Lab Code: 200167-0

FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

Actiontec Electronics, Inc.

760 North Mary Avenue,

Sunnyvale, CA 94085, USA

FCC ID: LNQMI424WRF
Model: MI424-WR Rev F

Report Type:	**Product Type:**
Original Report	Wireless 802.11b/g/n Broadband Home Router

Test Engineers:	Jack Liu
Report Number:	R0908055-247
Report Date:	2009-10-21
Reviewed By:	Boni Baniqued EMC/RF Supervisor
Prepared By: (25)	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Ave. Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0908055	Original Report	2009-10-21

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

The *Actiontec Electronics,* Inc., product model: *MI424-WR Rev F*, FCC ID: *LNQMI424WRF* or the "EUT" as referred to in this report is a Wireless 802.11b/g/n Broadband Home Router.

1.2 Mechanical Description of EUT

The "EUT" measures approximately *25.5cm L x 14cm W x4.5cm H*, and weighs approximately *531.5*g.

** The test data gathered are from typical production sample, serial number: CSJF9362300002, 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 +2.0 for Conducted Emissions tests and +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 with the host model: Q1000.

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	Bandwidth (MHz)	Frequency/Data rate		
		Low CH (MHz/Mbps)	Mid CH (MHz/Mbps)	High CH (MHz)
802.11b	20	2412/1	2437/1	2462/1
802.11g	20	2412/6	2437/6	2462/6
802.11n20	20	2412/6.5	2437/6.5	2462/6.5

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Actiontec Electronics, Inc.	Debugging Card	05441A	-
IBM	Laptop	T40	99-PCNYB

2.6 Power Supply and Line Filters

Manufacturer	Description	Model No.	Serial No.
Actiontec Electronics, Inc.	AC/DC Power Adapter	STD-10016U	828000224

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
CAT.5 cable	< 10m	EUT	Laptop
CAT.5 cable	< 10m	EUT	PSA
Converter cable (Com port /USB)	< 5m	EUT	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

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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 FCC §15.247 (i) & § 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)
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 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

4.2 MPE Results

Mode	Frequency Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mw/cm^2)	Result
WLAN	2.4 GHz	20	20.05	5	0.064	Compliance

The predicted power density level at 20 cm is 0.064 mw/cm^2 which is below the uncontrolled exposure limit of 1.0 mW/cm^2. 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 FCC §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 Connector Construction

EUT has one Transmitter/Receiver antennae which is 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 5 dBi which fulfills the requirements of FCC rule 15.203.

Frequency Band	Antenna Gain (dBi)
2.4 GHz	5.0

5.3 Antenna Detail Photo

6 FCC §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 AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

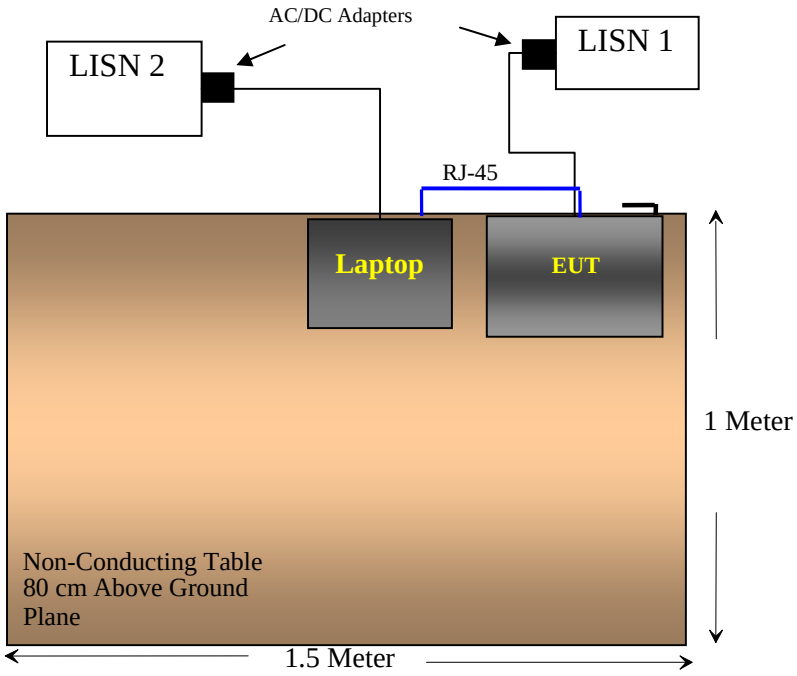
6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Solar Electronics	LISN	9252-R-24-BNC	511205	2009-07-31
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2009-04-21

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

6.4 Test Setup Block Diagram

Conducted Emissions



6.5 Test Procedure

During the conducted emissions test, the power cord of the EUT host system 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”.

6.6 Test Environmental Conditions

Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

6.7 Summary of Test Results

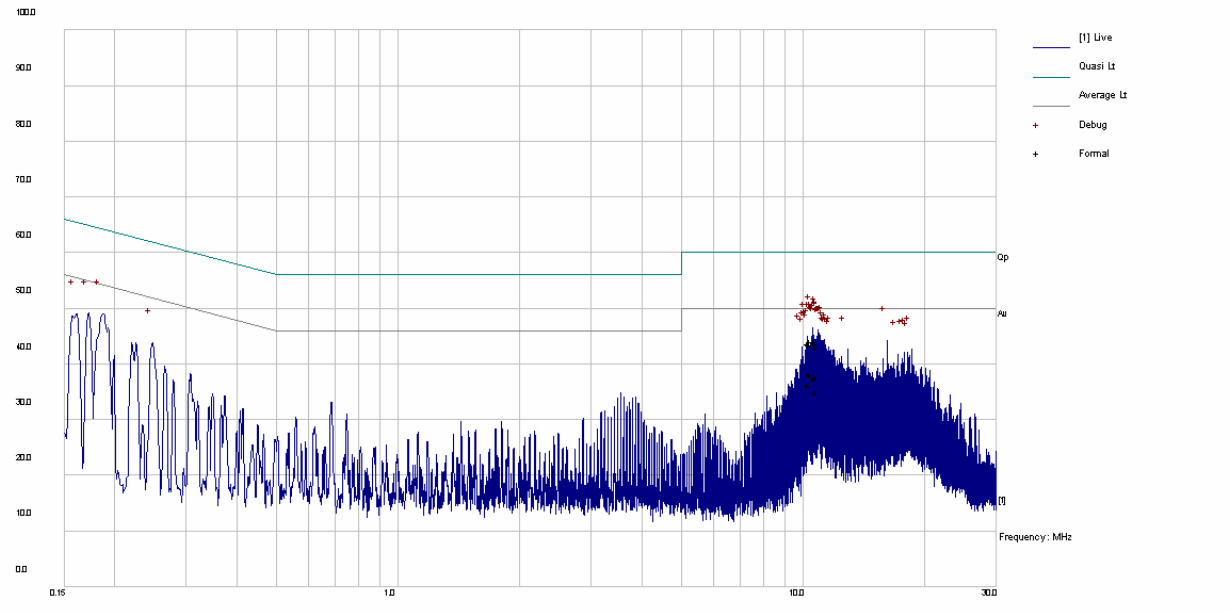
According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

Worst Case: 802.11b 20 MHz BW – Low Channel Transmitting Mode

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-11.89	10.56648	Line	0.15 to 30
-12.48	10.62595	Neutral	0.15 to 30

6.8 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



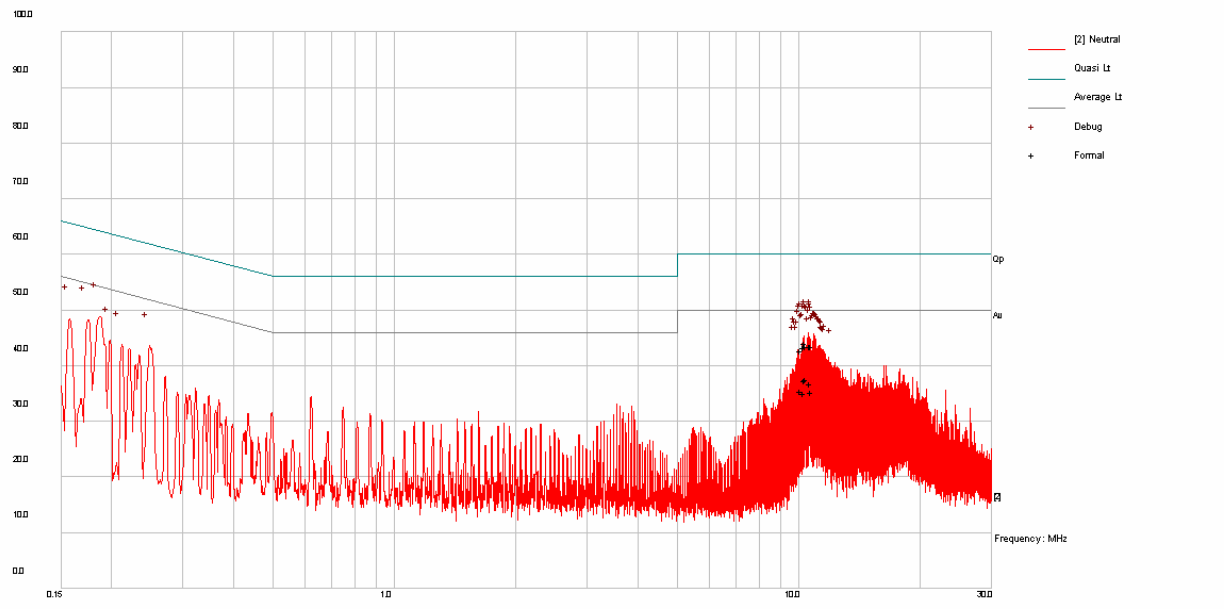
Quasi-Peak Measurements

Frequency (MHz)	Cord. Quasi-Peak (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
10.62881	44.08	Line	60	-15.92
10.87979	43.96	Line	60	-16.04
10.50733	43.70	Line	60	-16.30
10.94136	43.63	Line	60	-16.37
10.56648	43.45	Line	60	-16.55
10.99821	42.96	Line	60	-17.04

Average Measurements

Frequency (MHz)	Cord. Average (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
10.56648	38.11	Line	50	-11.89
10.62881	38.07	Line	50	-11.93
10.94136	37.69	Line	50	-12.31
10.87979	37.41	Line	50	-12.59
10.50733	36.15	Line	50	-13.85
10.99821	34.85	Line	50	-15.15

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Cord. Quasi-Peak (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
10.56773	44.12	Neutral	60	-15.88
10.94127	43.50	Neutral	60	-16.50
10.87740	43.49	Neutral	60	-16.51
10.62595	43.48	Neutral	60	-16.52
10.50546	43.24	Neutral	60	-16.76
10.31844	42.79	Neutral	60	-17.21

Average Measurements

Frequency (MHz)	Cord. Average (dBµV)	Conductor (Line/ Neutral)	Limit (dBµV)	Margin (dB)
10.62595	37.52	Neutral	50	-12.48
10.56773	37.37	Neutral	50	-12.63
10.87740	36.75	Neutral	50	-13.25
10.31844	35.38	Neutral	50	-14.62
10.94127	35.32	Neutral	50	-14.68
10.50546	35.11	Neutral	50	-14.89

7 FCC §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 10th harmonic.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4446A	US44300386	2009-06-29

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

7.4 Test Environmental Conditions

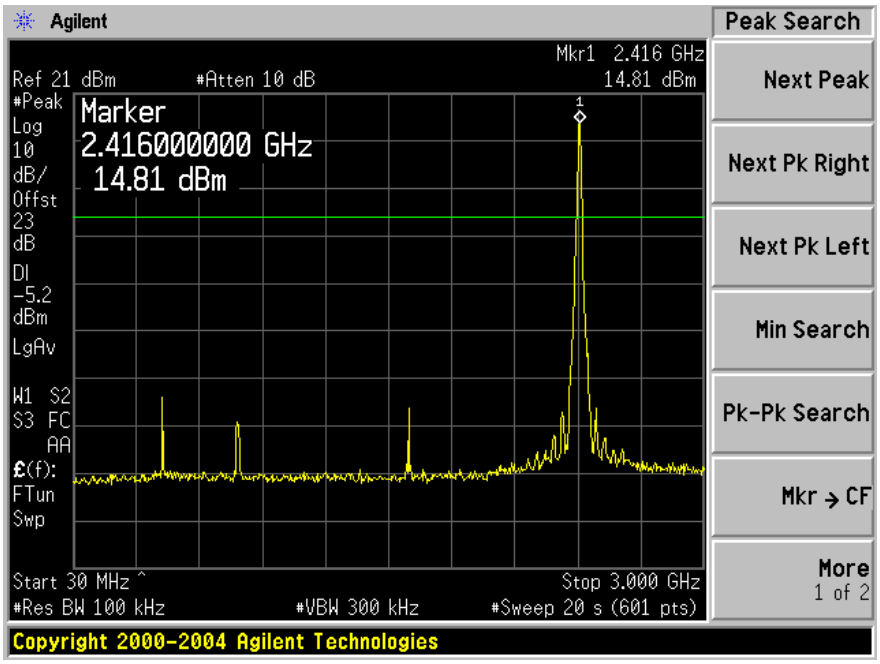
Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

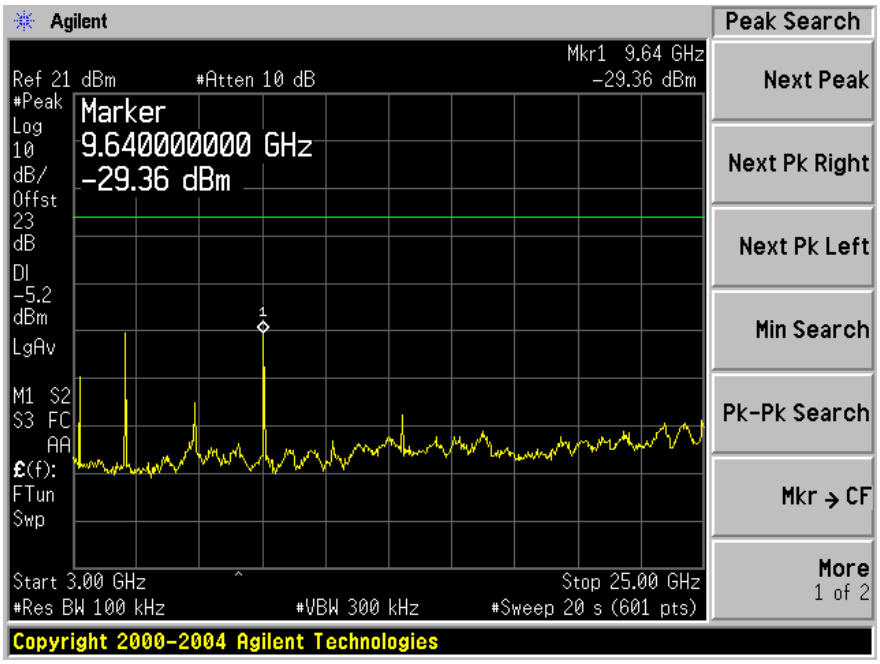
**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

7.5 Measurement Result:

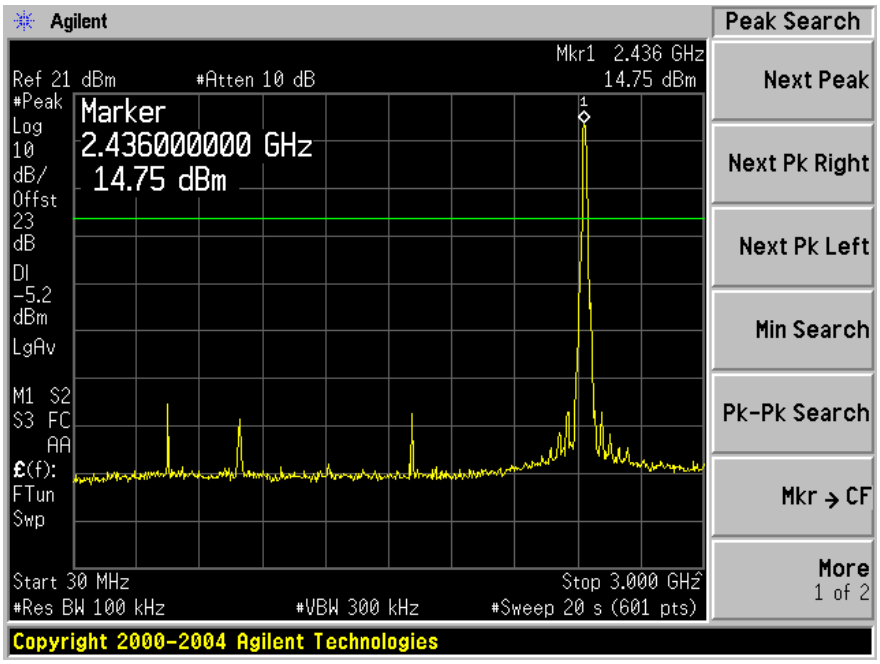
Please refer to following plots of spurious emissions.

