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

CERTIFICATION TEST REPORT

FOR

DC544D_3 PCIe DAUGHTER CARD FOR 2.4 / 5 GHz AP/ROUTER APPLICATIONS_NON DFS

MODEL NUMBER: 65-VN780-P3

FCC ID: J9C-DC544D3
IC: 2723A-DC544D3

REPORT NUMBER: 09U12687-3, Revision B

ISSUE DATE: OCTOBER 12, 2009

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	07/21/09	Initial Issue	F. Ibrahim
A	10/07/09	Revised PK power, AV power, PPSD, BE, Harmonics and Conducted Spurious for HT40 modes in all bands in this report.	F. Ibrahim
B	10/12/09	Removed the DFS bands data and setup photos from the report.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: QUALCOMM INC.
3165 KIFER RD
SANTA CLARA, CA 95051
USA

EUT DESCRIPTION: DC544D_3 PCIe DAUGHTER CARD FOR 2.4 / 5 GHz AP/ROUTER APPLICATIONS_NON DFS

MODEL: 65-VN780-P3

SERIAL NUMBER: 7916 for Antenna Port, 7929 for Radiated Emission

DATE TESTED: JUNE 24 – JULY 18, 2009

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 9	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (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 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

VIEN TRAN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 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. 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 802.11a/b/g/n WLAN transceiver module in a PCI form factor, for 2.4 / 5 GHz AP/Router Applications that do not include DFS bands. It is equipped with four identical transmitter / receiver chains.

The radio module is manufactured by Qualcomm, Inc.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz BAND			
5180 - 5240	802.11a	12.18	16.52
5180 - 5240	802.11n HT20	13.23	21.04
5190 - 5230	802.11n HT40	16.67	46.45

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dual band omni monopole (4 identical) antenna, each with a maximum gain of 3 dBi in the 5 GHz bands.

For the 802.11a legacy mode only two chains are transmitting, therefore the effective legacy antenna gain is:

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
3	3.01	6.01

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Qualcomm, rev. 0.0.500.5.

The test utility software used during emissions testing was PTT Gui, rev. 5.1.

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC.

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

802.11a Mode (20 MHz BW operation): 6 Mbps, OFDM.
802.11n MIMO HT20 Mode: MCS31, 260 Mbps, 4 Spatial Streams.
802.11n MIMO HT40 Mode: MCS31, 540 Mbps, 4 Spatial Streams.

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 11n HT40, high channel.

For bandwidth measurement preliminary testing showed that there is no significant difference among different chains, so the measurements were performed using Chain 0.

For 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 PPSD 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 Radiated Band Edge measurements preliminary testing showed that the worst case was vertical polarization, so final measurements were performed with vertical polarization.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	IBM	T43 ThinkPad	L3-XDLXW06/02	DoC
AC Adapter	IBM	08K8204	11S08K8204Z1Z9	DoC
DC Power Supply	Tektronic	PS2521G	N/A	N/A
DC Power Supply	HP	336108	KR24104150	N/A
Extender PCI	ALLION	V1 EC-PEM V1.0	A073	N/A

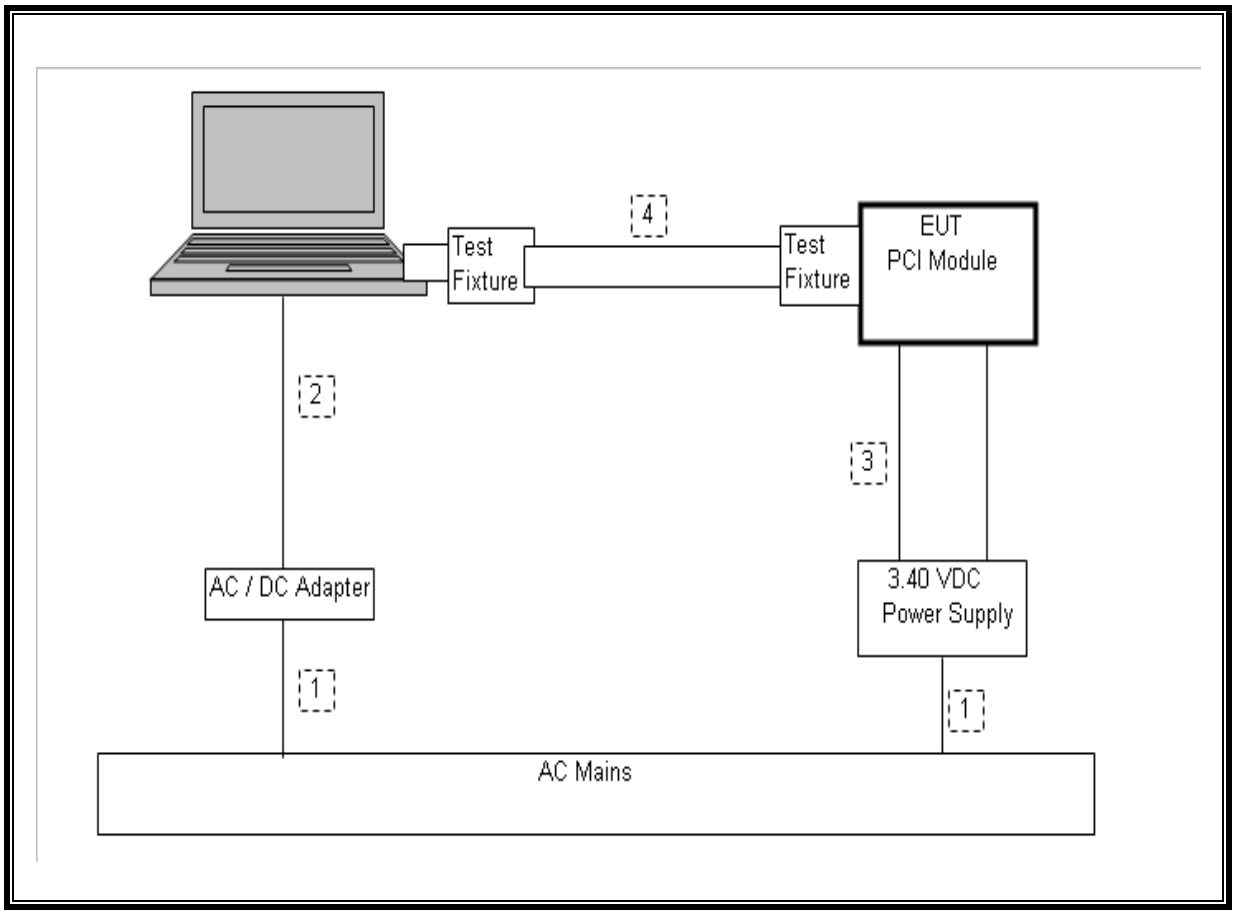
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connecto Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	2	US115	Un-shielded	1.5 m	For laptop
2	DC	1	DC	Un-shielded	1.5 m	For laptop
3	DC	1	Cable	Un-shielded	1.0 m	For EUT
4	Ribbon	1	Ribbon	Un-shielded	.4 m	Test Fixture

TEST SETUP

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

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/09	01/05/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/09	01/14/10
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/22/09	04/22/10
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	09/29/08	11/28/09
Antenna, Horn, 40 GHz	ARA	MWH-2640B	C00981	05/21/09	05/21/10
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/08	10/11/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/09	03/31/10
Preamplifier, 1-26GHz	Agilent / HP	8449B	C01052	08/05/08	08/05/09
Peak Power Meter	Boonton	4541	C01186	01/19/09	01/19/10
Peak Power Sensor	Boonton	4541	C01189	01/15/09	01/15/10
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/29/08	10/29/09
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	02/06/08	08/06/09

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.

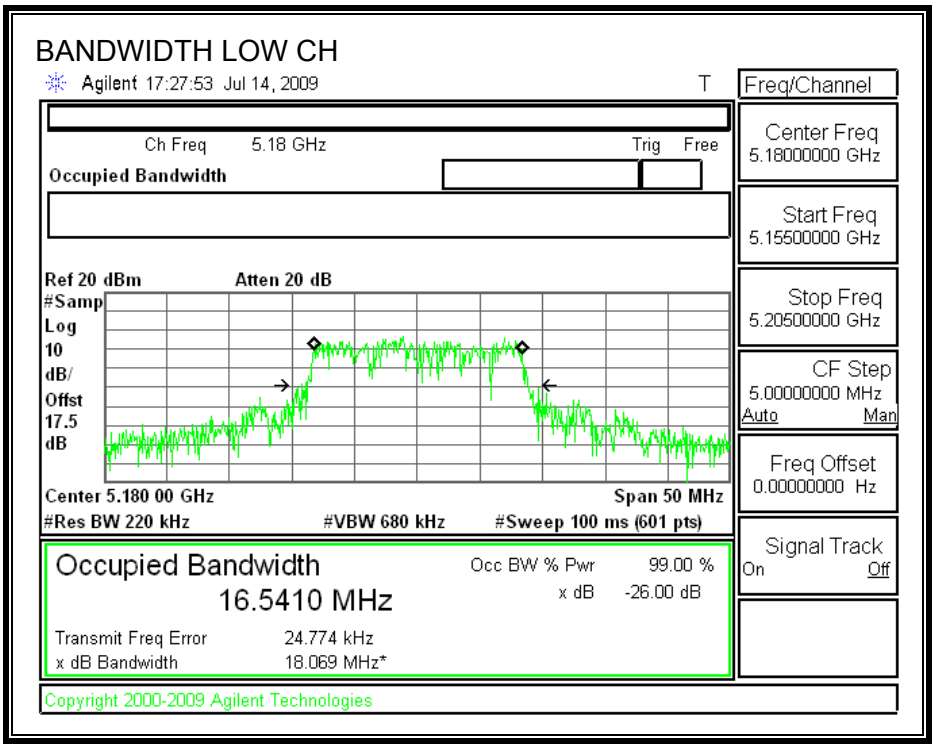
TEST PROCEDURE

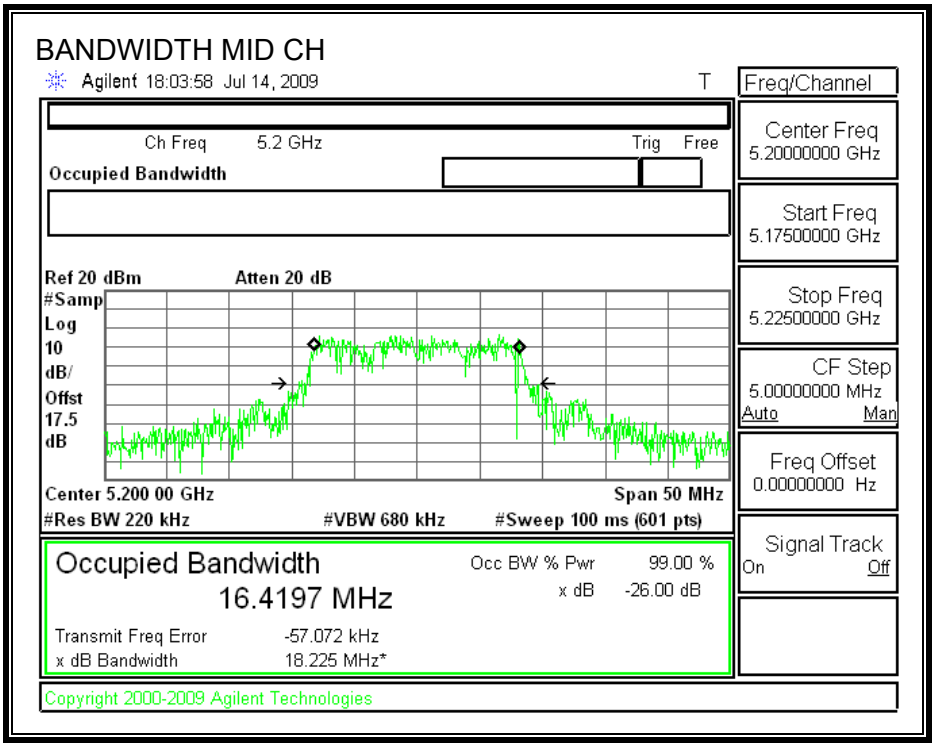
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

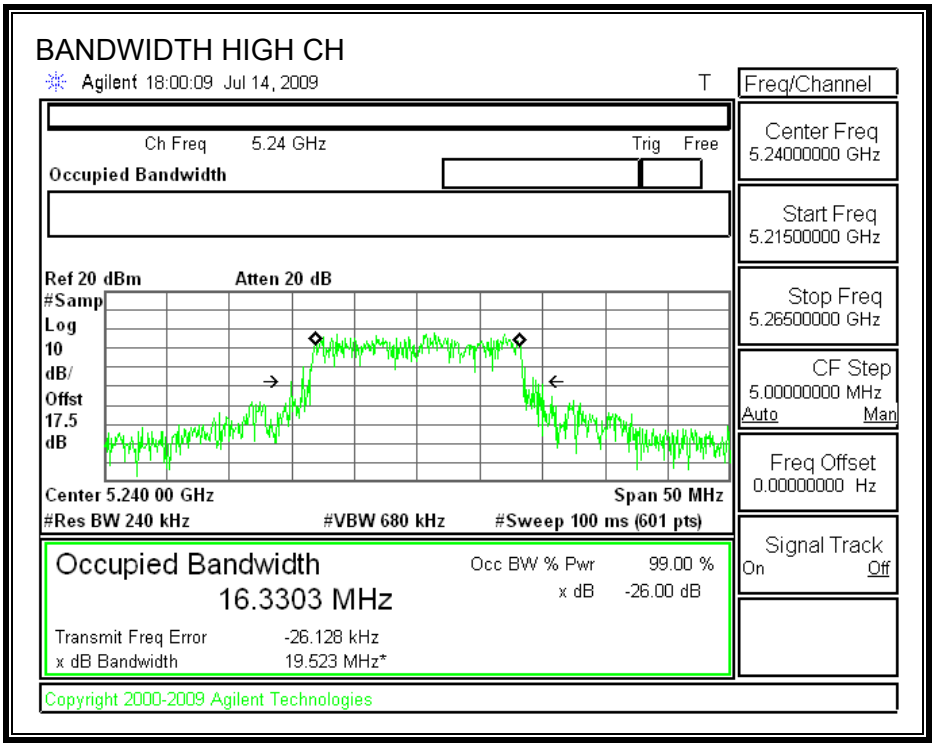
RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	5180	18.0690	16.5410
Middle	5200	18.2250	16.4197
High	5240	19.5230	16.3303

26 dB and 99% BANDWIDTH







7.1.2. OUTPUT POWER

LIMITS

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

Antenna gain of Chain 1 = antenna gain of Chain 2.

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
3	3.01	6.01

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

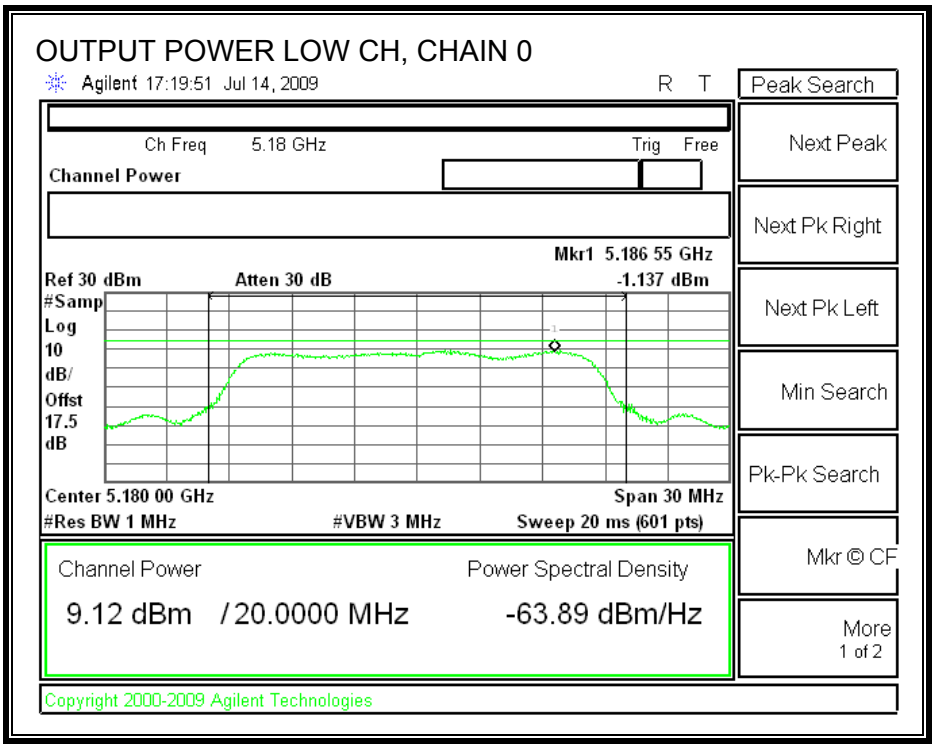
Limit

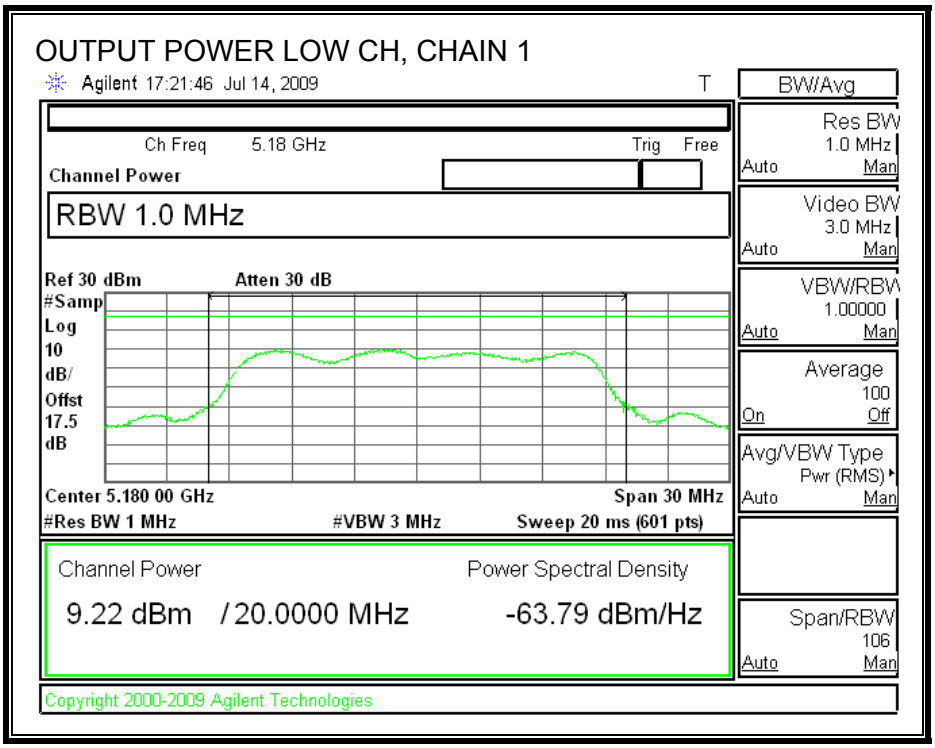
Channel	Freq (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Effective AntennaGain (dBi)	Limit (dBm)
Low	5180	17	18.069	16.57	6.01	16.56
Mid	5200	17	18.225	16.61	6.01	16.60
High	5240	17	19.523	16.91	6.01	16.90

Individual Chain Results

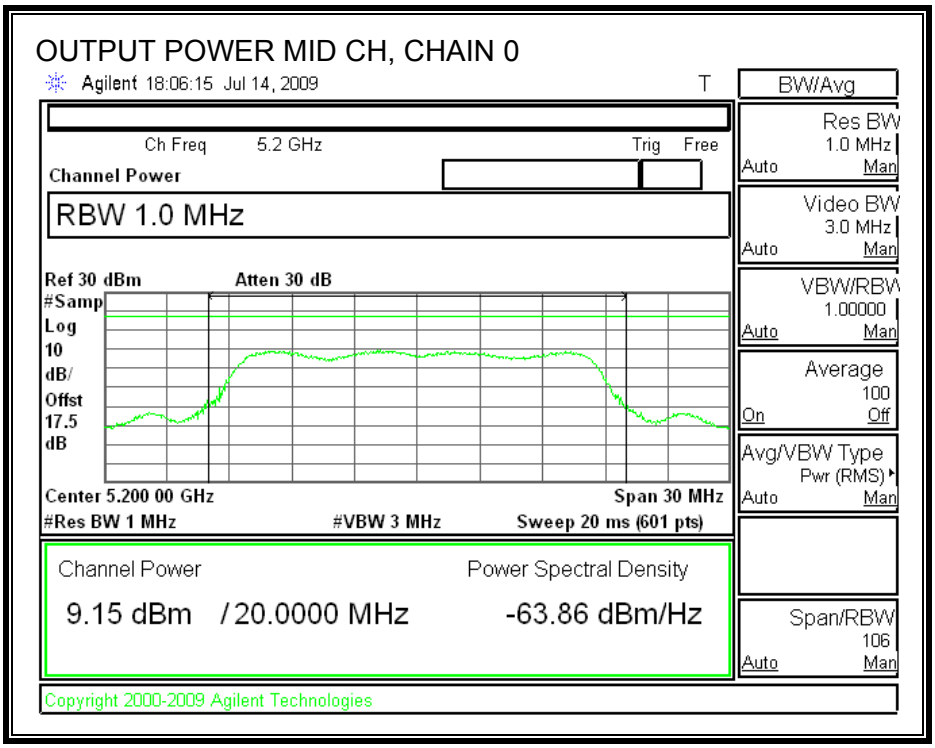
Channel	Freq (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.12	9.22	12.18	16.56	-4.38
Mid	5200	9.15	8.96	12.07	16.60	-4.53
High	5240	9.18	9.13	12.17	16.90	-4.73

