FCC PART 15.407
TEST AND MEASUREMENT REPORT

For

Ruckus Wireless, Inc.

350 West Java Drive,

Sunnyvale, CA 94089, USA

FCC ID: S9GTDBAC22N
Model: TDBAC22N

Report Type:	**Product Type:**
CIIPC Report	802.11 a/b/g/n/ac Modular

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1407152-407 W52	Initial	2014-10-30

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report has been compiled on behalf of Ruckus Wireless, Inc, and their product, model number: *TDBAC22N,* FCC ID: S9GTDBAC22N which henceforth is referred to as the EUT (Equipment Under Test.). EUT is an 802.11a/b/g/n/ac Radio Modular.

1.2 Mechanical Description of EUT

The EUT measures approximately 15 cm (L) x 13 cm (W) x 2.0 cm (H) and weighs 114.5 g.

The test data gathered are from typical production sample, serial number: 171406000022 assigned by the manufacturer.

1.3 Objective

This report is prepared on behalf of Ruckus Wireless, Inc, in accordance with FCC CFR47 §15.407.

The objective is to determine compliance with FCC Part 15.407 for Output Power, Antenna Requirements, AC Line Conducted Emissions, Bandwidth, power spectral density, Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

FCC 2.4 GHz Part 15.247 DTS and 5.8 GHz Part 15.407 NII filings with FCC ID: S9GTDBAC22N.

1.5 Test Methodology

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

1.6 Measurement Uncertainty

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

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from ±2.0 dB for Conducted Emissions tests and ±4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.7 Test Facility

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

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

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

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

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2009, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

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

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

http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009 and KDB-789033 D02 General UNII Test Procedures New Rules v01

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

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

2.2 EUT Exercise Software

The test utility used was *T301s ART* was provided by Ruckus Wireless Inc., and was verified by *Rui Zhou* to comply with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Ruckus	DC Adaptor/POE	NPE-5818	740-64157-001
Ruckus	AC Adaptor	PA10244HUB	740-64125-010
Dell	Laptop	Latitude E5420	CHZCMQ1

2.5 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Ruckus	Main Board (SANTORINI)	ASM 120-11257-003 rev. 4	RUK02806
Ruckus	Interface	-	-

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
§15.209(a), 15.407(b)	Spurious Radiated Emissions	Compliant
§15.407(a)	Emission Bandwidth	Compliant
§407(a)	Maximun Output Power Measurement	Compliant
§2.1051, §15.407(b)	Band Edges	Compliant
§15.407(a)	Power Spectral Density	Compliant
§2.1051, §15.407(b)	Spurious Emissions at Antenna Terminals	Compliant

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

4.1 Applicable Standard

According to FCC §15.407(f) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

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

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

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

5150-5250 MHz

Maximum peak output power at antenna input terminal (dBm):	22.87
Maximum peak output power at antenna input terminal (mW):	193.44
Prediction distance (cm):	20
Prediction frequency (MHz):	5230
Maximum Antenna Gain, typical (dBi):	8
Maximum Antenna Gain (numeric):	6.31
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.2428
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device meets FCC MPE requirement for uncontrolled exposure environment at 20 cm distance.

5 FCC §15.203 – Antenna Requirements

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.2 Antenna Description

The antenna uses a unique coupling to the EUT, which complies with the antenna requirement.And the antenna gain is 8 dBi. Please refer to the internal photos.

6 FCC §15.207 - AC Power Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 Conducted limits:

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

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 1
0.5-5	56	46
5-30	60	50

Note 1 Decreases with the logarithm of the frequency.

6.2 Test Setup

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

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

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

6.3 Test Procedure

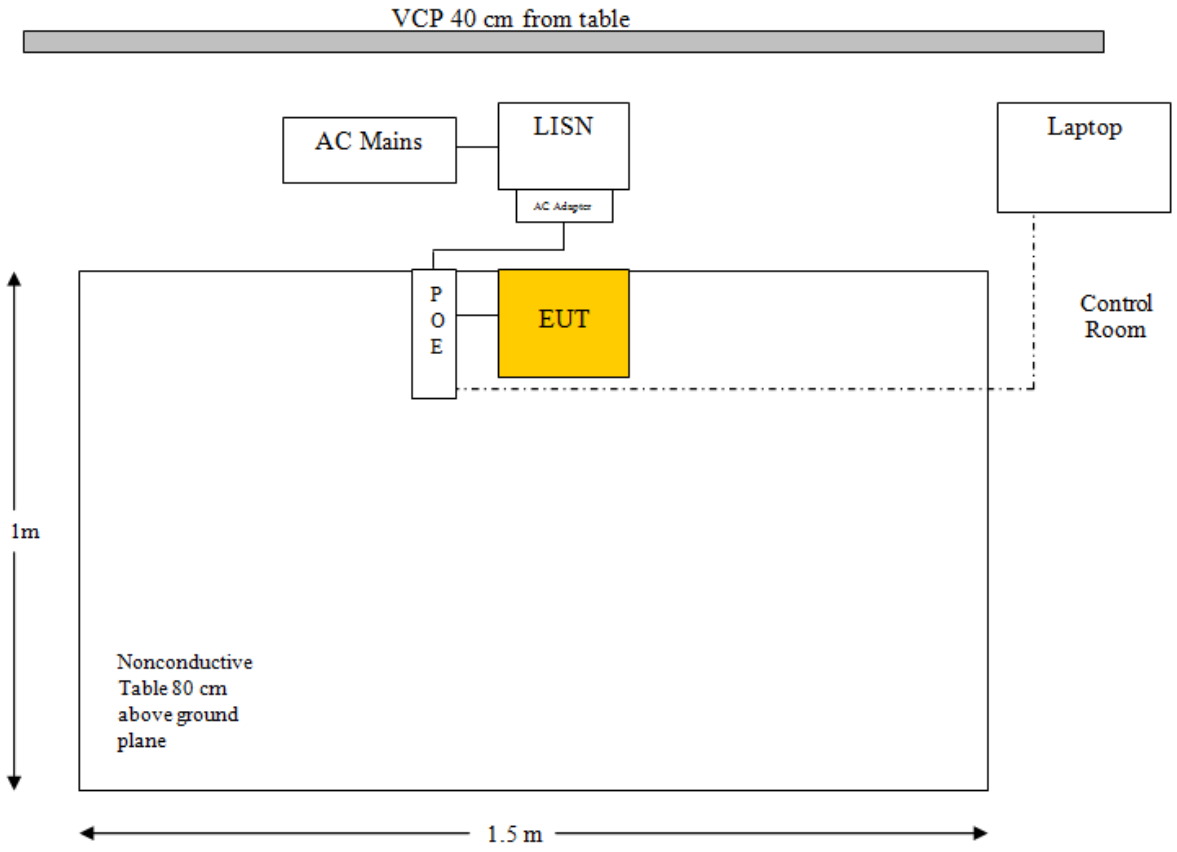
During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cord of the support equipment was connected to LISN-2.

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

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

6.4 Test Setup Block Diagram

POE:



6.5 Corrected Amplitude & Margin Calculation

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

CA = Ai + CL + Atten

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

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

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-09-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	511213	2014-7-14	1 year

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

6.7 Test Environmental Conditions

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

The testing was performed by Rui Zhou on 2014-07-22 in 5m chamber3.

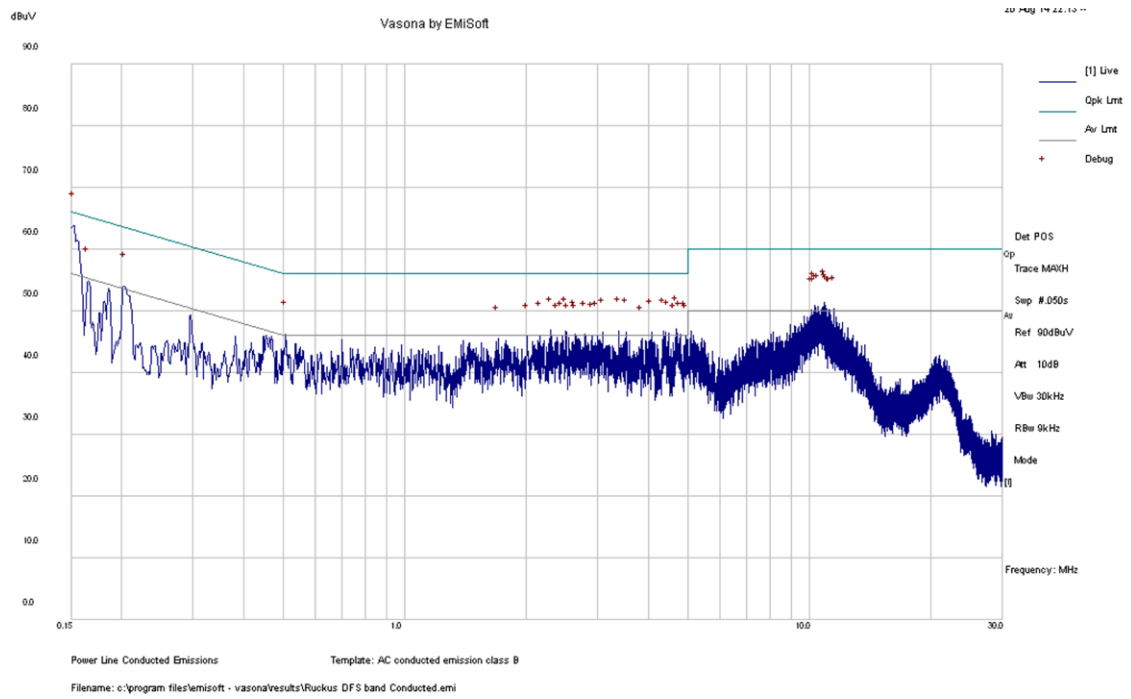
6.8 Summary of Test Results

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

Connection: POE connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-2.58	0.150162	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

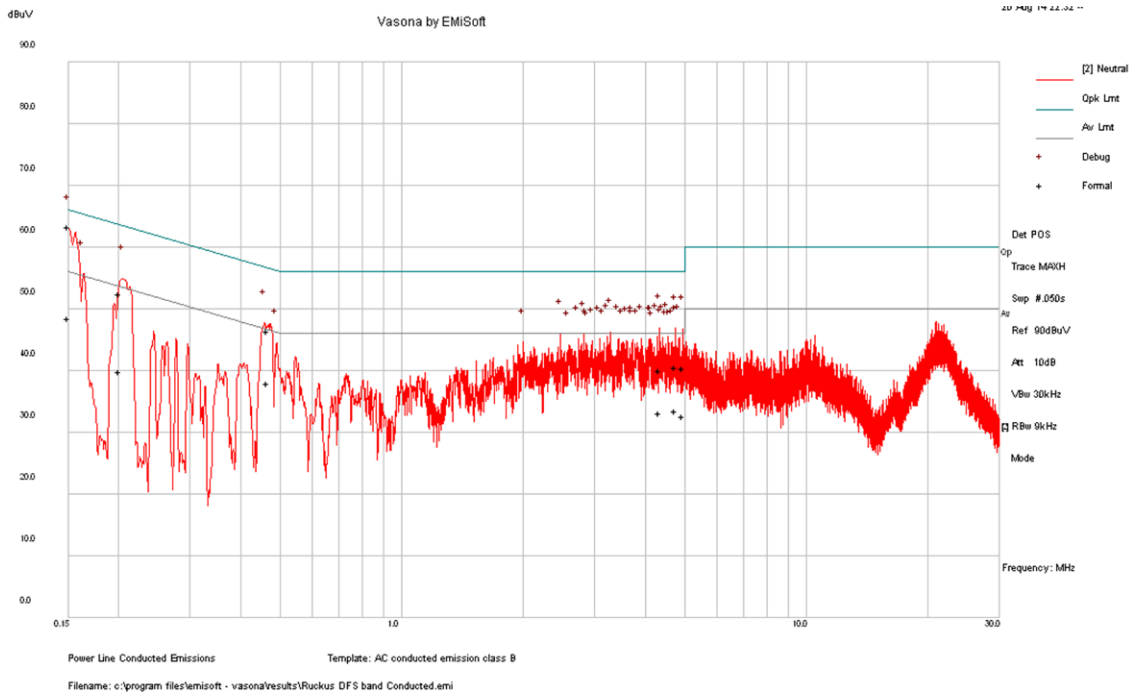
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150408	63.24	Line	65.98	-2.74	QP
10.887706	46.17	Line	60	-13.83	QP
4.690034	41.98	Line	56	-14.02	QP
2.29948	42.18	Line	56	-13.82	QP
10.303984	46.35	Line	60	-13.65	QP
3.391159	40.81	Line	56	-15.19	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150408	47.33	Line	55.98	-8.65	Ave.
10.887706	40.24	Line	50	-9.76	Ave.
4.690034	34.73	Line	46	-11.27	Ave.
2.29948	35.57	Line	46	-10.43	Ave.
10.303984	40.5	Line	50	-9.5	Ave.
3.391159	33.69	Line	46	-12.31	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150162	63.41	Neutral	65.99	-2.58	QP
0.201303	52.45	Neutral	63.56	-11.11	QP
0.467484	46.42	Neutral	56.56	-10.14	QP
4.347593	40.1	Neutral	56	-15.9	QP
4.749824	40.65	Neutral	56	-15.35	QP
4.959653	40.52	Neutral	56	-15.48	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150162	48.53	Neutral	55.99	-7.46	Ave.
0.201303	39.9	Neutral	53.56	-13.66	Ave.
0.467484	37.96	Neutral	46.56	-8.59	Ave.
4.347593	33.17	Neutral	46	-12.83	Ave.
4.749824	33.49	Neutral	46	-12.51	Ave.
4.959653	32.64	Neutral	46	-13.36	Ave.

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

7.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

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

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

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

As per FCC Part 15.407 (b)

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(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.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15C/15E 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 above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

7.4 Corrected Amplitude & Margin Calculation

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

CA = Ai + AF + CL + Atten – Ga

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

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

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Science Corp	System Controller	SC99V	122303-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2014-07-18	1 year
Hewlett Packard	Pre-amplifier 1-26.5 GHz	8447D	2944A06639	2013-08-09	1 year
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year
EMCO	Horn Antenna	3315	9511-4627	2013-10-17	1 year
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2013-09-28	1 year
Wisewave	Pre-amplifier 26.5-40 GHz	ALN-33144030-01	11424-01	2013-03-20	2 years
Wisewave	Horn Antenna	ARH-4223-02	10555-02	2013-09-20	3 years

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

7.6 Test Environmental Conditions

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

The testing was performed by Rui Zhou on 2014-07-21 at 5 meter 3.

7.7 Summary of Test Results

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

30 MHz-1 GHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-1.35	749.9958	Horizontal	30 MHz - 1 GHz

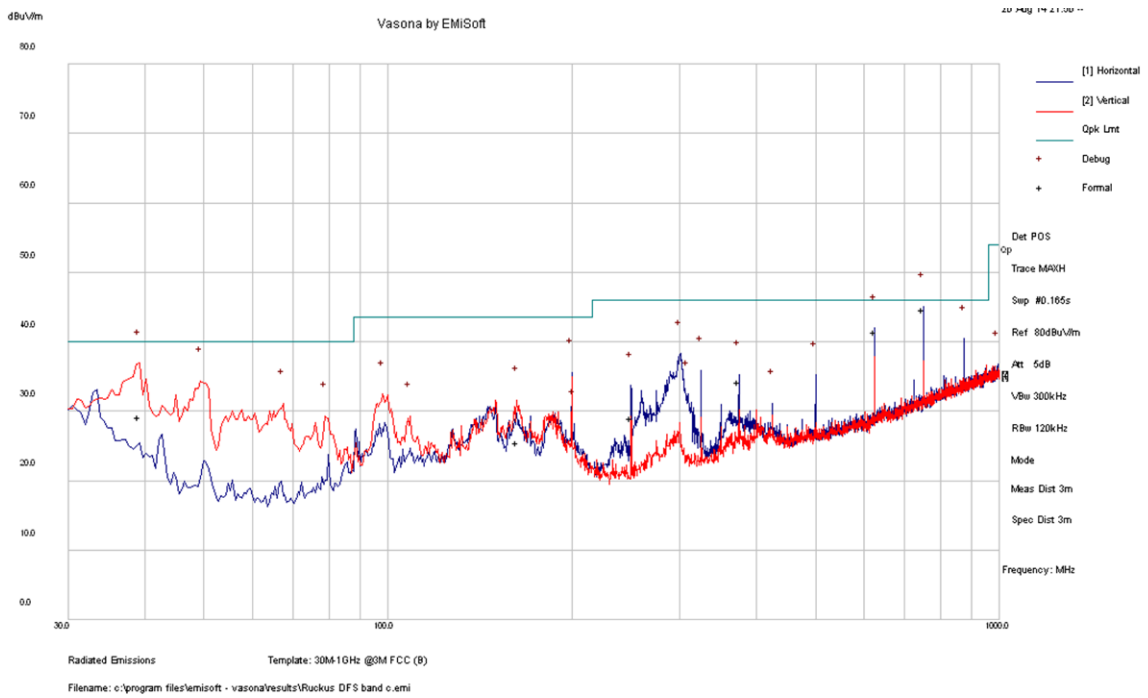
1 GHz-40 GHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-12.38	10360	Vertical	1 - 40 GHz

7.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz

Worst-case:



Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
749.9958	44.65	QP	H	98	248	46	-1.35
39.12875	29.23	QP	V	187	52	40	-10.77
625.0115	41.49	QP	H	104	141	46	-4.51
374.995	34.2	QP	H	102	265	46	-11.8
162.442	25.49	QP	V	114	360	43.5	-18.01
249.9505	29.1	QP	H	98	235	46	-16.9

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
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz, measured at 3 meters											
10360	47.54	0	100	V	38.1	4.08	33.87	55.85	74	-18.15	Peak
10360	47.97	0	100	H	38.1	4.08	33.87	56.28	74	-17.72	Peak
10360	33.31	0	100	V	38.1	4.08	33.87	41.62	54	-12.38	Ave
10360	33.34	0	100	H	38.1	4.08	33.87	41.65	54	-12.35	Ave
15540	45.8	0	100	V	38.54	3.93	33.82	54.45	74	-19.55	Peak
15540	44.45	0	100	H	38.54	3.93	33.82	53.1	74	-20.9	Peak
15540	31.3	0	100	V	38.54	3.93	33.82	39.95	54	-14.05	Ave
15540	32.08	0	100	H	38.54	3.93	33.82	40.73	54	-13.27	Ave
20720	43.02	0	100	V	34.75	5.72	34.79	48.7	74	-25.3	Peak
20720	42.73	0	100	H	34.75	5.72	34.79	48.41	74	-25.59	Peak
20720	28.39	0	100	V	34.75	5.72	34.79	34.07	54	-19.93	Ave
20720	28.65	0	100	H	34.75	5.72	34.79	34.33	54	-19.67	Ave
Middle Channel 5200 MHz, measured at 3 meters											
10400	47.66	0	100	V	38.845	4.07	33.87	56.705	74	-17.295	Peak
10400	46.51	0	100	H	38.845	4.07	33.87	55.555	74	-18.445	Peak
10400	32.28	0	100	V	38.845	4.07	33.87	41.325	54	-12.675	Ave
10400	31.29	0	100	H	38.845	4.07	33.87	40.335	54	-13.665	Ave
15600	46.74	0	100	V	38.59	3.94	33.82	55.45	74	-18.55	Peak
15600	46.99	0	100	H	38.59	3.94	33.82	55.7	74	-18.3	Peak
15600	31.9	0	100	V	38.59	3.94	33.82	40.61	54	-13.39	Ave
15600	31.91	0	100	H	38.59	3.94	33.82	40.62	54	-13.38	Ave
20800	43.3	0	100	V	34.81	5.78	34.74	49.15	74	-24.85	Peak
20800	42.48	0	100	H	34.81	5.78	34.74	48.33	74	-25.67	Peak
20800	28.19	0	100	V	34.81	5.78	34.74	34.04	54	-19.96	Ave
20800	28.01	0	100	H	34.81	5.78	34.74	33.86	54	-20.14	Ave
High Channel 5240 MHz, measured at 3 meters											
10480	46.27	0	100	V	38.55	4.09	34.71	54.2	74	-19.8	Peak
10480	45.97	0	100	H	38.55	4.09	34.71	53.9	74	-20.1	Peak
10480	31.78	0	100	V	38.55	4.09	34.71	39.71	54	-14.29	Ave
10480	31.15	0	100	H	38.55	4.09	34.71	39.08	54	-14.92	Ave
15720	46.44	0	100	V	38.61	5.17	33.78	56.44	74	-17.56	Peak
15720	46.7	0	100	H	38.61	3.93	33.78	55.46	74	-18.54	Peak
15720	31.4	0	100	V	38.61	3.93	33.78	40.16	54	-13.84	Ave
15720	31.94	0	100	H	38.61	3.93	33.78	40.7	54	-13.3	Ave
20960	42.75	0	100	V	37.92	5.78	34.71	51.74	74	-22.26	Peak
20960	42.4	0	100	H	37.92	5.78	34.71	51.39	74	-22.61	Peak
20960	27.34	0	100	V	37.92	5.78	34.71	36.33	54	-17.67	Ave
20960	27.48	0	100	H	37.92	5.78	34.71	36.47	54	-17.53	Ave

