



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

For

Motorola, Inc.

46653 Fremont Blvd., Fremont, CA 94538, USA

FCC ID: GZ52247N8
IC: 2525A-2247N8
Model: 2247-N8

Report Type: Original Report	Product Type: 802.11b/g/n Wireless Ethernet Modem
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Report Number: <u>R1006242-247</u>	
Report Date: <u>2010-11-09</u>	
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* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*" and

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1006242-247	Original Report	2010-11-09

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Motorola, Inc.*, and their product, *model: 2247-N8, FCC ID: GZ52247N8, IC: 2525A-2247N8* which will be henceforth in this report referred to as the EUT (Equipment Under Test). The EUT is a 802.11 b/g/n wireless, 4-port ethernet modem, working in 2.4 GHz.

1.2 Mechanical Description of EUT

The EUT measures approximately *174mm (L) x 130mm (W) x 30mm (H)* and weighs approximately 298g.

The test data gathered are from a production sample, S/N: MOTN8030-48, provided by the customer.

1.3 Objective

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

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 and ANSI C63.10-2009, American National Standard for Testing Unlicensed Wireless Devices.

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 ± 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.

1.7 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: R-2463 and C-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 & ANSI C63.10-2009.

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

Radio Mode	Band Width (MHz)	Frequency/Data Rate		
		Low Channel (MHz/Mbps)	Middle Channel (MHz/Mbps)	High Channel (MHz)
802.11b	20	2412/1	2437/1	2462/1
802.11g	20	2412/6	2437/6	2462/6
802.11n(20)	20	2412/6.5	2437/6.5	2462/6.5
802.11n(40)	20	2422/13	2437/13	2452/13

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 EUT Internal Configuration

Manufacturer	Description	Model	Serial Number
Motorola Inc.	PCB Assembly	MOTN8030	250-542600-403

2.6 Local /Remote Support Equipment

Manufacturer	Product Description	Model No.	Serial No.
IBM	Laptop	T40	-
Leader Electronics Inc.	AC/DC Power Supply	MU18-2120150-A1	-

2.7 Internal Parts List and Details

Manufacturer	Item Description	Model No.	Serial No.
Motorola Inc.	PCB Assembly	578080-00100 Rev1	45

2.8 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
USB	< 1m	EUT	Laptop
RF Cable	< 1m	EUT	Spectrum Analyzer
Ethernet Cable	< 1m	EUT	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC/IC Rules	Description of Test	Results
FCC §15.247(i), §2.1091; IC RSS-102	RF Exposure	Compliant
FCC §15.203; IC RSS-Gen §7.1.4	Antenna Requirement	Compliant
FCC §15.207(a); IC RSS-Gen §7.2.2	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209; IC RSS-210 §2.2	Restricted Bands	Compliant
FCC §15.209(a), §15.247(d); IC RSS-210 §A8.5, §2.6	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2); IC RSS-210 §A8.2	6 dB 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	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e); IC RSS-210 §A8.2(b)	Power Spectral Density	Compliant
IC RSS-210 §2.6 RSS-Gen § 4.10	Receiver Spurious Emission	Compliant

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

4.1 Applicable Standard

According to FCC §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 FCC §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.

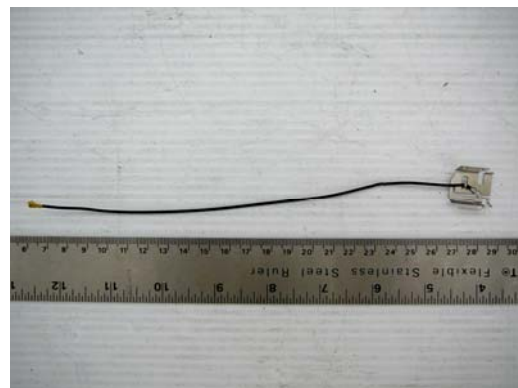
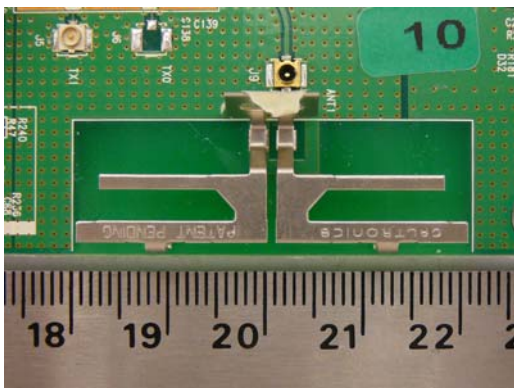
As per IC RSS-Gen §7.1.4: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be 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 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 RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

4.2 Result

The EUT has two antennas, maximum gain of 2 dBi antenna for each of them, 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.



5 FCC §15.207 & IC RSS-Gen §7.2.2 – AC Line Conducted Emissions

5.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.2 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 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the 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 and IC RSS-Gen limits.

External I/O cables were draped along the edge of the test table and bundle when necessary. The AC/DC adapter of the EUT was connected to LISN-1 which is connected to 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-2.

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

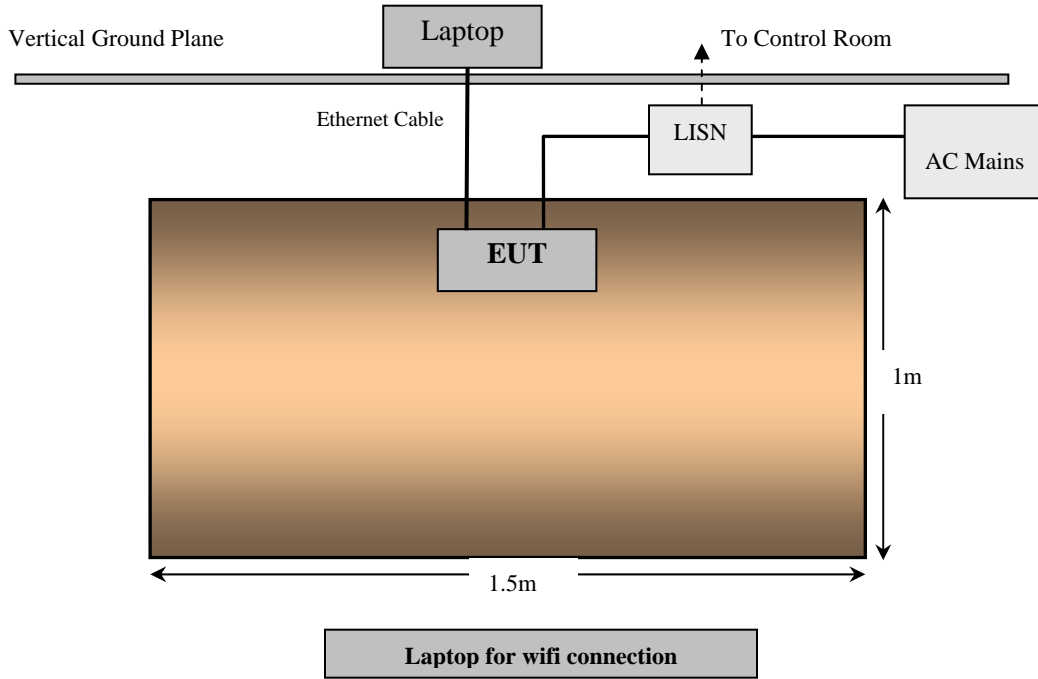
All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP”. Average readings are distinguished with an “Ave”.

5.4 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Solar Electronics	LISN	9252-R-24-BNC	511205	2010-06-25
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2010-06-24

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



5.6 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	42%
ATM Pressure:	102.1kPa

The testing was performed by Jerry Huang on 2010-07-27 in 5m Chamber 2.

5.7 Test Results

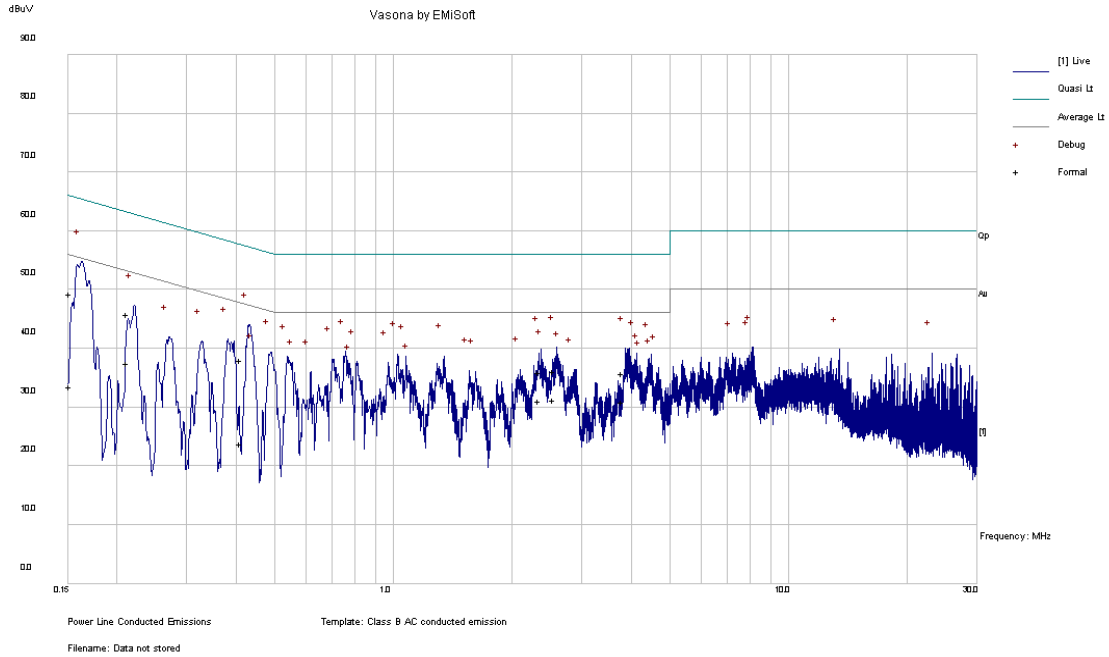
According to the recorded data in following table, the EUT complied with the FCC & IC standard's conducted emissions limits for consumer devices, with the *worst* margin reading of:

Connection: 120V/60Hz (Transmitting worst mode: 802.11 b Mode middle channel)			
Margin (dB)	Frequency (MHz)	Conductor (Line/Neutral)	Range (MHz)
-11.68	0.397872	Neutral	0.15 to 30 MHz
Connection: 120V/60Hz (Receiving Mode)			
-7.61	0.153261	Neutral	0.15 to 30 MHz

Please refer to the following plots and data:

Transmitting Mode:

(Worst Case 802.11 b, middle channel) 120V/60 Hz Line:



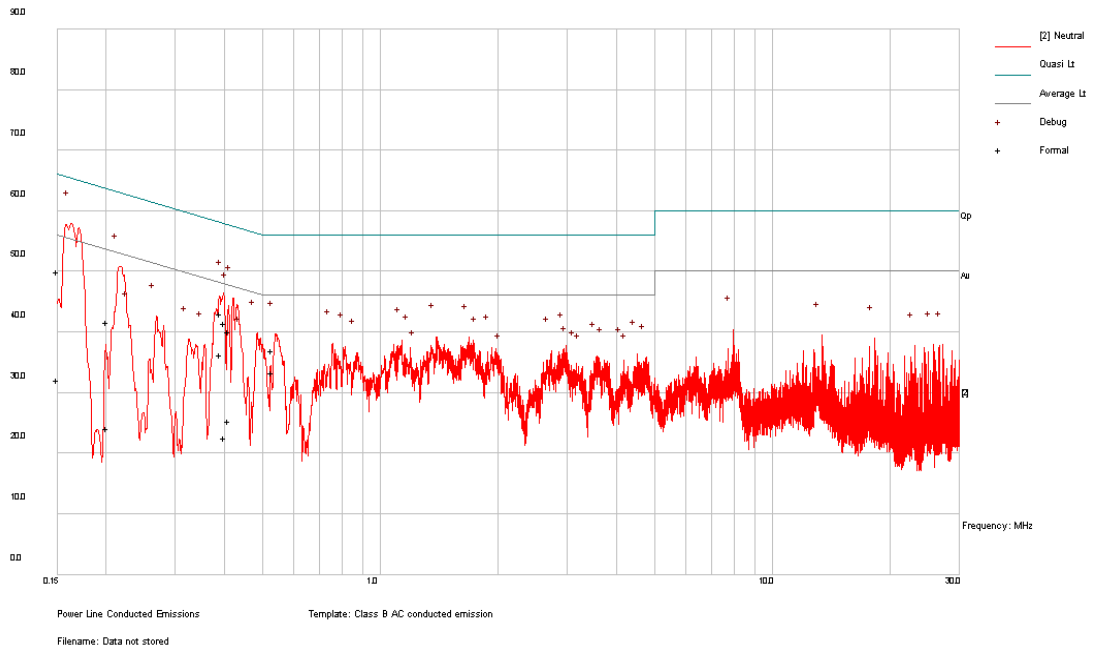
Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.155232	49.25	Line	65.72	-16.47
0.216336	45.85	Line	62.96	-17.11
0.417762	38.02	Line	57.49	-19.47
2.589952	36.12	Line	56.00	-19.88
2.377423	35.92	Line	56.00	-20.08
3.878781	35.81	Line	56.00	-20.19

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.155232	33.49	Line	55.72	-22.22
0.417762	23.8	Line	47.49	-23.69
0.216336	37.45	Line	52.96	-15.51
2.589952	31.28	Line	46	-14.72
3.878781	30.87	Line	46	-15.13
2.377423	31.13	Line	46	-14.87

(Worst Case 802.11 b, middle channel) 120V/60 Hz Neutral:



Quasi-Peak Measurement:

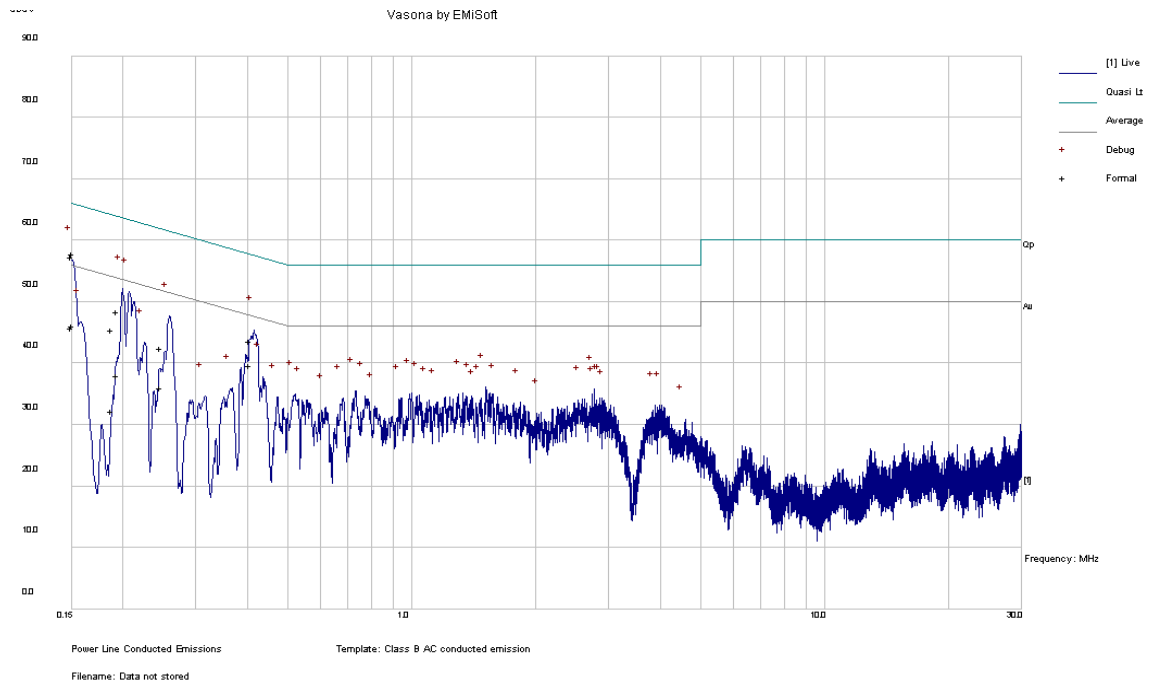
Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.397872	32.59	Neutral	57.90	-14.94
0.152838	36.14	Neutral	65.84	-15.93
0.407823	31.14	Neutral	57.69	-16.18
0.417741	29.68	Neutral	57.49	-17.44
0.540876	26.41	Neutral	56.00	-19.11
0.205281	30.70	Neutral	63.39	-21.70

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.397872	36.22	Neutral	47.90	-11.68
0.540876	33.35	Neutral	46.00	-12.65
0.417741	25.35	Neutral	47.49	-22.14
0.152838	32.19	Neutral	55.84	-23.65
0.407823	22.53	Neutral	47.69	-25.17
0.205281	24.07	Neutral	53.39	-29.32

Receiving Mode:

120V/60 Hz Line:



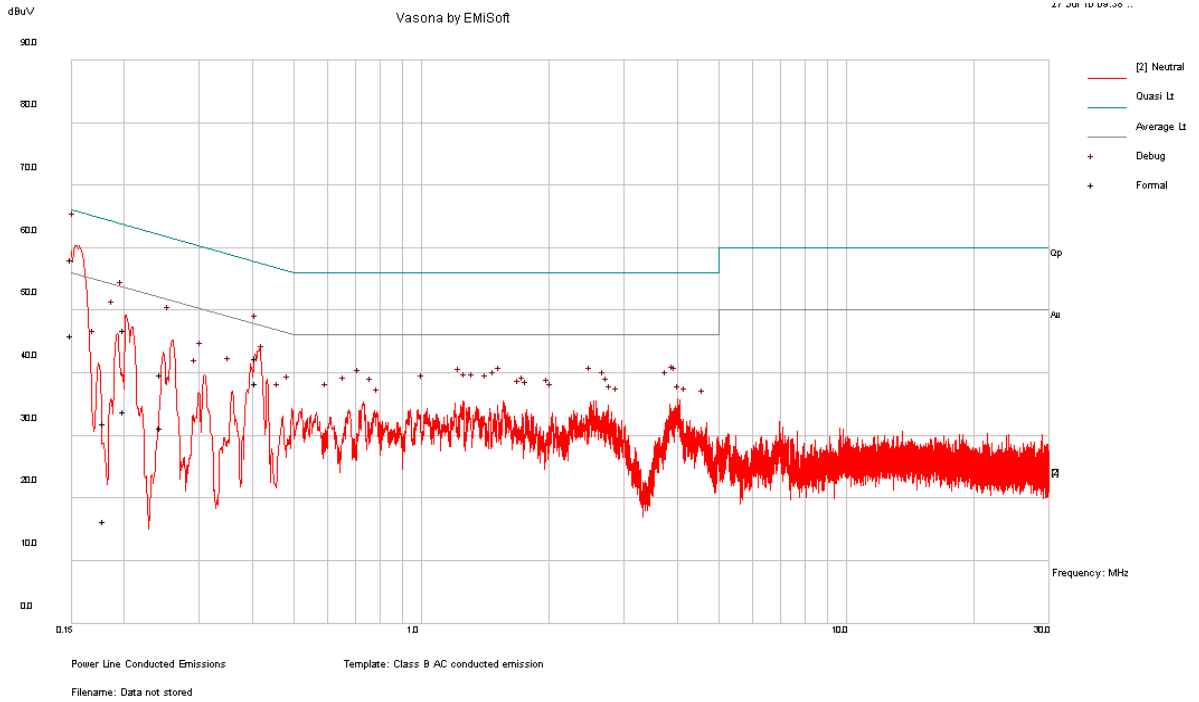
Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.153633	44.15	Line	65.80	-7.94
0.153051	43.56	Line	65.83	-8.52
0.413838	33.29	Line	57.57	-13.90
0.197229	37.21	Line	63.73	-15.33
0.191925	33.91	Line	63.95	-18.58
0.251511	31.86	Line	61.71	-19.23

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.413838	29.24	Line	47.57	-7.96
0.153633	32.45	Line	55.8	-9.63
0.153051	32.00	Line	55.83	-10.08
0.251511	25.39	Line	51.71	-15.70
0.197229	26.79	Line	53.73	-15.75
0.191925	20.69	Line	53.95	-21.80

120V/60 Hz Neutral:



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.153261	58.21	Neutral	65.82	-7.61
0.415146	42.35	Neutral	57.54	-15.20
0.415941	42.32	Neutral	57.53	-15.21
0.203817	46.82	Neutral	63.45	-16.63
0.249207	39.83	Neutral	61.78	-21.96
0.182859	31.89	Neutral	64.35	-32.47

Average Measurement:

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (L/N)	Limit (dBuV)	Margin (dB)
0.415146	38.35	Neutral	47.54	-9.20
0.415941	38.31	Neutral	47.53	-9.22
0.153261	45.94	Neutral	55.82	-9.88
0.203817	33.88	Neutral	53.45	-19.57
0.249207	31.22	Neutral	51.78	-20.56
0.182859	16.28	Neutral	54.35	-38.07

6 FCC §15.205, §15.209, §15.247(d) & IC RSS-210 §A8.5, §2.6 - Spurious Radiated Emissions

6.1 Applicable Standards

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) and RSS-210: 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) and IC RSS-210 §2.2, 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 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)).

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.

6.2 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/RSS-Gen 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.

6.3 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

6.4 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:

$$\text{Corrected Amplitude} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

6.5 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Numbers	Calibration Dates
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09
HP	Pre-Amplifier	8449B	3147A00400	2010-02-01
A.R.A.	Antenna, Horn	DRG-118/A	1132	2009-10-27
Sunol Science Corp.	Combination Antenna	JB1 Antenna	A103105-3	2010-05-28
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2010-06-24

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

6.6 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	42%
ATM Pressure:	102.1kPa

* The testing was performed by Jerry Huang on 2010-07-28 in 5m Chamber 3.

6.7 Test Result Summary

According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15, Subpart C and IC RSS-210/Gen, and had the worst margin of:

802.11 b mode:

Mode: Transmitting. 30-1000 MHz(Worst Channel)			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-8.21	249.9426	Horizontal	Middle, 30 to 1000 MHz
Mode: Transmitting, Above 1000 MHz			
-2.2	4824	Vertical	Low, 1 to 25 GHz
-6.1	4874	Horizontal	Middle, 1 to 25 GHz
-6.5	4924	Vertical	High, 1 to 25 GHz

802.11 g mode:

Mode: Transmitting. 30-1000 MHz(Worst Channel)			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-	-	-	- ¹
Mode: Transmitting, Above 1000 MHz			
-2.8	7236	Vertical	Low, 1 to 25 GHz
-3.4	7311	Vertical	Middle, 1 to 25 GHz
-14.1	4924	Vertical	High, 1 to 25 GHz

802.11 n 20MHz BW mode:

Mode: Transmitting. 30-1000 MHz(Worst Channel)			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-	-	-	- ¹
Mode: Transmitting, Above 1000 MHz			
-28.1	1660	Horizontal	Low, 1 to 25 GHz
-16.5	4880	Vertical	Middle, 1 to 25 GHz
-16.7	4920	Vertical	High, 1 to 25 GHz

¹Note: 20MHz bandwidth, 802.11 b Middle channel has the worst spurious emission for below 1GHz range.

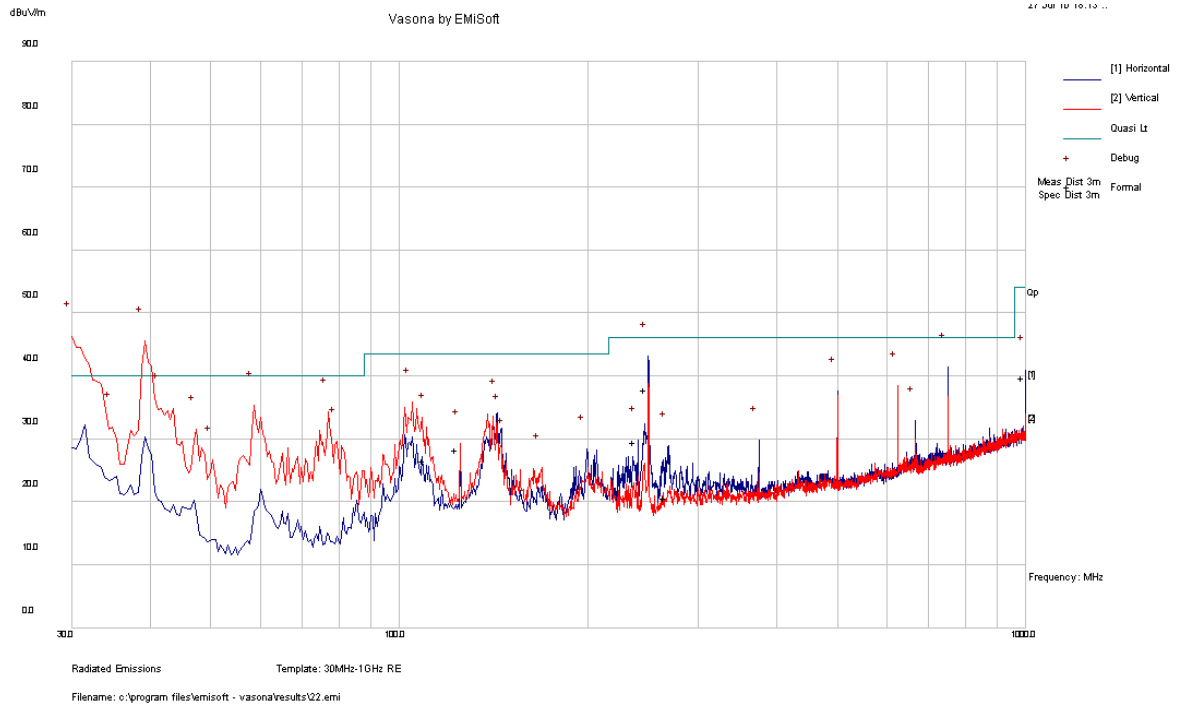
802.11 n 40MHz BW mode:

Mode: Transmitting. 30-1000 MHz(Worst Channel)			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
-7.01	249.9448	Horizontal	Middle, 30 to 1000 MHz
Mode: Transmitting, Above 1000 MHz			
-13.1	4844	Vertical	Low, 1 to 25 GHz
-18.3	4874	Horizontal	Middle, 1 to 25 GHz
-19.3	4904	Horizontal	High, 1 to 25 GHz

6.8 Radiated Emissions Test Plot & Data

1) 30 MHz – 1 GHz, measured at 3 meters distance

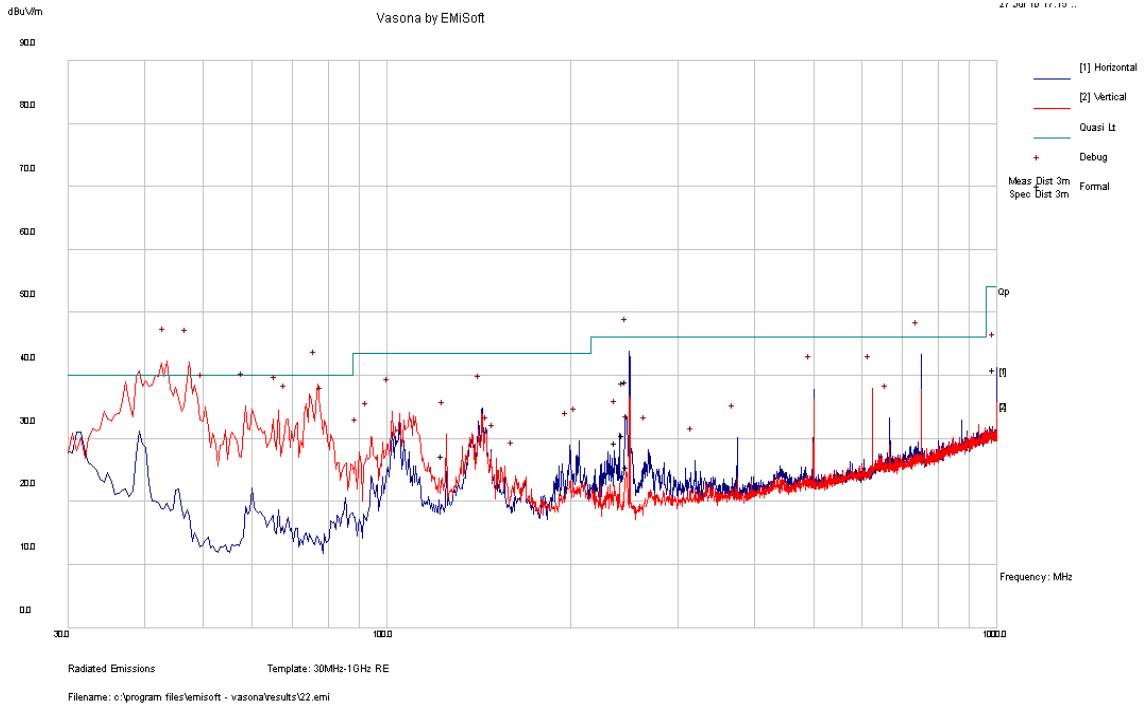
20 MHz: 802.11b mode, (worst case)



Quasi-Peak Measurement

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
249.9426	37.79	100	H	90	46	-8.21
1000	39.76	102	H	57	54	-14.24
125.0055	28.34	100	V	156	43.5	-15.16
240.0016	29.43	127	H	114	46	-16.57
110.7414	26.64	100	V	208	43.5	-16.86
268.5792	20.63	120	H	287	46	-25.37

802.11n, 40 MHz mode:



Quasi-Peak Measurement

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)
249.9448	38.99	100	H	112	46	-7.01
246.3626	30.52	158	H	105	46	-15.48
1000	40.93	100	H	63	54	-13.07
124.9897	27.21	141	V	159	43.5	-16.29
239.988	29.41	138	H	124	46	-16.59
251.0352	25.59	115	H	138	46	-20.41

2) 1 – 25 GHz, measured at 3 meters distance

802.11b mode:

Frequency (MHz)	S.A. Reading (dB μ V)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
4824	48.65	229	152	H	33.33	4.53	27.4	59.1	74	-14.9	Peak
4824	45.82	171	128	V	33.33	4.53	27.4	56.3	74	-17.7	Peak
4824	40.44	229	152	H	33.33	4.53	27.4	50.9	54	-3.1	Ave
4824	41.36	171	128	V	33.33	4.53	27.4	51.8	54	-2.2	Ave
Middle channel 2437 MHz measured at 3 meters											
4874	44.1	232	146	H	33.33	4.53	27.4	54.6	74	-19.4	Peak
4874	42.4	167	157	V	33.33	4.53	27.4	52.9	74	-21.1	Peak
4874	37.49	232	146	H	33.33	4.53	27.4	47.9	54	-6.1	Ave
4874	36.63	167	157	V	33.33	4.53	27.4	47.1	54	-6.9	Ave
High channel 2462 MHz measured at 3 meters											
4924	42.87	238	152	H	33.33	4.53	27.4	53.3	74	-20.7	Peak
4924	42.54	172	151	V	33.33	4.53	27.4	53.0	74	-21.0	Peak
4924	35.29	238	152	H	33.33	4.53	27.4	45.7	54	-8.3	Ave
4924	37.04	172	151	V	33.33	4.53	27.4	47.5	54	-6.5	Ave

802.11g mode:

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
1660	39.13	162	100	H	25.09	2.48	27.4	39.3	74	-34.7	Peak
1660	44.98	147	100	V	25.09	2.48	27.4	45.1	74	-28.9	Peak
1660	25.29	162	100	H	25.09	2.48	27.4	25.5	54	-28.5	Ave
1660	24.76	147	100	V	25.09	2.48	27.4	24.9	54	-29.1	Ave
4824	44.74	275	153	H	33.33	4.53	27.4	55.2	74	-18.8	Peak
4824	47.77	159	130	V	33.33	4.53	27.4	58.2	74	-15.8	Peak
4824	27.96	275	153	H	33.33	4.53	27.4	38.4	54	-15.6	Ave
4824	31.74	159	130	V	33.33	4.53	27.4	42.2	54	-11.8	Ave
7236	44.21	206	162	H	38.92	5.58	26.9	61.8	74	-12.2	Peak
7236	50	236	140	V	38.92	5.58	26.9	67.6	74	-6.4	Peak
7236	29.43	206	162	H	38.92	5.58	26.9	47.0	54	-7.0	Ave
7236	33.64	236	140	V	38.92	5.58	26.9	51.2	54	-2.8	Ave
Middle channel 2437 MHz measured at 3 meters											
1660	39.97	166	100	H	25.09	2.48	27.4	40.1	74	-33.9	Peak
1660	45.2	145	100	V	25.09	2.48	27.4	45.4	74	-28.6	Peak
1660	25.68	166	100	H	25.09	2.48	27.4	25.8	54	-28.2	Ave
1660	25.12	145	100	V	25.09	2.48	27.4	25.3	54	-28.7	Ave
4874	47.05	212	165	H	33.33	4.53	27.4	57.5	74	-16.5	Peak
4874	46.75	160	188	V	33.33	4.53	27.4	57.2	74	-16.8	Peak
4874	29.43	212	165	H	33.33	4.53	27.4	39.9	54	-14.1	Ave
4874	30.56	160	188	V	33.33	4.53	27.4	41.0	54	-13.0	Ave
7311	43.57	206	158	H	38.92	5.58	26.9	61.2	74	-12.8	Peak
7311	53.01	225	155	V	38.92	5.58	26.9	70.6	74	-3.4	Peak
7311	29.48	206	158	H	38.92	5.58	26.9	47.1	54	-6.9	Ave
7311	32.99	225	155	V	38.92	5.58	26.9	50.6	54	-3.4	Ave
High channel 2462 MHz measured at 3 meters											
1660	40.29	163	100	H	25.09	2.48	27.4	40.5	74	-33.5	Peak
1660	45.61	150	100	V	25.09	2.48	27.4	45.8	74	-28.2	Peak
1660	26.03	163	100	H	25.09	2.48	27.4	26.2	54	-27.8	Ave
1660	24.63	150	100	V	25.09	2.48	27.4	24.8	54	-29.2	Ave
4924	46.2	218	162	H	33.33	4.46	27.4	56.6	74	-17.4	Peak
4924	45.77	290	214	V	33.33	4.46	27.4	56.2	74	-17.8	Peak
4924	28.36	218	162	H	33.33	4.46	27.4	38.7	54	-15.3	Ave
4924	29.53	290	214	V	33.33	4.46	27.4	39.9	54	-14.1	Ave

802.11n, 20 MHz Mode:

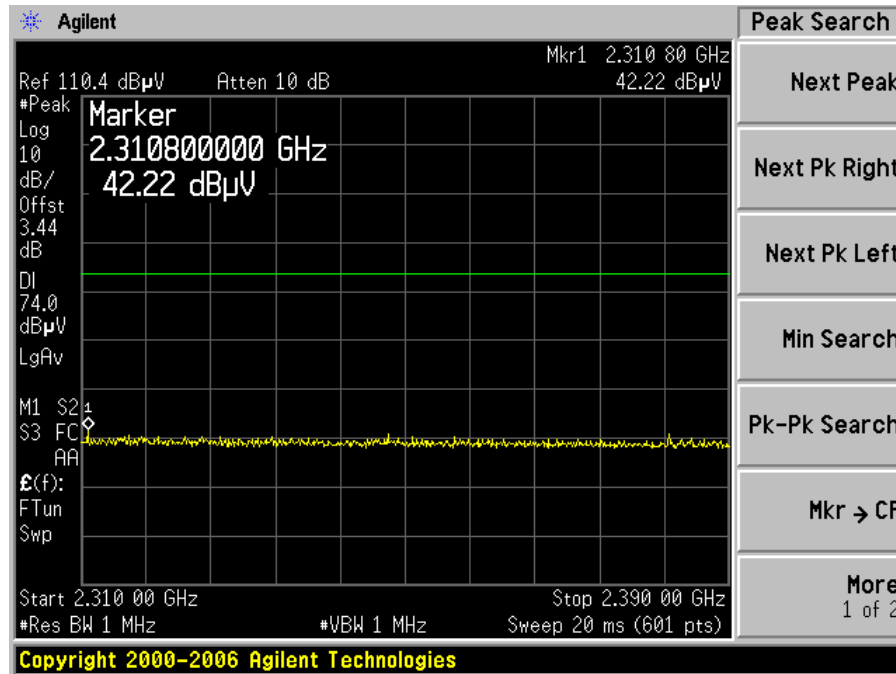
Frequency (MHz)	S.A. Reading (dB μ V)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/IC		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
1660	39.17	160	100	H	25.09	2.48	27.4	39.3	74	-34.7	Peak
1660	43.6	148	100	V	25.09	2.48	27.4	43.8	74	-30.2	Peak
1660	25.78	160	100	H	25.09	2.48	27.4	25.9	54	-28.1	Ave
1660	24.5	148	100	V	25.09	2.48	27.4	24.7	54	-29.3	Ave
Middle channel 2437 MHz measured at 3 meters											
4874	45.85	156	136	H	33.33	4.53	27.4	56.3	74	-17.7	Peak
4874	47.07	227	193	V	33.33	4.53	27.4	57.5	74	-16.5	Peak
4874	26.29	156	136	H	33.33	4.53	27.4	36.7	54	-17.3	Ave
4874	25.73	227	193	V	33.33	4.53	27.4	36.2	54	-17.8	Ave
High channel 2462 MHz measured at 3 meters											
4924	45.67	219	156	H	33.33	4.53	27.4	56.1	74	-17.9	Peak
4924	43.32	329	205	V	33.33	4.53	27.4	53.8	74	-20.2	Peak
4924	25.99	219	156	H	33.33	4.53	27.4	36.4	54	-17.6	Ave
4924	26.85	329	205	V	33.33	4.53	27.4	37.3	54	-16.7	Ave

802.11n, 40 MHz Mode:

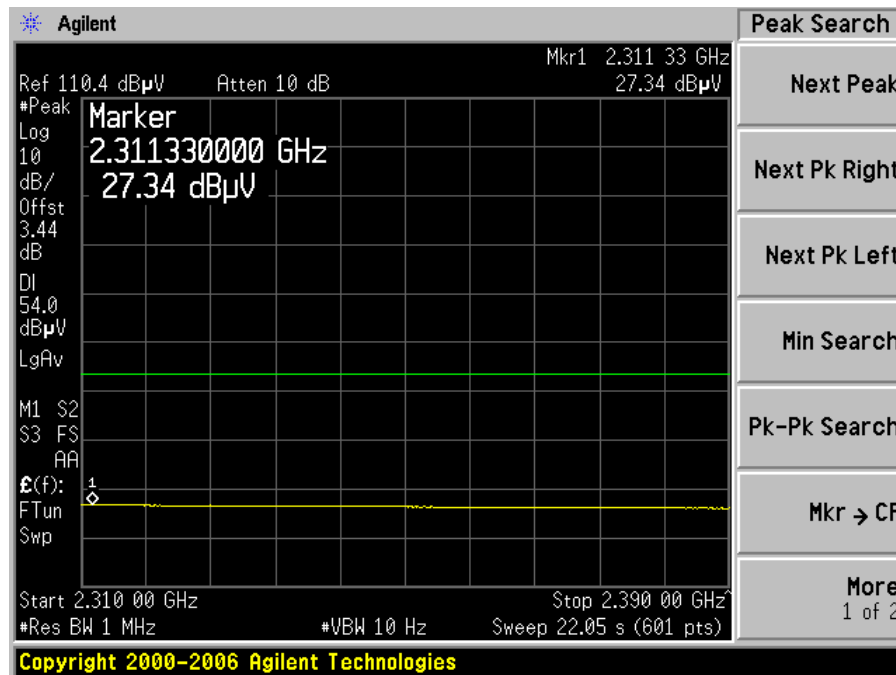
Frequency (MHz)	S.A. Reading (dB μ V)	Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB μ V/m)	FCC/IC		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dB μ V/m)	Margin (dB)	
Low Channel 2422 MHz, measured at 3 meters											
4844	48.32	226	172	H	33.33	2.48	27.4	56.73	74	-17.3	Peak
4844	46.54	221	136	V	33.33	4.53	27.4	57.00	74	-17.0	Peak
4844	27.98	226	172	H	33.33	4.53	27.4	38.44	54	-15.6	Ave
4844	30.45	221	136	V	33.33	4.53	27.4	40.91	54	-13.1	Ave
Middle channel 2437 MHz measured at 3 meters											
4874	45.66	227	137	H	33.33	2.48	27.4	54.07	74	-19.9	Peak
4874	42.26	223	162	V	33.33	4.53	27.4	52.72	74	-21.3	Peak
4874	25.25	227	137	H	33.33	4.53	27.4	35.71	54	-18.3	Ave
4874	24.73	223	162	V	33.33	4.53	27.4	35.19	54	-18.8	Ave
High channel 2452 MHz measured at 3 meters											
4904	44.32	225	133	H	33.33	2.48	27.4	52.73	74	-21.3	Peak
4904	41.33	221	167	V	33.33	4.53	27.4	51.79	74	-22.2	Peak
4904	24.21	225	133	H	33.33	4.53	27.4	34.67	54	-19.3	Ave
4904	23.37	221	167	V	33.33	4.53	27.4	33.83	54	-20.2	Ave

3) Spurious Emissions in Restricted Bands:

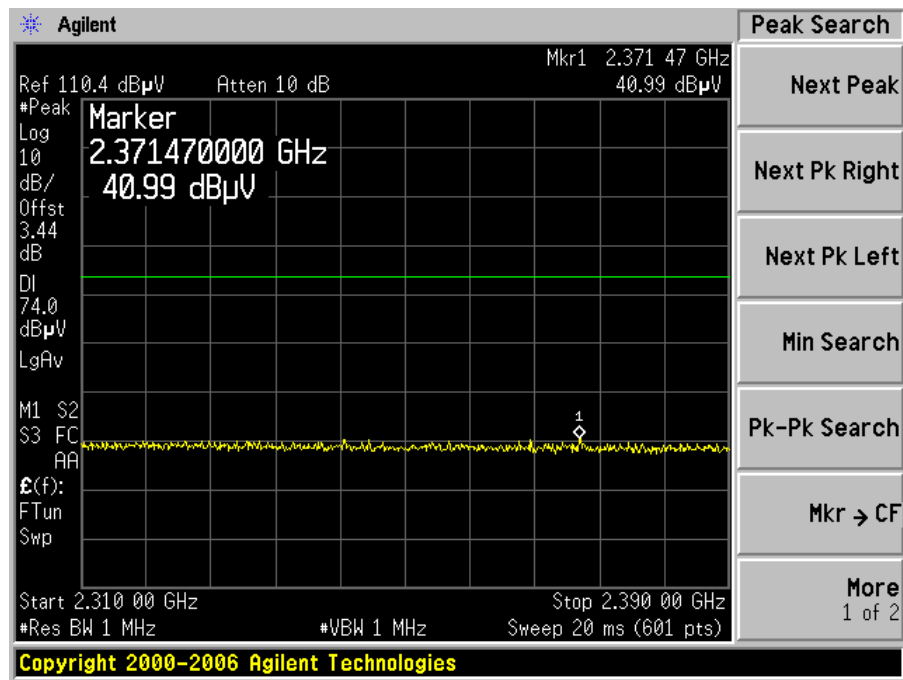
802.11 b, Lowest Channel at Horizontal, Peak



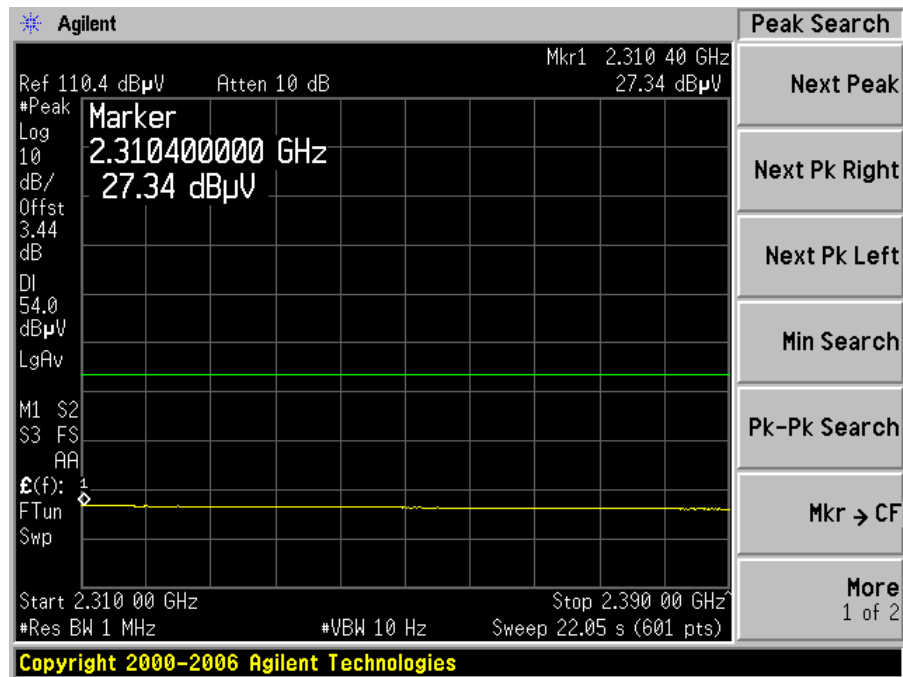
802.11b, Lowest Channel at Horizontal, Average



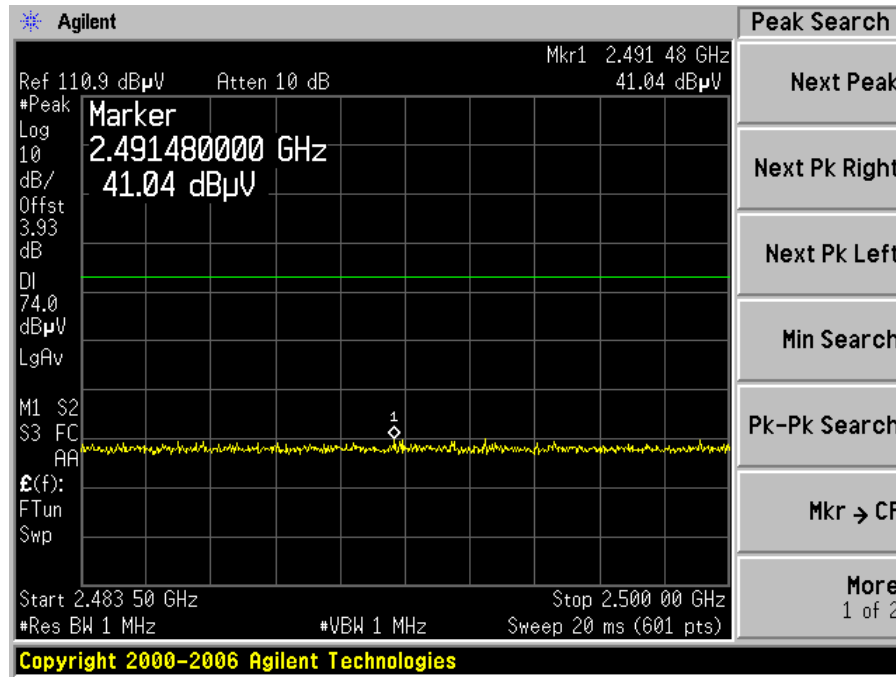
802.11b, Lowest Channel at Vertical, Peak