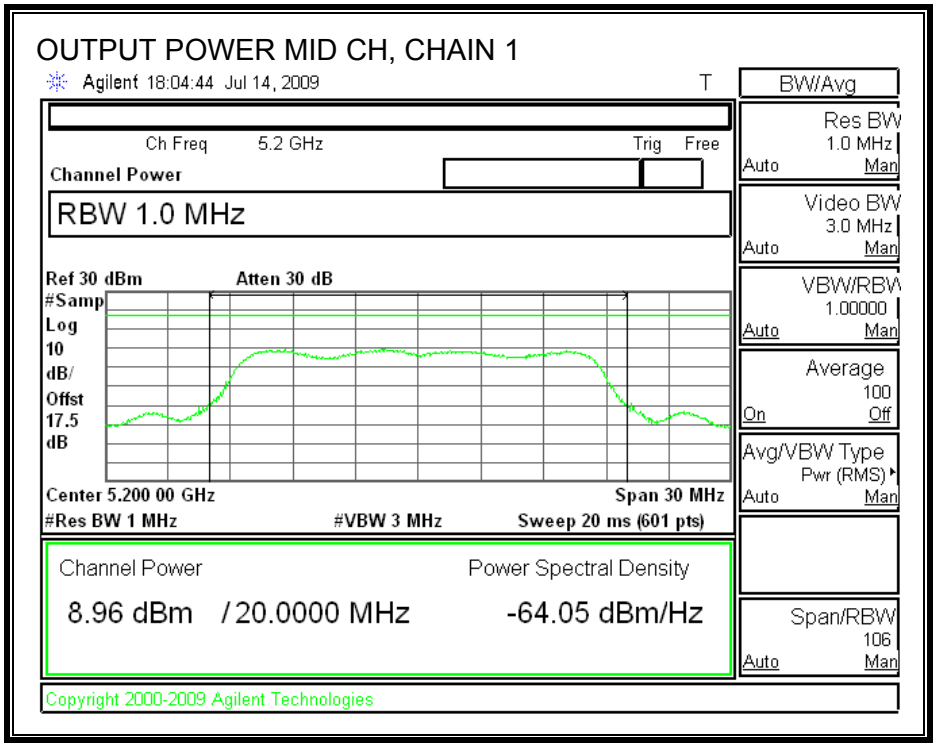
OUTPUT POWER, LOW CHANNEL



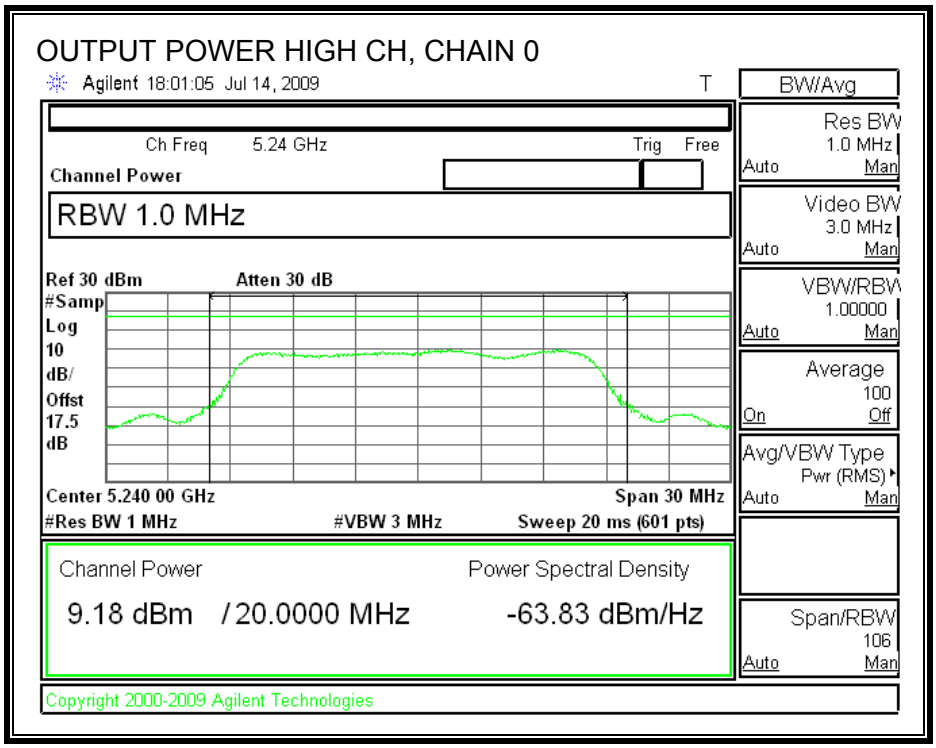


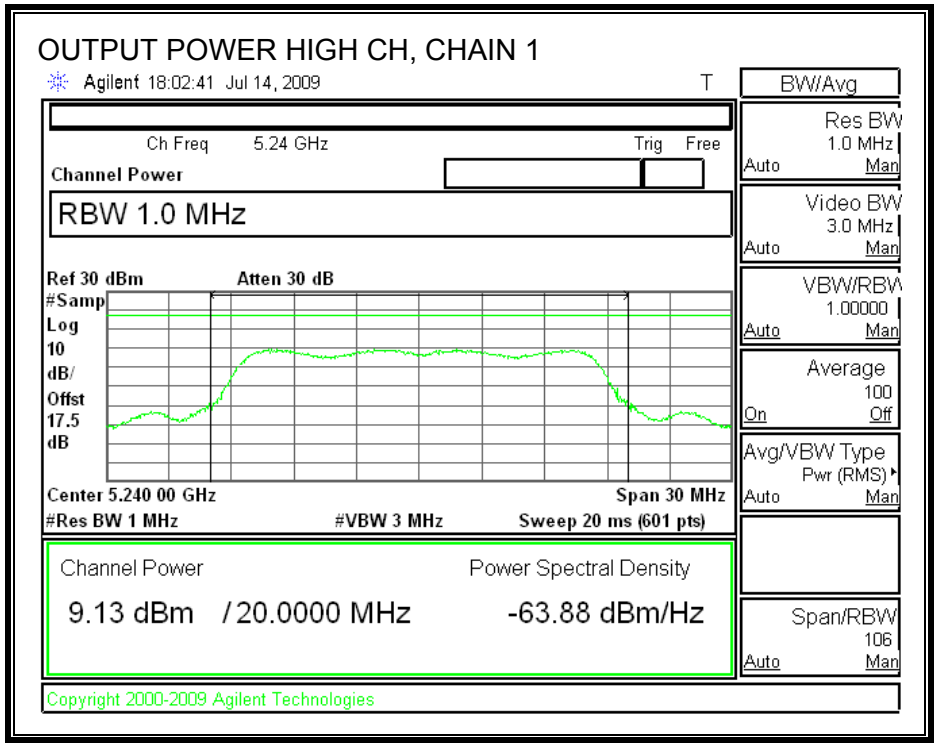
OUTPUT POWER, MID CHANNEL





OUTPUT POWER, HIGH CHANNEL





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.

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5180	9.12	9.08	12.11
Middle	5200	9.21	9.05	12.14
High	5240	9.16	8.99	12.09

7.1.4. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

Use this table if antenna gain for Chain 1 = antenna gain for Chain 2

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
3	3.01	6.01

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

The maximum effective antenna gain is 6.01 dBi, therefore the limit is 3.99 dBm.

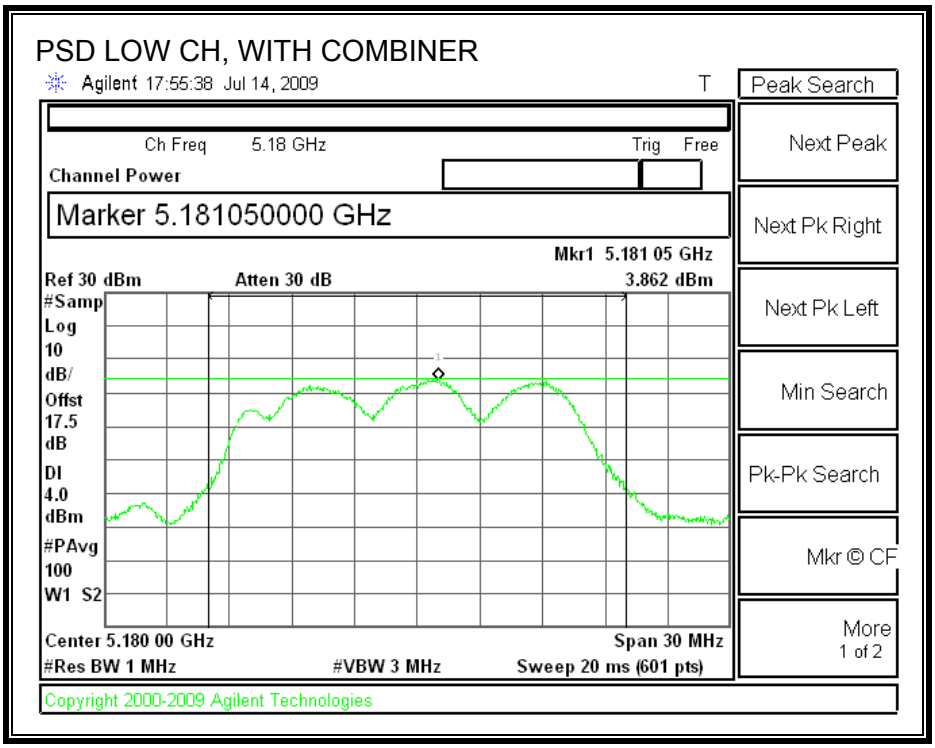
TEST PROCEDURE

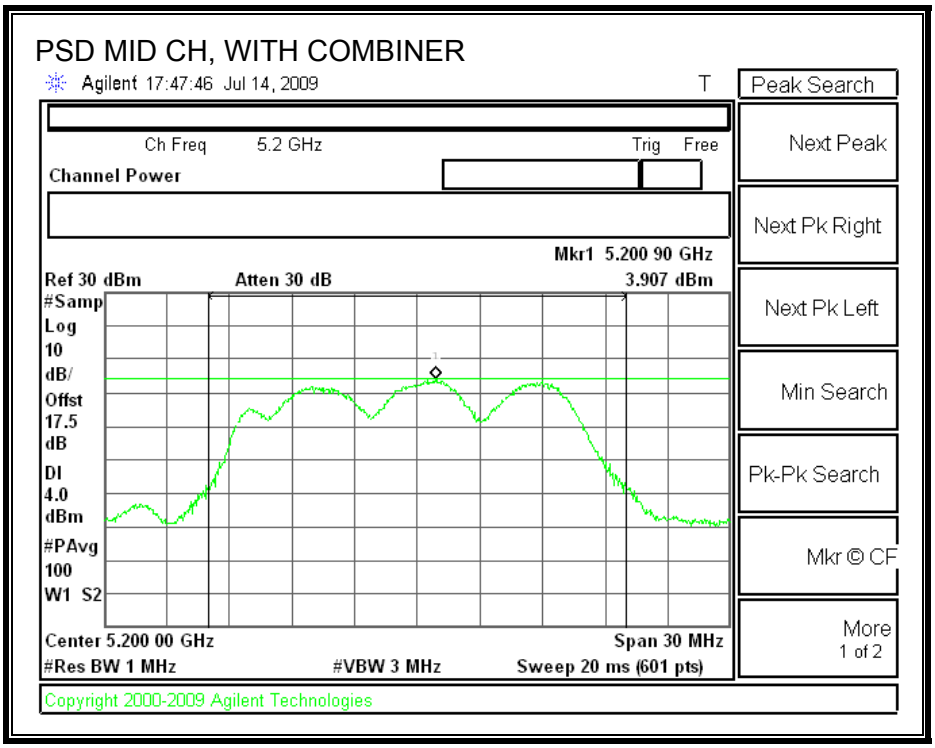
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

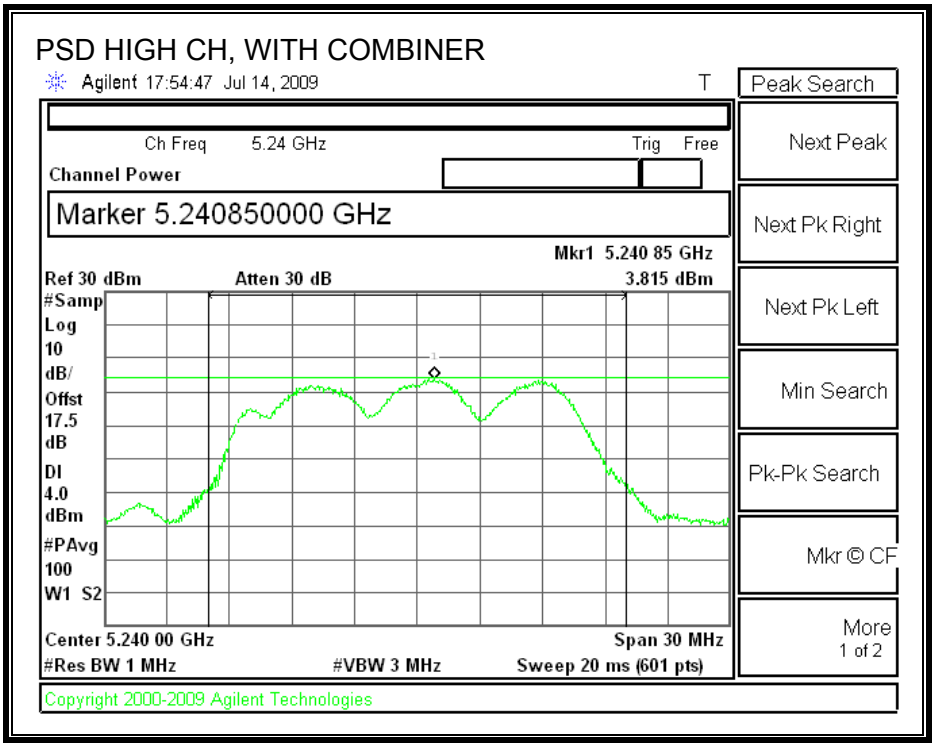
RESULTS

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	**5180**	**3.86**	**3.99**	**-0.13**
Middle	**5200**	**3.91**	**3.99**	**-0.08**
High	**5240**	**3.82**	**3.99**	**-0.18**

POWER SPECTRAL DENSITY WITH COMBINER







7.1.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

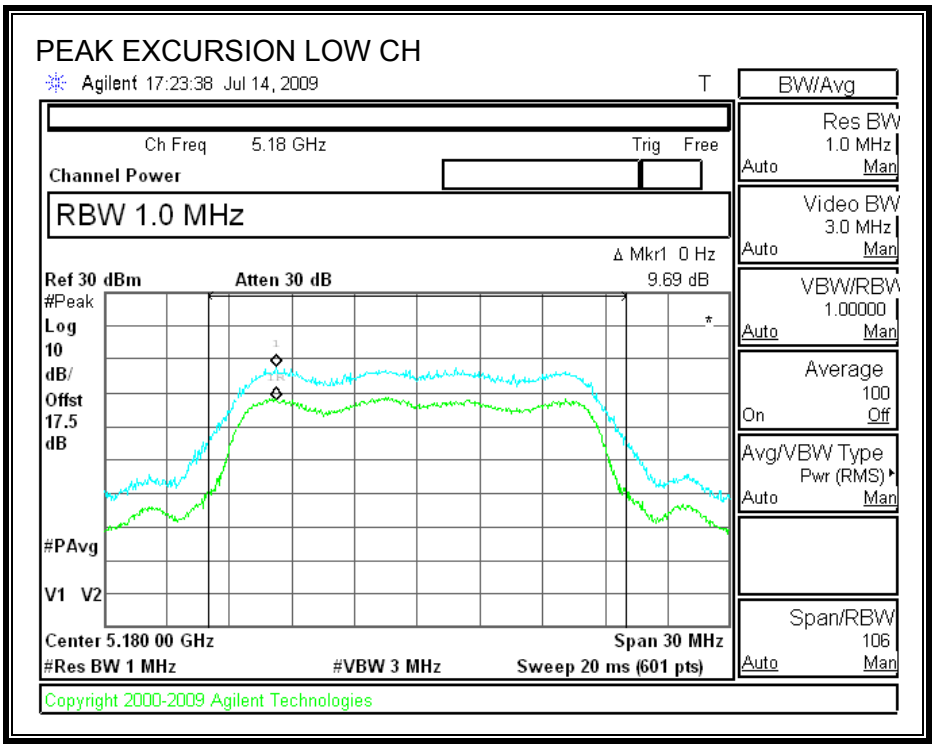
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

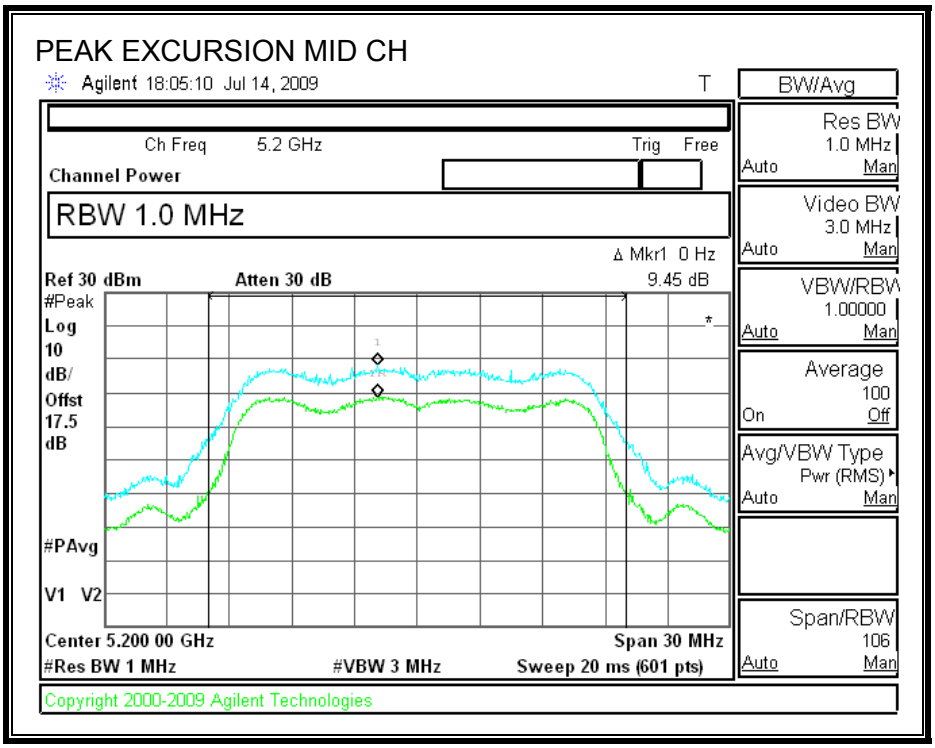
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

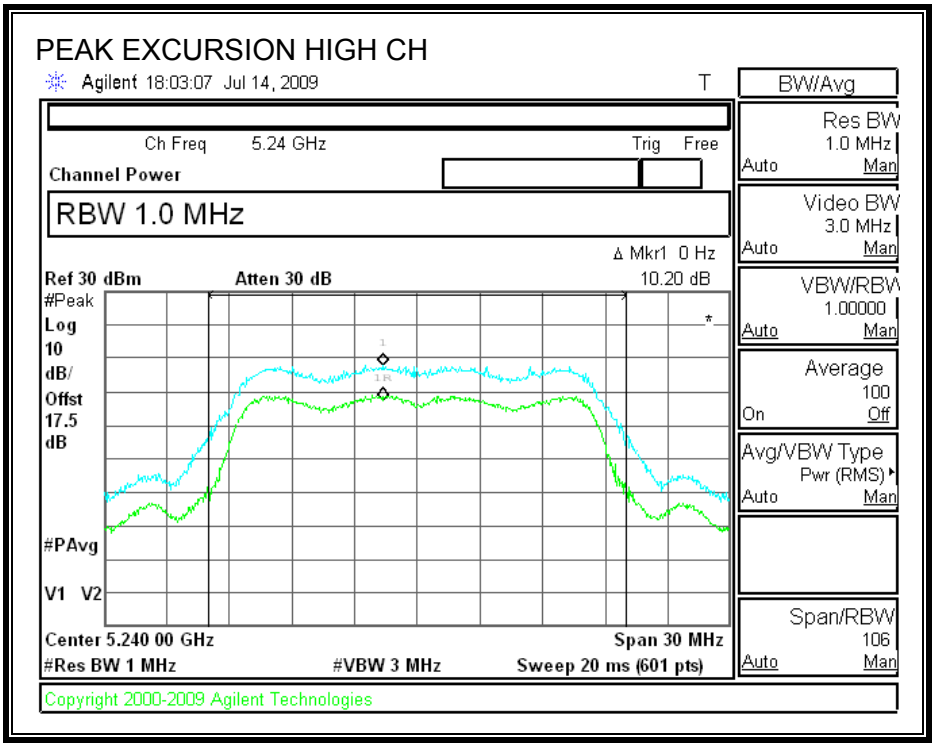
RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	9.69	13	-3.31
Middle	5200	9.45	13	-3.55
High	5240	10.20	13	-2.80

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.

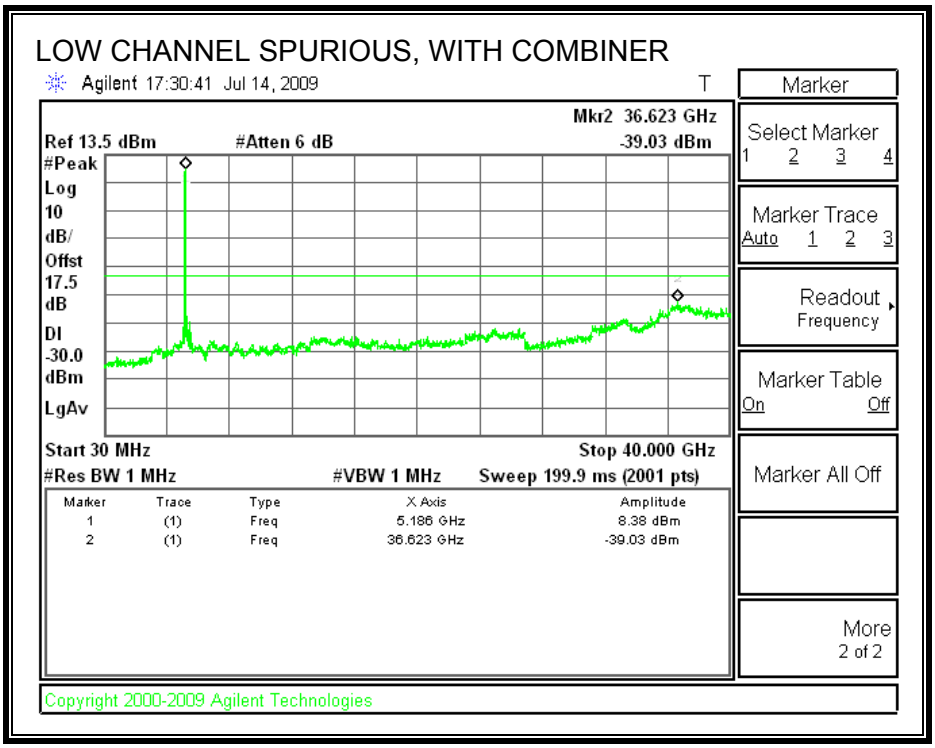
TEST PROCEDURE

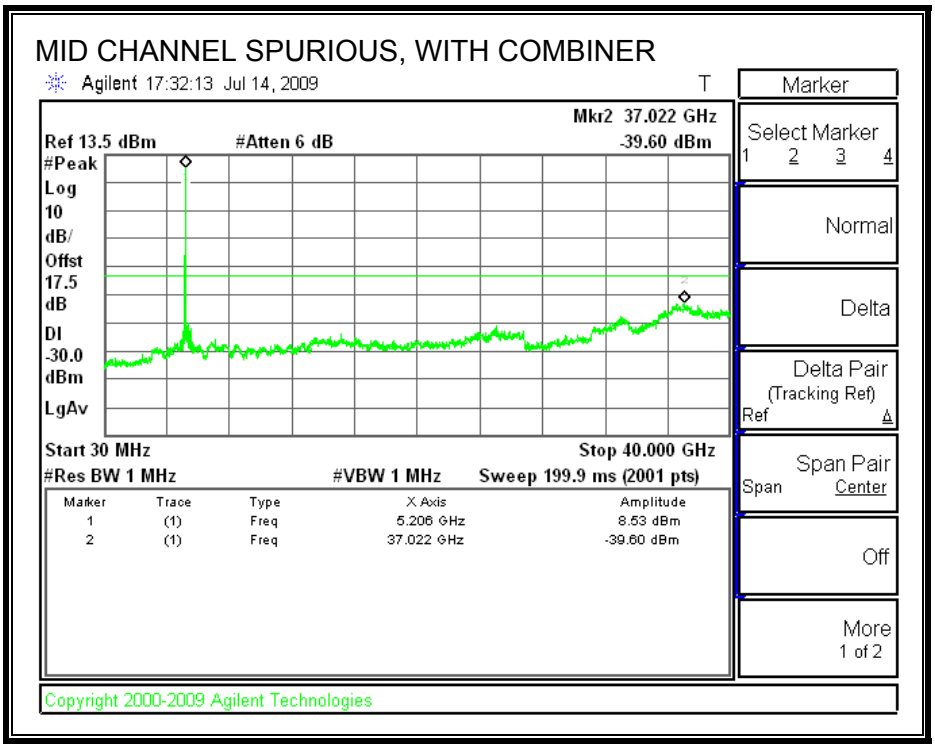
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

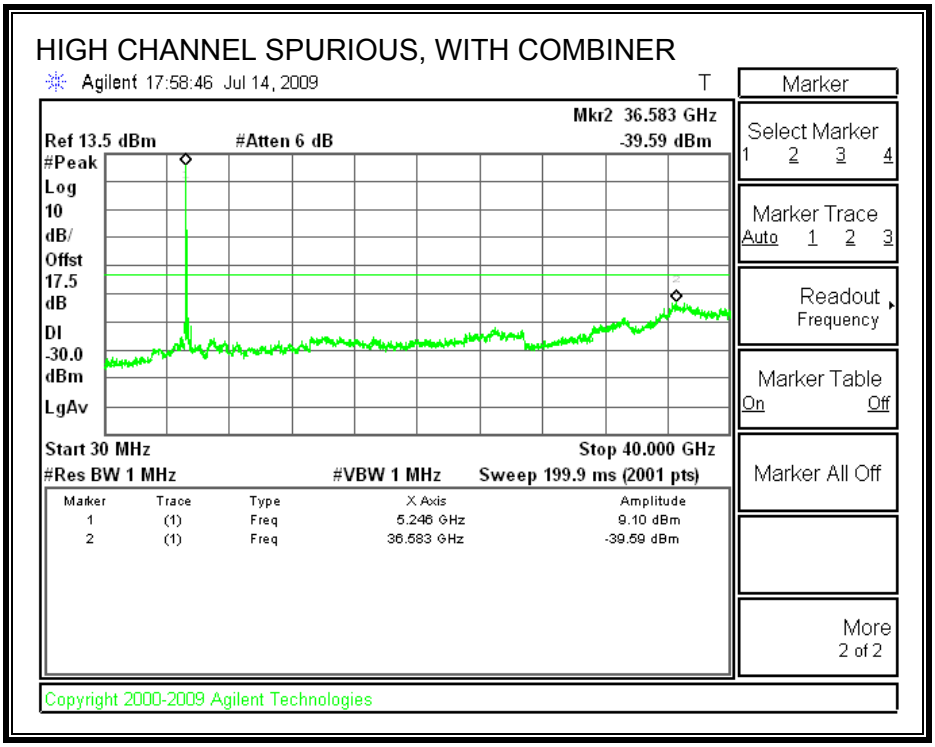
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to EIRP limit, adjusted for the maximum antenna gain.

