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TEST AND MEASUREMENT REPORT

For

Marvell Semiconductor, Inc.

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FCC ID: UAYK402
IC: 6549A-K402

Report Type:	**Product Type:**
Original Report	Software Development with Wi-Fi and BLE Technology

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1506088-407	Original Report	2015-09-09

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report has been compiled on behalf of *Marvell Semiconductor, Inc.* and their product, FCC ID: UAYK402; IC: 6549A-K402; model number: K4-02, which henceforth is referred to as the EUT (Equipment under Test.) The EUT is a Software Development Kit with 2.4/5 GHz Wi-Fi and BLE technology.

1.2 Mechanical Description of EUT

The EUT measures approximately 125mm (L) x 125 mm (W) x 30 mm (H) and weighs approximately 300 g.

The data gathered are from a typical production sample provided by the manufacturer with serial number: R1506088-01 provided by BACL corp.

1.3 Objective

This report is prepared on behalf of *Marvell Semiconductor, Inc in* accordance with FCC CFR47 §15.407 and IC RSS-247 Issue 1, May 2015.

The objective is to determine compliance with FCC Part 15.407 and IC RSS-247 rules for Output Power, Antenna Requirements, AC Line Conducted Emissions, Emission Bandwidth, Power spectral density, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

DTS application with FCC ID: UAYK402 and IC: 6549A-K402.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz, and FCC KDB 789033 D02 General UNII Test Procedure v01.

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 CISPR16-4-2:2011, 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

Bay area compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminares and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 C63.4-2009, 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 C63.10-2013.

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 software "Labtool" is provided by customer. The EUT exercise program used during testing was designed to exercise the system components.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
DELL	Laptop	Latitude E6530	-

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model
Marvell	Create Main Board	94v-0 1520mv
Marvell Kinoma	PCB Board	KAR4 – LCD - MT

2.6 Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number
JHD	Power Adapter	JHD-AP012U	050200AB

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	1.5	Laptop	EUT

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 §8.3	Antenna Requirement	Compliant
FCC §15.207 IC RSS-Gen §8.8	AC Power Line Conducted Emissions	Compliant
FCC §15.209(a), 15.407(b) IC RSS-247	Spurious Radiated Emissions	Compliant
FCC §15.407(a) IC RSS-Gen §6.6 (a)	Emission Bandwidth	Compliant
FCC §407(a) IC RSS-247 §6.2	Output Power	Compliant
FCC §2.1051, §15.407(b) IC RSS-247 §6.2	Band Edges	Compliant
FCC §15.407(a) IC RSS-247 §6.2	Power Spectral Density	Compliant
FCC §2.1051, §15.407(b) IC RSS-247 §6.2	Spurious Emissions at Antenna Terminals	Compliant
FCC §15.407(h) IC RSS-247 §6.3	Dynamic Frequency Selection (DFS)	N/A

4 FCC §2.1091, §15.407(f) & 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

According to IC RSS-102 Issue 5 section 4, 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)	Reference Period (minutes)
$0.003\text{-}10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

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):	10.92
Maximum peak output power at antenna input terminal (mW):	12.36
Prediction distance (cm):	20
Prediction frequency (MHz):	5210
Maximum Antenna Gain, typical (dBi):	0.3
Maximum Antenna Gain (numeric):	1.07
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0026
Power density of prediction frequency at 20.0 cm (W/m^2):	0.026
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
IC MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	9.08

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0026 mW/cm^2 (0.026 W/m^2). Limit is 1.0 mW/cm^2 (9.08 W/m^2).

5 FCC §15.203 & IC RSS-Gen §8.3 - Antenna Requirements

5.1 Applicable Standards

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 §8.3: Transmitter Antenna

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. [9] 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 a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

5.2 Antenna List

Antenna Type	Manufacturer	Peak Antenna Gain (dBi) @ 5 GHz
Chip Antenna	Johanson Technology	0.3

6 FCC §15.207 & IC RSS-Gen §8.8 - AC Power Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 & IC RSS GEN §8.8

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 C63.10-2013 measurement procedure. The specification used was FCC §15.207 limits & & IC RSS GEN §8.8.

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

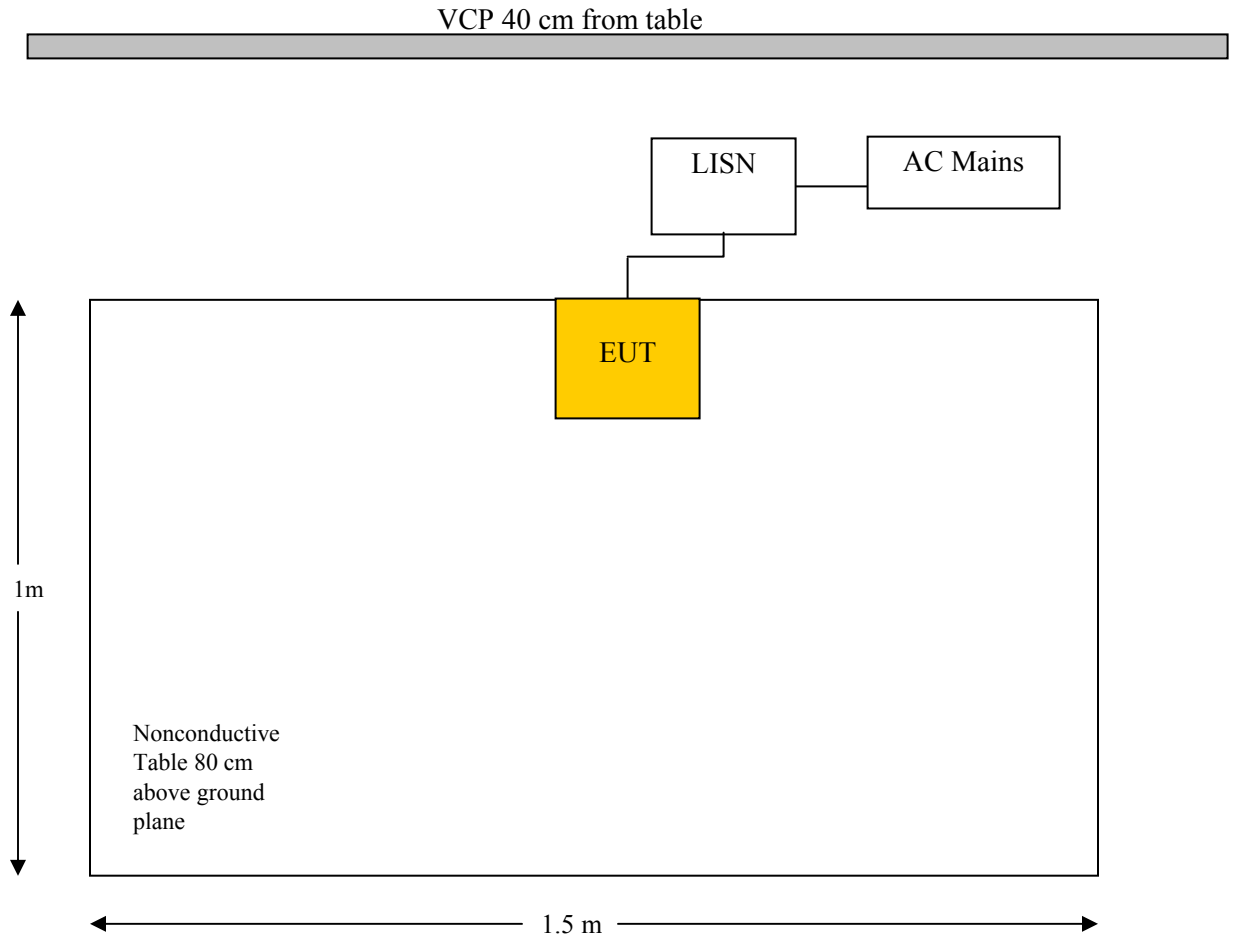
During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cord of the support equipment was connected to LISN-2.

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:



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	100337	2014-09-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	160131	2015-07-04	1 year
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2015-01-30	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	Cal. Not Required	N/A
Hewlett-Packard	5 ft N-type RF cable	-	1268	Cal. Not Required	N/A

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:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at 5 meter 3.

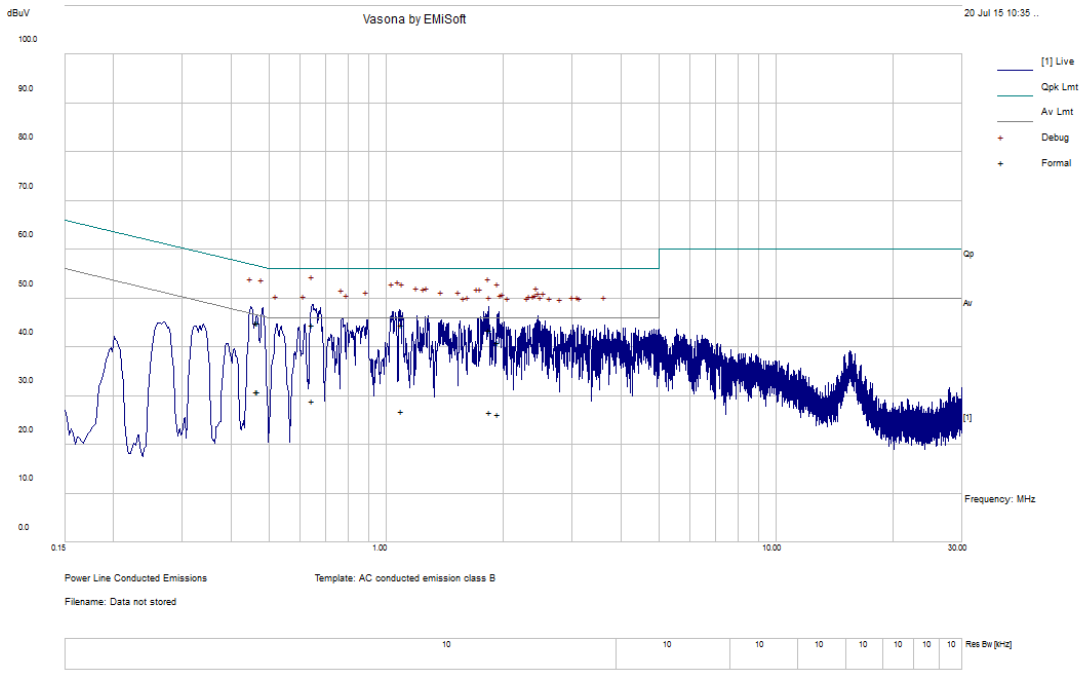
6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC Part 15 and RSS-Gen standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-11.36	0.469117	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

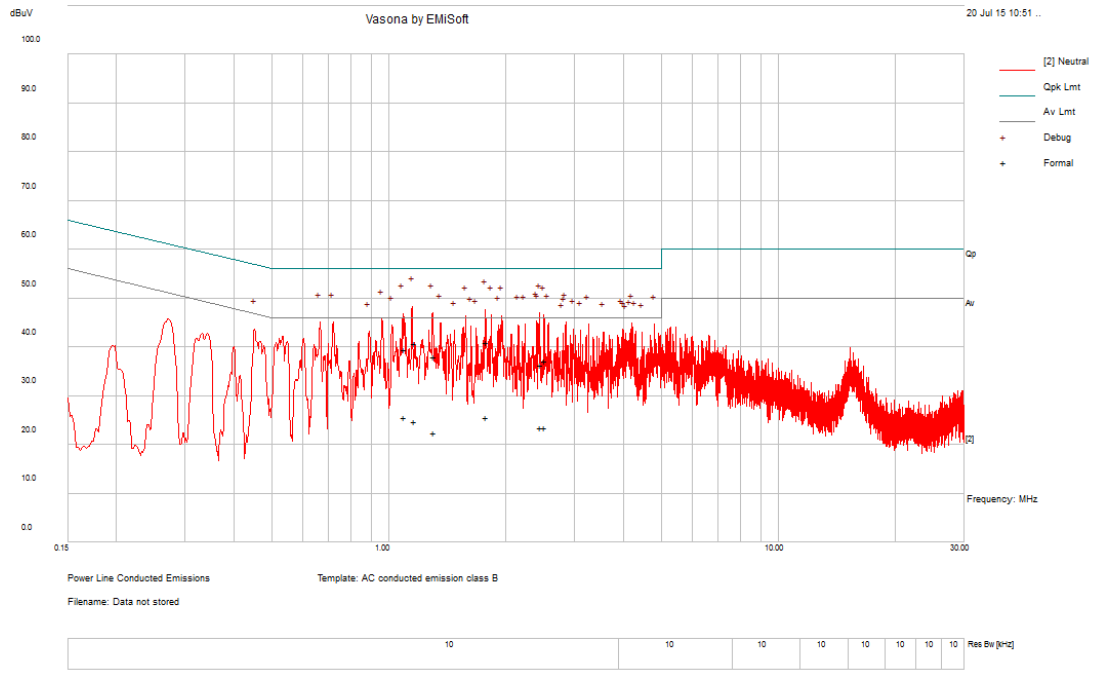
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.469117	45.17	Line	56.53	-11.36	QP
0.648341	44.63	Line	56	-11.37	QP
1.097019	44.58	Line	56	-11.42	QP
0.467932	45.05	Line	56.55	-11.50	QP
1.847574	43.58	Line	56	-12.42	QP
1.938228	41.12	Line	56	-14.88	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.467932	30.97	Line	46.55	-15.58	Ave.
0.469117	30.89	Line	46.53	-15.64	Ave.
0.648341	29.07	Line	46	-16.93	Ave.
1.097019	27.05	Line	46	-18.95	Ave.
1.847574	26.65	Line	46	-19.35	Ave.
1.938228	26.33	Line	46	-19.67	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
1.776166	41.16	Neutral	56	-14.84	QP
1.165629	40.92	Neutral	56	-15.08	QP
1.09682	39.68	Neutral	56	-16.32	QP
1.305162	38.11	Neutral	56	-17.89	QP
2.519982	37.24	Neutral	56	-18.76	QP
2.452032	36.39	Neutral	56	-19.61	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
1.09682	25.71	Neutral	46	-20.29	Ave.
1.776166	25.69	Neutral	46	-20.31	Ave.
1.165629	24.93	Neutral	46	-21.07	Ave.
2.519982	23.58	Neutral	46	-22.42	Ave.
2.452032	23.50	Neutral	46	-22.50	Ave.
1.305162	22.63	Neutral	46	-23.37	Ave.

7 FCC §15.209, §15.407(b) & IC RSS-247 - 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.

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 Part 15.407 (b)

(1) 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 e.i.r.p. of −27 dBm/MHz.

(2) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(3) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

As per RSS-247 §6.2.1

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250- 5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.407 and IC RSS-247 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 were 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 1.5 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 = 3MHz / Sweep = 100ms
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

7.4 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 for Class A. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-09-28	1 year
Agilent	Spectrum Analyzer	E4446A	US44300386	2014-10-24	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2014-09-18	1 year
EMCO	Horn Antenna	DRG-118/A	1132	2015-02-19	1 year
Hewlett Packard	Pre-amplifier	8449B	3008A01978	2015-05-19	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2014-08-09	3 Years
Suirong	30 ft conductive emission cable	LMR 400	-	2015-03-05	1 year
-	SMA cable	-	C0001	Each time[1]	N/A
IW Microwave (UTiFLEX)	High Frequency Cable	223458-002	223458-001	2015-05-29	1 year
IW Microwave	High Frequency cable	223458-002	223458-002	2015-05-29	1 year
Agilent	Pre-Amplifier	8449B	3008A01978	2015-03-11	1year
MICRO -TRONICS	Band Reject	BRM50701	160	N/A	N/A

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

7.6 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at 5 meter 3.
Note: the EUT was tested in the worst case orientation (flat).

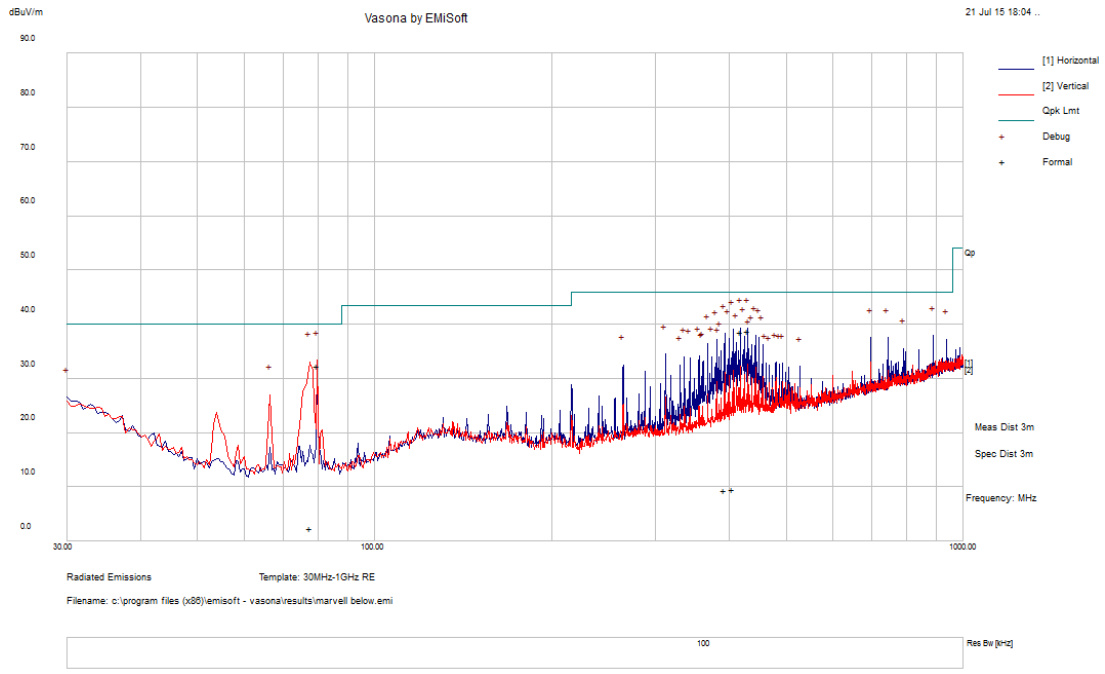
7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range**
-7.15	430.5608	Horizontal	30 - 1000 MHz
-0.161	5150	Vertical	1 - 40 GHz

7.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments (PK/QP/Ave.)
430.5608	38.85	99	H	71	46	-7.15	QP
405.7185	38.75	196	H	8	46	-7.25	QP
418.0803	38.71	101	H	83	46	-7.29	QP
79.99125	32.37	264	V	42	40	-7.63	QP
393.3393	37.53	134	H	337	46	-8.47	QP
77.767	30.41	100	V	273	40	-9.59	QP

2) 1–40 GHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	54.3	318	100	V	34.819	10.640	-	99.759	-	-	PK
5180	59.01	110	150	H	34.428	10.640	-	104.078	-	-	PK
5180	43.42	318	100	V	34.819	10.640	-	88.879	-	-	Ave
5180	47.87	110	150	H	34.428	10.640	-	92.938	-	-	Ave
5150	23.54	318	100	V	34.819	10.64	-	68.999	74	-5.001	PK
5150	23.56	110	150	H	34.428	10.64	-	68.628	74	-5.372	PK
5150	8.15	318	100	V	34.819	10.64	-	53.609	54	-0.391	Ave
5150	8.07	110	150	H	34.428	10.64	-	53.138	54	-0.862	Ave
10360	47.37	323	100	V	33.842	9.720	36.13	54.802	68.26	-13.458	PK
10360	47.07	115	148	H	33.795	9.720	36.13	54.455	68.26	-13.805	PK
10360	33.07	323	100	V	33.842	9.720	36.13	40.502	54	-13.498	Ave
10360	33.07	115	148	H	33.795	9.720	36.13	40.455	54	-13.545	Ave
15540	45.5	321	100	V	39.024	11.860	33.18	63.204	68.26	-5.056	PK
15540	45.42	121	147	H	39.118	11.860	33.18	63.218	68.26	-5.042	PK
15540	30.53	321	100	V	39.024	11.860	33.18	48.234	54	-5.766	Ave
15540	30.57	121	147	H	39.118	11.860	33.18	48.368	54	-5.632	Ave
Middle Channel 5200 MHz											
5200	54.18	317	100	V	34.757	10.640	-	99.577	-	-	PK
5200	58.31	144	137	H	34.746	10.640	-	103.696	-	-	PK
5200	43.3	317	100	V	34.757	10.640	-	88.697	-	-	Ave
5200	47.01	144	137	H	34.746	10.640	-	92.396	-	-	Ave
10400	47.63	330	100	V	33.842	9.720	36.13	55.062	68.26	-13.198	PK
10400	47.65	116	142	H	33.795	9.720	36.13	55.035	68.26	-13.225	PK
10400	32.68	330	100	V	33.842	9.720	36.13	40.112	54	-13.888	Ave
10400	32.67	116	142	H	33.795	9.720	36.13	40.055	54	-13.945	Ave
15600	45.19	330	100	V	39.024	11.860	33.18	62.894	68.26	-5.366	PK
15600	46.19	123	144	H	39.118	11.860	33.18	63.988	68.26	-4.272	PK
15600	30.76	330	100	V	39.024	11.860	33.18	48.464	54	-5.536	Ave
15600	30.77	123	144	H	39.118	11.860	33.18	48.568	54	-5.432	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 5240 MHz											
5240	53.42	323	100	V	34.757	10.640	-	98.817	-	-	PK
5240	58.81	103	147	H	34.905	10.640	-	104.355	-	-	PK
5240	41.81	323	100	V	34.757	10.640	-	87.207	-	-	Ave
5240	47.5	103	147	H	34.905	10.640	-	93.045	-	-	Ave
5416	23.08	323	100	V	34.757	10.64	-	68.477	74	-5.523	PK
5369	23.18	103	147	H	34.905	10.64	-	68.725	74	-5.275	PK
5400	8.09	323	100	V	34.757	10.64	-	53.487	54	-0.513	Ave
5398	8.11	103	147	H	34.905	10.64	-	53.655	54	-0.345	Ave
10480	47.84	328	100	V	33.873	9.720	36.13	55.303	68.26	-12.957	PK
10480	47.51	122	149	H	33.888	9.720	36.13	54.988	68.26	-13.272	PK
10480	47.84	328	100	V	33.873	9.720	36.13	55.303	54	1.303	Ave
10480	32.9	122	149	H	33.888	9.720	36.13	40.378	54	-13.622	Ave
15720	45.66	320	100	V	39.043	11.860	33.18	63.383	68.26	-4.877	PK
15720	45.56	124	144	H	39.117	11.860	33.18	63.357	68.26	-4.903	PK
15720	30.52	320	100	V	39.043	11.860	33.18	48.243	54	-5.757	Ave
15720	30.68	124	144	H	39.117	11.860	33.18	48.477	54	-5.523	Ave