802.11n-HT20 Mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz, measured at 3 meters											
10360	46.62	0	100	V	38.1	4.08	33.87	54.93	74	-19.07	Peak
10360	46.38	0	100	H	38.1	4.08	33.87	54.69	74	-19.31	Peak
10360	31.39	0	100	V	38.1	4.08	33.87	39.7	54	-14.3	Ave
10360	31.42	0	100	H	38.1	4.08	33.87	39.73	54	-14.27	Ave
15540	46.05	0	100	V	38.54	3.93	33.82	54.7	74	-19.3	Peak
15540	44.84	0	100	H	38.54	3.93	33.82	53.49	74	-20.51	Peak
15540	30.89	0	100	V	38.54	3.93	33.82	39.54	54	-14.46	Ave
15540	30.3	0	100	H	38.54	3.93	33.82	38.95	54	-15.05	Ave
20720	41.78	0	100	V	34.75	5.72	34.79	47.46	74	-26.54	Peak
20720	42.28	0	100	H	34.75	5.72	34.79	47.96	74	-26.04	Peak
20720	27.37	0	100	V	34.75	5.72	34.79	33.05	54	-20.95	Ave
20720	27.11	0	100	H	34.75	5.72	34.79	32.79	54	-21.21	Ave
Middle Channel 5200 MHz, measured at 3 meters											
10400	45.66	0	100	V	38.845	4.07	33.87	54.705	74	-19.295	Peak
10400	45.72	0	100	H	38.845	4.07	33.87	54.765	74	-19.235	Peak
10400	30.98	0	100	V	38.845	4.07	33.87	40.025	54	-13.975	Ave
10400	30.56	0	100	H	38.845	4.07	33.87	39.605	54	-14.395	Ave
15600	45.97	0	100	V	38.59	3.94	33.82	54.68	74	-19.32	Peak
15600	46.1	0	100	H	38.59	3.94	33.82	54.81	74	-19.19	Peak
15600	31.4	0	100	V	38.59	3.94	33.82	40.11	54	-13.89	Ave
15600	31.3	0	100	H	38.59	3.94	33.82	40.01	54	-13.99	Ave
20800	42.15	0	100	V	34.81	5.78	34.74	48	74	-26	Peak
20800	42.99	0	100	H	34.81	5.78	34.74	48.84	74	-25.16	Peak
20800	27.47	0	100	V	34.81	5.78	34.74	33.32	54	-20.68	Ave
20800	27.6	0	100	H	34.81	5.78	34.74	33.45	54	-20.55	Ave
High Channel 5240 MHz, measured at 3 meters											
10480	46.8	0	100	V	38.55	4.09	34.71	54.73	74	-19.27	Peak
10480	45.95	0	100	H	38.55	4.09	34.71	53.88	74	-20.12	Peak
10480	31.83	0	100	V	38.55	4.09	34.71	39.76	54	-14.24	Ave
10480	30.86	0	100	H	38.55	4.09	34.71	38.79	54	-15.21	Ave
15720	46.64	0	100	V	38.61	5.17	33.78	41.83	74	-32.17	Peak
15720	46.23	0	100	H	38.61	3.93	33.78	54.99	74	-19.01	Peak
15720	31.75	0	100	V	38.61	3.93	33.78	40.51	54	-13.49	Ave
15720	31.65	0	100	H	38.61	3.93	33.78	40.41	54	-13.59	Ave
20960	42.47	0	100	V	37.92	5.78	34.71	51.46	74	-22.54	Peak
20960	42.41	0	100	H	37.92	5.78	34.71	51.4	74	-22.6	Peak
20960	27.55	0	100	V	37.92	5.78	34.71	36.54	54	-17.46	Ave
20960	27.39	0	100	H	37.92	5.78	34.71	36.38	54	-17.62	Ave

802.11n-HT40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5190 MHz, measured at 3 meters											
10380	45.44	0	100	V	38.1	4.09	33.87	53.76	74	-20.24	Peak
10380	45.59	0	100	H	38.1	4.09	33.87	53.91	74	-20.09	Peak
10380	30.67	0	100	V	38.1	4.09	33.87	38.99	54	-15.01	Ave
10380	30.58	0	100	H	38.1	4.09	33.87	38.9	54	-15.1	Ave
15570	44.73	0	100	V	38.54	3.95	33.82	53.4	74	-20.6	Peak
15570	45.65	0	100	H	38.54	3.95	33.82	54.32	74	-19.68	Peak
15570	30.16	0	100	V	38.54	3.95	33.82	38.83	54	-15.17	Ave
15570	30.97	0	100	H	38.54	3.95	33.82	39.64	54	-14.36	Ave
20760	42.52	0	100	V	34.71	5.72	34.79	48.16	74	-25.84	Peak
20760	43.11	0	100	H	34.71	5.72	34.79	48.75	74	-25.25	Peak
20760	27.65	0	100	V	34.71	5.72	34.79	33.29	54	-20.71	Ave
20760	27.62	0	100	H	34.71	5.72	34.79	33.26	54	-20.74	Ave
High Channel 5230 MHz, measured at 3 meters											
10460	46.56	0	100	V	38.55	4.11	34.71	54.51	74	-19.49	Peak
10460	46.1	0	100	H	38.55	4.11	34.71	54.05	74	-19.95	Peak
10460	31.78	0	100	V	38.55	4.11	34.71	39.73	54	-14.27	Ave
10460	31.14	0	100	H	38.55	4.11	34.71	39.09	54	-14.91	Ave
15690	46.08	0	100	V	38.61	3.96	33.78	54.87	74	-19.13	Peak
15690	45.98	0	100	H	38.61	3.96	33.78	54.77	74	-19.23	Peak
15690	30.98	0	100	V	38.61	3.96	33.78	39.77	54	-14.23	Ave
15690	31.2	0	100	H	38.61	3.96	33.78	39.99	54	-14.01	Ave
20920	42.22	0	100	V	34.69	5.78	34.71	47.98	74	-26.02	Peak
20920	42.64	0	100	H	34.69	5.78	34.71	48.4	74	-25.6	Peak
20920	27.65	0	100	V	34.69	5.78	34.71	33.41	54	-20.59	Ave
20920	27.41	0	100	H	34.69	5.78	34.71	33.17	54	-20.83	Ave

802.11ac- VHT80 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
5210 MHz, measured at 3 meters											
10420	45.55	0	100	V	38.1	4.08	33.87	54.24	74	-19.76	Peak
10420	45.26	0	100	H	38.1	4.08	33.87	53.63	74	-20.37	Peak
10420	31.01	0	100	V	38.1	4.08	33.87	41.32	54	-12.68	Ave
10420	30.98	0	100	H	38.1	4.08	33.87	41.29	54	-12.71	Ave
15630	46.33	0	100	V	38.54	3.93	33.82	55.15	74	-18.85	Peak
15630	46.65	0	100	H	38.54	3.93	33.82	54.23	74	-19.77	Peak
15630	31.46	0	100	V	38.54	3.93	33.82	42.03	54	-11.97	Ave
15630	31.4	0	100	H	38.54	3.93	33.82	41.98	54	-12.02	Ave
20840	43.47	0	100	V	34.78	5.72	34.79	51.89	74	-22.11	Peak
20840	43.24	0	100	H	34.78	5.72	34.79	51.61	74	-22.39	Peak
20840	28.3	0	100	V	34.78	5.72	34.79	39.49	54	-14.51	Ave
20840	28.7	0	100	H	34.78	5.72	34.79	39.48	54	-14.52	Ave

8 FCC §15.407(a) – Bandwidth Measurement

8.1 Applicable Standards

FCC §15.407(a)

8.2 Measurement Procedure

99-percent occupied bandwidth:
The 99-percent occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission.
Measurement of the 99-percent occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in section II.G.3.d).
Measurements of 99-percent occupied bandwidth may also optionally be used in lieu of the EBW to 789033 D02 General UNII Test Procedures New Rules v01
Page 4define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in section II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).
The following procedure shall be used for measuring (99 %) power bandwidth:
1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW ⩾ 3 • RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29	1 year

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

8.4 Test Environmental Conditions

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

The testing was performed by Rui Zhou on 2014-07-18 to 2014-07-22 at RF site.

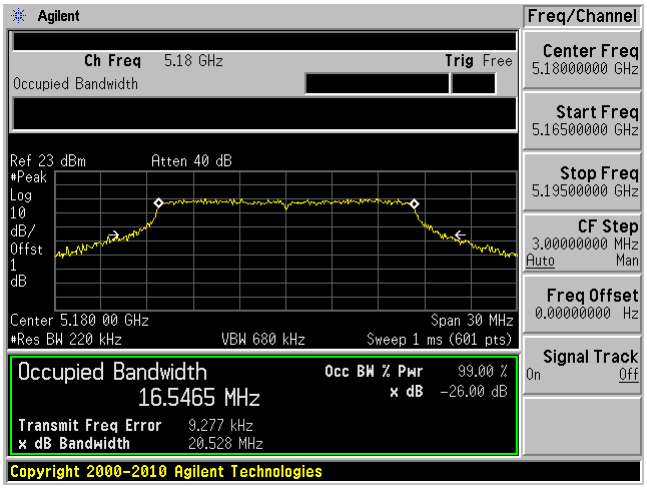
8.5 Test Results

Radio Mode	Channel	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
802.11a	Chain 0			
	Low	5180	20.528	16.5465
	Middle	5200	21.762	16.6468
	High	5240	20.912	16.5002
	Chain 1			
	Low	5180	20.776	16.5704
	Middle	5200	20.688	16.548
	High	5240	20.978	16.5739
802.11n-HT20	Chain 0			
	Low	5180	21.68	17.7596
	Middle	5200	21.835	17.8307
	High	5240	21.85	17.7278
	Chain 1			
	Low	5180	22.148	17.7481
	Middle	5200	21.879	17.7315
	High	5240	21.8	17.7839
802.11n-HT40	Chain 0			
	Low	5190	42.831	36.3038
	High	5230	43.084	36.2919
	Chain 1			
	Low	5190	43.322	36.2569
	High	5230	42.362	36.2873
802.11ac-VHT80	Chain 0			
	-	5210	85.619	75.9349
	Chain 1			
	-	5210	85.61	75.5129

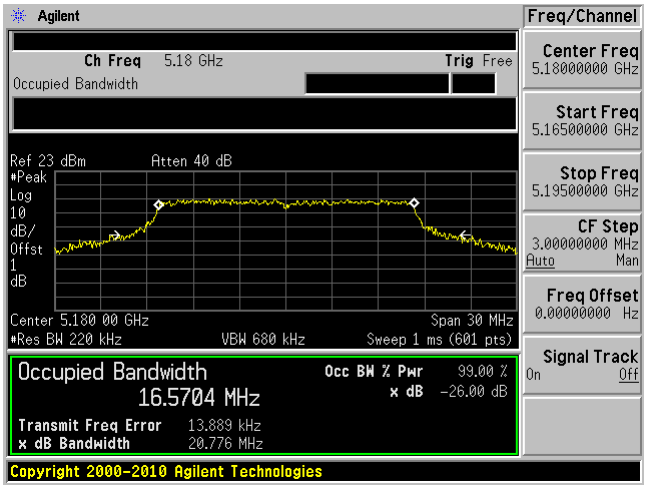
Please refer to the following plots.

