



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Wireless-N Gigabit Security Router with VPN

Model: WRVS4400N V2

Trade Name: Linksys

Issued to

**Cisco-Linksys LLC
121 Theory Drive Irvine, CA 92617**

Issued by



**Compliance Certification Services Inc.
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1. TEST RESULT CERTIFICATION

Applicant: Cisco-Linksys LLC
121 Theory Drive Irvine, CA 92617

Equipment Under Test: Wireless-N Gigabit Security Router with VPN

Trade Name: Linksys

Model Number: WRVS4400N V2

Date of Test: May 13 ~ 28, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Rex Lai
Section Manager
Compliance Certification Services Inc.

Reviewed by:

Amanda Wu
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

Product	Wireless-N Gigabit Security Router with VPN
Trade Name	Linksys
Model Number	WRVS4400N V2
Model Discrepancy	N/A
Power Supply	LINKSYS / MT12-Y120100-A1 I/P: 100-120V, 60Hz, 0.3A O/P: 12V, 1A
Frequency Range	2412 ~ 2462 MHz
Transmit Power	IEEE 802.11b mode: 15.51 dBm IEEE 802.11g mode: 18.82 dBm draft 802.11n Standard-20 MHz Channel mode: 20.86 dBm draft 802.11n Wide-40 MHz Channel mode: 21.24 dBm
Modulation Technique	IEEE 802.11b mode: DSSS (1, 2, 5.5 and 11 Mpbs) IEEE 802.11g mode: OFDM (6, 9, 12, 18, 24, 36, 48 and 54 Mpbs) draft 802.11n Standard-20 MHz Channel mode: OFDM (6.5, 7.2, 13, 14.4, 14.44, 19.5, 21.7, 26, 28.89, 28.9, 39, 43.3, 43.33 52, 57.78, 57.8, 58.5, 65.0, 72.2, 78, 86.67, 104, 115.56, 117, 130, 144.44 Mbps) draft 802.11n Wide-40 MHz Channel mode: OFDM (13.5, 15, 27, 30, 40.5, 45, 54, 60, 81, 90, 108, 120, 121.5, 135, 150, 162, 180, 216, 240, 243, 270, 300 Mbps)
Number of Channels	IEEE 802.11b/g mode: 11 Channels draft 802.11n Standard-20 MHz Channel mode: 11 Channels draft 802.11n Wide-40 MHz Channel mode: 7 Channels
Antenna Specification	Dipole Antenna / Gain: 1.8 dBi

Remark:

1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **Q87-WRVS4400NV2** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.



3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.

3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.



3.5 DESCRIPTION OF TEST MODES

The EUT (model: WRVS4400N V2) had been tested under operating condition.

The EUT is a 2x3 configuration spatial MIMO (2Tx & 3Rx) without beam forming function. The 2x3 configuration is implemented with two outside TX & RX chains (Chain 0 and 2).

Software used to control the EUT for staying in continuous transmitting mode was programmed.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

IEEE 802.11b mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 1Mbps data rate and cyclic delay diversity were chosen for full testing.

IEEE 802.11g mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 6Mbps data rate and cyclic delay diversity were chosen for full testing.

draft 802.11n Standard-20 MHz Channel mode:

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 6.5Mbps data rate were chosen for full testing.

draft 802.11n Wide-40 MHz Channel mode:

Channel Low (2422MHz), Channel Mid (2437MHz) and Channel High (2452MHz) with 13.5Mbps data rate were chosen for full testing.



4. INSTRUMENT CALIBRATION

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: Each piece of equipment is scheduled for calibration once a year.

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360131	02/24/2009

3M Semi Anechoic Chamber				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	09/11/2008
Test Receiver	Rohde&Schwarz	ESCI	100064	11/13/2008
Switch Controller	TRC	Switch Controller	SC94050010	05/03/2009
4 Port Switch	TRC	4 Port Switch	SC94050020	05/03/2009
Horn Antenna	EMCO	3115	9903-5761	01/11/2009
Bilog- Antenna	Sunol Sciences	JB3	A030205	03/28/2009
Turn Table	Max-Full	MFT-120S	T120S940302	N.C.R.
Antenna Tower	Max-Full	MFA-430	A440940302	N.C.R.
Controller	Max-Full	MF-CM886	CC-C-1F-13	N.C.R.
Site NSA	CCS	N/A	FCC: 965860 IC: IC 6106	09/25/2008
Test S/W			LABVIEW (V 6.1)	

Remark: The measurement uncertainty is less than +/- 2.0065dB (30MHz ~ 1GHz), +/- 3.0958dB (Above 1GHz) which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

Powerline Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI TEST RECEIVER 9kHz-30MHz	ROHDE & SCHWARZ	ESHS30	828144/003	10/31/2008
TWO-LINE V-NETWORK 9kHz-30MHz	SCHAFFNER	NNB41	03/10013	06/11/2009
LISN 10kHz-100MHz	EMCO	3825/2	9106-1809	04/09/2009
Test S/W			LABVIEW (V 6.1)	

Remark: The measurement uncertainty is less than +/- 2.81dB, which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

- No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029
- No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045
- No.81-1, Lane 210, Bade 2nd Rd., Luchu Hsiang, Taoyuan Hsien 338, Taiwan
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

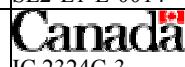
Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

5.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	EN 55011, EN 55014-1/2, CISPR 11, CISPR 14-1/2, EN 55022, EN 55015, CISPR 22, CISPR 15, AS/NZS 3548, VCCI V3 (2001), CFR 47, FCC Part 15/18, CNS 13783-1, CNS 13439, CNS 13438, CNS 13803, CNS 14115, EN 55024, IEC 801-2, IEC 801-3, IEC 801-4, IEC/EN 61000-3-2, IEC/EN 61000-3-3, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 50081-1/ EN 61000-6-3, EN 50081-2/EN 61000-6-4, EN 50081-2/EN 61000-6-1: 2001	 ACCREDITED TESTING CERT #0824.01
USA	FCC	3/10 meter Open Area Test Sites (93105, 90471) / 3M Semi Anechoic Chamber (965860) to perform FCC Part 15/18 measurements	 93105, 90471 965860
Japan	VCCI	3/10 meter Open Area Test Sites to perform conducted/radiated measurements	 R-393/1066/725/879 C-402/747/912
Norway	NEMKO	EN 50081-1/2, EN 50082-1/2, IEC 61000-6-1/2, EN 50091-2, EN 50130-4, EN 55011, EN 55013, EN 55014-1/2, EN 55015, EN 55022, EN 55024, EN 61000-3-2/3, EN 61326-1, IEC 61000-4-2/3/4/5/6/8/11, EN 60601-1-2, EN 300 328, EN 300 422-2, EN 301 419-1, EN 301 489-01/03/07/08/09/17, EN 301 419-2/3, EN 300 454-2, EN 301 357-2	 ELA 124a ELA 124b ELA 124c
Taiwan	TAF	EN 300 328, EN 300 220-1, EN 300 220-2, EN 300 220-3, 47 CFR FCC Part 15 Subpart C, EN 61000-3-2, EN 61000-3-3, CNS 13439, CNS 13783-1, CNS 14115, CNS 13438, AS/NZS CISPR 22, CNS 13022-1, IEC 61000-4-2/3/4/5/6/8/11, CNS 13022-2/3	 Testing Laboratory 0363
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	 SL2-IS-E-0014 SL2-IN-E-0014 SL2-A1-E-0014 SL2-R1-E-0014 SL2-R2-E-0014 SL2-L1-E-0014
Canada	Industry Canada	3/10 meter Open Area Test Sites (IC 2324C-3, IC 2324C-5) / 3M Semi Anechoic Chamber (IC 6106)	 IC 2324C-3 IC 2324C-5 IC 6106

* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No	Equipment	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC (Remote)	IBM	2672 (X31)	99KPZYN	WLAN: ANO20030400LEG Bluetooth: ANO20020100MTN	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core

Remark:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

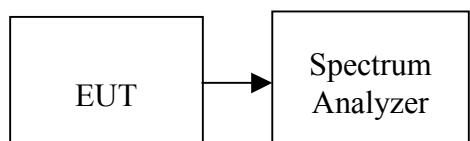
7. FCC PART 15.247 REQUIREMENTS

7.1 6DB BANDWIDTH

LIMIT

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 100 kHz, VBW = RBW, Span = 50 MHz, Sweep = auto.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

TEST RESULTS

No non-compliance noted

**Test Data****Test mode: IEEE 802.11b mode**

Channel	Frequency (MHz)	Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	12.25	>500	PASS
Mid	2437	12.25		PASS
High	2462	12.33		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)	Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	16.50	>500	PASS
Mid	2437	16.67		PASS
High	2462	16.58		PASS

Test mode: draft 802.11n Standard-20 MHz Channel mode / Chain 0

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
Low	2412	17.75	>500	PASS
Mid	2437	17.83		PASS
High	2462	17.67		PASS

Test mode: draft 802.11n Standard-20 MHz Channel mode / Chain 2

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
Low	2412	17.83	>500	PASS
Mid	2437	17.67		PASS
High	2462	17.67		PASS

Test mode: draft 802.11n Wide-40 MHz Channel mode / Chain 0

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
Low	2422	36.08	>500	PASS
Mid	2437	36.42		PASS
High	2452	36.42		PASS

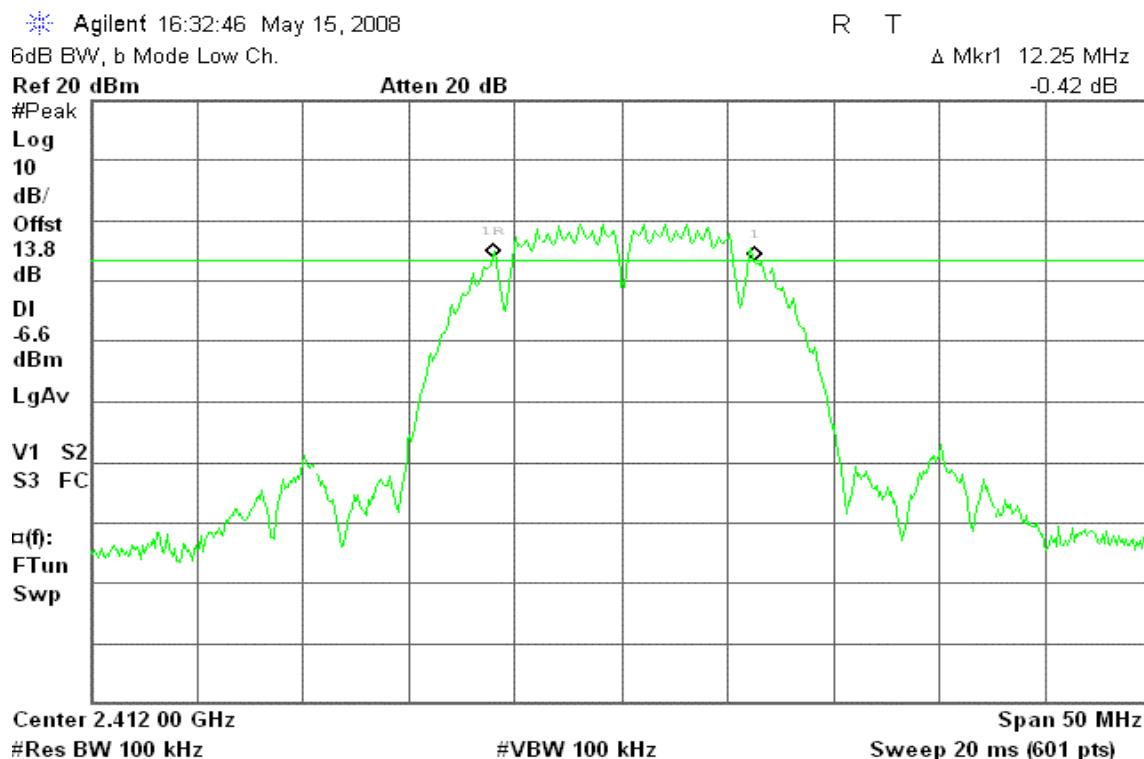
Test mode: draft 802.11n Wide-40 MHz Channel mode / Chain 2

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Result
Low	2422	36.25	>500	PASS
Mid	2437	36.33		PASS
High	2452	36.42		PASS

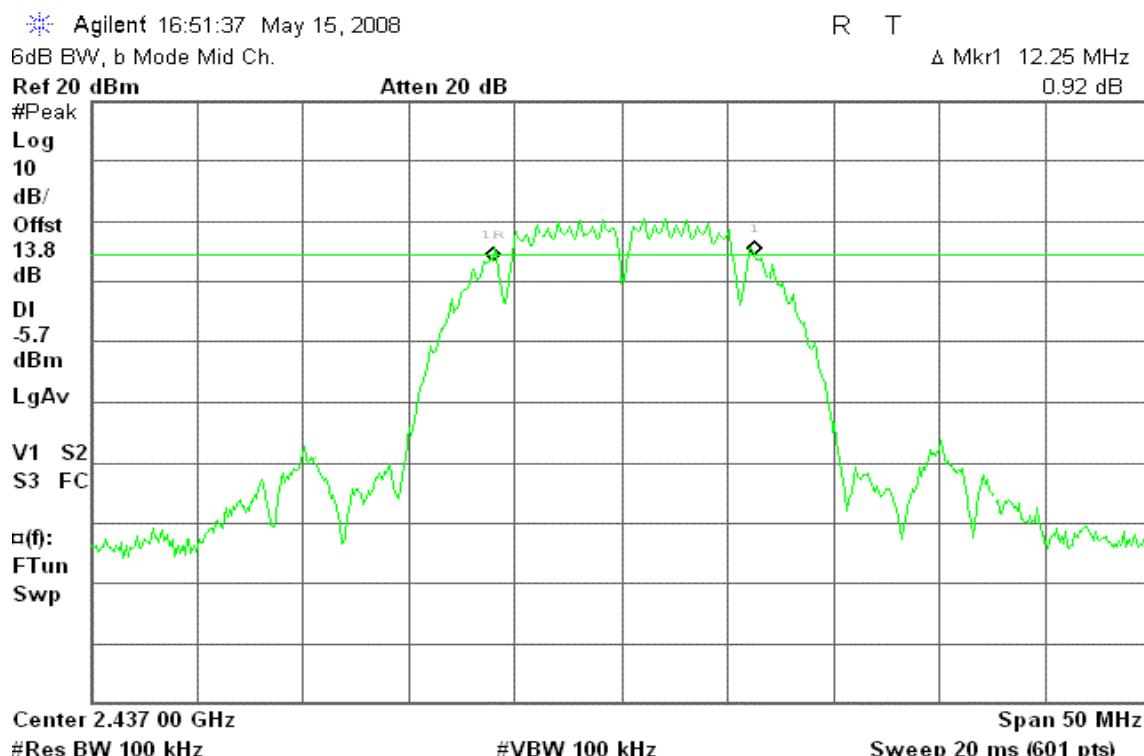
Test Plot

IEEE 802.11b mode

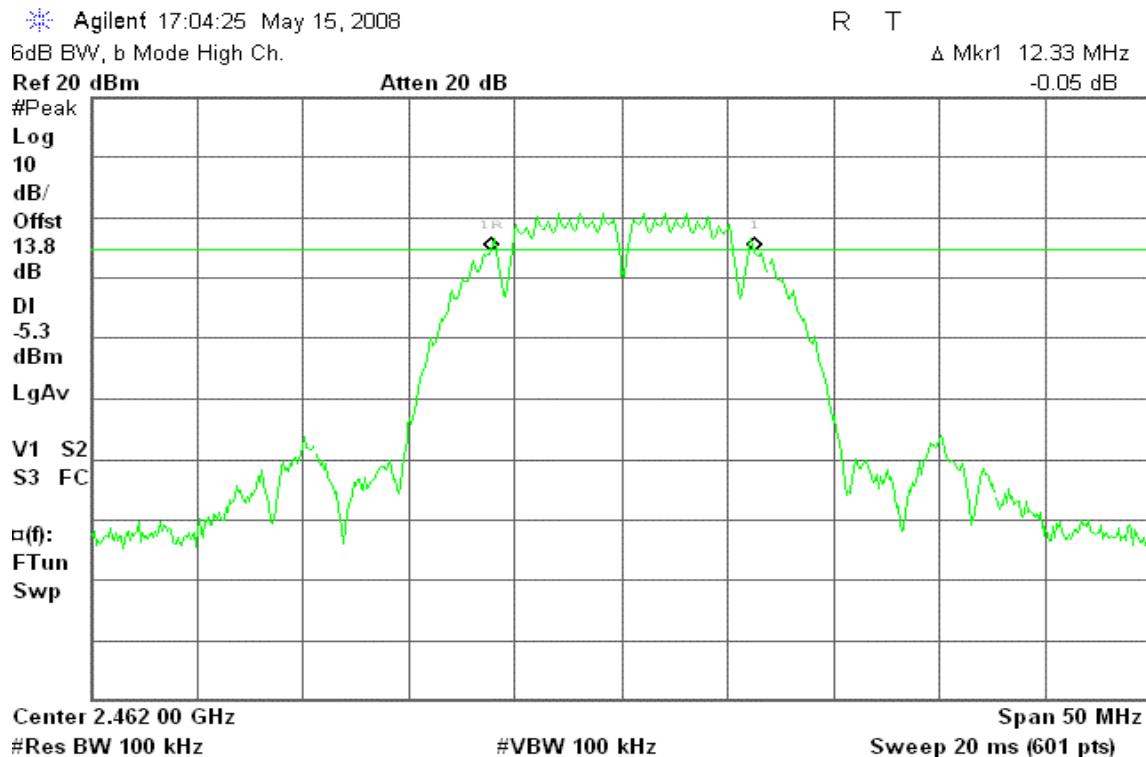
6dB Bandwidth (CH Low)



6dB Bandwidth (CH Mid)

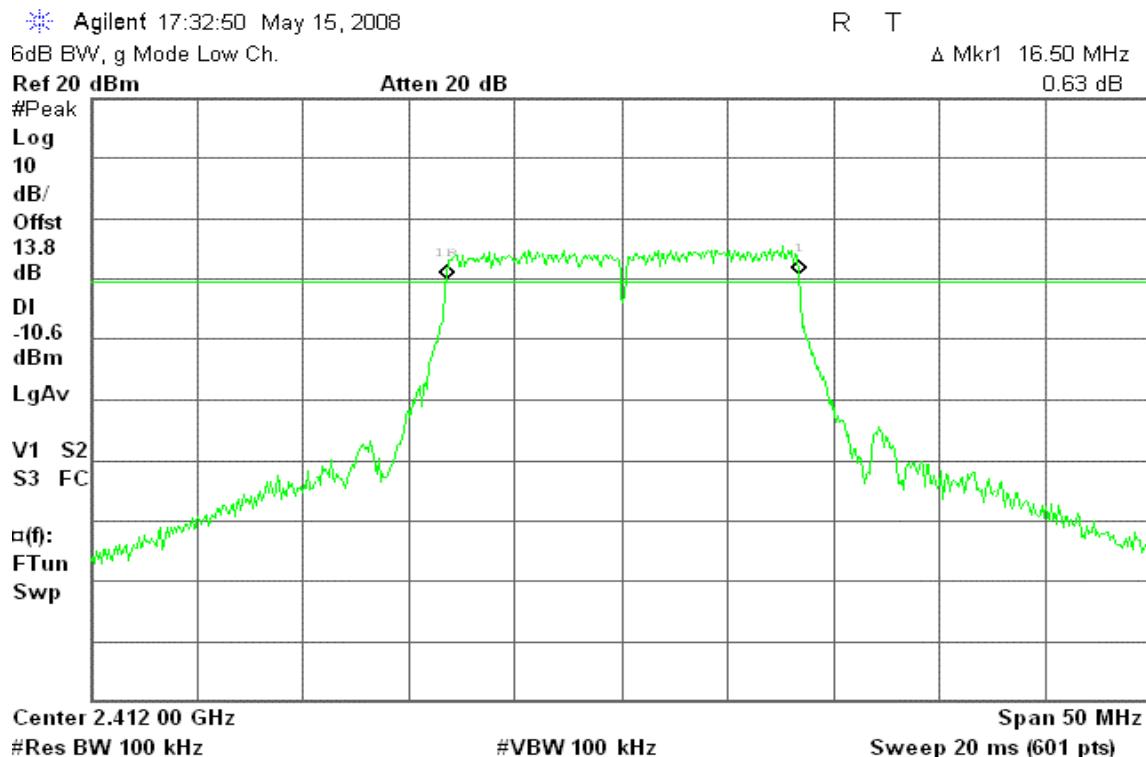


6dB Bandwidth (CH High)

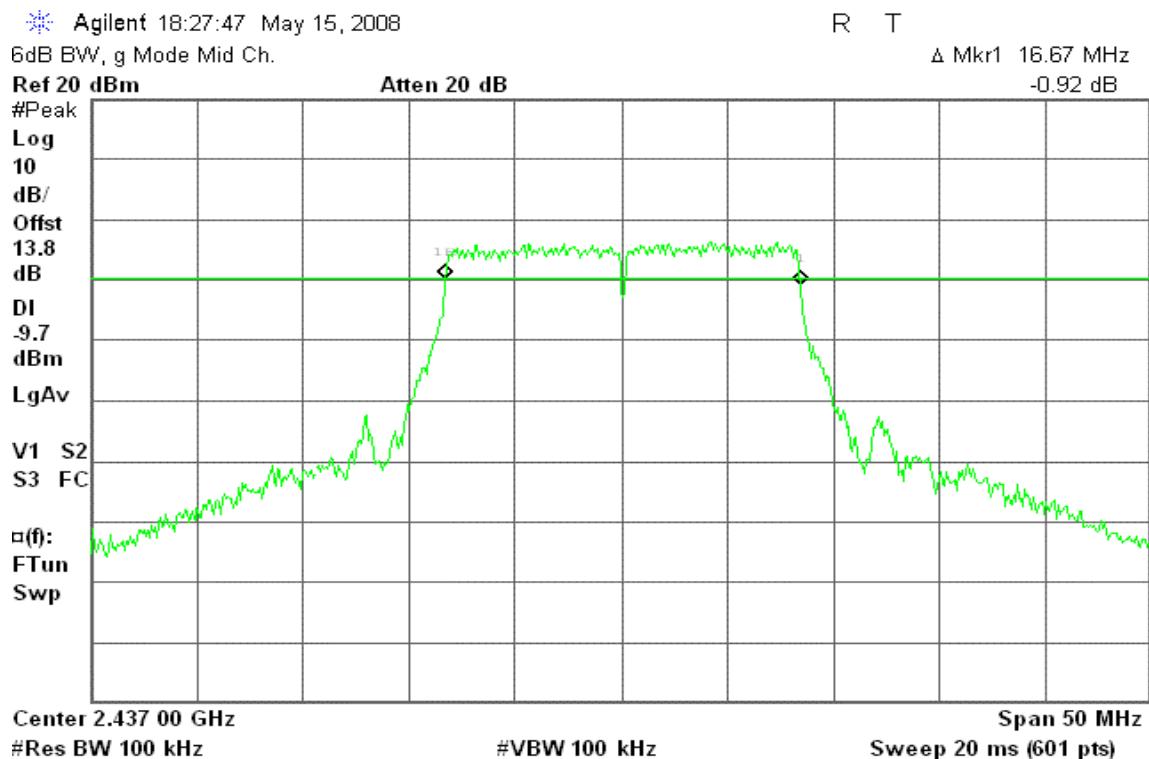


IEEE 802.11g mode

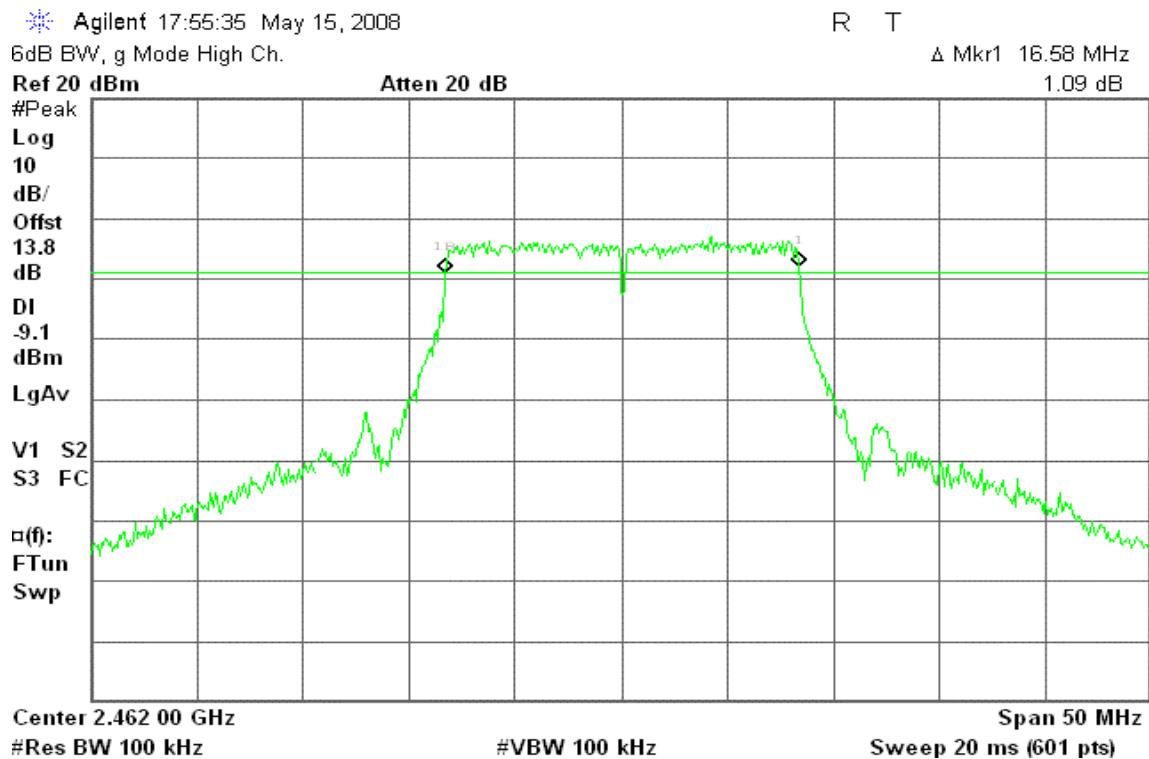
6dB Bandwidth (CH Low)

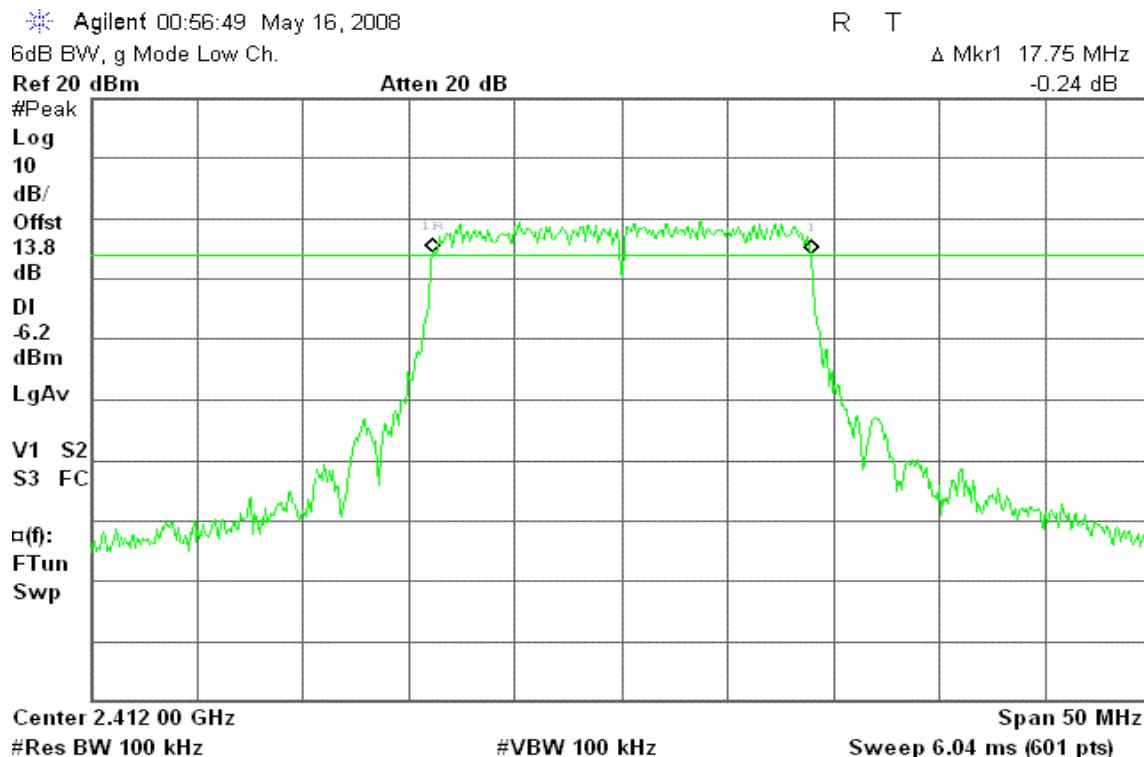
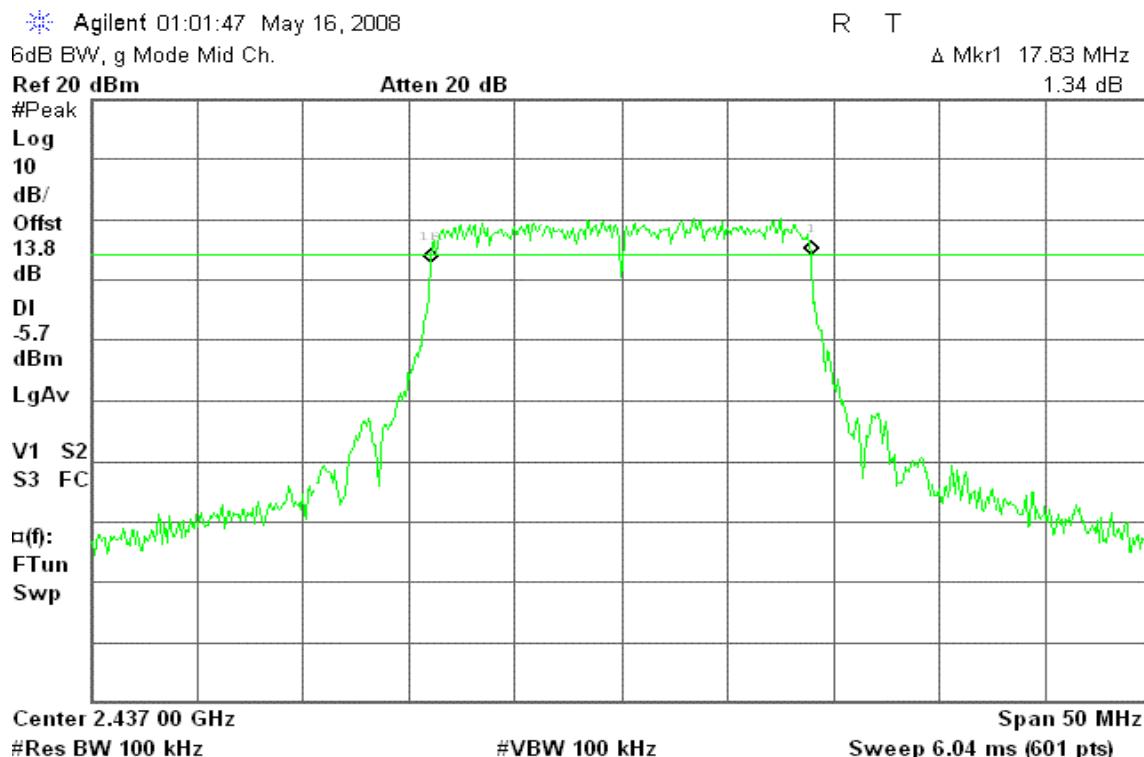


6dB Bandwidth (CH Mid)

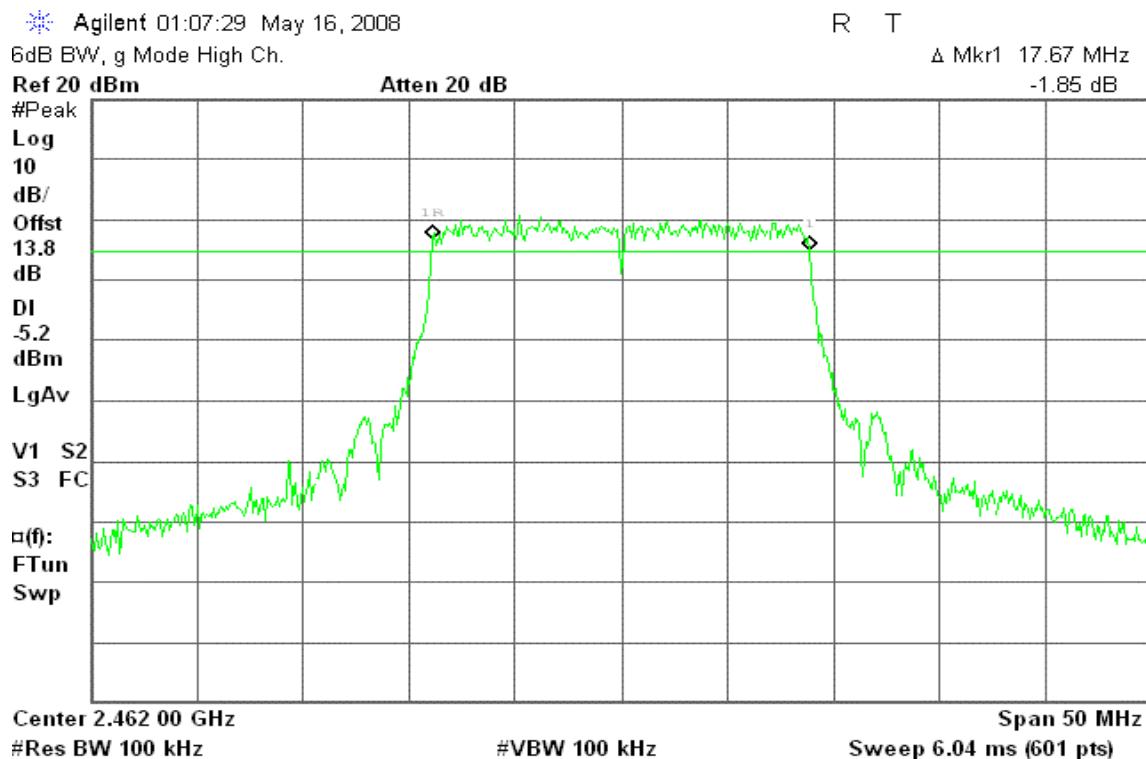


6dB Bandwidth (CH High)



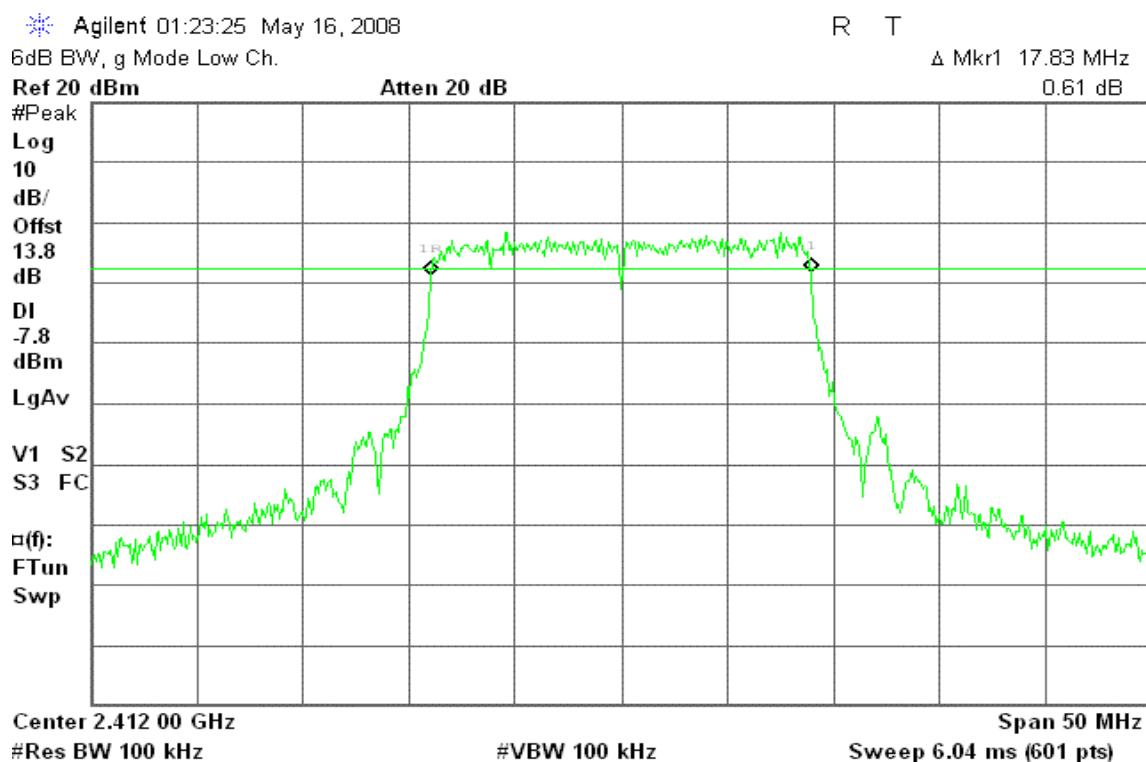
draft 802.11n Standard-20 MHz Channel mode / Chain 0**6dB Bandwidth (CH Low)****6dB Bandwidth (CH Mid)**

6dB Bandwidth (CH High)

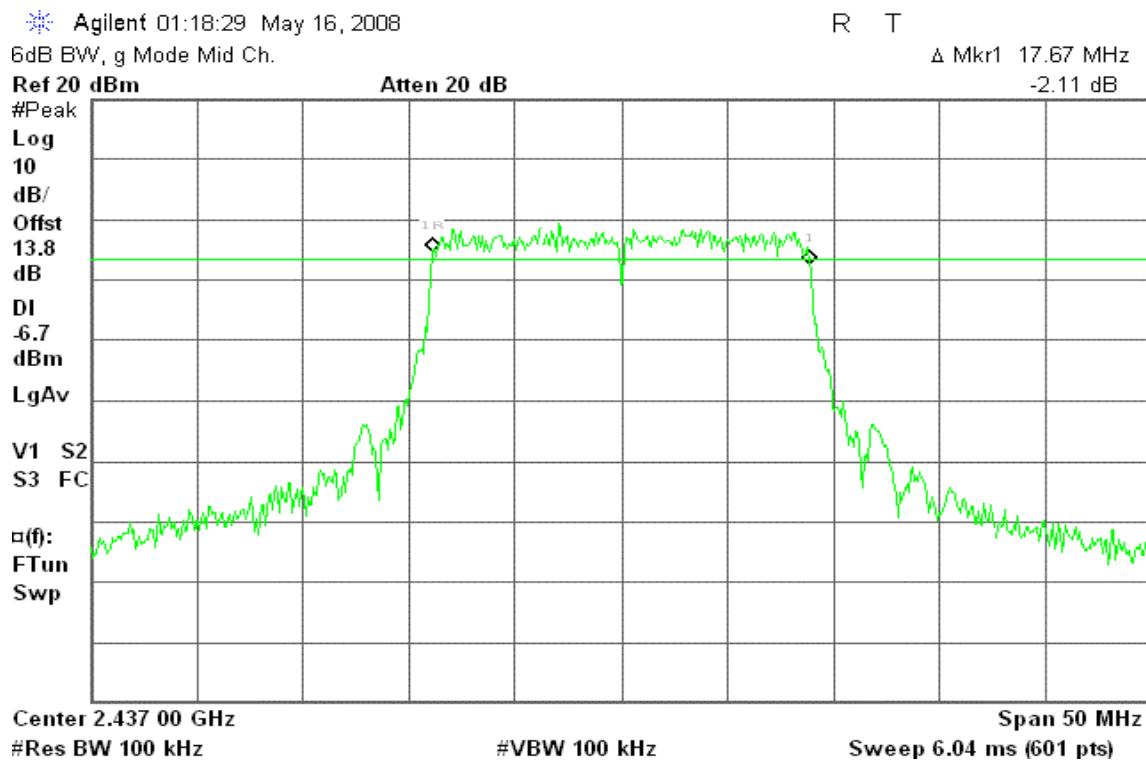


draft 802.11n Standard-20 MHz Channel mode / Chain 2

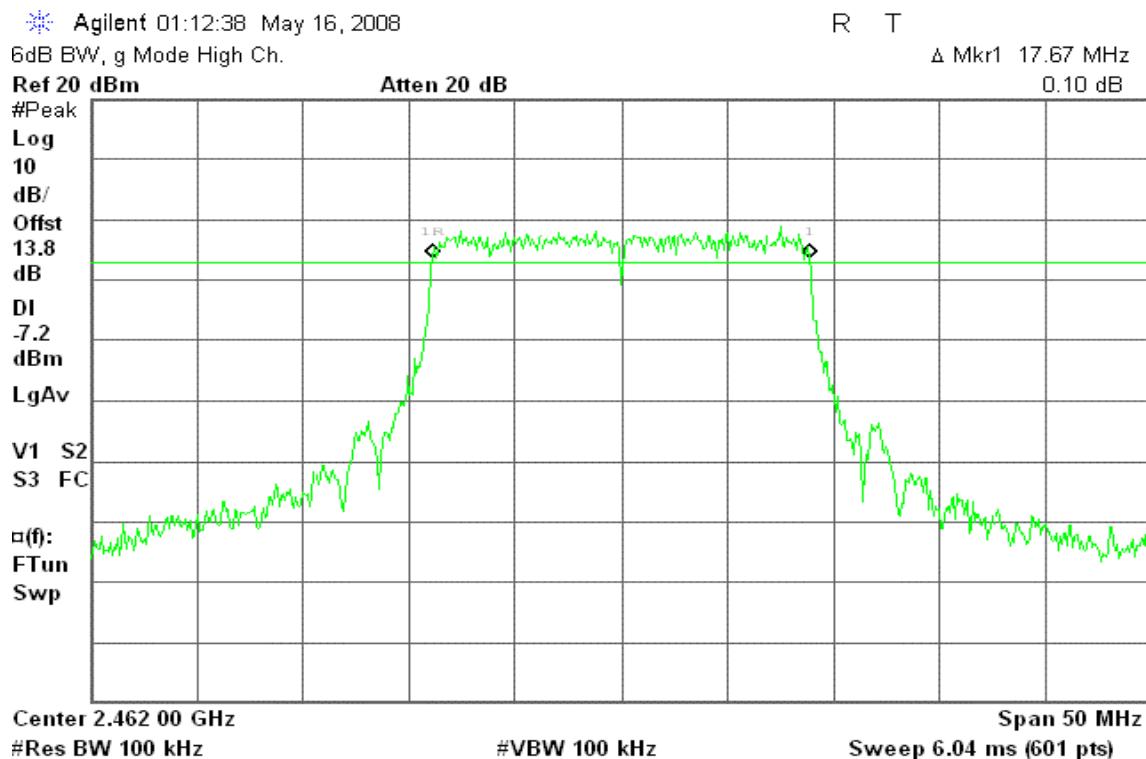
6dB Bandwidth (CH Low)

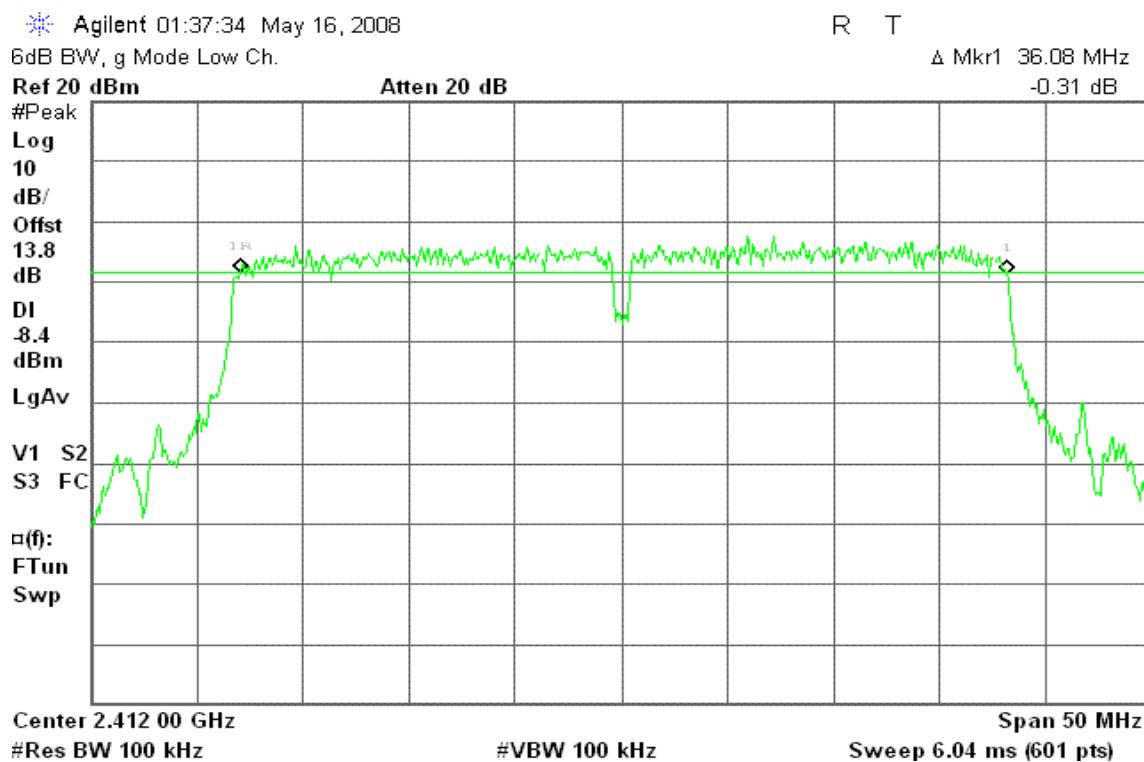
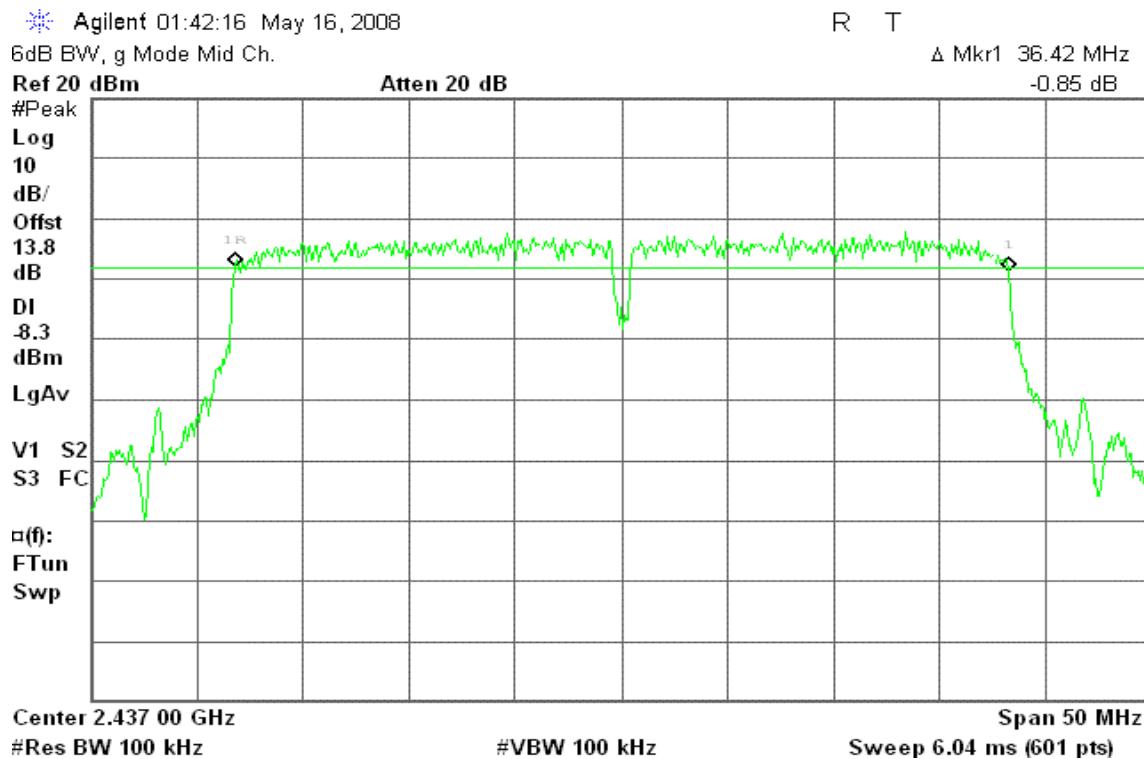


