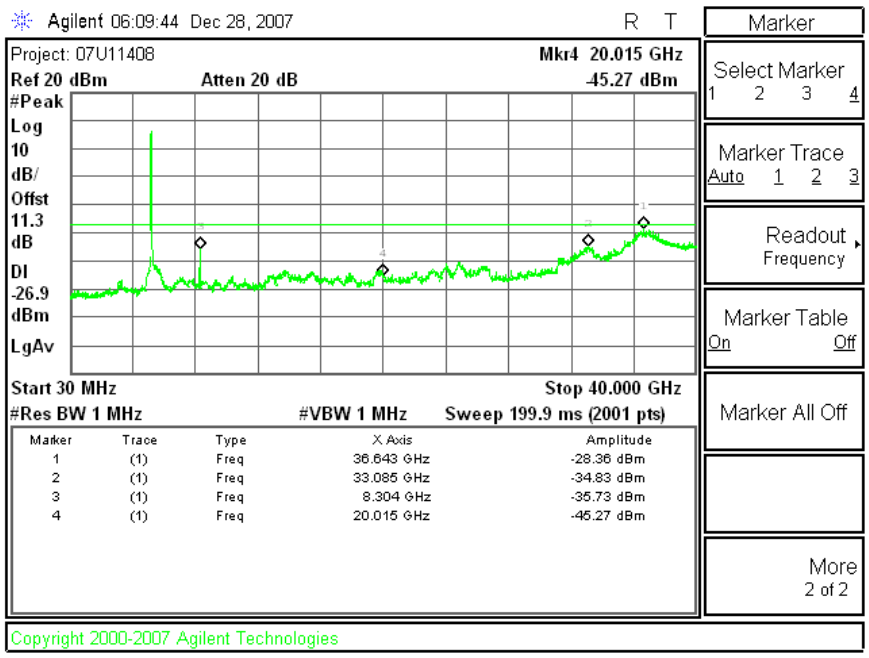


HIGH CHANNEL SPURIOUS, CHAIN A

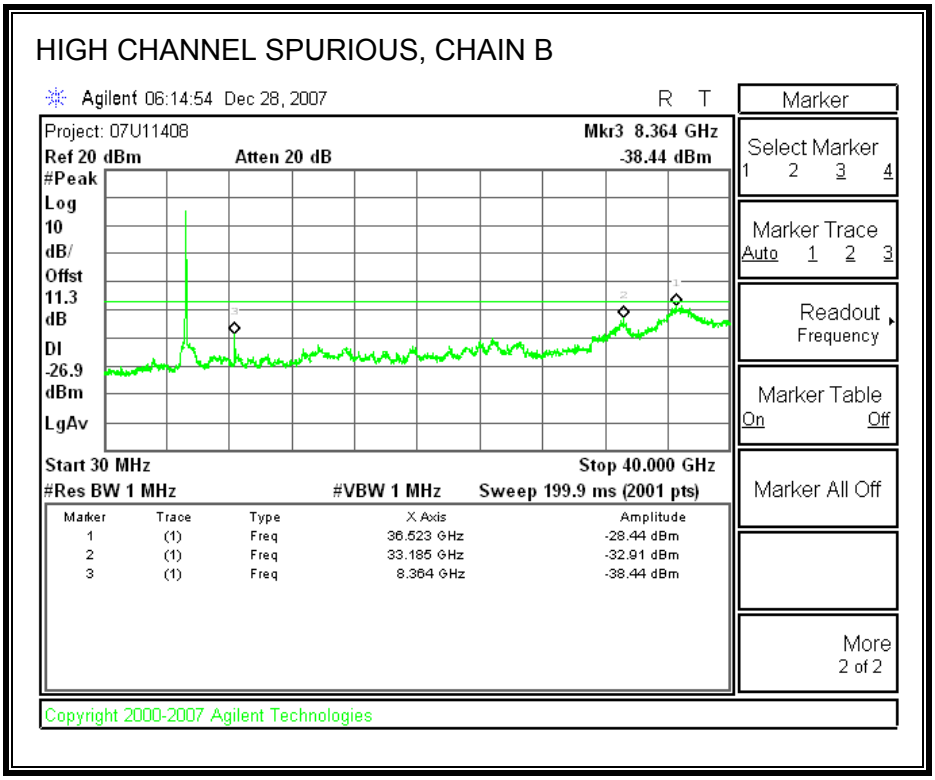


CHAIN B SPURIOUS EMISSIONS

LOW CHANNEL SPURIOUS, CHAIN B

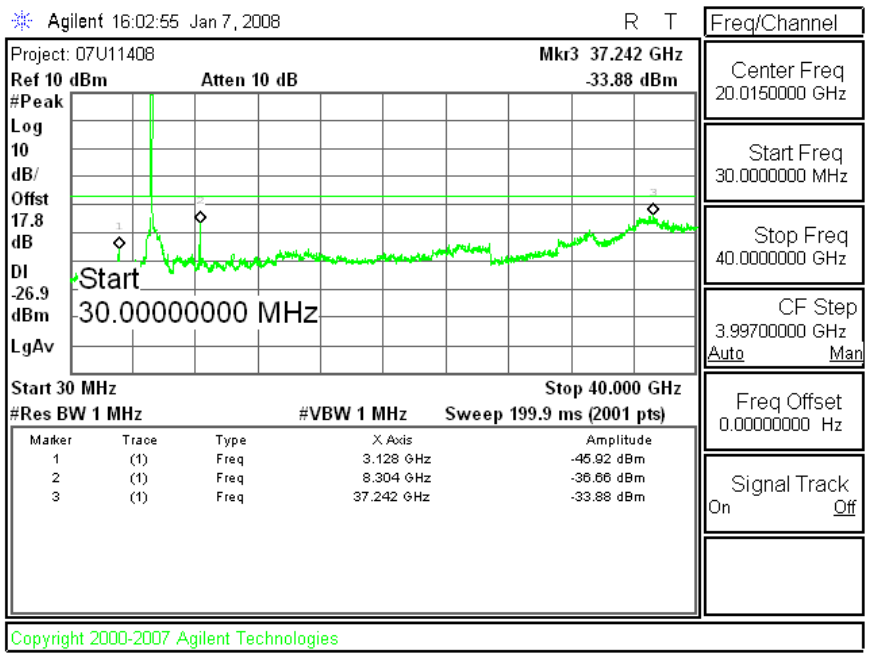


HIGH CHANNEL SPURIOUS, CHAIN B

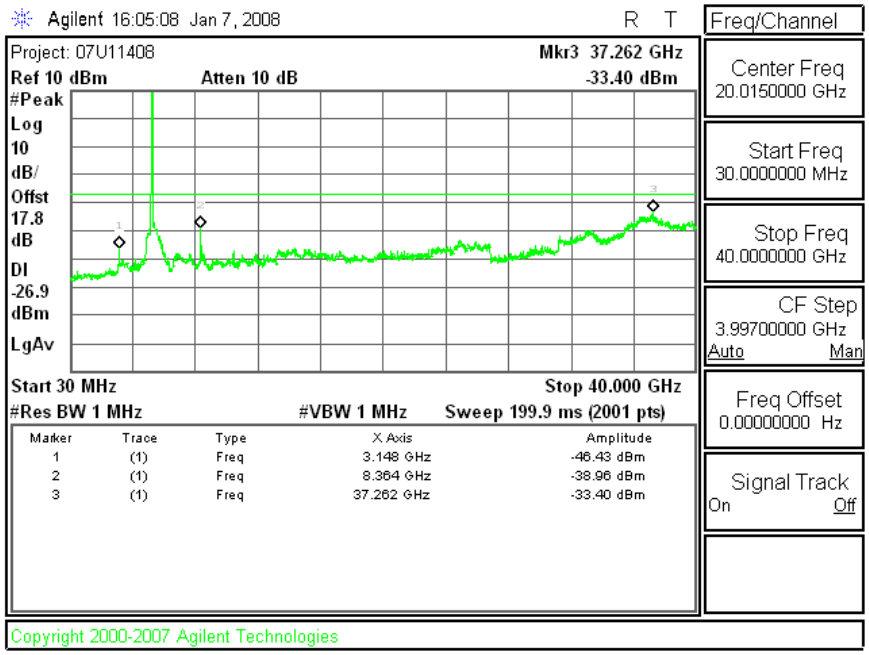


SPURIOUS EMISSIONS WITH COMBINER

LOW CHANNEL SPURIOUS, WITH COMBINER



HIGH CHANNEL SPURIOUS, WITH COMBINER



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

TEST PROCEDURE

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

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

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

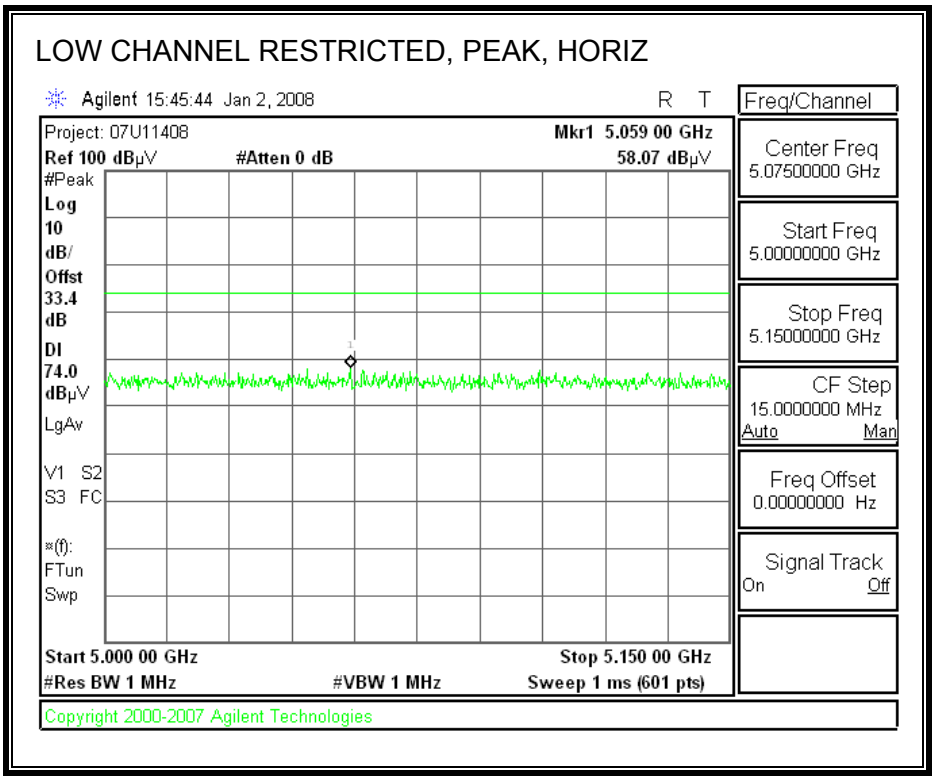
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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