802.11n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	54.04	316	100	V	34.819	10.640	-	99.499	-	-	PK
5180	58.91	112	117	H	34.428	10.640	-	103.978	-	-	PK
5180	42.23	316	100	V	34.819	10.640	-	87.689	-	-	Ave
5180	46.38	112	117	H	34.428	10.640	-	91.448	-	-	Ave
5150	23.89	316	100	V	34.819	10.64	-	69.349	74	-4.651	PK
5150	23.58	112	117	H	34.428	10.64	-	68.648	74	-5.352	PK
5150	8.16	316	100	V	34.819	10.64	-	53.619	54	-0.381	Ave
5150	8.22	112	117	H	34.428	10.64	-	53.288	54	-0.712	Ave
10360	46.73	319	100	V	33.842	9.720	36.13	54.162	68.26	-14.098	PK
10360	46.8	119	126	H	33.795	9.720	36.13	54.185	68.26	-14.075	PK
10360	31.77	319	100	V	33.842	9.720	36.13	39.202	54	-14.798	Ave
10360	31.85	119	126	H	33.795	9.720	36.13	39.235	54	-14.765	Ave
15540	45.26	313	100	V	39.024	11.860	33.18	62.964	68.26	-5.296	PK
15540	45.62	106	121	H	39.118	11.860	33.18	63.418	68.26	-4.842	PK
15540	30.56	313	100	V	39.024	11.860	33.18	48.264	54	-5.736	Ave
15540	30.58	106	121	H	39.118	11.860	33.18	48.378	54	-5.622	Ave
Middle Channel 5200 MHz											
5200	53.48	331	100	V	34.757	10.640	-	98.877	-	-	PK
5200	59.67	138	121	H	34.746	10.640	-	105.056	-	-	PK
5200	41.95	331	100	V	34.757	10.640	-	87.347	-	-	Ave
5200	47.56	138	121	H	34.746	10.640	-	92.946	-	-	Ave
10400	45.7	326	100	V	33.842	9.720	36.13	53.132	68.26	-15.128	PK
10400	46.15	122	118	H	33.795	9.720	36.13	53.535	68.26	-14.725	PK
10400	31.27	326	100	V	33.842	9.720	36.13	38.702	54	-15.298	Ave
10400	31.28	122	118	H	33.795	9.720	36.13	38.665	54	-15.335	Ave
15600	45.61	316	100	V	39.024	11.860	33.18	63.314	68.26	-4.946	PK
15600	45.11	131	124	H	39.118	11.860	33.18	62.908	68.26	-5.352	PK
15600	30.7	316	100	V	39.024	11.860	33.18	48.404	54	-5.596	Ave
15600	30.72	131	124	H	39.118	11.860	33.18	48.518	54	-5.482	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 5240 MHz											
5240	53.6	321	100	V	34.757	10.640	-	98.997	-	-	PK
5240	58.37	117	135	H	34.905	10.640	-	103.915	-	-	PK
5240	42.14	321	100	V	34.757	10.640	-	87.537	-	-	Ave
5240	46.72	117	135	H	34.905	10.640	-	92.265	-	-	Ave
5453	23.49	321	100	V	34.757	10.64	-	68.887	74	-5.113	PK
5411	23.33	117	135	H	34.905	10.64	-	68.875	74	-5.125	PK
5350	8.18	321	100	V	34.757	10.64	-	53.577	54	-0.423	Ave
5411	8.27	117	135	H	34.905	10.64	-	53.815	54	-0.185	Ave
10480	46	322	100	V	33.873	9.720	36.13	53.463	68.26	-14.797	PK
10480	46.13	128	126	H	33.888	9.720	36.13	53.608	68.26	-14.652	PK
10480	31.38	322	100	V	33.873	9.720	36.13	38.843	54	-15.157	Ave
10480	31.4	128	126	H	33.888	9.720	36.13	38.878	54	-15.122	Ave
15720	45.08	317	100	V	39.043	11.860	33.18	62.803	68.26	-5.457	PK
15720	45.39	125	126	H	39.117	11.860	33.18	63.187	68.26	-5.073	PK
15720	30.56	317	100	V	39.043	11.860	33.18	48.283	54	-5.717	Ave
15720	30.53	125	126	H	39.117	11.860	33.18	48.327	54	-5.673	Ave

802.11n40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5190 MHz											
5190	49.77	330	100	V	34.819	10.640	-	95.229	-	-	PK
5190	55.7	122	121	H	34.428	10.640	-	100.768	-	-	PK
5190	37.99	330	100	V	34.819	10.640	-	83.449	-	-	Ave
5190	44.24	122	121	H	34.428	10.640	-	89.308	-	-	Ave
5150	24.11	330	100	V	34.819	10.64	-	69.569	74	-4.431	PK
5150	24.29	122	121	H	34.428	10.64	-	69.358	74	-4.642	PK
5150	8.19	330	100	V	34.819	10.64	-	53.649	54	-0.351	Ave
5150	8.23	122	121	H	34.428	10.64	-	53.298	54	-0.702	Ave
10380	46.13	328	100	V	33.842	9.720	36.13	53.562	68.26	-14.698	PK
10380	45.79	123	120	H	33.795	9.720	36.13	53.175	68.26	-15.085	PK
10380	31.11	328	100	V	33.842	9.720	36.13	38.542	54	-15.458	Ave
10380	31.12	123	120	H	33.795	9.720	36.13	38.505	54	-15.495	Ave
15570	45.59	330	100	V	39.024	11.860	33.18	63.294	68.26	-4.966	PK
15570	45.56	119	122	H	39.118	11.860	33.18	63.358	68.26	-4.902	PK
15570	30.59	330	100	V	39.024	11.860	33.18	48.294	54	-5.706	Ave
15570	30.56	119	122	H	39.118	11.860	33.18	48.358	54	-5.642	Ave
High Channel 5230 MHz											
5230	50.03	320	100	V	34.757	10.640	-	95.427	-	-	PK
5230	54.87	117	169	H	34.905	10.640	-	100.415	-	-	PK
5230	38.3	320	100	V	34.757	10.640	-	83.697	-	-	Ave
5230	43.25	117	169	H	34.905	10.640	-	88.795	-	-	Ave
5454	23.44	320	100	V	34.757	10.64	-	68.837	74	-5.163	PK
5396	23.19	117	169	H	34.905	10.64	-	68.735	74	-5.265	PK
5404	8.13	320	100	V	34.757	10.64	-	53.527	54	-0.473	Ave
5402	8.09	117	169	H	34.905	10.64	-	53.635	54	-0.365	Ave
10460	46.23	318	100	V	33.873	9.720	36.13	53.693	68.26	-14.567	PK
10460	46.21	176	122	H	33.888	9.720	36.13	53.688	68.26	-14.572	PK
10460	31.44	318	100	V	33.873	9.720	36.13	38.903	54	-15.097	Ave
10460	31.46	176	122	H	33.888	9.720	36.13	38.938	54	-15.062	Ave
15690	45.17	318	100	V	39.043	11.860	33.18	62.893	68.26	-5.367	PK
15690	45.55	135	124	H	39.117	11.860	33.18	63.347	68.26	-4.913	PK
15690	30.52	318	100	V	39.043	11.860	33.18	48.243	54	-5.757	Ave
15690	30.49	135	124	H	39.117	11.860	33.18	48.287	54	-5.713	Ave

802.11ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	53.29	325	100	V	34.819	10.640	-	98.749	-	-	PK
5180	58.86	122	160	H	34.428	10.640	-	103.928	-	-	PK
5180	42.25	325	100	V	34.819	10.640	-	87.709	-	-	Ave
5180	47.34	122	160	H	34.428	10.640	-	92.408	-	-	Ave
5150	23.1	325	100	V	34.819	10.64	-	68.559	74	-5.441	PK
5150	23.59	122	160	H	34.428	10.64	-	68.658	74	-5.342	PK
5150	8.38	325	100	V	34.819	10.64	-	53.839	54	-0.161	Ave
5150	8.29	122	160	H	34.428	10.64	-	53.358	54	-0.642	Ave
10360	45.87	318	100	V	33.842	9.720	36.13	53.302	68.26	-14.958	PK
10360	46.69	132	156	H	33.795	9.720	36.13	54.075	68.26	-14.185	PK
10360	31.15	318	100	V	33.842	9.720	36.13	38.582	54	-15.418	Ave
10360	31.13	132	156	H	33.795	9.720	36.13	38.515	54	-15.485	Ave
15540	45.06	326	100	V	39.024	11.860	33.18	62.764	68.26	-5.496	PK
15540	45.49	141	148	H	39.118	11.860	33.18	63.288	68.26	-4.972	PK
15540	31.09	326	100	V	39.024	11.860	33.18	48.794	54	-5.206	Ave
15540	31.1	141	148	H	39.118	11.860	33.18	48.898	54	-5.102	Ave
Middle Channel 5200 MHz											
5200	53.52	339	100	V	34.757	10.640	-	98.917	-	-	PK
5200	57.92	156	146	H	34.746	10.640	-	103.306	-	-	PK
5200	41.41	339	100	V	34.757	10.640	-	86.807	-	-	Ave
5200	46.84	156	146	H	34.746	10.640	-	92.226	-	-	Ave
10400	45.73	328	100	V	33.842	9.720	36.13	53.162	68.26	-15.098	PK
10400	46.15	124	152	H	33.795	9.720	36.13	53.535	68.26	-14.725	PK
10400	31.82	328	100	V	33.842	9.720	36.13	39.252	54	-14.748	Ave
10400	31.18	124	152	H	33.795	9.720	36.13	38.565	54	-15.435	Ave
15600	45.22	327	100	V	39.024	11.860	33.18	62.924	68.26	-5.336	PK
15600	45.26	119	164	H	39.118	11.860	33.18	63.058	68.26	-5.202	PK
15600	30.68	327	100	V	39.024	11.860	33.18	48.384	54	-5.616	Ave
15600	31.08	119	164	H	39.118	11.860	33.18	48.878	54	-5.122	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 5240 MHz											
5240	52.39	319	100	V	34.757	10.640	-	97.787	-	-	PK
5240	58.38	118	160	H	34.905	10.640	-	103.925	-	-	PK
5240	41.33	319	100	V	34.757	10.640	-	86.727	-	-	Ave
5240	46.67	118	160	H	34.905	10.640	-	92.215	-	-	Ave
5389	23.1	319	100	V	34.757	10.64	-	68.497	74	-5.503	PK
5404	22.59	118	160	H	34.905	10.64	-	68.135	74	-5.865	PK
5391	8.22	319	100	V	34.757	10.64	-	53.617	54	-0.383	Ave
5399	8.13	118	160	H	34.905	10.64	-	53.675	54	-0.325	Ave
10480	46.18	314	100	V	33.873	9.720	36.13	53.643	68.26	-14.617	PK
10480	45.7	122	159	H	33.888	9.720	36.13	53.178	68.26	-15.082	PK
10480	31.13	314	100	V	33.873	9.720	36.13	38.593	54	-15.407	Ave
10480	31.08	122	159	H	33.888	9.720	36.13	38.558	54	-15.442	Ave
15720	45.19	303	100	V	39.043	11.860	33.18	62.913	68.26	-5.347	PK
15720	45.99	128	156	H	39.117	11.860	33.18	63.787	68.26	-4.473	PK
15720	30.51	303	100	V	39.043	11.860	33.18	48.233	54	-5.767	Ave
15720	30.98	128	156	H	39.117	11.860	33.18	48.777	54	-5.223	Ave

802.11ac40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5190 MHz											
5190	61.27	322	100	V	34.819	5.260	-	101.349	-	-	PK
5190	61.65	102	147	H	34.428	5.260	-	101.338	-	-	PK
5190	45.33	322	100	V	34.819	5.260	-	85.409	-	-	Ave
5190	50.71	102	147	H	34.428	5.260	-	90.398	-	-	Ave
5150	29.5	322	100	V	34.819	5.26	-	69.579	74	-4.421	PK
5150	28.98	102	147	H	34.428	5.26	-	68.668	74	-5.332	PK
5150	13.51	322	100	V	34.819	5.26	-	53.589	54	-0.411	Ave
5150	13.43	102	147	H	34.428	5.26	-	53.118	54	-0.882	Ave
10380	46.62	322	100	V	33.842	9.720	36.13	54.052	68.26	-14.208	PK
10380	45.44	121	130	H	33.795	9.720	36.13	52.825	68.26	-15.435	PK
10380	31.02	322	100	V	33.842	9.720	36.13	38.452	54	-15.548	Ave
10380	31.03	121	130	H	33.795	9.720	36.13	38.415	54	-15.585	Ave
15570	45.43	326	100	V	39.024	11.860	33.18	63.134	68.26	-5.126	PK
15570	45.52	112	131	H	39.118	11.860	33.18	63.318	68.26	-4.942	PK
15570	30.64	326	100	V	39.024	11.860	33.18	48.344	54	-5.656	Ave
15570	30.71	112	131	H	39.118	11.860	33.18	48.508	54	-5.492	Ave
High Channel 5230 MHz											
5230	55.96	305	100	V	34.757	5.260	-	95.977	-	-	PK
5230	61.64	95	151	H	34.905	5.260	-	101.805	-	-	PK
5230	44.79	305	100	V	34.757	5.260	-	84.807	-	-	Ave
5230	50.7	95	151	H	34.905	5.260	-	90.865	-	-	Ave
5454	29.16	305	100	V	34.757	5.26	-	69.177	74	-4.823	PK
5396	28.09	95	151	H	34.905	5.26	-	68.255	74	-5.745	PK
5404	12.38	305	100	V	34.757	5.26	-	52.397	54	-1.603	Ave
5402	12.57	95	151	H	34.905	5.26	-	52.735	54	-1.265	Ave
10460	46.14	325	100	V	33.873	9.720	36.13	53.603	68.26	-14.657	PK
10460	46.15	119	133	H	33.888	9.720	36.13	53.628	68.26	-14.632	PK
10460	31.37	325	100	V	33.873	9.720	36.13	38.833	54	-15.167	Ave
10460	31.34	119	133	H	33.888	9.720	36.13	38.818	54	-15.182	Ave
15690	45.04	321	100	V	39.043	11.860	33.18	62.763	68.26	-5.497	PK
15690	45.08	125	123	H	39.117	11.860	33.18	62.877	68.26	-5.383	PK
15690	30.5	321	100	V	39.043	11.860	33.18	48.223	54	-5.777	Ave
15690	30.48	125	123	H	39.117	11.860	33.18	48.277	54	-5.723	Ave

802.11ac80 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 5240 MHz											
5210	49.86	338	100	V	34.819	10.640	-	95.319	-	-	PK
5210	55.38	123	164	H	34.428	10.640	-	100.448	-	-	PK
5210	38.22	338	100	V	34.819	10.640	-	83.679	-	-	Ave
5210	43.4	123	164	H	34.428	10.640	-	88.468	-	-	Ave
10420	46.12	329	100	V	33.842	9.720	36.13	53.552	68.26	-14.708	PK
10420	46.81	120	166	H	33.795	9.720	36.13	54.195	68.26	-14.065	PK
10420	31.35	329	100	V	33.842	9.720	36.13	38.782	54	-15.218	Ave
10420	31.32	120	166	H	33.795	9.720	36.13	38.705	54	-15.295	Ave
15625	45.67	329	100	V	39.024	11.860	33.18	63.374	68.26	-4.886	PK
15652	45.11	125	160	H	39.118	11.860	33.18	62.908	68.26	-5.352	PK
15654	30.79	329	100	V	39.024	11.860	33.18	48.494	54	-5.506	Ave
15651	30.79	125	160	H	39.118	11.860	33.18	48.588	54	-5.412	Ave

8 FCC §15.407 & IC RSS-Gen §6.6 (a) - Occupied Bandwidth

8.1 Applicable Standards

FCC §15.407 & RSS-Gen §6.6 (a)

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	E440A	MY48250238	2014-09-03	1 year
-	RF cable	-	00609	2015-06-05	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:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at RF site.

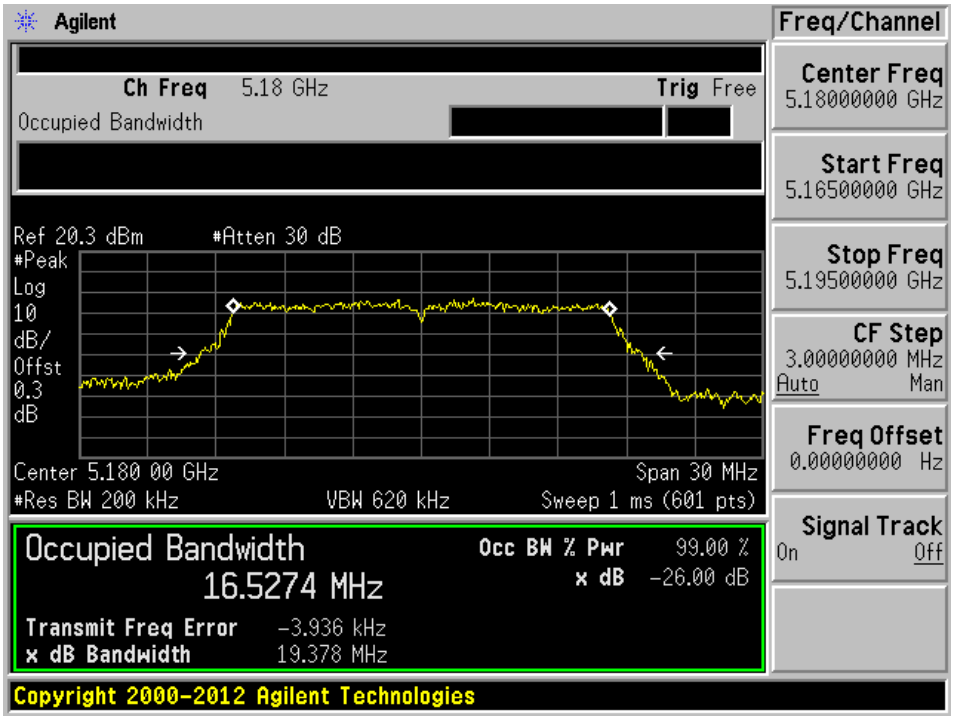
8.5 Test Results

Channel	Frequency (MHz)	26 dB OBW (MHz)	99% OBW (MHz)
802.11a			
Low	5180	19.378	16.5274
Middle	5200	19.195	16.4836
High	5240	19.467	16.5240
802.11n20			
Low	5180	19.672	17.6071
Middle	5200	19.660	17.6163
High	5240	19.820	17.6245
802.11n40			
Low	5190	39.265	35.9711
High	5230	39.838	36.049
802.11ac20			
Low	5180	19.001	17.4965
Middle	5200	23.107	17.5740
High	5240	19.003	17.5033
802.11ac40			
Low	5190	38.75	35.7771
High	5230	38.283	35.7209
802.11ac80			
-	5210	97.855	75.9434

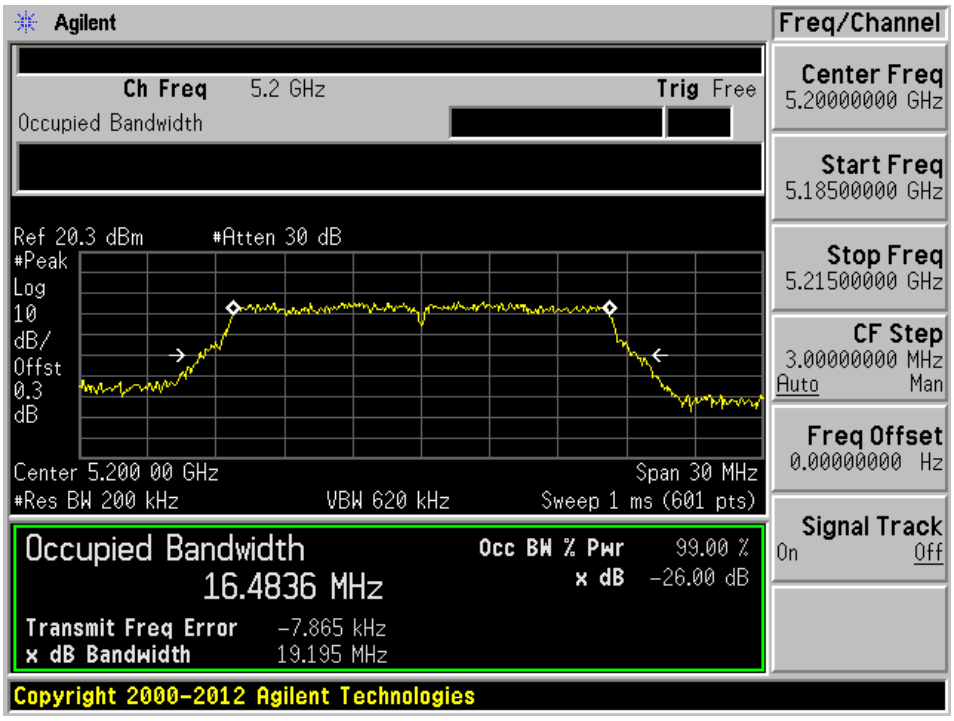
Please refer to the following plots.

