FCC PART 15, SUBPART C
IC RSS-210, ISSUE 8, DECEMBER 2010

TEST AND MEASUREMENT REPORT

For

Cisco Systems, Inc.

1700 West Tasman Drive,

San Jose, CA 95134, USA

FCC ID: LDKCALAB0676
IC: 2461B-CALAB0676
Product Name: Cisco Connected Grid Router w/ 802.11N Access Points, 2400-2483.5 MHz

Report Type:	**Product Type:**
Original Report	Smart Grid Router

Prepared By:	Jeffrey Wu
Report Number:	R1210294-247
Report Date:	2012-11-27
Reviewed By:	Quinn Jiang Test Engineer

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162
Fax: (408) 732-9164

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1210294-247	Original Report	2012-11-27

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Cisco Systems, Inc*., and their product model: *CGR1120, FCC ID: LDKCALAB0676, IC: 2461B-CALAB0676 which* will henceforth be referred to as the EUT (Equipment Under Test). The EUT is a smart grid router with 802.11 b/g/n and GPS technology.

1.2 Mechanical Description of EUT

The EUT measures approximately 20.2 cm (L) x 22.9 cm (W) x 8.9 cm (H) and weighs 3.45Kg.

The test data gathered are from typical production sample, serial number: JAF1634BDLP, provided by the manufacturer.

1.3 Objective

This report is prepared on behalf of *Cisco Systems, Inc*. in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 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)

N/A

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 the 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 CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB 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 Corp.

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 site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have 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 test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b3678l6b

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

2.2 EUT Exercise Software

The test utility used was Tera Term, Version 4.74, was provided by Cisco Systems Inc., and was verified Jeffrey Wu to comply with the standard requirements being tested against.

2.3 Special Equipment

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

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Toshiba	Laptop	Portege Z935-ST2N01	7C156355H

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Cisco	Main Board	CGR1120/K9	JAF1634BDLP

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
RF Cable	<1.0	PSA	EUT
USB to Serial Port Cable	<1.0	Laptop	Serial Port
RJ45 to Serial Port Cable	<1.0	Serial Port	EUT

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Results
FCC §15.247(i), §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirement	Compliant
FCC §15.207(a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	Compliant
FCC §15.247 (d) IC RSS-210 §A8.5	Spurious Emissions at Antenna Port	Compliant
FCC §15.205 IC RSS-210 §2.2	Restricted Bands	Compliant
FCC §15.209, §15.247 (d) IC RSS-210 §A8.5	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) IC RSS-210 §A8.2	6 dB Emission Bandwidth	Compliant
FCC §15.247(b)(3) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) IC RSS-210 §A8.2(b)	Power Spectral Density	Compliant
IC RSS-210 §2.3 & RSS-Gen §4.10	Receiver Spurious Emission	Compliant

4 FCC §15.247 (i), §2.1091 & IC RSS-102 – 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

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

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

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

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

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):	8.29
Maximum peak output power at antenna input terminal (mW):	6.75
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	2.2
Maximum Antenna Gain (numeric):	1.66
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.00223
Power density of prediction frequency at 20.0 cm (W/m^2):	0.0223
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00223mW/cm^2 (0.0223 W/m^2). Limit is 1.0 mW/cm^2 (10 W/m^2).

5 FCC §15.203 & IC RSS-Gen §7.1.2 – 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.

According to IC RSS-Gen §7.1.2: Transmitter Antenna

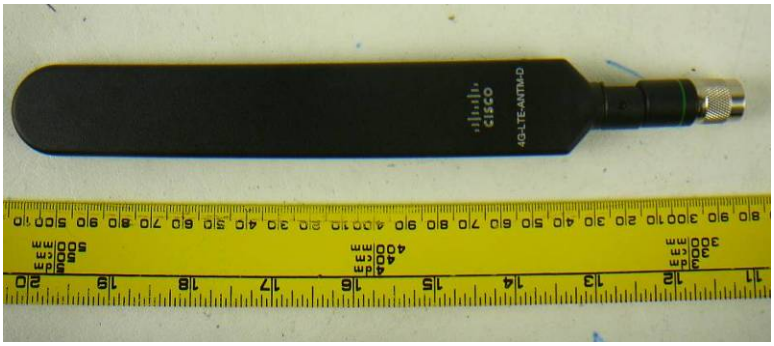
A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of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

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Antenna List

Manufacturers	Models/Name	Antenna Gain (dBi) 2.4 GHz
Laird Technologies	DBA6927C-CS2	2.2

The antenna consists of TNC connector with less than 6 dBi gain; therefore, it complies with the antenna requirement.



2.4 GHz Antennas

6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 Conducted limits:

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

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

**Decreases with the logarithm of the frequency.*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC §15.207 and IC RSS-Gen §7.2.4 limits.

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

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

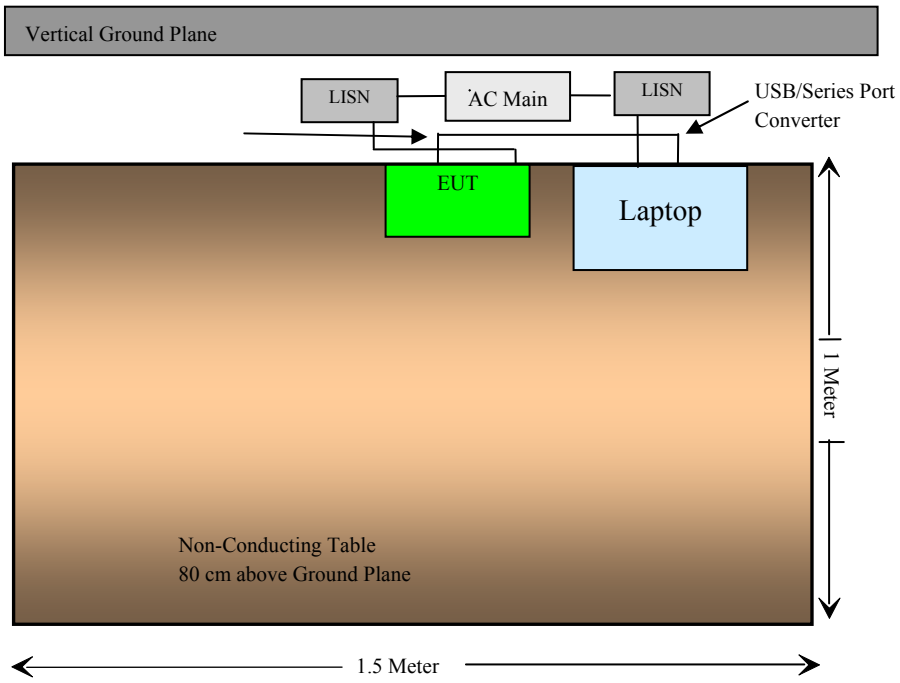
6.3 Test Procedure

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	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2012-04-18	1 year
Solar Electronics	LISN	9252-R-24-BNC	511205	2012-06-25	1 year
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2012-05-30	1 year

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

6.7 Test Environmental Conditions

Temperature:	24 ºC
Relative Humidity:	43%
ATM Pressure:	101.4 kPa

The testing was performed by Jeffrey Wu on 2012-11-08 in 5 m chamber 3.

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:

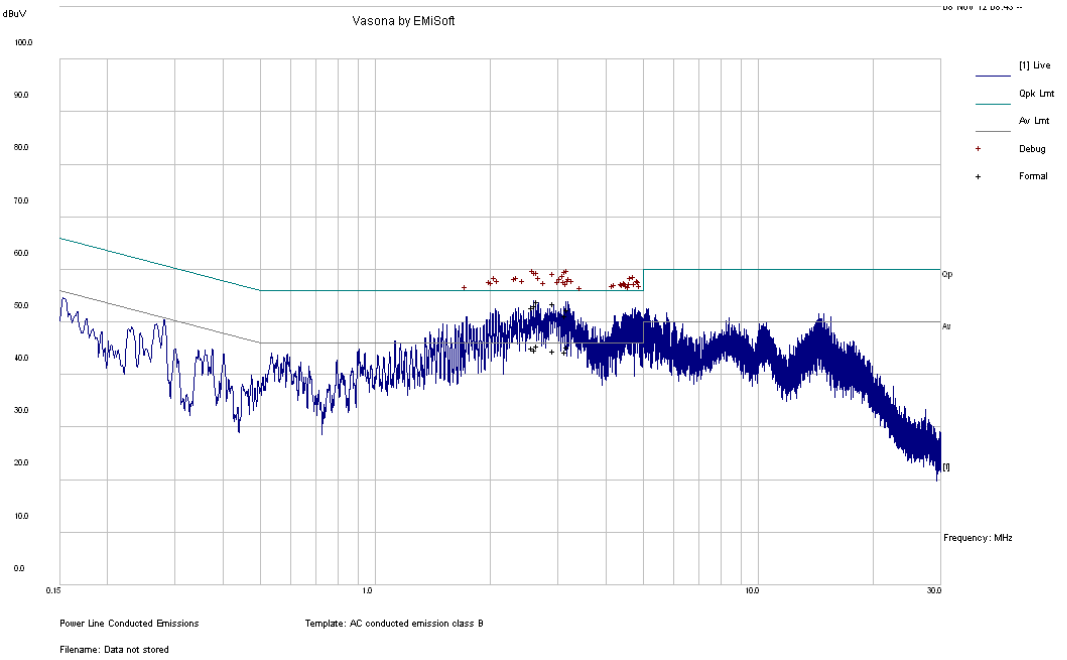
Transmitting Mode: Worst case 2.4 GHz, B mode.

Connection: AC 120 V/60 Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-0.47	2.658	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

Transmitting Mode: Worst case 2.4 GHz b mode

120 V, 60 Hz – Line



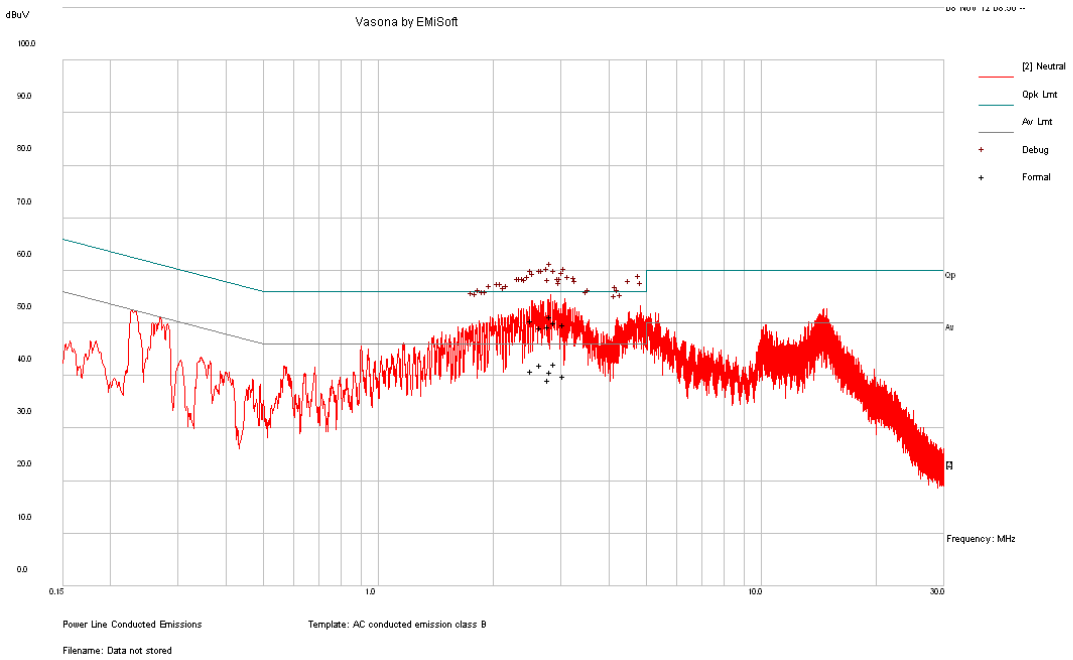
Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
2.658	53.93	Line	56	-2.07
2.919856	53.5	Line	56	-2.50
2.619933	53.2	Line	56	-2.80
2.582766	52.72	Line	56	-3.28
3.180898	52.45	Line	56	-3.55
3.144635	51.2	Line	56	-4.80

