

FCC TEST REPORT for UNII Device (5.3G & 5.6G Band) No. 140901615SHA-001R3

Applicant : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA, 94089

Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA, 94089

Equipment : Access Point

Type/Model : APEX0102

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2014): Radio Frequency Devices

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

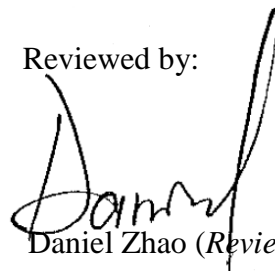
Date of issue: Oct 10, 2015

Prepared by:



Wakeyou Wang (*Project Engineer*)

Reviewed by:



Daniel Zhao (*Reviewer*)



Description of Test Facility

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IC Assigned Code: 2042B-1

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1. General Information

1.1 Applicant Information

Applicant : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Name of contact : Robert Hastings
Tel : 408-419-4093
Fax : /
Manufacturer : Aruba Networks, Inc
1344 Crossman Ave. Sunnyvale, CA,94089
Sample received date : Sep 25, 2014
Date of test : Sep 25, 2014 ~ Sep 30, 2015

1.2 Identification of the EUT

Equipment : Access Point
Type/model : APEX0102
FCC ID : Q9DAPEX0102
IC : 4675A-APEX0102

1.3 Technical specification

Operation Frequency Band: 5250 - 5350 MHz, 5470 – 5725MHz
 Modulation: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
 Gain of Antenna: Directional Antenna, Internal

Antenna Type	Applied Chain	Gain of antenna
AC-PUMORI-ANT-2014	3	2.4GHz band: 7.4dBi
		5GHz band: 9.1dBi

Rating: AC100-240V 50/60Hz 0.6A; DC 48V,0.6A (PoE)
 Declared Temperature range: -40°C ~ 65°C
 Description of EUT: The EUT is a wireless access point.
 Port identification: Power × 1, Console USB × 1; RJ45 ports × 2
 Category of EUT: Class B
 EUT type: Table top Floor standing
 EUT Modes: 802.11a/b/g/n20/n40/ac80
 (802.11a/n20/n40/ac80 assessed in this report)
 Channel Number: 4 Channel for 5260~5320MHz for 11a/n20;
 2 Channel for 5270~5310MHz for 11n40;
 1 Channel for 5290MHz for 11ac80;
 12 Channel for 5500~5720MHz for 11a/n20;
 6 Channel for 5510~5710MHz for 11n40;
 3 Channel for 5530-5690MHz for 11ac80;
 Channel Description: Channel bandwidth is 20MHz / 40MHz / 80MHz.

MIMO Function Description:

Modulation	Transmission / Idle			Beam forming	Beam forming gain
	Port 0	Port 1	Port 2		
802.11a	Transmission	Transmission	Transmission	NO	0 dBi
802.11 n20	Transmission	Transmission	Transmission	Port 0 & Port 1	3 dBi
802.11 n40	Transmission	Transmission	Transmission	Port 0 & Port 1	3 dBi
802.11 ac80	Transmission	Transmission	Transmission	Port 0 & Port 1	3 dBi

1.4 Mode of operation during the test / Test peripherals used

While testing transmitting mode of EUT, the internal modulation was applied.

The lowest, middle and highest channel were tested as representatives.

Freq. Band	Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
5250 - 5350MHz	802.11a	5260	5300	5320
	802.11 n20	5260	5300	5320
	802.11 n40	5270	/	5310
	802.11 ac80	/	5290	/

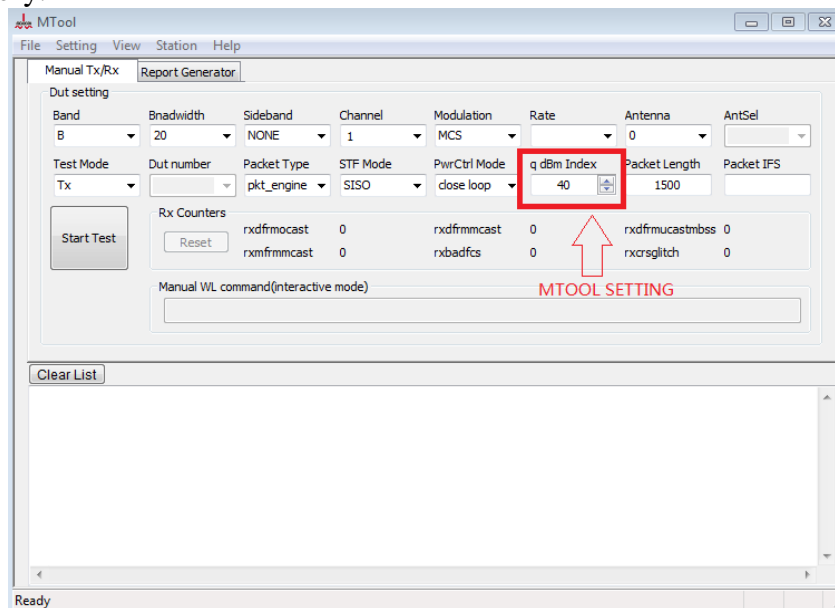
Freq. Band	Modulation	Lowest(MHz)	Middle(MHz)	Highest(MHz)
5470 - 5725MHz	802.11a	5500	5600	5720
	802.11 n20	5500	5600	5720
	802.11 n40	5510	5590	5710
	802.11 ac80	5530	5610	5690

Test Peripherals:

PC: HP ProBook 6450b

Test software setting:

The power level setting for 802.11a/n20/n40/ac80 is used with MTOOL software offered by the manufactory.



The power level setting for 802.11a/n20/n40/ac80 is used with the software offered by the manufactory.

Freq. Band	Mode	Frequency (MHz)	Software Setting	Power Expected (dBm)
5250 - 5350MHz	802.11a	5260	50	12.5
		5300	50	12.5
		5320	52	13
	802.11 n20	5260	42	10.5
		5300	42	10.5
		5320	42	10.5
	802.11 n40	5270	52	13
		5310	52	13
	802.11 ac80	5290	54	13.5

Freq. Band	Mode	Frequency (MHz)	Software Setting	Power Expected (dBm)
5470 - 5725MHz	802.11a	5500	48	12
		5600	50	12.5
		5720	50	12.5
	802.11 n20	5500	44	11
		5600	44	11
		5720	44	11
	802.11 n40	5510	54	13.5
		5590	54	13.5
		5710	54	13.5
	802.11 ac80	5530	68	17
		5610	68	17
		5690	68	17

Data rate VS Power

The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

After this pre-scan, we choose the following table of the data rata as the worst case.

