



# FCC PART 15.407



## TEST AND MEASUREMENT REPORT

For

### Aerohive Network, Inc.

330 Gibraltar Drive,  
Sunnyvale, CA 94089, USA

**FCC ID: WBV-AP230**

<b>Report Type:</b> Class II Permissive Change	<b>Product Type:</b> 802.11 a/b/g/n/ac Wireless Access Point
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\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" see 2.1

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### DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R16033114-407	CIIPC Report	2016-05-04

## 1 General Description

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### 1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *Aerohive Network, Inc.*, and their product model: *AP230*, *FCC ID: WBV-AP230* or the “EUT” as referred to in this report. The EUT is a 3x3 MIMO 802.11 a/b/g/n/ac Access Point.

### 1.2 Mechanical Description of EUT

The EUT measures approximately 185 mm (L) x 185 mm (W) x 50 mm (H) and weighs 0.75 kg.  
*The test data gathered are from typical production sample, serial number: R160331144-1 assigned by BACL*

### 1.3 Objective

This report is prepared on behalf of *Aerohive Network, Inc.* in accordance with FCC CFR47 §15.407. The objective is to determine compliance with FCC Part 15.407 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)

FCC Part 15, Subpart E, Equipment NII with FCC ID: *WBV-AP230*  
FCC Part 15, Subpart C, Equipment DTS with FCC ID: *WBV-AP230*

### 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 New Rules v01r01.

### 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 Luminaires 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:

Bay Area Compliance Laboratories Corp. (BACL) is:

**A- An independent, 3<sup>rd</sup>-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3279.02)**, in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (\*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

**B- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3279.03)** to certify

- For the USA (Federal Communications Commission):

- 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
- 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
- 3- All Telephone Terminal Equipment within FCC Scope C.

- For the Canada (Industry Canada):

- 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
- 2 All Scope 2-Licensed Personal Mobile Radio Services;
- 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
- 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
- 5 All Scope 5-Licensed Fixed Microwave Radio Services
- 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.

- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

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 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r01.

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 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 PuTTY, the software was verified by *Jin Yang* to comply with the standard requirements being tested against.

### 2.3 Equipment Modifications

N/A

### 2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude D630

### 2.5 EUT Internal Configuration Details

Manufacturer	Description	Model
Broadcom	CPU	BCM53016A1
SK hynic	RAM	H5TQ2G63FFR-PBC

### 2.6 Support Equipment

Manufacturer	Description	Model
PowerDsine	POE DC Power	PD-3501G/AC



## 2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	<1M	Laptop	EUT

### 3 Summary of Test Results

FCC Rules	Description of Test	Result
§2.1091, §15.407(f)	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207	AC Power Line Conducted Emissions	Compliant
§15.205, §15.209, §15.407(b)	Spurious Radiated Emissions	Compliant
§15.407(e)	Emission Bandwidth	Compliant
§407(a)	Output Power	Compliant
§15.407(b)	Band Edges	Compliant
§15.407(a)(5)	Power Spectral Density	Compliant
§15.407(b)	Spurious Emissions at Antenna Terminals	Compliant
§15.407(h)	Dynamic Frequency Selection (DFS)	N/A <sup>1</sup>

Note<sup>1</sup>: DFS is not required for 5.2 GHz band.

## 4 FCC §2.1091 & §15.407(f) - RF Exposure

### 4.1 Applicable Standards

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 <sup>2</sup> )	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 <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

### 4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

### 4.3 MPE Results

#### 5.2 GHz Band

##### Non-Beamforming

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>24.83</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>304.0885</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>11.13</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>12.9718</u>
<u>Power density of prediction frequency at 25.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.5025</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

### Beamforming

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>24.28</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>267.9168</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>11.13</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>12.9718</u>
<u>Power density of prediction frequency at 25.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.4425</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure at the distance of 25 cm.

### Co-location Evaluation:

2.4 GHz and 5 GHz bands can transmit simultaneously. Per FCC KDB 447498, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1. Please refer 2.4GHz WiFi data with original application report results. (FCC ID: WBV-AP230).

### 2.4 GHz Wi-Fi, Non-Beamforming

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>26.71</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>468.8134</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>8.87</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>7.709</u>
<u>Power density of prediction frequency at 25.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.4602</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

### 2.4 GHz Wi-Fi, Beamforming

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>26.8</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>478.6301</u>
<u>Prediction distance (cm):</u>	<u>25</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>8.87</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>7.709</u>
<u>Power density of prediction frequency at 25.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.47</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

Frequency Band	Max Conducted Power (dBm)	Evaluated Distance (cm)	Worst-Case MPE (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
Non-Beamforming							
2.4 GHz	26.71	25	0.4602	1.0	46.02 %	96.27 %	100 %
5.2 GHz	24.83	25	0.5025	1.0	50.25 %		
Beamforming							
2.4 GHz	26.8	25	0.47	1.0	47 %	91.25 %	100 %
5.2 GHz	24.28	25	0.4425	1.0	44.25 %		

The device is compliant with the requirement MPE limit for uncontrolled exposure at the distance of 25 cm.

## 5 FCC §15.203 - 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 §15.407, if transmitting antennas of directional gain greater than 6 dBi are used, the corresponding measurement such as power, PSD, etc. shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 5.2 Antenna List

The antennas used by the EUT are permanent attached antennas.

Antenna Chain	Antenna Gain (dBi) @ 5.2 GHz
Chain 4	6.24
Chain 5	6.13
Chain 6	6.7

## 6 FCC §15.207 - AC Power Line Conducted Emissions

### 6.1 Applicable Standards

As per FCC §15.207

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  $\mu$ H/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.

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.

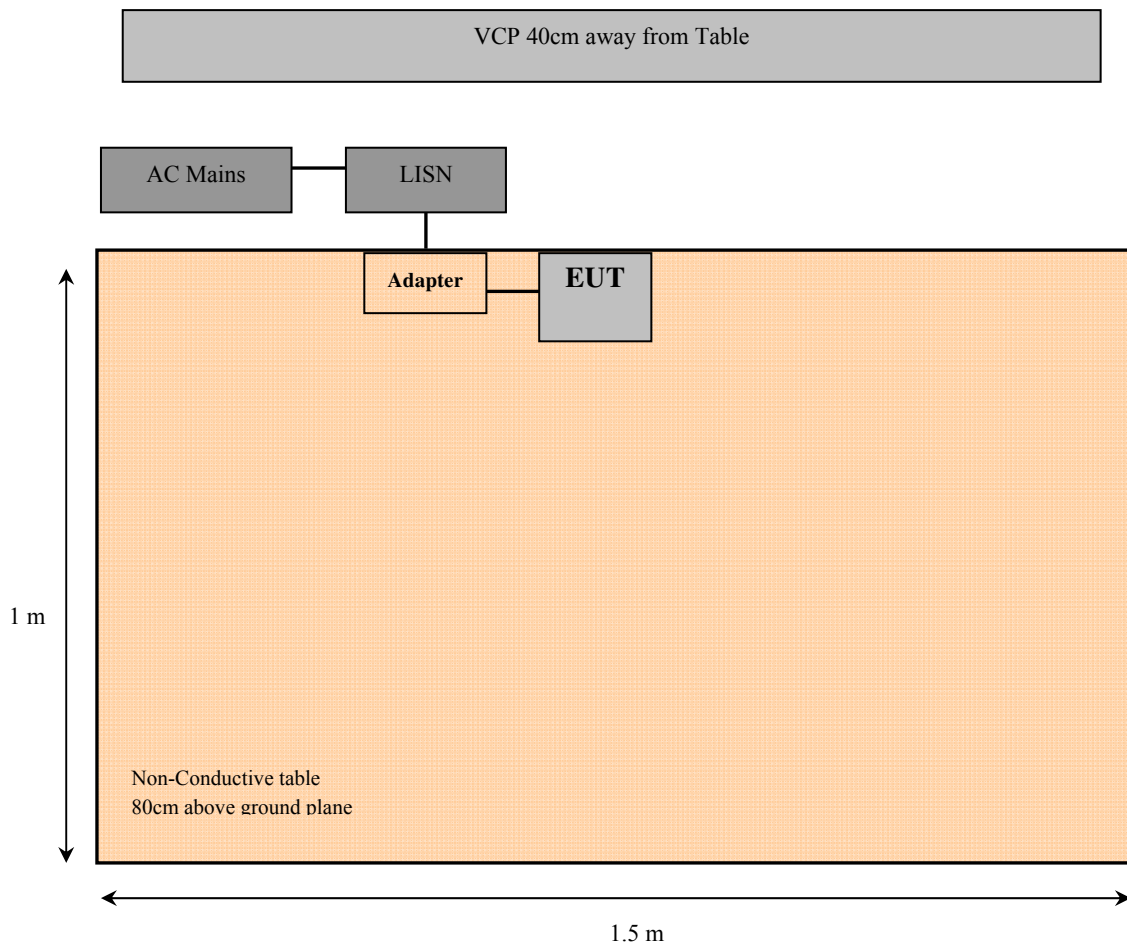
### 6.3 Test Procedure

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 cords of support equipment were connected to LISN-2.

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

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

## 6.4 Test Setup Block Diagram



## 6.5 Corrected Amplitude & Margin Calculation

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

$$CA = Ai + CL + Atten$$

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

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

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$



## 6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101963	2015-07-15	1 year
Keysight Technologies	RF Limiter	11867A	MY42242932	2015-12-15	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2016-03-09	1 Year
FCC	LISN	FCC-LISN-50-2-10-CISPR16 1PA ANSI 14	160130	2016-04-12	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2016-03-05	1 year

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

## 6.7 Test Environmental Conditions

<b>Temperature:</b>	22-24° C
<b>Relative Humidity:</b>	40-41 %
<b>ATM Pressure:</b>	103.1-104.1 kPa

The testing was performed by Jin Yang on 2016-04-18 at 5 meter 3.

## 6.8 Summary of Test Results

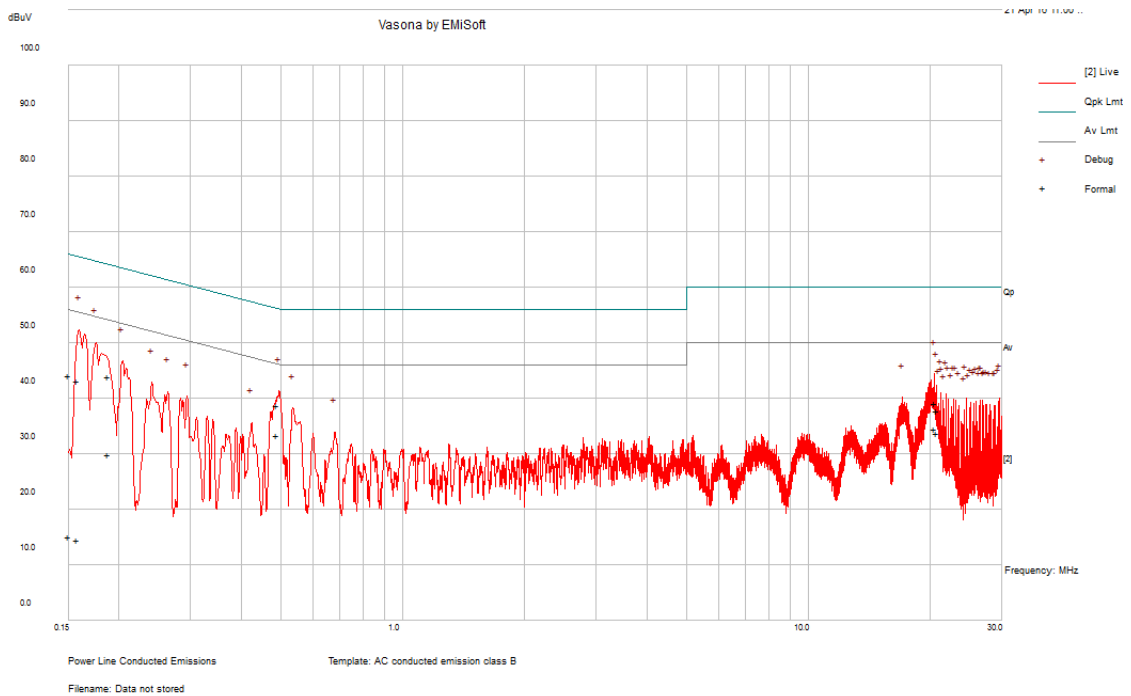
According to the recorded data in following table, the EUT complied with the FCC Part 15.207 conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	Frequency (MHz)	Conductor Mode (Live/Neutral)	Range (MHz)
-12.69	0.490149	Live	0.15-30

### 6.9 Conducted Emissions Test Plots and Data

Note: EUT was configured to co-located mode with 2.4 GHz and 5 GHz activated while testing.

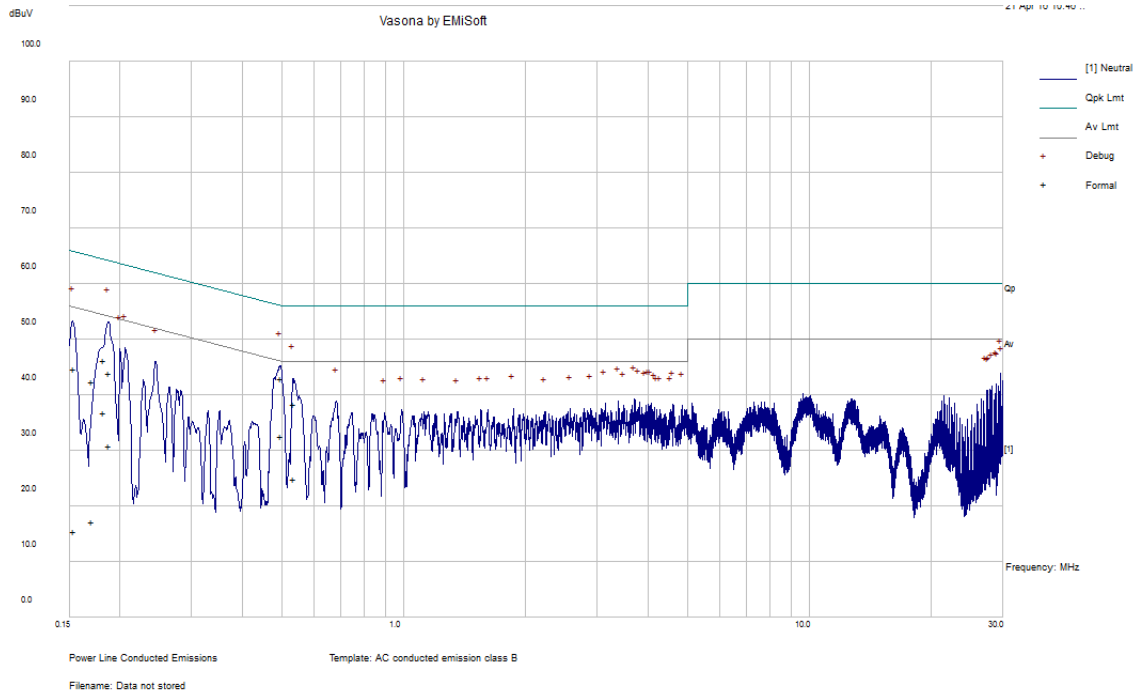
#### 120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.15051	44.19	Line	65.97	-21.78	QP
0.158163	43.15	Line	65.56	-22.41	QP
0.490149	38.82	Line	56.17	-17.35	QP
20.45641	39.08	Line	60	-20.92	QP
0.188508	43.97	Line	64.1	-20.13	QP
20.69472	37.89	Line	60	-22.11	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.15051	15.1	Line	55.97	-40.87	Ave
0.158163	14.54	Line	55.56	-41.02	Ave
0.490149	33.48	Line	46.17	-12.69	Ave
20.45641	34.61	Line	50	-15.39	Ave
0.188508	29.98	Line	54.1	-24.12	Ave
20.69472	33.69	Line	50	-16.31	Ave

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.498012	42.97	Neutral	56.03	-13.06	QP
0.170382	42.49	Neutral	64.94	-22.45	QP
0.154023	44.72	Neutral	65.78	-21.06	QP
0.535317	38.46	Neutral	56	-17.54	QP
0.188628	43.88	Neutral	64.1	-20.21	QP
0.182925	46.26	Neutral	64.35	-18.1	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.498012	32.72	Neutral	46.03	-13.32	Ave
0.170382	17.29	Neutral	54.94	-37.65	Ave
0.154023	15.59	Neutral	55.78	-40.19	Ave
0.535317	25	Neutral	46	-21	Ave
0.188628	31	Neutral	54.1	-23.1	Ave
0.182925	36.81	Neutral	54.35	-17.54	Ave

## 7 FCC §15.205, §15.209 & §15.407(b) - Spurious Radiated Emissions

### 7.1 Applicable Standard

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 §15.209: 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 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) 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.

(3) For transmitters operating in the 5.47 -5.725 GHz band: All emissions outside of the 5.47-5725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall noet exceed an e.i.r.p. of -27 dBm/MHz.

(5) 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.

(6) 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.

(7) The provisions of §15.205 apply to intentional radiators operating under this section.

## 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 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 0.8 meter or 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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

## 7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2015-07-23	1 year
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2015-07-11	2 years
EMCO	Antenna, Horn	3115	9511-4627	2016-01-28	2 years
Agilent	Amplifier, Pre	8447D	2944A10187	2015-06-09	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	2016-03-05	1 year
-	SMA cable	-	C0002	Each time <sup>1</sup>	N/A
IW Microwave	High Frequency Cable	DC-1438	SPS-2303-3840-SPS	2016-01-18	1 year
IW	AOBOR Hi frequency Co AX CabelCable	DC 1531	KPS-1501A3960KPS	2015-08-10	1 Year
Hewlett-Packard	5 ft N-type RF cable	-	1268	2015-05-15	1 year
Hewlett	Pre-Amplifier	8449B	3008A01978	2015-09-02	1year
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2013-09-20	3 year
Wisewave	Antenna, Horn	ARH-2823-02	10555-02	2013-09-20	3 year
Wisewave	Amplifier, Low Noise	ALN-33144030-01	11424-01	2015-04-28	1 year
Wisewave	Amplifier, Low Noise	ALN-22093530-01	12263-01	2015-04-28	1 year

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

## 7.6 Test Environmental Conditions

<b>Temperature:</b>	22-24 °C
<b>Relative Humidity:</b>	40-41 %
<b>ATM Pressure:</b>	103.1-104.1 kPa

The testing was performed by Jin Yang from 2016-04-18 at 5 meter 3.

## 7.7 Summary of Test Results

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

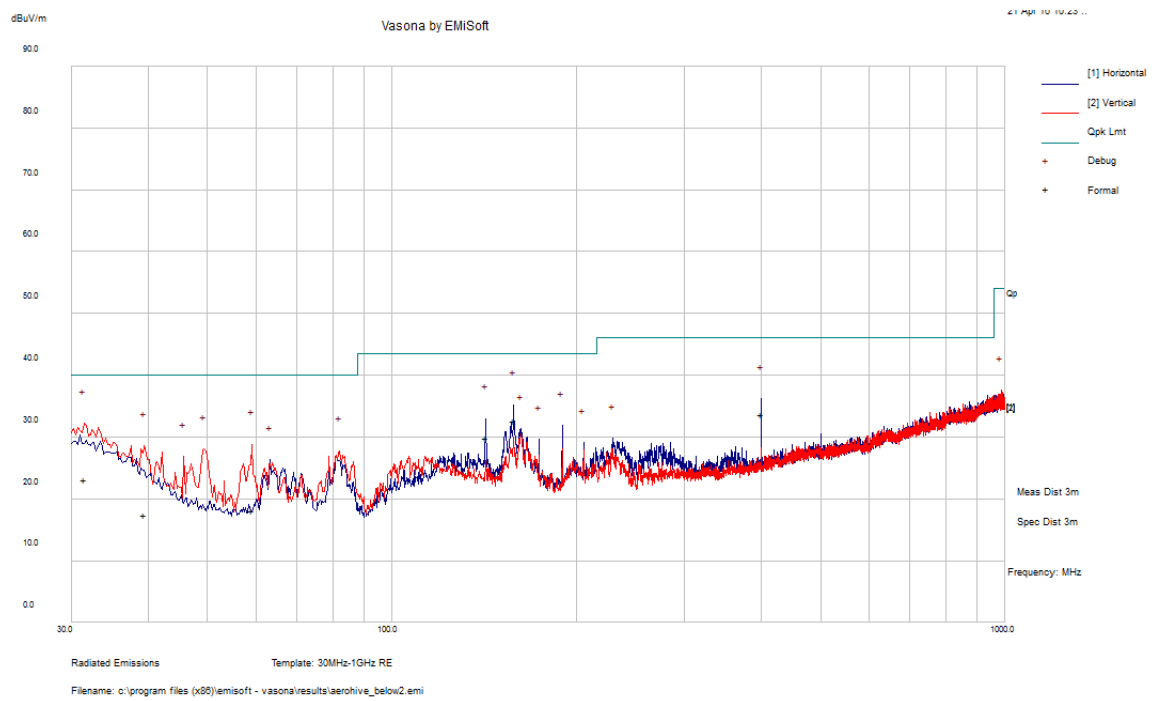
**Note:** After pre-testing, the non-beamforming mode is the worst case. Therefore the report only includes the test results of non-beamforming mode.

<b>Mode: Transmitting</b>			
<b>Margin (dB)</b>	<b>Frequency (MHz)</b>	<b>Polarization (Horizontal/Vertical)</b>	<b>Mode, Channel</b>
-2.01	15690	Horizontal	Co-location

### 7.8 Radiated Emissions Test Result Data

#### 1) 30 MHz – 1 GHz

Note: EUT was configured to co-located mode with 2.4 GHz and 5 GHz activated while testing.



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comments
31.50875	23.06	265	V	212	40	-16.94	Pass
157.9575	32.63	279	H	16	43.5	-10.87	Pass
399.999	33.65	102	H	44	46	-12.35	Pass
142.2123	29.85	178	H	58	43.5	-13.65	Pass
59.2815	18.06	128	V	172	40	-21.94	Pass
39.4725	17.48	244	V	32	40	-22.52	Pass



## 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		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	70.9	223	143	V	33.915	8.114	-	112.929	-	-	Peak
5180	63.42	161	164	H	33.947	8.114	-	105.481	-	-	Peak
5180	58.51	223	143	V	33.915	8.114	-	100.539	-	-	Ave
5180	53.1	161	164	H	33.947	8.114	-	95.161	-	-	Ave
5150	55.95	223	143	V	33.915	8.114	36.51	61.469	74	-12.531	Peak
5150	52.49	161	164	H	33.947	8.114	36.51	58.041	74	-15.959	Peak
5150	40.34	223	143	V	33.915	8.114	36.51	45.859	54	-8.141	Ave
5150	37.55	161	164	H	33.947	8.114	36.51	43.101	54	-10.899	Ave
10360	47.78	228	161	V	39.459	11.836	36.68	62.395	74	-11.605	Peak
10360	47.1	160	165	H	39.525	11.836	36.68	61.781	74	-12.219	Peak
10360	33.24	228	161	V	39.459	11.836	36.68	47.855	54	-6.145	Ave
10360	32.78	160	165	H	39.525	11.836	36.68	47.461	54	-6.539	Ave
15540	47.34	0	100	V	38.991	14.876	36.01	65.197	74	-8.803	Peak
15540	47.17	0	100	H	39.08	14.876	36.01	65.116	74	-8.884	Peak
15540	32.45	0	100	V	38.991	14.876	36.01	50.307	54	-3.693	Ave
15540	32.47	0	100	H	39.08	14.876	36.01	50.416	54	-3.584	Ave
Middle Channel 5220 MHz											
5220	69.91	184	154	V	33.915	8.114	-	111.939	-	-	Peak
5220	64.08	137	175	H	33.947	8.114	-	106.141	-	-	Peak
5220	59.37	184	154	V	33.915	8.114	-	101.399	-	-	Ave
5220	53.66	137	175	H	33.947	8.114	-	95.721	-	-	Ave
10440	47.71	0	100	V	39.459	11.836	36.63	62.38	74	-11.63	Peak
10440	46.90	0	100	H	39.525	11.836	36.63	61.63	74	-12.37	Peak
10440	33.01	0	100	V	39.459	11.836	36.63	47.68	54	-6.33	Ave
10440	33.21	0	100	H	39.525	11.836	36.63	47.94	54	-6.06	Ave
15660	48.03	0	100	V	38.858	14.876	35.97	65.79	74	-8.21	Peak
15660	48.25	0	100	H	38.907	14.876	35.97	66.06	74	-7.94	Peak
15660	33.44	0	100	V	38.858	14.876	35.97	51.20	54	-2.80	Ave
15660	33.66	0	100	H	38.907	14.876	35.97	51.47	54	-2.53	Ave

Frequency (MHz)	S.A. Reading (dB $\mu$ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB $\mu$ V/m)	FCC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB $\mu$ V/m)	Margin (dB)	
High channel 5240 MHz											
5240	70.31	219	155	V	33.915	8.114	-	112.339	-	-	Peak
5240	63.3	165	152	H	33.947	8.114	-	105.361	-	-	Peak
5240	59.66	219	155	V	33.915	8.114	-	101.689	-	-	Ave
5240	52.43	165	152	H	33.947	8.114	-	94.491	-	-	Ave
5350	53.02	219	155	V	34.34	8.29	36.51	59.14	74	-14.86	Peak
5350	47.53	165	152	H	34.38	8.29	36.51	53.69	74	-20.31	Peak
5350	39.26	219	155	V	34.34	8.29	36.51	45.38	54	-8.62	Ave
5350	34.00	165	152	H	34.38	8.29	36.51	40.16	54	-13.84	Ave
10480	46.65	0	100	V	39.477	11.836	36.63	61.33	74	-12.67	Peak
10480	47.50	0	100	H	39.49	11.836	36.63	62.20	74	-11.80	Peak
10480	32.55	0	100	V	39.477	11.836	36.63	47.23	54	-6.77	Ave
10480	32.78	0	100	H	39.49	11.836	36.63	47.48	54	-6.52	Ave
15720	46.79	0	100	V	38.858	14.972	35.97	64.65	74	-9.35	Peak
15720	47.51	0	100	H	38.907	14.972	35.97	65.42	74	-8.58	Peak
15720	33.08	0	100	V	38.858	14.972	35.97	50.94	54	-3.06	Ave
15720	33.31	0	100	H	38.907	14.972	35.97	51.22	54	-2.78	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		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	70.61	221	148	V	33.915	8.114	-	112.639	-	-	Peak
5180	64.47	161	166	H	33.947	8.114	-	106.531	-	-	Peak
5180	59.23	221	148	V	33.915	8.114	-	101.259	-	-	Ave
5180	53.6	161	166	H	33.947	8.114	-	95.661	-	-	Ave
5150	57.45	221	148	V	33.915	8.114	36.51	62.969	74	-11.031	Peak
5150	52.23	161	166	H	33.947	8.114	36.51	57.781	74	-16.219	Peak
5150	39.7	221	148	V	33.915	8.114	36.51	45.219	54	-8.781	Ave
5150	37.11	161	166	H	33.947	8.114	36.51	42.661	54	-11.339	Ave
10360	47.23	221	148	V	39.459	11.836	36.68	61.845	74	-12.155	Peak
10360	47.12	161	166	H	39.525	11.836	36.68	61.801	74	-12.199	Peak
10360	32.42	221	148	V	39.459	11.836	36.68	47.035	54	-6.965	Ave
10360	32.15	161	166	H	39.525	11.836	36.68	46.831	54	-7.169	Ave
15540	46.88	0	100	V	38.991	14.876	36.01	64.737	74	-9.263	Peak
15540	47.1	0	100	H	39.08	14.876	36.01	65.046	74	-8.954	Peak
15540	32.21	0	100	V	38.991	14.876	36.01	50.067	54	-3.933	Ave
15540	32.38	0	100	H	39.08	14.876	36.01	50.326	54	-3.674	Ave
Middle Channel 5220 MHz											
5220	70.46	188	146	V	33.915	8.114	-	112.489	-	-	Peak
5220	64.5	158	168	H	33.947	8.114	-	106.561	-	-	Peak
5220	59.42	188	146	V	33.915	8.114	-	101.449	-	-	Ave
5220	53.08	158	168	H	33.947	8.114	-	95.141	-	-	Ave
10440	46.84	188	146	V	39.459	11.836	36.63	61.51	74	-12.50	Peak
10440	47.12	158	168	H	39.525	11.836	36.63	61.85	74	-12.15	Peak
10440	33.05	188	146	V	39.459	11.836	36.63	47.72	54	-6.29	Ave
10440	32.78	158	168	H	39.525	11.836	36.63	47.51	54	-6.49	Ave
15660	48.16	0	100	V	38.858	14.876	35.97	65.92	74	-8.08	Peak
15660	47.53	0	100	H	38.907	14.876	35.97	65.34	74	-8.66	Peak
15660	33.41	0	100	V	38.858	14.876	35.97	51.17	54	-2.83	Ave
15660	33.48	0	100	H	38.907	14.876	35.97	51.29	54	-2.71	Ave

Frequency (MHz)	S.A. Reading (dB $\mu$ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dB $\mu$ V/m)	FCC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB $\mu$ V/m)	Margin (dB)	
High channel 5240 MHz											
5240	71.21	219	169	V	33.915	8.114	-	113.239	-	-	Peak
5240	64.1	139	186	H	33.947	8.114	-	106.161	-	-	Peak
5240	59.19	219	169	V	33.915	8.114	-	101.219	-	-	Ave
5240	53.18	139	186	H	33.947	8.114	-	95.241	-	-	Ave
5350	52.58	219	169	V	34.34	8.29	36.51	58.70	74	-15.30	Peak
5350	47.98	139	186	H	34.38	8.29	36.51	54.14	74	-19.86	Peak
5350	38.79	219	169	V	34.34	8.29	36.51	44.91	54	-9.09	Ave
5350	34.15	139	186	H	34.38	8.29	36.51	40.31	54	-13.69	Ave
10480	46.58	219	169	V	39.477	11.836	36.63	61.26	74	-12.74	Peak
10480	46.69	139	186	H	39.49	11.836	36.63	61.39	74	-12.61	Peak
10480	32.42	219	169	V	39.477	11.836	36.63	47.10	54	-6.90	Ave
10480	32.74	139	186	H	39.49	11.836	36.63	47.44	54	-6.56	Ave
15720	46.82	0	100	V	38.858	14.972	35.97	64.68	74	-9.32	Peak
15720	47.11	0	100	H	38.907	14.972	35.97	65.02	74	-8.98	Peak
15720	33.28	0	100	V	38.858	14.972	35.97	51.14	54	-2.86	Ave
15720	33.01	0	100	H	38.907	14.972	35.97	50.92	54	-3.08	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		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 5190 MHz											
5190	64.63	184	166	V	33.915	8.114	-	106.659	-	-	Peak
5190	64.25	234	150	H	33.947	8.114	-	106.311	-	-	Peak
5190	53.35	184	166	V	33.915	8.114	-	95.379	-	-	Ave
5190	52.18	234	150	H	33.947	8.114	-	94.241	-	-	Ave
5150	57.38	184	166	V	33.915	8.114	36.51	62.899	74	-11.101	Peak
5150	56.24	234	150	H	33.947	8.114	36.51	61.791	74	-12.209	Peak
5150	40.93	184	166	V	33.915	8.114	36.51	46.449	54	-7.551	Ave
5150	39.24	234	150	H	33.947	8.114	36.51	44.791	54	-9.209	Ave
10380	47.16	0	100	V	39.459	11.836	36.63	61.825	74	-12.175	Peak
10380	47.53	0	100	H	39.525	11.836	36.63	62.261	74	-11.739	Peak
10380	33.11	0	100	V	39.459	11.836	36.63	47.775	54	-6.225	Ave
10380	32.93	0	100	H	39.525	11.836	36.63	47.661	54	-6.339	Ave
15570	47.63	0	100	V	38.882	14.876	36.01	65.378	74	-8.622	Peak
15570	47.18	0	100	H	38.951	14.876	36.01	64.997	74	-9.003	Peak
15570	32.56	0	100	V	38.882	14.876	36.01	50.308	54	-3.692	Ave
15570	32.61	0	100	H	38.951	14.876	36.01	50.427	54	-3.573	Ave
High Channel 5230 MHz											
5230	65.89	178	166	V	33.915	8.114	-	107.919	-	-	Peak
5230	64.42	213	159	H	33.947	8.114	-	106.481	-	-	Peak
5230	53.95	178	166	V	33.915	8.114	-	95.979	-	-	Ave
5230	52.6	213	159	H	33.947	8.114	-	94.661	-	-	Ave
5350	47.95	178	166	V	34.34	8.29	36.51	54.07	74	-19.93	Peak
5350	47.23	213	159	H	34.38	8.29	36.51	53.39	74	-20.61	Peak
5350	34.73	178	166	V	34.34	8.29	36.51	40.85	54	-13.15	Ave
5350	33.83	213	159	H	34.38	8.29	36.51	39.99	54	-14.01	Ave
10460	47.62	0	100	V	39.477	11.836	36.63	62.30	74	-11.70	Peak
10460	47.23	0	100	H	39.49	11.836	36.63	61.93	74	-12.07	Peak
10460	32.85	0	100	V	39.477	11.836	36.63	47.53	54	-6.47	Ave
10460	32.76	0	100	H	39.49	11.836	36.63	47.46	54	-6.54	Ave
15690	47.64	0	100	V	38.858	14.876	35.97	65.40	74	-8.60	Peak
15690	47.80	0	100	H	38.907	14.876	35.97	65.61	74	-8.39	Peak
15690	33.17	0	100	V	38.858	14.876	35.97	50.93	54	-3.07	Ave
15690	33.24	0	100	H	38.907	14.876	35.97	51.05	54	-2.95	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		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 5180 MHz											
5180	70.41	220	151	V	33.915	8.114	-	112.439	-	-	Peak
5180	64.13	162	157	H	33.947	8.114	-	106.191	-	-	Peak
5180	58.85	220	151	V	33.915	8.114	-	100.879	-	-	Ave
5180	53.22	162	157	H	33.947	8.114	-	95.281	-	-	Ave
5150	53.99	220	151	V	33.915	8.114	36.51	59.509	74	-14.491	Peak
5150	50.55	162	157	H	33.947	8.114	36.51	56.101	74	-17.899	Peak
5150	39.67	220	151	V	33.915	8.114	36.51	45.189	54	-8.811	Ave
5150	36.16	162	157	H	33.947	8.114	36.51	41.711	54	-12.289	Ave
10360	47.2	0	100	V	39.459	11.836	36.68	61.815	74	-12.185	Peak
10360	47.88	0	100	H	39.525	11.836	36.68	62.561	74	-11.439	Peak
10360	35.23	0	100	V	39.459	11.836	36.68	49.845	54	-4.155	Ave
10360	35.23	0	100	H	39.525	11.836	36.68	49.911	54	-4.089	Ave
15540	47.16	0	100	V	38.991	14.876	36.01	65.017	74	-8.983	Peak
15540	47.52	0	100	H	39.08	14.876	36.01	65.466	74	-8.534	Peak
15540	33.18	0	100	V	38.991	14.876	36.01	51.037	54	-2.963	Ave
15540	33.23	0	100	H	39.08	14.876	36.01	51.176	54	-2.824	Ave
Middle Channel 5220 MHz											
5220	70.28	235	118	V	33.915	8.114	-	112.309	-	-	Peak
5220	64.06	159	160	H	33.947	8.114	-	106.121	-	-	Peak
5220	59.26	235	118	V	33.915	8.114	-	101.289	-	-	Ave
5220	52.55	159	160	H	33.947	8.114	-	94.611	-	-	Ave
10440	47.68	0	100	V	39.459	11.836	36.63	62.35	74	-11.66	Peak
10440	47.63	0	100	H	39.525	11.836	36.63	62.36	74	-11.64	Peak
10440	35.27	0	100	V	39.459	11.836	36.63	49.94	54	-4.06	Ave
10440	35.30	0	100	H	39.525	11.836	36.63	50.03	54	-3.97	Ave
15660	48.16	0	100	V	38.858	14.876	35.97	65.92	74	-8.08	Peak
15660	47.97	0	100	H	38.907	14.876	35.97	65.78	74	-8.22	Peak
15660	33.47	0	100	V	38.858	14.876	35.97	51.23	54	-2.77	Ave
15660	33.86	0	100	H	38.907	14.876	35.97	51.67	54	-2.33	Ave

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBμV/m)	FCC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
High channel 5240 MHz											
5240	71.01	224	158	V	33.915	8.114	-	113.039	-	-	Peak
5240	63.99	161	178	H	33.947	8.114	-	106.051	-	-	Peak
5240	61.74	224	158	V	33.915	8.114	-	103.769	-	-	Ave
5240	54.85	161	178	H	33.947	8.114	-	96.911	-	-	Ave
5350	51.75	224	158	V	34.34	8.29	36.51	57.87	74	-16.13	Peak
5350	46.91	161	178	H	34.38	8.29	36.51	53.07	74	-20.93	Peak
5350	41.66	224	158	V	34.34	8.29	36.51	47.78	54	-6.22	Ave
5350	36.35	161	178	H	34.38	8.29	36.51	42.51	54	-11.49	Ave
10480	46.62	0	100	V	39.477	11.836	36.63	61.30	74	-12.70	Peak
10480	45.90	0	100	H	39.49	11.836	36.63	60.60	74	-13.40	Peak
10480	34.01	0	100	V	39.477	11.836	36.63	48.69	54	-5.31	Ave
10480	34.05	0	100	H	39.49	11.836	36.63	48.75	54	-5.25	Ave
15720	41.22	0	100	V	38.858	14.972	35.97	59.08	74	-14.92	Peak
15720	42.27	0	100	H	38.907	14.972	35.97	60.18	74	-13.82	Peak
15720	32.88	0	100	V	38.858	14.972	35.97	50.74	54	-3.26	Ave
15720	32.94	0	100	H	38.907	14.972	35.97	50.85	54	-3.15	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		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel 5190 MHz											
5190	63.68	230	111	V	33.915	8.114	-	105.709	-	-	Peak
5190	62.48	182	134	H	33.947	8.114	-	104.541	-	-	Peak
5190	55.31	230	111	V	33.915	8.114	-	97.339	-	-	Ave
5190	53.4	182	134	H	33.947	8.114	-	95.461	-	-	Ave
5150	57.05	230	111	V	33.915	8.114	36.51	62.569	74	-11.431	Peak
5150	56.29	182	134	H	33.947	8.114	36.51	61.841	74	-12.159	Peak
5150	42.12	230	111	V	33.915	8.114	36.51	47.639	54	-6.361	Ave
5150	41.29	182	134	H	33.947	8.114	36.51	46.841	54	-7.159	Ave
10380	47.38	230	111	V	39.459	11.836	36.63	62.045	74	-11.955	Peak
10380	47.12	182	134	H	39.525	11.836	36.63	61.851	74	-12.149	Peak
10380	32.48	230	111	V	39.459	11.836	36.63	47.145	54	-6.855	Ave
10380	33.24	182	134	H	39.525	11.836	36.63	47.971	54	-6.029	Ave
15570	47.61	0	100	V	38.882	14.876	36.01	65.358	74	-8.642	Peak
15570	47.44	0	100	H	38.951	14.876	36.01	65.257	74	-8.743	Peak
15570	32.22	0	100	V	38.882	14.876	36.01	49.968	54	-4.032	Ave
15570	32.69	0	100	H	38.951	14.876	36.01	50.507	54	-3.493	Ave
High Channel 5230 MHz											
5230	64.32	234	118	V	33.915	8.114	-	106.349	-	-	Peak
5230	63.61	184	135	H	33.947	8.114	-	105.671	-	-	Peak
5230	55.83	234	118	V	33.915	8.114	-	97.859	-	-	Ave
5230	54.76	184	135	H	33.947	8.114	-	96.821	-	-	Ave
5350	47.48	234	118	V	34.34	8.29	36.51	53.60	74	-20.40	Peak
5350	46.77	184	135	H	34.38	8.29	36.51	52.93	74	-21.07	Peak
5350	37.58	234	118	V	34.34	8.29	36.51	43.70	54	-10.30	Ave
5350	36.48	184	135	H	34.38	8.29	36.51	42.64	54	-11.36	Ave
10460	47.25	234	118	V	39.477	11.836	36.63	61.93	74	-12.07	Peak
10460	47.32	184	135	H	39.49	11.836	36.63	62.02	74	-11.98	Peak
10460	32.71	234	118	V	39.477	11.836	36.63	47.39	54	-6.61	Ave
10460	32.80	184	135	H	39.49	11.836	36.63	47.50	54	-6.50	Ave
15690	47.58	0	100	V	38.858	14.876	35.97	65.34	74	-8.66	Peak
15690	47.23	0	100	H	38.907	14.876	35.97	65.04	74	-8.96	Peak
15690	33.25	0	100	V	38.858	14.876	35.97	51.01	54	-2.99	Ave
15690	32.89	0	100	H	38.907	14.876	35.97	50.70	54	-3.30	Ave



## 802.11ac80 mode

Frequency (MHz)	S.A. Reading (dB $\mu$ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dB $\mu$ V/m)	FCC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB $\mu$ V/m)	Margin (dB)	
5210 MHz											
5210	65.53	340	111	V	33.851	5.26	-	104.641	-	-	Peak
5210	66.28	341	103	H	33.84	5.26	-	105.38	-	-	Peak
5210	53.15	340	111	V	33.851	5.26	-	92.261	-	-	Ave
5210	52.77	341	103	H	33.84	5.26	-	91.87	-	-	Ave
5350	50.10	340	111	V	34.17	5.60	36.51	53.36	74	-20.64	Peak
5350	49.28	341	103	H	34.18	5.60	36.51	52.55	74	-21.45	Peak
5350	36.87	340	111	V	34.17	5.60	36.51	40.13	54	-13.87	Ave
5350	34.86	341	103	H	34.18	5.60	36.51	38.13	54	-15.87	Ave
10420	47.30	0	100	V	38.22	9.72	36.63	58.61	74	-15.39	Peak
10420	47.21	0	100	H	38.211	9.72	36.63	58.51	74	-15.49	Peak
10420	33.42	0	100	V	38.22	9.72	36.63	44.73	54	-9.27	Ave
10420	33.52	0	100	H	38.211	9.72	36.63	44.82	54	-9.18	Ave
15630	48.86	0	100	V	37.82	11.86	35.97	62.57	74	-11.43	Peak
15630	48.23	0	100	H	37.751	11.86	35.97	61.87	74	-12.13	Peak
15630	35.06	0	100	V	37.82	11.86	35.97	48.77	54	-5.23	Ave
15630	34.87	0	100	H	37.751	11.86	35.97	48.51	54	-5.49	Ave
5150	64.35	340	111	V	33.851	5.26	36.51	66.951	74	-7.049	Peak
5150	65.29	341	103	H	33.84	5.26	36.51	67.88	74	-6.12	Peak
5150	47.41	340	111	V	33.851	5.26	36.51	50.011	54	-3.989	Ave
5150	46.07	341	103	H	33.84	5.26	36.51	48.66	54	-5.34	Ave

## Co-location Configuration

Frequency (MHz)	S.A. Reading (dB $\mu$ V)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dB $\mu$ V/m)	FCC		Comments (PK/Ave.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dB $\mu$ V/m)	Margin (dB)	
2437MHz n20 mode & 5230MHz n40 mode											
10460	47.91	230	124	V	39.477	11.836	36.63	62.59	74	-11.41	Peak
10460	47.11	185	176	H	39.49	11.836	36.63	61.81	74	-12.19	Peak
10460	33.27	230	124	V	39.477	11.836	36.63	47.95	54	-6.05	Ave
10460	33.02	185	176	H	39.49	11.836	36.63	47.72	54	-6.28	Ave
15690	48.39	0	100	V	38.858	14.876	35.97	66.15	74	-7.85	Peak
15690	48.12	0	100	H	38.907	14.876	35.97	65.93	74	-8.07	Peak
15690	34.11	0	100	V	38.858	14.876	35.97	51.87	54	-2.13	Ave
15690	34.18	0	100	H	38.907	14.876	35.97	51.99	54	-2.01	Ave
4874	48.24	192	116	V	33.321	7.75	36.63	52.68	74	-21.32	Peak
4874	48.31	341	158	H	33.354	7.75	36.63	52.78	74	-21.22	Peak
4874	33.18	192	116	V	33.321	7.75	36.63	37.62	54	-16.38	Ave
4874	33.51	341	158	H	33.354	7.75	36.63	37.98	54	-16.02	Ave
7311	46.86	0	100	V	37.324	9.855	36.42	57.62	74	-16.38	Peak
7311	47.29	0	100	H	37.356	9.855	36.42	58.08	74	-15.92	Peak
7311	32.58	0	100	V	37.324	9.855	36.42	43.34	54	-10.66	Ave
7311	33.04	0	100	H	37.356	9.855	36.42	43.83	54	-10.17	Ave

Note 1: Any emissions above 18 GHz are 20 dB below the limit.