6dB Bandwidth (CH Mid)

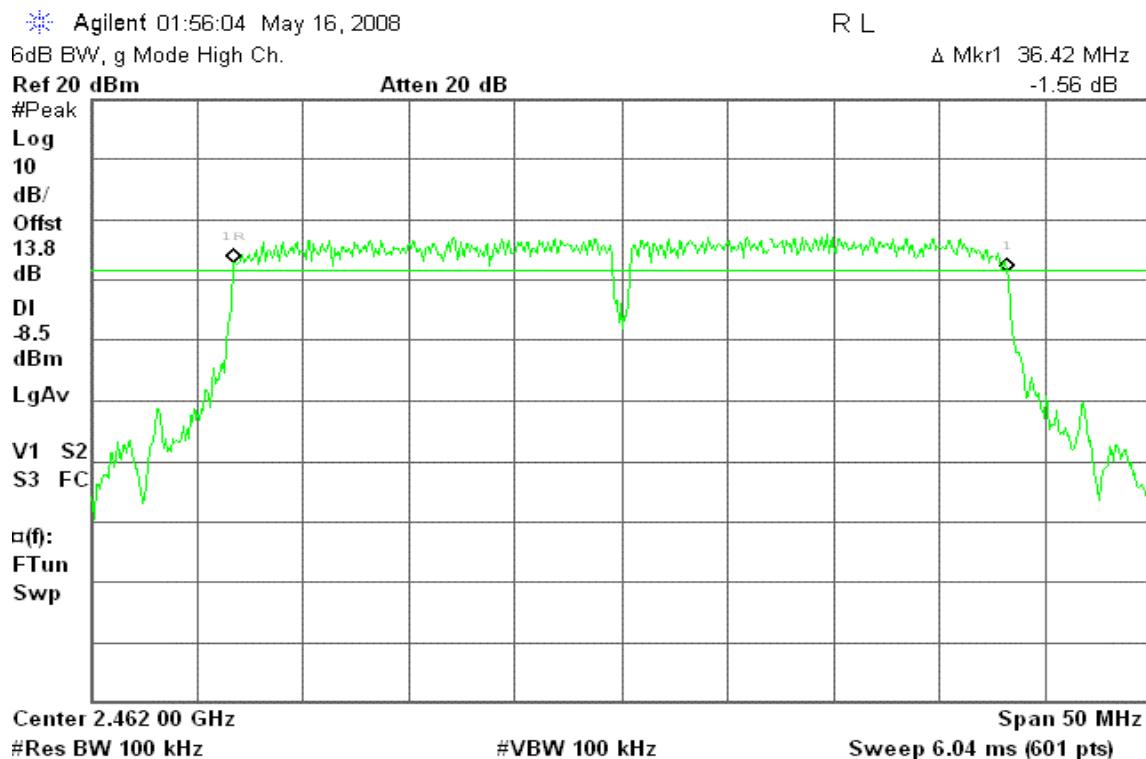


6dB Bandwidth (CH High)



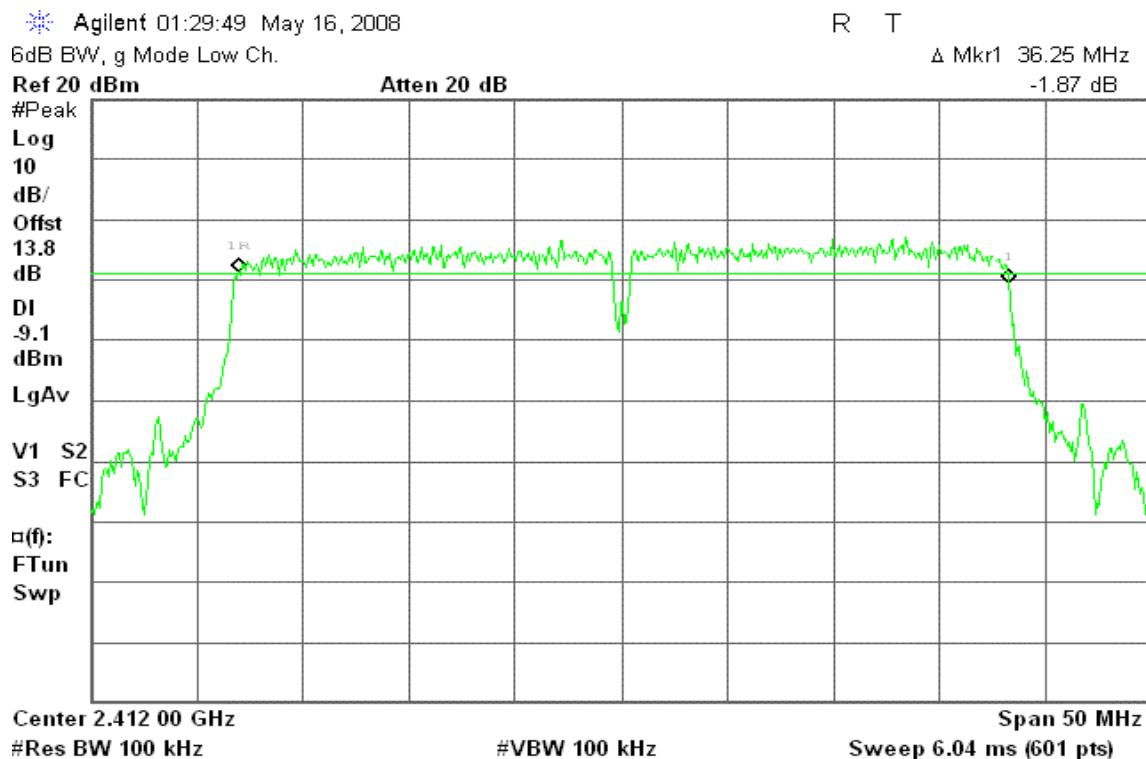
draft 802.11n Wide-40 MHz Channel mode / Chain 0**6dB Bandwidth (CH Low)****6dB Bandwidth (CH Mid)**

6dB Bandwidth (CH High)

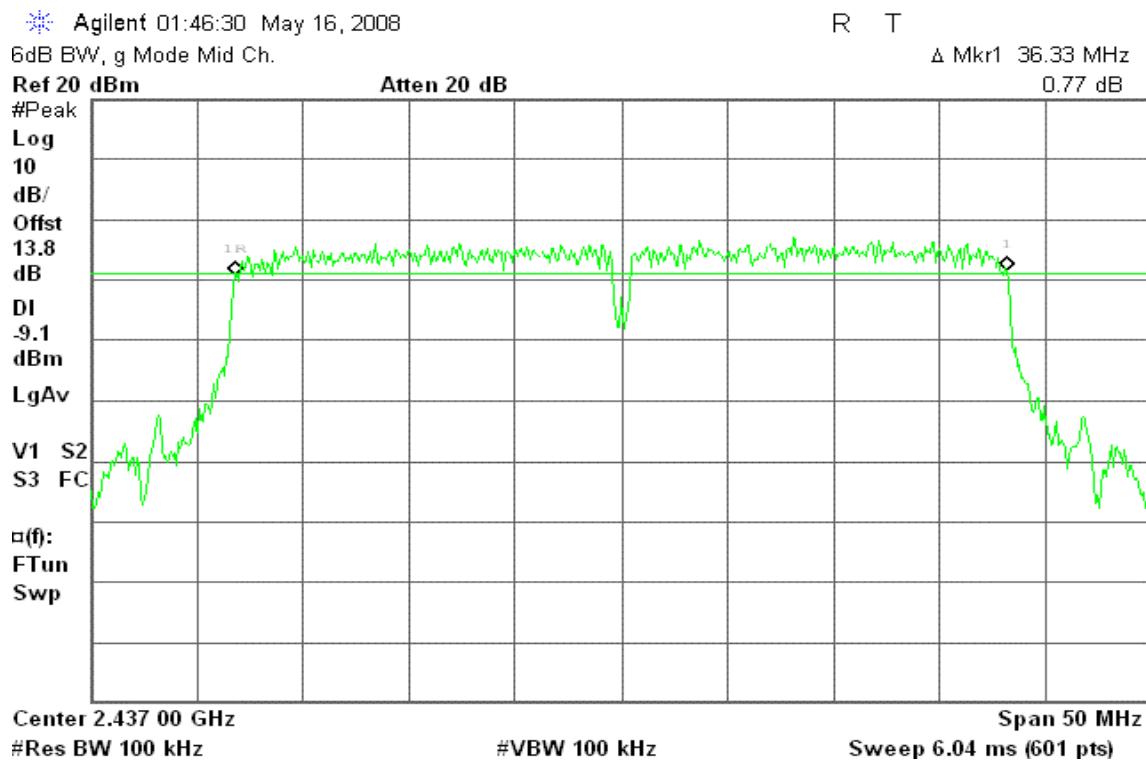


draft 802.11n Wide-40 MHz Channel mode / Chain 2

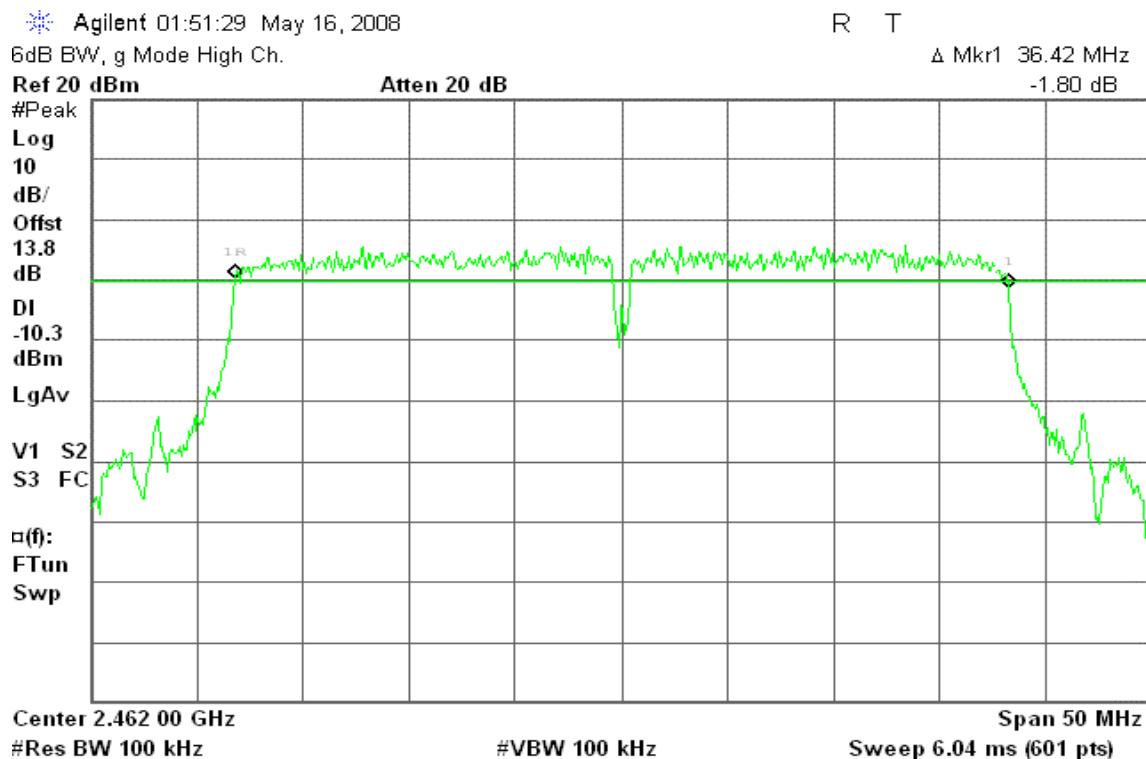
6dB Bandwidth (CH Low)



6dB Bandwidth (CH Mid)



6dB Bandwidth (CH High)



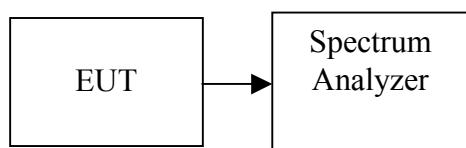
7.2 PEAK POWER

LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz: 1 Watt.
2. According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 1 MHz, VBW >= 3 MHz. in “Channel Power ” measurement.
4. Record the max reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

TEST RESULTS

No non-compliance noted



Test Data

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	14.19	0.0262	1.00	PASS
Mid	2437	15.12	0.0325		PASS
High	2462	15.51	0.0356		PASS

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	17.32	0.0540	1.00	PASS
Mid	2437	18.55	0.0716		PASS
High	2462	18.82	0.0762		PASS

Test mode: draft 802.11n Standard-20 MHz Channel mode

Channel	Frequency (MHz)	Chain 0 Output Power (dBm)	Chain 2 Output Power (dBm)	Total Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	17.79	16.52	20.21	0.1050	1.00	PASS
Mid	2437	18.38	17.12	20.81	0.1204		PASS
High	2462	18.65	16.86	20.86	0.1218		PASS

Test mode: draft 802.11n Wide-40 MHz Channel mode

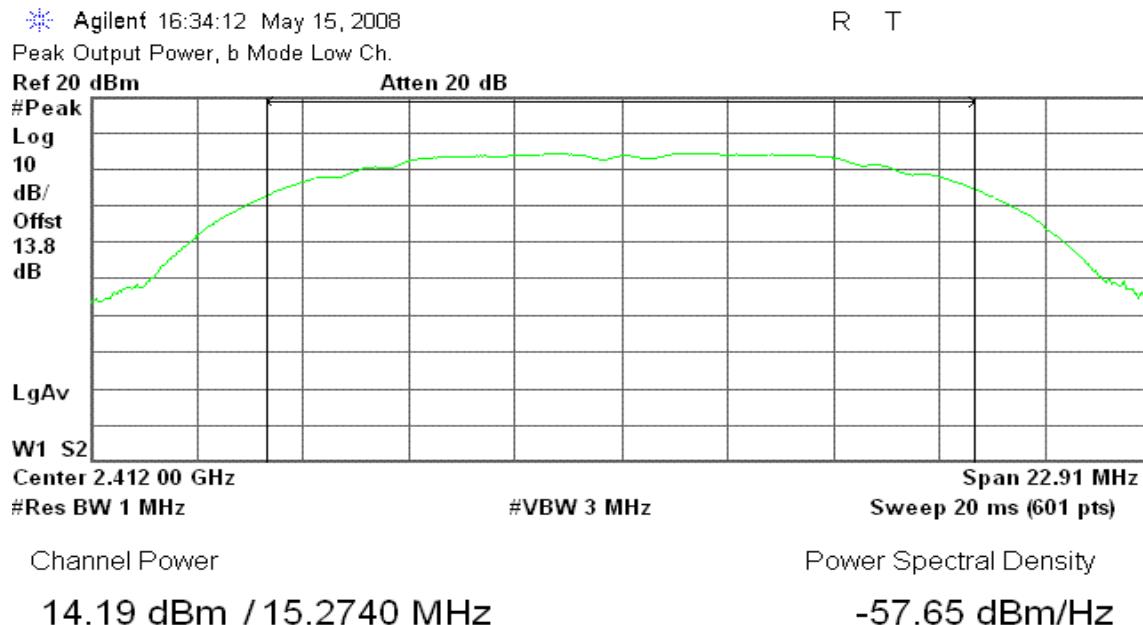
Channel	Frequency (MHz)	Chain 0 Output Power (dBm)	Chain 2 Output Power (dBm)	Total Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2422	18.14	17.72	20.95	0.1243	1.00	PASS
Mid	2437	18.88	17.46	21.24	0.1330		PASS
High	2452	18.96	16.72	20.99	0.1257		PASS

Remark: Total Output Power (w) = Chain 0 ($10^{(Output\ Power/10)/1000}$) + Chain 2 ($10^{(Output\ Power/10)/1000}$)

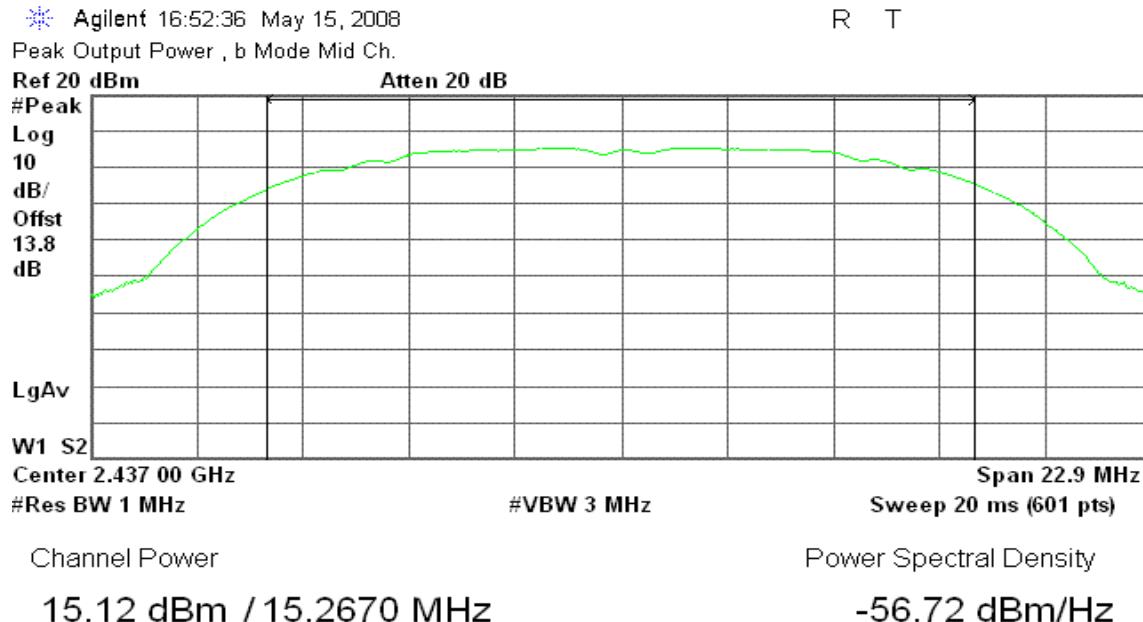
Test Plot

IEEE 802.11b mode

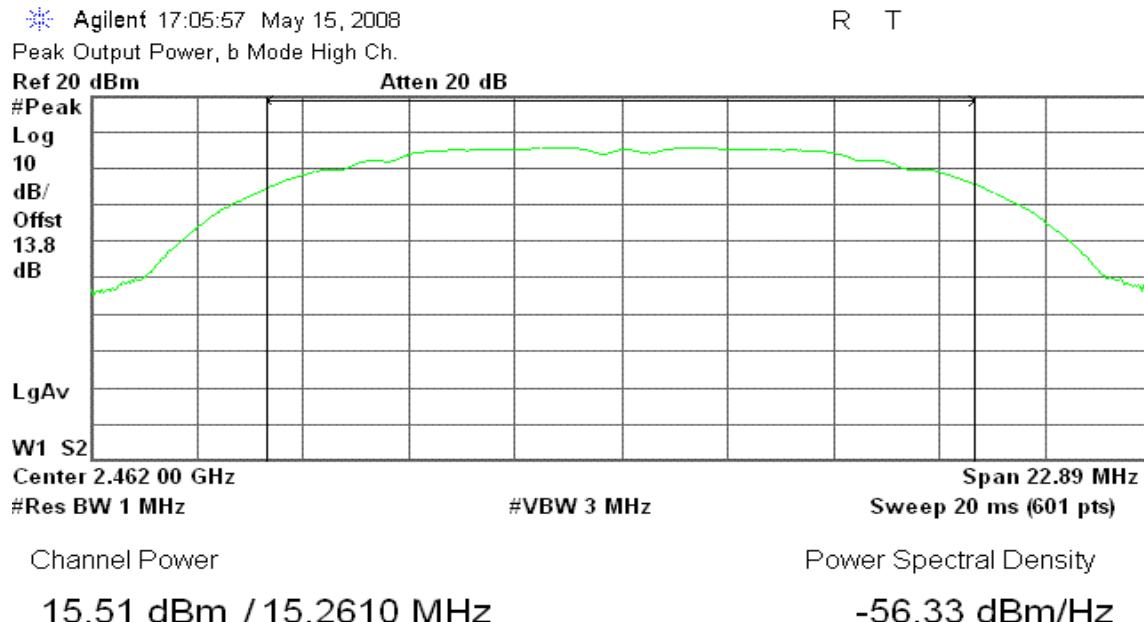
Peak Power (CH Low)



Peak Power (CH Mid)

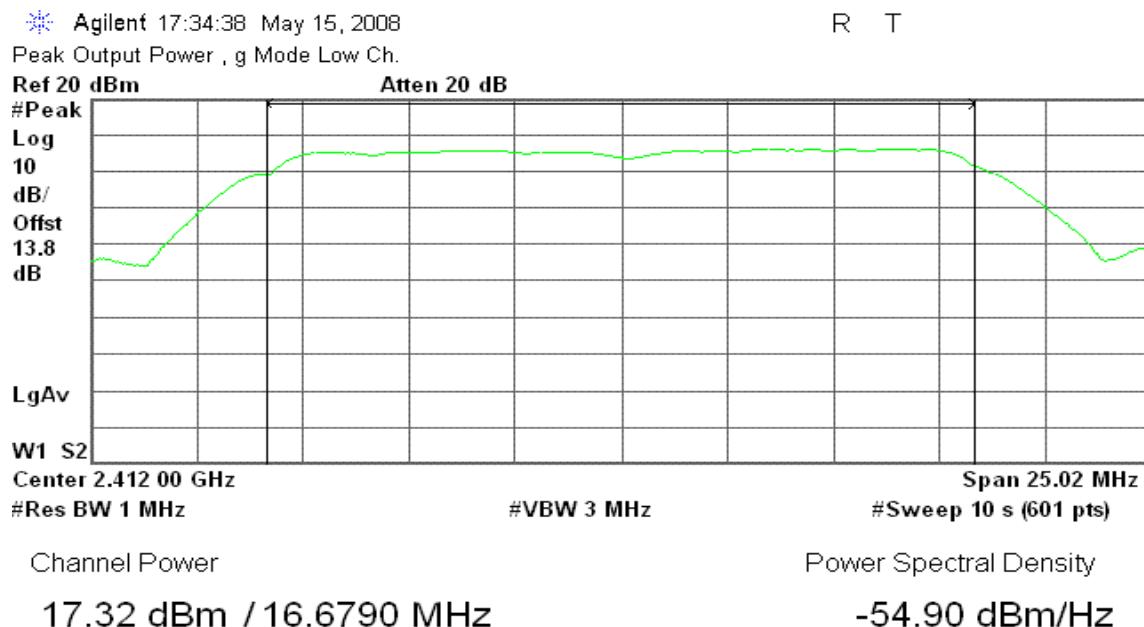


Peak Power (CH High)

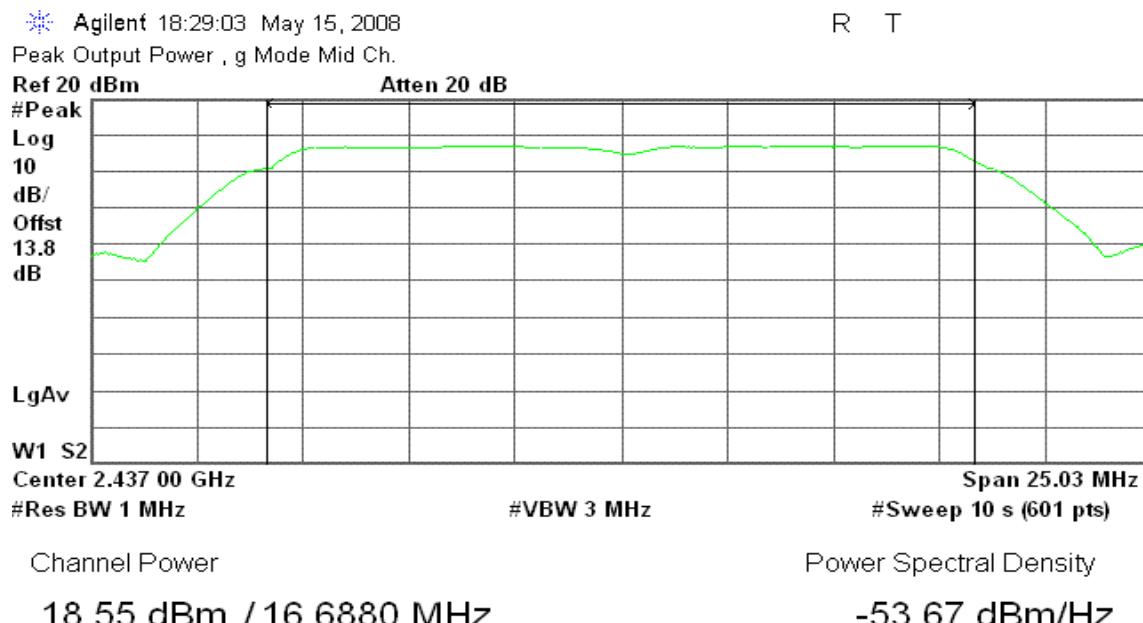


IEEE 802.11g mode

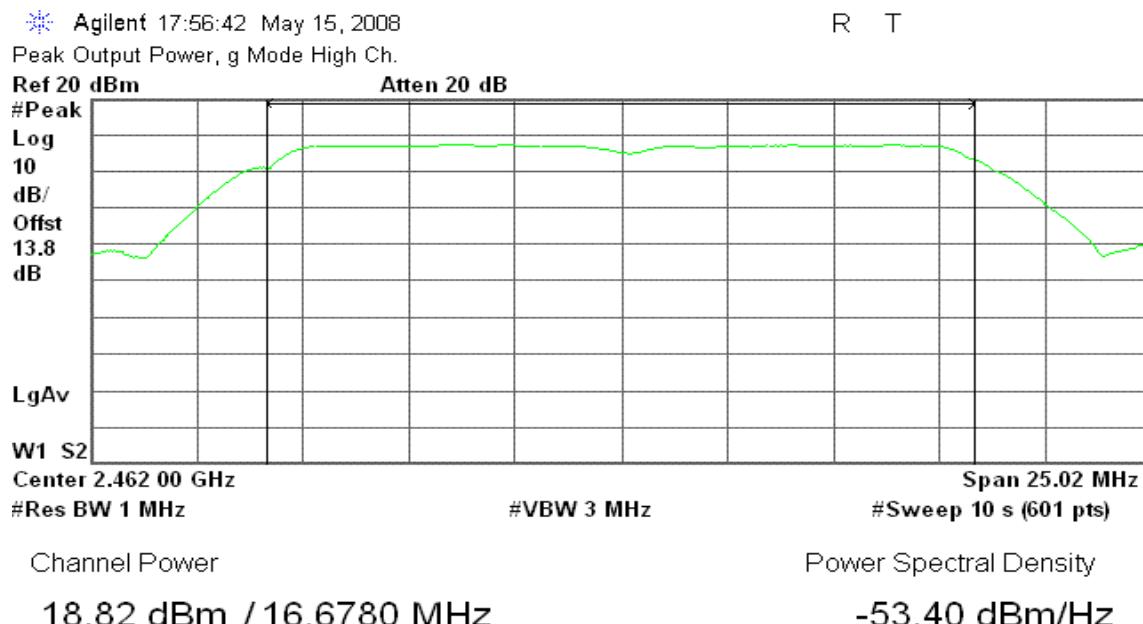
Peak Power (CH Low)

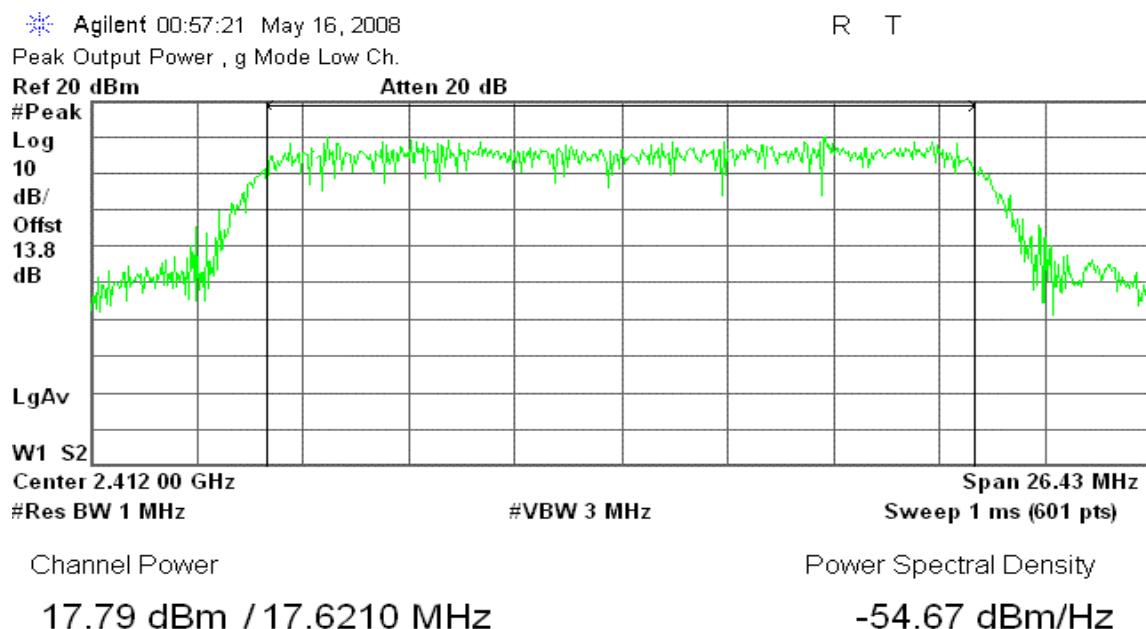
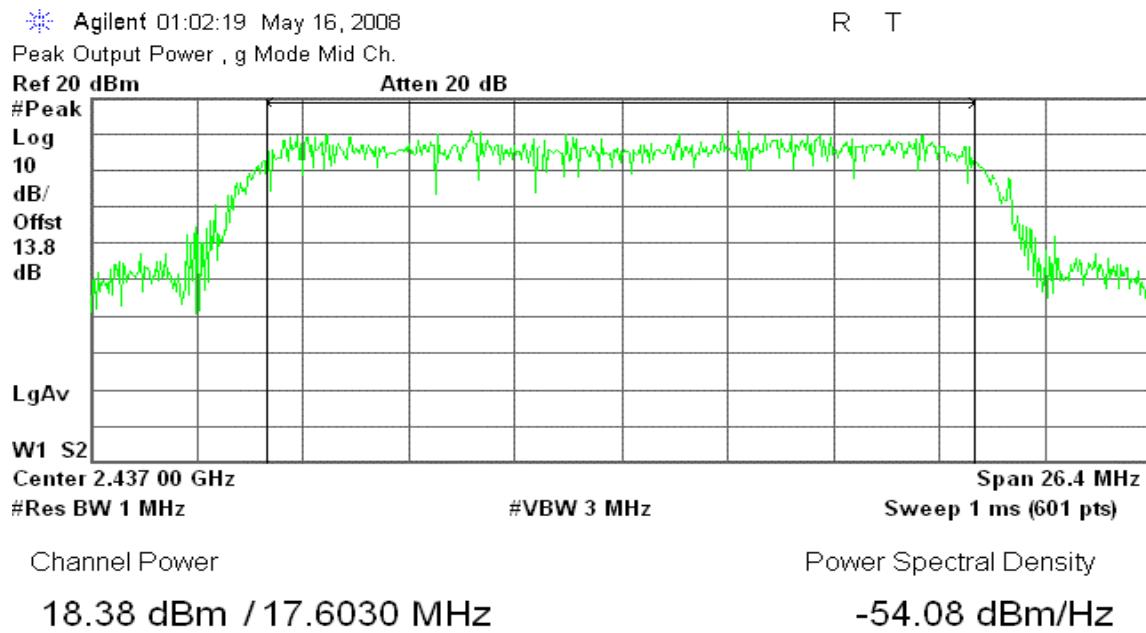


Peak Power (CH Mid)

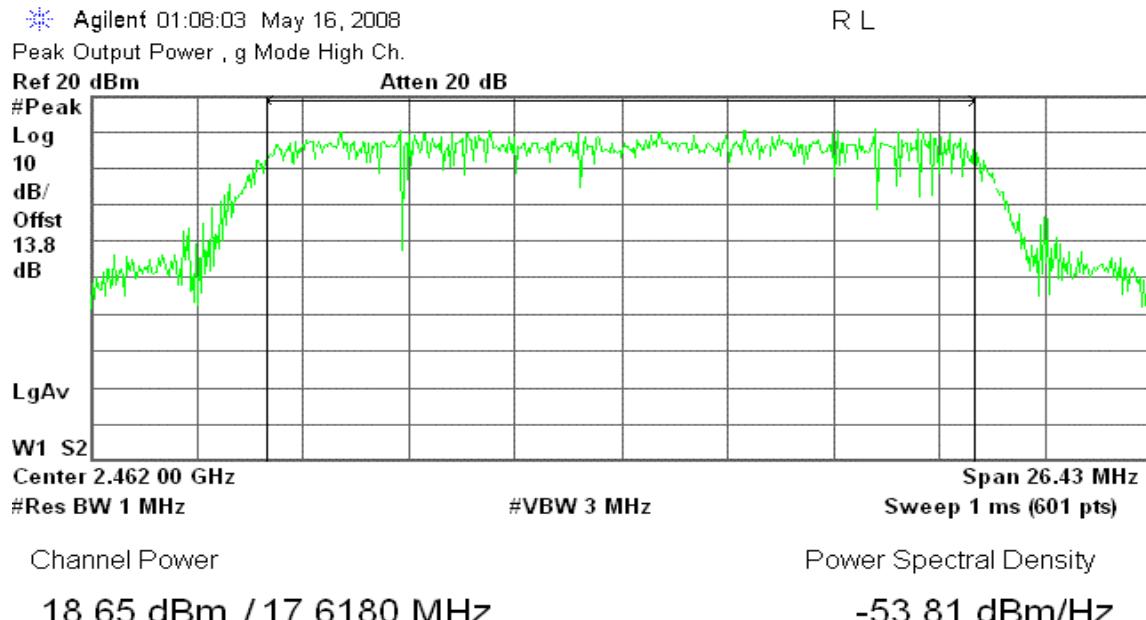


Peak Power (CH High)



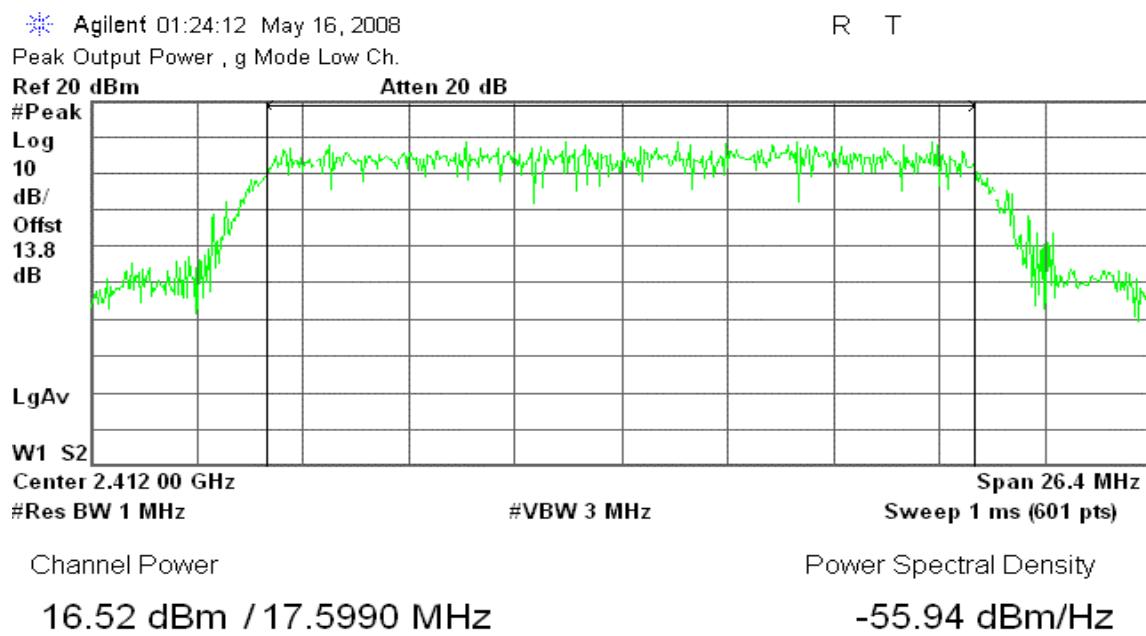
draft 802.11n Standard-20 MHz Channel mode / Chain 0**Peak Power (CH Low)****Peak Power (CH Mid)**

Peak Power (CH High)

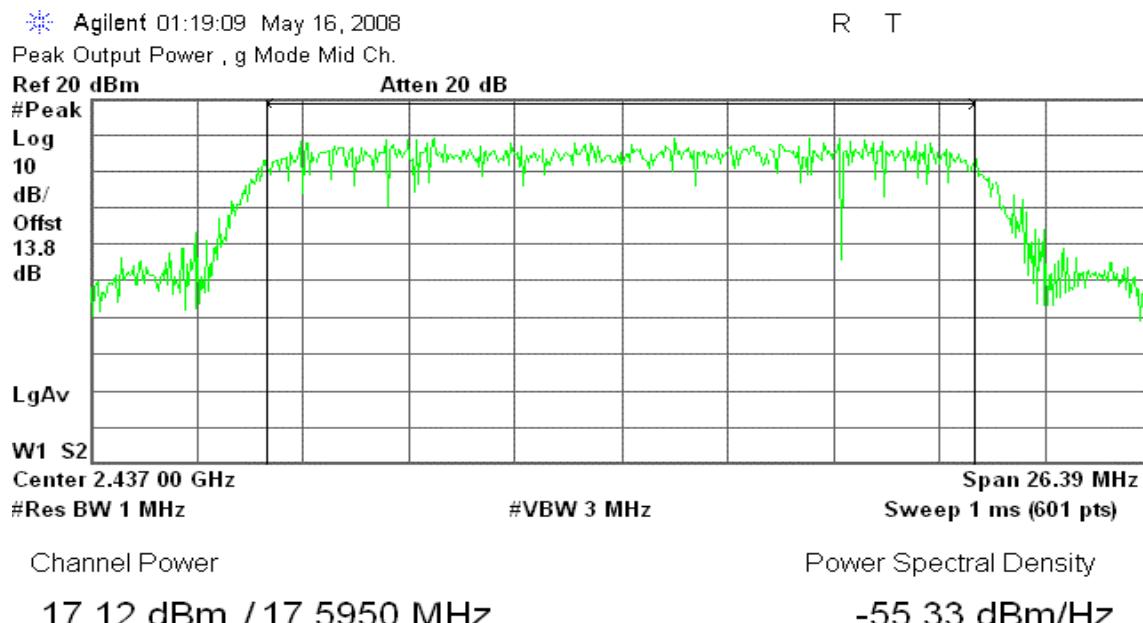


draft 802.11n Standard-20 MHz Channel mode / Chain 2

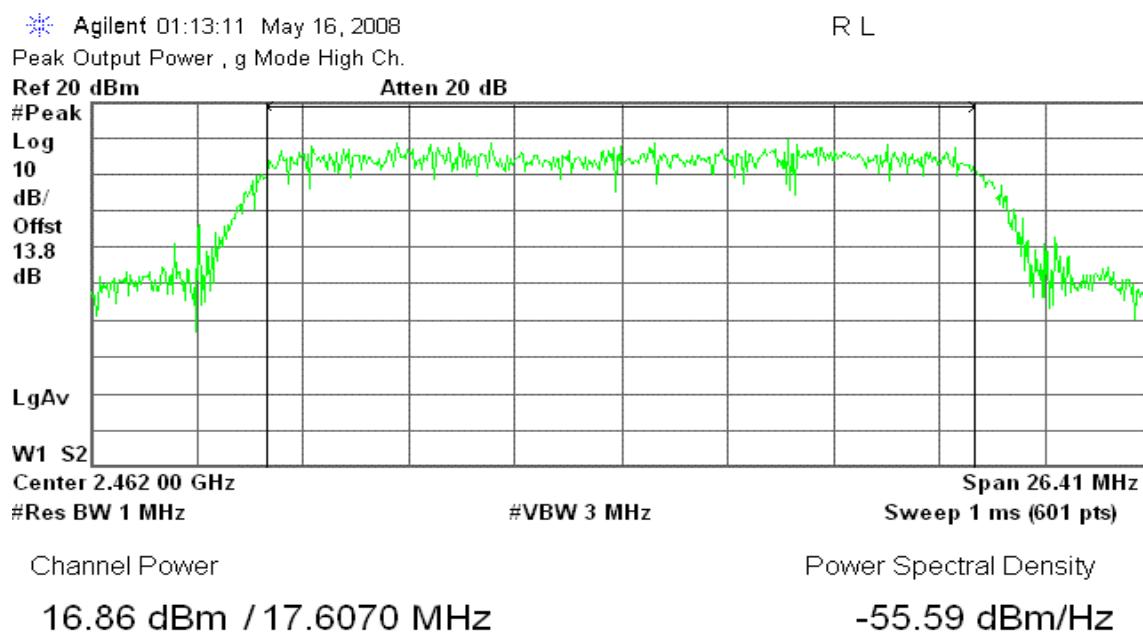
Peak Power (CH Low)

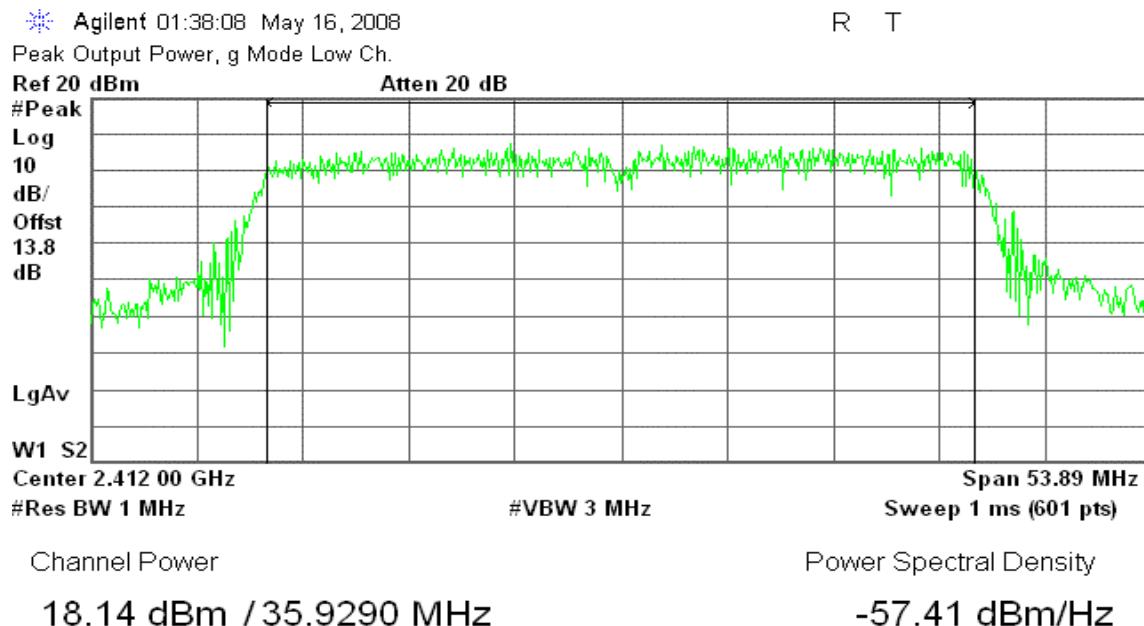
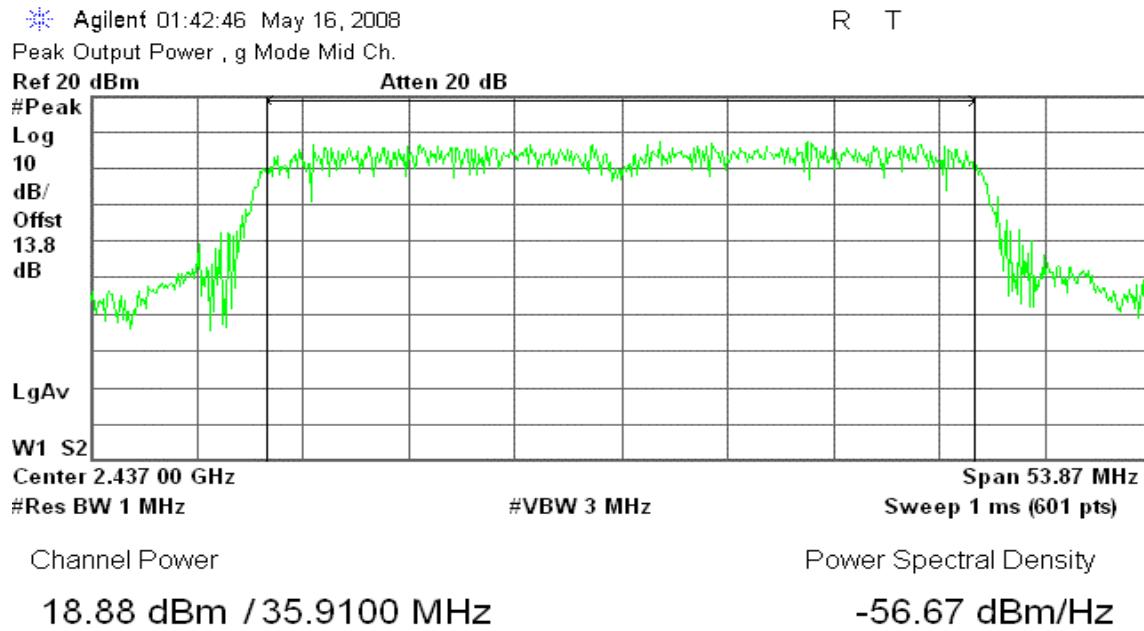


