FCC PART 15.407
IC RSS-210, ISSUE 8, DEC 2010
TEST AND MEASUREMENT REPORT

For

Ruckus Wireless, Inc.

350 West Java Drive,

Sunnyvale, CA 94089, USA

FCC ID: S9GZF7441
IC: 5912A-ZF7441

Report Type:	**Product Type:**
Original Report	Access Point

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Report Number:	R1303044-407
Report Date:	2013-06-13
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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1303044-407	Original Report	2013-06-13

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Ruckus Wireless, Inc*., and their product model: *ZF 7441 with FCC ID: S9GZF7441, IC: 5912A-ZF7441* or the "EUT" as referred to in this report. The EUT is an Access Point which operates on the 2400-2483.5 MHz, 5150-5250 MHz, 5250-5350 MHz, 5470-5725 MHz and 5725-5850 MHz bands.

1.2 Mechanical Description of EUT

The EUT measures approximately 14.3 cm (L) x 11.1 cm (W) x 2.8 cm (H) and weighs 549g.

The test data gathered are from typical production sample, serial number: 1303044 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *Ruckus Wireless, Inc., in* accordance with FCC CFR47 §15.407 and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.407 and IC RSS-210 rules for Antenna Requirements, Conducted Emissions, Occupied Bandwidth, Output Power, Power Spectral Density, Radiated and Conducted Spurious Emissions, and Band Edge. Please refer to the detail antenna list in the antenna requirement section.

1.4 Related Submittal(s)/Grant(s)

FCC Part 15.247 DTS with FCC ID: S9GZF7441, IC: 5912A-ZF7441

1.5 Test Methodology

FCC CFR 47 Part2, Part15.407 and IC RSS-210 Issue 8, Dec 2010.

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 CISPR16-4-2:2007, 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.

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 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=8430d44f1f47cf2996124343c704b367816b

2 EUT 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 St Bernard Art, was provided by Ruckus Wireless Inc., and was verified by Jeffery Wu to comply with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

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

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
DELL	Laptop	Latitude E5420	-

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Ruckus	Main PCB Board	RK13050032	94132600134

2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
RF Cable	<1.0	PSA	EUT
RJ 45 Cable	<1.0	Laptop	EUT

2.8 Power Supply List and Details

Manufacturer	Description	Model	Part Number
Ruckus	POE Switch-Mode Power Supply	NPE-5818	11A413366
Ruckus	Switching Adaptor	E305248	-
Ruckus	AC Adaptor of POE	PA1060-480T1A125	740-64156-001

3 Summary of Test Results

FCC & IC Rules	Description of Test	Result
FCC §15.407(f), §2.1091 IC RSS-102	RF Exposure	Compliant
FCC §15.203 IC RSS-Gen §7.1.2	Antenna Requirement	Compliant
FCC §15.207 IC RSS-Gen §7.2.4	AC Power Line Conducted Emissions	Compliant
FCC §15.209(a), 15.407(b) IC RSS-210 §A9.2	Spurious Radiated Emissions	Compliant
FCC §15.407(a) IC RSS-210 §A9.2	26 dB and 99% Emission Bandwidth	Compliant
FCC §407(a)(1) IC RSS-210 §A9.2	Peak Output Power Measurement	Compliant
FCC §2.1051, §15.407(b) IC RSS-210 §A9.2	Out of Band Emissions	Compliant
FCC §15.407(a)(1) IC RSS-210 §A9.2	Power Spectral Density	Compliant
FCC §15.407(a)(6)	Peak Excursion Ratio	Compliant
IC RSS-210 §2.3 IC RSS-Gen §6.1	Receiver Spurious Radiated Emissions	Compliant
FCC §2.1051, §15.407(b) IC RSS-210 §A9.2	Spurious Emissions at Antenna Terminals	Compliant

4 FCC §15.407(f), §2.1091 & IC RSS-102 - RF Exposure

4.1 Applicable Standard

According to FCC §15.407(f) 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

W52 Band:

Maximum peak output power at antenna input terminal (dBm):	16.89
Maximum peak output power at antenna input terminal (mW):	48.87
Prediction distance (cm):	20
Prediction frequency (MHz):	5230
Maximum Antenna Gain, typical (dBi):	2
Maximum Antenna Gain (numeric):	1.585
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0154
Power density of prediction frequency at 20.0 cm (W/m^2):	0.154
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 meets FCC/IC MPE requirement for uncontrolled exposure environment at 20 cm distance.

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.

As per 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 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Antenna List

The antenna used by the EUT will be 2.0 dBi gain (with cable loss considered) and contains an N-type connector; therefore, it complies with the antenna requirement. Professional installation is needed to ensure the product complies with legal restrictions.

6 FCC §15.207 & IC RSS-Gen §7.2.4 - AC Power 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 Note 1	56 to 46 Note 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 C63.4-2003 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 test support board was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

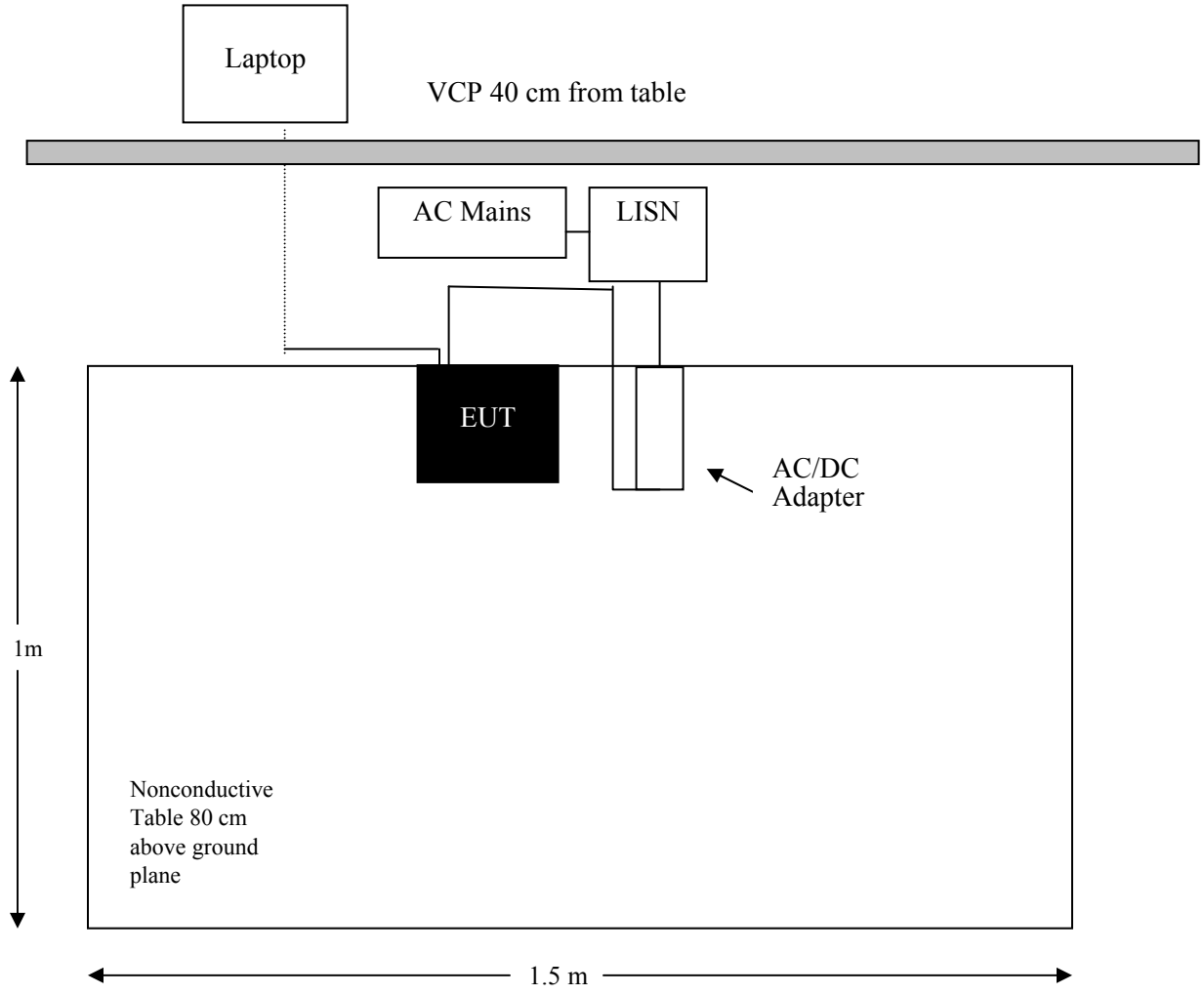
During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-2.

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

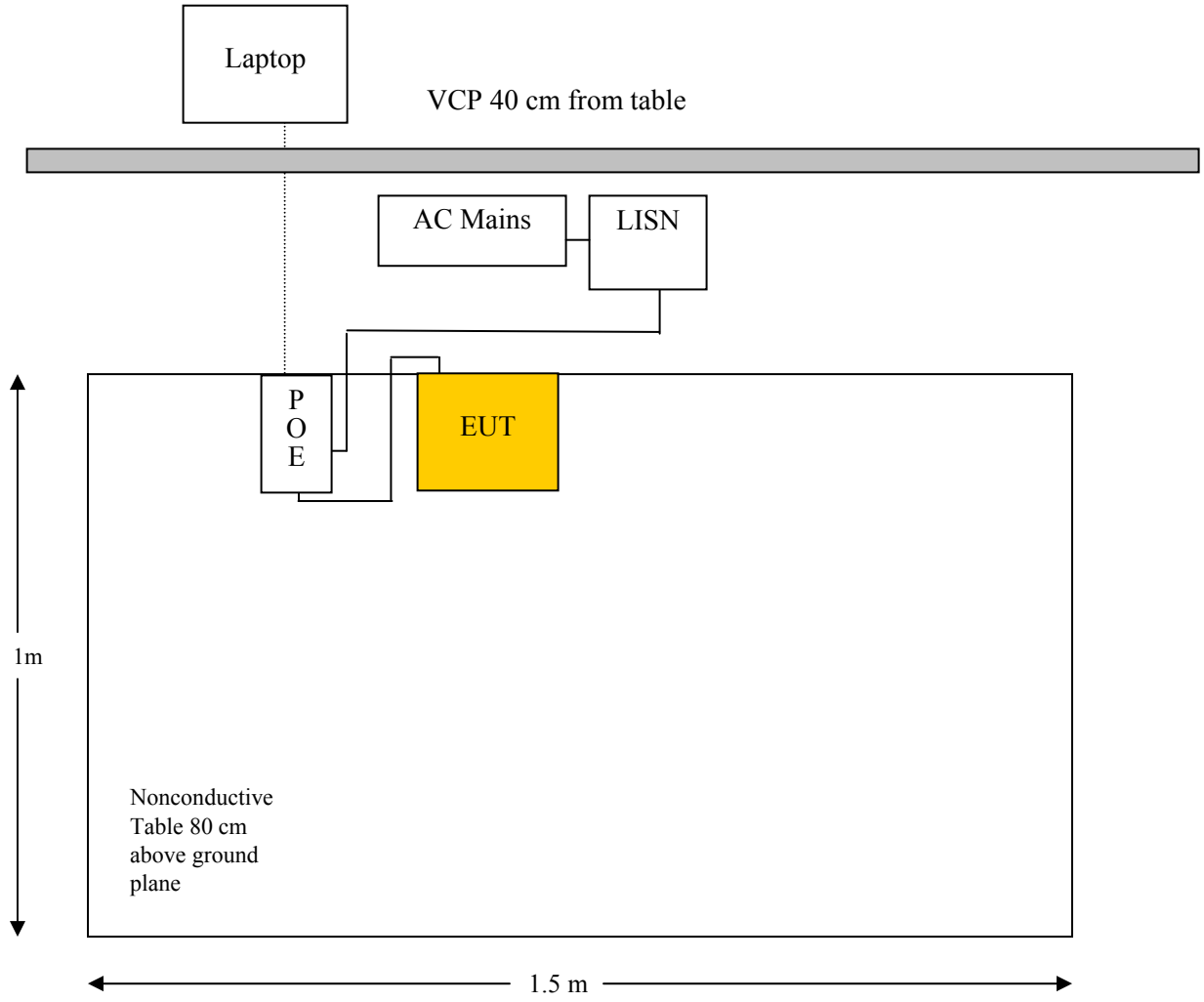
All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram

AC/DC Adaptor:



POE



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	2013-03-28	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 according to A2LA requirements, traceable to the NIST.*

6.7 Test Environmental Conditions

Temperature:	21 ºC
Relative Humidity:	51%
ATM Pressure:	101.42 kPa

The testing was performed by Wei Sun on 2013-05-03 in 5 m chamber 2.

6.8 Summary of Test Results

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

Transmitting Mode:

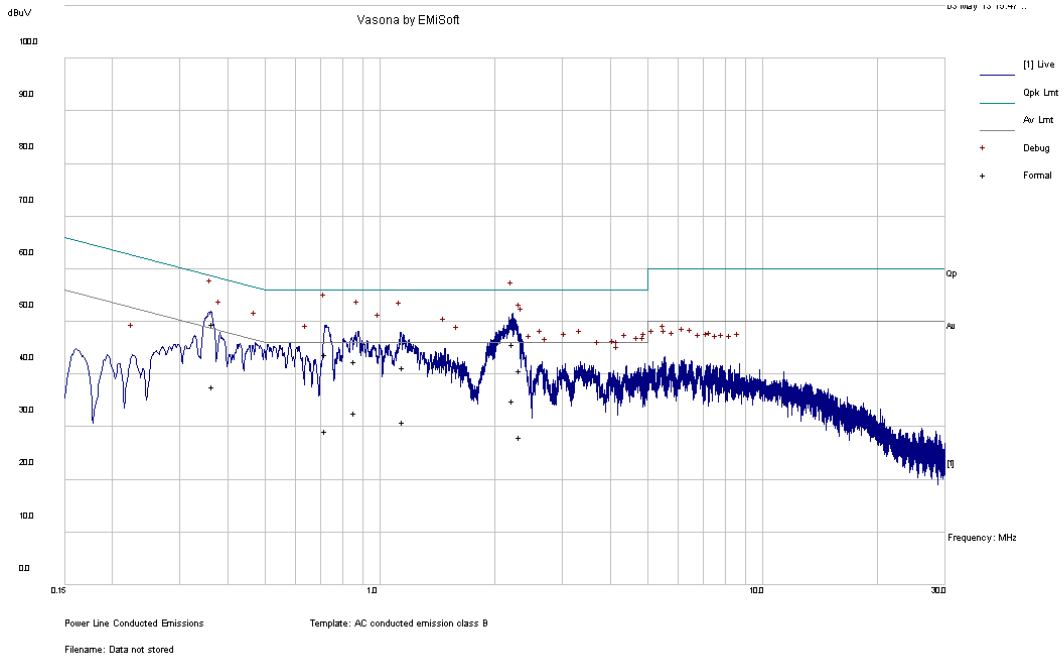
Connection: 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-0.82	0.441545	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

Please refer to the following tables and plots.

Worst case in 5 GHz Band:

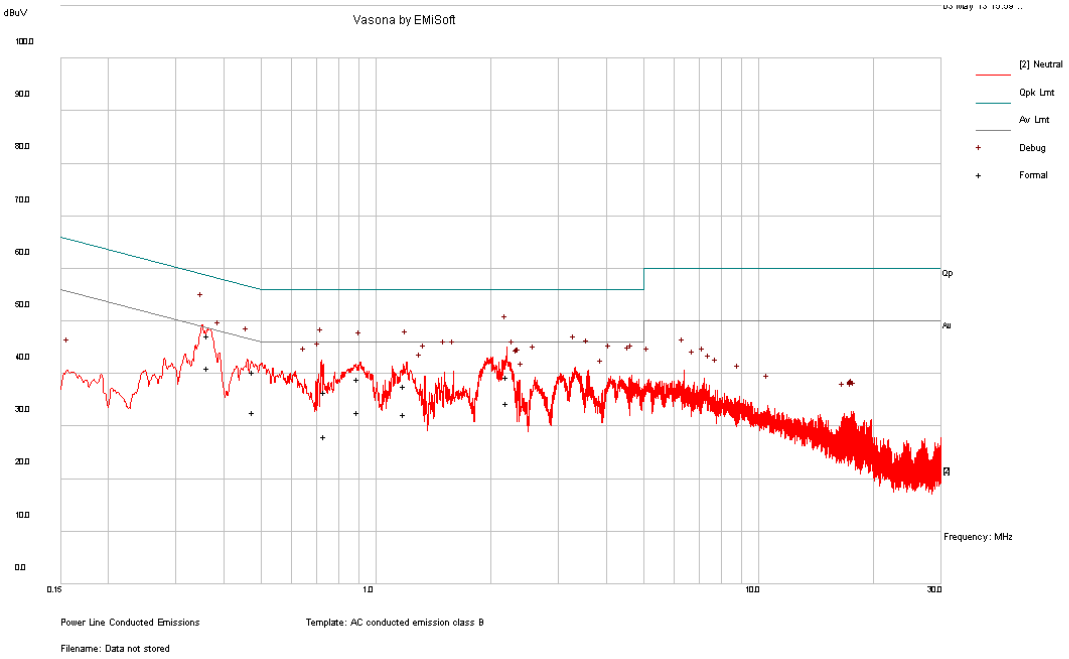
120 V, 60 Hz – Line, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.226147	45.78	Line	56	-10.22	QP
0.720678	43.83	Line	56	-12.17	QP
0.365949	49.44	Line	58.59	-9.15	QP
0.862134	42.43	Line	56	-13.57	QP
1.148469	41.33	Line	56	-14.67	QP
2.323621	40.78	Line	56	-15.22	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.226147	34.98	Line	46	-11.02	Ave.
0.720678	29.3	Line	46	-16.70	Ave.
0.365949	37.68	Line	48.59	-10.91	Ave.
0.862134	32.68	Line	46	-13.32	Ave.
1.148469	31.02	Line	46	-14.98	Ave.
2.323621	28.12	Line	46	-17.88	Ave.

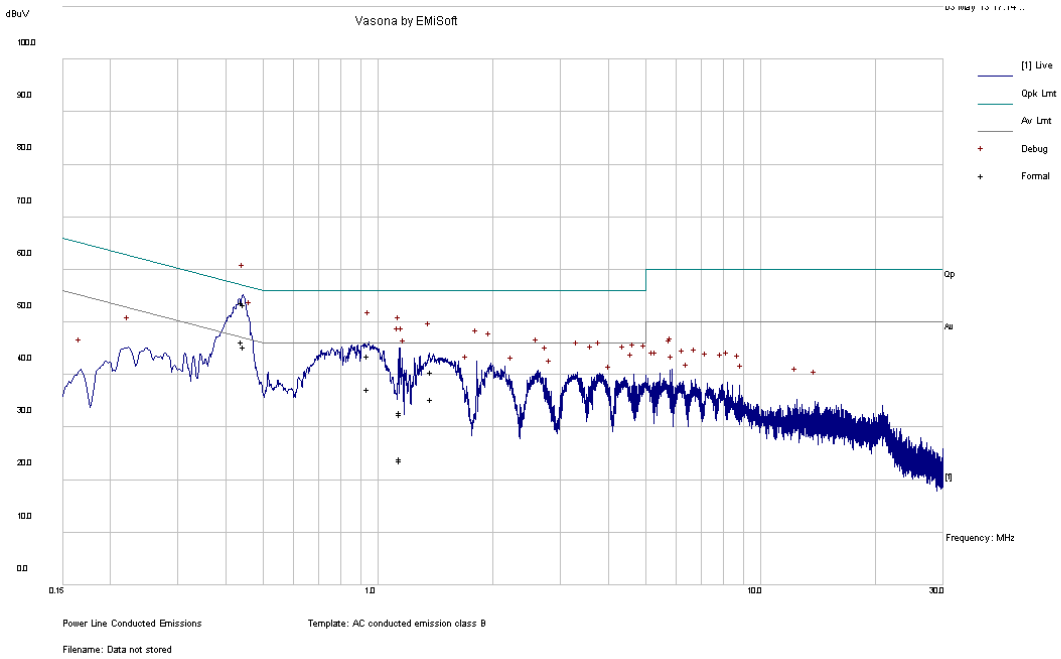
120 V, 60 Hz – Neutral, AC/DC Adaptor



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.365064	47.2	Neutral	58.61	-11.41	QP
2.202564	39.35	Neutral	56	-16.65	QP
0.734517	36.48	Neutral	56	-19.52	QP
1.185801	37.59	Neutral	56	-18.41	QP
0.478689	40.24	Neutral	56.36	-16.12	QP
0.898137	38.92	Neutral	56	-17.08	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.365064	41.01	Neutral	48.61	-7.60	Ave.
2.202564	34.47	Neutral	46	-11.53	Ave.
0.734517	28.02	Neutral	46	-17.98	Ave.
1.185801	32.22	Neutral	46	-13.78	Ave.
0.478689	32.7	Neutral	46.36	-13.66	Ave.
0.898137	32.69	Neutral	46	-13.31	Ave.

