Lab Code: 200167-0

FCC PART 15 SUBPART C

TEST AND MEASUREMENT REPORT

For

Venstar Inc.

9250 Owensmouth Ave.,

Chatsworth, CA 91311, USA

FCC ID: MUH-SKYPORT1

Report Type:	Product Type:
Original Report	802.11 b/g Wi-Fi Accessory

Test Engineers:	Lionel Lara
Report Number:	R1202133-247
Report Date:	2012-03-01
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	R1202133-247	Original Report	2012-03-01

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Venstar Inc*, and their product FCC ID: MUH-SKYPORT1, model: *ACC 0454* which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is an 802.11 b/g Wi-Fi accessory for devices such as thermostats.

1.2 Mechanical Description of EUT

The "EUT" measures *50mm (L) x 28mm (W) x 8 mm (H)*, and weighs approximately *6*g.

The test data gathered are from typical production sample with s/n: BY22II for Conducted Test assigned by BACL.
The test data gathered are from typical production sample with s/n: R16KCA for Radiated Test assigned by BACL

1.3 Objective

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

The objective is to determine compliance with FCC Part 15.247 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

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

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from +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.

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 C63.4-2009.

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 was configured for testing according to ANSI C63.4-2009.

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

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

Radio Mode	Bandwidth (MHz)	Frequency/Data Rate		
		Low CH (MHz/Mbps)	Mid CH (MHz/Mbps)	High CH (MHz)
802.11b	20	2412/1	2437/1	2462/1
802.11g	20	2412/6	2437/6	2462/6

2.2 EUT Exercise Software

The test utility used was Atmel AVR32 support testing board was provided by client and was verified Lionel Lara to comply with the standard requirements being tested against.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Atmel	Supporting board	AVR 32	0200004288

2.6 Power Supply List and Details

Manufacturer	Description	Model No.	Serial No.
ELPAC Power System	AC/DC adapter	WM050-1950	00197

2.7 EUT Internal Configuration Details

For Conducted: s/n BY22II

Manufacturers	Description	Model No.	Serial No.
Venstar Inc	PCB Board	022511 Rev-C	-

For Radiated: s/n R16KCA

Manufacturers	Description	Model No.	Serial No.
Venstar Inc	PCB Board	022511 Rev-C	-

2.8 External I/O Cabling List and AC Cord

Cable Description	Length (m)	From	To
RF cable	< 1m	EUT	PSA

3 Summary of Test Results

Results reported relate only to the product tested.

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

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

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.

Limits for General Population/Uncontrolled Exposure

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

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

4.2 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

Maximum peak output power at antenna input terminal (dBm):	16.85
Maximum peak output power at antenna input terminal (mW):	48.42
Prediction distance (cm):	20
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	2.0
Maximum Antenna Gain (numeric):	1.58
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0152
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0152 mW/cm^2, Limit is 1.0 mW/cm^2.

5 FCC §15.203 – Antenna Requirements

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 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.

5.2 Antenna Connector Construction

The radio utilizes the integral antennas and the antennas with the Max antenna gain of 2.0 dBi on 2400-2500 MHz range, which fulfilled the antenna requirement.

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standards

As per 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

Note [1]: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §15.207 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 Supported Board was connected with LISN-1 which provided 120 V/60 Hz AC power.

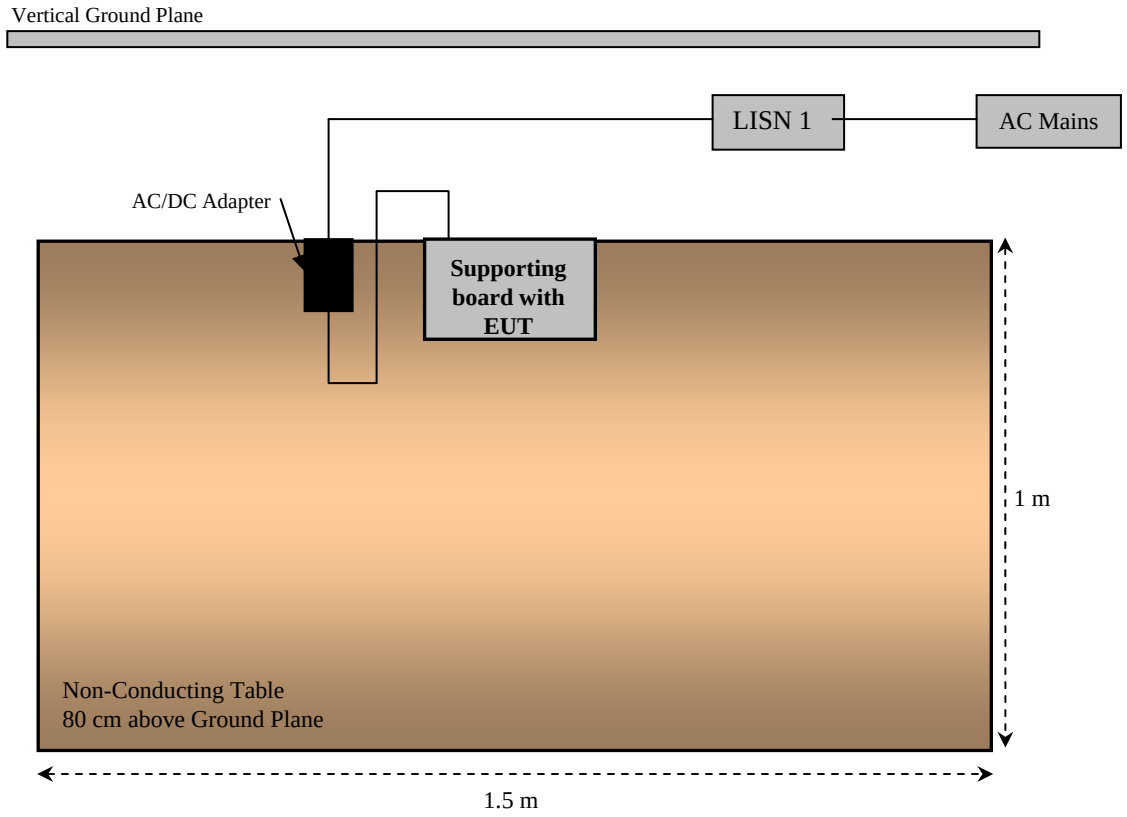
6.3 Test Procedure

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”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
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.

6.7 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	48%
ATM Pressure:	101.7kPa

The testing was performed by Lionel Lara on 2011-02-17 at 5 meter chamber2.

6.8 Summary of Test Results

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

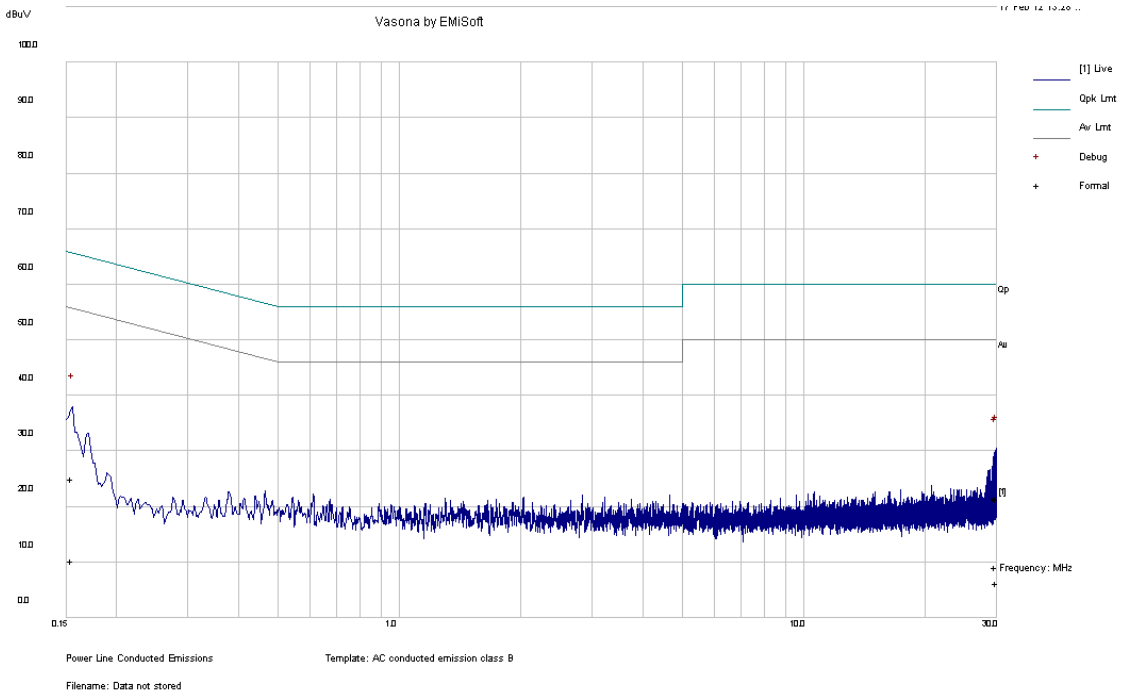
Transmitting Mode the Worst Case: 802.11 b Middle channel

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-36.01	29.68078	Neutral	0.15 to 30

6.9 Conducted Emissions Test Plots and Data

Transmitting Mode the Worst Case: 802.11 b Middle channel

120 V, 60 Hz – Line



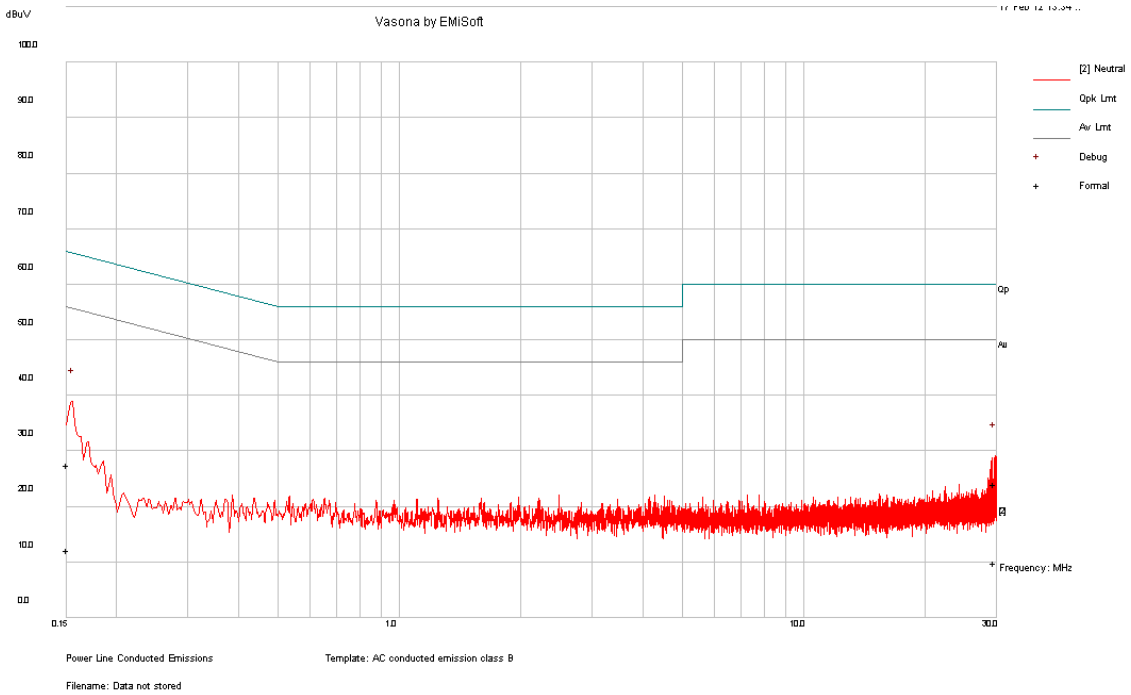
Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
29.73018	21.57	Line	60	-38.43
29.92982	21.34	Line	60	-38.66
0.155255	25.01	Line	65.71	-40.71

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
29.73018	9.15	Line	50	-40.85
29.92982	6.19	Line	50	-43.81
0.155255	10.16	Line	55.71	-45.56

120 V, 60 Hz – Neutral



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
29.68078	23.99	Neutral	60	-36.01
0.151439	27.44	Neutral	65.92	-38.48

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
29.68078	9.88	Neutral	50	-40.12
0.151439	12.23	Neutral	55.92	-43.69

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.