Mode	Worst case data rate
802.11a	6Mbps
802.11 n20	MCS16
802.11 n40	MCS16
802.11 ac80	MCS0NSS3

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESCS 30	R&S	EC 2107	2014-10-21	2015-10-20
Test Receiver	ESIB 26	R&S	EC 3045	2014-10-20	2015-10-19
Test Receiver	ESCI 7	R&S	EC 4501	2014-12-25	2015-12-24
Semi-anechoic chamber	-	Albatross project	EC 3048	2015-5-11	2016-5-10
High Pass Filter	WHKX 1.0/15G-10SS	Wainwright	EC4297-1	2015-1-8	2016-1-7
High Pass Filter	WHKX 2.8/18G-12SS	Wainwright	EC4297-2	2015-1-8	2016-1-7
High Pass Filter	WHKX 7.0/1.8G-8SS	Wainwright	EC4297-3	2015-1-8	2016-1-7
Band Reject Filter	WRCGV 2400/2483- 2390/2493- 35/10SS	Wainwright	EC4297-4	2015-1-8	2016-1-7
RF cable	SUCOFLEX 104	HUBER+SUHNER	/	2015-2-13	2016-2-12
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2015-4-27	2016-4-26
Horn antenna	HF 906	R&S	EC 3049	2015-4-27	2016-4-26
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2015-4-20	2016-4-19
Pre-amplifier	Tpa0118-40	TOYO	EC 4792-2	2015-4-12	2016-4-11
Horn antenna	3117	ETS	EC 4792-1	2015-4-22	2016-4-21
PXA Signal Analyzer	N9030A	Agilent	EC5338	2014-11-18	2015-11-17

2.2 Test Standard

47CFR Part 15:2014
ANSI C63.10: 2013
KDB789033 D02 General UNII Test Procedures New Rules v01
KDB 662911 D01 Multiple Transmitter Output v02r01.

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	RESULT
Maximum Conducted Output Power & EIRP	15.407(a)	Pass
Power spectral density	15.407(a)	Pass
Minimum 6dB Bandwidth	15.407(e)	NA
Radiated emission	15.407(b), 15.209	Pass
Power line conducted emission	15.207	Pass
99% Bandwidth & 26dB Emission Bandwidth	15.407	Tested

3. Maximum Conducted Output Power & EIRP

Test result: Pass

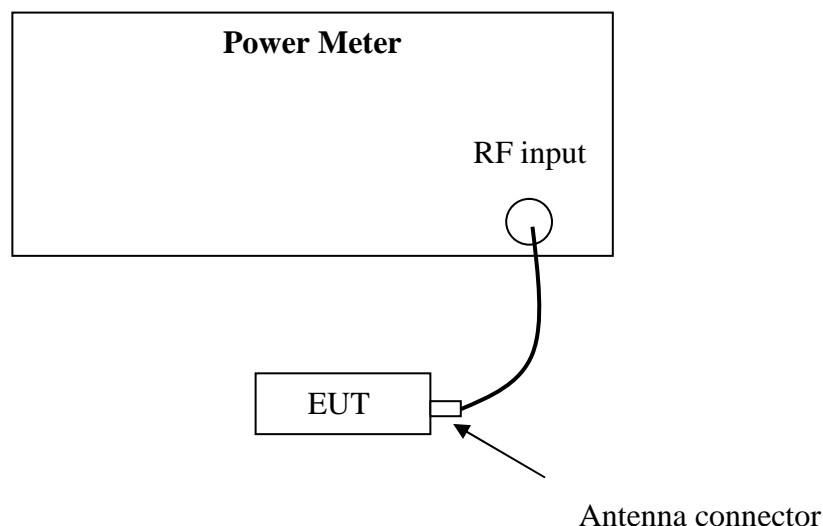
3.1 Test limit

- For outdoor access point operating in 5150-5250MHz: 30dBm, Maximum EIRP at any elevation angle above 30 degrees ≤ 21 dBm;
- For indoor access point operating in 5150-5250MHz: 30dBm;
- For fixed point-to-point access point operating in 5150-5250MHz: 30dBm;
- For mobile and portable client devices operating in 5150-5250MHz: 24dBm;
- For device operating in 5.25-5.35 GHz and 5.47-5.725 GHz: 24dBm or 11dBm + 10logB (B is 26dB bandwidth / 99% bandwidth);
- For device operating in 5.725-5.85 GHz: 30dBm

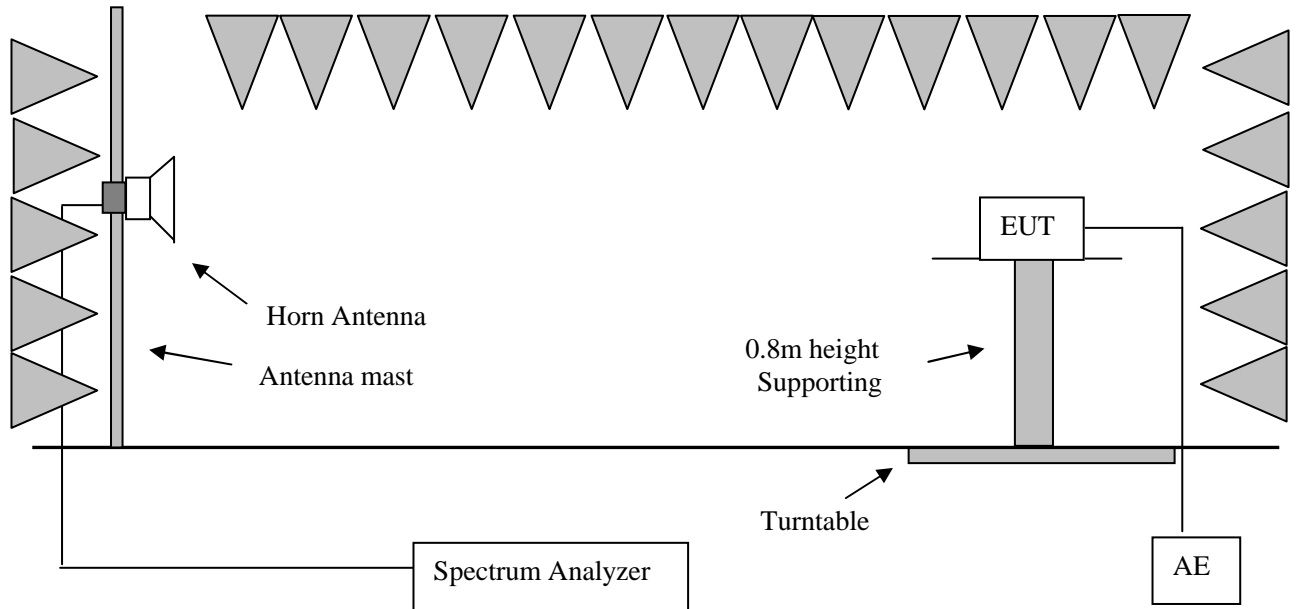
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beamforming type, the limit should be the less of original and original + 6 –antenna gain-beamforming gain.

3.2 Test Configuration

- Maximum Conducted Output Power test



Maximum EIRP test



3.3 Test procedure and test setup

The power output per FCC §15.407(a) was measured on the EUT using a 50 ohm RF cable connected to spectrum analyzer and the measurement method refer to KDB 789033D02: Method PM.

The EIRP test is conducted at any elevation angle above 30 degrees as measured from the horizon.