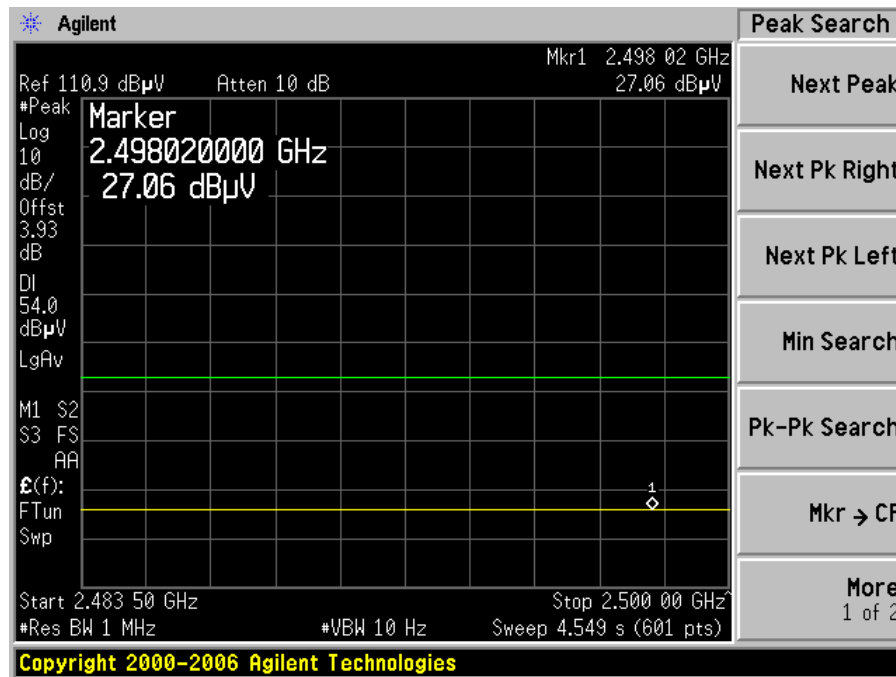
802.11b, Lowest Channel at Vertical, Average



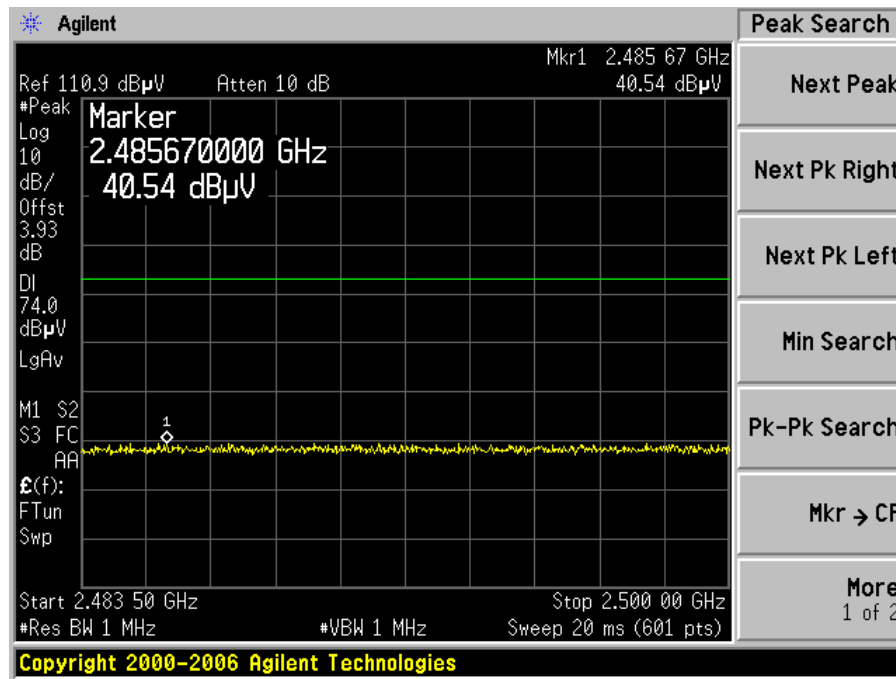
802.11b, Highest Channel at Horizontal, Peak



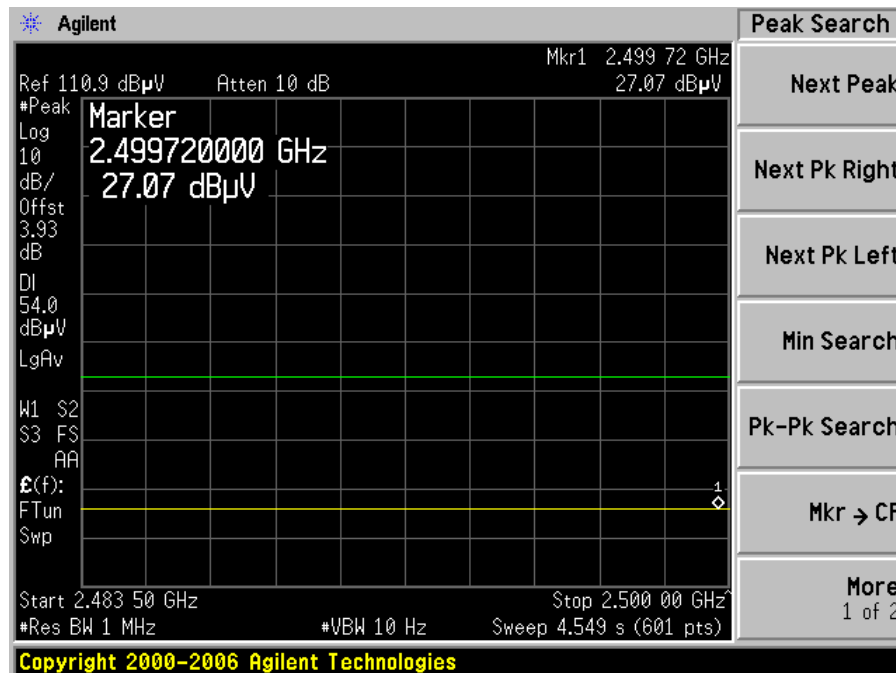
802.11b, Highest Channel at Horizontal, Average



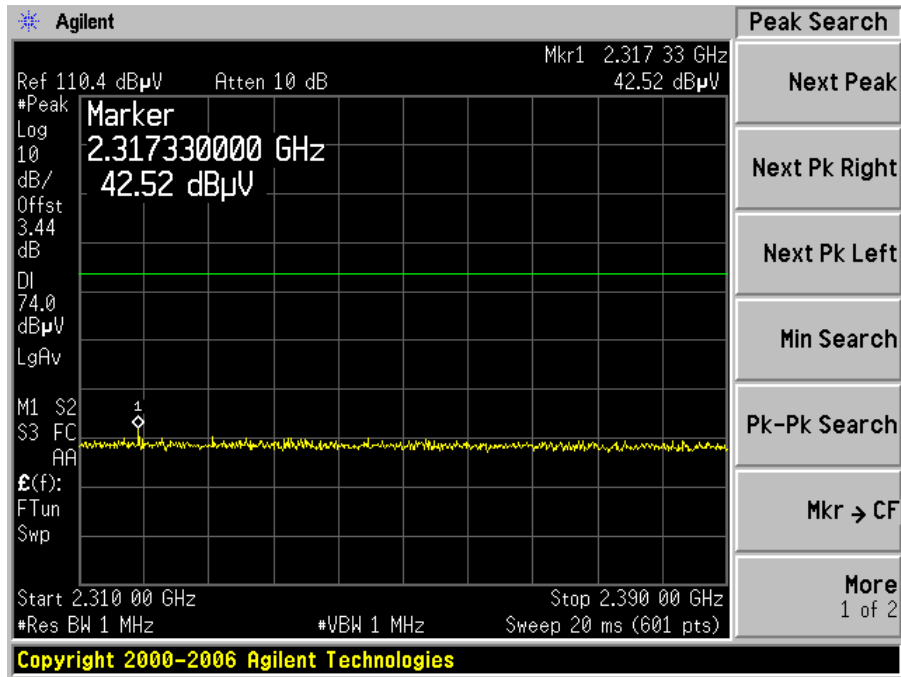
802.11b, Highest Channel at Vertical, Peak



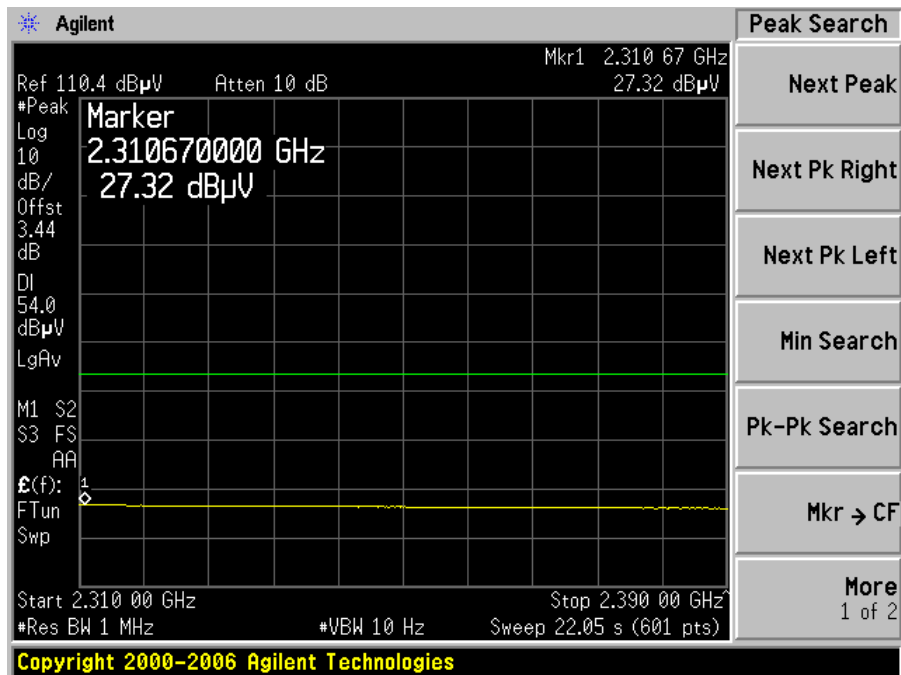
802.11b, Highest Channel at Vertical, Average



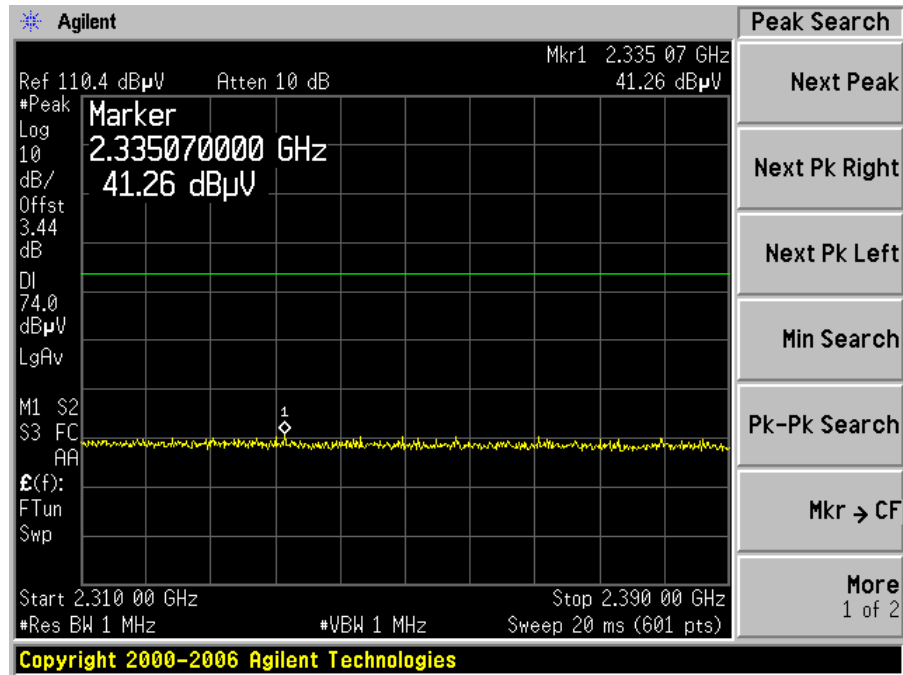
802.11 g, Lowest Channel at Horizontal, Peak



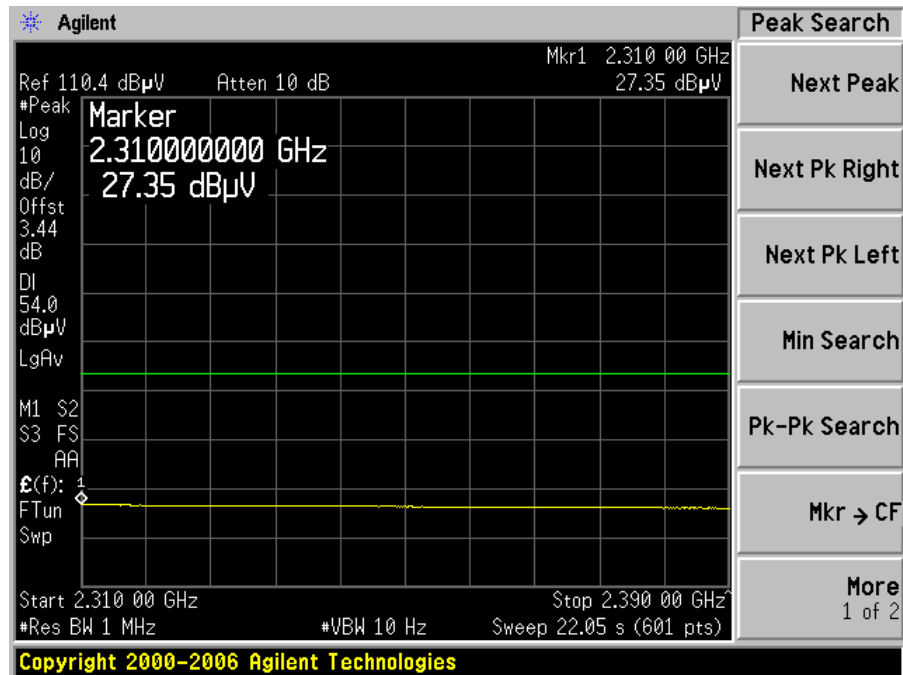
802.11g, Lowest Channel at Horizontal, Average



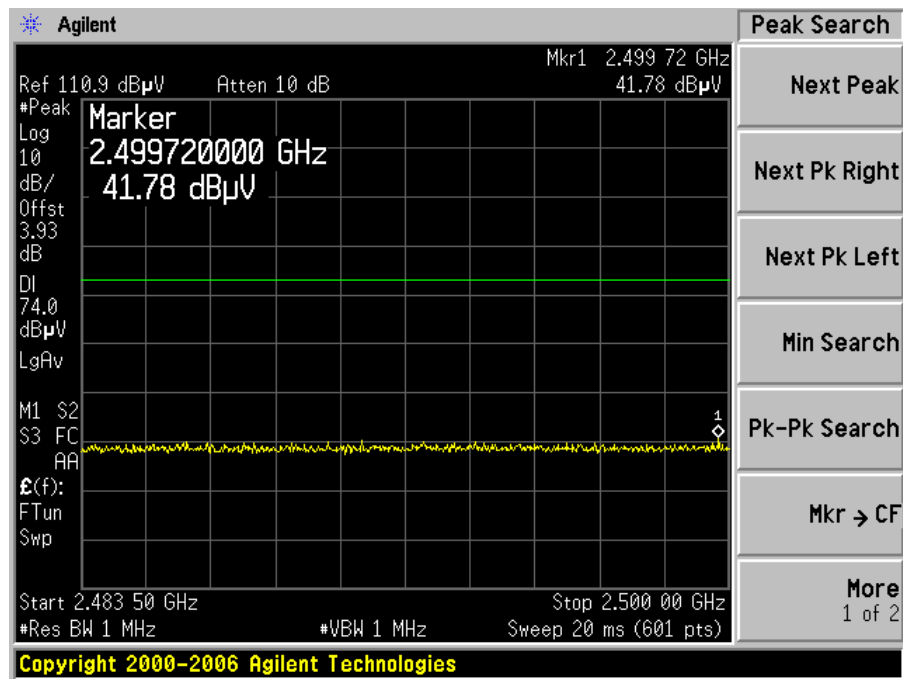
802.11g, Lowest Channel at Vertical, Peak



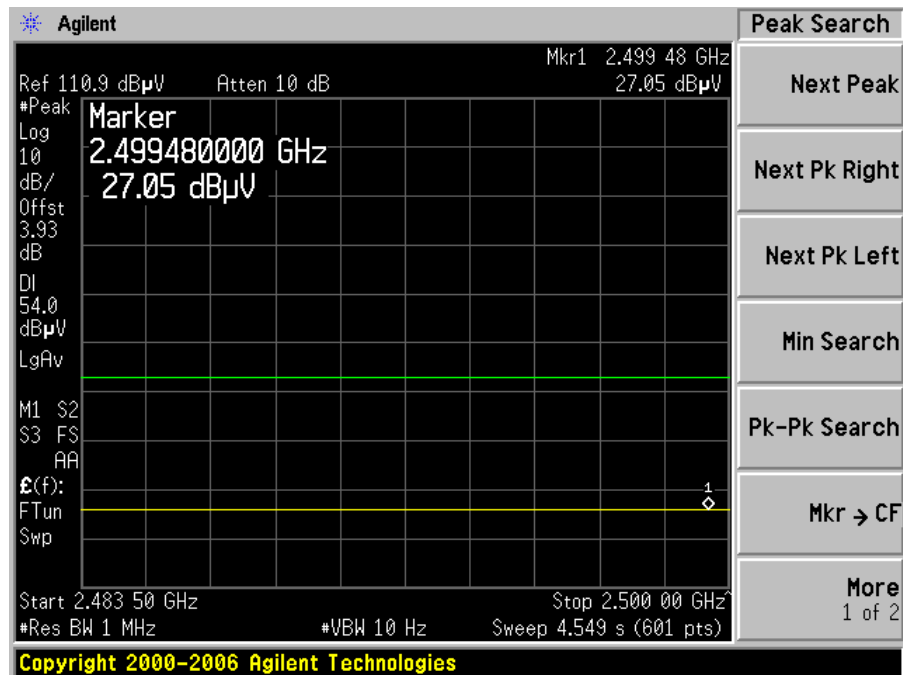
802.11g, Lowest Channel at Vertical, Average



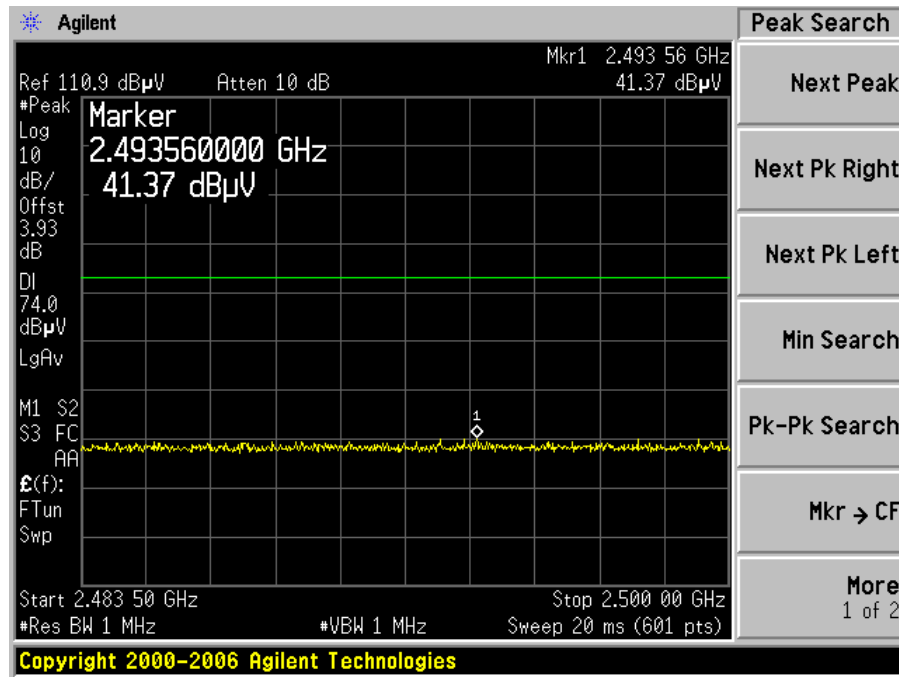
802.11g, Highest Channel at Horizontal, Peak



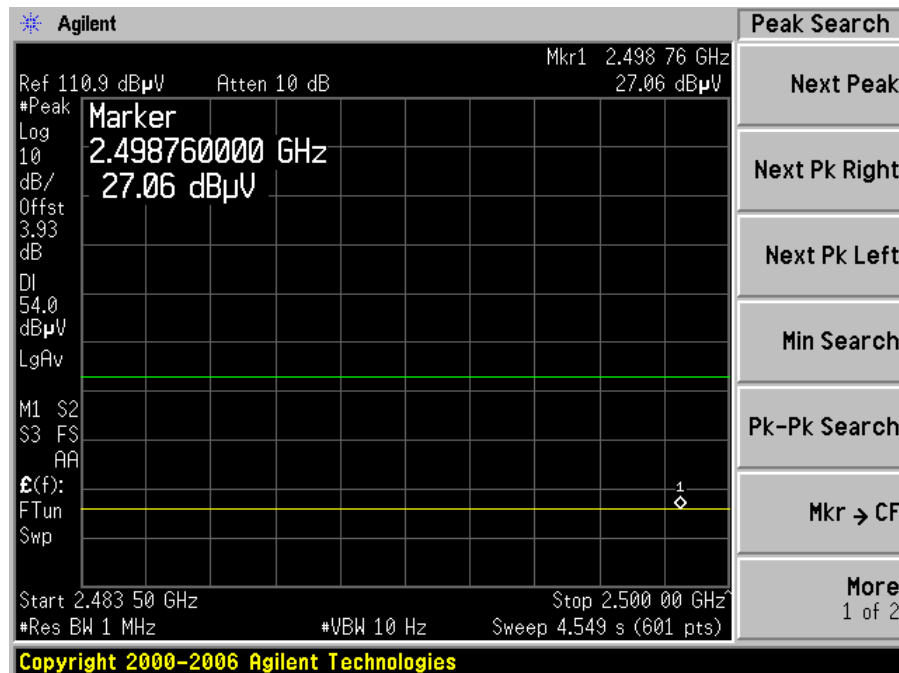
80.211g, Highest Channel at Horizontal, Average



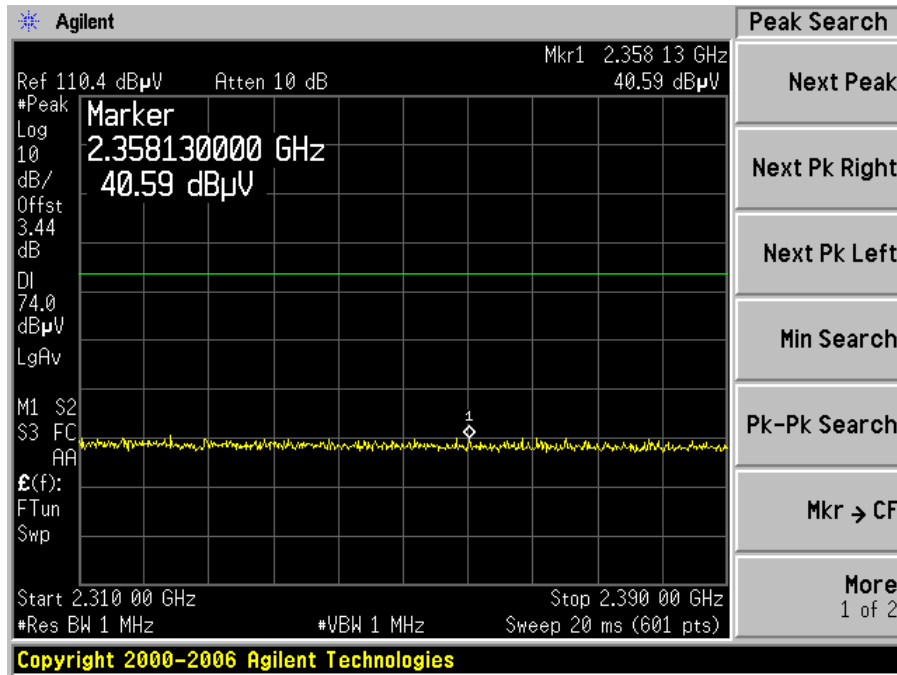
802.11g, Highest Channel at Vertical, Peak



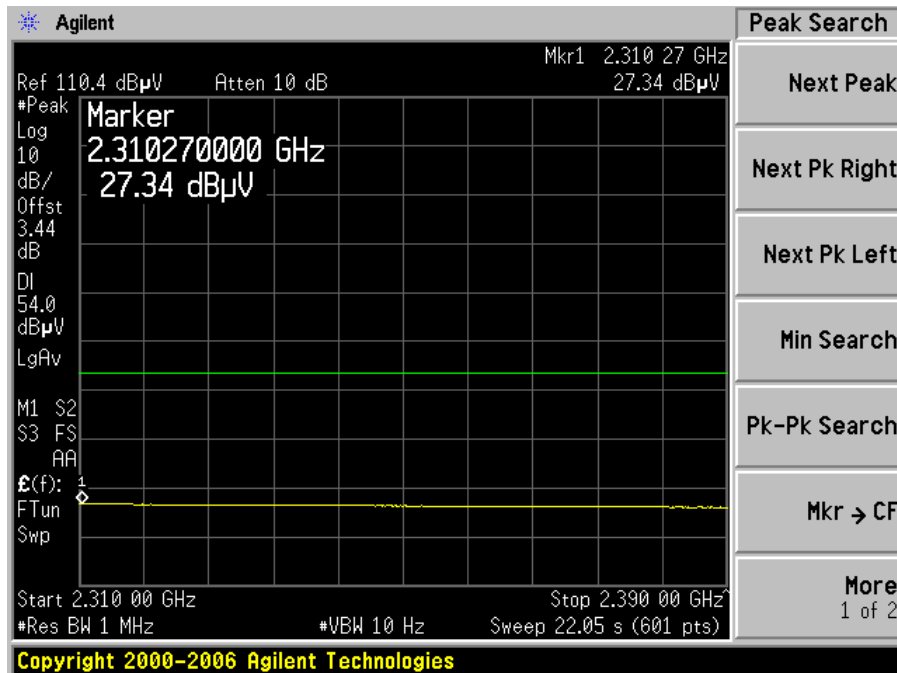
802.11g, Highest Channel at Vertical, Average



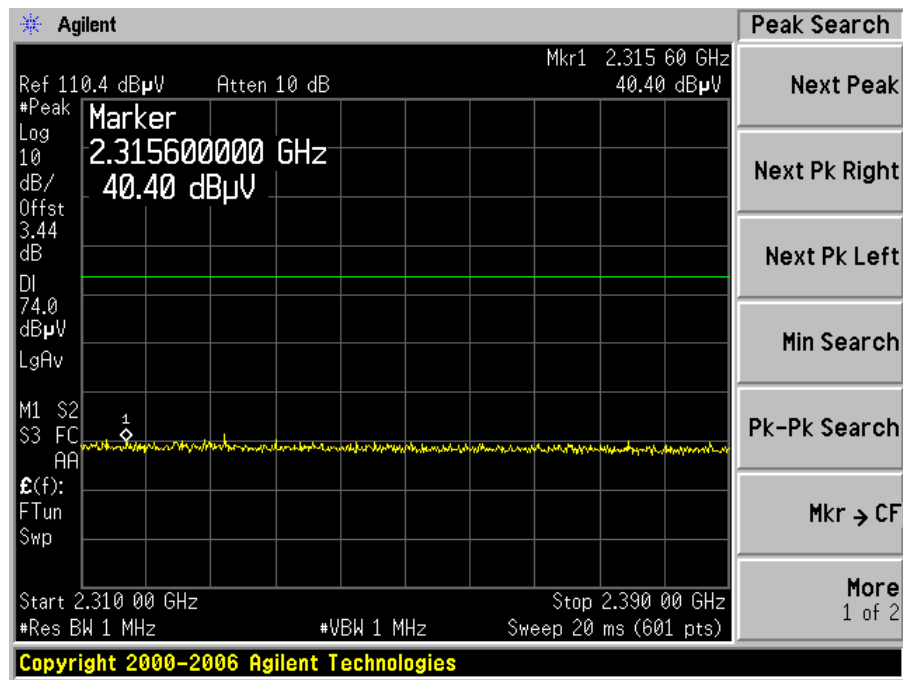
802.11 n20, Lowest Channel at Horizontal, Peak



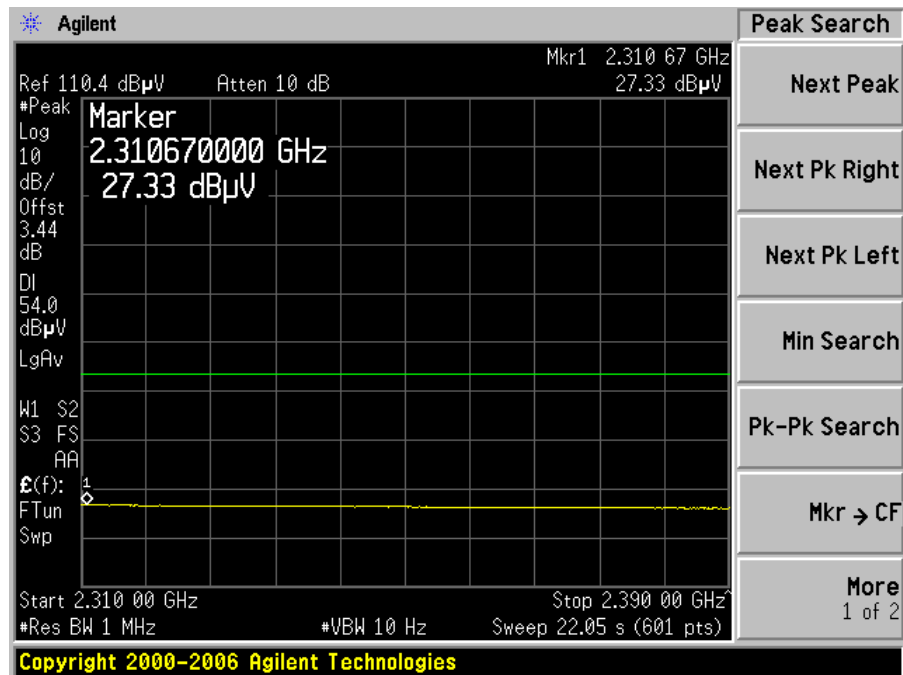
802.11n20, Lowest Channel at Horizontal, Average



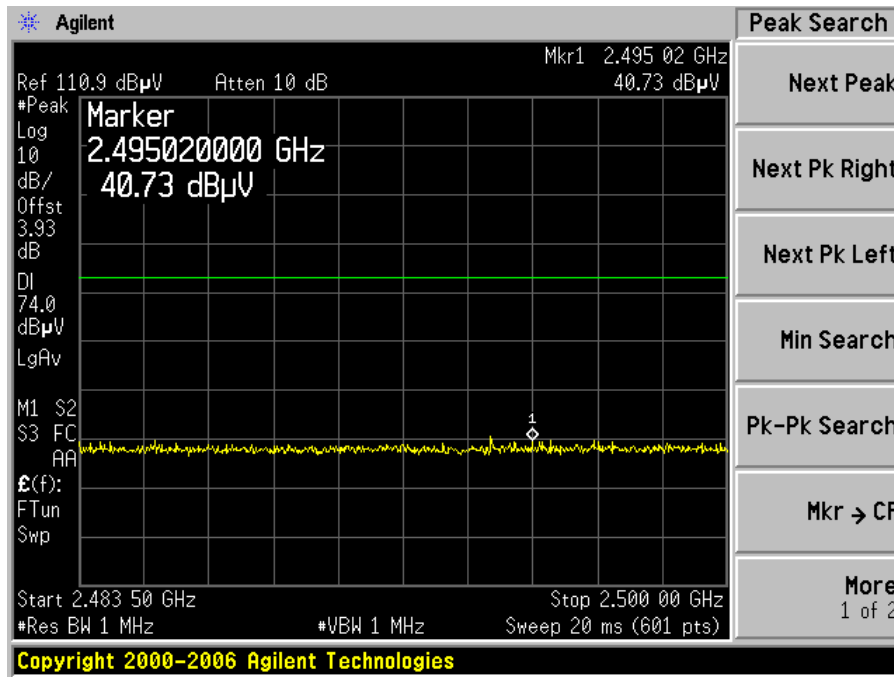
802.11n20, Lowest Channel at Vertical, Peak



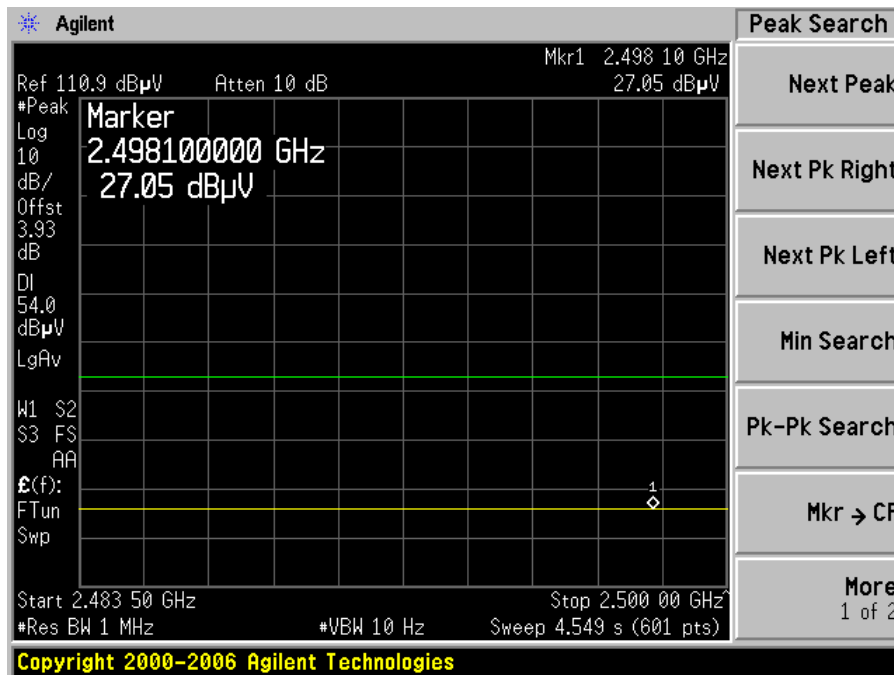
802.11n20, Lowest Channel at Vertical, Average



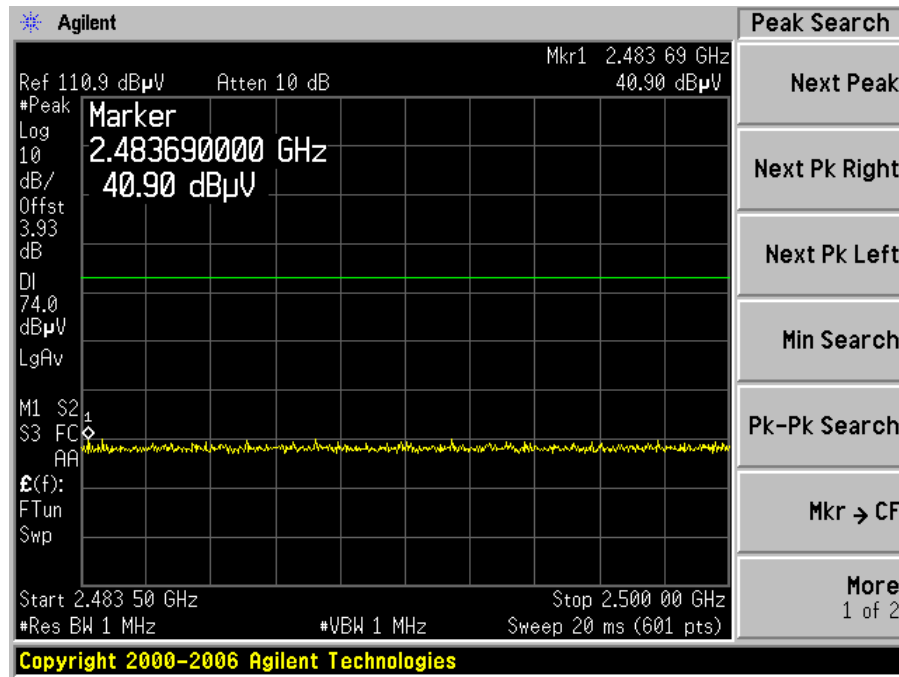
802.11n20, Highest Channel at Horizontal, Peak



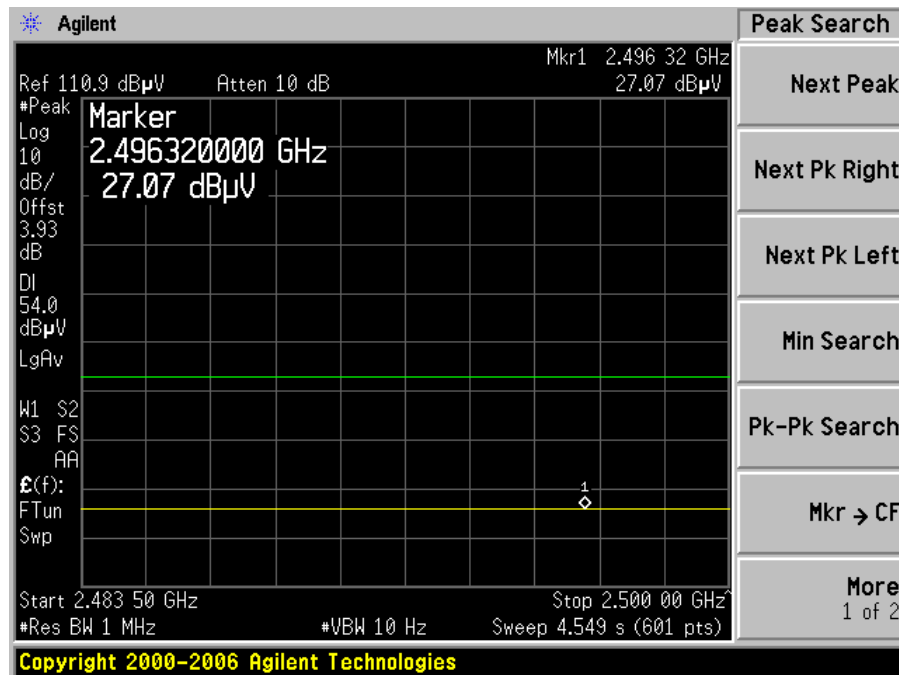
802.11n20, Highest Channel at Horizontal, Average



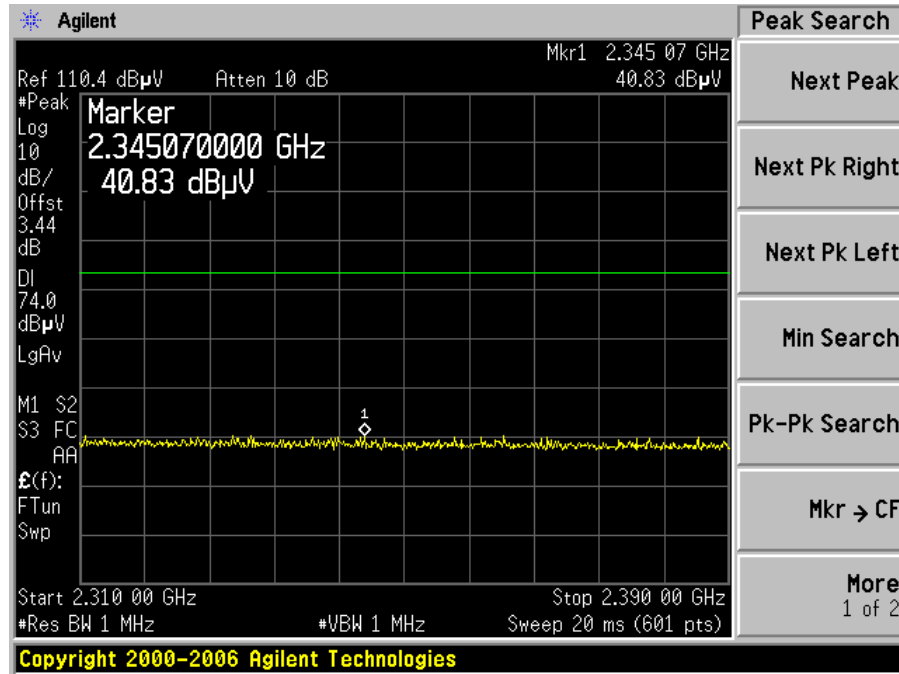
802.11n20, Highest Channel at Vertical, Peak



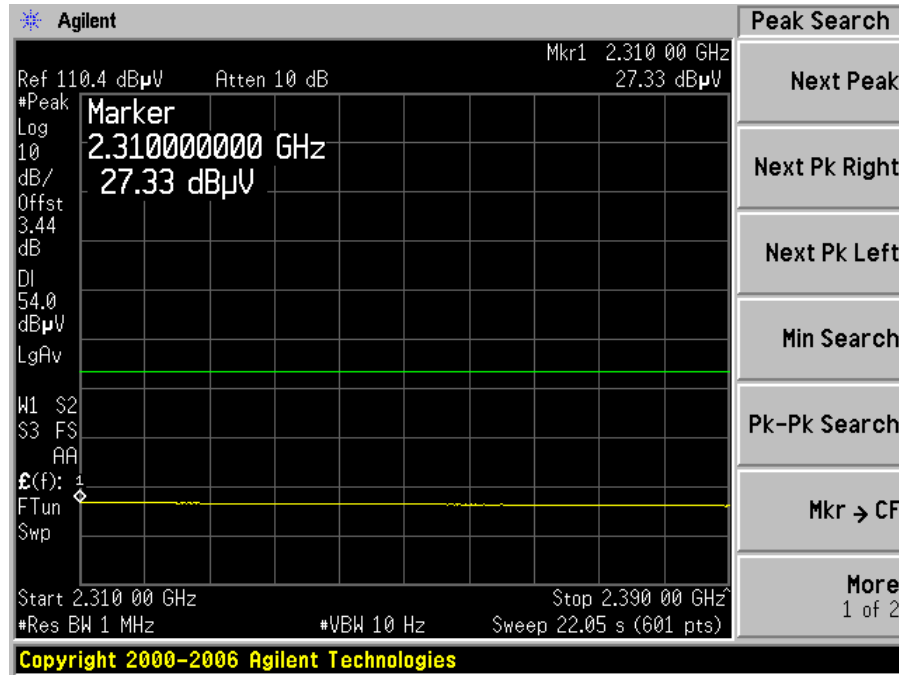
802.11n20, Highest Channel at Vertical, Average



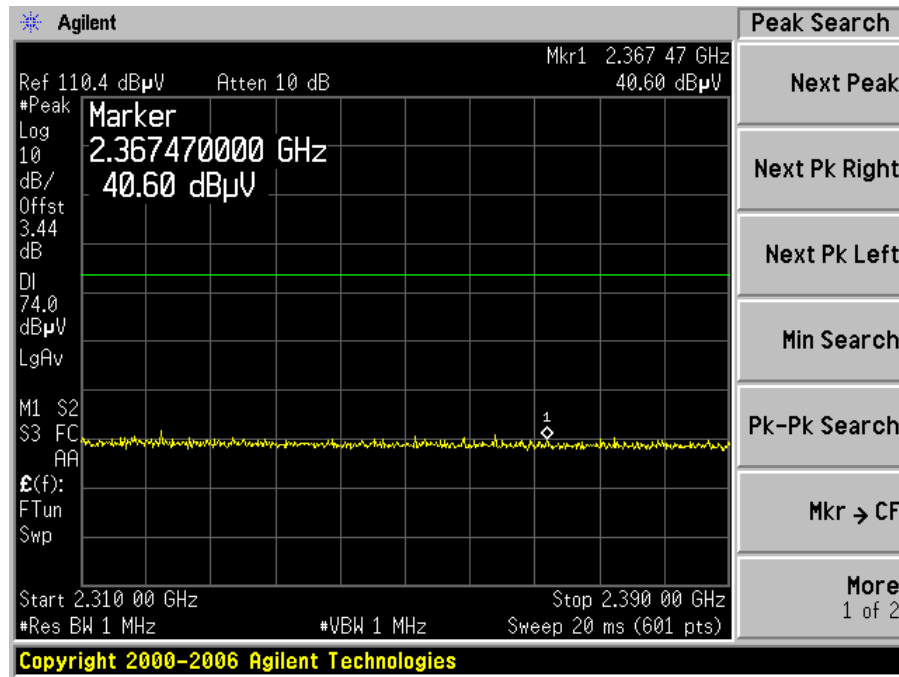
802.11 n40, Lowest Channel at Horizontal, Peak



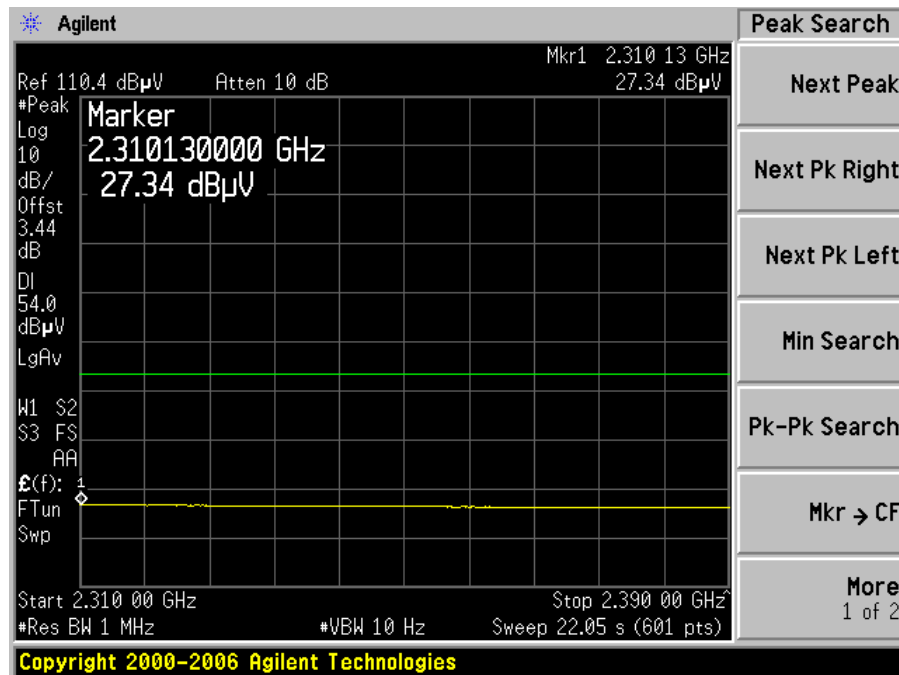
802.11 n40, Lowest Channel at Horizontal, Average



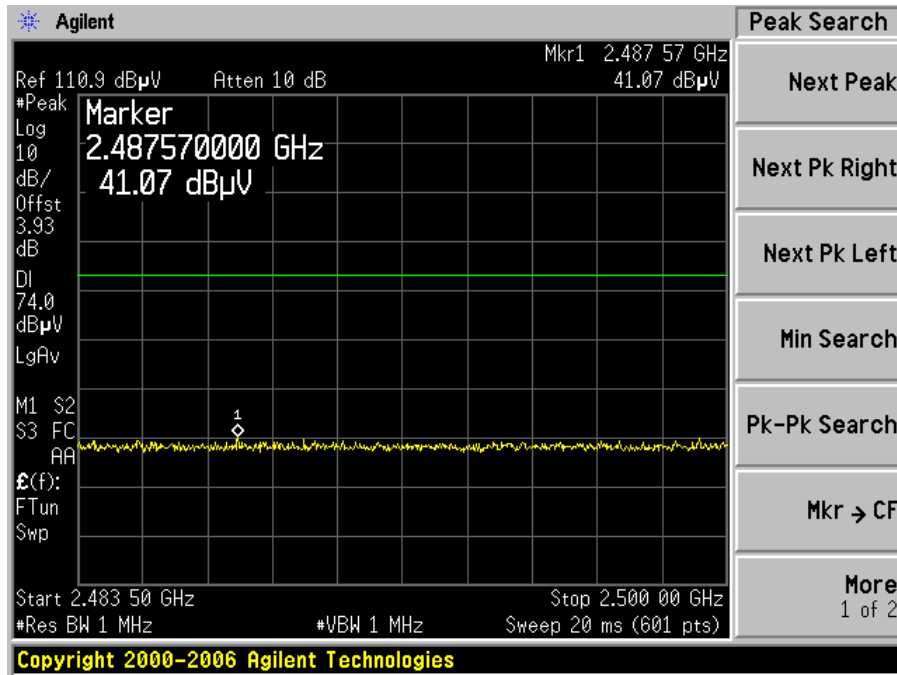
802.11 n40, Lowest Channel at Vertical, Peak



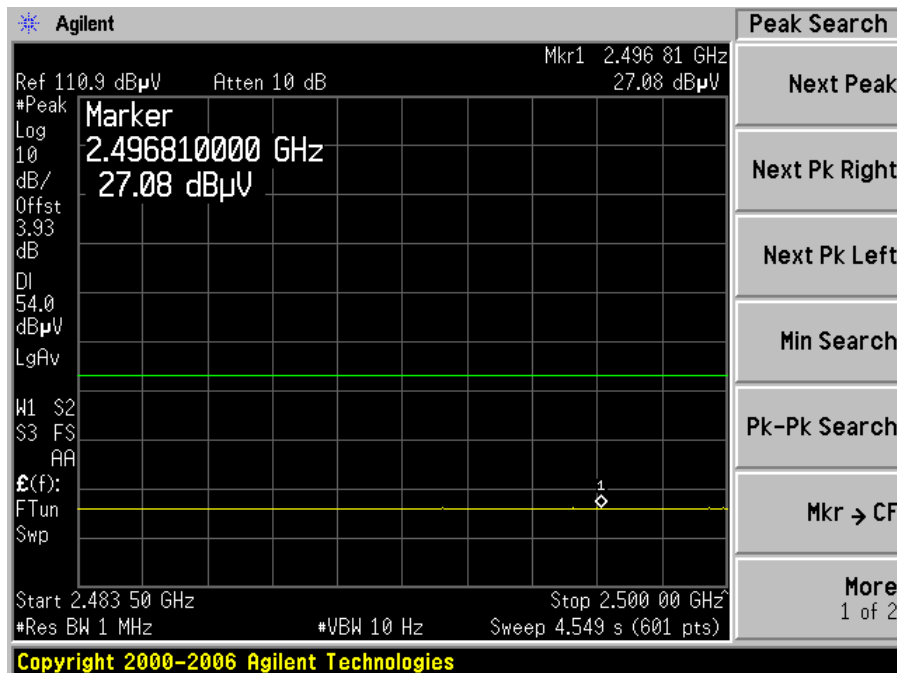
802.11 n40, Lowest Channel at Vertical, Average



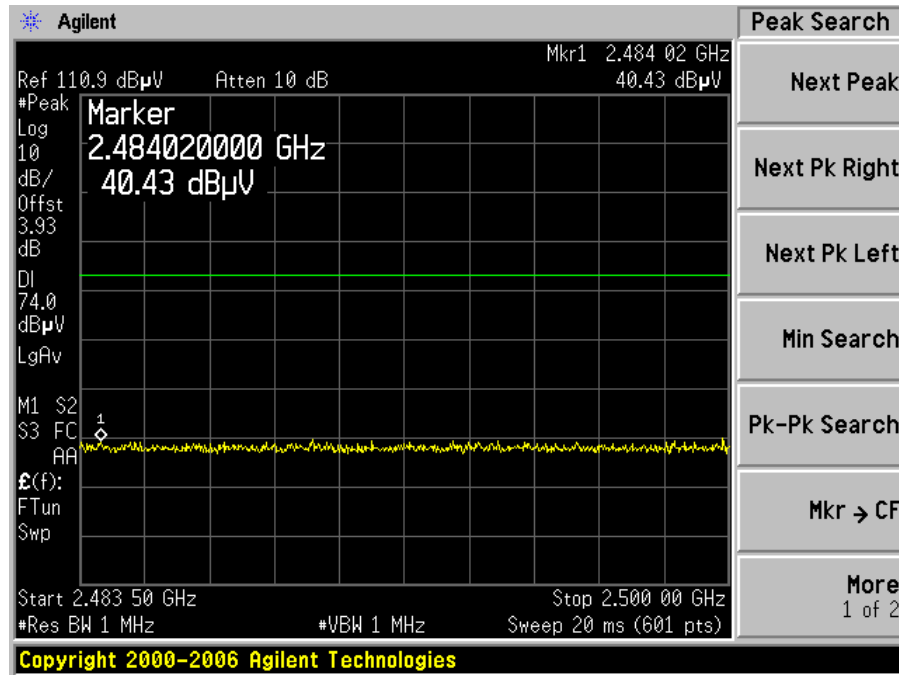
802.11 n40, Highest Channel at Horizontal, Peak



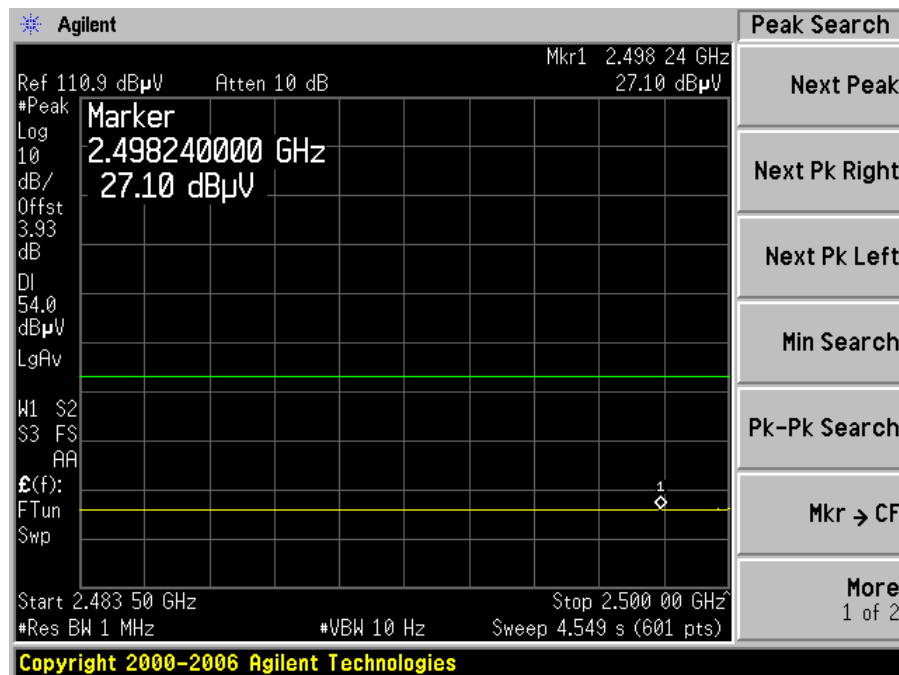
802.11 n40, Highest Channel at Horizontal, Average



802.11 n40, Highest Channel at Vertical, Peak



802.11 n40, Highest Channel at Vertical, Average



7 FCC §15.247(d) & IC RSS-210 §A8.5 - Spurious Emissions at Antenna Terminals

7.1 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).