802.11a, Low Channel, 5180 MHz

Chain 0

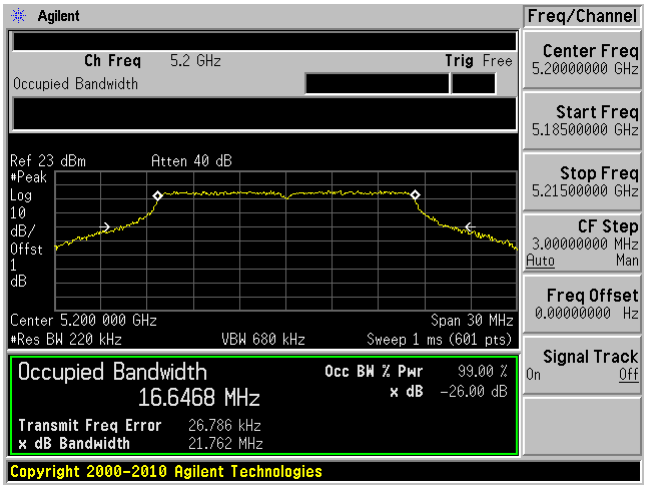


Chain 1

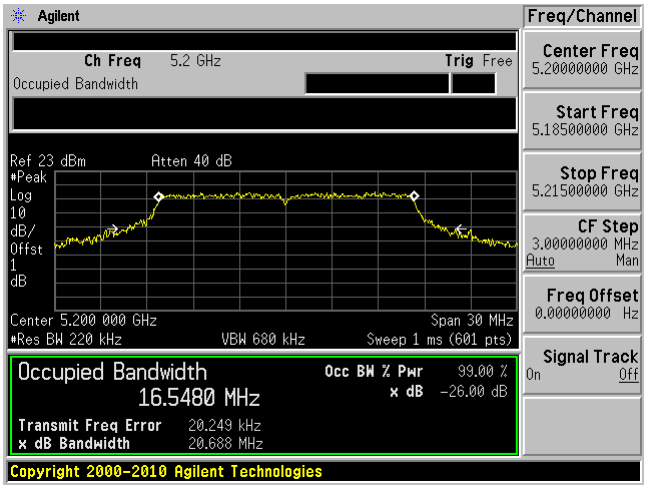


802.11a, Middle Channel, 5200 MHz

Chain 0

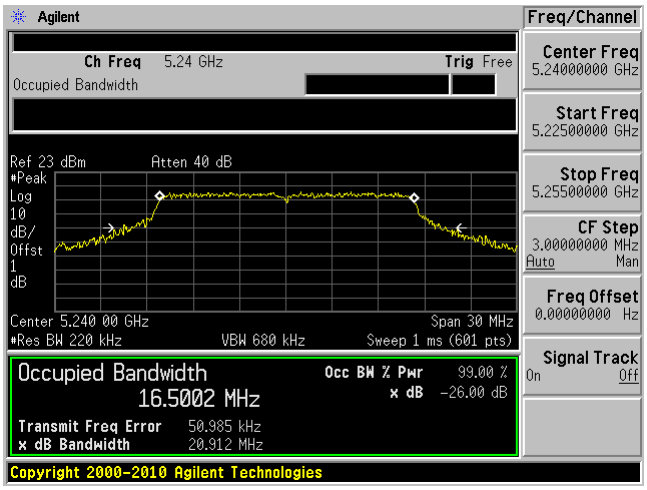


Chain 1

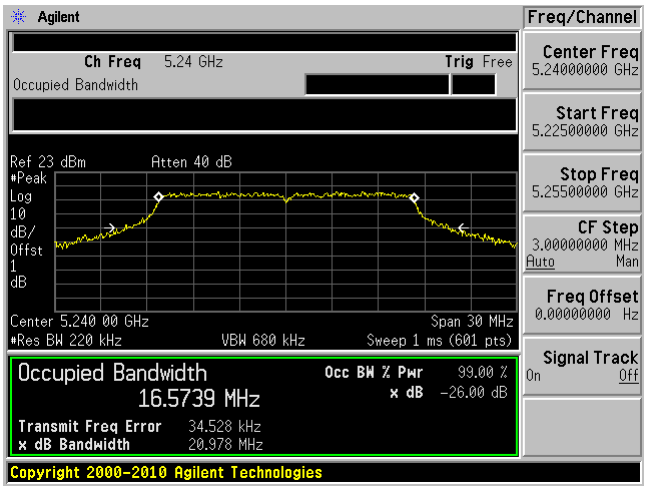


802.11a, High Channel, 5240 MHz

Chain 0

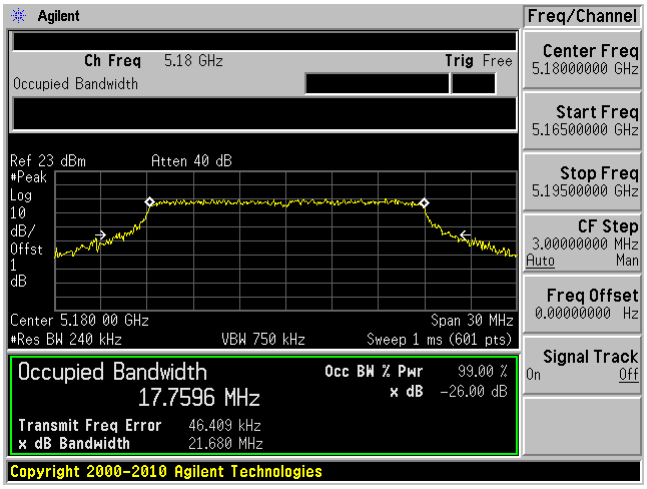


Chain 1

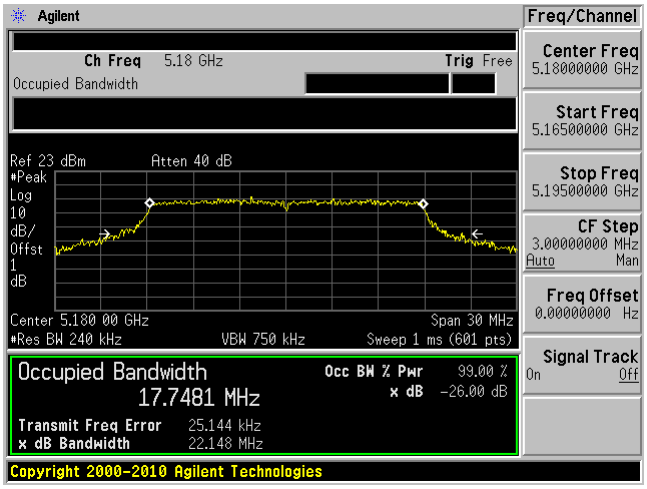


802.11n-HT20, Low Channel 5180 MHz

Chain 0

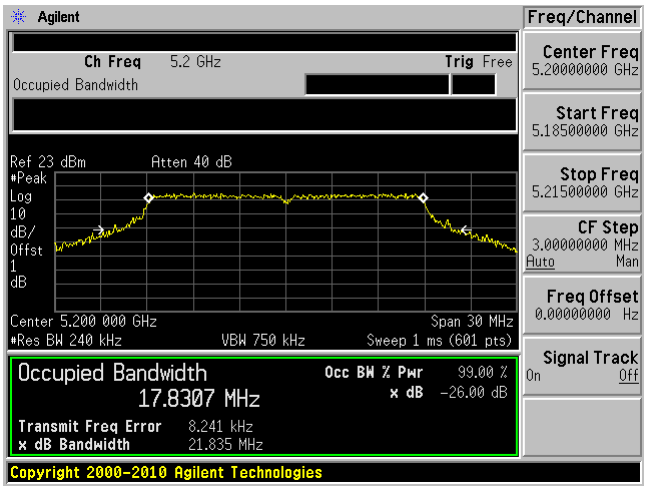


Chain 1

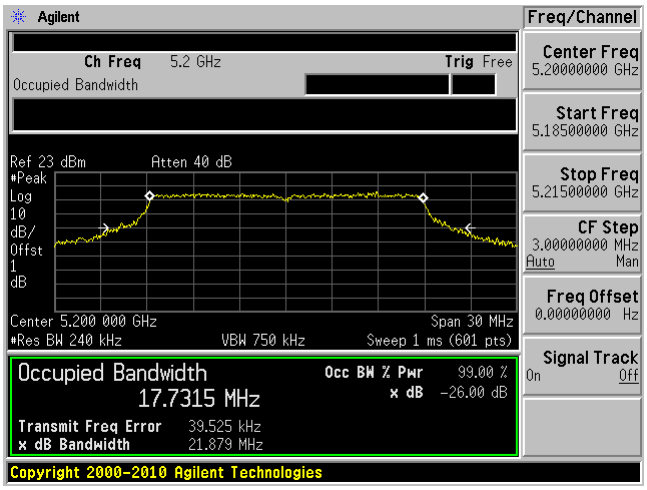


802.11n-HT20, Middle Channel 5200 MHz

Chain 0

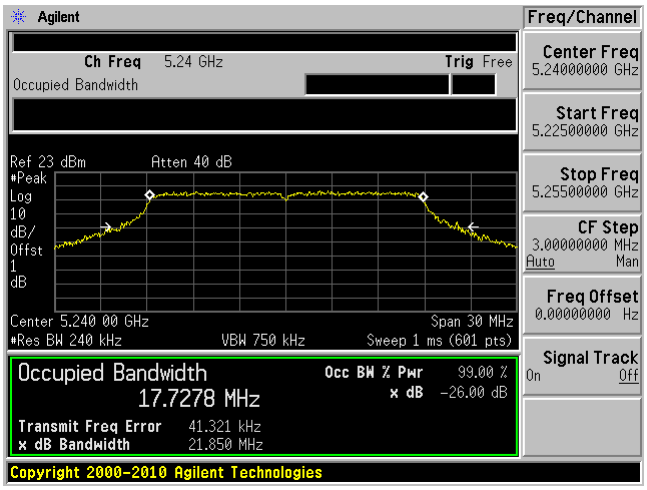


Chain 1

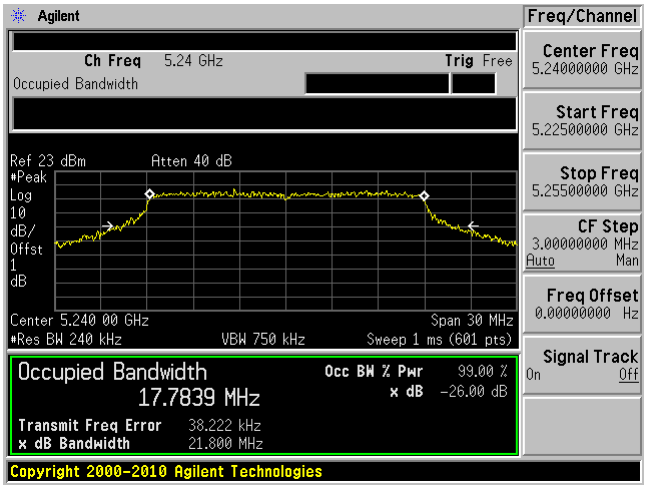


802.11n-HT20, High Channel, 5240 MHz

Chain 0

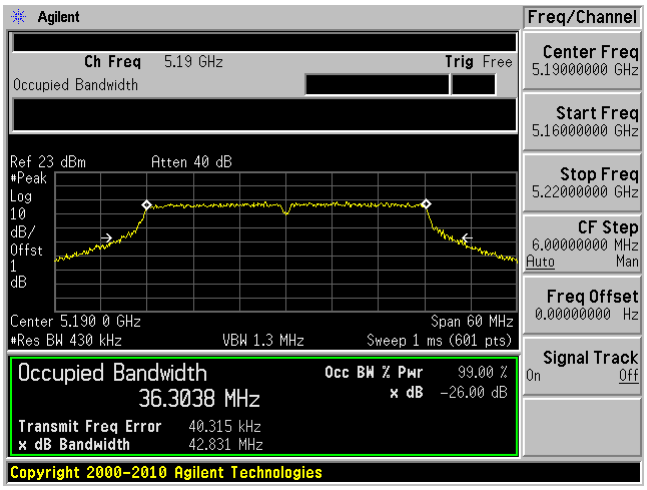


Chain 1

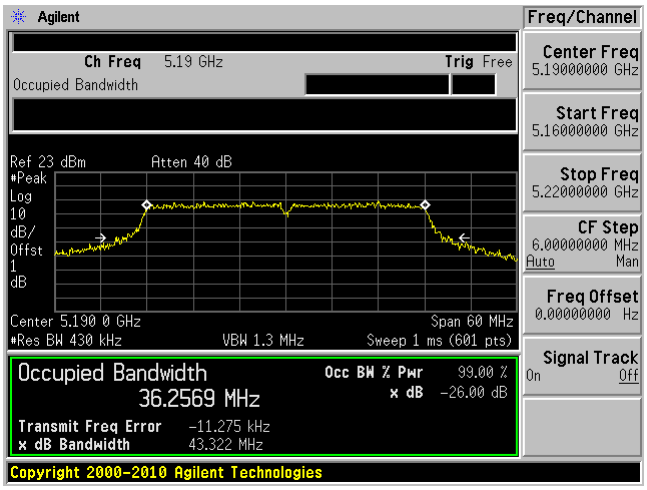


802.11n-HT40, Low Channel 5190 MHz

Chain 0

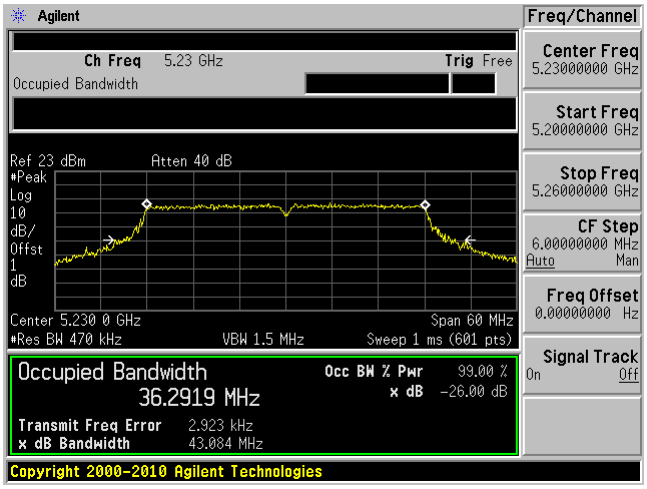


Chain 1

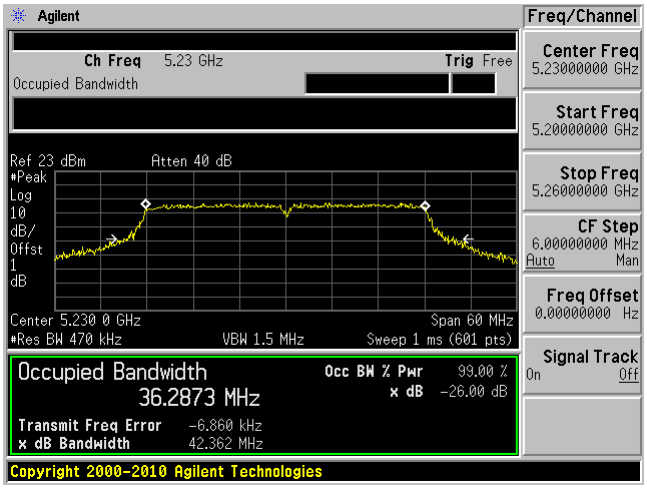


802.11n-HT40, High Channel 5230 MHz

Chain 0

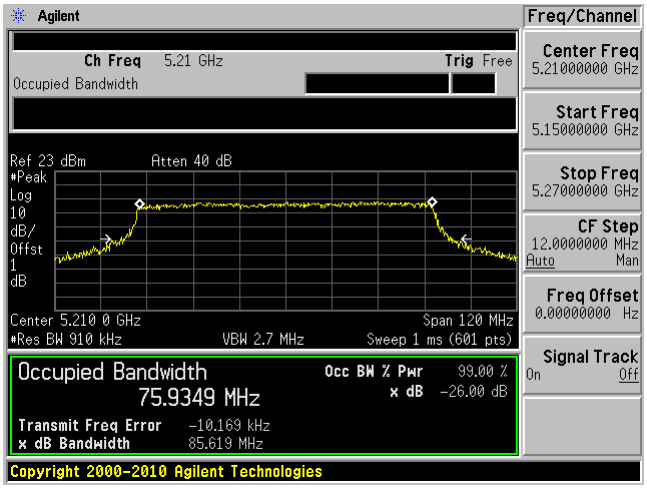


Chain 1

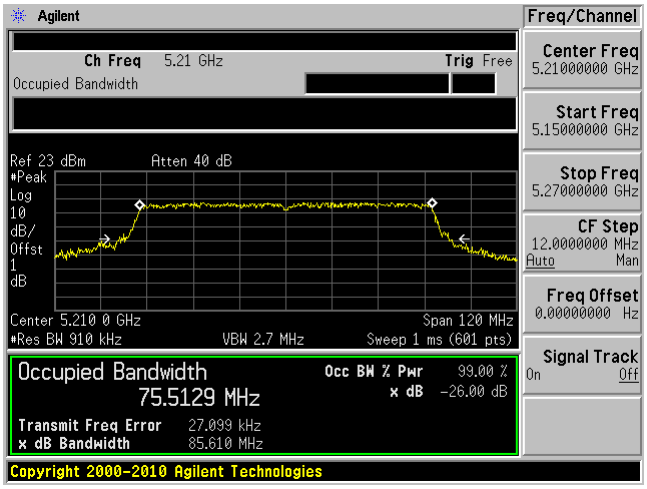


802.11ac-VHT80, High Channel 5210 MHz

Chain 0



Chain 1



9 FCC §407(a) – Maximum Conducted Output Power

9.1 Applicable Standards

According to FCC §15.407(a)

(i) For an outdoor 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) 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

Test measurements are base on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01, GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORAMTION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29	1 year

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

9.4 Test Environmental Conditions

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

The testing was performed by Rui Zhou on 2014-07-18 to 2014-07-22 at RF site.

9.5 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Output Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
		Chain J0	Chain J1				
802.11a mode							
Low	5180	14.03	13.84	16.95	28	-13.05	14
Middle	5200	19.23	18.74	22.00	28	-8.00	19
High	5240	19.77	19.49	22.64	28	-7.36	19
802.11n-HT20 mode							
Low	5180	13.93	13.86	16.91	28	-13.09	14
Middle	5200	19.05	18.88	21.98	28	-8.02	19
High	5240	19.57	19.45	22.52	28	-7.48	19
802.11n-HT40 mode							
Low	5190	11.45	11.39	14.43	28	-14.57	12
High	5230	19.83	19.88	22.87	28	-7.13	20
802.11ac-VHT80 mode							
-	5210	11.06	11.12	14.10	28	-15.90	12

Note: The antenna gain is 8 dBi, which is over 2 dB of 6 dBi, the conducted output power shall be reduced to 30-2=28 dBm.

10 FCC §15.407(b) - Out of Band Emissions

10.1 Applicable Standard

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

10.2 Measurement Procedure

The measurements are base on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01: GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORAMTION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29	1 year

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

10.4 Test Environmental Conditions

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

The testing was performed by Rui Zhou from 2014-07-18 to 2014-07-22 at RF site.

10.5 Test Results

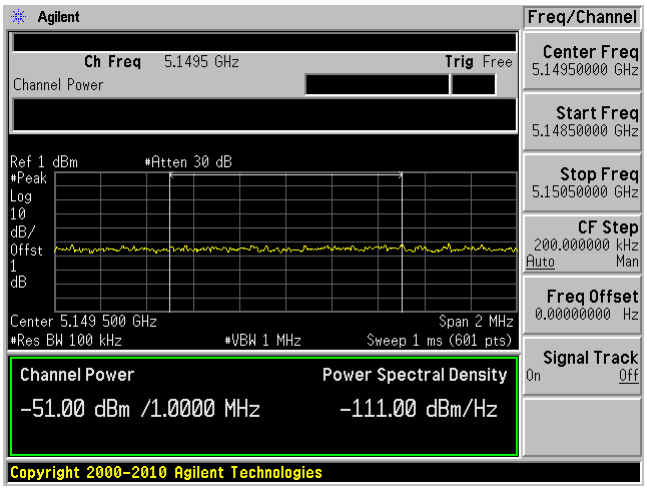
Please refer to the following plots.

Note: the offset include the attenuation, cable loss and antenna gain 8 dBi. And the magin between limit line and the emission covers other requirements in the KDB 789033.