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
2.658	45.53	Line	46	-0.47
3.180898	45.36	Line	46	-0.64
2.582766	45.06	Line	46	-0.94
2.619933	44.81	Line	46	-1.19
2.919856	44.61	Line	46	-1.39
3.144635	44.34	Line	46	-1.66

120 V, 60 Hz – Neutral



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
2.819488	51.33	Neutral	56	-4.67
2.520328	50.54	Neutral	56	-5.46
2.886171	50.13	Neutral	56	-5.87
3.055811	49.68	Neutral	56	-6.32
2.789135	49.3	Neutral	56	-6.70
2.650594	49.08	Neutral	56	-6.92

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
2.886171	42.16	Neutral	46	-3.84
2.650594	42.15	Neutral	46	-3.85
2.520328	40.88	Neutral	46	-5.12
2.819488	40.81	Neutral	46	-5.19
3.055811	39.87	Neutral	46	-6.13
2.789135	39.23	Neutral	46	-6.77

7 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For FCC §15.247(d) and IC RSS-210 §A8.5 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	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 years

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

7.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	41 %
ATM Pressure:	101.3kPa

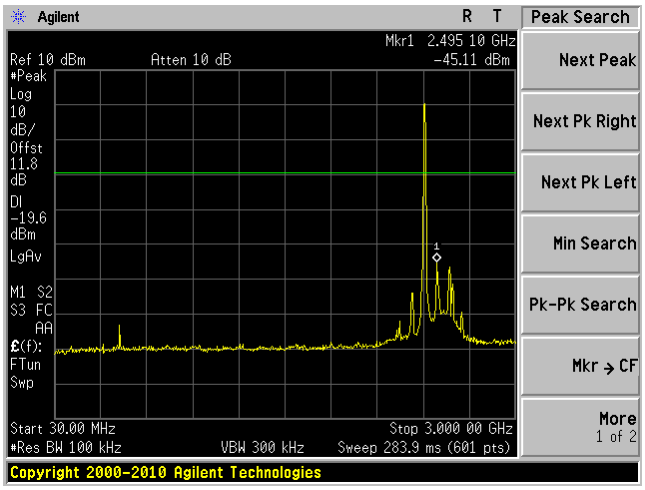
The testing was performed by Jeffrey Wu on 2012-11-05 at RF site.

7.5 Measurement Results

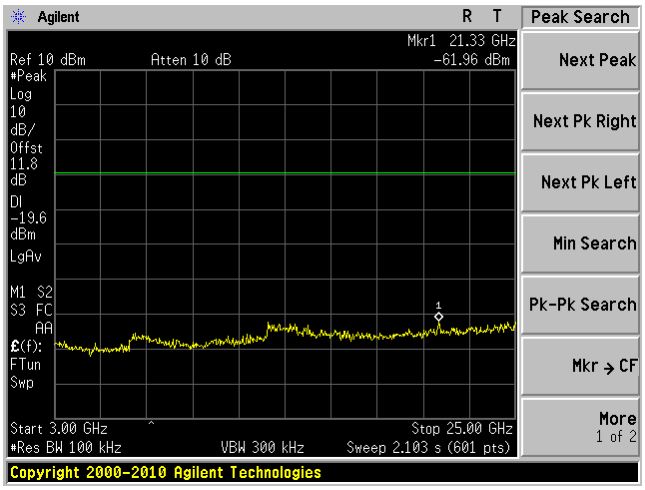
Please refer to following plots of spurious emissions.

