Lab Code: 200167-0

FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

Actiontec Electronics, Inc.

760 N. Mary Avenue,

Sunnyvale, CA 94085, USA

FCC ID: LNQPK5001A
Model: PK5001A

Report Type:	**Product Type:**
Original Report	Wireless 11n ADSL2 + Modem Gateway

Test Engineers:	Wei Sun
Report Number:	R1202032-247
Report Date:	2012-05-01
Reviewed By:	Victor Zhang EMC/RF Lead
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1202032-247	Origin Report	2012-05-01

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Actiontec Electronics, Inc.,* and their product model: *PK5001A*, FCC ID: LNQPK5001A which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a Wireless 11n ADSL2+Modem Gateway operates in 2.4 GHz ISM band.

The EUT has two series with different transformer:
1. with transformer: Midcom Model: 52237. Here after mentioned as MDC in this report.
2. with transformer: LinkCom Model: LAL2618. Here after mentioned as LKC in this report.
Please refer to the DOS for more detail information.

1.2 Mechanical Description of EUT

The "EUT" measures 17cm (L) x 12.7cm (W) x 3 cm (H), and weighs approximately 273 g.

The test data gathered are from typical production sample, MDC S/N: CPBA2091300025 and LKC S/N: CPBA2091300012*, provided by the manufacturer.*

1.3 Objective

This report is prepared on behalf of *Actiontec Electronics, Inc.* in accordance with Part 15, Subparts B and C of the Federal Communication Commissions rules.

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

1.4 Related Submittal(s)/Grant(s)

NA

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 $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

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

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

1.7 Test Facility

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

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

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

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

2 System Test Configuration

2.1 Justification

The EUT and its host were configured for testing according to ANSI C63.4-2003 & ANSI C63.10-2009.

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

2.2 EUT Exercise Software

Software: DUT GUI

The EUT had been tested with the following data rate settings:

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	2412/6.5	2437/6.5	2462/6.5

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

N/A

2.5 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
Actiontec Electronics, Inc.	I.T.E. Power Supply	MT12-Y120100-A1	-

2.6 EUT Internal Configuration Details

MDC

Manufacturer	Description	Model	Serial Number
Actiontec Electronics, Inc.	Main Board	PK5001A	CPBA2091300025

LKC

Manufacturer	Description	Model	Serial Number
Actiontec Electronics, Inc.	Main Board	PK5001A	CPBA2091300012

2.7 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
RJ 11 Loop Cable	< 1 m	EUT	EUT
RJ45 Loop Cable	< 1 m	EUT	EUT
RJ45 Cable	> 5 m	Laptop	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

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

Note: All test result is base on the MDC unit, the alternate transformer does not effect the RF part and RF performance, and the digital portion result was reported in the different report under FCC part 15B.

4 FCC §15.247(i) & §2.1091 - RF Exposure Information

4.1 Applicable Standard

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

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

Limits for General Population/Uncontrolled Exposure

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

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

4.2 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

4.3 MPE Results

Mode	Frequency Band	MPE Evaluation Distance (cm)	Conducted Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)	FCC MPE Limit (mW/cm^2)	Result
WLAN	2.4 GHz	20	24.14	4.5	0.145	1.0	Compliance

The predicted power density level at 20 cm is 0.145 mW/cm^2 which is below the uncontrolled exposure limit of 1.0 mW/cm^2. The EUT is used at least 20 cm away from the user's body. It is determined as mobile equipment and complies with the MPE limit.

5 FCC §15.203 - Antenna Requirement

5.1 Applicable Standard

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

5.2 Antenna List

Frequency Band	Antenna Gain (dBi)
2.4 GHz	4.5

The antenna connectors are u.fl. They are not accessible by the end users. Please refer to the EUT internal photos.

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standard

FCC §15.207 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 ([1])	56 to 46 ([1])
0.5-5	56	46
5-30	60	50

([1]) *Decreases with the logarithm of the frequency.*

6.2 Test Setup

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

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

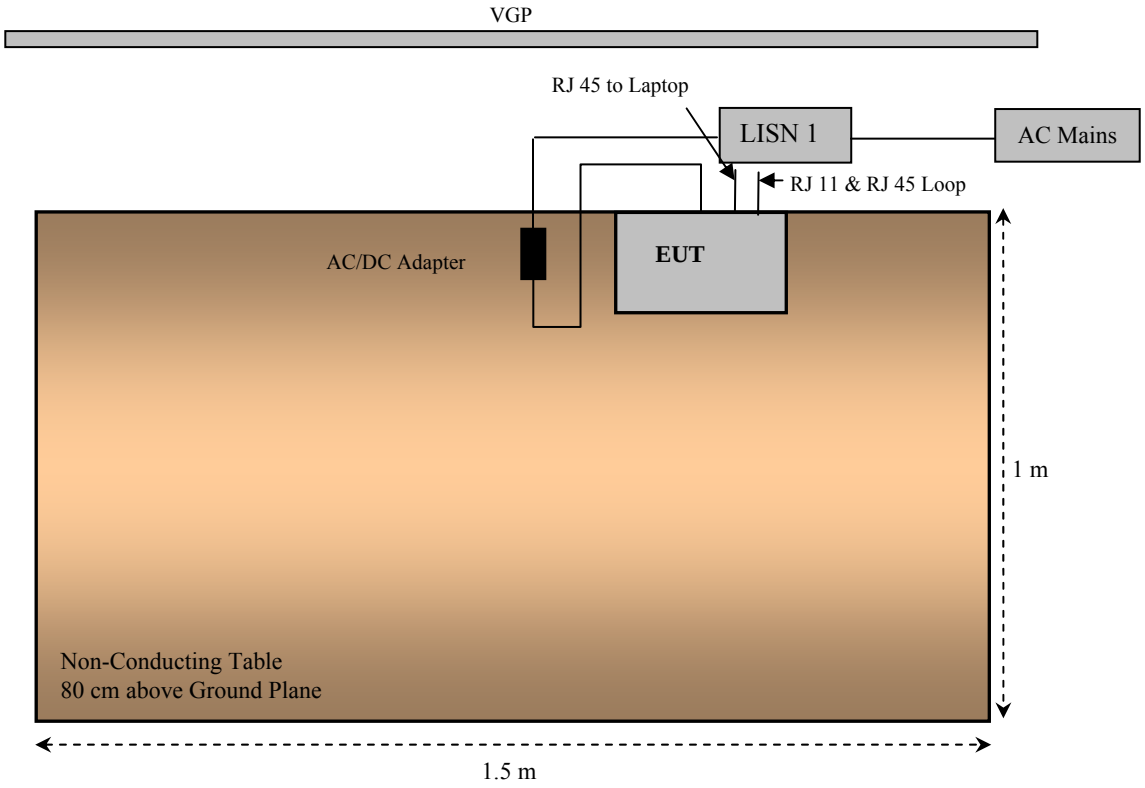
The AC/DC power adapter of the unit was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Equipment List and Details

Manufacturers	Descriptions	Model No.	Serial No.	Calibration Dates
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2011-04-14
Solar Electronics	LISN	9252-R-24-BNC	511205	2011-06-25
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2011-06-10

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

6.4 Test Setup Block Diagram



6.5 Test Procedure

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

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

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

6.6 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

The testing was performed by Wei Sun on 2012-03-20 in 5m Chamber 3.

6.7 Summary of Test Results

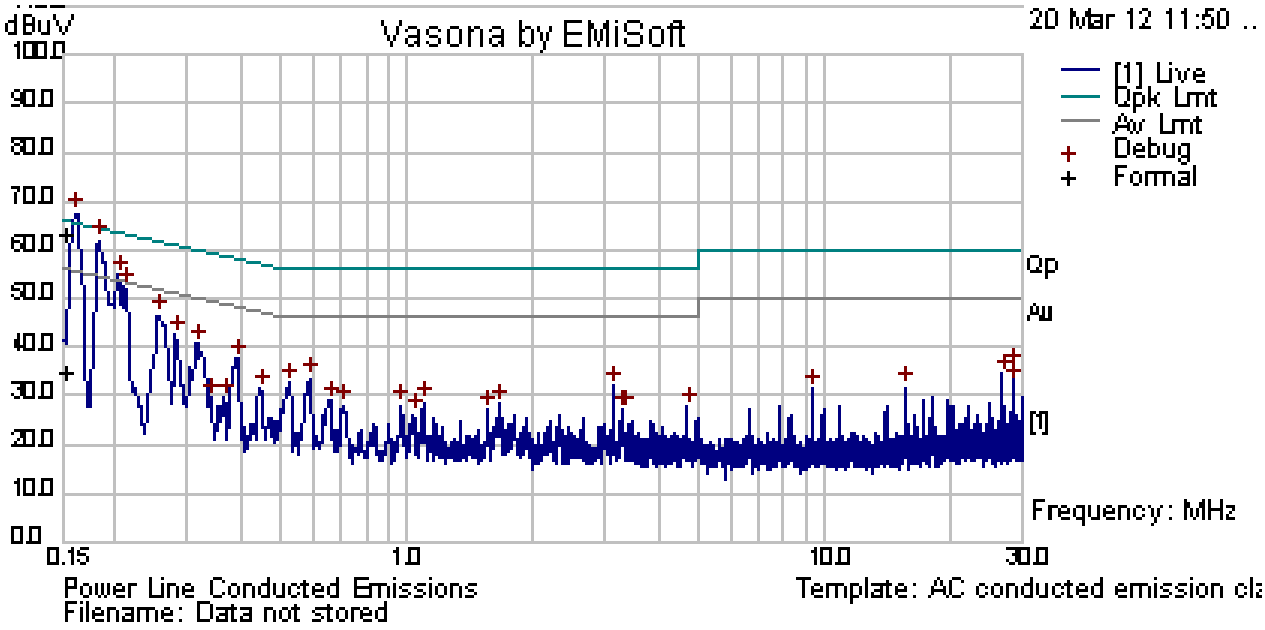
According to the recorded data in following table, the EUT complied with the FCC 15.207 standard's conducted emissions limits, with the *worst* margin reading of:

Worst Case: 802.11b Mode Middle Channel (2437 MHz)

Connection: AC/DC adapter connected to 120 V/60 Hz AC Mode: 802.11 b Mode Middle Channel Transmitting			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-1.49	0.171285	Line	0.15 to 30

6.8 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



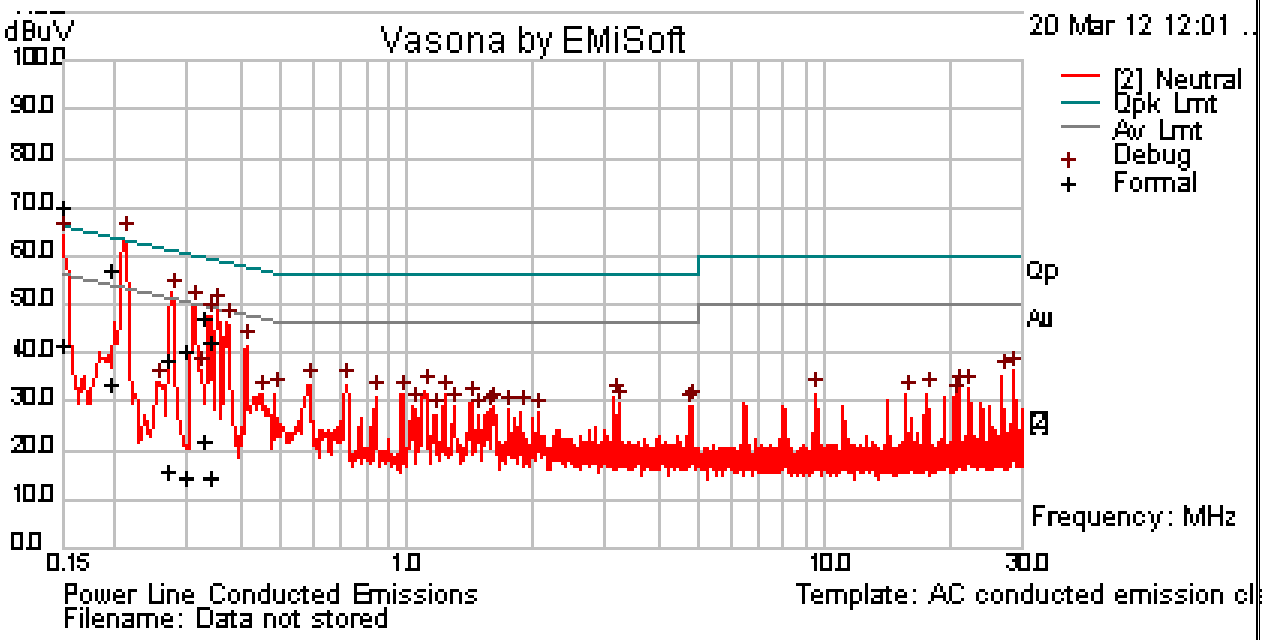
Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.153165	63.3	Line	65.83	-2.53
0.171285	63.41	Line	64.9	-1.49
0.19069	51.63	Line	64.01	-12.37
0.196604	54.43	Line	63.75	-9.33
0.23972	49.58	Line	62.11	-12.52
0.264925	51.9	Line	61.28	-9.37

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.153165	34.54	Line	55.83	-21.28
0.171285	31.9	Line	54.9	-23
0.19069	30.55	Line	54.01	-23.46
0.196604	28.2	Line	53.75	-25.55
0.23972	17.58	Line	52.11	-34.53
0.264925	18.6	Line	51.28	-32.68

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.19484	57.38	Neutral	63.83	-6.45
0.156312	63.98	Neutral	65.66	-1.68
0.268293	38.3	Neutral	61.17	-22.87
0.33918	42.31	Neutral	59.22	-16.91
0.298139	40.31	Neutral	60.29	-19.99
0.32497	47.48	Neutral	59.58	-12.1

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.19484	33.76	Neutral	53.83	-20.07
0.156312	35.33	Neutral	55.66	-20.32
0.268293	15.9	Neutral	51.17	-35.27
0.33918	14.72	Neutral	49.22	-34.5
0.298139	14.64	Neutral	50.29	-35.65
0.32497	21.56	Neutral	49.58	-28.02

7 FCC §2.1051 & §15.247(d) - Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For 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.

Requirements: FCC §2.1051.

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

7.2 Test Procedure

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

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10

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

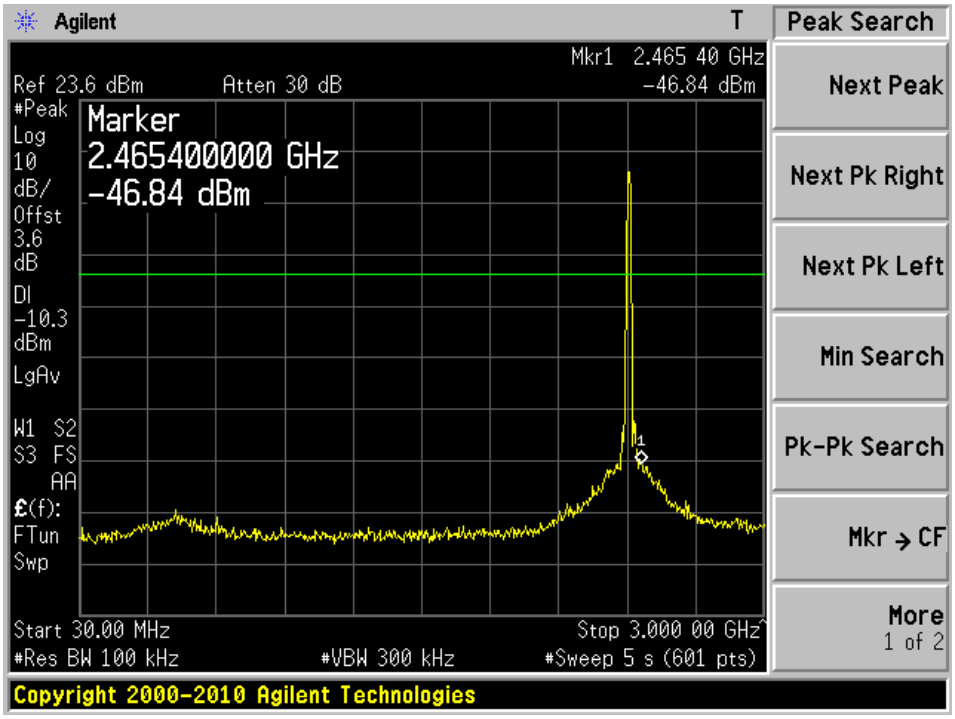
Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

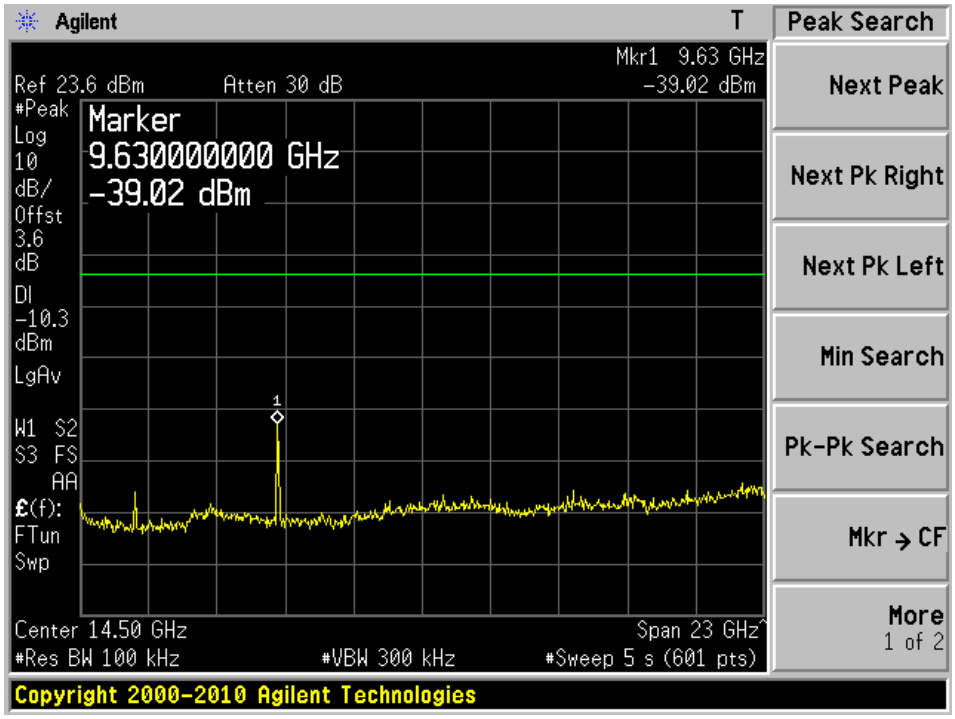
The testing was performed by Wei Sun on 2012-03-17 on RF Site.

7.5 Test Results

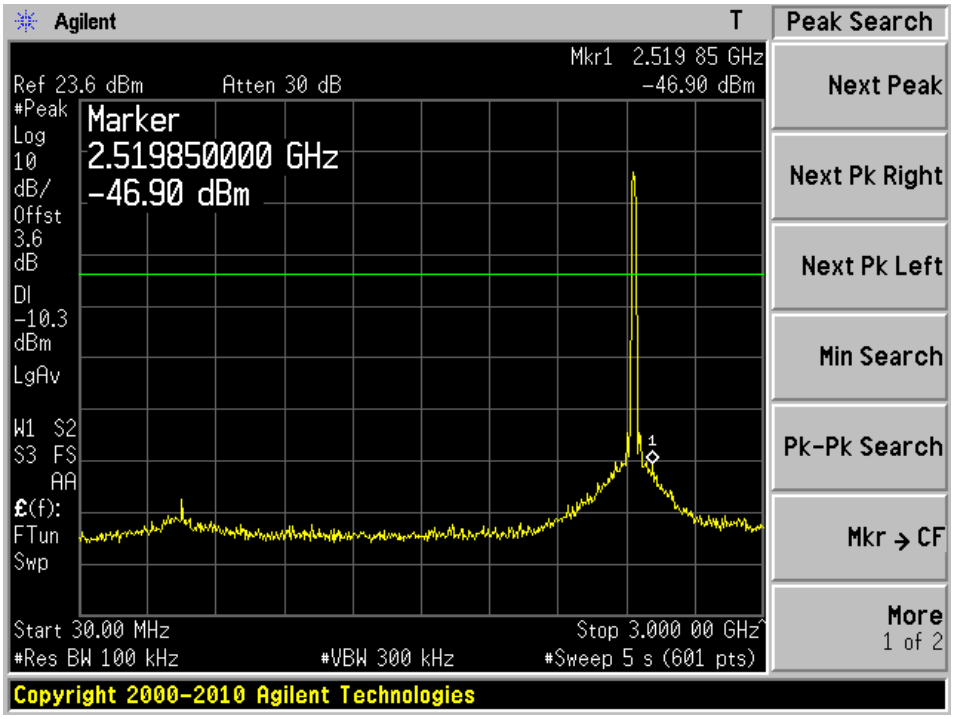
Please refer to the following plots

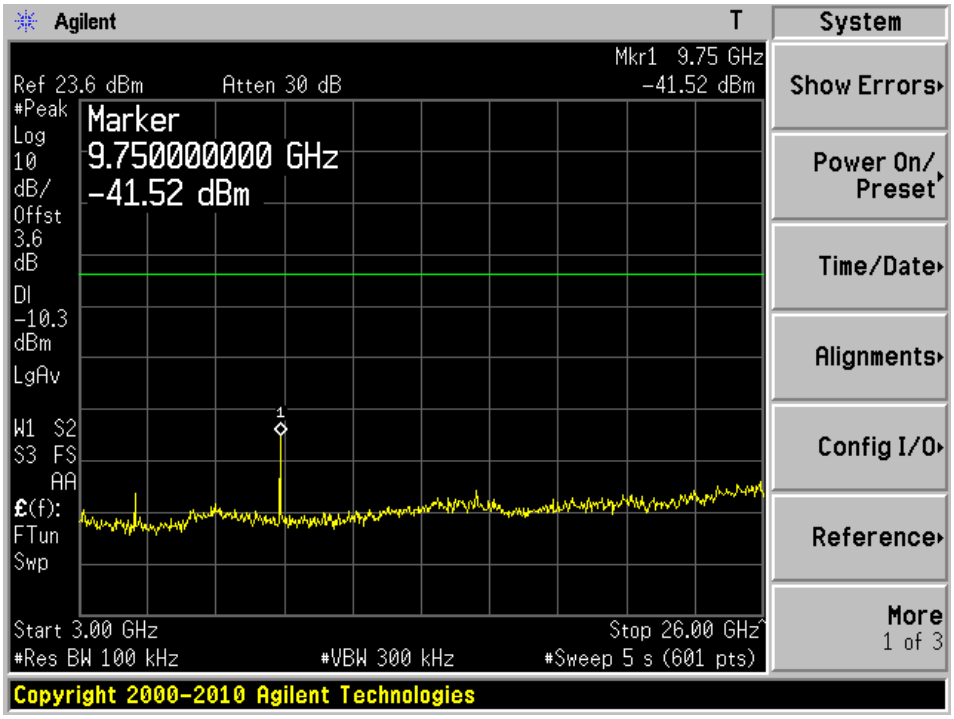
802.11 b, chain 0, Low Channel 2412 MHz



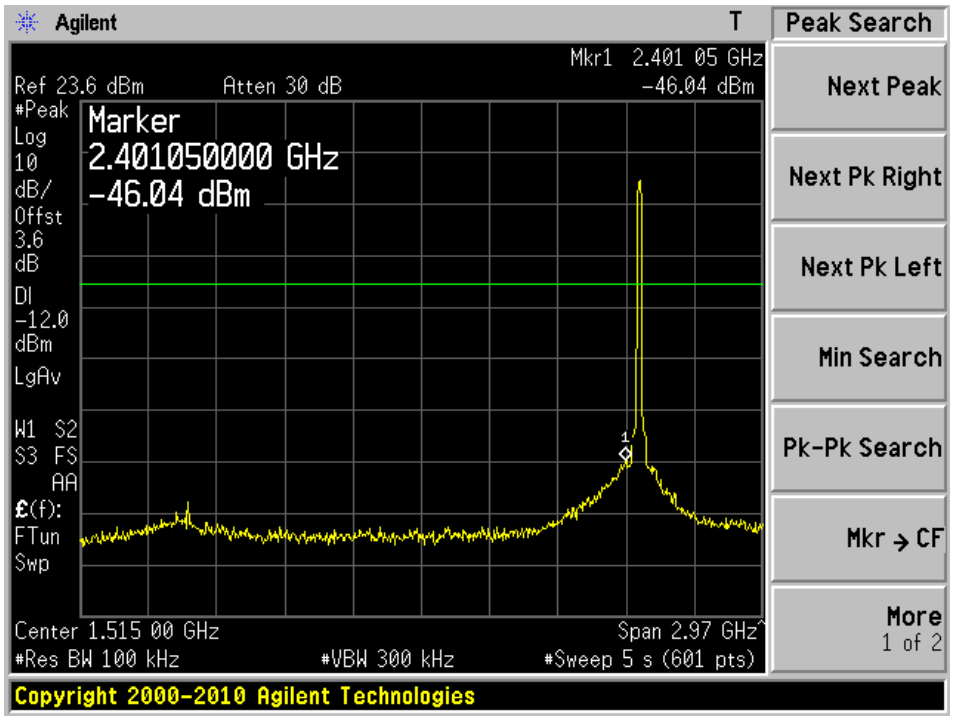


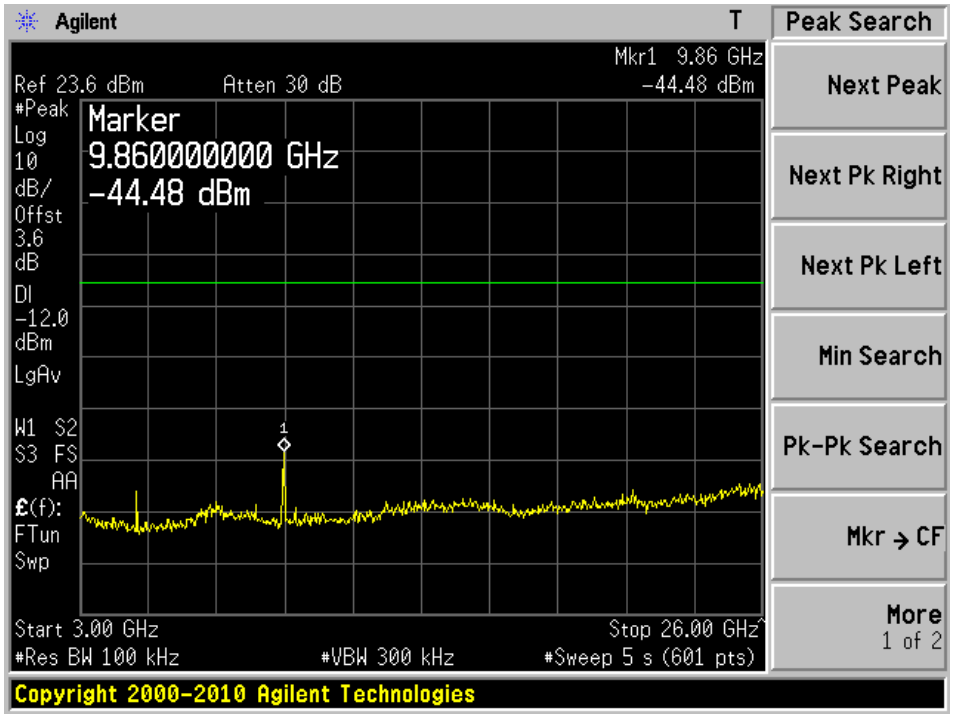
802.11 b, chain 0, Middle Channel 2437 MHz





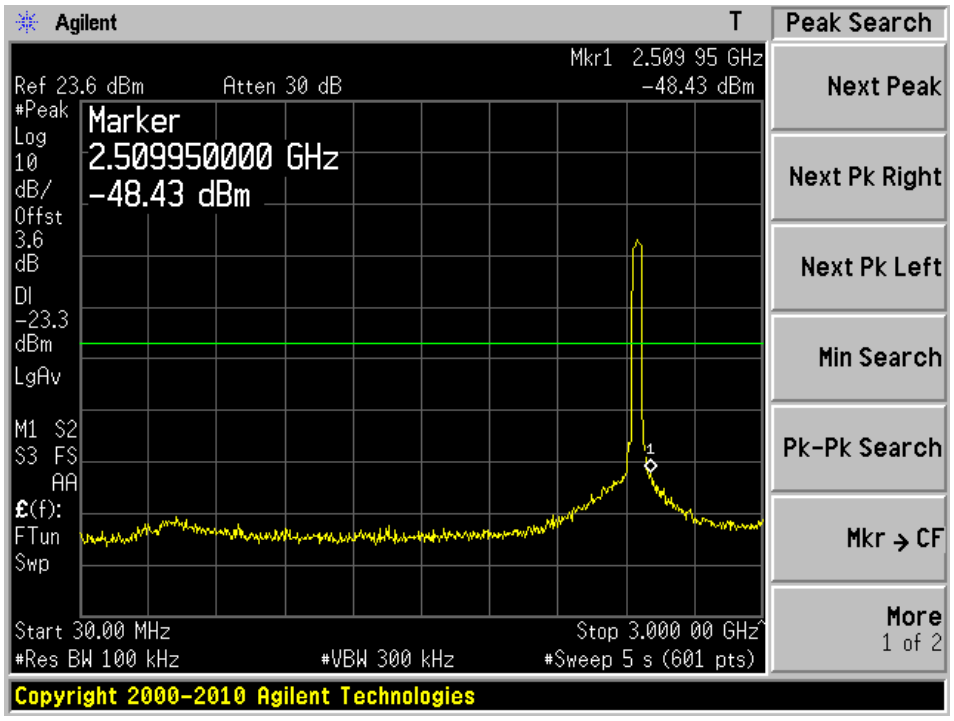
802.11 b, chain 0, High Channel 2462 MHz

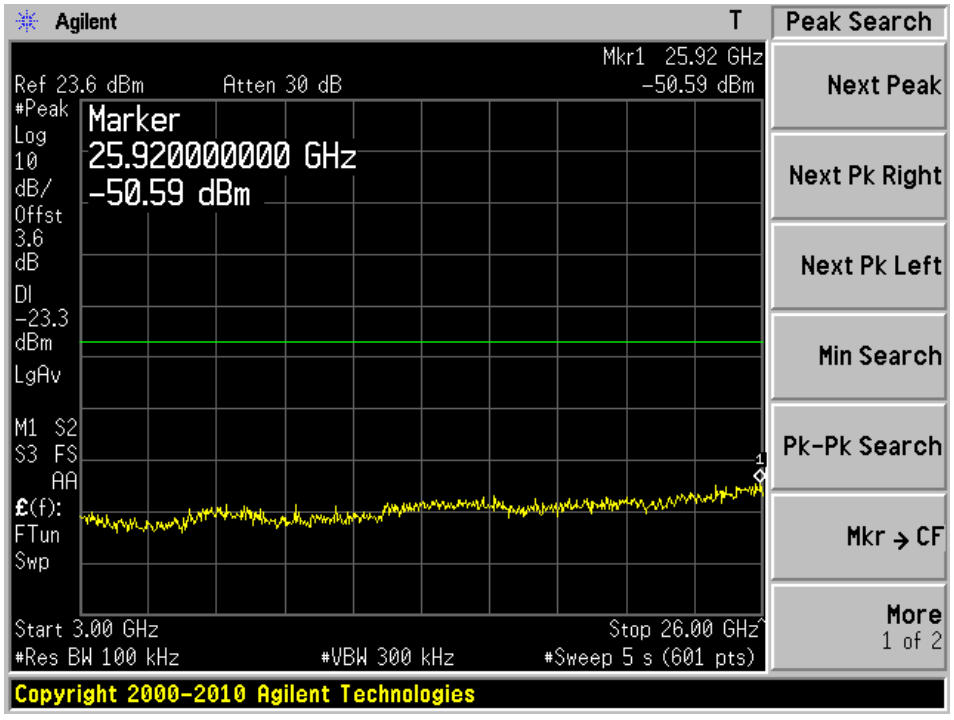




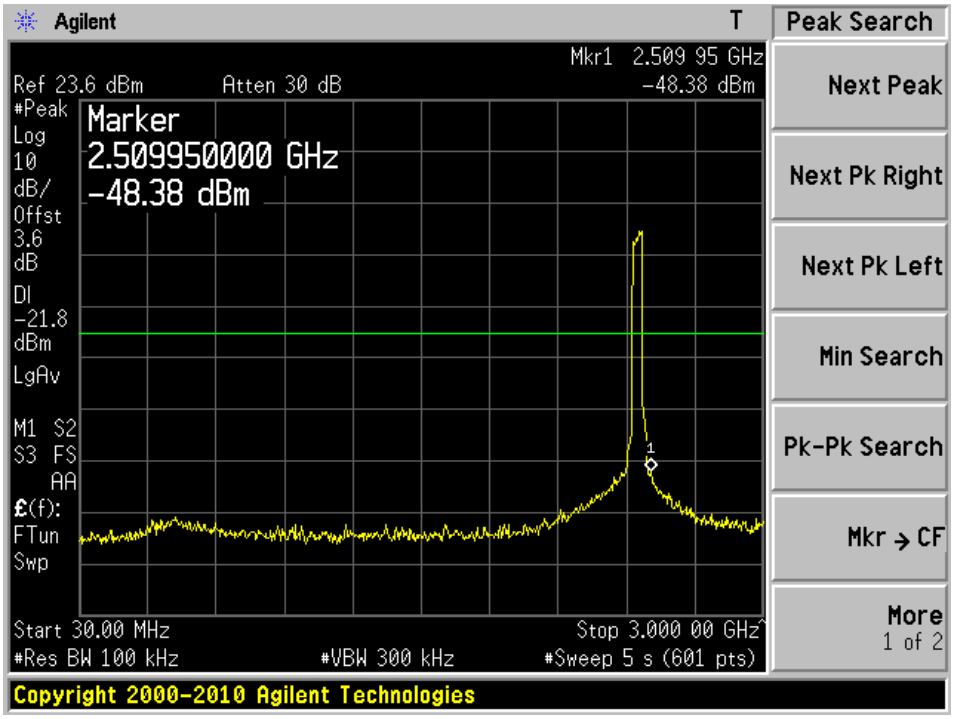
Note: 802.11b only working on Chain 0, there is no Chain 1 functional for 802.11b mode.