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







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.

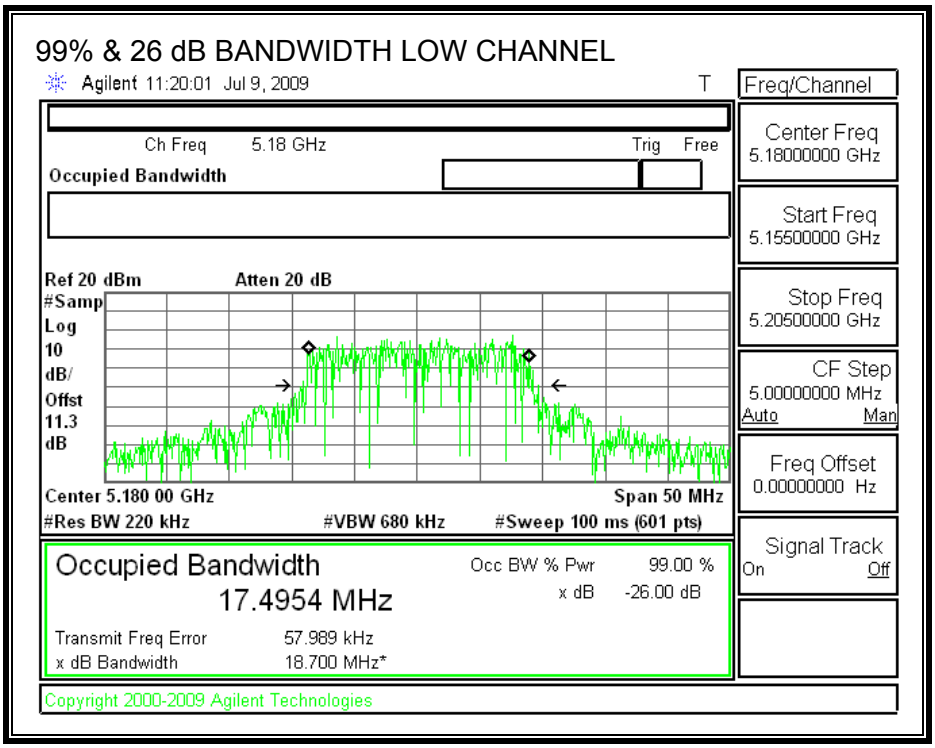
TEST PROCEDURE

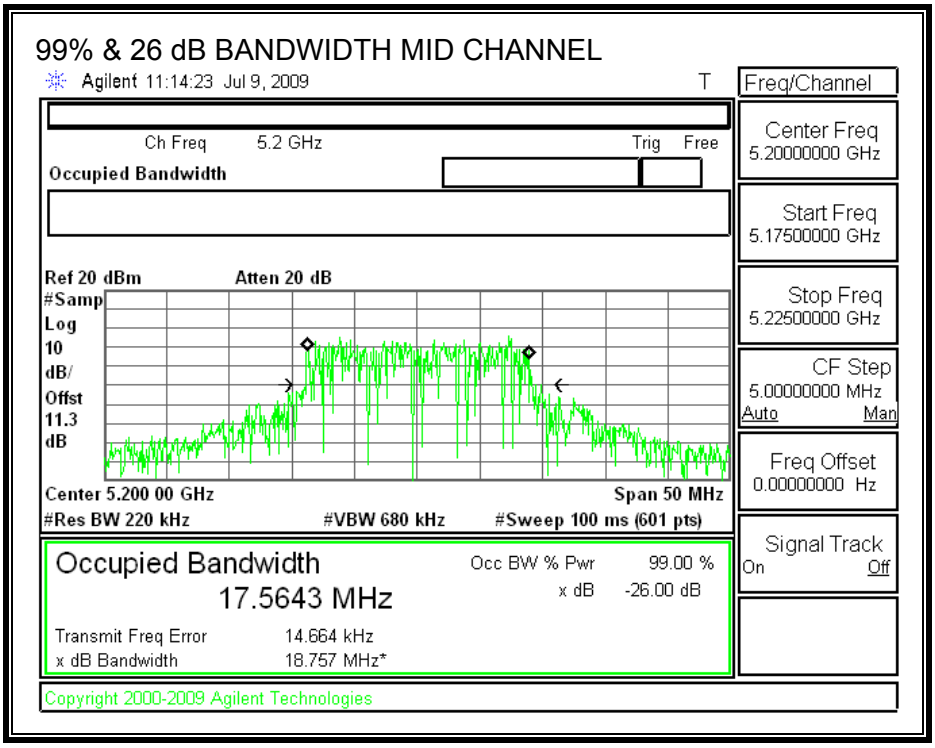
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

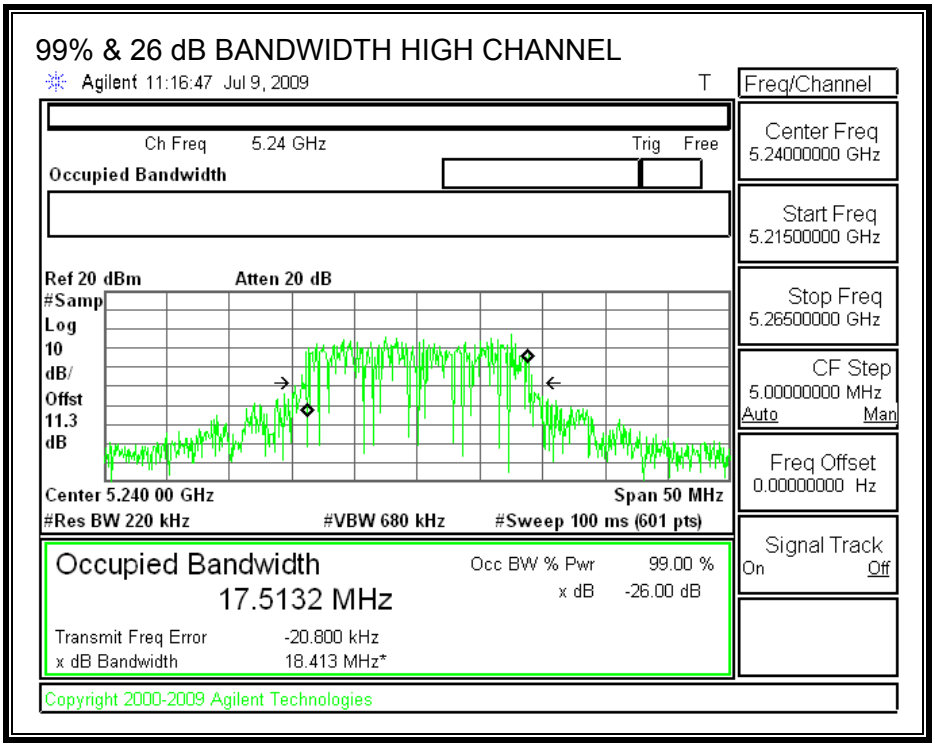
Channel	Frequency (MHz)	99% OBW (MHz)	26 dB BW (MHz)
Low	5180	17.4954	18.700
Middle	5200	17.5643	18.757
High	5240	17.5132	18.413

99% & 26 dB BANDWIDTH





99% & 26 dB BANDWIDTH HIGH CHANNEL



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.

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

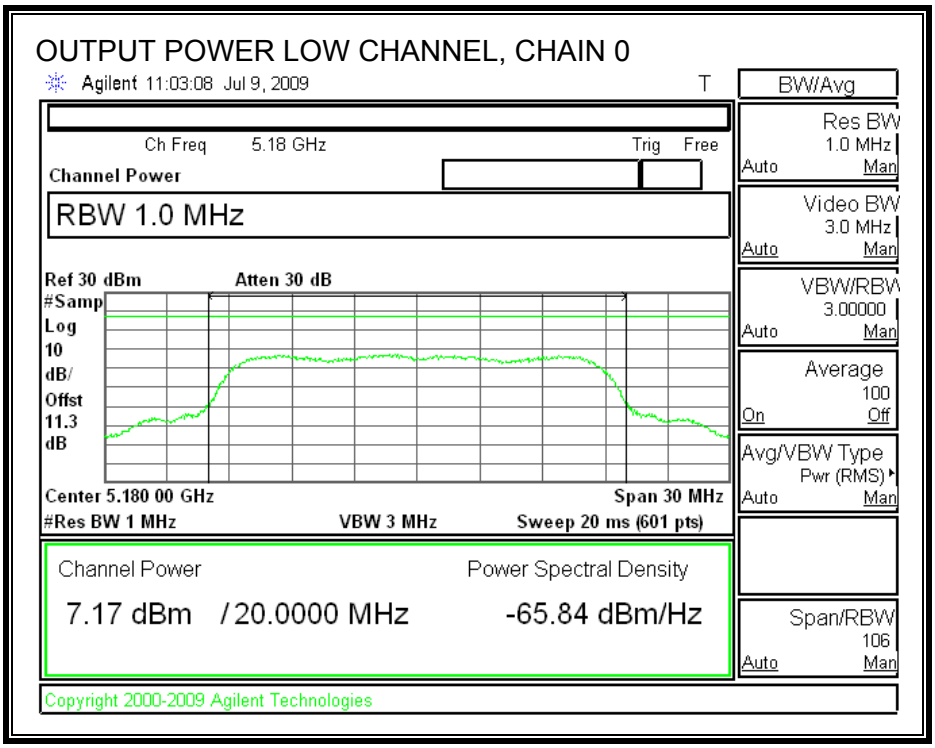
Limit

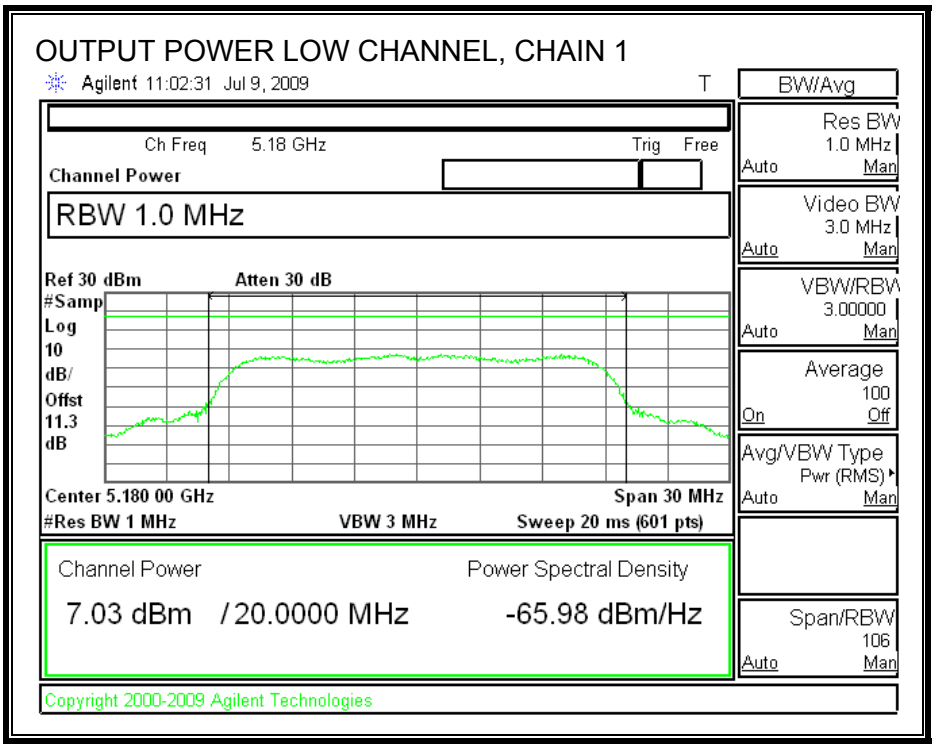
Channel	Freq (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	18.700	16.72	3	16.72
Mid	5200	17	18.757	16.73	3	16.73
High	5240	17	18.413	16.65	3	16.65

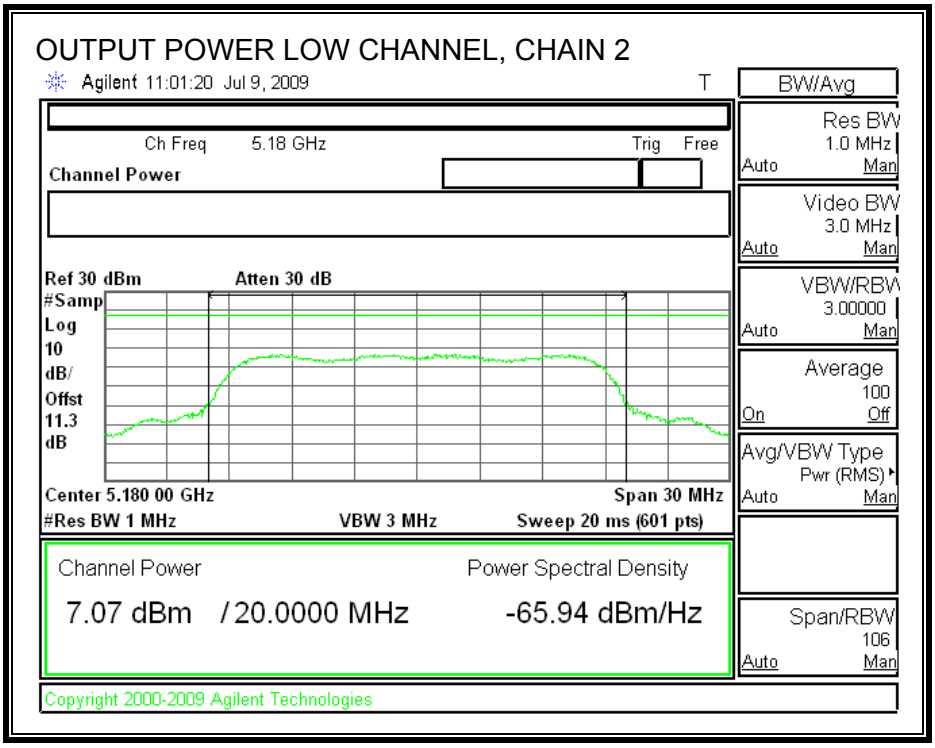
Individual Chain Results

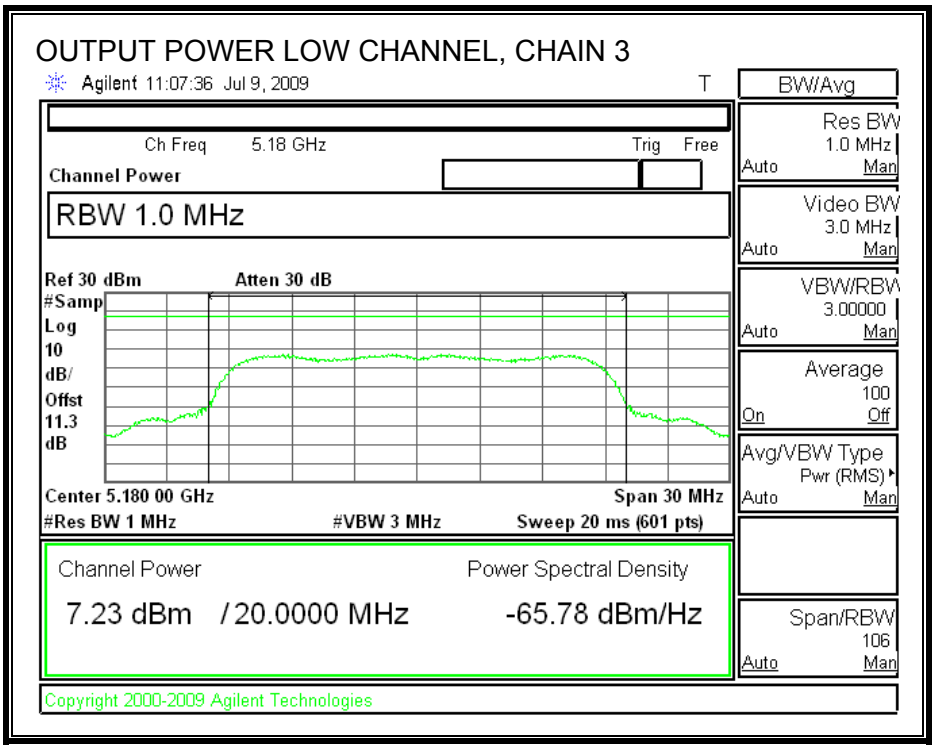
Channel	Freq (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	7.17	7.03	7.07	7.23	13.15	16.72	-3.57
Mid	5200	7.16	7.17	7.22	7.28	13.23	16.73	-3.50
High	5240	7.16	7.14	7.18	7.28	13.21	16.65	-3.44

