FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

802.11a/b/g AP

Model: SS-200-AT

Trade Name: AirTight Networks

Issued to

AirTight Networks, Inc
339N. Bernardo Avenue, Suite 200 Mountain View, CA 94043

Issued by

Compliance Certification Services Inc.
No. 81-1, Lane 210, Bade Rd. 2, Luchu Hsiang, Taoyuan Hsien, (338) Taiwan, R.O.C.
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CNLA
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ILAC MRA

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1. TEST RESULT CERTIFICATION

Applicant: AirTight Networks, Inc
339N. Bernardo Avenue, Suite 200 Mountain View,
CA 94043

Equipment Under Test: 802.11a/b/g AP

Trade Name: AirTight Networks

Model: SS-200-AT

Date of Test: September 14 ~ October 7, 2005

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:

Gavin Lim
Section Manager
Compliance Certification Services Inc.

Reviewed by:

Amanda Wu
Section Manager
Compliance Certification Services Inc.

2. EUT DESCRIPTION

<table>
<tr><td>Product</td><td colspan="5">802.11a/b/g AP</td></tr>
<tr><td>Trade Name</td><td colspan="5">AirTight Networks</td></tr>
<tr><td>Model Number</td><td colspan="5">SS-200-AT</td></tr>
<tr><td>Model Discrepancy</td><td colspan="5">N/A</td></tr>
<tr><td>Power Supply</td><td colspan="5">DELTA / ADP-15KB
I/P: AC 100-240V, 0.5A, 50-60Hz
O/P: DC 5.1V, 3.0A</td></tr>
<tr><td>Frequency Range</td><td colspan="5">IEEE 802.11a Base mode: 5.745~5.825 GHz
Turbo mode: 5.760 GHz / 5.800 GHz
IEEE 802.11b/g Base mode: 2.412~2.462 GHz
IEEE 802.11g Turbo mode: 2.437 GHz</td></tr>
<tr><td rowspan="4">Transmit Power</td><td></td><td>b Base mode (dBm)</td><td>g Base mode (dBm)</td><td>g Turbo mode (dBm)</td><td>a Base mode (dBm)</td><td>a Turbo mode (dBm)</td></tr>
<tr><td>Omnidirectional antenna / 12.0 dBi for 2.4 GHz</td><td>19.68</td><td>14.76</td><td>16.1</td><td></td><td></td></tr>
<tr><td>Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz</td><td>21.64</td><td>19.9</td><td>20.18</td><td>19.63</td><td>19.72</td></tr>
<tr><td>Omnidirectional antenna / 6.0 dBi for 5 GHz</td><td></td><td></td><td></td><td>19.63</td><td>19.72</td></tr>
<tr><td>Modulation Technique</td><td colspan="5">IEEE 802.11a: OFDM (QPSK, BPSK, 16-QAM, 64-QAM)
IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK)
IEEE 802.11g: DSSS (CCK, DQPSK, DBPSK) + OFDM (QPSK, BPSK, 16-QAM, 64-QAM)</td></tr>
<tr><td>Transmit Data Rate</td><td colspan="5">IEEE 802.11a: 108, 54, 48, 36, 24, 18, 12, 9, 6 Mbps
IEEE 802.11b: 11, 5.5, 2, 1 Mbps
IEEE 802.11g: 108, 54, 48, 36, 24, 18, 12, 11, 9, 6, 5.5, 2, 1Mbps</td></tr>
<tr><td>Number of Channels</td><td colspan="5">IEEE 802.11a Base mode: 5 Channels
Turbo mode: 2 Channels
IEEE 802.11b/g Base mode: 11 Channels
IEEE 802.11g Turbo mode: 1 Channel</td></tr>
<tr><td>Enclosure Material Type</td><td colspan="5">Metal</td></tr>
<tr><td>Antenna Specification</td><td colspan="5">The EUT comes with five different antennas:
Omnidirectional antenna / 12.0 dBi for 2.4 GHz
Omnidirectional antenna / 10.5 dBi for 2.4 GHz
Omnidirectional antenna / 5.2 dBi for 2.4 GHz
Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz
Omnidirectional antenna / 6.0 dBi for 5 GHz
For detail descriptions, please refer to antenna specification and external photos.</td></tr>
</table>

Remark:

1. *The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*
2. *This submittal(s) (test report) is intended for FCC ID: **TORSS-200-AT** 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 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[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: SS-200-AT) comes with five different antennas.

The EUT with antenna as below had been tested under operating condition.

1. **Omnidirectional antenna / 12.0 dBi for 2.4 GHz**
2. **Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz**
3. **Omnidirectional antenna / 6.0 dBi for 5 GHz**

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, which worst case was in normal link mode only.

IEEE802.11a Base mode:
Channel Low(5745MHz), Channel Mid(5785MHz) and Channel High(5825MHz) with 6Mbps data rate were chosen for full testing.

IEEE802.11a Turbo mode:
Channel Low(5760MHz), Channel High(5800MHz) with 12Mbps data rate were chosen for full testing.

IEEE802.11b Base mode:
Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 11Mbps data rate were chosen for full testing.

IEEE802.11g Base mode:
Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 6Mbps data rate were chosen for full testing.

IEEE802.11g Turbo mode:
Channel Mid(2437MHz) with 12Mbps data rate was chosen for full testing.

4. 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.

4.1 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	01/10/2006

3M Semi Anechoic Chamber				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	Agilent	E4446A	US42510252	07/25/2006
Test Receiver	Rohde&Schwarz	ESCI	100064	06/28/2006
Switch Controller	TRC	Switch Controller	SC94050010	05/05/2006
4 Port Switch	TRC	4 Port Switch	SC94050020	05/05/2006
Horn-Antenna	TRC	HA-0502	06	06/02/2006
Horn-Antenna	TRC	HA-0801	04	05/05/2006
Bilog- Antenna	Sunol Sciences	JB3	A030205	03/09/2006
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	965860	09/26/2008
Test S/W	LABVIEW (V 6.1)			

Remark: *The measurement uncertainty is less than +/- 2.0065dB, 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	09/24/2006
TWO-LINE V-NETWORK 9kHz-30MHz	SCHAFFNER	NNB41	03/10013	06/11/2006
LISN 10kHz-100MHz	EMCO	3825/2	9106-1809	02/17/2006
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. 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 LABORATORY ACCREDITATIONS AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200600-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (Registration no: 93105 and 90471).

5.4 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP*	EN 55011, EN 55014-1, AS/NZS 1044, CNS 13783-1, EN 55022, CNS 13438, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, FCC OST/MP-5, AS/NZS CISPR 22, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11	200600-0
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 300 328-2, 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	CNLA	EN 300 328-1/2, EN 300 220-1/2/3, EN 300 440-1/2, EN 61000-3-2, EN 61000-3-3, 47 CFR FCC Part 15 Subpart C/D/E, EN 55013, CNS 13439, EN 55014-1, CNS 13783-1, EN 55022, CNS 13438, CISPR 22, AS/NZS 3548, EN 61000-4-2/3/4/5/6/8/11, ENV 50204, IEEE Std 1528, FCC OET Bulletin, 65+Supplement C, EN50360, EN50361, EN50371, RSS102	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 3991-3, IC 3991-4) / 3M Semi Anechoic Chamber (IC 6106) to perform RSS 212 Issue 1	IC 3991-3 IC 3991-4 IC 6106

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

** Australia: MRA of NVLAP AS/NZS 4771 &AS/NZS 4268.*

6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC (Remote)	IBM	2672(X31)	99PBTKB	FCC DoC	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.*

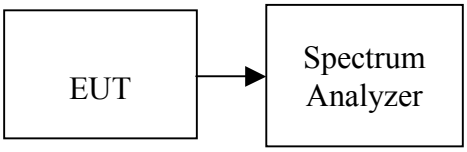
7. FCC PART 15.247 REQUIREMENTS

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 = 100kHz, VBW = RBW, Span = 50MHz, 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

Omnidirectional antenna / 12.0 dBi for 2.4 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Low	2412	11250	>500	PASS
Mid	2437	10170		PASS
High	2462	12250		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)		Bandwidth (kHz)	Limit (kHz)	Test Result
Low	Base mode	2412	16500	>500	PASS
Mid		2437	16500		PASS
High		2462	16420		PASS
Mid	Turbo mode	2437	32670		PASS

Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Low	2412	11080	>500	PASS
Mid	2437	10000		PASS
High	2462	12080		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)		Bandwidth (kHz)	Limit (kHz)	Test Result
Low	Base mode	2412	16420	>500	PASS
Mid		2437	16500		PASS
High		2462	16500		PASS
Mid	Turbo mode	2437	33080		PASS

Test mode: IEEE 802.11a mode

Channel	Frequency (MHz)		Bandwidth (kHz)	Limit (kHz)	Test Result
Low	Base mode	5745	16500	>500	PASS
Mid		5785	16500		PASS
High		5825	16500		PASS
Low	Turbo mode	5760	33000		PASS
High		5800	32920		PASS

Omnidirectional antenna / 6.0 dBi for 5 GHz

Test mode: IEEE 802.11a mode

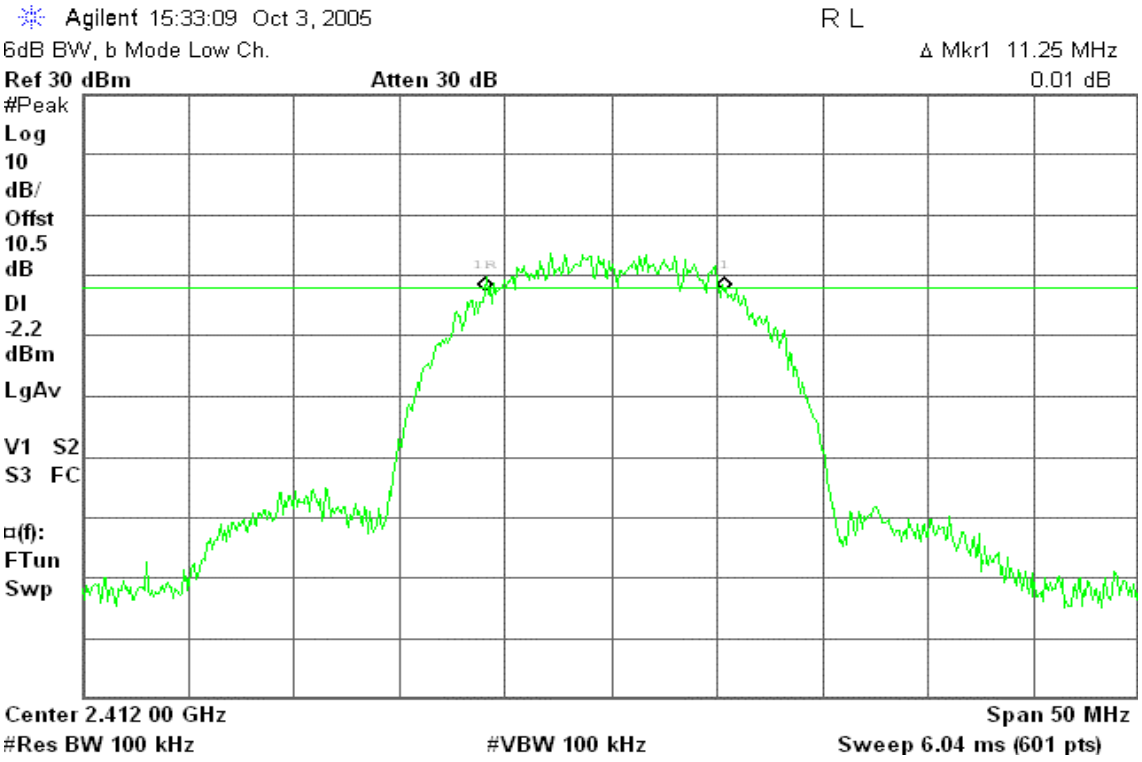
Channel	Frequency (MHz)		Bandwidth (kHz)	Limit (kHz)	Test Result
Low	Base mode	5745	16500	>500	PASS
Mid		5785	16500		PASS
High		5825	16500		PASS
Low	Turbo mode	5760	33000		PASS
High		5800	32920		PASS

Test Plot

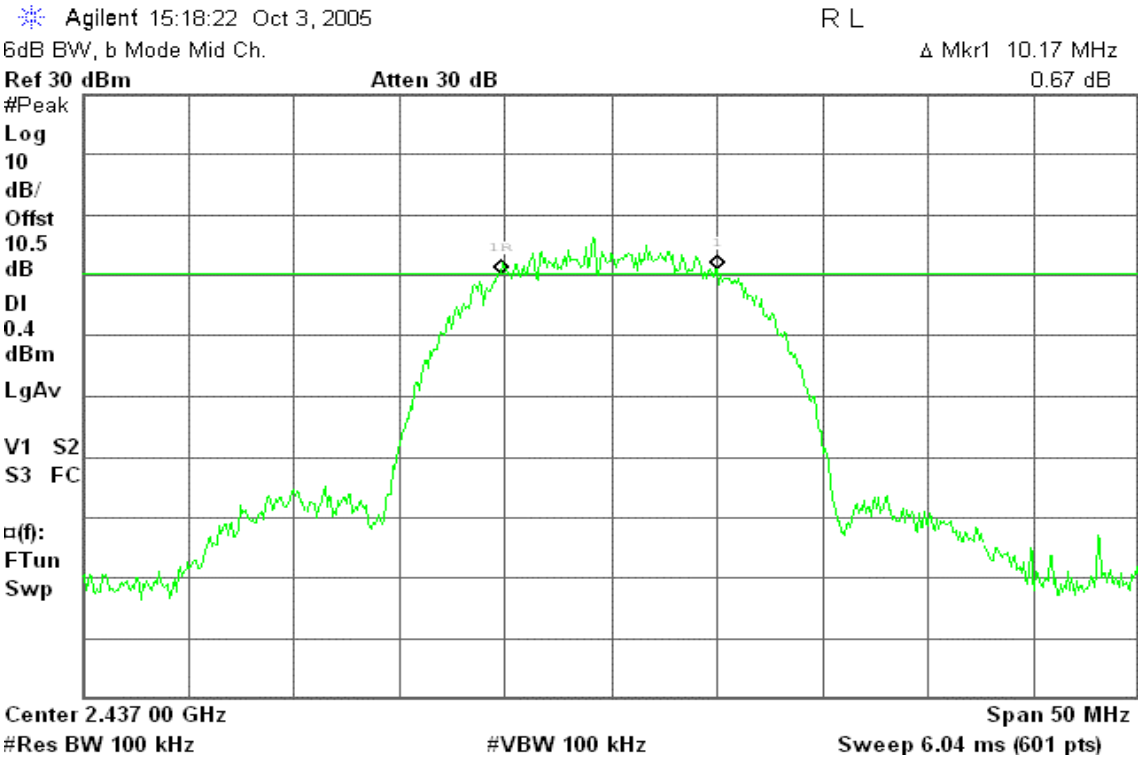
Omnidirectional antenna / 12.0 dBi for 2.4 GHz

IEEE 802.11b Base mode

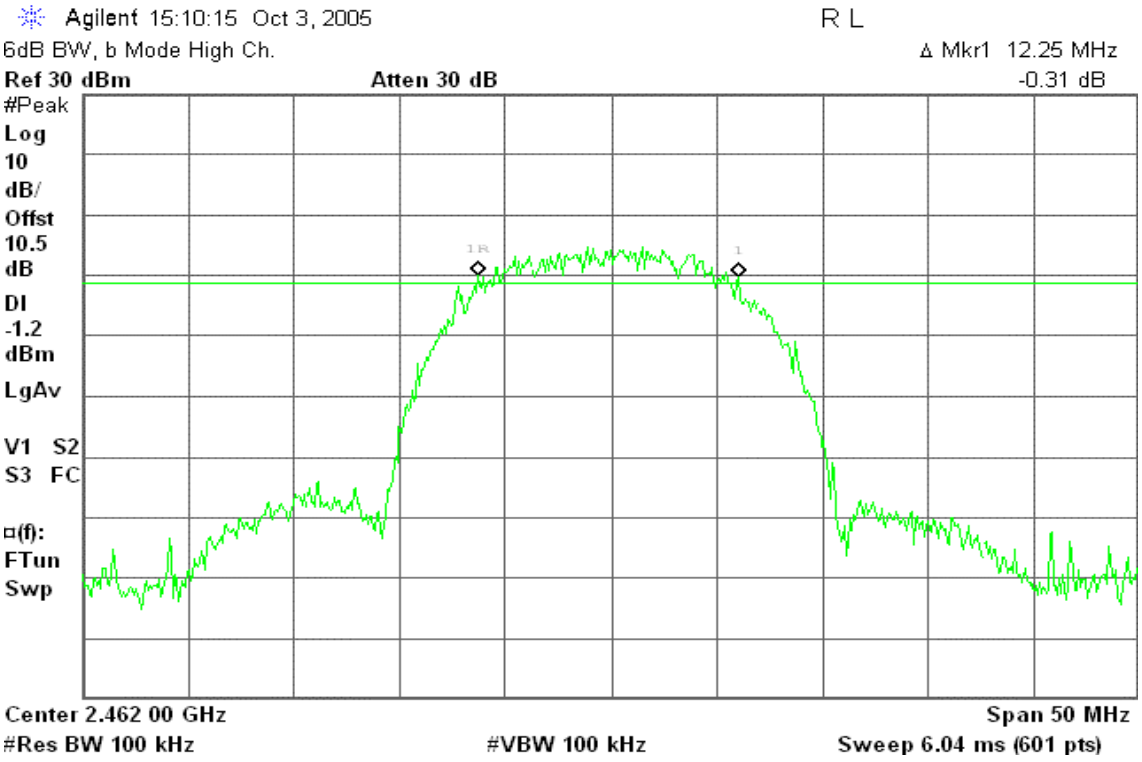
CH Low



CH Mid

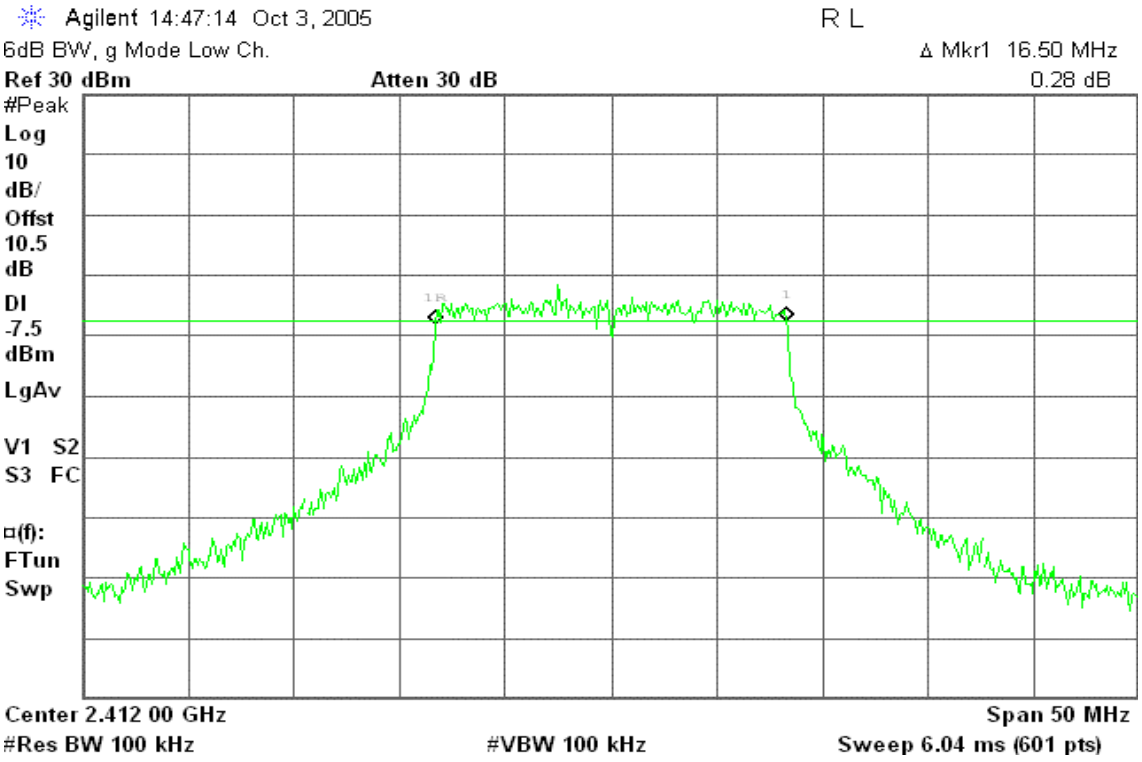


CH High

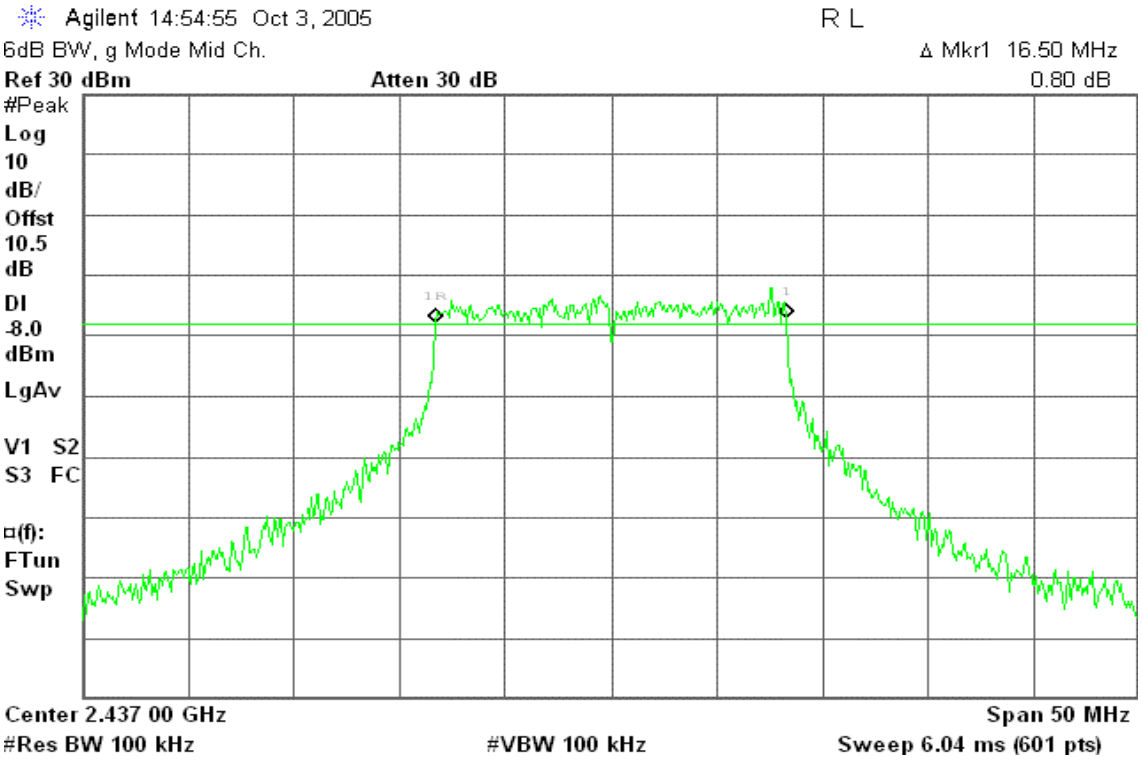


IEEE 802.11g Base mode

CH Low



CH Mid



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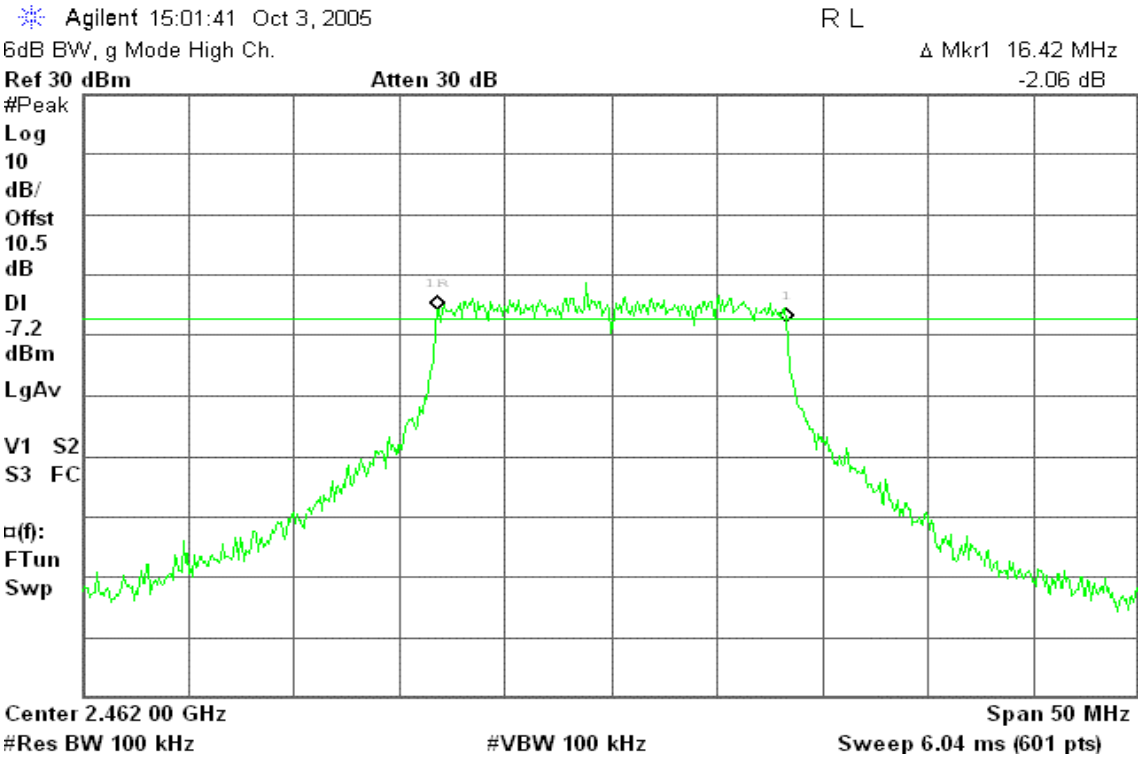
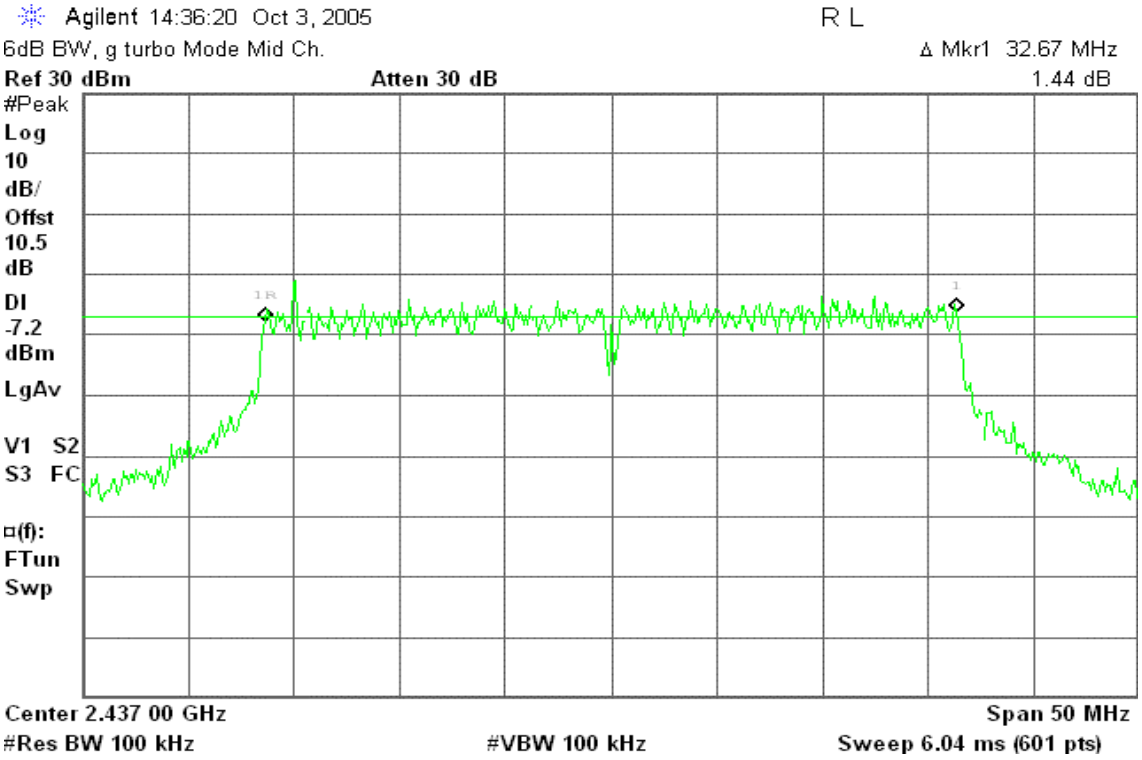


IEEE 802.11g Turbo mode

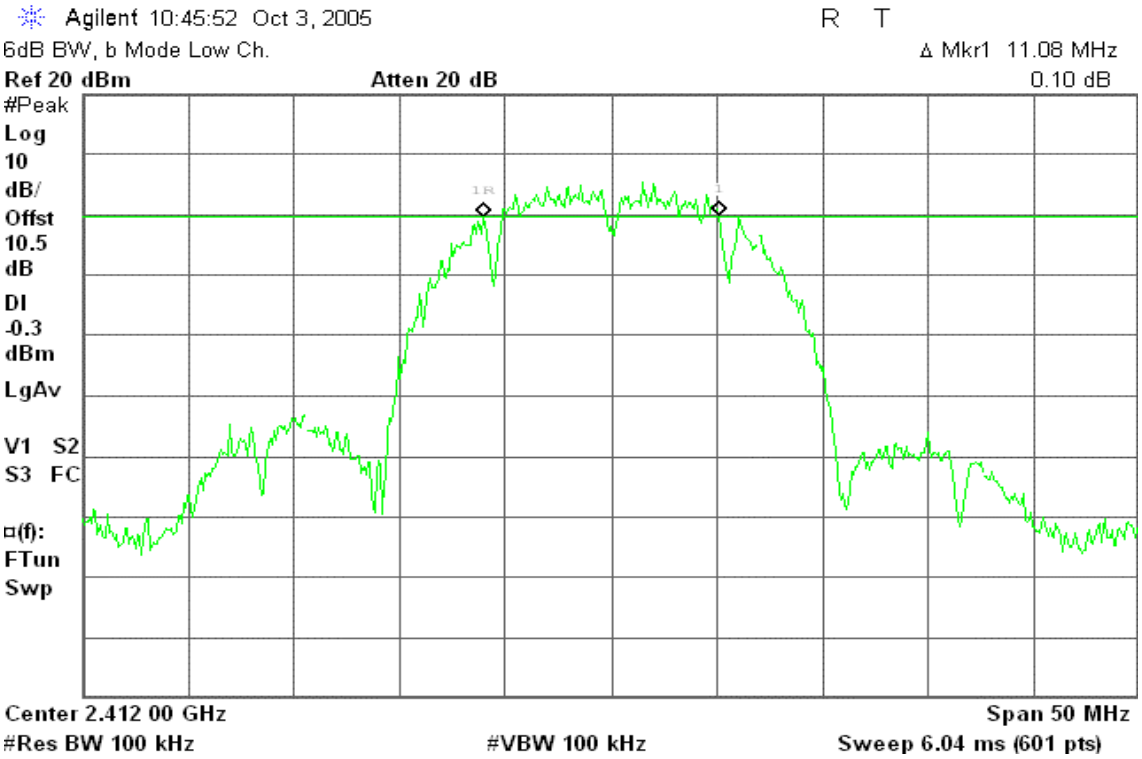
CH Mid



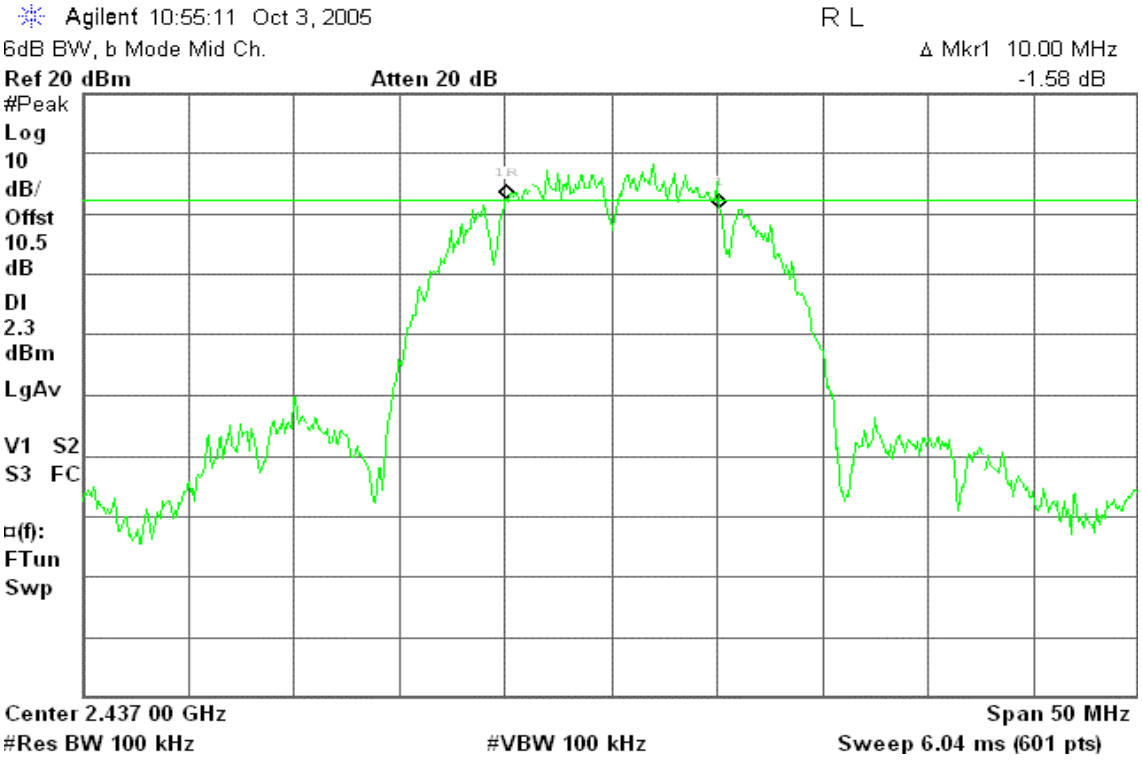
Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