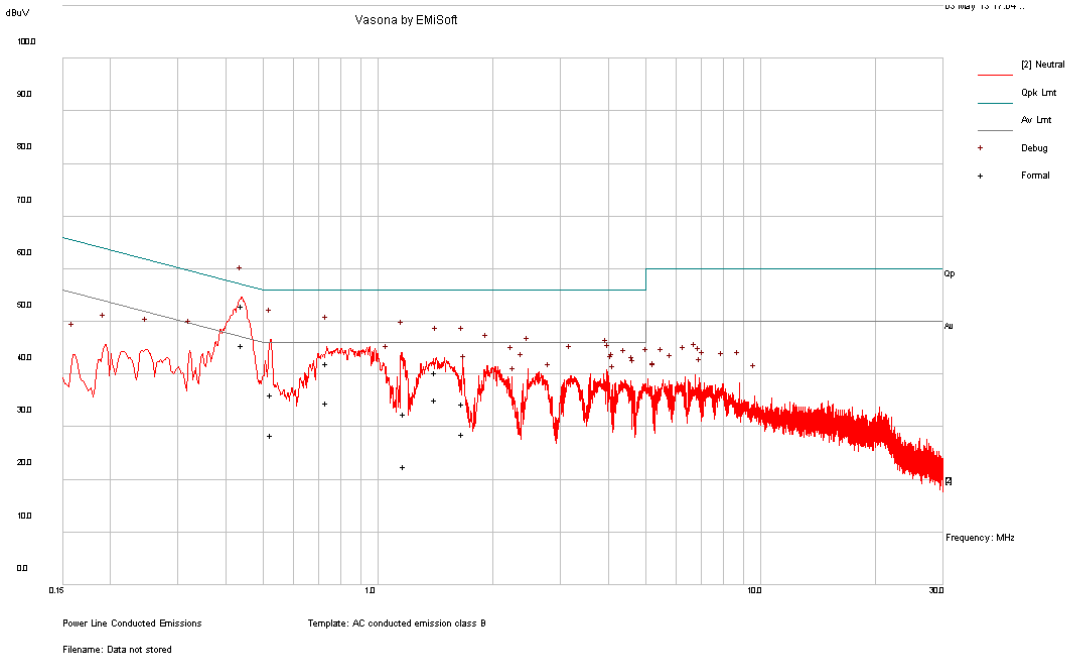
120 V, 60 Hz – Line, POE



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.441545	53.69	Line	57.03	-3.35	QP
0.44727	53.31	Line	56.93	-3.62	QP
0.944337	43.61	Line	56	-12.39	QP
1.144374	32.95	Line	56	-23.05	QP
1.381739	40.62	Line	56	-15.38	QP
1.141555	32.44	Line	56	-23.56	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.441545	46.22	Line	47.03	-0.82	Ave.
0.44727	45.26	Line	46.93	-1.67	Ave.
0.944337	37.29	Line	46	-8.71	Ave.
1.144374	23.59	Line	46	-22.41	Ave.
1.381739	35.43	Line	46	-10.57	Ave.
1.141555	24.05	Line	46	-21.95	Ave.

120 V, 60 Hz – Neutral, POE



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.443167	52.97	Neutral	57	-4.03	QP
0.527234	36.1	Neutral	56	-19.90	QP
0.733409	42.09	Neutral	56	-13.91	QP
1.172652	32.52	Neutral	56	-23.48	QP
1.416367	40.25	Neutral	56	-15.75	QP
1.666514	34.47	Neutral	56	-21.53	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.443167	45.51	Neutral	47	-1.49	Ave.
0.527234	28.45	Neutral	46	-17.55	Ave.
0.733409	34.58	Neutral	46	-11.42	Ave.
1.172652	22.48	Neutral	46	-23.52	Ave.
1.416367	35.11	Neutral	46	-10.89	Ave.
1.666514	28.71	Neutral	46	-17.29	Ave.

7 FCC §15.209, §15.407(b) & IC RSS-210 §A9.2 - Spurious Radiated Emissions

7.1 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 IC 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 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

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

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

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 §15.407(b)(1) and IC RSS-210, For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz.

7.2 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 15C/15E and IC RSS-210/RSS-Gen limits.

The spacing between the peripherals was 10 centimeters.

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

7.3 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

7.4 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

7.5 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Cycle
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2012-06-18	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2012-06-08	1 Year
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2012-05-08	1 Year
Eaton	Horn antenna	96001	3/1/1907	2012-10-17	1 Year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-03-28	1 year
Wisewave	Low Noise Amplifier	ALN-22093530-01	12263-01	2012-06-13	2 years
Wisewave	Horn Antenna	ARH-4223-02	10555-02	2010-06-14	3 years

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

7.6 Test Environmental Conditions

Temperature:	18-22 °C
Relative Humidity:	45-48 %
ATM Pressure:	101-102 kPa

The testing was performed by Wei Sun on 2013-05-01 at 5 meter 3.

7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.205, 15.209 and 15.407 & IC RSS-210, RSS-Gen standard's radiated emissions limits, and had the worst margin of:

5150-5250 MHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range, Mode, Antenna**
-10.99	33.157	Vertical	30 MHz to 1 GHz,
-*	-*	-*	1 GHz to 40 GHz,

* Note: all emissions are in the level of noise floor.

7.8 Radiated Emissions Test Result Data

1) Radiated Emission 30 MHz -1 GHz @ 3 meters, termination method was used

Worst Case: 802.11a Mode, High Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
33.15975	28.03	150	V	251	40	-11.97	QP
34.11725	20.09	100	V	36	40	-19.91	QP

Worst Case: 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)	Comment
33.157	29.01	100	V	247	40	-10.99	QP
399.9565	25.32	118	V	266	46	-20.68	QP

Worst Case: 802.11n HT40 Mode, High Channel

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
37.02825	13.68	137	V	41	40	-26.32	QP
33.15825	28.6	130	V	241	40	-11.4	QP

2) Radiated Emission 1-40 GHz @ 3 meters, termination method was used

802.11a 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 5180 MHz, measured at 3 meters											
10360	30*	0	100	H	39.12	6.14	26.98	48.28	88.23	-39.95	Peak
10360	30*	0	100	V	39.12	6.14	26.98	48.28	88.23	-39.95	Peak
10360	18*	0	100	H	39.12	6.14	26.98	36.28	68.23	-31.95	Ave
10360	18*	0	100	V	39.12	6.14	26.98	36.28	68.23	-31.95	Ave
15540	30*	0	100	H	39.19	7.47	25.92	50.74	74	-23.26	Peak
15540	30*	0	100	V	39.19	7.47	25.92	50.74	74	-23.26	Peak
15540	18*	0	100	H	39.19	7.47	25.92	38.74	54	-15.26	Ave
15540	18*	0	100	V	39.19	7.47	25.92	38.74	54	-15.26	Ave
20720	30*	0	100	H	34.04	9.28	29	44.32	74	-29.68	Peak
20720	30*	0	100	V	34.04	9.28	29	44.32	74	-29.68	Peak
20720	18*	0	100	H	34.04	9.28	29	32.32	54	-21.68	Ave
20720	18*	0	100	V	34.04	9.28	29	32.32	54	-21.68	Ave

* Note: all the readings are in the level of noise floor.

802.11a 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 5200 MHz, measured at 3 meters											
10400	30*	0	100	H	39.12	6.14	26.97	48.29	88.23	-39.94	Peak
10400	30*	0	100	V	39.12	6.14	26.97	48.29	88.23	-39.94	Peak
10400	18*	0	100	H	39.12	6.14	26.97	36.29	68.23	-31.94	Ave
10400	18*	0	100	V	39.12	6.14	26.97	36.29	68.23	-31.94	Ave
15600	30*	0	100	H	39.15	7.47	25.92	50.7	74	-23.3	Peak
15600	30*	0	100	V	39.15	7.47	25.92	50.7	74	-23.3	Peak
15600	18*	0	100	H	39.15	7.47	25.92	38.7	54	-15.3	Ave
15600	18*	0	100	V	39.15	7.47	25.92	38.7	54	-15.3	Ave
20800	30*	0	100	H	34.04	9.36	28.9	44.5	74	-29.5	Peak
20800	30*	0	100	V	34.04	9.36	28.9	44.5	74	-29.5	Peak
20800	18*	0	100	H	34.04	9.36	28.9	32.5	54	-21.5	Ave
20800	18*	0	100	V	34.04	9.36	28.9	32.5	54	-21.5	Ave

* Note: all the readings are in the level of noise floor.

802.11a 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 5240 MHz, measured at 3 meters											
10480	30*	0	100	H	39.2	6.14	26.93	48.41	88.23	-39.82	Peak
10480	30*	0	100	V	39.2	6.14	26.93	48.41	88.23	-39.82	Peak
10480	18*	0	100	H	39.2	6.14	26.93	36.41	68.23	-31.82	Ave
10480	18*	0	100	V	39.2	6.14	26.93	36.41	68.23	-31.82	Ave
15720	30*	0	100	H	39.09	7.47	25.97	50.59	74	-23.41	Peak
15720	30*	0	100	V	39.09	7.47	25.97	50.59	74	-23.41	Peak
15720	18*	0	100	H	39.09	7.47	25.97	38.59	54	-15.41	Ave
15720	18*	0	100	V	39.09	7.47	25.97	38.59	54	-15.41	Ave
20960	30*	0	100	H	34.1	9.36	29	44.46	74	-29.54	Peak
20960	30*	0	100	V	34.1	9.36	29	44.46	74	-29.54	Peak
20960	18*	0	100	H	34.1	9.36	29	32.46	54	-21.54	Ave
20960	18*	0	100	V	34.1	9.36	29	32.46	54	-21.54	Ave

* Note: all the readings are in the level of noise floor.

802.11n HT20 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 5180 MHz, measured at 3 meters											
10360	30*	0	100	H	39.12	6.14	26.98	48.28	88.23	-39.95	Peak
10360	30*	0	100	V	39.12	6.14	26.98	48.28	88.23	-39.95	Peak
10360	18*	0	100	H	39.12	6.14	26.98	36.28	68.23	-31.95	Ave
10360	18*	0	100	V	39.12	6.14	26.98	36.28	68.23	-31.95	Ave
15540	30*	0	100	H	39.19	7.47	25.92	50.74	74	-23.26	Peak
15540	30*	0	100	V	39.19	7.47	25.92	50.74	74	-23.26	Peak
15540	18*	0	100	H	39.19	7.47	25.92	38.74	54	-15.26	Ave
15540	18*	0	100	V	39.19	7.47	25.92	38.74	54	-15.26	Ave
20720	30*	0	100	H	34.04	9.28	29	44.32	74	-29.68	Peak
20720	30*	0	100	V	34.04	9.28	29	44.32	74	-29.68	Peak
20720	18*	0	100	H	34.04	9.28	29	32.32	54	-21.68	Ave
20720	18*	0	100	V	34.04	9.28	29	32.32	54	-21.68	Ave

* Note: all the readings are in the level of noise floor.

802.11n HT20 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 5200 MHz, measured at 3 meters											
10400	30*	0	100	H	39.12	6.14	26.97	48.29	88.23	-39.94	Peak
10400	30*	0	100	V	39.12	6.14	26.97	48.29	88.23	-39.94	Peak
10400	18*	0	100	H	39.12	6.14	26.97	36.29	68.23	-31.94	Ave
10400	18*	0	100	V	39.12	6.14	26.97	36.29	68.23	-31.94	Ave
15600	30*	0	100	H	39.15	7.47	25.92	50.7	74	-23.3	Peak
15600	30*	0	100	V	39.15	7.47	25.92	50.7	74	-23.3	Peak
15600	18*	0	100	H	39.15	7.47	25.92	38.7	54	-15.3	Ave
15600	18*	0	100	V	39.15	7.47	25.92	38.7	54	-15.3	Ave
20800	30*	0	100	H	34.04	9.36	28.9	44.5	74	-29.5	Peak
20800	30*	0	100	V	34.04	9.36	28.9	44.5	74	-29.5	Peak
20800	18*	0	100	H	34.04	9.36	28.9	32.5	54	-21.5	Ave
20800	18*	0	100	V	34.04	9.36	28.9	32.5	54	-21.5	Ave

* Note: all the readings are in the level of noise floor.

802.11n HT20 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 5240 MHz, measured at 3 meters											
10480	30*	0	100	H	39.2	6.14	26.93	48.41	88.23	-39.82	Peak
10480	30*	0	100	V	39.2	6.14	26.93	48.41	88.23	-39.82	Peak
10480	18*	0	100	H	39.2	6.14	26.93	36.41	68.23	-31.82	Ave
10480	18*	0	100	V	39.2	6.14	26.93	36.41	68.23	-31.82	Ave
15720	30*	0	100	H	39.09	7.47	25.97	50.59	74	-23.41	Peak
15720	30*	0	100	V	39.09	7.47	25.97	50.59	74	-23.41	Peak
15720	18*	0	100	H	39.09	7.47	25.97	38.59	54	-15.41	Ave
15720	18*	0	100	V	39.09	7.47	25.97	38.59	54	-15.41	Ave
20960	30*	0	100	H	34.1	9.36	29	44.46	74	-29.54	Peak
20960	30*	0	100	V	34.1	9.36	29	44.46	74	-29.54	Peak
20960	18*	0	100	H	34.1	9.36	29	32.46	54	-21.54	Ave
20960	18*	0	100	V	34.1	9.36	29	32.46	54	-21.54	Ave

* Note: all the readings are in the level of noise floor.

802.11n HT40 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 5190 MHz, measured at 3 meters											
10380	30	0	100	H	37.72	7.02	26.9	47.84	88.23	-40.39	Peak
10380	30	0	100	V	37.72	7.02	26.9	47.84	88.23	-40.39	Peak
10380	18	0	100	H	37.72	7.02	26.9	35.84	68.23	-32.39	Ave
10380	18	0	100	V	37.72	7.02	26.9	35.84	68.23	-32.39	Ave
15570	30	0	100	H	37.64	8.4	26	50.04	74	-23.96	Peak
15570	30	0	100	V	37.64	8.4	26	50.04	74	-23.96	Peak
15570	18	0	100	H	37.64	8.4	26	38.04	54	-15.96	Ave
15570	18	0	100	V	37.64	8.4	26	38.04	54	-15.96	Ave
20760	30	0	100	H	34.04	9.75	29	44.79	74	-29.21	Peak
20760	30	0	100	V	34.04	9.75	29	44.79	74	-29.21	Peak
20760	18	0	100	H	34.04	9.75	29	32.79	54	-21.21	Ave
20760	18	0	100	V	34.04	9.75	29	32.79	54	-21.21	Ave

* Note: all the readings are in the level of noise floor.

802.11n HT40 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 5230 MHz, measured at 3 meters											
10460	30	0	100	H	37.93	7	26.93	48	88.23	-40.23	Peak
10460	30	0	100	V	37.93	7	26.93	48	88.23	-40.23	Peak
10460	18	0	100	H	37.93	7	26.93	36	68.23	-32.23	Ave
10460	18	0	100	V	37.93	7	26.93	36	68.23	-32.23	Ave
15690	30	0	100	H	37.64	8.44	25.97	50.11	74	-23.89	Peak
15690	30	0	100	V	37.64	8.44	25.97	50.11	74	-23.89	Peak
15690	18	0	100	H	37.64	8.44	25.97	38.11	54	-15.89	Ave
15690	18	0	100	V	37.64	8.44	25.97	38.11	54	-15.89	Ave
20920	30	0	100	H	34.01	9.81	29	44.82	74	-29.18	Peak
20920	30	0	100	V	34.01	9.81	29	44.82	74	-29.18	Peak
20920	18	0	100	H	34.01	9.81	29	32.82	54	-21.18	Ave
20920	18	0	100	V	34.01	9.81	29	32.82	54	-21.18	Ave

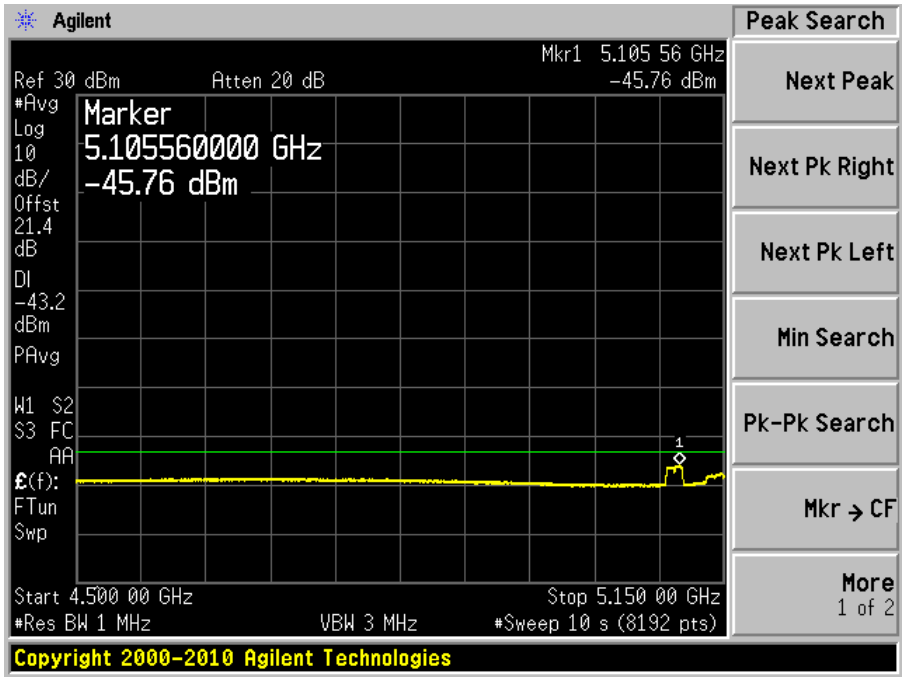
* Note: all the readings are in the level of noise floor.