OUTPUT POWER, LOW CHANNEL

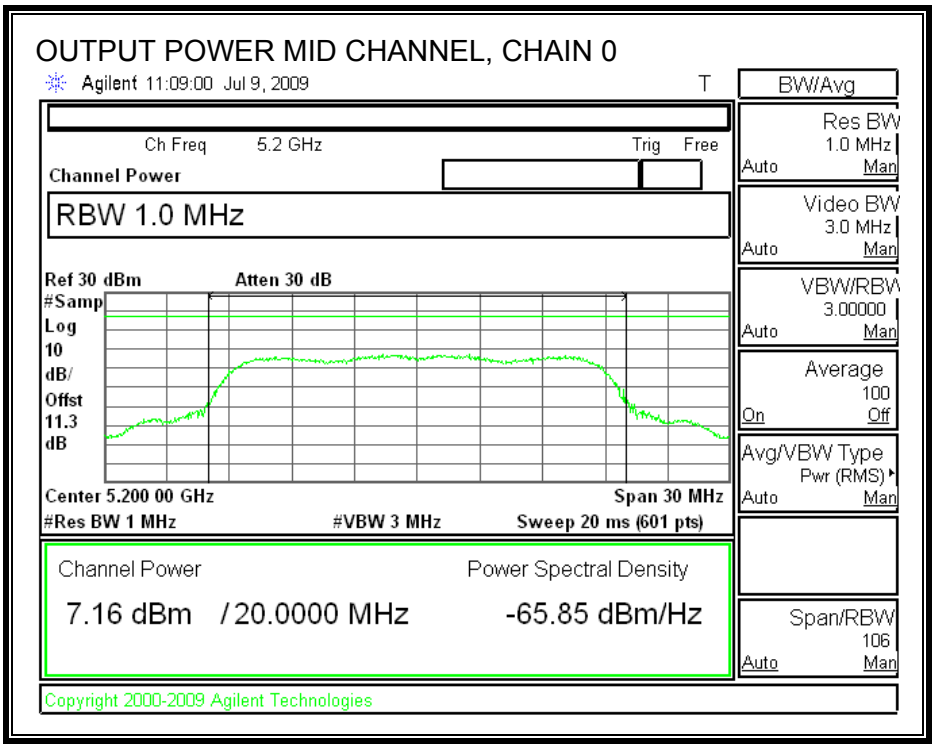


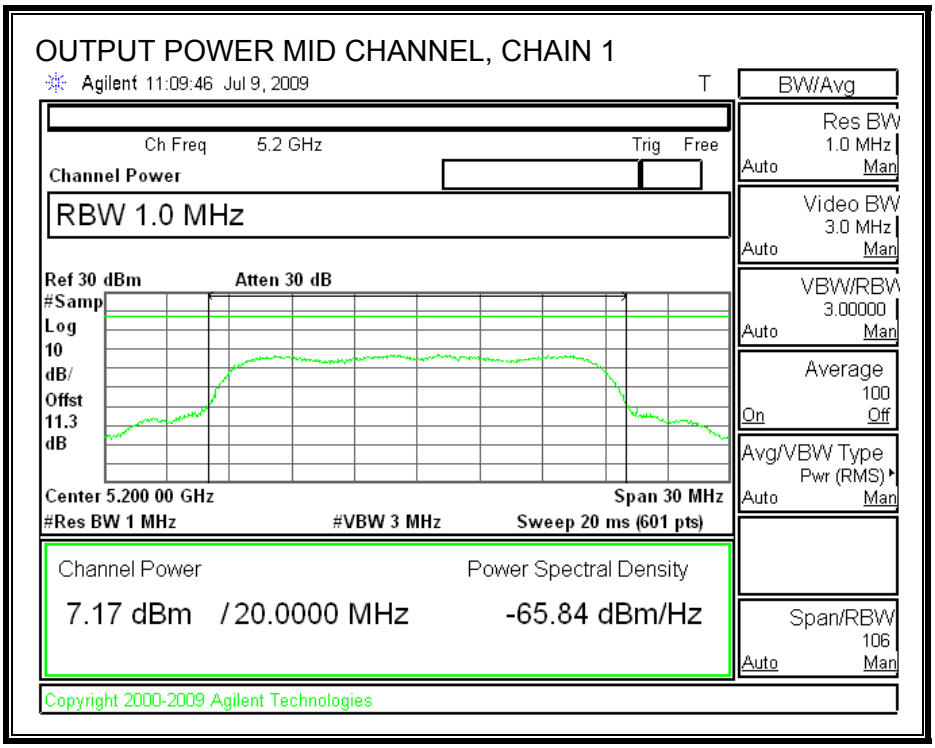


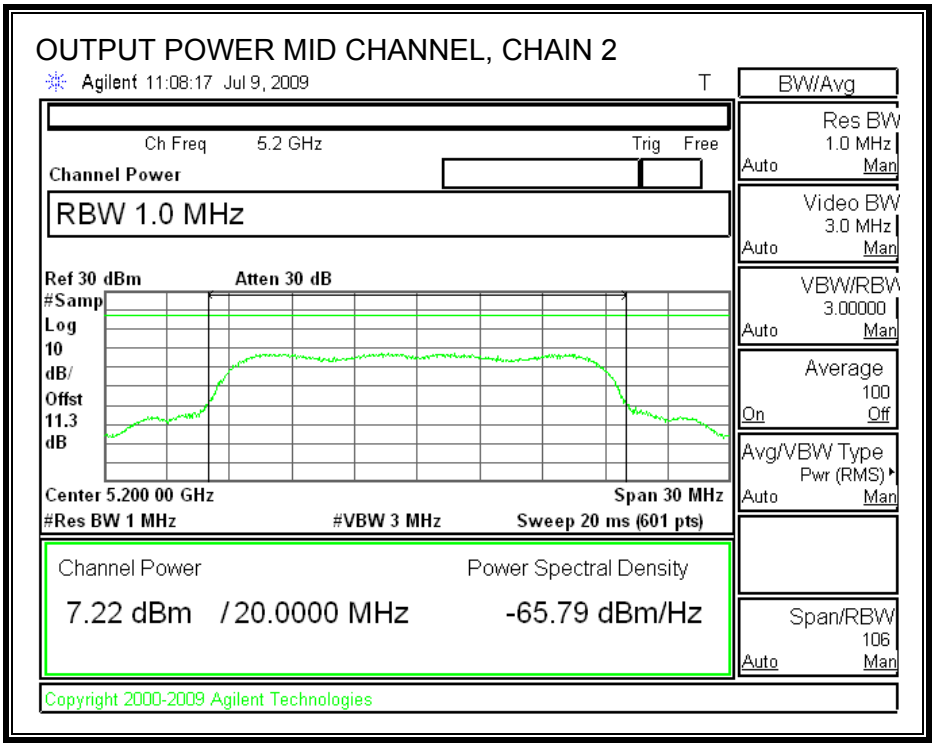


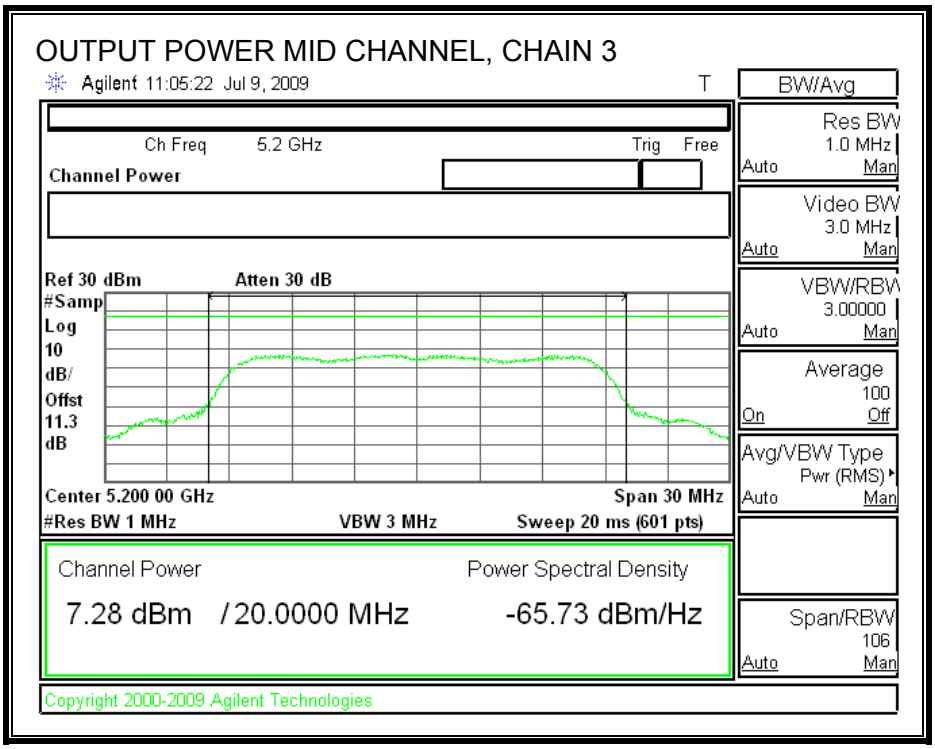


OUTPUT POWER, MID CHANNEL

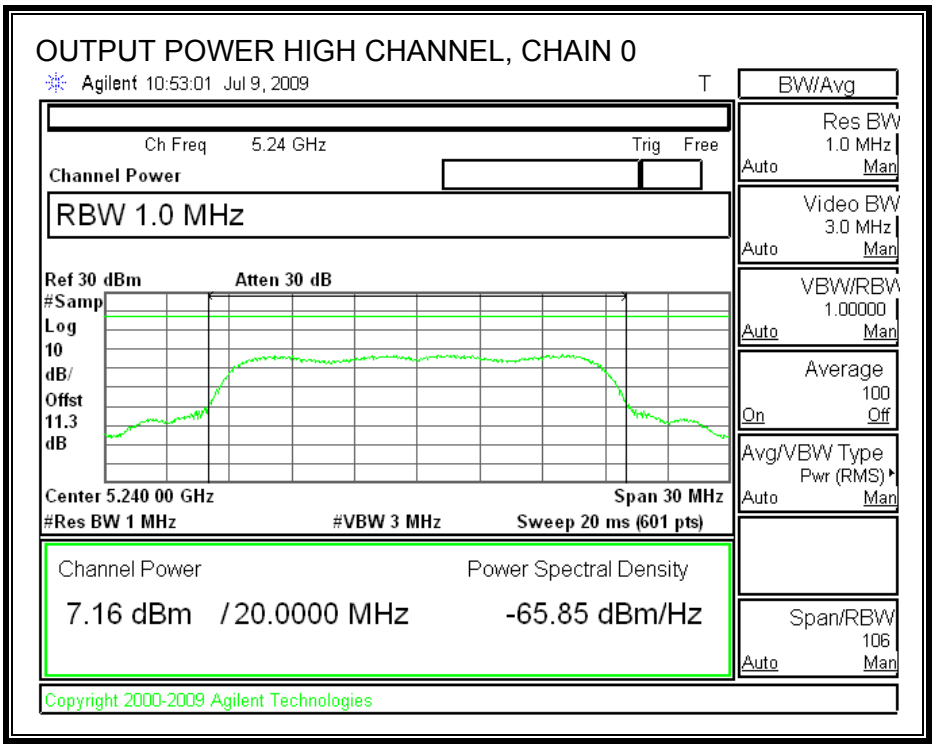


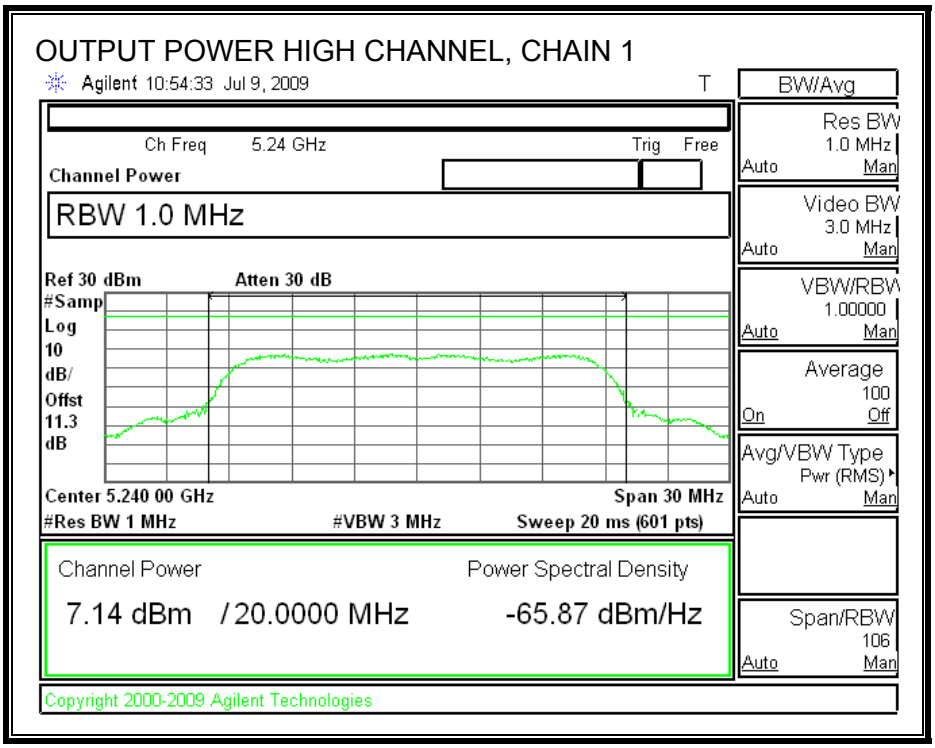


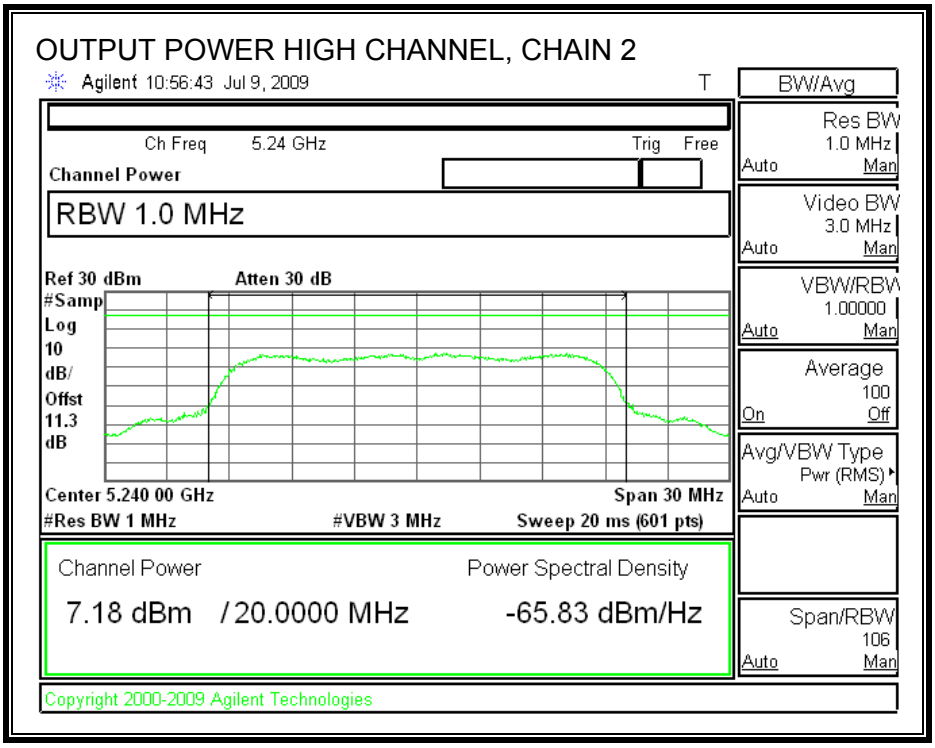


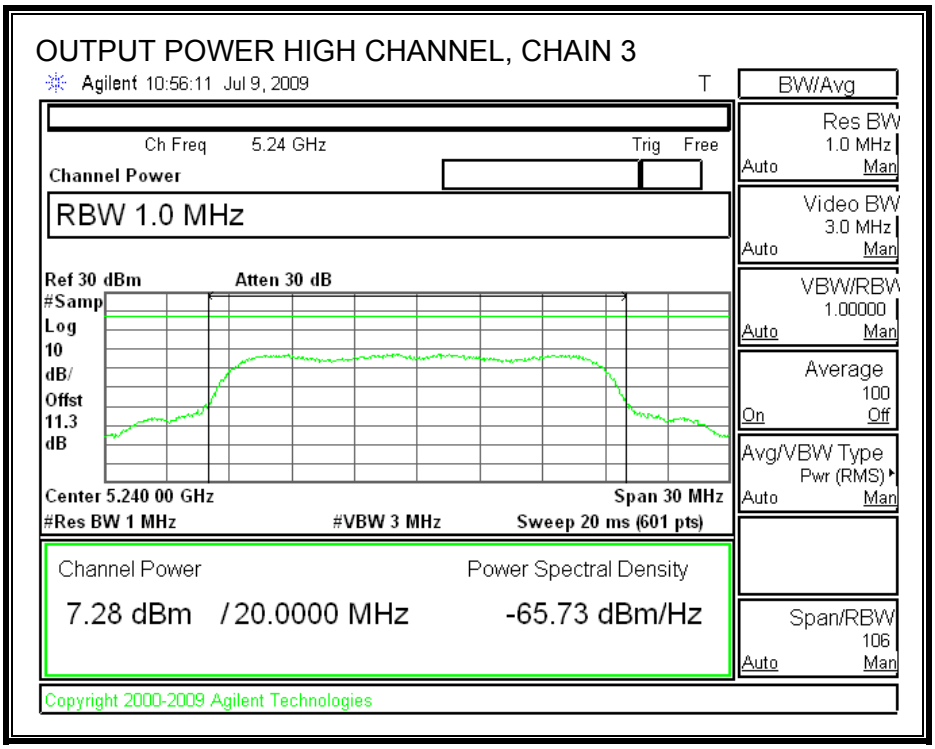


OUTPUT POWER, HIGH CHANNEL









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 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

Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)
5180	7.14	7.26	7.10	7.23
5200	7.15	7.21	7.24	7.23
5240	7.35	7.32	7.39	7.28

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.

TEST PROCEDURE

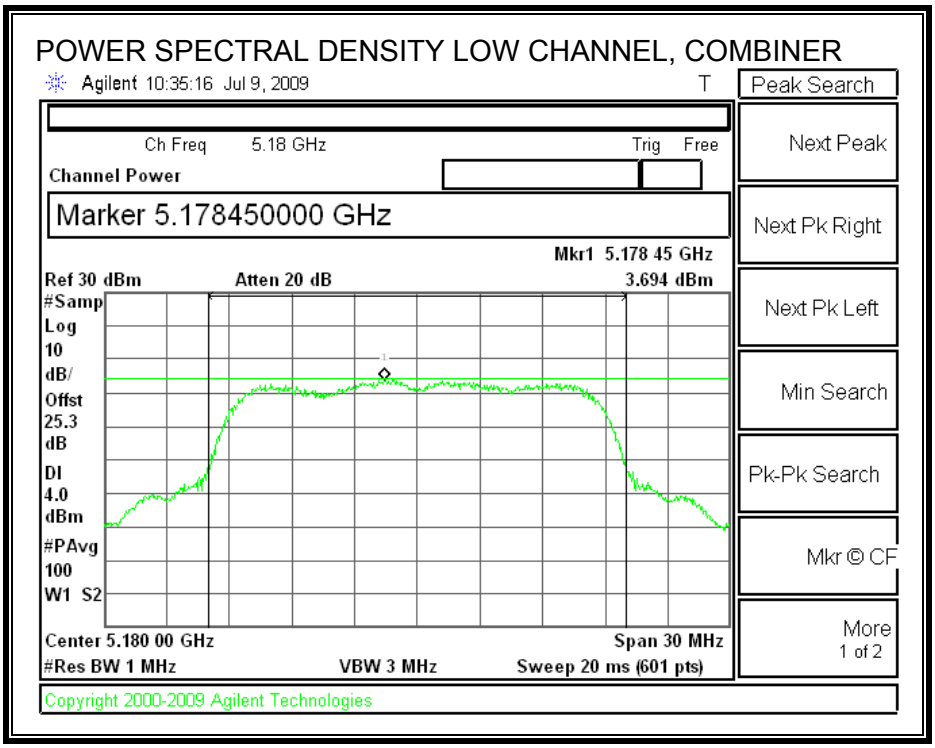
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

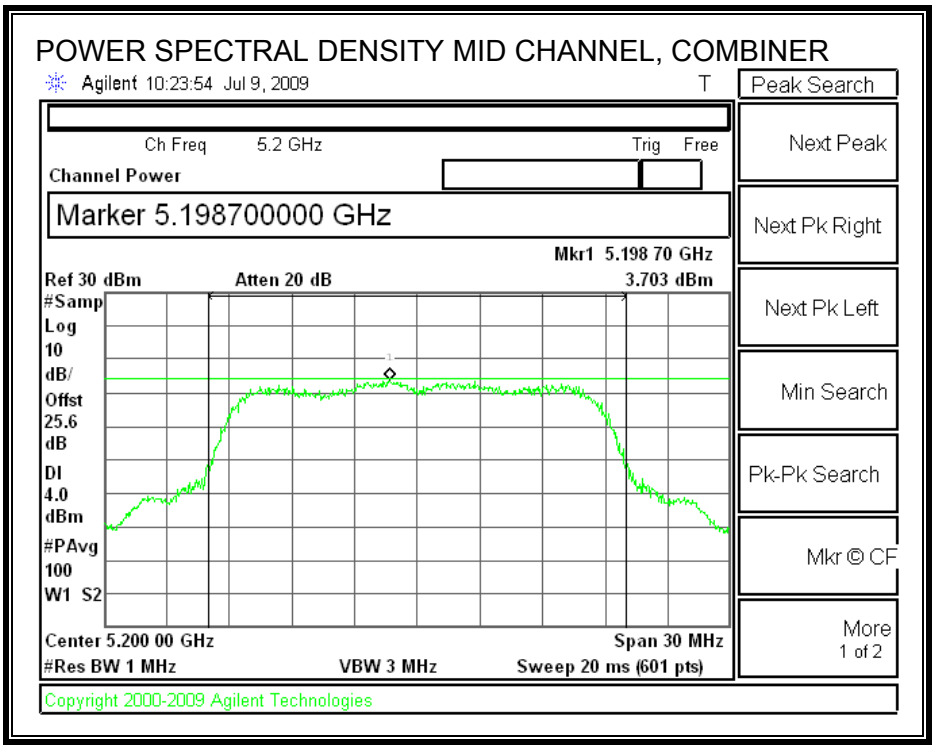
Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

RESULTS

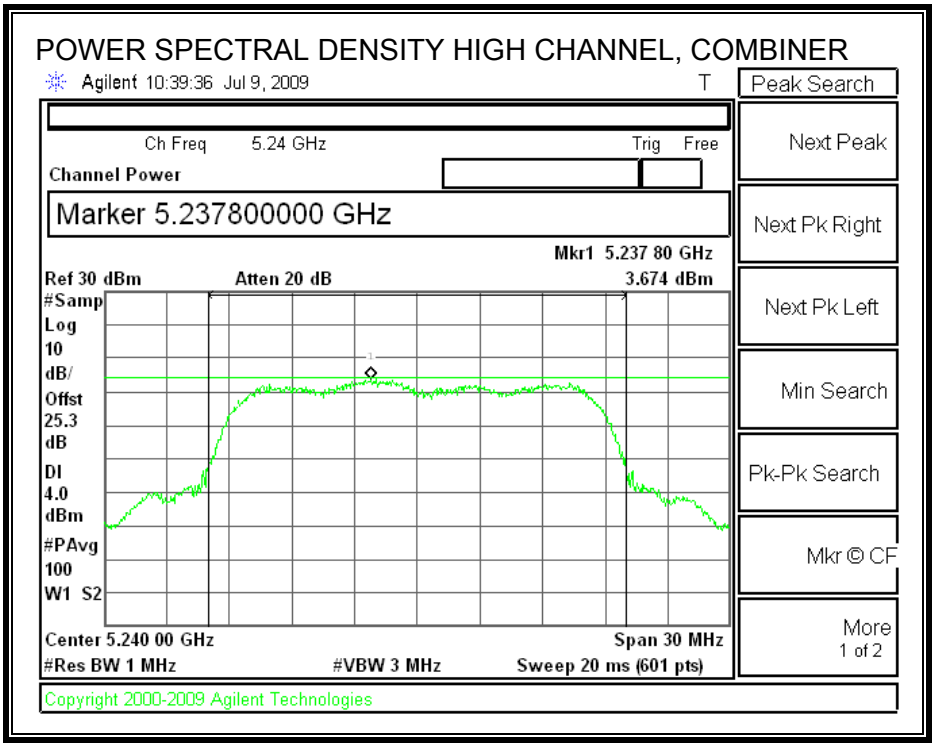
Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.69	4	-0.31
Middle	5200	3.70	4	-0.30
High	5240	3.67	4	-0.33

POWER SPECTRAL DENSITY





POWER SPECTRAL DENSITY HIGH CHANNEL, COMBINER



7.2.5. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

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

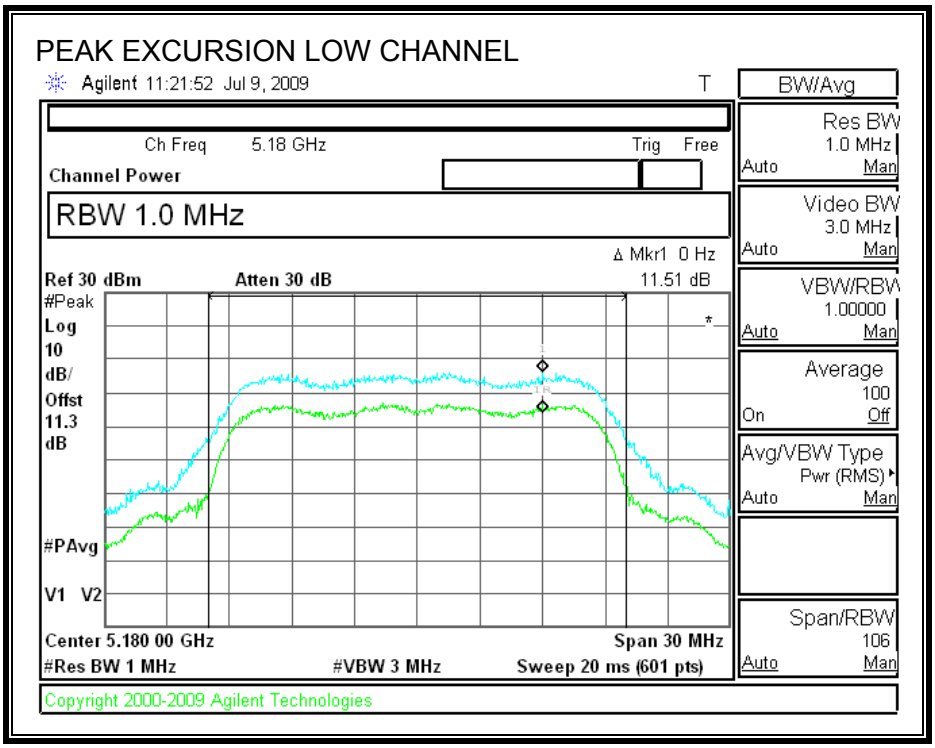
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

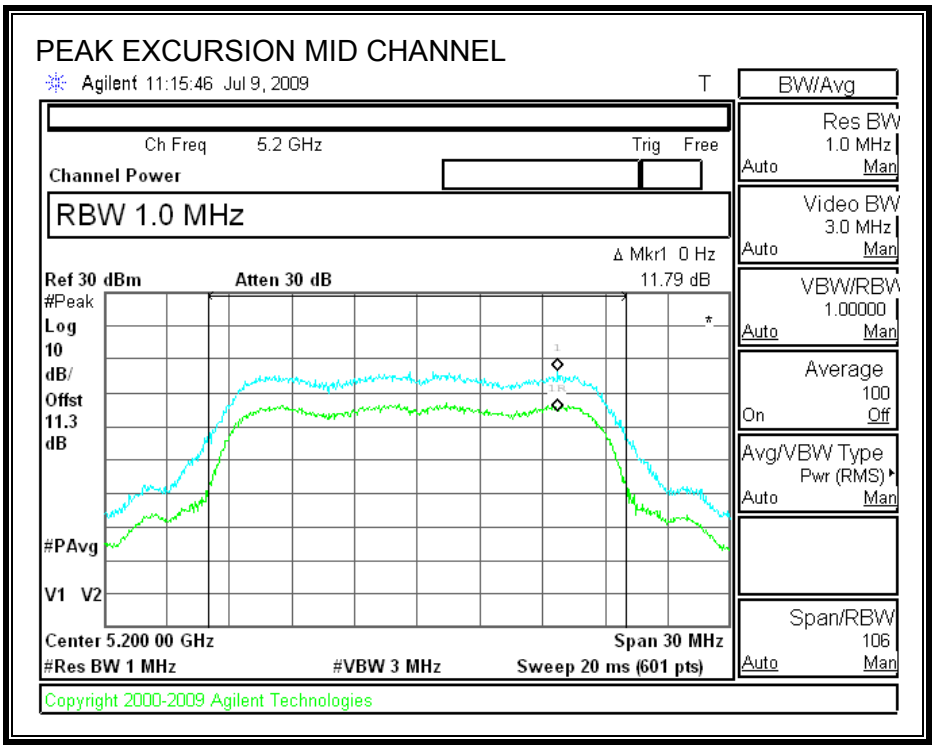
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

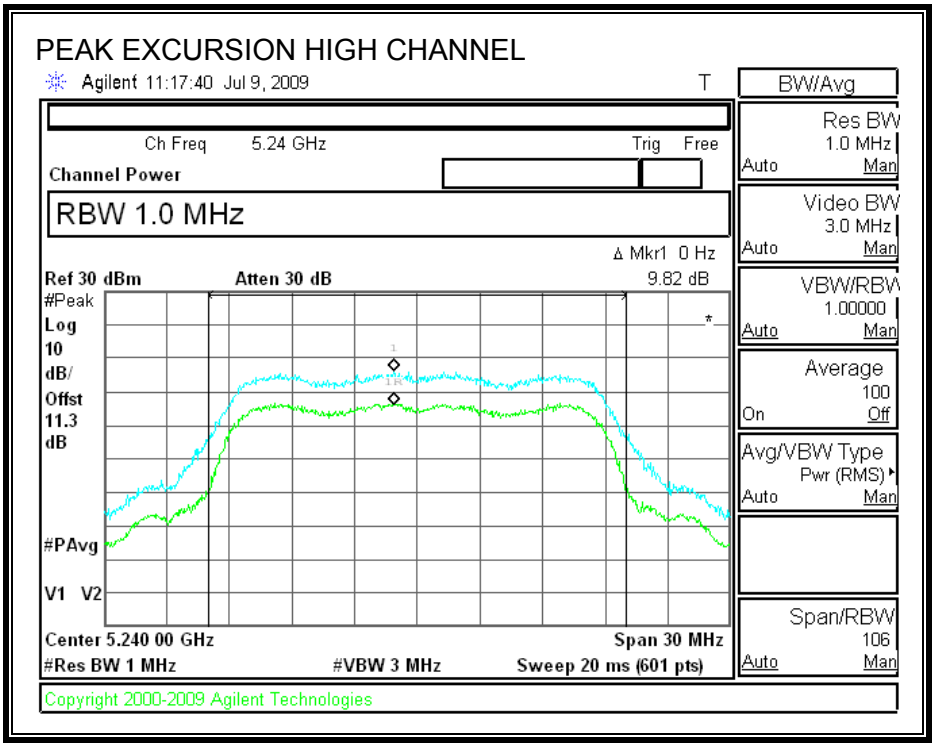
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	11.51	13	-1.49
Middle	5200	11.79	13	-1.21
High	5240	9.82	13	-3.18

PEAK EXCURSION





PEAK EXCURSION HIGH CHANNEL



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

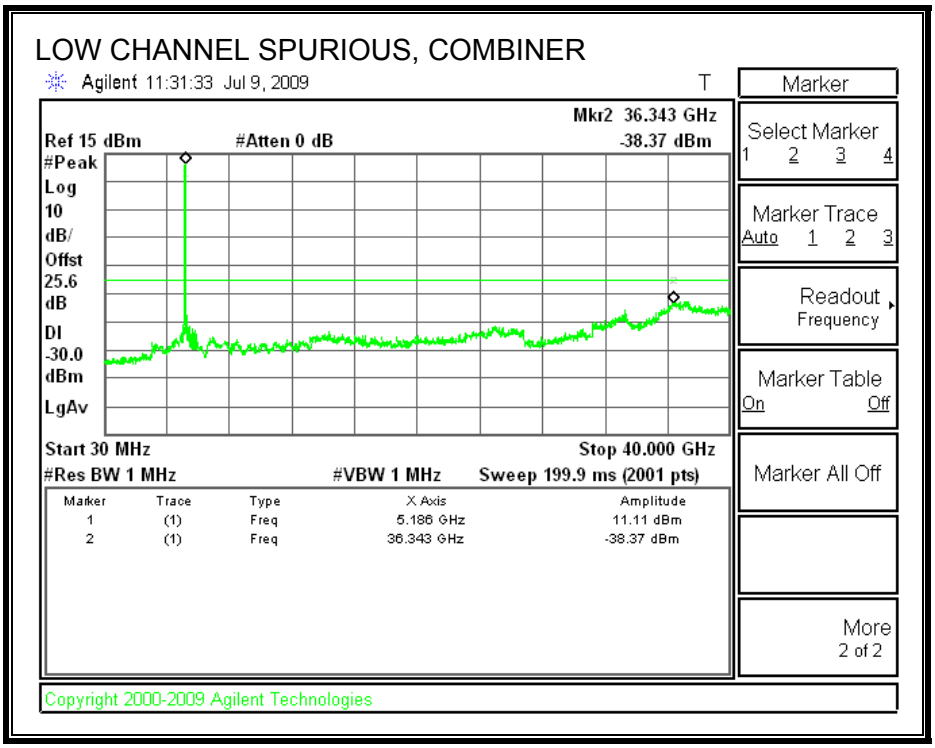
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

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.