802.11b, Low Channel, 2412 MHz

Plot: 30 MHz – 3 GHz

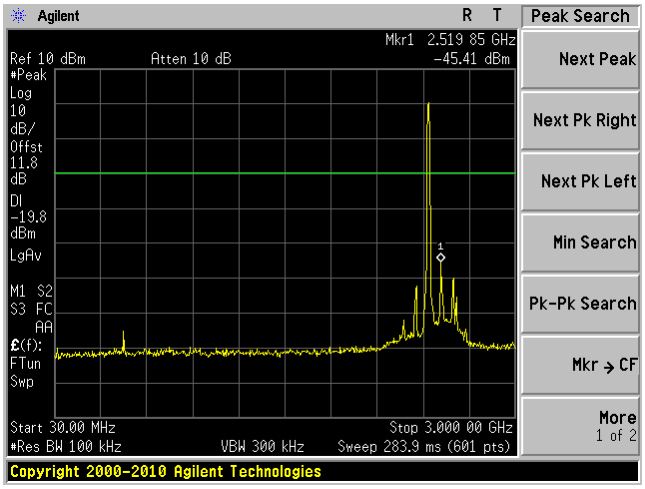


Plot: 3 GHz – 25 GHz

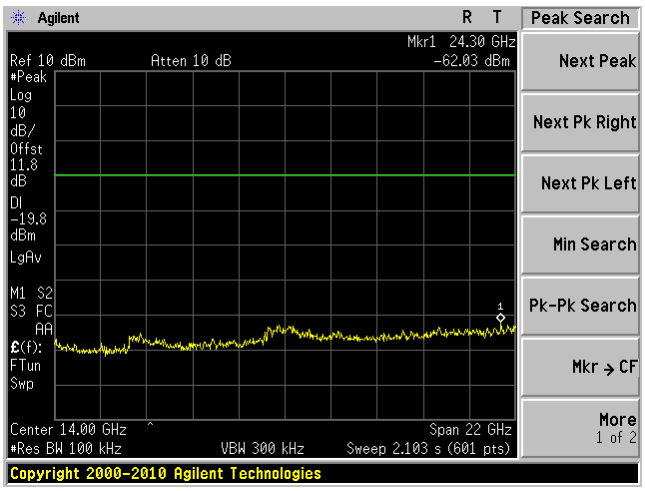


802.11b, Middle Channel, 2437 MHz

Plot: 30 MHz – 3 GHz

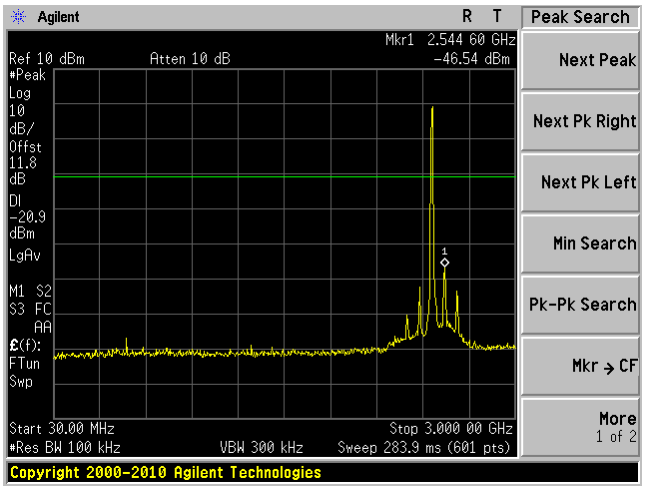


Plot: 3 GHz – 25 GHz

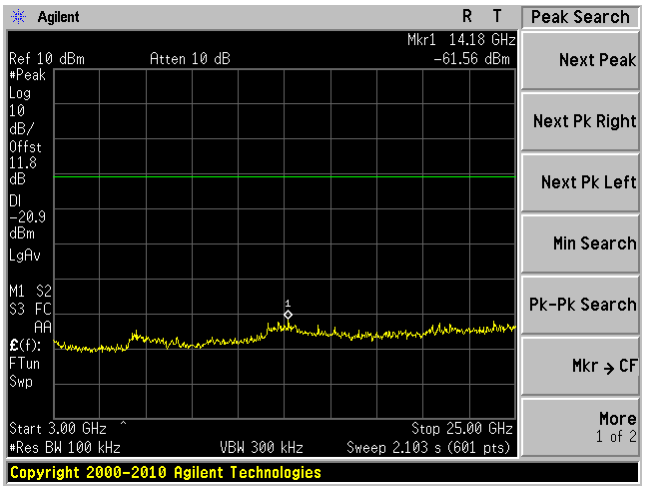


802.11b, High Channel, 2462 MHz

Plot: 30 MHz – 3 GHz

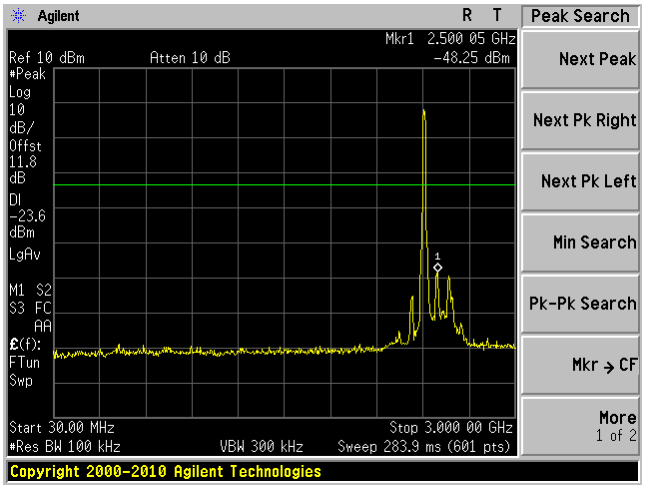


Plot: 3 GHz – 25 GHz

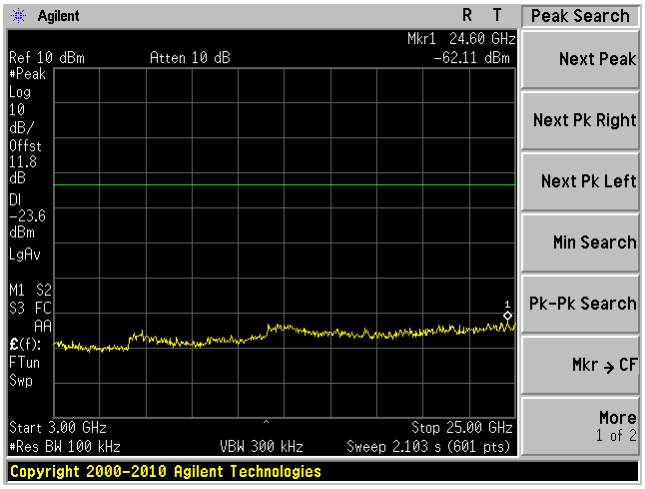


802.11g, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

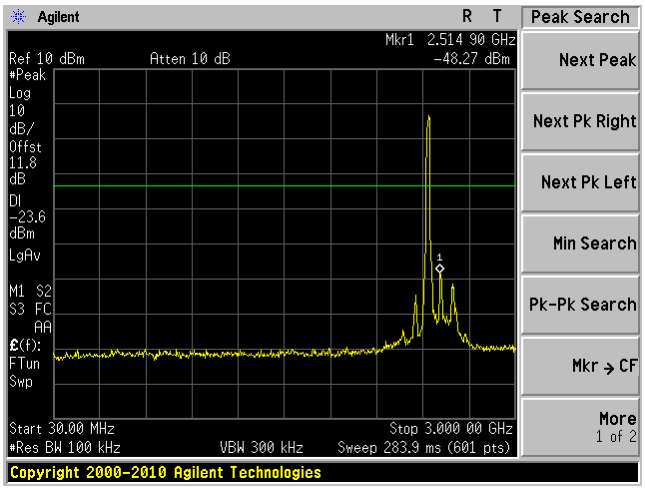


Plot: 3 GHz – 25 GHz

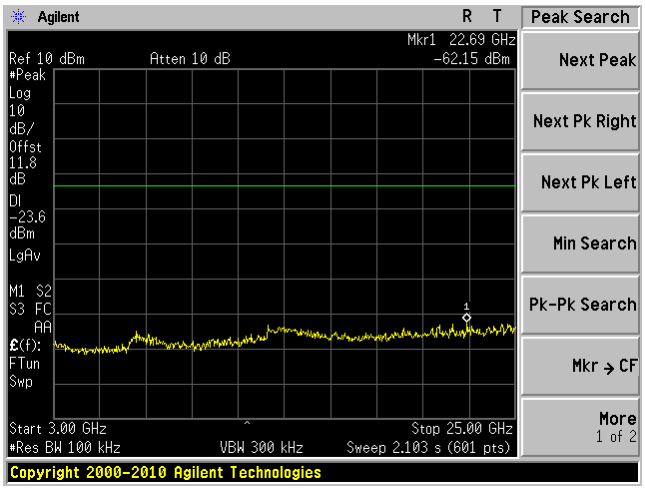


802.11g, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

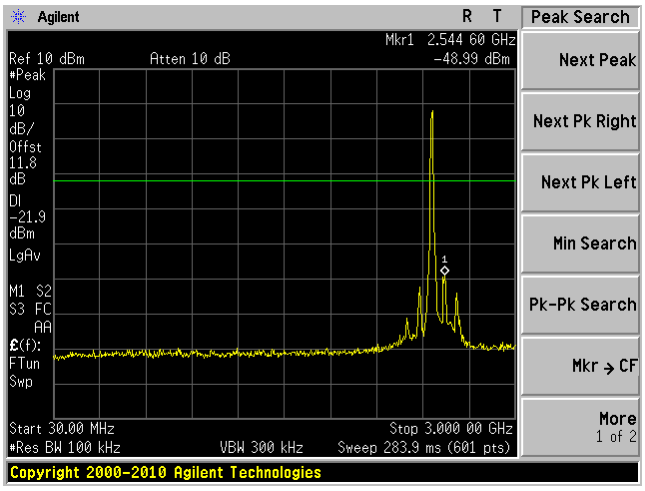


Plot: 3 GHz – 25 GHz

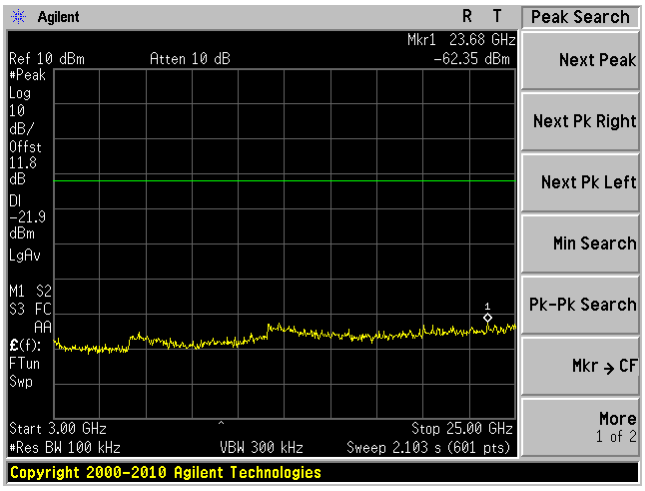


802.11g, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz

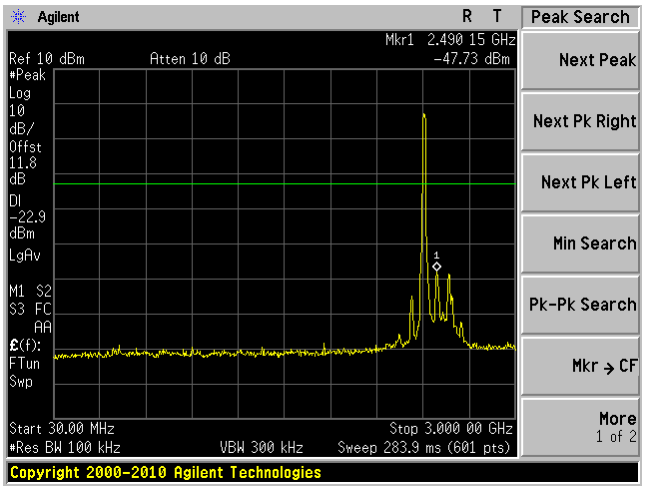


Plot: 3 GHz – 25 GHz

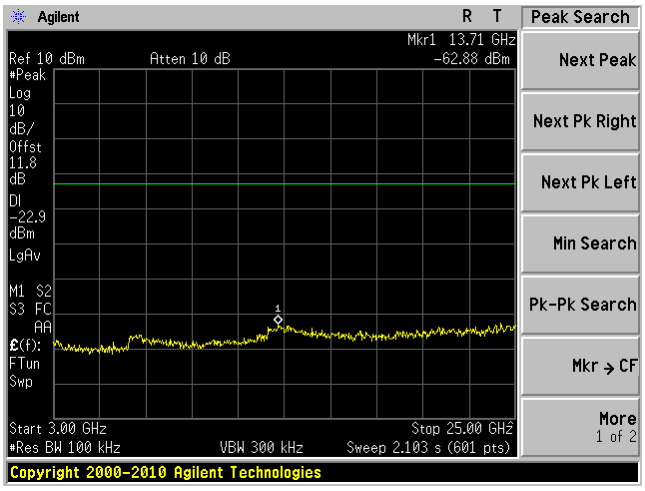


802.11n HT20, Low Channel 2412 MHz

Plot: 30 MHz – 3 GHz

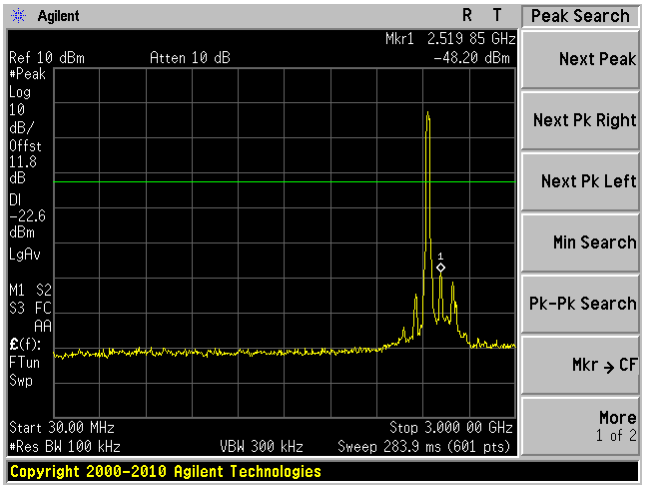


Plot: 3 GHz – 25 GHz

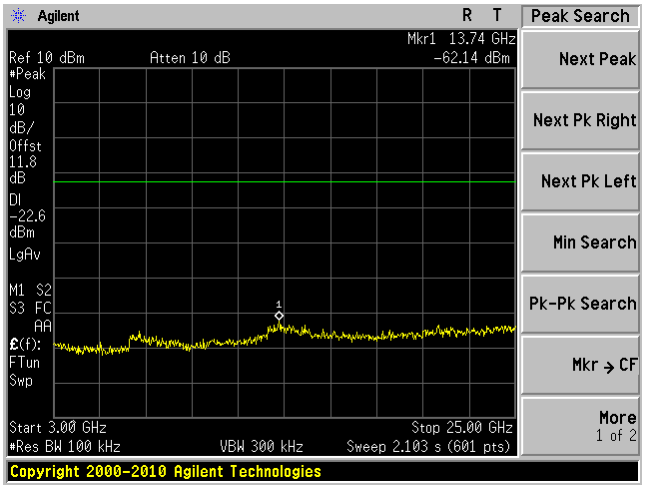


802.11n HT20, Middle Channel 2437 MHz

Plot: 30 MHz – 3 GHz

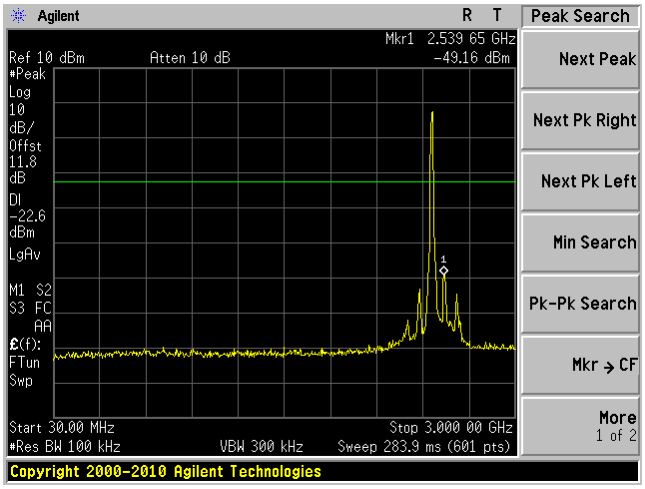


Plot: 3 GHz – 25 GHz

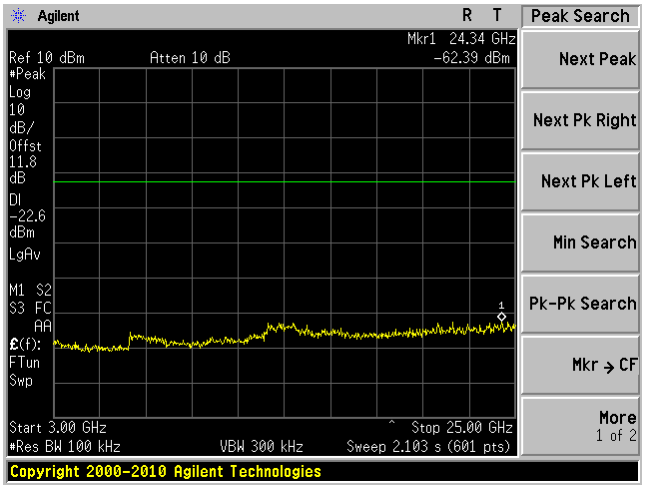


802.11n HT20, High Channel 2462 MHz

Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 25 GHz



8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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

As per IC RSS-210 A8.5 Out-of-band Emissions, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-08-15	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2012-06-09	1 year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1 year
Agilent	Spectrum Analyzer	E4440A	US42221851	2012-02-28	1 year
Sunol Science Corp	Horn Antenna	DHR-118	A052704	2012-02-24	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-22	1 year

