Lab Code: 200167-0

FCC PART 15.247
IC RSS-210, ISSUE 7, JUNE 2007
TEST AND MEASUREMENT REPORT

For

Ruckus Wireless, Inc.

880 West Maude Avenue, Suite 101,
Sunnyvale, CA 94085, USA

FCC ID: S9GMF7211
IC: 5912A-MF7211

Report Type:	**Product Type:**
Original Report	802.11b/g/n Access Point

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Report Number:	R0912181-247
Report Date:	2010-04-08
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0912181-247	Original Report	2010-04-08

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Ruckus Wireless, Inc.* and their product, *FCC ID: S9GMF7211, IC: 5912A-MF7211, model: MF7211,* which will be henceforth in this report referred to as the EUT (Equipment under Test). The EUT is a 802.11b/g/n Access Point; Operation frequency is from 2.4 to 2.4835 GHz.

1.2 Mechanical Description of EUT

The EUT measures approximately 110 mm **(L)** x 40 mm **(W)** x 135 mm **(H)** and weighs approximately 250g.

**The data gathered are from a production sample provided by the manufacturer, serial number: 410 and 415.*

1.3 Objective

This report is prepared on behalf of *Ruckus Wireless, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules and Industry Canada RSS-210 Issue 7, June 2007.

The objective is to determine compliance with FCC and IC standards, rules and limits for this device including:

- RF Exposure
- Antenna Requirement
- Conducted Emissions
- Spurious Emissions at Antenna Port
- Radiated Spurious Emissions
- Restricted Band
- Receiver Spurious Emissions
- 6 dB Bandwidth & 99% Bandwidth
- Maximum Peak Output Power
- 100 kHz Bandwidth of Frequency Band Edge
- Power Spectral Density

1.4 Related Submittal(s)/Grant(s)

No related submittals.

1.5 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.

1.6 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.

1.7 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 host system was configured for testing according to ANSI C63.4-2003.

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

2.2 EUT Exercise Software

The EUT is programmed with the following settings that were used during testing:

Channel	Low CH (2412 MHz) Data Rate	Middle CH (2437 MHz) Data Rate	High CH (2462 MHz) Data Rate
802.11b	1 Mbps	1 Mbps	1 Mbps
802.11g	6 Mbps	6 Mbps	6 Mbps
802.11n, 20 MHz	6.5 Mbps	6.5 Mbps	6.5 Mbps

Channel	Low CH (2422 MHz) Data Rate	Middle CH (2437 MHz) Data Rate	High CH (2452 MHz) Data Rate
802.11n 40 MHz	6.5 Mbps	6.5 Mbps	6.5 Mbps

2.3 Special Accessories

There were no special accessories were required, included, or intended for use with EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturers	Descriptions	Models	Serial Numbers
IBM	Laptop	-	-

2.6 EUT Internal Configuration Details

Manufacturers	Descriptions	Models	Serial Numbers
Ruckus Wireless, Inc	PCB Assembly (Integral Antenna)	120-11139-0002	415
Ruckus Wireless, Inc	PCB Assembly (External Antenna)	120-11139-0002	414
Ruckus Wireless, Inc	POE Adapter	091320013730	5216A03239000

2.7 External I/O Cabling List and Details

Cable Descriptions	Length (m)	From	To
Ethernet Cable	1	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Result
FCC §15.203 IC RSS-Gen §7.1.4	Antenna Requirement	Compliant
FCC § 15.207 (a) IC RSS-Gen §7.2.2	Conducted Emissions	Compliant
FCC §15.247 (a)(2) IC RSS-210 §A8.2 (a)	6 dB Bandwidth & 99% Bandwidth	Compliant
FCC §15.247 (b)(3) IC RSS-210 § A8.4	Maximum Peak Output Power	Compliant
FCC § 15.247 (d) IC RSS-210 § A8.5	Out of Band Emissions	Compliant
FCC §15.247 (e) IC RSS-210 §A8.2 (b)	Power Spectral Density	Compliant
FCC §15.205, §15.209 & §15.247(d) IC RSS-Gen §4.9	Radiated Spurious Emissions	Compliant
FCC §15.205 IC RSS-210 § 2.6	Restricted Band	Compliant
IC RSS-210 § 2.6 RSS-Gen § 6	Receiver Spurious Emissions	Compliant
FCC §15.247 (i), §2.1091 IC RSS-102	RF Exposure	Compliant

4 FCC §15.203 & IC RSS-Gen §7.1.4 – Antenna Requirement

4.1 Applicable Standard

For intentional device, according to FCC Part §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Per IC RSS-Gen §7.1.4, A transmitter can only be sold or operated with antennas with which it was certified. A transmitter maybe certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

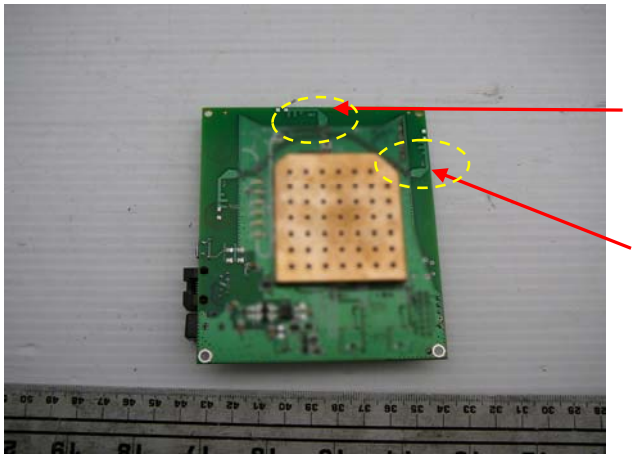
When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in IC RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to IC RSS-210 Annex 8 or RSS-210 Annex 9, the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to IC RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

4.2 Result

The EUT has maximum gain of 9 dBi antenna (External Antenna)*, and 2 dBi PCB (Internal Antenna) which in accordance to sections FCC Part 15.203 and IC RSS-Gen §7.1.4, is considered sufficient to comply with the provisions of these sections.

**Note: External Antenna output power is adjusted to 29 dBm.*

9 dBi Antenna



2 dBi Integral Antenna

5 FCC §15.207 & IC RSS-GEN §7.2.2- Conducted Emissions

5.1 Applicable Standard

FCC Part 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.*

5.2 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.

5.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1.

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".

EUT Powered by AC/DC adapter and Power over Ethernet (POE) were tested. POE was the Worst Case studied in this report.

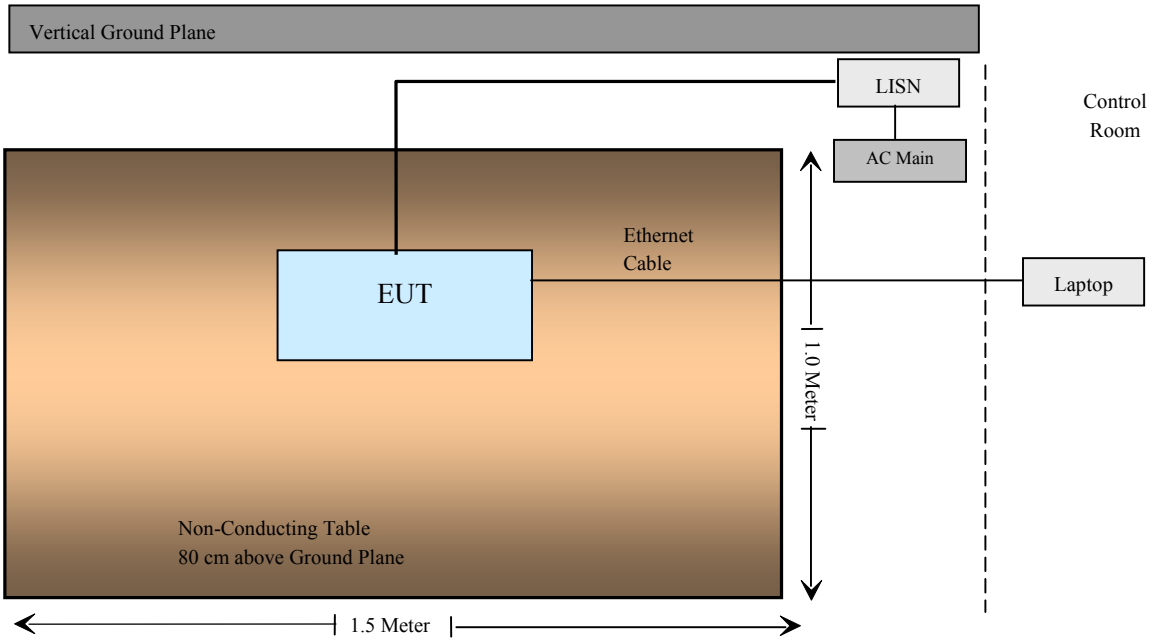
5.4 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Solar Electronics	LISN	9252-R-24-BNC	511205	2009-06-09
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2009-04-29

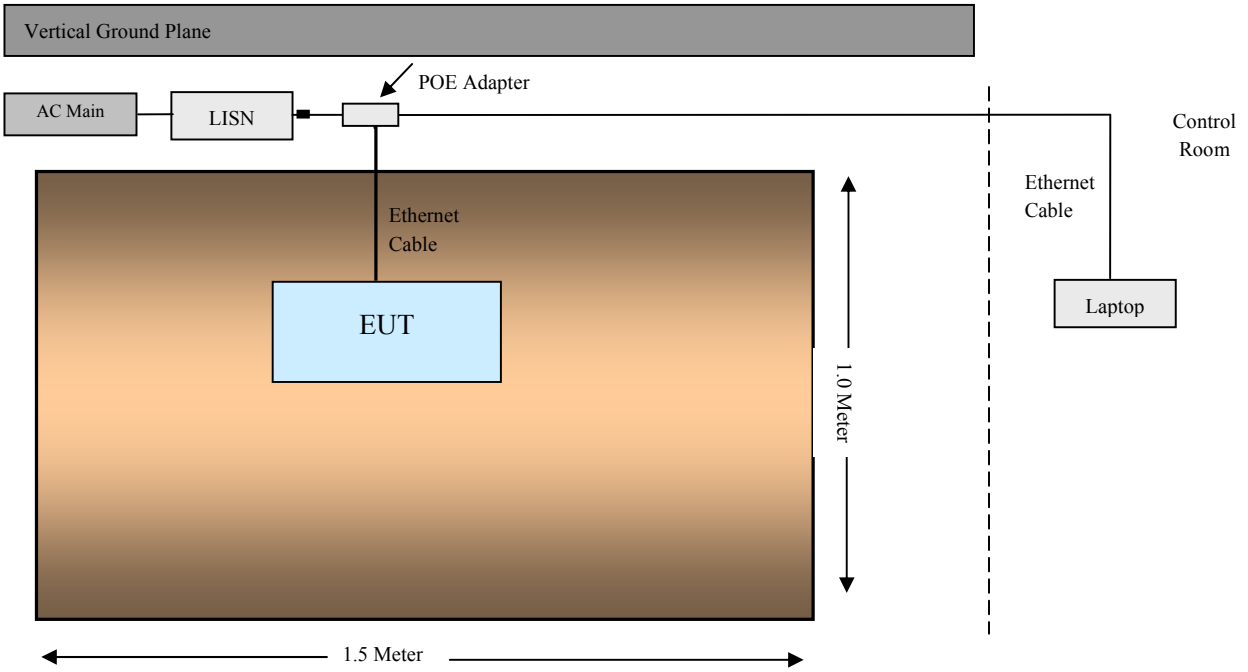
*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

5.5 Test Setup Block Diagrams

AC/DC Power Adapter



Power Over Ethernet (Worst Case)



5.6 Test Environmental Conditions

Temperature:	20~22 °C
Relative Humidity:	33~50 %
ATM Pressure:	98~102.0kPa

**The testing was performed by Dennis Huang on 2010-03-15 in Chamber 3.*

5.7 Test Results

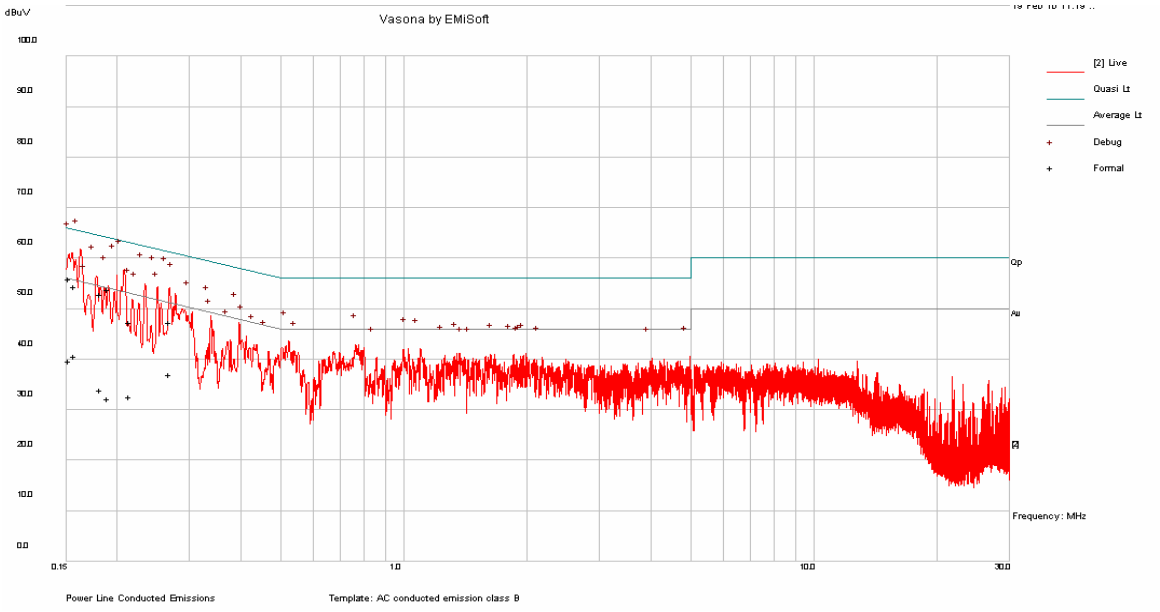
According to the recorded data in following table, the EUT complied with the FCC & IC standard's conducted emissions limits for consumer devices, with the *worst* margin reading of:

Connection: AC/DC Power Adapter, 120 V/60 Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-9.80	0.156368	Line	0.15 to 30
-8.16	0.164172	Neutral	0.15 to 30
Connection: POE connected to 120 V/60 Hz			
-7.18	0.383127	Line	0.15 to 30
-6.80	0.378929	Neutral	0.15 to 30

Please refer to the following plots for test results.

5.8 Conducted Emissions Test Plots and Data

Configuration - AC/DC Power Adapter- 120 V, 60 Hz – Line



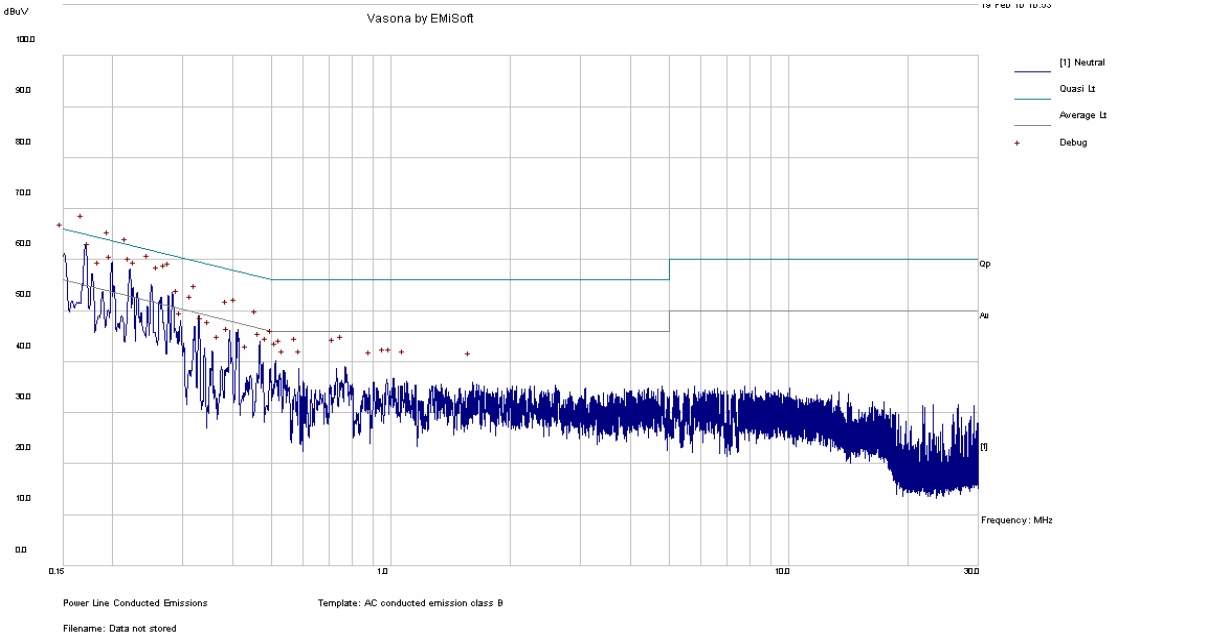
Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.156368	55.86	Quasi Peak	Line	65.65	-9.80
0.193752	53.84	Quasi Peak	Line	63.87	-10.03
0.160262	54.32	Quasi Peak	Line	65.45	-11.13
0.185769	52.96	Quasi Peak	Line	64.22	-11.26
0.273462	47.30	Quasi Peak	Line	61.01	-13.71
0.218634	47.36	Quasi Peak	Line	62.87	-15.51

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.273462	36.98	Average	Line	51.01	-14.03
0.160262	40.58	Average	Line	55.45	-14.87
0.156368	39.65	Average	Line	55.65	-16.00
0.185769	33.97	Average	Line	54.22	-20.25
0.218634	32.55	Average	Line	52.87	-20.32
0.193752	32.16	Average	Line	53.87	-21.72

Configuration - AC/DC Power Adapter - 120 V, 60 Hz – Neutral



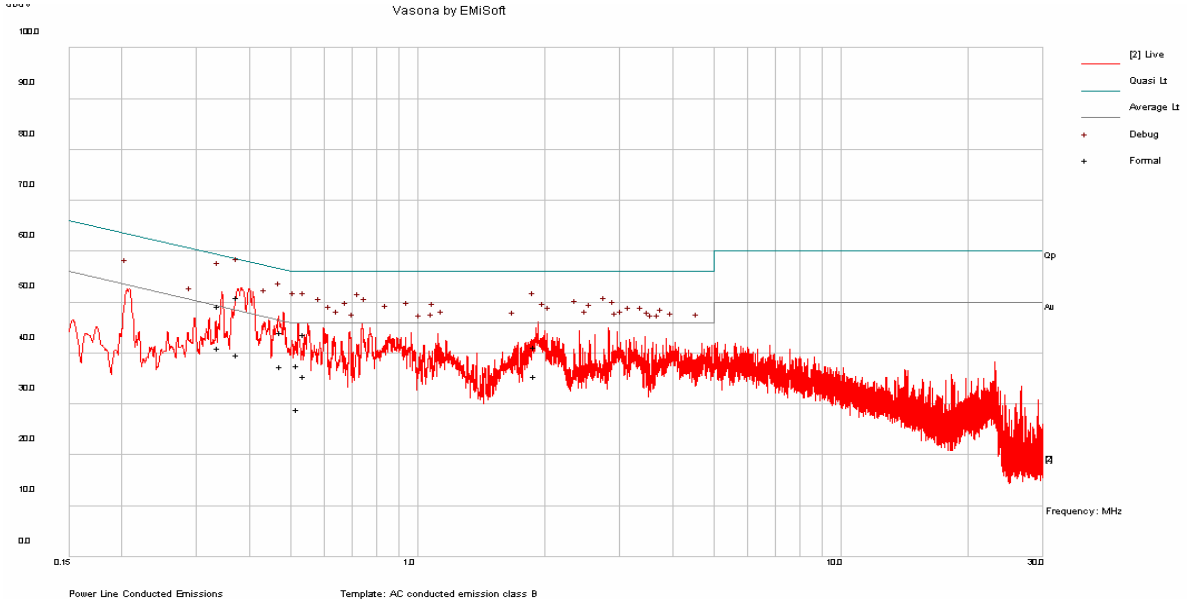
Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.160473	57.84	Quasi Peak	Neutral	65.44	-7.59
0.164172	57.09	Quasi Peak	Neutral	65.25	-8.16
0.183053	54.59	Quasi Peak	Neutral	64.35	-9.76
0.209156	51.11	Quasi Peak	Neutral	63.24	-12.12
0.235881	48.01	Quasi Peak	Neutral	62.24	-14.23
0.266286	45.71	Quasi Peak	Neutral	61.23	-15.52

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.164172	54.39	Average	Neutral	65.16	-10.77
0.235881	38.52	Average	Neutral	55.44	-16.92
0.183053	37.39	Average	Neutral	55.25	-17.86
0.209156	32.96	Average	Neutral	54.35	-21.39
0.160473	31.22	Average	Neutral	53.24	-22.02
0.266286	28.87	Average	Neutral	52.24	-23.37

Configuration – POE - 120 V, 60 Hz – Line



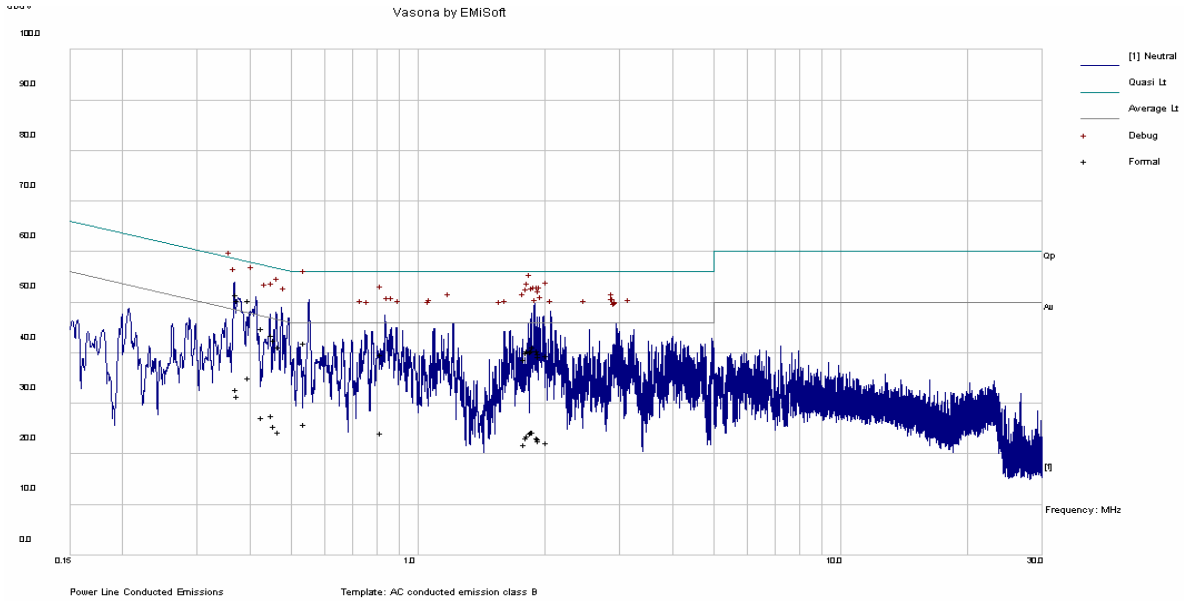
Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.383127	51.03	Quasi Peak	Line	58.21	-7.18
0.343919	49.32	Quasi Peak	Line	59.11	-9.78
0.483861	44.08	Quasi Peak	Line	56.27	-12.19
1.93041	41.26	Quasi Peak	Line	56	-14.74
0.549488	43.6	Quasi Peak	Line	56	-12.4
0.529796	37.56	Quasi Peak	Line	56	-18.44

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.383127	39.61	Average	Line	48.21	-8.60
0.343919	41.09	Average	Line	49.11	-8.01
0.483861	37.29	Average	Line	46.27	-8.98
1.93041	35.54	Average	Line	46	-10.46
0.549488	35.47	Average	Line	46	-10.53
0.529796	28.95	Average	Line	46	-17.05

Configuration – POE - 120V/60 Hz Neutral:



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.378929	51.51	Quasi Peak	Neutral	58.30	-6.80
0.405078	50.44	Quasi Peak	Neutral	57.75	-7.30
0.381441	50.30	Quasi Peak	Neutral	58.25	-7.95
0.462587	43.42	Quasi Peak	Neutral	56.65	-13.23
0.551012	41.88	Quasi Peak	Neutral	56.00	-14.12
1.892264	40.33	Quasi Peak	Neutral	56.00	-15.67

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Measurement Type	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)
0.405078	35.04	Average	Neutral	47.75	-12.71
0.378929	32.76	Average	Neutral	48.30	-15.55
0.381441	31.46	Average	Neutral	48.25	-16.79
0.462587	27.56	Average	Neutral	46.65	-19.09
0.551012	25.83	Average	Neutral	46.00	-20.17
1.892264	24.12	Average	Neutral	46.00	-21.88

6 FCC §15.247(a)(2) & IC RSS-210 §A8.2(a) – 6 dB Occupied Bandwidth

6.1 Applicable Standard

According to FCC §15.247(a)(2) and RSS-210 §A8.2(a), 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

6.2 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. (6 dB bandwidth for DTS)
4. Repeat above procedures until all frequencies measured were complete.

6.3 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2009-03-25

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

6.4 Test Environmental Conditions

Temperature:	20~22 °C
Relative Humidity:	33~50 %
ATM Pressure:	98~102.0kPa

**The testing was performed by Dennis Huang on 2010-02-24.*

6.5 Test Results

802.11b:

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (kHz)
Low	2412	14.584	11.280	> 500
Middle	2437	14.564	10.230	> 500
High	2462	14.578	10.169	> 500

802.11g:

Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (kHz)
Low	2412	16.429	16.531	> 500
Middle	2437	16.431	16.531	> 500
High	2462	16.442	16.530	> 500

802.11n 20 MHz:

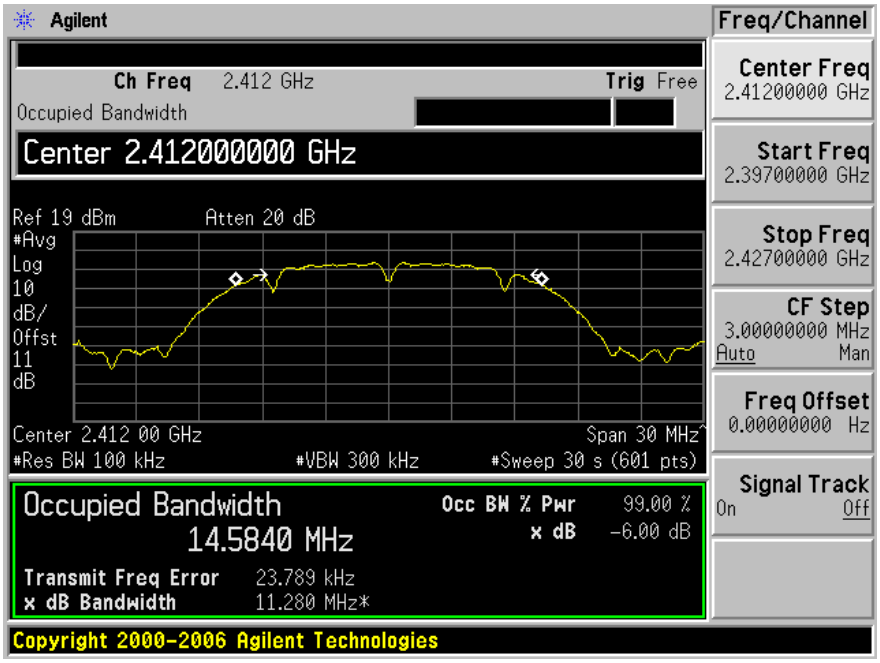
Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (kHz)
Low	2412	17.604	17.744	> 500
Middle	2437	17.607	17.704	> 500
High	2462	17.611	17.743	> 500

802.11n 40 MHz:

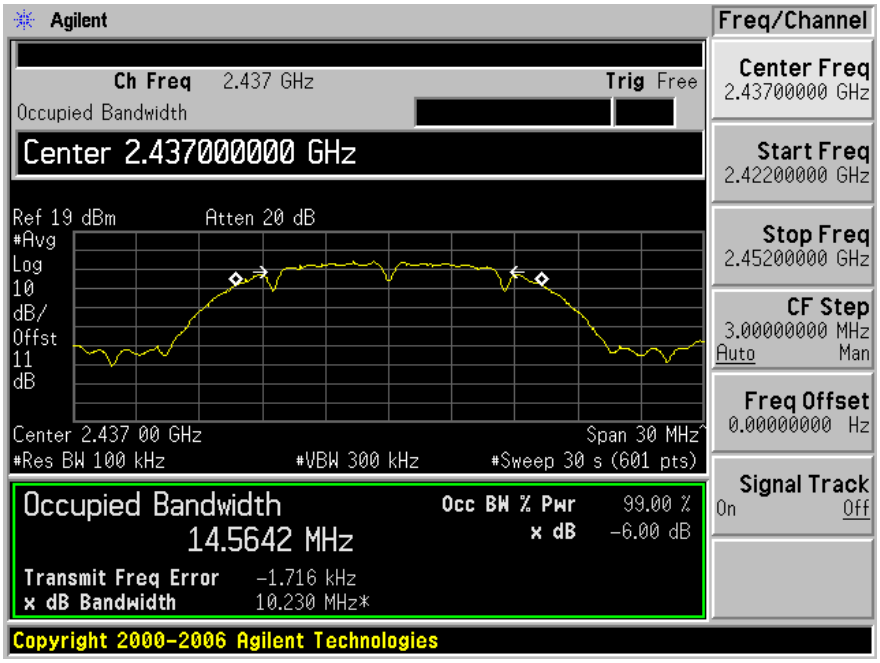
Channel	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	Limit (kHz)
Low	2422	36.027	36.440	> 500
Middle	2437	36.031	36.437	> 500
High	2452	36.051	36.437	> 500