7.2 Measurement Procedure

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

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	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:	22 °C
Relative Humidity:	33 %
ATM Pressure:	101.3kPa

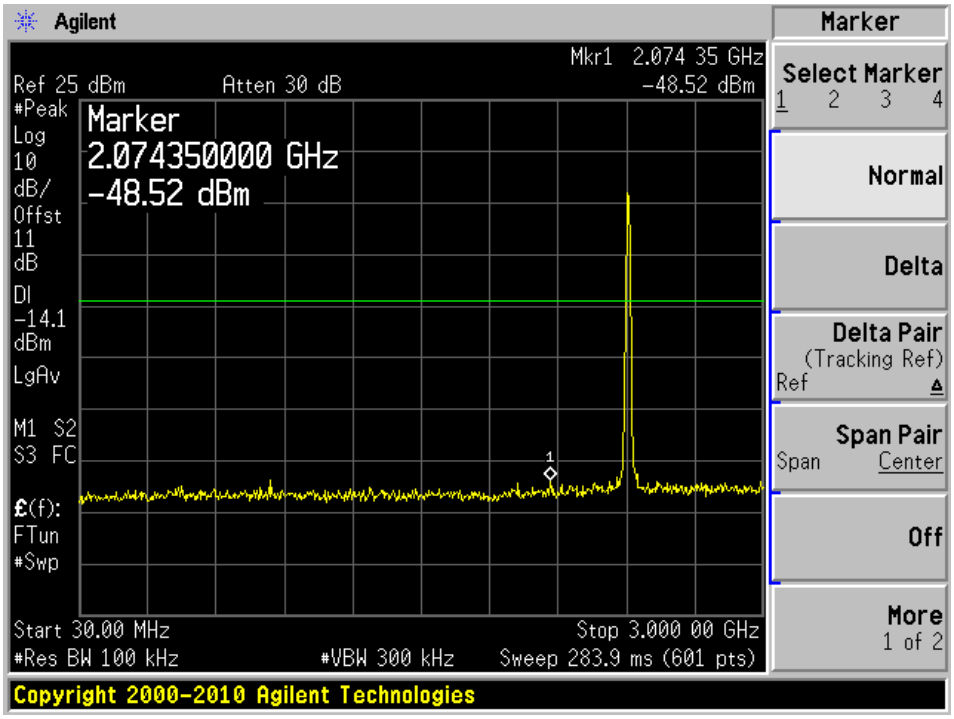
The testing was performed by Lionel Lara on 2012-02-16 at RF Site.

7.5 Test Results

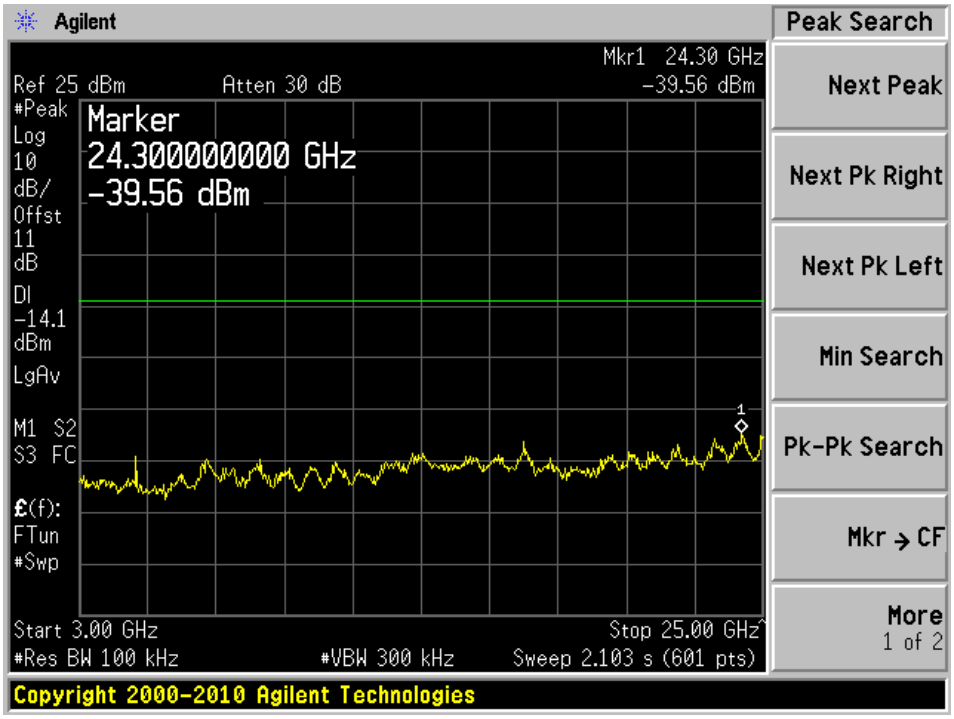
Please refer to following plots of spurious emissions.