3.4 Test protocol

Temperature : 25 °C
Relative Humidity : 55 %

Power limit calculation

Mode	Limit calculation		Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
	Min B _{99%} (MHz)	11dBm + 10logB (dBm)			
802.11a	17.06	23.30	23.30	9.10	20.20
802.11n20	18.15	23.60	23.60	12.10	17.50
802.11n40	36.38	26.60	24.00	12.10	17.90
802.11ac80	75.64	29.80	24.00	12.10	17.90

Note: 1. Chosen limit is 24dBm or 11dBm + 10logB which is lesser;
2. Antenna value = Antenna gain + beamforming if applied;
3. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.

Conducted Power test

Mode	Freq (MHz)	Factor (dB)	Reading (dBm)			Total power (dBm)	Limit (dBm)
			Port 0	Port 1	Port 2		
802.11a	5260	1.2	11.68	12.76	12.24	17.02	20.20
	5300	1.2	12.02	12.65	12.26	17.09	20.20
	5320	1.2	12.32	13.13	13.01	17.61	20.20
	5500	1.2	11.03	11.36	11.40	16.04	20.20
	5600	1.2	11.98	11.94	11.90	16.71	20.20
	5720	1.2	12.03	11.98	11.88	16.73	20.20
802.11n20	5260	1.6	9.40	10.59	10.40	14.93	17.50
	5300	1.6	9.38	10.38	10.22	14.79	17.50
	5320	1.6	9.40	10.21	10.31	14.76	17.50
	5500	1.6	10.03	10.24	10.16	14.92	17.50
	5600	1.6	10.04	10.16	10.11	14.87	17.50

	5720	1.6	10.22	10.14	9.86	14.85	17.50
802.11n40	5270	2.0	11.85	12.86	12.23	17.10	17.90
	5310	2.0	11.98	12.69	12.65	17.22	17.90
	5510	2.0	12.26	12.41	11.98	16.99	17.90
	5590	2.0	12.23	12.21	12.08	16.95	17.90
	5710	2.0	12.42	12.23	12.01	16.99	17.90
802.11ac80	5290	1.6	11.56	12.28	12.56	16.92	17.90
	5530	1.6	12.01	12.04	12.56	16.98	17.90
	5610	1.6	12.29	12.15	12.24	17.00	17.90
	5690	1.6	12.31	12.13	11.89	16.88	17.90

Note: 1. Factor = Cable loss + duty cycle.

2. For antenna gain = 9.1dBi and with beamforming, the limit should be corrected.

3. Total power = $10 * \lg(10^{\text{port } 0 / 10} + 10^{\text{port } 1 / 10} + 10^{\text{port } 2 / 10})$

4. Power spectral density

Test result: Pass

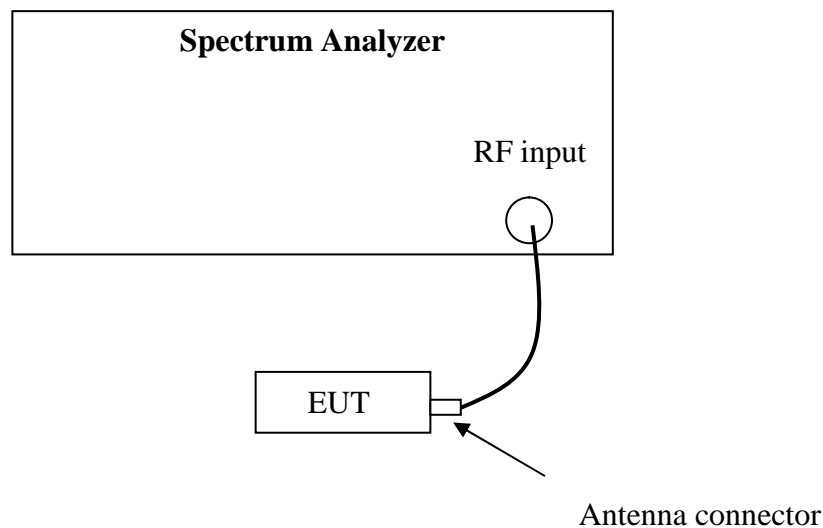
4.1 Test limit

- For outdoor access point operating in 5150-5250MHz: 17dBm/MHz;
- For indoor access point operating in 5150-5250MHz: 17dBm/MHz;
- For fixed point-to-point access point operating in 5150-5250MHz: 17dBm/MHz;
- For mobile and portable client devices operating in 5150-5250MHz: 11dBm/MHz;
- For device operating in 5.25-5.35 GHz and 5.47-5.725 GHz: 11dBm/MHz;
- For device operating in 5.725-5.85 GHz: 30dBm/500kHz;

If the transmitting antenna of directional gain greater than 6dBi is used, the PSD shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

If there have a beamforming type, the limit should be the less of original and original + 6 – antenna gain-beamforming gain.

4.2 Test Configuration



4.3 Test procedure and test setup

The power spectral density per FCC §15.407(a) was measured from the antenna port of the EUT using a 50 ohm spectrum analyzer with the resolution bandwidth set at 1MHz, the video bandwidth set >RBW (measurement method refer to KDB 789033D02: section F).

4.4 Test Protocol

Temperature : 25 °C
Relative Humidity : 55 %

Mode	Chosen limit (dBm)	Antenna value (dBi)	Final limit (dBm)
802.11a	11.00	9.10	7.90
802.11n20	11.00	12.10	4.90
802.11n40	11.00	12.10	4.90
802.11ac80	11.00	12.10	4.90

Note: 1. Antenna value = Antenna gain + beamforming if applied;
2. Final limit is calculated as Chosen limit – Antenna value exceeding 6dBi.

Mode	Freq (MHz)	Factor (dB)	Reading (dBm/MHz)			Total PSD (dBm/MHz)	Limit (dBm/MHz)
			Port 0	Port 1	Port 2		
802.11a	5260	1.2	2.511	2.689	1.876	7.14	7.90
	5300	1.2	2.229	2.572	1.526	6.90	7.90
	5320	1.2	1.968	2.838	1.909	7.03	7.90
	5500	1.2	3.260	2.151	1.589	7.16	7.90
	5600	1.2	2.825	2.214	1.356	6.94	7.90
	5720	1.2	3.215	2.245	1.719	7.21	7.90
802.11n20	5260	1.6	-0.663	-0.648	-0.830	4.06	4.90
	5300	1.6	-0.677	-0.682	-0.602	4.12	4.90
	5320	1.6	-0.621	-0.861	-0.819	4.01	4.90
	5500	1.6	-0.035	-0.251	-1.386	4.25	4.90
	5600	1.6	-0.099	-0.462	-0.949	4.28	4.90
	5720	1.6	-0.105	-0.349	-0.539	4.44	4.90
802.11n40	5270	2.0	-0.351	-0.309	-0.509	4.38	4.90
	5310	2.0	-0.328	-0.468	-0.611	4.30	4.90

	5510	2.0	-0.122	-0.410	-1.132	4.24	4.90
	5590	2.0	-0.178	-0.418	-1.040	4.24	4.90
	5710	2.0	-0.122	-0.453	-0.693	4.35	4.90
802.11ac80	5290	1.6	-0.748	-0.832	-0.788	3.98	4.90
	5530	1.6	-0.242	-0.979	-0.917	4.07	4.90
	5610	1.6	-0.013	-0.676	-0.911	4.25	4.90
	5690	1.6	-0.221	-0.485	-0.896	4.25	4.90

Note: 1. Faktor = Cable loss + duty cycle.