3) Restricted Band Edges

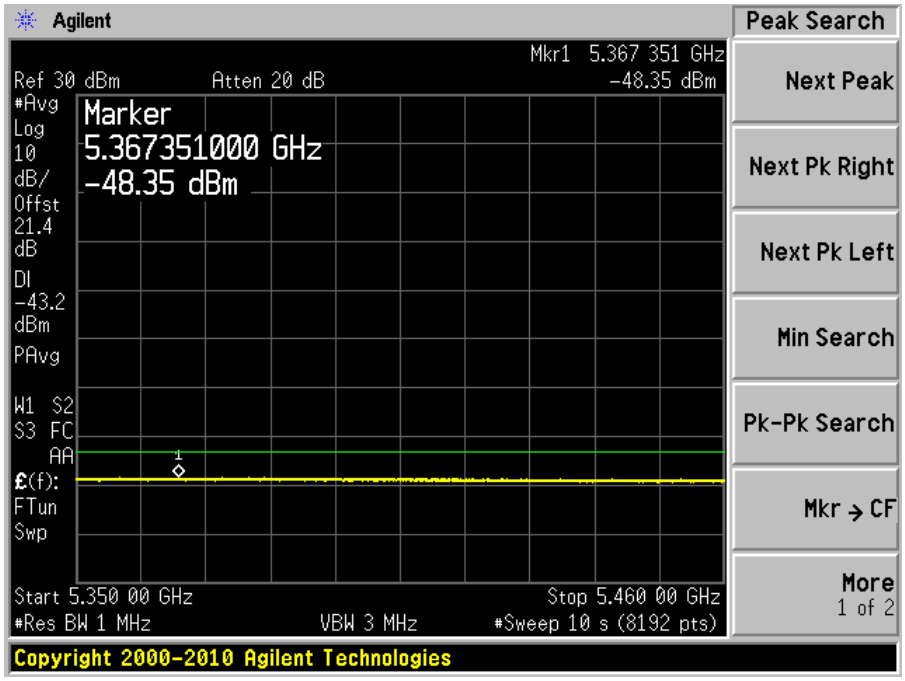
5.2 GHz Band

802.11a mode, Low Channel

Restricted Band: 4500 MHz – 5150 MHz

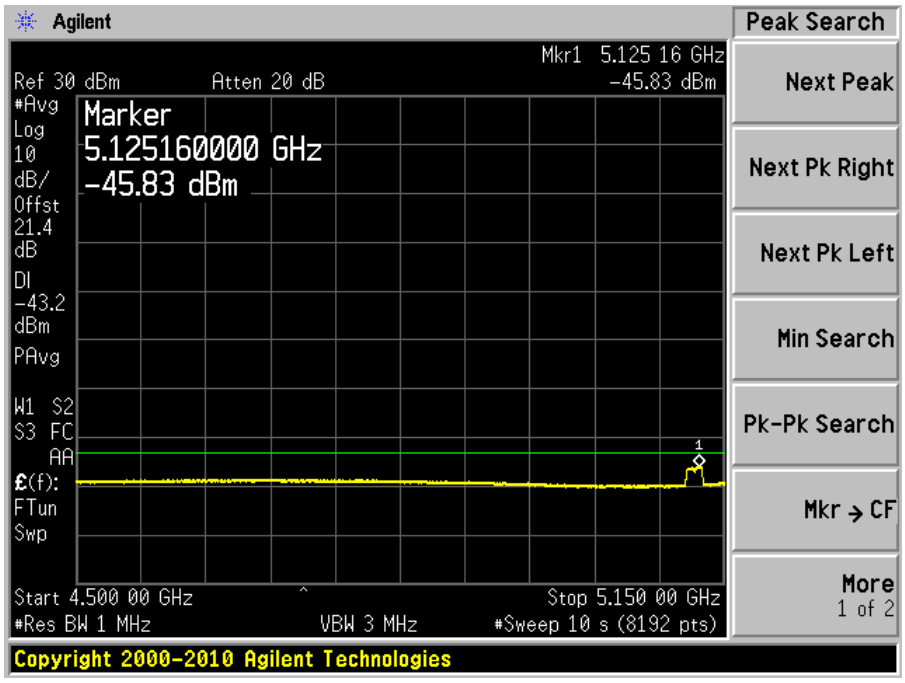


Restricted Band: 5350 MHz – 5460 MHz

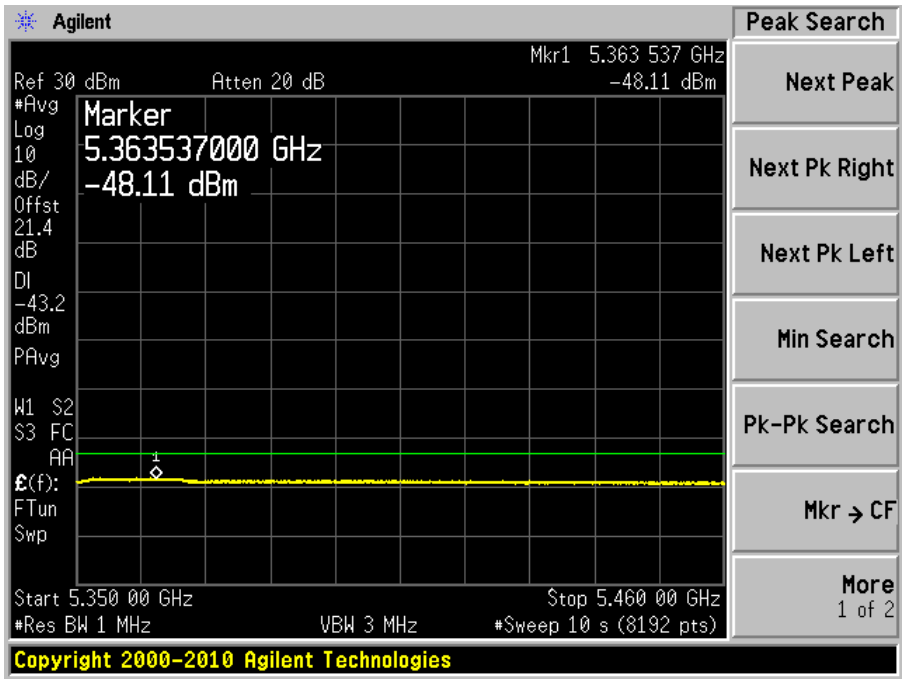


802.11a mode, Middle Channel

Restricted Band: 4500 MHz – 5150 MHz

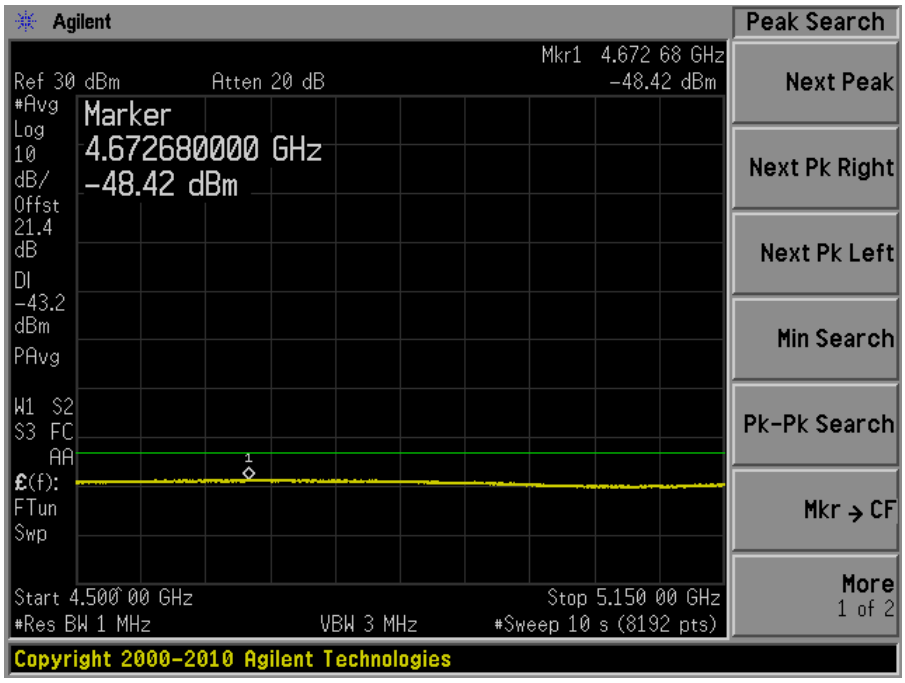


Restricted Band: 5350 MHz – 5460 MHz

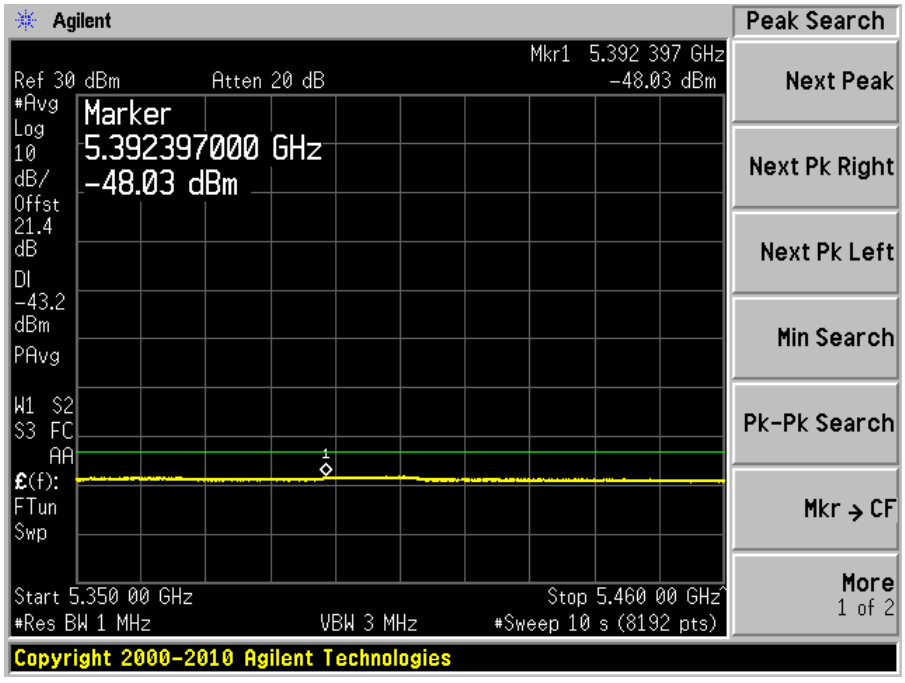


802.11a mode, High Channel

Restricted Band: 4500 MHz – 5150 MHz

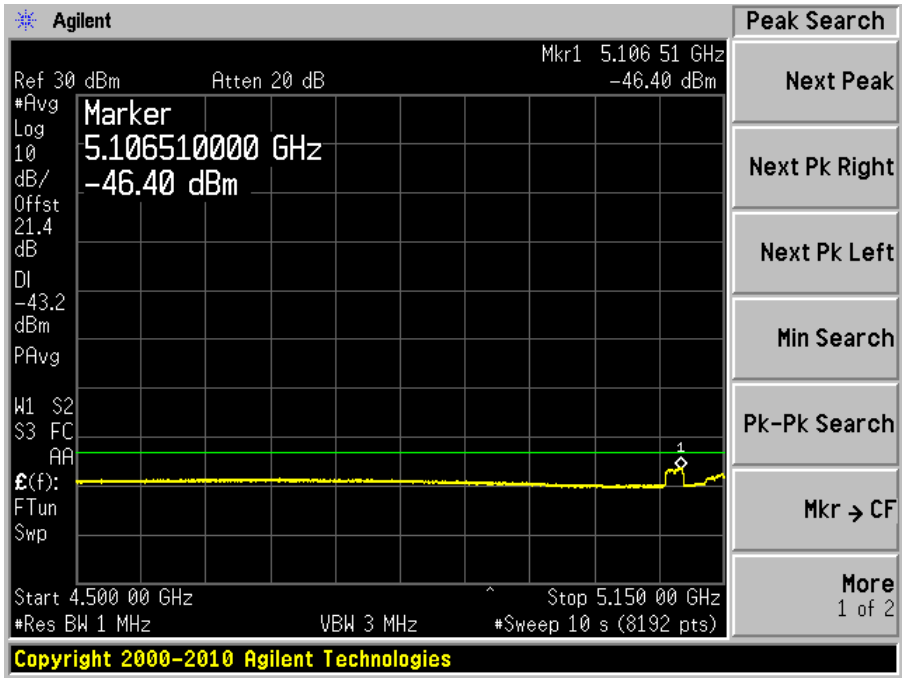


Restricted Band: 5350 MHz – 5460 MHz

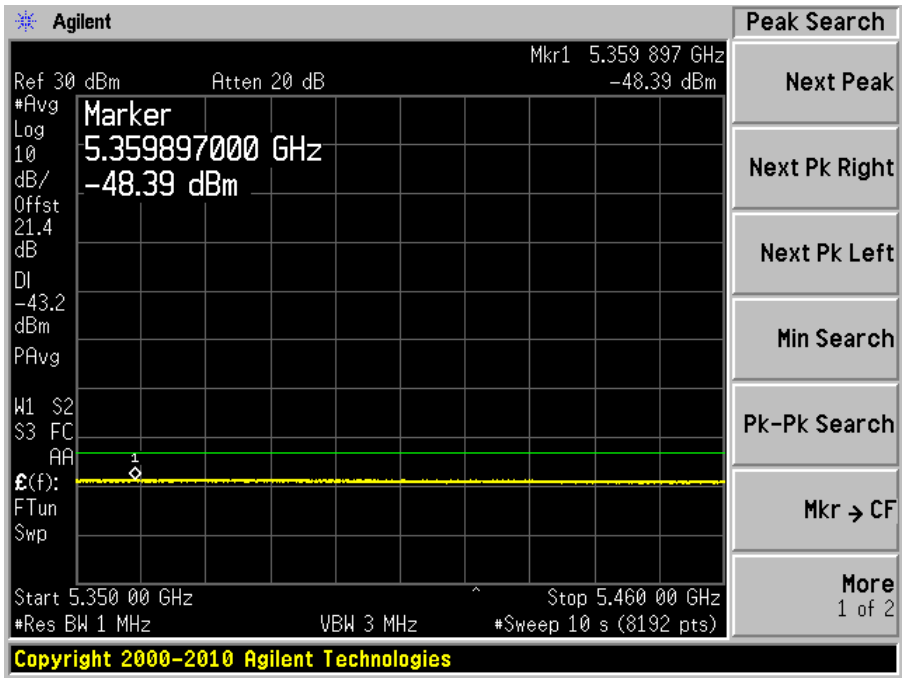


802.11n HT 20 mode, Low Channel

Restricted Band: 4500 MHz – 5150 MHz

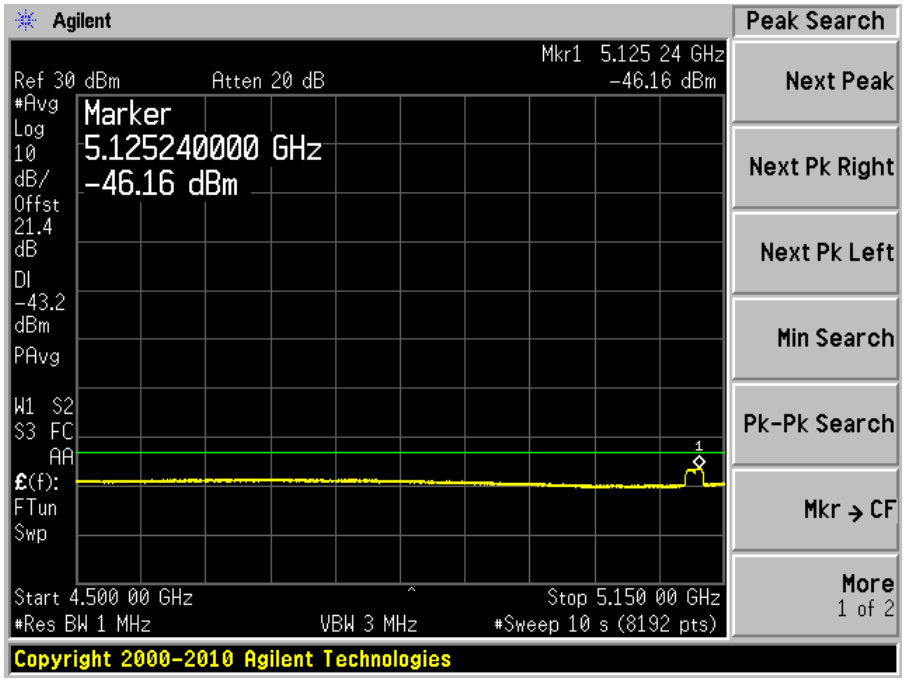


Restricted Band: 5350 MHz – 5460 MHz

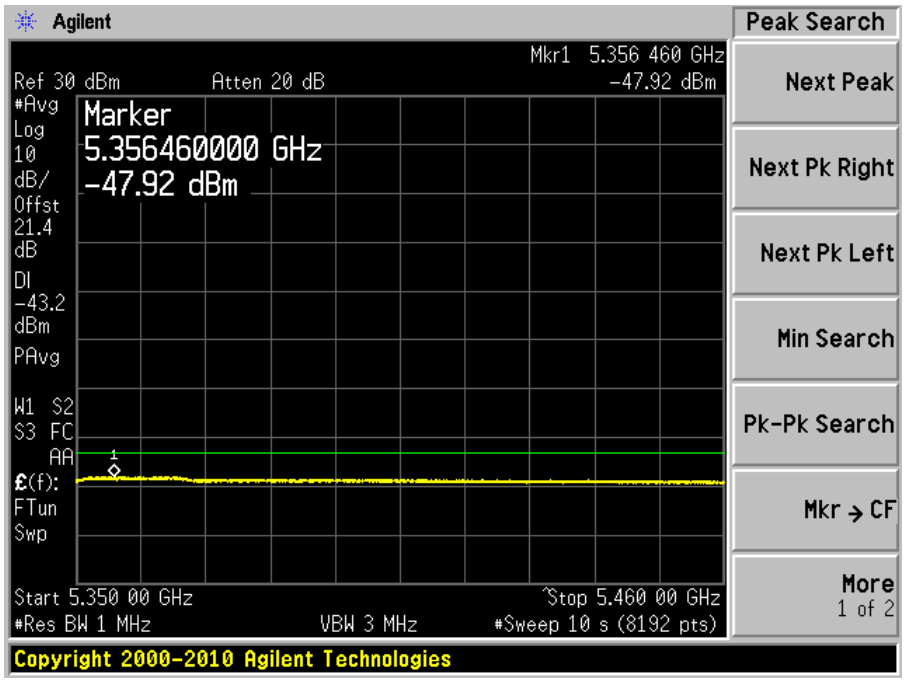


802.11n HT 20 mode, Middle Channel

Restricted Band: 4500 MHz – 5150 MHz

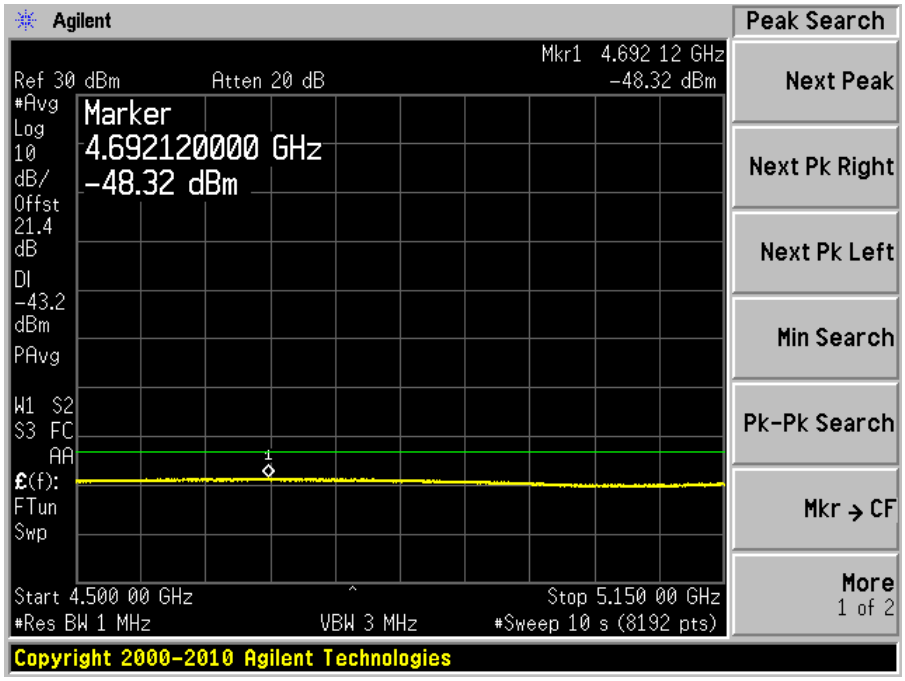


Restricted Band: 5350 MHz – 5460 MHz

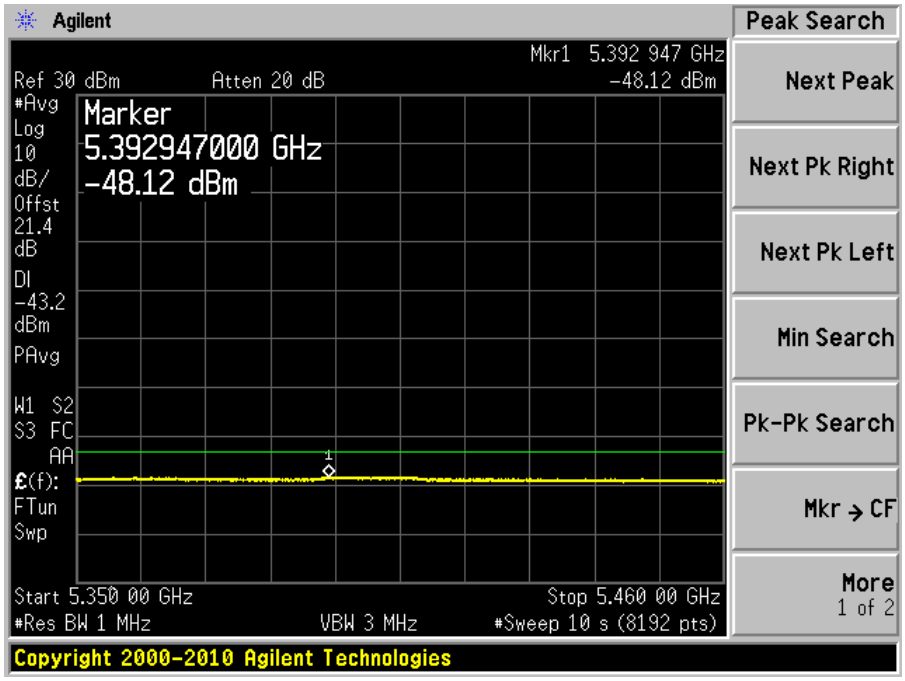


802.11n HT 20 mode, High Channel

Restricted Band: 4500 MHz – 5150 MHz

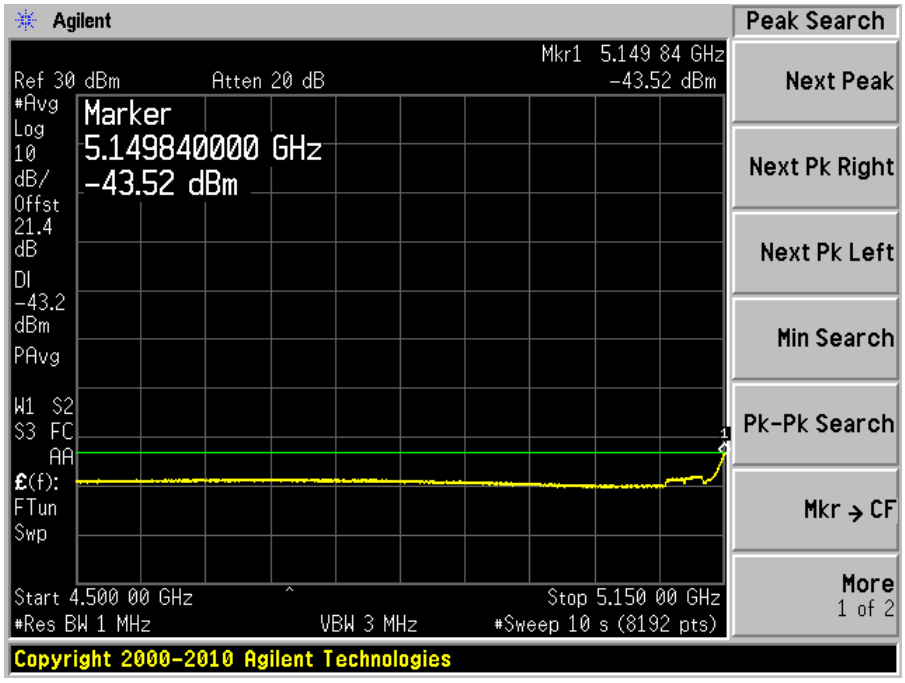


Restricted Band: 5350 MHz – 5460 MHz

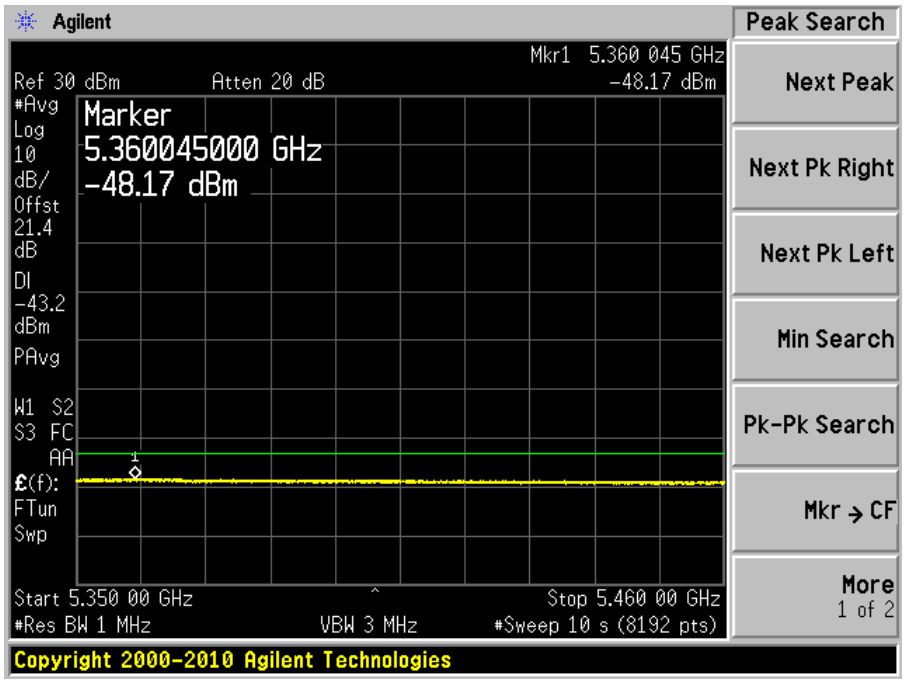


802.11n HT40 mode, Low Channel

Restricted Band: 4500 MHz – 5150 MHz

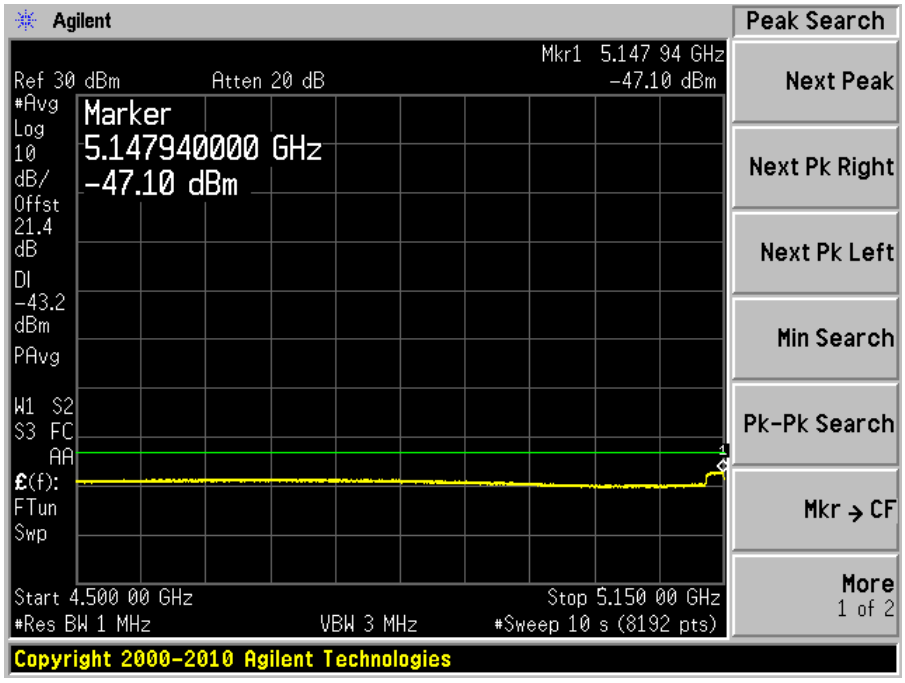


Restricted Band: 5350 MHz – 5460 MHz

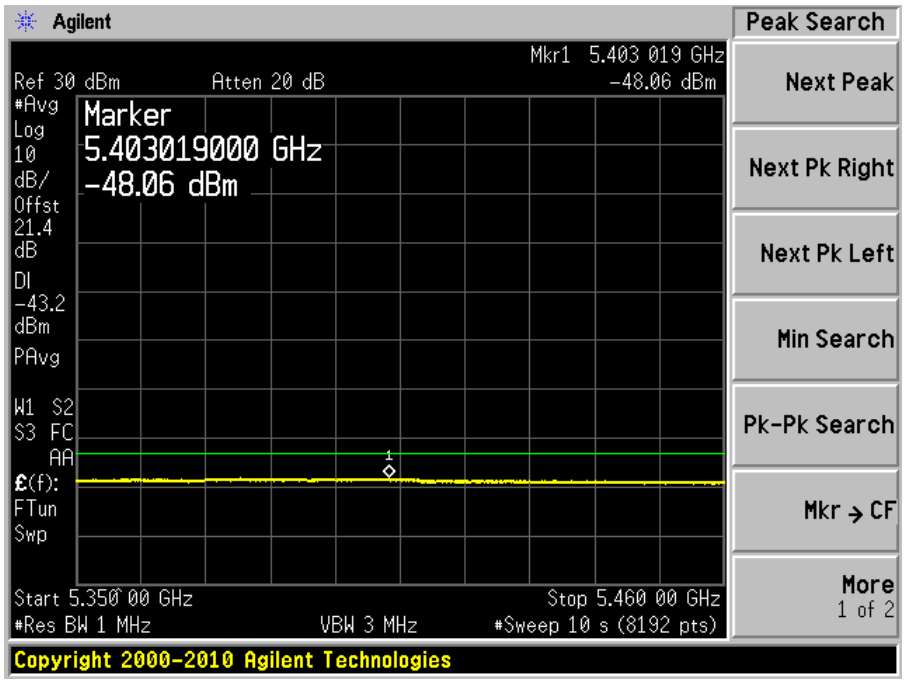


802.11n HT40 mode, High Channel

Restricted Band: 4500 MHz – 5150 MHz



Restricted Band: 5350 MHz – 5460 MHz



8 FCC §15.407(a) & IC RSS-210 §A9.2 – 26 dB & 99% Emission Bandwidth

8.1 Applicable Standard

FCC §15.407(a) and IC RSS-210 §A9.2.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect 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 26 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

