Lab Code: 200167-0

FCC PART 15 SUBPART 247

TEST AND MEASUREMENT REPORT

For

Actiontec Electronics, Inc.

760 N. Mary Avenue, Sunnyvale, CA 94085, USA

FCC ID: LNQPK5000
Model: PK5000

Report Type:	**Product Type:**
Original Report	ADSL2+ with 4-Port Ethernet Wireless Gateway

Test Engineers:	Victor Zhang
Report Number:	R0811131-247
Report Date:	2008-12-08
Reviewed By:	Boni Baniqued Sr. RF Engineer
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0811131-247	Original	2008-12-08

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics, Inc. p*roduct, models: *PK5000,* or the "EUT" as referred to in this report is an ADSL 802.11b/g Ethernet Modem. The EUT is a cost-effective full-rate ADSL (Optional 10/100Mbps Ethernet WAN Port)/4 Port Ethernet LAN /Wireless Gateway. It provides 4 10/100 Based Ethernet LAN port and an embedded 802.11G wireless Access Point. The ADSL is rate-adaptive and it supports downstream data rates up to 8Mbps and an upstream data rate up to 1 Mbps. PK5000 is based on Infineon PSB7200 Broadband Communication Processor, and TNETW1350A 802.11 MAC and Base-band Processor.

1.2 Mechanical Description of EUT

The *Actiontec Electronics, Inc.* EUT measures approximately *164 mm L x 130 mm W x32 mm H*, and weighs approximately 290 g.

** The test data gathered are from typical production sample, serial number: CMMA8421900015, provided by the manufacturer.*

1.3 EUT Photo

Please refer to Exhibit C for more EUT photographs.

1.4 Objective

This original measurement and test report is prepared on behalf of *Actiontec Electronics, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.5 Related Submittal(s)/Grant(s)

No Related Submittals

1.6 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.8 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/Standards/scopes/2001670.htm

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT and its host were configured for testing according to ANSI C63.4-2003.

The EUT was tested in a testing mode to represent *worst*-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The EUT had been tested with the following data rate settings (worst case):

Radio Mode	Data Rates		
	Low Channel (2412 MHz)	Middle Channel (2437 MHz)	High Channel (2462 MHz)
802.11b	1 Mbps	1 Mbps	1 Mbps
802.11g	6 Mbps	6 Mbps	6 Mbps

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

N/A

2.5 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Actiontec Electronics, Inc	AC/DC Switch Adapter	MT12-Y120100-A1	0835

2.6 Internal Parts List and Details

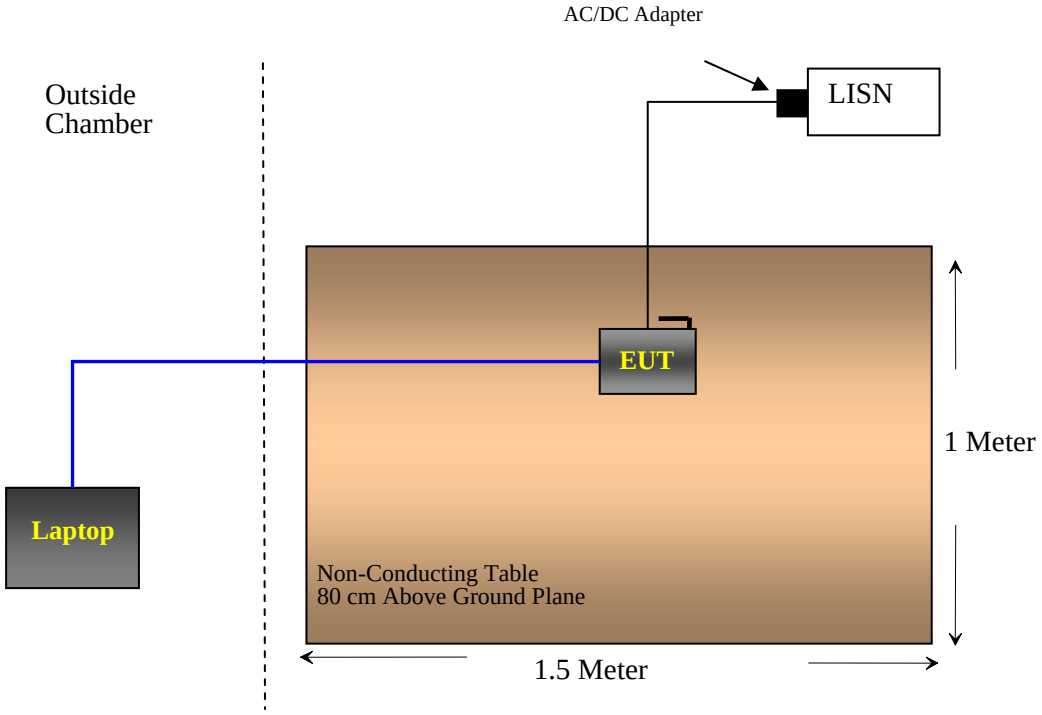
Manufacturer	Description	Model	Serial Number
Actiontec Electronics, Inc	PCB Board	-	06182A

2.7 Interface Ports and Cabling

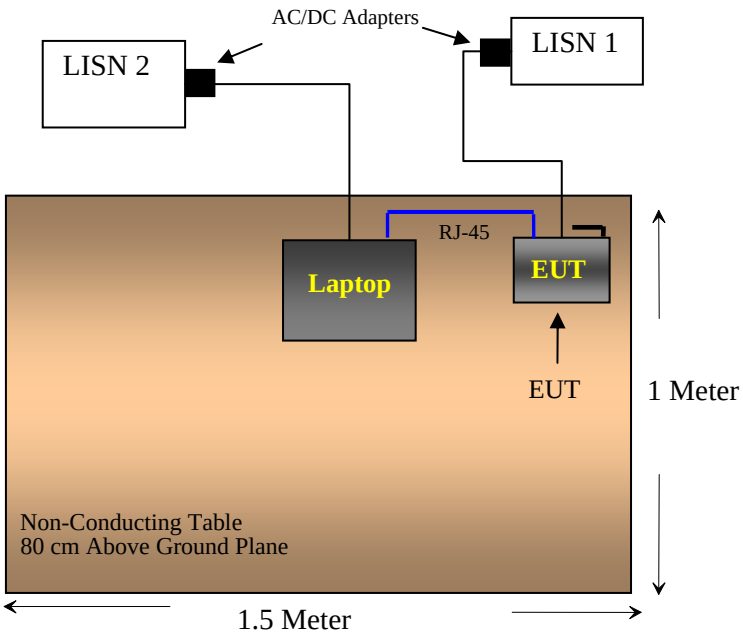
Cable Description	Length (m)	From	To
RF cable	< 3m	Output/ EUT	Spectrum analyzer

2.8 Test Setup Block Diagram

Radiated Emissions



Conducted Emissions



3 SUMMARY OF TEST RESULTS

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.247 (i) §2.1091	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§ 15.207 (a)	Conducted Emissions	Compliant
§2.1051 §15.247 (d)	Spurious Emissions at Antenna Port	Compliant
§15.205	Restricted Bands	Compliant
§15.209 (a) §15.247 (d)	Radiated Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Bandwidth	Compliant
§15.247 (b)(3)	Maximum Peak Output Power	Compliant
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247 (e)	Power Spectral Density	Compliant

4 §15.247 (i) and § 2.1091 - RF EXPOSURE

According to §15.247(i) and §1.1307(b)(1), 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 level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

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

4.1 MPE Prediction

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

802.11b Mode:

Maximum peak output power at antenna input terminal (dBm):	22.87
Maximum peak output power at antenna input terminal (mW):	193.64
Prediction distance(cm):	20
Prediction frequency(MHz):	2437
Antenna Gain (Maximum)(dBi):	4
Maximum Antenna Gain(numeric):	2.512
Power density at prediction frequency at 20 cm (mW/cm^2):	0.0968
MPE limit for uncontrolled exposure at predication frequency(mW/cm^2):	1.0

802.11g Mode:

Maximum peak output power at antenna input terminal (dBm):	20.52
Maximum peak output power at antenna input terminal (mW):	112.72
Prediction distance(cm):	20
Prediction frequency(MHz):	2437
Antenna Gain (maximum)(dBi):	4
Maximum Antenna Gain(numeric):	2.512
Power density at prediction frequency at 20 cm (mW/cm^2):	0.0563
MPE limit for uncontrolled exposure at predication frequency(mW/cm^2):	1.0

4.2 Test Result

The predicted power density level at 20 cm is 0.0968 mW/cm^2 for 802.11b mode, and 0.0563 mW/cm^2 for 802.11g mode. Both are below the uncontrolled exposure limit of 1.0 mW/cm^2 at 2437 MHz. The EUT is used at least 20 cm away from user's body. It is determined as mobile equipment and complies with the MPE limit.

5 §15.203 - ANTENNA REQUIREMENT

5.1 Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to § 15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna Connected Construction

EUT has a transmitter and receiver antennae which are both external antennae and features a permanent attachment to the EUT chassis as well as non-standard connector. The Transmitter antenna has a max gain of 4 dBi which fulfills the requirements of FCC rule 15.203, and the directional gain is less than 6 dBi thus not requiring reduction of the EUT output power.

Antenna Detail Photo

6 §15.207 - CONDUCTED EMISSIONS

6.1 Applicable Standard

Section 15.207 Conducted limits:

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 µH/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 frequencies ranges.

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

** Decreases with the logarithm of the frequency.*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4 – 2003 measurement procedure. The specification used was FCC Part15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT AC/DC power adapter was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Solar Electronics	LISN	9252-R-24-BNC	511205	2008-07-31
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2008-04-12

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.4 Test Procedure

During the conducted emissions test, the power cord of the EUT was connected to the mains outlet of the LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a "QP". Average readings are distinguished with an "Ave".

6.5 Environmental Conditions

Temperature:	18 °C
Relative Humidity:	42 %
ATM Pressure:	101.7 kPa

**The testing was performed by Victor Zhang from 2008-12-04.*

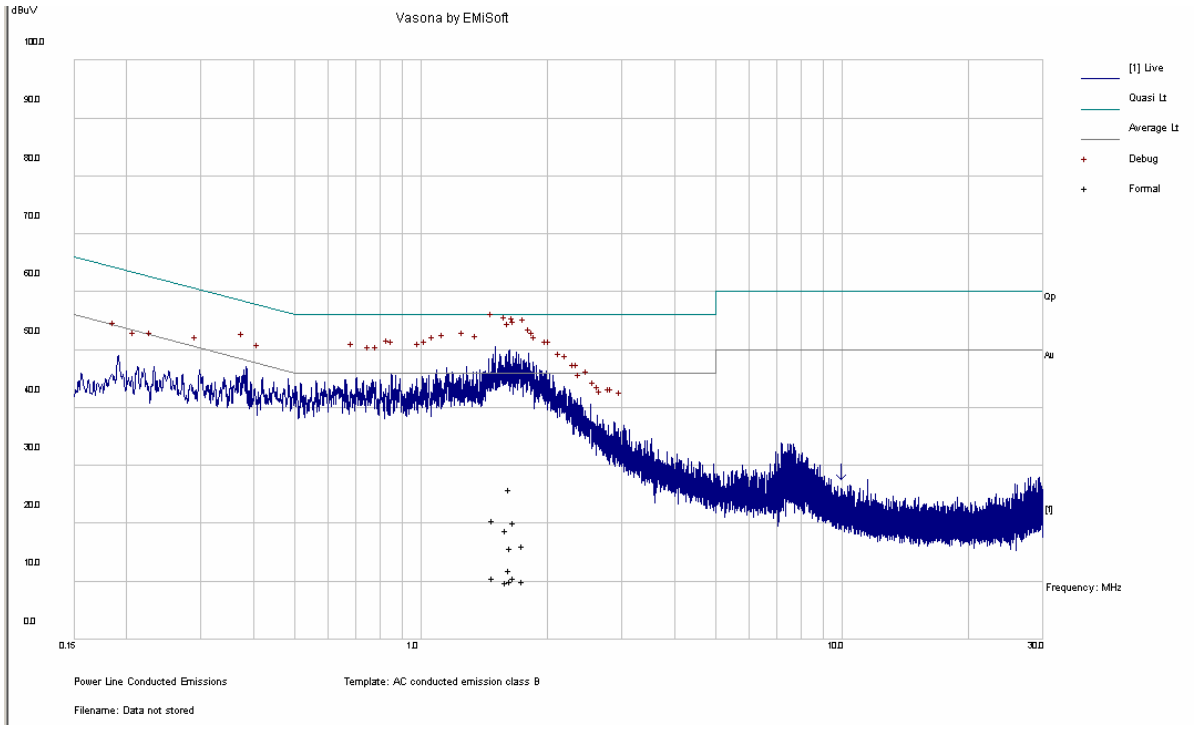
6.6 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the *worst* margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-30.04	1.658	Line	0.15 to 30
-36.01	1.838	Neutral	0.15 to 30

6.7 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



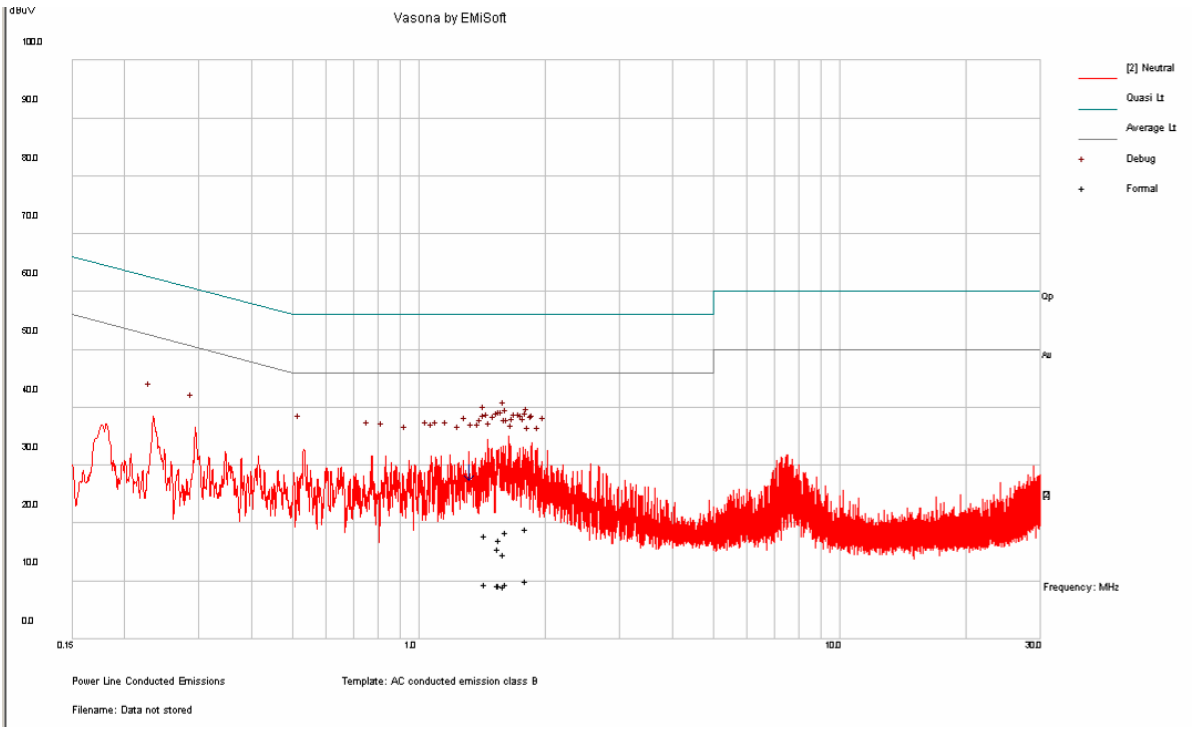
Quasi-Peak Measurements

Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
1.658	25.96	Line	56	-30.04
1.515	20.47	Line	56	-35.53
1.698	20.18	Line	56	-35.82
1.63	18.91	Line	56	-37.09
1.786	16.13	Line	56	-39.87
1.666	15.75	Line	56	-40.25

Average Measurements

Frequency (MHz)	Average (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
1.658	11.95	Line	46	-34.05
1.698	10.64	Line	46	-35.36
1.515	10.58	Line	46	-35.42
1.786	10.00	Line	46	-36.00
1.666	9.94	Line	46	-36.06
1.630	9.79	Line	46	-36.21

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
1.838	18.99	Neutral	56	-37.01
1.650	18.48	Neutral	56	-37.52
1.472	17.92	Neutral	56	-38.08
1.590	17.10	Neutral	56	-38.90
1.575	15.56	Neutral	56	-40.44
1.630	14.67	Neutral	56	-41.33

Average Measurements

Frequency (MHz)	Average (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
1.838	9.99	Neutral	46	-36.01
1.472	9.48	Neutral	46	-36.52
1.650	9.48	Neutral	46	-36.52
1.590	9.33	Neutral	46	-36.67
1.575	9.32	Neutral	46	-36.68
1.630	9.02	Neutral	46	-36.98

7 §2.1051 & §15.247(d) - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

7.1 Applicable Standard

For §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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.

Requirements: CFR 47, §2.1051.

The spectrum was to be investigated to the tenth harmonics of the highest fundamental frequency as specified in §2.1057.

7.2 Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10^{th} harmonic.