2. For antenna gain = 9.1dBi and with beamforming, the limit should be corrected.

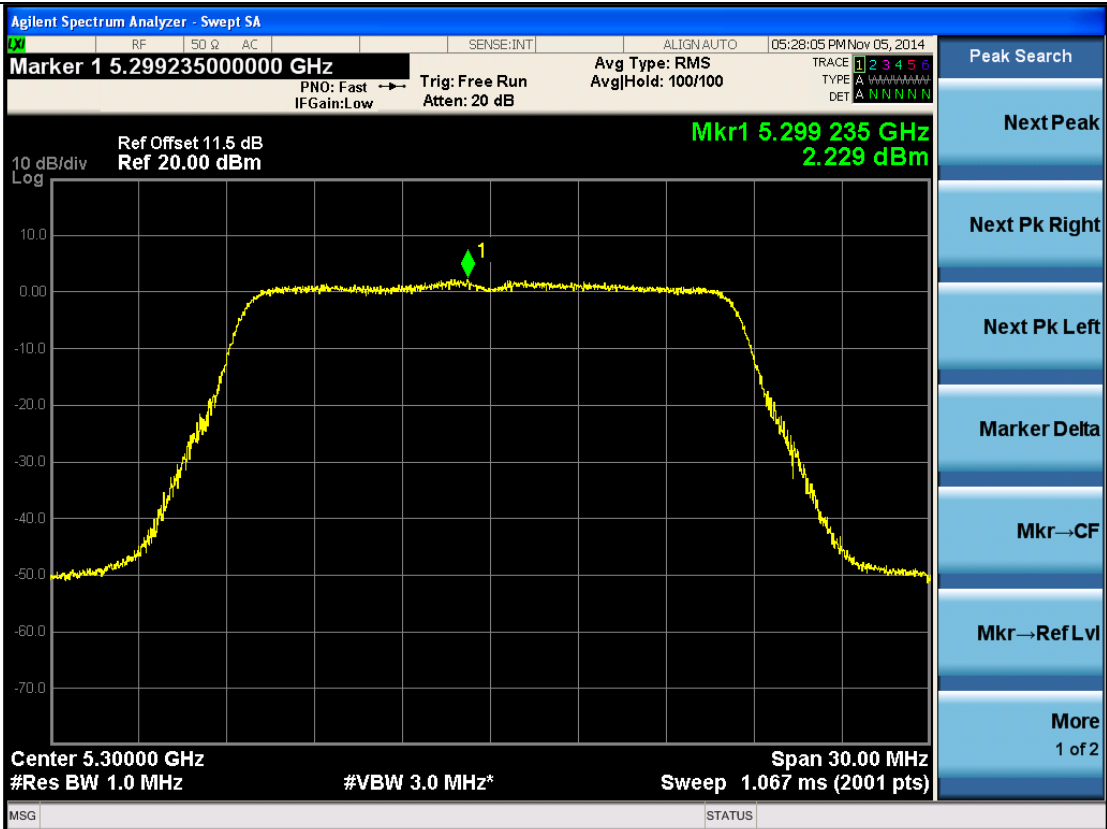
3. Total PSD = $10 * \lg(10^{\text{port } 0 / 10} + 10^{\text{port } 1 / 10} + 10^{\text{port } 2 / 10})$