802.11a mode

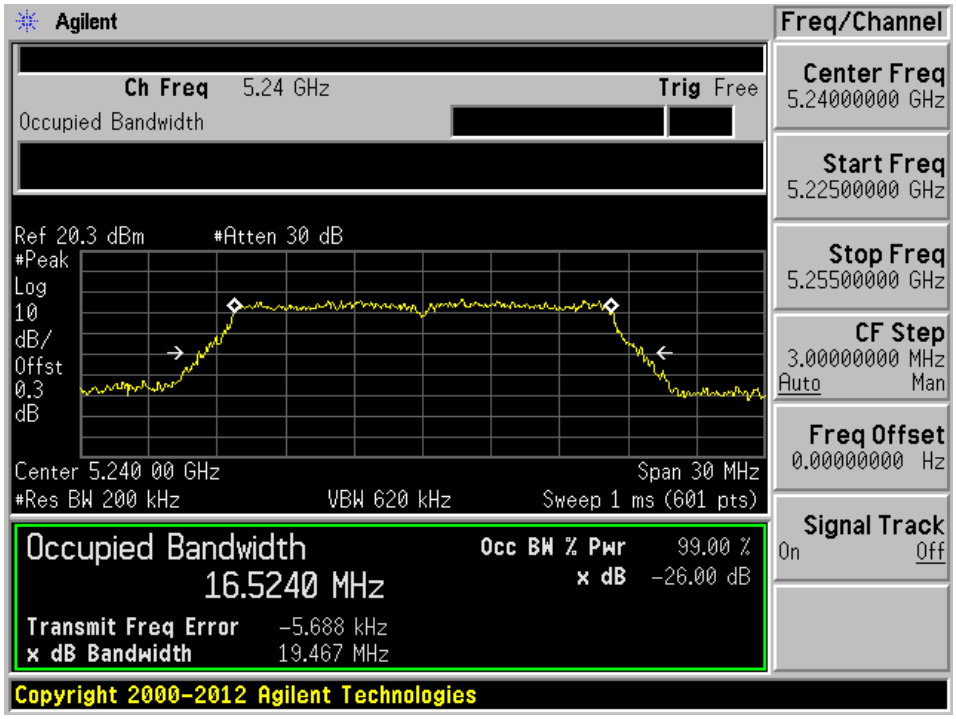
802.11a Low channel: 5180 MHz



802.11a Middle channel: 5200 MHz

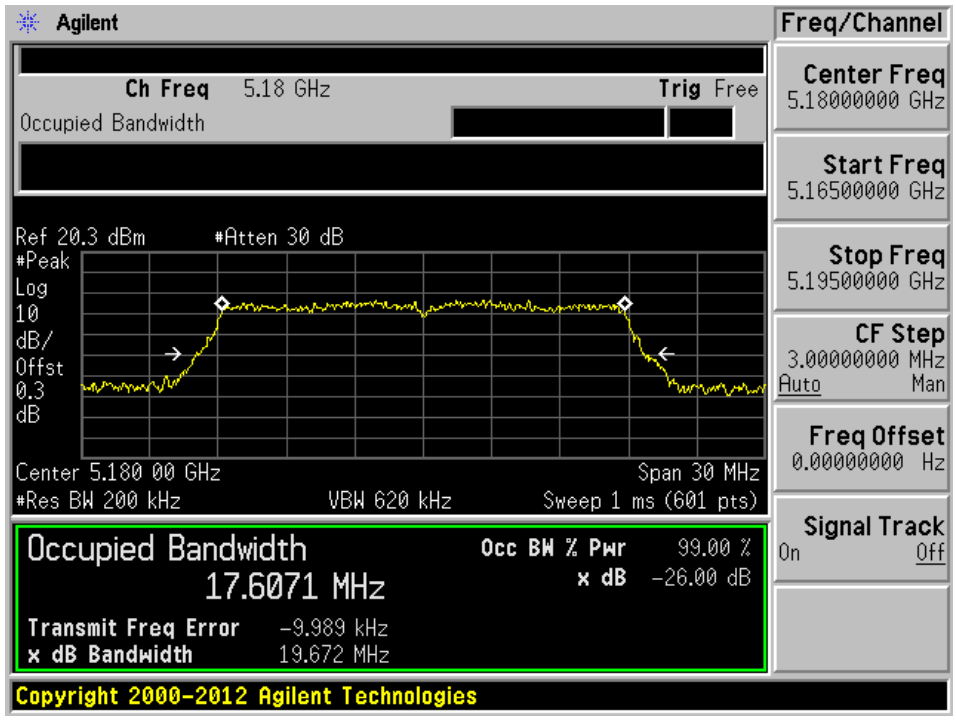


802.11a High channel: 5240 MHz

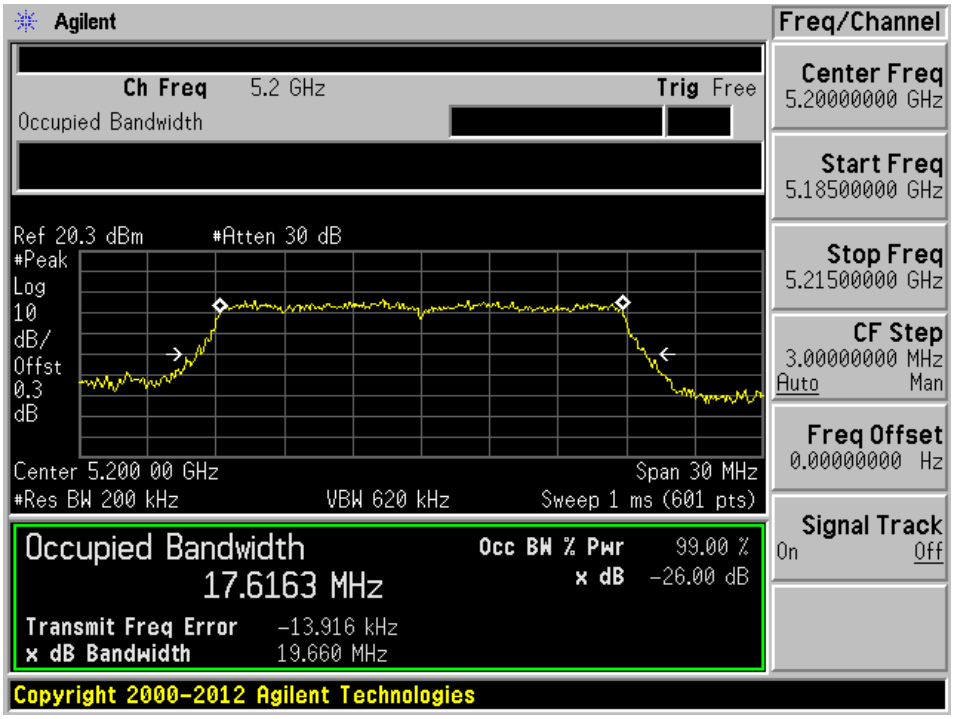


802.11n20 mode

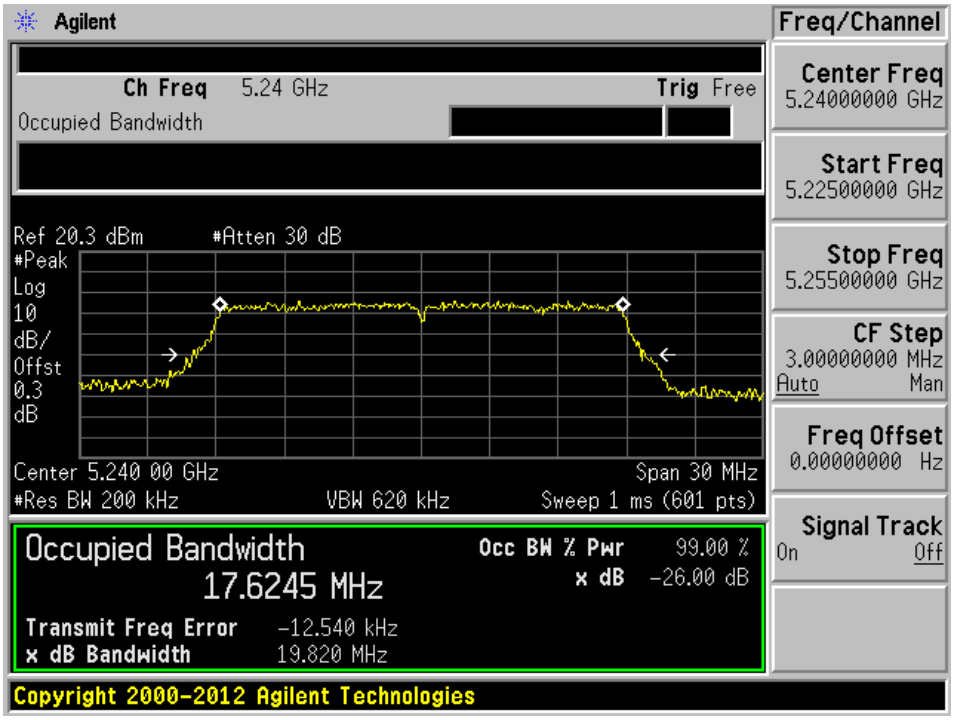
802.11n20 Low channel: 5180 MHz



802.11n20 Middle channel: 5200 MHz

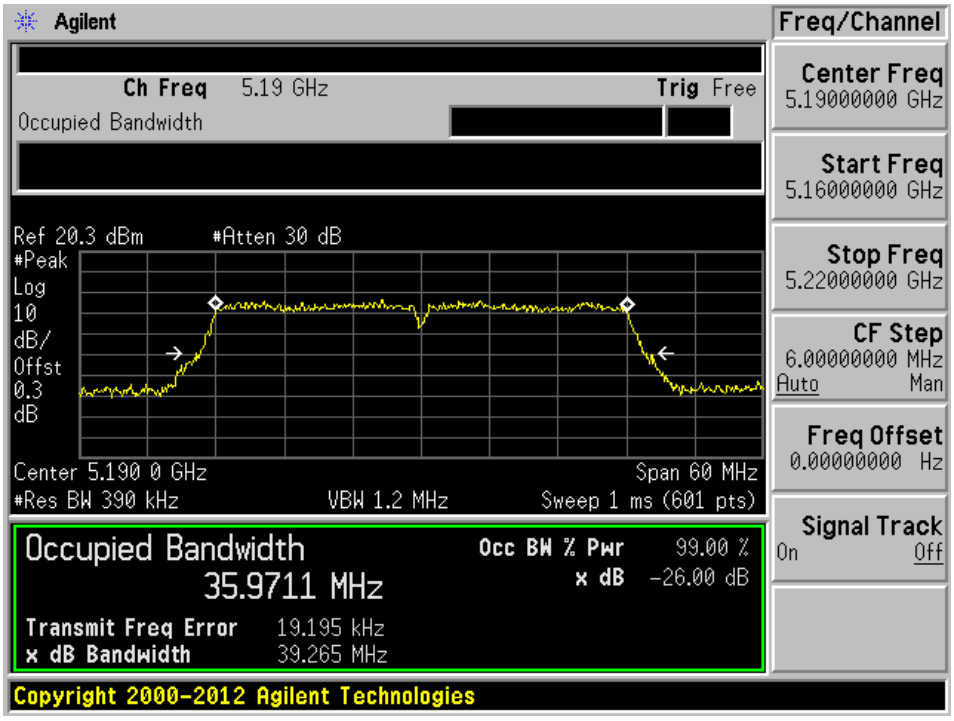


802.11n20 Middle channel: 5240 MHz

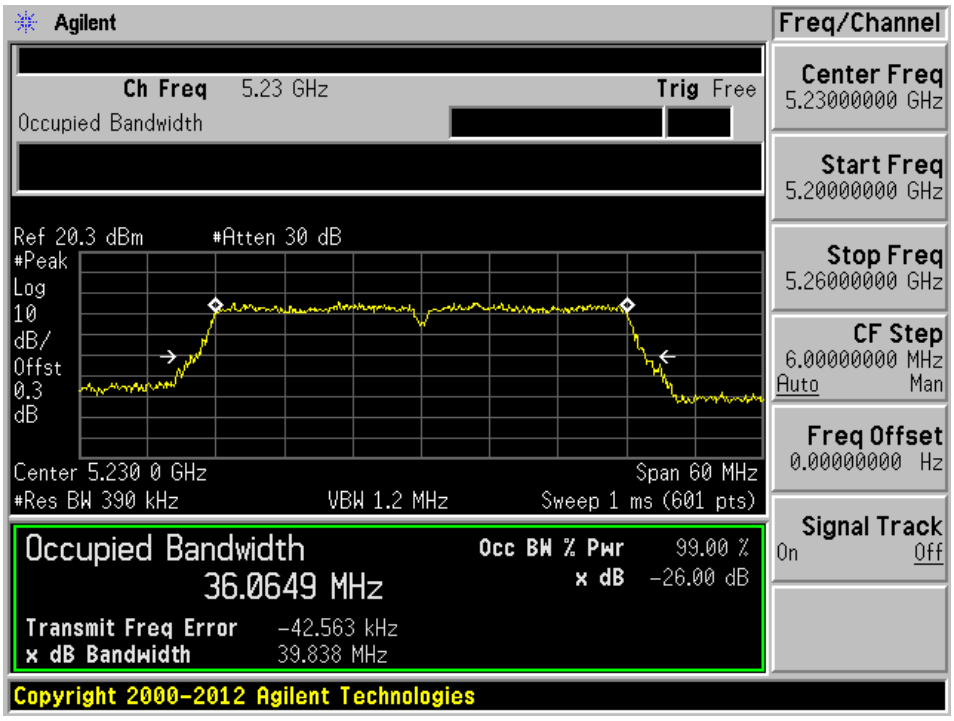


802.11n40 mode

802.11n40 Low channel: 5190 MHz

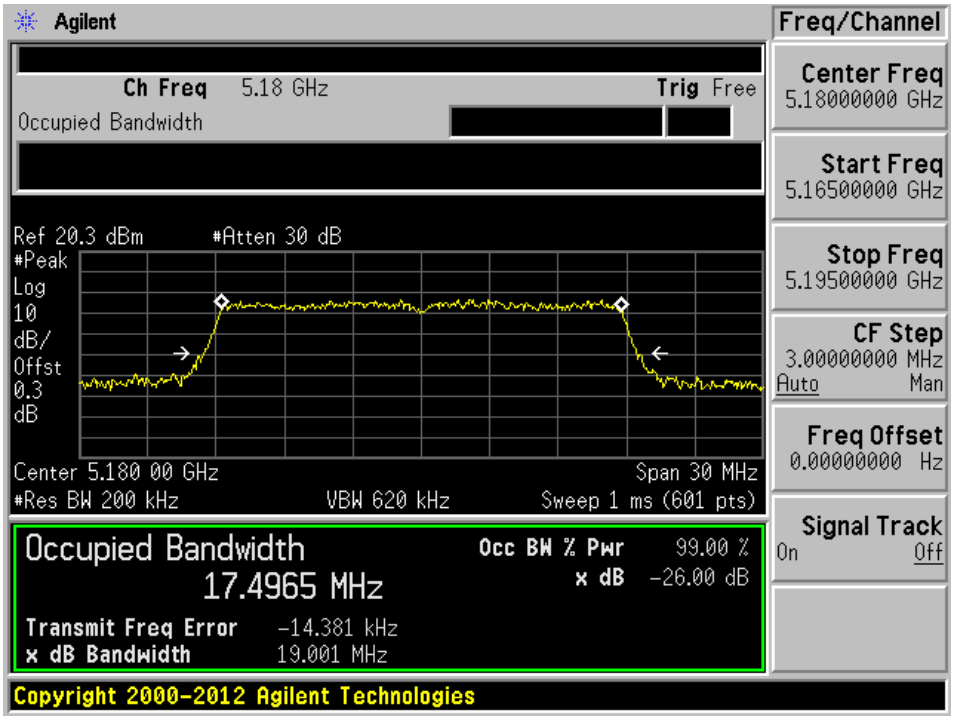


802.11n40 High channel: 5230 MHz

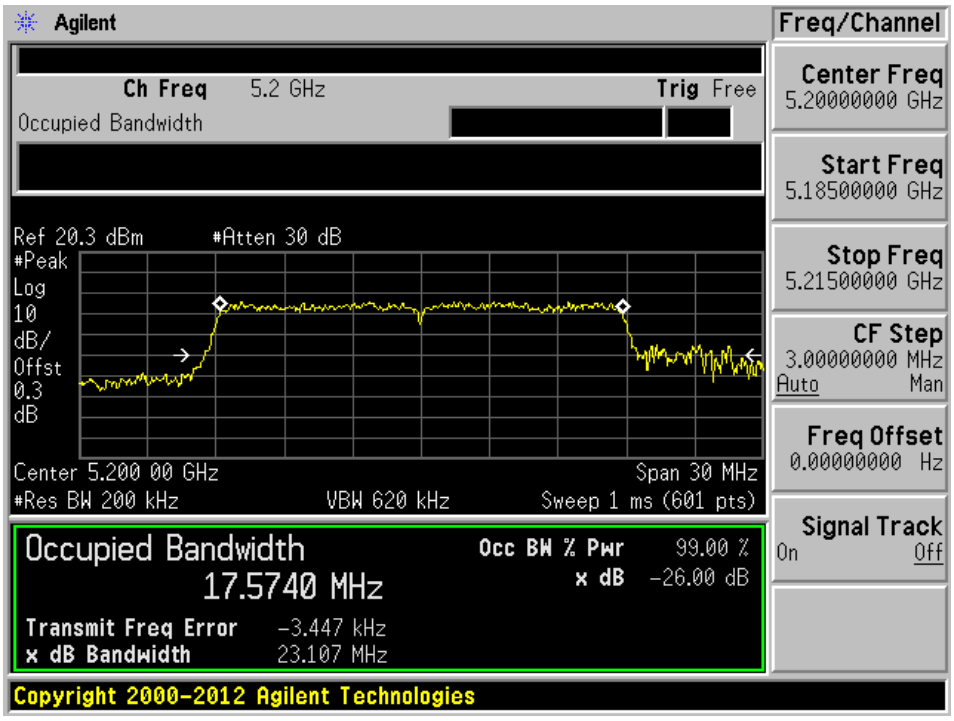


802.11ac20 mode

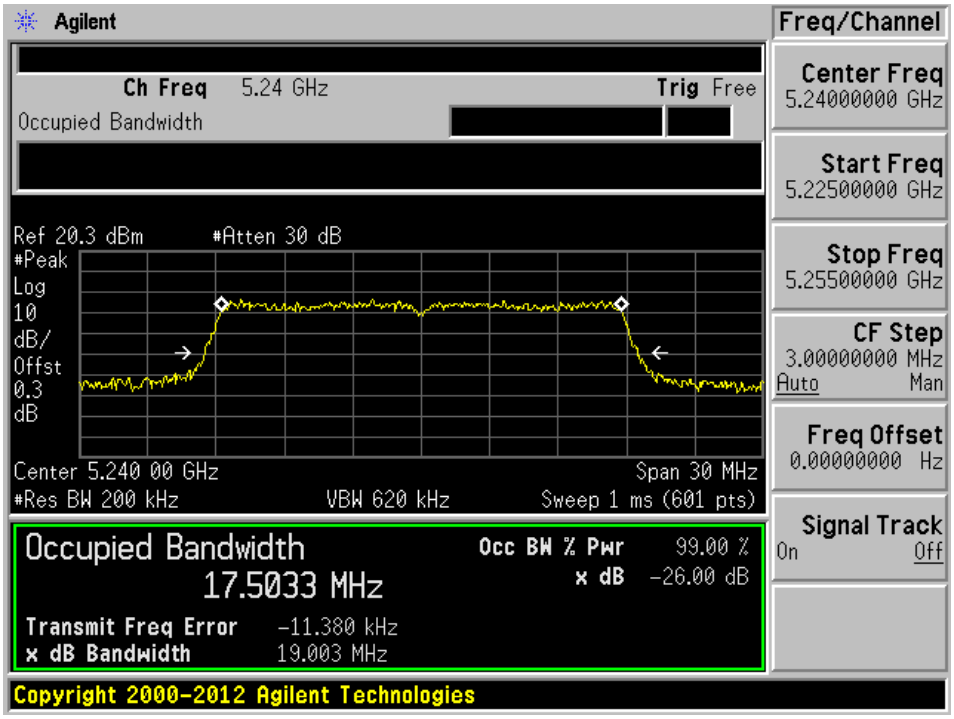
802.11ac20 Low channel: 5180 MHz



802.11ac20 Middle channel: 5200 MHz

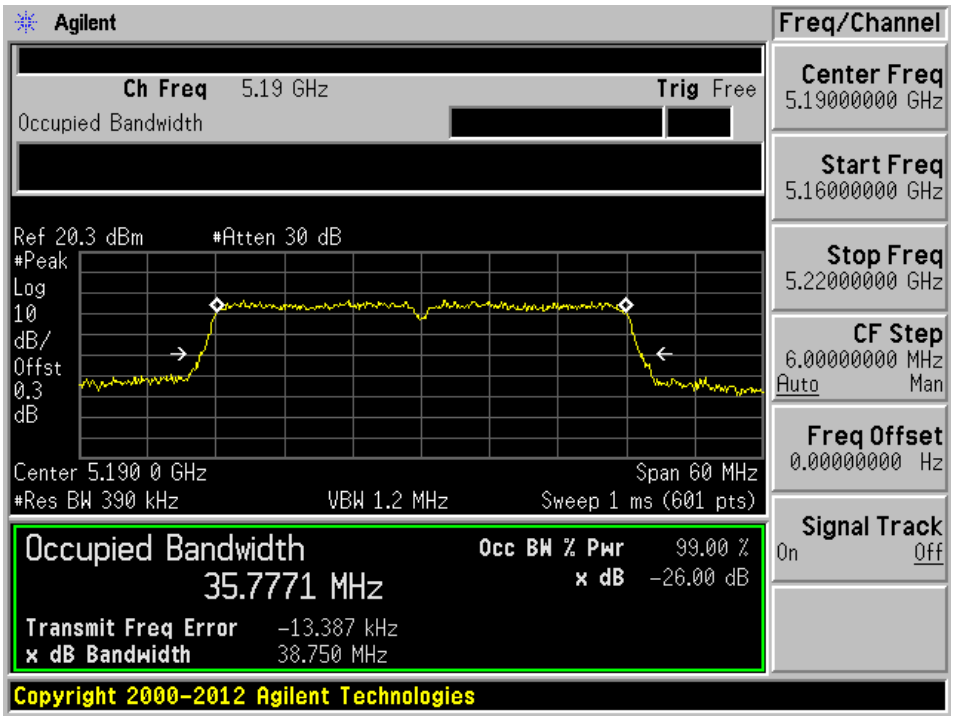


802.11ac20 High channel: 5240 MHz

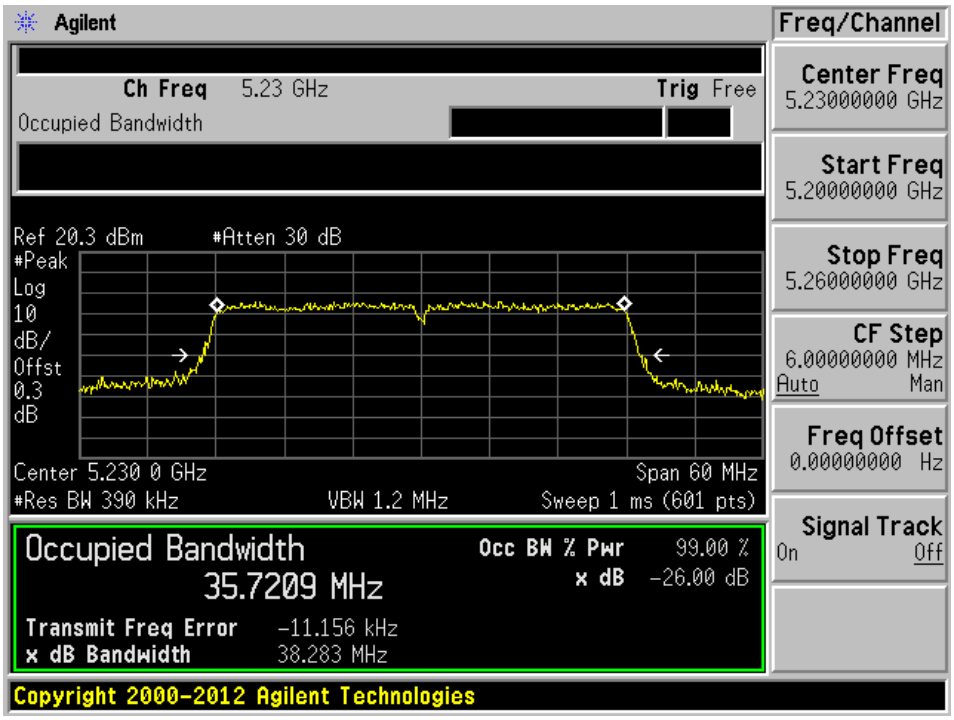


802.11ac40 mode

802.11ac40 Low channel: 5190 MHz

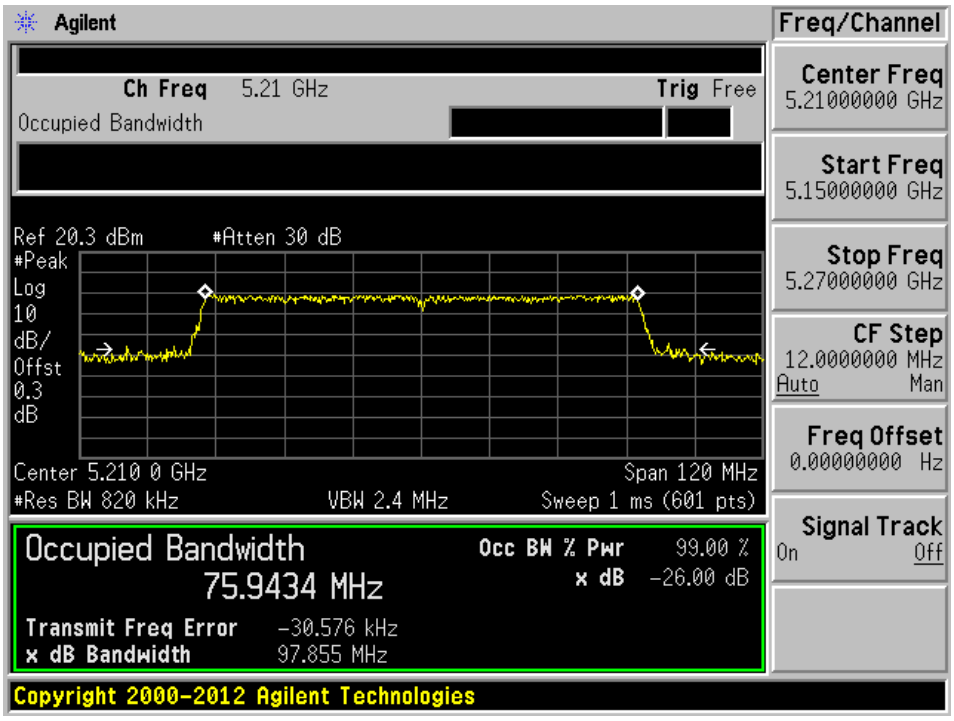


802.11ac40 High channel: 5230 MHz



802.11ac80 mode

802.11ac80, 5210 MHz



9 FCC §407(a) & IC RSS-247 §6.2 - Output Power

9.1 Applicable Standards

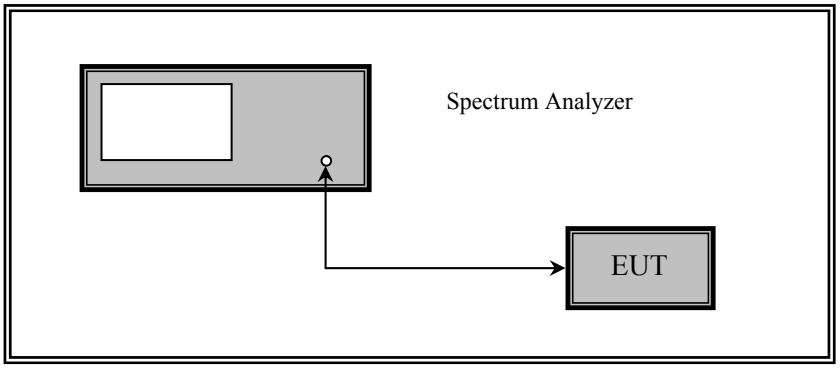
According to FCC §15.407(a) (1) (iv): For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum 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-247 §6.2.1

The maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. 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	E440A	MY48250238	2014-09-03	1 year
-	RF cable	-	00609	2015-06-05	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:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at RF site.