## 8 FCC §15.407- 26 dB & 99% Occupied Bandwidth

### 8.1 Applicable Standards

FCC§15.407

### 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 minimum emission or emission 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	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
-	20 dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

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

### 8.4 Test Environmental Conditions

<b>Temperature:</b>	22-24 °C
<b>Relative Humidity:</b>	40-41 %
<b>ATM Pressure:</b>	103.1-104.1 kPa

*The testing was performed by Jin Yang on 2016-04-15 at RF site.*

## 8.5 Test Results

Channel	Frequency (MHz)	99% OBW (MHz)		
		Chain 4	Chain 5	Chain 6
802.11a mode				
36	5180	16.5429	-	-
44	5220	16.7070	-	-
48	5240	16.6789	-	-
802.11n20 mode				
36	5180	17.7345	17.7547	17.7215
44	5220	17.7265	17.7006	17.7089
48	5240	17.7437	17.6858	17.7321
802.11n40 mode				
38	5190	36.1620	36.2467	36.2555
46	5230	36.2443	36.2459	36.2663
802.11ac20 mode				
36	5180	17.7114	17.7051	17.7443
44	5220	17.6969	17.7619	17.7001
48	5240	17.6838	17.7178	17.6793
802.11ac40 mode				
38	5190	36.2111	36.1390	36.1631
46	5230	36.3625	36.4090	36.3741
802.11ac80 mode				
42	5210	75.6162	75.5390	75.5187

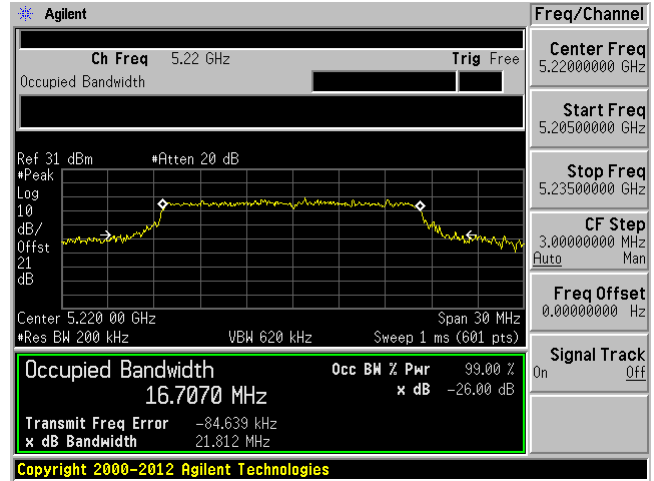
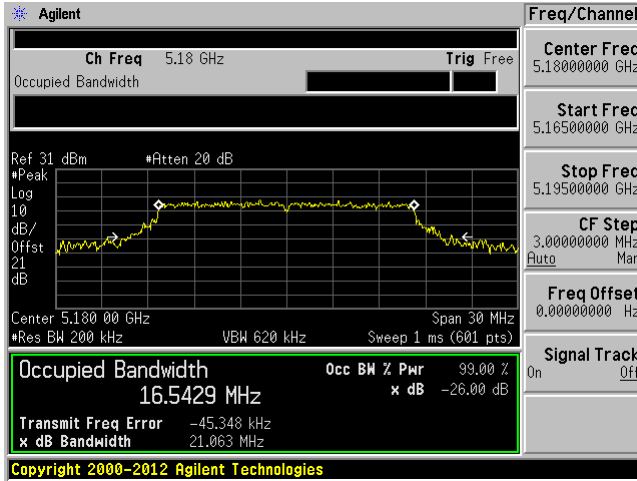
**Note:** 802.11a mode only transmits signal through antenn 4.

Please refer to the following plots.

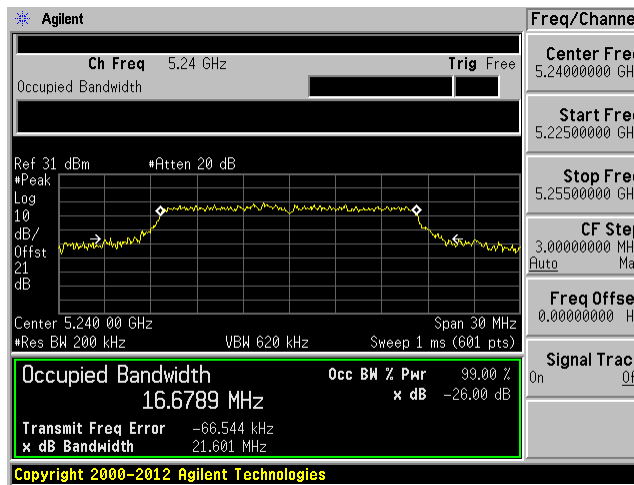
802.11a mode

802.11a mode Low Channel 5180MHz

802.11a mode Middle Channel 5220MHz

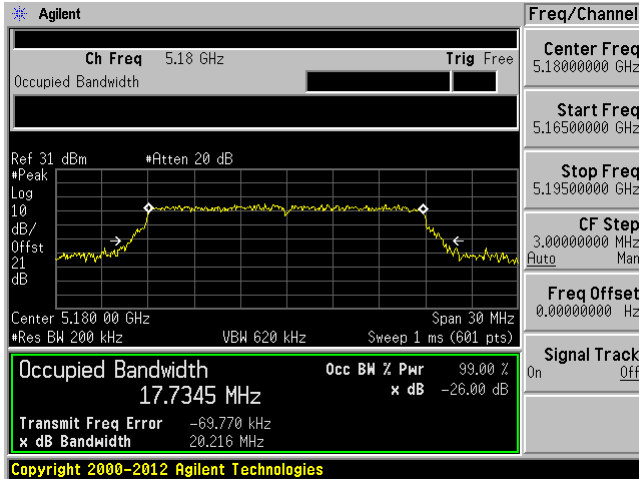


802.11a mode High Channel 5240MHz

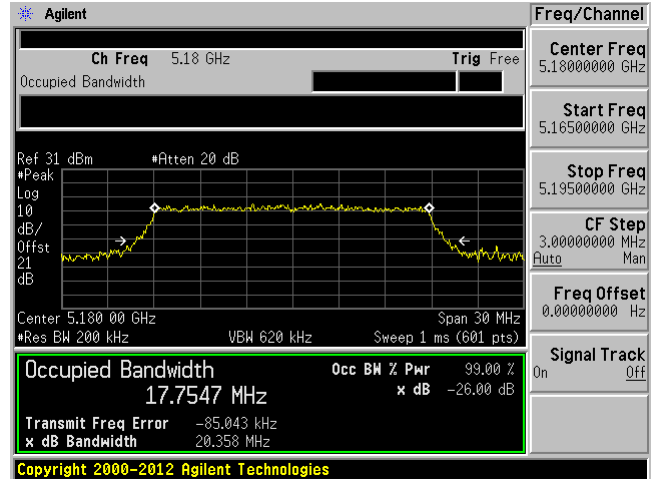


802.11n20 mode Low Channel 5180MHz

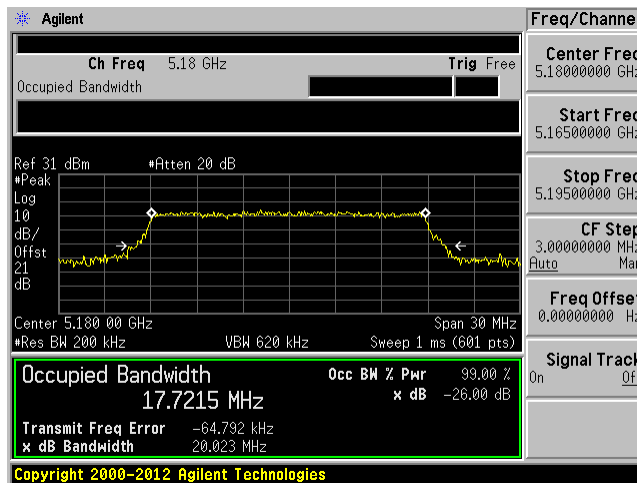
Chain #4



Chain #5

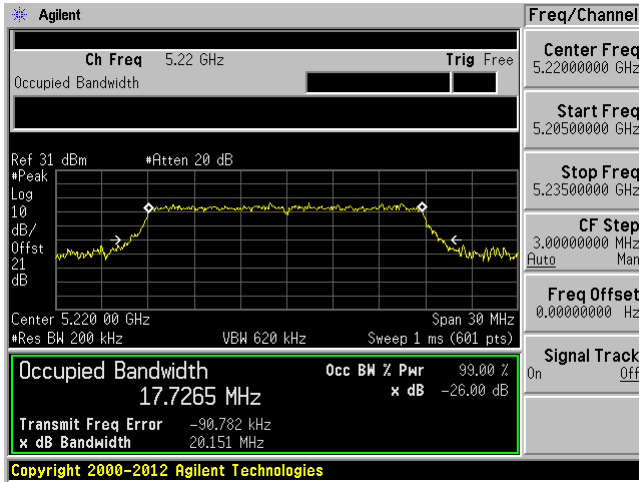


Chain #6

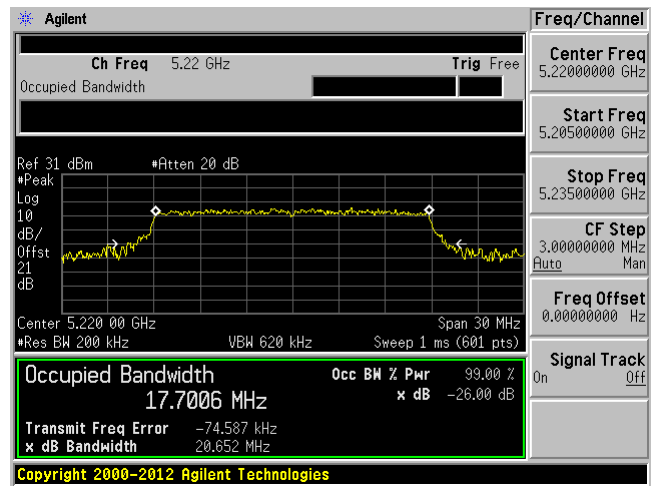


802.11n20 mode Middle Channel 5220MHz

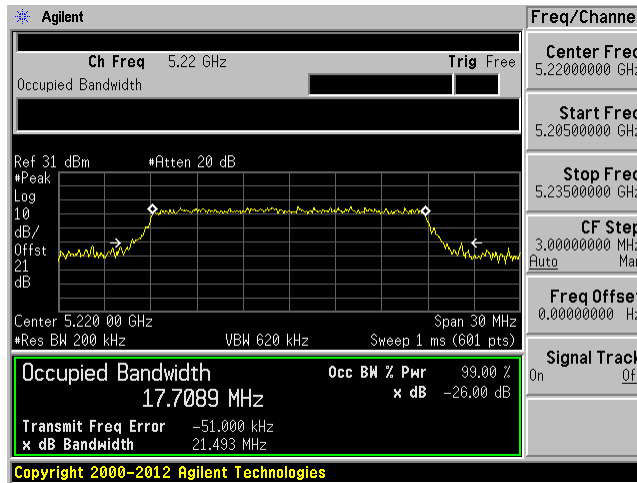
Chain #4



Chain #5

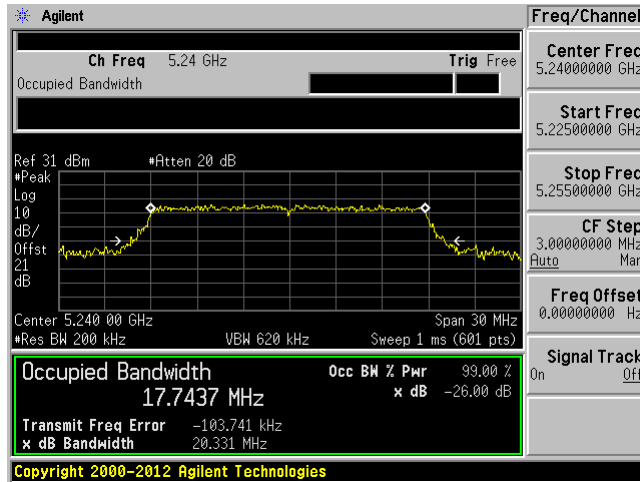


Chain #6

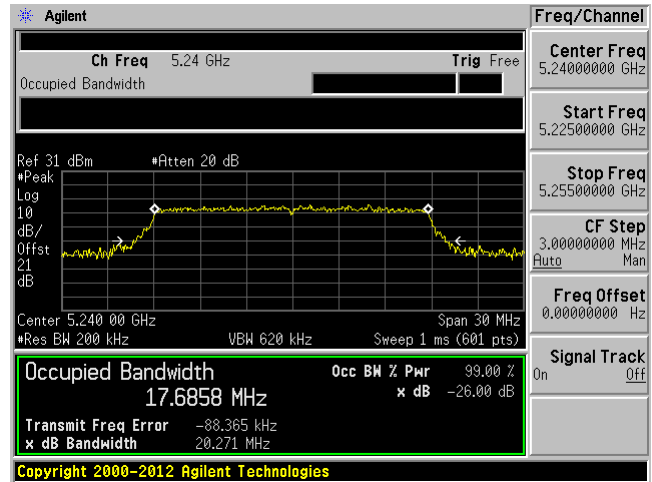


802.11n20 mode High Channel 5240MHz

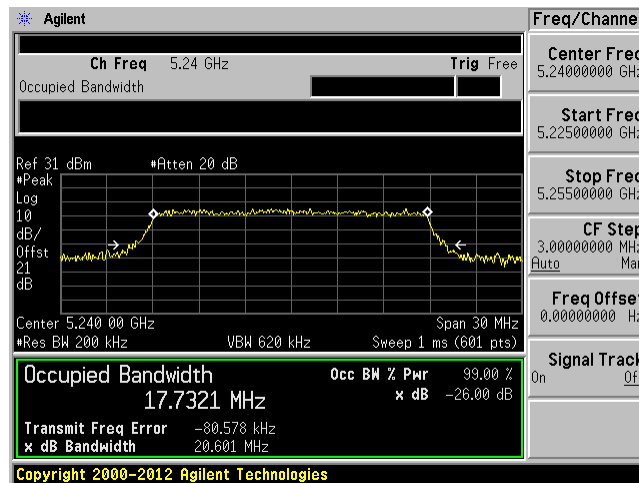
Chain #4



Chain #5



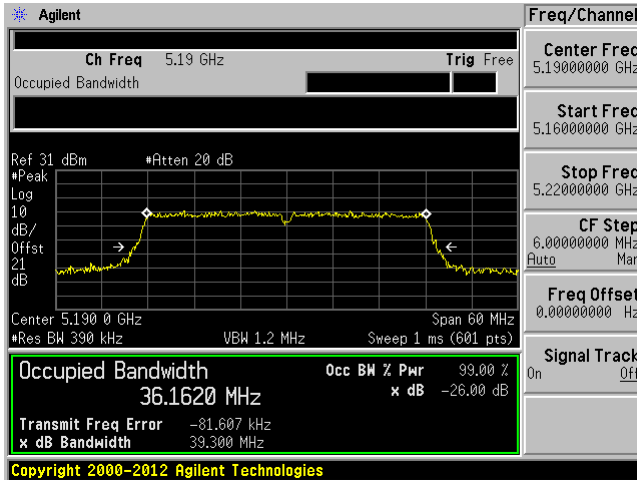
Chain #6



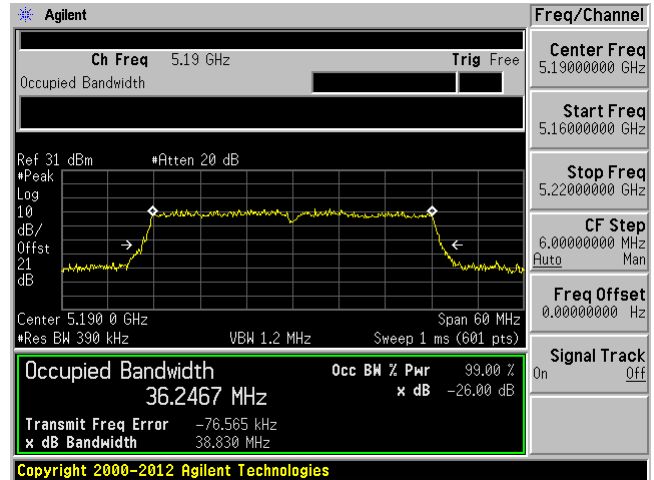


802.11n40 mode Low Channel 5190MHz

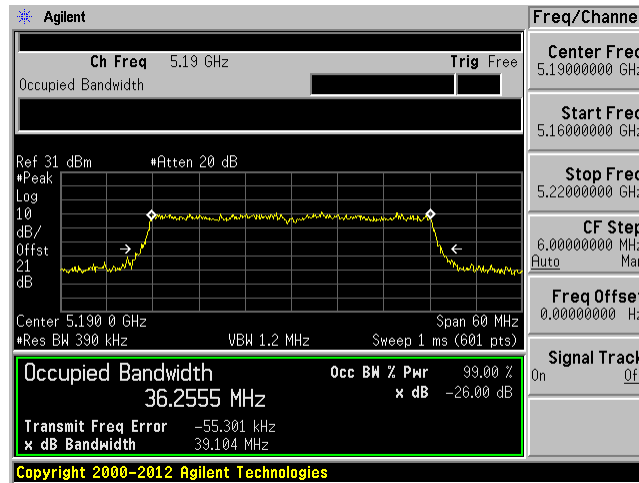
Chain #4



Chain #5

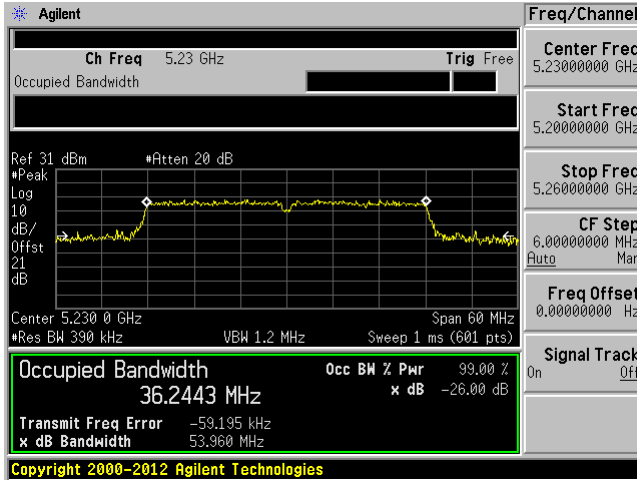


Chain #6

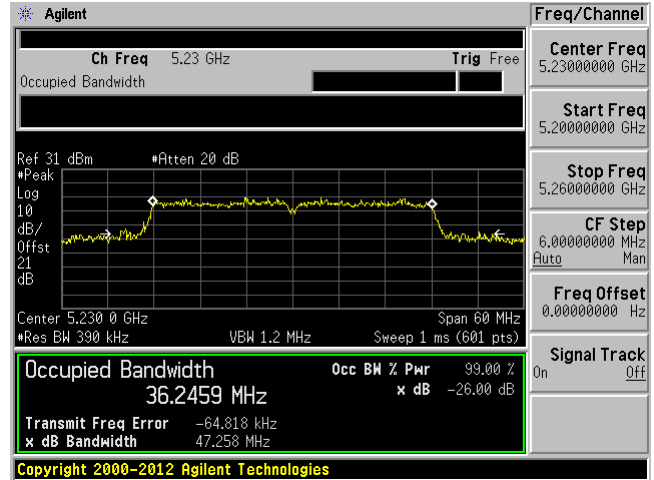


802.11n40 mode High Channel 5230MHz

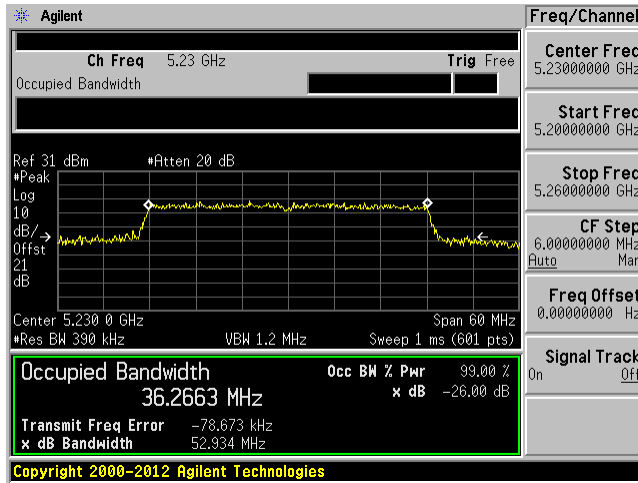
Chain #4



Chain #5

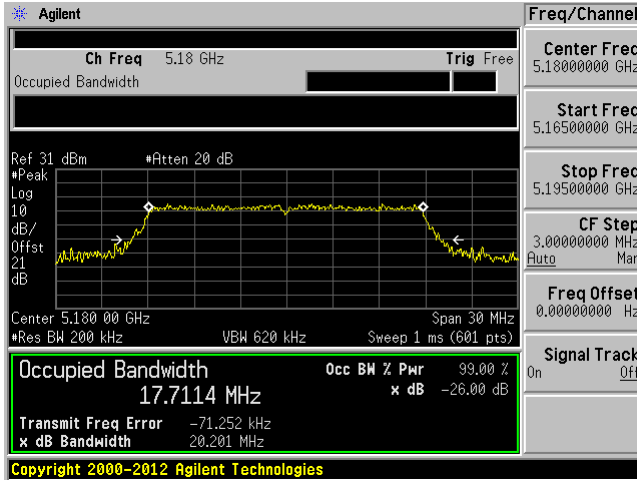


Chain #6

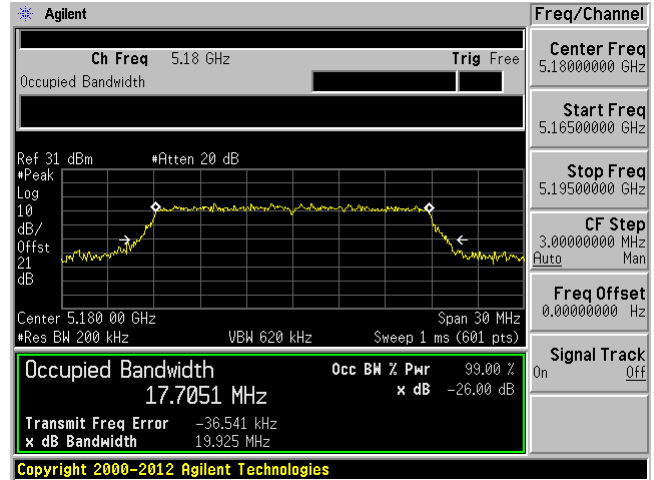


802.11ac20 mode Low Channel 5180MHz

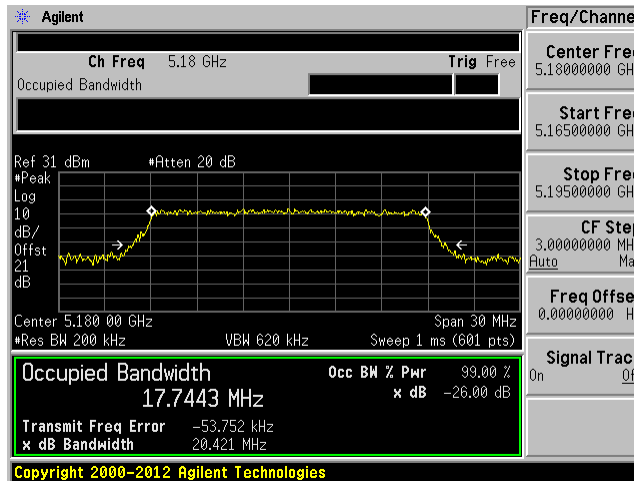
Chain #4



Chain #5

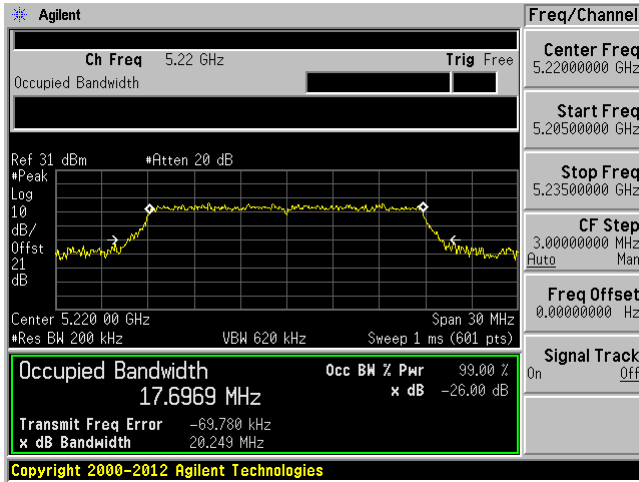


Chain #6

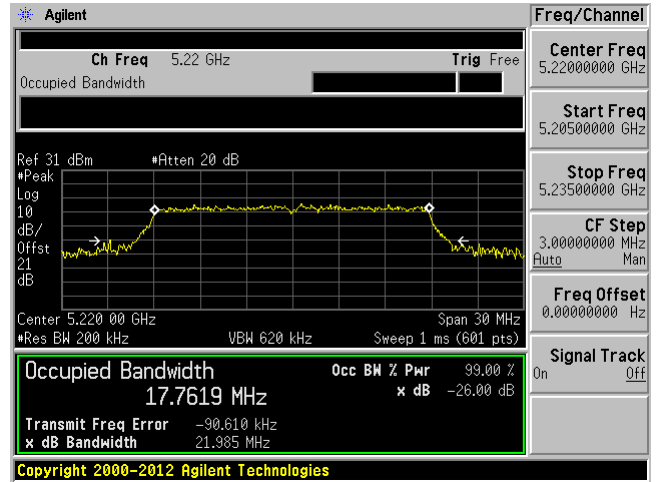


802.11ac20 mode Middle Channel 5220MHz

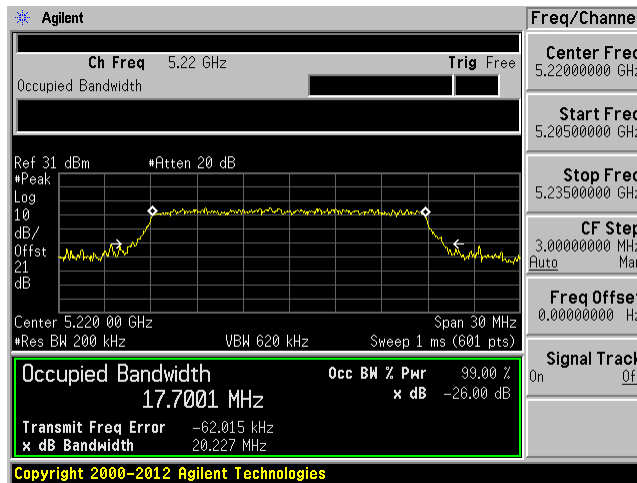
Chain #4



Chain #5

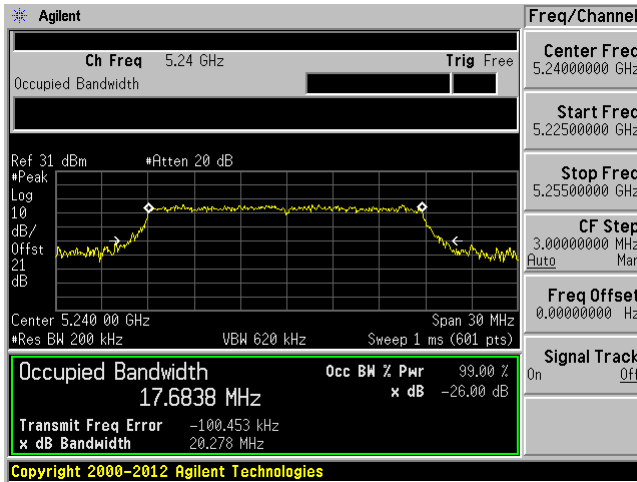


Chain #6

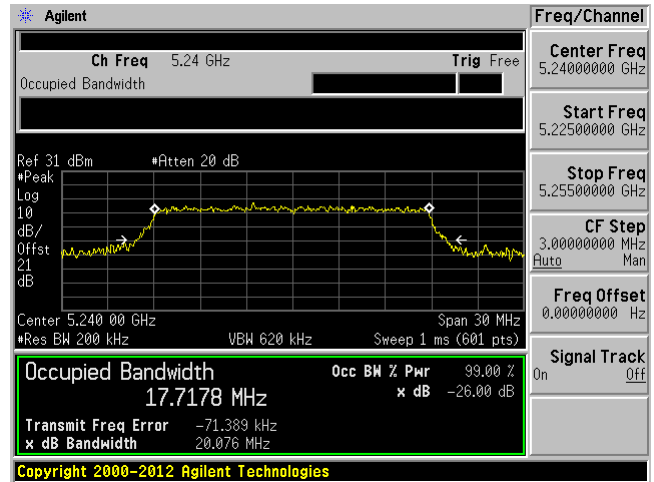


802.11ac20 mode High Channel 5240MHz

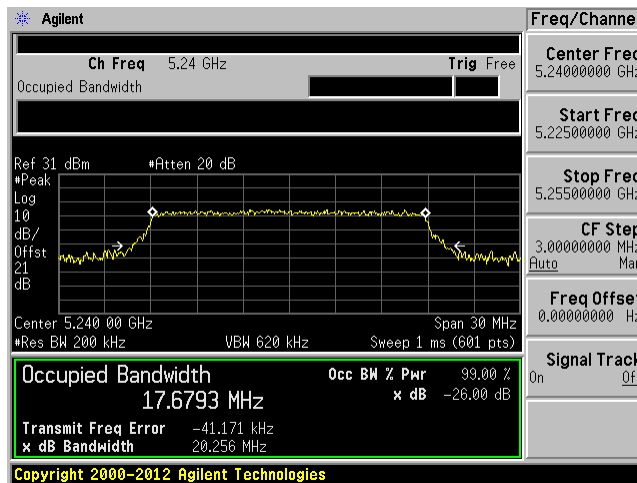
Chain #4



Chain #5

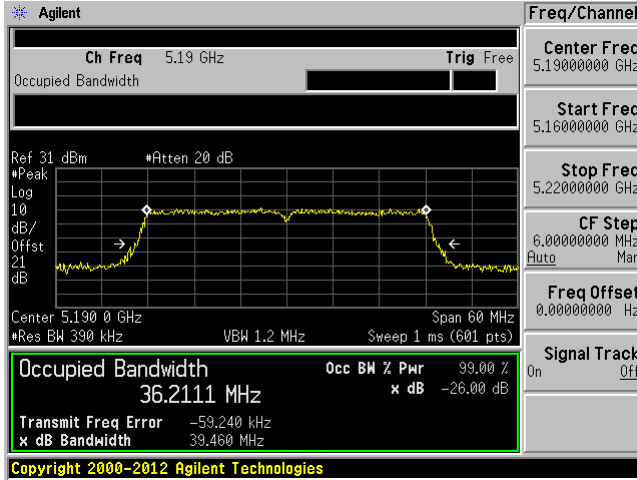


Chain #6

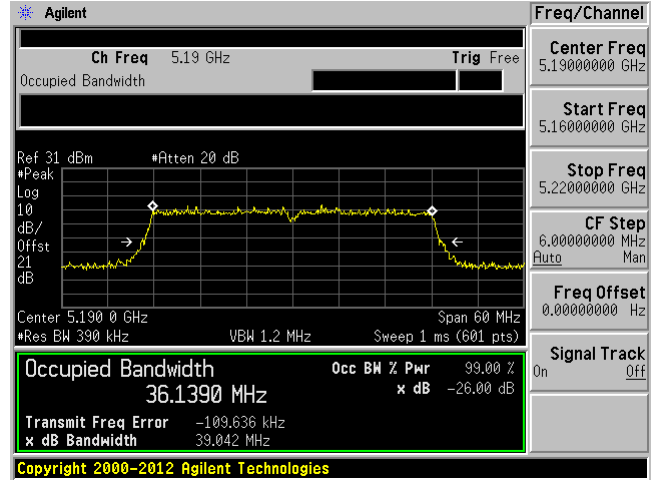


802.11ac40 mode Low Channel 5190MHz

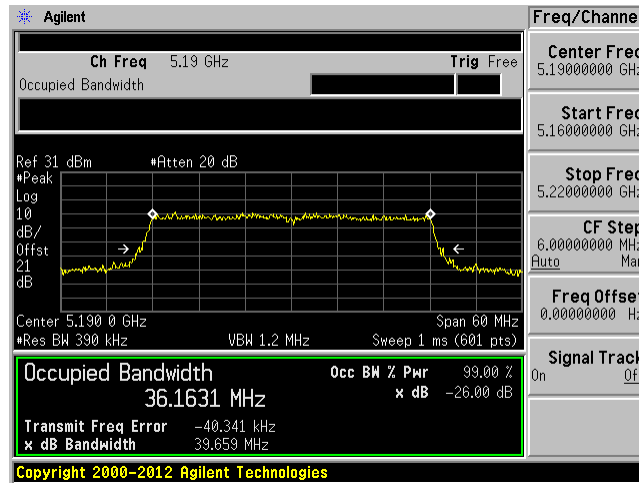
Chain #4



Chain #5

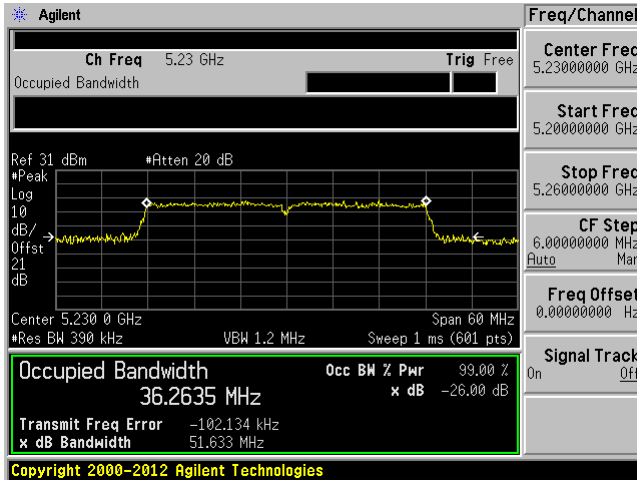


Chain #6

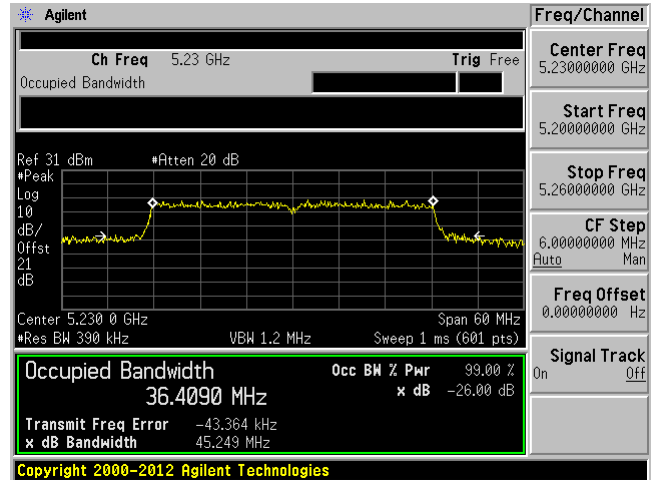


802.11ac40 mode High Channel 5230MHz

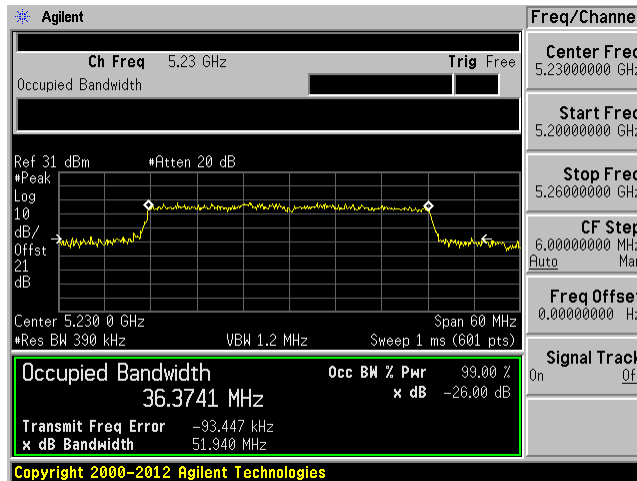
Chain #4



Chain #5

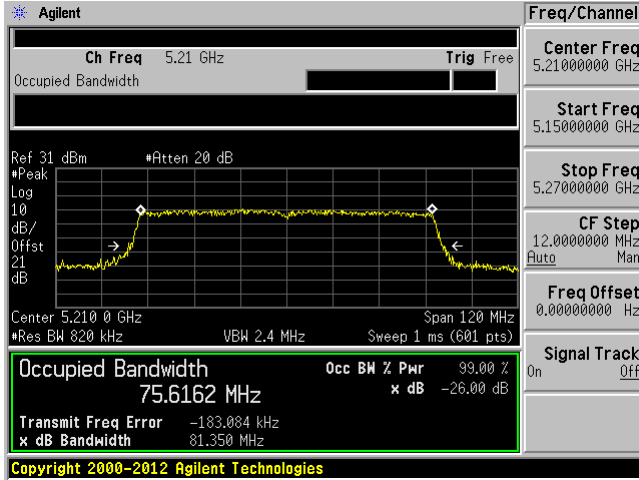


Chain #6

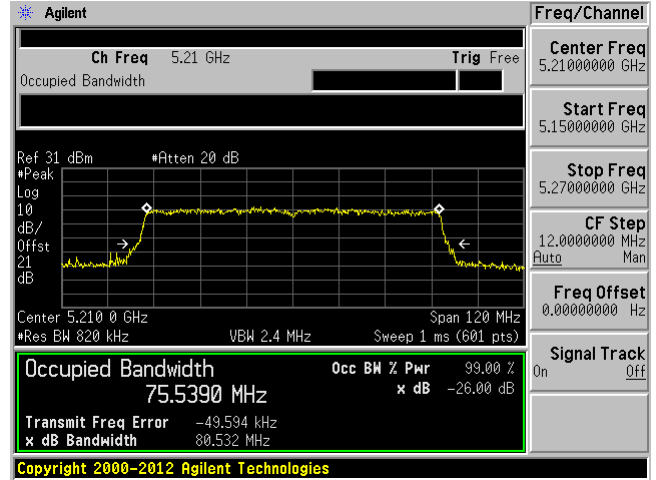


802.11ac80 mode 5210MHz

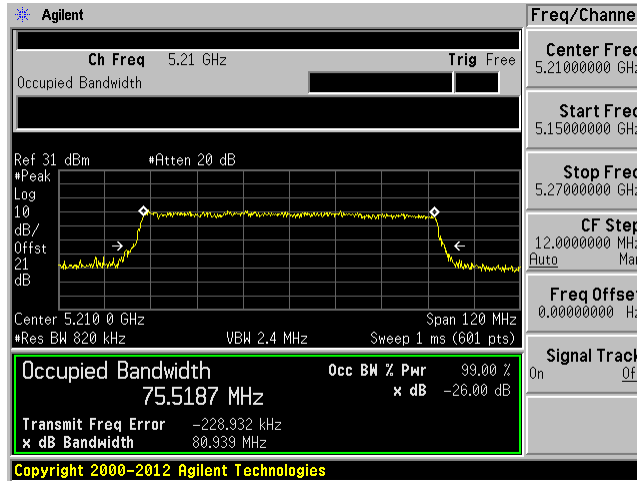
Chain #4



Chain #5



Chain #6





## 9 FCC §407(a) - Output Power

### 9.1 Applicable Standards

According to FCC §15.407(a):

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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.