Port 0

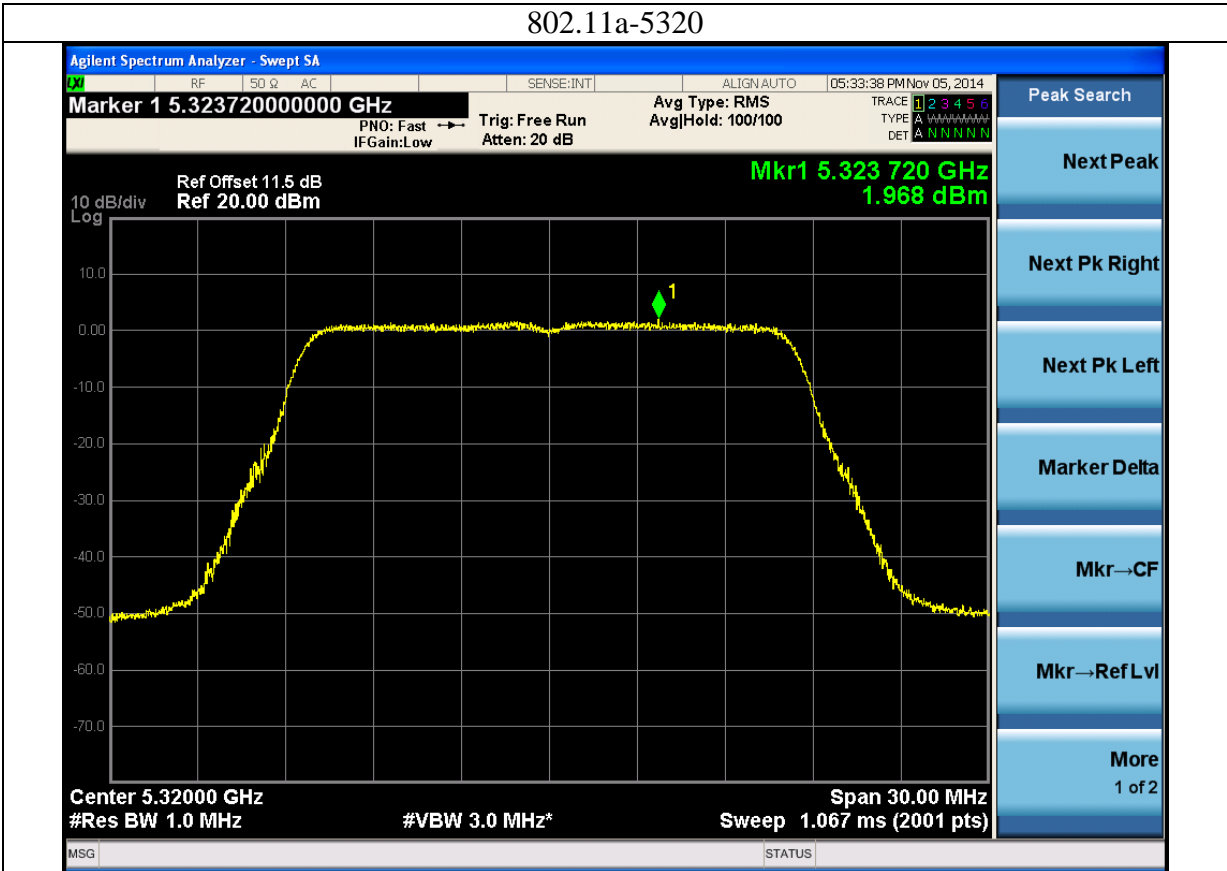
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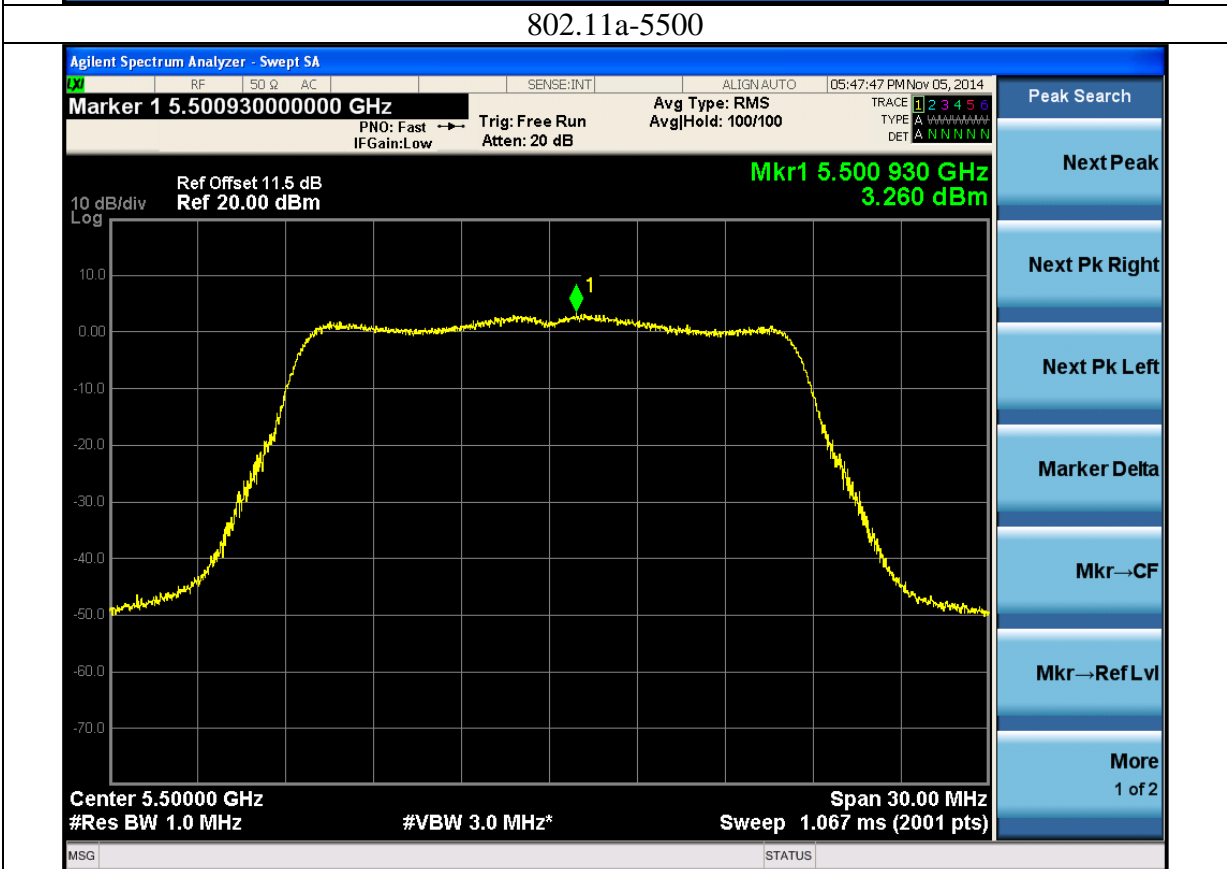
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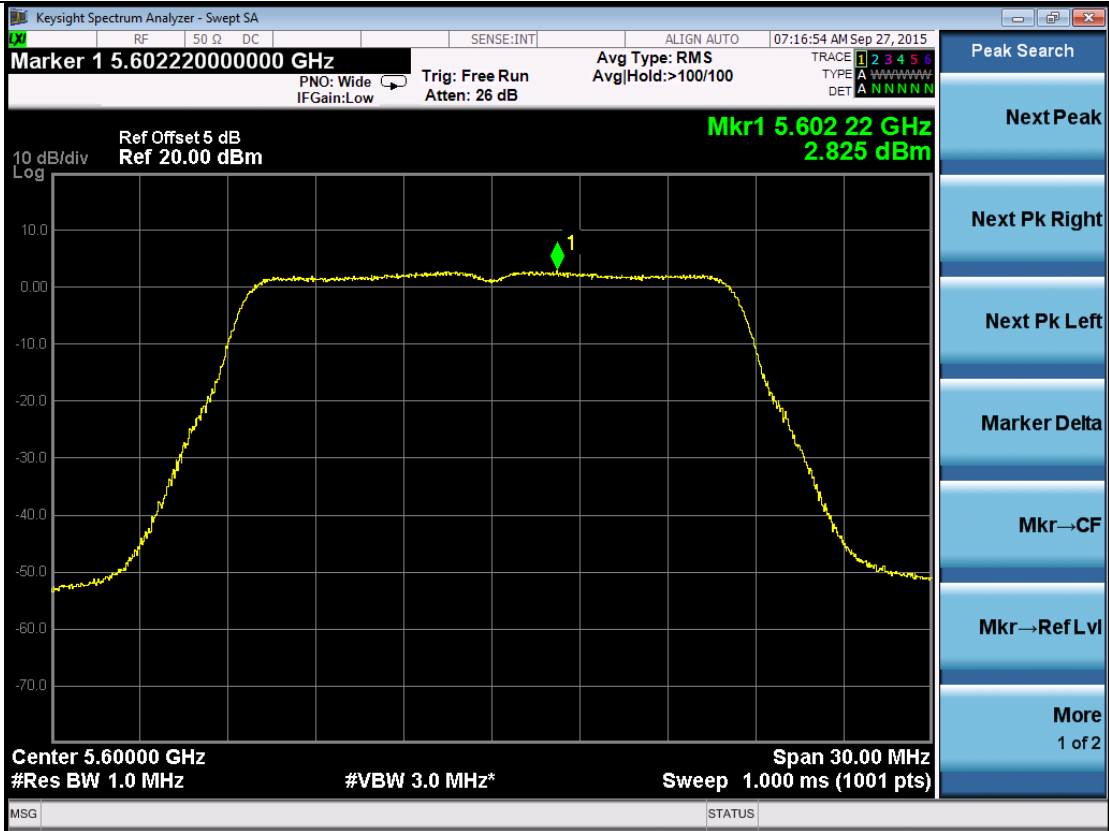