9.5 Test Results

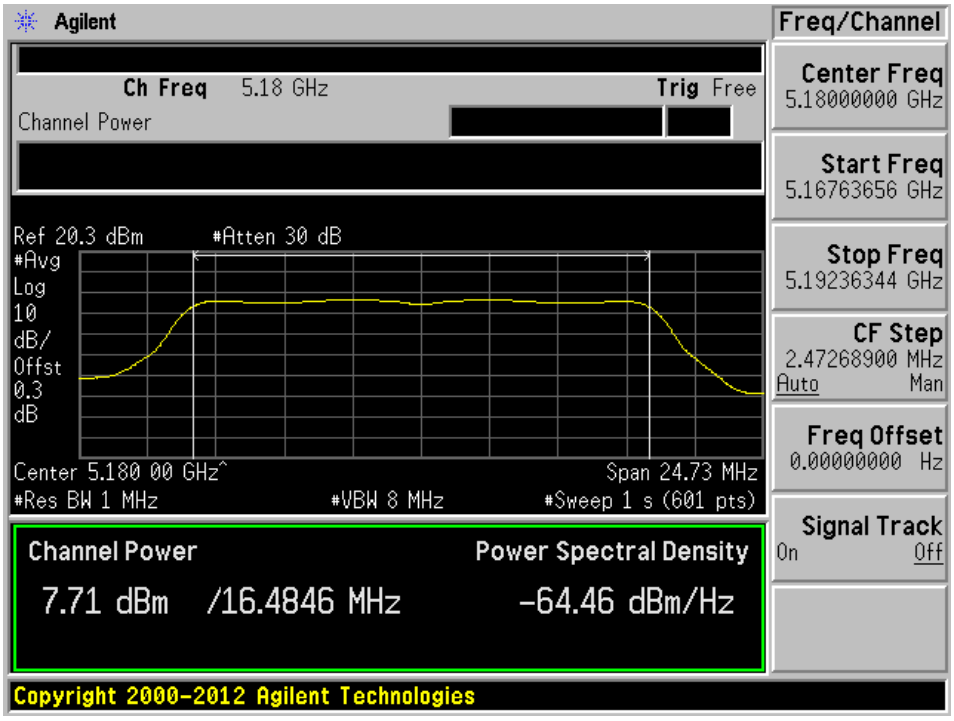
Channel	Frequency (MHz)	Conducted Output Power (dBm)	EIRP (dBm)	FCC Conducted Power Limit (dBm)	IC EIRP Limit (dBm)
802.11a					
Low	5180	7.71	8.01	24	23
Middle	5200	7.59	7.89	24	23
High	5240	7.36	7.66	24	23
802.11n20					
Low	5180	8.05	8.35	24	23
Middle	5200	7.54	7.84	24	23
High	5240	7.71	8.01	24	23
802.11n40					
Low	5190	7.4	7.8	24	23
High	5230	7.0	7.3	24	23
802.11ac20					
Low	5180	8.22	8.52	24	23
Middle	5200	7.98	8.28	24	23
High	5240	7.9	8.2	24	23
802.11ac40					
Low	5190	8.07	8.37	24	23
High	5230	7.67	7.97	24	23
802.11ac80					
-	5210	10.92	11.22	24	23

Note: the antenna gain is 0.3 dBi

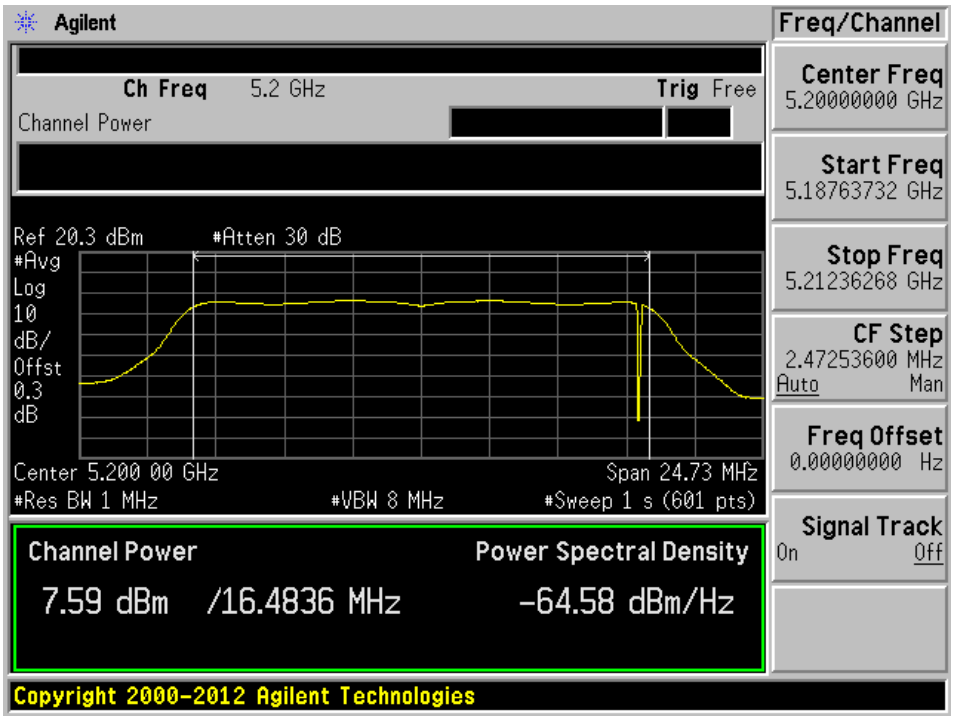
Please refer to the following plots.