Please refer to the following plots for detailed test results

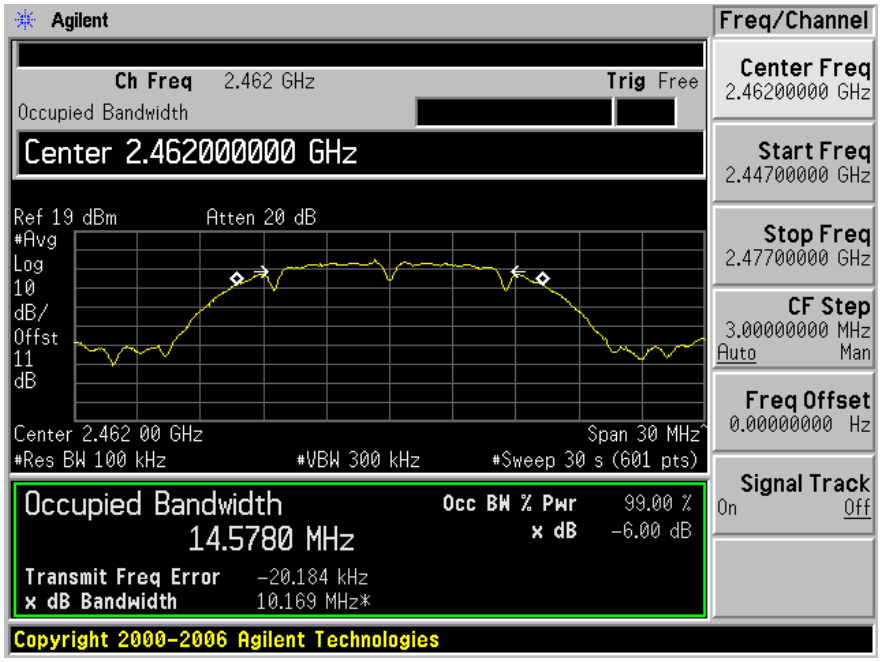
802.11b, Low Channel – 2412 MHz



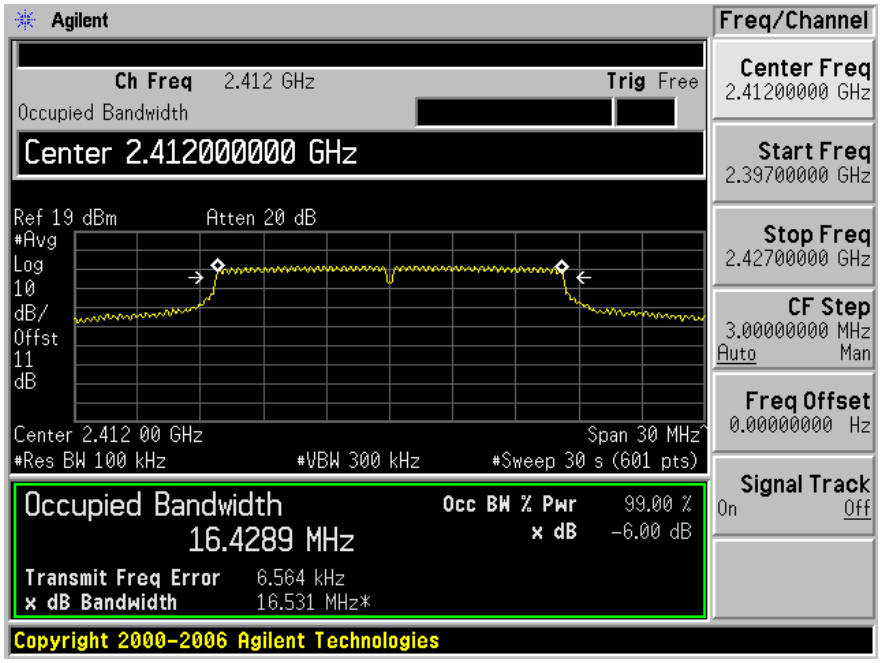
802.11b, Middle Channel – 2437 MHz



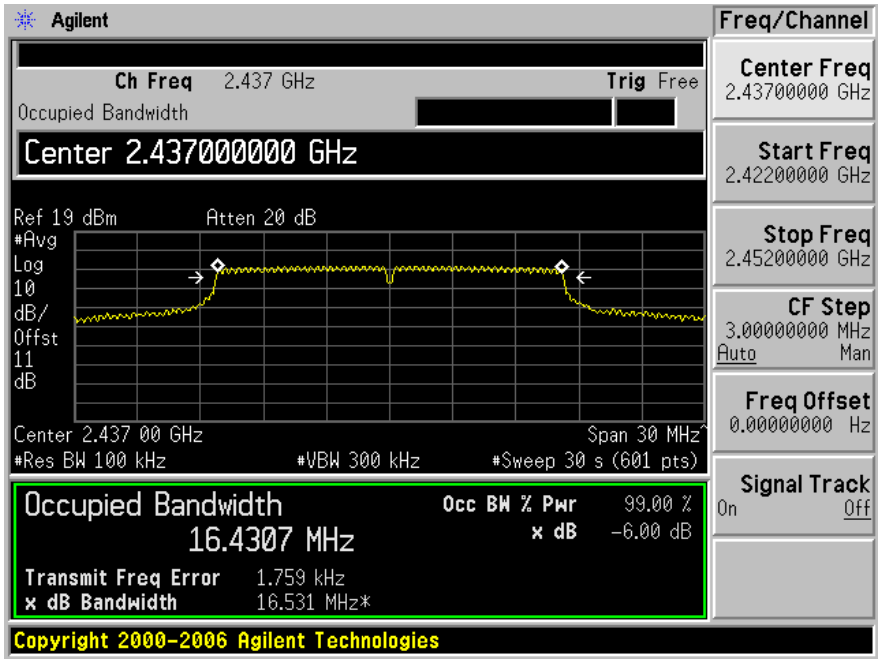
802.11b, High Channel – 2462 MHz



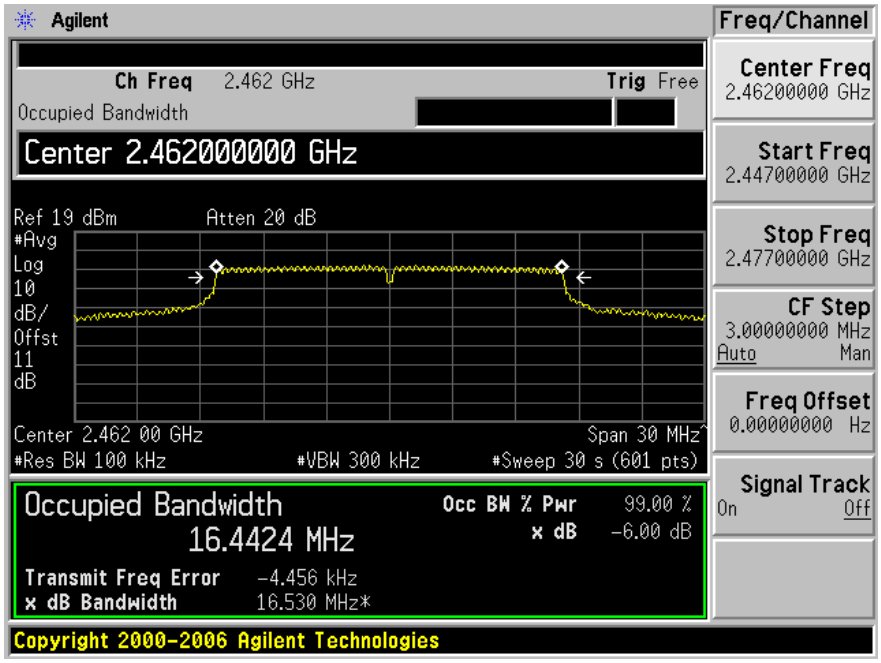
802.11g, Low Channel – 2412 MHz



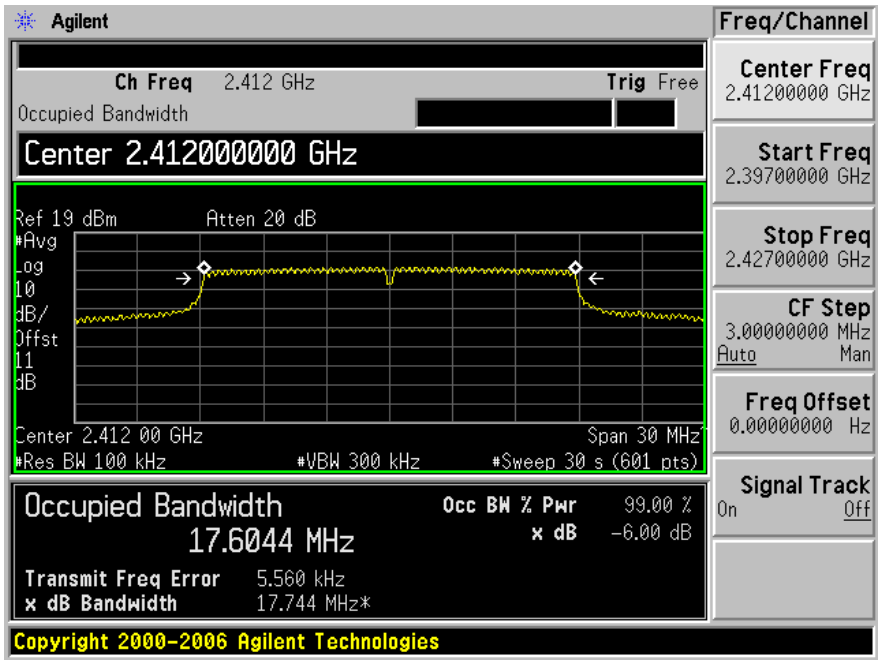
802.11g, Middle Channel – 2437 MHz



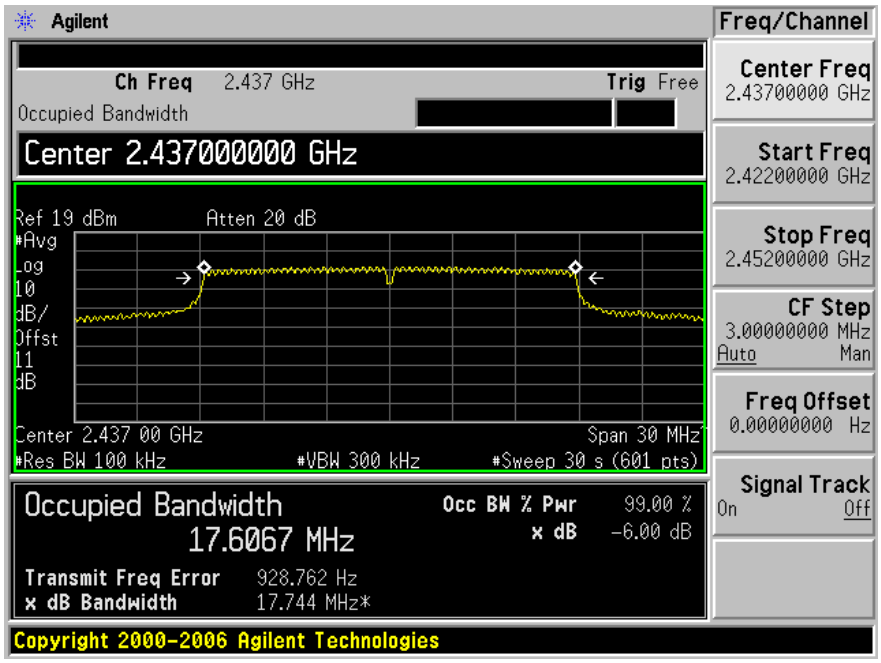
802.11g, High Channel – 2462 MHz



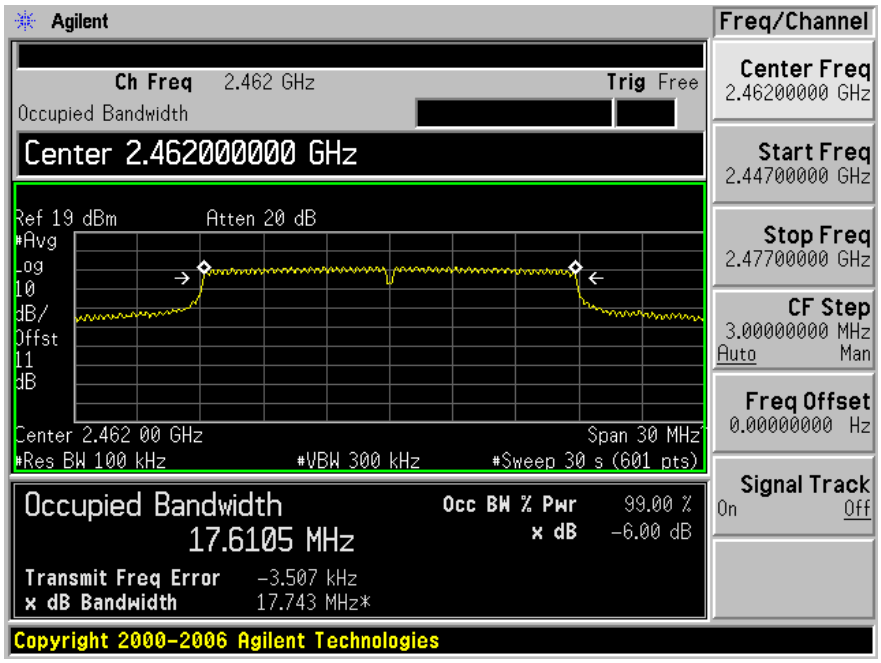
802.11n 20 MHz, Low Channel – 2412 MHz



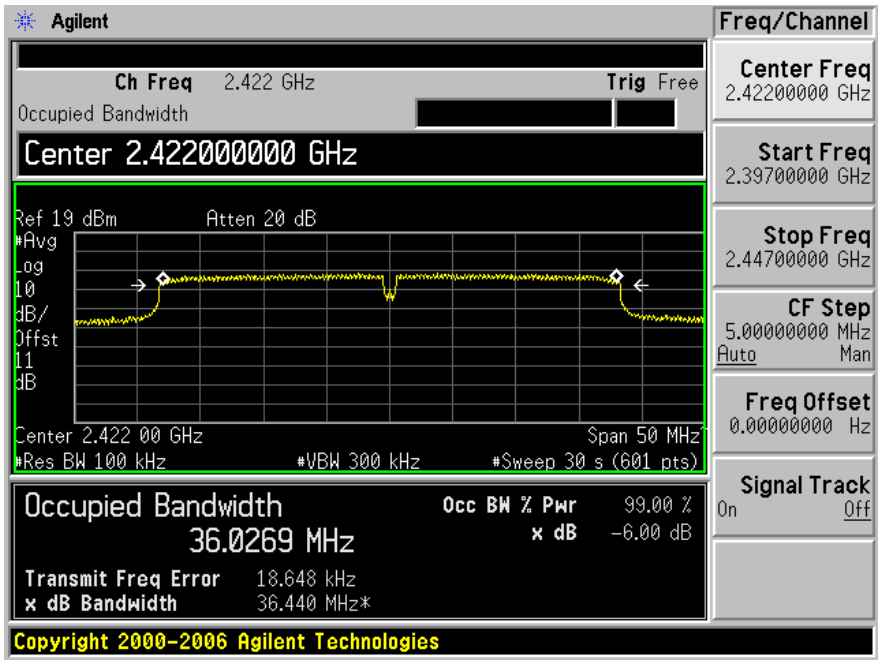
802.11n 20 MHz, Middle Channel – 2437 MHz



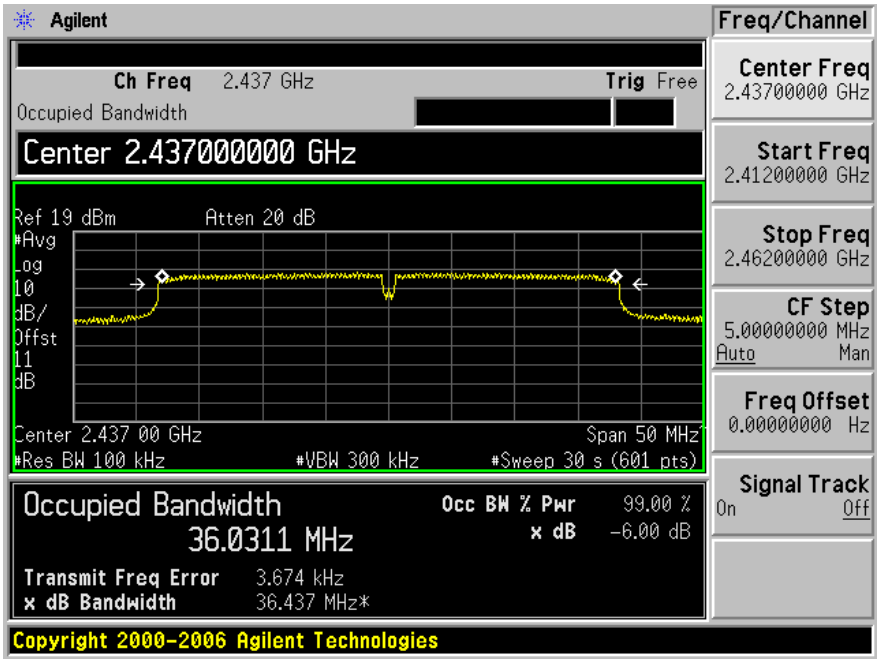
802.11n 20 MHz, High Channel – 2462 MHz



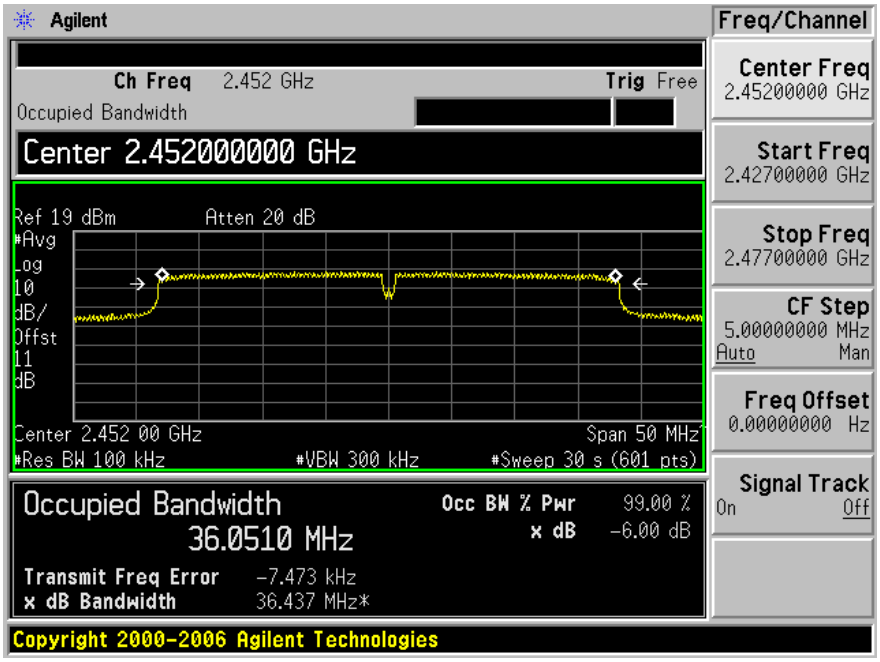
802.11n 40 MHz, Low Channel – 2422 MHz



802.11n 40 MHz, Middle Channel – 2437 MHz



802.11n 40 MHz, High Channel – 2462 MHz



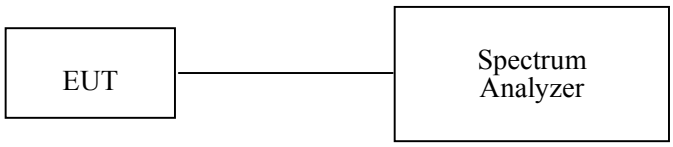
7 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power

7.1 Applicable Standard

According to §15.247(b) (3) and RSS210 § A8.4 (4) for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt (30dBm).

7.2 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.



7.3 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2009-03-25

*** 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:	20~22 °C
Relative Humidity:	33~50 %
ATM Pressure:	98~102.0kPa

**The testing was performed by Dennis Huang on 2010-02-24.*

7.5 Test Results

Radio Mode	Channel	Frequency (MHz)	Max Power (dBm)	Limit (dBm)	Result
802.11b	Low	2412	21.42	29	Compliant
	Mid	2437	21.34	29	Compliant
	High	2462	21.33	29	Compliant
802.11g	Low	2412	21.22	29	Compliant
	Mid	2437	21.26	29	Compliant
	High	2462	21.19	29	Compliant
802.11n 20 MHz	Low	2412	21.05	29	Compliant
	Mid	2437	21.17	29	Compliant
	High	2462	21.07	29	Compliant
802.11n 40 MHz	Low	2422	20.80	29	Compliant
	Mid	2437	20.76	29	Compliant
	High	2452	20.88	29	Compliant

**Note: EUT's maximum antenna gain is 9 dBi; according to the FCC15.247 Antenna gain "greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi."*

8 FCC §15.247(d) & IC RSS-210 §A8.5 – Out of Band Emissions

8.1 Applicable Standard

According to FCC §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)).

As per IC RSS-210 §A8.5: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emissions limits specified in Tables 2 and 3.

8.2 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.

8.3 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2009-03-25

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

8.4 Test Environmental Conditions

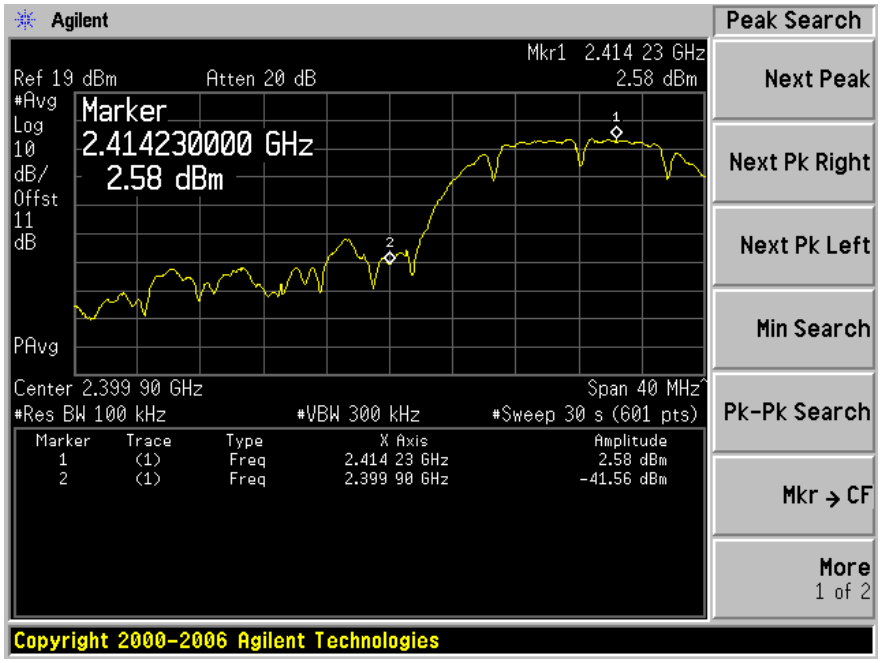
Temperature:	20~22 °C
Relative Humidity:	33~50 %
ATM Pressure:	98~102.0kPa

**The testing was performed by Dennis Huang 2010-02-24.*

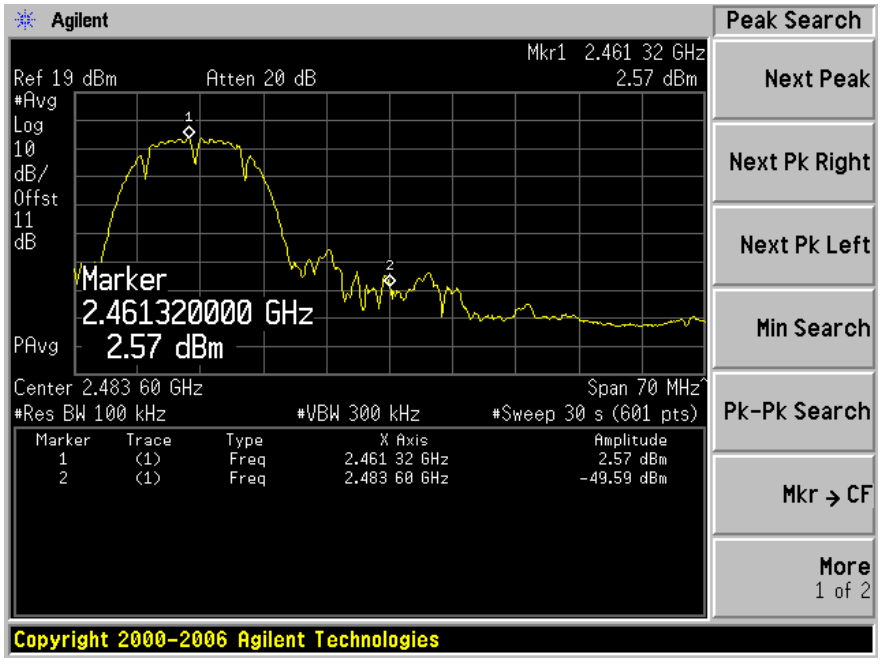
Please refer to the following plots for detailed results

Plots of 100 kHz Band Edge:

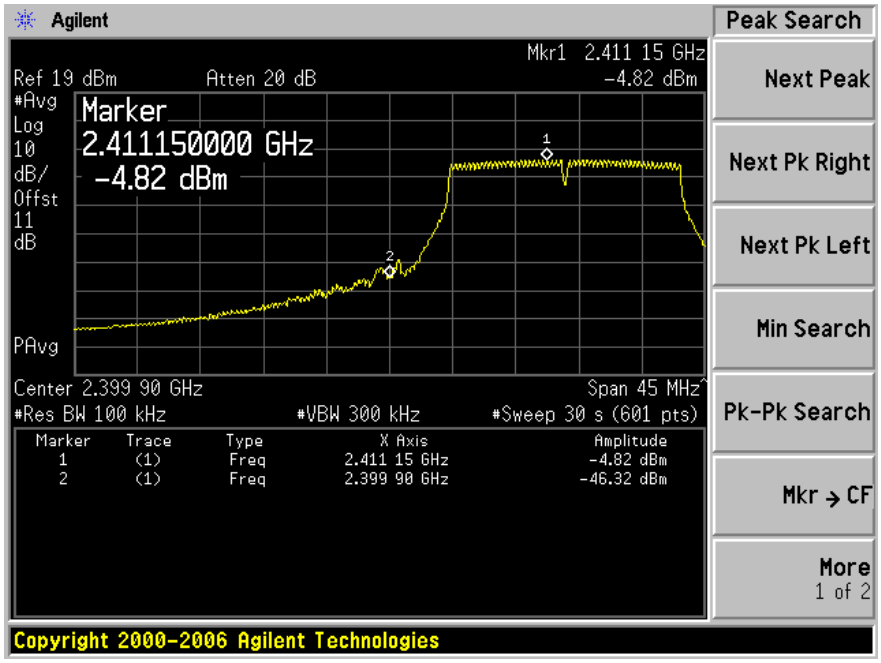
802.11b, Lowest Channel – 2412 MHz



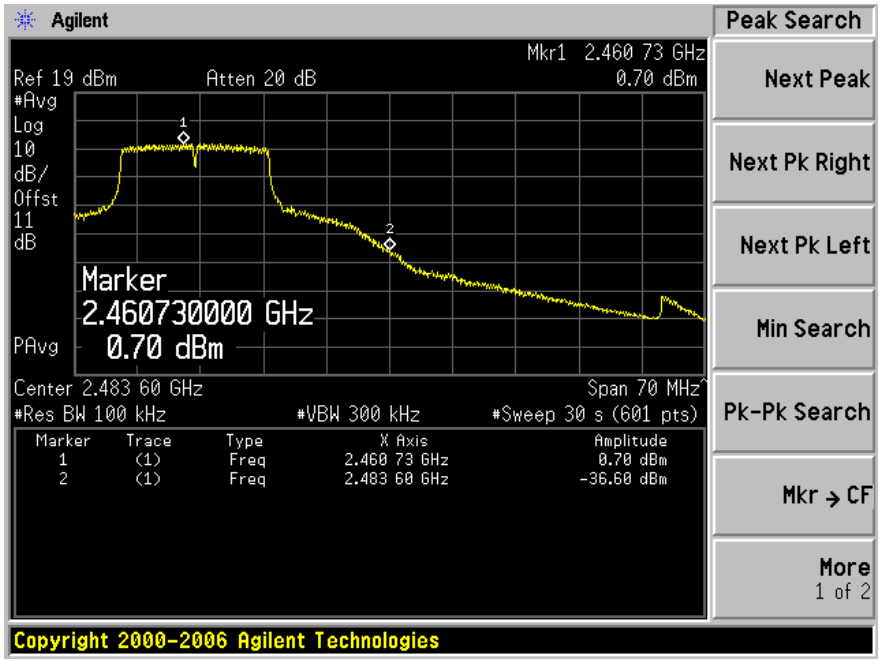
802.11b, Highest Channel – 2462 MHz



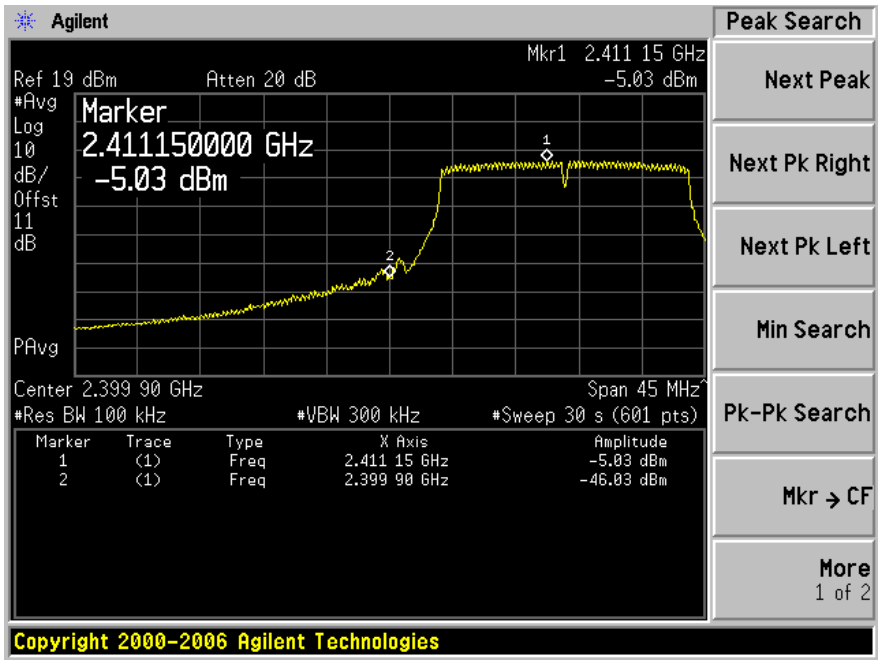
802.11g, Lowest Channel – 2412 MHz



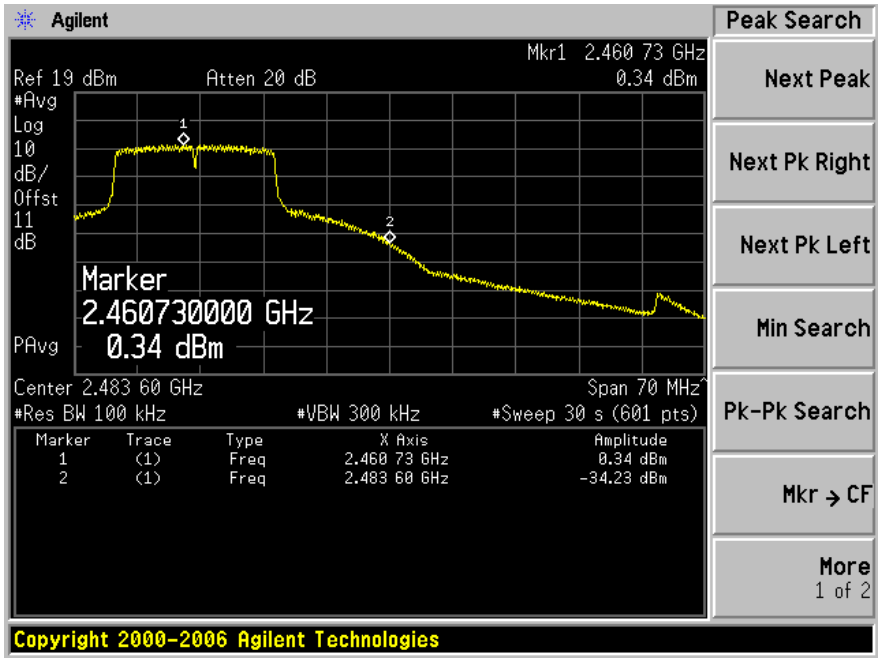
802.11g, Highest Channel – 2462 MHz



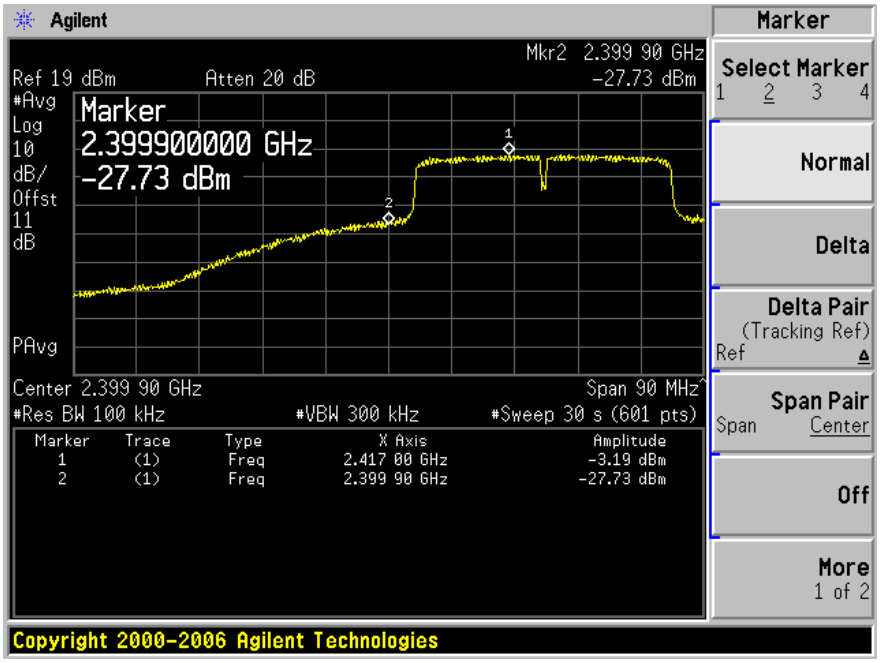
802.11n 20 MHz, Lowest Channel – 2412 MHz



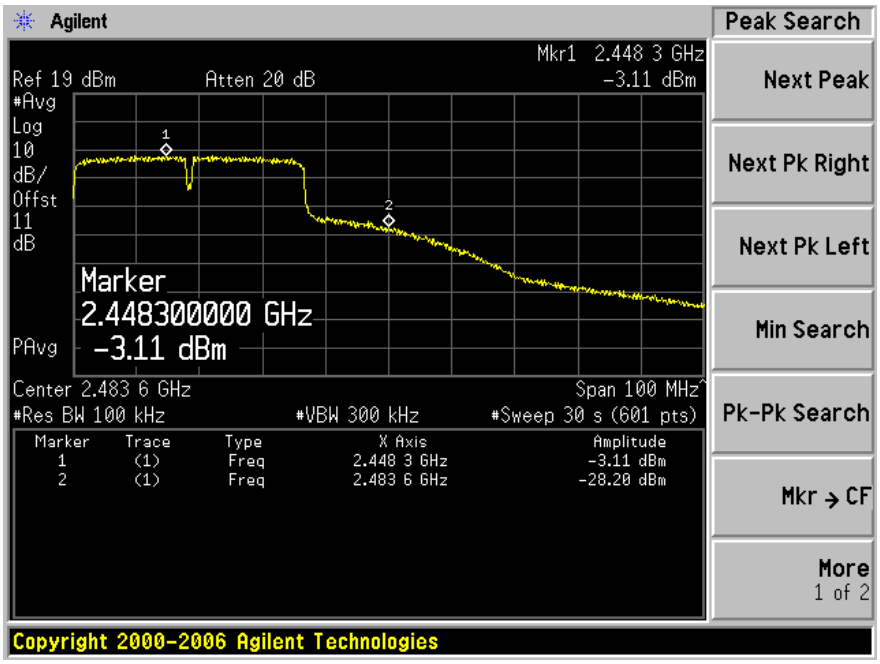
802.11n 20 MHz, Highest Channel – 2462 MHz