### 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 power meter.

### 9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
ETS- Lingerin	Power Sensor	7002-006	160097	2014-10-21	2 years
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

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

### 9.4 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

*The testing was performed by Jin Yang on 2016-04-15 in RF site.*

### 9.5 Test Results

Note:  $\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}] \text{ dBi} = 11.13 \text{ dBi}$

Note: 802.11a mode only transmits signal through antenna 4, and the antenna gain for chain 4 is greater than 6dBi, therefore, the limit is reduced by amount exceed 6dBi.

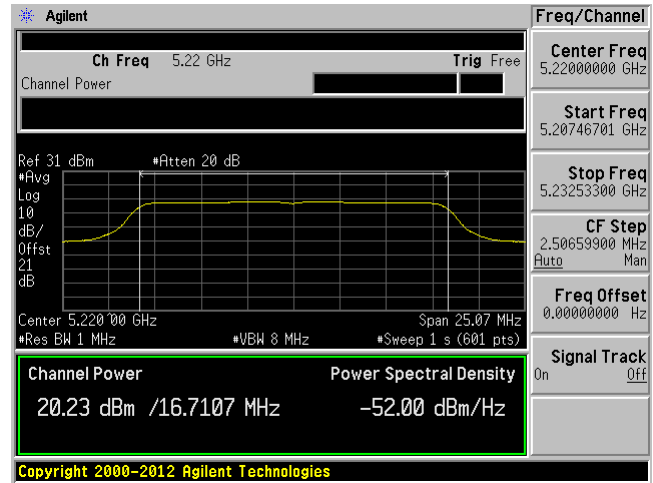
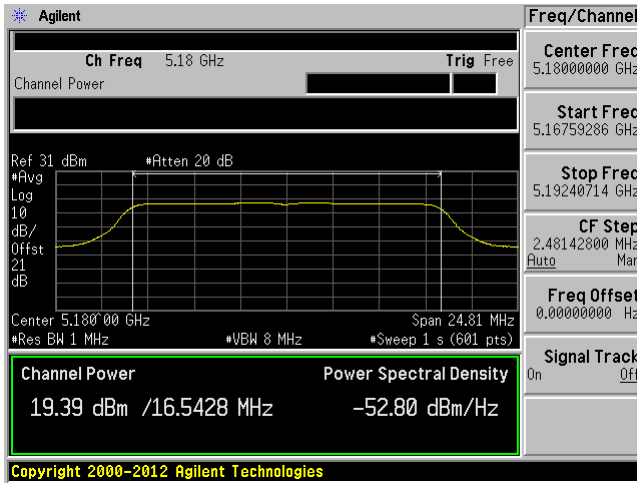
## Non-Beamforming

Mode	Channel	Frequency MHz	Chain #	Conducted Output Power (dBm)	Total Power (dBm)	Limit (dBm)	Comment
802.11a	36	5180	4	19.39	-	29.76	Pass
	44	5220	4	20.23	-	29.76	Pass
	48	5240	4	20.3	-	29.76	Pass
802.11n20	36	5180	4	17.58	21.97	24.87	Pass
			5	17.22			Pass
			6	16.75			Pass
	44	5220	4	18.07	22.77	24.87	Pass
			5	18.21			Pass
			6	17.7			Pass
	48	5240	4	18.56	22.92	24.87	Pass
			5	18.12			Pass
			6	17.71			Pass
802.11ac20	36	5180	4	17.48	21.91	24.87	Pass
			5	17.18			Pass
			6	16.73			Pass
	44	5220	4	18.54	22.91	24.87	Pass
			5	18.15			Pass
			6	17.69			Pass
	48	5240	4	18.5	22.89	24.87	Pass
			5	18.09			Pass
			6	17.74			Pass
802.11n40	38	5190	4	13	17.73	24.87	Pass
			5	13.34			Pass
			6	12.49			Pass
	46	5230	4	20.35	24.83	24.87	Pass
			5	20.01			Pass
			6	19.8			Pass
802.11ac40	38	5190	4	13.42	17.89	24.87	Pass
			5	13.34			Pass
			6	12.54			Pass
	46	5230	4	20.37	24.76	24.87	Pass
			5	19.84			Pass
			6	19.73			Pass
802.11ac80	42	5210	4	12.12	16.93	24.87	Pass
			5	12.47			Pass
			6	11.87			Pass

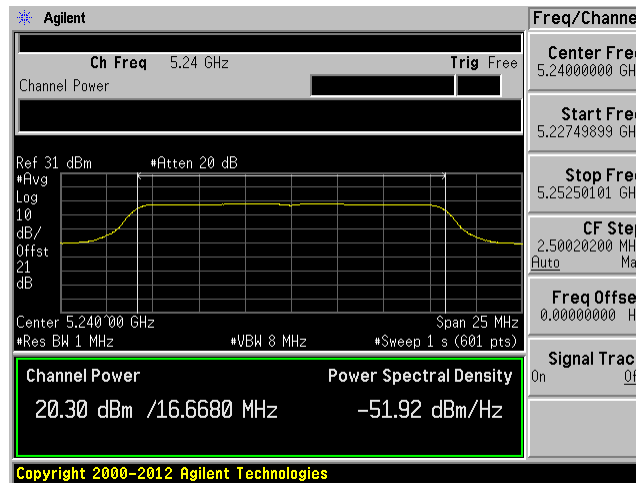
802.11a mode

802.11a mode Low Channel 5180MHz

802.11a mode Middle Channel 5220MHz

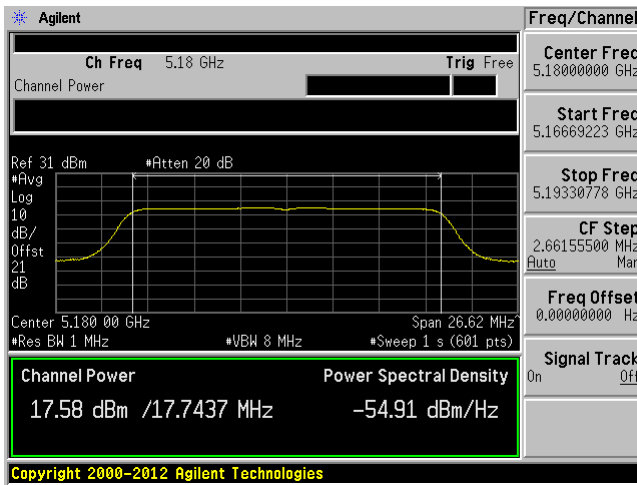


802.11a mode High Channel 5240MHz

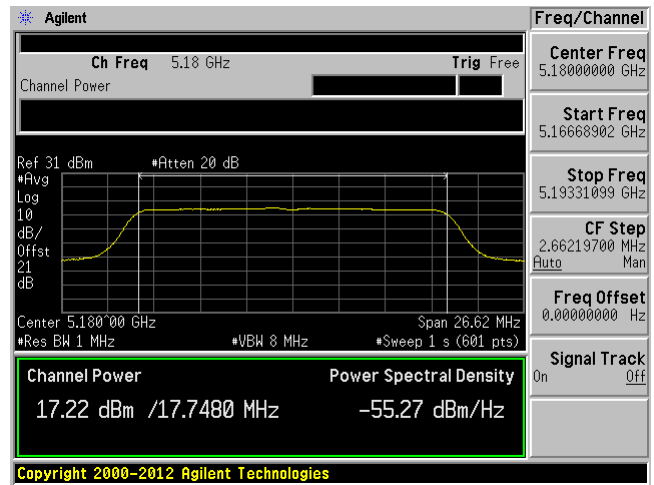


802.11n20 mode Low Channel 5180MHz

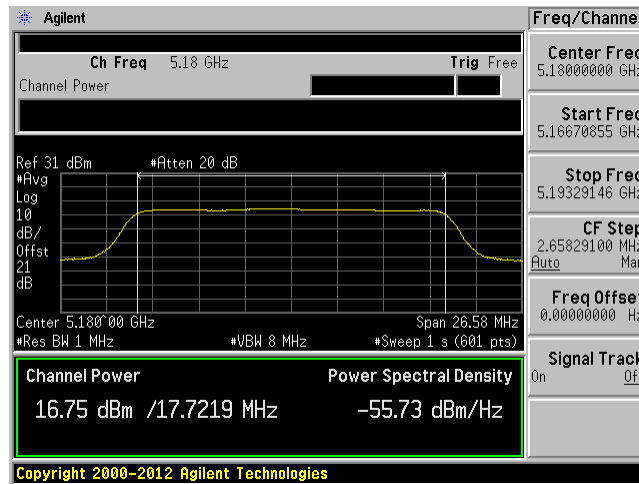
Chain #4



Chain #5

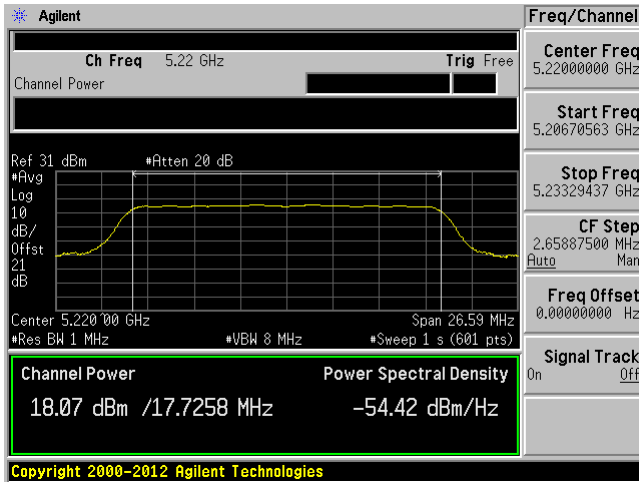


Chain #6

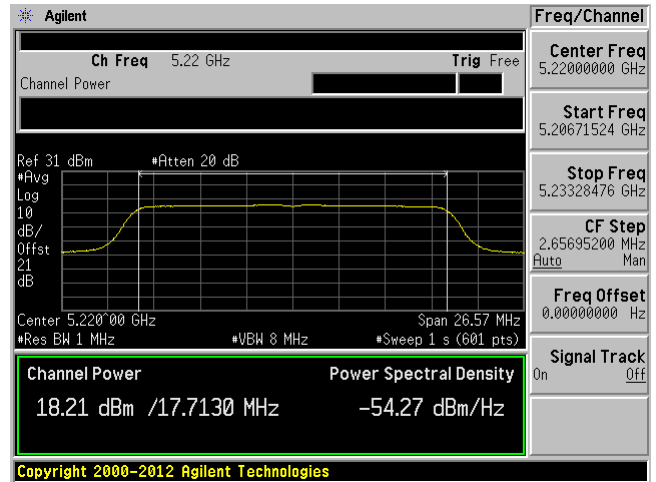


802.11n20 mode Middle Channel 5220MHz

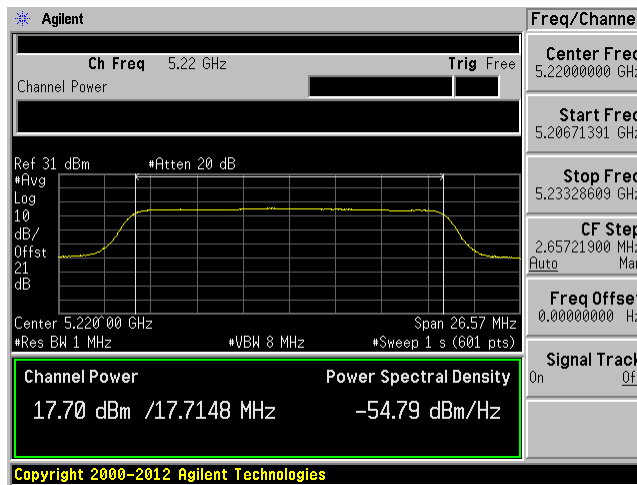
Chain #4



Chain #5

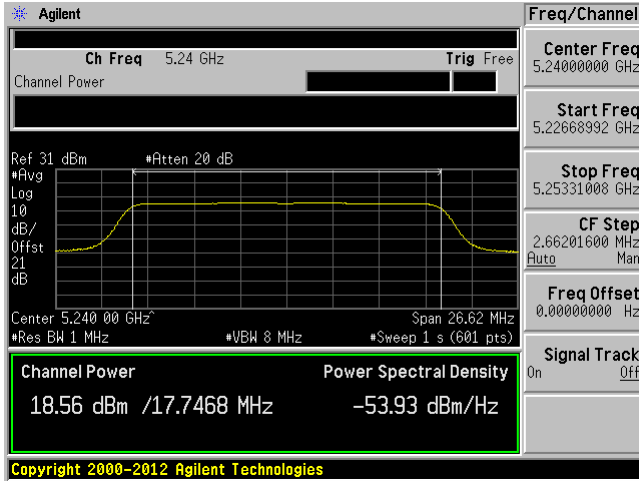


Chain #6

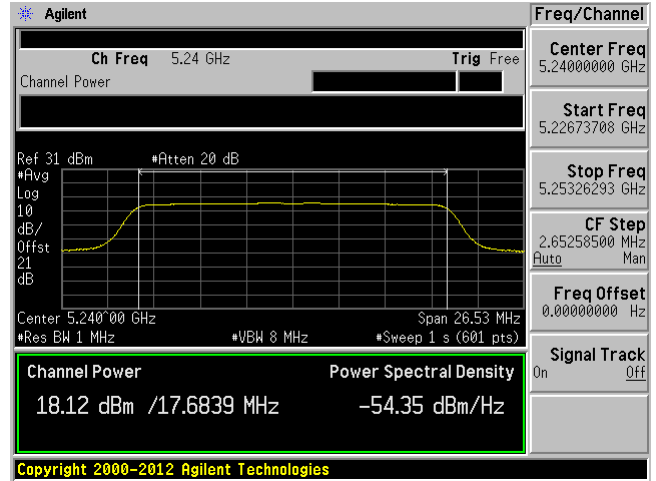


802.11n20 mode High Channel 5240MHz

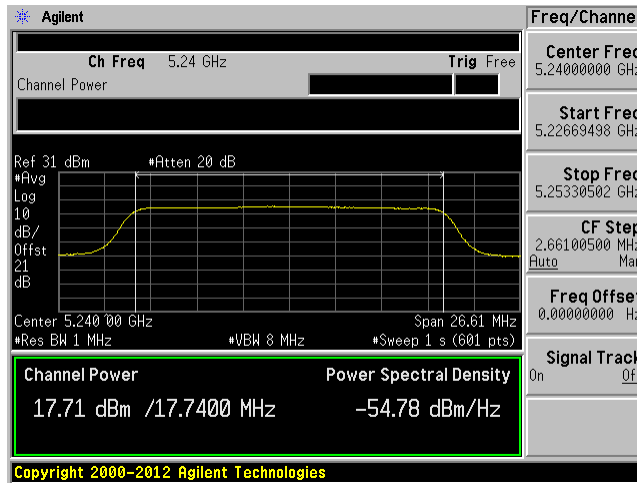
Chain #4



Chain #5

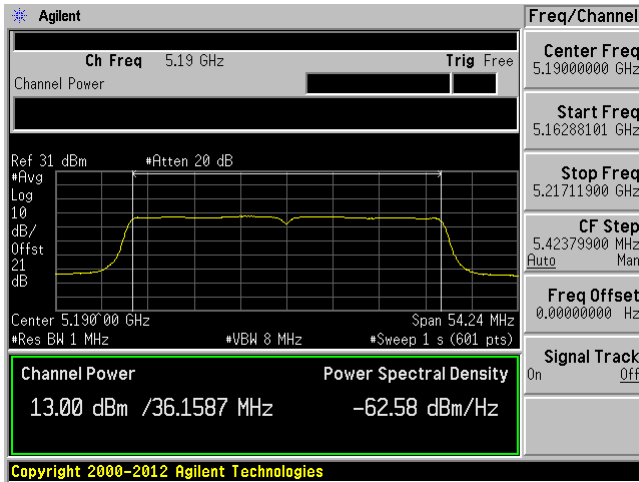


Chain #6

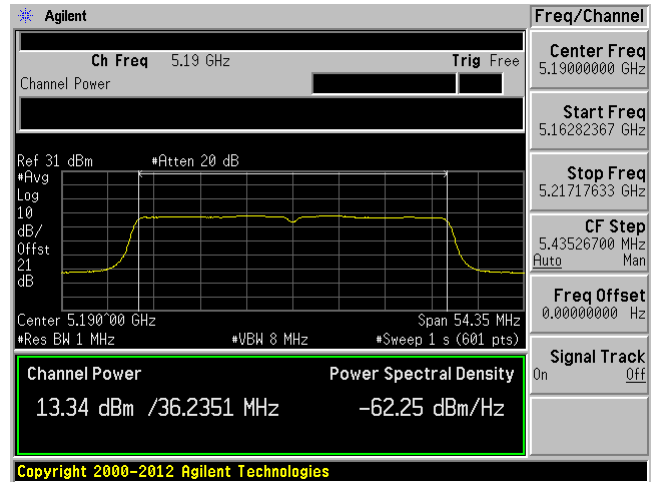


802.11n40 mode Low Channel 5190MHz

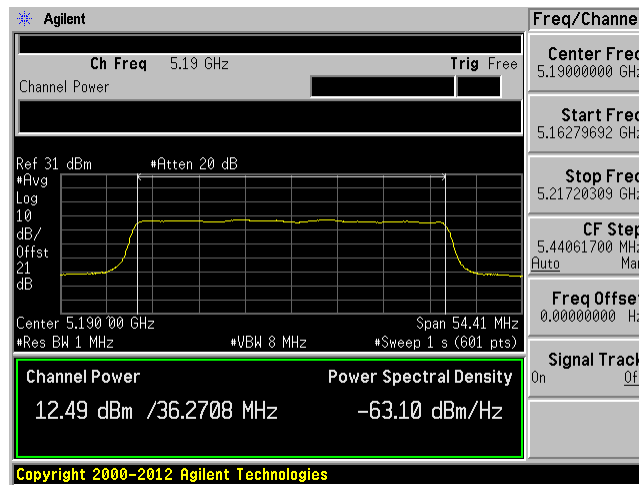
Chain #4



Chain #5

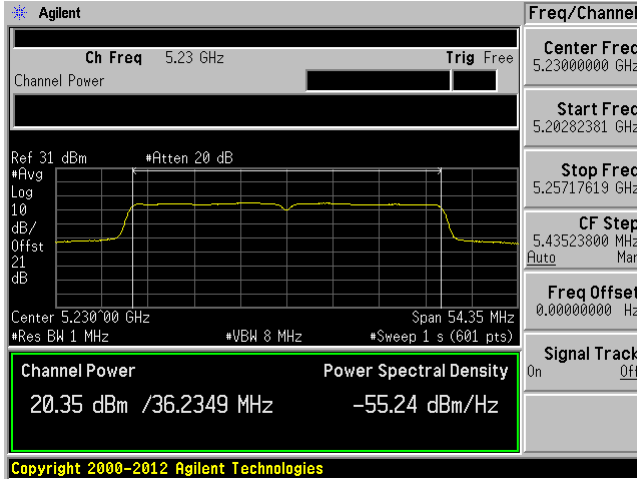


Chain #6

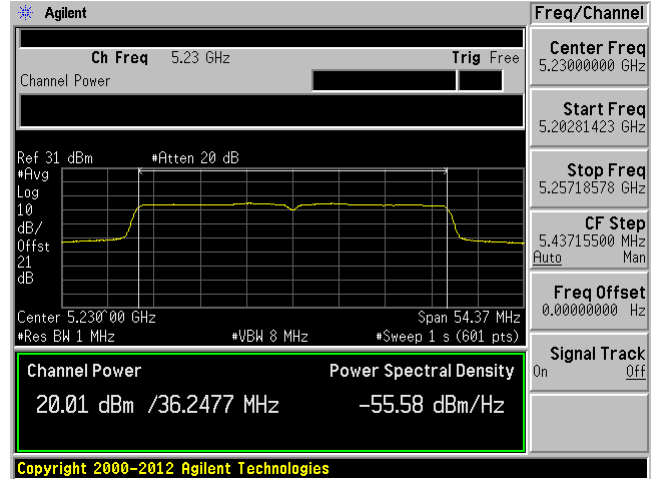


802.11n40 mode High Channel 5230MHz

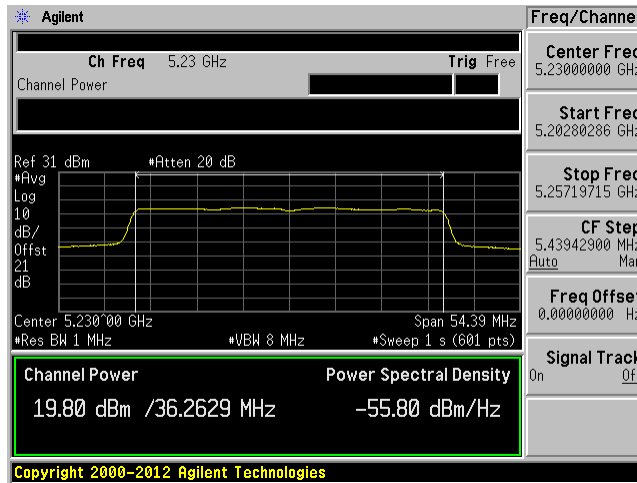
Chain #4



Chain #5



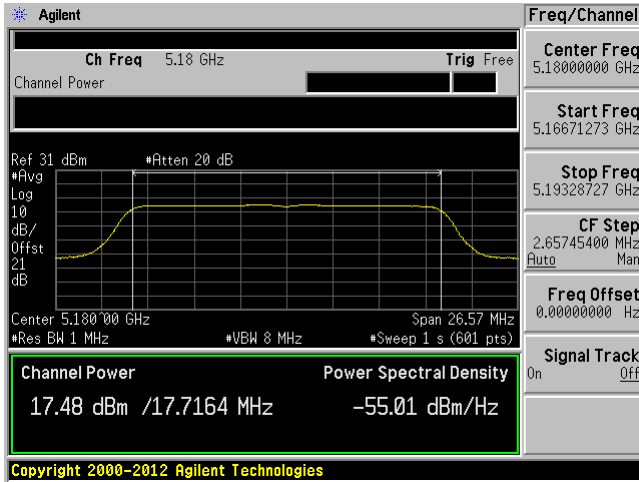
Chain #6



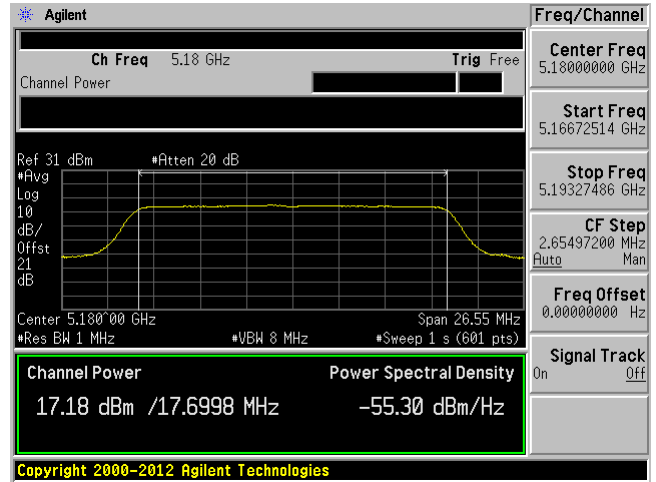


802.11ac20 mode Low Channel 5180MHz

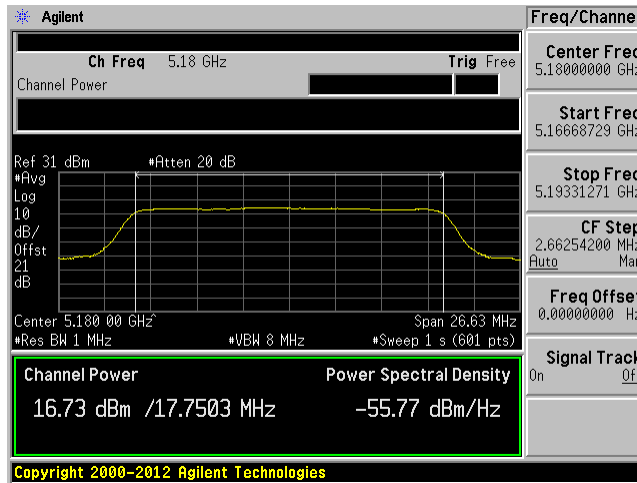
Chain #4



Chain #5

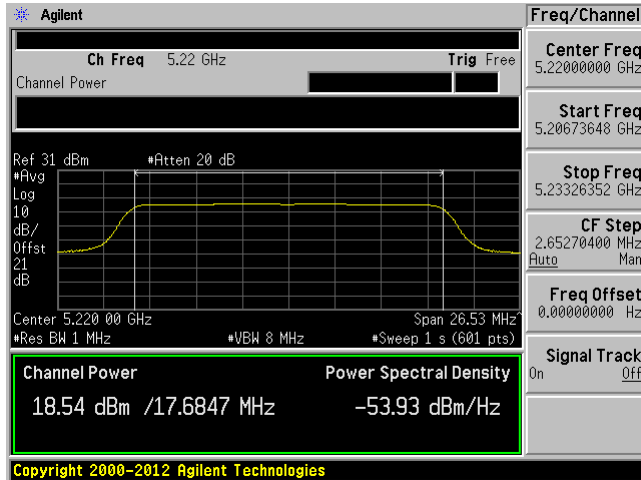


Chain #6

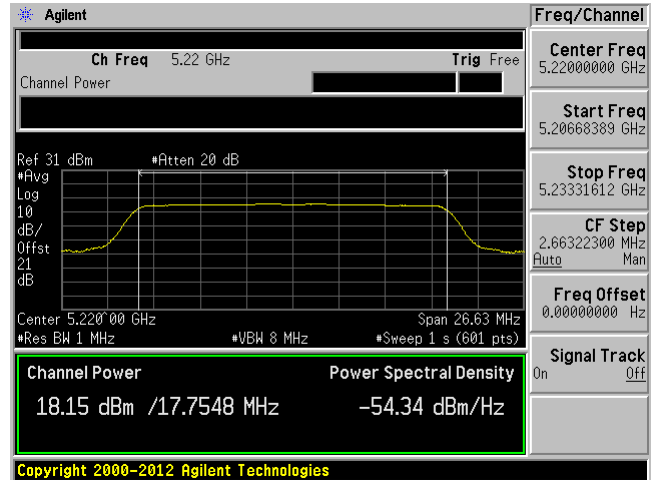


802.11ac20 mode Middle Channel 5220MHz

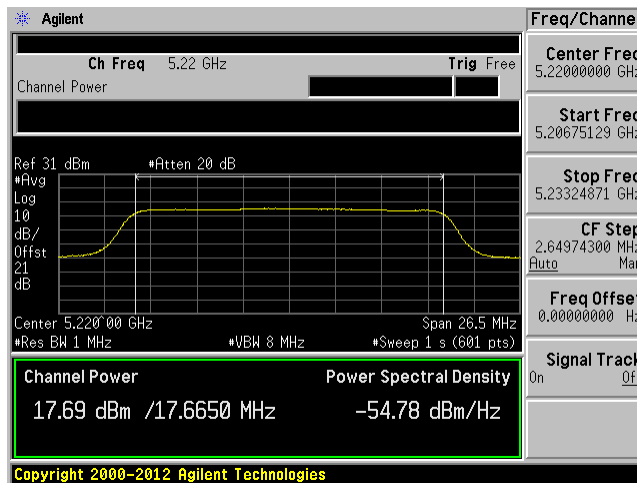
Chain #4



Chain #5

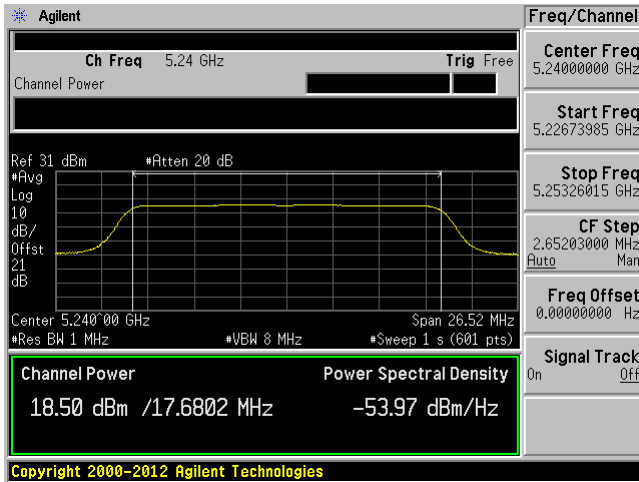


Chain #6

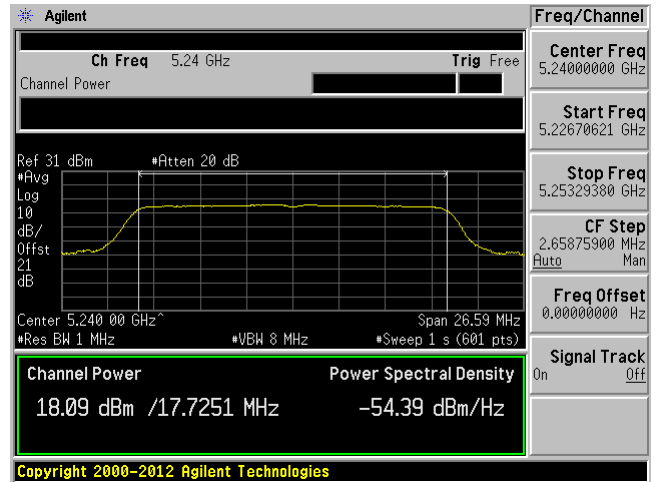


802.11ac20 mode High Channel 5240MHz

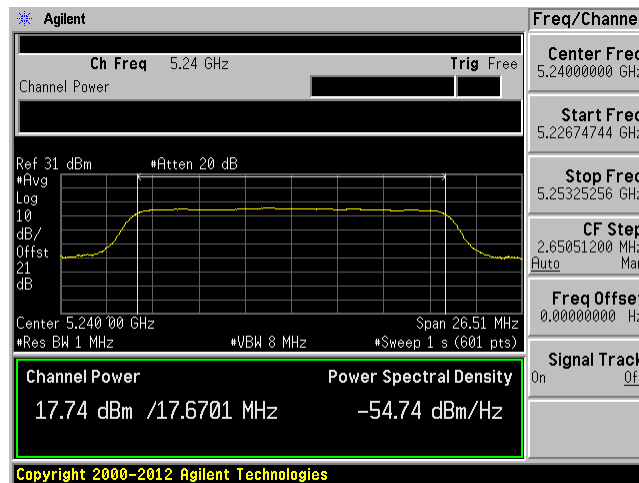
Chain #4



Chain #5

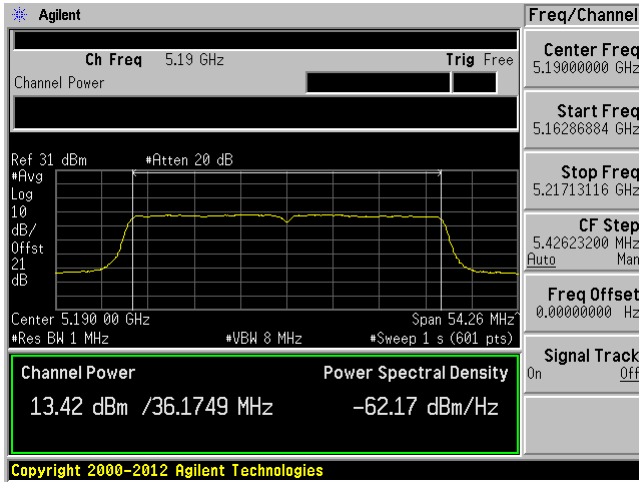


Chain #6

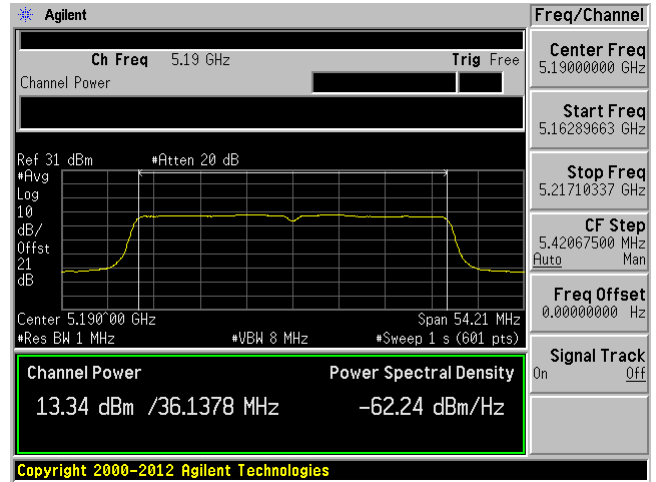


802.11ac40 mode Low Channel 5190MHz

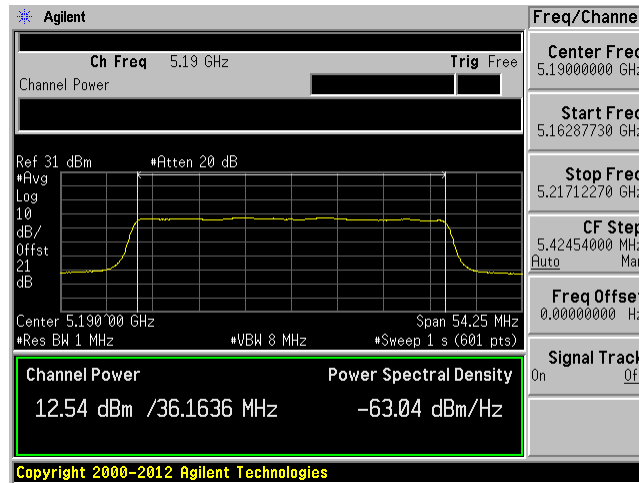
Chain #4



Chain #5

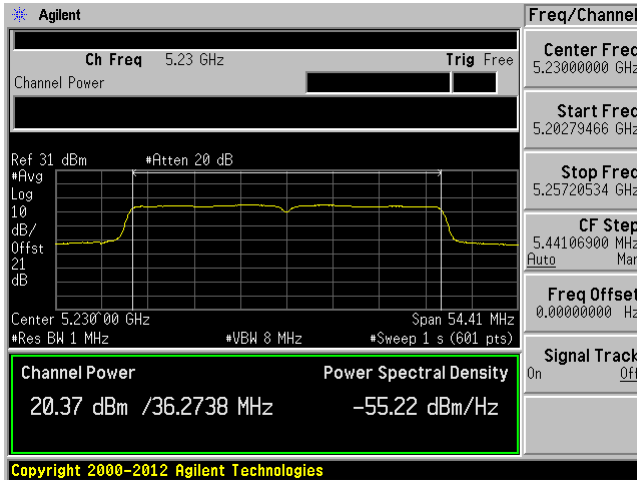


Chain #6

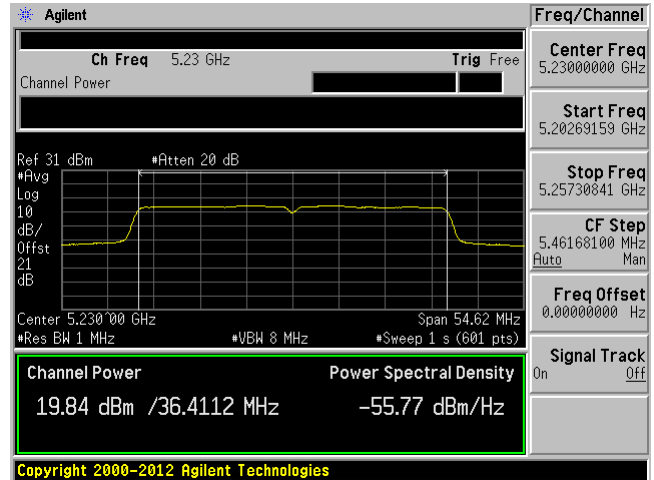


802.11ac40 mode High Channel 5230MHz

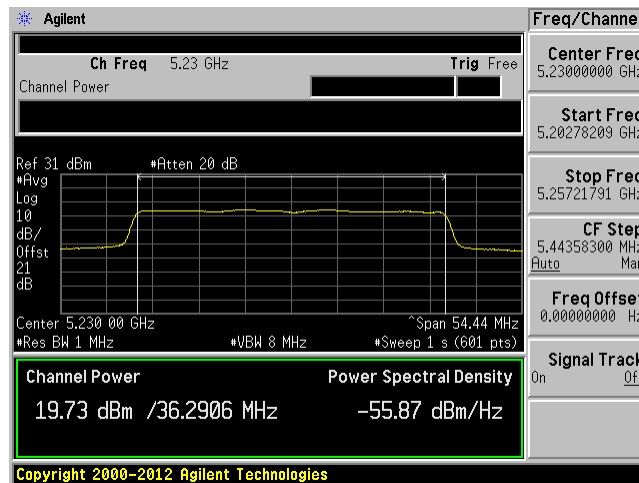
Chain #4



Chain #5

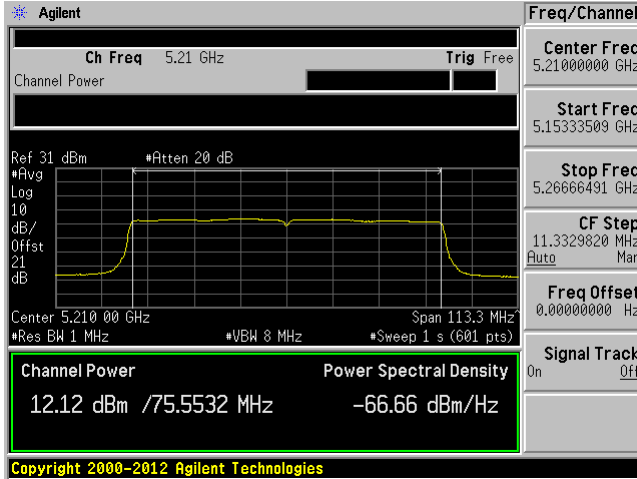


Chain #6

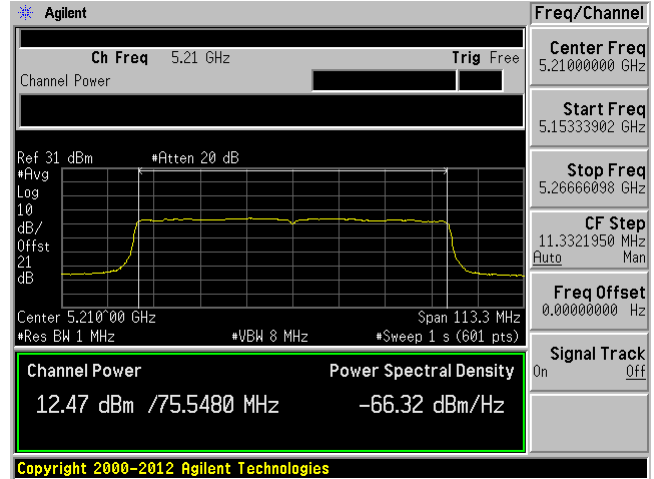


802.11ac80 mode 5210MHz

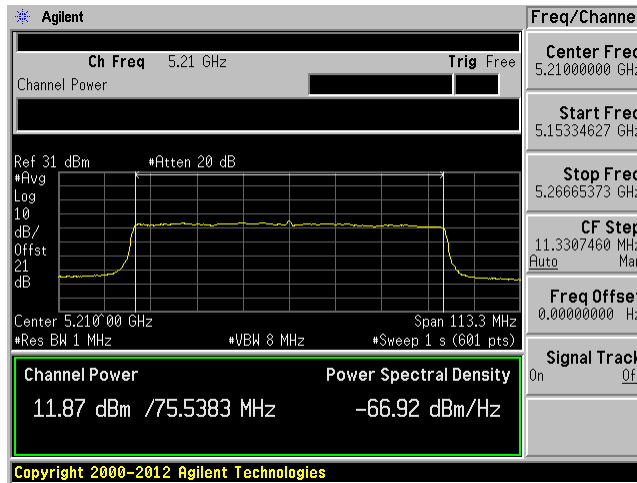
Chain #4



Chain #5



Chain #6



## Beamforming

Mode	Channel	Frequency MHz	Chain #	Conducted Output Power (dBm)	Total Power (dBm)	Limit (dBm)	Comment
802.11a	36	5180	4	19.11	-	29.76	Pass
	44	5220	4	20.04	-	29.76	Pass
	48	5240	4	19.95	-	29.76	Pass
802.11n20	36	5180	4	17.16	21.61	24.87	Pass
			5	16.9			Pass
			6	16.43			Pass
	44	5220	4	18	22.31	24.87	Pass
			5	17.5			Pass
			6	17.06			Pass
	48	5240	4	18.07	22.36	24.87	Pass
			5	17.55			Pass
			6	17.08			Pass
802.11ac20	36	5180	4	17.13	21.53	24.87	Pass
			5	16.84			Pass
			6	16.26			Pass
	44	5220	4	17.88	22.27	24.87	Pass
			5	17.45			Pass
			6	17.15			Pass
	48	5240	4	17.99	22.38	24.87	Pass
			5	17.7			Pass
			6	17.08			Pass
802.11n40	38	5190	4	12.88	17.38	24.87	Pass
			5	12.8			Pass
			6	12.1			Pass
	46	5230	4	19.92	24.25	24.87	Pass
			5	19.41			Pass
			6	19.07			Pass
802.11ac40	38	5190	4	12.88	17.44	24.87	Pass
			5	12.88			Pass
			6	12.21			Pass
	46	5230	4	19.87	24.28	24.87	Pass
			5	19.53			Pass
			6	19.09			Pass
802.11ac80	42	5210	4	11.59	16.43	24.87	Pass
			5	11.92			Pass
			6	11.44			Pass

## 10 FCC §15.407(a) - Power Spectral Density

### 10.1 Applicable Standards

According to FCC §15.407(a):

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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.