802.11a mode

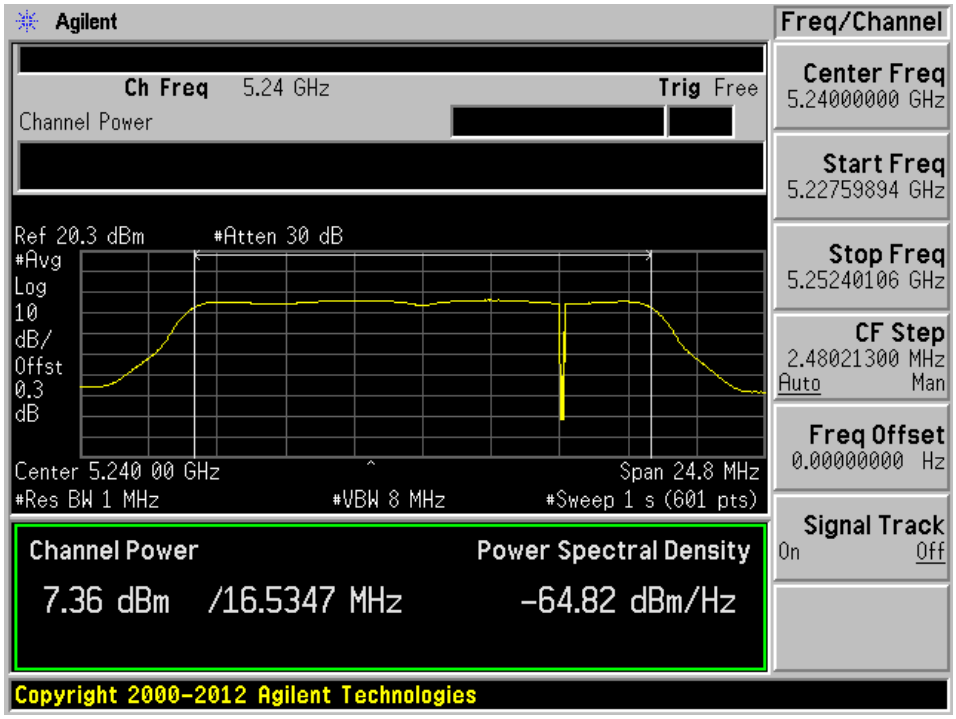
802.11a Low channel: 5180 MHz



802.11a Middle channel: 5200 MHz

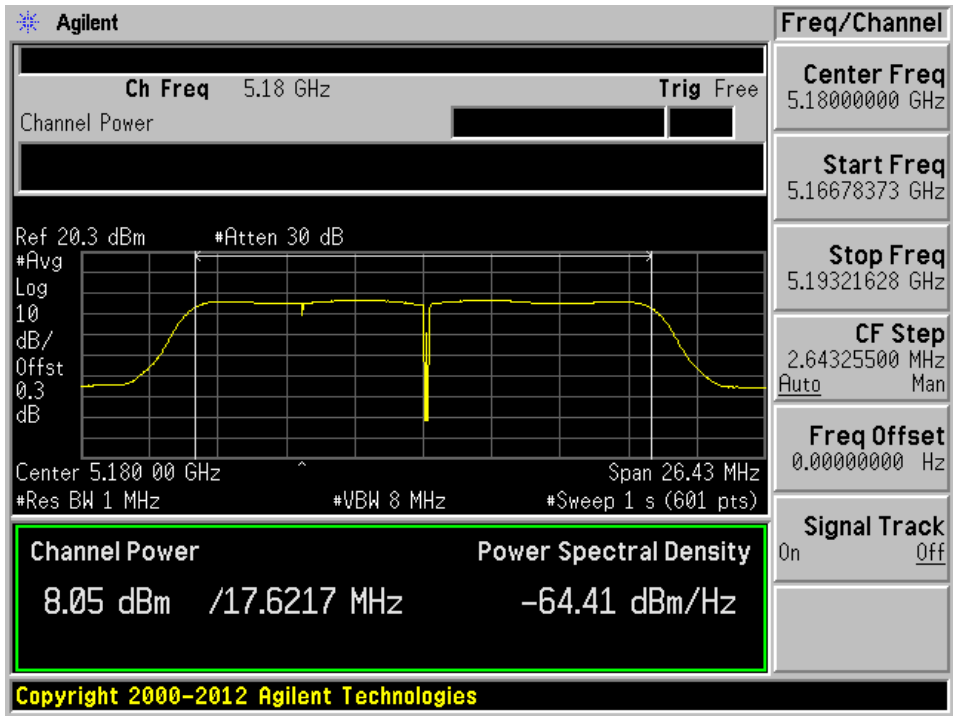


802.11a High channel: 5240 MHz

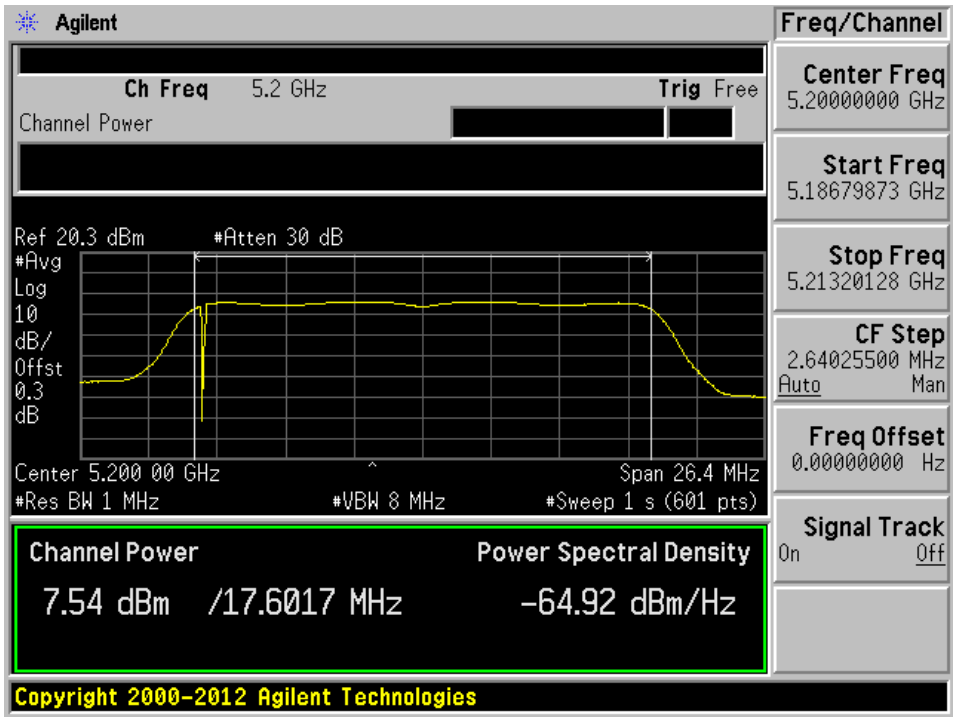


802.11 n20

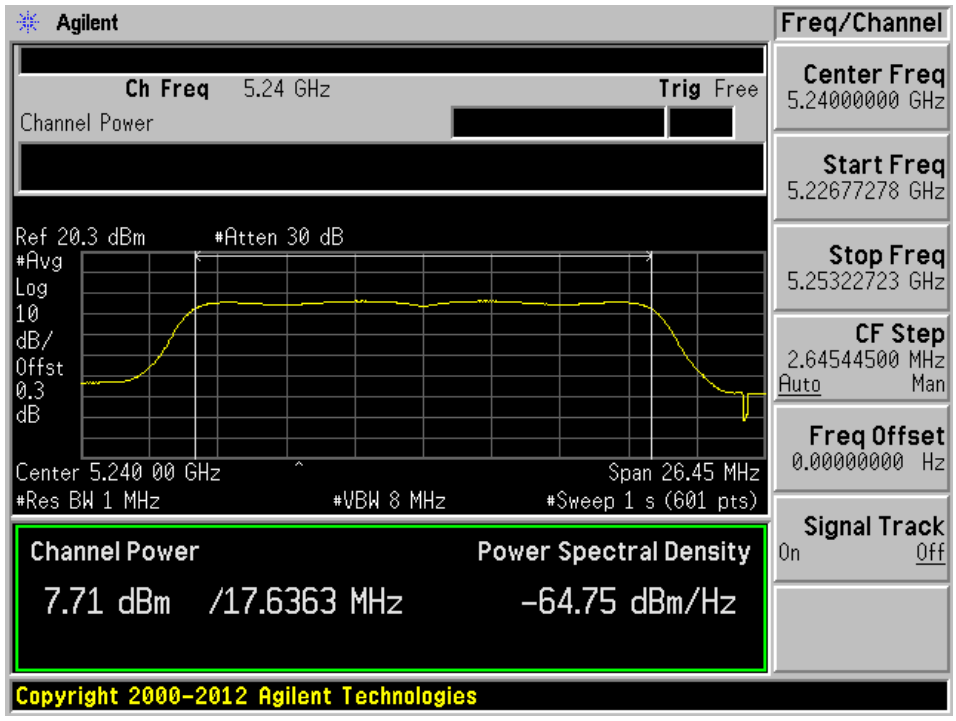
802.11n20 Low channel: 5180 MHz



802.11n20 Middle channel: 5200 MHz

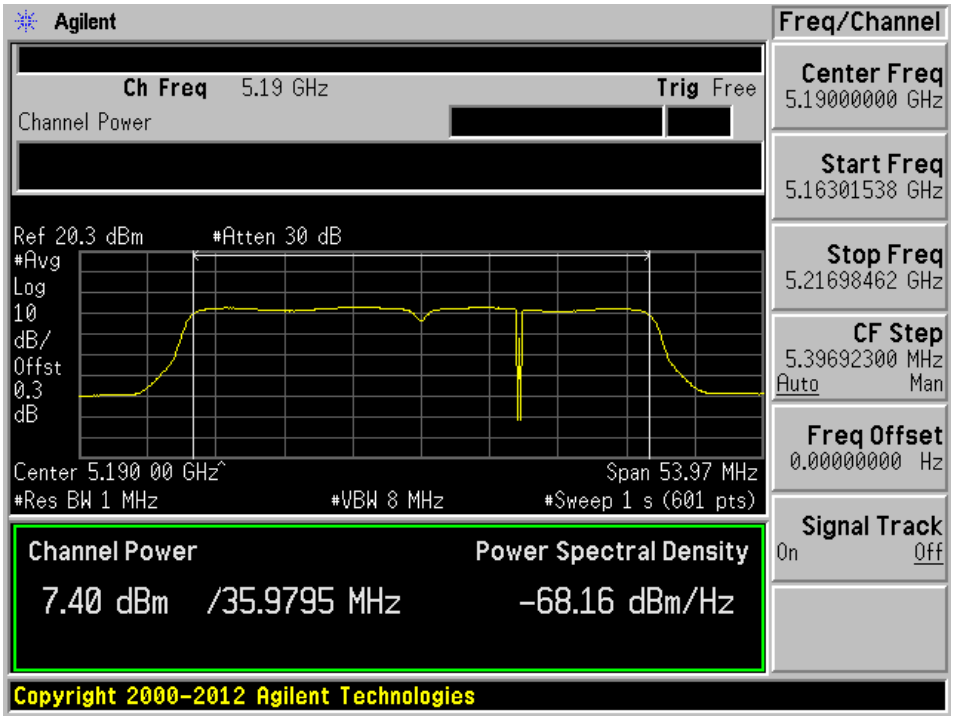


802.11n20 High channel: 5240 MHz

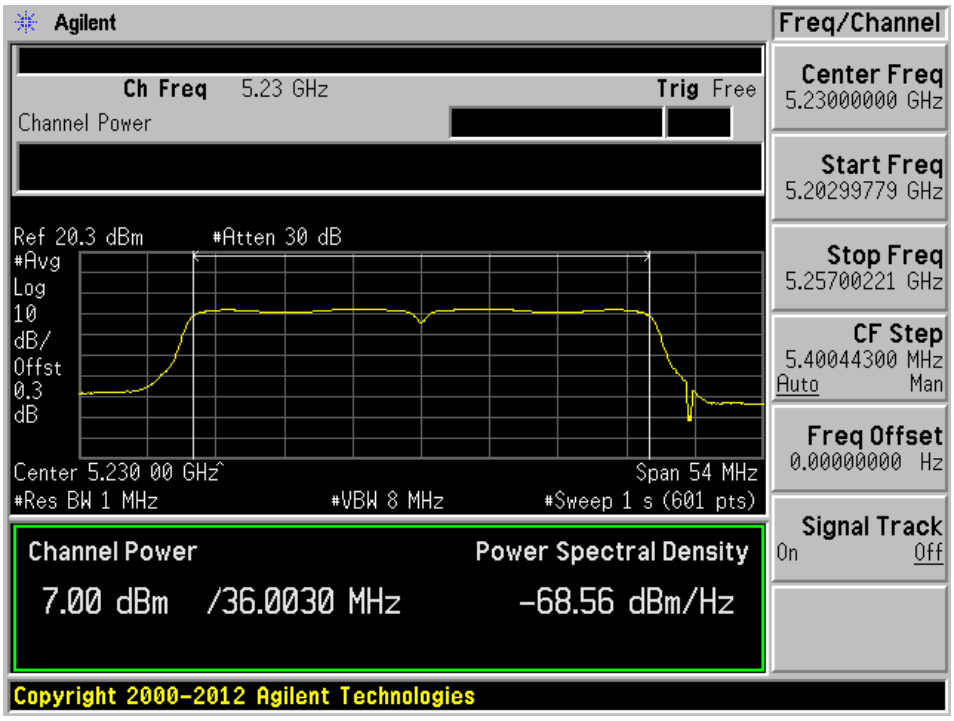


802.11n40

802.11n40 Low channel: 5190 MHz

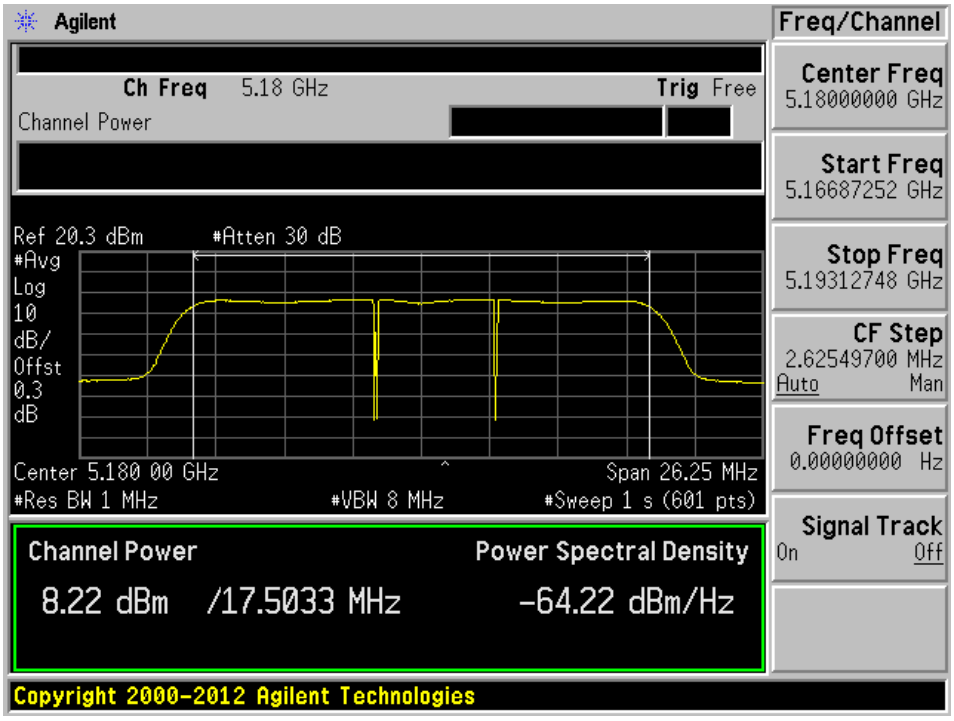


802.11n40 High Channel: 5230 MHz

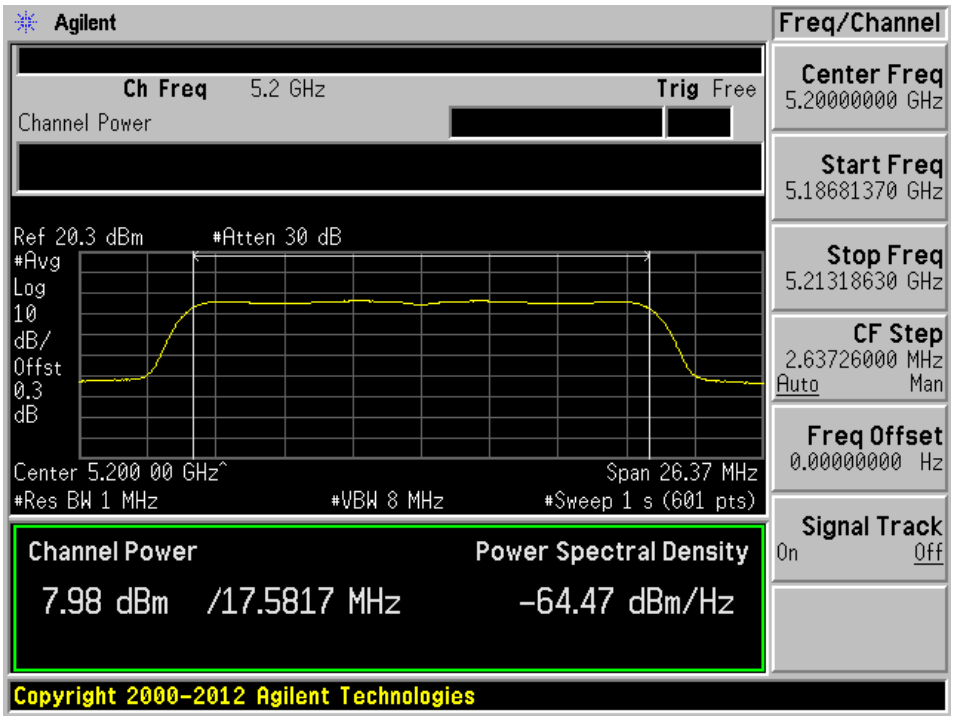


802.11ac20

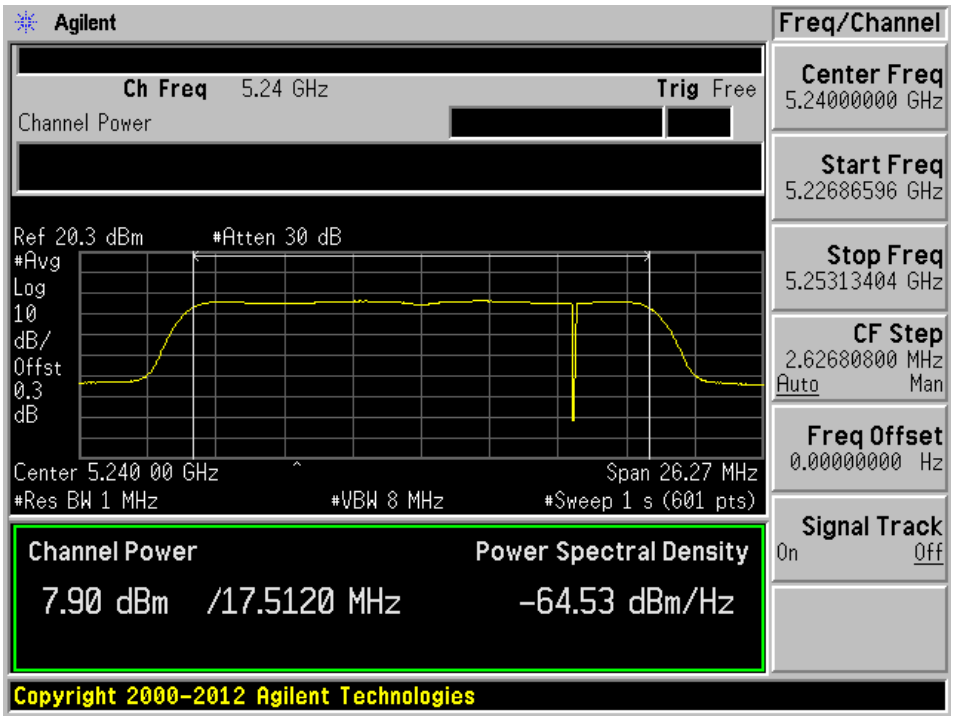
802.11ac20 Low channel: 5190 MHz



802.11ac20 Middle channel: 5200 MHz

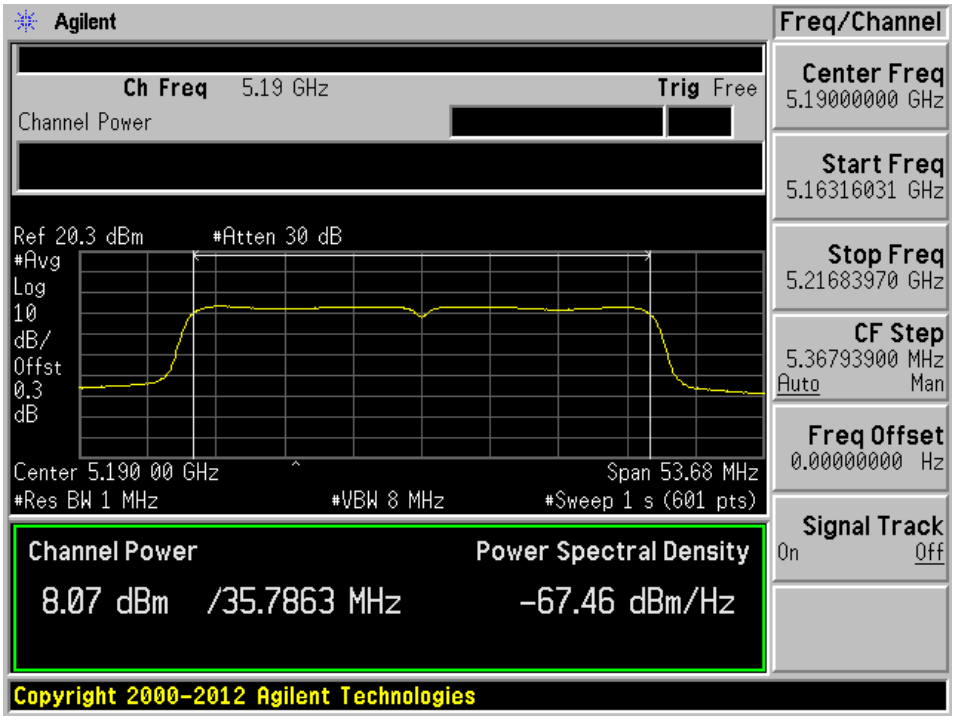


802.11ac20 High channel: 5240 MHz

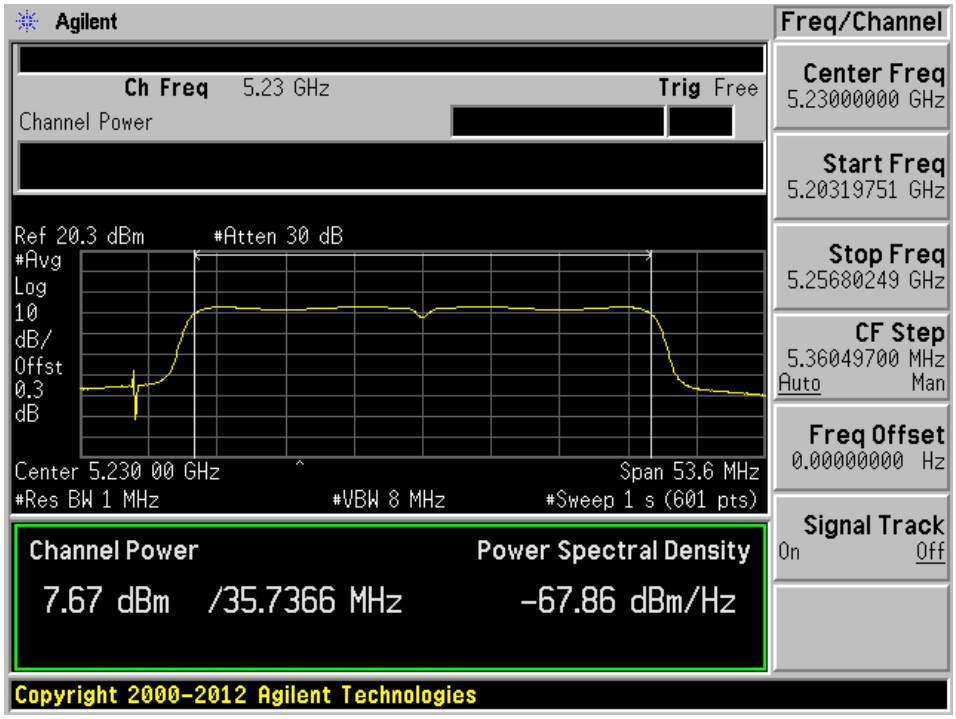


802.11ac40

802.11ac40 Low channel: 5190 MHz

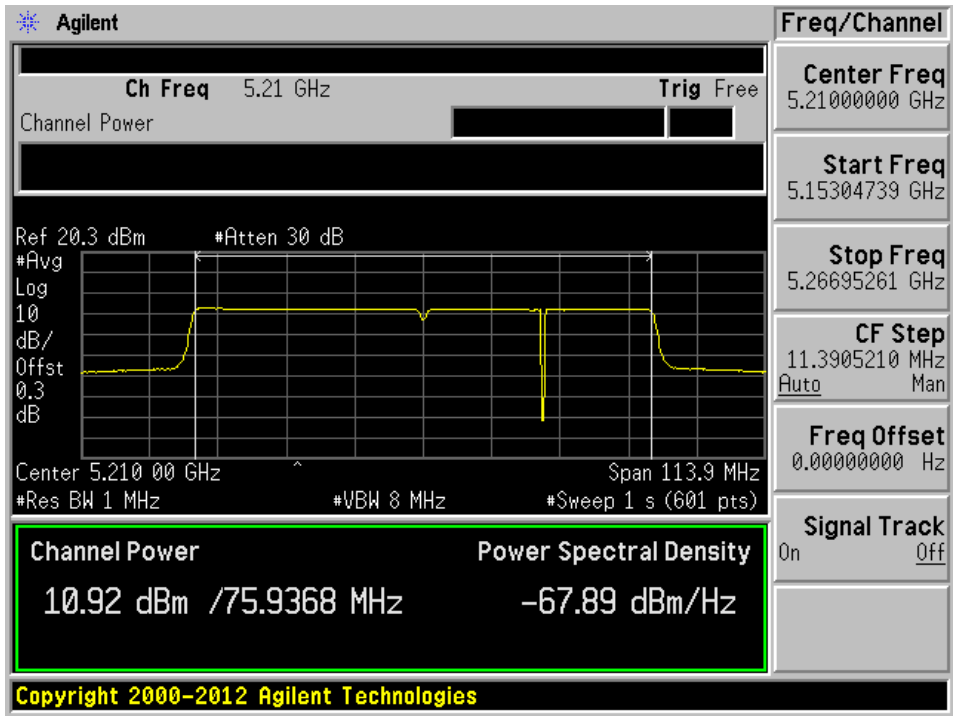


802.11ac40 High channel: 5230 MHz



802.11ac n80

802.11ac80: 5210 MHz



10 §15.407(b) & IC RSS-247 §6.2 - Out of Band Emissions

10.1 Applicable Standards

According to FCC §15.407(b)
Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits: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 e.i.r.p. of −27 dBm/MHz. For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

According to & IC RSS-247 §6.2
For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz.

10.2 Measurement Procedure

Add a correction factor (antenna gain+ Attenuator loss+cable loss) to the display.

Integration Method

1. For peak emissions measurements, follow the procedures described in section H)5), "Procedures for Peak Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

- Set RBW = 100 kHz
- Set VBW = 3 · RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured. CAUTION: You must ensure that the spectrum analyzer or EMI receiver is set for peak-detection and max-hold for this measurement.

2. For average emissions measurements, follow the procedures described in section H)6), "Procedures for Average Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

- Set RBW = 100 kHz
- Set VBW = 3xRBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E440A	MY48250238	2014-09-03	1 year
-	RF cable	-	00609	2015-06-05	1 year
-	10 dB Attenuator	-	-	-	-

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:	22-24º C
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at RF site.

10.5 Test Results

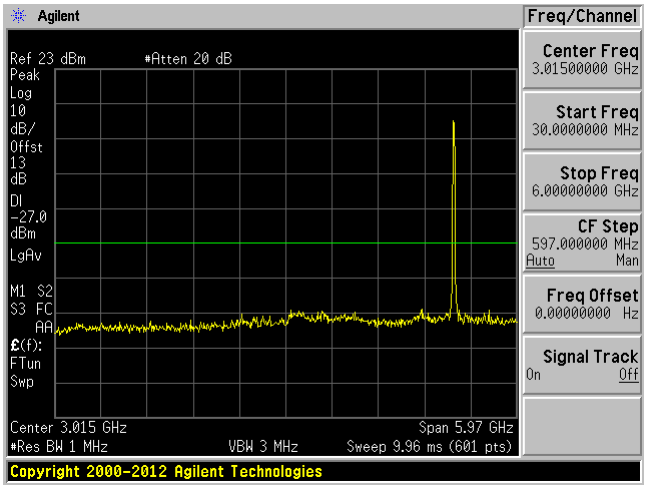
Please refer to following plots.

Note: the offset include the attenuation, cable loss and the maximum antenna gain. And the margin between limit line and the emission covers other requirements in the KDB 789033.

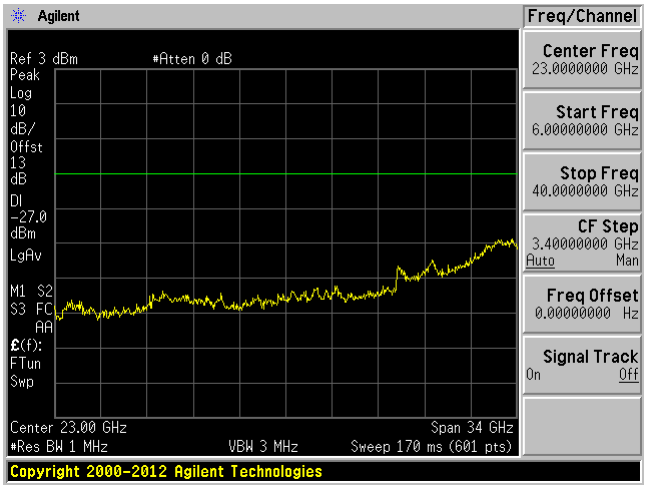
1) Out-of-band spurious emission

802.11a mode

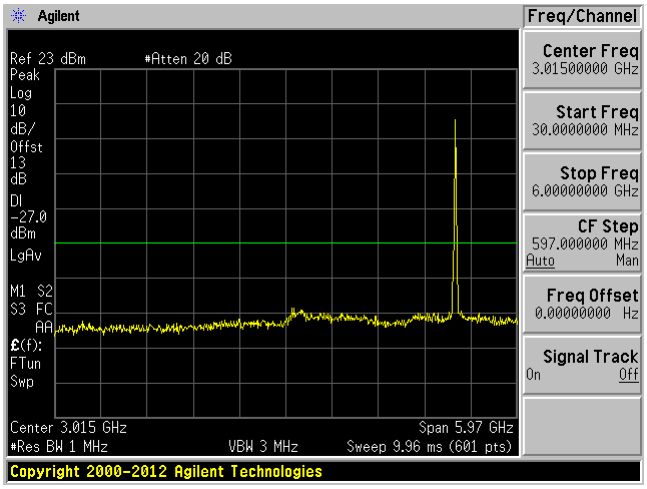
802.11a Low 5180MHz (30MHz-6GHz)



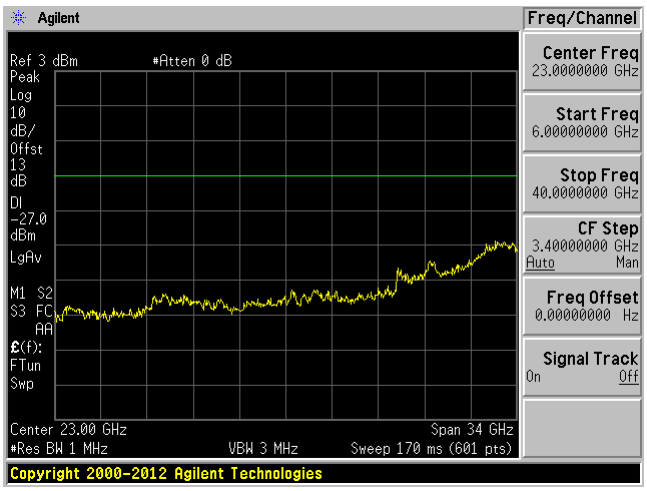
802.11a Low 5180 MHz (6-40GHz)



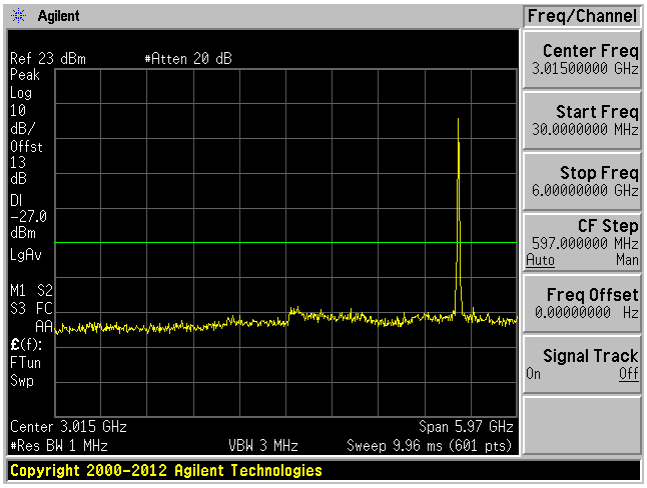
802.11a Middle 5200MHz (30MHz-6GHz)



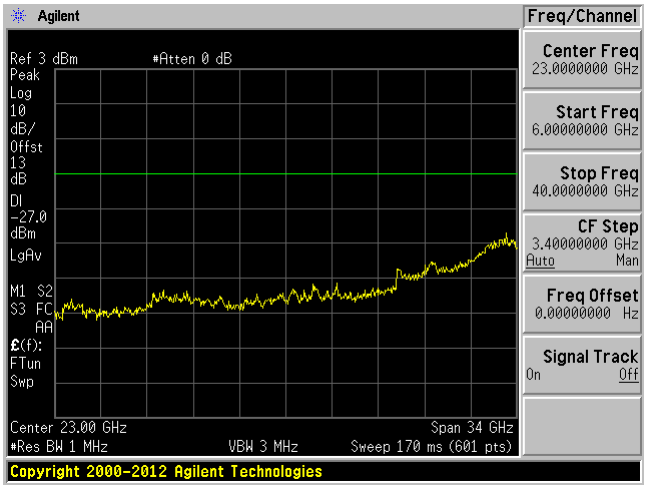
802.11a Middle 5200 MHz (6-40GHz)



802.11a High 5240MHz (30MHz-6GHz)

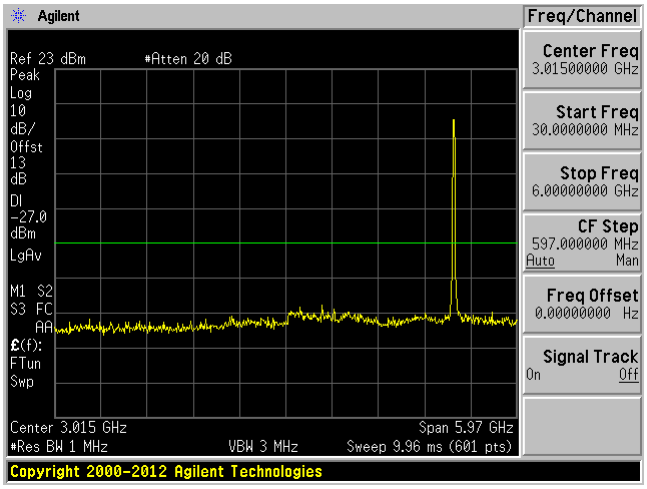


802.11a High 5240 MHz (6-40GHz)

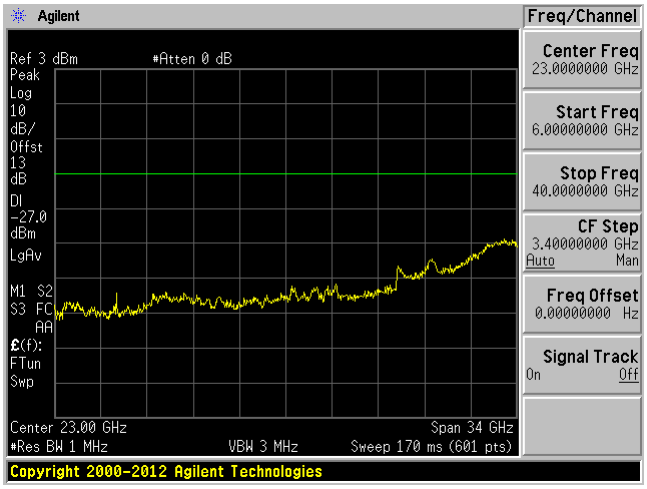


802.11n20 mode

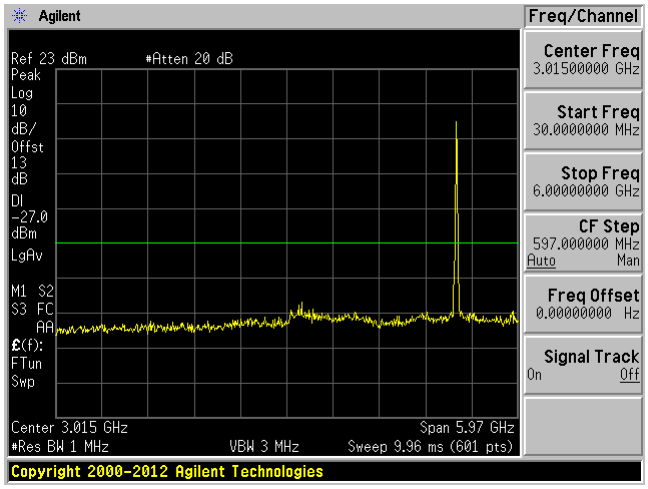
802.11n20 Low 5180MHz (30MHz-6GHz)



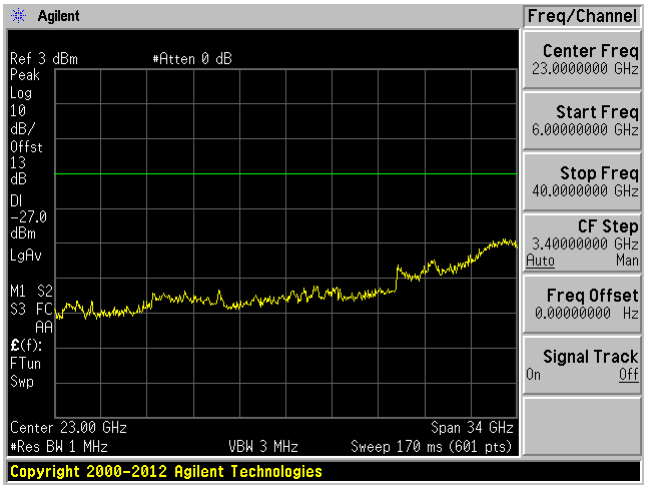
802.11n20 Low 5180 MHz (6-40GHz)



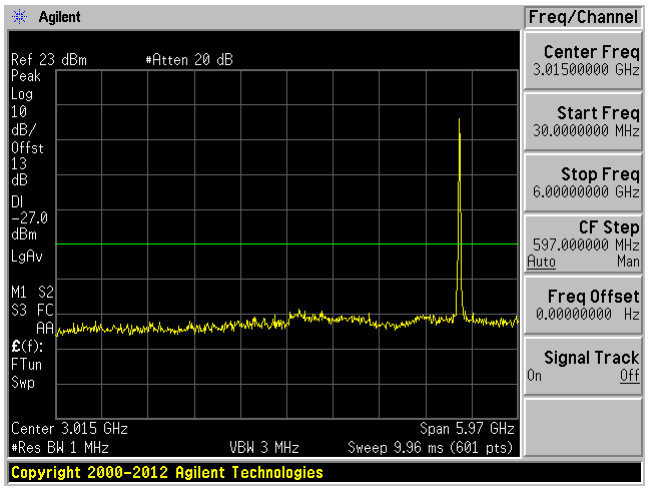
802.11n20 Middle 5200MHz (30MHz-6GHz)



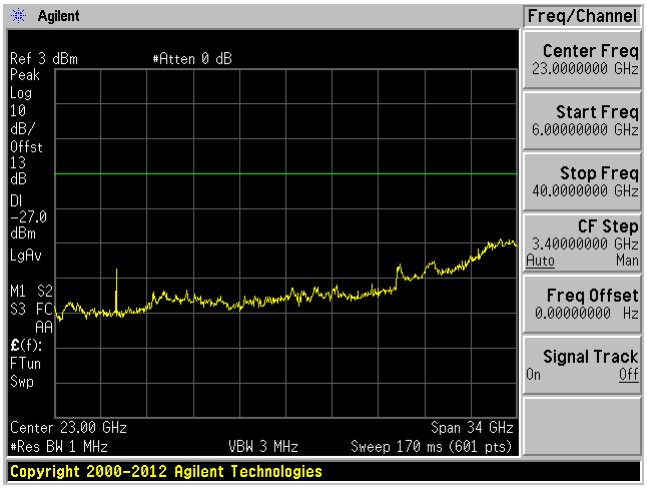
802.11n20 Middle 5200 MHz (6-40GHz)



802.11n20 High 5240MHz (30MHz-6GHz)

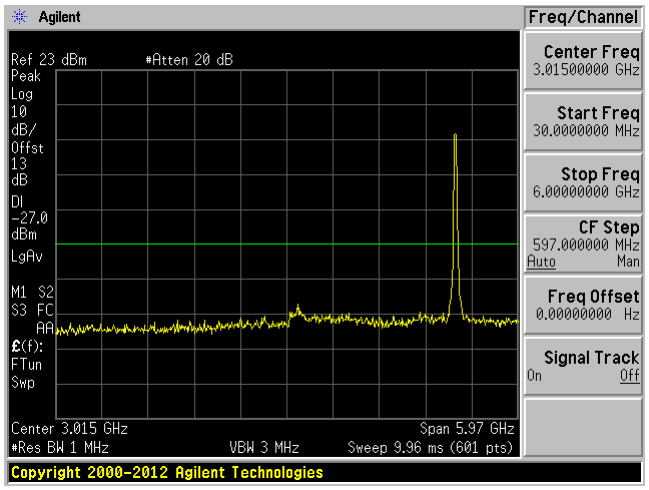


802.11n20 High 5240 MHz (6-40GHz)

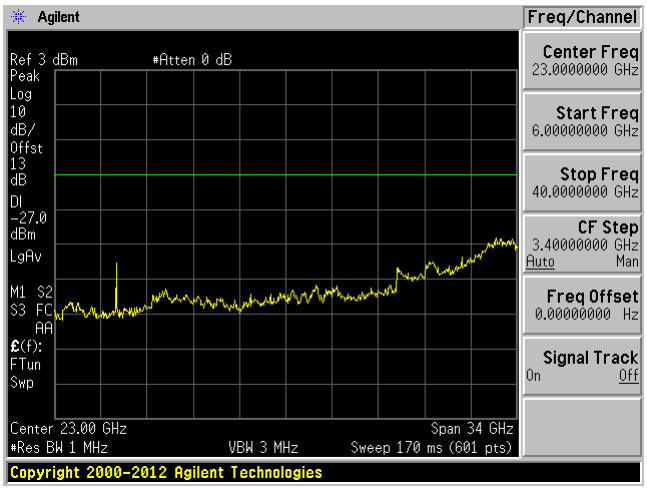


802.11n40 mode

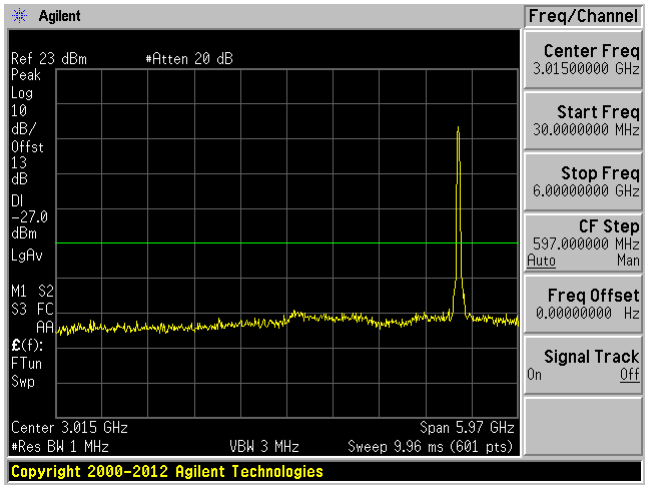
802.11n40 Low 5190MHz (30MHz-6GHz)