Peak Power (CH Mid)

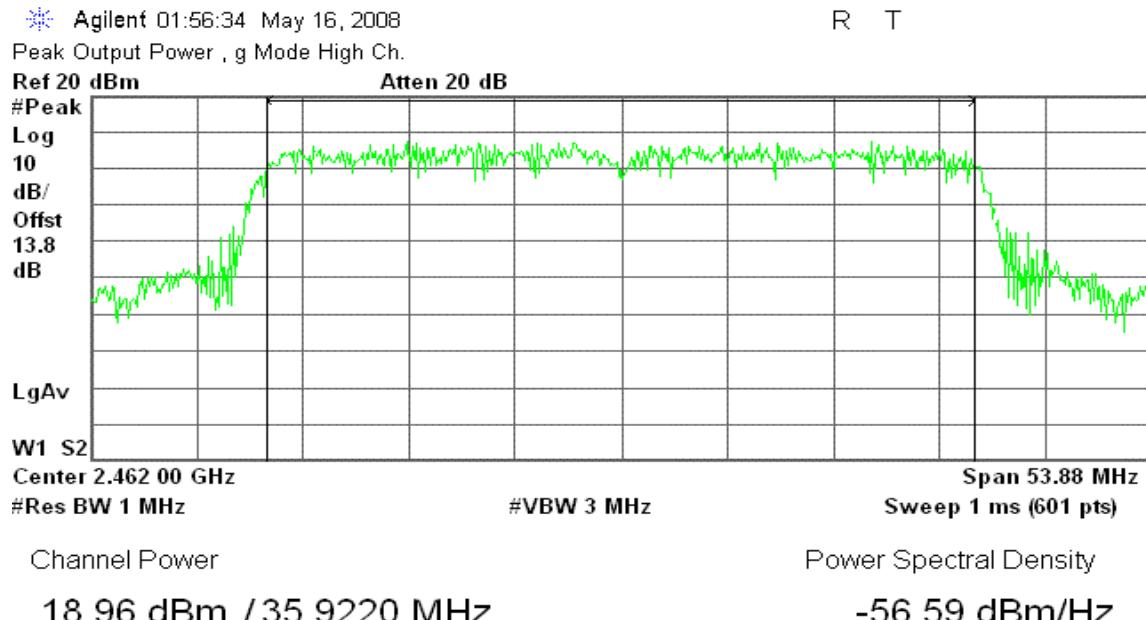


Peak Power (CH High)



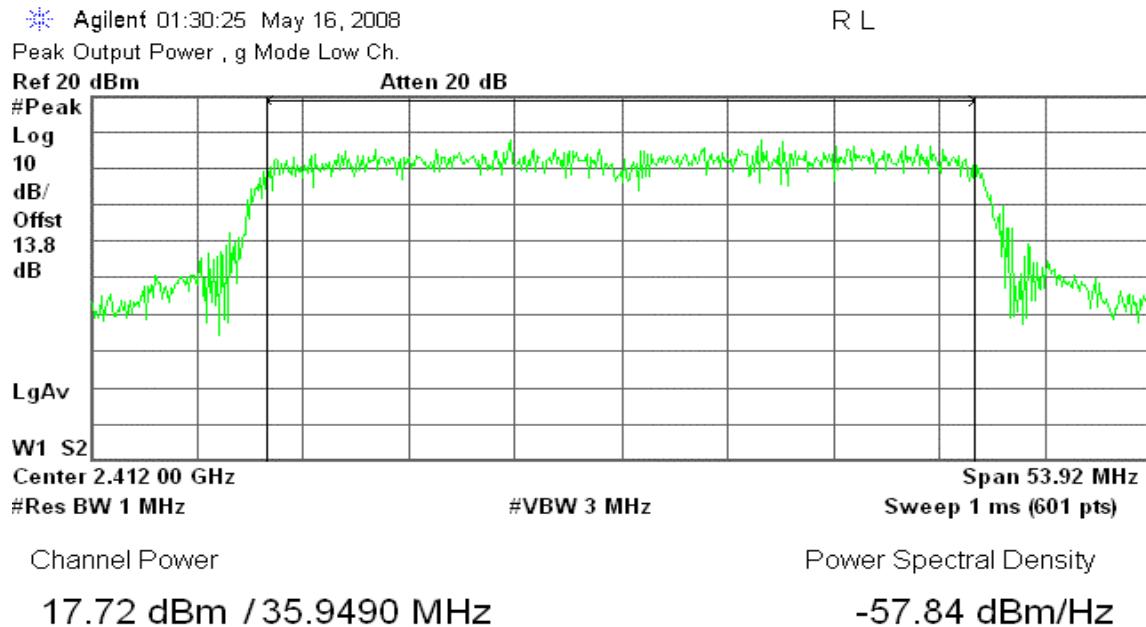
draft 802.11n Wide-40 MHz Channel mode / Chain 0**Peak Power (CH Low)****Peak Power (CH Mid)**

Peak Power (CH High)

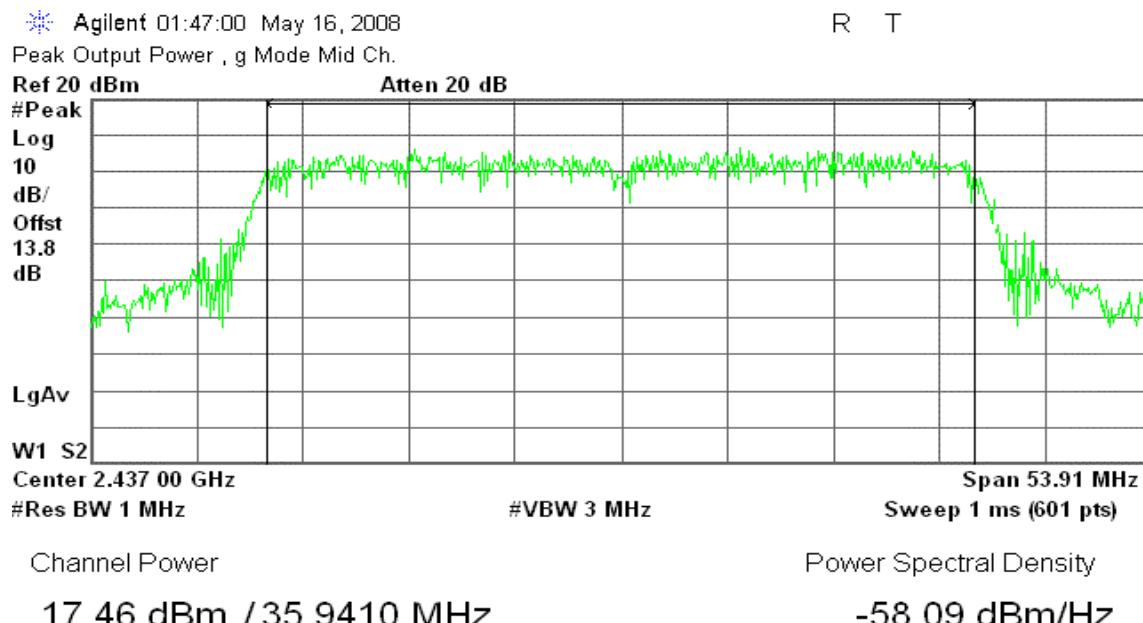


draft 802.11n Wide-40 MHz Channel mode / Chain 2

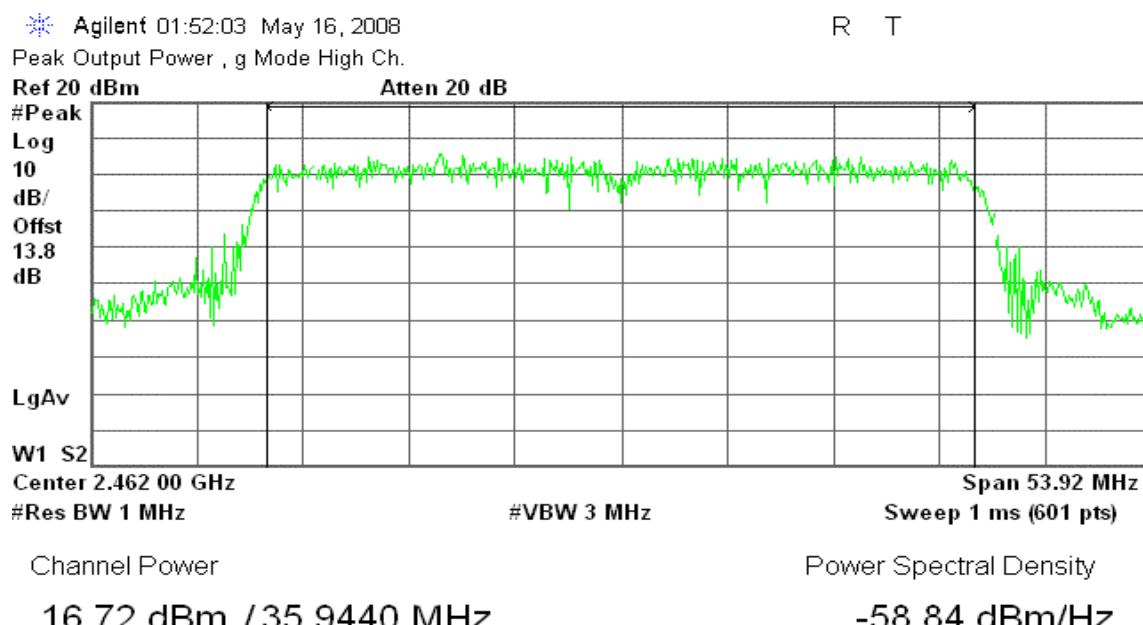
Peak Power (CH Low)



Peak Power (CH Mid)



Peak Power (CH High)

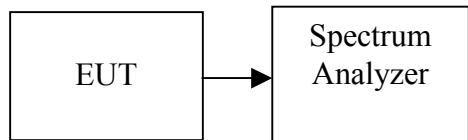


7.3 AVERAGE POWER

LIMIT

None; for reporting purposes only.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum analyzer. The Spectrum analyzer is set to the average power detection.

TEST RESULTS

No non-compliance noted



Test Data

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	11.40	0.0138	1.00	PASS
Mid	2437	12.27	0.0169		PASS
High	2462	12.66	0.0185		PASS

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	9.85	0.0097	1.00	PASS
Mid	2437	10.95	0.0124		PASS
High	2462	11.04	0.0127		PASS

Test mode: draft 802.11n Standard-20 MHz Channel mode

Channel	Frequency (MHz)	Chain 0 Output Power (dBm)	Chain 2 Output Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	14.38	13.10	16.80	0.0478	1.00	PASS
Mid	2437	14.78	13.88	17.36	0.0545		PASS
High	2462	14.91	13.69	17.35	0.0544		PASS

Test mode: draft 802.11n Wide-40 MHz Channel mode

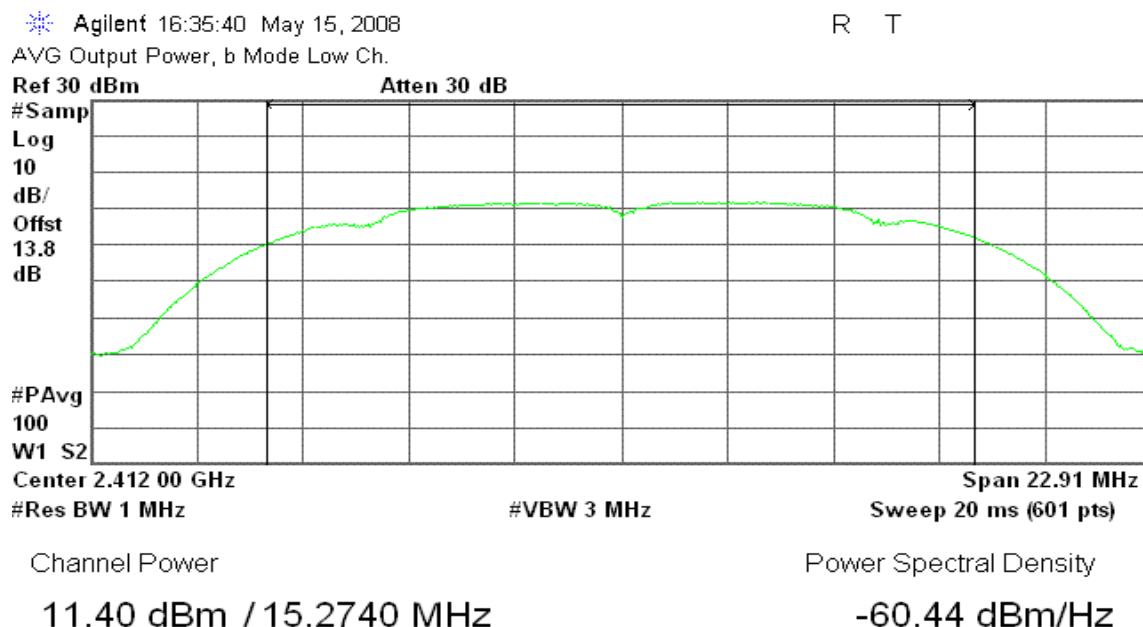
Channel	Frequency (MHz)	Chain 0 Output Power (dBm)	Chain 2 Output Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2422	14.68	14.36	17.53	0.0567	1.00	PASS
Mid	2437	15.37	14.22	17.84	0.0609		PASS
High	2452	15.72	13.60	17.80	0.0602		PASS

Remark: Total Output Power (w) = Chain 0 ($10^{(Output\ Power/10)/1000}$) + Chain 2 ($10^{(Output\ Power/10)/1000}$)

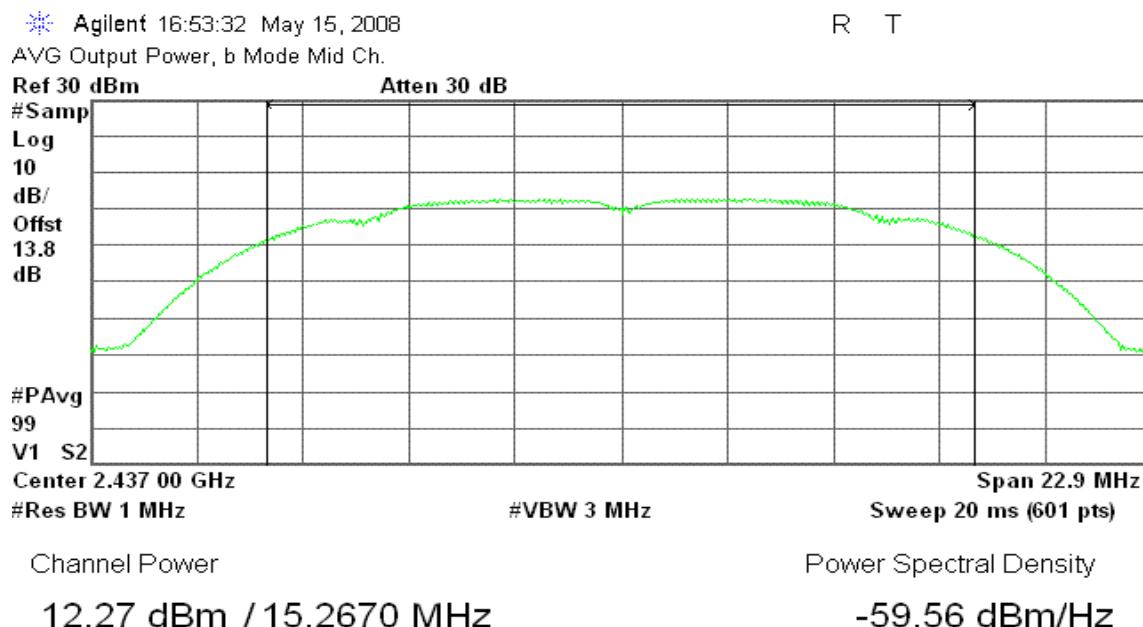
Test Plot

IEEE 802.11b mode

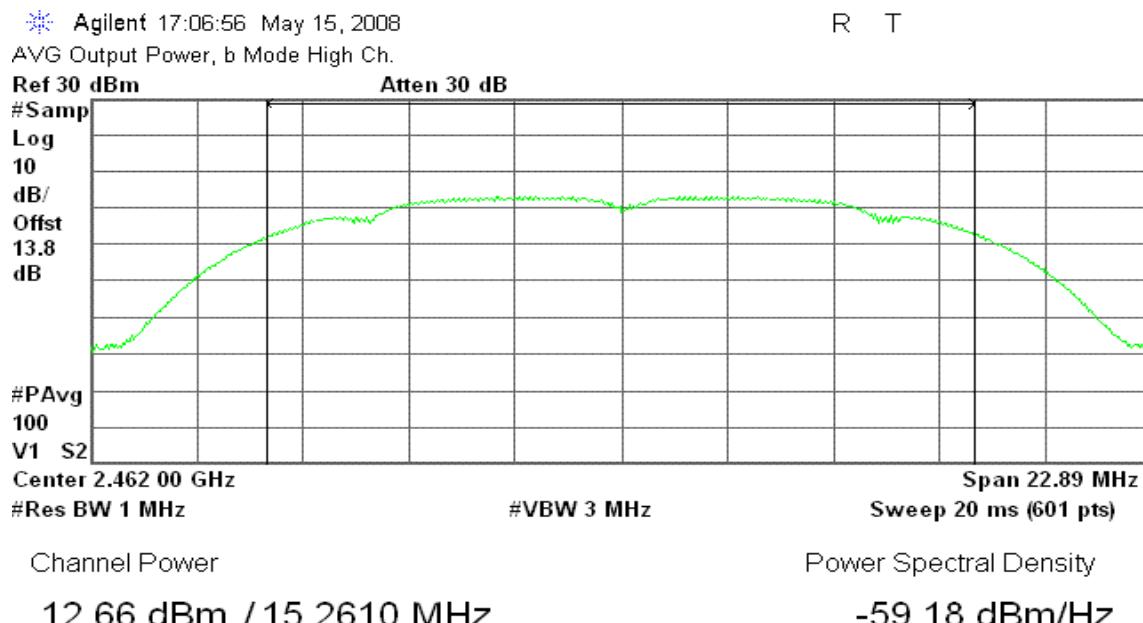
Average Power (CH Low)



Average Power (CH Mid)

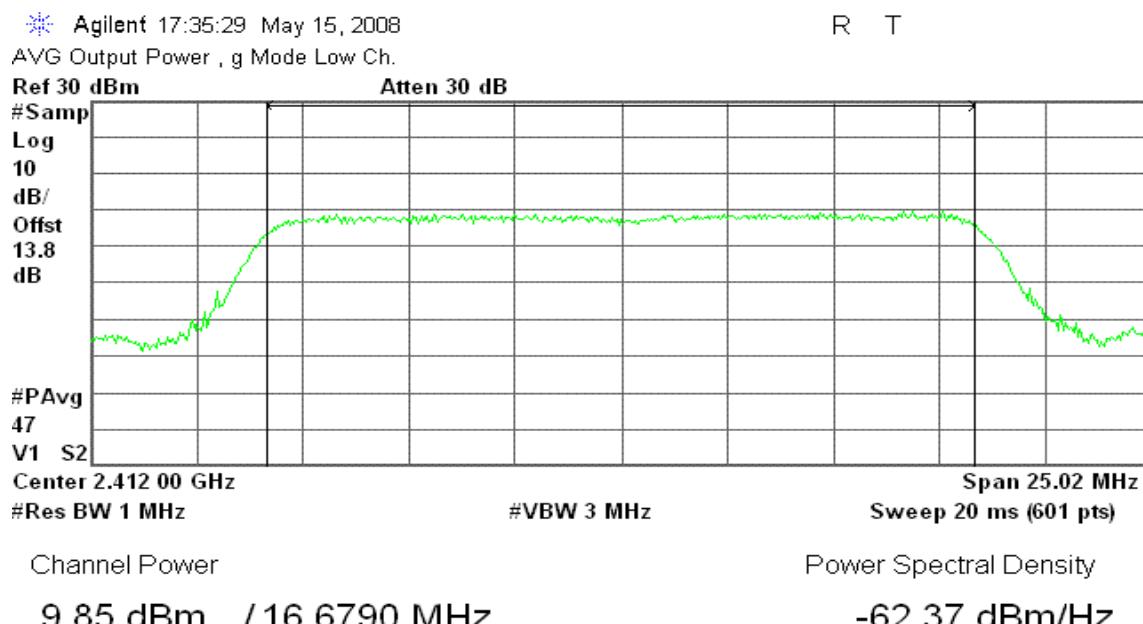


Average Power (CH High)



IEEE 802.11g mode

Average Power (CH Low)



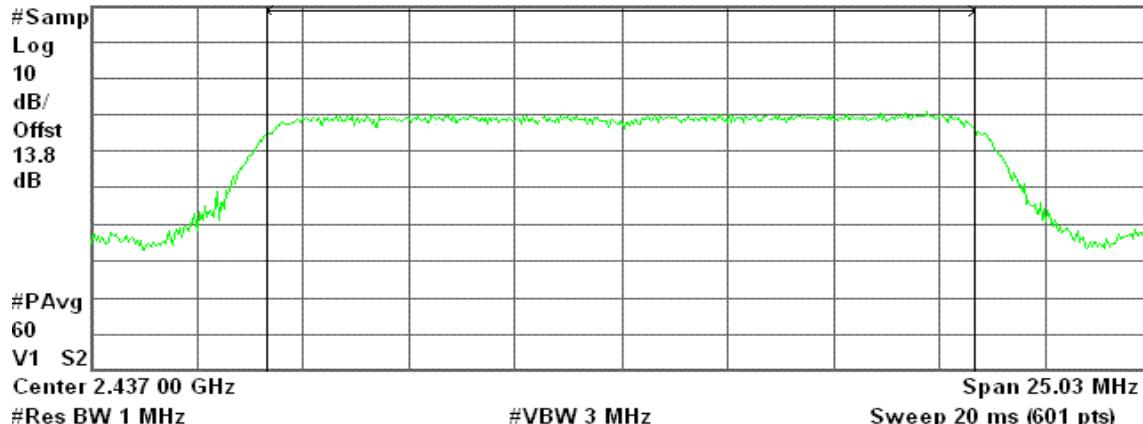
Average Power (CH Mid)

Agilent 18:31:52 May 15, 2008

R T

Avg Output Power, g Mode Mid Ch.

Ref 30 dBm Atten 30 dB



Channel Power

10.95 dBm / 16.6880 MHz

Power Spectral Density

-61.28 dBm/Hz

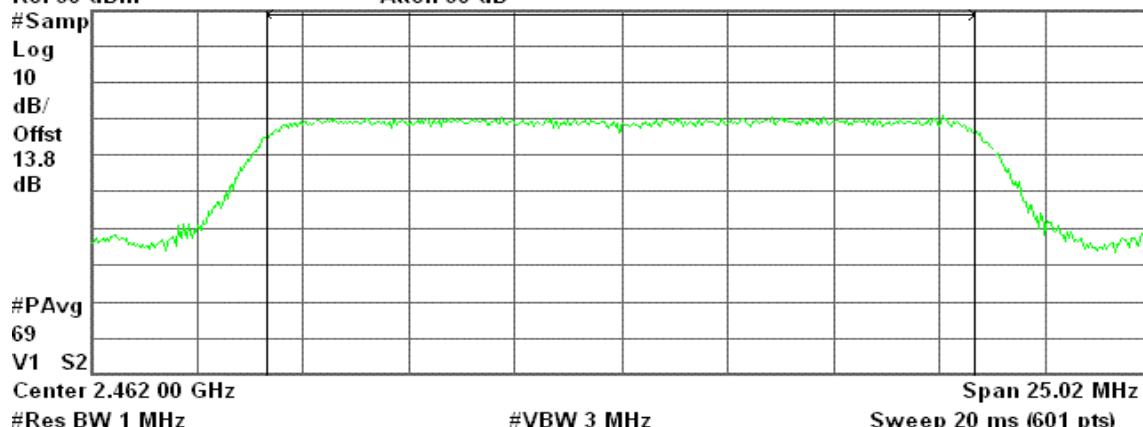
Average Power (CH High)

Agilent 17:57:38 May 15, 2008

R T

Avg Output Power, g Mode High Ch.

Ref 30 dBm Atten 30 dB

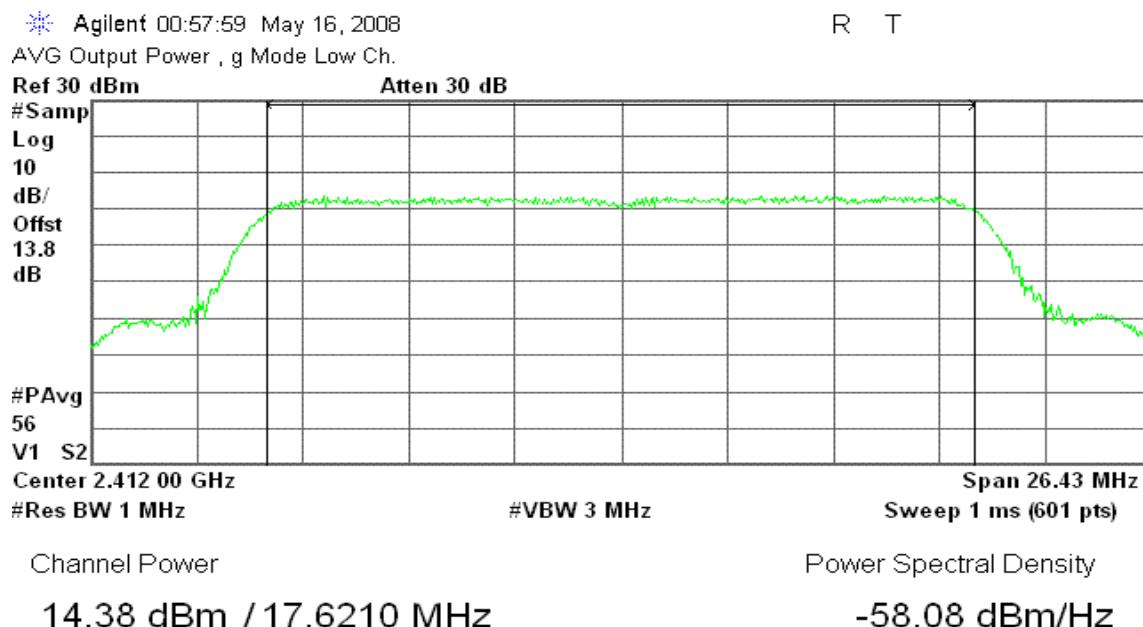
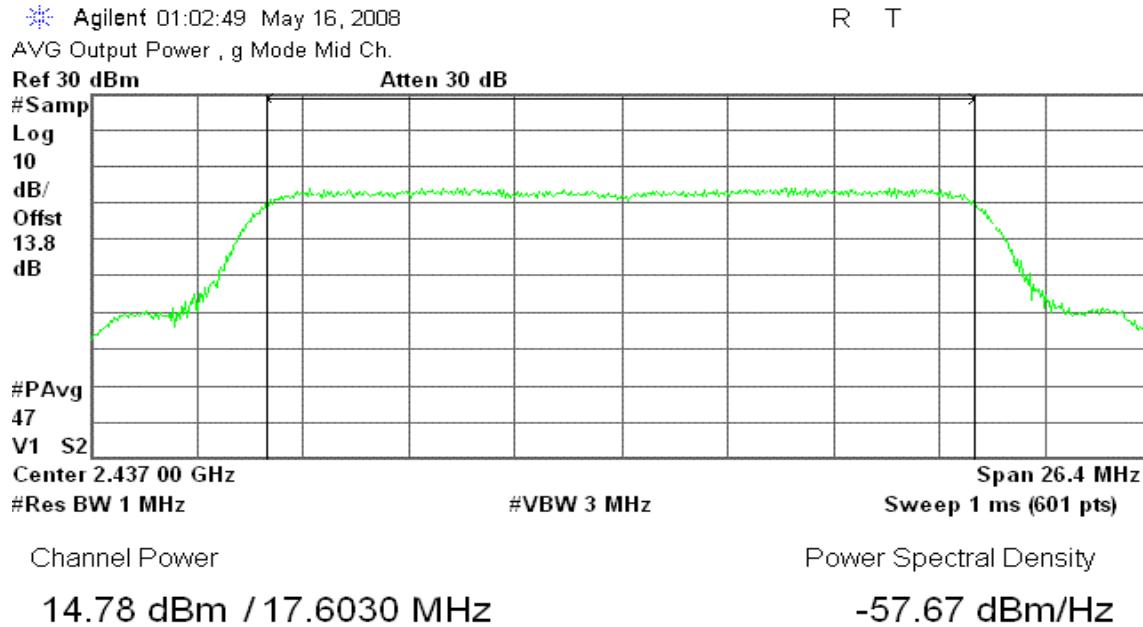


Channel Power

11.04 dBm / 16.6780 MHz

Power Spectral Density

-61.19 dBm/Hz

draft 802.11n Standard-20 MHz Channel mode / Chain 0**Average Power (CH Low)****Average Power (CH Mid)**

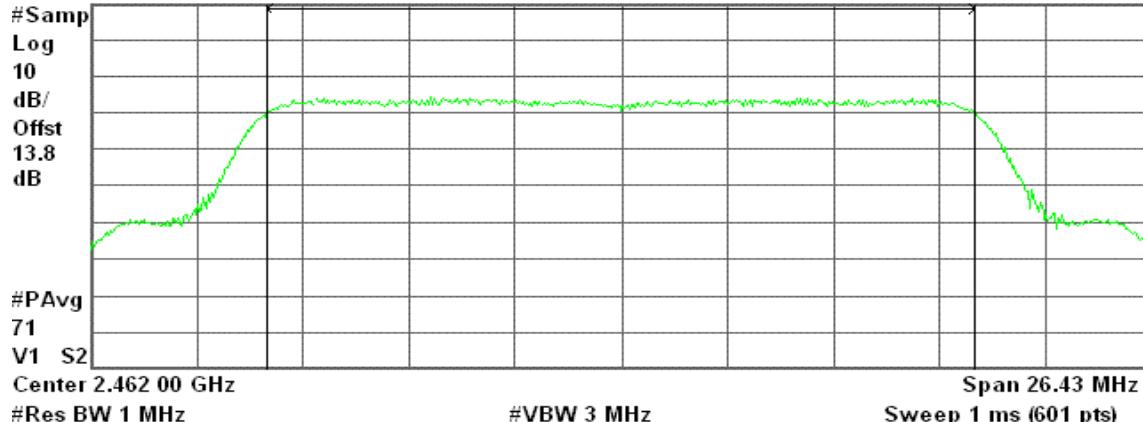
Average Power (CH High)

Agilent 01:08:37 May 16, 2008

Avg Output Power, g Mode High Ch.

Ref 30 dBm

Atten 30 dB



Channel Power

14.91 dBm / 17.6180 MHz

Power Spectral Density

-57.55 dBm/Hz

draft 802.11n Standard-20 MHz Channel mode / Chain 2

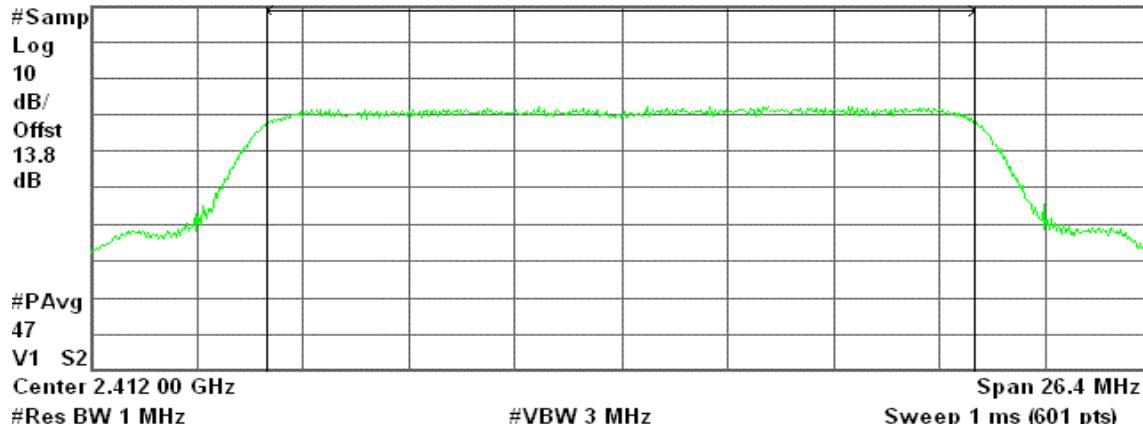
Average Power (CH Low)

Agilent 01:24:43 May 16, 2008

Avg Output Power, g Mode Low Ch.

Ref 30 dBm

Atten 30 dB



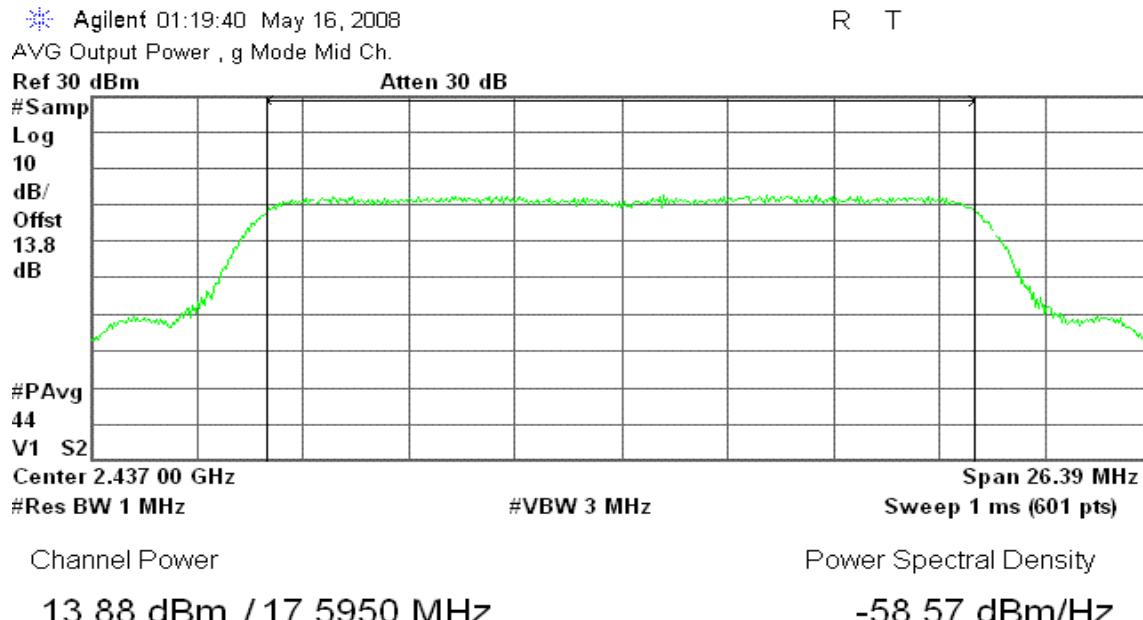
Channel Power

13.10 dBm / 17.5990 MHz

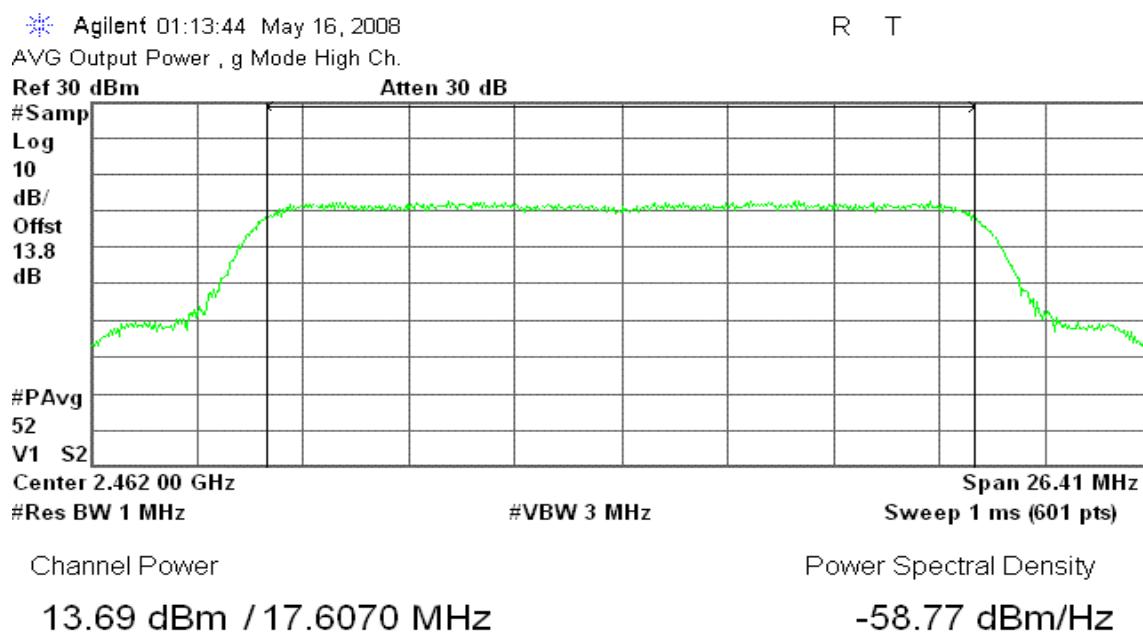
Power Spectral Density

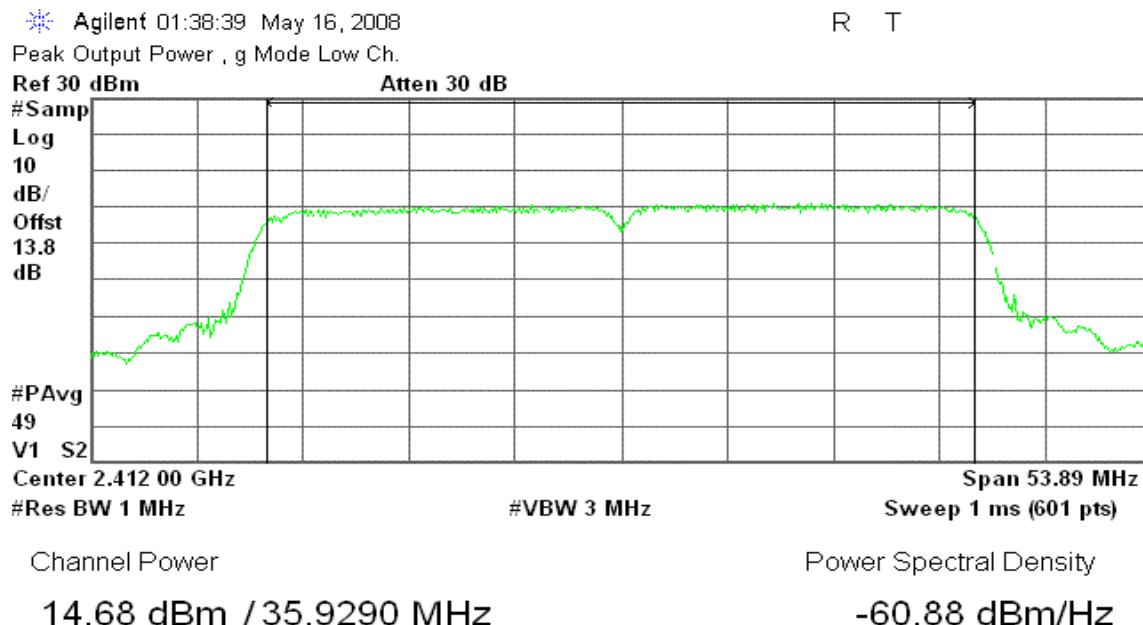
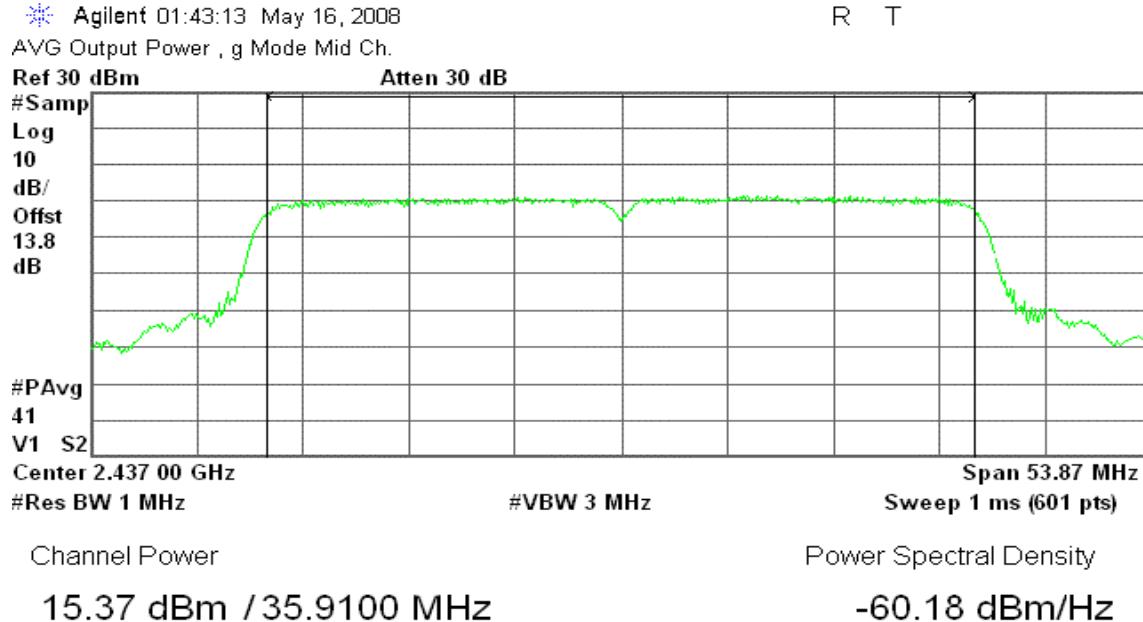
-59.36 dBm/Hz

Average Power (CH Mid)



Average Power (CH High)



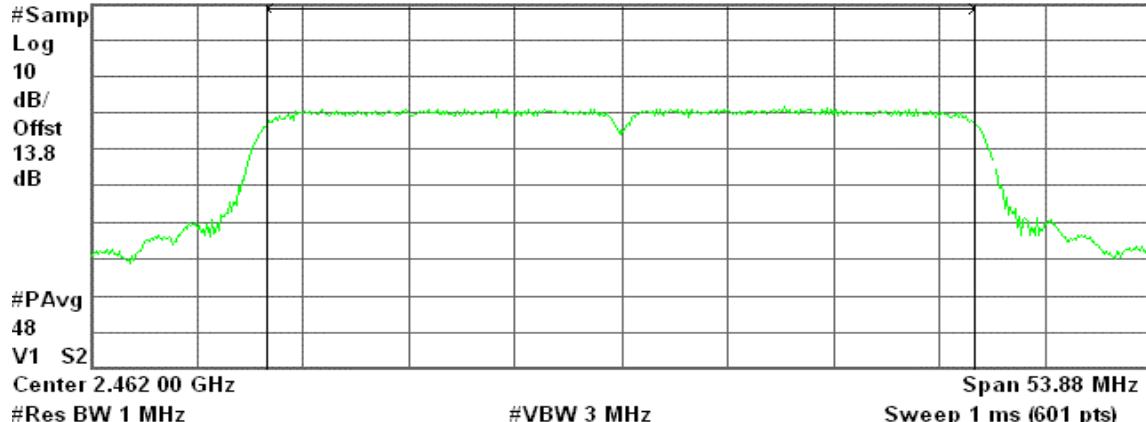
draft 802.11n Wide-40 MHz Channel mode / Chain 0**Average Power (CH Low)****Average Power (CH Mid)**

Average Power (CH High)

Agilent 01:57:08 May 16, 2008

Avg Output Power , g Mode High Ch.

Ref 30 dBm Atten 30 dB



Channel Power

15.72 dBm / 35.9220 MHz

Power Spectral Density

-59.84 dBm/Hz

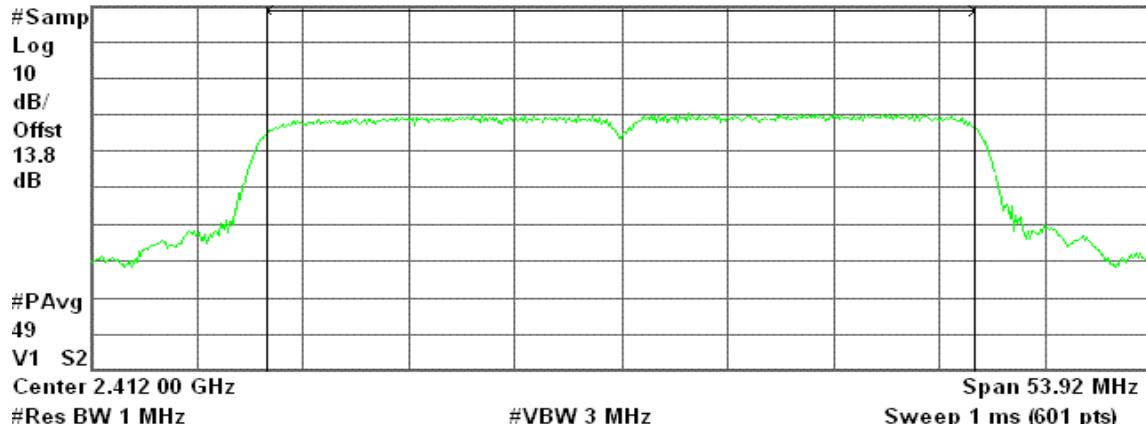
draft 802.11n Wide-40 MHz Channel mode / Chain 2

Average Power (CH Low)

Agilent 01:30:57 May 16, 2008

Avg Output Power , g Mode Low Ch.