IEEE 802.11b Base mode

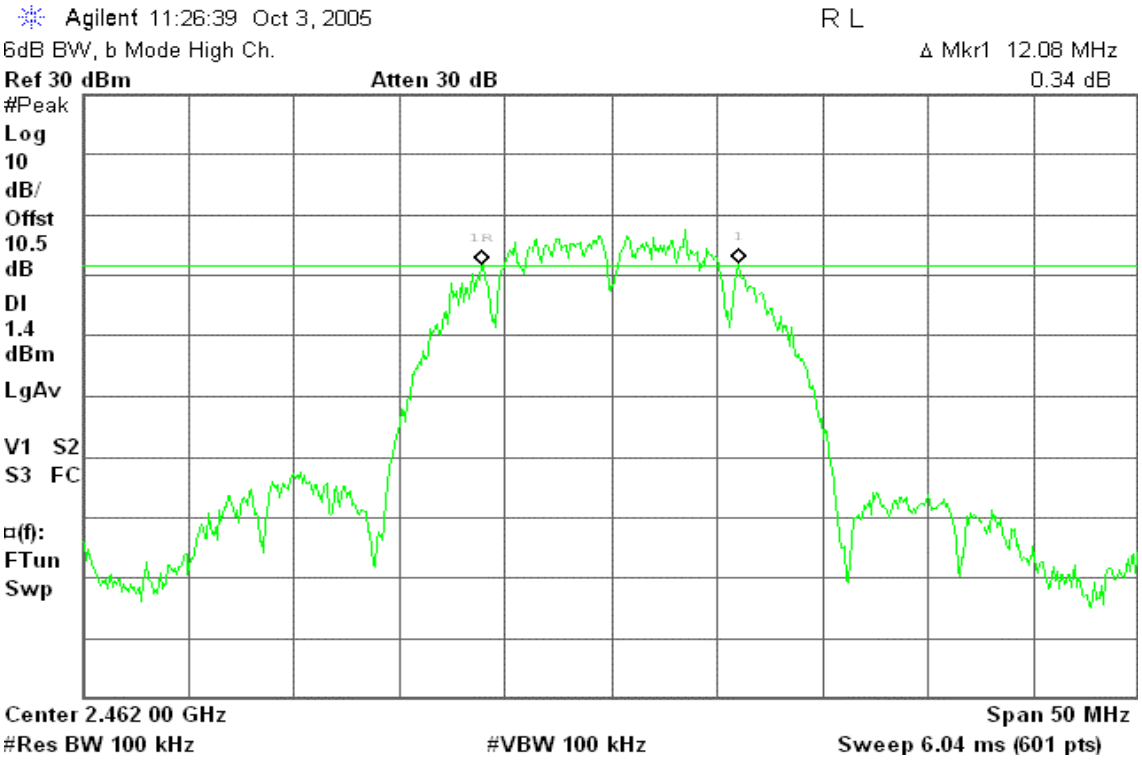
CH Low



CH Mid

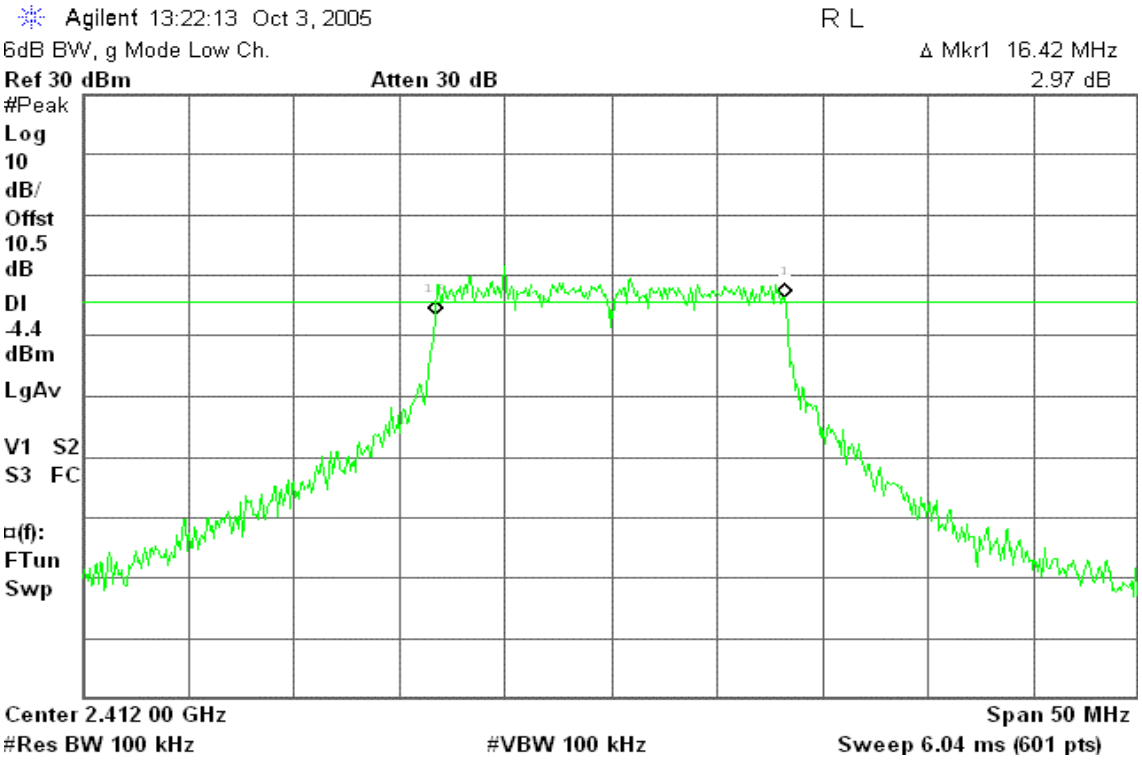


CH High

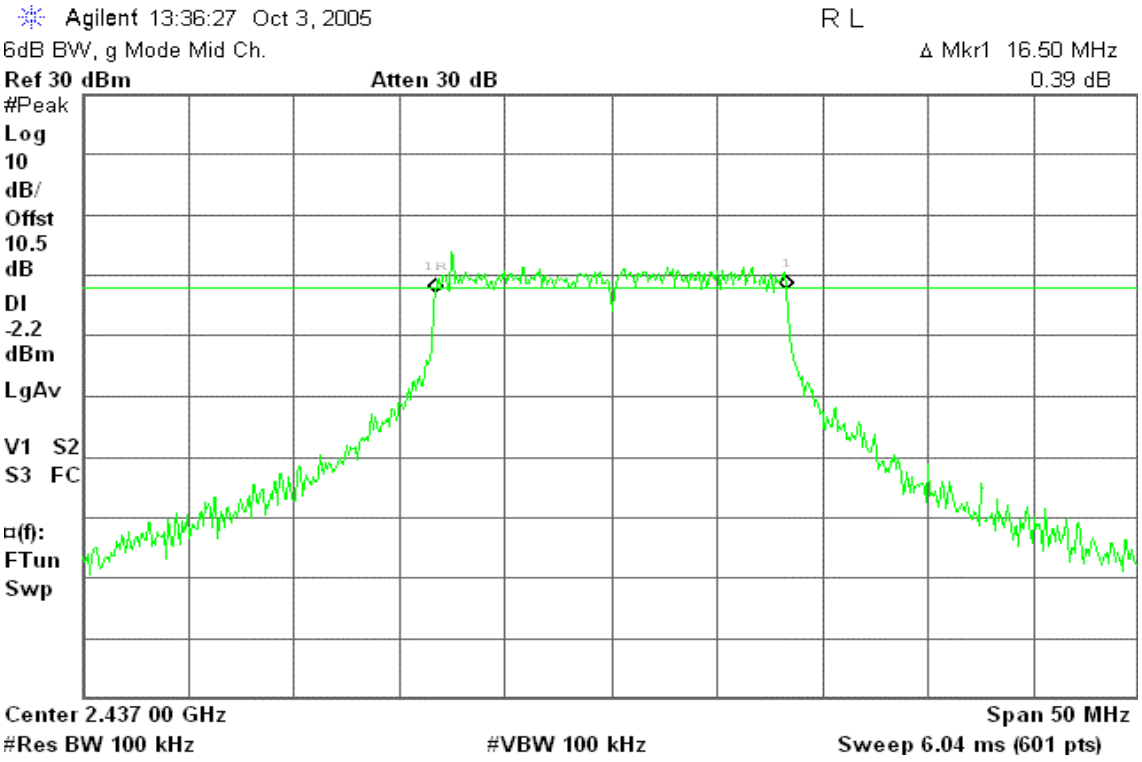


IEEE 802.11g Base mode

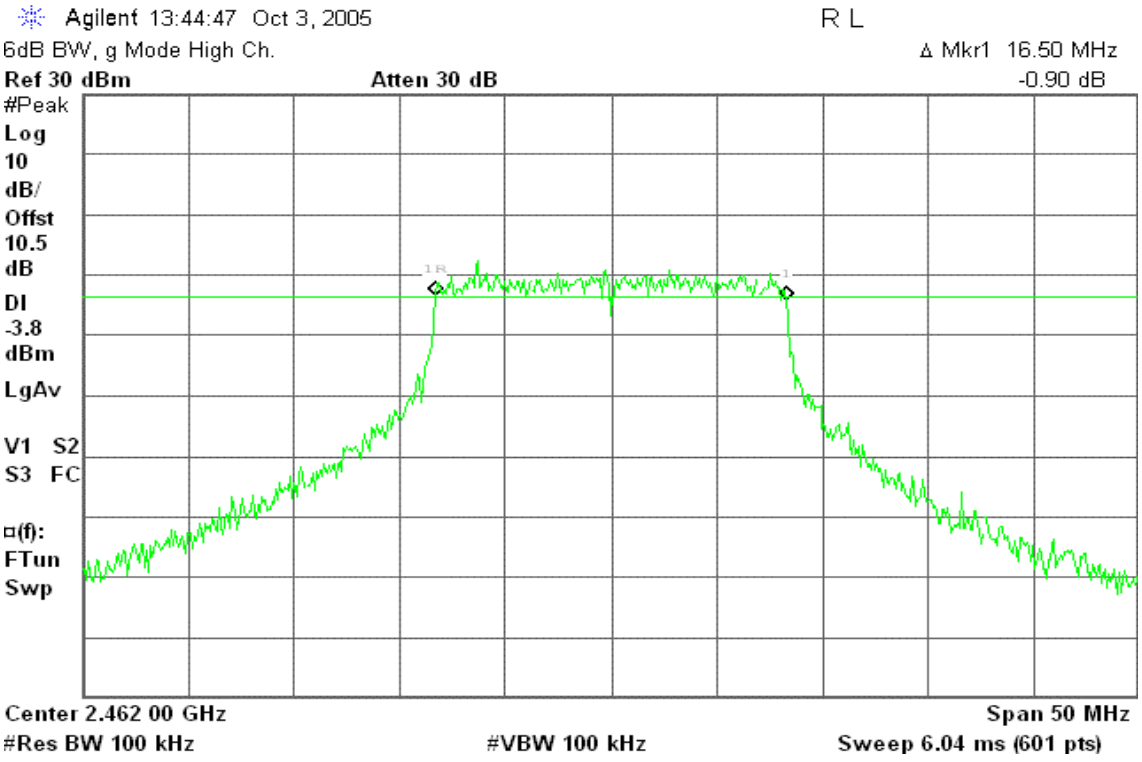
CH Low



CH Mid

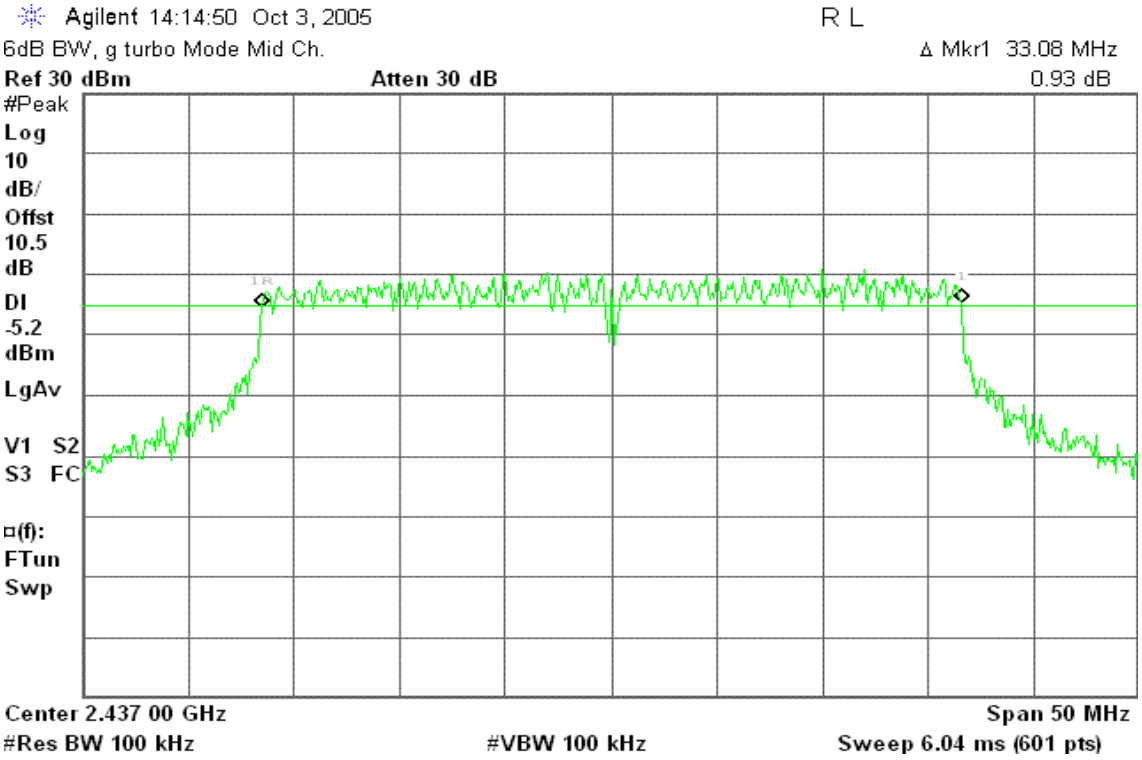


CH High



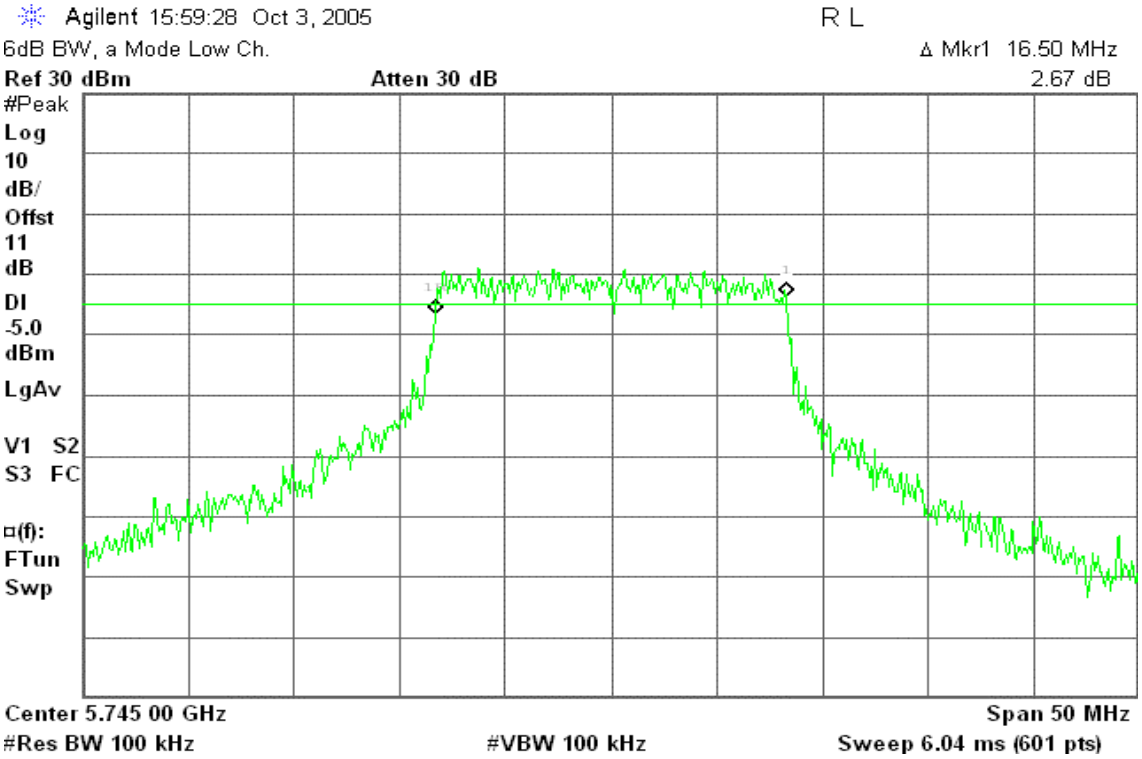
IEEE 802.11g Turbo mode

CH Mid

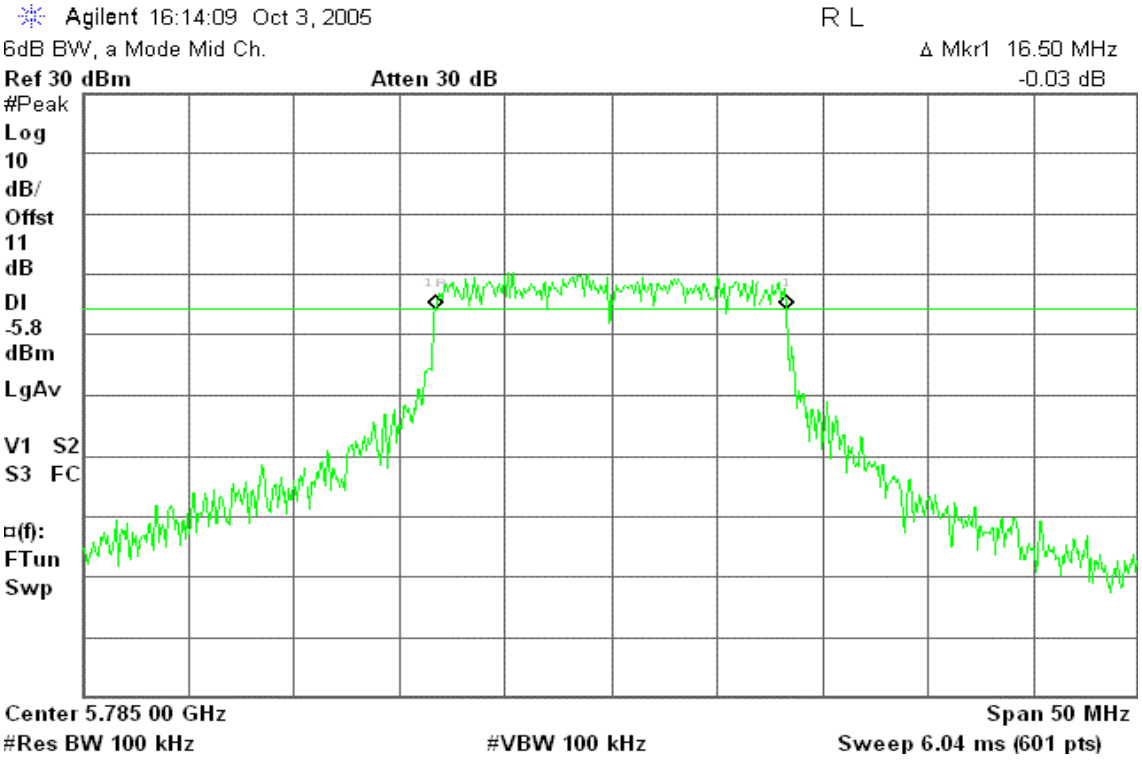


IEEE 802.11a Base mode

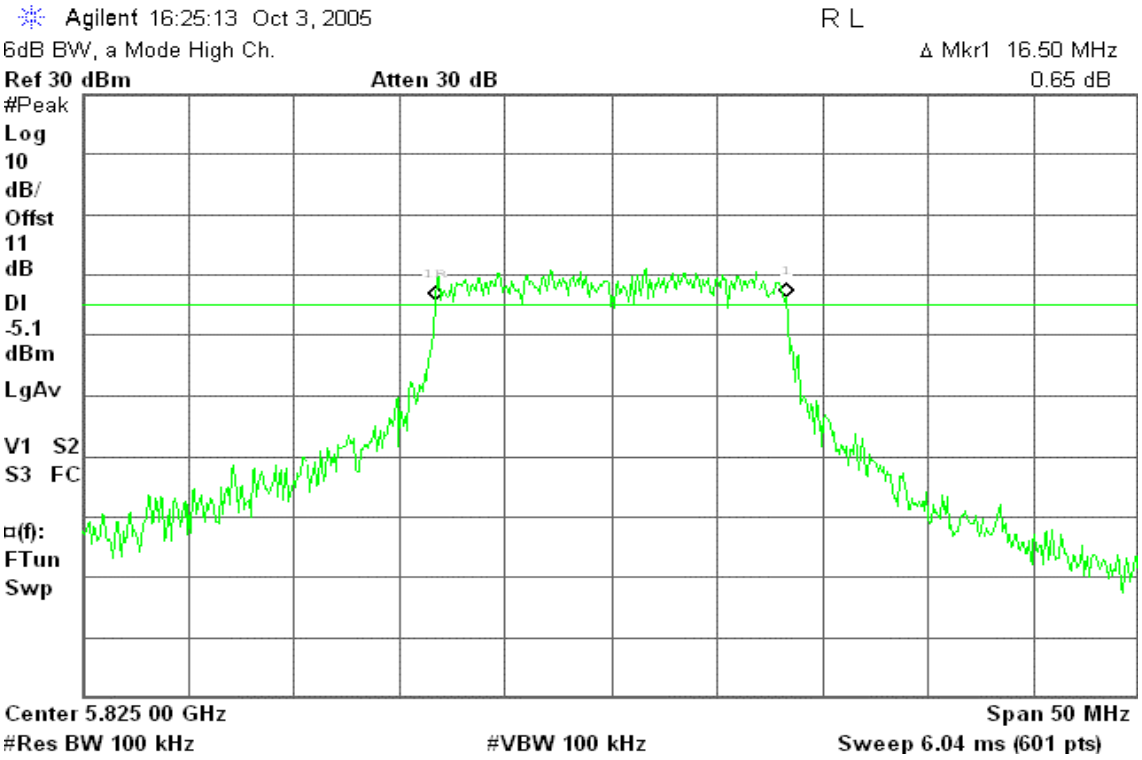
CH Low



CH Mid

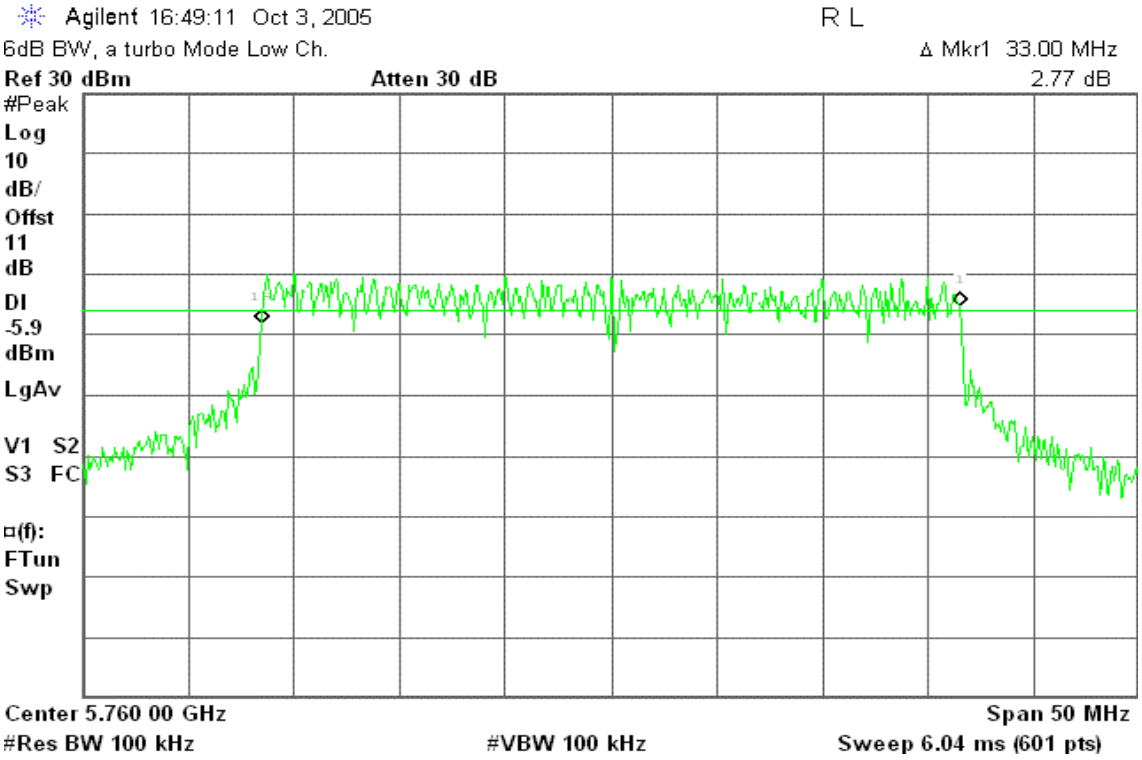


CH High

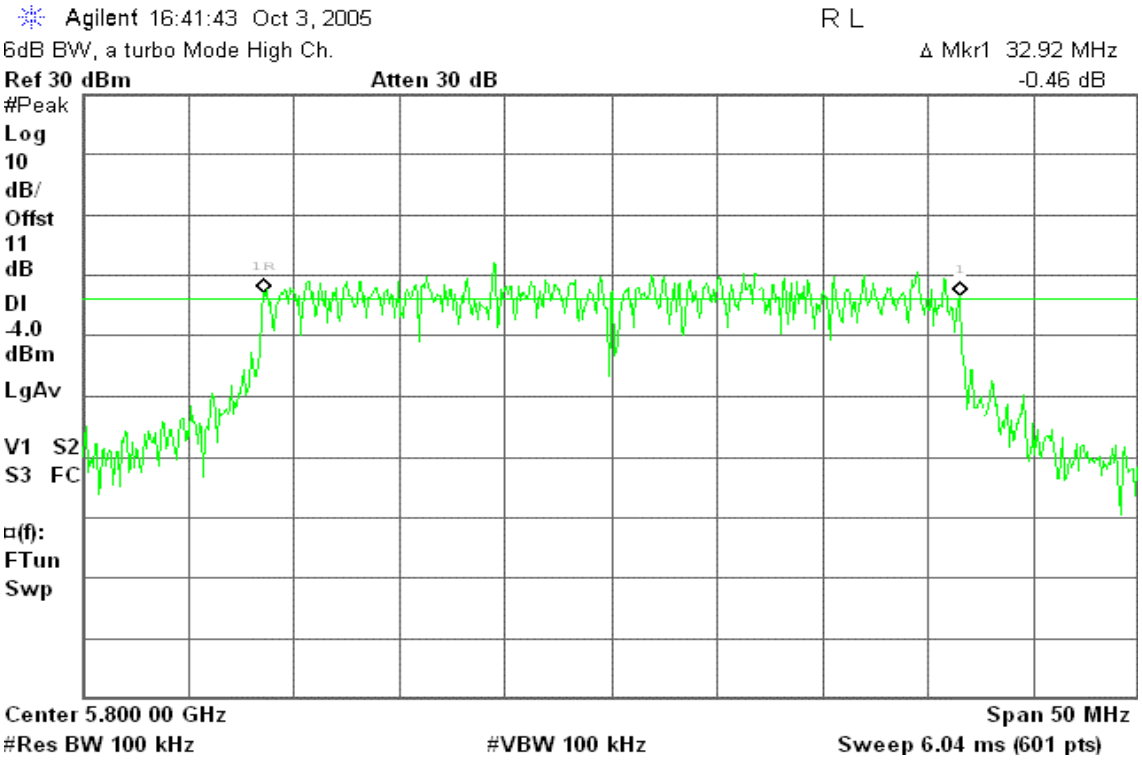


IEEE 802.11a Turbo mode

CH Low



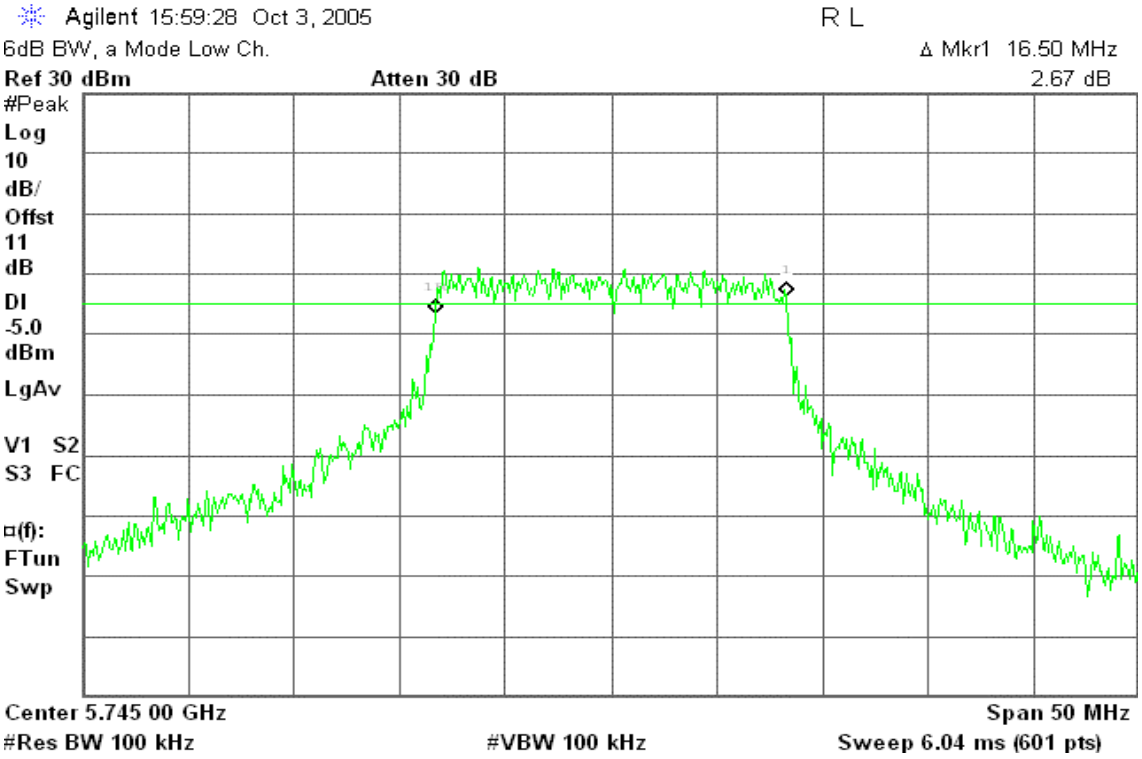
CH High



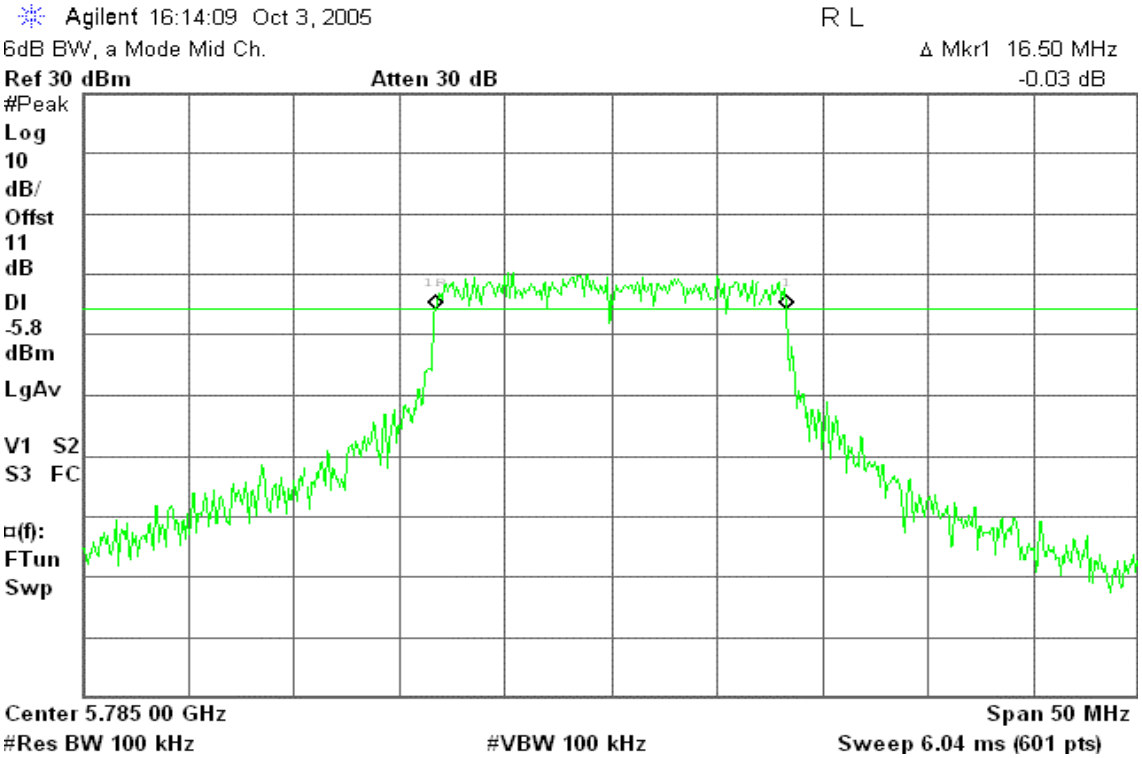
Omnidirectional antenna / 6.0 dBi for 5 GHz

IEEE 802.11a Base mode

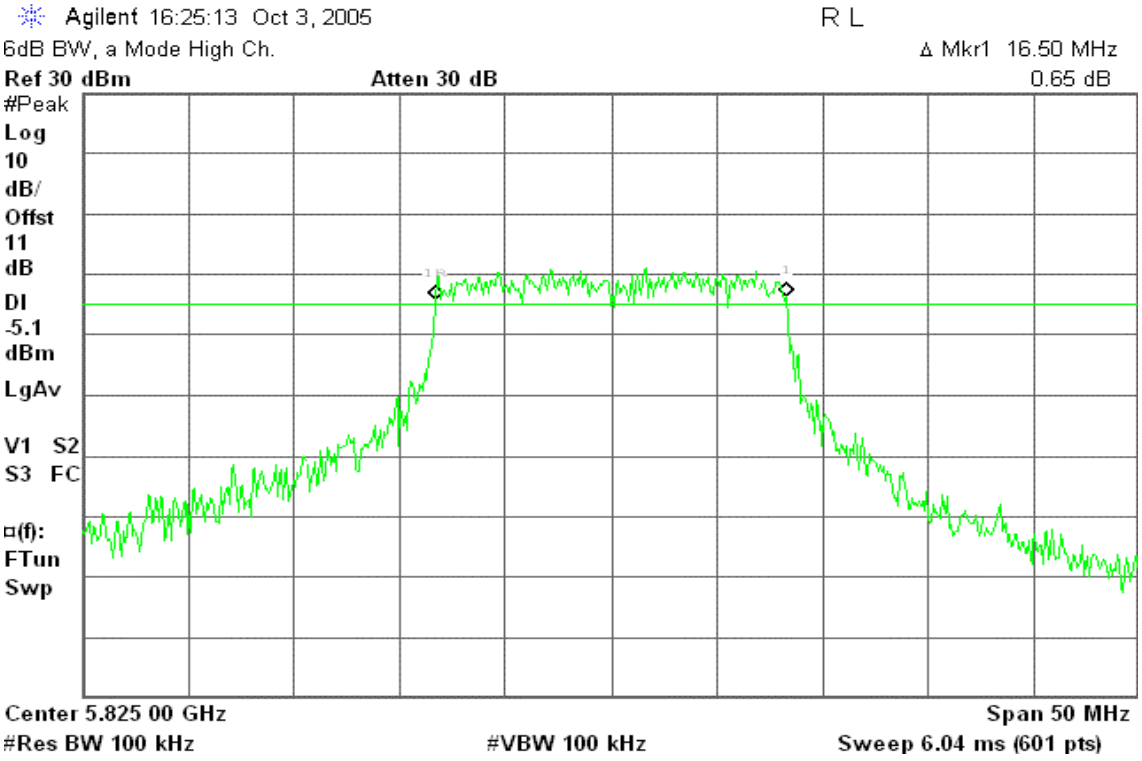
CH Low



CH Mid

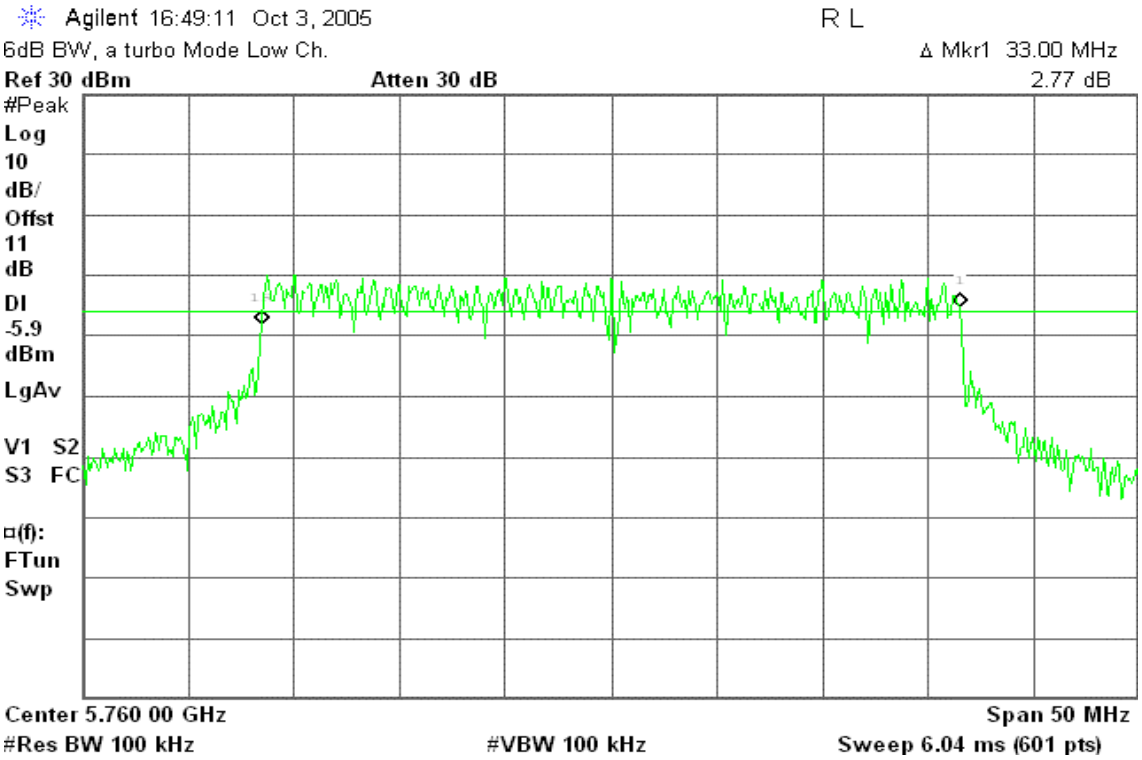


CH High

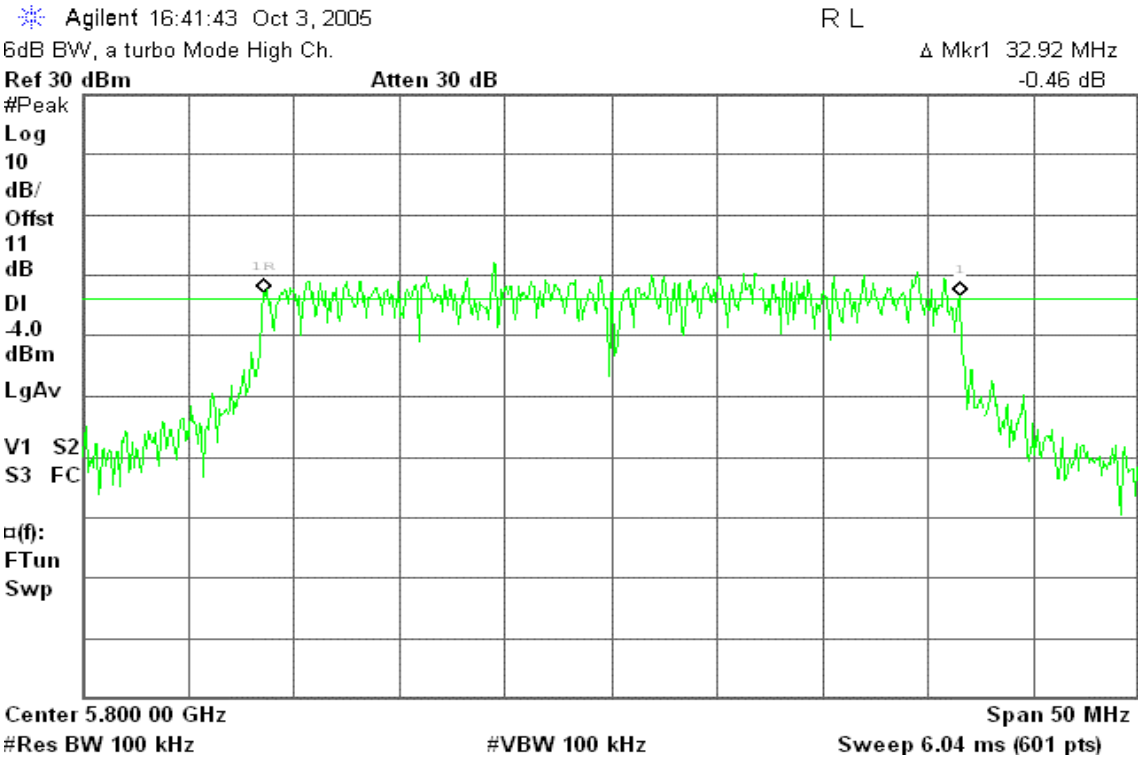


IEEE 802.11a Turbo mode

CH Low



CH High


Agilent 16:41:43 Oct 3, 2005
R L
6dB BW, a turbo Mode High Ch.
Δ Mkr1 32.92 MHz
Ref 30 dBm
Atten 30 dB
-0.46 dB
#Peak
Log
10
dB/
Offst
11
dB
Dl
-4.0
dBm
LgAv
V1 S2
S3 FC
¤(f):
FTun
Swp
Center 5.800 00 GHz
Span 50 MHz
#Res BW 100 kHz
#VBW 100 kHz
Sweep 6.04 ms (601 pts)

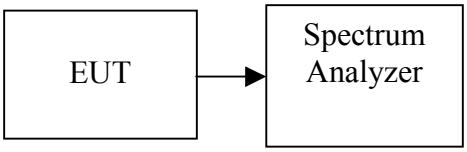
7.2 PEAK POWER

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

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

TEST RESULTS

No non-compliance noted.

Test Data

Omnidirectional antenna / 12.0 dBi for 2.4 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	18.48	0.07047	0.251	PASS
Mid	2437	19.23	0.08375		PASS
High	2462	19.68	0.09290		PASS

Remark: The maximum antenna gain is 12.0dBi; therefore the reduction due to antenna gain is 6.0dB, so the limit is 24.0dBm.

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)		Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	Base mode	2412	14.71	0.02958	0.251	PASS
Mid		2437	14.76	0.02992		PASS
High		2462	14.61	0.02891		PASS
Mid	Turbo mode	2437	16.10	0.04074		PASS

Remark: The maximum antenna gain is 12.0dBi; therefore the reduction due to antenna gain is 6.0dB, so the limit is 24.0dBm.

Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	18.81	0.07603	1	PASS
Mid	2437	21.64	0.14588		PASS
High	2462	21.59	0.14421		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)		Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	Base mode	2412	17.18	0.05224	1	PASS
Mid		2437	19.90	0.09772		PASS
High		2462	18.73	0.07464		PASS
Mid	Turbo mode	2437	20.18	0.10423		PASS

Test mode: IEEE 802.11a mode

Channel	Frequency (MHz)		Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	Base mode	5745	19.42	0.08750	1	PASS
Mid		5785	19.21	0.08337		PASS
High		5825	19.63	0.09183		PASS
Low	Turbo mode	5760	19.30	0.08511		PASS
High		5800	19.72	0.09376		PASS

Omnidirectional antenna / 6.0 dBi for 5 GHz

Test mode: IEEE 802.11a mode

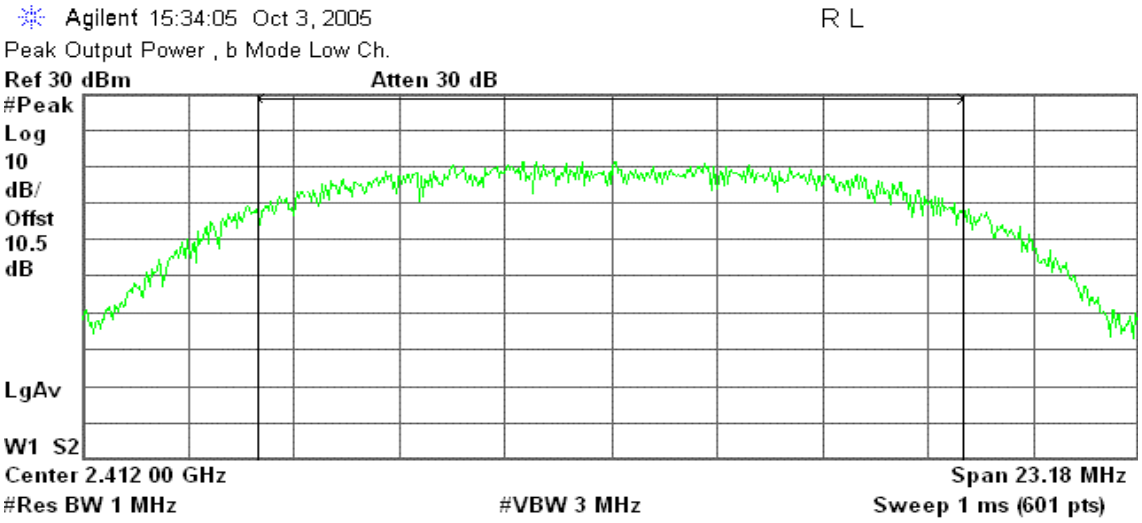
Channel	Frequency (MHz)		Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	Base mode	5745	19.42	0.08750	1	PASS
Mid		5785	19.21	0.08337		PASS
High		5825	19.63	0.09183		PASS
Low	Turbo mode	5760	19.30	0.08511		PASS
High		5800	19.72	0.09376		PASS