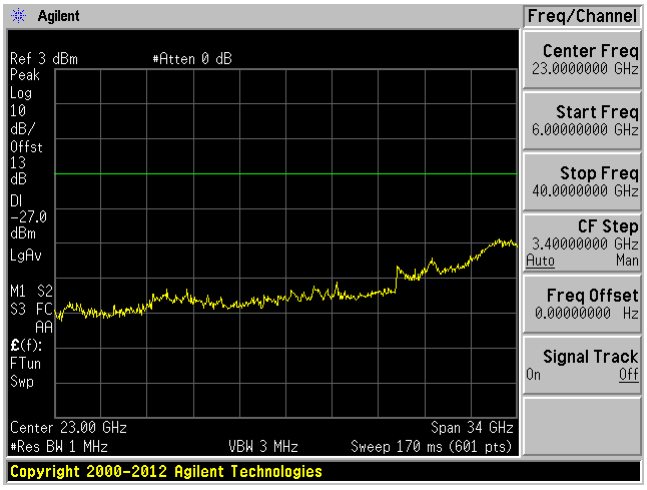
802.11n20 Low 5190 MHz (6-40GHz)



802.11n40 High 5230MHz (30MHz-6GHz)

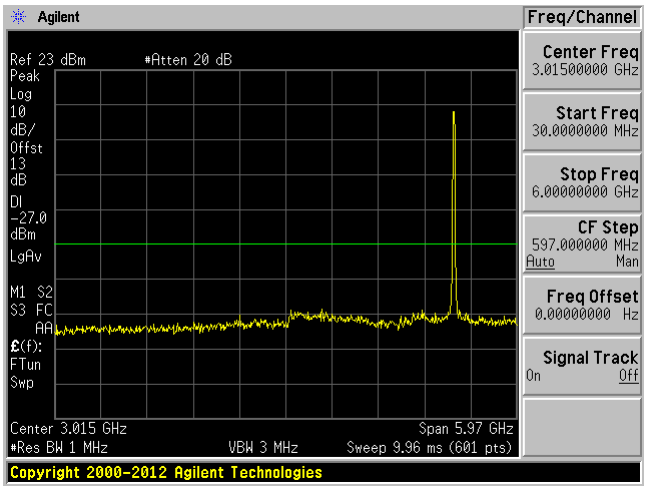


802.11n40 High 5230 MHz (6-40GHz)

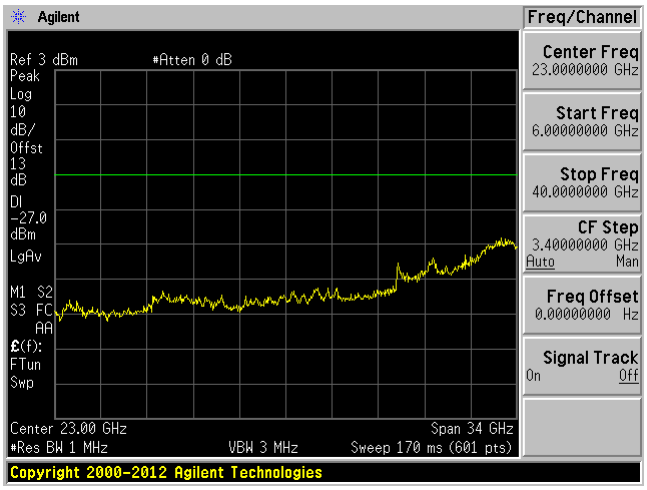


802.11ac20 mode

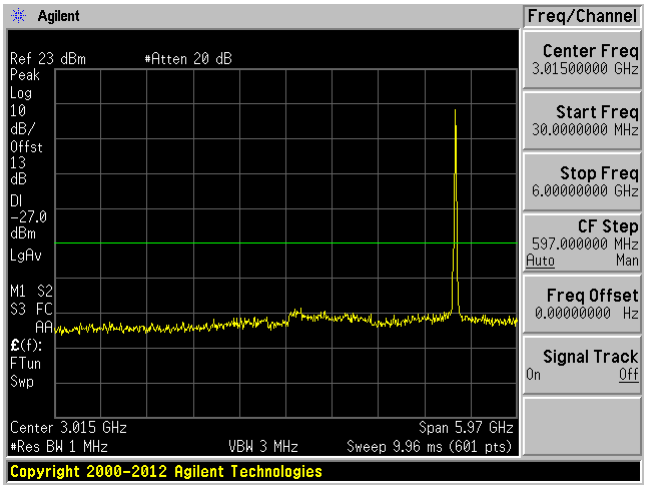
Low 5180MHz (30MHz-6GHz)



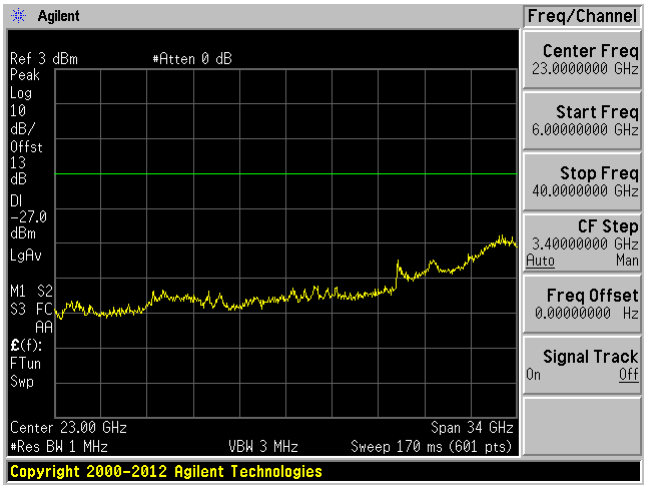
Low 5180 MHz (6-40GHz)



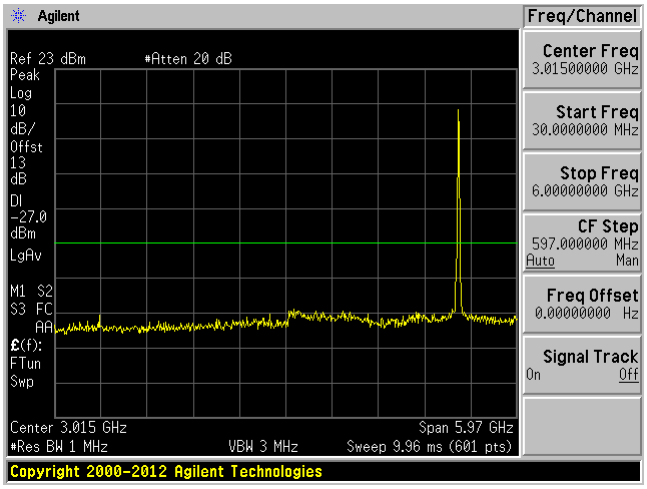
Middle 5200MHz (30MHz-6GHz)



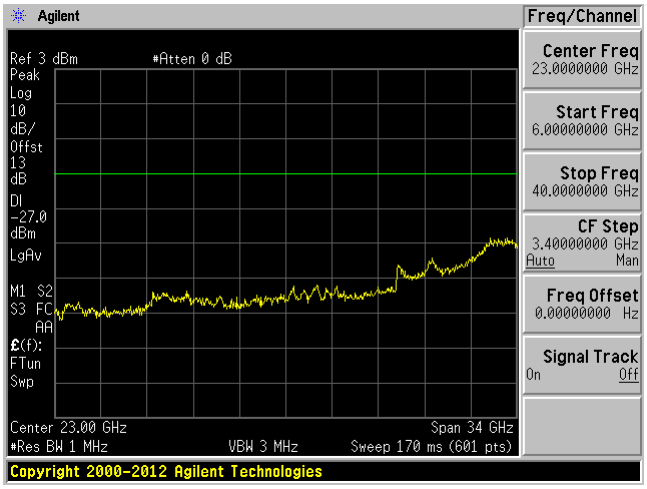
Middle 5200 MHz (6GHz – 40GHz)



High 5240MHz (30MHz-6GHz)

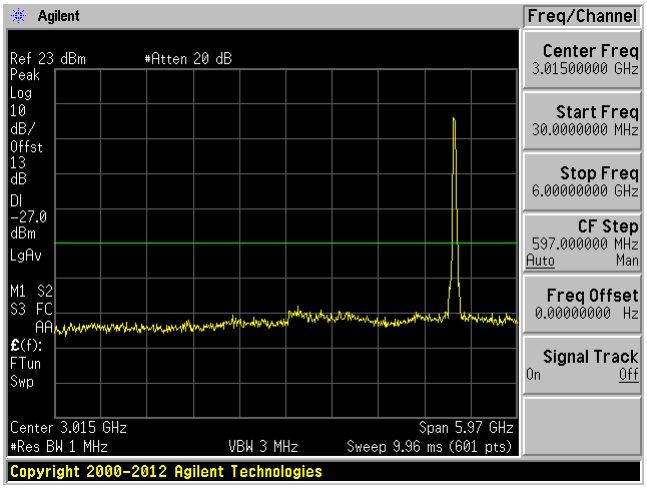


High 5240 MHz (6GHz – 40GHz)

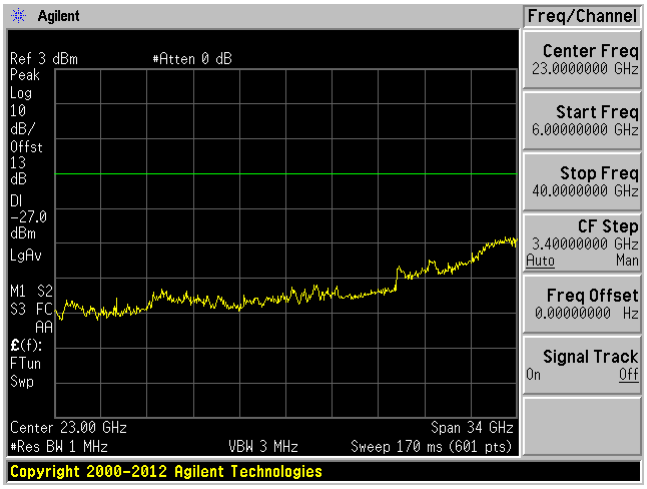


802.11ac40 mode

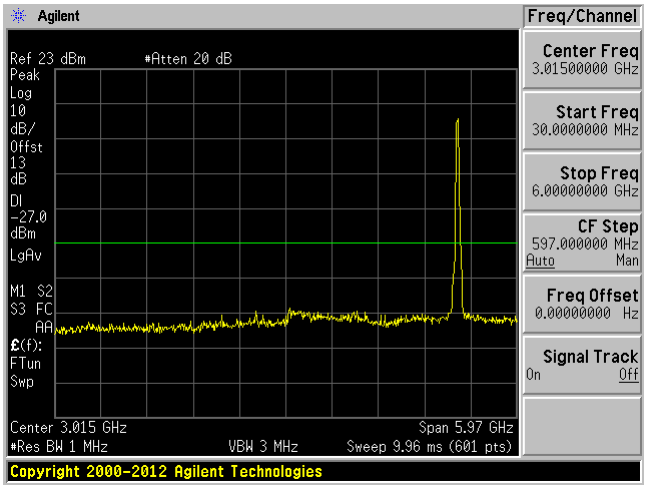
Low 5190MHz (30MHz-6GHz)



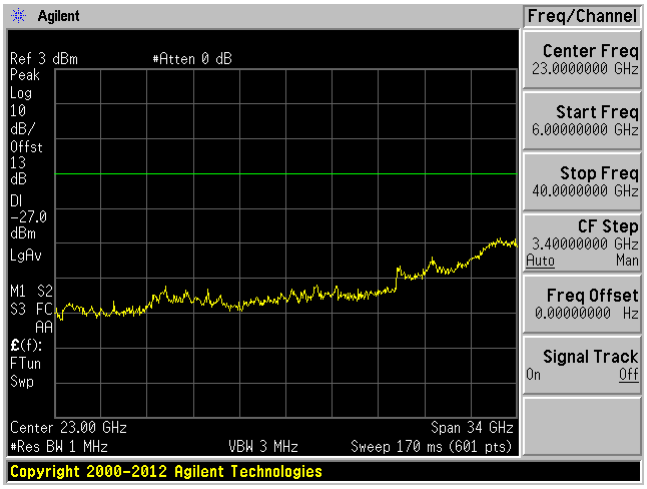
Low 5190 MHz (6-40GHz)



High 5230MHz (30MHz-6GHz)

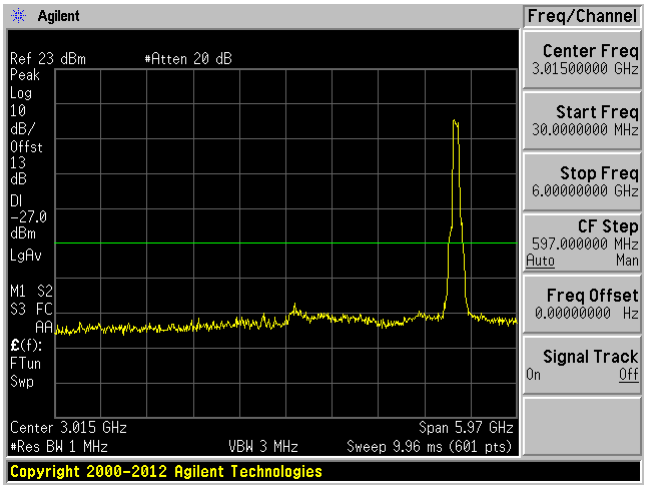


High 5230 MHz (6GHz – 40GHz)

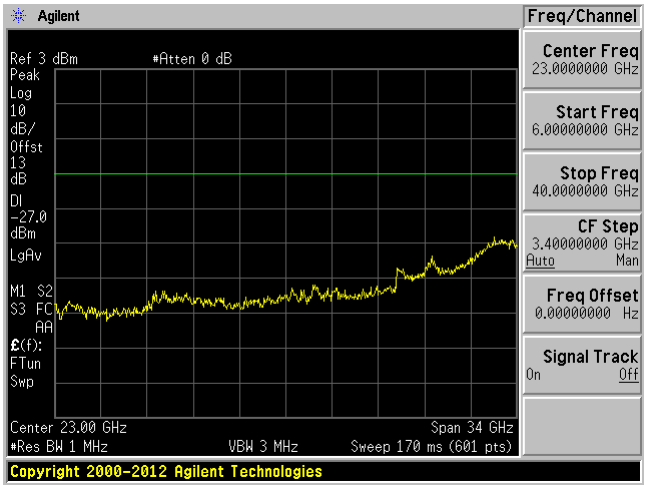


802.11ac80 mode

Middle 5210MHz (30MHz-6GHz)



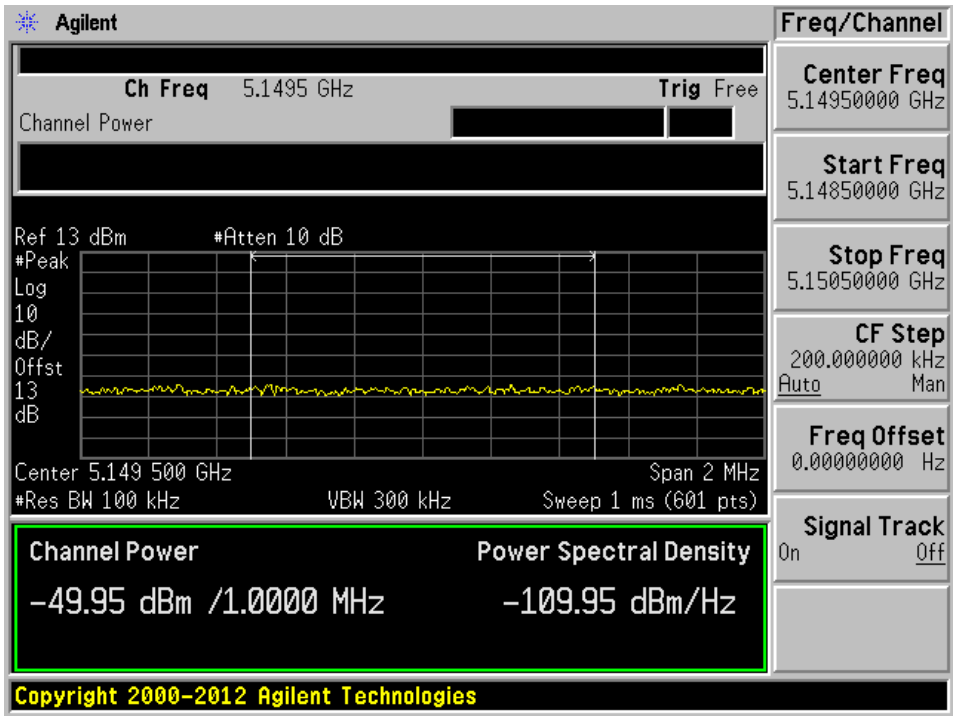
High 5210 MHz (6GHz – 40GHz)