8.4 Test Environmental Conditions

Temperature:	22 °C
Relative Humidity:	43 %
ATM Pressure:	101.1 kPa

The testing was performed by Jeffrey Wu on 2013-04-17in RF site.

8.5 Test Results

802.11a mode

Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Low	5180	22.628	16.6341
Middle	5200	22.721	16.7086
High	5240	22.870	16.7279

802.11n HT20 mode

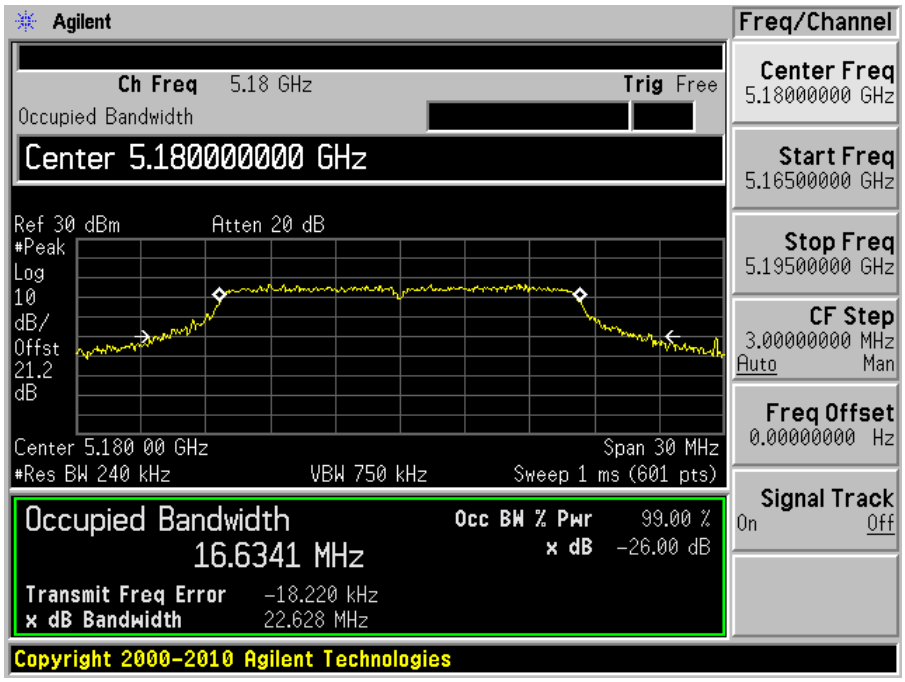
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Low	5180	22.923	17.7926
Middle	5200	22.940	17.7693
High	5240	23.102	17.7751

802.11n HT40 mode

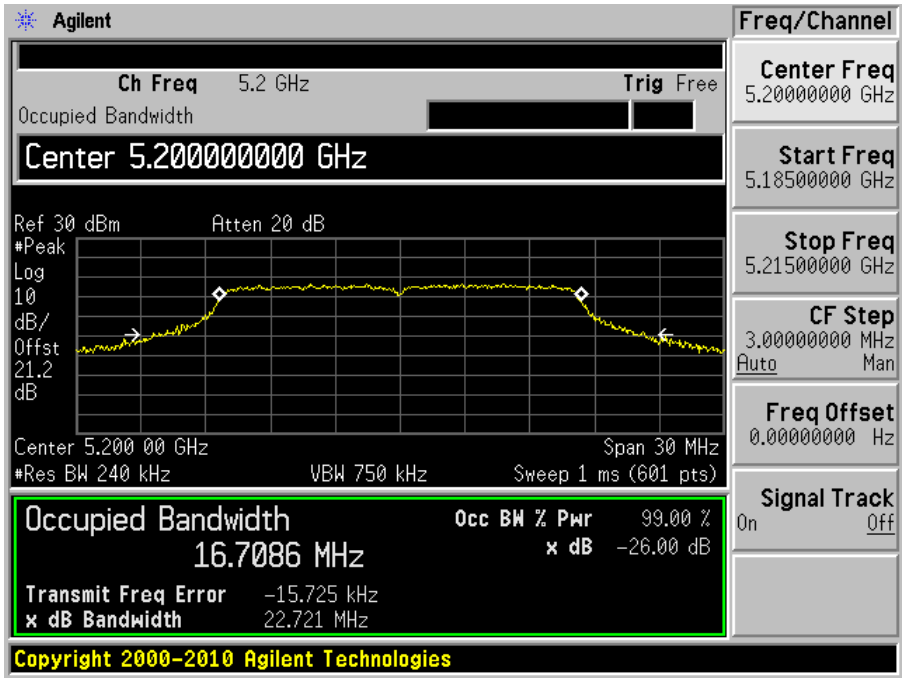
Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Low	5190	46.238	36.5858
High	5230	47.336	36.5318

5150-5250 MHz Band

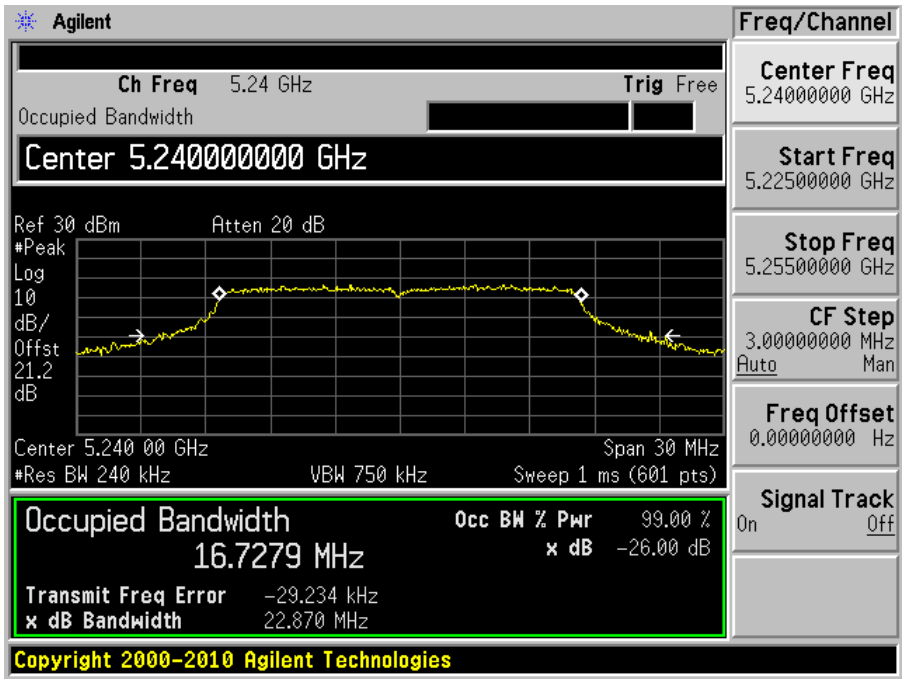
802.11a mode, Low channel, 5180 MHz



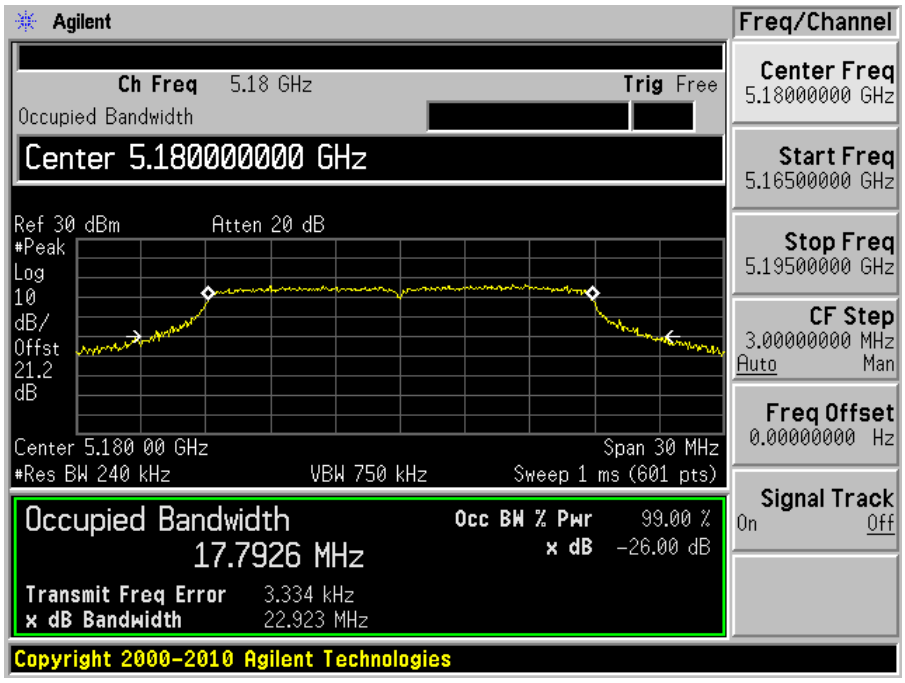
802.11a mode, Middle channel, 5200 MHz



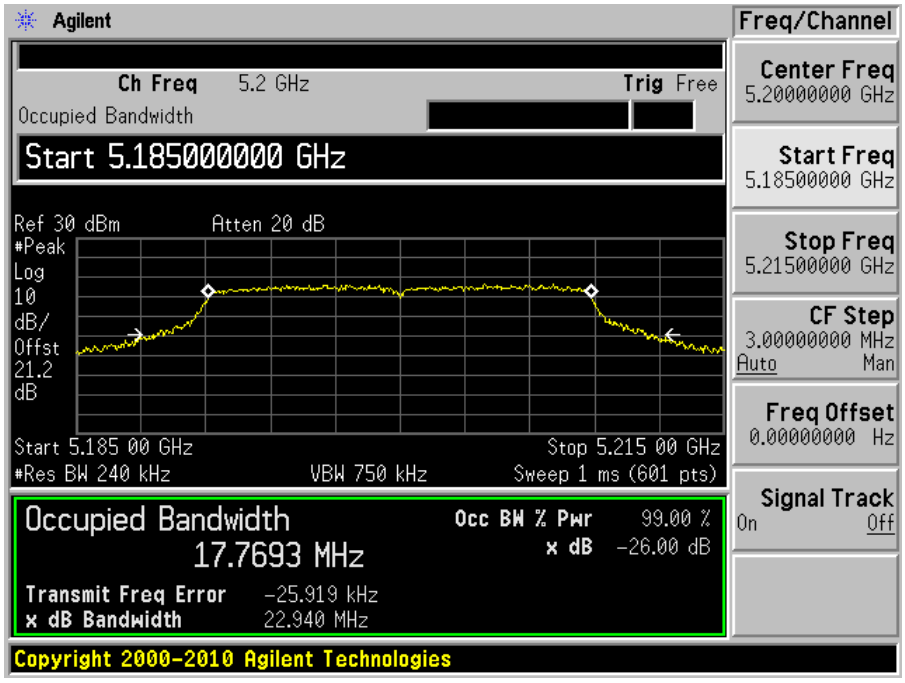
802.11a mode, High channel, 5240 MHz



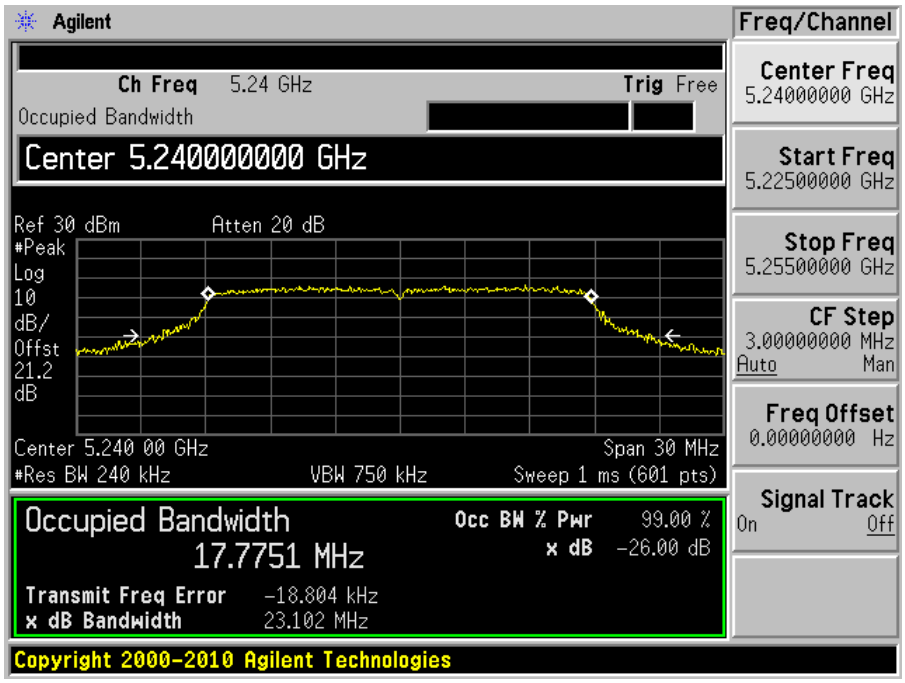
802.11n HT20 mode, low channel, 5180 MHz



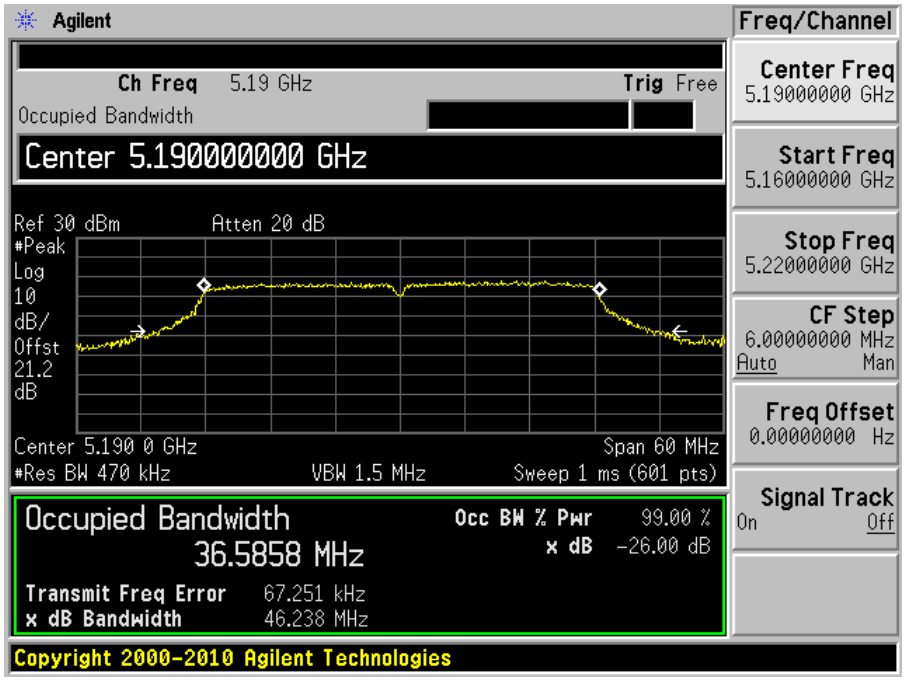
802.11n HT20 mode, Middle channel, 5200 MHz



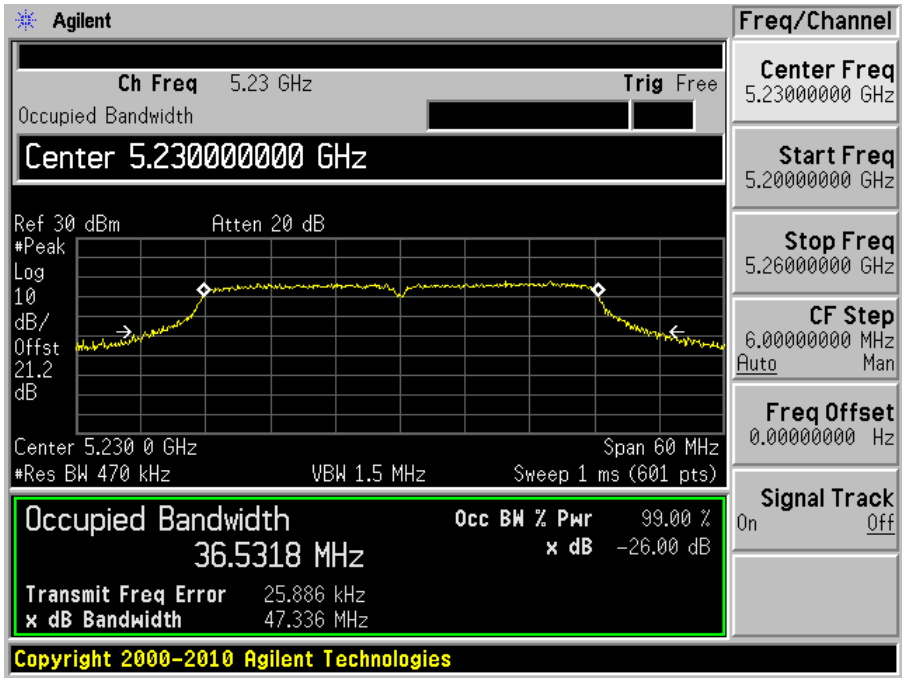
802.11n HT20 mode, High channel, 5240 MHz



802.11n HT40 mode, low channel, 5190 MHz



802.11n HT40 mode, high channel, 5230 MHz



9 FCC §407(a)(1) & IC RSS-210 §A9.2 - Peak Output Power Measurement

9.1 Applicable Standard

According to FCC §15.407(a)(1)

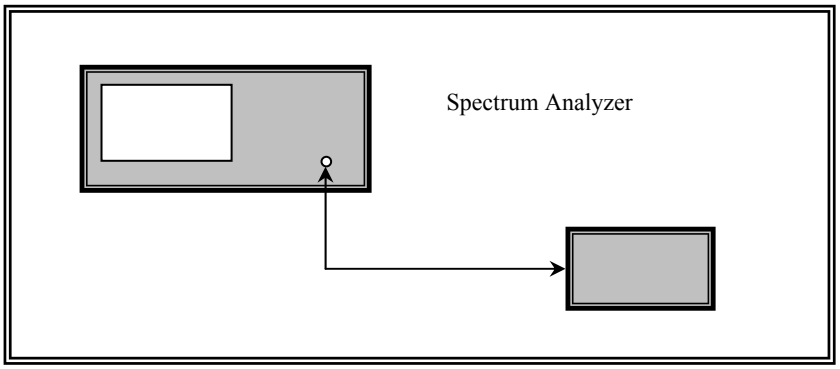
For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26–dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-210 §A9.2:

For the 5.15–5.250 GHz bands, the maximum e.i.r.p shall not exceed 200 mW or 10 + 10 log B, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p spectral density shall not exceed 10 dBm in any 1.0 MHz band.