Test Plot

Omnidirectional antenna / 12.0 dBi for 2.4 GHz

IEEE 802.11b Base mode

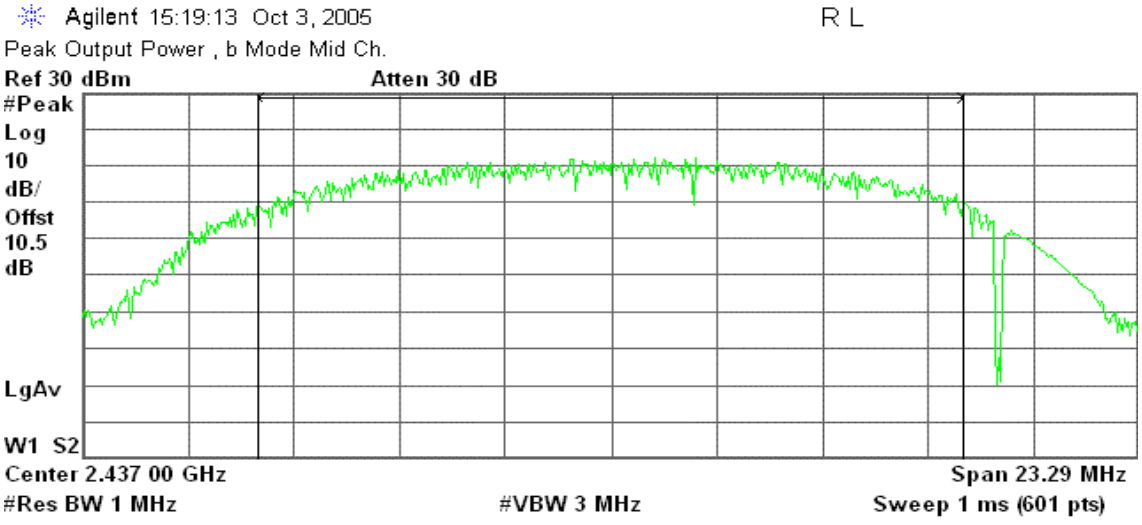
CH Low



Channel Power
18.48 dBm / 15.4530 MHz

Power Spectral Density
-53.41 dBm/Hz

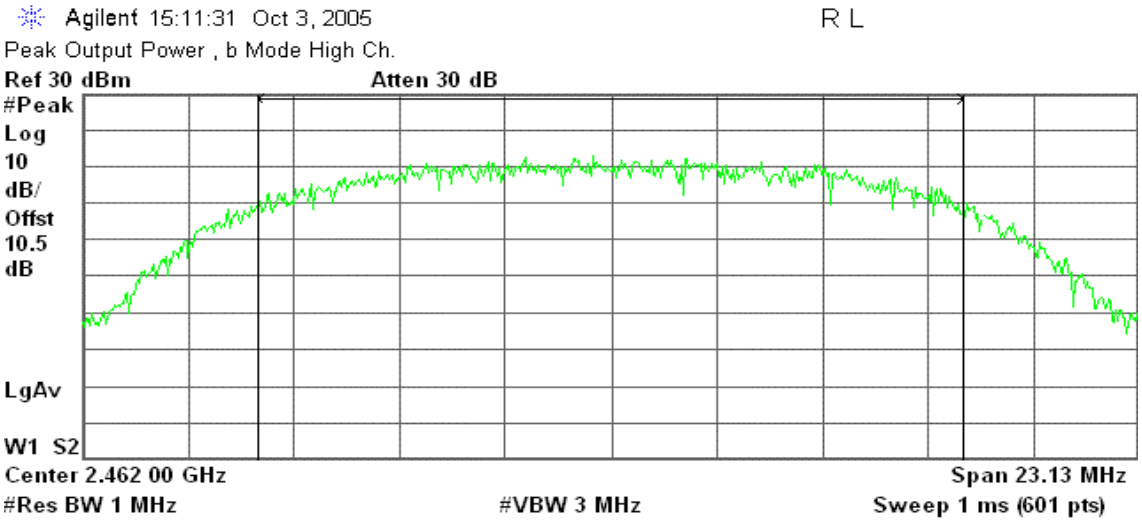
CH Mid



Channel Power
19.23 dBm / 15.5250 MHz

Power Spectral Density
-52.68 dBm/Hz

CH High

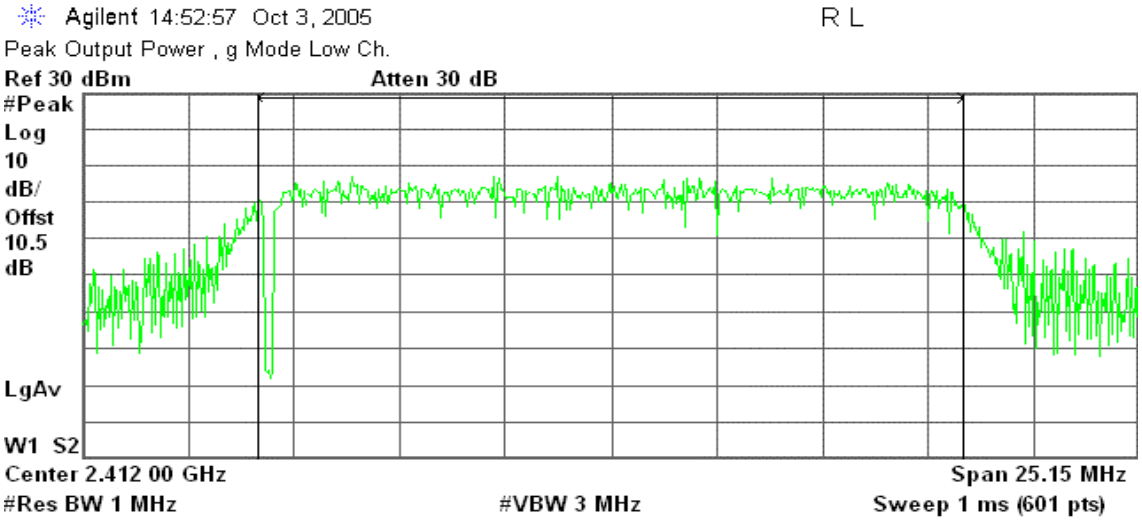


Channel Power
19.68 dBm / 15.4220 MHz

Power Spectral Density
-52.20 dBm/Hz

IEEE 802.11g Base mode

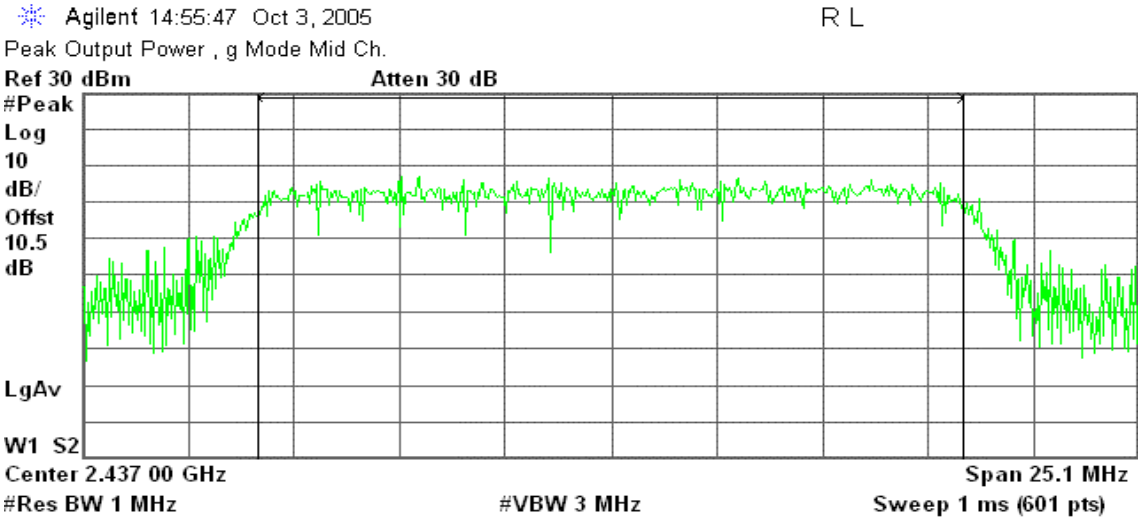
CH Low



Channel Power
14.71 dBm / 16.7640 MHz

Power Spectral Density
-57.54 dBm/Hz

CH Mid



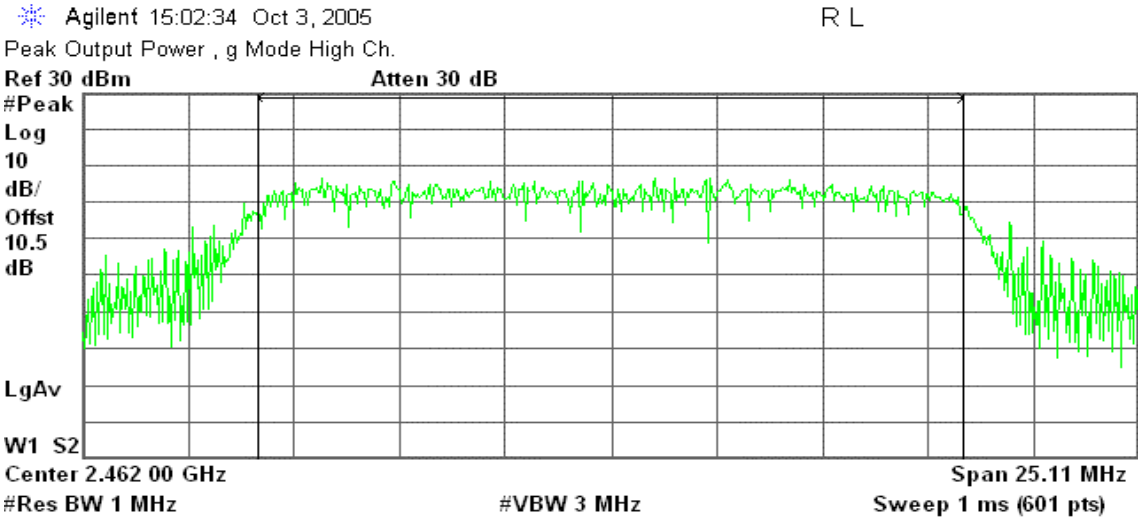
Channel Power

14.76 dBm / 16.7310 MHz

Power Spectral Density

-57.47 dBm/Hz

CH High



Channel Power

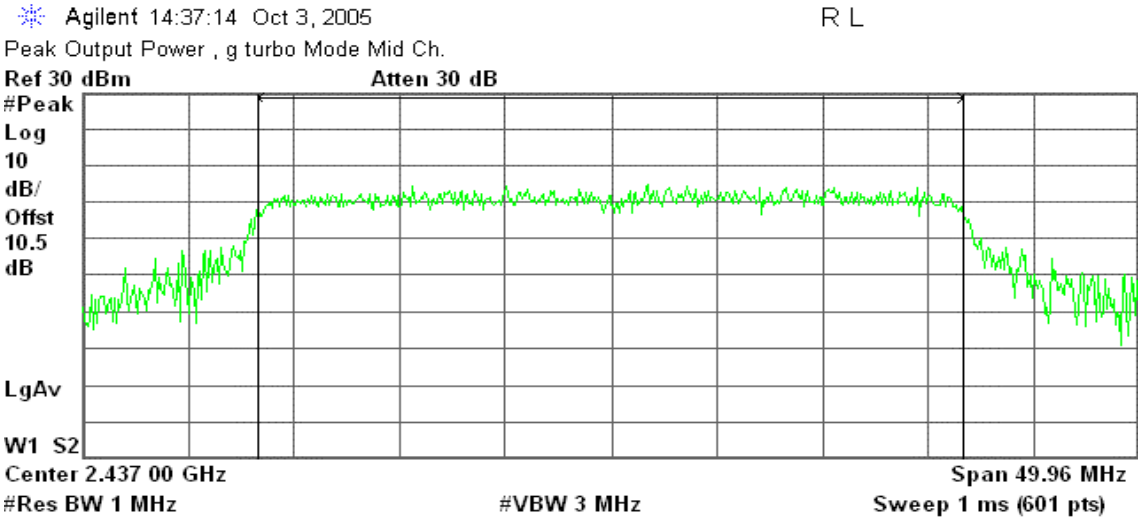
14.61 dBm / 16.7430 MHz

Power Spectral Density

-57.63 dBm/Hz

IEEE 802.11g Turbo mode

CH Mid



Channel Power

16.10 dBm / 33.3090 MHz

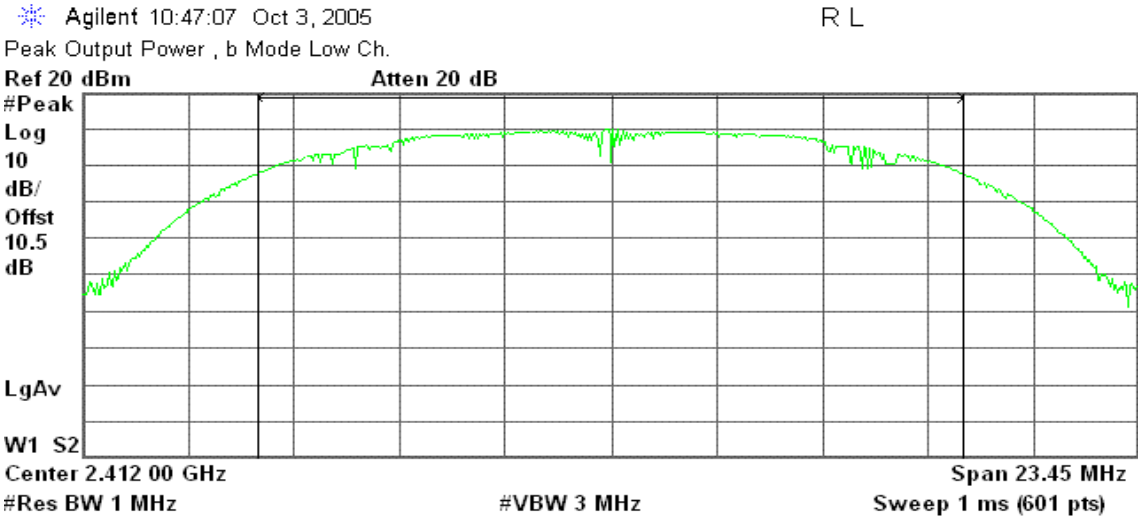
Power Spectral Density

-59.13 dBm/Hz

Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

IEEE 802.11b Base mode

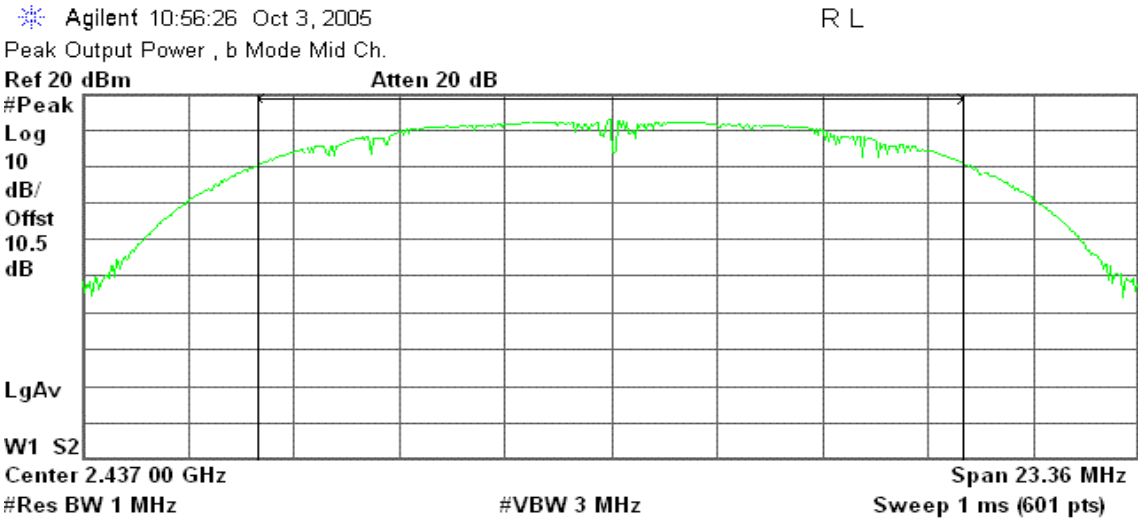
CH Low



Channel Power
18.81 dBm / 15.6330 MHz

Power Spectral Density
-53.13 dBm/Hz

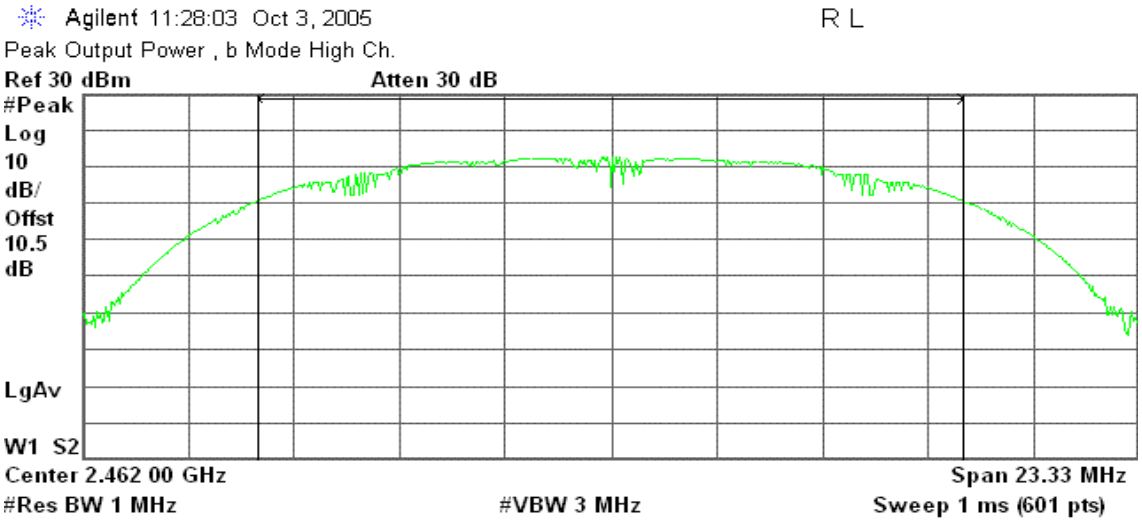
CH Mid



Channel Power
21.64 dBm / 15.5720 MHz

Power Spectral Density
-50.28 dBm/Hz

CH High

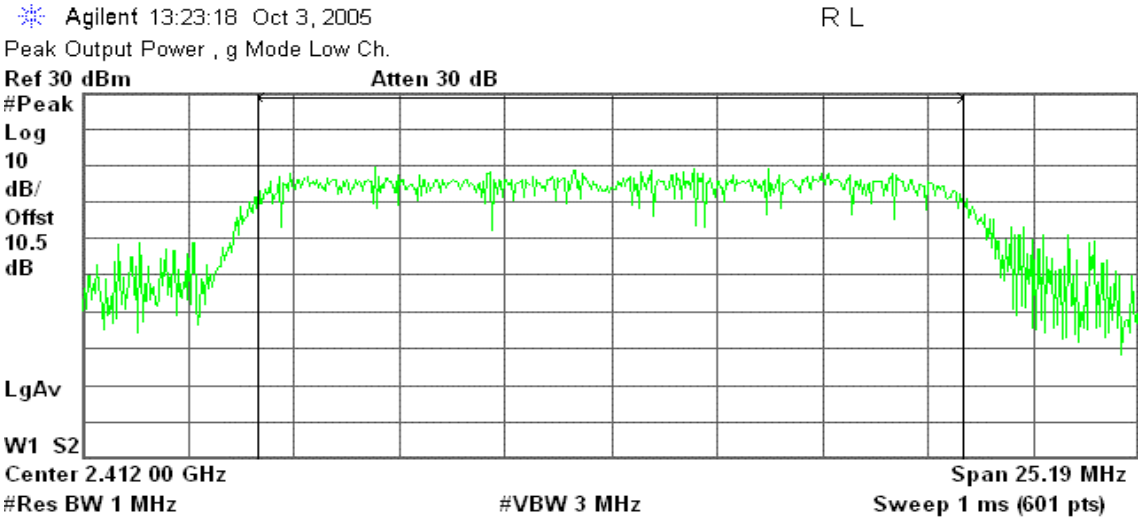


Channel Power
21.59 dBm / 15.5540 MHz

Power Spectral Density
-50.32 dBm/Hz

IEEE 802.11g Base mode

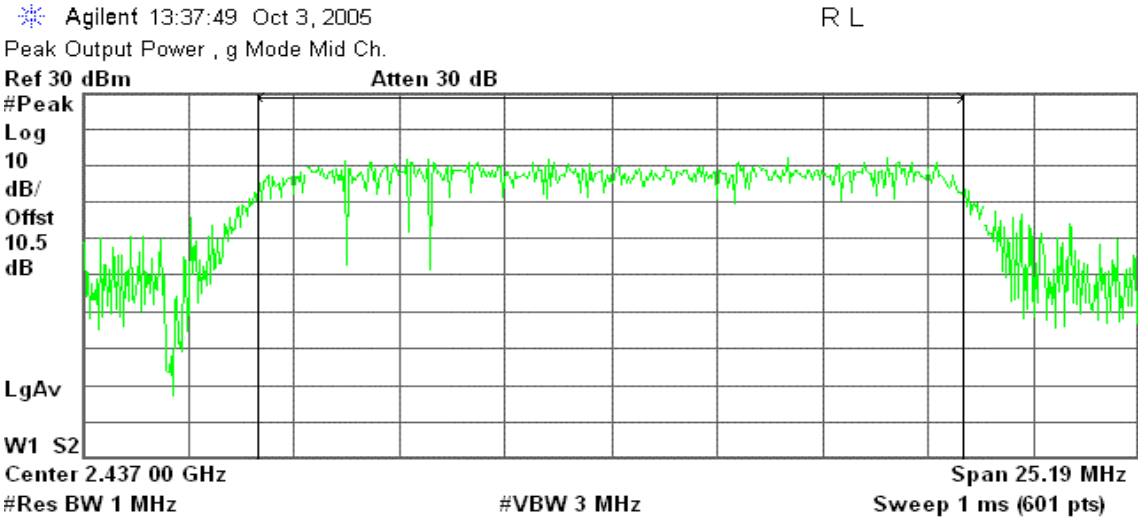
CH Low



Channel Power
17.18 dBm / 16.7910 MHz

Power Spectral Density
-55.07 dBm/Hz

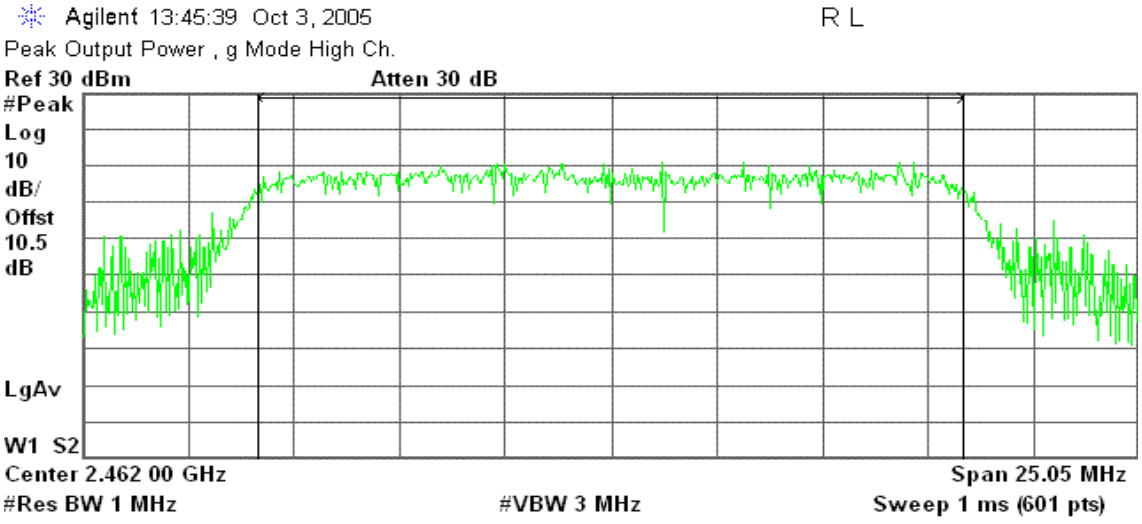
CH Mid



Channel Power
19.90 dBm / 16.7960 MHz

Power Spectral Density
-52.35 dBm/Hz

CH High

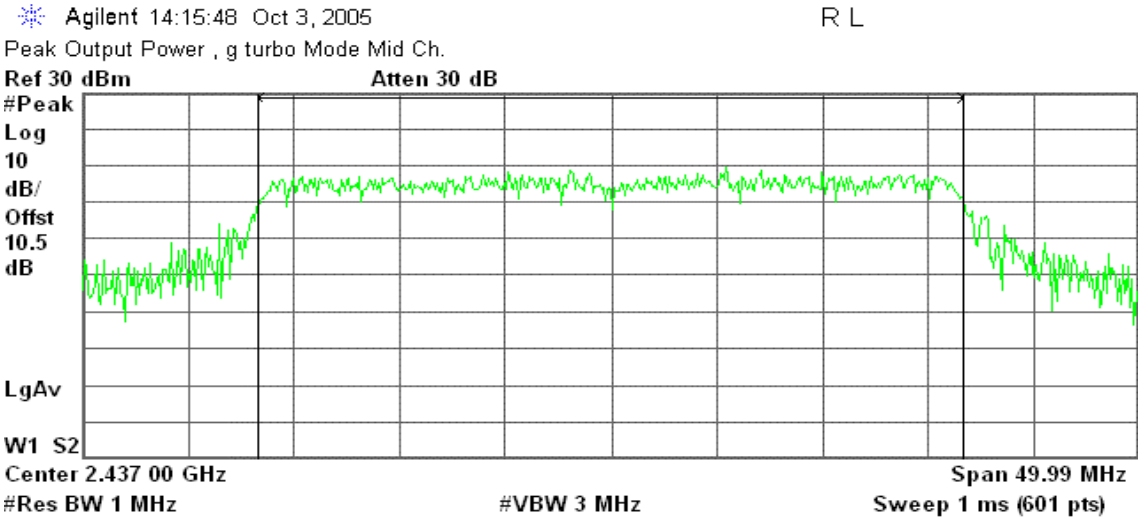


Channel Power
18.73 dBm / 16.7000 MHz

Power Spectral Density
-53.50 dBm/Hz

IEEE 802.11g Turbo mode

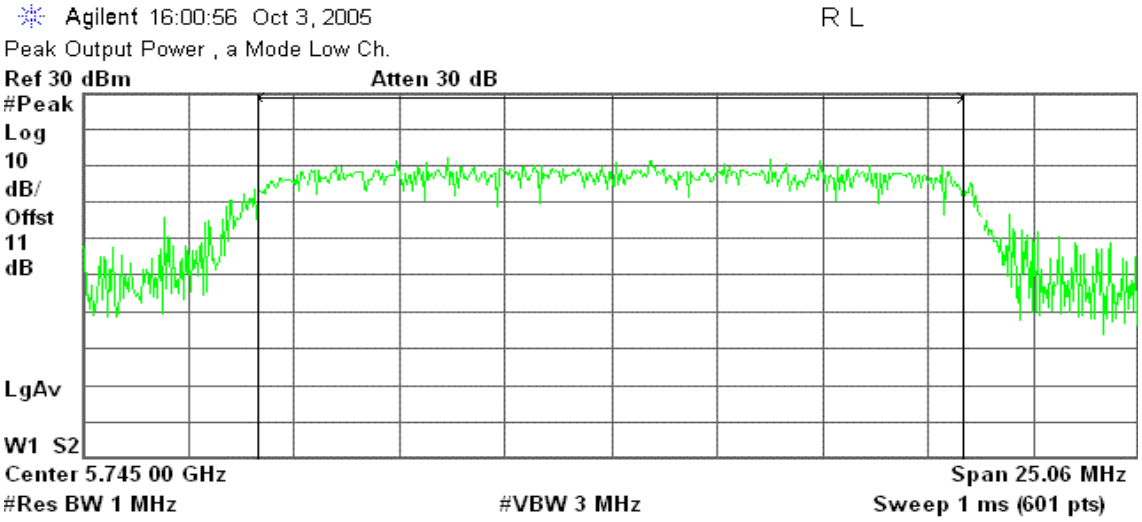
CH Mid



Channel Power	Power Spectral Density
20.18 dBm / 33.3270 MHz	-55.05 dBm/Hz

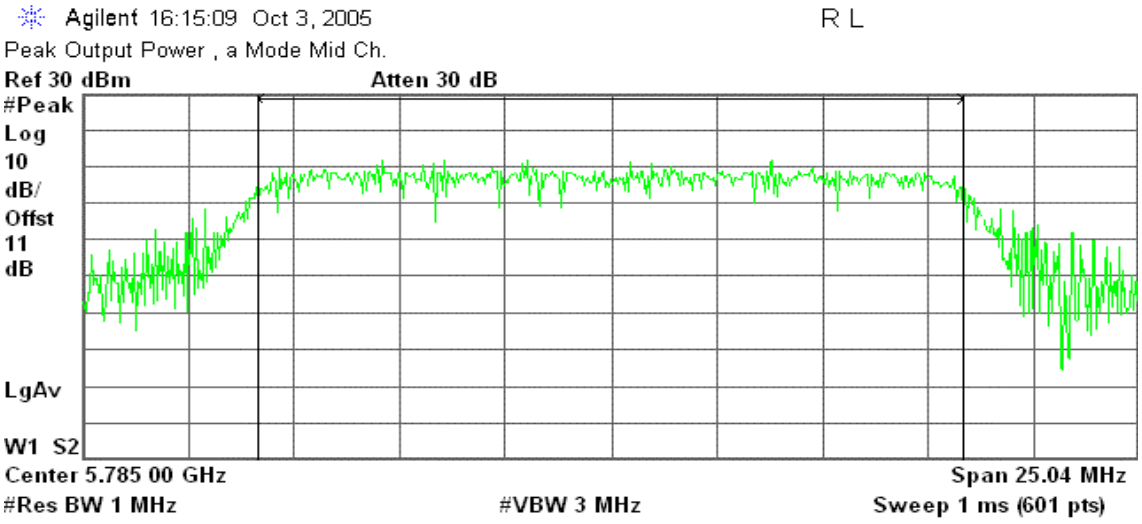
IEEE 802.11a Base mode

CH Low



Channel Power	Power Spectral Density
19.42 dBm / 16.7080 MHz	-52.81 dBm/Hz

CH Mid



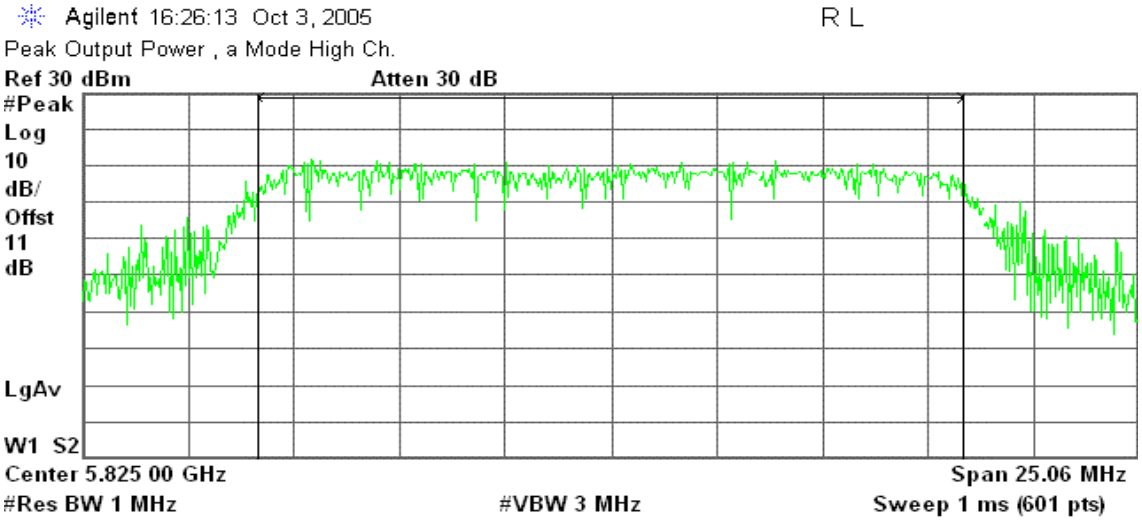
Channel Power

19.21 dBm / 16.6930 MHz

Power Spectral Density

-53.02 dBm/Hz

CH High



Channel Power

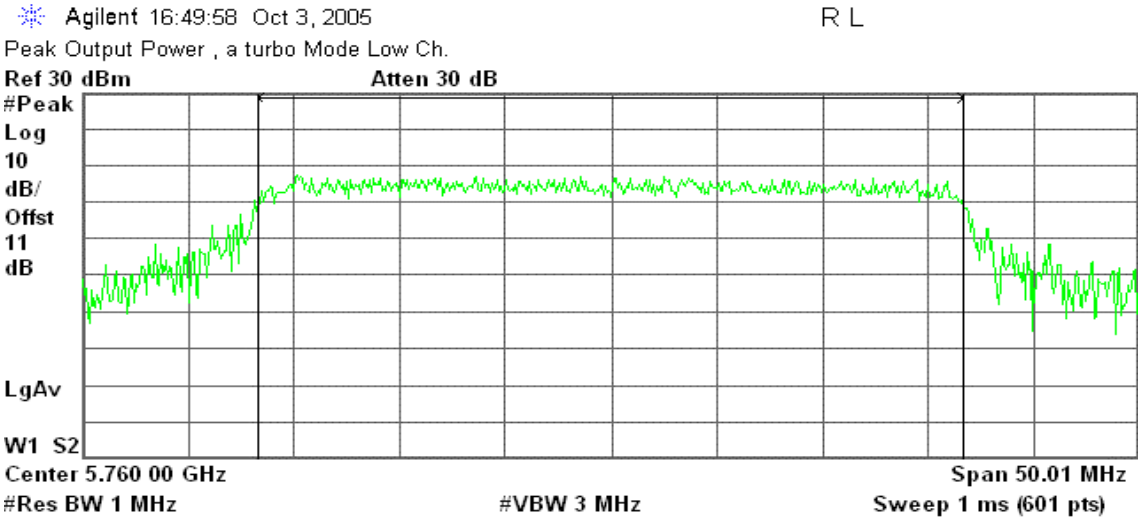
19.63 dBm / 16.7040 MHz

Power Spectral Density

-52.60 dBm/Hz

IEEE 802.11a Turbo mode

CH Low



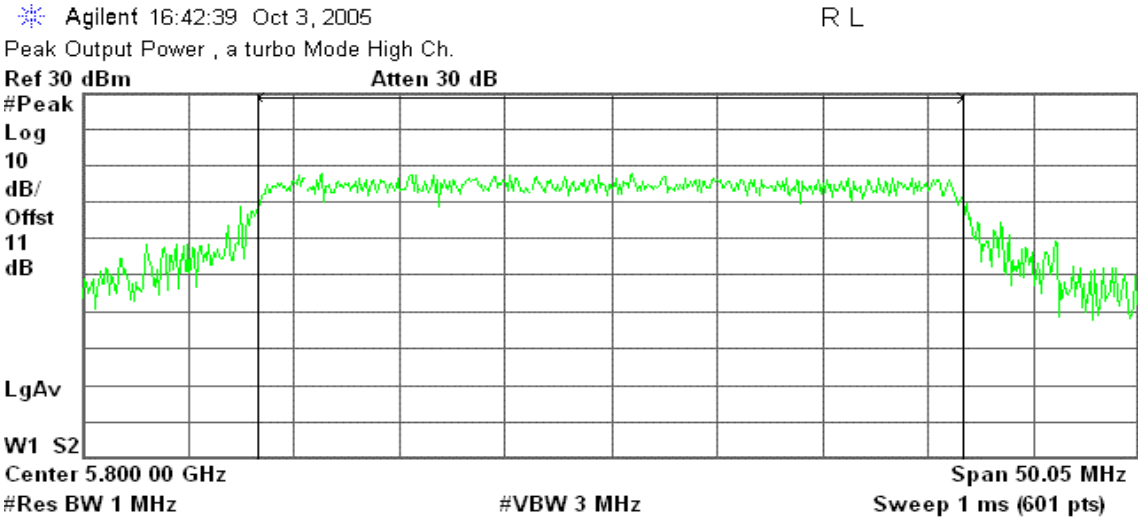
Channel Power

19.30 dBm / 33.3420 MHz

Power Spectral Density

-55.93 dBm/Hz

CH High



Channel Power

19.72 dBm / 33.3640 MHz

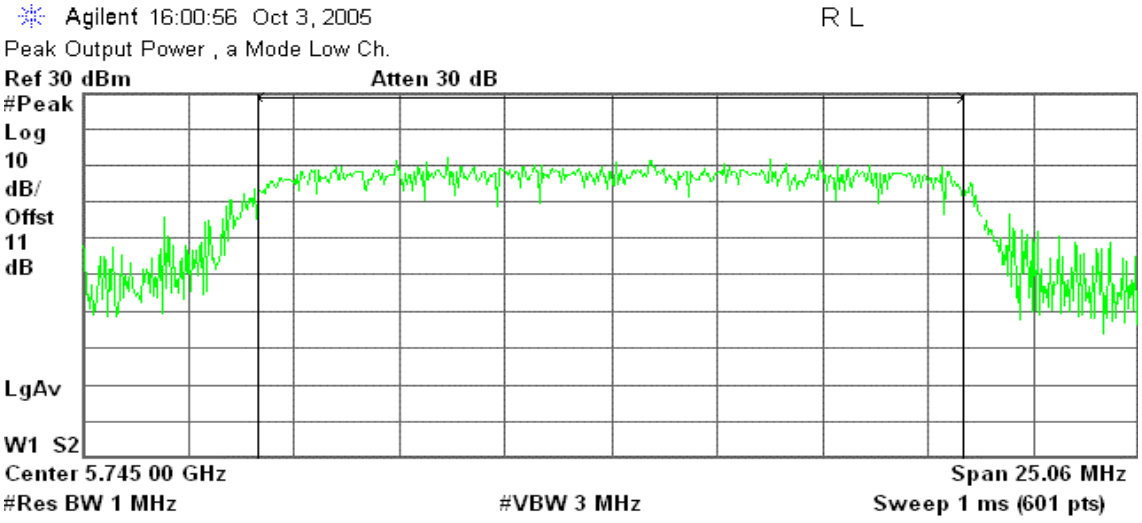
Power Spectral Density

-55.52 dBm/Hz

Omnidirectional antenna / 6.0 dBi for 5 GHz

IEEE 802.11a Base mode

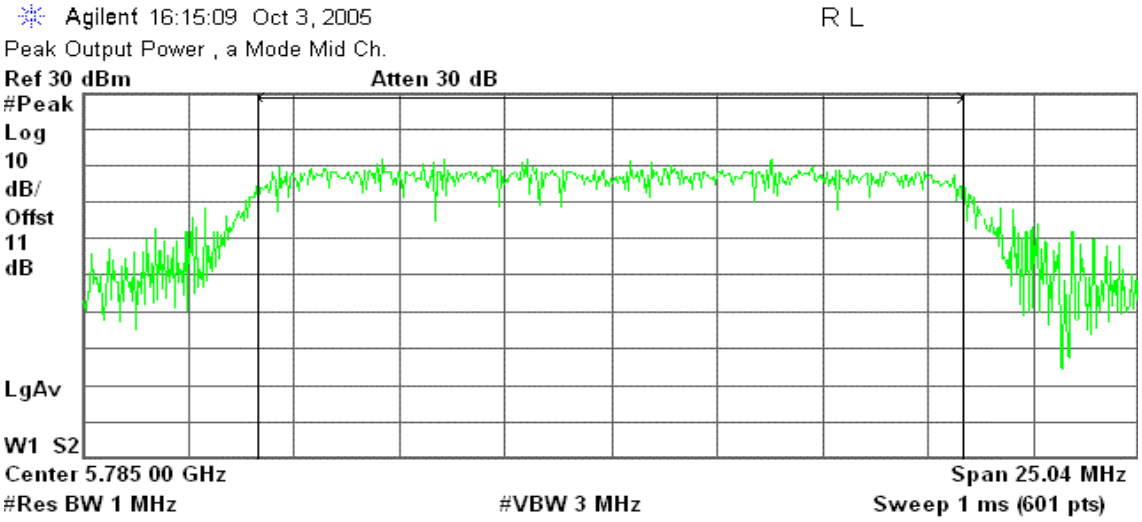
CH Low



Channel Power
19.42 dBm / 16.7080 MHz

Power Spectral Density
-52.81 dBm/Hz

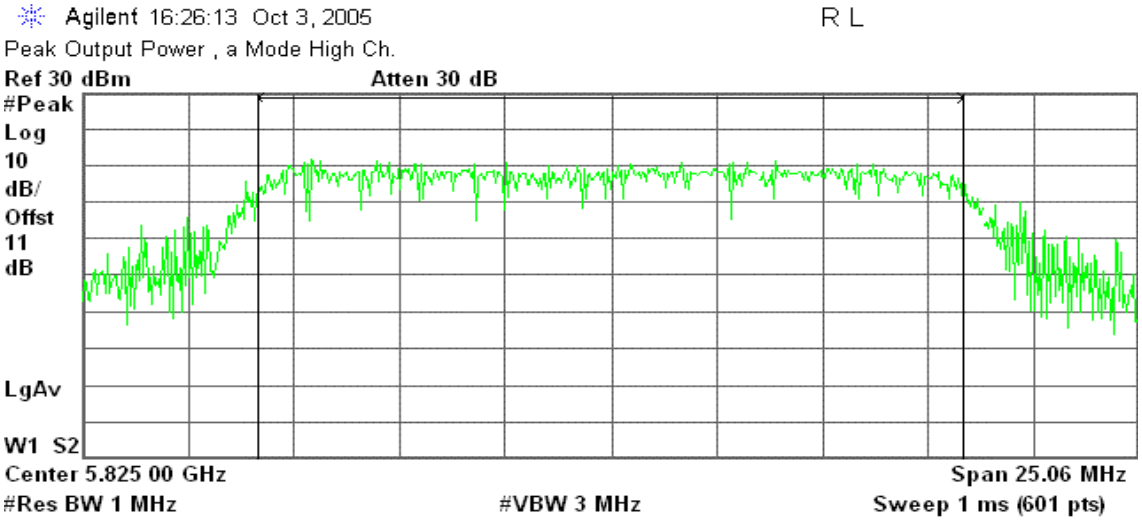
CH Mid



Channel Power
19.21 dBm / 16.6930 MHz

Power Spectral Density
-53.02 dBm/Hz

CH High

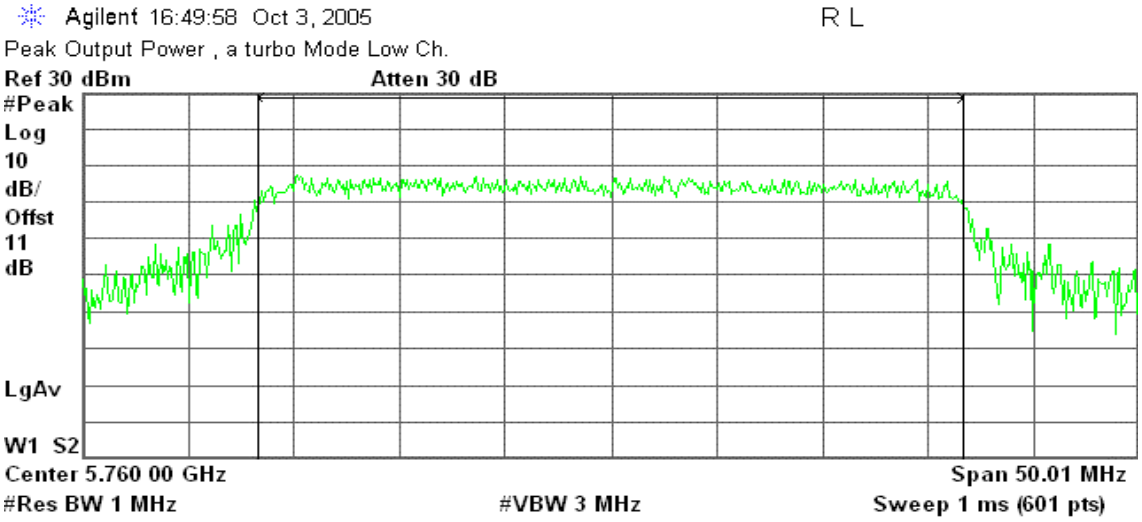


Channel Power
19.63 dBm / 16.7040 MHz

Power Spectral Density
-52.60 dBm/Hz

IEEE 802.11a Turbo mode

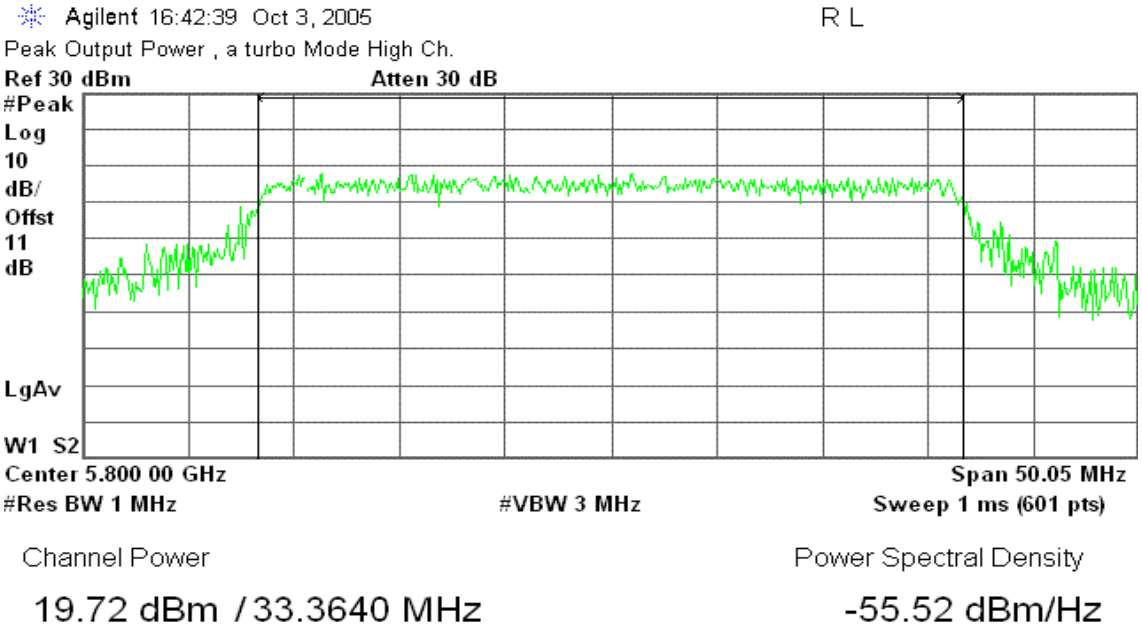
CH Low



Channel Power
19.30 dBm / 33.3420 MHz

Power Spectral Density
-55.93 dBm/Hz

CH High



Channel Power

19.72 dBm / 33.3640 MHz

Power Spectral Density

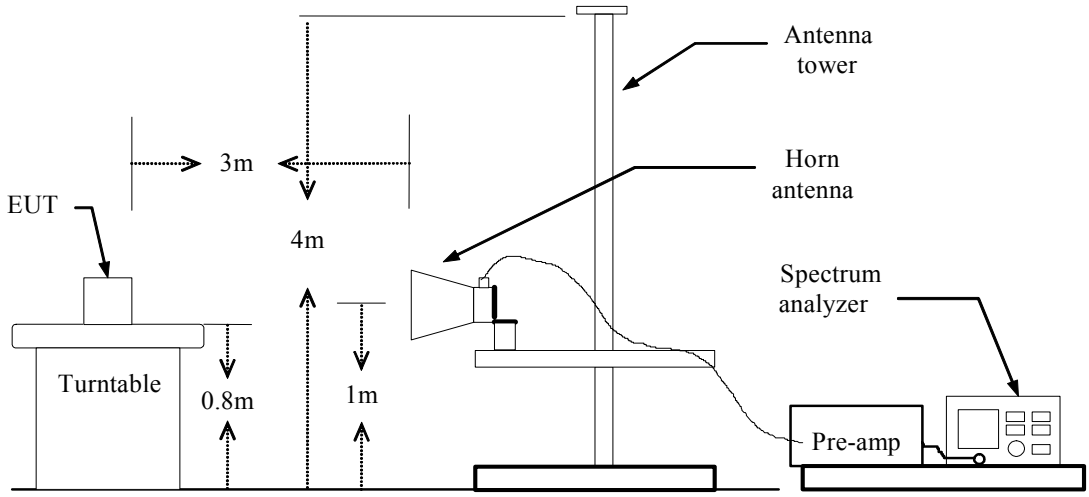
-55.52 dBm/Hz

7.3 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 in 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.

