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: Original Report	**Product Type:** 802.11a/b/g/n/ac Module
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1407152-407 W58	Original Report	2014-08-08
1	R1407152-407W58 Rev A	Revised Report with updated model number	2014-08-21
2	R1407152-407W58 Rev B	Updated MPE	2014-08-28
3	R1407152-407W58 Rev C	Updated IC	2014-09-02

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 Module.

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.
Note: The EUT was tested without enclosure.

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

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)

N/A.

1.5 Test Methodology

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

1.6 Measurement Uncertainty

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

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

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

1.7 Test Facility

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

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

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

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

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

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

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

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

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

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009 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 *T300 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
FCC§2.1091, §15.407(f)	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207	AC Power Line Conducted Emissions	Compliant
FCC §15.209(a), 15.407(b)	Spurious Radiated Emissions	Compliant
FCC §15.407(a)	Emission Bandwidth	Compliant
FCC §407(a)	Maximun Output Power Measurement	Compliant
FCC §2.1051, §15.407(b)	Band Edges	Compliant
FCC §15.407(a)	Power Spectral Density	Compliant
FCC §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

5725-5850 MHz

Maximum peak output power at antenna input terminal (dBm):	24.9
Maximum peak output power at antenna input terminal (mW):	309.03
Prediction distance (cm):	20
Prediction frequency (MHz):	5785
Maximum Antenna Gain, typical (dBi):	8
Maximum Antenna Gain (numeric):	6.31
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.3813
Power density of prediction frequency at 20.0 cm (W/m^2):	3.813
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

2400-2483.5 MHz

Maximum peak output power at antenna input terminal (dBm):	24.58
Maximum peak output power at antenna input terminal (mW):	287.08
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	6
Maximum Antenna Gain (numeric):	3.9811
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.2275
Power density of prediction frequency at 20.0 cm (W/m^2):	2.275
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	10

According to KDB 447498 D01 General RF Exposure Guidance v05r02, EUT has 5 GHz and 2.4 GHz transmitting simultaneously. So the sum of MPE ratio for four antennas is 0.6088 which is smaller than 1.0. So the colocation exposure exclusion applies.

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 8dBi. 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

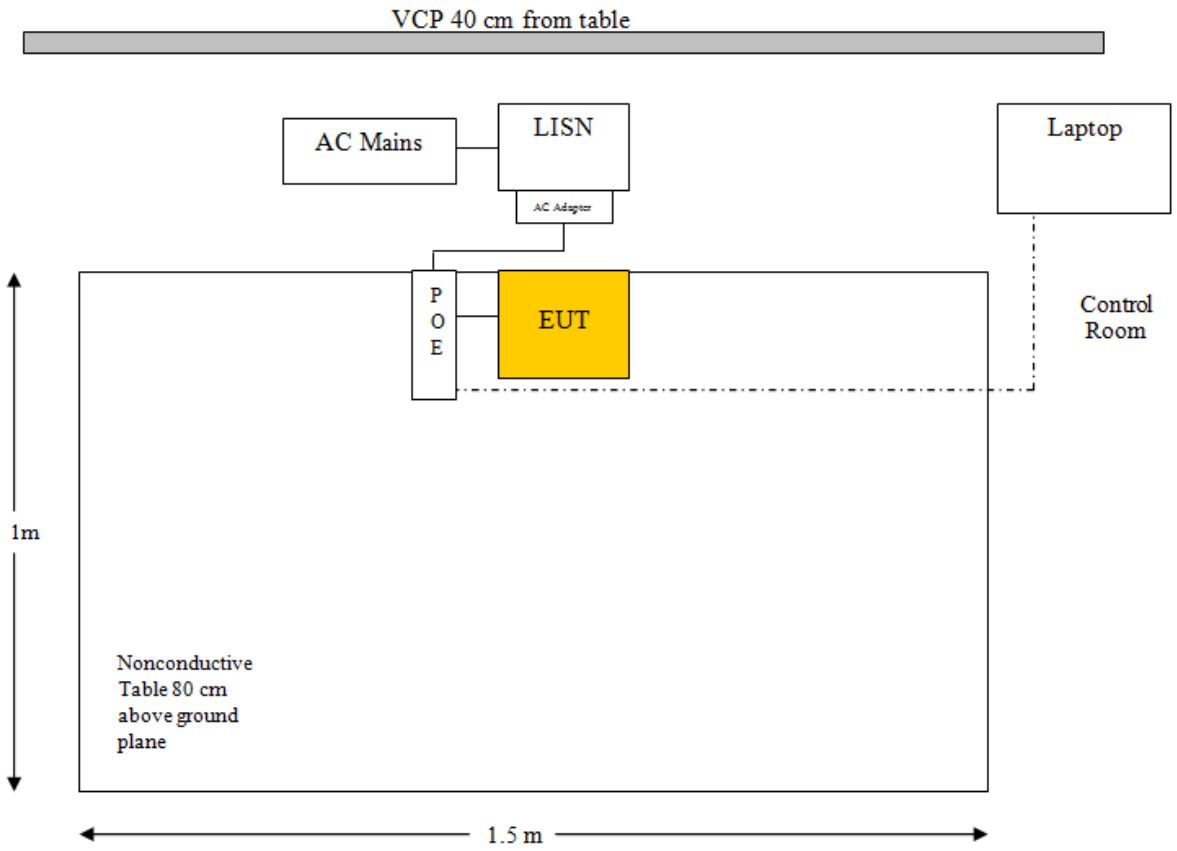
During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cord of the support equipment was connected to LISN-2.

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
TTE	Filter, High Pass	H962-150K-50-21378	K7133	2013-07-30	1 year

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

6.7 Test Environmental Conditions

Temperature:	22-24º C
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.

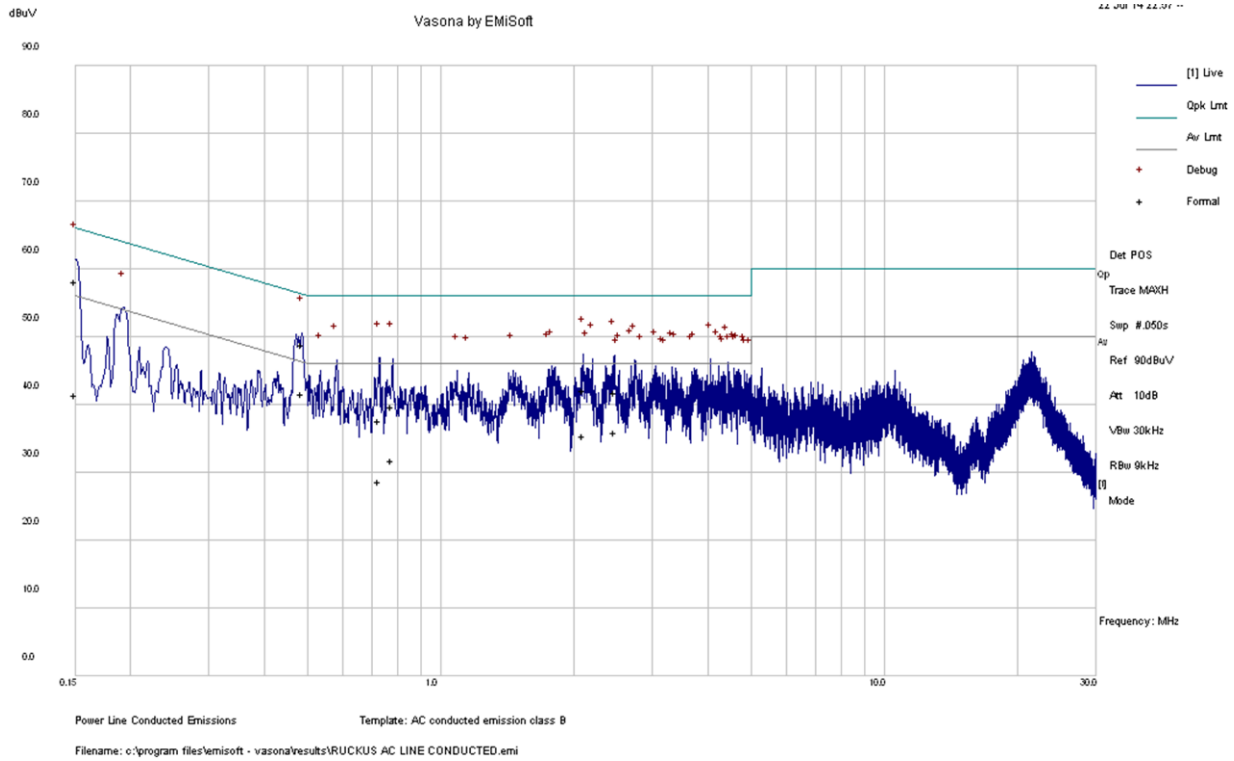
6.8 Summary of Test Results

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: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-3.61	0.483687	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

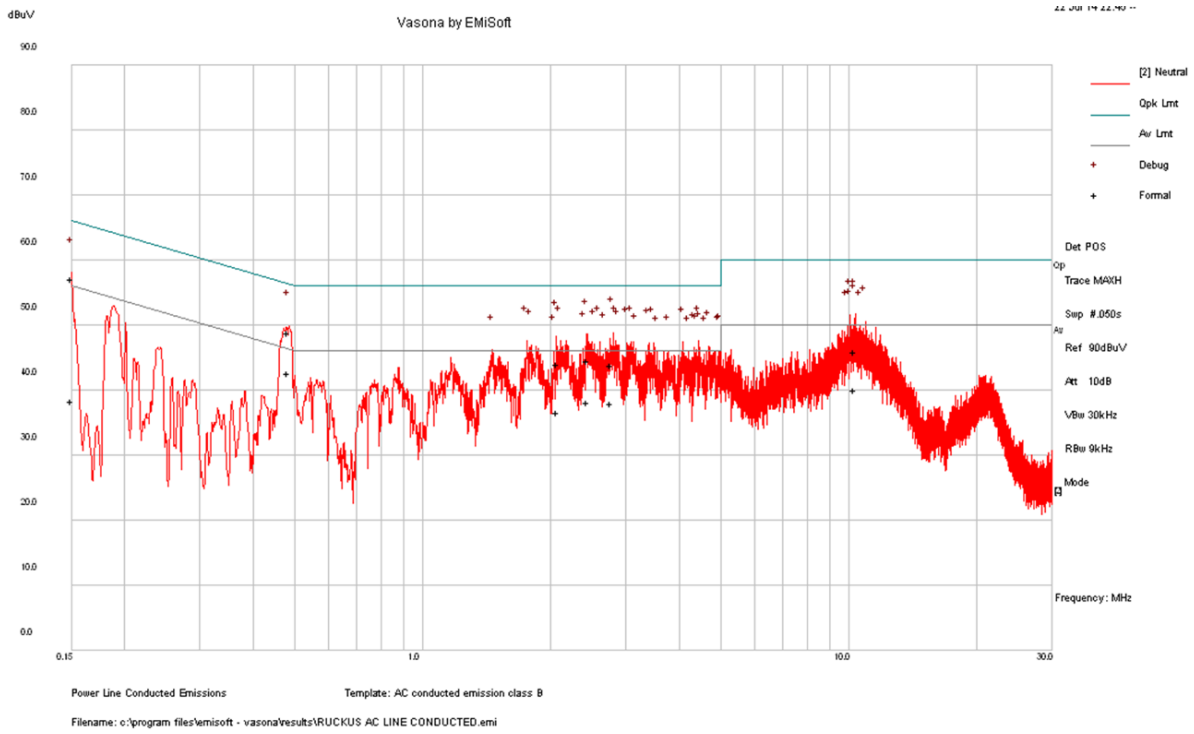
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.485898	48.83	Line	56.24	-7.4	QP
0.150024	58.2	Line	66	-7.8	QP
2.098737	42.21	Line	56	-13.79	QP
2.466447	41.83	Line	56	-14.17	QP
0.774414	39.73	Line	56	-16.27	QP
0.728286	37.63	Line	56	-18.37	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.485898	41.7	Line	46.24	-4.54	Ave.
2.466447	35.9	Line	46	-10.1	Ave.
2.098737	35.41	Line	46	-10.59	Ave.
0.774414	31.73	Line	46	-14.27	Ave.
0.150024	41.41	Line	56	-14.59	Ave.
0.728286	28.76	Line	46	-17.24	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.483687	48.84	Neutral	56.28	-7.44	QP
0.150341	57.22	Neutral	65.98	-8.76	QP
2.435819	44.61	Neutral	56	-11.39	QP
2.071862	44.06	Neutral	56	-11.94	QP
2.778528	43.89	Neutral	56	-12.11	QP
10.350781	45.92	Neutral	60	-14.08	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.483687	42.67	Neutral	46.28	-3.61	Ave.
2.435819	38.26	Neutral	46	-7.74	Ave.
2.778528	38.03	Neutral	46	-7.97	Ave.
2.071862	36.63	Neutral	46	-9.37	Ave.
10.35078	40.14	Neutral	50	-9.86	Ave.
0.150341	38.46	Neutral	55.98	-17.52	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)

(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 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 1GHz-26.5GHz	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 26.5GHz-40GHz	ALN-33144030-01	11424-01	2013-03-20	2 years
Wisewave	Horn Antenna 26.5GHz-40GHz	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:	22-24º C
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

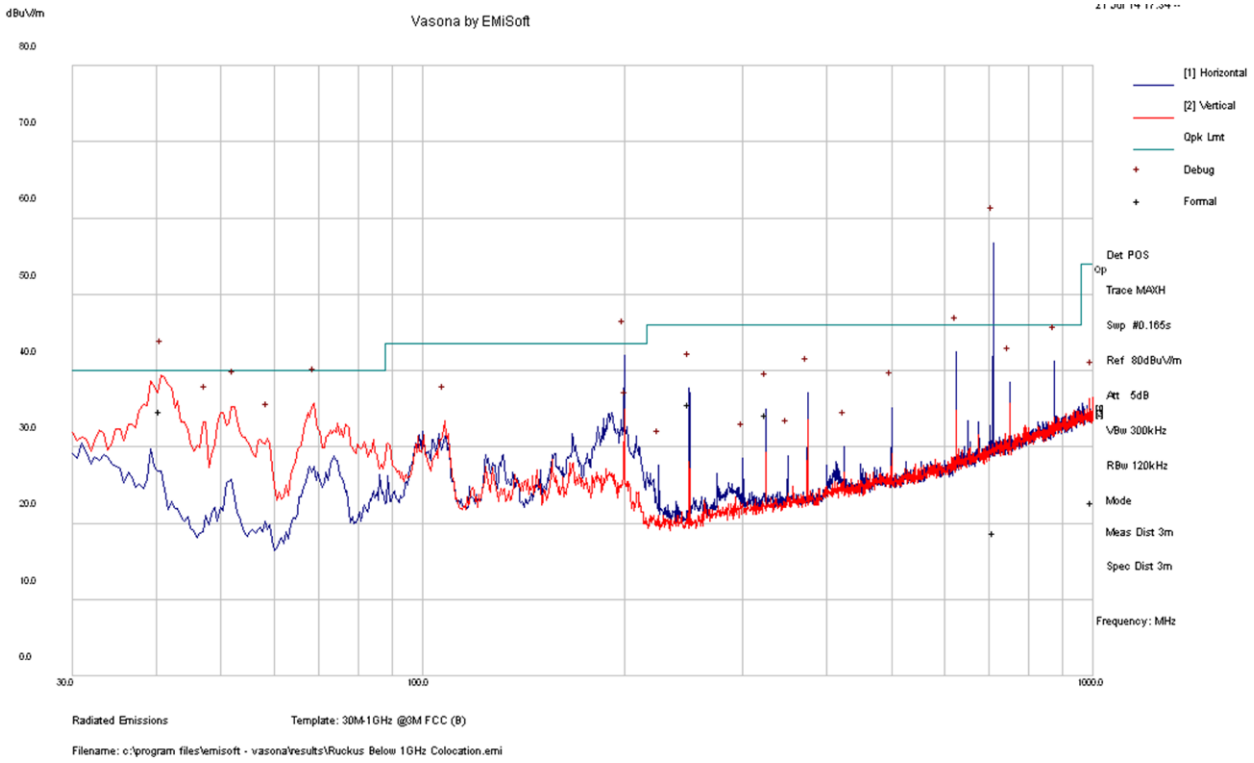
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-5.3	40.53075	Vertical	30MHz-1GHz

1 GHz-40 GHz

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-2.39	17385	Vertical	1 GHz-40 GHz

7.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz



Frequency MHz	Cord. Reading (dBµV/m)	Measurement Type	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
40.53075	34.7	QP	V	102	252	40	-5.30
249.95275	35.69	QP	H	101	324	46	-10.31
324.9985	34.24	QP	H	103	313	46	-11.76
709.69125	18.83	QP	H	264	25	46	-27.17
997.00275	22.79	QP	V	101	52	54	-31.21

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 5745 MHz, measured at 3 meters											
11490	45.53	0	100	V	38.1	4.07	33.87	53.83	74	-20.17	Peak
11490	44.72	0	100	H	38.1	4.07	33.87	53.02	74	-20.98	Peak
11490	31.53	0	100	V	38.1	4.07	33.87	39.83	54	-14.17	Ave
11490	31.52	0	100	H	38.1	4.07	33.87	39.82	54	-14.18	Ave
17235	47.79	0	100	V	42.941	5.17	33.82	62.081	74	-11.919	Peak
17235	47.77	0	100	H	42.941	5.17	33.82	62.061	74	-11.939	Peak
17235	33.62	0	100	V	42.941	5.17	33.82	47.911	54	-6.089	Ave
17235	33.6	0	100	H	42.941	5.17	33.82	47.891	54	-6.109	Ave
22980	44.47	0	100	V	35.001	6.04	34.79	50.721	74	-23.279	Peak
22980	44.53	0	100	H	35.001	6.04	34.79	50.781	74	-23.219	Peak
22980	30.76	0	100	V	35.001	6.04	34.79	37.011	54	-16.989	Ave
22980	30.7	0	100	H	35.001	6.04	34.79	36.951	54	-17.049	Ave
Middle Channel 5785 MHz, measured at 3 meters											
11570	45.98	0	100	V	38.845	4.07	33.87	55.025	74	-18.975	Peak
11570	45.59	0	100	H	38.845	4.07	33.87	54.635	74	-19.365	Peak
11570	31.74	0	100	V	38.845	4.07	33.87	40.785	54	-13.215	Ave
11570	31.94	0	100	H	38.845	4.07	33.87	40.985	54	-13.015	Ave
17355	48.68	0	100	V	46.58	5.17	33.82	66.61	74	-7.39	Peak
17355	48.23	0	100	H	46.58	5.17	33.82	66.16	74	-7.84	Peak
17355	33.08	0	100	V	46.58	5.17	33.82	51.01	54	-2.99	Ave
17355	32.8	0	100	H	46.58	5.17	33.82	50.73	54	-3.27	Ave
23140	44	0	100	V	35.001	6.04	34.74	50.301	74	-23.699	Peak
23140	43.58	0	100	H	35.001	6.04	34.74	49.881	74	-24.119	Peak
23140	29.83	0	100	V	35.001	6.04	34.74	36.131	54	-17.869	Ave
23140	29.99	0	100	H	35.001	6.04	34.74	36.291	54	-17.709	Ave
High Channel 5825 MHz, measured at 3 meters											
11650	44.54	0	100	V	39.015	4.07	34.27	53.355	74	-20.645	Peak
11650	44.37	0	100	H	39.015	4.07	34.27	53.185	74	-20.815	Peak
11650	30.55	0	100	V	39.015	4.07	34.27	39.365	54	-14.635	Ave
11650	30.76	0	100	H	39.015	4.07	34.27	39.575	54	-14.425	Ave
17475	47.32	0	100	V	45.021	5.17	33.78	63.731	74	-10.269	Peak
17475	47.66	0	100	H	45.021	5.17	33.78	64.071	74	-9.929	Peak
17475	32.78	0	100	V	45.021	5.17	33.78	49.191	54	-4.809	Ave
17475	33.48	0	100	H	45.021	5.17	33.78	49.891	54	-4.109	Ave
23300	44.22	0	100	V	34.854	6.04	34.71	50.404	74	-23.596	Peak
23300	43.57	0	100	H	34.854	6.04	34.71	49.754	74	-24.246	Peak
23300	30.46	0	100	V	34.854	6.04	34.71	36.644	54	-17.356	Ave
23300	29.81	0	100	H	34.854	6.04	34.71	35.994	54	-18.006	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 5745 MHz, measured at 3 meters											
11490	45.72	0	100	V	38.1	4.07	33.87	54.02	74	-19.98	Peak
11490	44.85	0	100	H	38.1	4.07	33.87	53.15	74	-20.85	Peak
11490	31.57	0	100	V	38.1	4.07	33.87	39.87	54	-14.13	Ave
11490	32.12	0	100	H	38.1	4.07	33.87	40.42	54	-13.58	Ave
17235	48.04	0	100	V	42.941	5.17	33.82	62.33	74	-11.67	Peak
17235	46.97	0	100	H	42.941	5.17	33.82	61.26	74	-12.74	Peak
17235	33.58	0	100	V	42.941	5.17	33.82	47.87	54	-6.13	Ave
17235	32.93	0	100	H	42.941	5.17	33.82	47.22	54	-6.78	Ave
22980	43.95	0	100	V	35.001	6.04	34.79	50.20	74	-23.80	Peak
22980	43.58	0	100	H	35.001	6.04	34.79	49.83	74	-24.17	Peak
22980	29.9	0	100	V	35.001	6.04	34.79	36.15	54	-17.85	Ave
22980	30.07	0	100	H	35.001	6.04	34.79	36.32	54	-17.68	Ave
Middle Channel 5785 MHz, measured at 3 meters											
11570	45.94	0	100	V	38.845	4.07	33.87	54.985	74	-19.015	Peak
11570	44.83	0	100	H	38.845	4.07	33.87	53.875	74	-20.125	Peak
11570	31.93	0	100	V	38.845	4.07	33.87	40.975	54	-13.025	Ave
11570	31.64	0	100	H	38.845	4.07	33.87	40.685	54	-13.315	Ave
17355	47.83	0	100	V	46.58	5.17	33.82	65.76	74	-8.24	Peak
17355	48.19	0	100	H	46.58	5.17	33.82	66.12	74	-7.88	Peak
17355	33.64	0	100	V	46.58	5.17	33.82	51.57	54	-2.43	Ave
17355	33.98	0	100	H	46.58	5.17	33.82	51.91	54	-2.09	Ave
23140	43.59	0	100	V	35.001	6.04	34.74	49.891	74	-24.109	Peak
23140	44.51	0	100	H	35.001	6.04	34.74	50.811	74	-23.189	Peak
23140	30.01	0	100	V	35.001	6.04	34.74	36.311	54	-17.689	Ave
23140	30.04	0	100	H	35.001	6.04	34.74	36.341	54	-17.659	Ave
High Channel 5825 MHz, measured at 3 meters											
11650	44.89	0	100	V	39.015	4.07	34.27	53.705	74	-20.295	Peak
11650	44.19	0	100	H	39.015	4.07	34.27	53.005	74	-20.995	Peak
11650	30.68	0	100	V	39.015	4.07	34.27	39.495	54	-14.505	Ave
11650	31.45	0	100	H	39.015	4.07	34.27	40.265	54	-13.735	Ave
17475	47.69	0	100	V	45.021	5.17	33.78	64.101	74	-9.899	Peak
17475	47.61	0	100	H	45.021	5.17	33.78	64.021	74	-9.979	Peak
17475	33.37	0	100	V	45.021	5.17	33.78	49.781	54	-4.219	Ave
17475	34.16	0	100	H	45.021	5.17	33.78	50.571	54	-3.429	Ave
23300	44.67	0	100	V	34.854	6.04	34.71	50.854	74	-23.146	Peak
23300	44.97	0	100	H	34.854	6.04	34.71	51.154	74	-22.846	Peak
23300	31.21	0	100	V	34.854	6.04	34.71	37.394	54	-16.606	Ave
23300	30.93	0	100	H	34.854	6.04	34.71	37.114	54	-16.886	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 5755 MHz, measured at 3 meters											
11510	45.8	0	100	V	38.1	4.07	33.87	54.1	74	-19.9	Peak
11510	45.06	0	100	H	38.1	4.07	33.87	53.36	74	-20.64	Peak
11510	31.68	0	100	V	38.1	4.07	33.87	39.98	54	-14.02	Ave
11510	32.26	0	100	H	38.1	4.07	33.87	40.56	54	-13.44	Ave
17265	48.73	0	100	V	42.941	5.17	33.82	63.021	74	-10.979	Peak
17265	48.43	0	100	H	42.941	5.17	33.82	62.721	74	-11.279	Peak
17265	34.06	0	100	V	42.941	5.17	33.82	48.351	54	-5.649	Ave
17265	33.3	0	100	H	42.941	5.17	33.82	47.591	54	-6.409	Ave
23020	44.38	0	100	V	35.001	6.04	34.79	50.631	74	-23.369	Peak
23020	44.25	0	100	H	35.001	6.04	34.79	50.501	74	-23.499	Peak
23020	29.78	0	100	V	35.001	6.04	34.79	36.031	54	-17.969	Ave
23020	29.93	0	100	H	35.001	6.04	34.79	36.181	54	-17.819	Ave
High Channel 5795 MHz, measured at 3 meters											
11590	45.73	0	100	V	38.845	4.07	33.87	54.775	74	-19.225	Peak
11590	45.03	0	100	H	38.845	4.07	33.87	54.075	74	-19.925	Peak
11590	31.77	0	100	V	38.845	4.07	33.87	40.815	54	-13.185	Ave
11590	31.66	0	100	H	38.845	4.07	33.87	40.705	54	-13.295	Ave
17385	48.61	0	100	V	46.58	5.17	33.82	66.54	74	-7.46	Peak
17385	48.3	0	100	H	46.58	5.17	33.82	66.23	74	-7.77	Peak
17385	33.68	0	100	V	46.58	5.17	33.82	51.61	54	-2.39	Ave
17385	32.87	0	100	H	46.58	5.17	33.82	50.8	54	-3.2	Ave
23180	43.76	0	100	V	35.001	6.04	34.74	50.061	74	-23.939	Peak
23180	44.47	0	100	H	35.001	6.04	34.74	50.771	74	-23.229	Peak
23180	30.66	0	100	V	35.001	6.04	34.74	36.961	54	-17.039	Ave
23180	30.66	0	100	H	35.001	6.04	34.74	36.961	54	-17.039	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)	
5775 MHz, measured at 3 meters											
11550	45.19	0	100	V	38.845	4.07	33.87	54.235	74	-19.765	Peak
11550	44.18	0	100	H	38.845	4.07	33.87	53.225	74	-20.775	Peak
11550	31.52	0	100	V	38.845	4.07	33.87	40.565	54	-13.435	Ave
11550	31.05	0	100	H	38.845	4.07	33.87	40.095	54	-13.905	Ave
17325	47.53	0	100	V	46.58	5.17	33.82	65.46	74	-8.54	Peak
17325	47.42	0	100	H	46.58	5.17	33.82	65.35	74	-8.65	Peak
17325	33.22	0	100	V	46.58	5.17	33.82	51.15	54	-2.85	Ave
17325	33.81	0	100	H	46.58	5.17	33.82	51.74	54	-2.26	Ave
23100	44.62	0	100	V	35.001	6.04	34.74	50.921	74	-23.079	Peak
23100	45.42	0	100	H	35.001	6.04	34.74	51.721	74	-22.279	Peak
23100	31.17	0	100	V	35.001	6.04	34.74	37.471	54	-16.529	Ave
23100	30.81	0	100	H	35.001	6.04	34.74	37.111	54	-16.889	Ave

Note: Restrict band limit is used in all of the frequency as it is tighter limit comparing to the limit outside of restrict band.