Ref 30 dBm Atten 30 dB



Channel Power

14.36 dBm / 35.9490 MHz

Power Spectral Density

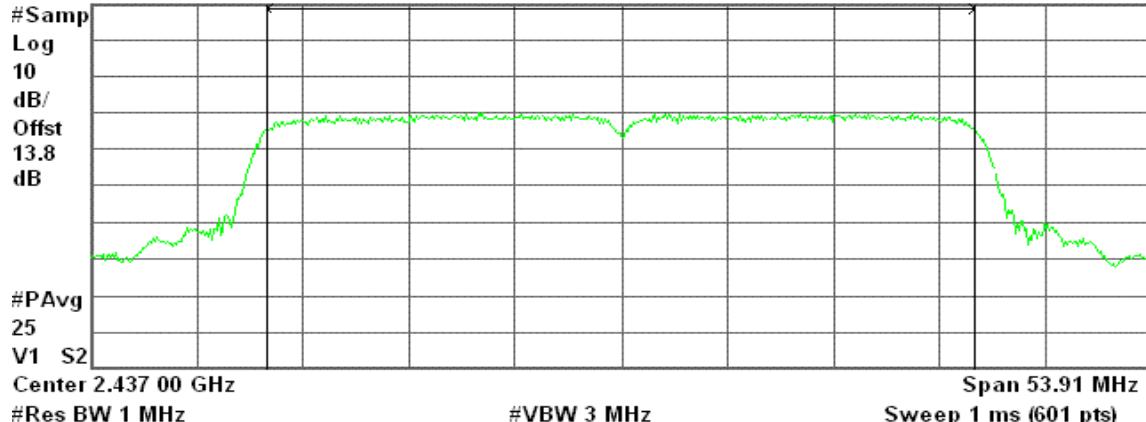
-61.19 dBm/Hz

Average Power (CH Mid)

Agilent 01:47:37 May 16, 2008

AVG Output Power , g Mode Mid Ch.

Ref 30 dBm Atten 30 dB



Channel Power

14.22 dBm / 35.9410 MHz

Power Spectral Density

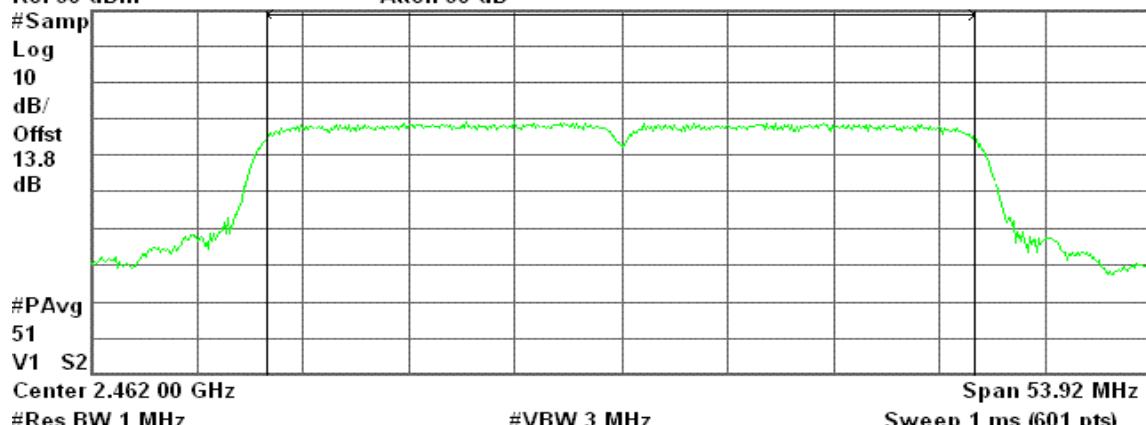
-61.33 dBm/Hz

Average Power (CH High)

Agilent 01:52:36 May 16, 2008

AVG Output Power , g Mode High Ch.

Ref 30 dBm Atten 30 dB



Channel Power

13.60 dBm / 35.9440 MHz

Power Spectral Density

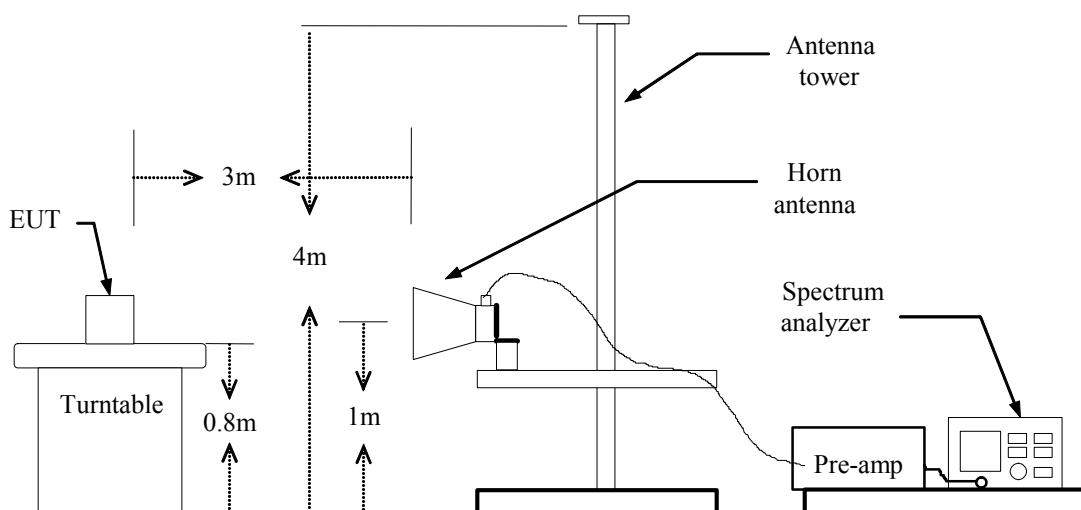
-61.96 dBm/Hz

7.4 BAND EDGES MEASUREMENT

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration

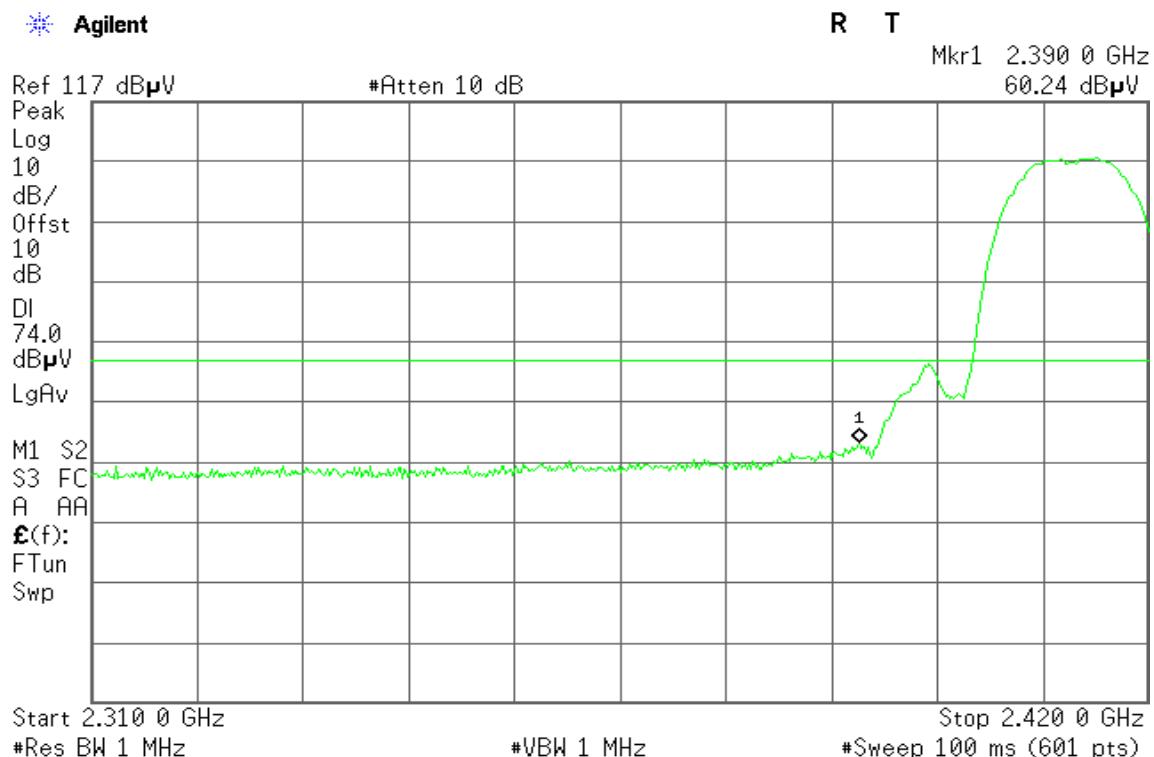
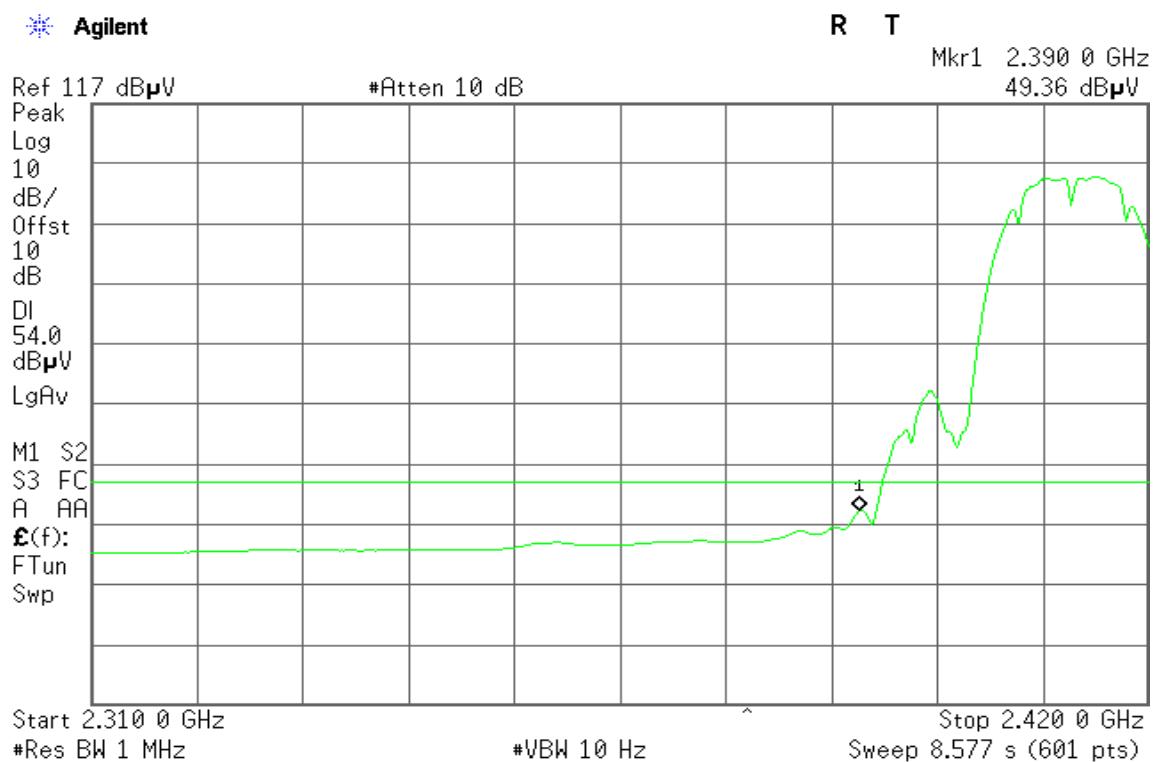


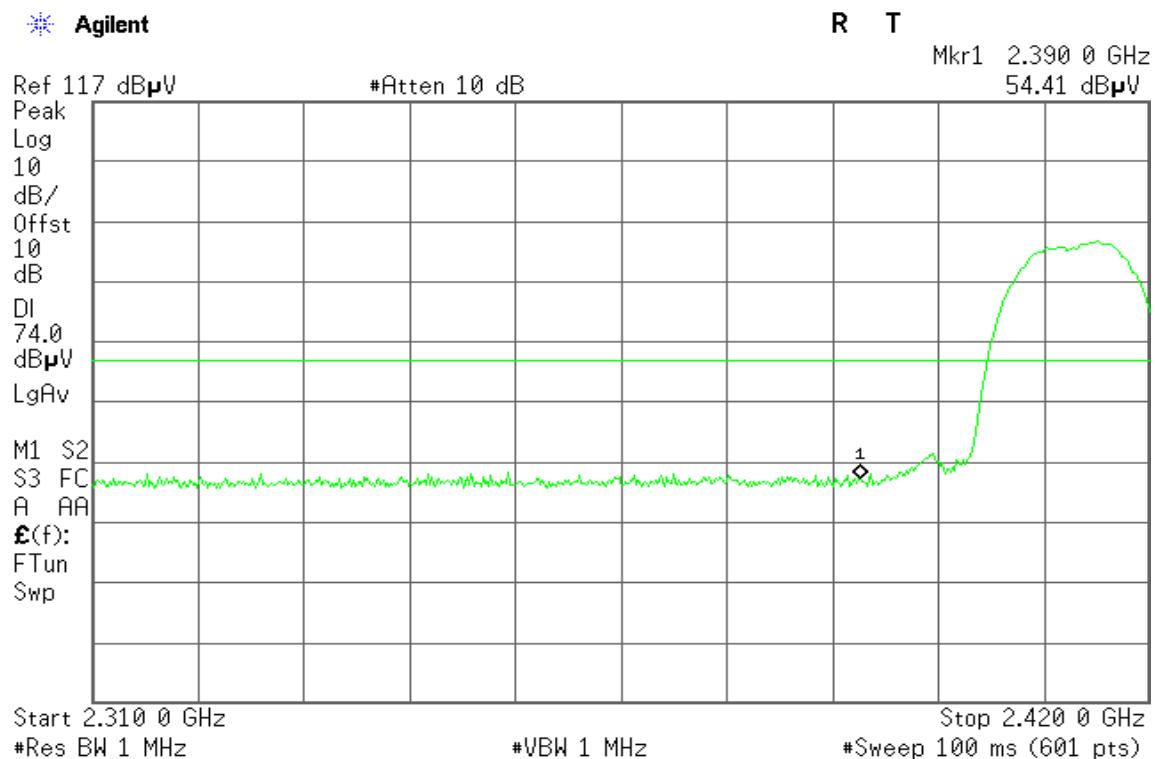
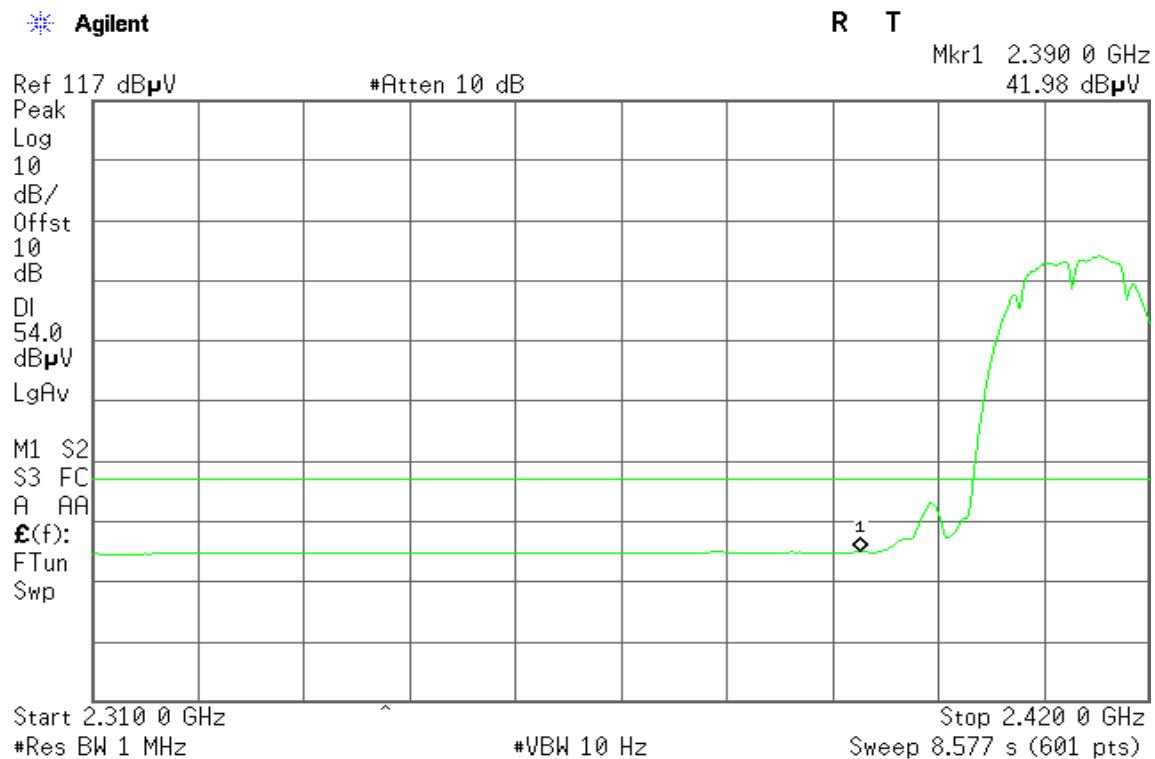
TEST PROCEDURE

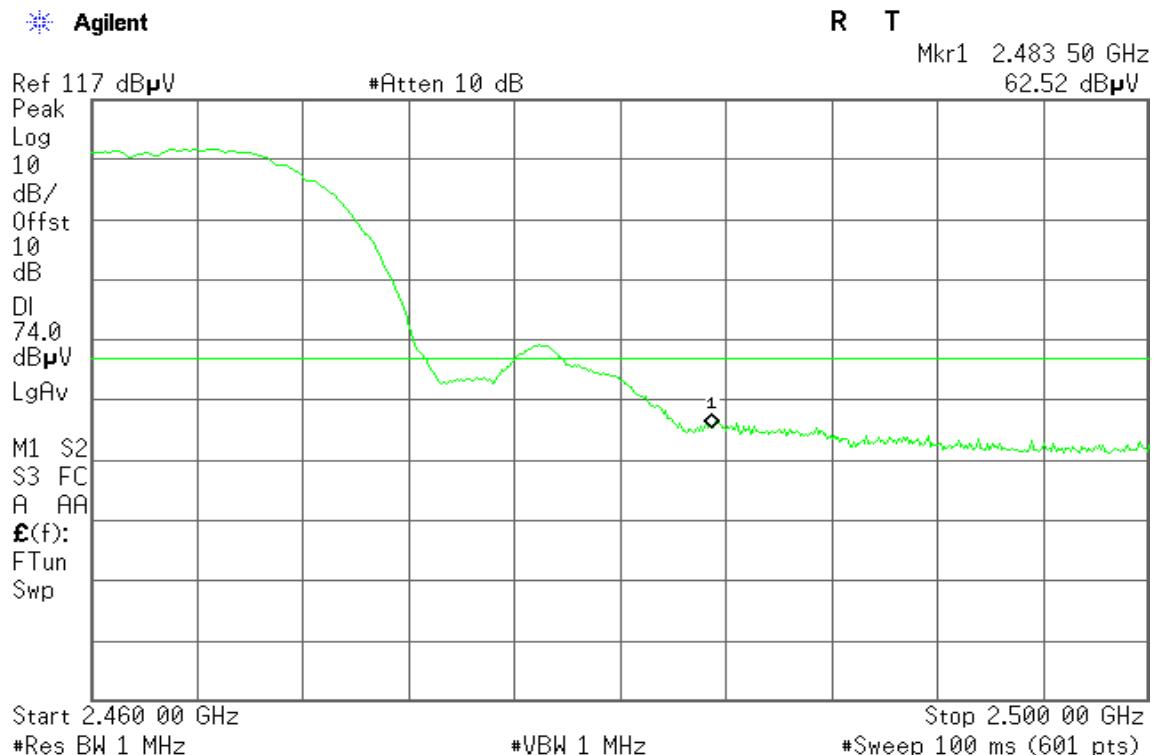
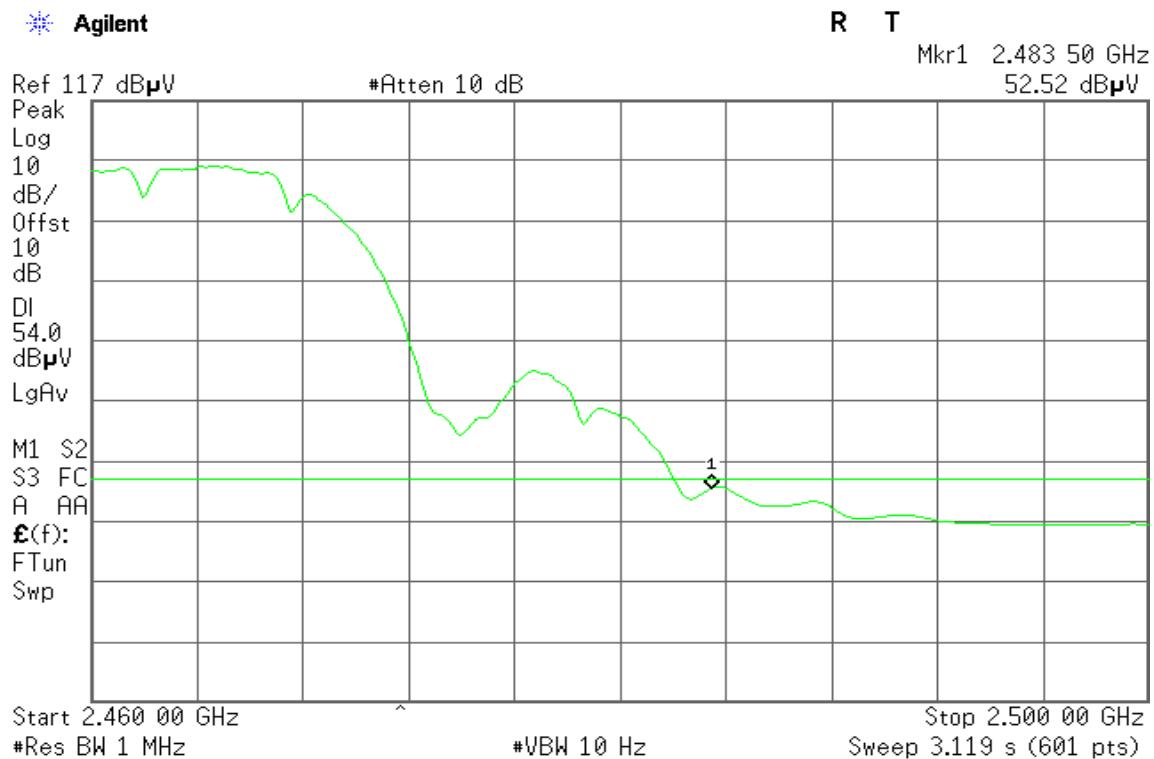
1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

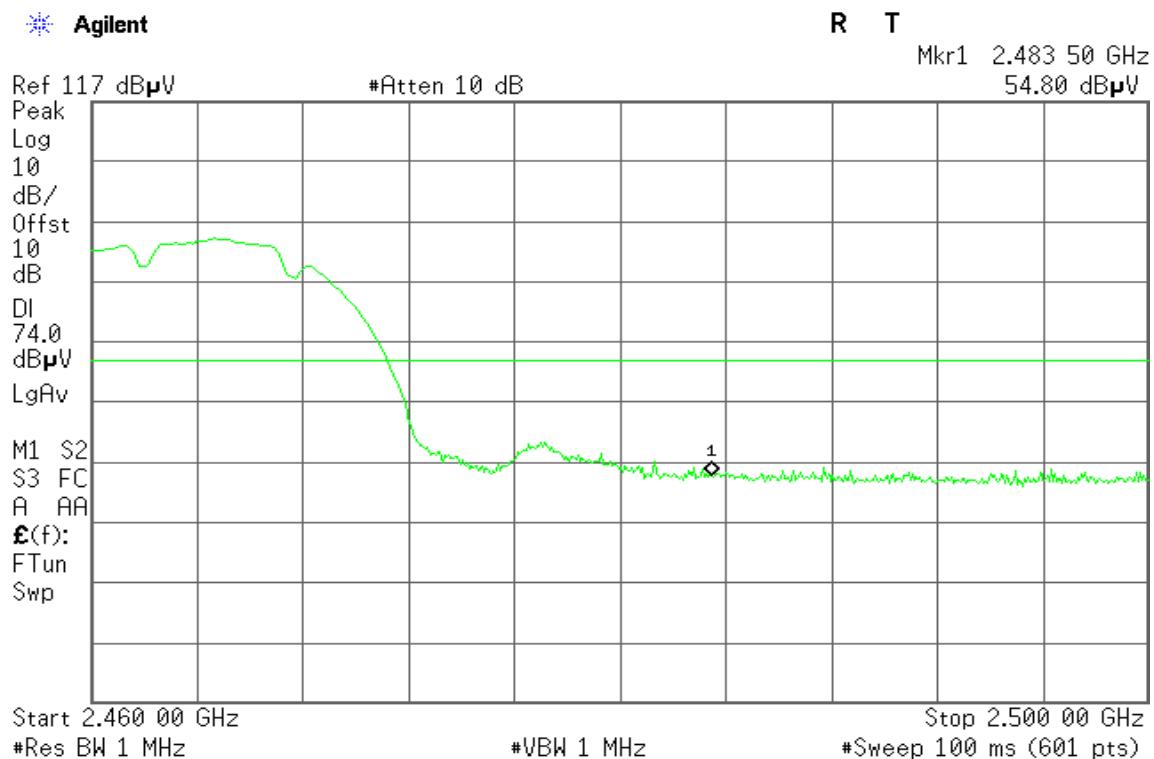
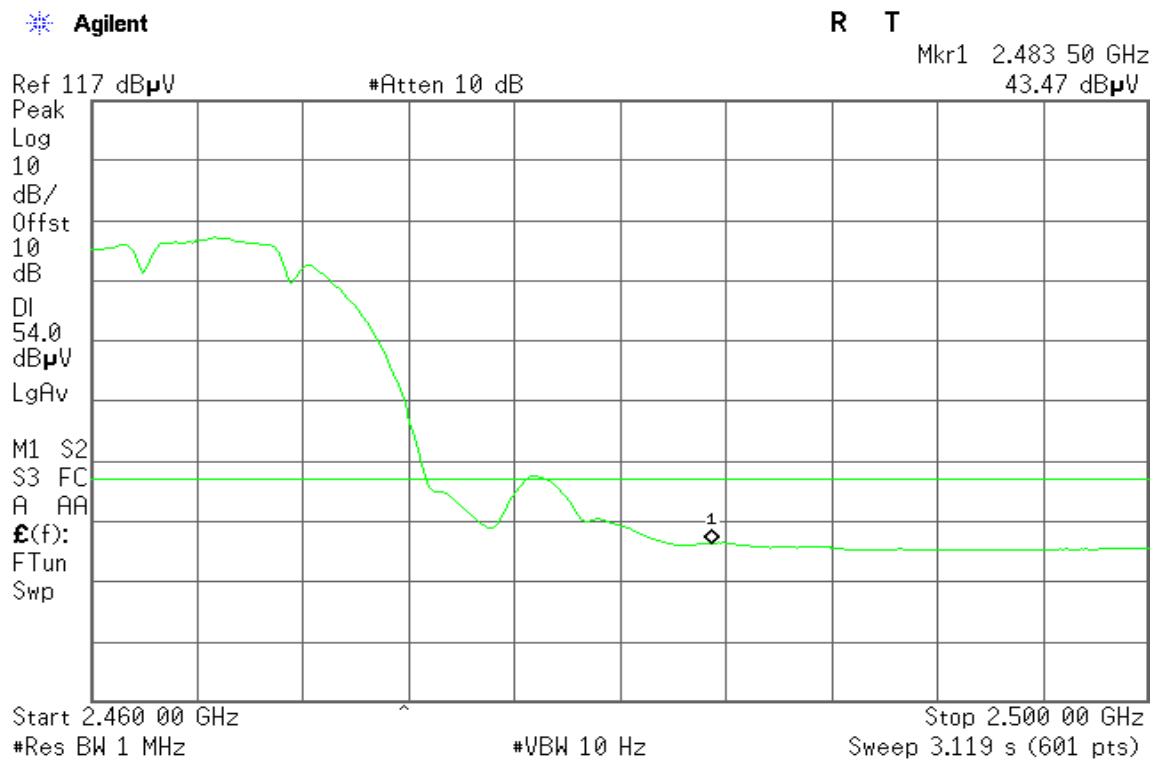
TEST RESULTS

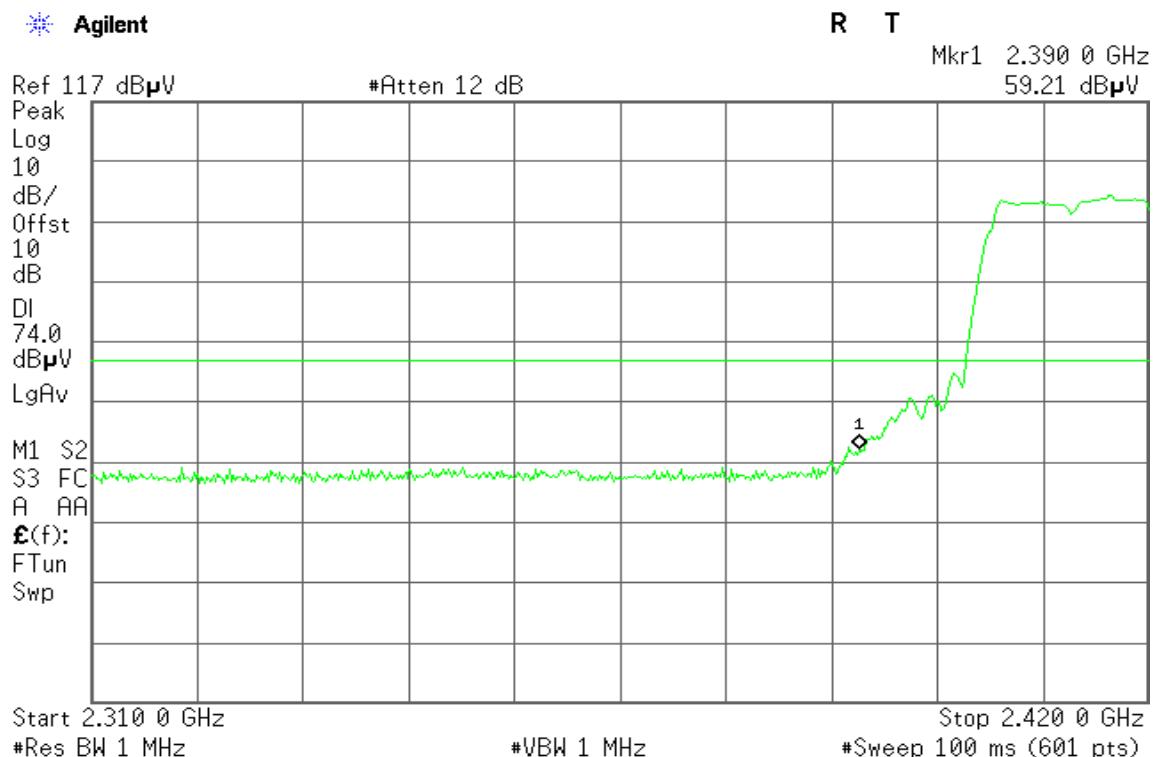
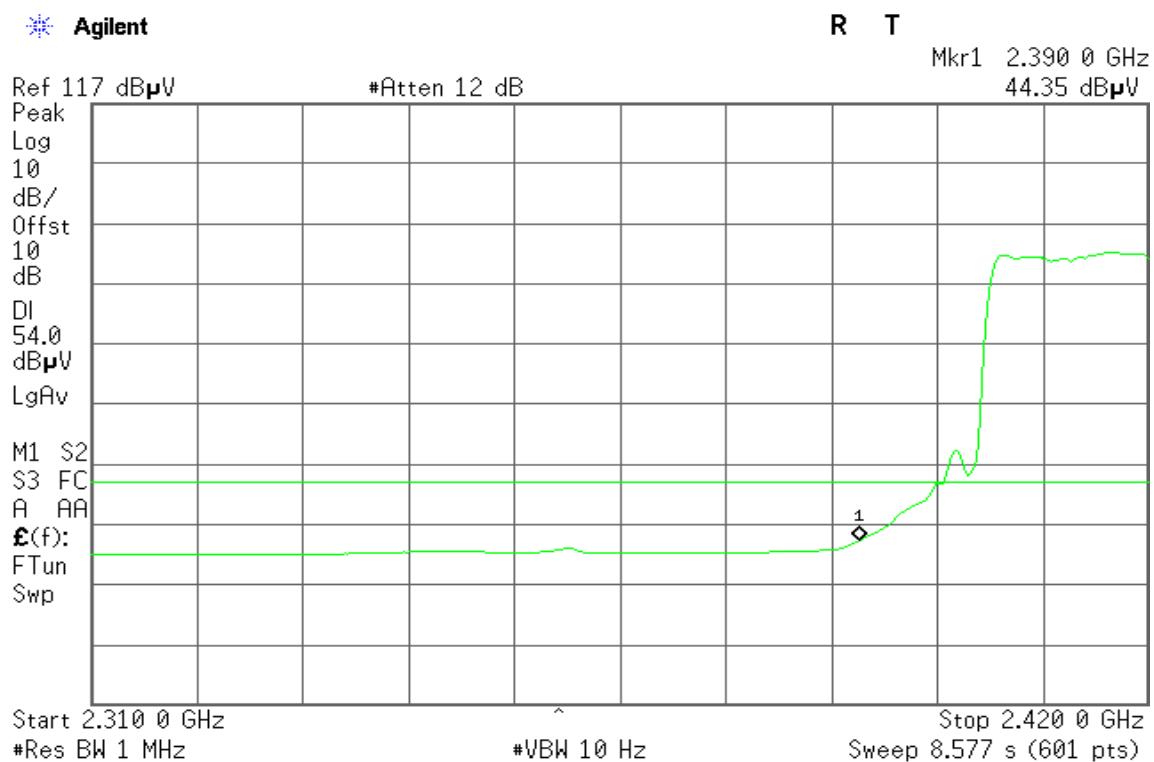
Refer to attach spectrum analyzer data chart.

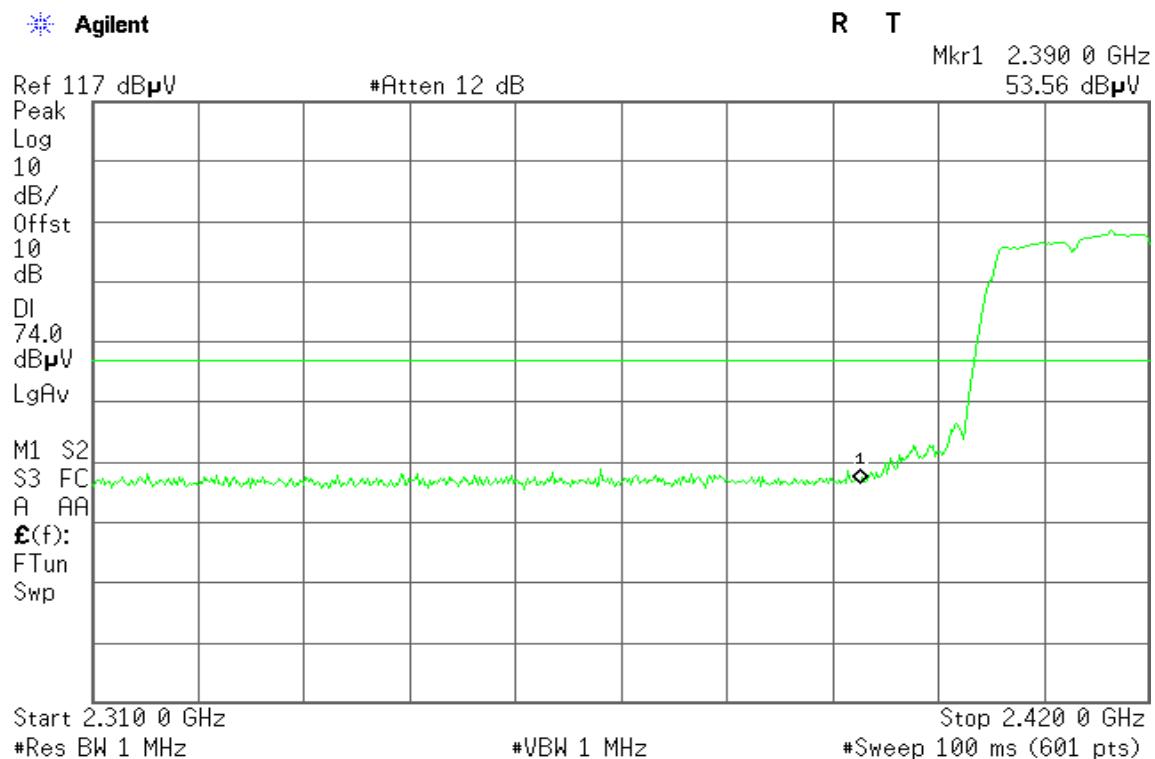
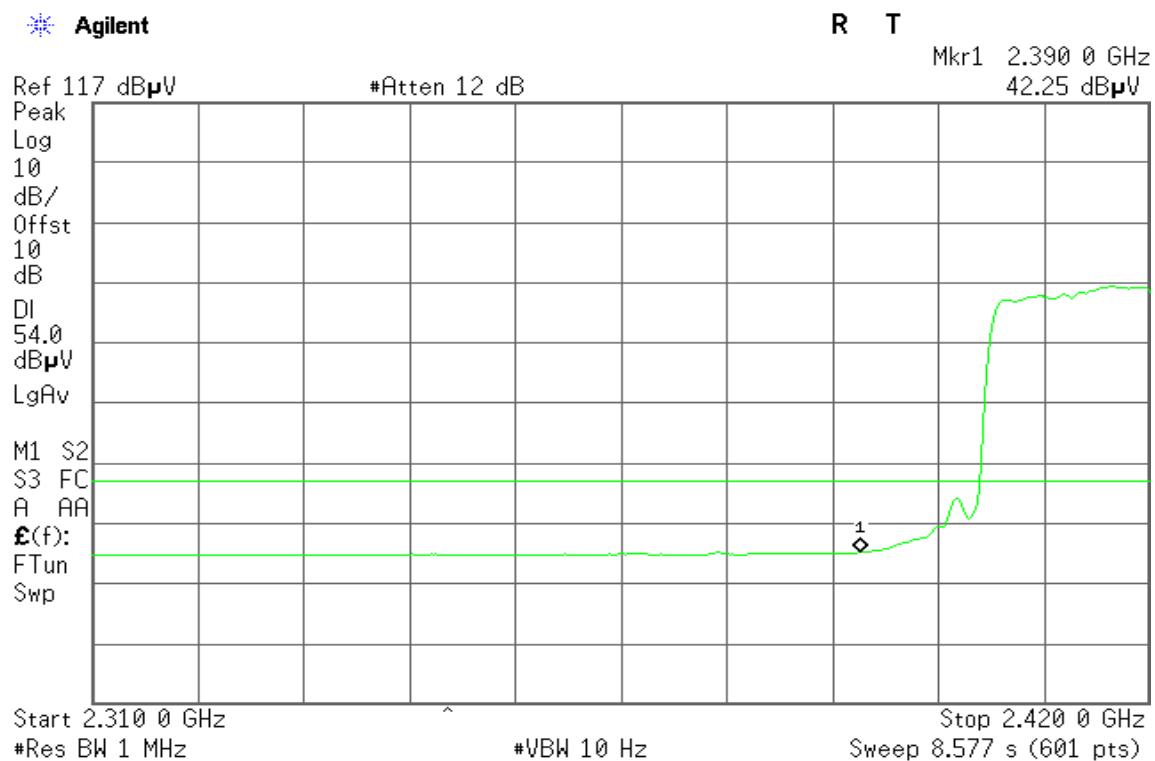
Band Edges (IEEE 802.11b mode / CH Low)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

Band Edges (IEEE 802.11b mode / CH High)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

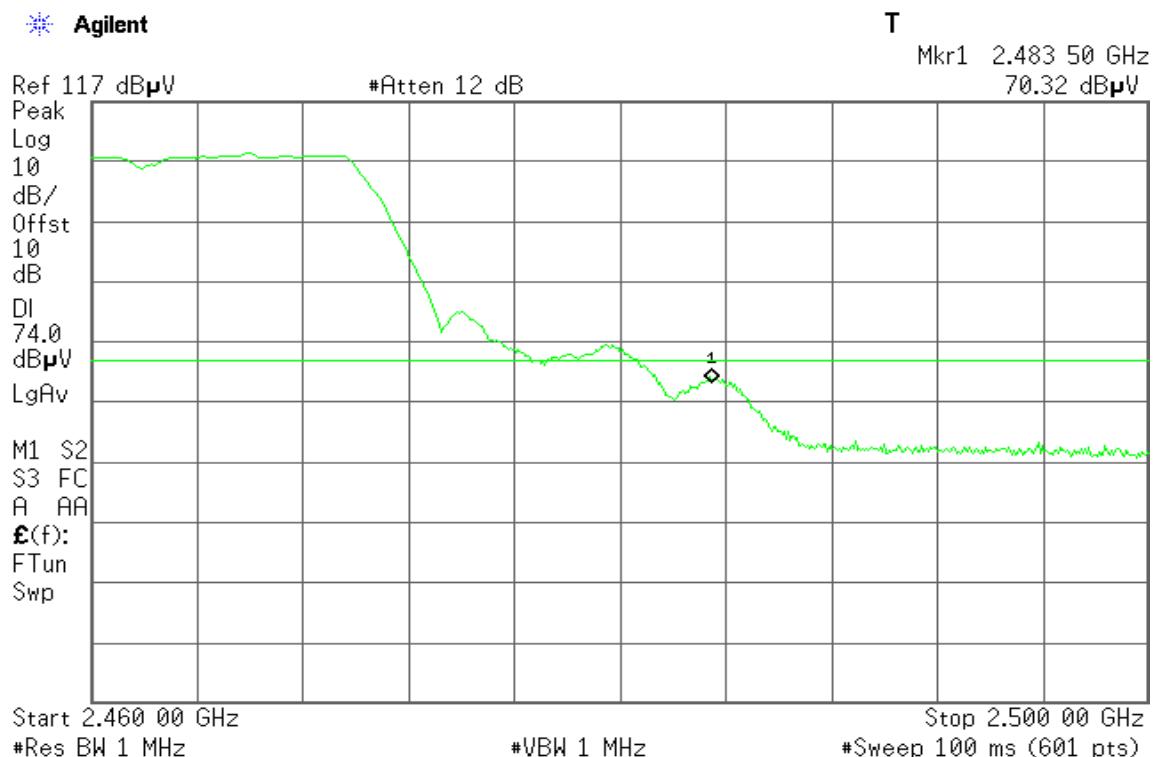
Band Edges (IEEE 802.11g mode / CH Low)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

Band Edges (IEEE 802.11g mode / CH High)