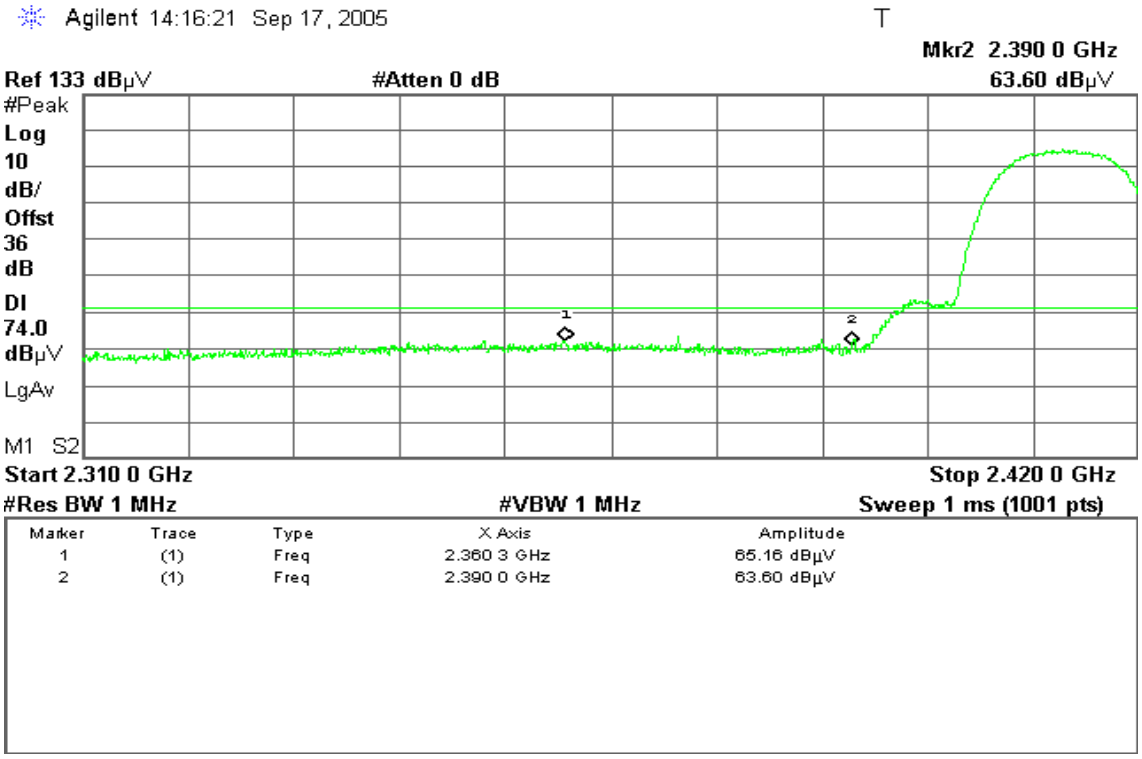
TEST RESULTS

Refer to attach spectrum analyzer data chart.

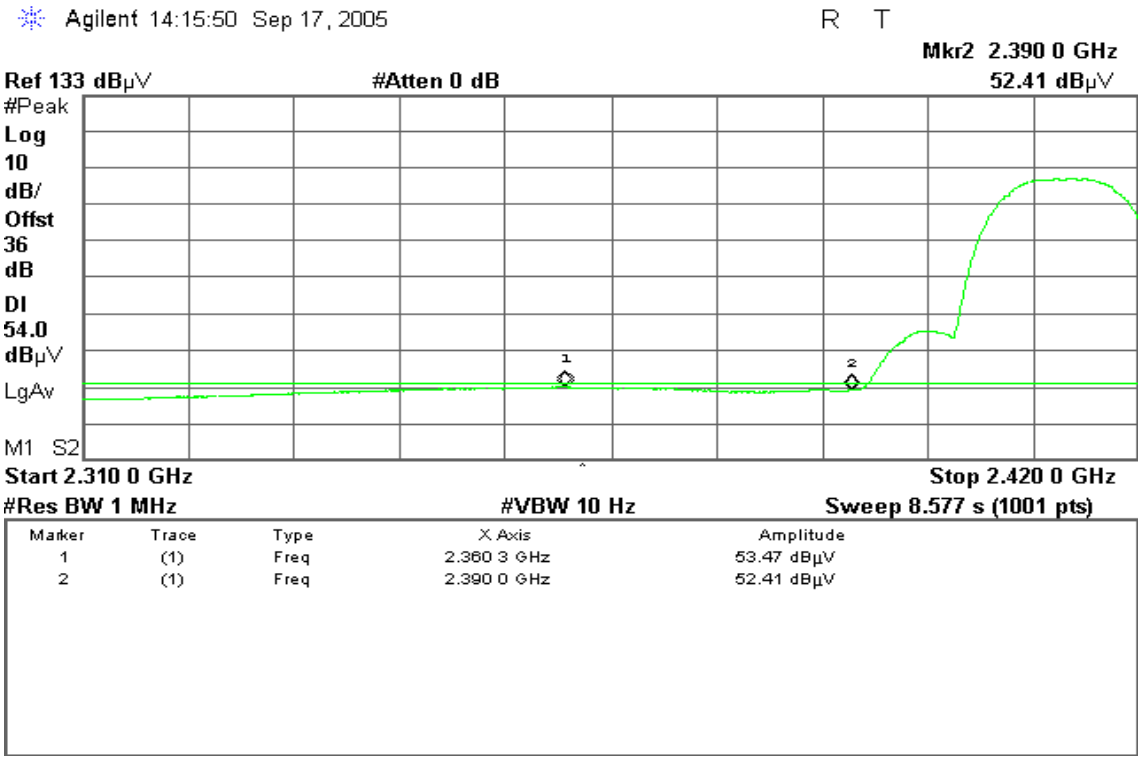
Omnidirectional antenna / 12.0 dBi for 2.4 GHz

Band Edges (IEEE 802.11b Base mode / CH Low)

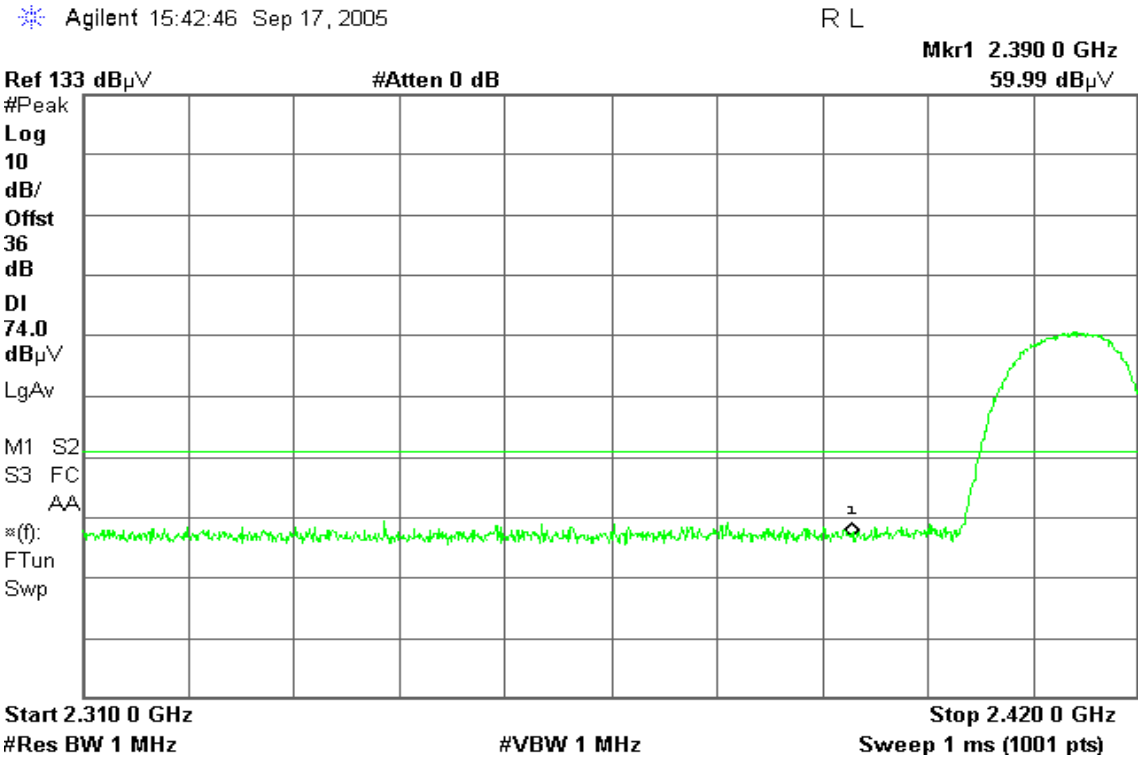
Detector mode: Peak Polarity: Vertical



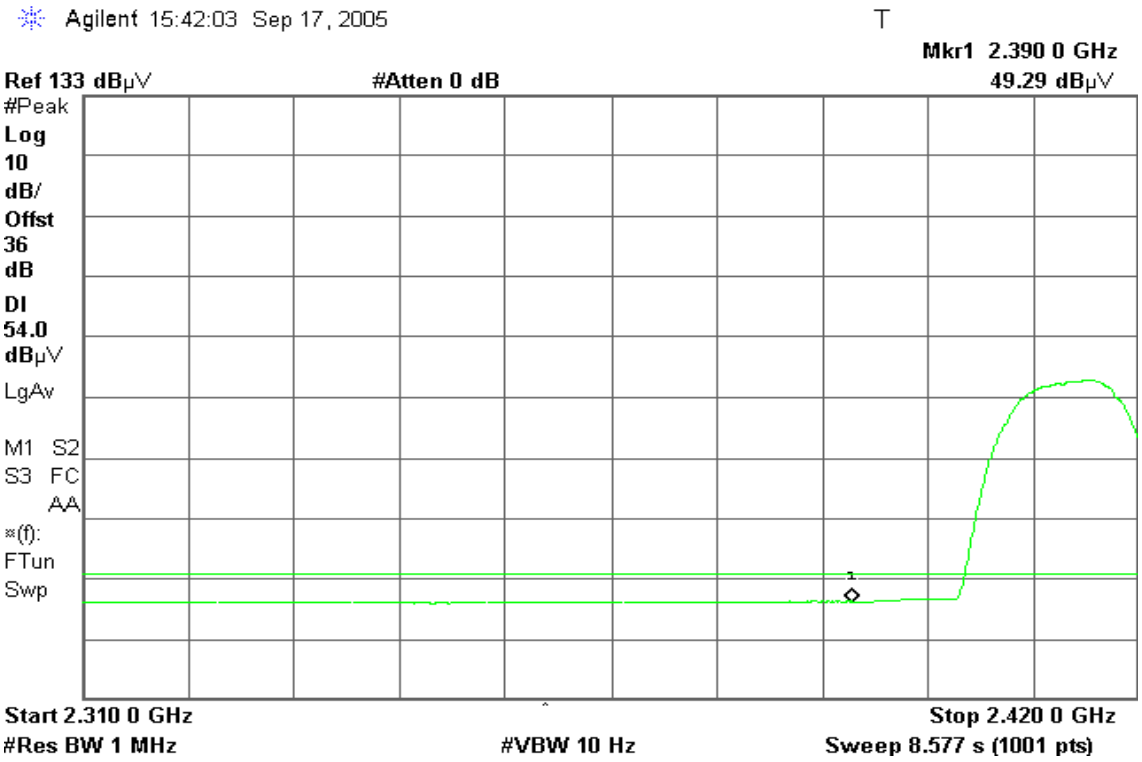
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

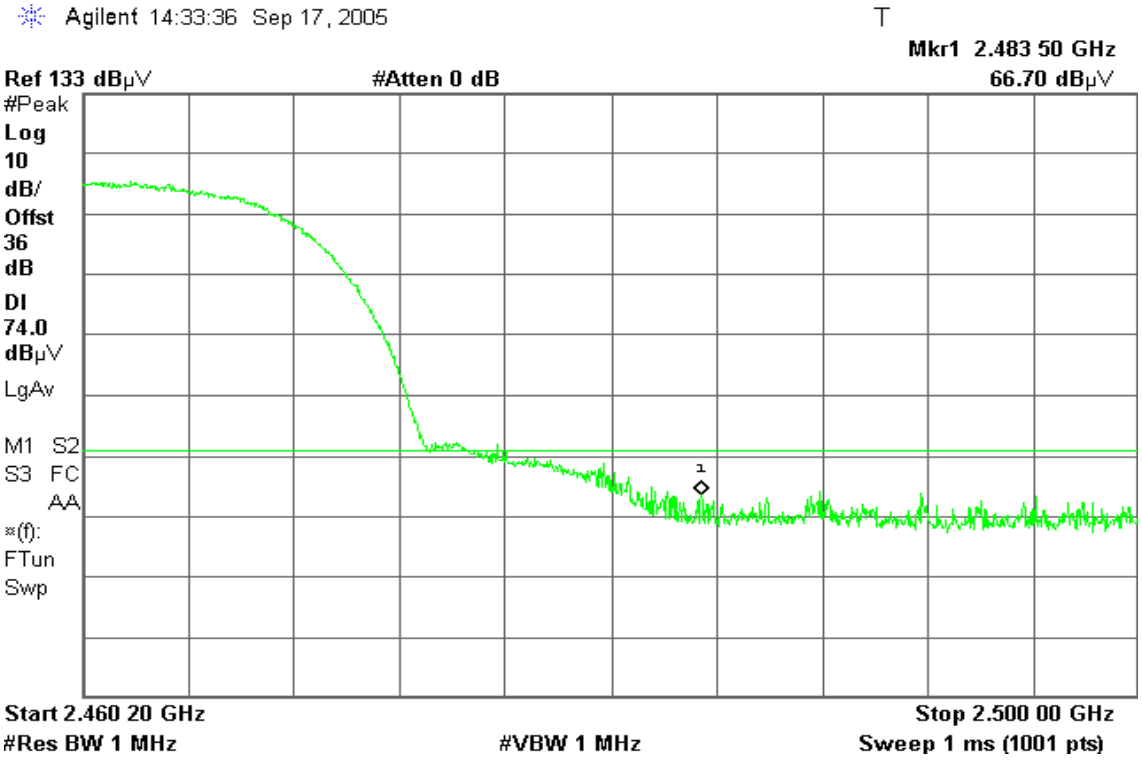


Detector mode: Average **Polarity: Horizontal**

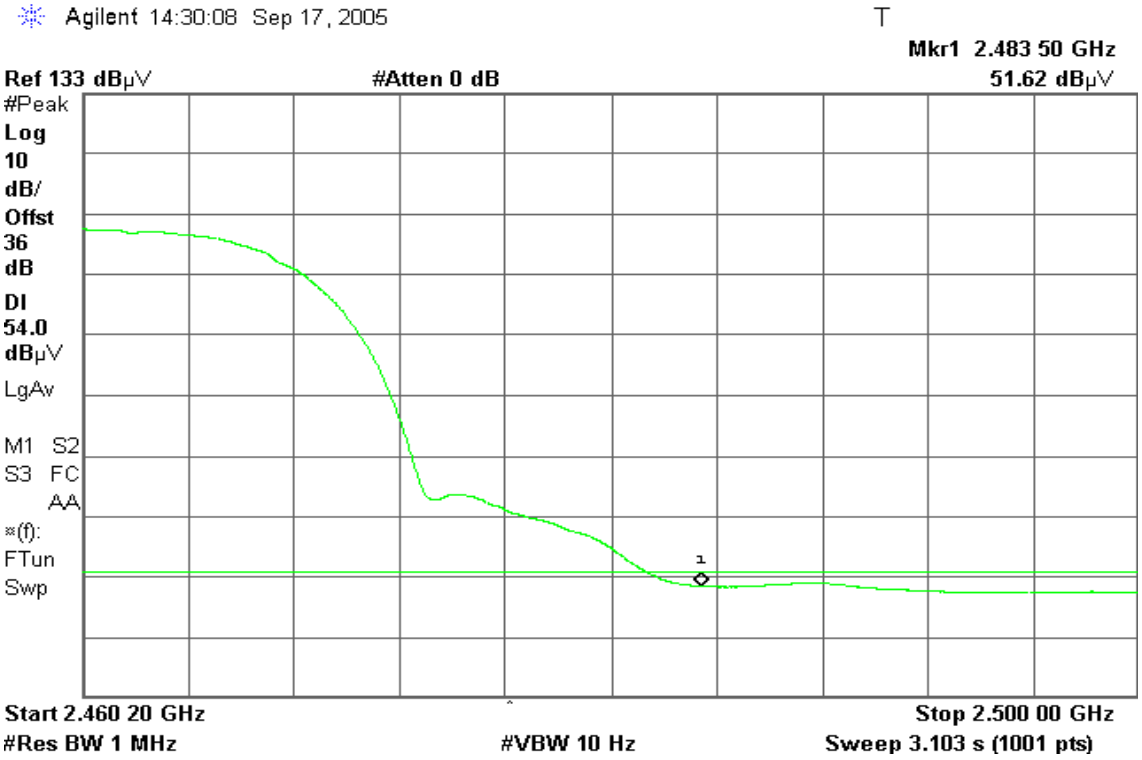


Band Edges (IEEE 802.11b Base mode / CH High)

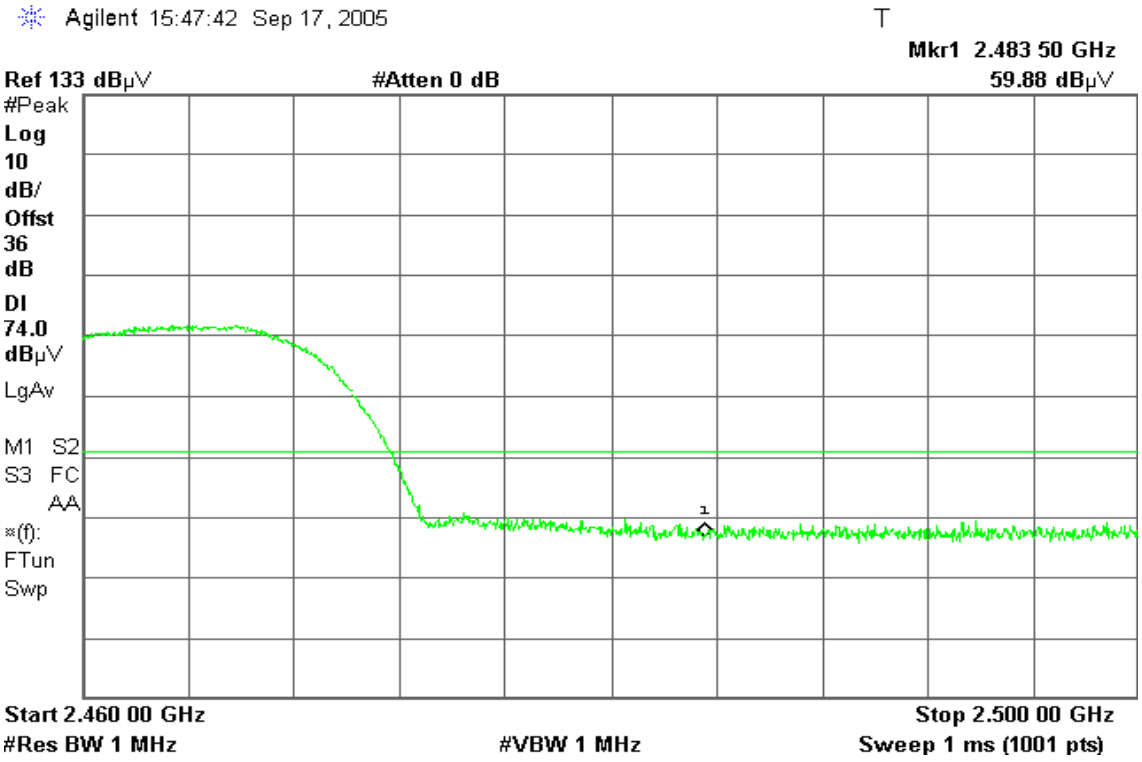
Detector mode: Peak Polarity: Vertical



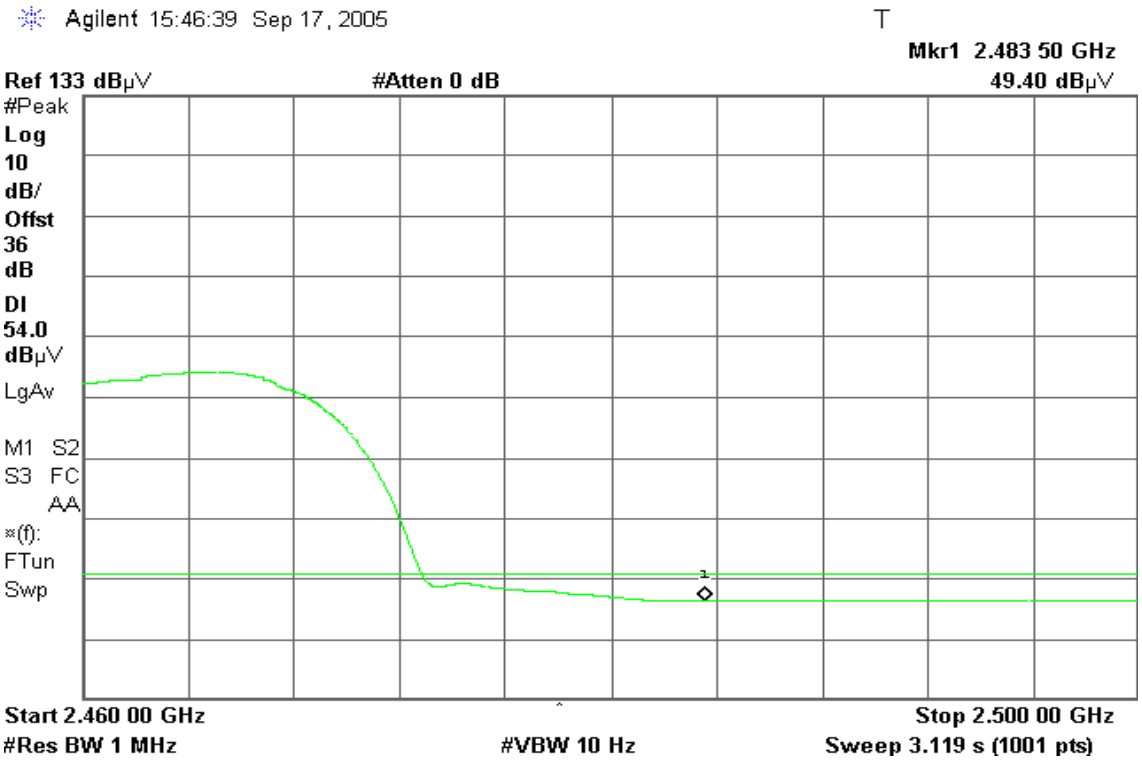
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

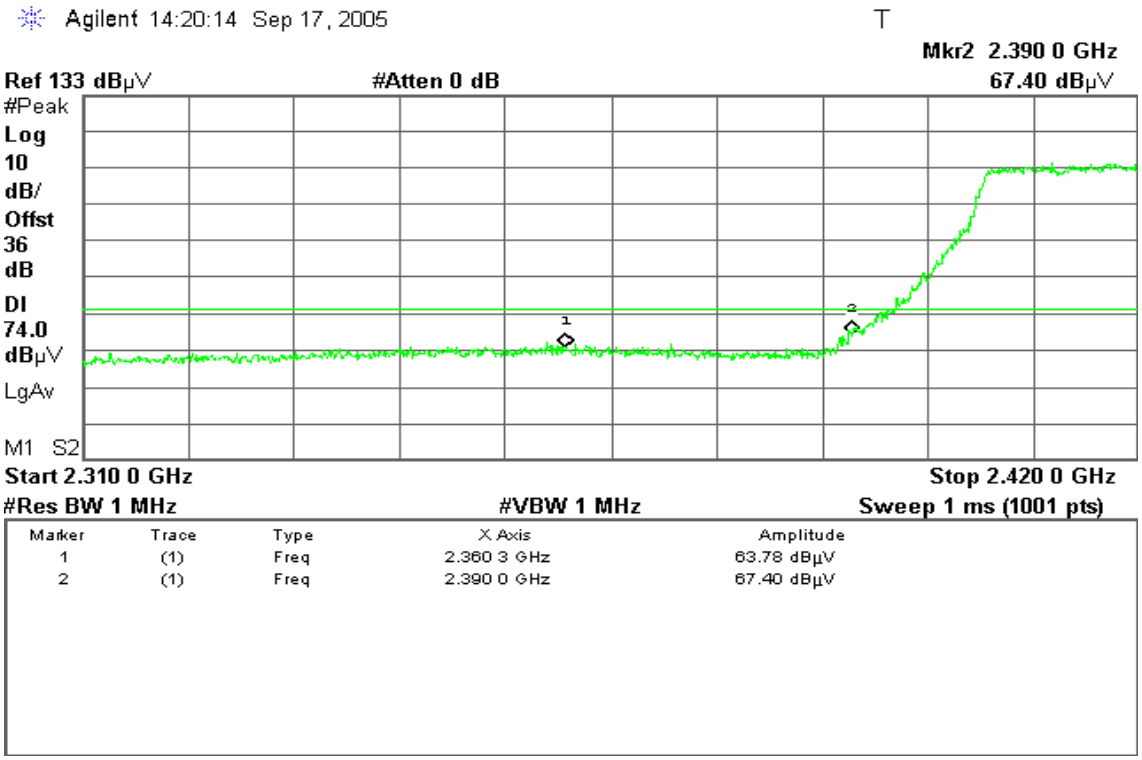


Detector mode: Average **Polarity: Horizontal**

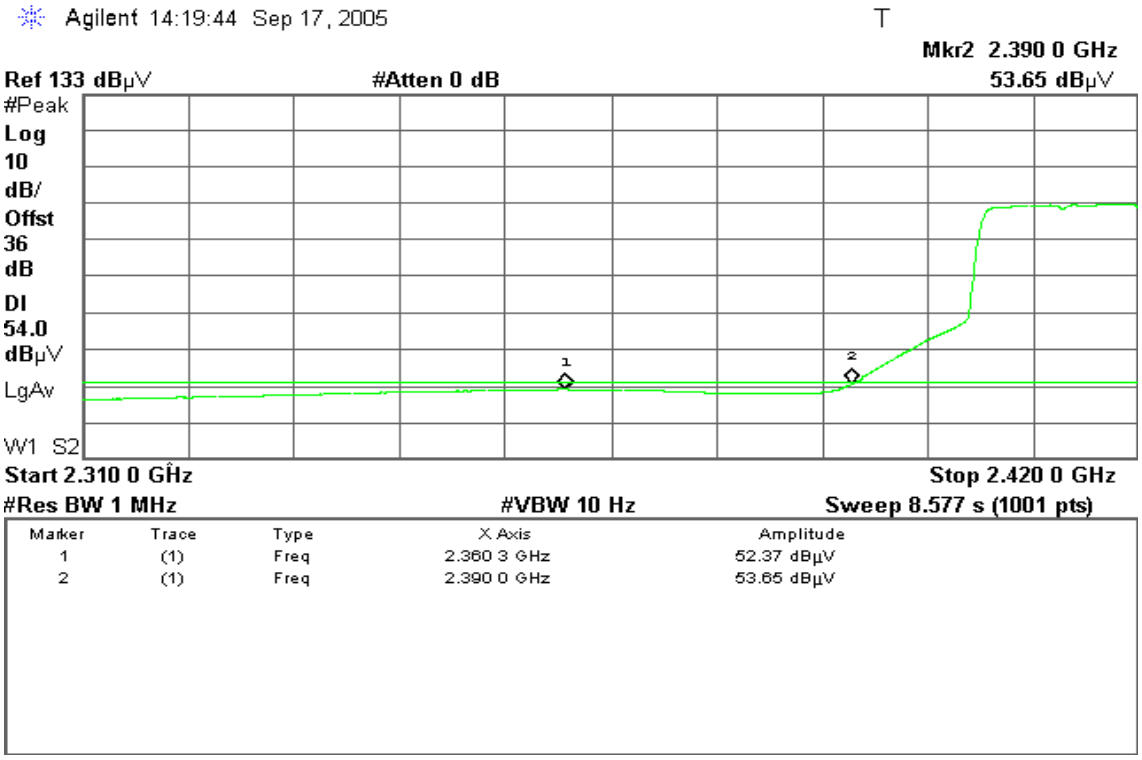


Band Edges (IEEE 802.11g Base mode / CH Low)

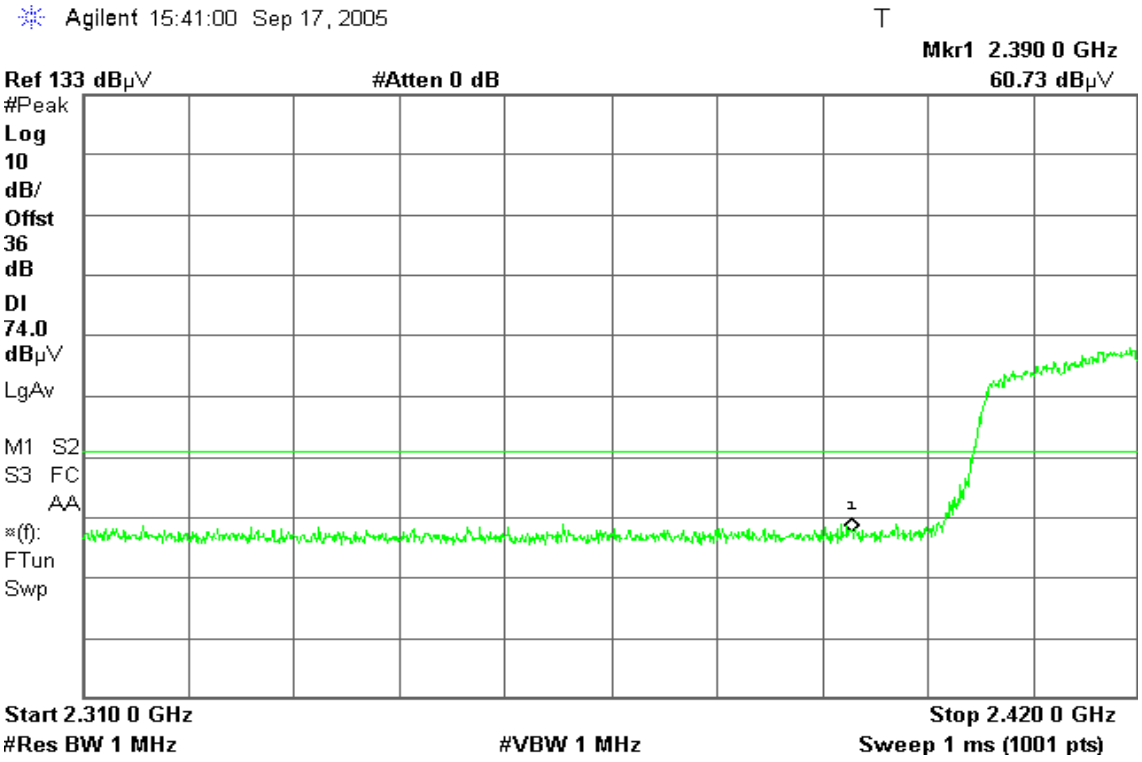
Detector mode: Peak Polarity: Vertical



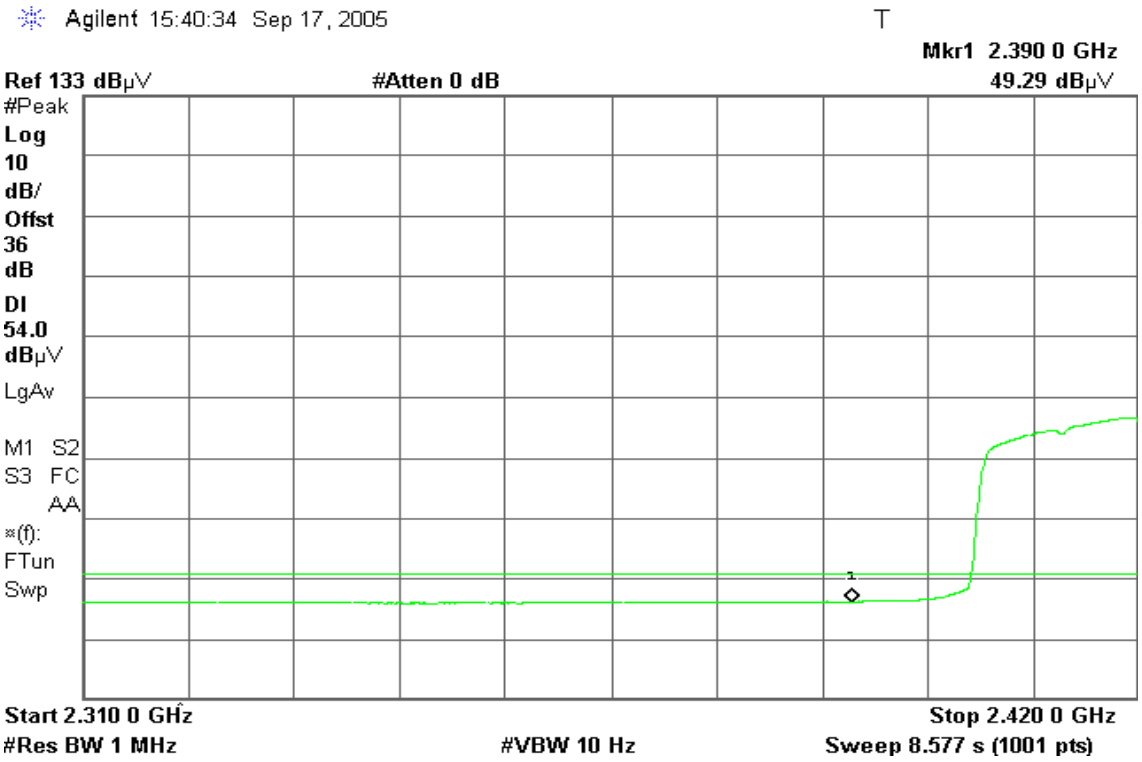
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

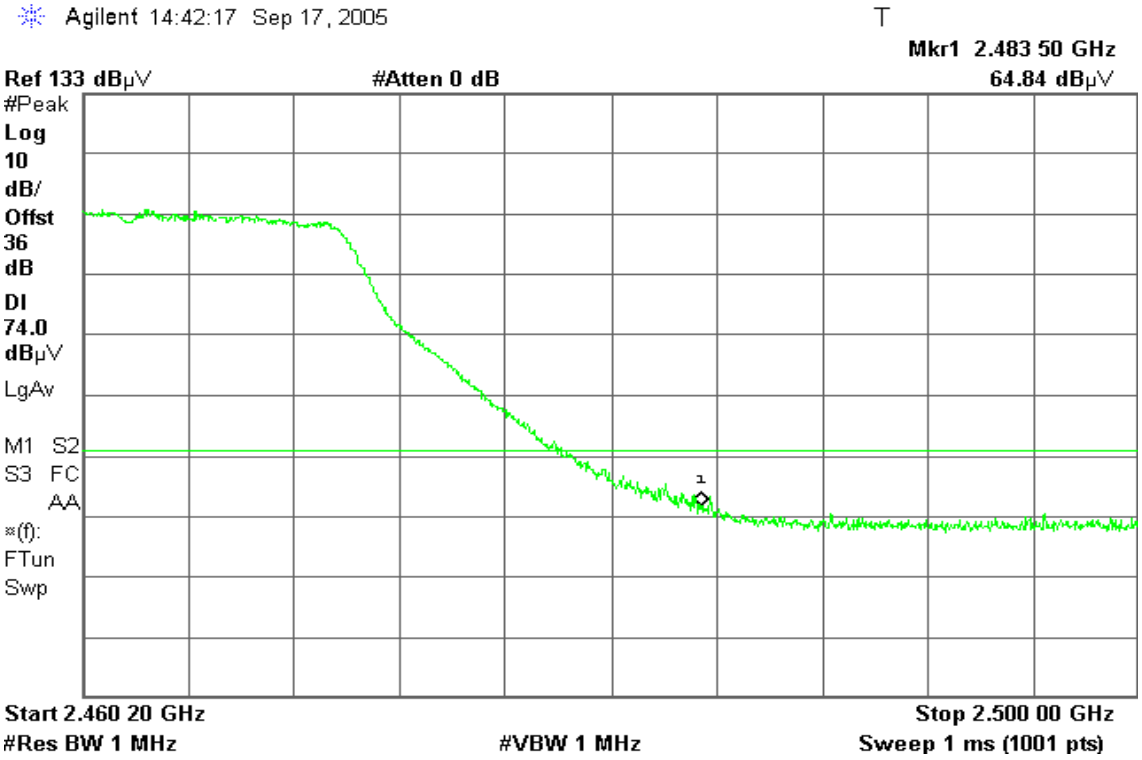


Detector mode: Average **Polarity: Horizontal**

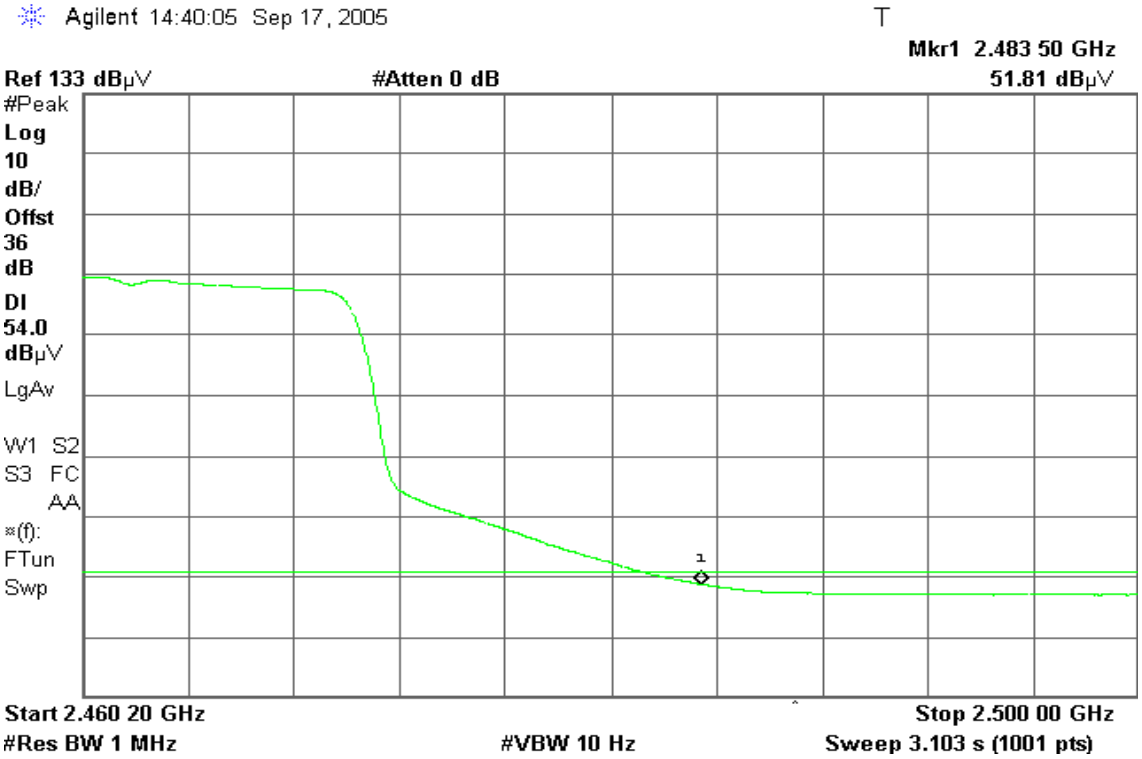


Band Edges (IEEE 802.11g Base mode / CH High)