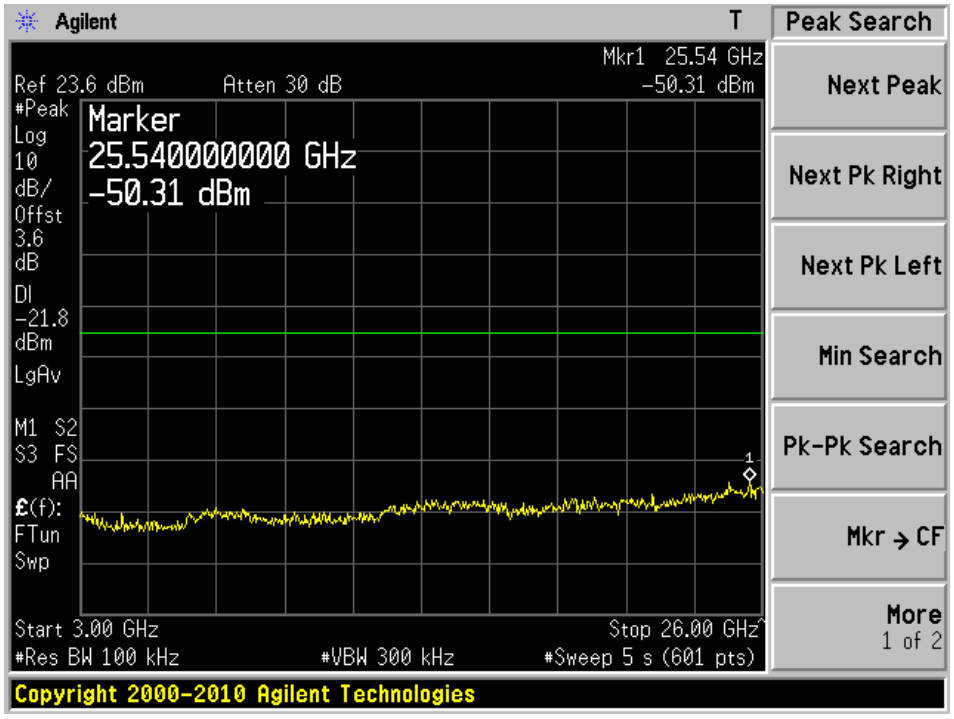
802.11 g, chain 0, Low Channel 2412 MHz



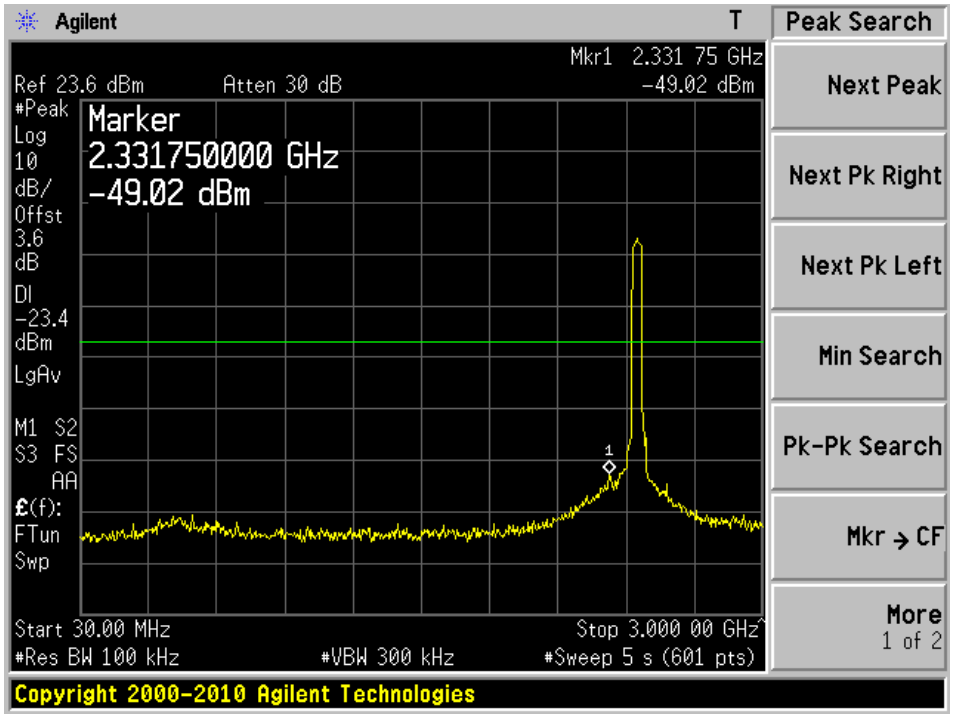


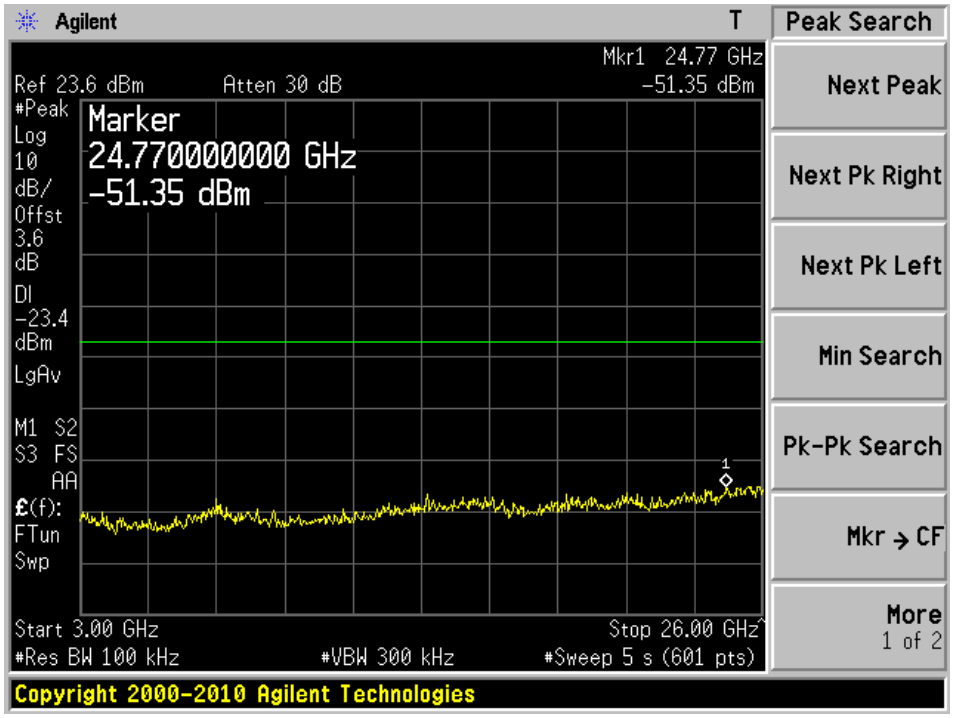
802.11 g, chain 0, Middle Channel 2437 MHz



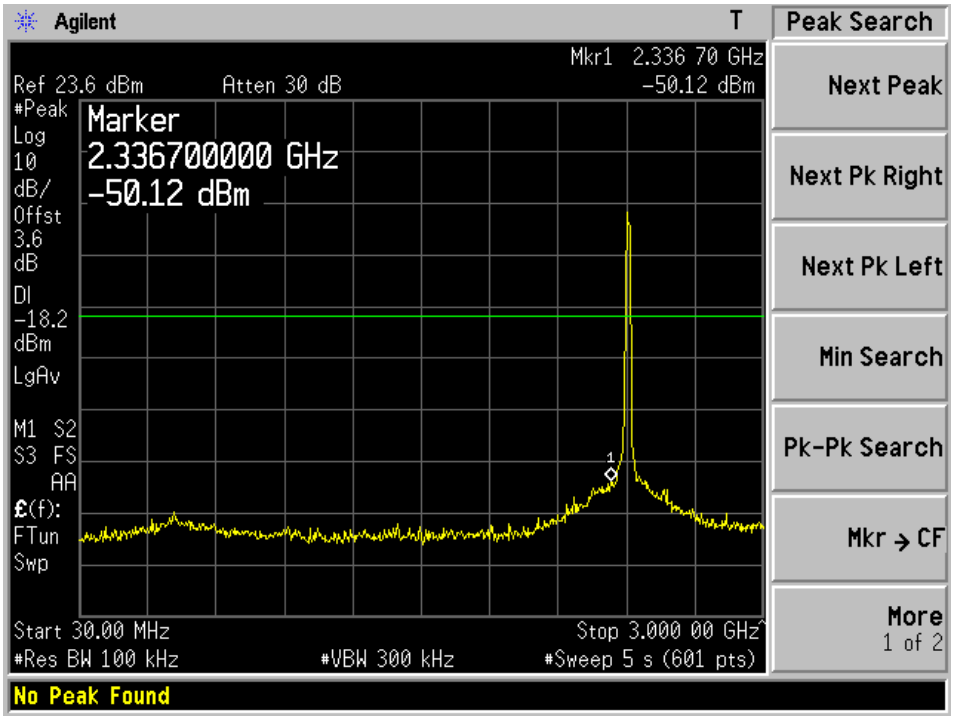


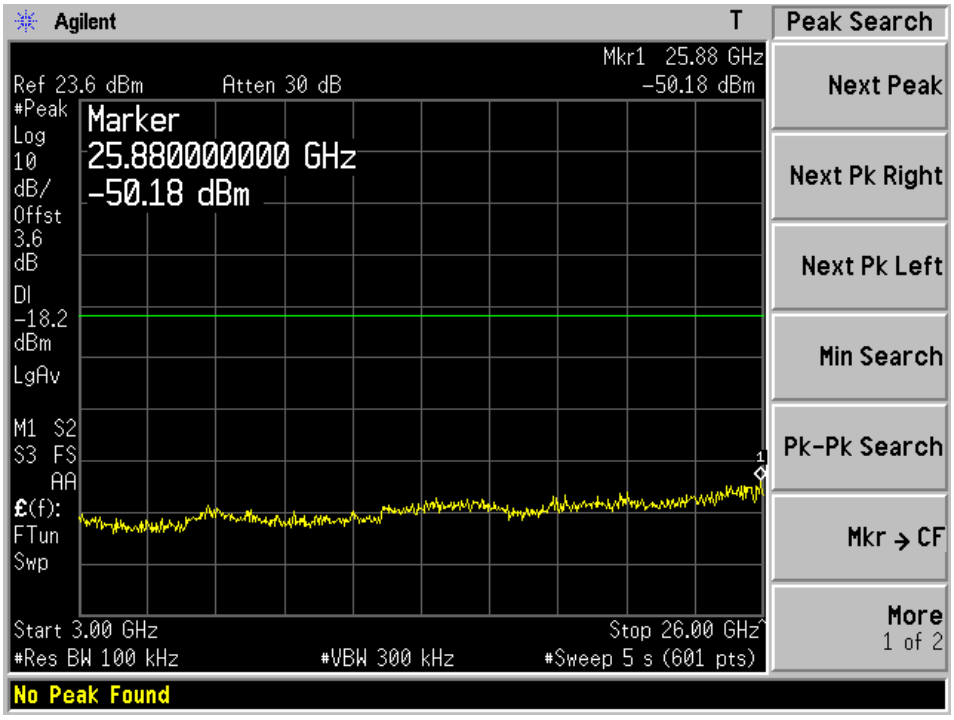
802.11 g, chain 0, High Channel 2462 MHz



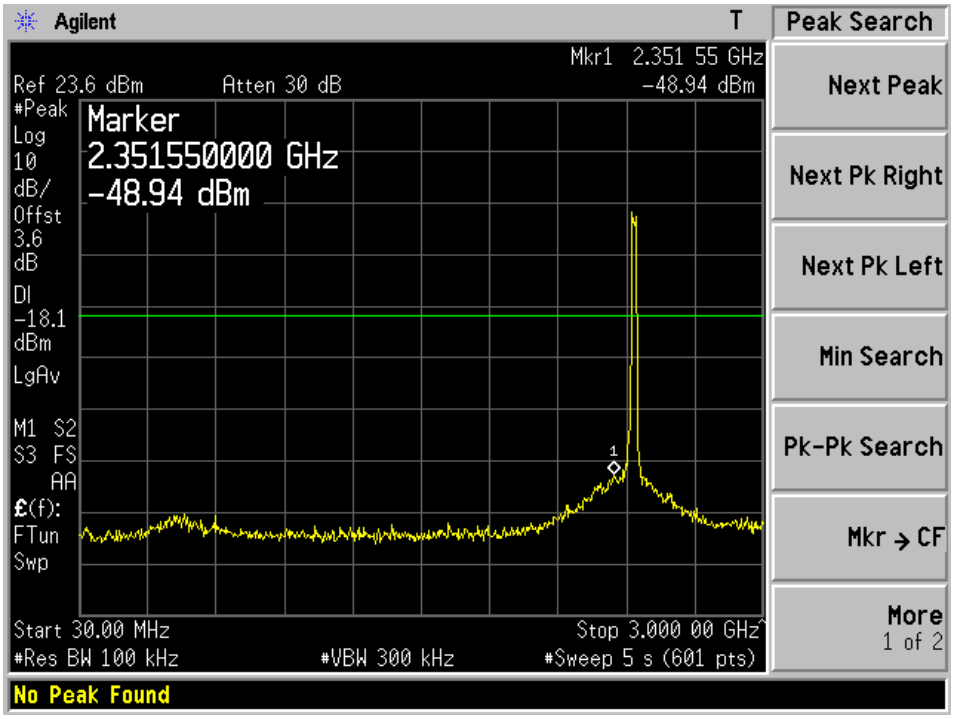


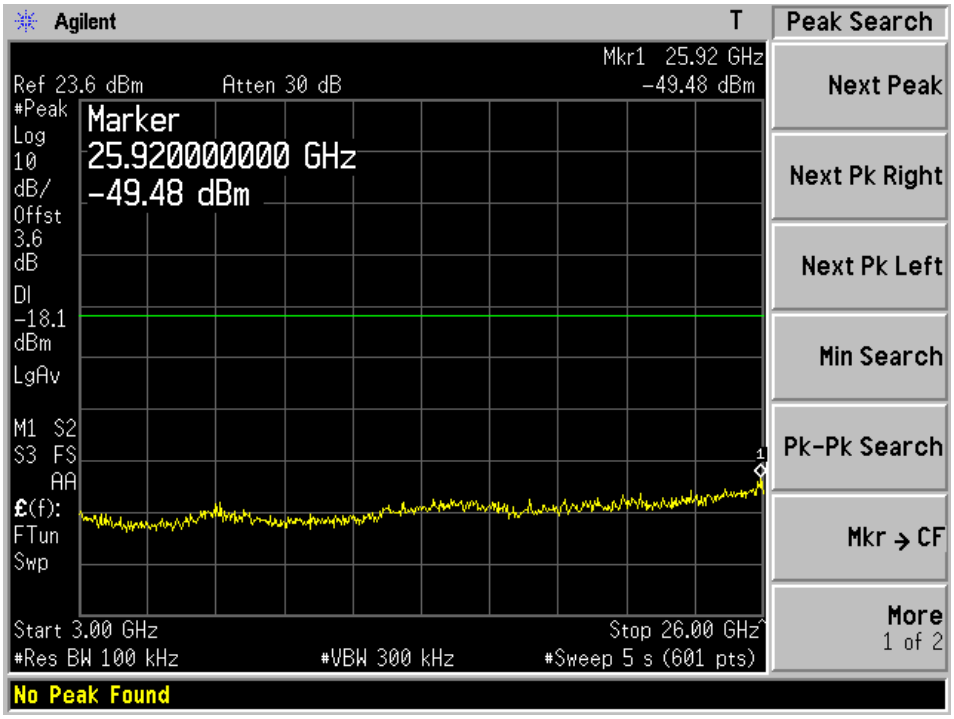
802.11 g, chain 1, Low Channel 2412 MHz



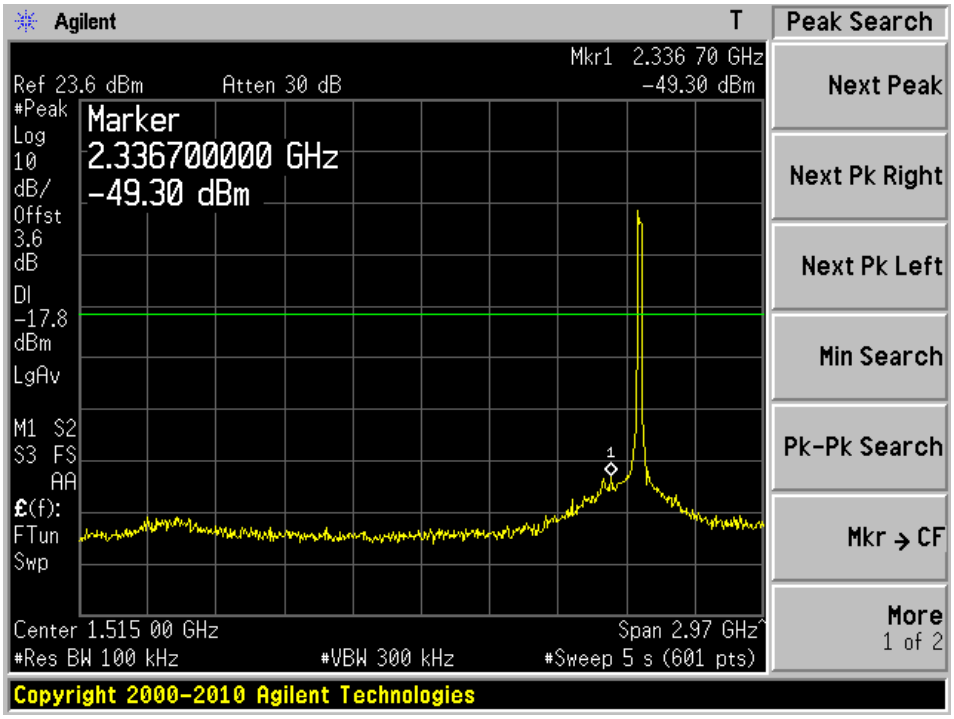


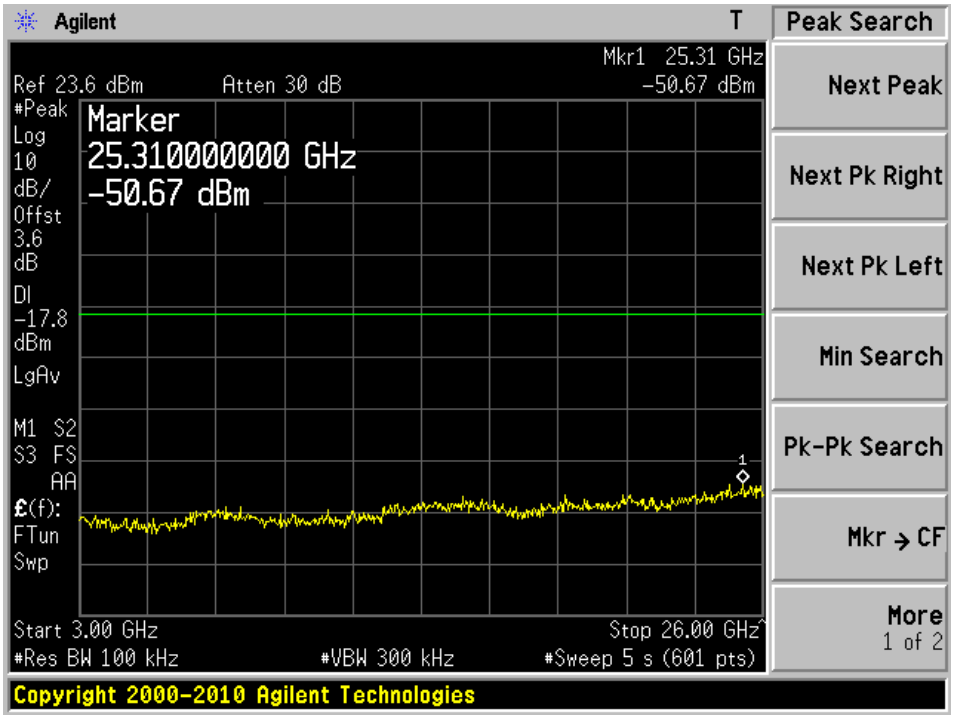
802.11 g, chain 1, Middle Channel 2437 MHz



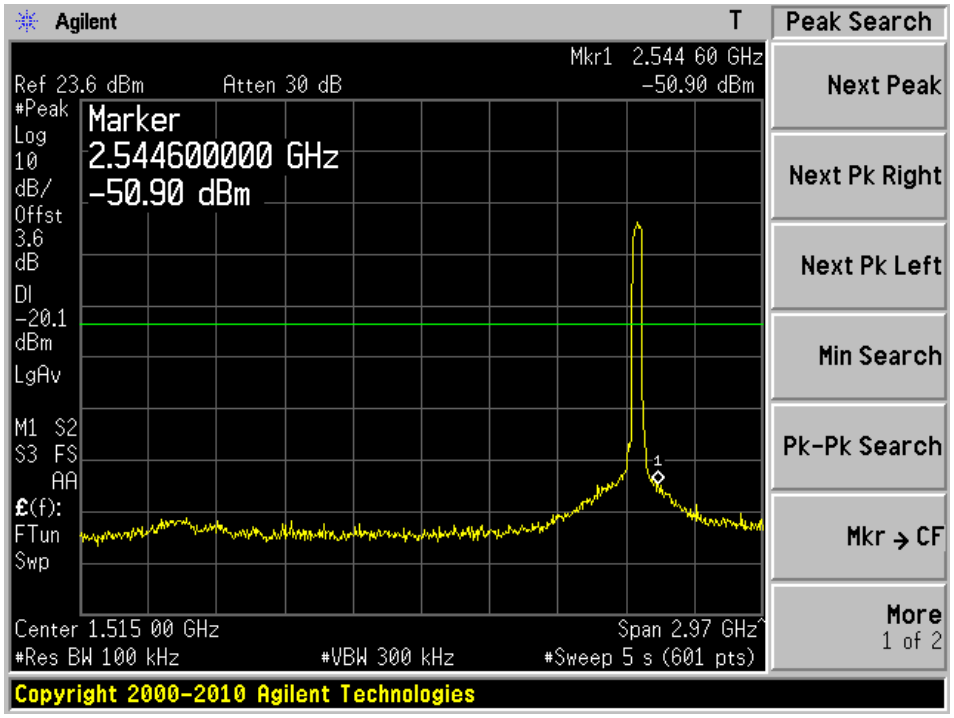


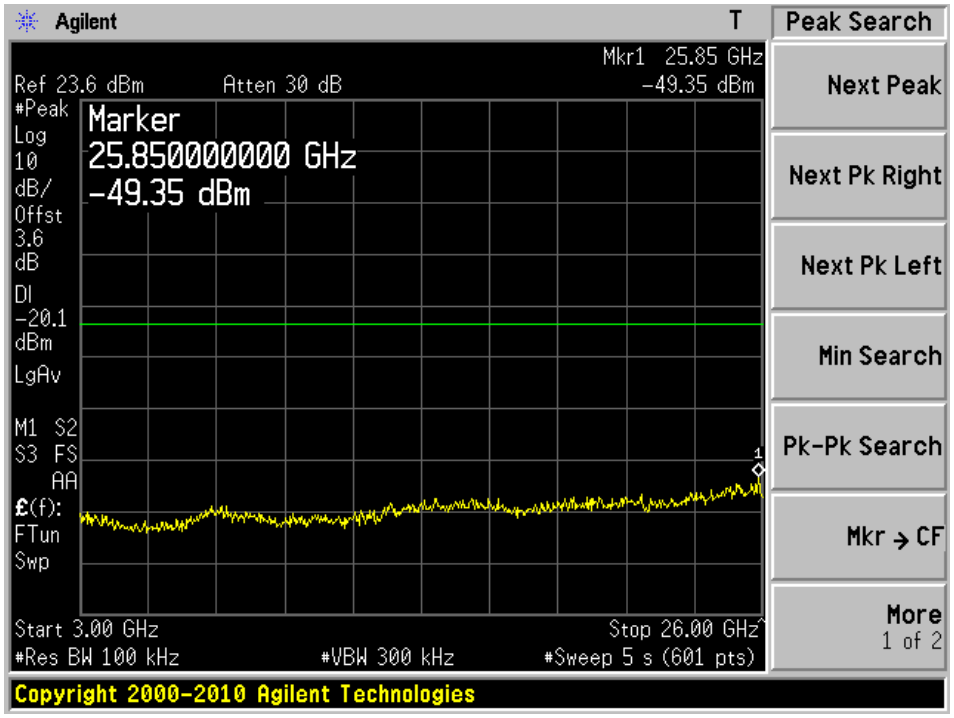
802.11 g, chain 1, High Channel 2462 MHz



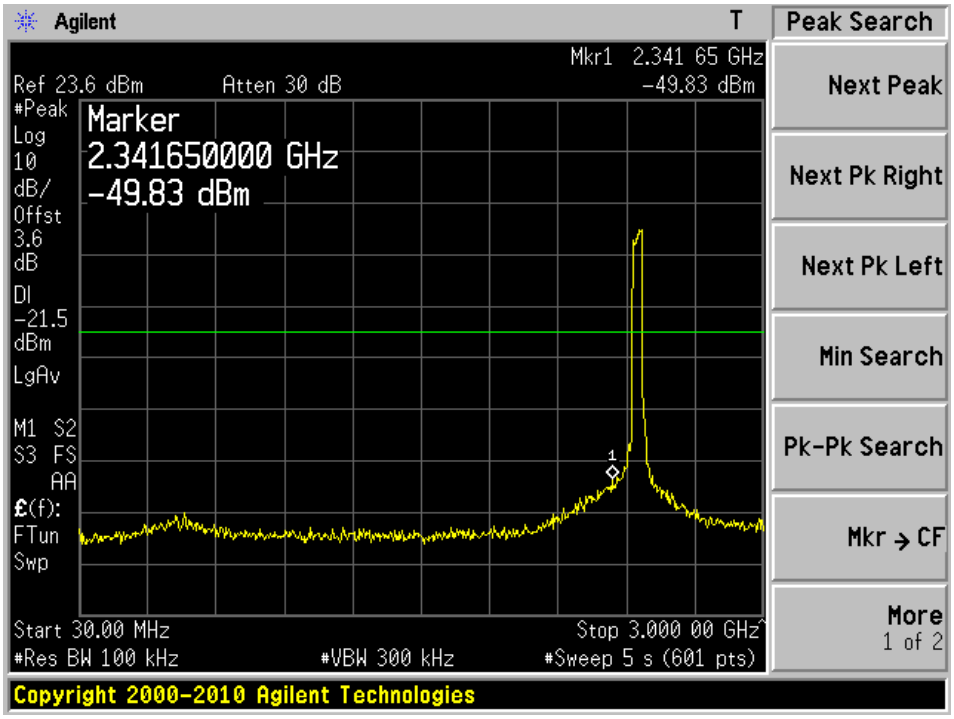


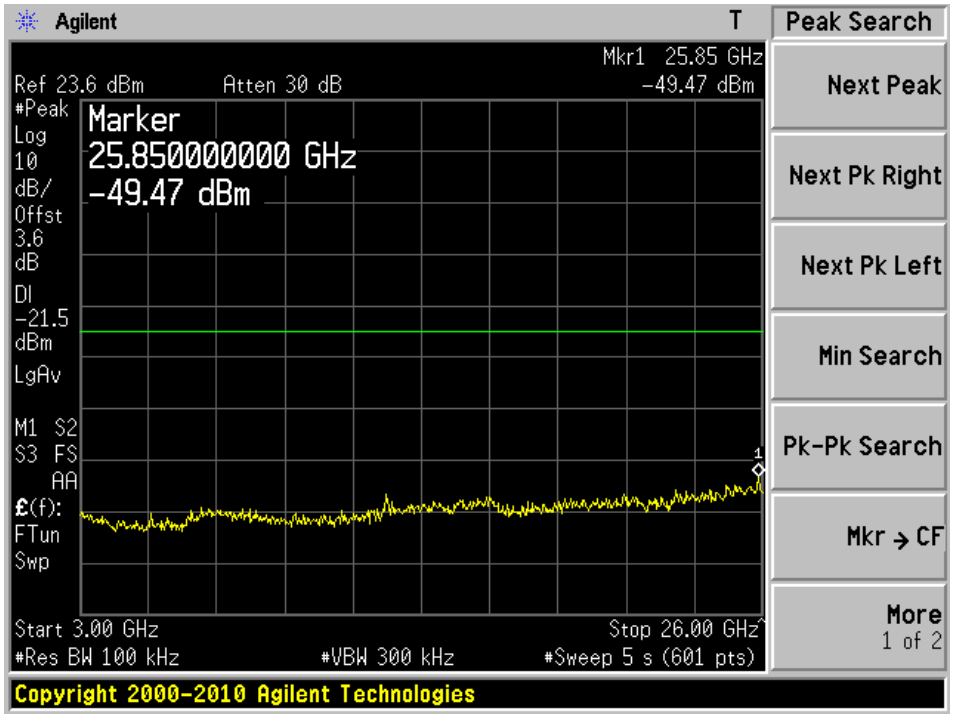
802.11n HT20, chain 0, Low Channel 2412 MHz