802.11n 40 MHz, Lowest Channel – 2422 MHz

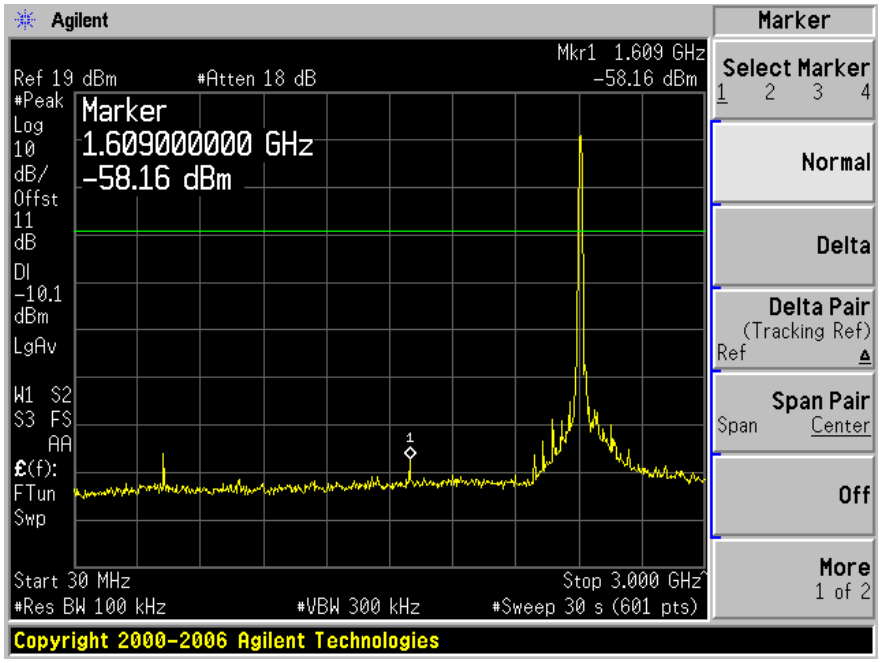


802.11n 40 MHz, Highest Channel – 2452 MHz

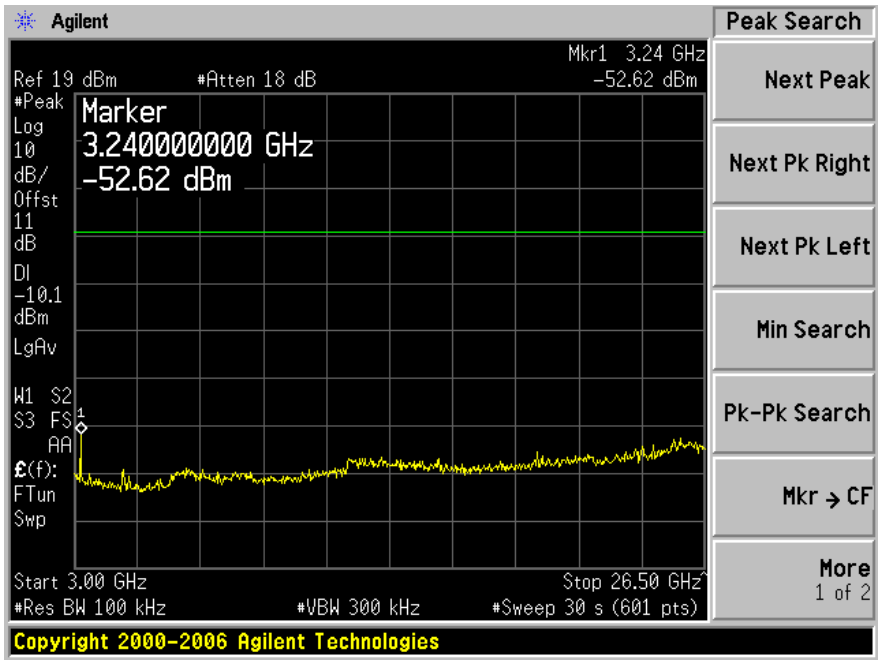


Plots of Spurious Emission at Antenna Port

802.11b, Low Channel – 2412 MHz

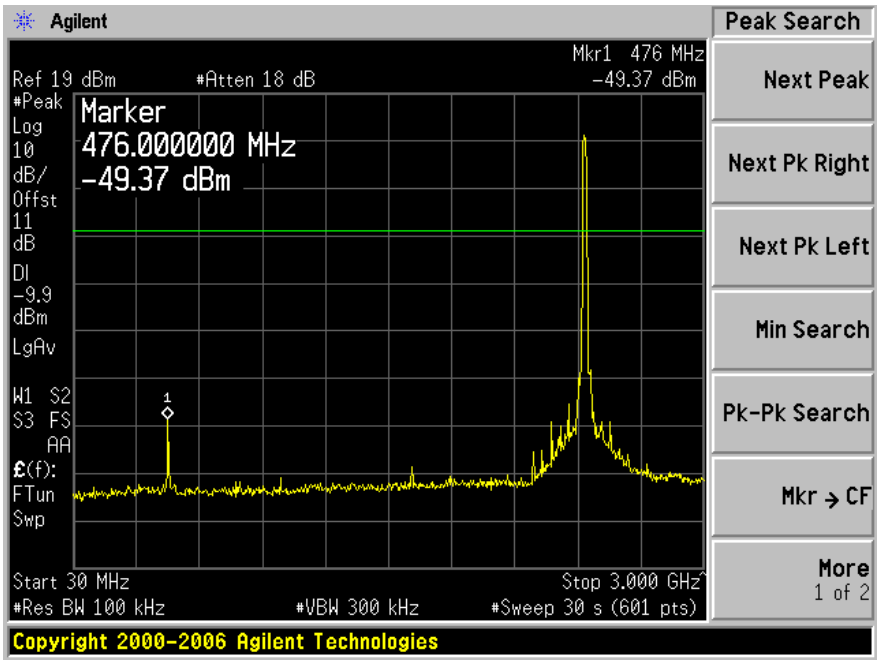


Plot 1: 30 MHz to 3.0 GHz

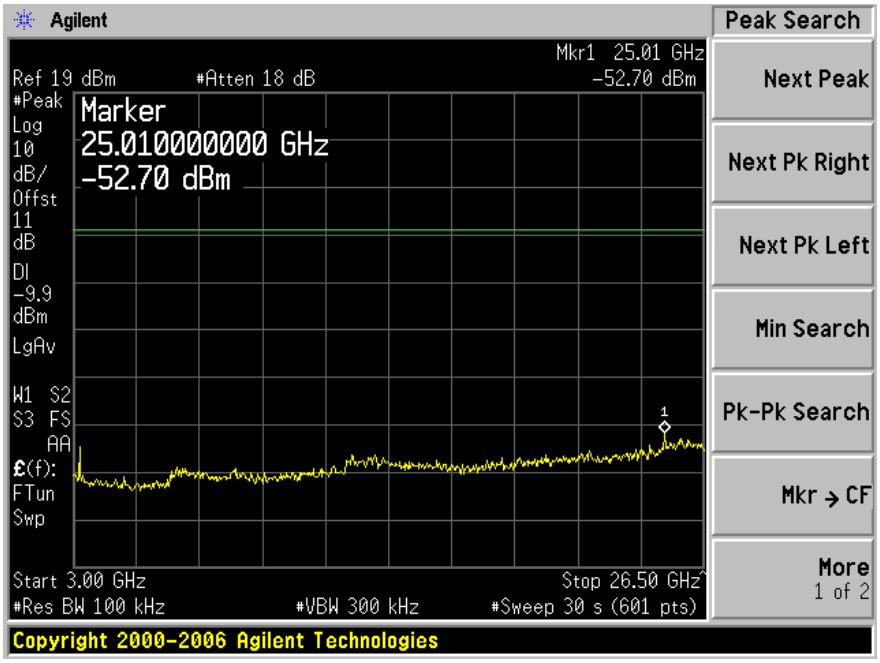


Plot 2: 3.0 GHz to 26.5 GHz

802.11b, Middle Channel – 2437 MHz

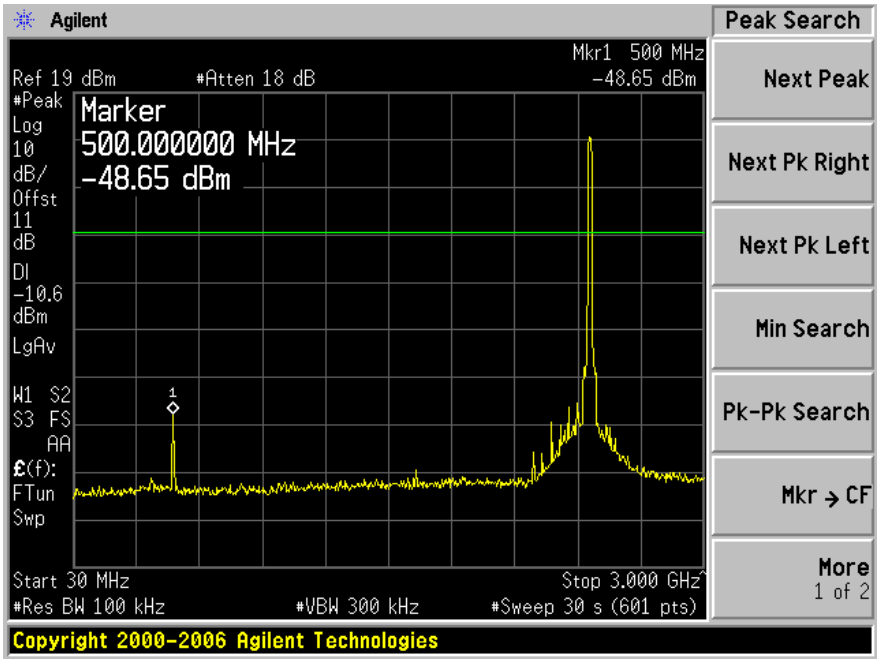


Plot 1: 30 MHz to 3.0 GHz

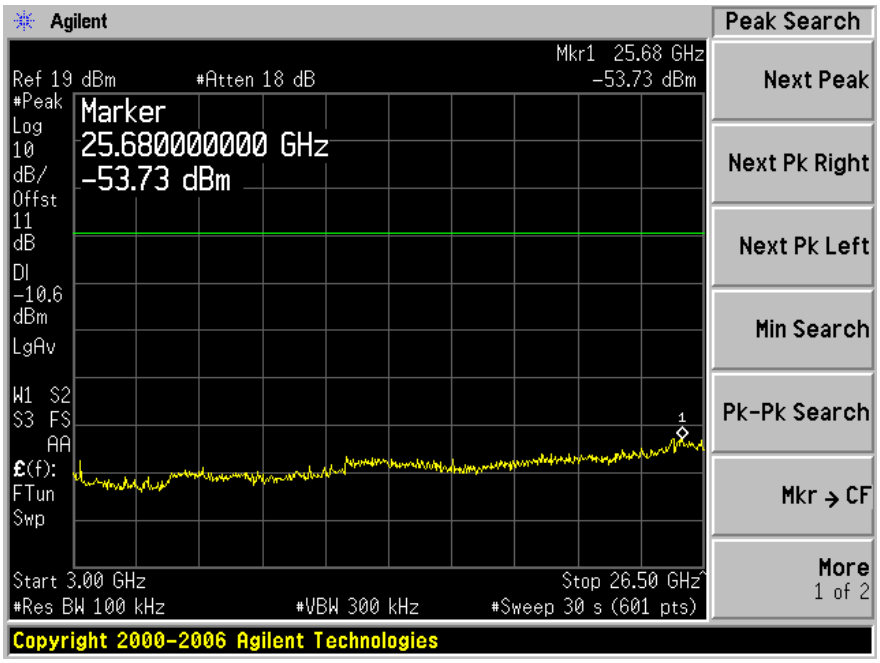


Plot 2: 3.0 GHz to 26.5 GHz

802.11b, High Channel – 2462 MHz

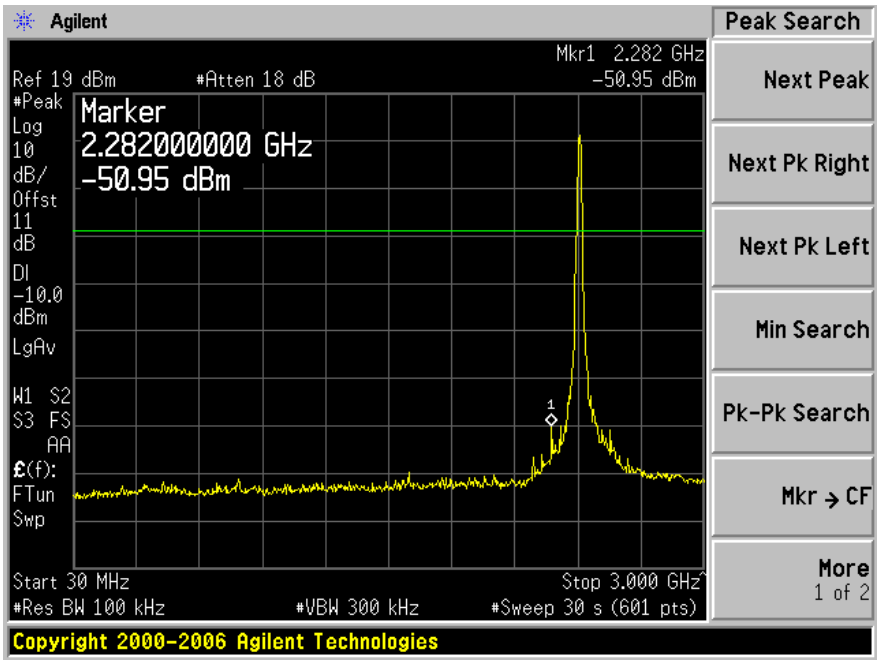


Plot 1: 30 MHz to 3.0 GHz

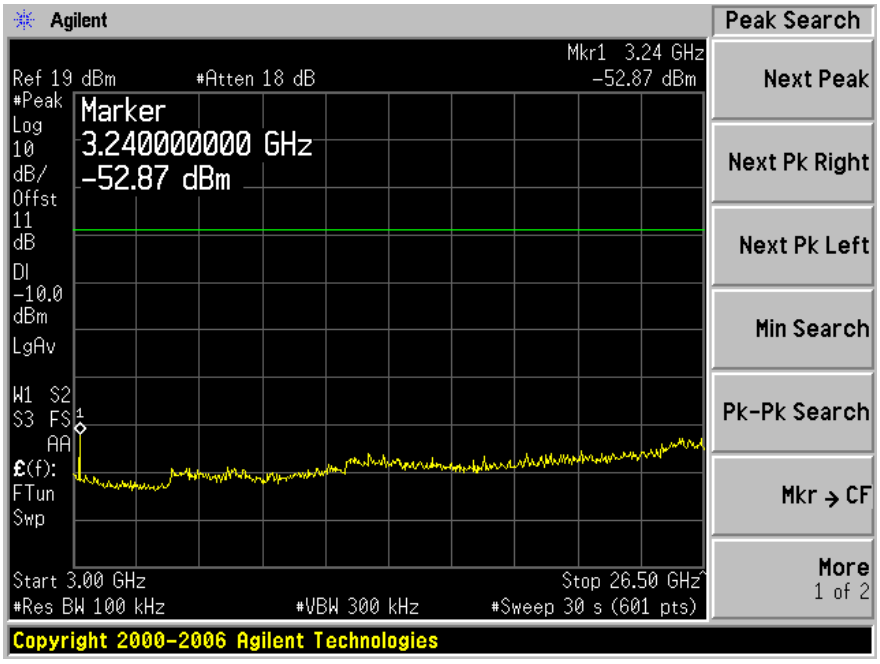


Plot 2: 3.0 GHz to 26.5 GHz

802.11g, Low Channel – 2412 MHz

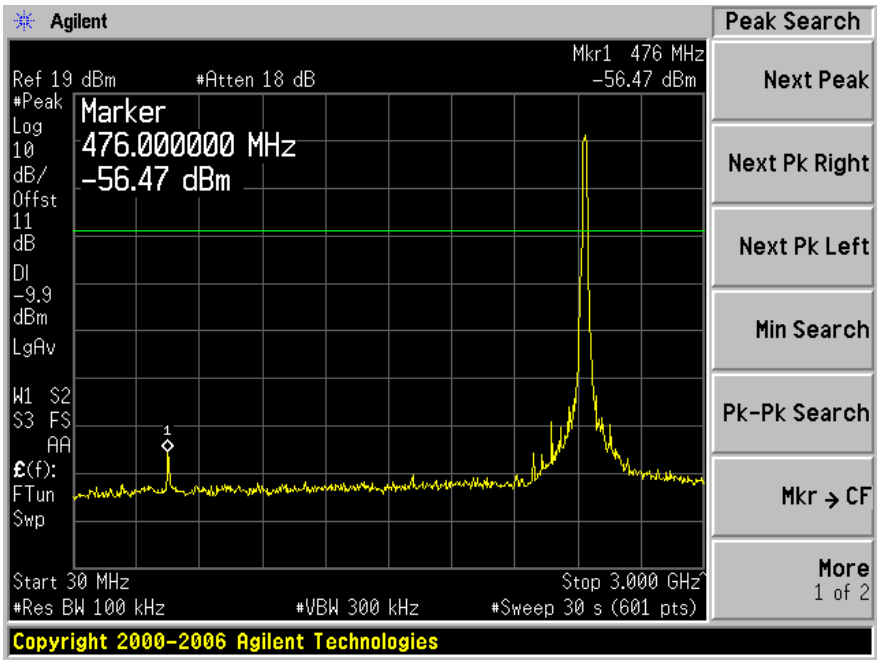


Plot 1: 30 MHz to 3.0 GHz

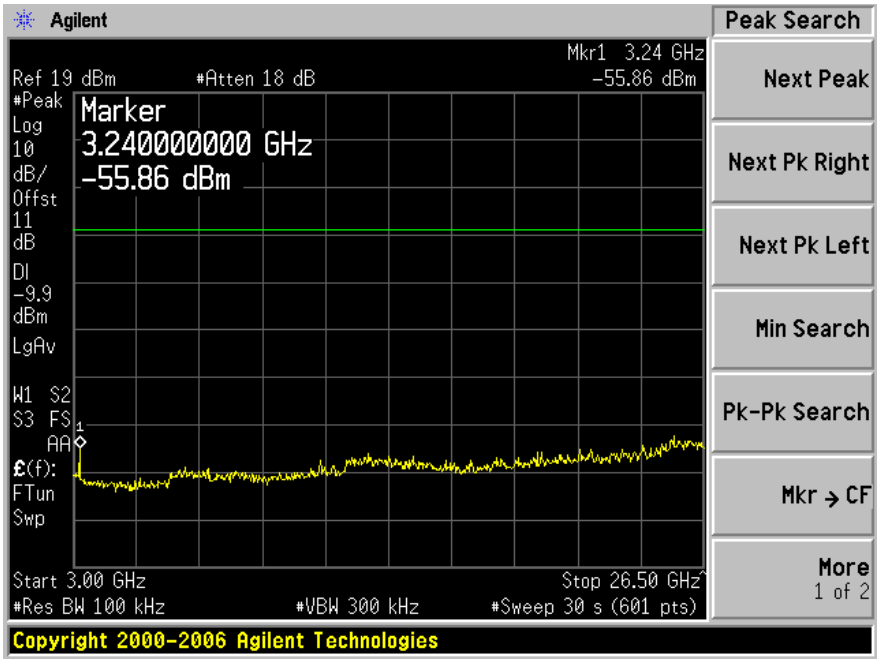


Plot 2: 3.0 GHz to 26.5 GHz

802.11g, Middle Channel – 2437 MHz

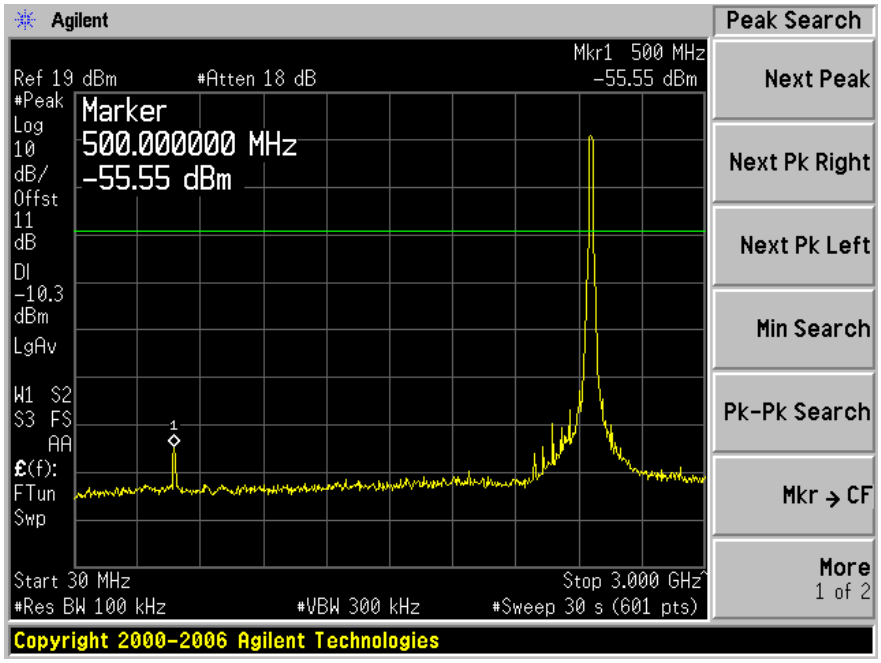


Plot 1: 30 MHz to 3.0 GHz

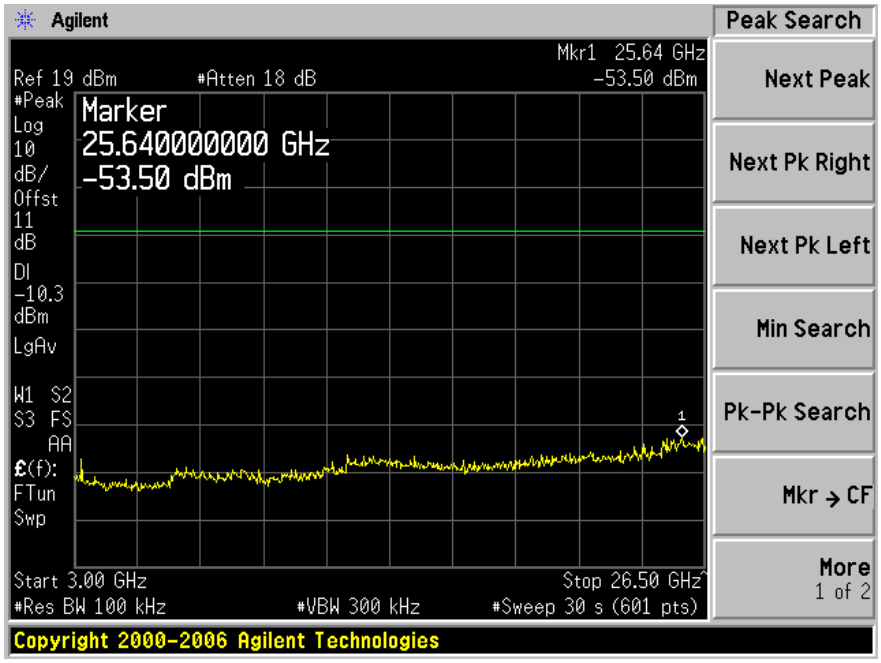


Plot 2: 3.0 GHz to 26.5 GHz

802.11g, High Channel – 2462 MHz

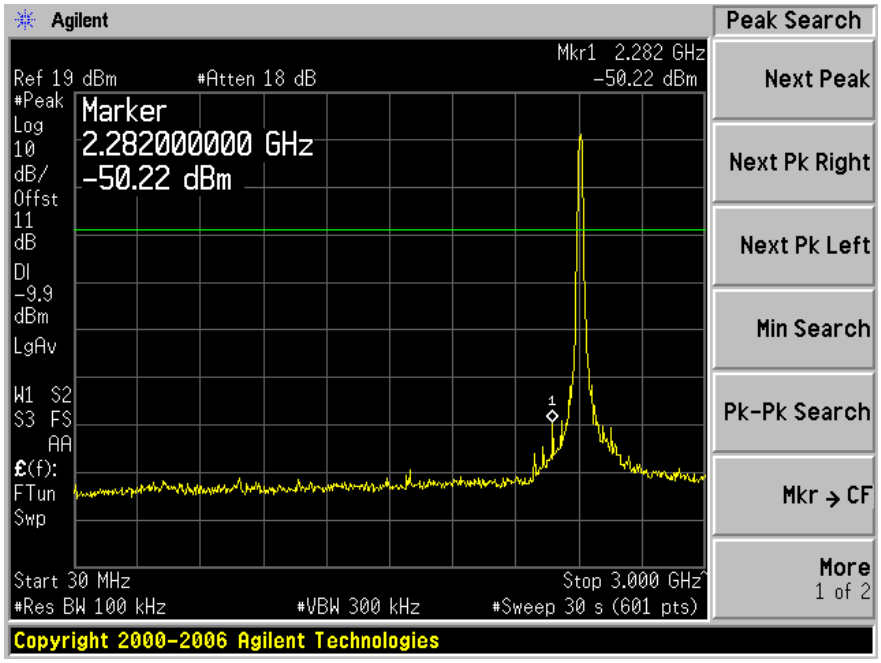


Plot 1: 30 MHz to 3.0 GHz

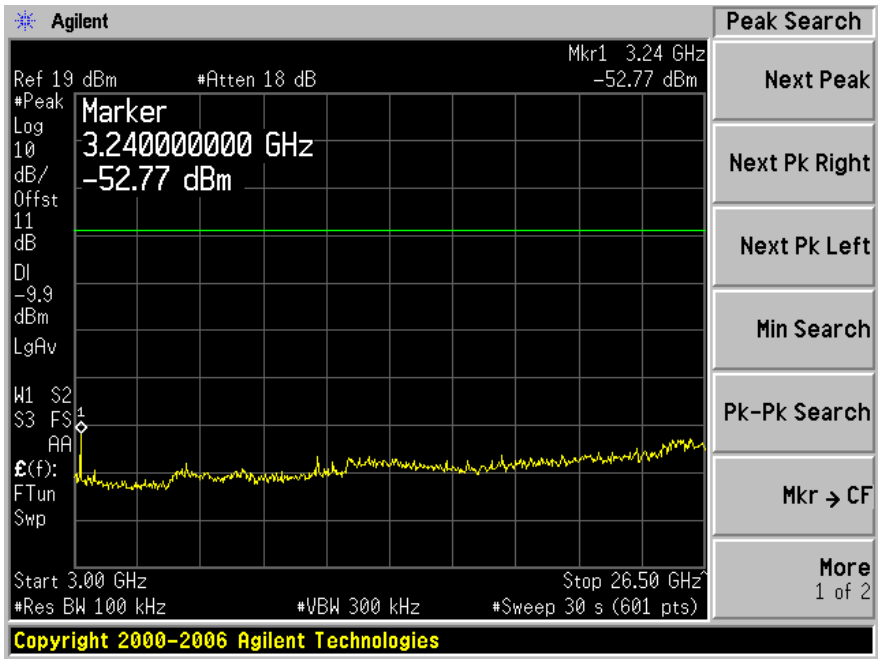


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 20 MHz, Low Channel – 2412 MHz

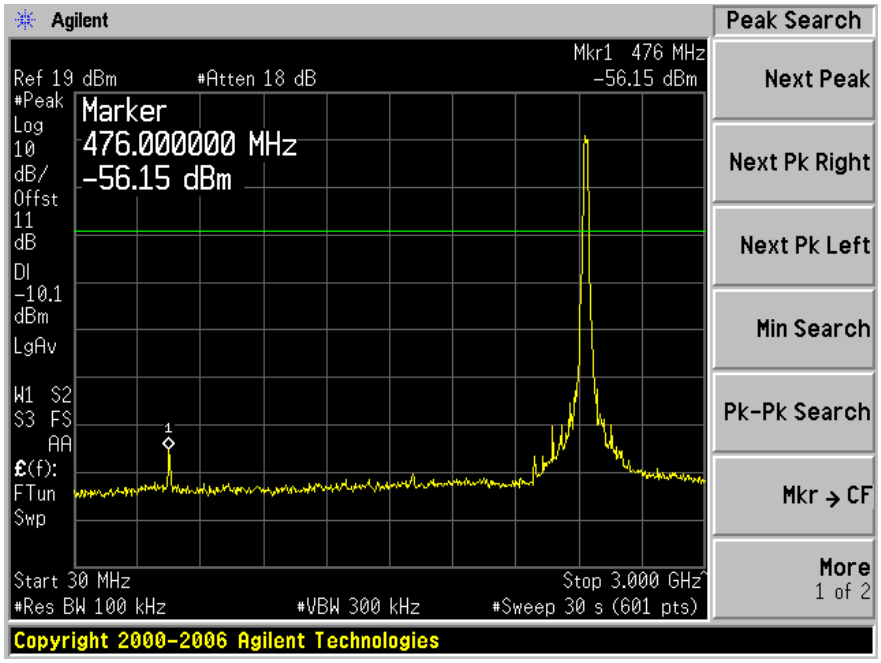


Plot 1: 30 MHz to 3.0 GHz

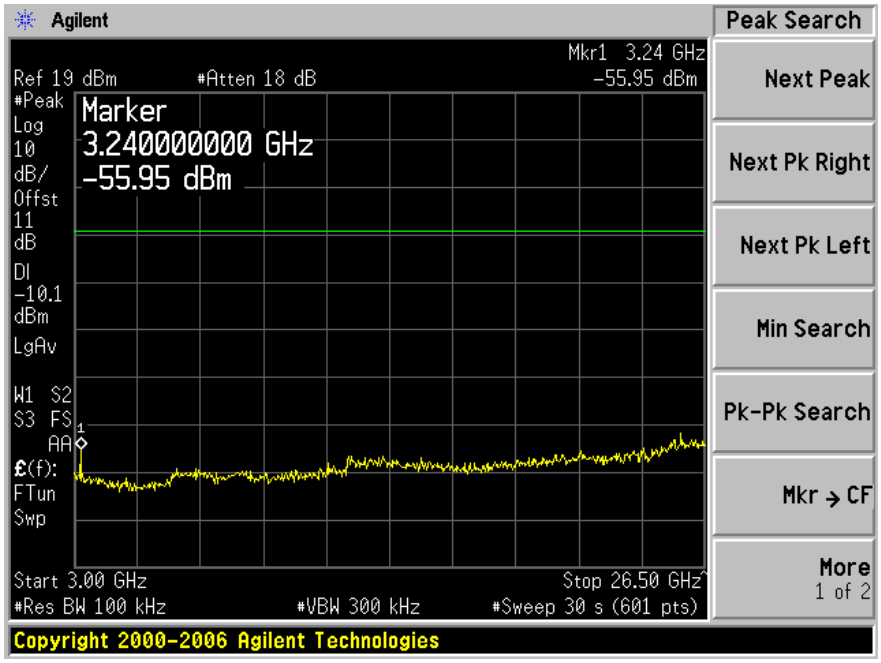


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 20 MHz, Middle Channel – 2437 MHz

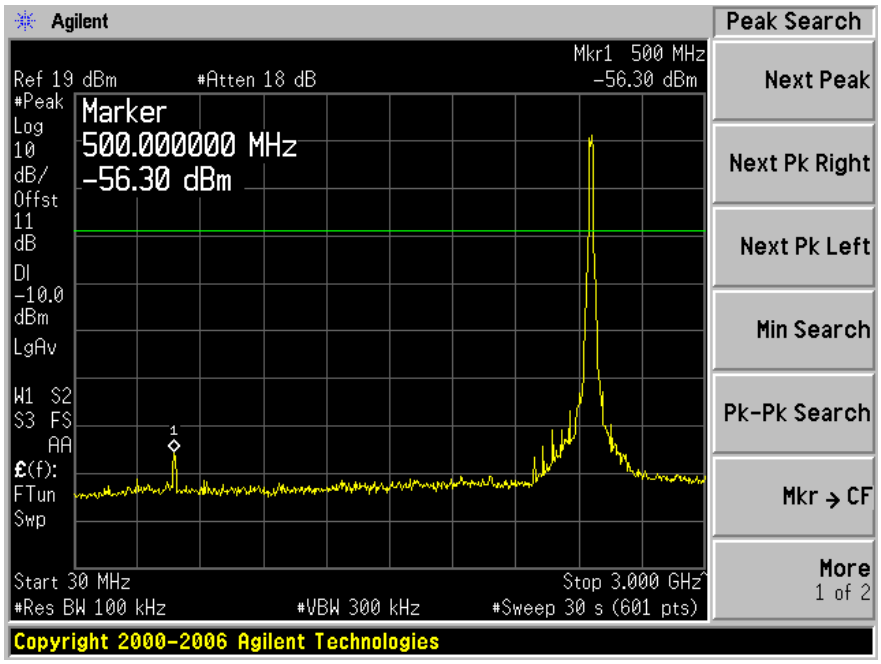


Plot 1: 30 MHz to 3.0 GHz

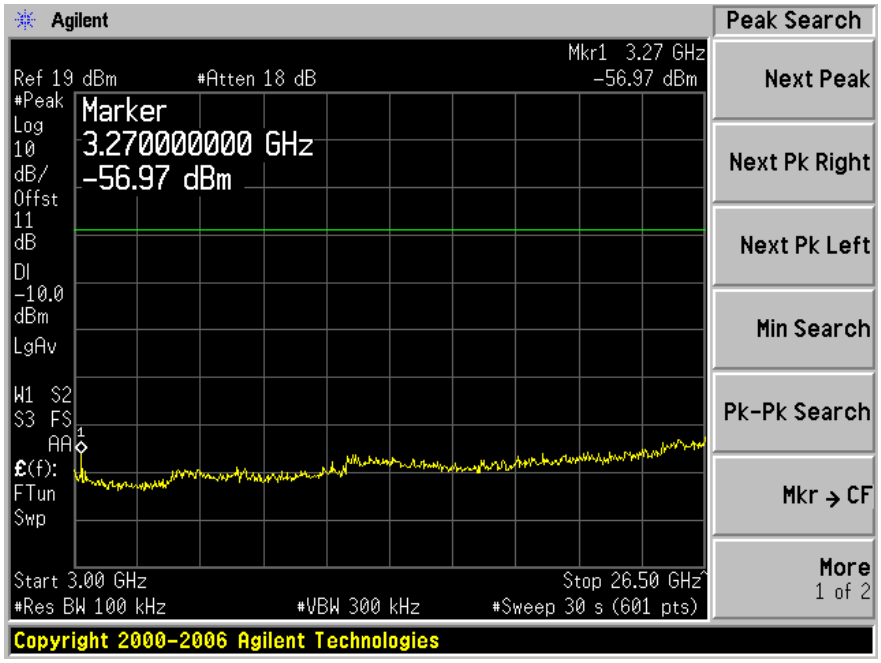


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 20 MHz, High Channel – 2462 MHz

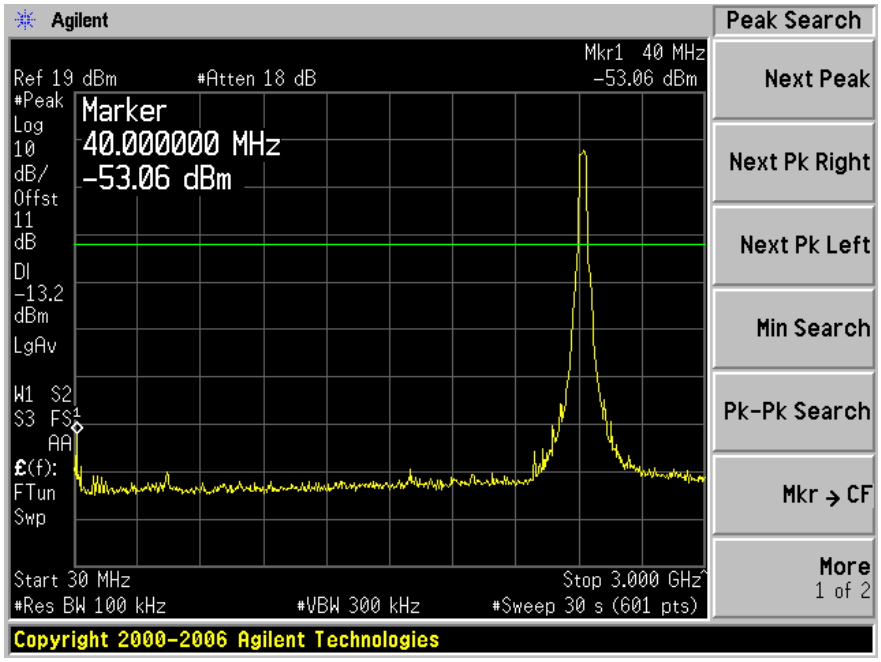


Plot 1: 30 MHz to 3.0 GHz

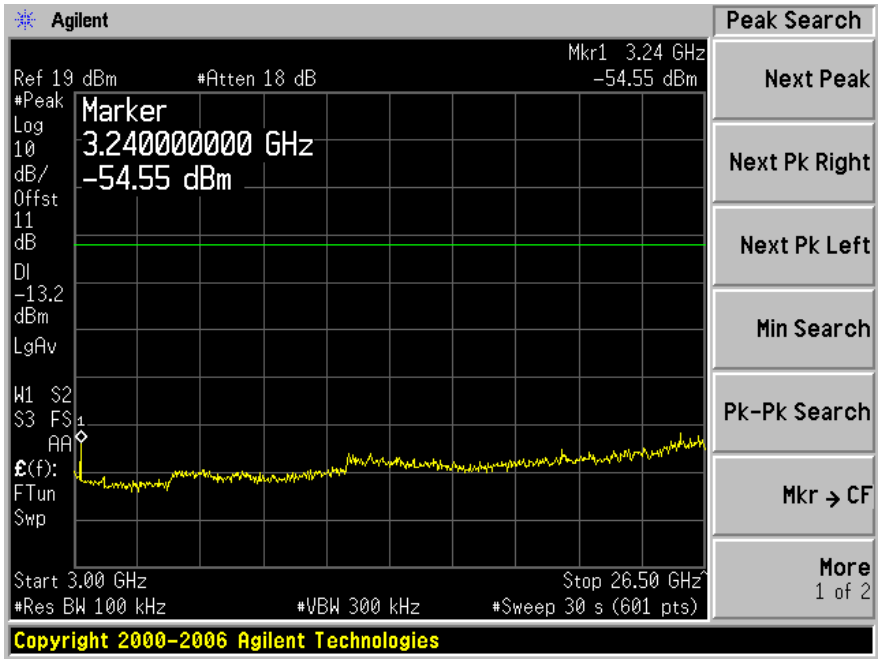


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 40 MHz, Low Channel – 2422 MHz

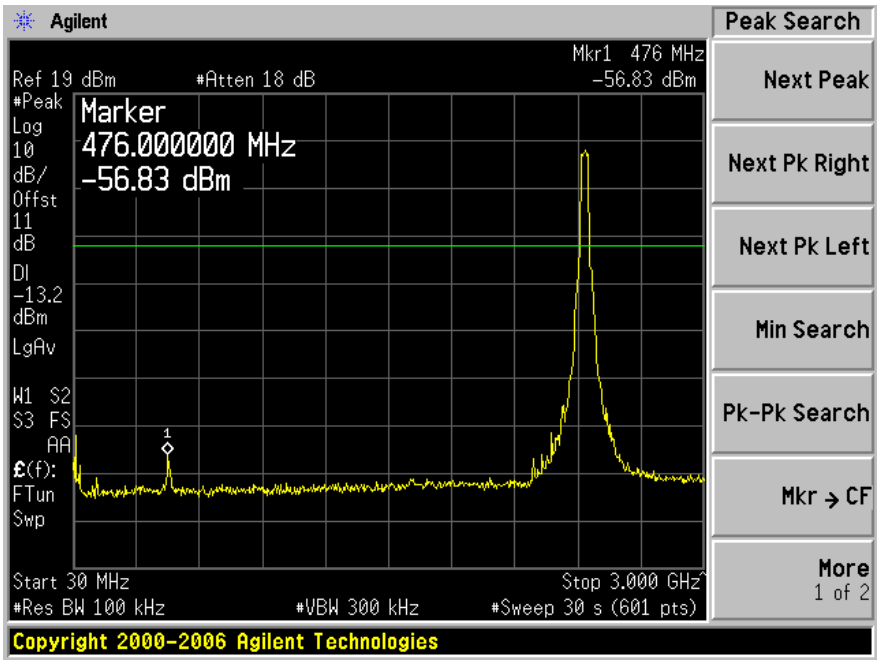


Plot 1: 30 MHz to 3.0 GHz

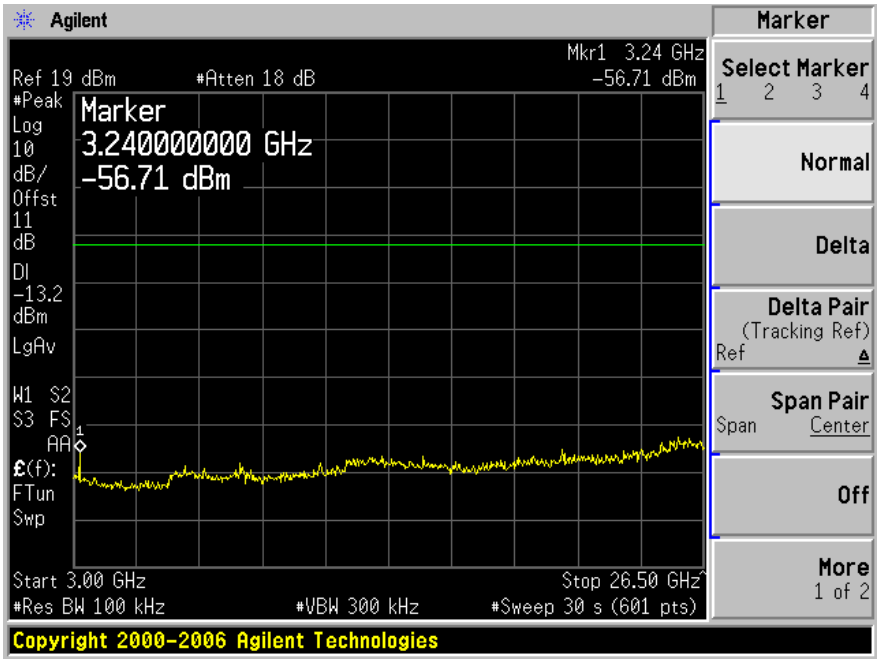


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 40 MHz, Middle Channel – 2437 MHz