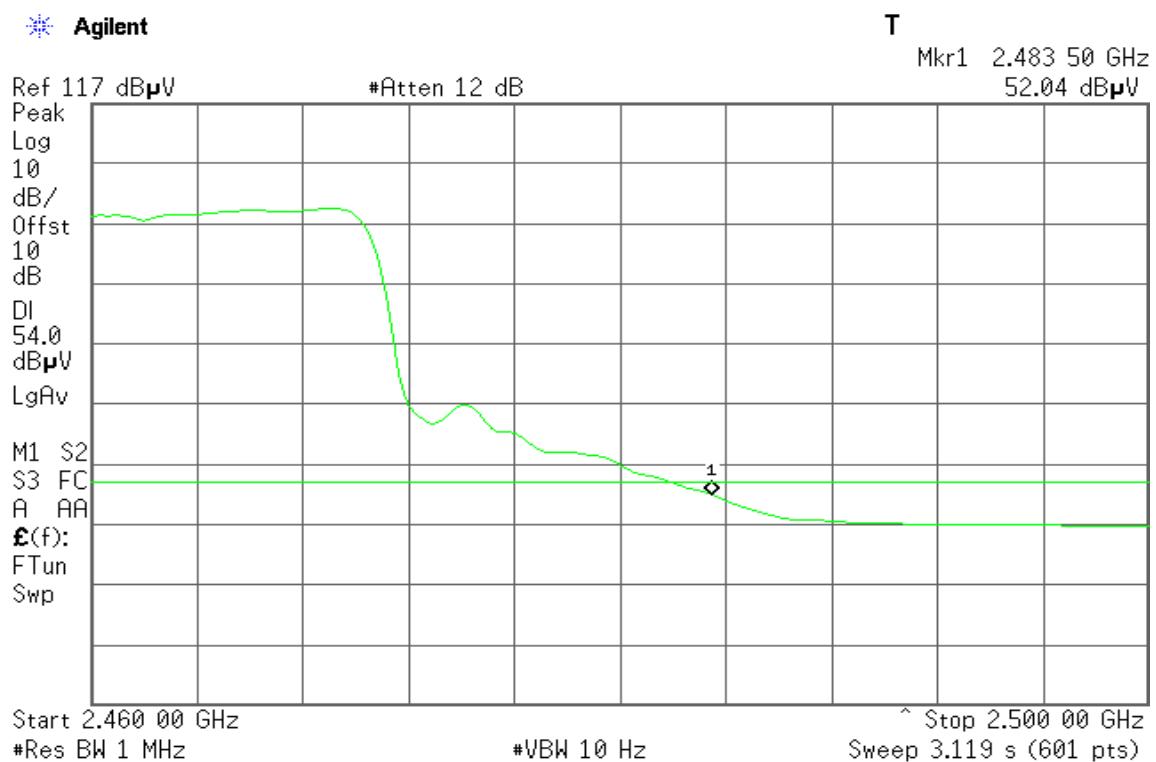
Detector mode: Peak

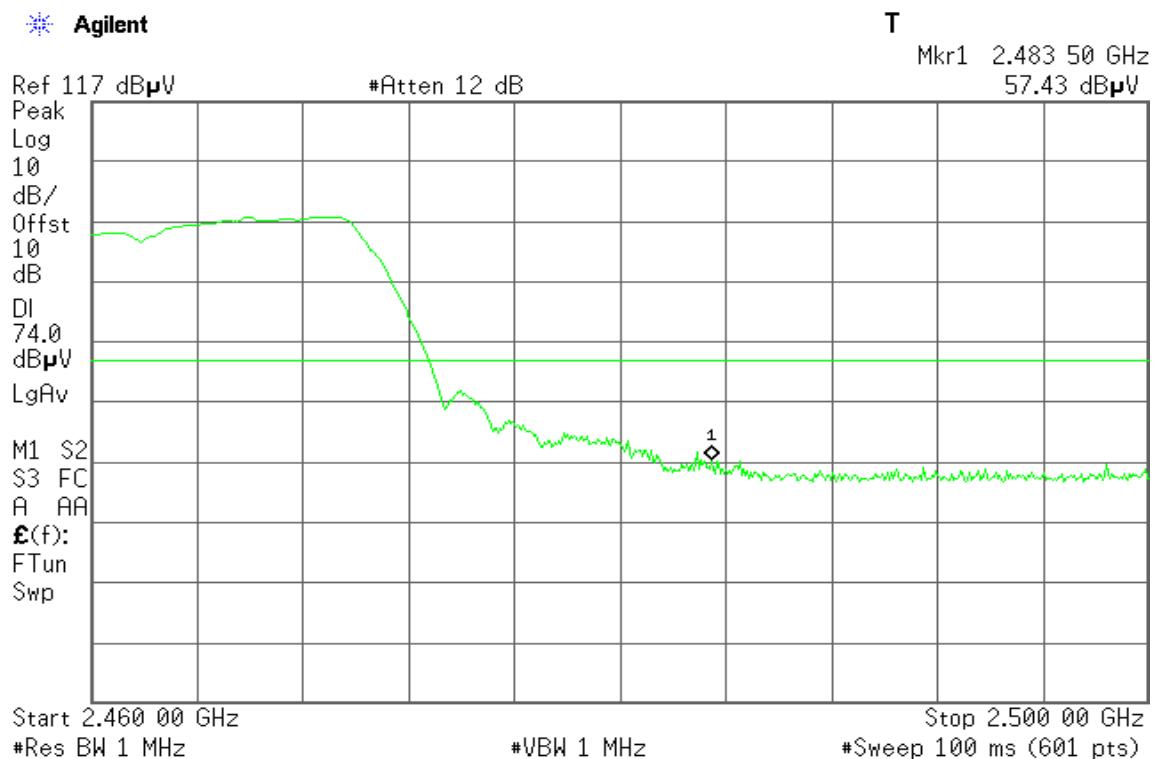
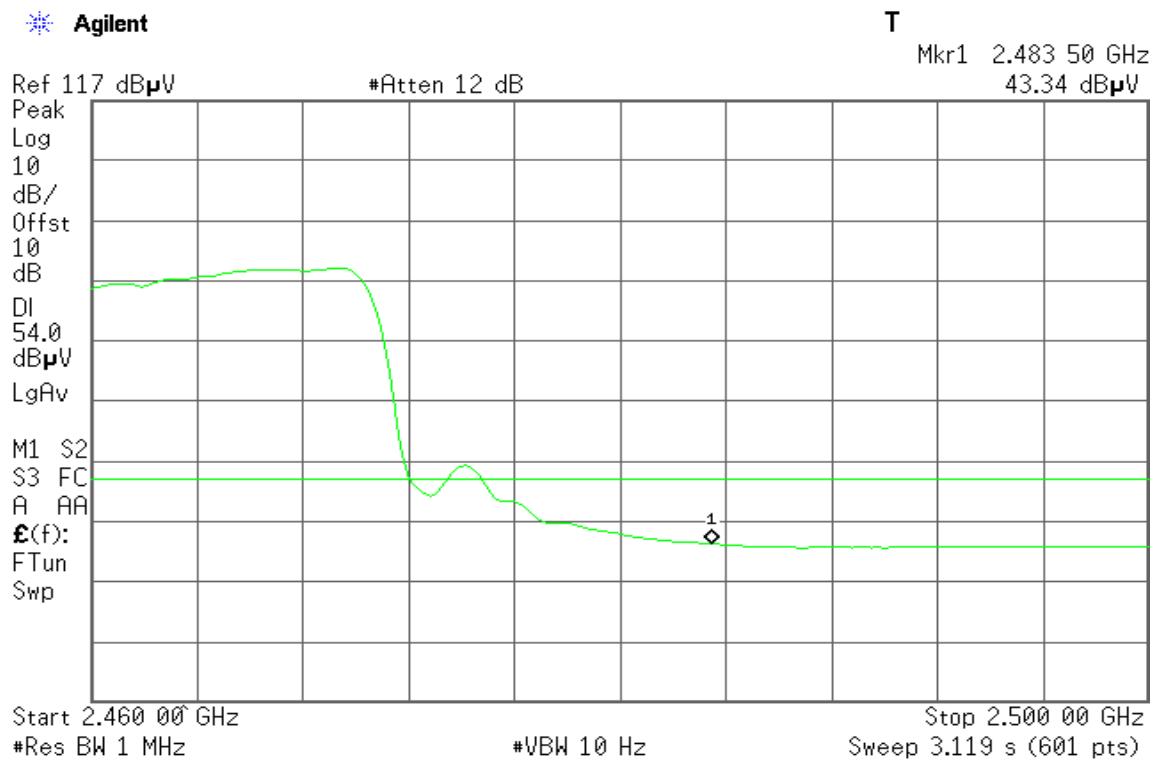
Polarity: Vertical

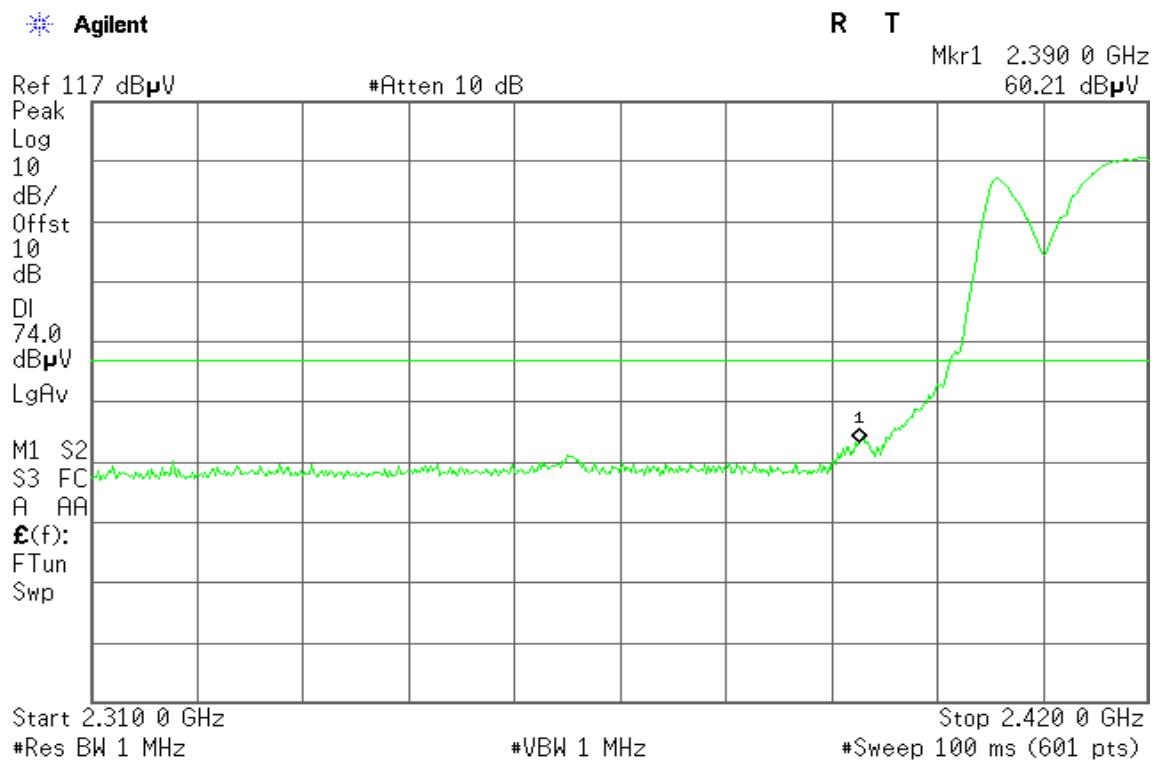
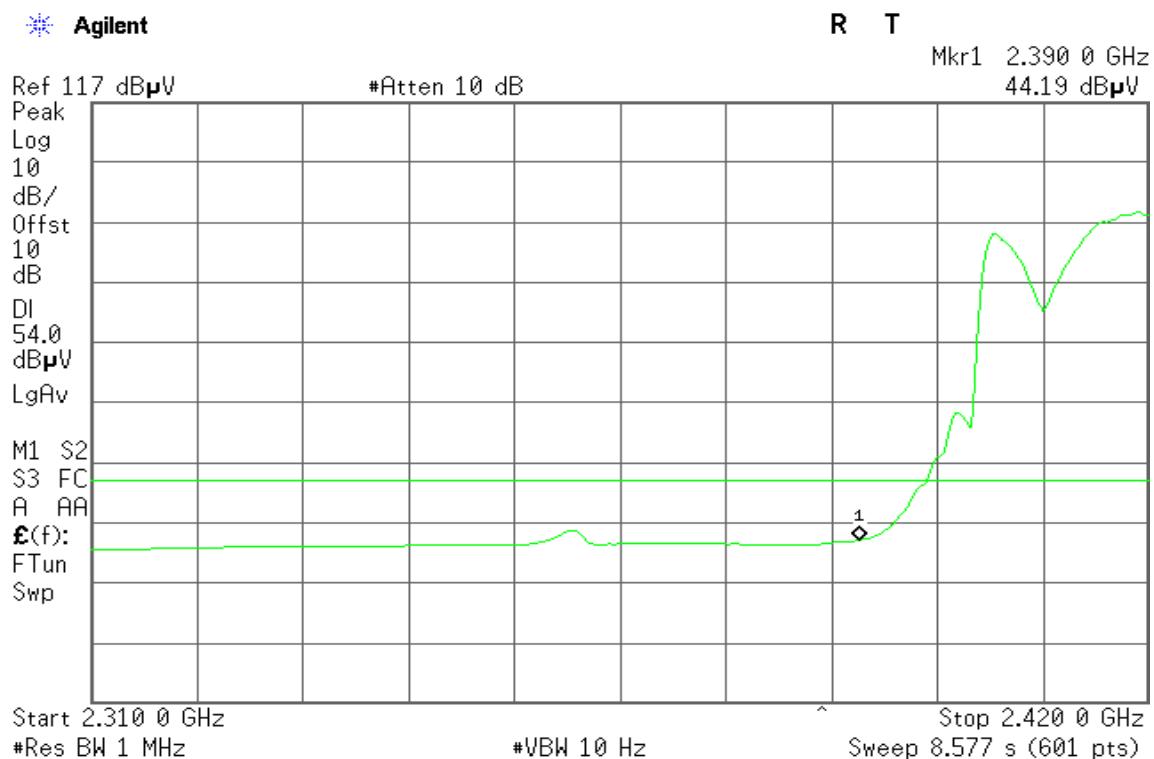


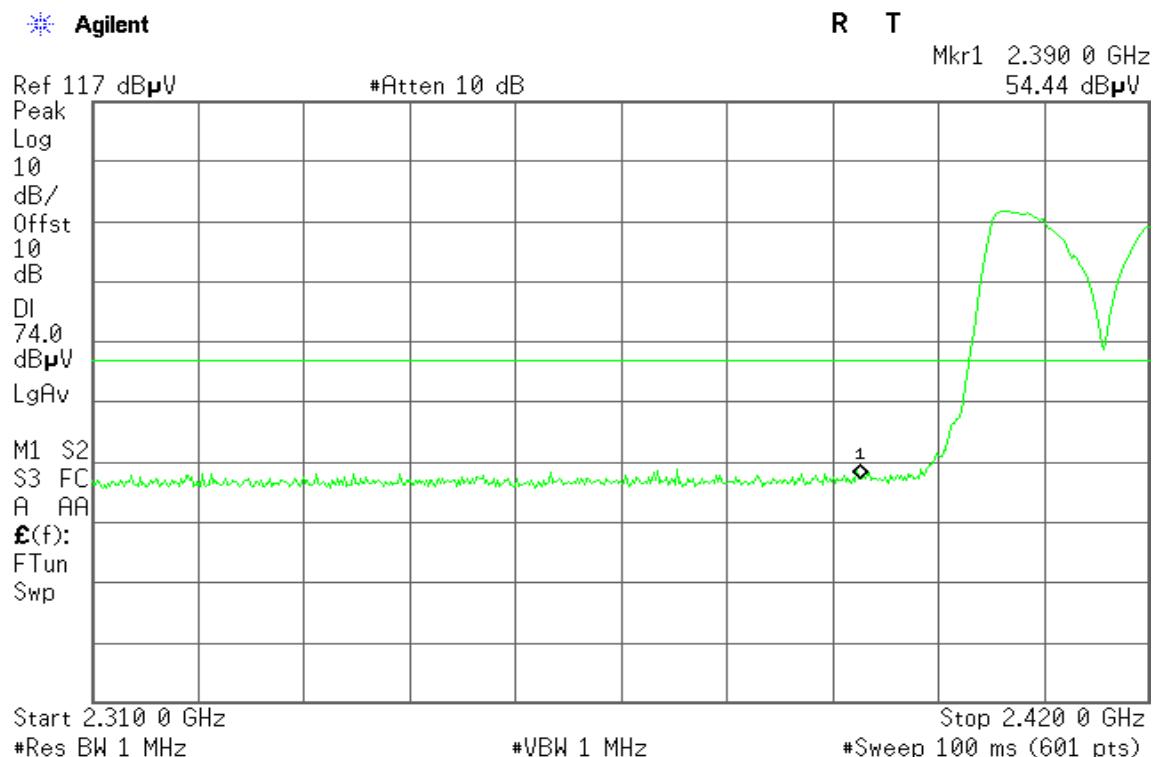
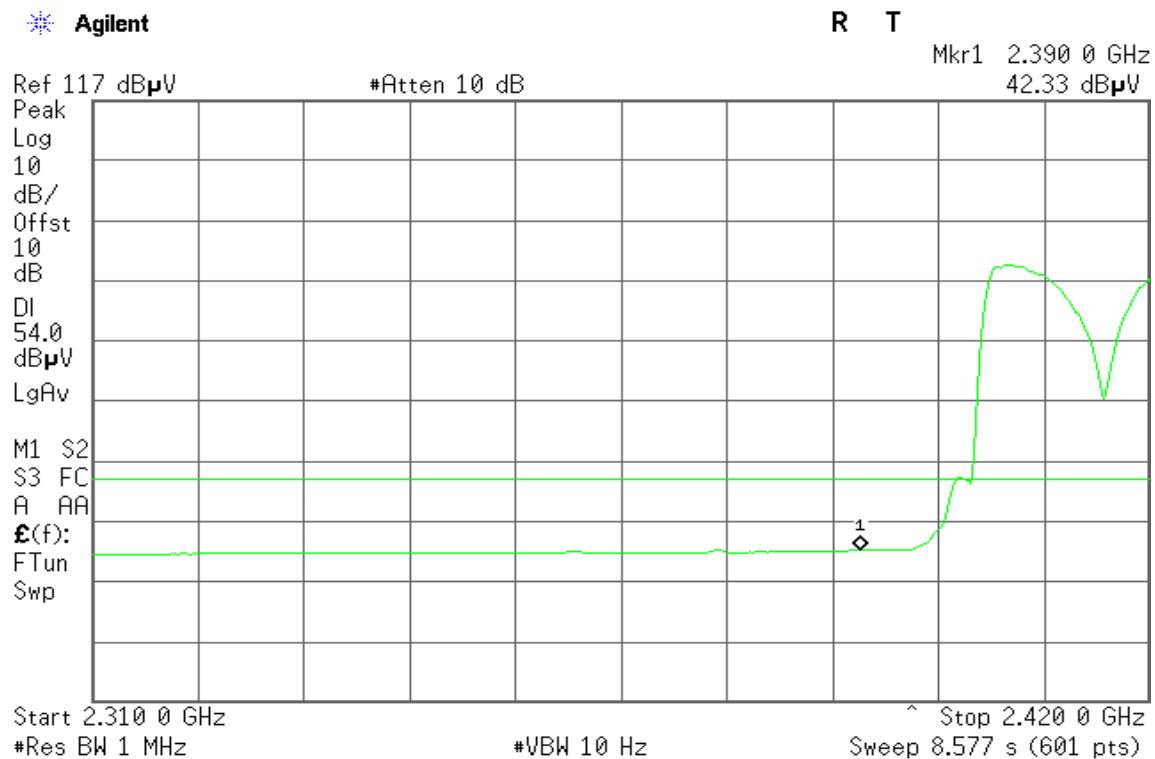
Detector mode: Average

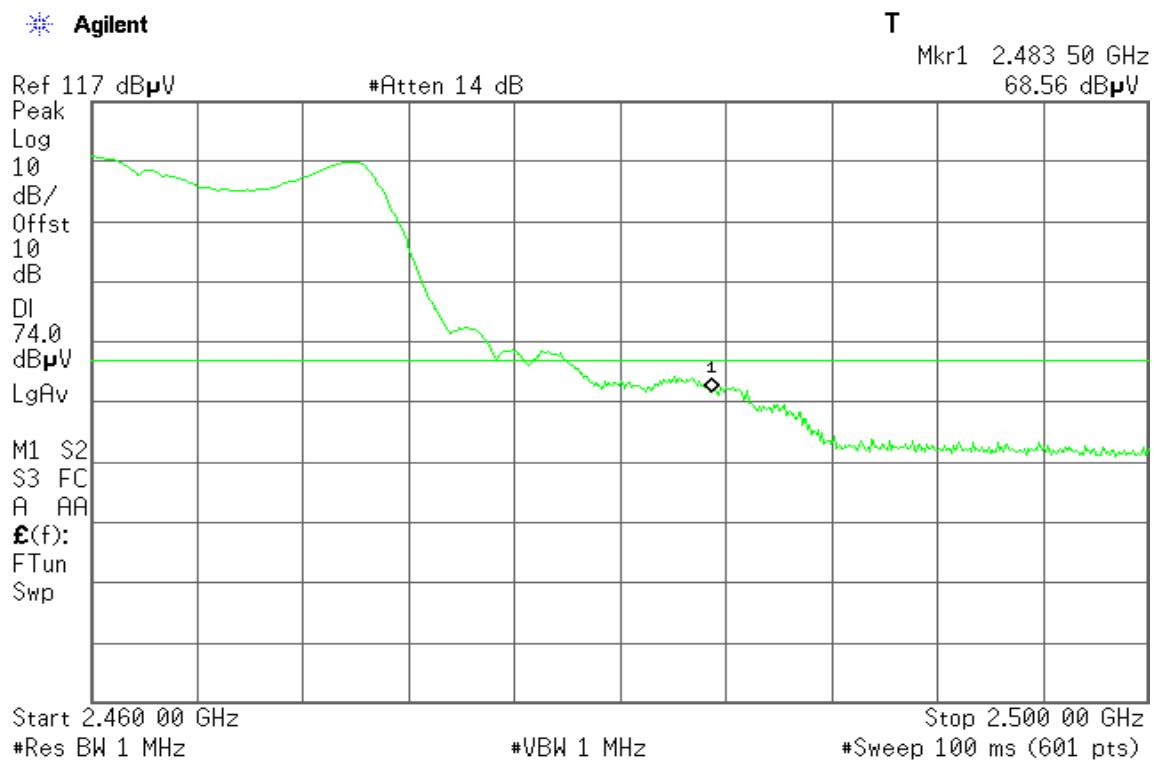
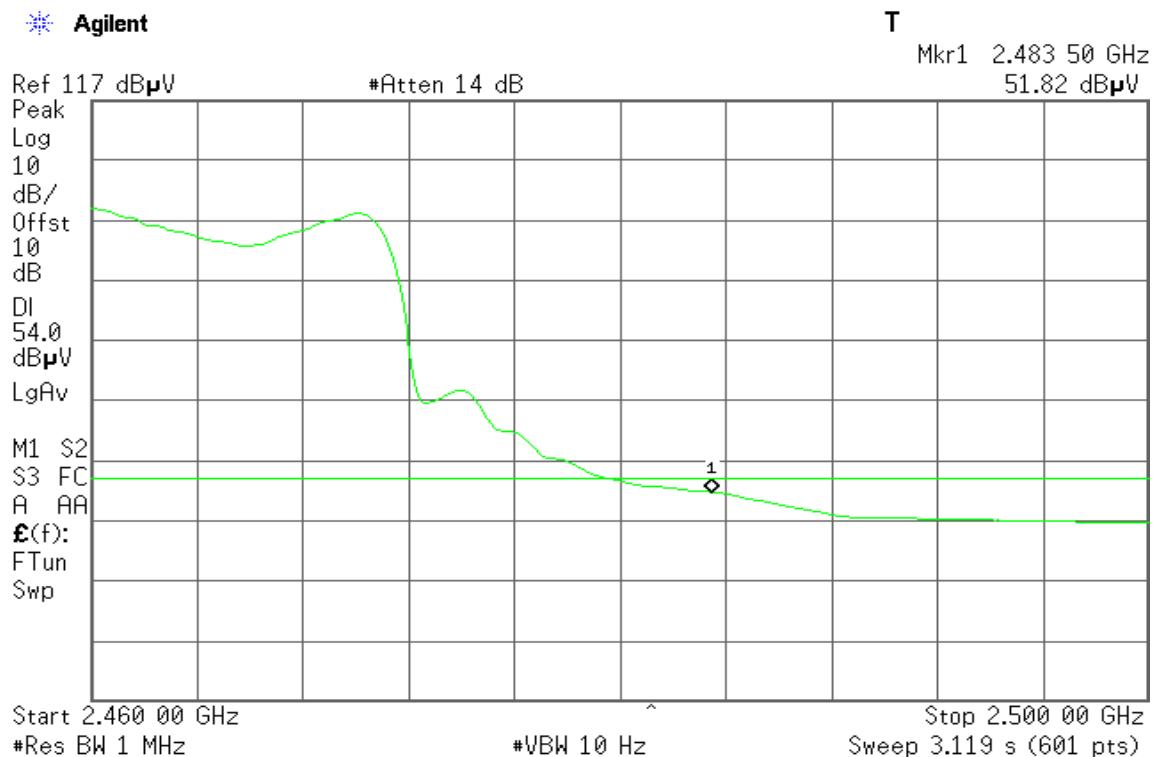
Polarity: Vertical

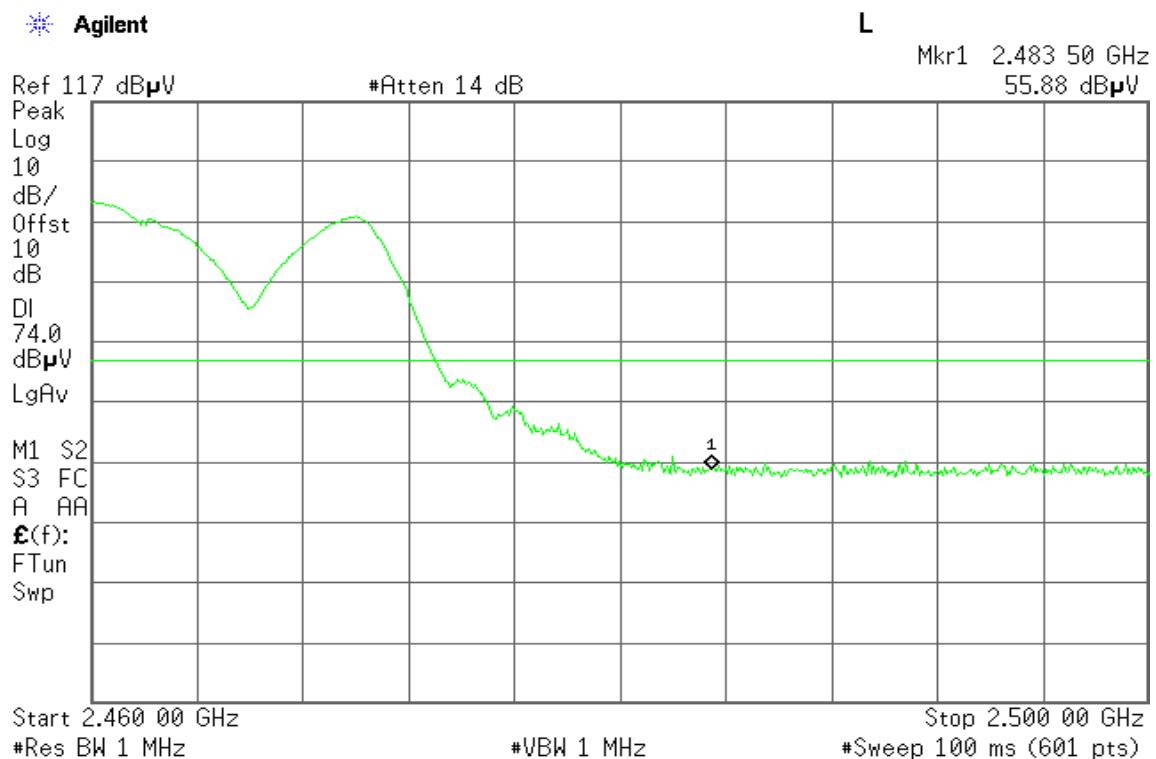
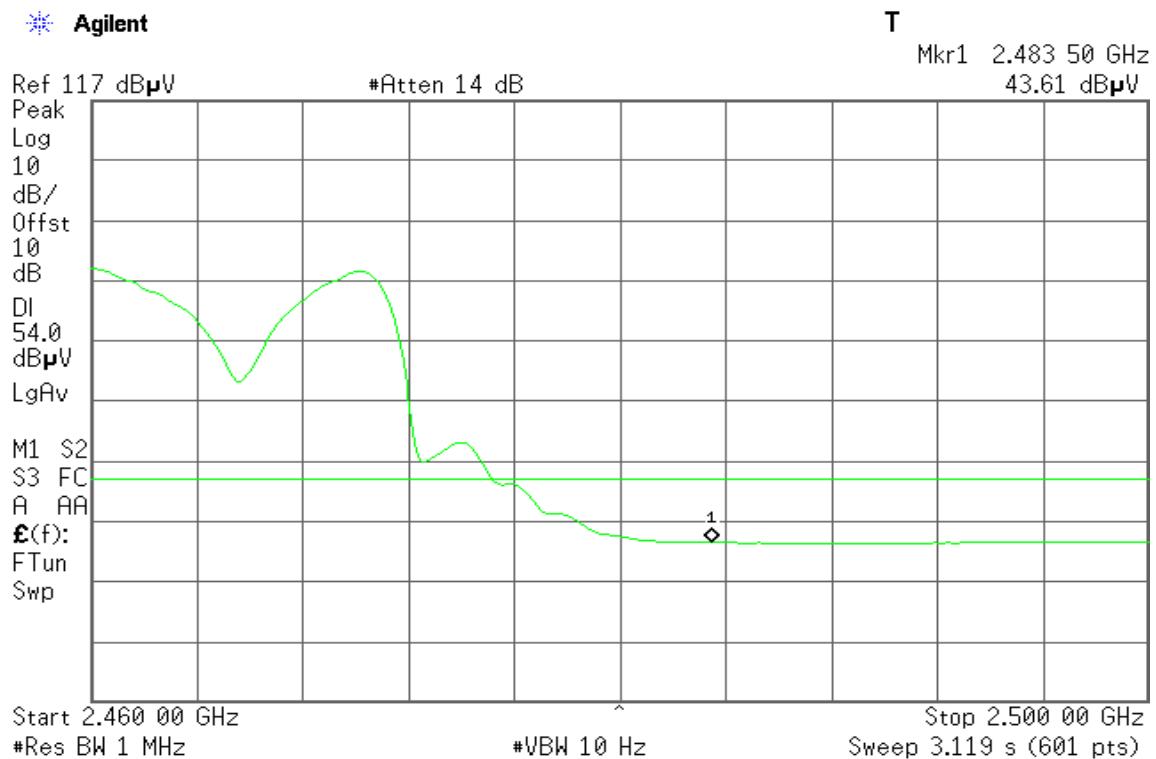


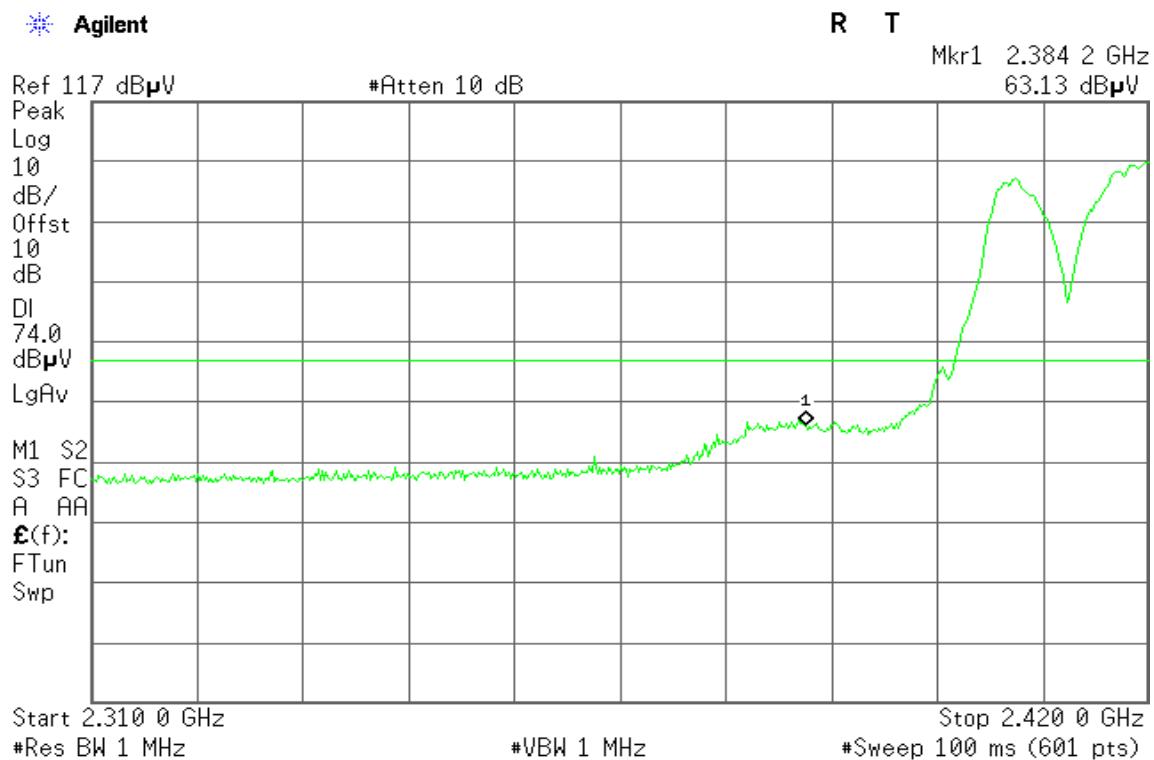
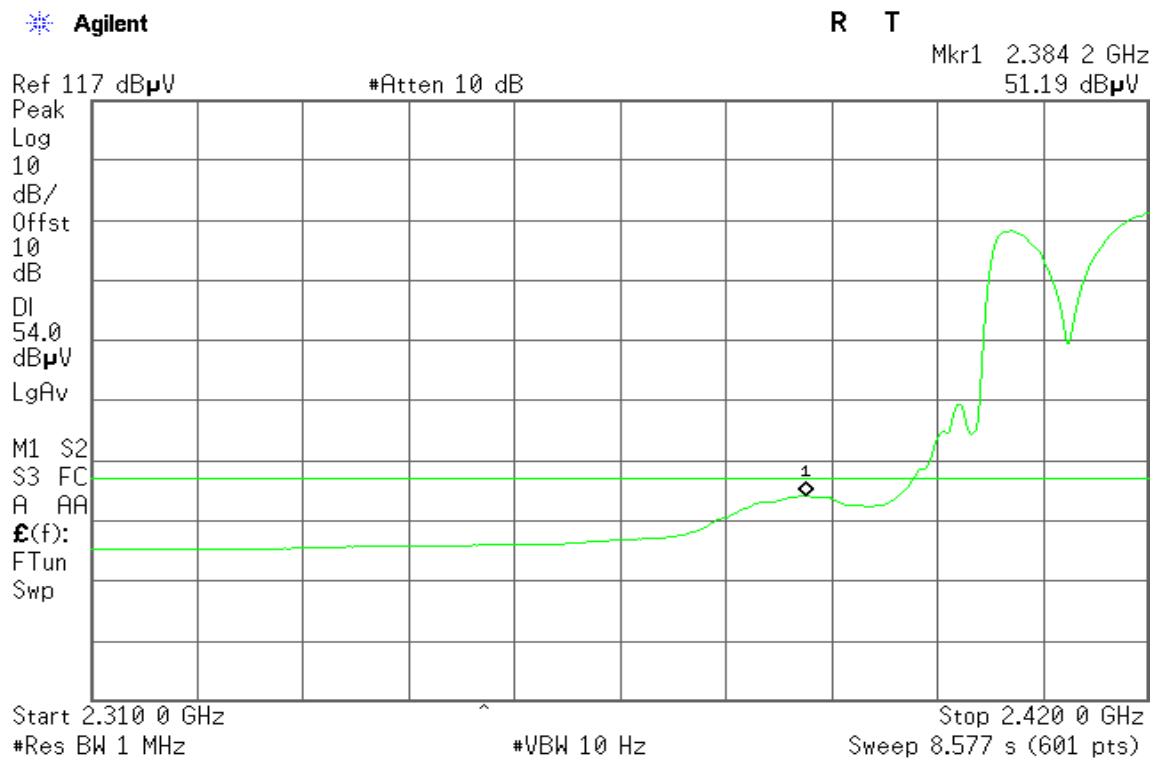
Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

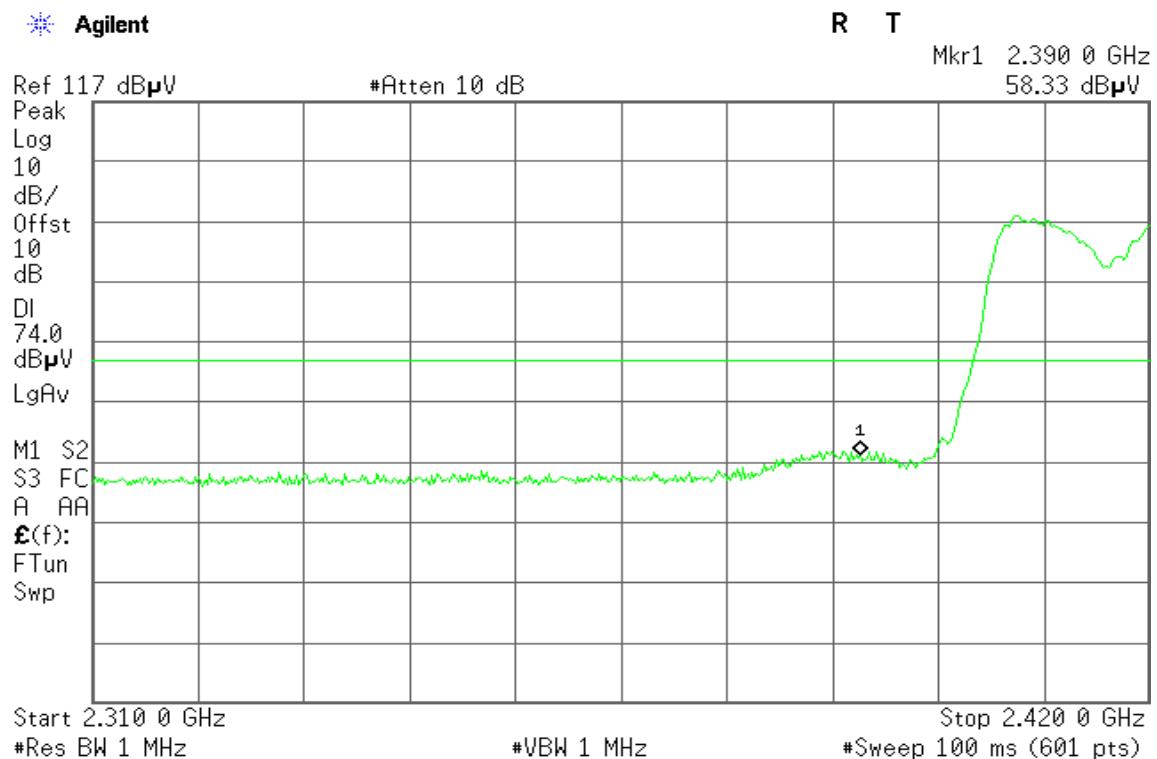
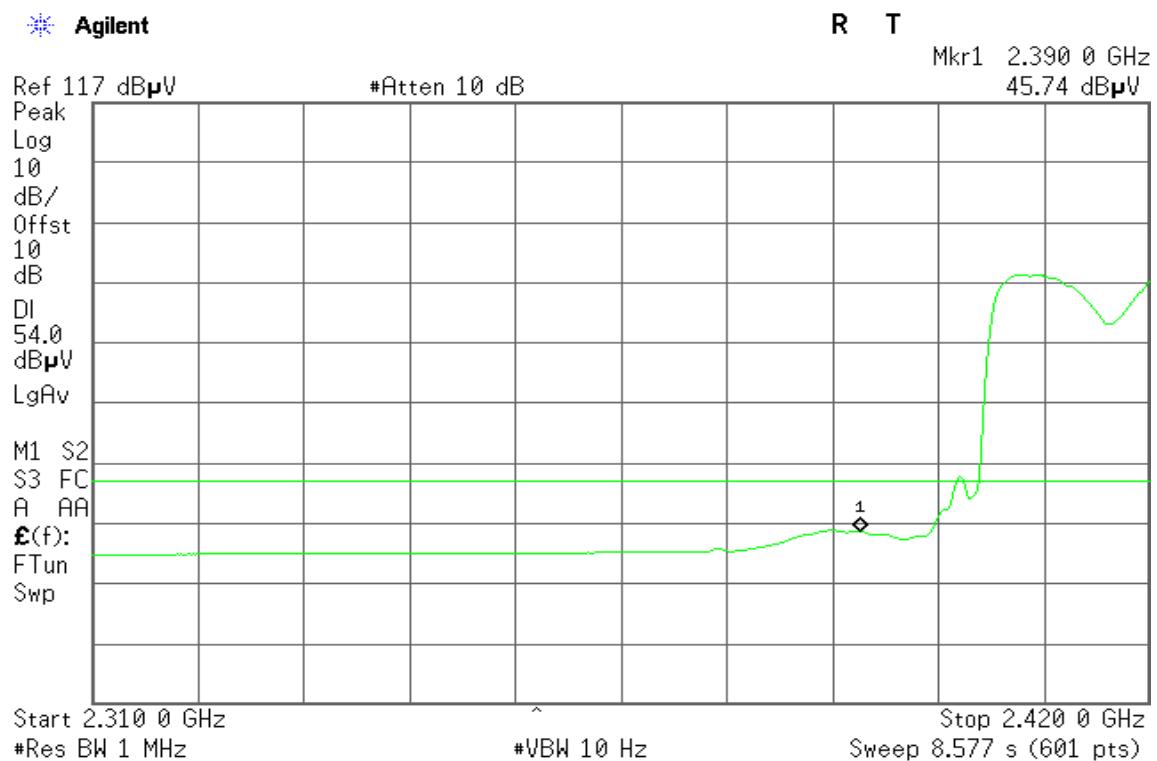
Band Edges (draft 802.11n Standard-20 MHz Channel mode / CH Low)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

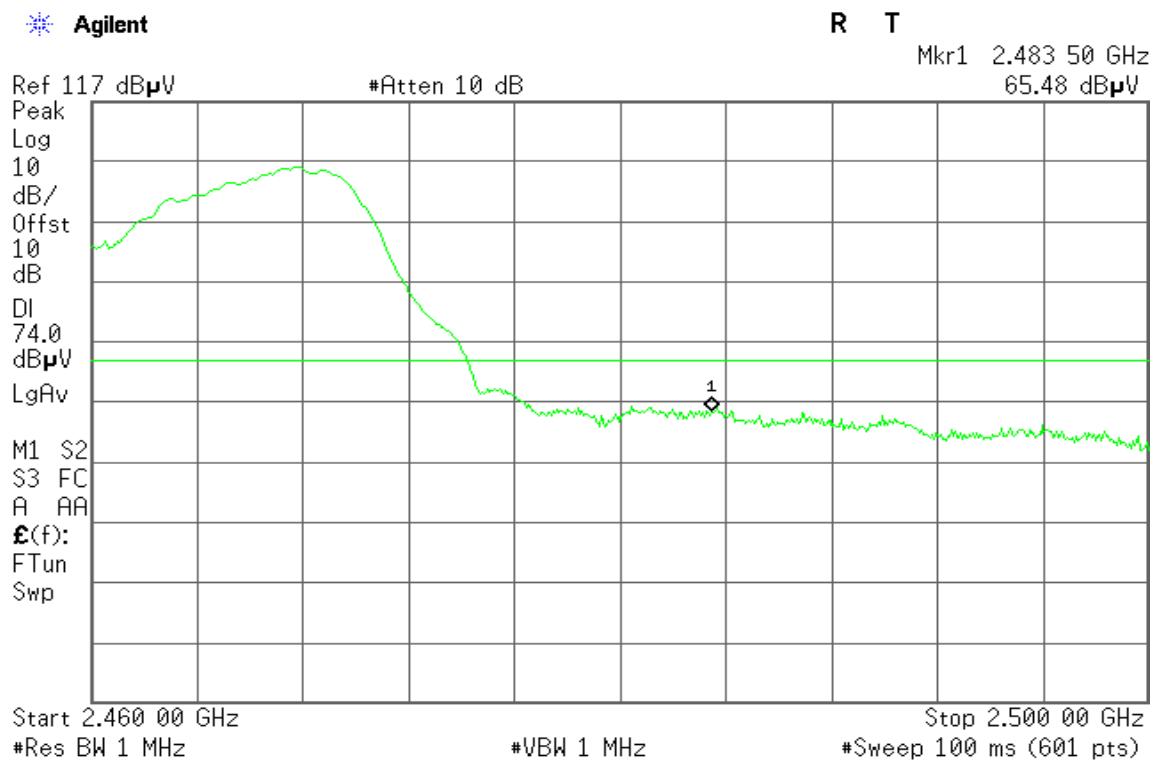
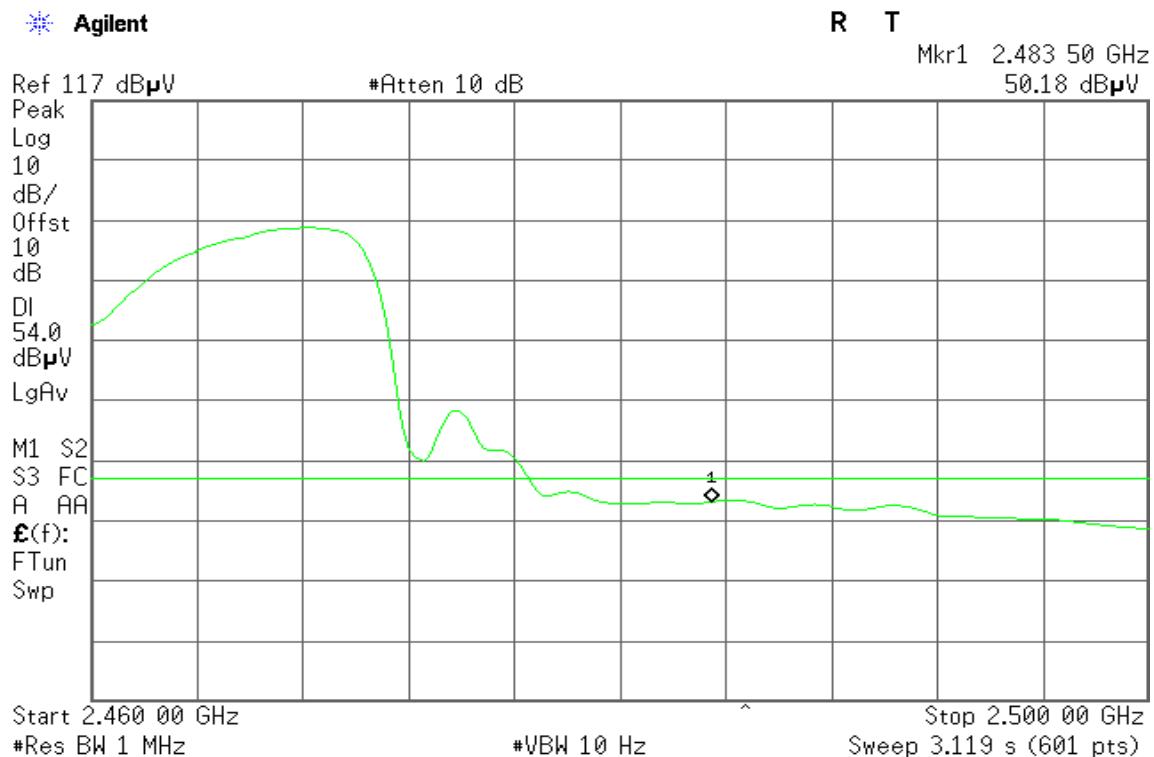
Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

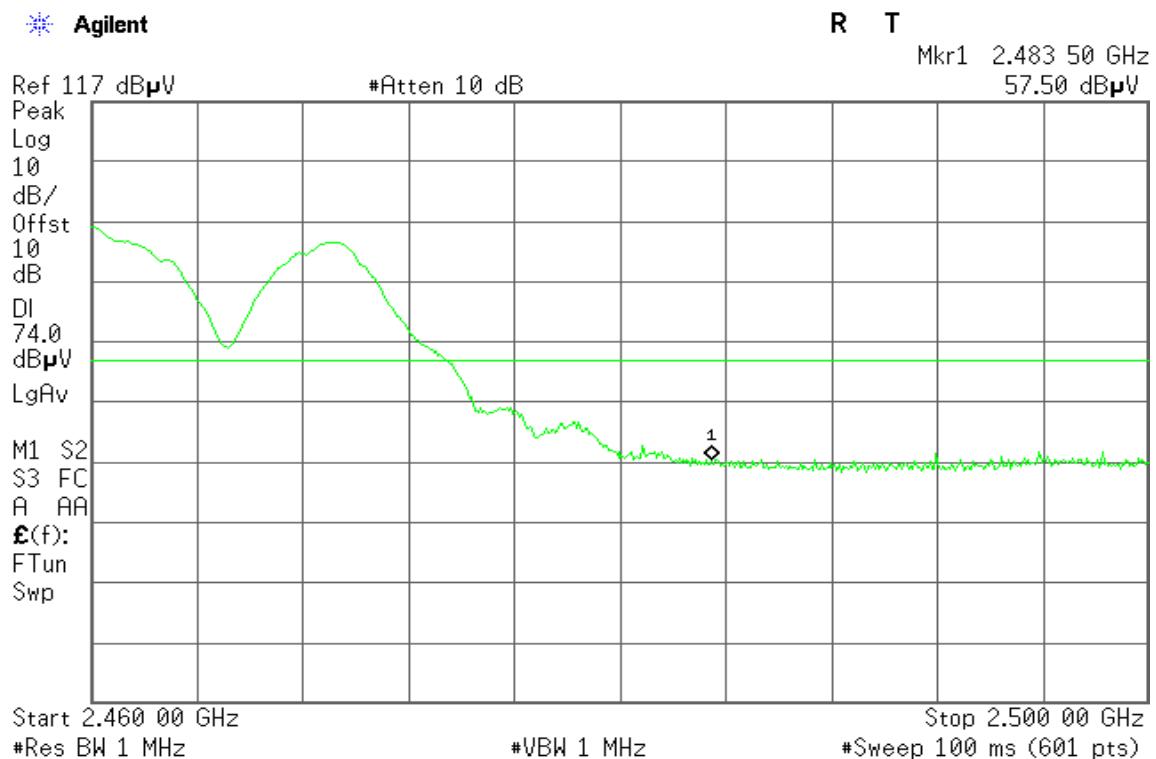
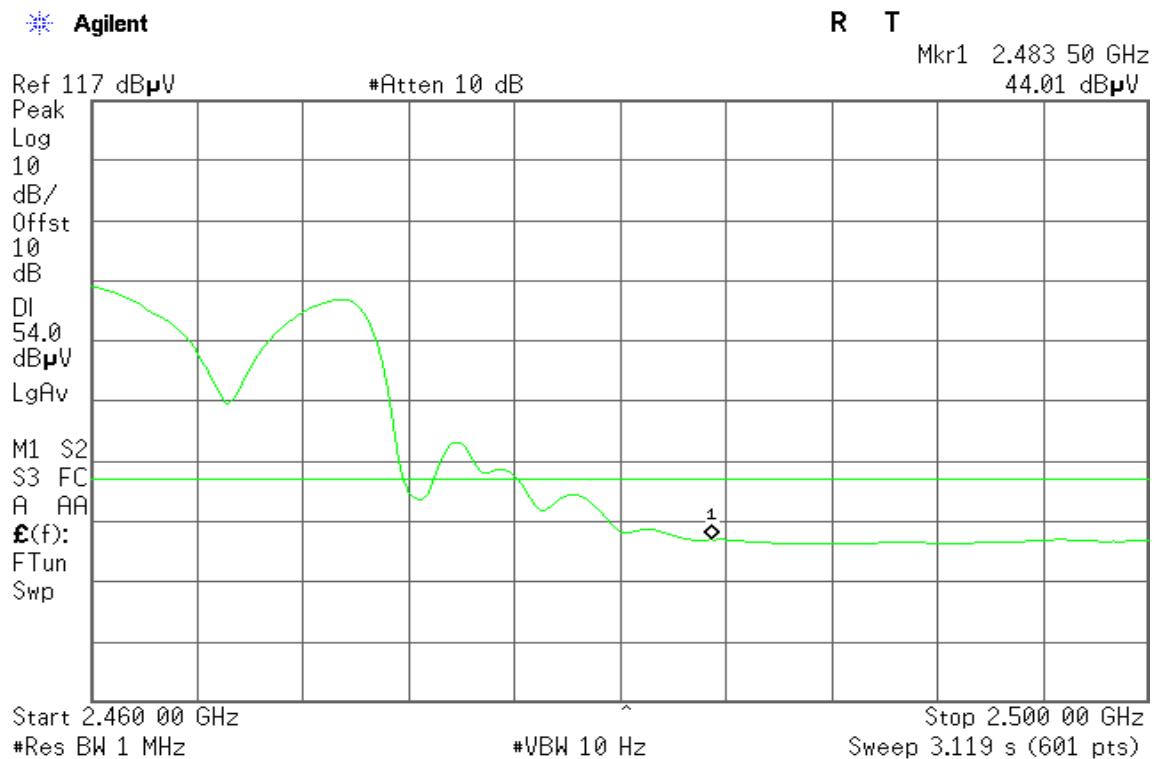
Band Edges (draft 802.11n Standard-20 MHz Channel mode / CH High)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

Band Edges (draft 802.11n Wide-40 MHz Channel mode / CH Low)**Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**

Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

Band Edges (draft 802.11n Wide-40 MHz Channel mode / CH High)
Detector mode: Peak
Polarity: Vertical

Detector mode: Average
Polarity: Vertical


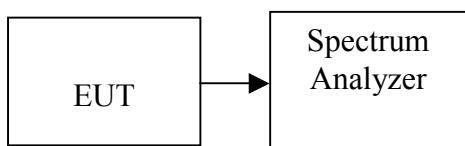
Detector mode: Peak**Polarity: Horizontal****Detector mode: Average****Polarity: Horizontal**

7.5 PEAK POWER SPECTRAL DENSITY

LIMIT

1. According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

Test Configuration



TEST PROCEDURE

1. Place the EUT on the table and set it in transmitting mode. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3 kHz, VBW = 10 kHz, Span = 300 kHz, Sweep time = 100 s
3. Record the max reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.