7.3 Equipment Lists

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.4 Environmental Conditions

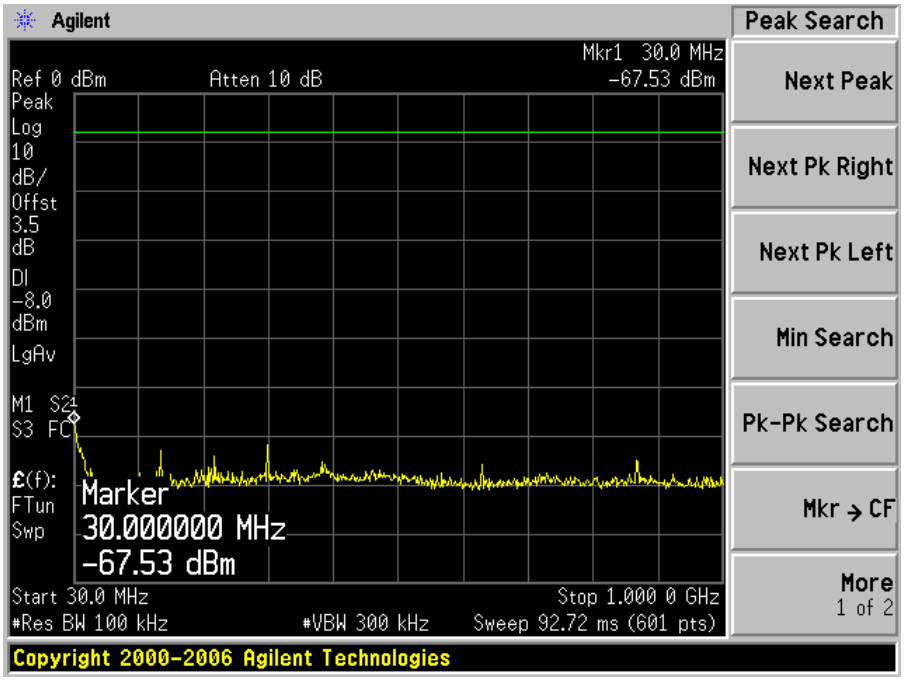
Temperature:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.5kPa

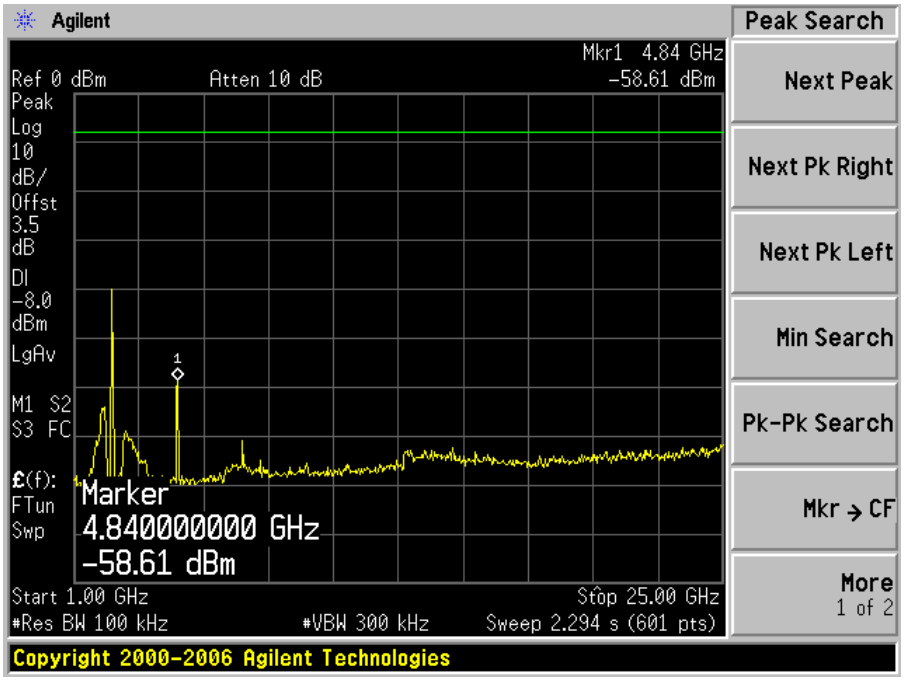
** The testing was performed by Victor Zhang on 2008-12-02.*

7.5 Measurement Result:

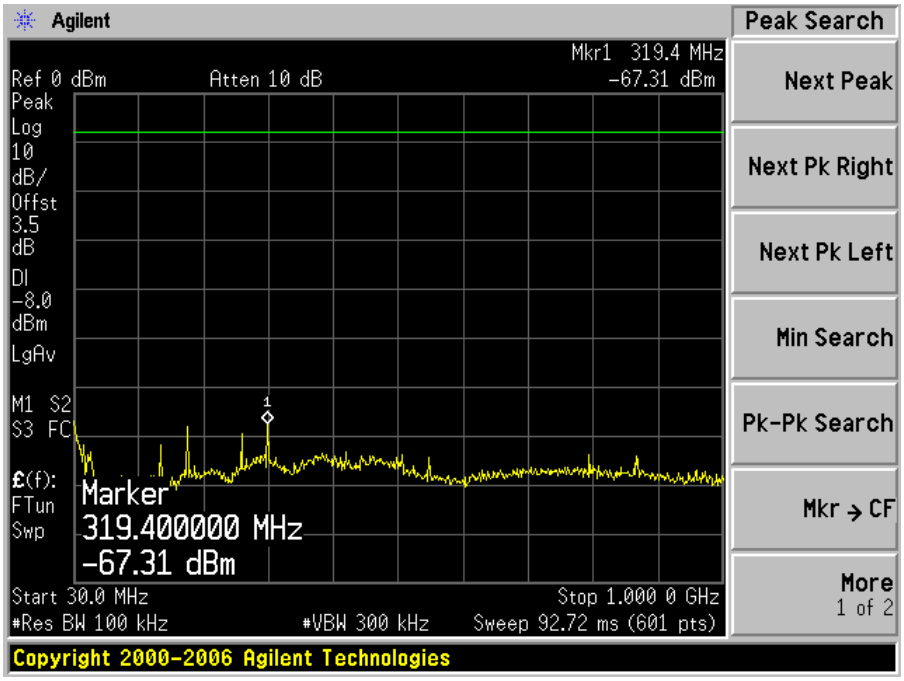
Please refer to following plots of spurious emissions.

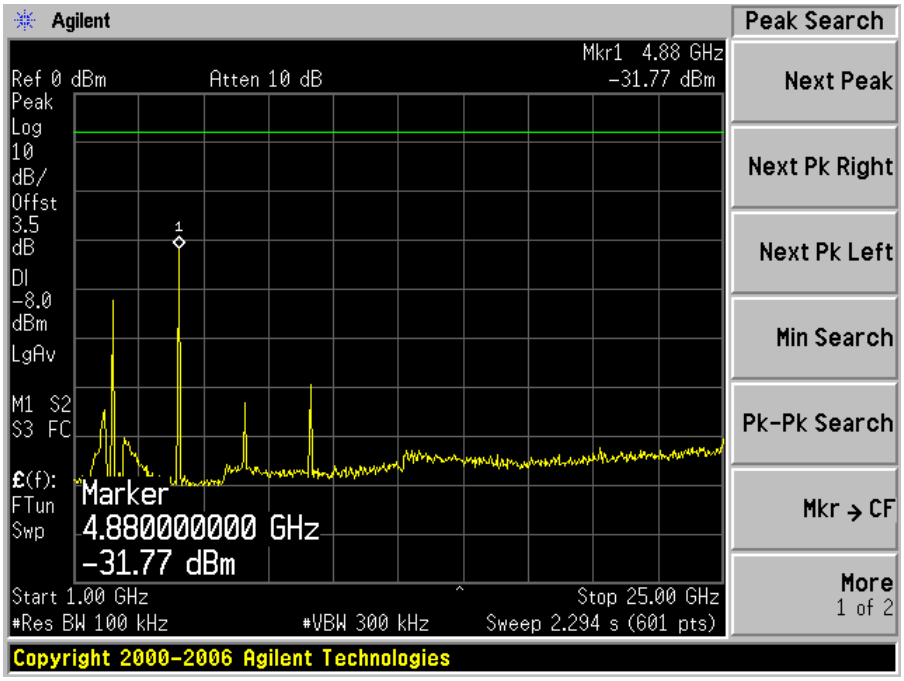
802.11 b (Low Channel)



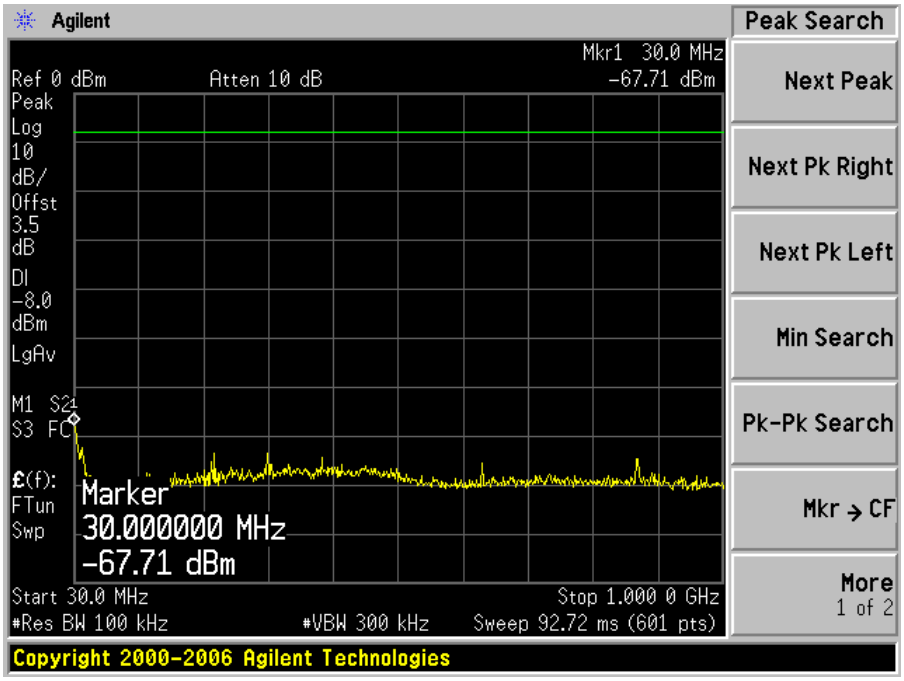


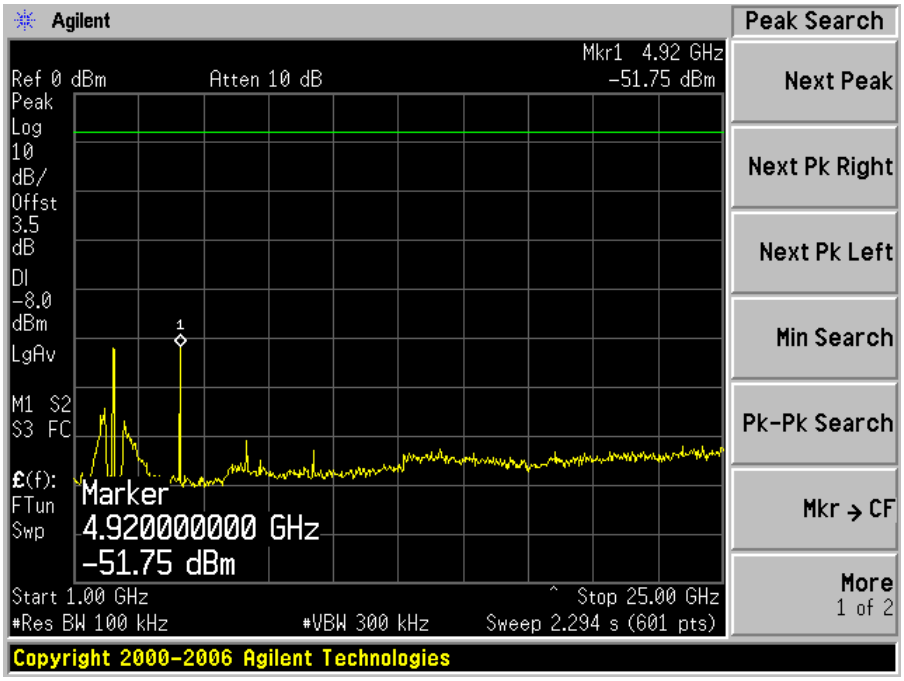
802.11 b (Middle Channel)



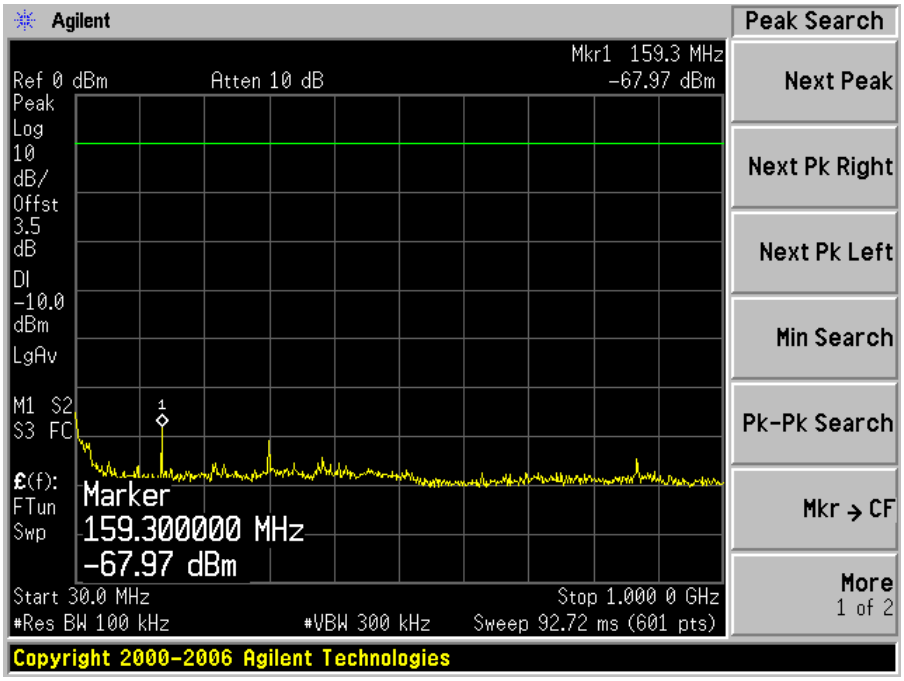


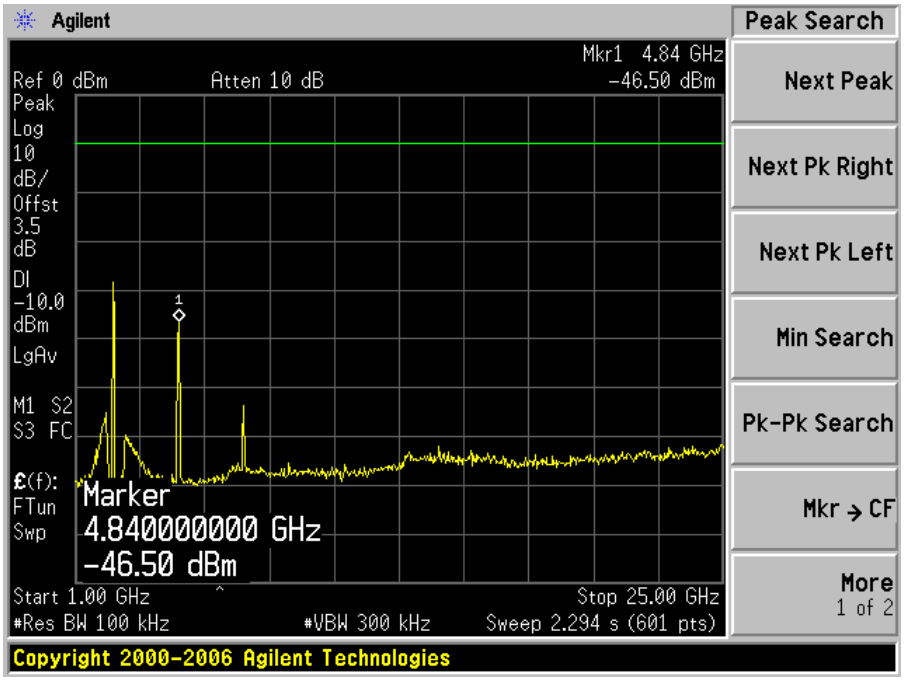
802.11 b (High Channel)



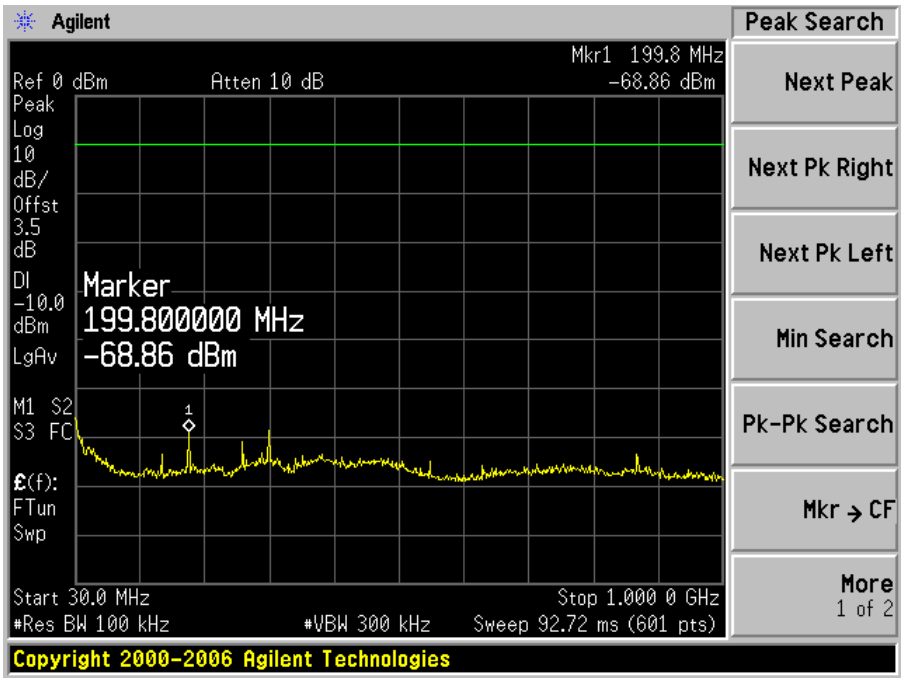


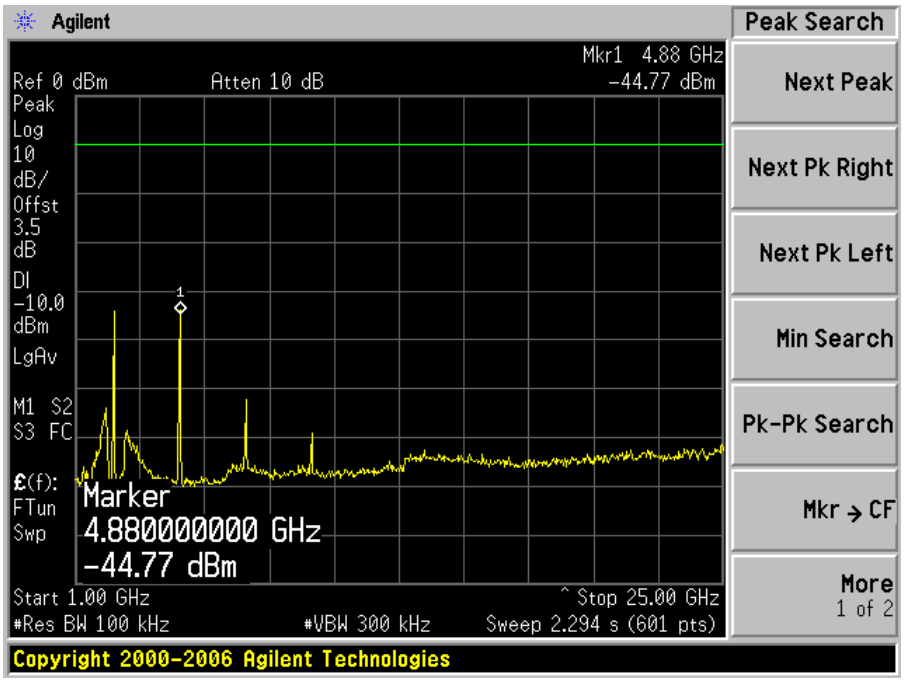
802.11 g (Low Channel)