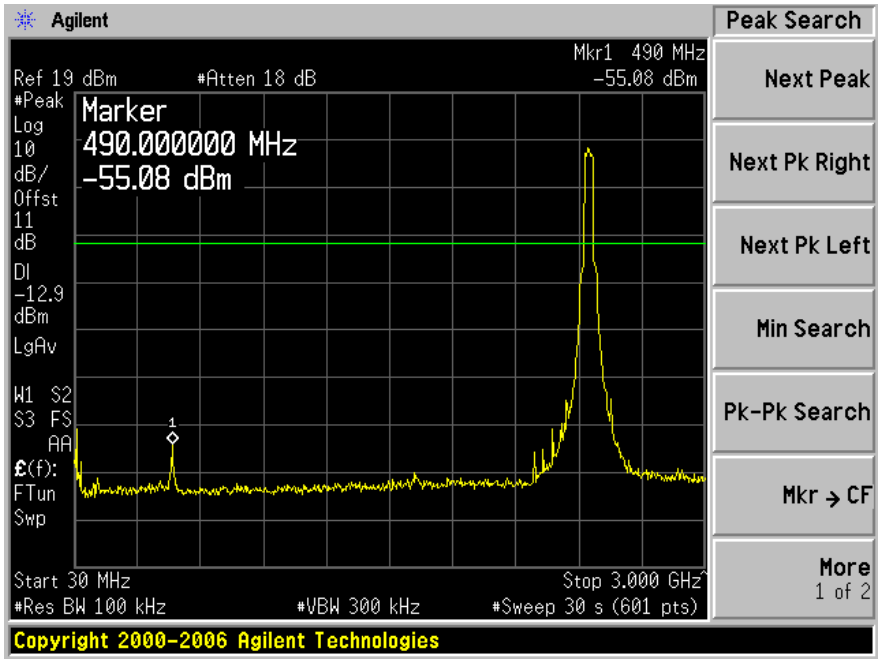


Plot 1: 30 MHz to 3.0 GHz

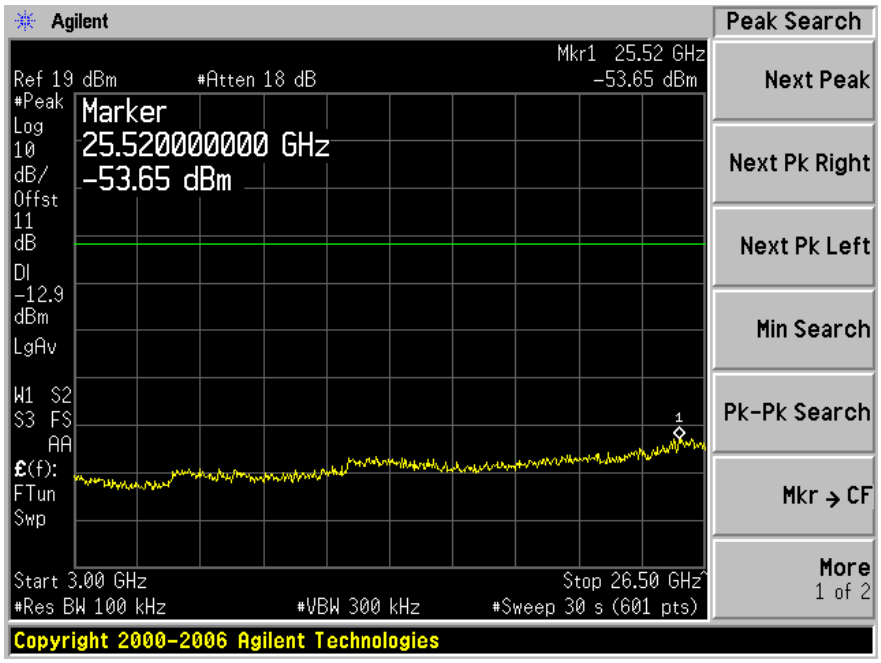


Plot 2: 3.0 GHz to 26.5 GHz

802.11n 40 MHz, High Channel – 2452 MHz



Plot 1: 30 MHz to 3.0 GHz



Plot 2: 3.0 GHz to 26.5 GHz

9 FCC §15.247(e) & IC RSS-210 §A8.2(b) - Power Spectral Density

9.1 Applicable Standard

According to §15.247 (e) and RSS-210 § A8.2 (b) , 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.

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 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. Measure the power spectral density as follows:
   A. Tune the analyzer to the highest point of the maximized fundamental emission. Reset the analyzer to a RBW = 3 kHz, VBW > RBW, span = 10 kHz, sweep = 340 sec.
   B. From the peak level obtained in (A), derive the field strength, E, by applying the appropriate antenna factor, cable loss, pre-amp gain, etc.
4. P = (E x d) squared / (30 x G)
   G = the numeric gain of the transmitting antenna over an isotropic radiator.
   d = the distance in meters from which the field strength was measured.
   P = the power in watts for which you are solving:
5. Using the equation listed in (4), calculate a power level for comparison to the + 8 dBm limit.

9.3 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US45303156	2009-03-25

*** 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:	20~22 °C
Relative Humidity:	33~50 %
ATM Pressure:	98~102.0kPa

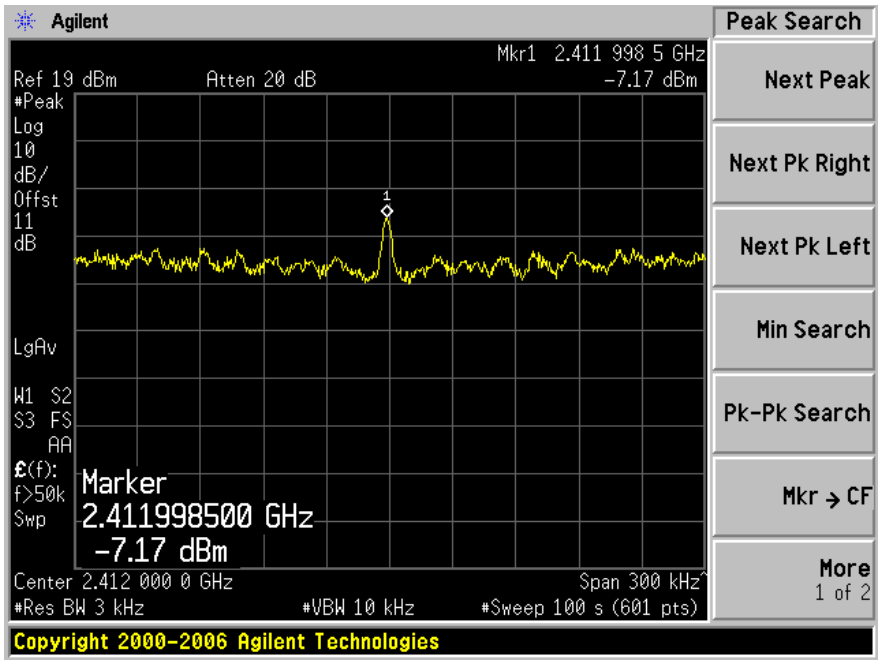
**The testing was performed by Dennis Huang 2010-02-24.*

9.5 Test Results

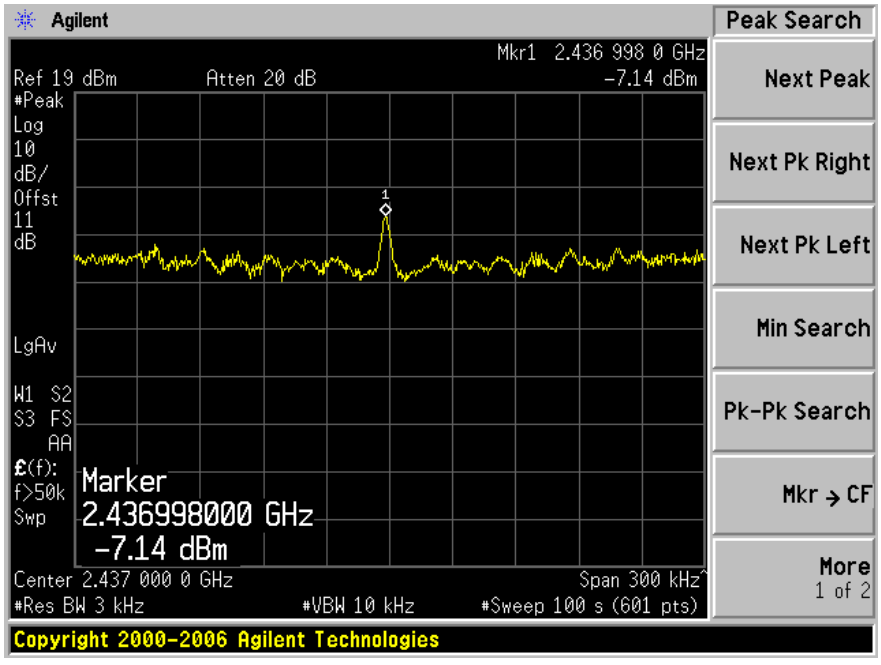
Radio Mode	Channel	Frequency (MHz)	PPSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
802.11b	Low	2412	-7.17	8	Compliant
	Mid	2437	-7.14	8	Compliant
	High	2462	-7.59	8	Compliant
802.11g	Low	2412	-9.35	8	Compliant
	Mid	2437	-9.30	8	Compliant
	High	2462	-9.34	8	Compliant
802.11n 20 MHz	Low	2412	-10.12	8	Compliant
	Mid	2437	-10.09	8	Compliant
	High	2462	-10.35	8	Compliant
802.11n 40 MHz	Low	2422	-10.83	8	Compliant
	Mid	2437	-10.87	8	Compliant
	High	2452	-10.79	8	Compliant

Please refer to the following plots for detailed test results

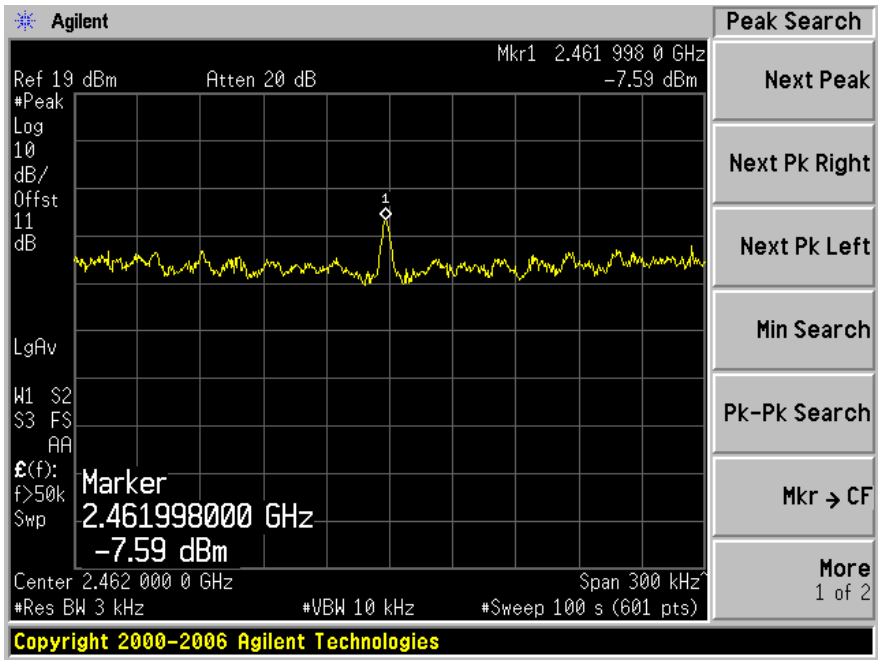
802.11b, Low Channel – 2412 MHz



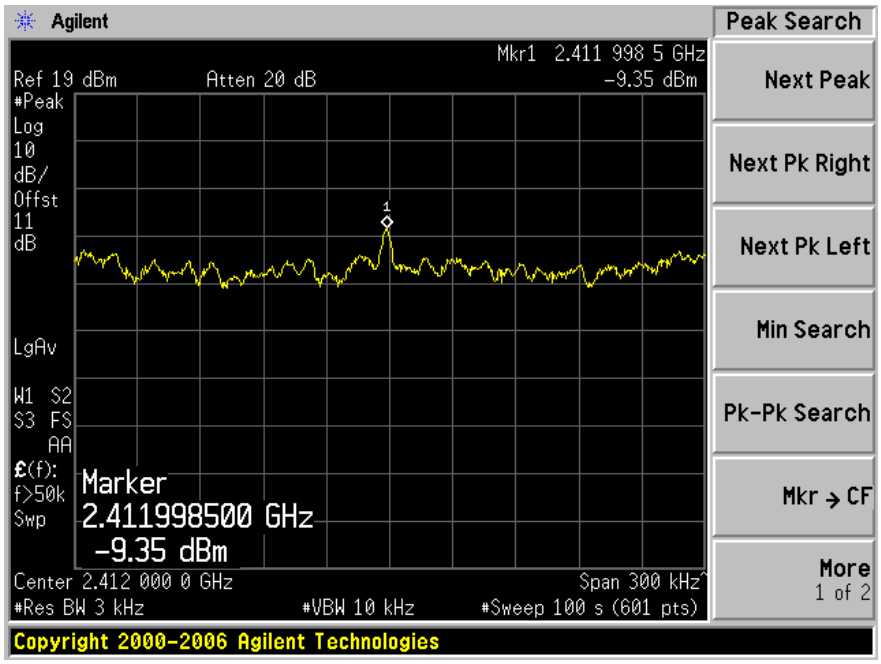
802.11b, Middle Channel – 2437 MHz



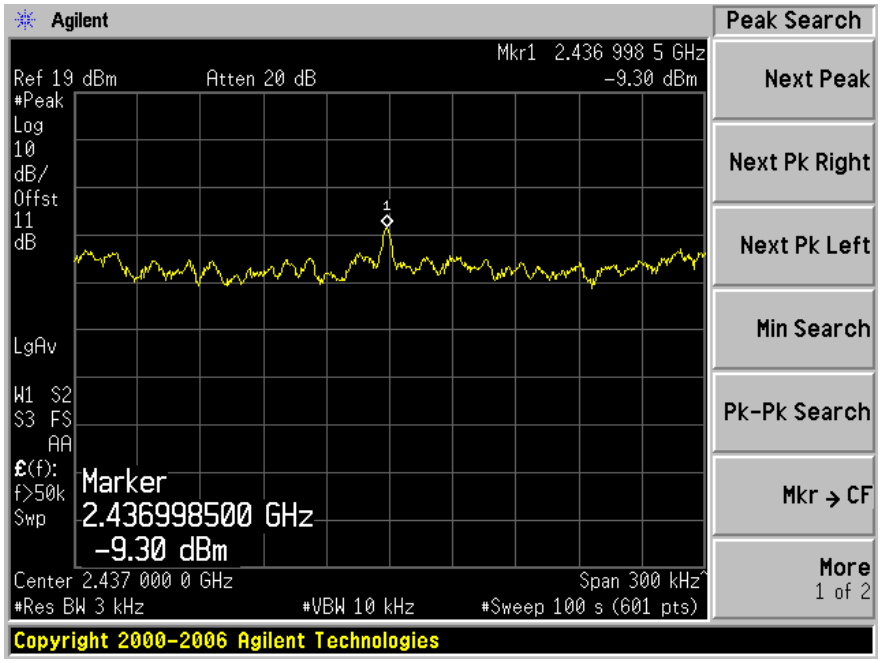
802.11b, High Channel – 2462 MHz



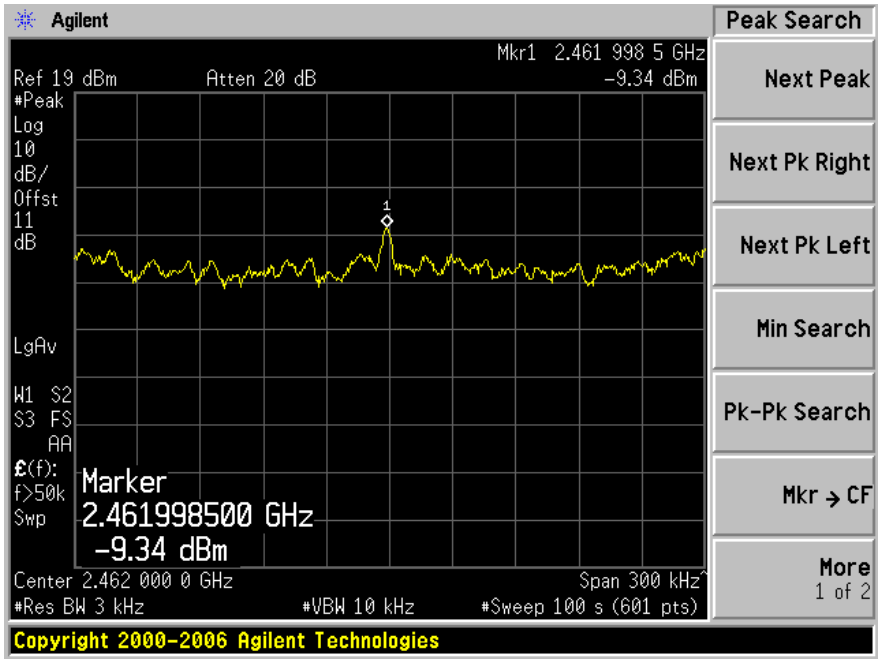
802.11g, Low Channel – 2412 MHz



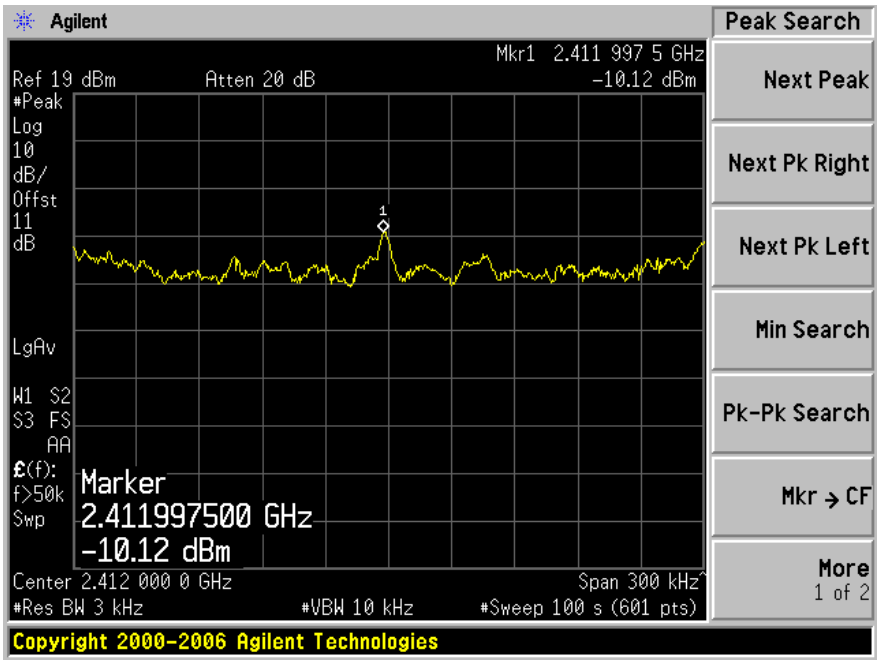
802.11g, Middle Channel – 2437 MHz



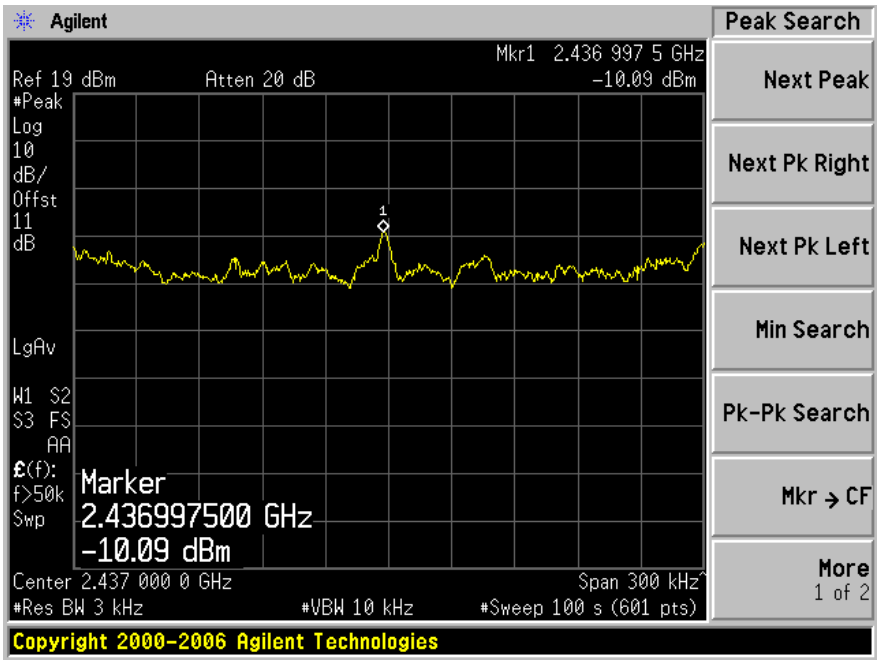
802.11g, High Channel – 2462 MHz



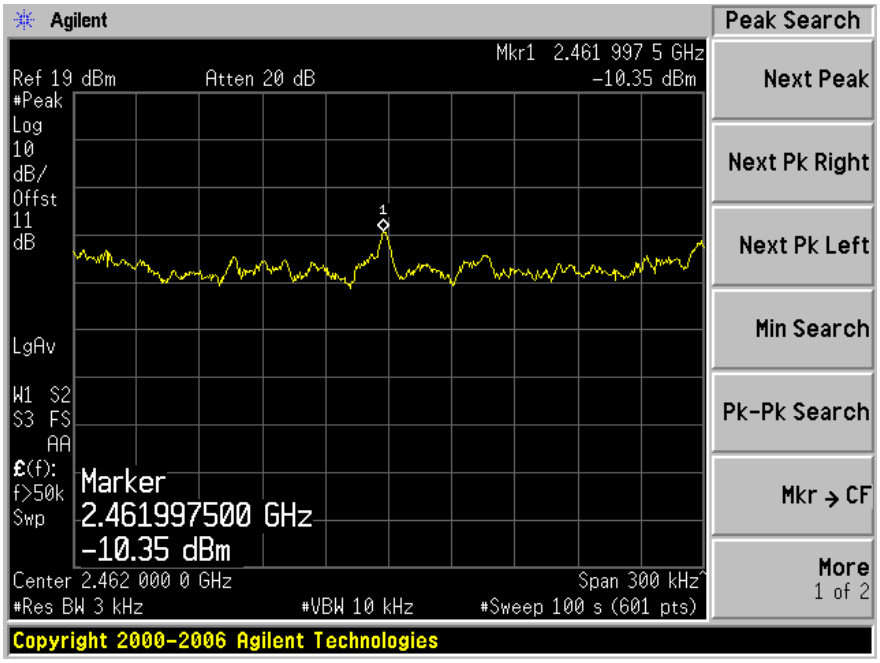
802.11n 20 MHz, Low Channel – 2412 MHz



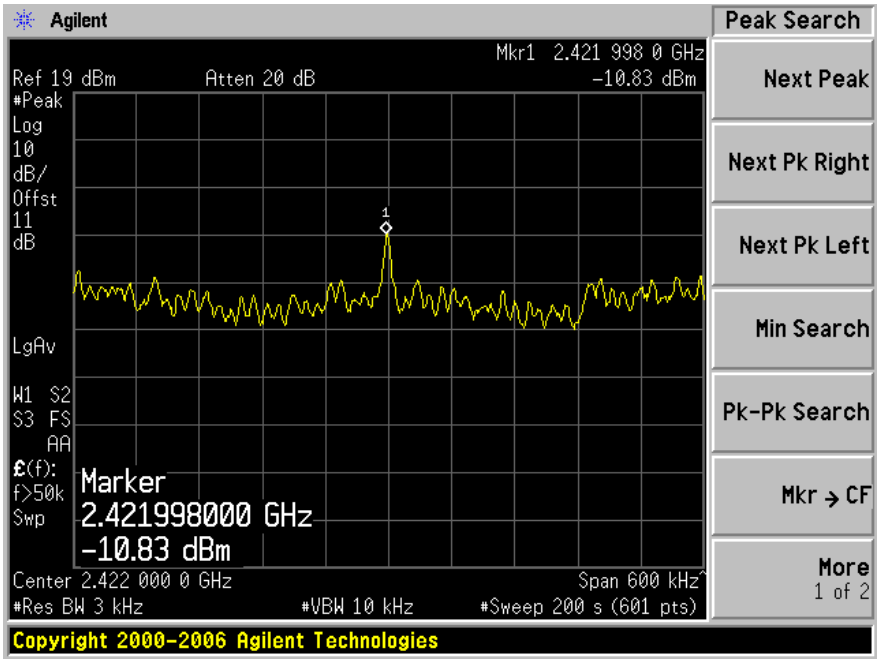
802.11n 20 MHz, Middle Channel – 2437 MHz



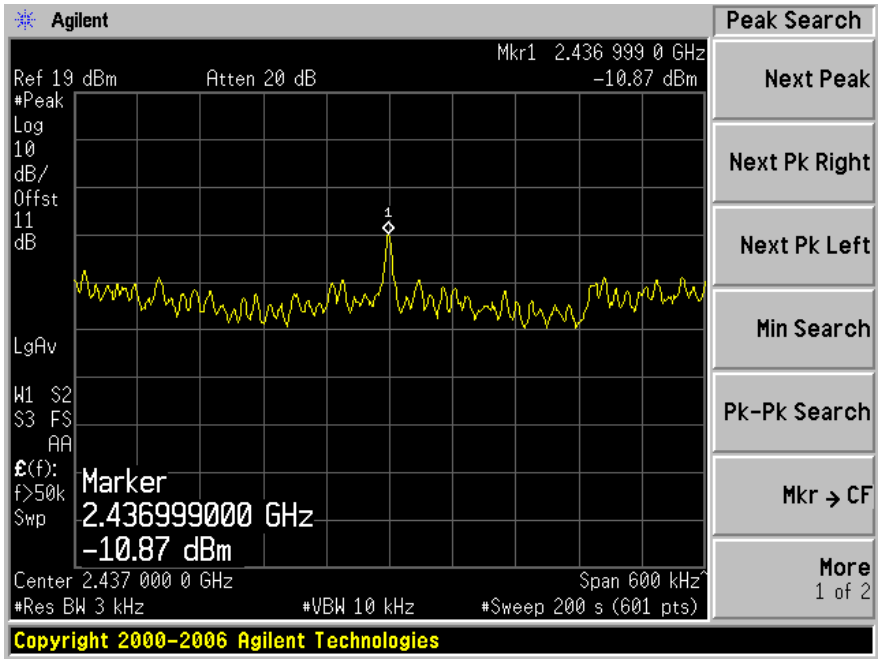
802.11n 20 MHz, High Channel – 2462 MHz



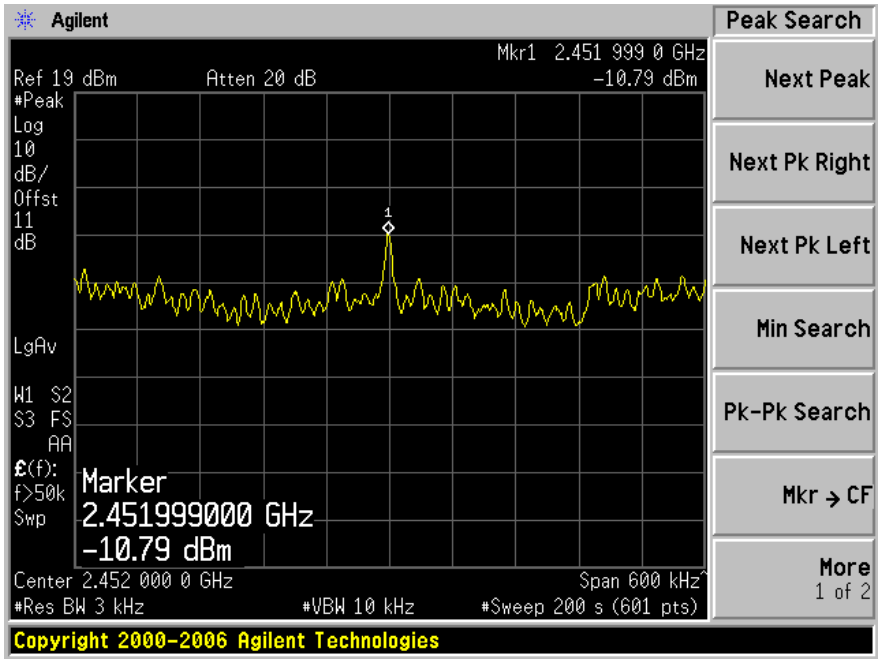
802.11n 40 MHz, Low Channel – 2422 MHz



802.11n 40 MHz, Middle Channel – 2437 MHz



802.11n 40 MHz, High Channel – 2452 MHz



Note: Sweep time ≥ (300 kHz/3kHz) seconds = 100 seconds

10 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §A8.5, RSS-Gen §4.9 - Spurious Radiated Emissions

10.1 Applicable Standard

As per FCC §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 FCC §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 FCC §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 FCC §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)).

As per IC RSS-210 §A8.5: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emissions limits specified in Tables 2 and 3.

IC RSS-Gen §4.9 the measurement method shall be described in the test report. The same parameter, peak power or average power, used for the transmitter output power measurement shall be used for unwanted emission measurements. The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or from 30 MHz, whichever is the lower, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

10.2 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 and RSS-210 limits.

10.3 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 and RSS-210 limits.

The spacing between the peripherals was 3 centimeters.

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

10.4 Test Procedure

For the radiated emissions test, the EUT was connected to the DC power source, 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 meters away from the testing antenna, which is varied from 1-4 meters, 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 1000 MHz:
RBW = 100 kHz/VBW = 300 kHz/Sweep = Auto

Above 1000 MHz:
(1) Peak: RBW = 1MHz/VBW = 1MHz/Sweep = Auto
(2) Average: RBW = 1MHz/VBW = 10Hz/Sweep = Auto

10.5 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 - Limit

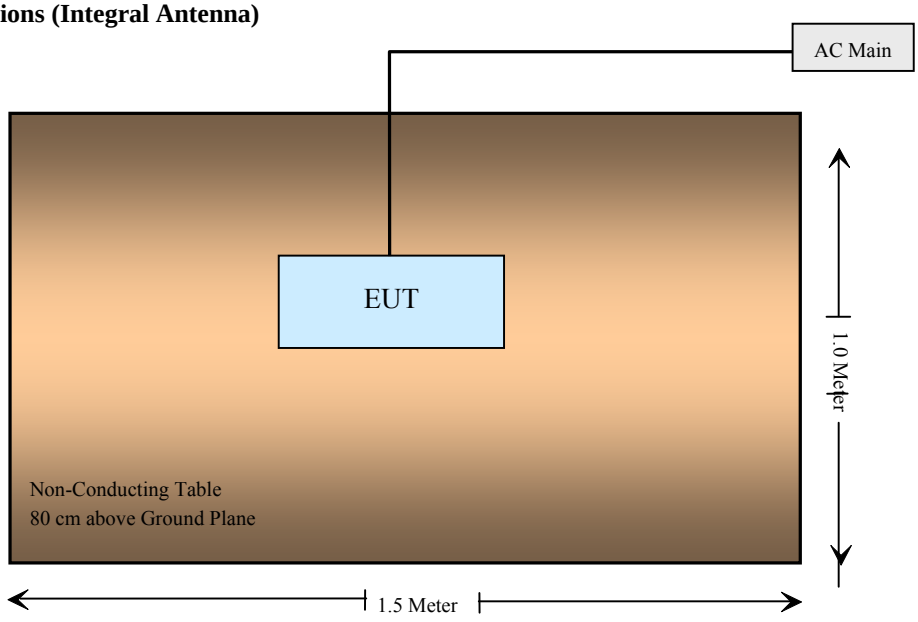
10.6 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US44303352	2009-04-27
Hewlett Packard	Pre amplifier	8447D	2944A06639	2009-06-05
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2009-05-05
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2009-04-29
HP	Pre Amplifier	8449B	3147A00400	2010-02-01
A.R.A Inc	Horn antenna	DRG-1181A	1132	2009-10-27
Sunol Science Corp	System Controller	SC99V	122303-1	N/R

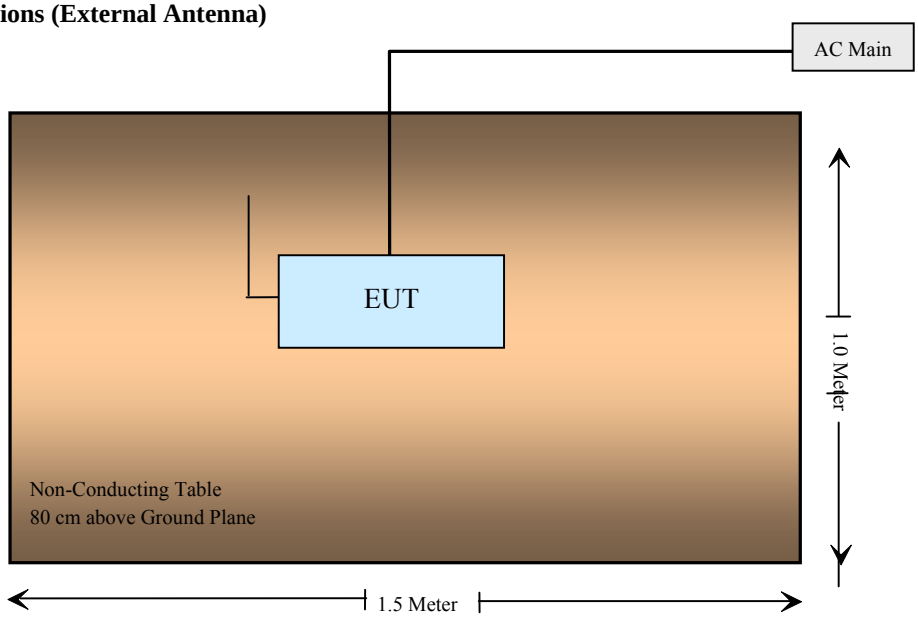
*** Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

10.7 Test Setup Block Diagram

Radiated Emissions (Integral Antenna)



Radiated Emissions (External Antenna)



10.8 Test Environmental Conditions

Temperature:	20~22°C
Relative Humidity:	31~55 %
ATM Pressure:	80~101.1kPa

**The testing was performed by Dennis Huang on 2010-02-04 in Chamber 3.*

10.9 Test Results

According to the data hereinafter, the EUT complied with the FCC and IC requirements, and had the worst margin readings of:

Below 1 GHz:

Integral Antenna

Middle Channel: 2437 MHz (802.11b)			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-1.70	45.24836	Vertical	30 to 1000 MHz
-*	-	-	Above 1 GHz

External Antenna

Middle Channel: 2437 MHz (802.11b)			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-5.17	31.45764	Vertical	30 to 1000 MHz
-*	-	-	Above 1 GHz

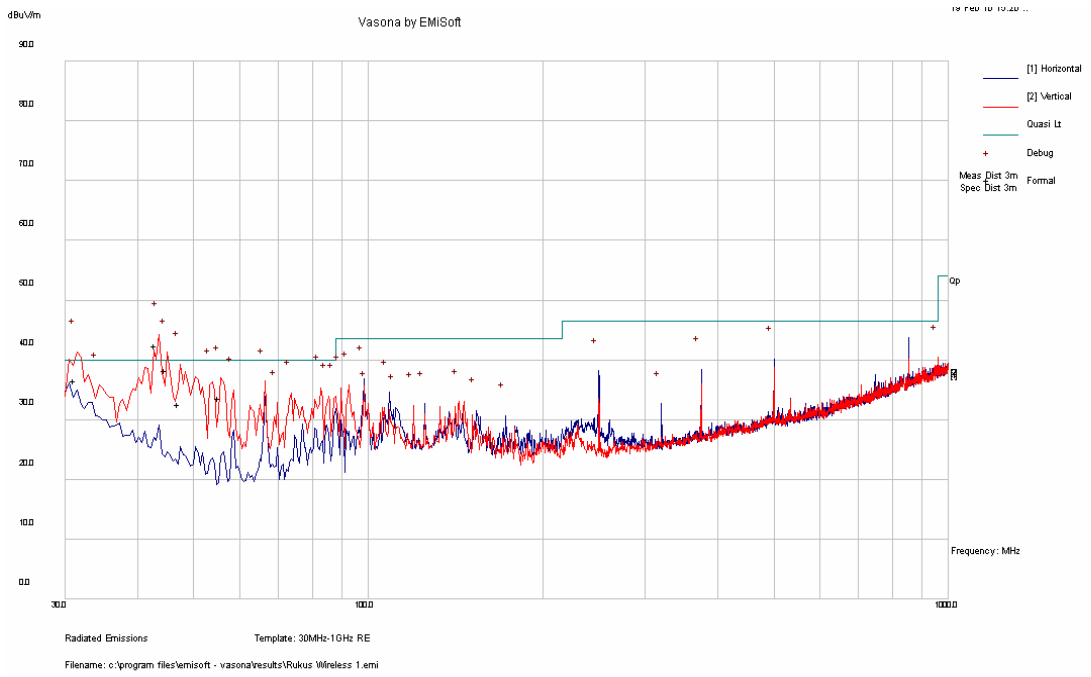
**Note: All emissions were at the noise floor level and/or 20 dB below the limit.*

Please refer to the following tables for more detailed results.