According to 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.

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	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

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:	23 °C
Relative Humidity:	42%
ATM Pressure:	101.2kPa

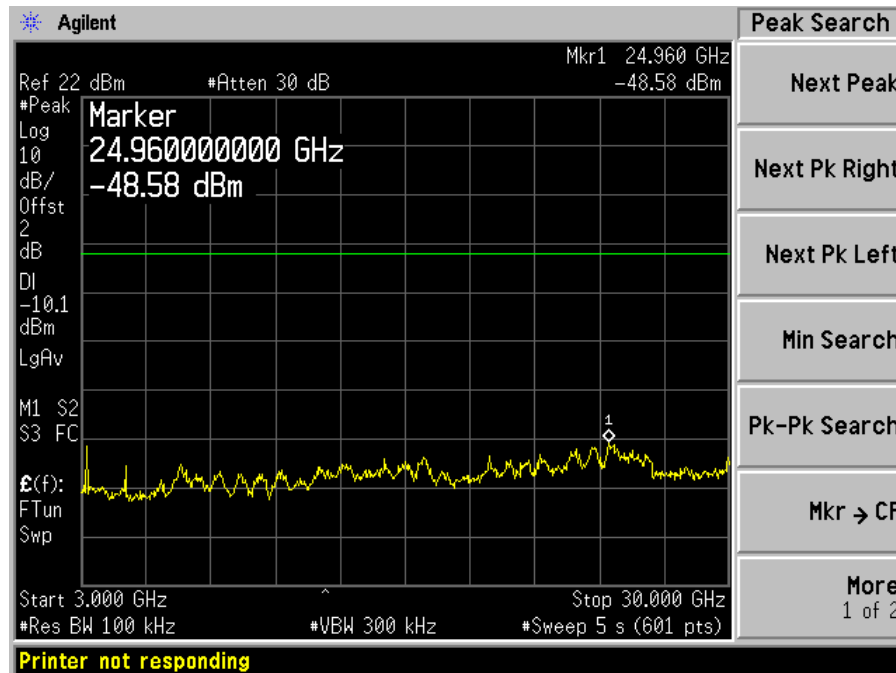
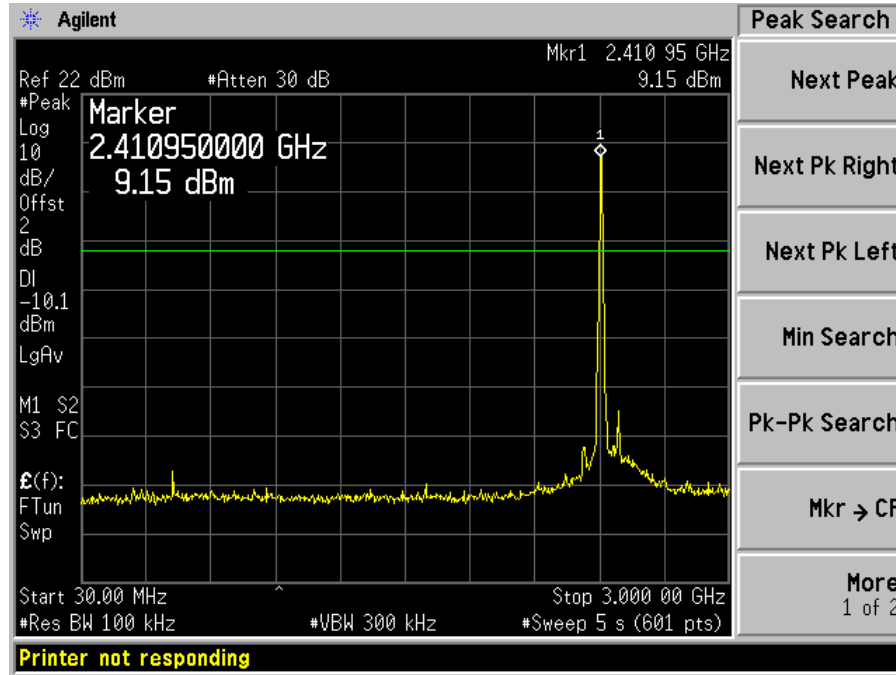
The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

7.5 Test Results

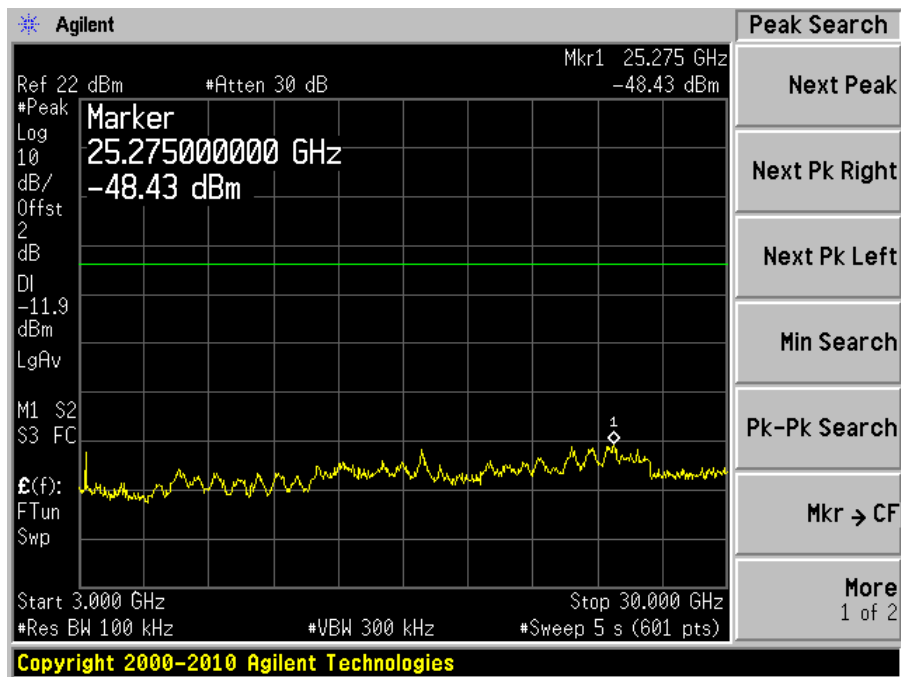
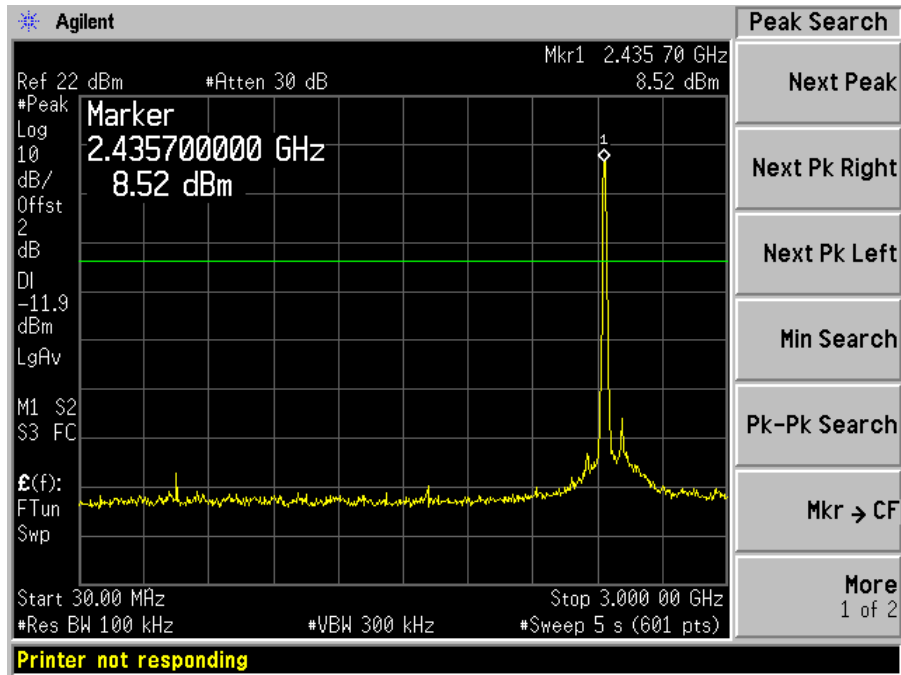
Please refer to following plots of spurious emissions.

802.11 b (Antenna #0)

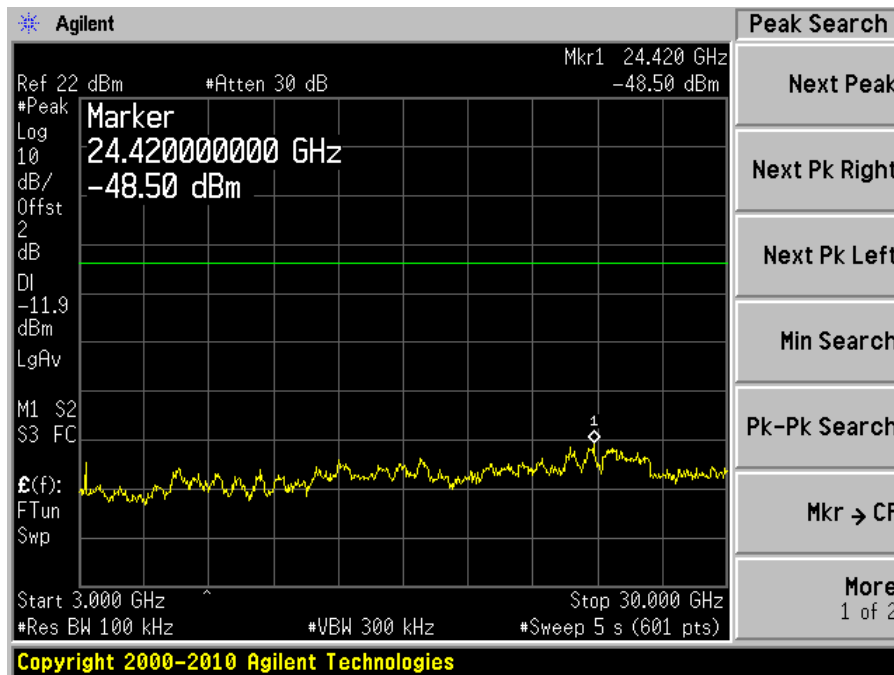
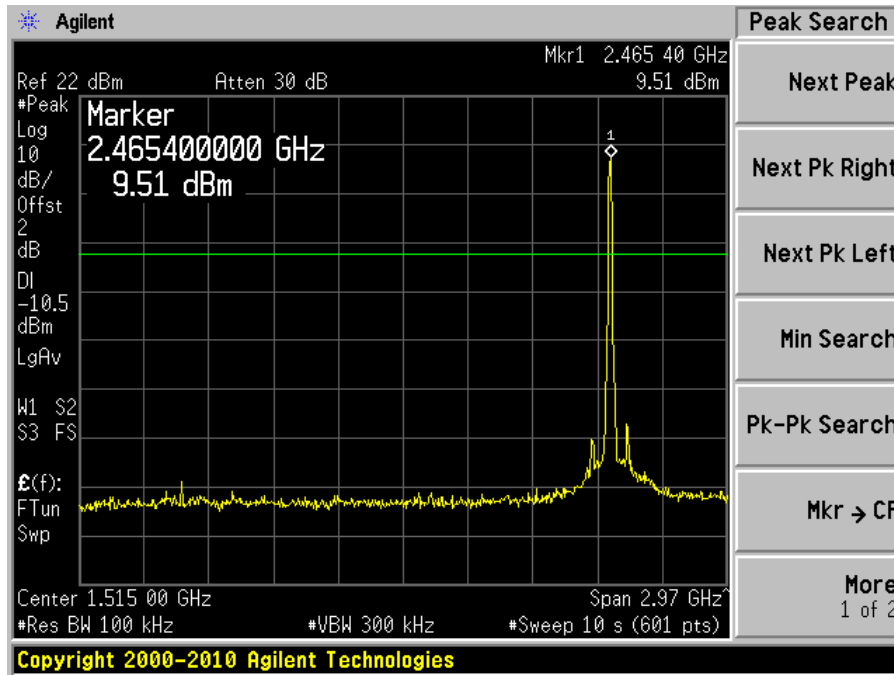
Low Channel 2412 MHz



Middle Channel 2437 MHz

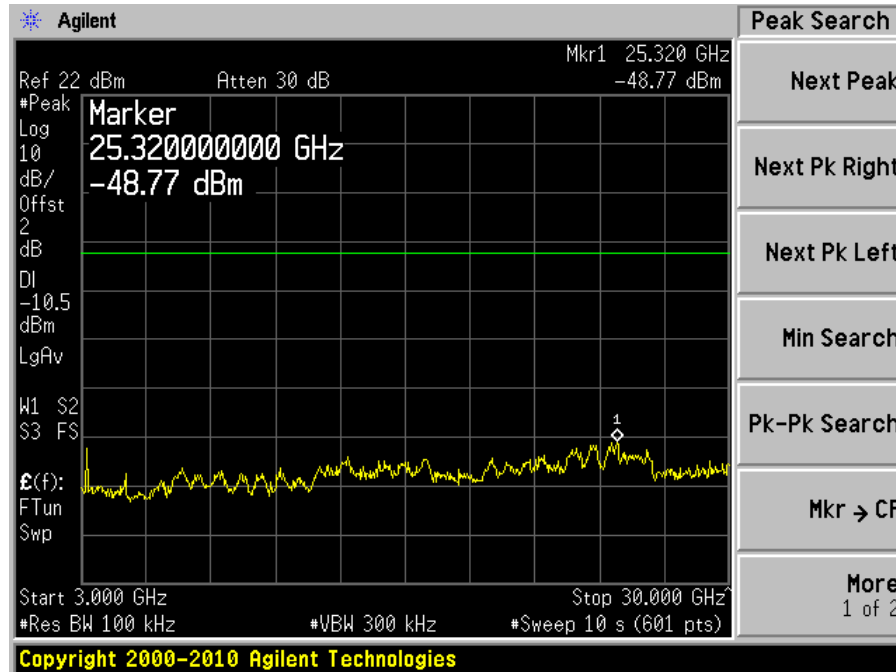
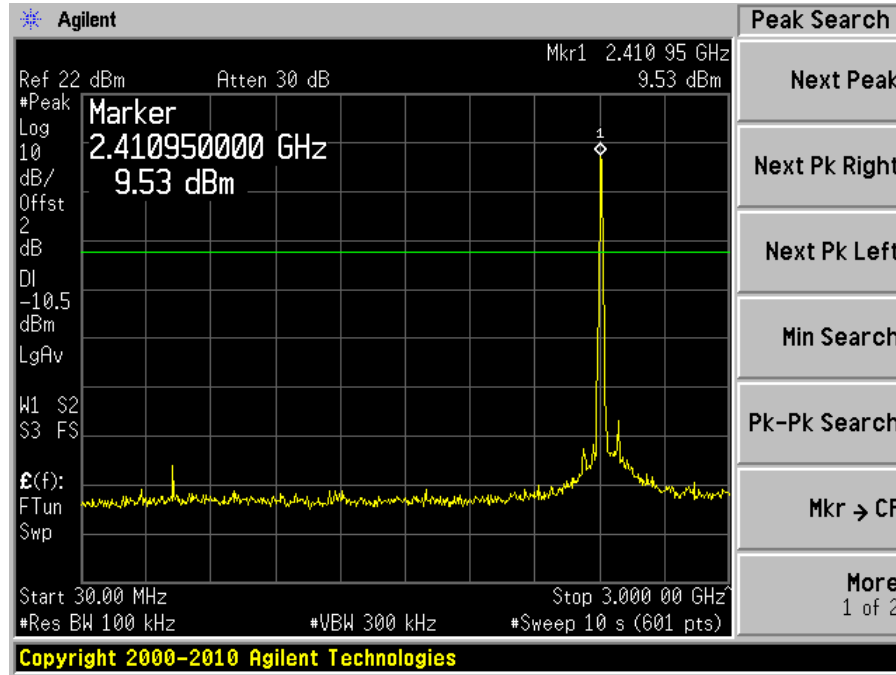


High Channel 2462 MHz

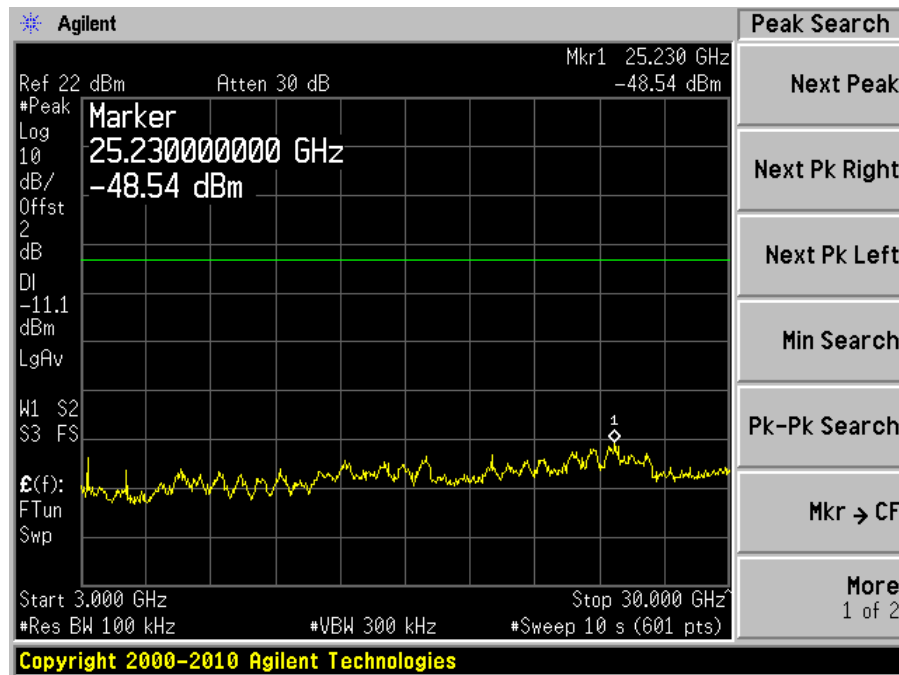
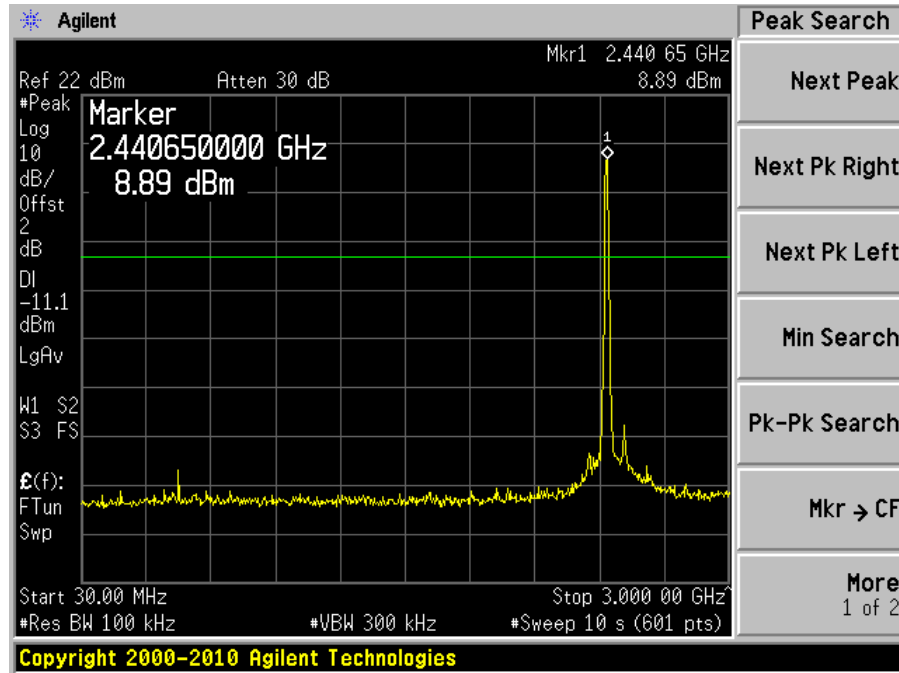


802.11 b (Antenna #1)

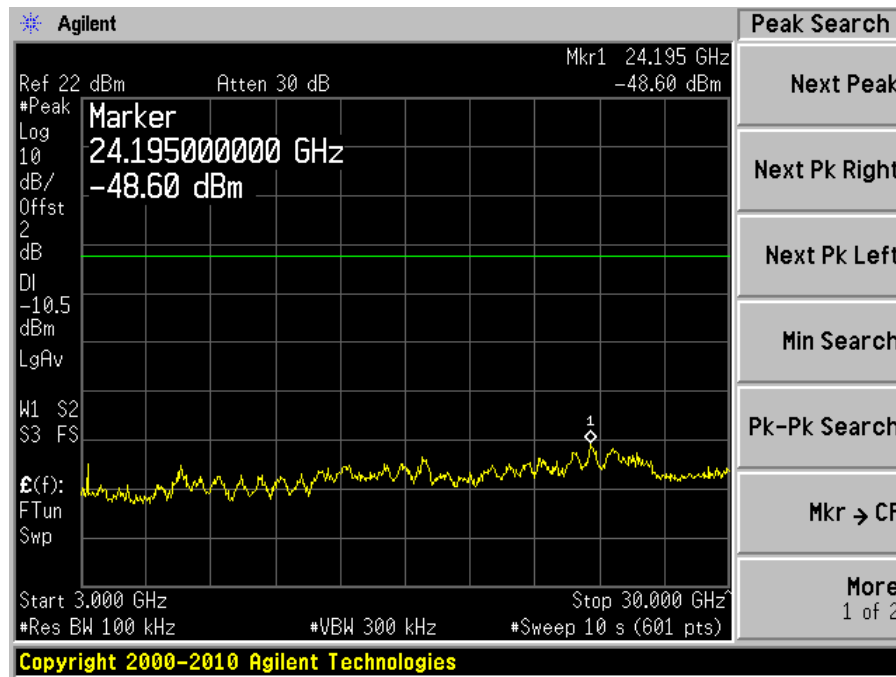
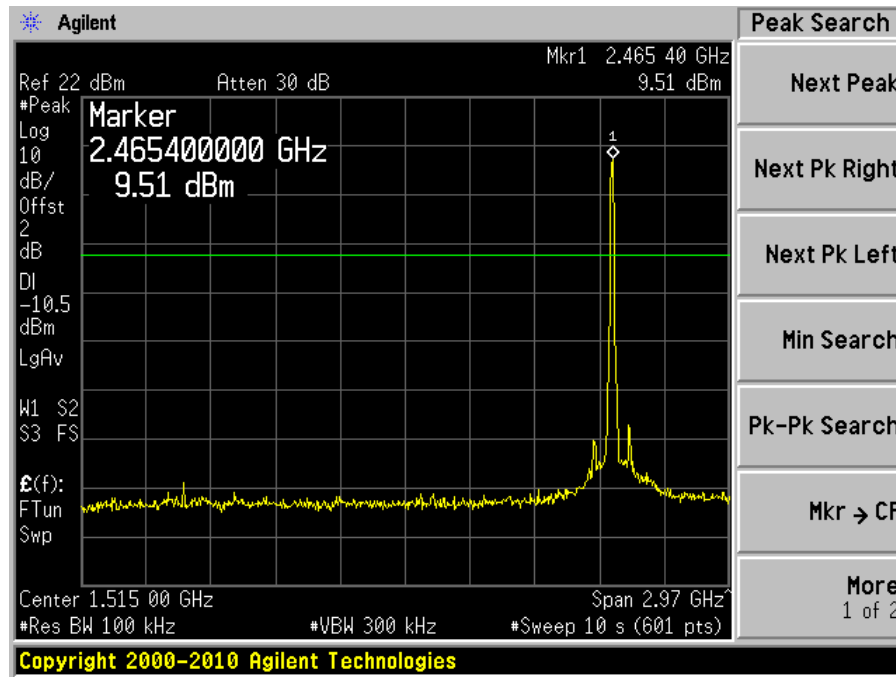
Low Channel 2412 MHz



Middle Channel 2437 MHz

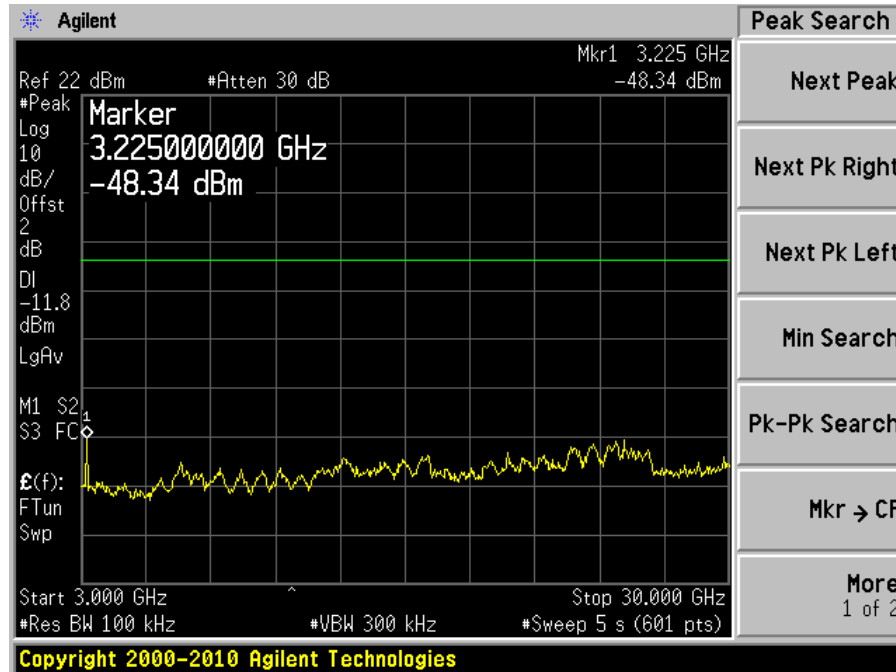
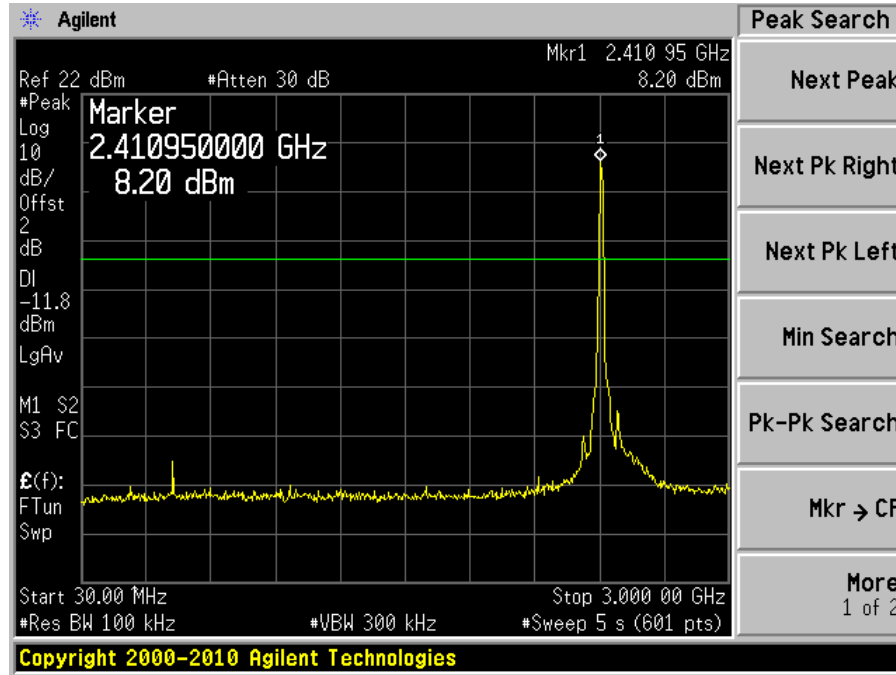


High Channel 2462 MHz

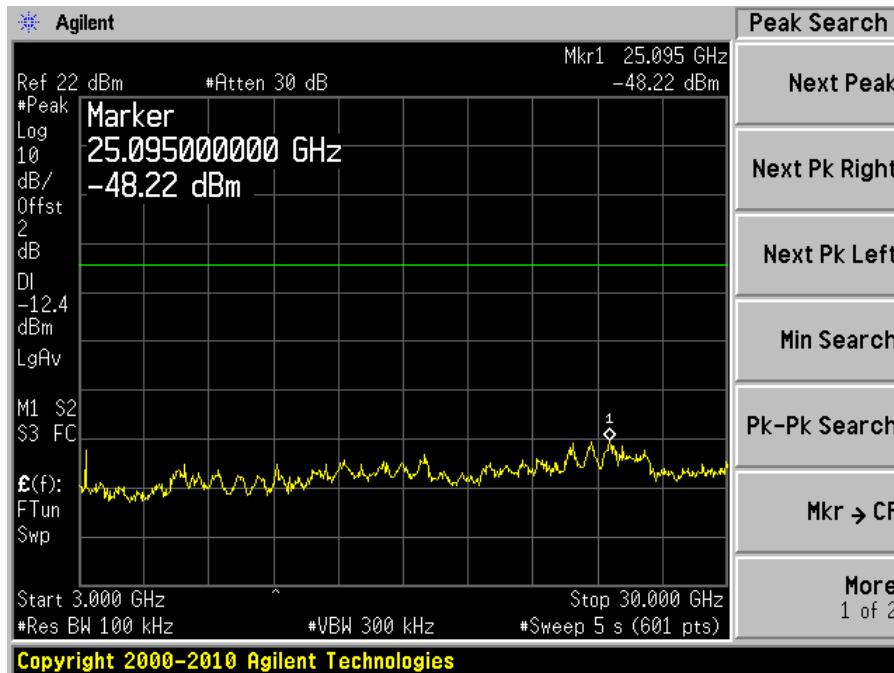
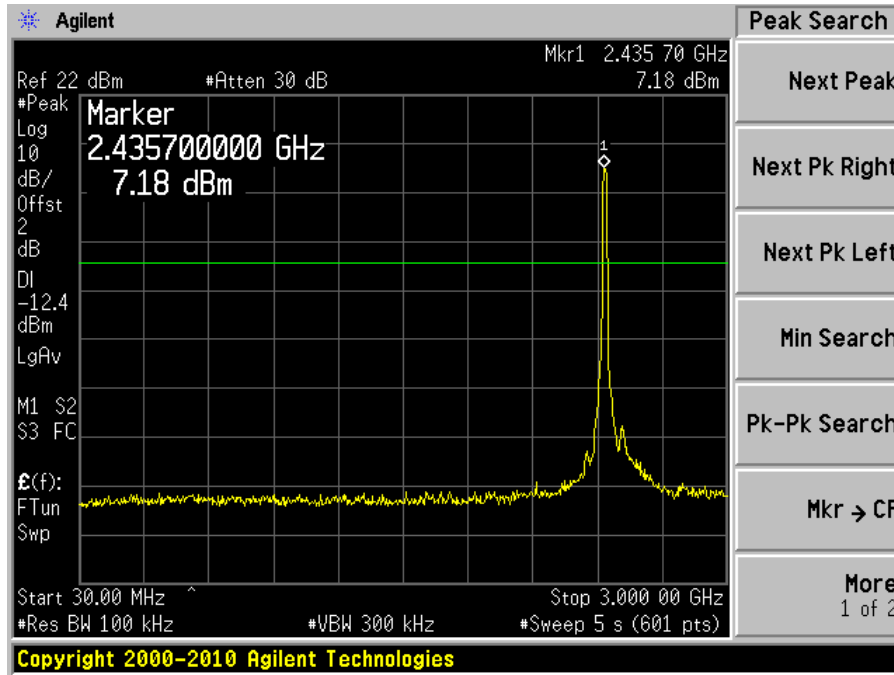


802.11 g (Antenna #0)

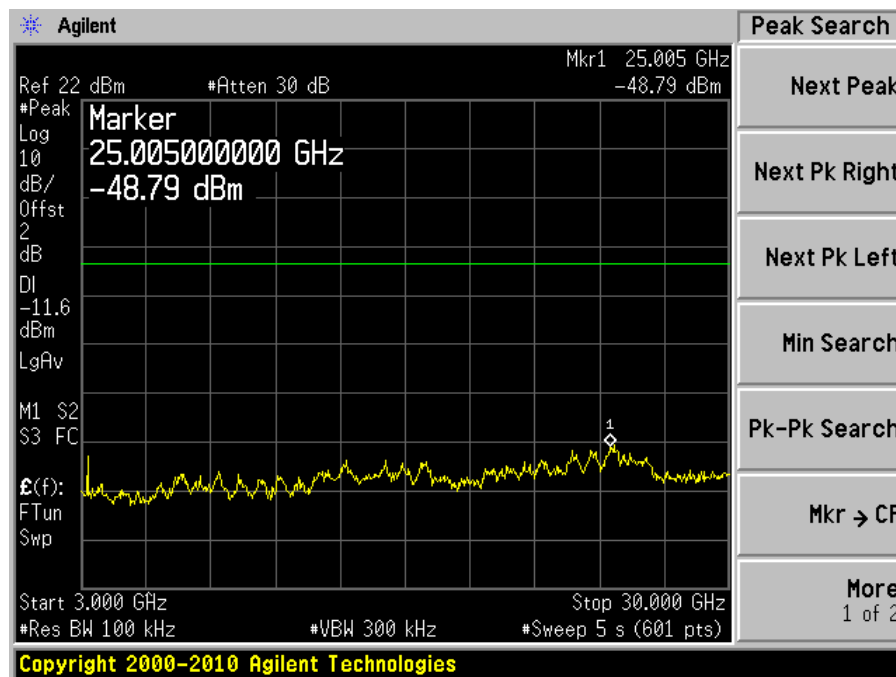
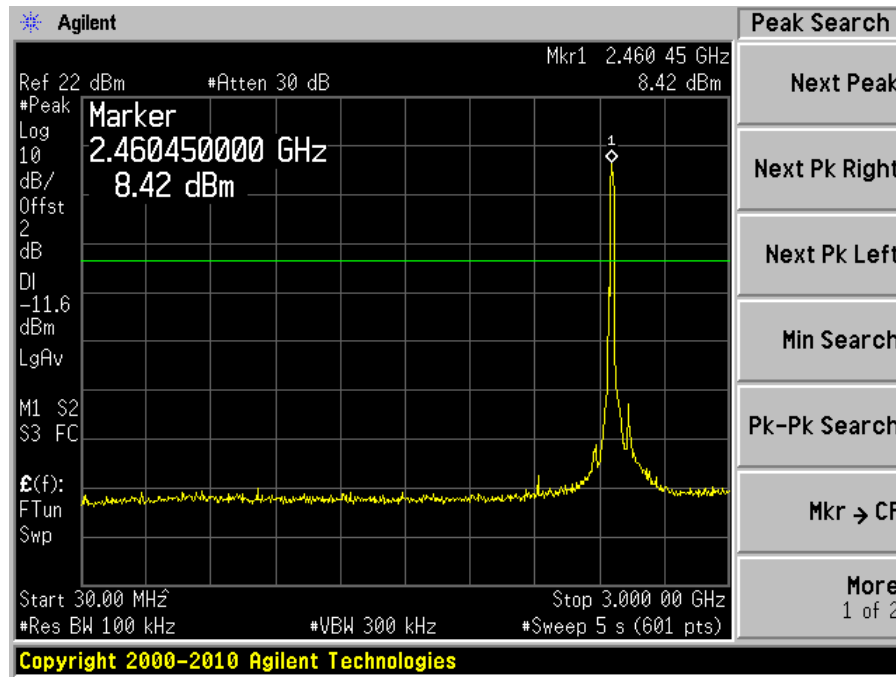
Low Channel 2412 MHz



Middle Channel 2437 MHz

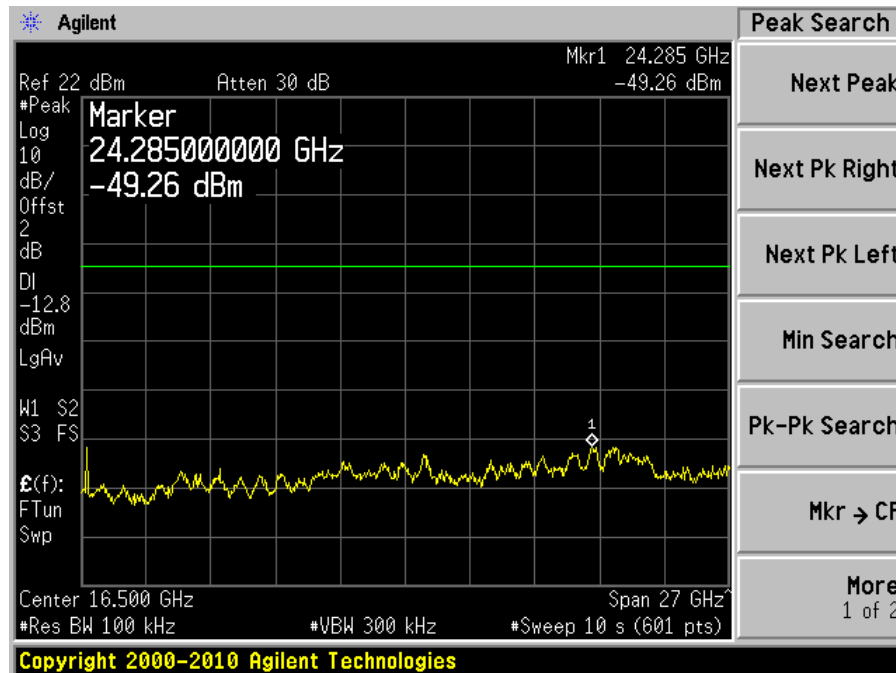
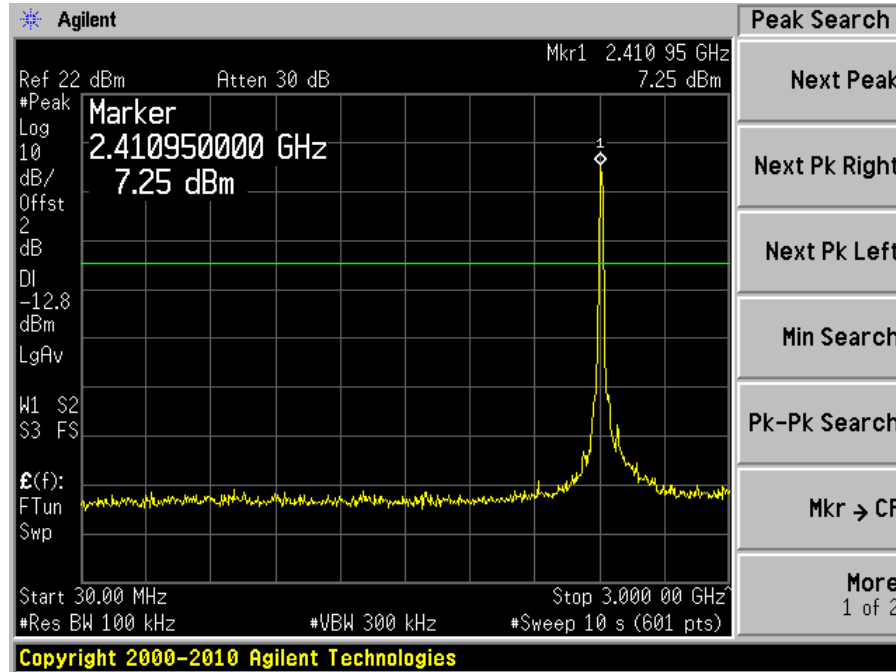


High Channel 2462 MHz

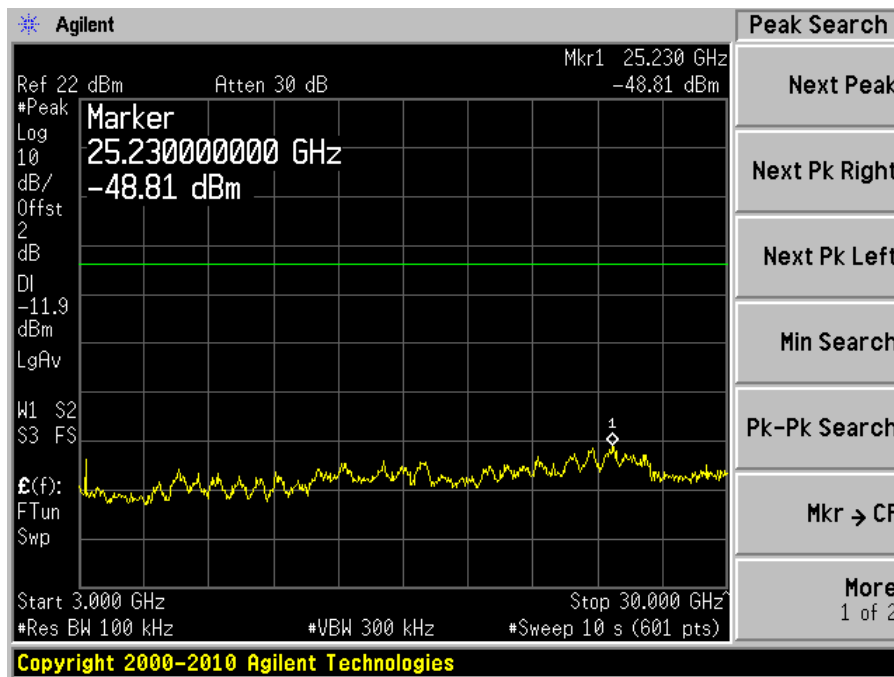
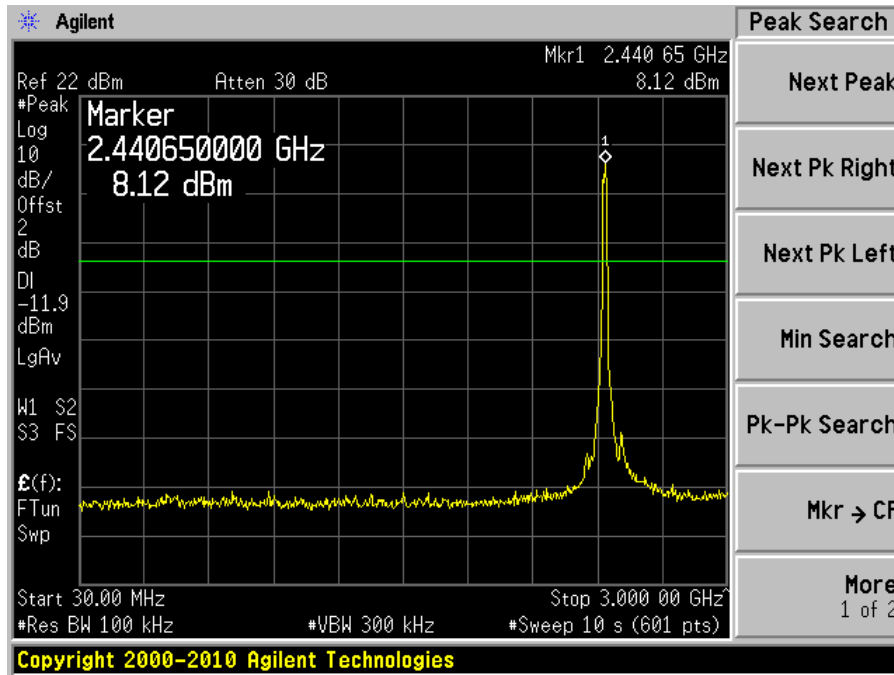