### 10.2 Measurement Procedure

- (i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- (ii) Set RBW = 1 MHz.
- (iii) Set VBW  $\geq$  3 MHz.
- (iv) Number of points in sweep  $\geq$  2 Span / RBW. (This ensures that bin-to-bin spacing is  $\leq$  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  $\geq$  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.

### 10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

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



#### 10.4 Test Environmental Conditions

<b>Temperature:</b>	22-24 °C
<b>Relative Humidity:</b>	40-41 %
<b>ATM Pressure:</b>	103.1-104.1 kPa

*The testing was performed by Jin Yang on 2016-04-15 at RF site.*

#### 10.5 Test Results

Note:  $\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{\text{ANT}}] \text{ dBi} = 11.13 \text{ dBi}$

Note: 802.11a mode only transmits signal through antenna 4, and the antenna gain for chain 4 is greater than 6dBi, therefore, the limit is reduced by amount exceed 6 dBi.

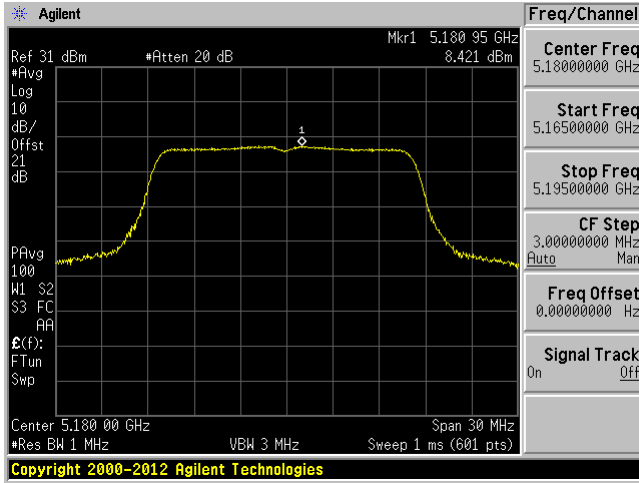
## Non-Beamforming

Mode	Channel	Frequency MHz	Chain #	PSD (dBm/MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Comment
802.11a	36	5180	4	8.421	-	16.76	Pass
	44	5220	4	9.057	-	16.76	Pass
	48	5240	4	9.248	-	16.76	Pass
802.11n20	36	5180	4	6.404	10.69	11.87	Pass
			5	5.976			Pass
			6	5.306			Pass
	44	5220	4	6.871	11.66	11.87	Pass
			5	7.003			Pass
			6	6.79			Pass
	48	5240	4	7.075	11.72	11.87	Pass
			5	7.114			Pass
			6	6.631			Pass
802.11ac20	36	5180	4	5.943	10.55	11.87	Pass
			5	5.972			Pass
			6	5.388			Pass
	44	5220	4	7.164	11.72	11.87	Pass
			5	6.936			Pass
			6	6.749			Pass
	48	5240	4	7.213	11.71	11.87	Pass
			5	6.985			Pass
			6	6.605			Pass
802.11n40	38	5190	4	-1.41	3.55	11.87	Pass
			5	-0.522			Pass
			6	-1.851			Pass
	46	5230	4	6.09	10.62	11.87	Pass
			5	5.924			Pass
			6	5.498			Pass
802.11ac40	38	5190	4	-1.015	3.75	11.87	Pass
			5	-0.621			Pass
			6	-1.462			Pass
	46	5230	4	6.084	10.61	11.87	Pass
			5	5.836			Pass
			6	5.579			Pass
802.11ac80	42	5210	4	-5.24	-0.05	11.87	Pass
			5	-4.921			Pass
			6	-4.36			Pass

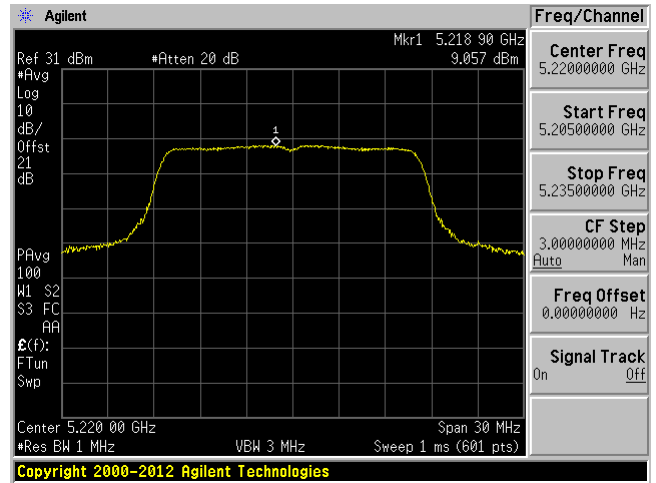
Please refer to the following plots.