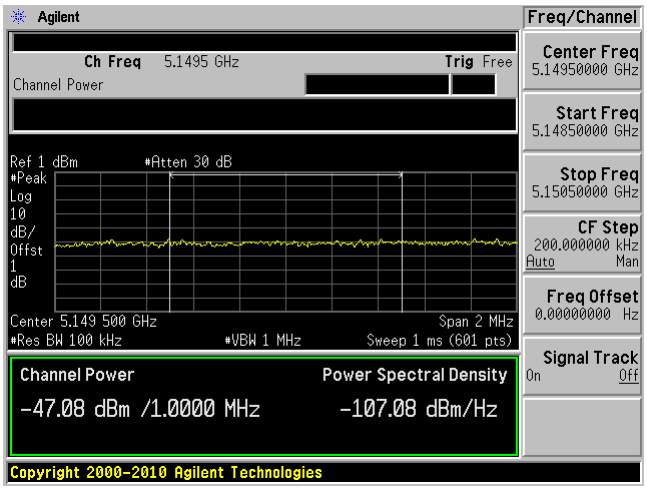
Band Edge Measurement

802.11a, Low Channel, 5180 MHz

Chain 0

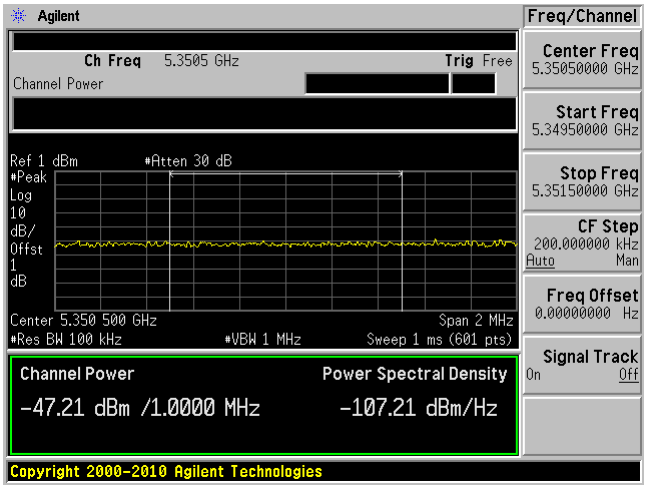


Chain 1

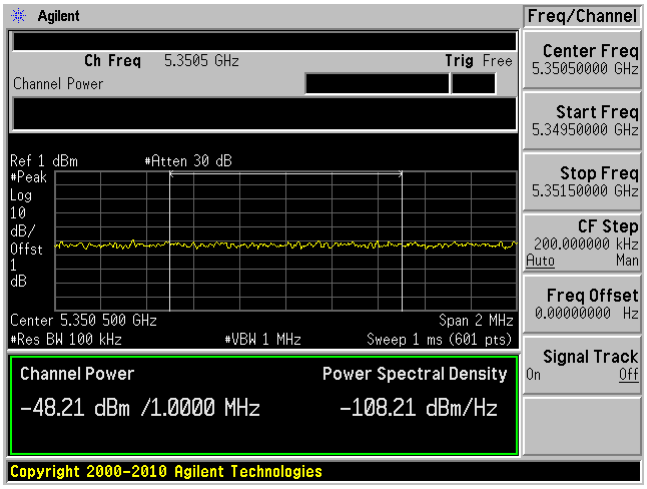


802.11a, High Channel, 5240 MHz

Chain 0

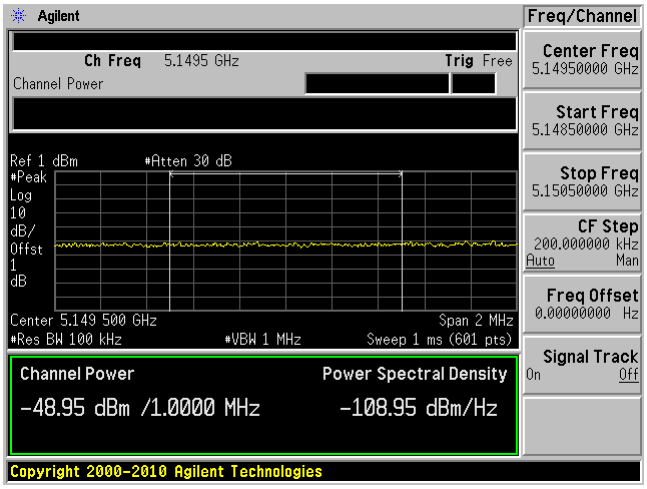


Chain 1

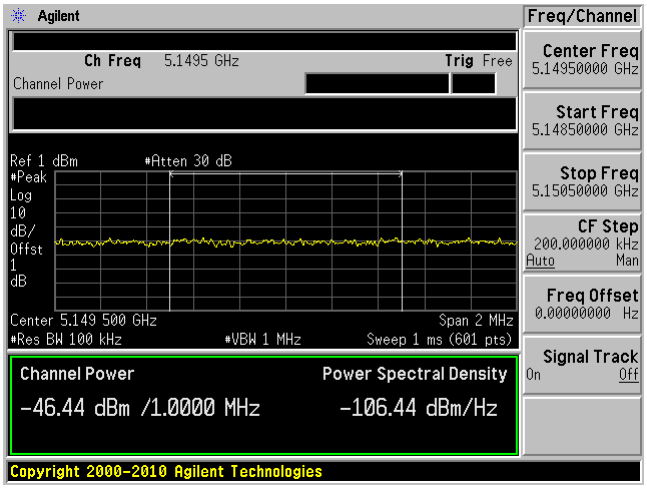


802.11n-HT 20, Low Channel 5180 MHz

Chain 0

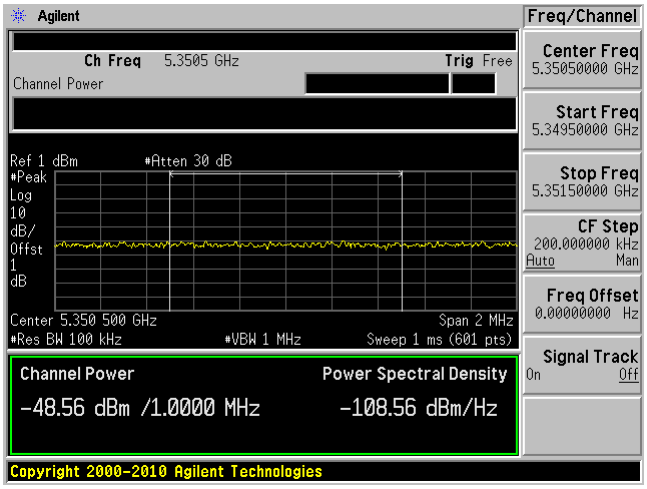


Chain 1

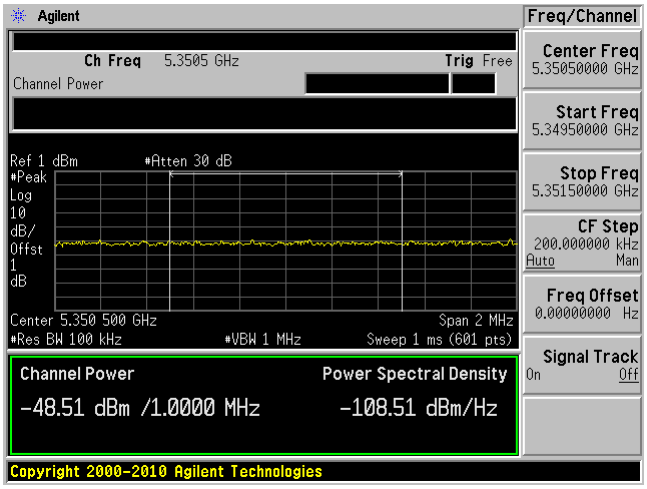


802.11n-HT20, High Channel, 5240 MHz

Chain 0

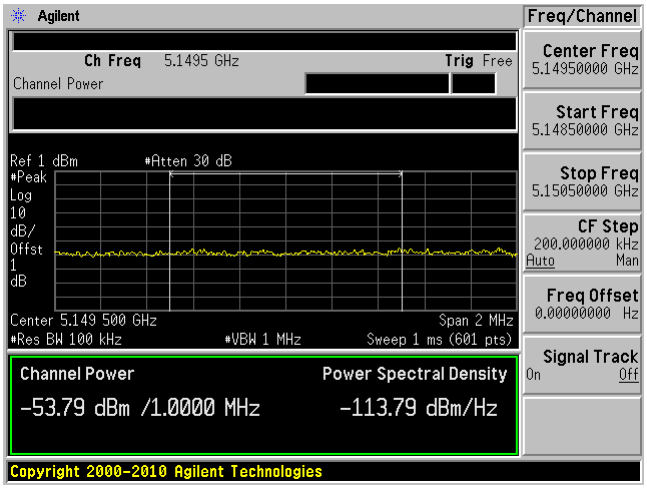


Chain 1

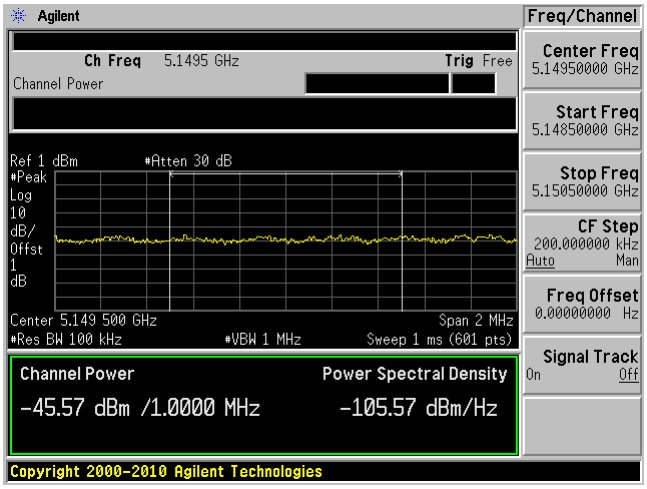


802.11n-HT40, Low Channel 5190 MHz

Chain 0

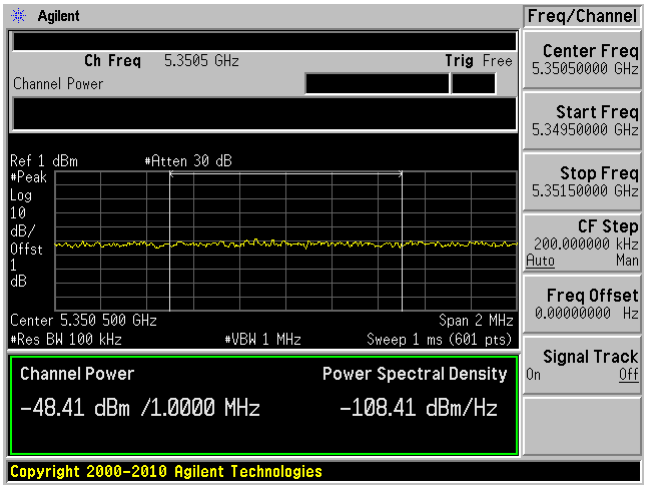


Chain 1

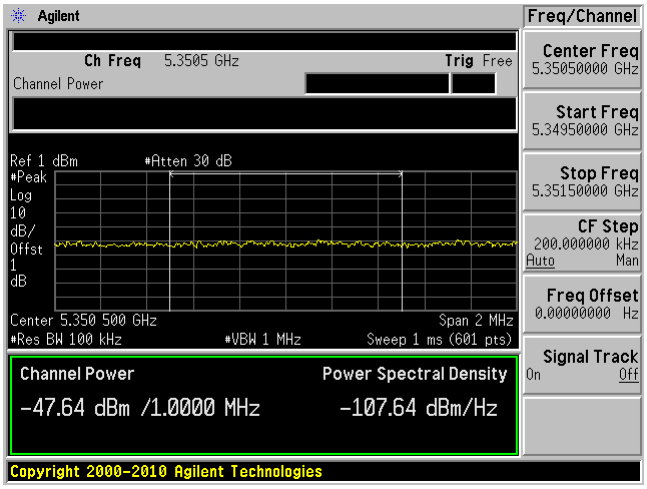


802.11n-HT40, High Channel 5230 MHz

Chain 0

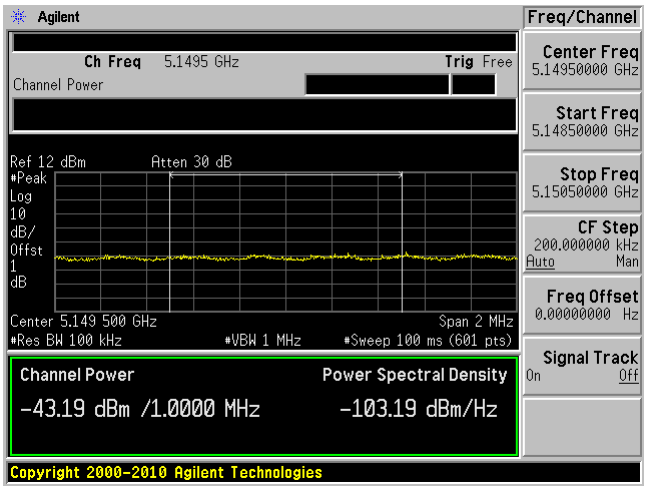


Chain 1

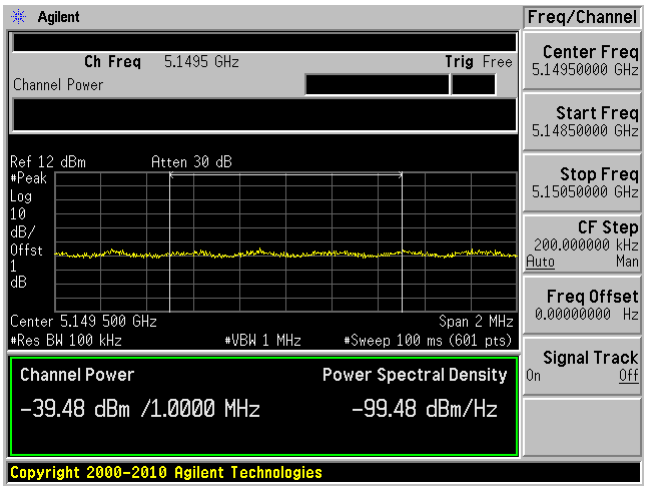


802.11ac-VHT80, 5210 MHz Lower Band

Chain 0

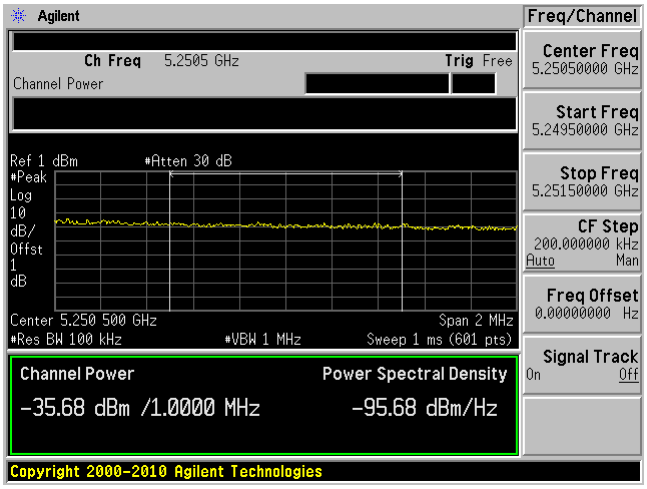


Chain 1

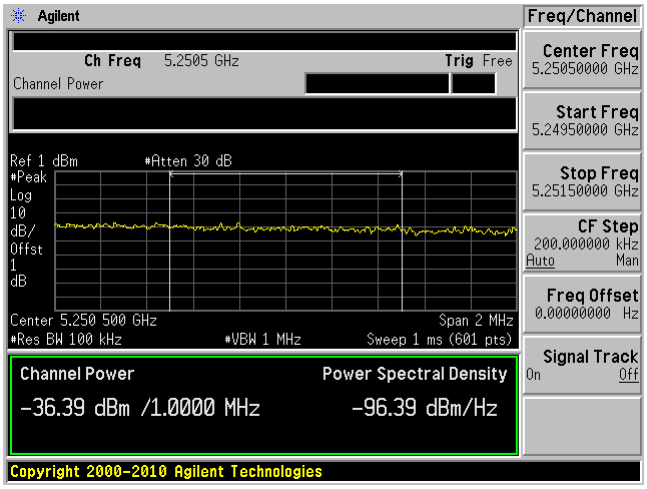


802.11ac-VHT80, 5210 MHz Higher Band

Chain 0



Chain 1



11 FCC §15.407(b) - Spurious Emissions at Antenna Ports

11.1 Applicable Standards

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

11.2 Measurement Procedure

Procedure for Unwanted Emissions Measurements below 1000 MHz
a) Follow the requirements in section II.G.3., “General Requirements for Unwanted Emissions Measurements”.
b) Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.
5. Procedure for Unwanted Maximum Emissions Measurements above 1000 MHz
a) Follow the requirements in section II.G.3., “General Requirements for Unwanted Emissions Measurements”.
b) Maximum emission levels are measured by setting the analyzer as follows:
(i) RBW = 1 MHz.
(ii) VBW ⩾ 3 MHz.
(iii) Detector = Peak.
(iv) Sweep time = auto.
(v) Trace mode = max hold.
(vi) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle. For example, at 50 percent duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission.

Unwanted Emissions in the Restricted Bands
a) For all measurements, follow the requirements in section II.G.3., “General Requirements for Unwanted Emissions Measurements”.
b) At frequencies below 1000 MHz, use the procedure described in section II.G.4., “Procedure for Unwanted Emissions Measurements Below 1000 MHz”.
c) At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in sections II.G.5. and II.G.6, respectively, must satisfy the respective peak and average limits. If all peak measurements satisfy the average limit, then average measurements are not required.
d) For conducted measurements above 1000 MHz, EIRP shall be computed as specified in section II.G.3.b) and then field strength shall be computed as follows (see KDB Publication
412172):
(i) E[dBμV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and
d = distance at which field strength limit is specified in the rules;
(ii) E[dBμV/m] = EIRP[dBm] + 95.2, for d = 3 meters.789033 D02 General UNII Test Procedures New Rules v01
Page 11
e) For conducted measurements below 1000 MHz, the field strength shall be computed as specified in d), above, and then an additional 4.7 dB shall be added as an upper bound on the field strength that would be observed on a test range with a ground plane for frequencies between 30 MHz and 1000 MHz, or an additional 6 dB shall be added for frequencies below 30 MHz.2

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29	1 year

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

11.4 Test Environmental Conditions

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

The testing was performed by Rui Zhou 2014-07-18 to 2014-07-22 at RF site.

11.5 Test Results

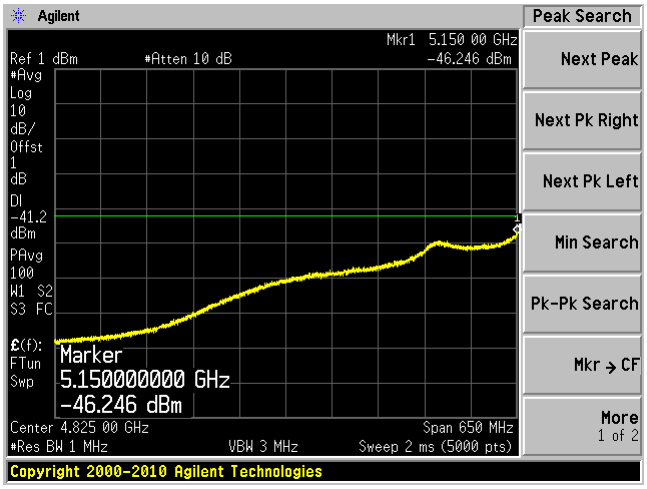
Please refer to following plots of spurious emissions.