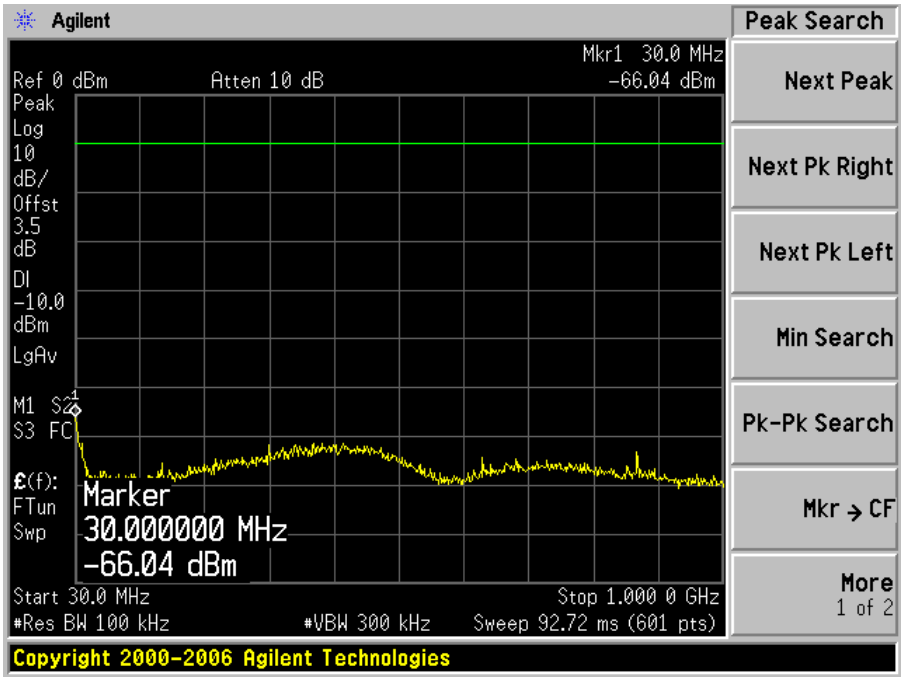


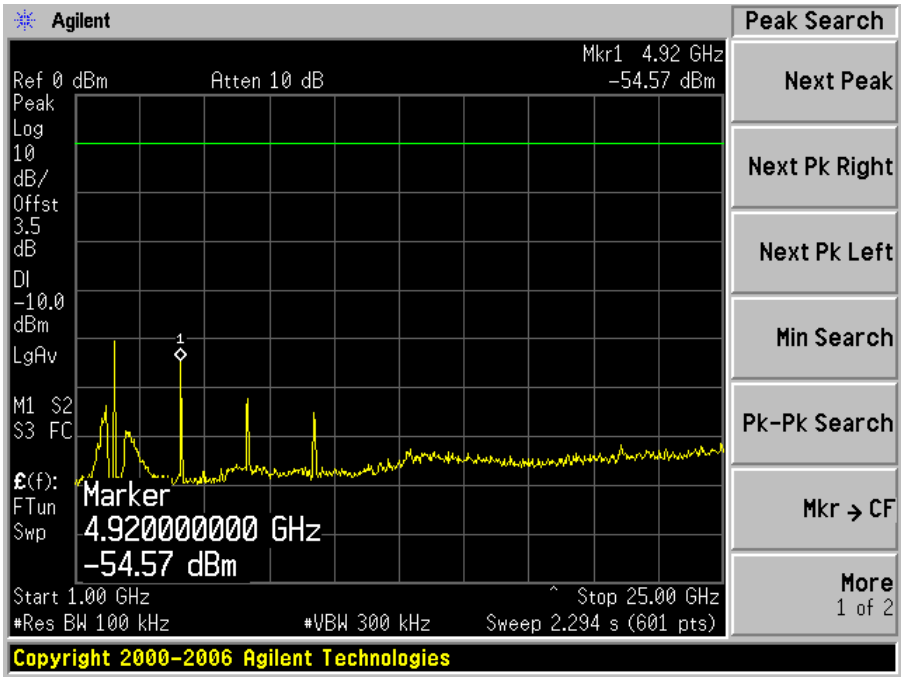
802.11 g (Middle Channel)





802.11 g (High Channel)





8 §15.109, §15.205, §15.209 & §15.247(d) - SPURIOUS RADIATED EMISSIONS

8.1 Applicable Standard

As per 15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per 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 (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** 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.

As Per 15.205(a) except as show 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	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As Per 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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 §15.205(c)).

8.2 Test Setup

The radiated emissions tests were performed in the 3-meter open area test site, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

8.3 EUT Setup

The radiated emissions tests were performed using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Mini-Circuits	Pre amplifier	ZKL-2	7786100643	2008-01-02
HP	Pre amplifier	8449B	3147A00400	2008-10-22
Sunol Science Corp	Combination Antenna	JB1 Antenna	A103105-3	2008-03-25
A. H. Systems	Antenna, Horn, DRG	SAS-200/571	261	2008-07-01
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28
A.R.A.	Antenna, Horn	DRG-118/A	1132	2008-07-28

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

8.5 Test Procedure

For the radiated emissions test, the EUT, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000MHz:

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

Above 1000MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

8.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit.
The equation for margin calculation is as follows:

Margin = Corrected Amplitude - FCC Limit

8.7 Environmental Conditions

Temperature:	21 °C
Relative Humidity:	40 %
ATM Pressure:	101.3 kPa

**The testing was performed by Victor Zhang on 2008-11-25.*

Temperature:	18 °C
Relative Humidity:	42 %
ATM Pressure:	101.7 kPa

**The testing was performed by Victor Zhang on 2008-12-04.*

8.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, and had the worst margin of:

802.11 b:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-8.33	665.532	Vertical	Low, 30 MHz – 1GHz
-5.01	44.909	Vertical	Mid, 30 MHz – 1GHz
-6.03	48.319	Vertical	High, 30 MHz – 1GHz

Above 1GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-15.48	4824	Vertical	Low, 1GHz – 25GHz
-13.38	4874	Vertical	Mid, 1GHz – 25GHz
-14.06	4927	Vertical	High, 1GHz – 25GHz

802.11 g:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-7.97	50.718	Vertical	Low, 30 MHz – 1GHz
-6.34	80.004	Vertical	Mid, 30 MHz – 1GHz
-5.43	53.472	Vertical	High, 30 MHz – 1GHz

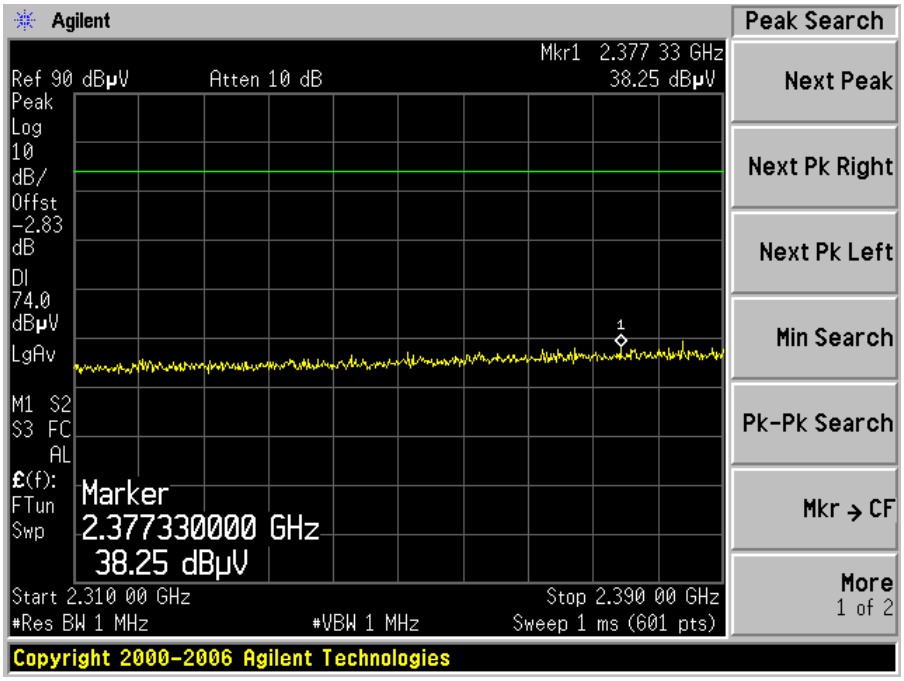
Above 1GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-17.11	4824	Vertical	Low, 1GHz – 25GHz
-14.63	4874	Vertical	Mid, 1GHz – 25GHz
-14.87	4924	Vertical	High, 1GHz – 25GHz

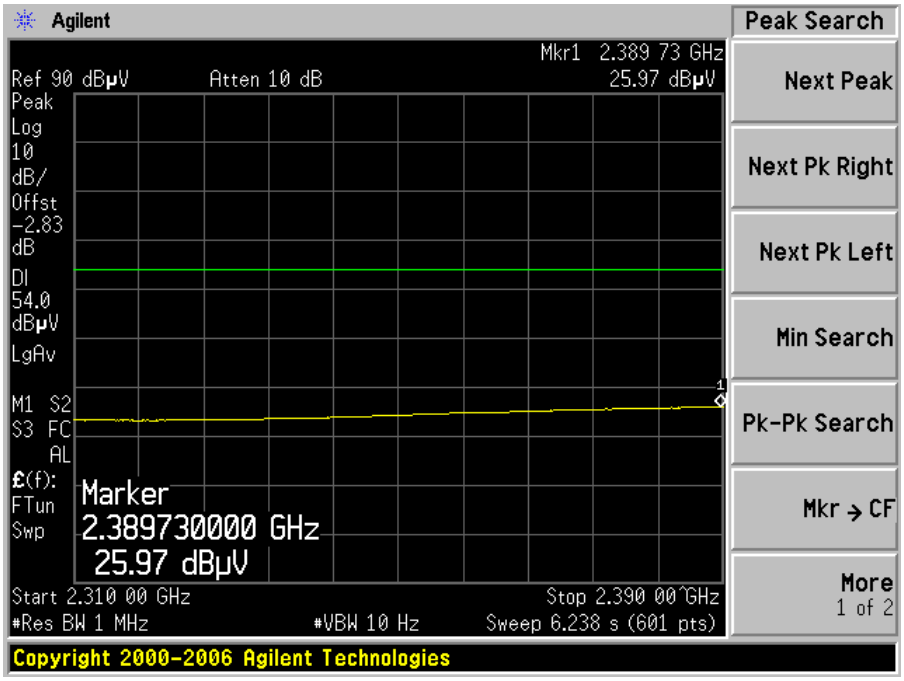
Band Edge Emissions:

802.11 b:

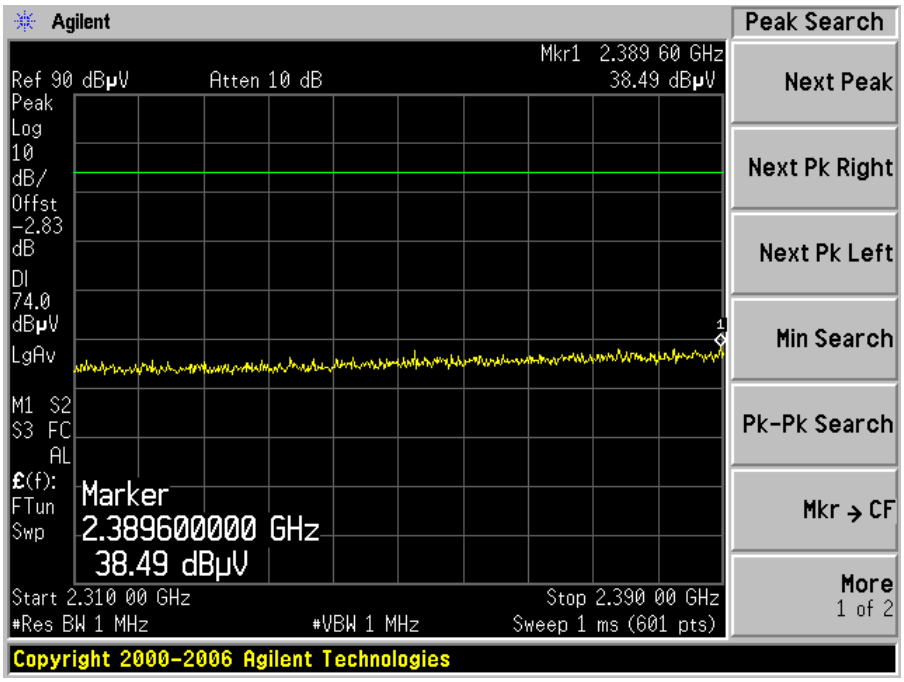
Lowest Channel at Horizontal, Peak



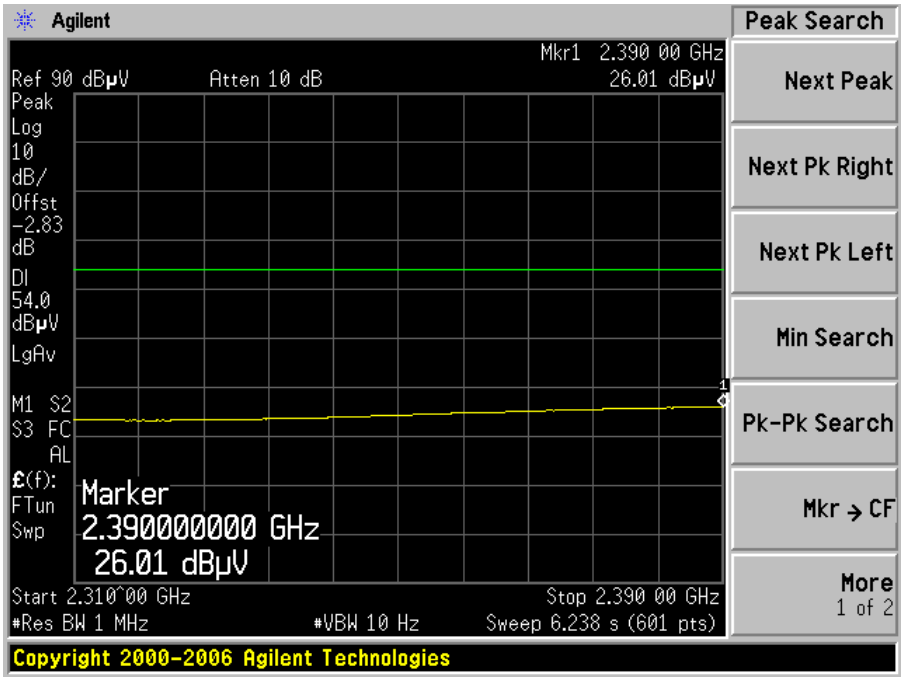
Lowest Channel at Horizontal, Average



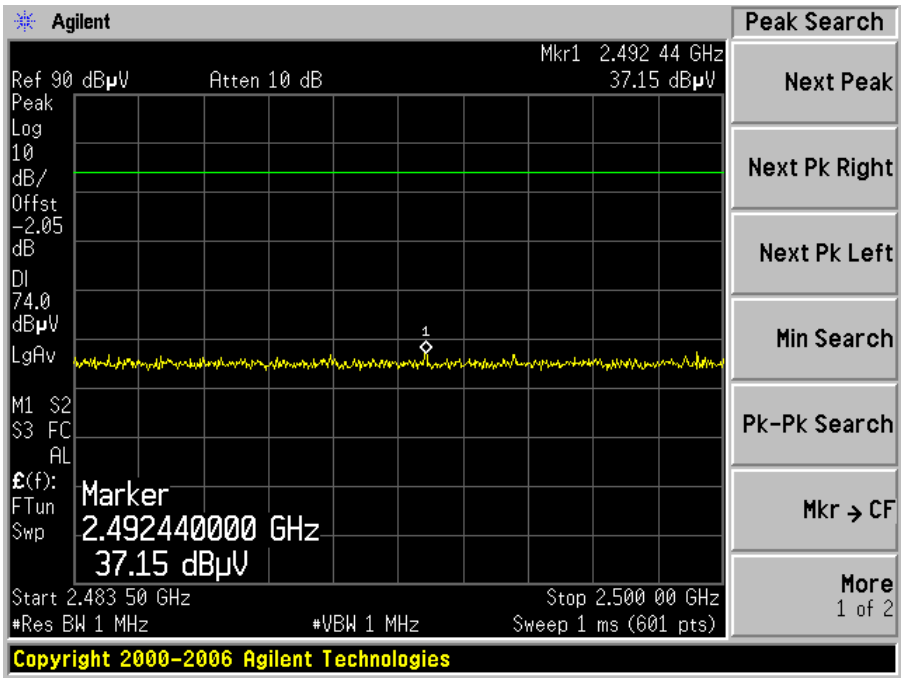
Lowest Channel at Vertical, Peak



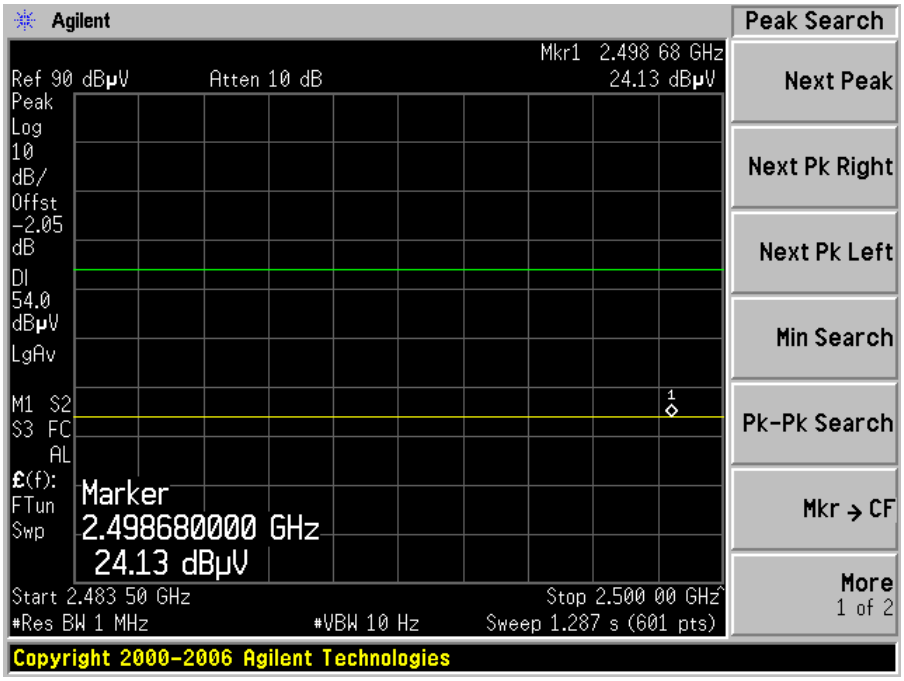
Lowest Channel at Vertical, Average



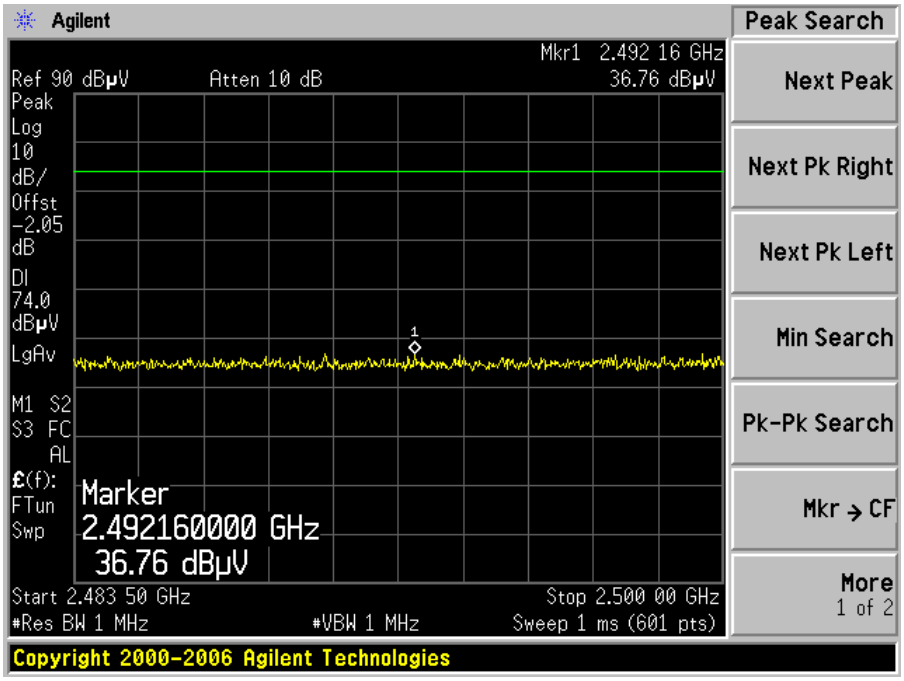
Highest Channel at Horizontal, Peak



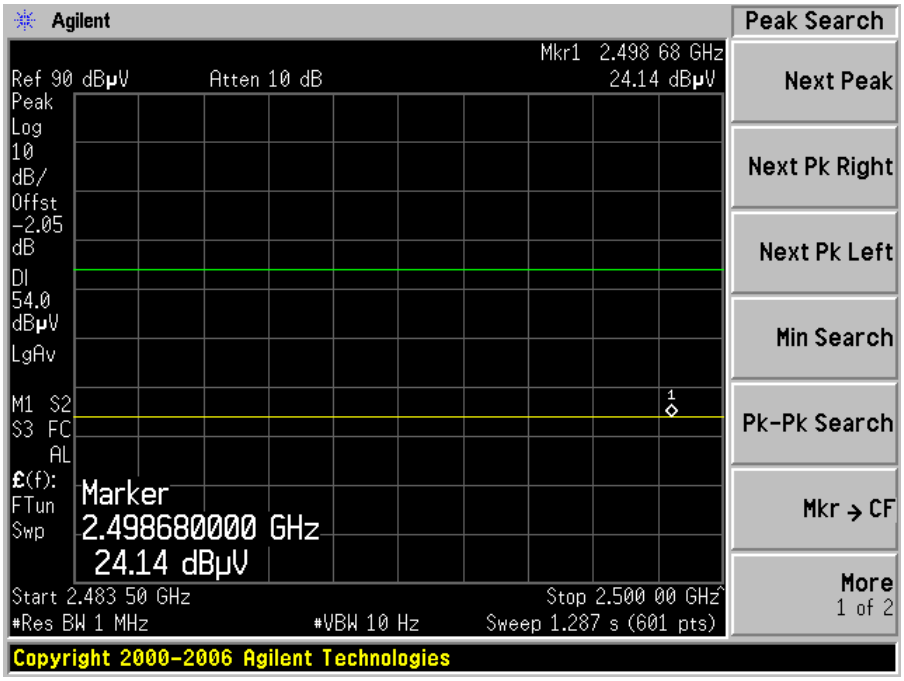
Highest Cannel at Horizontal, Average



Highest Channel at Vertical, Peak

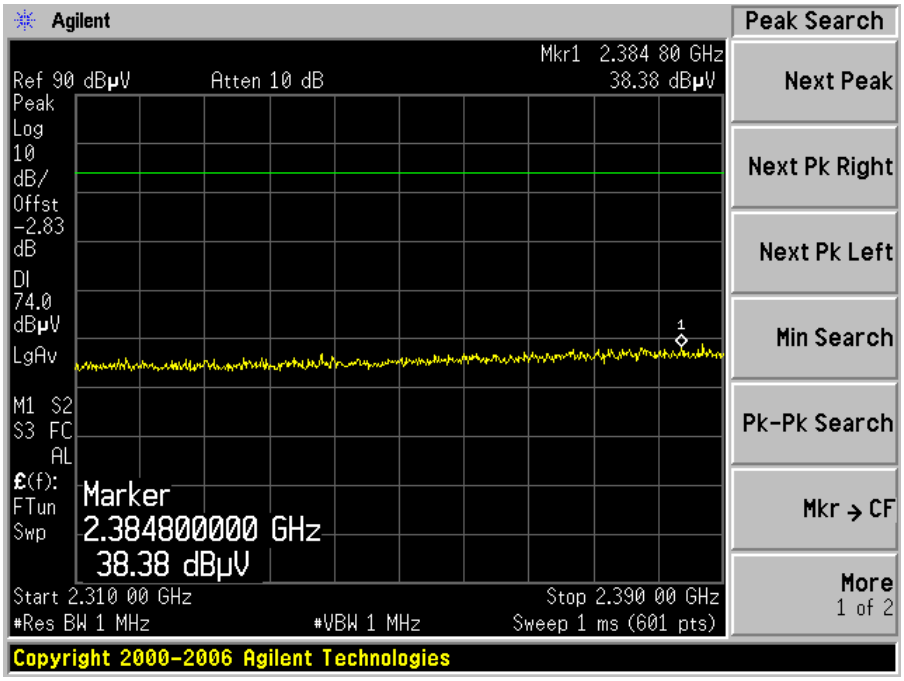


Highest Channel at Vertical, Average

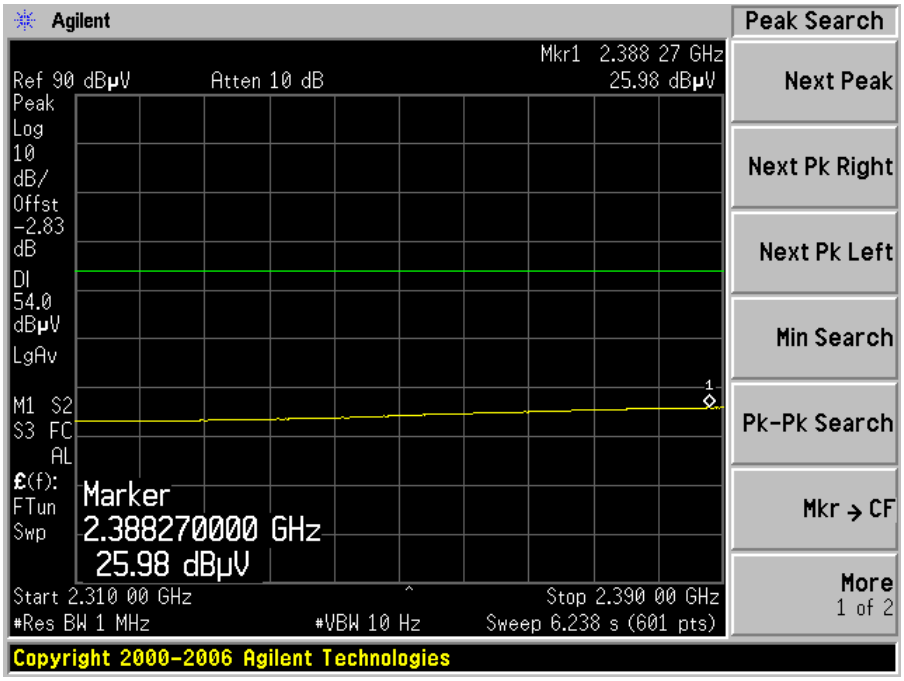


802.11 g:

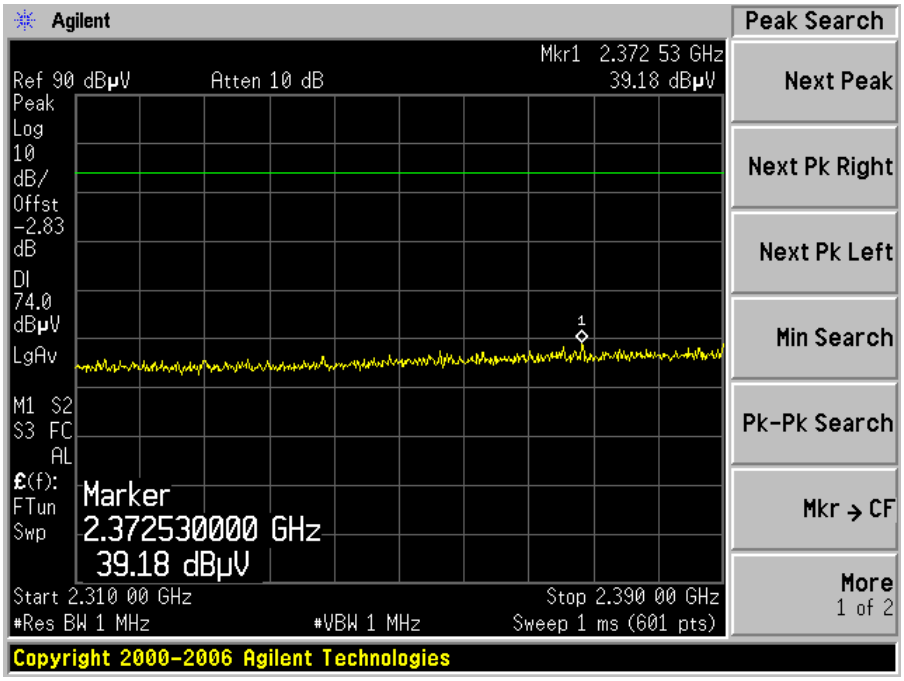
Lowest Channel at Horizontal, Peak



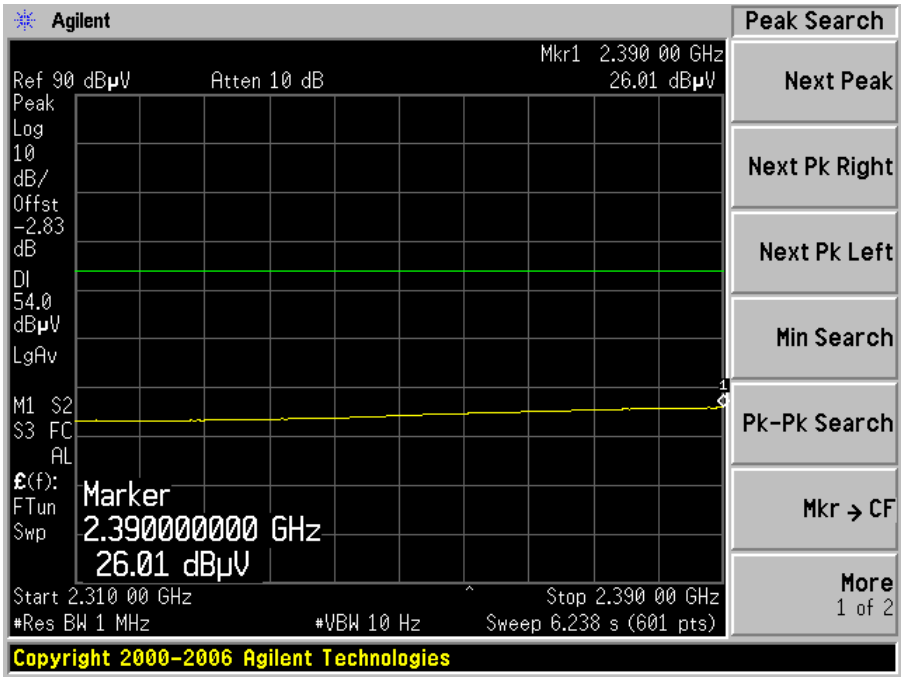
Lowest Channel at Horizontal, Average



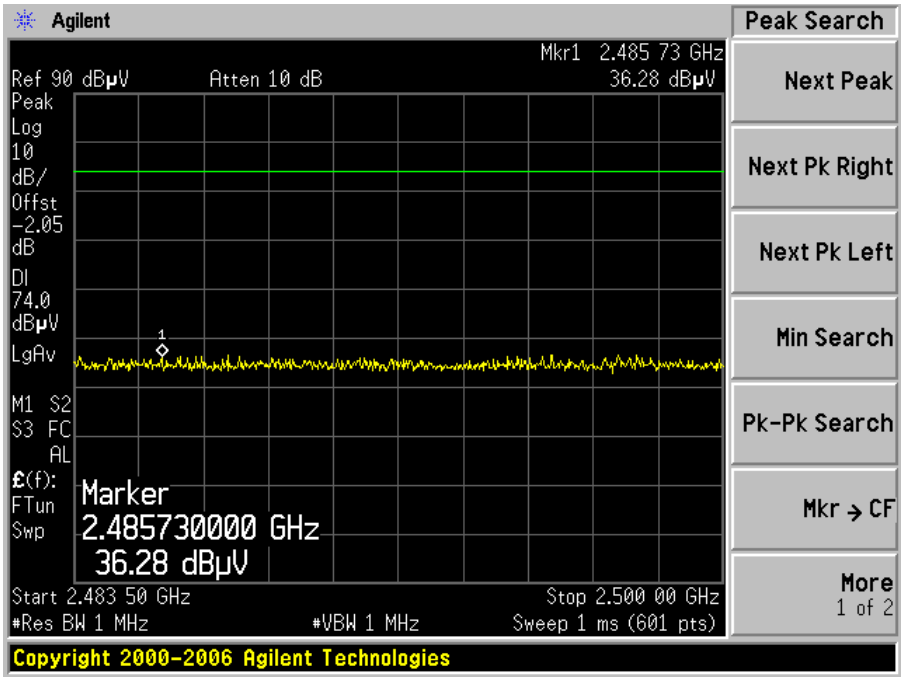
Lowest Channel at Vertical, Peak



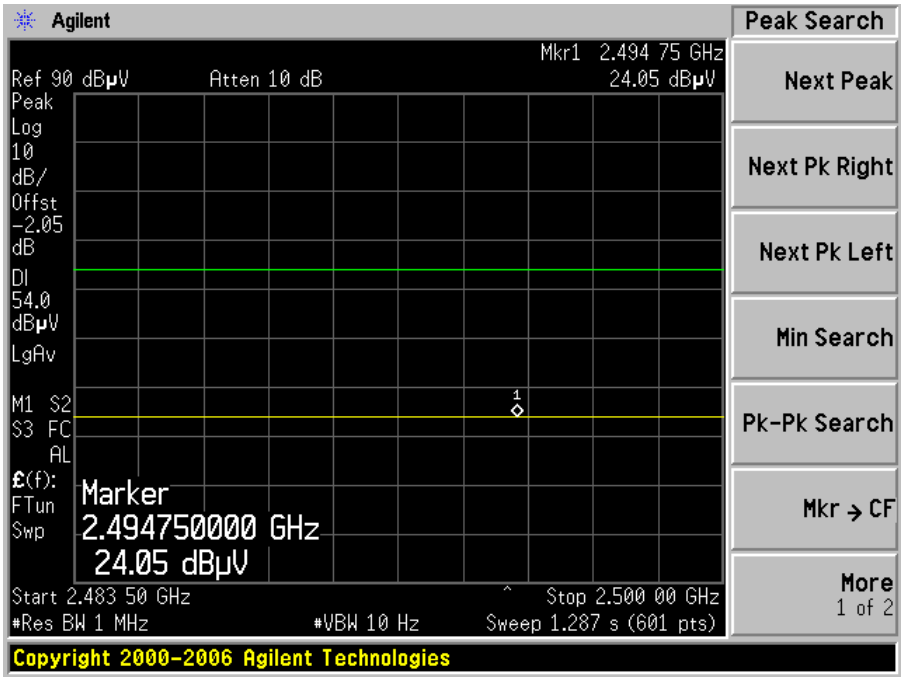
Lowest Channel at Vertical, Average



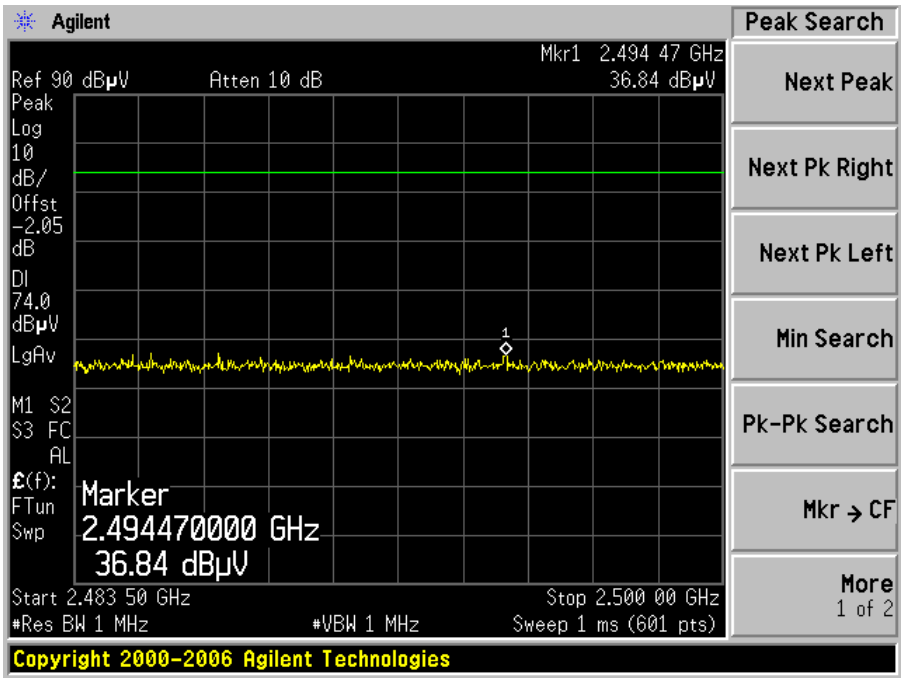
Highest Channel at Horizontal, Peak



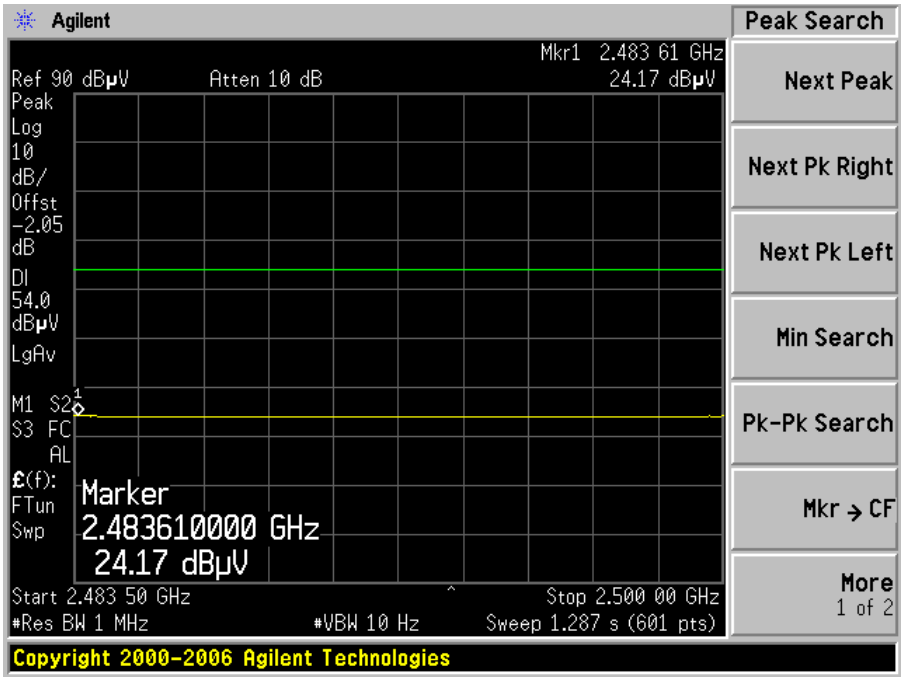
Highest Channel at Horizontal, Average



Highest Channel at Vertical, Peak



Highest Channel at Vertical, Average

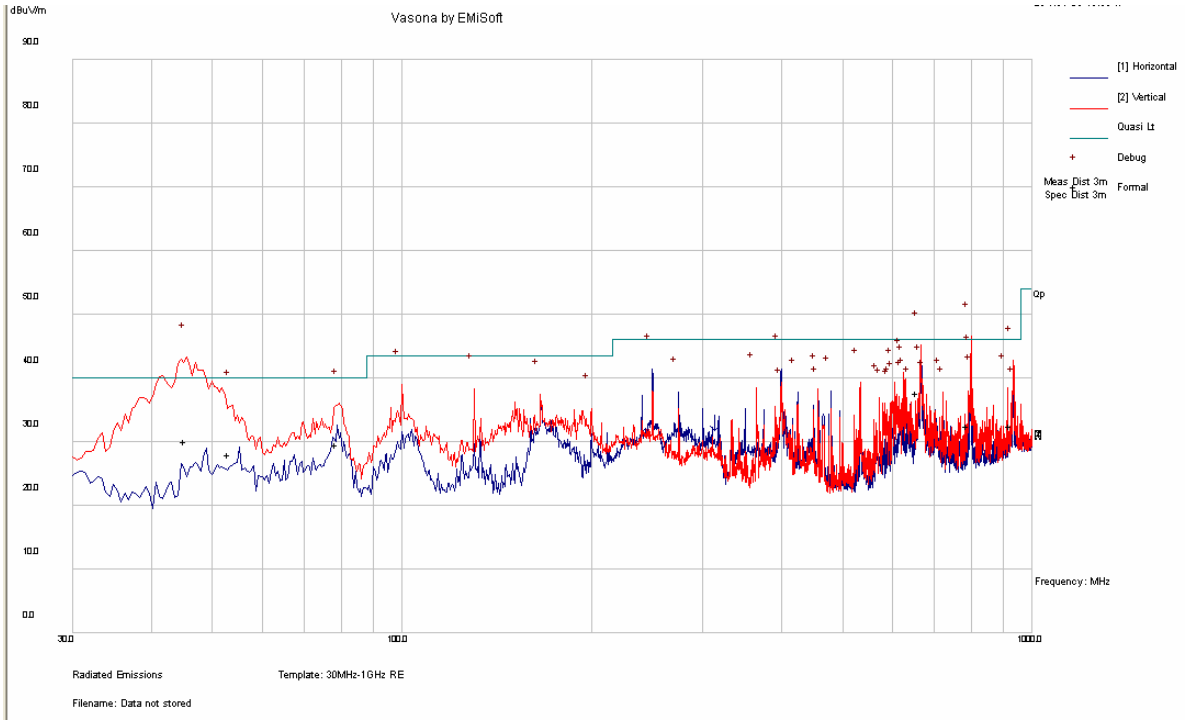


8.9 Radiated Emissions Test plot & data:

802.11b Mode:

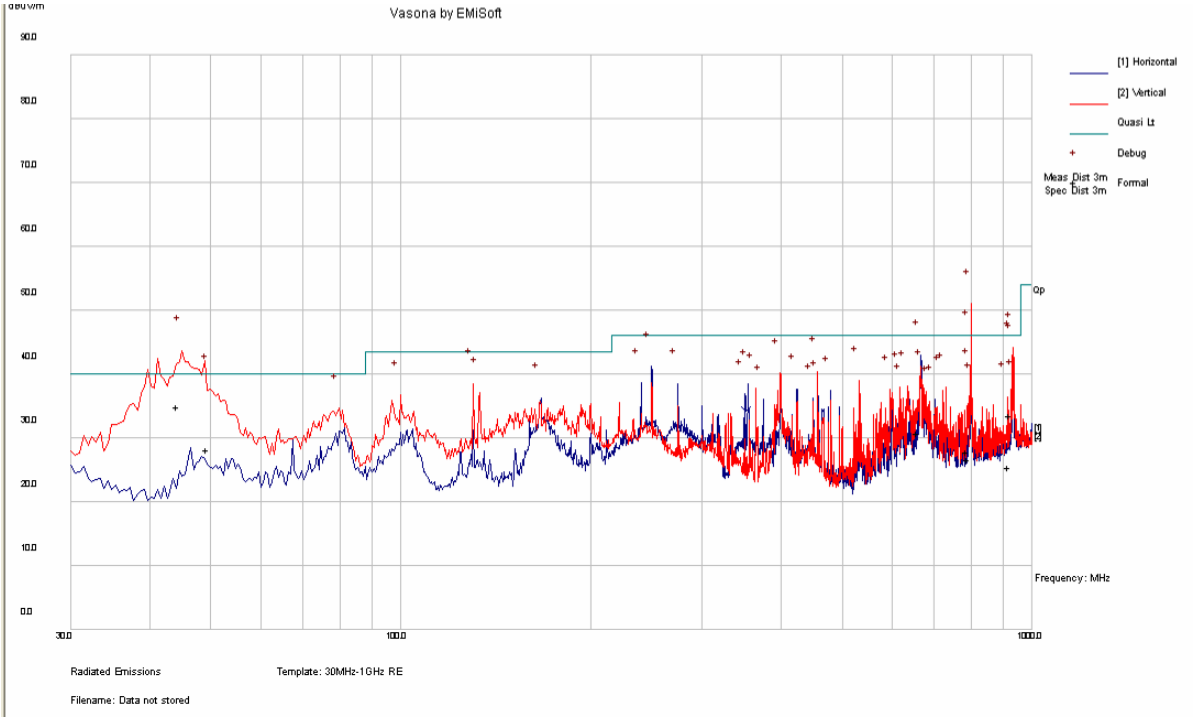
30 MHz – 1000 MHz:

802.11 b, Low Channel 2412 MHz, measured at 3 meters



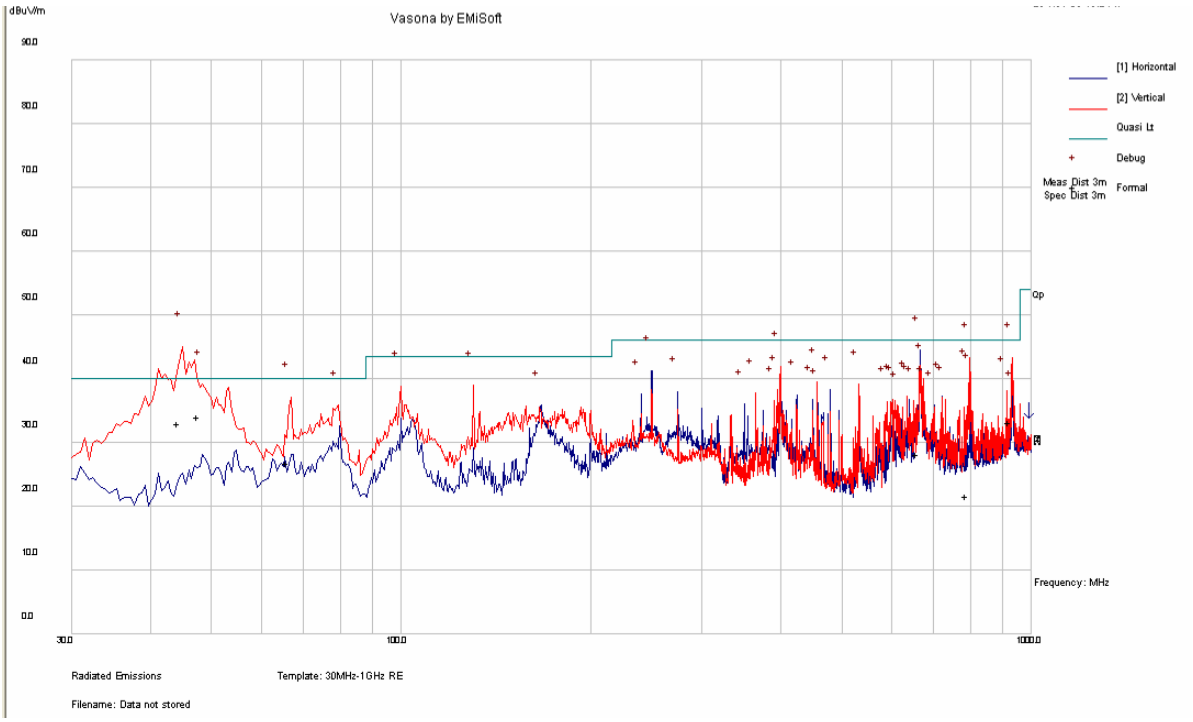
Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
665.532	37.67	137	V	162	1.43	46	-8.33
45.702	30.17	305	V	202	-9.11	40	-9.83
79.547	29.59	201	V	51	-11.38	40	-10.41
53.711	28.00	187	V	203	-11.75	40	-12.00
799.315	32.46	128	V	147	3.73	46	-13.54
932.773	32.46	159	V	149	5.73	46	-13.54

802.11 b, Middle Channel 2437 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
44.909	34.99	112	V	193	-8.64	40	-5.01
50.056	28.22	262	V	103	-10.99	40	-11.78
932.645	33.46	100	V	119	5.72	46	-12.54
666.781	30.83	342	H	282	1.43	46	-15.17
798.986	27.88	121	V	44	3.71	46	-18.12
801.014	26.63	175	V	125	3.79	46	-19.37

802.11 b, High Channel 2462 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (deg.)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
48.319	33.97	186	V	180	-10.40	40	-6.03
44.964	33.02	173	V	218	-8.67	40	-6.98
932.555	33.20	114	V	194	5.72	46	-12.80
66.762	26.90	106	V	225	-11.31	40	-13.10
666.421	28.26	100	H	196	1.43	46	-17.74
797.969	21.67	356	V	42	3.64	46	-24.33

Above 1 GHz:

802.11 b, Low Channel 2412 MHz, measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2412	81.41	98	1.3	V	29.1	5.66	0	116.17			Fund/Peak
2412	73.68	98	1.3	V	29.1	5.66	0	108.44			Fund/ Ave.
2412	68.70	142	1	H	29.1	5.66	0	104.95			Fund/Peak
2412	60.99	142	1	H	29.1	5.66	0	93.12			Fund/ Ave.
4824	33.53	158	1	V	33.1	8.23	36.34	38.52	54	-15.48	Ave
4824	32.19	350	1	H	33.1	8.23	36.34	37.18	54	-16.82	Ave
4824	43.45	158	1	V	33.1	8.23	36.34	48.44	74	-25.56	Peak
4824	41.68	350	1	H	33.1	8.23	36.34	46.67	74	-27.33	Peak

802.11 b, Middle channel 2437 MHz, measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2437	82.47	98	1.31	V	29.2	5.68	0	117.35			Fund/Peak
2437	74.97	98	1.31	V	29.2	5.68	0	109.85			Fund/ Ave.
2437	69.43	141	1	H	29.2	5.68	0	104.31			Fund/Peak
2437	61.84	141	1	H	29.2	5.68	0	96.72			Fund/ Ave.
4874	35.53	153	1	V	33.1	8.29	36.3	40.62	54	-13.38	Ave
4874	31.22	355	1	H	33.1	8.29	36.3	36.31	54	-17.69	Ave
4874	43.91	153	1	V	33.1	8.29	36.3	49.00	74	-25.00	Peak
4874	42.05	355	1	H	33.1	8.29	36.3	47.14	74	-26.86	Peak

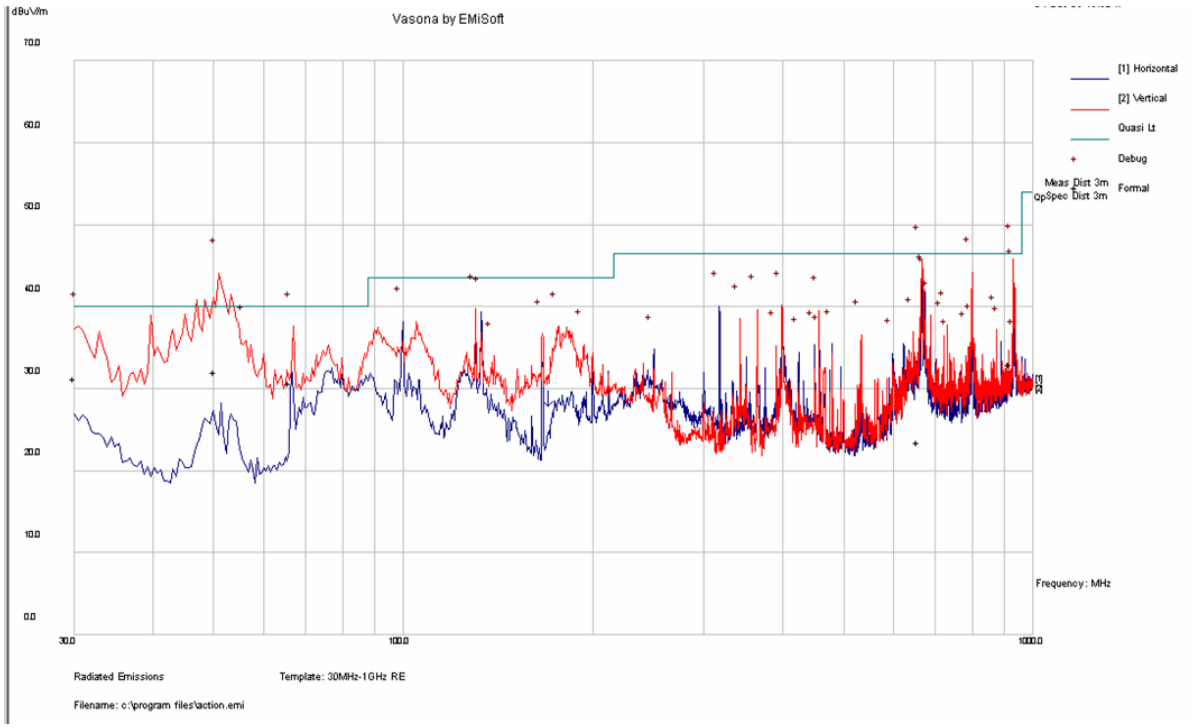
802.11 b, High channel 2462 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2462	81.90	98	1.3	V	29.2	5.7	0	116.80			Fund/Peak
2462	74.21	98	1.3	V	29.2	5.7	0	109.11			Fund/ Ave.
2462	68.71	142	1	H	29.2	5.7	0	103.61			Fund/Peak
2462	61.13	142	1	H	29.2	5.7	0	96.03			Fund/ Ave.
4924	34.74	152	1	V	33.1	8.35	36.25	39.94	54	-14.06	Ave
4924	31.36	349	1	H	33.1	8.35	36.25	36.56	54	-17.44	Ave
4924	45.15	152	1	V	33.1	8.35	36.25	50.35	74	-23.65	Peak
4924	42.60	349	1	H	33.1	8.35	36.25	47.80	74	-26.20	Peak

802.11 g Mode:

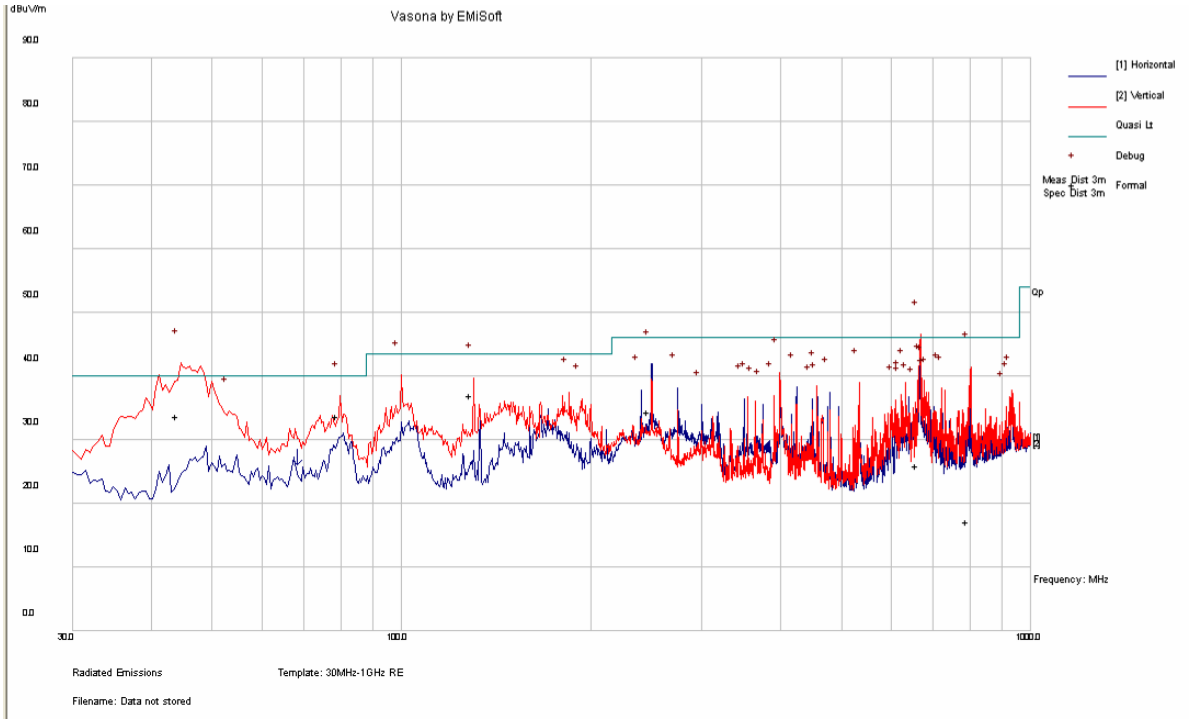
30 MHz – 1000 MHz:

Low Channel 2412 MHz, measured at 3 meters



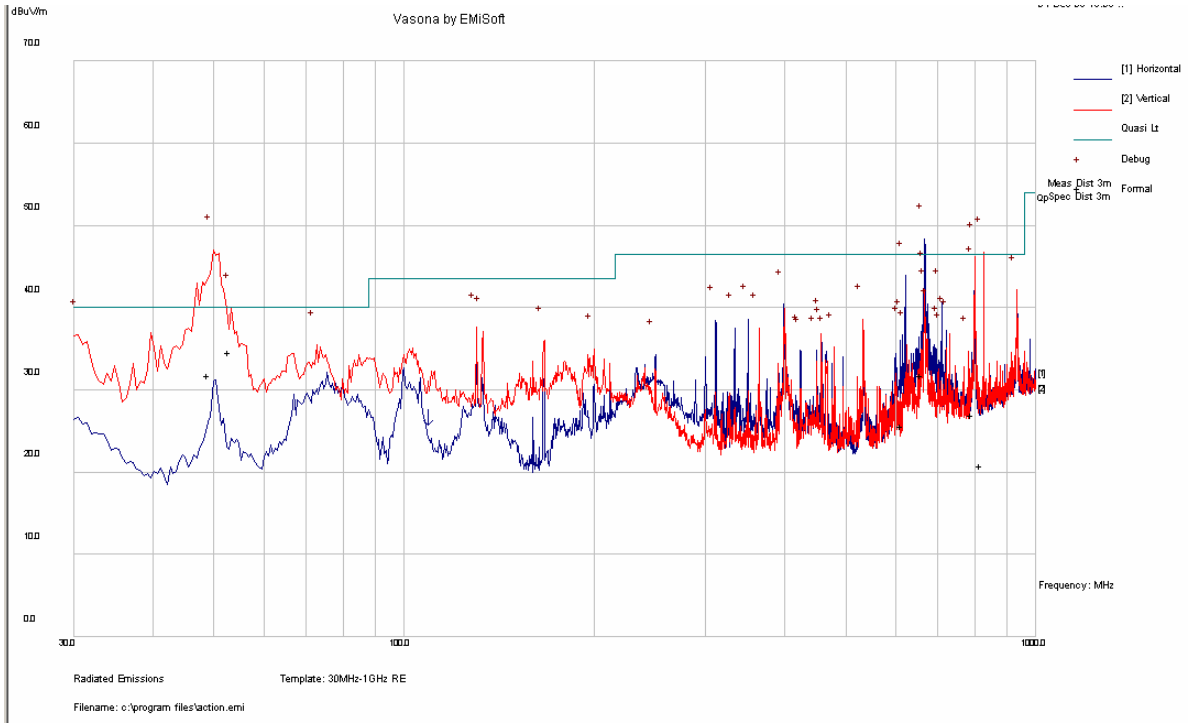
Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
50.718	32.03	193	V	318	-11.08	40.0	-7.97
30.404	31.24	100	V	210	2.21	40.0	-8.76
66.675	30.77	159	V	167	-11.15	40.0	-9.23
930.064	32.94	128	V	306	5.75	46.5	-13.56
799.287	27.80	163	V	335	3.85	46.5	-18.70
665.367	23.51	211	V	0	1.73	46.5	-22.99

802.11 g, Middle Channel 2437 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
80.004	33.66	117	V	349	-11.40	40	-6.34
44.428	33.64	149	V	127	-8.35	40	-6.36
130.493	36.94	106	V	105	-4.95	43.5	-6.56
249.944	34.44	115	H	129	-6.07	46	-11.56
667.823	26.01	303	V	337	1.44	46	-19.99
802.663	17.20	354	V	133	3.84	46	-28.80

802.11 g, High channel 2462 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi - Peak (dBµV/m)	Ant. Height (cm)	Ant. Polarity (H/V)	Azimuth (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
53.472	34.57	100	V	127	-11.60	40.0	-5.43
49.662	31.83	169	V	31	-10.77	40.0	-8.17
666.223	31.73	314	H	247	1.73	46.5	-14.77
801.301	27.02	162	V	5	3.85	46.5	-19.48
621.666	25.63	115	H	166	0.93	46.5	-20.87
826.709	20.81	119	V	154	4.42	46.5	-25.69

Above 1 GHz:

802.11 g, Low Channel 2412 MHz, measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2412	82.90	78	1.38	V	28.2	5.66	0	116.76			Fund/Peak
2412	69.95	78	1.38	V	28.2	5.66	0	103.81			Fund/ Ave.
2412	68.20	143	1.07	H	28.2	5.66	0	102.06			Fund/Peak
2412	56.62	143	1.07	H	28.2	5.66	0	90.48			Fund/ Ave.
4824	31.90	154	1.2	V	33.1	8.23	36.34	36.89	54	-17.11	Ave
4824	30.82	355	1	H	33.1	8.23	36.34	35.81	54	-18.19	Ave
4824	43.05	154	1.2	V	33.1	8.23	36.34	48.04	74	-25.96	Peak
4824	40.16	355	1	H	33.1	8.23	36.34	45.15	74	-28.85	Peak

802.11 g, Middle channel 2437 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2437	83.24	79	1.4	V	28.3	5.68	0	117.22			Fund/Peak
2437	71.09	79	1.4	V	28.3	5.68	0	105.07			Fund/ Ave.
2437	70.19	142	1.05	H	28.3	5.68	0	104.17			Fund/Peak
2437	58.36	142	1.05	H	28.3	5.68	0	92.34			Fund/ Ave.
4874	34.28	159	114	V	33.1	8.29	36.3	39.37	54	-14.63	Ave
4874	30.85	352	1	H	33.1	8.29	36.3	35.94	54	-18.06	Ave
4874	47.00	159	114	V	33.1	8.29	36.3	52.09	74	-21.91	Peak
4874	40.53	352	1	H	33.1	8.29	36.3	45.62	74	-28.38	Peak

802.11 g, High channel 2462 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)						
2462	81.03	78	1.42	V	28.4	5.7	0	115.13			Fund/Peak
2462	68.52	78	1.42	V	28.4	5.7	0	102.62			Fund/ Ave.
2462	68.47	144	1	H	28.4	5.7	0	102.57			Fund/Peak
2462	56.17	144	1	H	28.4	5.7	0	90.27			Fund/ Ave.
4924	33.93	158	1.05	V	33.1	8.35	36.25	39.13	54	-14.87	Ave
4924	29.09	355	1	H	33.1	8.35	36.25	34.29	54	-19.71	Ave
4924	41.83	158	1.05	V	33.1	8.35	36.25	47.03	74	-26.97	Peak
4924	38.82	355	1	H	33.1	8.35	36.25	44.02	74	-29.98	Peak

9 §15.247(a) (2) – 6 dB & 99% BANDWIDTH

9.1 Applicable Standard

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 6 dB bandwidth shall be at least 500 kHz

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

9.3 Equipment List

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

9.4 Environmental Conditions

Temperature:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.5kPa

** The testing was performed by Victor Zhang on 2008-12-02.*

9.5 Summary of Test Results

802.11 b Mode:

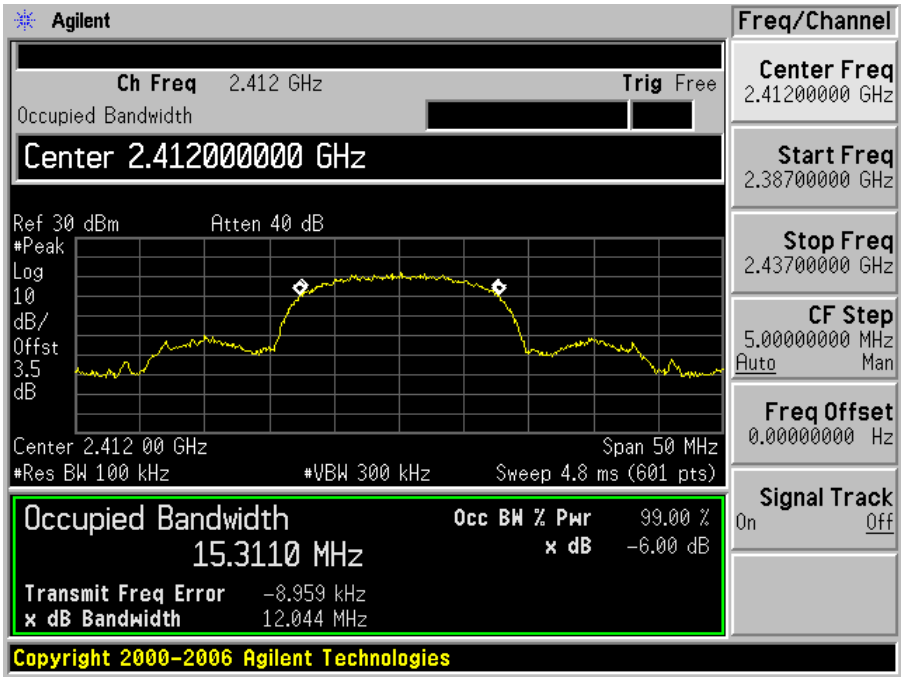
Channel	Frequency (MHz)	6dB Channel Bandwidth (kHz)	99% Bandwidth (MHz)	Limit (kHz)	Results
Low	2412	12044	15311.0	>500	Compliant
Middle	2437	11940	15828.3	>500	Compliant
High	2462	12159	15331.3	>500	Compliant

802.11 g Mode:

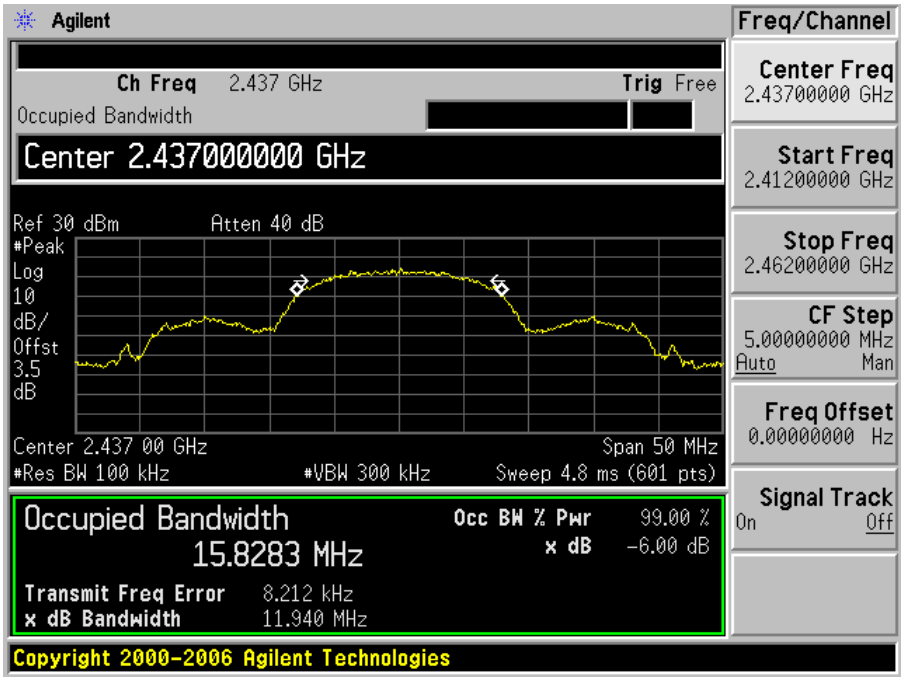
Channel	Frequency (MHz)	6dB Channel Bandwidth (kHz)	99% Bandwidth (MHz)	Limit (kHz)	Results
Low	2412	16596	16525.2	>500	Compliant
Middle	2437	16601	18284.3	>500	Compliant
High	2462	16608	16518.8	>500	Compliant