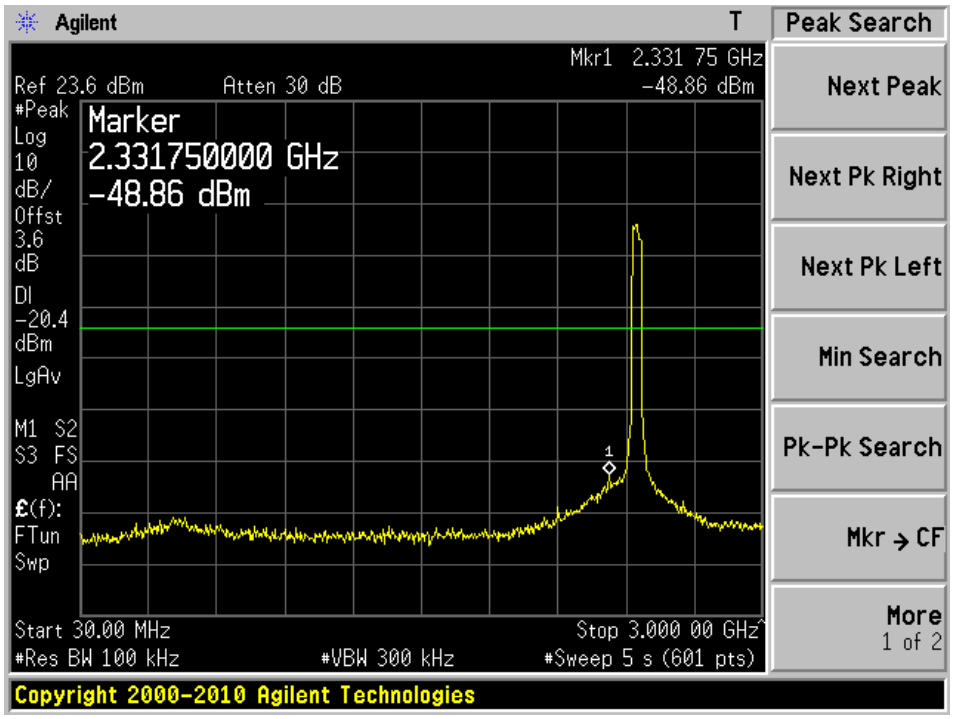


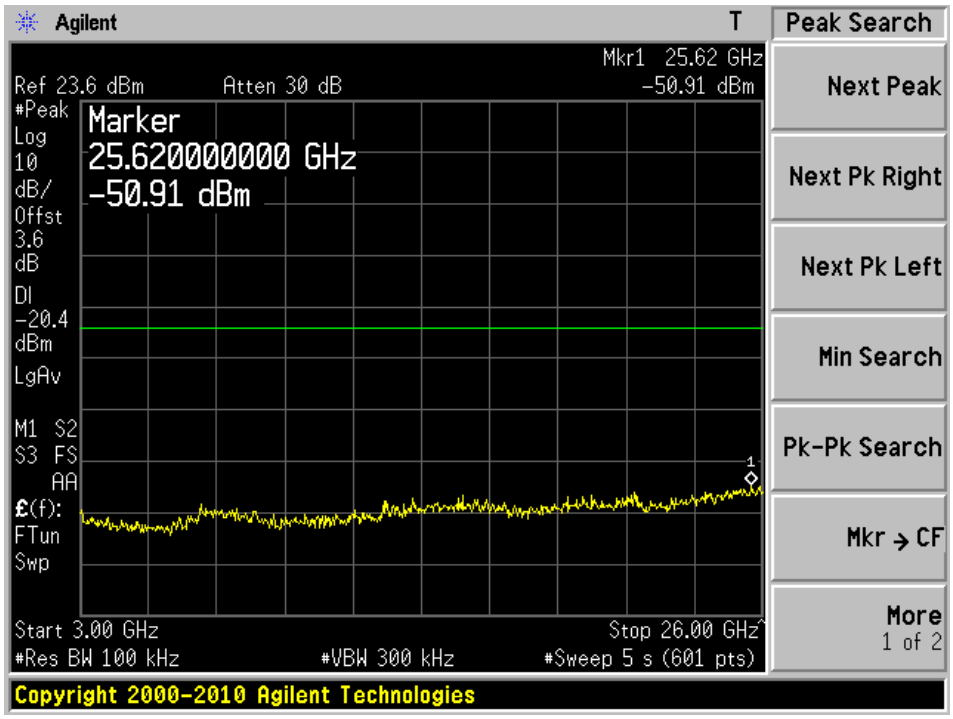
802.11n HT20, chain 0, Middle Channel 2437 MHz



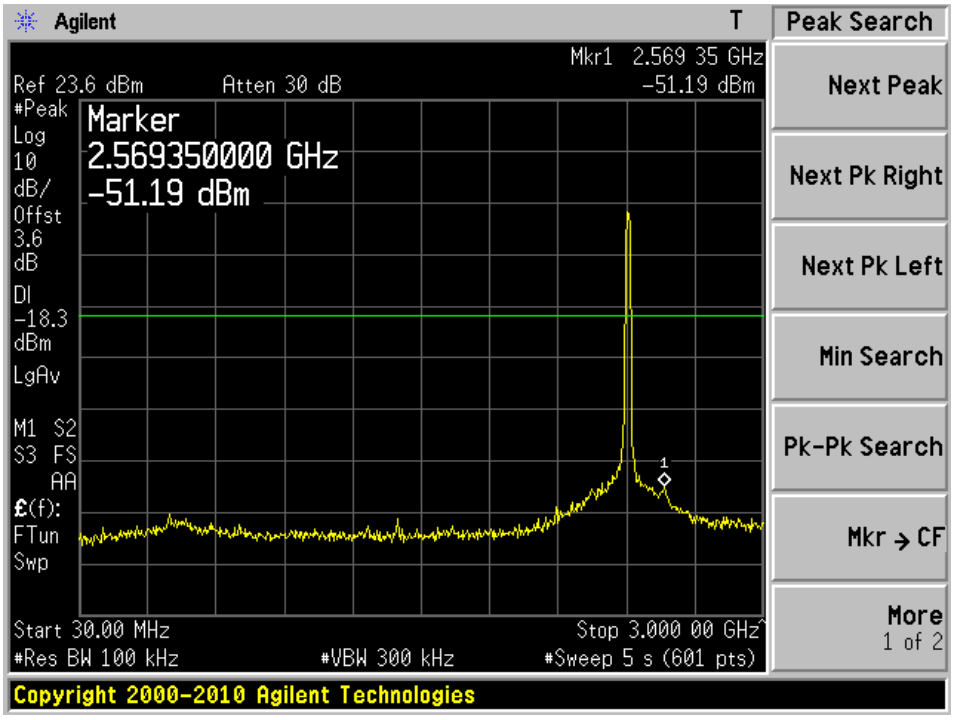


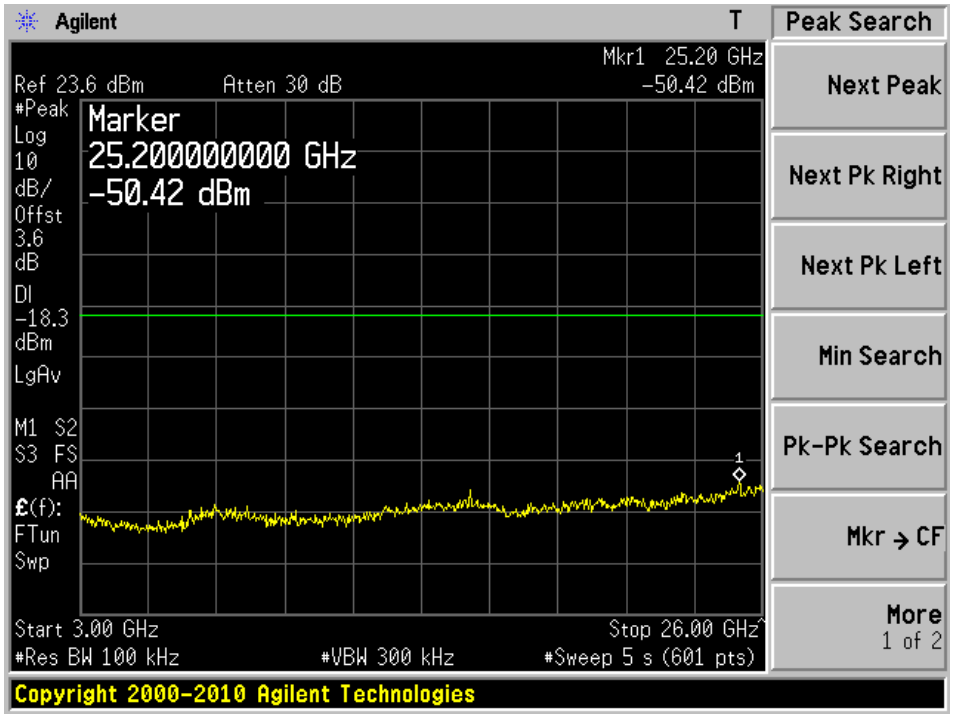
802.11n HT20, chain 0, High Channel 2462 MHz



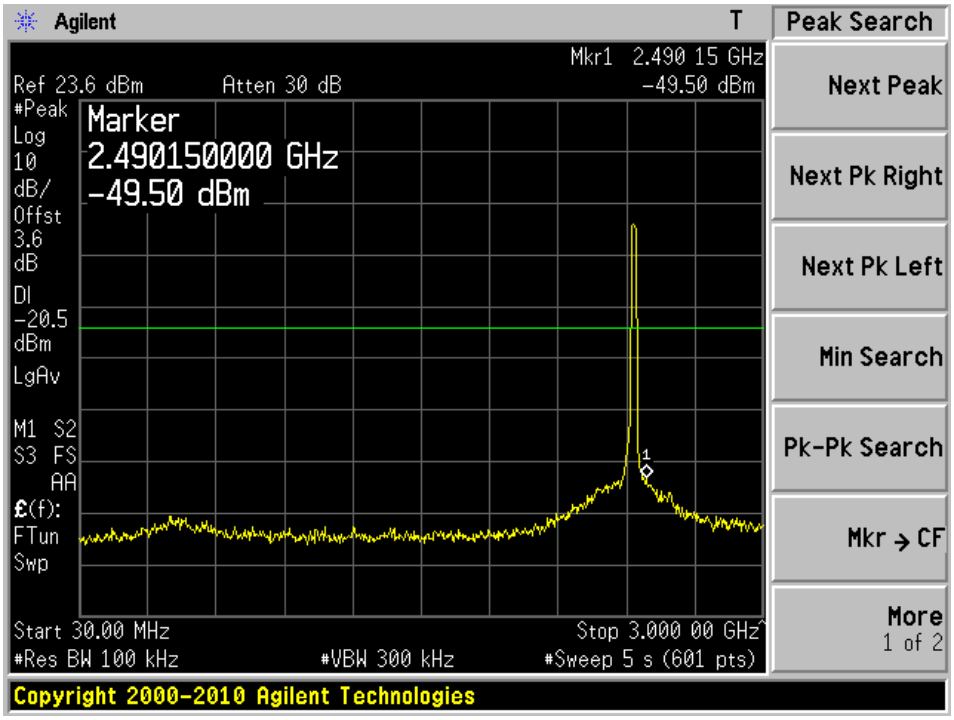


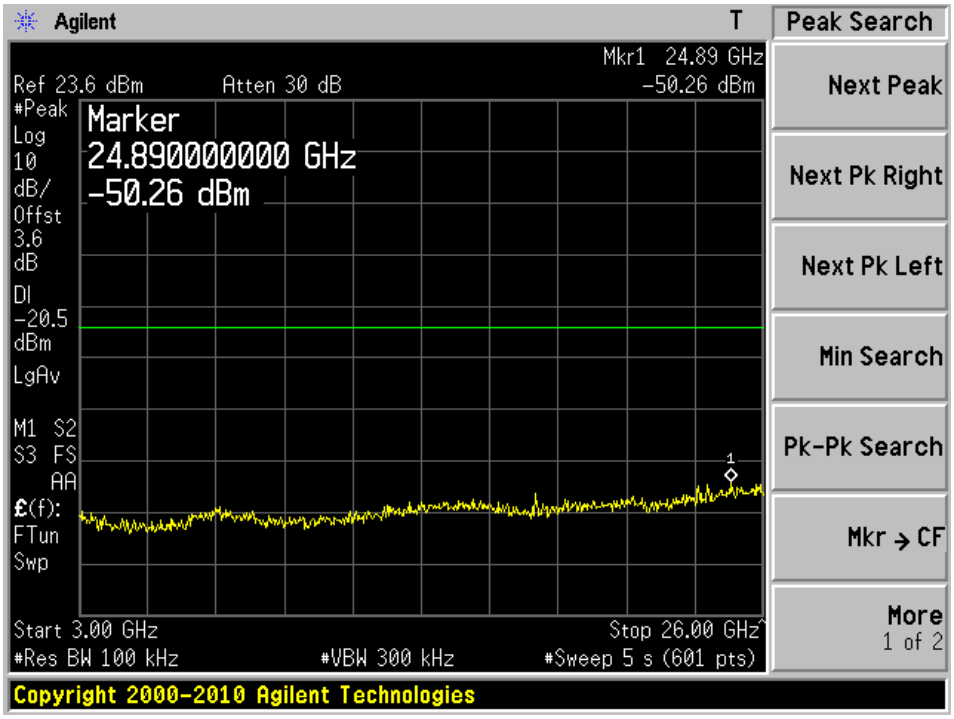
802.11n HT20, chain 1, Low Channel 2412 MHz



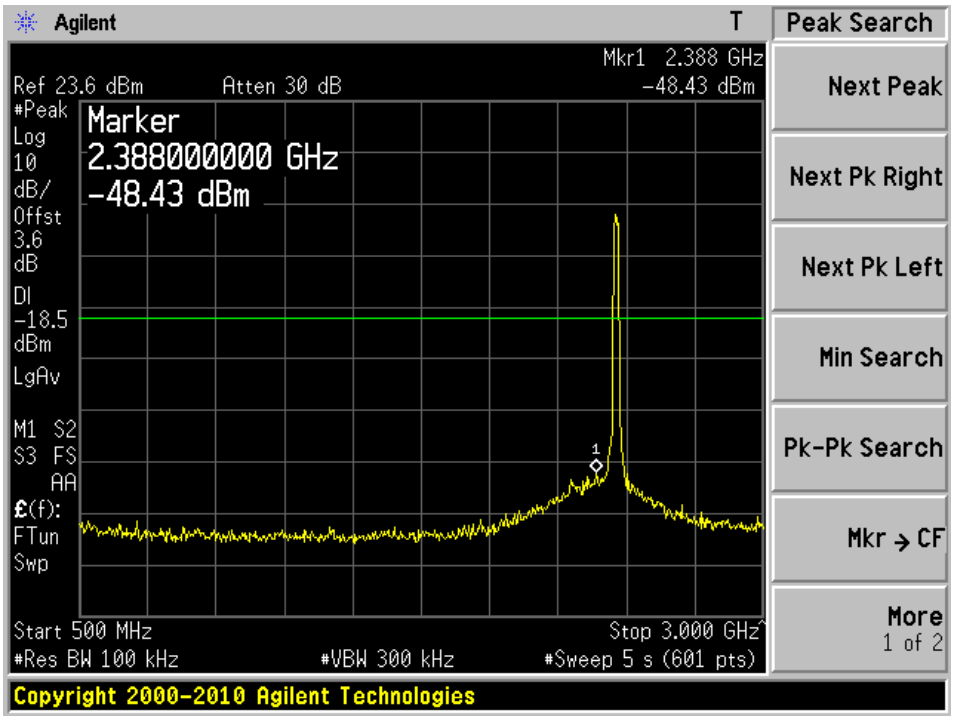


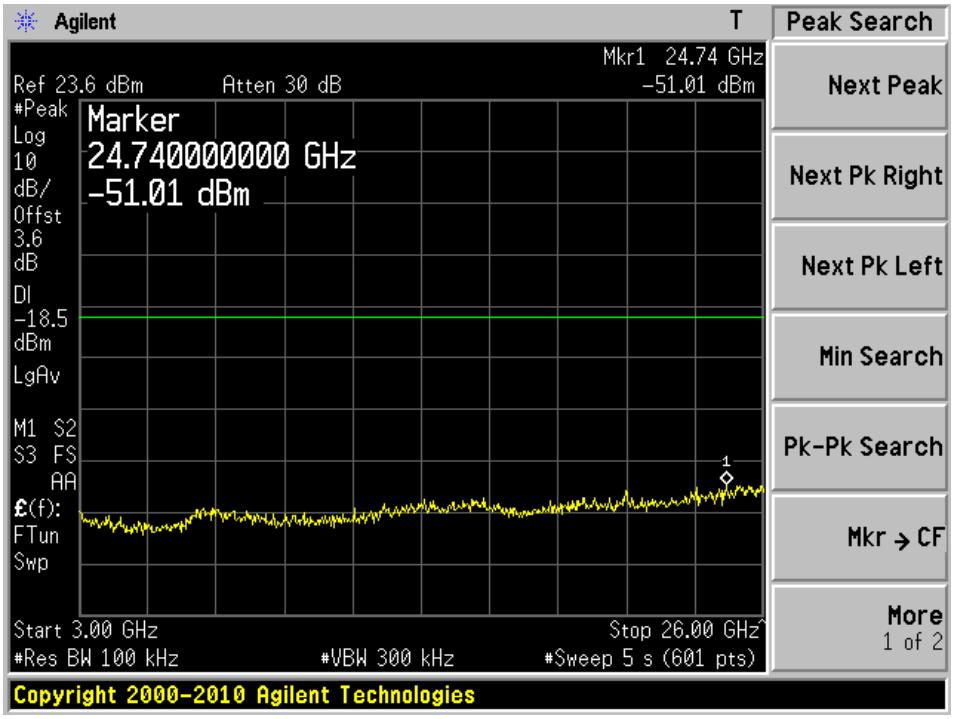
802.11n HT20, chain 1, Middle Channel 2437 MHz





802.11n HT20, chain 1, High Channel 2462 MHz





8 FCC §15.205, §15.209 & §15.247(d) - Spurious Radiated Emissions

8.1 Applicable Standard

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

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 ([1])	3
88 - 216	150 ([1])	3
216 - 960	200 ([1])	3
Above 960	500	3

([1]) Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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 – 3339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	33458 – 3358	23.6 – 24.0
12.29 – 12.293	240 – 285	3600 – 4400	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)).

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

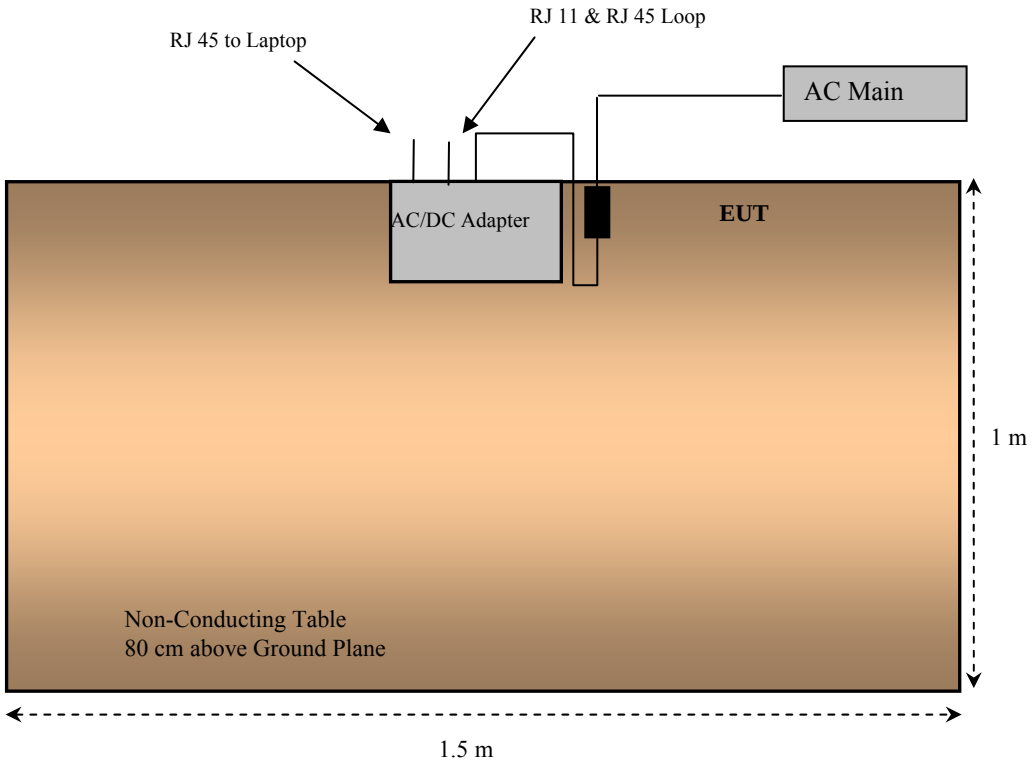
8.3 EUT Setup

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

The spacing between the peripherals was 10 centimeters.

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

8.4 Test Setup Block Diagram



8.5 Test Equipment List and Details

Manufacturers	Descriptions	Model No.	Serial No.	Calibration Dates
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2011-09-14
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
EMCO	Horn antenna	3115	9511-4627	2011-10-03
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2011-05-08

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

8.6 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 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

8.7 Corrected Amplitude & Margin Calculation

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

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

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

Margin = Corrected Amplitude - FCC Limit

8.8 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

The testing was performed by Wei Sun on 2012-03-17 in 5m Chamber 3.

8.9 Summary of Test Results

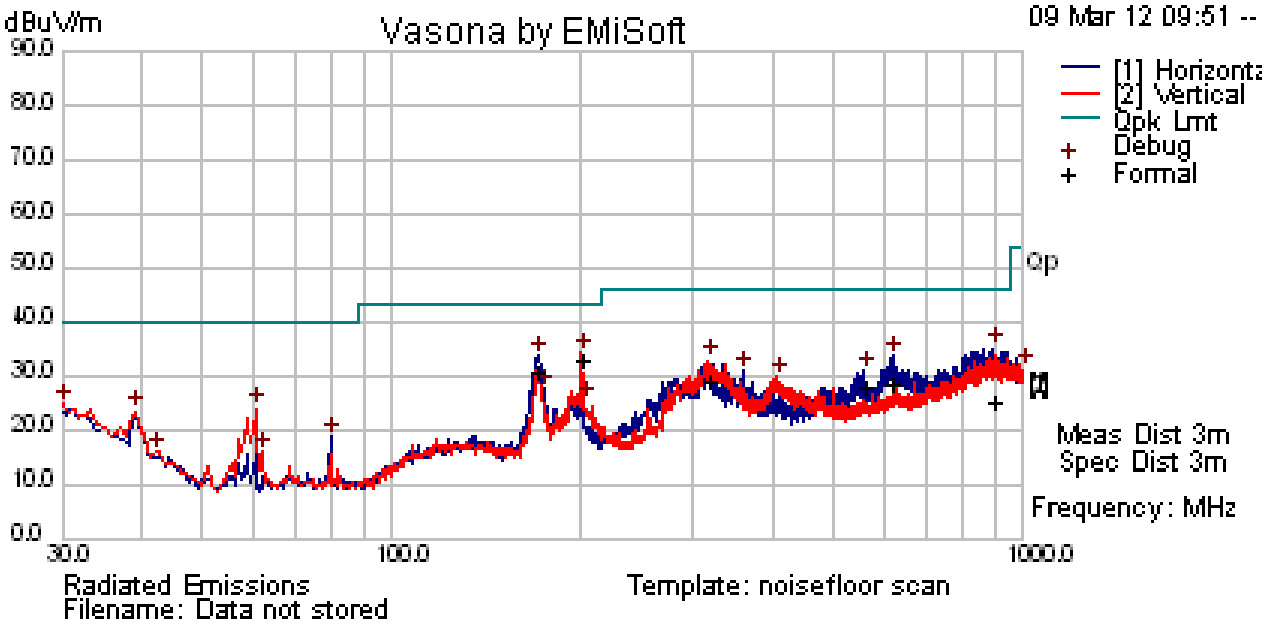
According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
30-1000 MHz			
-8.63	879.71375	Horizontal	802.11 g middle 30 MHz – 1 GHz
Above 1 GHz			
-0.133	4874	Vertical	802.11 b middle 1 GHz – 25 GHz

8.10 Radiated Spurious Emissions Test Plots & Data

1) 30 – 1000 MHz Measured at 3 meters

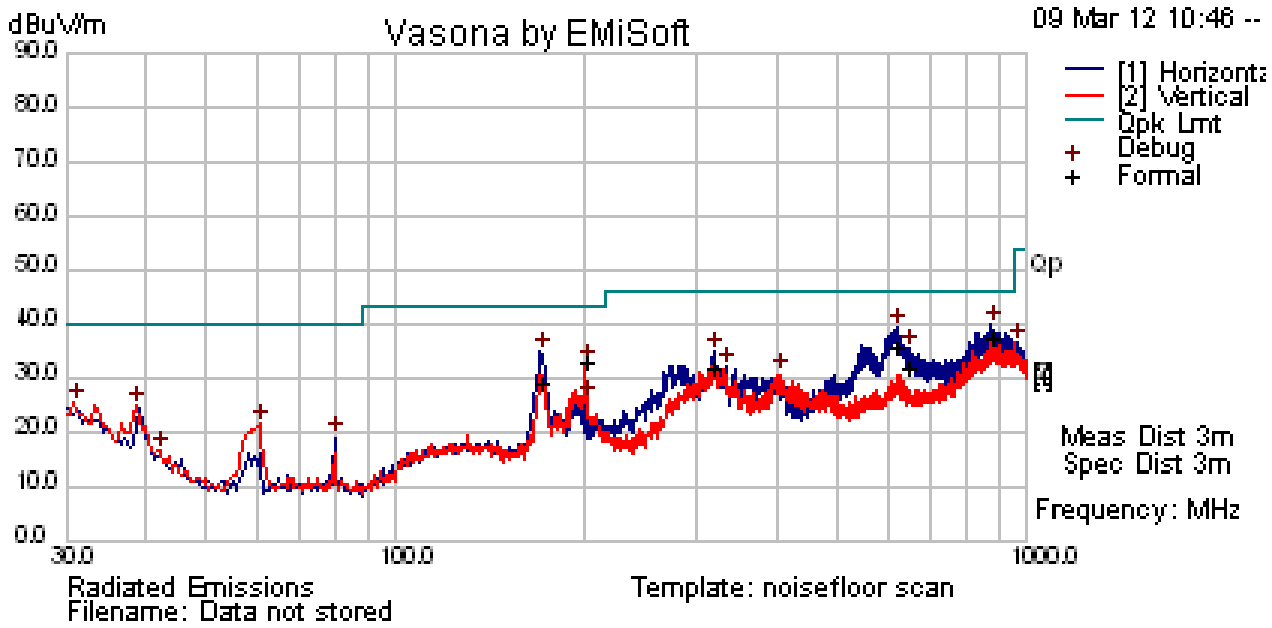
802.11b mode (Worst Case, Low Channel 2412 MHz)



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
199.9903	33.23	99	V	114	43.5	-10.27
170.0865	30.54	159	H	173	43.5	-12.96
897.5998	25.22	175	H	249	46	-20.78
622.2363	28.71	126	H	181	46	-17.29
316.5775	28.92	145	V	176	46	-17.08
559.9698	28.2	169	H	205	46	-17.8

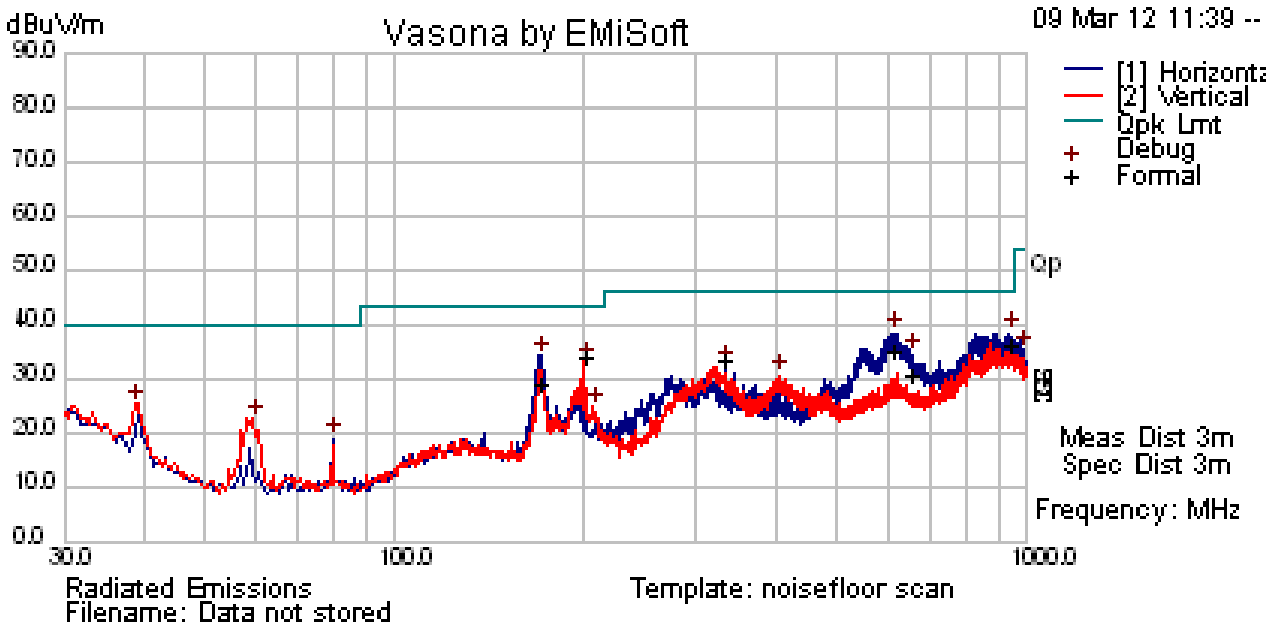
802.11g mode (Worst Case, Middle Channel 2437 MHz)