TEST RESULTS

No non-compliance noted



Test Data

Test mode: IEEE 802.11b

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-18.79	8.00	PASS
Mid	2437	-17.92		PASS
High	2462	-17.49		PASS

Test mode: IEEE 802.11g

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-18.91	8.00	PASS
Mid	2437	-17.89		PASS
High	2462	-17.61		PASS

Test mode: draft 802.11n Standard-20 MHz Channel mode

Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 2 PPSD (dBm)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-13.12	-16.44	-11.46	8.00	PASS
Mid	2437	-12.76	-13.93	-10.30		PASS
High	2462	-14.03	-14.36	-11.18		PASS

Test mode: draft 802.11n Wide-40 MHz Channel mode

Channel	Frequency (MHz)	Chain 0 PPSD (dBm)	Chain 2 PPSD (dBm)	PPSD (dBm)	Limit (dBm)	Result
Low	2422	-15.45	-16.06	-12.73	8.00	PASS
Mid	2437	-15.26	-16.85	-12.97		PASS
High	2452	-14.62	-16.34	-12.39		PASS

*Remark: Total PPSD (dBm) = 10*LOG(10^(Chain 0 PPSD / 10)+10^(Chain 2 PPSD / 10))*

**Test mode: draft 802.11n Standard-20 MHz Channel mode with combiner**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-13.50	8.00	PASS
Mid	2437	-12.76		PASS
High	2462	-12.68		PASS

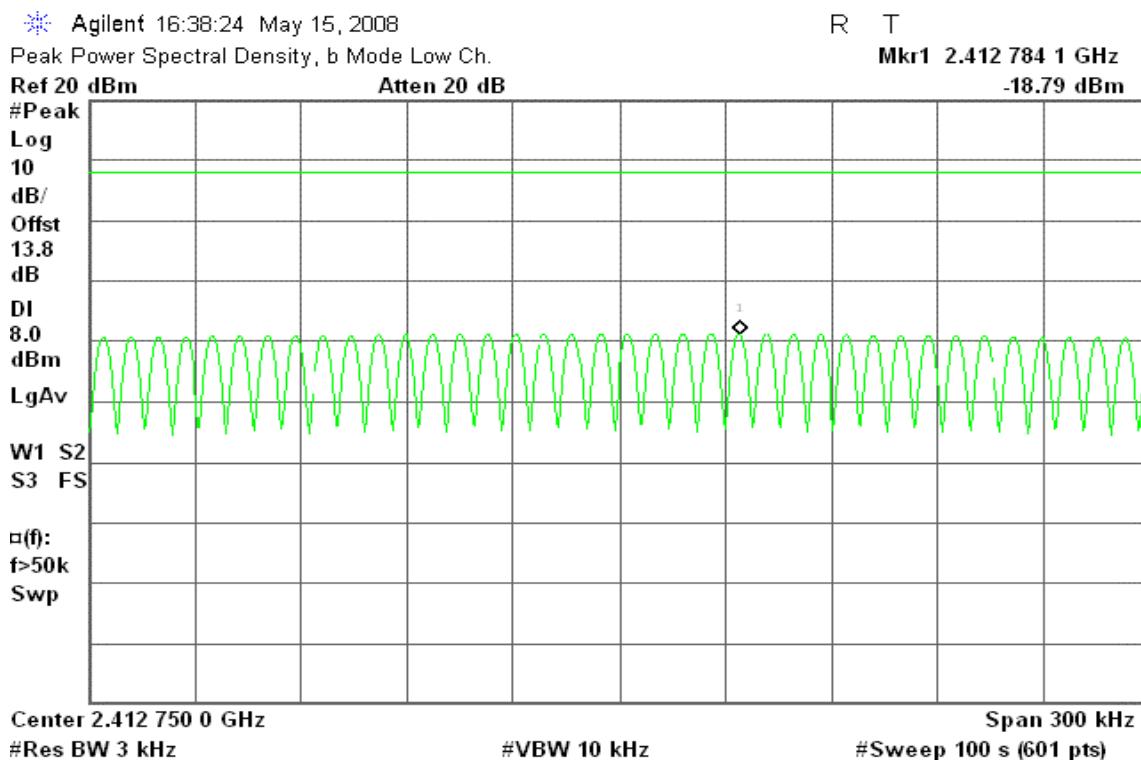
Test mode: draft 802.11n Wide-40 MHz Channel mode with combiner

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2422	-12.07	8.00	PASS
Mid	2437	-12.05		PASS
High	2452	-12.08		PASS

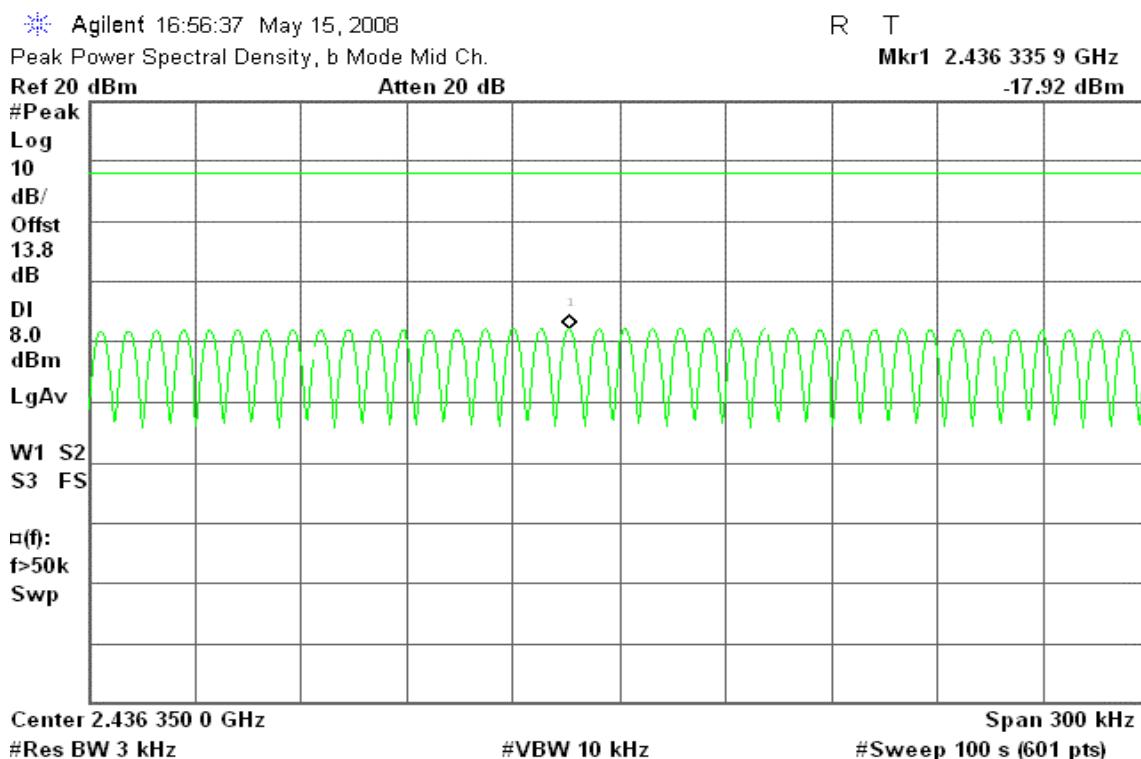
Test Plot

IEEE 802.11b mode

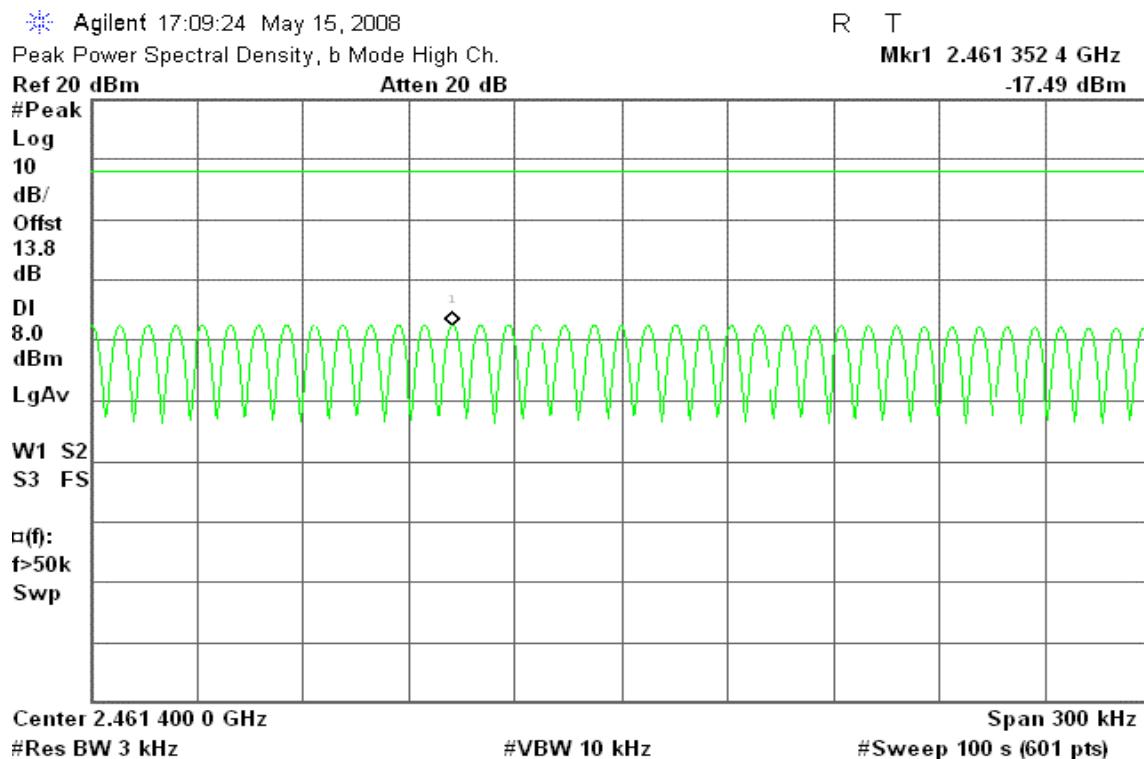
PPSD (CH Low)



PPSD (CH Mid)

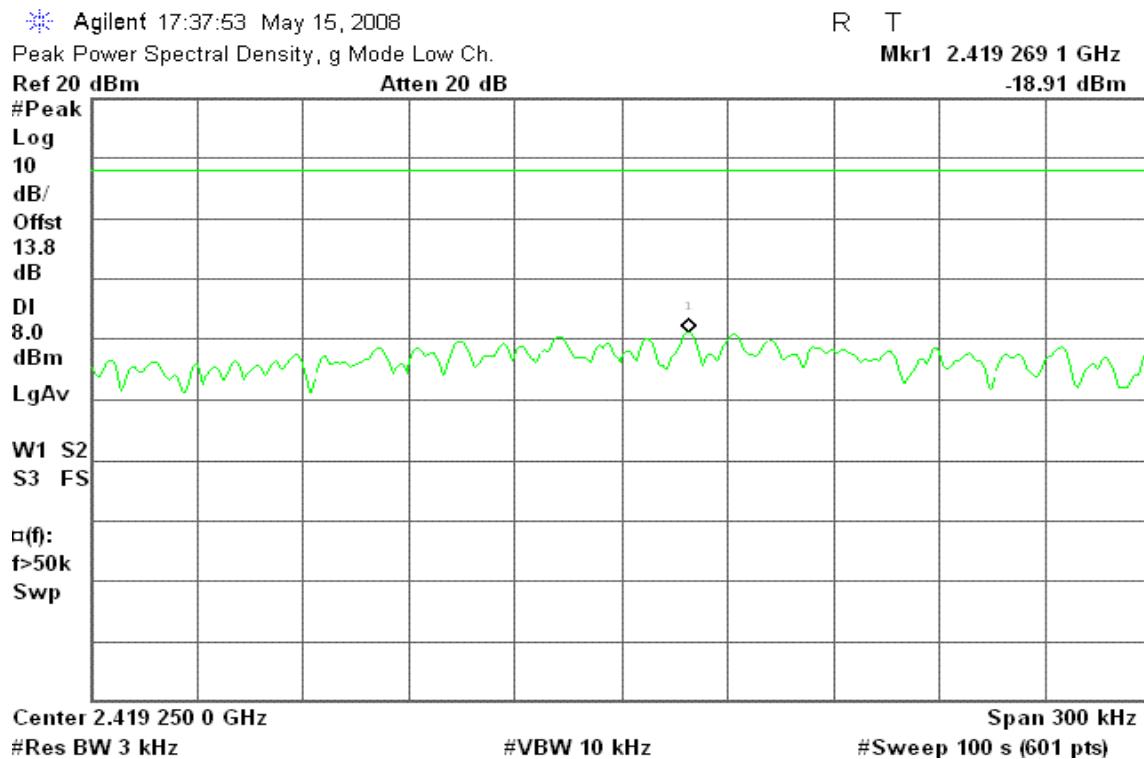


PPSD (CH High)

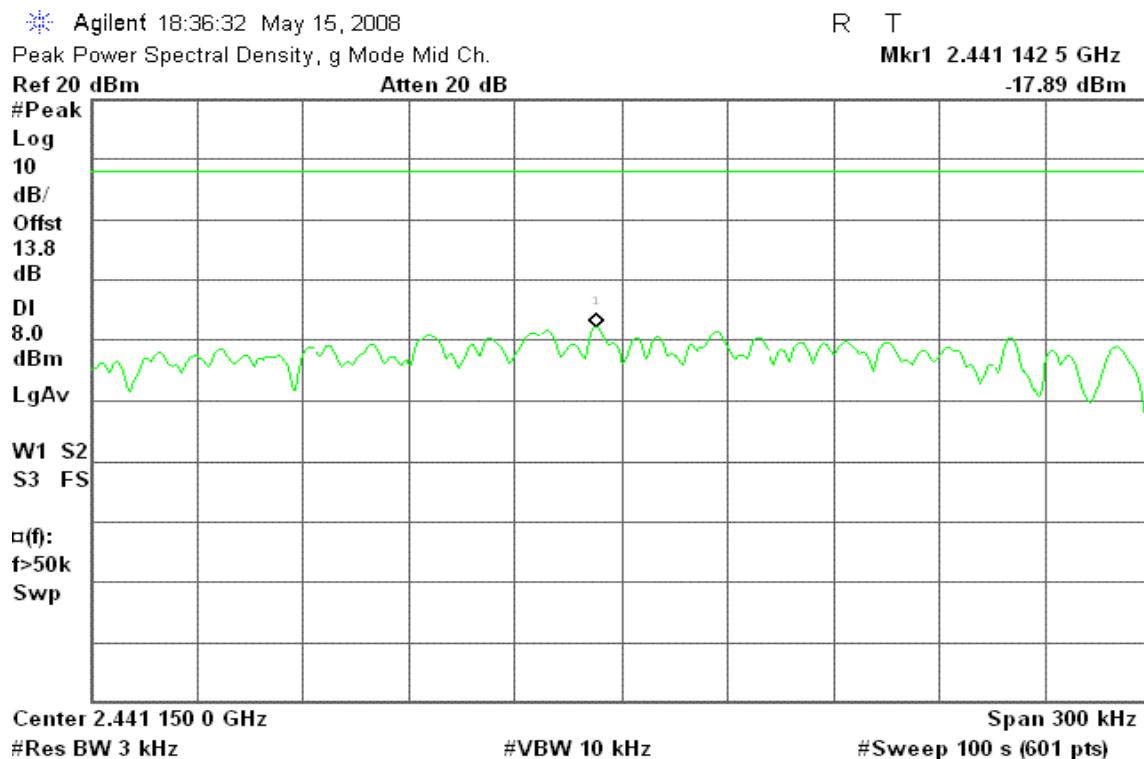


IEEE 802.11g mode

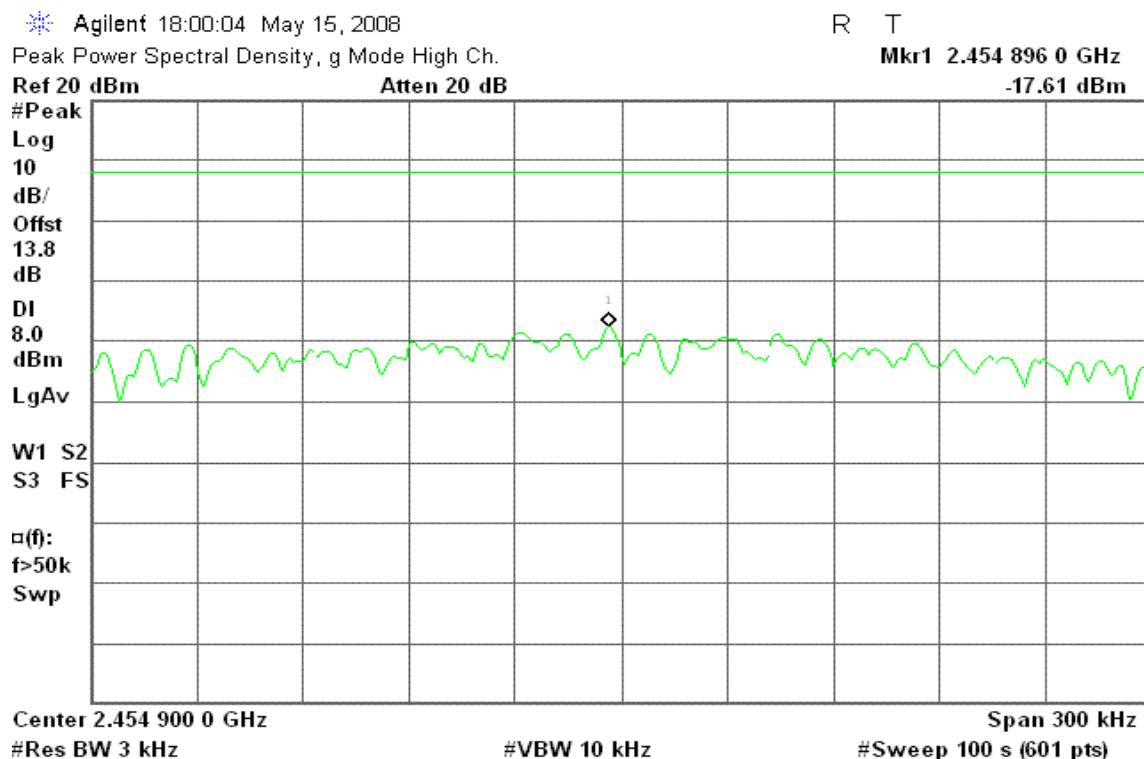
PPSD (CH Low)

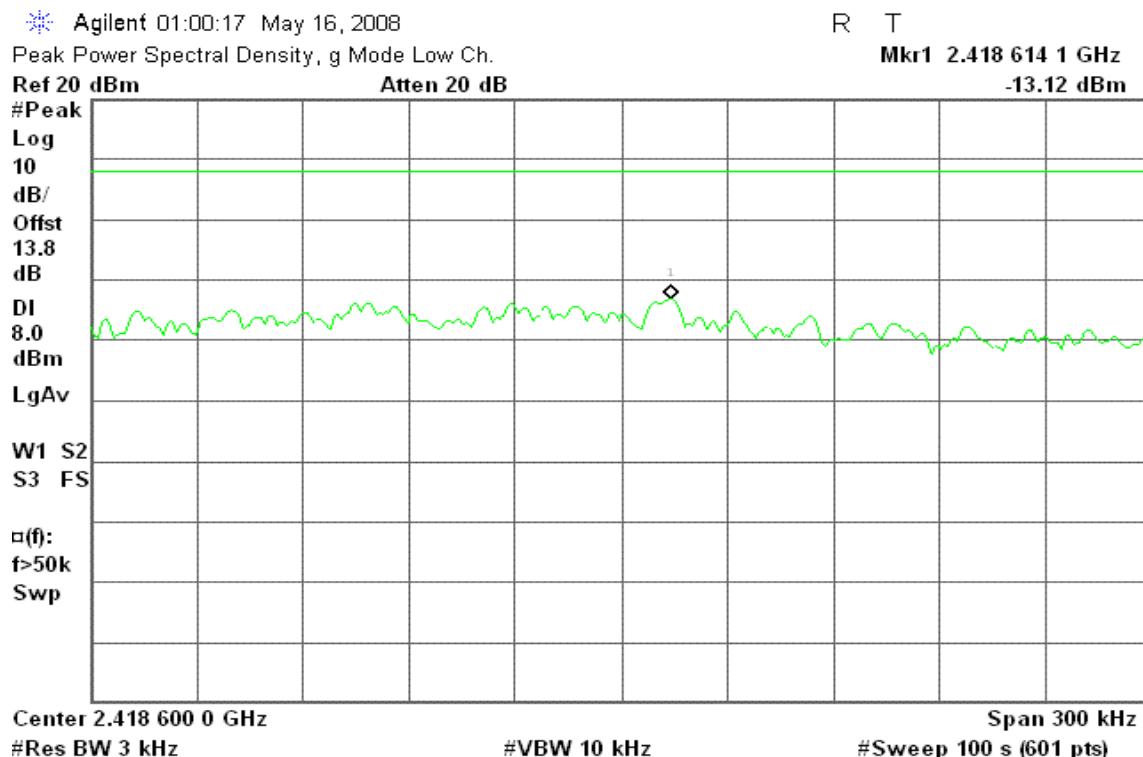
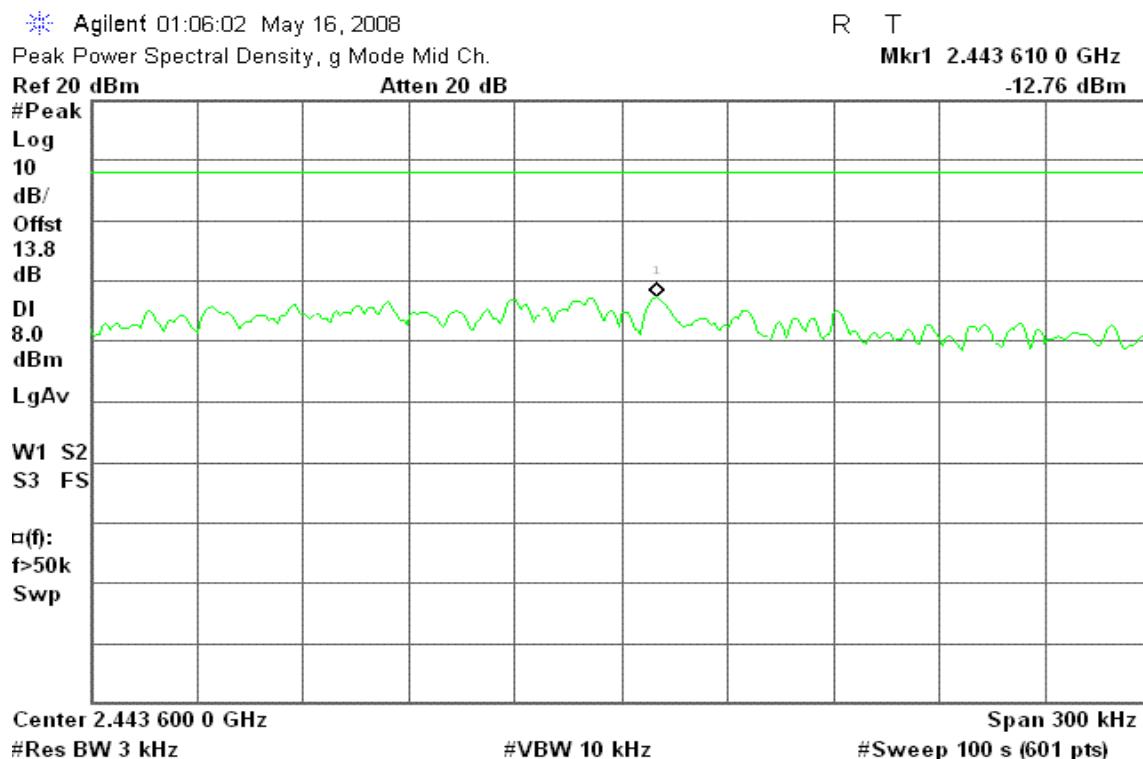


PPSD (CH Mid)

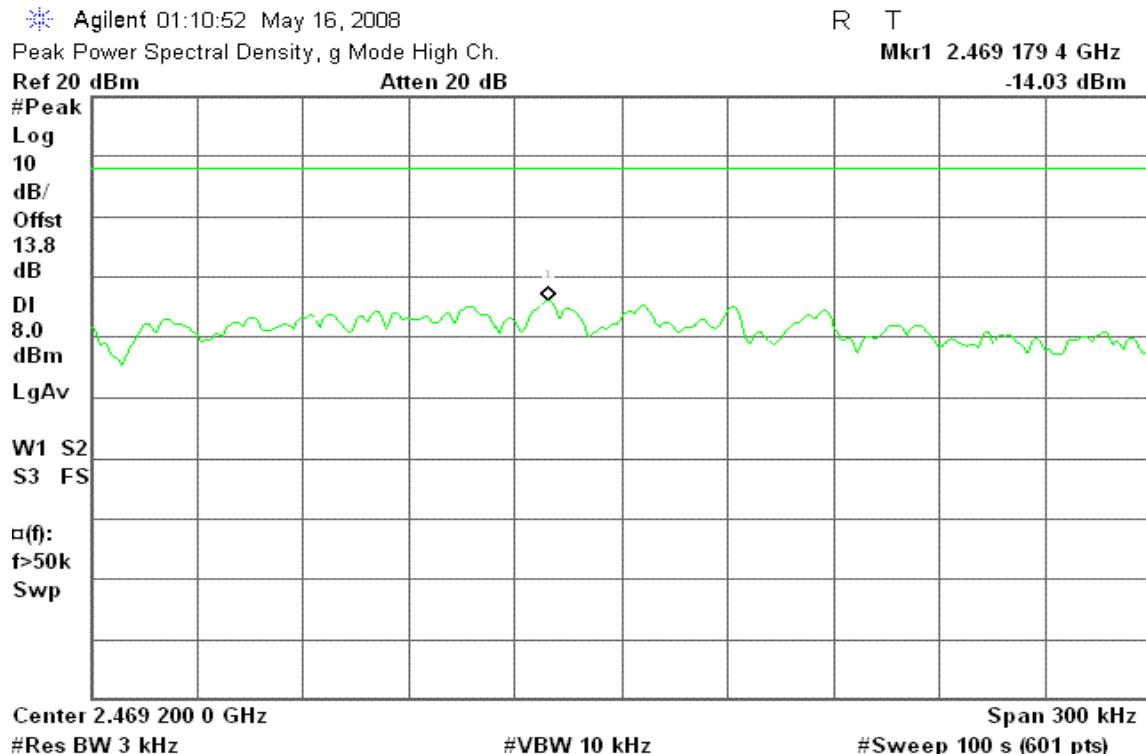


PPSD (CH High)



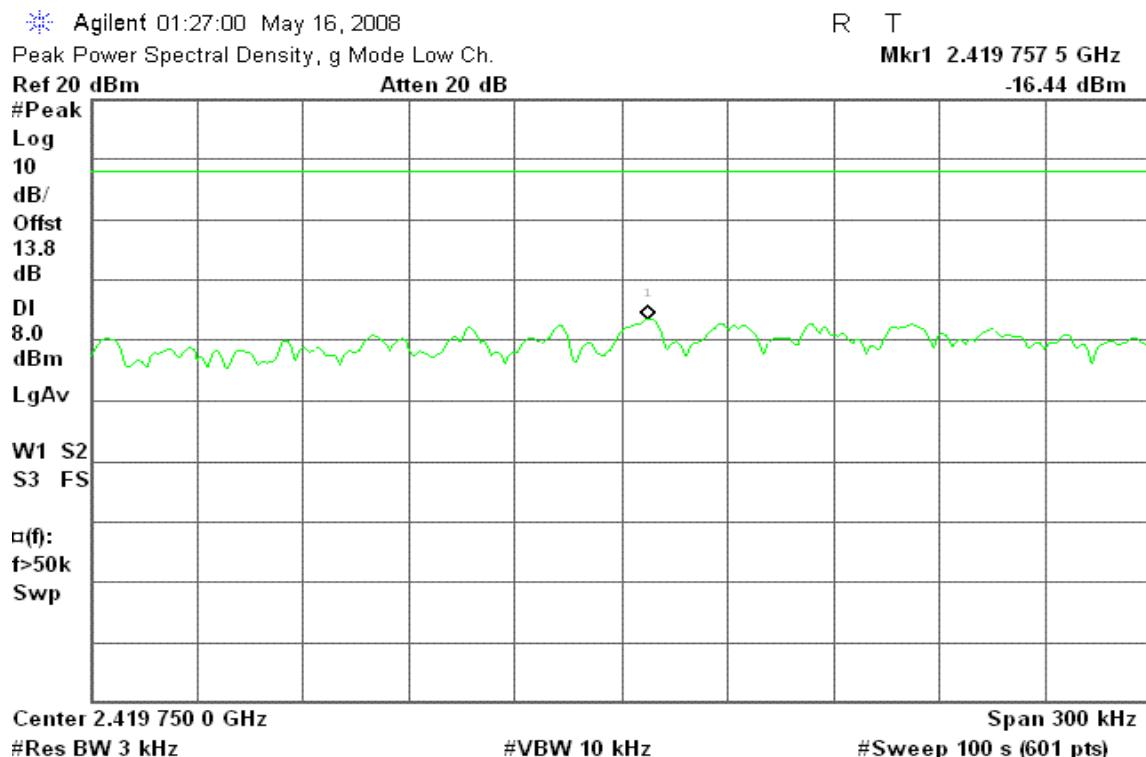
draft 802.11n Standard-20 MHz Channel mode / Chain 0**PPSD (CH Low)****PPSD (CH Mid)**

PPSD (CH High)

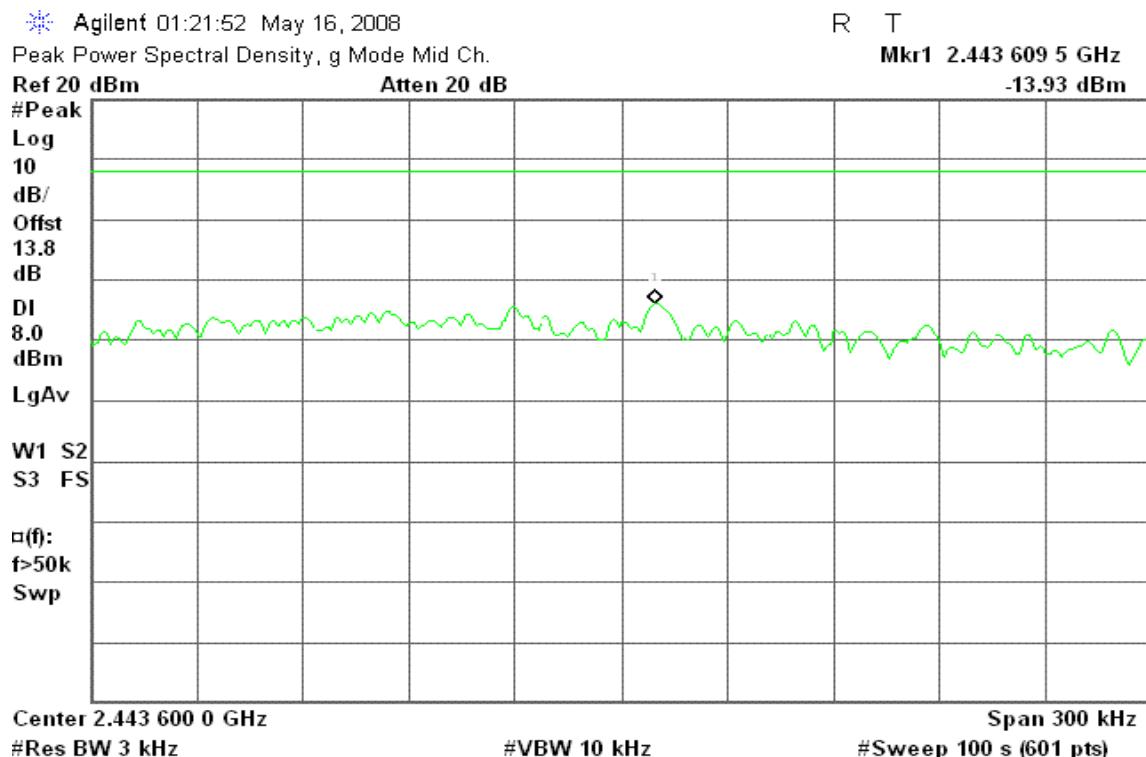


draft 802.11n Standard-20 MHz Channel mode / Chain 2

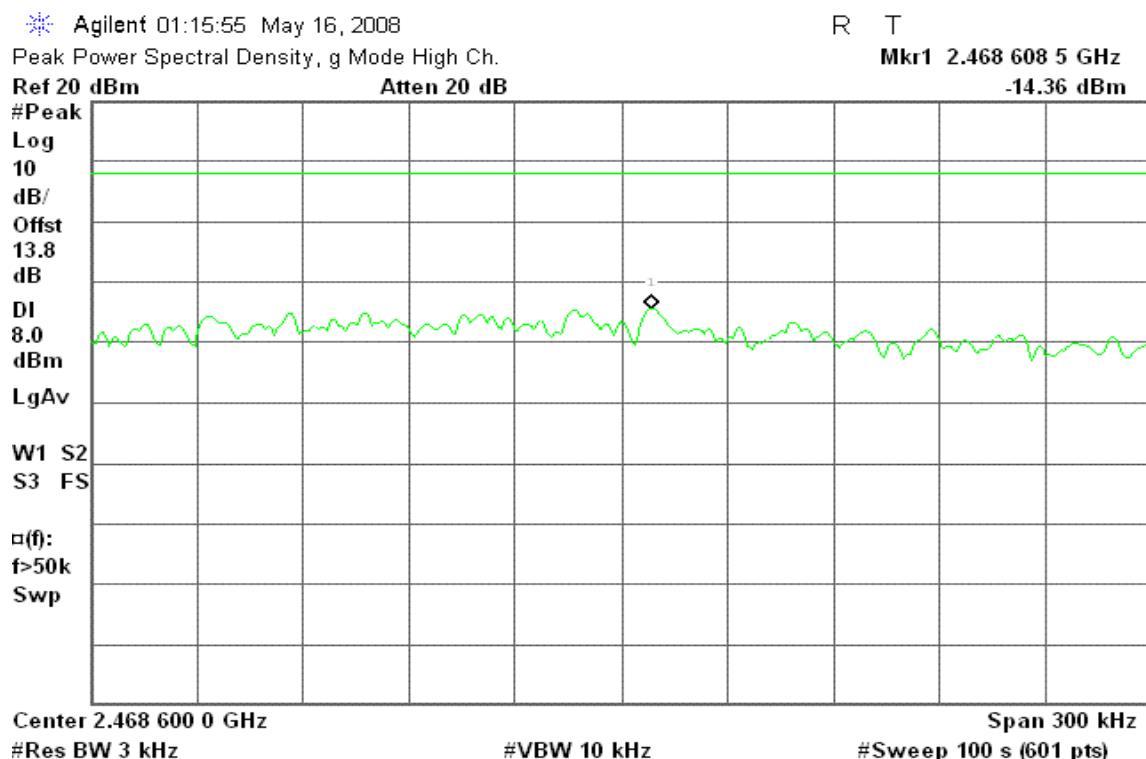
PPSD (CH Low)

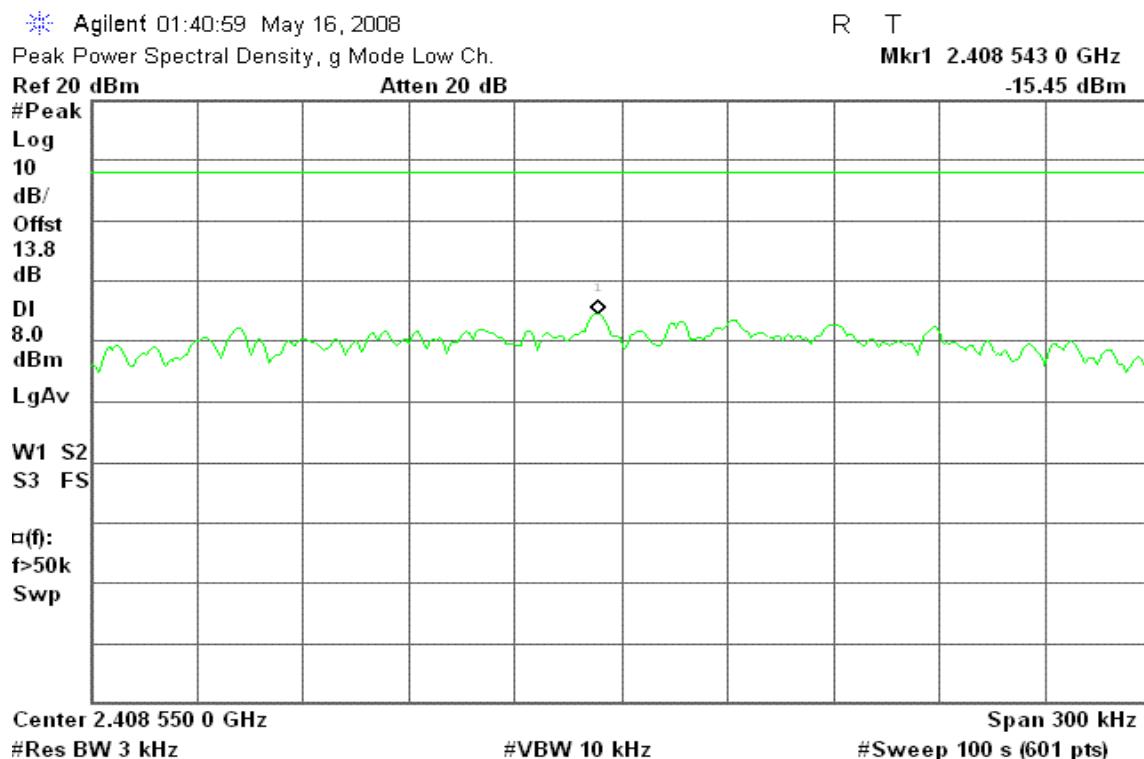
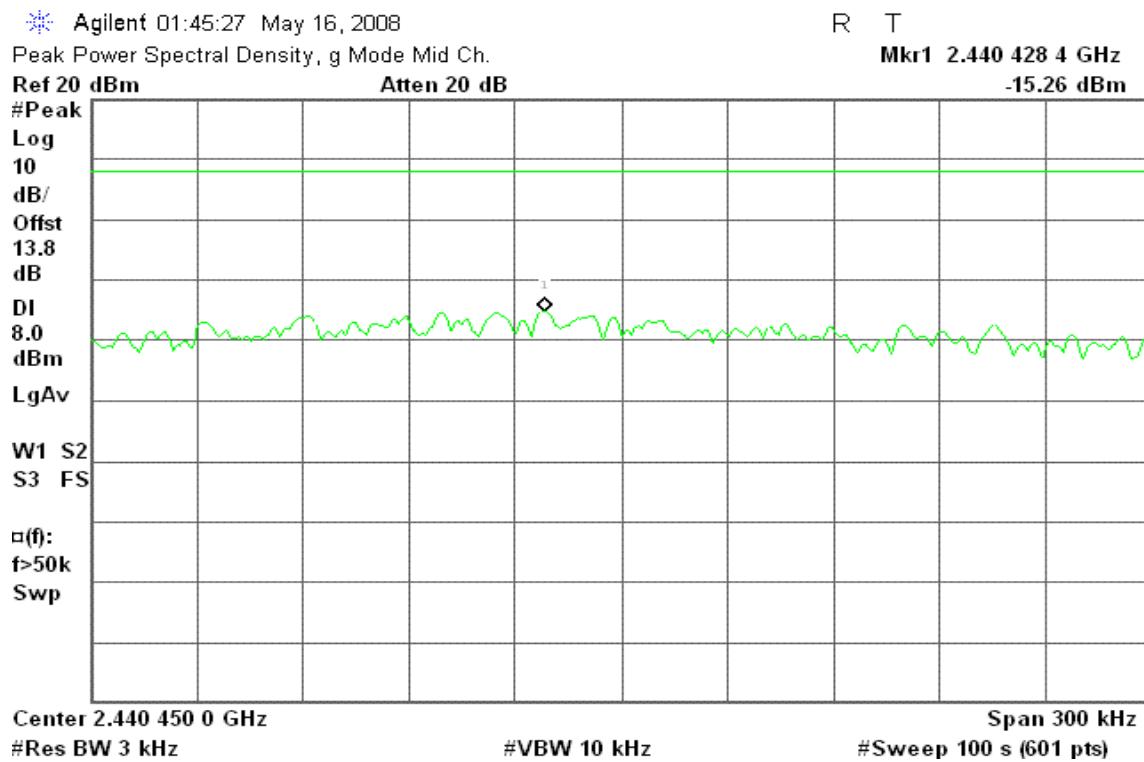