Statement of Traceability: BACL *attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

8.6 Test Environmental Conditions

Temperature:	21-24°C
Relative Humidity:	43-46%
ATM Pressure:	101-103kPa

The testing was performed by Jeffrey Wu and Lionel Lara from 2012-11-08 to 2012-11-12 at 5 meter 3.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15C and IC RSS-210 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**
-5.11	80.007	Vertical	802.11 b mode Middle Channel

1 – 25 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-3.675	2483.5	Vertical	802.11 n HT20 mode High Channel

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

8.8 Radiated Emissions Test Data

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

Quasi-Peak Measurements

802.11b mode Low Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
37.4755	30.3	118	V	126	40	-9.70
45.2225	31.67	100	V	297	40	-8.33
900.0643	37.81	100	H	309	46	-8.19
46.76325	26.72	123	V	161	40	-13.28
875.1143	26.84	106	H	314	46	-19.16
125.8548	21.14	130	V	47	43.5	-22.36

802.11b mode Middle Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
80.007	34.89	156	V	86	40	-5.11
42.85975	29.92	146	V	141	40	-10.08
37.1475	26.16	132	V	348	40	-13.84
50.181	25.07	113	V	326	40	-14.93
125.0315	20.38	137	V	336	43.5	-23.12
326.6525	10.09	146	H	227	46	-35.91

802.11b mode High Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.0605	38.04	100	H	313	46	-7.96
45.05825	31.38	109	V	326	40	-8.62
37.407	30.64	100	V	90	40	-9.36
800.0498	35.57	100	H	123	46	-10.43
875.1135	28.07	100	H	320	46	-17.93
126.8248	23.26	100	V	42	43.5	-20.24

802.11g mode Low Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.043	38.58	100	H	313	46	-7.42
37.267	28.21	164	V	348	40	-11.79
79.987	26.39	106	V	263	40	-13.61
43.26225	25.06	182	V	360	40	-14.94
128.9298	21.98	124	V	0	43.5	-21.52
128.894	19.45	111	V	85	43.5	-24.05

802.11g mode Middle Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.035	37.33	100	H	137	46	-8.67
37.647	28.55	134	V	20	40	-11.45
45.25875	27.99	129	V	312	40	-12.01
700.0448	33.43	100	H	266	46	-12.57
128.885	22.92	122	V	0	43.5	-20.58
830.5935	17.61	166	V	39	46	-28.39

802.11g mode High Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.036	38.02	100	H	319	46	-7.98
37.42375	30.71	138	V	347	40	-9.29
45.05875	26.7	119	V	28	40	-13.30
875.105	30.11	100	H	309	46	-15.89
79.9835	22.81	149	V	154	40	-17.19
126.0675	22.08	102	V	53	43.5	-21.42

802.11n HT20 mode Low Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.07	36.04	100	H	332	46	-9.96
37.9725	29.22	194	V	258	40	-10.78
46.9995	26.68	112	V	303	40	-13.32
700.0753	32.15	127	H	259	46	-13.85
44.226	24.56	177	V	334	40	-15.44
126.991	20.51	145	V	343	43.5	-22.99

802.11n HT20 mode Middle Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.036	38.59	100	H	313	46	-7.41
44.6305	29.4	120	V	288	40	-10.60
37.3395	28.73	143	V	264	40	-11.27
700.0263	34.25	109	H	100	46	-11.75
79.9755	23.57	100	V	220	40	-16.43
128.7518	19.07	176	V	41	43.5	-24.43

802.11n HT20 mode High Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
900.0648	37.45	100	H	303	46	-8.55
37.499	30.43	103	V	351	40	-9.57
44.76425	27.65	106	V	311	40	-12.35
47.04875	27.36	126	V	337	40	-12.64
127.2913	24.23	105	V	0	43.5	-19.27
705.3988	15.7	207	V	218	46	-30.30

2) 1–25 GHz, Measured at 3 meters

802.11b mode, Low Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	70.79	351	136	V	28.96	2.94	-	102.686	-	-	Peak
2412	59.54	233	140	H	28.96	2.94	-	91.436	-	-	Peak
2412	67.18	351	136	V	28.96	2.94	-	99.076	-	-	Ave
2412	56.04	233	140	H	28.96	2.94	-	87.936	-	-	Ave
2390	27.53	350	136	V	28.96	2.94	-	59.426	74	-14.574	Peak
2390	27.17	220	135	H	28.96	2.94	-	59.066	74	-14.934	Peak
2390	13.10	351	136	V	28.96	2.94	-	44.996	54	-9.004	Ave
2390	12.25	220	135	H	28.96	2.94	-	44.146	54	-9.854	Ave
4824	32.60	0	100	V	32.7	4.06	27.70	41.671	74	-32.329	Peak
4824	32.66	0	100	H	32.7	4.06	27.70	41.731	74	-32.269	Peak
4824	17.95	0	100	V	32.7	4.06	27.70	27.021	54	-26.979	Ave
4824	18.19	0	100	H	32.7	4.06	27.70	27.261	54	-26.739	Ave
7236	32.87	0	100	V	36.4	4.88	27.58	46.606	82.686	-36.080	Peak
7236	33.03	0	100	H	36.4	4.88	27.58	46.766	71.436	-24.670	Peak
7236	17.41	0	100	V	36.4	4.88	27.58	31.146	79.076	-47.930	Ave
7236	18.35	0	100	H	36.4	4.88	27.58	32.086	67.936	-35.850	Ave
9648	31.48	0	100	V	37.3	5.82	27.06	47.568	82.686	-35.118	Peak
9648	31.41	0	100	H	37.3	5.82	27.06	47.498	71.436	-23.938	Peak
9648	16.83	0	100	V	37.3	5.82	27.06	32.918	79.076	-46.158	Ave
9648	16.75	0	100	H	37.3	5.82	27.06	32.838	67.936	-35.098	Ave

802.11b mode, Middle Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 2437 MHz, measured at 3 meters											
2437	69.56	353	133	V	28.96	2.94	-	101.456	-	-	Peak
2437	58.27	232	137	H	28.96	2.94	-	90.166	-	-	Peak
2437	66.03	353	133	V	28.96	2.94	-	97.926	-	-	Ave
2437	54.60	232	137	H	28.96	2.94	-	86.496	-	-	Ave
4874	32.53	0	100	V	32.8	4.10	27.67	41.788	74	-32.212	Peak
4874	32.10	0	100	H	32.8	4.10	27.67	41.358	74	-32.642	Peak
4874	17.82	0	100	V	32.8	4.10	27.67	27.078	54	-26.922	Ave
4874	17.90	0	100	H	32.8	4.10	27.67	27.158	54	-26.842	Ave
7311	32.75	0	100	V	36.5	4.83	27.51	46.593	74	-27.407	Peak
7311	32.98	0	100	H	36.5	4.83	27.51	46.823	74	-27.177	Peak
7311	18.46	0	100	V	36.5	4.83	27.51	32.303	54	-21.697	Ave
7311	18.50	0	100	H	36.5	4.83	27.51	32.343	54	-21.657	Ave
9748	31.36	0	100	V	37.3	5.74	26.98	47.438	81.456	-34.018	Peak
9748	31.51	0	100	H	37.3	5.74	26.98	47.588	70.166	-22.578	Peak
9748	16.96	0	100	V	37.3	5.74	26.98	33.038	77.926	-44.888	Ave
9748	16.98	0	100	H	37.3	5.74	26.98	33.058	66.496	-33.438	Ave

802.11b mode, High Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2462 MHz, measured at 3 meters											
2462	67.26	353	127	V	29.07	3.01	-	99.336	-	-	Peak
2462	56.89	232	131	H	29.07	3.01	-	88.966	-	-	Peak
2462	63.45	353	127	V	29.07	3.01	-	95.526	-	-	Ave
2462	53.22	232	131	H	29.07	3.01	-	85.296	-	-	Ave
2483.5	26.49	350	126	V	29.16	3.01	-	58.655	74	-15.345	Peak
2483.5	26.72	236	131	H	29.16	3.01	-	58.885	74	-15.115	Peak
2483.5	13.12	350	126	V	29.16	3.01	-	45.285	54	-8.715	Ave
2483.5	12.86	236	131	H	29.16	3.01	-	45.025	54	-8.975	Ave
4924	32.28	0	100	V	32.9	4.10	27.75	41.488	74	-32.512	Peak
4924	31.97	0	100	H	32.9	4.10	27.75	41.178	74	-32.822	peak
4924	18.13	0	100	V	32.9	4.10	27.75	27.338	54	-26.662	Ave
4924	18.15	0	100	H	32.9	4.10	27.75	27.358	54	-26.642	Ave
7386	33.01	0	100	V	36.3	4.89	27.51	46.733	74	-27.267	Peak
7386	32.83	0	100	H	36.3	4.89	27.51	46.553	74	-27.447	Peak
7386	18.30	0	100	V	36.3	4.89	27.51	32.023	54	-21.977	Ave
7386	18.28	0	100	H	36.3	4.89	27.51	32.003	54	-21.997	Ave
9848	31.68	0	100	V	37.4	5.77	26.98	47.911	79.336	-31.425	Peak
9848	31.46	0	100	H	37.4	5.77	26.98	47.691	68.966	-21.275	Peak
9848	16.85	0	100	V	37.4	5.77	26.98	33.081	75.526	-42.445	Ave
9848	16.89	0	100	H	37.4	5.77	26.98	33.121	65.296	-32.175	Ave

802.11g mode, Low Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	72.52	351	137	V	28.96	2.94	-	104.416	-	-	Peak
2412	62.15	232	140	H	28.96	2.94	-	94.046	-	-	Peak
2412	60.22	351	137	V	28.96	2.94	-	92.116	-	-	Ave
2412	49.60	232	140	H	28.96	2.94	-	81.496	-	-	Ave
2390	31.74	349	138	V	28.96	2.94	-	63.636	74	-10.364	Peak
2390	26.44	235	142	H	28.96	2.94	-	58.336	74	-15.664	Peak
2390	15.84	349	138	V	28.96	2.94	-	47.736	54	-6.264	Ave
2390	12.77	235	142	H	28.96	2.94	-	44.666	54	-9.334	Ave
4824	33.32	0	100	V	32.7	4.06	27.70	42.391	74	-31.609	Peak
4824	33.32	0	100	H	32.7	4.06	27.70	42.391	74	-31.609	Peak
4824	17.96	0	100	V	32.7	4.06	27.70	27.031	54	-26.969	Ave
4824	17.96	0	100	H	32.7	4.06	27.70	27.031	54	-26.969	Ave
7236	34.13	0	100	V	36.4	4.88	27.58	47.866	84.416	-36.550	Peak
7236	34.13	0	100	H	36.4	4.88	27.58	47.866	74.046	-26.180	Peak
7236	18.39	0	100	V	36.4	4.88	27.58	32.126	72.116	-39.990	Ave
7236	18.39	0	100	H	36.4	4.88	27.58	32.126	61.496	-29.370	Ave
9648	32.12	0	100	V	37.3	5.82	27.06	48.208	84.416	-36.208	Peak
9648	32.12	0	100	H	37.3	5.82	27.06	48.208	74.046	-25.838	Peak
9648	16.74	0	100	V	37.3	5.82	27.06	32.828	72.116	-39.288	Ave
9648	16.74	0	100	H	37.3	5.82	27.06	32.828	61.496	-28.668	Ave