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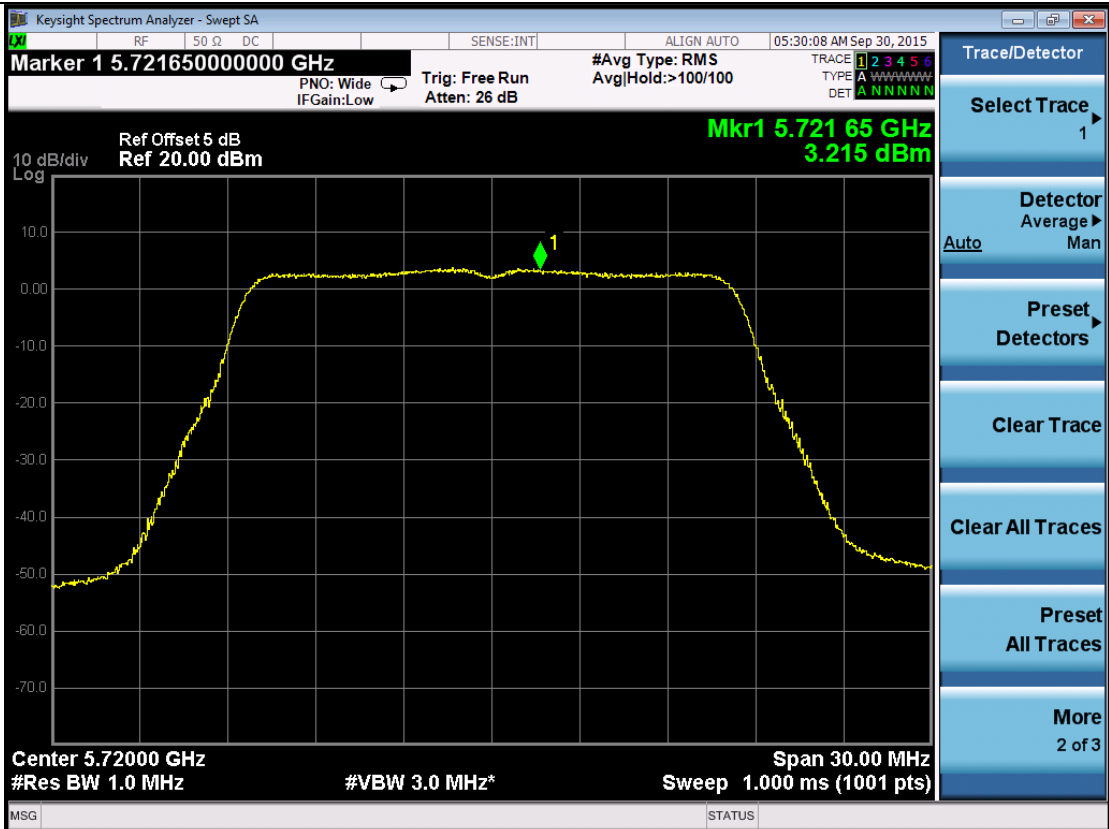
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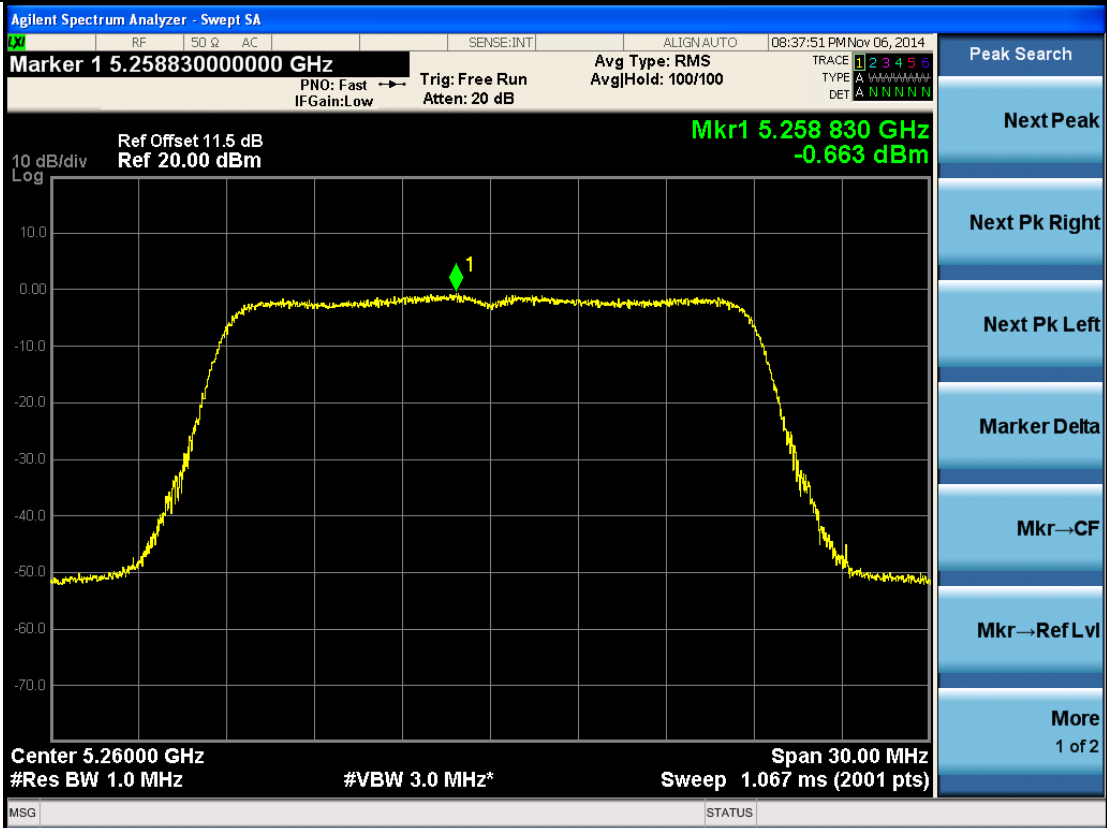
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