PPSD (CH Mid)

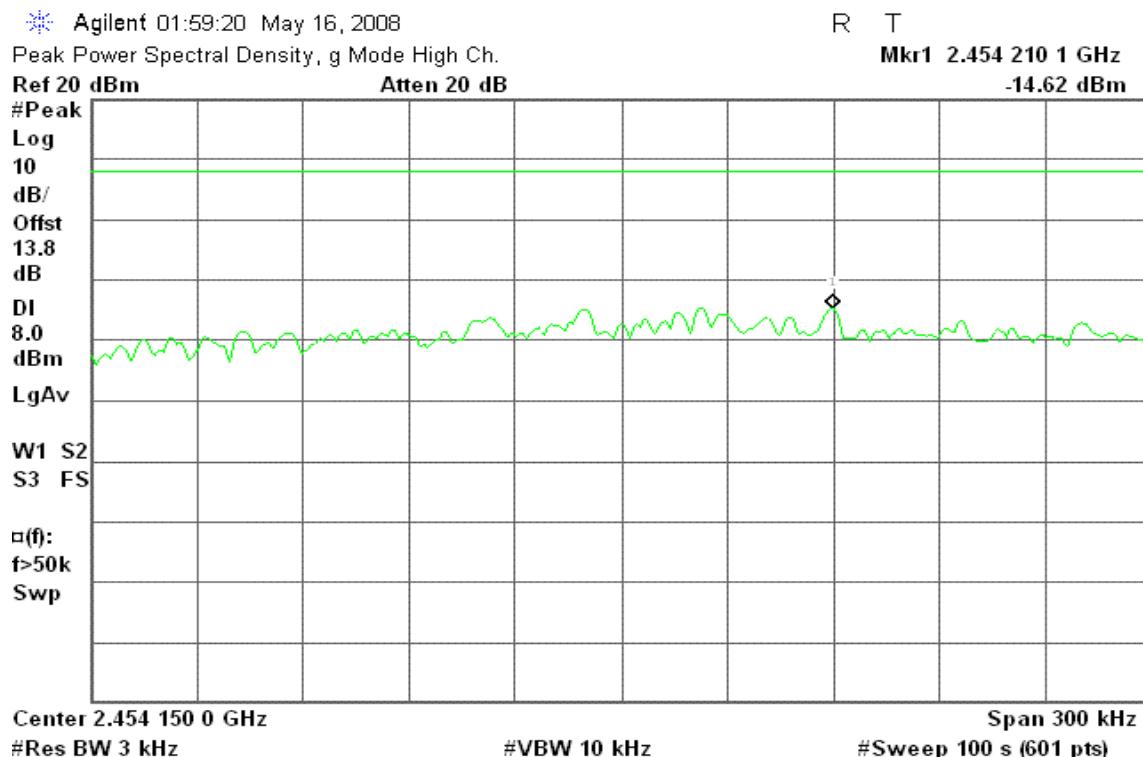


PPSD (CH High)



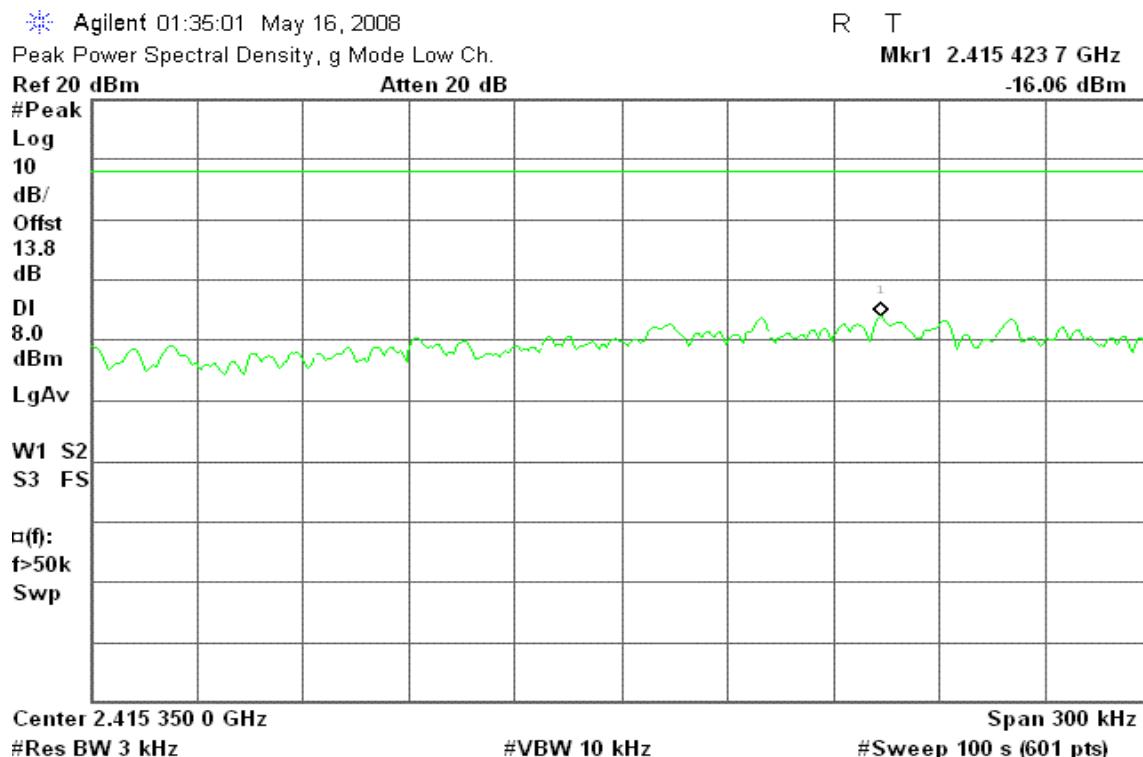
draft 802.11n Wide-40 MHz Channel mode / Chain 0**PPSD (CH Low)****PPSD (CH Mid)**

PPSD (CH High)

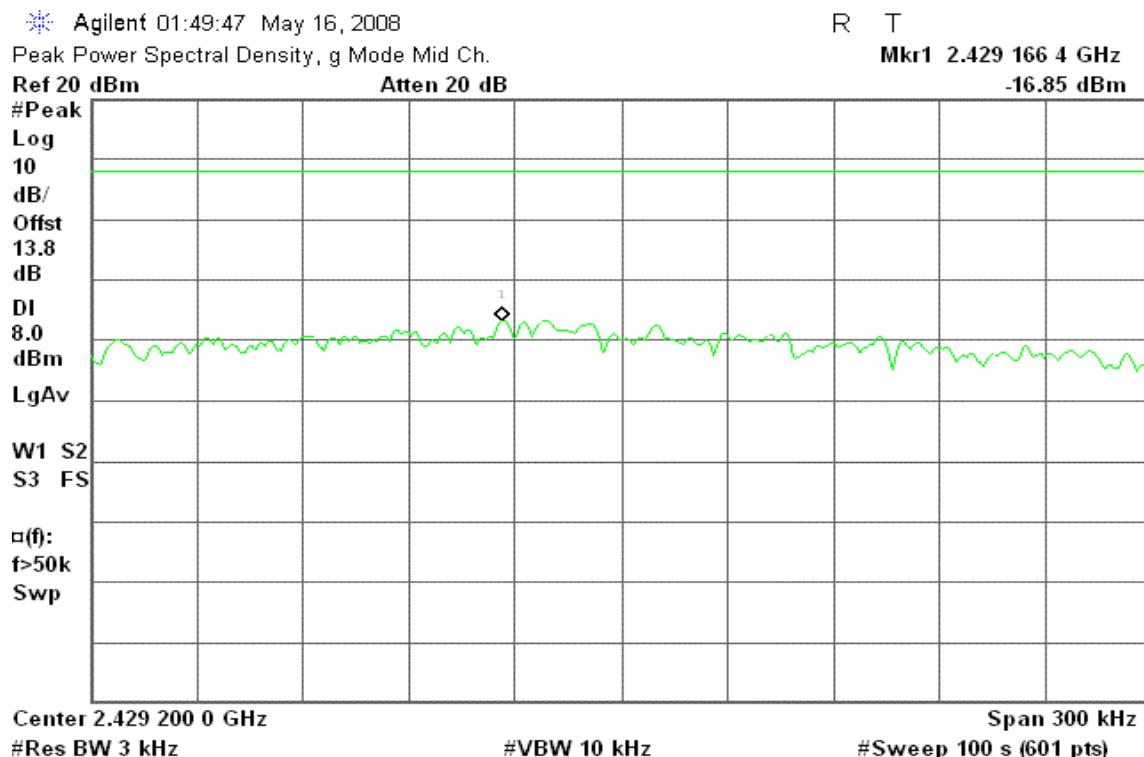


draft 802.11n Wide-40 MHz Channel mode / Chain 2

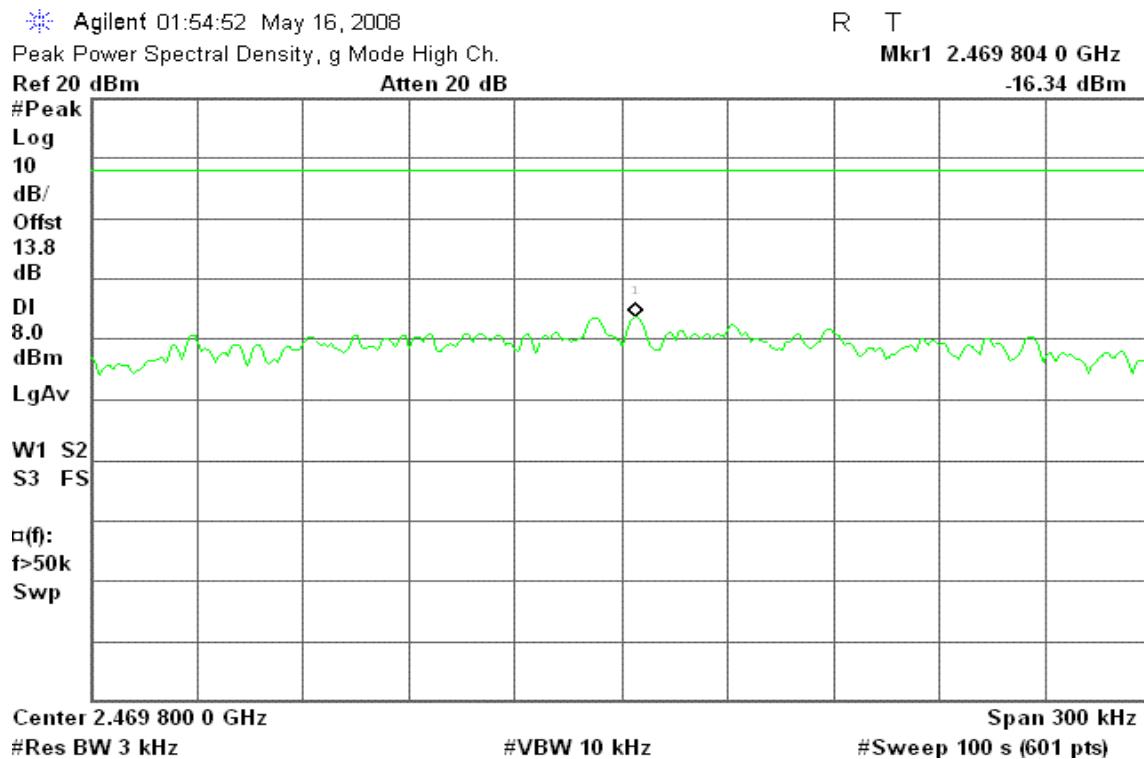
PPSD (CH Low)

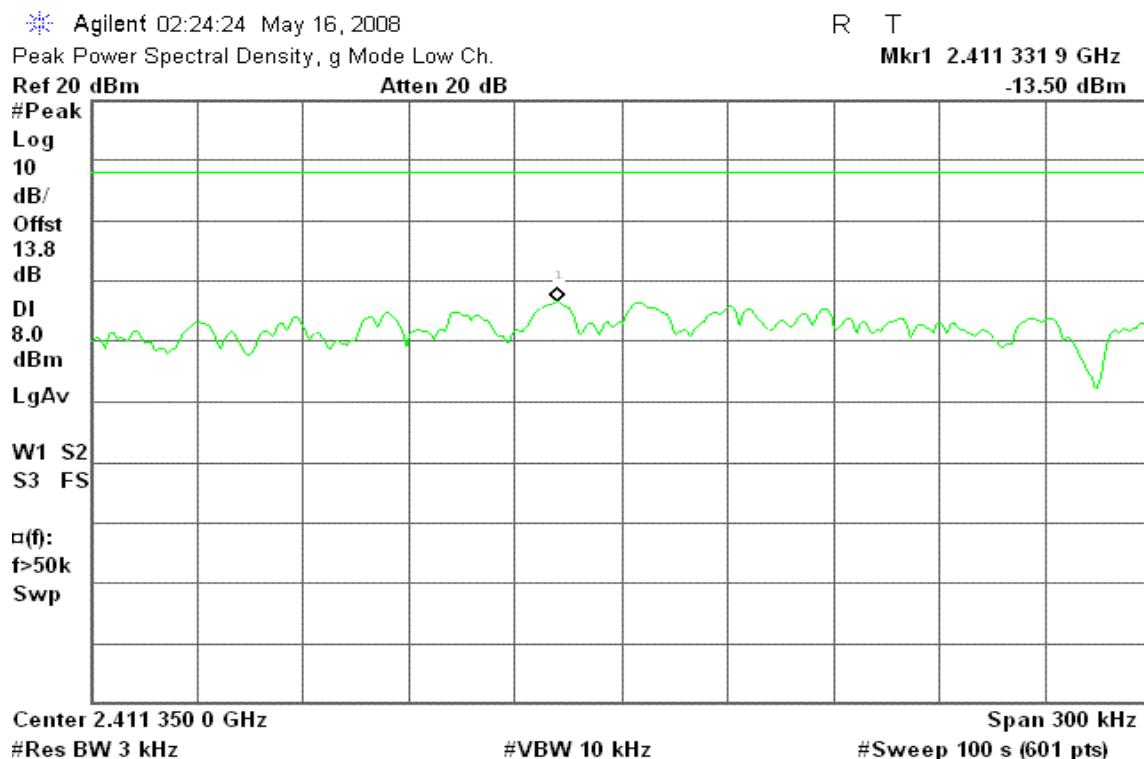
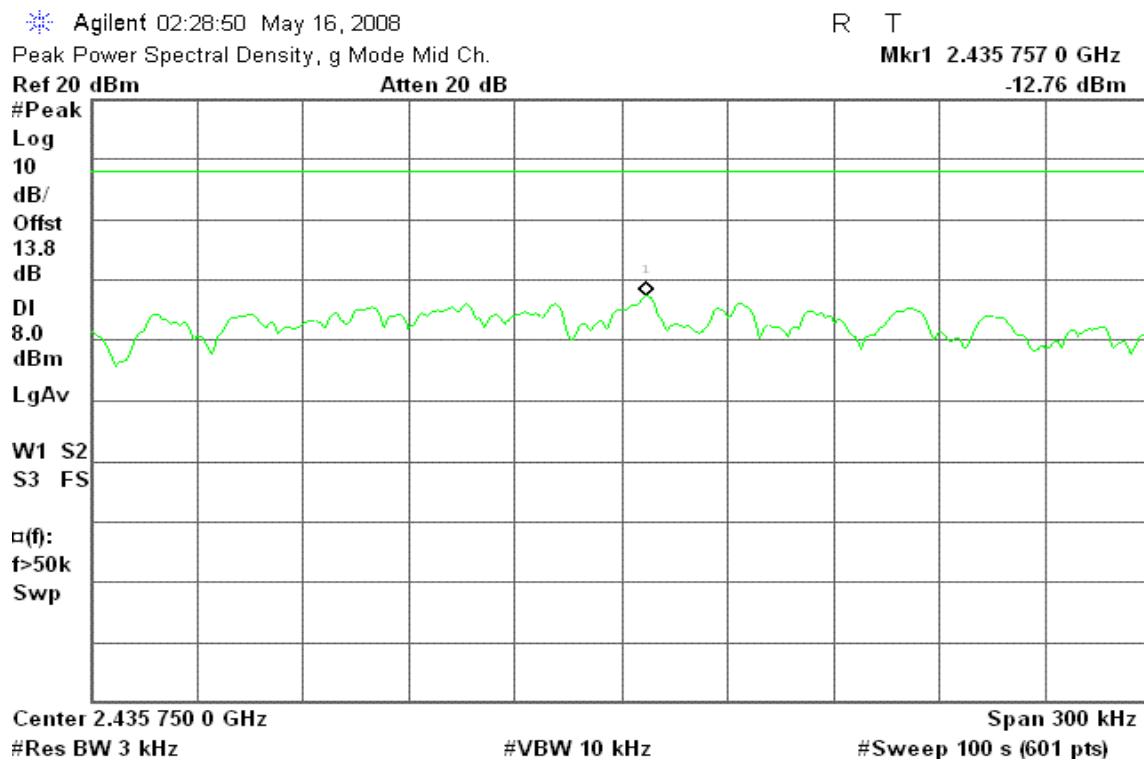


PPSD (CH Mid)

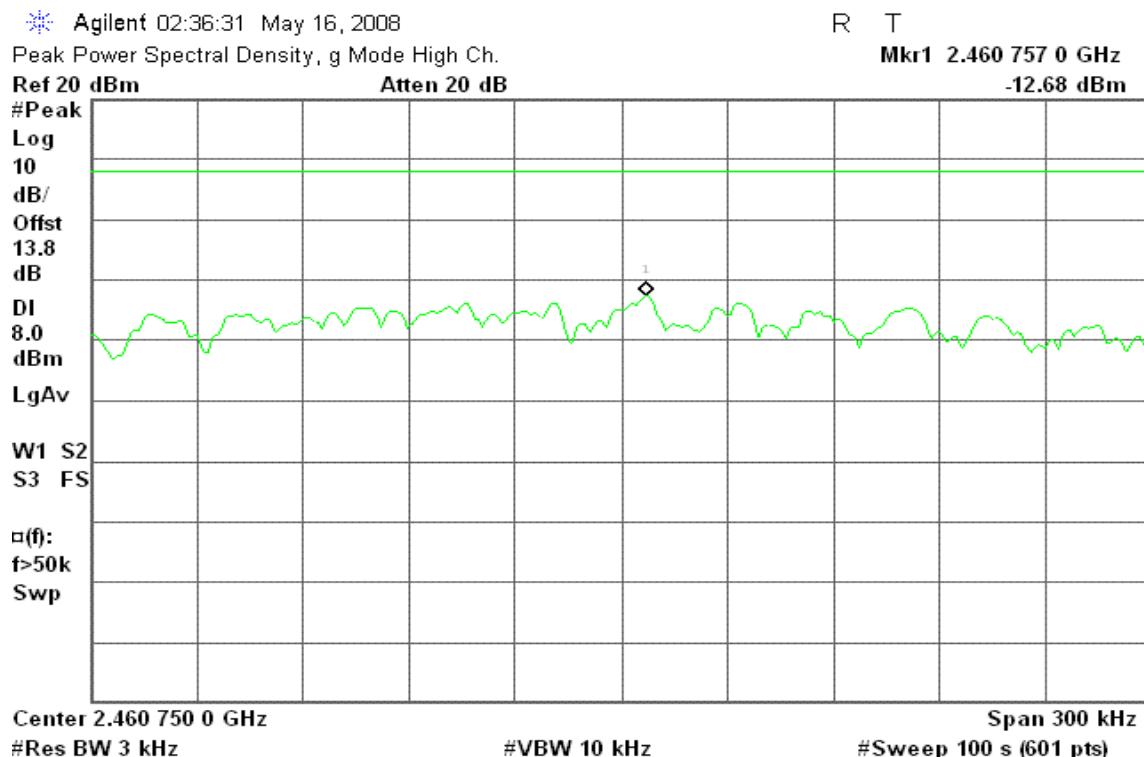


PPSD (CH High)



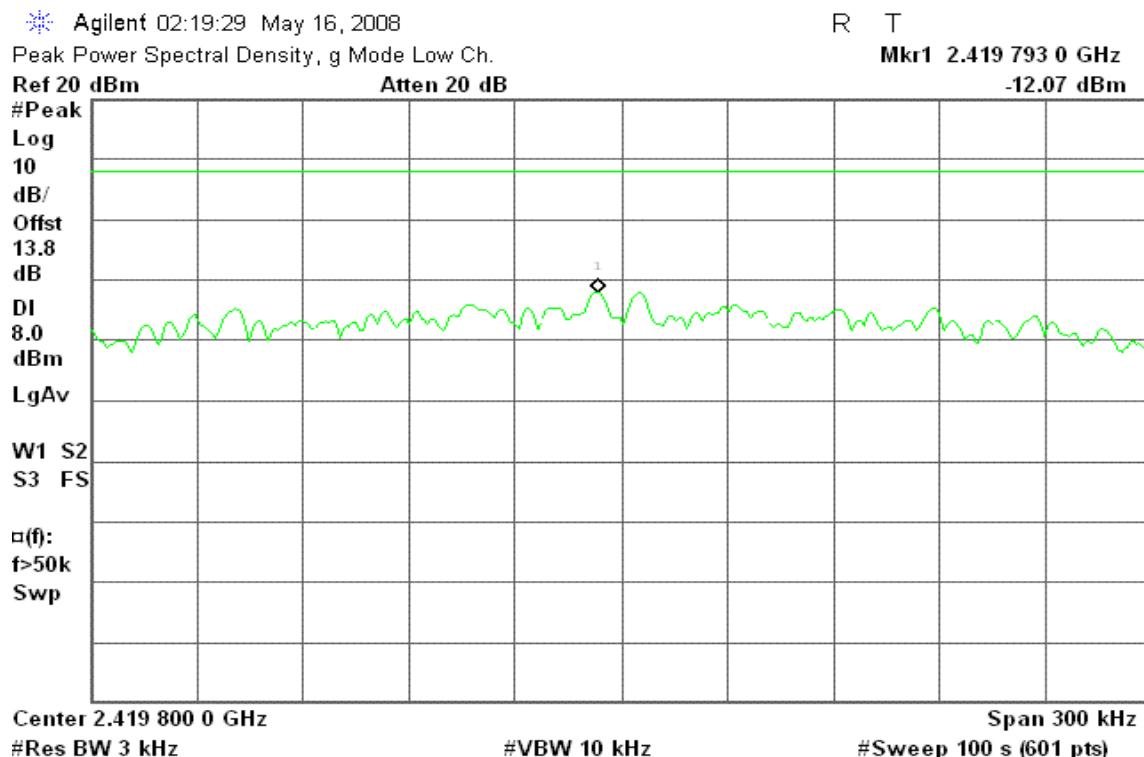
draft 802.11n Standard-20 MHz Channel mode with combiner**PPSD (CH Low)****PPSD (CH Mid)**

PPSD (CH High)

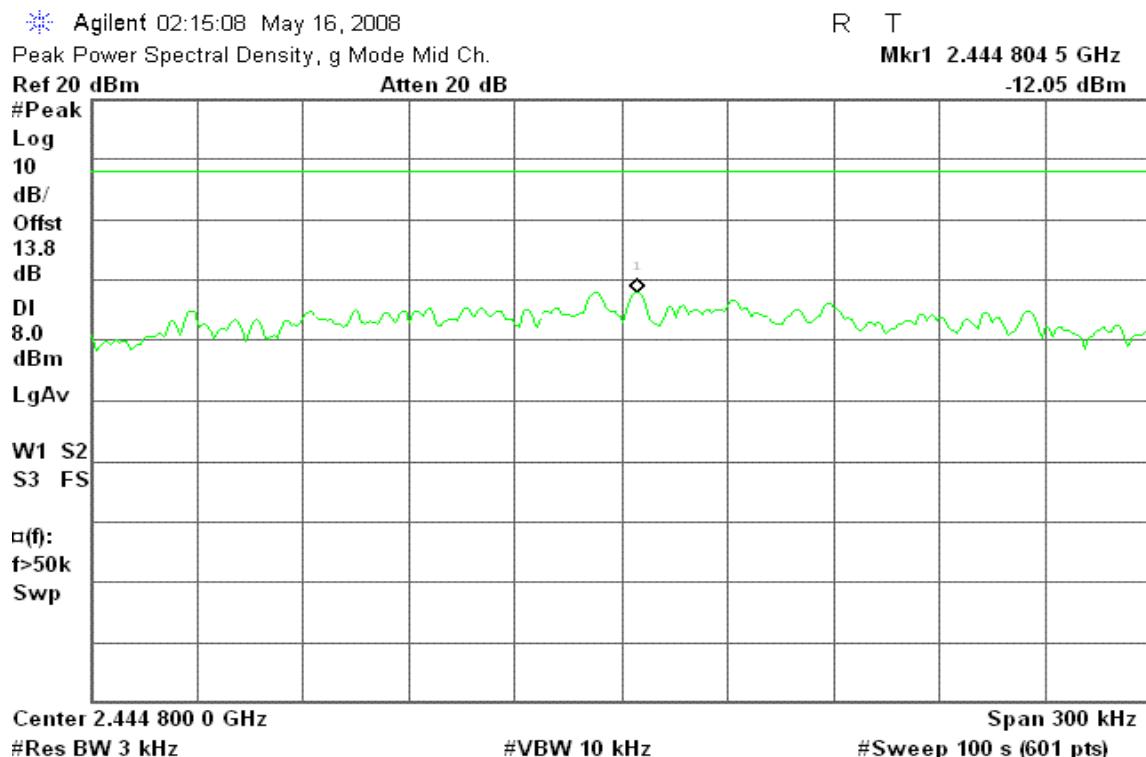


draft 802.11n Wide-40 MHz Channel mode with combiner

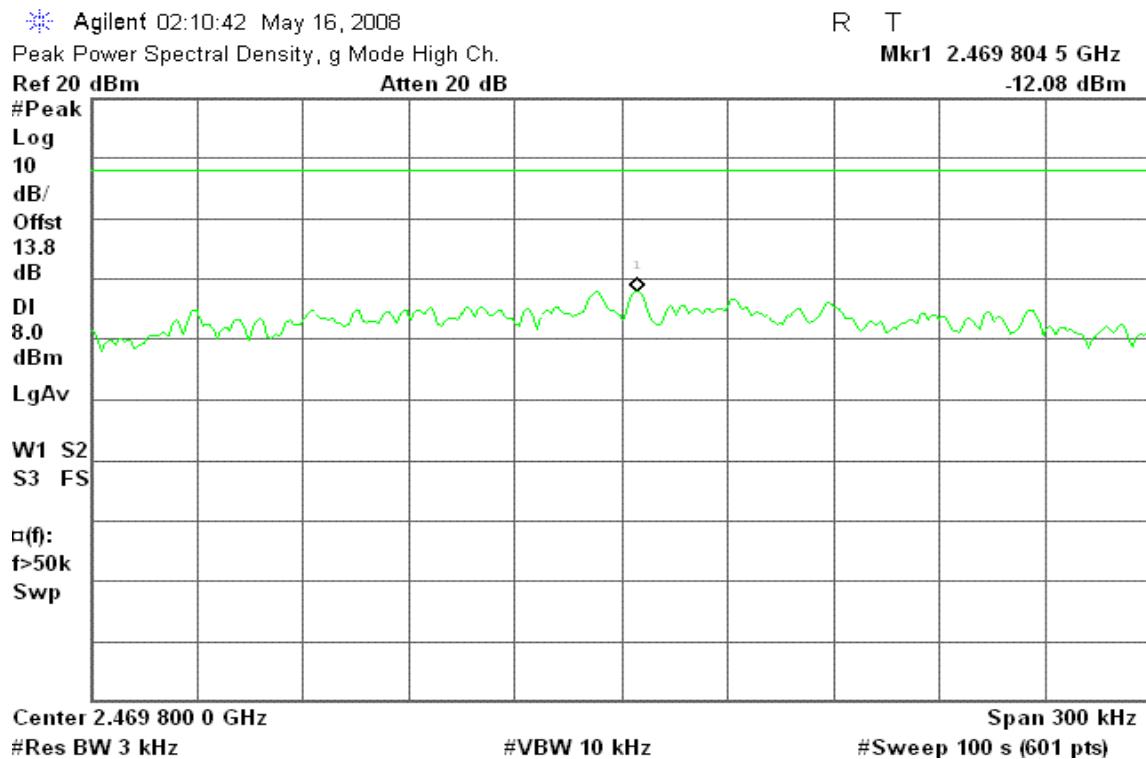
PPSD (CH Low)



PPSD (CH Mid)



PPSD (CH High)



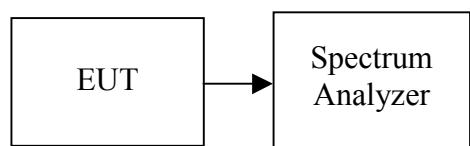
7.6 SPURIOUS EMISSIONS

7.6.1 Conducted Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were 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 100 kHz. The video bandwidth is set to 100 kHz.

Measurements are made over the 30MHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels.

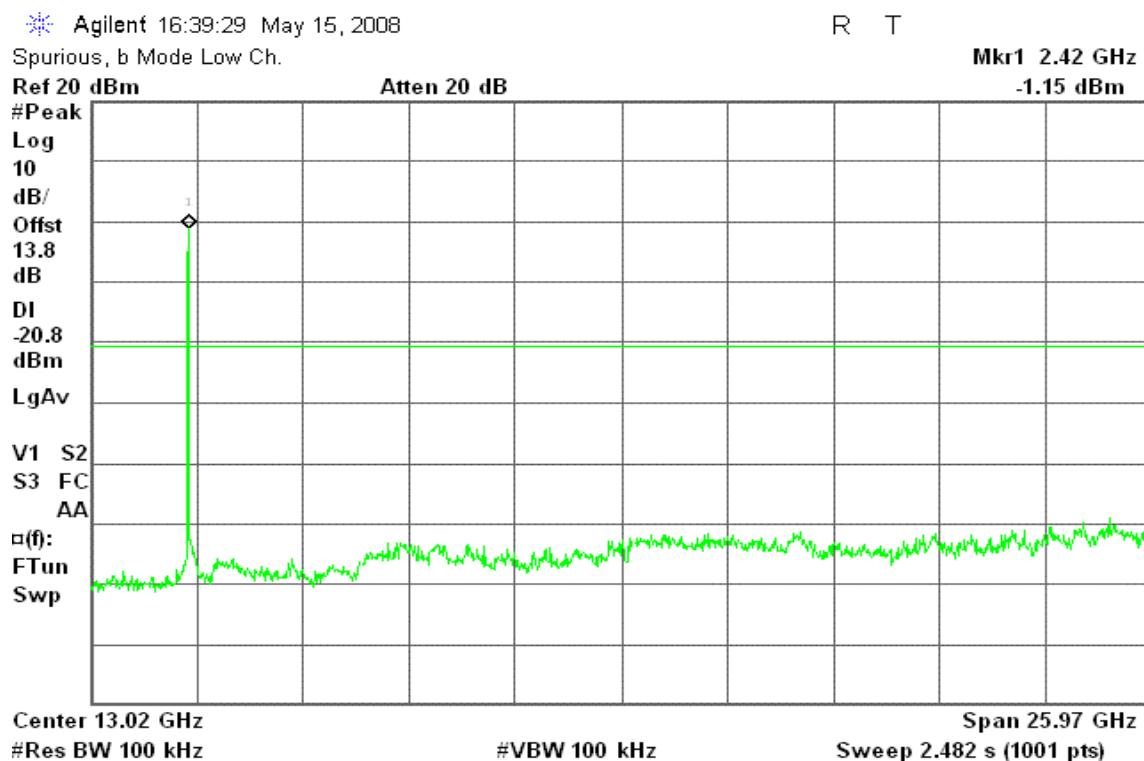
TEST RESULTS

No non-compliance noted

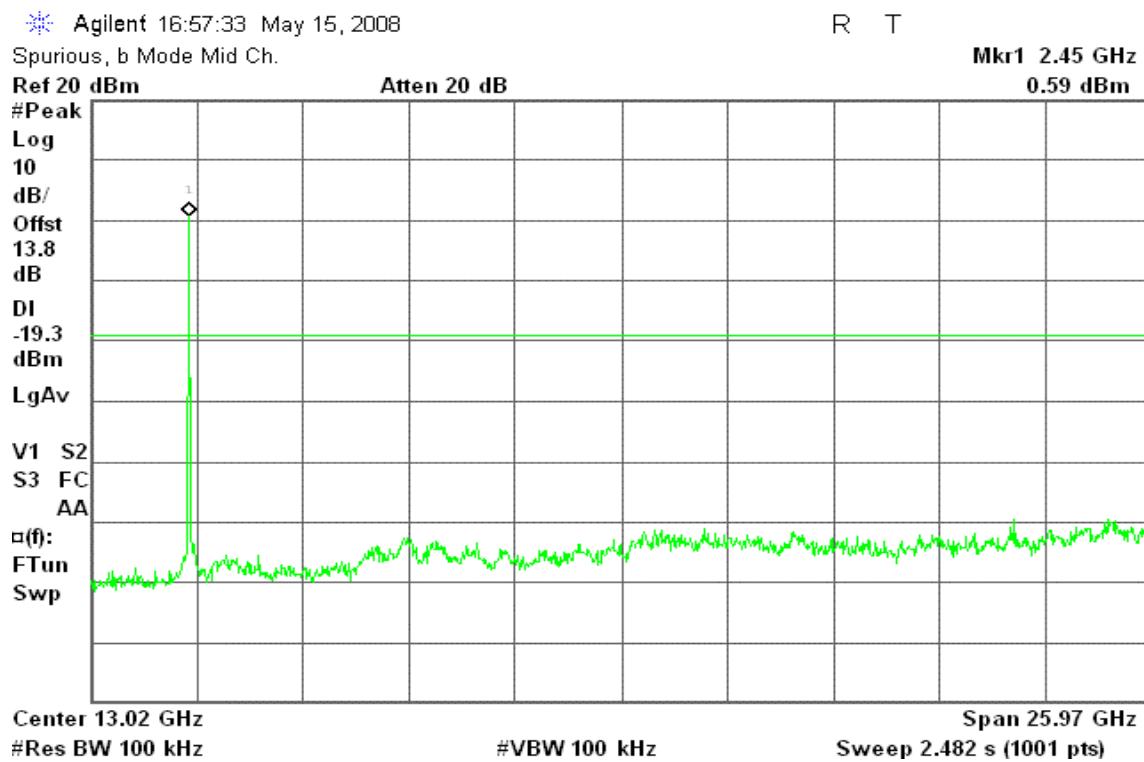
Test Plot

IEEE 802.11b mode

CH Low



CH Mid

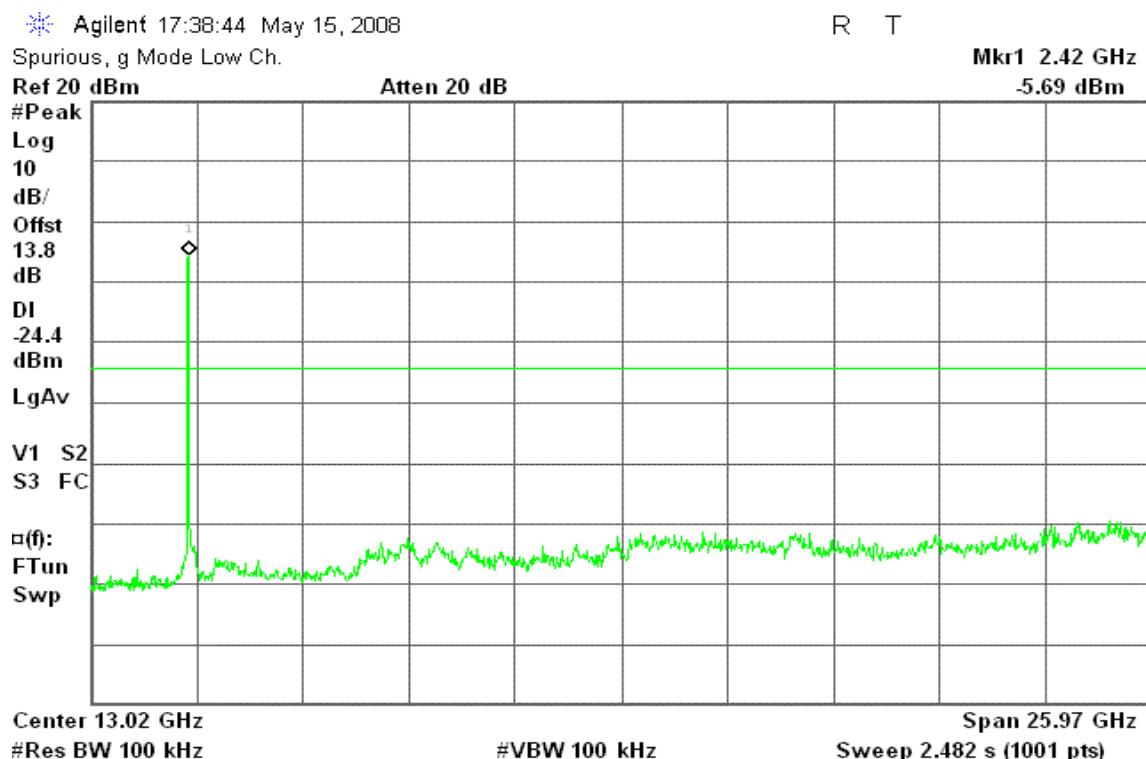


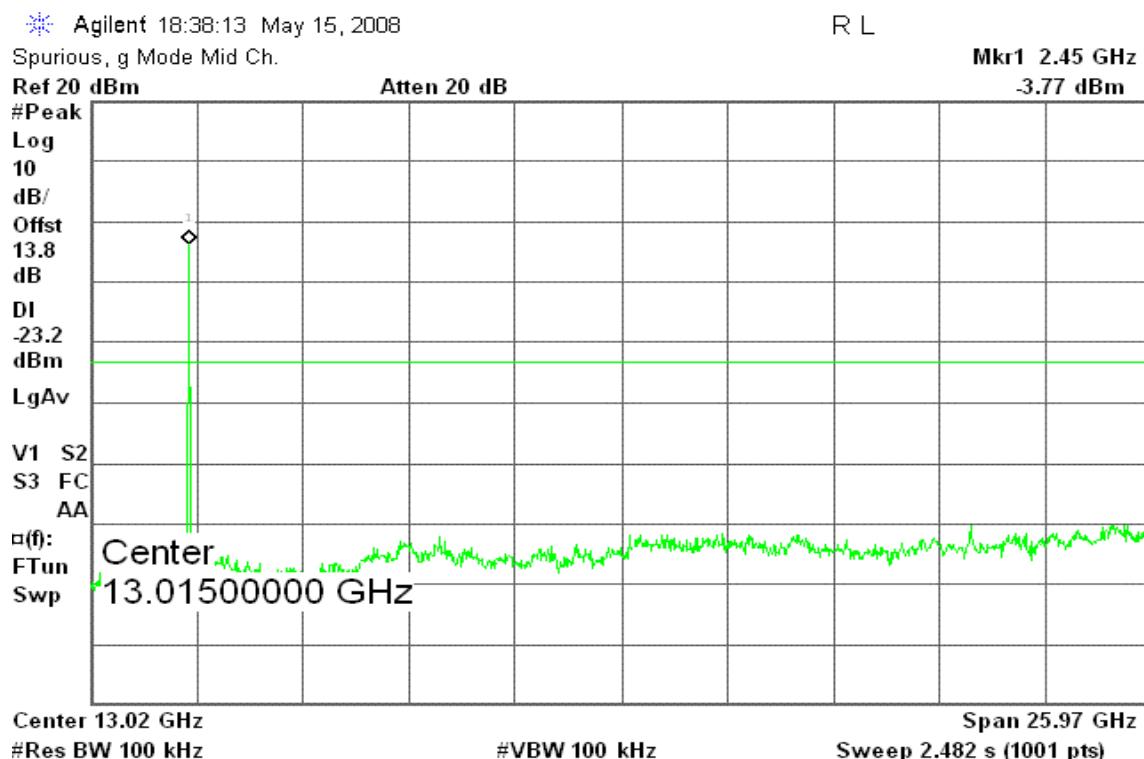
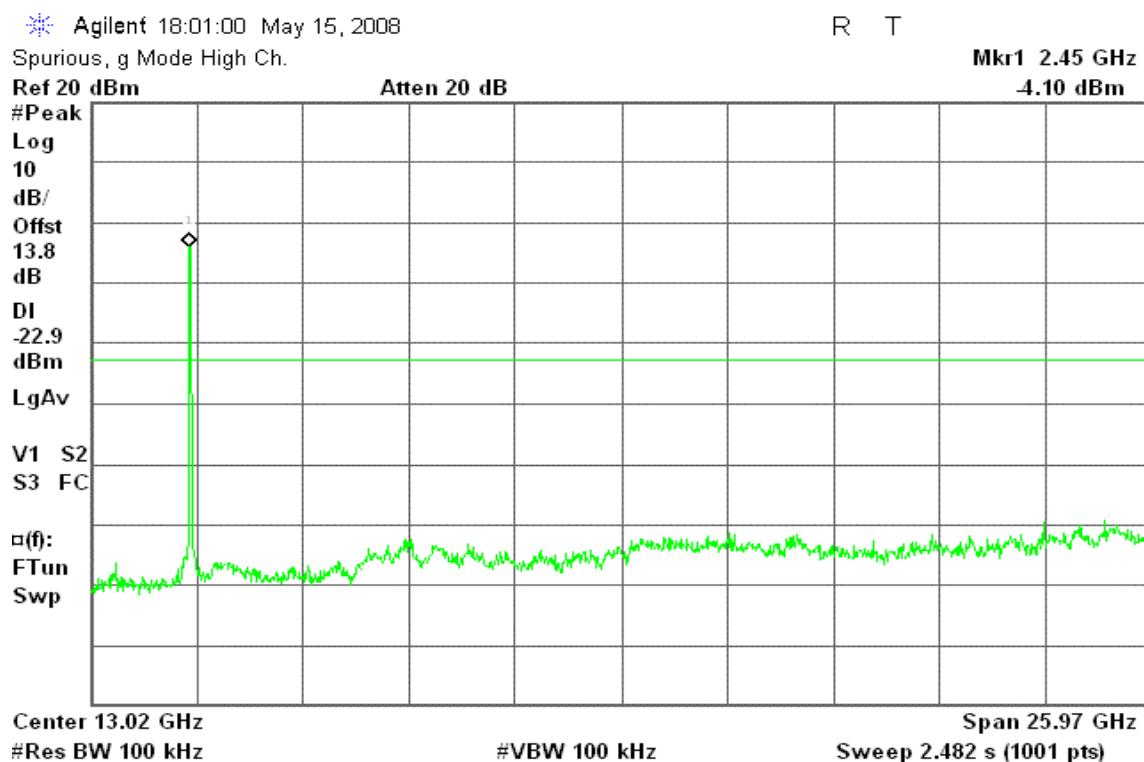
CH High