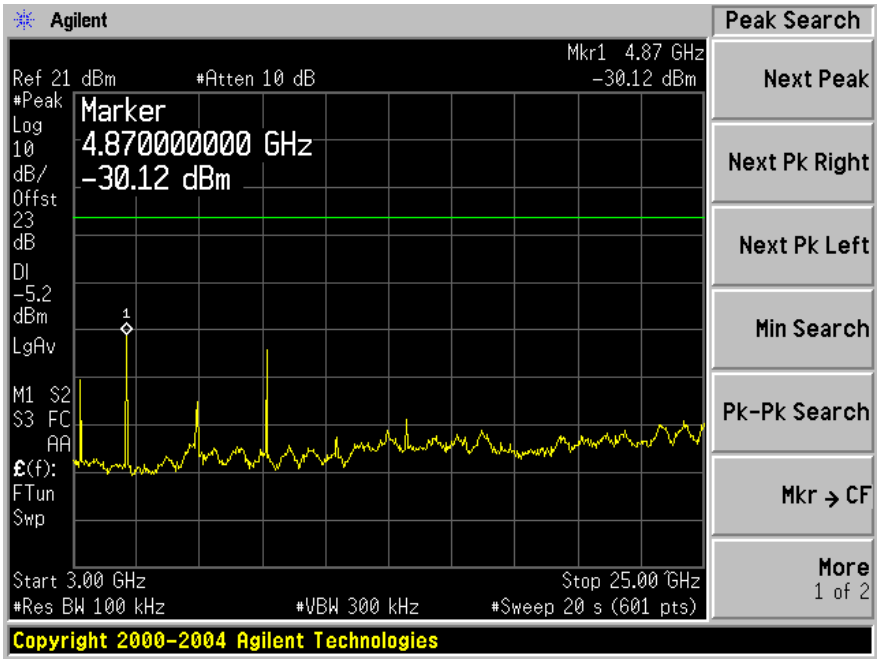
802.11 b, Low Channel 2412 MHz



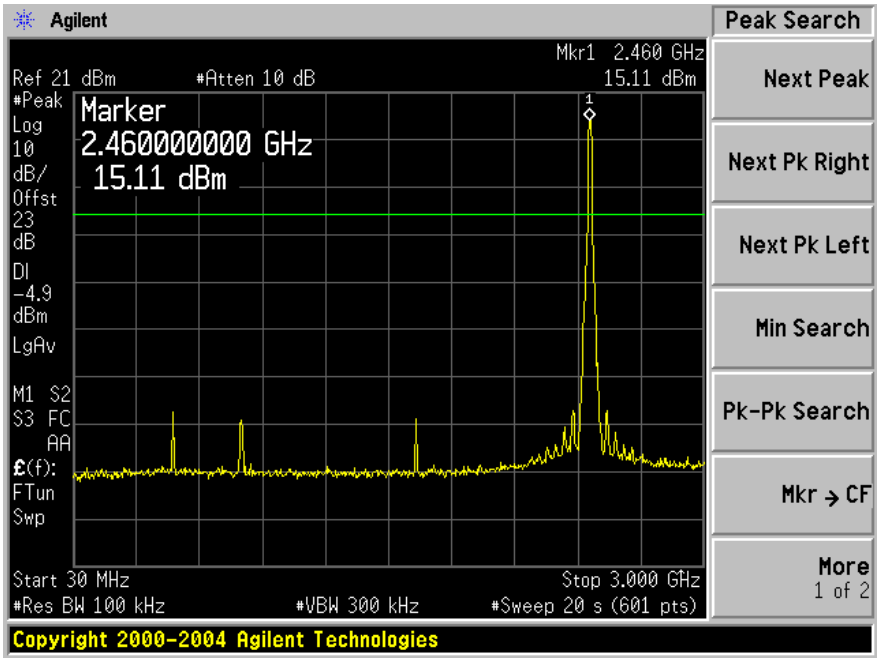


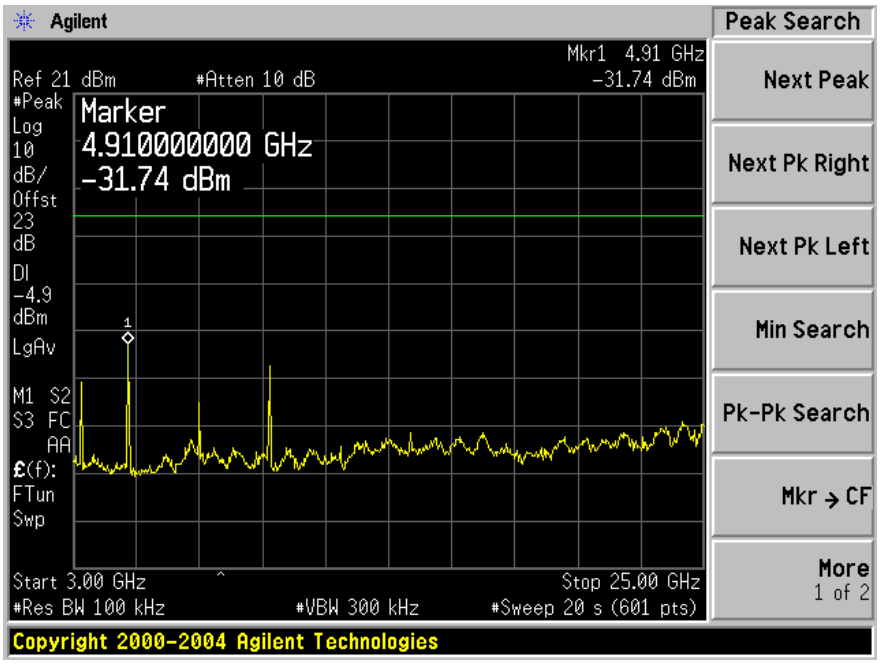
802.11 b, Middle Channel 2437 MHz



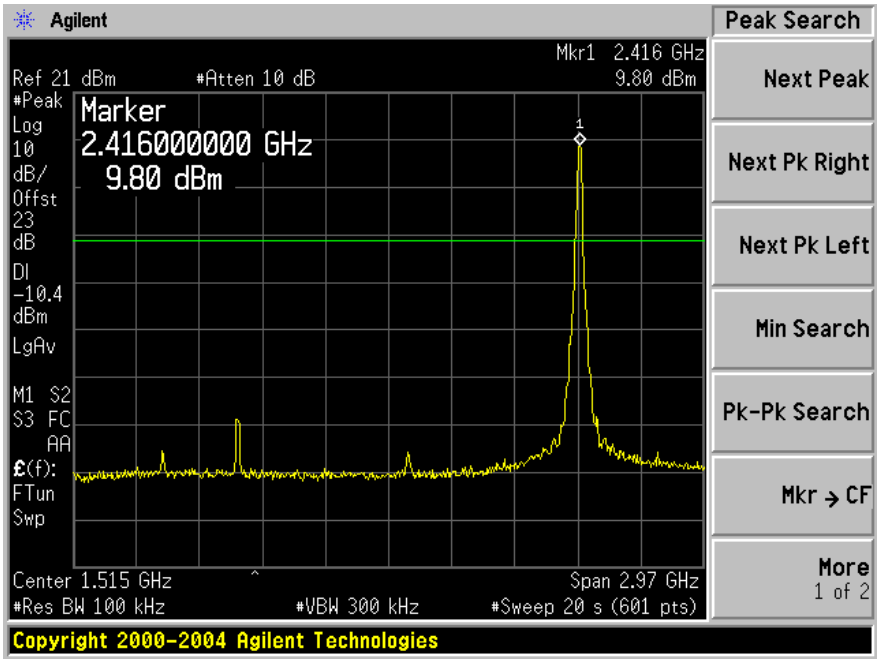


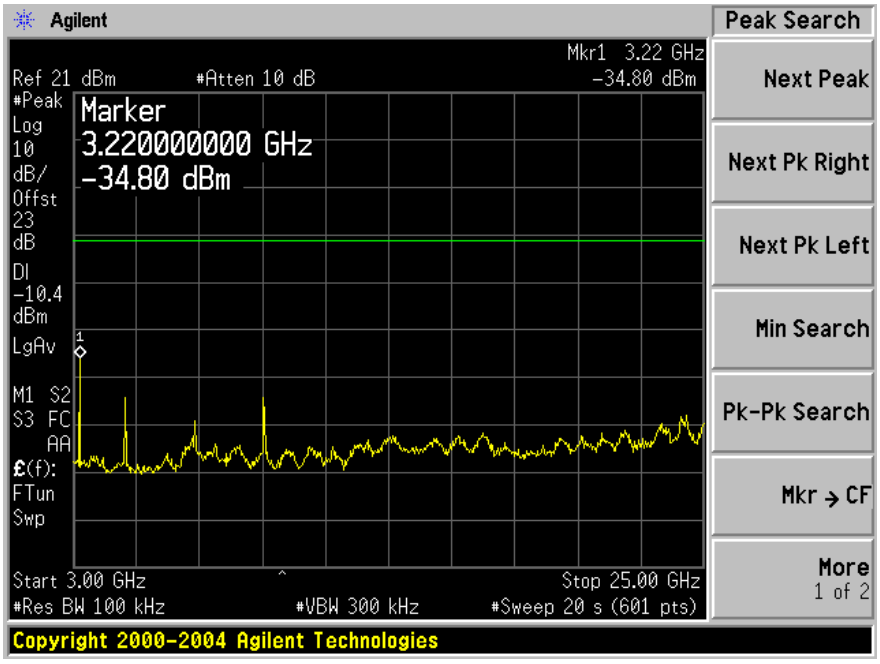
802.11 b, High Channel 2462 MHz



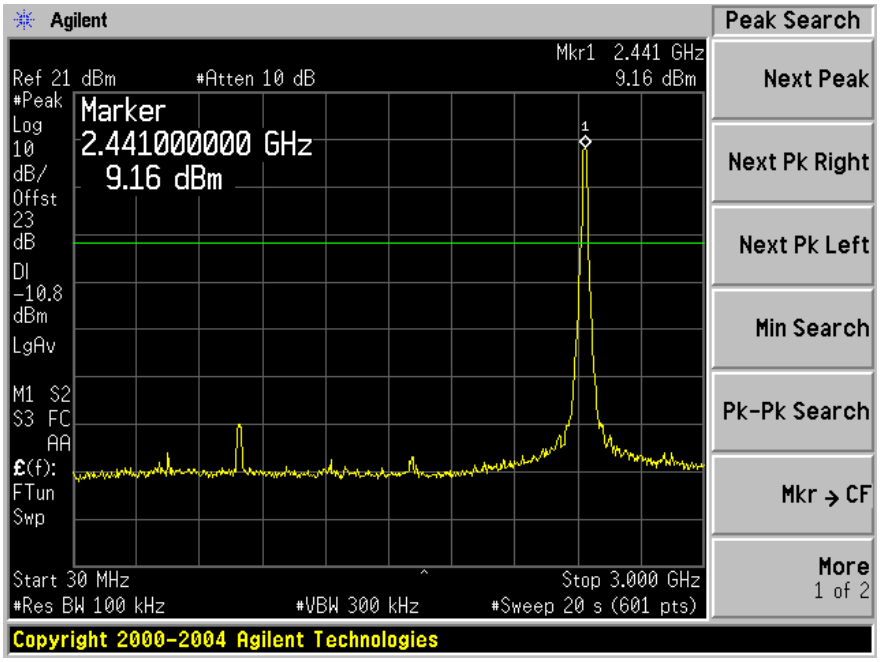


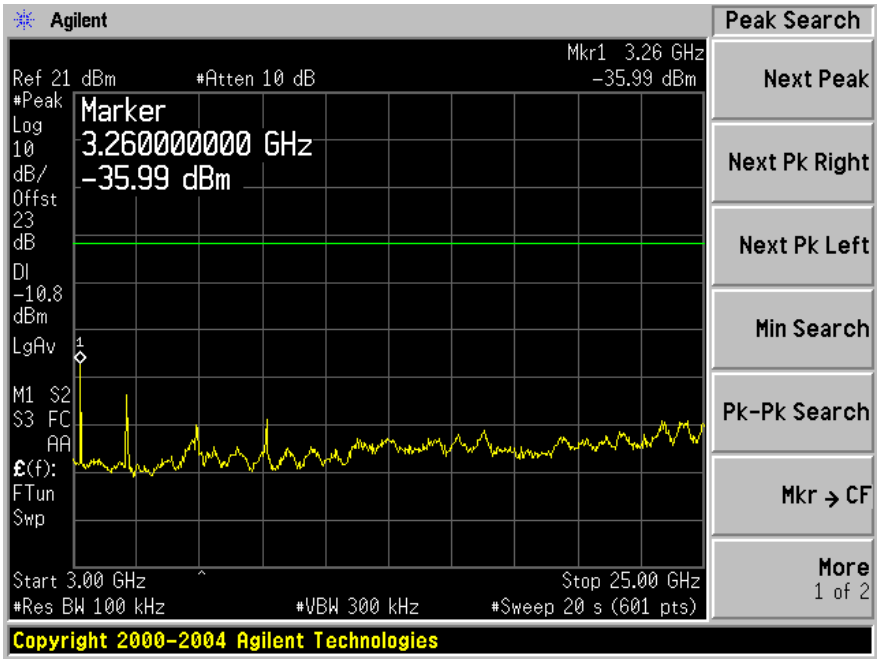
802.11 g, Low Channel 2412 MHz



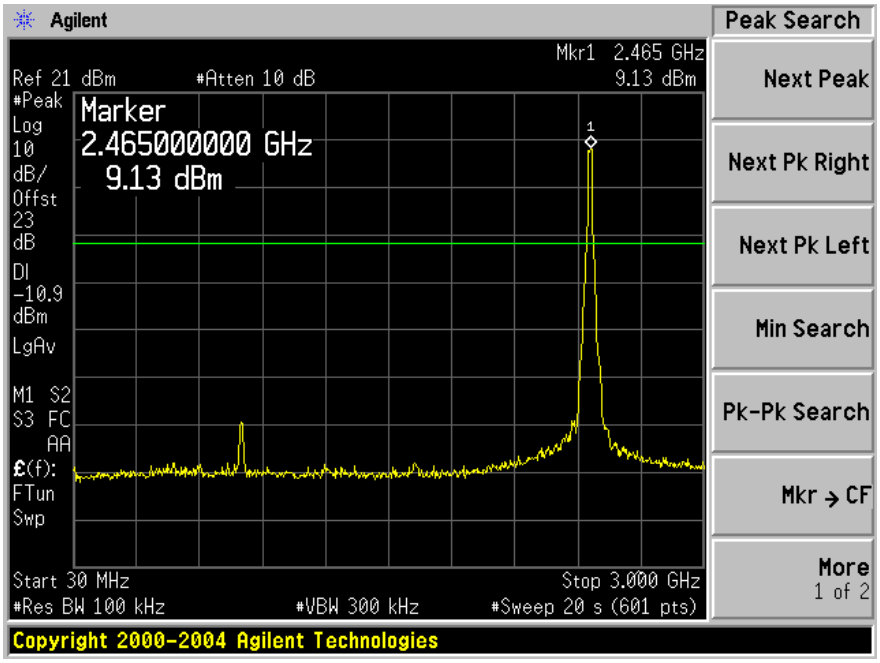


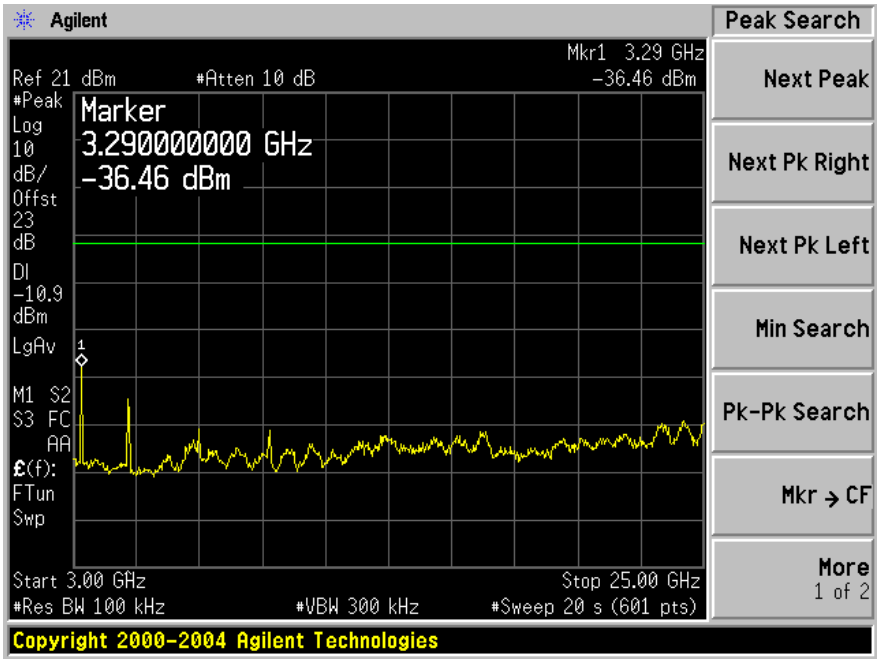
802.11 g, Middle Channel 2437 MHz



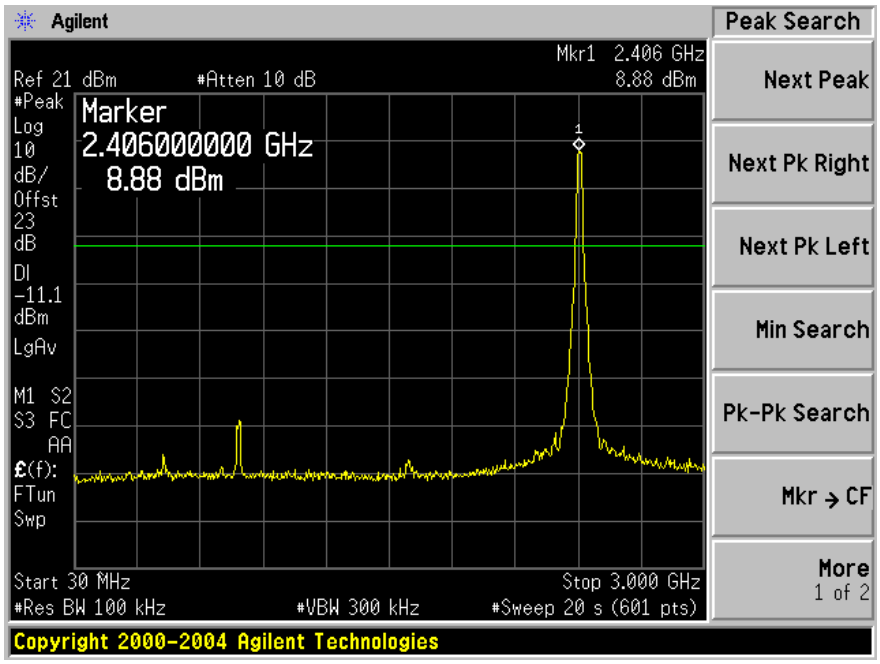


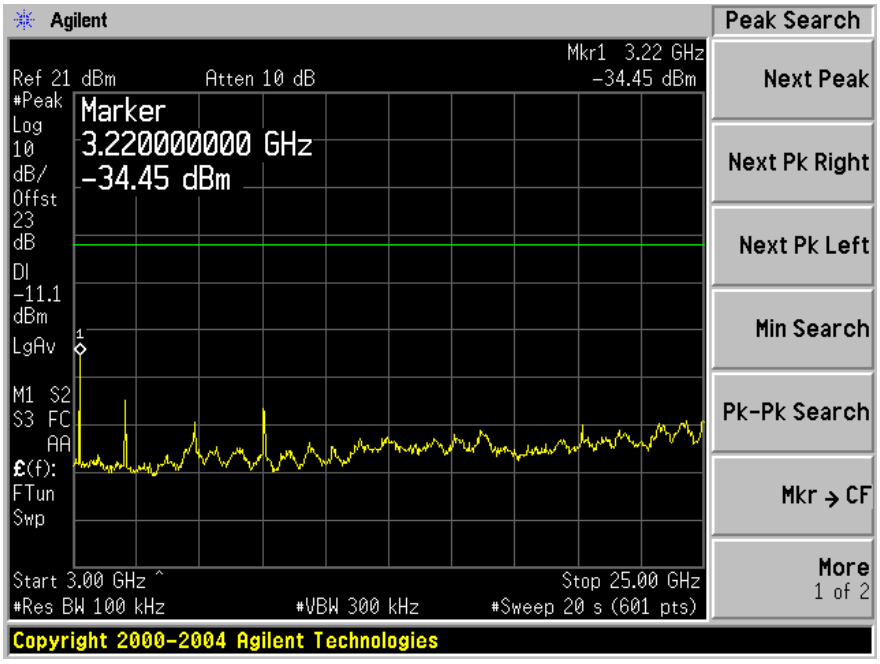
802.11 g, High Channel 2462 MHz



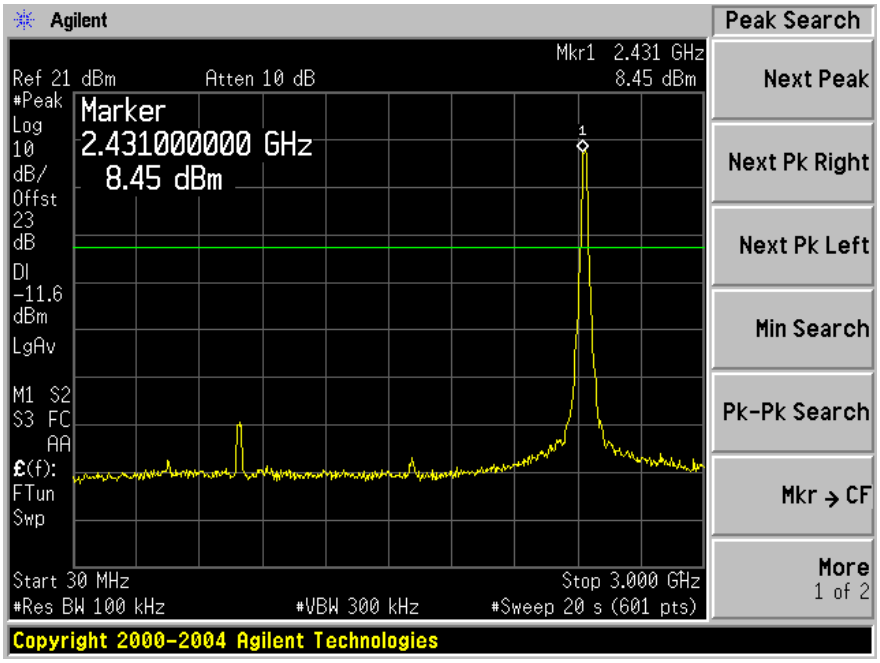


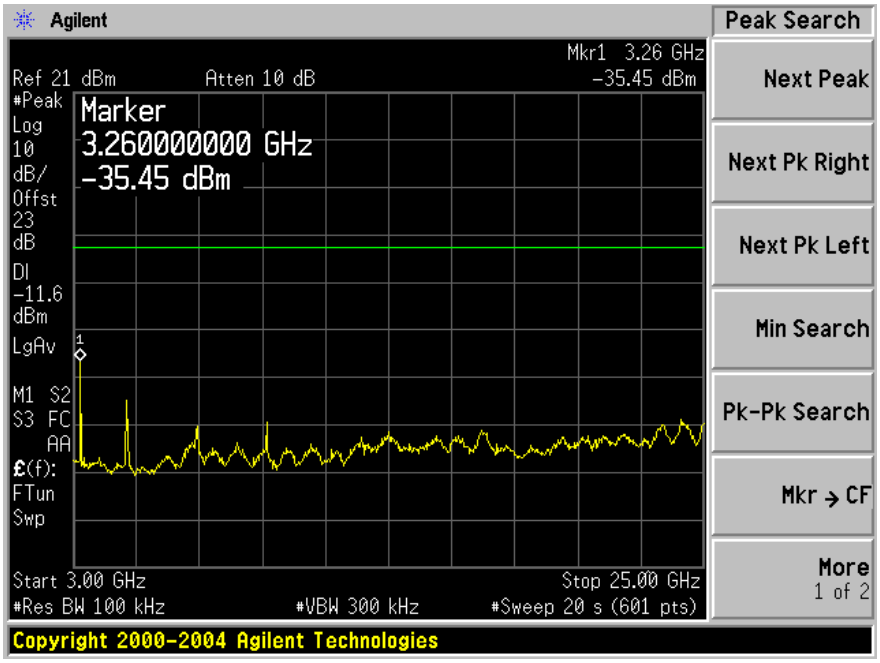
802.11 n20, Low Channel 2412 MHz



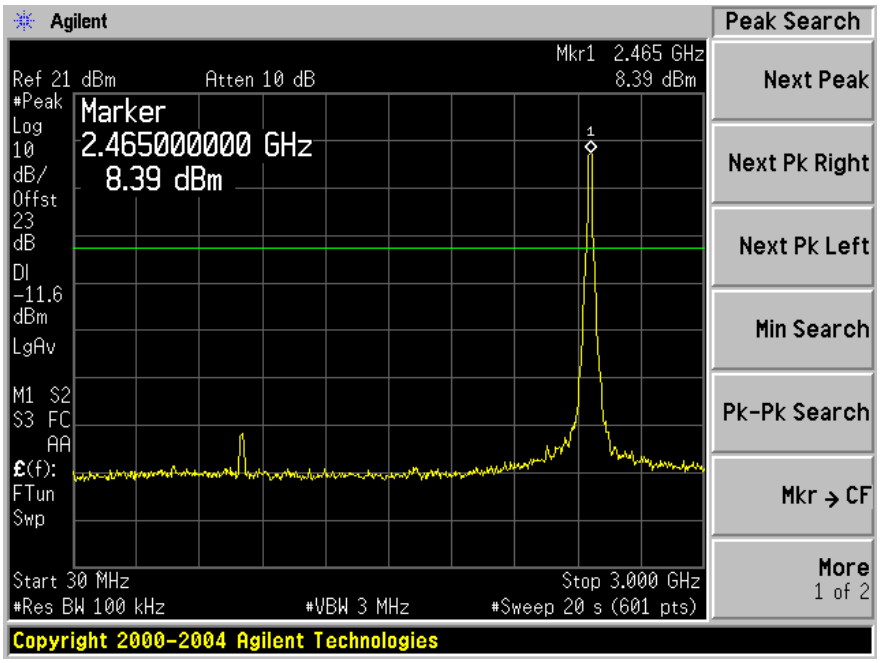


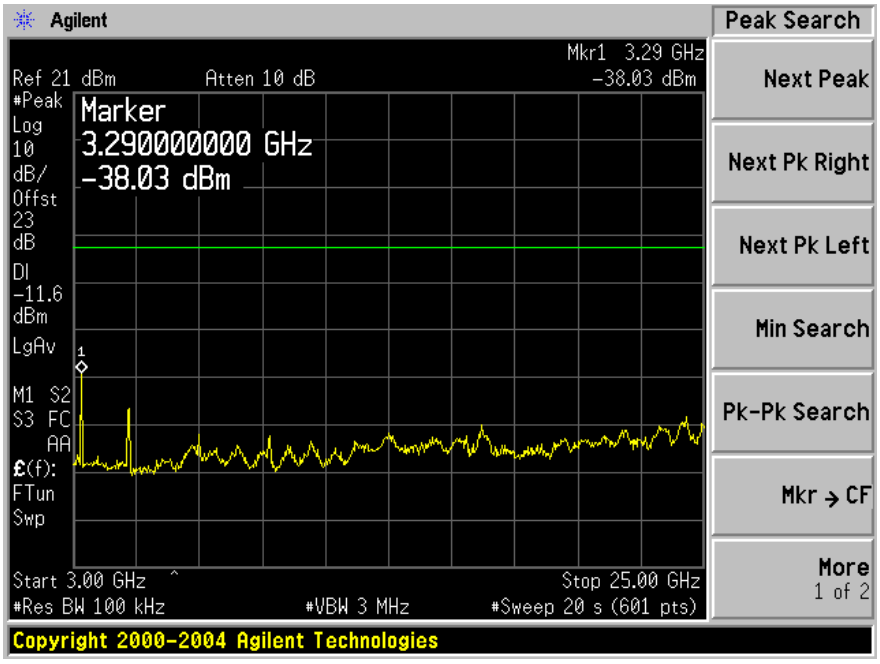
802.11 n20, Middle Channel 2437 MHz





802.11 n20, High Channel 2462 MHz





8 FCC §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:

f (MHz)	f (MHz)	f (MHz)	f (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 5-meter Chamber, 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 No.	Serial No.	Calibration Date
Documun	Pre amplifier	ALN-09173030-01	988251-0312	2009-03-04
HP	Pre amplifier	8447D	2944A06639	2009-06-05
Sunol Science Corp.	Combination Antenna	JB1 Antenna	A103105-3	2009-03-25
Agilent	Spectrum Analyzer	E4440A	MY44303352	2009-04-27
A. H. Systems	Antenna, Horn	SAS-200/571	261	2009-09-23

* **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 host, 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 meter, 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 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 -7 dB means the emission is 7 dB below the maximum limit.