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

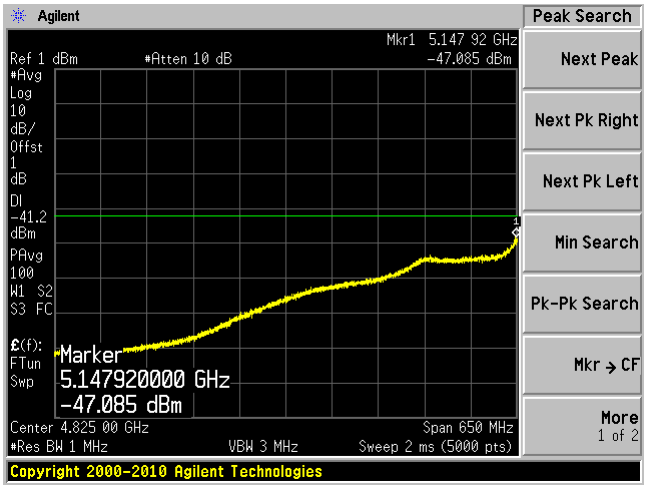
Restrict Band Measurement

802.11a, Low Channel, 5180 MHz

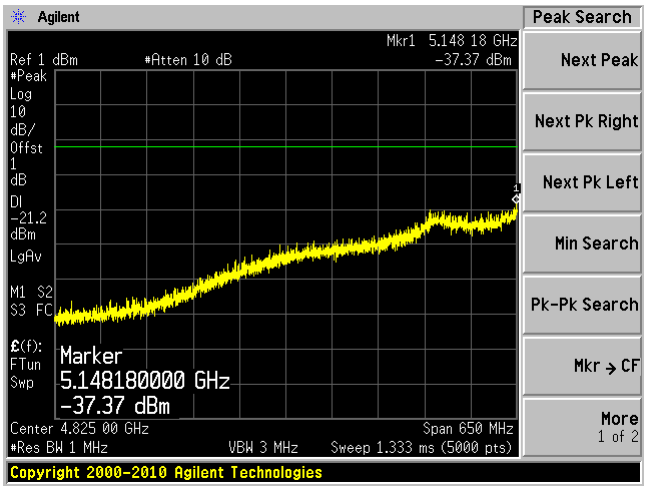
Chain 0 AVG



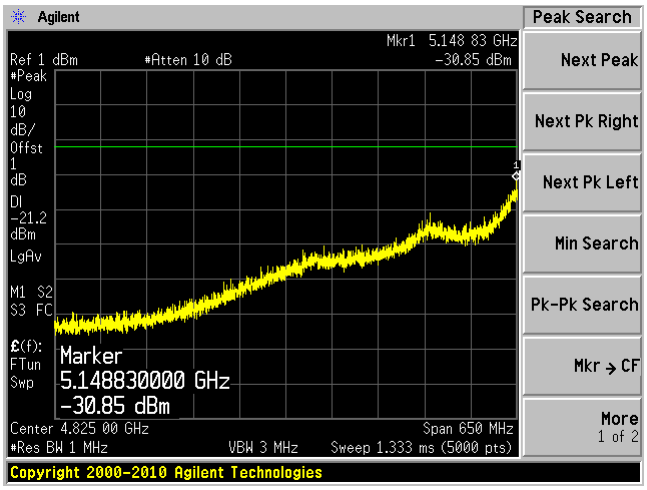
Chain 1 AVG



Chain 0 PEAK

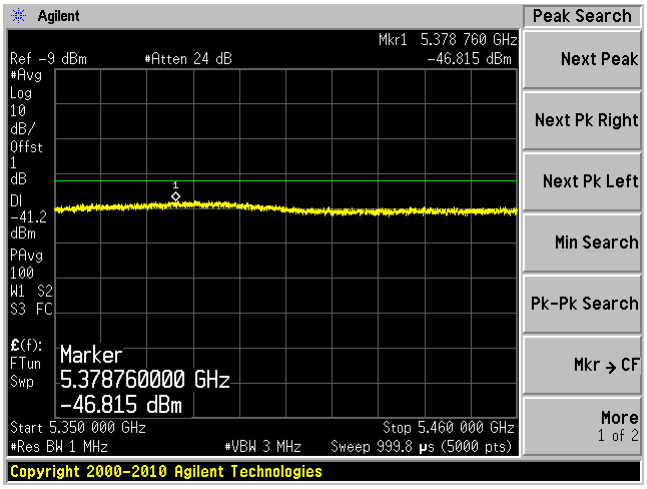


Chain 1 PEAK

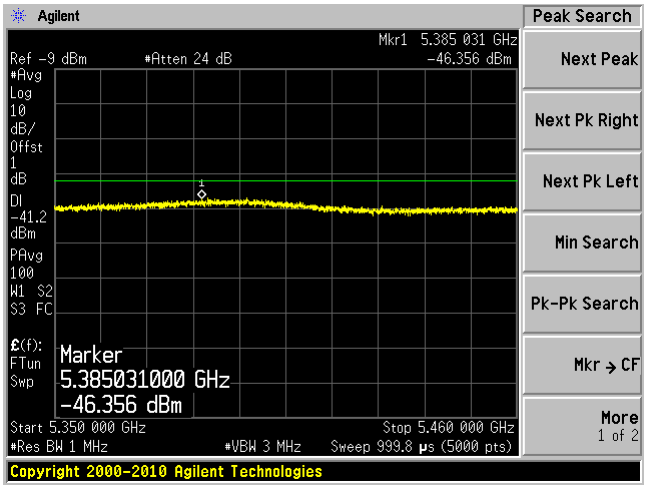


802.11a High Channel 5240 MHz

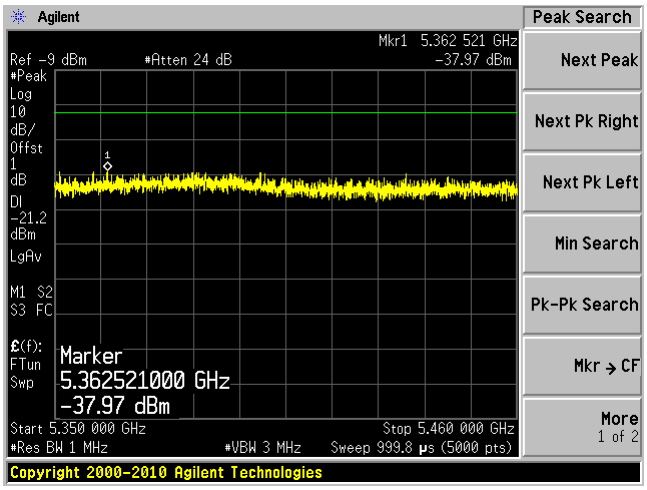
Chain 0 AVG



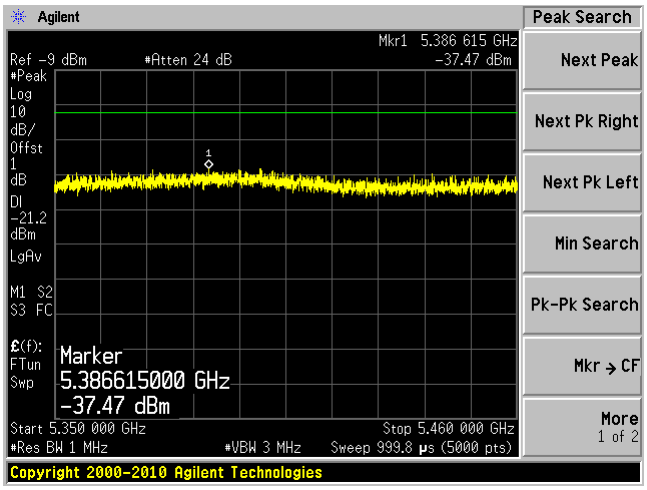
Chain 1 AVG



Chain 0 PEAK

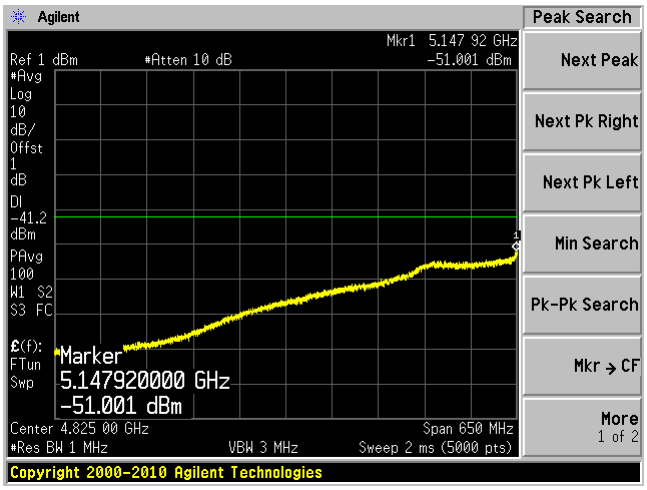


Chain 1 PEAK

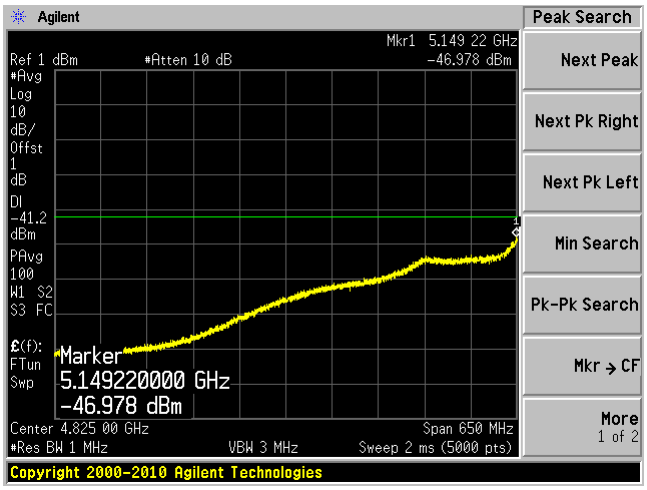


802.11n-HT20, Low Channel 5180 MHz

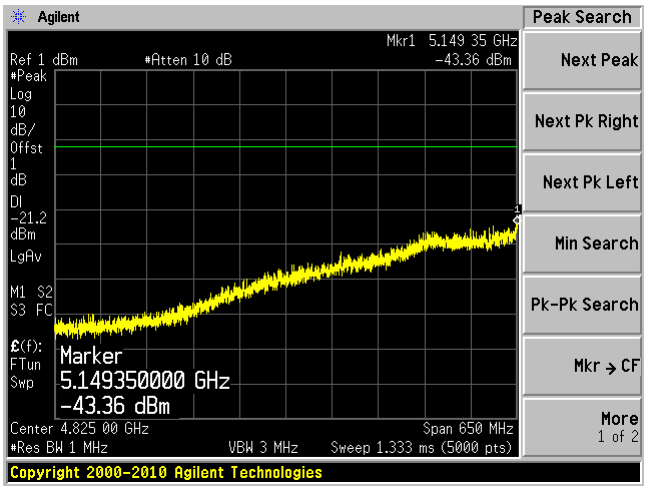
Chain 0 AVG



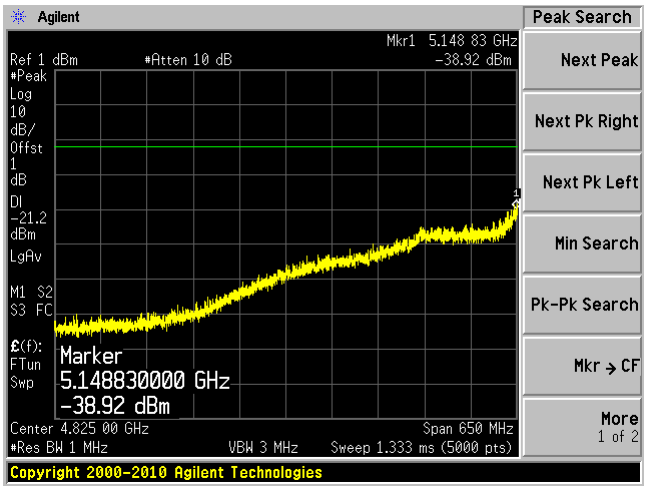
Chain 1 AVG



Chain 0 PEAK

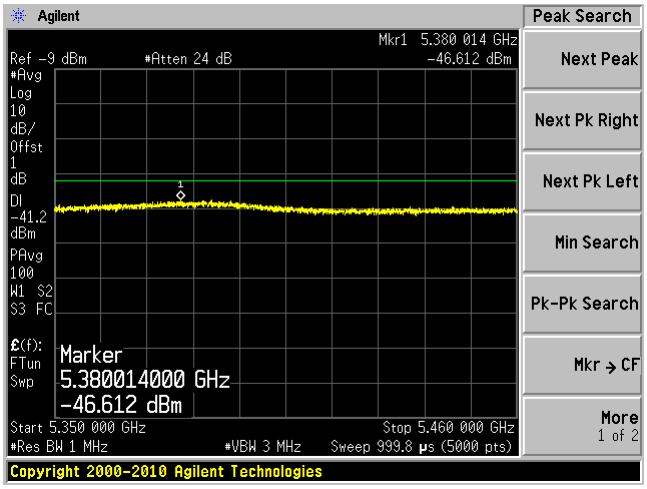


Chain 1 PEAK

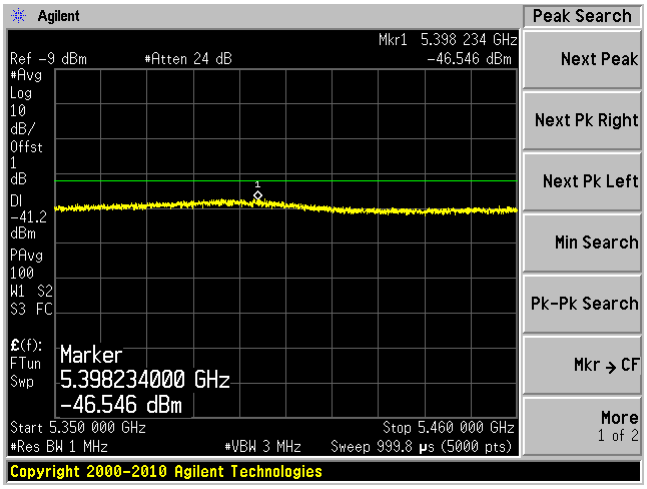


802.11n-HT20, High Channel 5240 MHz

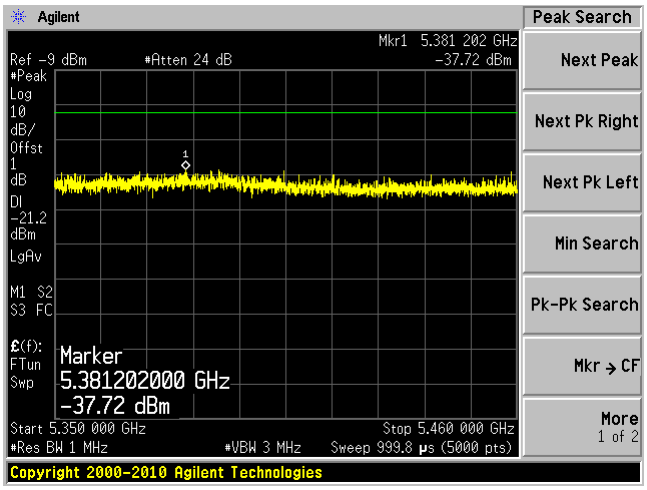
Chain 0 AVG



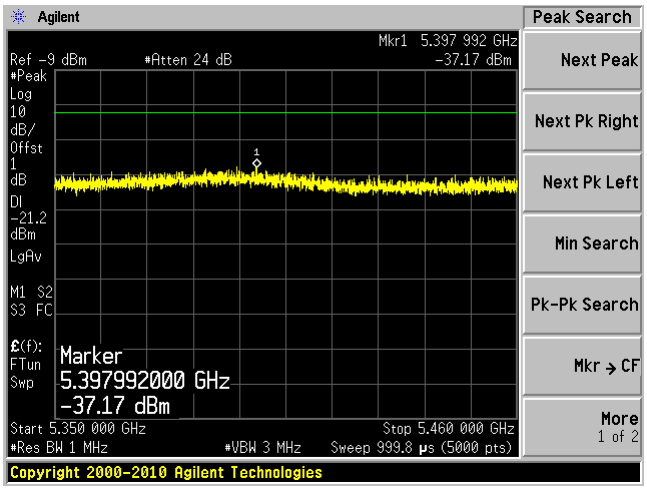
Chain 1 AVG



Chain 0 PEAK

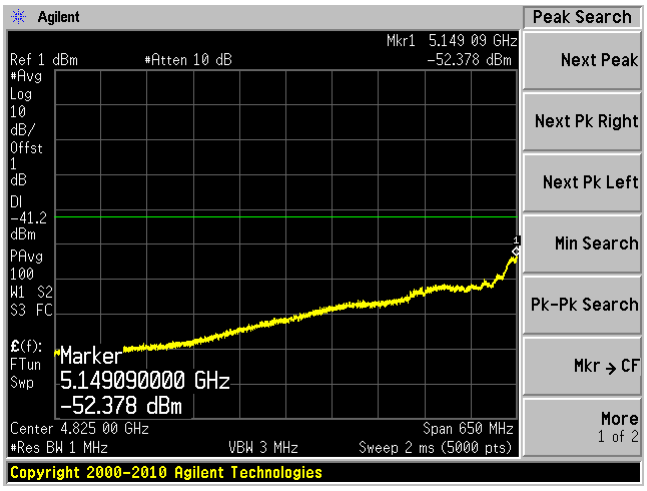


Chain 1 PEAK

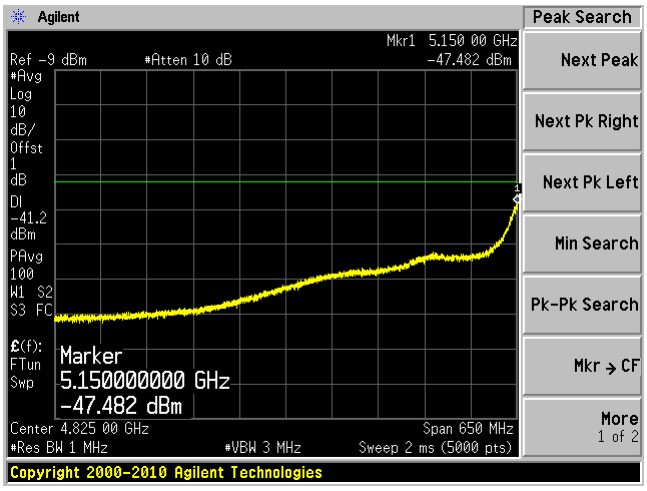


802.11n-HT40, Low Channel 5190 MHz

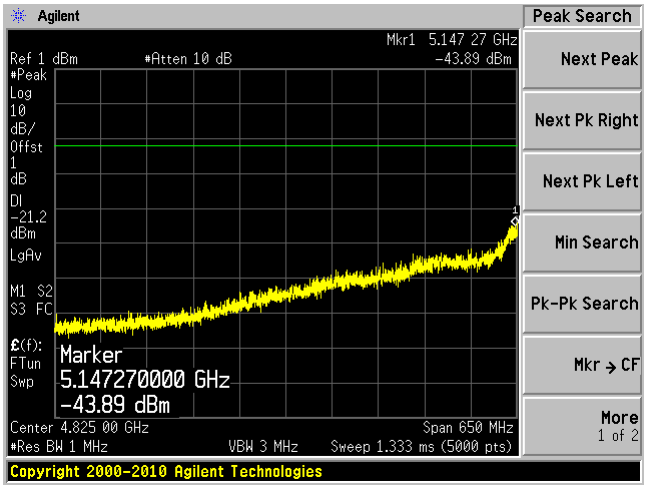
Chain 0 AVG



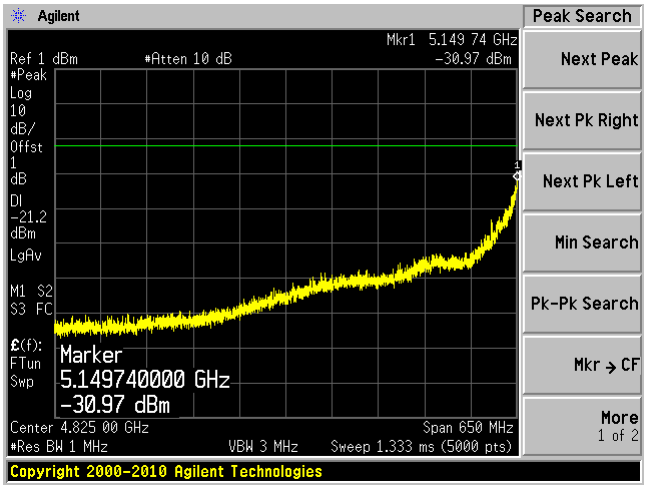
Chain 1 AVG



Chain 0 PEAK

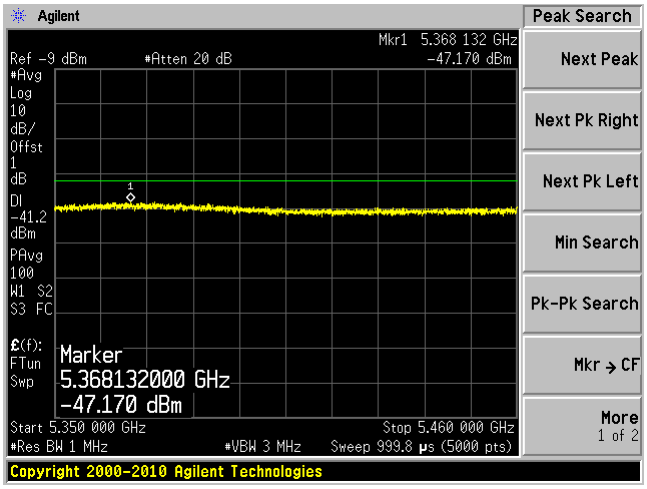


Chain 1 PEAK

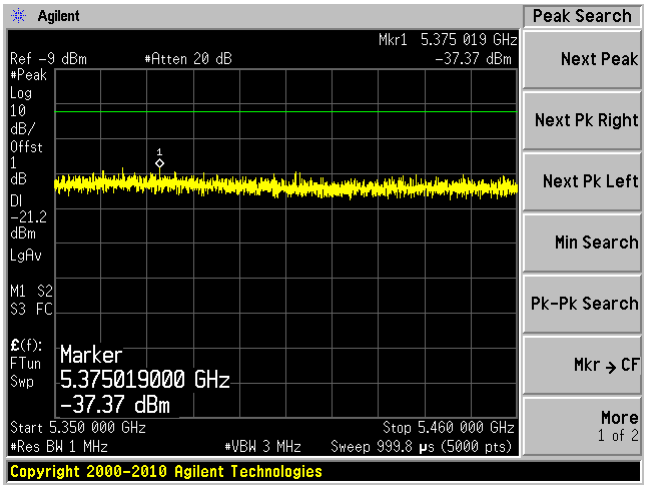


802.11n-HT40, High Channel 5230 MHz

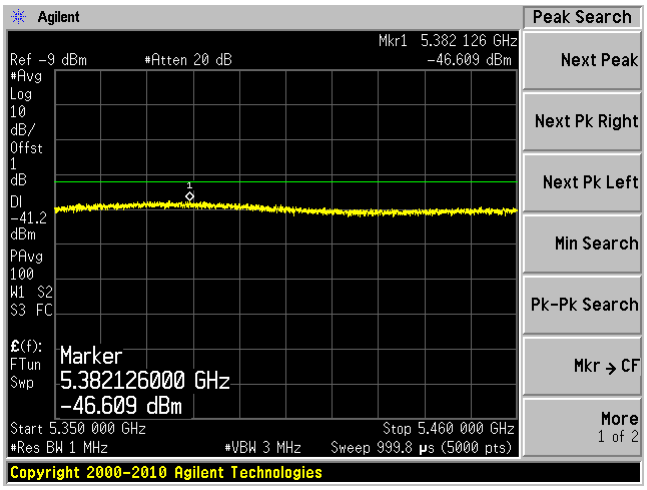
Chain 0 AVG



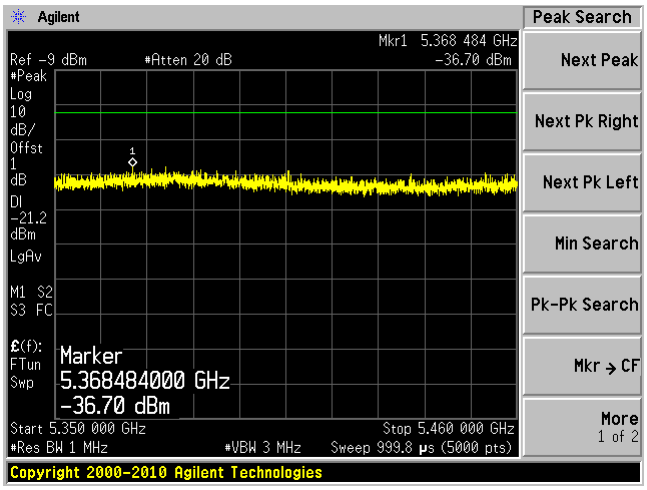
Chain 1 AVG



Chain 0 PEAK

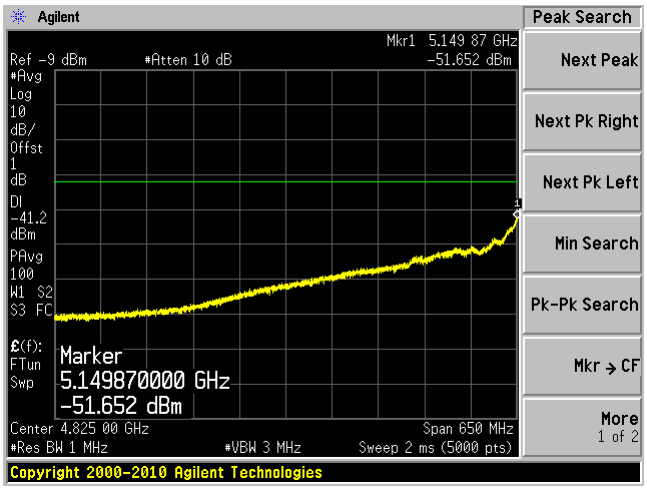


Chain 1 PEAK

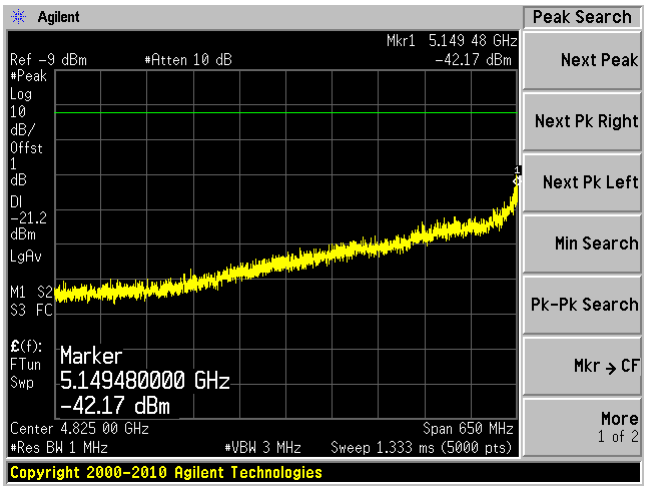


802.11ac-VHT80, 5210 MHz

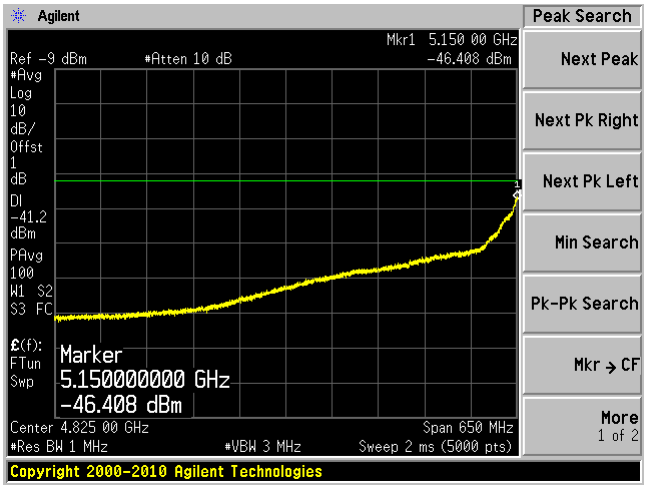
Chain 0 AVG



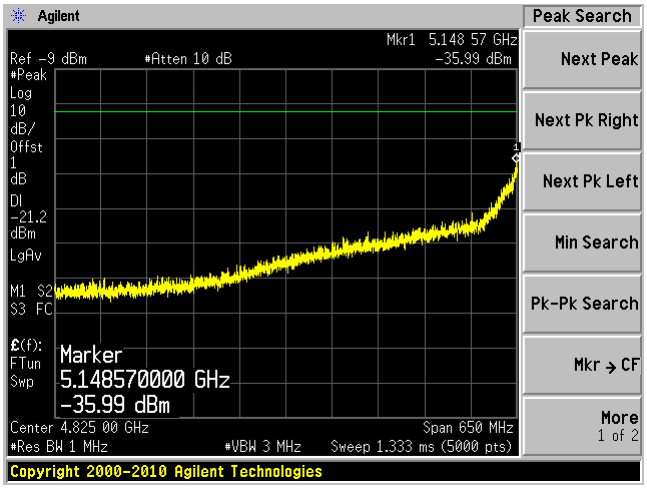
Chain 1 AVG



Chain 0 PEAK



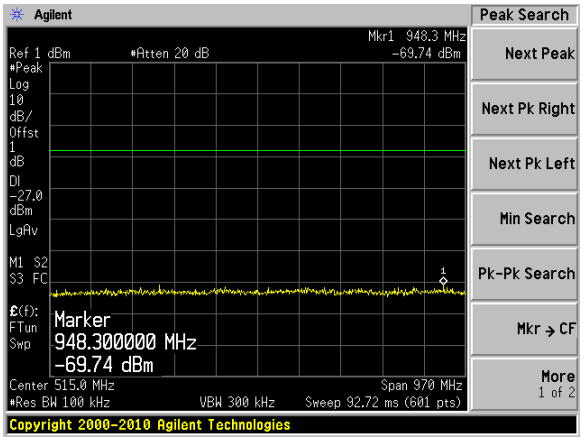
Chain 1 PEAK



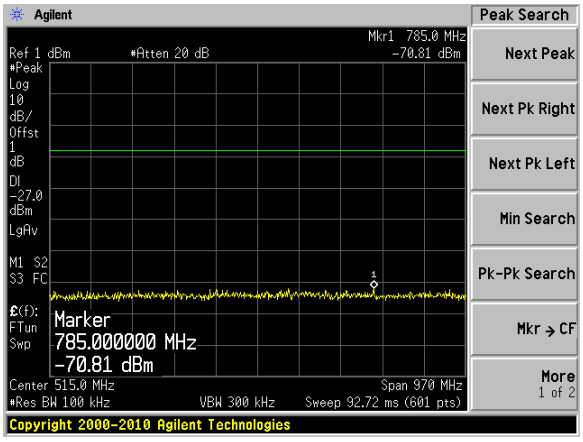
Conducted Spurious Emissions from 30 MHz-40 GHz:

802.11a, Low Channel, 5180 MHz

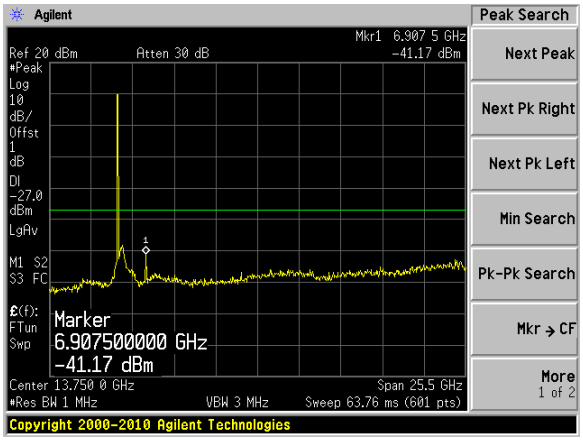
Chain 0, Plot: 30 MHz – 1 GHz



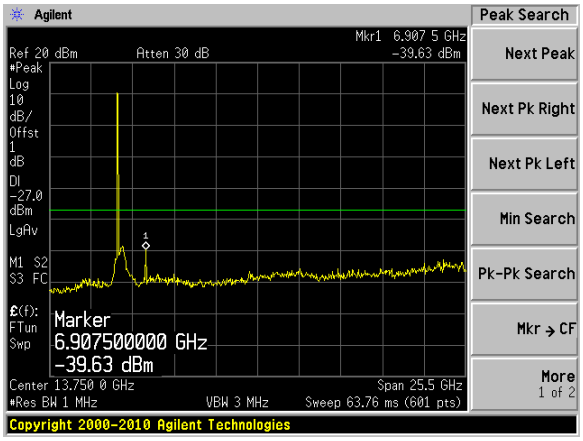
Chain 1, Plot: 30 MHz – 1 GHz



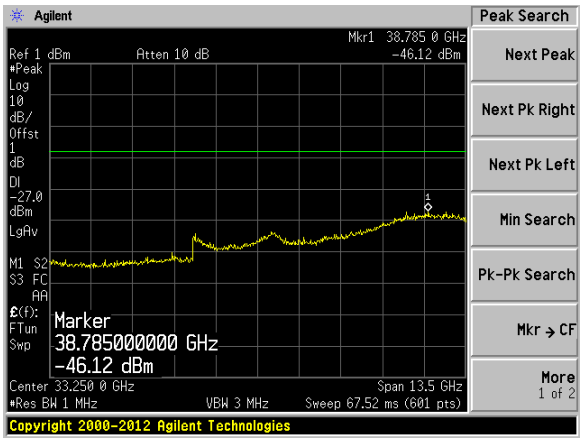
Chain 0, Plot: 1 GHz –26 GHz



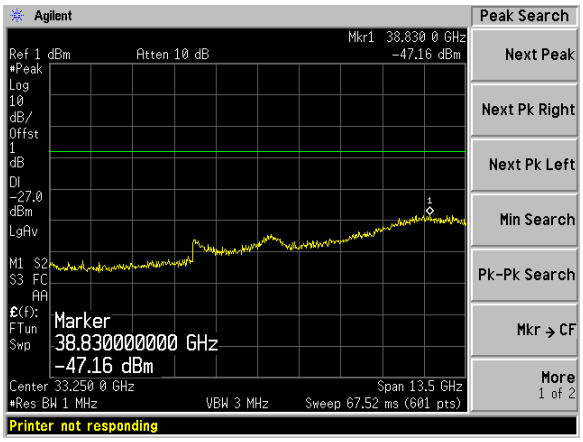
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