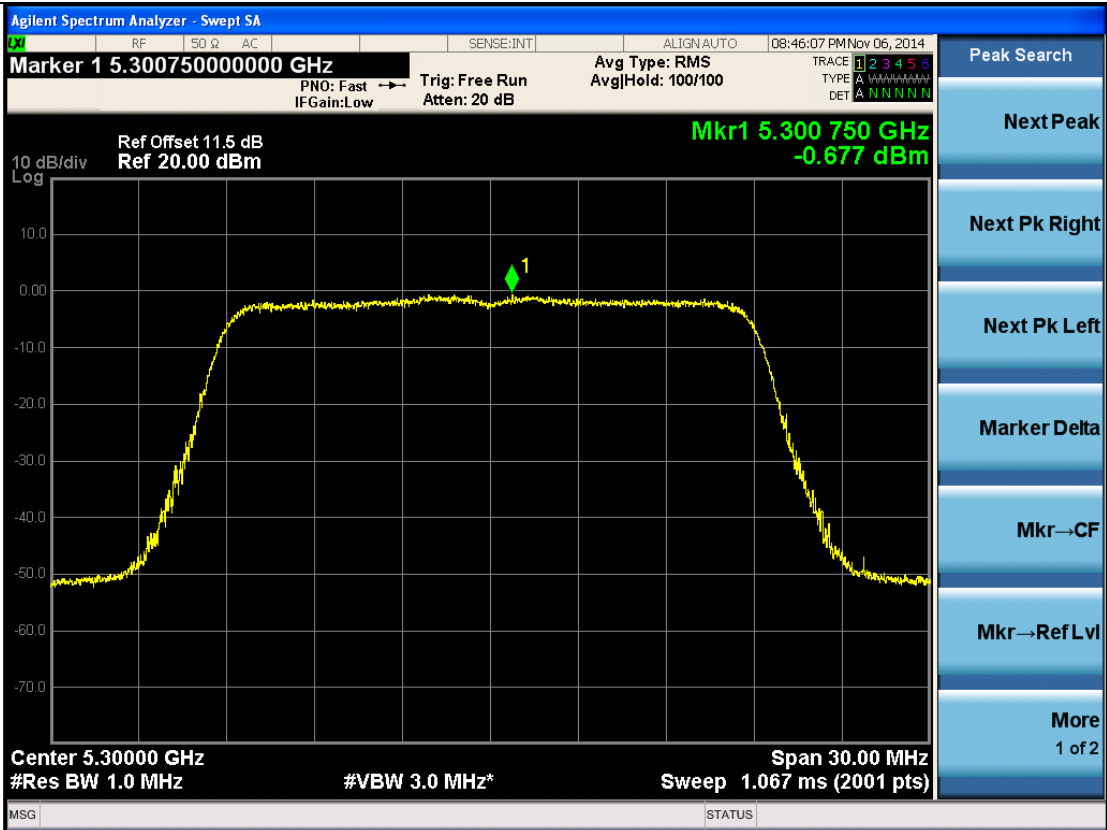
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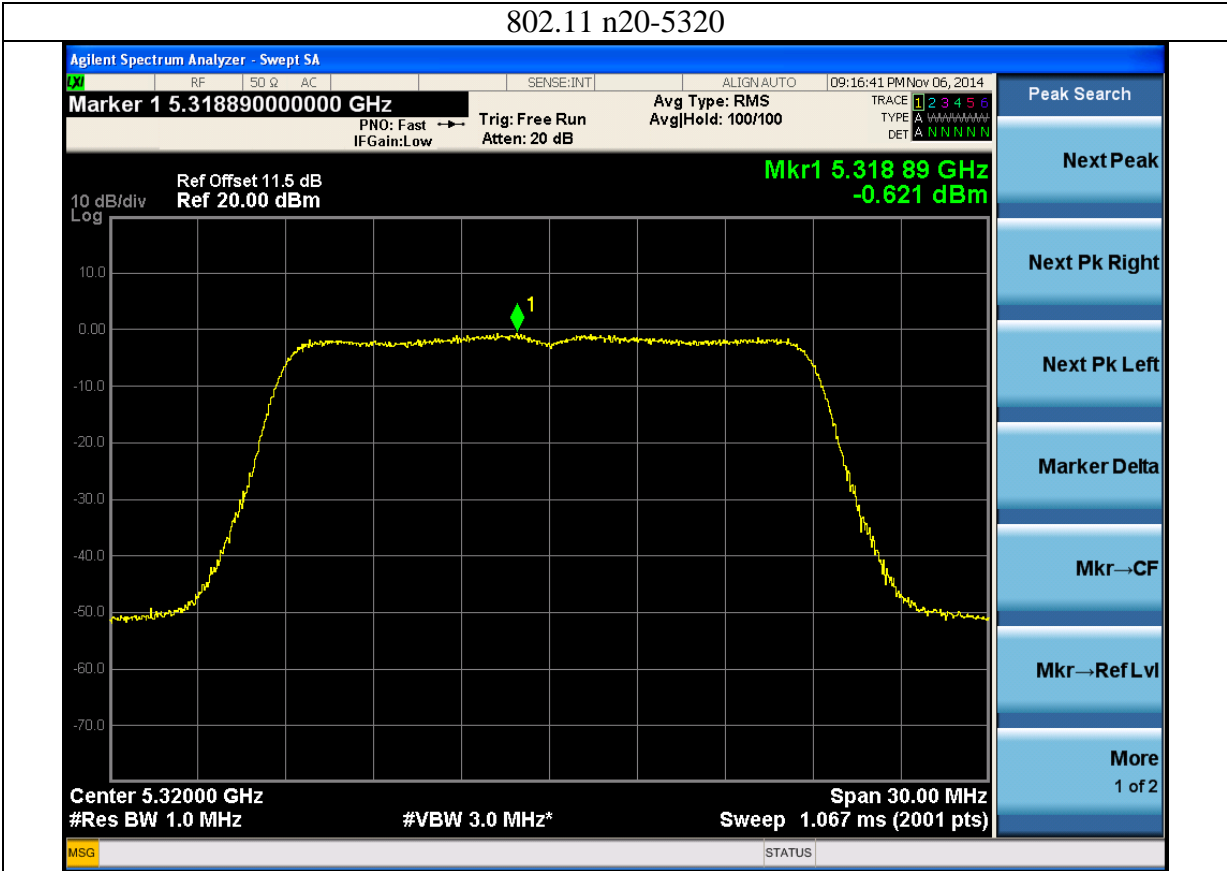
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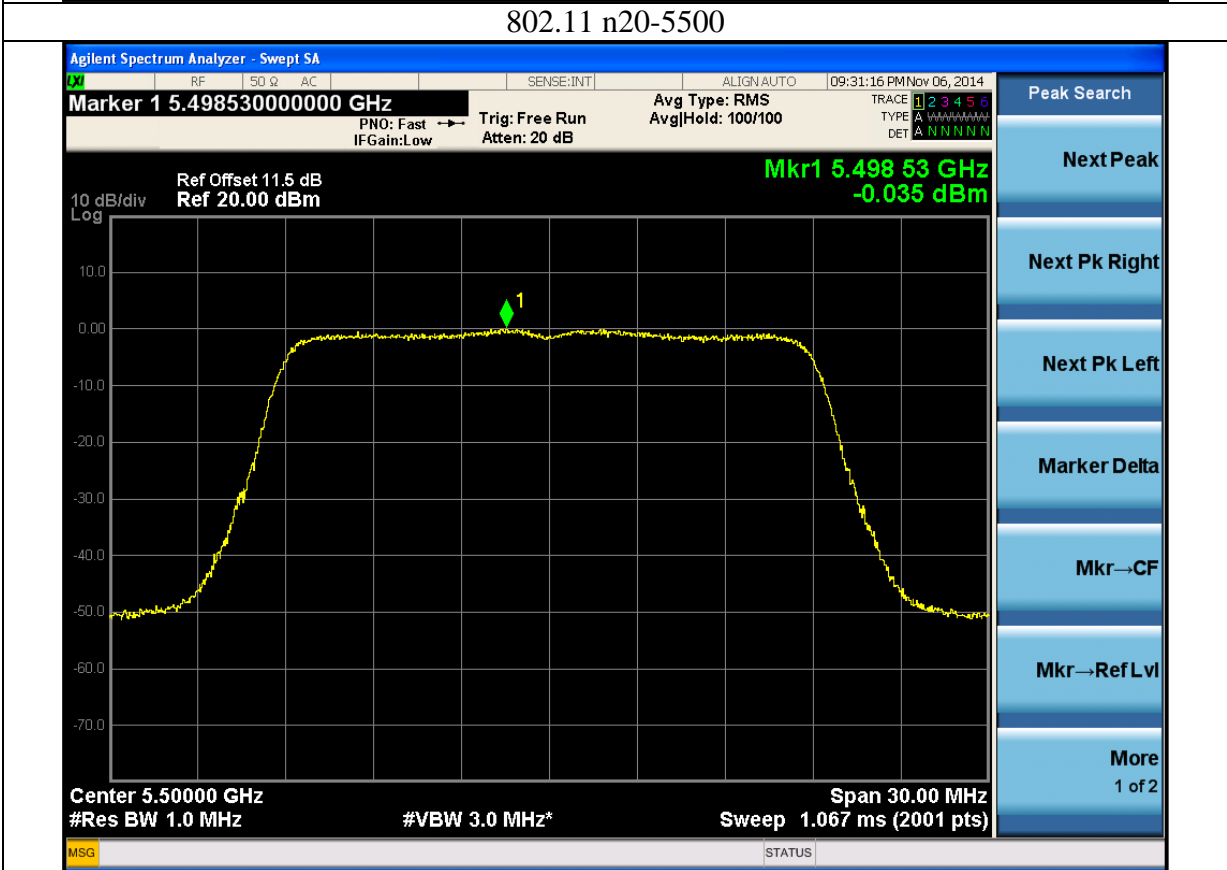