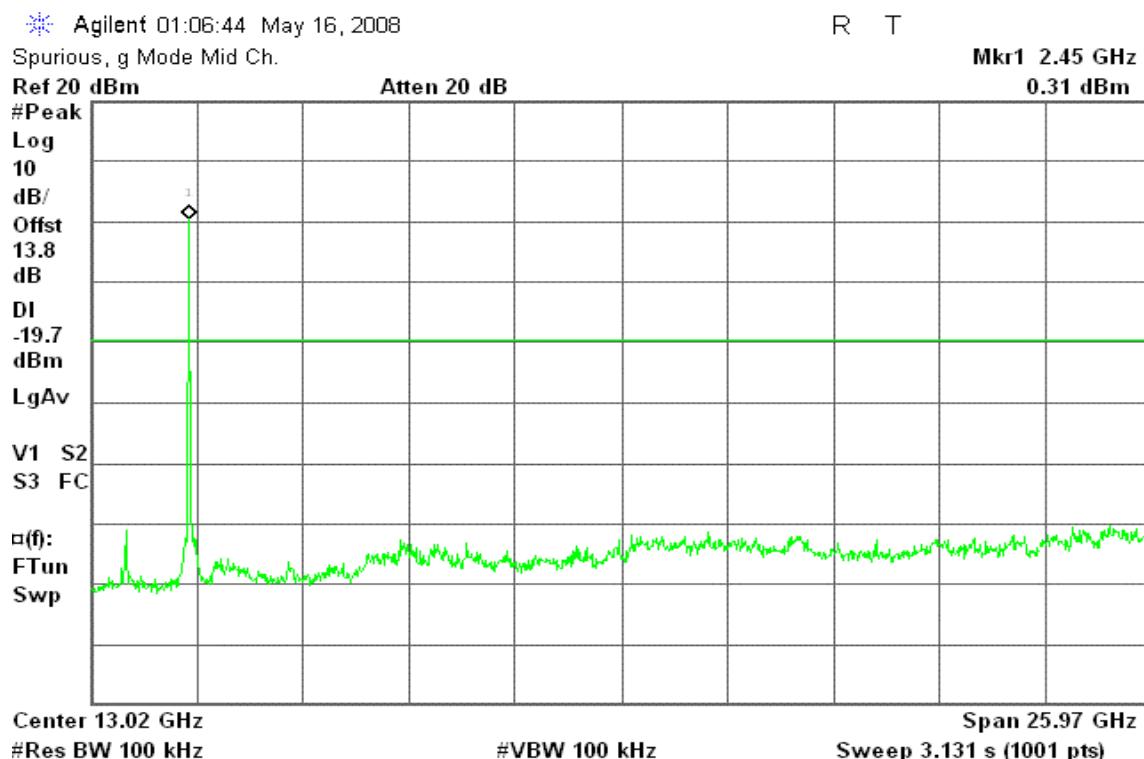


IEEE 802.11g mode

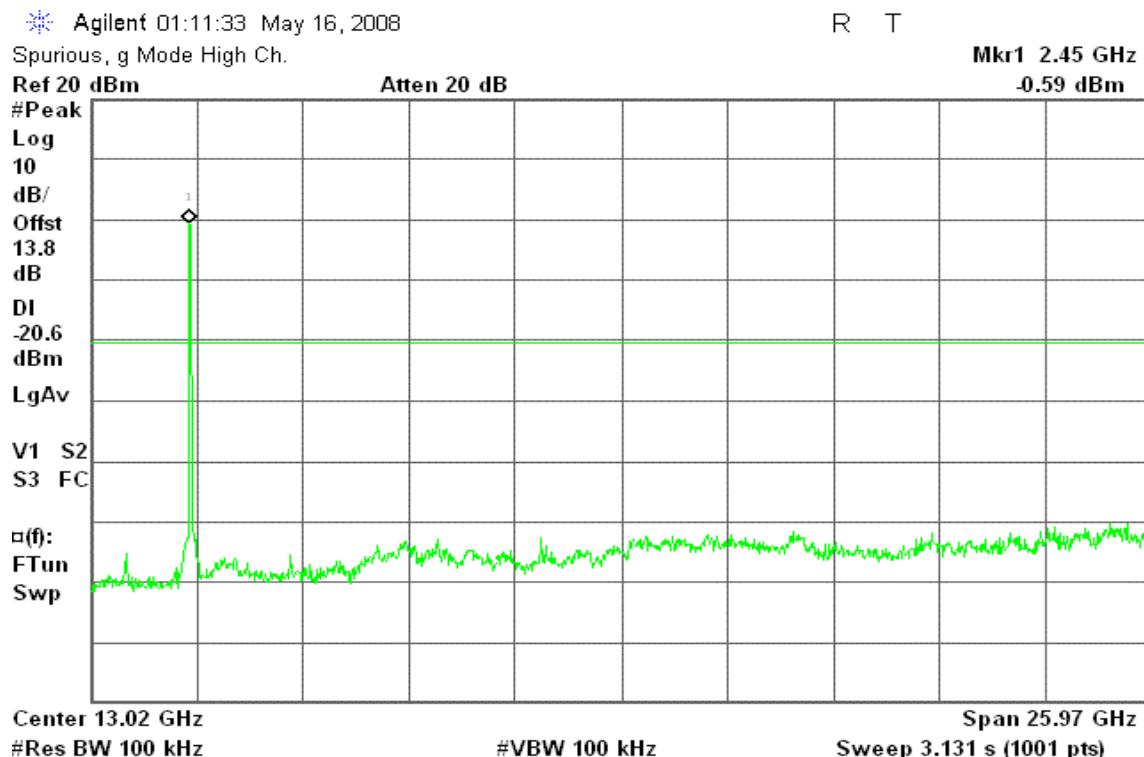
CH Low



CH Mid**CH High**

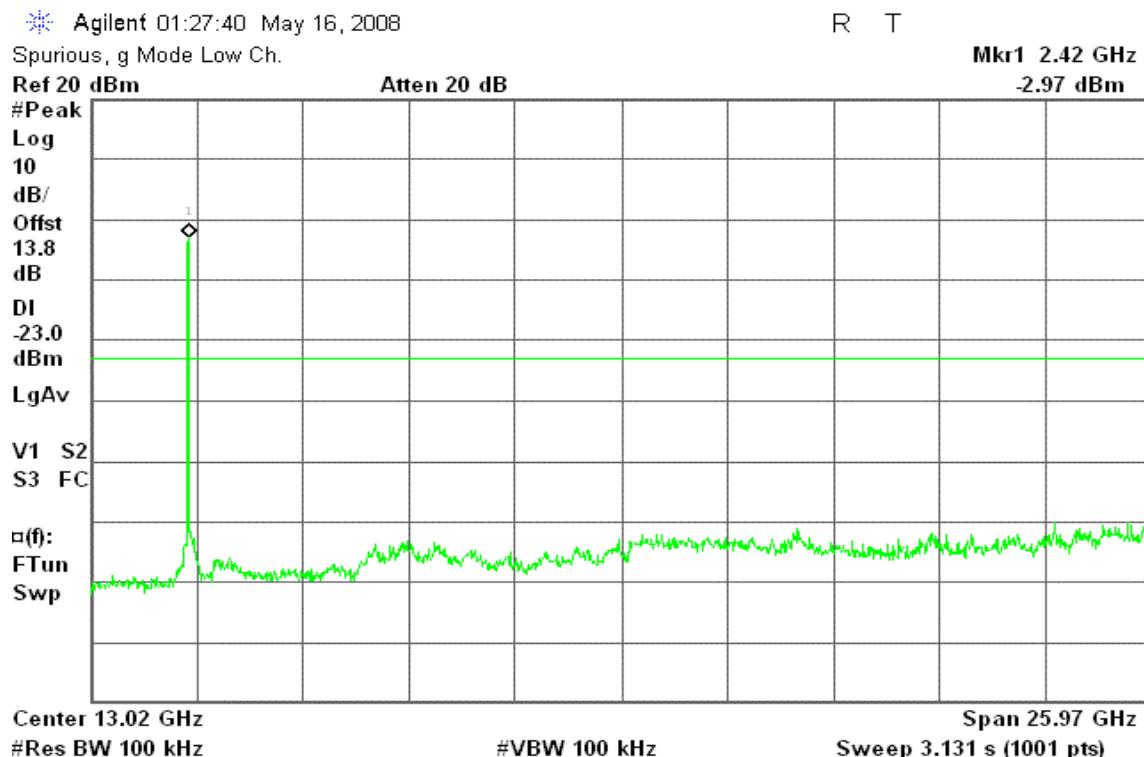
draft 802.11n Standard-20 MHz Channel mode / Chain 0**CH Low****CH Mid**

CH High

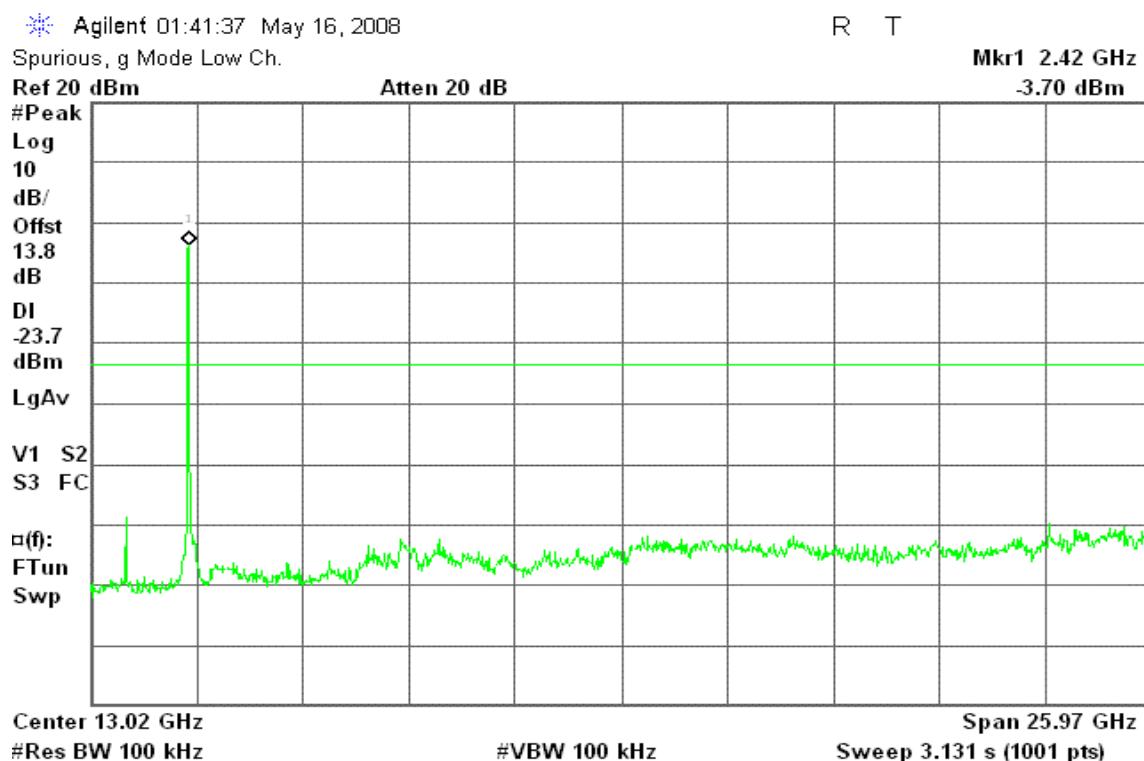
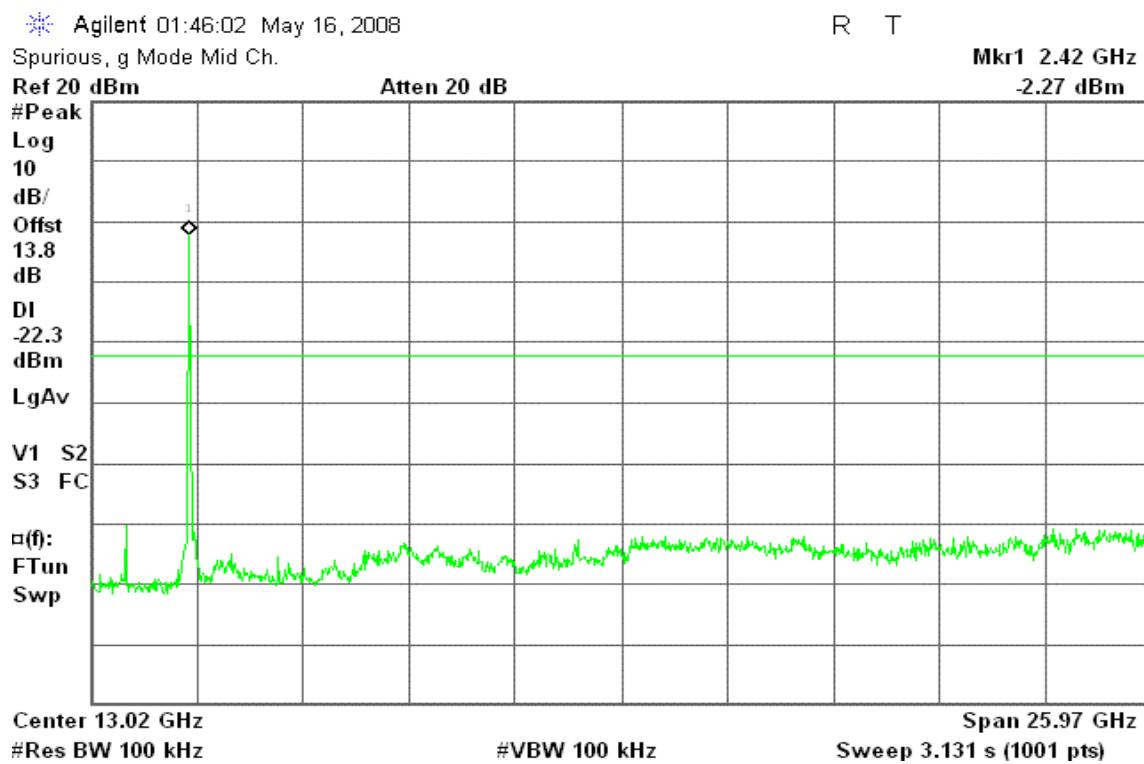


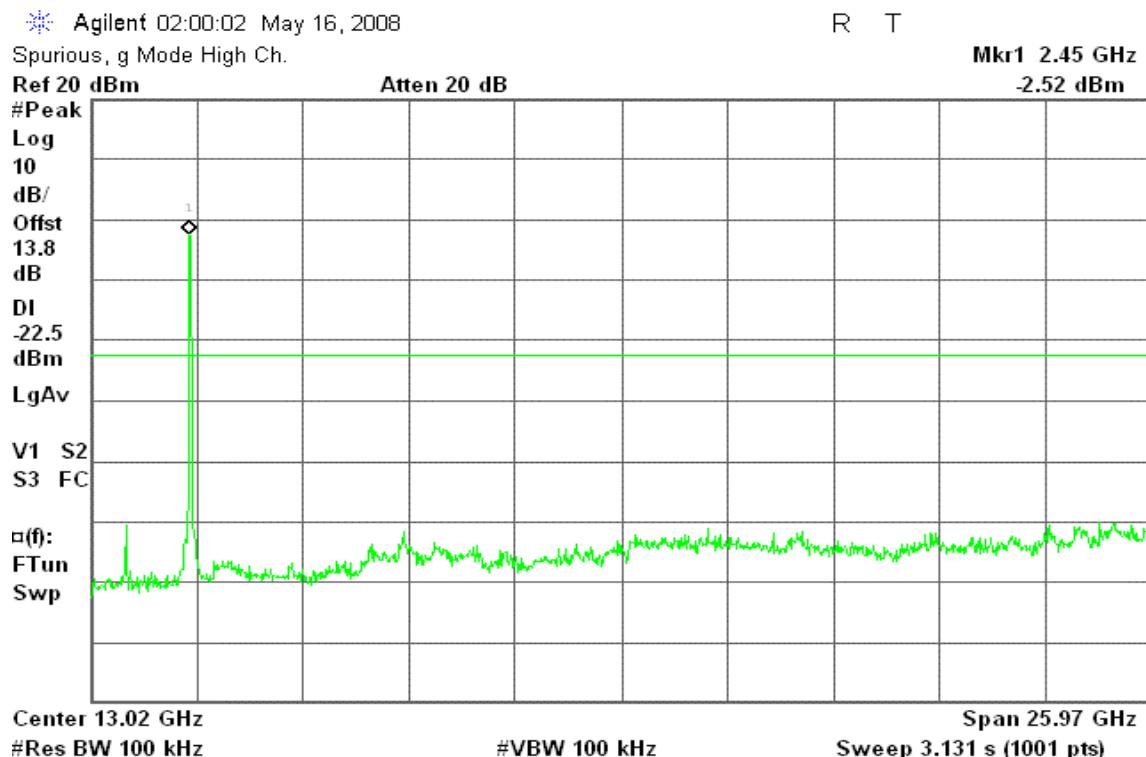
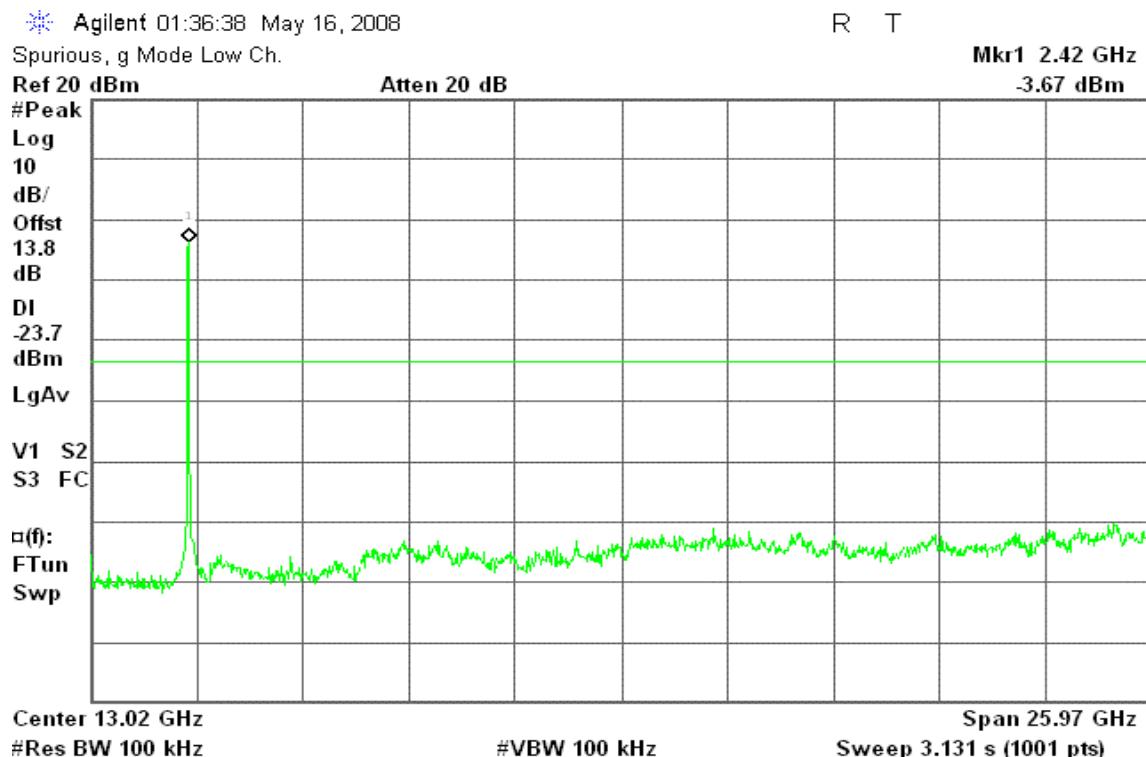
draft 802.11n Standard-20 MHz Channel mode / Chain 2

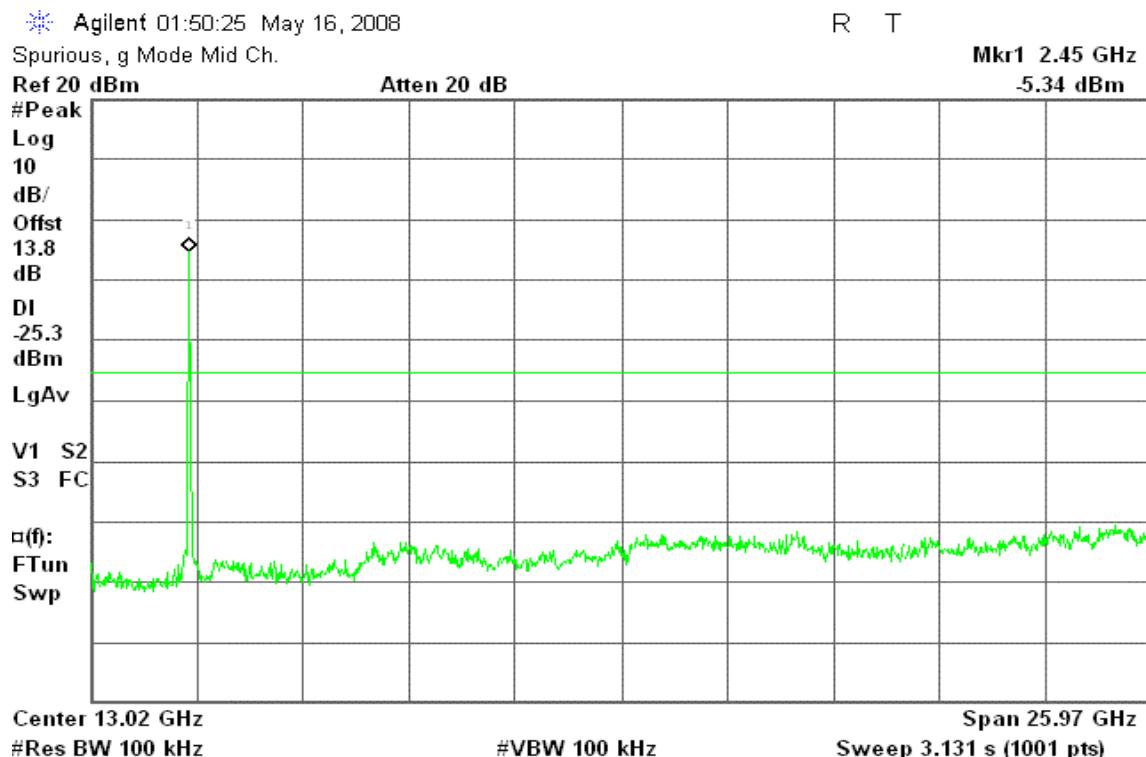
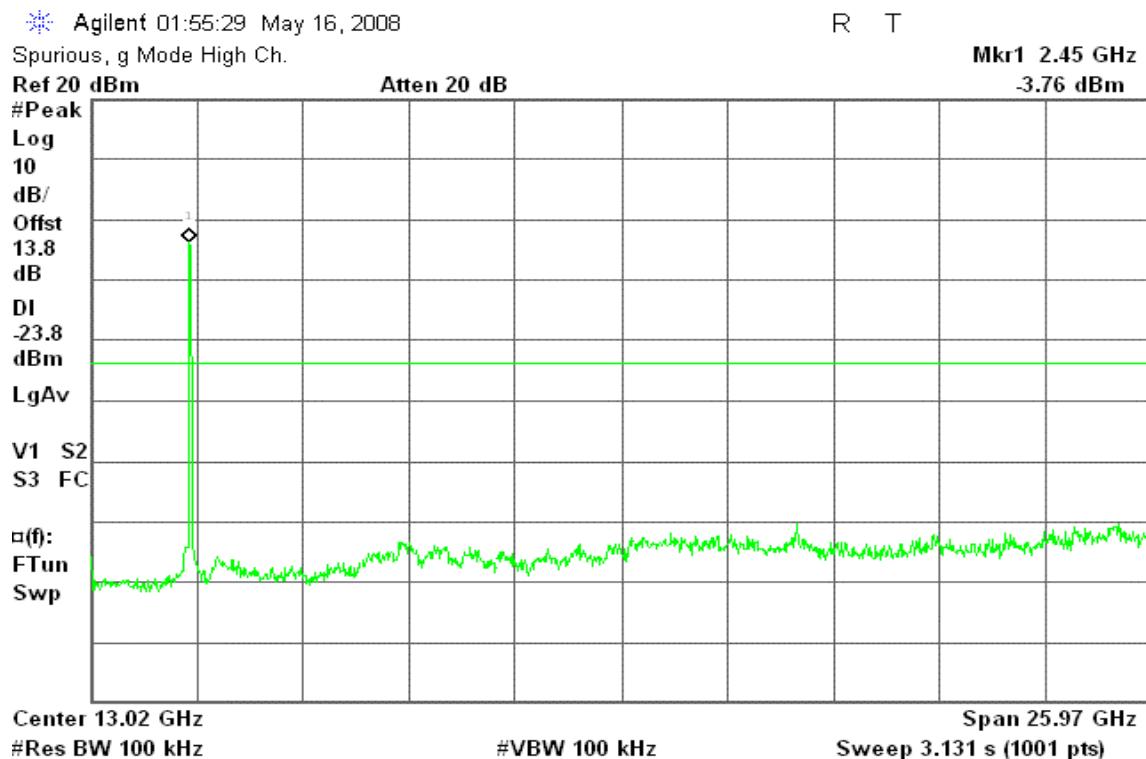
CH Low

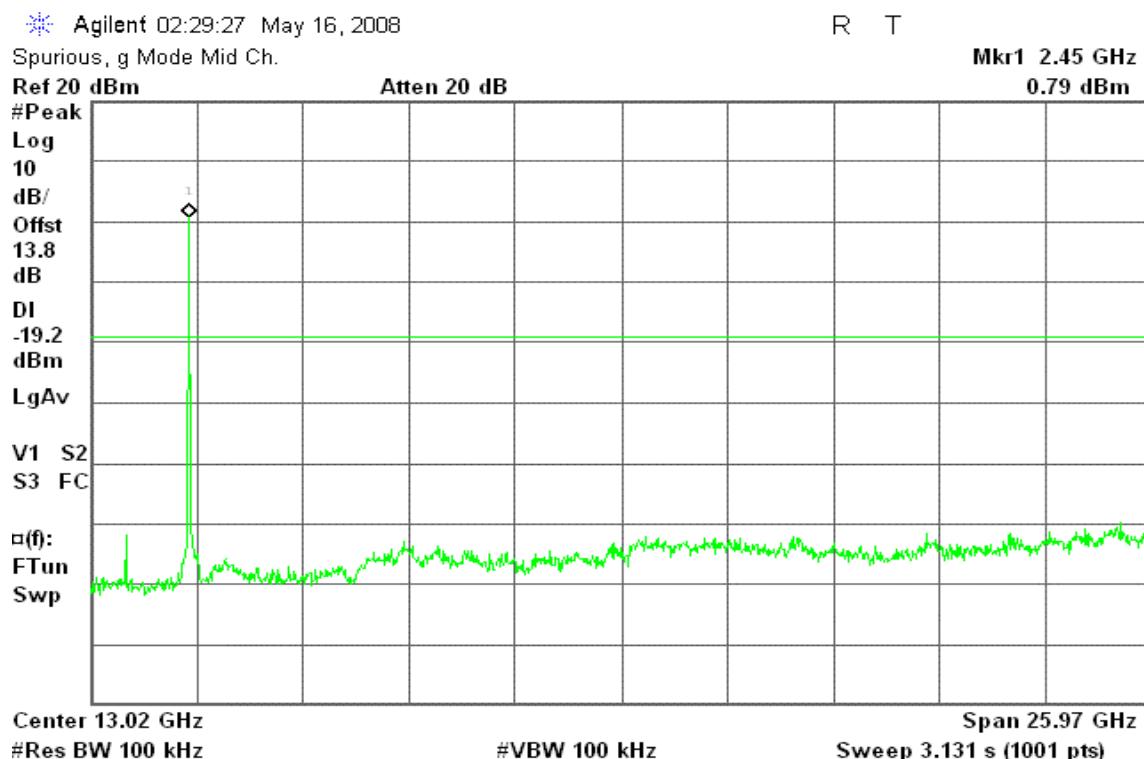


CH Mid**CH High**

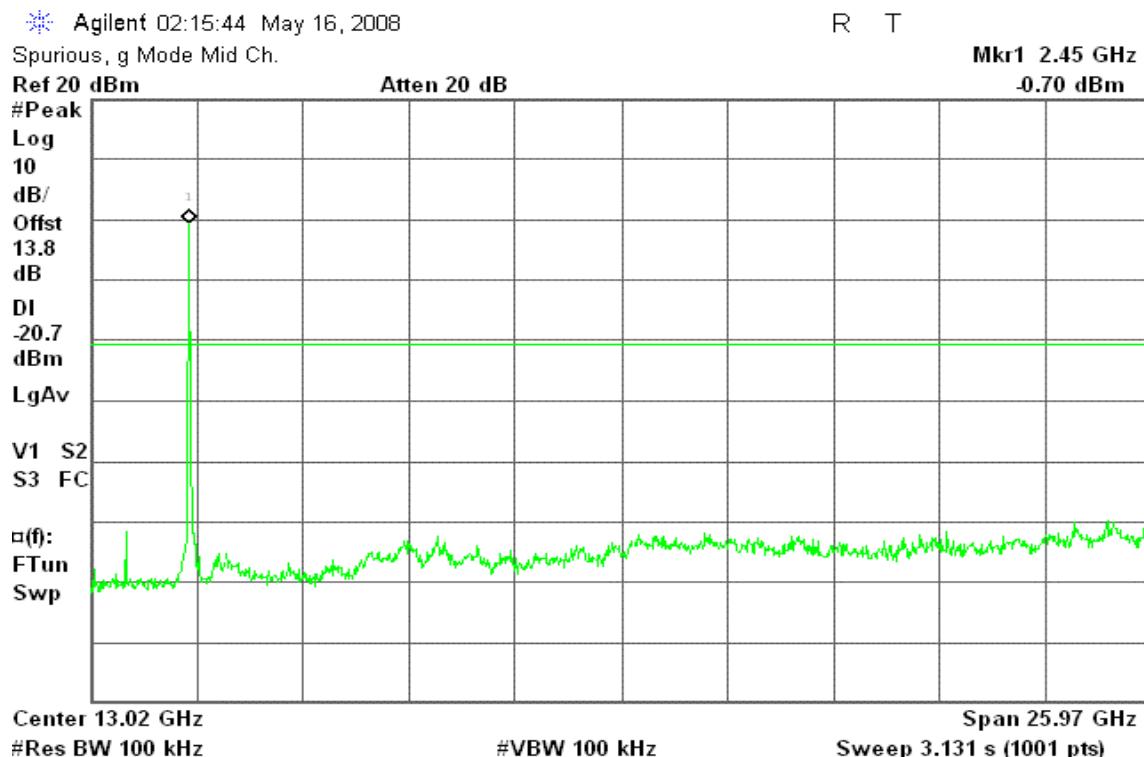
draft 802.11n Wide-40 MHz Channel mode / Chain 0**CH Low****CH Mid**

CH High**draft 802.11n Wide-40 MHz Channel mode / Chain 2****CH Low**

CH Mid**CH High**

draft 802.11n Standard-20 MHz Channel mode with combiner**CH Low****CH Mid**

CH High**draft 802.11n Wide-40 MHz Channel mode with combiner****CH Low**

CH Mid**CH High**



7.7 RADIATED EMISSIONS

LIMIT

1. According to §15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μ V/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

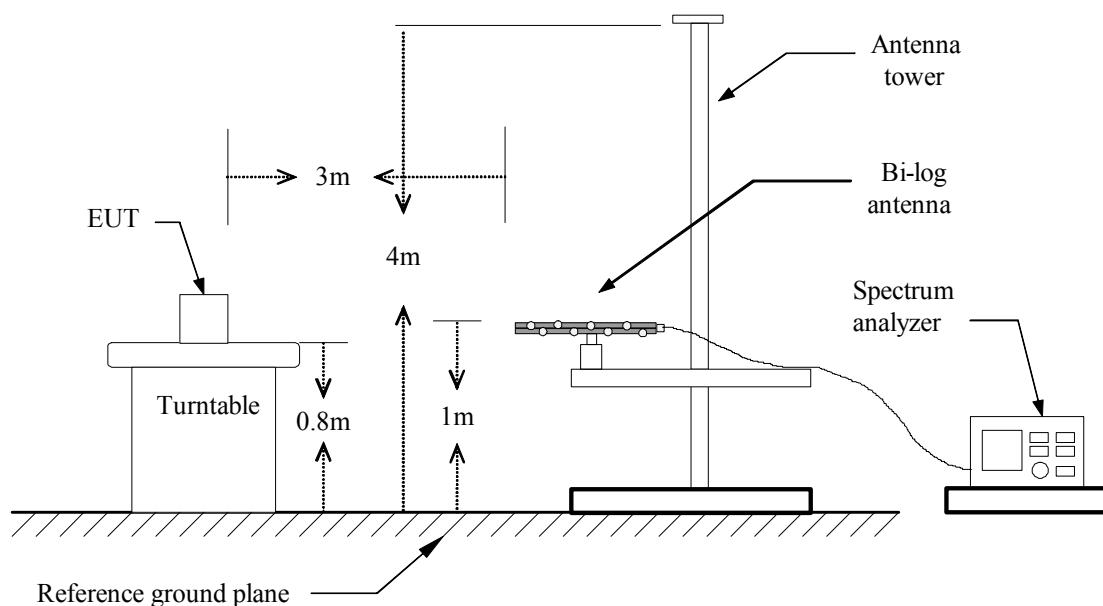
Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

2. In the emission table above, the tighter limit applies at the band edges.

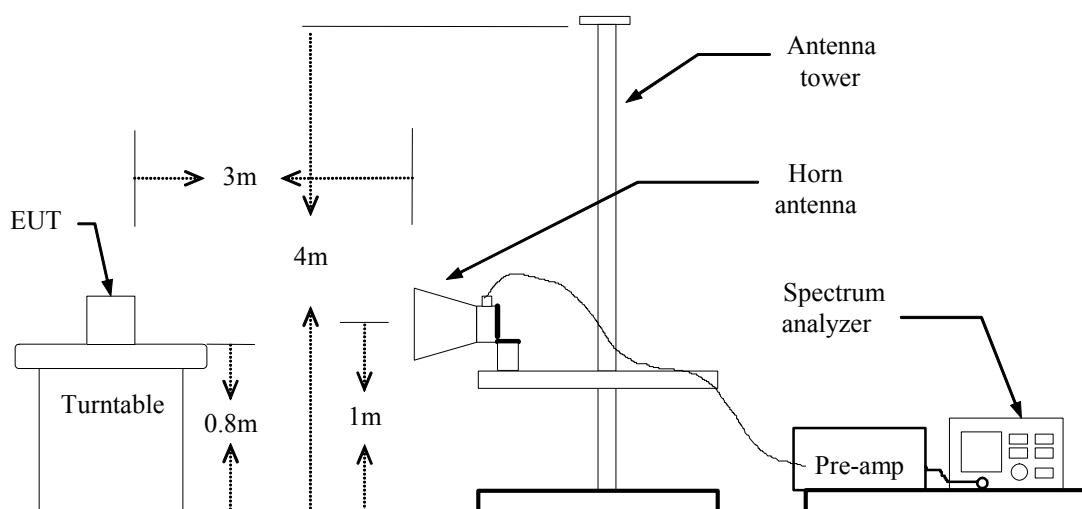
Frequency (MHz)	Field Strength (μ V/m at 3-meter)	Field Strength (dB μ V/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

Test Configuration

Below 1 GHz



Above 1 GHz





TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz:

(a) PEAK: RBW=VBW=1MHz / Sweep=AUTO

(b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO

7. Repeat above procedures until the measurements for all frequencies are complete.

**Below 1GHz****Operation Mode:** Normal Link**Test Date:** May 30, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 53% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
30.00	V	31.20	2.74	33.94	40.00	-6.06	QP
317.77	V	47.04	-5.05	41.99	46.00	-4.01	Peak
374.35	V	45.34	-4.16	41.18	46.00	-4.82	Peak
500.45	V	45.10	-2.03	43.07	46.00	-2.93	QP
624.93	V	43.61	-1.13	42.48	46.00	-3.52	Peak
749.42	V	33.45	0.55	34.01	46.00	-11.99	Peak
30.00	H	30.10	2.74	32.84	40.00	-7.16	QP
249.87	H	43.85	-6.01	37.84	46.00	-8.16	Peak
374.35	H	47.80	-4.16	43.64	46.00	-2.36	QP
500.45	H	45.90	-2.03	43.87	46.00	-2.13	QP
749.42	H	36.76	0.55	37.31	46.00	-8.69	Peak
875.52	H	38.02	0.56	38.58	46.00	-7.42	Peak

Remark:

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.
3. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
4. Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).

**Above 1 GHz****Operation Mode:** TX / IEEE 802.11b / CH Low**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.03	55.15	-10.58	54.45	44.57	74.00	54.00	-9.43	AVG
4825.00	V	50.08	---	0.55	50.63	---	74.00	54.00	-3.37	Peak
N/A										
1420.00	H	59.49	---	-10.10	49.39	---	74.00	54.00	-4.61	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / IEEE 802.11b / CH Mid**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	64.62	54.46	-10.58	54.04	43.88	74.00	54.00	-10.12	AVG
4875.00	V	50.74	---	0.60	51.34	---	74.00	54.00	-2.66	Peak
N/A										
1376.67	H	60.99	---	-10.18	50.81	---	74.00	54.00	-3.19	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / IEEE 802.11b / CH High**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1123.33	V	65.47	55.59	-10.59	54.88	45.00	74.00	54.00	-9.00	AVG
4925.00	V	50.05	---	0.65	50.70	---	74.00	54.00	-3.30	Peak
N/A										
1543.33	H	59.55	---	-9.54	50.01	---	74.00	54.00	-3.99	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / IEEE 802.11g / CH Low**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.47	53.76	-10.58	54.89	43.18	74.00	54.00	-10.82	AVG
N/A										
1376.67	H	61.03	---	-10.18	50.85	---	74.00	54.00	-3.15	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / IEEE 802.11g / CH Mid**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.13	54.54	-10.58	54.55	43.96	74.00	54.00	-10.04	AVG
N/A										
1373.33	H	60.65	---	-10.18	50.47	---	74.00	54.00	-3.53	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** TX / IEEE 802.11g / CH High**Test Date:** May 13, 2008**Temperature:** 23°C**Tested by:** Mimic Young**Humidity:** 52 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	64.59	53.27	-10.58	54.01	42.69	74.00	54.00	-11.31	AVG
N/A										
1376.67	H	61.11	---	-10.18	50.94	---	74.00	54.00	-3.06	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Standard-20 MHz Channel mode / CH Low

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.00	52.27	-10.58	54.42	41.69	74.00	54.00	-12.31	AVG
N/A										
1373.33	H	60.92	---	-10.18	50.74	---	74.00	54.00	-3.26	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Standard-20 MHz Channel mode / CH Mid

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	63.48	---	-10.58	52.90	---	74.00	54.00	-1.10	Peak
N/A										
1376.67	H	60.81	---	-10.18	50.64	---	74.00	54.00	-3.36	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Standard-20 MHz Channel mode / CH High

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.19	53.41	-10.58	54.61	42.83	74.00	54.00	-11.17	AVG
N/A										
1376.67	H	60.98	---	-10.18	50.81	---	74.00	54.00	-3.19	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Wide-40 MHz Channel mode / CH Low

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	65.17	55.24	-10.58	54.59	44.66	74.00	54.00	-9.34	AVG
N/A										
1376.67	H	61.68	---	-10.18	51.51	---	74.00	54.00	-2.49	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Wide-40 MHz Channel mode / CH Mid

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1126.67	V	62.22	---	-10.58	51.64	---	74.00	54.00	-2.36	Peak
N/A										
1373.33	H	62.28	---	-10.18	52.10	---	74.00	54.00	-1.90	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / draft 802.11n Wide-40 MHz Channel mode / CH High

Test Date: May 13, 2008

Temperature: 23°C

Tested by: Mimic Young

Humidity: 52 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Ant. Pol. (H/V)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark
1123.33	V	62.44	---	-10.59	51.85	---	74.00	54.00	-2.15	Peak
N/A										
1373.33	H	62.45	---	-10.18	52.27	---	74.00	54.00	-1.73	Peak
N/A										

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with “N/A” remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Average limit (dBuV/m).



7.8 POWERLINE CONDUCTED EMISSIONS

LIMIT

According to §15.207(a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

* Decreases with the logarithm of the frequency.

Test Configuration

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.



TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Test Data

Operation Mode: Normal Link **Test Date:** May 28, 2008
Temperature: 22°C **Tested by:** Wolf Huang
Humidity: 45% RH

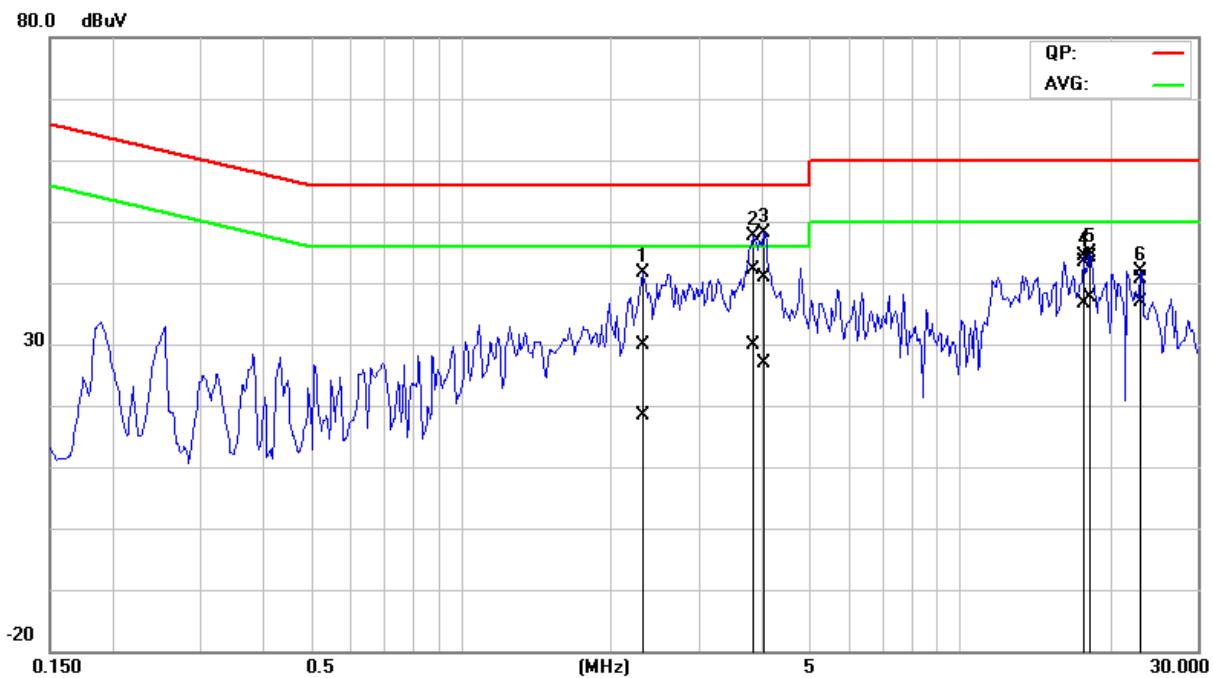
Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB/m)	QP Result (dBuV/m)	AV Result (dBuV/m)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
2.3100	29.75	18.45	0.05	29.80	18.50	56.00	46.00	-26.20	-27.50	L1
3.8550	41.95	29.85	0.15	42.10	30.00	56.00	46.00	-13.90	-16.00	L1
4.0700	40.63	26.73	0.17	40.80	26.90	56.00	46.00	-15.20	-19.10	L1
17.6943	42.62	35.92	0.68	43.30	36.60	60.00	50.00	-16.70	-13.40	L1
18.2437	43.51	36.91	0.69	44.20	37.60	60.00	50.00	-15.80	-12.40	L1
23.1300	39.77	36.17	0.83	40.60	37.00	60.00	50.00	-19.40	-13.00	L1
3.1500	38.29	28.79	0.11	38.40	28.90	56.00	46.00	-17.60	-17.10	L2
3.8150	44.15	44.15	0.15	44.30	44.30	56.00	46.00	-11.70	-1.70	L2
4.0150	43.44	32.14	0.16	43.60	32.30	56.00	46.00	-12.40	-13.70	L2
5.7889	44.32	37.62	0.28	44.60	37.90	60.00	50.00	-15.40	-12.10	L2
11.9500	38.00	31.00	0.60	38.60	31.60	60.00	50.00	-21.40	-18.40	L2
18.3050	42.11	36.21	0.69	42.80	36.90	60.00	50.00	-17.20	-13.10	L2

Remark:

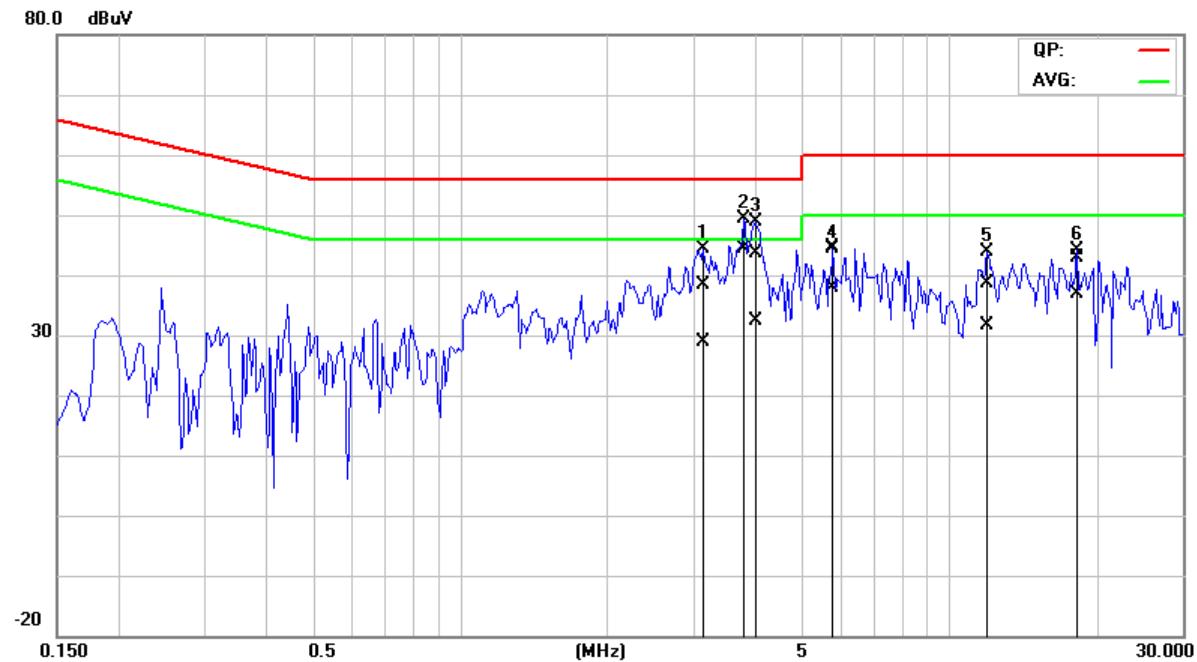
1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10 kHz; the IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9 kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)





APPENDIX I

RADIO FREQUENCY EXPOSURE

LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

EUT Specification

EUT	Wireless-N Gigabit Security Router with VPN
Frequency band (Operating)	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input type="checkbox"/> Others
Device category	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
Exposure classification	<input type="checkbox"/> Occupational/Controlled exposure ($S = 5\text{mW/cm}^2$) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ($S=1\text{mW/cm}^2$)
Antenna diversity	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input checked="" type="checkbox"/> Tx/Rx diversity
Max. output power	IEEE 802.11b mode: 15.51 dBm(35.56 mW) IEEE 802.11g mode: 18.82 dBm(76.21 mW) draft 802.11n Standard-20 MHz Channel mode: 20.86 dBm(121.90 mW) draft 802.11n Wide-40 MHz Channel mode: 21.24 dBm(133.05 mW)
Antenna gain (Max)	1.8 dBi (Numeric gain: 1.51)
Evaluation applied	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A

Remark:

1. The maximum output power is 21.24dBm (133.05mW) at 2437MHz (with 1.51 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.

TEST RESULTS

No non-compliance noted.

**Calculation**

$$\text{Given } E = \frac{\sqrt{30 \times P \times G}}{d} \quad \& \quad S = \frac{E^2}{3770}$$

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 and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770d^2}$$

Changing to units of mW and cm, using:

$$P (\text{mW}) = P (\text{W}) / 1000 \text{ and}$$

$$d (\text{cm}) = d(\text{m}) / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where d = Distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²

Maximum Permissible Exposure

Substituting the MPE safe distance using $d = 20$ cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where P = Power in mW

G = Numeric antenna gain

S = Power density in mW / cm²



IEEE 802.11b mode:

EUT output power = 35.56 mW

Numeric Antenna gain = 1.51

→ Power density = 0.0107 mW/cm²

IEEE 802.11g mode:

EUT output power = 76.21 mW

Numeric Antenna gain = 1.51

→ Power density = 0.0229 mW/cm²

draft 802.11n Standard-20 MHz Channel mode:

EUT output power = 121.90 mW

Numeric Antenna gain = 1.51

→ Power density = 0.0366 mW/cm²

draft 802.11n Wide-40 MHz Channel mode:

EUT output power = 133.05mW

Numeric Antenna gain = 1.51

→ Power density = 0.03998 mW/cm²

(For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.)