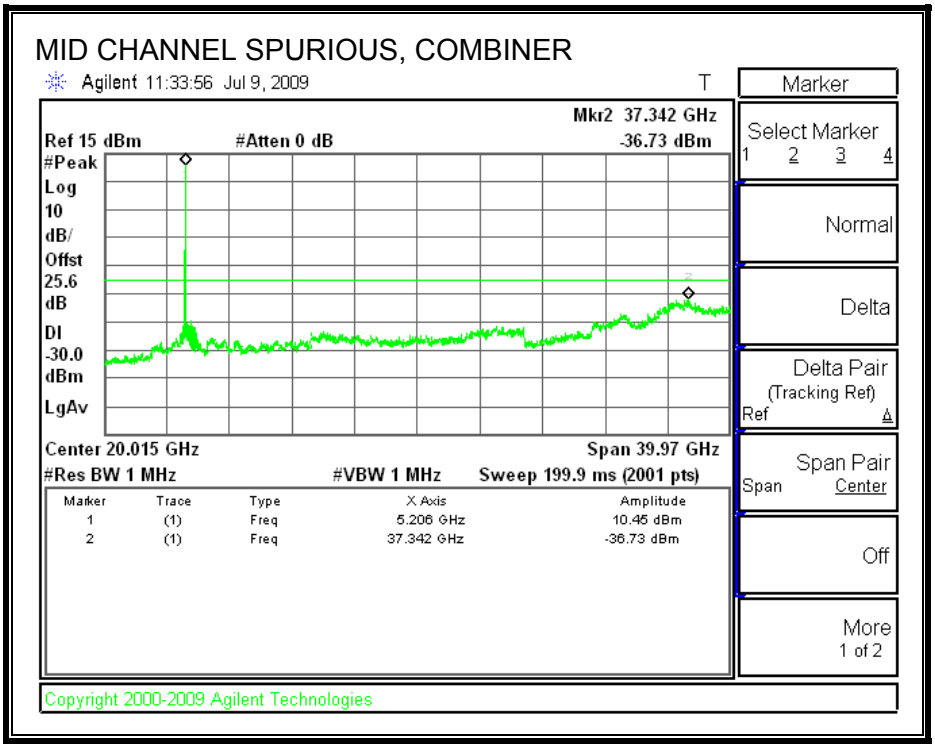
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

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.

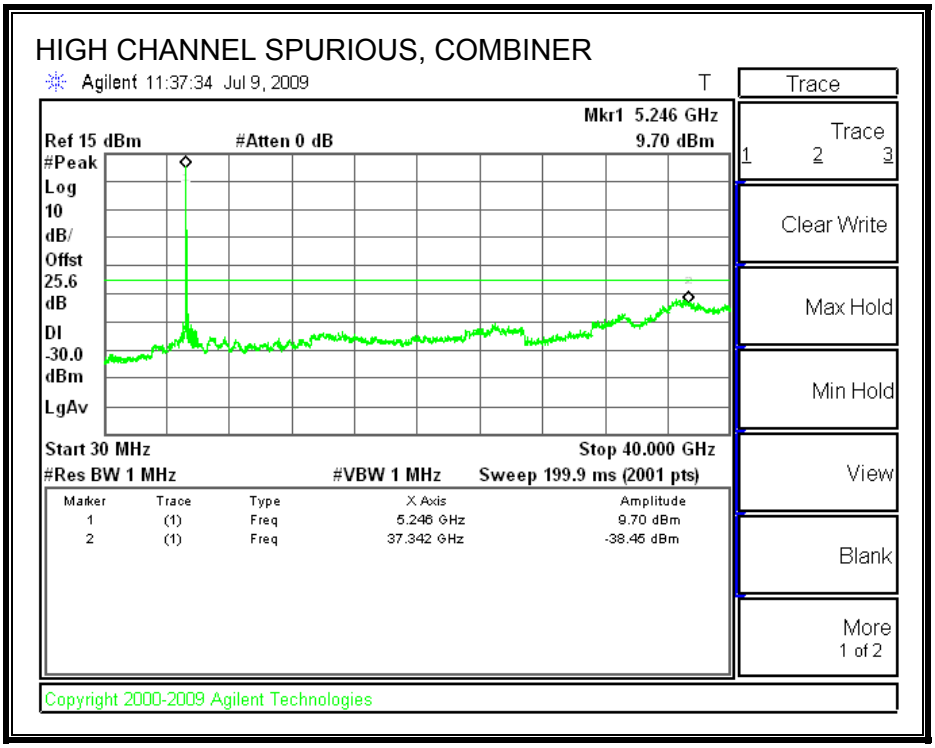
LOW CHANNEL SPURIOUS EMISSIONS



MID 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.

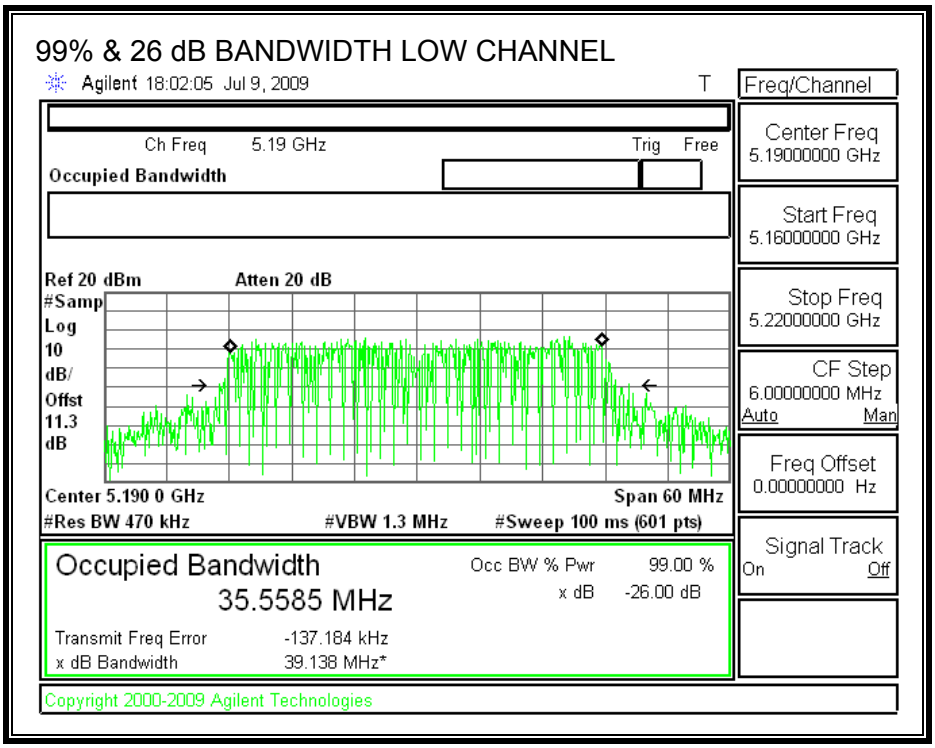
TEST PROCEDURE

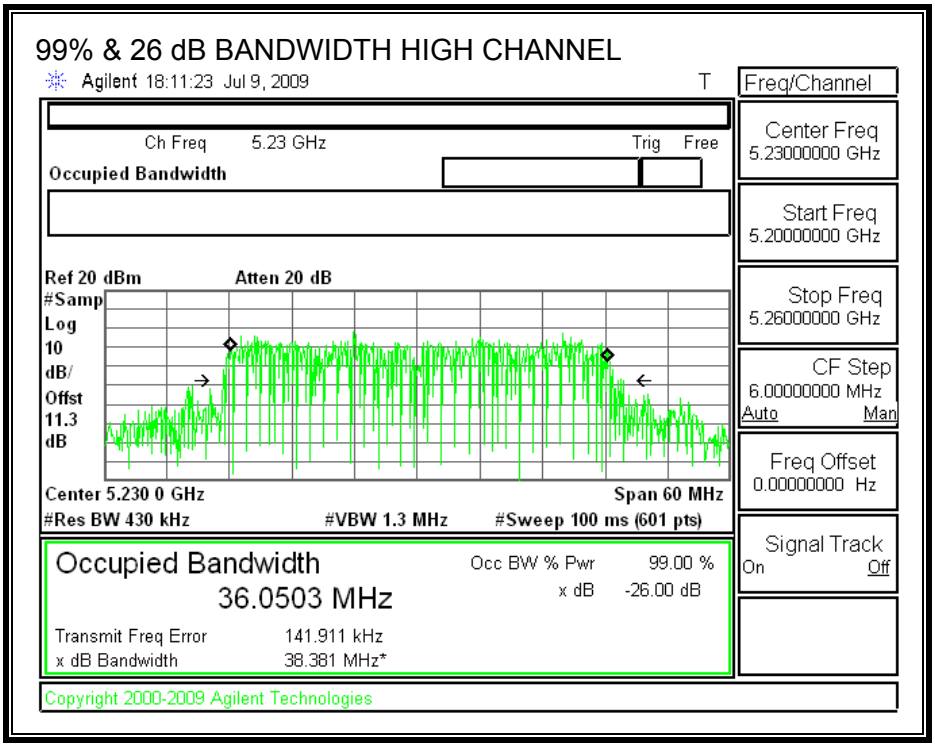
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth measurement function is utilized.

RESULTS

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB BW (MHz)
Low	5190	35.5585	39.138
High	5230	36.0503	38.381

99% & 26 dB 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.

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

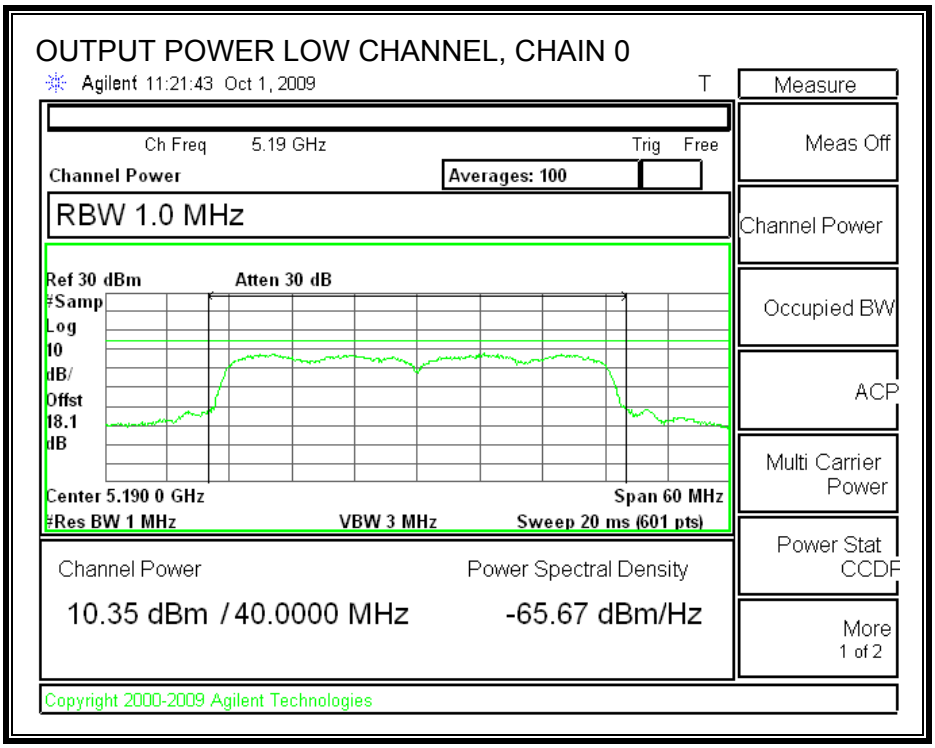
Limit

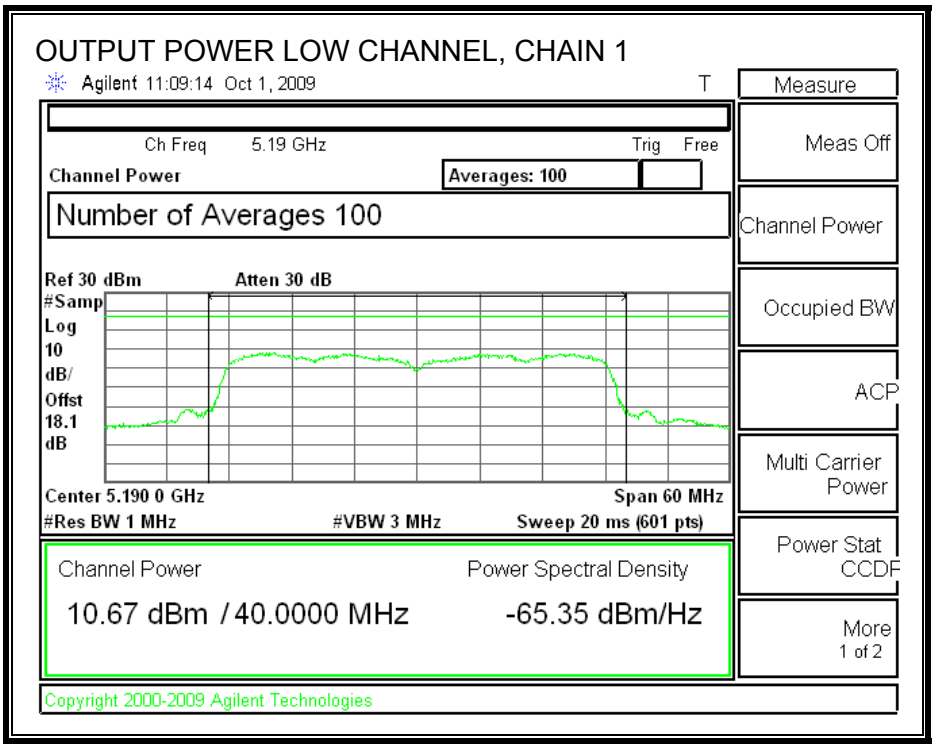
Channel	Freq (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	39.138	19.93	3	17.00
High	5230	17	38.381	19.84	3	17.00

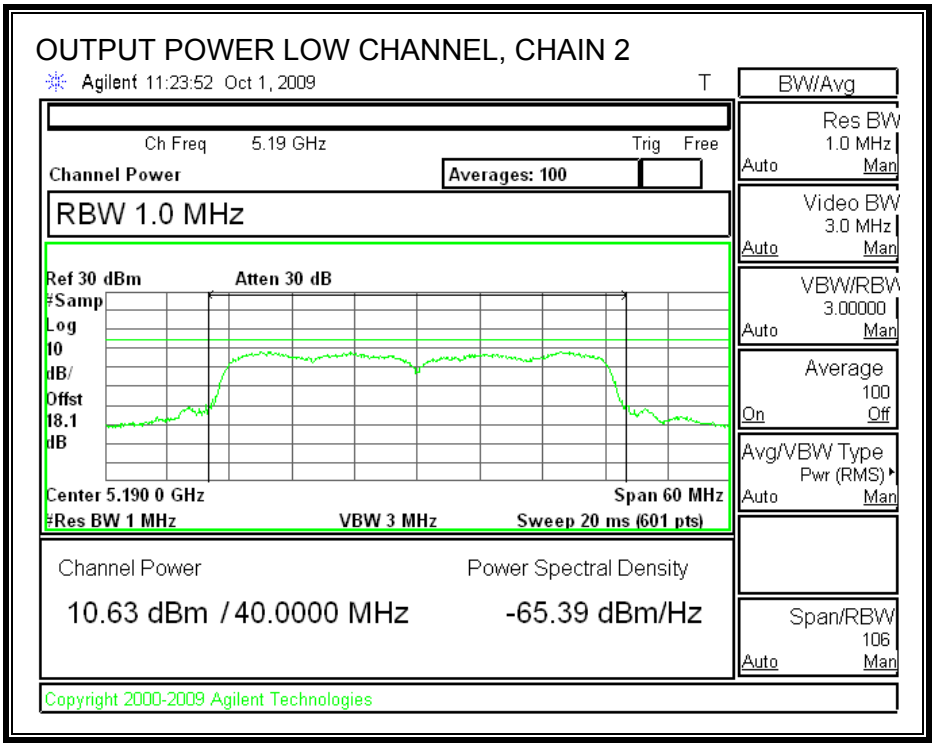
Individual Chain Results

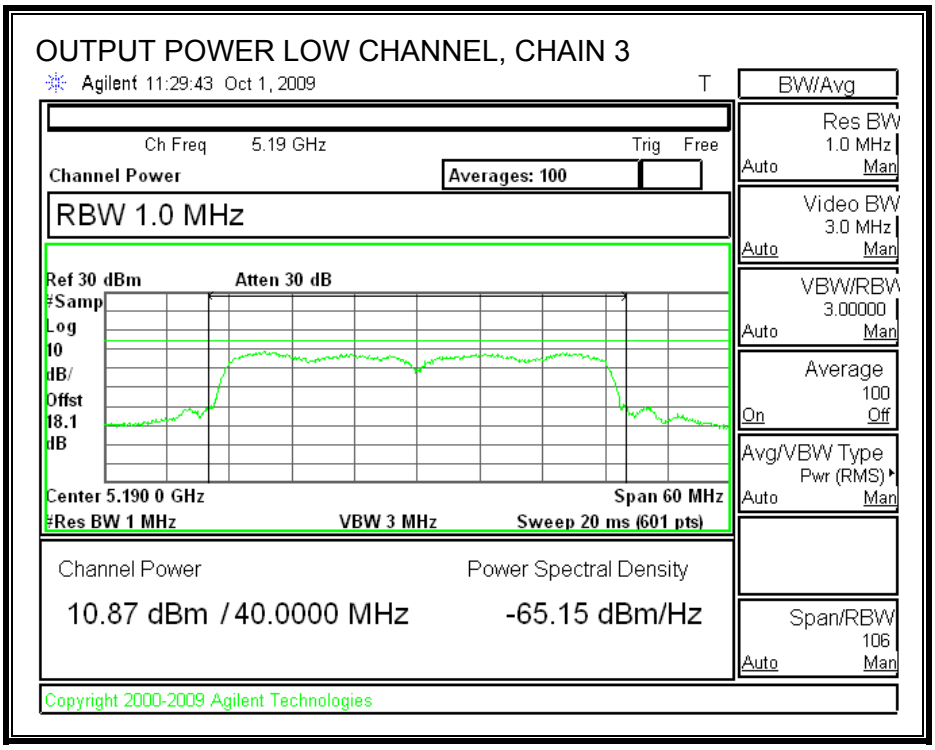
Channel	Freq (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	10.35	10.67	10.63	10.87	16.65	17.00	-0.35
High	5230	10.56	10.79	10.54	10.70	16.67	17.00	-0.33