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
879.7138	37.37	103	H	250	46	-8.63
621.207	35.72	128	H	202	46	-10.28
169.694	28.94	159	H	260	43.5	-14.56
648.8108	31.86	115	H	205	46	-14.14
199.9983	33.15	99	V	105	43.5	-10.35
317.8668	31.82	125	H	217	46	-14.18

802.11n HT20 (Worst Case, Middle Channel 2437 MHz)



Quasi-Peak Measurement:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
938.5063	36.18	100	H	285	46	-9.82
615.3758	35.01	145	H	194	46	-10.99
169.879	29.24	227	H	156	43.5	-14.26
200	34.1	101	V	99	43.5	-9.4
657.7503	30.79	131	H	198	46	-15.21
333.3913	33.85	100	H	29	46	-12.15

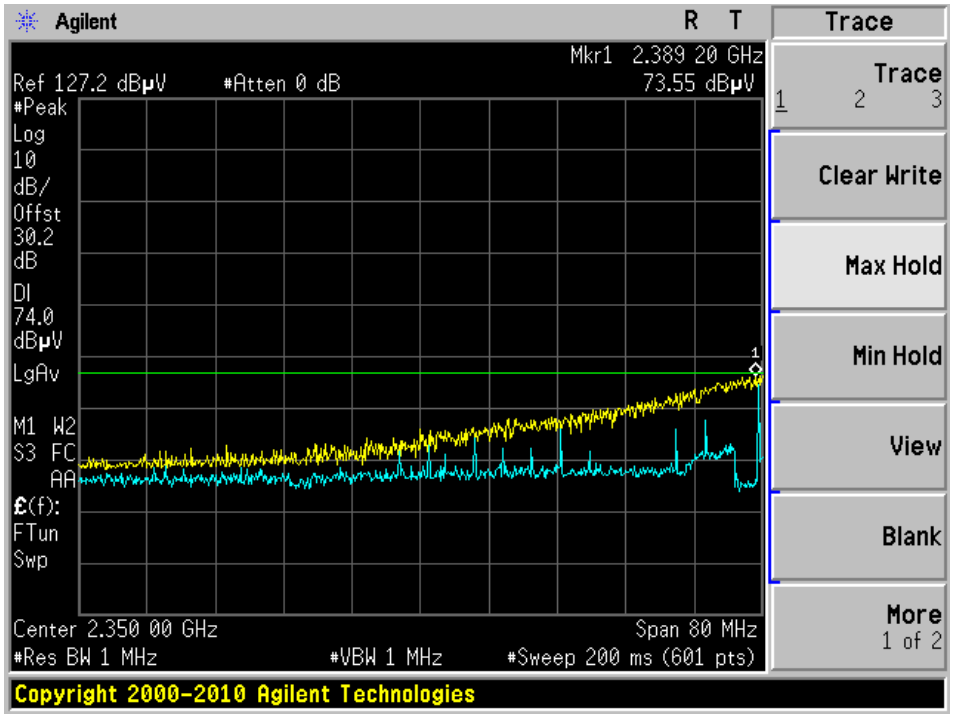
2) Above 1 GHz measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
802.11 b, Low Channel 2412 MHz, measured at 3 meters											
4824	45.04	160	100	V	32.884	4.06	27.5	54.484	74	-19.516	peak
4824	43.07	208	100	H	32.884	4.06	27.5	52.514	74	-21.486	peak
4824	43.18	160	100	V	32.884	4.06	27.5	52.624	54	-1.376	Ave
4824	40.64	208	100	H	32.884	4.06	27.5	50.084	54	-3.916	Ave
802.11 b, Middle Channel 2437 MHz, measured at 3 meters											
4874	45.62	357	100	V	32.957	4.1	27.4	55.277	74	-18.723	peak
4874	42.59	142	173	H	32.957	4.1	27.4	52.247	74	-21.753	peak
4874	44.21	357	100	V	32.957	4.1	27.4	53.867	54	-0.133	Ave
4874	40.33	142	173	H	32.957	4.1	27.4	49.987	54	-4.013	Ave
802.11 b, High Channel 2462 MHz, measured at 3 meters											
4924	45.08	218	100	V	32.957	4.1	27.4	54.737	74	-19.263	peak
4924	41.29	73	100	H	32.957	4.1	27.4	50.947	74	-23.053	peak
4924	43.86	218	100	V	32.957	4.1	27.4	53.517	54	-0.483	Ave
4924	38.88	73	100	H	32.957	4.1	27.4	48.537	54	-5.463	Ave
802.11 g, Low Channel 2412 MHz, measured at 3 meters											
4824	42.55	219	100	V	32.884	4.06	27.5	51.994	74	-22.006	peak
4824	40.94	221	168	H	32.884	4.06	27.5	50.384	74	-23.616	peak
4824	31.12	219	100	V	32.884	4.06	27.5	40.564	54	-13.436	Ave
4824	25.44	221	168	H	32.884	4.06	27.5	34.884	54	-19.116	Ave
802.11 g, Middle Channel 2437 MHz, measured at 3 meters											
4874	53.32	210	100	V	32.957	4.1	27.4	62.977	74	-11.023	peak
4874	50.29	60	100	H	32.957	4.1	27.4	59.947	74	-14.053	peak
4874	43.21	210	100	V	32.957	4.1	27.4	52.867	54	-1.133	Ave
4874	39.28	60	100	H	32.957	4.1	27.4	48.937	54	-5.063	Ave
802.11 g, High Channel 2462 MHz, measured at 3 meters											
4924	44.07	20	100	V	32.957	4.1	27.4	53.727	74	-20.273	peak
4924	43.19	65	169	H	32.957	4.1	27.4	52.847	74	-21.153	peak
4924	29.48	20	100	V	32.957	4.1	27.4	39.137	54	-14.863	Ave
4924	28.2	65	169	H	32.957	4.1	27.4	37.857	54	-16.143	Ave

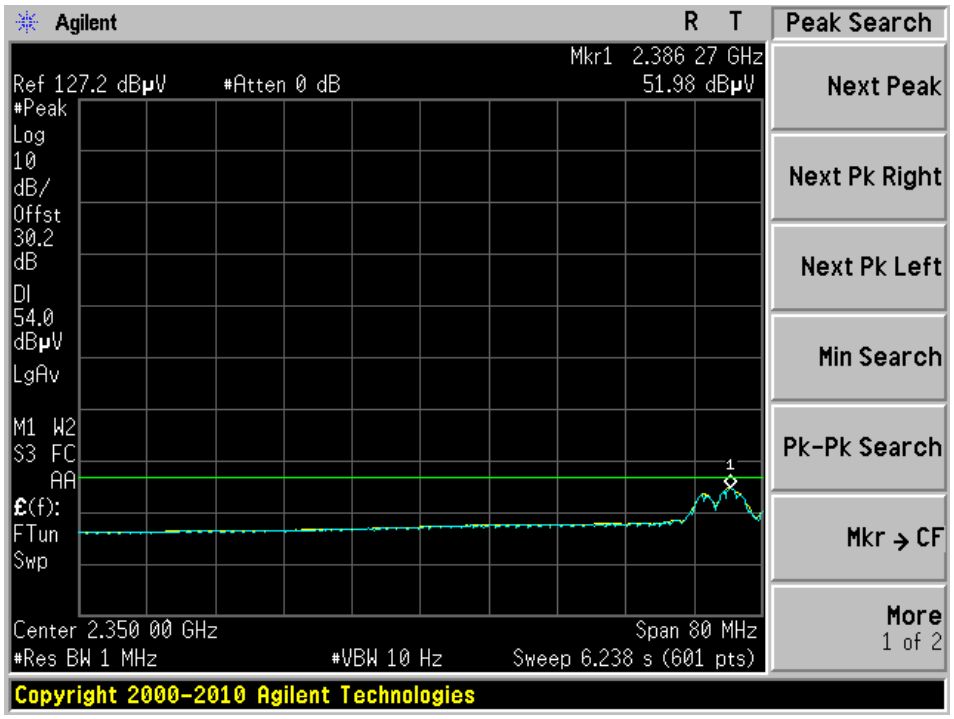
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Amp. (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
802.11n HT20, Low Channel 2412 MHz, measured at 3 meters											
4824	46.64	260	112	V	32.884	4.06	27.5	56.084	74	-17.916	peak
4824	42.97	319	100	H	32.884	4.06	27.5	52.414	74	-21.586	peak
4824	32.13	319	112	V	32.884	4.06	27.5	41.574	54	-12.426	Ave
4824	27.94	248	100	H	32.884	4.06	27.5	37.384	54	-16.616	Ave
802.11n HT20, Middle Channel 2437 MHz, measured at 3 meters											
4874	48.08	250	100	V	32.957	4.1	27.4	57.737	74	-16.263	peak
4874	43.77	60	100	H	32.957	4.1	27.4	53.427	74	-20.573	peak
4874	33.72	250	100	V	32.957	4.1	27.4	43.377	54	-10.623	Ave
4874	30.24	60	100	H	32.957	4.1	27.4	39.897	54	-14.103	Ave
802.11n HT20, High Channel 2462 MHz, measured at 3 meters											
4924	47.83	228	100	V	32.957	4.1	27.4	57.487	74	-16.263	peak
4924	44.37	73	100	H	32.957	4.1	27.4	54.027	74	-20.573	peak
4924	33.38	228	100	V	32.957	4.1	27.4	43.037	54	-10.623	Ave
4924	29.75	73	100	H	32.957	4.1	27.4	39.407	54	-14.103	Ave

3) Spurious Emissions in the Restricted Bands

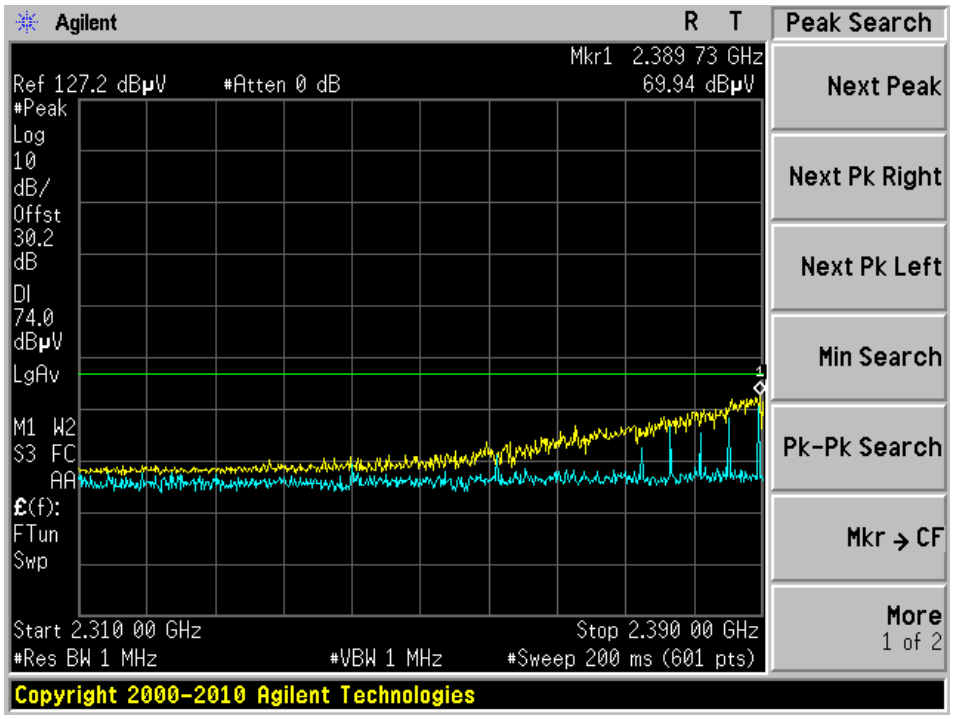
802.11b mode, Low channel, Vertical, Peak measurement



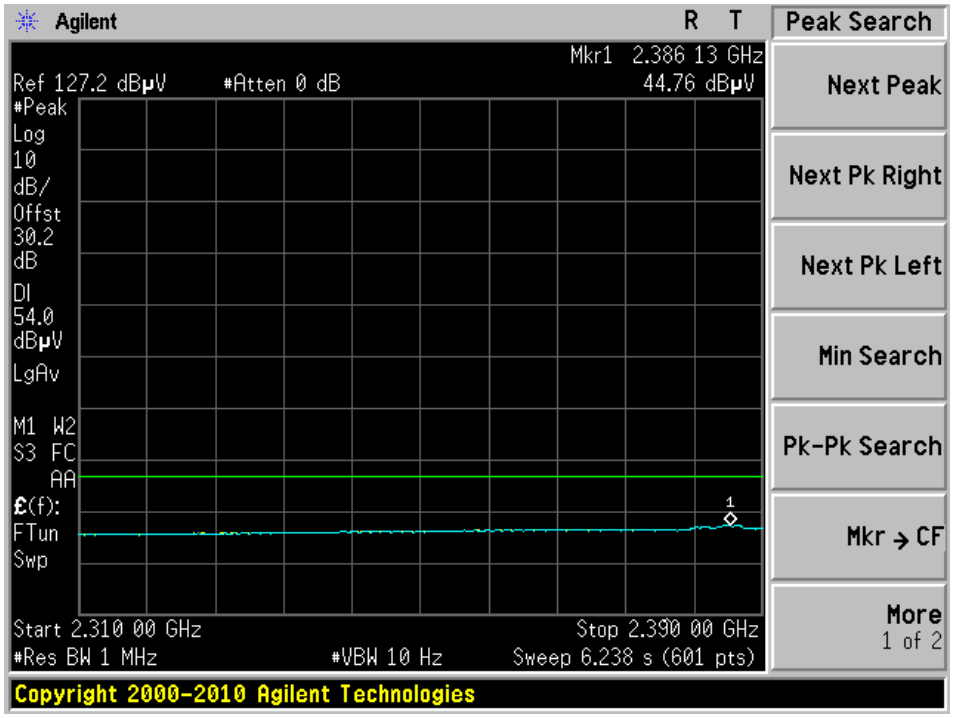
802.11b mode, Low channel, Vertical, Average measurement



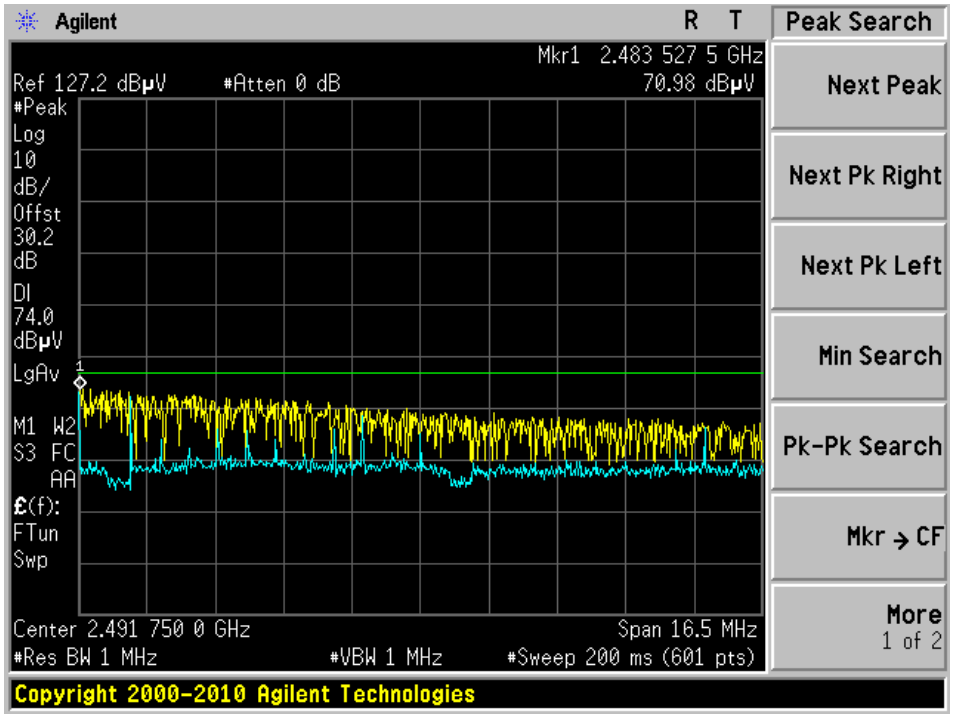
802.11b mode, Low channel, Horizontal, Peak measurement



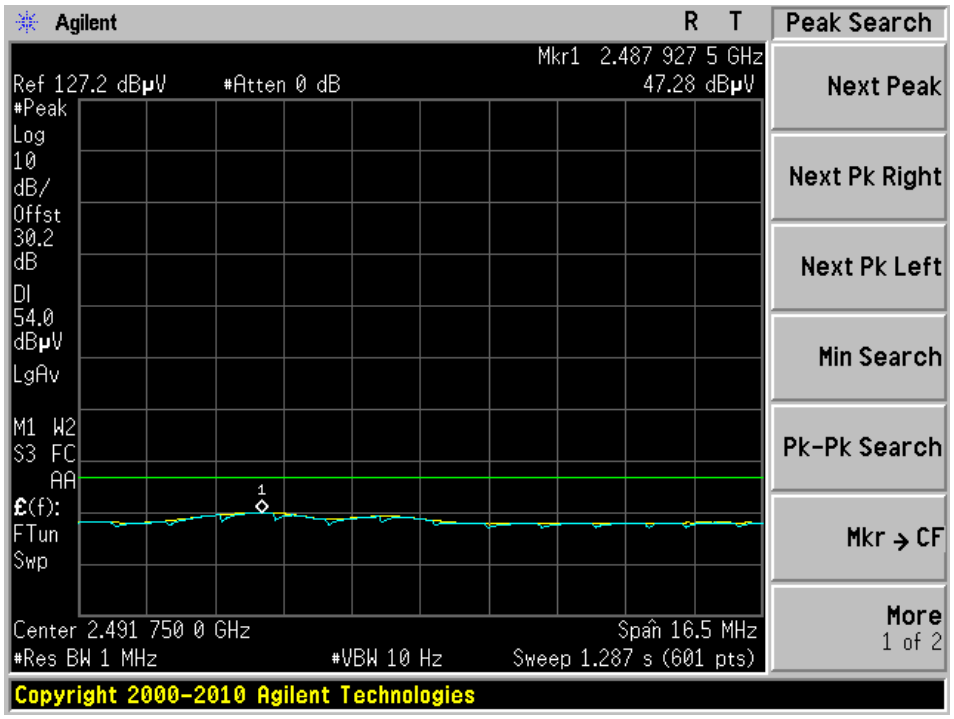
802.11b mode, Low channel, Horizontal, Average measurement



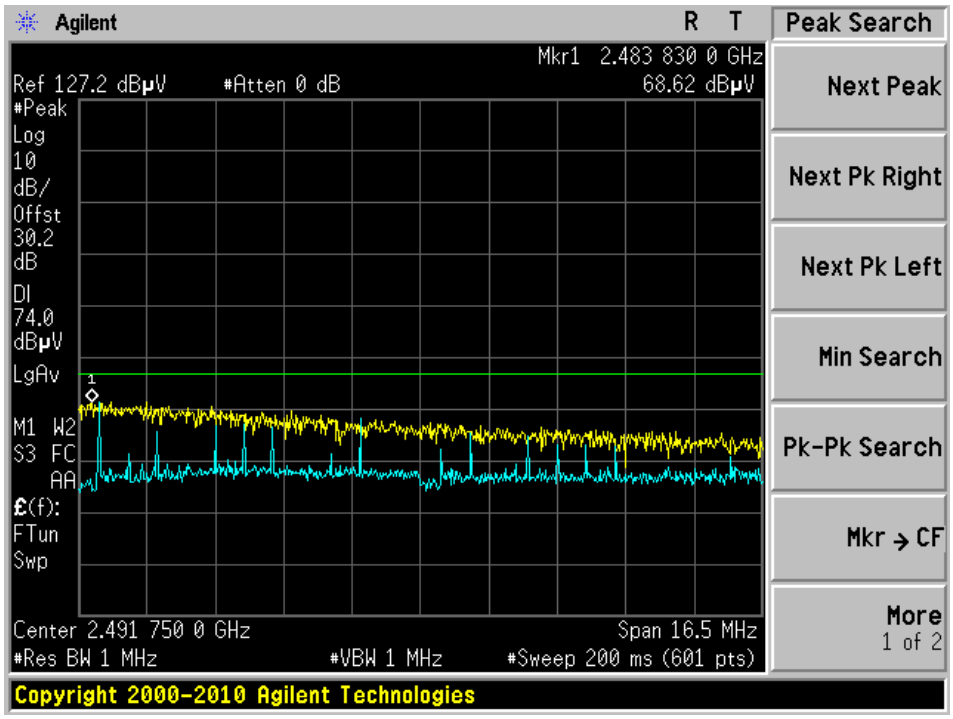
802.11b mode, High channel, Vertical, Peak measurement



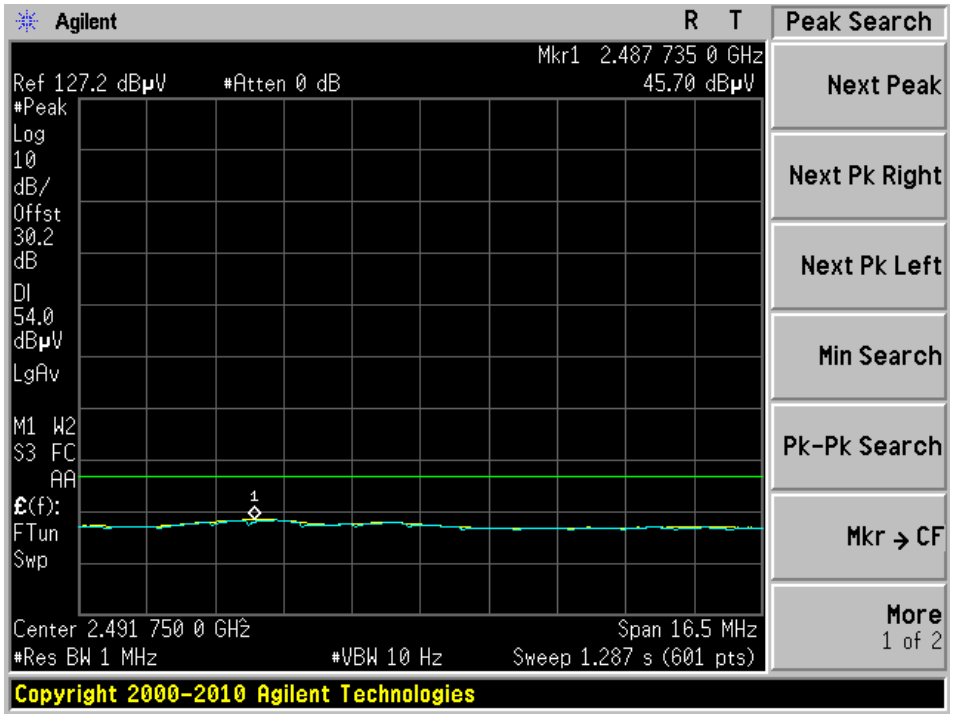
802.11b mode, High channel, Vertical, Average measurement



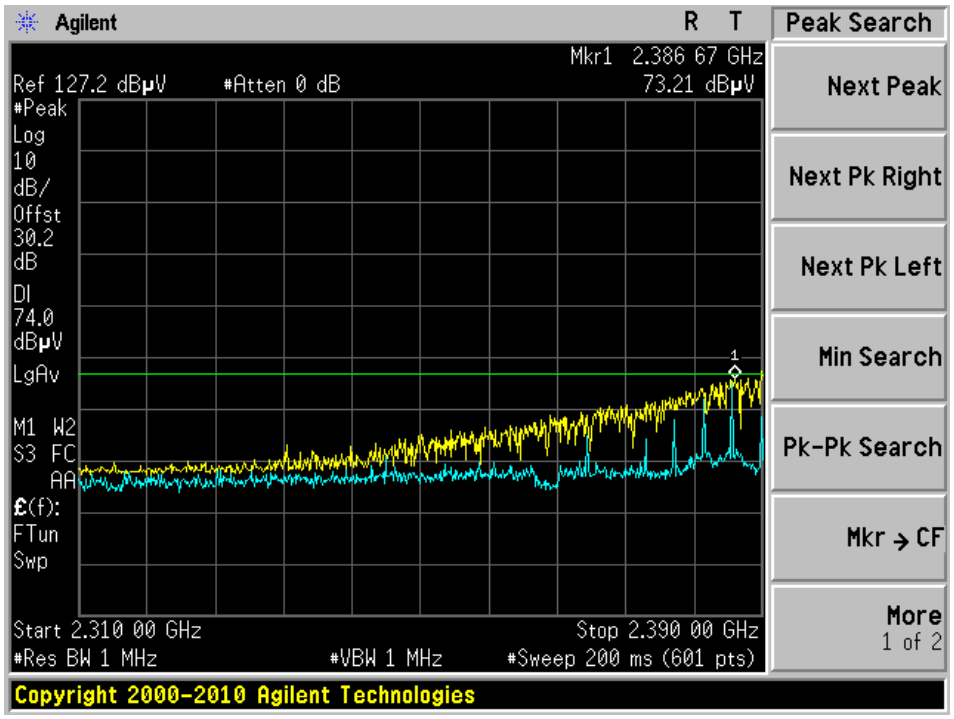
802.11b mode, High channel, Horizontal, Peak measurement



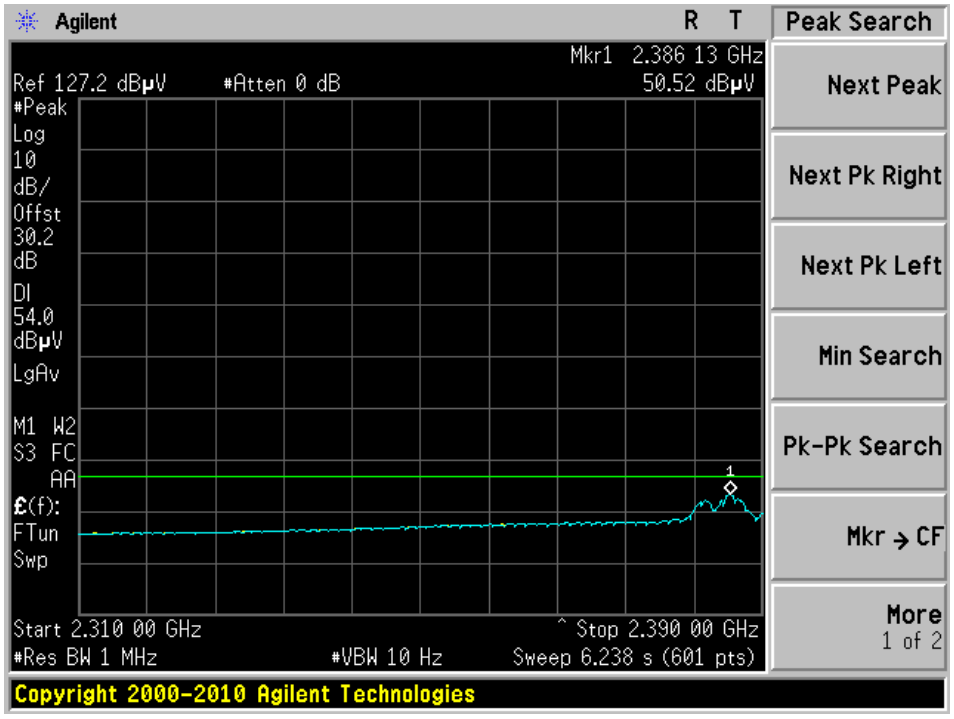
802.11b mode, High channel, Horizontal, Average measurement



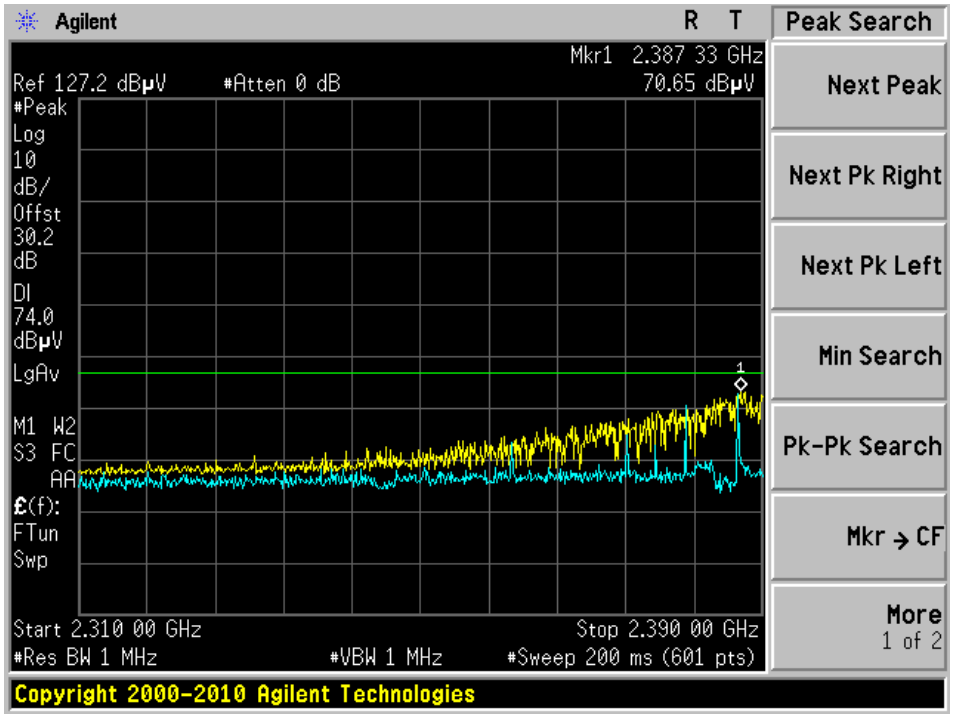
802.11g mode, Low channel, Vertical, Peak measurement