802.11a mode

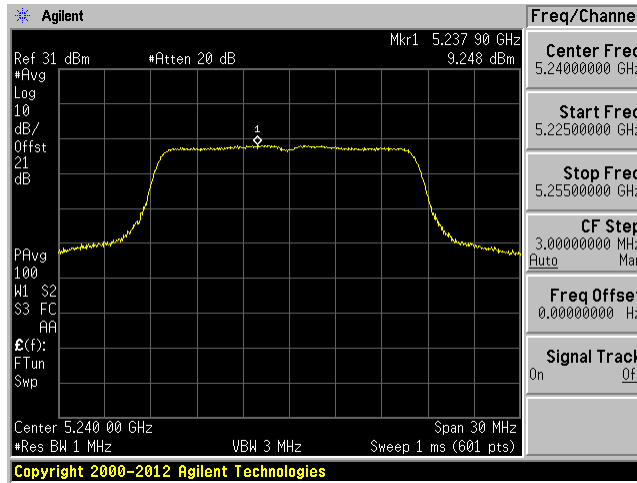
802.11a mode Low Channel 5180MHz



802.11a mode Middle Channel 5220MHz

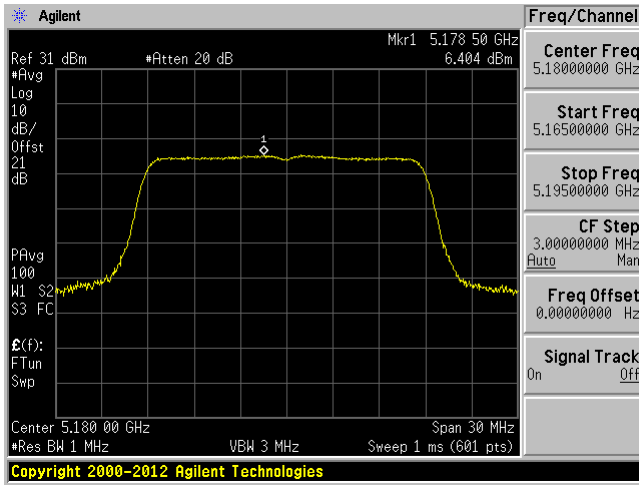


802.11a mode High Channel 5240MHz

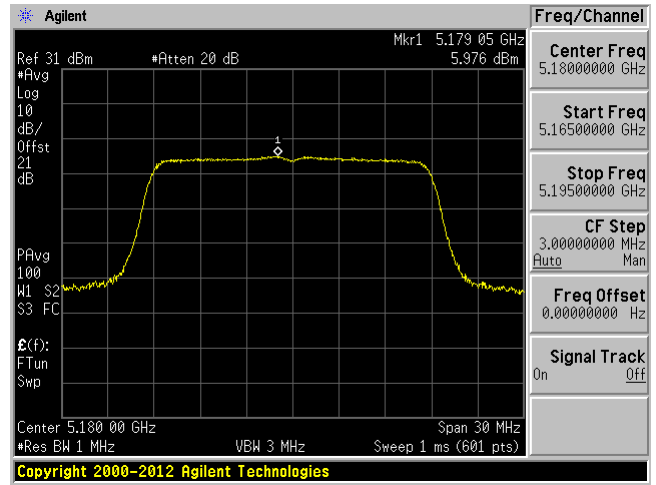


802.11n20 mode Low Channel 5180MHz

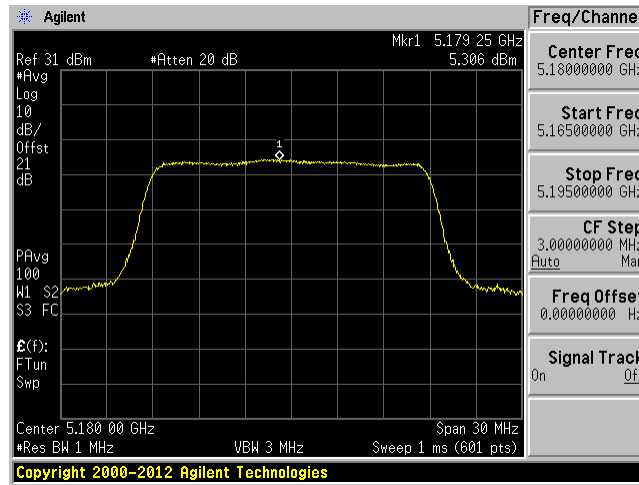
Chain #4



Chain #5

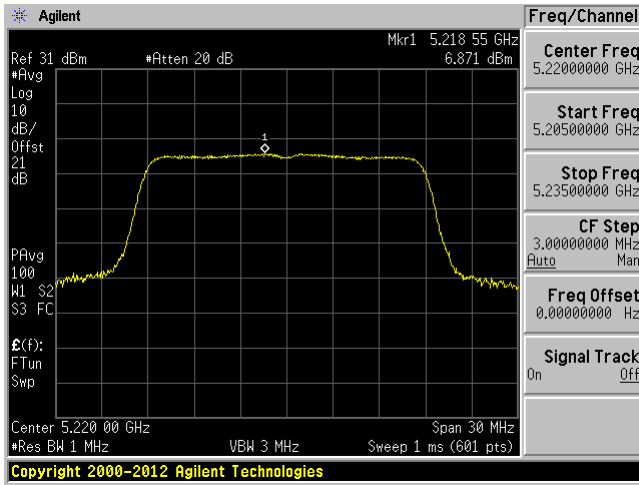


Chain #6

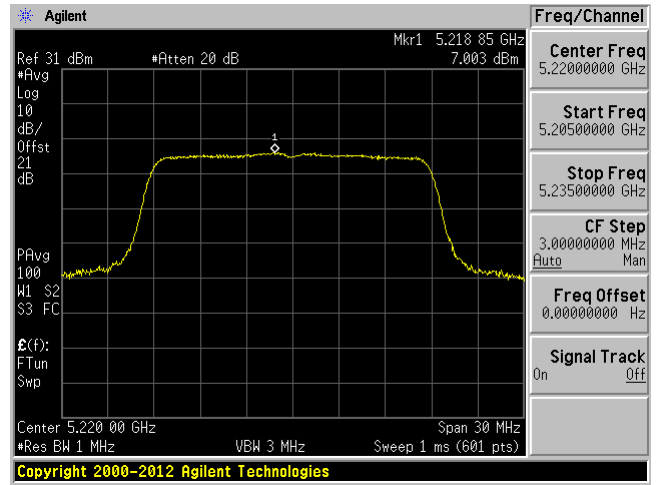


802.11n20 mode Middle Channel 5220MHz

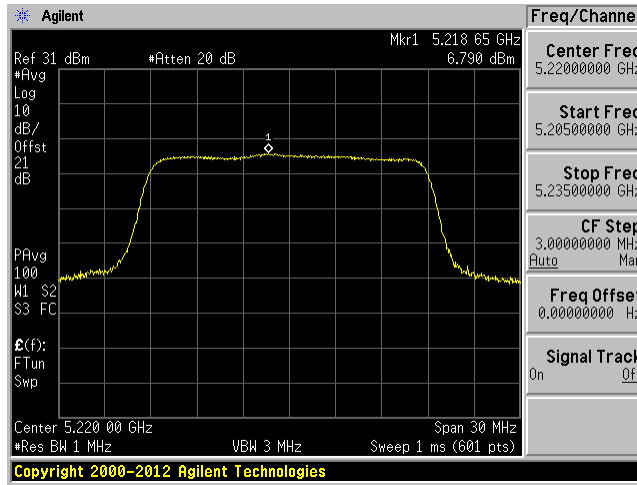
Chain #4



Chain #5

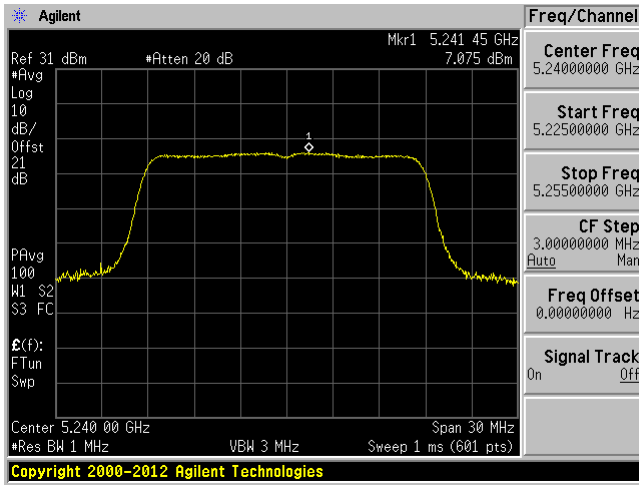


Chain #6

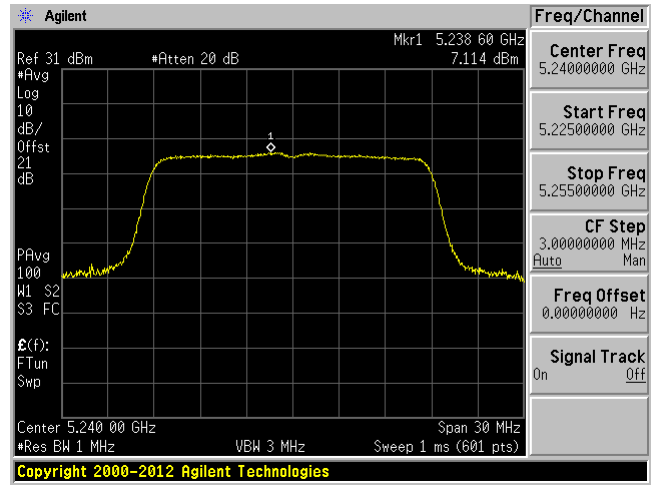


802.11n20 mode High Channel 5240MHz

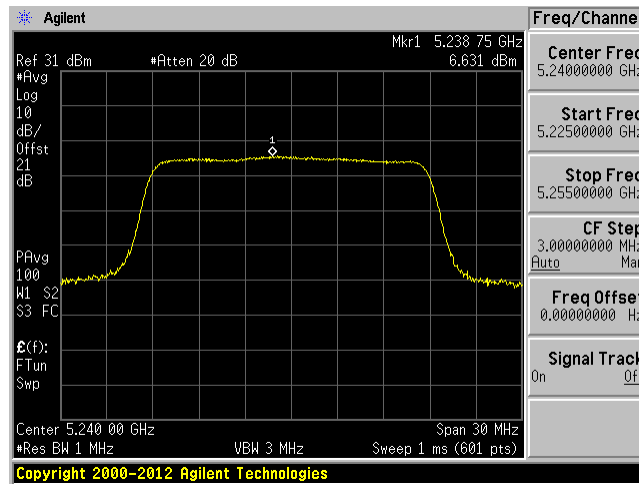
Chain #4



Chain #5

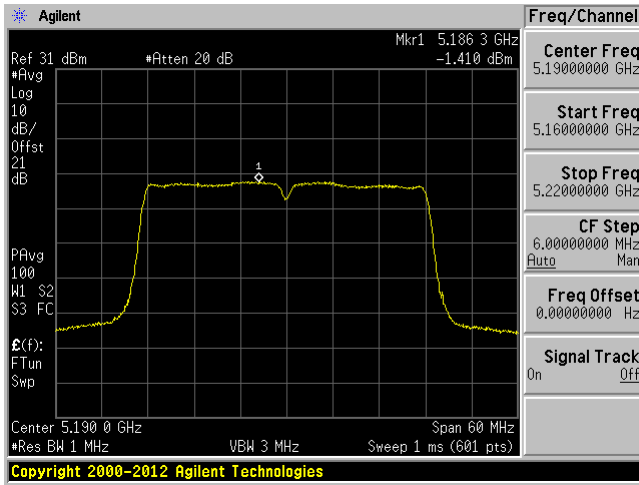


Chain #6

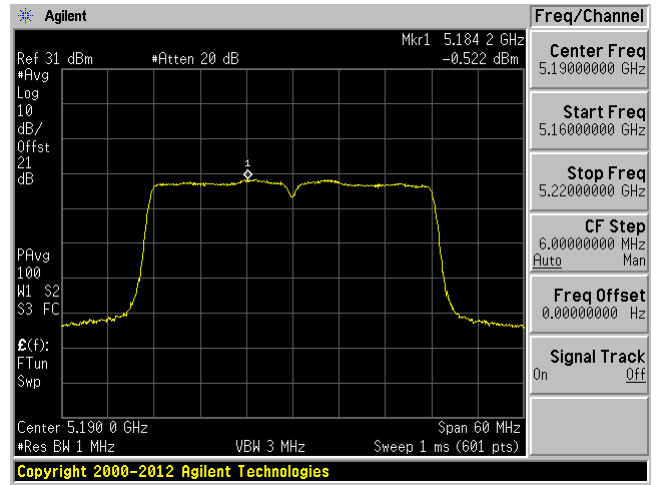


802.11n40 mode Low Channel 5190MHz

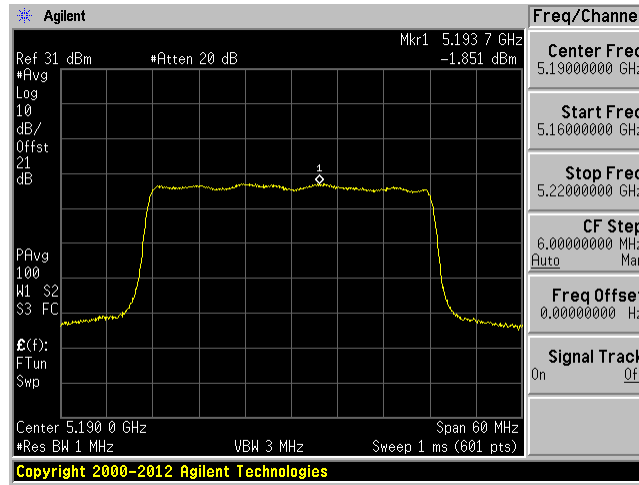
Chain #4



Chain #5

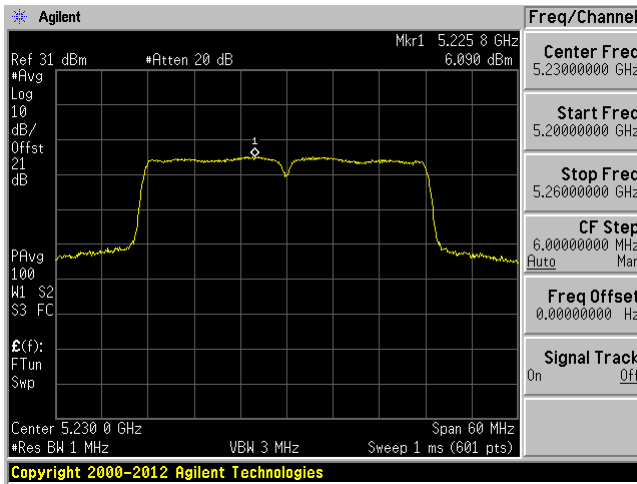


Chain #6

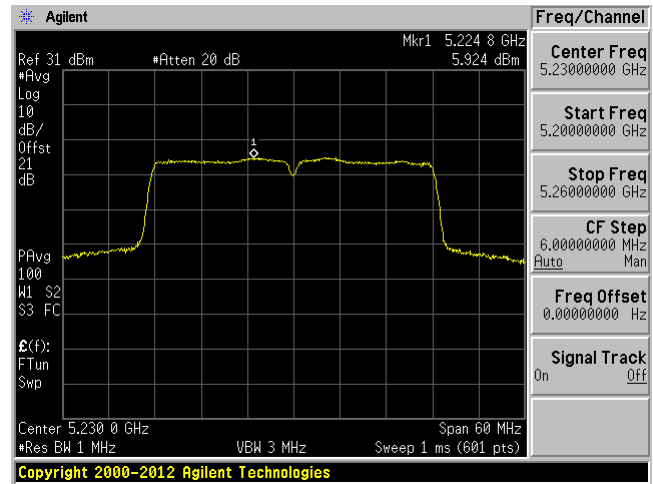


802.11n40 mode High Channel 5230MHz

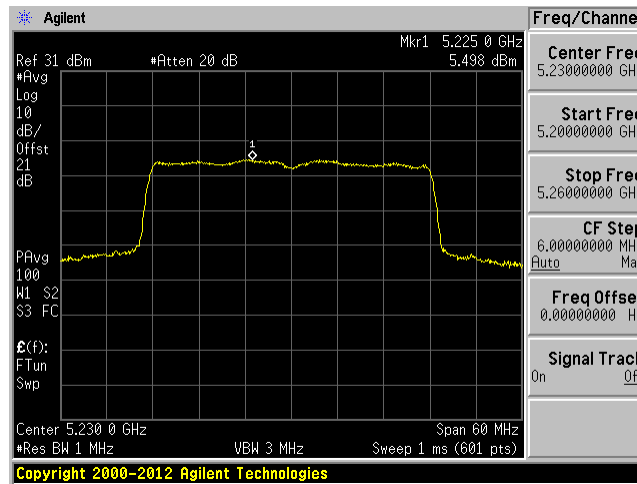
Chain #4



Chain #5



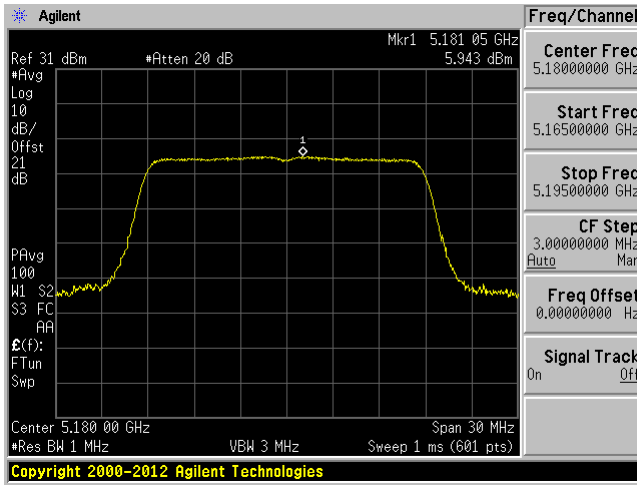
Chain #6



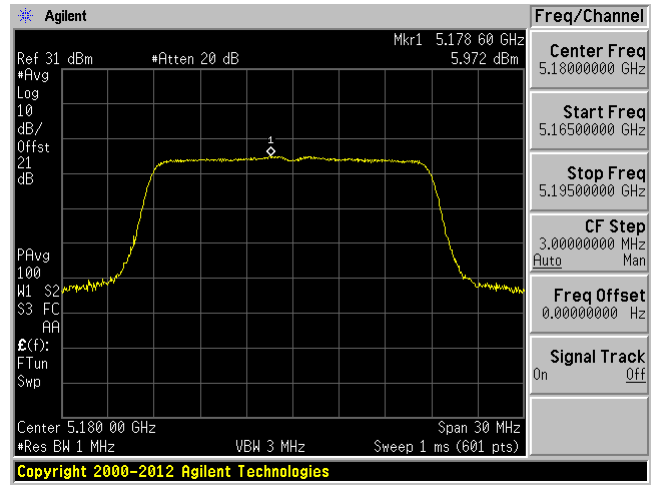


802.11ac20 mode Low Channel 5180MHz

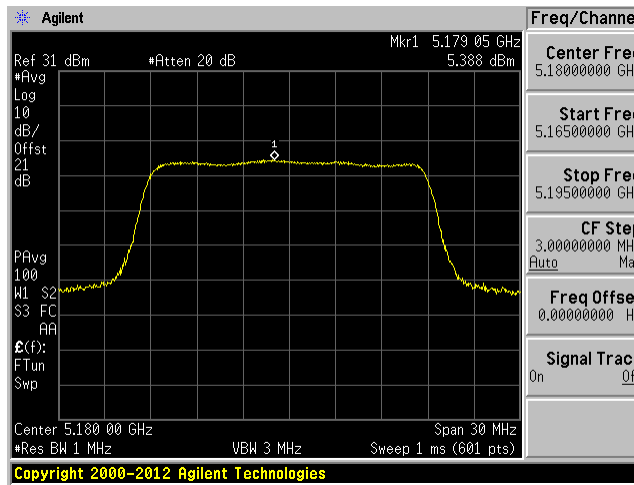
Chain #4



Chain #5

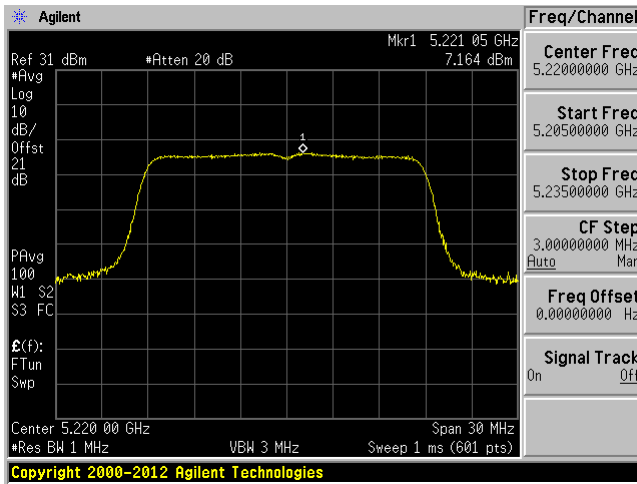


Chain #6

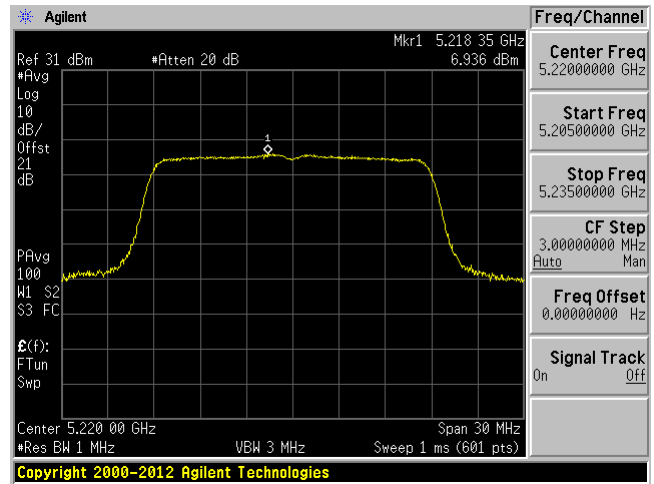


802.11ac20 mode Middle Channel 5220MHz

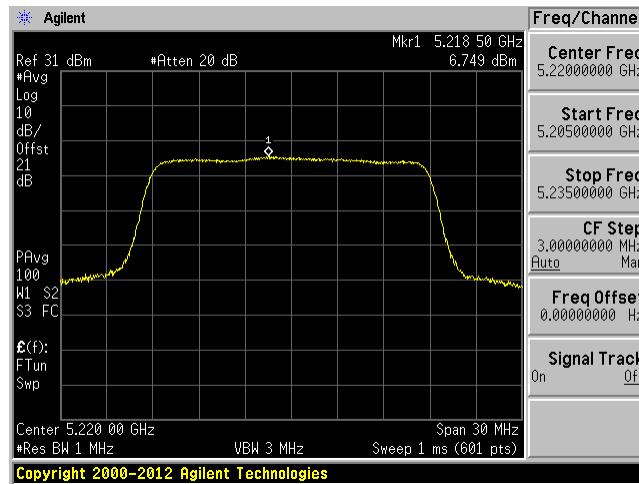
Chain #4



Chain #5

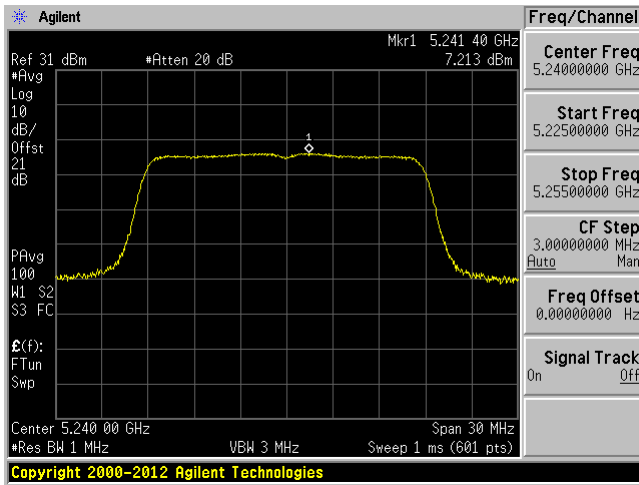


Chain #6

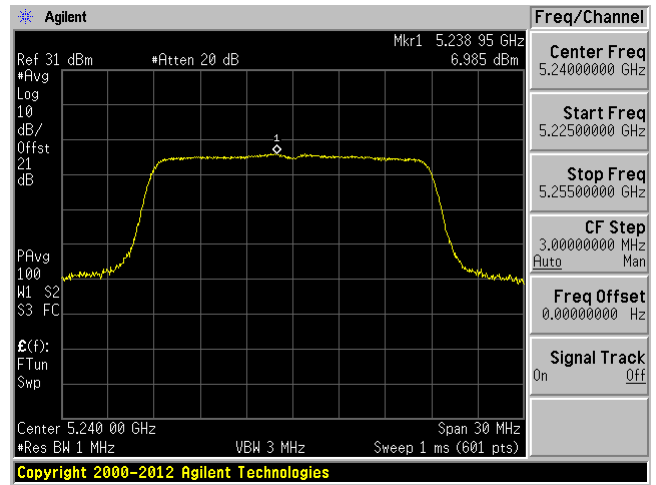


802.11ac20 mode High Channel 5240MHz

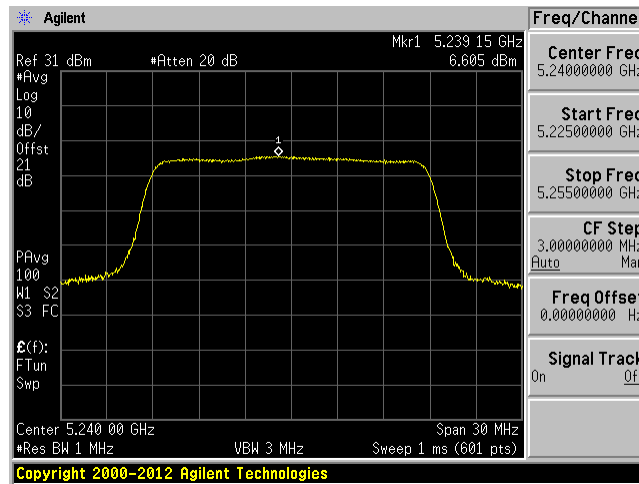
Chain #4



Chain #5

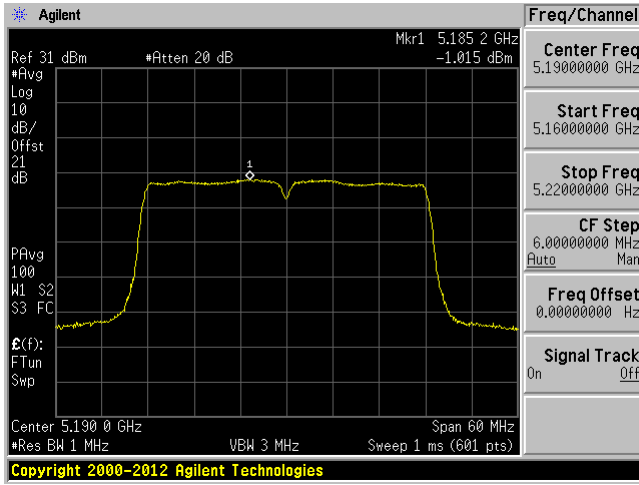


Chain #6

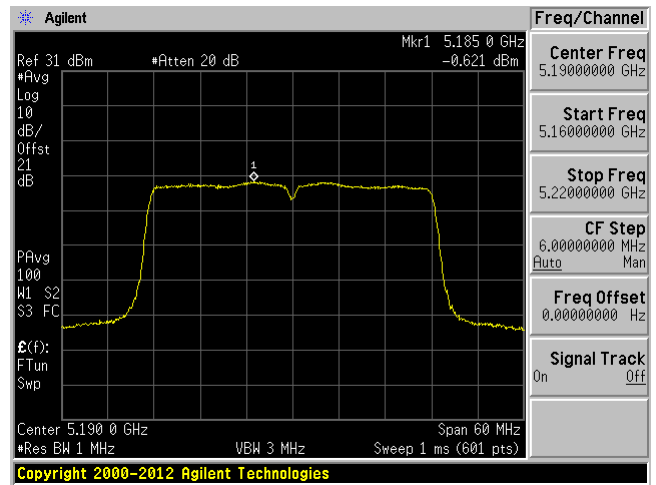


802.11ac40 mode Low Channel 5190MHz

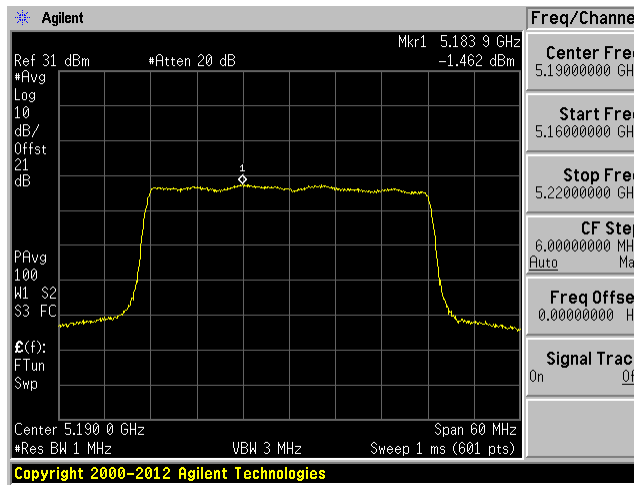
Chain #4



Chain #5

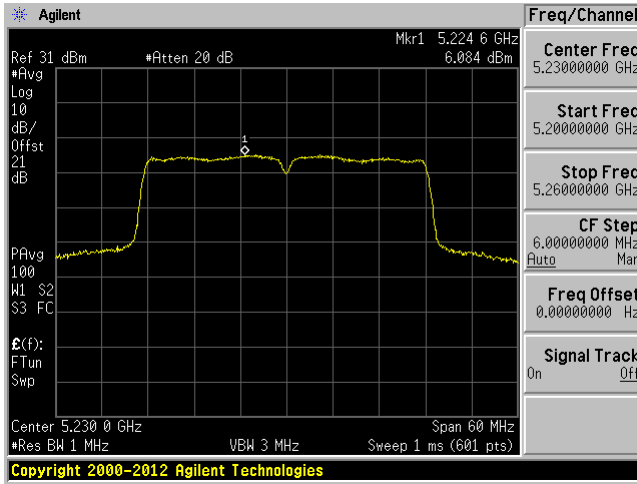


Chain #6

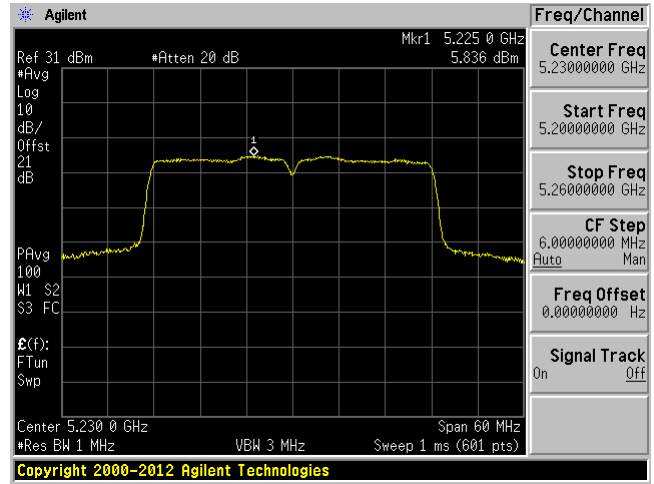


802.11ac40 mode High Channel 5230MHz

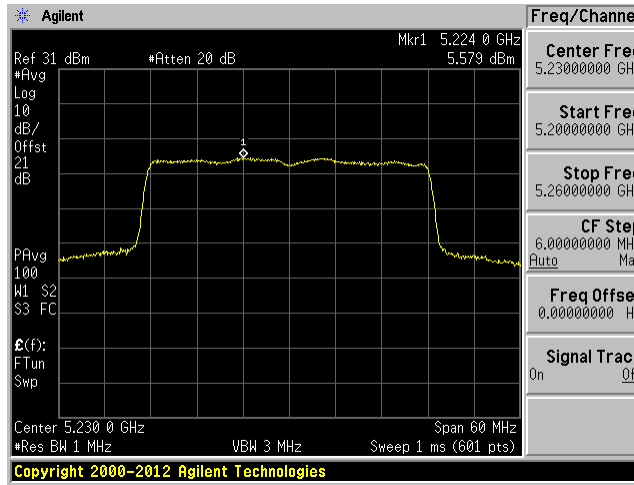
Chain #4



Chain #5

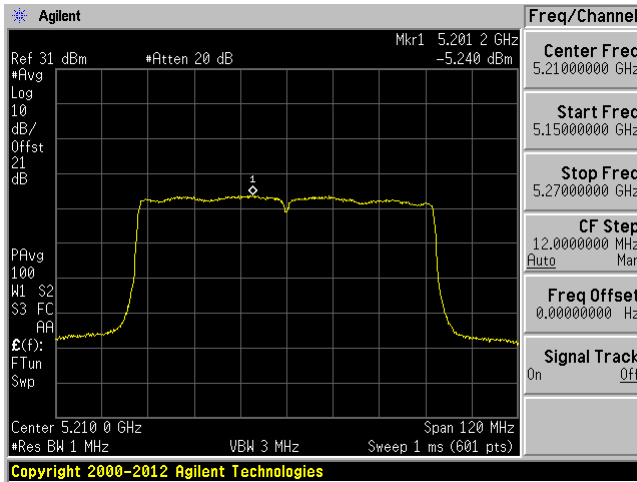


Chain #6

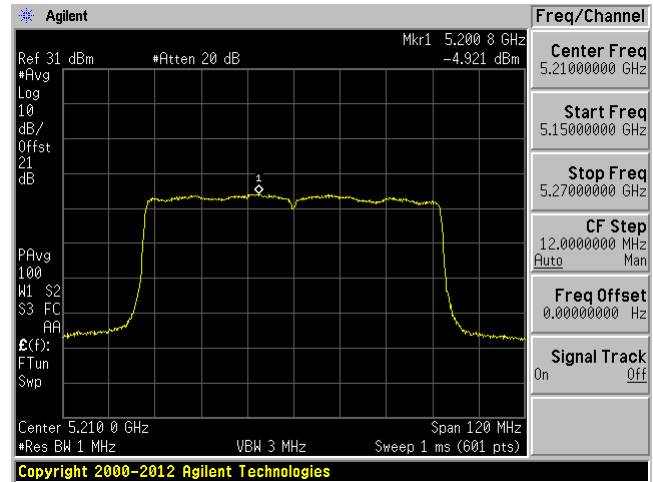


802.11ac80 mode 5210MHz

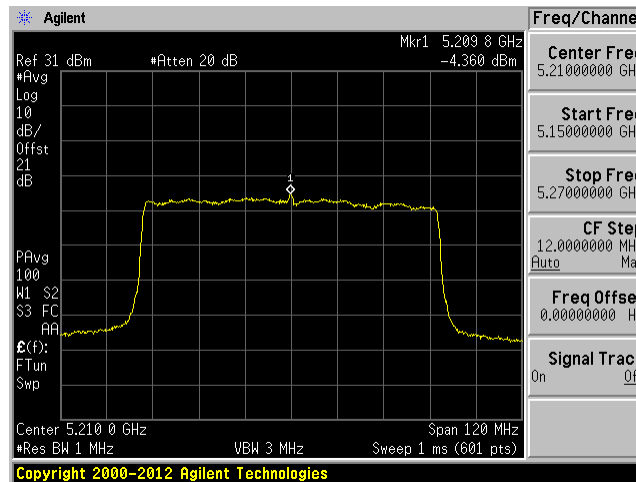
Chain #4



Chain #5



Chain #6



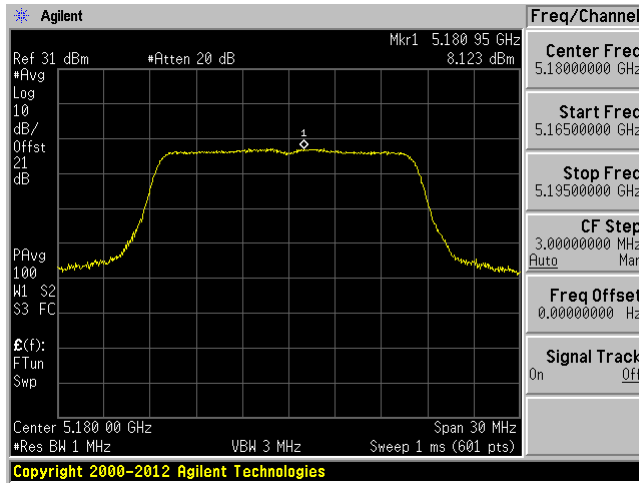
**Beamforming**

Mode	Channel	Frequency MHz	Chain #	PSD (dBm/MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Comment
802.11a	36	5180	4	8.123	-	16.76	Pass
	44	5220	4	8.926	-	16.76	Pass
	48	5240	4	8.894	-	16.76	Pass
802.11n20	36	5180	4	6.001	10.46	11.87	Pass
			5	5.797			Pass
			6	5.221			Pass
	44	5220	4	6.432	11.07	11.87	Pass
			5	6.481			Pass
			6	5.951			Pass
	48	5240	4	6.699	11.02	11.87	Pass
			5	6.205			Pass
			6	5.802			Pass
802.11ac20	36	5180	4	5.763	10.33	11.87	Pass
			5	5.678			Pass
			6	5.203			Pass
	44	5220	4	6.7	11.08	11.87	Pass
			5	6.385			Pass
			6	5.798			Pass
	48	5240	4	6.647	11.08	11.87	Pass
			5	6.374			Pass
			6	5.874			Pass
802.11n40	38	5190	4	-1.257	3.12	11.87	Pass
			5	-1.379			Pass
			6	-2.423			Pass
	46	5230	4	5.809	10.14	11.87	Pass
			5	5.437			Pass
			6	4.8			Pass
802.11ac40	38	5190	4	-1.322	3.29	11.87	Pass
			5	-1.319			Pass
			6	-1.836			Pass
	46	5230	4	5.486	10.19	11.87	Pass
			5	5.735			Pass
			6	5.016			Pass
802.11ac80	42	5210	4	-5.902	-0.67	11.87	Pass
			5	-5.366			Pass
			6	-5.104			Pass

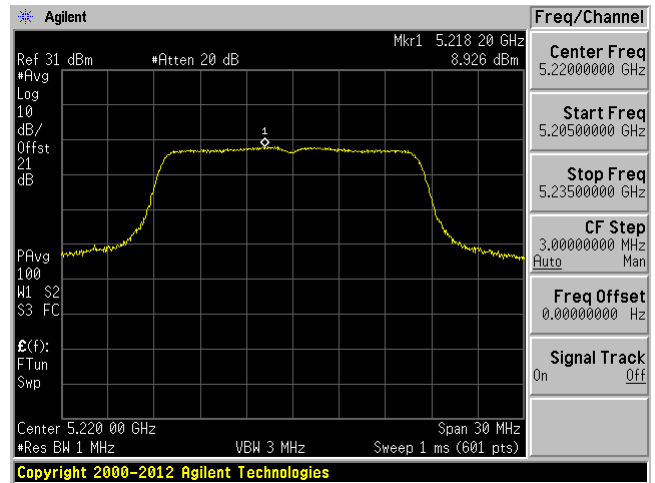
Please refer to the following plots.

802.11a mode

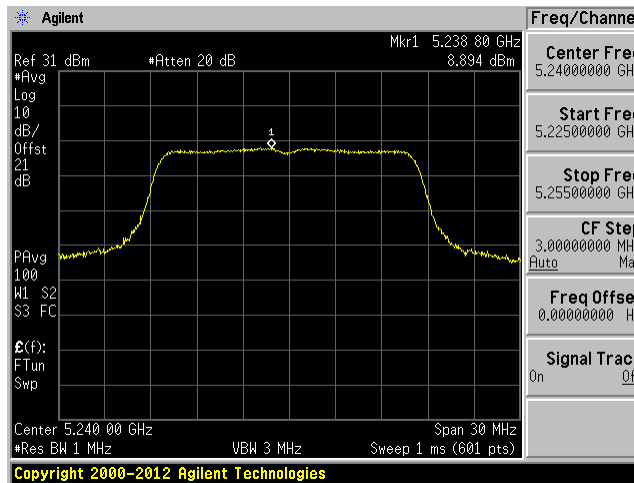
802.11a mode Low Channel 5180MHz



802.11a mode Middle Channel 5220MHz



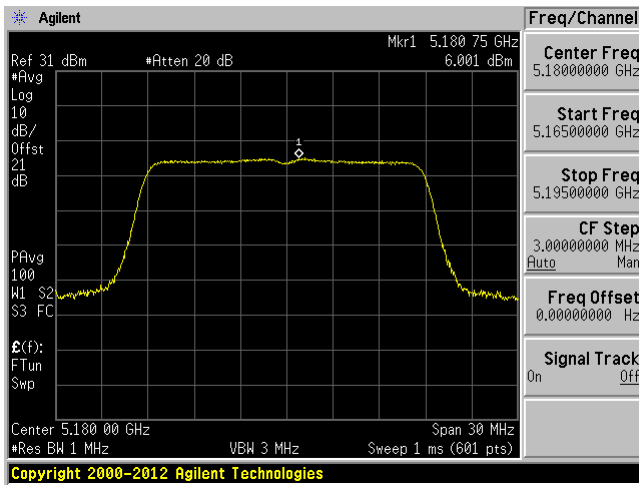
802.11a mode High Channel 5240MHz



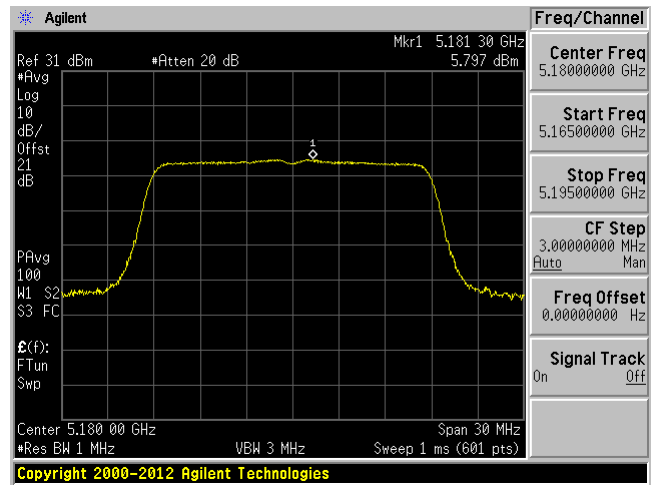


802.11n20 mode Low Channel 5180MHz

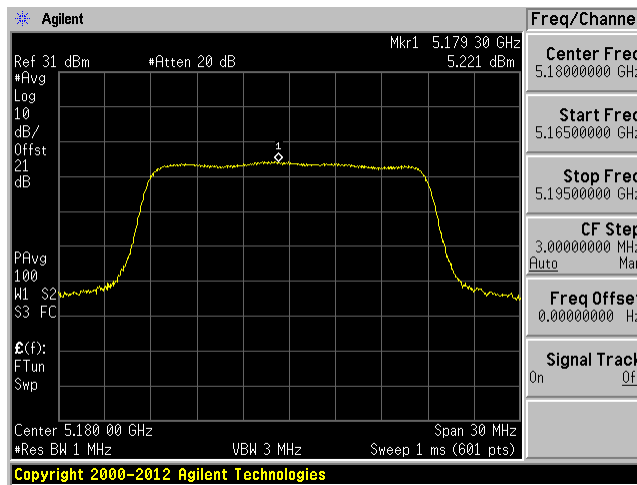
Chain #4



Chain #5

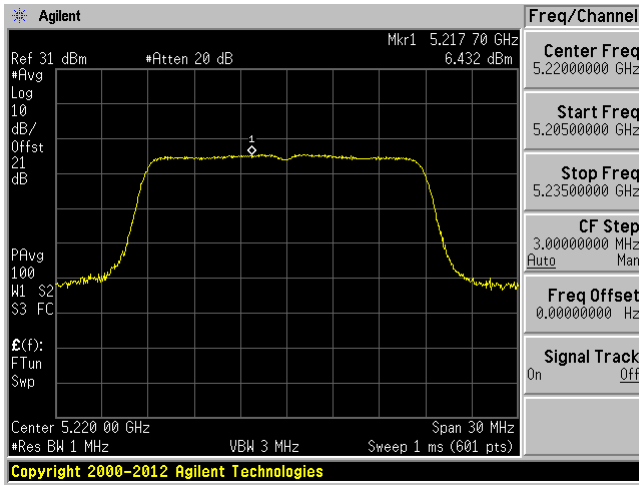


Chain #6

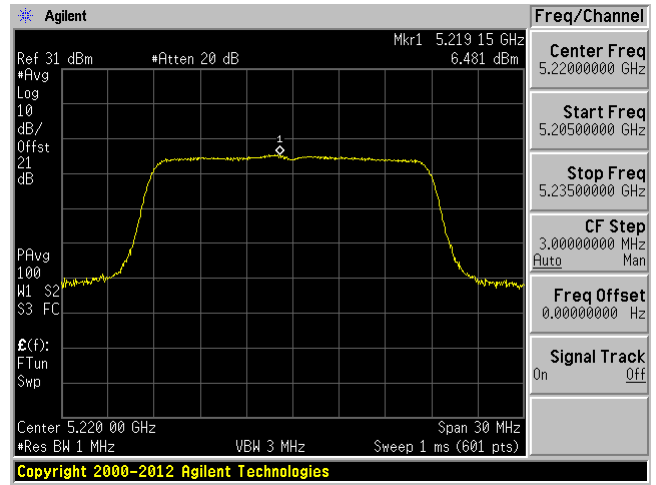


802.11n20 mode Middle Channel 5220MHz

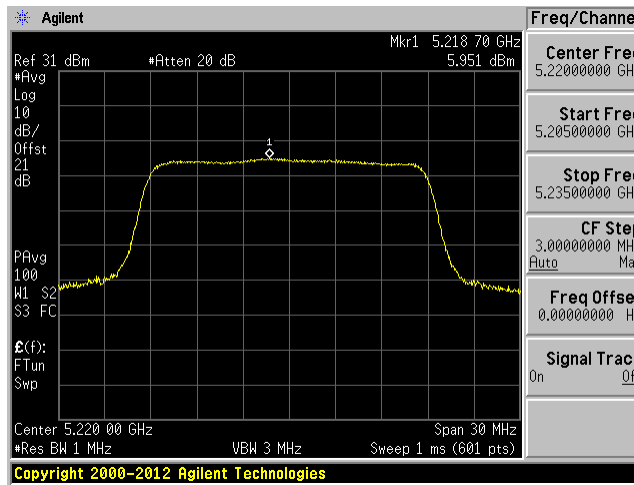
Chain #4



Chain #5

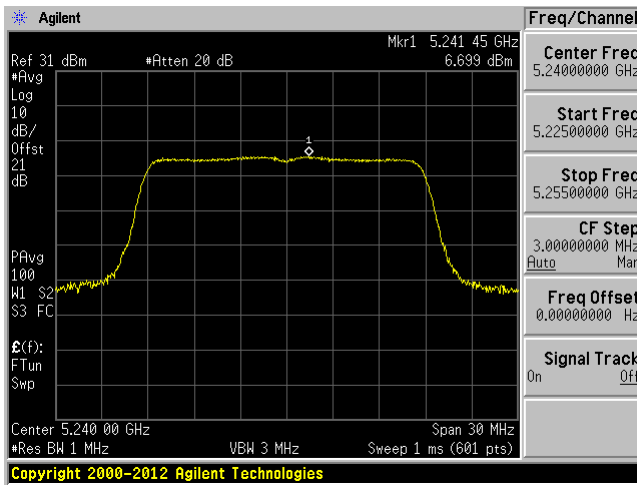


Chain #6

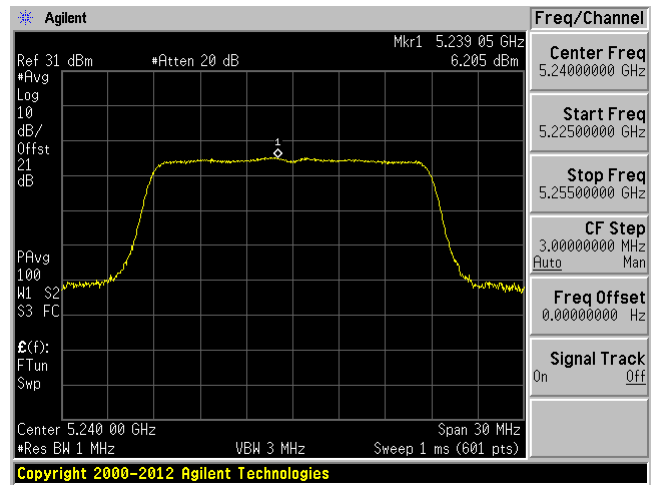


802.11n20 mode High Channel 5240MHz

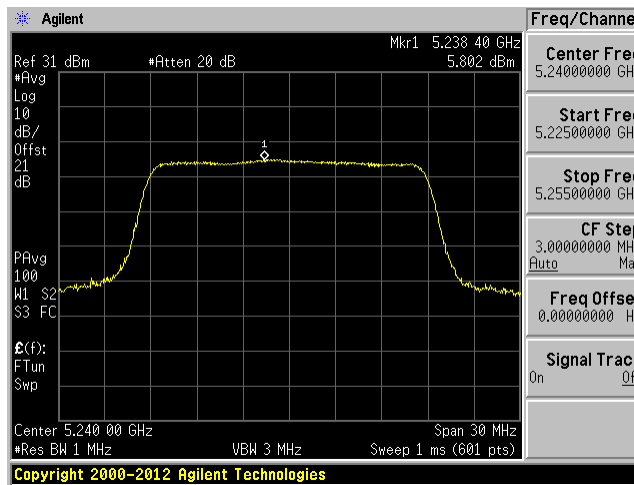
Chain #4



Chain #5

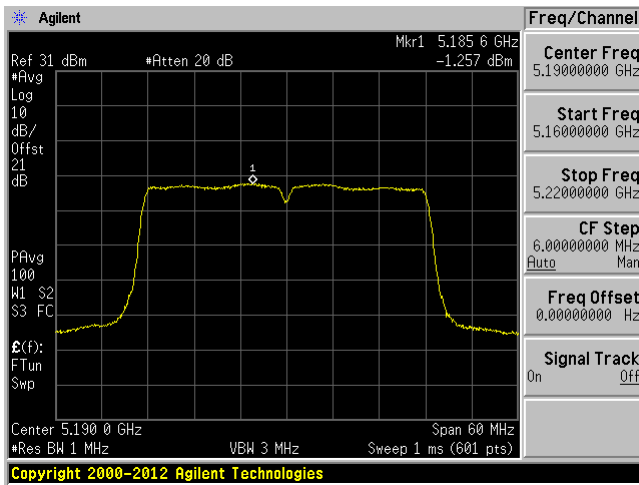


Chain #6

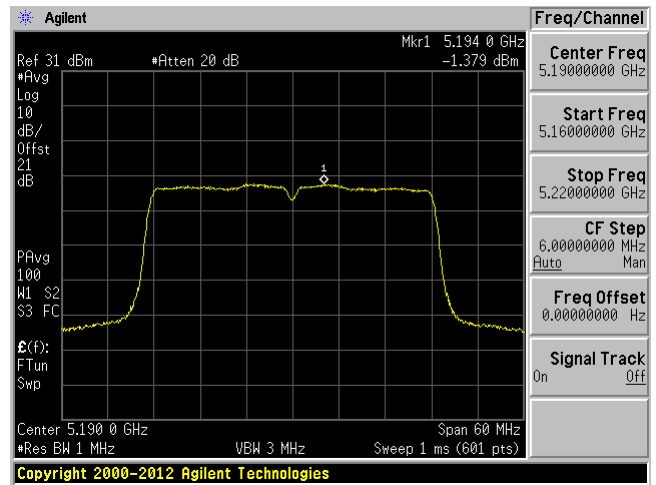


802.11n40 mode Low Channel 5190MHz

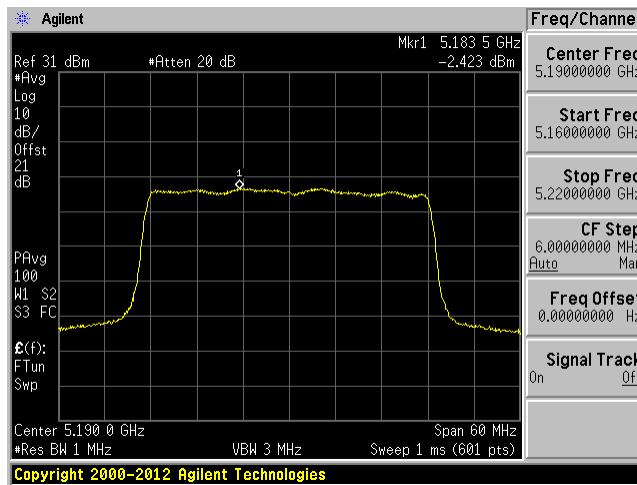
Chain #4



Chain #5

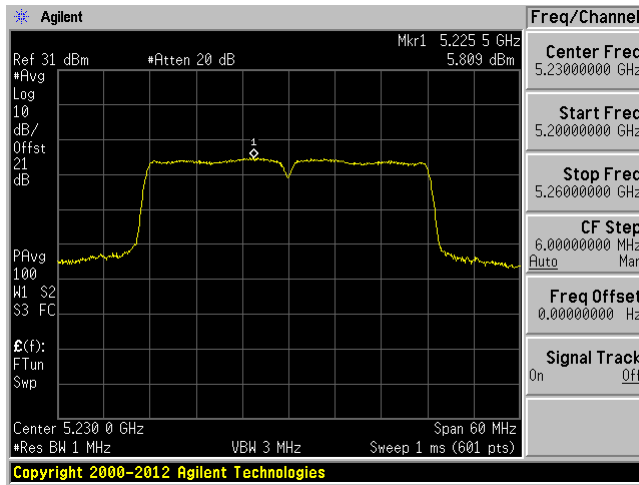


Chain #6

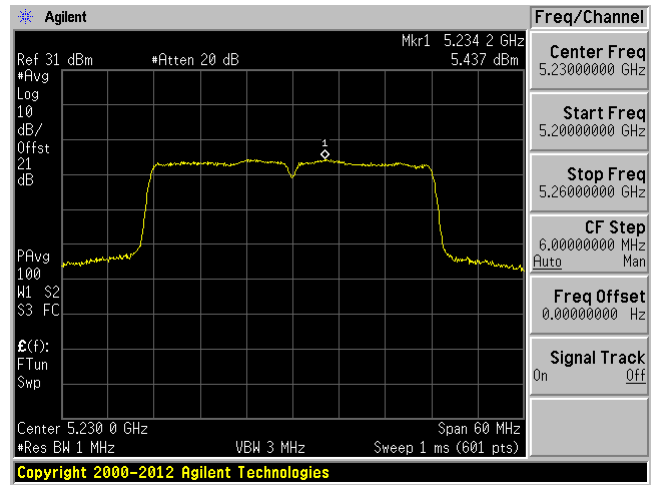


802.11n40 mode High Channel 5230MHz

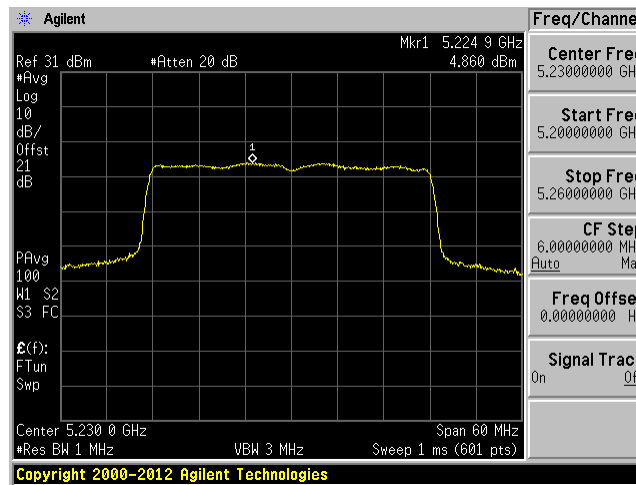
Chain #4



Chain #5

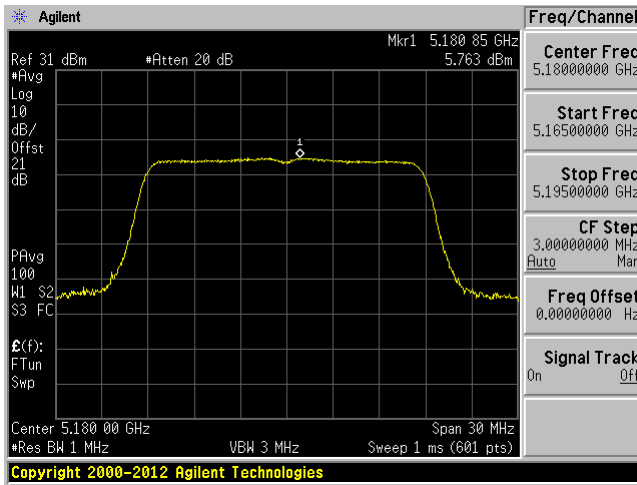


Chain #6

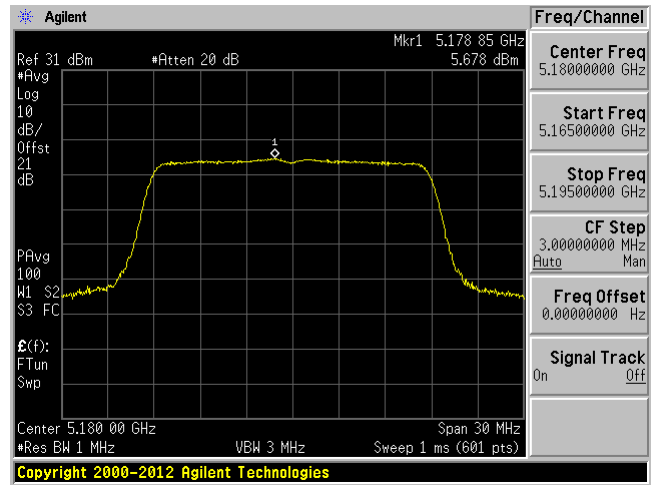


802.11ac20 mode Low Channel 5180MHz

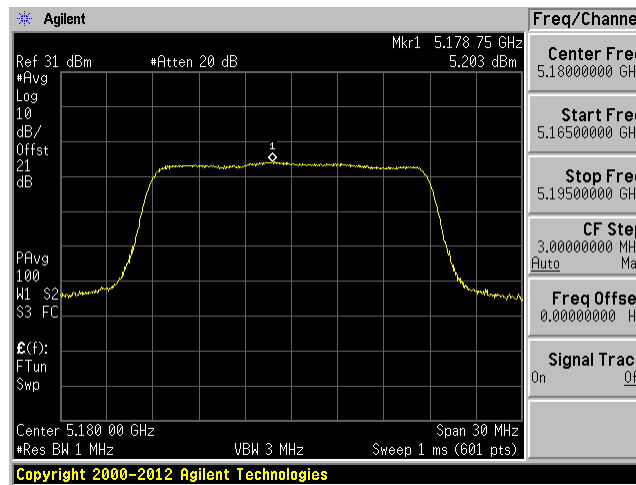
Chain #4



Chain #5

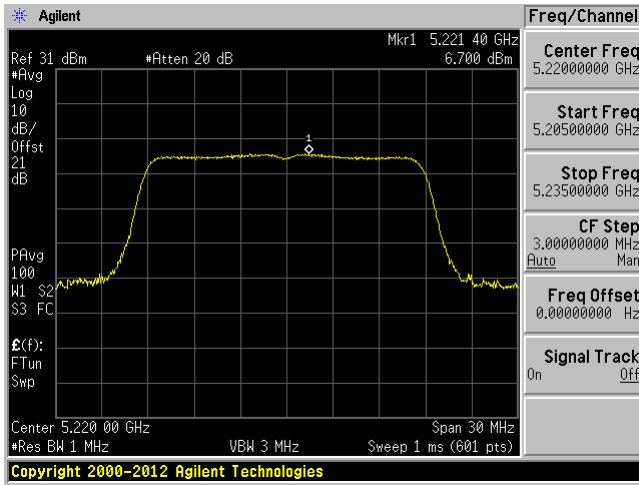


Chain #6

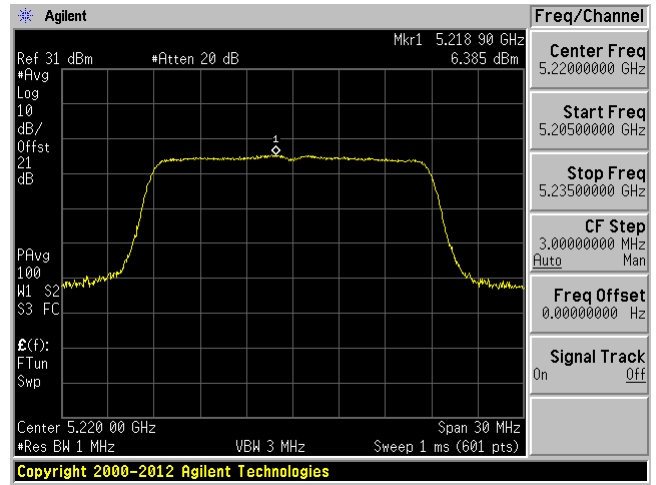


802.11ac20 mode Middle Channel 5220MHz

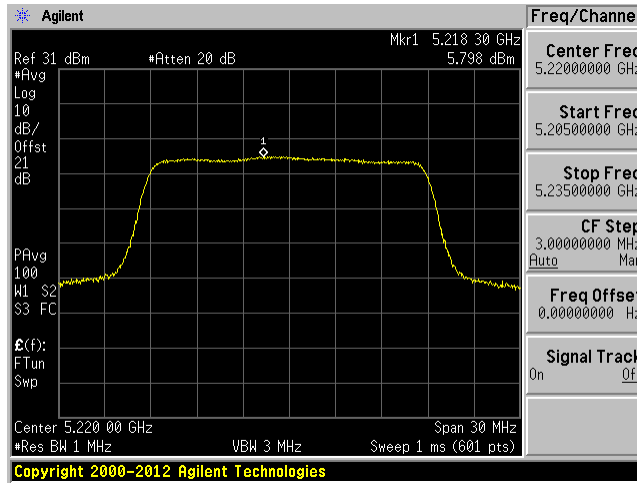
Chain #4



Chain #5

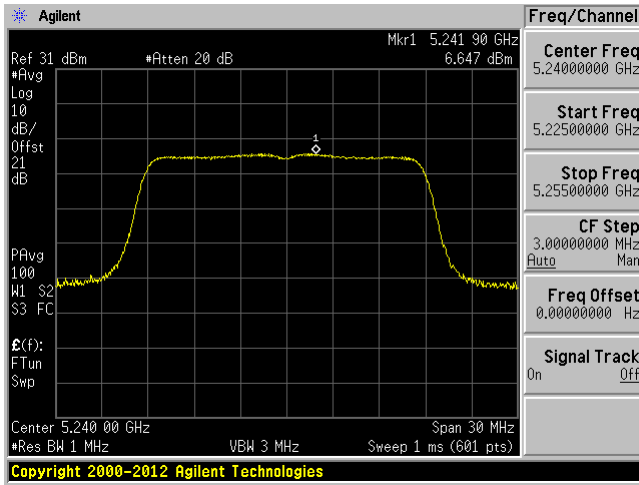


Chain #6

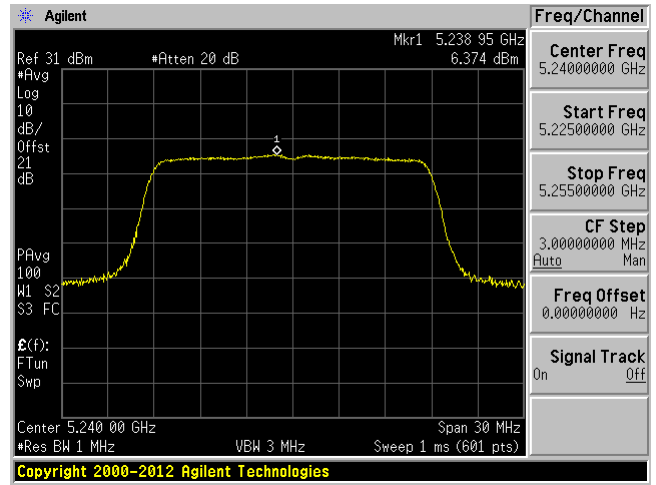


802.11ac20 mode High Channel 5240MHz

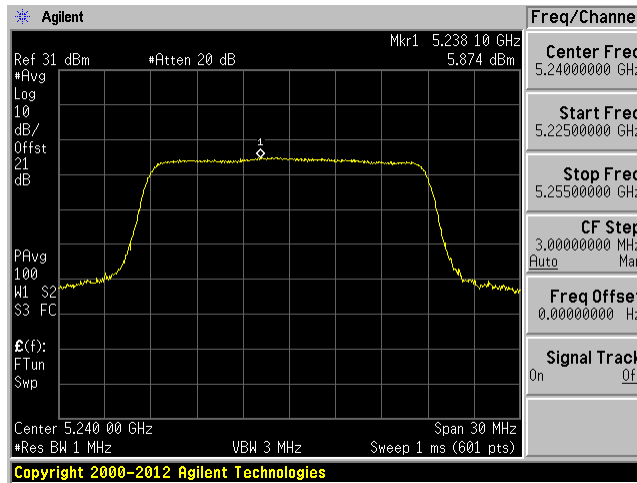
Chain #4



Chain #5



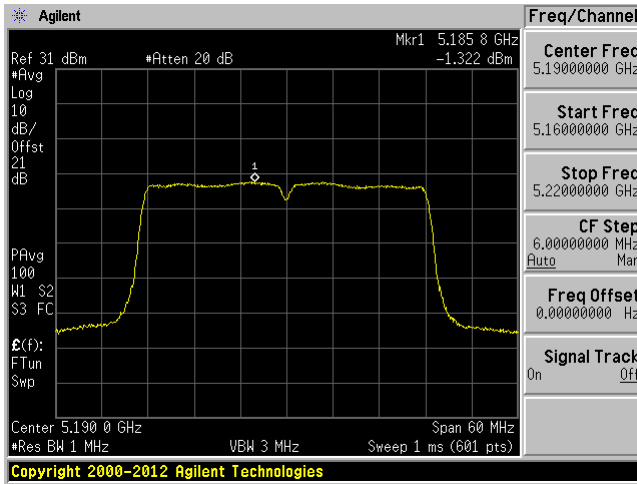
Chain #6



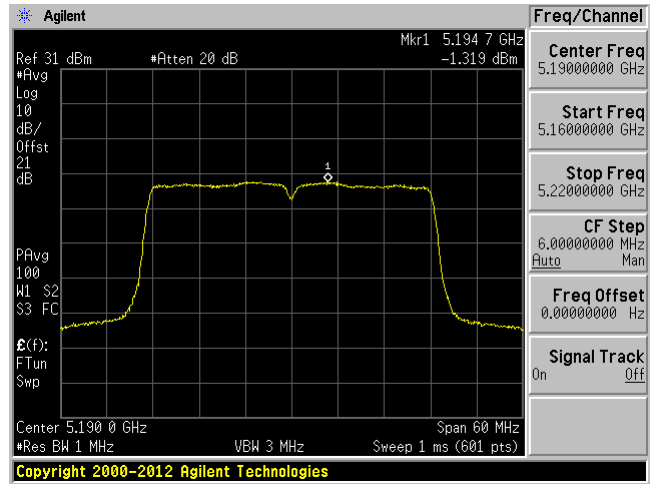


802.11ac40 mode Low Channel 5190MHz

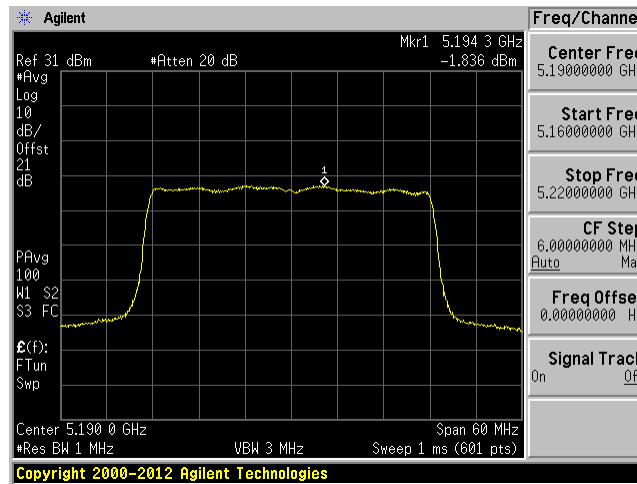
Chain #4



Chain #5

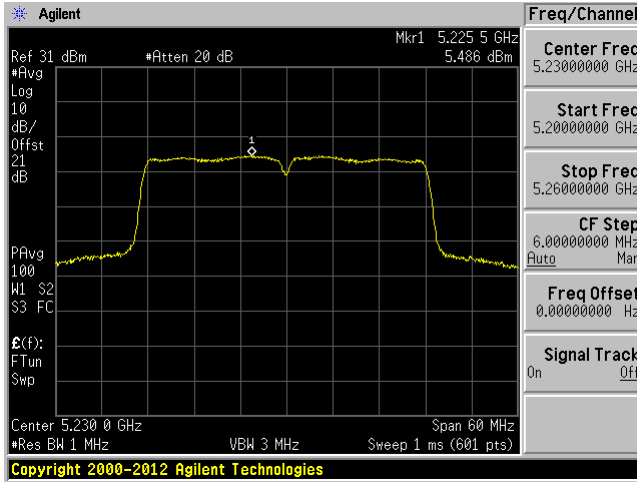


Chain #6

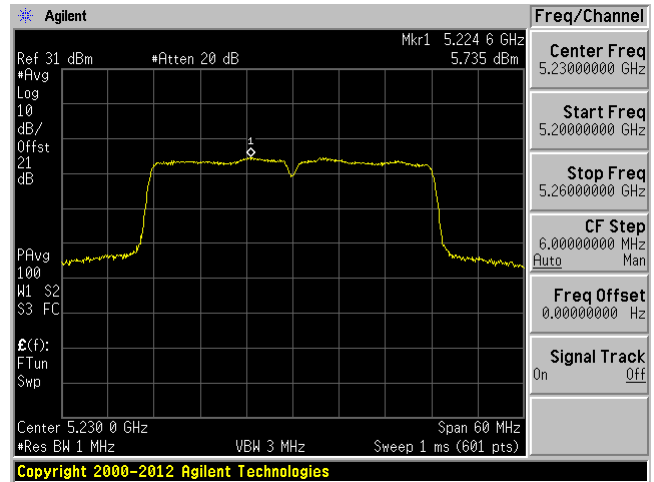


802.11ac40 mode High Channel 5230MHz

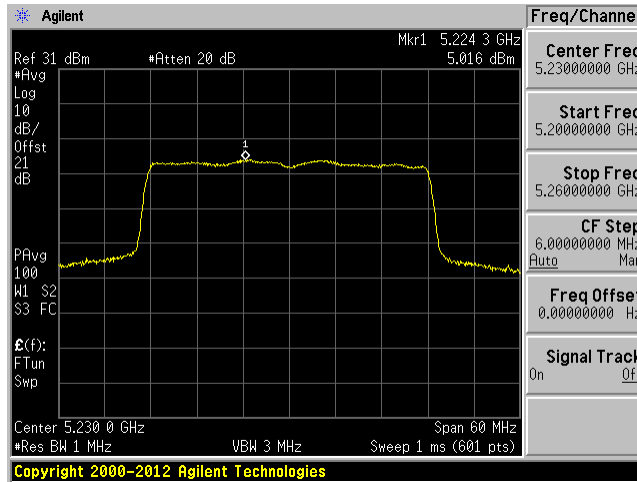
Chain #4



Chain #5

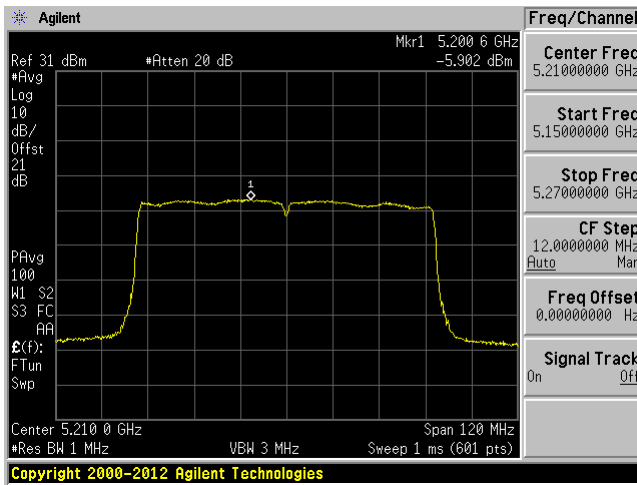


Chain #6

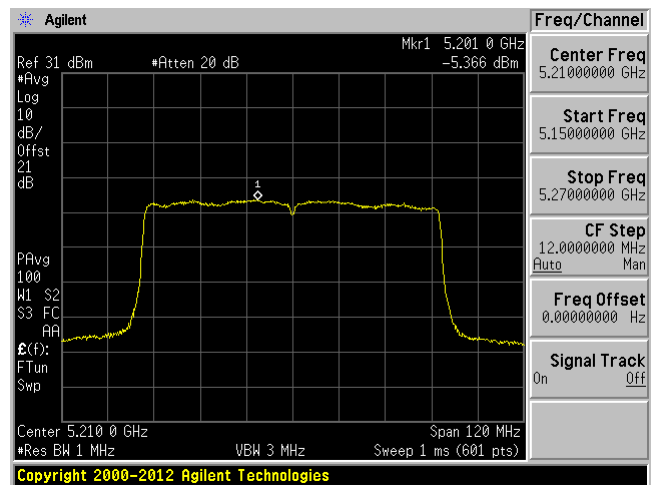


802.11ac80 mode 5210MHz

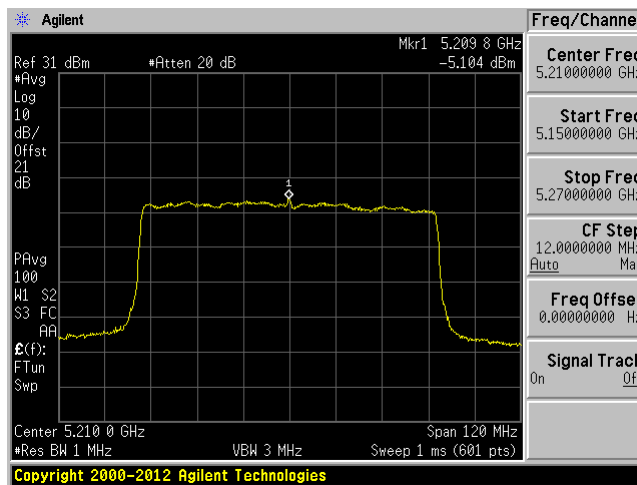
Chain #4



Chain #5



Chain #6



## 11 §15.407(b) - Out of Band Emissions

### 11.1 Applicable Standards

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 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.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of  $-27$  dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of  $-17$  dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of  $-27$  dBm/MHz. 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.