802.11b, Low Channel, 2412 MHz

Plot: 30 MHz – 3 GHz

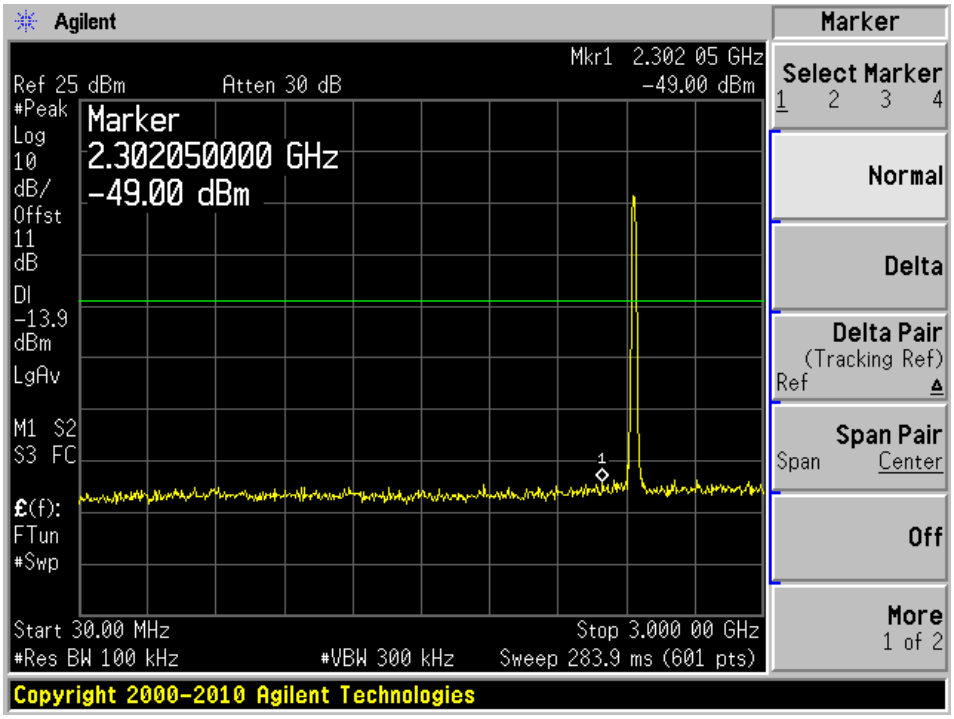


Plot: 3 GHz – 25 GHz

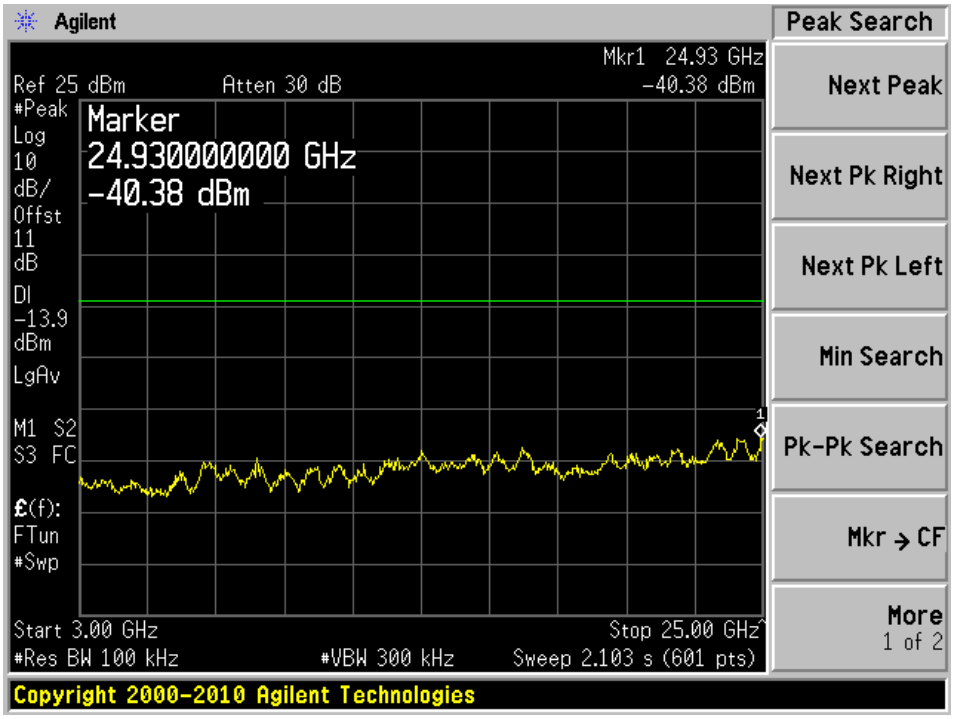


802.11b, Middle Channel, 2437 MHz

Plot: 30 MHz – 3 GHz

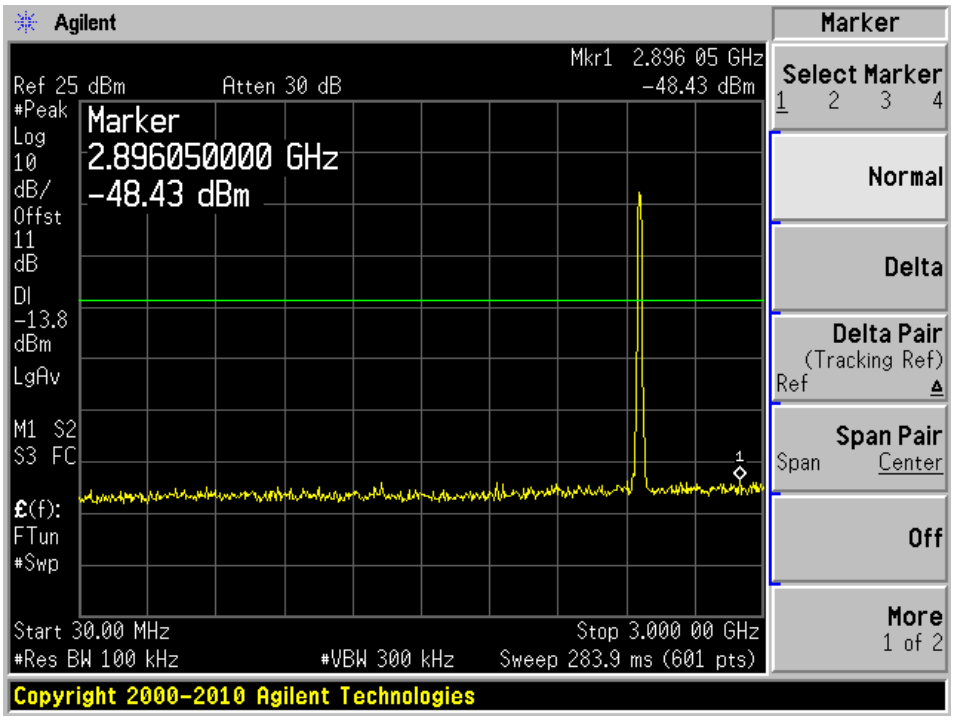


Plot: 3 GHz – 25 GHz

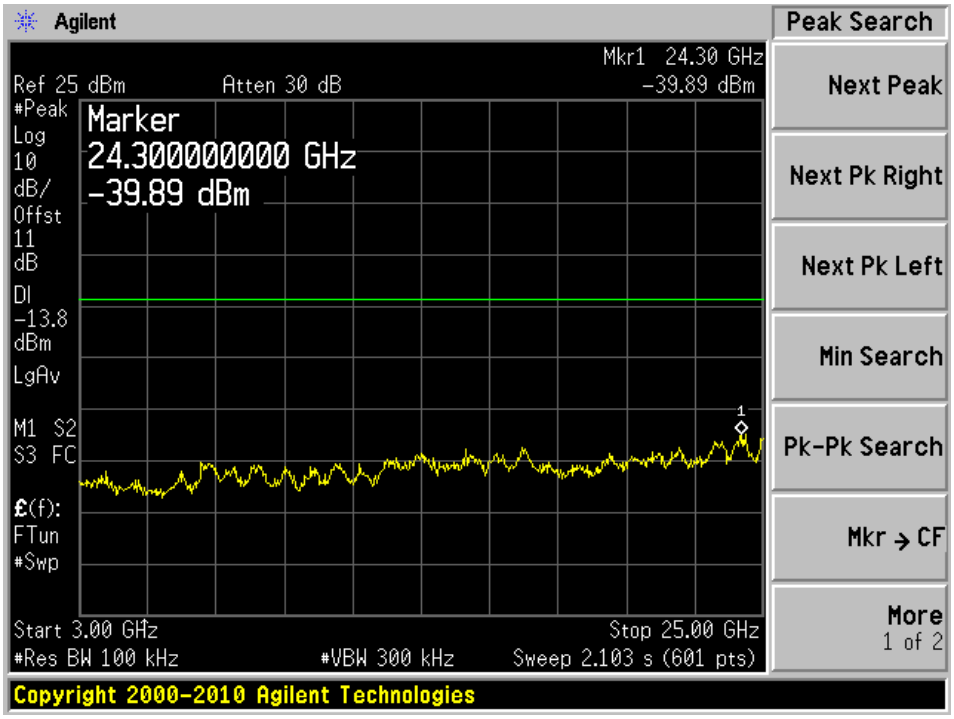


802.11b, High Channel, 2462 MHz

Plot: 30 MHz – 3 GHz

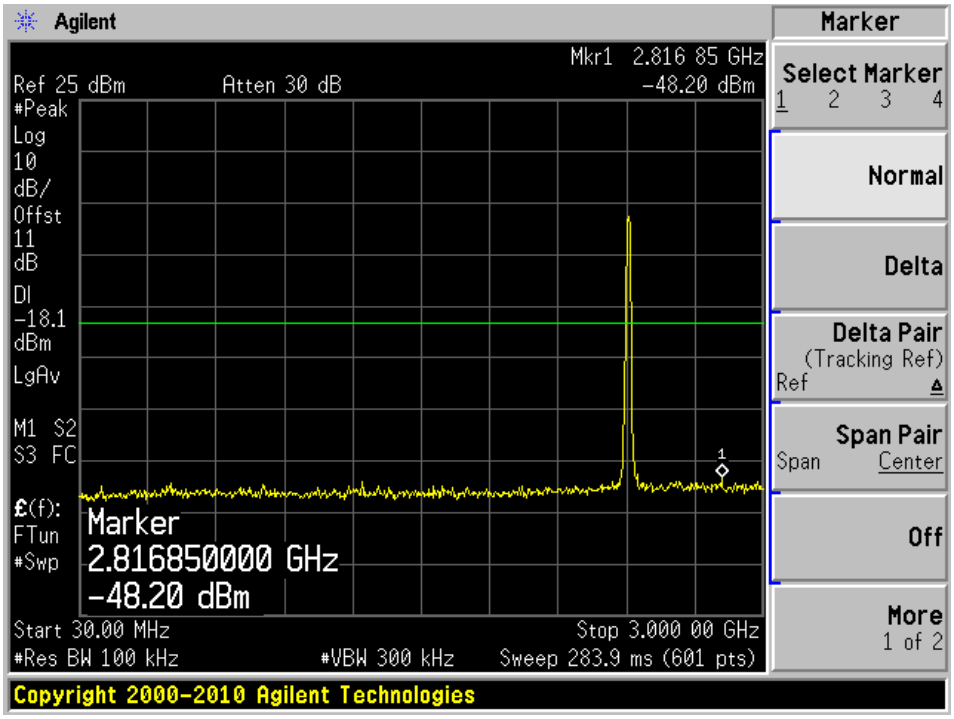


Plot: 3 GHz – 25 GHz

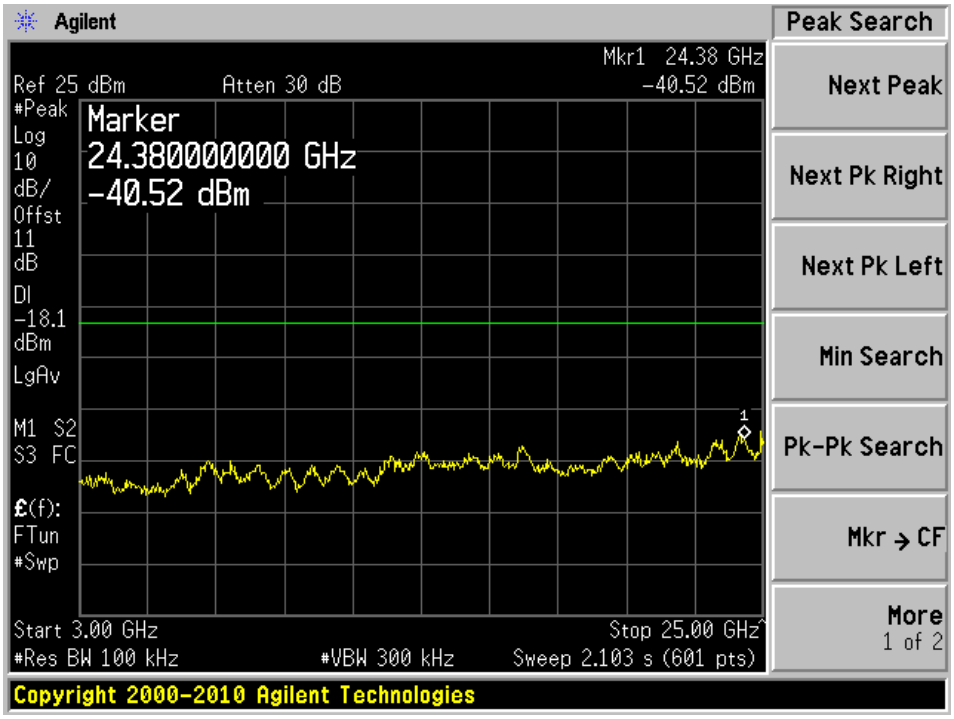


802.11g, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

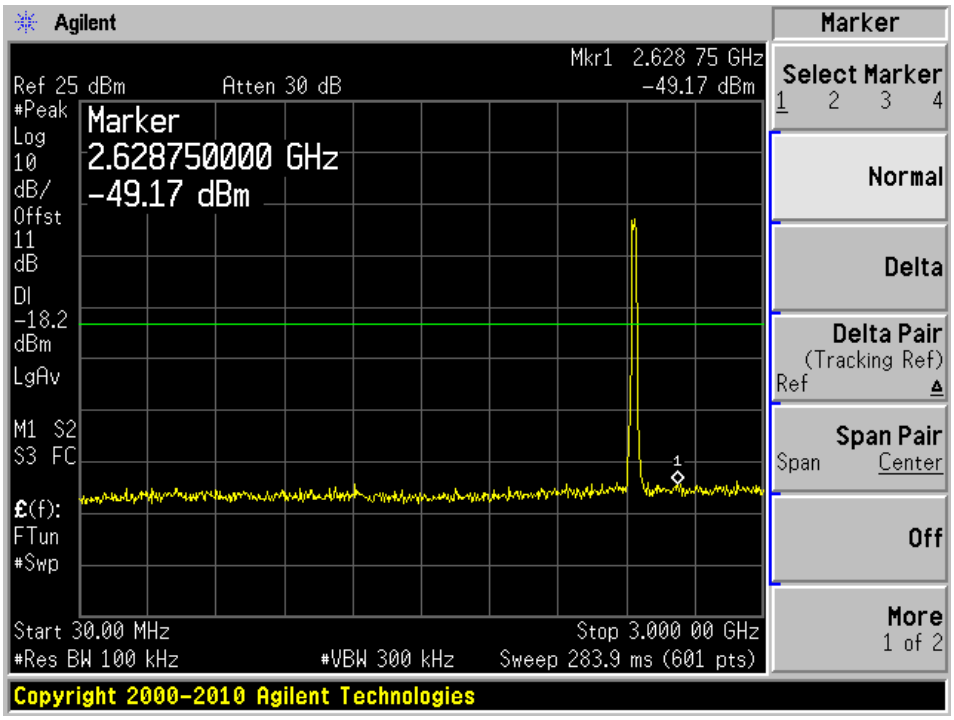


Plot: 3 GHz – 25 GHz

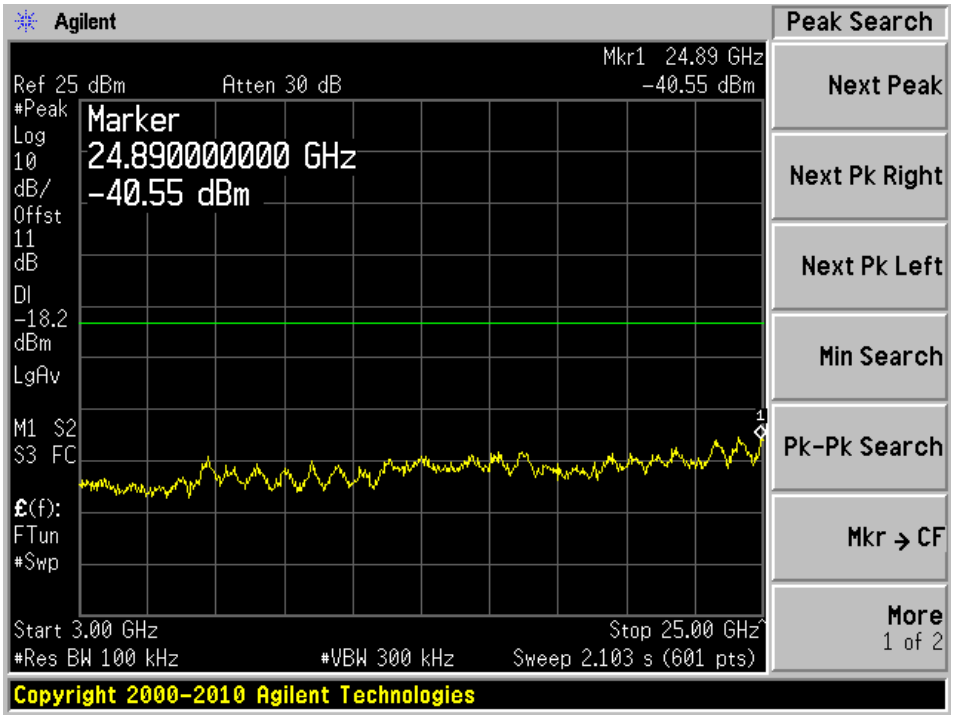


802.11g, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

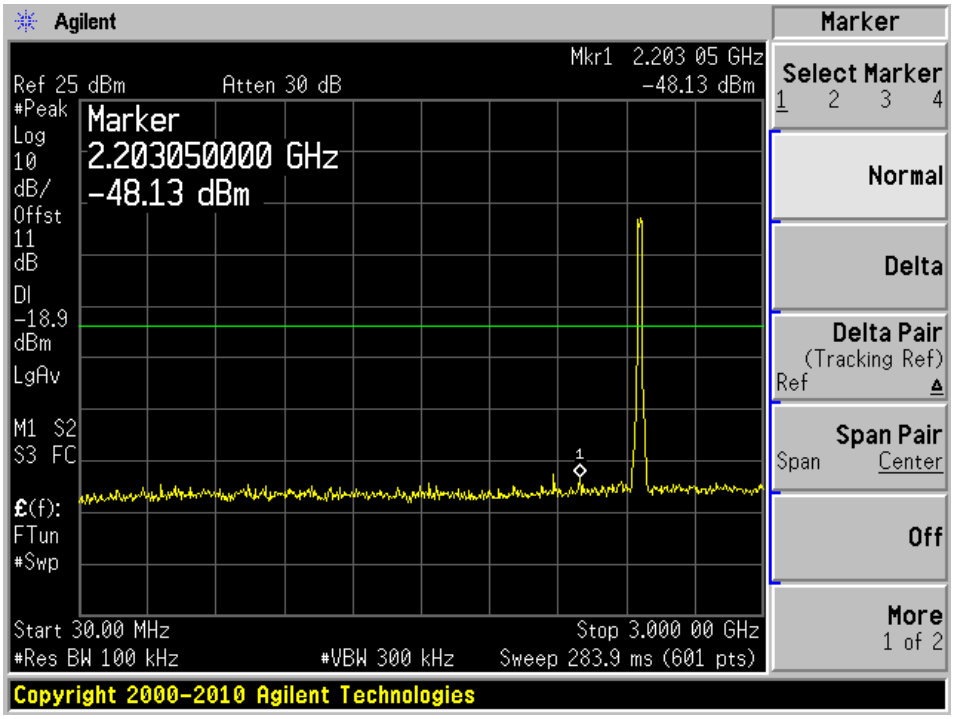


Plot: 3 GHz – 25 GHz

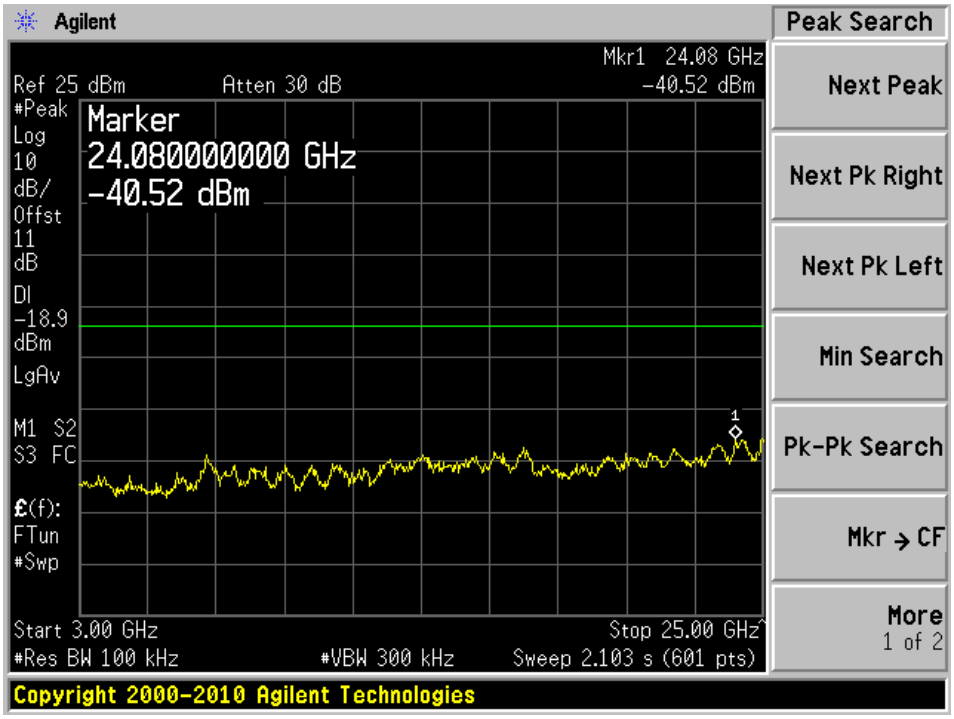


802.11g, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 25 GHz



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

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C and IC RSS-210 limits.

The spacing between the peripherals was 3 centimeters.

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