The equation for margin calculation is as follows:

Margin = Corrected Amplitude - FCC Limit

8.7 Test Environmental Conditions

Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

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 mode:

30-1000 MHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-1.14	1000	Vertical	Low, 30 MHz – 1GHz

Above 1 GHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-3.11	4824	Vertical	Low, 1GHz – 25GHz
-4.30	4874	Vertical	Mid, 1GHz – 25GHz
-7.33	4924	Vertical	High, 1GHz – 25GHz

802.11 g mode:

30-1000 MHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-1.07	1000	Horizontal	Low, 30 MHz – 1GHz

Above 1 GHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-14.90	4824	Vertical	Low, 1GHz – 25GHz
-16.75	4874	Vertical	Mid, 1GHz – 25GHz
-17.41	4924	Vertical	High, 1GHz – 25GHz

802.11 n 20 mode:

30-1000 MHz

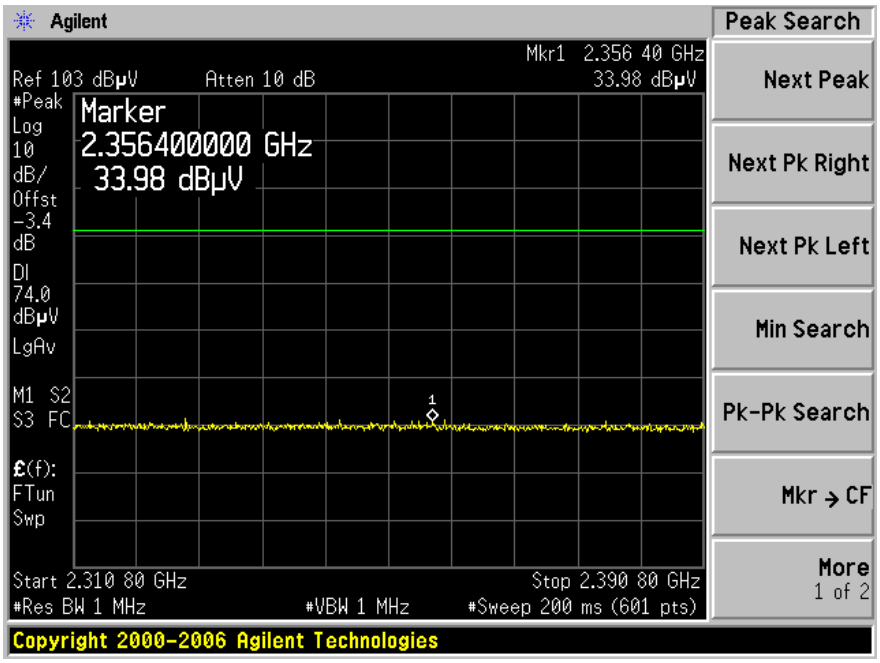
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-0.43	199.9871	Horizontal	Low, 30 MHz – 1GHz

Above 1 GHz

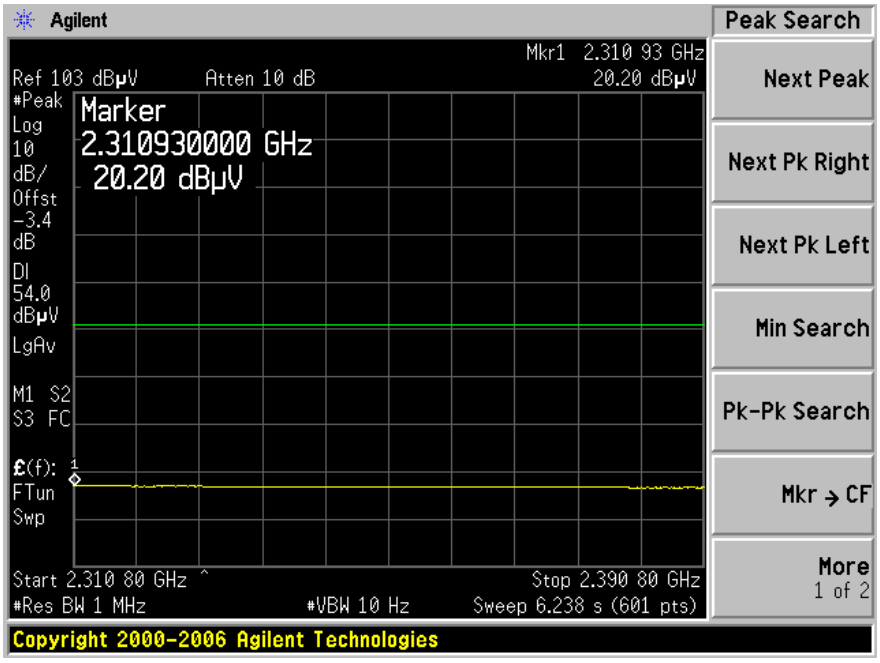
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-16.88	4824	Vertical	Low, 1GHz – 25GHz
-16.78	4874	Vertical	Mid, 1GHz – 25GHz
-18.44	4924	Vertical	High, 1GHz – 25GHz

Restricted Band Emissions

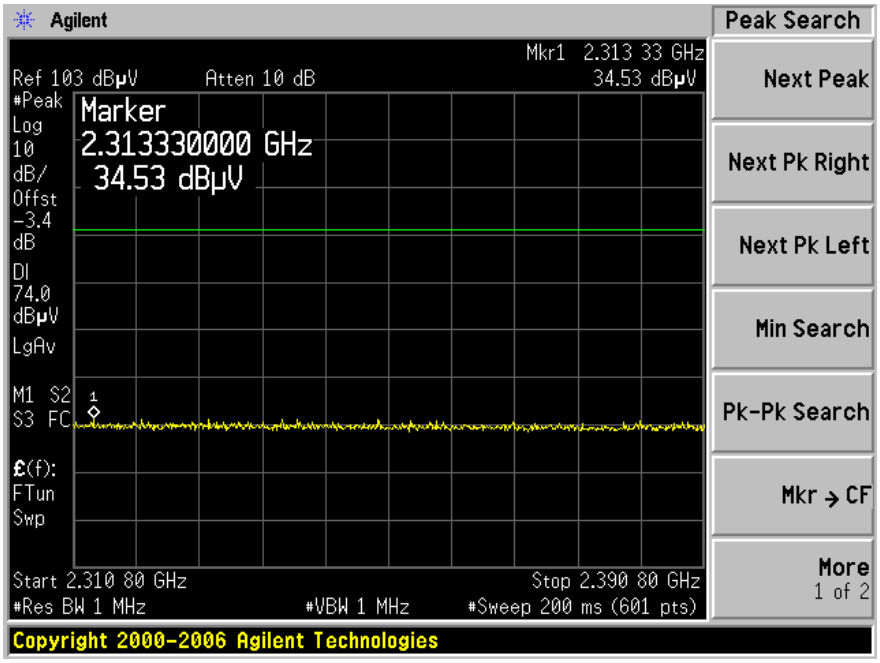
802.11 b, Lowest Channel at Horizontal, Peak



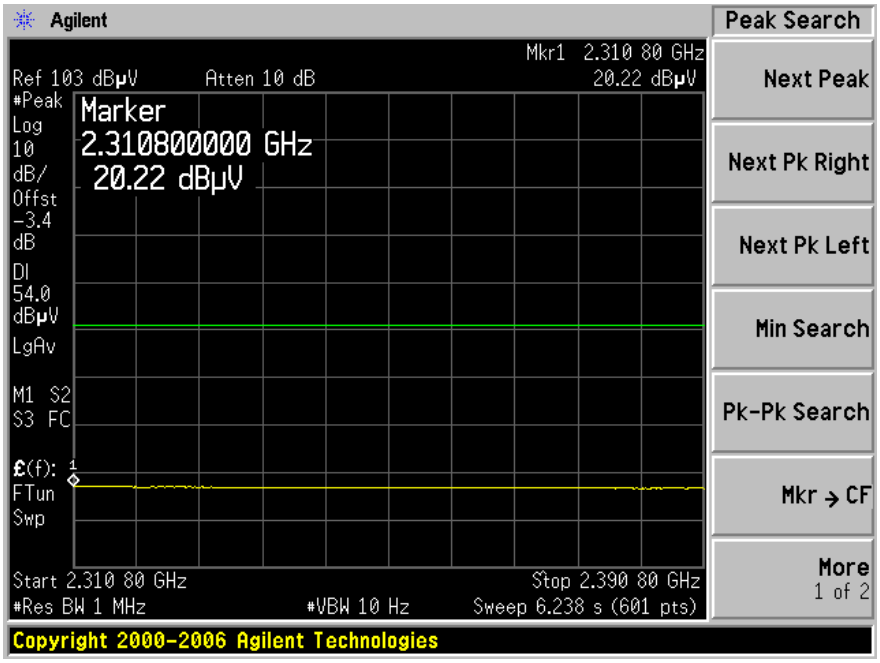
802.11b, Lowest Channel at Horizontal, Average



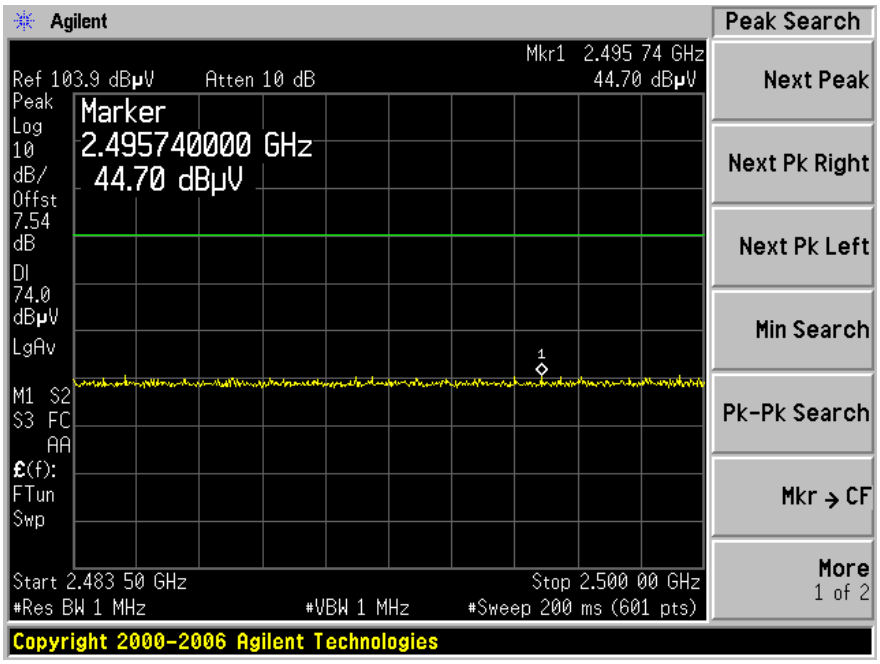
802.11b, Lowest Channel at Vertical, Peak



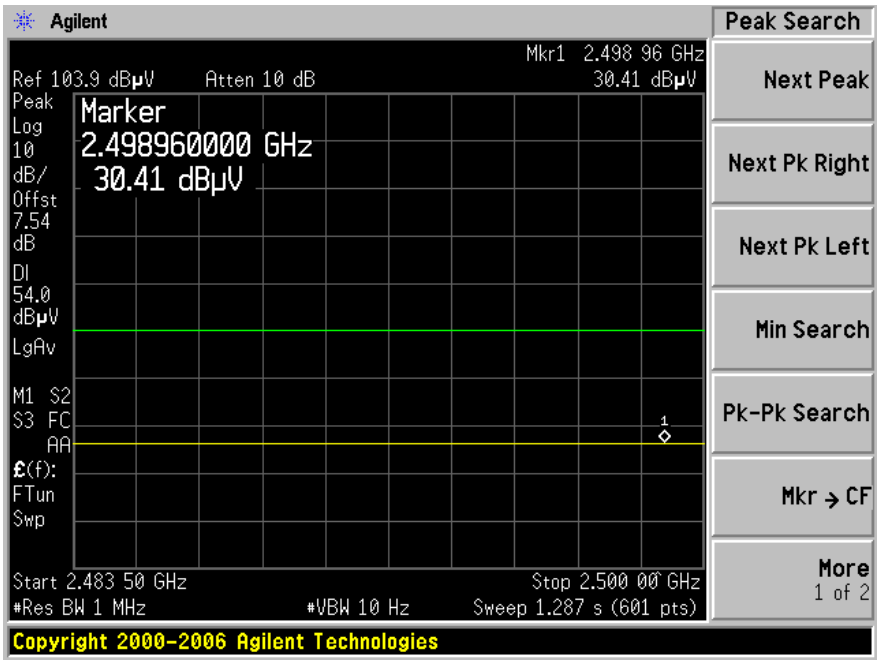
802.11b, Lowest Channel at Vertical, Average