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.

The provisions of §15.205 apply to intentional radiators operating under this section.

### 11.2 Measurement Procedure

Add a correction factor (antenna gain+ Attenuator loss+cable loss) to the offset of the spectrum analyzer.  
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 = 3RBW
  - 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 = 3RBW
  - Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

### 11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Analyzer, Spectrum	E4440A	MY44303352	2015-06-22	1 year
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2016-03-24	1 year

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

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

### 11.4 Test Environmental Conditions

<b>Temperature:</b>	22-24° C
<b>Relative Humidity:</b>	40-41 %
<b>ATM Pressure:</b>	103.1-104.1 kPa

The testing was performed by Jin Yang on 2016-04-15 at RF site.

### 11.5 Test Results

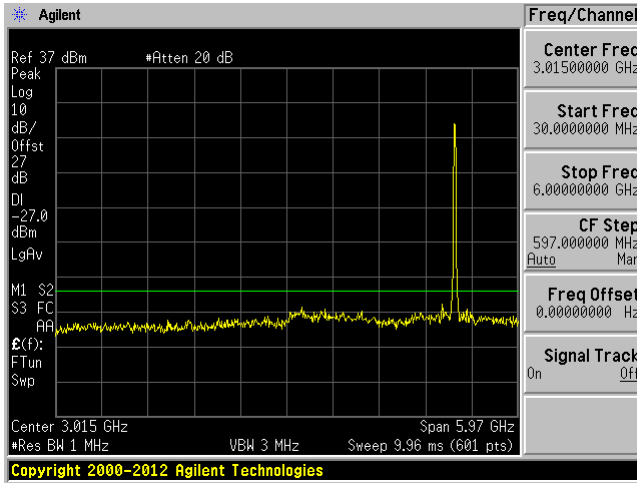
**Note 1:** After pre-testing, the non-beamforming mode is the worst case; therefore the report only includes the test results of non-beamforming mode.

**Note 2:** 802.11a mode only transmits signal through antenna 4.

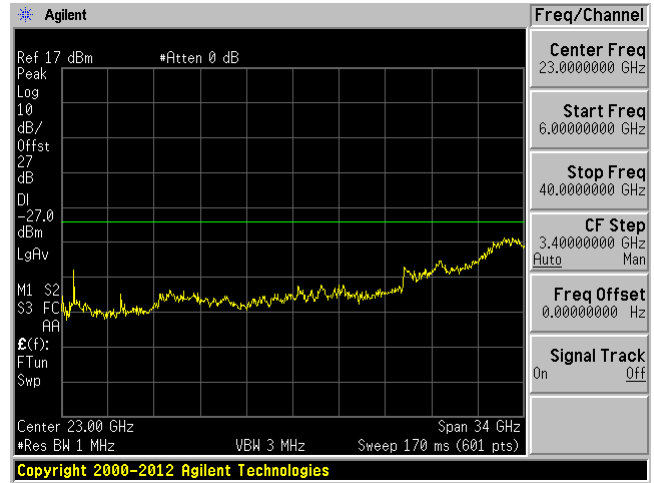
### 1) Out-of-band spurious emission

#### 802.11a mode chain 4

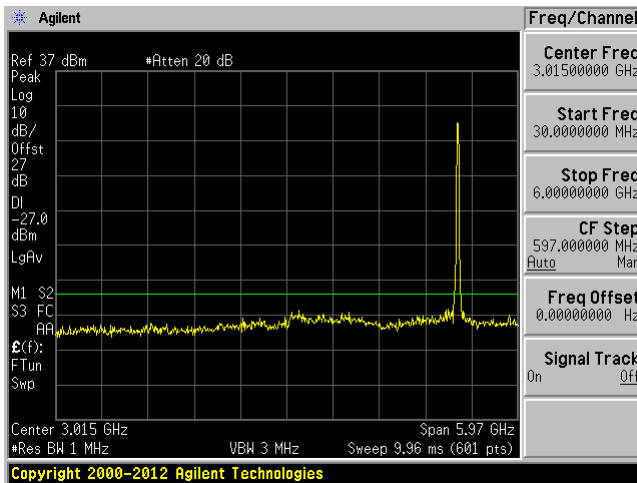
Low Channel 5180MHz (30MHz-6GHz)



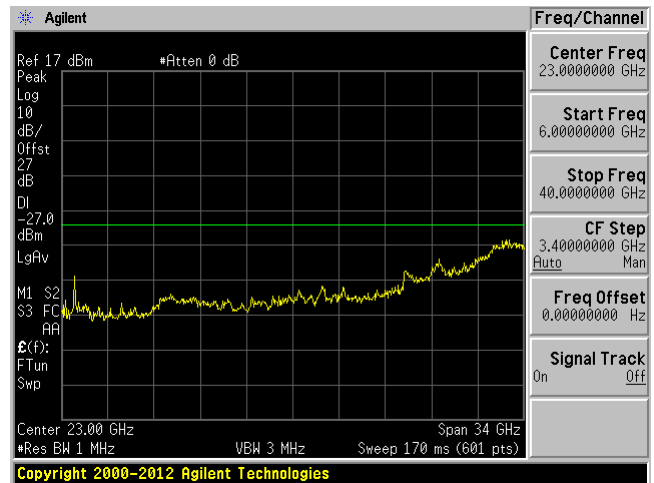
Low Channel 5180 MHz (6-40GHz)



Middle Channel 5220MHz (30MHz-6GHz)

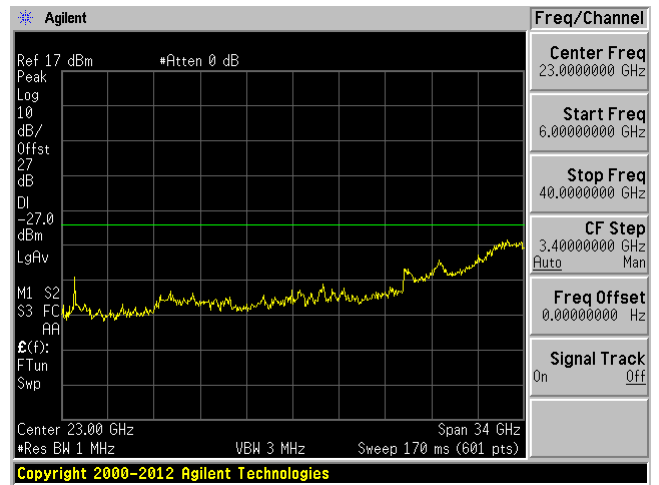
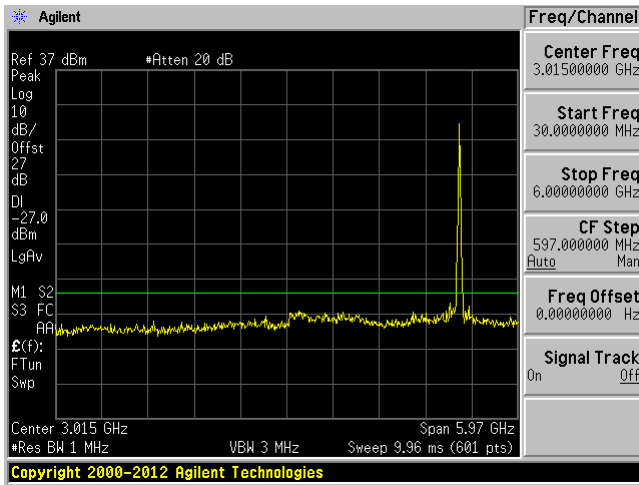


Middle Channel 5220 MHz (6-40GHz)



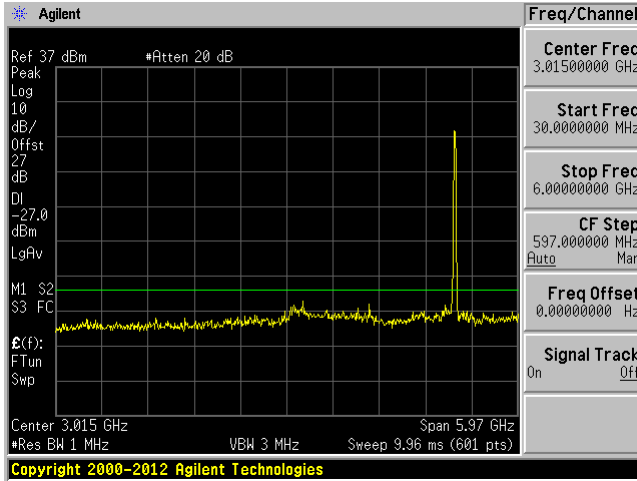
High Channel 5240MHz (30MHz-6GHz)

High Channel 5240 MHz (6-40GHz)

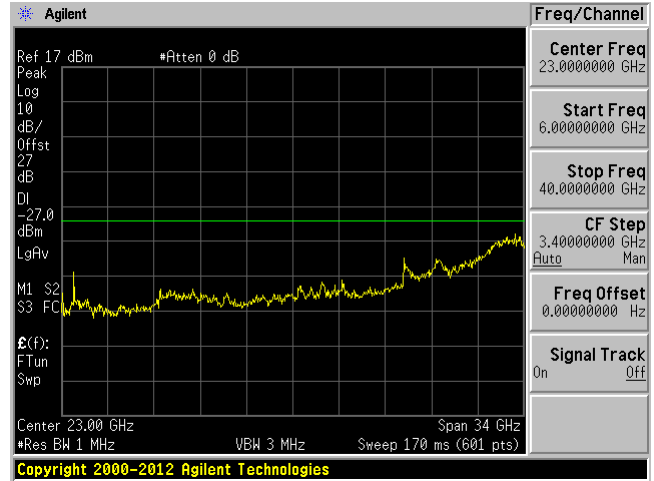


### 802.11n20 mode chain 4

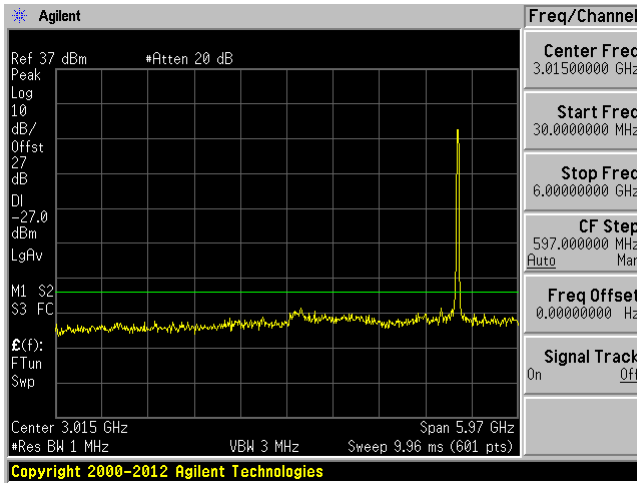
Low Channel 5180MHz (30MHz-6GHz)



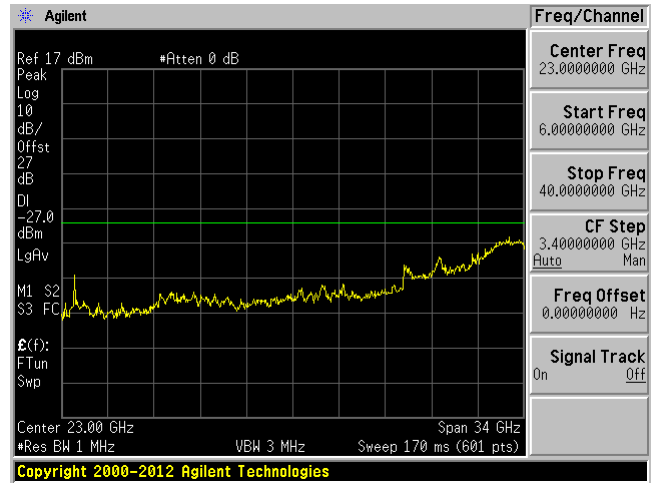
Low Channel 5180 MHz (6-40GHz)



Middle Channel 5220MHz (30MHz-6GHz)



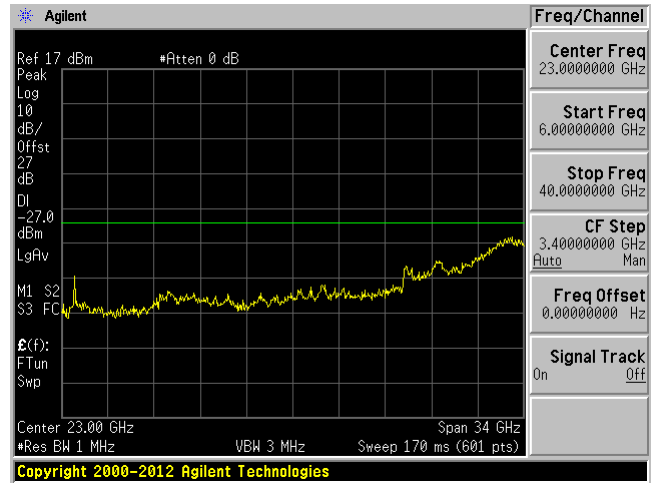
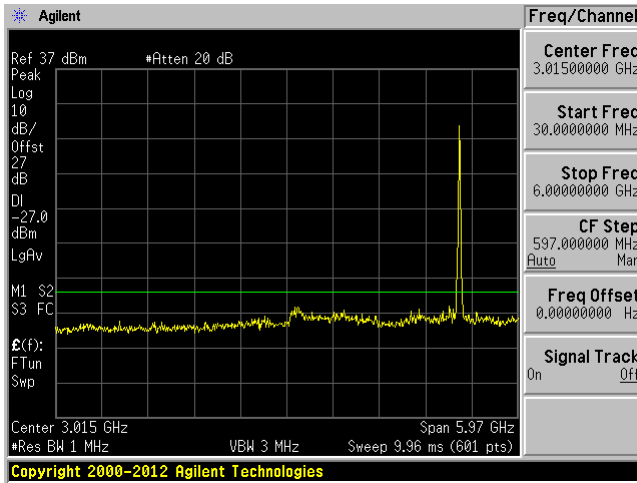
Middle Channel 5220 MHz (6-40GHz)





High Channel 5240MHz (30MHz-6GHz)

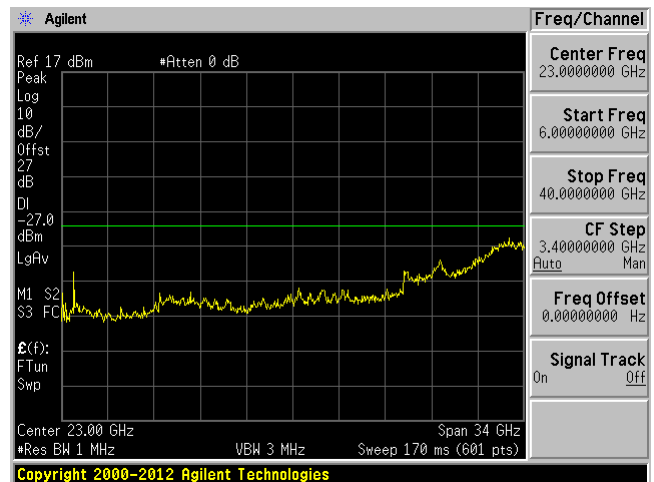
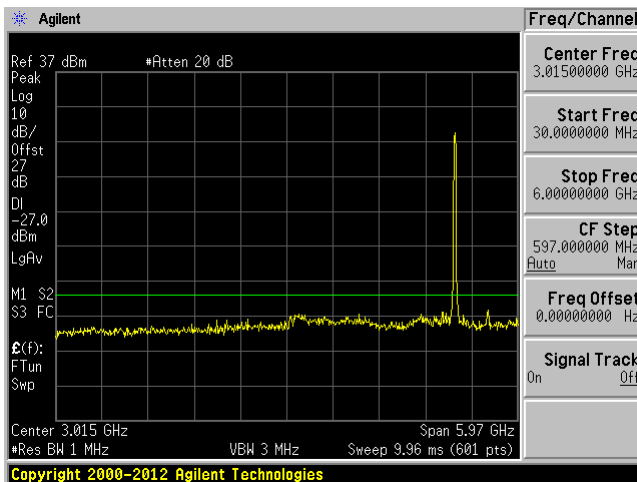
High Channel 5240 MHz (6-40GHz)



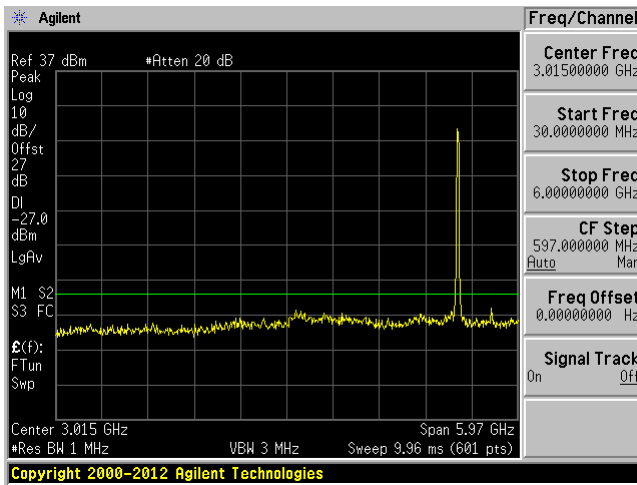
802.11n20 mode chain 5

Low Channel 5180MHz (30MHz-6GHz)

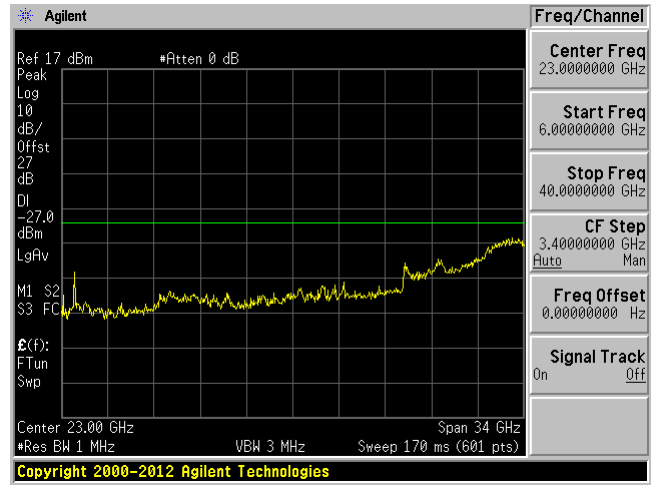
Low Channel 5180 MHz (6-40GHz)



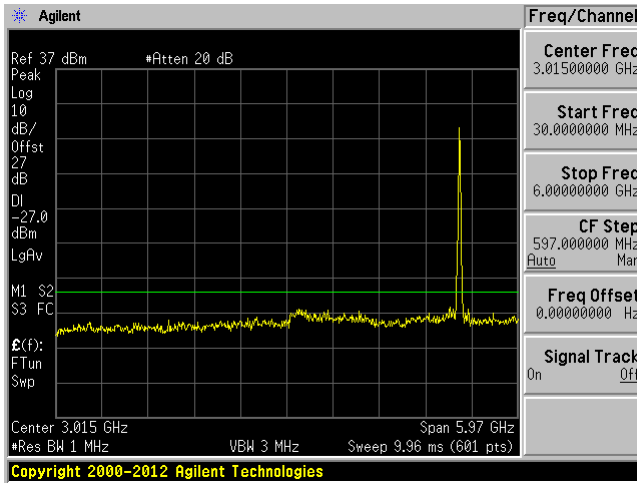
Middle Channel 5220MHz (30MHz-7GHz)



Middle Channel 5220 MHz (7-40GHz)



High Channel 5240MHz (30MHz-6GHz)

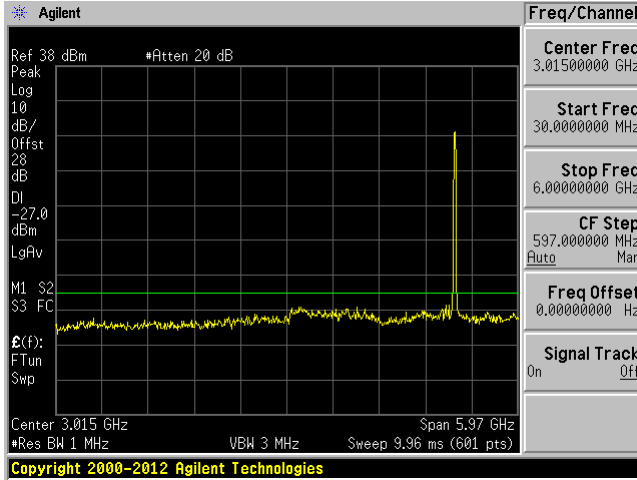


High Channel 5240 MHz (6-40GHz)

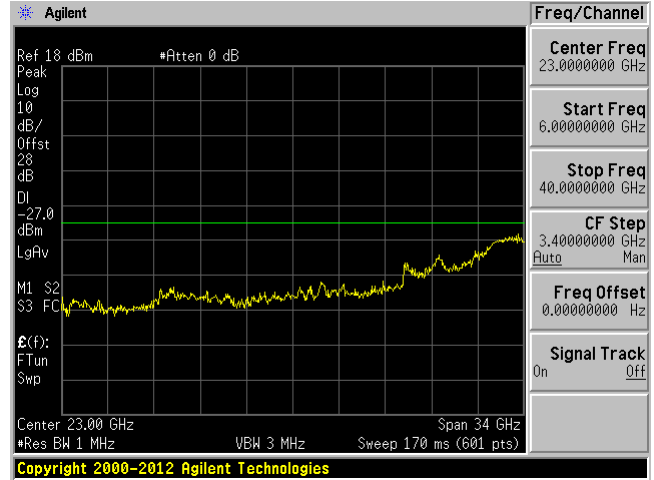


### 802.11n20 mode chain 6

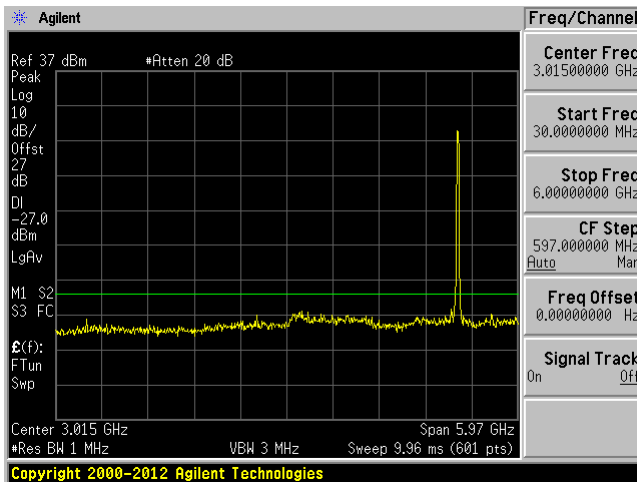
Low Channel 5180MHz (30MHz-6GHz)



Low Channel 5180 MHz (6-40GHz)



Middle Channel 5220MHz (30MHz-6GHz)

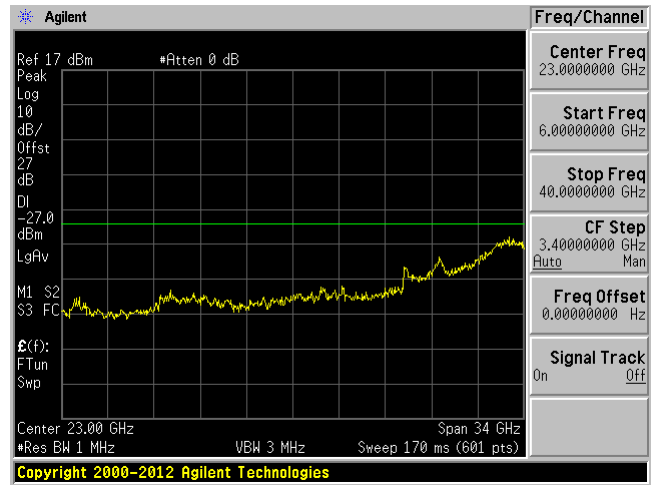
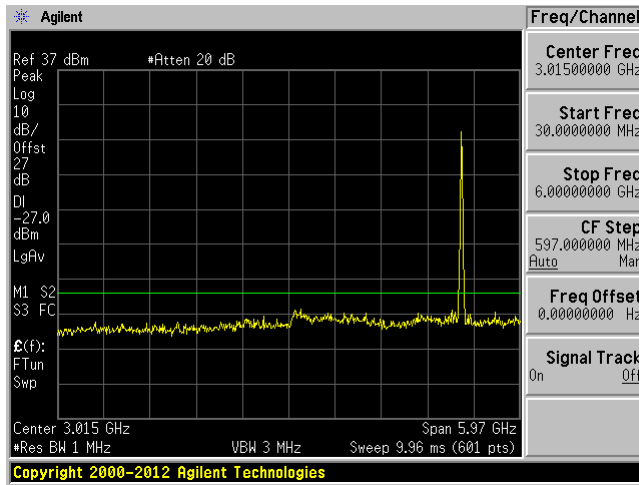


Middle Channel 5220 MHz (6-40GHz)



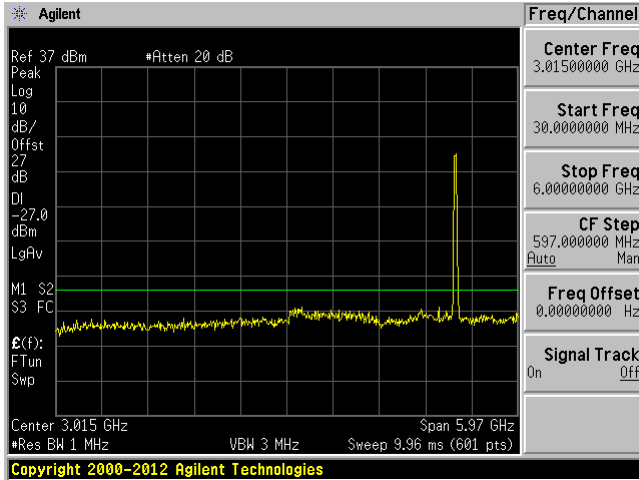
High Channel 5240MHz (30MHz-6GHz)

High Channel 5240 MHz (6-40GHz)

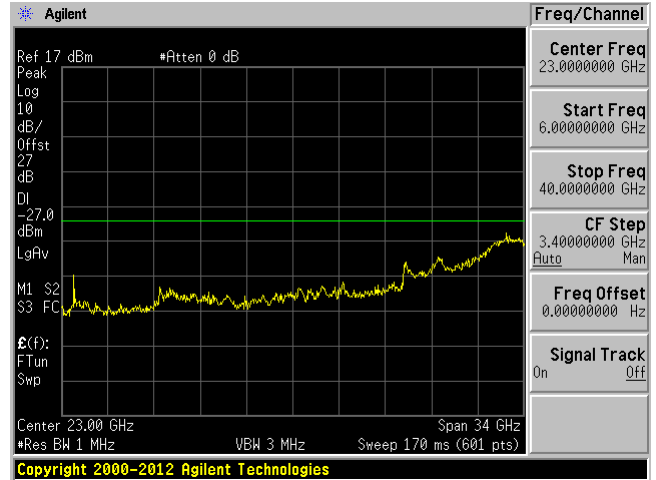


802.11n40 mode chain 4

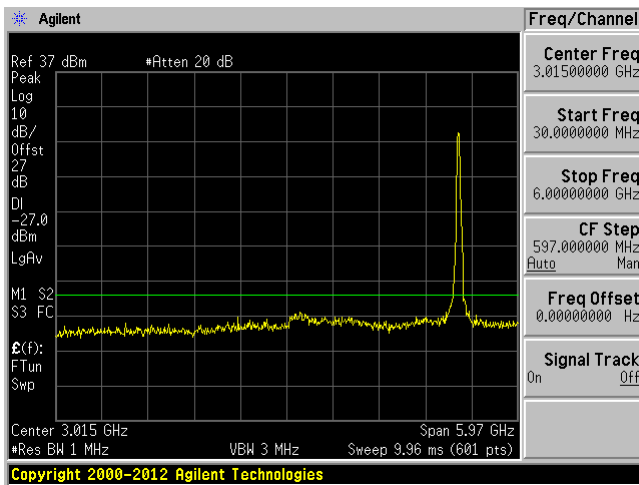
Low Channel 5190MHz (30MHz-6GHz)



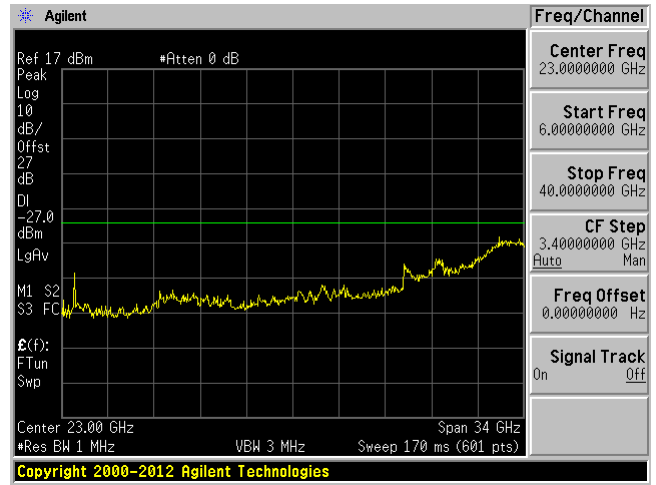
Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)

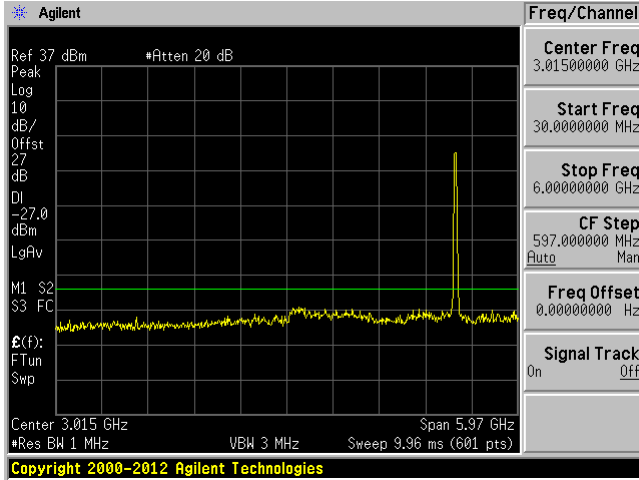


High Channel 5230 MHz (6-40GHz)

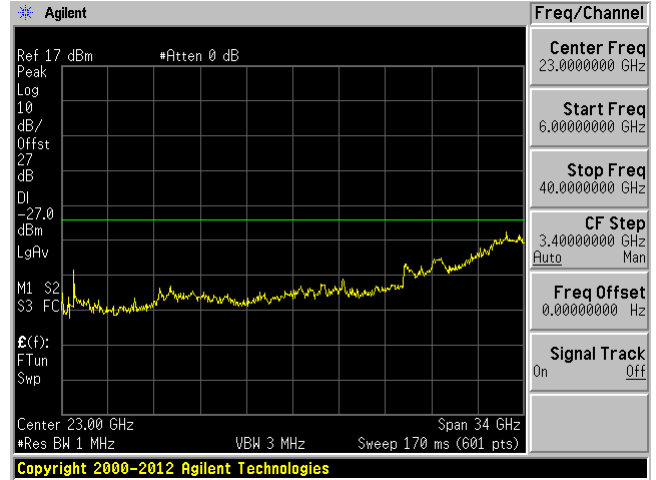


802.11n40 mode chain 5

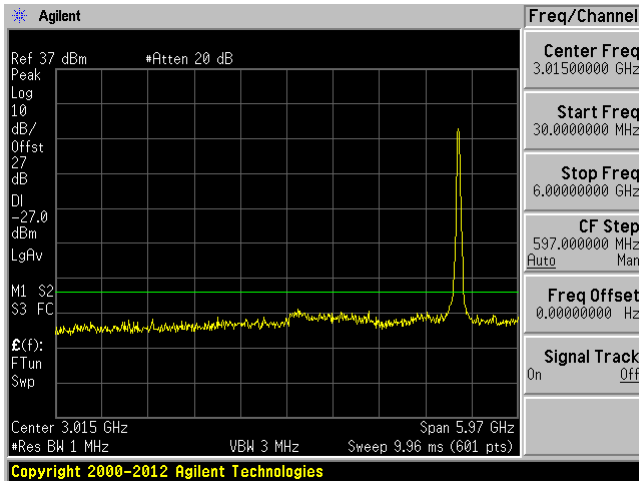
Low Channel 5190MHz (30MHz-6GHz)



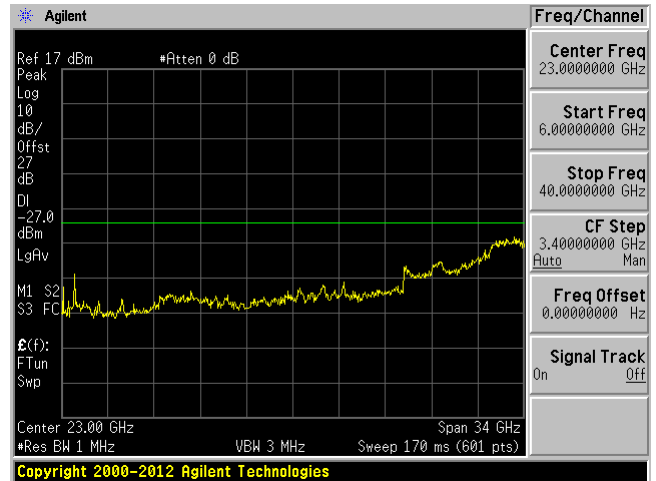
Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)

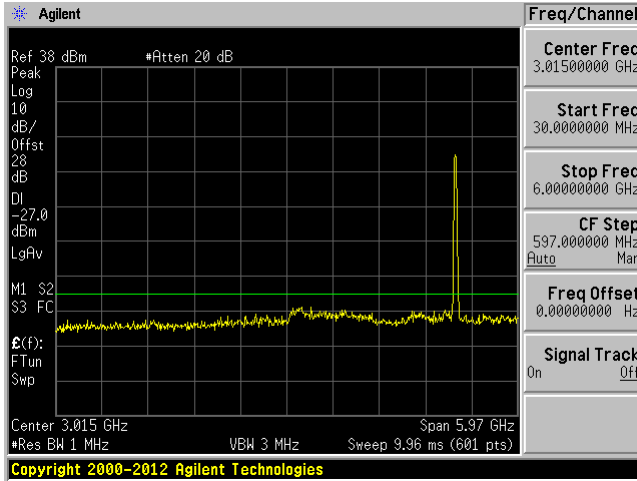


High Channel 5230 MHz (6-40GHz)