8.3 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

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

The "**Margin**" column of the following data tables indicates the degree of compliance within 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 - Limit

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2011-03-21
Agilent	Spectrum Analyzer	E4440A	MY44303352	2011-05-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A0020106-3	2011-06-29
A.R.A Inc	Horn antenna	DRG-1181A	1132	2011-11-29
Hewlett Packard	Pre amplifier	8447D	2944A06639	2011-06-09
Mini-Circuits	Pre Amplifier	ZVA-183-S	570400946	2011-05-09

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

8.6 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	48%
ATM Pressure:	101.7kPa

The testing was performed by Thien Vo on 2011-02-17 at 5meter chamber2.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel, Range**
-4.43	549.9988	Horizontal	802.11g, Middle, 30-1000 MHz

1 – 25 GHz:

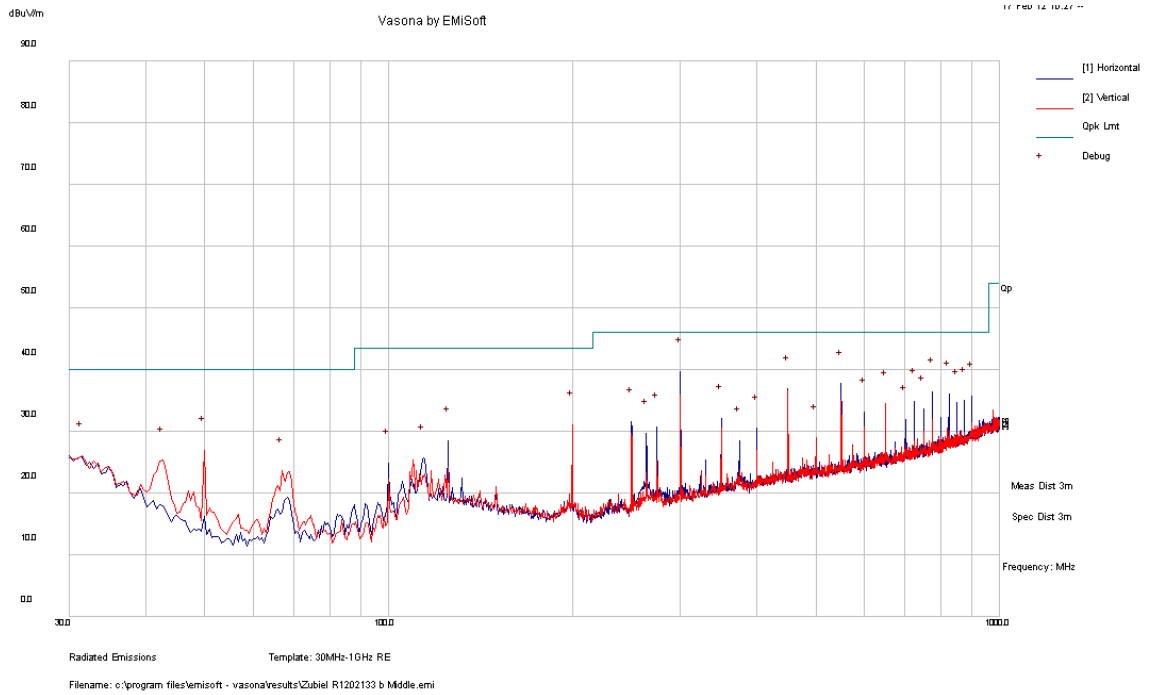
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel, Range**
-0.201	4874	Horizontal	802.11b Middle, 1GHz – 25GHz