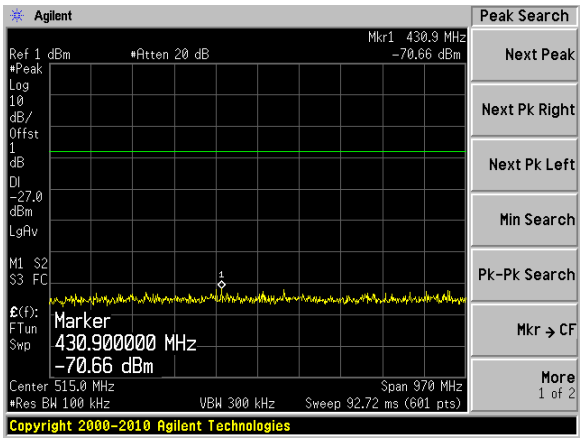


Chain 1, Plot: 26 GHz – 40 GHz

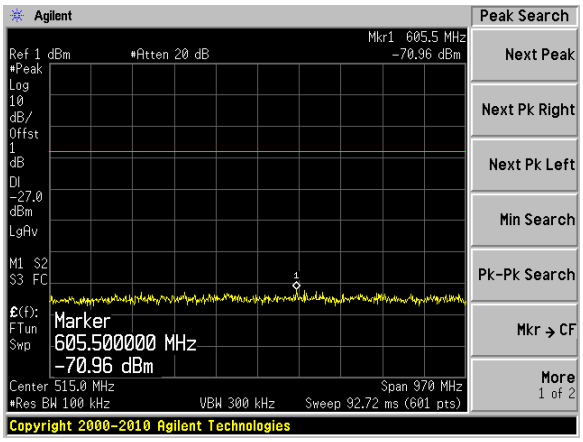


802.11a, Middle Channel, 5200 MHz

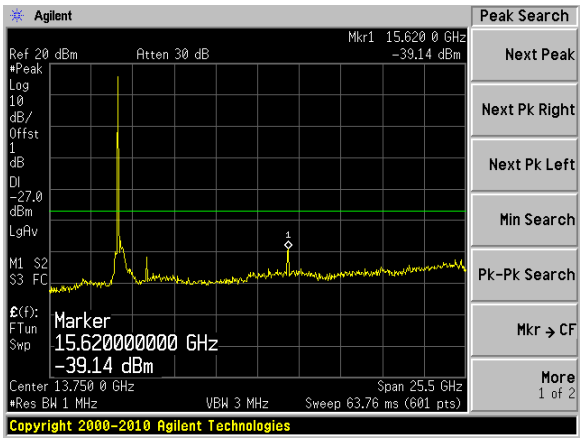
Chain 0, Plot: 30 MHz – 1 GHz



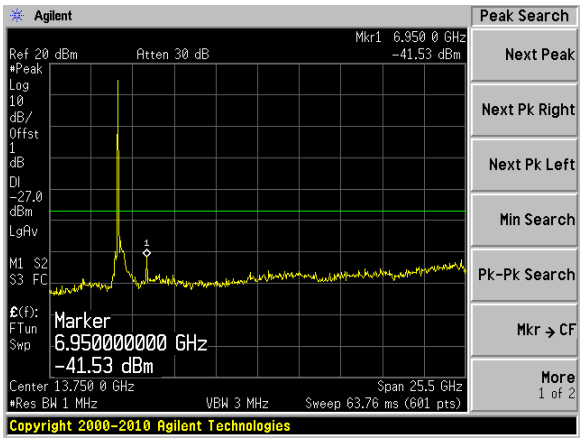
Chain 1, Plot: 30 MHz – 1 GHz



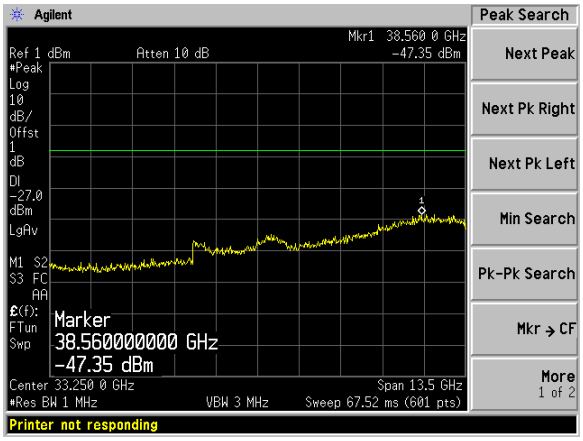
Chain 0, Plot: 1 GHz –26 GHz



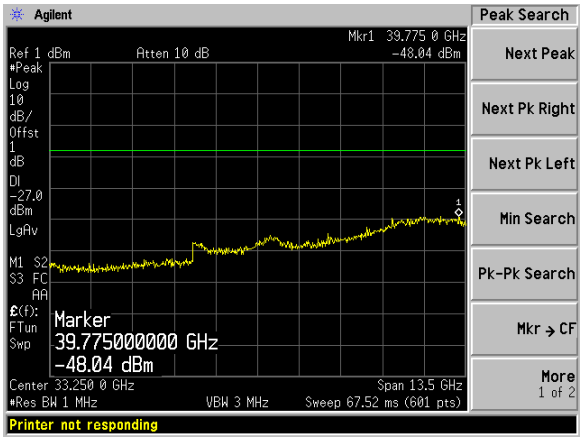
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

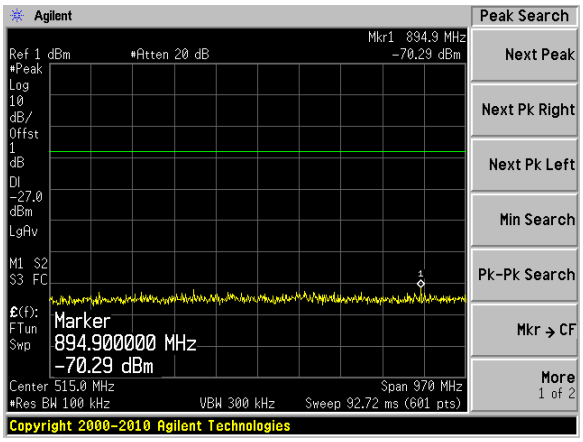


Chain 1, Plot: 26 GHz – 40 GHz

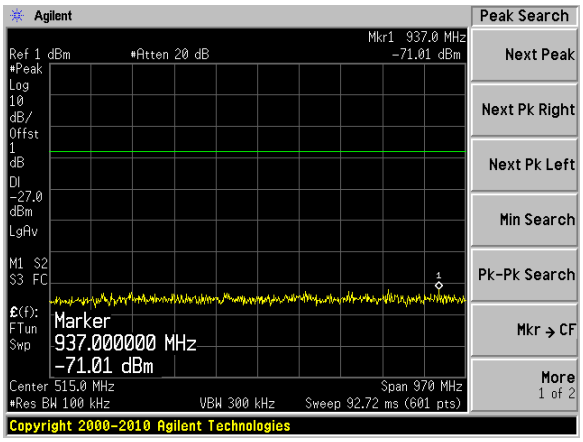


802.11a, High Channel, 5240 MHz

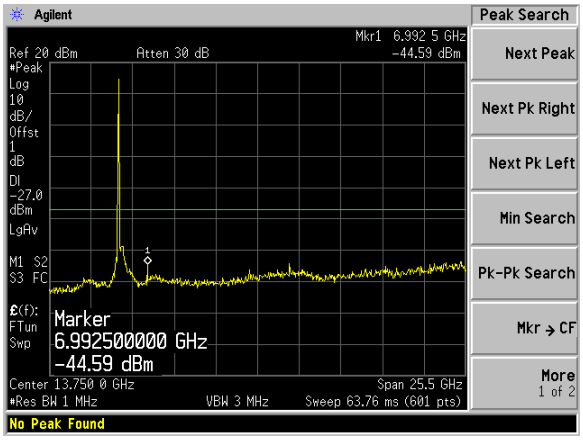
Chain 0, Plot: 30 MHz – 1 GHz



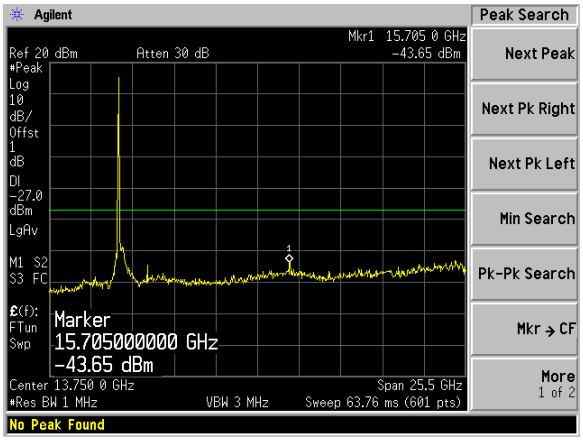
Chain 1, Plot: 30 MHz – 1 GHz



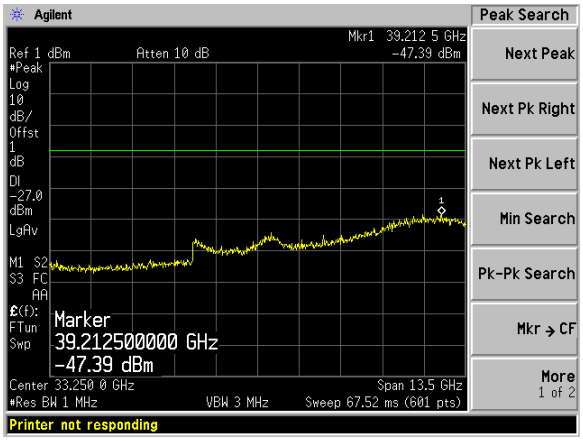
Chain 0, Plot: 1 GHz –26 GHz



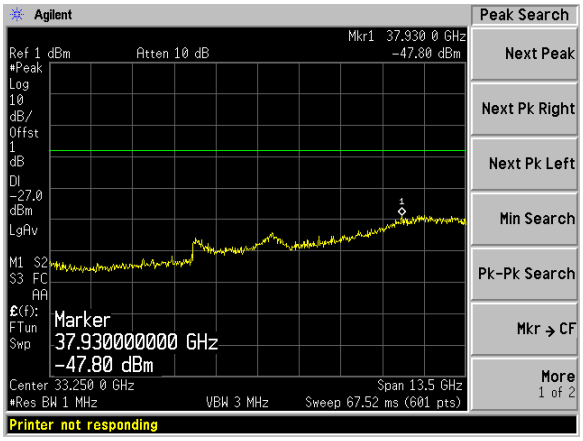
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

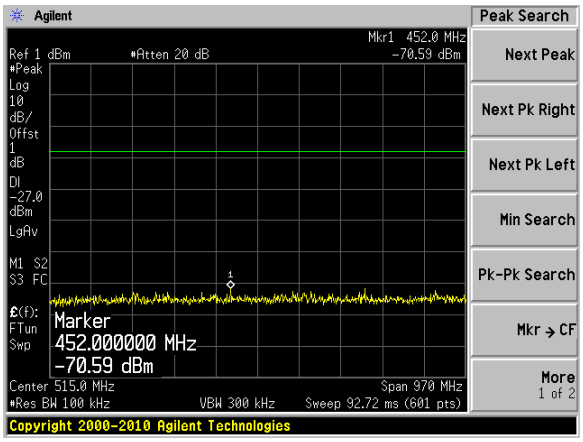


Chain 1, Plot: 26 GHz – 40 GHz

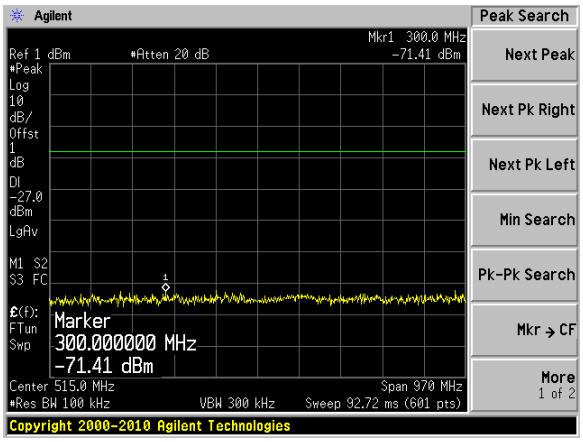


802.11n-HT20, Low Channel 5180 MHz

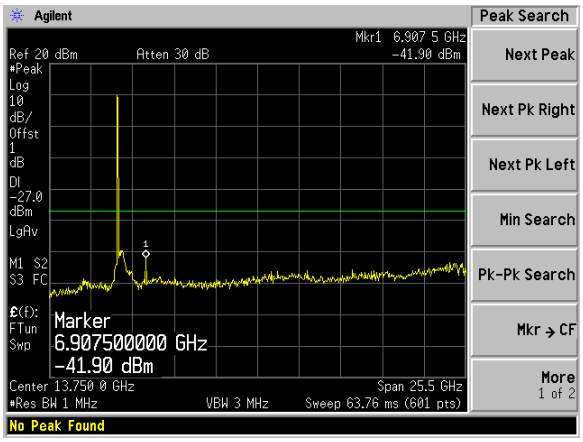
Chain 0, Plot: 30 MHz – 1 GHz



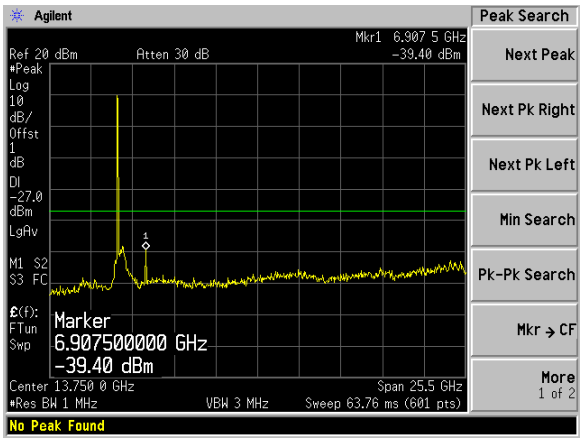
Chain 1, Plot: 30 MHz – 1 GHz



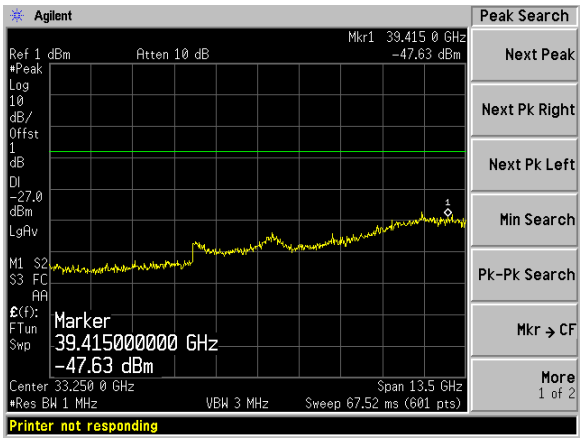
Chain 0, Plot: 1 GHz –26 GHz



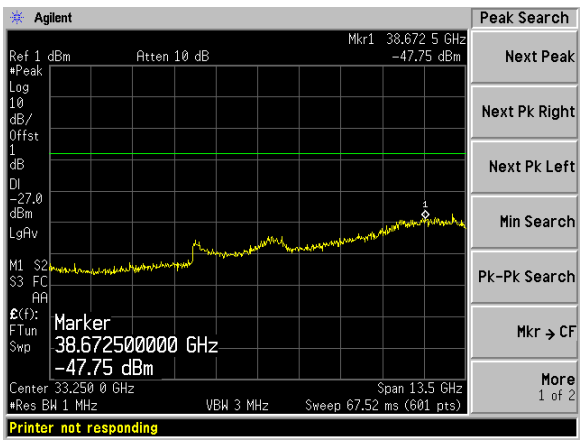
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

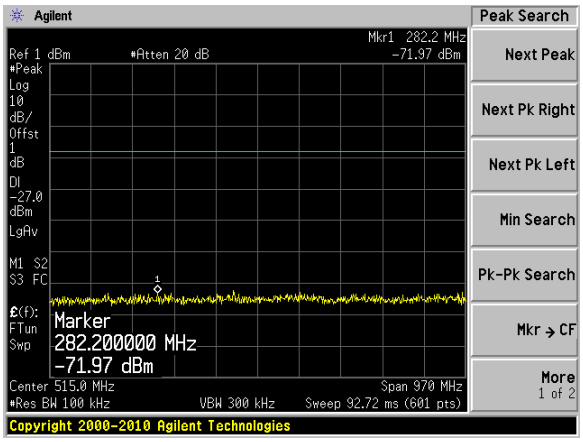


Chain 1, Plot: 26 GHz – 40 GHz

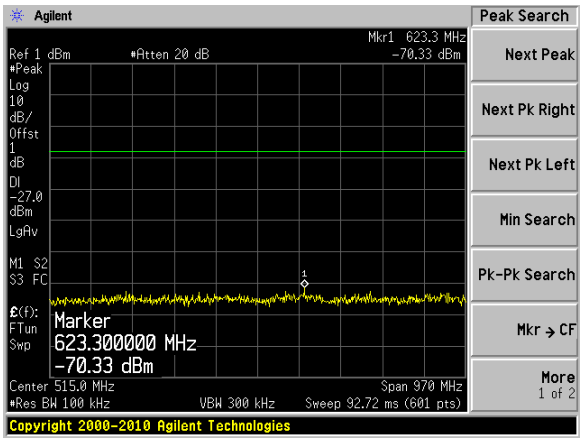


802.11n-HT20, Middle Channel 5200 MHz

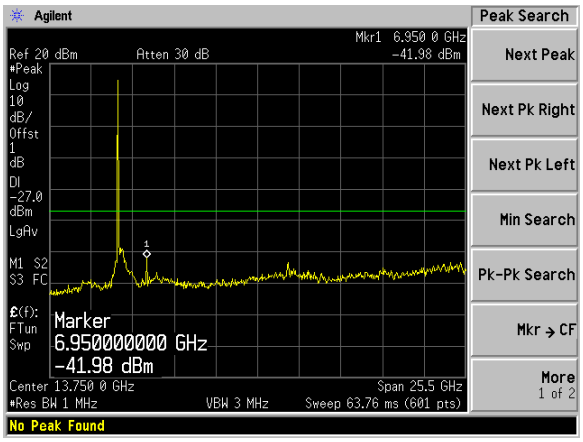
Chain 0, Plot: 30 MHz – 1 GHz



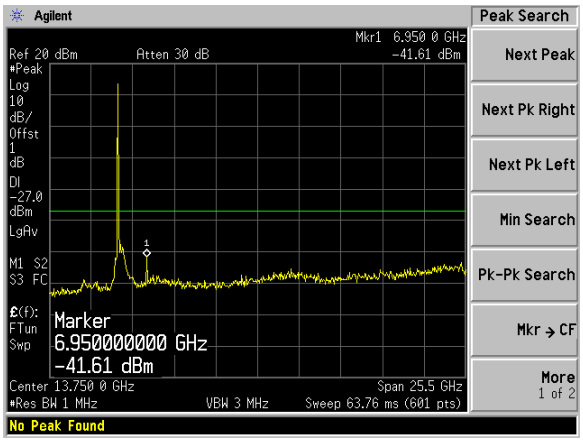
Chain 1, Plot: 30 MHz – 1 GHz



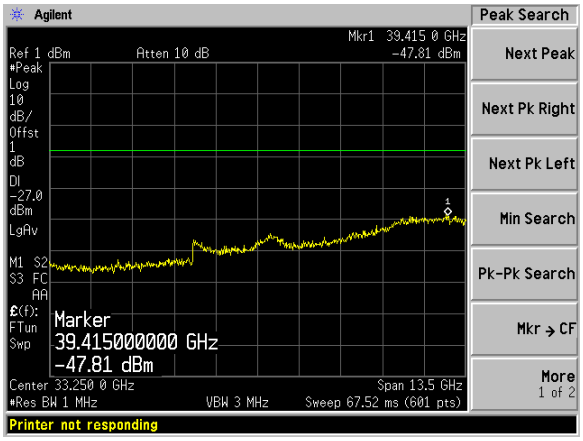
Chain 0, Plot: 1 GHz –26 GHz



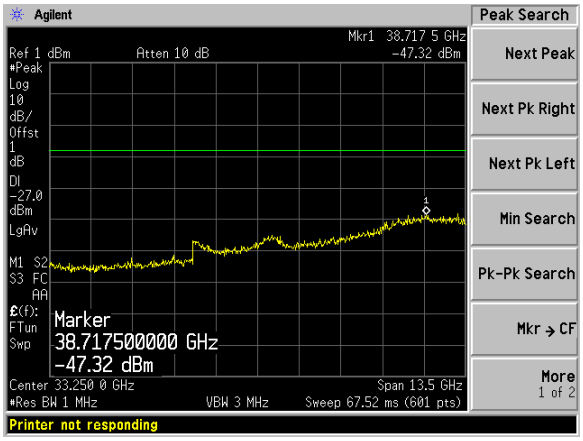
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