8 FCC §15.407(e) – Bandwidth Measurement

8.1 Applicable Standards

FCC §15.407(e)

8.2 Measurement Procedure

Emission Bandwidth:
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 × RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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:	22-24º C
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

802.11a mode

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Chain 0			
Low	5745	16.567	16.515
Middle	5785	16.577	16.5376
High	5825	16.545	16.5373
Chain 1			
Low	5745	16.534	16.4916
Middle	5785	16.546	16.5563
High	5825	16.424	16.5485

802.11n-HT20 mode

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Chain 0			
Low	5745	17.649	17.6978
Middle	5785	17.763	17.6992
High	5825	17.718	17.7656
Chain 1			
Low	5745	17.771	17.7028
Middle	5785	17.777	17.7739
High	5825	17.633	17.7011

802.11n-HT40 mode

Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Chain 0			
Low	5755	36.545	36.2121
High	5795	36.371	36.1669
Chain 1			
Low	5755	36.44	36.236
High	5795	36.395	36.1984

802.11ac-VHT80 mode

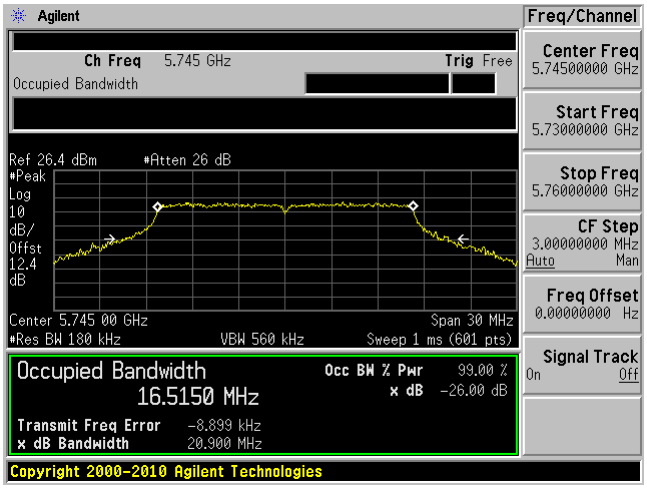
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
Chain 0			
-	5775	76.54	75.6068
Chain 1			
-	5775	76.626	75.5636

Please refer to the following plots.

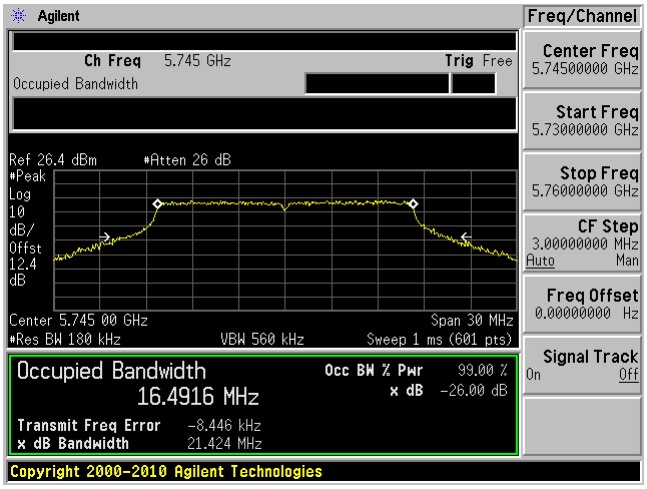
99% Occupied Channel Bandwidth:

802.11a, Low Channel, 5745 MHz

Chain 0

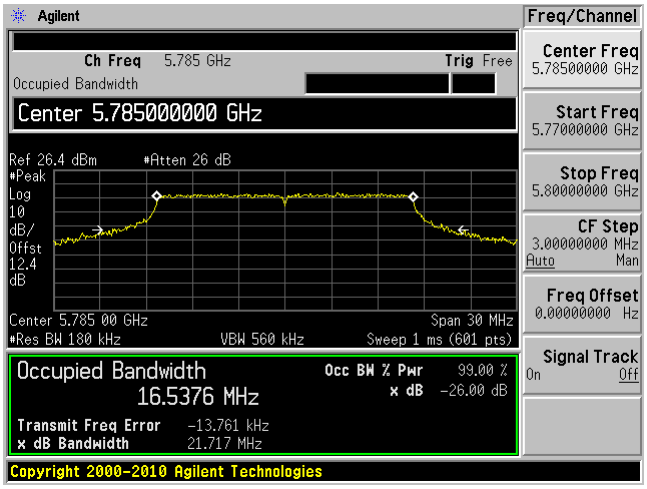


Chain 1

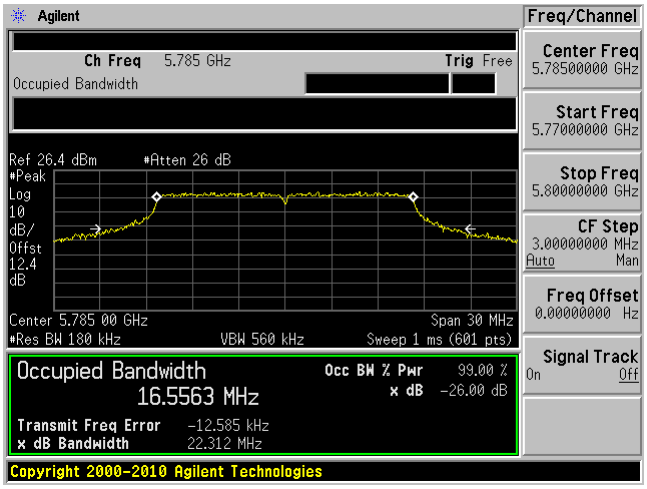


802.11a, Middle Channel, 5785 MHz

Chain 0

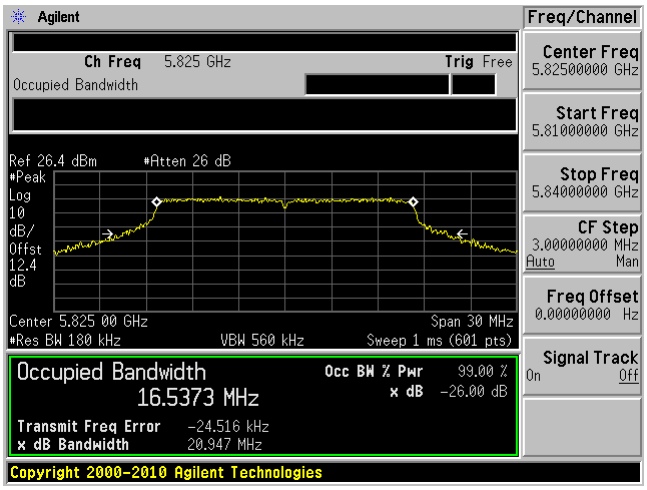


Chain 1

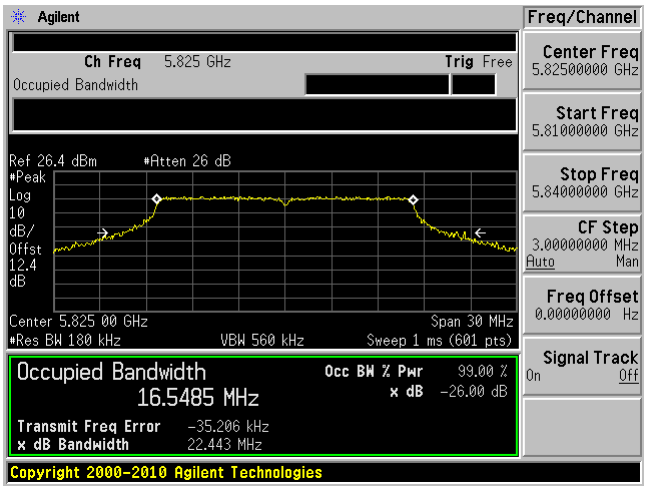


802.11a, High Channel, 5825 MHz

Chain 0

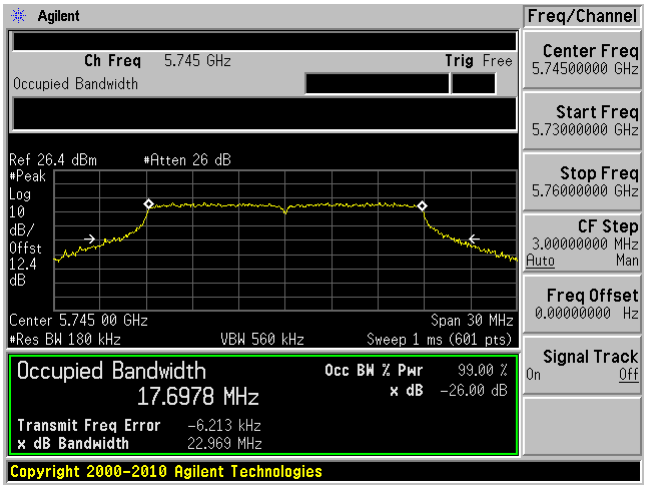


Chain 1

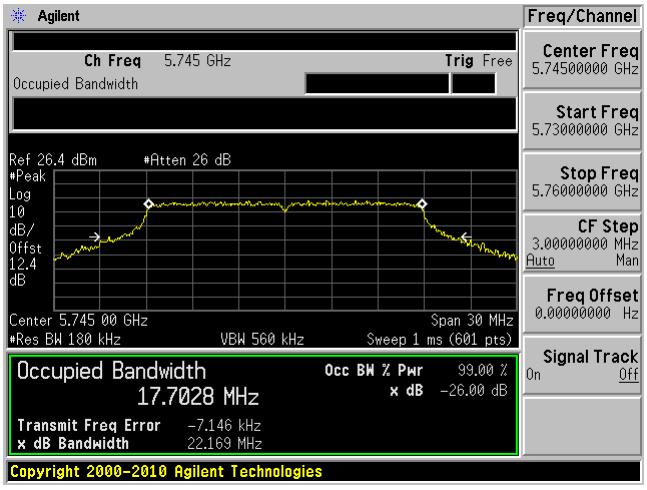


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

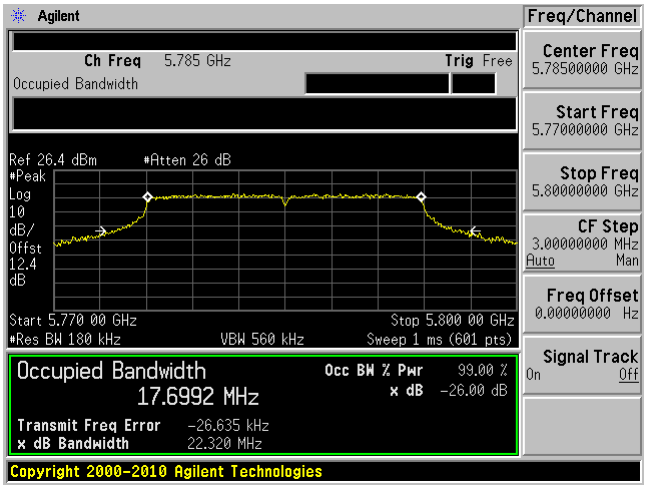


Chain 1

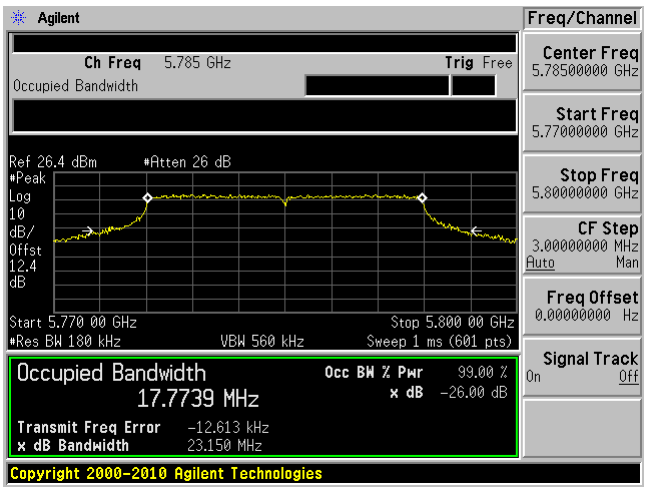


802.11n-HT20, Middle Channel 5785 MHz

Chain 0

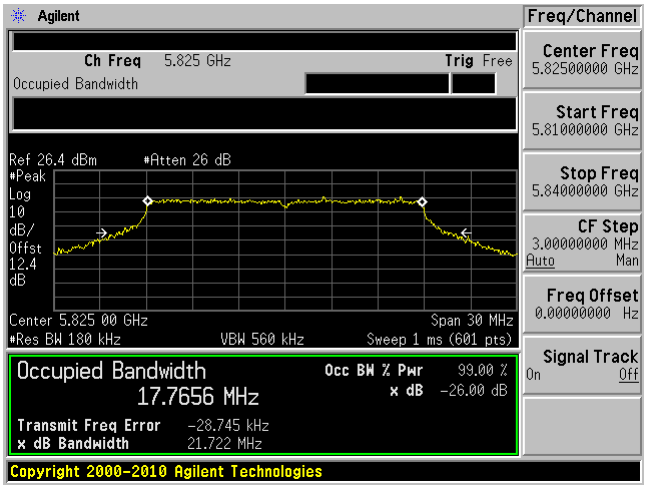


Chain 1

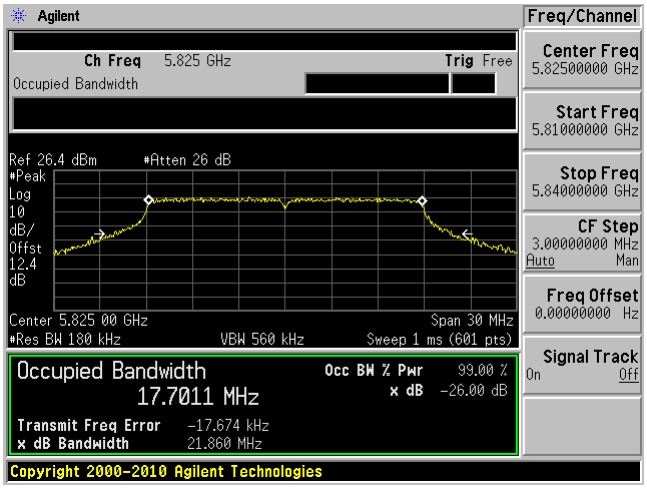


802.11n-HT20, High Channel, 5825 MHz

Chain 0

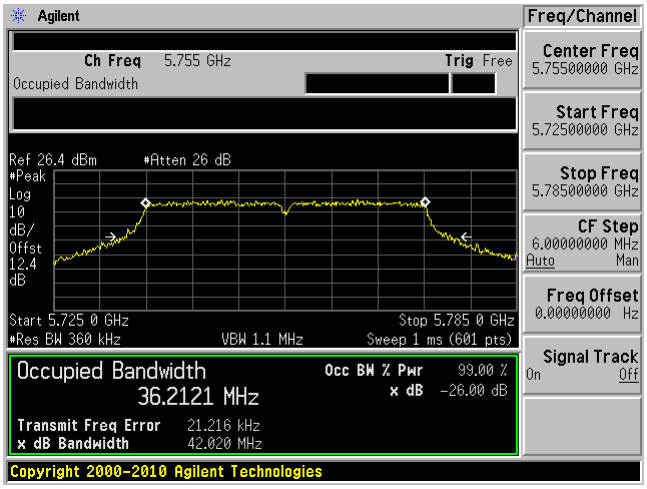


Chain 1

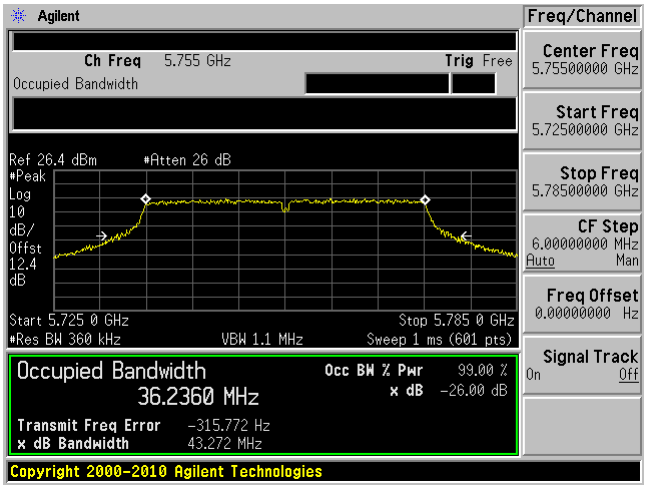


802.11n-HT40, Low Channel 5755 MHz

Chain 0

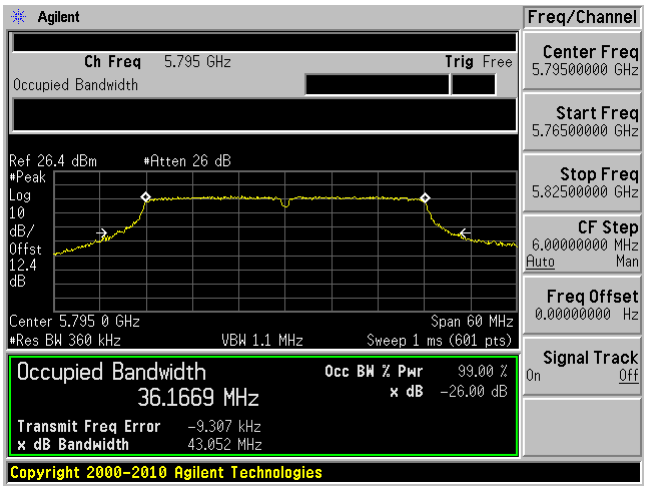


Chain 1

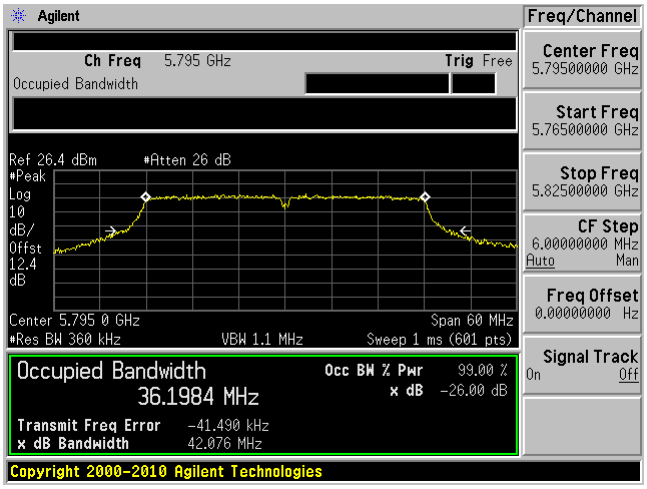


802.11n-HT40, High Channel 5795 MHz

Chain 0

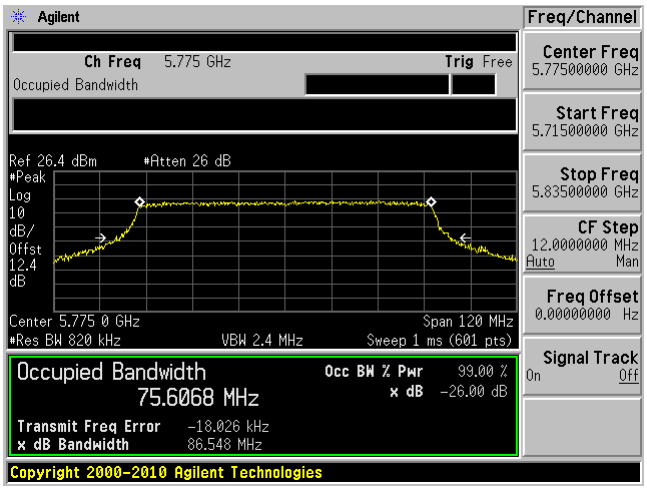


Chain 1

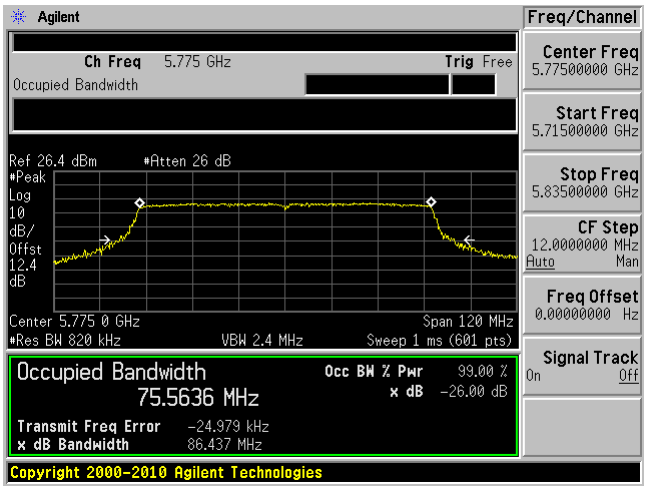


802.11ac-VHT80, High Channel 5775 MHz

Chain 0



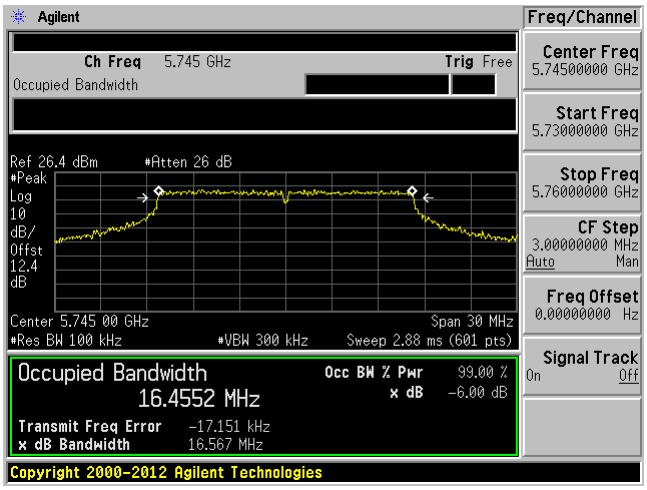
Chain 1



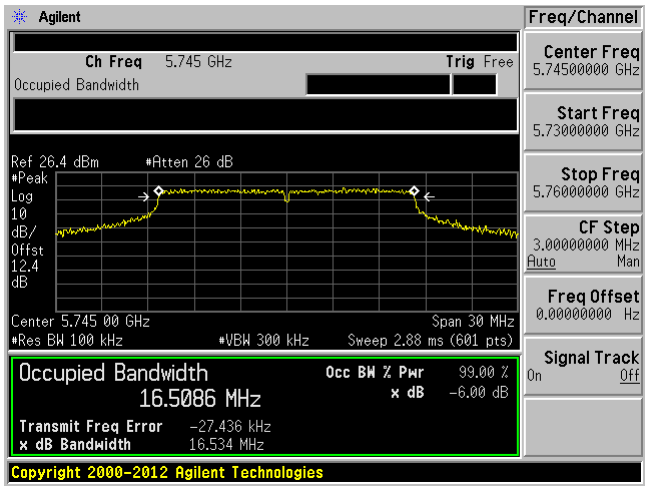
6 dB Emission Bandwidth:

802.11a, Low Channel, 5745 MHz

Chain 0

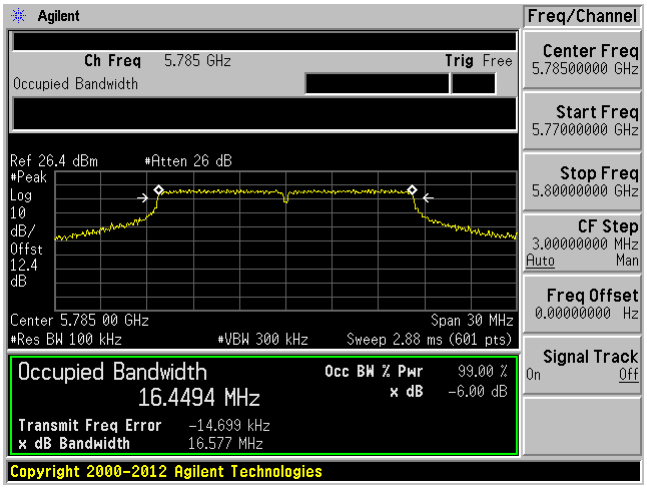


Chain 1

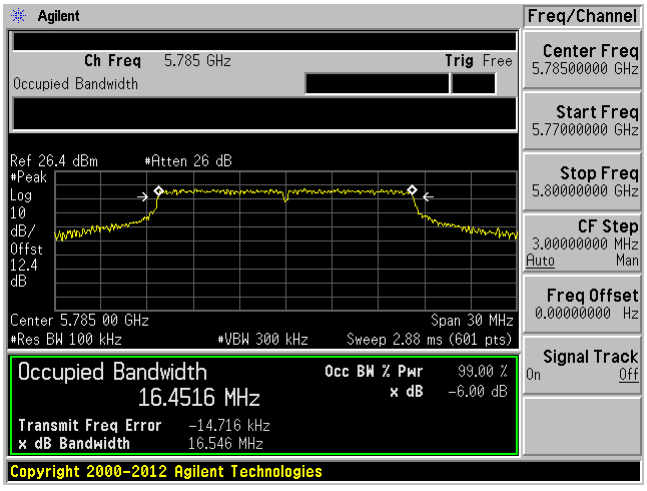


802.11a, Middle Channel, 5785 MHz

Chain 0

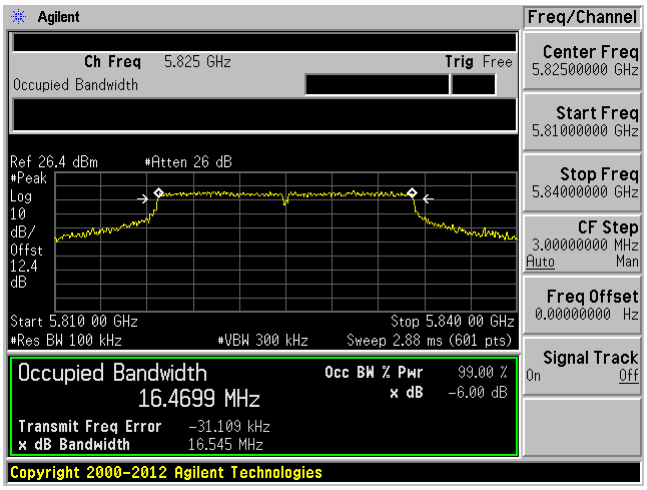


Chain 1

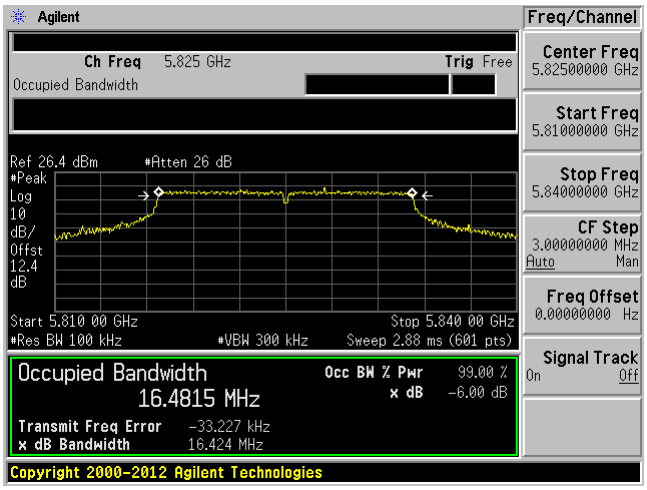


802.11a, High Channel, 5825 MHz

Chain 0

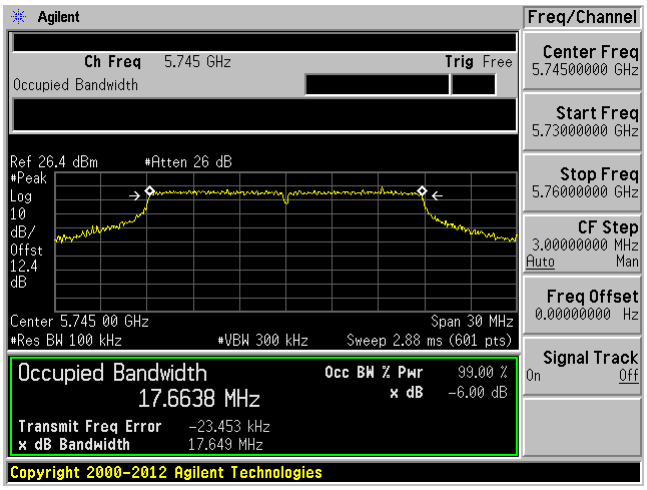


Chain 1

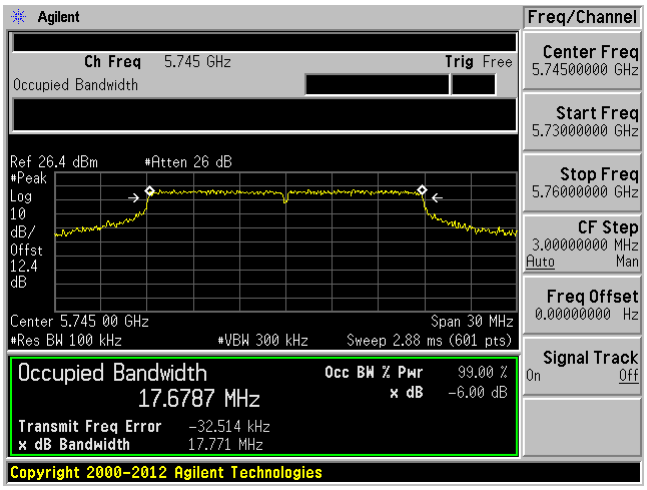


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

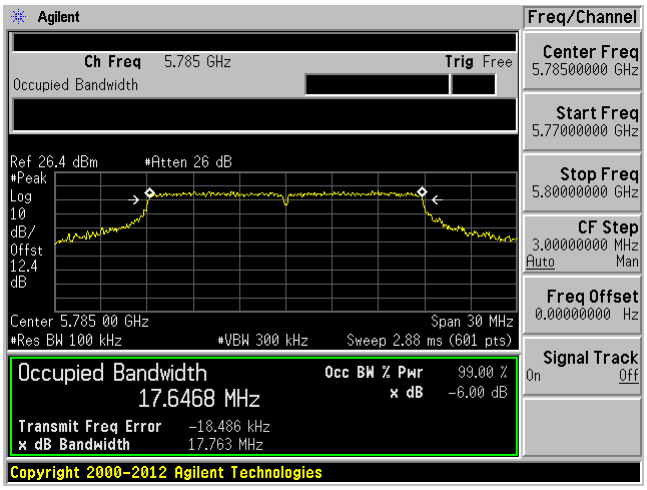


Chain 1

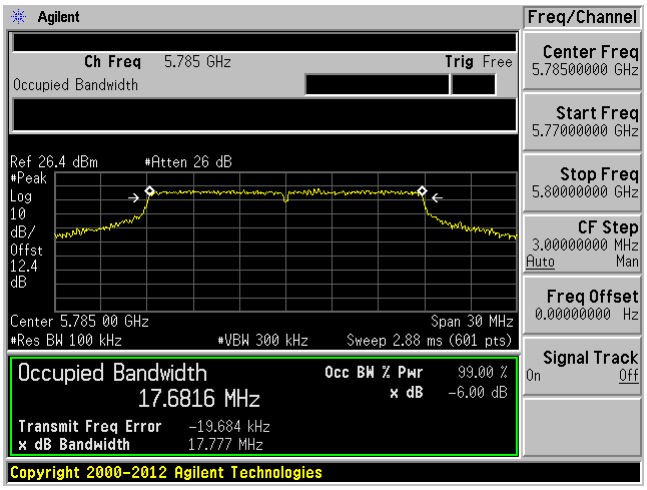


802.11n-HT20, Middle Channel 5785 MHz

Chain 0

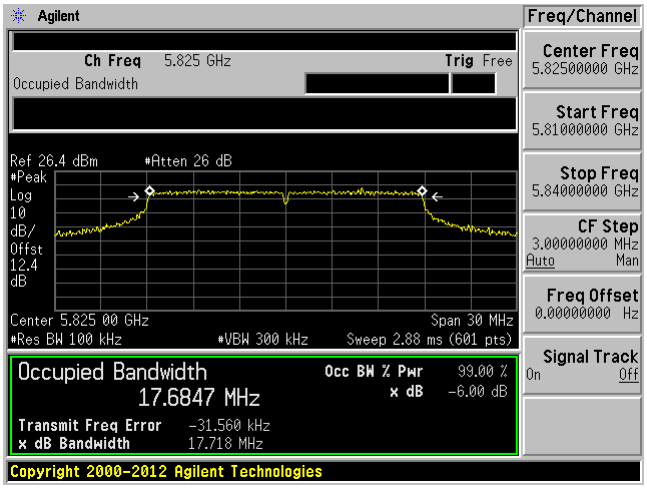


Chain 1

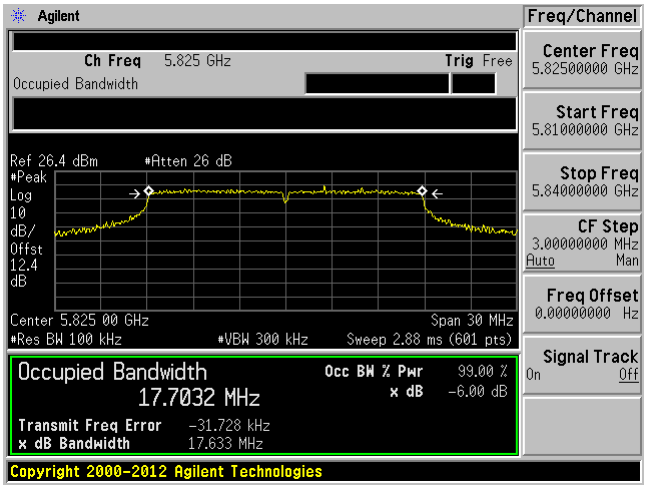


802.11n-HT20, High Channel, 5825 MHz

Chain 0

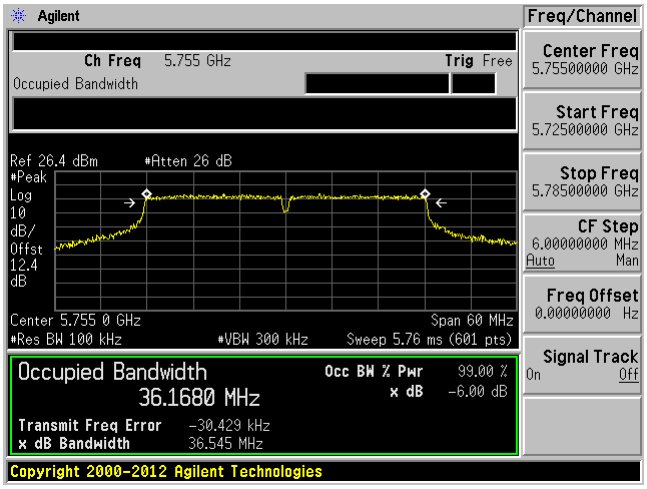


Chain 1

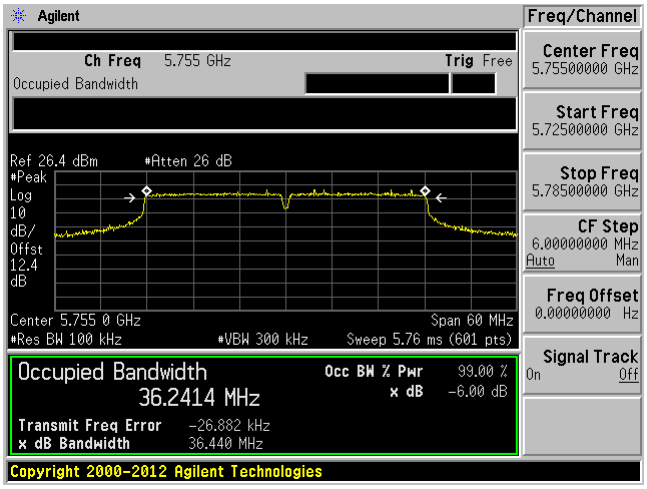


802.11n-HT40, Low Channel 5755 MHz

Chain 0

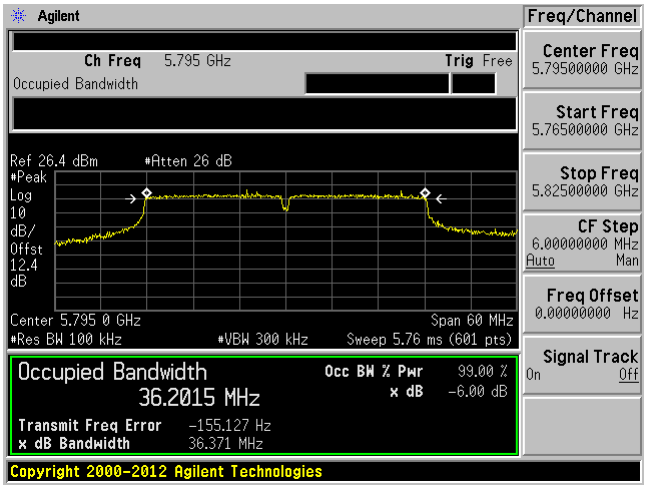


Chain 1

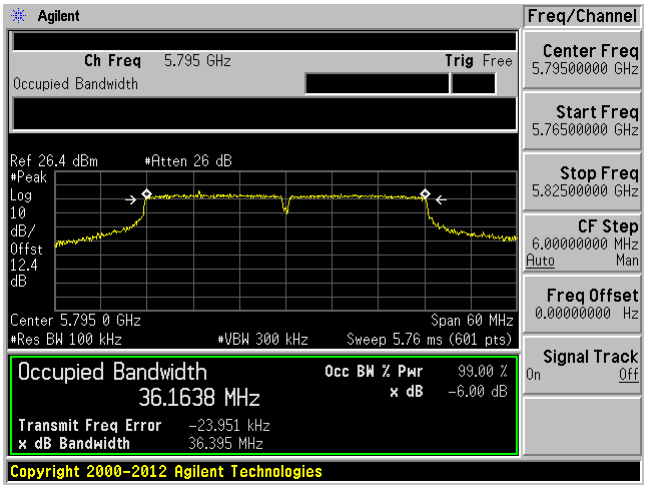


802.11n-HT40, High Channel 5795 MHz

Chain 0

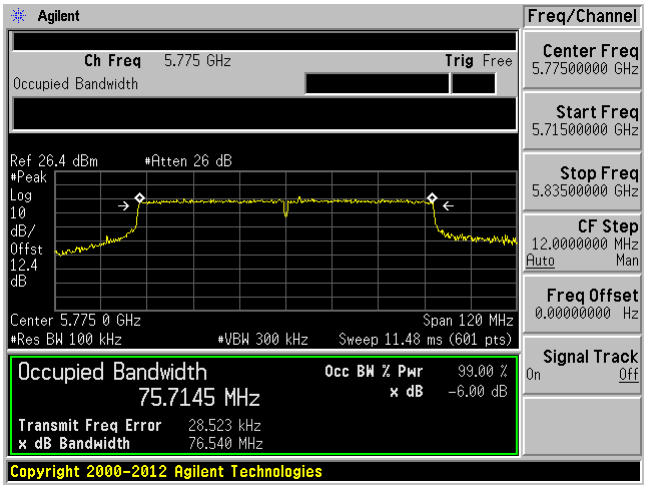


Chain 1

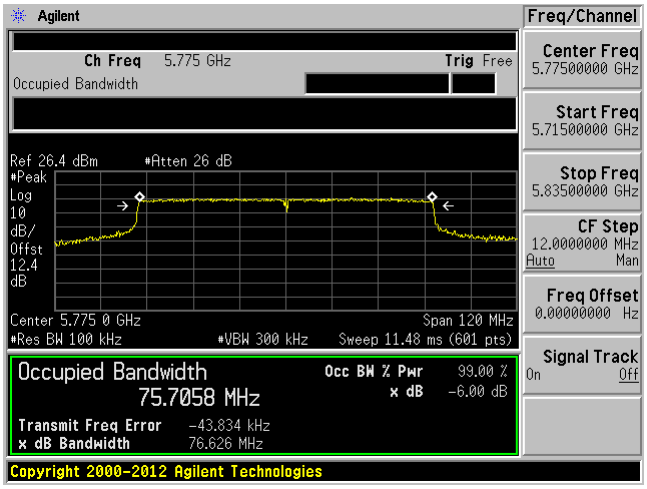


802.11ac-VHT80, High Channel 5775 MHz

Chain 0



Chain 1



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

9.1 Applicable Standards

According to FCC §15.407(a)

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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:	22-24º C
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

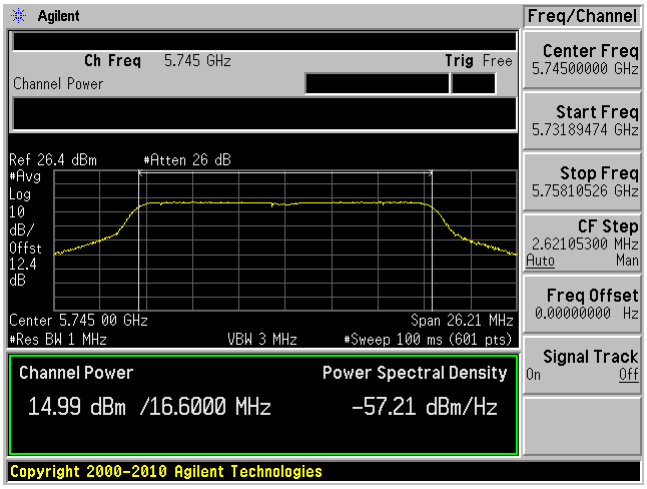
Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Output Power (dBm)	Limit (dBm)	Margin (dB)	Power Setting
		Chain J0	Chain J1				
802.11a mode							
Low	5745	15.00	16.06	18.57	28	-9.43	15.5
Middle	5785	21.63	22.14	24.90	28	-3.10	target
High	5825	18.80	20.03	22.47	28	-5.53	20
802.11n-HT20 mode							
Low	5745	14.94	16.09	18.56	28	-9.44	15.5
Middle	5785	21.45	22.09	24.79	28	-3.21	target
High	5825	17.66	18.57	21.15	28	-6.85	19
802.11n-HT40 mode							
Low	5755	16.31	17.48	19.94	28	-8.06	17
High	5795	19.40	20.25	22.86	28	-5.14	20
802.11ac-VHT80 mode							
-	5775	13.88	14.98	17.48	28	-10.52	15

Note: The antenna gain is 8 dBi, so 8-6=2 dBi should be declined for the limit 30 dBm, and the limit is 28 dBm.

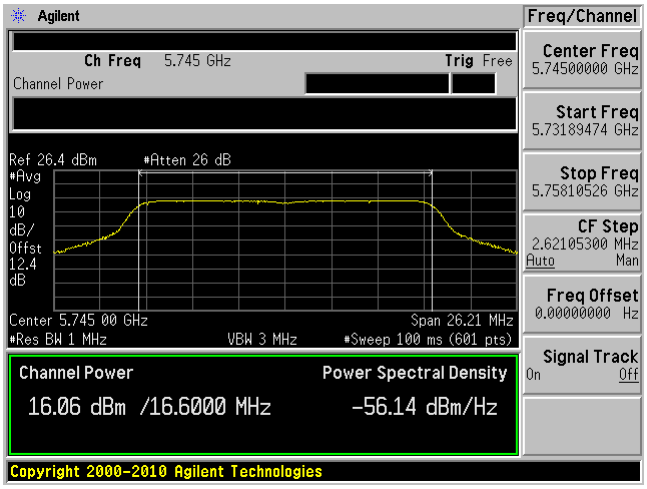
Please refer to the plots as following:

802.11a, Low Channel, 5745 MHz

Chain 0

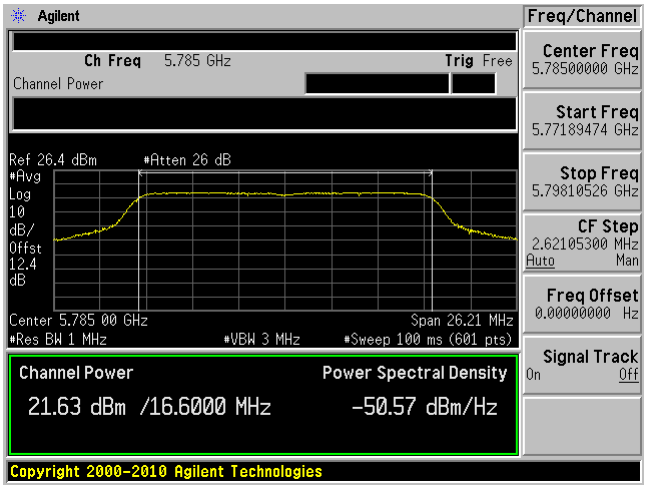


Chain 1

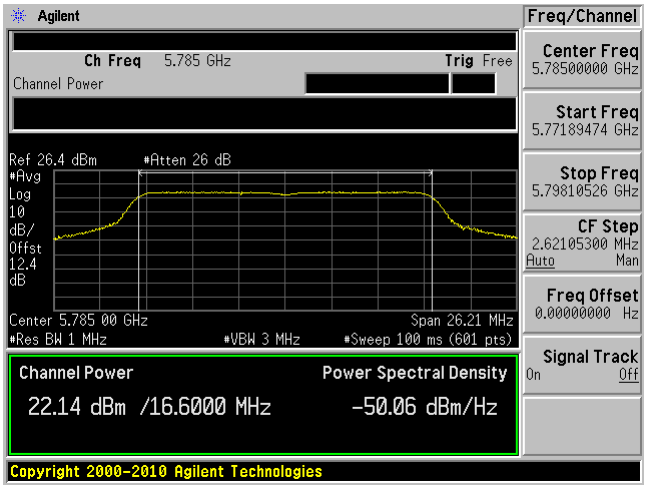


802.11a, Middle Channel, 5785 MHz

Chain 0

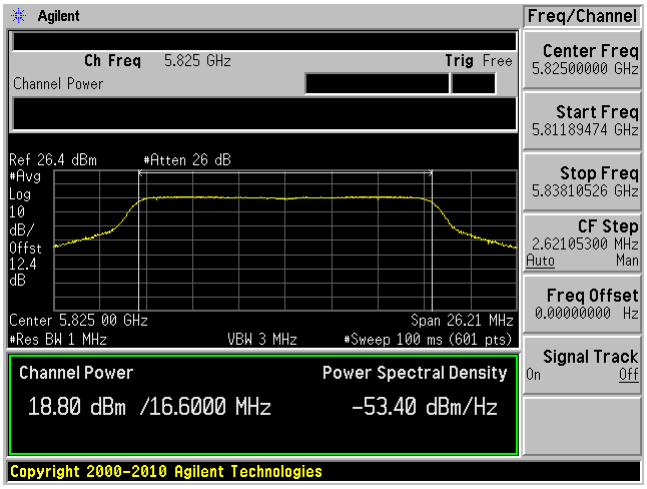


Chain 1

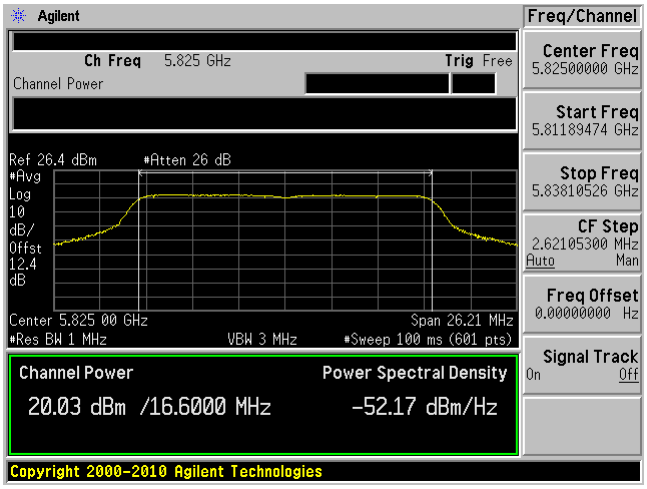


802.11a, High Channel, 5825 MHz

Chain 0

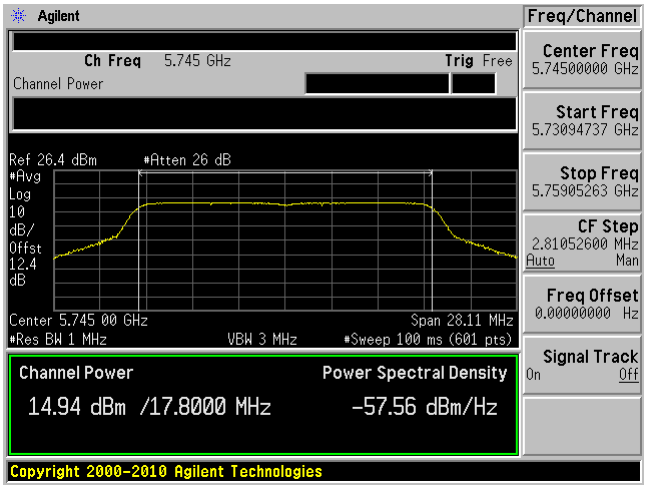


Chain 1

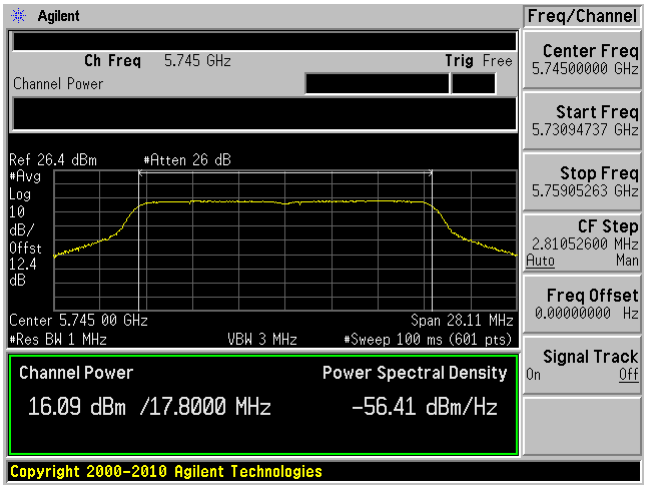


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

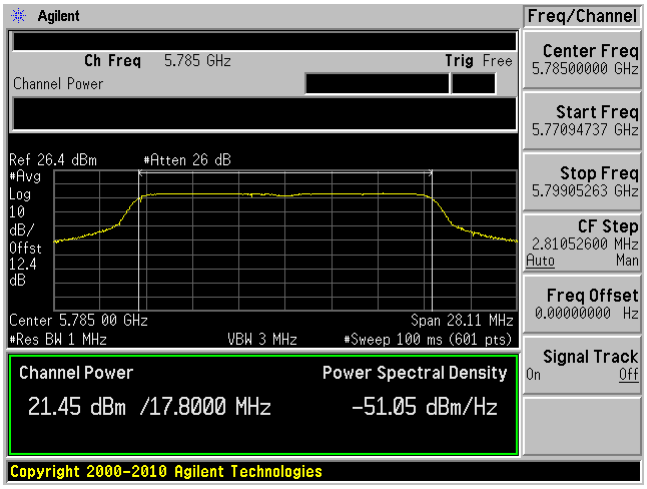


Chain 1

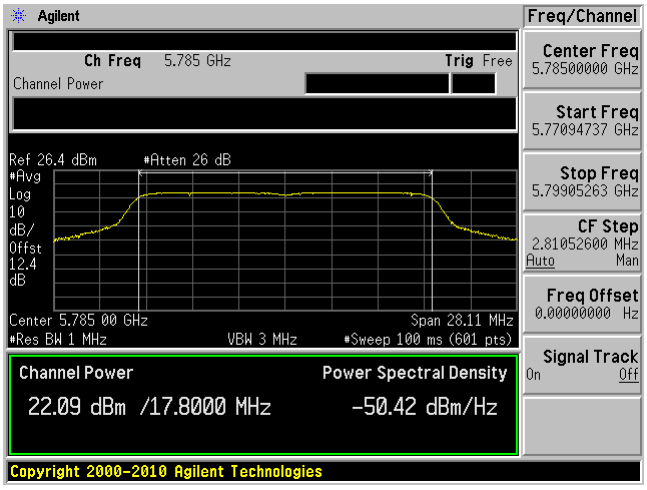


802.11n-HT20, Middle Channel 5785 MHz

Chain 0

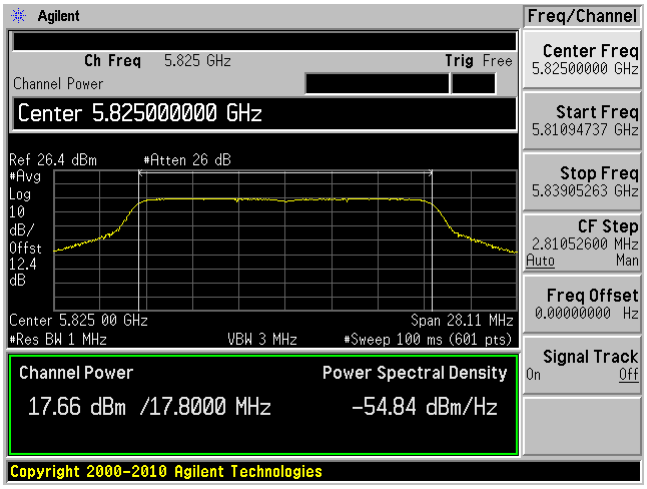


Chain 1

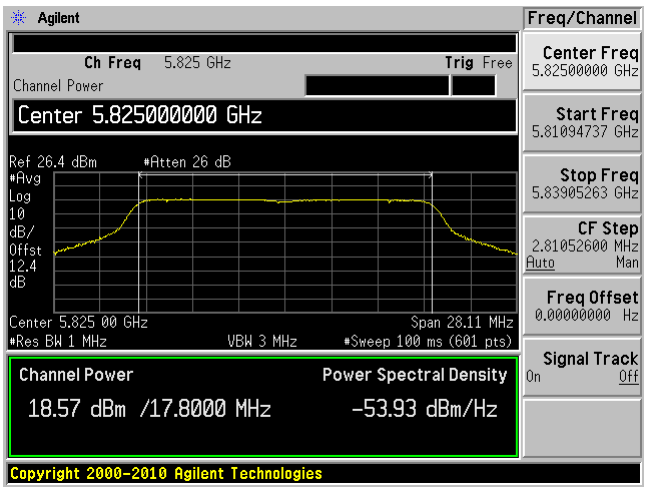


802.11n-HT20, High Channel, 5825 MHz

Chain 0

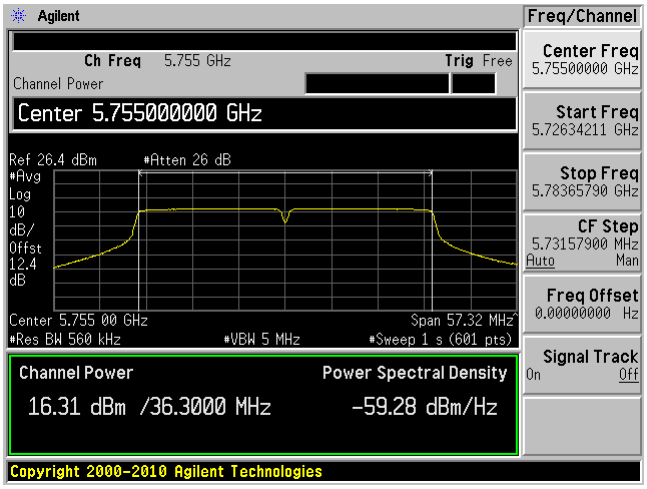


Chain 1

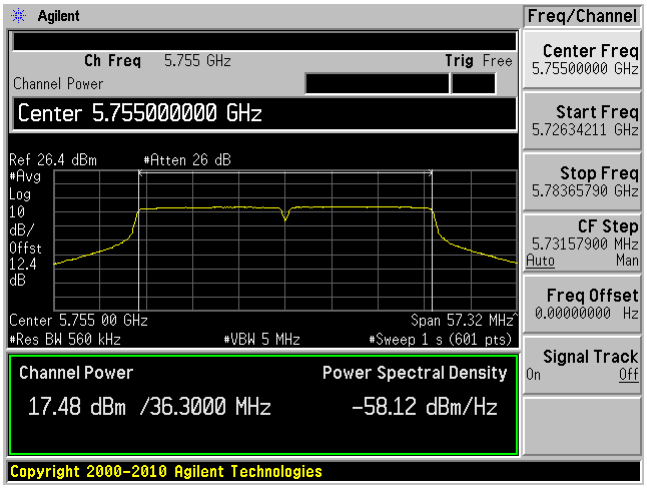


802.11n-HT40, Low Channel 5755 MHz

Chain 0

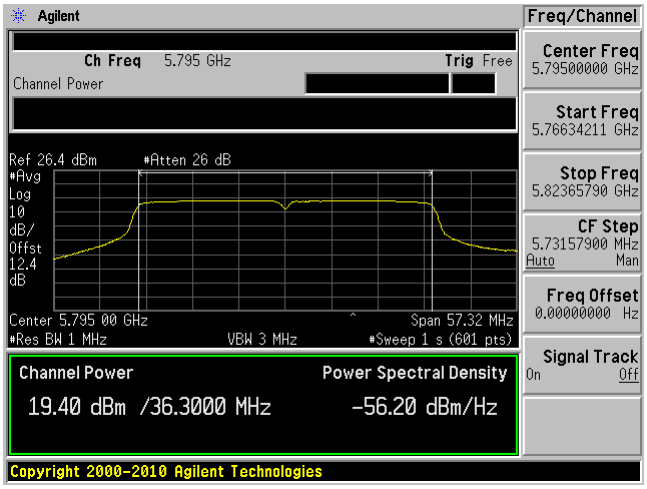


Chain 1

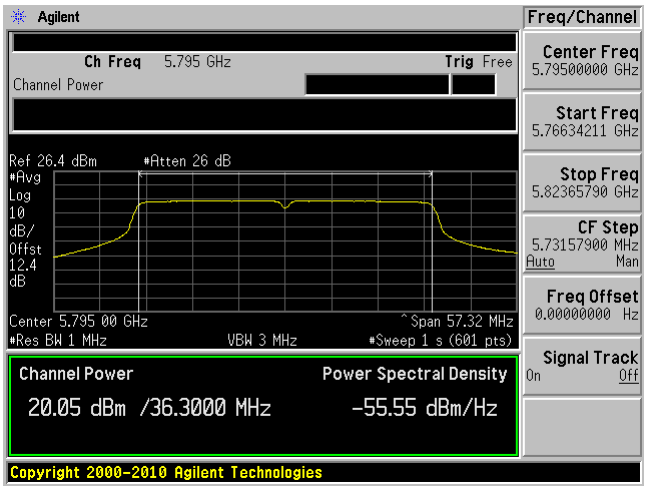


802.11n-HT40, High Channel 5795 MHz

Chain 0

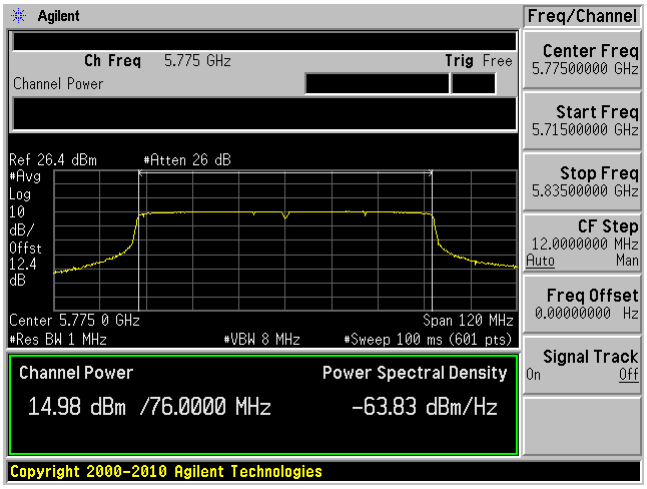


Chain 1

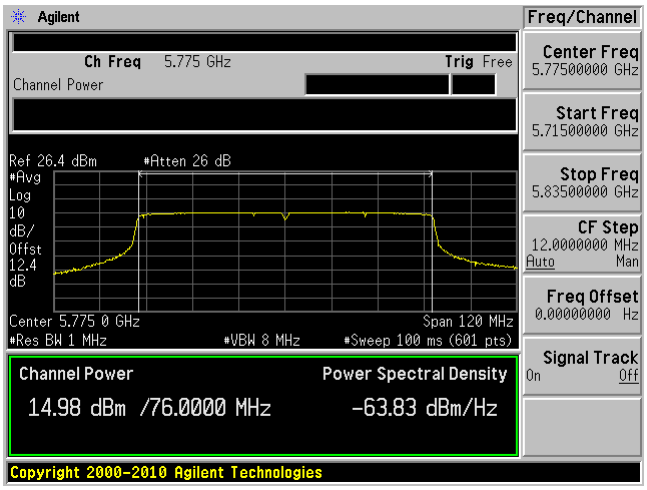


802.11ac-VHT80, 5775 MHz

Chain 0



Chain 1



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

10.1 Applicable Standard

According to FCC §15.407(b)

(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:
(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 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.

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.

Please refer to the following plots.

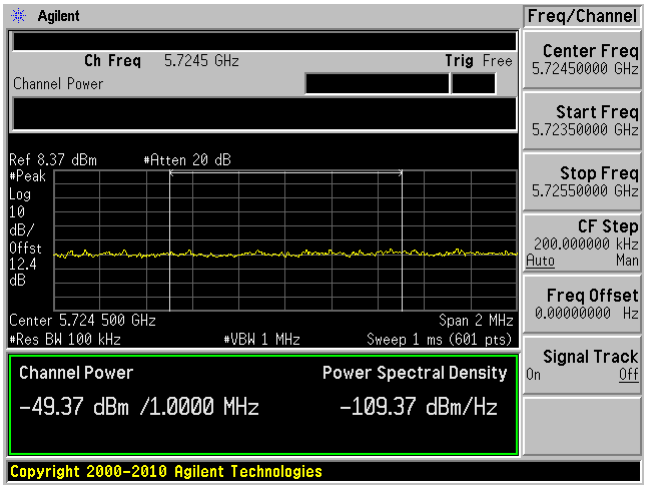
Note: The offset include the attenuation, cable loss and antenna gain 8dBi. And the magin between limit line and the emission covers other requirements in the KDB 789033.

10.5 Test Results

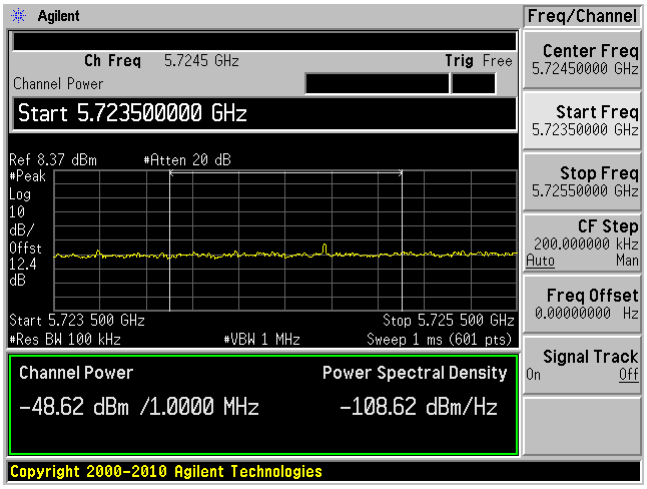
Band Edge Measurement

802.11a, Low Channel, 5745 MHz

Chain 0

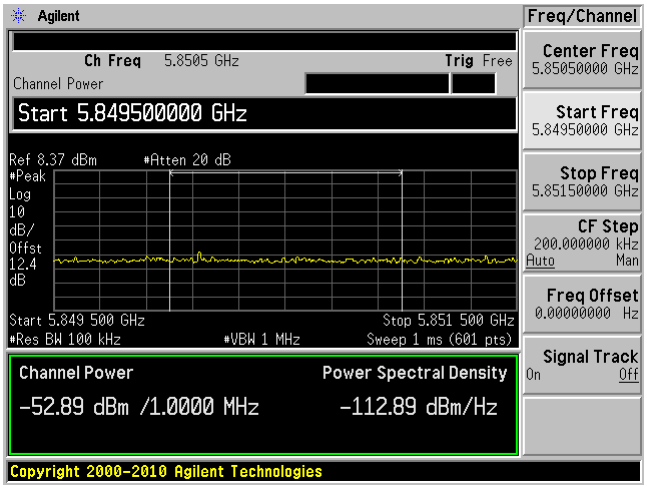


Chain 1

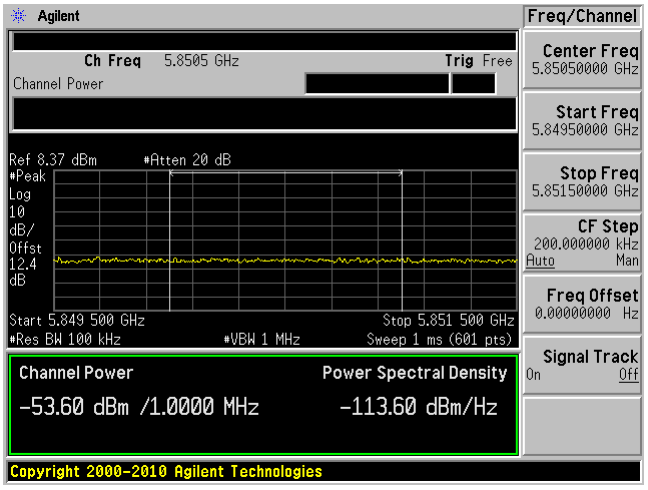


802.11a, High Channel, 5825 MHz

Chain 0

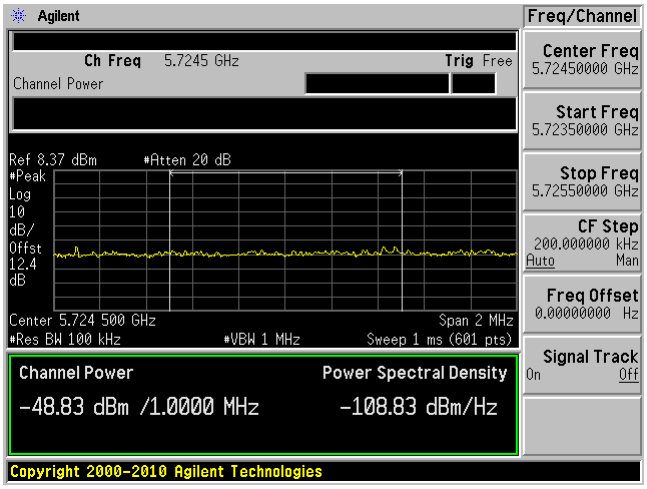


Chain 1

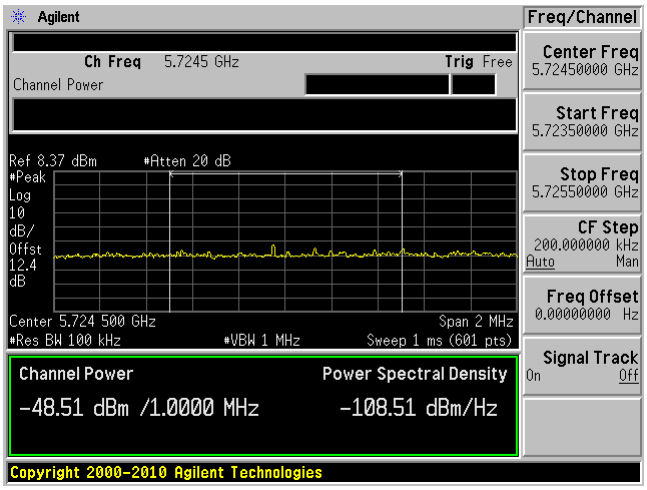


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

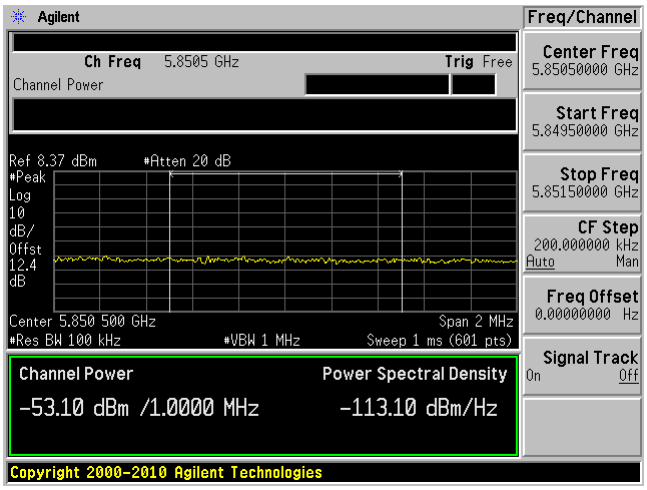


Chain 1

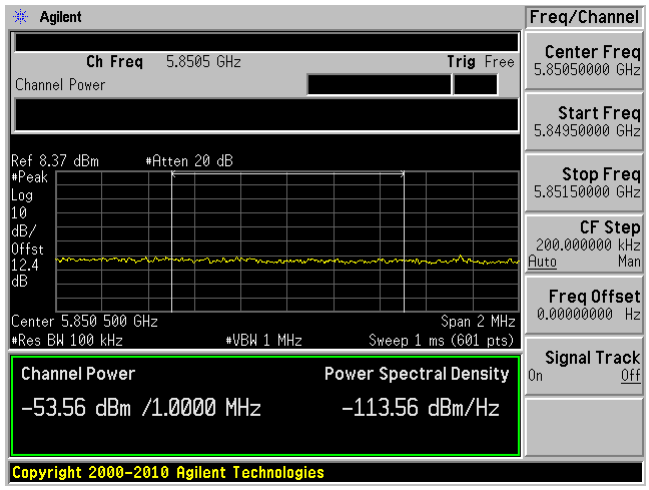


802.11n-HT20, High Channel, 5825 MHz

Chain 0

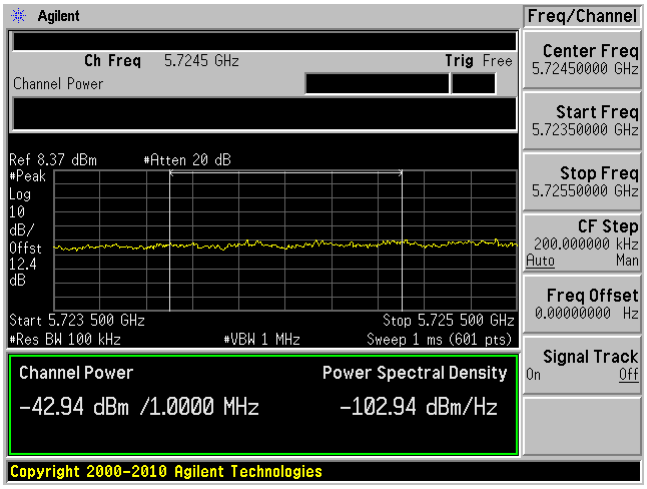


Chain 1

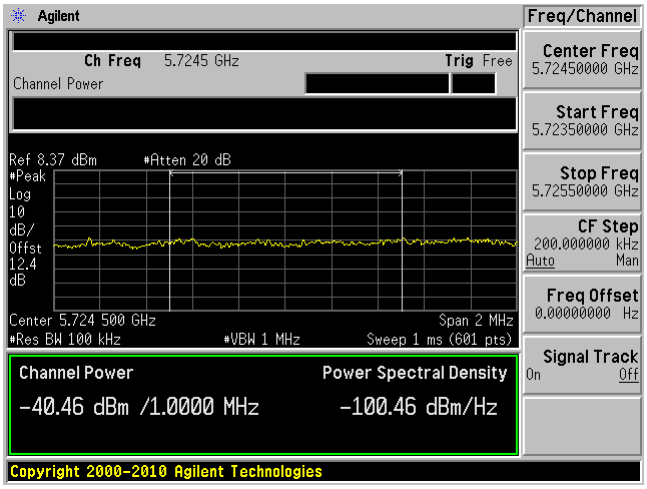


802.11n-HT40, Low Channel 5755 MHz

Chain 0

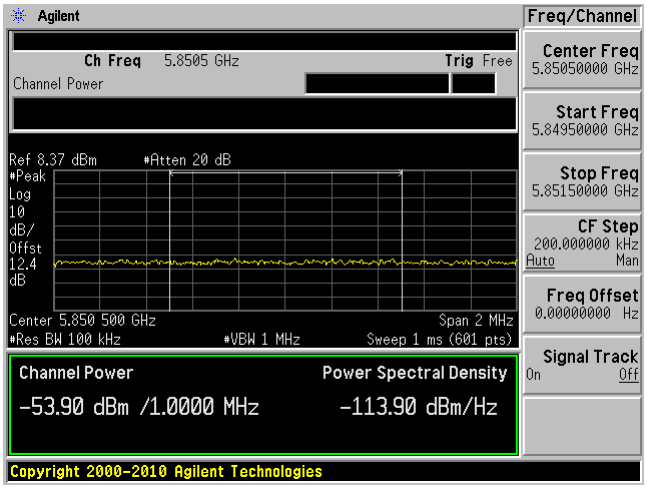


Chain 1

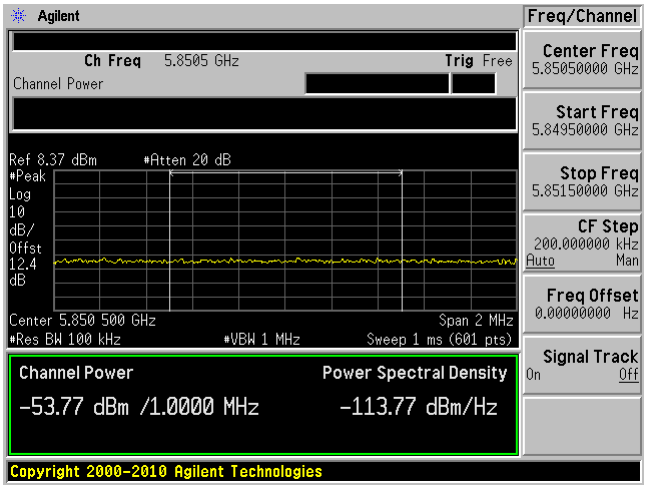


802.11n-HT40, High Channel 5795 MHz

Chain 0

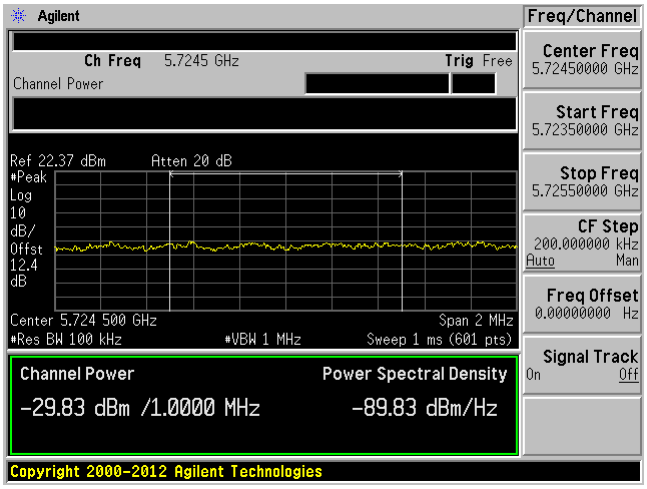


Chain 1

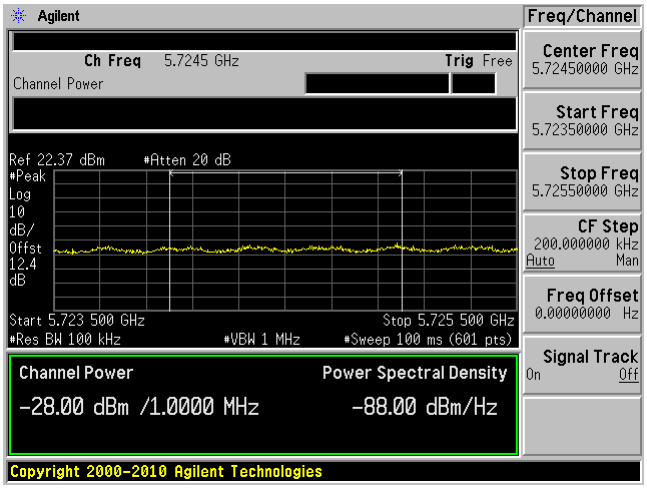


802.11ac-VHT80, 5775 MHz Lower Band at 5725MHz

Chain 0

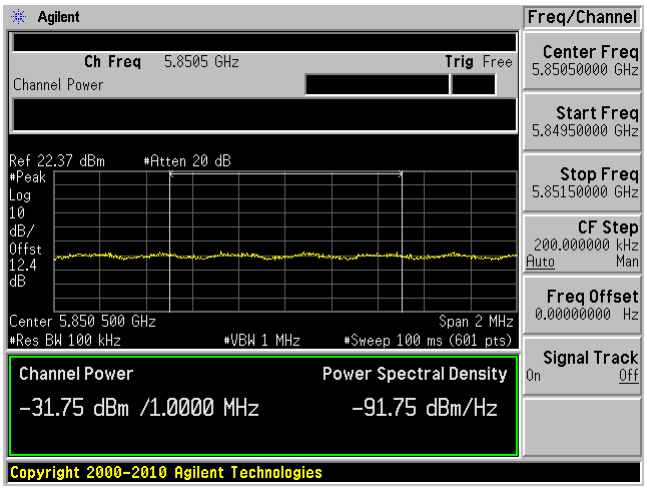


Chain 1

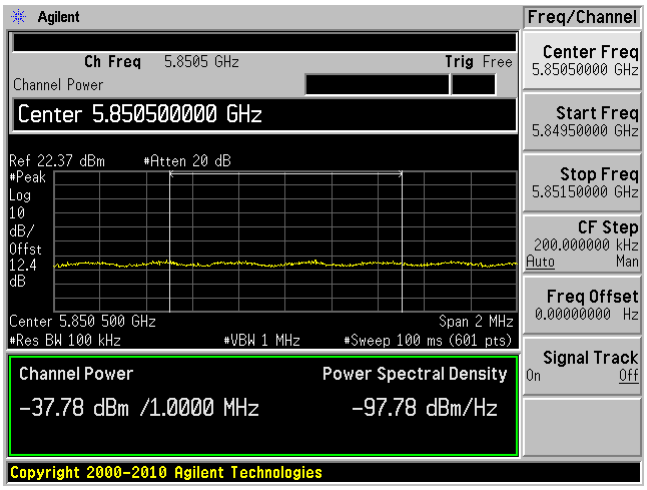


802.11ac-VHT80, 5775 MHz Higher Band at 5850MHz

Chain 0



Chain 1



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

11.1 Applicable Standards

FCC §15.407(b)

(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 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:	22-24º C
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

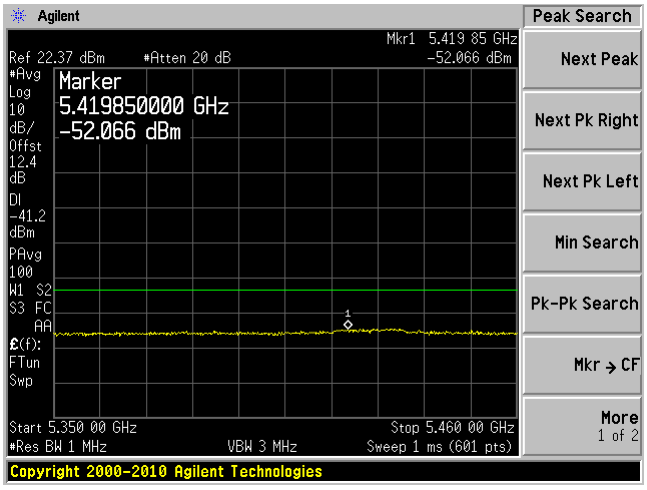
Note: The offset include the attenuation, cable loss. And the magin between limit line and the emission covers other requirements in the KDB 789033.

Please refer to following plots of spurious emissions.