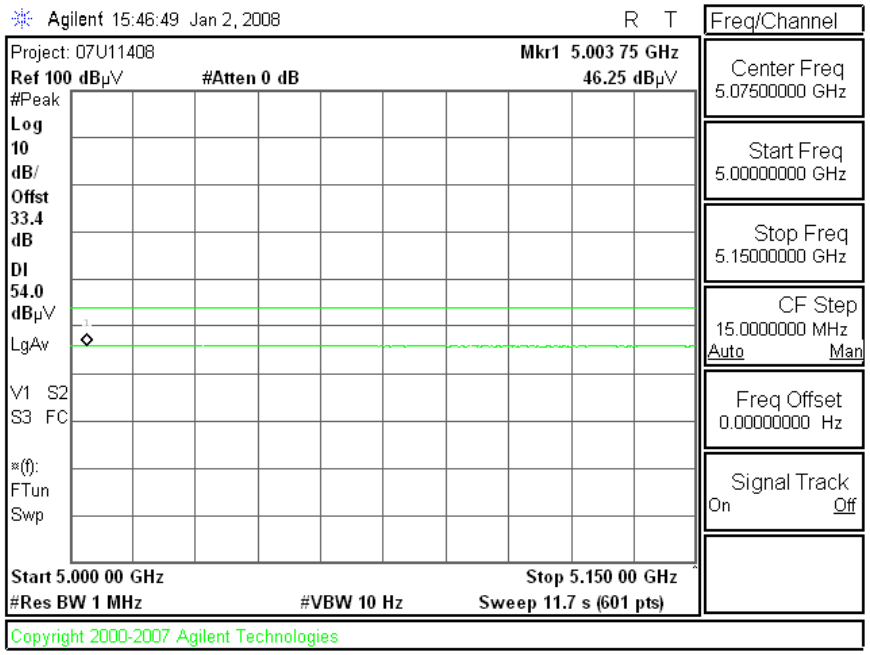
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. TX ABOVE 1 GHz FOR 802.11a DUAL CHAIN LEGACY MODE

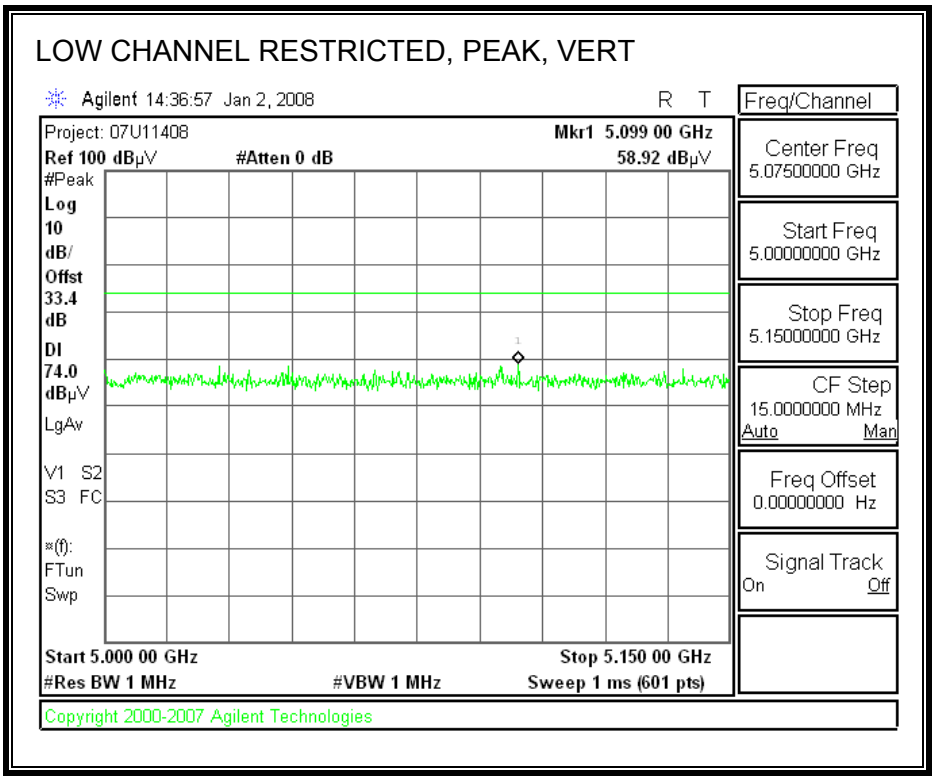
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



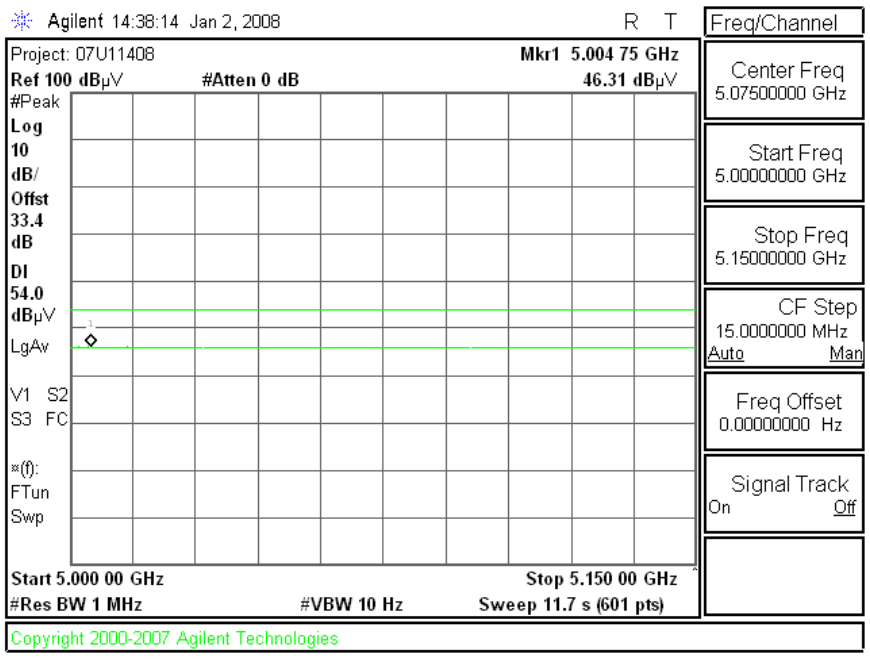
LOW CHANNEL RESTRICTED, AVG, HORIZ



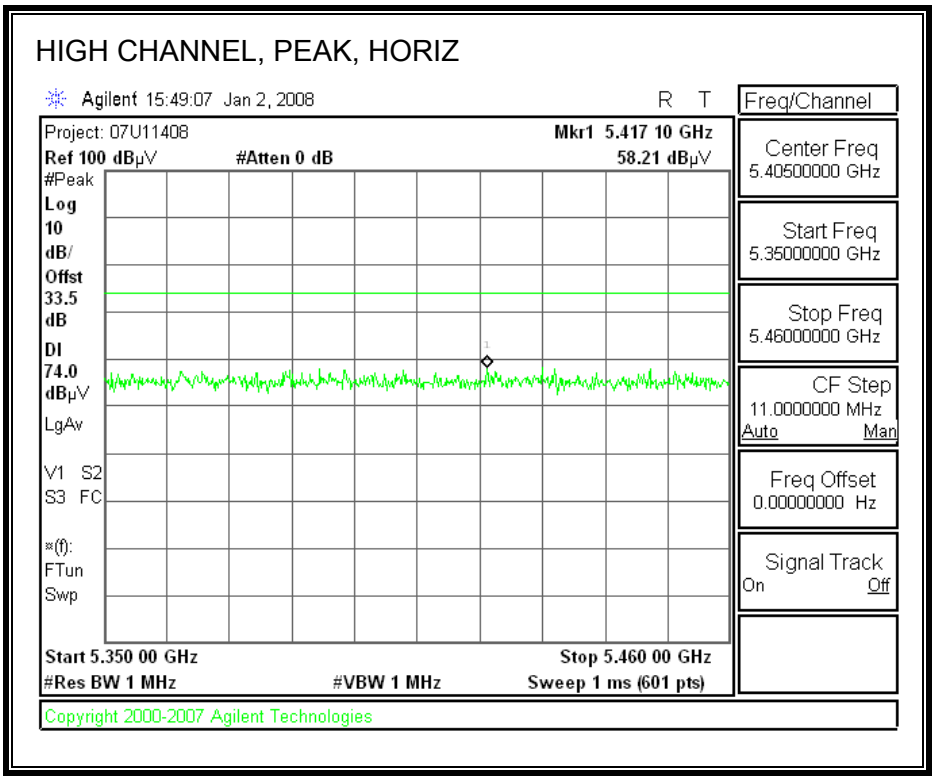
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