802.11 g (Antenna #1)

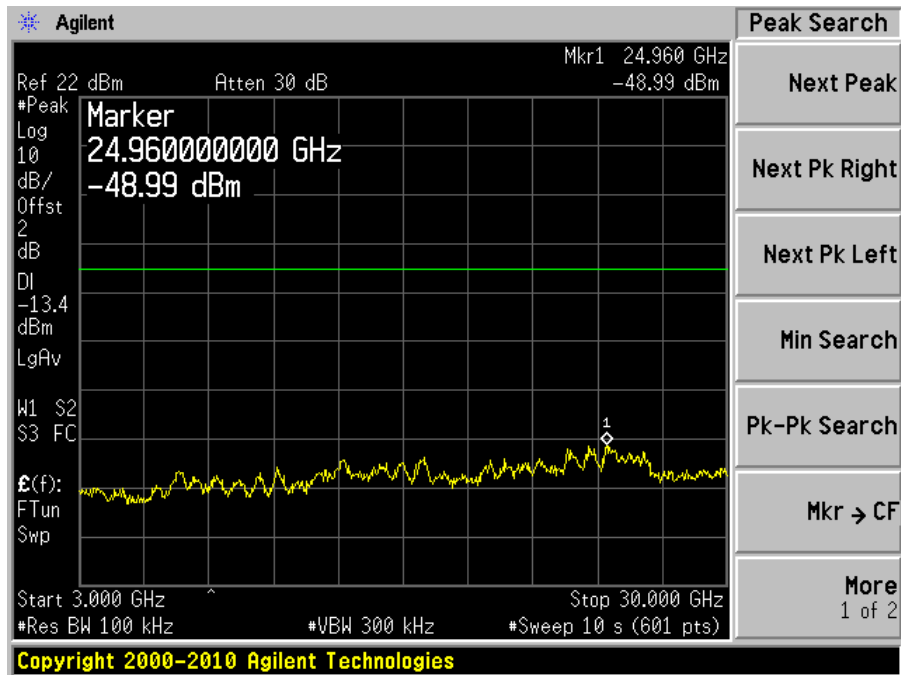
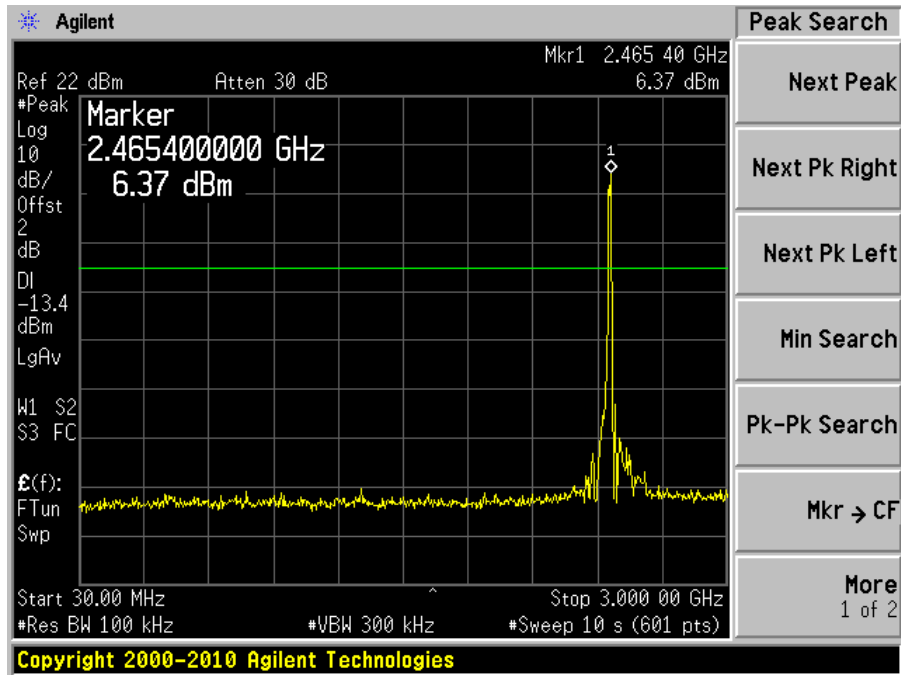
Low Channel 2412 MHz



Middle Channel 2437 MHz

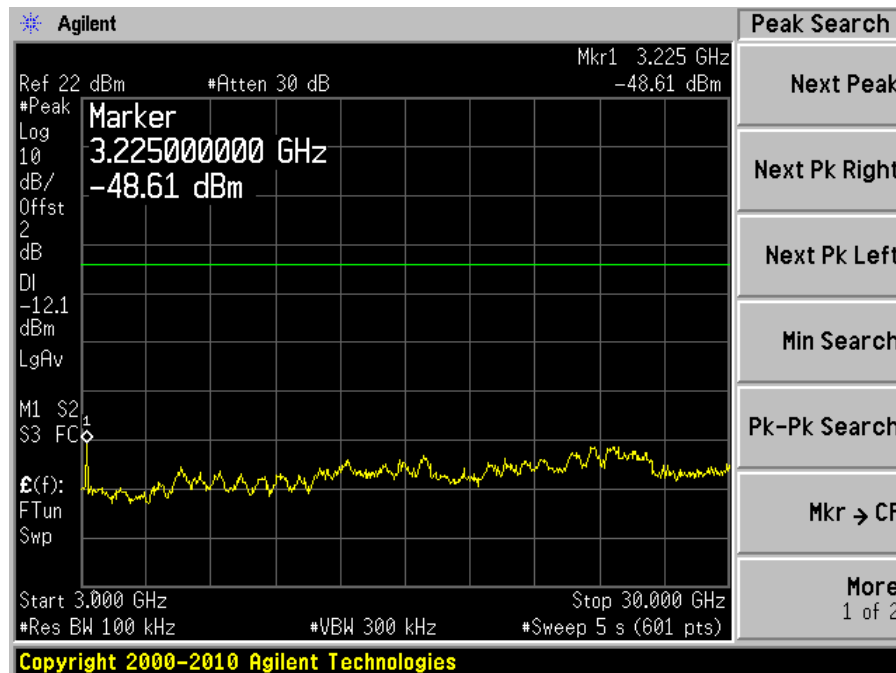
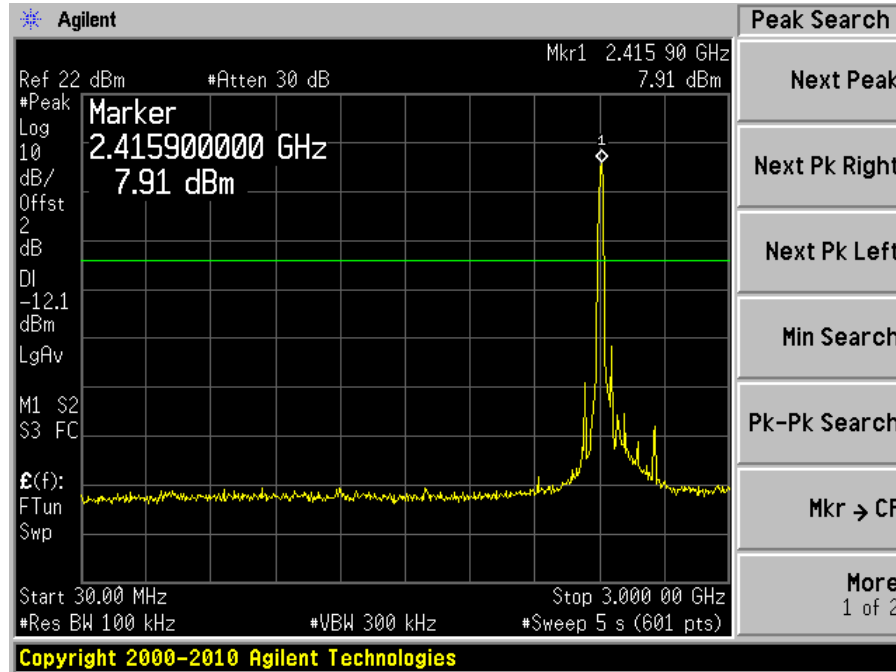


High Channel 2462 MHz

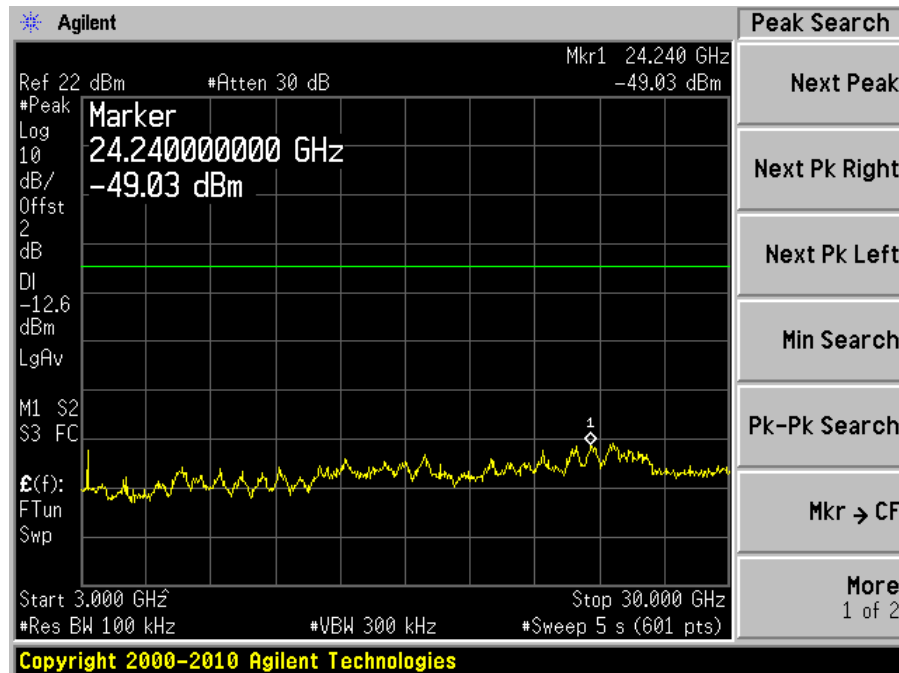
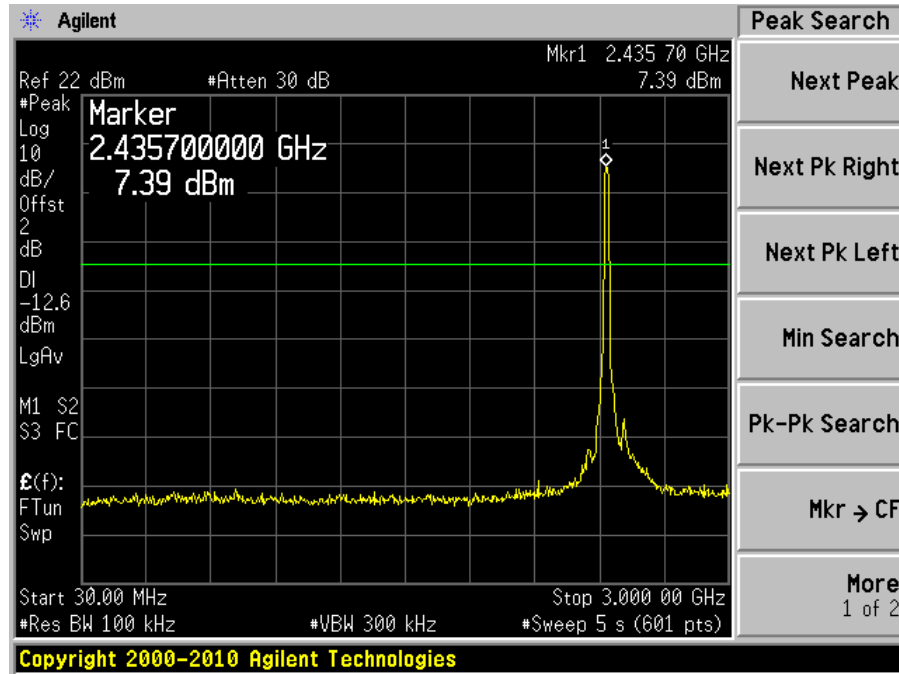


802.11 n 20 MHz (Antenna #0)

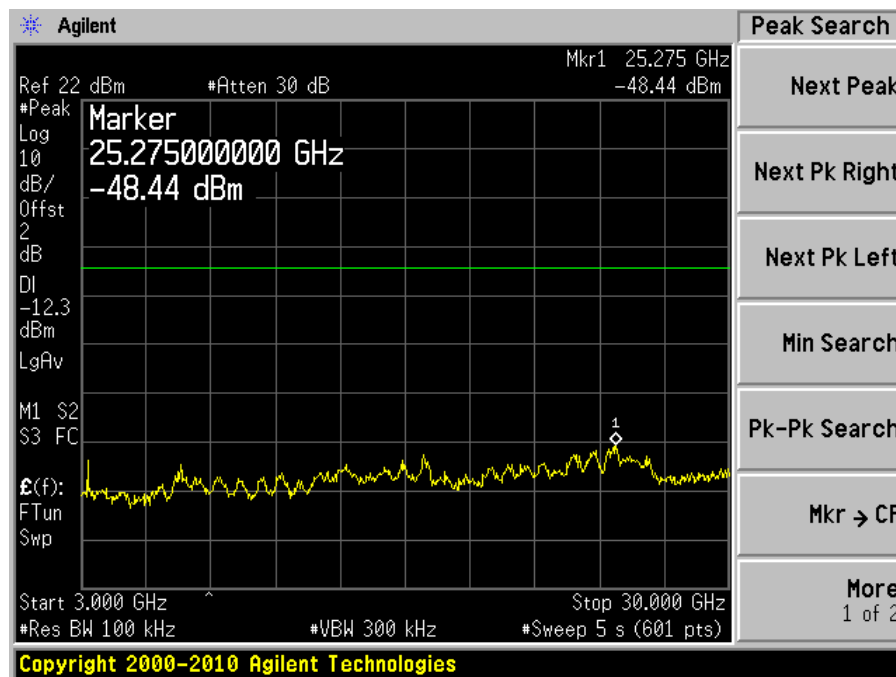
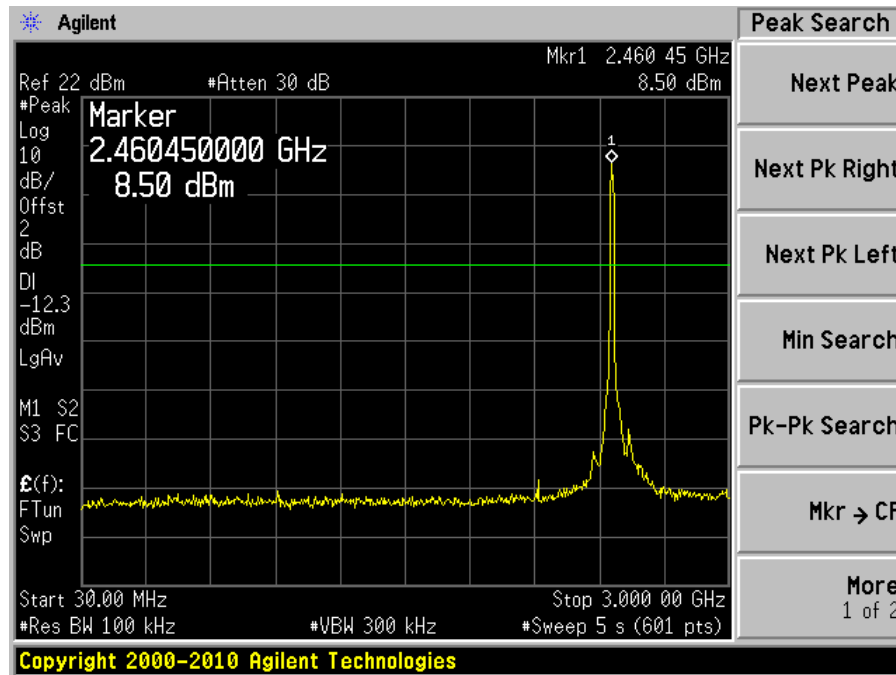
Low Channel 2412 MHz



Middle Channel 2437 MHz

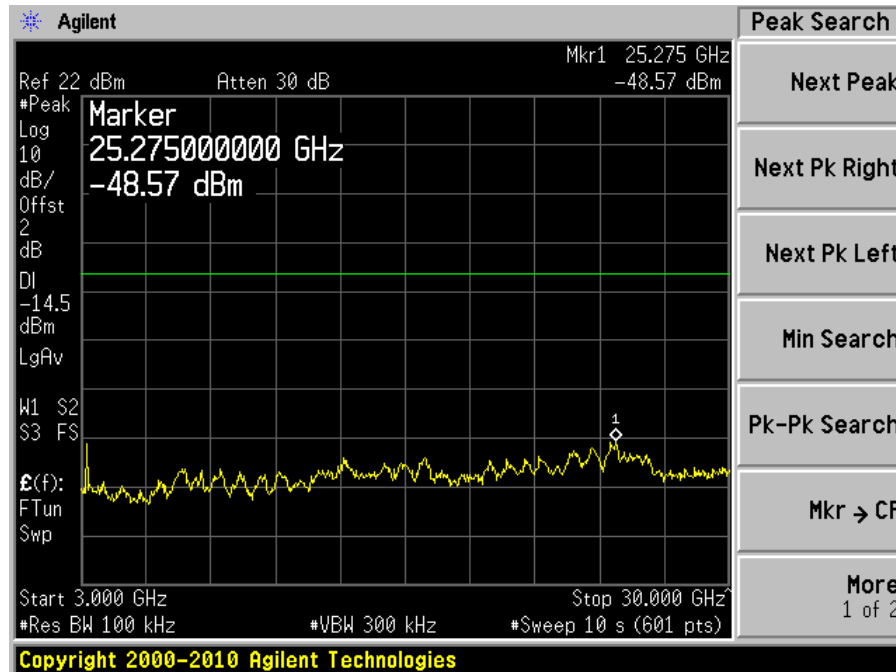
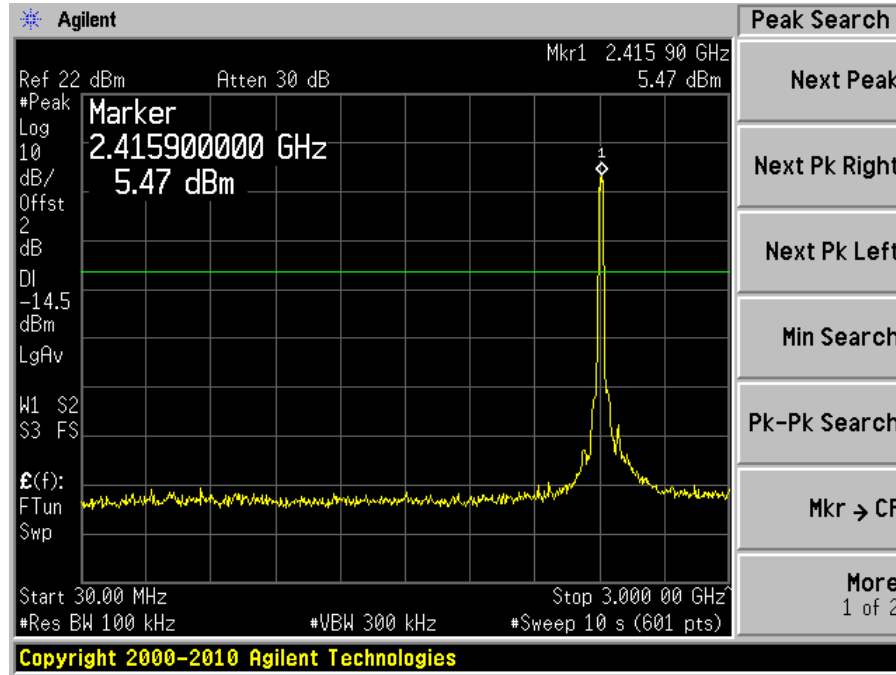


High Channel 2462 MHz

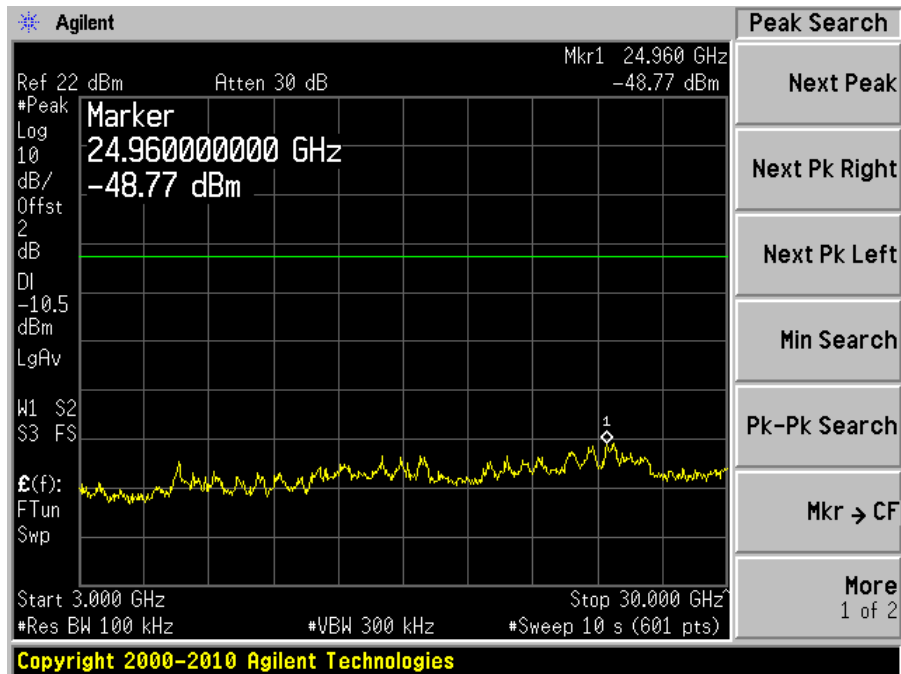
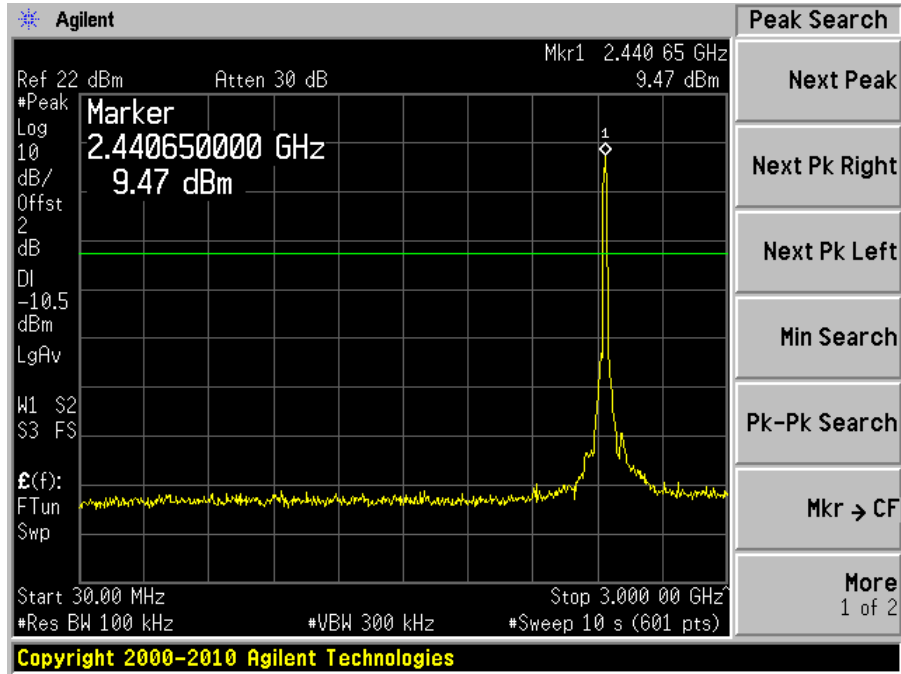


802.11 n 20 MHz (Antenna #1)

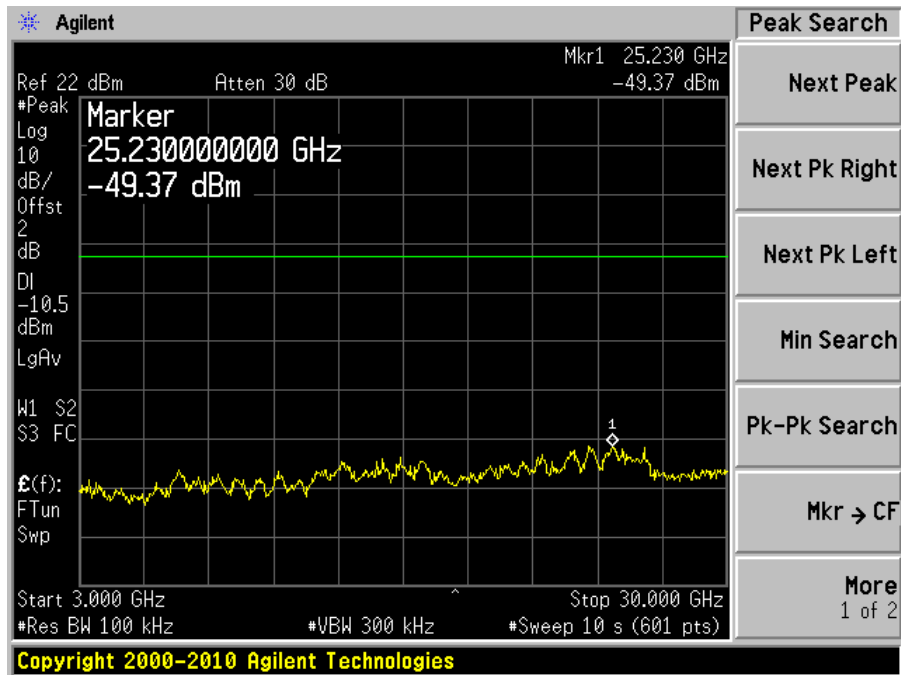
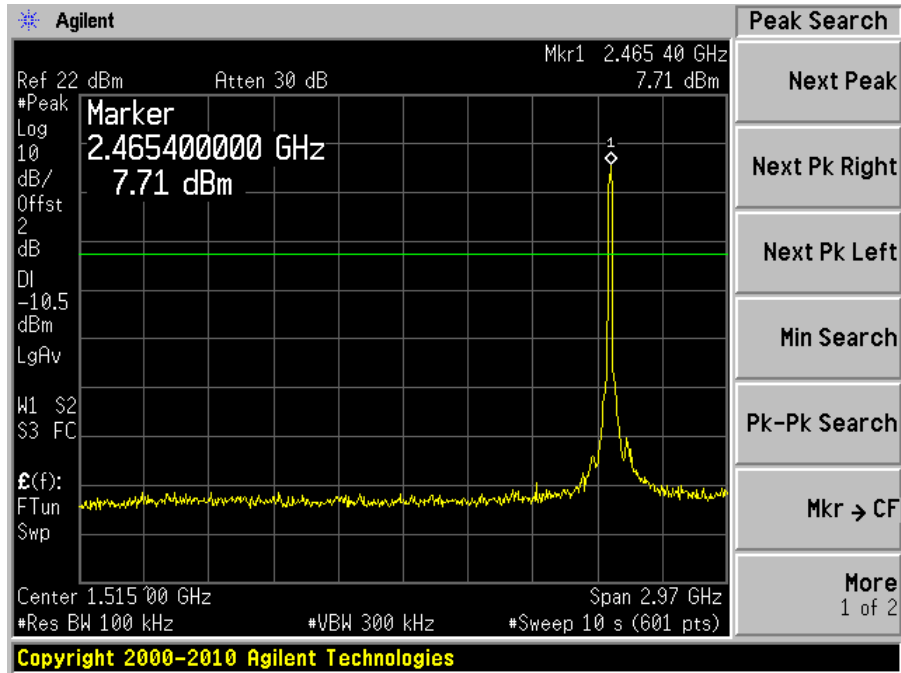
Low Channel 2412 MHz



Middle Channel 2437 MHz

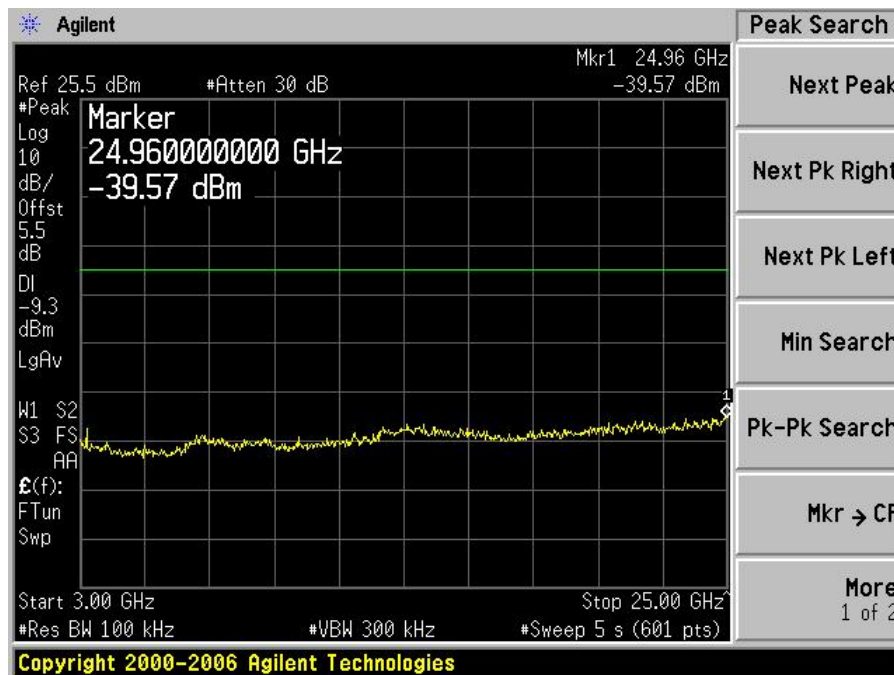
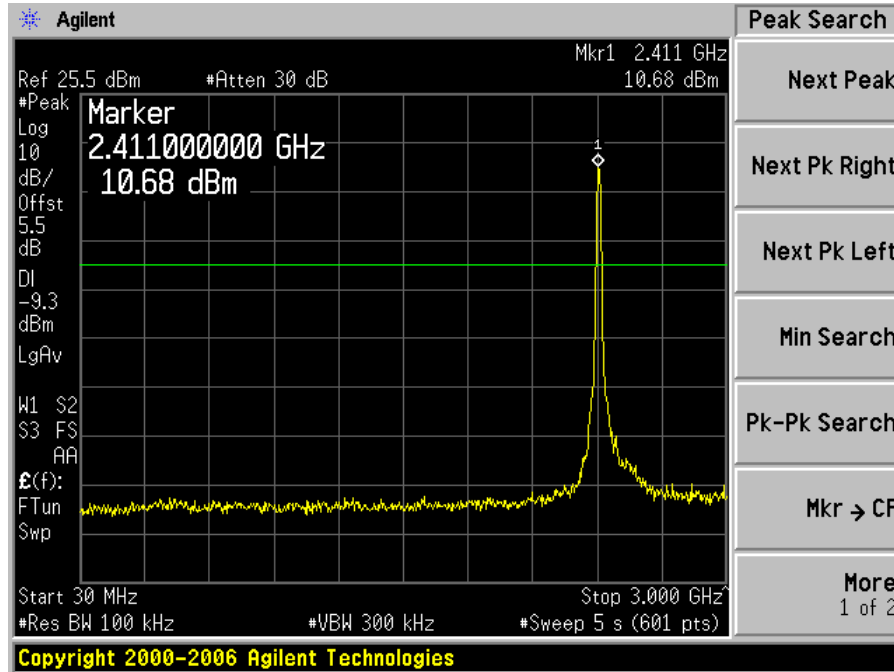


High Channel 2462 MHz

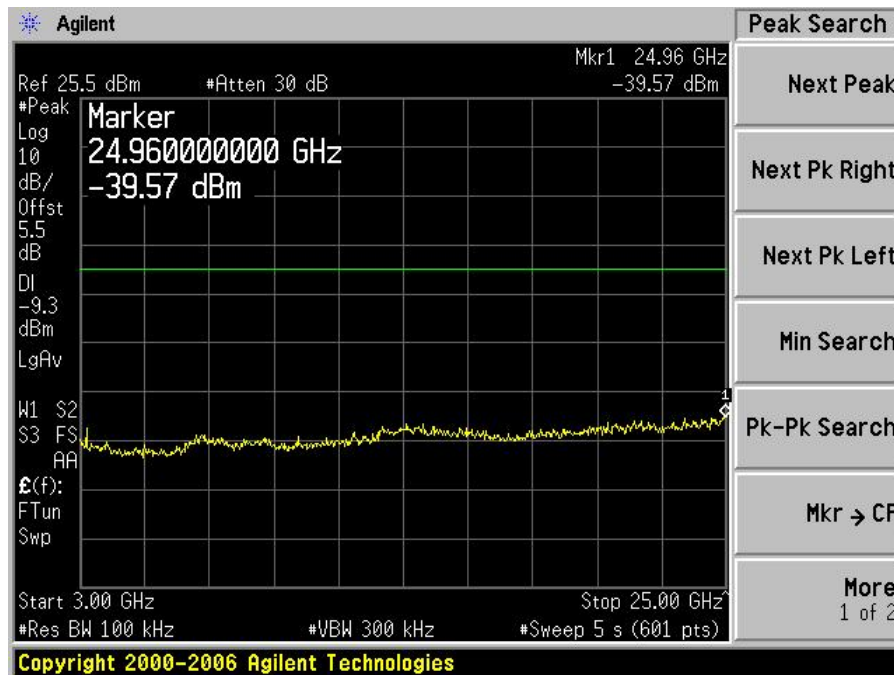
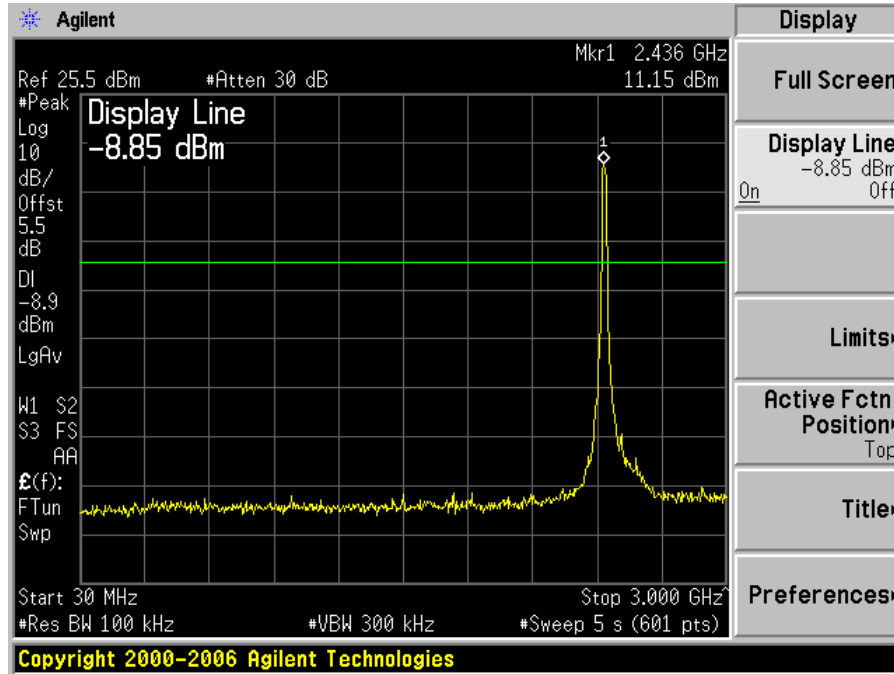


802.11 n 20 MHz (Antenna #0 + Antenna #1)

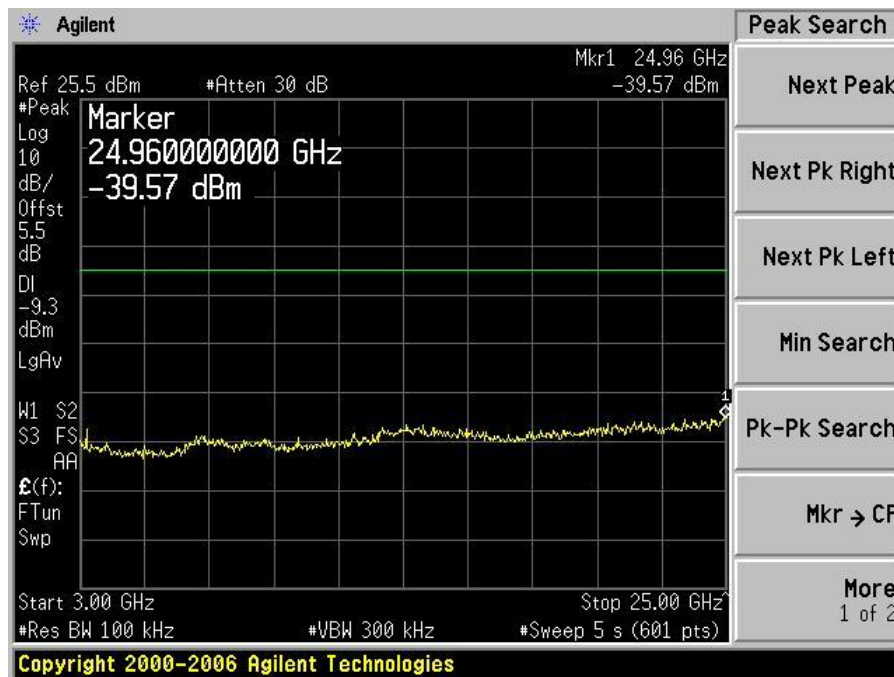
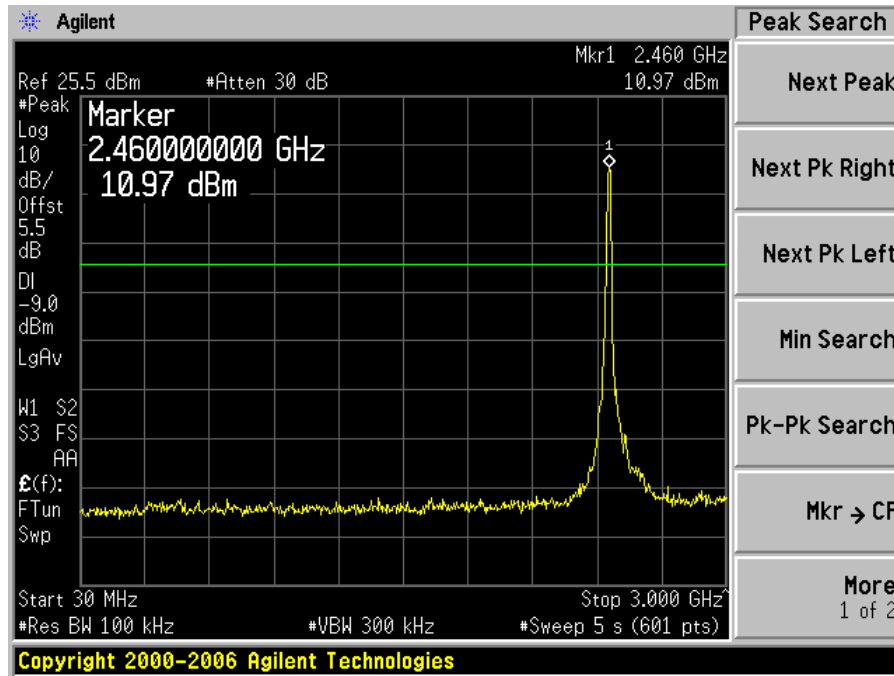
Low Channel 2412 MHz



Middle Channel 2437 MHz

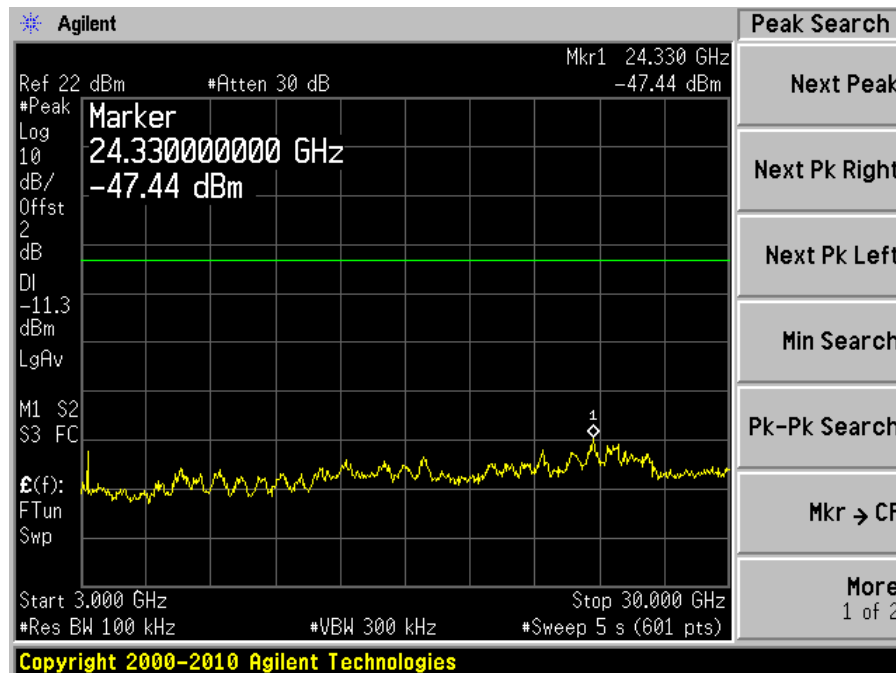
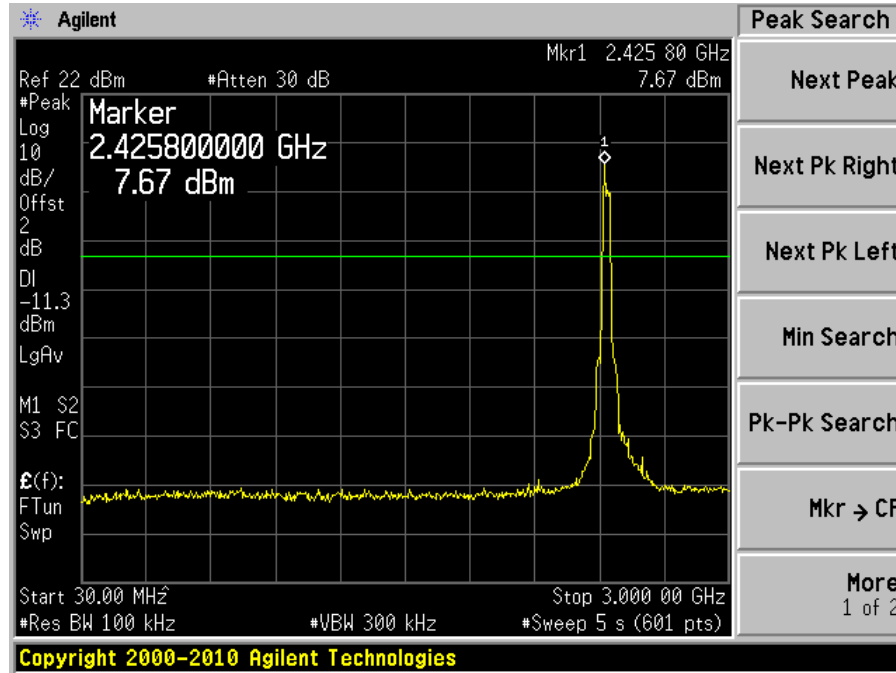


High Channel 2462 MHz

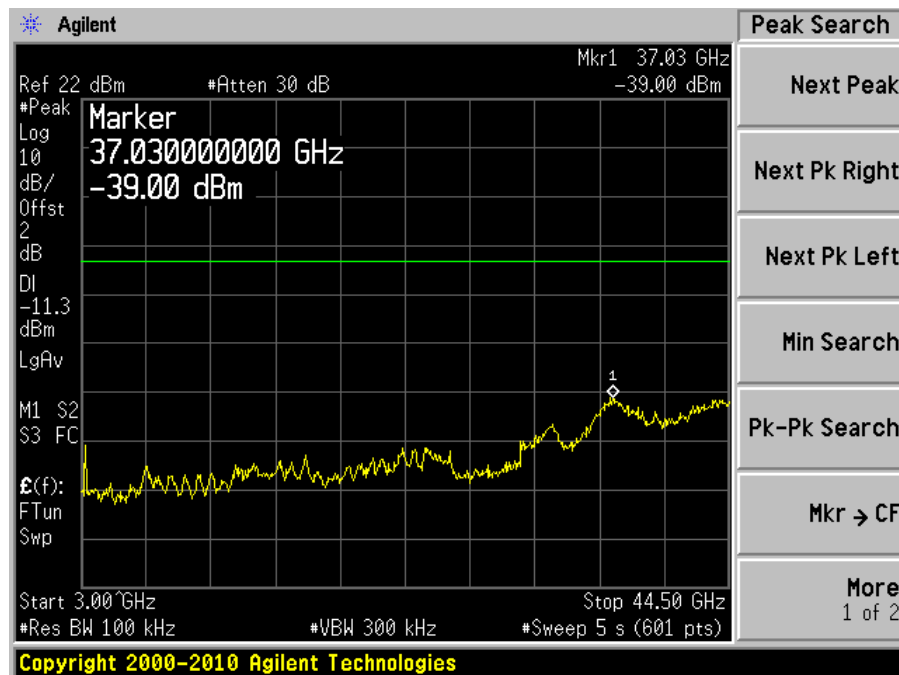
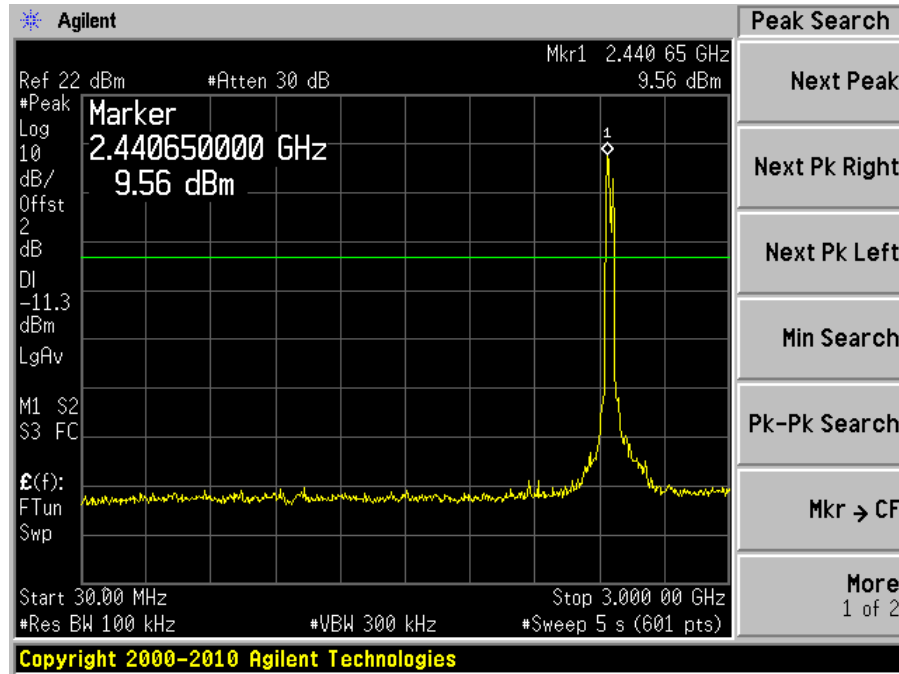