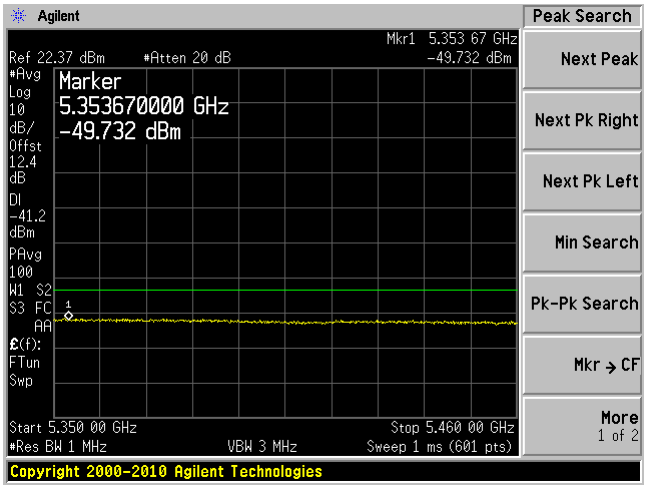
Restrict Band Measurement

802.11a, Low Channel, 5745 MHz

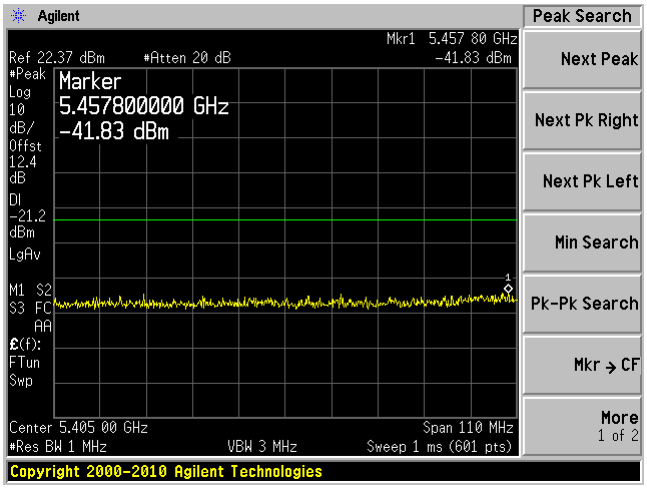
Chain 0 AVG



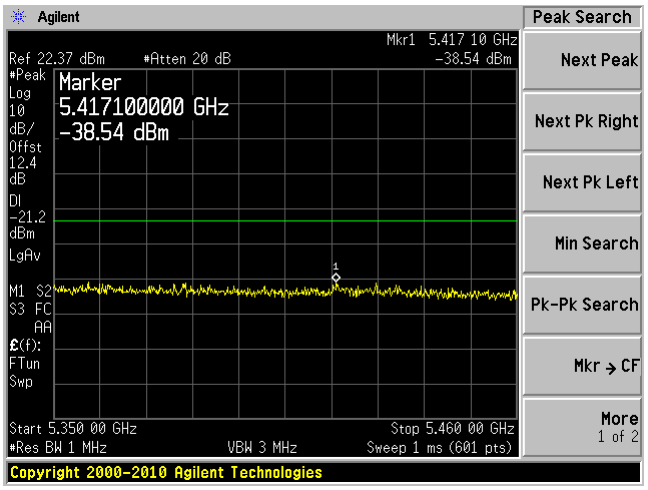
Chain 1 AVG



Chain 0 PEAK

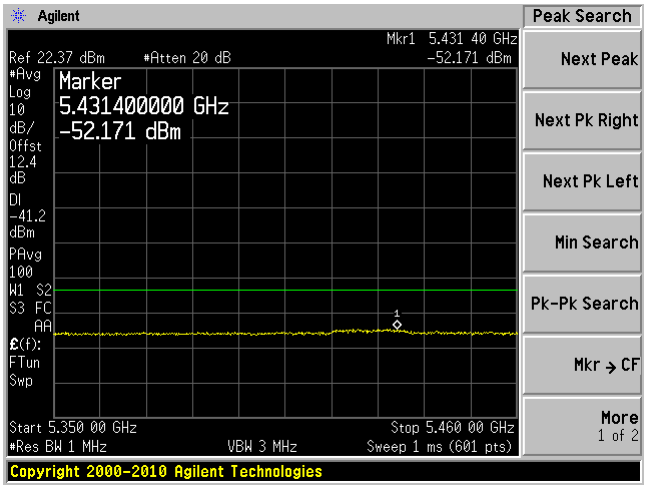


Chain 1 PEAK

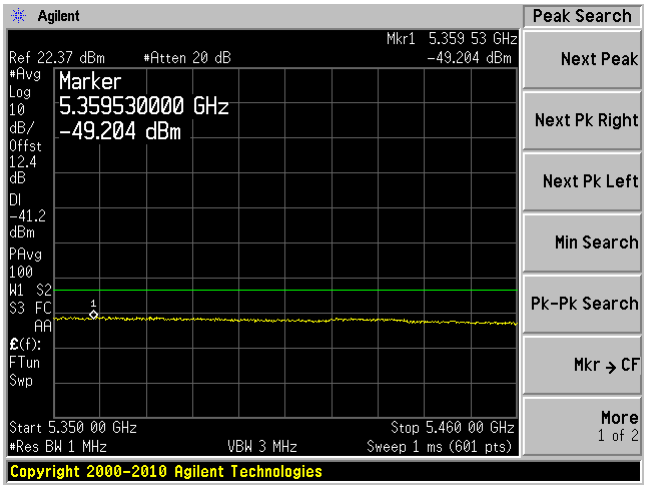


802.11n-HT 20, Low Channel 5745 MHz

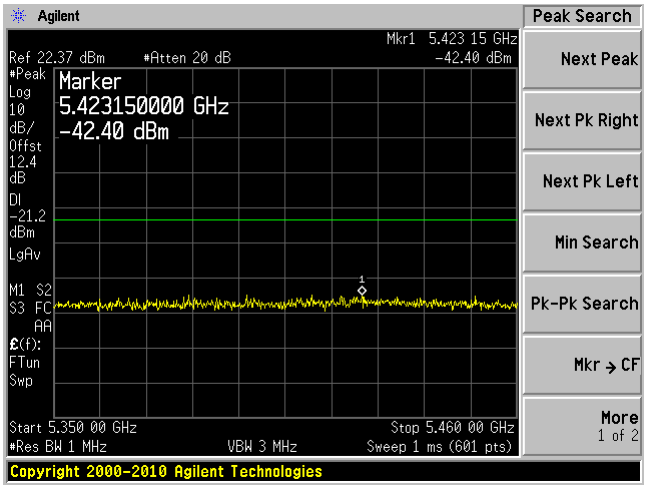
Chain 0 AVG



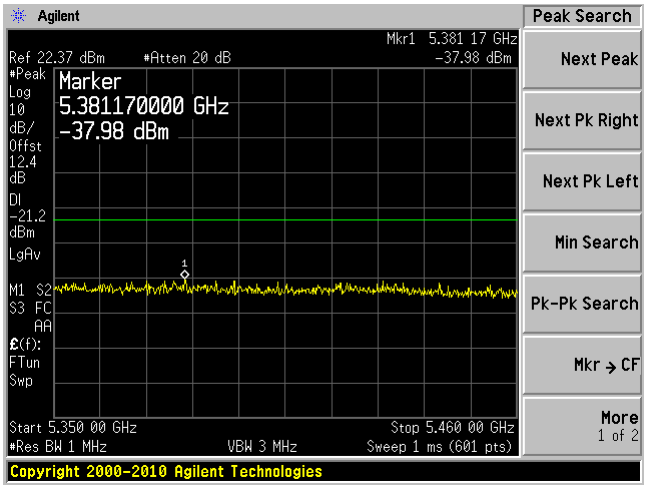
Chain 1 AVG



Chain 0 PEAK

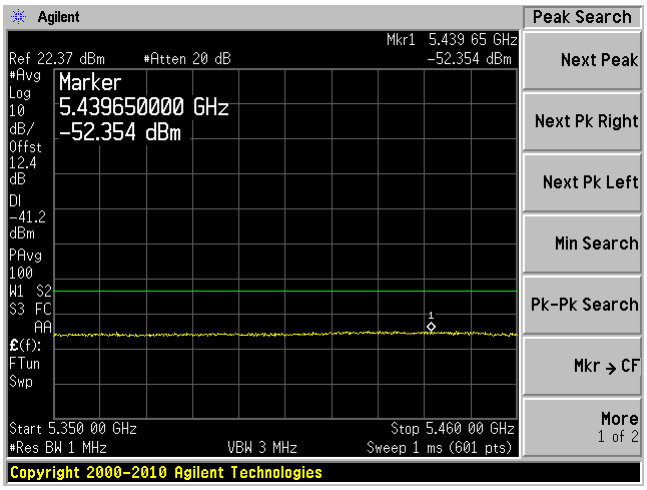


Chain 1 PEAK

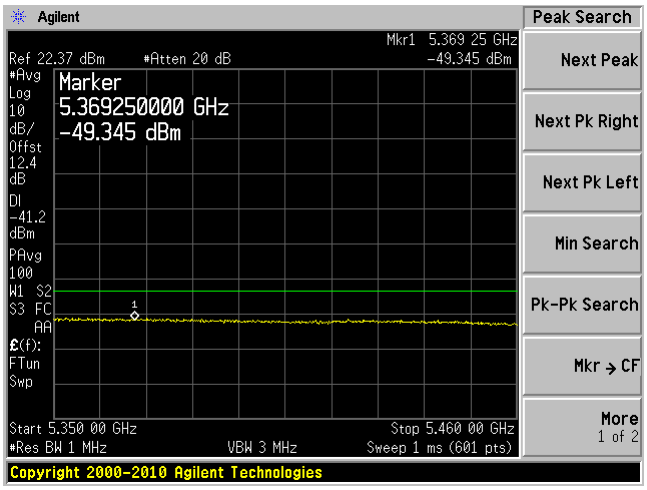


802.11n-HT40, Low Channel 5755 MHz

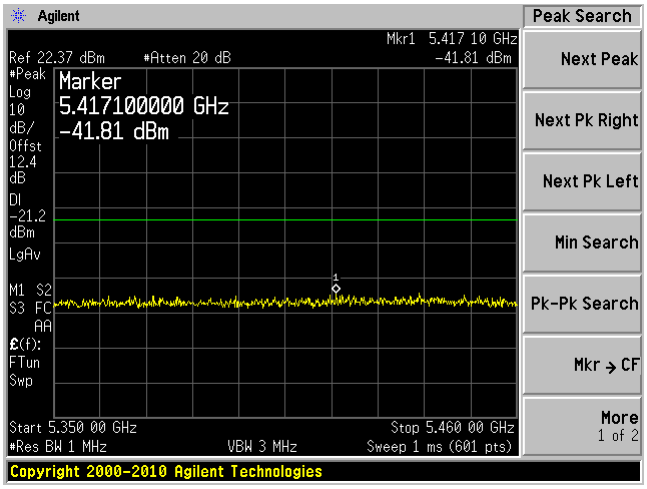
Chain 0 AVG



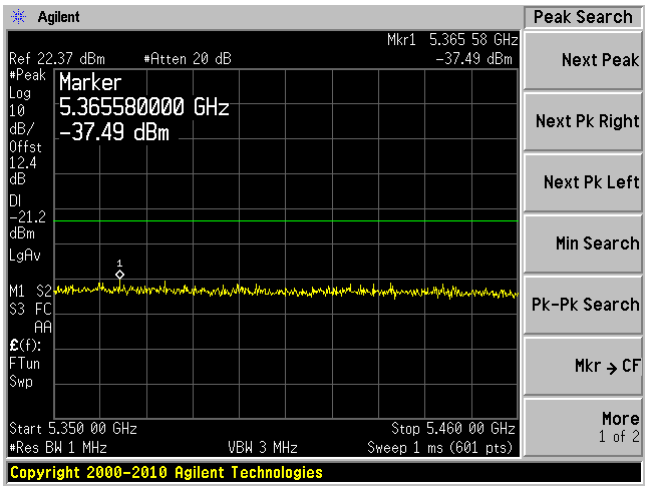
Chain 1 AVG



Chain 0 PEAK

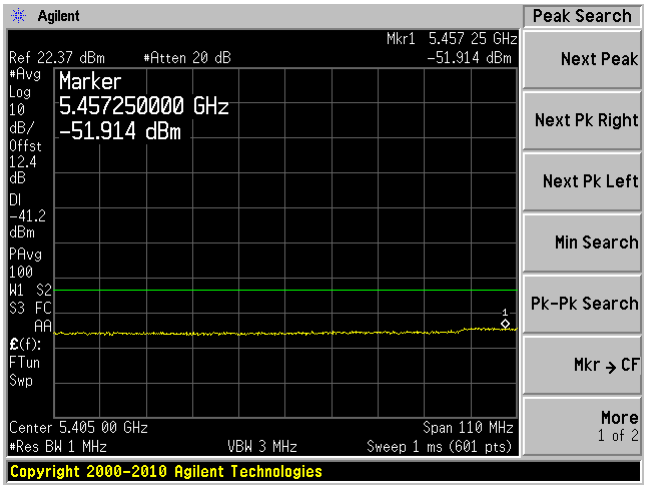


Chain 1 PEAK

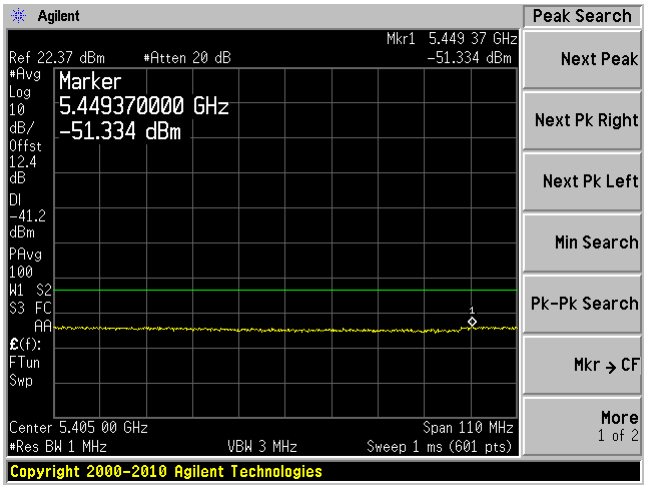


802.11ac-VHT80, High Channel 5775 MHz

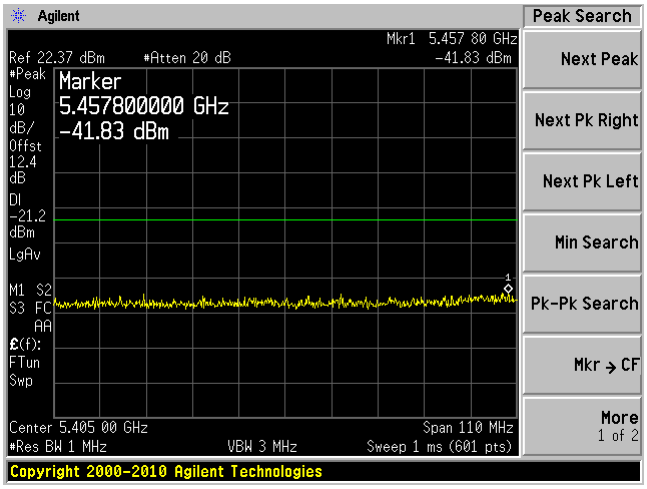
Chain 0 AVG



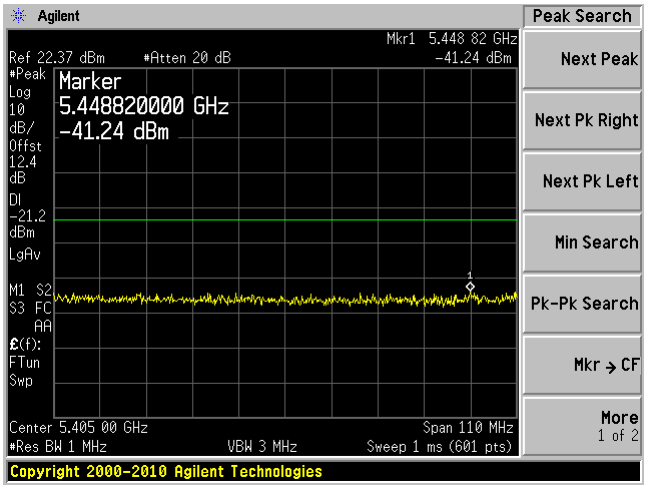
Chain 1 AVG



Chain 0 PEAK



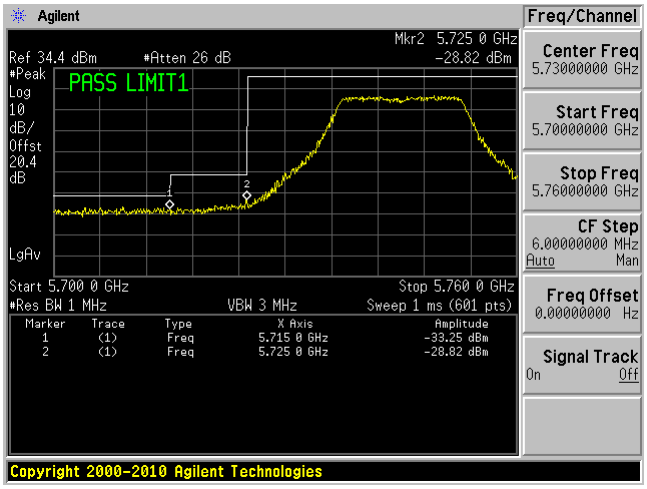
Chain 1 PEAK



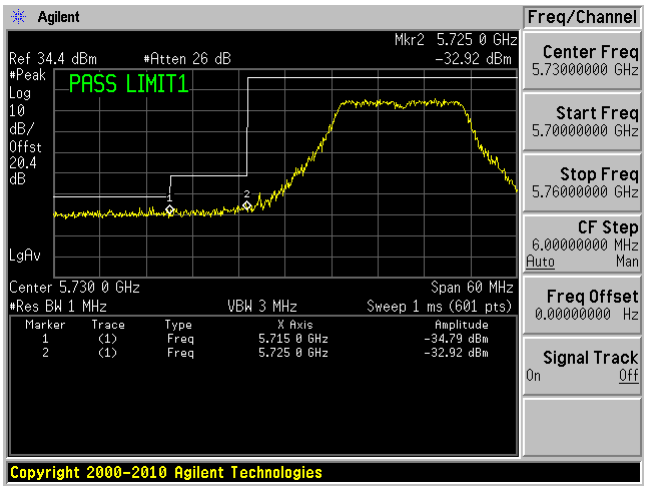
10 MHz Band Edge Emission Mask:

802.11a, Low Channel, 5745 MHz

Chain 0

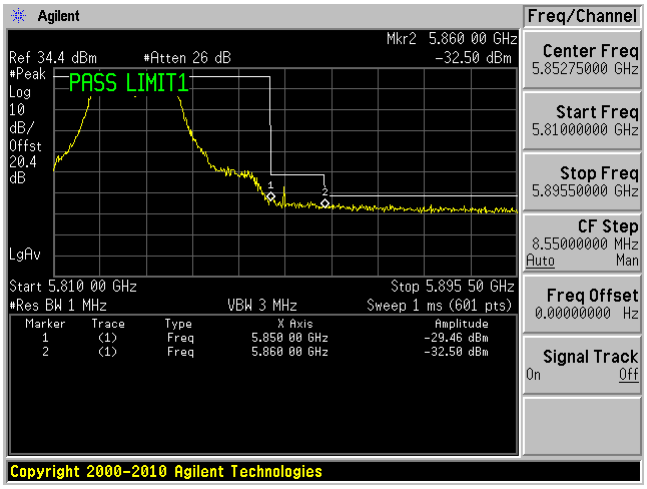


Chain 1

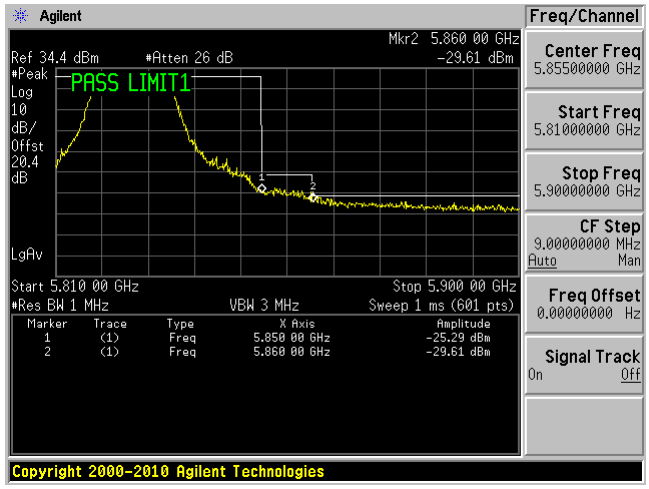


802.11a, High Channel, 5825 MHz

Chain 0

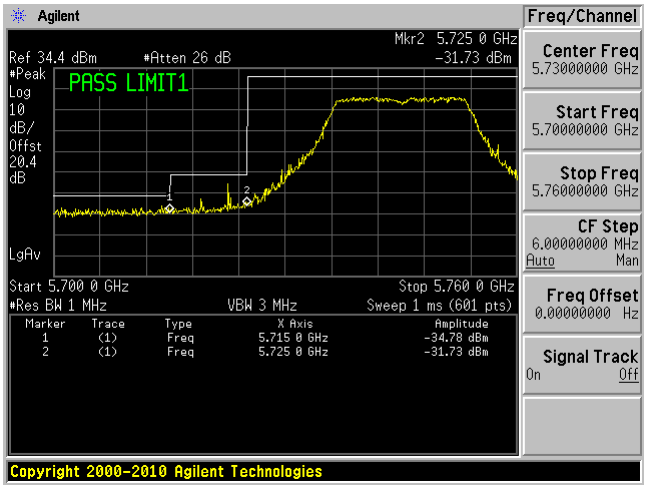


Chain 1

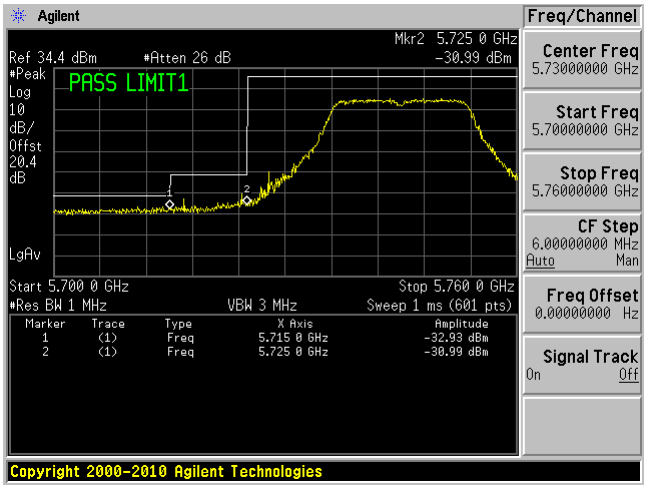


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

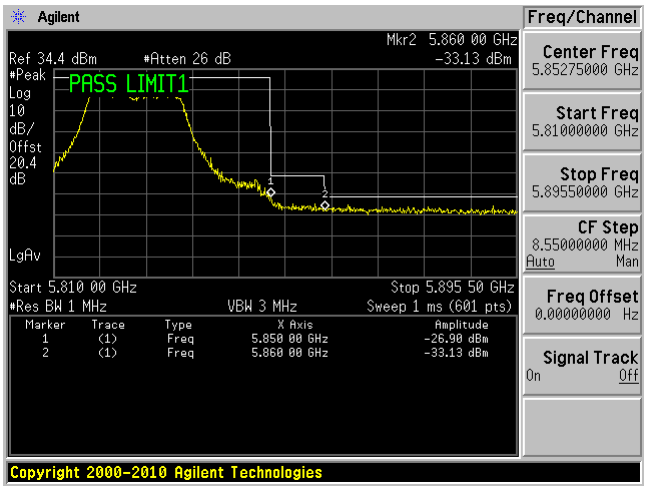


Chain 1

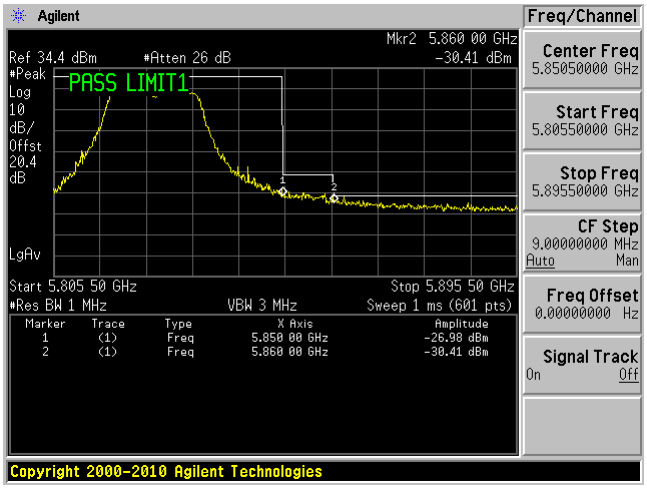


802.11n-HT20, High Channel, 5825 MHz

Chain 0

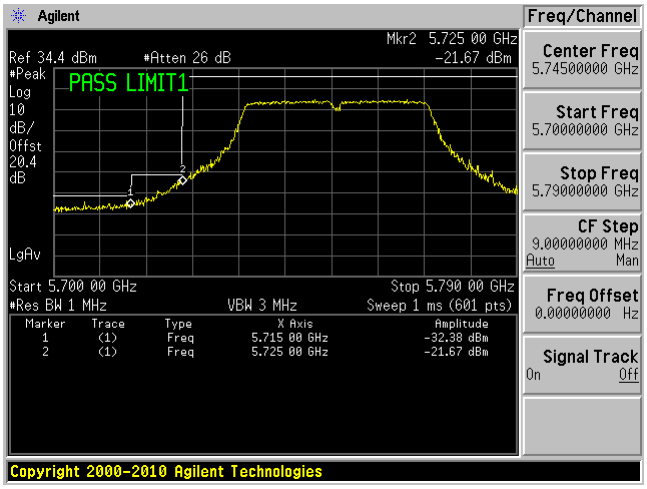


Chain 1

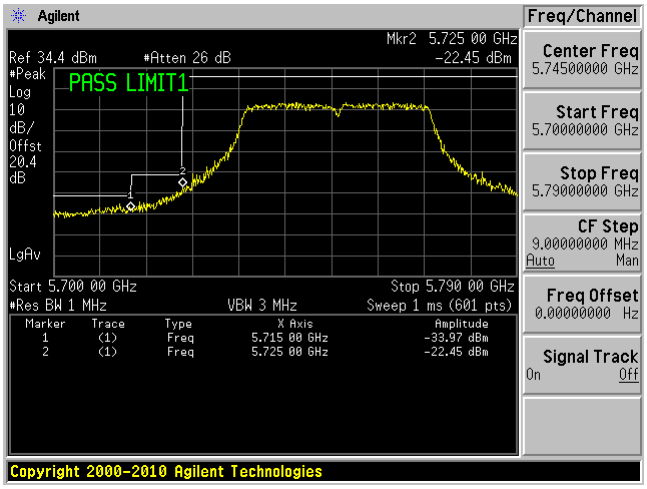


802.11n-HT40, Low Channel 5755 MHz

Chain 0

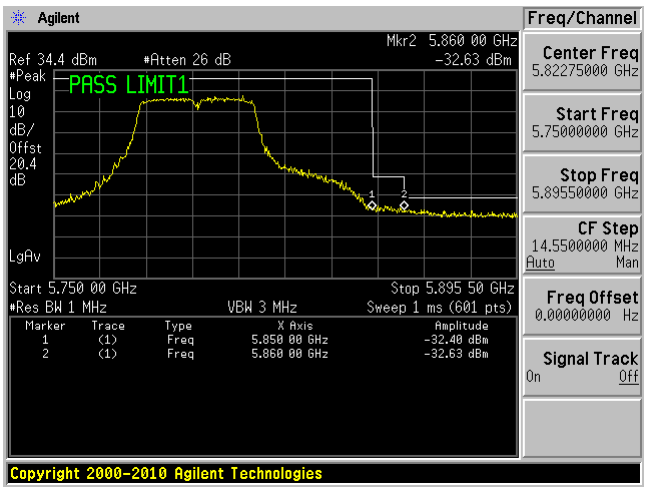


Chain 1

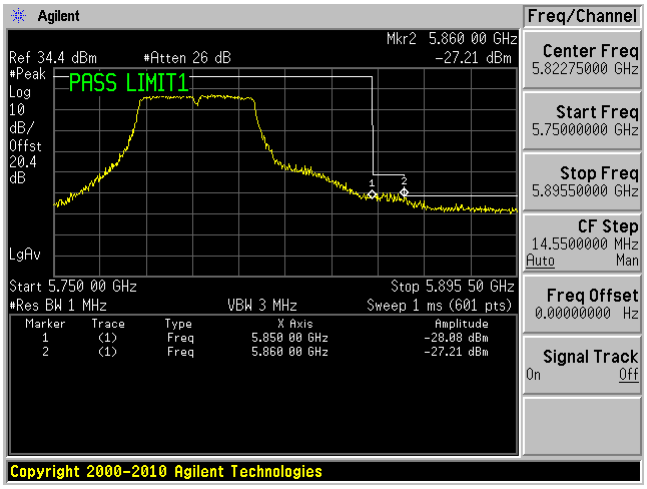


802.11n-HT40, High Channel 5795 MHz

Chain 0

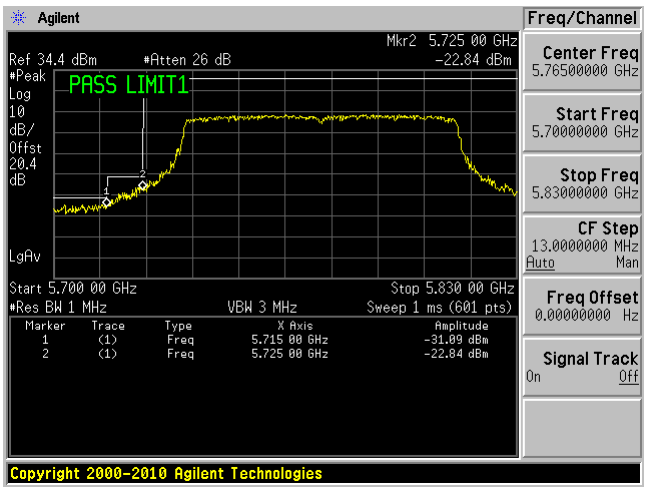


Chain 1

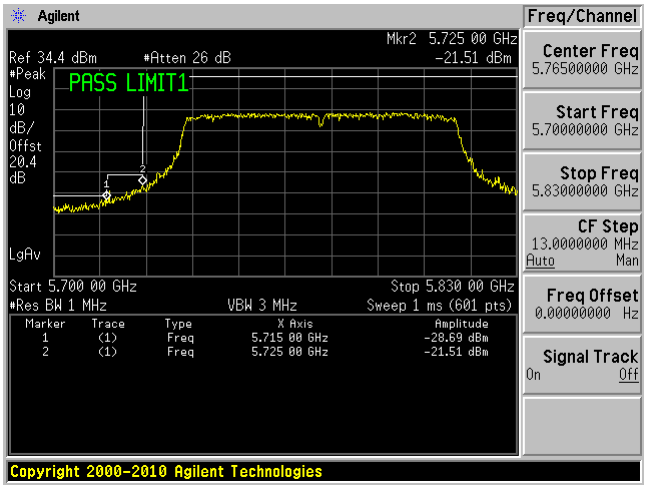


802.11ac-VHT80, High Channel 5775 MHz

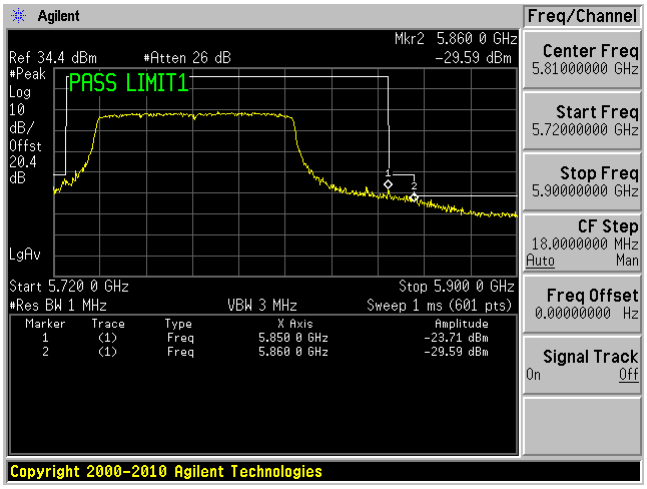
Chain 0 Lower Band Edge



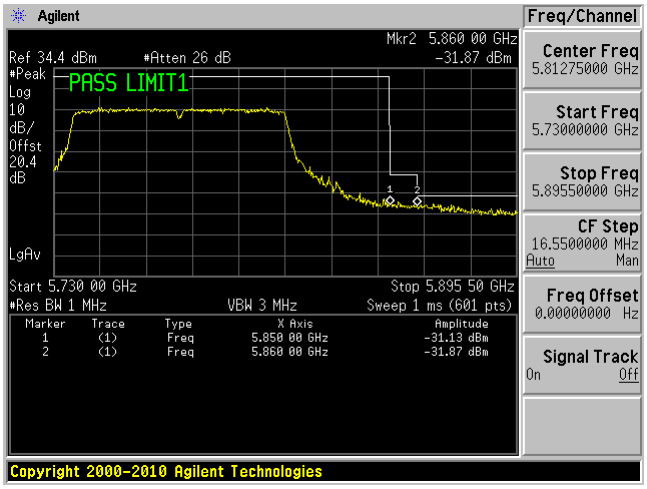
Chain 1 Lower Band Edge



Chain 0 Higher Band Edge



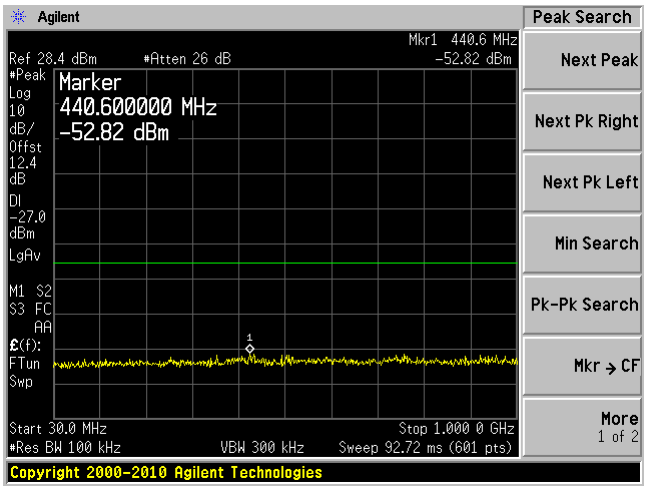
Chain 1 Higher Band Edge



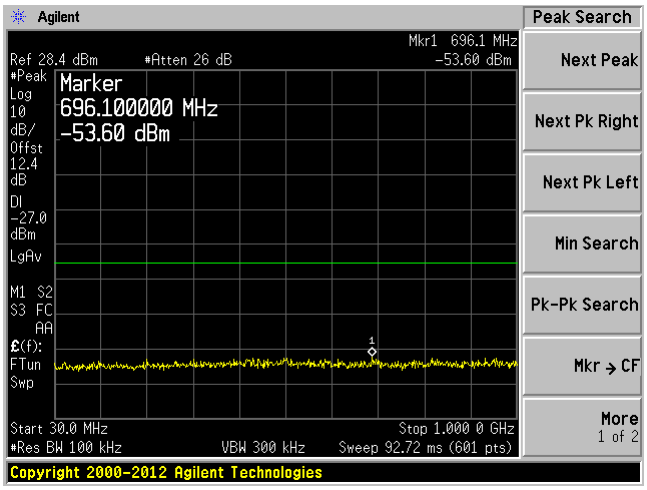
Spurious Emission 30 MHz-40 GHz:

802.11a Mode Low Channel 5745MHz

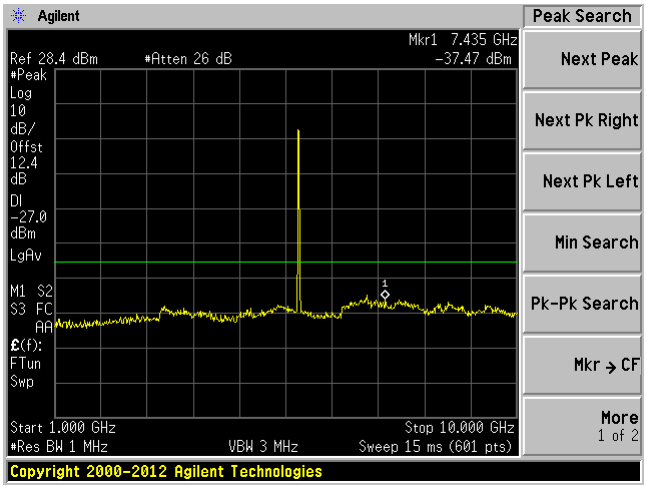
Chain 0 30MHz—1GHz



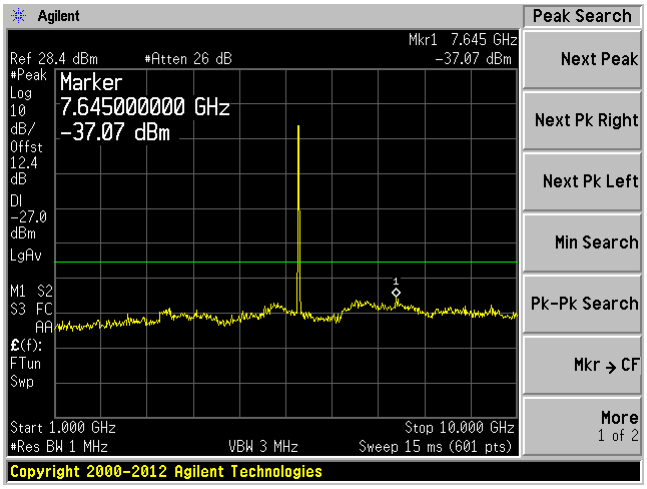
Chain 1 30MHz---1GHz



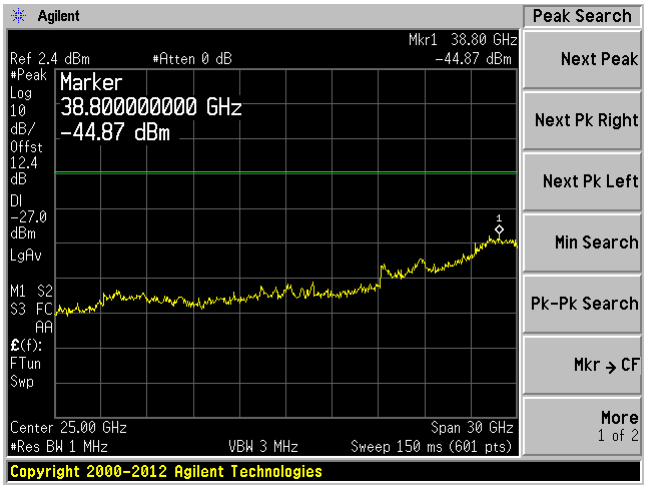
Chain 0 1GHz---10GHz



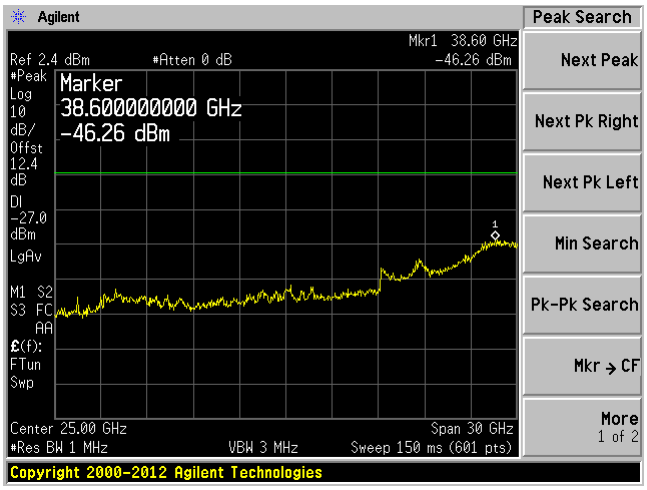
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

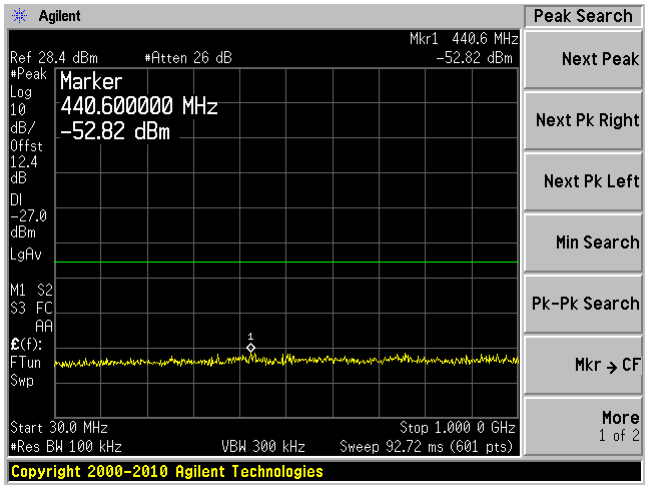


Chain 1 10GHz---40GHz

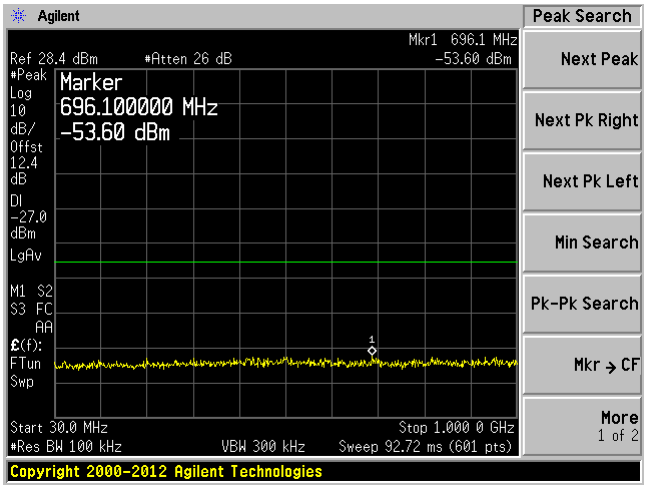


802.11 a Mode Mid Channel 5785MHz

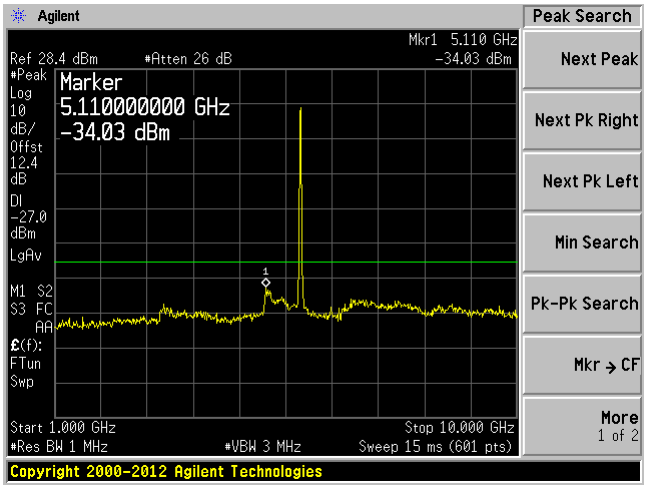
Chain 0 30MHz—1GHz



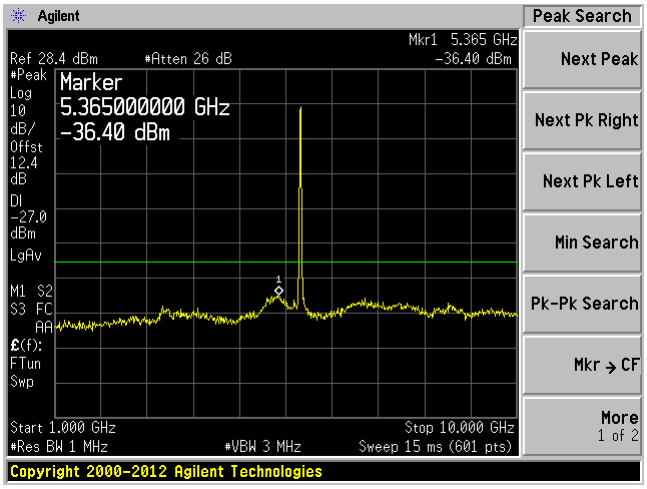
Chain 1 30MHz---1GHz



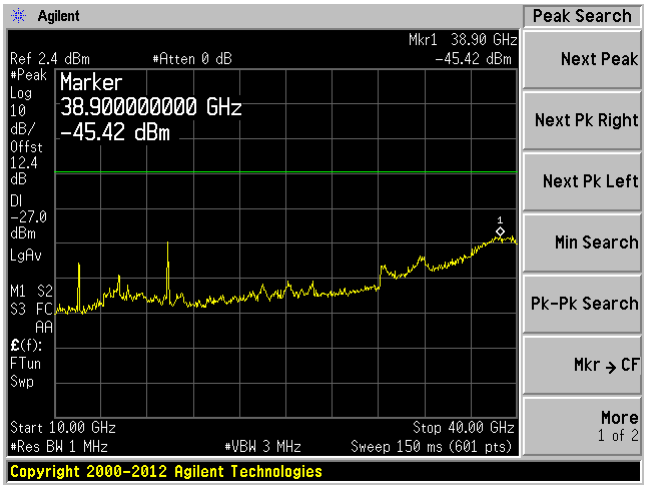
Chain 0 1GHz---10GHz



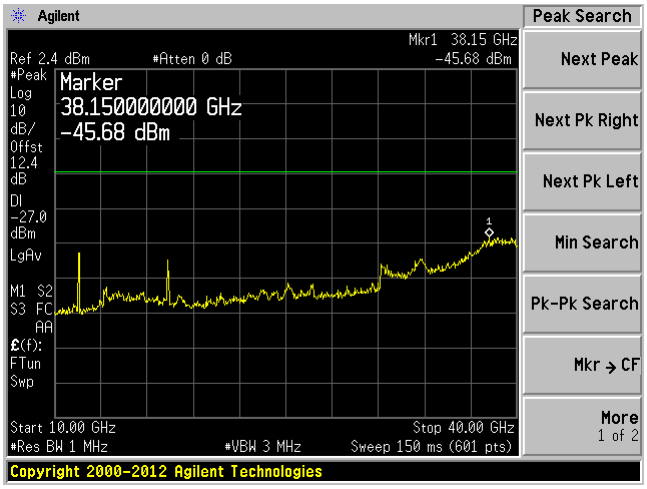
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

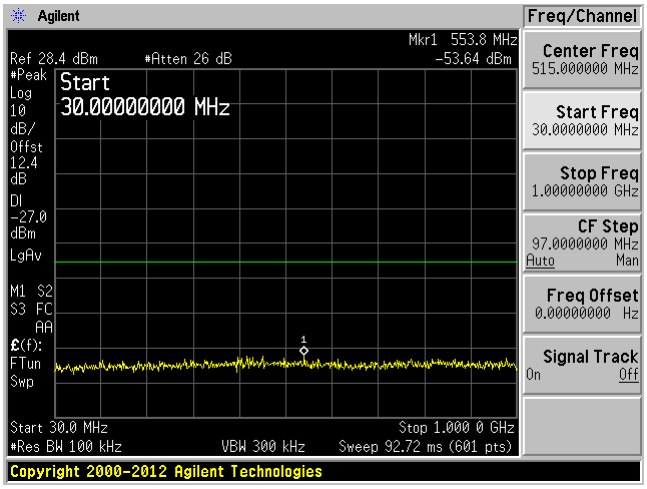


Chain 1 10GHz---40GHz

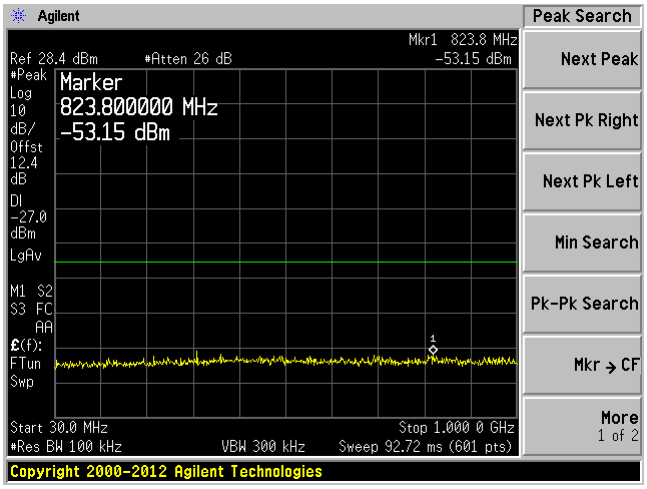


802.11a Mode High Channel 5825MHz

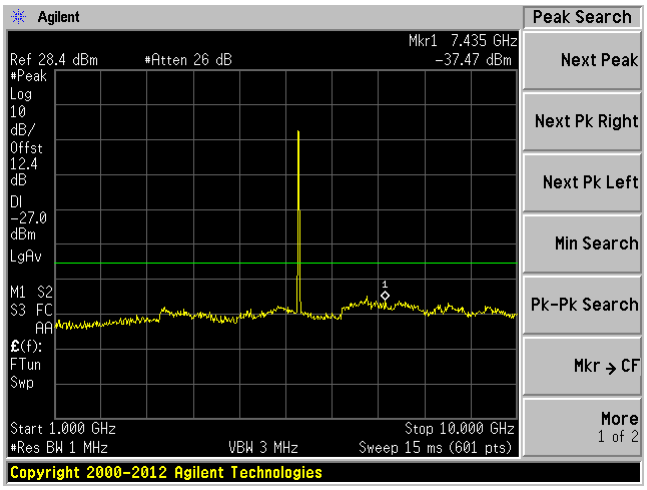
Chain 0 30MHz—1GHz



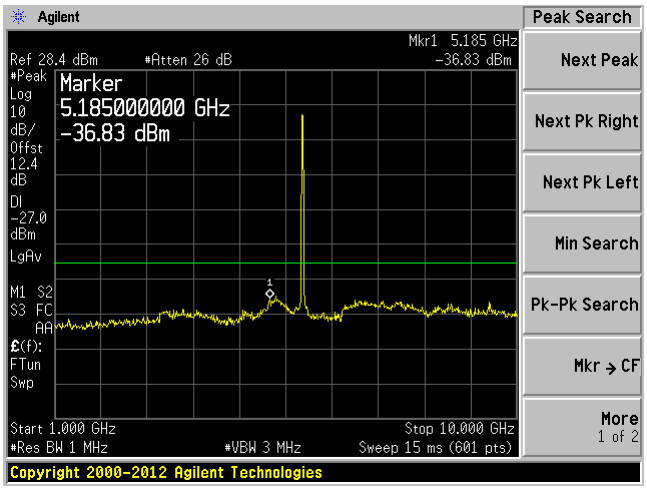
Chain 1 30MHz---1GHz



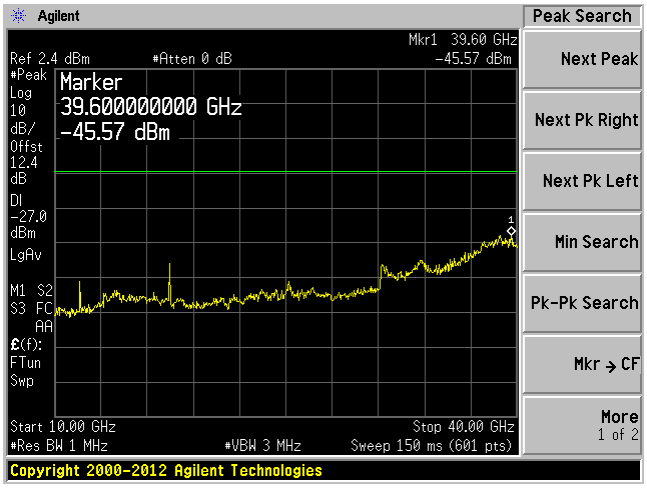
Chain 0 1GHz---10GHz



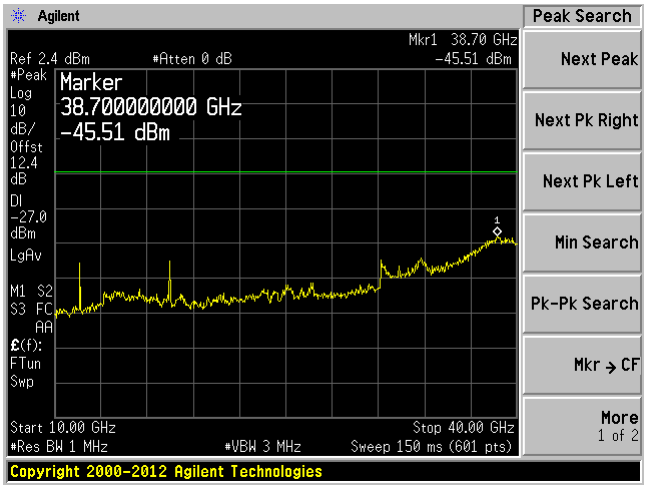
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

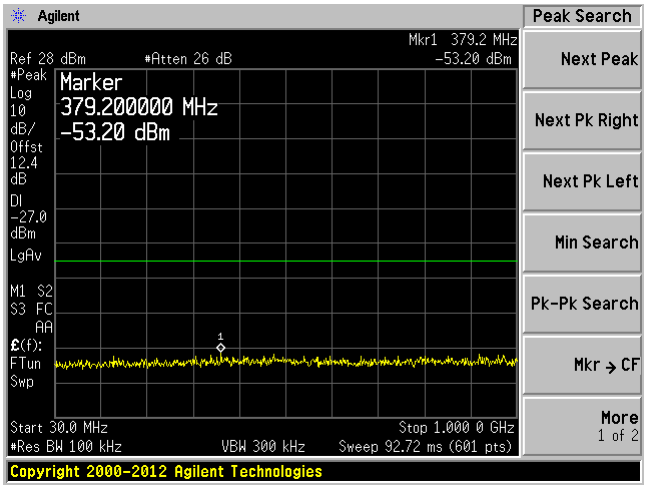


Chain 1 10GHz---40GHz

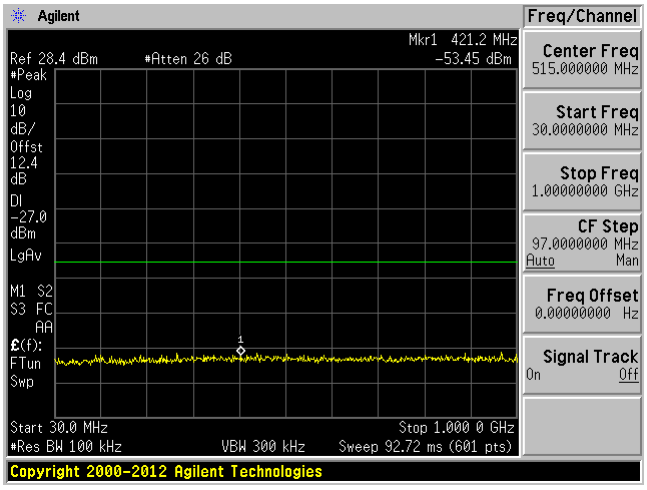


802.11 n-HT20 Mode Low Channel 5745 MHz

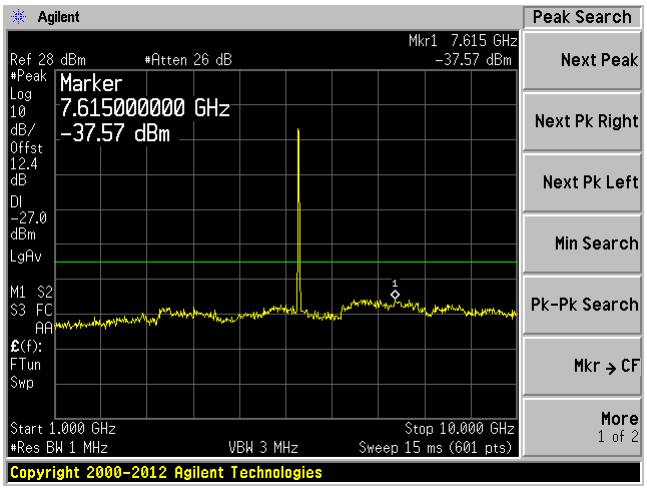
Chain 0 30MHz—1GHz



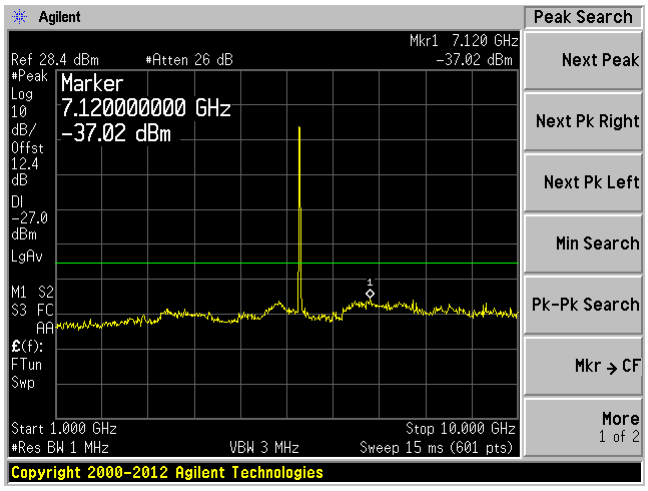
Chain 1 30MHz---1GHz



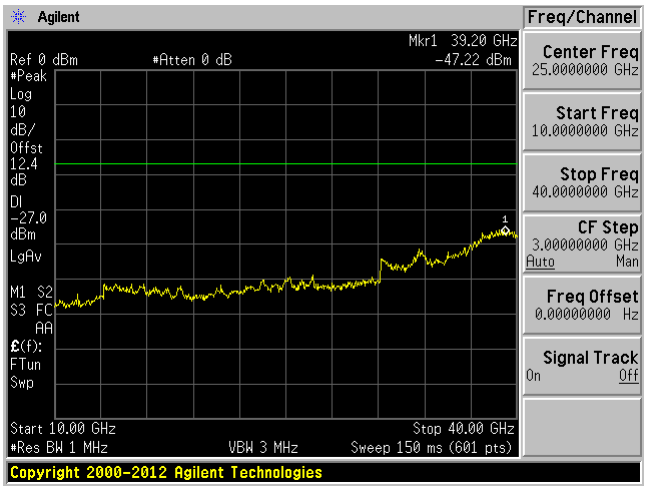
Chain 0 1GHz---10GHz



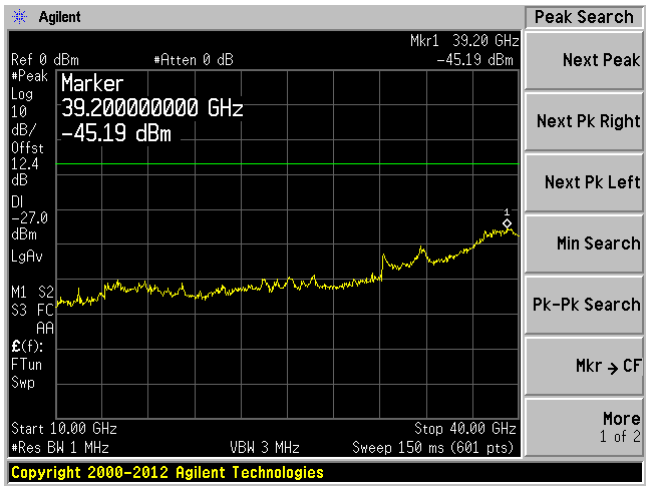
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