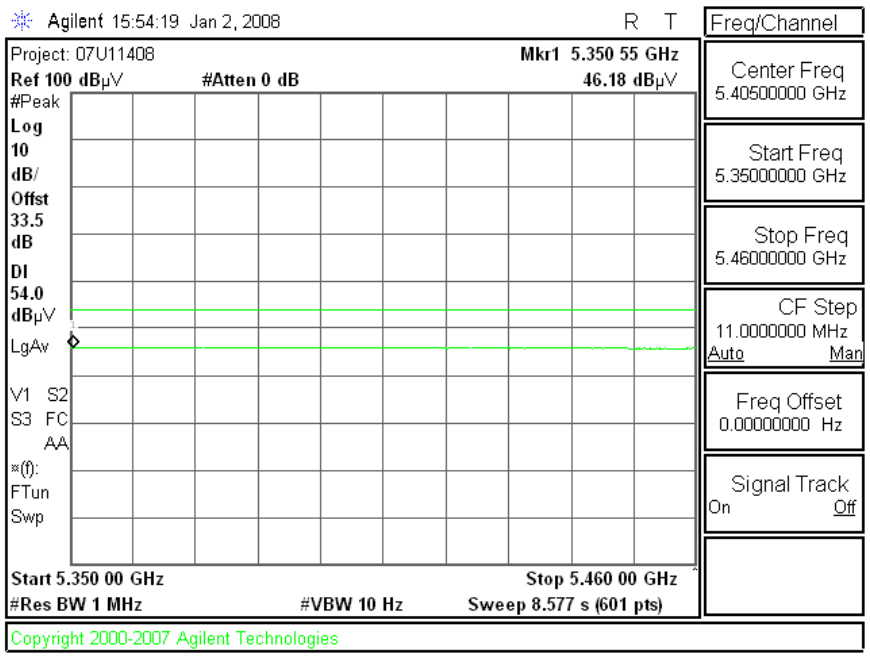
LOW CHANNEL RESTRICTED, AVG, VERT



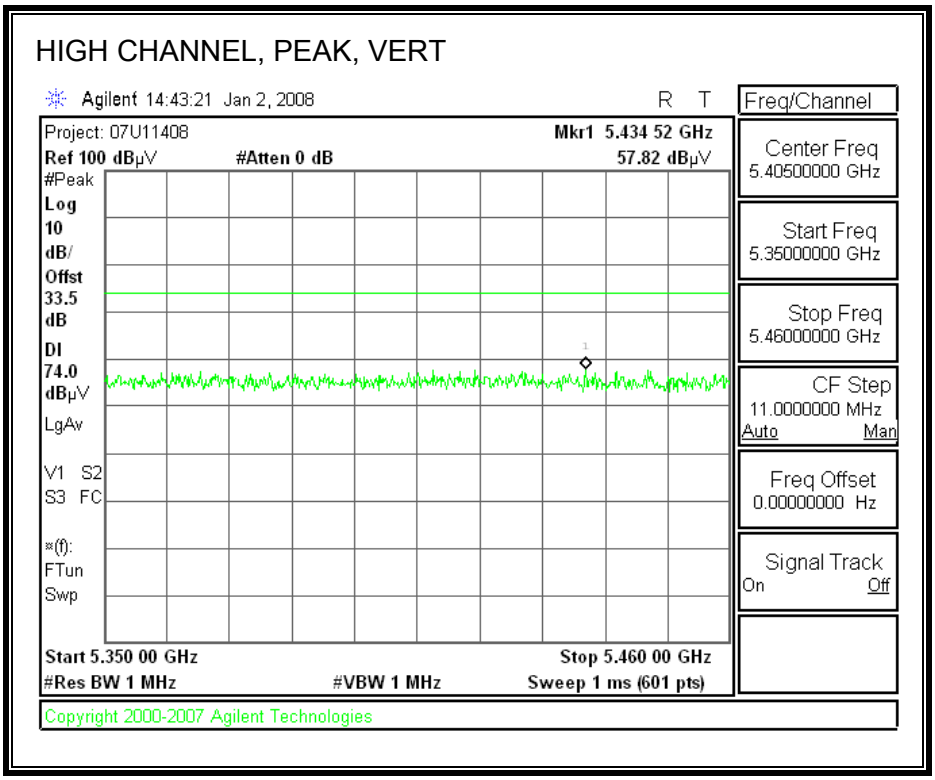
AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



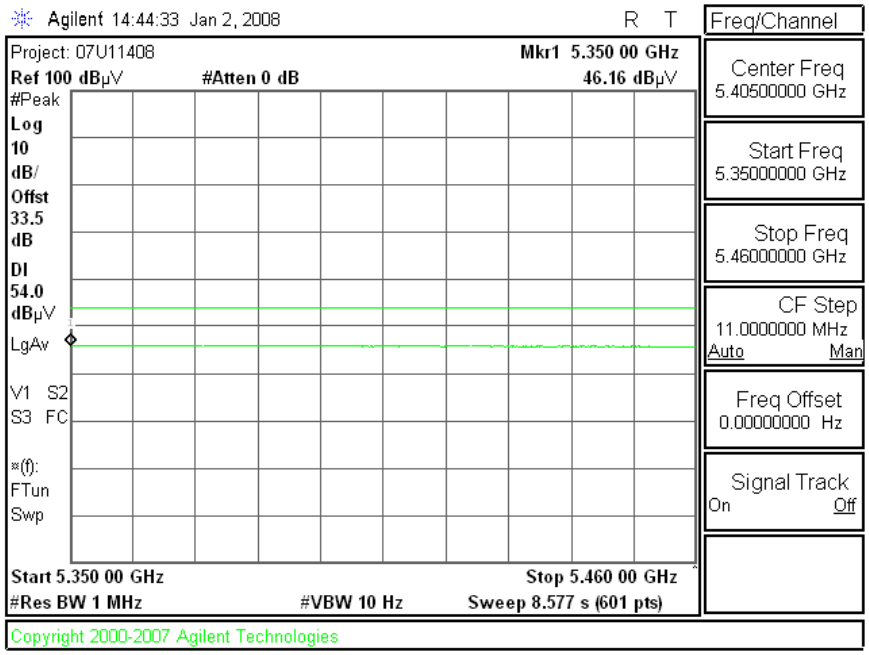
HIGH CHANNEL, AVG, HORIZ



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band a Mode, Tx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

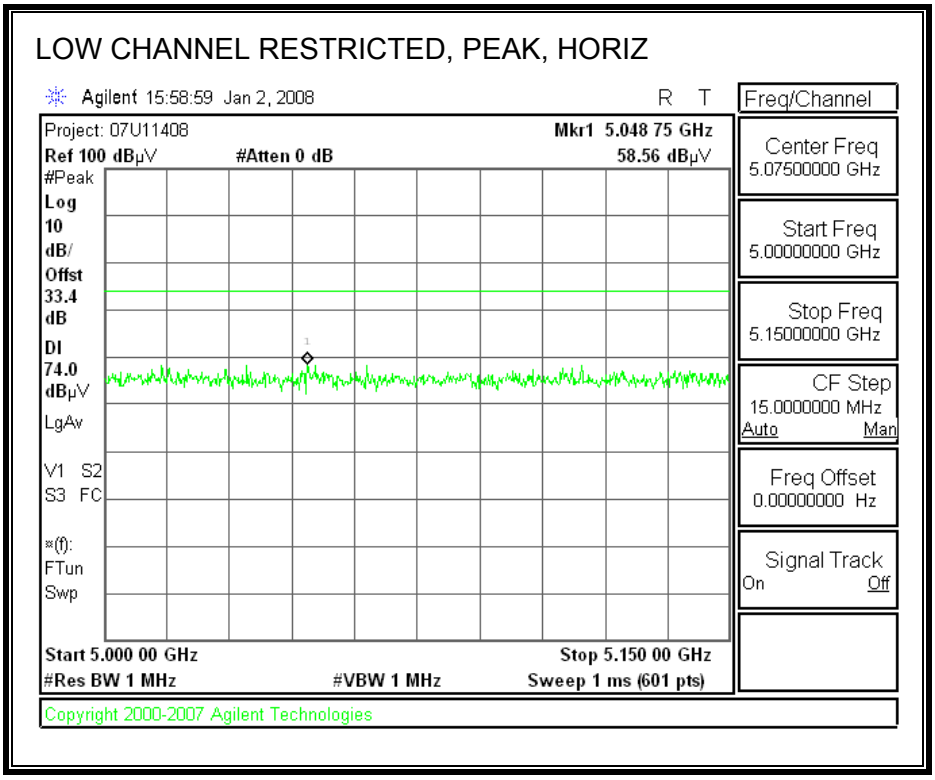
Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch. 5180 MHz, setting: 54-53															
10.360	3.0	44.5	30.3	37.0	10.4	-36.8	0.0	0.8	55.9	41.7	74	54	-18.1	-12.3	V
15.540	3.0	40.4	29.9	38.1	12.7	-34.8	0.0	0.7	57.0	46.5	74	54	-17.0	-7.5	V
10.360	3.0	41.6	29.5	37.0	10.4	-36.8	0.0	0.8	53.0	40.9	74	54	-21.0	-13.1	H
15.540	3.0	41.7	28.8	38.1	12.7	-34.8	0.0	0.7	58.3	45.4	74	54	-15.7	-8.6	H
Mid Ch. 5200 MHz, setting: 53-52															
10.400	3.0	42.8	29.4	37.0	10.5	-36.8	0.0	0.8	54.3	40.9	74	54	-19.7	-13.1	V
15.600	3.0	42.5	30.5	37.9	12.7	-34.8	0.0	0.7	59.1	47.1	74	54	-14.9	-6.9	V
10.400	3.0	41.7	28.9	37.0	10.5	-36.8	0.0	0.8	53.2	40.4	74	54	-20.8	-13.6	H
15.600	3.0	41.4	29.1	37.9	12.7	-34.8	0.0	0.7	58.0	45.7	74	54	-16.0	-8.3	H
High Ch. 5240 MHz, setting: 52-51															
10.480	3.0	41.3	29.9	37.0	10.6	-36.7	0.0	0.8	53.0	41.6	74	54	-21.0	-12.4	V
15.720	3.0	41.7	29.8	37.6	12.8	-34.7	0.0	0.7	58.1	46.2	74	54	-15.9	-7.8	V
10.480	3.0	41.5	28.5	37.0	10.6	-36.7	0.0	0.8	53.2	40.2	74	54	-20.8	-13.8	H
15.720	3.0	41.3	29.1	37.6	12.8	-34.7	0.0	0.7	57.7	45.5	74	54	-16.3	-8.5	H