Please refer to the following table and plots for specific test result details

8.8 Radiated Emissions Test Data and Plots

1) 30 MHz – 1 GHz, Measured at 3 meters

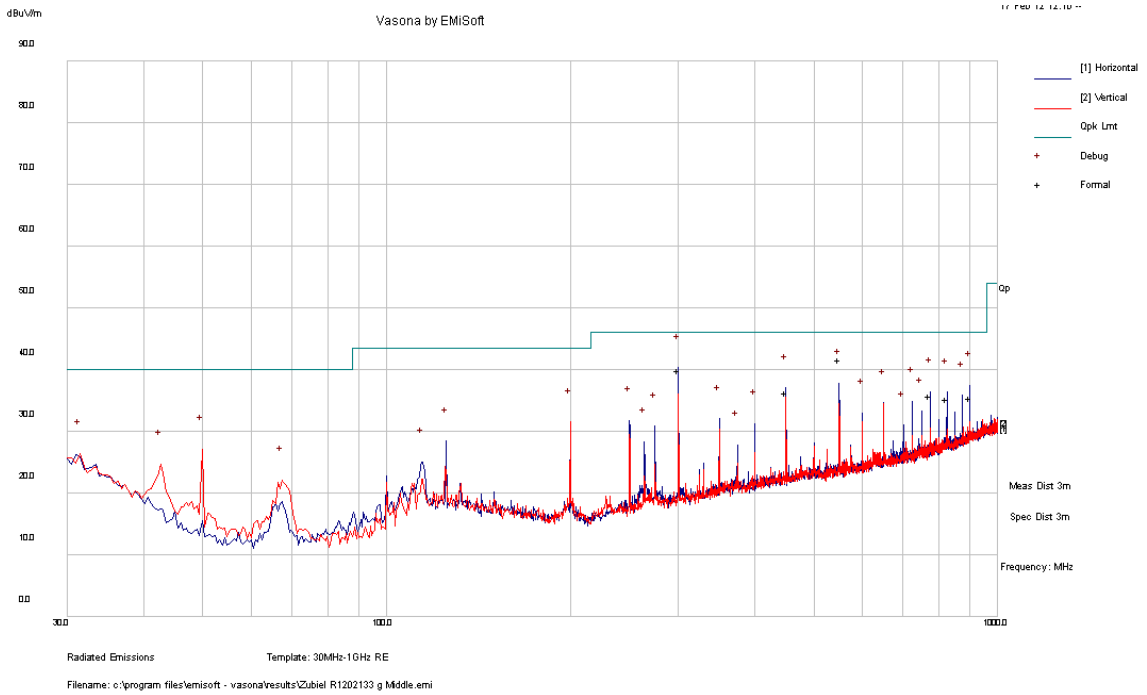
802.11b Mode, Worst Channel Middle channel (2437 MHz)



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
549.983	41.07	156	H	272	46	-4.93
299.999	39.12	113	H	135	46	-6.88
449.9853	36.3	192	H	292	46	-9.7
899.9943	33.79	100	H	339	46	-12.21
774.98	28.5	109	V	360	46	-17.5
825.5533	26.84	175	H	354	46	19.16

802.11g Mode, Worst Channel Middle channel (2437 MHz)



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
549.9988	41.57	148	H	277	46	-4.43
299.9995	39.93	100	H	136	46	-6.07
450.0103	36.37	186	H	291	46	-9.63
774.9835	35.77	100	H	313	46	-10.23
900.0018	35.48	100	H	292	46	-10.52
824.9805	35.2	100	H	310	46	-10.8

2) 1–25 GHz, Measured at 3 meters

802.11b mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
4824	53.42	142	118	V	32.603	3.96	27.77	62.213	74	-11.787	peak
4824	53.03	209	130	H	32.629	3.96	27.77	61.849	74	-12.151	peak
4824	43.99	142	118	V	32.603	3.96	27.77	52.783	54	-1.217	Ave
4824	43.38	209	130	H	32.629	3.96	27.77	52.199	54	-1.801	Ave
2386.67	27.48	128	104	V	28.12	3.12	0	58.72	74	-15.28	peak
2386.4	26.72	192	102	H	28.159	3.12	0	57.999	74	-16.001	peak
2386.67	15.14	128	104	V	28.12	3.12	0	46.38	54	-7.62	Ave
2386.4	14.24	192	102	H	28.159	3.12	0	45.519	54	-8.481	Ave
Middle Channel 2437 MHz, measured at 3 meters											
4874	52.68	139	119	V	32.603	3.96	27.71	61.533	74	-12.467	peak
4874	53.97	294	157	H	32.629	3.96	27.71	62.849	74	-11.151	peak
4874	43.59	139	119	V	32.603	3.96	27.71	52.443	54	-1.557	Ave
4874	44.92	294	157	H	32.629	3.96	27.71	53.799	54	-0.201	Ave
High Channel 2462 MHz, measured at 3 meters											
4924	50.14	140	101	V	32.732	4.02	27.71	59.182	74	-14.818	peak
4924	52.73	296	141	H	32.8	4.02	27.71	61.84	74	-12.16	peak
4924	41.5	140	101	V	32.732	4.02	27.71	50.542	54	-3.458	Ave
4924	43.91	296	141	H	32.8	4.02	27.71	53.02	54	-0.98	Ave
2487.3	27.87	127	100	V	28.12	3.25	0	59.24	74	-14.76	peak
2487.37	27.89	190	131	H	28.3	3.25	0	59.44	74	-14.56	peak
2487.3	16.08	127	100	V	28.12	3.25	0	47.45	54	-6.55	Ave
2487.37	14.87	190	131	H	28.3	3.25	0	46.42	54	-7.58	Ave

802.11g mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
4824	47.24	139	121	V	32.603	3.96	27.77	56.033	74	-17.967	peak
4824	50.06	294	143	H	32.629	3.96	27.77	58.879	74	-15.121	peak
4824	38.69	139	121	V	32.603	3.96	27.77	47.483	54	-6.517	Ave
4824	39.05	294	143	H	32.629	3.96	27.77	47.869	54	-6.131	Ave
2390	29.06	191	100	V	28.12	3.12	0	60.3	74	-13.7	peak
2389.73	31.86	126	100	H	28.159	3.12	0	63.139	74	-10.861	peak
2390	12.57	191	100	V	28.12	3.12	0	43.81	54	-10.19	Ave
2389.73	12.78	126	100	H	28.159	3.12	0	44.059	54	-9.941	Ave
Middle Channel 2437 MHz, measured at 3 meters											
4874	47.33	141	118	V	32.603	3.96	27.71	56.183	74	-17.817	peak
4874	49.77	301	144	H	32.629	3.96	27.71	58.649	74	-15.351	peak
4874	38.94	141	118	V	32.603	3.96	27.71	47.793	54	-6.207	Ave
4874	40.23	301	144	H	32.629	3.96	27.71	49.109	54	-4.891	Ave
High Channel 2462 MHz, measured at 3 meters											
4924	43.16	139	118	V	32.732	4.02	27.71	52.202	74	-21.798	peak
4924	49.28	297	143	H	32.8	4.02	27.71	58.39	74	-15.61	peak
4924	38.57	139	118	V	32.732	4.02	27.71	47.612	54	-6.388	Ave
4924	40.09	297	143	H	32.8	4.02	27.71	49.2	54	-4.8	Ave
2483.69	34.64	125	100	V	28.12	3.25	0	66.01	74	-7.99	peak
2483.5	37.05	189	100	H	28.3	3.25	0	68.6	74	-5.4	peak
2483.69	13.9	125	100	V	28.12	3.25	0	45.27	54	-8.73	Ave
2483.5	13.73	189	100	H	28.3	3.25	0	45.28	54	-8.72	Ave

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 Measurement Procedure

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

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	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:	22 °C
Relative Humidity:	33 %
ATM Pressure:	101.3kPa

The testing was performed by Lionel Lara on 2012-02-16 at RF Site.

9.5 Test Results

802.11 b mode:

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2412	9.815	14.723	> 0.5	Compliant
Middle	2437	9.776	14.727	> 0.5	Compliant
High	2462	9.891	14.779	> 0.5	Compliant

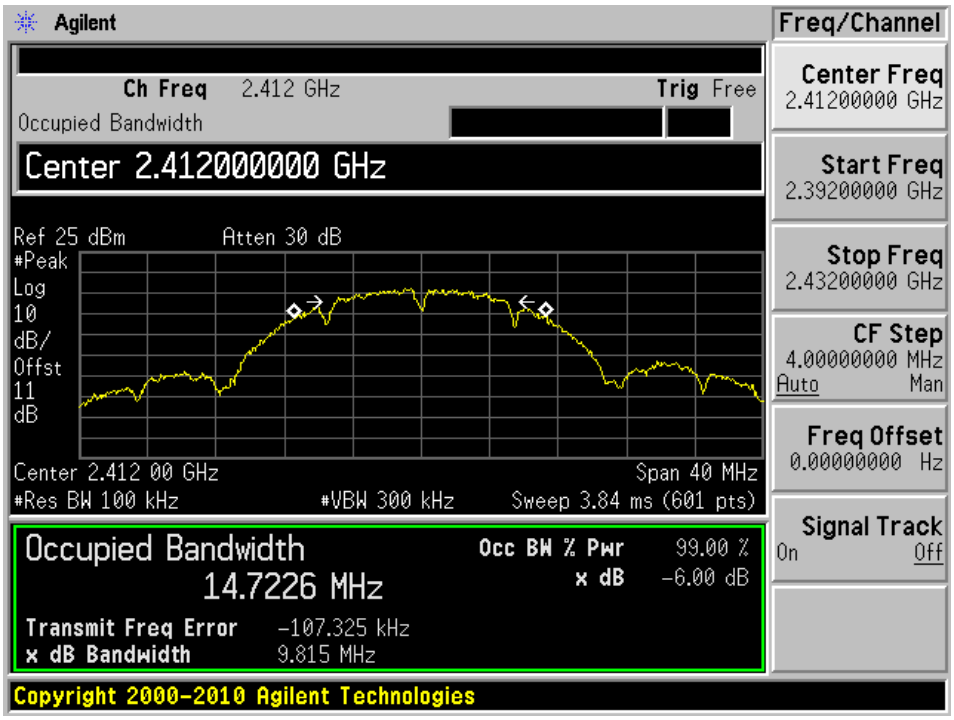
802.11 g mode:

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2412	16.483	16.443	> 0.5	Compliant
Middle	2437	16.358	16.426	> 0.5	Compliant
High	2462	16.411	16.435	> 0.5	Compliant

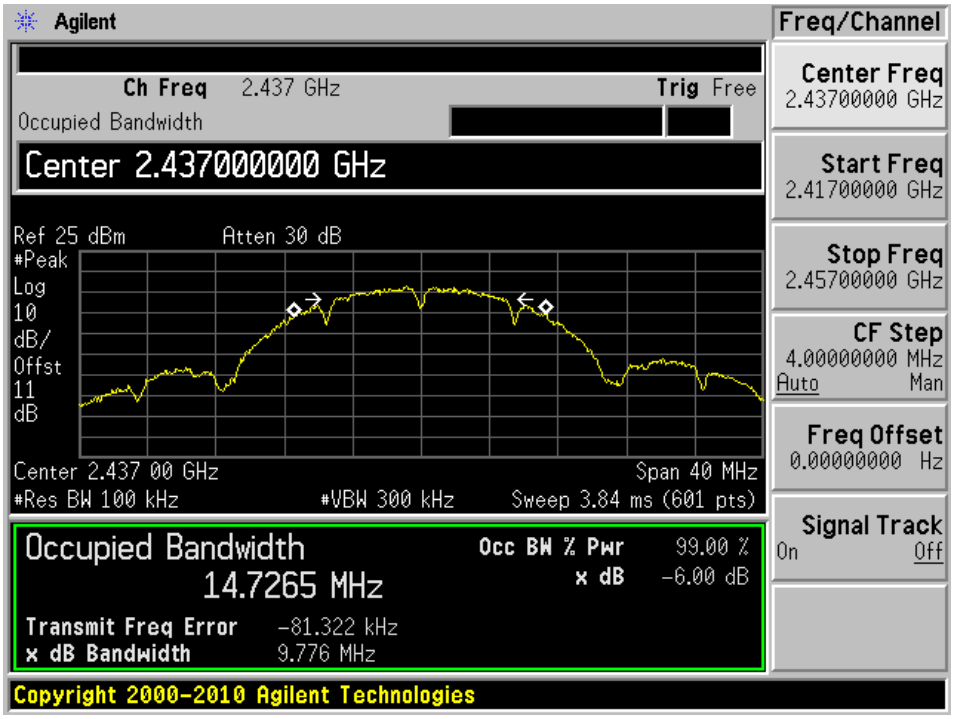
Please refer to the following plots for detailed test results