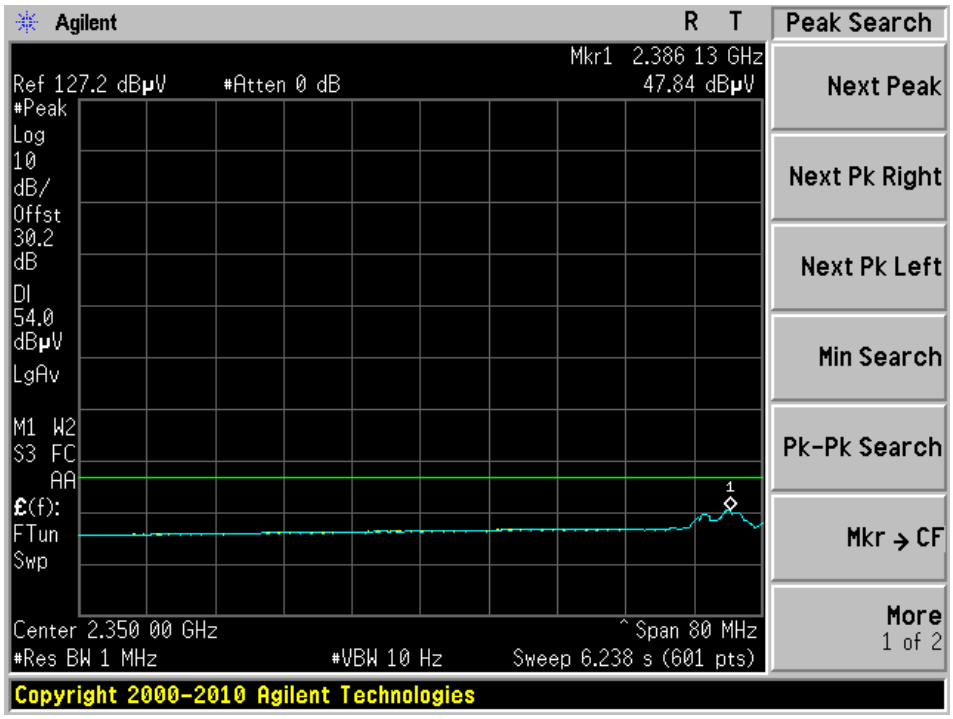
802.11g mode, Low channel, Vertical, Average measurement



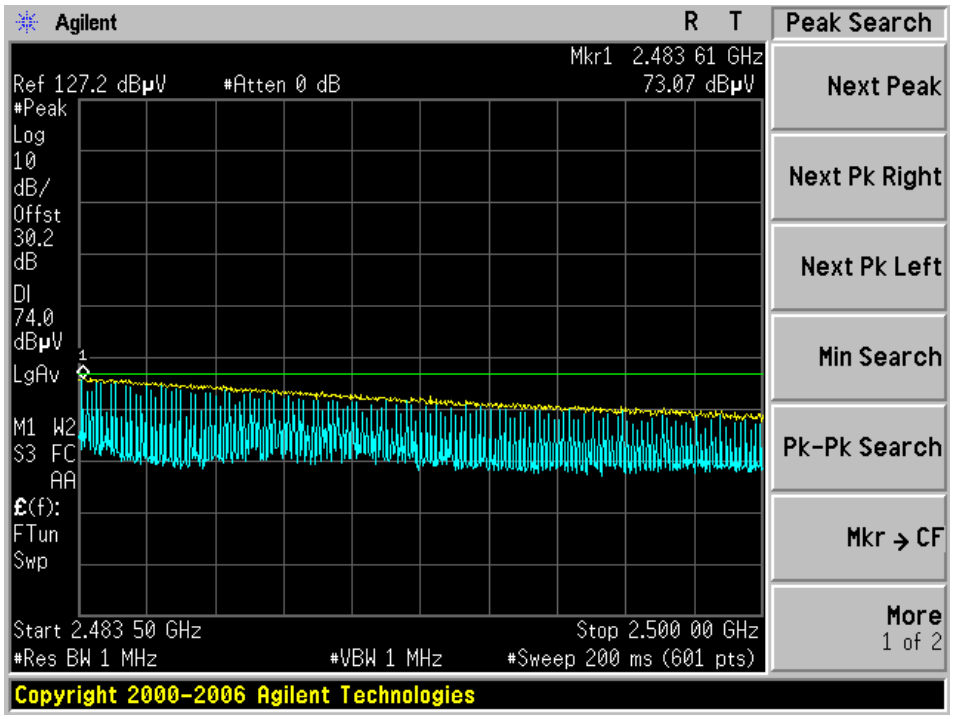
802.11g mode, Low channel, Horizontal, Peak measurement



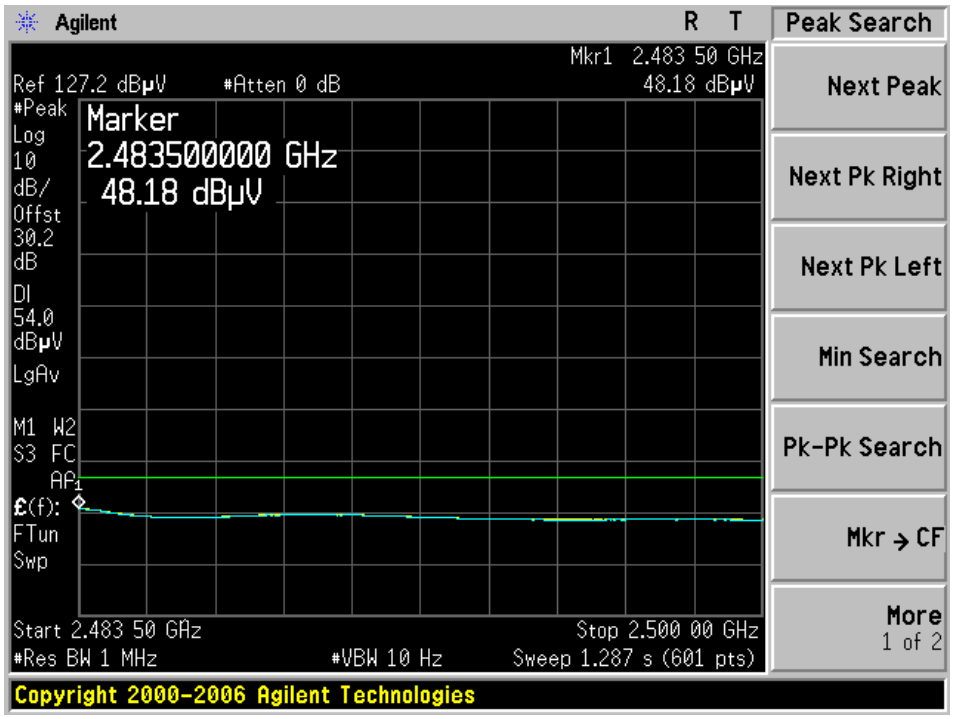
802.11g mode, Low channel, Horizontal, Average measurement



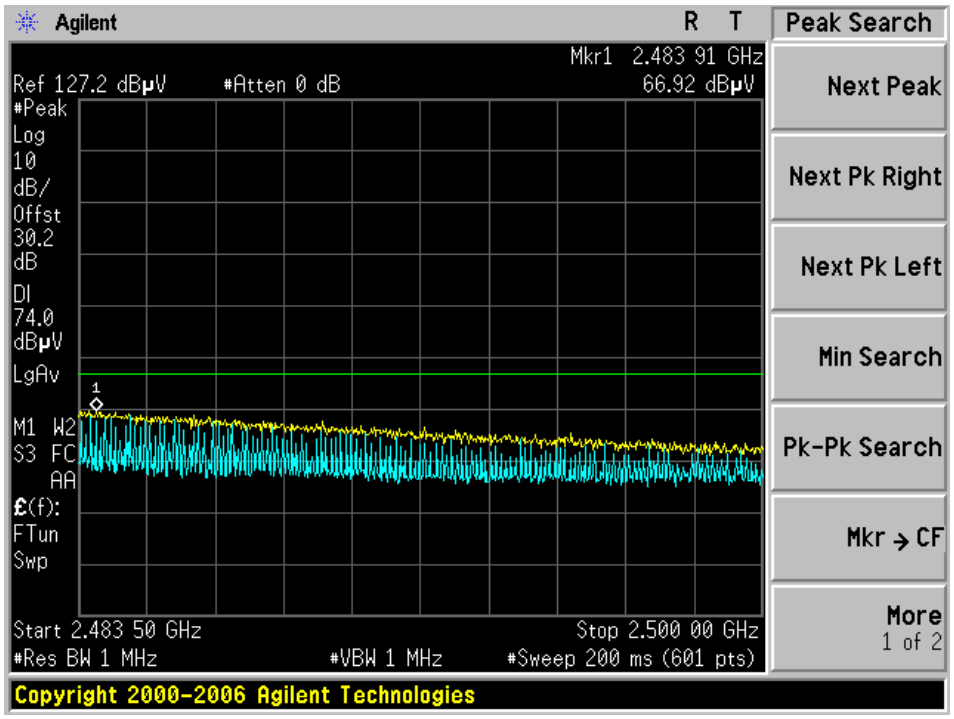
802.11g mode, High channel, Vertical, Peak measurement



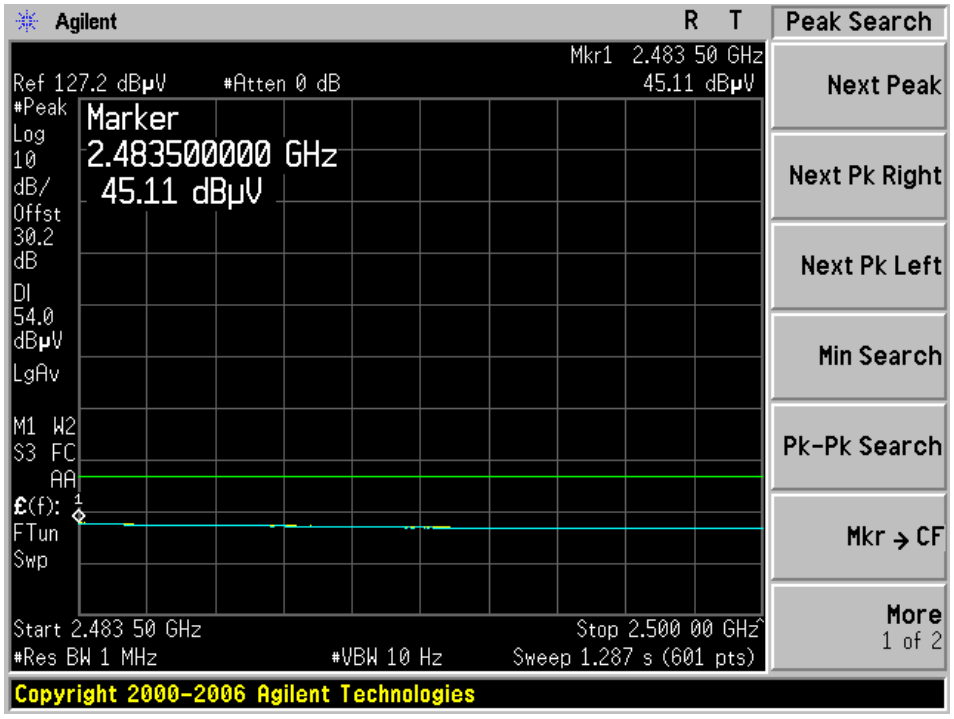
802.11g mode, High channel, Vertical, Average measurement



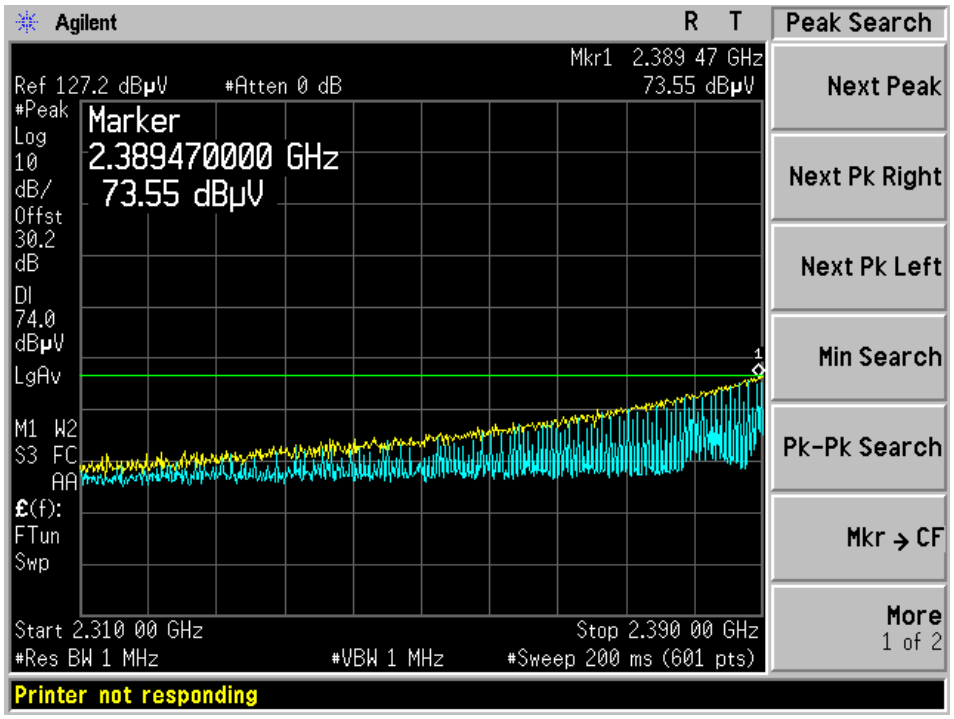
802.11g mode, High channel, Horizontal, Peak measurement



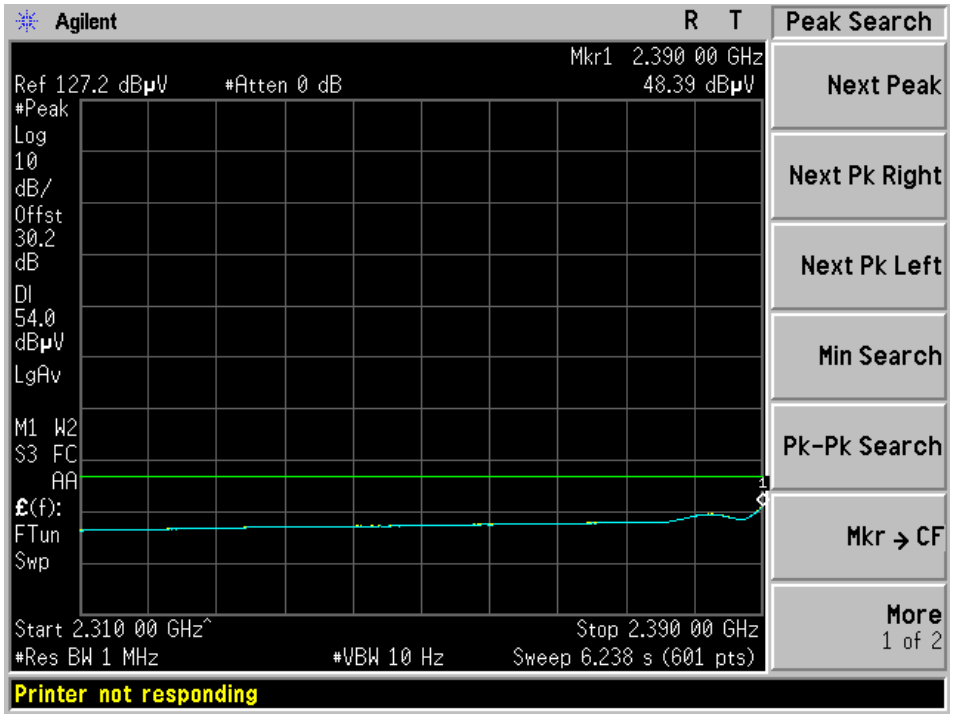
802.11g mode, High channel, Horizontal, Average measurement



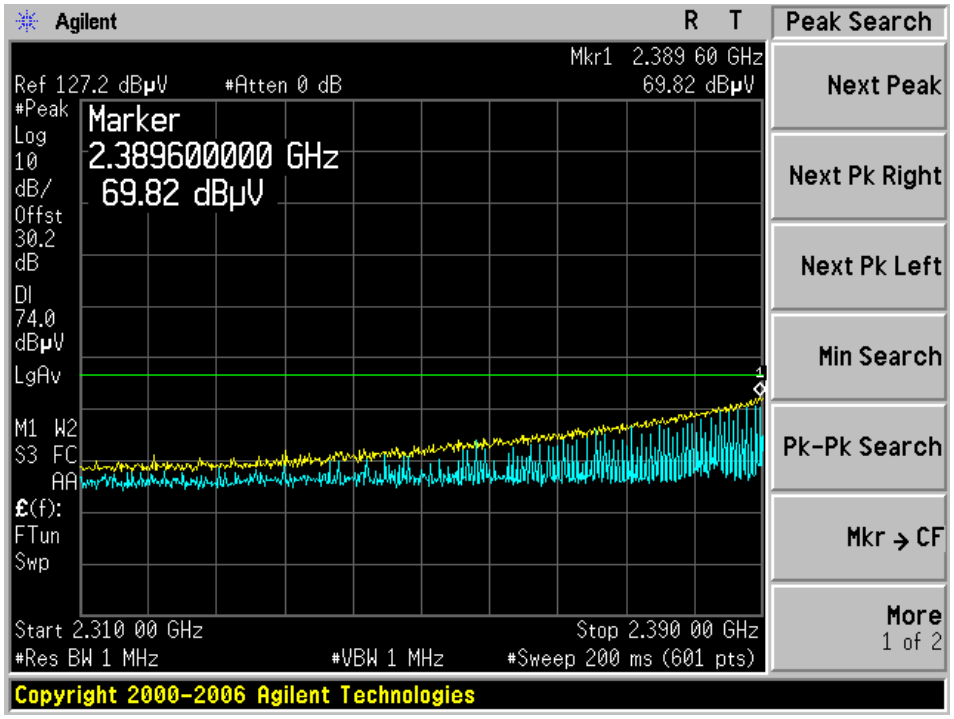
802.11n HT20 mode, Low channel, Vertical, Peak measurement



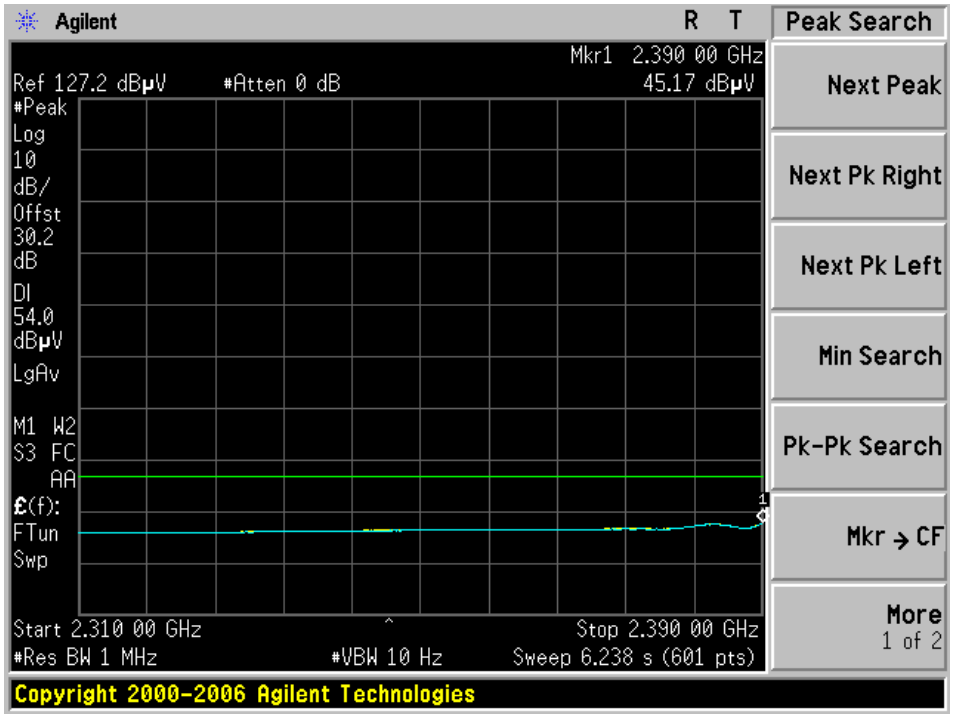
802.11n HT20 mode, Low channel, Vertical, Average measurement



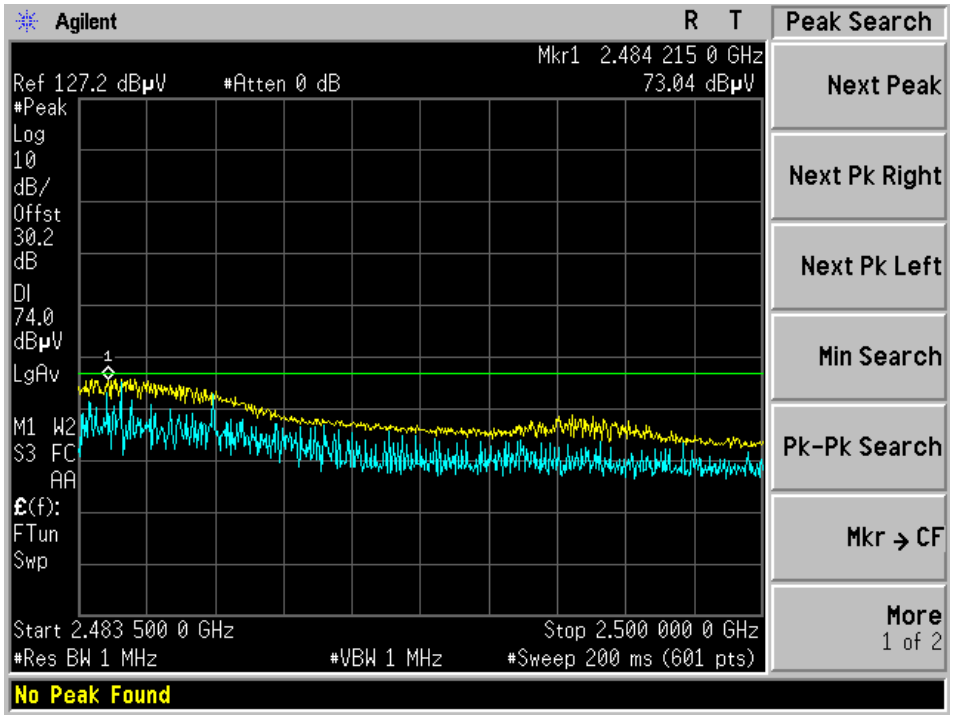
802.11n HT20 mode, Low channel, Horizontal, Peak measurement



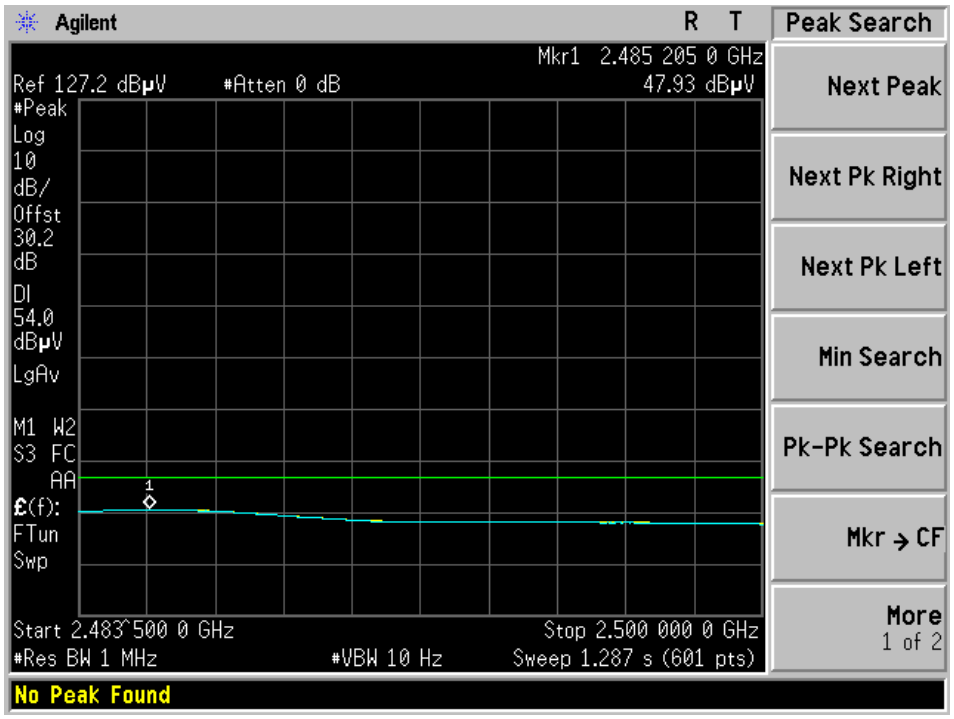
802.11n HT20 mode, Low channel, Horizontal, Average measurement



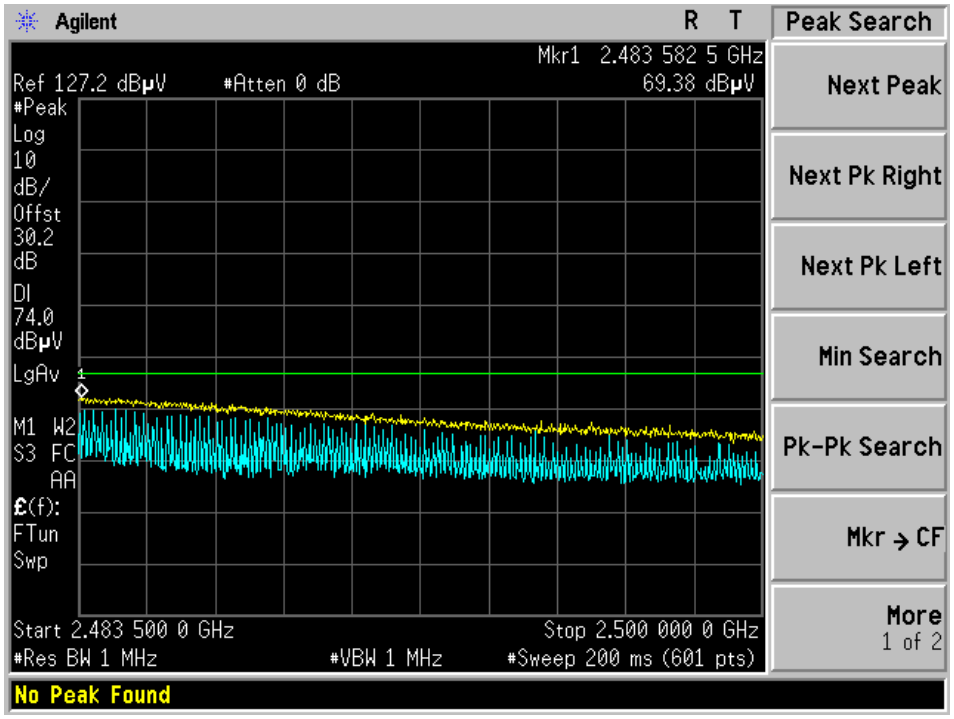
802.11n HT20 mode, High channel, Vertical, Peak measurement



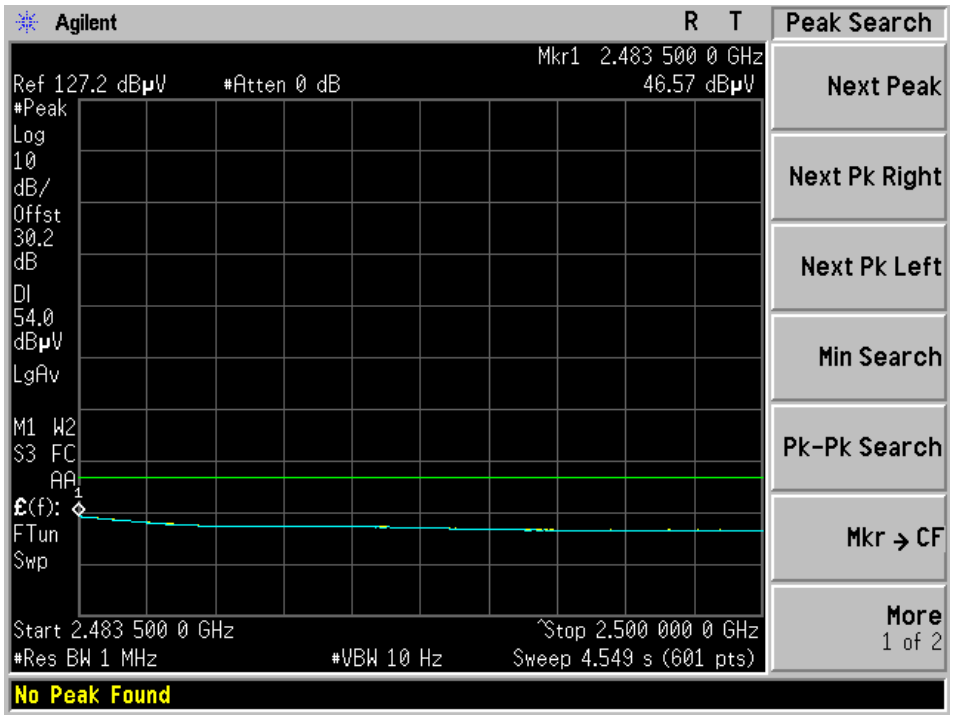
802.11n HT20 mode, High channel, Vertical, Average measurement



802.11n HT20 mode, High channel, Horizontal, Peak measurement



802.11n HT20 mode, High channel, Horizontal, Average measurement



9 FCC §15.247(a) (2) – 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

9.2 Test Procedure

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

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10

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

9.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

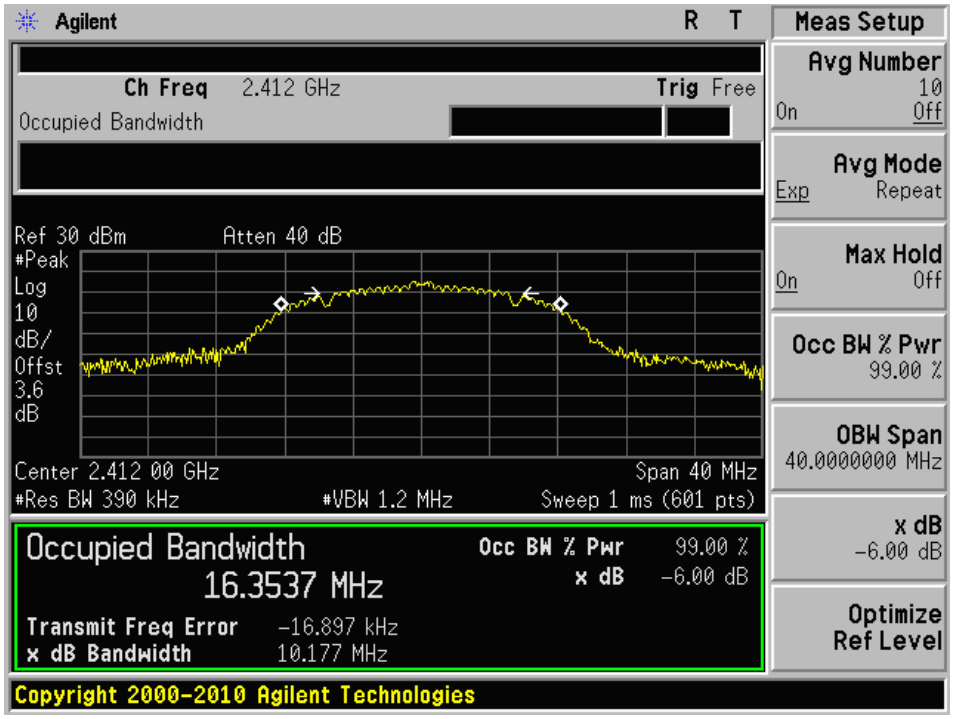
The testing was performed by Wei Sun on 2012-03-18 on RF Site.