Please refer to the following plots for detailed test results

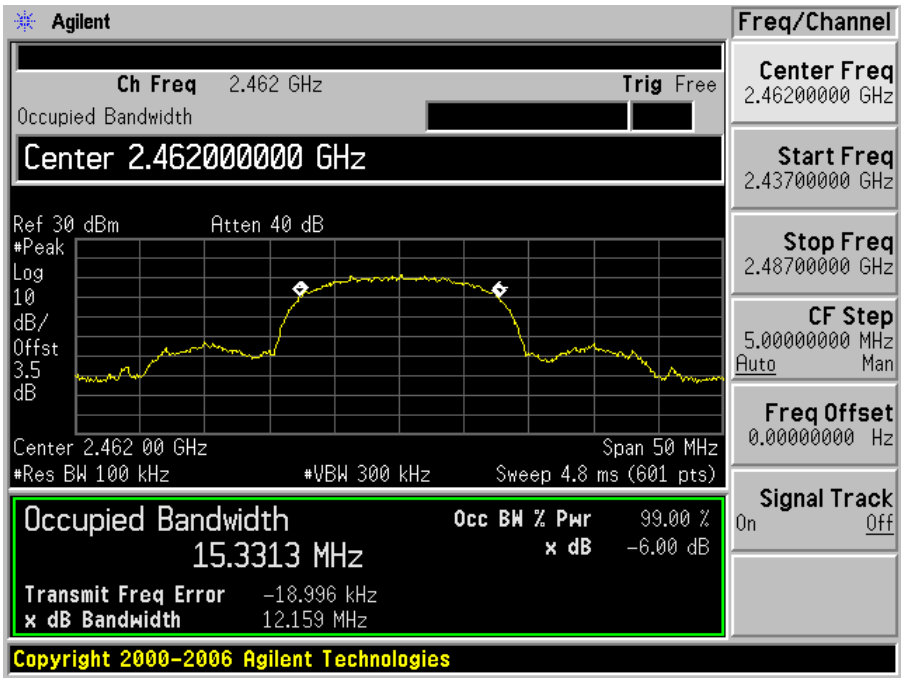
802.11 b – Low Channel 2412 MHz



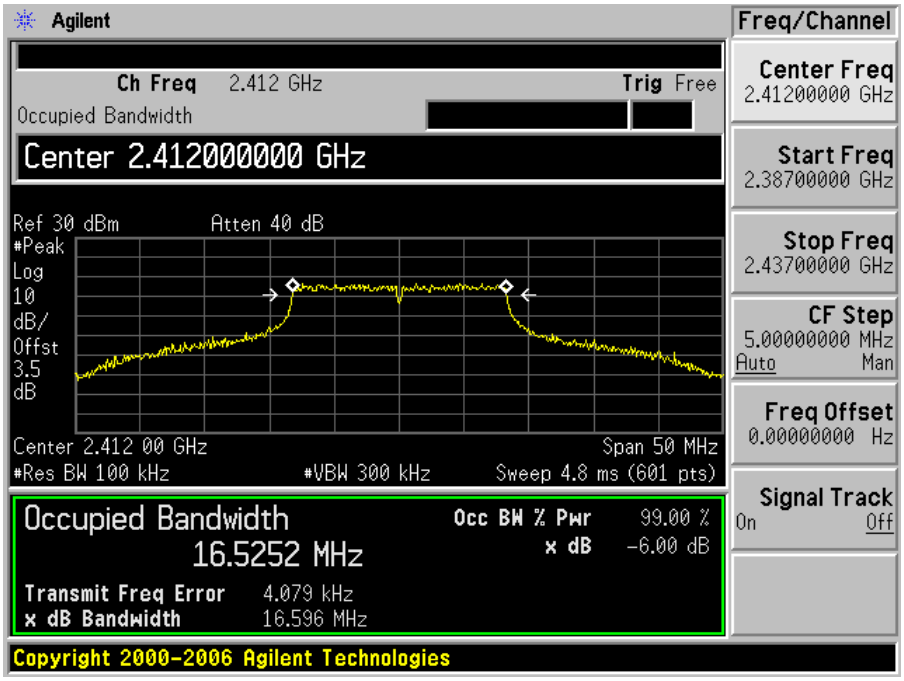
802.11 b – Middle Channel 2437 MHz



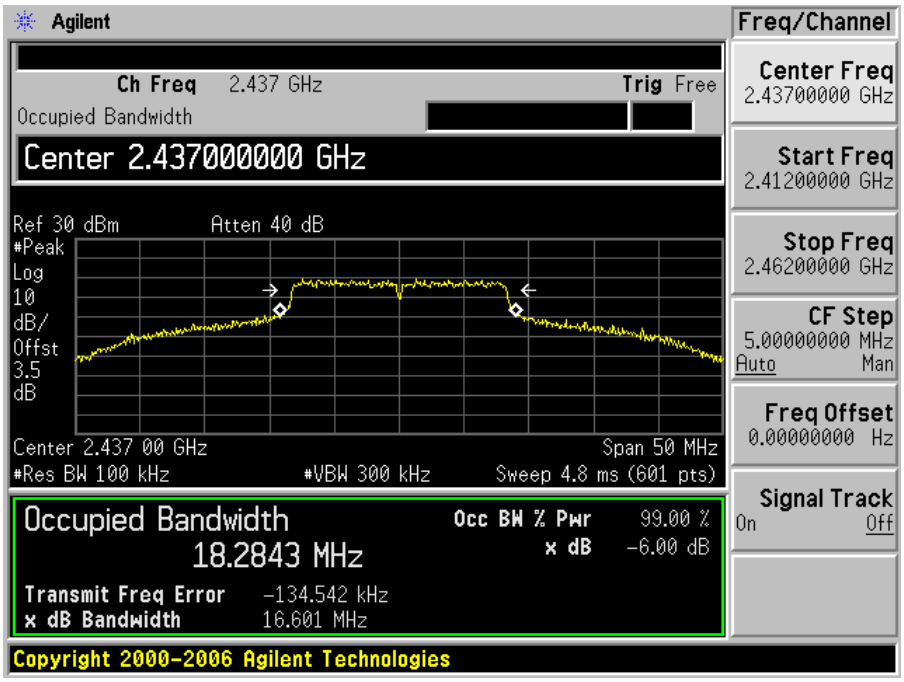
802.11 b – High Channel 2462 MHz



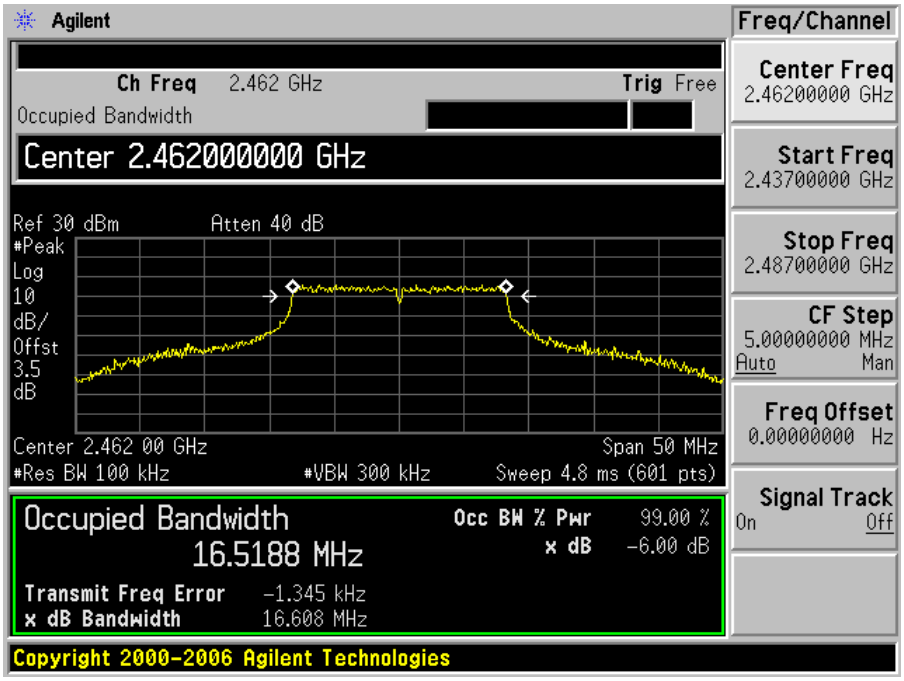
802.11 g – Low Channel 2412 MHz



802.11 g – Middle Channel 2437 MHz



802.11 g – High Channel 2462 MHz



10 §15.247(b) - PEAK OUTPUT POWER MEASUREMENT

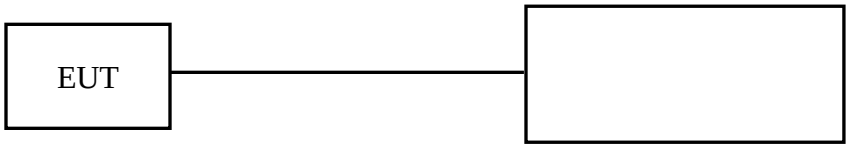
10.1 Applicable Standard

§15.247(b) the maximum peak output power of the intentional radiator shall not exceed the following:

§15.247(b) (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

10.2 Measurement Procedure

1. Place the EUT on a bench 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 a spectrum analyzer.
3. Add a correction factor to the display.



10.3 Equipment Lists

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

10.4 Environmental Conditions

Temperature:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.5kPa

** The testing was performed by Victor Zhang on 2008-12-02.*

10.5 Summary of Test Results

802.11 b Mode:

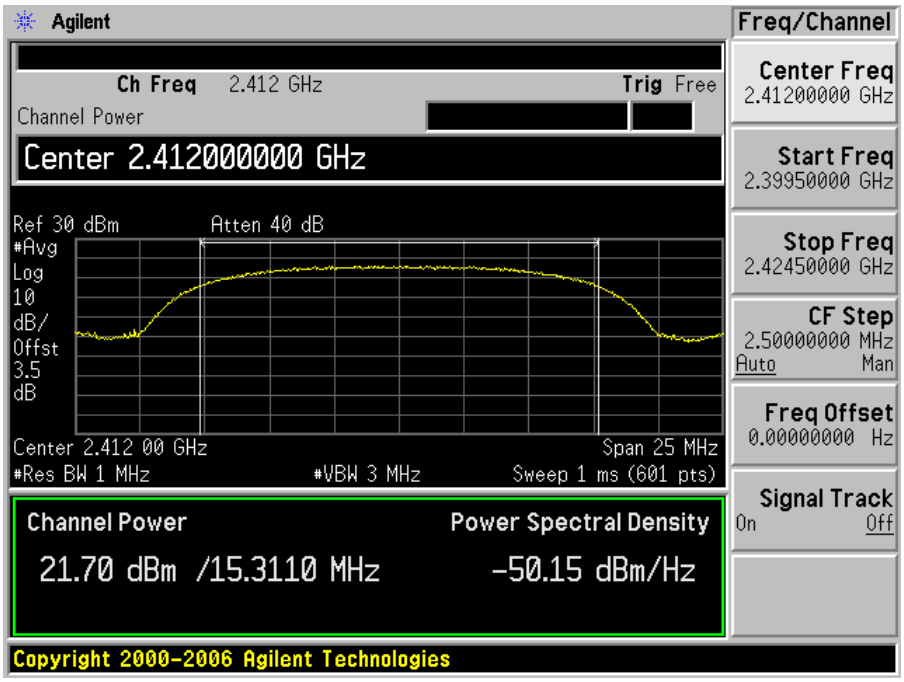
Frequency (MHz)	Max Power (dBm)	Max Power (mW)	Limit (mW)	Results
2412	21.70	147.91	1000	Compliant
2437	22.87	193.64	1000	Compliant
2462	21.99	158.12	1000	Compliant

802.11g Mode:

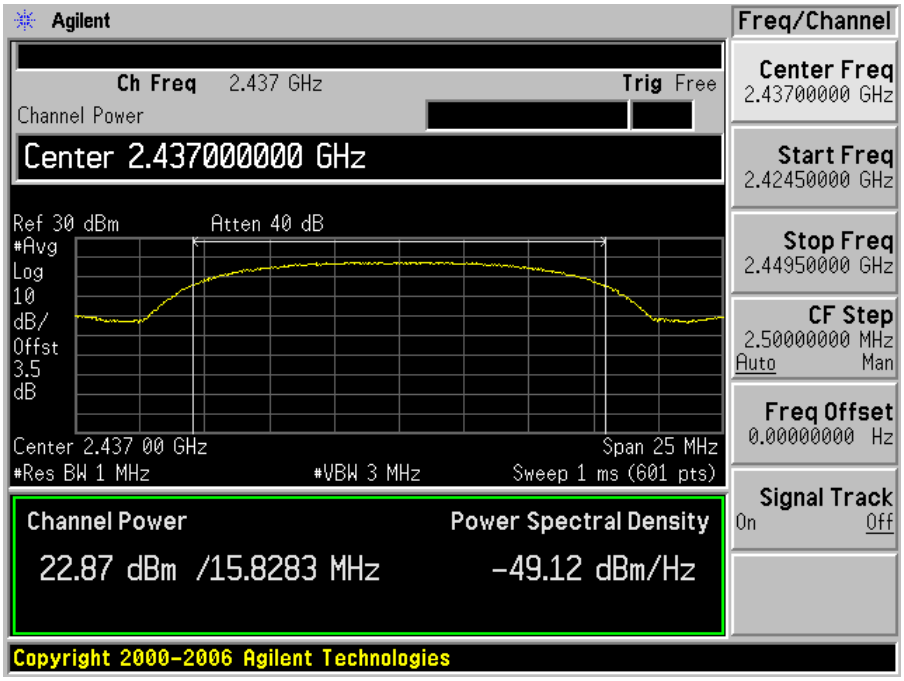
Frequency (MHz)	Max Power (dBm)	Max Power (mW)	Limit (mW)	Result
2412	20.09	102.09	1000	Compliant
2437	20.52	112.72	1000	Compliant
2462	20.00	100.00	1000	Compliant

Please refer to the following plots for detailed test results

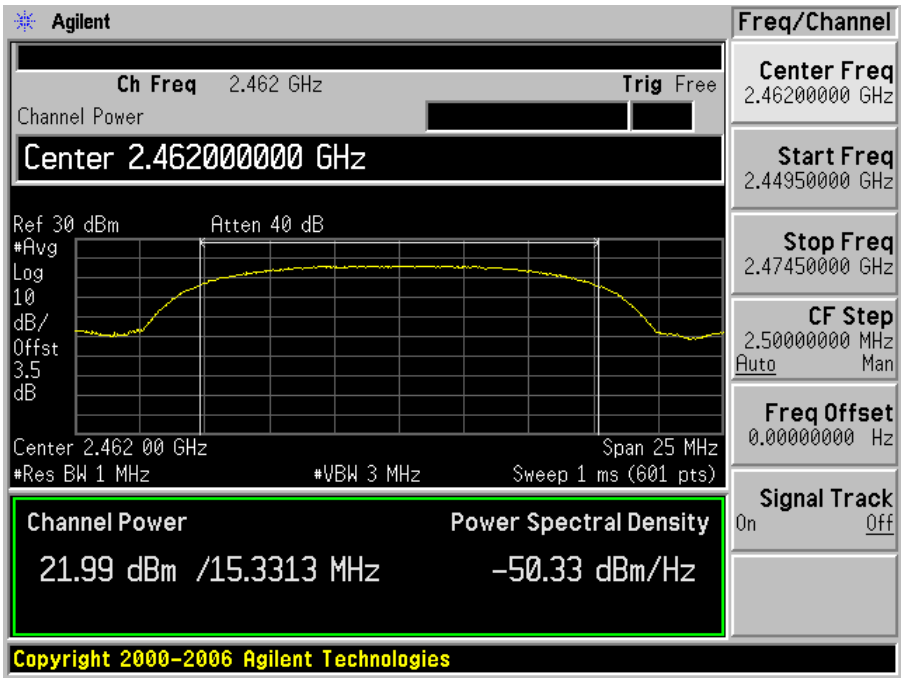
802.11 b – Low Channel 2412 MHz



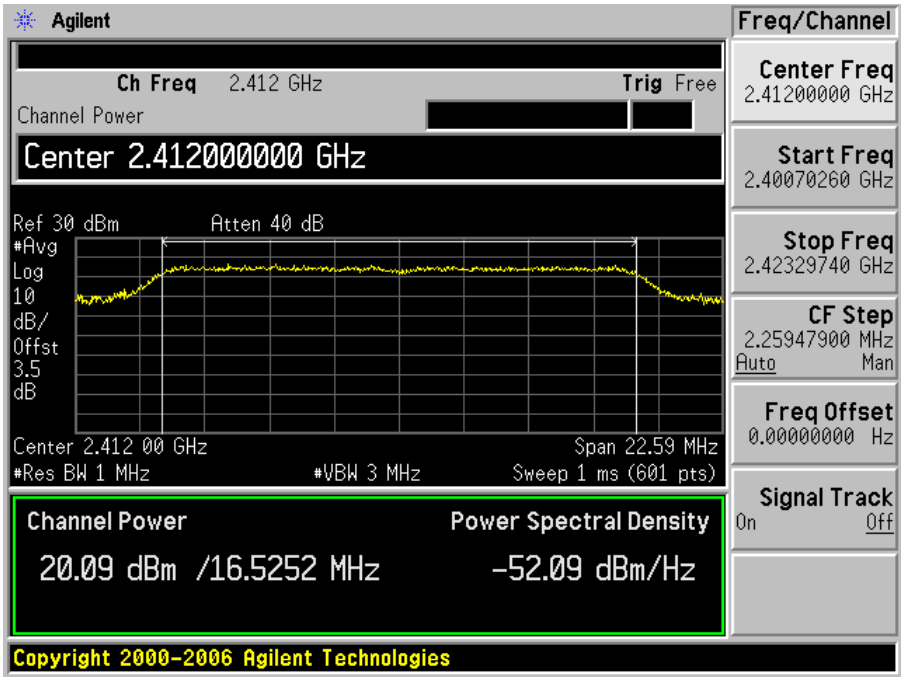
802.11 b – Middle Channel 2437 MHz



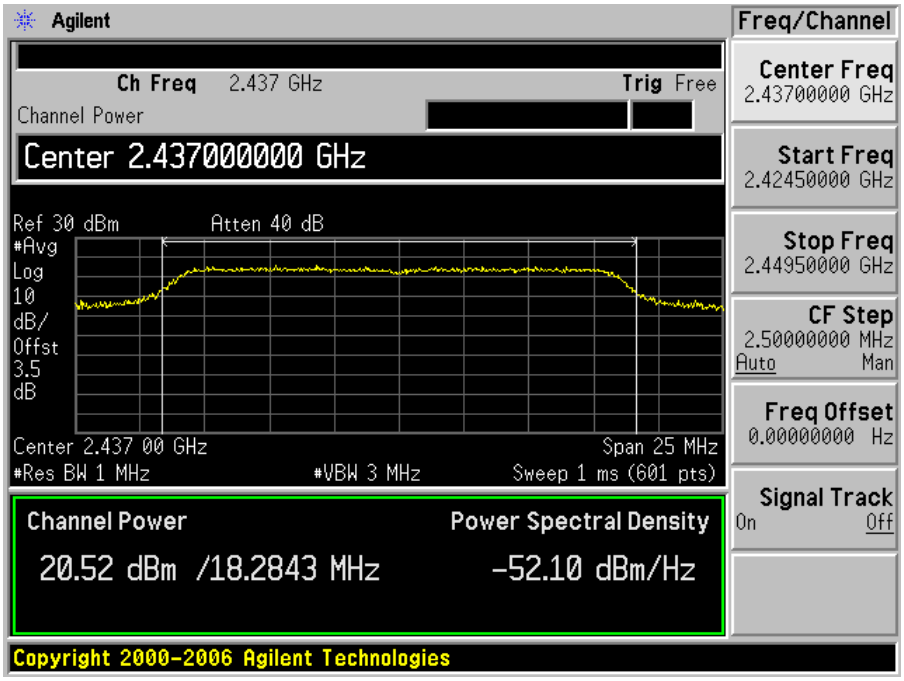
802.11 b – High Channel 2462 MHz



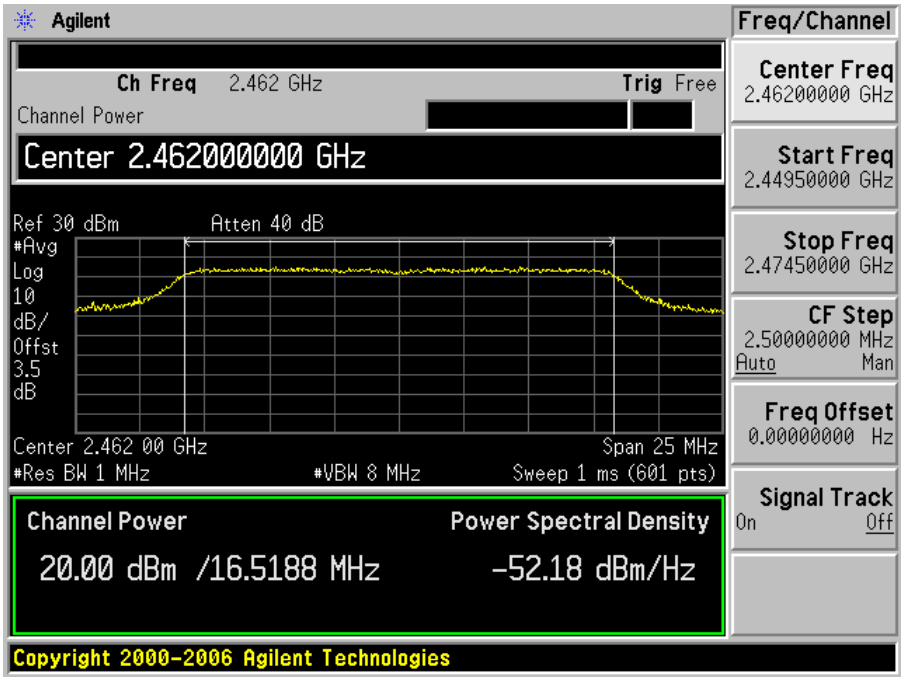
802.11 g – Low Channel 2412 MHz



802.11 g – Middle Channel 2437 MHz



802.11 g – High Channel 2462 MHz



11 §15.247(d) - 100 kHz BANDWIDTH OF BAND EDGES

11.1 Applicable Standard

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c)).