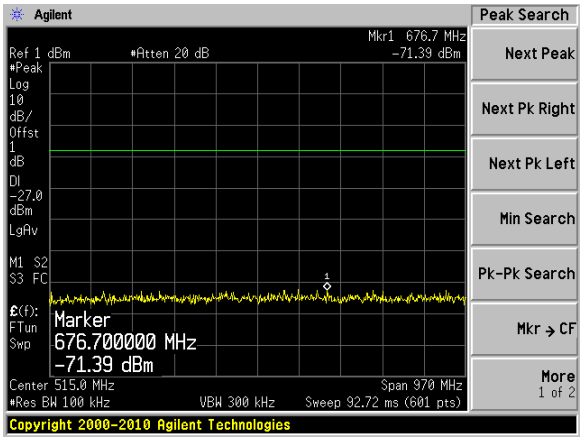


Chain 1, Plot: 26 GHz – 40 GHz

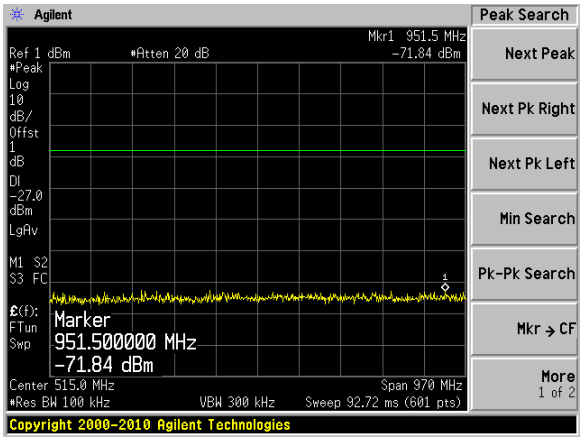


802.11n-HT20, High Channel 5240 MHz

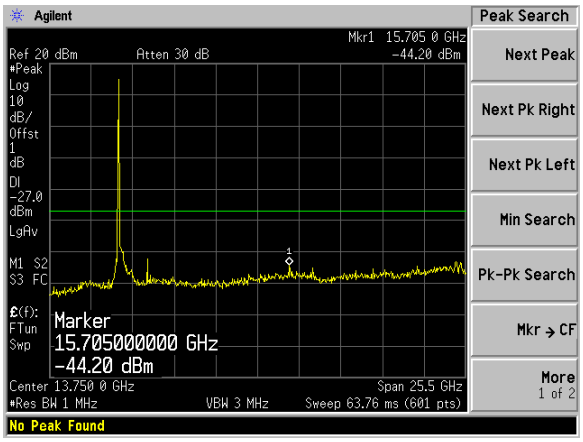
Chain 0, Plot: 30 MHz – 1 GHz



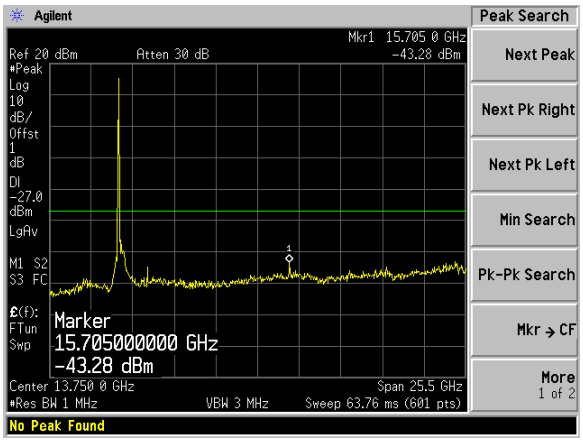
Chain 1, Plot: 30 MHz – 1 GHz



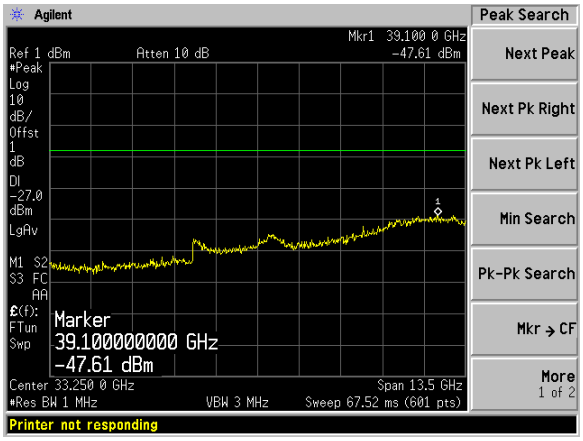
Chain 0, Plot: 1 GHz –26 GHz



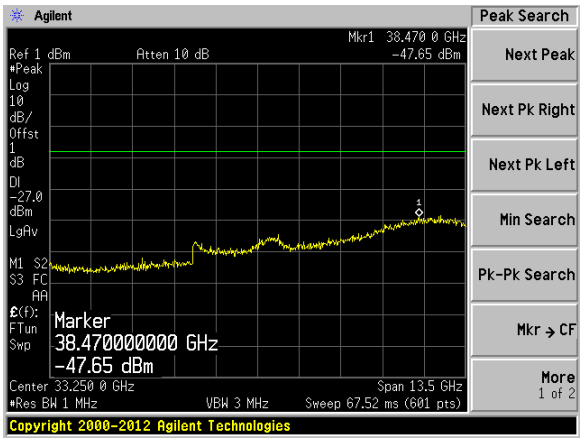
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

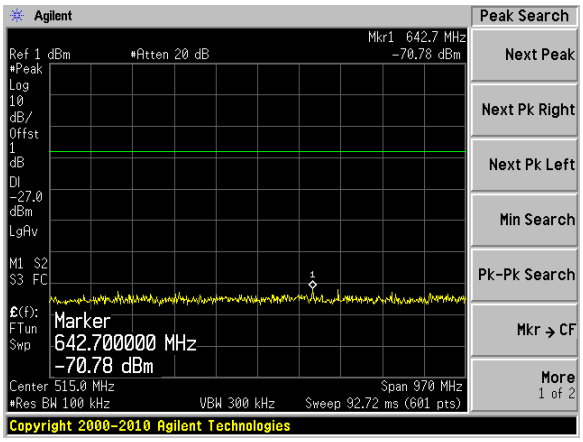


Chain 1, Plot: 26 GHz – 40 GHz

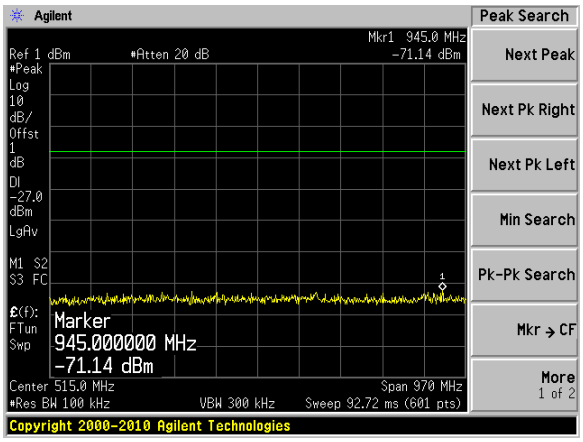


802.11n-HT40, Low Channel 5190 MHz

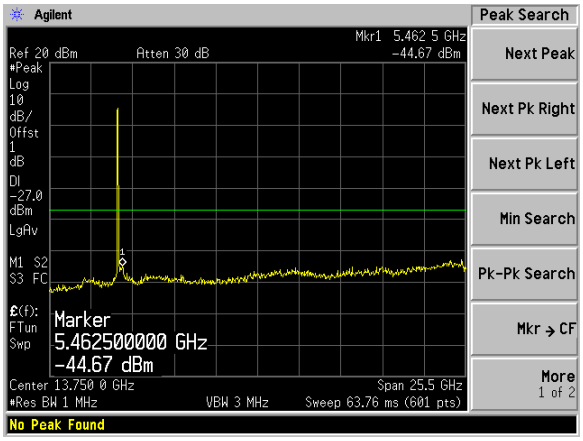
Chain 0, Plot: 30 MHz – 1 GHz



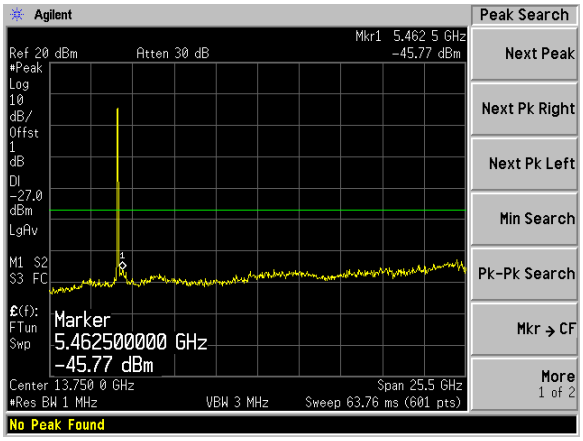
Chain 1, Plot: 30 MHz – 1 GHz



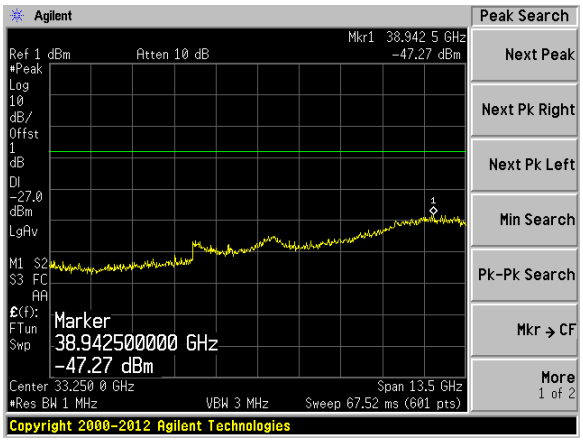
Chain 0, Plot: 1 GHz –26 GHz



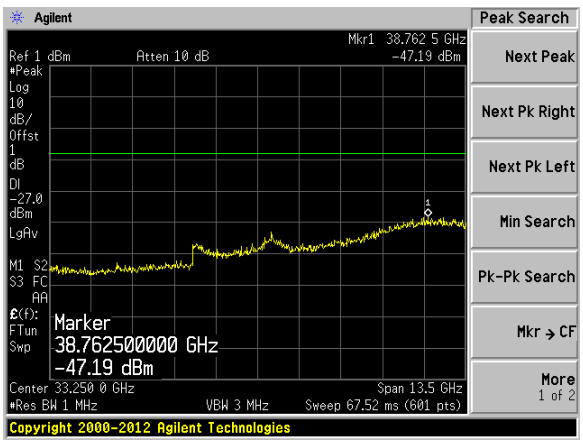
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

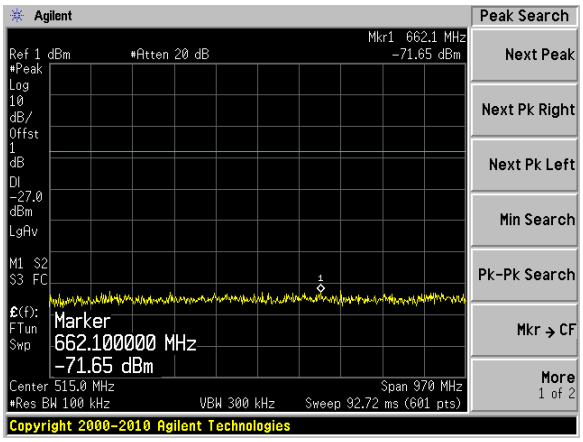


Chain 1, Plot: 26 GHz – 40 GHz

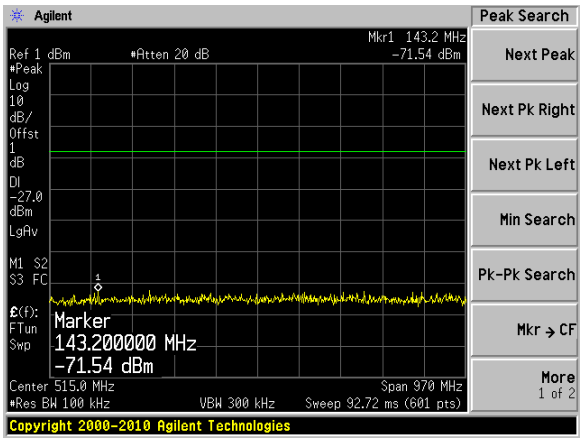


802.11n-HT40, High Channel 5230 MHz

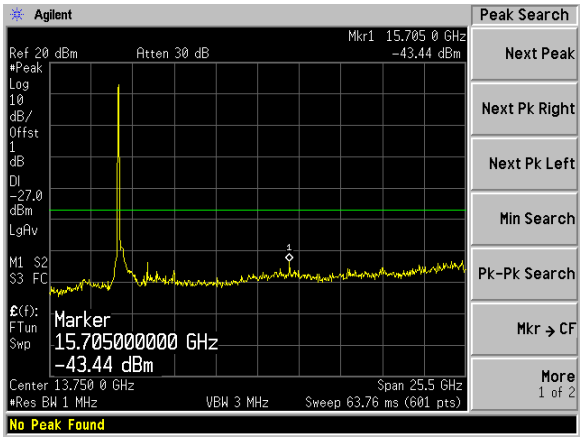
Chain 0, Plot: 30 MHz – 1 GHz



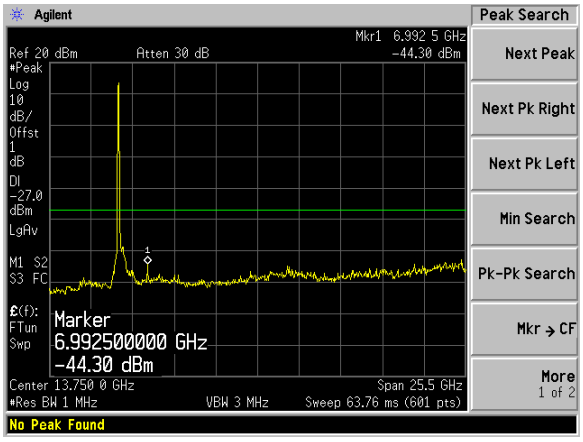
Chain 1, Plot: 30 MHz – 1 GHz



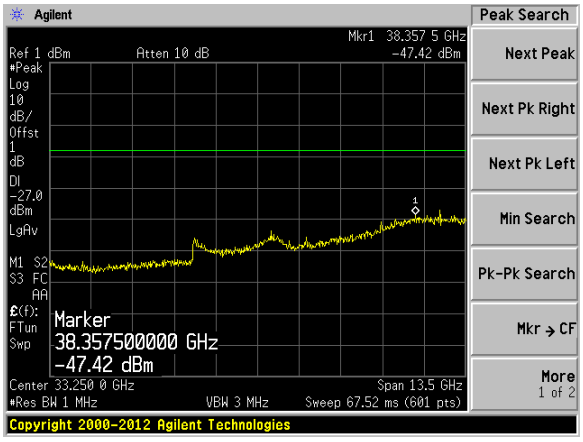
Chain 0, Plot: 1 GHz –26 GHz



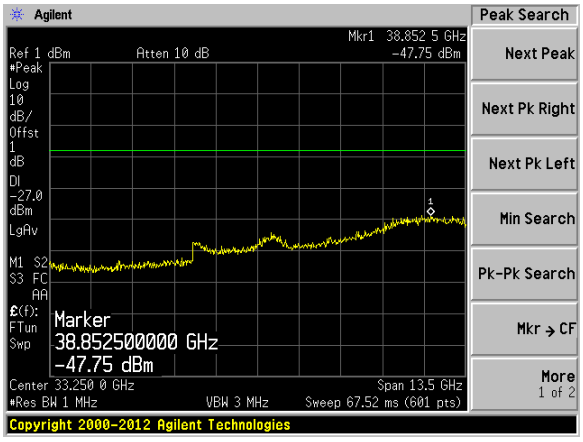
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz

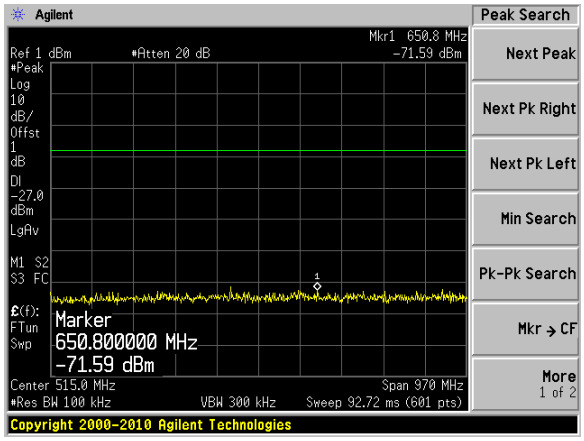


Chain 1, Plot: 26 GHz – 40 GHz

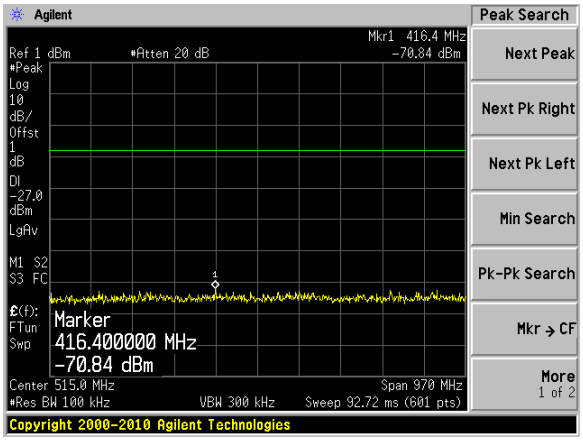


802.11ac-VHT80, 5210 MHz

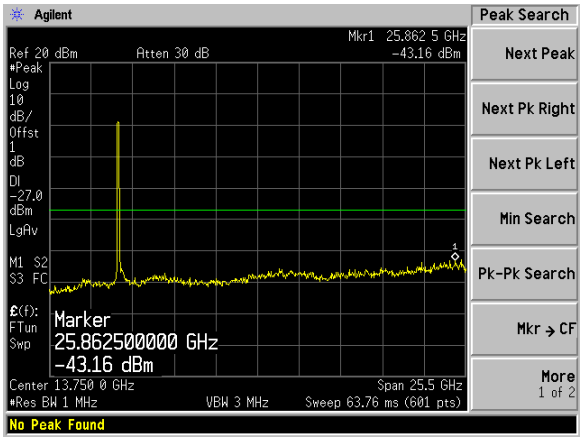
Chain 0, Plot: 30 MHz – 1 GHz



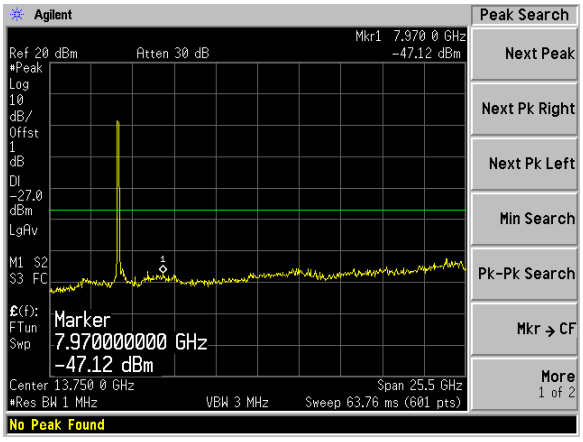
Chain 1, Plot: 30 MHz – 1 GHz



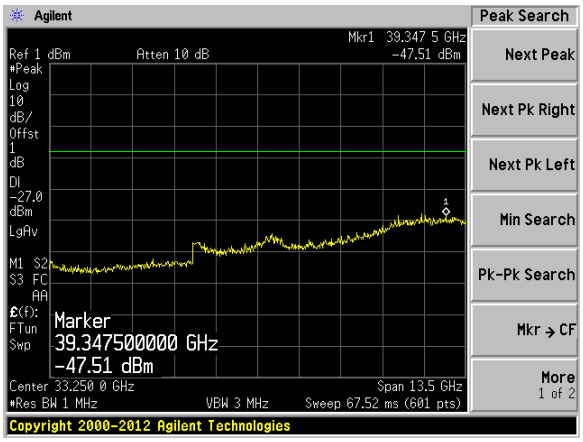
Chain 0, Plot: 1 GHz –26 GHz



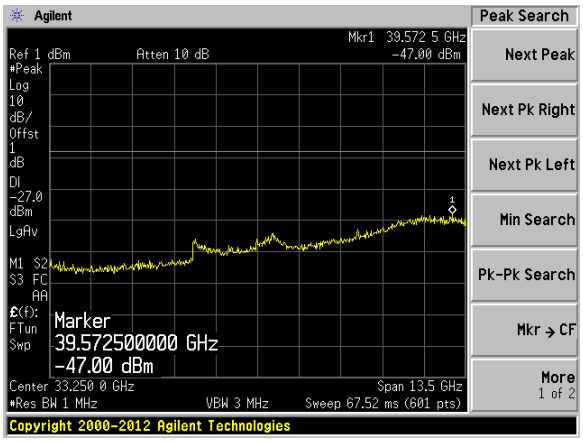
Chain 1, Plot: 1 GHz – 26 GHz



Chain 0, Plot: 26 GHz –40 GHz



Chain 1, Plot: 26 GHz – 40 GHz



12 FCC §15.407(a) - Power Spectral Density

12.1 Applicable Standards

According to FCC §15.407(a)

(i) For an outdoor 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) 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..

12.2 Measurement Procedure

For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ⩾ 1/T, where T is defined in section II.B.l.a).

b) Set VBW ⩾ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10log(1MHz/RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	US44300386	2013-09-29	1 year

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

12.4 Test Environmental Conditions

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

The testing was performed by Rui Zhou on 2014-07-18 to 2014-07-22 at RF site.