802.11g mode, Middle Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 2437 MHz, measured at 3 meters											
2437	70.87	353	135	V	28.96	2.94	-	102.766	-	-	Peak
2437	60.09	231	137	H	28.96	2.94	-	91.986	-	-	Peak
2437	58.96	353	135	V	28.96	2.94	-	90.856	-	-	Ave
2437	48.03	231	137	H	28.96	2.94	-	79.926	-	-	Ave
4874	32.64	0	100	V	32.8	4.10	27.67	41.898	74	-32.102	Peak
4874	32.64	0	100	H	32.8	4.10	27.67	41.898	74	-32.102	Peak
4874	17.96	0	100	V	32.8	4.10	27.67	27.218	54	-26.782	Ave
4874	17.96	0	100	H	32.8	4.10	27.67	27.218	54	-26.782	Ave
7311	33.05	0	100	V	36.5	4.83	27.51	46.893	74	-27.107	Peak
7311	33.05	0	100	H	36.5	4.83	27.51	46.893	74	-27.107	Peak
7311	18.14	0	100	V	36.5	4.83	27.51	31.983	54	-22.017	Ave
7311	18.14	0	100	H	36.5	4.83	27.51	31.983	54	-22.017	Ave
9748	31.70	0	100	V	37.3	5.74	26.98	47.778	82.766	-34.988	Peak
9748	31.70	0	100	H	37.3	5.74	26.98	47.778	71.986	-24.208	Peak
9748	16.56	0	100	V	37.3	5.74	26.98	32.638	70.856	-38.218	Ave
9748	16.56	0	100	H	37.3	5.74	26.98	32.638	59.926	-27.288	Ave

802.11g mode, High Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 2462 MHz, measured at 3 meters											
2462	68.34	353	130	V	29.07	3.01	-	100.416	-	-	Peak
2462	59.09	233	137	H	29.07	3.01	-	91.166	-	-	Peak
2462	57.18	353	130	V	29.07	3.01	-	89.256	-	-	Ave
2462	46.59	233	137	H	29.07	3.01	-	78.666	-	-	Ave
2483.5	34.38	352	130	V	29.16	3.01	-	66.545	74	-7.455	Peak
2483.5	29.28	237	135	H	29.16	3.01	-	61.445	74	-12.555	Peak
2483.5	16.74	352	130	V	29.16	3.01	-	48.905	54	-5.095	Ave
2483.5	13.91	237	135	H	29.16	3.01	-	46.075	54	-7.925	Ave
4924	32.94	0	100	V	32.9	4.10	27.75	42.148	74	-31.852	Peak
4924	32.94	0	100	H	32.9	4.10	27.75	42.148	74	-31.852	Peak
4924	18.19	0	100	V	32.9	4.10	27.75	27.398	54	-26.602	Ave
4924	18.19	0	100	H	32.9	4.10	27.75	27.398	54	-26.602	Ave
7386	33.28	0	100	V	36.3	4.89	27.51	47.003	74	-26.997	Peak
7386	33.28	0	100	H	36.3	4.89	27.51	47.003	74	-26.997	Peak
7386	18.03	0	100	V	36.3	4.89	27.51	31.753	54	-22.247	Ave
7386	18.03	0	100	H	36.3	4.89	27.51	31.753	54	-22.247	Ave
9848	31.84	0	100	V	37.4	5.77	26.98	48.071	80.416	-32.345	Peak
9848	31.84	0	100	H	37.4	5.77	26.98	48.071	71.166	-23.095	Peak
9848	17.00	0	100	V	37.4	5.77	26.98	33.231	69.256	-36.025	Ave
9848	17.00	0	100	H	37.4	5.77	26.98	33.231	58.666	-25.435	Ave

802.11n HT20, Low Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2412 MHz, measured at 3 meters											
2412	72.38	352	133	V	28.96	2.94	-	104.276	-	-	Peak
2412	61.74	231	141	H	28.96	2.94	-	93.636	-	-	Peak
2412	55.08	352	133	V	28.96	2.94	-	86.976	-	-	Ave
2412	45.79	231	141	H	28.96	2.94	-	77.686	-	-	Ave
2390	33.01	354	130	V	28.96	2.94	-	64.906	74	-9.094	Peak
2390	27.16	231	141	V	28.96	2.94	-	59.056	74	-14.944	Peak
2390	15.84	354	130	V	28.96	2.94	-	47.736	54	-6.264	Ave
2390	12.83	231	141	H	28.96	2.94	-	44.726	54	-9.274	Ave
4824	32.66	0	100	V	32.7	4.06	27.70	41.731	74	-32.269	Peak
4824	32.66	0	100	H	32.7	4.06	27.70	41.731	74	-32.269	Peak
4824	17.92	0	100	V	32.7	4.06	27.70	26.991	54	-27.009	Ave
4824	17.92	0	100	H	32.7	4.06	27.70	26.991	54	-27.009	Ave
7236	33.64	0	100	V	36.4	4.88	27.58	47.376	84.276	-36.900	Peak
7236	33.64	0	100	H	36.4	4.88	27.58	47.376	73.636	-26.260	Peak
7236	18.41	0	100	V	36.4	4.88	27.58	32.146	66.976	-34.830	Ave
7236	18.41	0	100	H	36.4	4.88	27.58	32.146	57.686	-25.540	Ave
9648	31.96	0	100	V	37.3	5.82	27.06	48.048	84.276	-36.228	Peak
9648	31.96	0	100	H	37.3	5.82	27.06	48.048	73.636	-25.588	Peak
9648	16.70	0	100	V	37.3	5.82	27.06	32.788	66.976	-34.188	Ave
9648	16.70	0	100	H	37.3	5.82	27.06	32.788	57.686	-24.898	Ave

802.11n HT20, Middle Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 2437 MHz, measured at 3 meters											
2437	70.23	354	136	V	28.96	2.94	-	102.126	-	-	Peak
2437	59.62	231	136	H	28.96	2.94	-	91.516	-	-	Peak
2437	58.32	354	136	V	28.96	2.94	-	90.216	-	-	Ave
2437	47.94	231	136	H	28.96	2.94	-	79.836	-	-	Ave
4874	32.97	0	100	V	32.8	4.10	27.67	42.228	74	-31.772	Peak
4874	32.97	0	100	H	32.8	4.10	27.67	42.228	74	-31.772	Peak
4874	17.95	0	100	V	32.8	4.10	27.67	27.208	54	-26.792	Ave
4874	17.95	0	100	H	32.8	4.10	27.67	27.208	54	-26.792	Ave
7311	33.95	0	100	V	36.5	4.83	27.51	47.793	74	-26.207	Peak
7311	33.95	0	100	H	36.5	4.83	27.51	47.793	74	-26.207	Peak
7311	18.13	0	100	V	36.5	4.83	27.51	31.973	54	-22.027	Ave
7311	18.13	0	100	H	36.5	4.83	27.51	31.973	54	-22.027	Ave
9748	31.46	0	100	V	37.3	5.74	26.98	47.538	82.126	-34.588	Peak
9748	31.46	0	100	H	37.3	5.74	26.98	47.538	71.516	-23.978	Peak
9748	16.57	0	100	V	37.3	5.74	26.98	32.648	70.216	-37.568	Ave
9748	16.57	0	100	H	37.3	5.74	26.98	32.648	59.836	-27.188	Ave

802.11n HT20, High Channel

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 2462 MHz, measured at 3 meters											
2462	69.04	353	130	V	29.07	3.01	-	101.116	-	-	Peak
2462	58.60	232	135	H	29.07	3.01	-	90.676	-	-	Peak
2462	56.92	353	130	V	29.07	3.01	-	88.996	-	-	Ave
2462	46.57	232	135	H	29.07	3.01	-	78.646	-	-	Ave
2483.5	37.13	350	132	V	29.16	3.01	-	69.295	74	-4.705	Peak
2483.5	28.16	234	137	H	29.16	3.01	-	60.325	74	-13.675	Peak
2483.5	18.16	350	132	V	29.16	3.01	-	50.325	54	-3.675	Ave
2483.5	13.36	234	137	H	29.16	3.01	-	45.525	54	-8.475	Ave
4924	33.08	0	100	V	32.9	4.10	27.75	42.288	74	-31.712	Peak
4924	33.08	0	100	H	32.9	4.10	27.75	42.288	74	-31.712	Peak
4924	18.20	0	100	V	32.9	4.10	27.75	27.408	54	-26.592	Ave
4924	18.20	0	100	H	32.9	4.10	27.75	27.408	54	-26.592	Ave
7386	32.68	0	100	V	36.3	4.89	27.51	46.403	74	-27.597	Peak
7386	32.68	0	100	H	36.3	4.89	27.51	46.403	74	-27.597	Peak
7386	18.08	0	100	V	36.3	4.89	27.51	31.803	54	-22.197	Ave
7386	18.08	0	100	H	36.3	4.89	27.51	31.803	54	-22.197	Ave
9848	31.67	0	100	V	37.4	5.77	26.98	47.901	81.116	-33.215	Peak
9848	31.67	0	100	H	37.4	5.77	26.98	47.901	70.676	-22.775	Peak
9848	17.02	0	100	V	37.4	5.77	26.98	33.251	68.996	-35.745	Ave
9848	17.02	0	100	H	37.4	5.77	26.98	33.251	58.646	-25.395	Ave

9 FCC§15.247(a)(2) & IC RSS-210 §A8.2– 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

9.2 Measurement Procedure

1. Set resolution bandwidth (RBW)=1-5% or DTS BW, not to exceed 100 kHz
2. Set the video bandwidth (VBW) > 3 X RBW measurement instrument.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measured the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 years

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

9.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	41 %
ATM Pressure:	101.3kPa

The testing was performed by Jeffrey Wu on 2012-11-05 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	7.621	11.6293	>0.5	Compliant
Middle	2437	7.599	11.6407	>0.5	Compliant
High	2462	7.601	11.6533	>0.5	Compliant

802.11 g mode:

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2412	15.188	16.3590	>0.5	Compliant
Middle	2437	15.114	16.3497	>0.5	Compliant
High	2462	15.082	16.3563	>0.5	Compliant

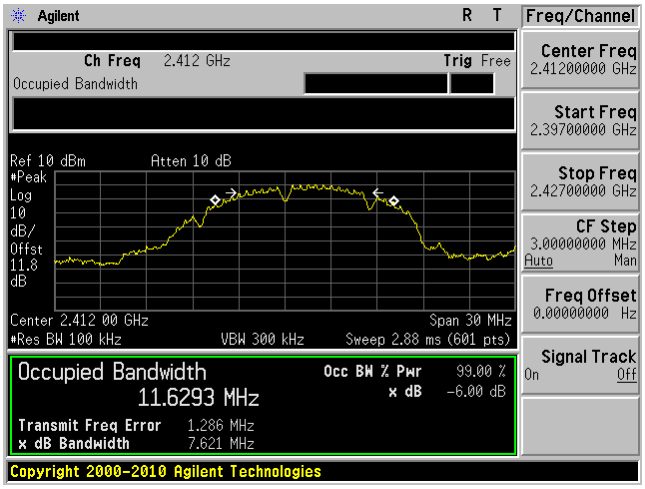
802.11n HT20 mode:

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (MHz)	Results
Low	2412	15.174	17.5296	>0.5	Compliant
Middle	2437	15.161	17.5322	>0.5	Compliant
High	2462	15.186	17.5321	>0.5	Compliant