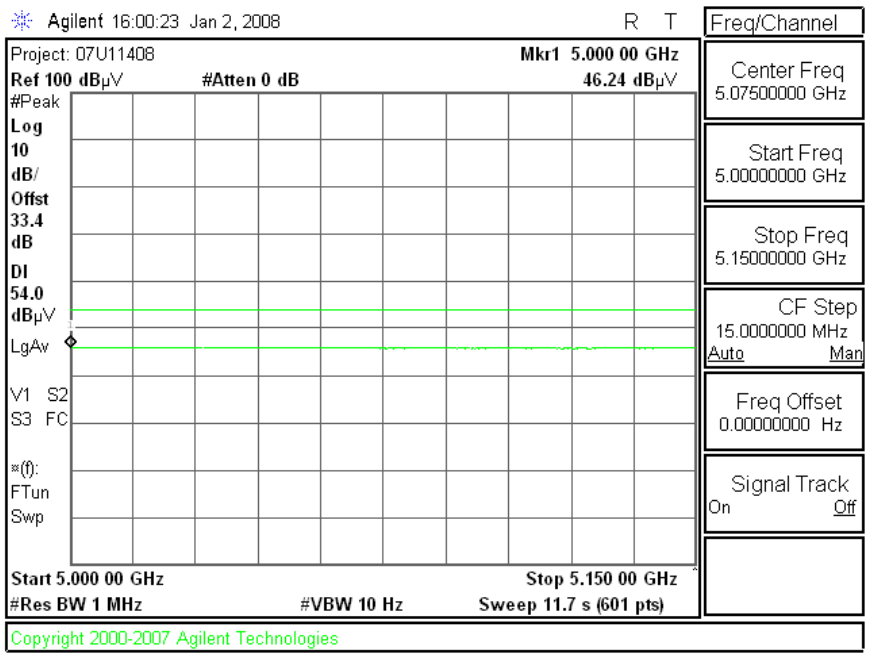
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

8.2.2. TX ABOVE 1 GHz FOR 802.11n HT20 MODE

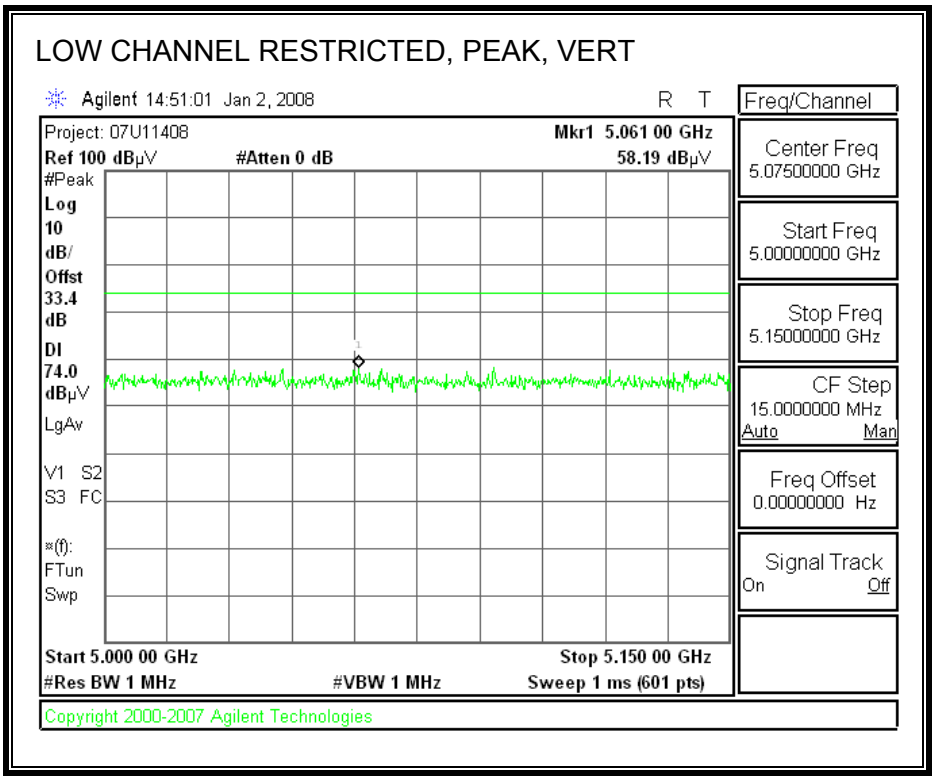
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



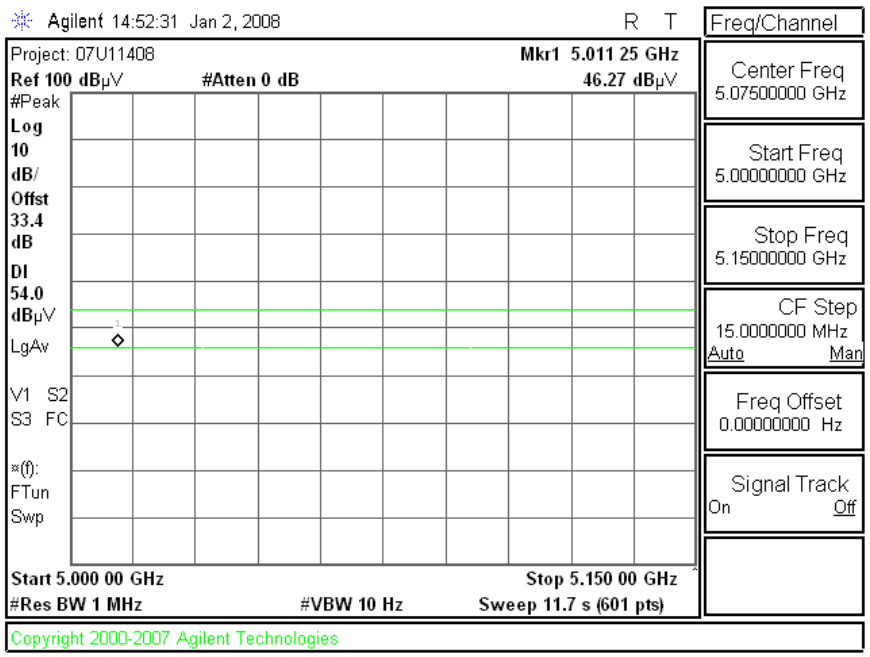
LOW CHANNEL RESTRICTED, AVG, HORIZ



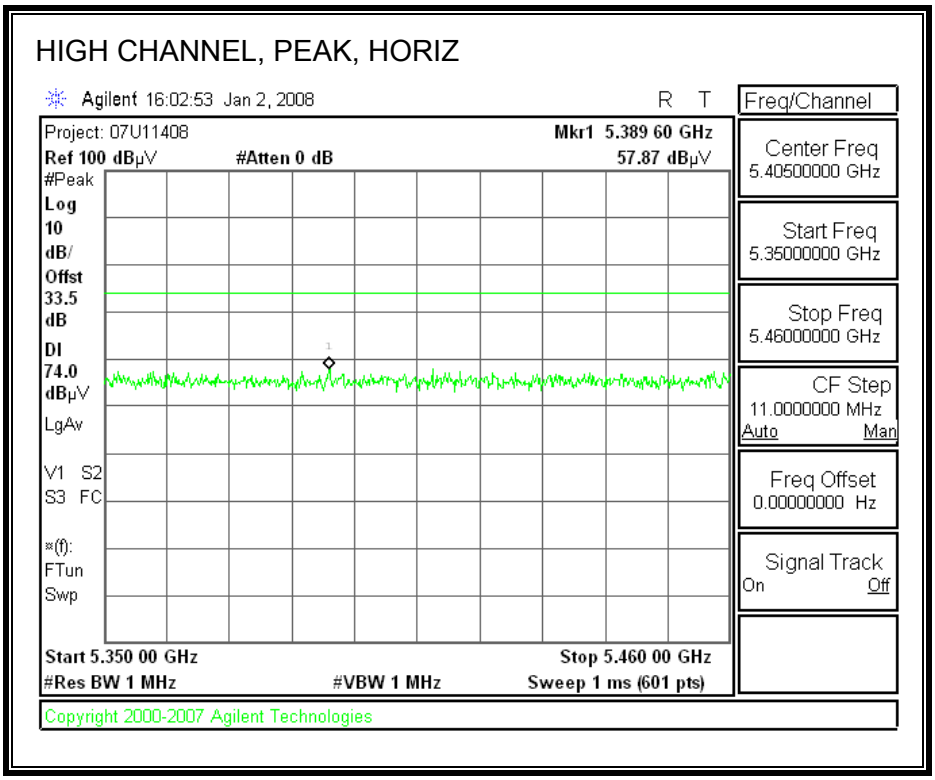
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