12.5 Test Results

802.11a mode

Channel	Frequency (MHz)	PSD (dBm/MHz) Chain 0	PSD (dBm/MHz) Chain 1	Total PSD (dBm/MHz)	Limit (dBm/MHz)
Low	5180	2.829	2.86	5.85	15
Middle	5200	7.993	7.894	10.95	15
High	5240	8.497	8.322	11.42	15

802.11n-HT20 mode

Channel	Frequency (MHz)	PSD (dBm/MHz) Chain 0	PSD (dBm/MHz) Chain 1	Total PSD (dBm/MHz)	Limit (dBm/MHz)
Low	5180	2.427	2.489	5.47	15
Middle	5200	7.63	7.651	10.65	15
High	5240	8.078	7.923	11.01	15

802.11n-HT40 mode

Channel	Frequency (MHz)	PSD (dBm/MHz) Chain 0	PSD (dBm/MHz) Chain 1	Total PSD (dBm/MHz)	Limit (dBm/MHz)
Low	5190	-2.272	-2.417	0.67	15
High	5230	5.214	5.343	8.29	15

802.11ac-VHT80 mode

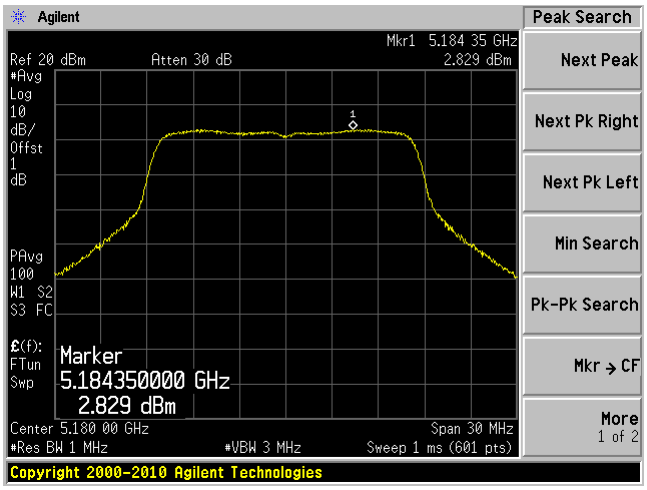
Channel	Frequency (MHz)	PSD (dBm/MHz) Chain 0	PSD (dBm/MHz) Chain 1	Total PSD (dBm/MHz)	Limit (dBm/MHz)
-	5210	-6.425	-6.65	-3.53	15

Note: The antenna gain is 8 dBi which is ove 2 dB of 6 dBi. The PSD limit shall be reduced to 17-2=15 dBm.

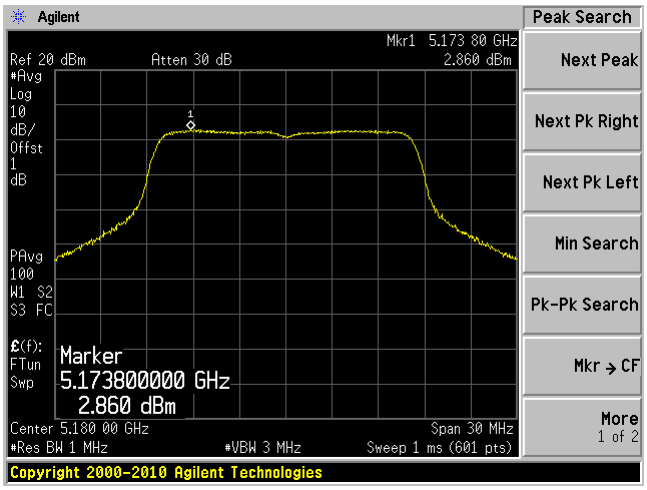
Please refer to the following plots.

802.11a, Low Channel, 5180 MHz

Chain 0

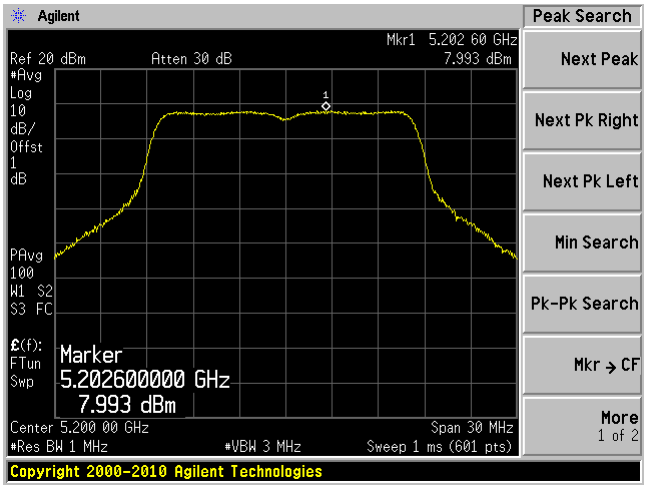


Chain 1

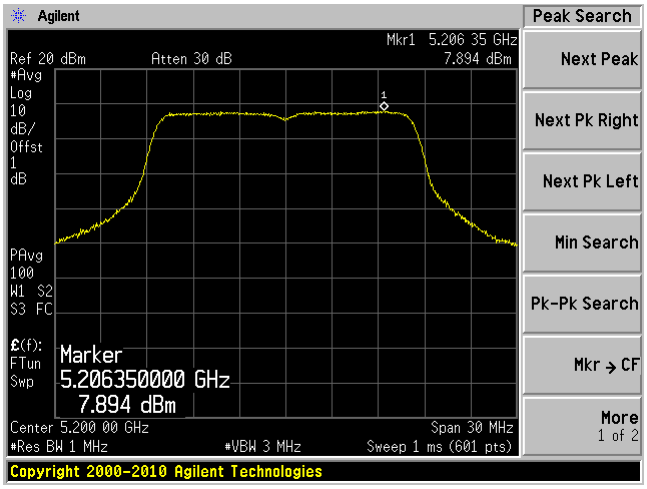


802.11a, Middle Channel, 5200 MHz

Chain 0

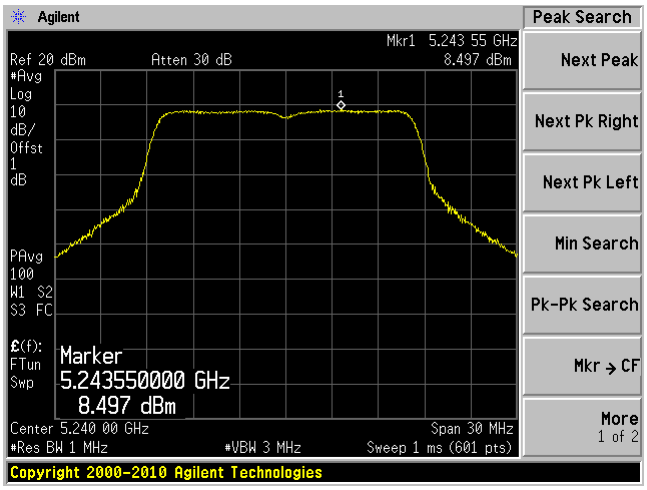


Chain 1

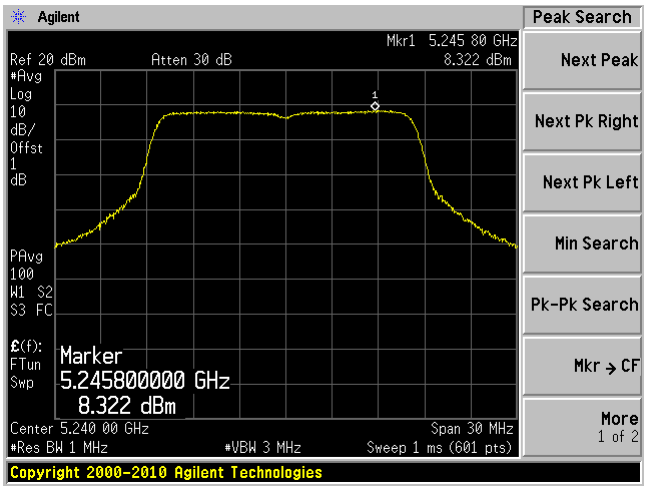


802.11a, High Channel, 5240 MHz

Chain 0

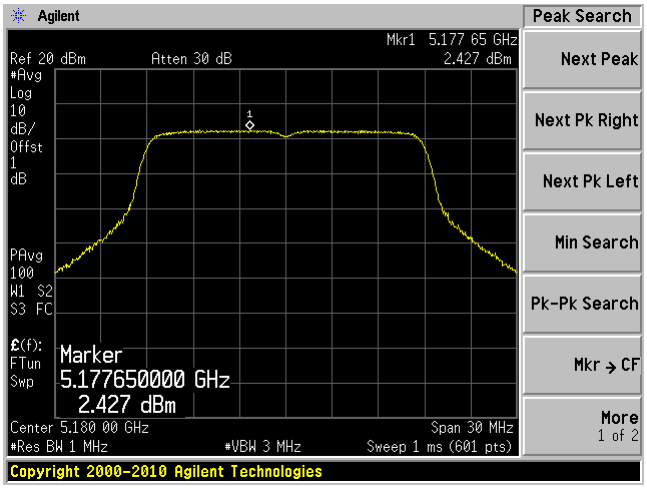


Chain 1

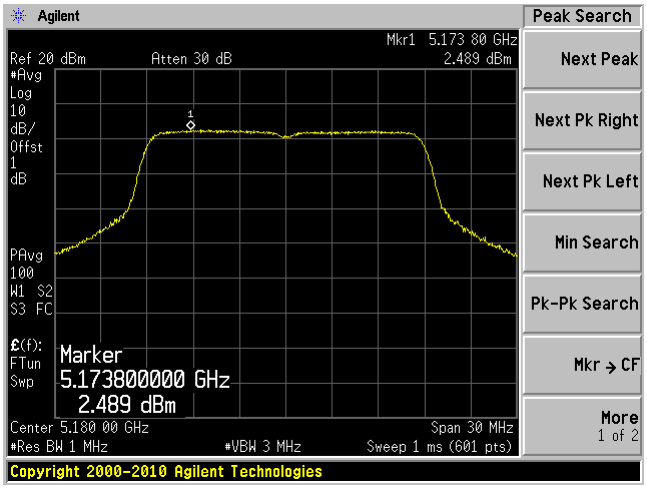


802.11n-HT 20, Low Channel 5180 MHz

Chain 0

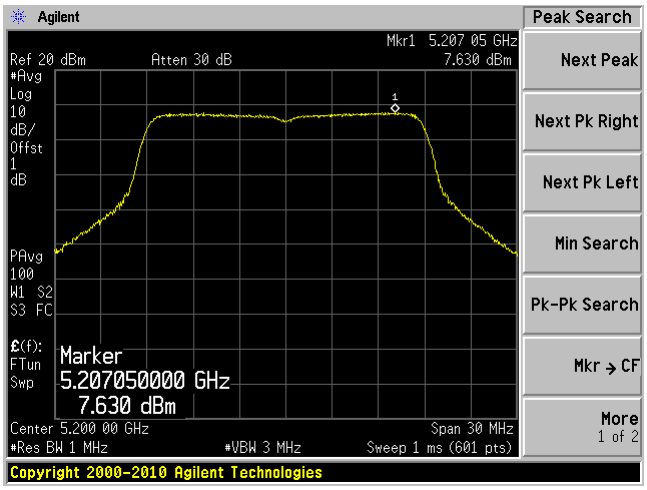


Chain 1

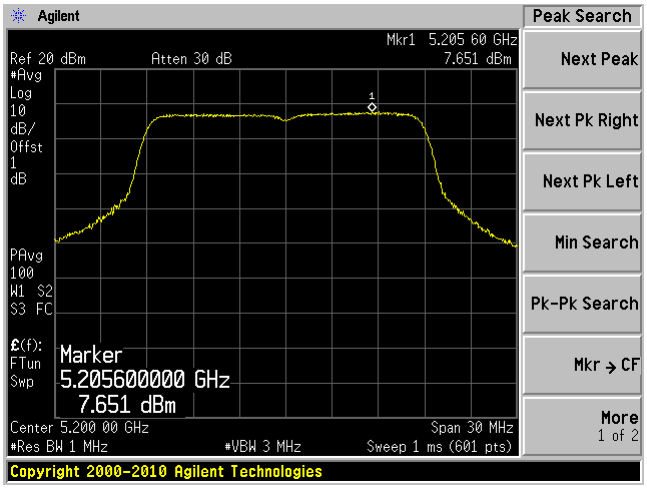


802.11n-HT20, Middle Channel 5200 MHz

Chain 0

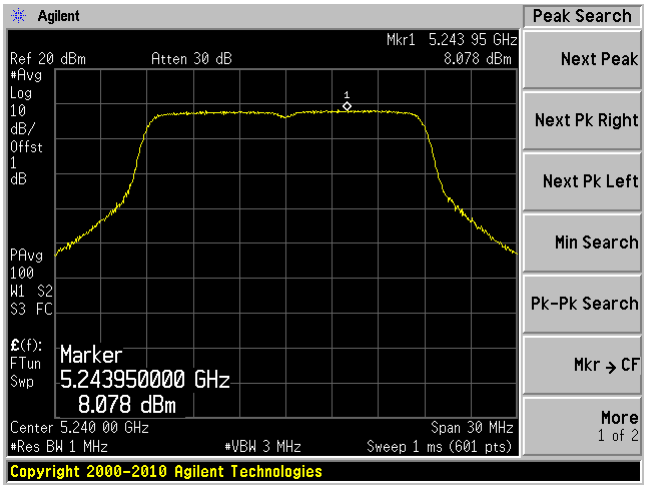


Chain 1

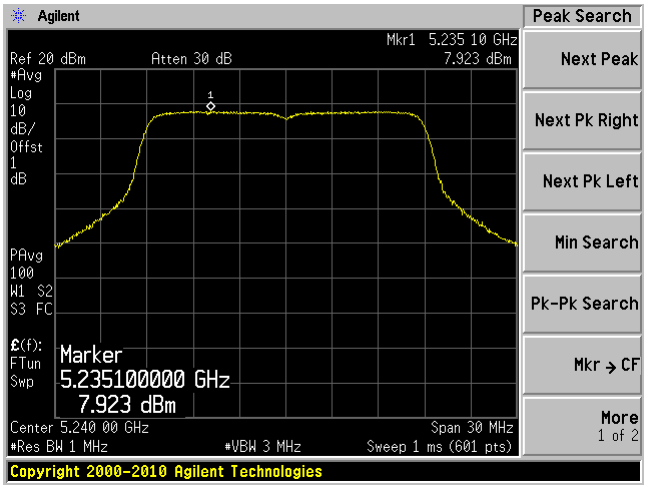


802.11n-HT20, High Channel, 5240 MHz

Chain 0

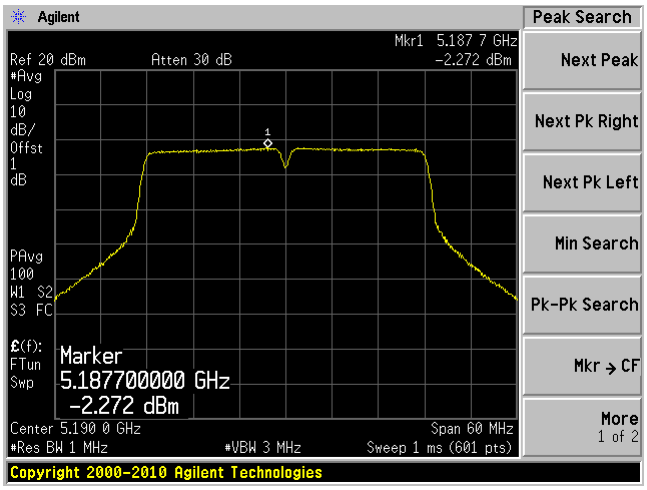


Chain 1

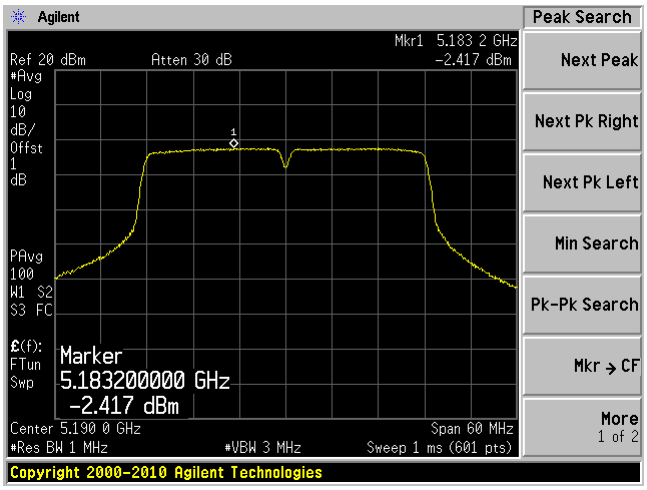


802.11n-HT40, Low Channel 5190 MHz

Chain 0

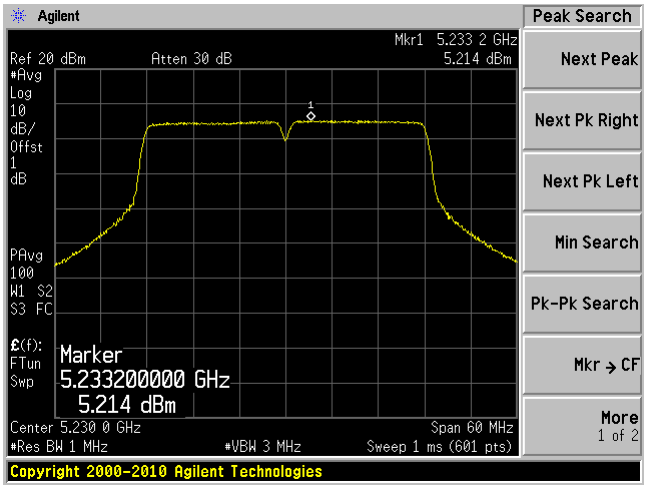


Chain 1

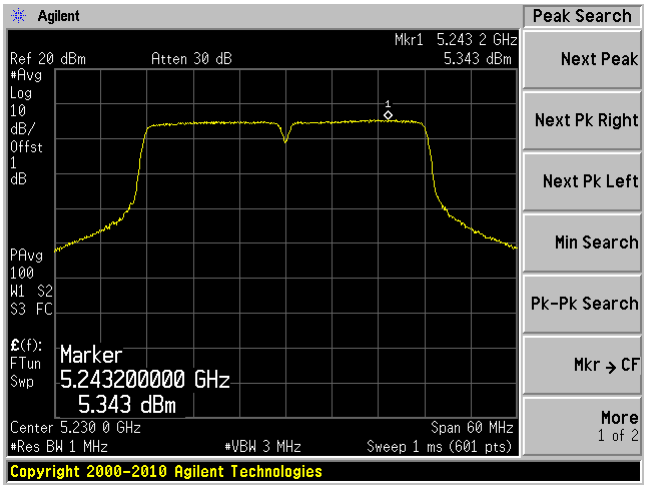


802.11n-HT40, High Channel 5230 MHz

Chain 0

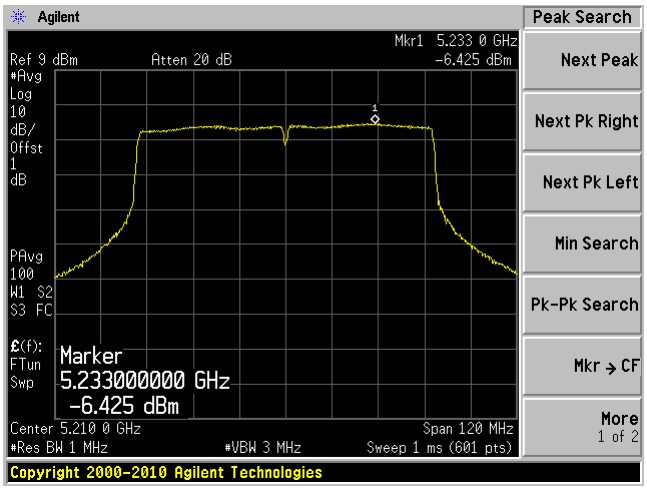
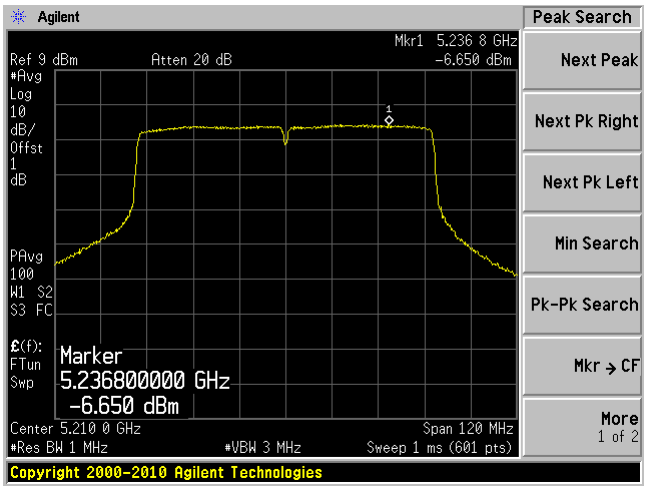


Chain 1



802.11ac-VHT80, High Channel 5210 MHz

Chain 0



Chain 1