OUTPUT POWER, LOW CHANNEL

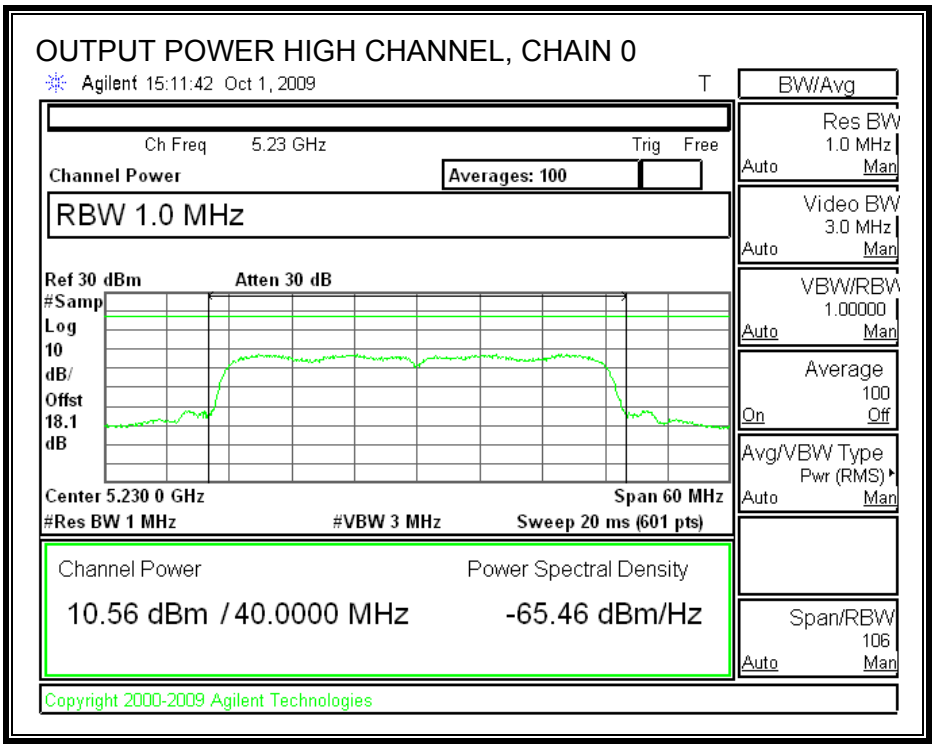


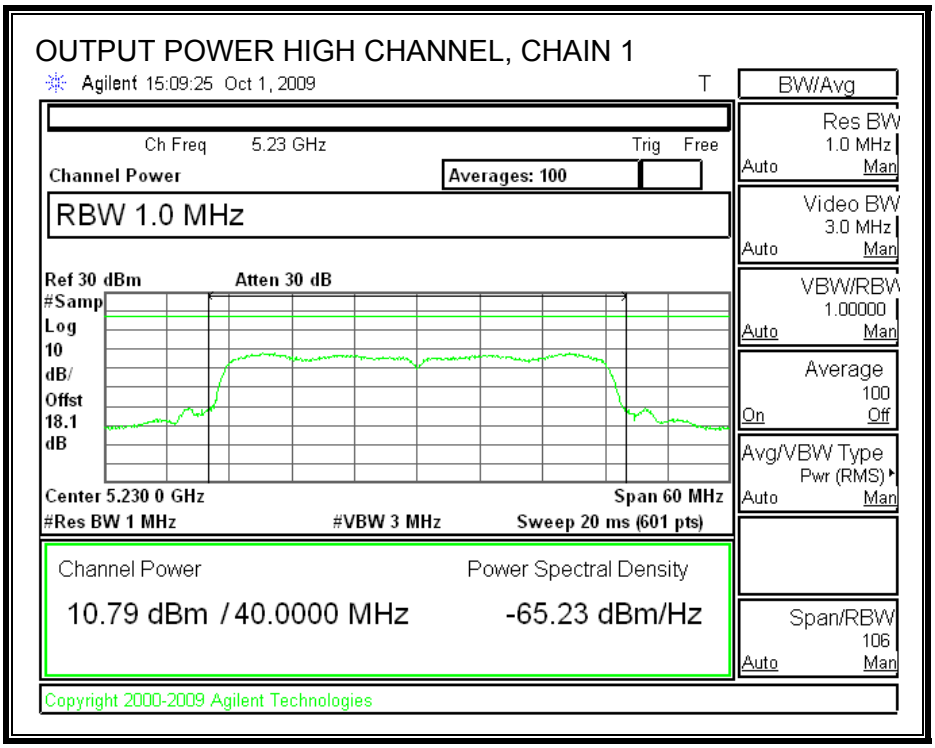


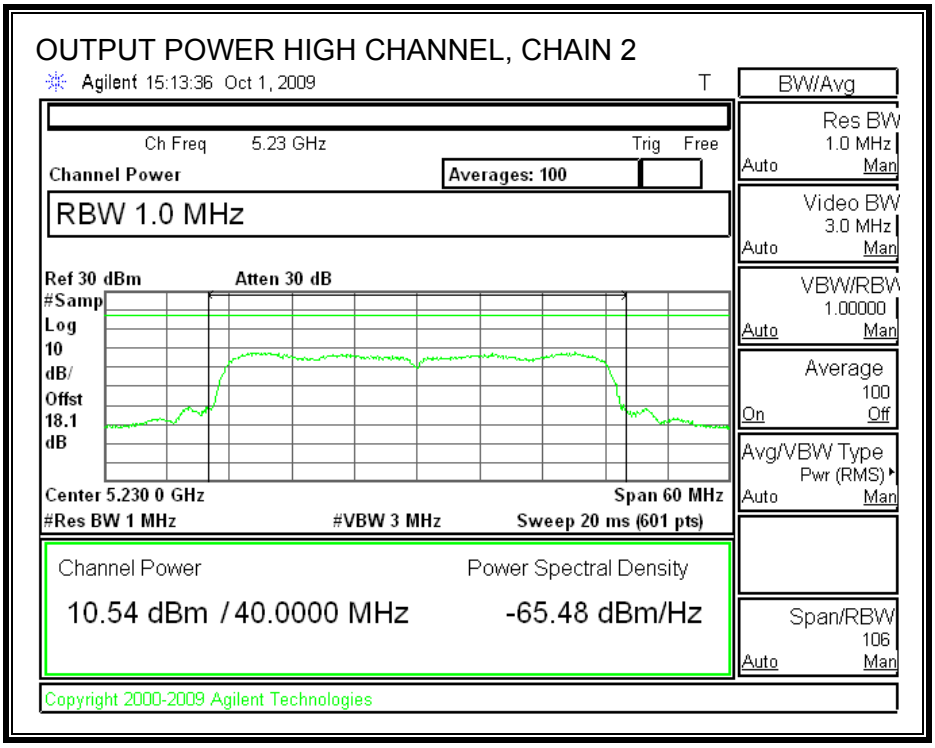


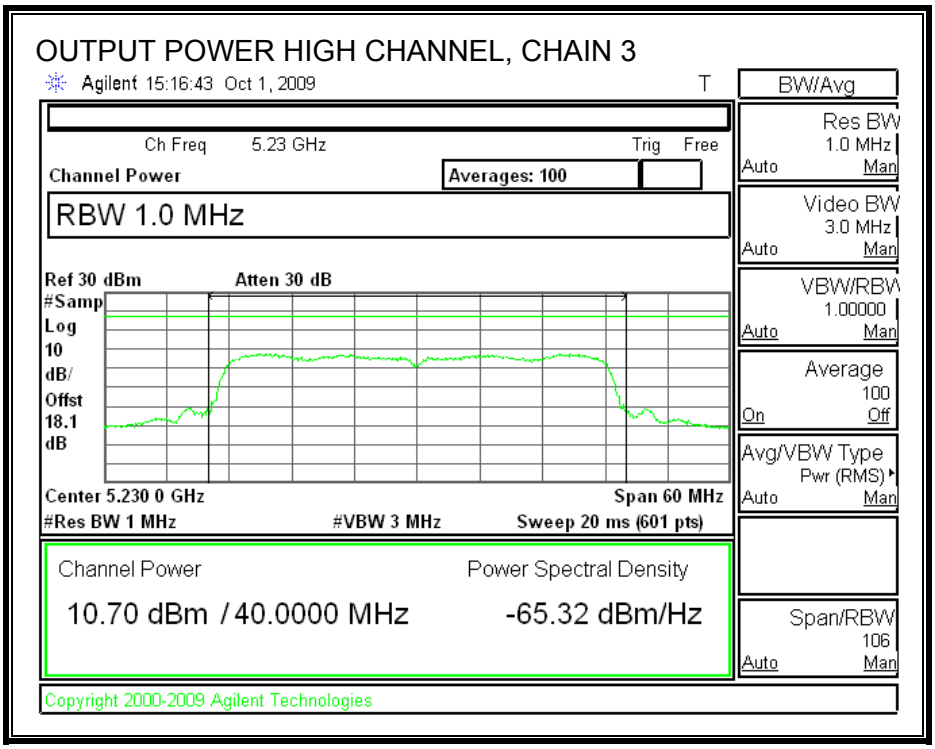


OUTPUT POWER, HIGH CHANNEL









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

Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Chain 3 Power (dBm)
5190	10.57	10.98	10.59	10.82
5230	10.47	10.70	10.52	10.66

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.

TEST PROCEDURE

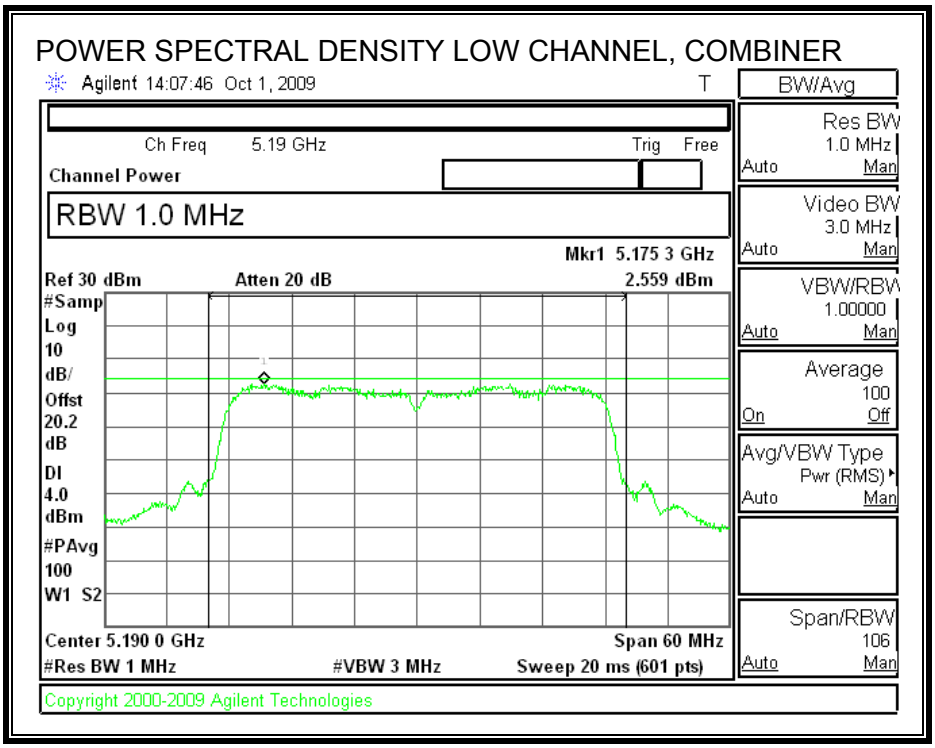
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

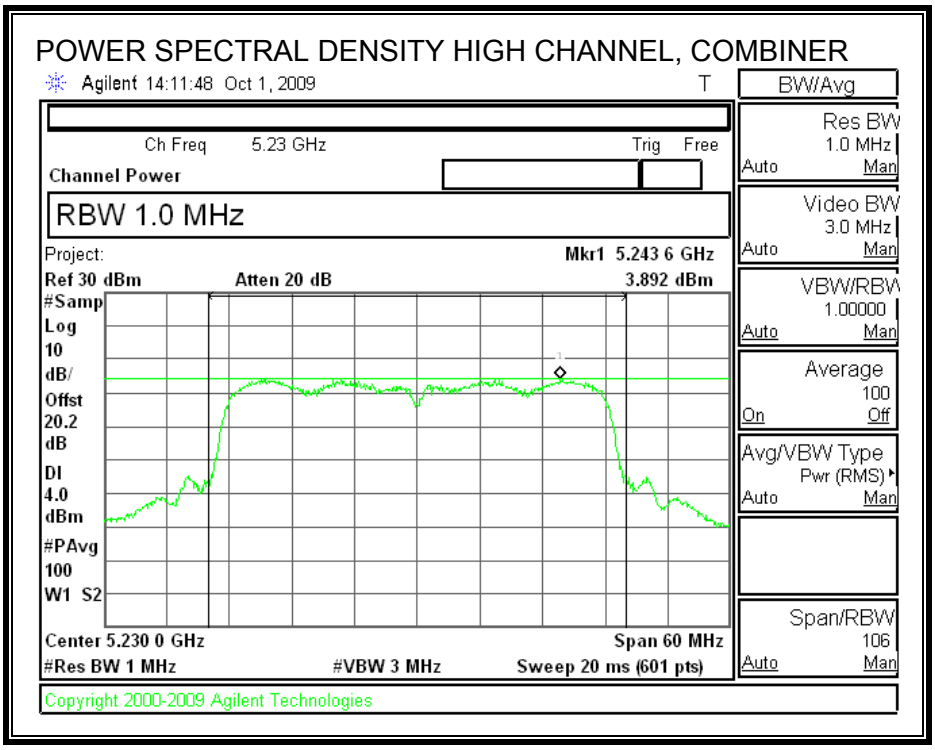
Preliminary tests on individual chains, and on all chains with a combiner, were performed. The worst-case configuration was with a combiner, therefore final test were performed with all chains feeding a combiner.

RESULTS

Channel	Frequency (MHz)	PSD with Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5190	2.559	4	-1.44
High	5230	3.892	4	-0.11

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.

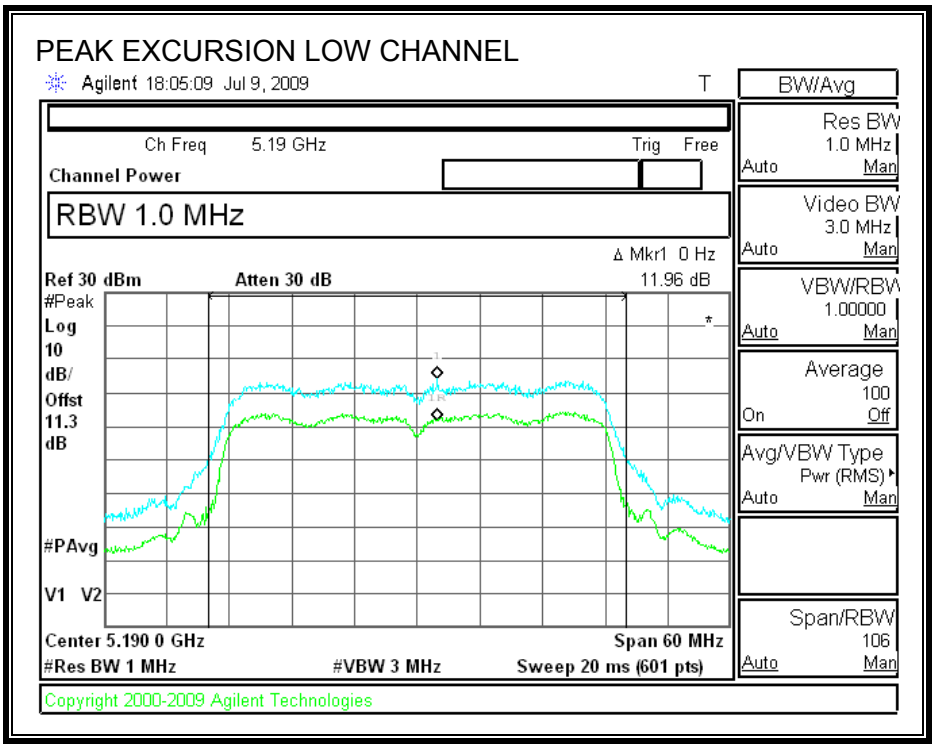
The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

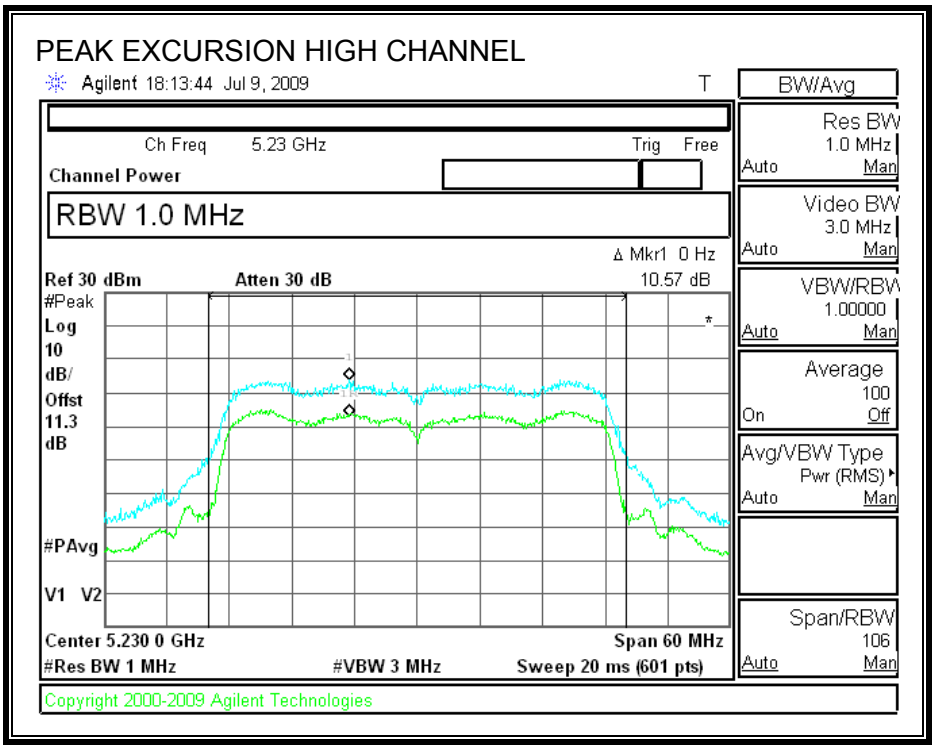
Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	11.96	13	-1.04
High	5230	10.57	13	-2.43

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

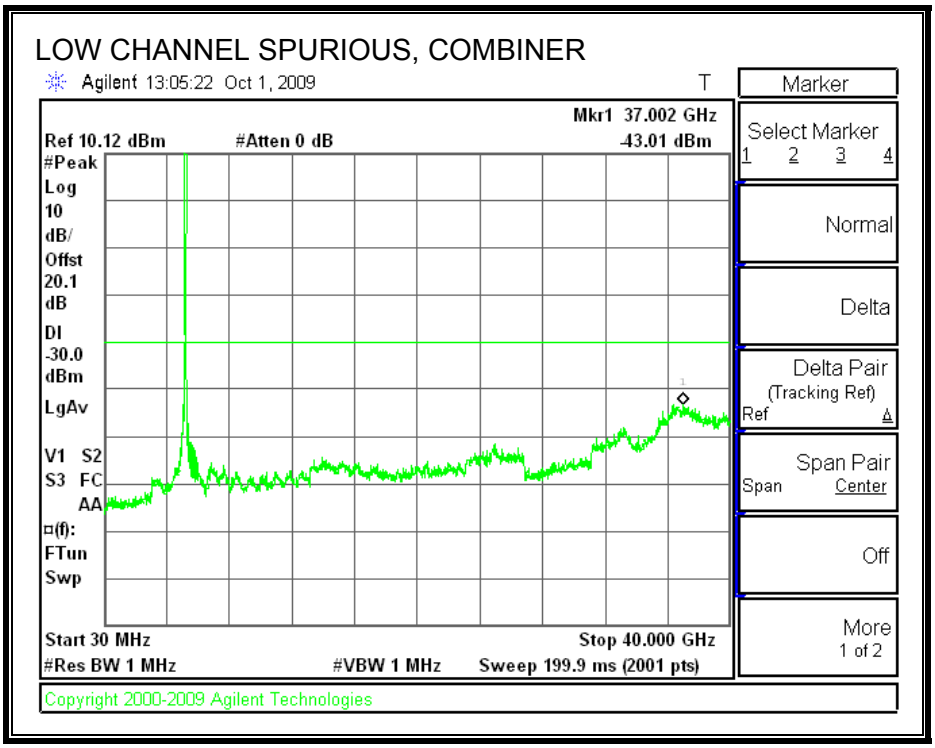
Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

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.

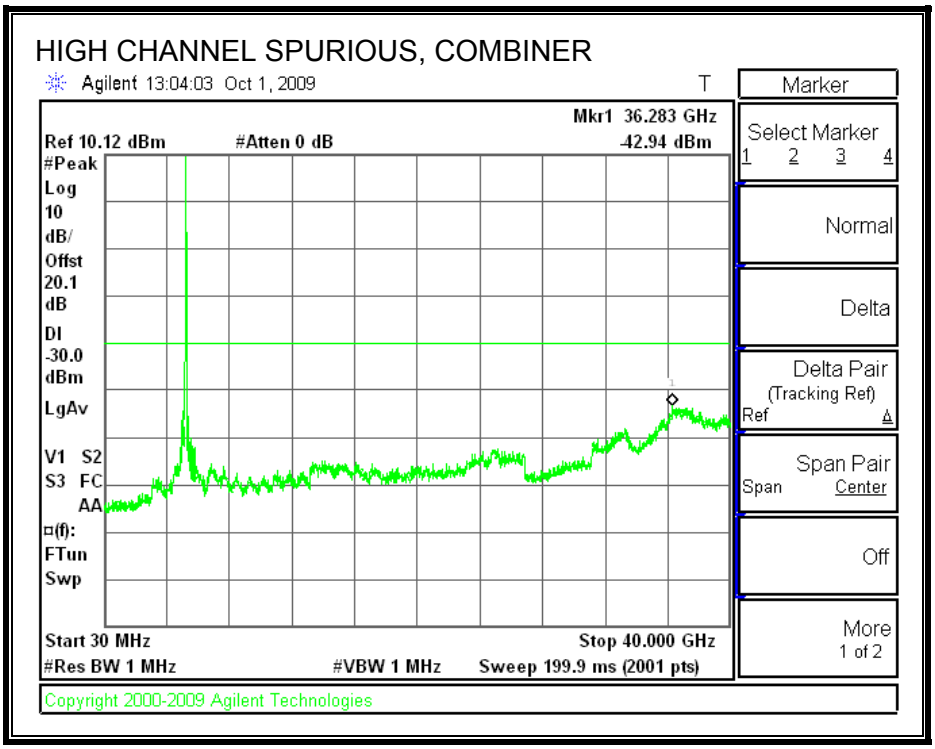
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

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. RECEIVER CONDUCTED SPURIOUS EMISSIONS

LIMITS

IC RSS-GEN 7.2.3.1

Antenna Conducted Measurement: Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts (-57 dBm) in the band 30-1000 MHz, or 5 nanowatts (-53 dBm) above 1 GHz.

TEST PROCEDURE

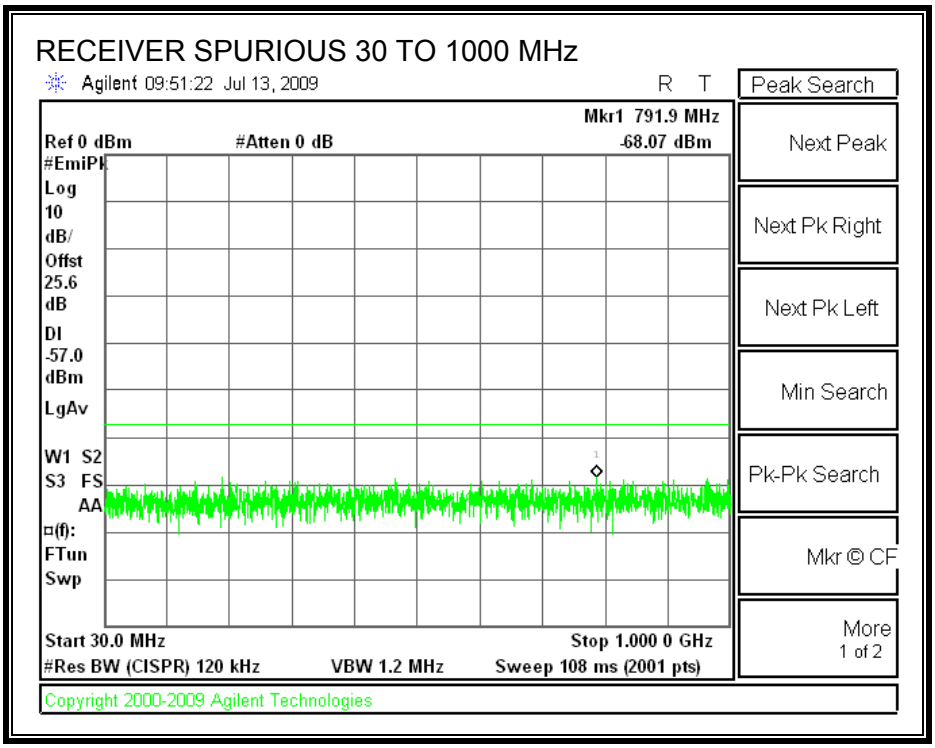
IC RSS-GEN 4.10, Conducted Method

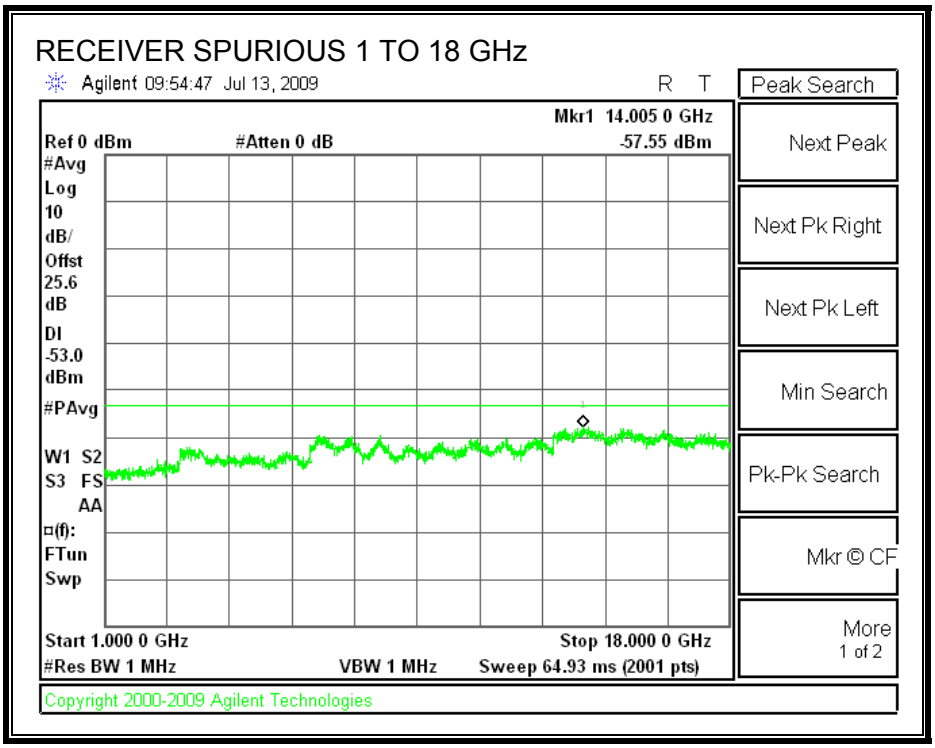
The receiver antenna port is connected to a spectrum analyzer.