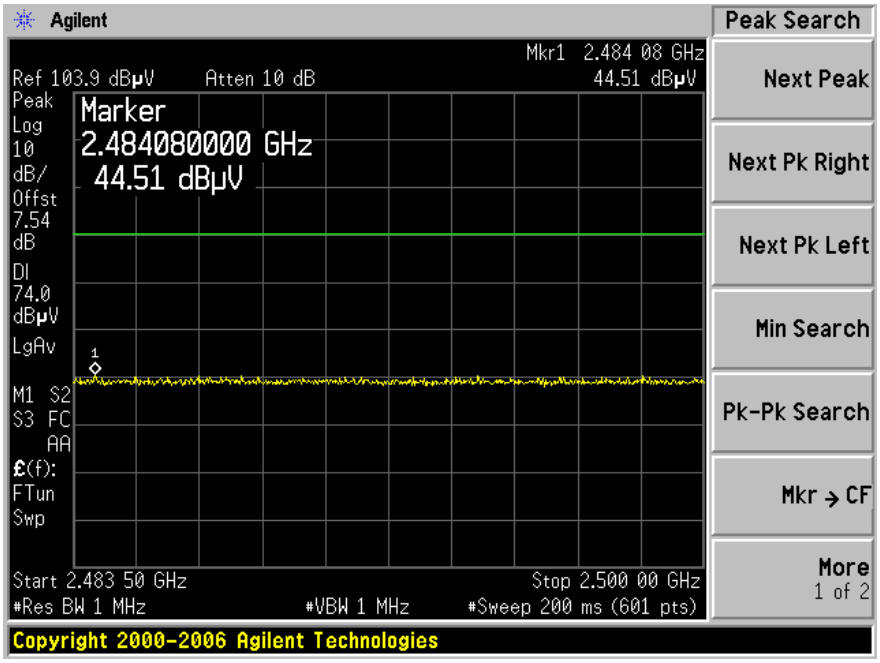
802.11b, Highest Channel at Horizontal, Peak



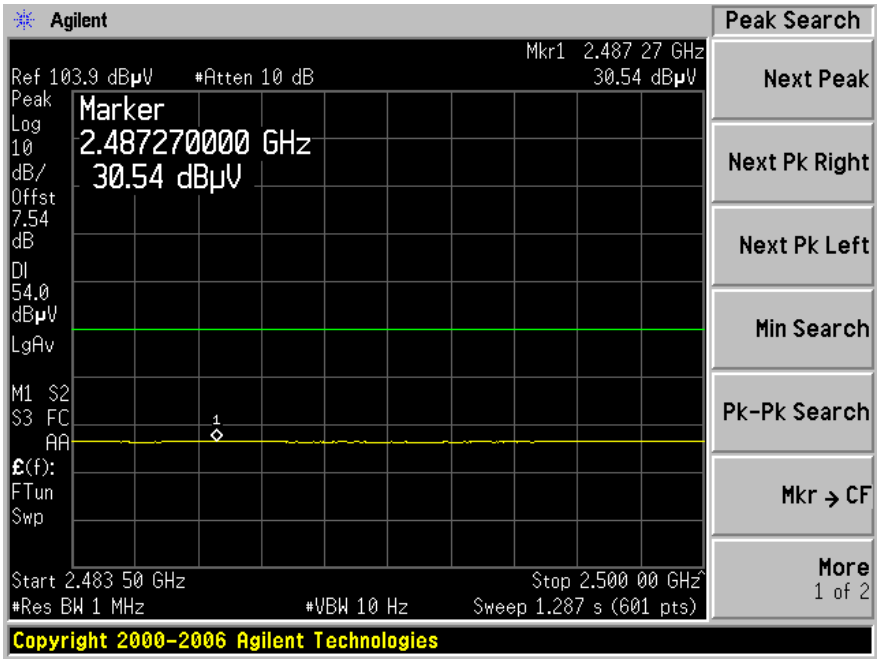
802.11b, Highest Channel at Horizontal, Average



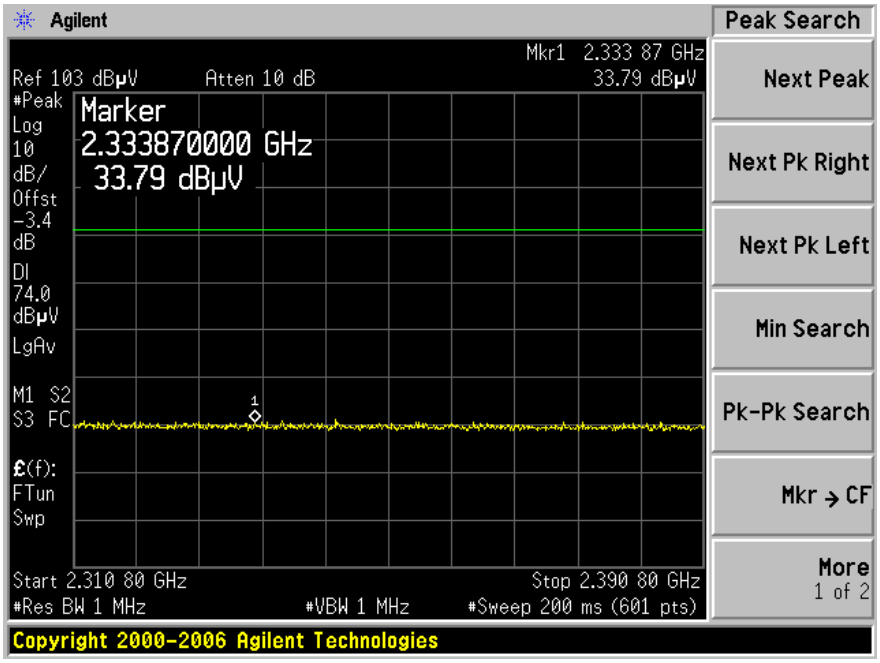
802.11b, Highest Channel at Vertical, Peak



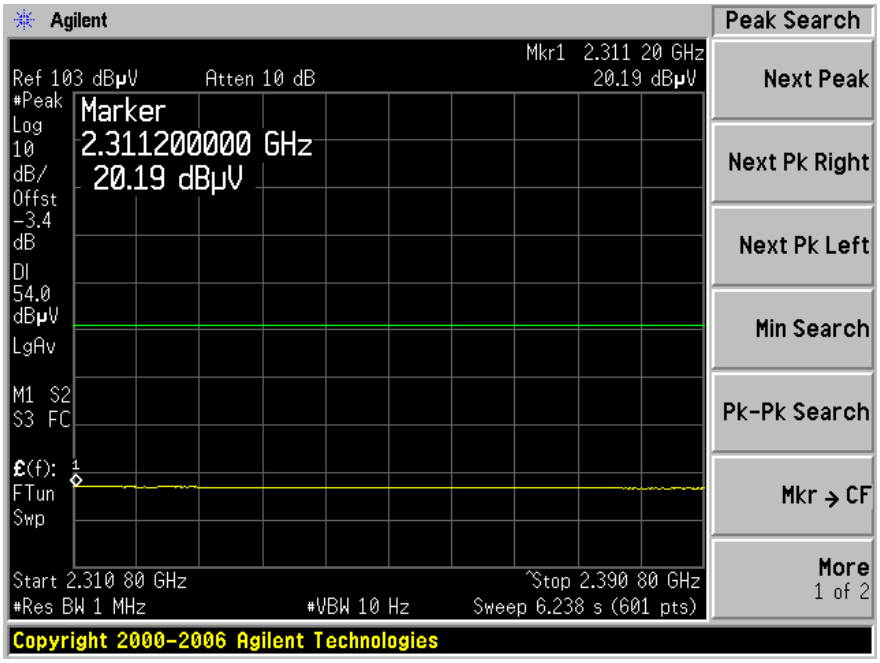
802.11b, Highest Channel at Vertical, Average



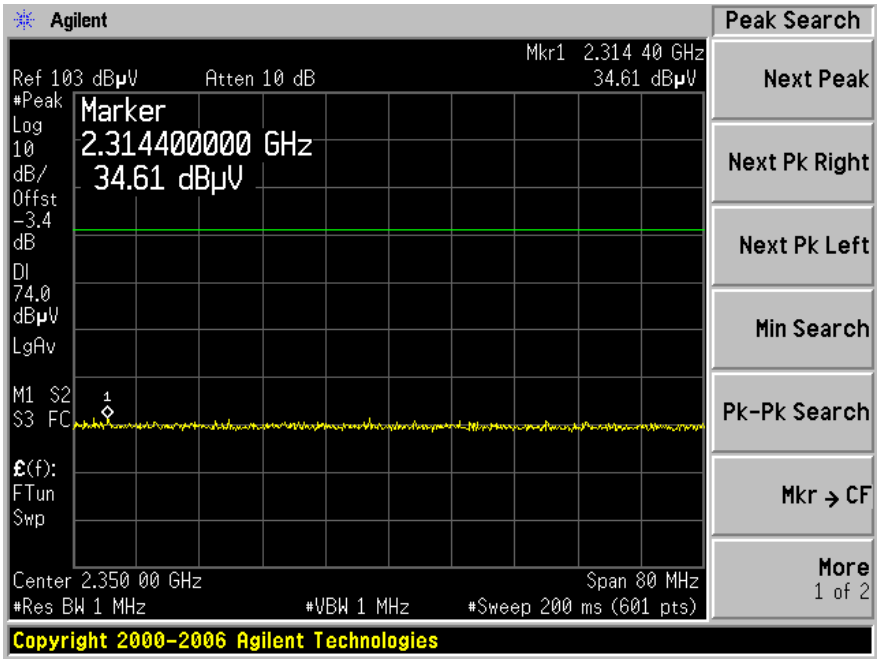
802.11 g, Lowest Channel at Horizontal, Peak



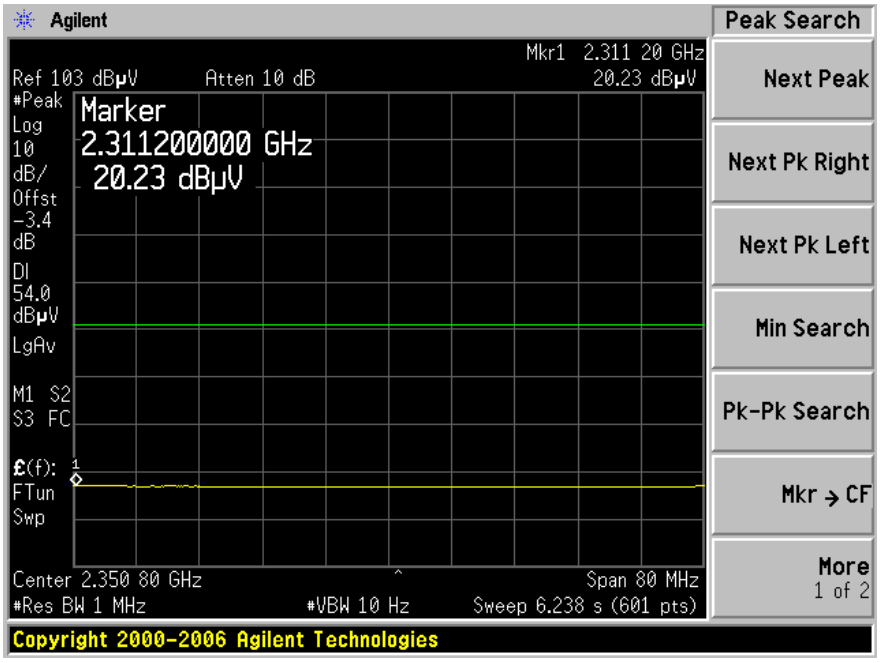
802.11g, Lowest Channel at Horizontal, Average



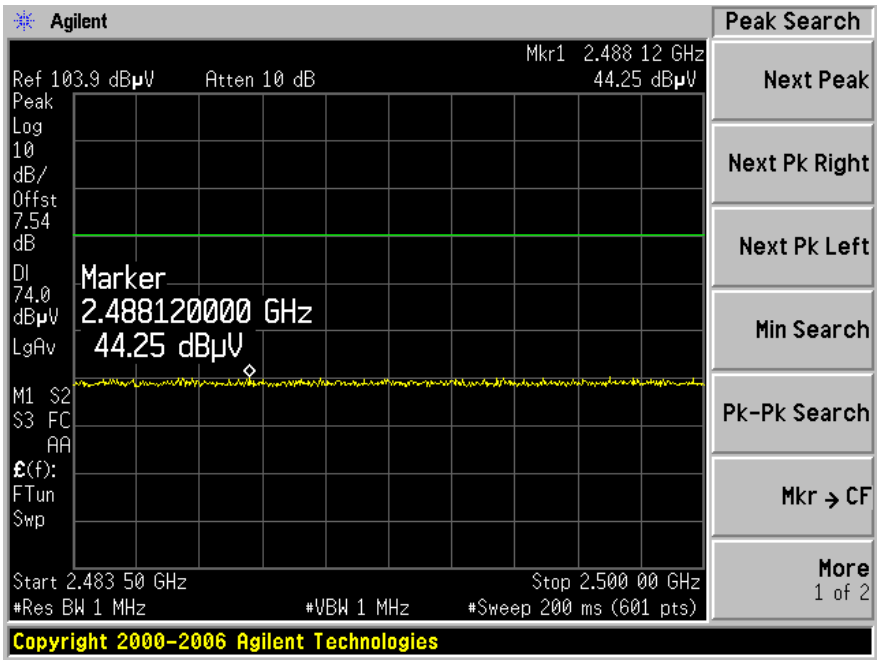
802.11g, Lowest Channel at Vertical, Peak



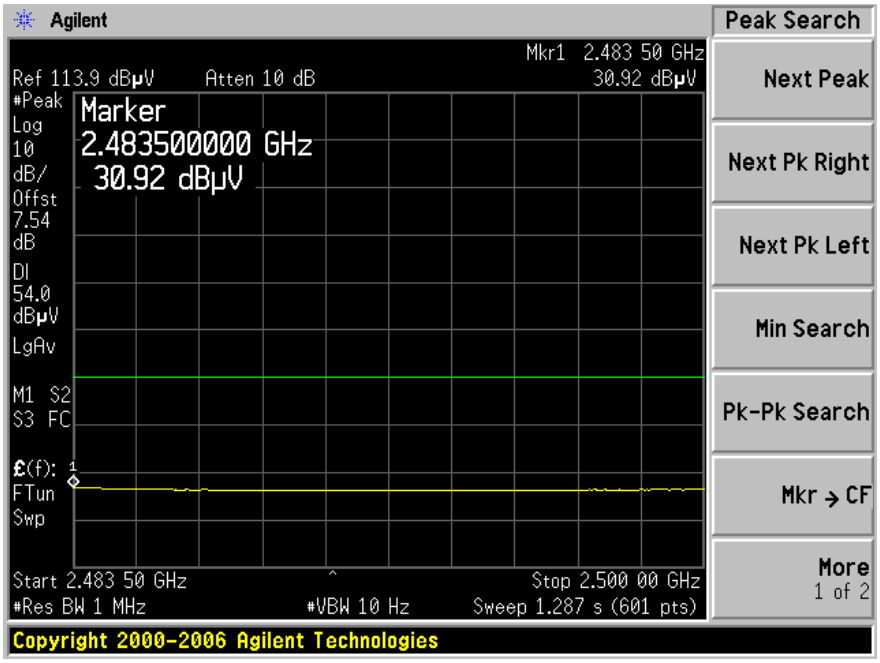
802.11g, Lowest Channel at Vertical, Average



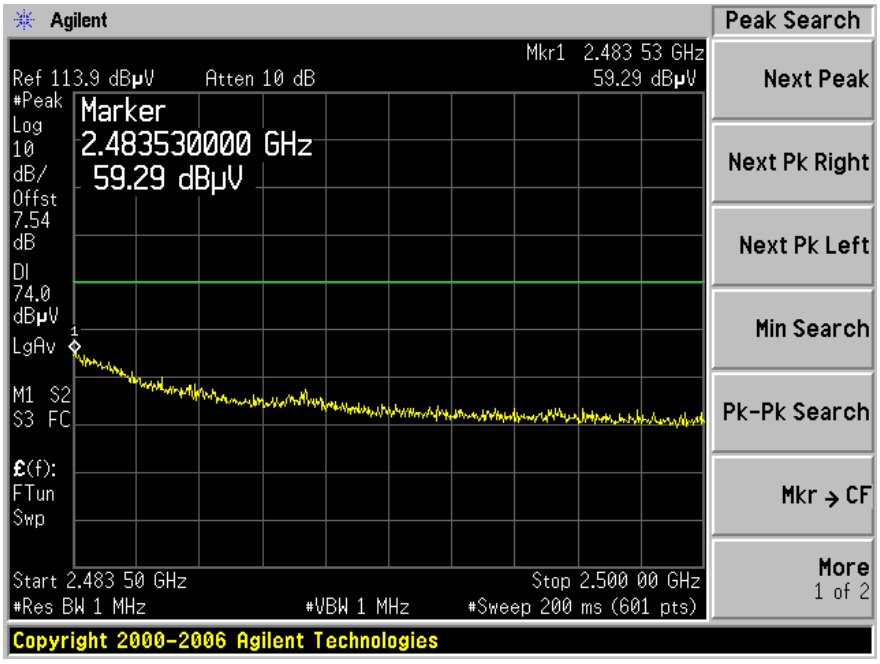
802.11g, Highest Channel at Horizontal, Peak



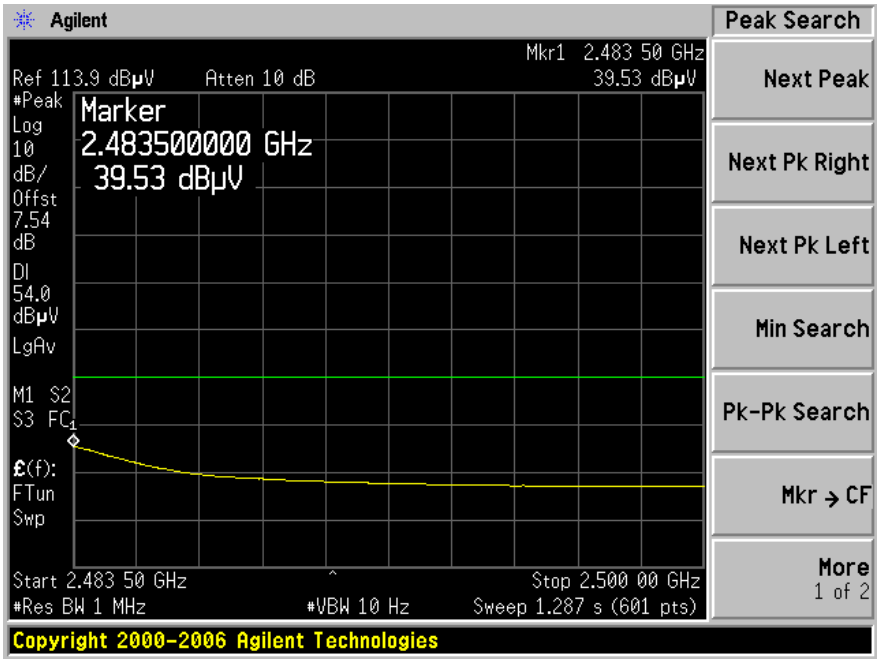
80.211g, Highest Channel at Horizontal, Average