802.11 b mode

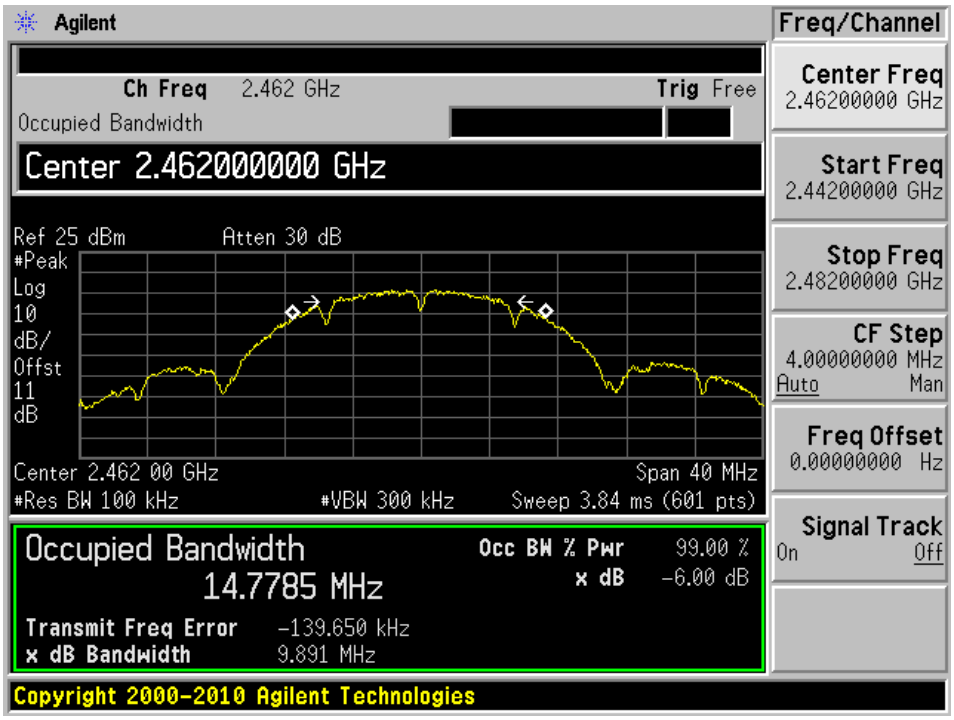
Low channel: 2412 MHz



Middle channel: 2437 MHz

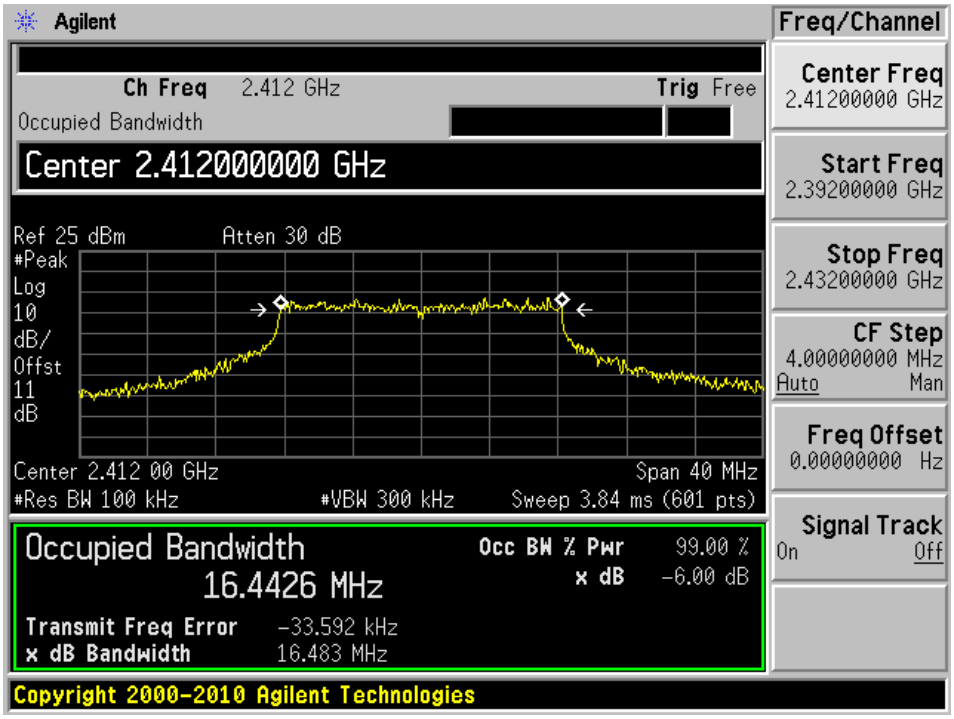


High channel: 2462 MHz

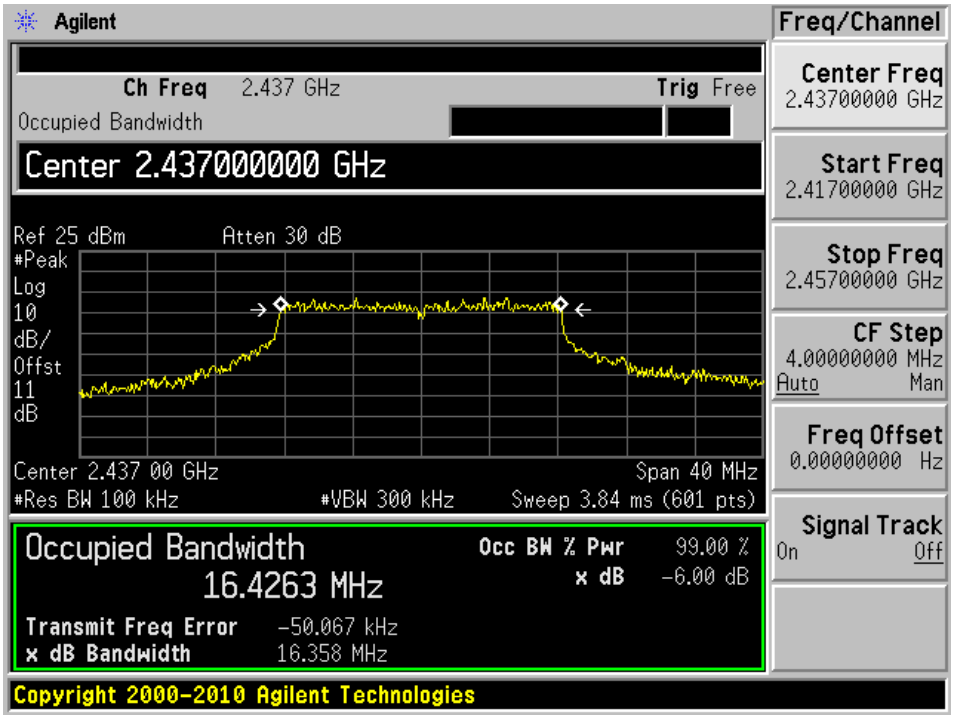


802.11 g mode

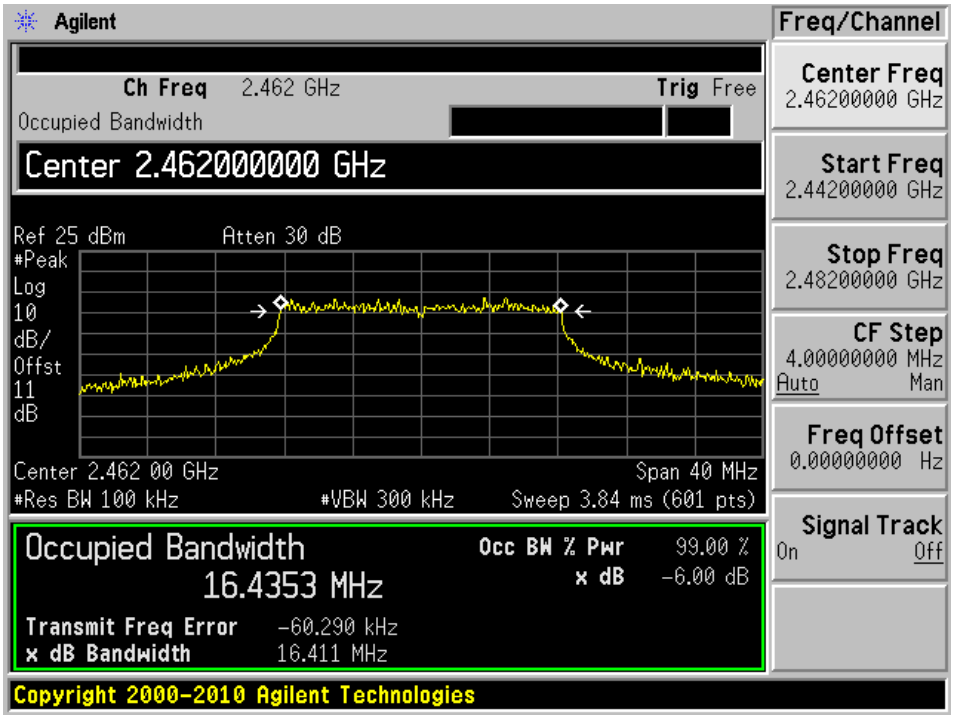
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



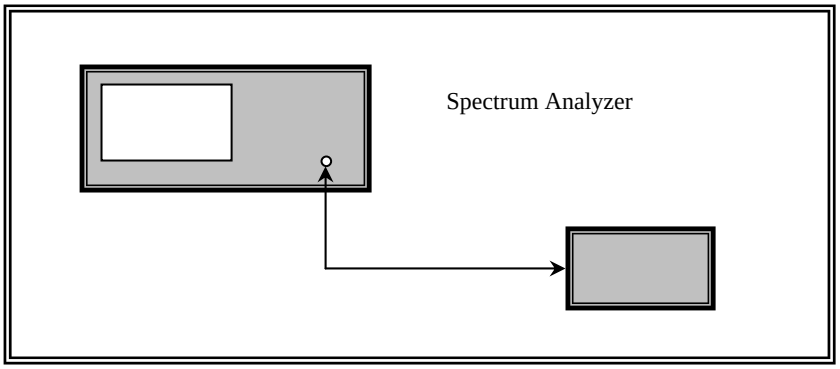
10 FCC §15.247(b) - Peak Output Power Measurement

10.1 Applicable Standard

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

10.2 Measurement Procedure

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



10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	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:	22 °C
Relative Humidity:	33 %
ATM Pressure:	101.3kPa

The testing was performed by Lionel Lara on 2012-02-16 at RF Site.