The spectrum from 30 MHz to 18 GHz is investigated with the receiver set to the middle channel of each 5 GHz band.

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.

RECEIVER SPURIOUS EMISSIONS IN THE 5.2 GHz BAND





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

TEST PROCEDURE

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

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

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

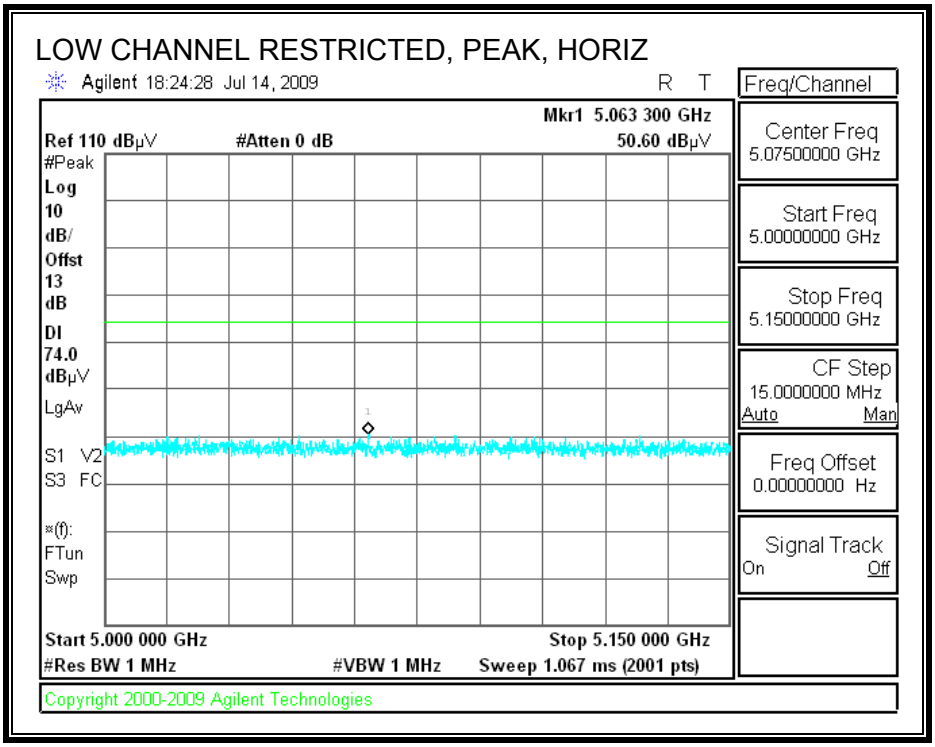
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

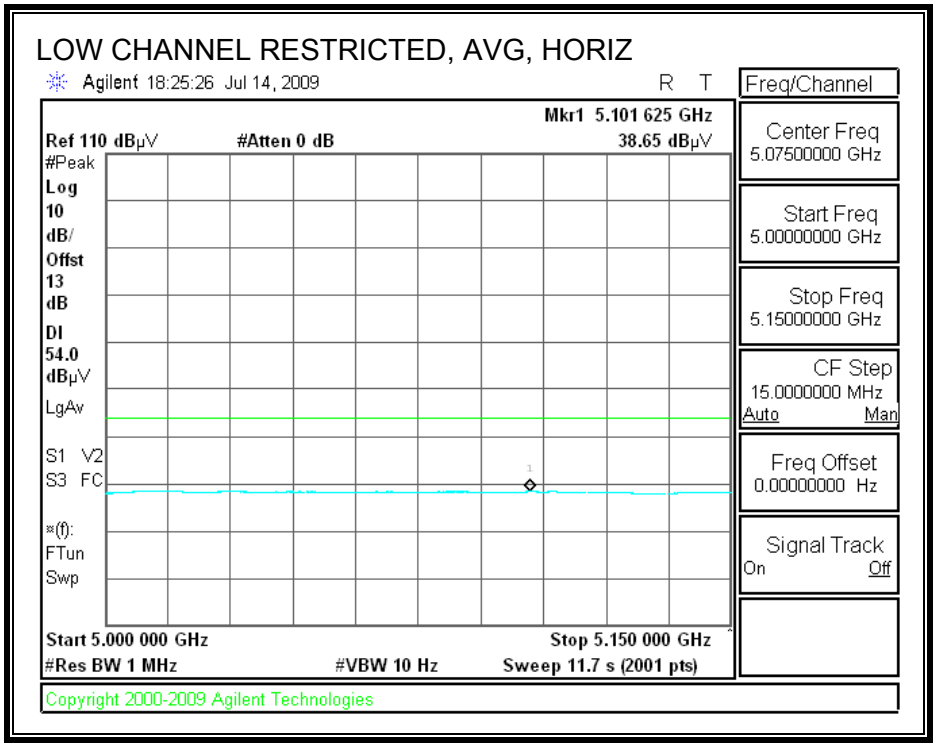
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

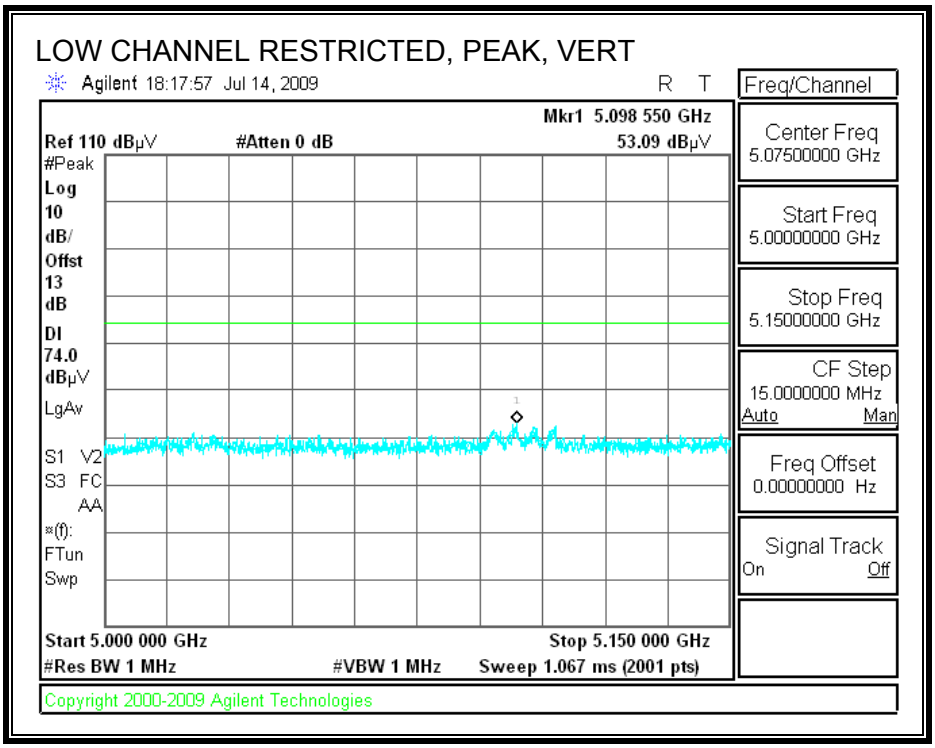
8.2.1. 802.11a MODE IN 5.2 GHz BAND

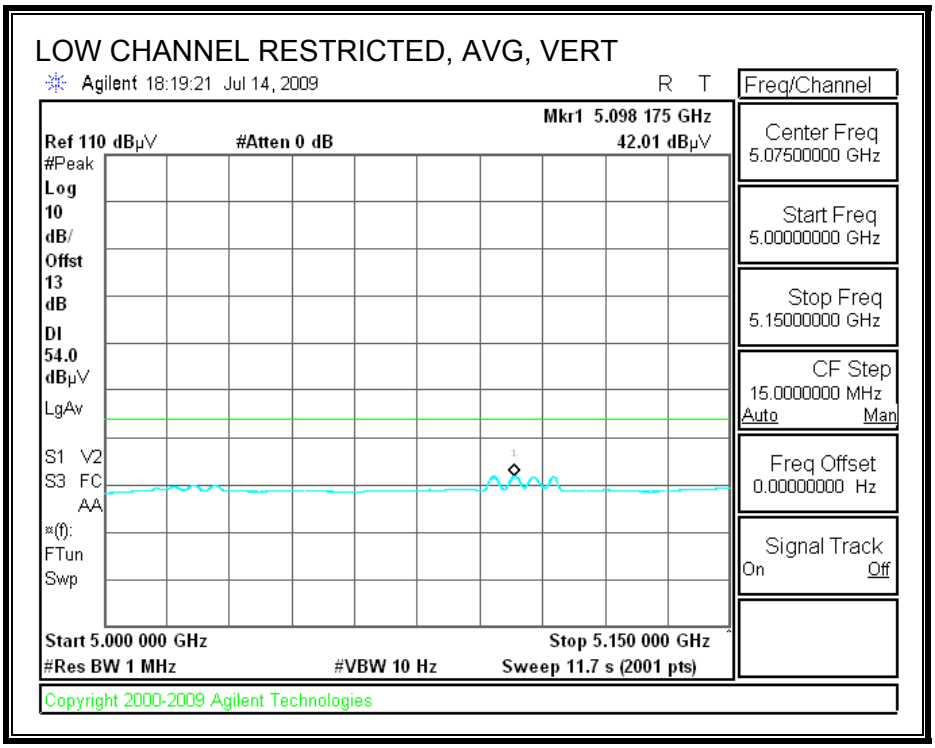
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Thanh Nguyen
Date: 07/14/09
Project #: 09U12652
Company: QualComm
EUT Description: 5000 Series PCI Card
EUT M/N: 65-VN780-P2
Test Target: FCC 15.247/15.407
Mode Oper:

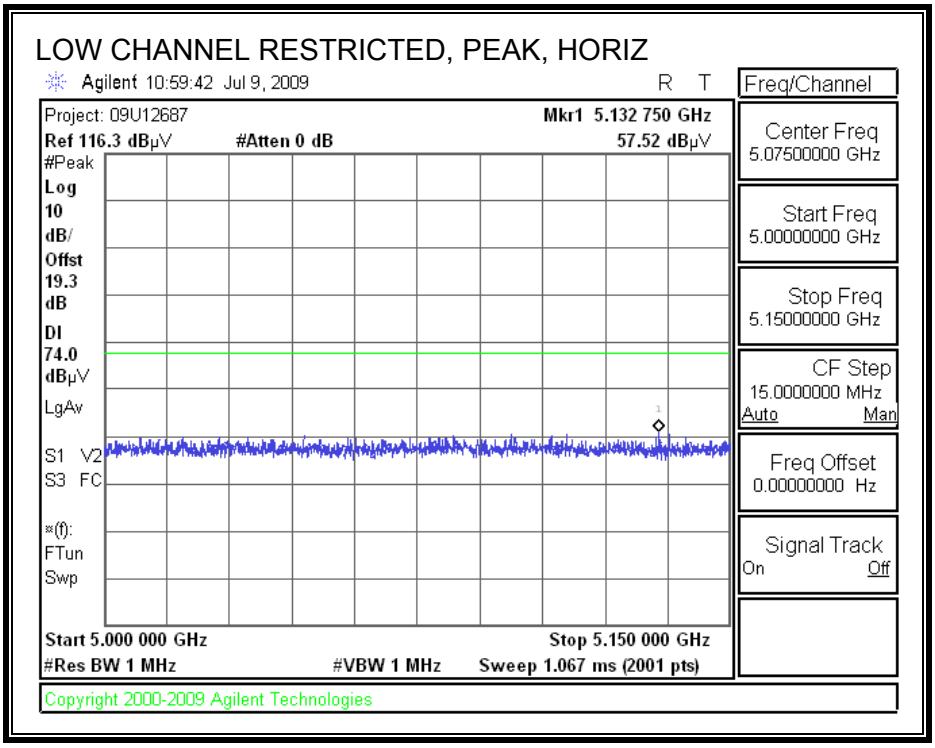
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

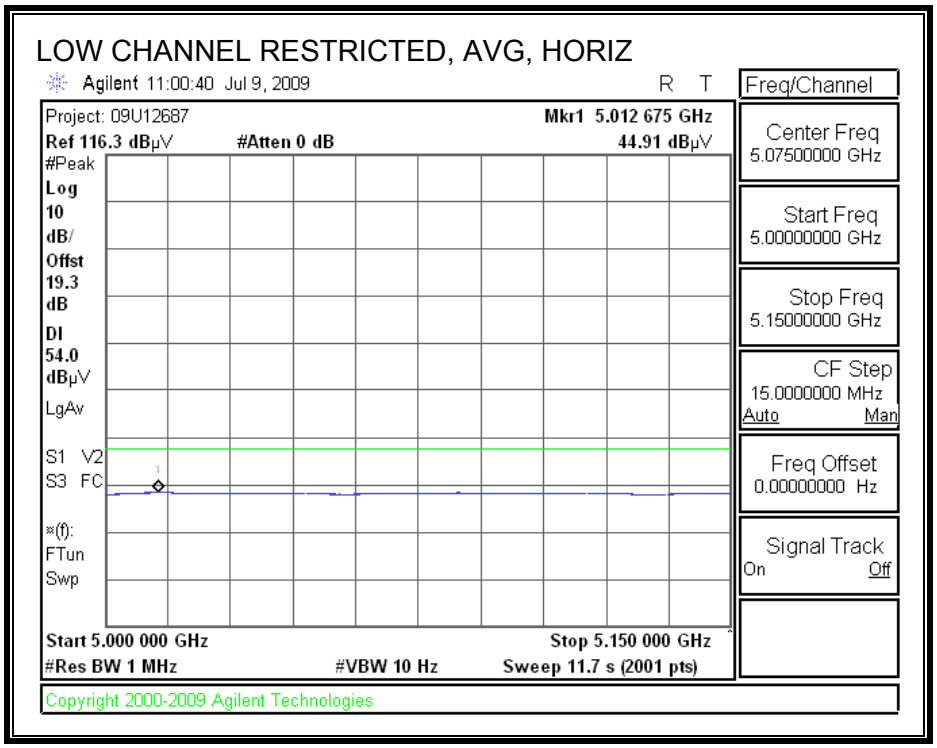
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch 5180MHz															
15.540	3.0	36.0	38.9	11.3	-34.8	0.0	10.0	61.4	74.0	-12.6	V	P	145.0	233.3	
15.540	3.0	23.7	38.9	11.3	-34.8	0.0	10.0	49.1	54.0	-4.9	V	A	145.0	233.3	
Mid Ch 5200MHz															
15.600	3.0	37.2	38.7	11.4	-34.8	0.0	10.0	62.5	74.0	-11.5	V	P	199.8	319.8	
15.600	3.0	24.3	38.7	11.4	-34.8	0.0	10.0	49.6	54.0	-4.4	V	A	199.8	319.8	
High Ch 5240MHz															
15.720	3.0	36.9	38.4	11.4	-34.7	0.0	10.0	62.0	74.0	-12.0	V	P	200.0	75.6	
15.720	3.0	24.2	38.4	11.4	-34.7	0.0	10.0	49.3	54.0	-4.7	V	A	200.0	75.6	
10.480	3.0	36.1	37.5	9.0	-36.7	0.0	10.0	55.8	74.0	-18.2	H	P	121.7	358.7	
10.480	3.0	23.8	37.5	9.0	-36.7	0.0	10.0	43.5	54.0	-10.5	H	A	121.7	358.7	

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

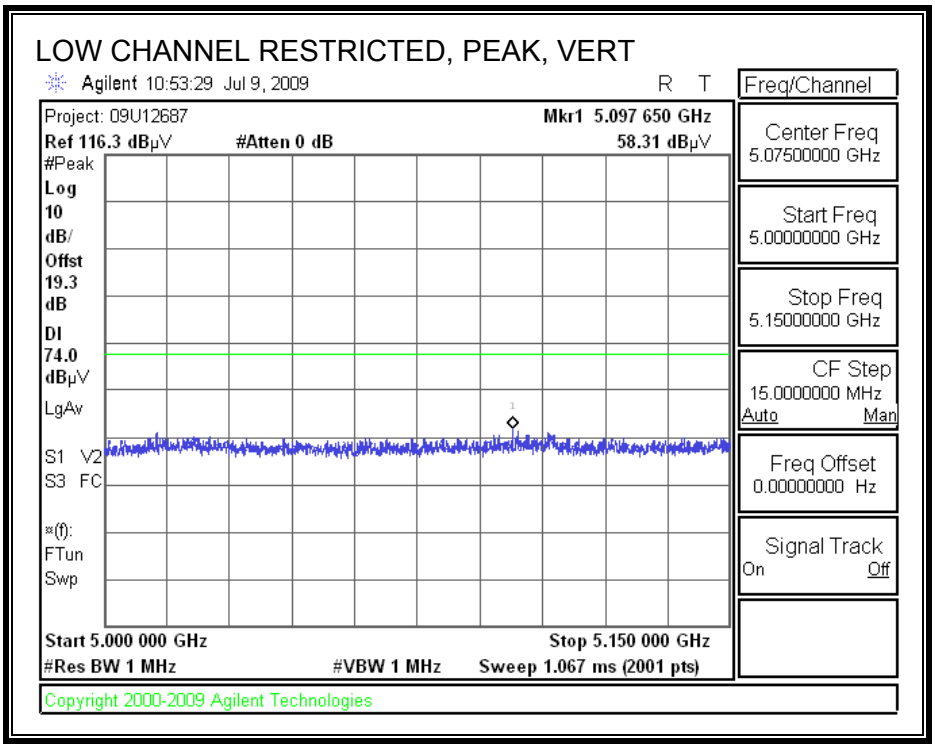
8.2.2. 802.11n HT20 MODE IN 5.2 GHz BAND

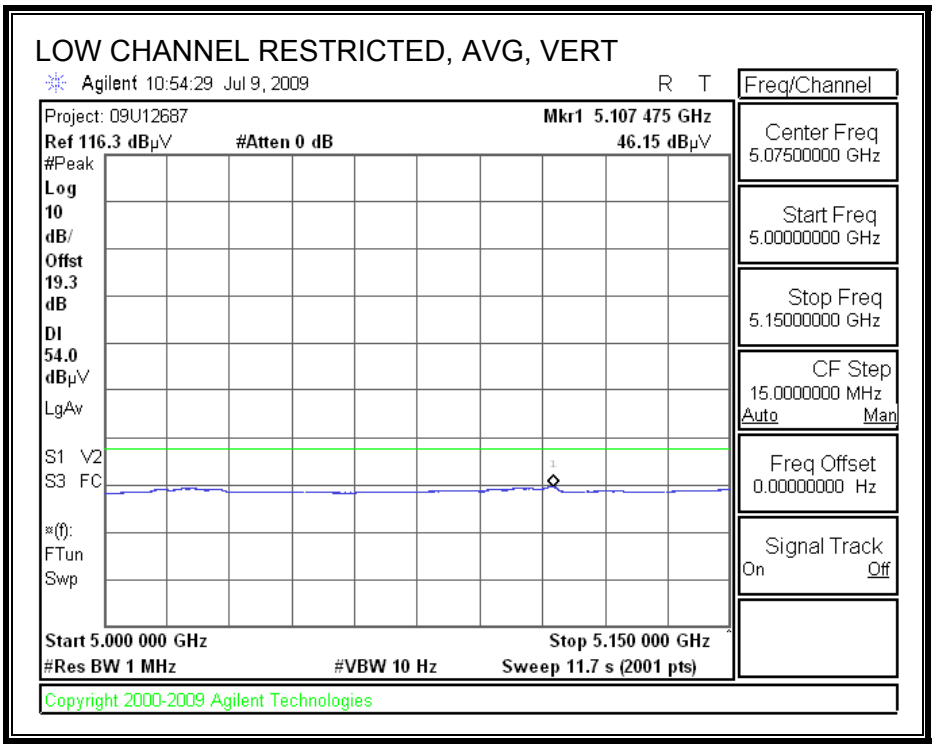
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



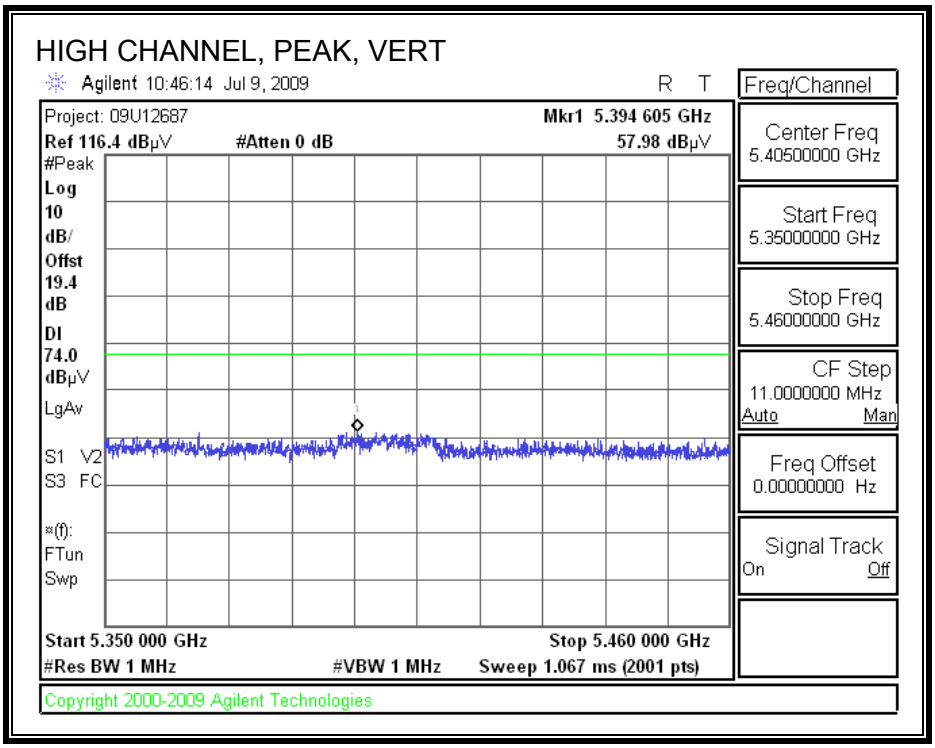


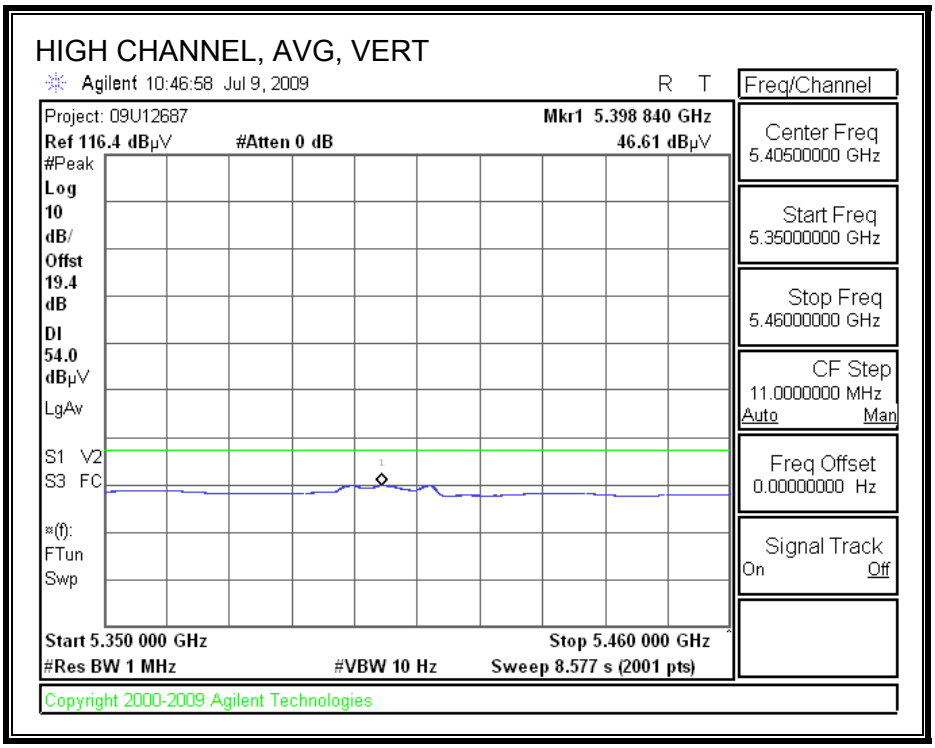
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Qualcomm
Project #: 09U12687
Date: 07/09/09
Test Engineer: Doug Anderson
Configuration: EUT w/Support Notebook PC
Mode: Tx / HT20