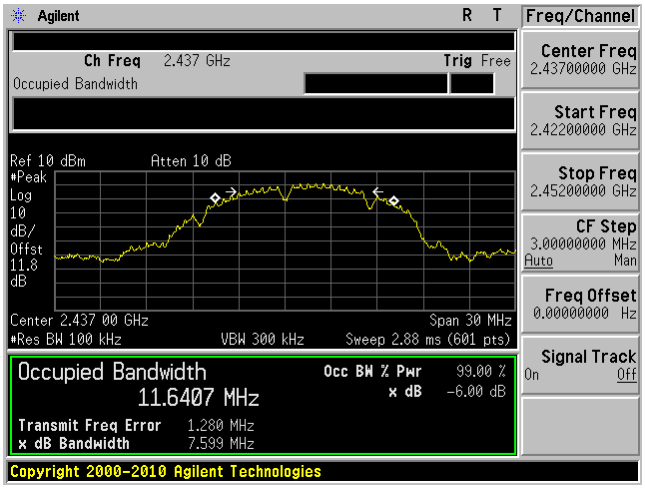
Please refer to the following plots for detailed test results

802.11 b mode

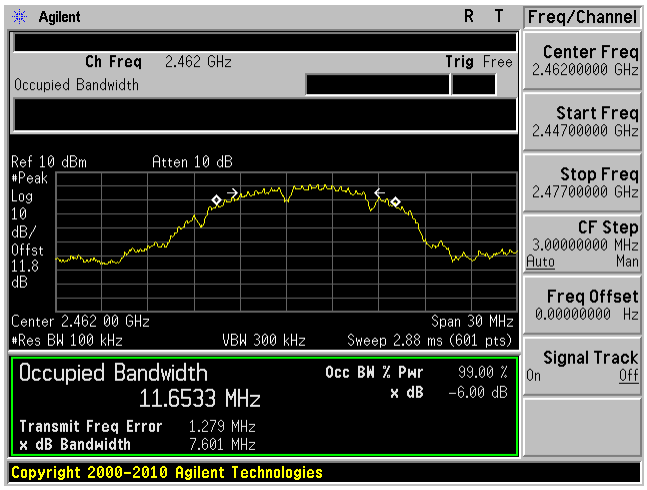
Low channel: 2412 MHz



Middle channel: 2437 MHz

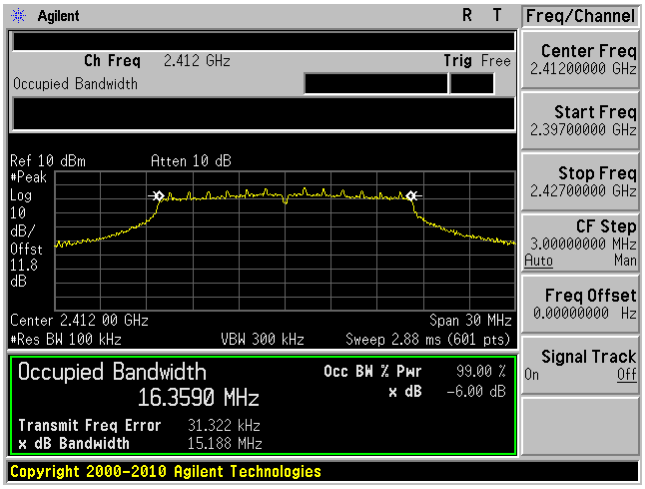


High channel: 2462 MHz

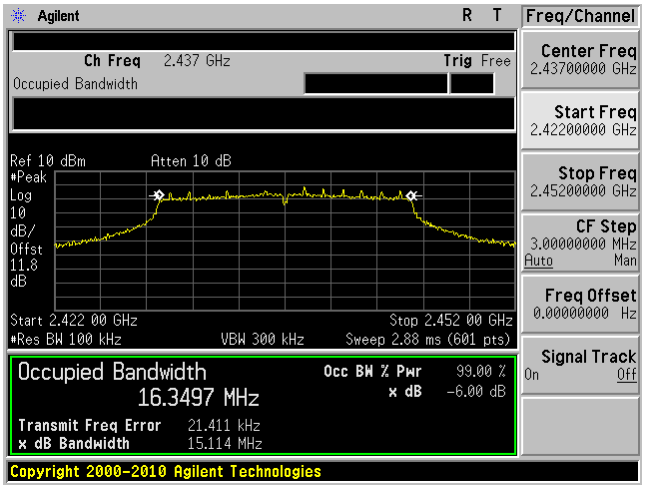


802.11 g mode

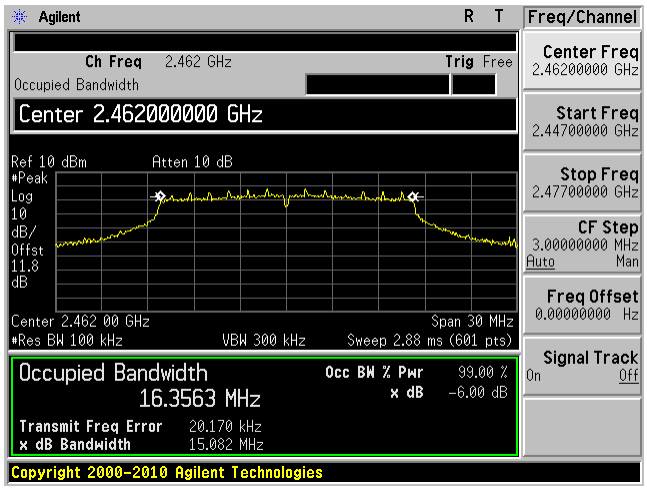
Low channel: 2412 MHz



Middle channel: 2437 MHz

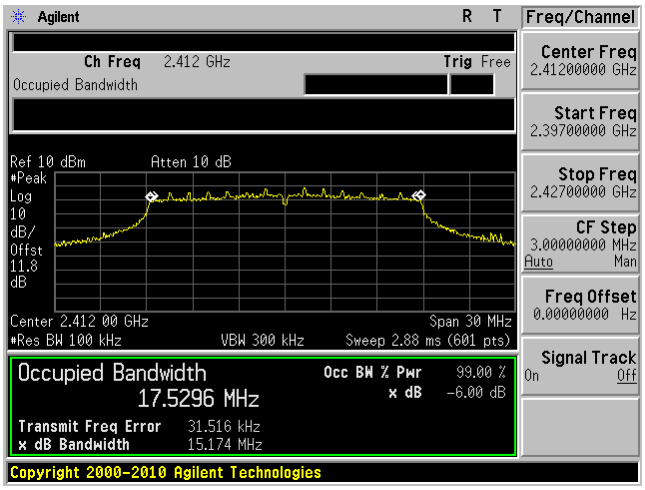


High channel: 2462 MHz

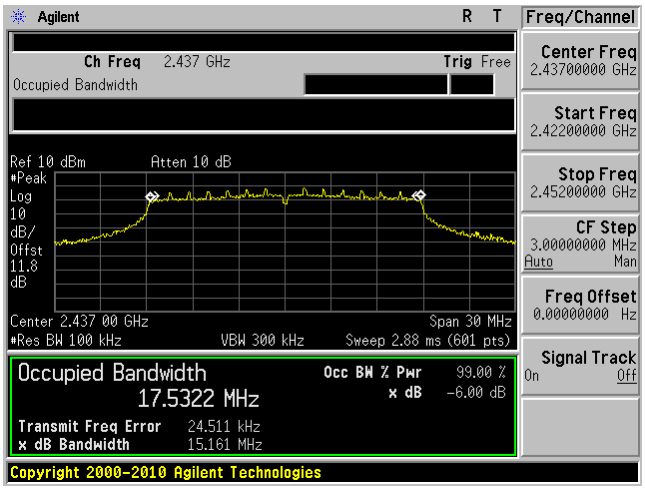


802.11 n HT20 mode

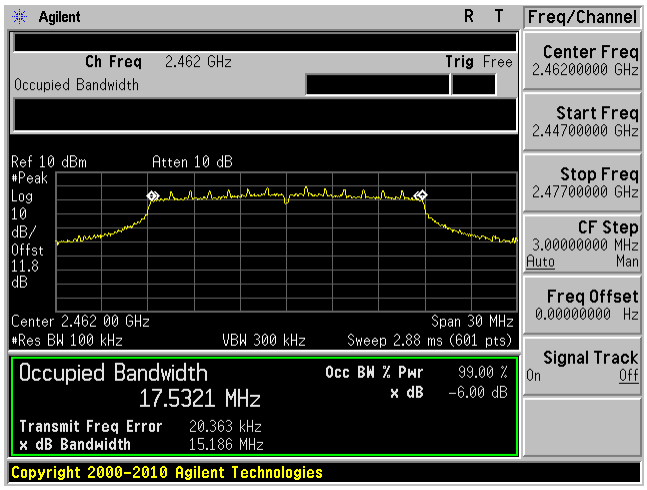
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



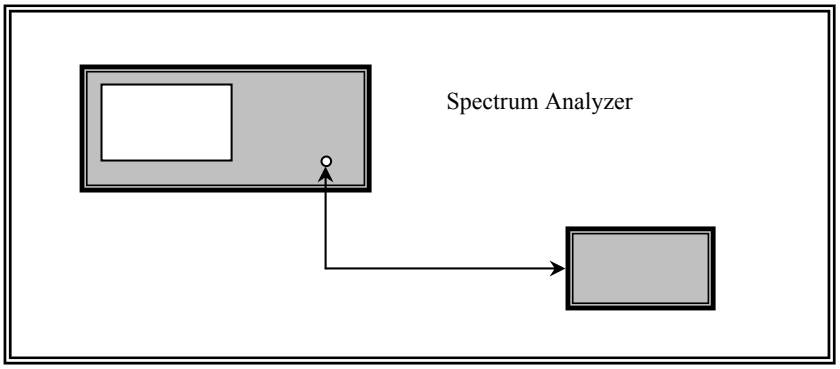
10 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

10.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4 (4) 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	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 years

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	50 %
ATM Pressure:	101.4kPa

The testing was performed by Jeffrey Wu on 2012-11-02at RF site.

10.5 Test Results

802.11 b mode:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
Low	2412	8.13	30	-21.87
Middle	2437	8.29	30	-21.71
High	2462	8.00	30	-22.00

802.11 g mode:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
Low	2412	7.09	30	-22.91
Middle	2437	7.19	30	-22.81
High	2462	7.36	30	-22.64

802.11n HT20 mode:

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/IC Limit (dBm)	Margin (dB)
Low	2412	6.41	30	-23.59
Middle	2437	6.52	30	-23.48
High	2462	6.84	30	-23.16

11 FCC §15.247(d) & IC RSS-210 §A8.5 – 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).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

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	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 years

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

11.4 Test Environmental Conditions

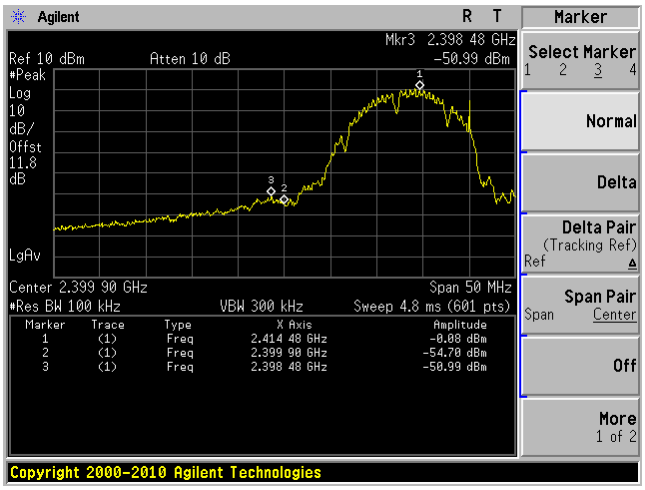
Temperature:	22 °C
Relative Humidity:	41 %
ATM Pressure:	101.3kPa

The testing was performed by Jeffrey Wu on 2012-11-05 at RF site.