10.10 Radiated Emissions Test Plot & Data

30 MHz – 1 GHz:

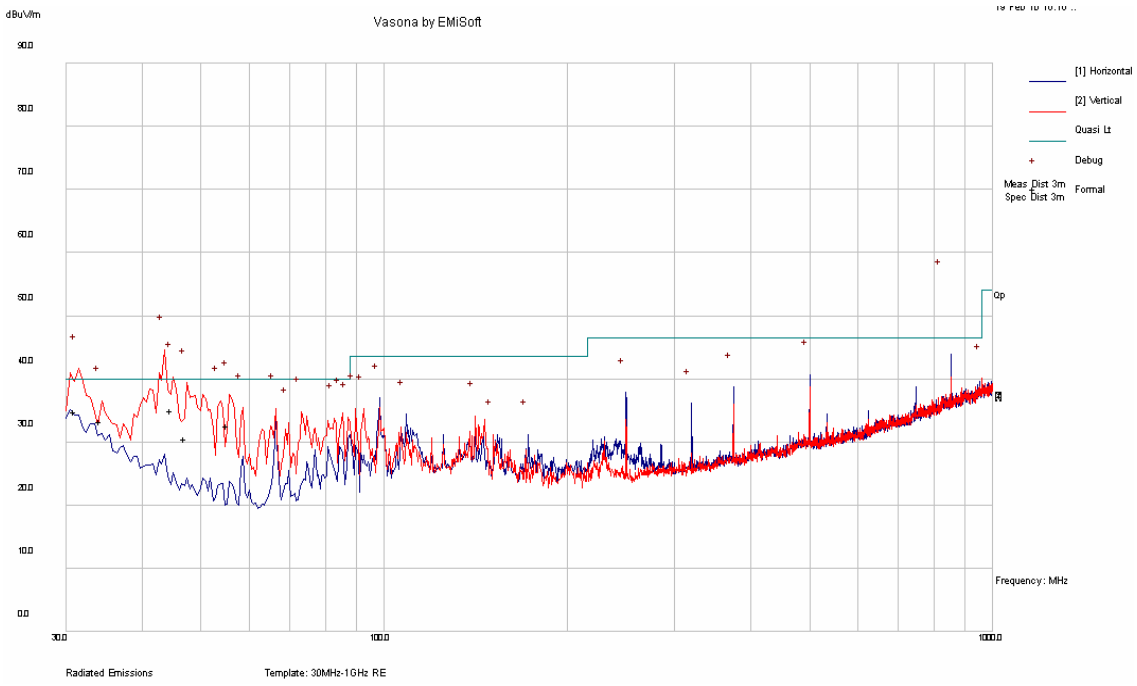
Integral Antenna, 802.11b Middle Channel: 2437 MHz, measured at 3 meters



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
45.24836	38.30	130	V	37	40.0	-1.70
31.47396	36.59	98	V	93	40.0	-3.41
853.3205	42.43	93	H	158	46.5	-4.07
66.28164	34.98	300	V	203	40.0	-5.02
55.85476	33.61	93	V	196	40.0	-6.39
47.58096	32.67	106	V	26	40.0	-7.33

External Antenna, 802.11b Middle Channel: 2437 MHz, measured at 3 meters



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
853.3339	42.04	102	H	150	46.5	-4.46
45.25292	35.06	166	V	340	40.0	-4.94
31.45764	34.83	159	V	256	40.0	-5.17
34.58988	33.38	96	V	247	40.0	-6.62
55.87636	32.61	142	V	175	40.0	-7.39
47.56848	30.53	156	V	323	40.0	-9.47

Above 1 GHz, measured at 3 Meter:

Integral Antenna

802.11b, 802.11g, 802.11n 20 MHz

Low Channel: 2412 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*
Middle Channel: 2437 MHz -*All emissions were at the noise floor level and/or 20dB below the limit.*
High Channel: 2462 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*

802.11n 40 MHz

Low Channel: 2422 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*
Middle Channel: 2437 MHz -*All emissions were at the noise floor level and/or 20dB below the limit.*
High Channel: 2452 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*

External Antenna

802.11b, 802.11g, 802.11n 20 MHz

Low Channel: 2412 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*
Middle Channel: 2437 MHz -*All emissions were at the noise floor level and/or 20dB below the limit.*
High Channel: 2462 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*

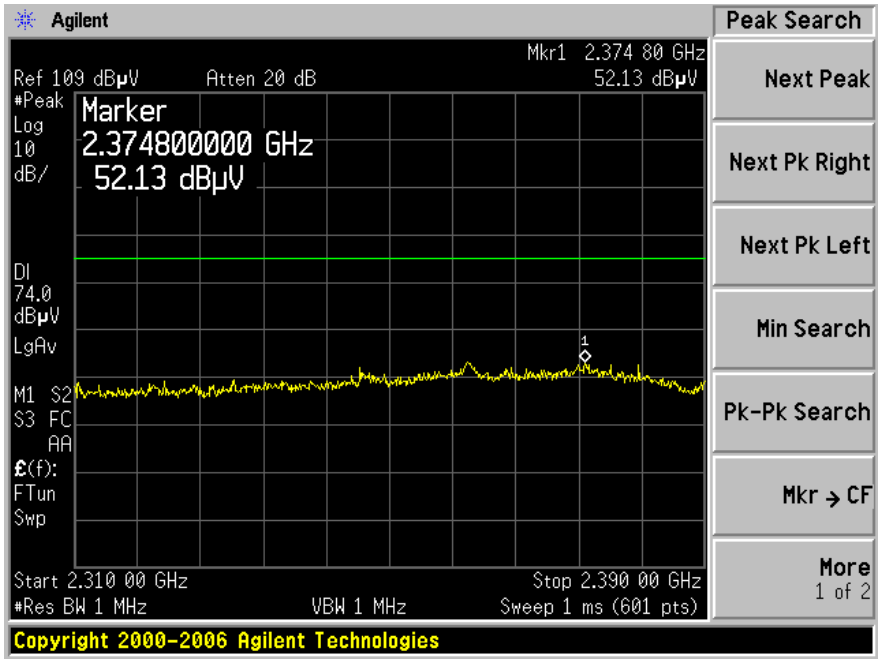
802.11n 40 MHz

Low Channel: 2422 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*
Middle Channel: 2437 MHz -*All emissions were at the noise floor level and/or 20dB below the limit.*
High Channel: 2452 MHz - *All emissions were at the noise floor level and/or 20dB below the limit.*

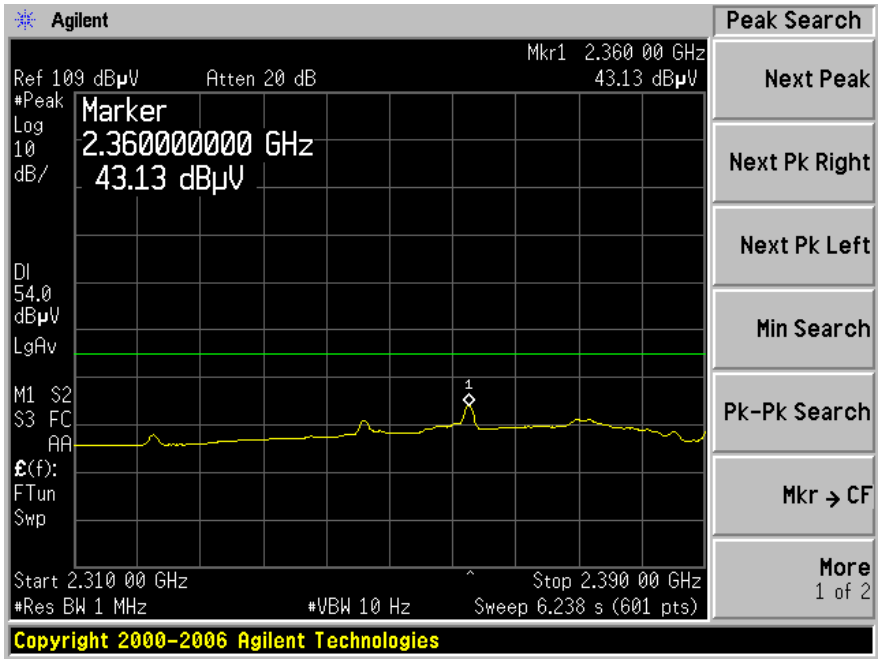
Out of Band Emissions:

Integral Antenna

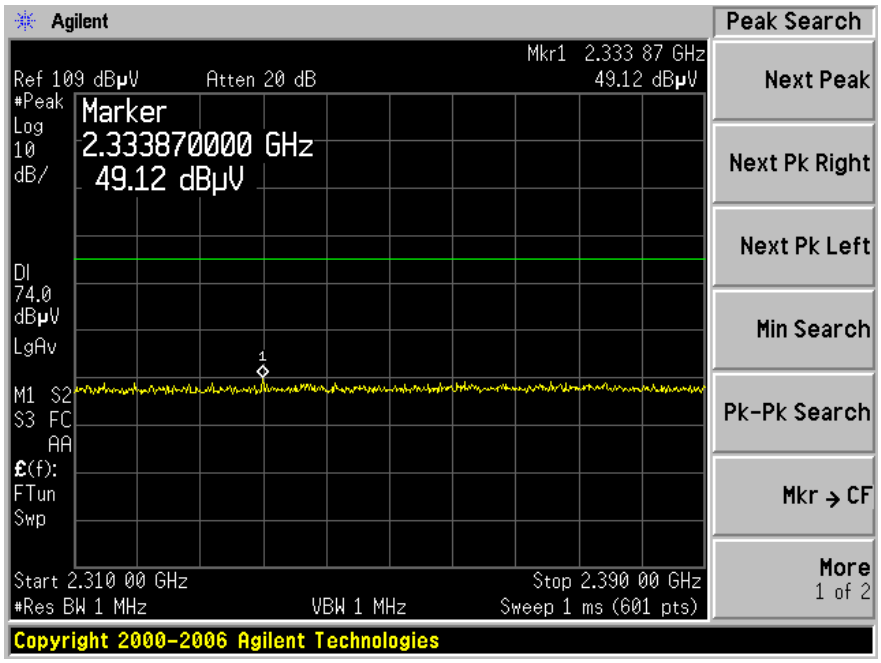
802.11b, Lowest Channel 2412 MHz



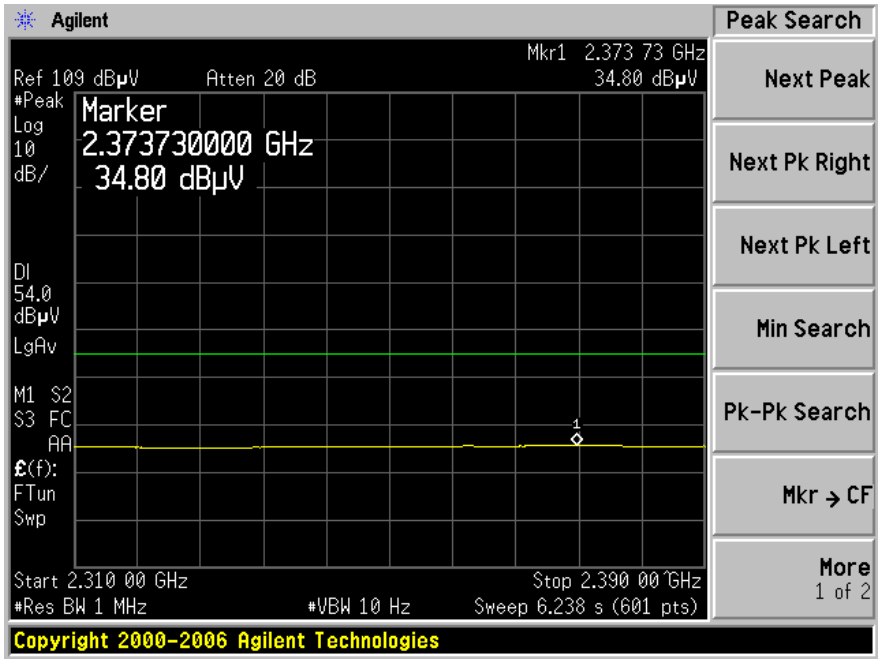
Horizontal - Peak



Horizontal - Average

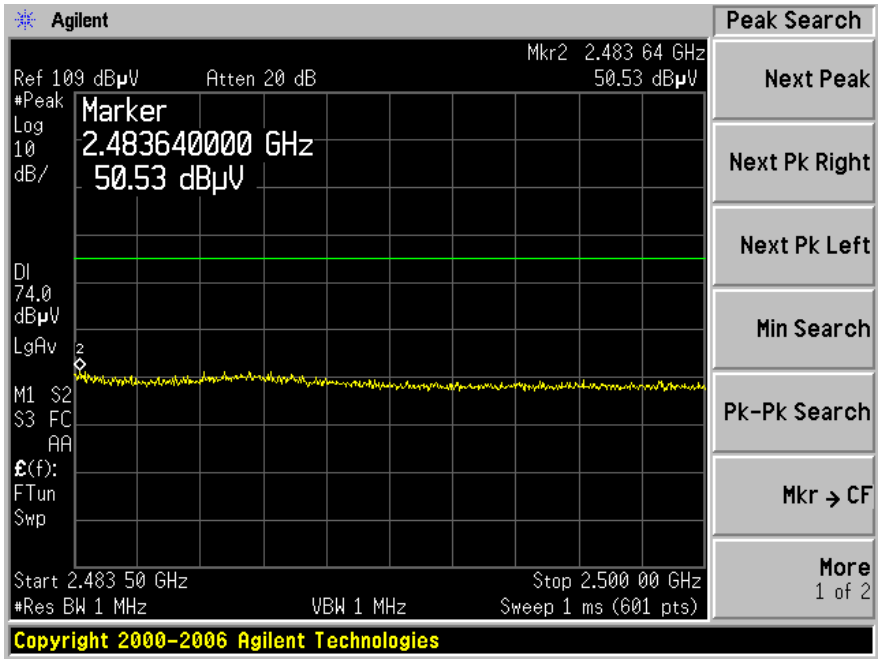


Vertical - Peak

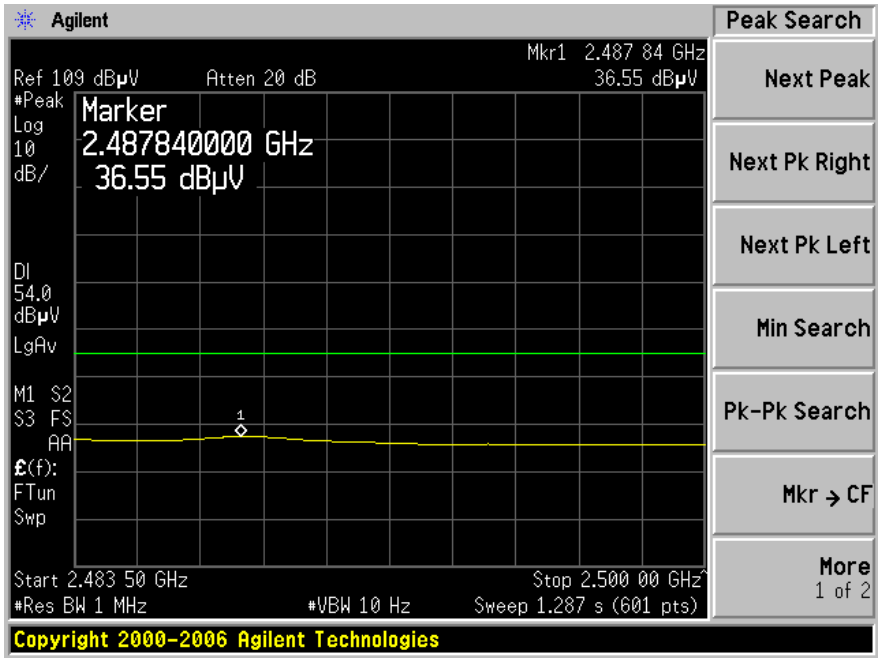


Vertical – Average

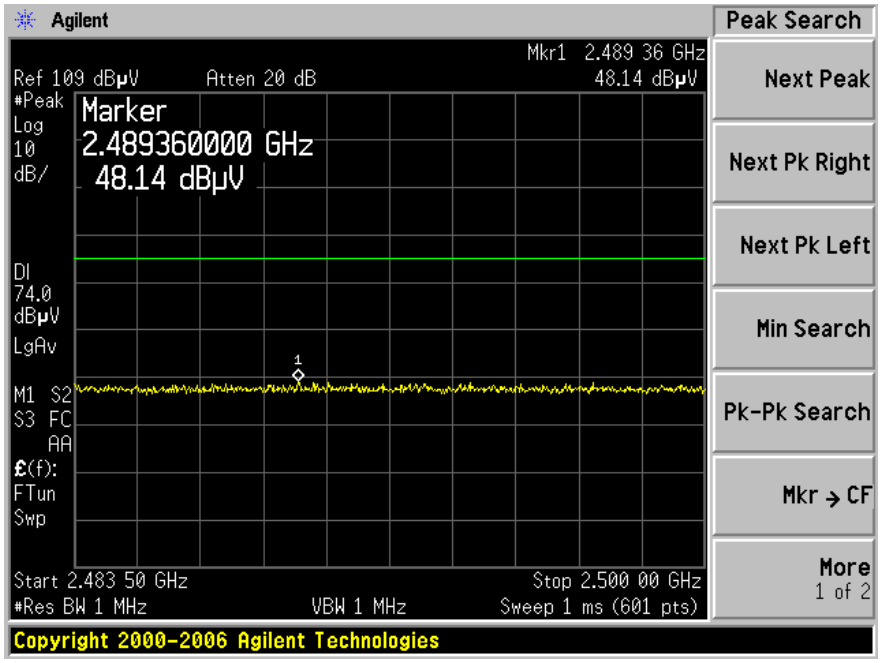
802.11b, Highest Channel: 2462 MHz



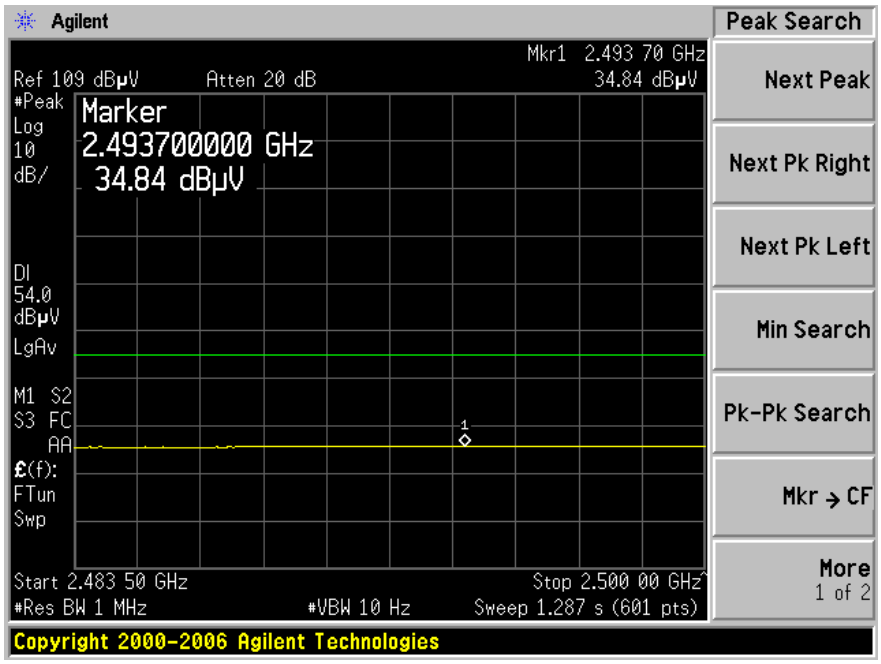
Horizontal - Peak



Horizontal - Average

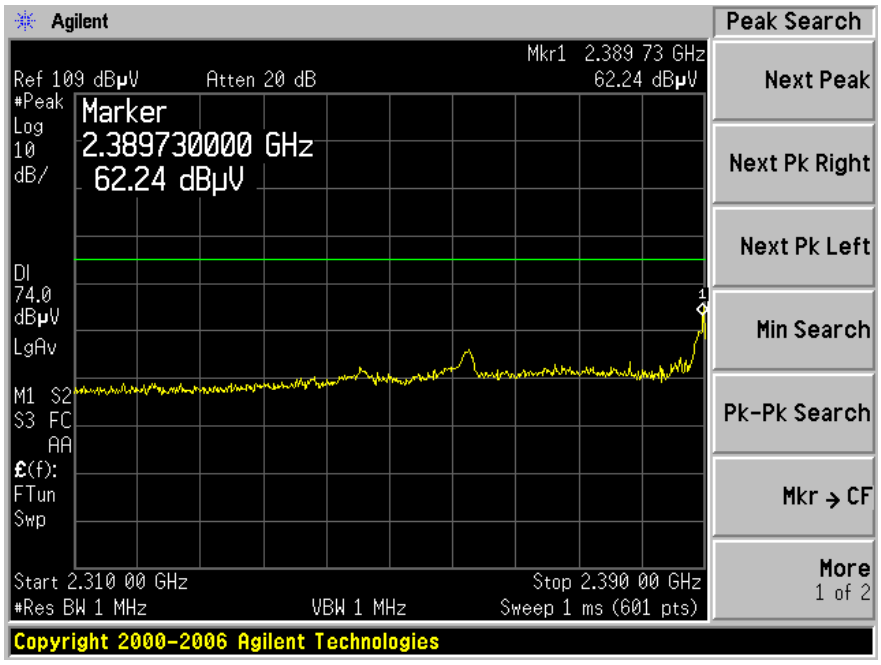


Vertical - Peak

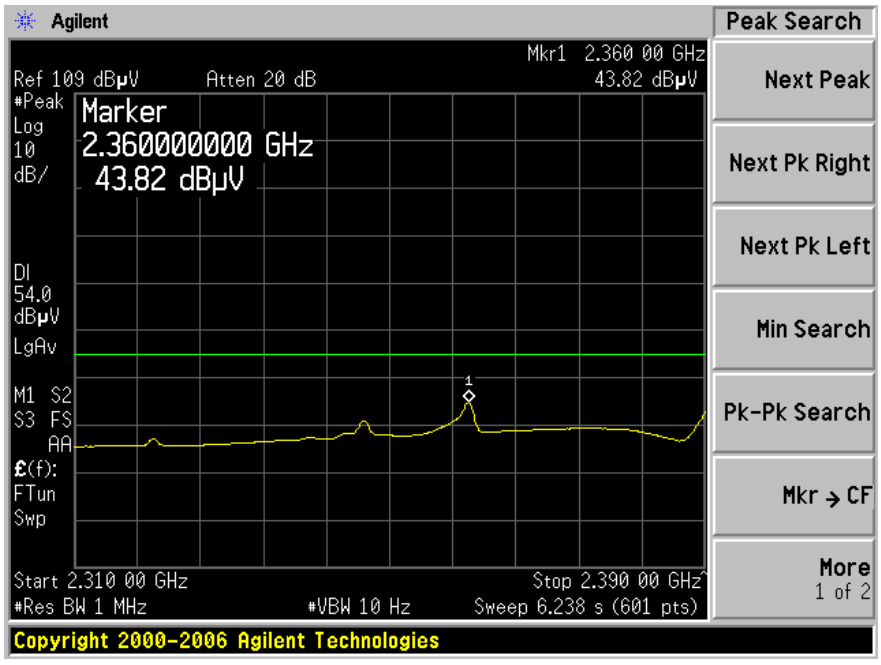


Vertical - Average

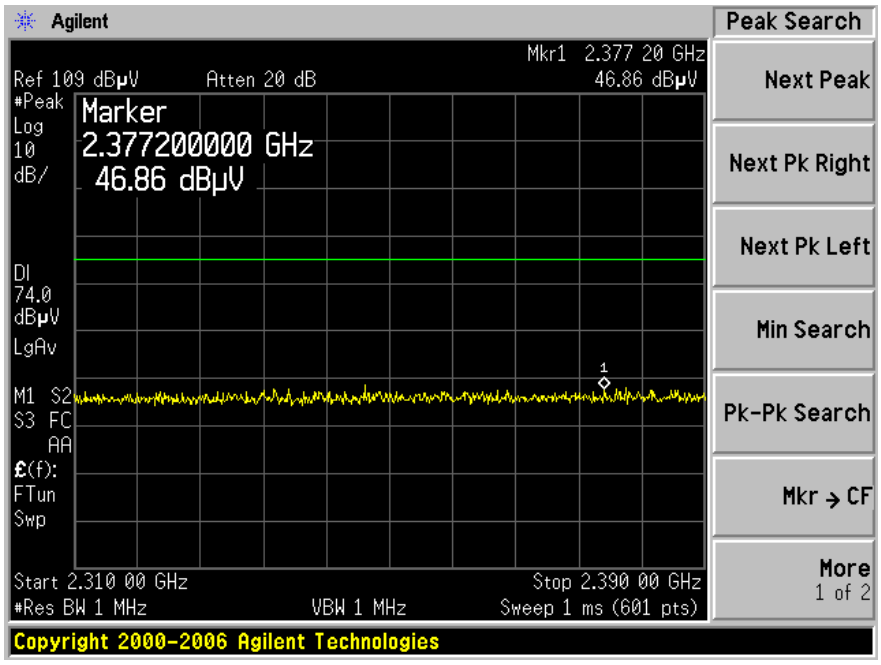
802.11g, Lowest Channel 2412 MHz



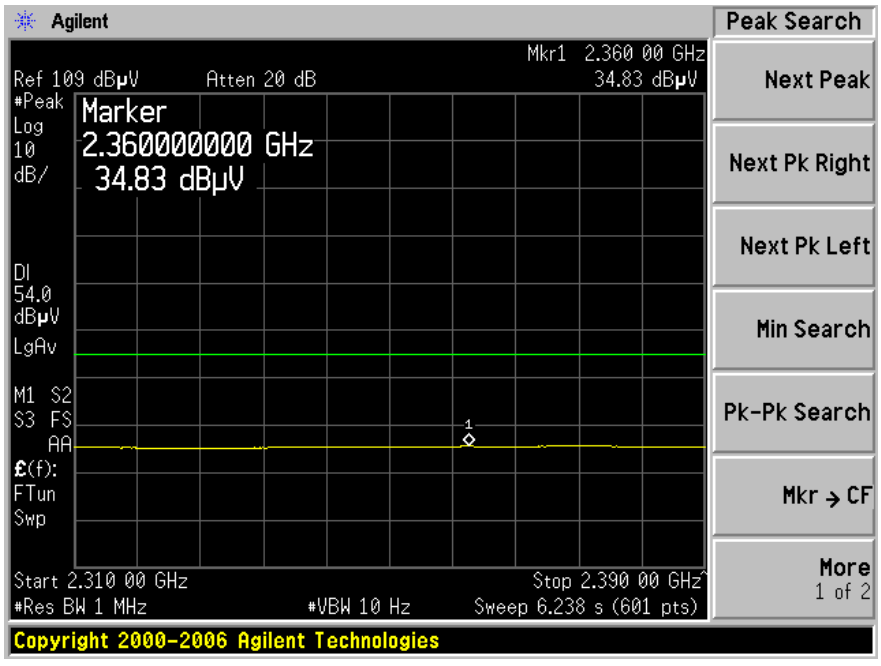
Horizontal - Peak



Horizontal - Average

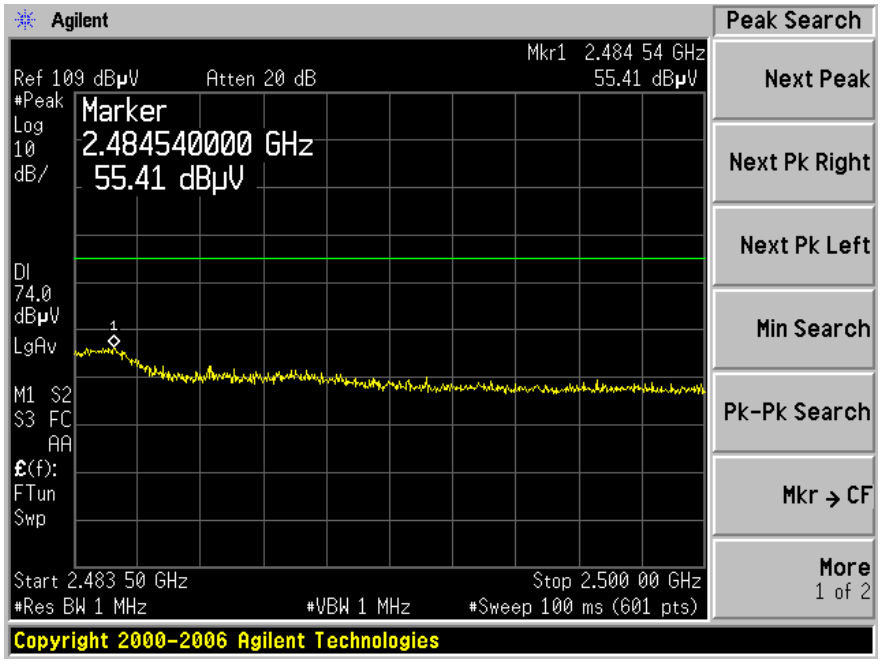


Vertical - Peak

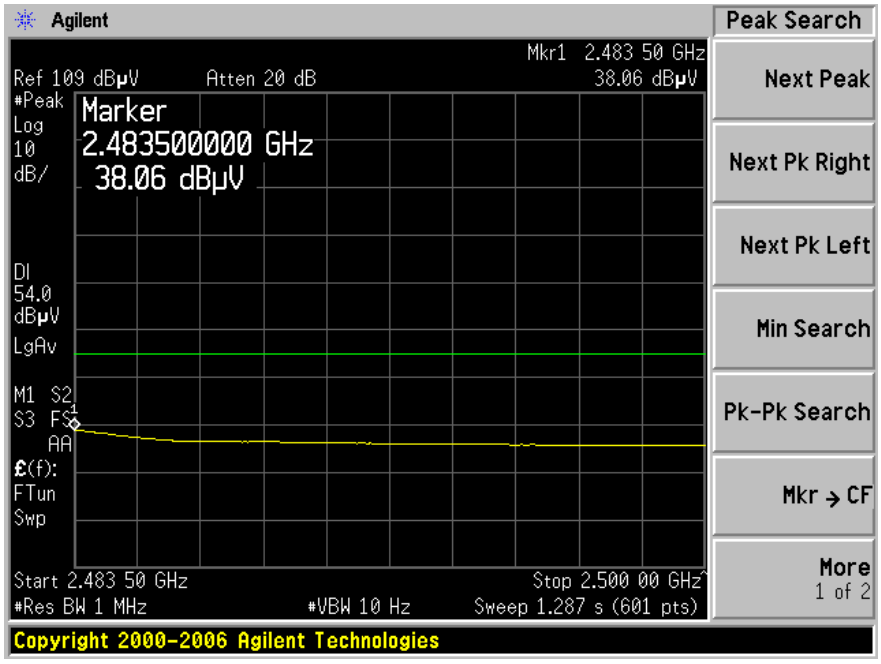


Vertical – Average

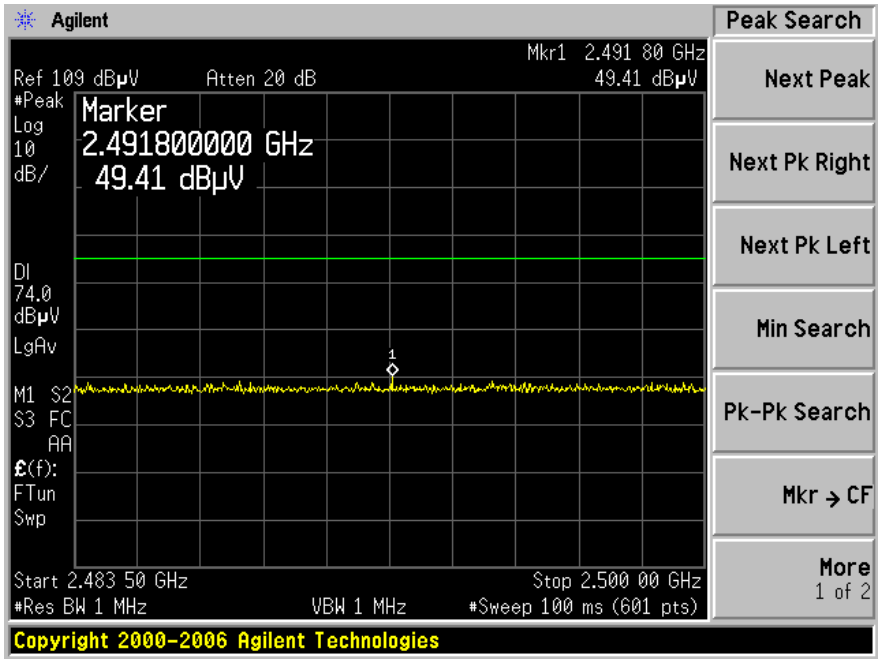
802.11g, Highest Channel: 2462 MHz



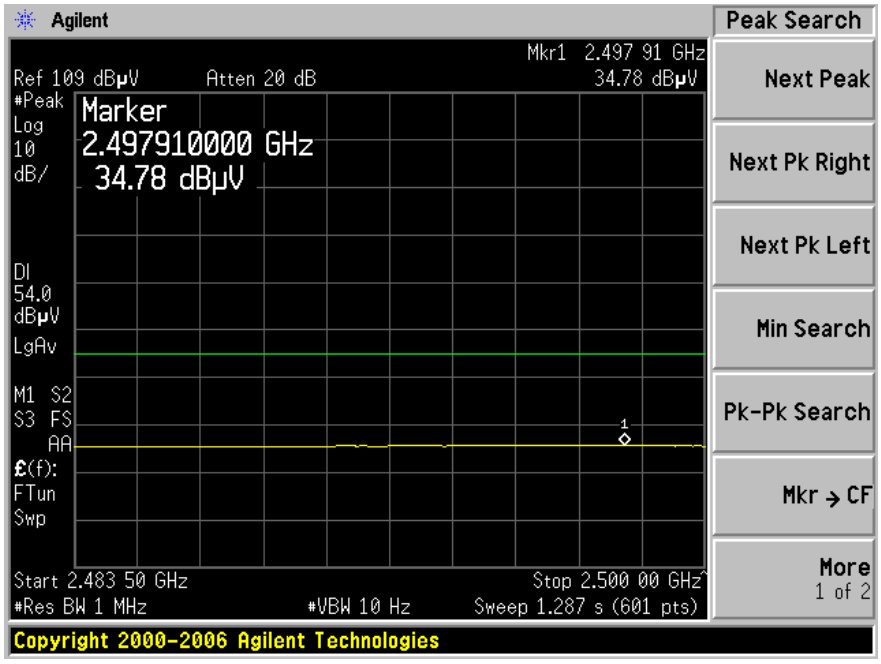
Horizontal - Peak



Horizontal - Average

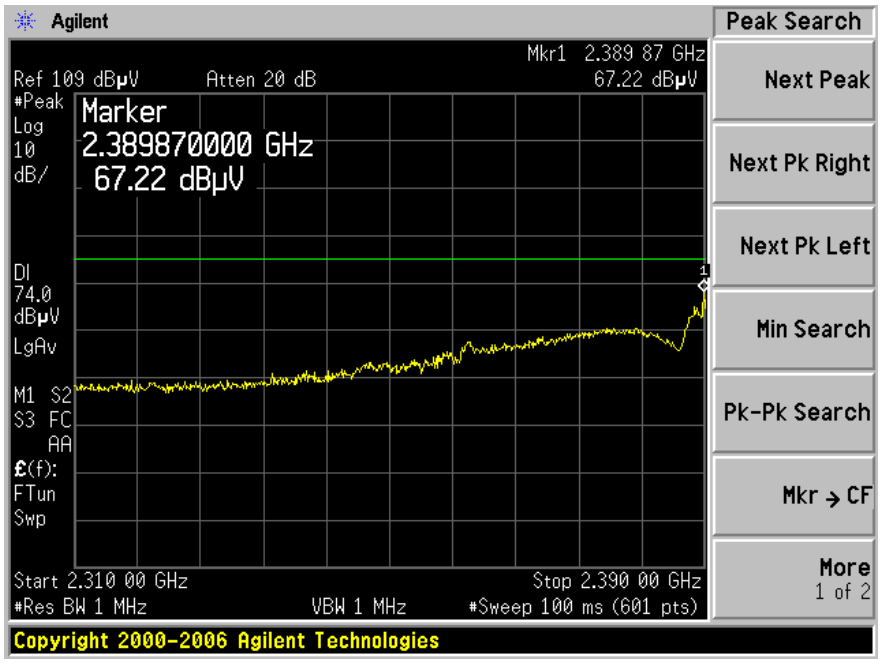


Vertical - Peak

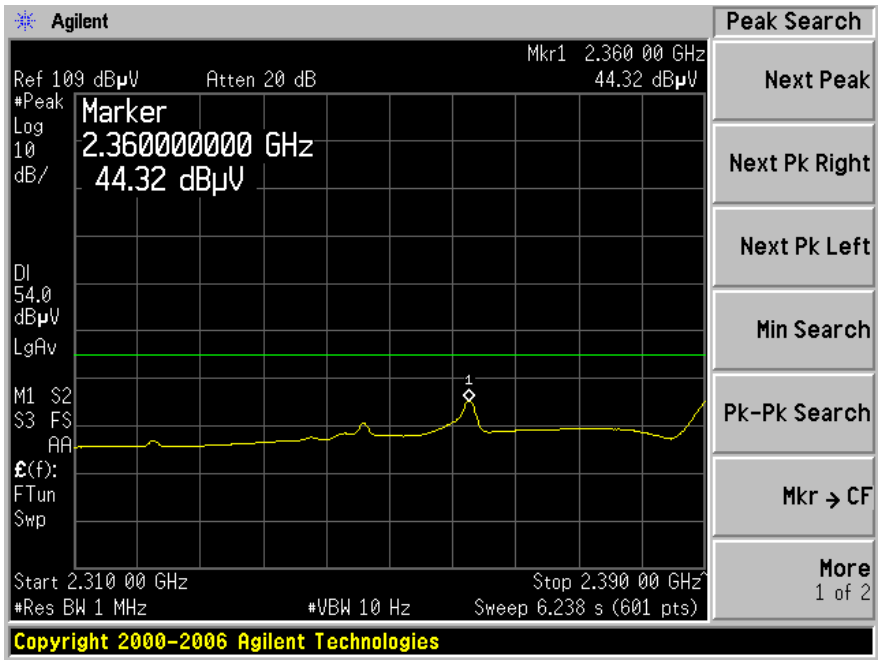


Vertical - Average

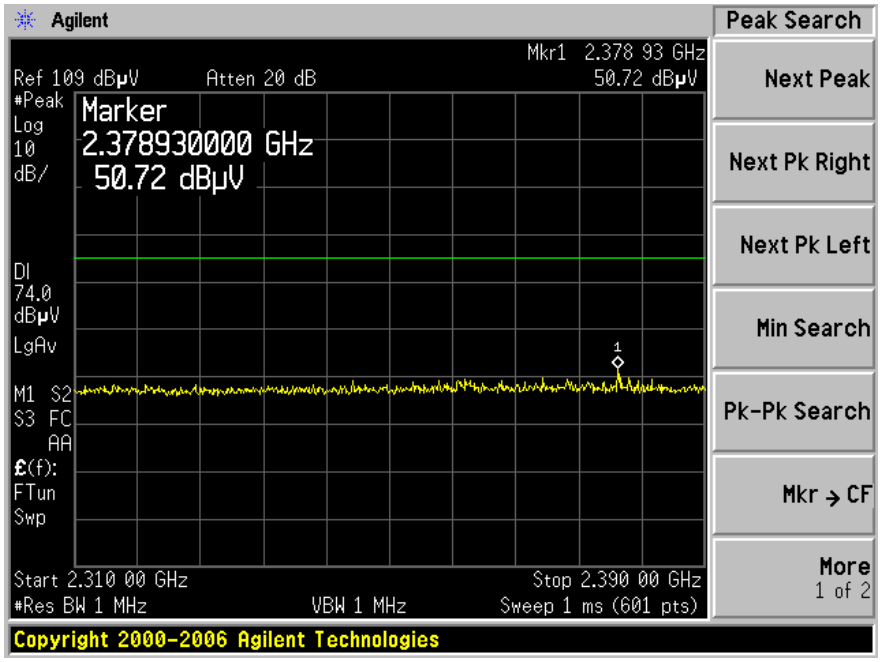
802.11n 20 MHz, Lowest Channel 2412 MHz



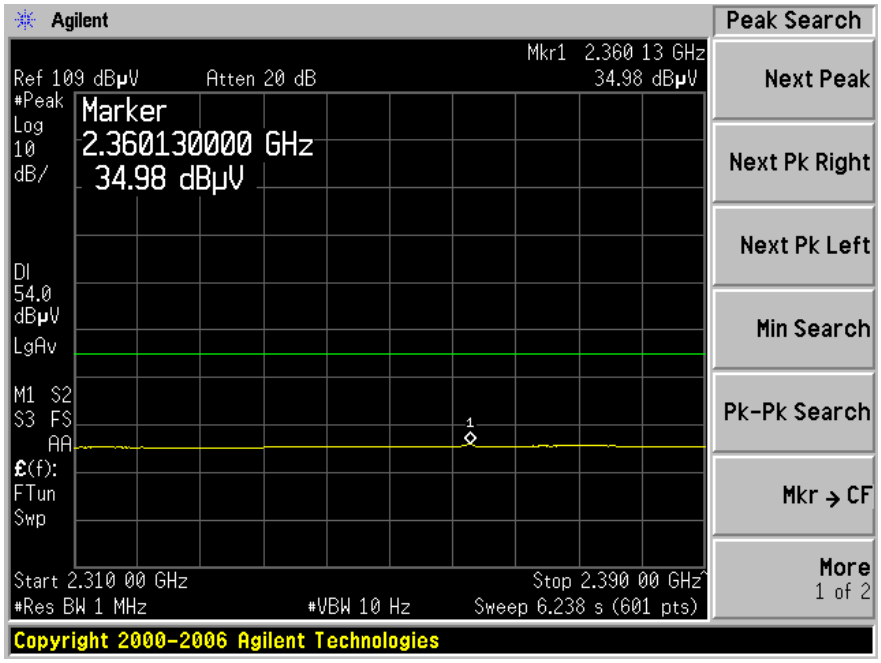
Horizontal - Peak



Horizontal - Average

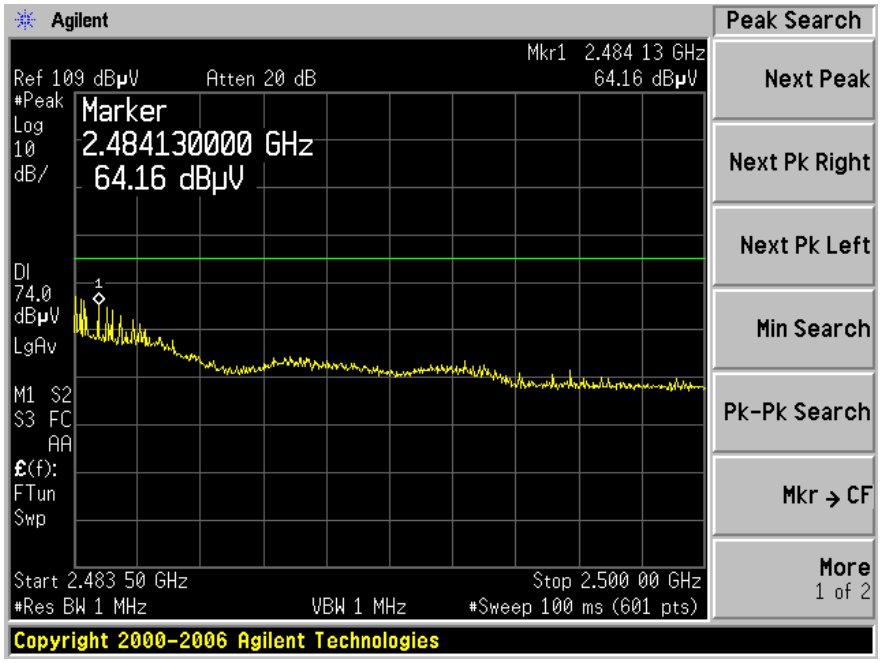


Vertical - Peak

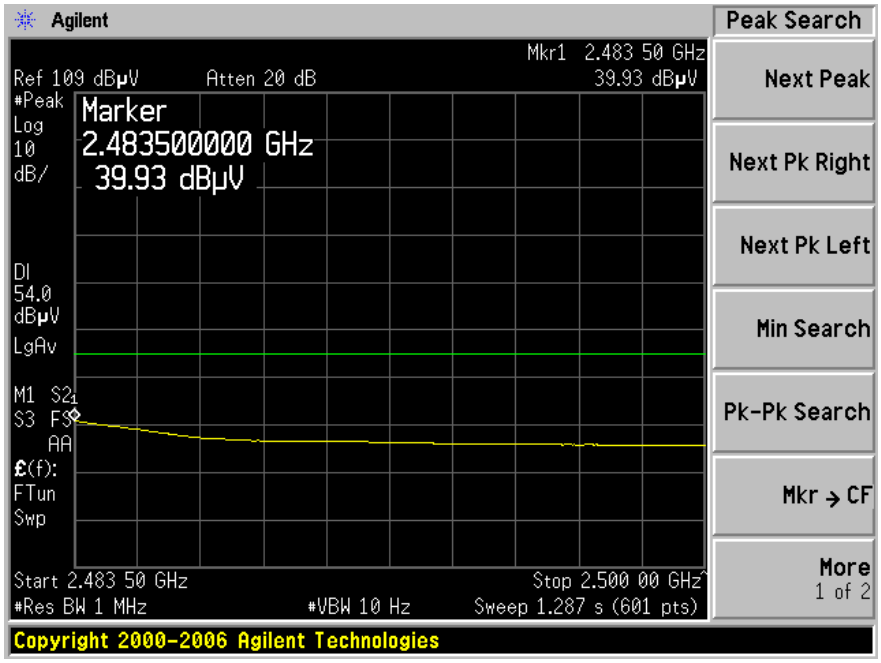


Vertical – Average

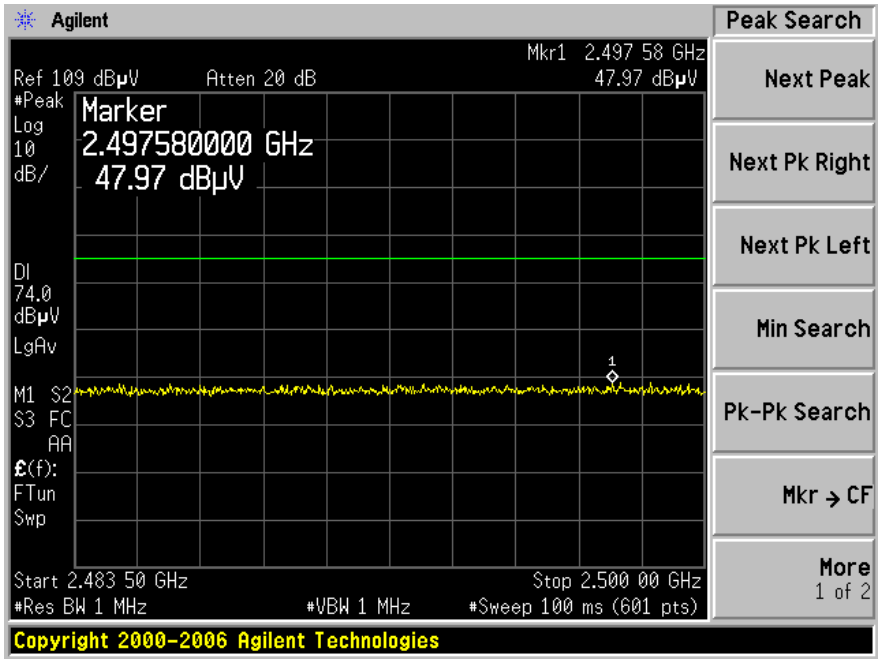
802.11n 20 MHz, Highest Channel: 2462 MHz