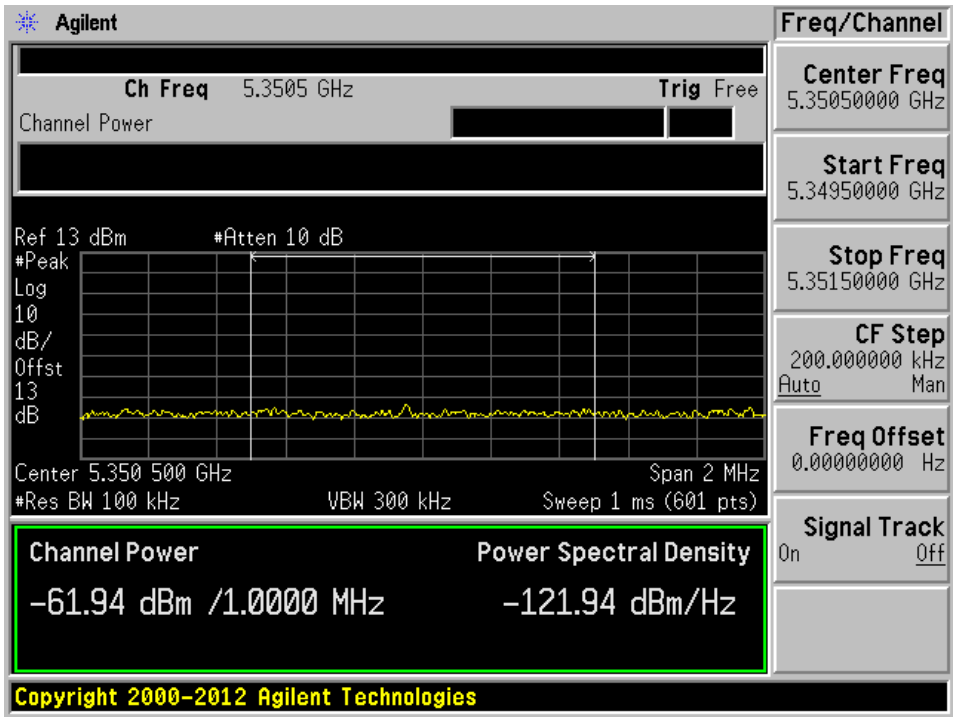
2) Band Edge EMissions

802.11a mode

802.11a Low channel: 5180 MHz

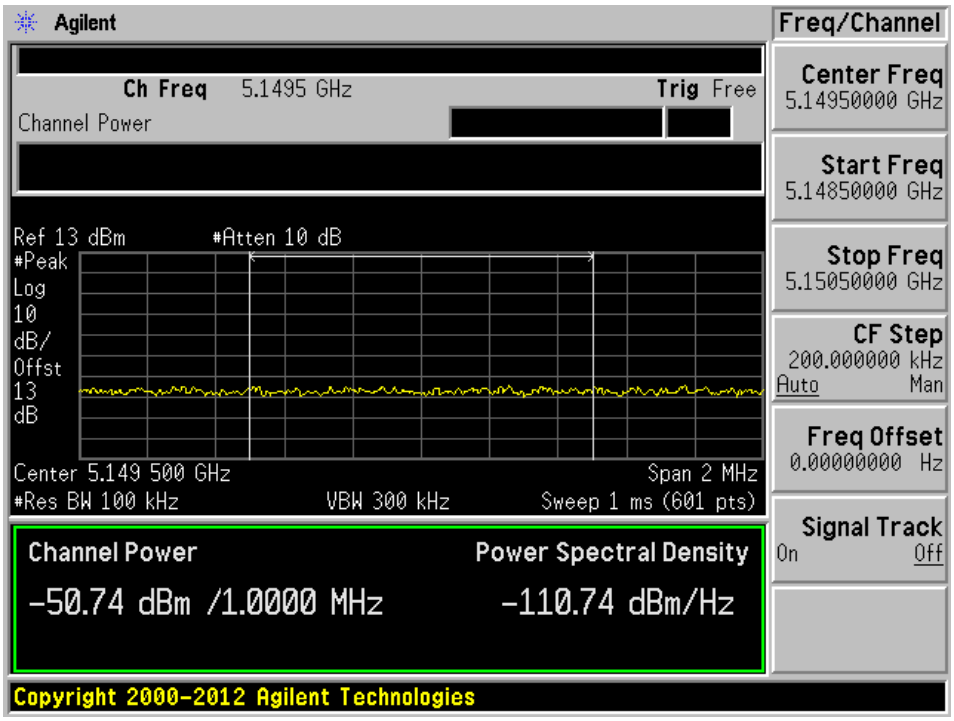


802.11a High channel: 5240 MHz

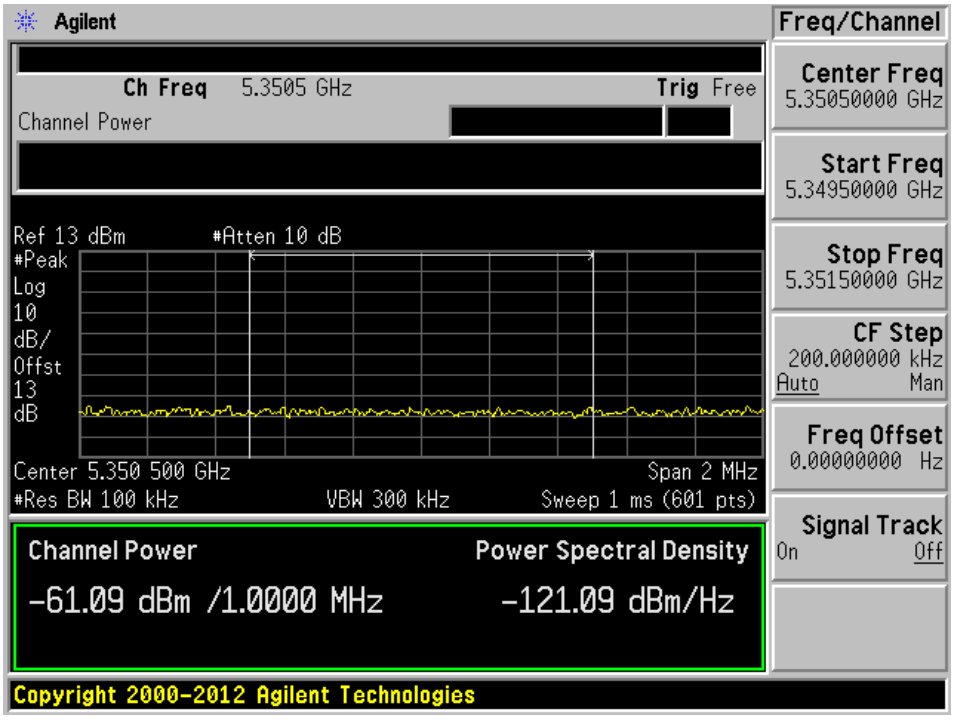


802.11n20 mode

802.11n20 Low channel: 5180 MHz

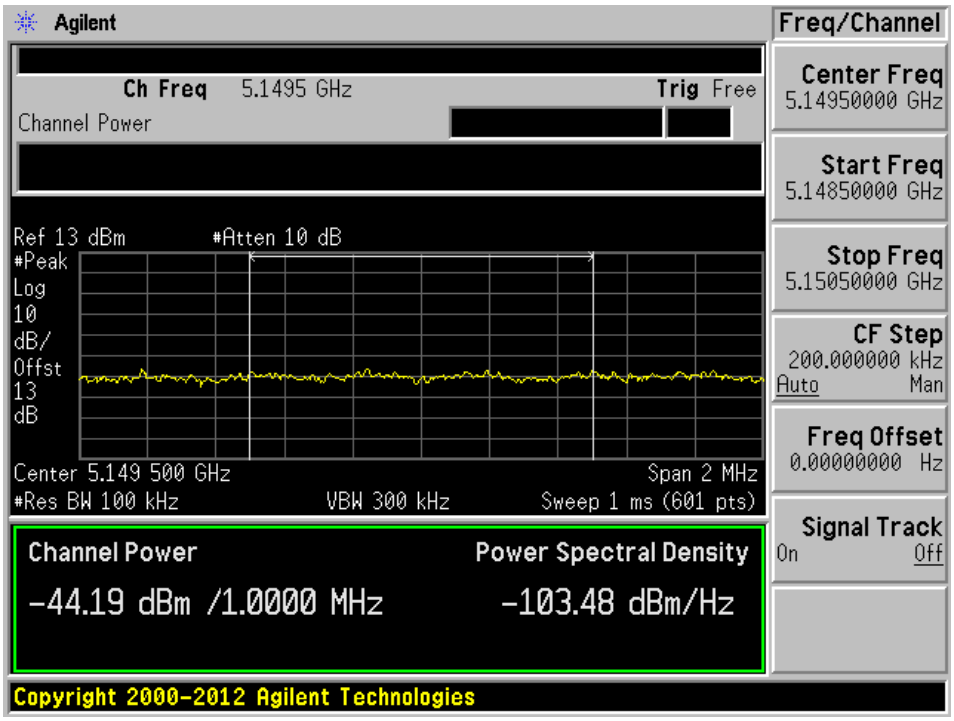


802.11n20 High channel: 5240 MHz

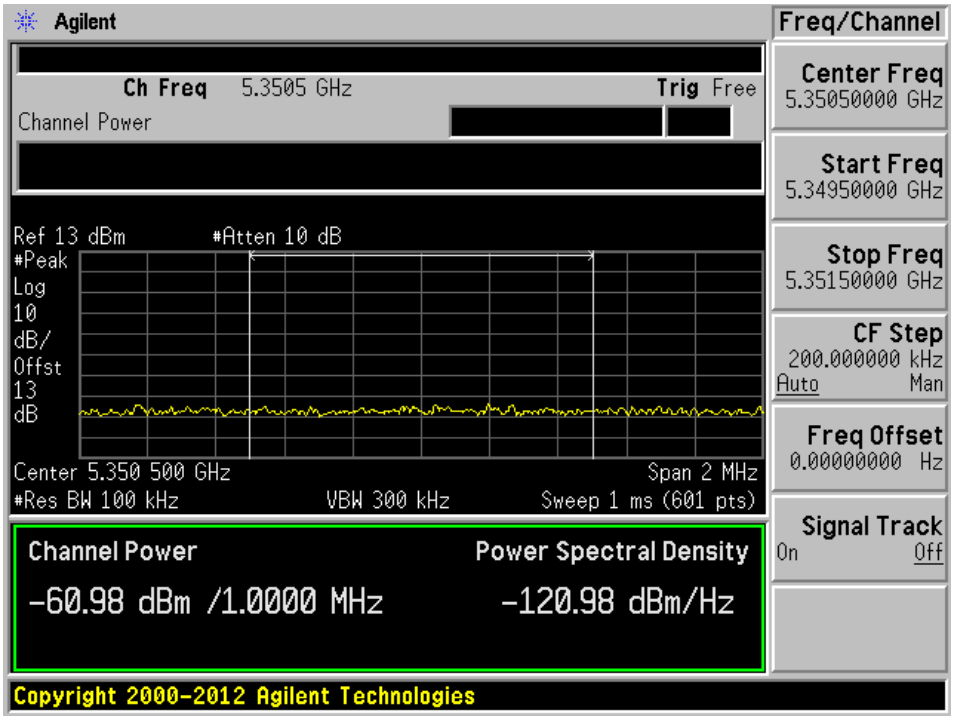


802.11n40 mode

802.11n40 Low channel: 5190 MHz

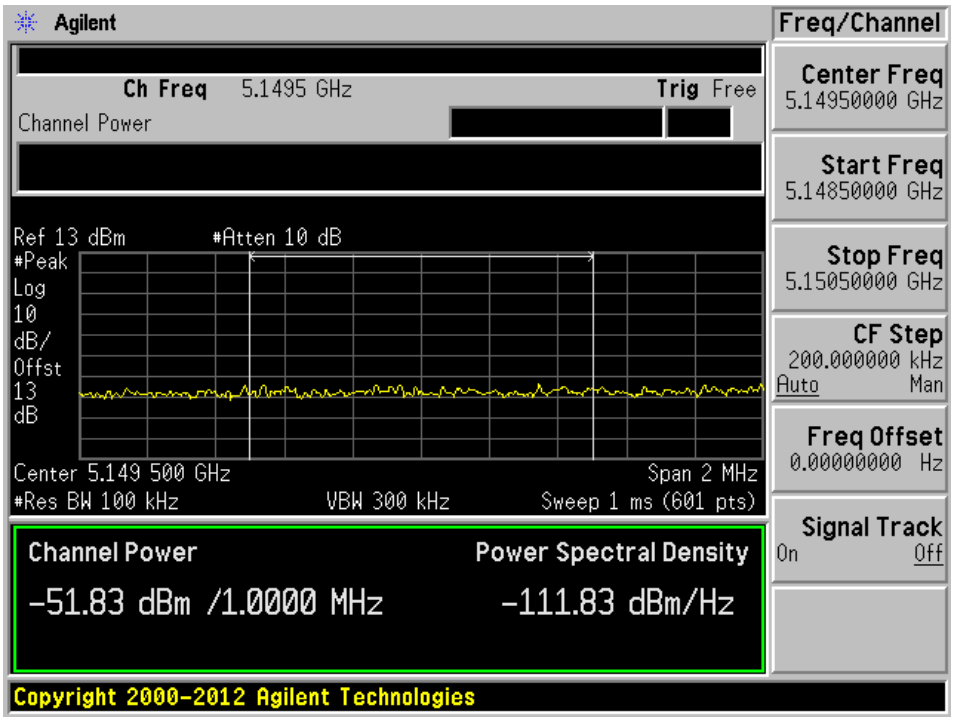


802.11n40 High channel: 5230 MHz

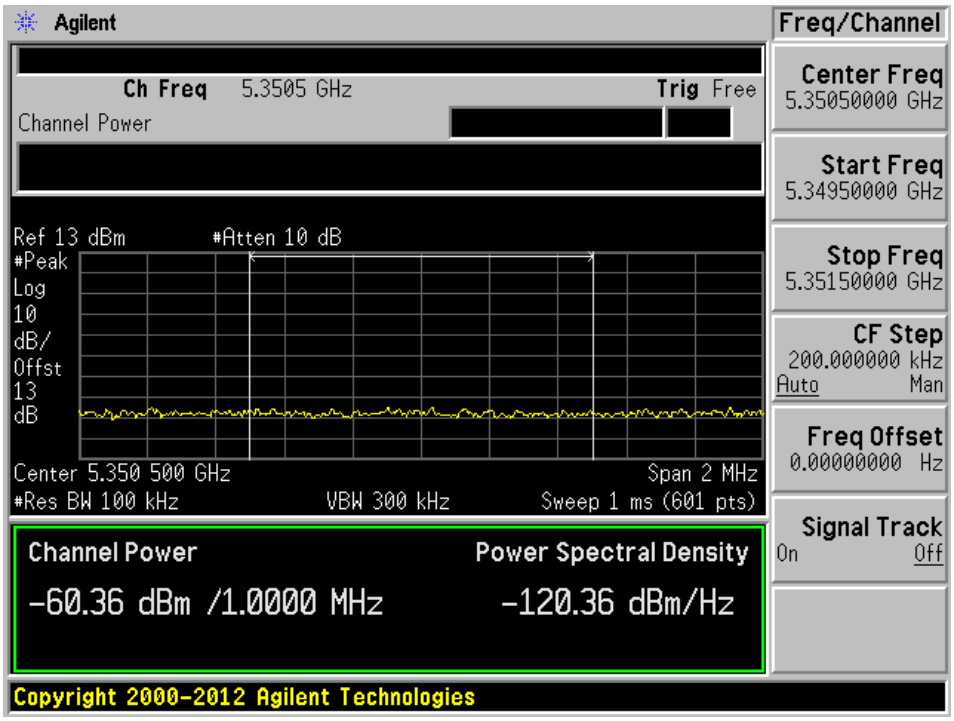


802.11ac20 mode

802.11ac20 Low channel: 5180 MHz

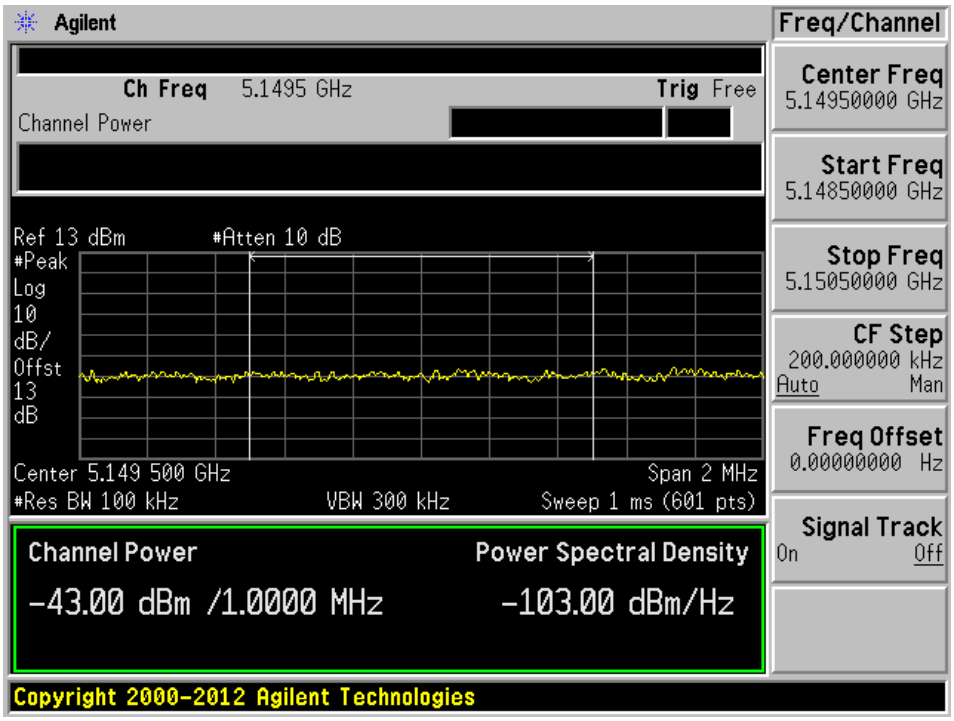


802.11ac20 High channel: 5240 MHz

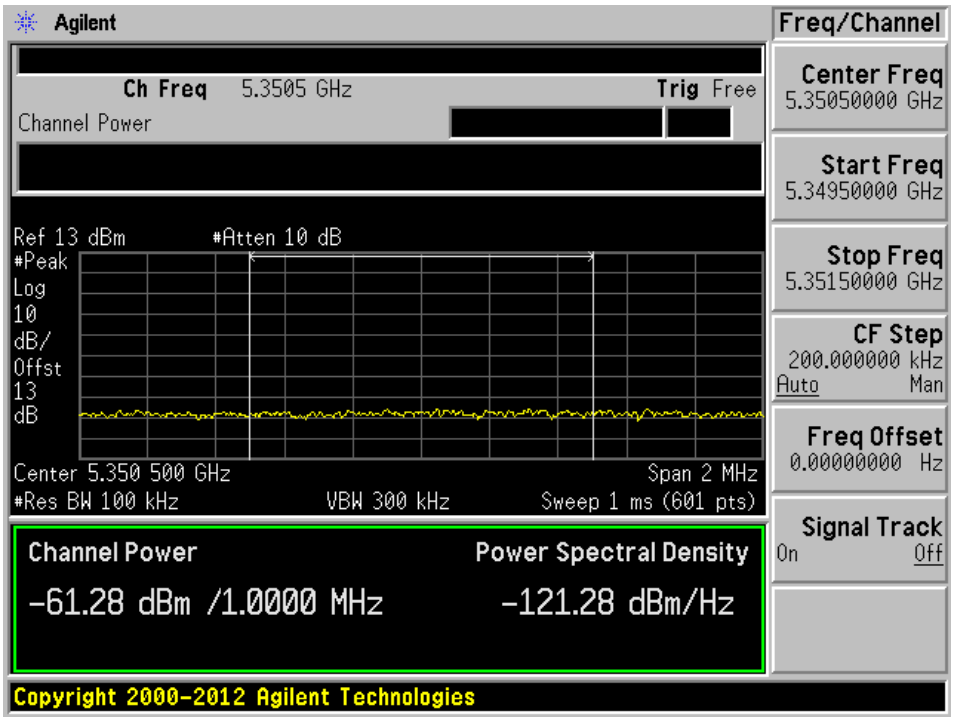


802.11ac40 mode

802.11ac40 Low channel: 5190 MHz

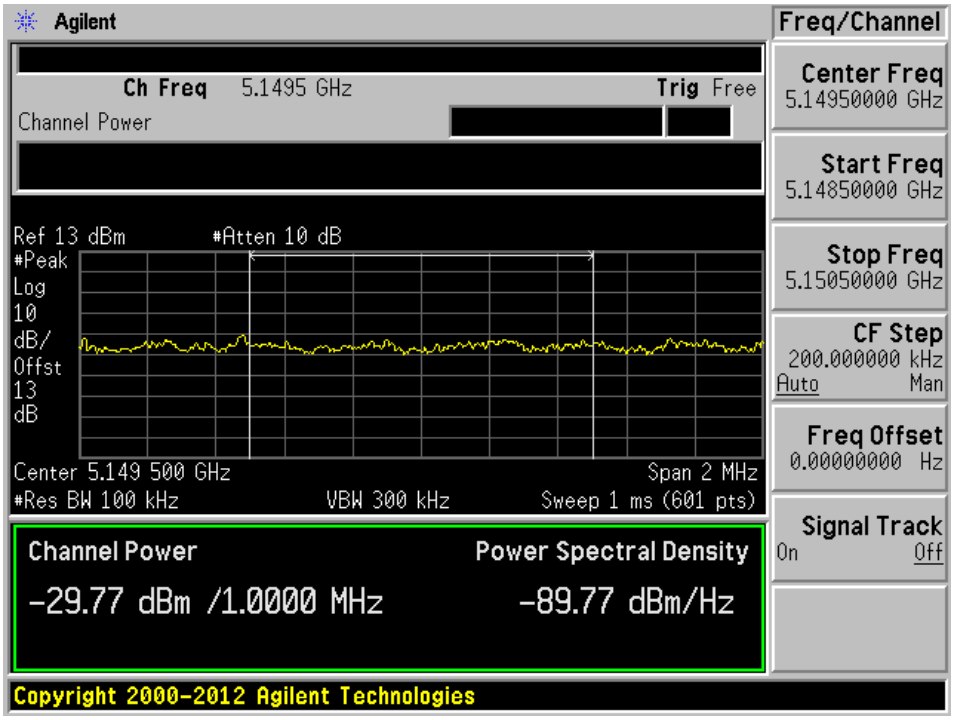


802.11ac40 High channel: 5230 MHz

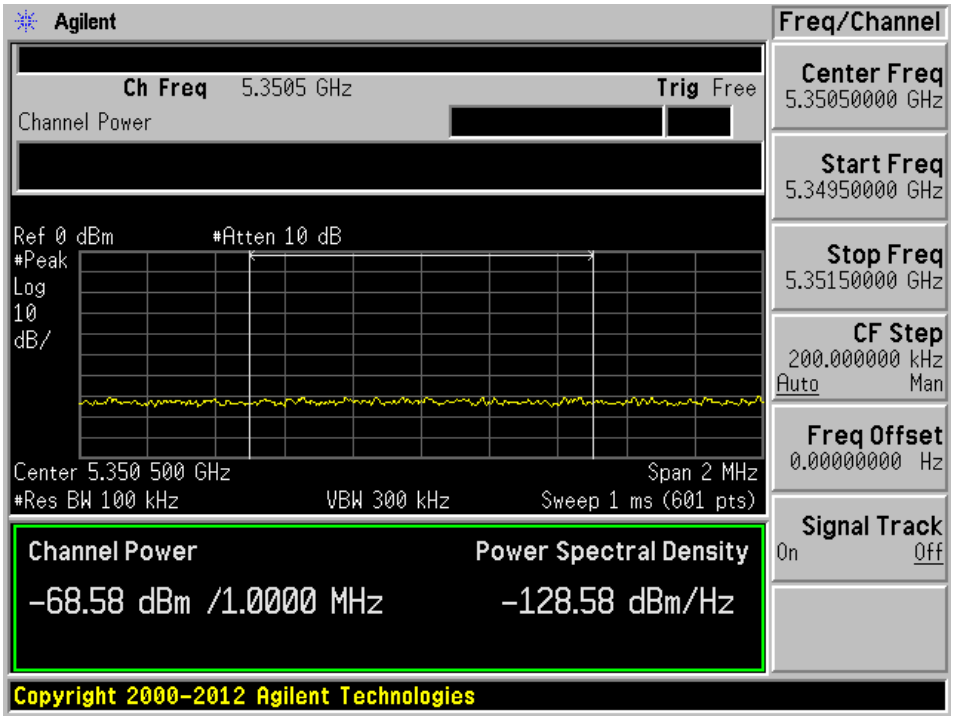


802.11ac80 mode

802.11ac80: 5210 MHz



802.11ac80: 5210 MHz



11 FCC §15.407(a) & IC RSS-247 §6.2 - Power Spectral Density

11.1 Applicable Standards

According to FCC §15.407(a) (1)

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum 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-247 §6.2

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	E440A	MY48250238	2014-09-03	1 year
-	RF cable	-	00609	2015-06-05	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:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Ronak Patel on 2015-07-09 to 2015-07-21 at RF site.

11.5 Test Results

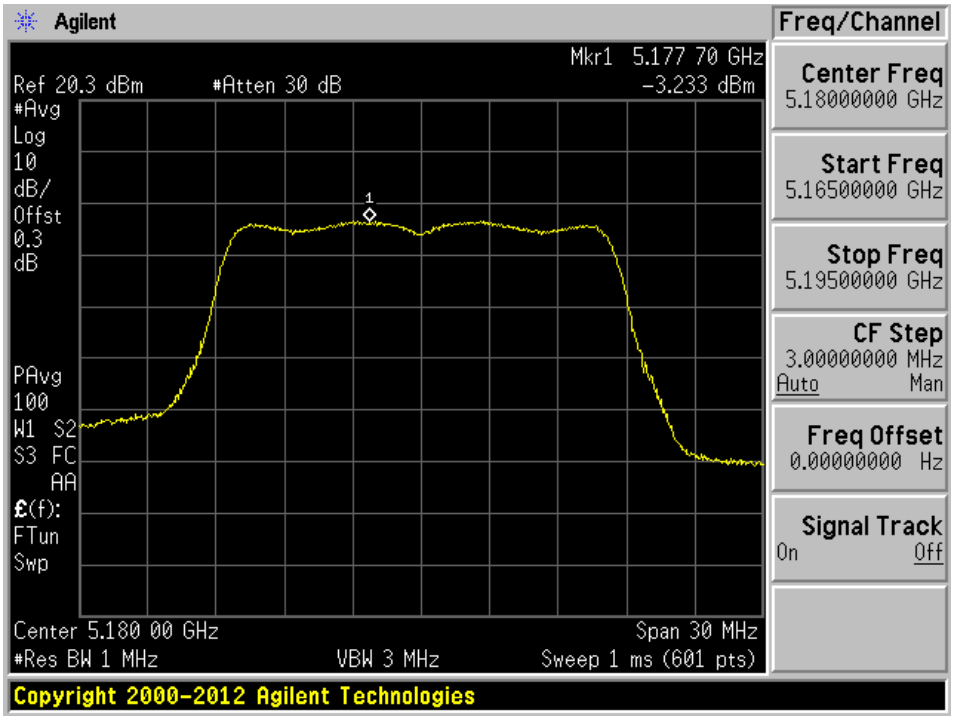
Channel	Frequency (MHz)	PSD (dBm)	FCC Limit (dBm)	IC Limit e.i.r.p. (dBm)
802.11a				
Low	5180	-3.233	11	10
Middle	5200	-3.269	11	10
High	5240	-3.487	11	10
802.11n20				
Low	5180	-2.999	11	10
Middle	5200	-3.430	11	10
High	5240	-3.323	11	10
802.11n40				
Low	5190	-6.743	11	10
High	5230	-7.307	11	10
802.11ac20				
Low	5180	-3.005	11	10
Middle	5200	-3.403	11	10
High	5240	-3.241	11	10
802.11ac40				
Low	5190	-5.948	11	10
High	5230	-6.818	11	10
802.11ac80				
-	5210	-6.931	11	10