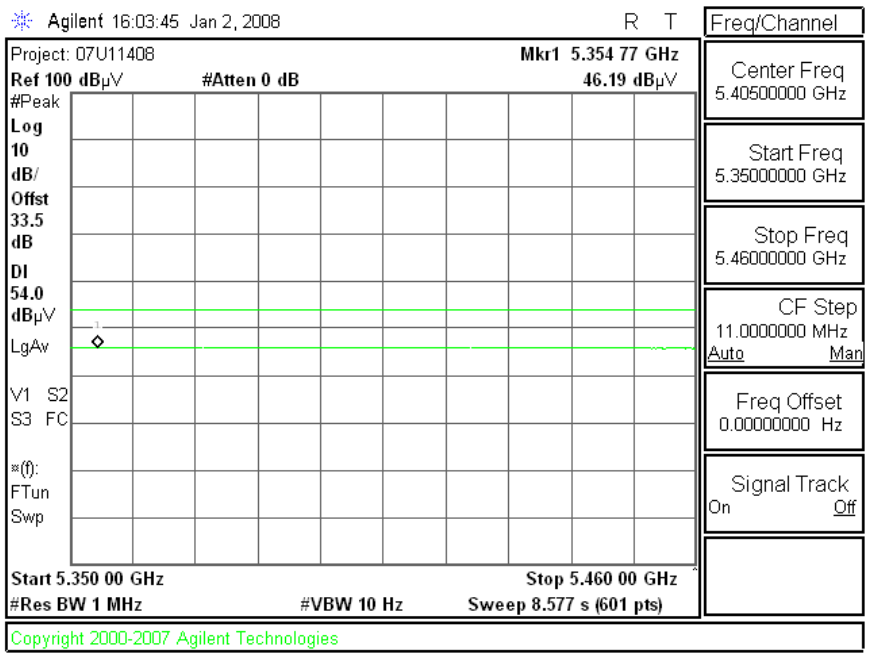
LOW CHANNEL RESTRICTED, AVG, VERT



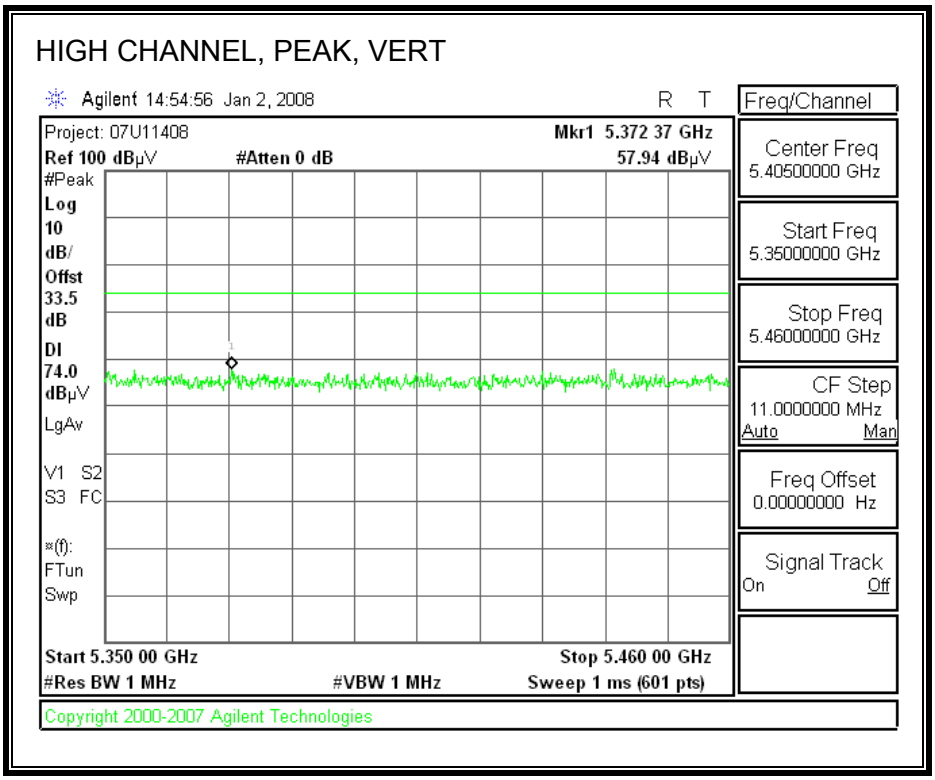
AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



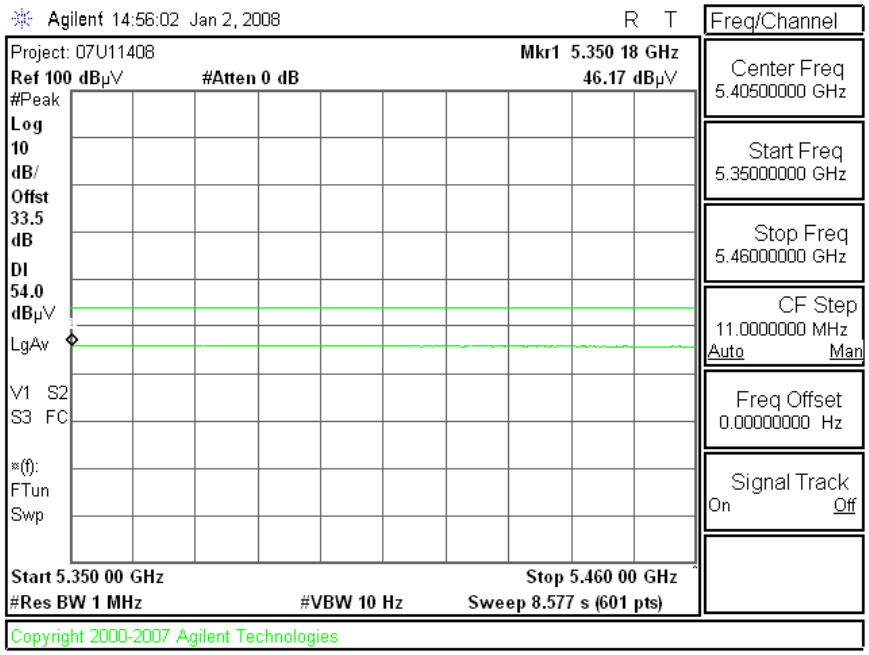
HIGH CHANNEL, AVG, HORIZ



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band 802.11n HT20 Mode, Tx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

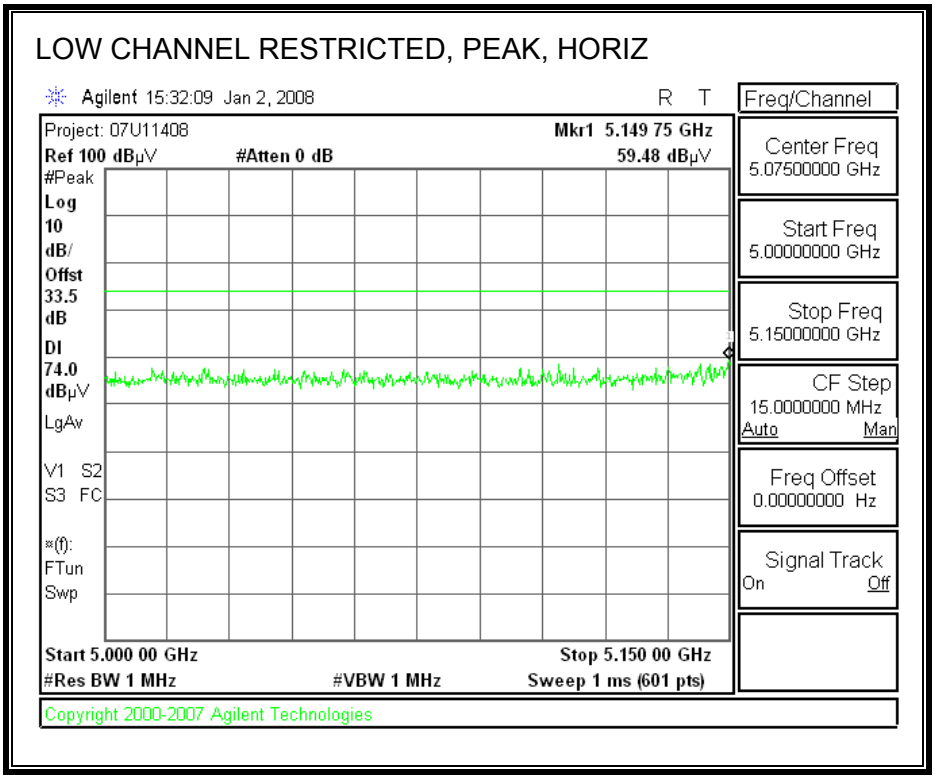
Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch. 5180 MHz, setting: 54-53															
10.360	3.0	41.6	29.4	37.0	10.4	-36.8	0.0	0.8	53.0	40.8	74	54	-21.0	-13.2	V
15.540	3.0	41.9	29.7	38.1	12.7	-34.8	0.0	0.7	58.5	46.3	74	54	-15.5	-7.7	V
10.360	3.0	43.0	29.1	37.0	10.4	-36.8	0.0	0.8	54.4	40.5	74	54	-19.6	-13.5	H
15.540	3.0	42.3	29.8	38.1	12.7	-34.8	0.0	0.7	58.9	46.4	74	54	-15.1	-7.6	H
Mid Ch. 5200 MHz, setting: 54-53															
10.400	3.0	41.4	29.1	37.0	10.5	-36.8	0.0	0.8	52.9	40.6	74	54	-21.1	-13.4	V
15.600	3.0	41.7	30.1	37.9	12.7	-34.8	0.0	0.7	58.3	46.7	74	54	-15.7	-7.3	V
10.400	3.0	42.5	29.0	37.0	10.5	-36.8	0.0	0.8	54.0	40.5	74	54	-20.0	-13.5	H
15.600	3.0	42.6	28.7	37.9	12.7	-34.8	0.0	0.7	59.2	45.3	74	54	-14.8	-8.7	H
High Ch. 5240 MHz, setting: 53-51															
10.480	3.0	41.3	29.3	37.0	10.6	-36.7	0.0	0.8	53.0	41.0	74	54	-21.0	-13.0	V
15.720	3.0	41.1	29.3	37.6	12.8	-34.7	0.0	0.7	57.5	45.7	74	54	-16.5	-8.3	V
10.480	3.0	42.3	29.1	37.0	10.6	-36.7	0.0	0.8	54.0	40.8	74	54	-20.0	-13.2	H
15.720	3.0	41.9	28.8	37.6	12.8	-34.7	0.0	0.7	58.3	45.2	74	54	-15.7	-8.8	H

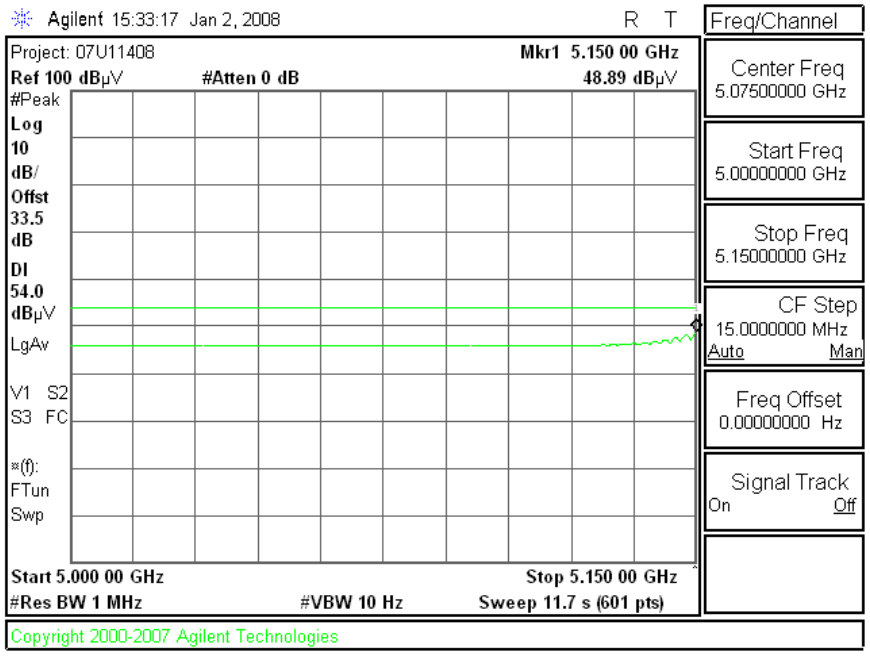
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