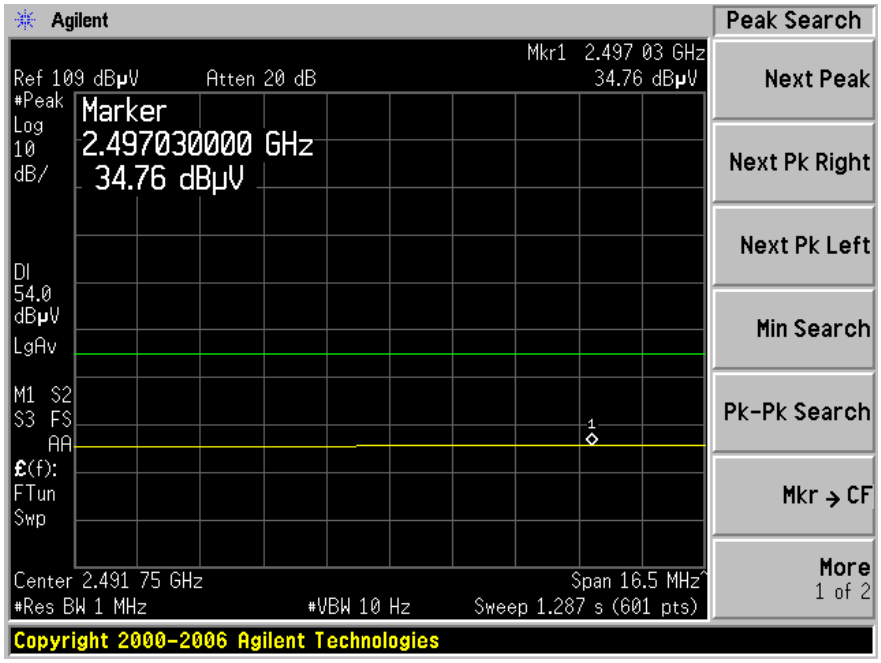
Horizontal - Peak



Horizontal - Average

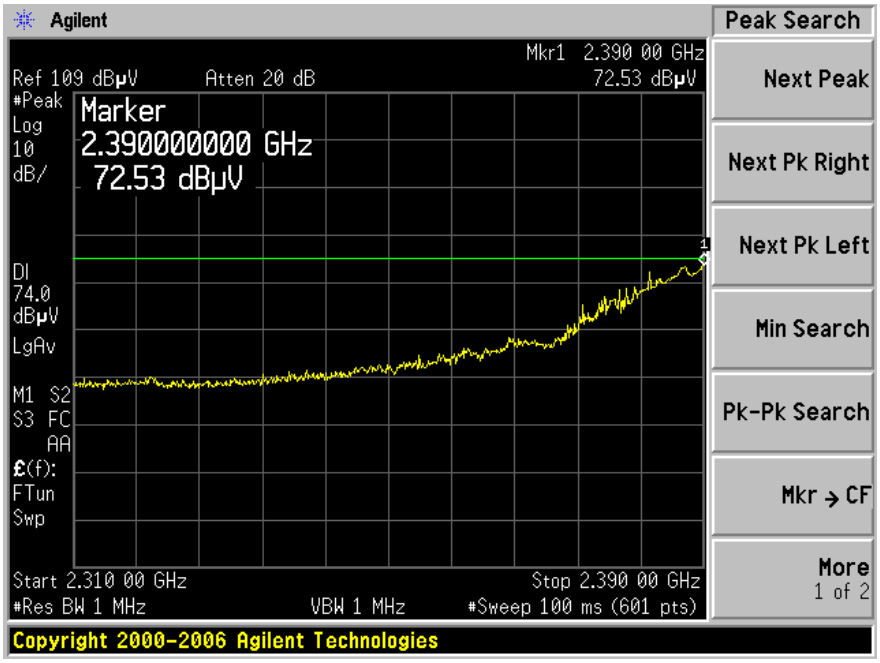


Vertical - Peak

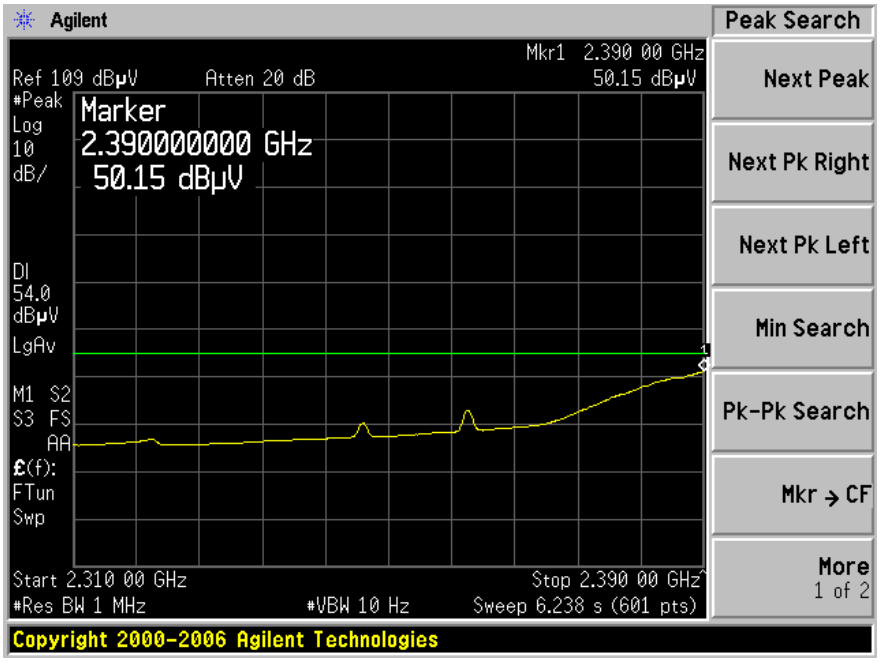


Vertical - Average

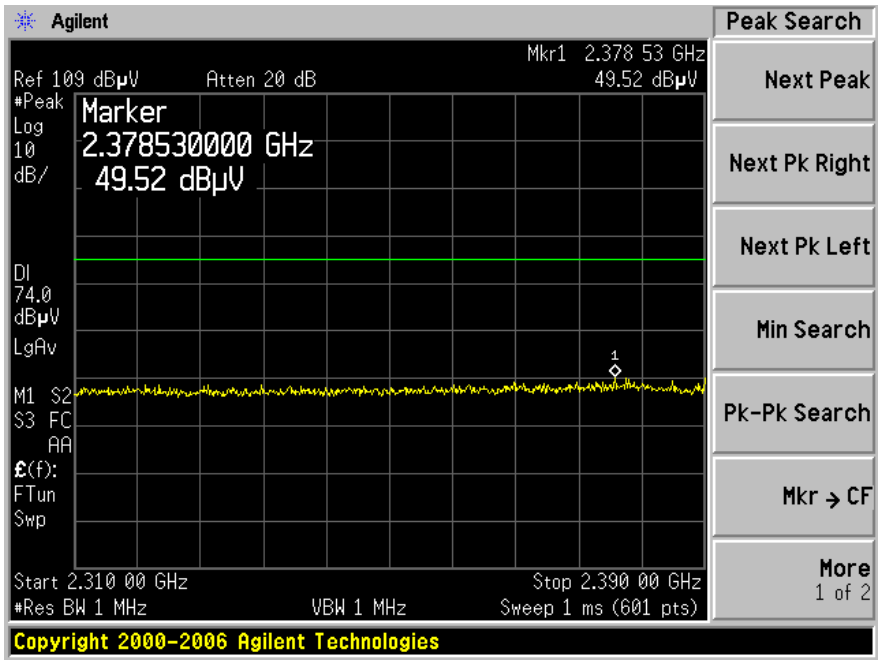
802.11n 40 MHz, Lowest Channel 2422 MHz



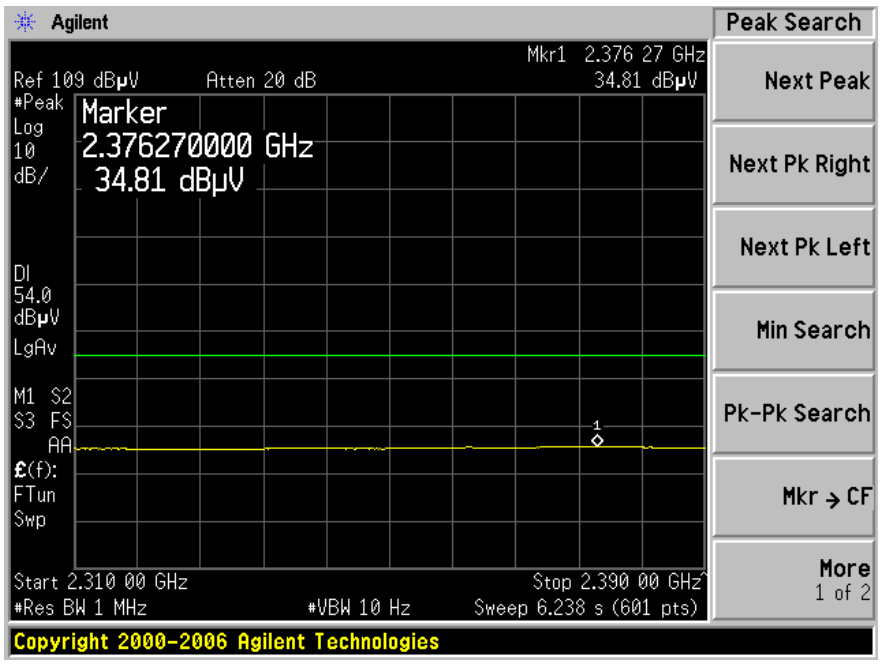
Horizontal - Peak



Horizontal - Average

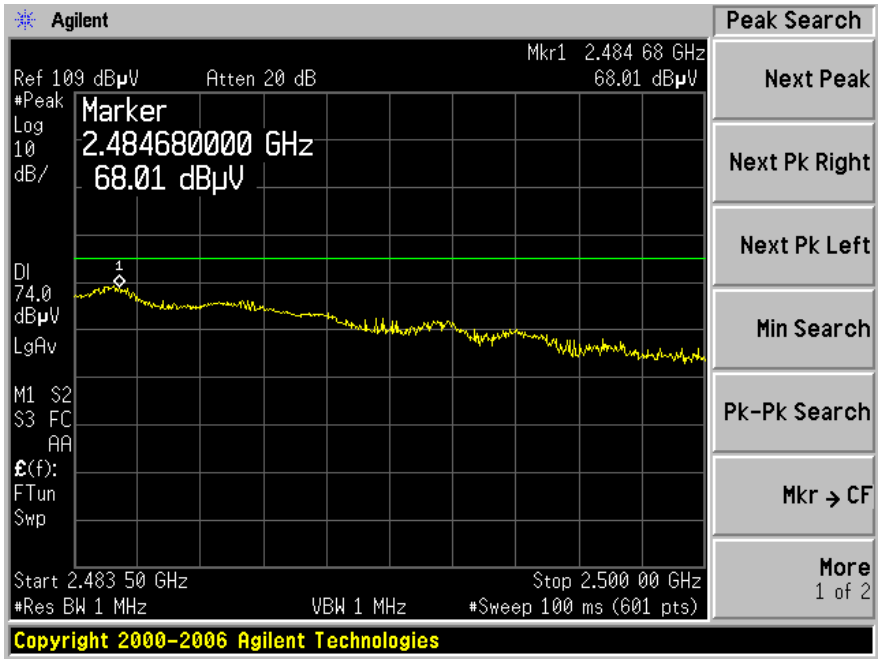


Vertical - Peak

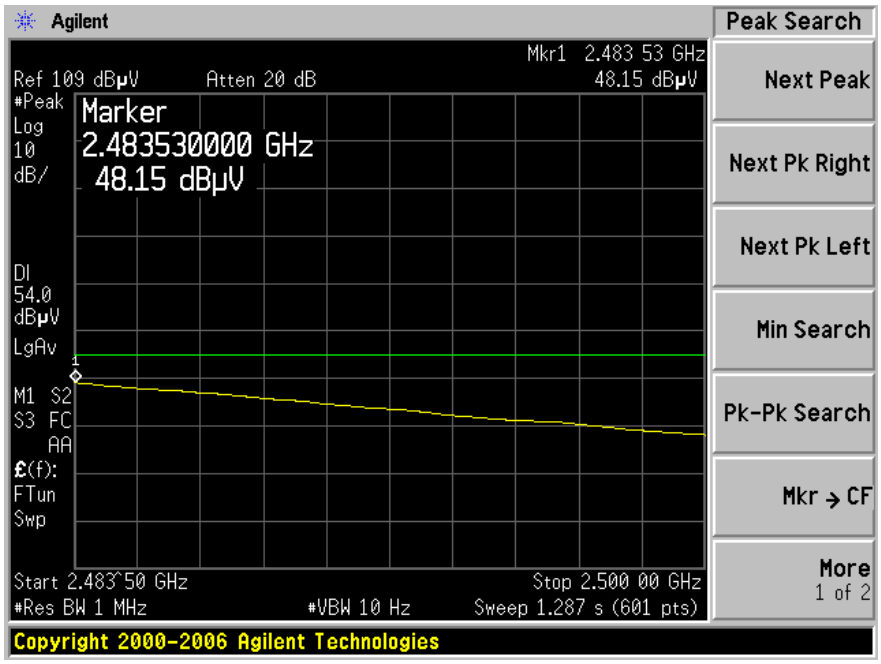


Vertical – Average

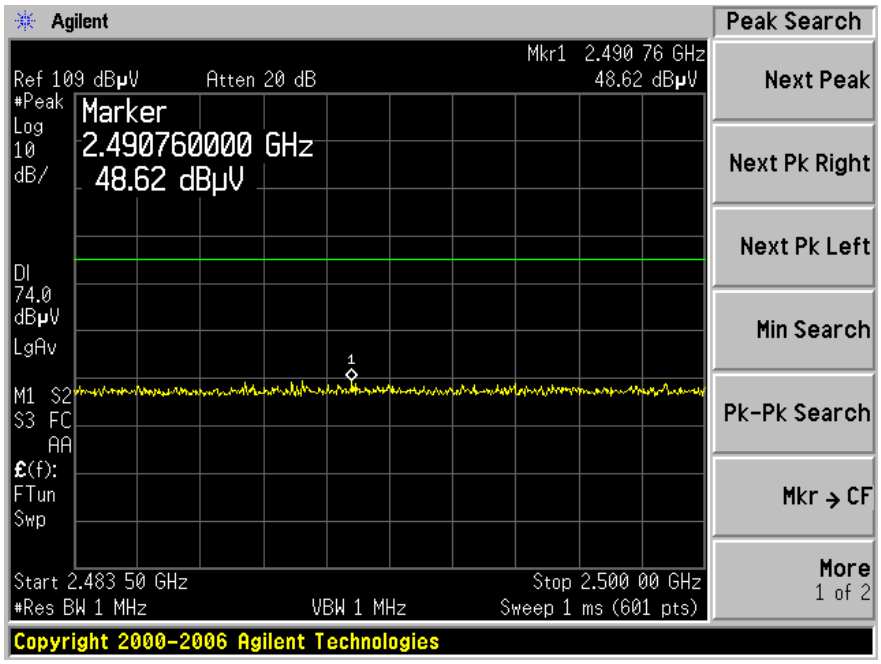
802.11n 40 MHz, High Channel: 2452 MHz



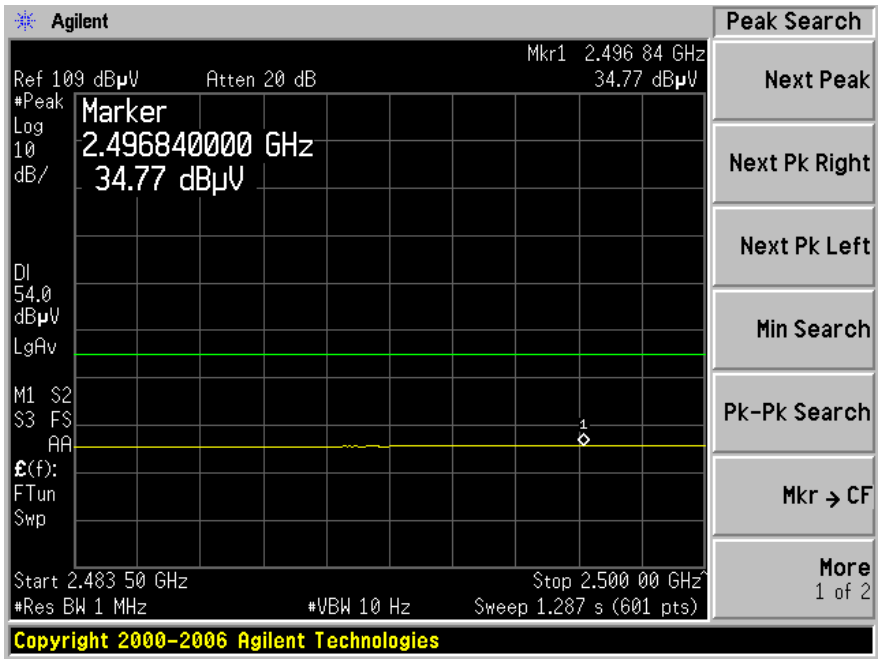
Horizontal - Peak



Horizontal - Average



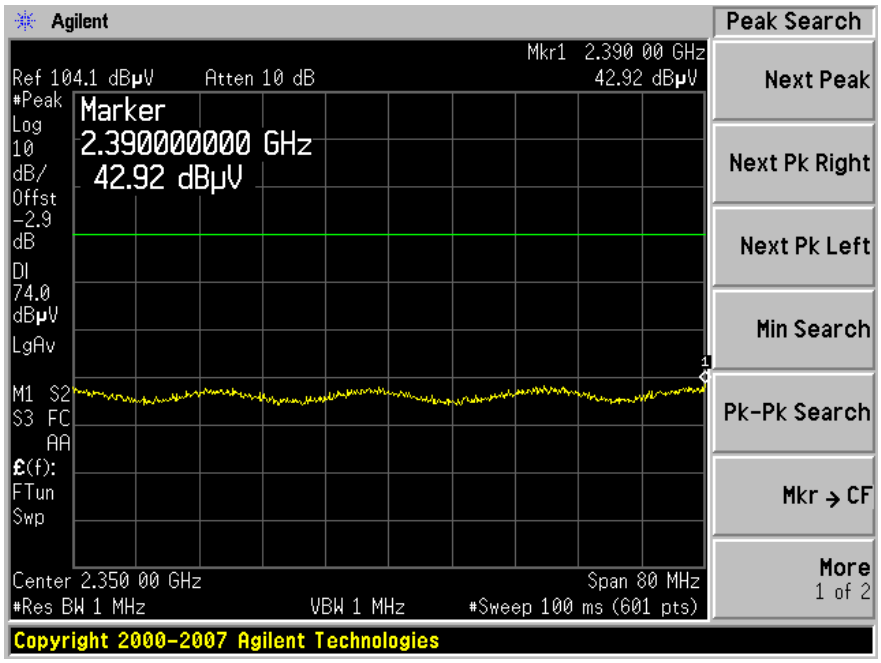
Vertical - Peak



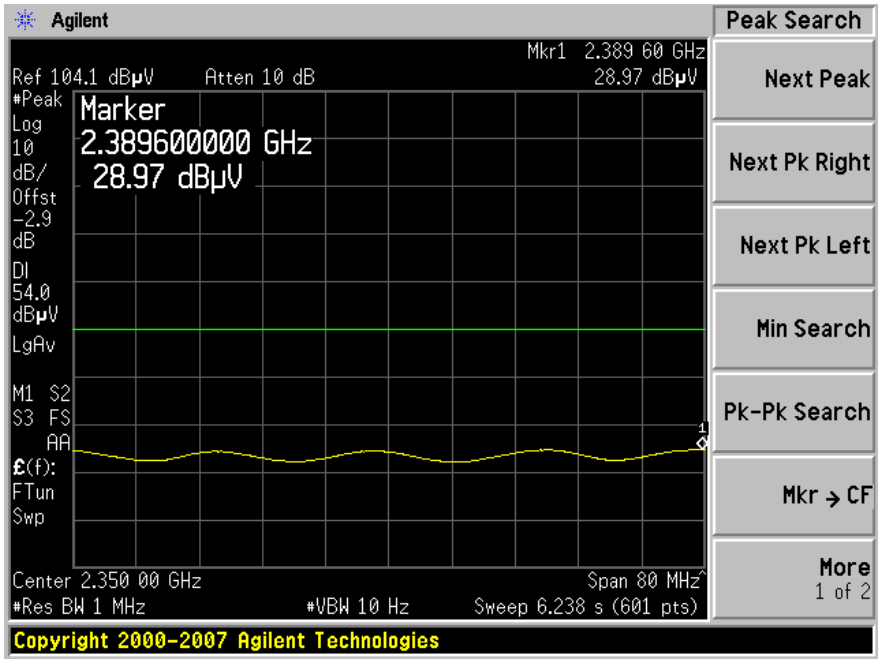
Vertical - Average

External Antenna

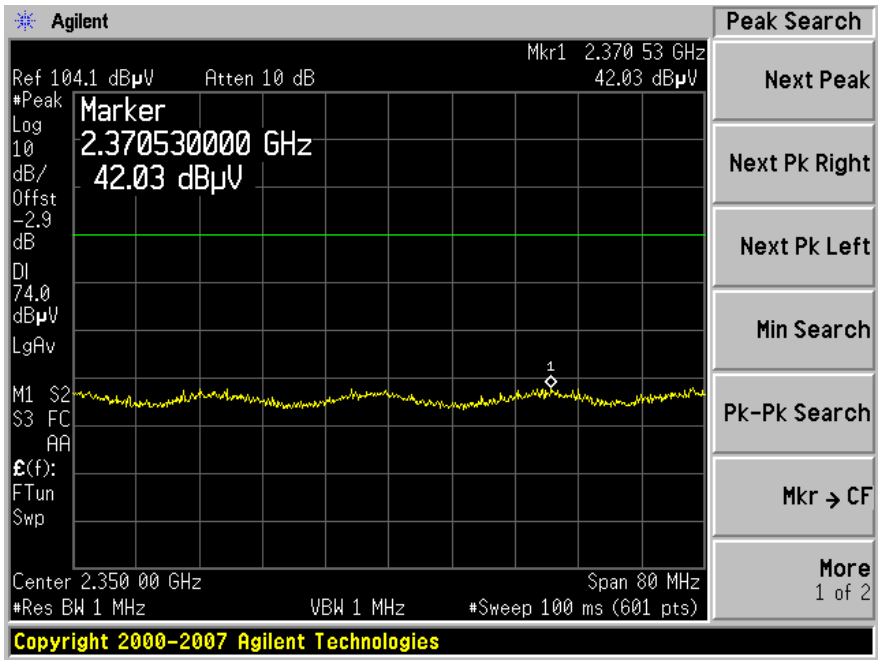
802.11b, Lowest Channel 2412 MHz



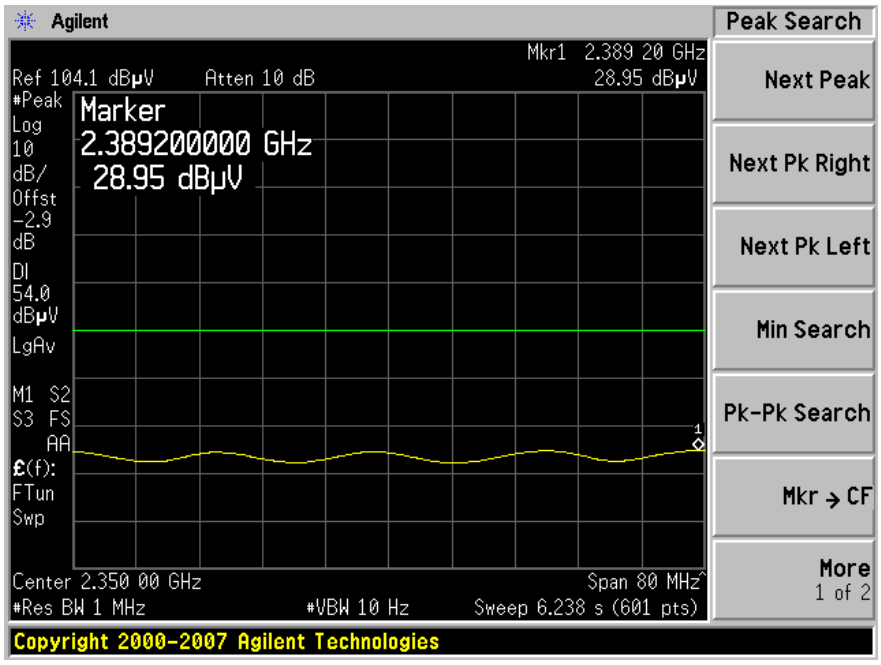
Horizontal - Peak



Horizontal - Average

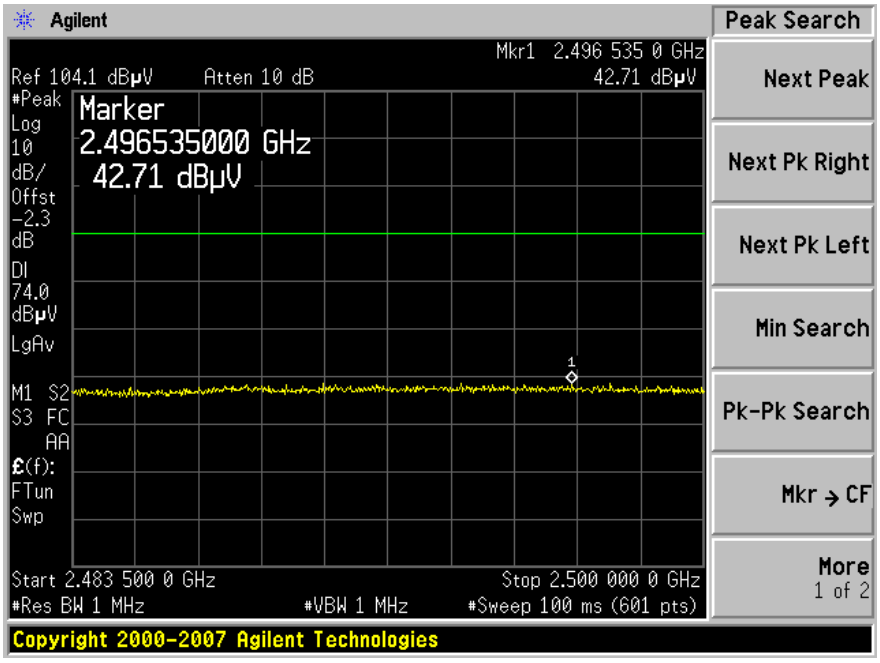


Vertical - Peak

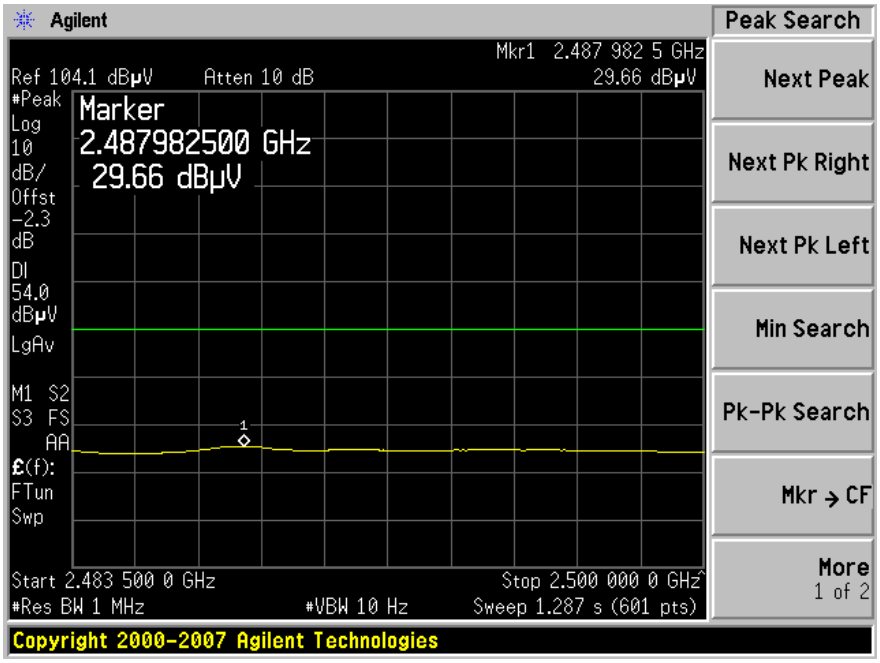


Vertical – Average

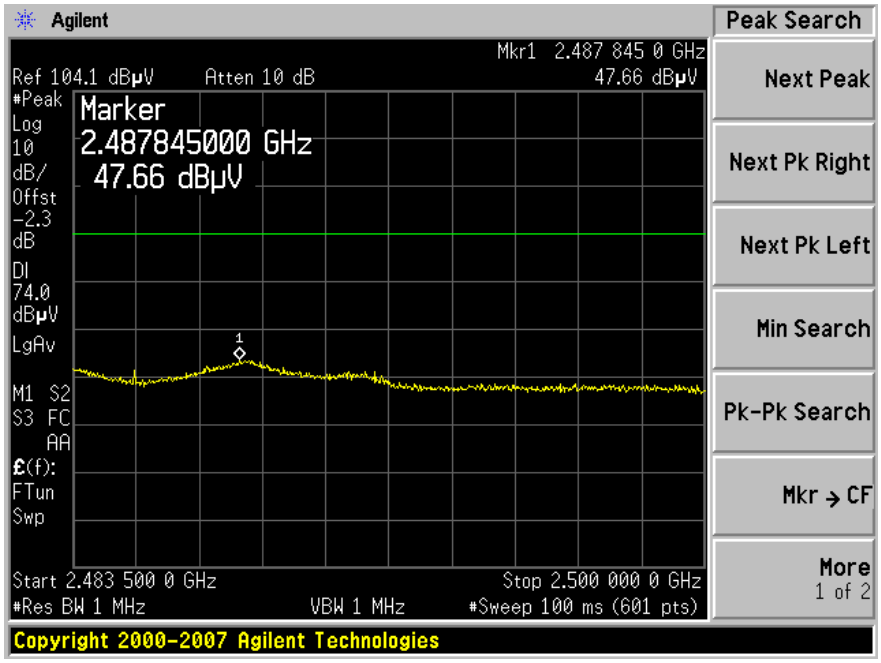
802.11b, Highest Channel: 2462 MHz



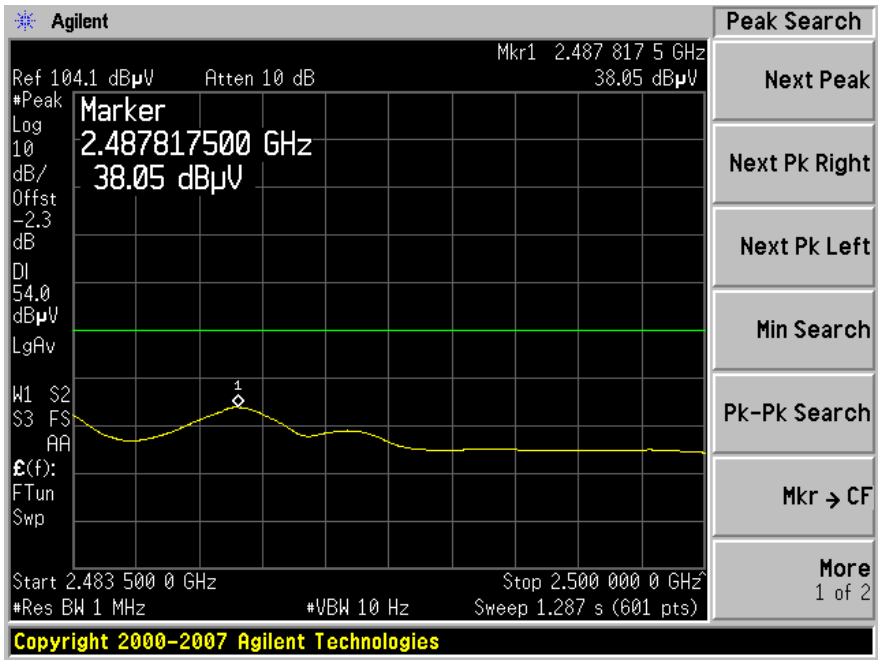
Horizontal - Peak



Horizontal - Average

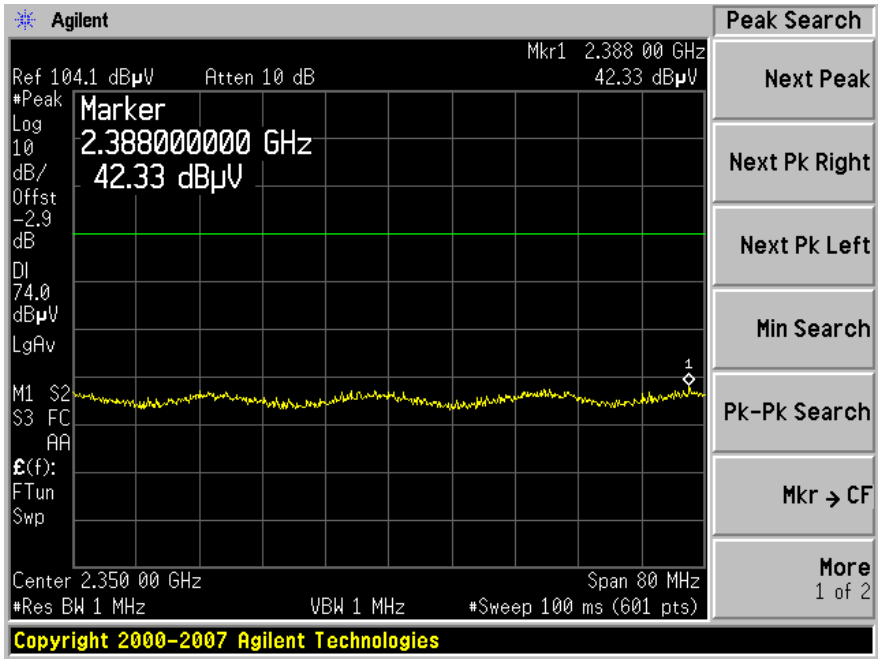


Vertical - Peak

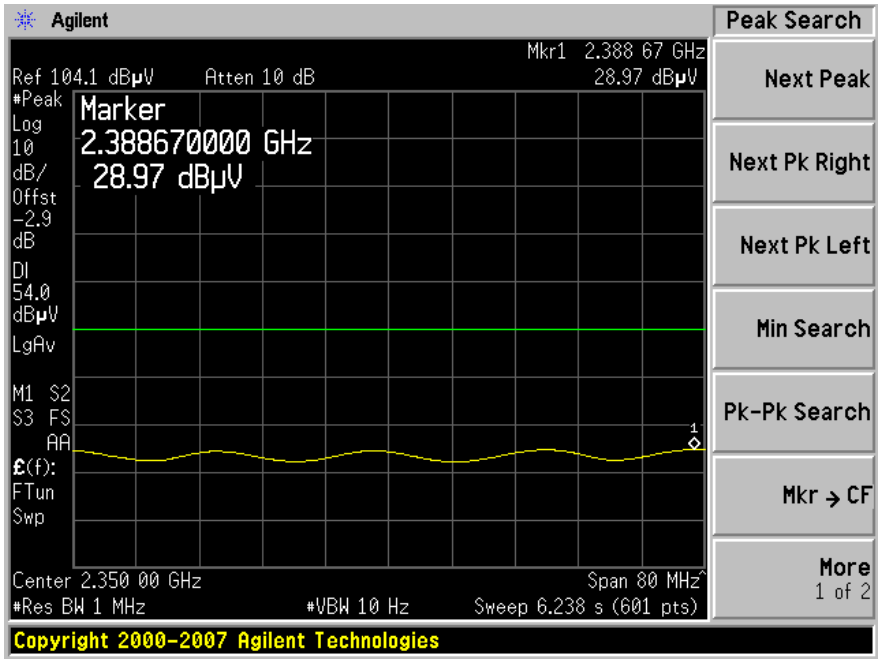


Vertical - Average

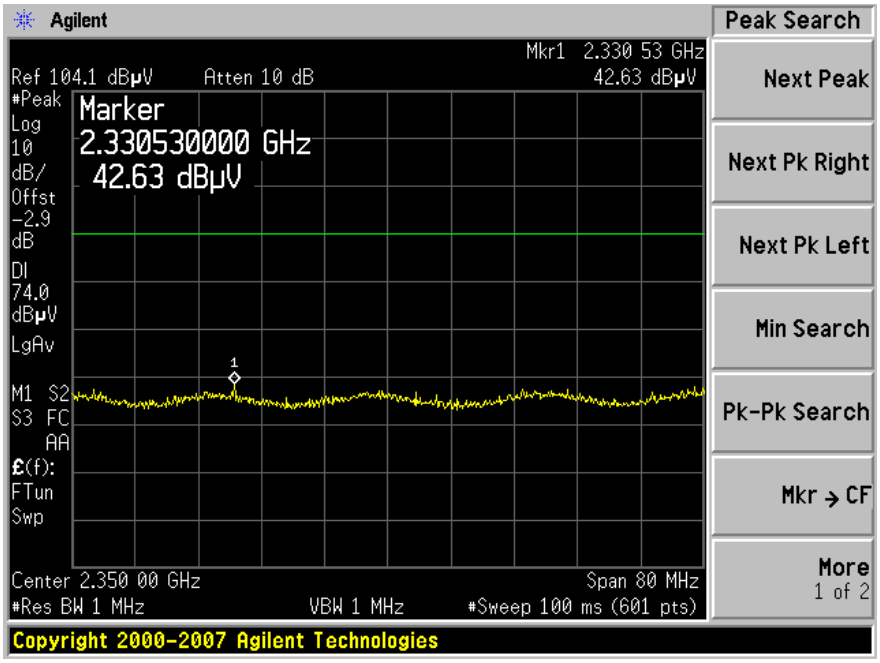
802.11g, Lowest Channel 2412 MHz



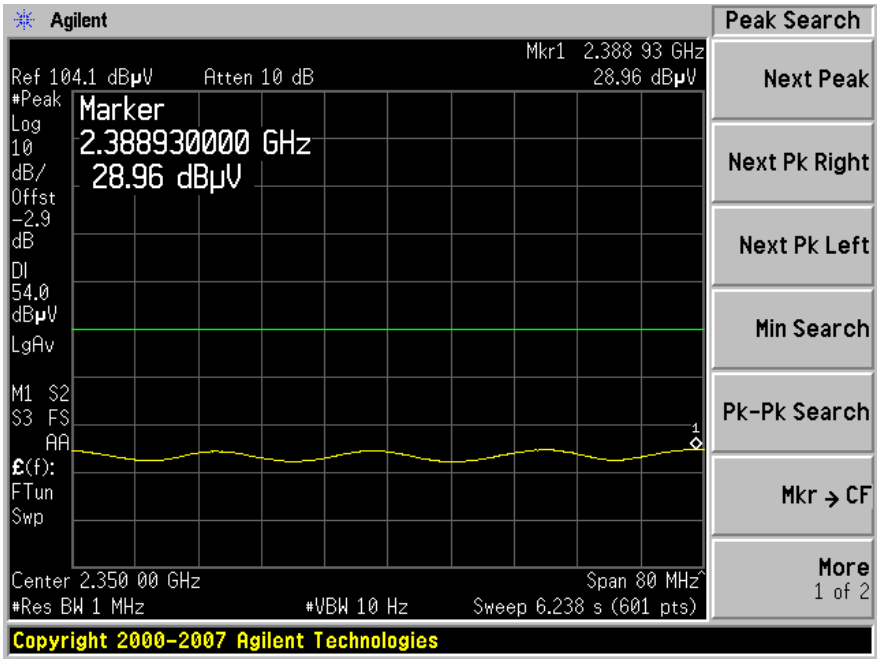
Horizontal - Peak



Horizontal - Average

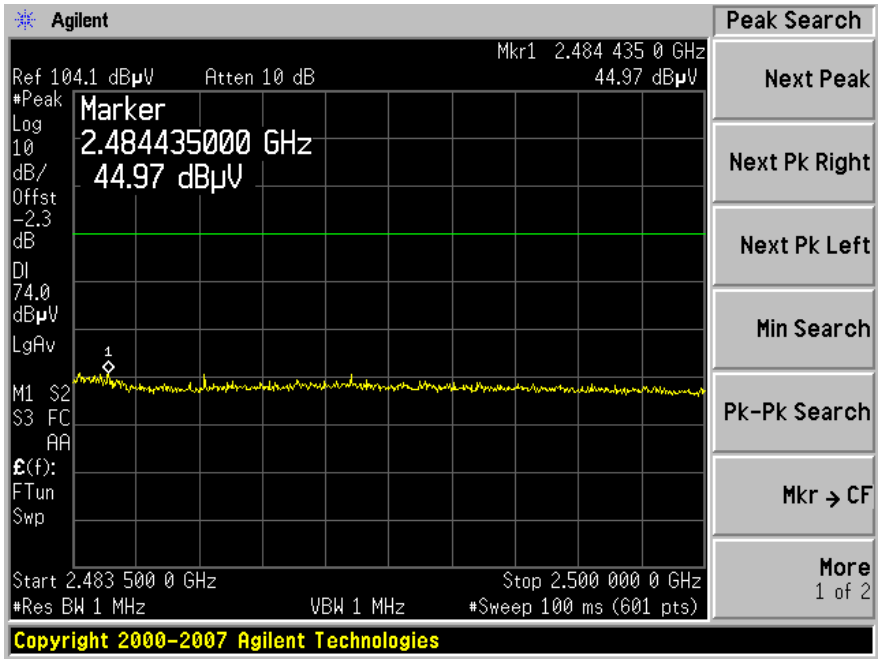


Vertical - Peak

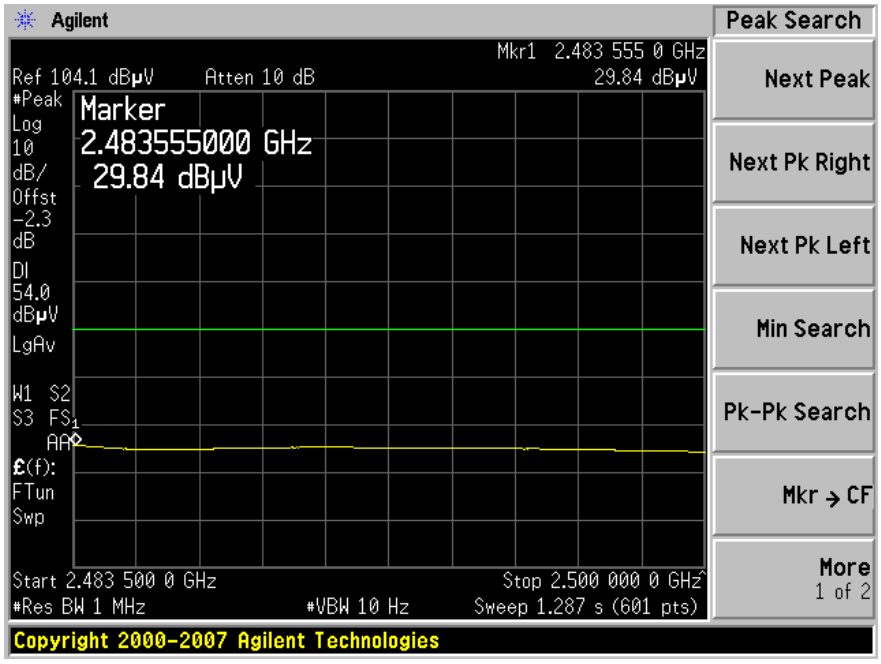


Vertical – Average

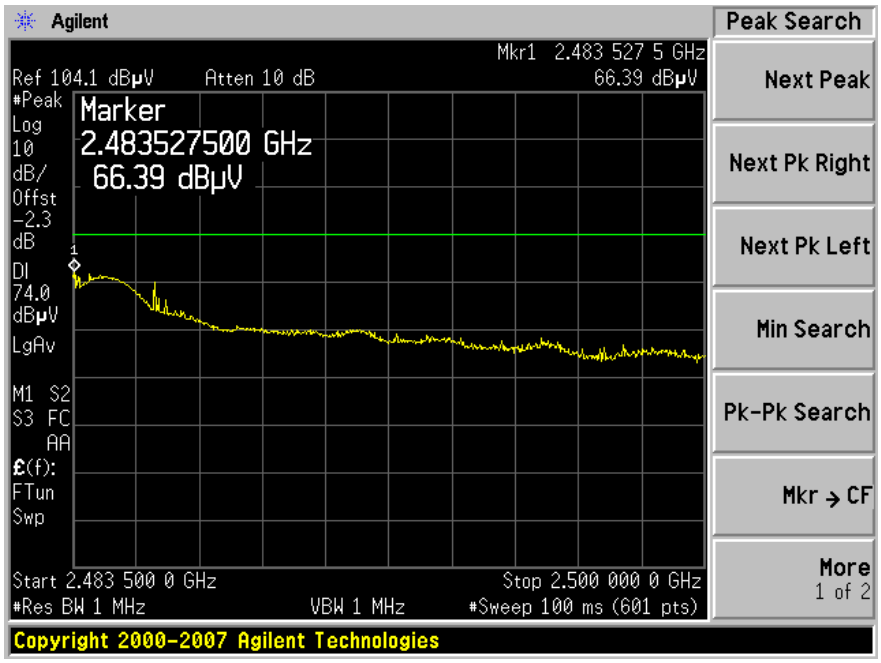
802.11g, Highest Channel: 2462 MHz



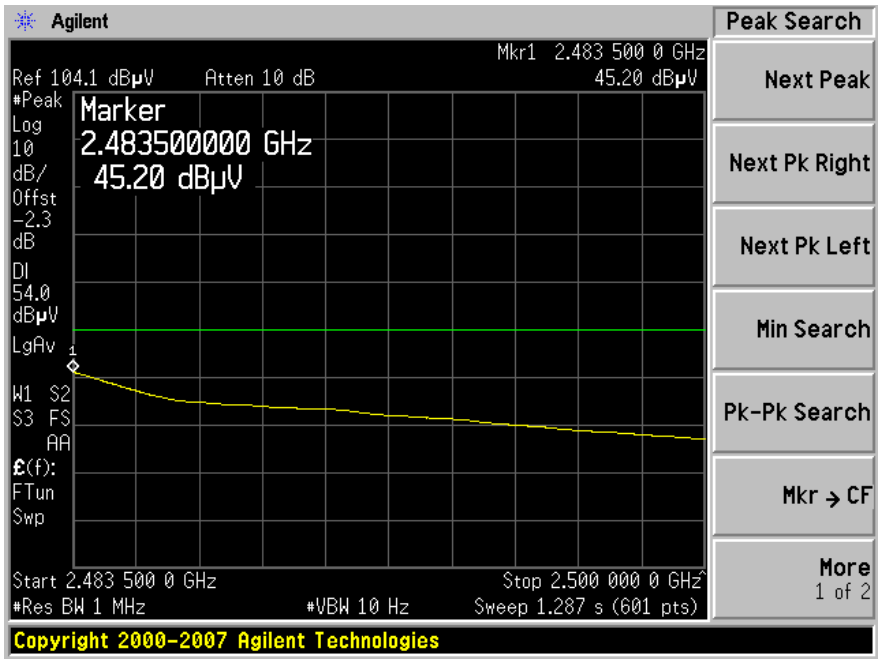
Horizontal - Peak



Horizontal - Average

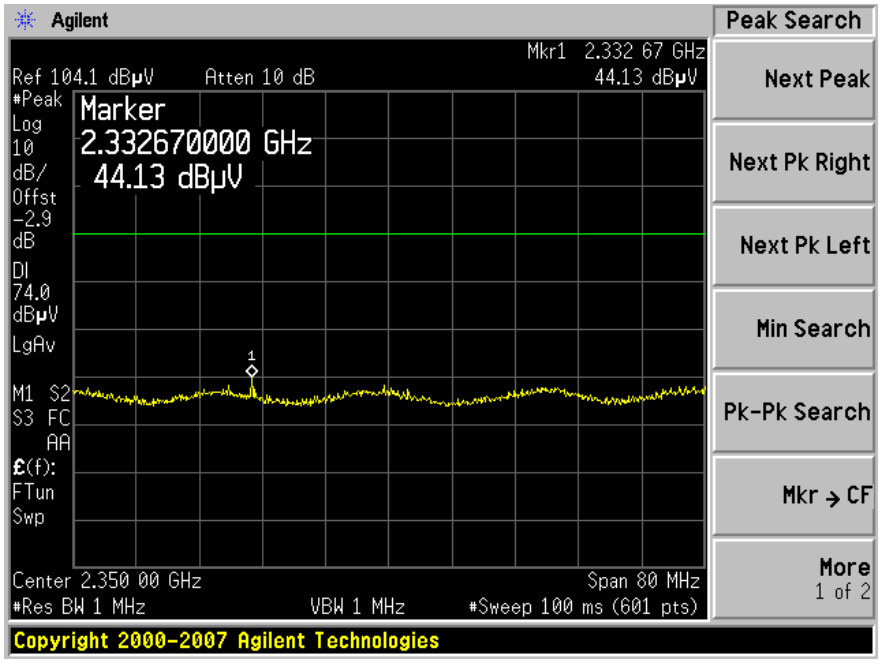


Vertical - Peak

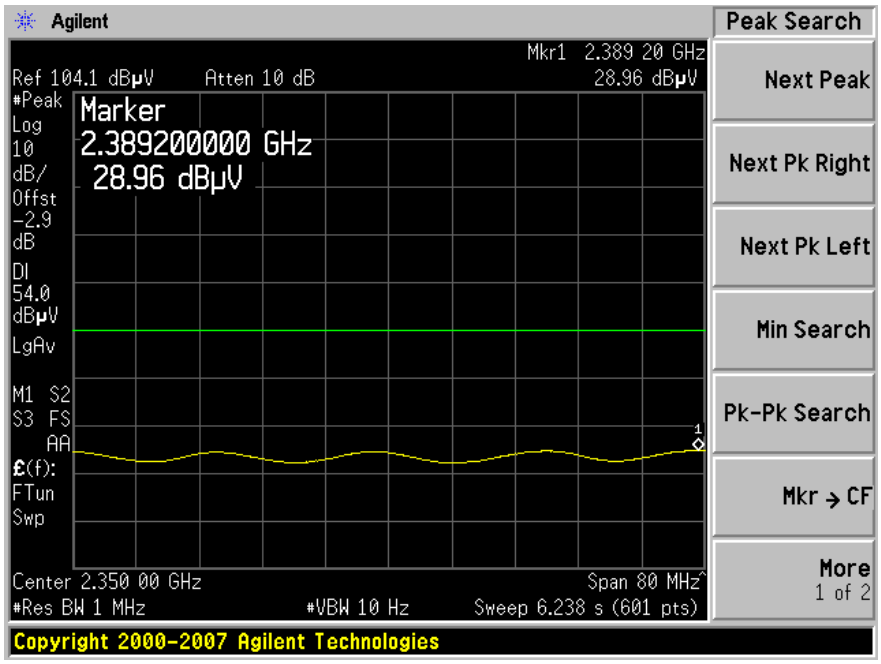


Vertical - Average

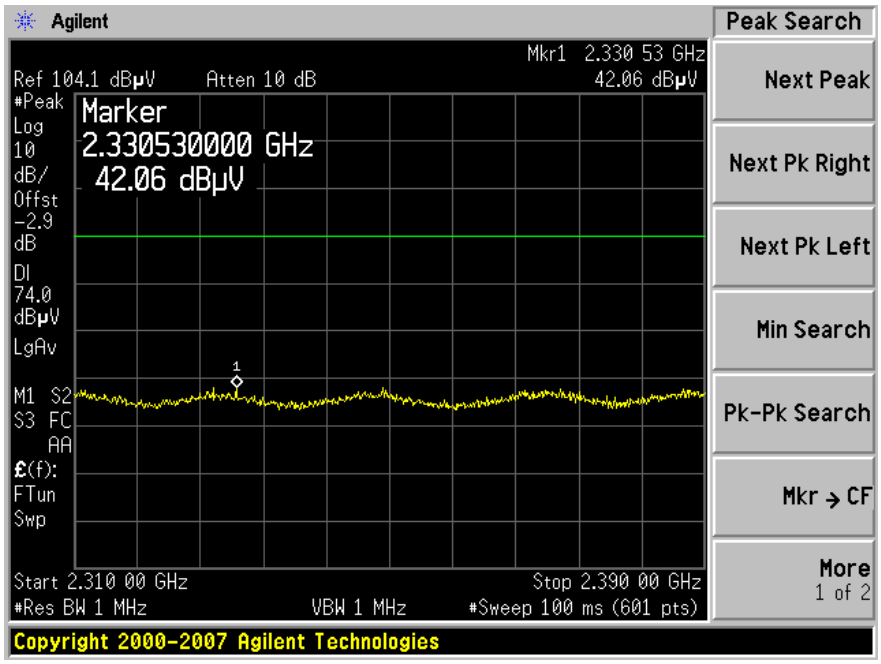
802.11n 20 MHz, Lowest Channel 2412 MHz



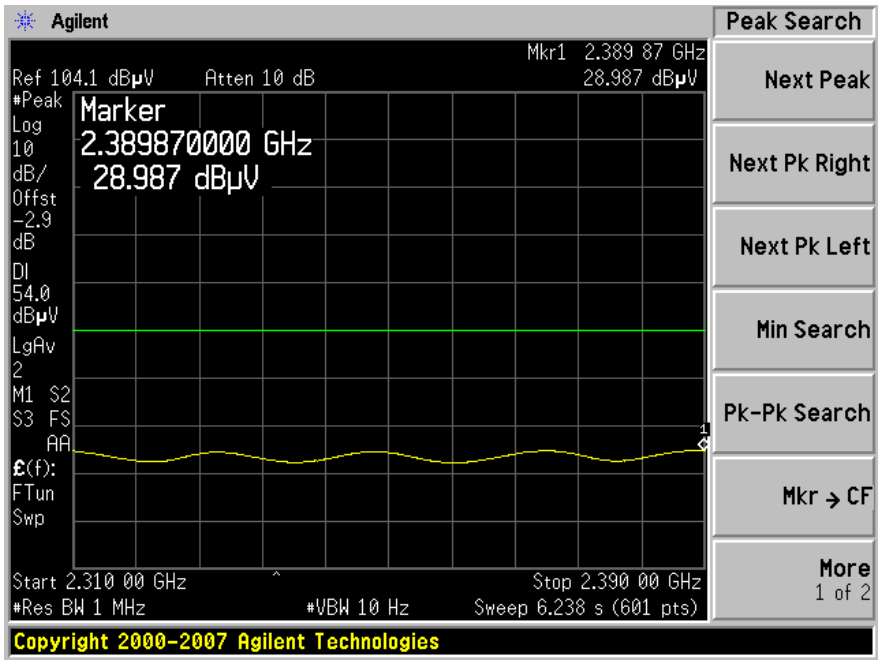
Horizontal - Peak



Horizontal - Average

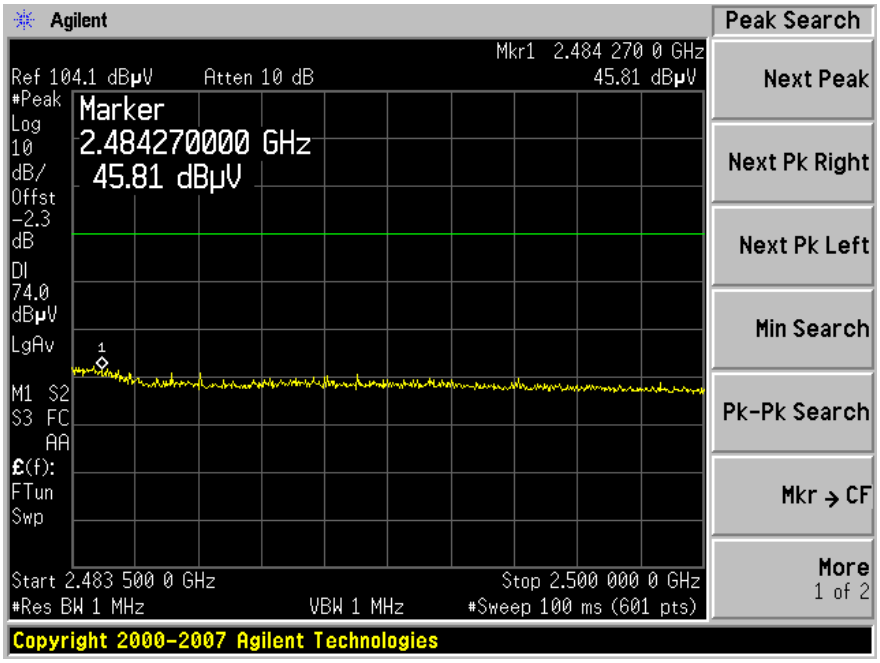


Vertical - Peak

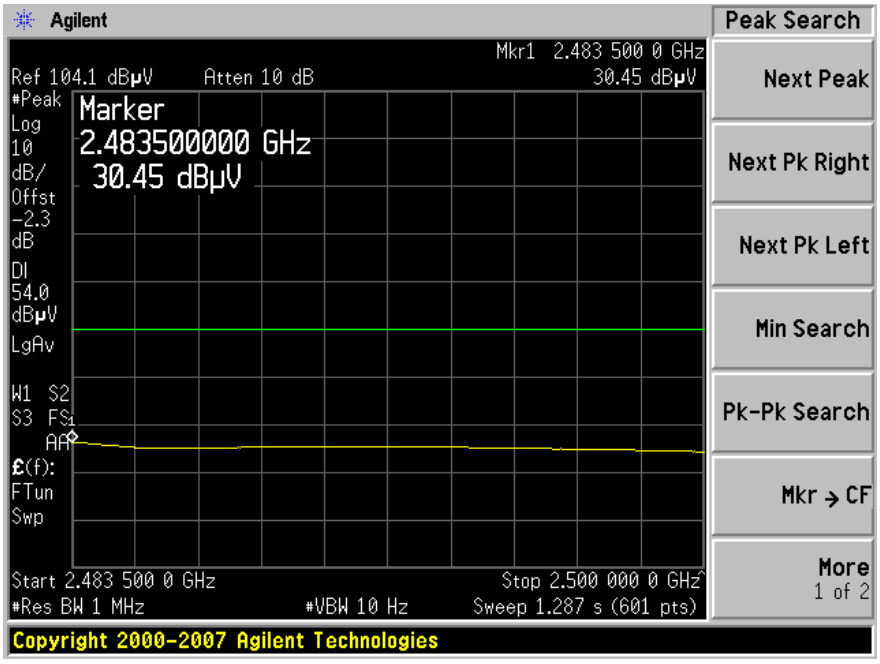


Vertical – Average

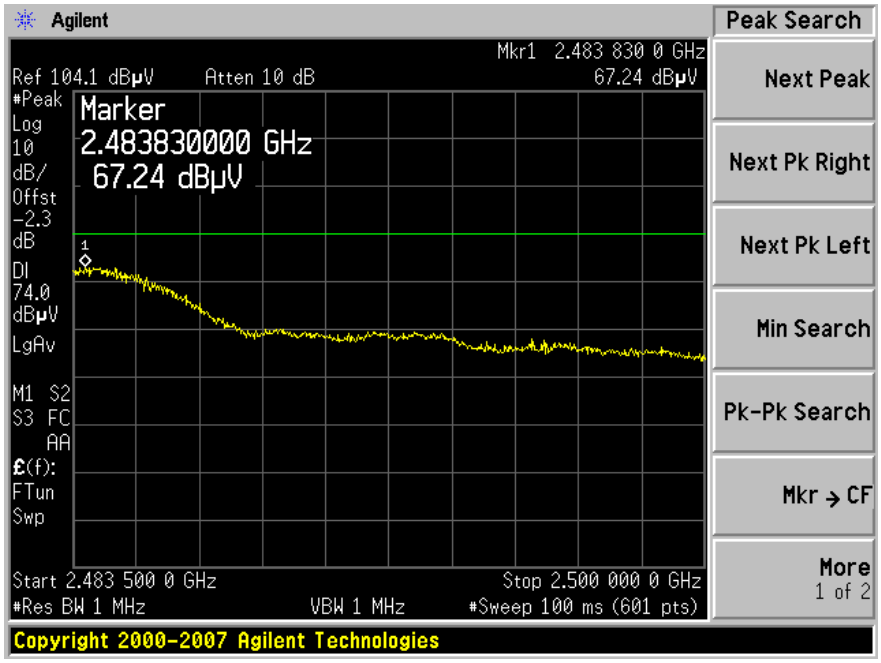
802.11n 20 MHz, Highest Channel: 2462 MHz