10.5 Test Results

802.11 b mode

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC Limit (dBm)	Margin (dB)
Low	2412	16.85	30	-13.15
Middle	2437	16.80	30	-13.20
High	2462	16.27	30	-13.73

802.11 g mode:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC Limit (dBm)	Margin (dB)
Low	2412	15.21	30	-14.79
Middle	2437	15.34	30	-14.66
High	2462	14.98	30	-15.02

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

11.1 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).

11.2 Measurement Procedure

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

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	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

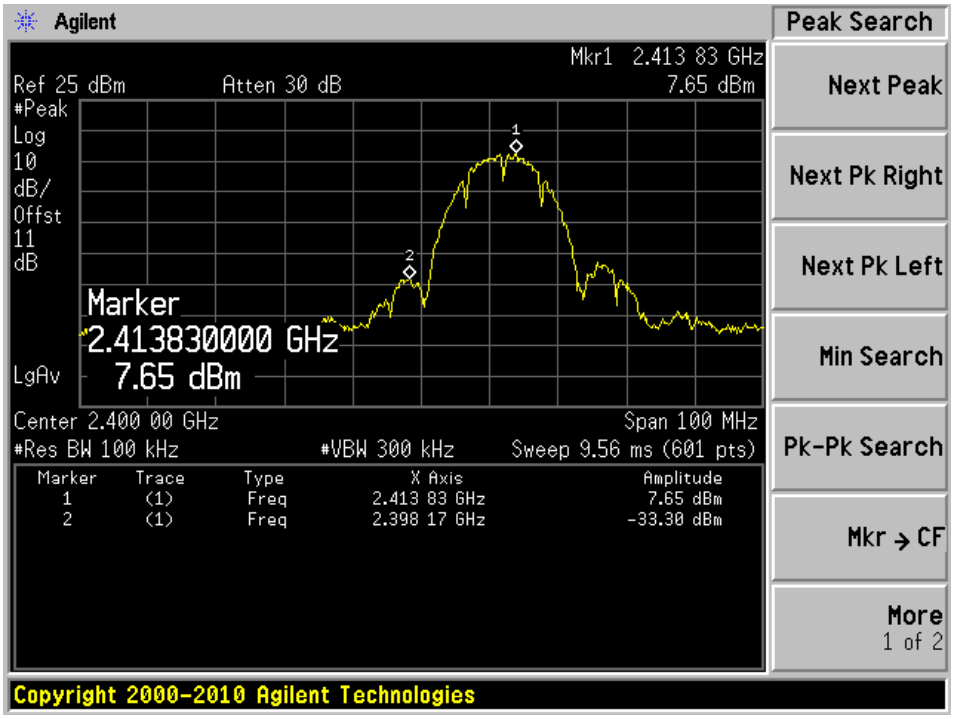
Temperature:	22 °C
Relative Humidity:	33 %
ATM Pressure:	101.3kPa

The testing was performed by Lionel Lara on 2012-02-16 at RF Site.

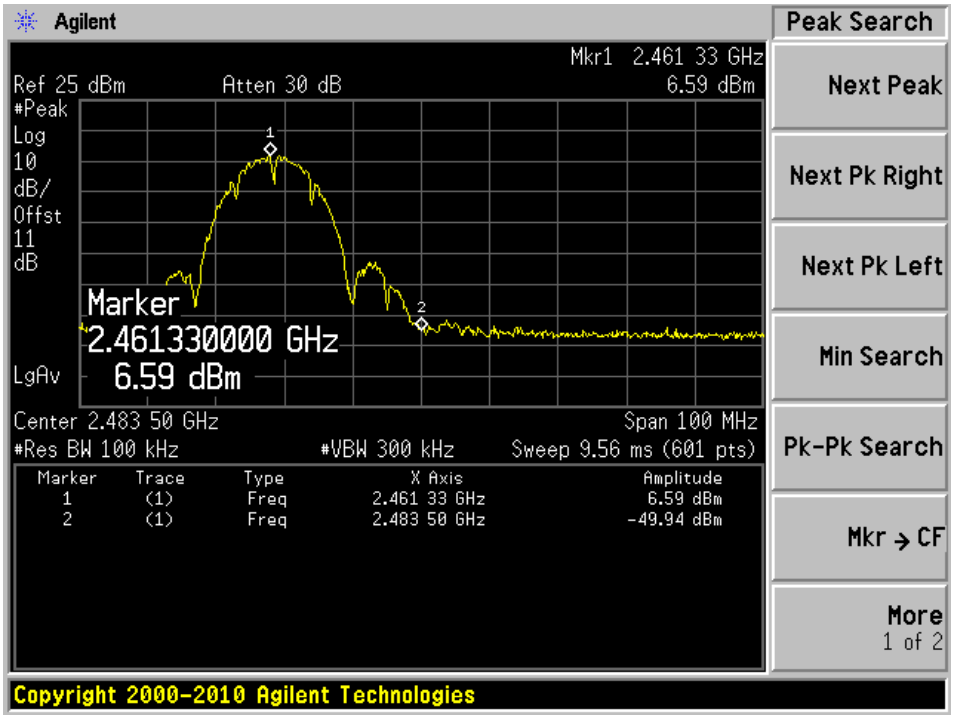
11.5 Test Results

Please refer to following pages for plots of band edge.

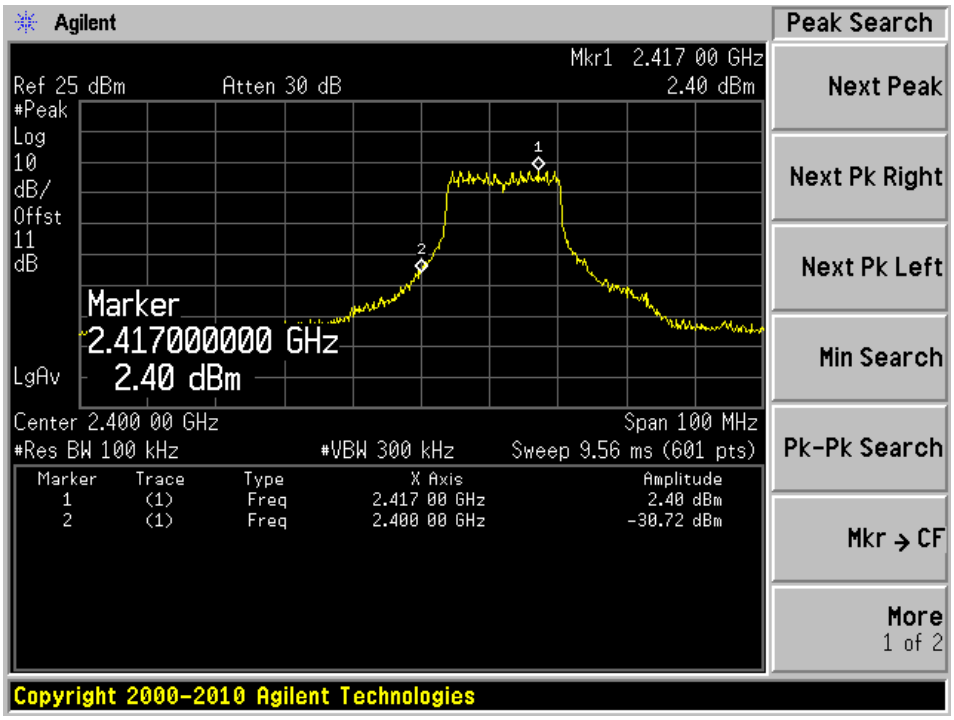
802.11b, Low Band Edge



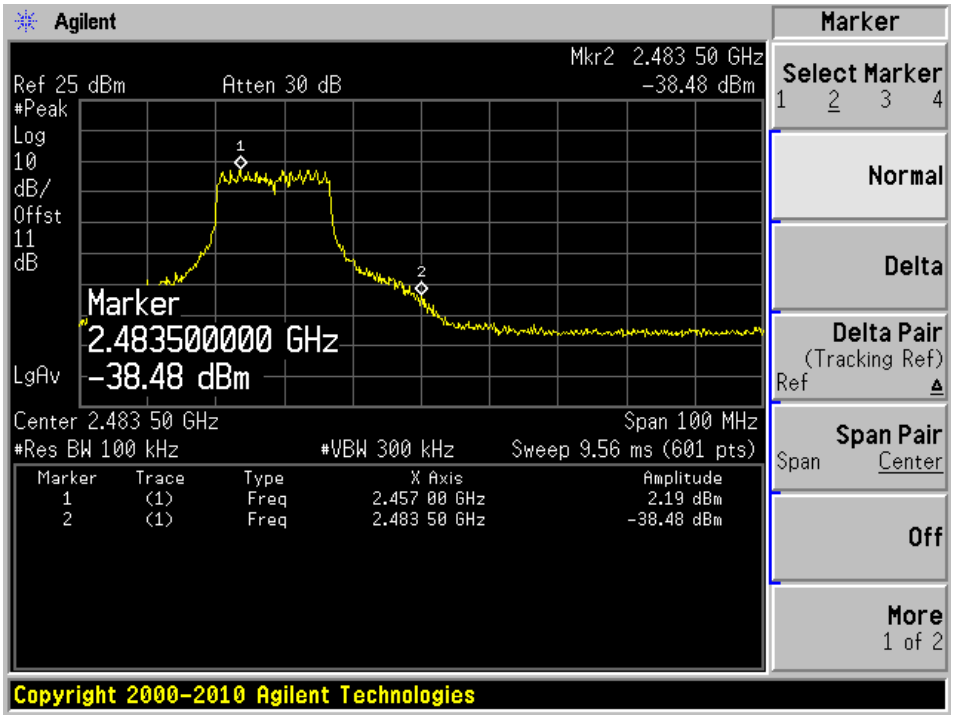
802.11b, High Band Edge



802.11g, Low Band Edge



802.11g, High Band Edge



12 FCC §15.247(e) - Power Spectral Density

12.1 Applicable Standard

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

12.2 Measurement Procedure

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

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	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:	22 °C
Relative Humidity:	33 %
ATM Pressure:	101.3kPa

The testing was performed by Lionel Lara on 2012-02-16 at RF Site.