9.2 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.



9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

9.4 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	43 %
ATM Pressure:	101.3kPa

The testing was performed by Jeffery Wu on 2013-04-20 at the RF site.

9.5 Test Results

FCC

Channel	Frequency (MHz)	TX Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
802.11a mode					
Low	5180	15.50	17	-1.50	16.5
Middle	5200	15.55	17	-1.45	17
High	5240	15.77	17	-1.23	17
802.11n HT20 mode					
Low	5180	15.48	17	-1.52	16.5
Middle	5200	15.17	17	-1.83	17
High	5240	15.60	17	-1.40	17
802.11n HT40 mode					
Middle	5190	14.13	17	-2.87	15.5
High	5230	16.89	17	-0.11	18.5

IC

Channel	Frequency (MHz)	TX Power (dBm)	Antenna Gain (dBi)	Total TX Power (dBm)	Limit (e.i.r.p.) (dBm)	Margin (dB)	Power Setting
802.11a mode							
Low	5180	15.50	2	17.50	23	-5.5	16.5
Middle	5200	15.55	2	17.55	23	-5.45	17
High	5240	15.77	2	17.77	23	-5.23	17
802.11n HT20 mode							
Low	5180	15.48	2	17.48	23	-5.52	16.5
Middle	5200	15.17	2	17.17	23	-5.83	17
High	5240	15.60	2	17.60	23	-5.40	17
802.11n HT40 mode							
Low	5190	14.13	2	16.13	23	-6.87	16.5
High	5230	16.89	2	18.89	23	-6.11	17

10 FCC §15.407(b) & IC RSS-210 §A9.2 - Out of Band Emissions

10.1 Applicable Standard

According to FCC §15.407(b)

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz

According to RSS-210 §A9.2, emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

10.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	44 %
ATM Pressure:	101.2 kPa

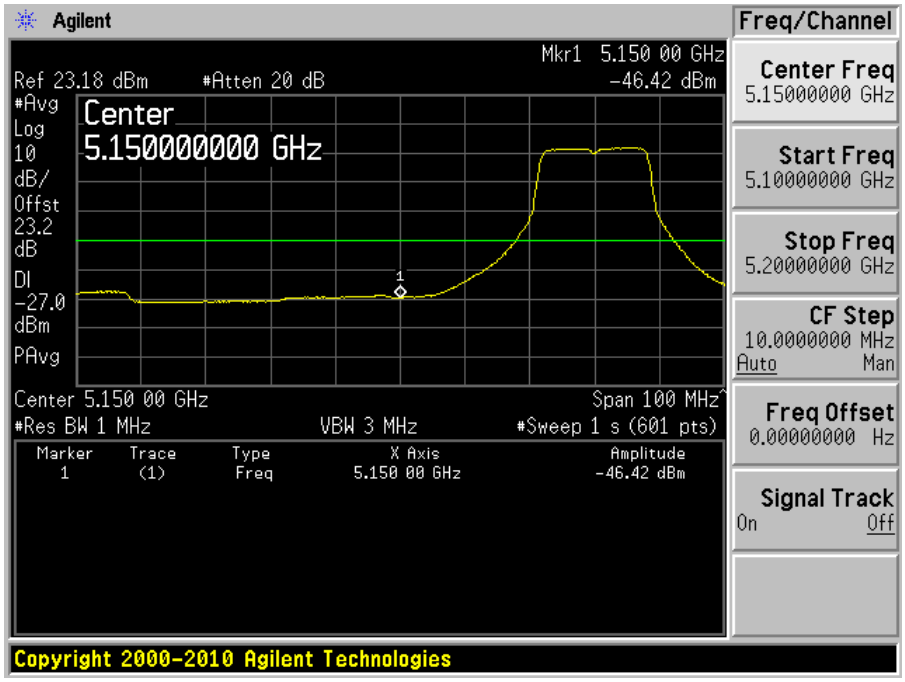
The testing was performed by Jeffrey Wu on 2013-04-17in RF site.

10.5 Test Results

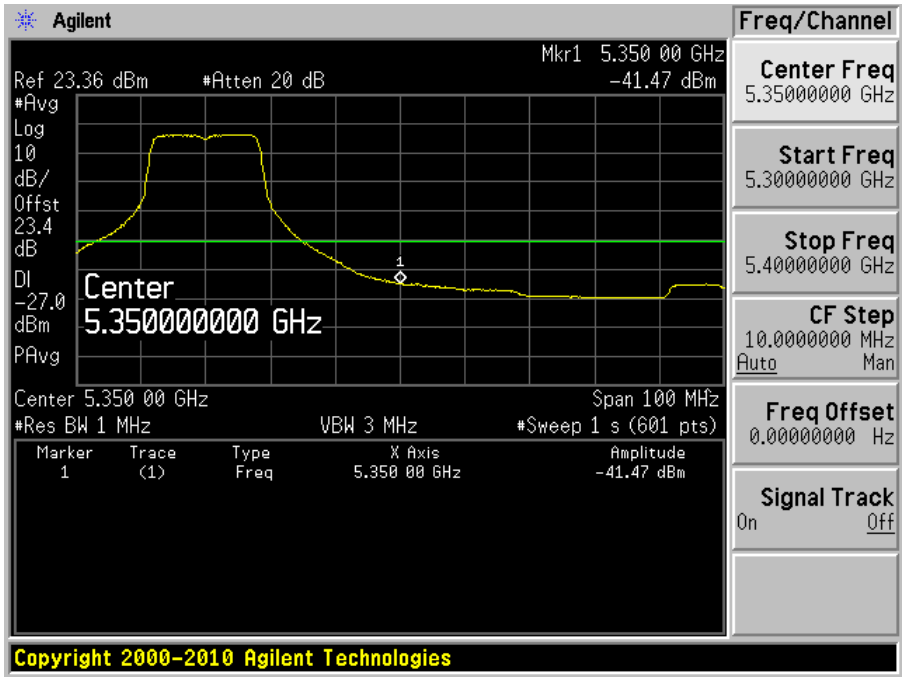
Please refer to following pages for plots of band edge.

5150-5250 MHz Band

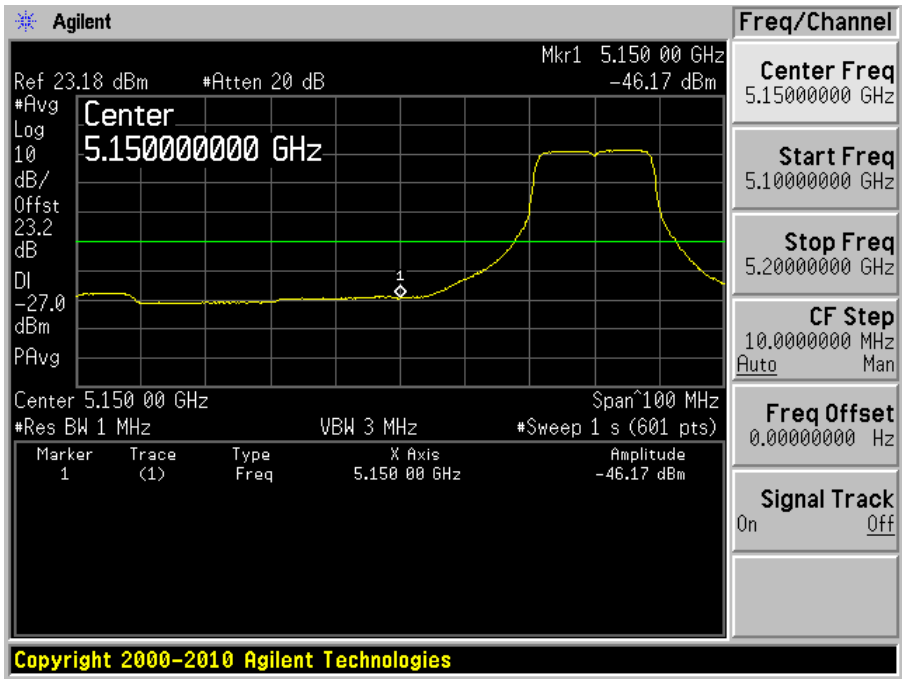
802.11a mode, Lowest Channel



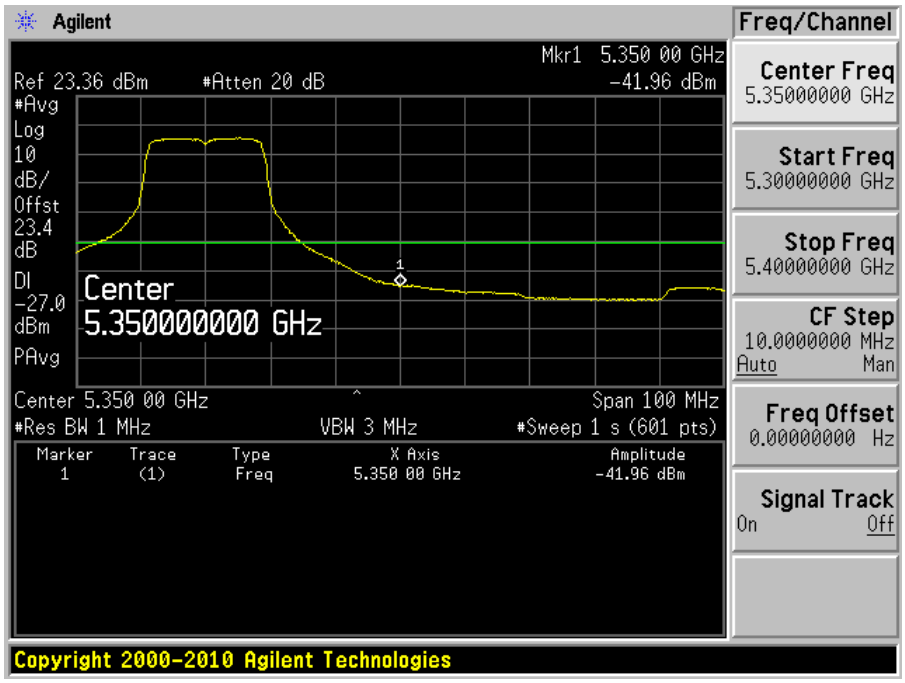
802.11a mode, Highest Channel



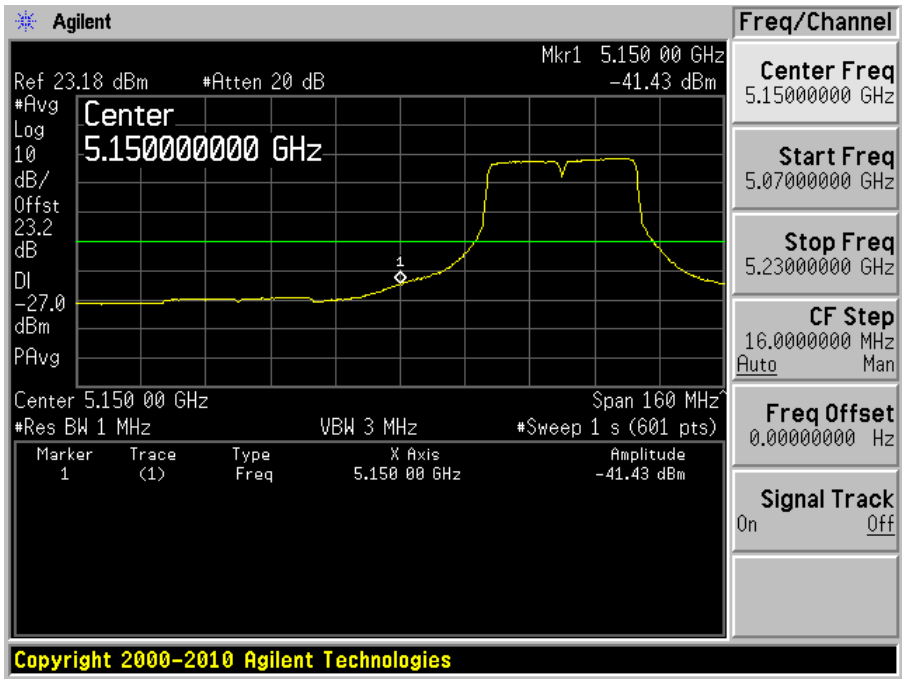
802.11n HT20 mode, Lowest Channel



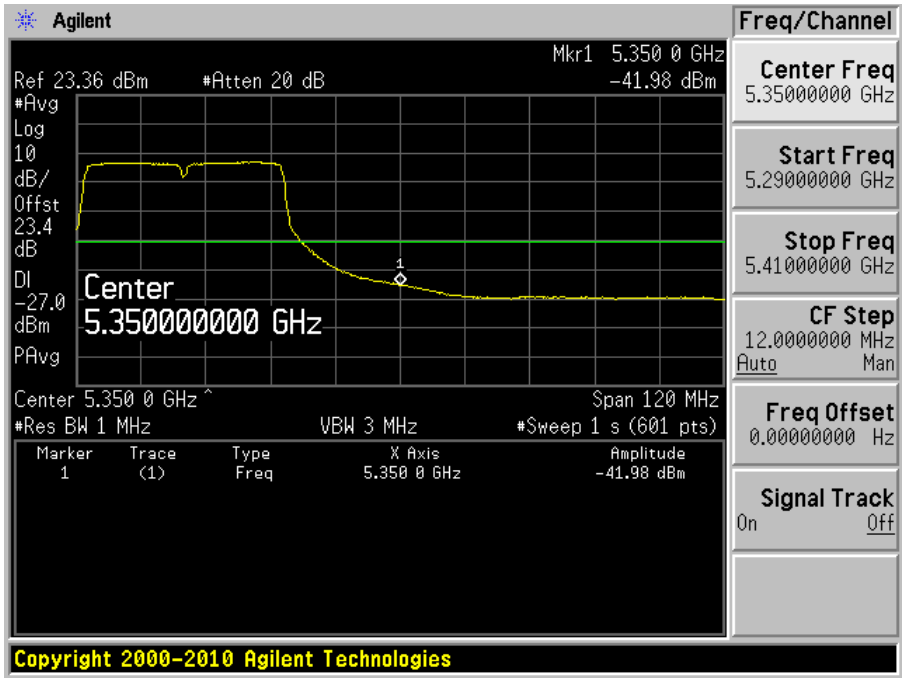
802.11n HT20 mode, Highest Channel



802.11n HT40 mode, Lowest Channel



802.11n HT40 mode, Highest Channel



11 FCC §15.407(a)(1) & IC RSS-210 §A9.2 - Power Spectral Density

11.1 Applicable Standard

According to FCC §15.407(a)(1)

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26–dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to IC RSS-210 §A9.2:

5150-5250MHz the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10 B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

11.2 Measurement Procedure

(i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto.
(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".
(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
(ix) Compute power by integrating the spectrum across the 26 dB EBW of the signal using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. If the spectrum analyzer does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the 26 dB EBW of the spectrum.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

11.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	45 %
ATM Pressure:	101.7 kPa

The testing was performed by Jeffrey Wu on 2013-04-19 at the RF site.

11.5 Test Results

FCC

Channel	Frequency (MHz)	PSD (dBm/MHz)	Limit (dBm)	Margin (dB)
802.11a mode				
Low	5180	3.992	4	-0.008
Middle	5200	3.993	4	-0.007
High	5240	3.878	4	-0.122
802.11n HT20 mode				
Low	5180	3.650	4	-0.350
Middle	5200	3.777	4	-0.223
High	5240	3.680	4	-0.320
802.11n HT40 mode				
Low	5190	2.507	4	-1.493
High	5230	2.168	4	-1.832

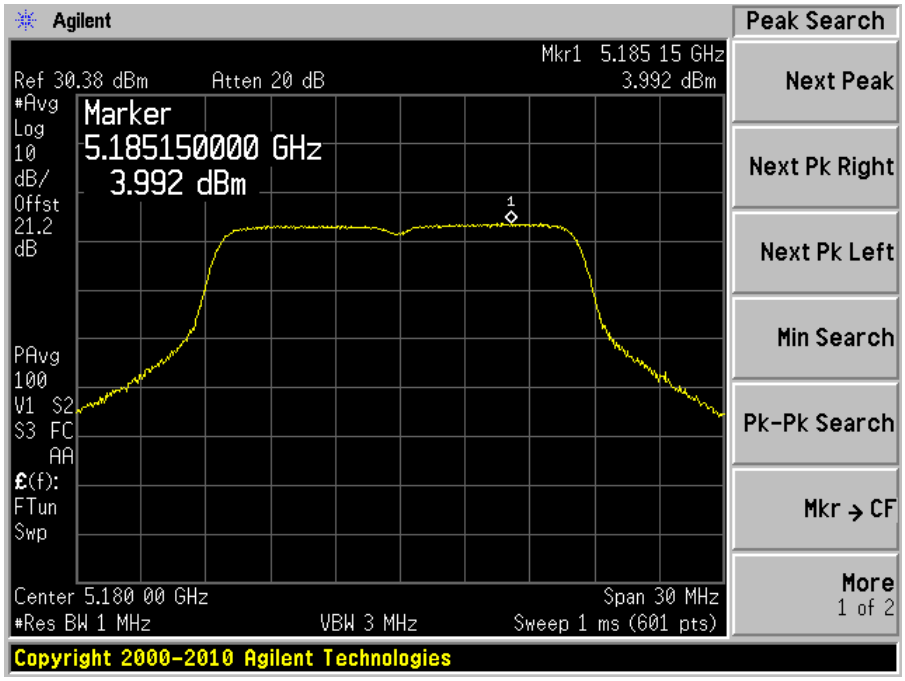
IC

Channel	Frequency (MHz)	PSD (dBm/MHz)	Antenna Gain (dBi)	Total PSD (dBm/MHz)	Limit (e.i.r.p.) (dBm/MHz)	Margin (dB)
802.11a mode						
Low	5180	3.992	2	5.992	10	-4.008
Middle	5200	3.993	2	5.993	10	-4.007
High	5240	3.878	2	5.878	10	-4.122
802.11n HT20 mode						
Low	5180	3.650	2	5.650	10	-4.350
Middle	5200	3.777	2	5.777	10	-4.223
High	5240	3.680	2	5.680	10	-4.320
802.11n HT40 mode						
Low	5190	2.507	2	4.570	10	-5.493
High	5230	2.168	2	4.168	10	-5.832

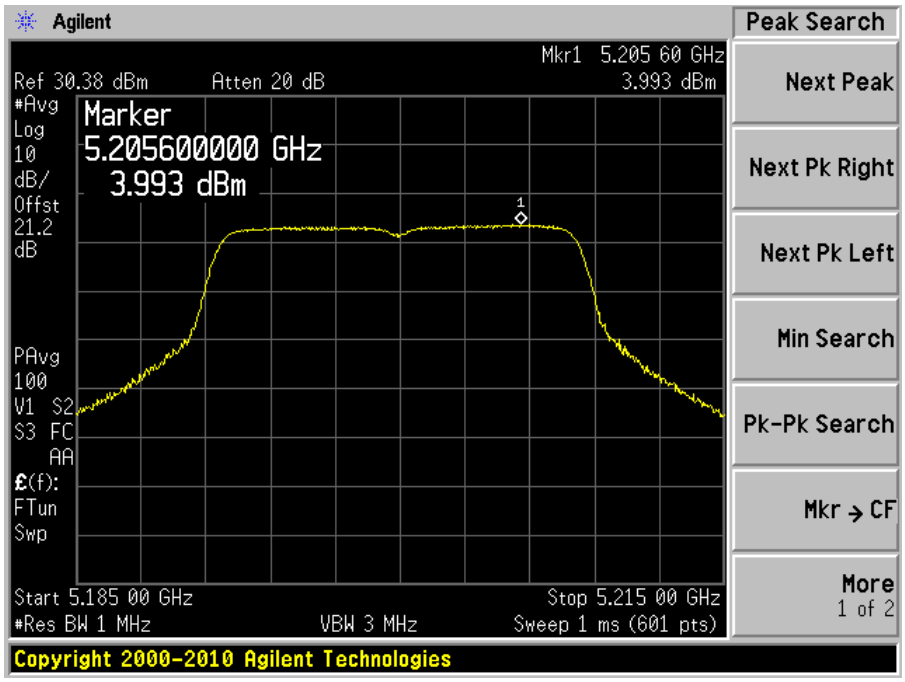
Please refer to the following plots.