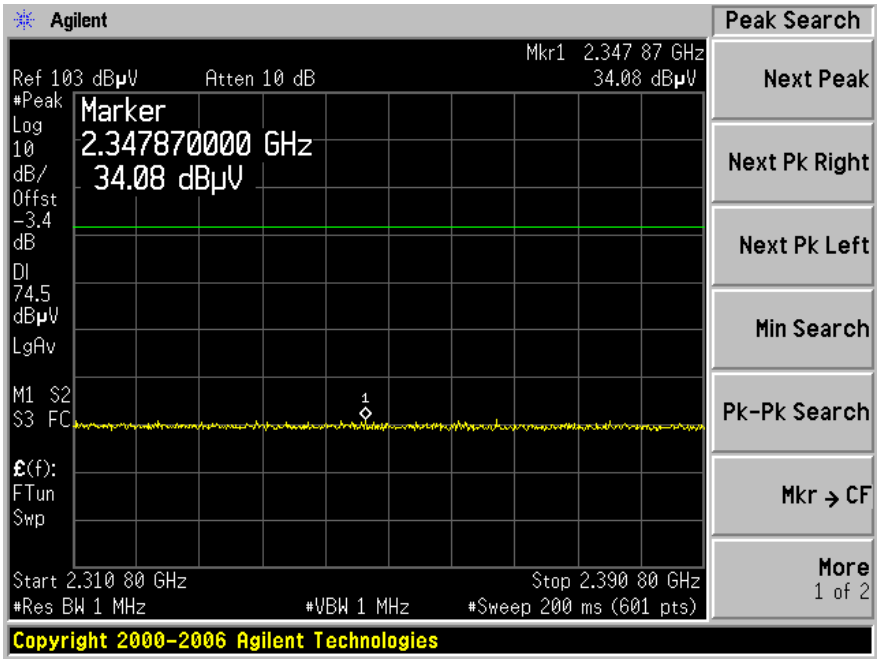
802.11g, Highest Channel at Vertical, Peak



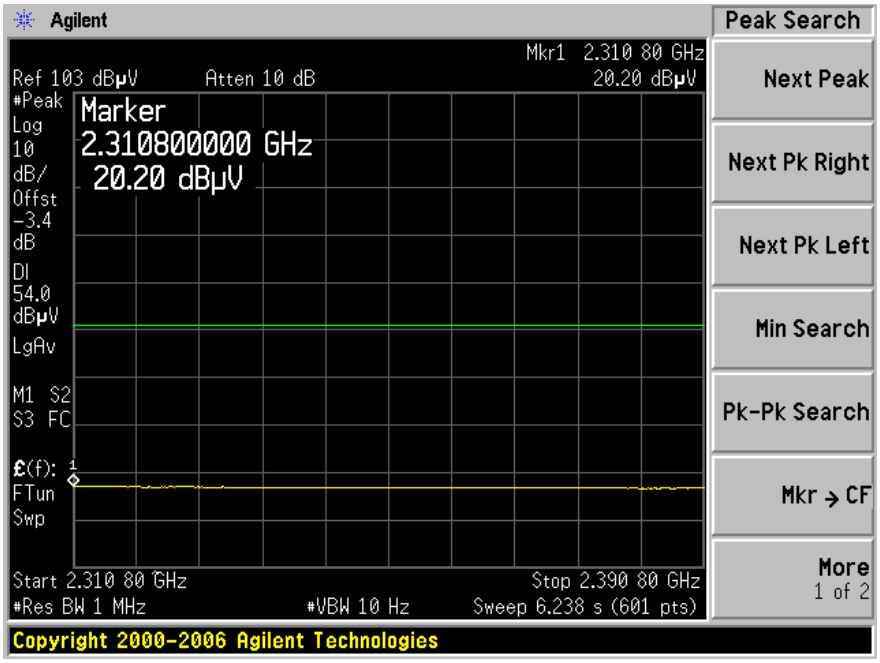
802.11g, Highest Channel at Vertical, Average



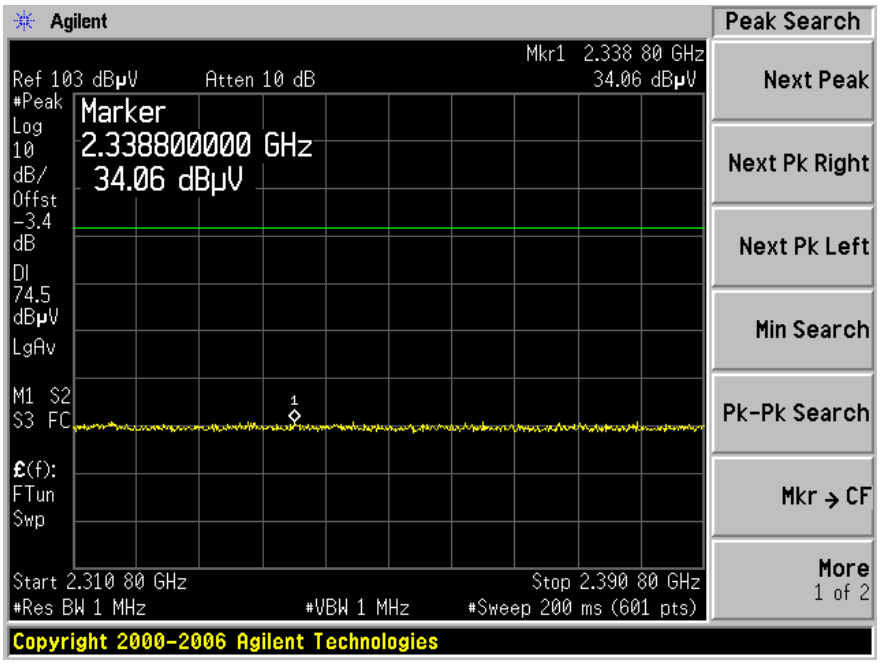
802.11 n20, Lowest Channel at Horizontal, Peak



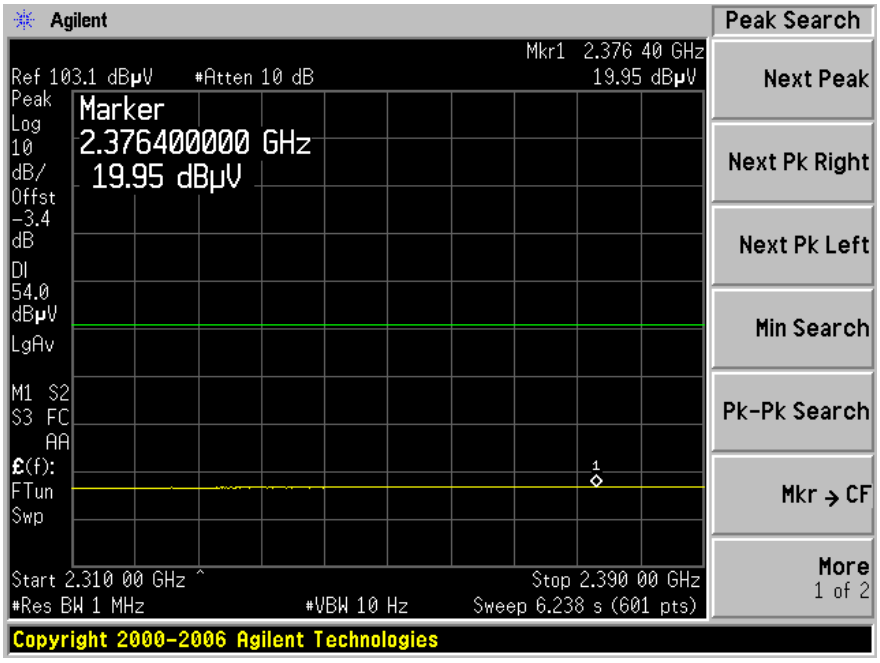
802.11n20, Lowest Channel at Horizontal, Average



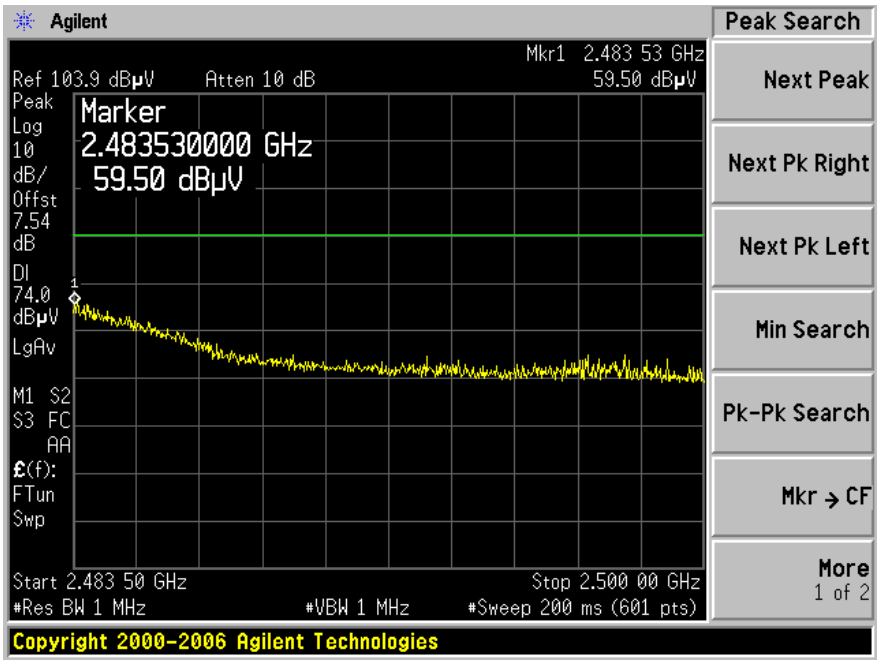
802.11n20, Lowest Channel at Vertical, Peak



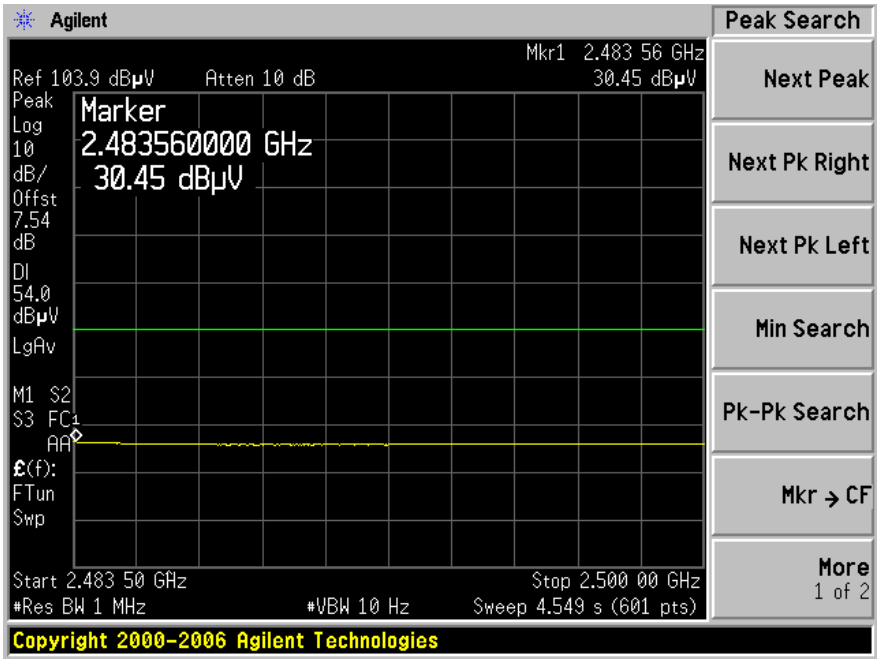
802.11n20, Lowest Channel at Vertical, Average



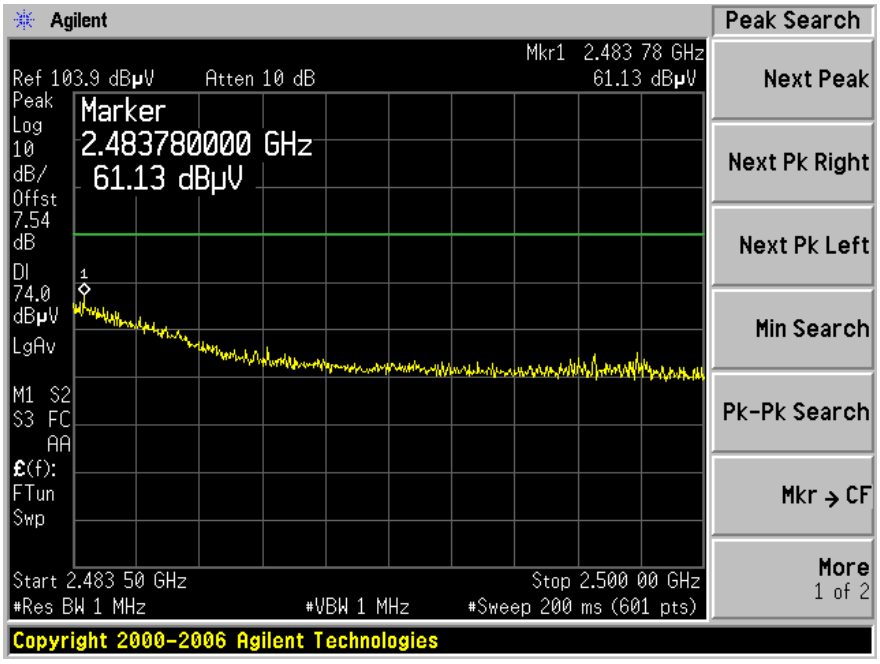
802.11n20, Highest Channel at Horizontal, Peak



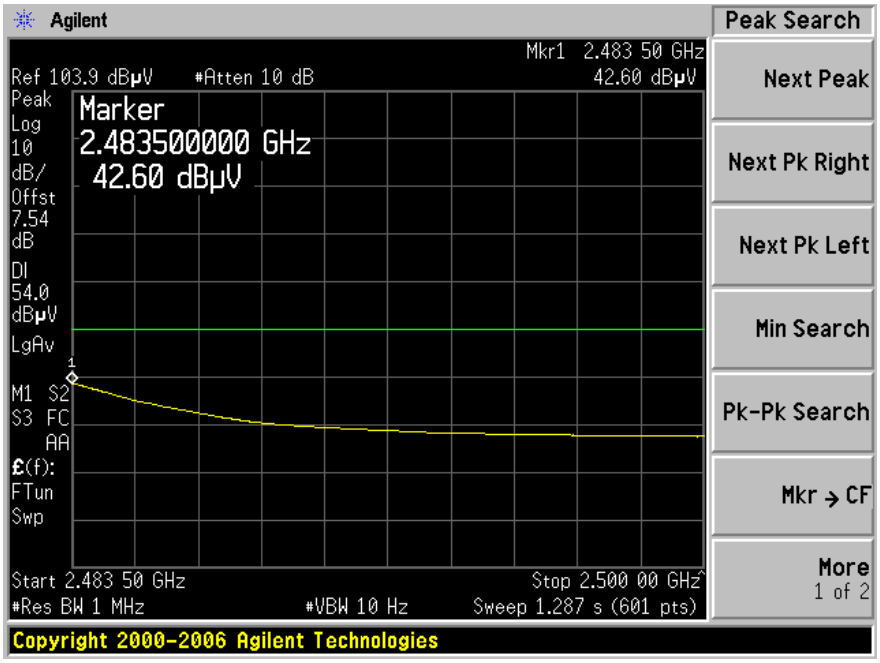
802.11n20, Highest Channel at Horizontal, Average



802.11n20, Highest Channel at Vertical, Peak



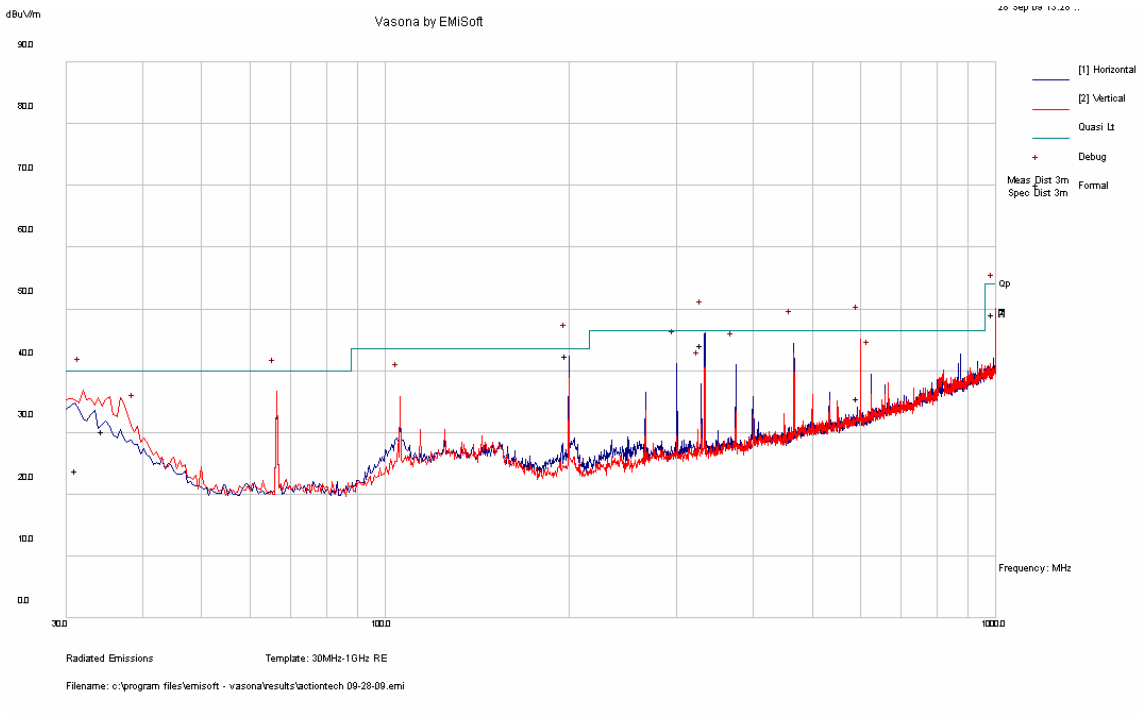
802.11n20, Highest Channel at Vertical, Average



8.9 Radiated Emissions Test plot & data:

802.11b Mode:

30 MHz – 1000 MHz: Worst Case, Low Channel 2412 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi-Peak (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
199.9886	42.36	191	H	122	43.5	-1.14
333.3726	43.76	98	H	310	46.0	-2.24
466.6985	42.88	198	H	20	46.0	-3.12
1000.000	48.74	102	V	18	54.0	-5.26
32.56180	28.94	114	V	274	40.0	-11.06
600.1548	32.63	182	V	248	54.0	-21.37