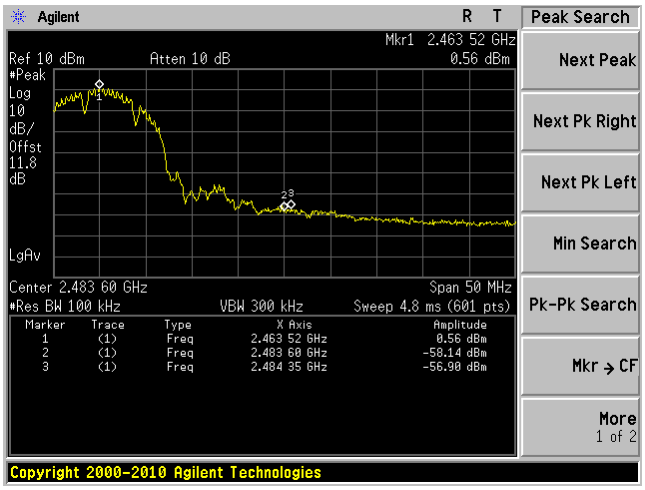
11.5 Test Results

Please refer to following pages for plots of band edge.

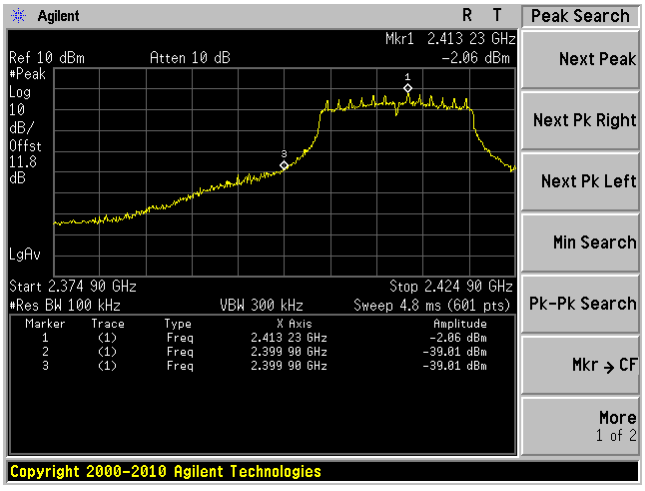
802.11b Low Band Edge



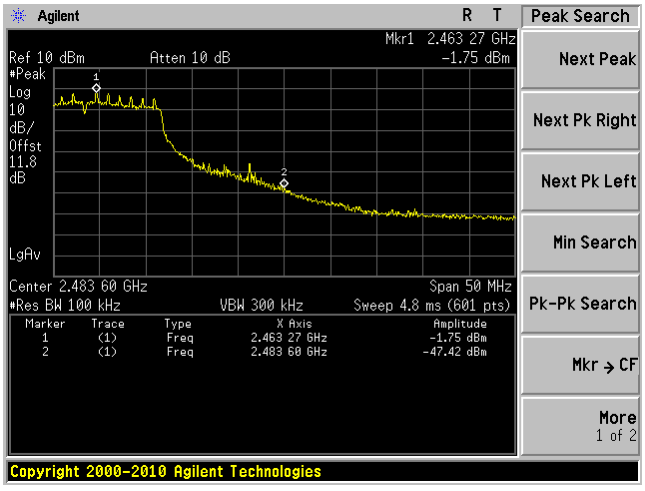
802.11b High Band Edge



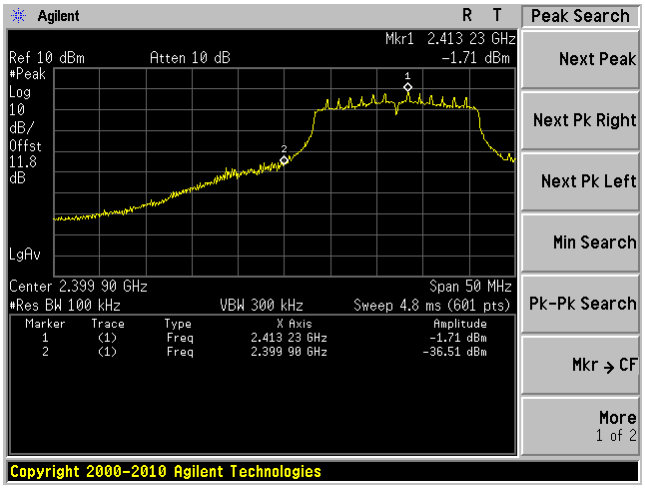
802.11g Low Band Edge



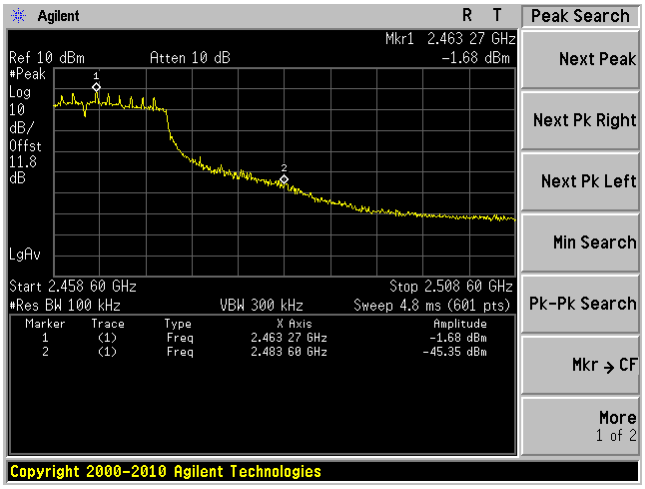
802.11g High Band Edge



802.11n HT20 Low Band Edge



802.11n HT20 High Band Edge



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

12.1 Applicable Standard

According to FCC §15.247(e) and RSS-210 §A8.2 (b) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Measurement 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	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2012-08-22	2 years

Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

12.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	41 %
ATM Pressure:	101.3kPa

The testing was performed by Jeffrey Wu on 2012-11-05 at RF site.

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12.5 Test Results

802.11 b mode

Channel	Frequency (MHz)	PSD (dBm/100 kHz)	Corrected PSD (dBm/3kHz)	Limit (dBm/3 kHz)	Margin (dB)
Low	2412	0.94	-14.26	8	-22.26
Middle	2437	0.93	-14.27	8	-22.27
High	2462	1.13	-14.07	8	-22.07

802.11 g mode

Channel	Frequency (MHz)	PSD (dBm/100 kHz)	Corrected PSD (dBm/3kHz)	Limit (dBm/3 kHz)	Margin (dB)
Low	2412	-2.12	-17.32	8	-25.32
Middle	2437	-1.89	-17.09	8	-25.09
High	2462	-1.49	-16.69	8	-24.69

802.11n HT20 mode

Channel	Frequency (MHz)	PSD (dBm/100 kHz)	Corrected PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
Low	2412	-1.88	-17.08	8	-25.08
Middle	2437	-1.89	-17.09	8	-25.09
High	2462	-1.71	-16.91	8	-24.91

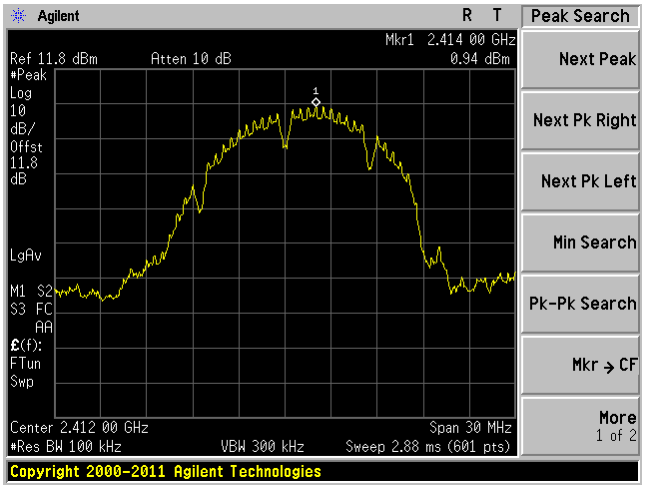
Note: Corrected PSD (dBm/3kHz) was converted from measured PSD (dBm/100kHz) as following:

Corrected PSD (dBm/3kHz) = Measured PSD (dBm/100kHz)- Bandwidth Correction Factor (BWCF), where BWCF = 10log (3 kHz/100 kHz) = -15.2 dB.

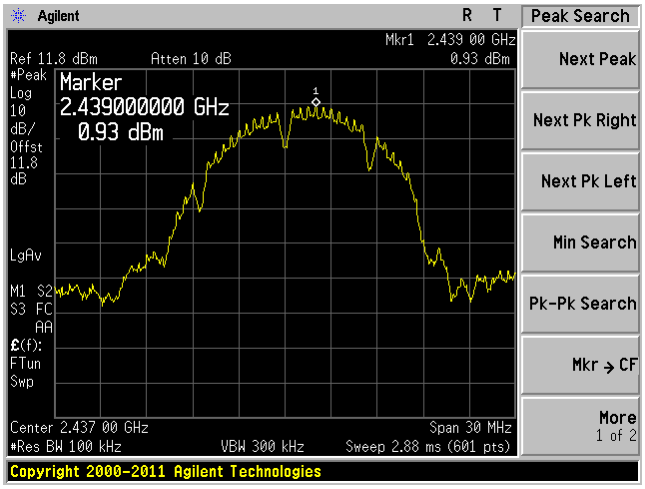
Please refer to the following plots for detailed test results:

802.11b mode

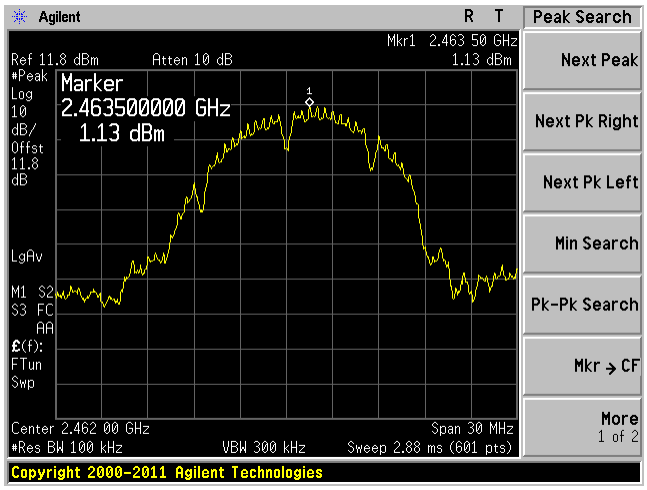
Low channel: 2412 MHz



Middle channel: 2437 MHz

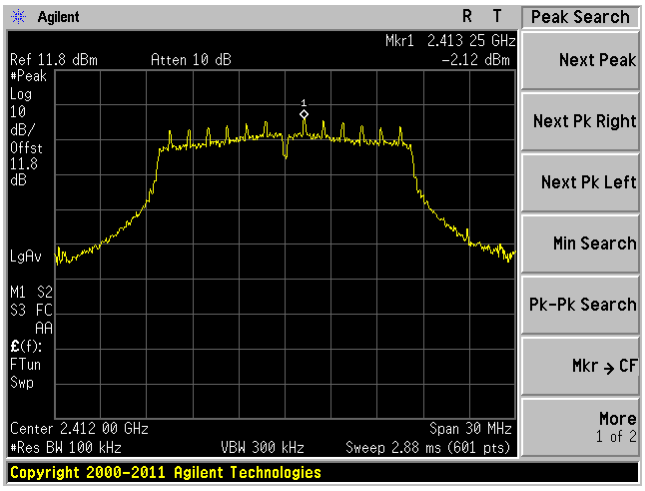


High channel: 2462 MHz

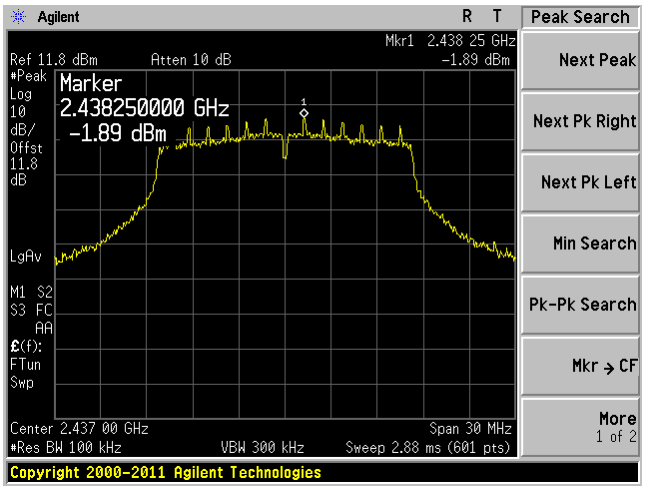


802.11g mode

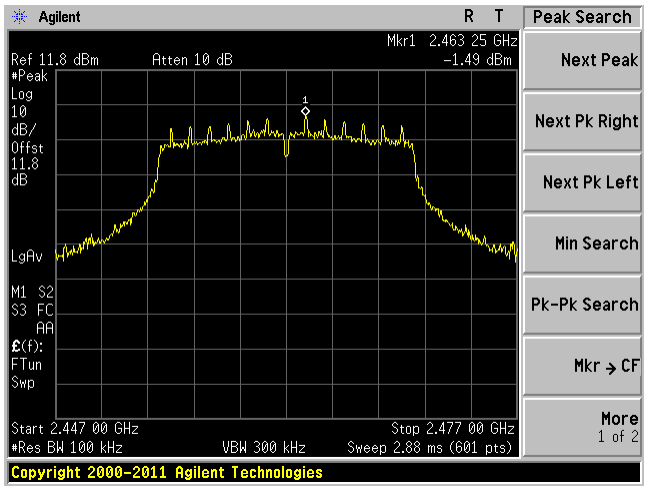
Low channel: 2412 MHz



Middle channel: 2437 MHz

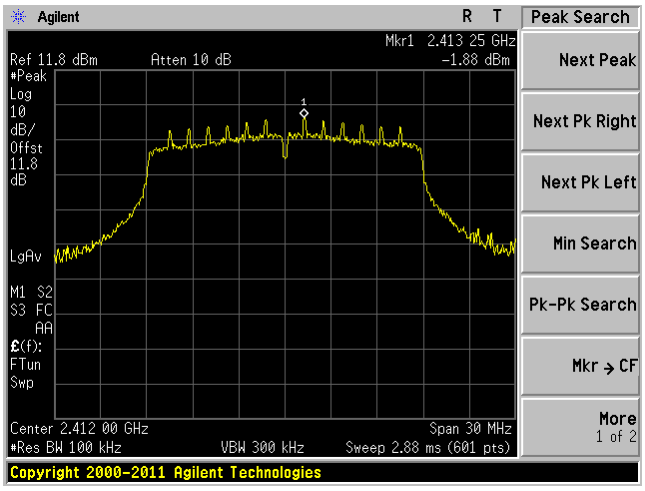


High channel: 2462 MHz

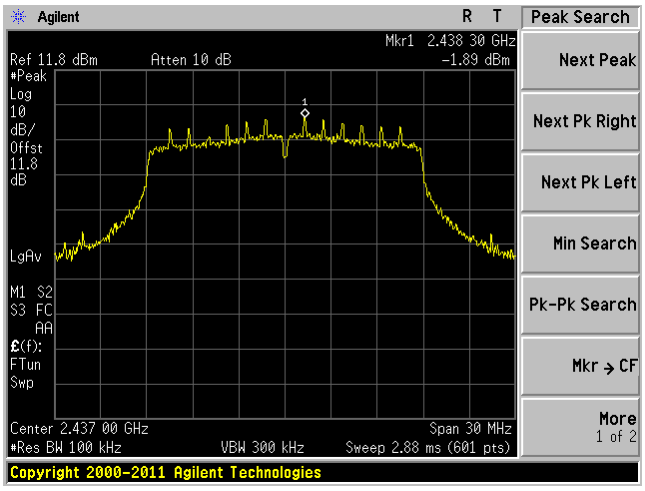


802.11n HT20 mode

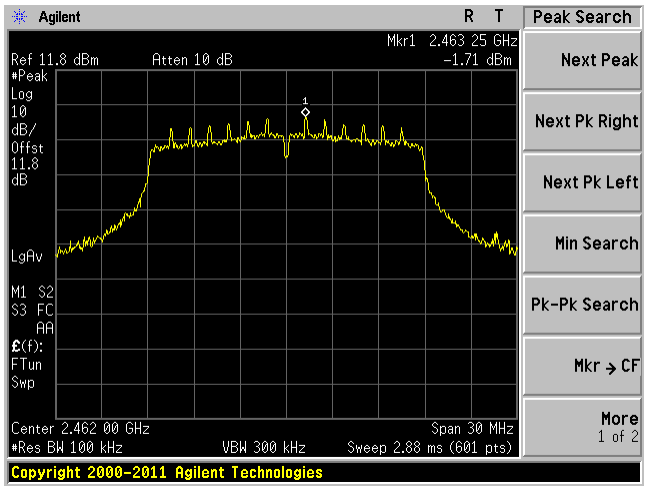
Low channel: 2412 MHz



Middle channel: 2437 MHz



High channel: 2462 MHz



13 IC RSS-210 §2.3 & RSS-Gen §4.10 – Receiver Spurious Radiated Emissions

13.1 Applicable Standard

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

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

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

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

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

According to RSS-Gen §6.1, Tables 2 show the general field strength limits of receiver spurious emissions

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (Microvolts/m at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960	500

13.2 EUT Setup

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.

13.3 Test Procedure

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

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

13.4 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

13.5 Test Equipment Lists and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2012-08-15	1 Year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100444	2012-04-18	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-03-08	1Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	570400946	2012-05-09	1Year
Agilent	Spectrum Analyzer	E4440A	US42221851	2012-02-28	1 Year
EMCO	Horn Antenna	DRH-118	A052704	2012-02-24	1Year

Statement of Traceability: *BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

13.6 Test Environmental Conditions

Temperature:	21-23°C
Relative Humidity:	43-45 %
ATM Pressure:	101-102kPa

The testing was performed by Jeffrey Wu and Lionel Lara from 2012-11-08 to 2012-11-09 at 5 meter 3.

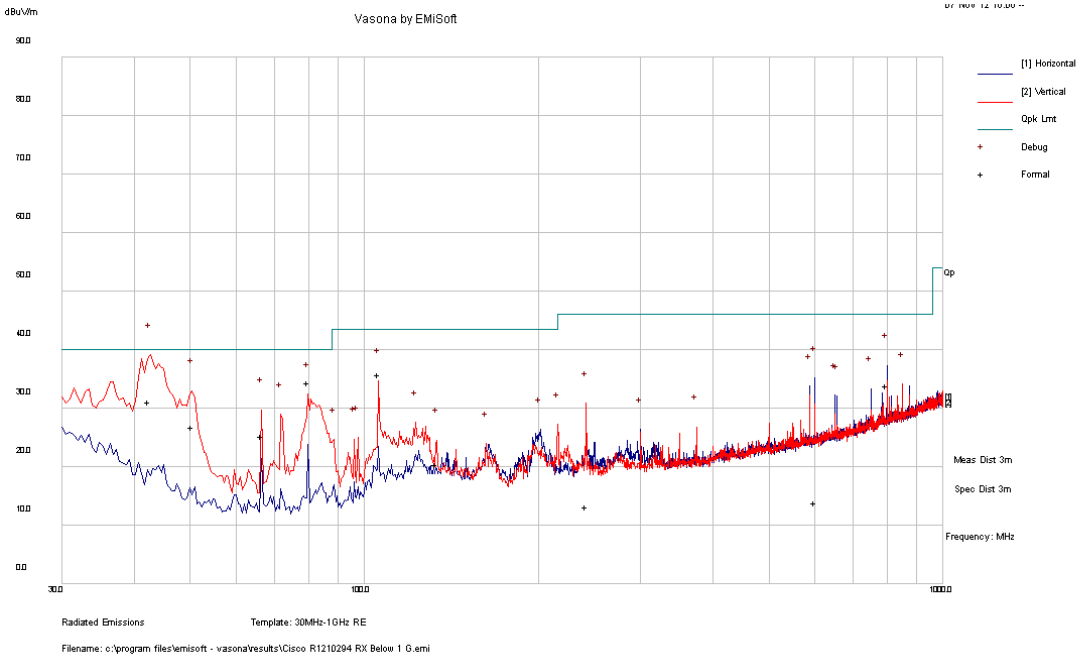
13.7 Summary of Test Results

According to the test data, the EUT complied with the with the RSS-210, with the closest margins from the limit listed below:

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz)**
-5.58	79.99075	Vertical	30-18000

13.8 Test Results

1) 30-1000 MHz, Measured at 3 meters



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
79.99075	34.42	152	V	138	40	-5.58
105.6565	35.71	104	V	360	43.5	-7.79
42.36825	31.12	100	V	360	40	-8.88
800.0645	33.89	105	H	42	46	-12.11
50.31325	26.8	100	V	8	40	-13.20
66.40225	25.31	123	V	37	40	-14.69

2) Above 1 GHz Measured at 3 meters

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
1100	35.630	100	V	0	74	-38.370	Peak
1100	35.630	100	H	0	74	-38.370	Peak
1100	21.240	100	V	0	54	-32.760	Ave
1100	21.240	100	H	0	54	-32.760	Ave
2428	40.486	100	V	0	74	-33.514	Peak
2428	40.486	100	H	0	74	-33.514	Peak
2428	26.036	100	V	0	54	-27.964	Ave
2428	26.036	100	H	0	54	-27.964	Ave
17000	56.397	100	V	0	74	-17.603	Peak
17000	56.397	100	H	0	74	-17.603	Peak
17000	42.117	100	V	0	54	-11.883	Ave
17000	42.117	100	H	0	54	-11.883	Ave