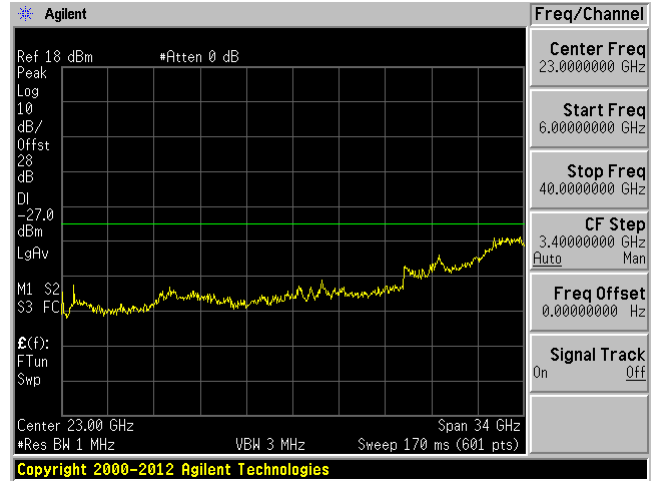


### 802.11n40 mode chain 6

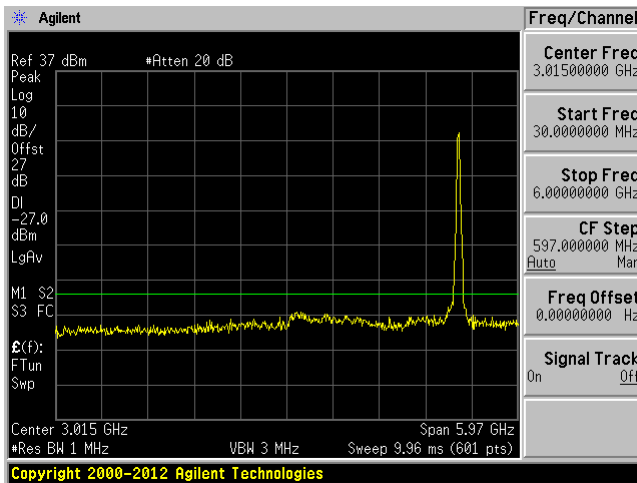
Low Channel 5190MHz (30MHz-6GHz)



Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)

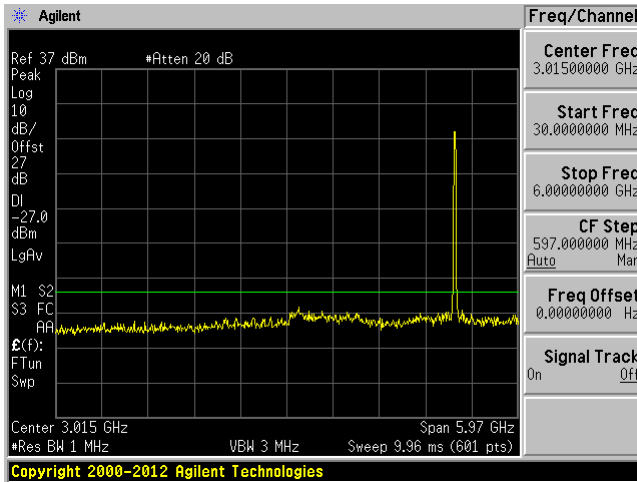


High Channel 5230 MHz (6-40GHz)

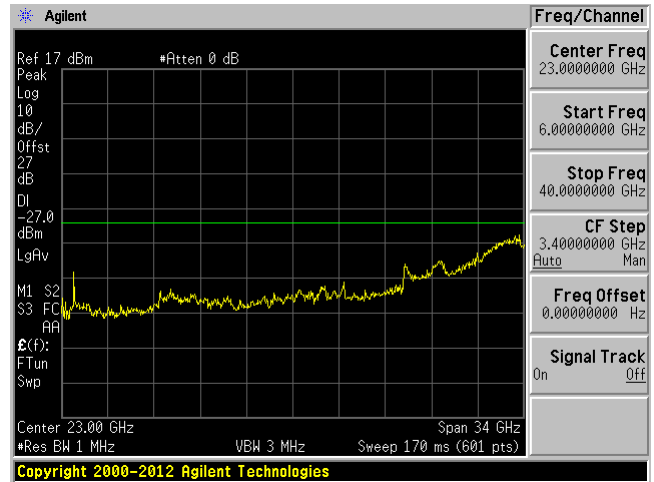


### 802.11ac20 mode chain 4

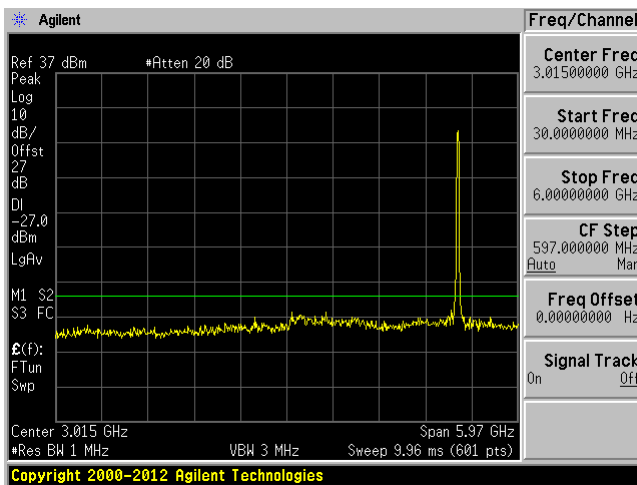
Low Channel 5180MHz (30MHz-6GHz)



Low Channel 5180 MHz (6-40GHz)



Middle Channel 5220MHz (30MHz-6GHz)



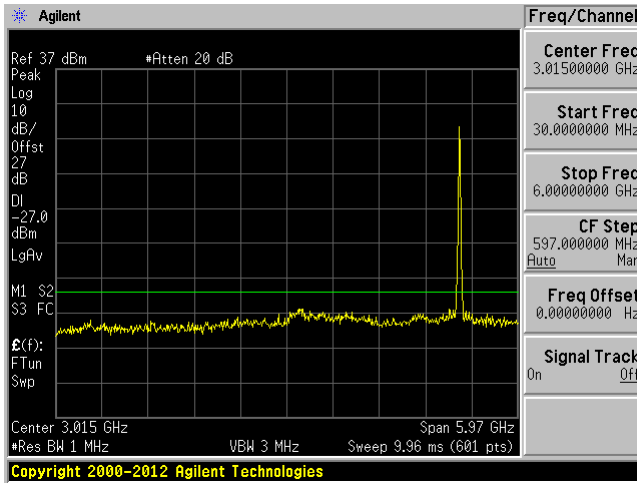
Middle Channel 5220 MHz (6-40GHz)





High Channel 5240MHz (30MHz-6GHz)

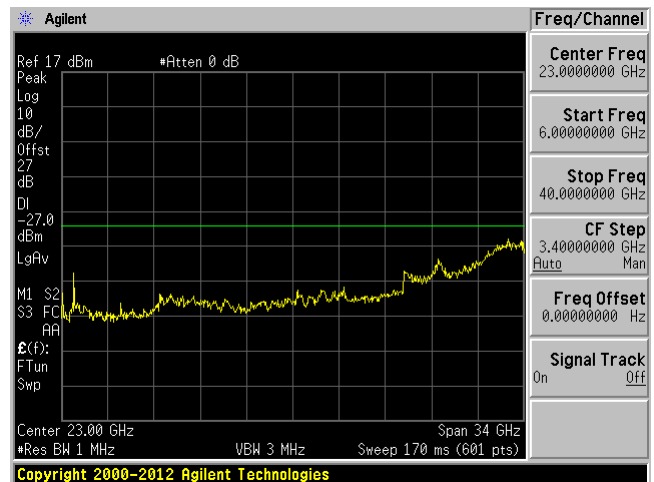
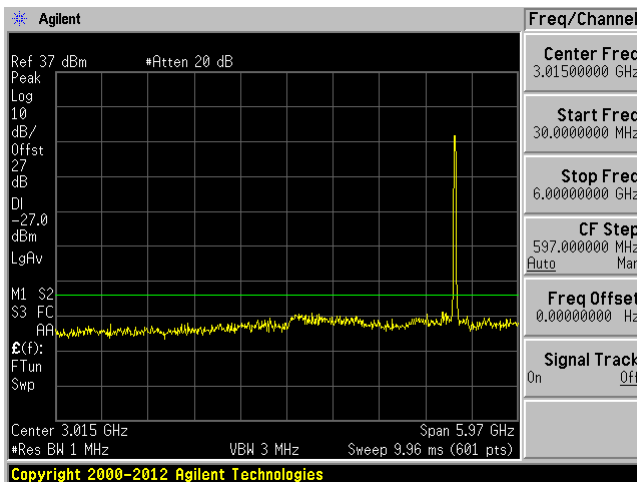
High Channel 5240 MHz (6-40GHz)



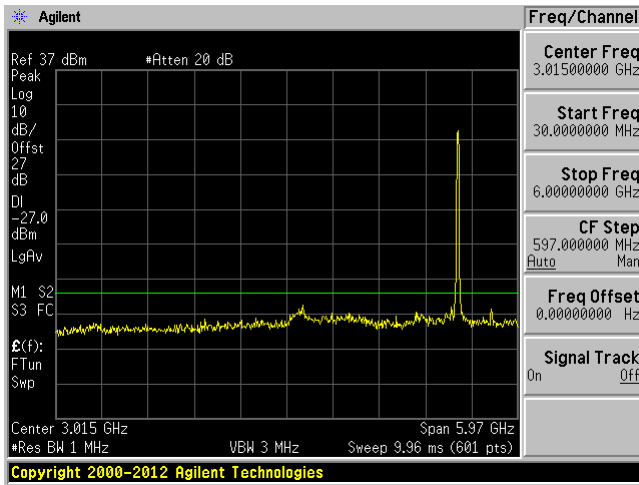
802.11ac20 mode chain 5

Low Channel 5180MHz (30MHz-6GHz)

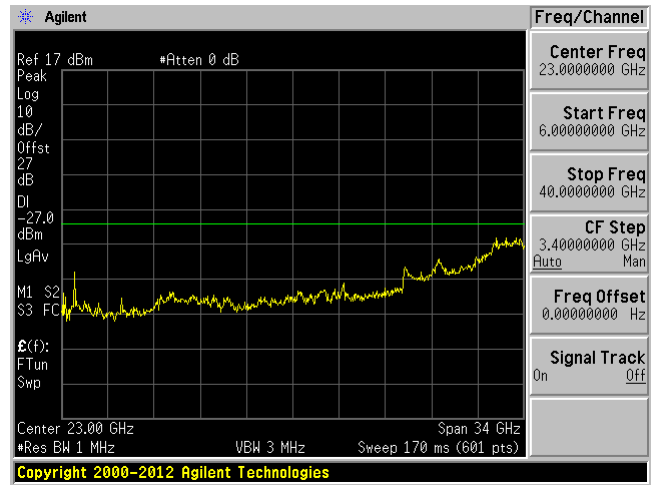
Low Channel 5180 MHz (6-40GHz)



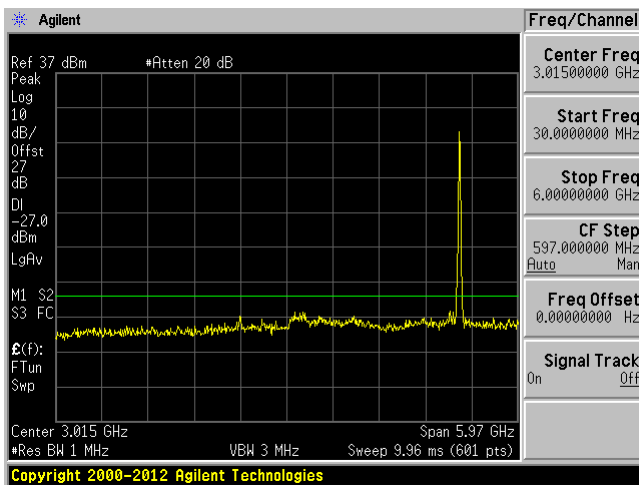
Middle Channel 5220MHz (30MHz-6GHz)



Middle Channel 5220 MHz (6-40GHz)



High Channel 5240MHz (30MHz-6GHz)

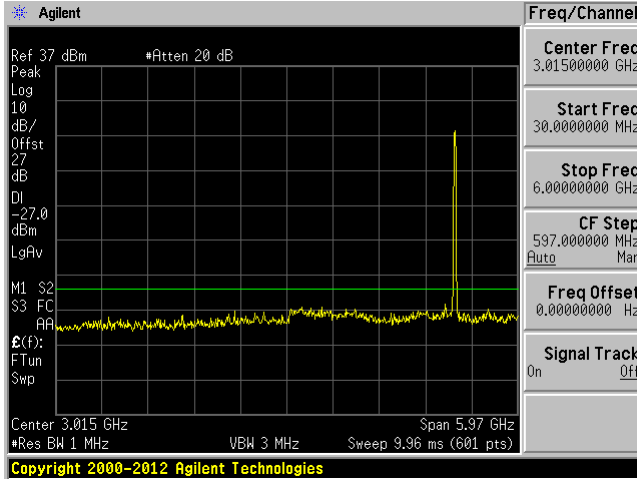


High Channel 5240 MHz (6-40GHz)

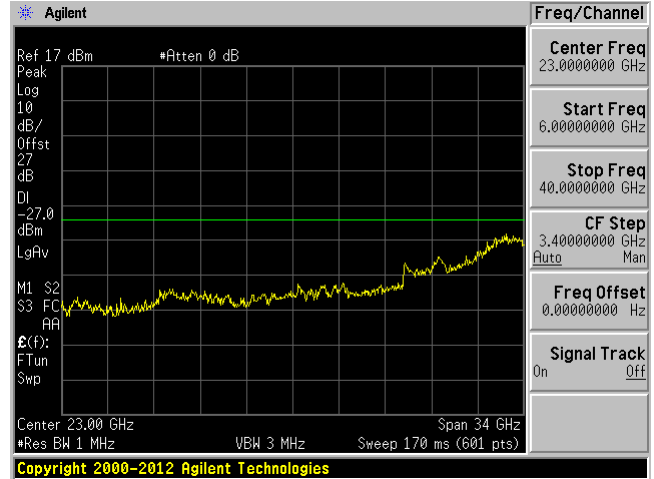


### 802.11ac20 mode chain 6

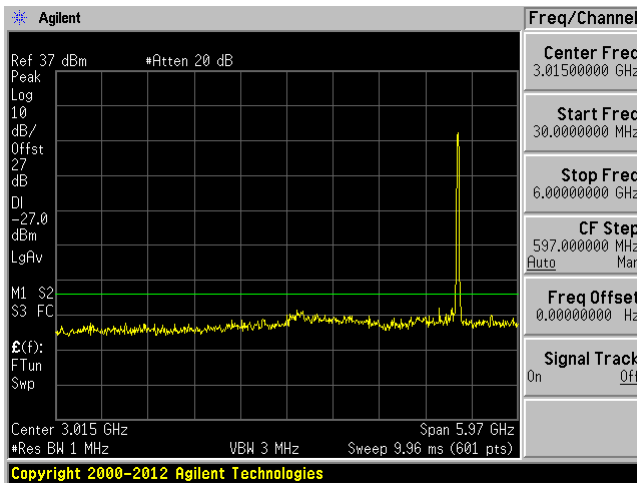
Low Channel 5180MHz (30MHz-6GHz)



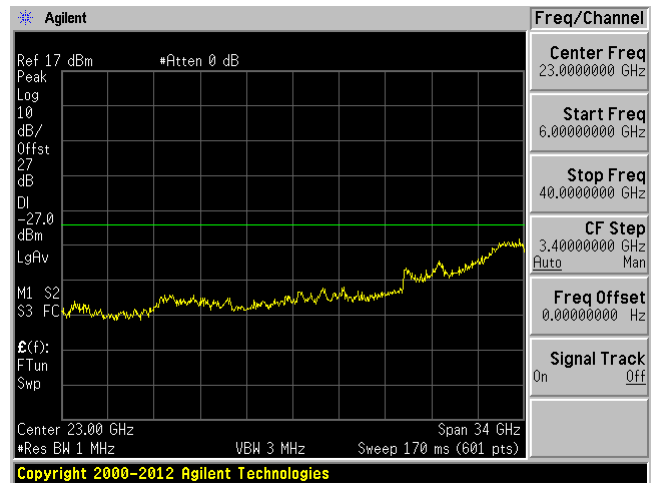
Low Channel 5180 MHz (6-40GHz)



Middle Channel 5220MHz (30MHz-6GHz)

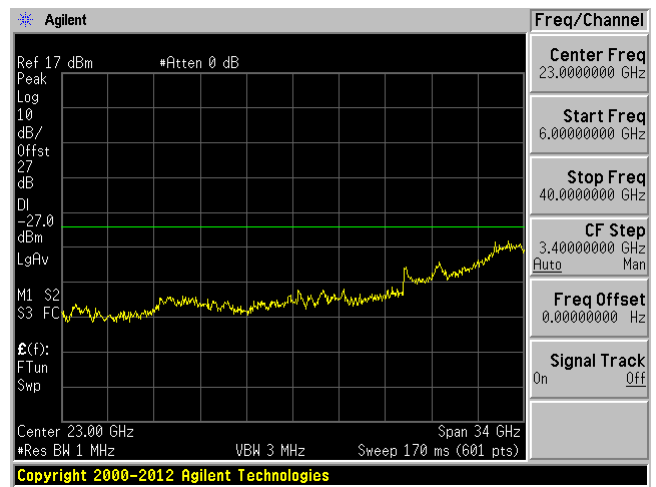
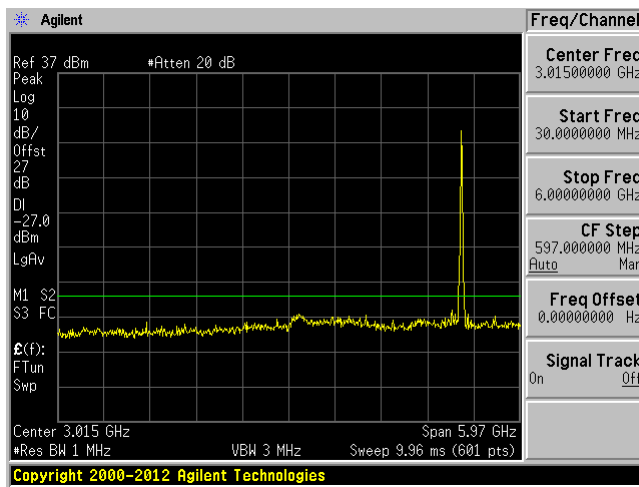


Middle Channel 5220 MHz (6-40GHz)



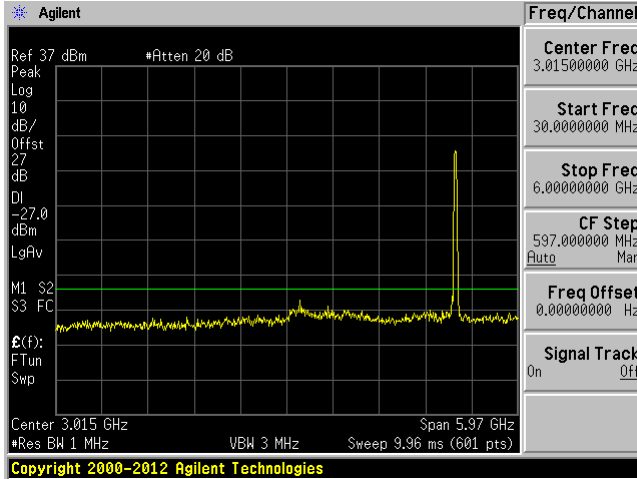
High Channel 5240MHz (30MHz-6GHz)

High Channel 5240 MHz (6-40GHz)

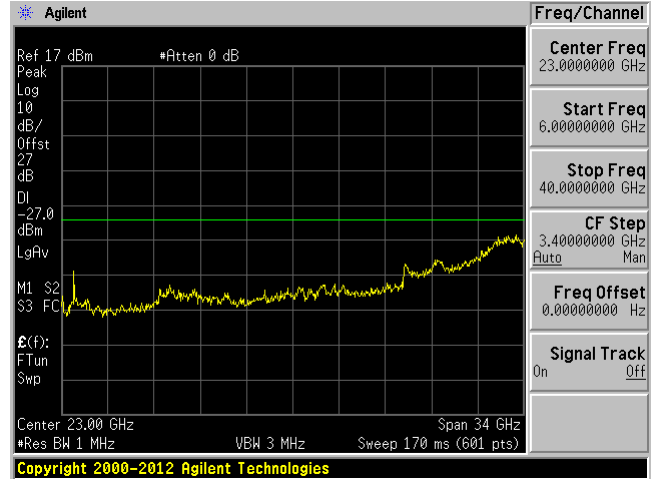


### 802.11ac40 mode chain 4

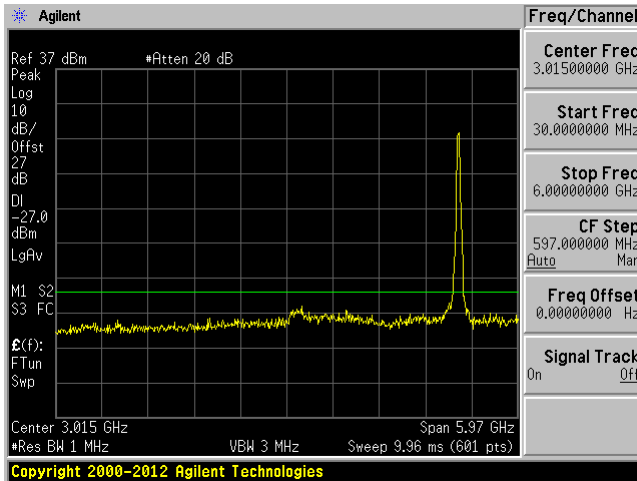
Low Channel 5190MHz (30MHz-6GHz)



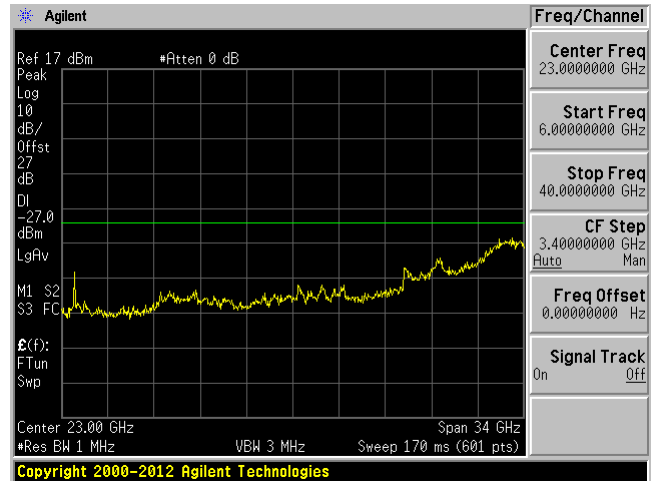
Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)

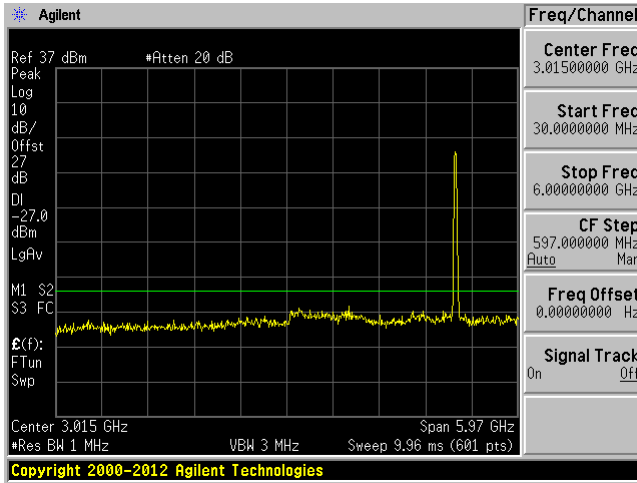


High Channel 5230 MHz (6-40GHz)

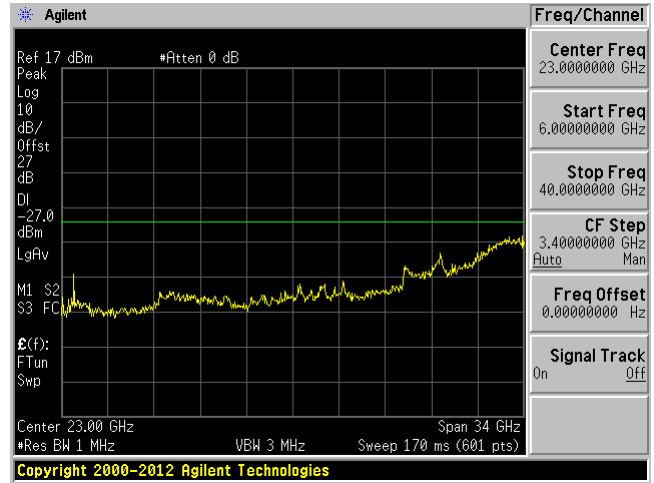


### 802.11ac40 mode chain 5

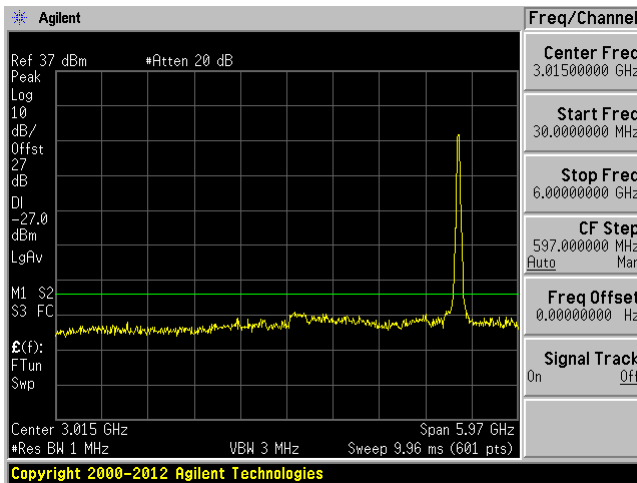
Low Channel 5190MHz (30MHz-6GHz)



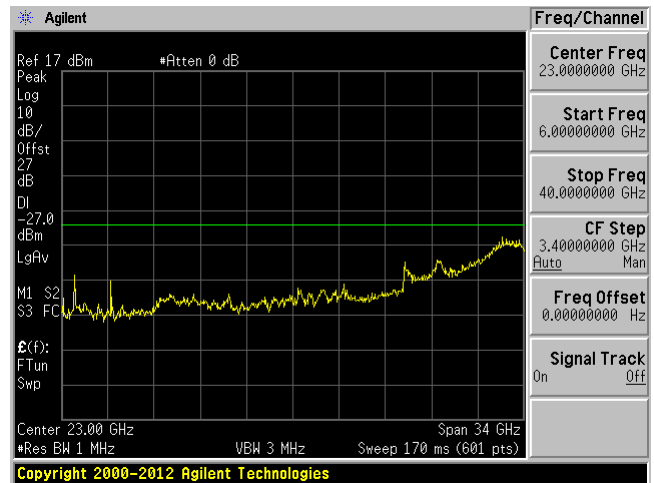
Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)

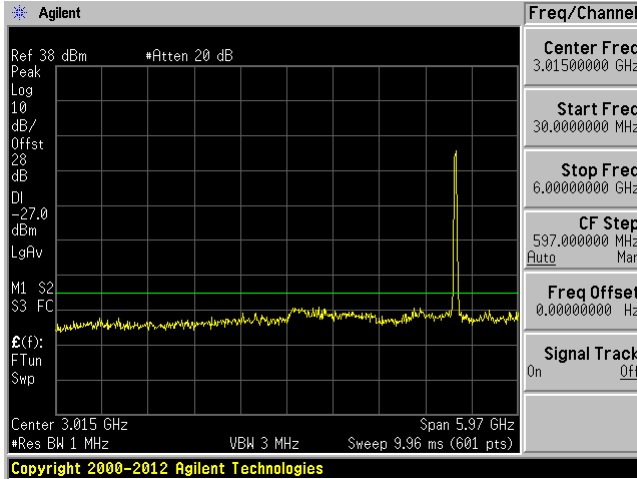


High Channel 5230 MHz (6-40GHz)

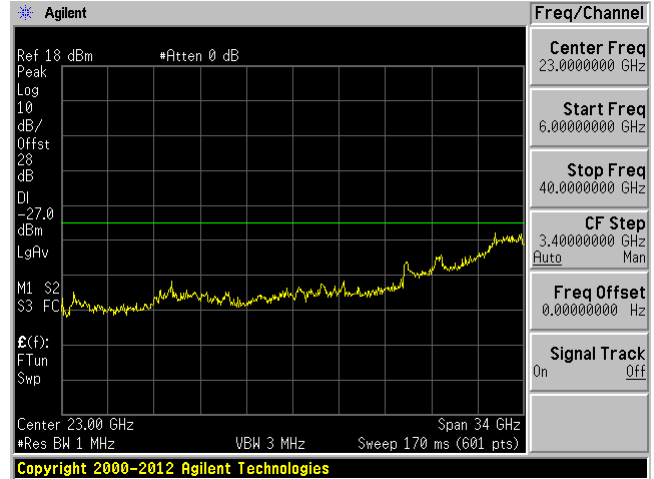


### 802.11ac40 mode chain 6

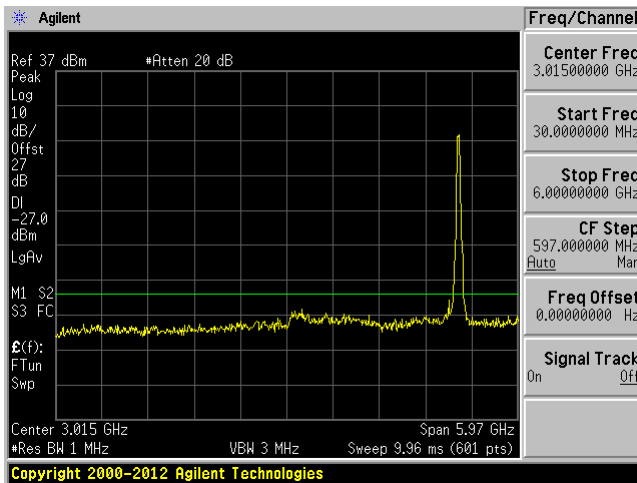
Low Channel 5190MHz (30MHz-6GHz)



Low Channel 5190 MHz (6-40GHz)



High Channel 5230MHz (30MHz-6GHz)



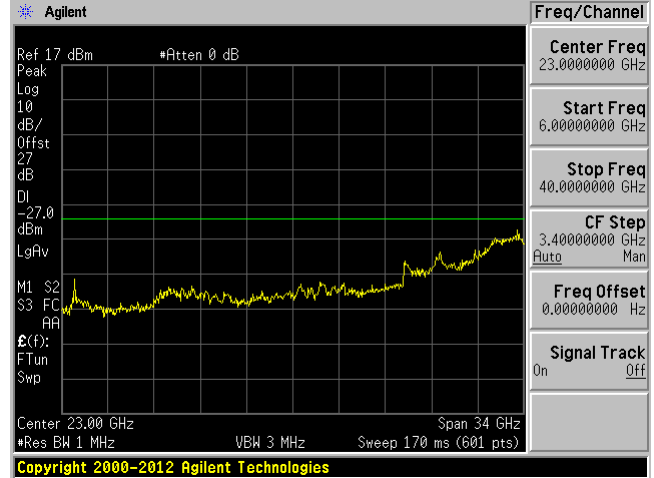
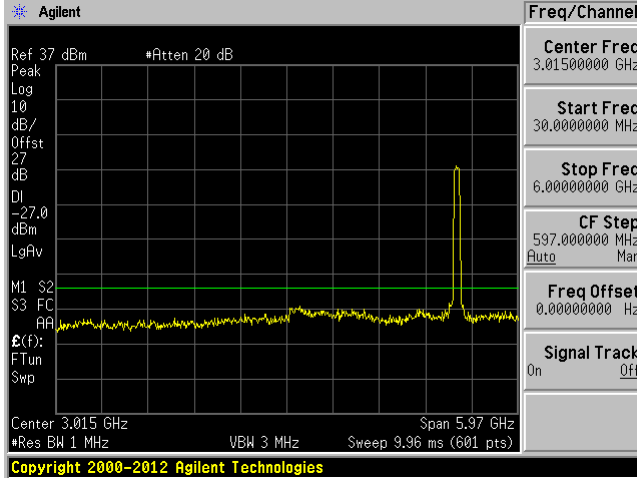
High Channel 5230 MHz (6-40GHz)



### 802.11ac80 mode chain 4

5210 MHz (30MHz-6GHz)

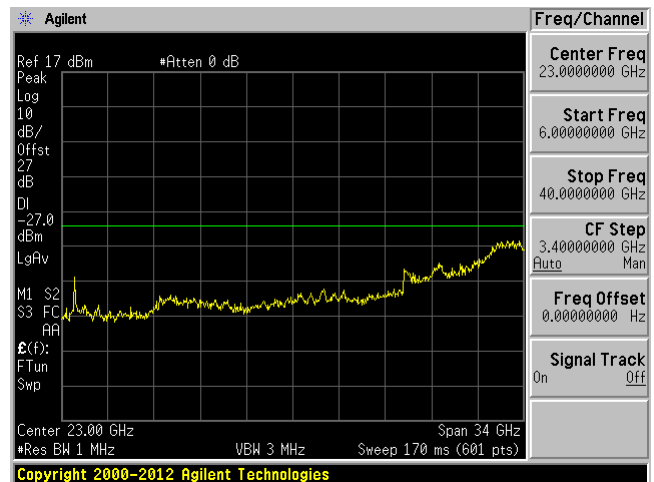
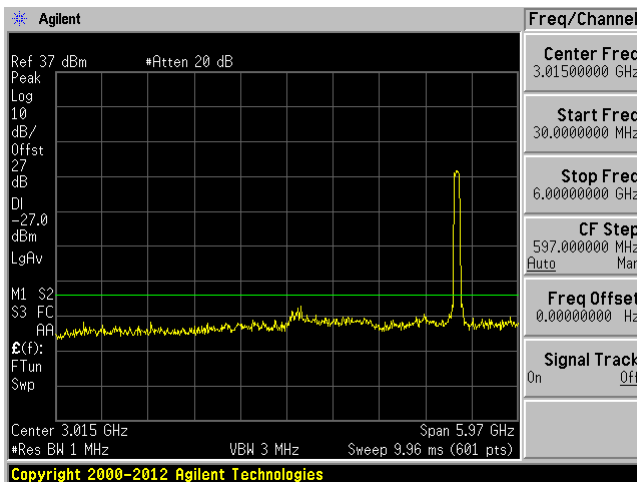
5210 MHz (6GHz – 40GHz)



### 802.11ac80 mode chain 5

5210 MHz (30MHz-6GHz)

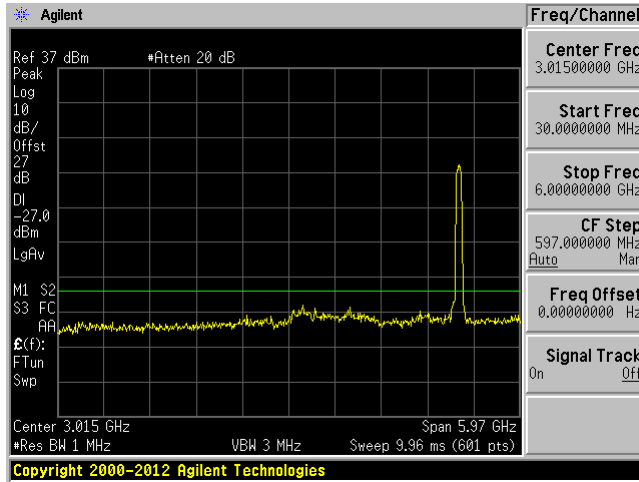
5210 MHz (6GHz – 40GHz)



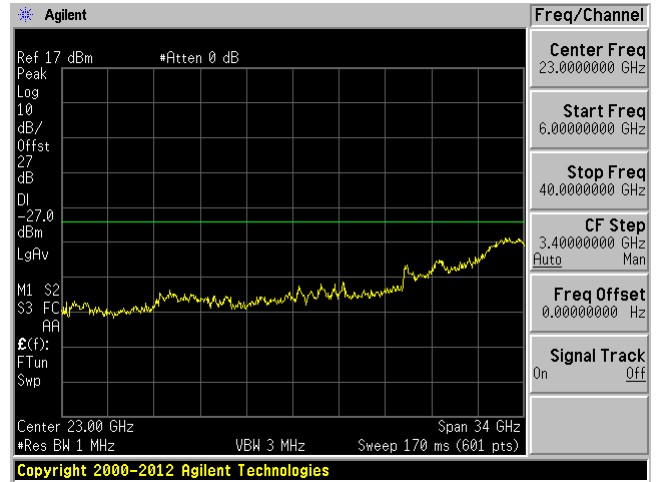


### 802.11ac80 mode chain 6

5210 MHz (30MHz-6GHz)



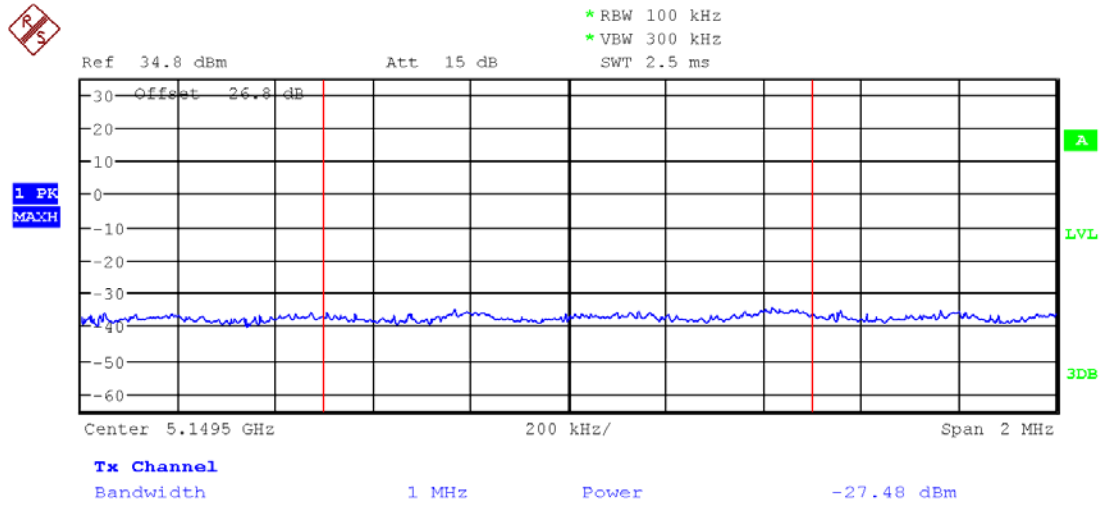
5210 MHz (6GHz – 40GHz)