9.5 Test Results

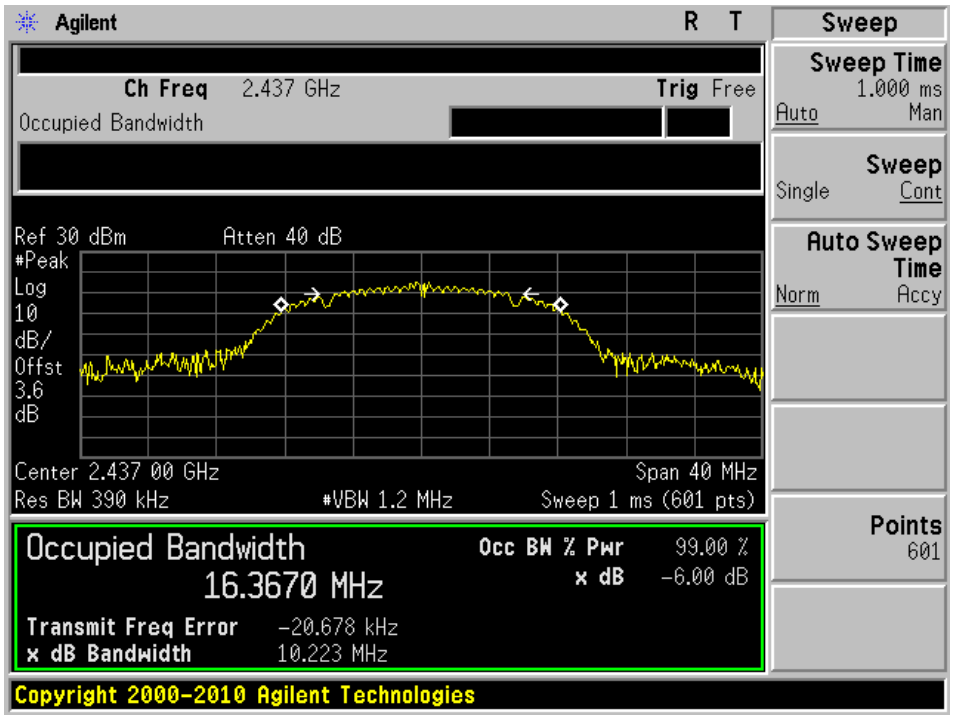
Antenna	Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	6 dB Emission Bandwidth (MHz)	Limit (kHz)	Results
802.11b (Note: 802.11b only working on Chain0, there is no Chain1 functional for 802.11b mode)						
Chain 0	Low	2412	16.3537	10.177	> 500	Compliant
	Middle	2437	16.3670	10.223	> 500	Compliant
	High	2462	16.3622	10.197	> 500	Compliant
802.11g						
Chain 0	Low	2412	17.2985	16.721	> 500	Compliant
	Middle	2437	17.2243	16.790	> 500	Compliant
	High	2462	17.2252	16.557	> 500	Compliant
Chain 1	Low	2412	17.1472	16.633	> 500	Compliant
	Middle	2437	17.1590	16.455	> 500	Compliant
	High	2462	17.1872	16.610	> 500	Compliant
802.11n20						
Chain 0	Low	2412	17.8868	17.568	> 500	Compliant
	Middle	2437	17.9446	17.587	> 500	Compliant
	High	2462	17.9387	17.715	> 500	Compliant
Chain 1	Low	2412	18.0763	17.845	> 500	Compliant
	Middle	2437	18.0419	17.822	> 500	Compliant
	High	2462	18.1511	17.960	> 500	Compliant

Please refer to the following plots for detailed test results

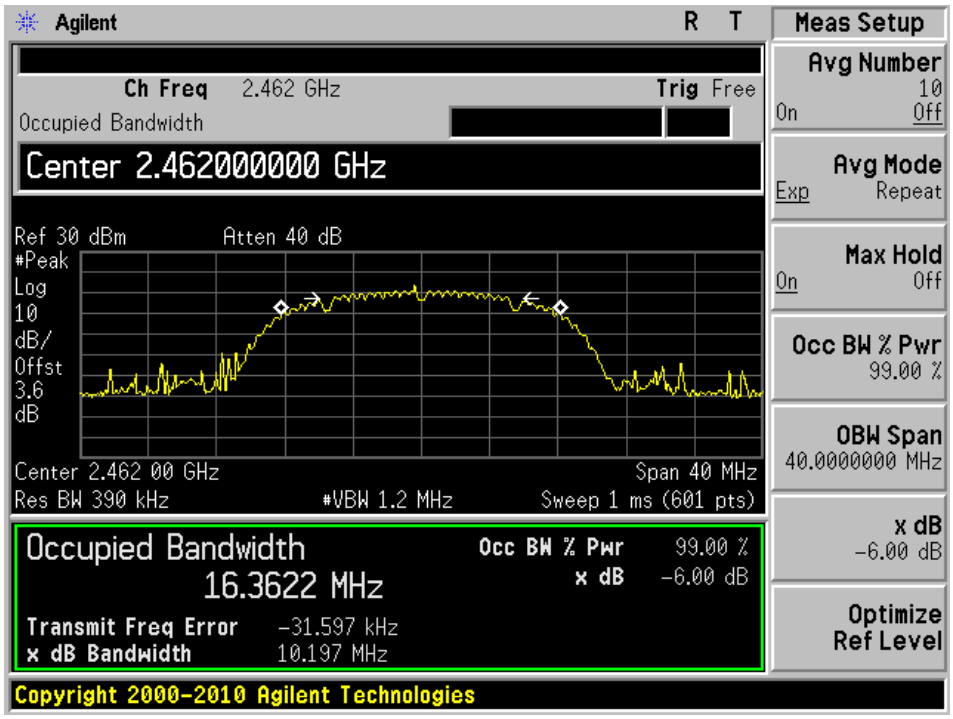
Antenna 0, 802.11 b Low Channel 2412 MHz



Antenna 0, 802.11 b Middle Channel 2437 MHz

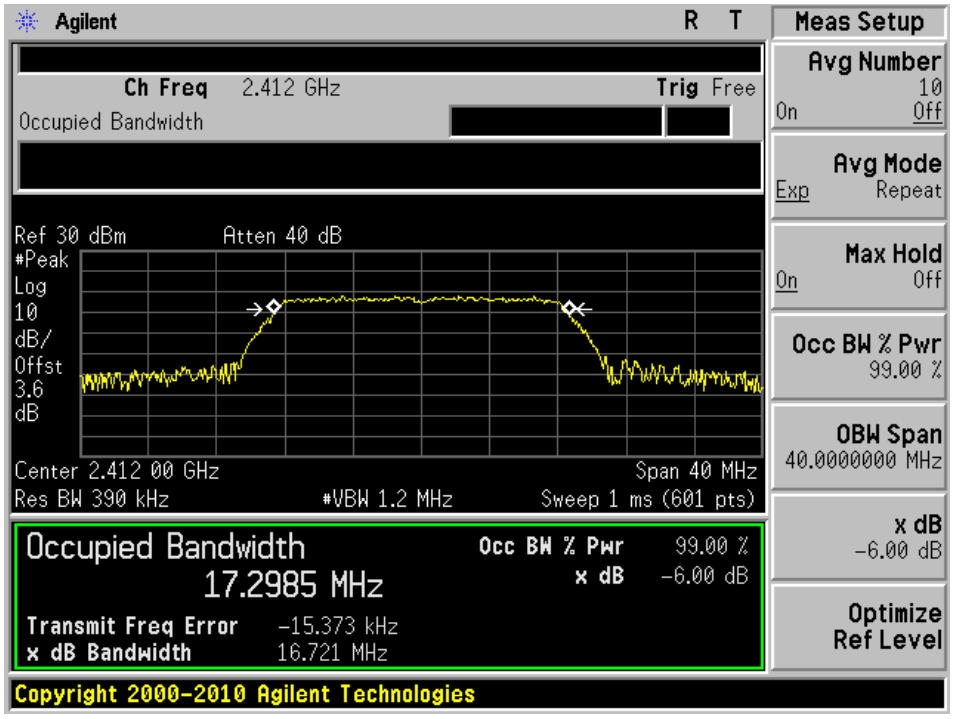


Antenna 0, 802.11 b High Channel 2462 MHz

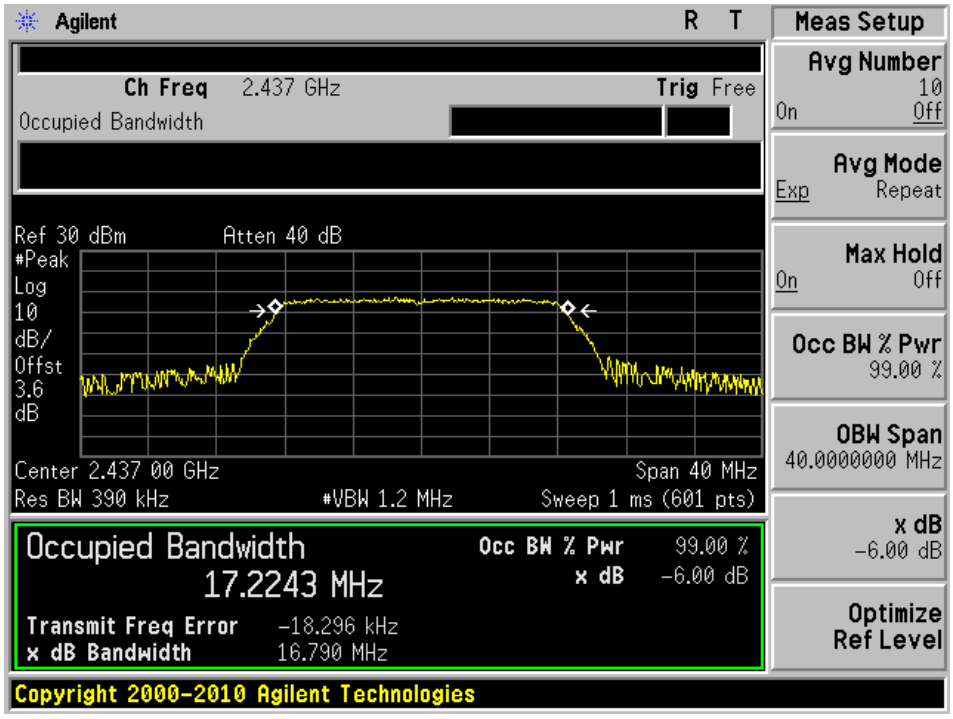


Note: 802.11b only working on Chain 0, there is no Chain1 functional for 802.11b mode.

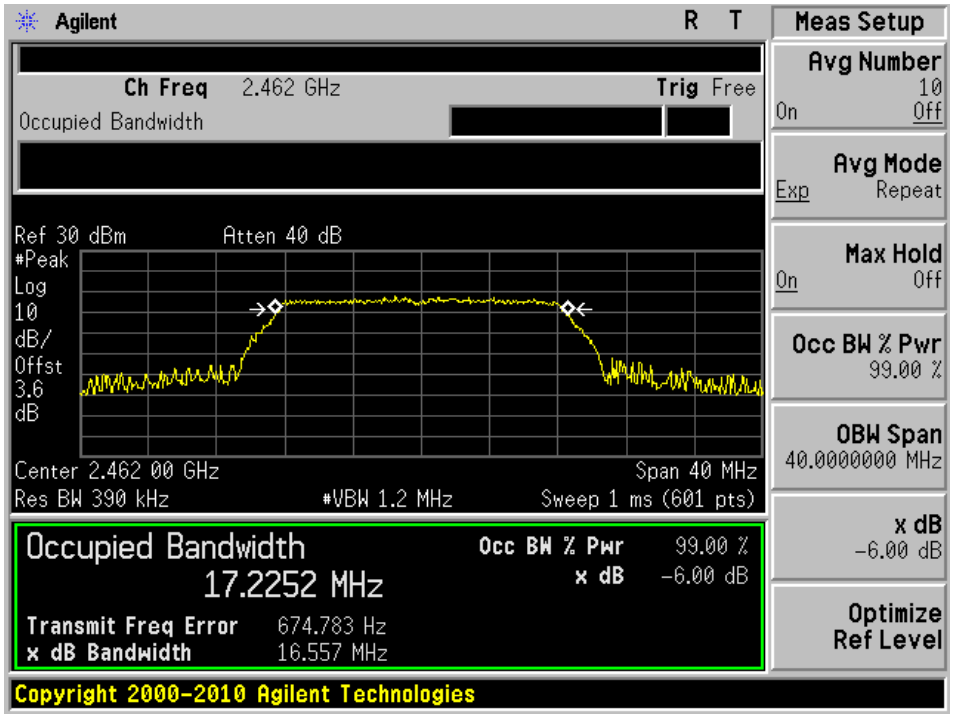
Antenna 0, 802.11 g Low Channel 2412 MHz



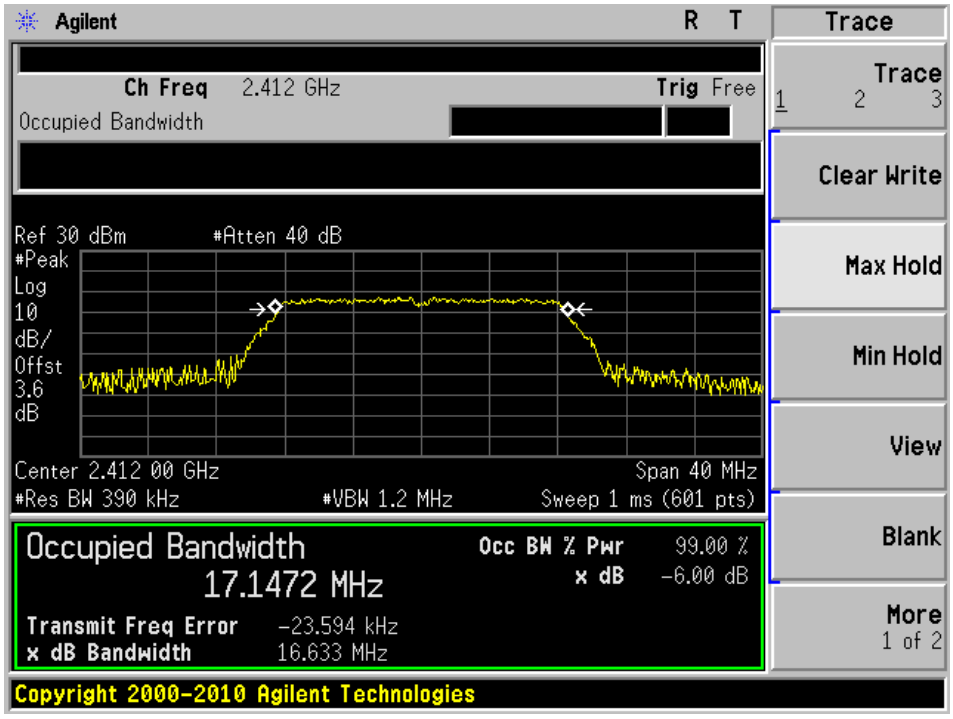
Antenna 0, 802.11 g Middle Channel 2437 MHz



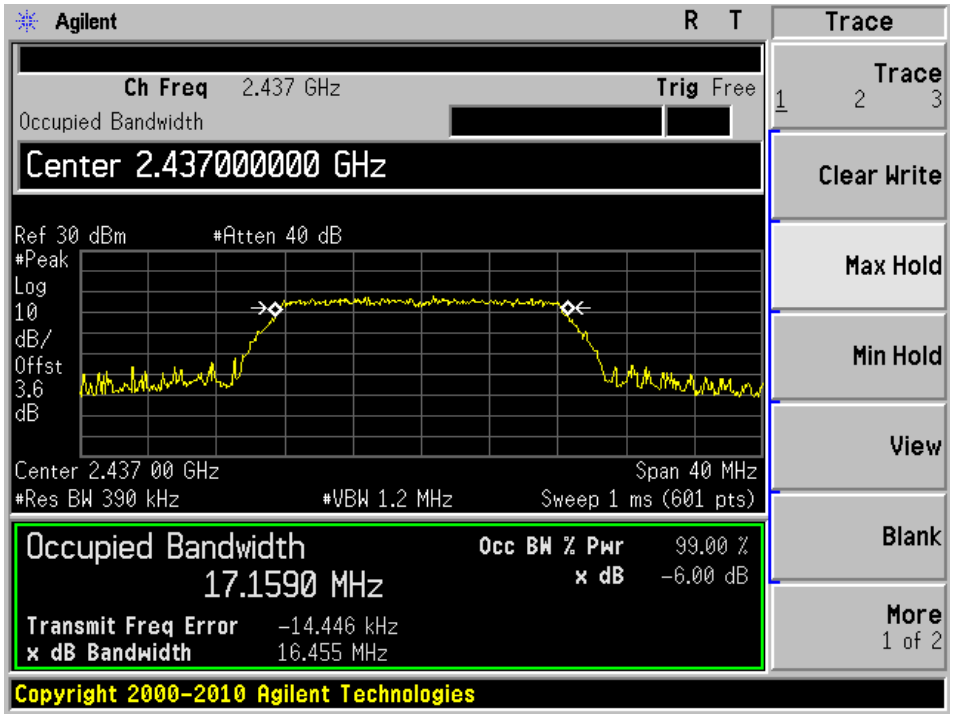
Antenna 0, 802.11 g High Channel 2462 MHz



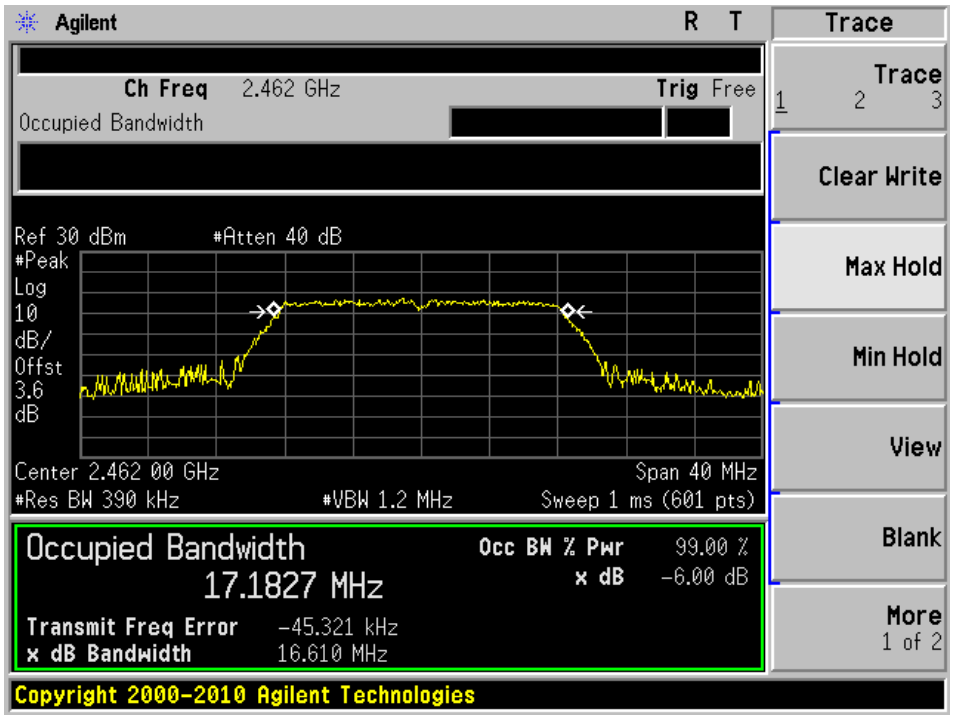
Antenna 1, 802.11 g Low Channel 2412 MHz



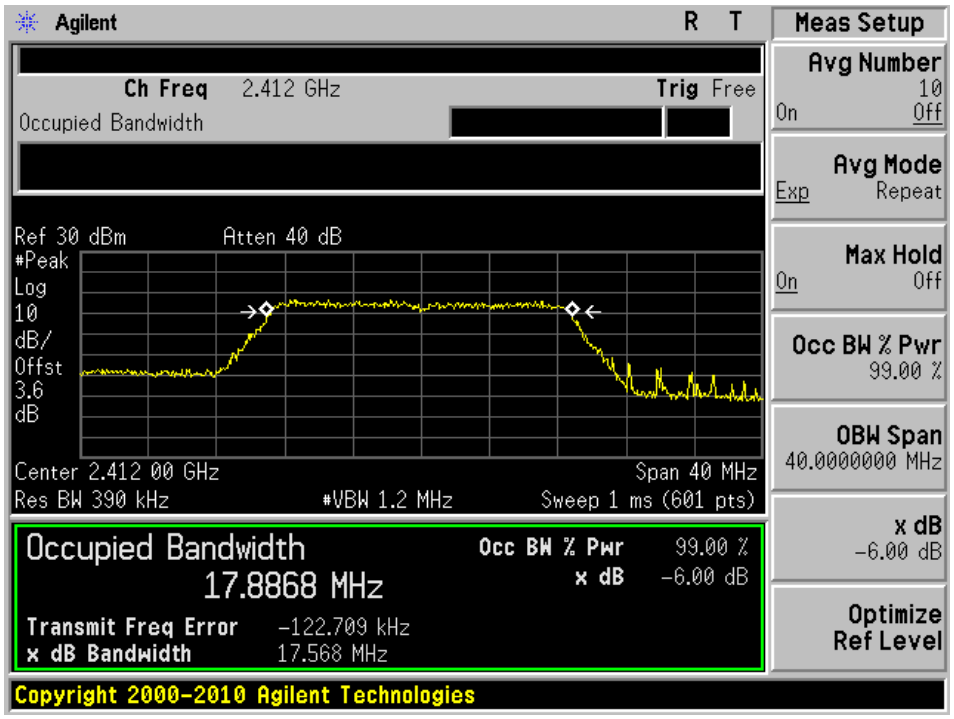
Antenna 1, 802.11 g Middle Channel 2437 MHz



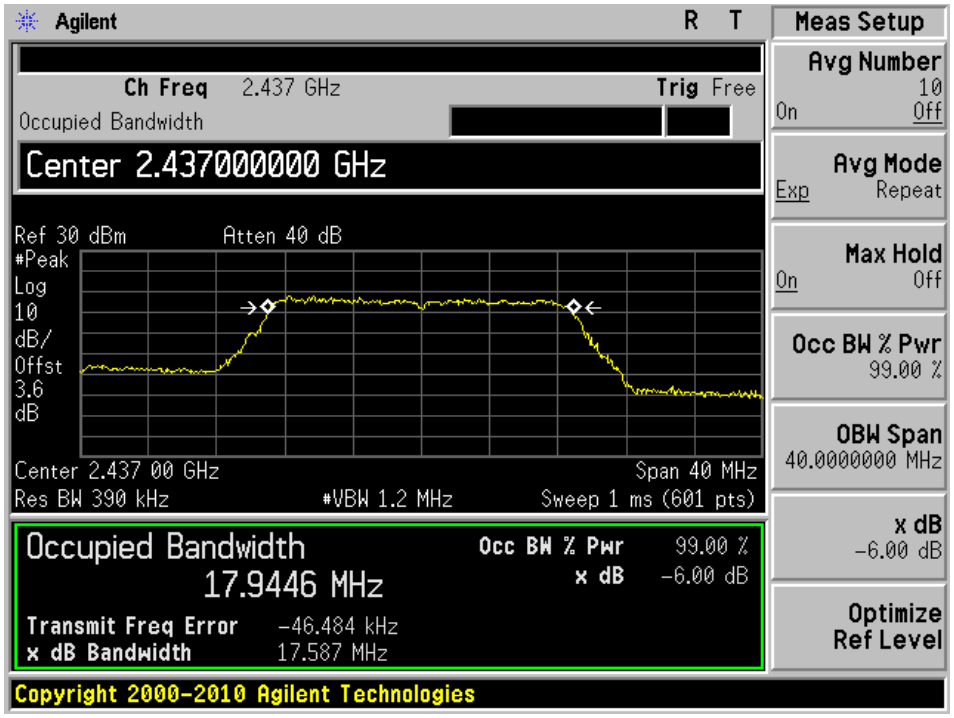
Antenna 1, 802.11 g High Channel 2462 MHz



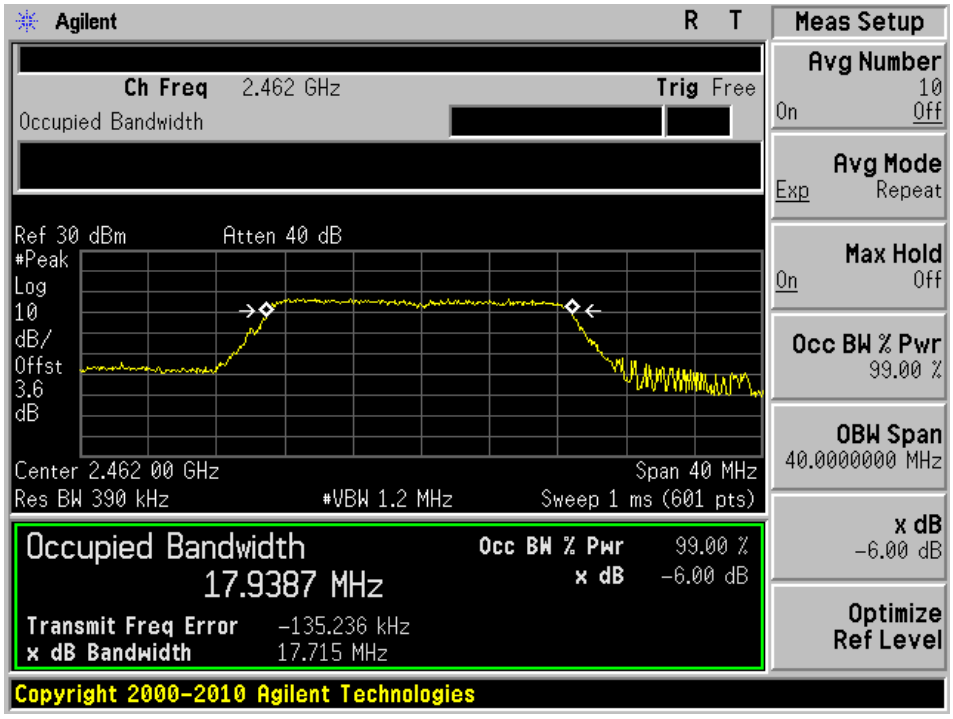
Antenna 0, 802.11n HT20, Low Channel 2412 MHz



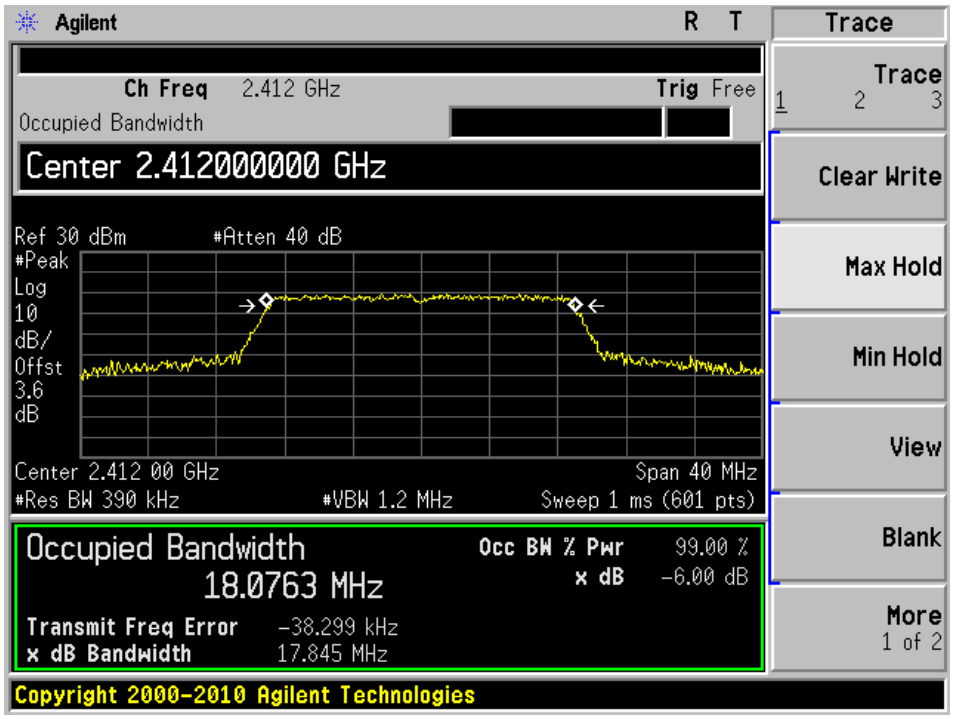
Antenna 0, 802.11n HT20, Middle Channel 2437 MHz



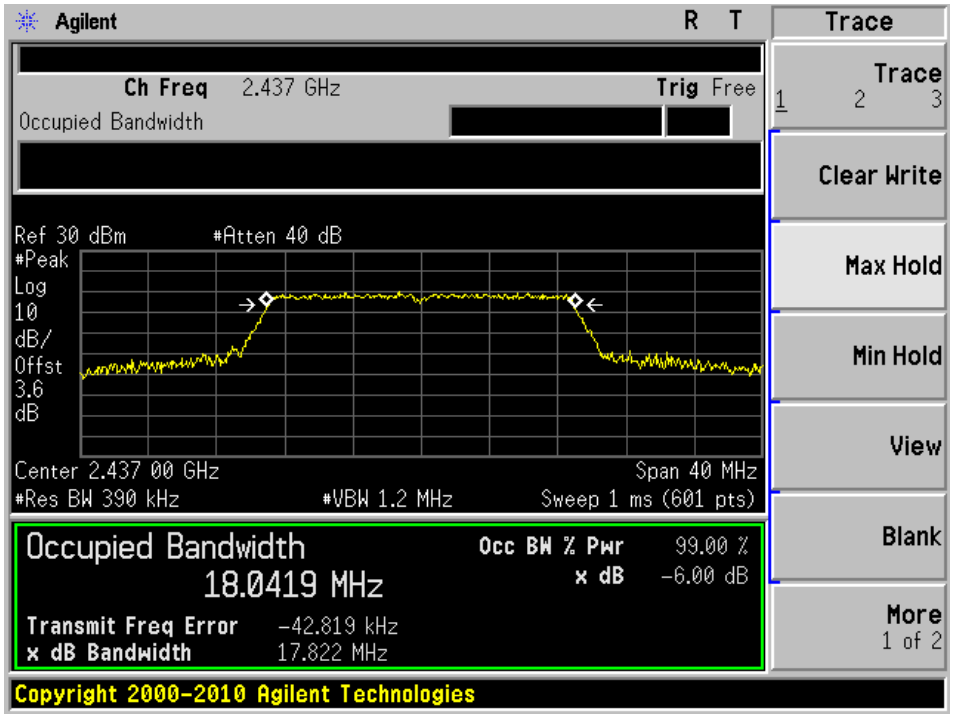
Antenna 0, 802.11n HT20, High Channel 2462 MHz



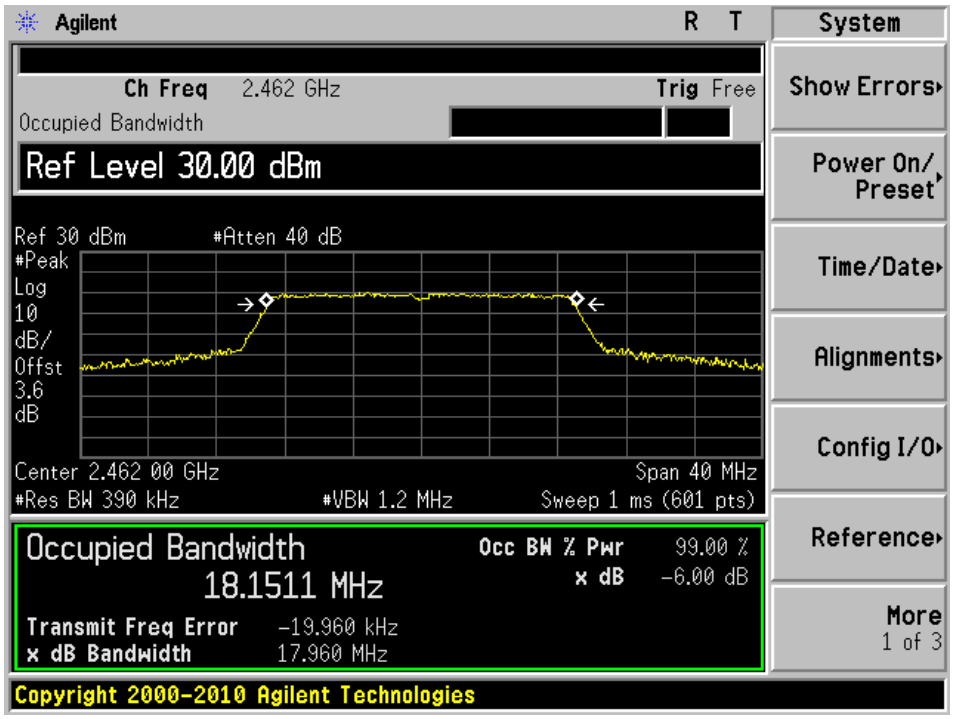
Antenna 1, 802.11n HT20, Low Channel 2412 MHz



Antenna 1, 802.11n HT20, Middle Channel 2437 MHz



Antenna 1, 802.11n HT20, High Channel 2462 MHz



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

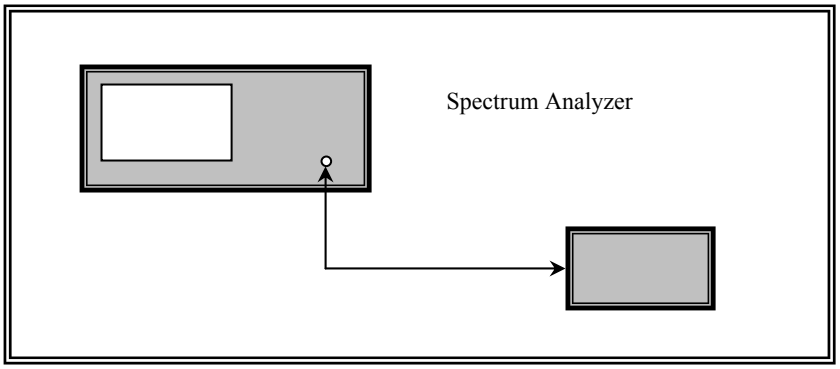
10.1 Applicable Standard

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

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

10.2 Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10

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:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

The testing was performed Wei Sun on 2012-03-19 on RF Site.