8.2.3. TX ABOVE 1 GHz FOR 802.11n HT40 MODE

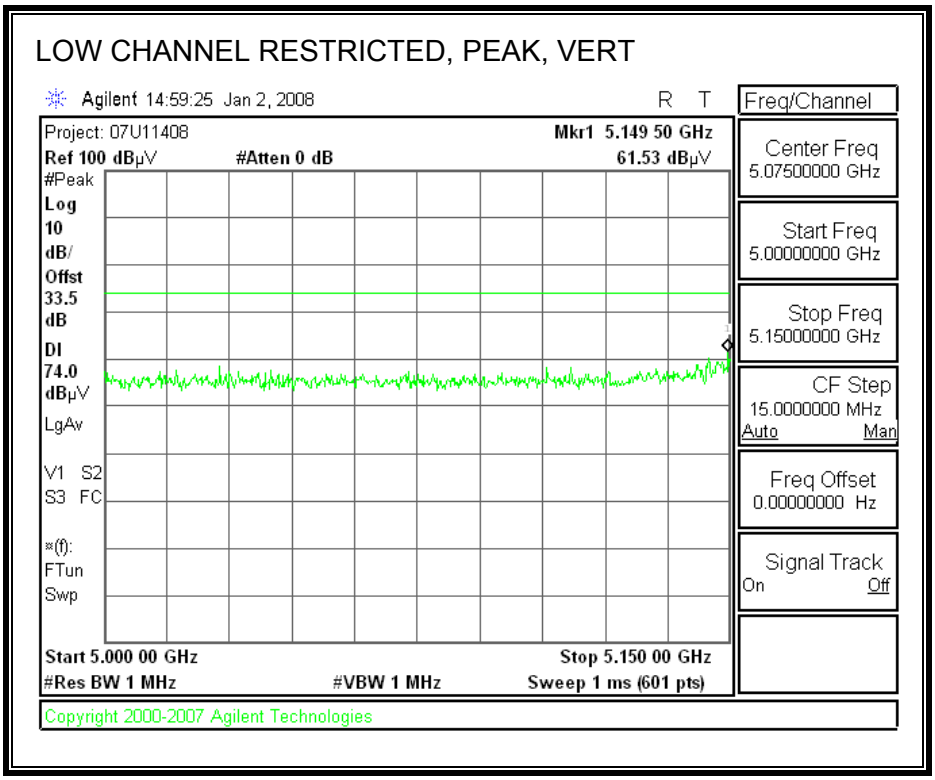
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



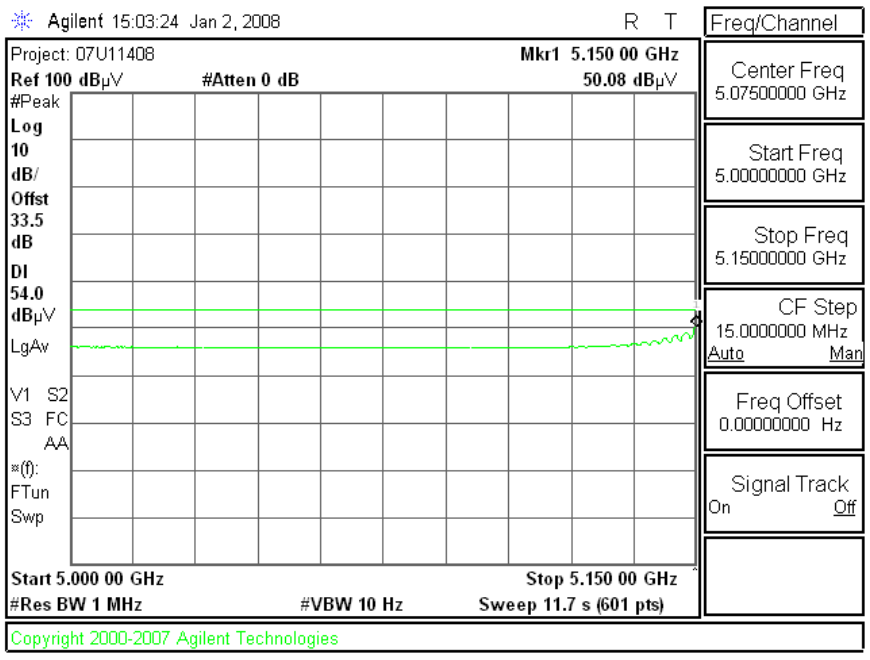
LOW CHANNEL RESTRICTED, AVG, HORIZ



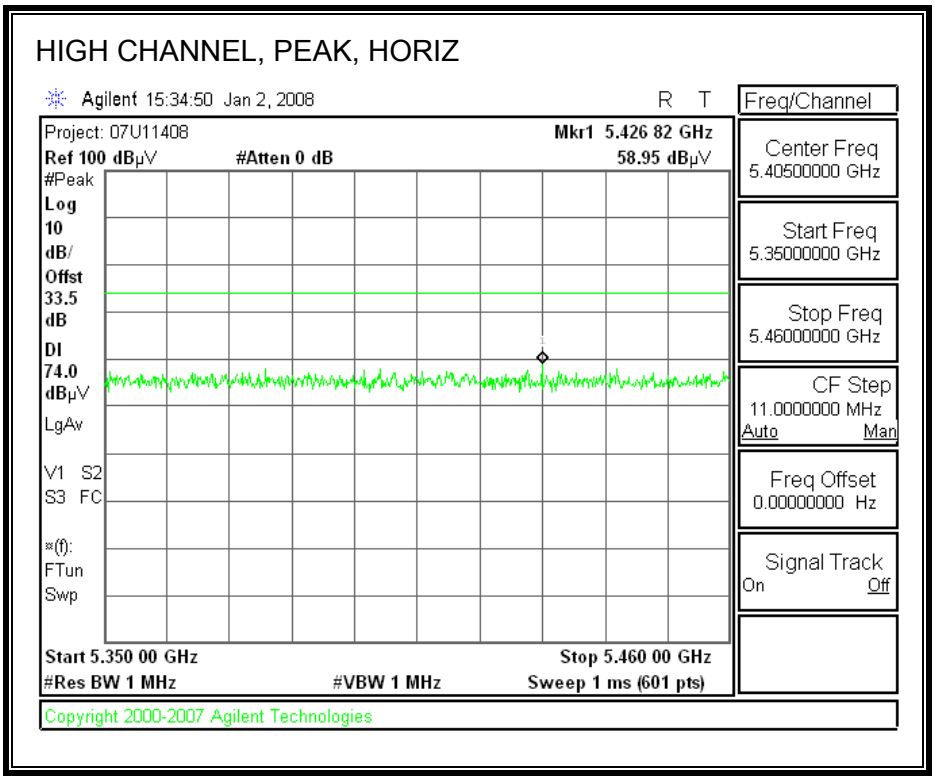
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