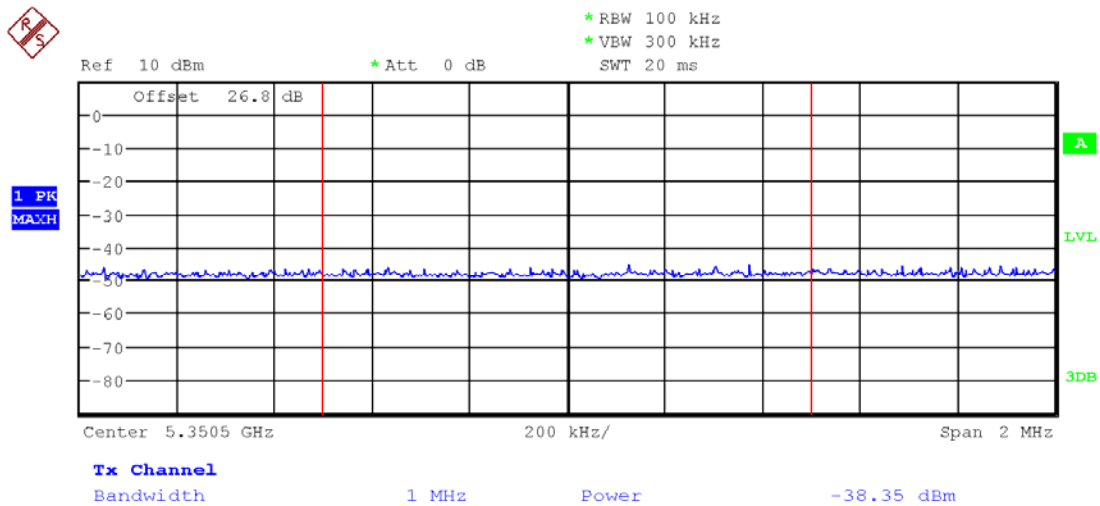
**2) Band Edge Emissions**

Mode	Channel	Band Edge (Lower /Upper)	Chain #4 (dBm/MHz)	Chain #5 (dBm/MHz)	Chain #6 (dBm/MHz)	Max/Total (dBm/MHz)	Limit (dBm/MHz)	Comment
802.11a	36	Lower	-27.48	-	-	-27.48	-27	Pass
	48	Upper	-38.35	-	-	-38.35	-27	Pass
802.11n20	36	Lower	-32.03	-31.94	-32.86	-27.49	-27	Pass
	48	Upper	-39.39	-40.65	-41.78	-35.73	-27	Pass
802.11ac20	36	Lower	-32.19	-34.9	-33.13	-28.50	-27	Pass
	48	Upper	-39.53	-40.19	-42.31	-35.75	-27	Pass
802.11n40	38	Lower	-32.84	-32.58	-31.64	-27.55	-27	Pass
	46	Upper	-37.13	-38.19	-39.15	-33.31	-27	Pass
802.11ac40	38	Lower	-33.4	-32.11	-31.75	-27.59	-27	Pass
	46	Upper	-37.29	-37.99	-38.97	-33.26	-27	Pass
802.11ac80	42	Lower	-32.62	-32	-31.65	-27.30	-27	Pass
		Upper	-44.44	-44.77	-45.77	-40.19	-27	Pass

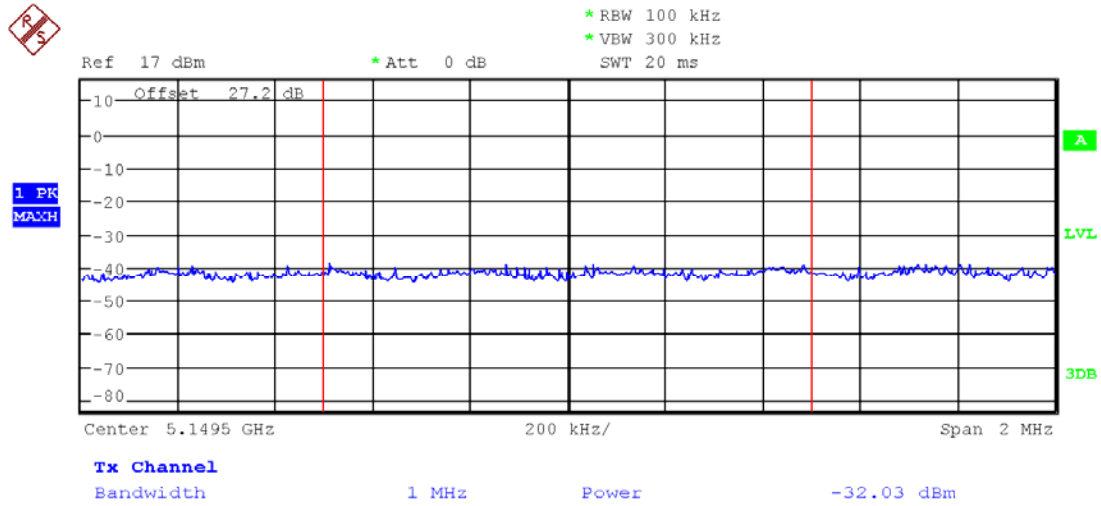
### 802.11a mode chain 4 Low Channel



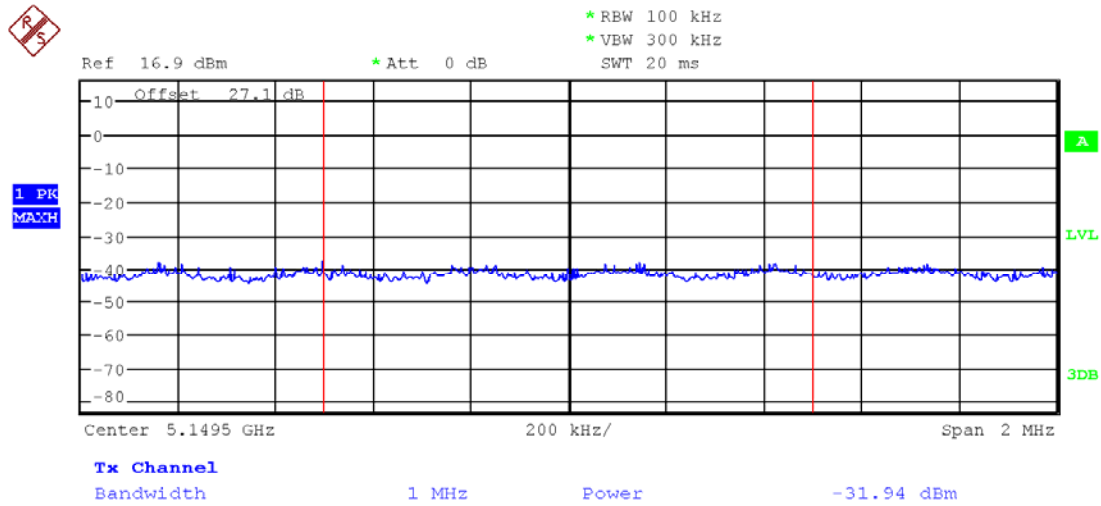
### 802.11a mode chain 4 High Channel



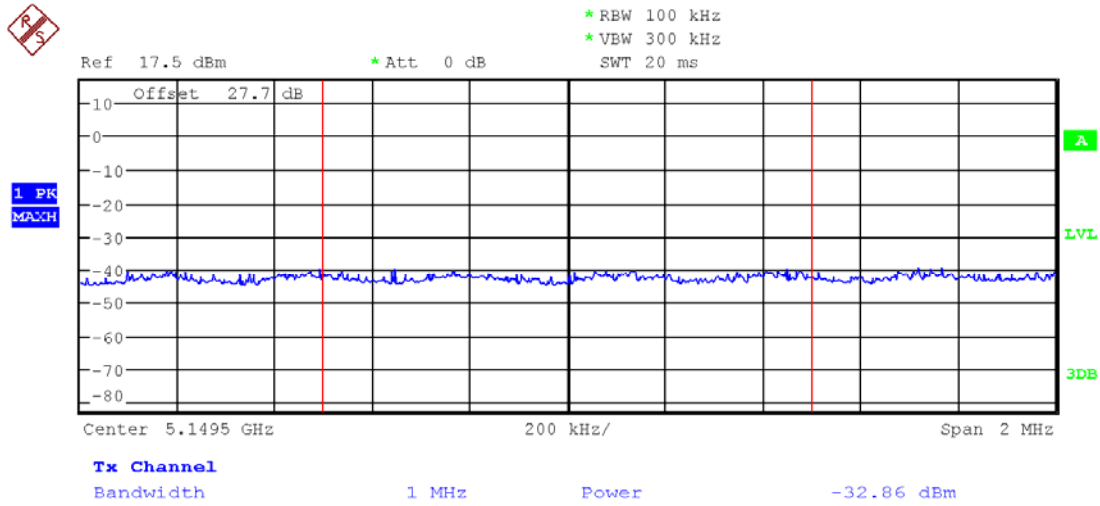
### 802.11n20 mode chain 4 Low Channel



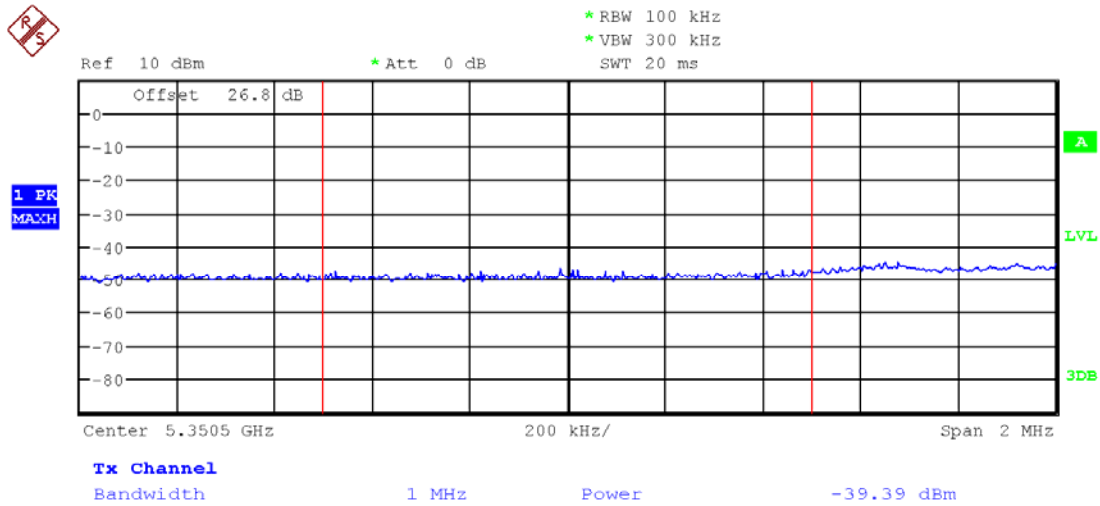
### 802.11n20 mode chain 5 Low Channel



### 802.11n20 mode chain 6 Low Channel



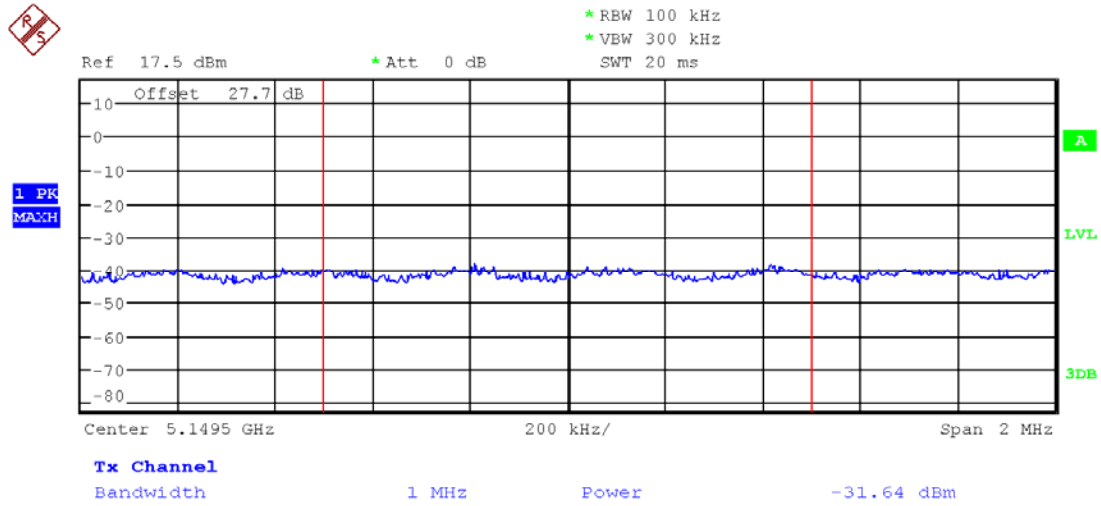
### 802.11n20 mode chain 4 High Channel



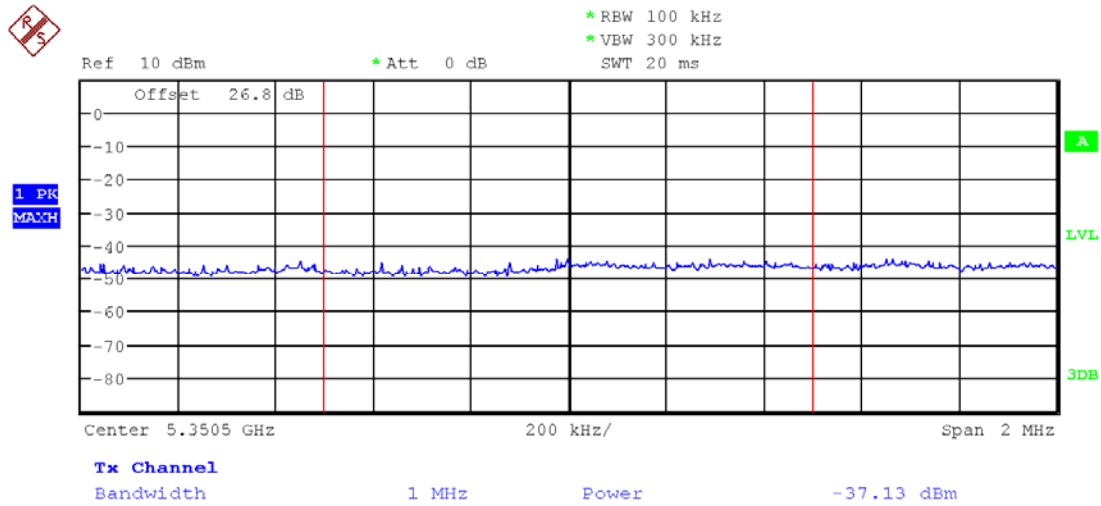




### 802.11n40 mode chain 6 Low Channel

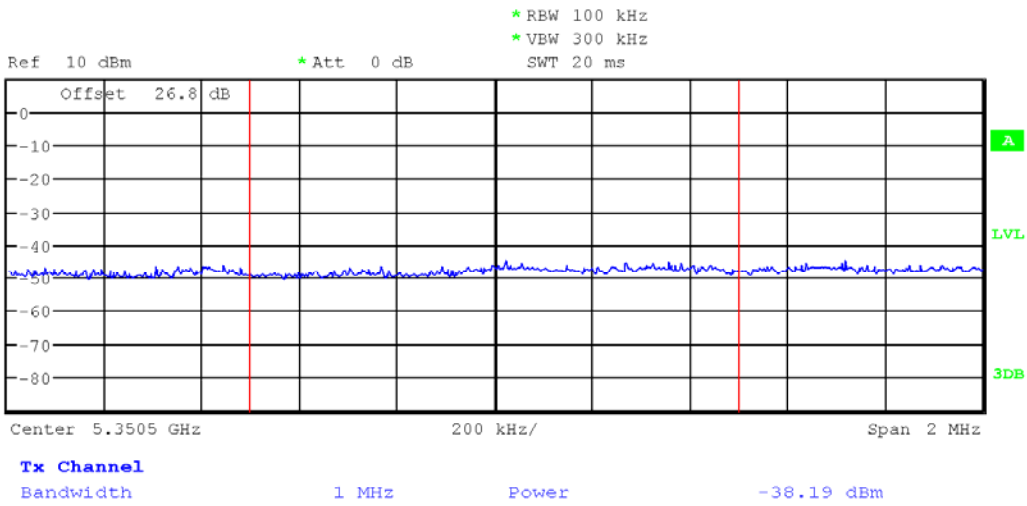


### 802.11n40 mode chain 4 High Channel

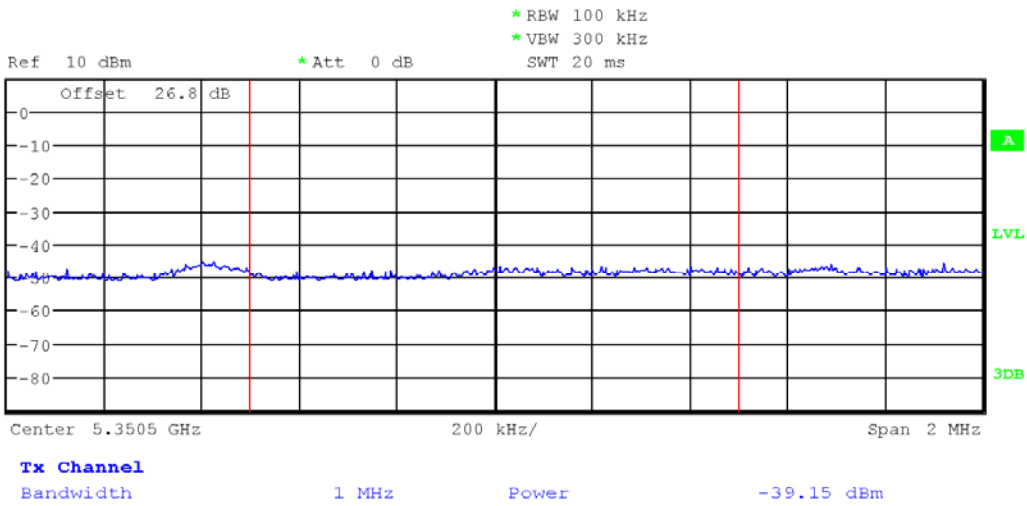




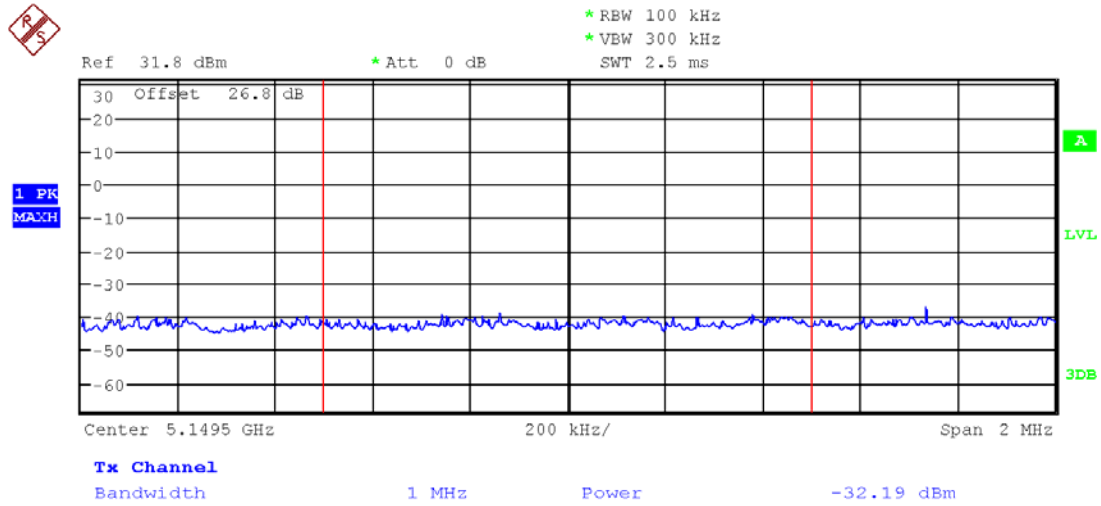
### 802.11n40 mode chain 5 High Channel



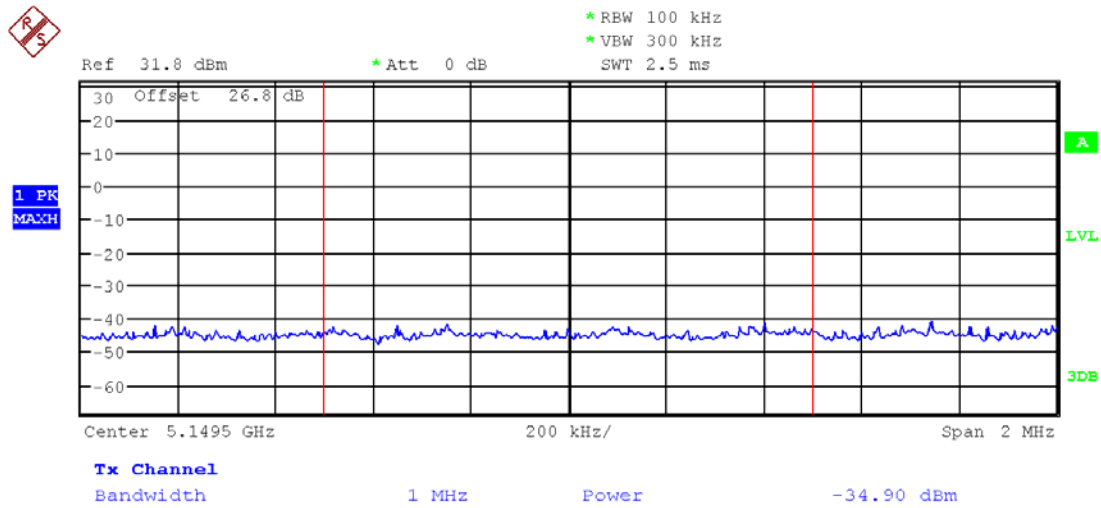
### 802.11n40 mode chain 6 High Channel



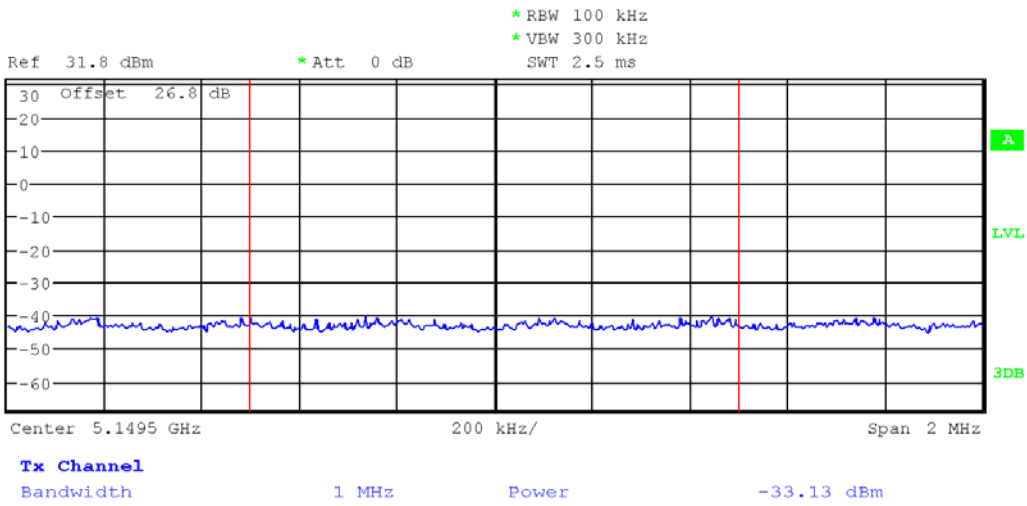
### 802.11ac20 mode chain 4 Low Channel



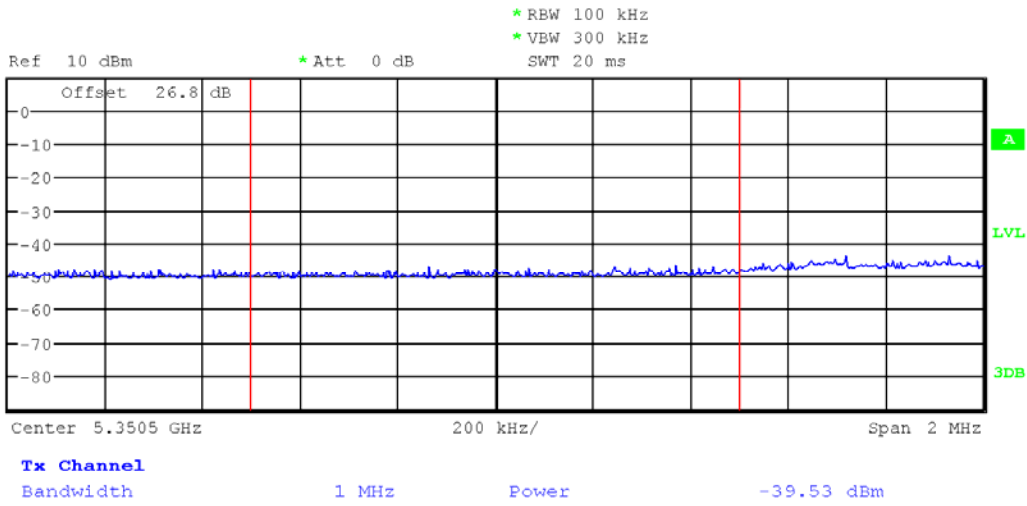
### 802.11ac20 mode chain 5 Low Channel



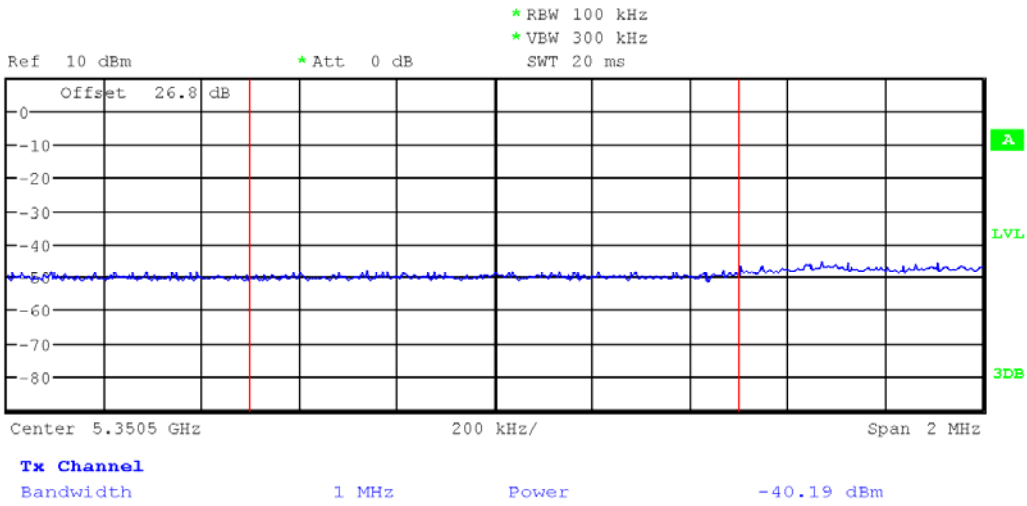
### 802.11ac20 mode chain 6 Low Channel



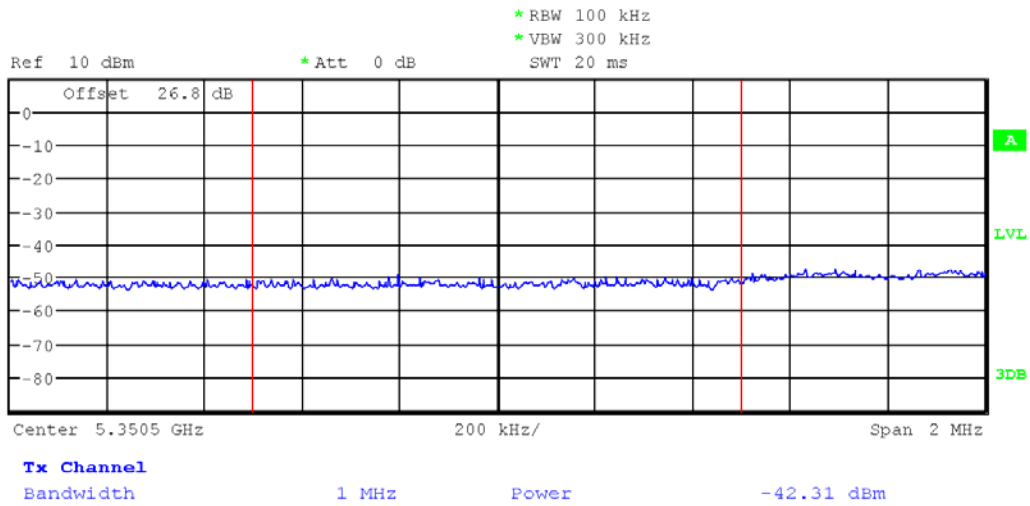
### 802.11ac20 mode chain 4 High Channel



### 802.11ac20 mode chain 5 High Channel

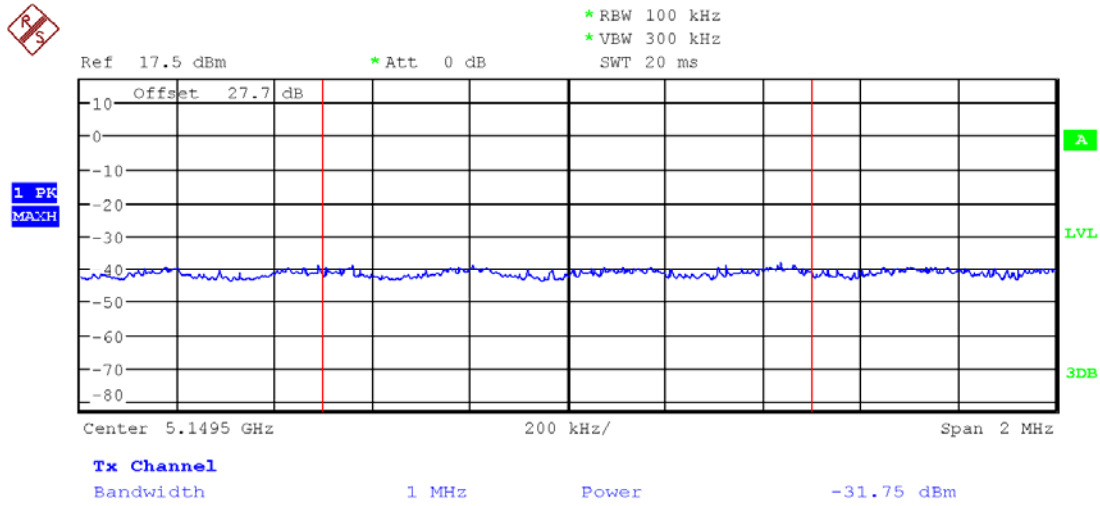


### 802.11ac20 mode chain 6 High Channel

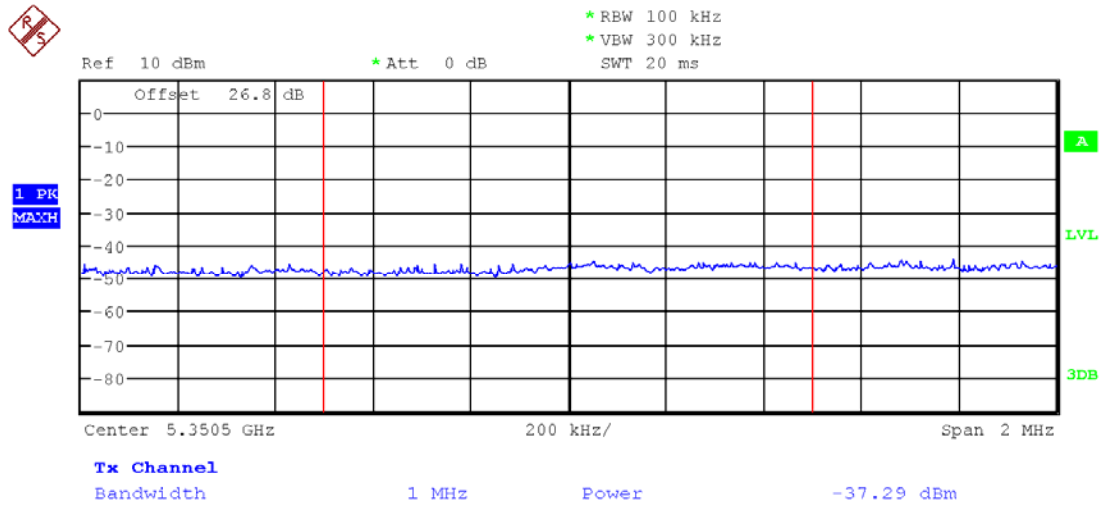




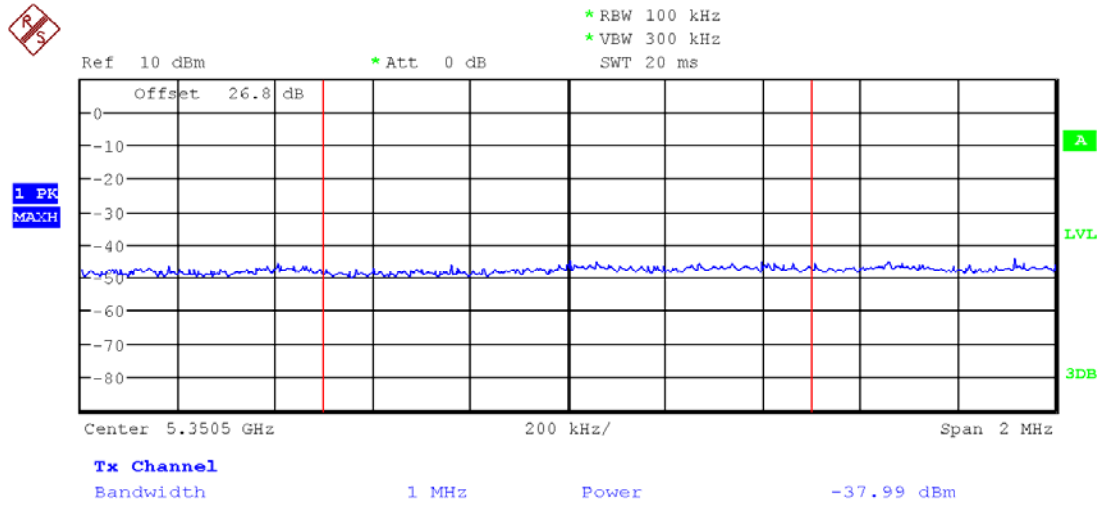
### 802.11ac40 mode chain 6 Low Channel



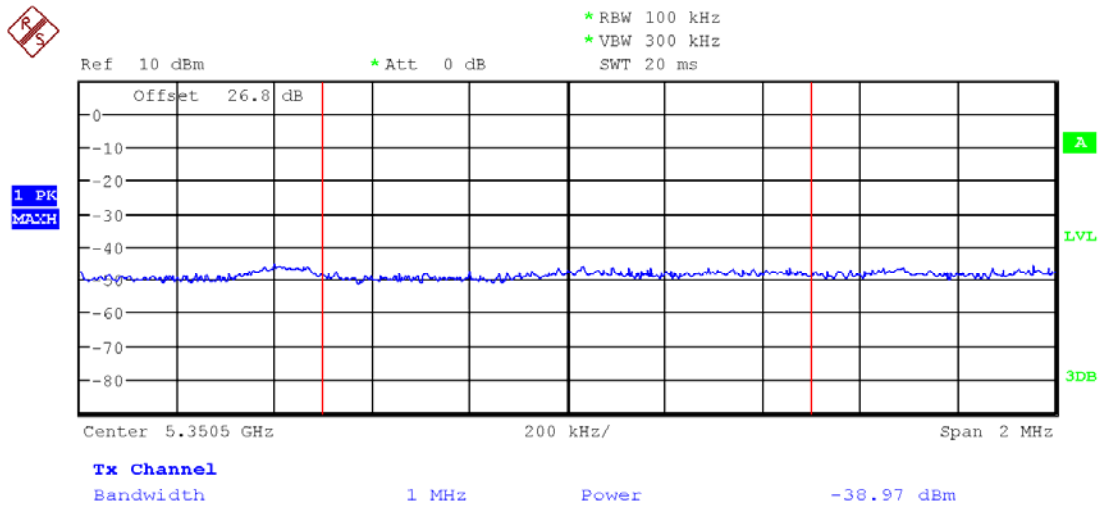
### 802.11ac40 mode chain 4 High Channel



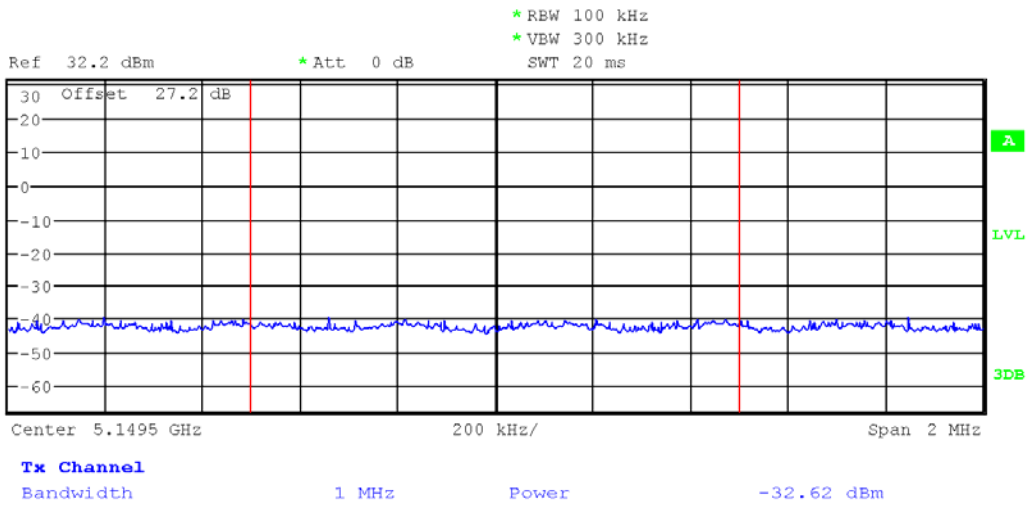
### 802.11ac40 mode chain 5 High Channel



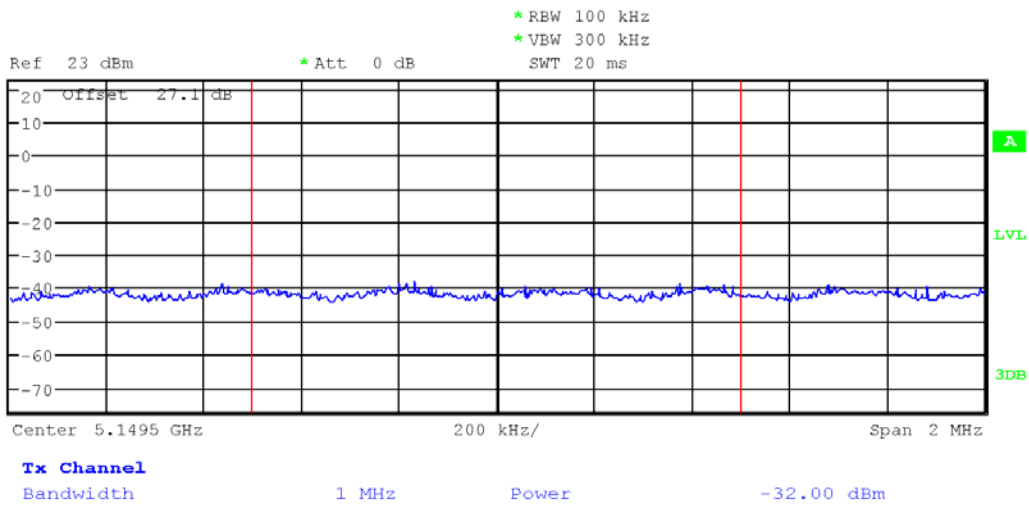
### 802.11ac40 mode chain 6 High Channel



### 802.11ac80 mode chain 4 Low Edge

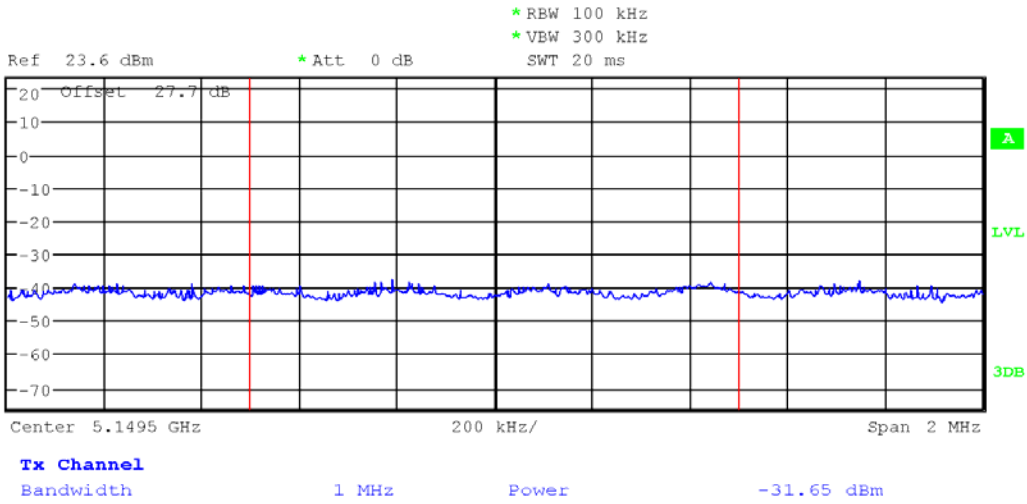


### 802.11ac80 mode chain 5 Low Edge





### 802.11ac80 mode chain 6 Low Edge



### 802.11ac80 mode chain 4 High Edge