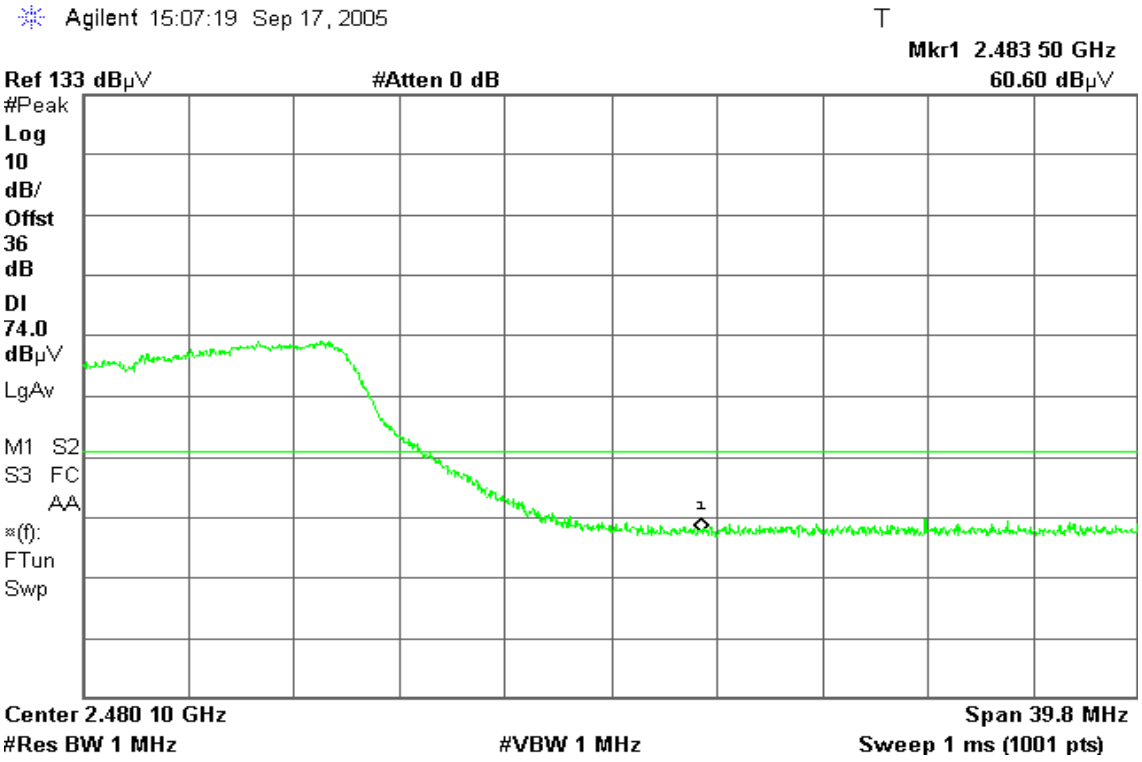
Detector mode: Peak Polarity: Vertical



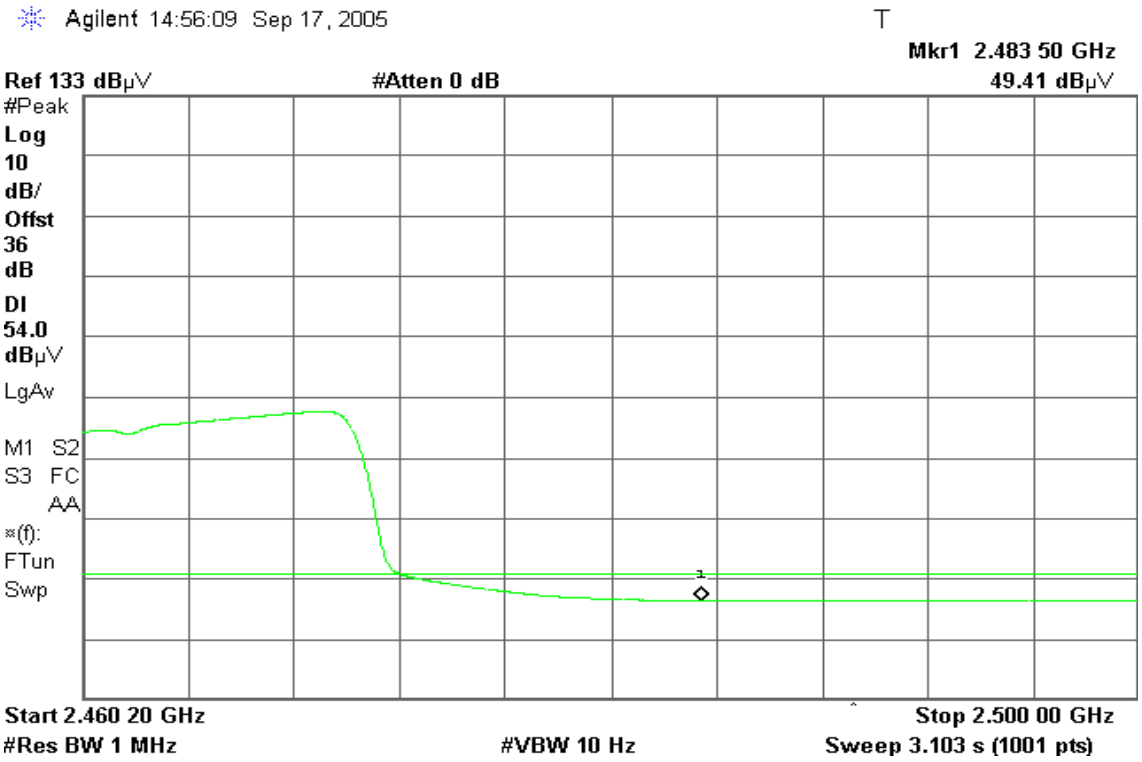
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

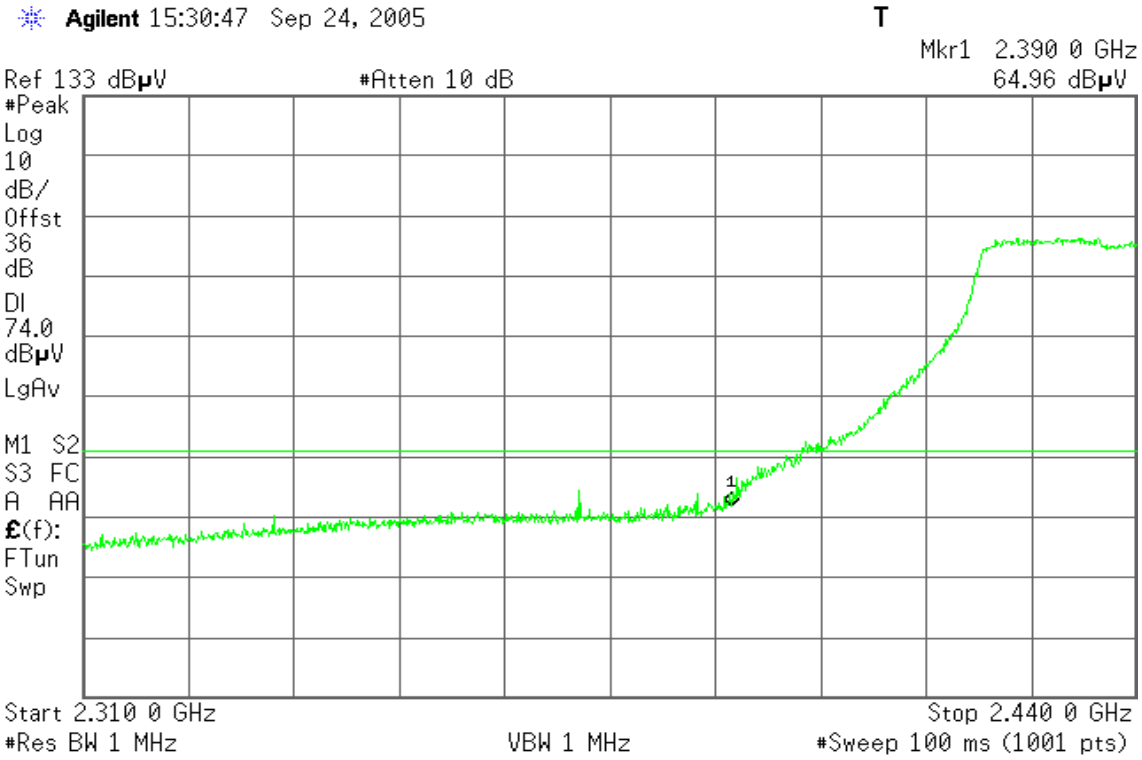


Detector mode: Average **Polarity: Horizontal**

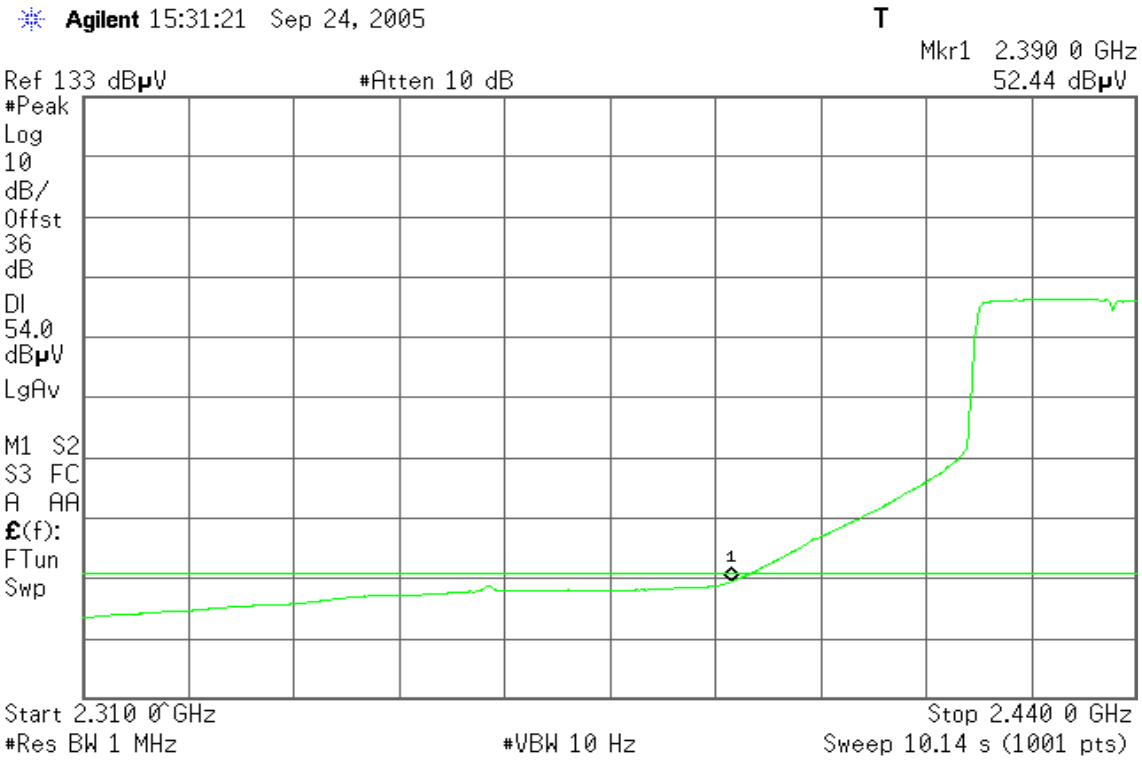


Band Edges (IEEE 802.11g Turbo mode / CH Mid)

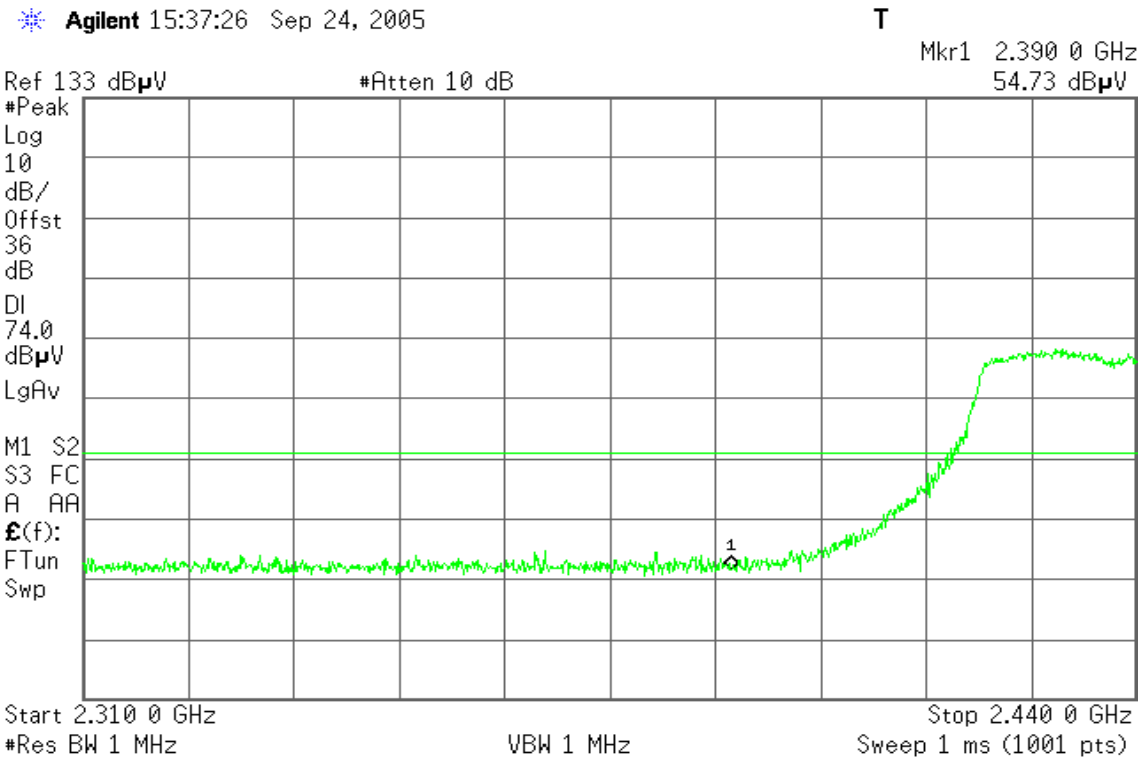
Detector mode: Peak **Polarity: Vertical**



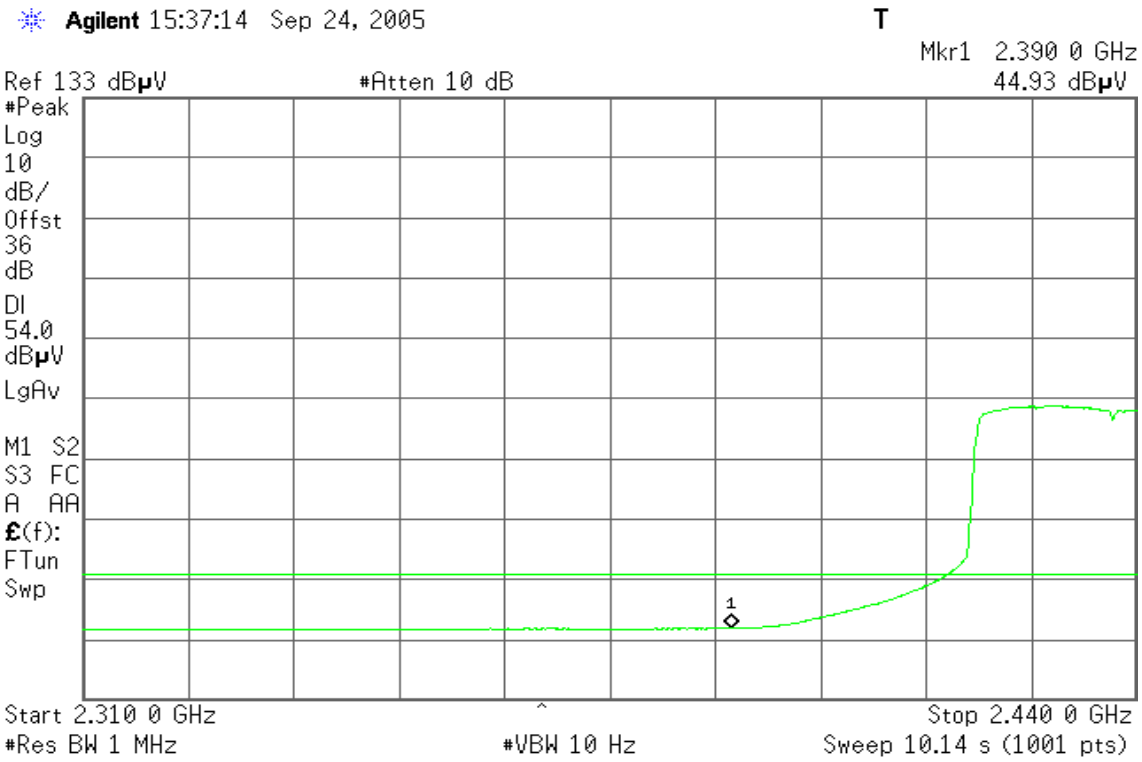
Detector mode: Average **Polarity: Vertical**



Detector mode: Peak **Polarity: Horizontal**

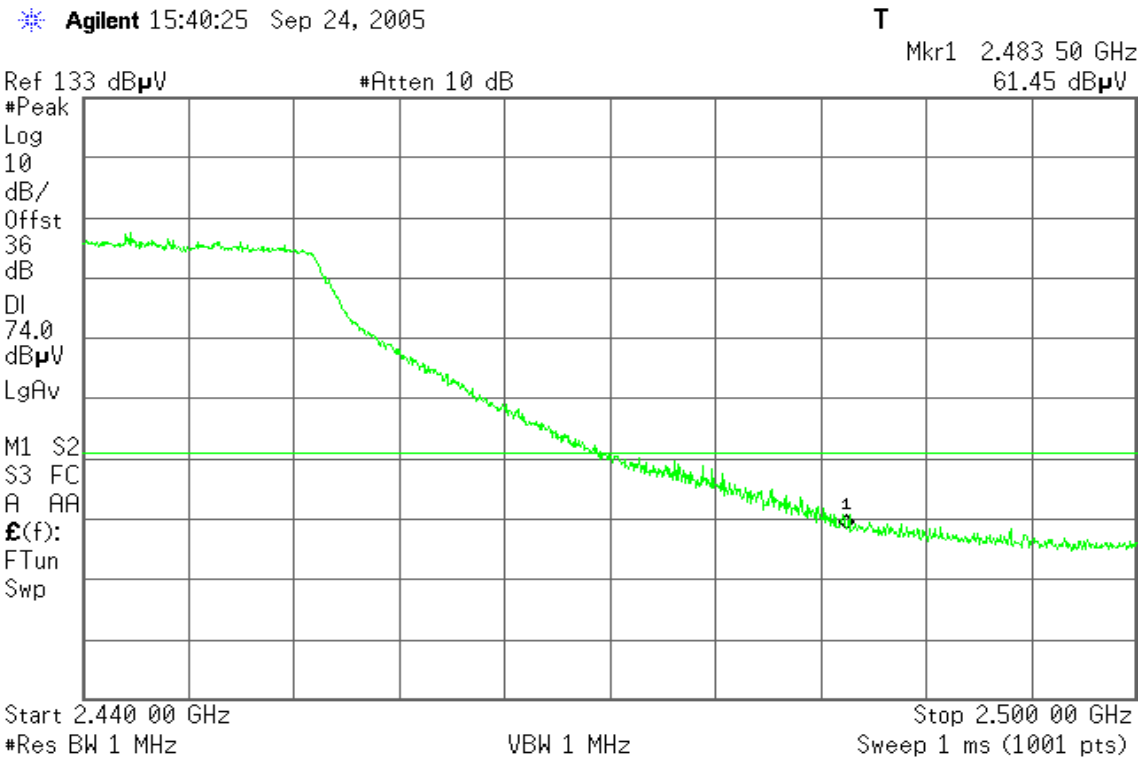


Detector mode: Average **Polarity: Horizontal**

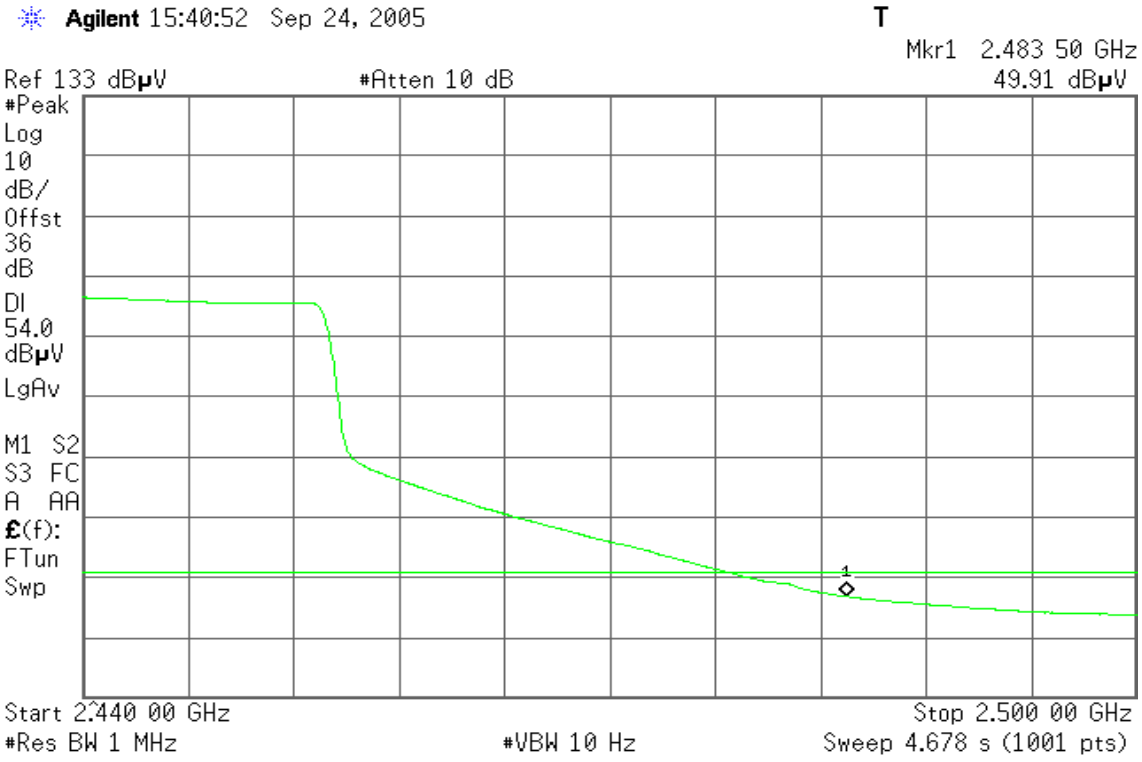


Band Edges (IEEE 802.11g Turbo mode / CH Mid)

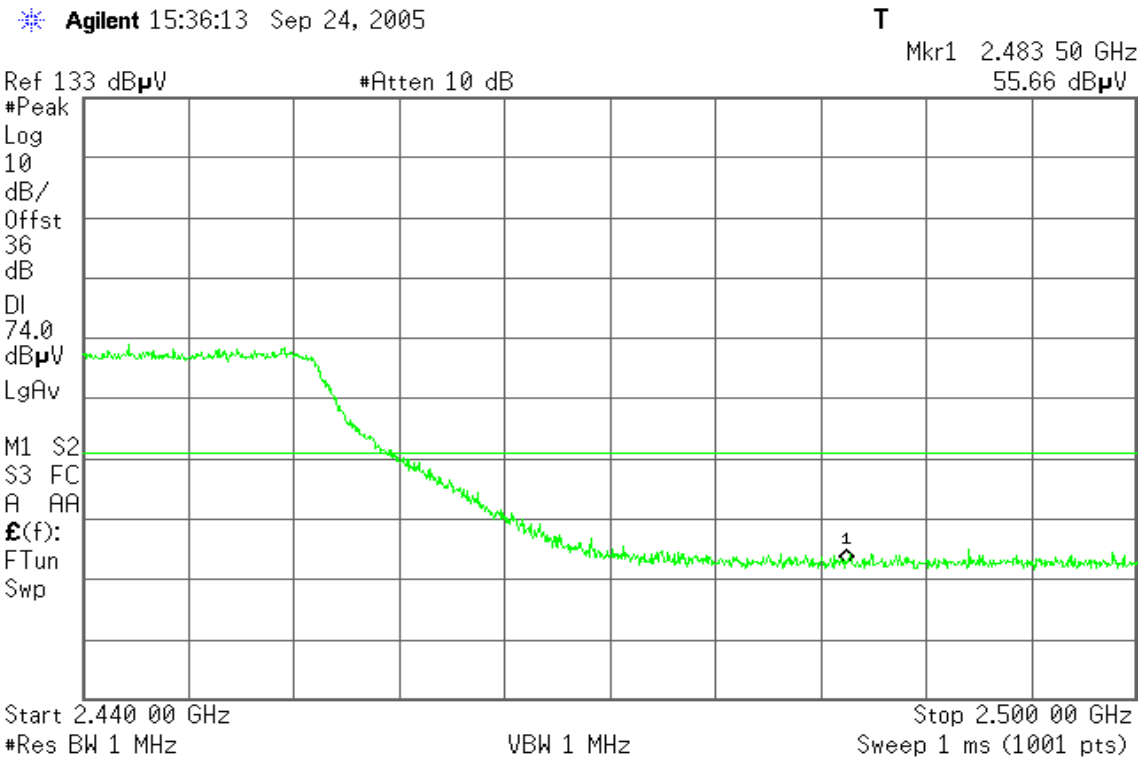
Detector mode: Peak Polarity: Vertical



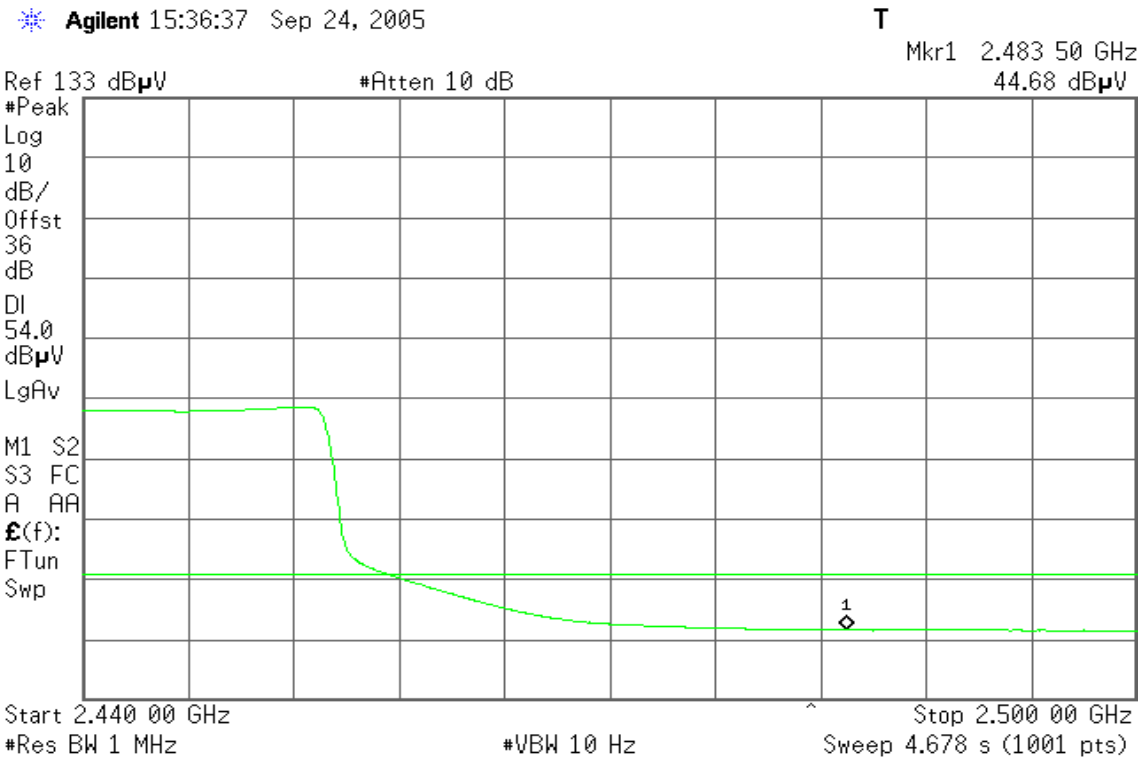
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**



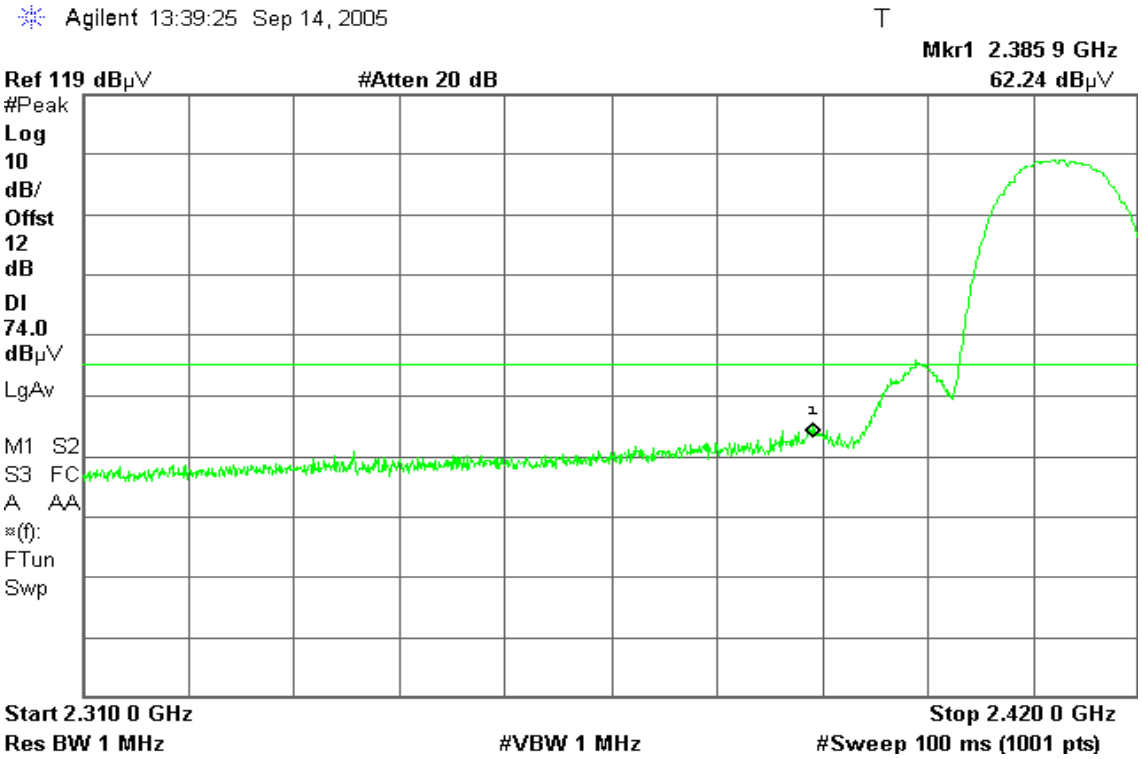
Detector mode: Average **Polarity: Horizontal**



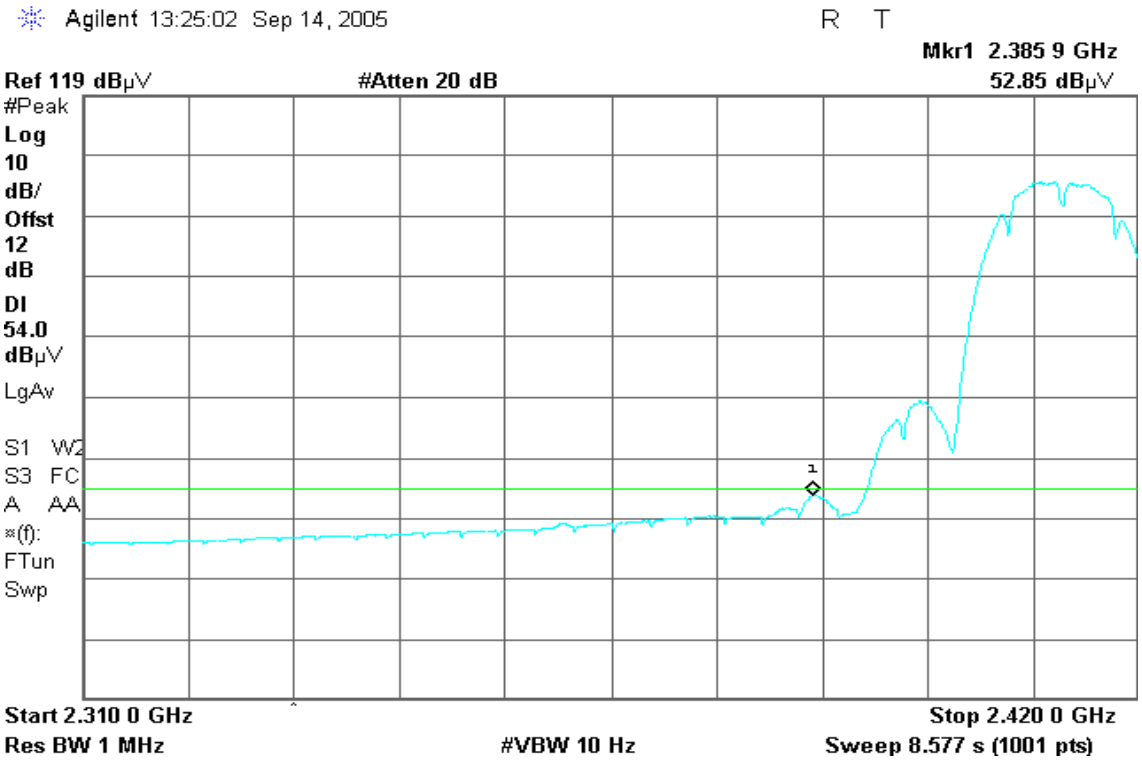
Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

Band Edges (IEEE 802.11b Base mode / CH Low)

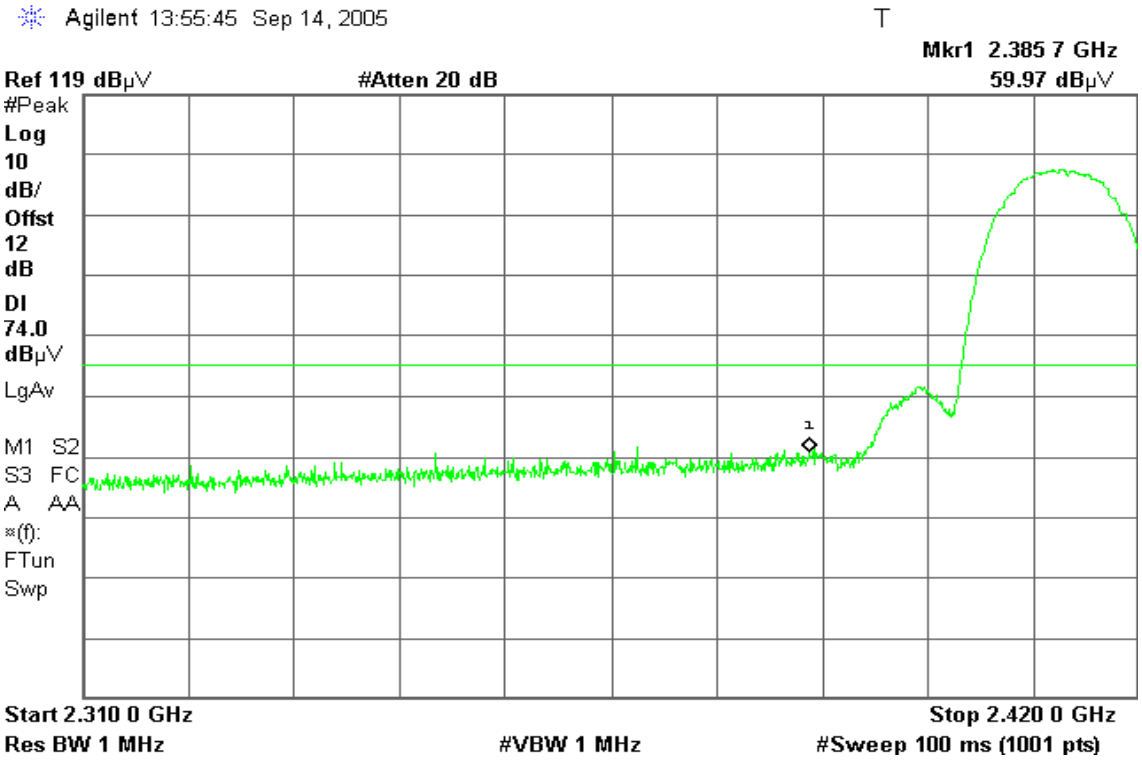
Detector mode: Peak **Polarity: Vertical**



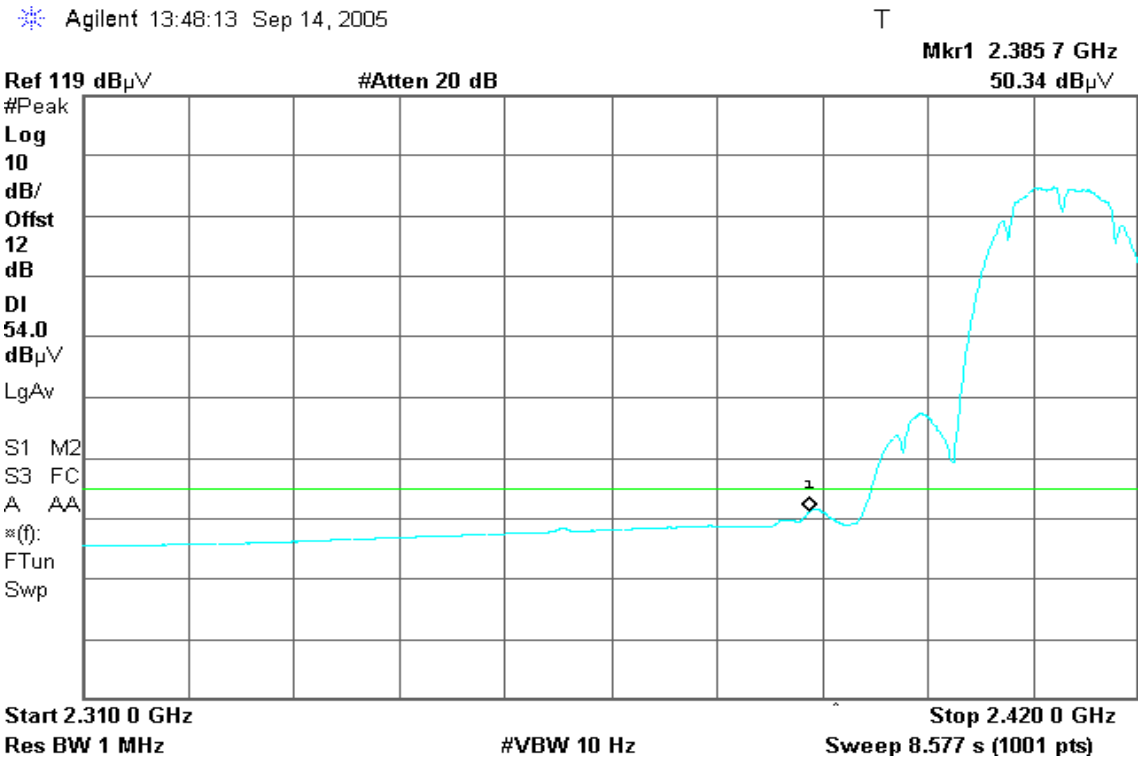
Detector mode: Average **Polarity: Vertical**