802.11a mode

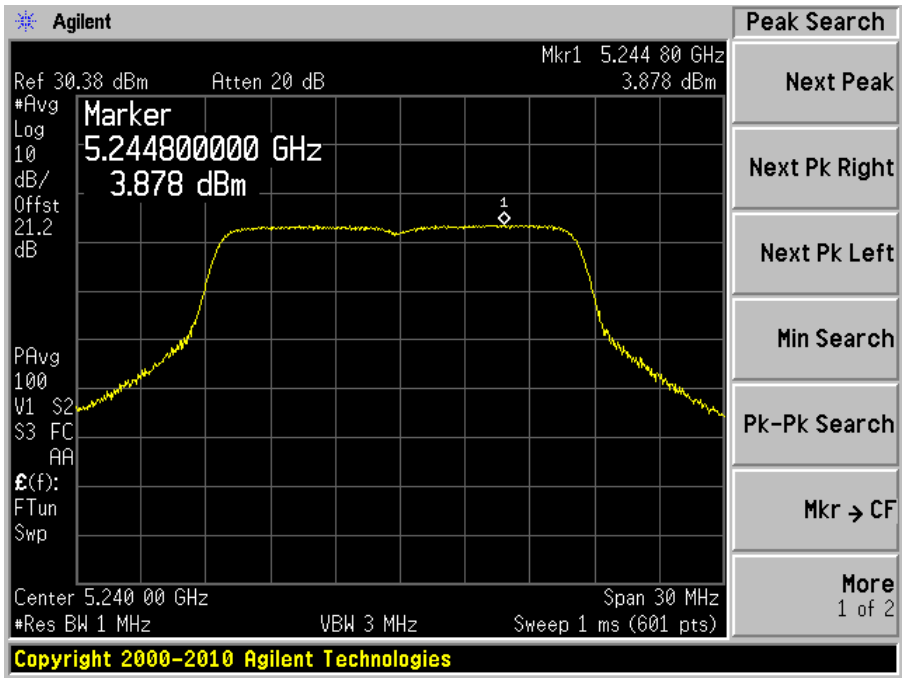
Low channel, 5180 MHz



Middle channel, 5200 MHz

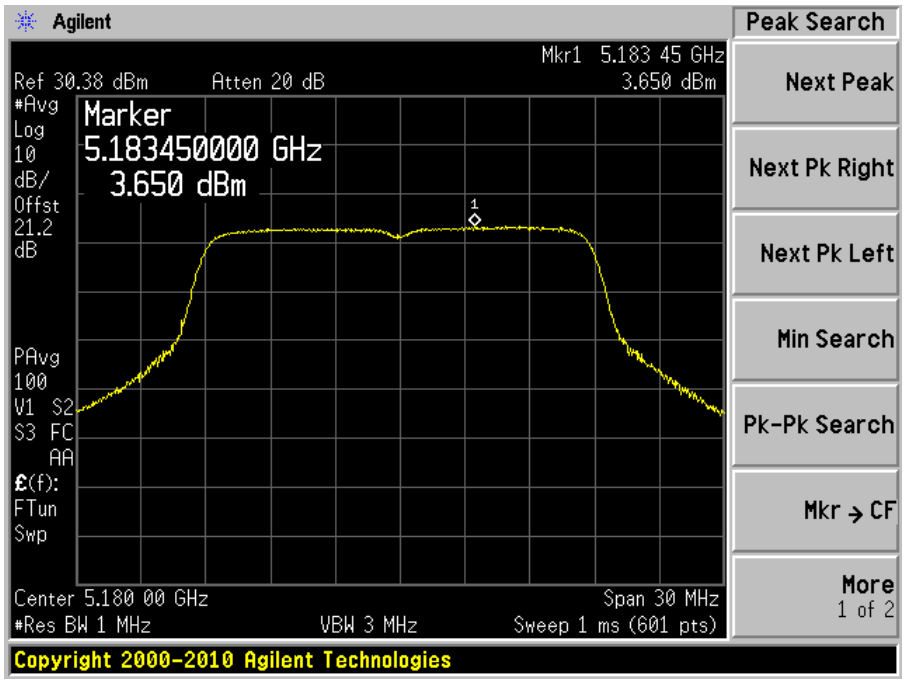


High channel, 5240 MHz

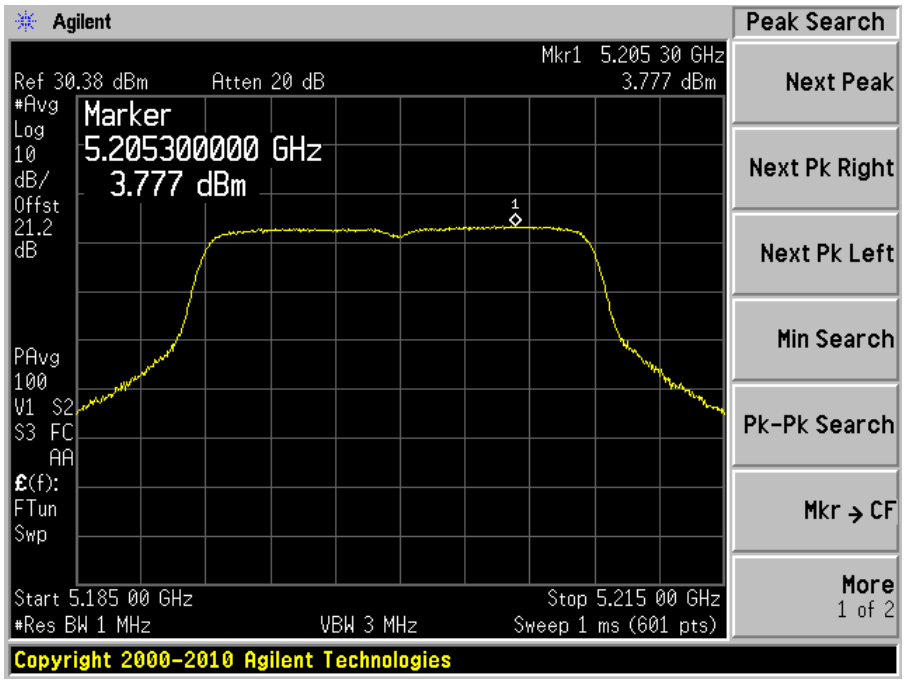


802.11n HT20 mode

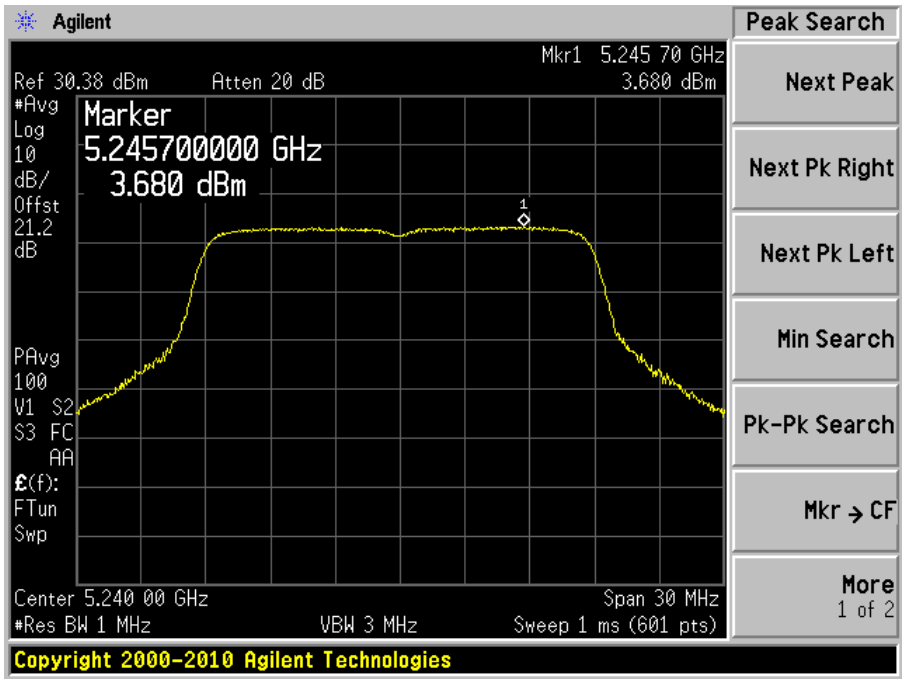
Low channel, 5180 MHz



Middle channel, 5200 MHz

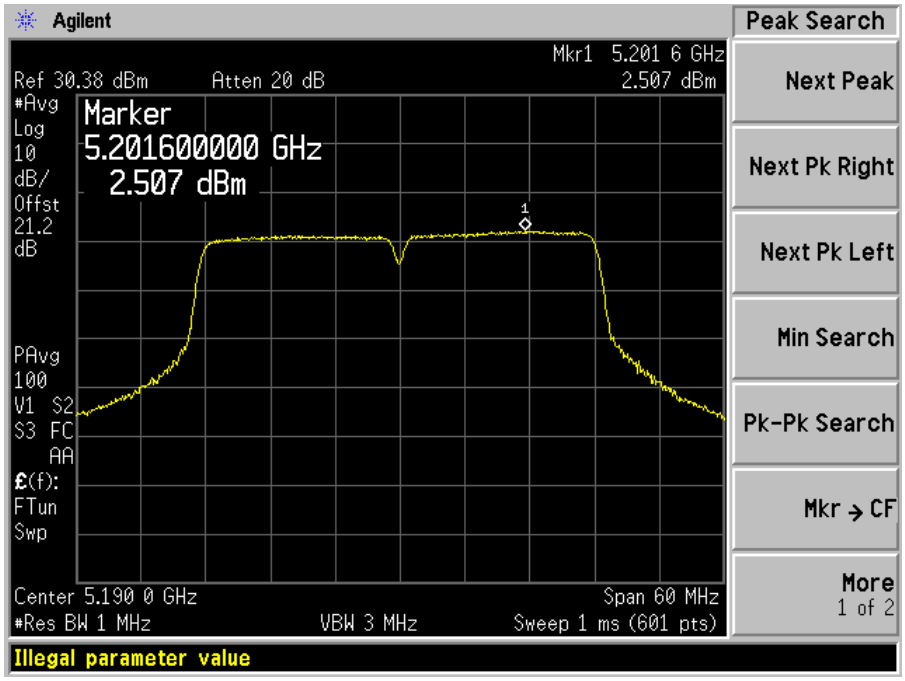


High channel, 5240 MHz

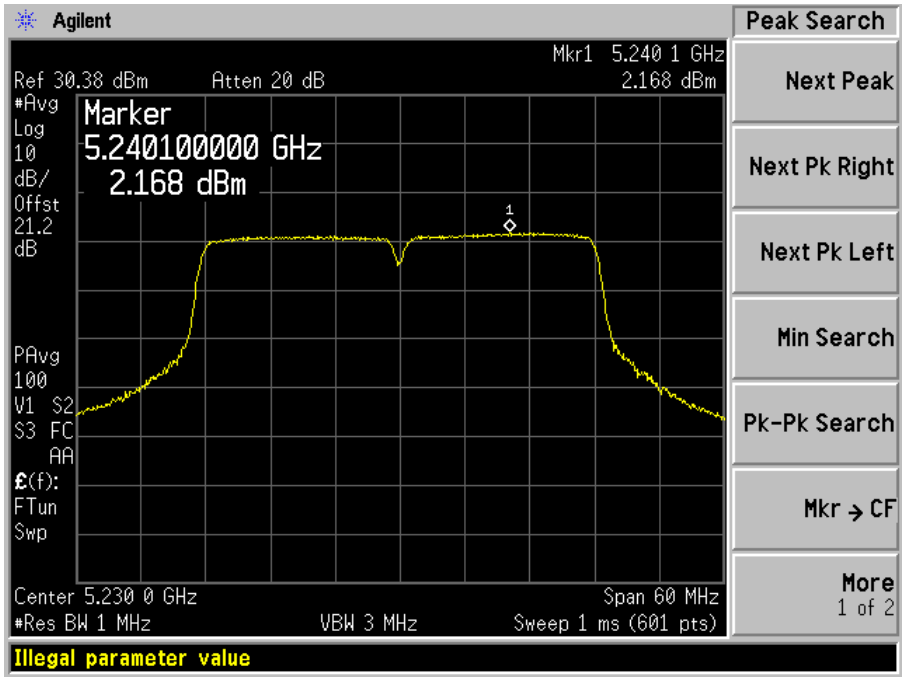


802.11n HT40 mode

Low channel, 5190 MHz



High channel, 5230 MHz



12 FCC §15.407(a)(6) – Peak Excursion Ratio

12.1 Applicable Standard

According to FCC §15.407(a) (6), the ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

12.2 Test Procedure

Set the spectrum analyzer span to view the entire emission bandwidth.
The largest difference between the following two traces must be ≤ 13 dB for all frequencies across the emission bandwidth. Submit a plot.

1st Trace:
• Set RBW = 1 MHz, VBW ≥ 3 MHz with peak detector and maxhold settings.

2nd Trace:
• create the 2nd trace using the settings described in the setion "FCC §15.407(a)(1)(2) – CONDUCTED TRANSMITTER OUTPUT POWER".

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

12.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	44 %
ATM Pressure:	101.2 kPa

The testing was performed by Jeffrey Wu on 2013-04-17 in RF site.

12.5 Test Results

5150-5250 MHz Band

802.11a amode

Channel	Frequency (MHz)	Results (dB)	Limit (dB)
Low	5180	8.804	13
Middle	5200	8.072	
High	5240	8.661	

802.11n HT20 amode

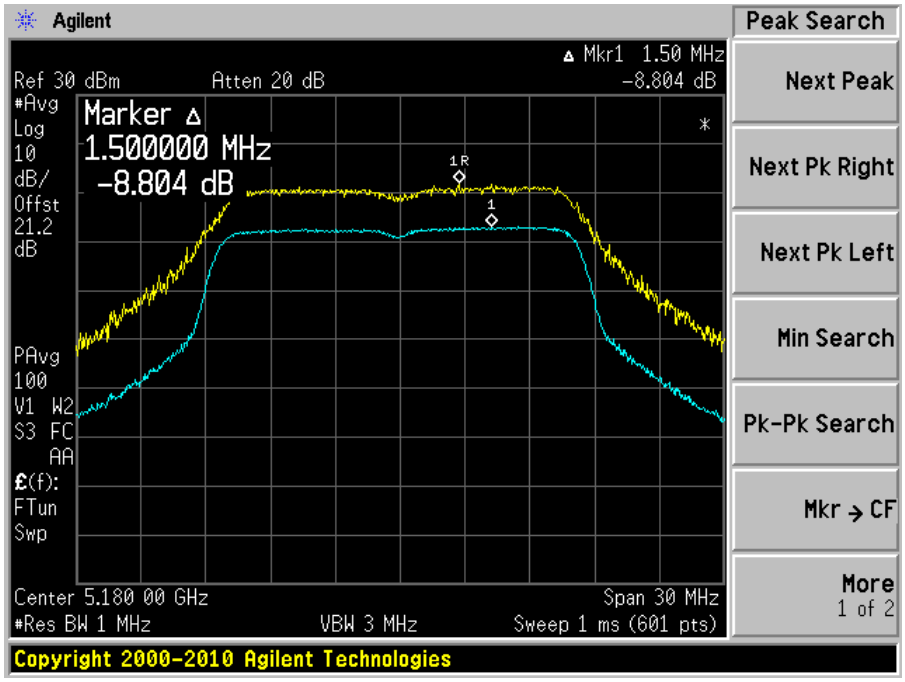
Channel	Frequency (MHz)	Results (dB)	Limit (dB)
Low	5180	8.349	13
Middle	5200	7.873	
High	5240	8.219	

802.11n HT40 amode

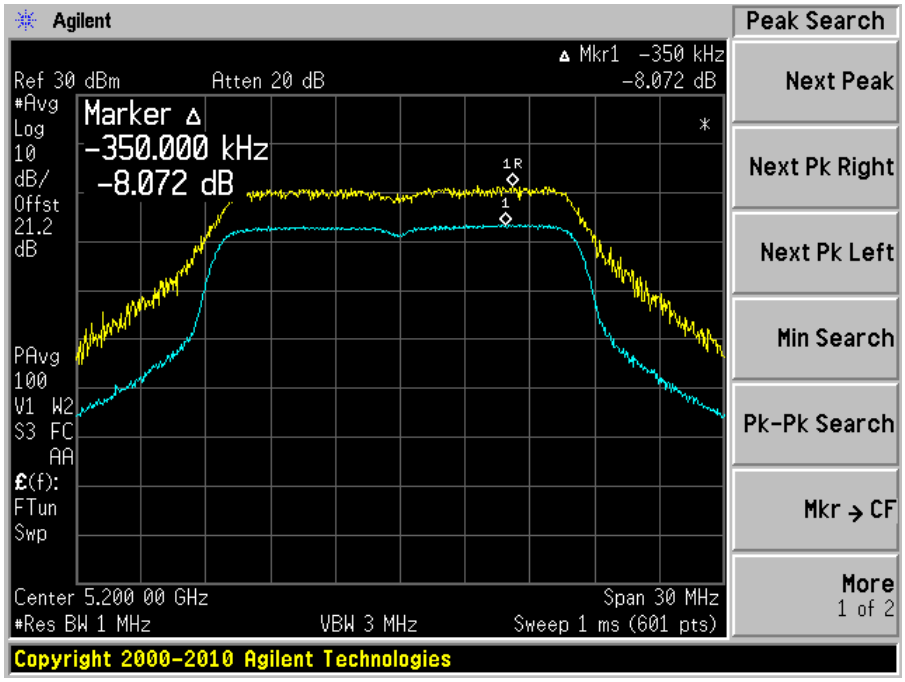
Channel	Frequency (MHz)	Results (dB)	Limit (dB)
Low	5190	8.994	13
High	5230	8.971	

Please refer to the following plots for detailed test results:

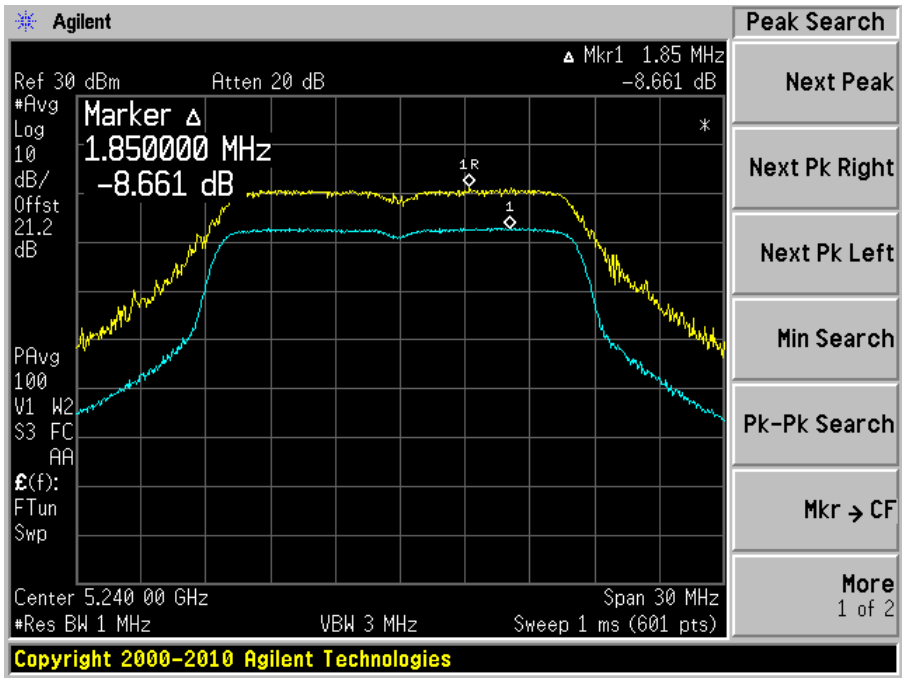
802.11a mode, Low channel, 5180 MHz



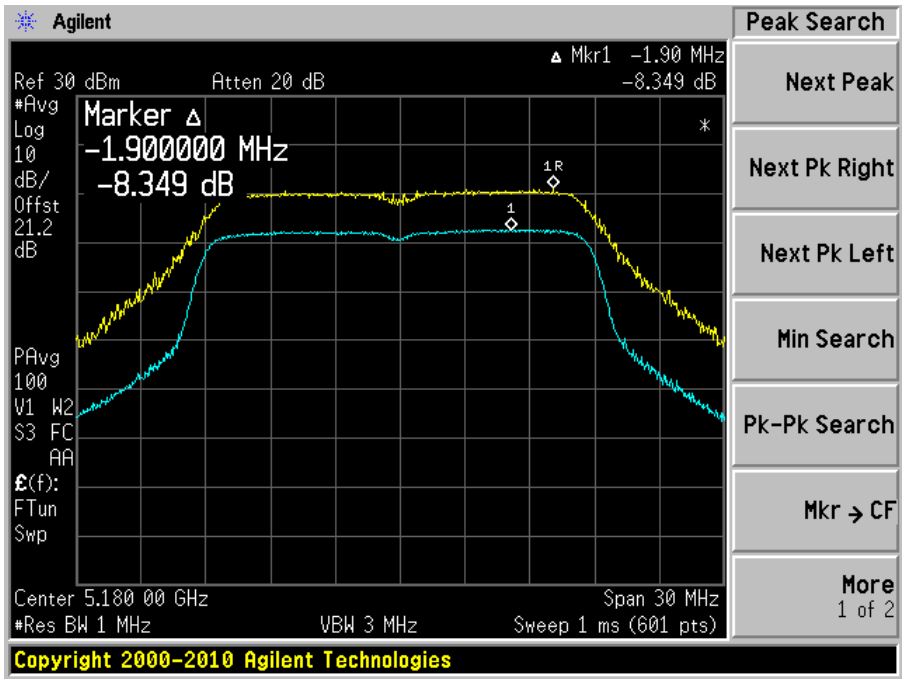
802.11a mode, Middle channel, 5200 MHz



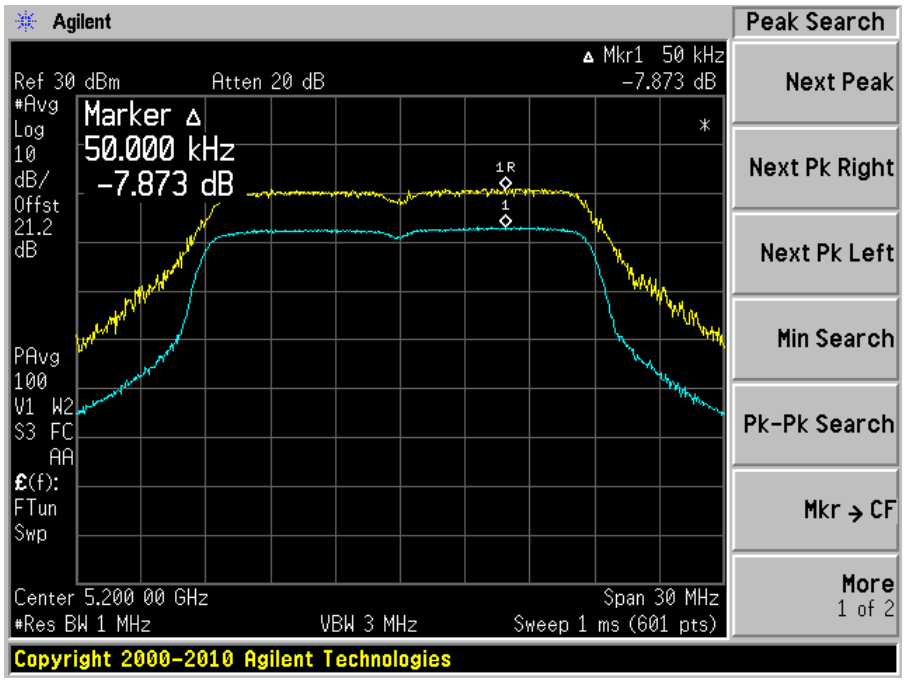
802.11a mode, Higch channel, 5240 MHz



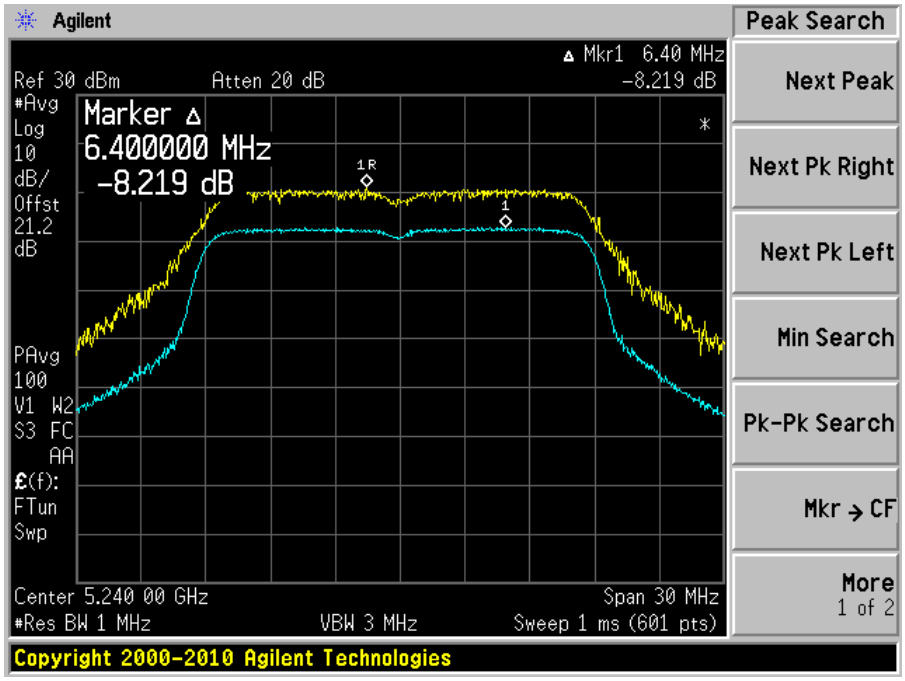
802.11n HT20 mode, Low channel, 5180 MHz



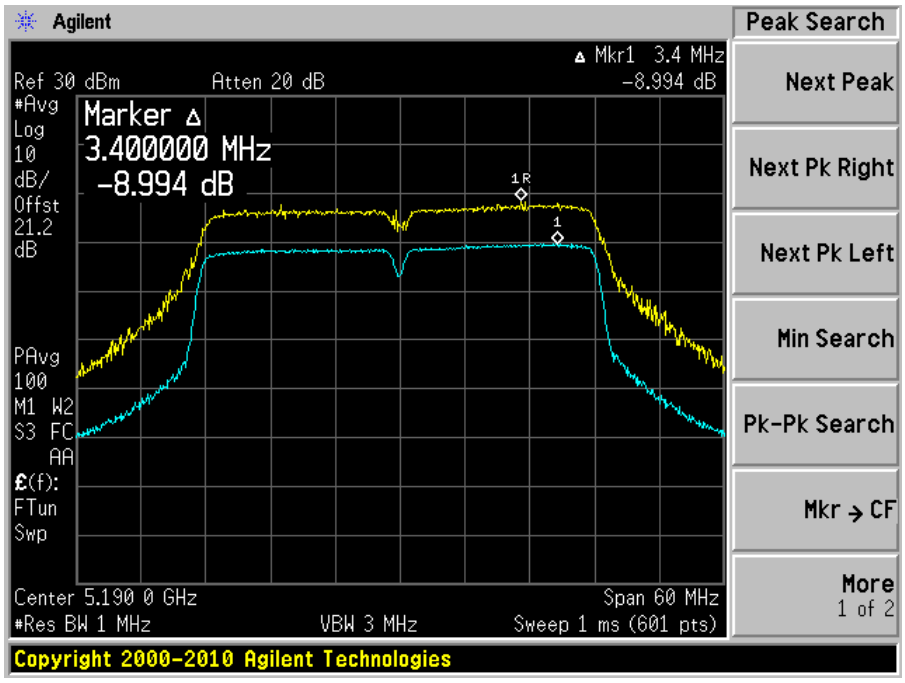
802.11n HT20 mode, Middle channel, 5200 MHz



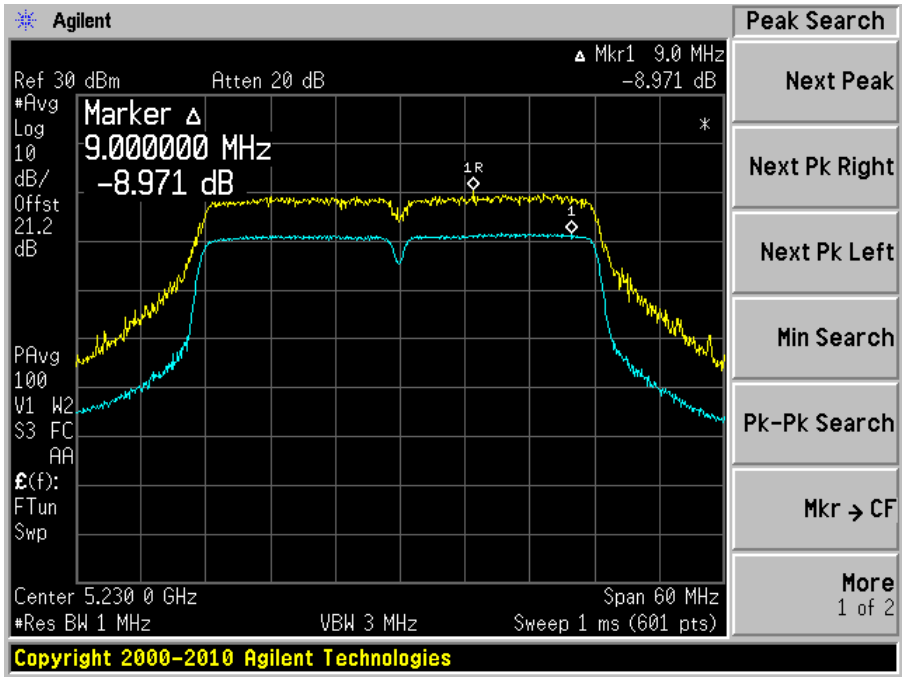
802.11n HT20 mode, High channel, 5240 MHz



802.11n HT40 mode, Low channel, 5190 MHz



802.11n HT40 mode, High channel, 5230 MHz



13 IC RSS-210 §2.3 & RSS-Gen §6.1 - Receiver Spurious Radiated Emissions

13.1 Applicable Standard

According to IC RSS-Gen §6.1, spurious emissions from receivers shall not exceed the radiated limits shown in the table below.

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

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
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	MY44303352	2012-10-16	1 year
EMCO	Horn Antenna	3115	9511-4627	2012-10-17	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2012-09-19	1 year

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

13.6 Test Environmental Conditions

Temperature:	18-22 °C
Relative Humidity:	45-48 %
ATM Pressure:	101-102 kPa

The testing was performed by Wei Sun on 2013-05-03 at 5 meter 3.

13.7 Summary of Test Results

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

Mode: Receiving			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range (MHz), Antenna**
-4.86	142.382	Horizontal	30-18000

13.8 Test Results

1) 30-1000 MHz, Measured at 3 meters

With AC/DC Adaptor

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (QP/Ave.)
31.62625	17.22	155	V	301	40	-22.78	QP
40.6135	10.61	119	V	53	40	-29.39	QP
49.15325	6	100	V	360	40	-34.00	QP
963.1473	23.07	292	H	269	54	-30.93	QP
199.5725	11.03	107	H	248	43.5	-32.47	QP

With POE

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (QP/Ave.)
142.382	38.64	186	H	37	43.5	-4.86	QP
186.0805	37.27	153	H	23	43.5	-6.23	QP
34.736	16.63	129	V	336	40	-23.37	QP
40.52075	12.49	201	V	360	40	-27.51	QP
151.5075	29.12	208	H	48	43.5	-14.38	QP
48.8795	10.87	103	V	1	40	-29.13	QP

2) Above 1 GHz Measured at 3 meters

With AC/DC Adaptor

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4800	30*	0	100	V	33.08	4.06	27.70	39.444	74	-34.556	Peak
4800	30*	0	100	H	33.08	4.06	27.70	39.444	74	-34.556	Peak
4800	18*	0	100	V	33.08	4.06	27.70	27.444	54	-26.556	Ave
4800	18*	0	100	H	33.08	4.06	27.70	27.444	54	-26.556	Ave

With POE

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
4800	30*	0	100	V	33.08	4.06	27.70	39.444	74	-34.556	Peak
4800	30*	0	100	H	33.08	4.06	27.70	39.444	74	-34.556	Peak
4800	18*	0	100	V	33.08	4.06	27.70	27.444	54	-26.556	Ave
4800	18*	0	100	H	33.08	4.06	27.70	27.444	54	-26.556	Ave

* Note: all the readings are in the level of noise floor.

14 FCC §15.407(b) & IC RSS-210 §A9.2 - Spurious Emissions at Antenna Terminals

14.1 Applicable Standard

According to FCC §15.407(b)

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

According to RSS-210 §A9.2 all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

14.2 Measurement Procedure

4) Procedure for Unwanted Emissions Measurements Below 1000 MHz.
a) Follow the requirements in section G)3), "General Requirements for Unwanted Emissions Measurements".
b) Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

6) Procedures for Average Unwanted Emissions Measurements above 1000 MHz.
a) Follow the requirements in section G)3), "General Requirements for Unwanted Emissions Measurements".
b) Average emission levels shall be measured using one of the following two methods.
c) Method AD (Average Detection): Primary method
(i) RBW = 1 MHz.
(ii) VBW ≥ 3 MHz.
(iii) Detector = RMS, if span/(# of points in sweep) ≤ RBW/2. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, the detector mode shall be set to peak.
(iv) Averaging type = power (i.e., RMS)
• As an alternative, the detector and averaging type may be set for linear voltage averaging. Some analyzers require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
(v) Sweep time = auto.
(vi) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 percent duty cycle, at least 200 traces should be averaged.
(vii) If tests are performed with the EUT transmitting at a duty cycle less than 98 percent, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
• If power averaging (RMS) mode was used in step (iv) above, the correction factor is10 log(1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 3 dB must be added to the measured emission levels.
• If linear voltage averaging mode was used in step (iv) above, the correction factor is 20 log(1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 6 dB must be added to the measured emission levels.

14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2012-09-29	1 year

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

14.4 Test Environmental Conditions

Temperature:	24 °C
Relative Humidity:	44 %
ATM Pressure:	101.3kPa

The testing was performed by Jeffrey Wu on 2013-04-20 in RF site.

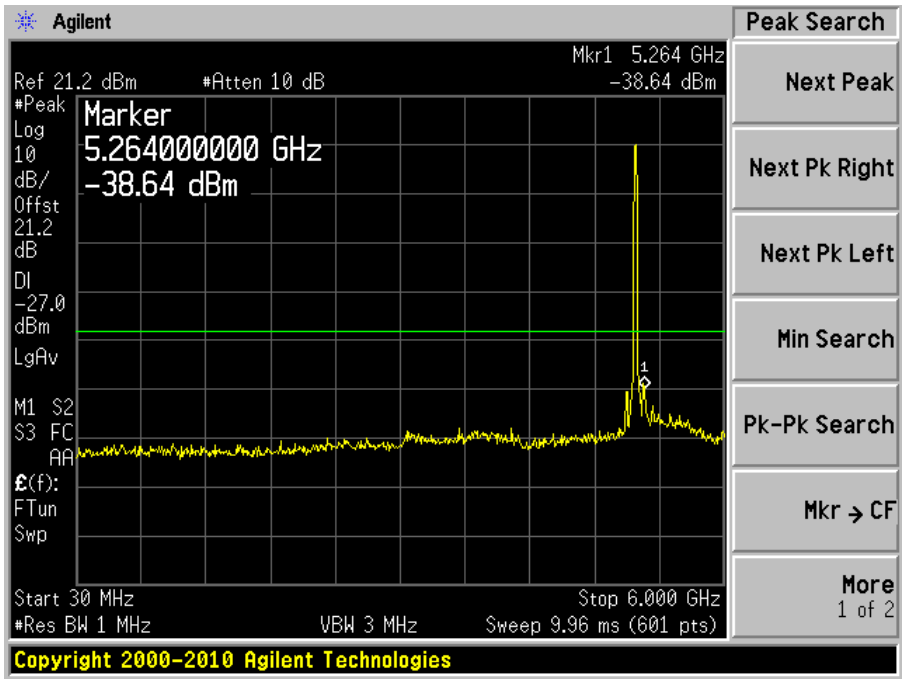
14.5 Test Results

Please refer to following plots of spurious emissions.