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF_7.6GHz	

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

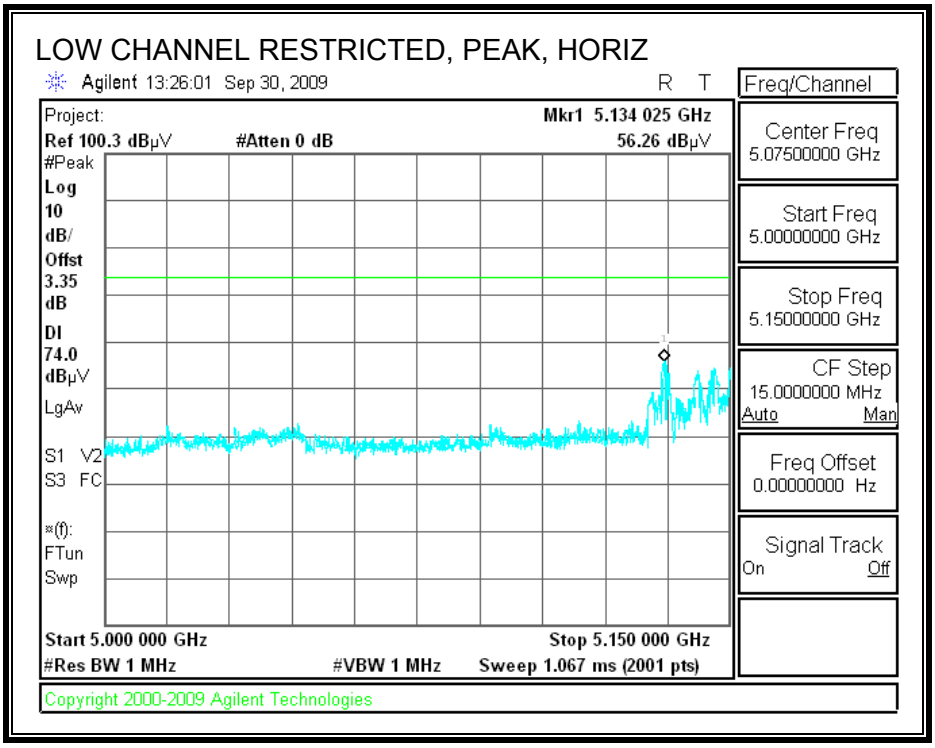
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch. 5180															
15.540	3.0	44.5	29.6	38.7	11.3	-34.8	0.0	0.7	60.4	45.5	74	54	-13.6	-8.5	H (Noise Floor)
15.540	3.0	44.5	29.6	38.7	11.3	-34.8	0.0	0.7	60.4	45.5	74	54	-13.6	-8.5	V (Noise Floor)
Mid Ch. 5200															
15.600	3.0	43.6	29.8	38.5	11.4	-34.8	0.0	0.7	59.4	45.7	74	54	-14.6	-8.3	H (Noise Floor)
15.600	3.0	43.4	29.9	38.5	11.4	-34.8	0.0	0.7	59.2	45.7	74	54	-14.8	-8.3	H (Noise Floor)
High Ch. 5240															
15.720	3.0	43.7	29.6	38.2	11.4	-34.7	0.0	0.7	59.3	45.3	74	54	-14.7	-8.7	H (Noise Floor)
15.720	3.0	43.6	29.7	38.2	11.4	-34.7	0.0	0.7	59.3	45.3	74	54	-14.7	-8.7	H (Noise Floor)

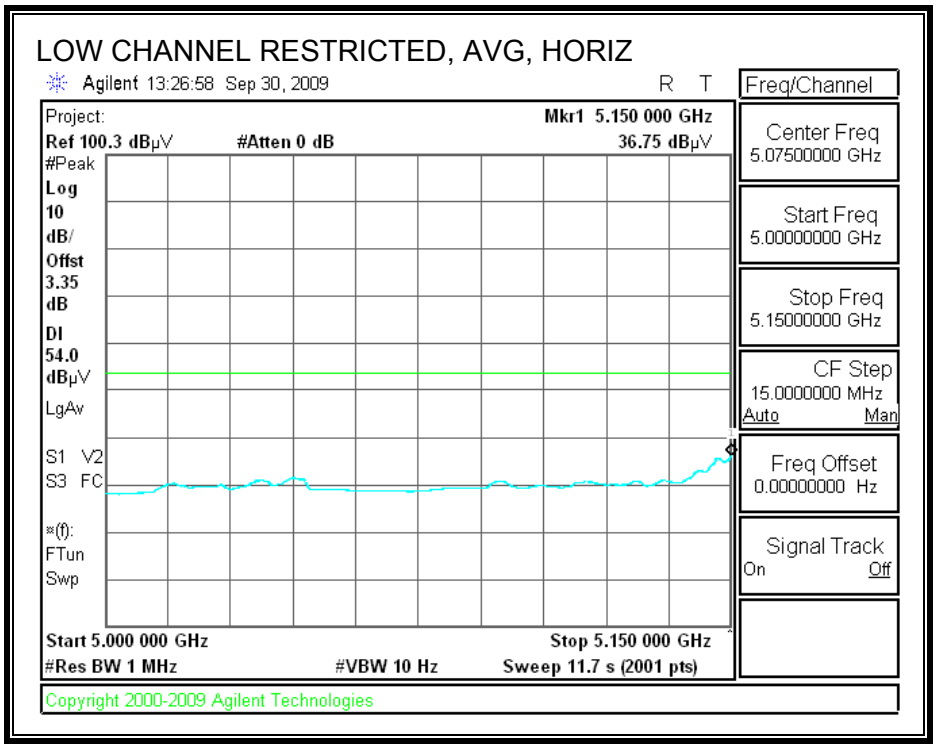
Rev. 11.10.08

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		

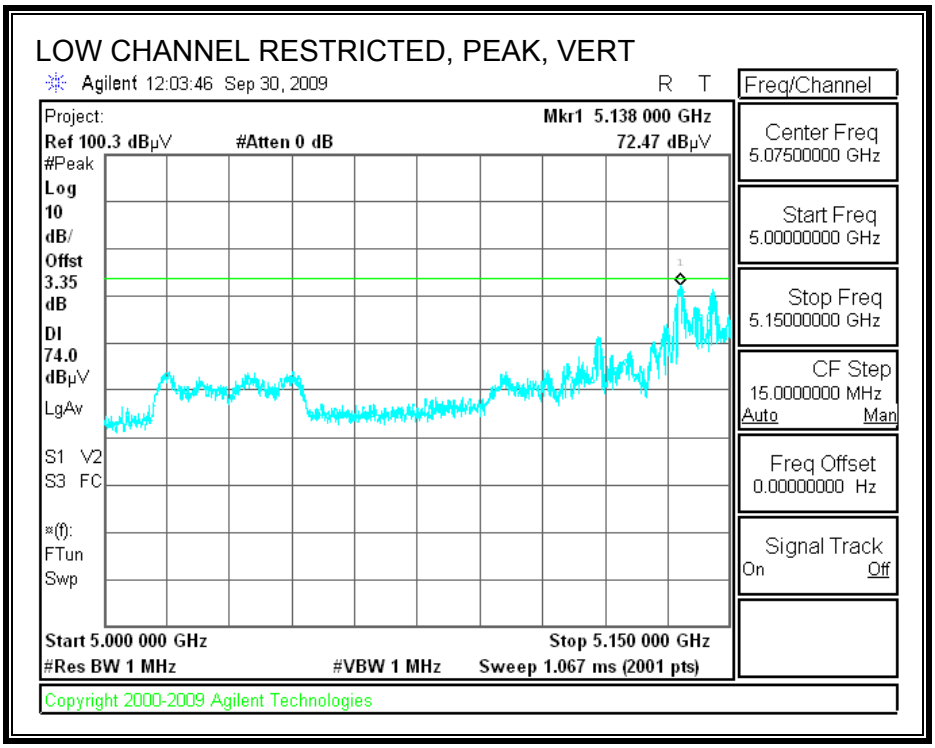
8.2.3. 802.11n HT40 MODE IN 5.2 GHz BAND

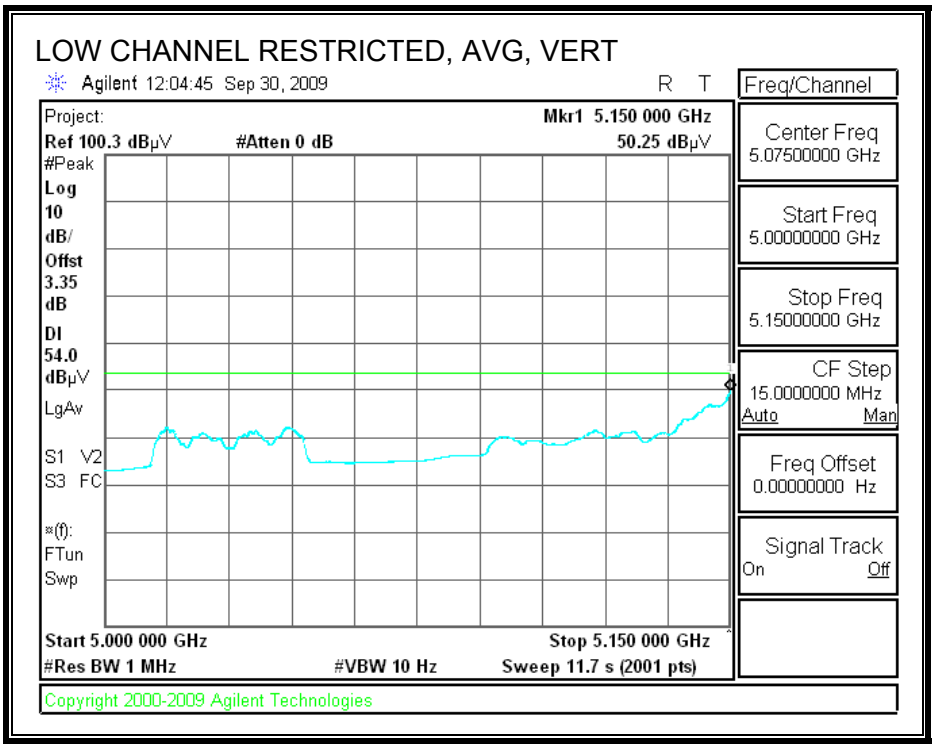
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



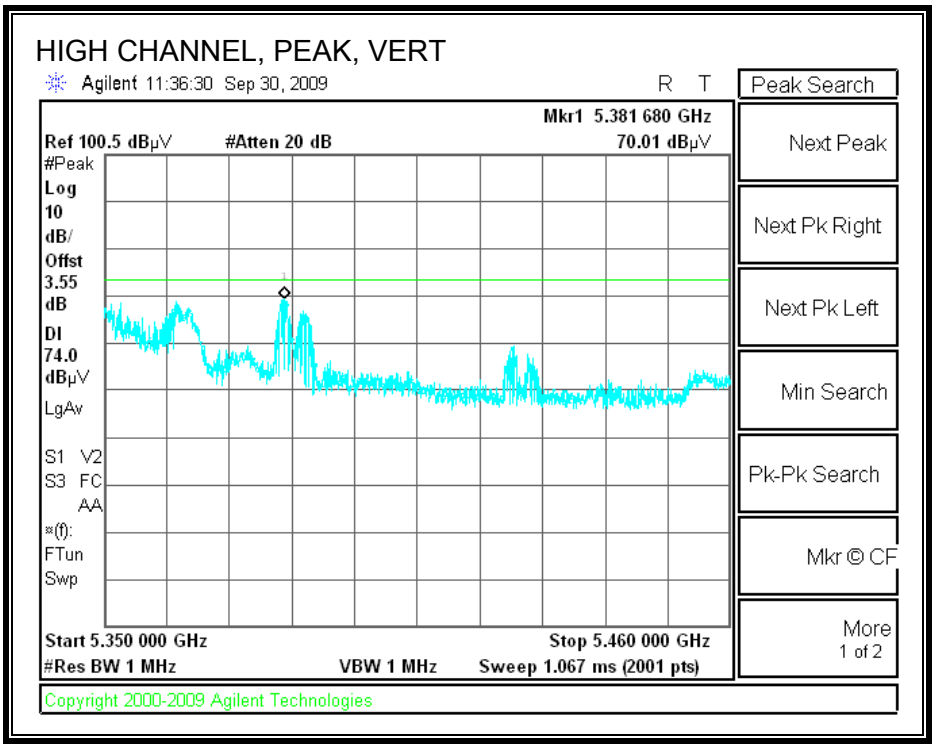


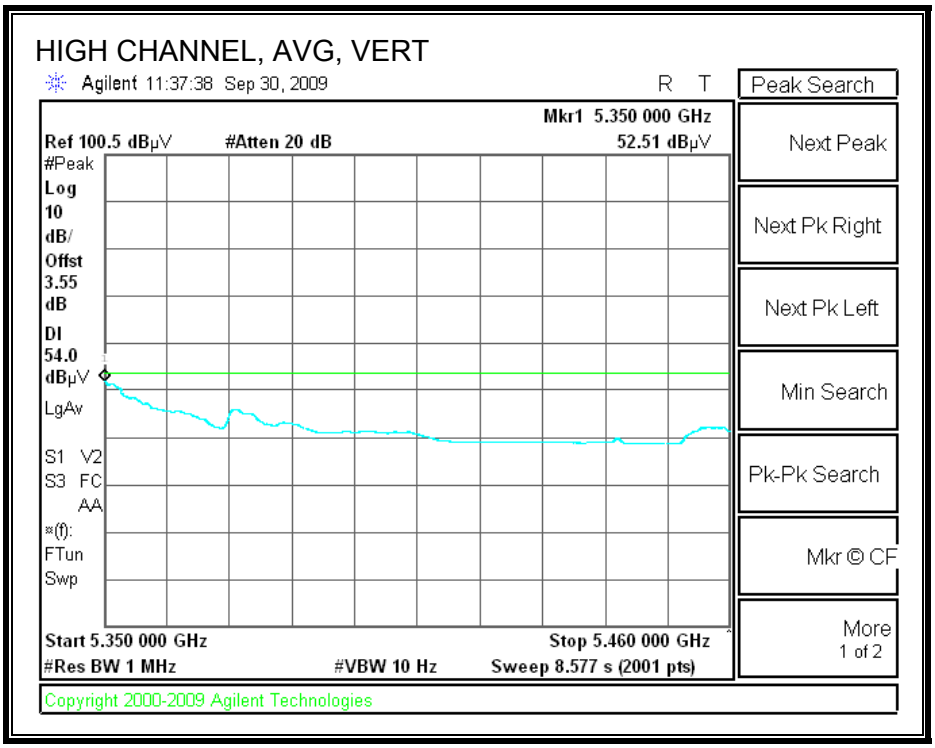
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Qualcomm
Project #: 09U12687
Date: 09/30/09
Test Engineer: Thanh Nguyen
Configuration: EUT w/Support Notebook PC
Mode: Tx HT 40, MCS 31

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500	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															
15.570	3.0	36.4	23.4	38.6	11.4	-34.8	0.0	0.7	52.3	39.3	74	54	-21.7	-14.7	V (Noise Floor)
15.570	3.0	34.8	23.4	38.6	11.4	-34.8	0.0	0.7	50.6	39.3	74	54	-23.4	-14.7	H (Noise Floor)
High Ch. 5230															
15.690	3.0	37.5	23.8	38.3	11.4	-34.7	0.0	0.7	53.1	39.5	74	54	-20.9	-14.5	H (Noise Floor)
15.690	3.0	38.4	23.8	38.3	11.4	-34.7	0.0	0.7	54.1	39.5	74	54	-19.9	-14.5	V (Noise Floor)

Rev. 11.10.08

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. WORST-CASE BELOW 1 GHz

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

HORIZONTAL

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

Test Engr: Thanh Nguyen
Date: 06/25/09
Project #: 09U12652
Company: QualCom Inc.
EUT Description: 802.11n 4x4 WLAN module
EUT M/N: 65-VN780-P1
Test Target: FCC Class B
Mode Oper: Tx worst case UNII band

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

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
90.002	3.0	52.1	7.6	0.8	28.3	0.0	0.0	32.2	43.5	-11.3	H	EP	
234.608	3.0	51.0	11.9	1.3	28.2	0.0	0.0	36.0	46.0	-10.0	H	EP	
299.171	3.0	51.5	13.4	1.5	28.1	0.0	0.0	38.2	46.0	-7.8	H	EP	
429.136	3.0	45.8	15.4	1.9	28.0	0.0	0.0	35.1	46.0	-10.9	H	EP	
639.985	3.0	44.1	18.9	2.3	27.4	0.0	0.0	37.9	46.0	-8.1	H	EP	

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

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

VERTICAL

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

Test Engr: Thanh Nguyen
Date: 06/25/09
Project #: 09U12652
Company: QualCom Inc.
EUT Description: 802.11n 4x4 WLAN module
EUT M/N: 65-VN780-P1
Test Target: FCC Class B
Mode Oper: Tx worst case UNII band

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

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
61.441	3.0	53.4	7.9	0.7	28.4	0.0	0.0	33.7	40.0	-6.3	V	EP	
142.925	3.0	45.9	13.1	1.1	28.3	0.0	0.0	31.8	43.5	-11.7	V	EP	
498.379	3.0	39.0	16.7	2.0	27.8	0.0	0.0	29.9	46.0	-16.1	V	EP	
599.303	3.0	41.0	18.4	2.2	27.5	0.0	0.0	34.1	46.0	-11.9	V	EP	
799.952	3.0	43.7	21.0	2.6	27.4	0.0	0.0	39.9	46.0	-6.1	V	EP	

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

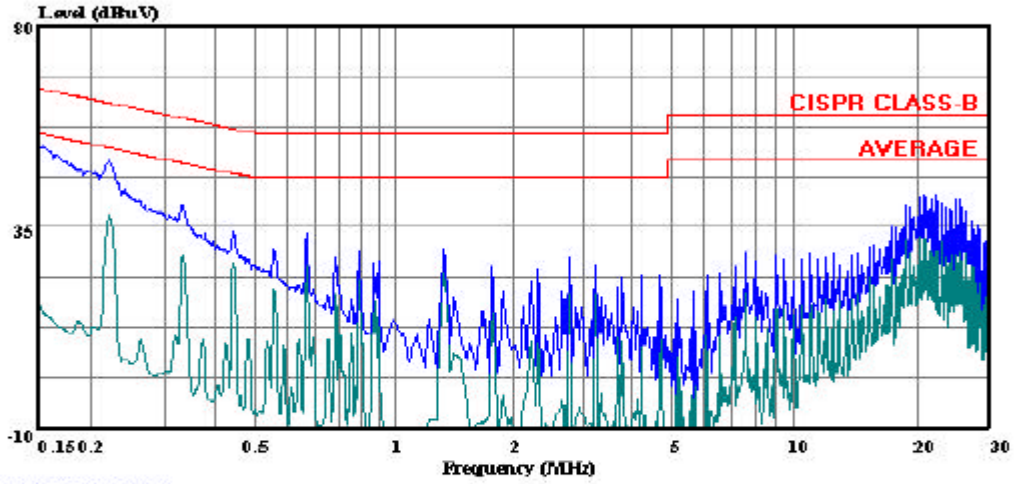
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.22	49.94	--	36.55	0.00	62.74	52.74	-12.80	-16.19	L1
0.33	39.76	--	28.62	0.00	59.35	49.35	-19.59	-20.73	L1
21.15	41.63	--	37.25	0.00	60.00	50.00	-18.37	-12.75	L1
0.22	49.89	--	36.03	0.00	62.82	52.82	-12.93	-16.79	L2
0.33	39.80	--	27.12	0.00	59.35	49.35	-19.55	-22.23	L2
21.71	38.81	--	32.20	0.00	60.00	50.00	-21.19	-17.80	L2
6 Worst Data									

LINE 1 RESULTS

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

Data#: 32 File#: 09U12652 LC.EMI Date: 06-26-2009 Time: 14:57:07



(Line Conduction)

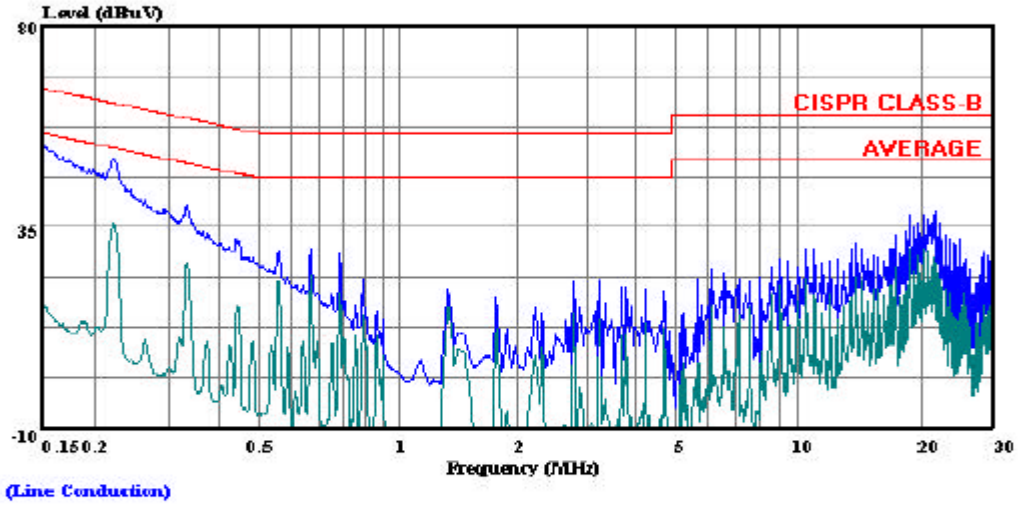
Trace: 30 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Thanh Nguyen
Project #: : 09U12652
Company: : Qualcomm
EUT Description:: 802.11n 4x4 WLAN Module
: 5000 Series PCIe, 2.4 and 5GHz AP router
Mode: : Tx 5 GHz Band
Target: : FCC Class B
Voltage: : 115VAC, 60Hz
: L1: 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#: 25 File#: 09U12652 LC.EMI Date: 06-26-2009 Time: 14:46:54



(Line Conduction)

Trace: 23 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Thanh Nguyen
Project #: : 09U12652
Company: : Qualcomm
EUT Description:: 802.11n 4x4 WLAN Module
: 5000 Series PCIe, 2.4 and 5GHz AP router
Mode: : Tx 5 GHz Band
Target: : FCC Class B
Voltage: : 115VAC, 60Hz
: L2: 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).

EQUATIONS

Power density is given by:

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

where

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

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

Distance is given by:

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

where

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

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

(MPE distance equals 20 cm)

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
5.2 GHz	11a (2 Chains)	0.20	12.18	6.01	0.13	0.013
5.2 GHz	11n HT20 (4 Chains)	0.20	13.23	3.0	0.08	0.008
5.2 GHz	11n HT40 (4 Chains)	0.20	16.67	3.0	0.18	0.018