Detector mode: Peak **Polarity: Horizontal**

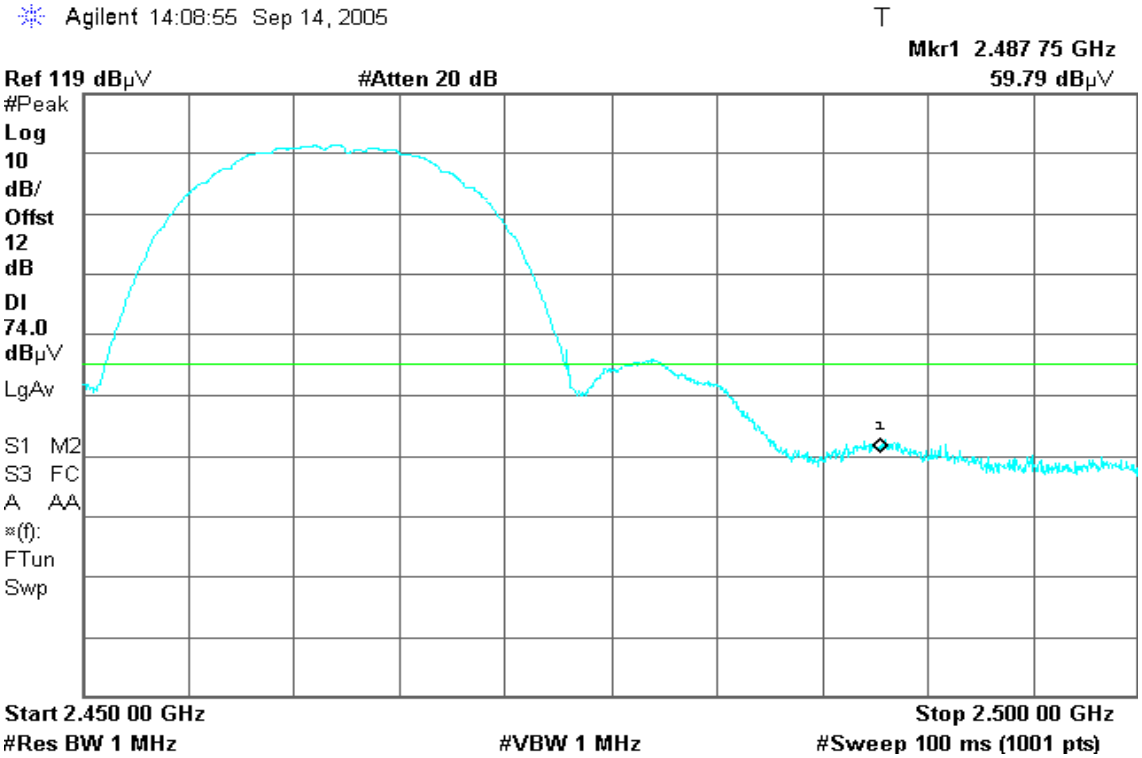


Detector mode: Average **Polarity: Horizontal**

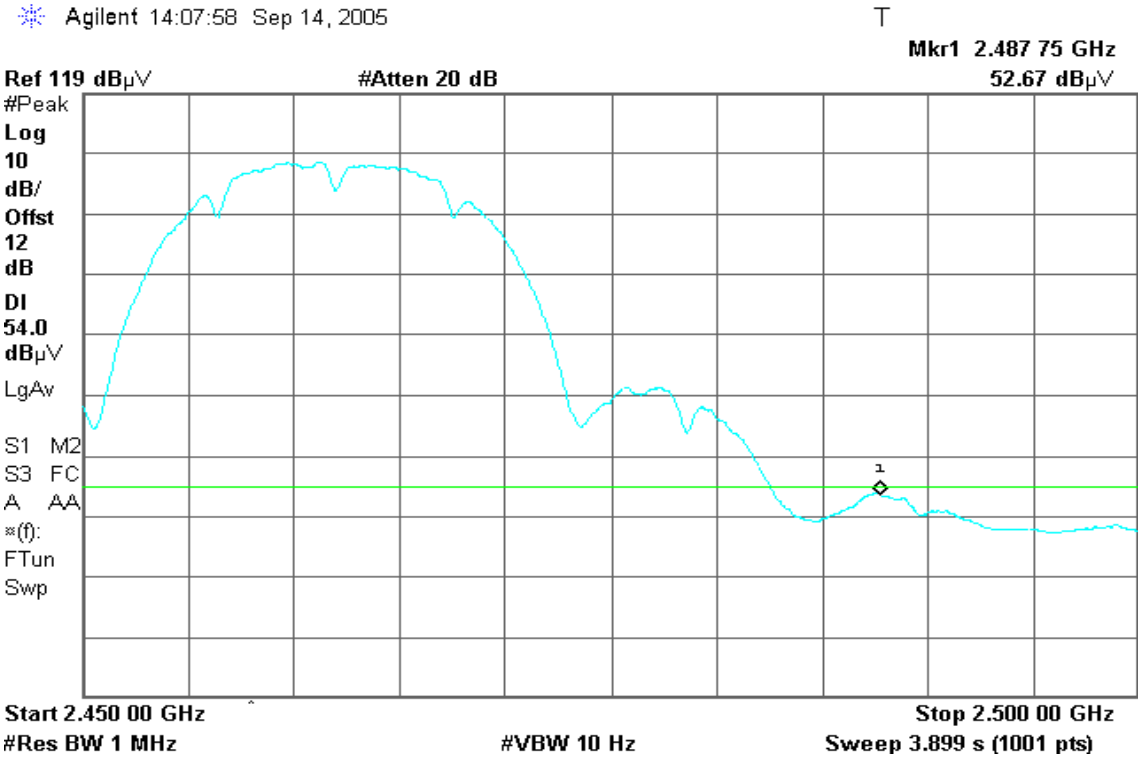


Band Edges (IEEE 802.11b Base mode / CH High)

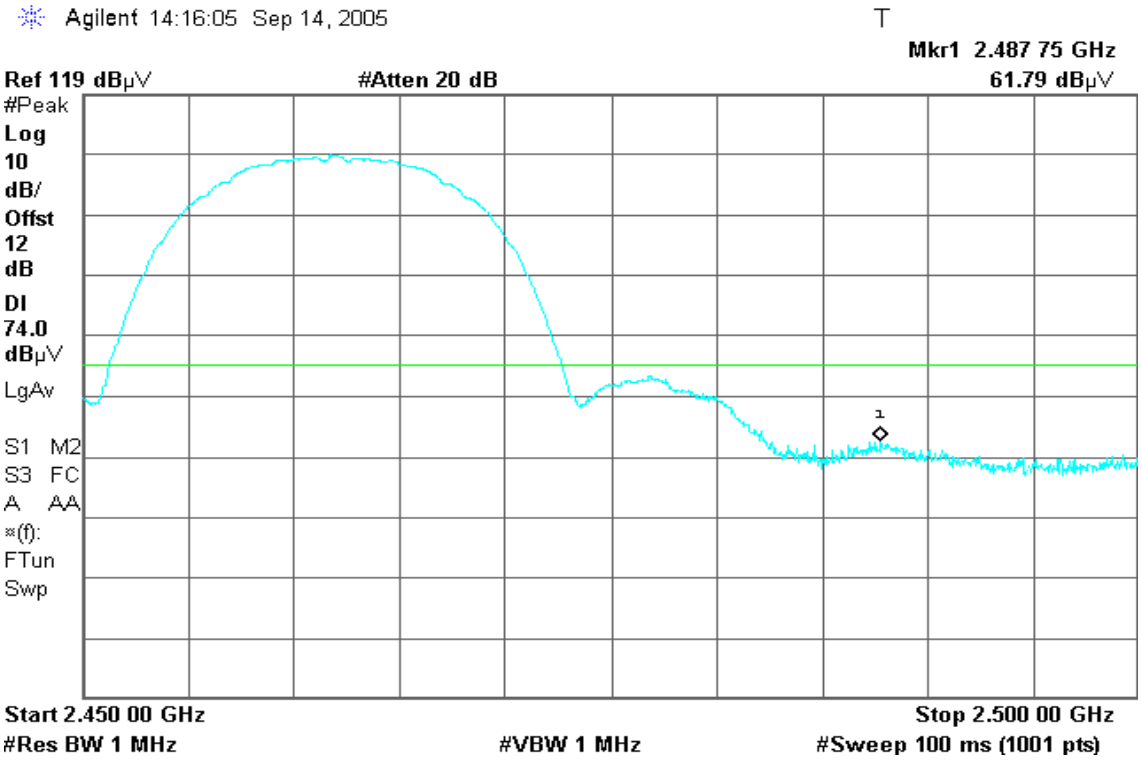
Detector mode: Peak Polarity: Vertical



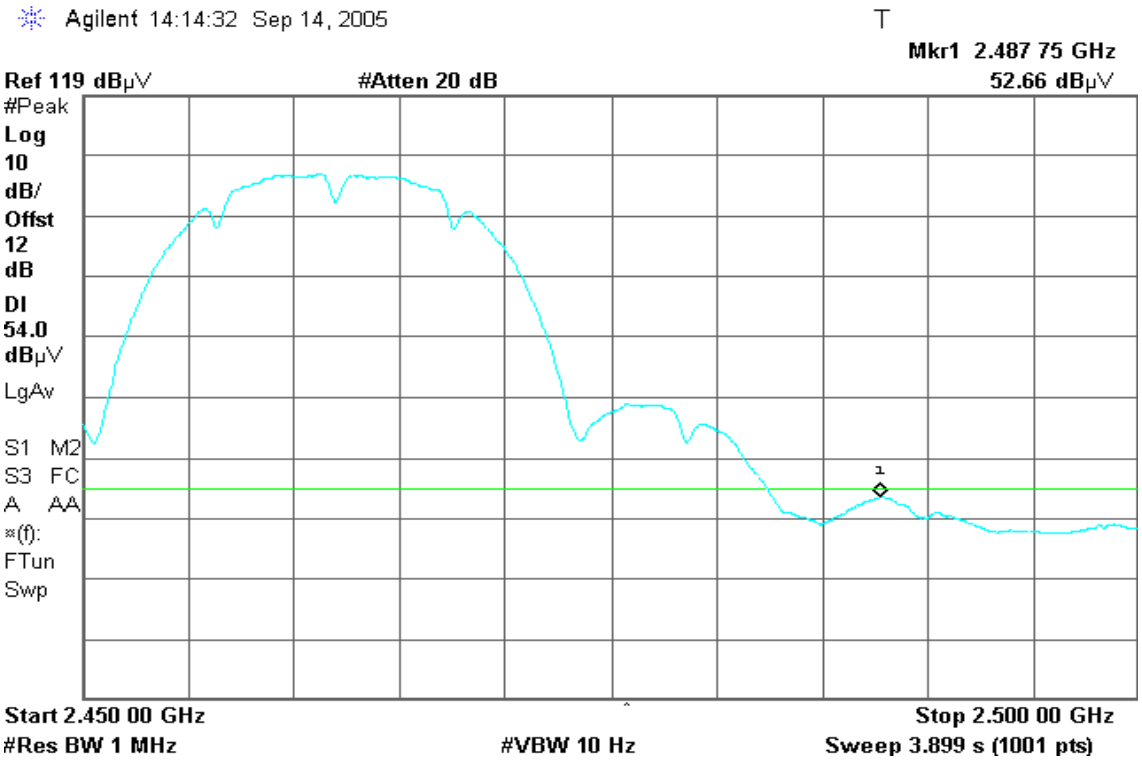
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

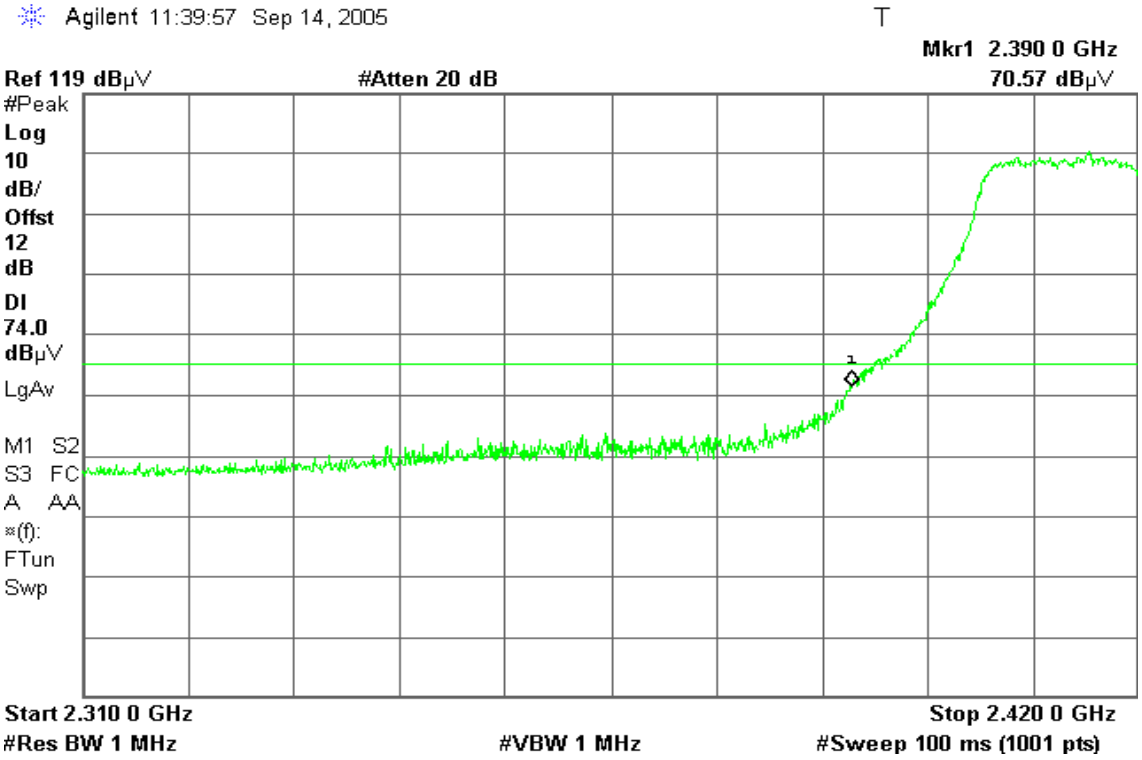


Detector mode: Average **Polarity: Horizontal**

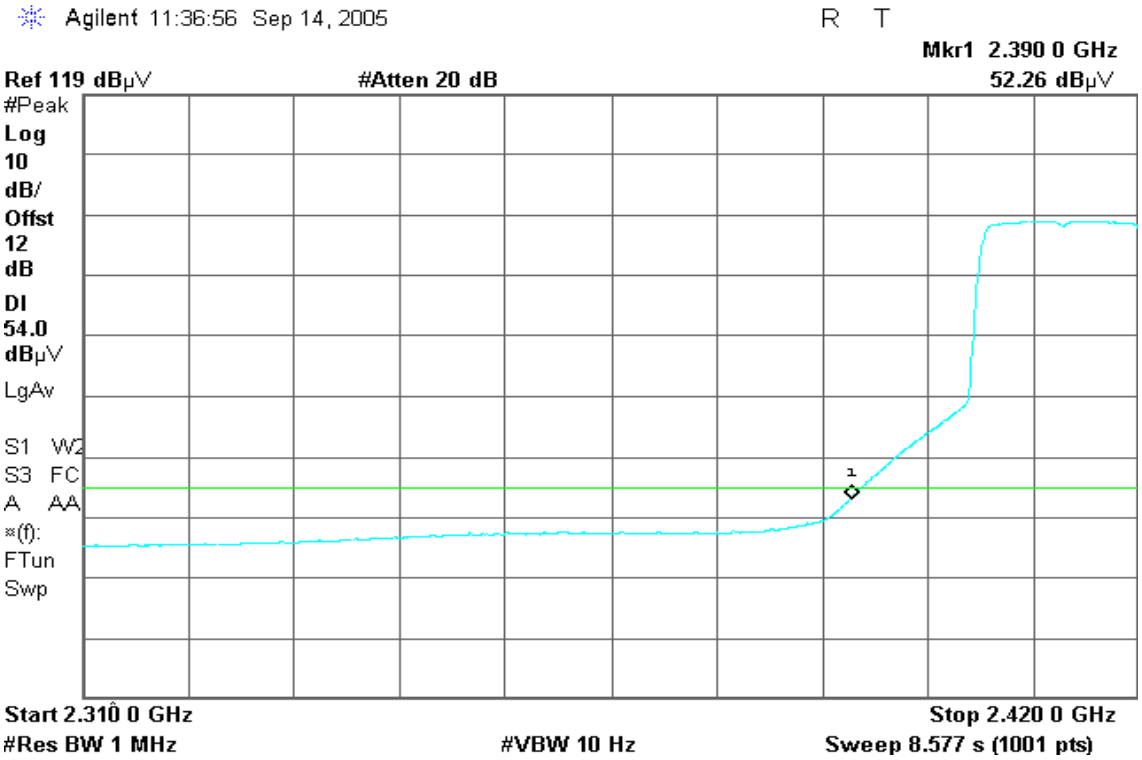


Band Edges (IEEE 802.11g Base mode / CH Low)

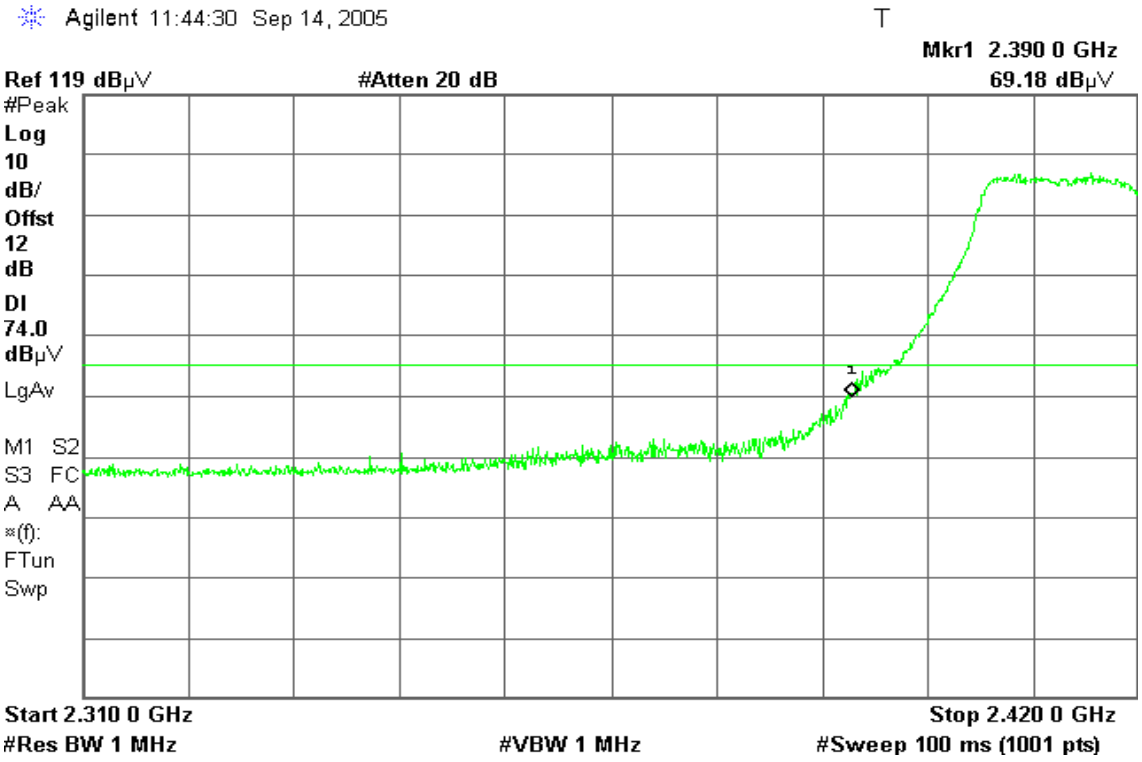
Detector mode: Peak Polarity: Vertical



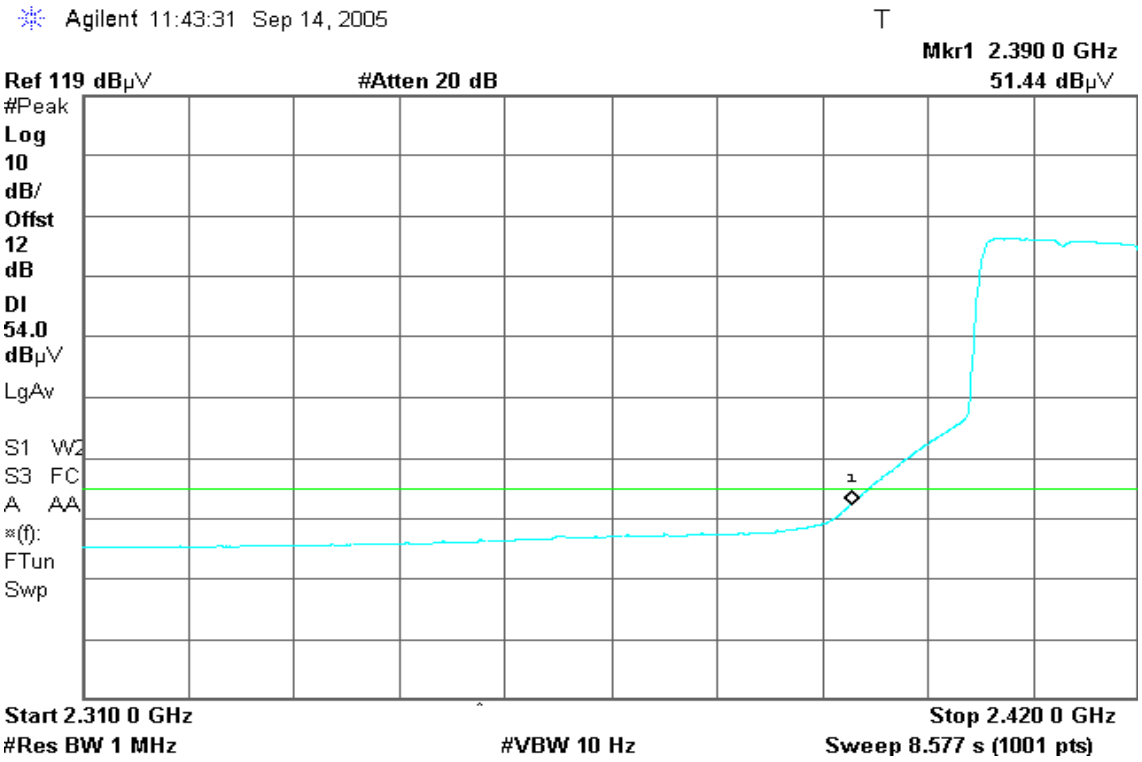
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

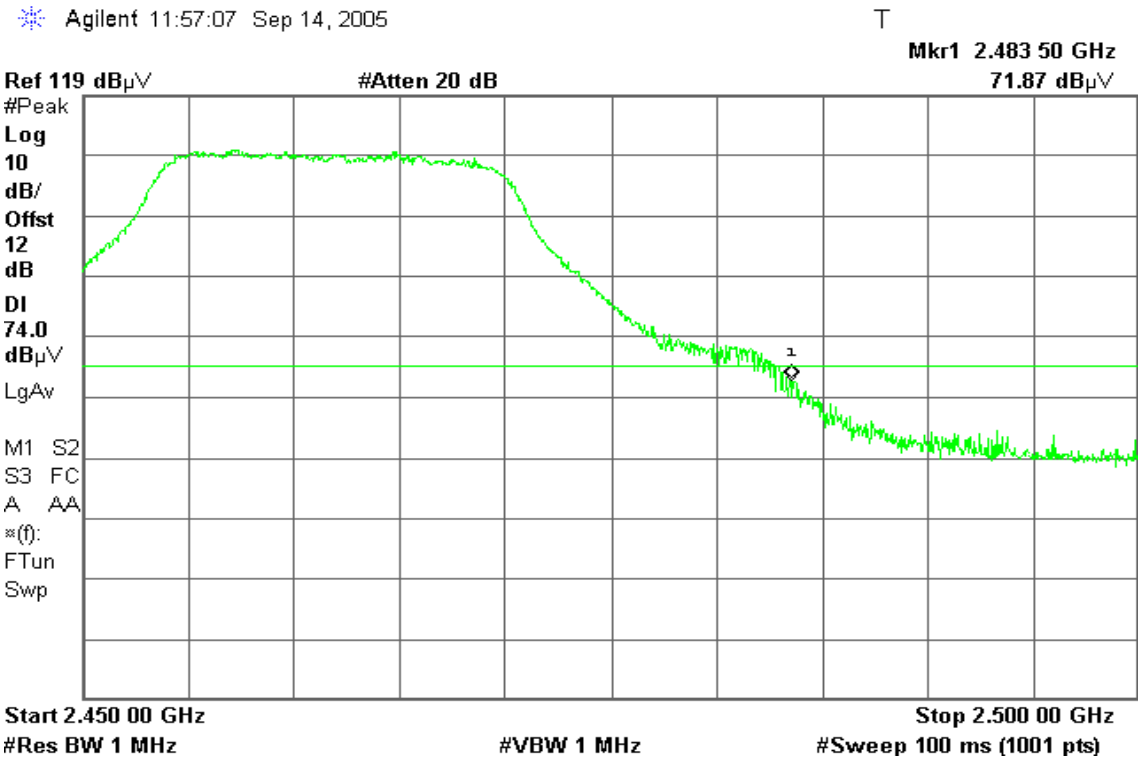


Detector mode: Average **Polarity: Horizontal**

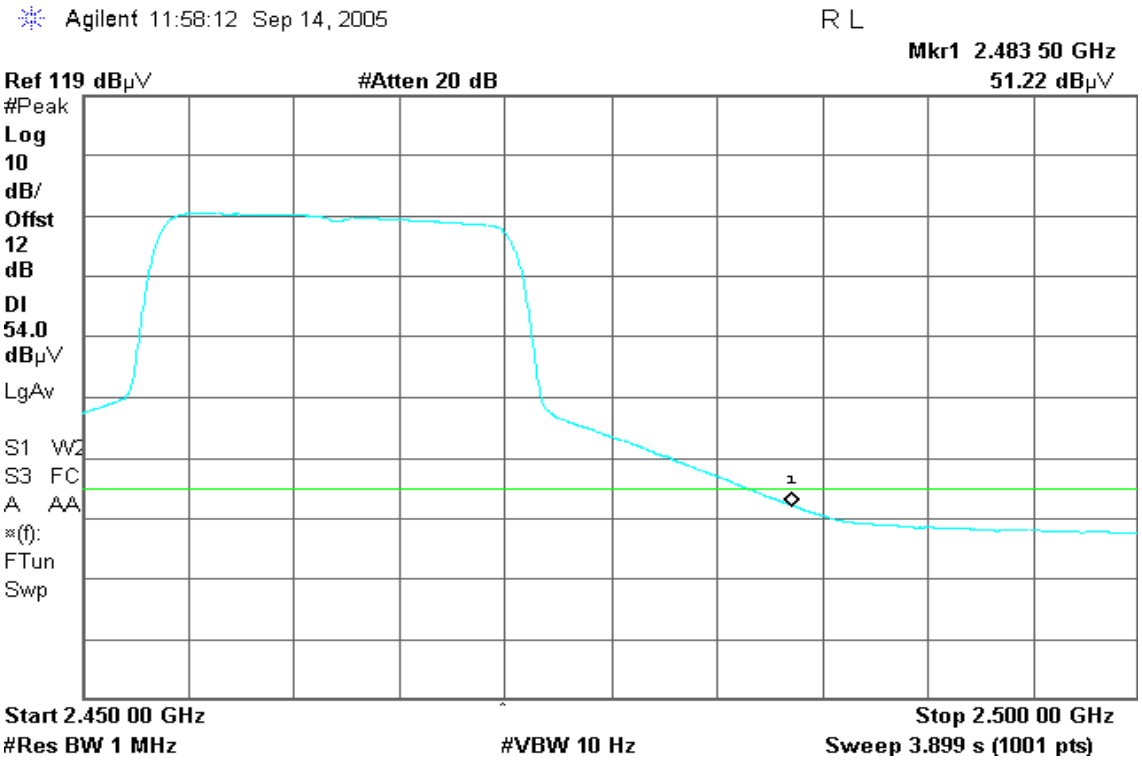


Band Edges (IEEE 802.11g Base mode / CH High)

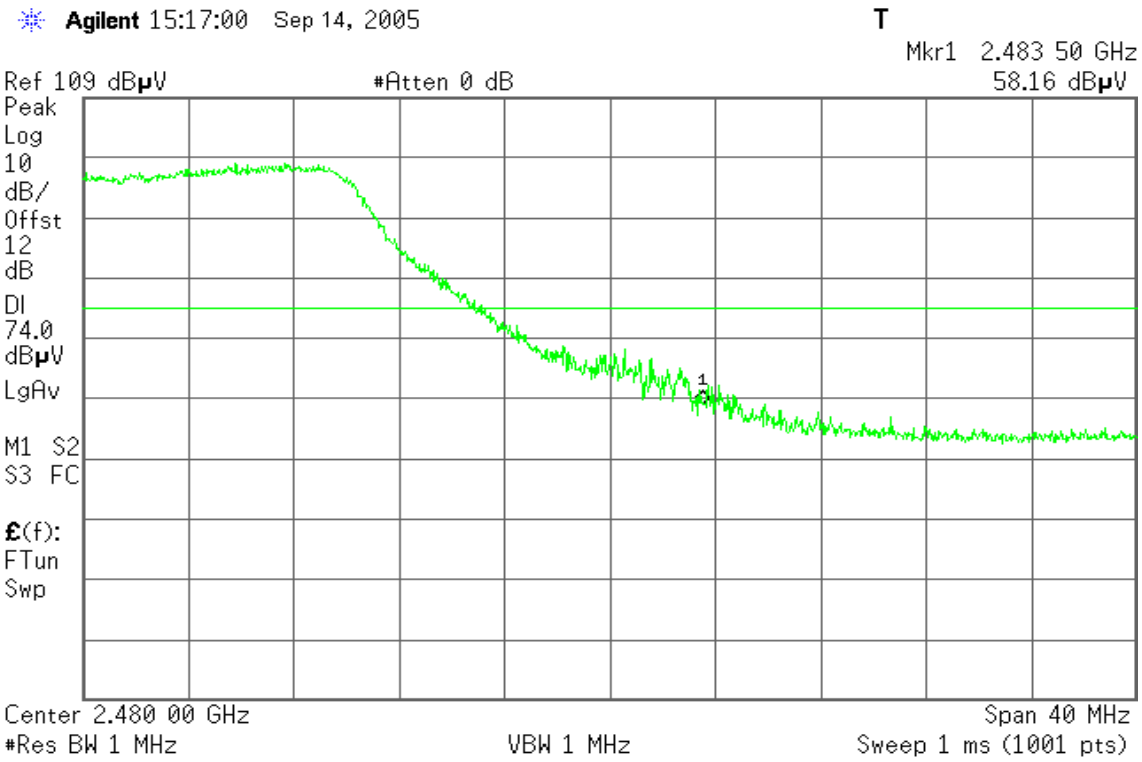
Detector mode: Peak Polarity: Vertical



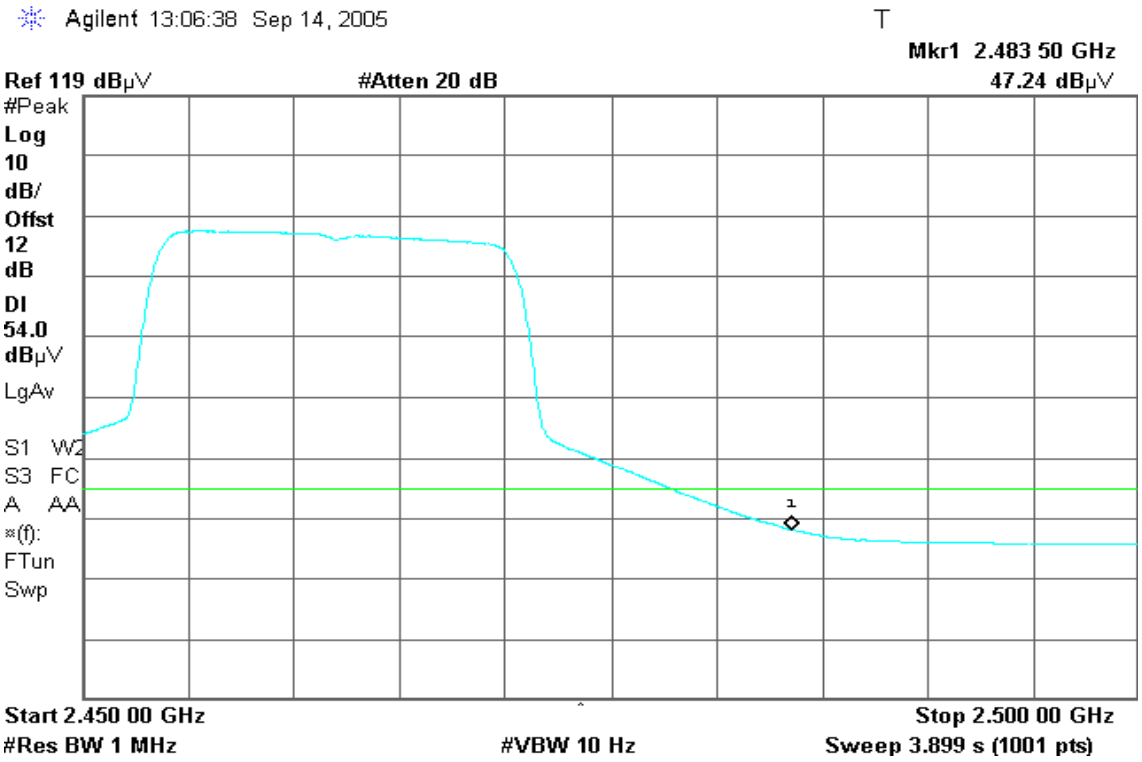
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

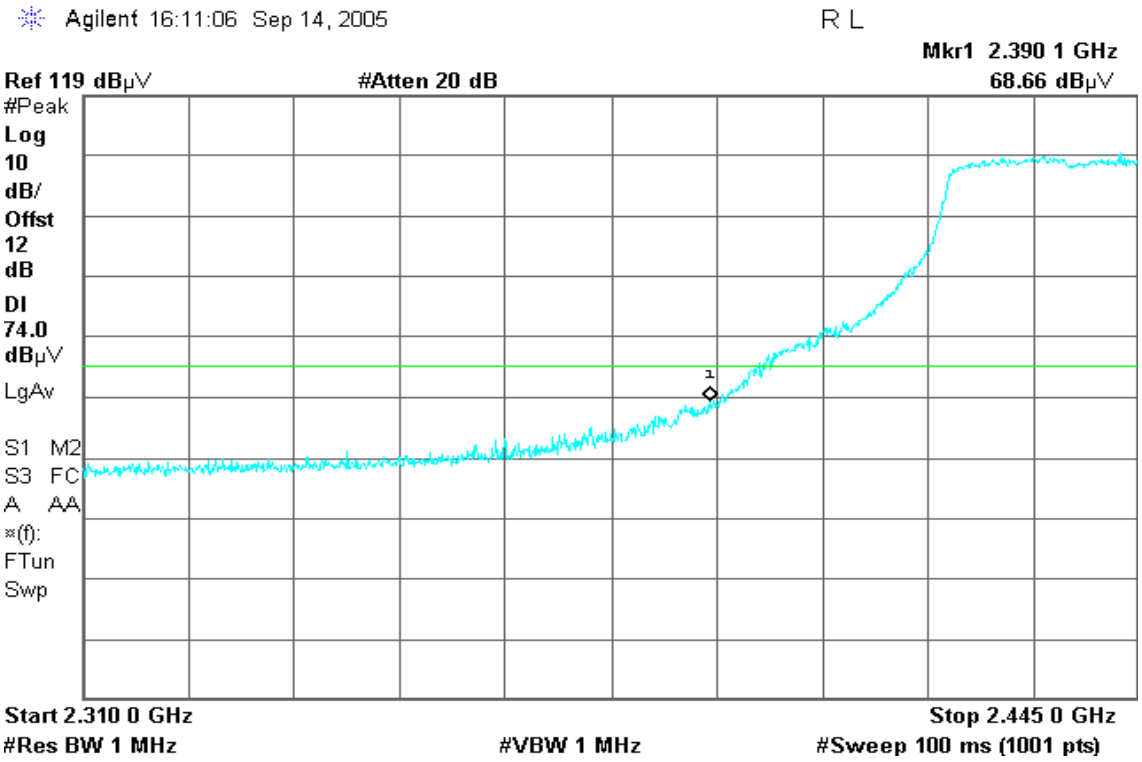


Detector mode: Average **Polarity: Horizontal**

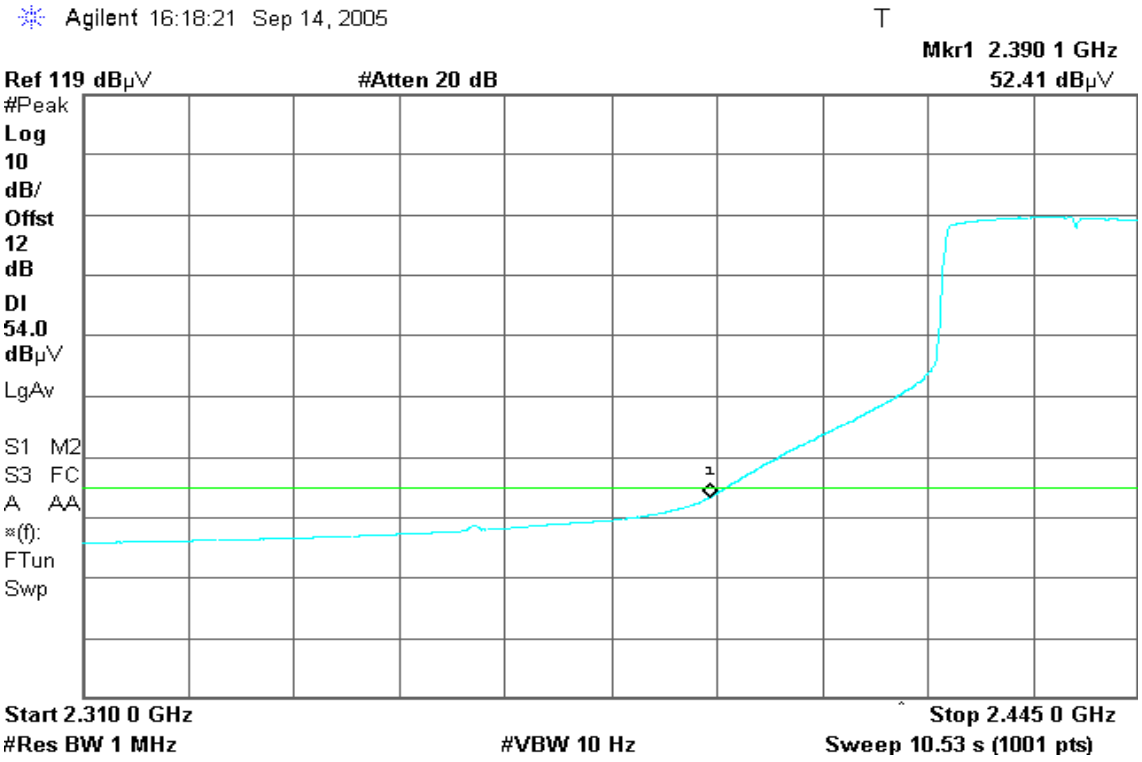


Band Edges (IEEE 802.11g Turbo mode / CH Mid)

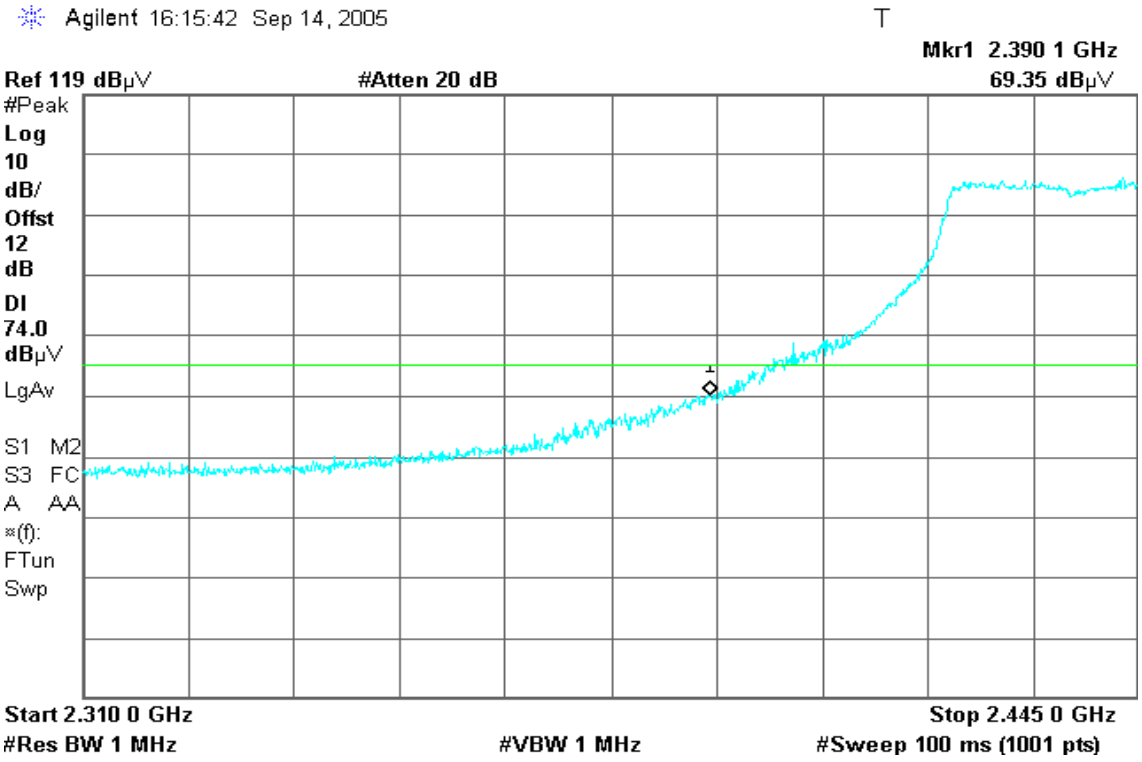
Detector mode: Peak Polarity: Vertical



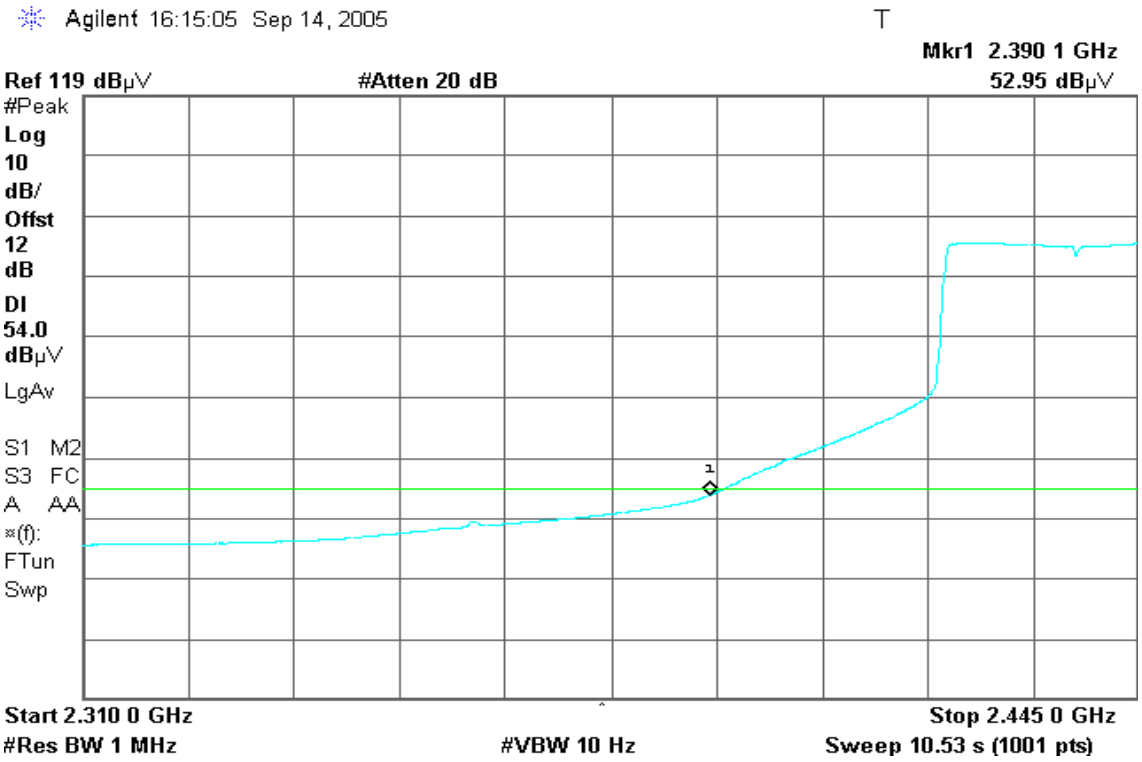
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**