10.5 Test Results

802.11 b:

Channel	Frequency (MHz)	Output Power @ Chain 0 (dBm)	Output Power @ Chain 1 (dBm)	Highest Power (dBm)	Limit (dBm)	Margin (dB)
Low (Power Level=23)	2412	19.77	-	19.77	30	-10.23
Mid (Power Level=24)	2437	19.20	-	19.20	30	-10.8
High (Power Level=25)	2462	18.23	-	18.23	30	-11.77

802.11 g:

Channel	Frequency (MHz)	Output Power @ Chain 0 (dBm)	Output Power @ Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low (Power Level=21)	2412	14.42	14.02	17.23	30	-12.77
Mid (Power Level=13)	2437	18.39	18.11	21.26	30	-8.74
High (Power Level=16)	2462	16.9	16.38	19.658	30	-10.342

802.11n HT20:

Channel	Frequency (MHz)	Output Power @ Chain 0 (dBm)	Output Power @ Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low (Power Level=16)	2412	16.92	16.54	19.744	30	-10.256
Mid (Power Level=0)	2437	21.15	21.11	24.14	30	-5.86
High (Power Level=15)	2462	17.30	17.1	20.21	30	-9.79

11 FCC §15.247(d) - 100 kHz Bandwidth of Band Edges

11.1 Applicable Standard

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c)).

11.2 Test Procedure

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

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10

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

11.4 Test Environmental Conditions

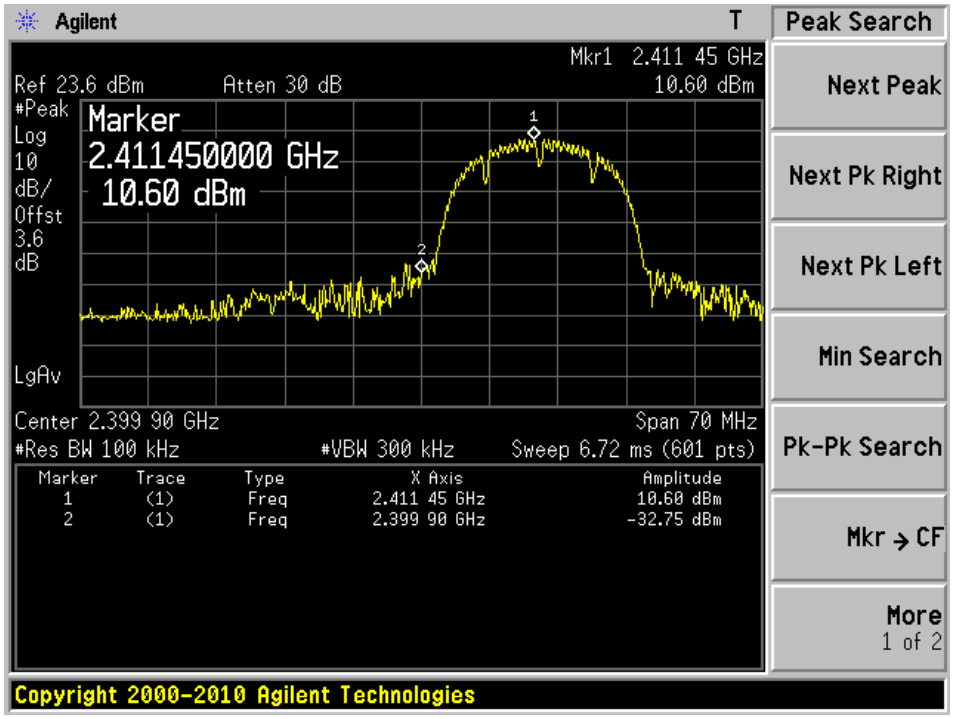
Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

The testing was performed by Wei Sun 2012-03-18 on RF Site.

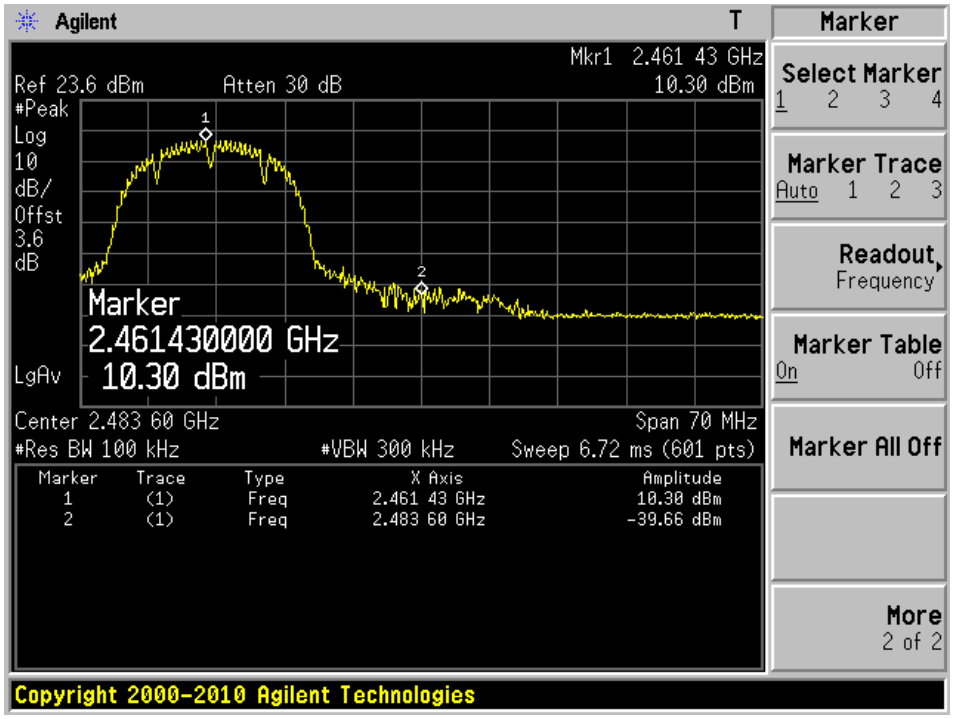
11.5 Test Results

Please refer to following pages for plots of band edge.

Antenna 0, 802.11 b Low Band Edge

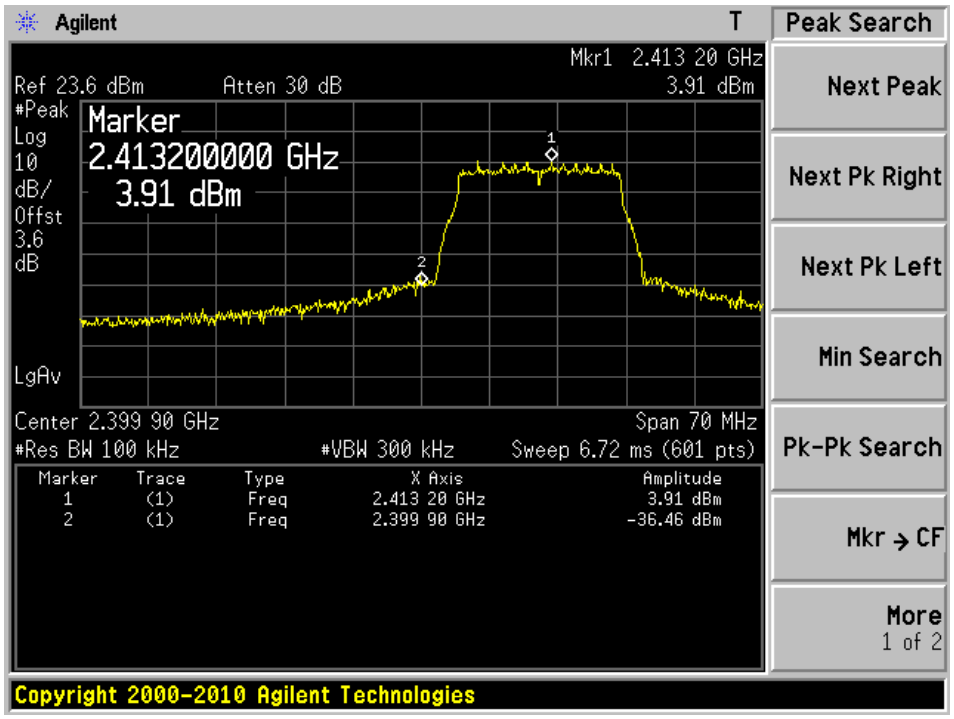


Antenna 0, 802.11 b High Band Edge

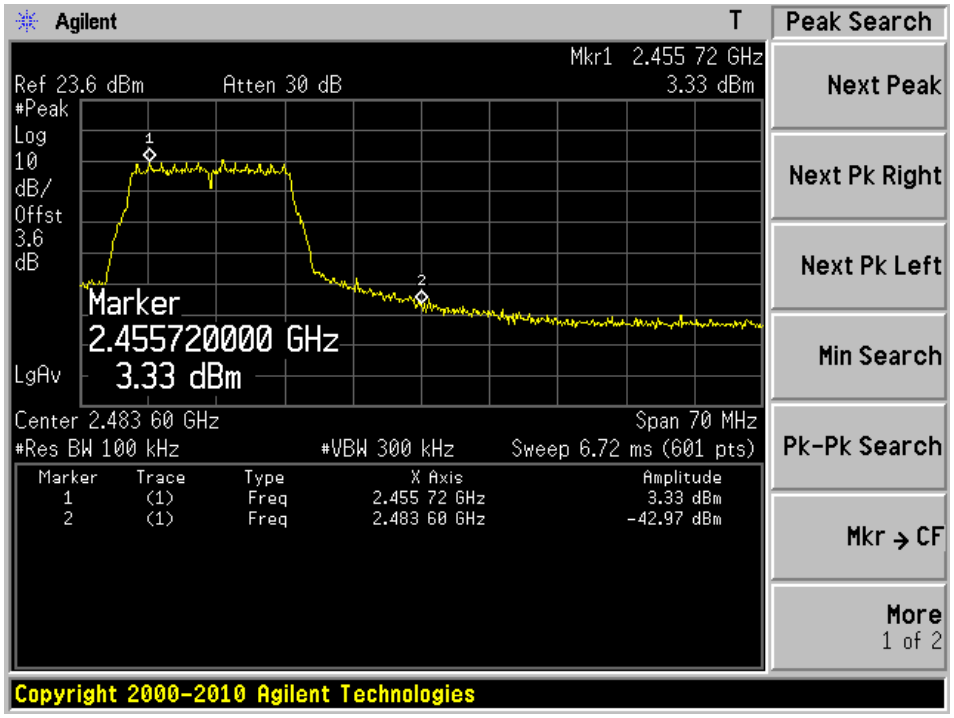


Note: 802.11b only working on Chain 0, there is no Chain 1 functional for 802.11b mode.

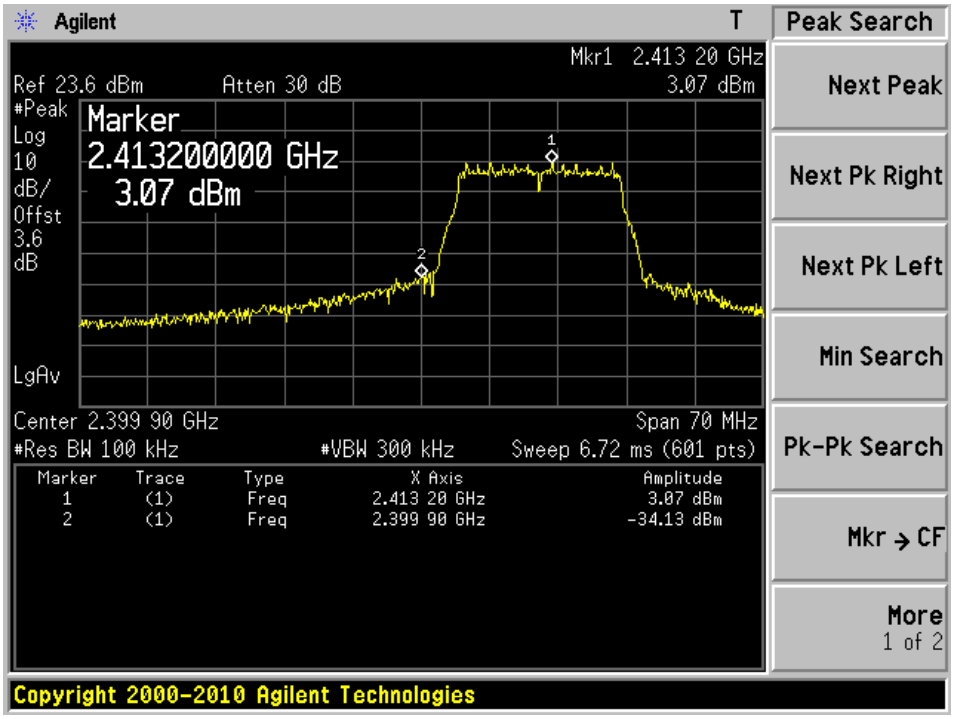
Antenna 0, 802.11 g Low Band Edge



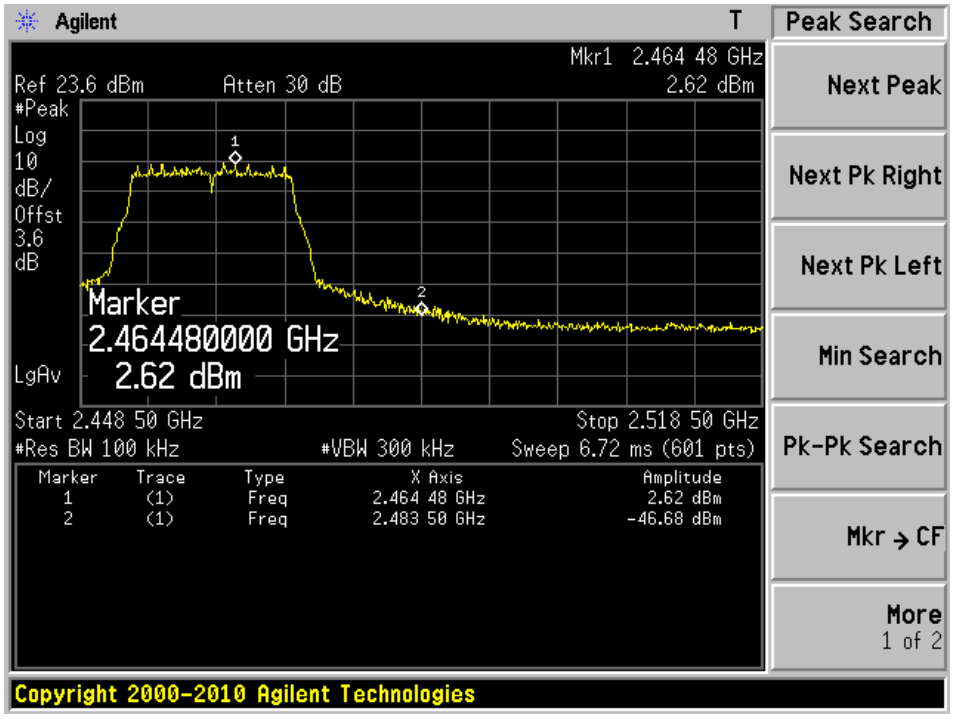
Antenna 0, 802.11 g High Band Edge



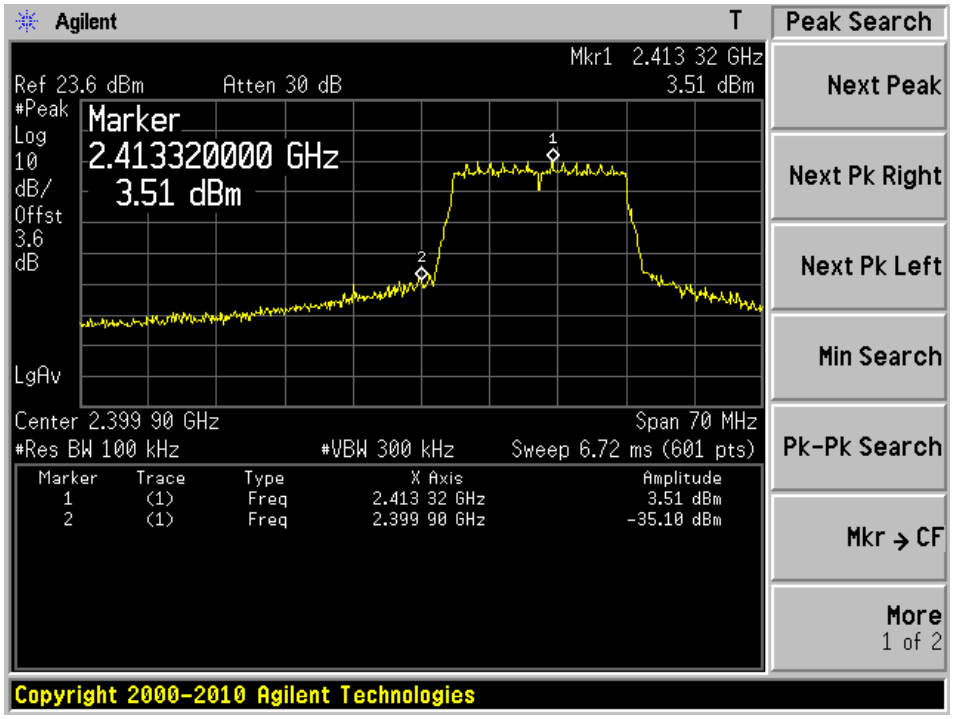
Antenna 1, 802.11 g Low Band Edge



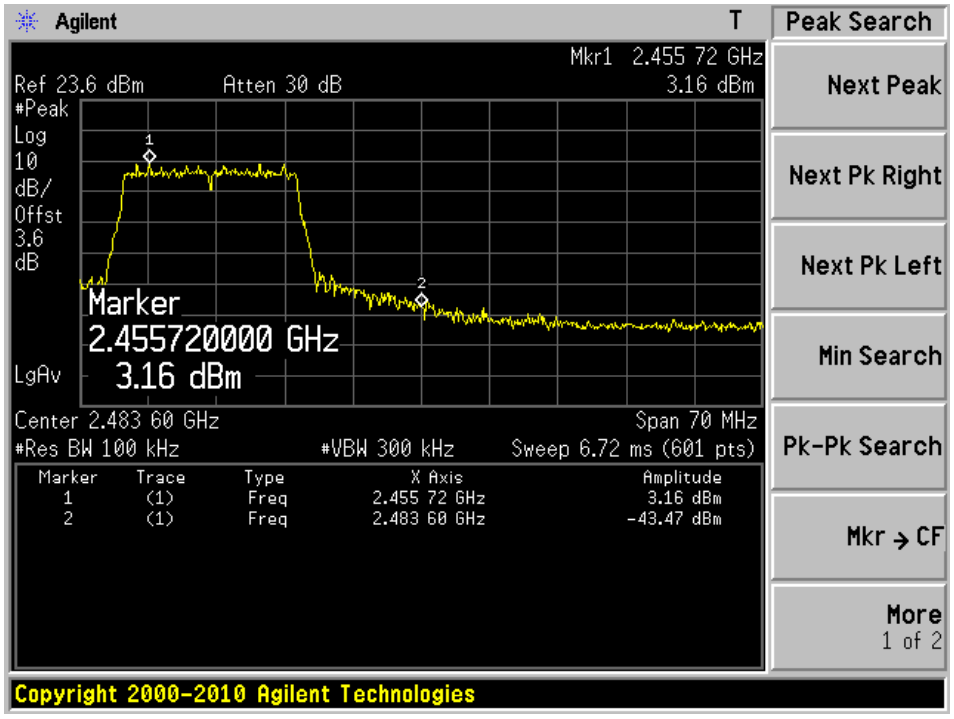
Antenna 1, 802.11 g High Band Edge



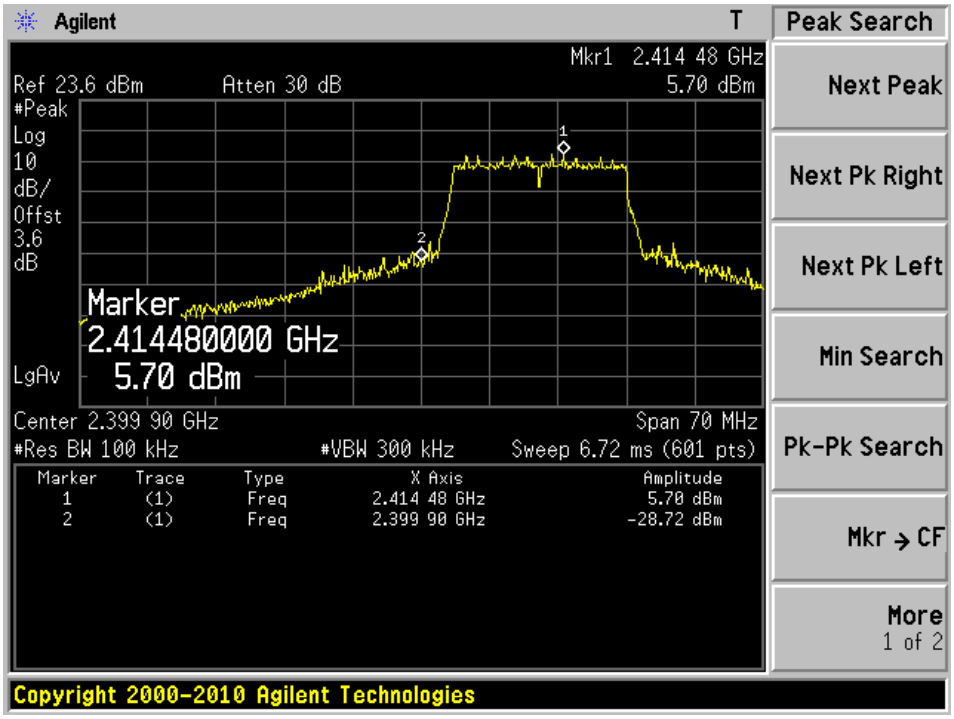
Antenna 0, 802.11n HT20, Low Band Edge



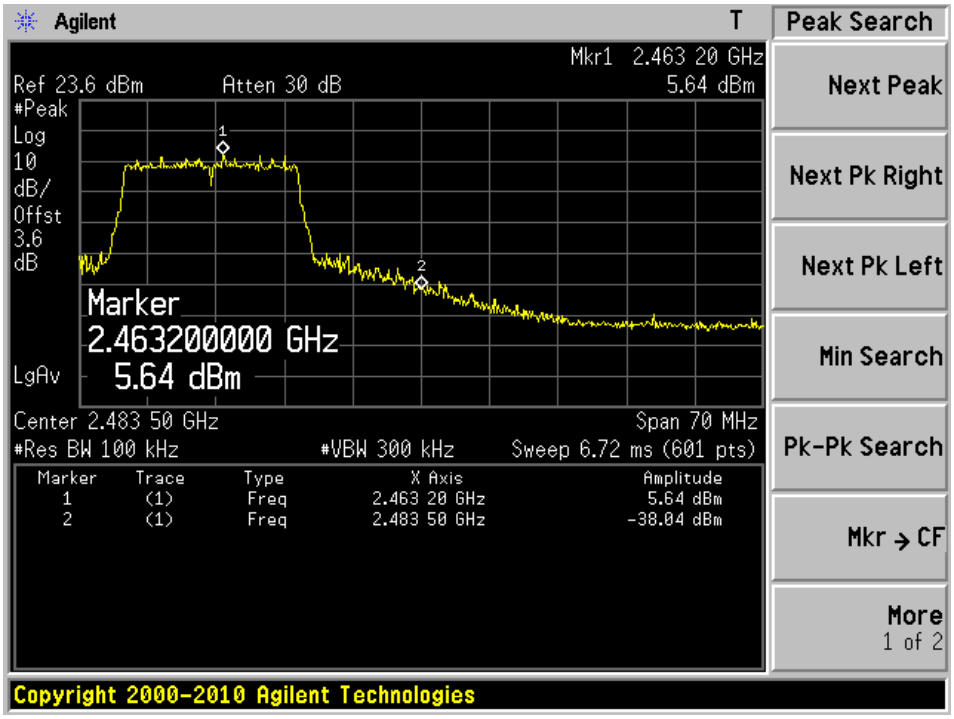
Antenna 0, 802.11n HT20 High Band Edge



Antenna 1, 802.11n HT20, Low Band Edge



Antenna 1, 802.11n HT20, High Band Edge



12 FCC §15.247(e) - Power Spectral Density

12.1 Applicable Standard

According to §15.247 (e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log (3 kHz/100 kHz = -15.2 dB).
11. The resulting peak PSD level must be ≤ 8 dBm.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10

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

12.4 Test Environmental Conditions

Temperature:	23-25 °C
Relative Humidity:	50-55 %
ATM Pressure:	99-103kPa

The testing was performed by Wei Sun on 2012-03-19 on RF Site.