12.5 Test Results

802.11 b mode:

Channel	Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Corrected PSD (dBm)	FCC Limit (dBm/3kHz)	Results
Low	2412	7.71	-7.49	8	Compliant
Mid	2437	7.88	-7.32	8	Compliant
High	2462	7.17	-8.03	8	Compliant

*BWCF (Bandwidth Correction Factor) =10*log (3 kHz/100kHz) =-15.2 dB*

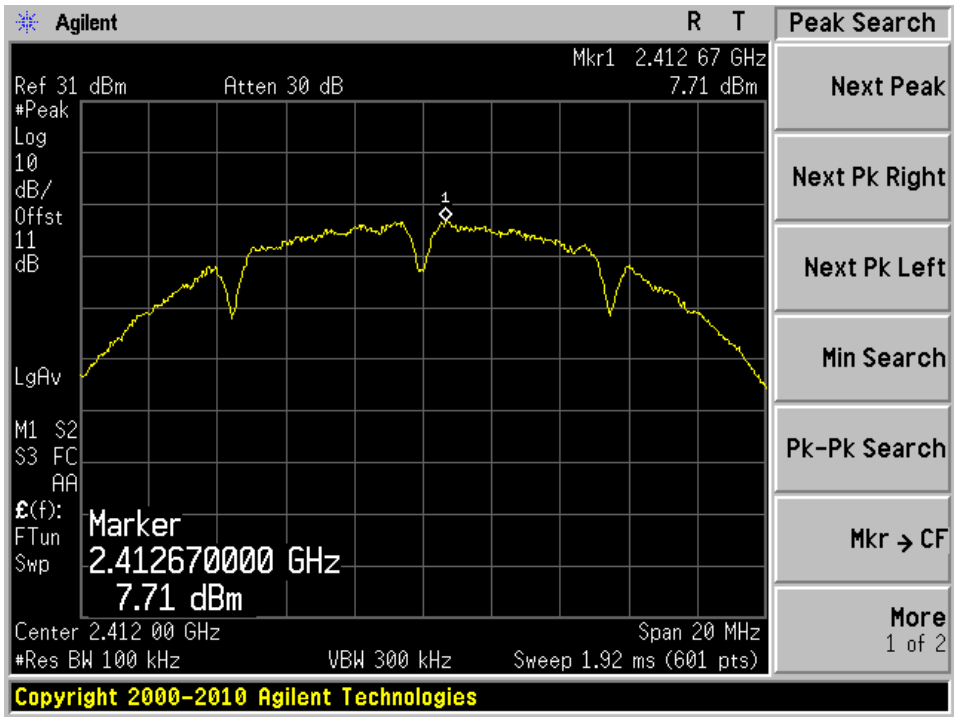
802.11 g mode:

Channel	Frequency (MHz)	Power Spectral Density (dBm/100kHz)	Corrected PSD (dBm)	FCC Limit (dBm/3kHz)	Results
Low	2412	2.42	-12.78	8	Compliant
Mid	2437	2.62	-12.58	8	Compliant
High	2462	2.46	-12.74	8	Compliant

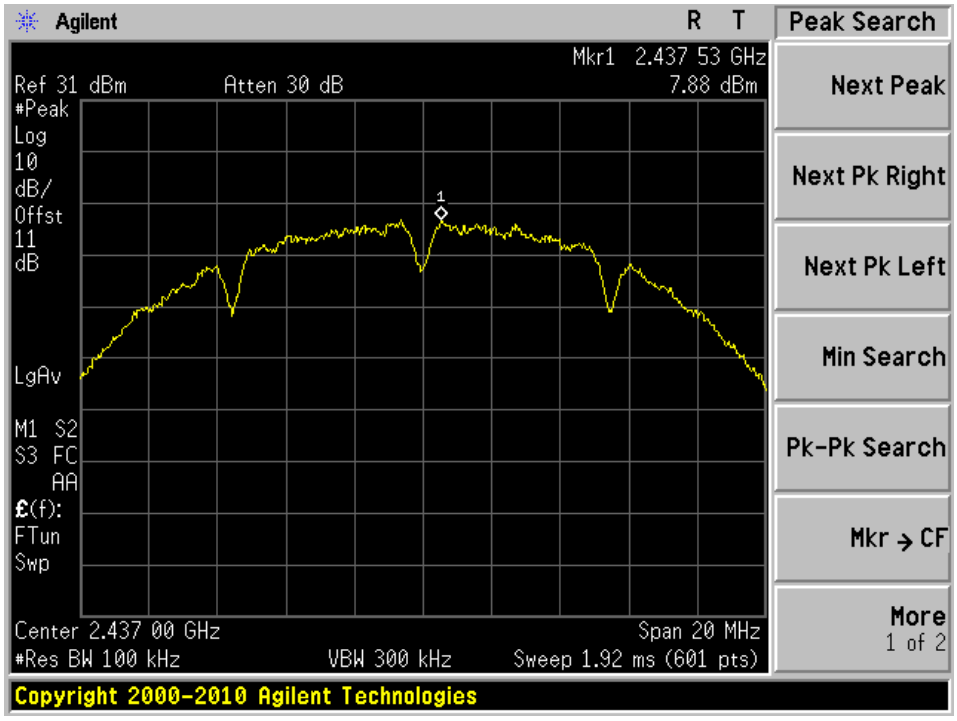
*BWCF (Bandwidth Correction Factor) =10*log (3 kHz/100kHz) =-15.2 dB*

Please refer to the following plots for detailed test results:

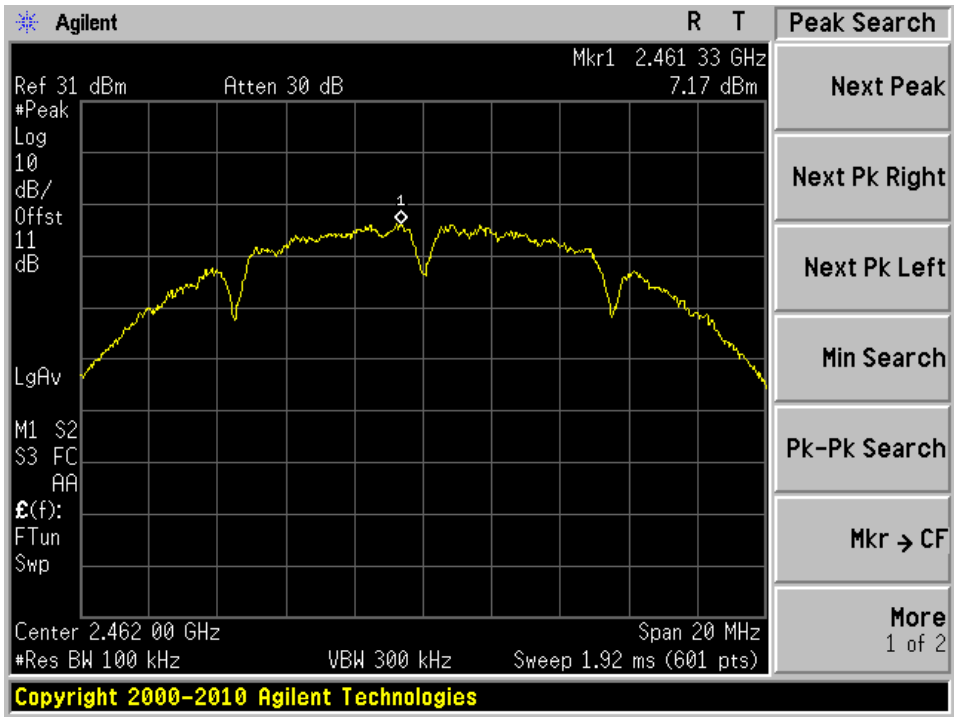
802.11b, Low channel: 2412 MHz



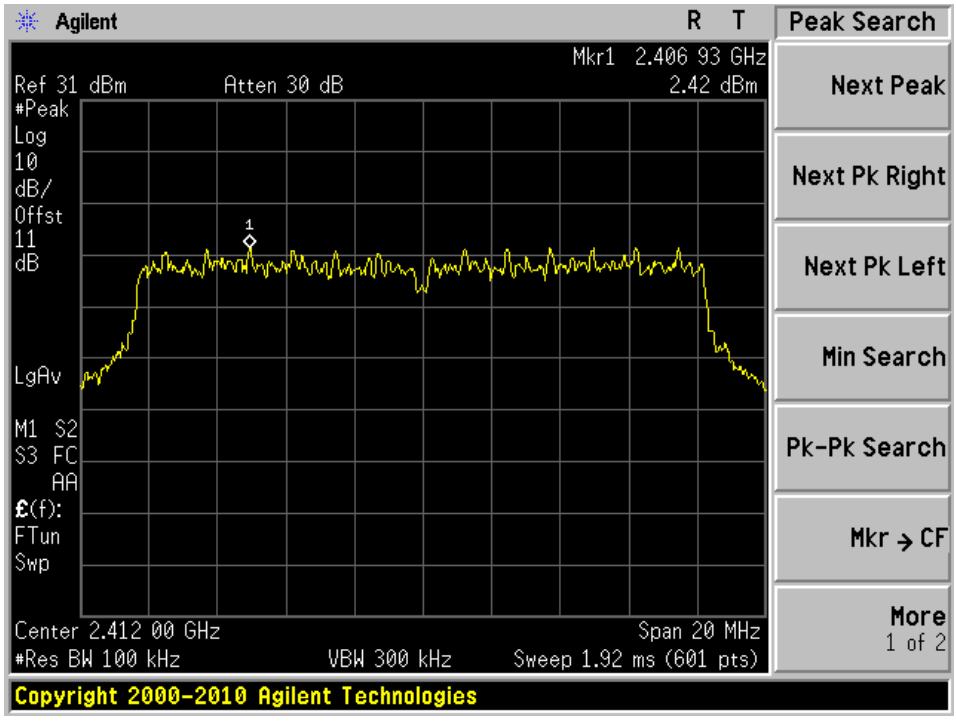
802.11b, Middle channel: 2437 MHz



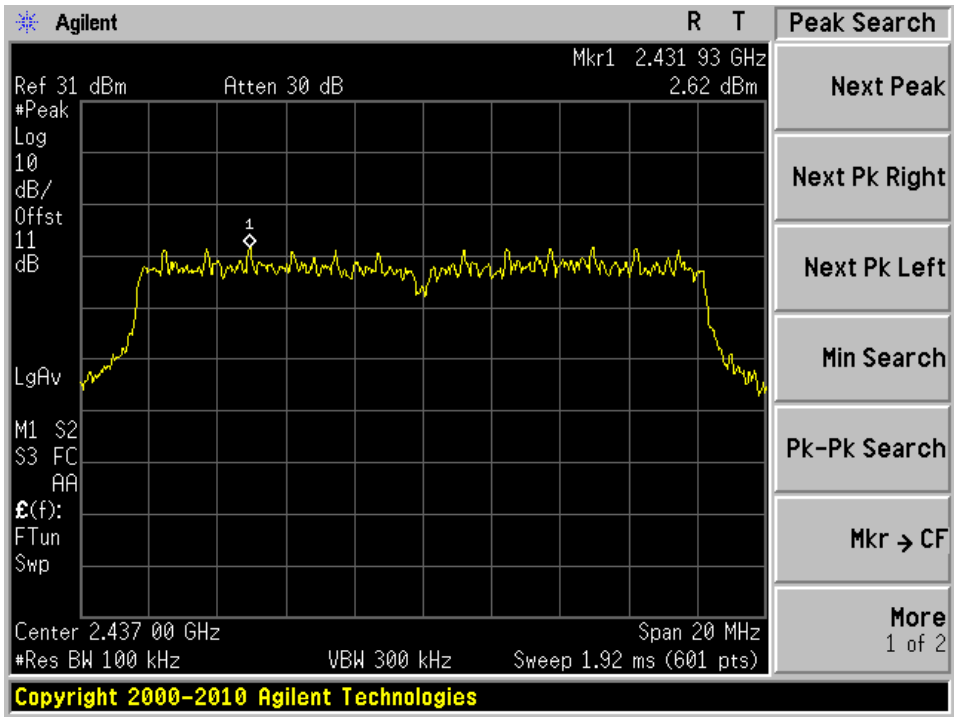
802.11b, High channel: 2462 MHz



802.11g, Low channel: 2412 MHz



802.11g, Middle channel: 2437 MHz



802.11g, High channel: 2462 MHz