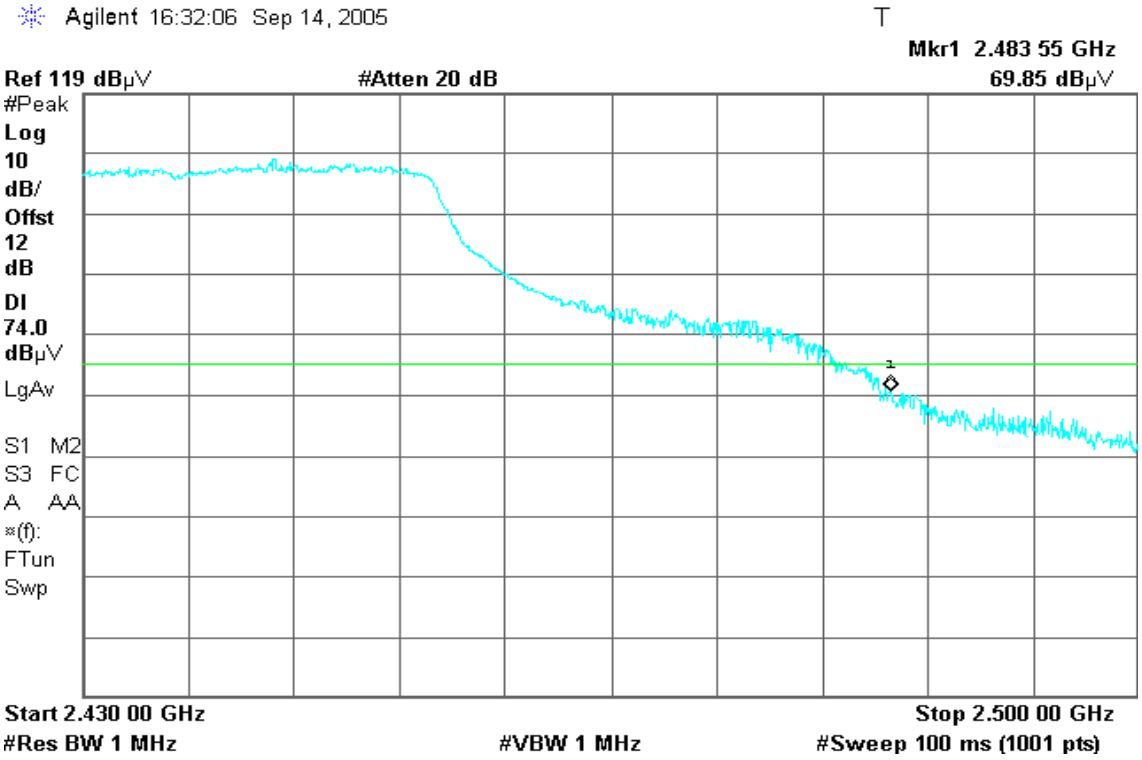


Detector mode: Average **Polarity: Horizontal**

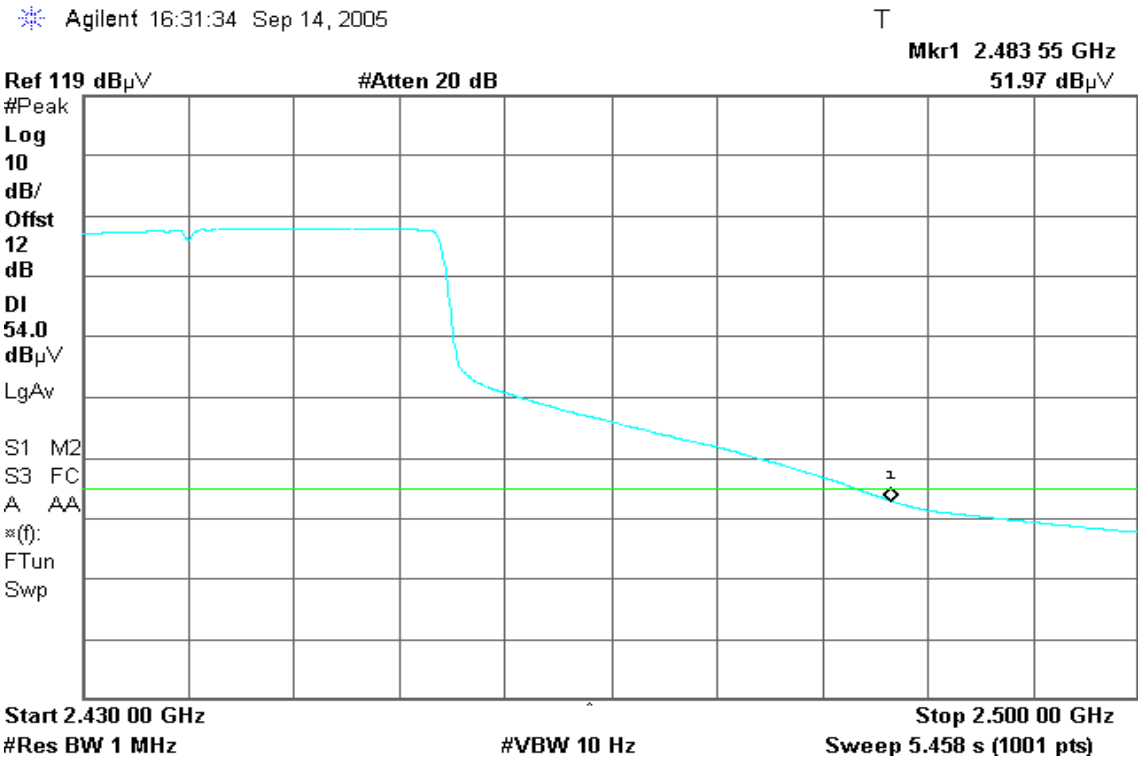


Band Edges (IEEE 802.11g Turbo mode / CH Mid)

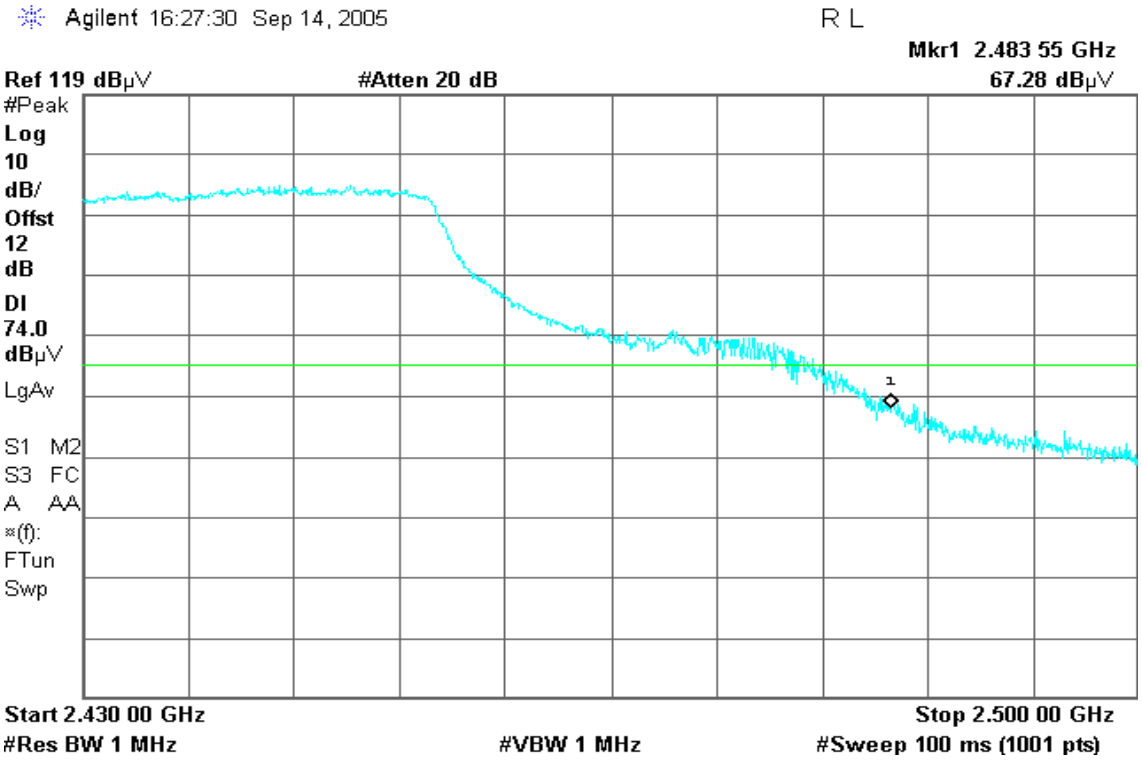
Detector mode: Peak Polarity: Vertical



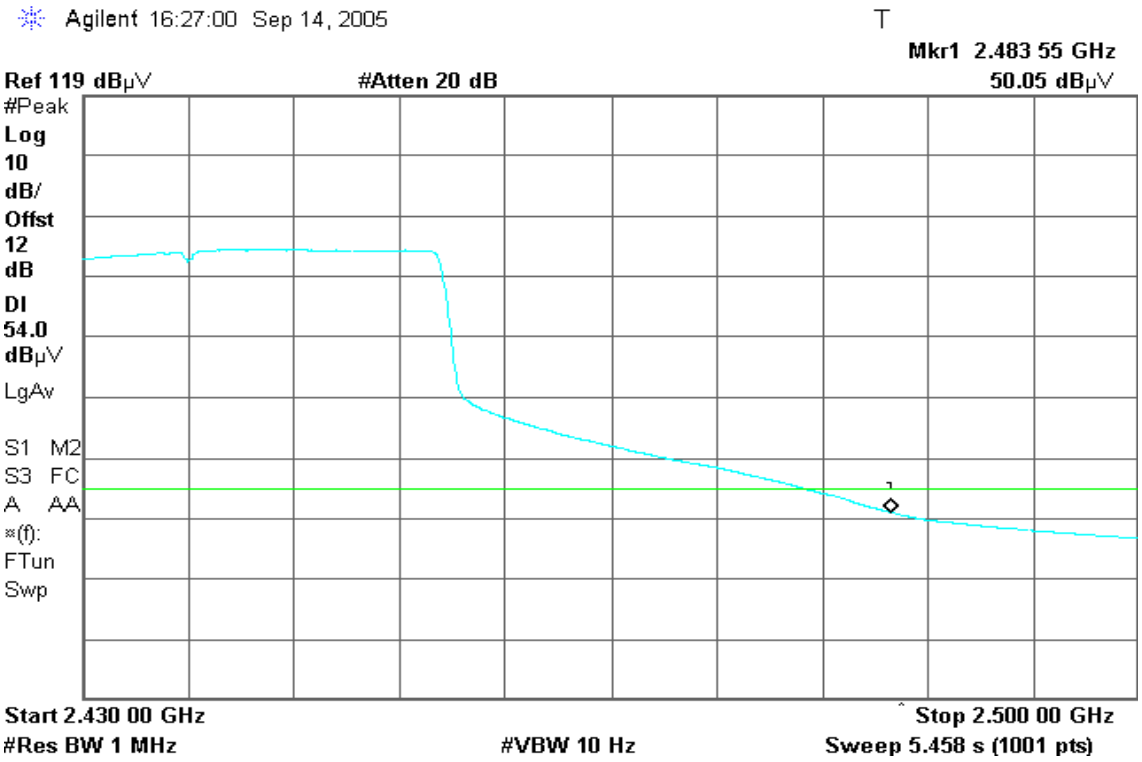
Detector mode: Average Polarity: Vertical



Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**



Omnidirectional antenna / 6.0 dBi for 5 GHz

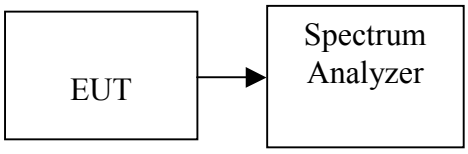
Not applicable.

7.4 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 = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s.
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

Omnidirectional antenna / 12.0 dBi for 2.4 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-5.18	2.00	PASS
Mid	2437	-8.73		PASS
High	2462	-4.57		PASS

Remark: The maximum antenna gain is 12.0dBi; therefore the reduction due to antenna gain is 6.0dB, so the limit is 24.0dBm.

Test mode: IEEE 802.11g mode

Channel	Frequency		PPSD (dBm)	Limit (dBm)	Result
Low	Base mode	2412	-11.24	2.00	PASS
Mid		2437	-11.04		PASS
High		2462	-11.00		PASS
Mid	Turbo mode	2437	-11.07		PASS

Remark: The maximum antenna gain is 12.0dBi; therefore the reduction due to antenna gain is 6.0dB, so the limit is 24.0dBm.

Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

Test mode: IEEE 802.11b mode

Channel	Frequency	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-6.83	8.00	PASS
Mid	2437	-4.58		PASS
High	2462	-4.35		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency		PPSD (dBm)	Limit (dBm)	Result
Low	Base mode	2412	-8.59	8.00	PASS
Mid		2437	-7.89		PASS
High		2462	-8.02		PASS
Mid	Turbo mode	2437	-6.24		PASS

Test mode: IEEE 802.11a mode

Channel	Frequency		PPSD (dBm)	Limit (dBm)	Result
Low	Base mode	5745	-3.23	8.00	PASS
Mid		5785	-2.58		PASS
High		5825	-1.78		PASS
Low	Turbo mode	5760	-1.59		PASS
High		5800	-1.79		PASS

Omnidirectional antenna / 6.0 dBi for 5 GHz

Test mode: IEEE 802.11a mode

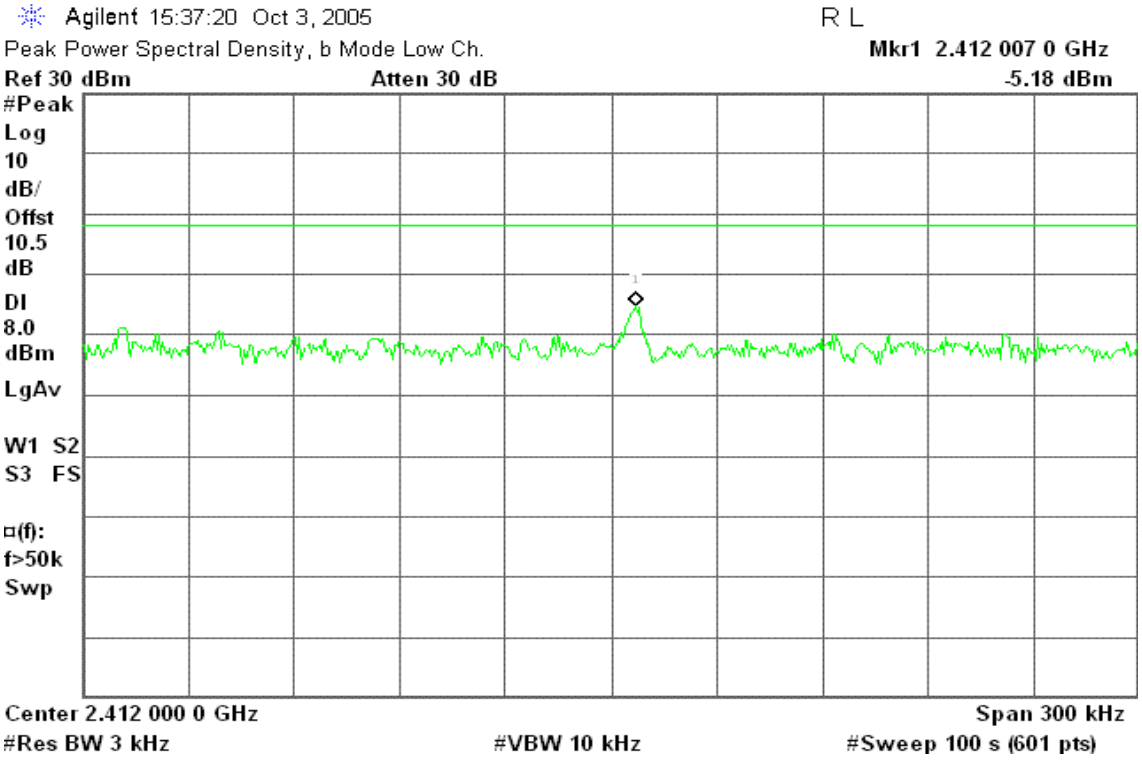
Channel	Frequency		PPSD (dBm)	Limit (dBm)	Result
Low	Base mode	5745	-3.23	8.00	PASS
Mid		5785	-2.58		PASS
High		5825	-1.78		PASS
Low	Turbo mode	5760	-1.59		PASS
High		5800	-1.79		PASS

Test Plot

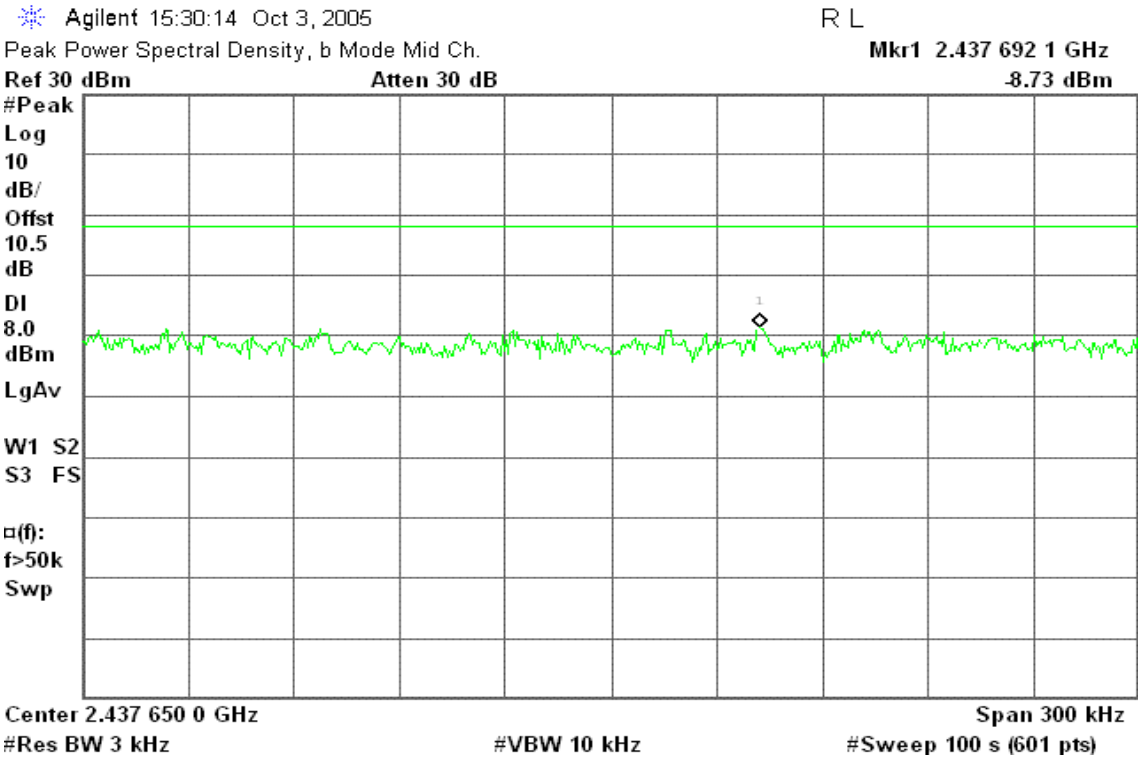
Omnidirectional antenna / 12.0 dBi for 2.4 GHz

IEEE 802.11b Base mode

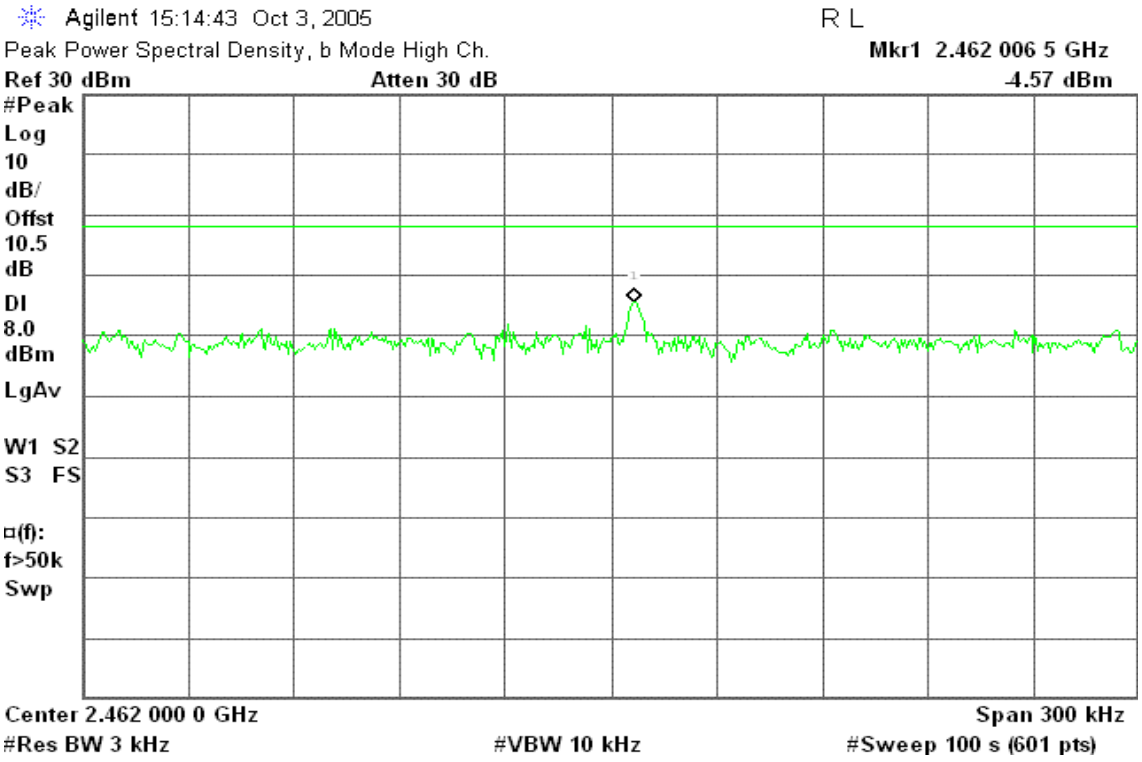
CH Low



CH Mid

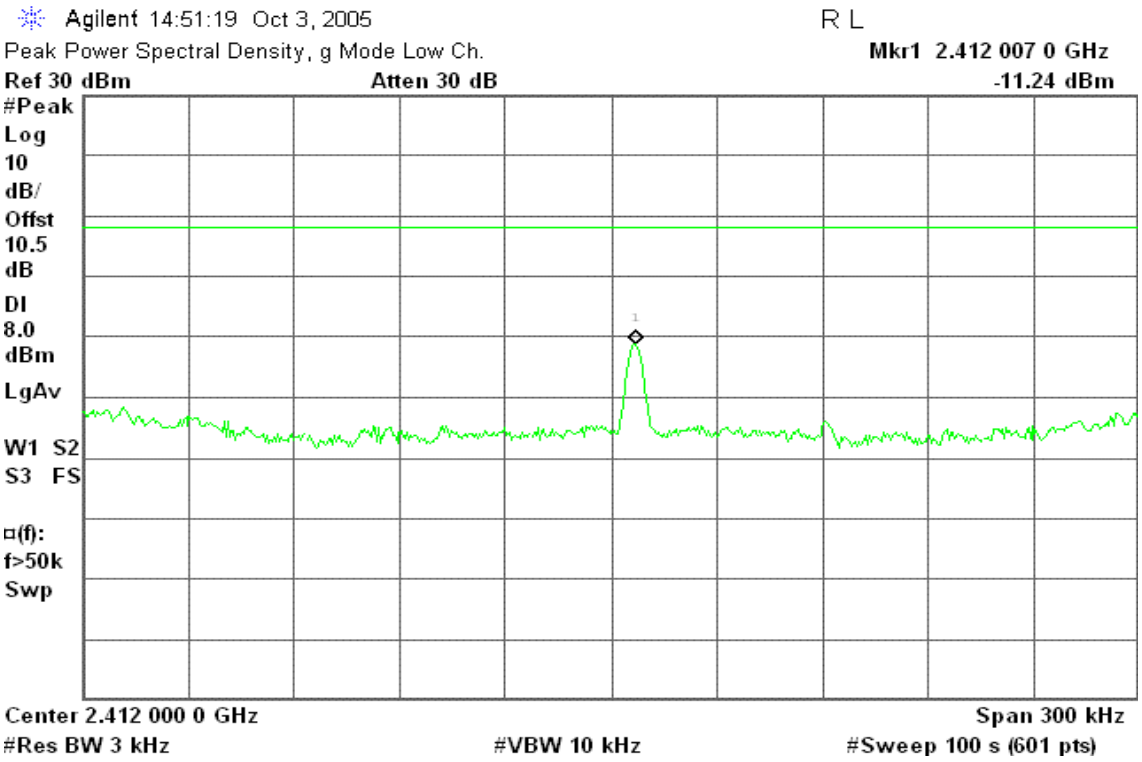


CH High

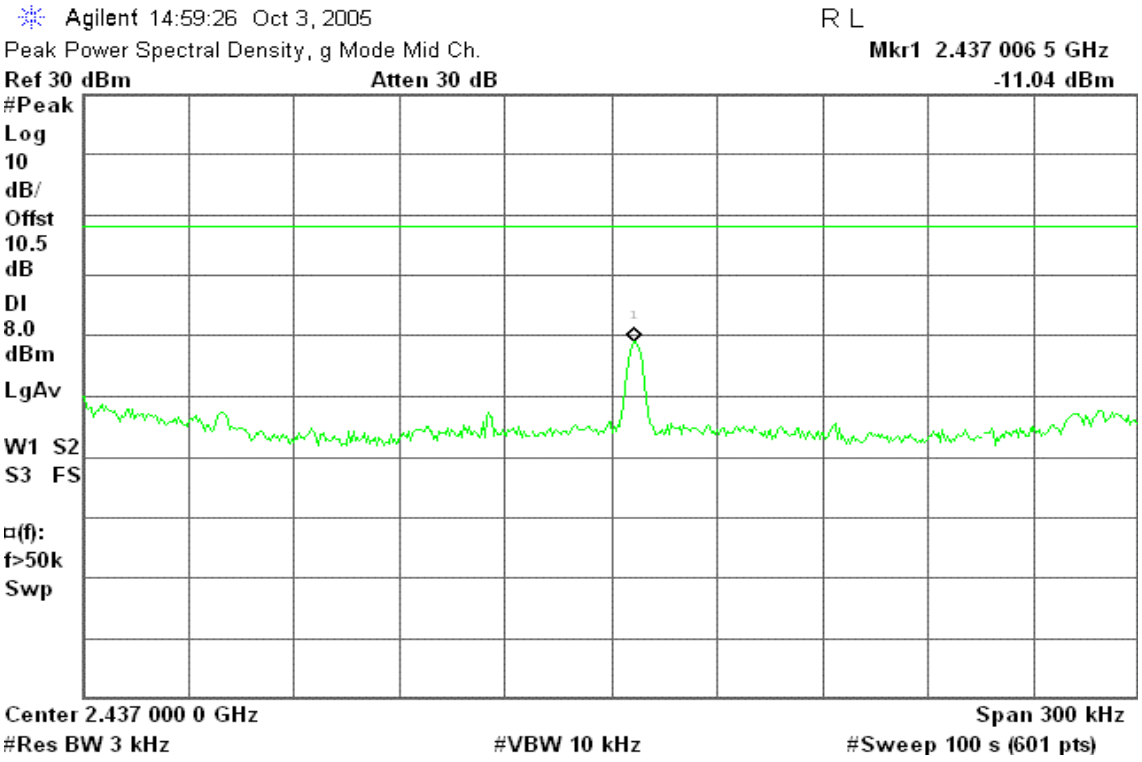


IEEE 802.11g Base mode

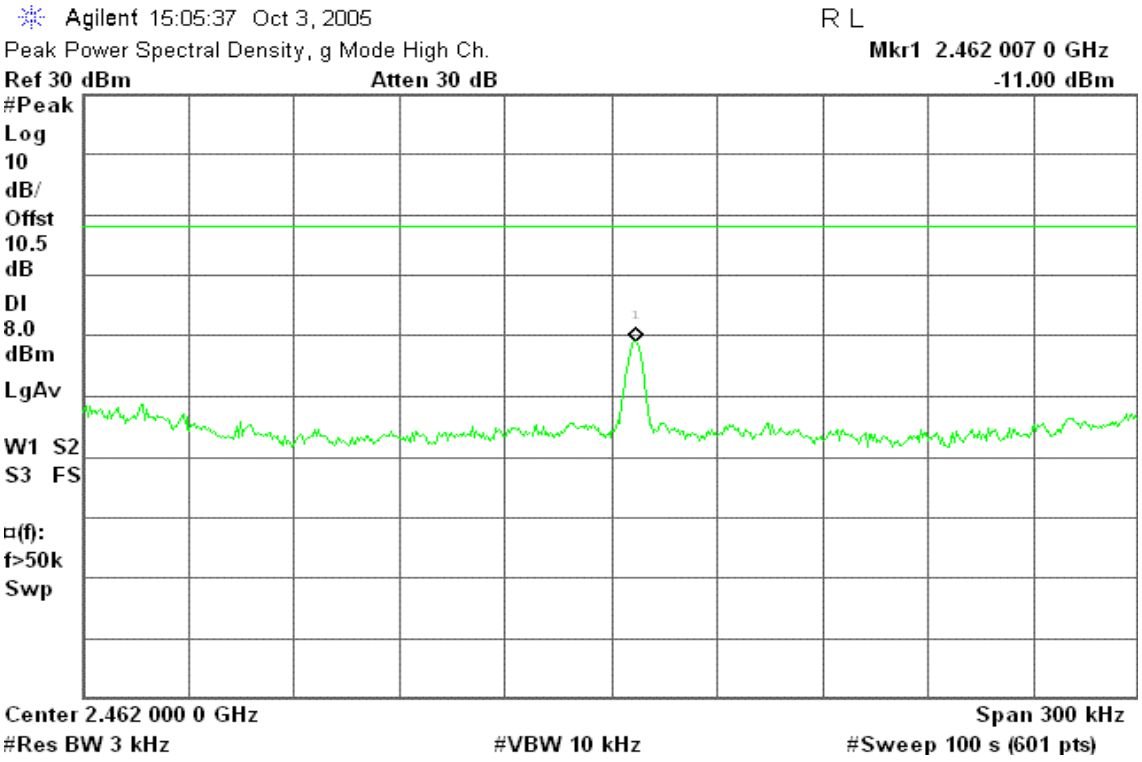
CH Low



CH Mid

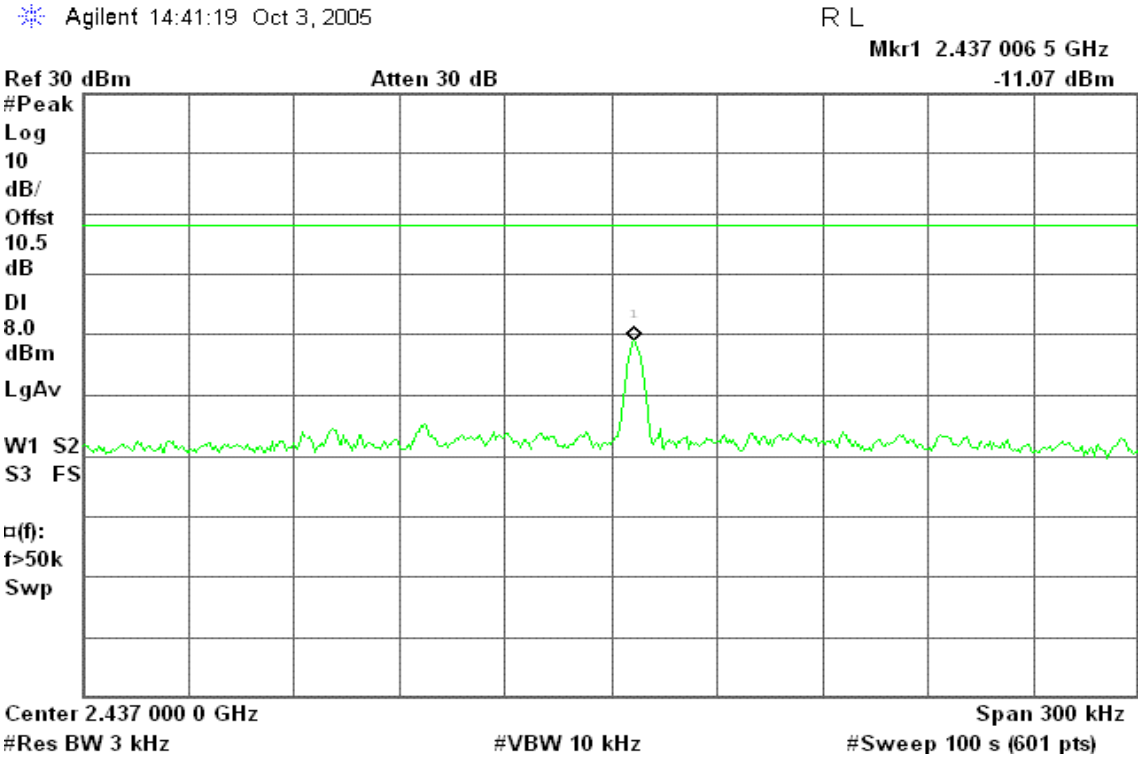


CH High



IEEE 802.11g Turbo mode

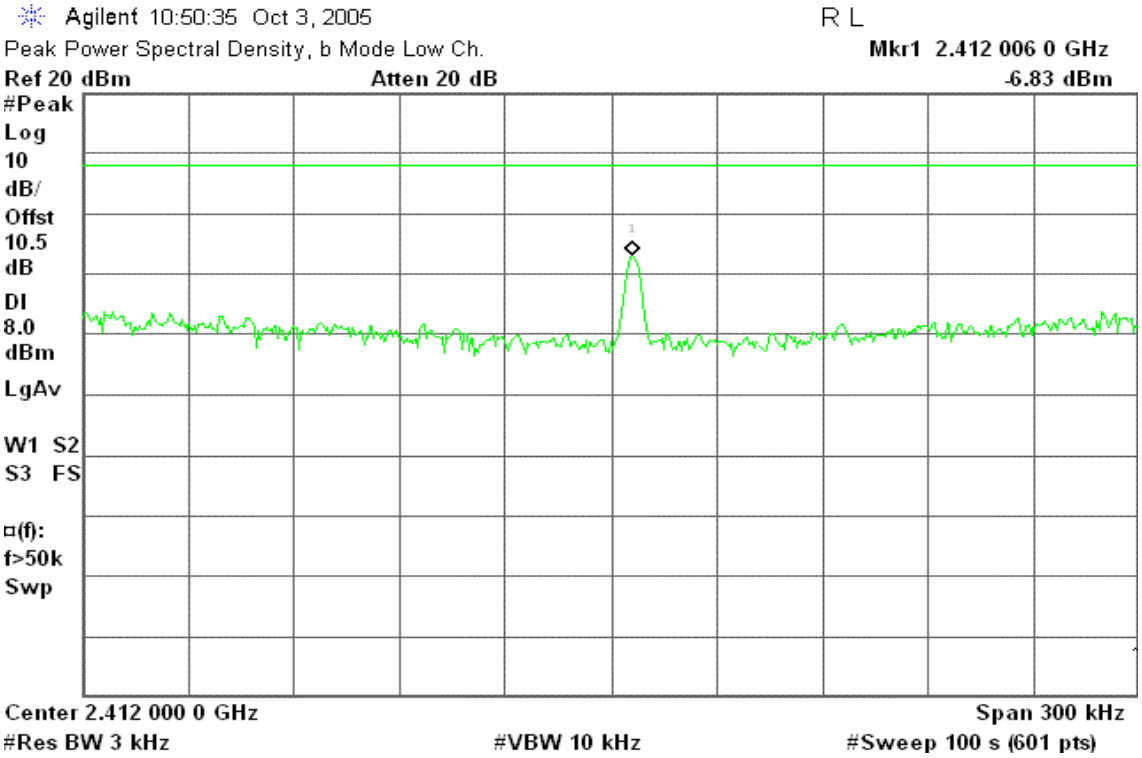
CH Mid



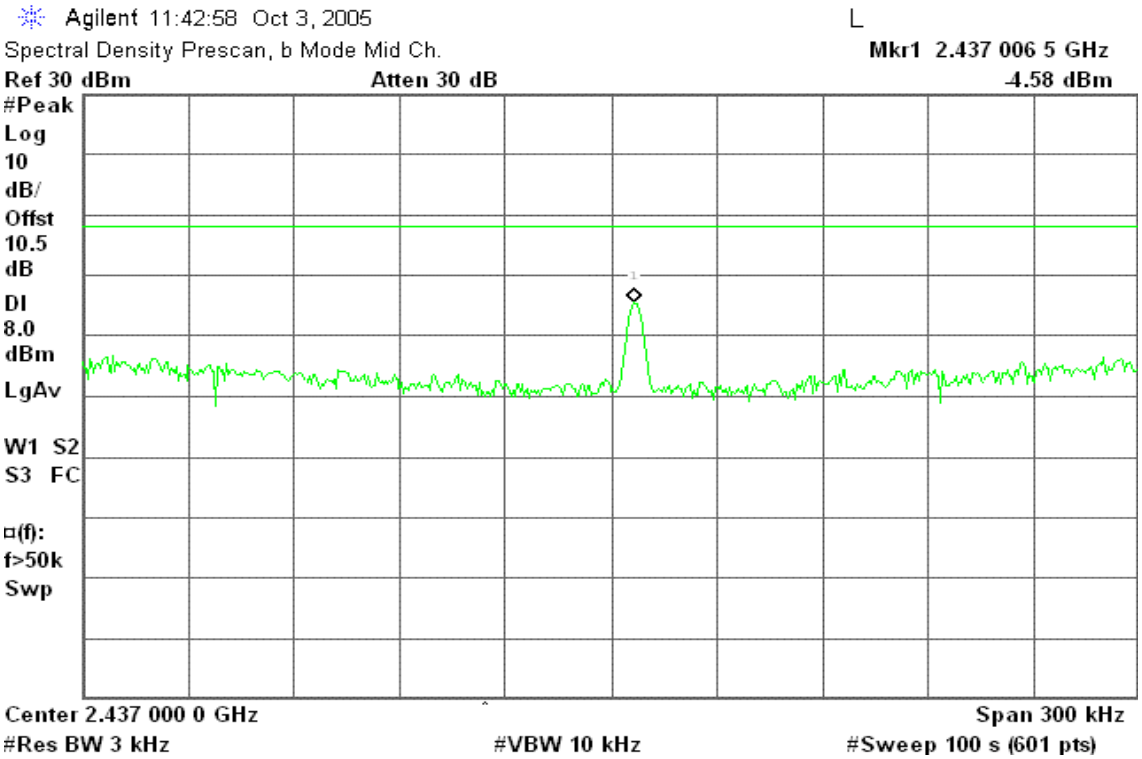
Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