12.5 Test Results

802.11 b mode:

Antenna	Channel	Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
#0	Low	2412	12.07	-3.13	8
	Mid	2437	12.32	-2.88	8
	High	2462	12.56	-2.64	8
#1	Low	2412	-	-	8
	Mid	2437	-	-	8
	High	2462	-	-	8

802.11 g mode:

Antenna	Channel	Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
#0	Low	2412	3.85	-11.35	8
	Mid	2437	3.28	-11.92	8
	High	2462	3.96	-11.24	8
#1	Low	2412	2.86	-12.34	8
	Mid	2437	2.81	-12.39	8
	High	2462	2.69	-12.51	8
#0+#1	Low	2412	6.39	-8.81	8
	Mid	2437	6.06	-9.14	8
	High	2462	6.38	-8.82	8

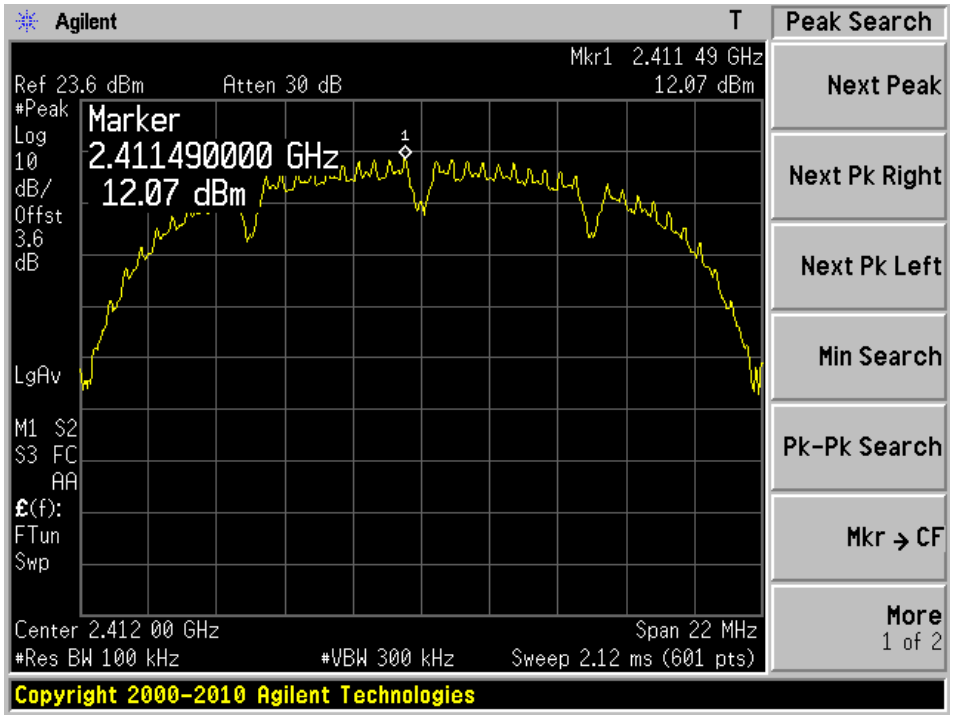
802.11n HT20 mode:

Antenna	Channel	Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
#0	Low	2412	3.64	-11.56	8
	Mid	2437	3.69	-11.51	8
	High	2462	3.2	-12.00	8
#1	Low	2412	3.04	-12.16	8
	Mid	2437	2.79	-12.41	8
	High	2462	2.34	-12.86	8
#0+#1	Low	2412	6.36	-8.84	8
	Mid	2437	6.27	-8.93	8
	High	2462	5.80	-9.40	8

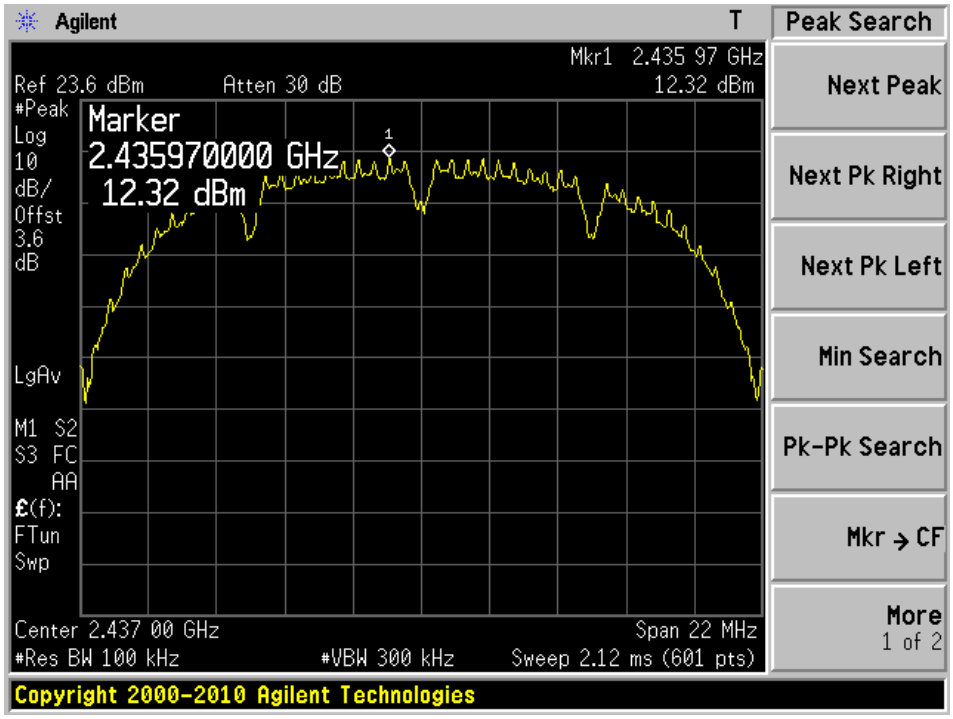
All the data can be scaled to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF=10log (3 kHz/100 kHz=-15.2 dB).

Please refer to the following plots for detailed test results:

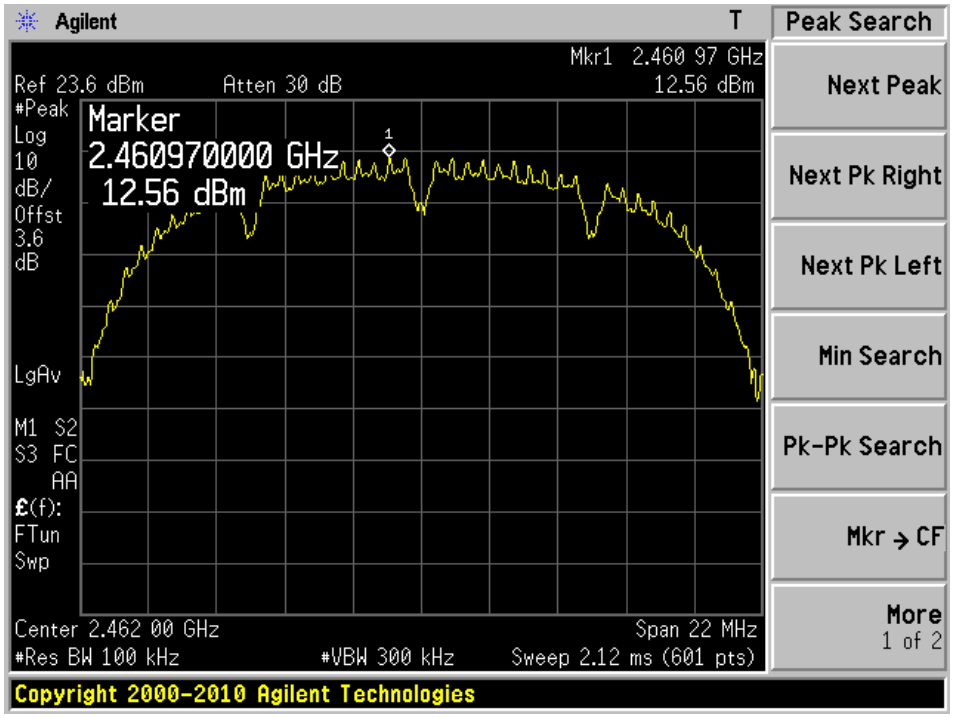
Antenna 0, 802.11 b Low Channel 2412 MHz



Antenna 0, 802.11 b Middle Channel 2437 MHz

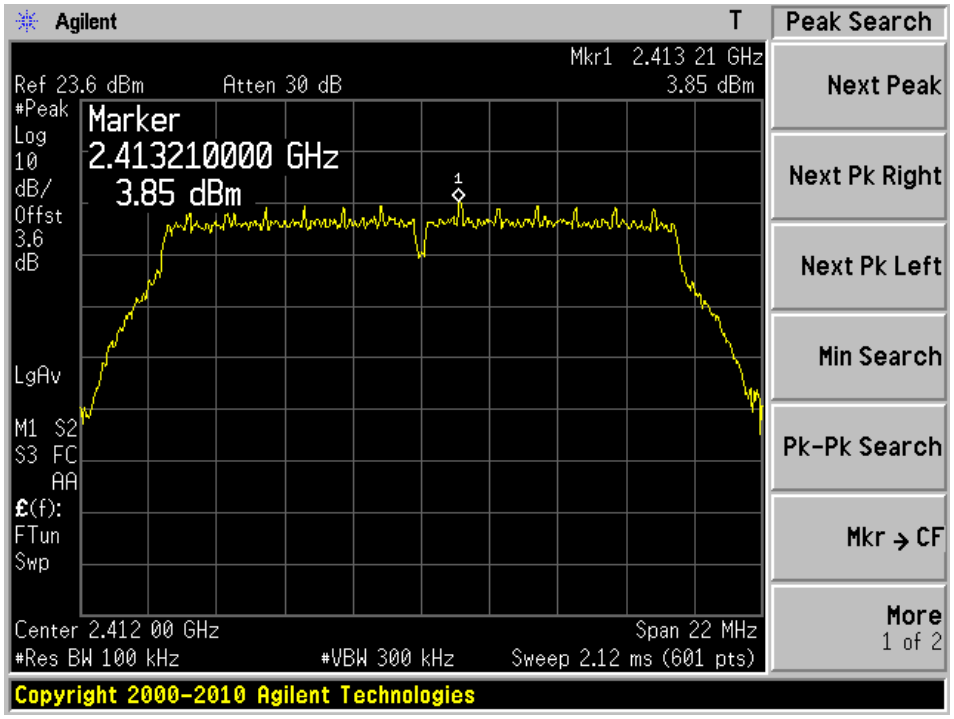


Antenna 0, 802.11 b High Channel 2462 MHz

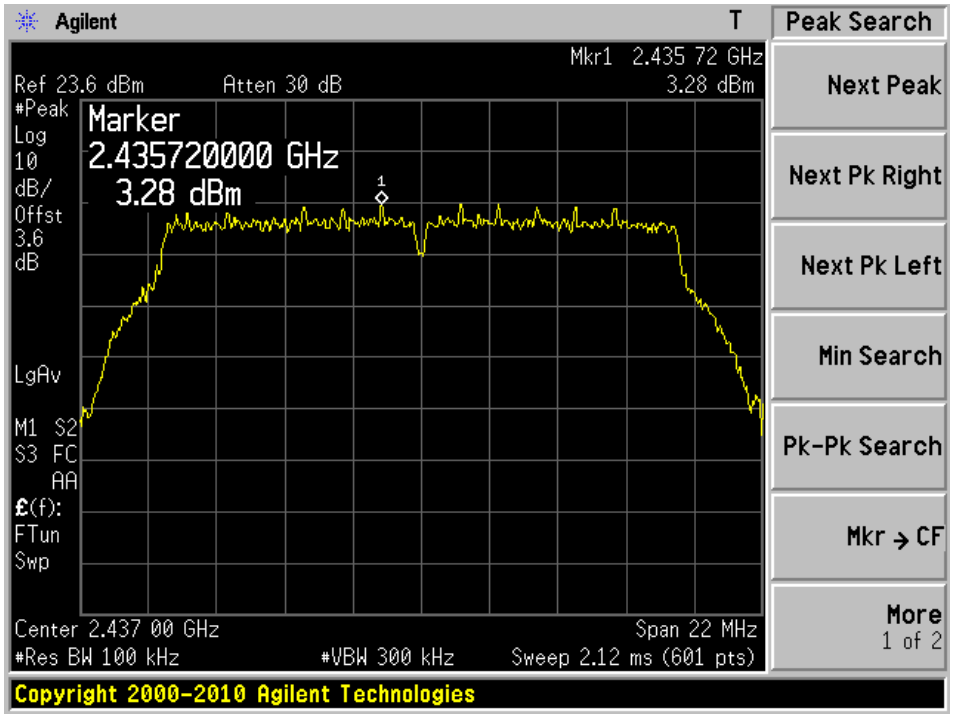


Note: 802.11b only working on Chain0, there is no Chain1 functional for 802.11b mode.

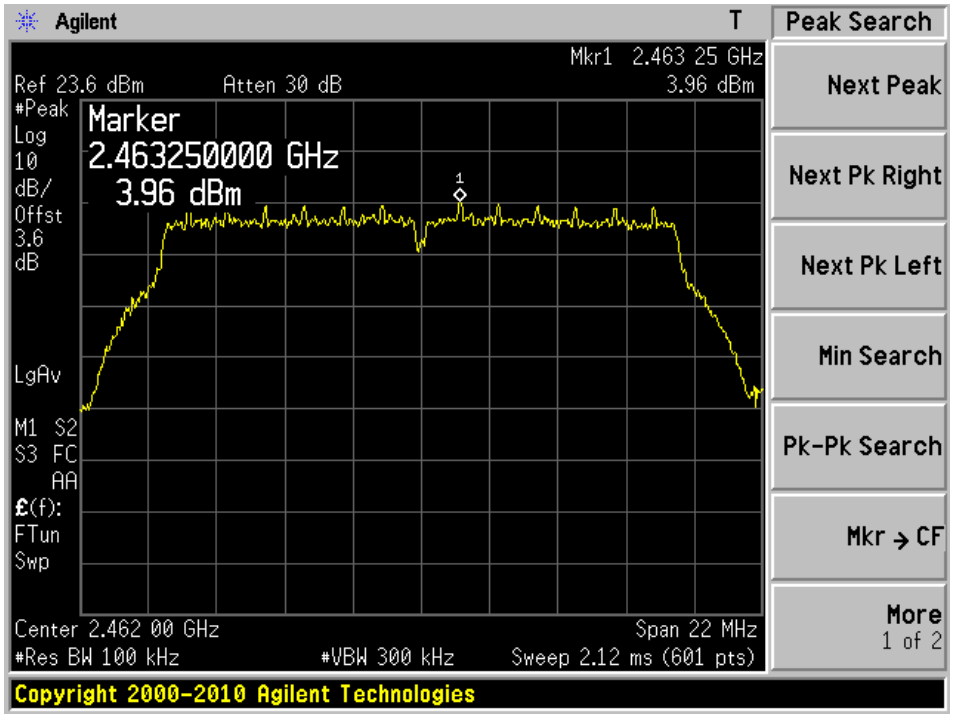
Antenna 0, 802.11 g Low Channel 2412 MHz



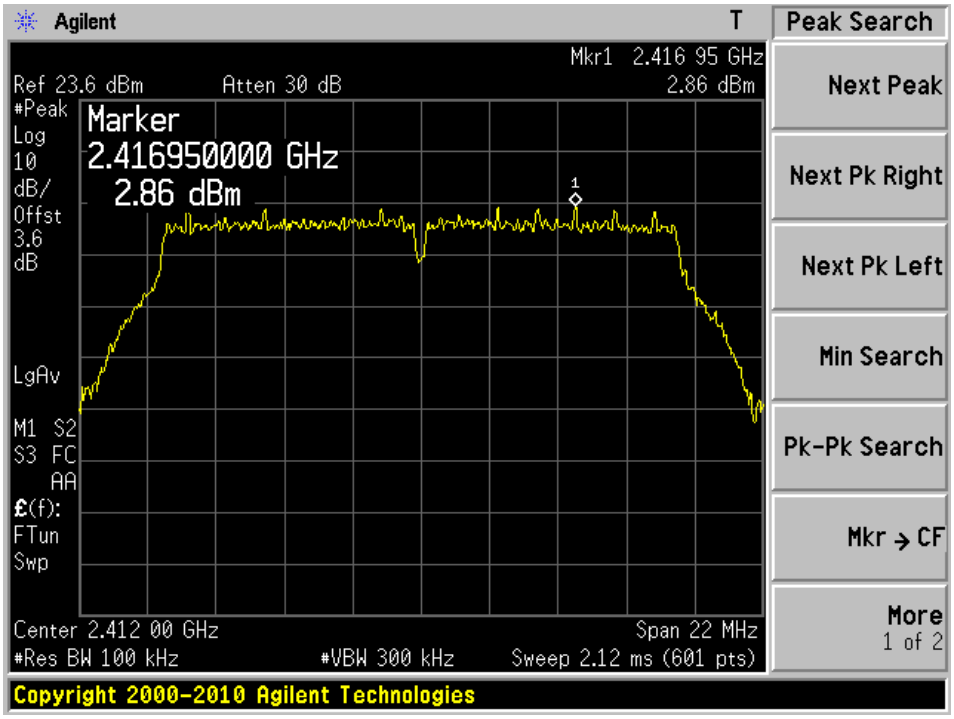
Antenna 0, 802.11 g Middle Channel 2437 MHz



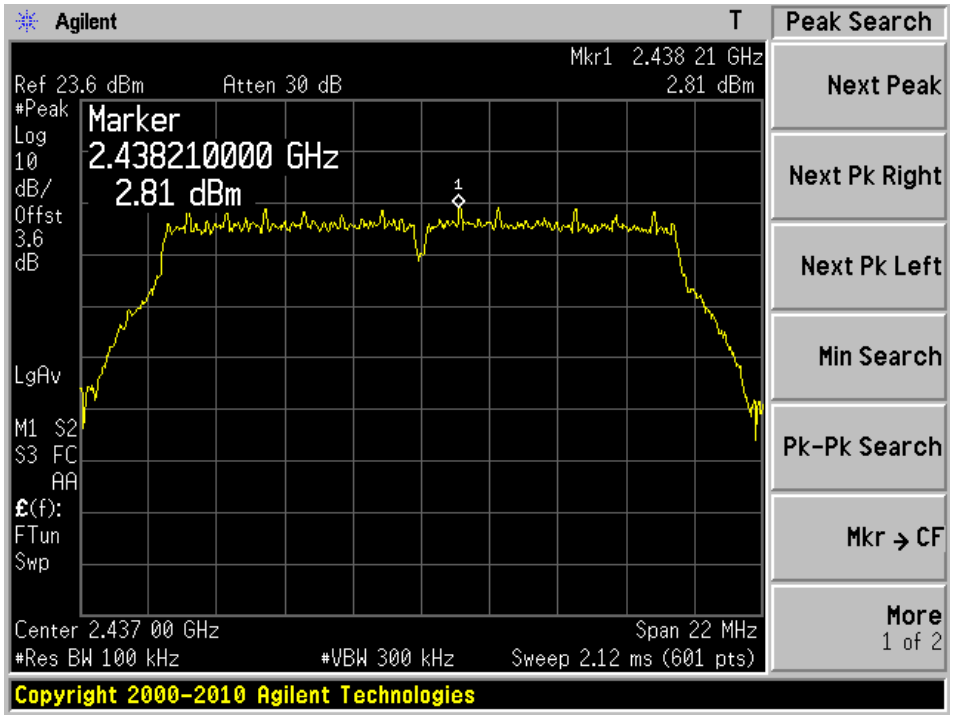
Antenna 0, 802.11 g High Channel 2462 MHz



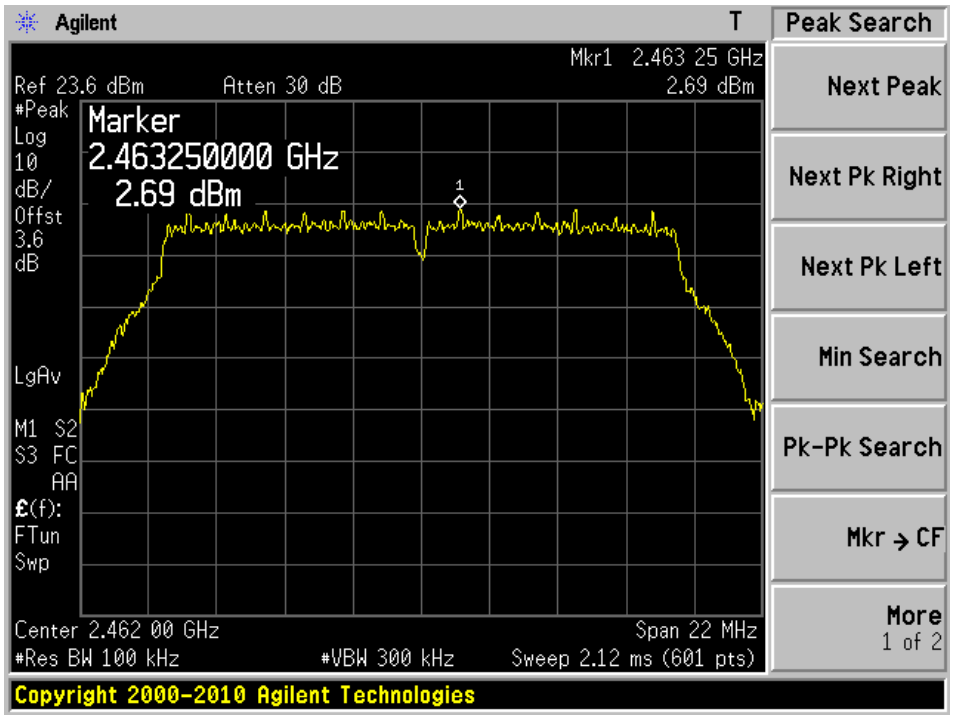
Antenna 1, 802.11 g Low Channel 2412 MHz



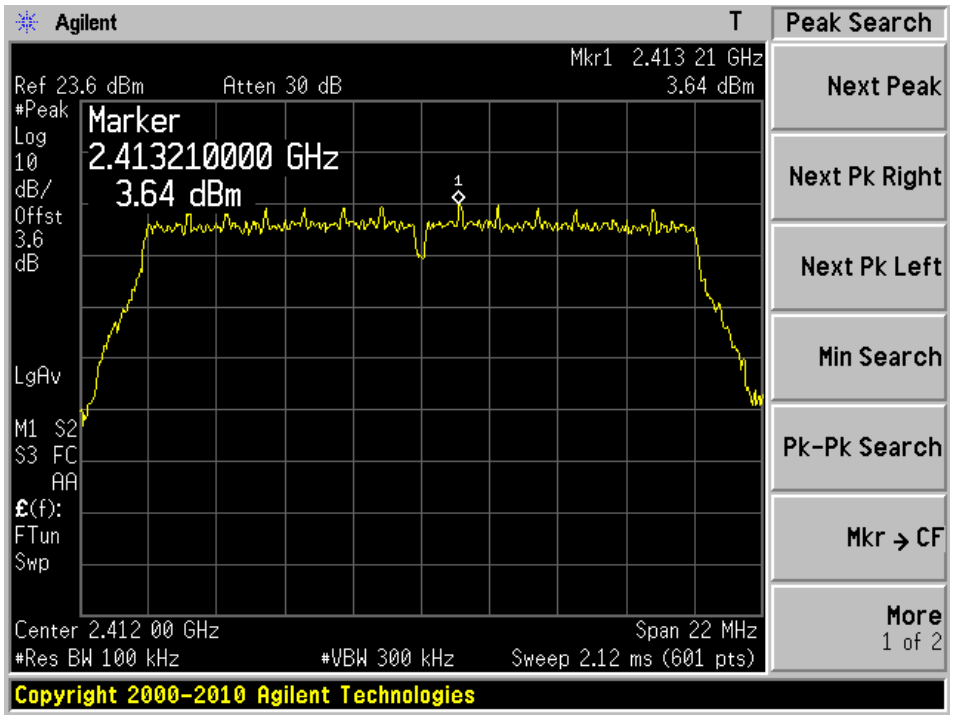
Antenna 1, 802.11 g Middle Channel 2437 MHz



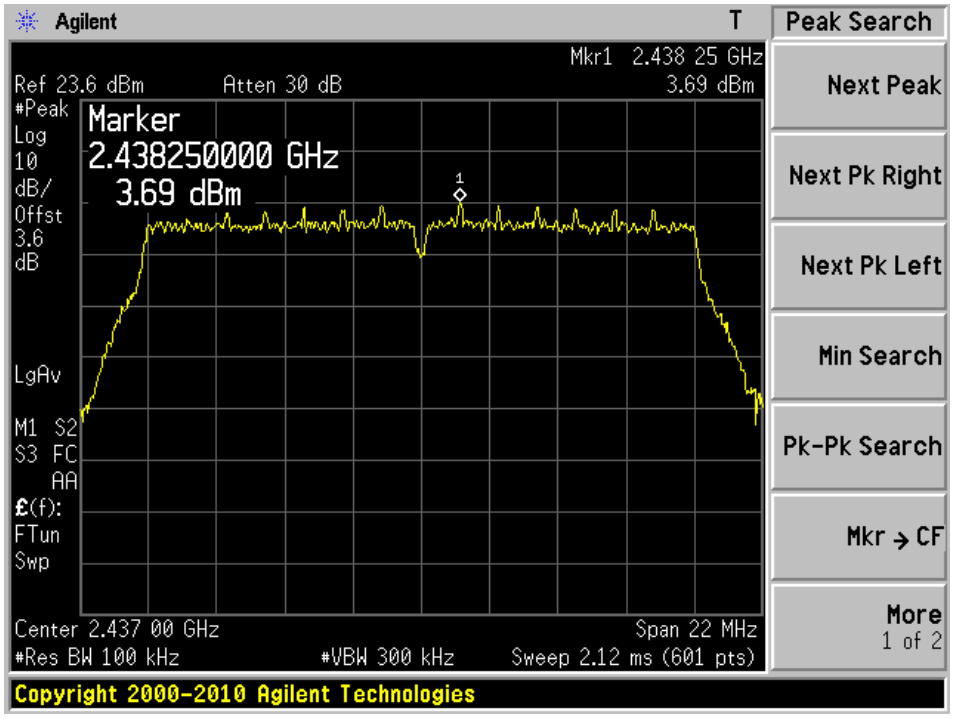
Antenna 1, 802.11 g High Channel 2462 MHz



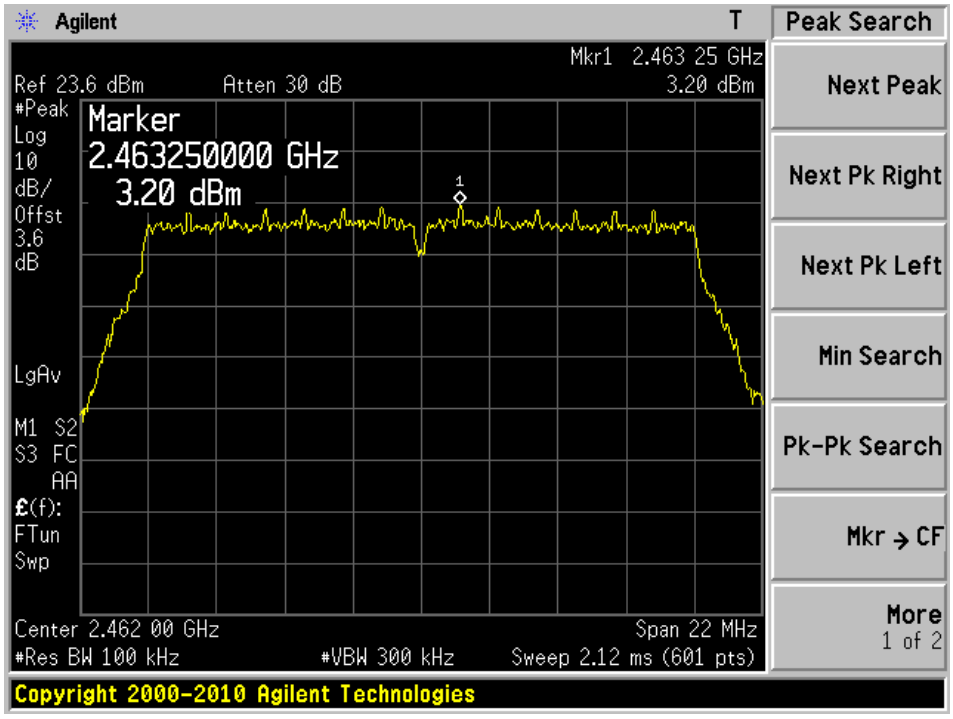
Antenna 0, 802.11n HT20, Low Channel 2412 MHz



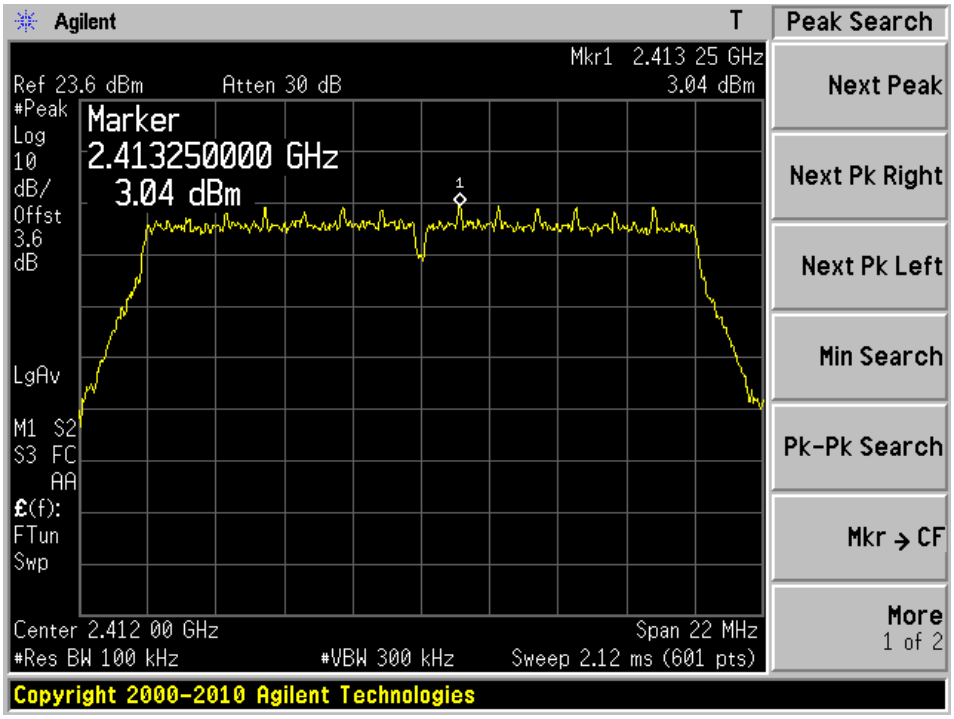
Antenna 0, 802.11n HT20, Middle Channel 2437 MHz



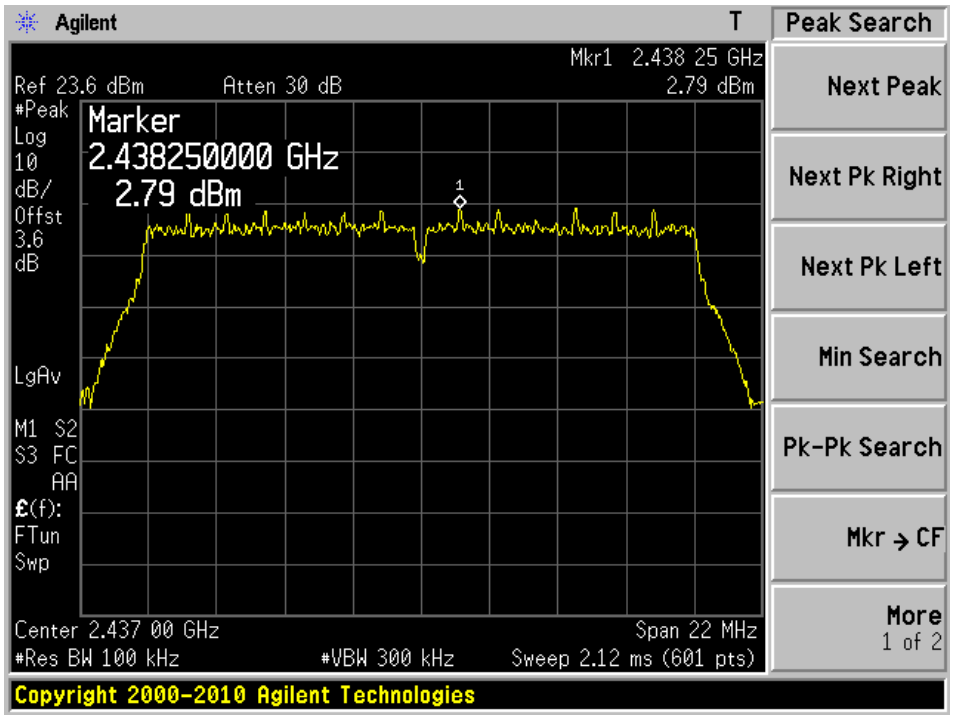
Antenna 0, 802.11n HT20, High Channel 2462 MHz



Antenna 1, 802.11n HT20, Low Channel 2412 MHz



Antenna 1, 802.11n HT20, Middle Channel 2437 MHz



Antenna 1, 802.11n HT20, High Channel 2462 MHz