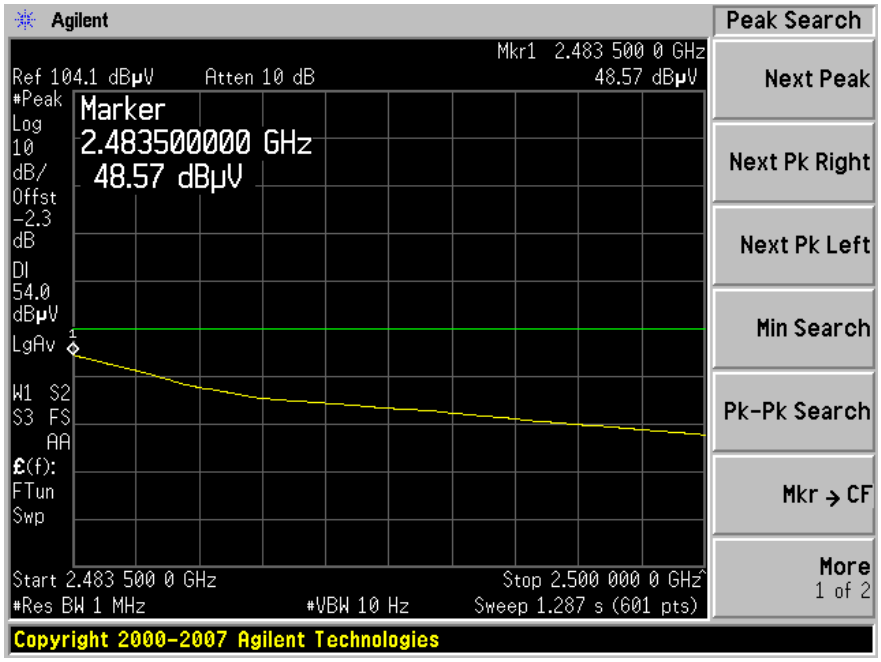
Horizontal - Peak



Horizontal - Average

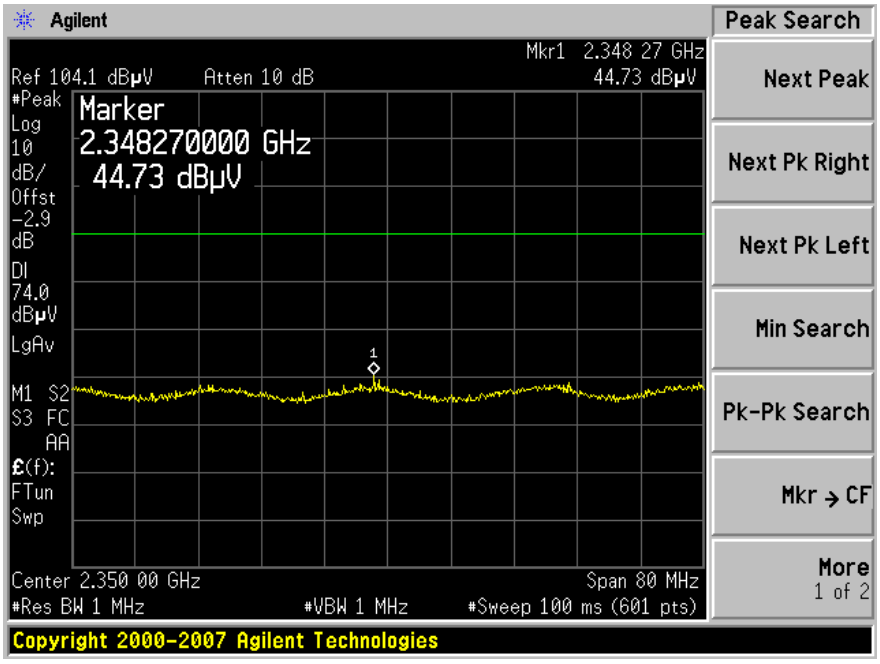


Vertical - Peak

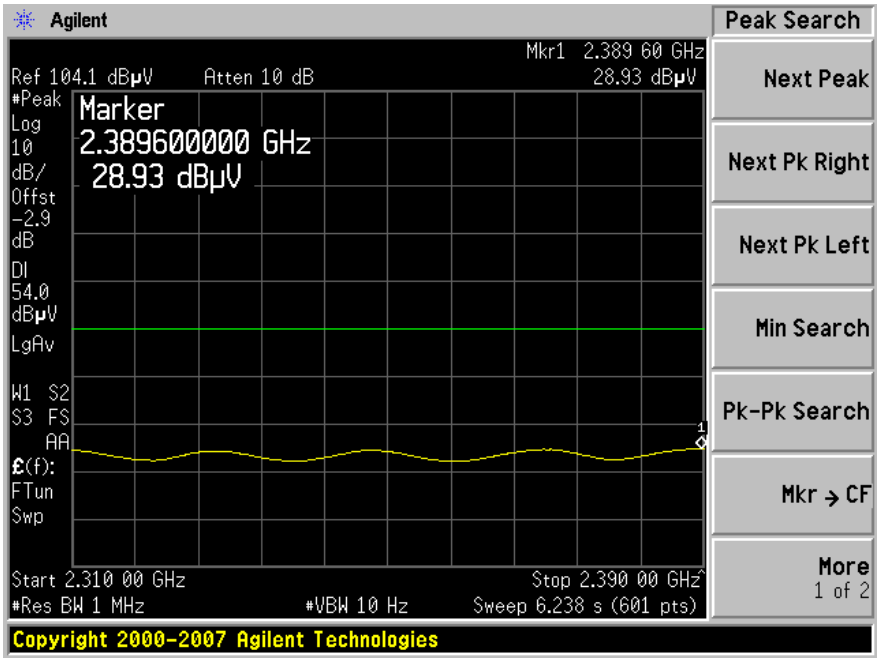


Vertical - Average

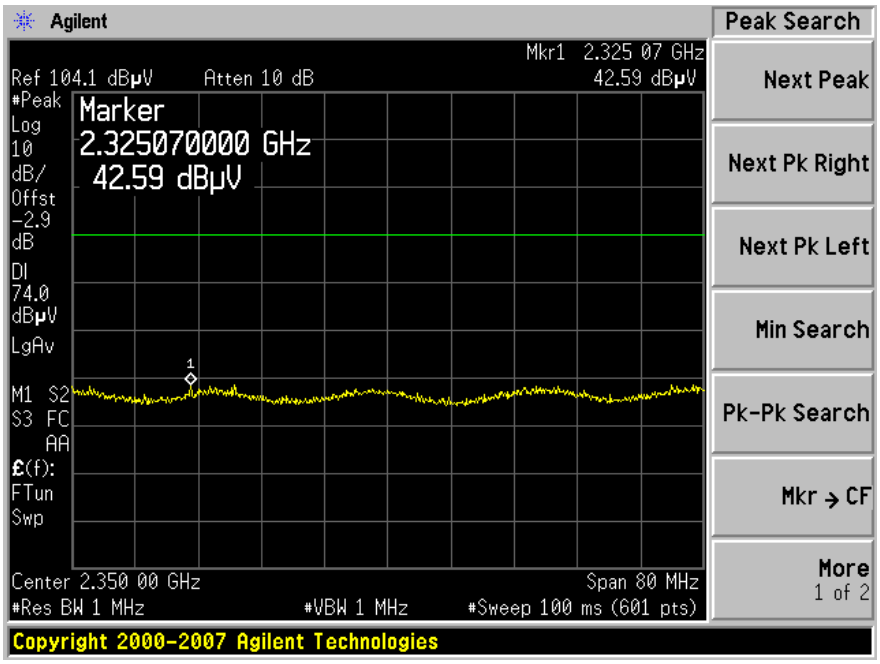
802.11n 40 MHz, Lowest Channel 2422 MHz



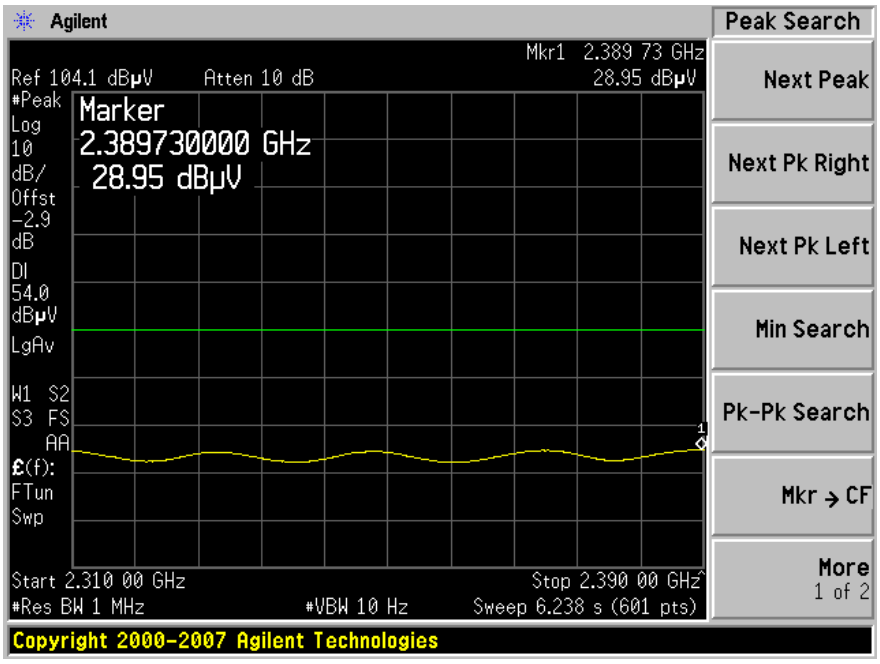
Horizontal - Peak



Horizontal - Average

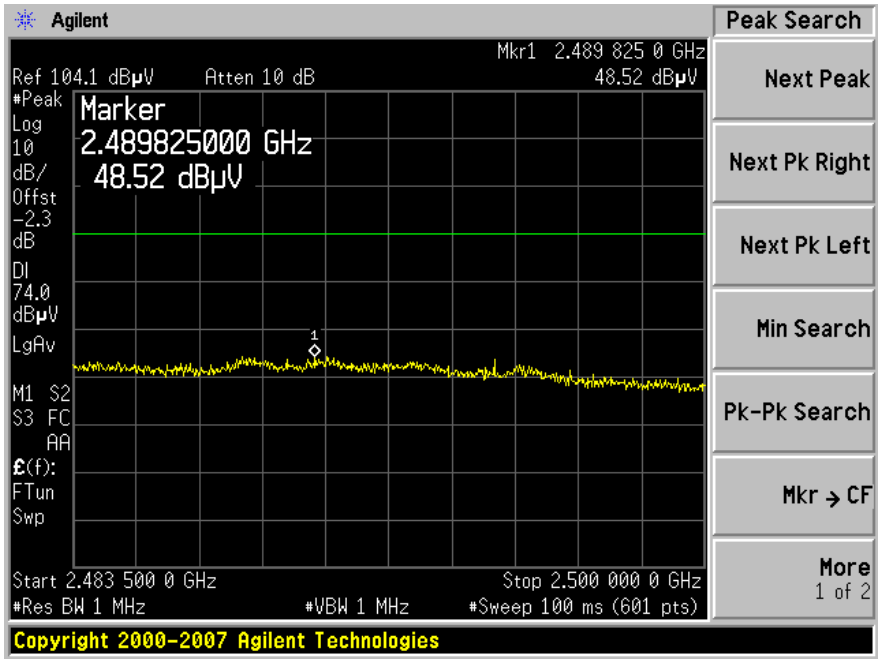


Vertical - Peak

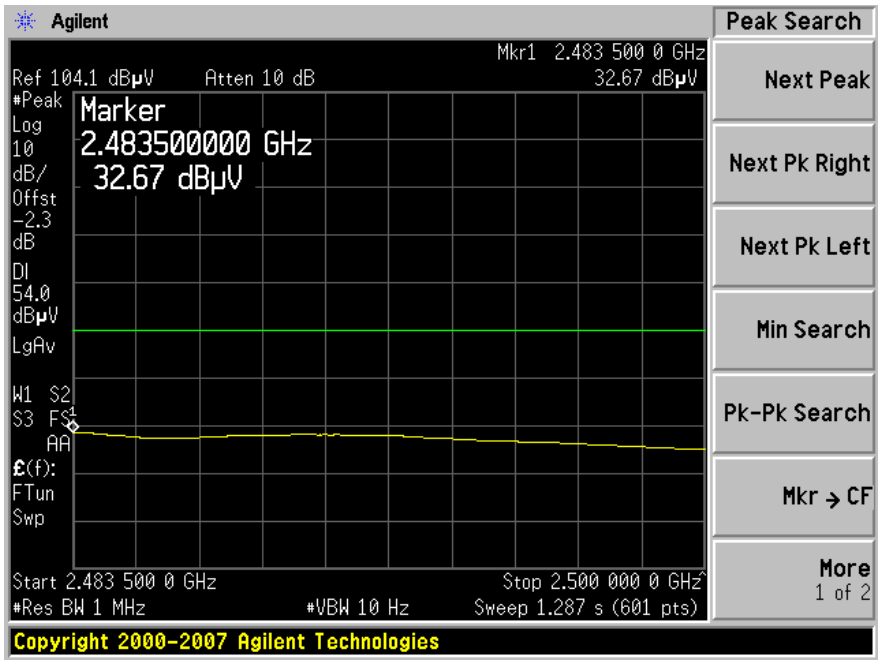


Vertical – Average

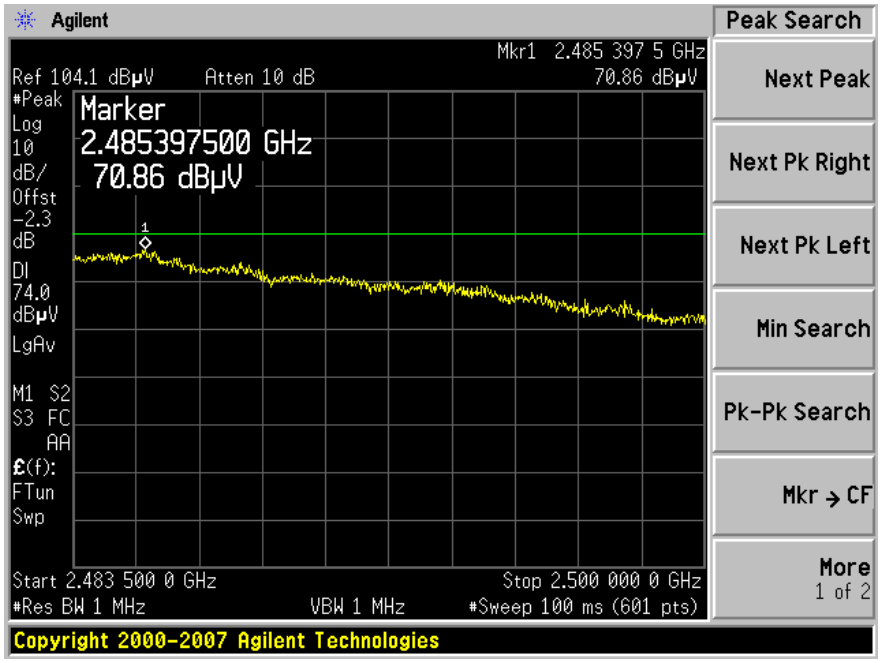
802.11n 40 MHz, High Channel: 2452 MHz



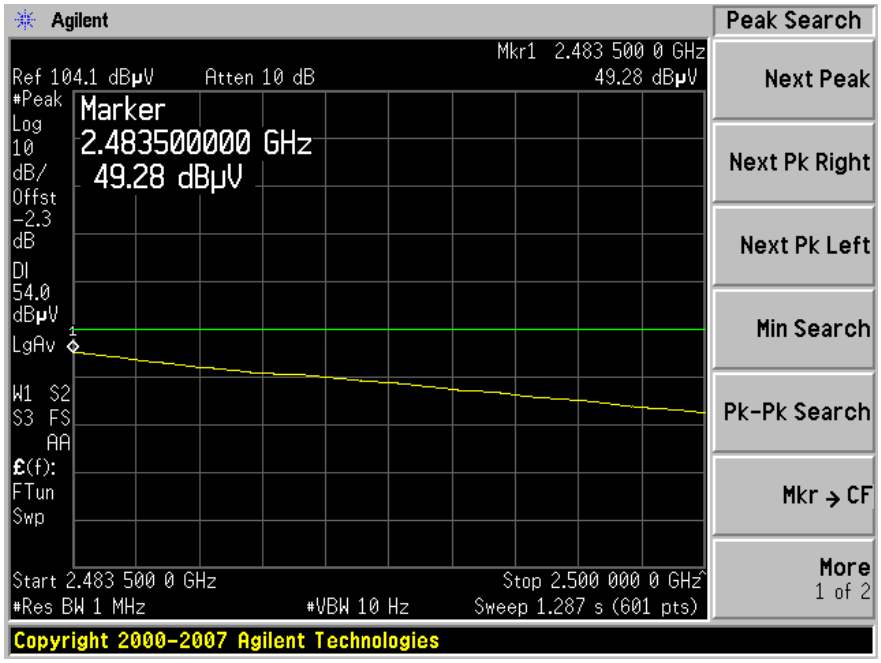
Horizontal - Peak



Horizontal - Average



Vertical - Peak



Vertical - Average

11 IC RSS-210 §2.6 Receiver Spurious Radiated Emissions

11.1 Applicable Standard

As per RSS-210 §2.6

Tables 2 and 3 show the general field strength limits of unwanted emissions, where applicable, for transmitters and receivers operating in accordance with the provisions specified in this RSS. Transmitters whose wanted emissions are also within the limits shown in Tables 2 and 3 may operate in any of the frequency bands of Tables 2 and 3, other than the restricted bands of Table 1 and the TV bands, and shall be certified under RSS-210. (Note: Devices operating below 490 kHz all of whose emissions are at least 40 dB below the limit given in Table 3 are Category II devices subject to RSS-310.) Unwanted emissions of transmitters and receivers are permitted to fall into Table 1 and TV frequencies but intentional emissions are prohibited. See the note of Table 2 for further details.

Table 2: General Field Strength Limits for Transmitters and Receivers at Frequencies above 30 MHz **(Note)**

Frequency (MHz)	Field Strength Microvolts/m at 3 meters (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

Note: Transmitting devices are not permitted in Table 1 bands or in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz, and 614-806 MHz). Prohibition of operation in TV bands does not apply to momentary devices, or to medical telemetry devices in the band 174-216 MHz, and to perimeter protection systems in the bands 54-72 and 76-88 MHz. The perimeter protection devices are to meet Table 3 field strengths limits.

Table 3: General Field Strength Limits for Transmitters at Frequencies below 30 MHz (Transmit)

Frequency (fundamental or spurious)	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector.

11.2 Test Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2003.

11.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

All data were recorded in the peak detection mode. Quasi-peak readings was performed only when an emissions was found to be marginal (within -4 dB of specification limits), and are distinguished with a "**QP**" in the data table.

11.4 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 - Limit

11.5 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Spectrum Analyzer	E4440A	US44303352	2009-04-27
Hewlett Packard	Pre amplifier	8447D	2944A06639	2009-06-05
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2009-05-05
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2009-04-29
HP	Pre Amplifier	8449B	3147A00400	2010-02-01
A.R.A Inc	Horn antenna	DRG-1181A	1132	2009-10-27
Sunol Science Corp	System Controller	SC99V	122303-1	N/R

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

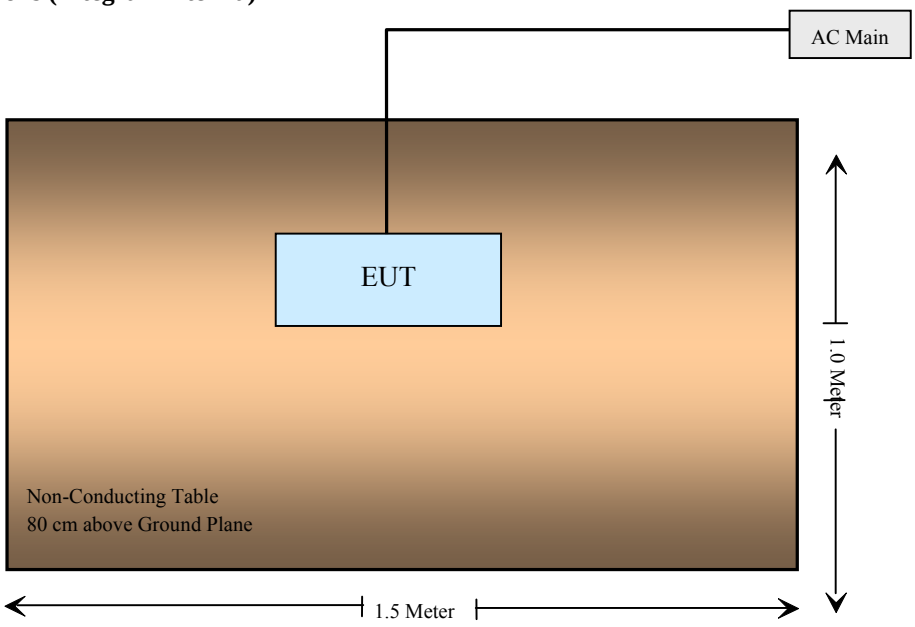
11.6 Test Environmental Conditions

Temperature:	20~22°C
Relative Humidity:	31~55 %
ATM Pressure:	80~101.1kPa

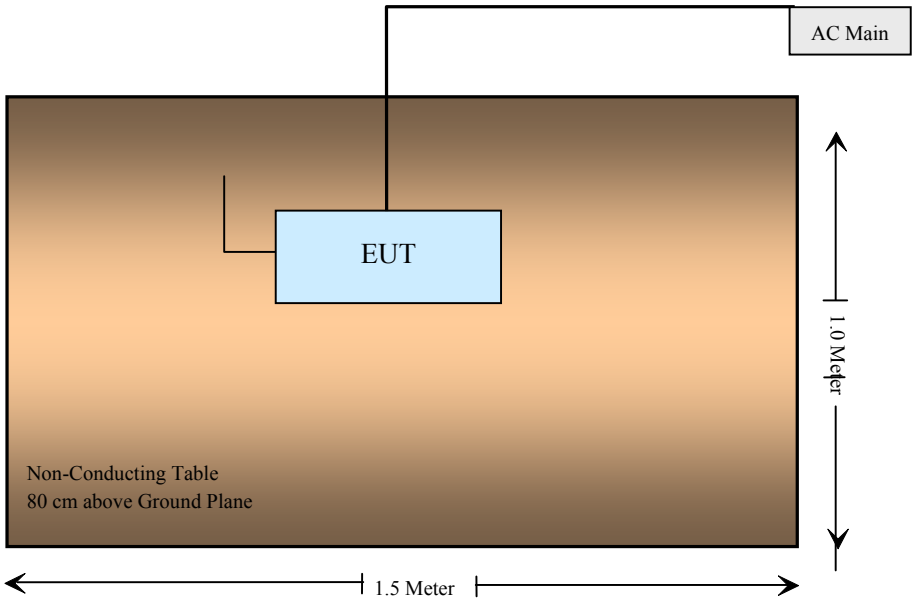
**The testing was performed by Dennis Huang on 2010-02-04 in Chamber 3.*

11.7 Test Setup Block Diagram

Radiated Emissions (Integral Antenna)



Radiated Emissions (External antenna)



11.8 Test Results

According to the recorded data, the EUT complied with RSS-210 Standard, and had the worst margin reading of:

Note: EUT with external antenna is the worst case configuration.

Receiving Mode:

Integral Antenna

Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range
-1.67	249.9445	Vertical	30 MHz to 1 GHz
-*	-	-	Above 1 GHz

**Note: All emissions were on the noise floor level and/or 20dB below the limit.*

External Antenna

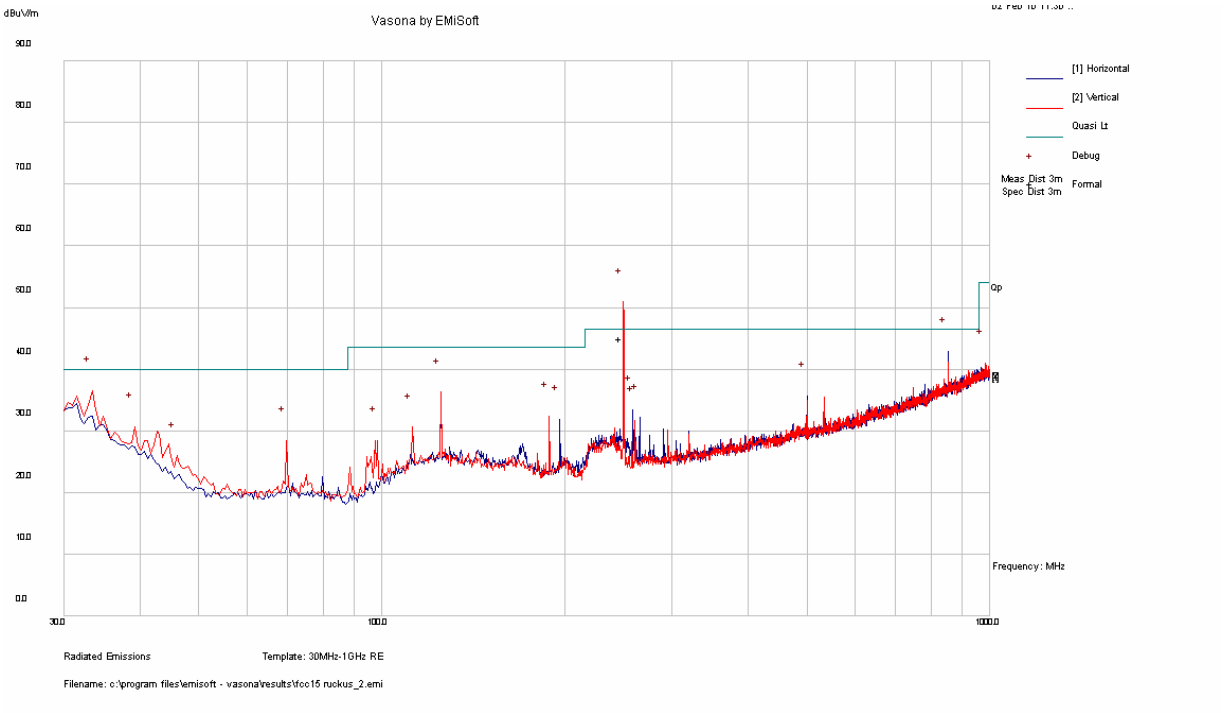
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range
-0.27	31.42956	Vertical	30 MHz to 1 GHz
-9.01	1173	Vertical	Above 1 GHz

Please refer to the following plot and data:

11.9 Radiated Emissions Test Plots and Data

30 MHz – 1 GHz, measured at 3 meters

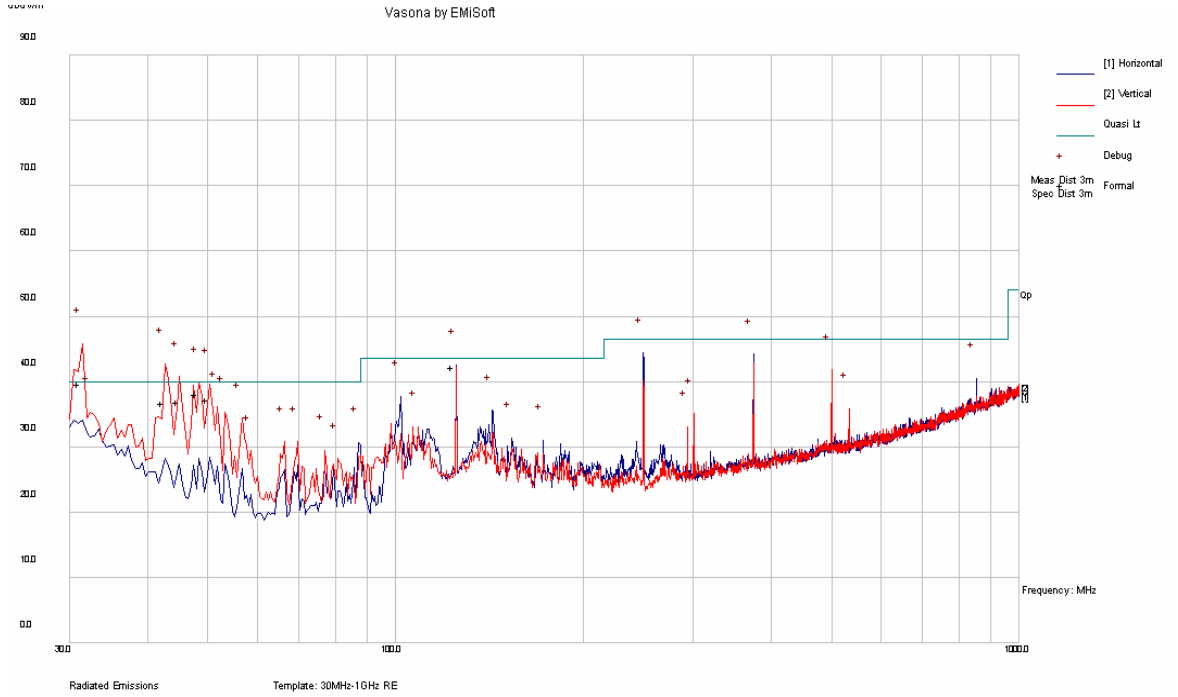
Integral Antenna – Receive Mode



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
249.9445	44.83	100	V	92	46.5	-1.67
853.3277	41.73	100	H	144	46.5	-4.77
125.0055	37.68	250	H	296	43.5	-5.82
135.245	33.31	300	H	0	43.5	-10.19
31.33212	21.66	106	V	182	40.0	-18.34
34.42572	17.97	303	V	252	40.0	-22.03

External Antenna - Receive Mode



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
31.42956	39.73	91	V	263	40	-0.27
42.7984	36.68	101	V	29	40	-3.32
45.25892	36.84	140	V	197	40	-3.16
48.43072	38.17	92	V	44	40	-1.83
50.44008	37.21	168	V	310	40	-2.79
124.9978	42.17	293	H	123	43.5	-1.33

Above 1 GHz, measured at 3 Meter:

Integral Antenna – Receive Mode

Frequency (MHz)	Indicated Reading (dBµV)	Table Azimuth (degree)	Test Antenna			Cable Loss (dB)	Pre-Amp. Gain (dB)	Corrected Reading (dBµV/m)	IC RSS-Gen		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
-	-	-	-	-	-	-	-	-	-	-	*

***Note:** *All emissions were at the noise floor level and/or 20dB below the limit.*

External Antenna – Receive Mode

Frequency (MHz)	Indicated Reading (dBµV)	Table Azimuth (degree)	Test Antenna			Cable Loss (dB)	Pre-Amp. Gain (dB)	Corrected Reading (dBµV/m)	IC RSS-Gen		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
1173	57.47	187	100	V	24.6	3.49	37.53	48.03	74	-25.97	Peak
1173	53.37	77	100	H	24.6	3.49	37.53	43.93	74	-30.07	Peak
1173	54.43	187	100	V	24.6	3.49	37.53	44.99	54	-9.01	Ave
1173	48.64	77	100	H	24.6	3.49	37.53	39.2	54	-14.8	Ave
1920	52.42	193	100	V	26.4	4.62	35.97	47.47	74	-26.53	Peak
1920	49.05	145	179	H	26.4	4.62	35.97	44.1	74	-29.9	Peak
1920	48.24	193	100	V	26.4	4.62	35.97	43.29	54	-10.71	Ave
1920	42.02	145	179	H	26.4	4.62	35.97	37.07	54	-16.93	Ave

12 FCC §15.247 (i), § 2.1091 & IC RSS-102 - RF Exposure

12.1 Applicable Standard

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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Time Averaging (min)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 – 300	28	0.073	2*	6
300 – 1 500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	f / 150	6
1 500 – 15 000	61.4	0.163	10	6
15 000 – 150 000	61.4	0.163	10	$616000 / f^{1.2}$
150 000- 300 000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000 / f^{1.2}$

Note: *f* is frequency in MHz
* Power density limit is applicable at frequencies greater than 100 MHz

12.2 MPE Prediction

Prediction 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

Maximum peak output power at antenna input terminal (dBm):	21.42
Maximum peak output power at antenna input terminal (mW):	138.67
Prediction distance (cm):	20
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	9.0
Maximum Antenna Gain (numeric):	7.94
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.219
Power density of prediction frequency at 20.0 cm (W/m^2):	2.19
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

12.3 Test Result

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is $0.219 mW/cm^2$ ($2.19 W/m^2$).Limit is $1 mW/cm^2$ ($10 W/m^2$).