Above 1 GHz:

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

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4824	44.90	232	127	V	33.1	9.79	36.9	50.89	54	-3.11	Ave
4824	29.15	150	148	H	33.1	9.79	36.9	35.14	54	-18.86	Ave
4824	47.65	150	148	V	33.1	9.79	36.9	53.64	74	-20.36	Peak
4824	39.31	150	148	H	33.1	9.79	36.9	45.30	74	-28.70	Peak

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

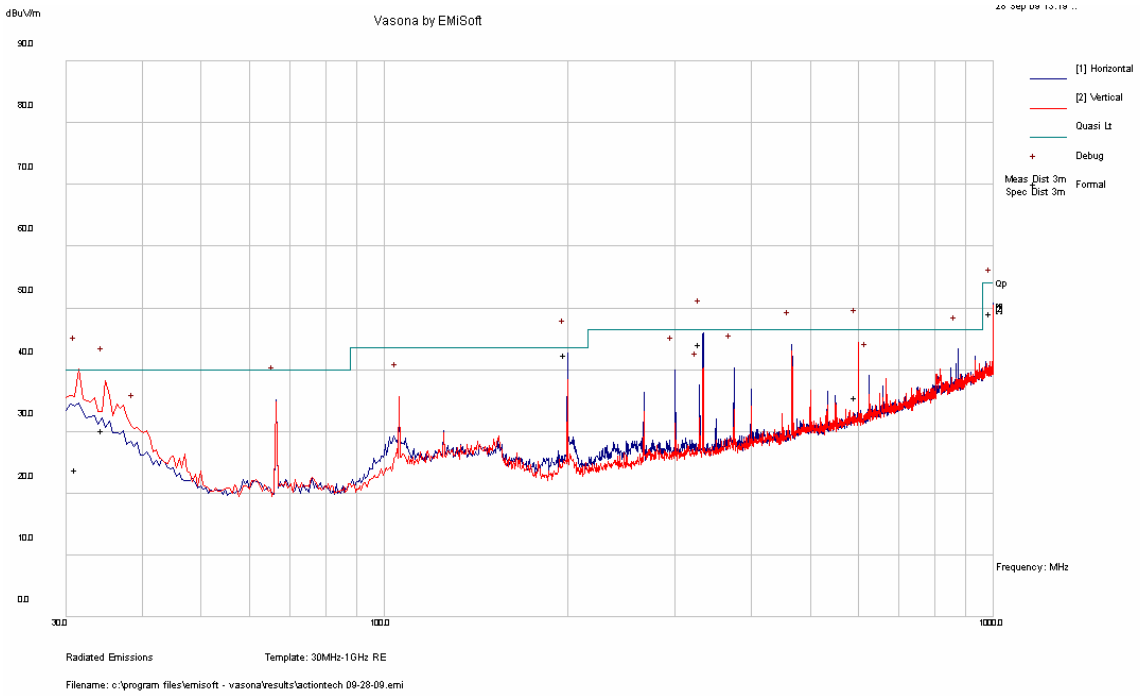
Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4874	43.75	227	140	V	33.1	9.75	36.9	49.70	54	-4.30	Ave
4872	30.29	304	120	H	33.1	9.75	36.9	36.24	54	-17.76	Ave
4874	46.82	227	140	V	33.1	9.75	36.9	52.77	74	-21.23	Peak
4874	38.74	304	120	H	33.1	9.75	36.9	44.69	74	-29.31	Peak

802.11 b, High channel 2462 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4924	40.72	222	141	V	33.1	9.75	36.9	46.67	54	-7.33	Ave
4924	30.52	12	140	H	33.1	9.75	36.9	36.47	54	-17.53	Ave
4924	45.31	222	141	V	33.1	9.75	36.9	51.26	74	-22.74	Peak
4924	39.51	12	140	H	33.1	9.75	36.9	45.46	74	-28.54	Peak

802.11 g Mode:

30 MHz – 1000 MHz: Worst Case, Low Channel 2412 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi-Peak (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
199.9816	42.43	169	H	120	43.5	-1.07
333.3714	44.19	111	H	308	46	-1.81
1000.000	49.19	98	H	298	54	-4.81
34.84136	30.26	110	V	174	40	-9.74
600.1591	35.58	98	V	282	46	-10.42
31.58652	23.86	111	V	46	40	-16.14

Above 1 GHz:

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

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4824	33.11	230	145	V	33.1	9.79	36.9	39.10	54	-14.90	Ave
4824	47.51	230	145	V	33.1	9.79	36.9	53.50	74	-20.50	Peak
4824	23.78	255	190	H	33.1	9.79	36.9	29.77	54	-24.23	Ave
4824	37.74	255	190	H	33.1	9.79	36.9	43.73	74	-30.27	Peak

802.11 g, Middle channel 2437 MHz measured at 3 meters

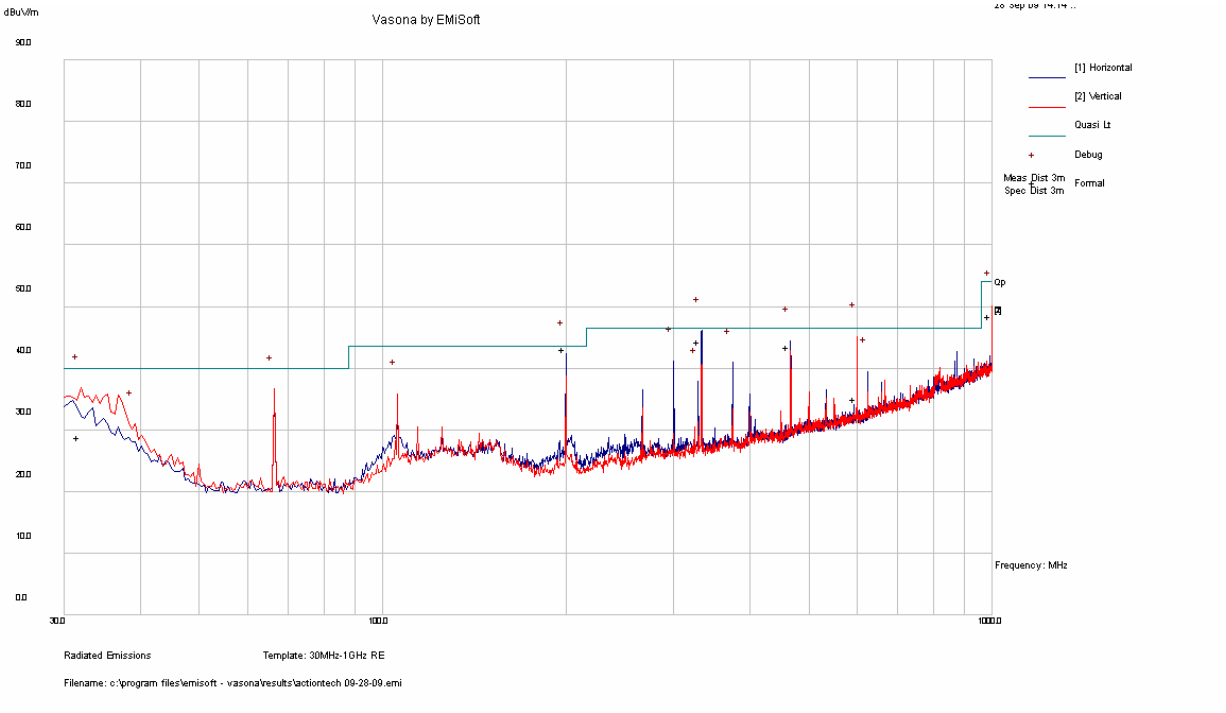
Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4874	31.30	293	143	V	33.1	9.75	36.9	37.25	54	-16.75	Ave
4874	45.04	293	143	V	33.1	9.75	36.9	50.99	74	-23.01	Peak
4872	23.72	183	125	H	33.1	9.75	36.9	29.67	54	-24.33	Ave
4874	37.19	183	125	H	33.1	9.75	36.9	43.14	74	-30.86	Peak

802.11 g, High channel 2462 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4924	30.64	227	125	V	33.1	9.75	36.9	36.59	54	-17.41	Ave
4924	45.43	227	125	V	33.1	9.75	36.9	51.38	74	-22.62	Peak
4924	24.01	180	124	H	33.1	9.75	36.9	29.96	54	-24.04	Ave
4924	38.28	180	124	H	33.1	9.75	36.9	44.23	74	-29.77	Peak

802.11 n20 Mode:

30 MHz – 1000 MHz: Worst Case, Low Channel 2412 MHz, measured at 3 meters



Frequency (MHz)	Corrected Quasi-Peak (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
199.9871	43.07	167	H	116	43.5	-0.43
333.3710	44.32	100	H	310	46	-1.68
466.6680	43.51	177	H	0	46	-2.49
1000.000	48.53	102	V	8	54	-5.47
600.1301	35.08	116	V	240	46	-10.92
32.08040	28.78	101	V	110	40	-11.22

Above 1 GHz:

802.11 n20, Low Channel 2412 MHz, measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4824	31.13	262	146	V	33.1	9.79	36.9	37.12	54	-16.88	Ave
4824	45.56	262	146	V	33.1	9.79	36.9	51.55	74	-22.45	Peak
4824	24.40	262	168	H	33.1	9.79	36.9	30.39	54	-23.61	Ave
4824	38.38	262	168	H	33.1	9.79	36.9	44.37	74	-29.63	Peak

802.11 n20, Middle channel 2437 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4874	31.27	232	140	V	33.1	9.75	36.9	37.22	54	-16.78	Ave
4874	45.30	232	140	V	33.1	9.75	36.9	51.25	74	-22.75	Peak
4872	23.63	283	145	H	33.1	9.75	36.9	29.58	54	-24.42	Ave
4874	37.61	283	145	H	33.1	9.75	36.9	43.56	74	-30.44	Peak

802.11 n20, High channel 2462 MHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4924	29.61	225	150	V	33.1	9.75	36.9	35.56	54	-18.44	Ave
4924	23.30	262	178	H	33.1	9.75	36.9	29.25	54	-24.75	Ave
4924	43.14	225	150	V	33.1	9.75	36.9	49.09	74	-24.91	Peak
4924	36.81	262	178	H	33.1	9.75	36.9	42.76	74	-31.24	Peak

9 FCC §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 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2009-07-23

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

9.4 Test Environmental Conditions

Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

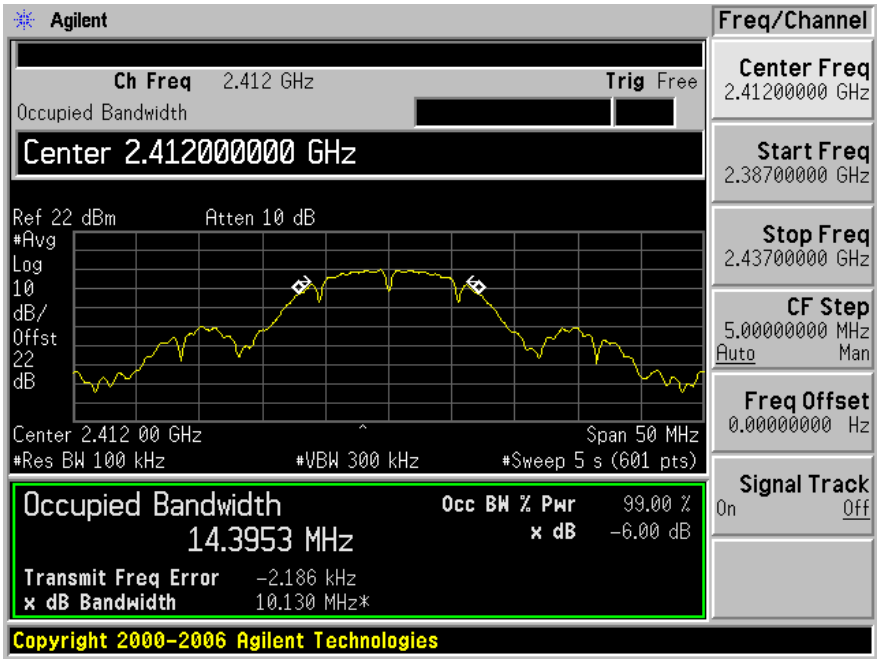
**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

9.5 Summary of Test Results

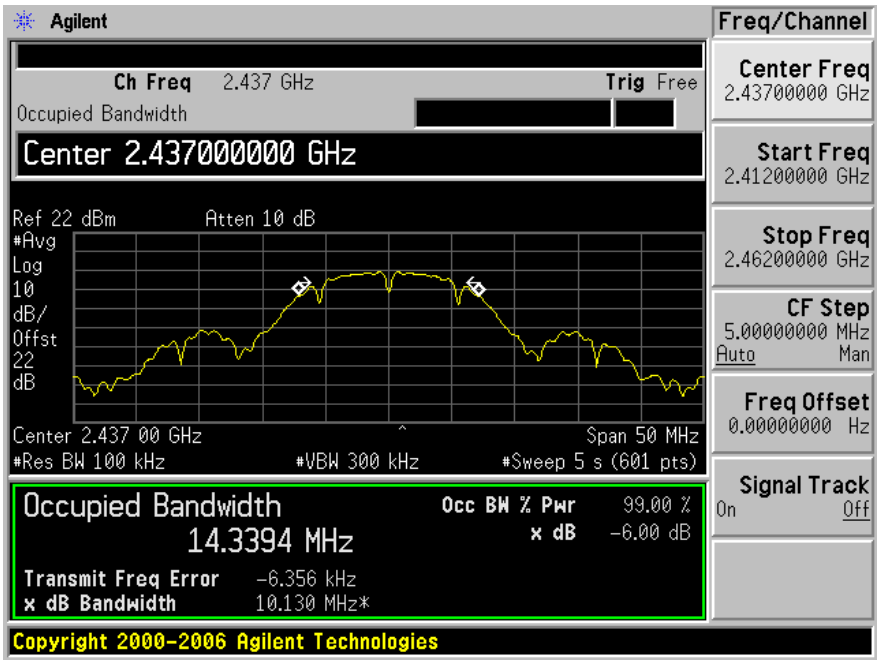
Radio Mode	Channel	Frequency (MHz)	6 dB Channel Bandwidth (MHz)	99% Bandwidth (MHz)	Limit (MHz)	Results
802.11 b	Low	2412	10.130	14.3953	> 0.5	Compliant
	Middle	2437	10.130	14.3394	> 0.5	Compliant
	High	2462	10.133	14.2848	> 0.5	Compliant
802.11 g	Low	2412	16.593	16.8518	> 0.5	Compliant
	Middle	2437	16.598	16.6856	> 0.5	Compliant
	High	2462	16.595	16.5925	> 0.5	Compliant
802.11 n20	Low	2412	17.821	17.9538	> 0.5	Compliant
	Middle	2437	17.815	17.8570	> 0.5	Compliant
	High	2462	17.823	17.8120	> 0.5	Compliant