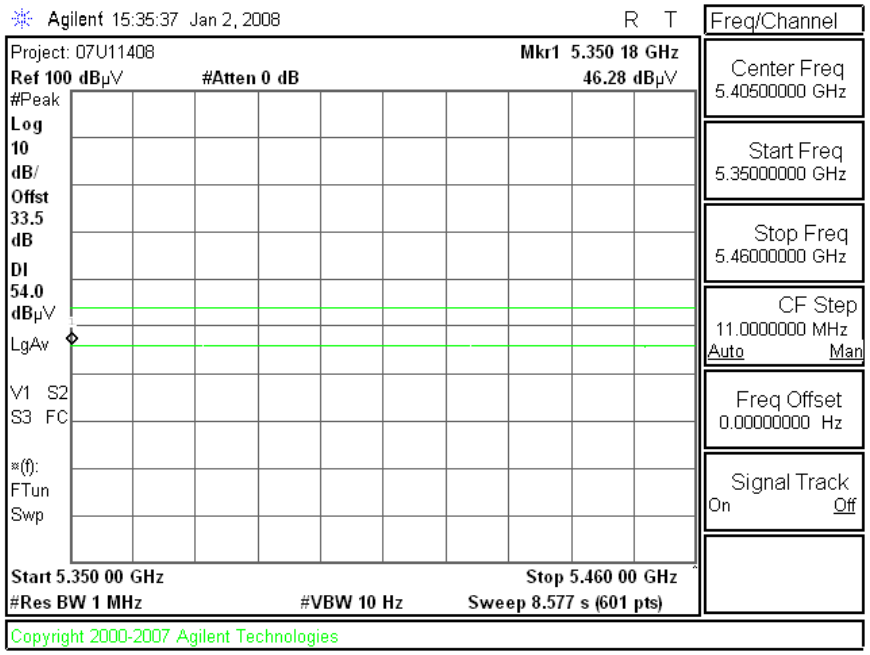
LOW CHANNEL RESTRICTED, AVG, VERT



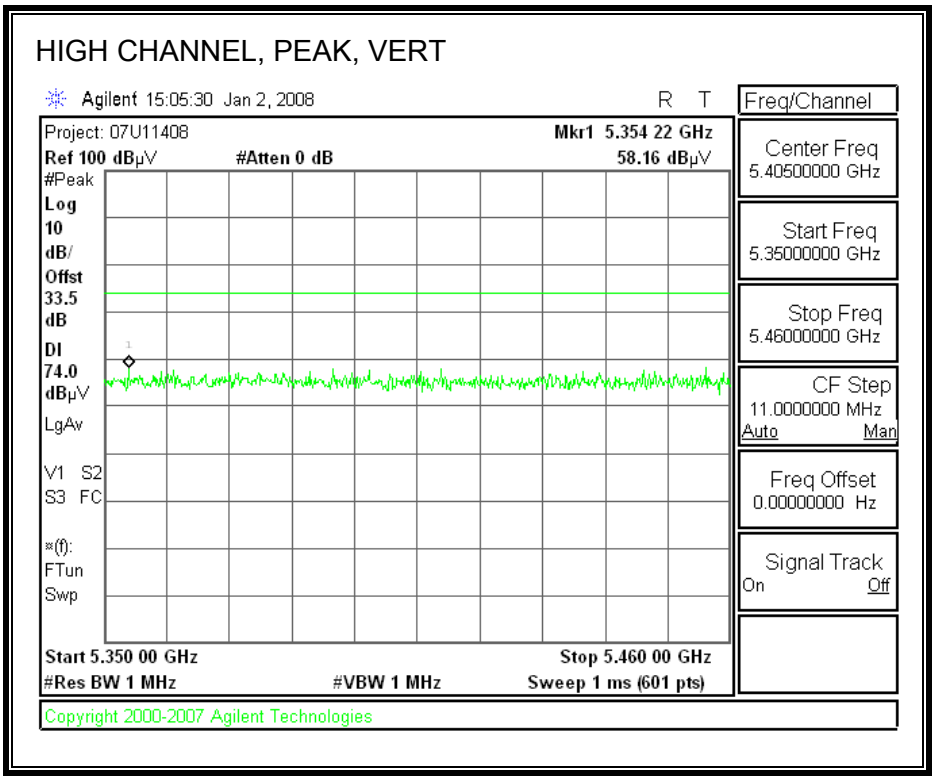
AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



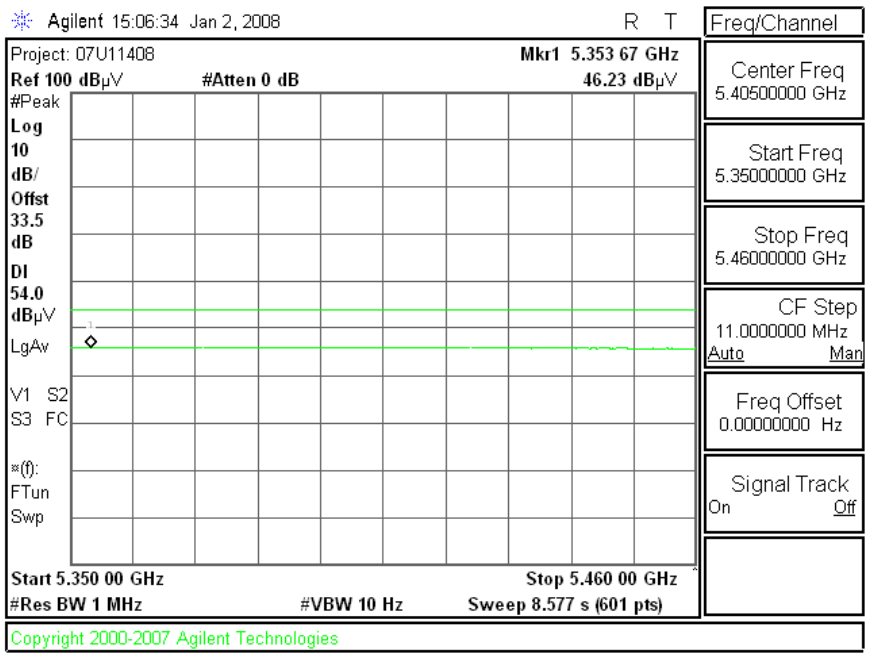
HIGH CHANNEL, AVG, HORIZ



AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band 802.11n HT40 Mode, Tx On

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch. 5190 MHz, setting: 5B-59															
10.380	3.0	41.4	29.7	37.0	10.5	-36.8	0.0	0.8	52.9	41.2	74	54	-21.1	-12.8	V
15.570	3.0	39.0	29.6	38.0	12.7	-34.8	0.0	0.7	55.6	46.2	74	54	-18.4	-7.8	V
10.380	3.0	42.3	29.8	37.0	10.5	-36.8	0.0	0.8	53.8	41.3	74	54	-20.2	-12.7	H
15.570	3.0	41.5	29.7	38.0	12.7	-34.8	0.0	0.7	58.1	46.3	74	54	-15.9	-7.7	H
High Ch. 5230 MHz, setting: 59-57															
10.480	3.0	41.1	29.3	37.0	10.6	-36.7	0.0	0.8	52.8	41.0	74	54	-21.2	-13.0	V
15.720	3.0	40.9	29.7	37.6	12.8	-34.7	0.0	0.7	57.3	46.1	74	54	-16.7	-7.9	V
10.480	3.0	41.7	29.6	37.0	10.6	-36.7	0.0	0.8	53.4	41.3	74	54	-20.6	-12.7	H
15.720	3.0	41.9	29.3	37.6	12.8	-34.7	0.0	0.7	58.3	45.7	74	54	-15.7	-8.3	H

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

8.3. RECEIVER ABOVE 1 GHz

8.3.1. RX ABOVE 1 GHz FOR 11a 20 MHz BANDWIDTH IN

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band 802.11a Mode, Rx

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber		

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.293	3.0	47.8	35.1	24.9	3.4	-39.1	0.0	0.0	37.0	24.2	74	54	-37.0	-29.8	H
1.940	3.0	46.0	33.2	27.2	4.2	-38.1	0.0	0.0	39.3	26.5	74	54	-34.7	-27.5	H
2.607	3.0	45.8	33.5	28.9	5.0	-37.4	0.0	0.0	42.2	29.9	74	54	-31.8	-24.1	H
3.247	3.0	43.5	30.3	30.6	5.5	-37.2	0.0	0.0	42.5	29.3	74	54	-31.5	-24.7	H
1.295	3.0	47.1	33.2	24.9	3.4	-39.1	0.0	0.0	36.3	22.4	74	54	-37.7	-31.6	V
1.955	3.0	45.0	33.3	27.3	4.2	-38.1	0.0	0.0	38.4	26.7	74	54	-35.6	-27.3	V
2.580	3.0	43.7	30.1	28.8	5.0	-37.5	0.0	0.0	40.0	26.4	74	54	-34.0	-27.6	V
3.255	3.0	43.9	30.1	30.6	5.5	-37.2	0.0	0.0	42.9	29.1	74	54	-31.1	-24.9	V

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

8.3.2. RX ABOVE 1 GHz FOR HT 20 MHz BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band 802.11n HT20 Mode, Rx

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber		

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.215	3.0	46.3	33.5	24.6	3.3	-39.2	0.0	0.0	35.0	22.2	74	54	-39.0	-31.8	H
1.660	3.0	44.1	32.2	26.2	3.9	-38.5	0.0	0.0	35.6	23.7	74	54	-38.4	-30.3	H
2.015	3.0	43.7	31.8	27.5	4.3	-38.0	0.0	0.0	37.4	25.5	74	54	-36.6	-28.5	H
3.440	3.0	42.0	28.9	31.1	5.7	-37.0	0.0	0.0	41.7	28.7	74	54	-32.3	-25.3	H
1.500	3.0	47.8	36.5	25.6	3.7	-38.8	0.0	0.0	38.3	27.0	74	54	-35.7	-27.0	V
1.965	3.0	43.7	33.7	27.3	4.3	-38.1	0.0	0.0	37.1	27.1	74	54	-36.9	-26.9	V
2.160	3.0	44.0	34.3	27.8	4.5	-37.8	0.0	0.0	38.4	28.7	74	54	-35.6	-25.3	V
3.267	3.0	41.7	31.9	30.7	5.6	-37.2	0.0	0.0	40.8	31.0	74	54	-33.2	-23.0	V

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

8.3.3. RX ABOVE 1 GHz FOR HT 40 MHz BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Computer Inc.
Project #: 07U11408
Date: 01-08-2008
Test Engineer: Tom Chen
Configuration: EUT with support equipment
Mode: 5.2 GHz Band 802.11n HT40 Mode, Rx

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931	T88 Miteq 26-40GHz	T89; ARA 18-26GHz; S/N:1049	RX RSS 210

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber		

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.330	3.0	46.0	33.3	25.0	3.4	-39.0	0.0	0.0	35.4	22.7	74	54	-38.6	-31.3	H
1.895	3.0	44.5	31.2	27.0	4.2	-38.2	0.0	0.0	37.5	24.2	74	54	-36.5	-29.8	H
2.395	3.0	43.8	30.8	28.3	4.8	-37.5	0.0	0.0	39.4	26.4	74	54	-34.6	-27.6	H
3.240	3.0	41.5	29.3	30.6	5.5	-37.2	0.0	0.0	40.5	28.3	74	54	-33.5	-25.7	H
1.330	3.0	46.2	34.1	25.0	3.4	-39.0	0.0	0.0	35.6	23.5	74	54	-38.4	-30.5	V
1.665	3.0	47.7	35.6	26.2	3.9	-38.5	0.0	0.0	39.3	27.1	74	54	-34.7	-26.9	V
2.310	3.0	42.2	30.3	28.1	4.7	-37.6	0.0	0.0	37.4	25.5	74	54	-36.6	-28.5	V
3.285	3.0	42.0	30.2	30.7	5.6	-37.1	0.0	0.0	41.1	29.3	74	54	-32.9	-24.7	V