802.11 n 40 MHz (Antenna #0)

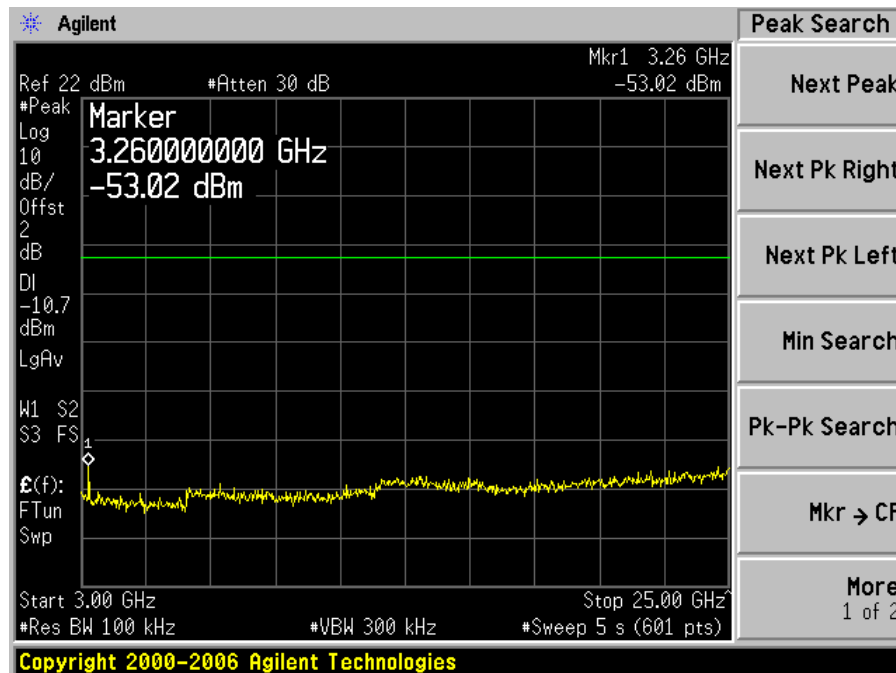
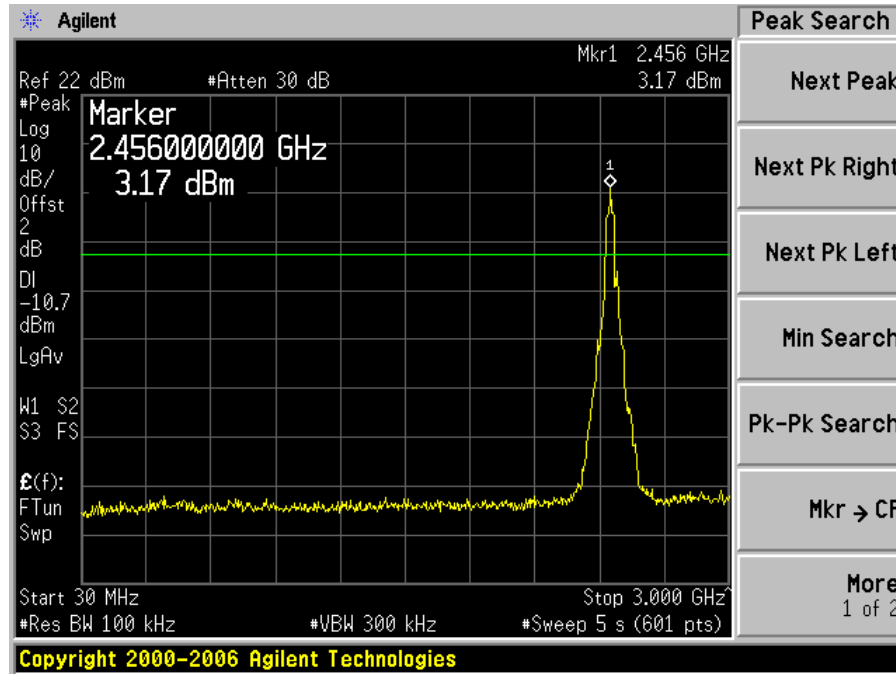
Low Channel 2422 MHz



Middle Channel 2437 MHz

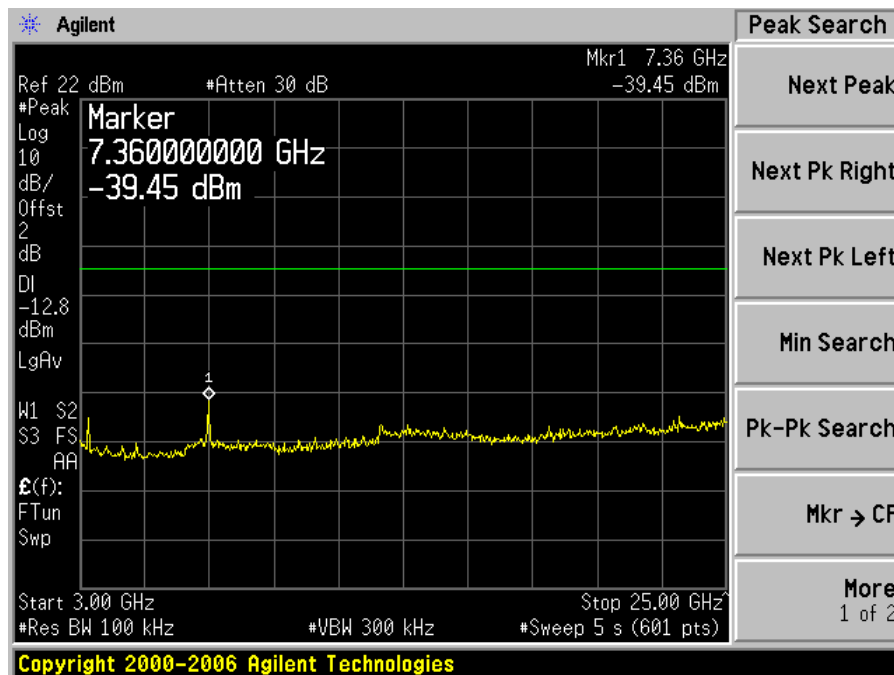
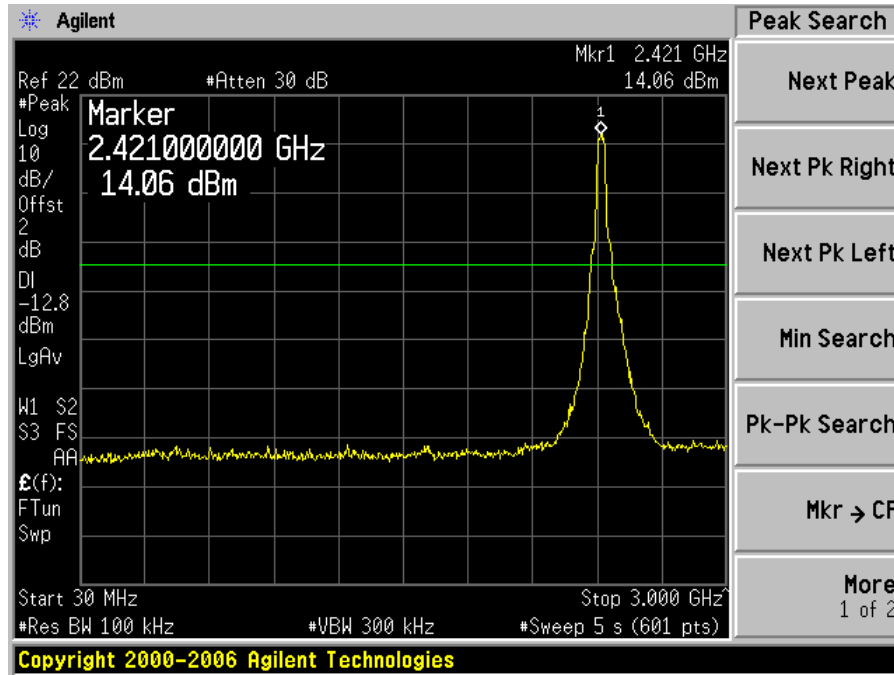


High Channel 2452 MHz

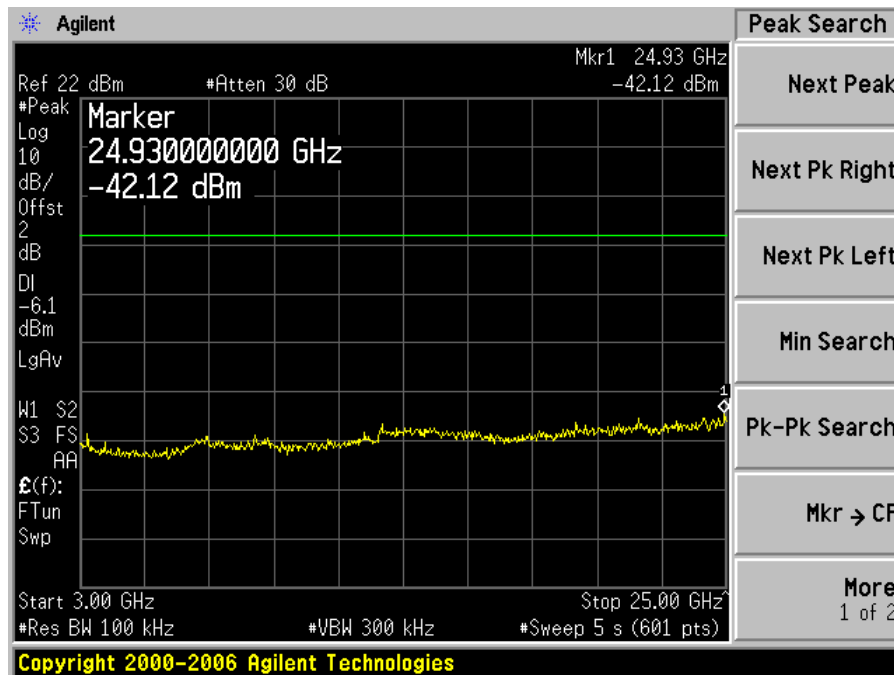
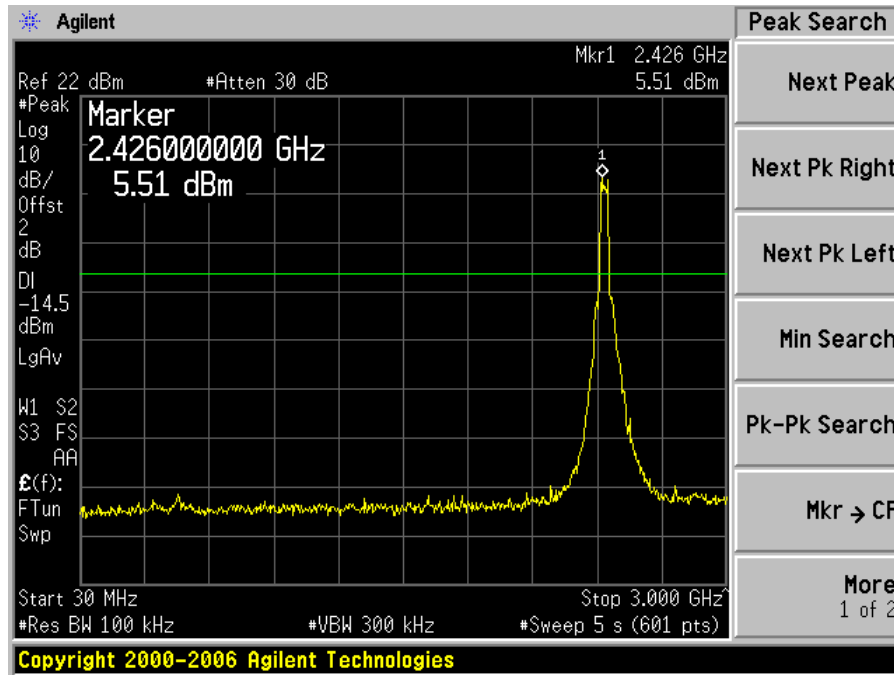


802.11 n 40 MHz (Antenna #1)

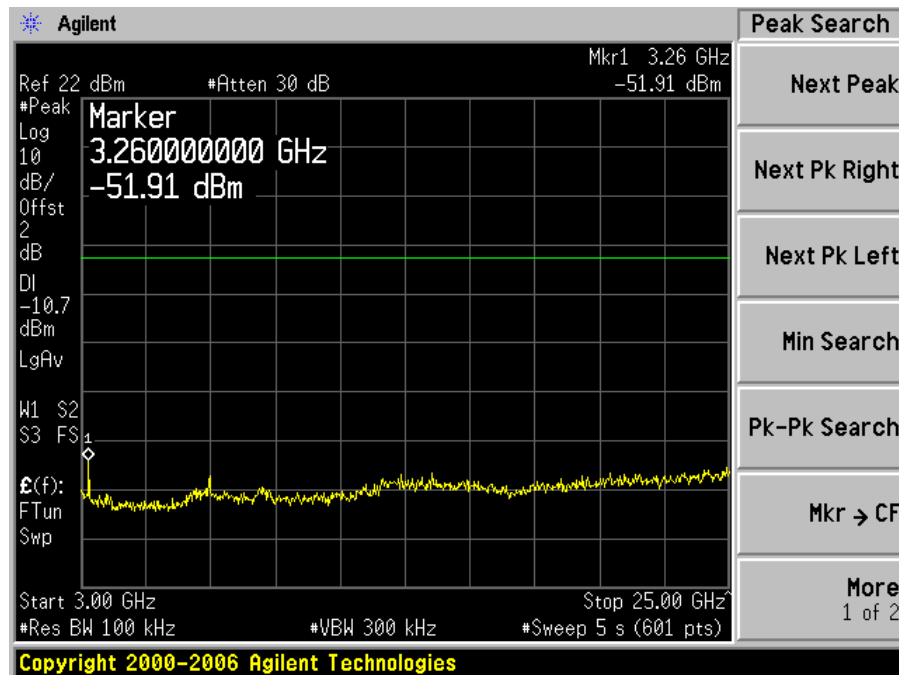
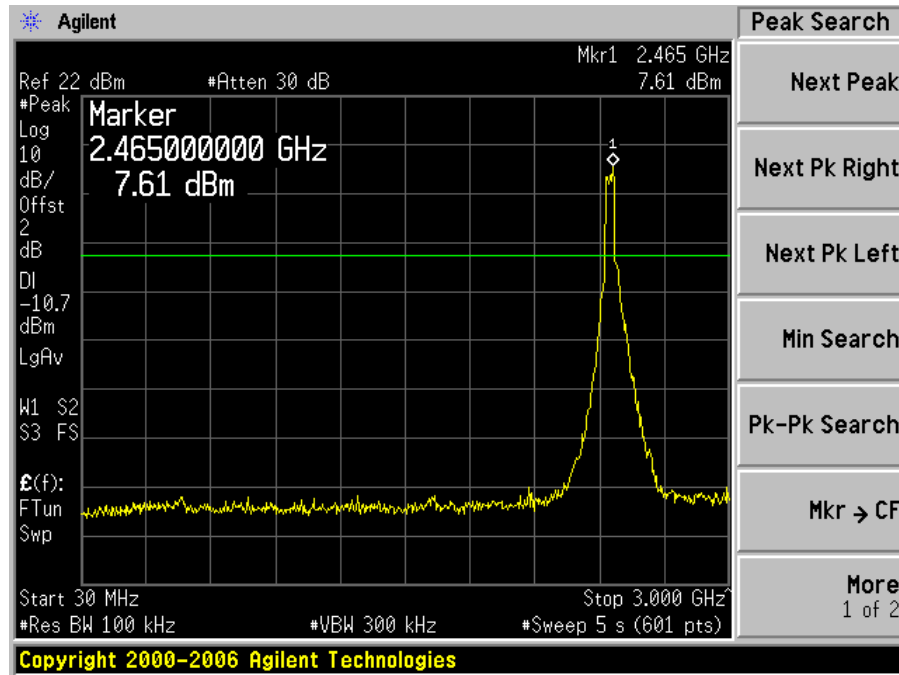
Low Channel 2422 MHz



Middle Channel 2437 MHz

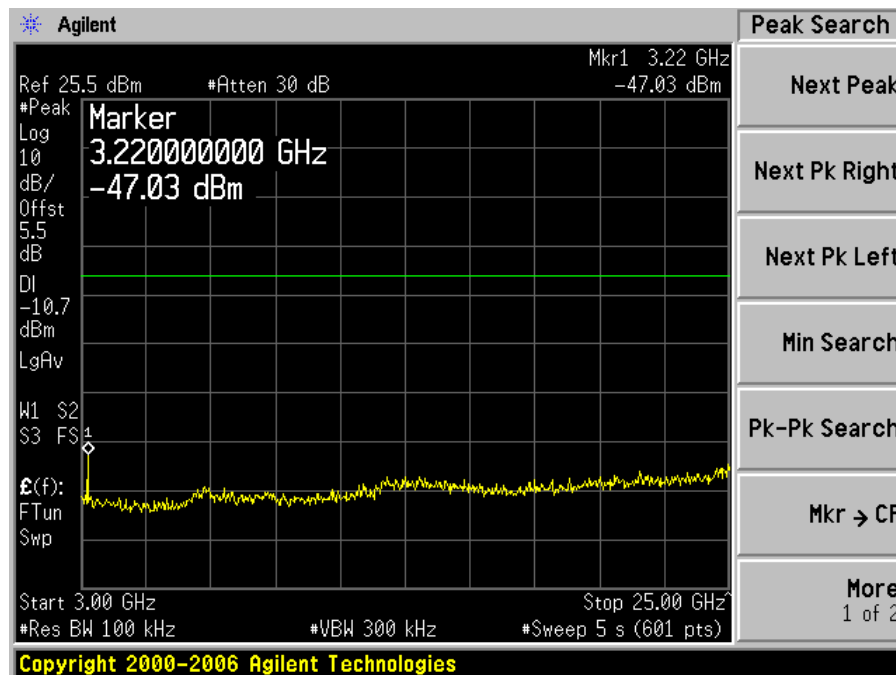
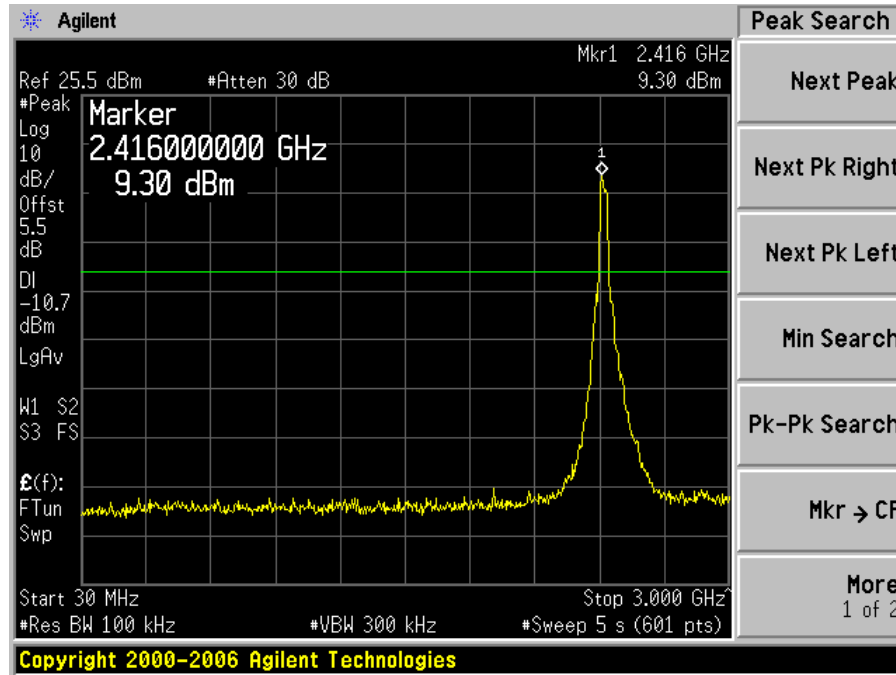


High Channel 2452 MHz

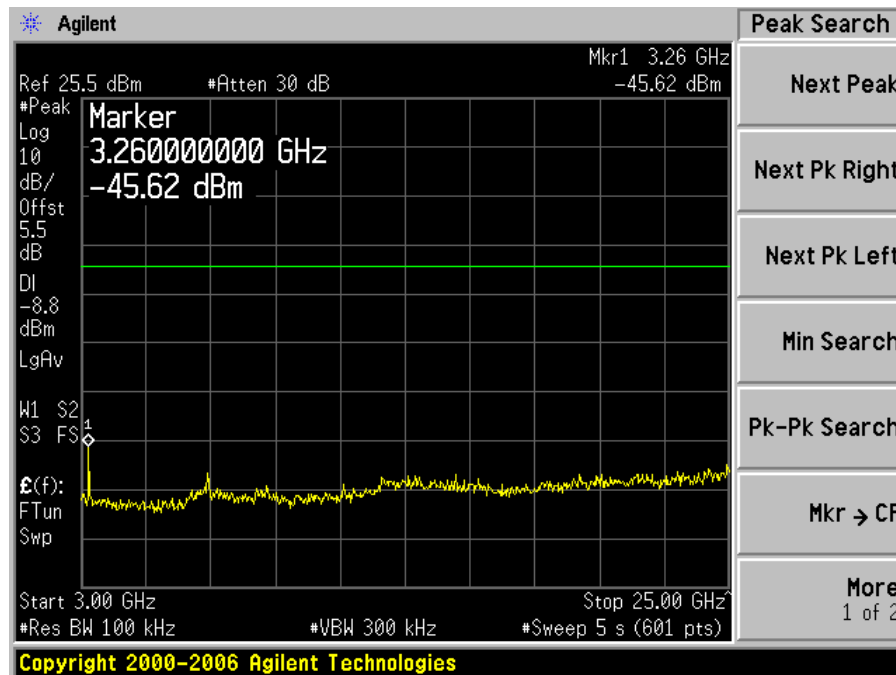
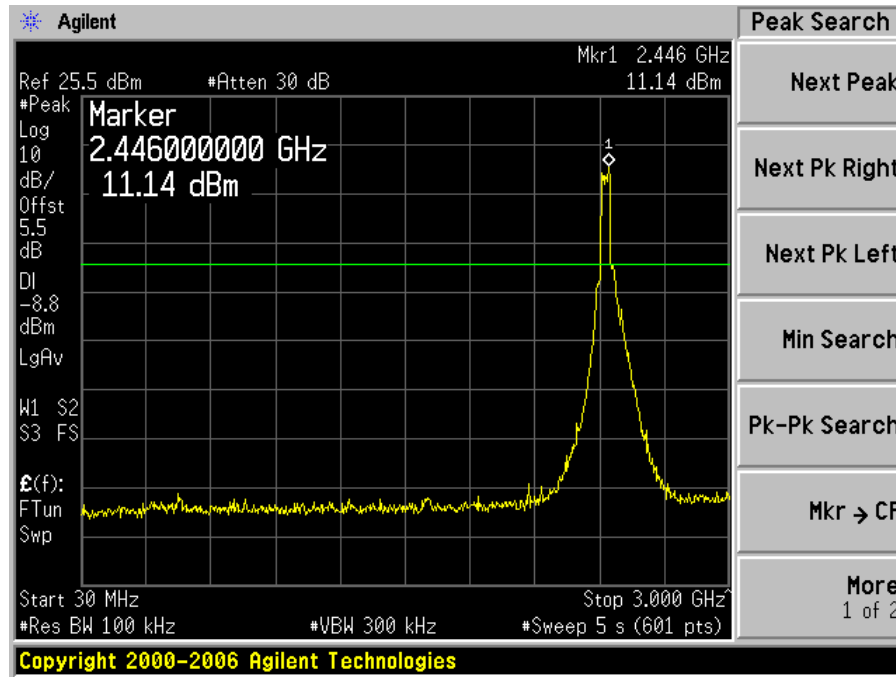


802.11 n 40 MHz (Antenna #0 + Antenna #1)

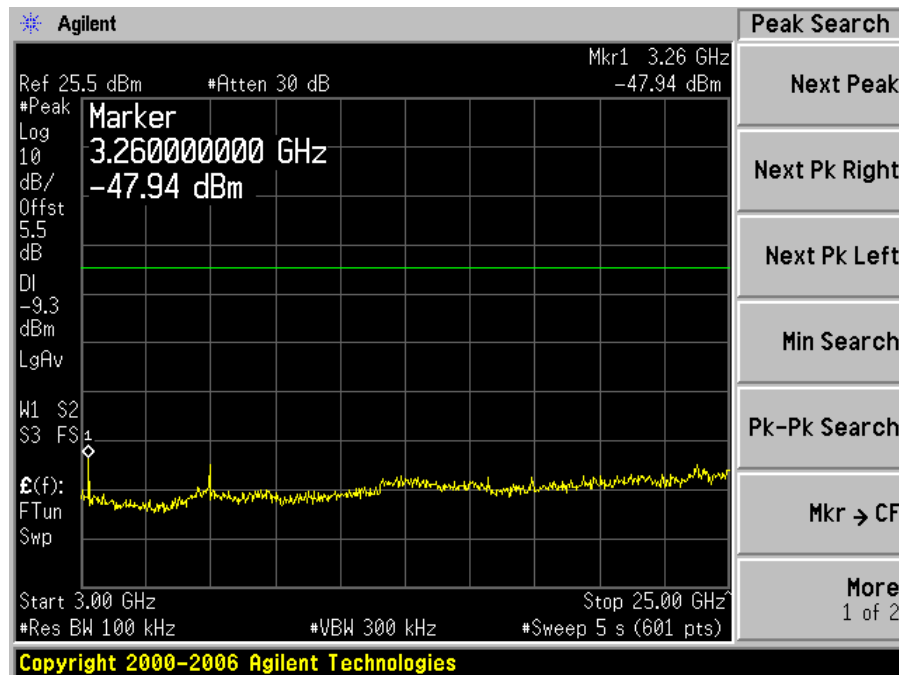
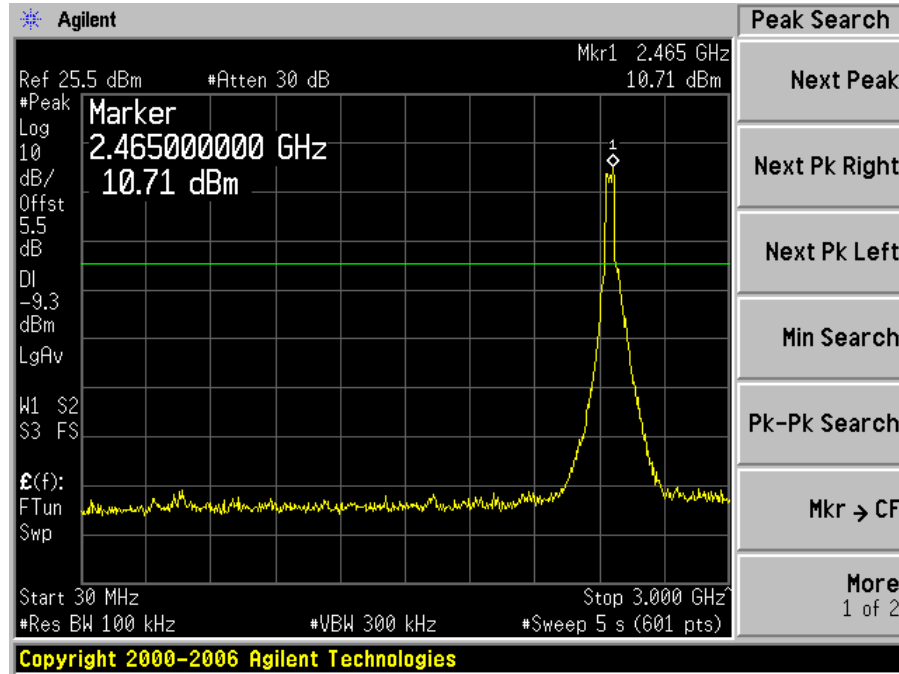
Low Channel 2422 MHz



Middle Channel 2437 MHz



High Channel 2452 MHz



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

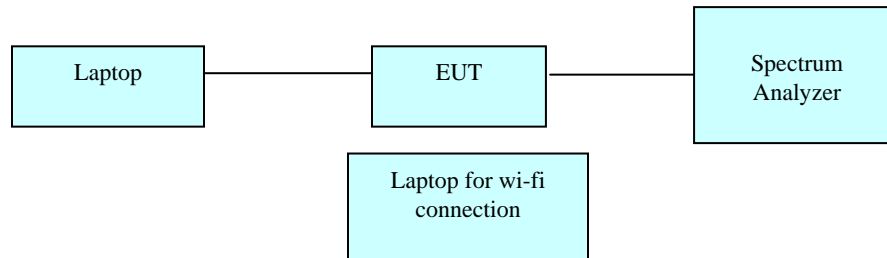
7.6 Applicable Standard

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

7.7 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 on the table. Turn on the EUT , the spectrum analyzer. 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.

7.8 Test Setup Block Diagram



7.9 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

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

7.10 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	42%
ATM Pressure:	101.2kPa

The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

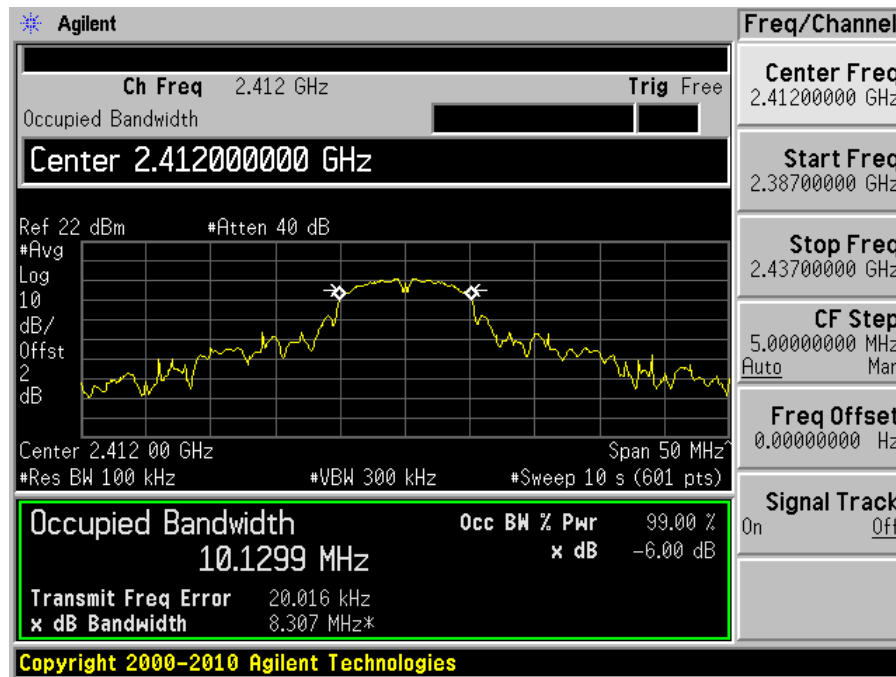
7.11 Test Results

Antenna	Radio Mode	Channel	Frequency (MHz)	99% Bandwidth (MHz)	6 dB Channel Bandwidth (MHz)	Limit (MHz)	Results
#0	802.11 b	Low	2412	10.130	8.307	> 0.5	Compliance
		Middle	2437	10.129	8.236	> 0.5	Compliance
		High	2462	10.134	8.267	> 0.5	Compliance
	802.11g	Low	2412	16.295	16.364	> 0.5	Compliance
		Middle	2437	16.298	16.360	> 0.5	Compliance
		High	2462	16.287	15.162	> 0.5	Compliance
	802.11 n20	Low	2412	17.471	15.444	> 0.5	Compliance
		Middle	2437	17.525	17.641	> 0.5	Compliance
		High	2462	17.439	12.964	> 0.5	Compliance
	802.11 n40	Low	2422	36.082	20.790	> 0.5	Compliance
		Middle	2437	36.245	22.242	> 0.5	Compliance
		High	2452	36.106	25.295	> 0.5	Compliance
#1	802.11 b	Low	2412	10.149	9.905	> 0.5	Compliance
		Middle	2437	10.162	8.147	> 0.5	Compliance
		High	2462	10.139	8.107	> 0.5	Compliance
	802.11g	Low	2412	16.762	15.844	> 0.5	Compliance
		Middle	2437	19.370	14.635	> 0.5	Compliance
		High	2462	16.282	13.496	> 0.5	Compliance
	802.11 n20	Low	2412	17.445	16.981	> 0.5	Compliance
		Middle	2437	17.456	17.584	> 0.5	Compliance
		High	2462	17.471	17.531	> 0.5	Compliance
	802.11 n40	Low	2422	36.090	26.492	> 0.5	Compliance
		Middle	2437	36.311	35.548	> 0.5	Compliance
		High	2452	36.072	25.811	> 0.5	Compliance

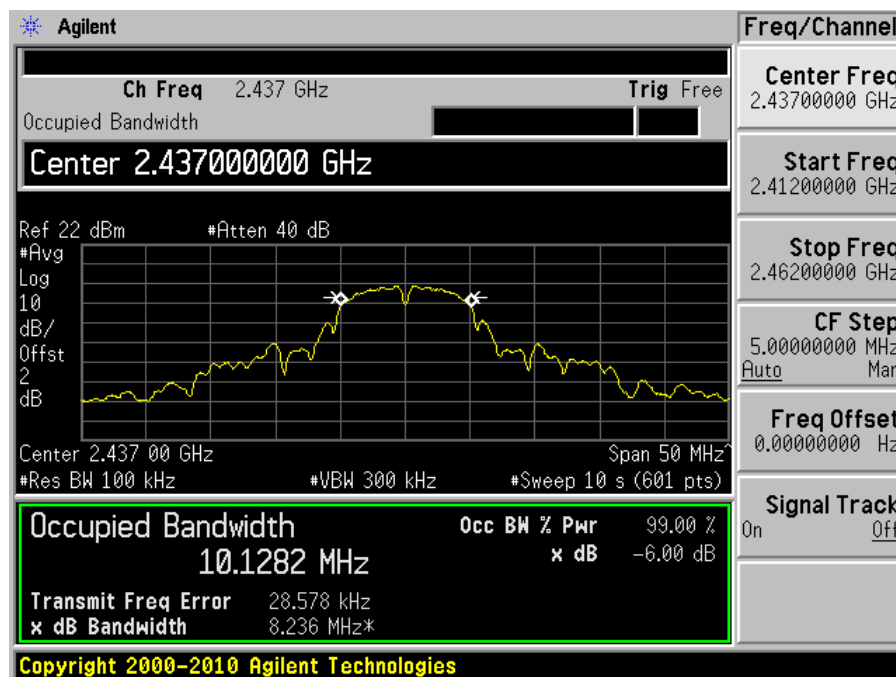
Please refer to the following plots for detailed test results

Antenna #0:

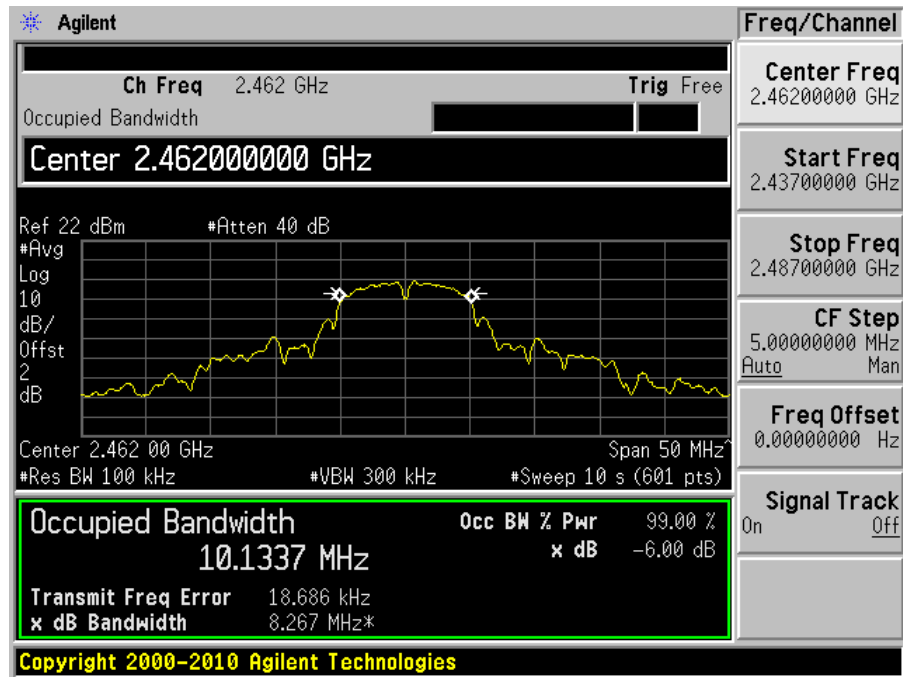
802.11b, Low Channel 2412 MHz



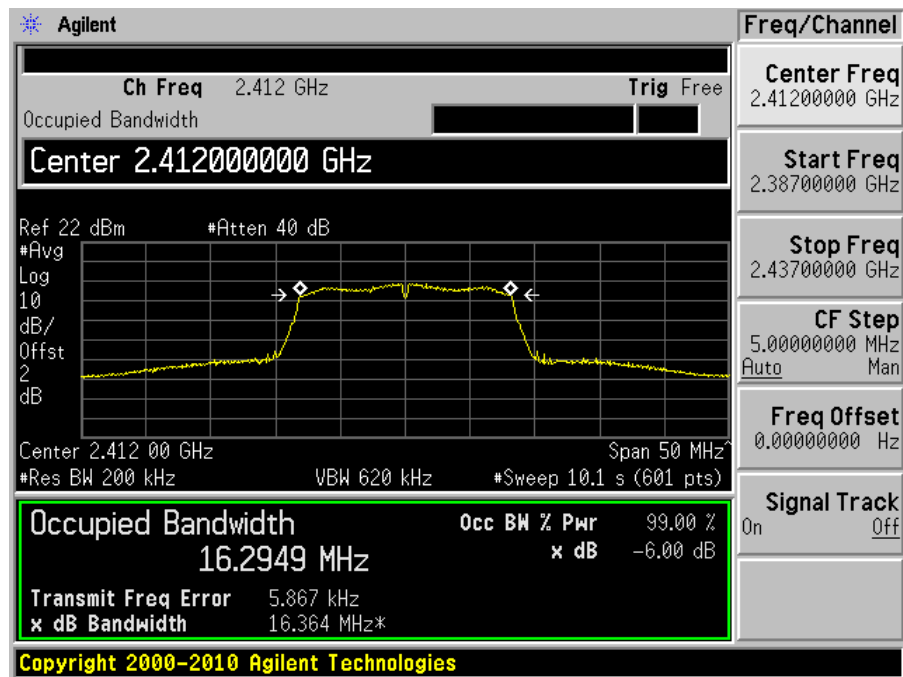
802.11b, Middle Channel 2437 MHz



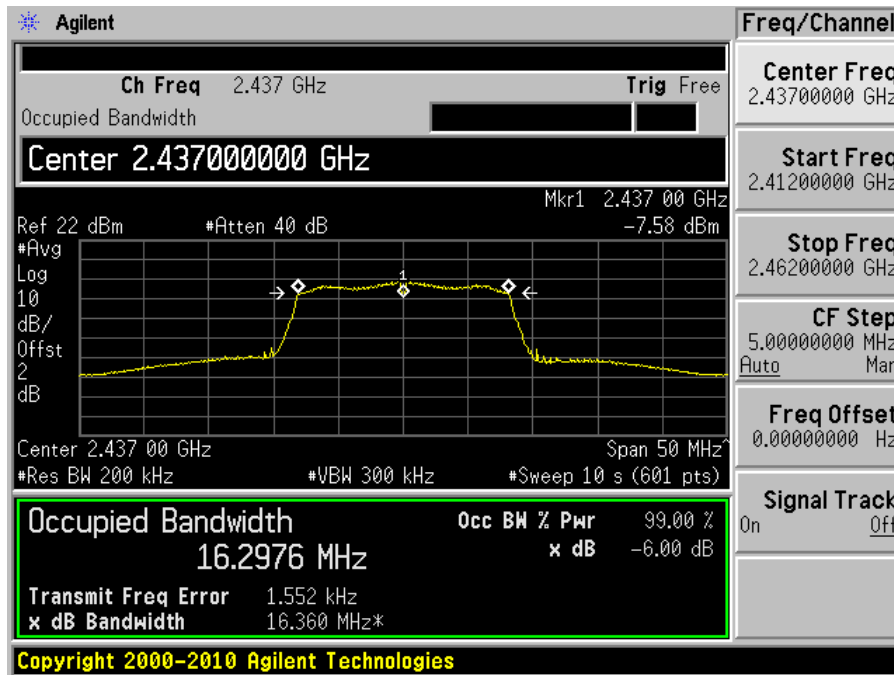
802.11b, High Channel 2462 MHz



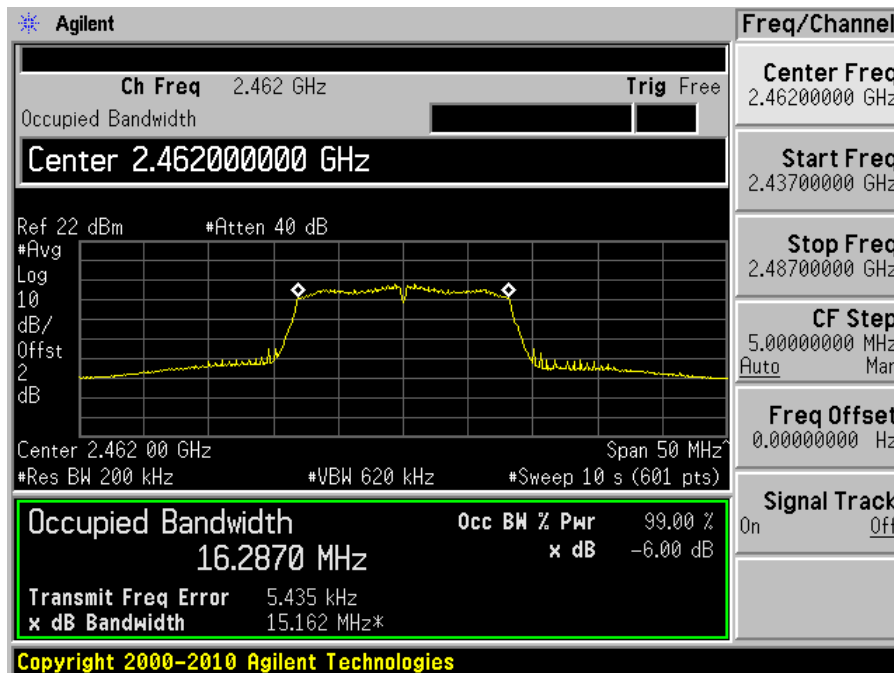
802.11 g, Low Channel 2412 MHz



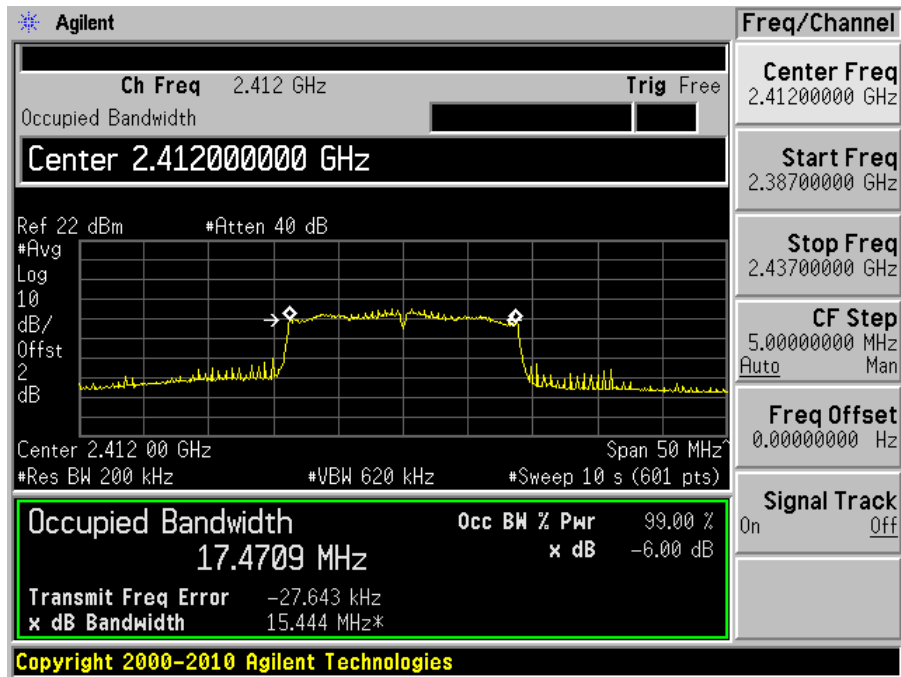
802.11g, Middle Channel 2437 MHz



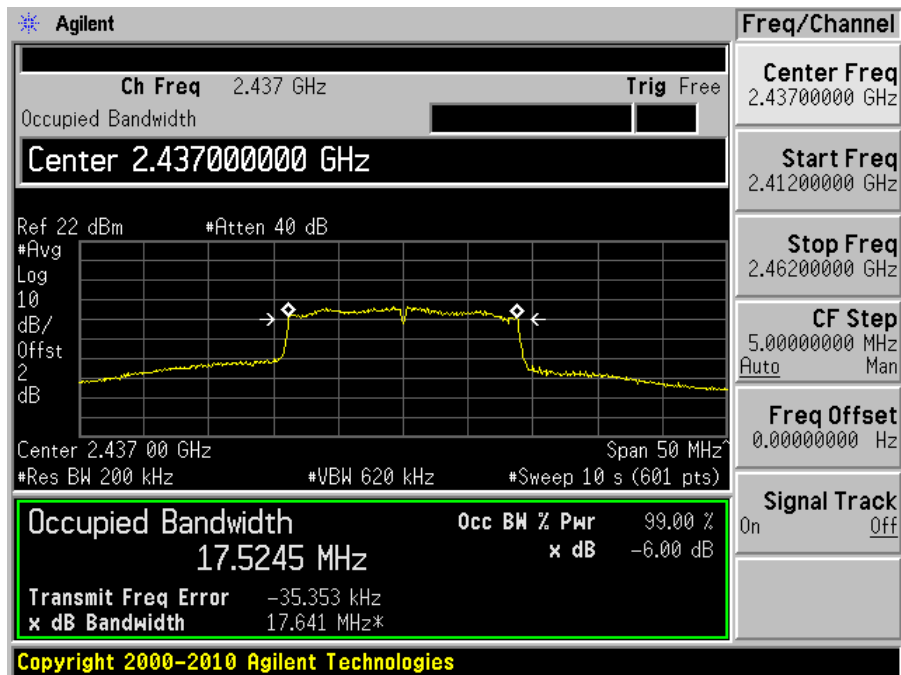
802.11g, High Channel 2462 MHz



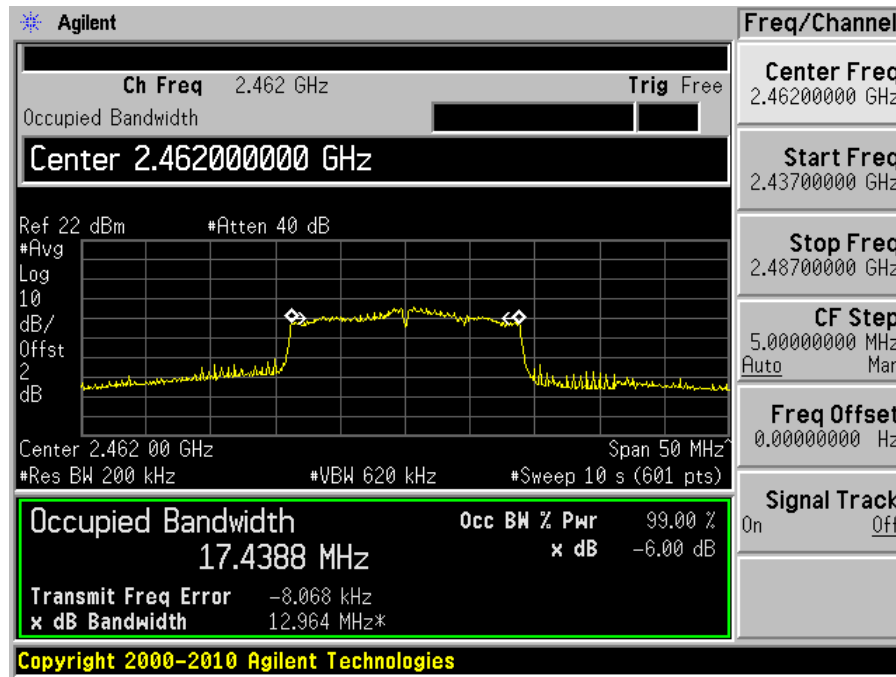
802.11 n20, Low Channel 2412 MHz



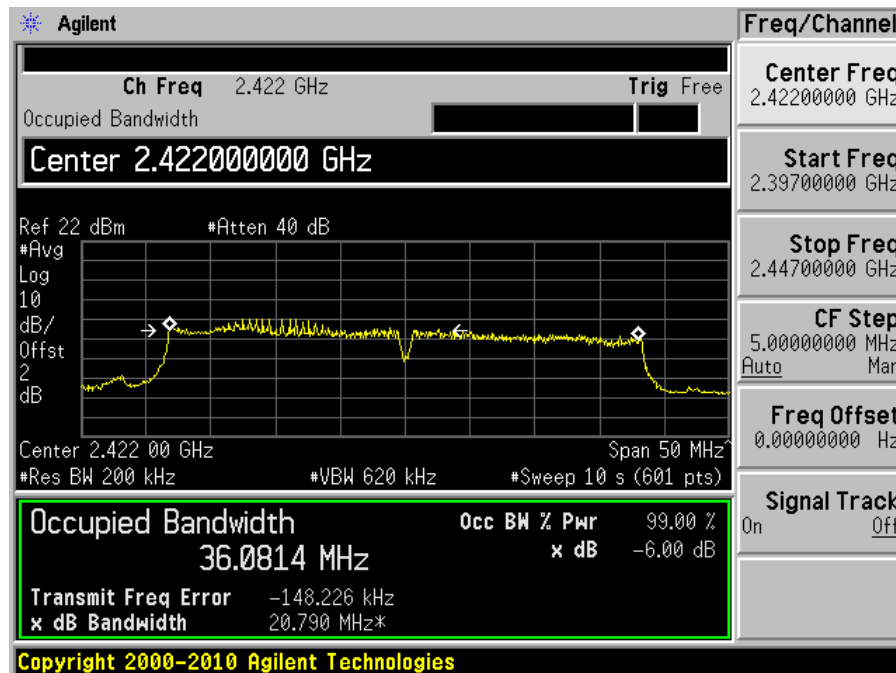
802.11 n20, Middle Channel 2437 MHz



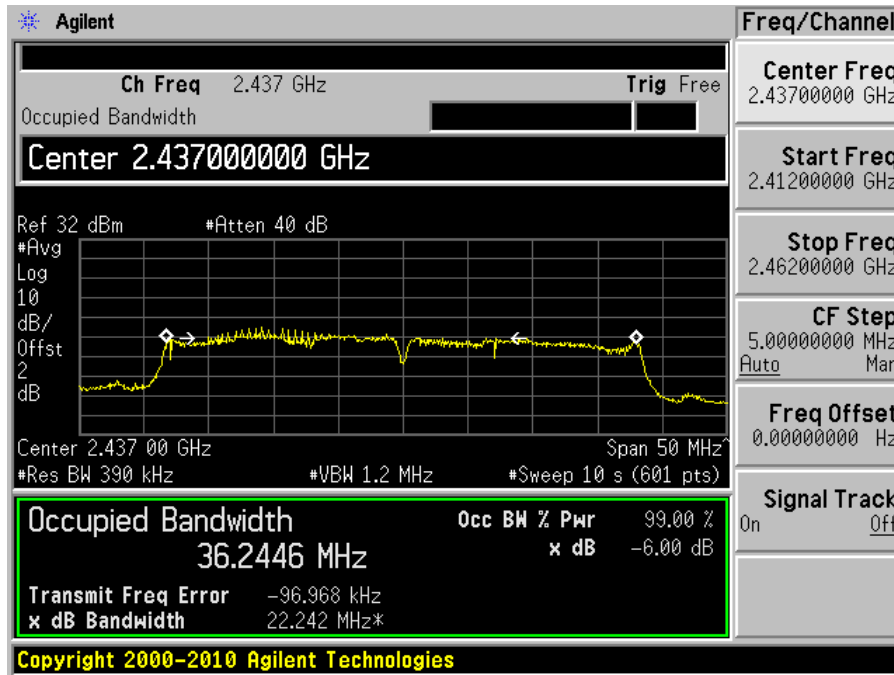
802.11 n20, High Channel 2462 MHz



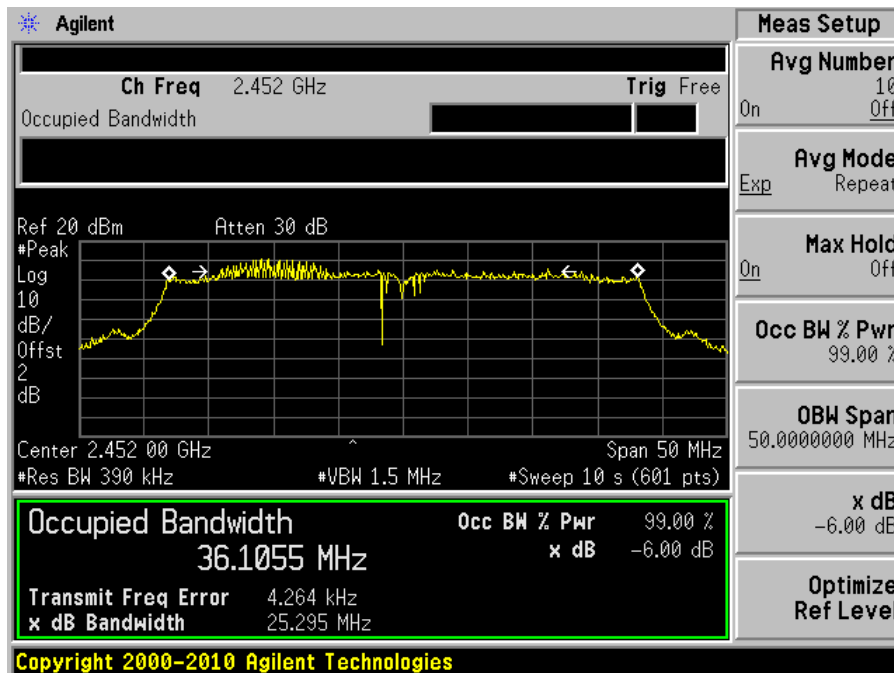
802.11 n40, Low Channel 2422 MHz



802.11 n40, Middle Channel 2437 MHz

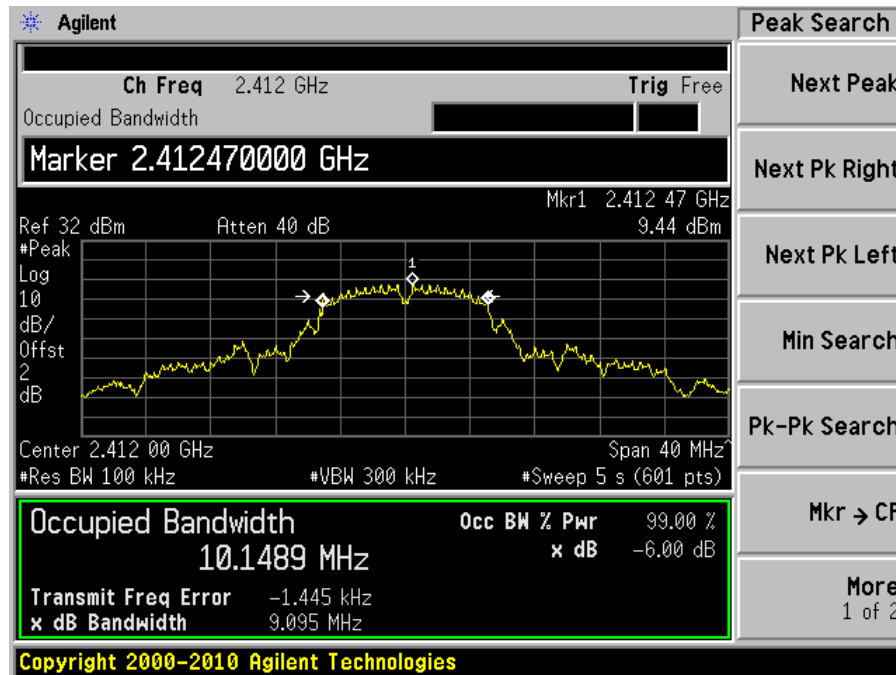


802.11 n40, High Channel 2452 MHz

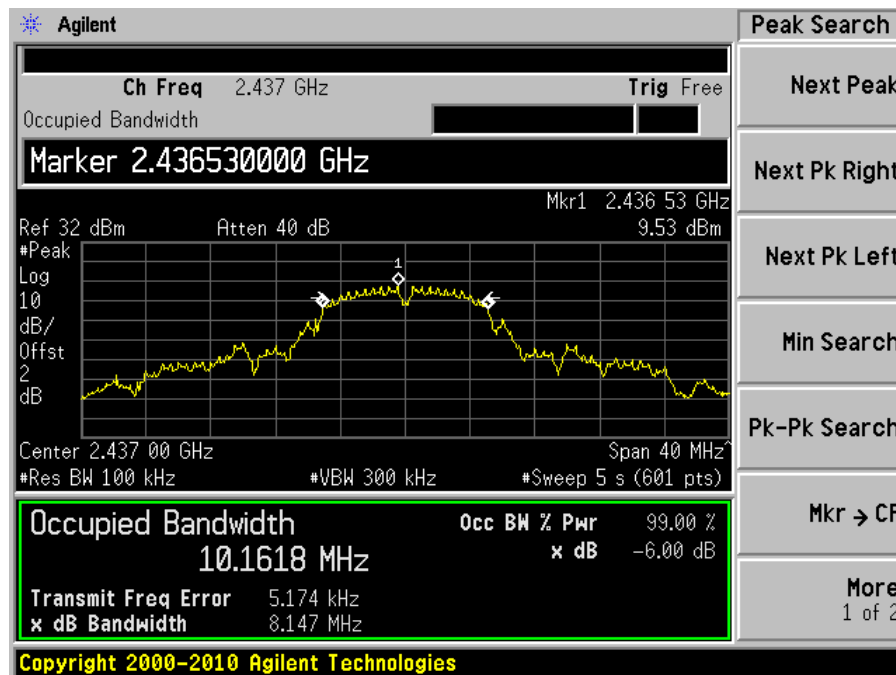


Antenna #1:

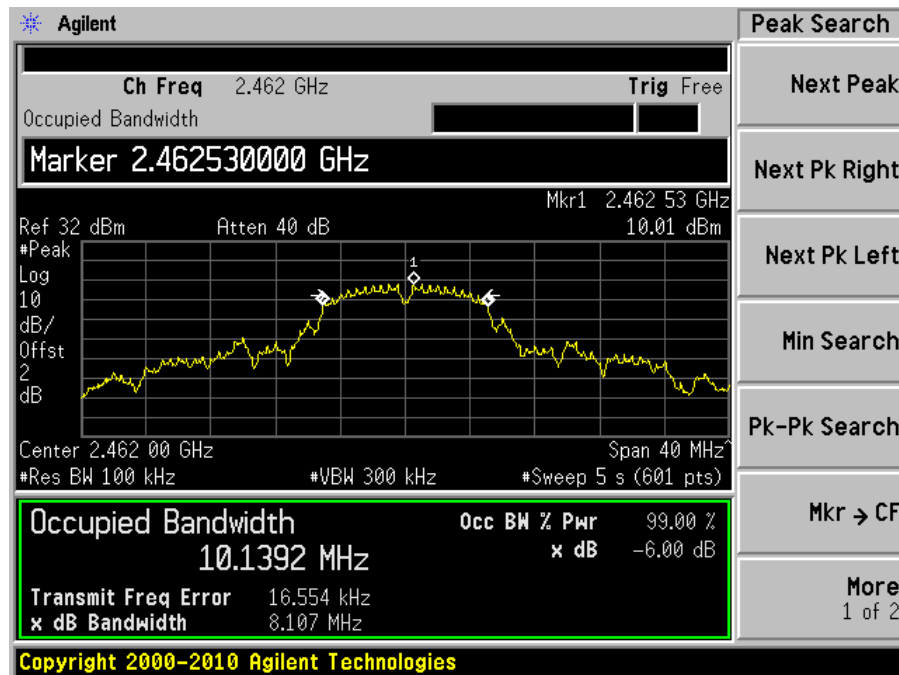
802.11b, Low Channel 2412 MHz



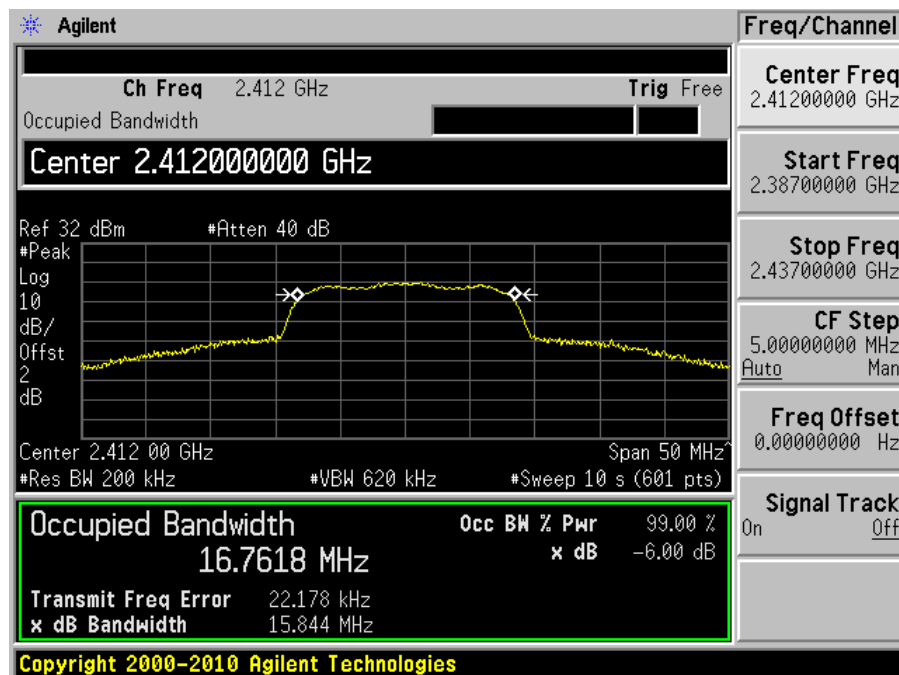
802.11b, Middle Channel 2437 MHz



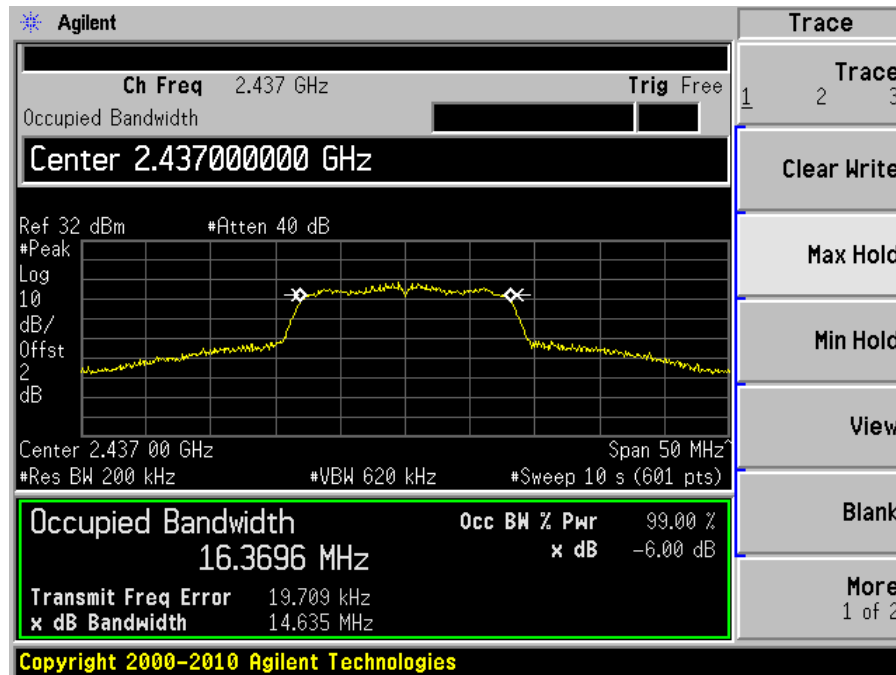
802.11b, High Channel 2462 MHz



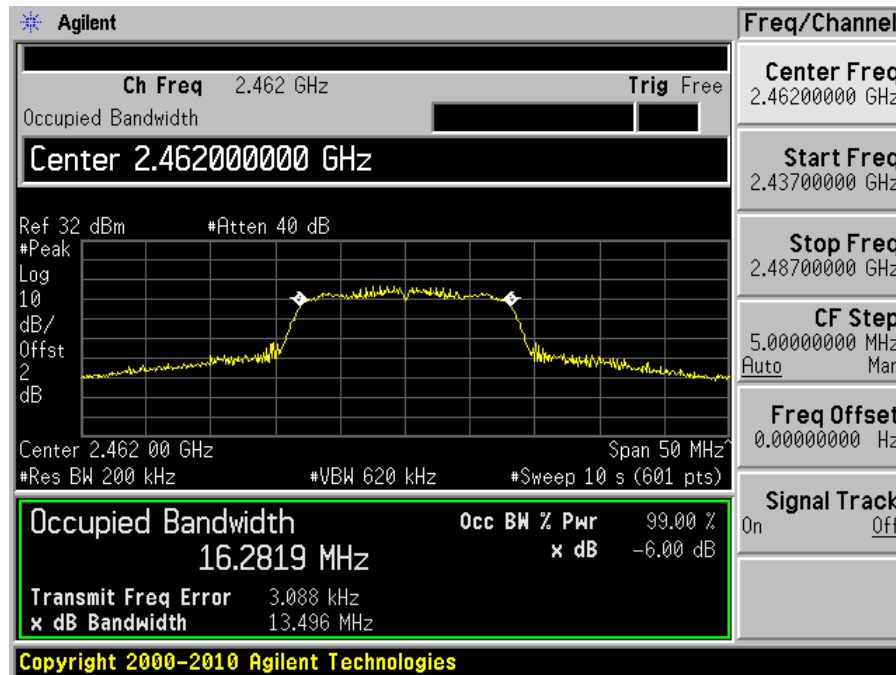
802.11 g, Low Channel 2412 MHz



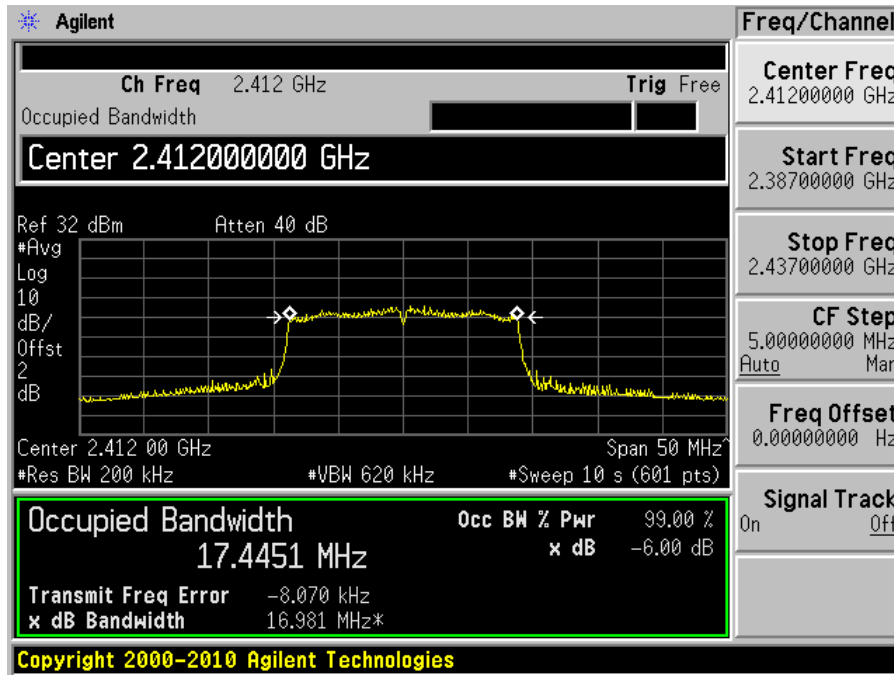
802.11g, Middle Channel 2437 MHz



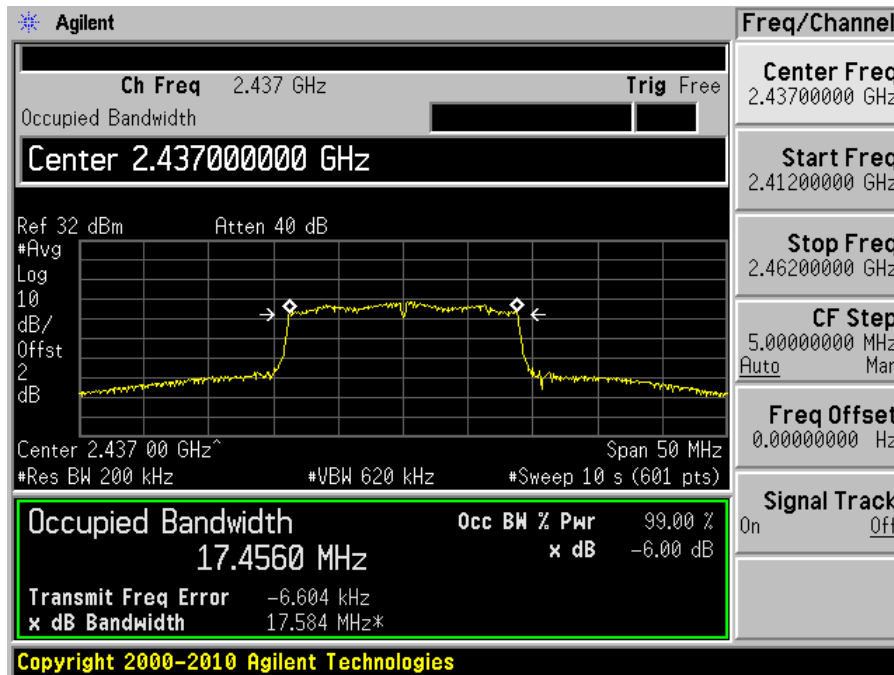
802.11g, High Channel 2462 MHz



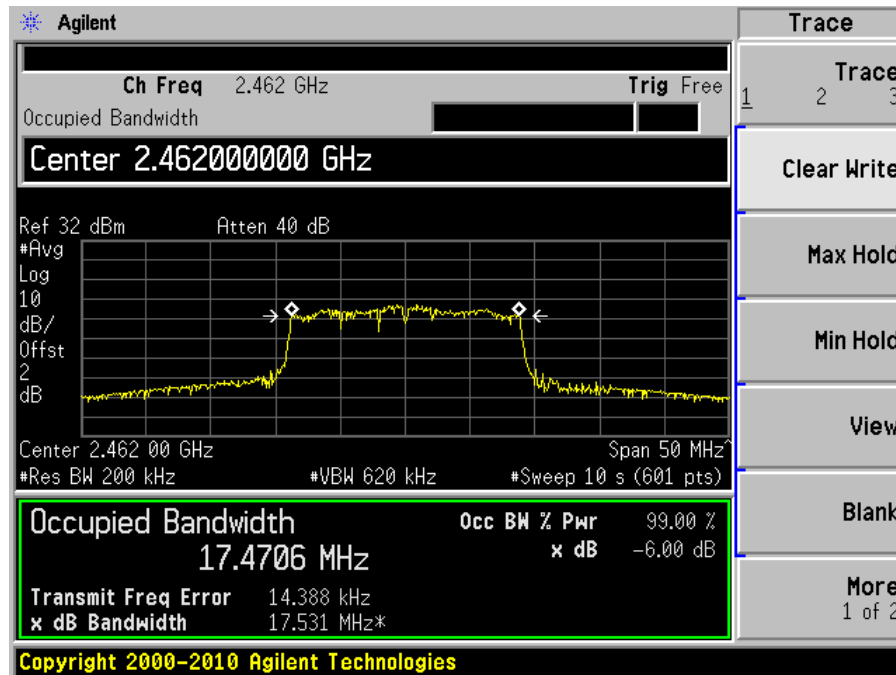
802.11 n20, Low Channel 2412 MHz



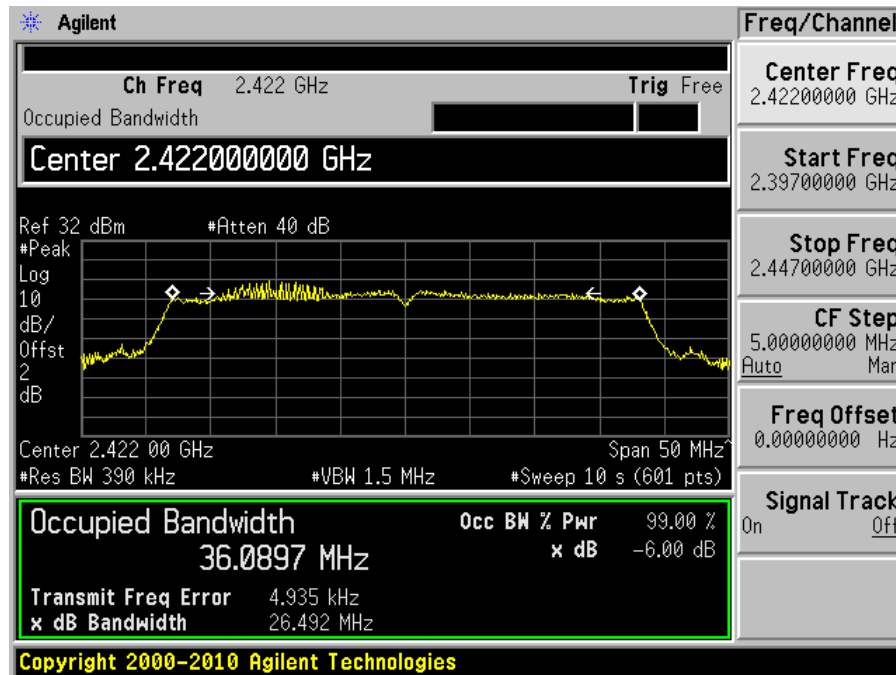
802.11 n20, Middle Channel 2437 MHz



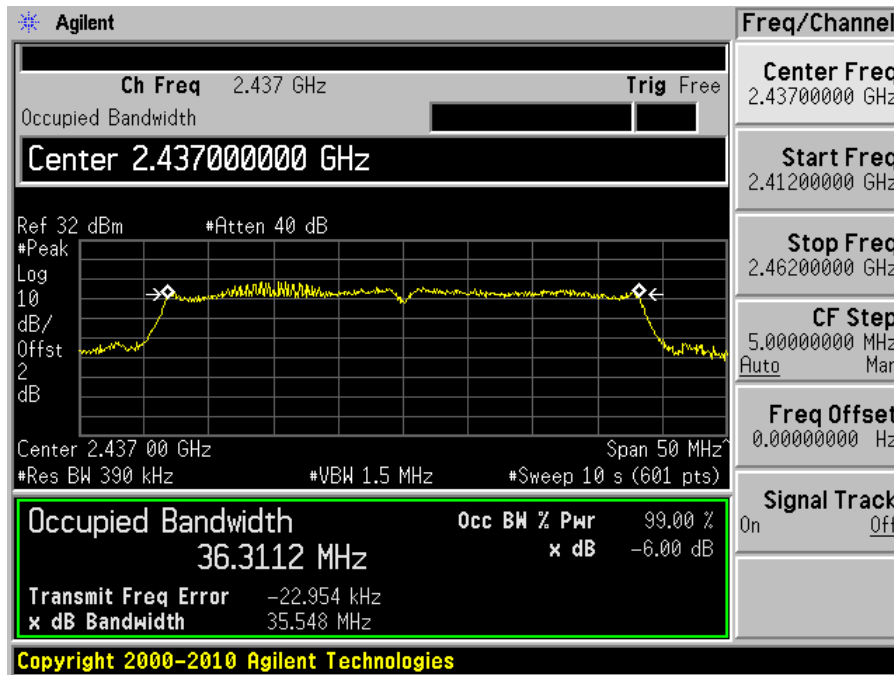
802.11 n20, High Channel 2462 MHz



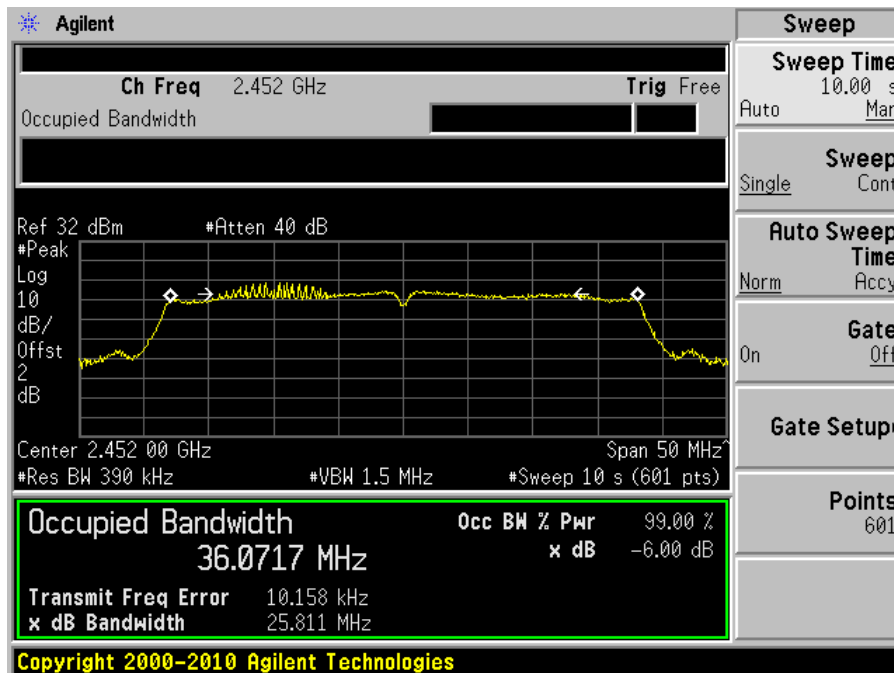
802.11 n40, Low Channel 2422 MHz



802.11 n40, Middle Channel 2437 MHz



802.11 n40, High Channel 2452 MHz



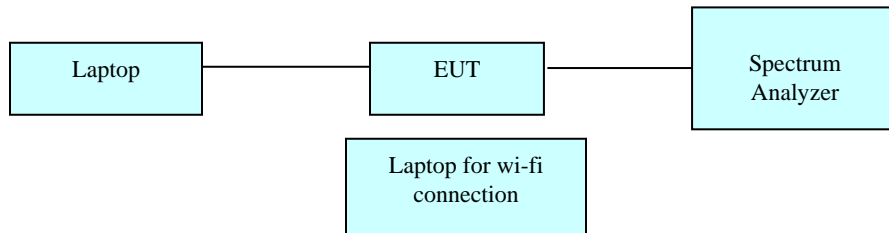
8 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power

8.1 Applicable Standard

According to FCC §15.247(b)(3) and IC RSS-210 §A8.4 for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

8.2 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.



8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

* **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:	24°
Relative Humidity:	43 %
ATM Pressure:	101.2kPa

The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

8.5 Test Results

802.11 b mode:

Channel	Frequency (MHz)	Output Power Antenna 0 (dBm)	Output Power Antenna 1 (dBm)	Highest Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	16.88	16.90	16.90	30	-13.1
Mid	2437	17.17	17.21	17.21	30	-12.79
High	2462	17.02	17.12	17.12	30	-12.88

802.11 g mode:

Channel	Frequency (MHz)	Output Power Antenna 0 (dBm)	Output Power Antenna 1 (dBm)	Highest Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	16.45	16.74	16.74	30	-13.26
Mid	2437	16.57	16.47	16.57	30	-13.43
High	2462	14.83	14.50	14.83	30	-15.17

802.11 n 20 MHz mode:

Channel	Frequency (MHz)	Output Power Antenna 0 (dBm)	Output Power Antenna 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	14.09	14.94	17.55	30	-12.45
Mid	2437	14.71	14.54	17.64	30	-12.36
High	2462	13.07	13.02	16.06	30	-13.94

802.11 n 40 MHz mode:

Channel	Frequency (MHz)	Output Power Antenna 0 (dBm)	Output Power Antenna 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2422	10.72	10.82	13.78	30	-16.22
Mid	2437	13.04	13.78	16.44	30	-13.56
High	2452	10.11	10.01	13.07	30	-16.93

9 FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges

9.1 Applicable Standard

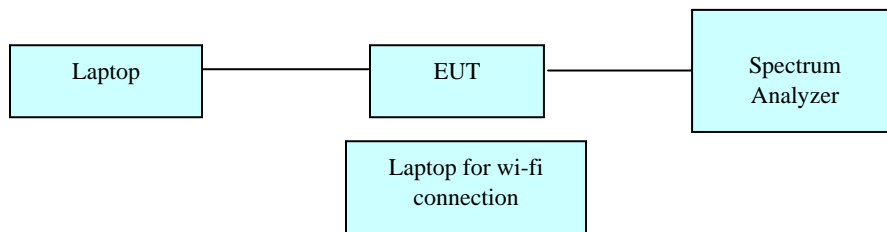
According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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).

According to 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.

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 on the table. Turn on the EUT, the spectrum analyzer. 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.

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

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

9.5 Test Environmental Conditions

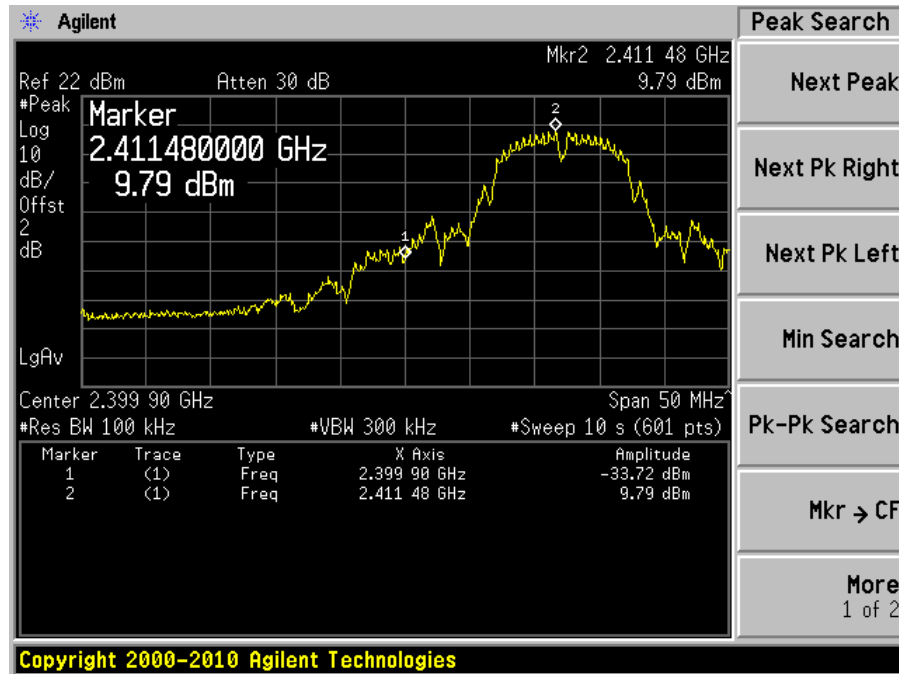
Temperature:	24°
Relative Humidity:	43 %
ATM Pressure:	101.2kPa

The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

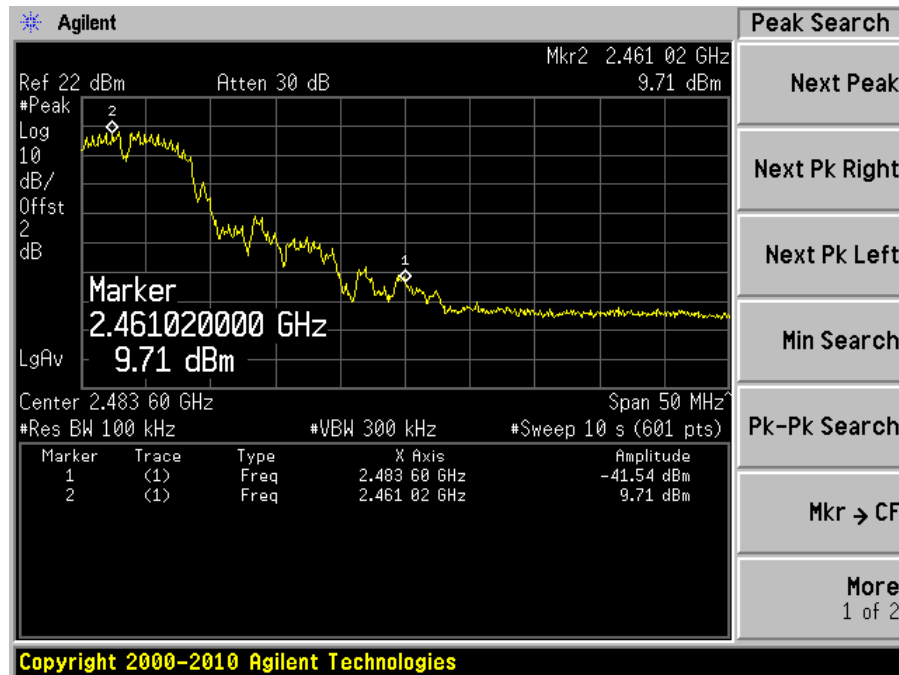
Please refer to the following plots for detailed results

Antenna #0:

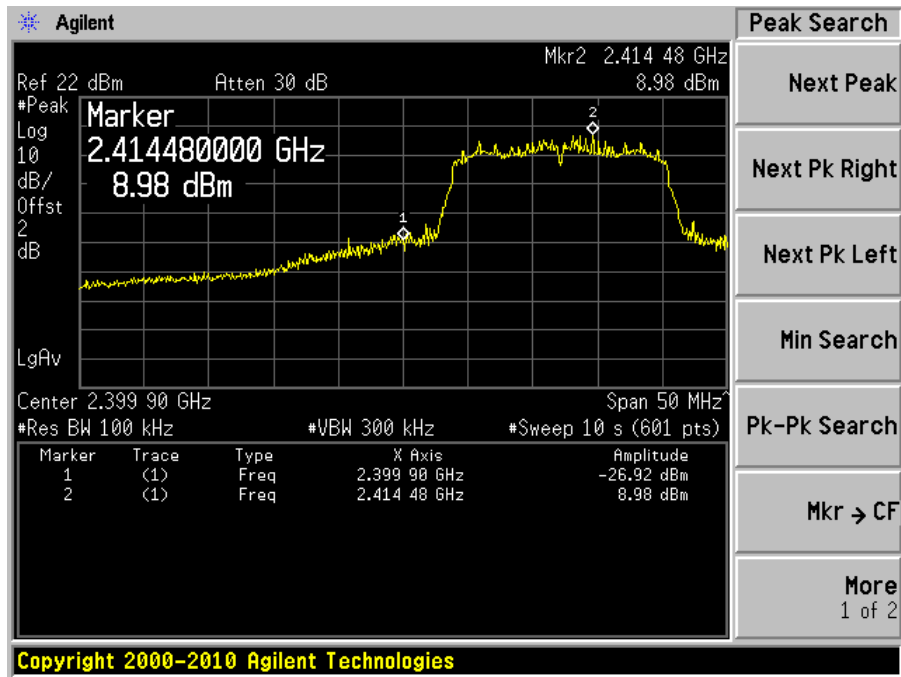
802.11b, Low Band Edge



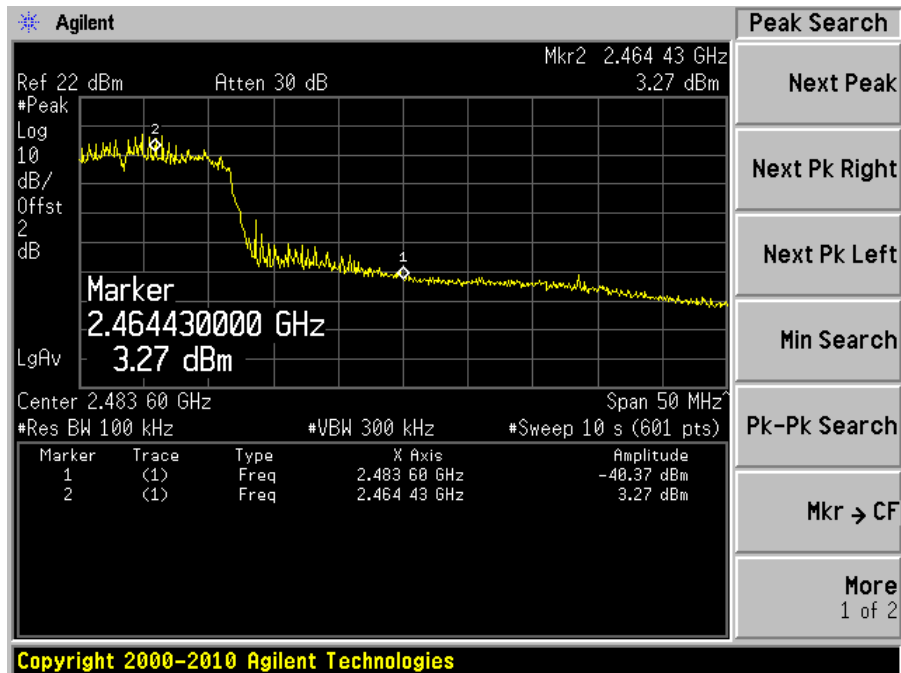
802.11b, High Band Edge



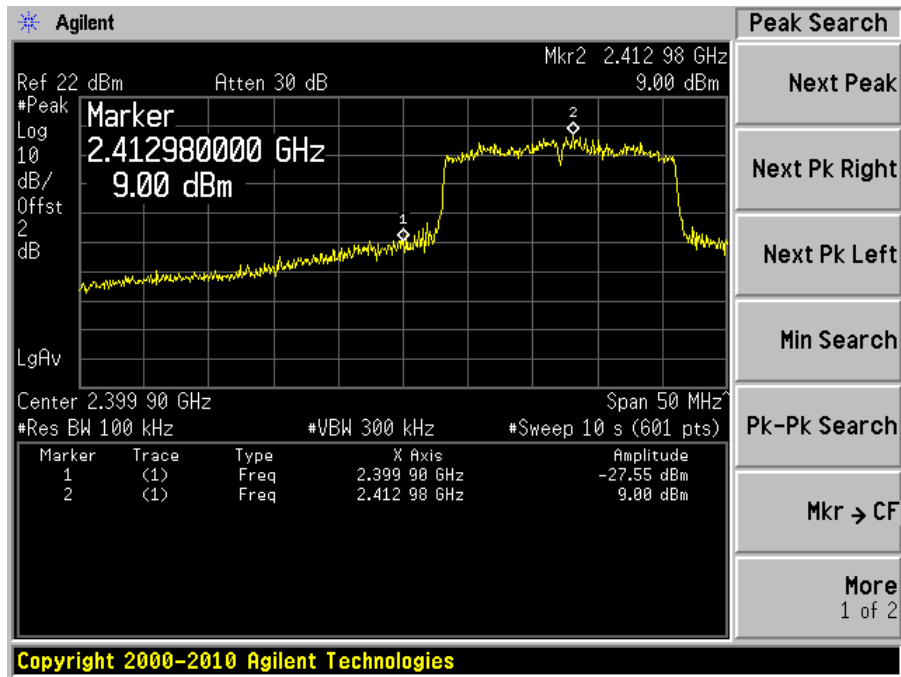
802.11g, Low Band Edge



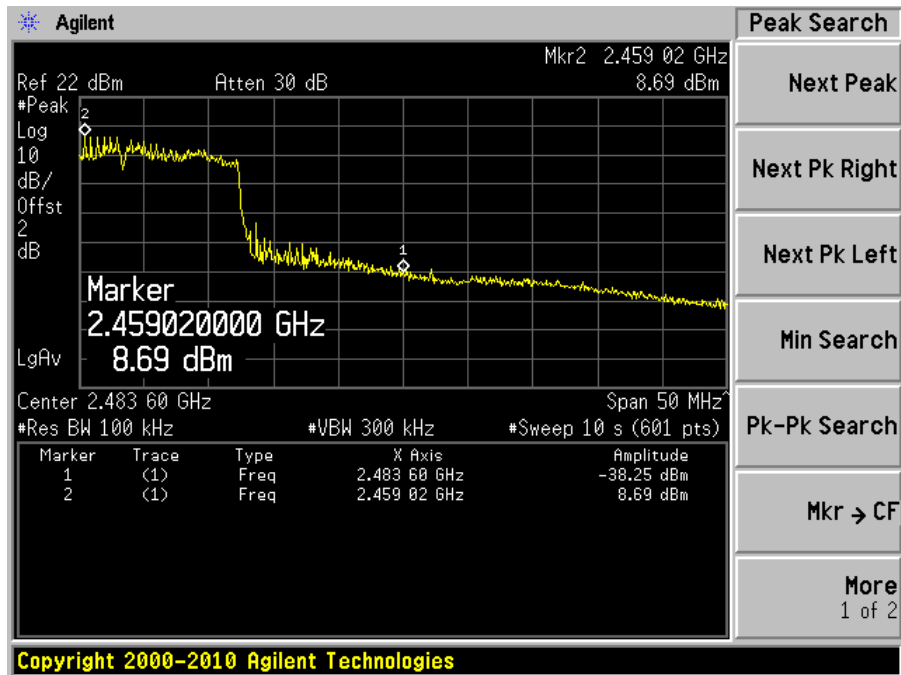
802.11g, High Band Edge



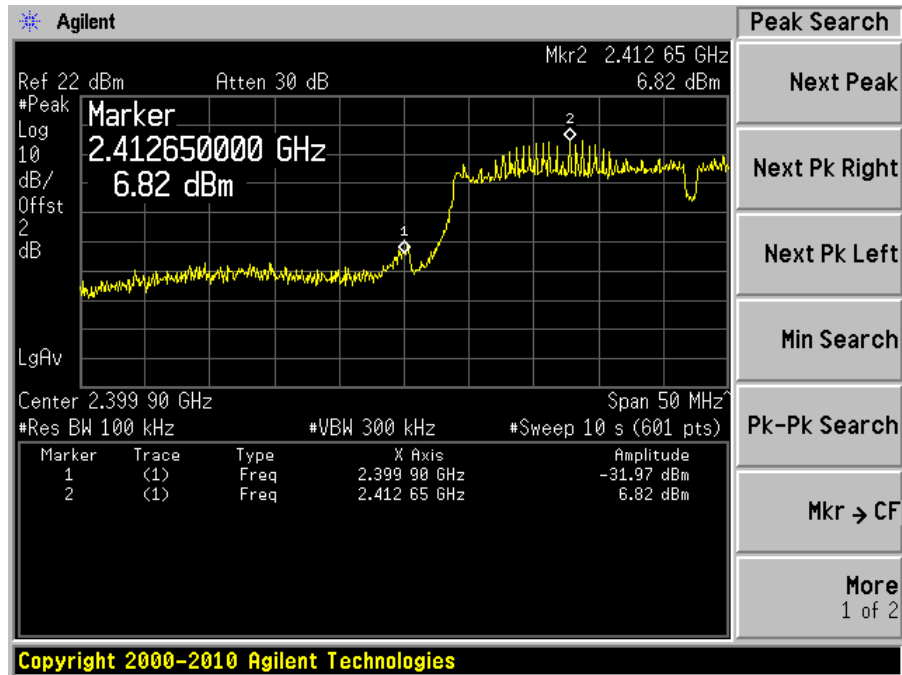
802.11 n20, Low Band Edge



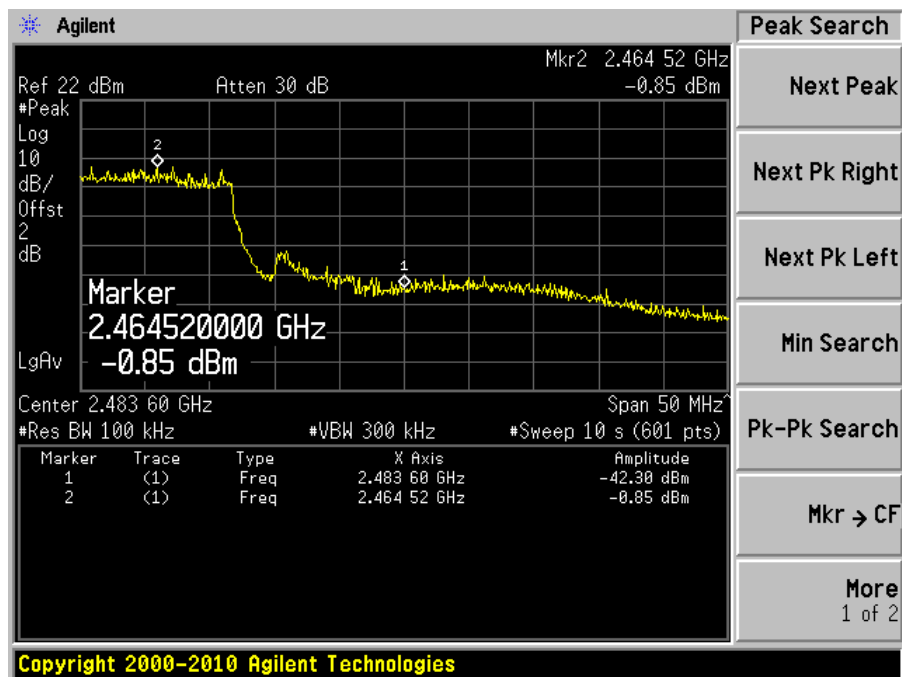
802.11 n20, High Band Edge



802.11 n40, Low Band Edge

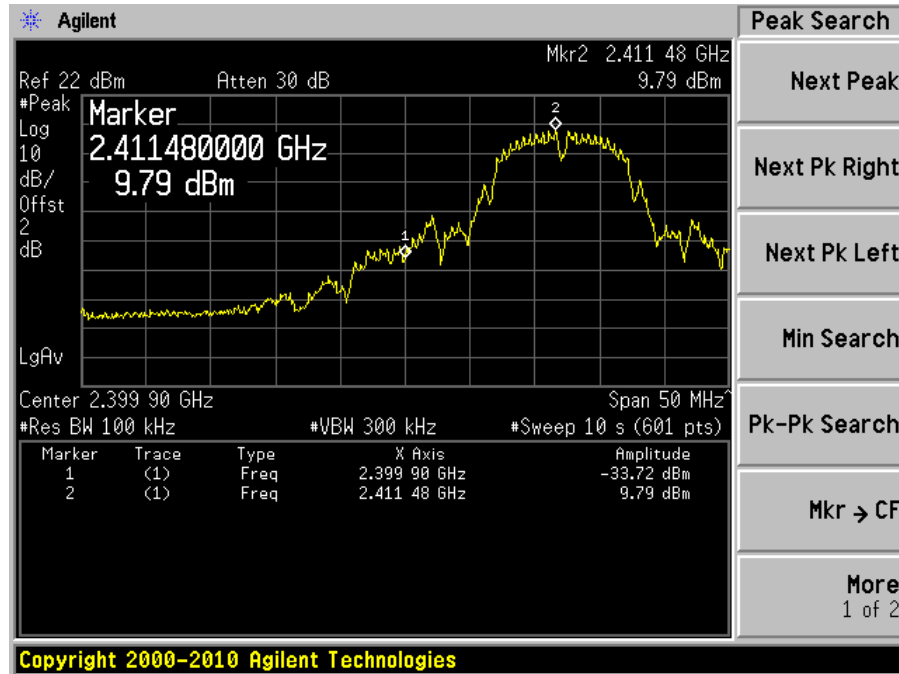


802.11 n40, High Band Edge

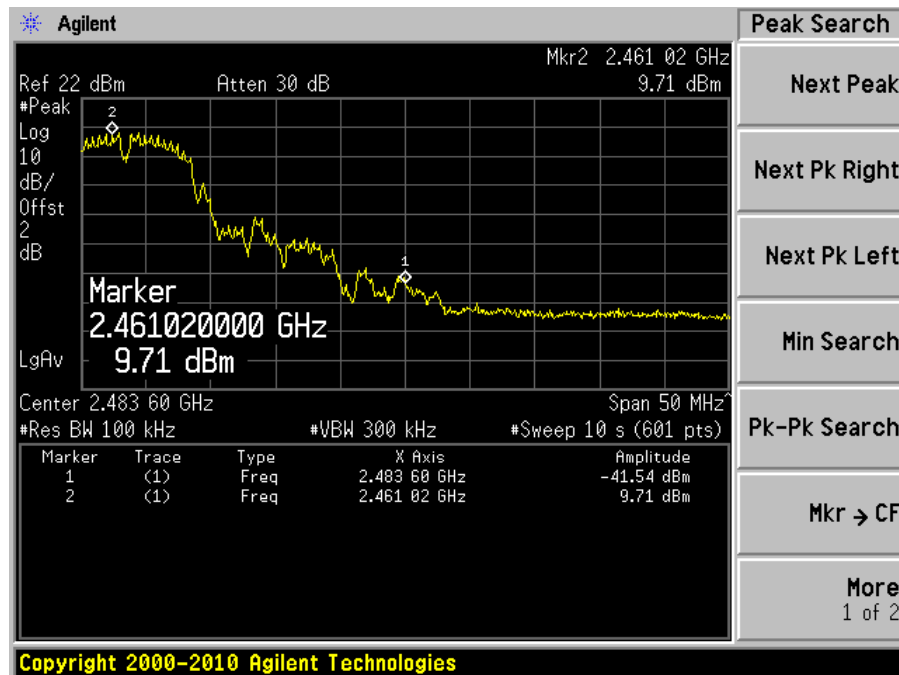


Antenna #1:

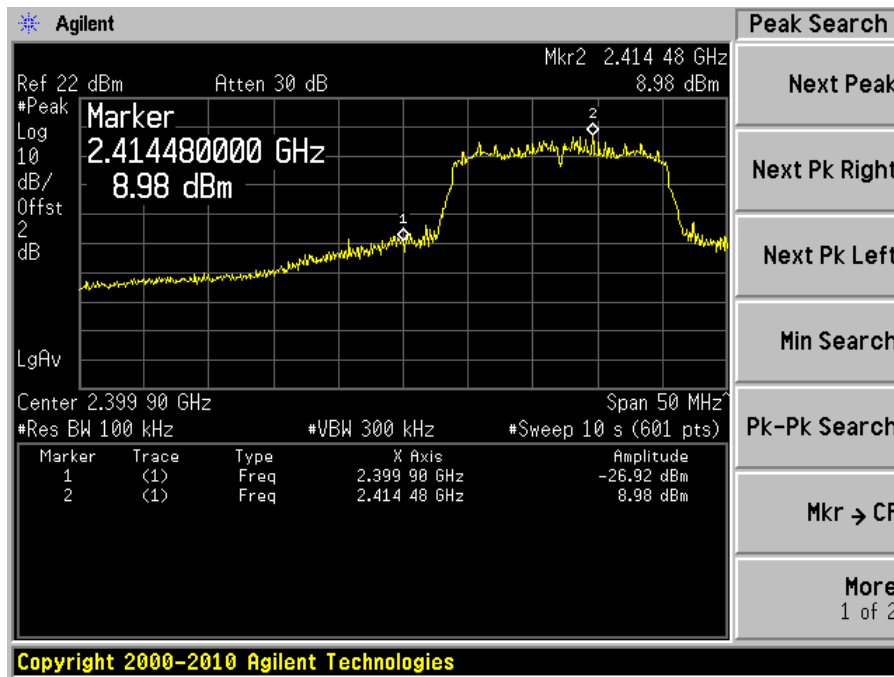
802.11b, Low Band Edge



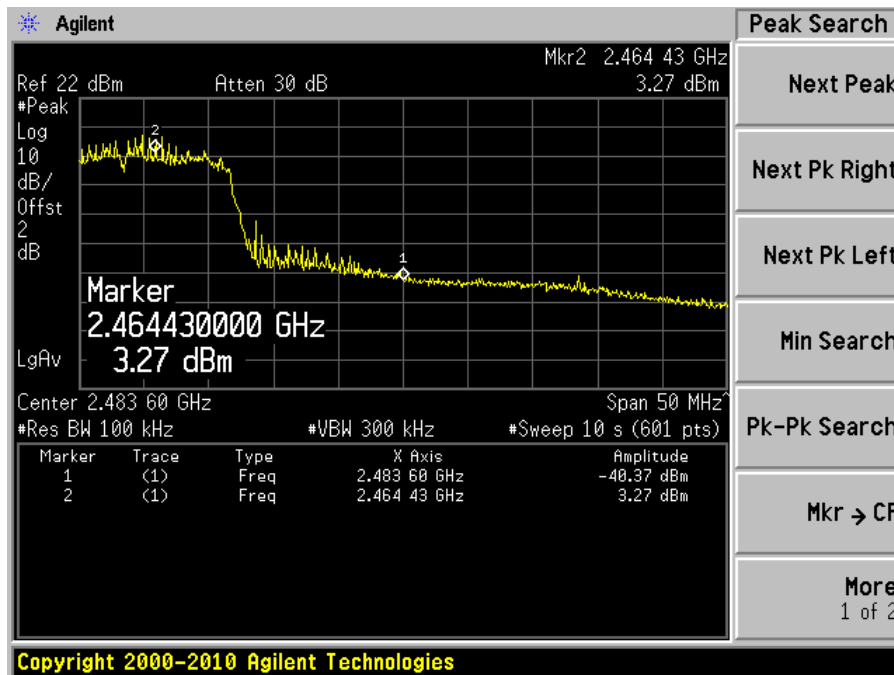
802.11b, High Band Edge



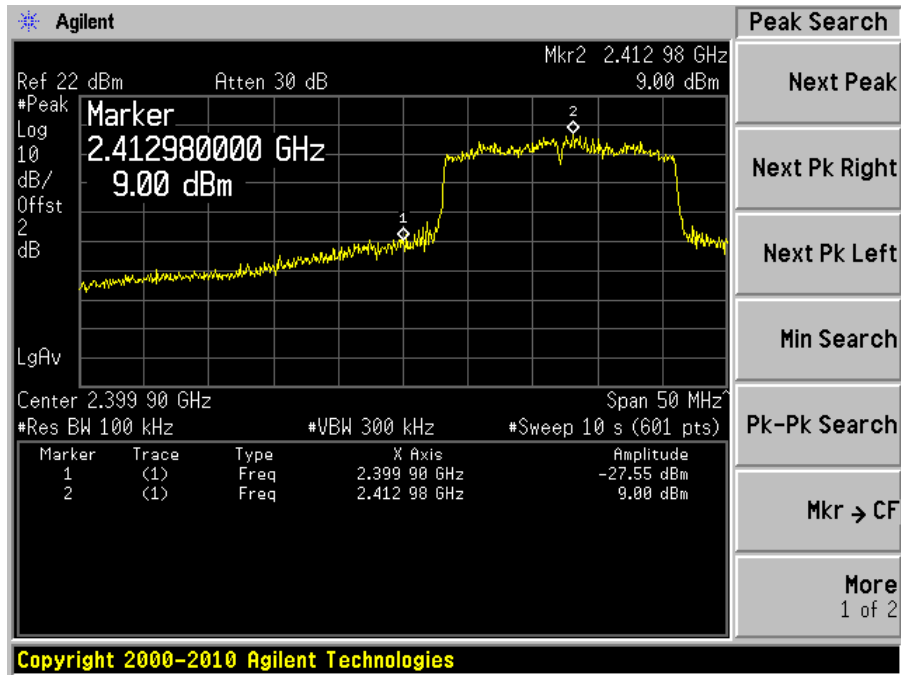
802.11g, Low Band Edge



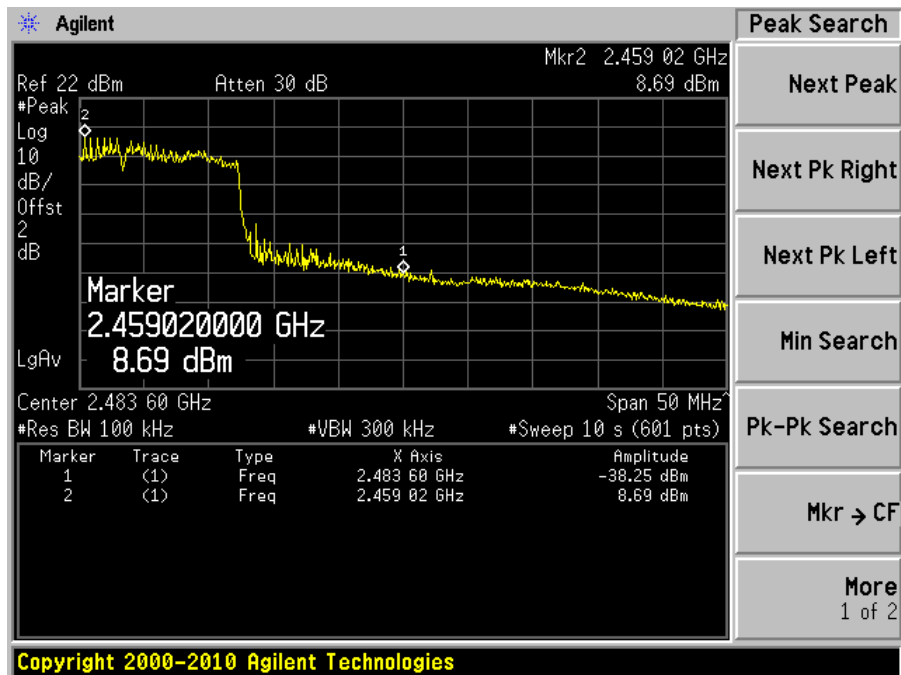
802.11g, High Band Edge



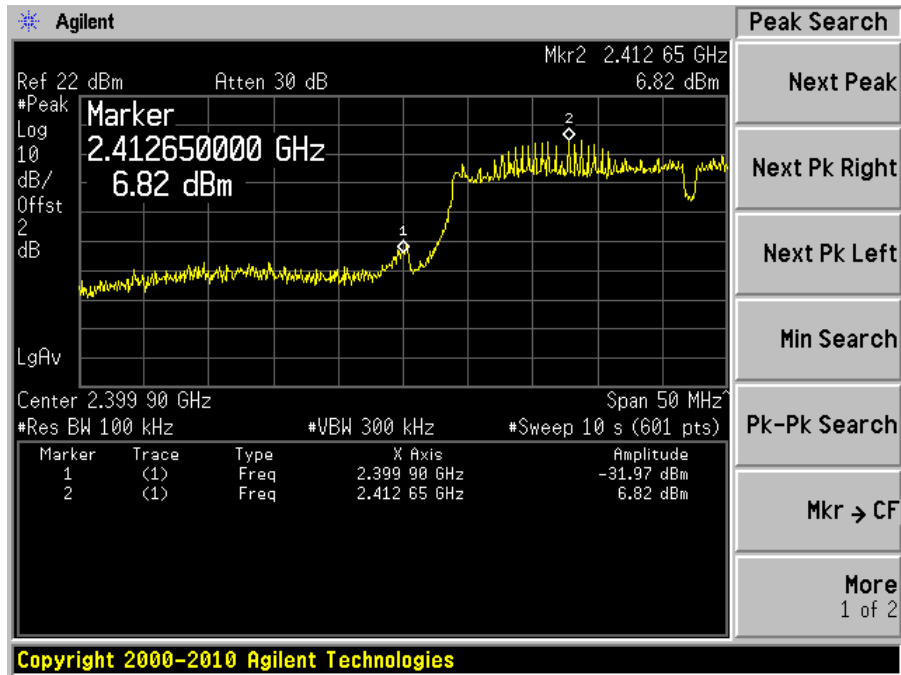
802.11 n20, Low Band Edge



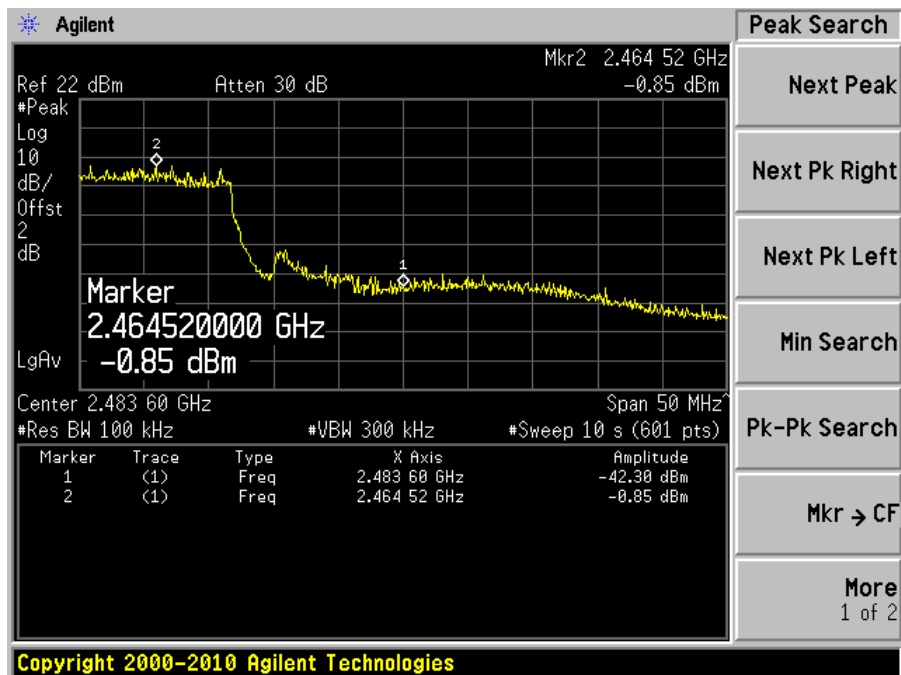
802.11 n20, High Band Edge



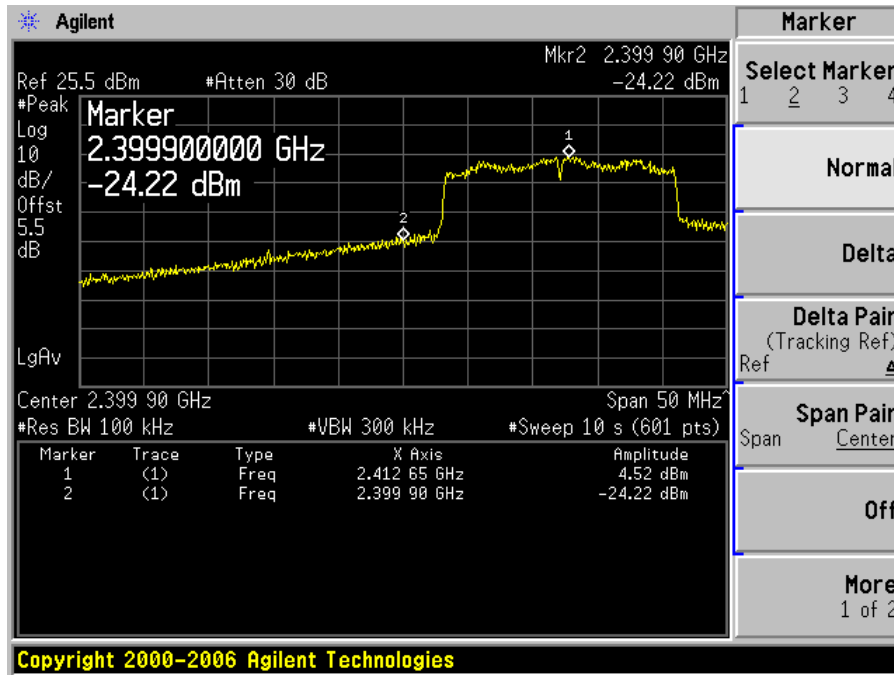
802.11 n40, Low Band Edge



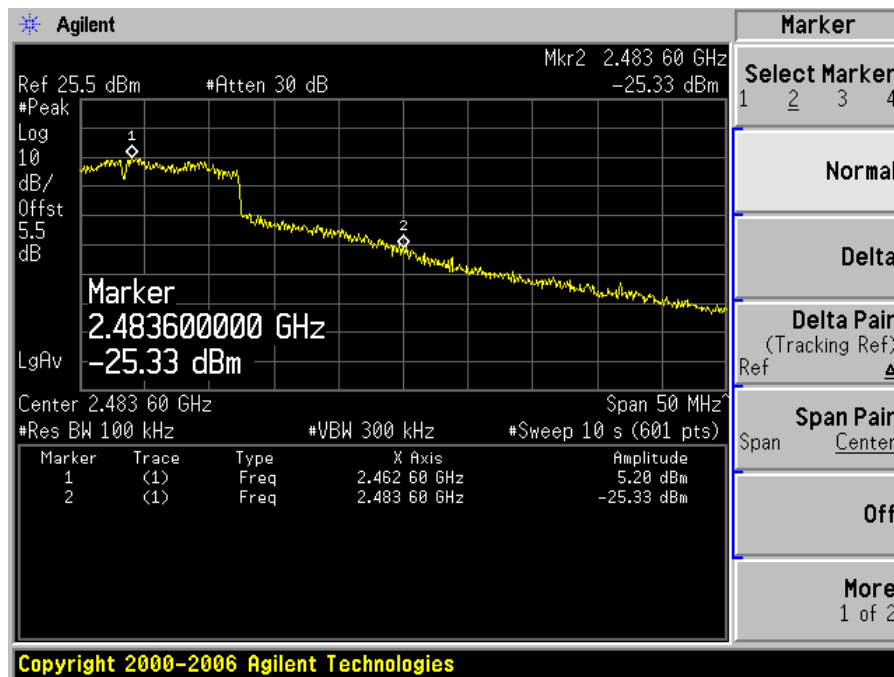
802.11 n40, High Band Edge



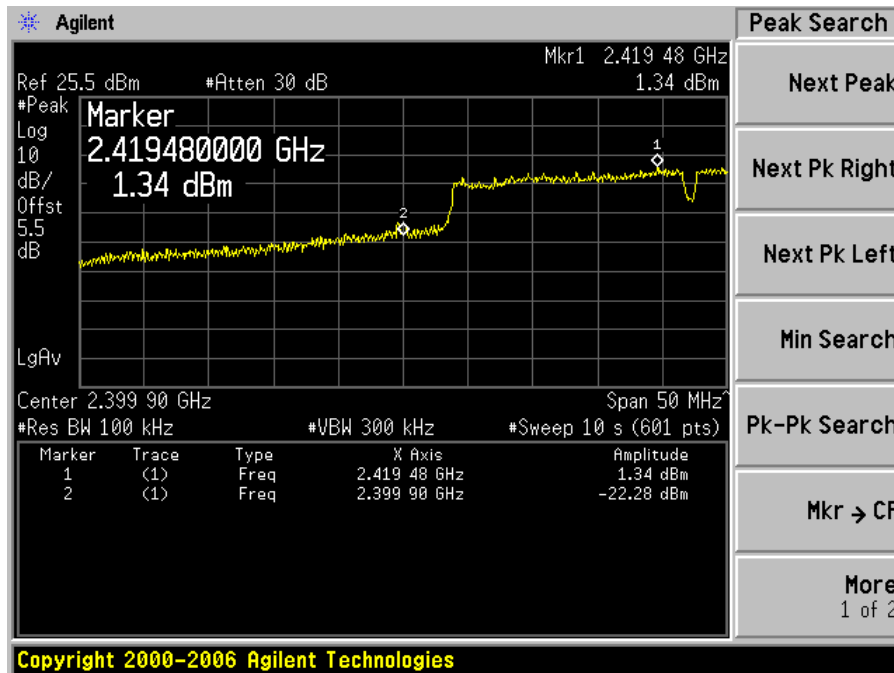
802.11 n20 (Antenna #0 + Antenna #1), Low Band Edge



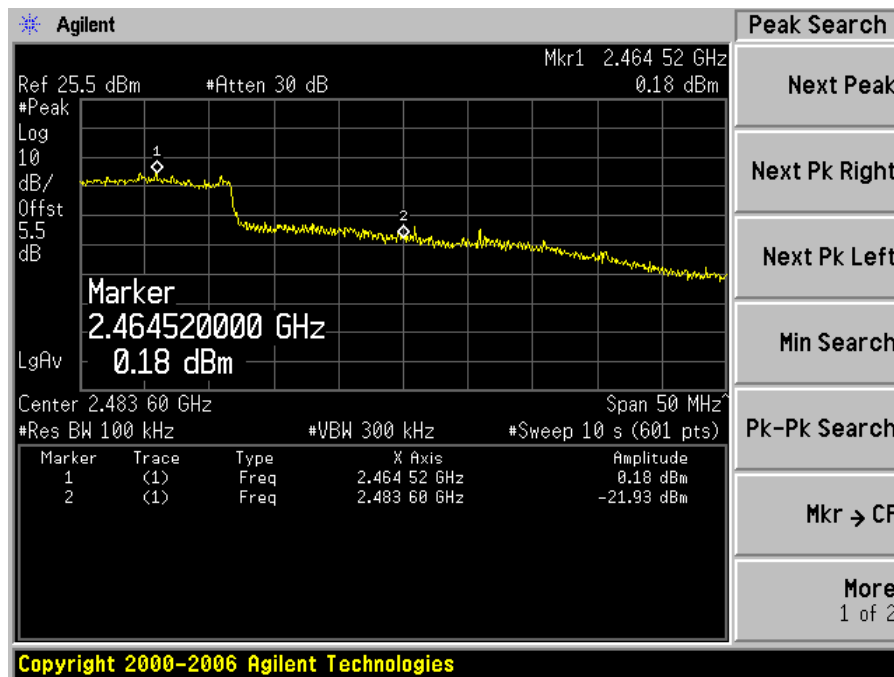
802.11 n20 (Antenna #0 + Antenna #1), High Band Edge



802.11 n40 (Antenna #0 + Antenna #1), Low Band Edge



802.11 n40 (Antenna #0 + Antenna #1), High Band Edge



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

10.1 Applicable Standard

According to FCC §15.247 (e) and IC 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.

10.2 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

* **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:	24°
Relative Humidity:	43 %
ATM Pressure:	101.2kPa

The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

Please refer to the following plots for detailed results

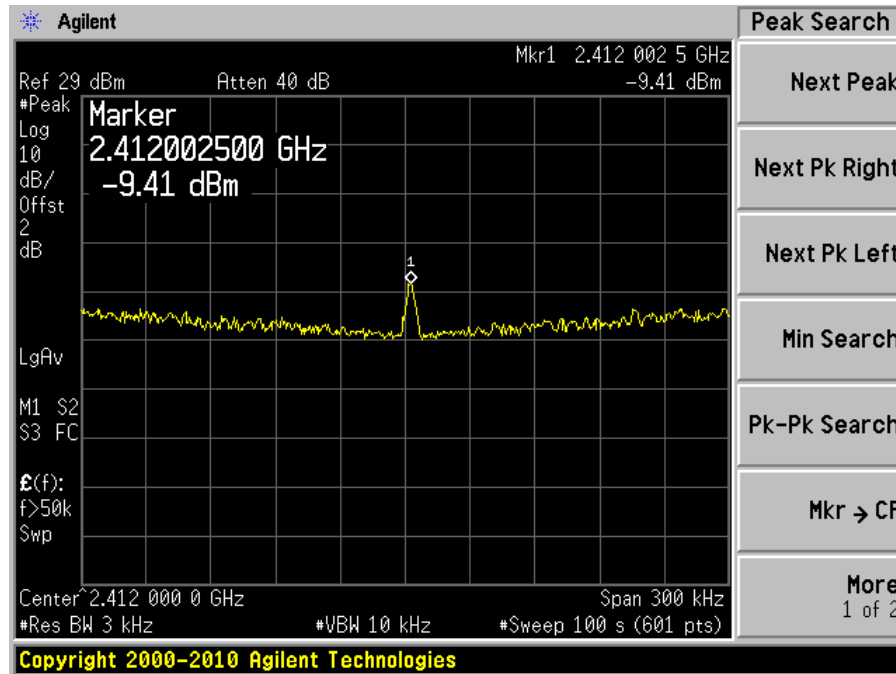
10.5 Test Results

Antenna	Radio Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm)	FCC/IC Limit (dBm)	Result
#0	802.11 b	Low	2412	-9.41	8	Compliance
		Mid	2437	-8.38	8	Compliance
		High	2462	-8.38	8	Compliance
	802.11 g	Low	2412	-7.99	8	Compliance
		Mid	2437	-3.8	8	Compliance
		High	2462	-7.46	8	Compliance
	802.11 n20	Low	2412	-11.94	8	Compliance
		Mid	2437	-10.30	8	Compliance
		High	2462	-9.46	8	Compliance
	802.11 n40	Low	2422	-6.20	8	Compliance
		Mid	2437	-22.90	8	Compliance
		High	2452	-21.18	8	Compliance
#1	802.11 b	Low	2412	-7.49	8	Compliance
		Mid	2437	-7.22	8	Compliance
		High	2462	-6.16	8	Compliance
	802.11 g	Low	2412	-8.13	8	Compliance
		Mid	2437	-8.07	8	Compliance
		High	2462	-6.68	8	Compliance
	802.11 n20	Low	2412	-7.90	8	Compliance
		Mid	2437	-8.07	8	Compliance
		High	2462	-8.43	8	Compliance
	802.11 n40	Low	2422	-7.46	8	Compliance
		Mid	2437	-24.15	8	Compliance
		High	2452	-22.17	8	Compliance
#0 + #1	802.11 n20	Low	2412	-17.83	8	Compliance
		Mid	2437	-17.76	8	Compliance
		High	2462	-16.88	8	Compliance
	802.11 n40	Low	2422	-14.68	8	Compliance
		Mid	2437	-15.01	8	Compliance
High	2452	-14.02	8	Compliance		

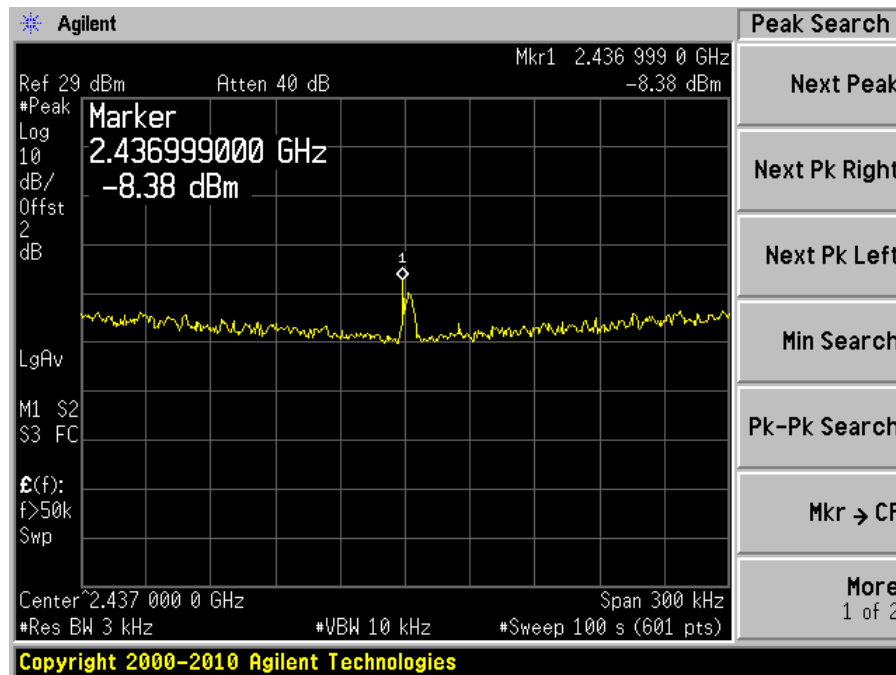
Please refer to the following plots for detailed test results

Antenna #0:

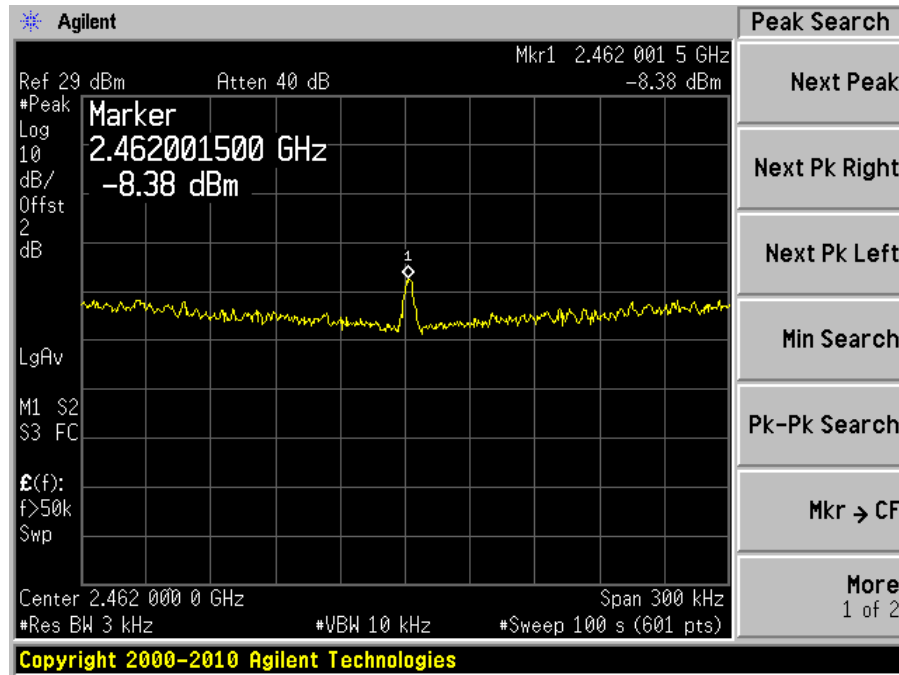
802.11 b, Low Channel 2412 MHz



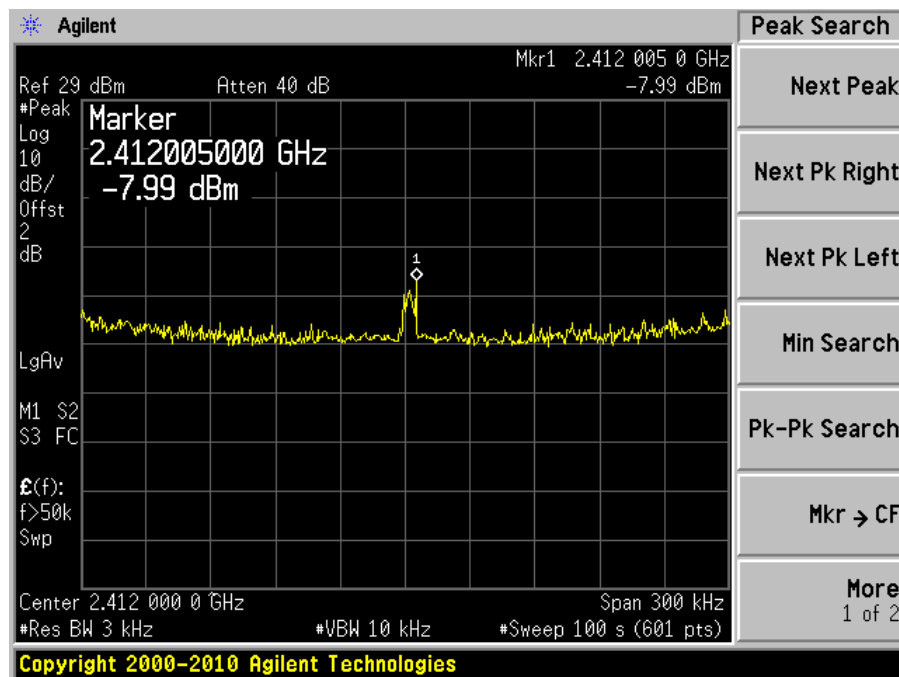
802.11 b, Middle Channel 2437 MHz



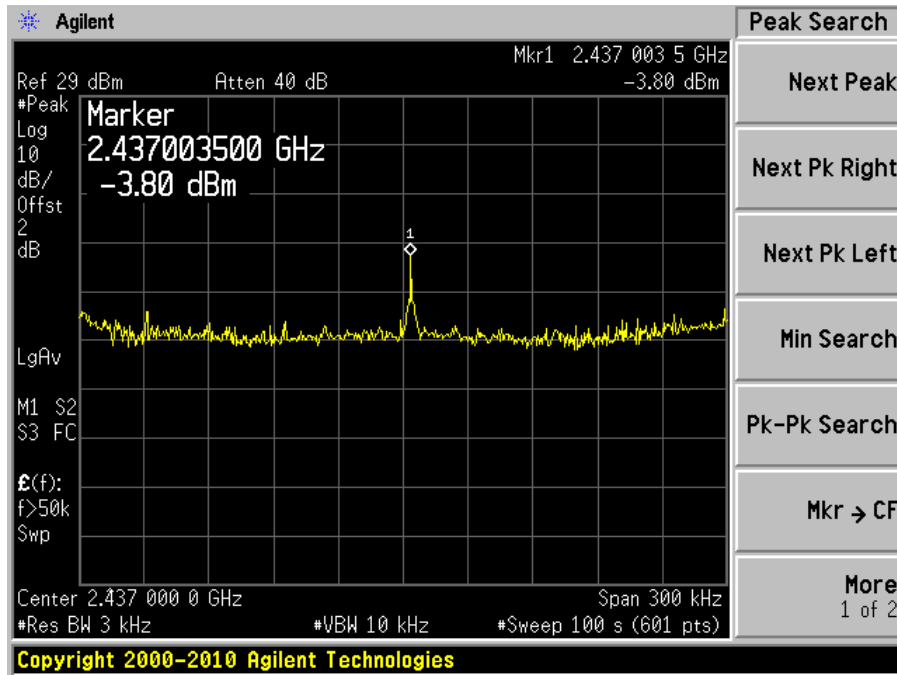
802.11 b, High Channel 2462 MHz



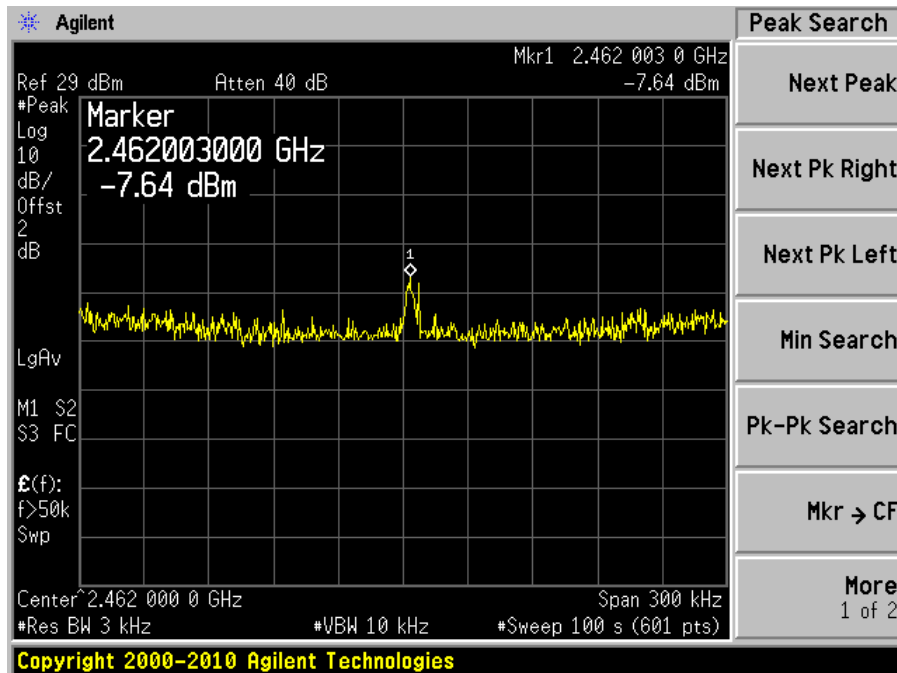
802.11 g, Low Channel 2412 MHz



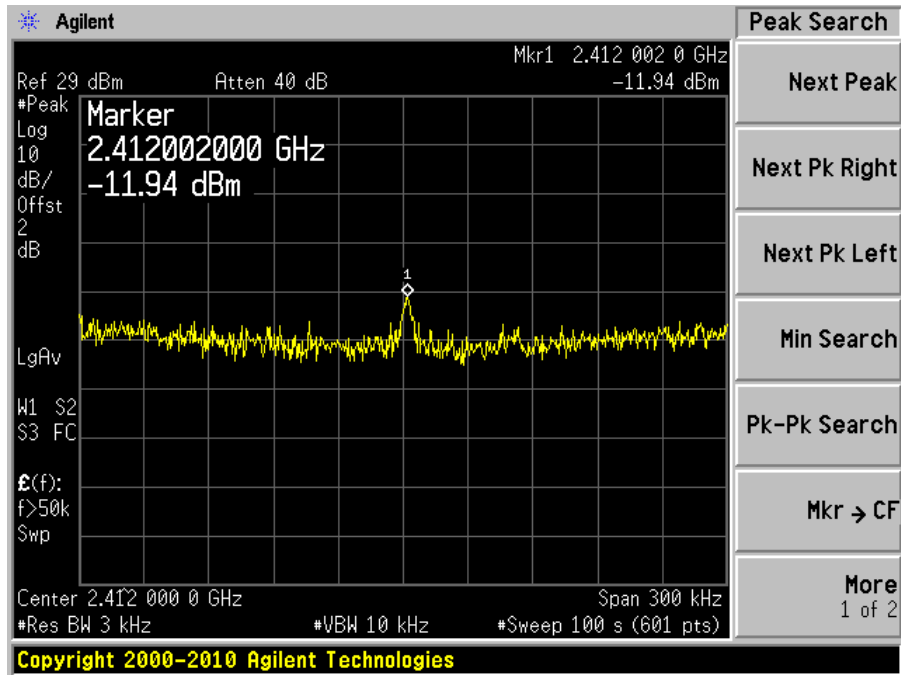
802.11 g, Middle Channel 2437 MHz



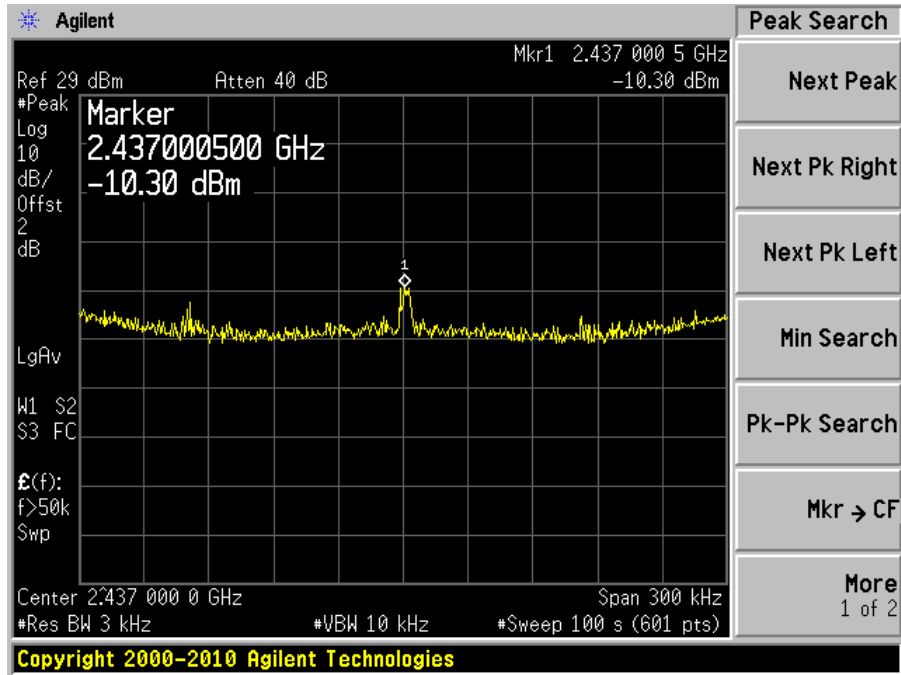
802.11 g, High Channel 2462 MHz



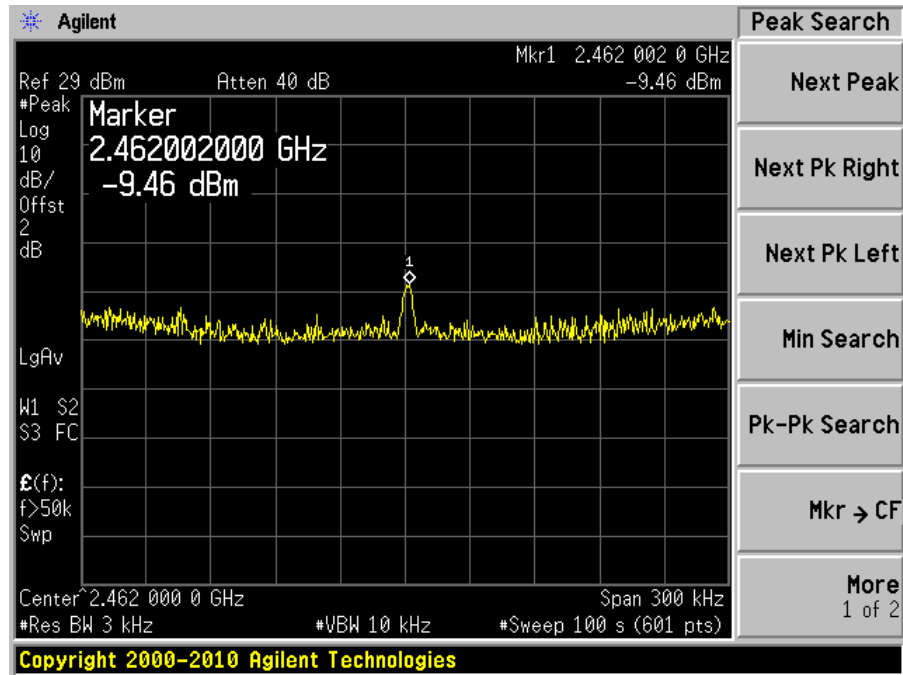
802.11 n20, Low Channel 2412 MHz



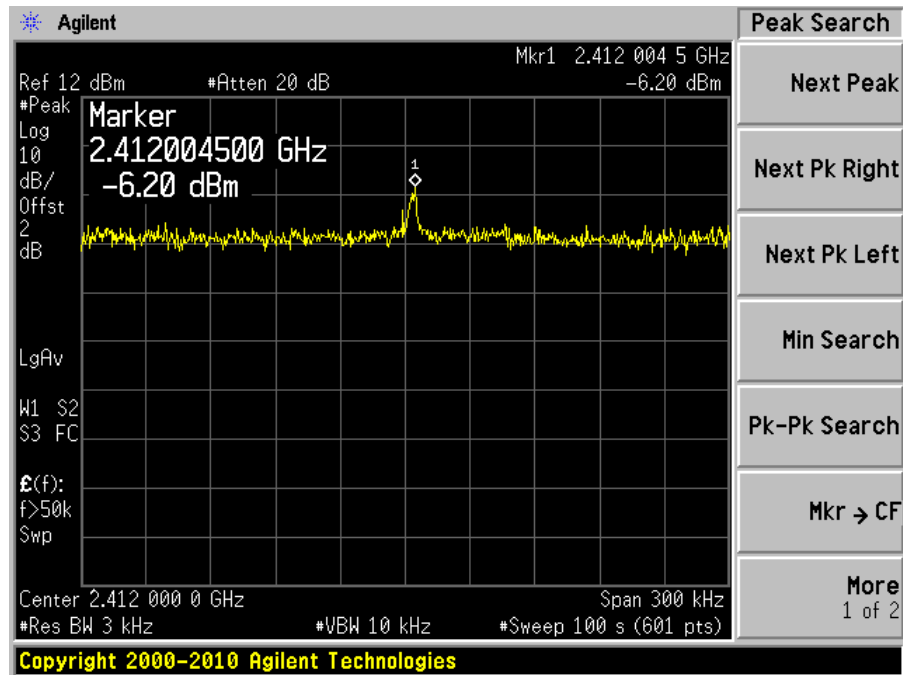
802.11 n20, Middle Channel 2437 MHz



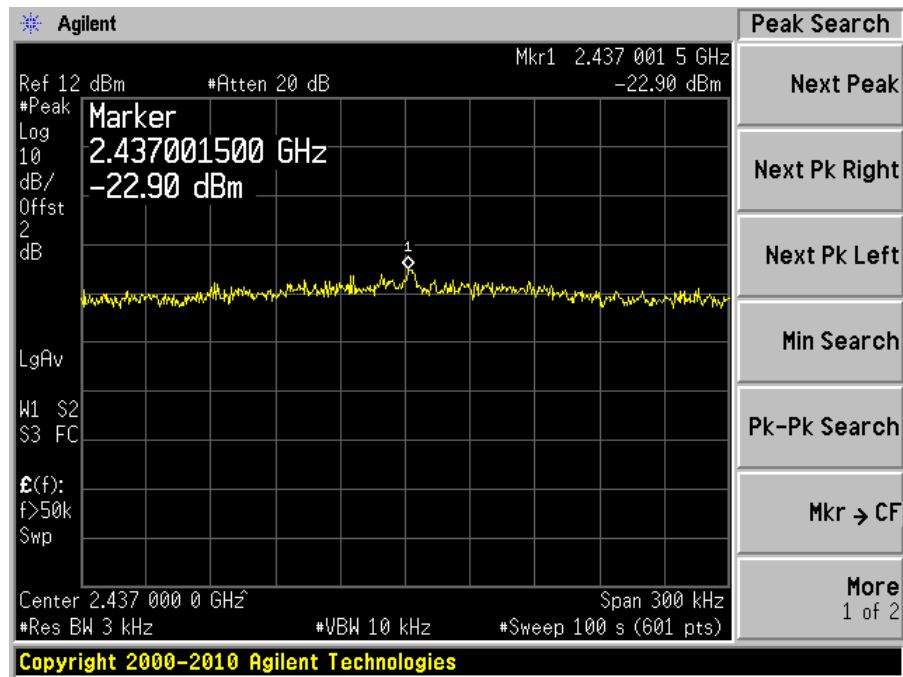
802.11 n20, High Channel 2462 MHz



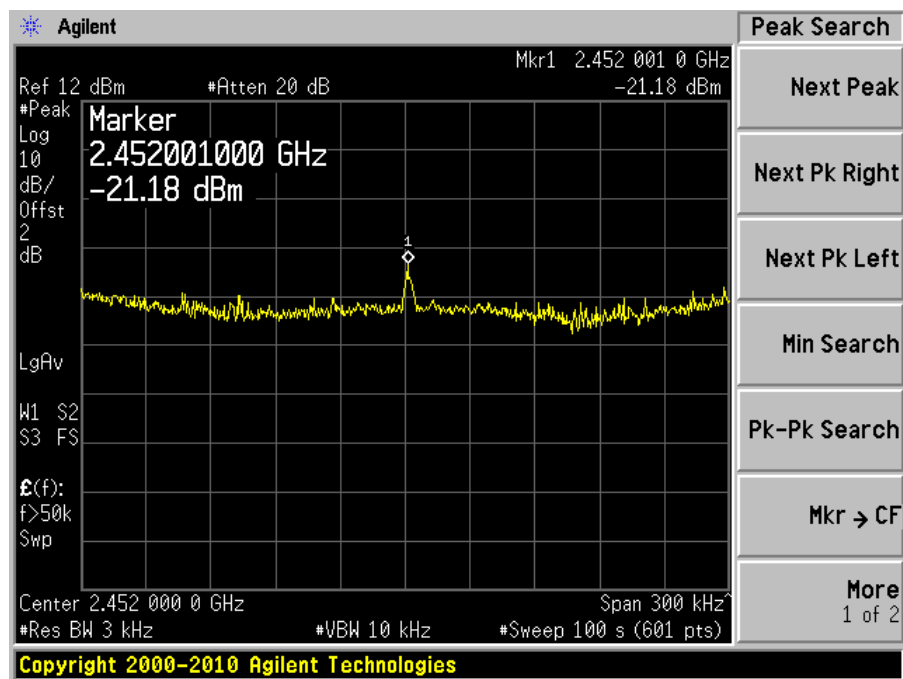
802.11 n40, Low Channel 2422 MHz



802.11 n40, Middle Channel 2437 MHz

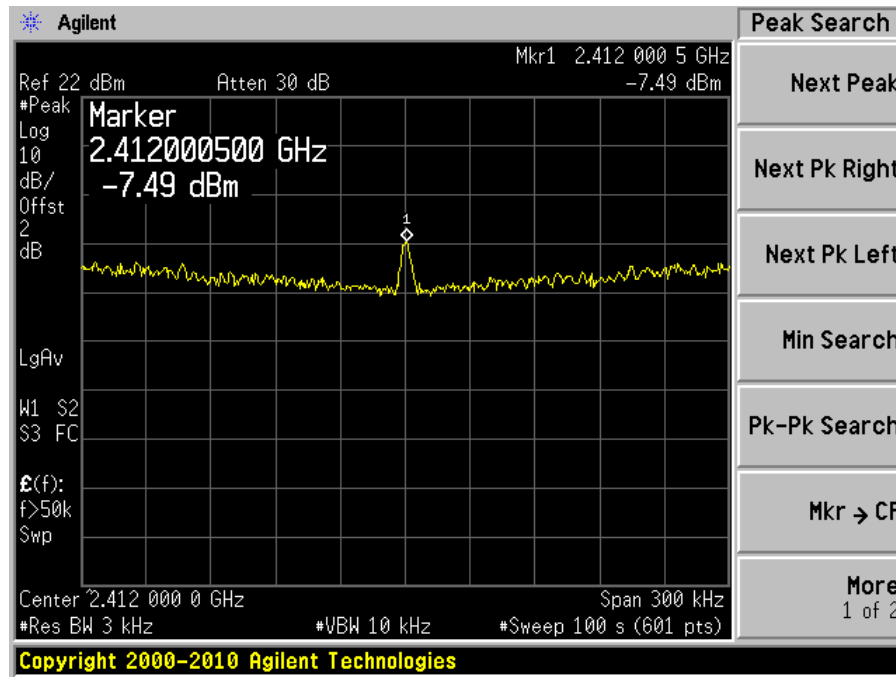


802.11 n40, High Channel 2452 MHz

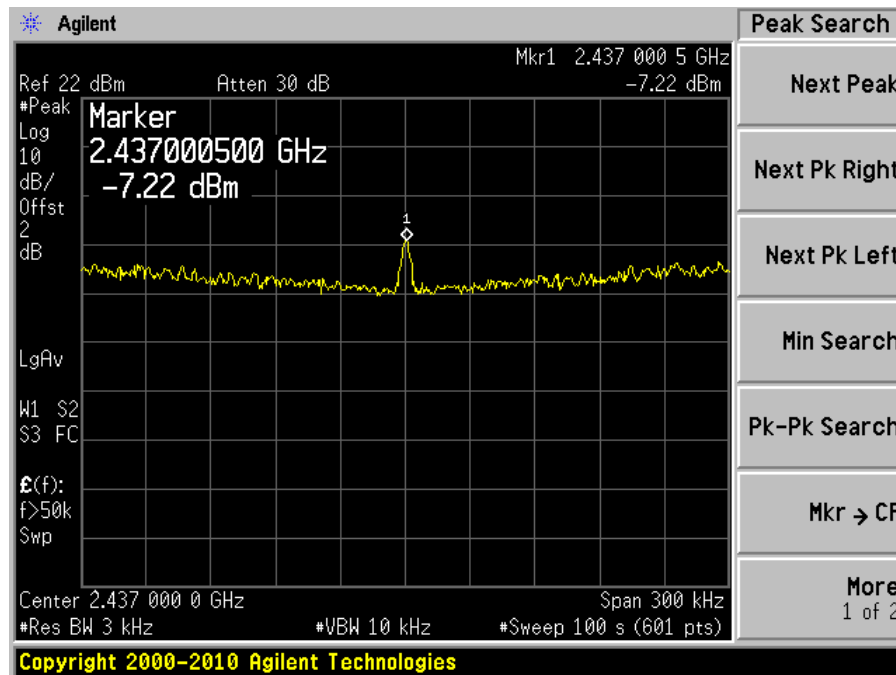


Antenna #1:

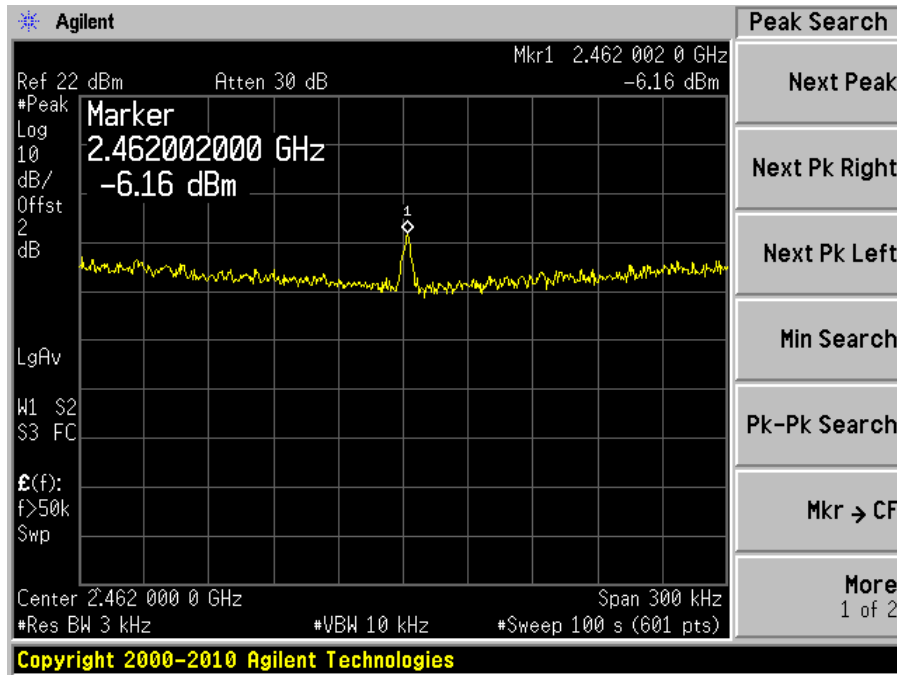
802.11 b, Low Channel 2412 MHz



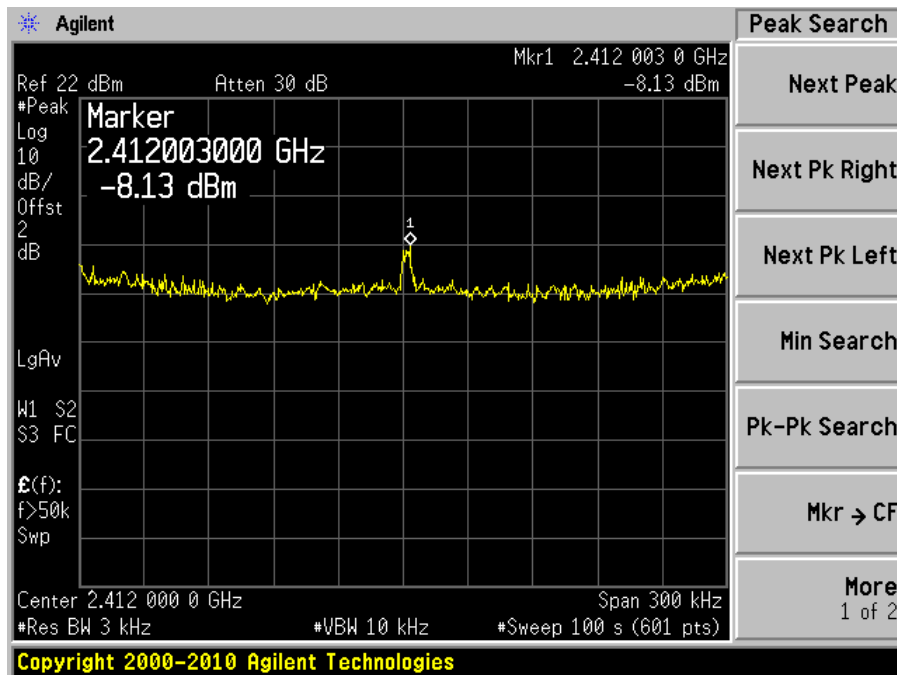
802.11 b, Middle Channel 2437 MHz



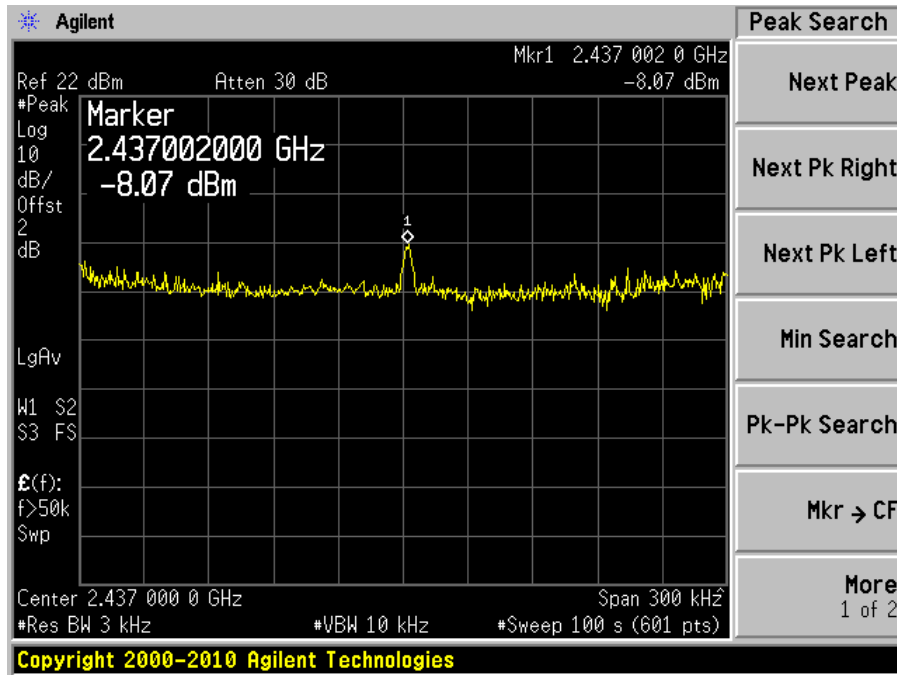
802.11 b, High Channel 2462 MHz



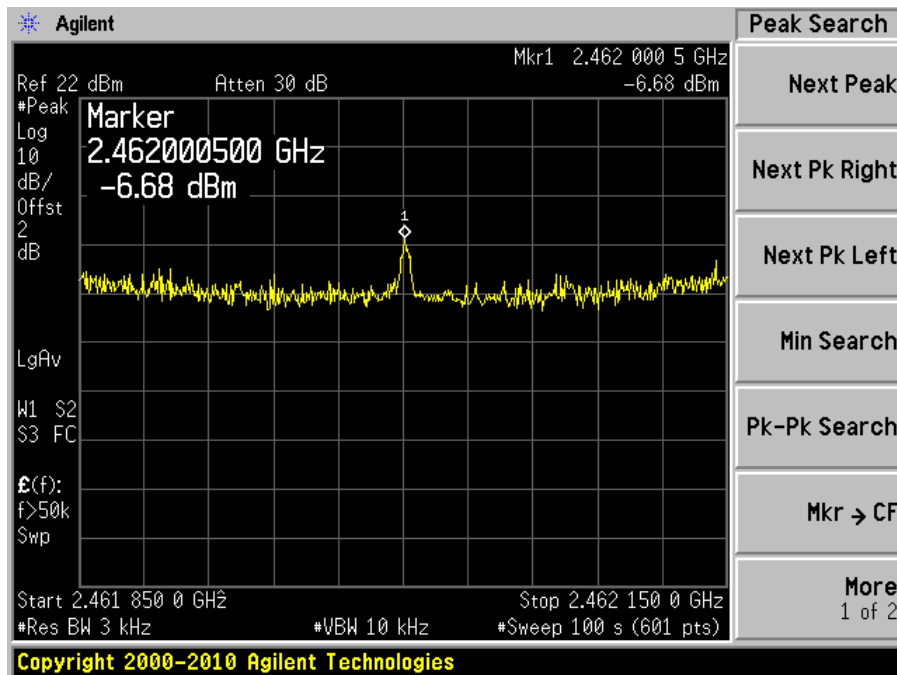
802.11 g, Low Channel 2412 MHz



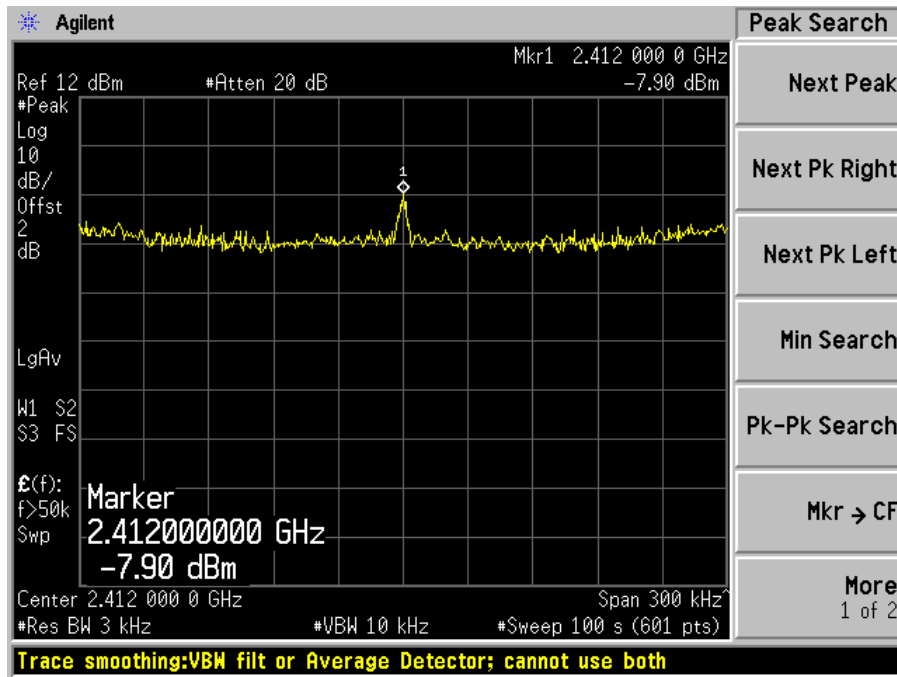
802.11 g, Middle Channel 2437 MHz



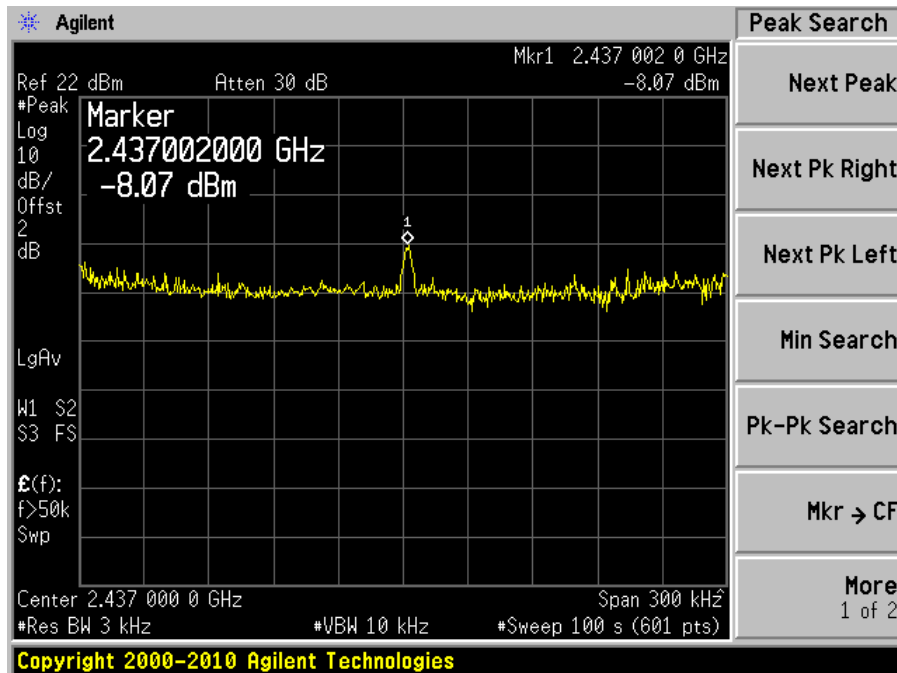
802.11 g, High Channel 2462 MHz



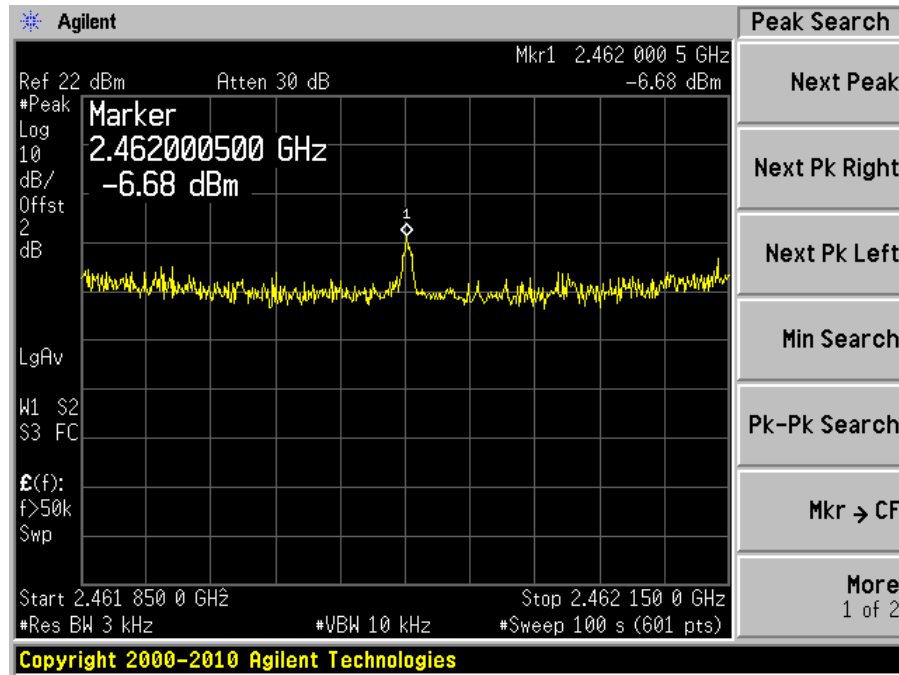
802.11 n20, Low Channel 2412 MHz



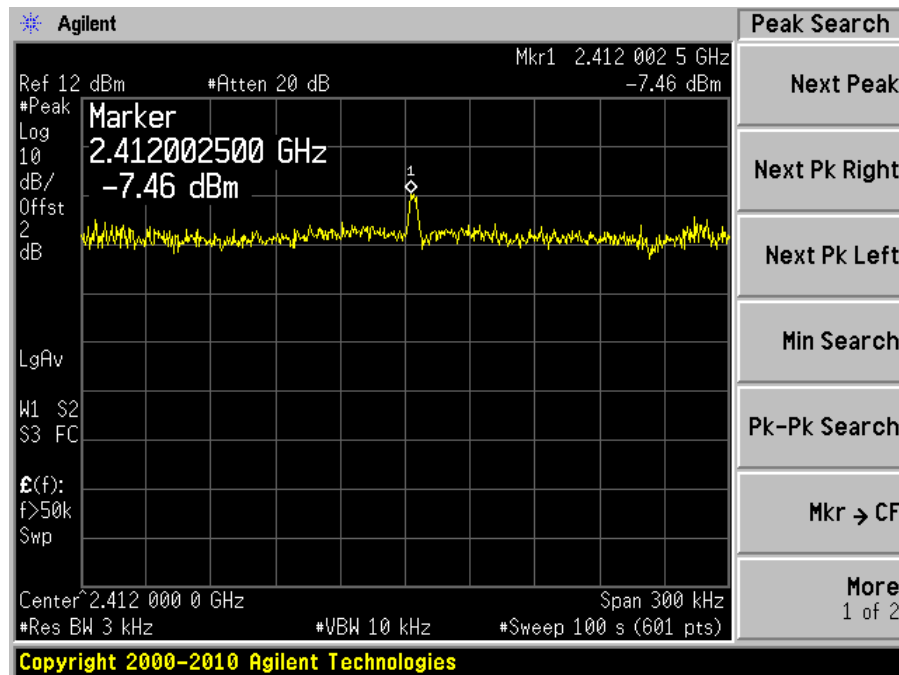
802.11 n20, Middle Channel 2437 MHz



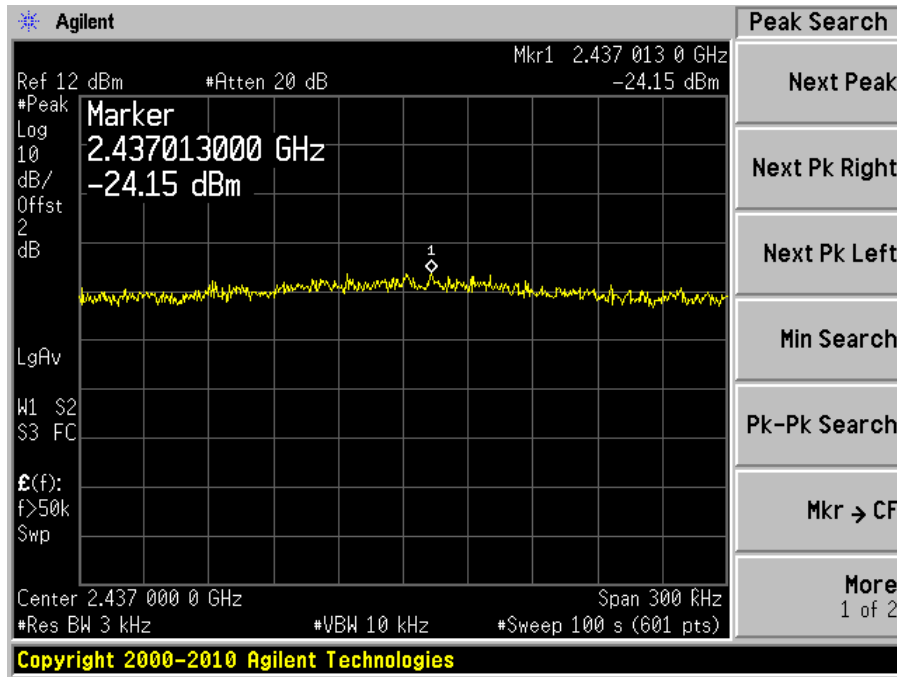
802.11 n20, High Channel 2462 MHz



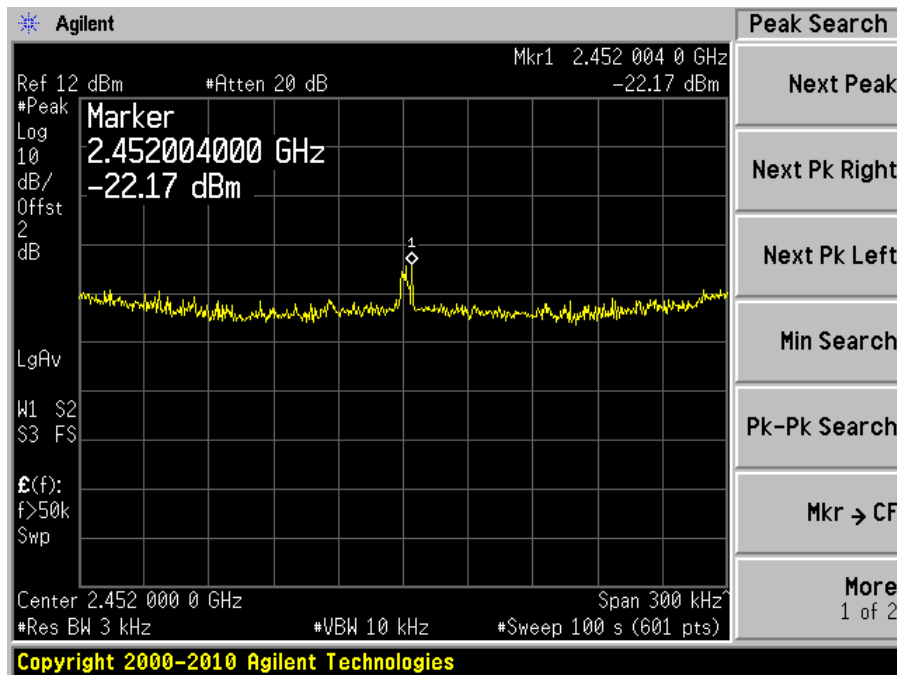
802.11 n40, Low Channel 2422 MHz



802.11 n40, Middle Channel 2437 MHz

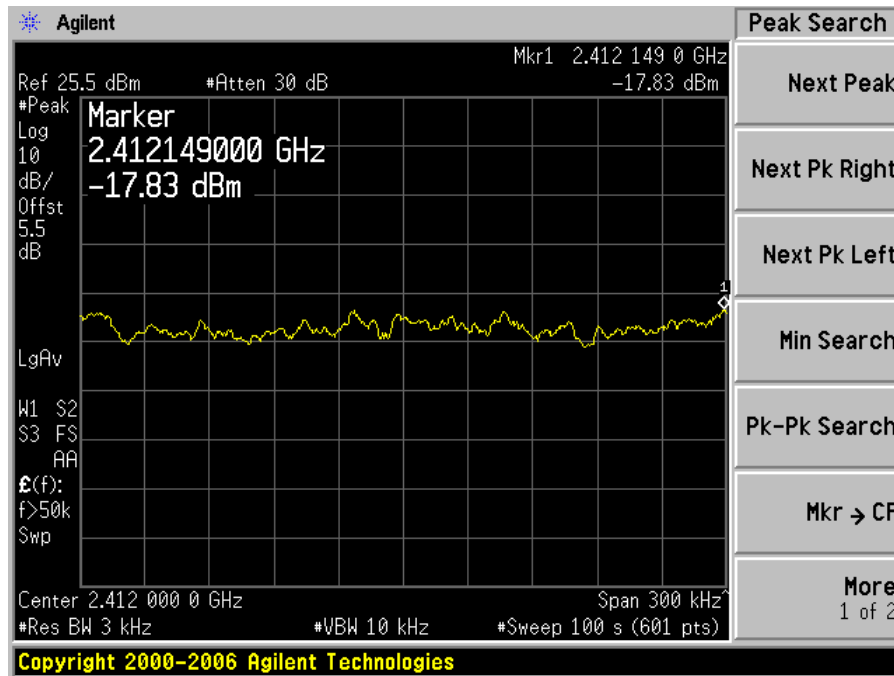


802.11 n40, High Channel 2452 MHz

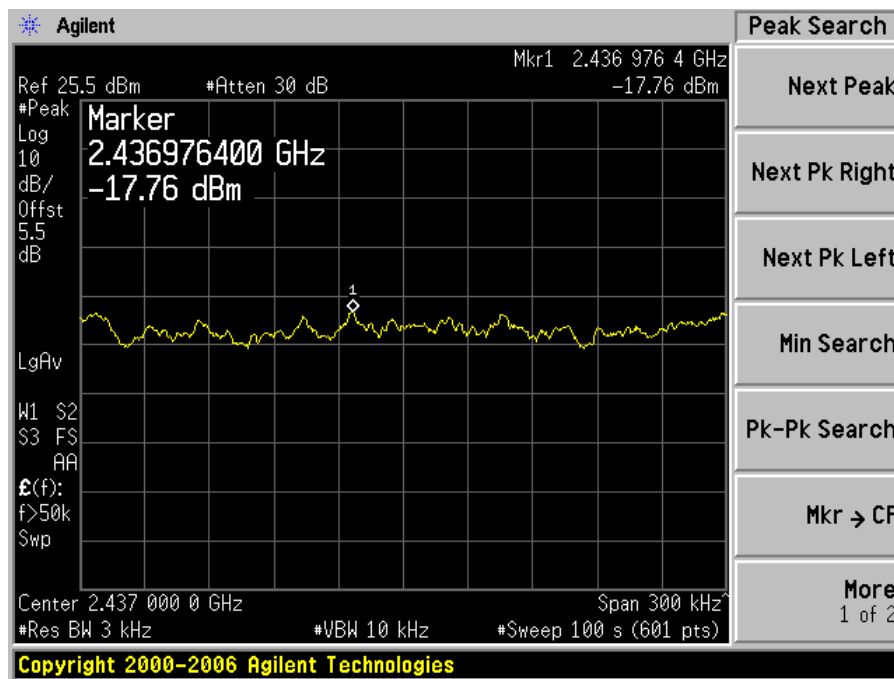


Antenna #0 + Antenna #1:

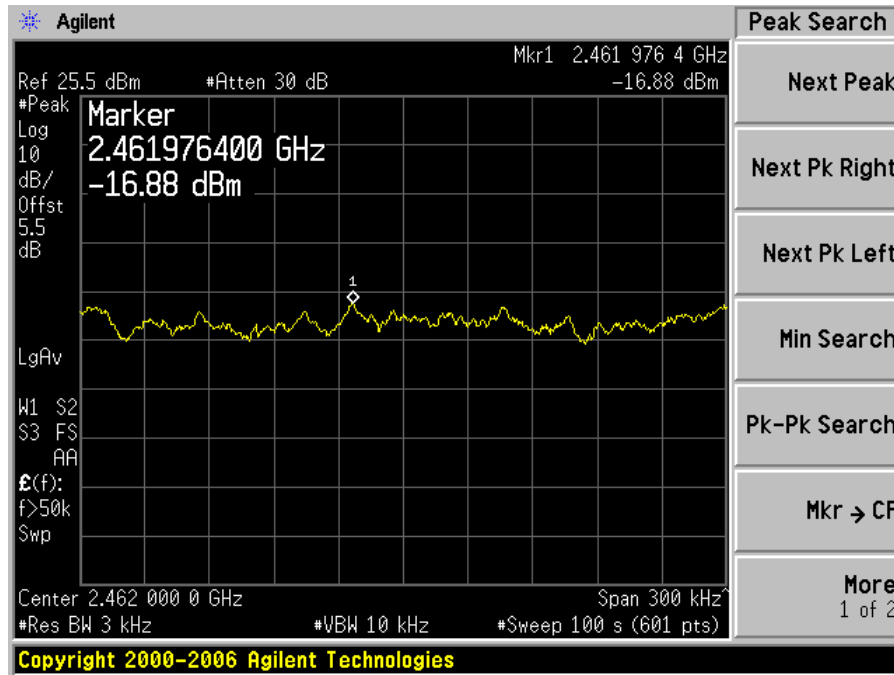
802.11 n20, Low Channel 2412 MHz



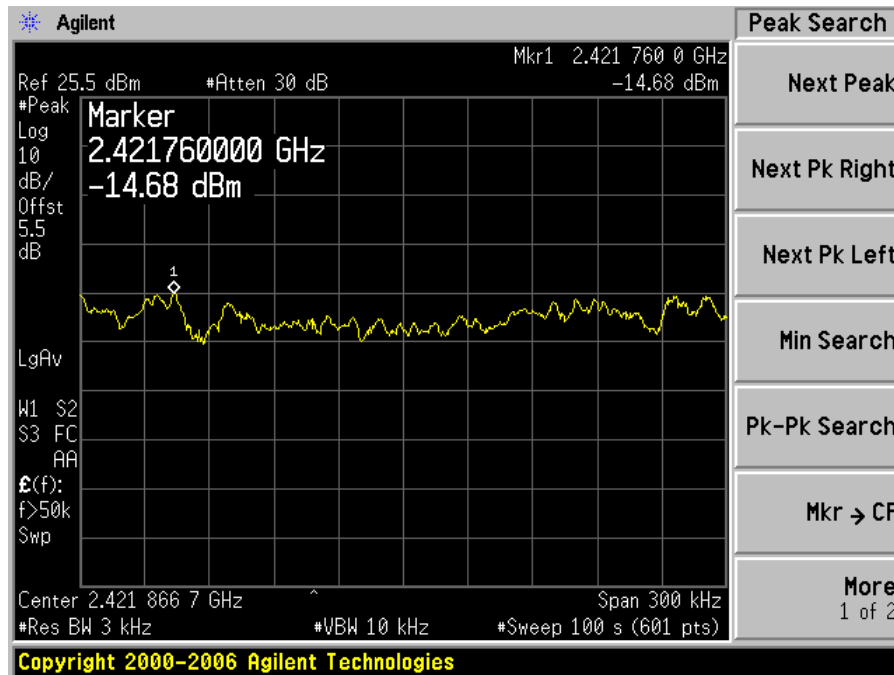
802.11 n20, Middle Channel 2437 MHz



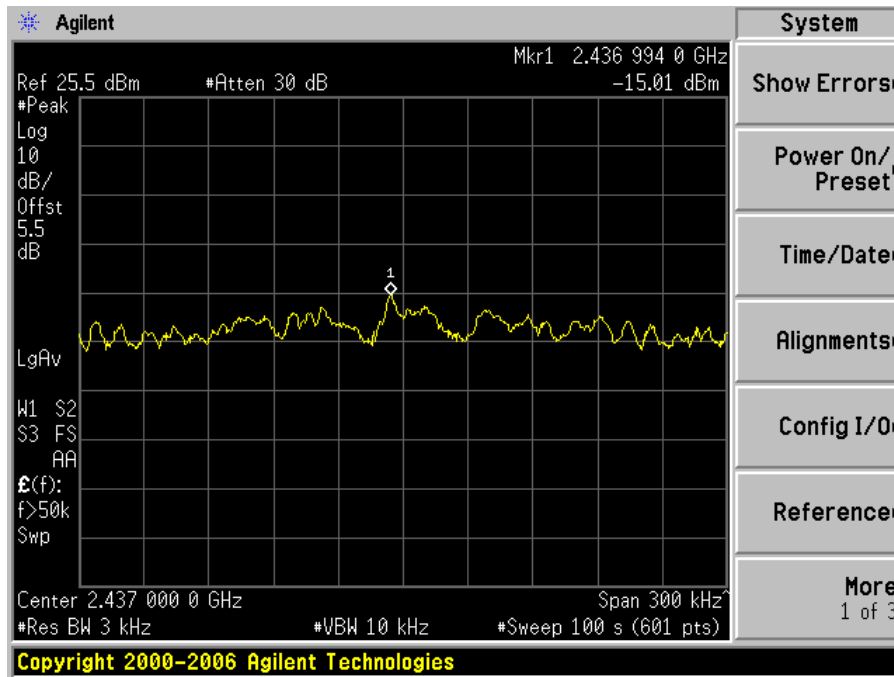
802.11 n20, High Channel 2462 MHz



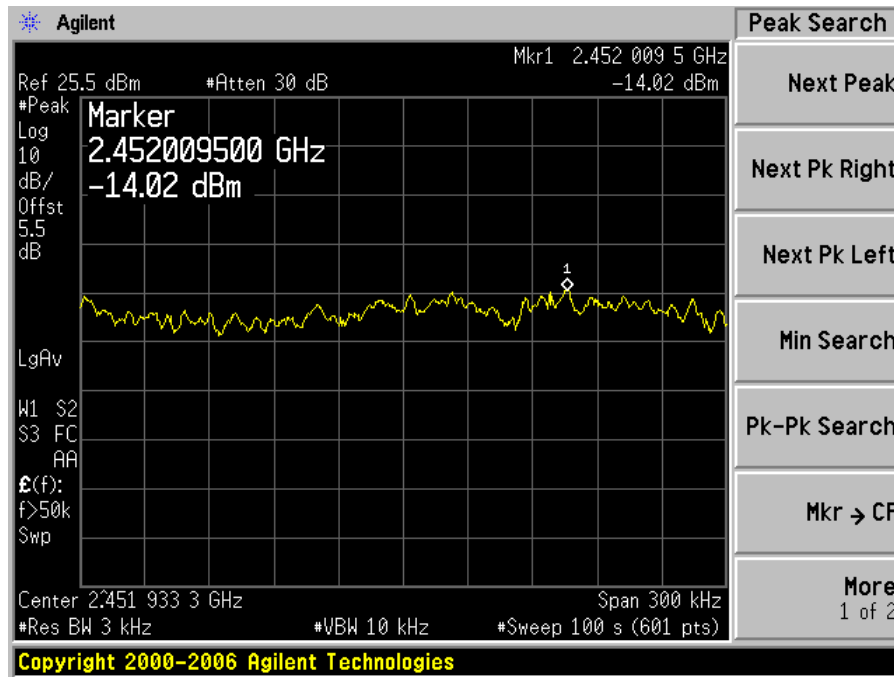
802.11 n40, Low Channel 2422 MHz



802.11 n40, Middle Channel 2437 MHz



802.11 n40, Middle Channel 2452 MHz



11 IC RSS-Gen §4.10 & RSS-210 §2.6 - Receiver Spurious Emissions

11.1 Applicable Standard

According to IC RSS-Gen §4.10, The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

According to 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.

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:

$$\text{Corrected Amplitude} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

11.5 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09
HP	Pre-Amplifier	8449B	3147A00400	2010-02-01
A.R.A.	Antenna, Horn	DRG-118/A	1132	2009-10-27
Sunol Science Corp.	Combination Antenna	JB1 Antenna	A103105-3	2010-05-28
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2010-06-24
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2010-05-09

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

11.6 Test Environmental Conditions

Temperature:	24°
Relative Humidity:	43 %
ATM Pressure:	101.2kPa

The testing was performed by Jerry Huang on 2010-07-29 in RF Site.

11.7 Test Results

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

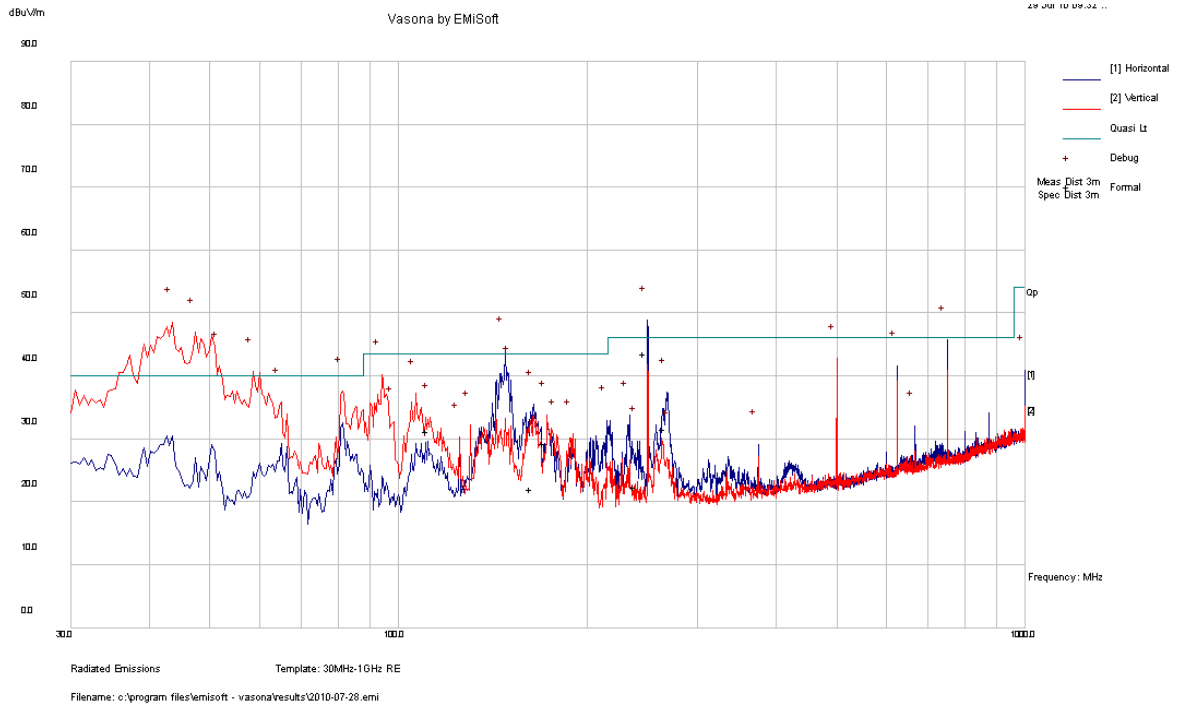
Receiving Mode:

Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Range
-13.14	44.70168	Vertical	30 MHz to 1 GHz
-	-	-	Above 1 GHz ¹

¹**Note:** All above 1 GHz emission levels are at the noise floor and/or more than 20 dB below the limit.

Please refer to the following plot and data:

11.8 Radiated Emissions Test Plots and Data



1) 30 MHz – 1 GHz

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
249.9419	43.51	120	H	265	46.00	-2.49
112.258	31.26	98	V	3	43.50	-12.24
172.8091	29.24	99	V	77	43.50	-14.26
268.1751	31.54	98	H	79	46.00	-14.46
164.4648	22.07	282	H	95	43.50	-21.43
240.5985	22.44	202	H	96	46.00	-23.56

2) Above 1 GHz (Middle Channel measured at 3 meters)

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)	
-	-	-	-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	1

¹Note: All emission levels are at the noise floor and/or more then 20 dB below the limit.

12 FCC §15.247(i), § 2.1093 & IC RSS-102 - RF Exposure Information

12.1 Applicable Standards

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

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

According to IC 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 (Note 1)	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 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000 / f ^{1.2}

Note: f is frequency in MHz

Note 1 = Power density limit is applicable at frequencies greater than 100 MHz

12.2 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

12.3 MPE Results

Mode	Frequency Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mw/cm ²)	Power Density Limit (mw/cm ²)	Result
WLAN	2.4 GHz	20	17.64	2.0	0.018	1.0	Compliance

The predicted power density level at 20 cm is 0.018 mw/cm² which is below the uncontrolled exposure limit of 1.0 mW/cm². 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.