Please refer to the following plots for detailed test results

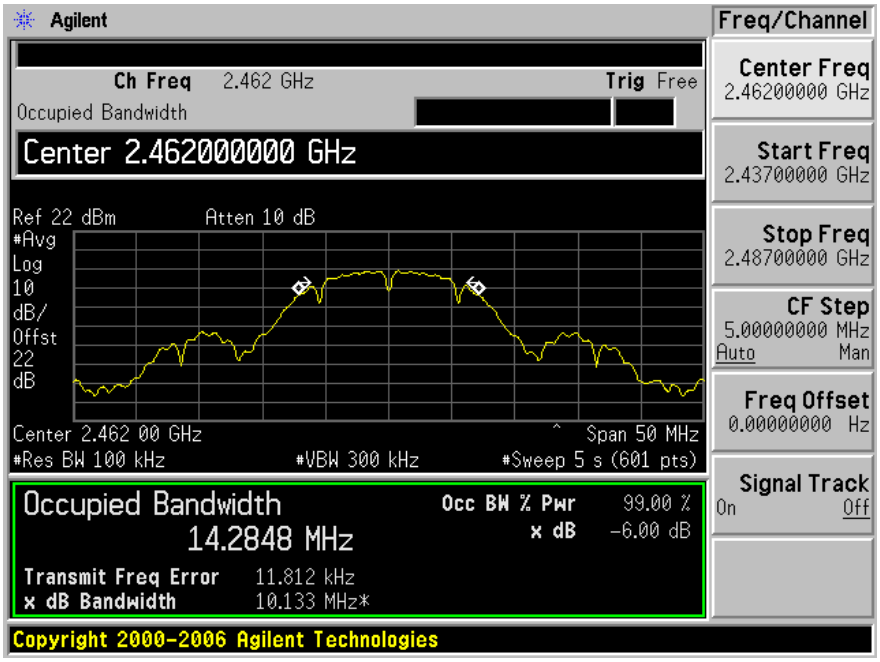
802.11b, Low Channel 2412 MHz



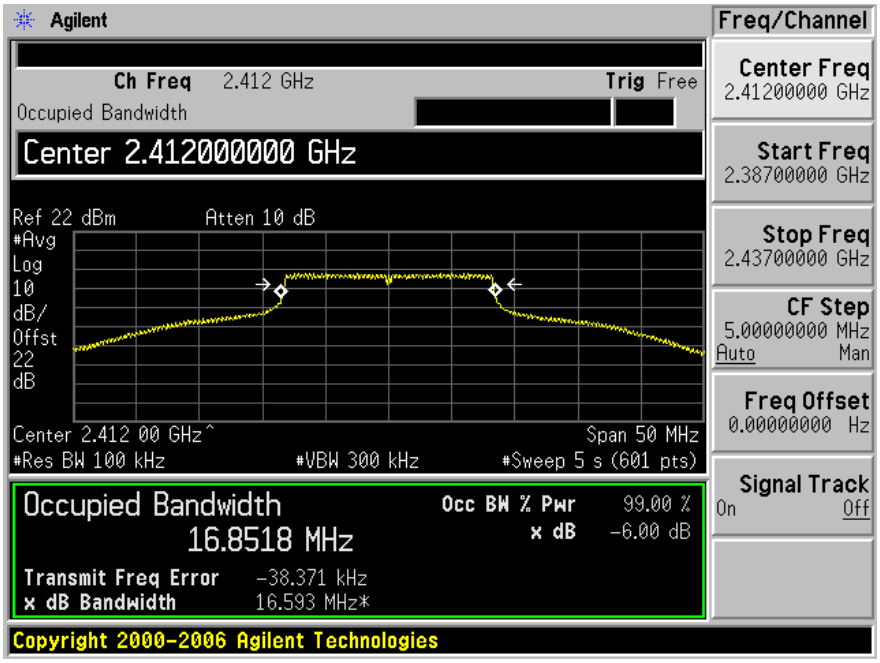
802.11b, Middle Channel 2437 MHz



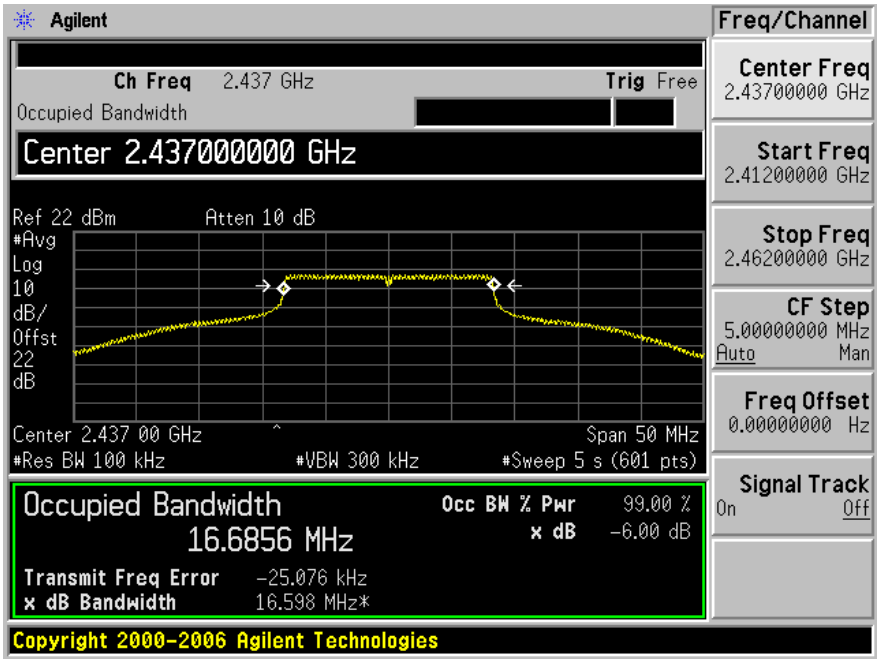
802.11b, High Channel 2462 MHz



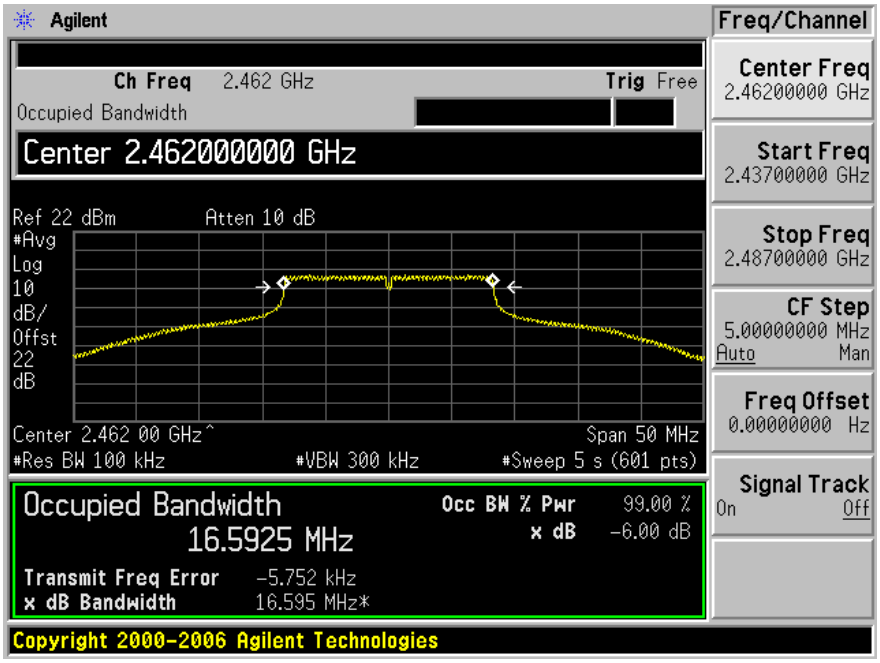
802.11 g, Low Channel 2412 MHz



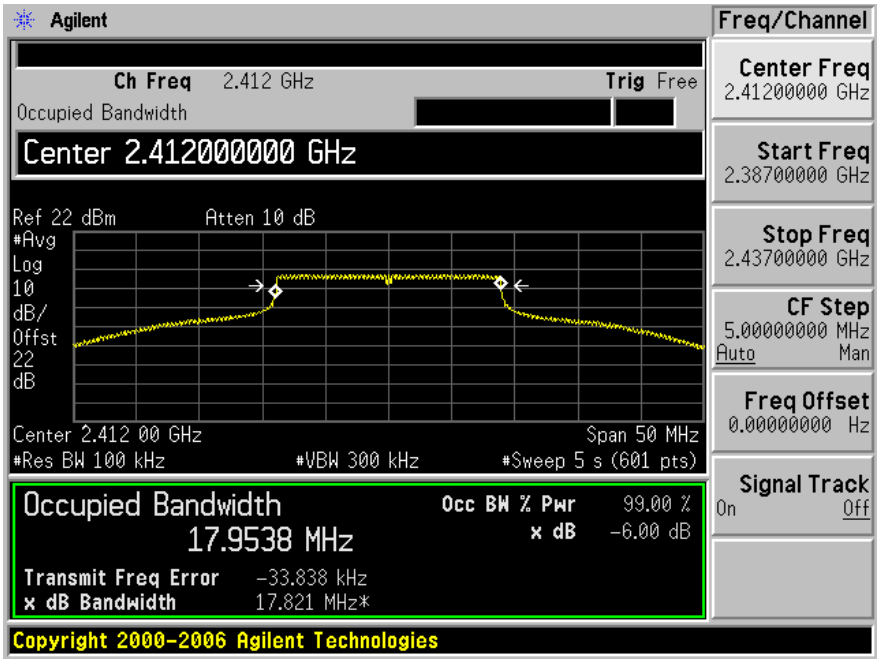
802.11g, Middle Channel 2437 MHz



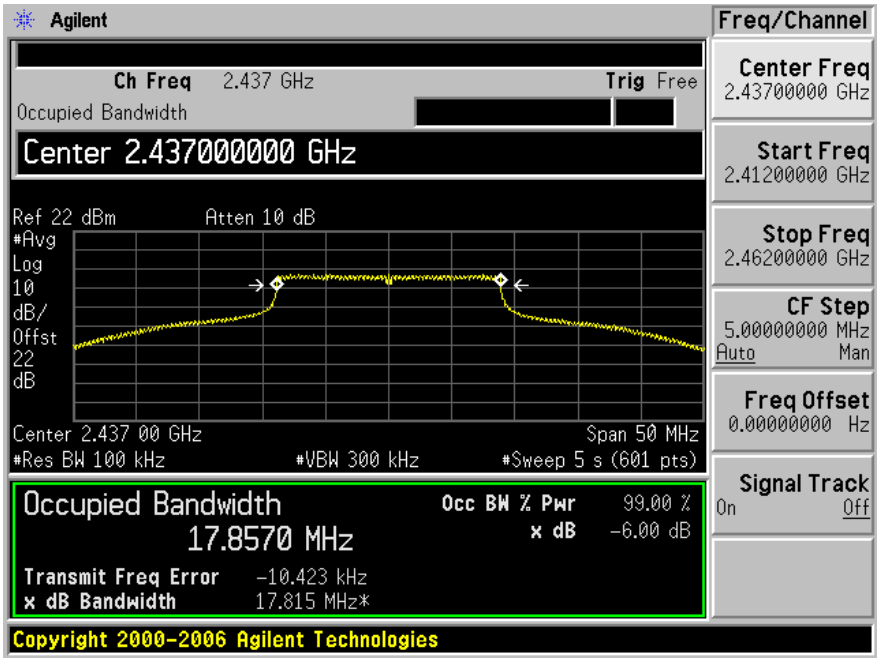
802.11g, High Channel 2462 MHz



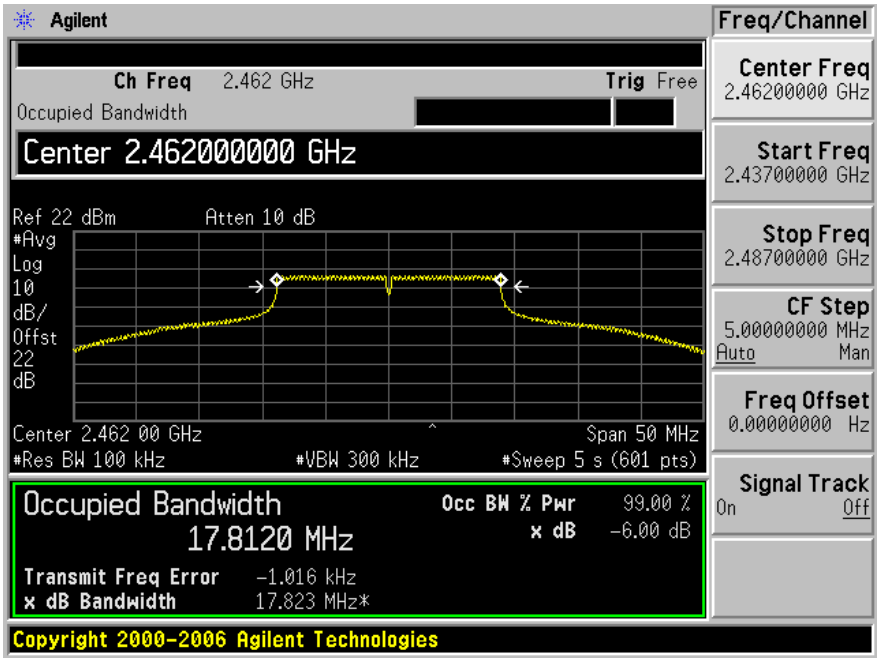
802.11 n20, Low Channel 2412 MHz



802.11 n20, Middle Channel 2437 MHz



802.11 n20, High Channel 2462 MHz



10 FCC §15.247(b) - Peak Output Power Measurement

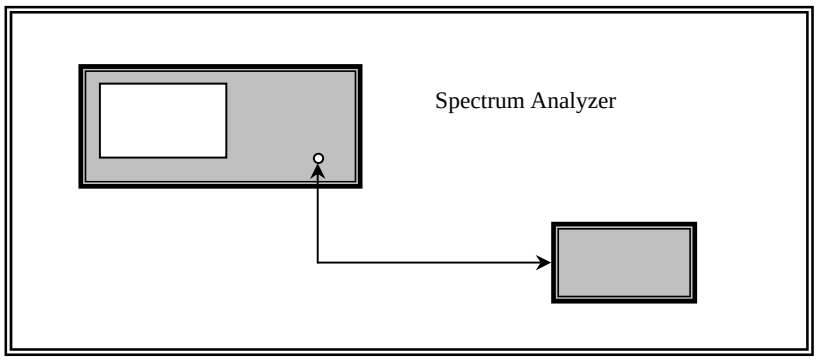
10.1 Applicable Standard

§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 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2009-07-23

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

10.4 Test Environmental Conditions

Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

10.5 Summary of Test Results

Radio Mode	Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
802.11 b	Low	2412	20.05	30	9.95
	Mid	2437	19.89	30	10.11
	High	2462	19.62	30	10.38
802.11 g	Low	2412	19.88	30	10.12
	Mid	2437	19.28	30	10.72
	High	2462	19.16	30	10.84
802.11 n20	Low	2412	20.01	30	9.99
	Mid	2437	19.67	30	10.33
	High	2462	19.27	30	10.73

11 FCC §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 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2009-07-23

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

11.4 Test Environmental Conditions

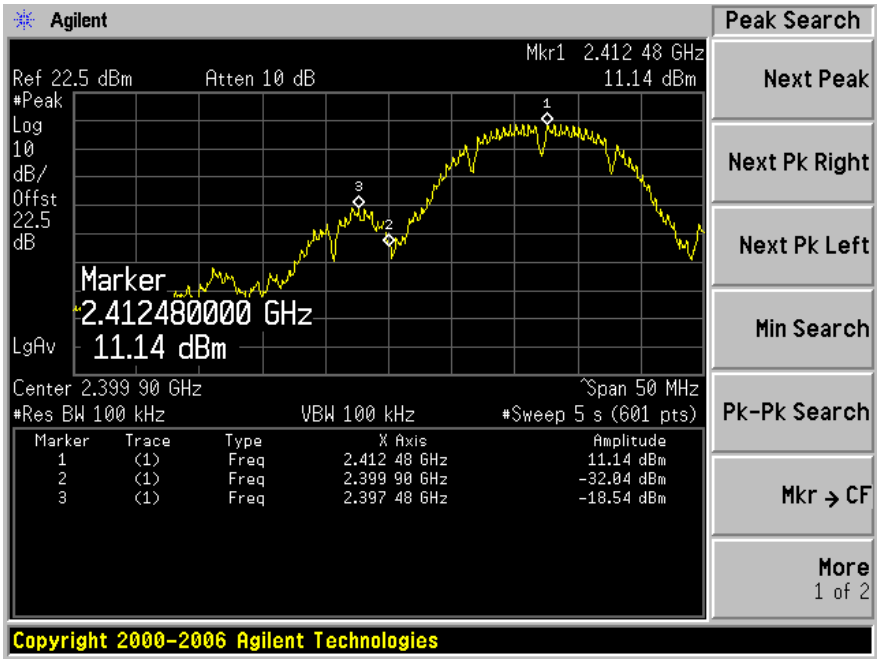
Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

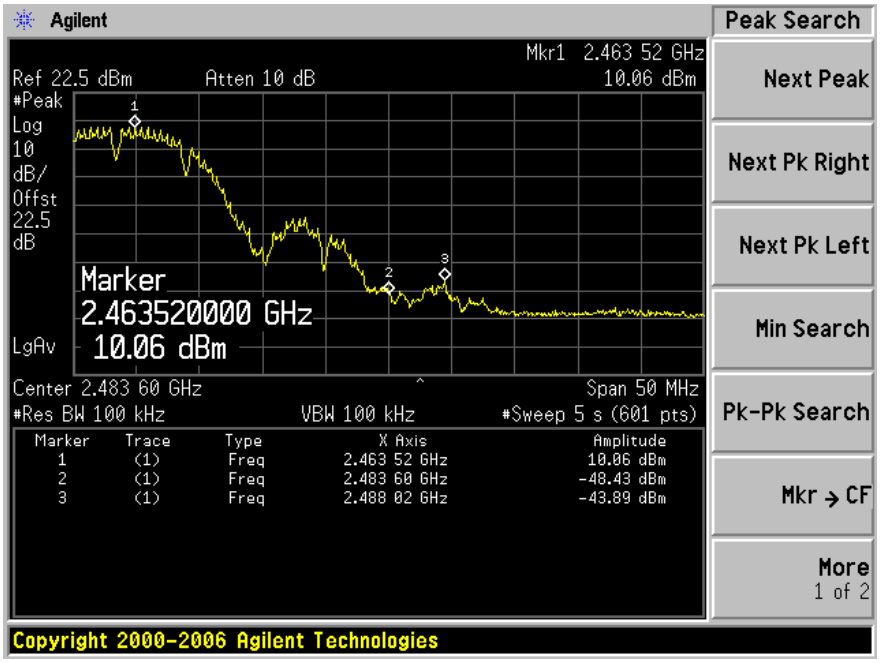
11.5 Measurement Results

Please refer to following pages for plots of band edge.