IEEE 802.11b Base mode

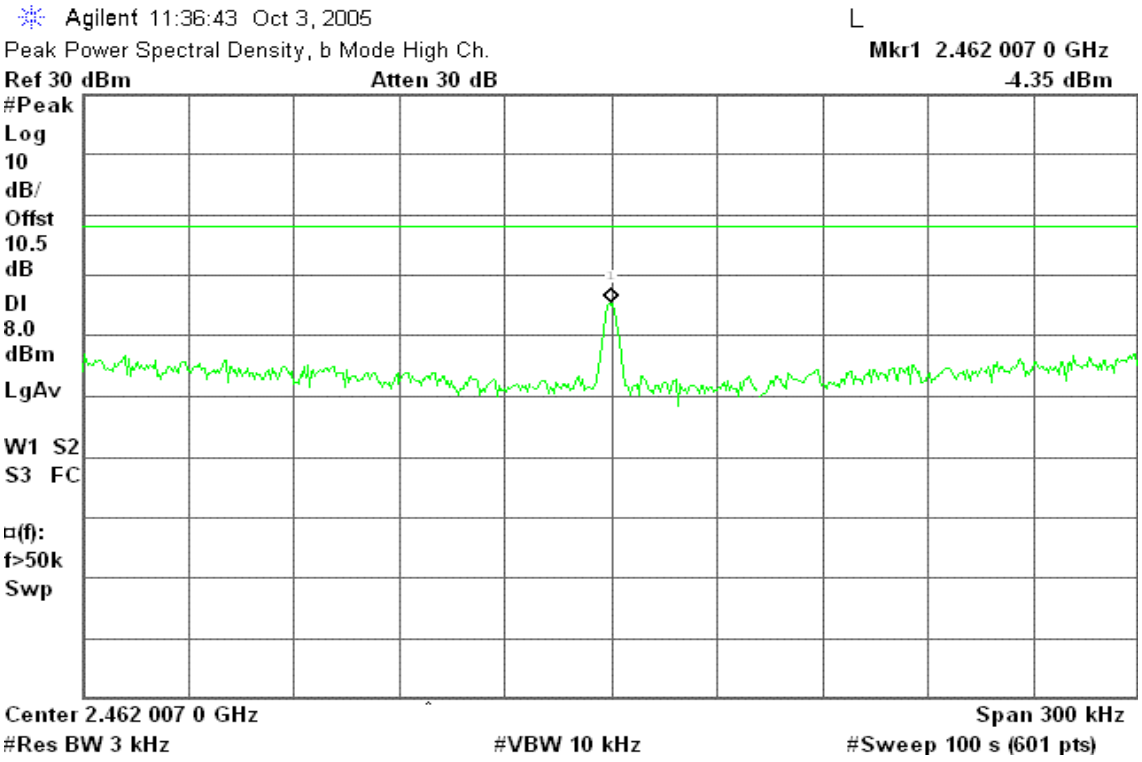
CH Low



CH Mid

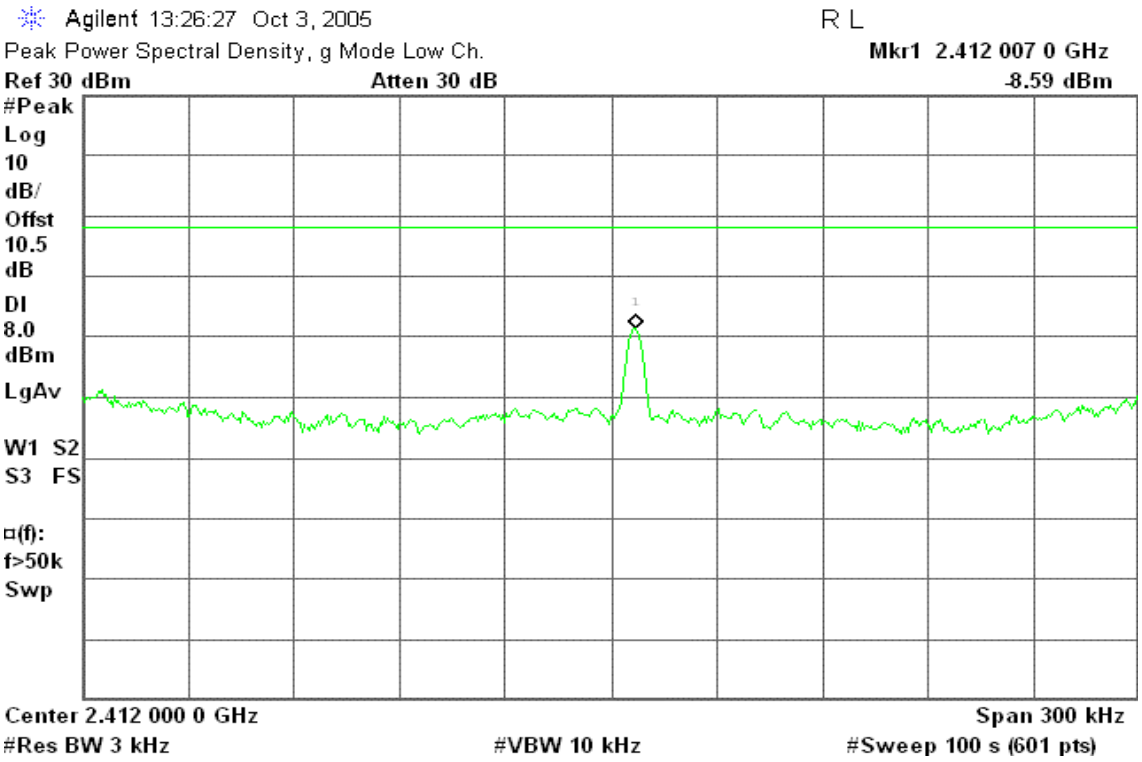


CH High

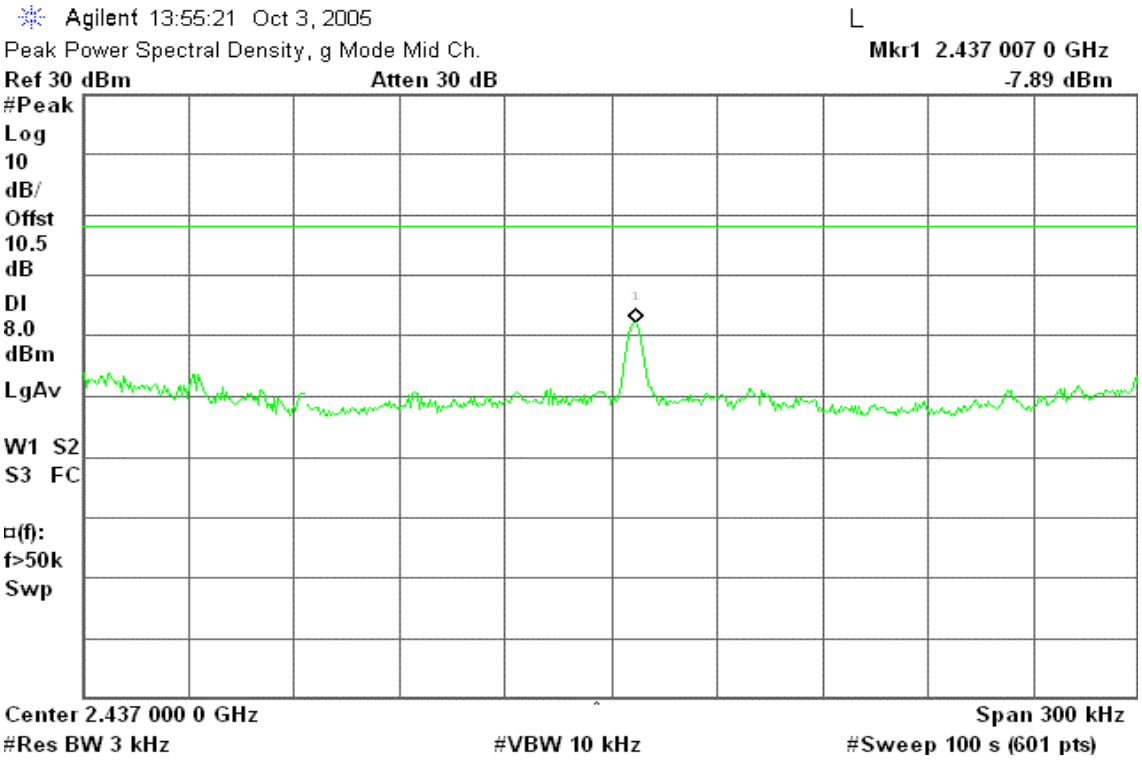


IEEE 802.11g Base mode

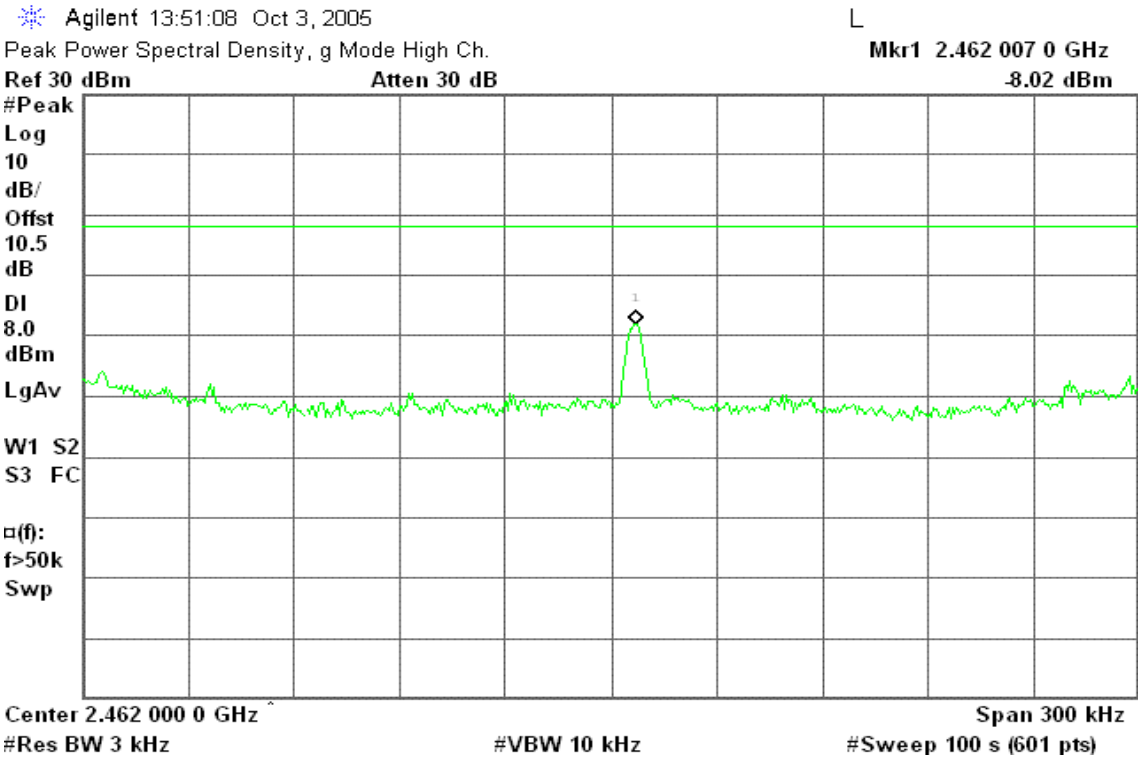
CH Low



CH Mid

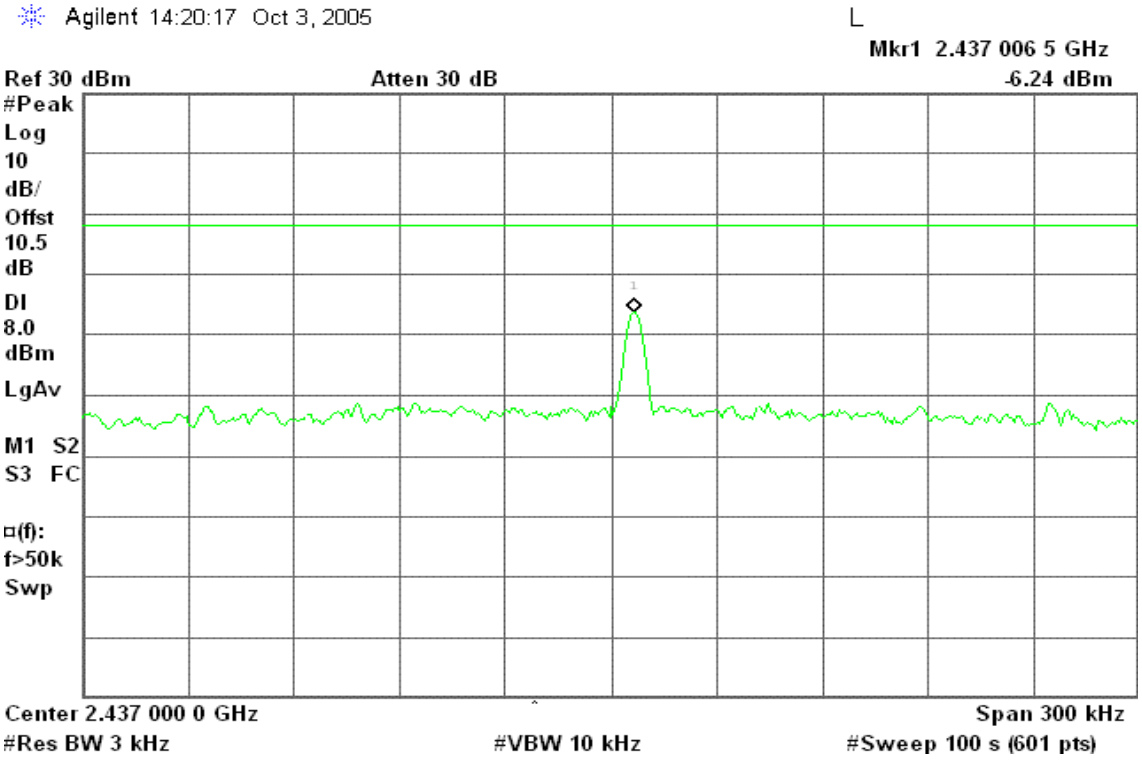


CH High



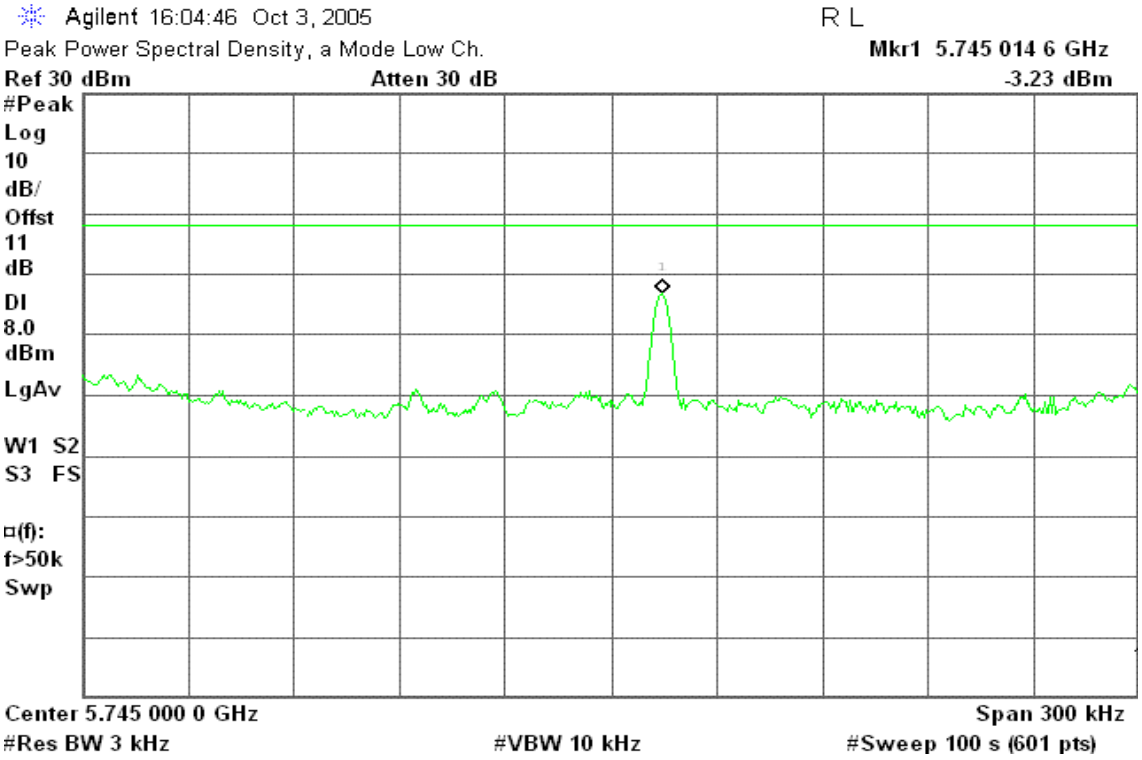
IEEE 802.11g Turbo mode

CH Mid

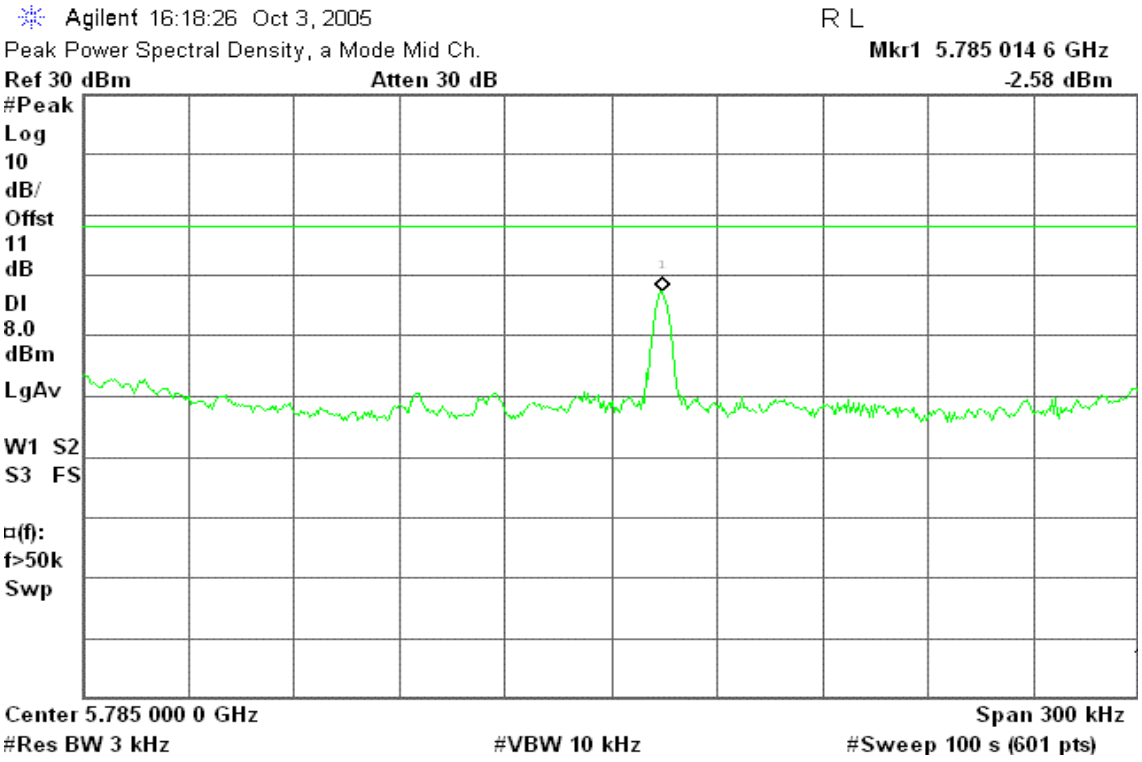


IEEE 802.11a Base mode

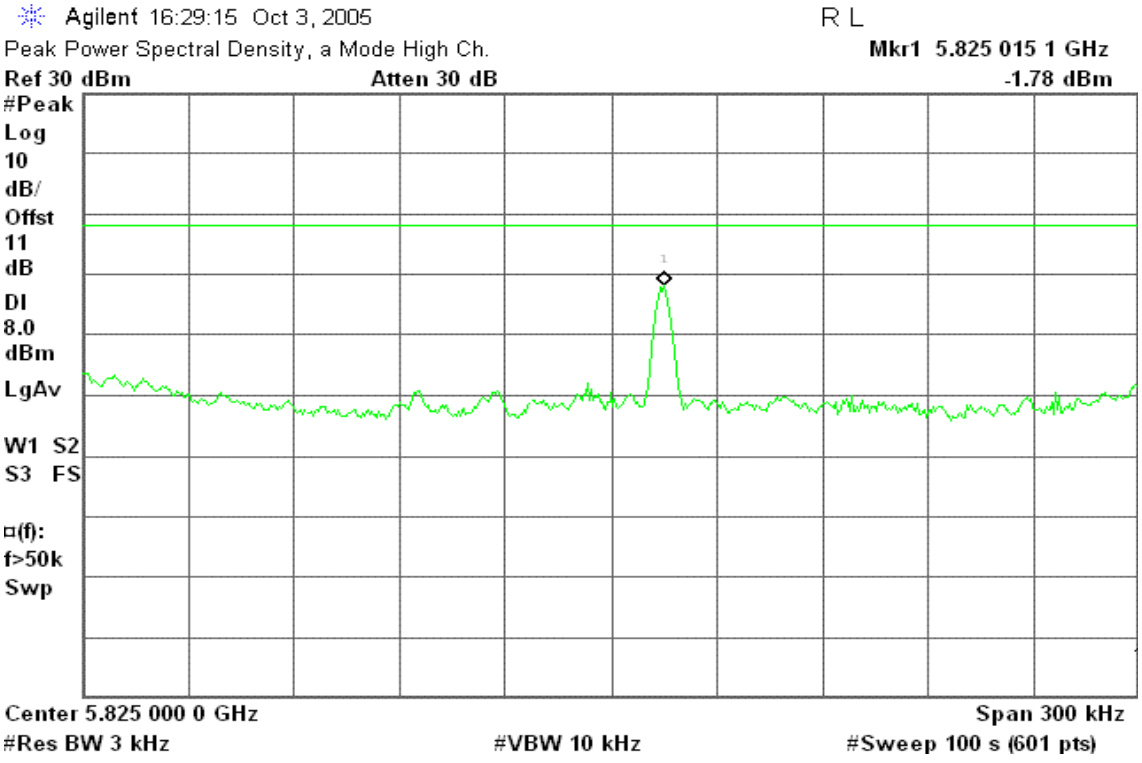
CH Low



CH Mid

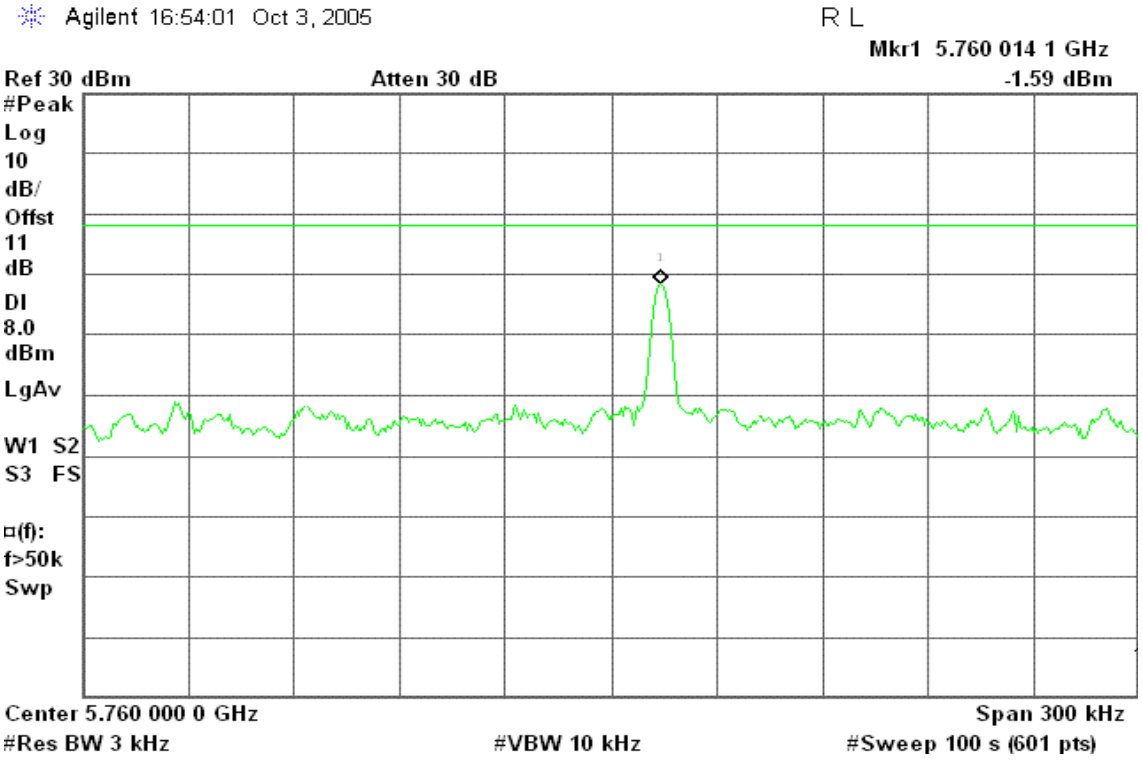


CH High

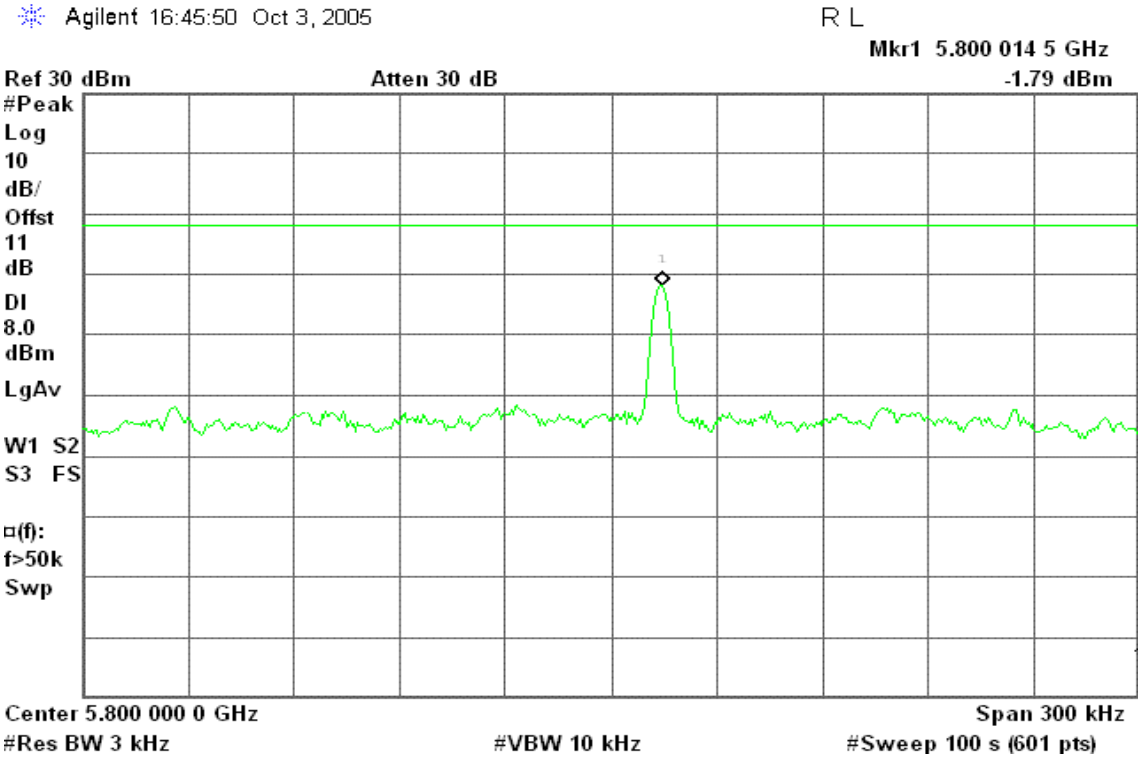


IEEE 802.11a Turbo mode

CH Low



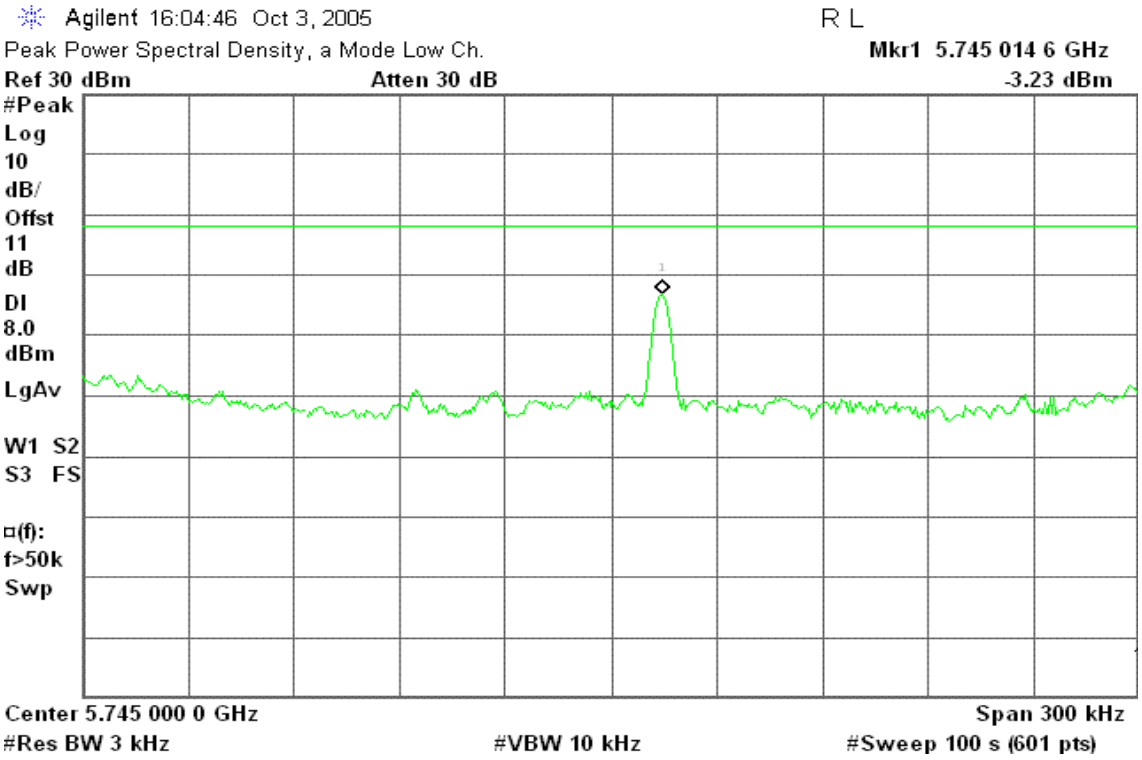
CH High



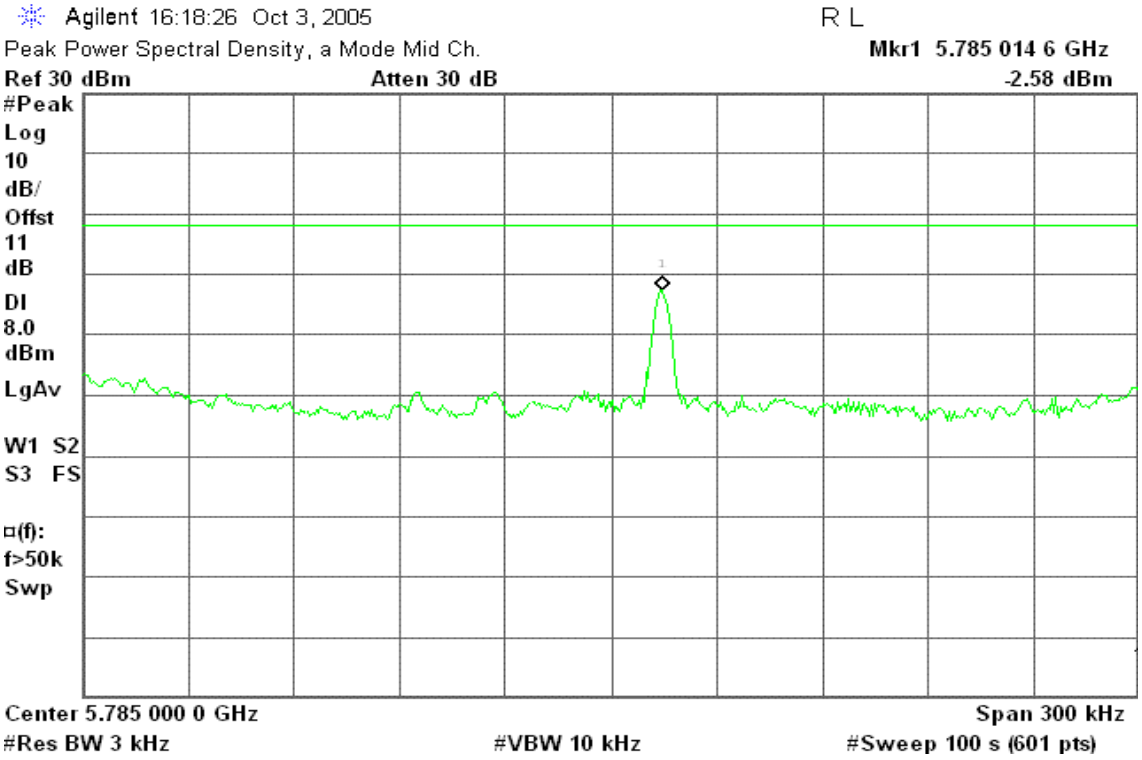
Omnidirectional antenna / 6.0 dBi for 5 GHz

IEEE 802.11a Base mode

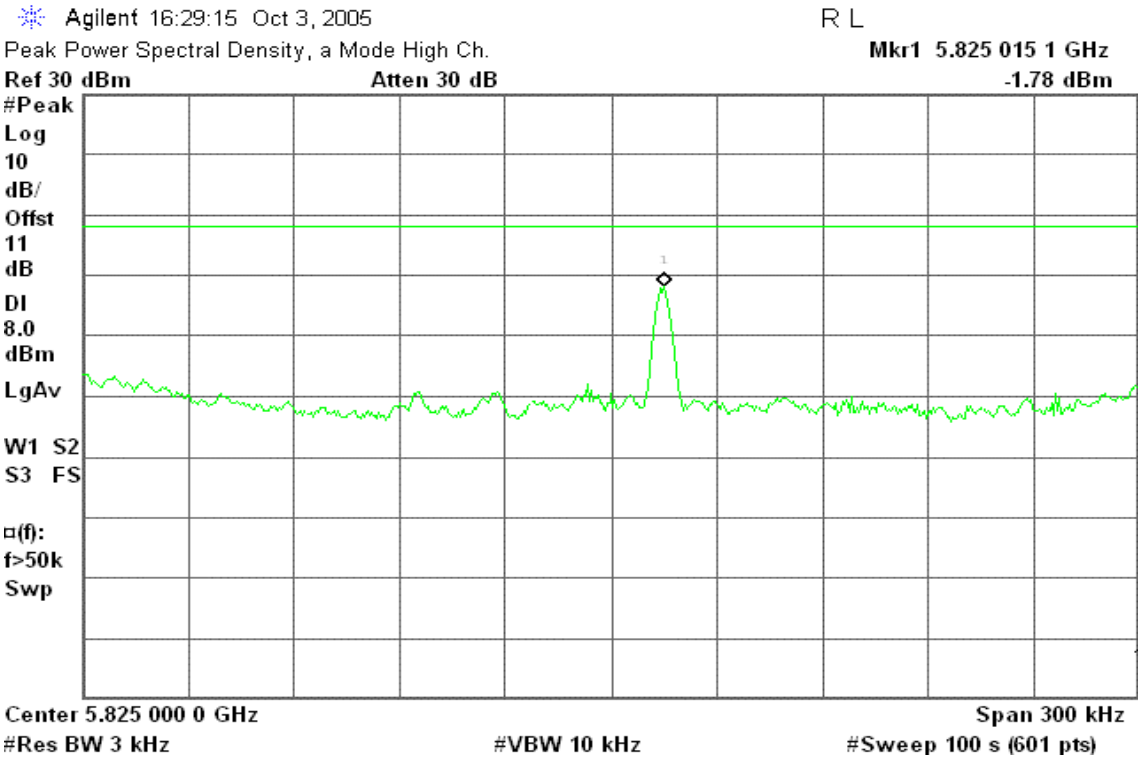
CH Low



CH Mid

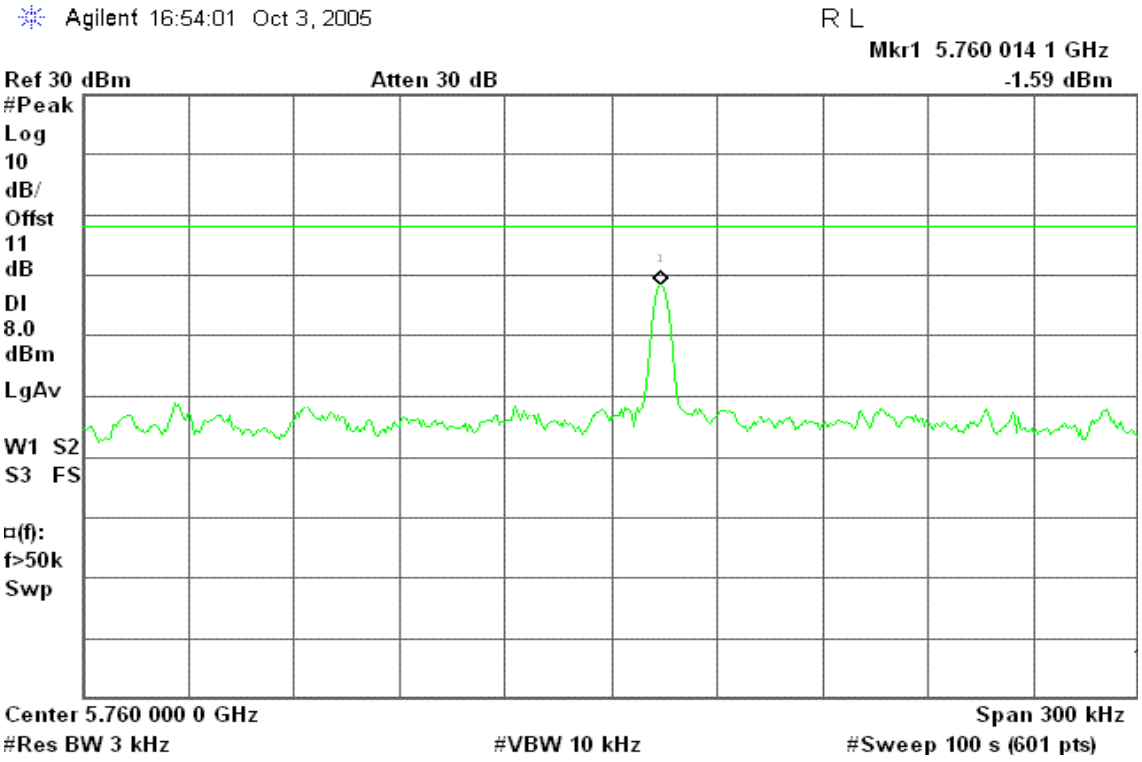


CH High

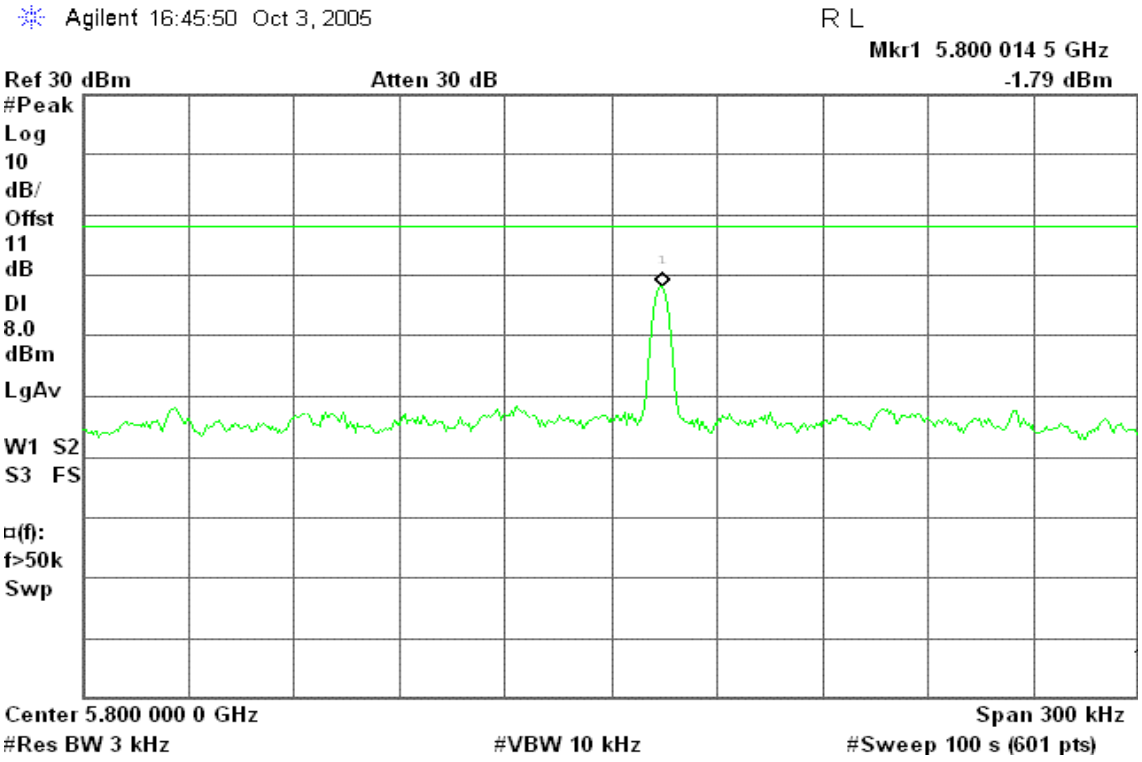


IEEE 802.11a Turbo mode

CH Low



CH High


Agilent 16:45:50 Oct 3, 2005
R L
Mkr1 5.800 014 5 GHz
-1.79 dBm
Ref 30 dBm
Atten 30 dB
#Peak
Log
10
dB/
Offst
11
dB
Dl
8.0
dBm
LgAv
W1 S2
S3 FS
¤(f):
f>50k
Swp
Center 5.800 000 0 GHz
Span 300 kHz
#Res BW 3 kHz
#VBW 10 kHz
#Sweep 100 s (601 pts)

7.5 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

Omnidirectional antenna / 12.0 dBi for 2.4 GHz

EUT	802.11a/b/g AP
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☐ Others
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm2) ☒ General Population/Uncontrolled exposure (S=1mW/cm2)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11b Base mode: 19.68 dBm (92.90mW) IEEE 802.11g Base mode: 14.76 dBm (29.92mW) IEEE 802.11g Turbo mode: 16.10 dBm (40.74mW)
Antenna gain (Max)	12.0 dBi (Numeric gain: 15.85)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation

Remark:

1. *The maximum output power is 19.68dBm (92.90mW) at 2462MHz (with 15.85 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/cm^2 even if the calculation indicates that the power density would be larger.*

TEST RESULTS

No non-compliance noted.

Calculation

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

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:

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

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) = d(m) / 100

Yields

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

Where *d = Distance in cm*
P = Power in mW
G = Numeric antenna gain
S = Power density in mW / cm²

Maximum Permissible Exposure

EUT output power = 92.90mW

Numeric Antenna gain = 15.85

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

→ Power density = 0.29302 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.)

Omnidirectional Panel antenna / 3.0 dBi for 2.4 GHz and 5 GHz

EUT	802.11a/b/g AP
Frequency band (Operating)	☒ WLAN: 2.412GHz ~ 2.462GHz ☐ WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz ☐ WLAN: 5.745GHz ~ 5.825GHz ☐ Others
Device category	☐ Portable (<20cm separation) ☒ Mobile (>20cm separation) ☐ Others
Exposure classification	☐ Occupational/Controlled exposure (S = 5mW/cm2) ☒ General Population/Uncontrolled exposure (S=1mW/cm2)
Antenna diversity	☐ Single antenna ☒ Multiple antennas ☐ Tx diversity ☐ Rx diversity ☒ Tx/Rx diversity
Max. output power	IEEE 802.11b Base mode: 21.64 dBm (145.88mW) IEEE 802.11g Base mode: 19.90 dBm (97.72mW) IEEE 802.11g Turbo mode: 20.18 dBm (104.23mW)
Antenna gain (Max)	3.0 dBi (Numeric gain: 2.00)
Evaluation applied	☒ MPE Evaluation ☐ SAR Evaluation

Remark:

1. *The maximum output power is 21.64dBm (145.88mW) at 2437MHz (with 2.00 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/cm^2 even if the calculation indicates that the power density would be larger.*

TEST RESULTS

No non-compliance noted.

Calculation

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

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:

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

Changing to units of mW and cm, using:

P (mW) = P (W) / 1000 and

d (cm) = d(m) / 100

Yields

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

Where *d = Distance in cm*
P = Power in mW
G = Numeric antenna gain
S = Power density in mW / cm²

Maximum Permissible Exposure

EUT output power = 145.88mW

Numeric Antenna gain = 2.00

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

→ Power density = 0.05806 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.)