Note: Antenna gain is 0.3 dBi

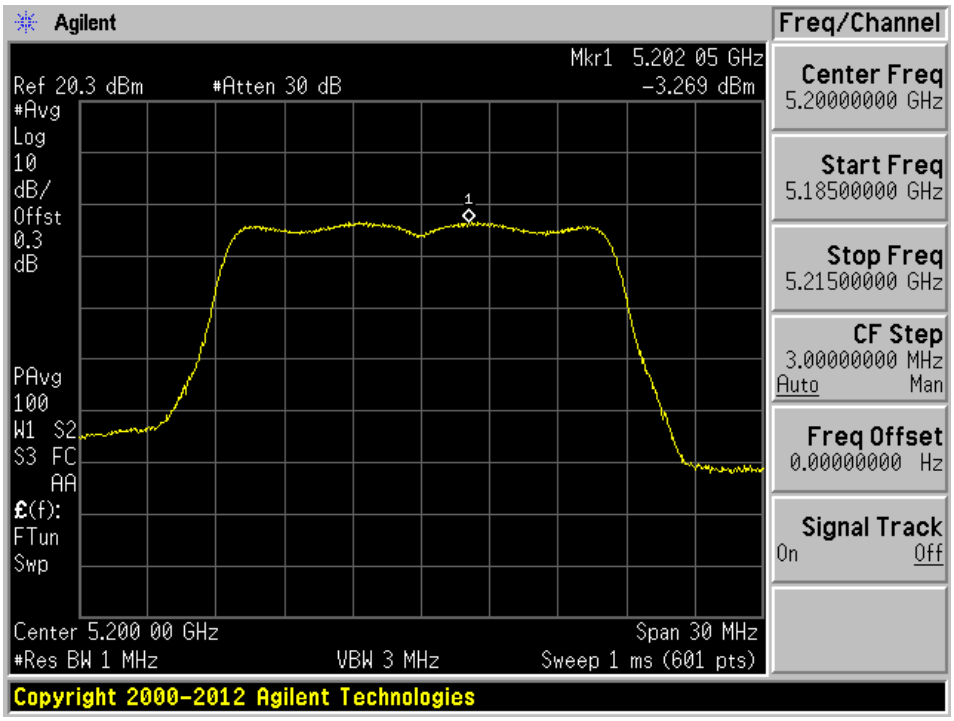
Please refer to the following plots

802.11a mode

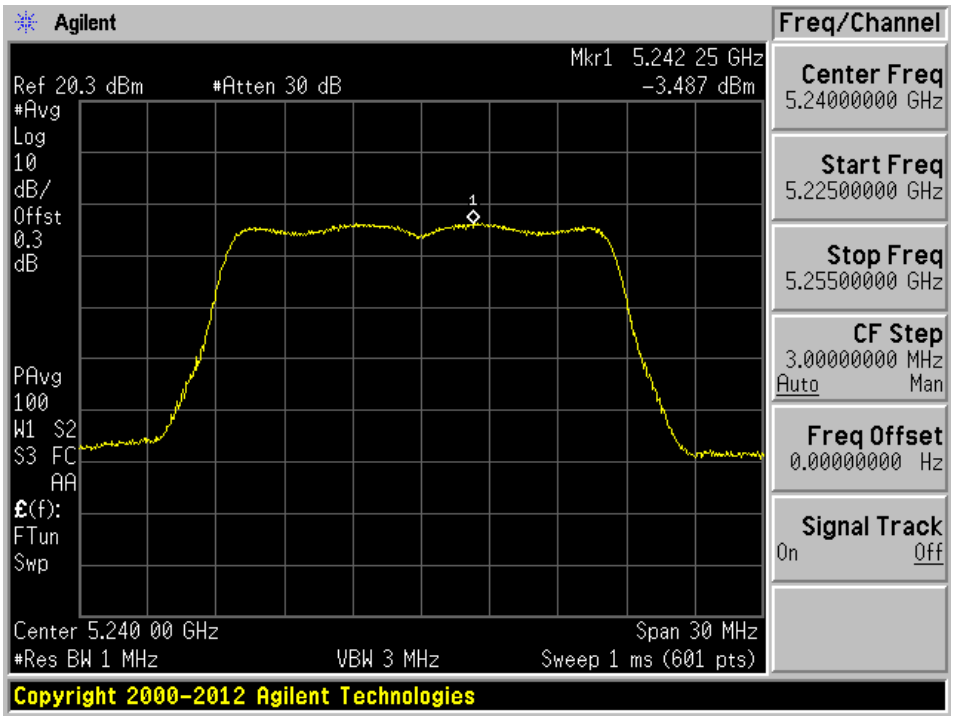
Low channel: 5180 MHz



Middle channel: 5200 MHz

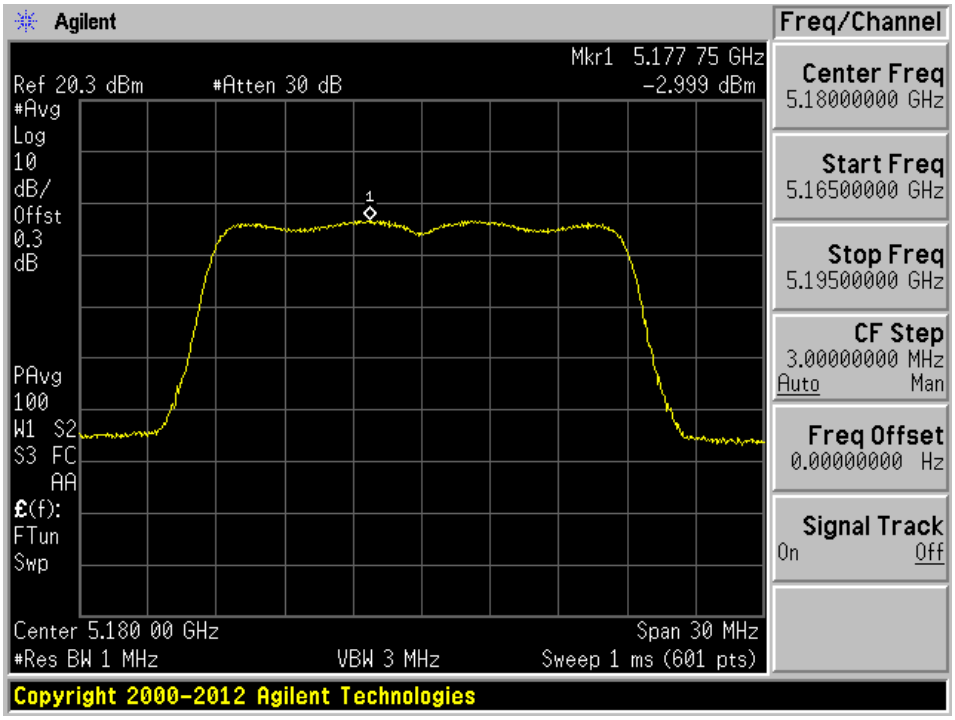


High channel: 5240 MHz

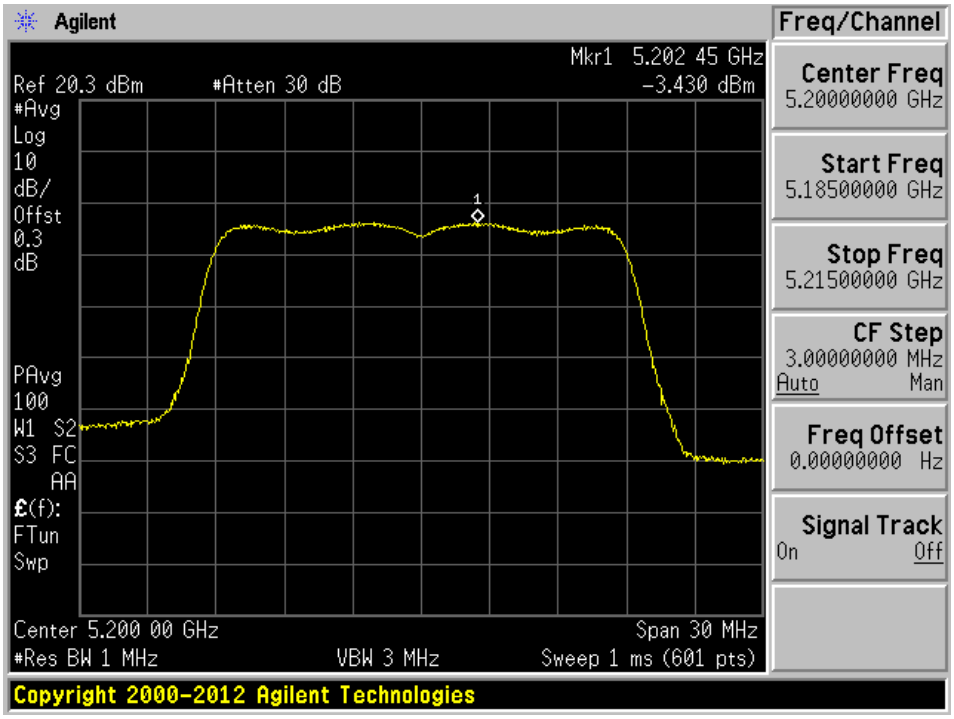


802.11n20 mode

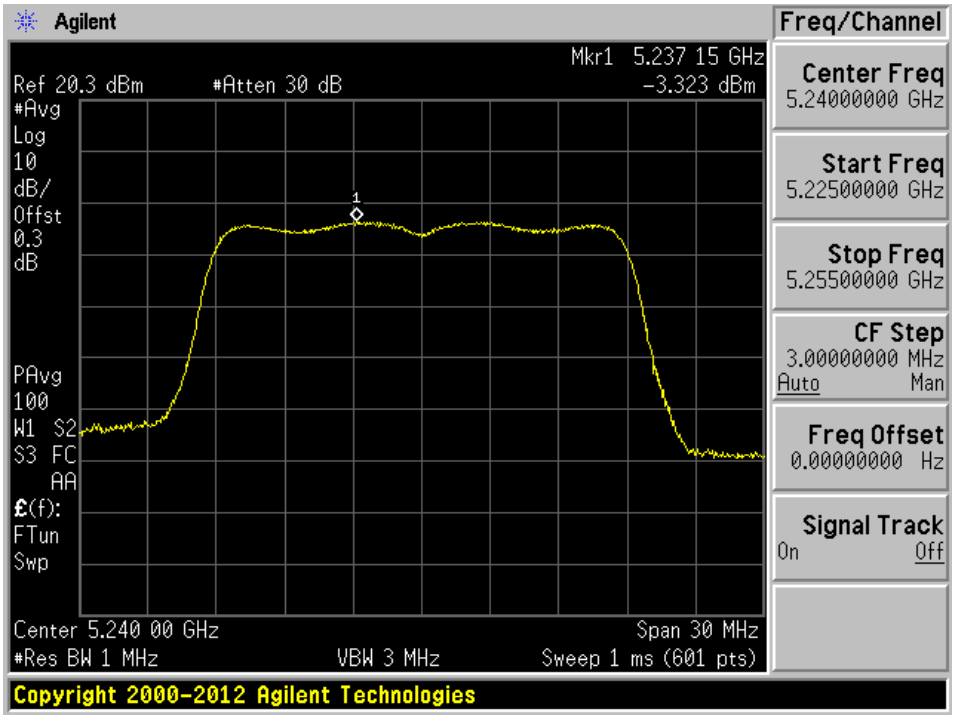
Low channel: 5180



Middle channel: 5200 MHz

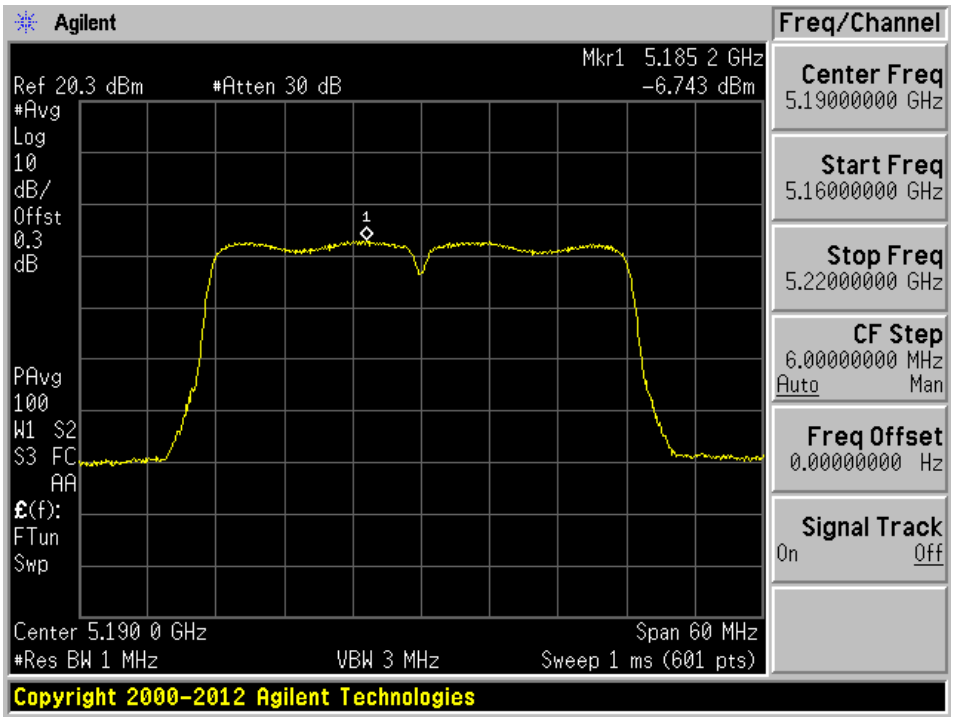


High channel: 5240 MHz

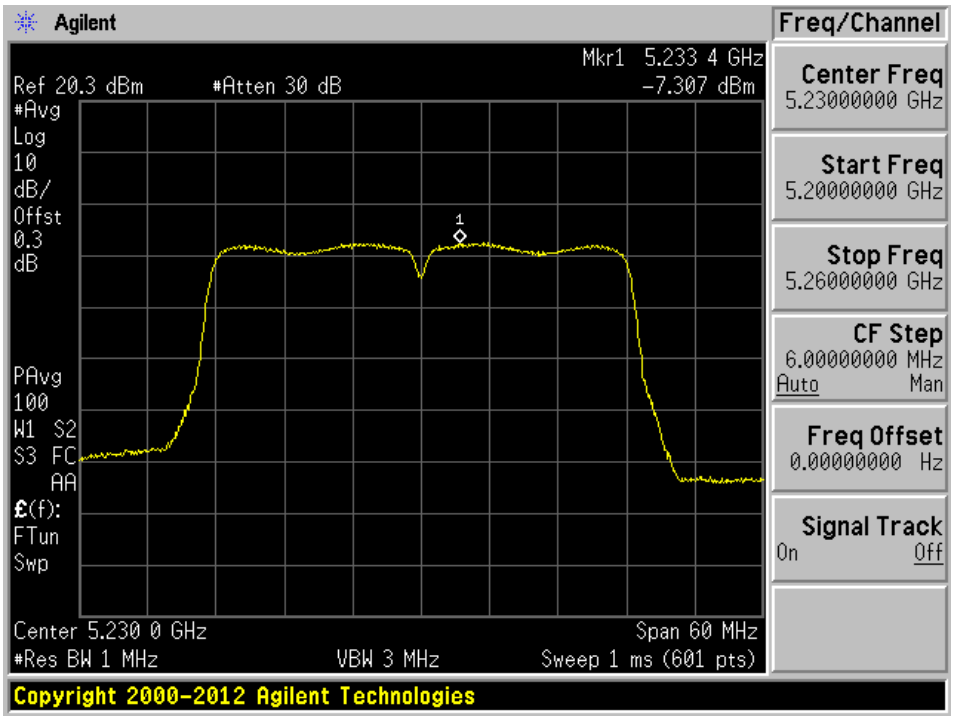


802.11n40 mode

Low channel: 5190 MHz

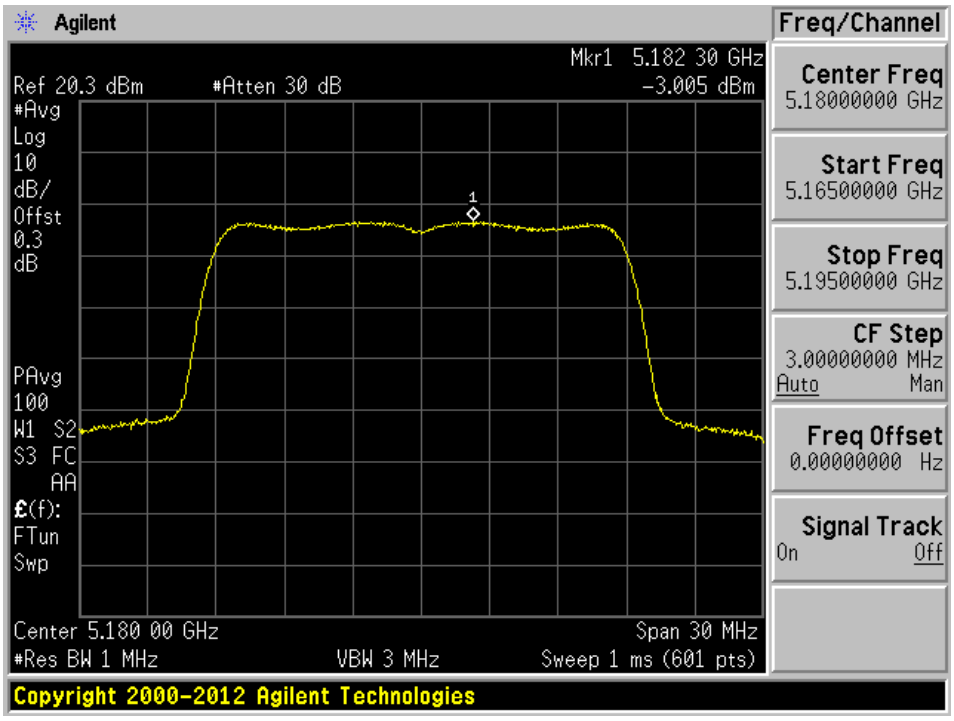


High channel: 5230 MHz

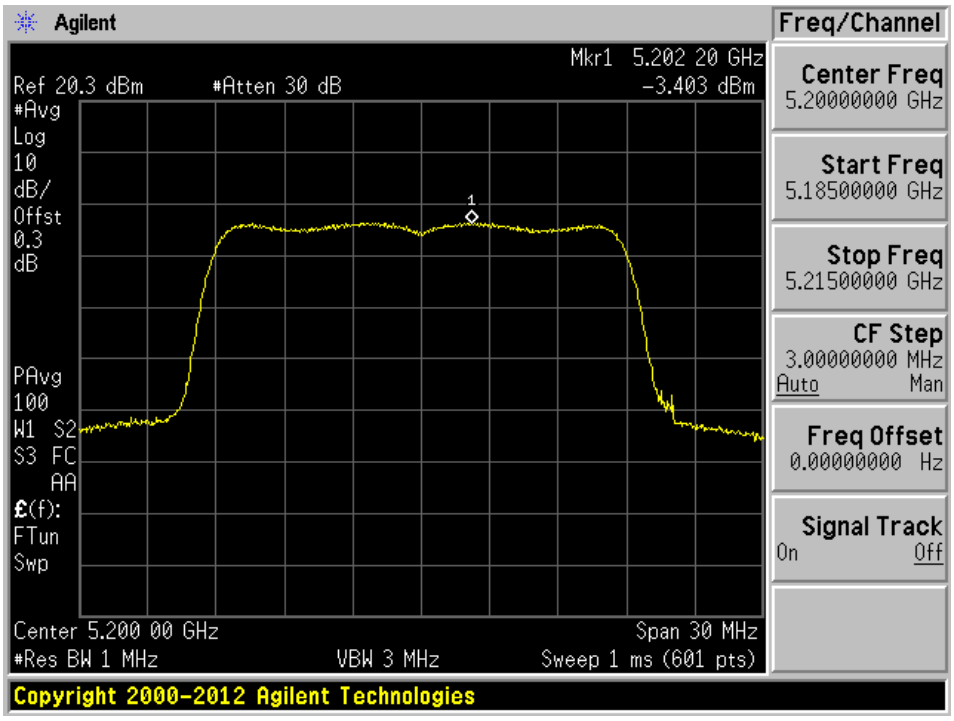


802.11ac20 mode

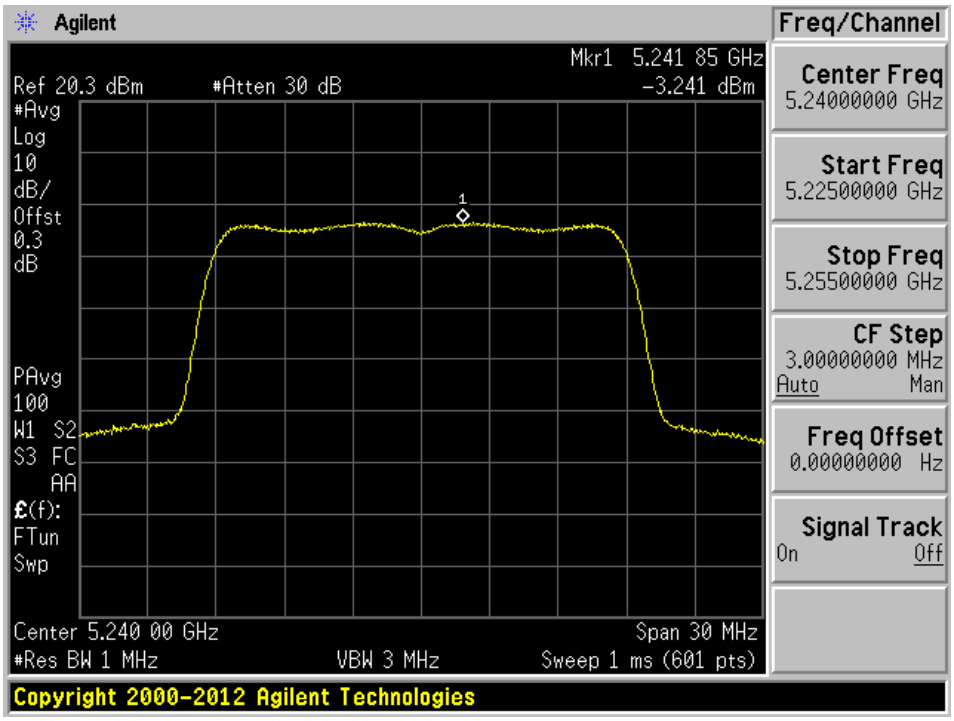
Low channel: 5180 MHz



Middle channel: 5200 MHz

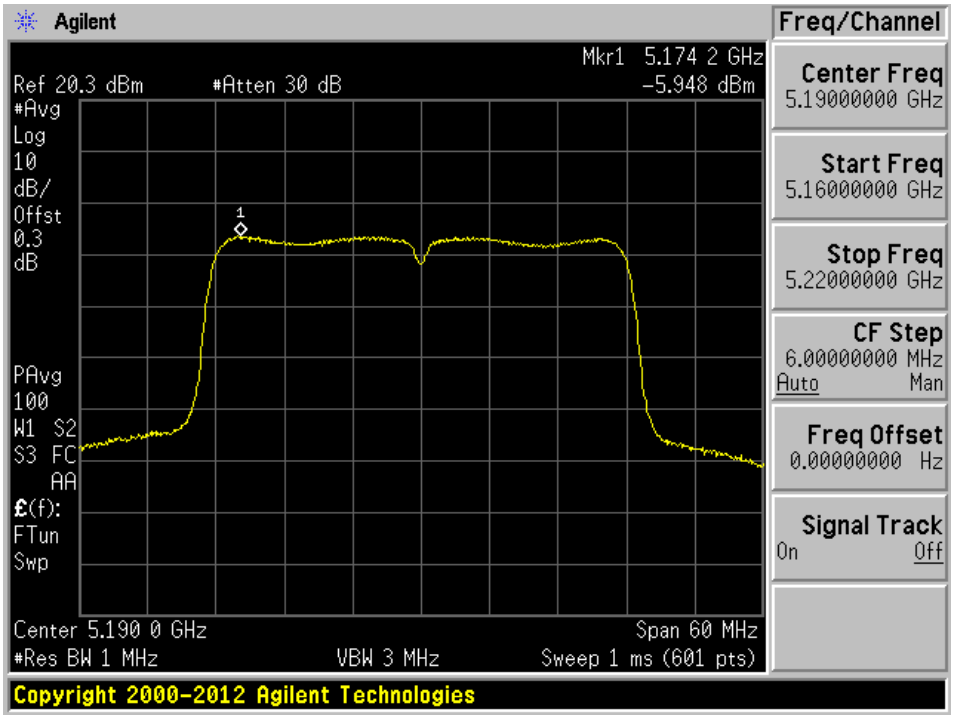


High channel: 5240 MHz

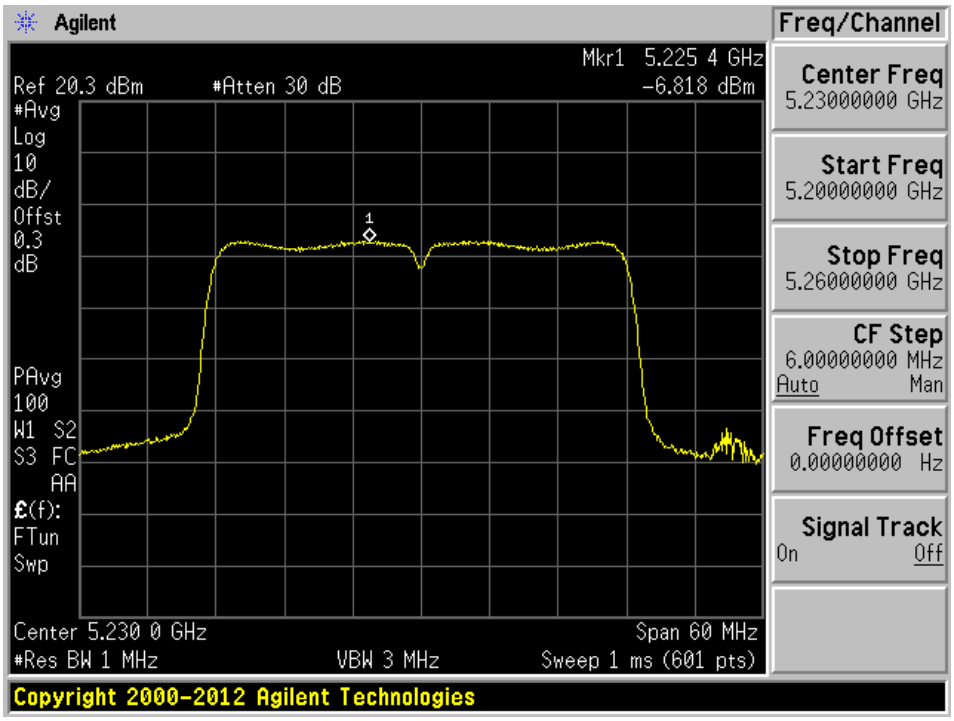


802.11ac40 mode

Low channel: 5190 MHz



High channel: 5230 MHz



802.11ac80 mode

5210 MHz