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

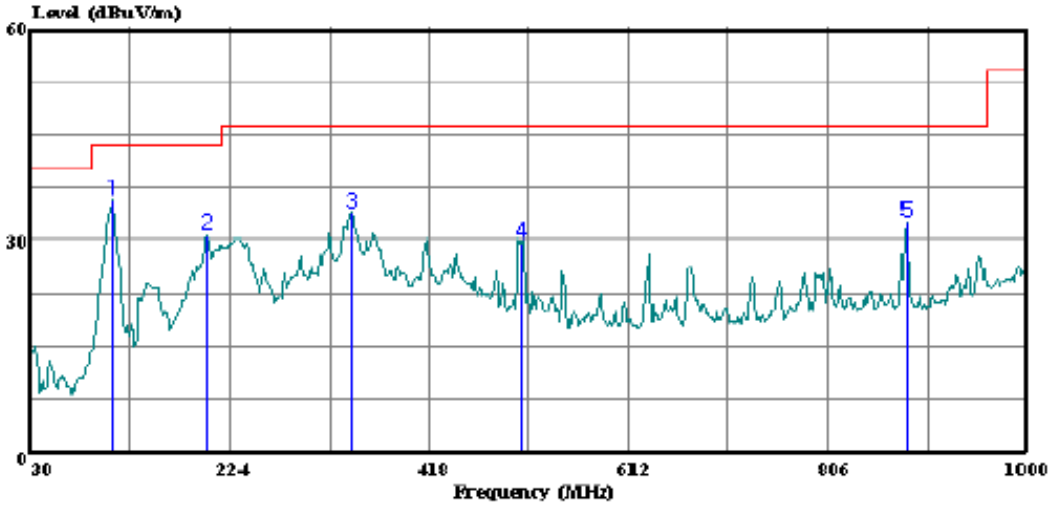
8.4. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT

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

Data#: 9 File#: 07U11408 FCC.EMI Date: 01-02-2008 Time: 11:57:56



Trace: 8 Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator: Tom Chen
Project # : 07U11408
Company : Apple Computer Inc,.
Config : EUT with Support Laptop
Mode : Contiunal TX Mode
Target : FCC Class B

HORIZONTAL DATA

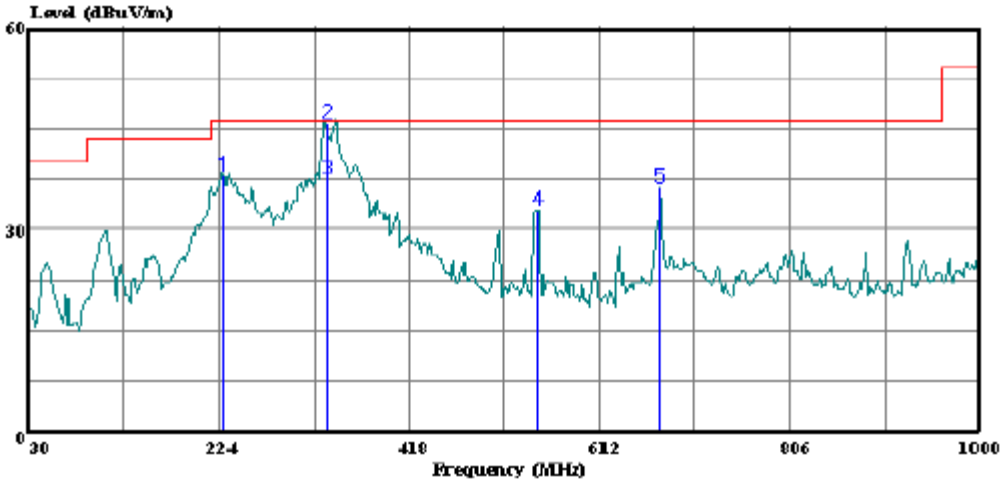
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	109.540	54.42	-18.87	35.55	43.50	-7.95	Peak
2	201.690	47.93	-17.22	30.71	43.50	-12.79	Peak
3	342.340	48.79	-14.94	33.85	46.00	-12.15	Peak
4	507.240	40.95	-11.35	29.60	46.00	-16.40	Peak
5	882.630	37.85	-5.49	32.36	46.00	-13.64	Peak

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

VERTICAL PLOT

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

Data#: 7 File#: 07U11408 FCC.EMI Date: 01-02-2008 Time: 11:16:04



Trace: 3 Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: Tom Chen
Project # : 07U11408
Company : Apple Computer Inc,.
Config : EUT with Support Laptop
Mode : Contiunal TX Mode
Target : FCC Class B

VERTICAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	228.850	56.46	-18.55	37.91	46.00	-8.09	Peak
2	334.000	60.58	-14.93	45.65	46.00	-0.35	Peak
3	334.000	52.26	-14.94	37.32	46.00	-8.68	QP
4	549.920	43.43	-10.66	32.76	46.00	-13.24	Peak
5	674.080	45.03	-9.02	36.01	46.00	-9.99	Peak

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

FCC 15.107

6 WORST EMISSIONS

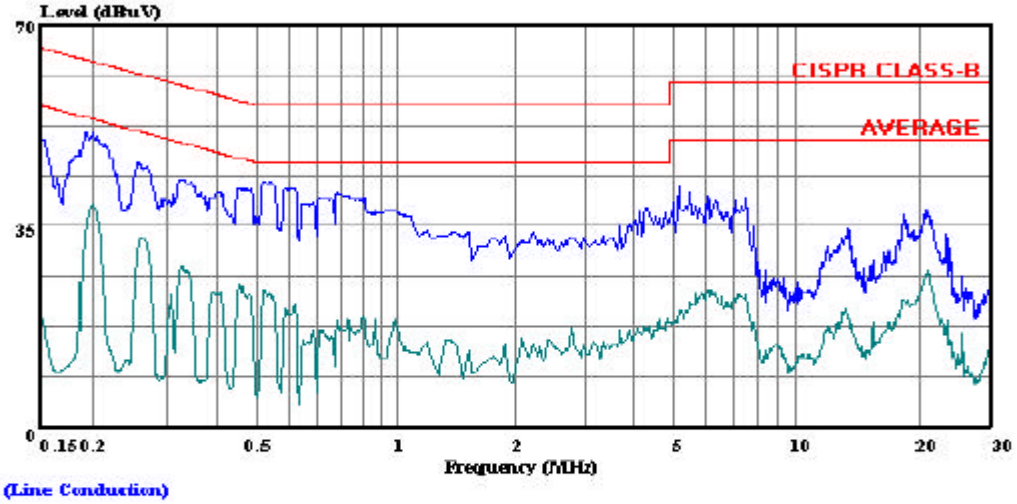
CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	FCC_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	50.21	--	16.19	0.00	65.78	55.78	-15.57	-39.59	L1
0.19	51.28	--	33.76	0.00	63.99	53.99	-12.71	-20.23	L1
0.52	42.86	--	22.75	0.00	56.00	46.00	-13.14	-23.25	L1
0.20	52.16	--	39.07	0.00	63.45	53.45	-11.29	-14.38	L2
0.27	47.06	--	32.59	0.00	61.24	51.24	-14.18	-18.65	L2
0.54	42.04	--	22.47	0.00	56.00	46.00	-13.96	-23.53	L2
6 Worst Data									

FCC 15.107

LINE 1 RESULTS

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

Data#: 49 File#: 07U11408 LC.EMI Date: 12-18-2007 Time: 16:20:10



(Line Conduction)

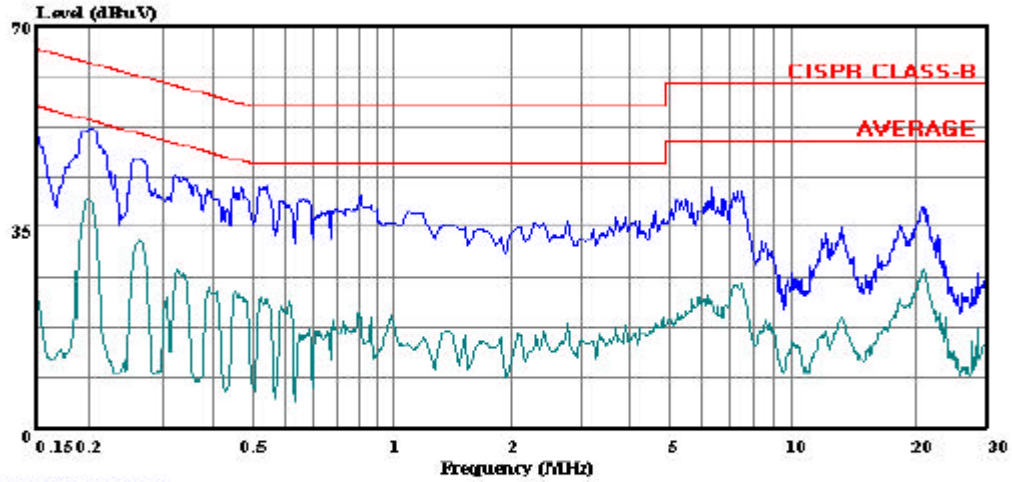
Trace: 47 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Tom Chen
Project #: : 07U11408
Company: : Apple
Configuration:: EUT with Support Notebook PC
: with Apple AC Cable
Mode: : Normal
Target: : FCC CLASS B
Voltage: : 115VAC / 60Hz
: Line 1: Peak (Blue) ; Average (Green)

LINE 2 RESULTS

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

Data#: 56 File#: 07U11408 LC.EMI Date: 12-18-2007 Time: 16:28:42



(Line Conduction)

Trace: 54 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Tom Chen
Project #: : 07U11408
Company: : Apple
Configuration:: EUT with Support Notebook PC
: with Apple AC Cable
Mode: : Normal
Target: : FCC CLASS B
Voltage: : 115VAC / 60Hz
: Line 2: Peak (Blue) ; Average (Green)

10. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

f = frequency in MHz
* = Plane-wave equivalent power density

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

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

IC RULES

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

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

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

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

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

CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$d = 0.282 * 10 ^ ((P + G) / 20) / \sqrt{S}$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm^2

Rearranging terms to calculate the power density at a specific distance yields

$S = 0.0795 * 10 ^ ((P + G) / 10) / (d^2)$

The power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by a factor of 10.

LIMITS

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

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

RESULTS

(MPE distance is equal to 20 cm)

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
802.11a	5 GHz	20.0	12.83	1.53	0.0054	0.0542
802.11n HT20	5 GHz	20.0	13.57	1.53	0.0064	0.0643
802.11n HT40	5 GHz	20.0	16.16	1.53	0.0117	0.1168