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Equipment Lists

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

11.4 Environmental Conditions

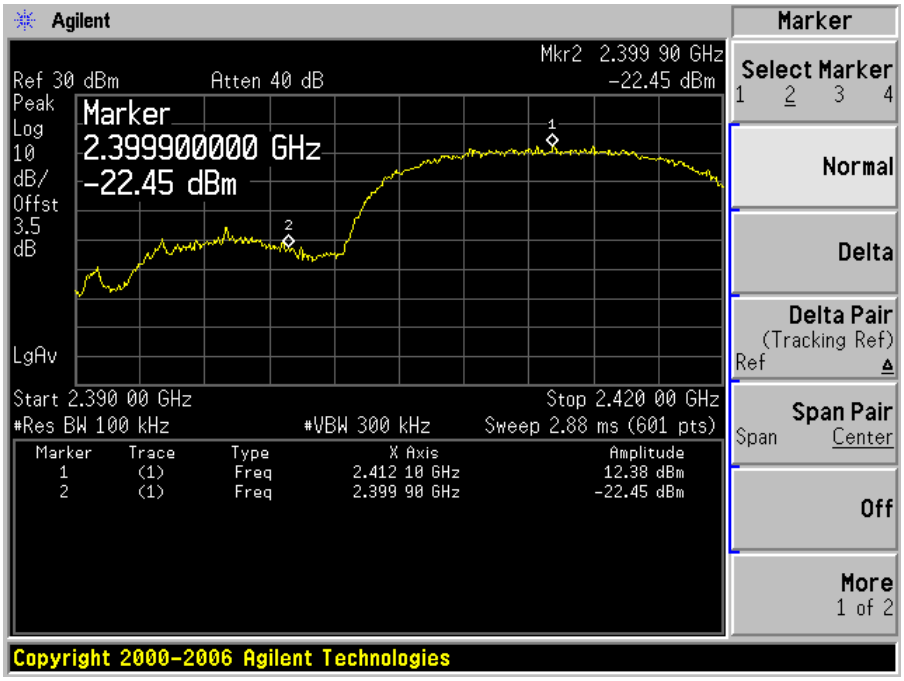
Temperature:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.5kPa

** The testing was performed by Victor Zhang on 2008-12-02.*

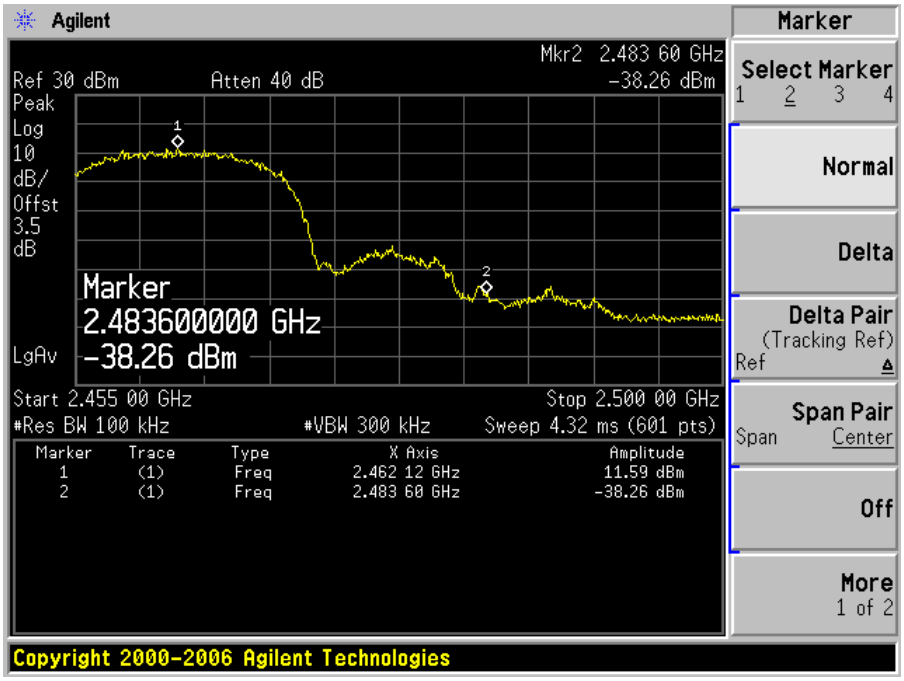
11.5 Measurement Results

Please refer to following pages for plots of band edge.

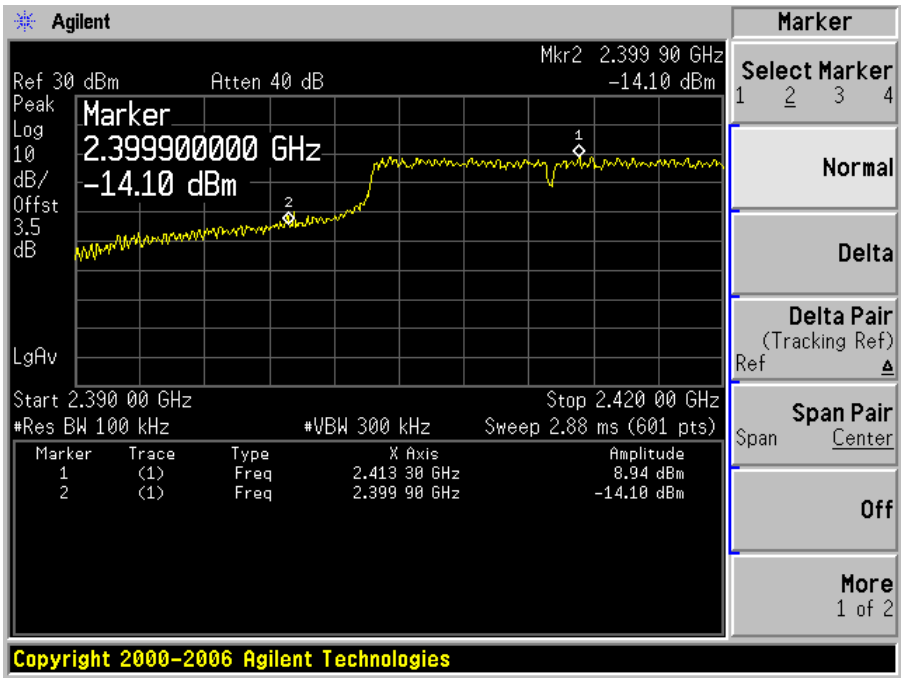
802.11 b – Low Band edge



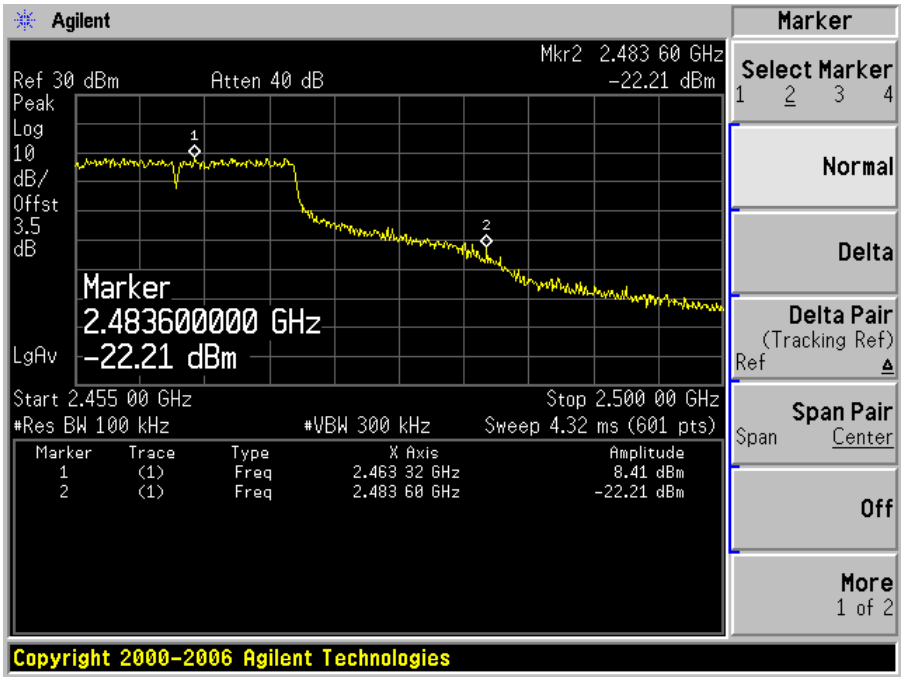
802.11 b – High Band edge



802.11 g –Low Band edge



802.11 g – High Band edge



12 §15.247(e) - POWER SPECTRAL DENSITY

12.1 Applicable Standard

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.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to 1.5MHz span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Repeat above procedures until all frequencies measured were complete.

12.3 Equipment Lists

Manufacturer	Description	Model	Serial Number	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

12.4 Environmental Conditions

Temperature:	19 °C
Relative Humidity:	42 %
ATM Pressure:	101.5kPa

** The testing was performed by Victor Zhang on 2008-12-02.*

12.5 Summary of Test Results

802.11 b Mode:

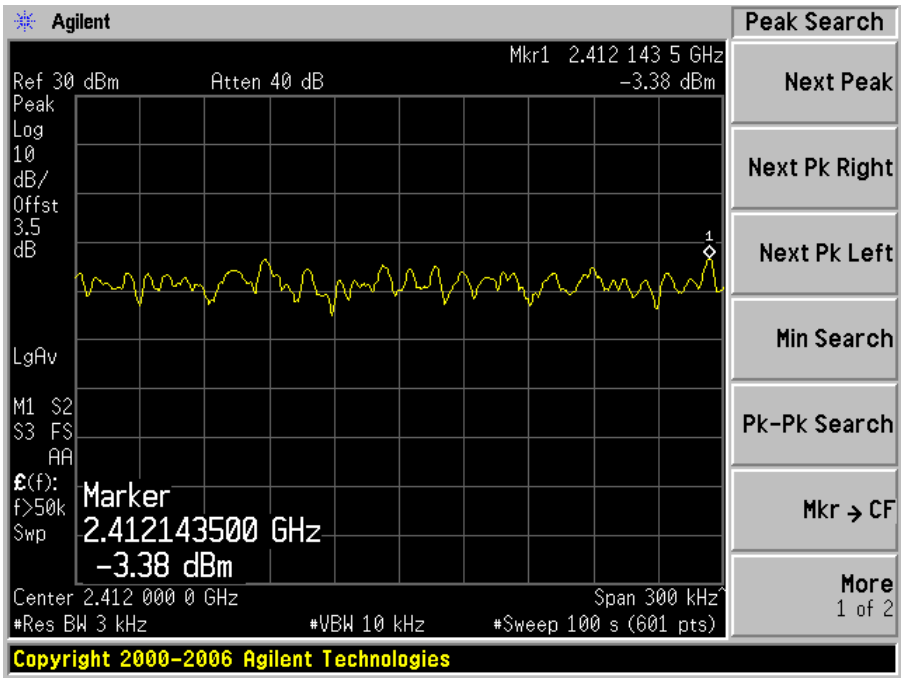
Frequency (MHz)	PPSD (dBm)	Limit (dBm/3kHz)	Results
2412	-3.38	8	Compliant
2437	-2.49	8	Compliant
2462	-4.26	8	Compliant

802.11 g Mode:

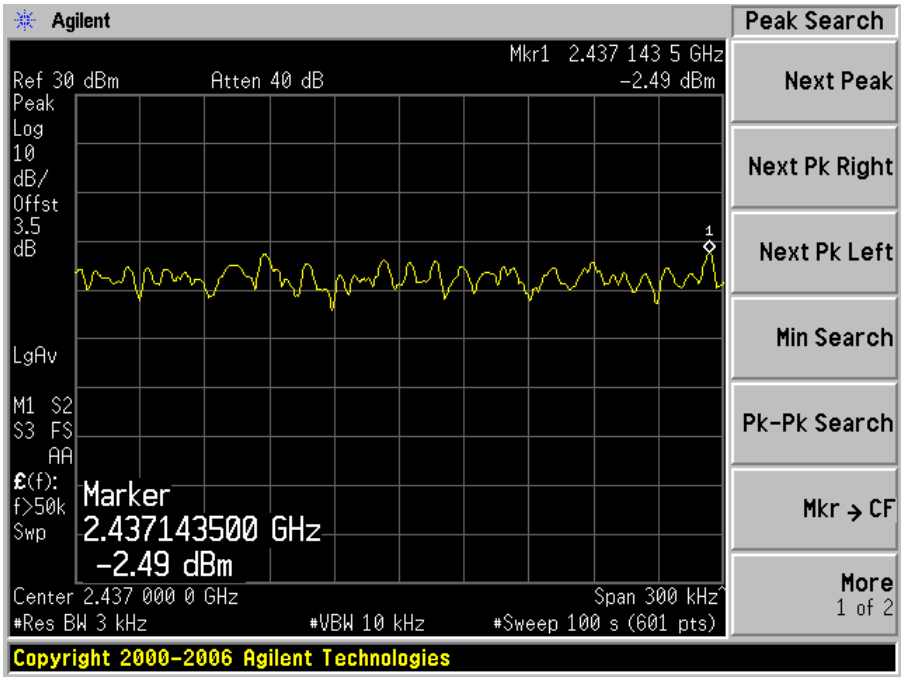
Frequency (MHz)	PPSD (dBm)	Limit (dBm/3kHz)	Results
2412	-13.25	8	Compliant
2437	-11.29	8	Compliant
2462	-15.34	8	Compliant

Please refer to the following plots for detailed test results

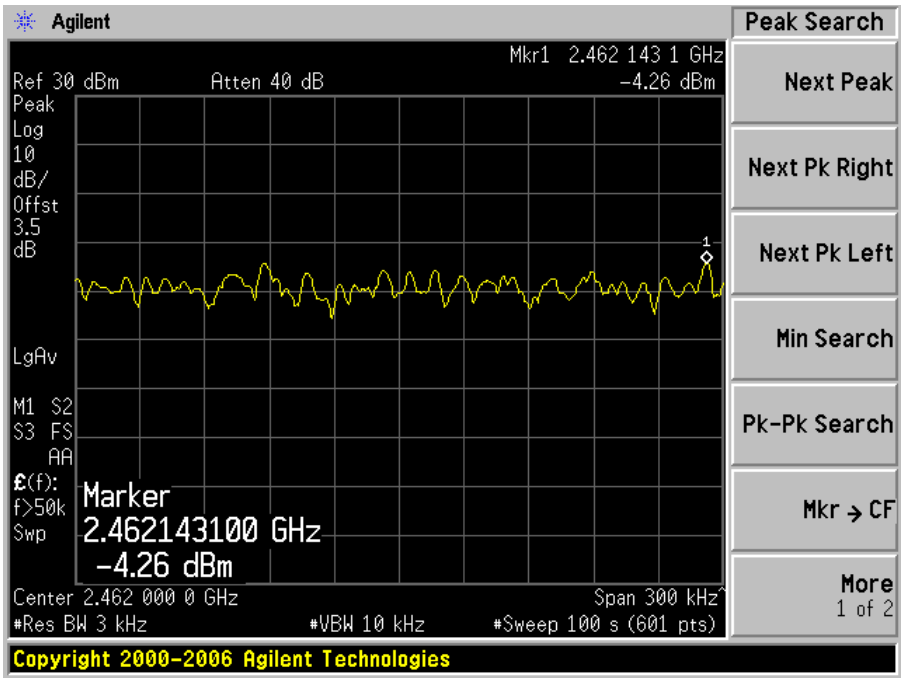
802.11 b – Low Channel 2412 MHz



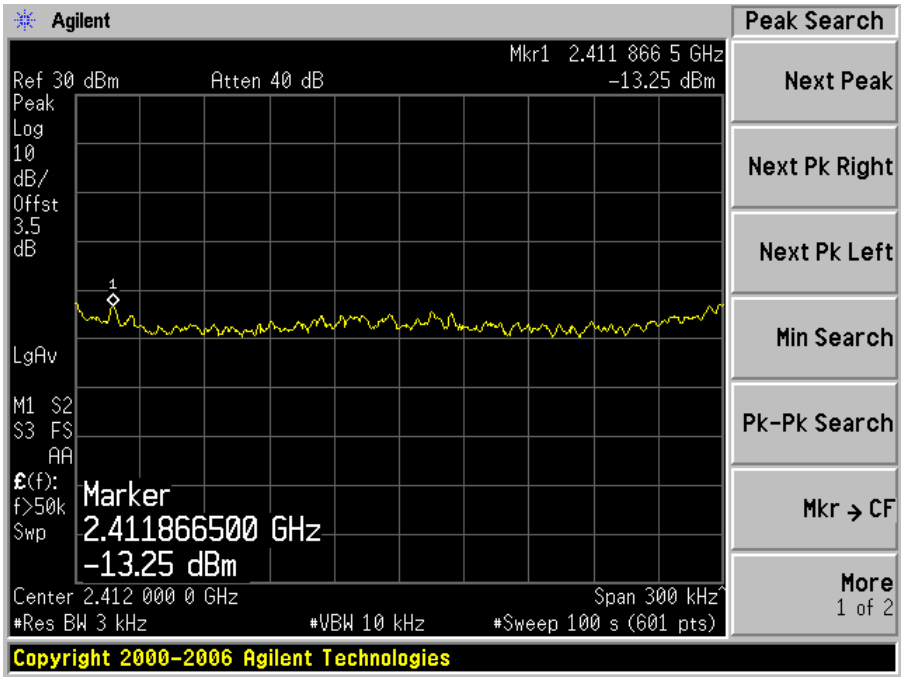
802.11 b – Middle Channel 2437 MHz



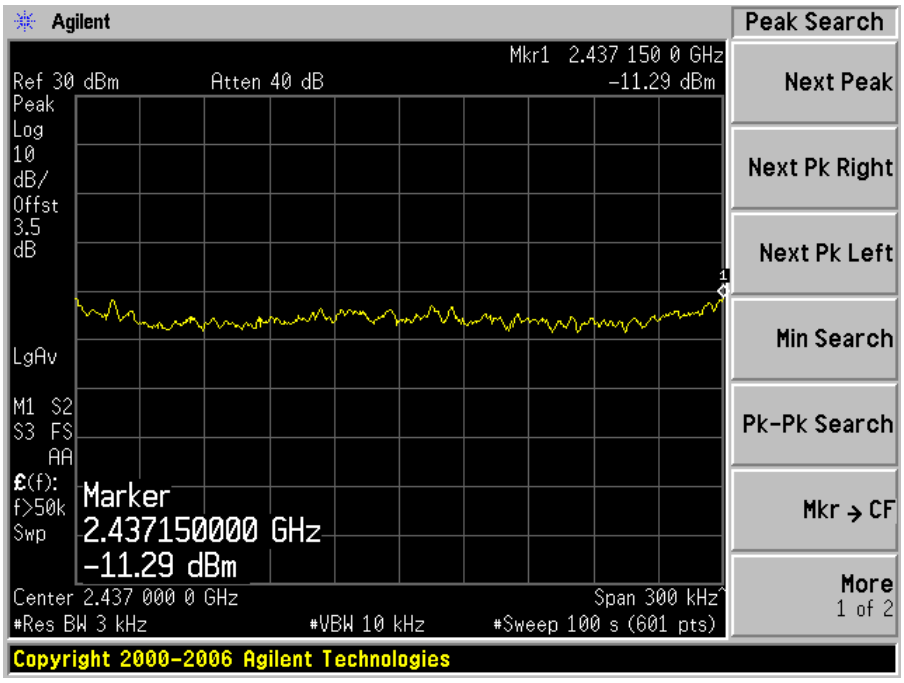
802.11 b –High Channel 2462 MHz



802.11 g – Low Channel 2412 MHz



802.11 g – Middle Channel 2437 MHz



802.11 g –High Channel 2462 MHz