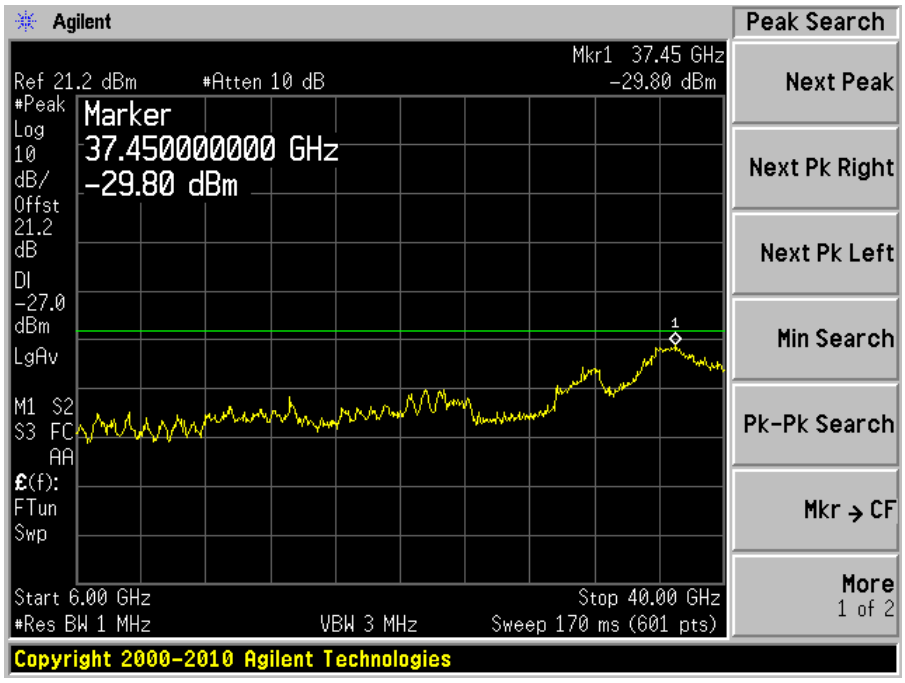
5150-5250 MHz Band

802.11a mode, Low Channel

30 MHz – 6 GHz

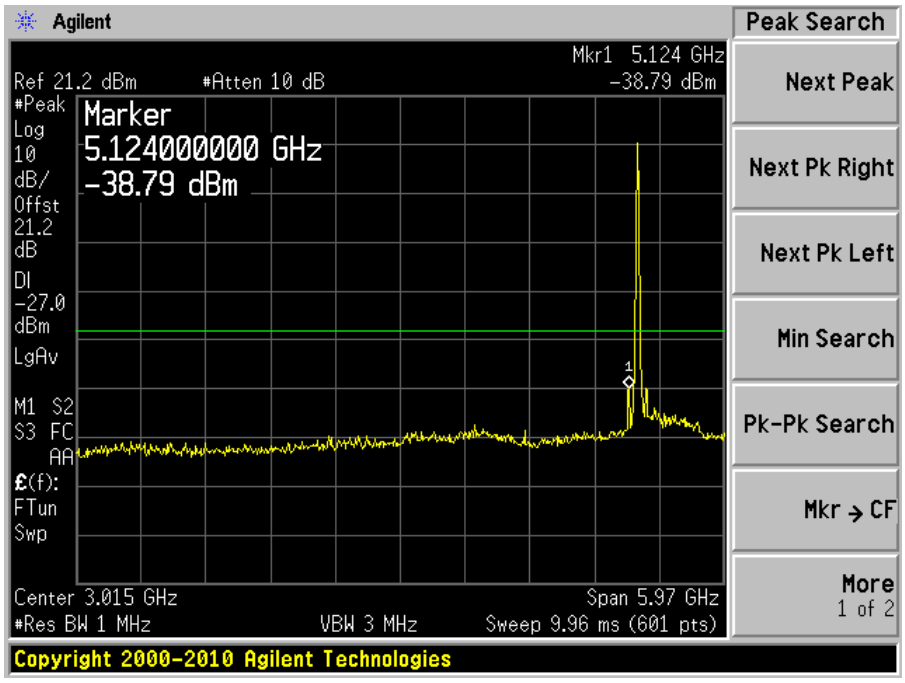


6 GHz – 40 GHz

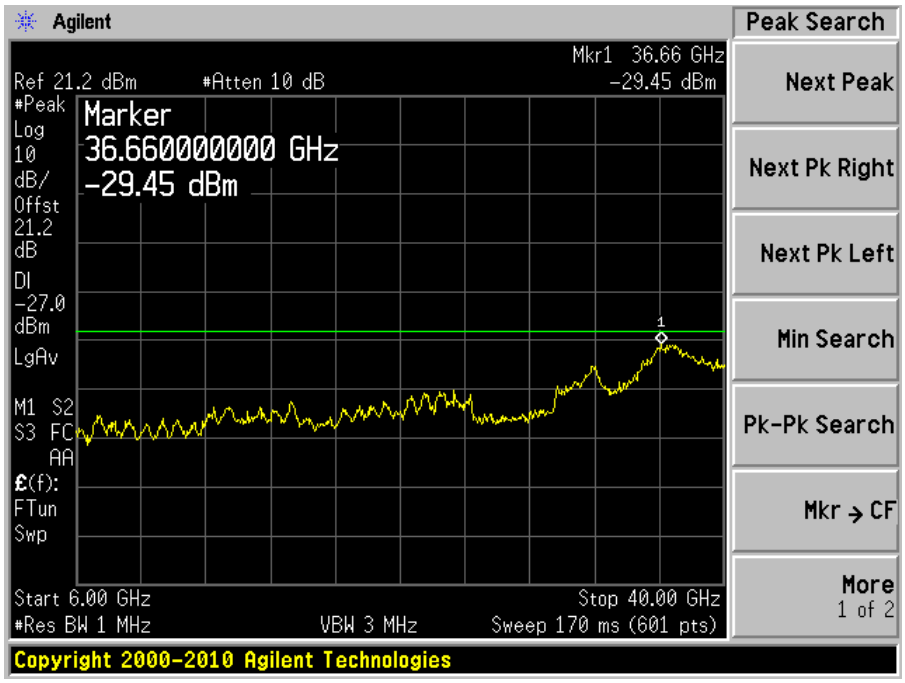


802.11a mode, Middle Channel

30 MHz – 6 GHz

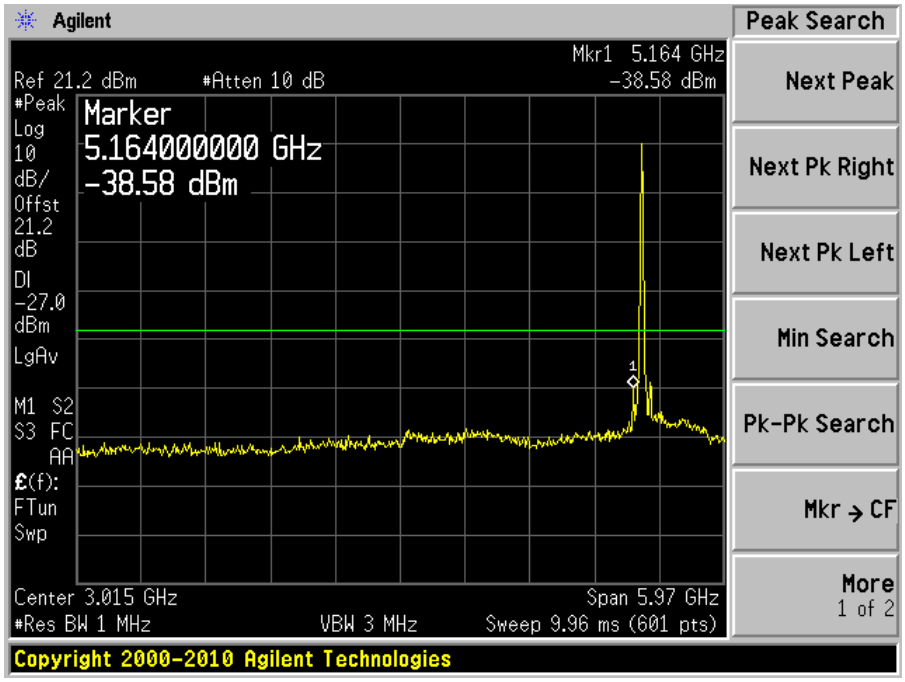


6 GHz – 40 GHz

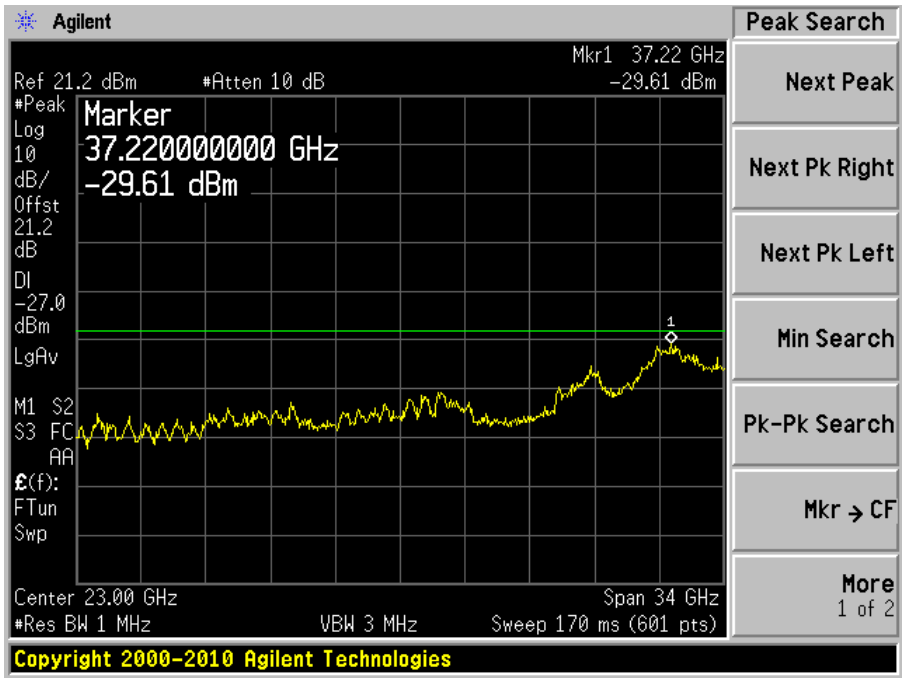


802.11a mode, High Channel

30 MHz – 6 GHz

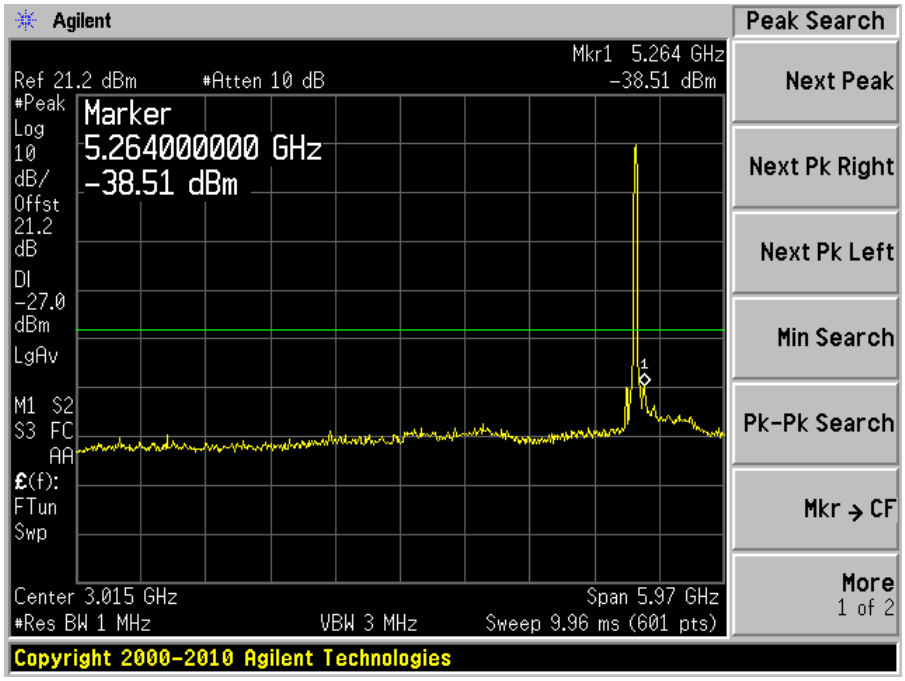


6 GHz – 40 GHz

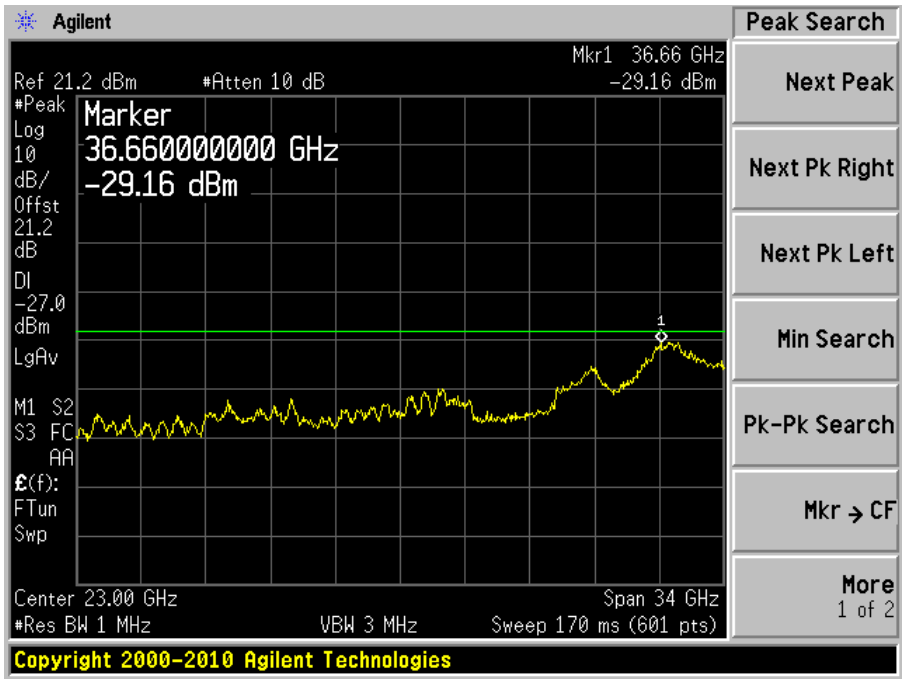


802.11n HT20 mode, Low channel

30 MHz – 6 GHz

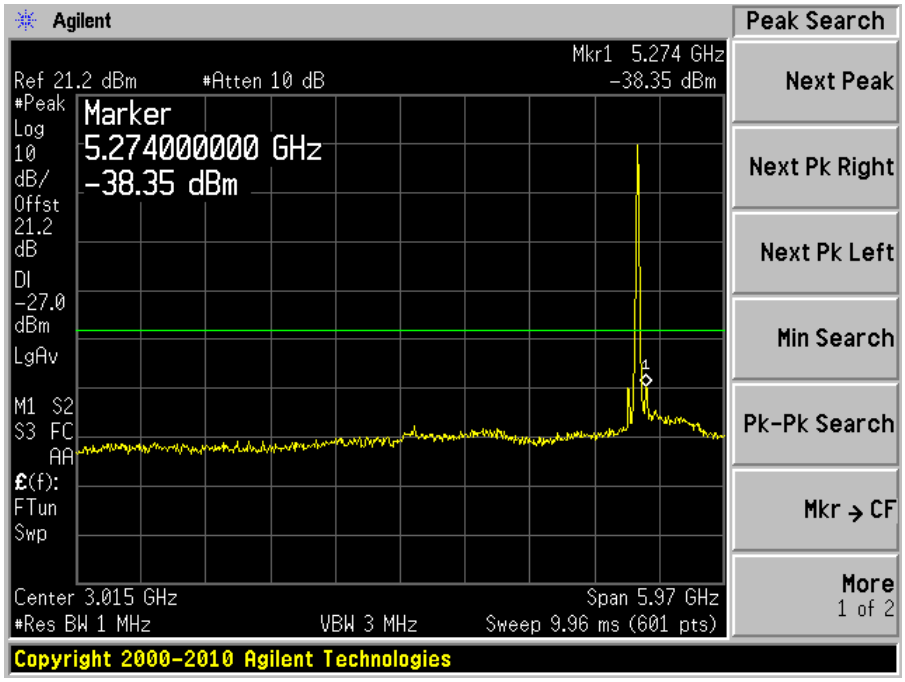


6 GHz – 40 GHz

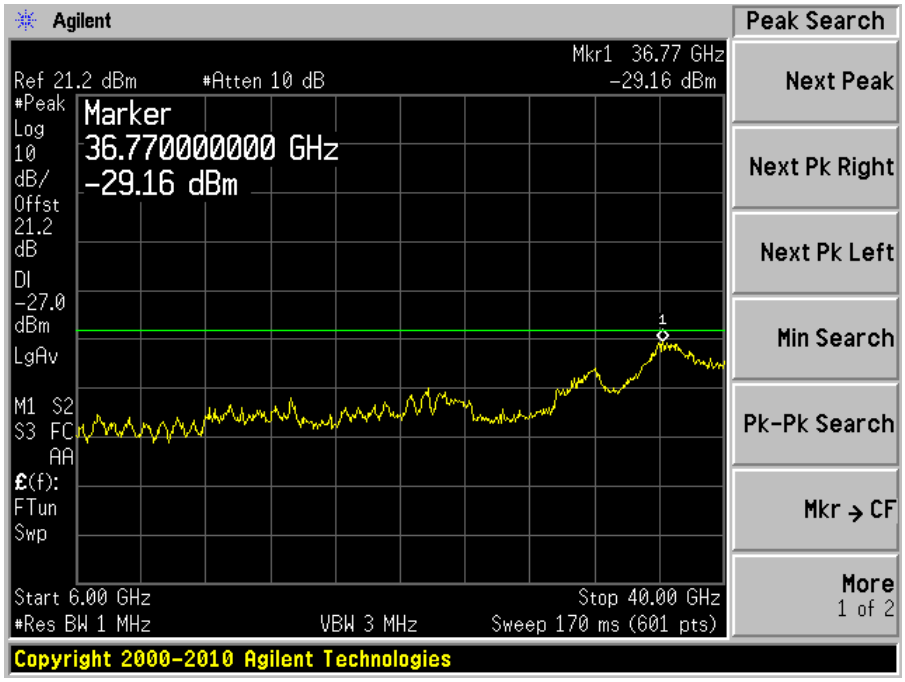


802.11n HT20 mode, Middle Channel

30 MHz – 6 GHz

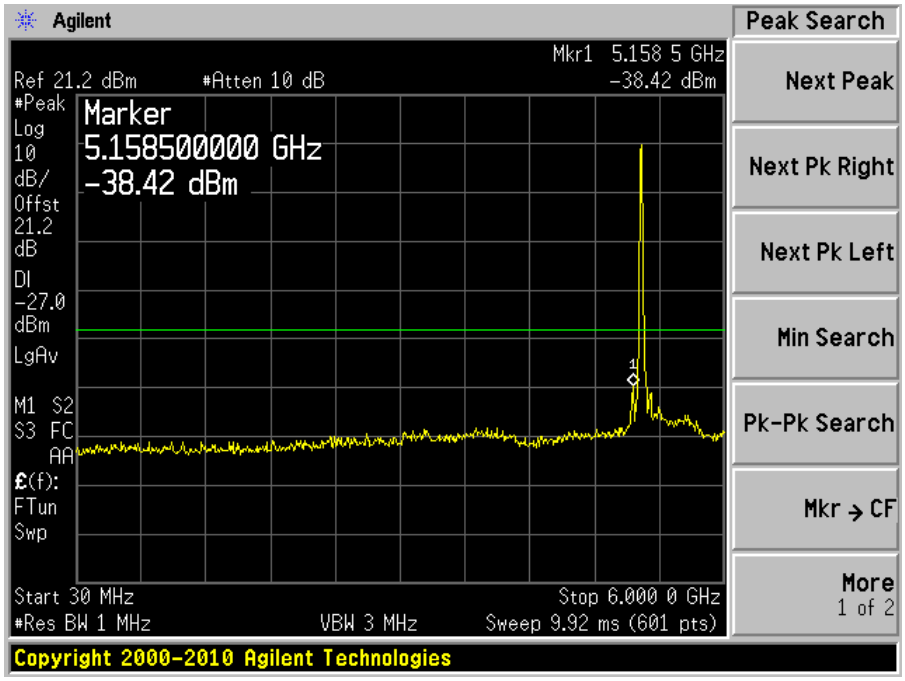


6 GHz – 40 GHz

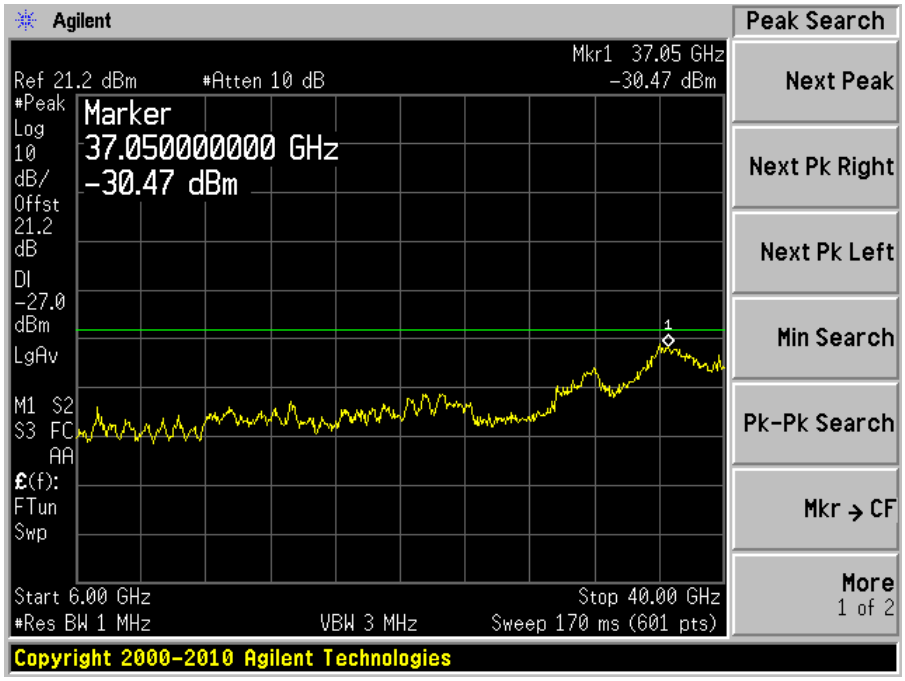


802.11n HT20 mode, High Channel

30 MHz – 6 GHz

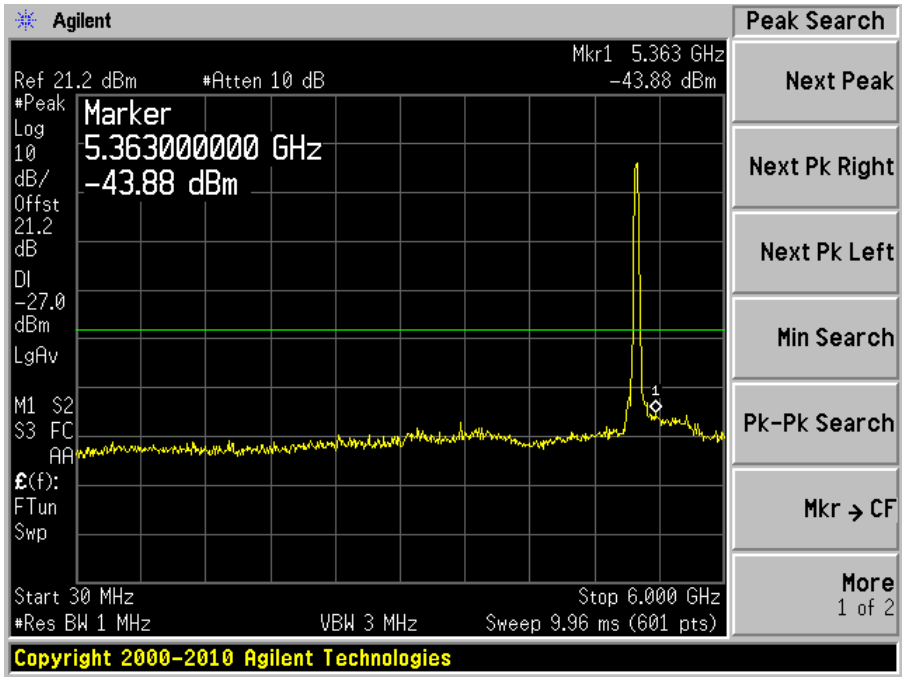


6 GHz – 40 GHz

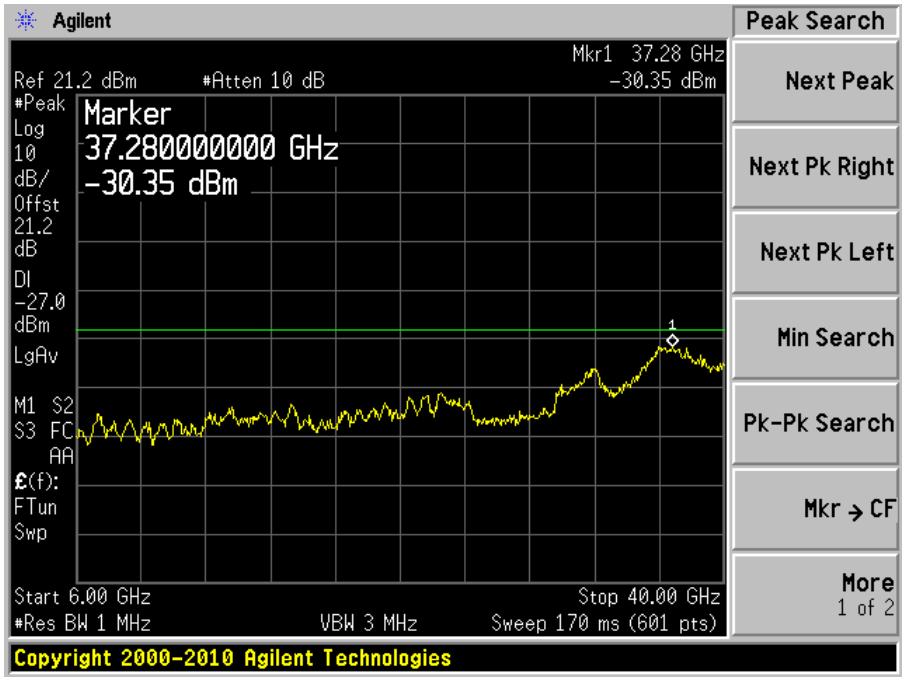


802.11n HT40 mode, Low channel

30 MHz – 6 GHz

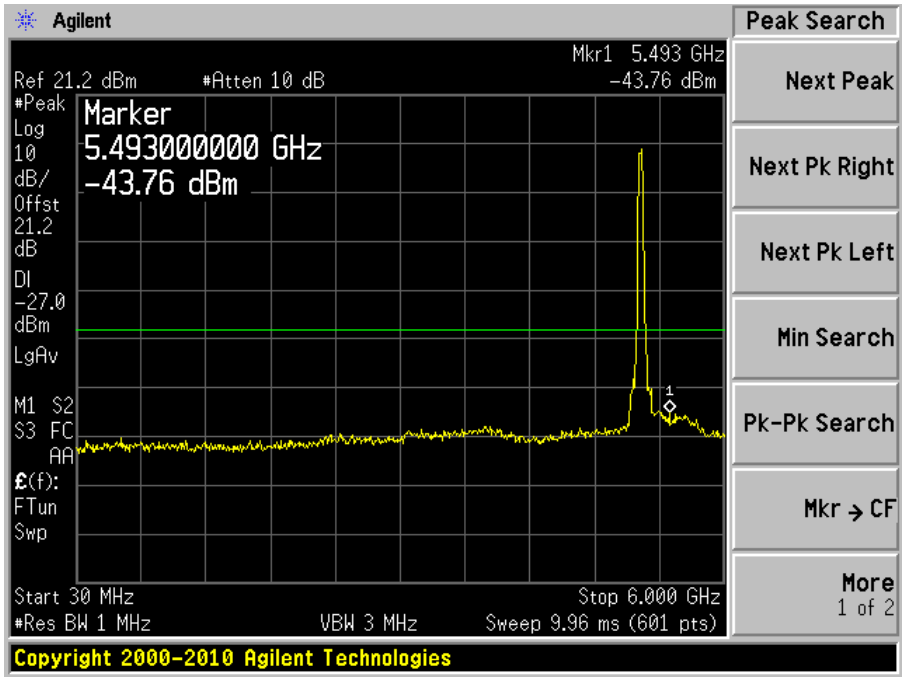


6 GHz – 40 GHz



802.11n HT40 mode, High Channel

30 MHz – 6 GHz



6 GHz – 40 GHz