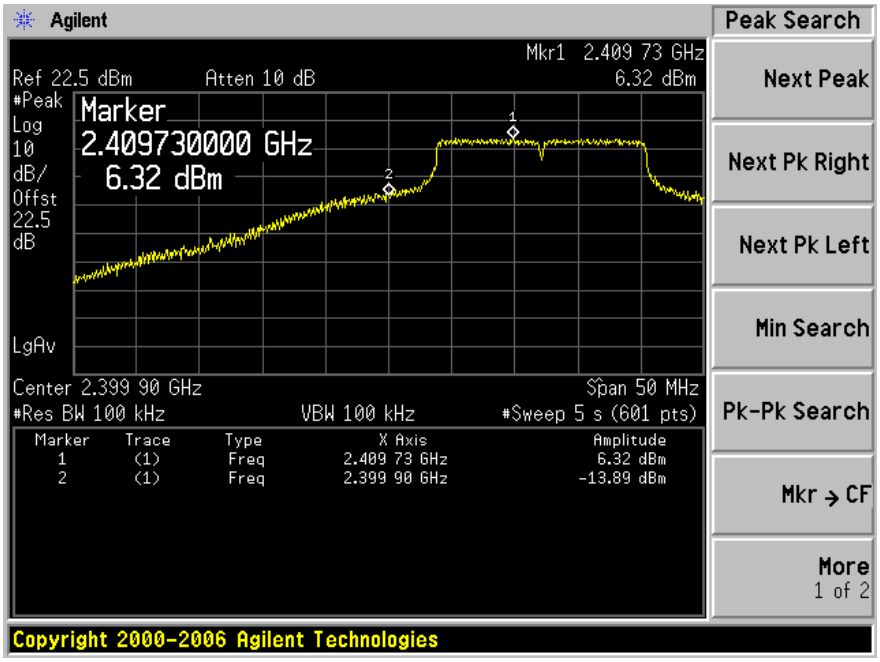
802.11b, Low Band Edge



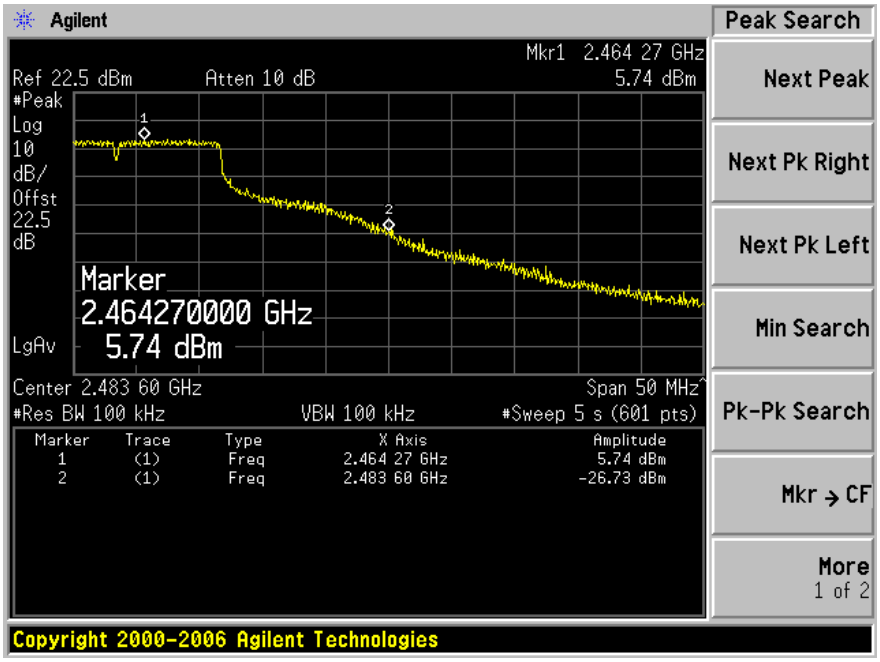
802.11b, High Band Edge



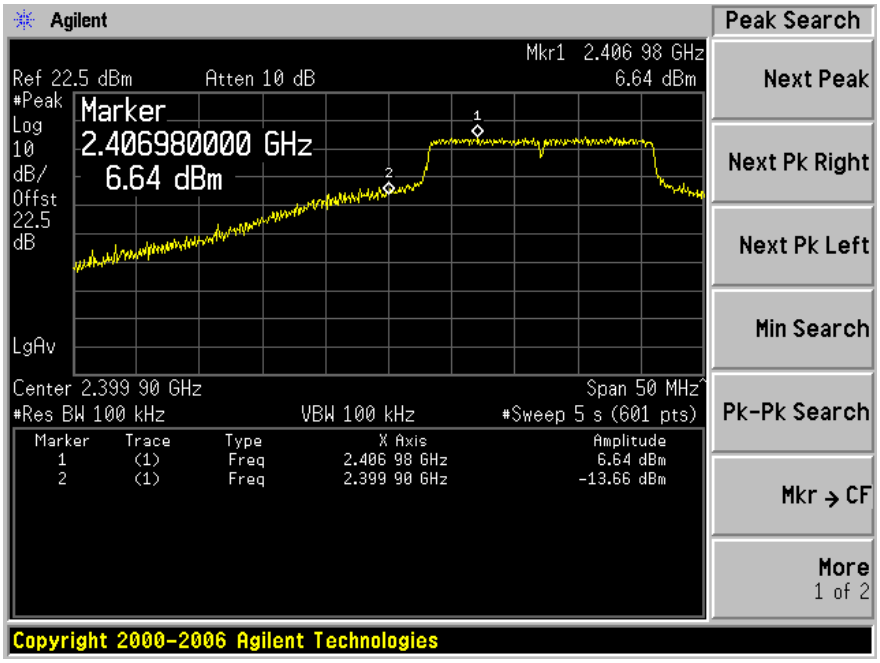
802.11g, Low Band Edge



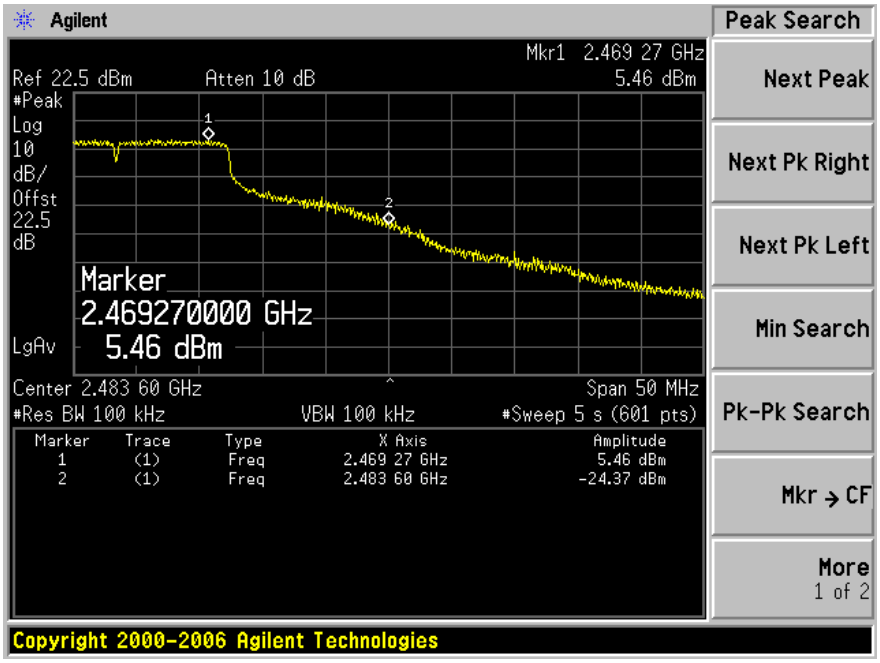
802.11g, High Band Edge



802.11 n20, Low Band Edge



802.11 n20, High Band Edge



12 FCC §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 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2009-07-23

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

12.4 Test Environmental Conditions

Temperature:	18~21 °C
Relative Humidity:	30~35 %
ATM Pressure:	101.2-102.2kPa

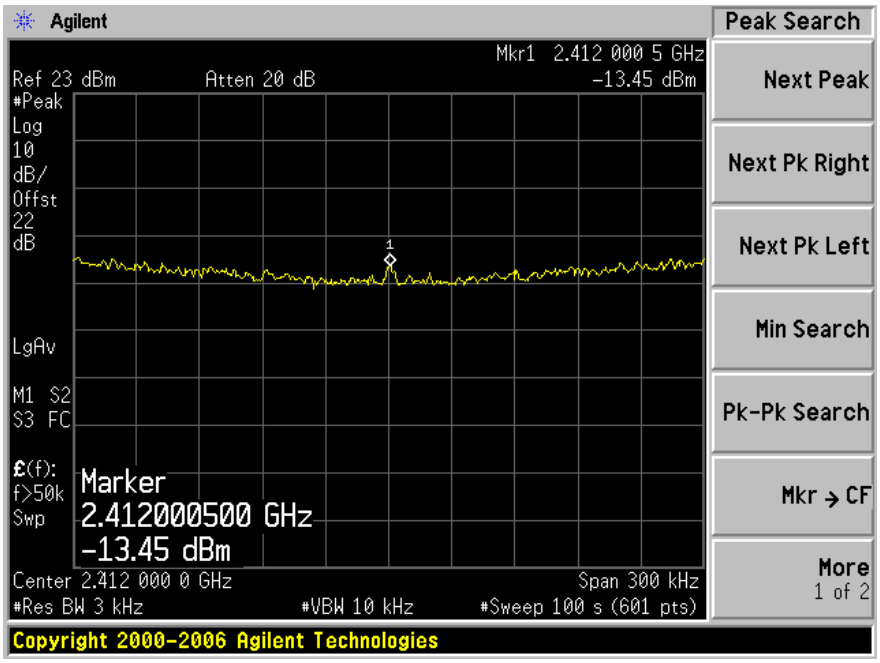
**The testing was performed by Jack Liu from 2009-09-16 to 2009-09-25.*

12.5 Summary of Test Results

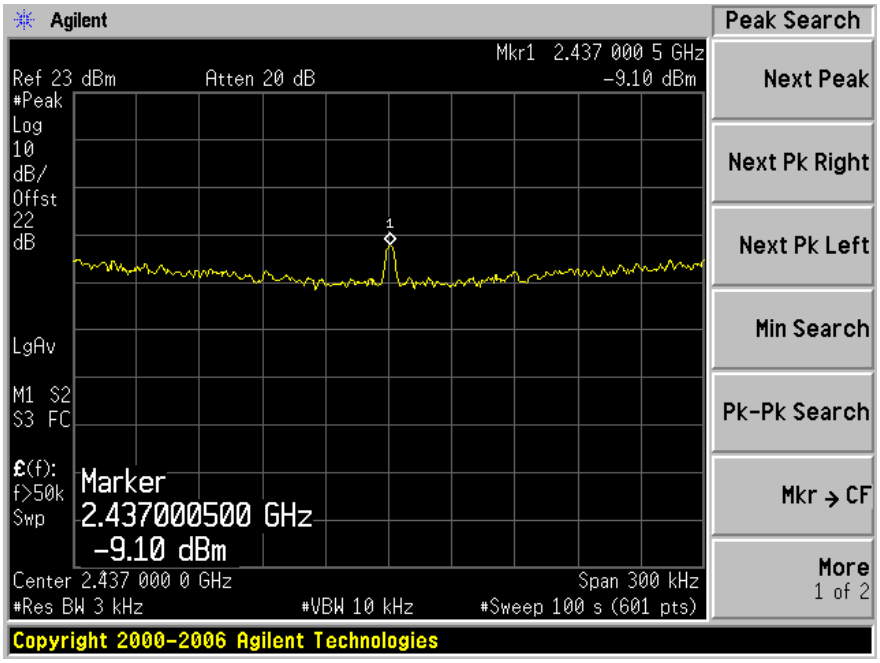
Radio Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
802.11 b	Low	2412	-13.45	8	Compliance
	Mid	2437	-9.10	8	Compliance
	High	2462	-11.6	8	Compliance
802.11 g	Low	2412	-1.0	8	Compliance
	Mid	2437	-4.31	8	Compliance
	High	2462	-3.05	8	Compliance
802.11 n20	Low	2412	-9.65	8	Compliance
	Mid	2437	-3.37	8	Compliance
	High	2462	-1.39	8	Compliance

Please refer to the following plots for detailed test results

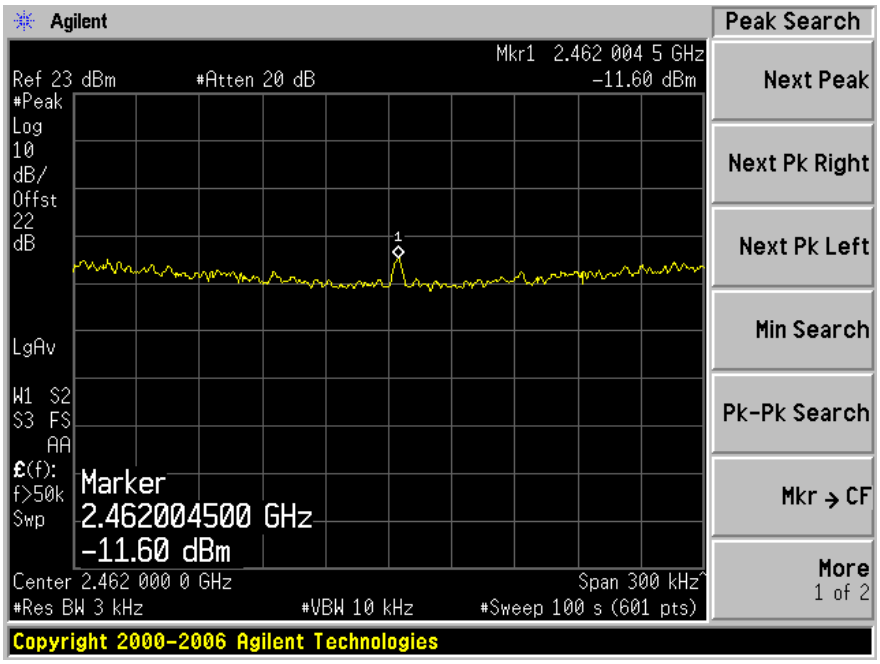
802.11 b, Low Channel 2412 MHz



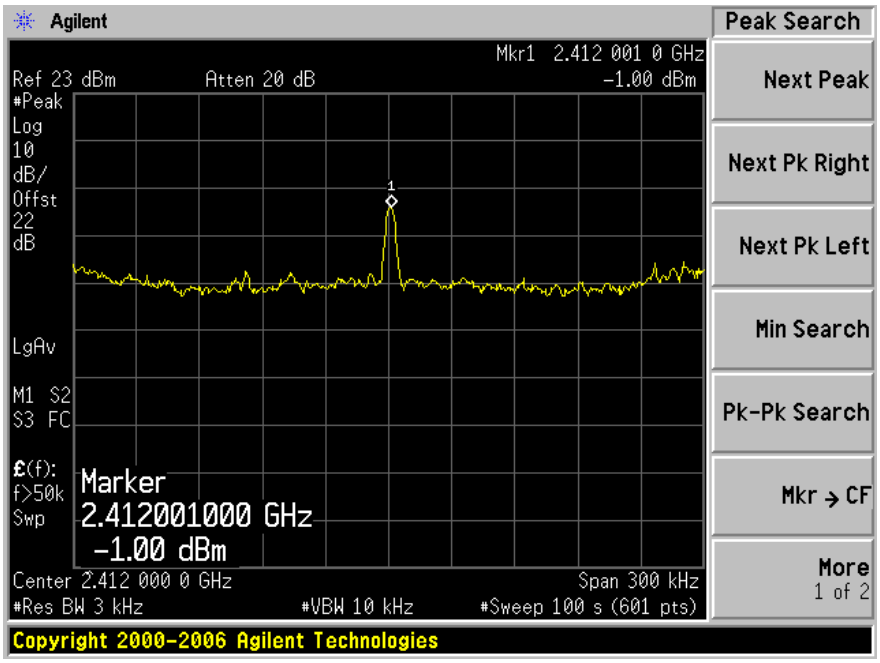
802.11 b, Middle Channel 2437 MHz



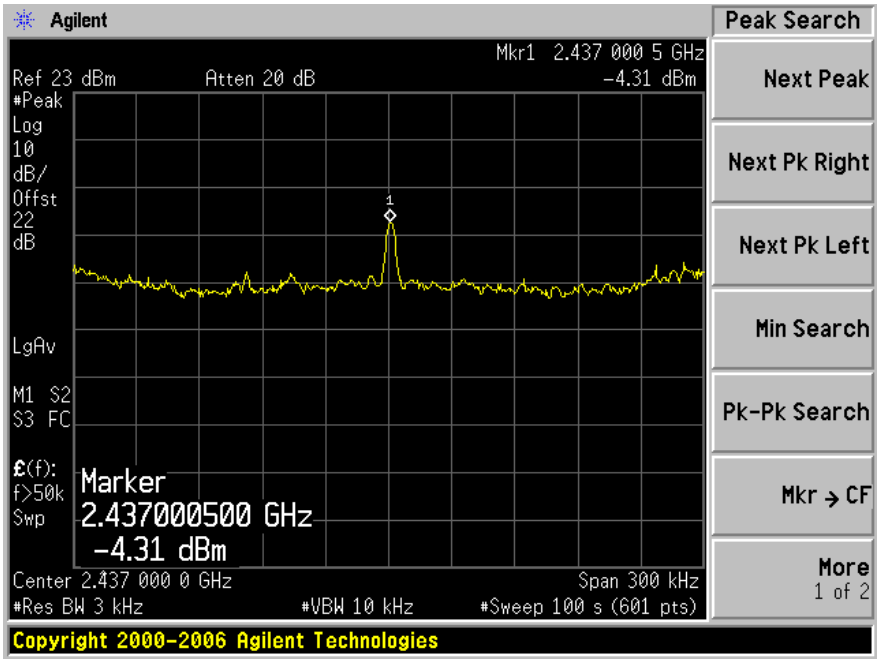
802.11 b, High Channel 2462 MHz



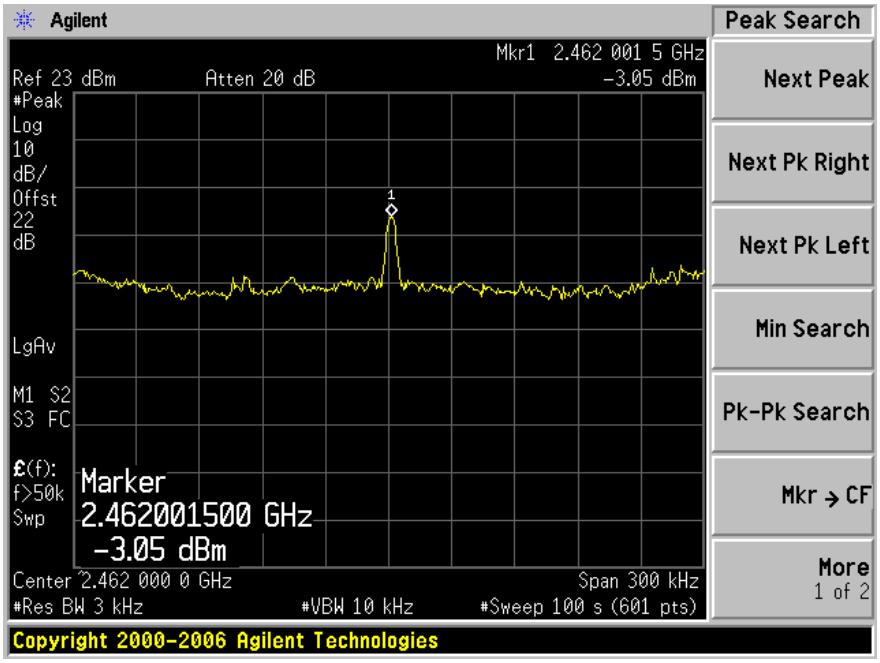
802.11 g, Low Channel 2412 MHz



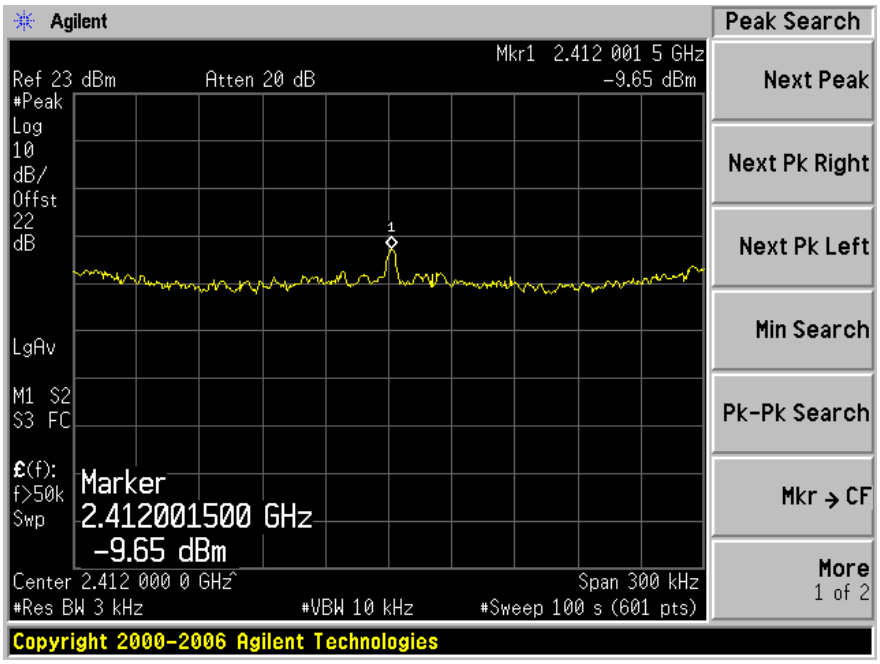
802.11 g, Middle Channel 2437 MHz



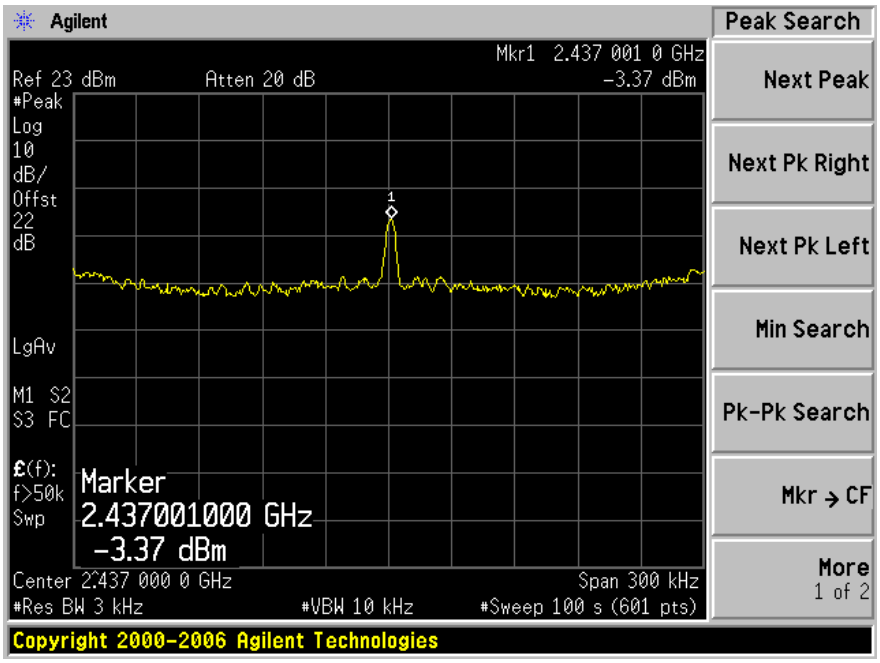
802.11 g, High Channel 2462 MHz



802.11 n20, Low Channel 2412 MHz



802.11 n20, Middle Channel 2437 MHz



802.11 n20, High Channel 2462 MHz