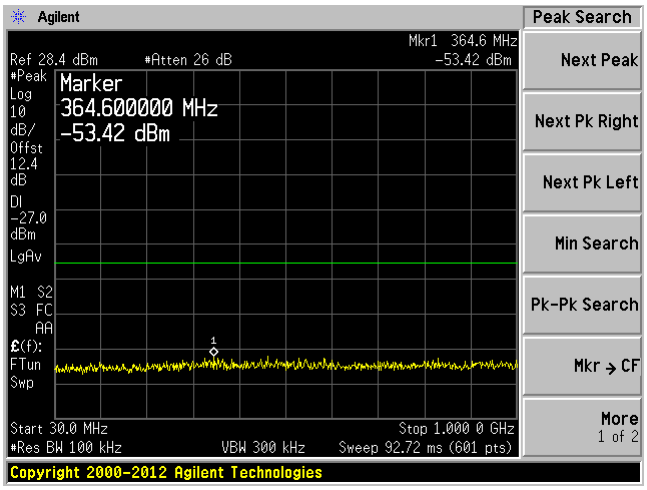


Chain 1 10GHz---40GHz

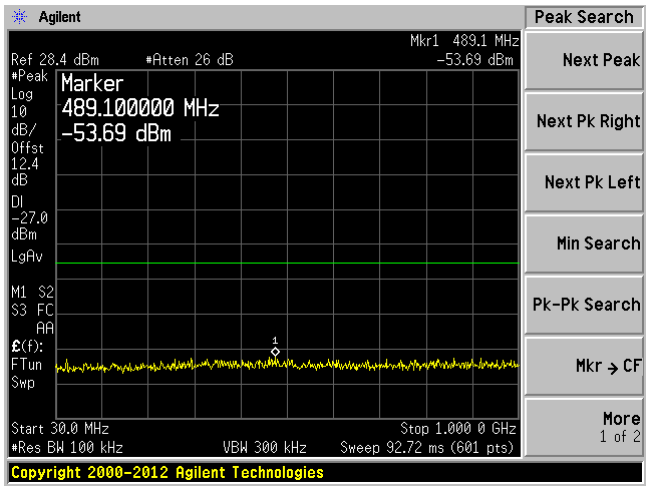


802.11 n-HT20 Mode Middle Channel 5785MHz

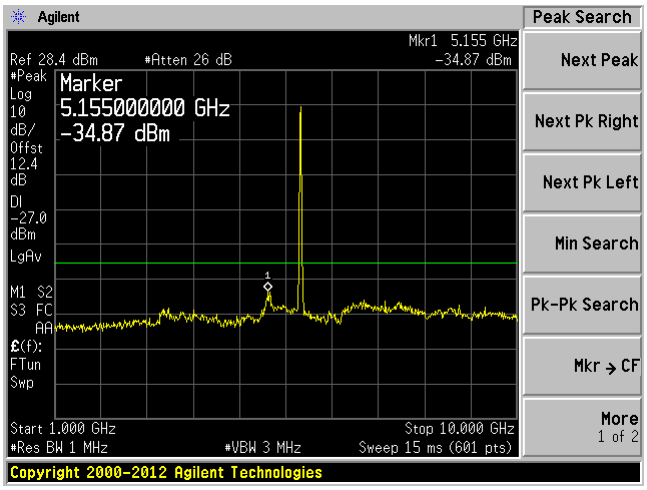
Chain 0 30MHz—1GHz



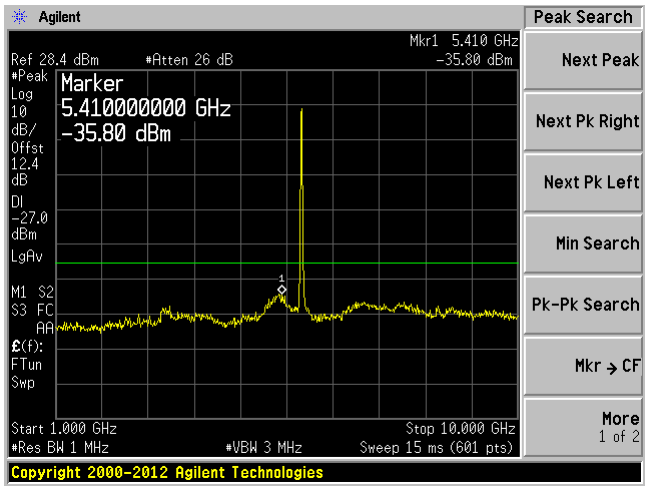
Chain 1 30MHz---1GHz



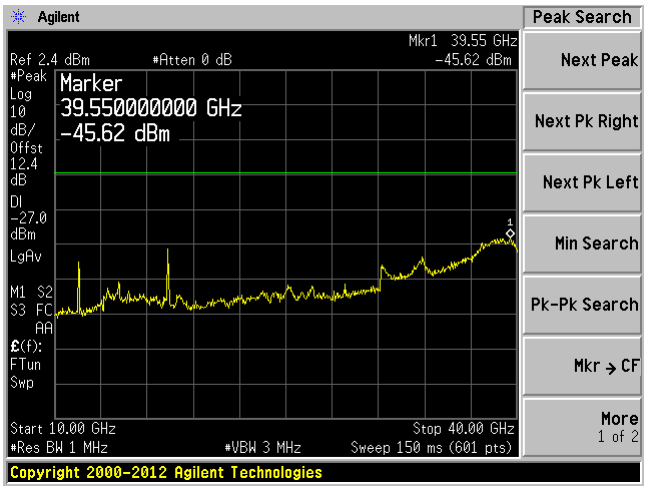
Chain 0 1GHz---10GHz



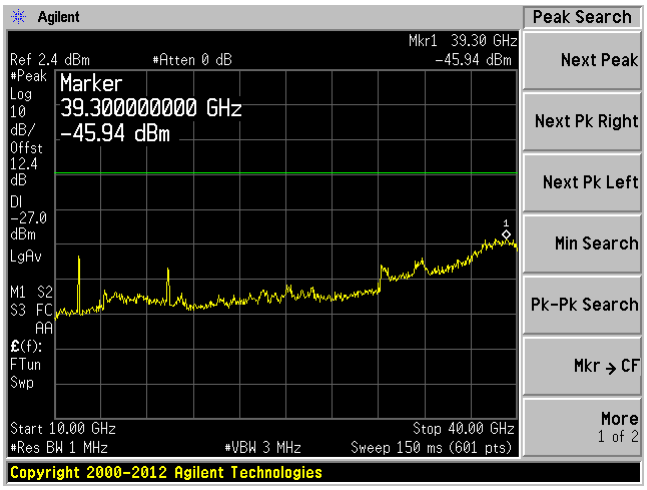
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

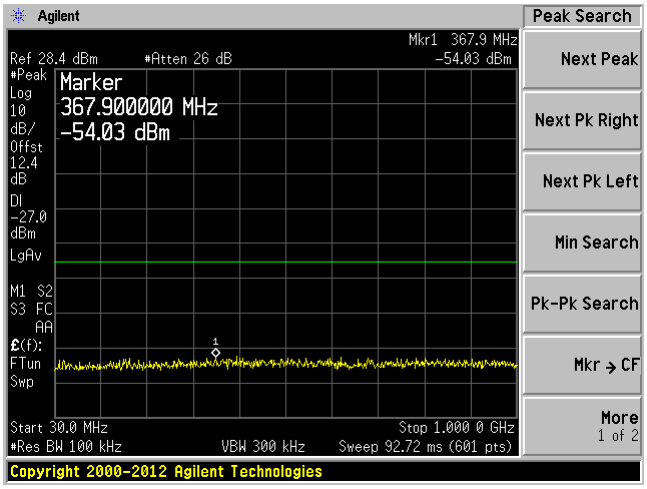


Chain 1 10GHz---40GHz

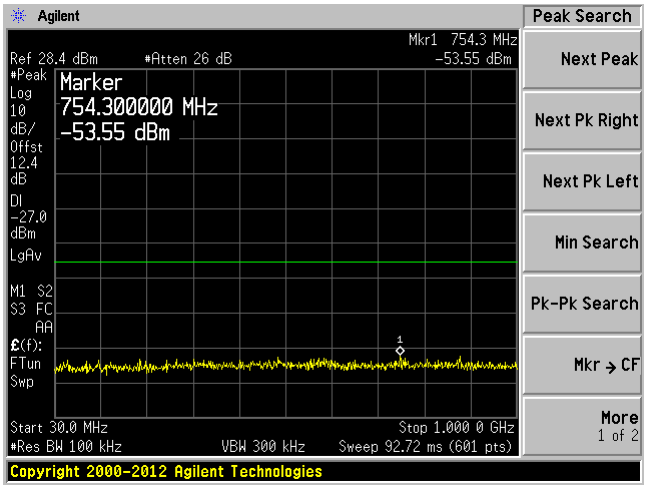


802.11 n-HT20 Mode High Channel 5825 MHz

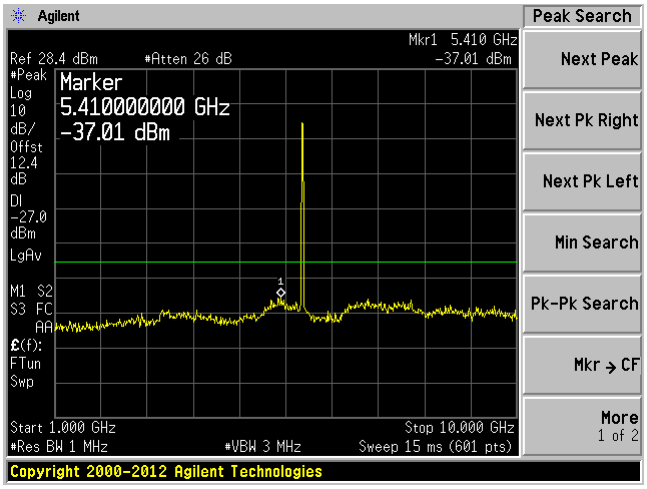
Chain 0 30MHz—1GHz



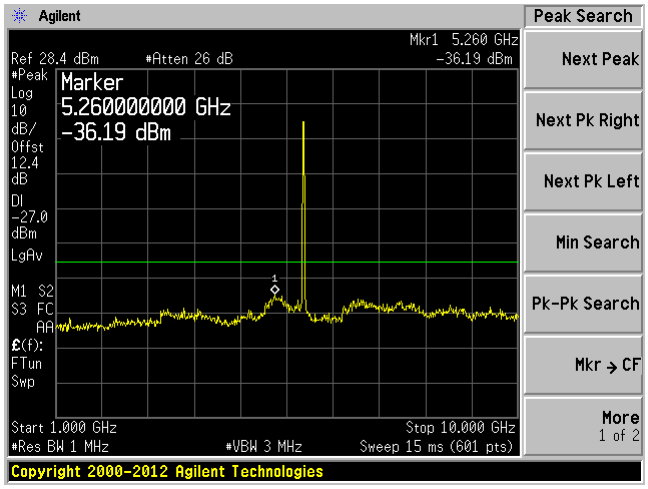
Chain 1 30MHz---1GHz



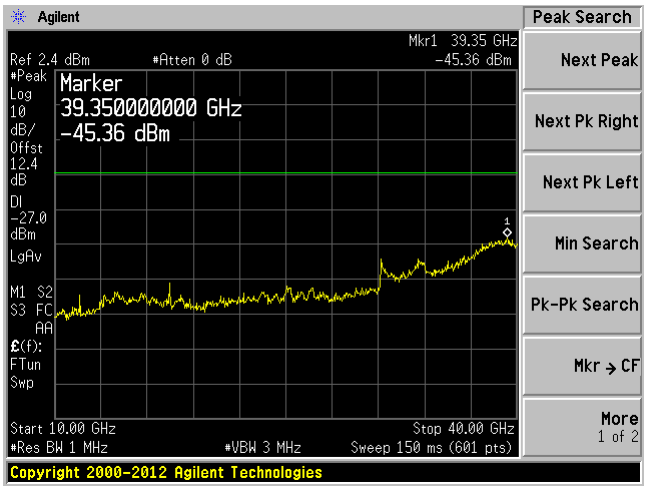
Chain 0 1GHz---10GHz



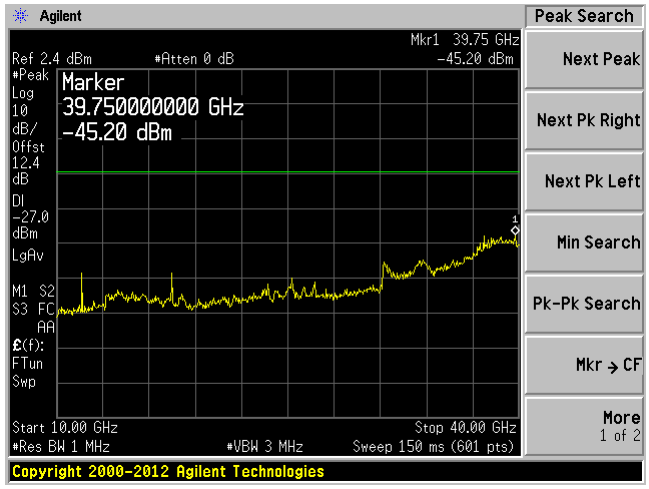
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

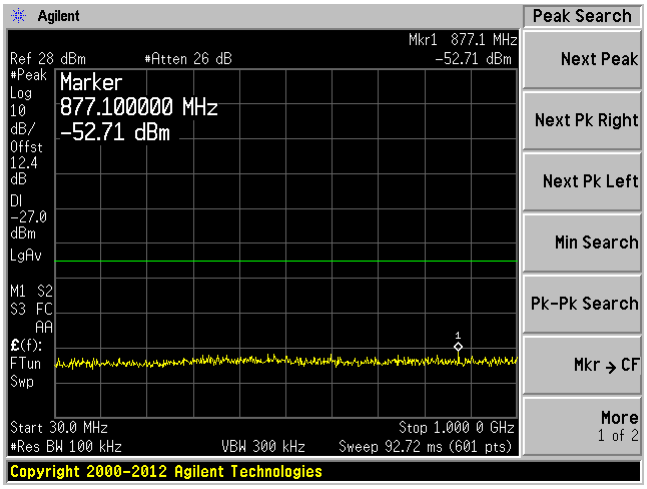


Chain 1 10GHz---40GHz

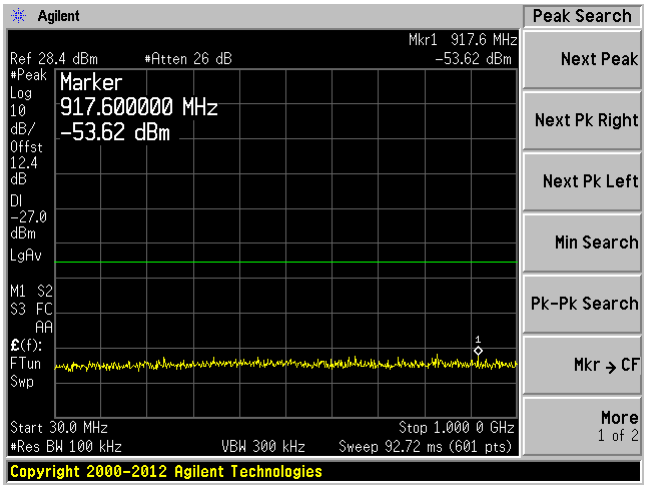


802.11 n-HT40 Mode Low Channel 5755 MHz

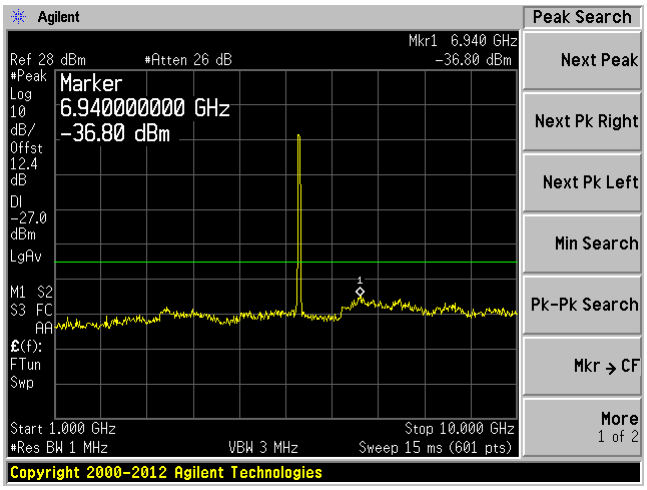
Chain 0 30MHz—1GHz



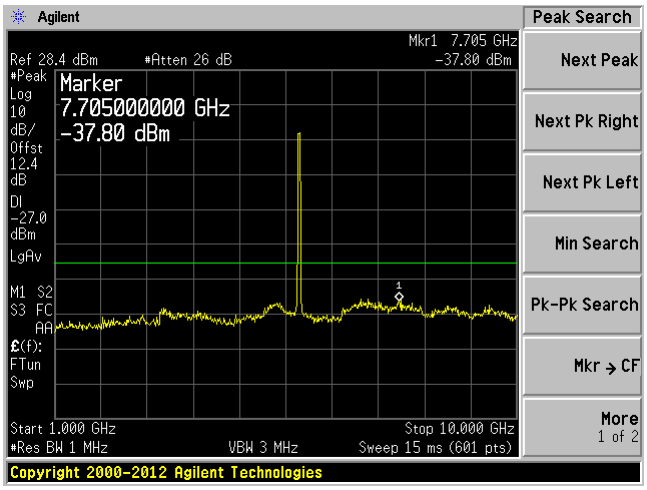
Chain 1 30MHz---1GHz



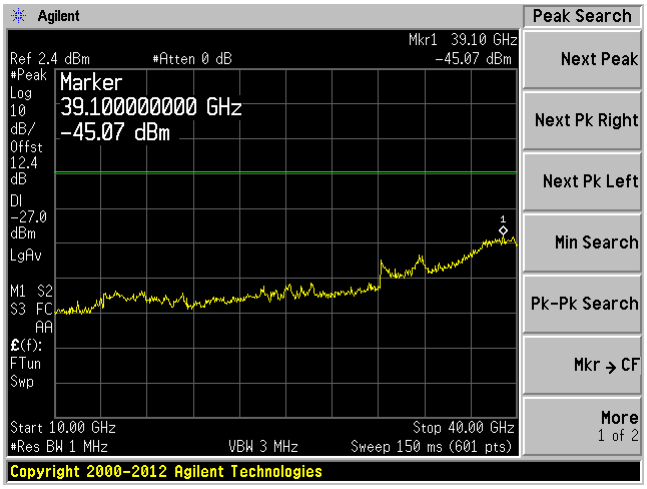
Chain 0 1GHz---10GHz



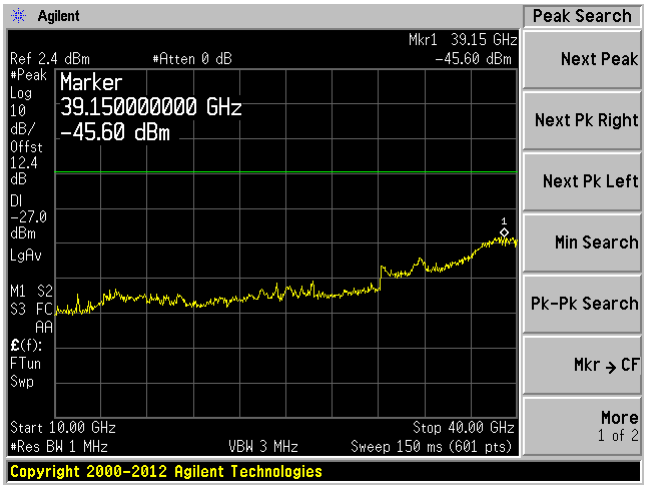
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

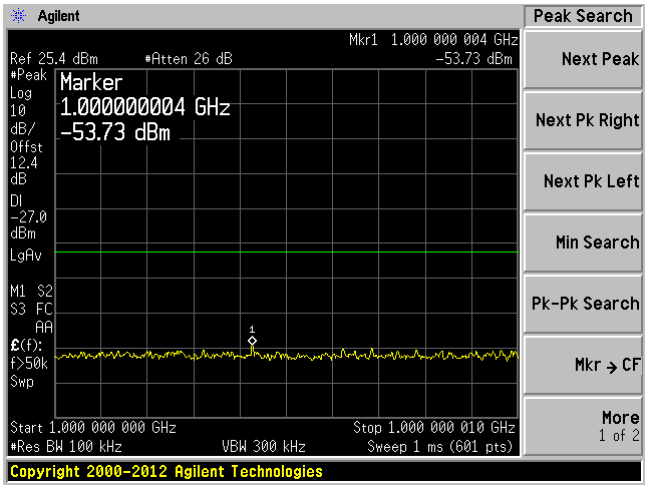


Chain 1 10GHz---40GHz

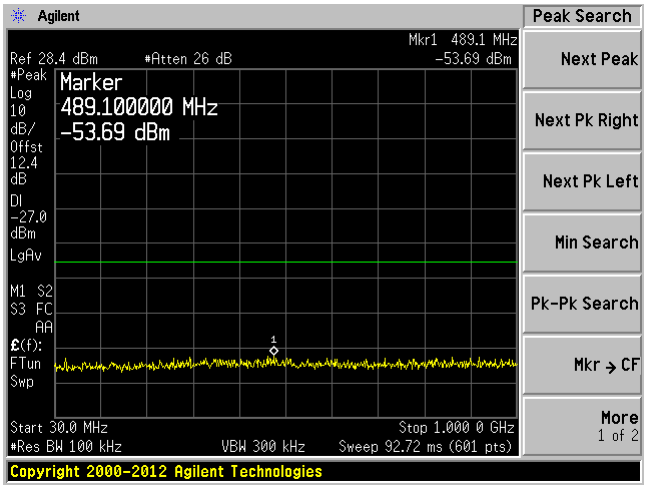


802.11 n-HT40 Mode High Channel 5795MHz

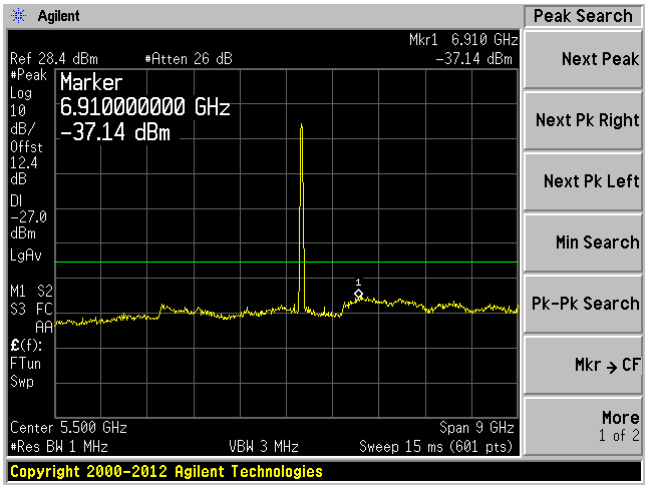
Chain 0 30MHz—1GHz



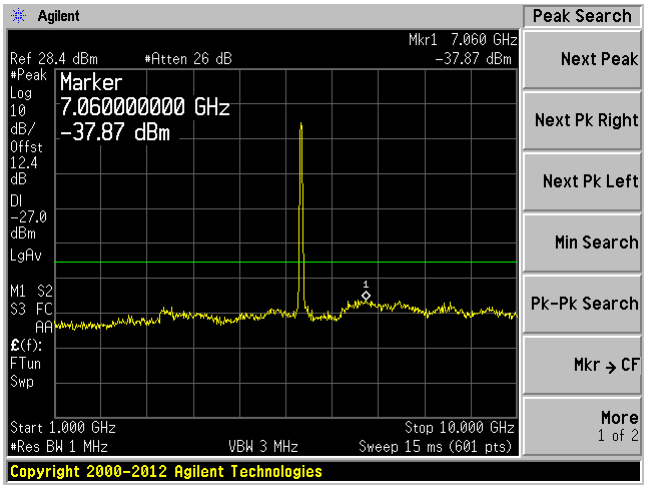
Chain 1 30MHz---1GHz



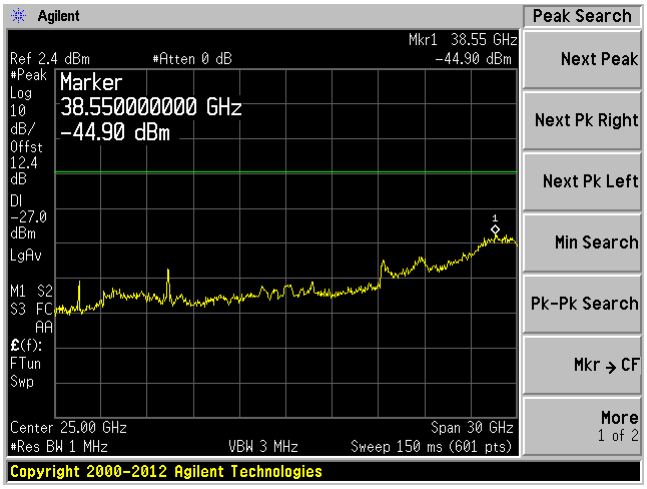
Chain 0 1GHz---10GHz



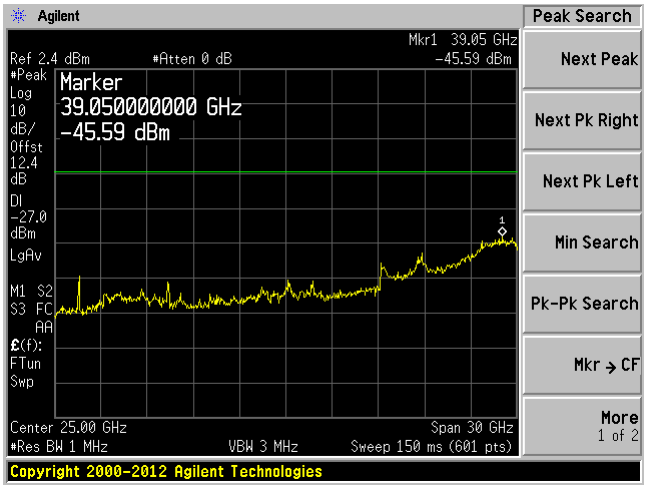
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz

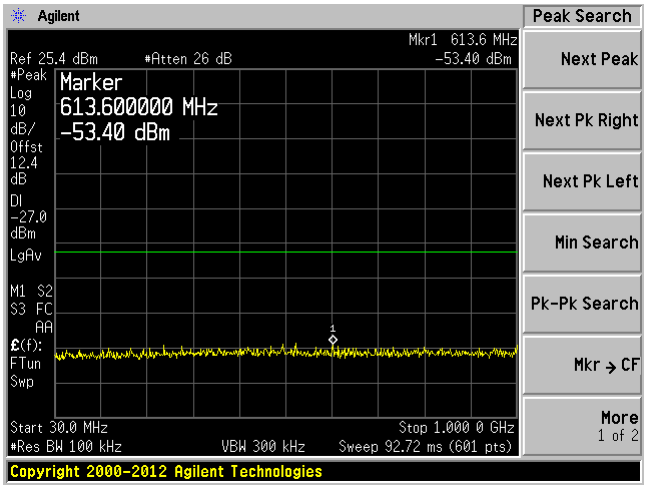


Chain 1 10GHz---40GHz

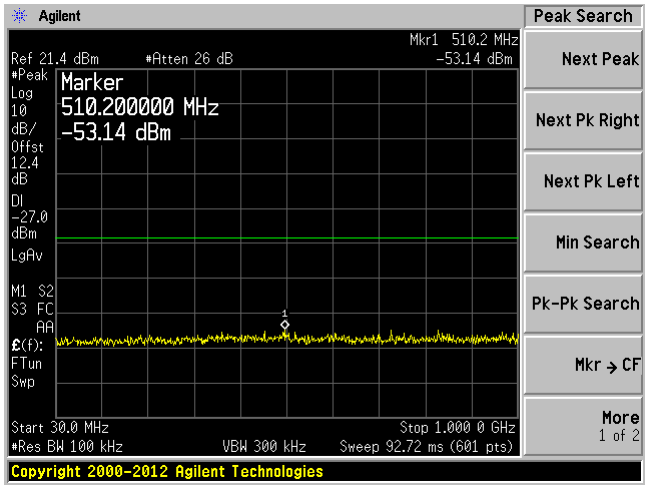


802.11 ac-VHT80 Mode 5775 MHz

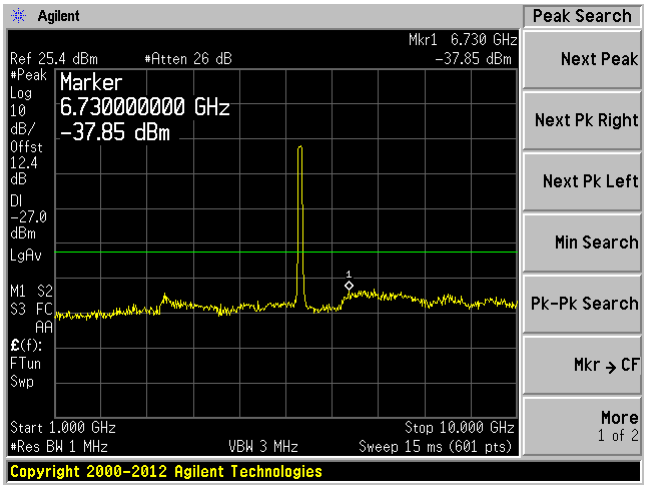
Chain 0 30MHz—1GHz



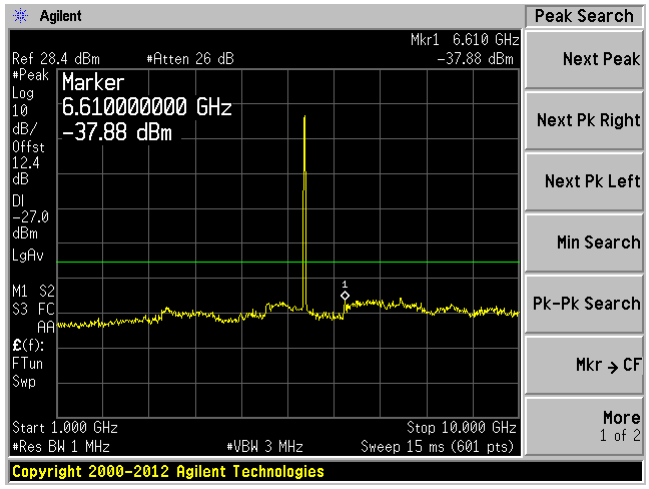
Chain 1 30MHz---1GHz



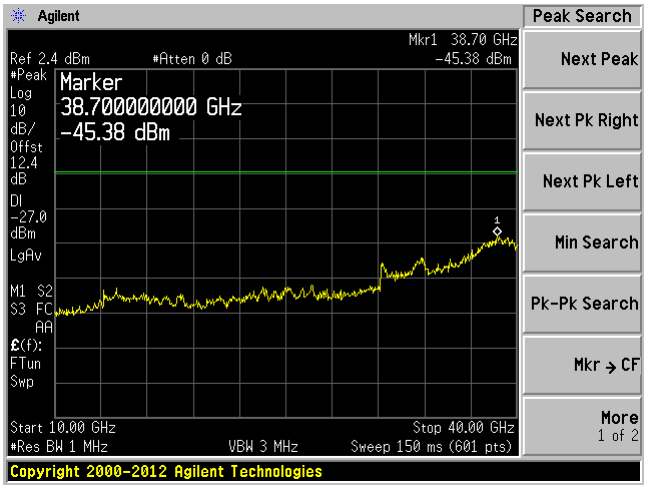
Chain 0 1GHz---10GHz



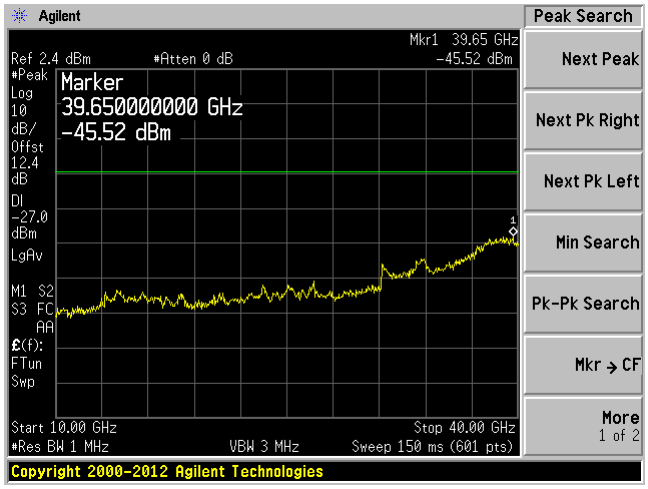
Chain 1 1GHz—10GHz



Chain 0 10GHz—40GHz



Chain 1 10GHz---40GHz



12 FCC §15.407(a) - Power Spectral Density

12.1 Applicable Standards

According to FCC §15.407(a)

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

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:	22-24º C
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.

Note: The PSA's RBW=100kHz and a 10*log(5) factor is added to compare the limit as 30dBm/500kHz.

12.5 Test Results

802.11a mode

Channel	Frequency (MHz)	Chain 0 PSD (dBm)	Chain 1 PSD (dBm)	Factor (dBi)	Total PSD (dBm)	Limit (dBm)
Low	5745	-5.49	-5.38	6.99	4.56	28
Middle	5785	-0.09	1.66	6.99	10.87	28
High	5825	-1.76	-0.46	6.99	8.94	28

802.11n-HT20 mode

Channel	Frequency (MHz)	Chain 0 PSD (dBm)	Chain 1 PSD (dBm)	Factor (dBi)	Total PSD (dBm)	Limit (dBm)
Low	5745	-5.78	-4.71	6.99	4.78	28
Middle	5785	0.78	1.29	6.99	11.04	28
High	5825	-3.20	-2.07	6.99	7.40	28

802.11n-HT40 mode

Channel	Frequency (MHz)	Chain 0 PSD (dBm)	Chain 1 PSD (dBm)	Factor (dBi)	Total PSD (dBm)	Limit (dBm)
Low	5755	-7.57	-6.56	6.99	2.97	28
High	5795	-4.71	-3.98	6.99	5.67	28

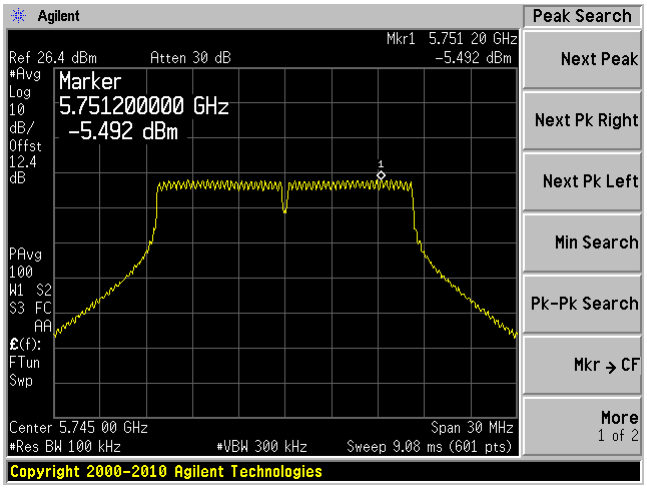
802.11ac-VHT80 mode

Channel	Frequency (MHz)	Chain 0 PSD (dBm)	Chain 1 PSD (dBm)	Factor (dBi)	Total PSD (dBm)	Limit (dBm)
-	5775	-13.76	-12.67	6.99	-3.18	28

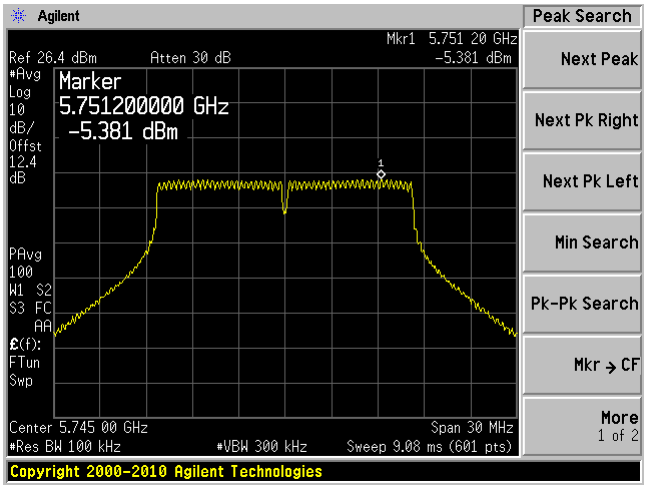
Please refer to the following plots.

802.11a, Low Channel, 5745 MHz

Chain 0

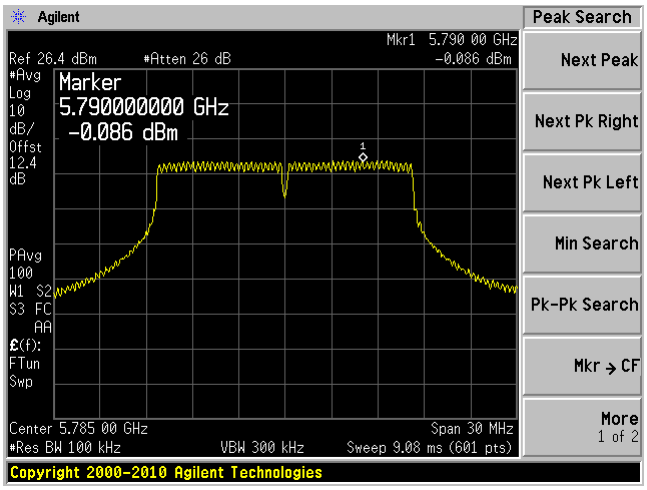


Chain 1

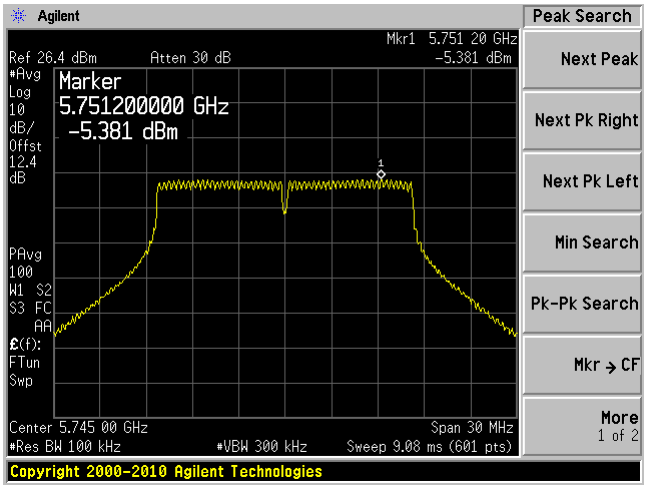


802.11a, Middle Channel, 5785 MHz

Chain 0

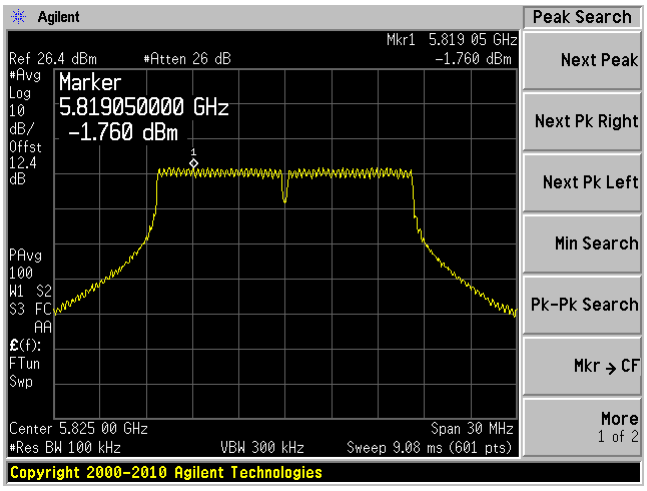


Chain 1

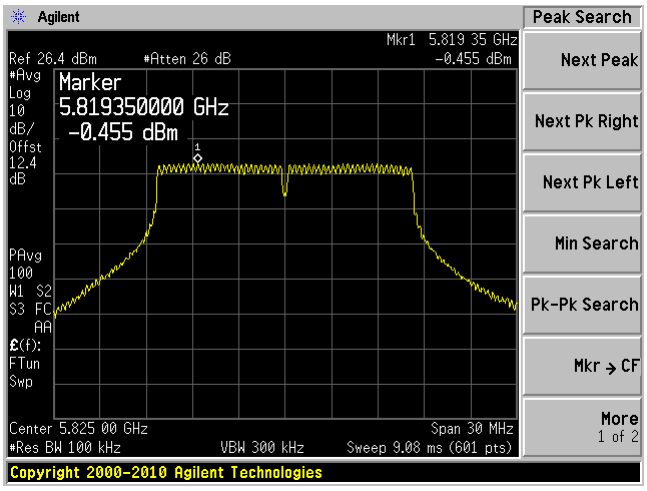


802.11a, High Channel, 5825 MHz

Chain 0

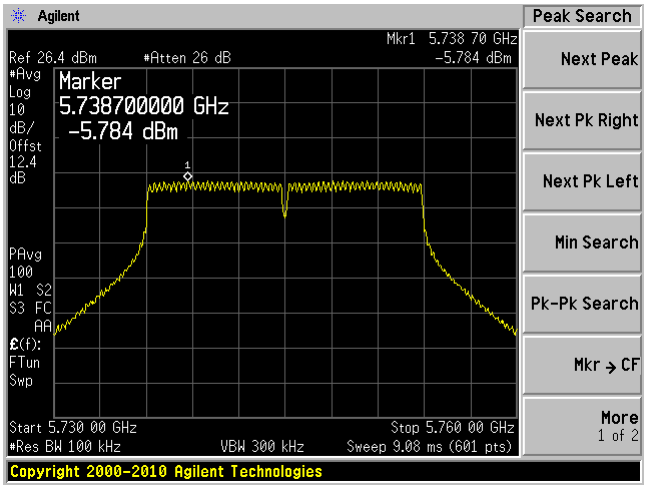


Chain 1

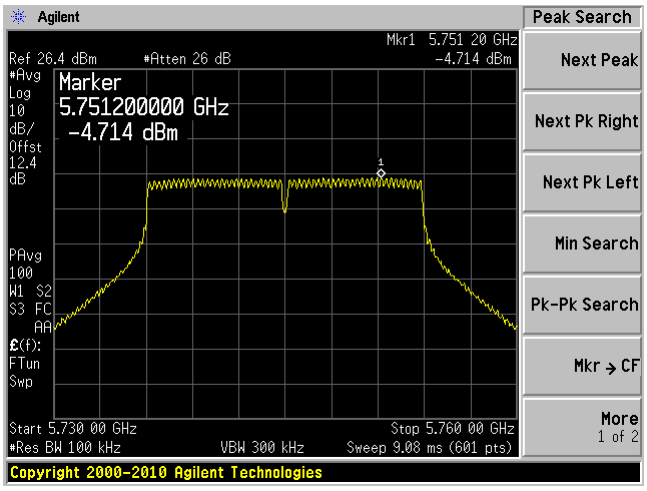


802.11n-HT 20, Low Channel 5745 MHz

Chain 0

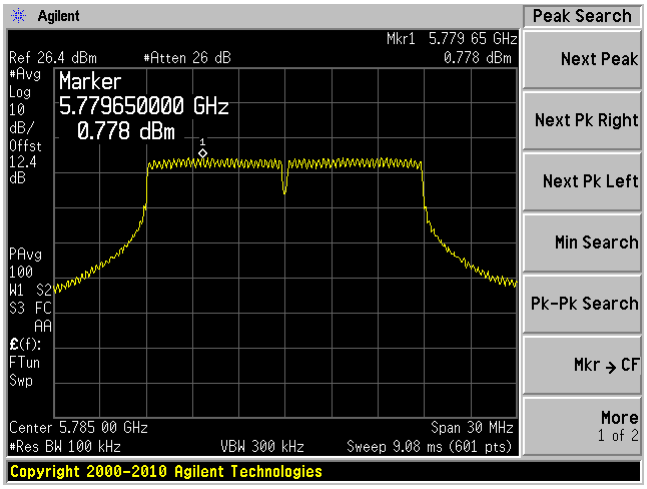


Chain 1

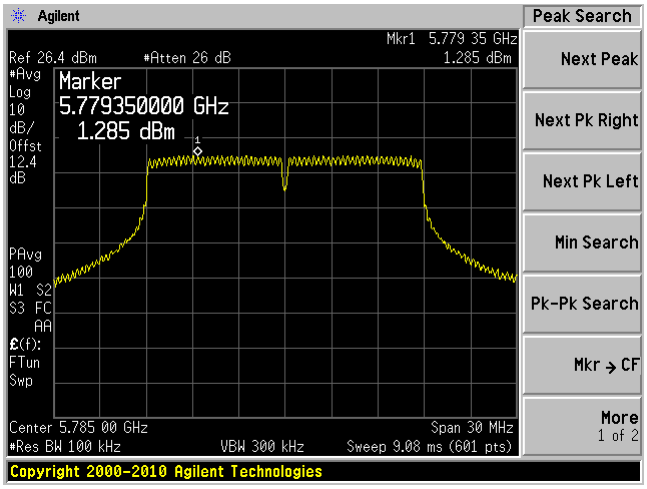


802.11n-HT20, Middle Channel 5785 MHz

Chain 0

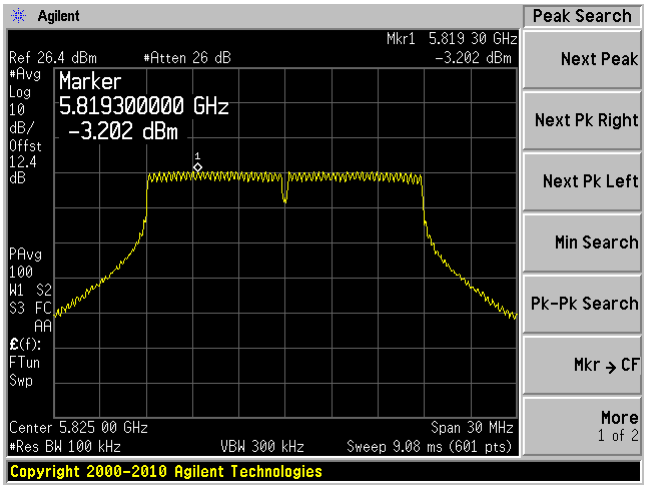


Chain 1

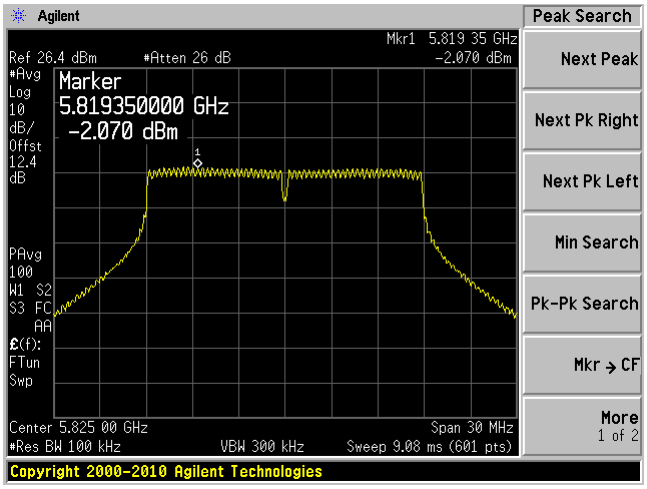


802.11n-HT20, High Channel, 5825 MHz

Chain 0

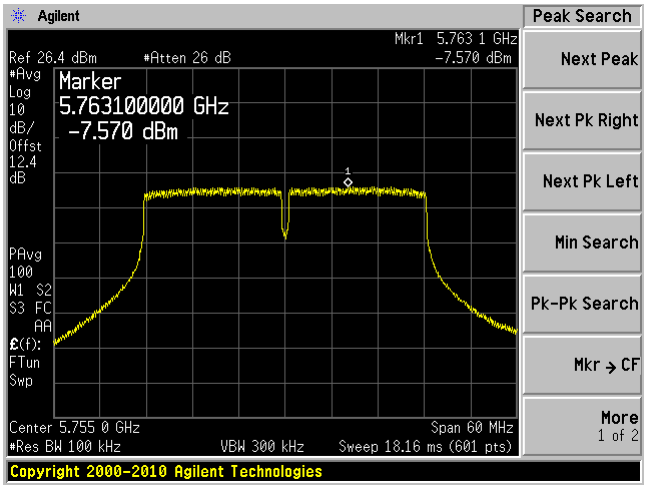


Chain 1

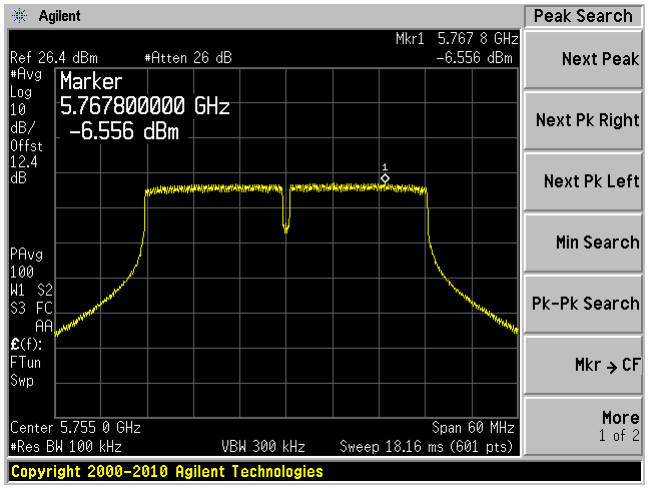


802.11n-HT40, Low Channel 5755 MHz

Chain 0

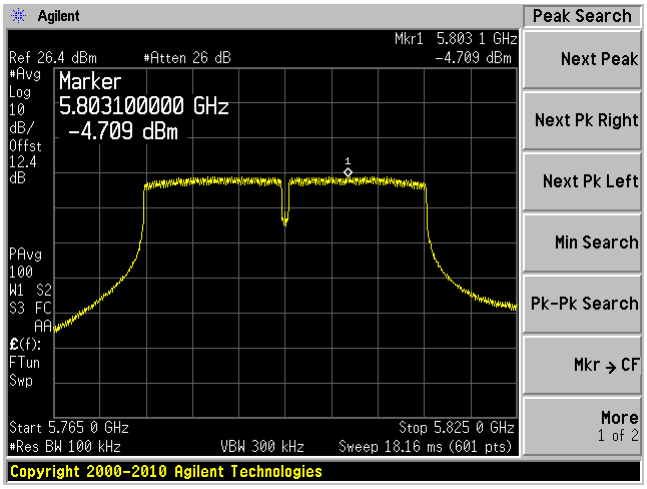


Chain 1

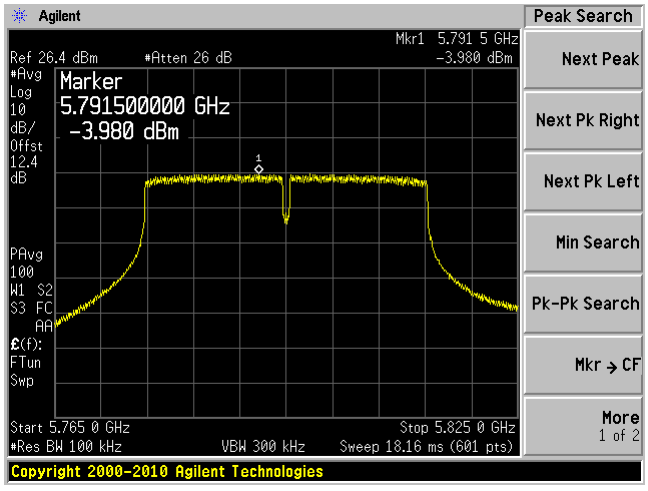


802.11n-HT40, High Channel 5795 MHz

Chain 0

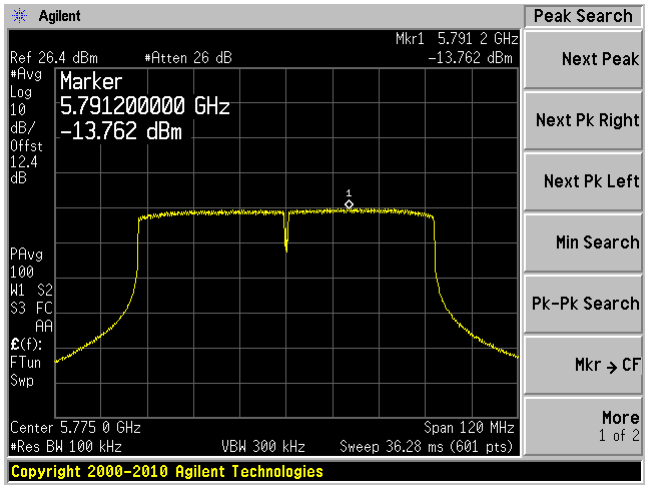


Chain 1



802.11ac-VHT80, High Channel 5775 MHz

Chain 0



Chain 1