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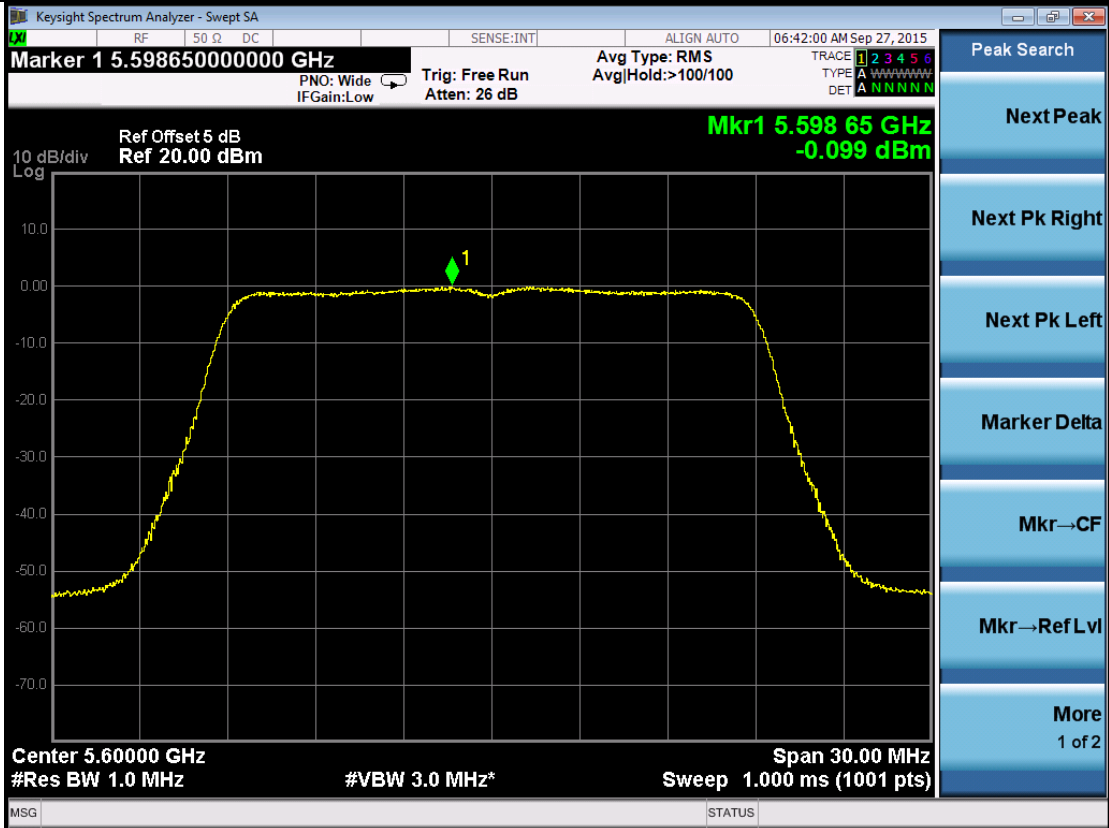
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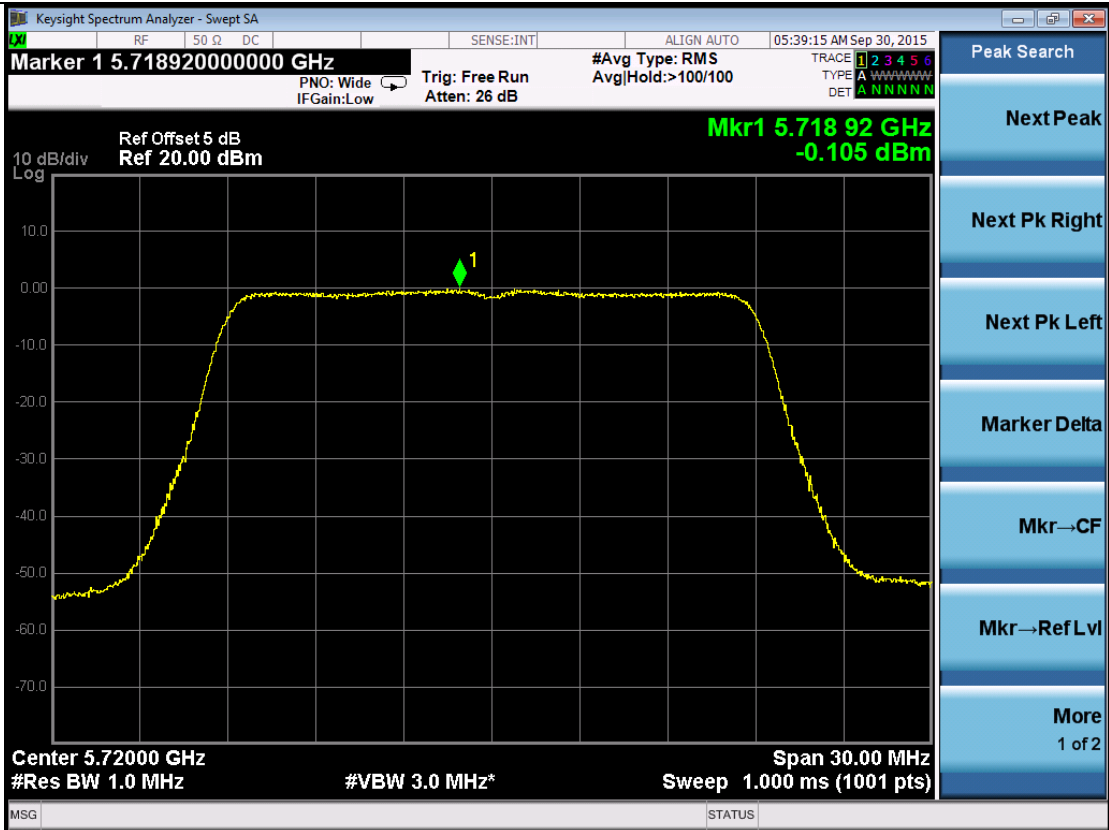
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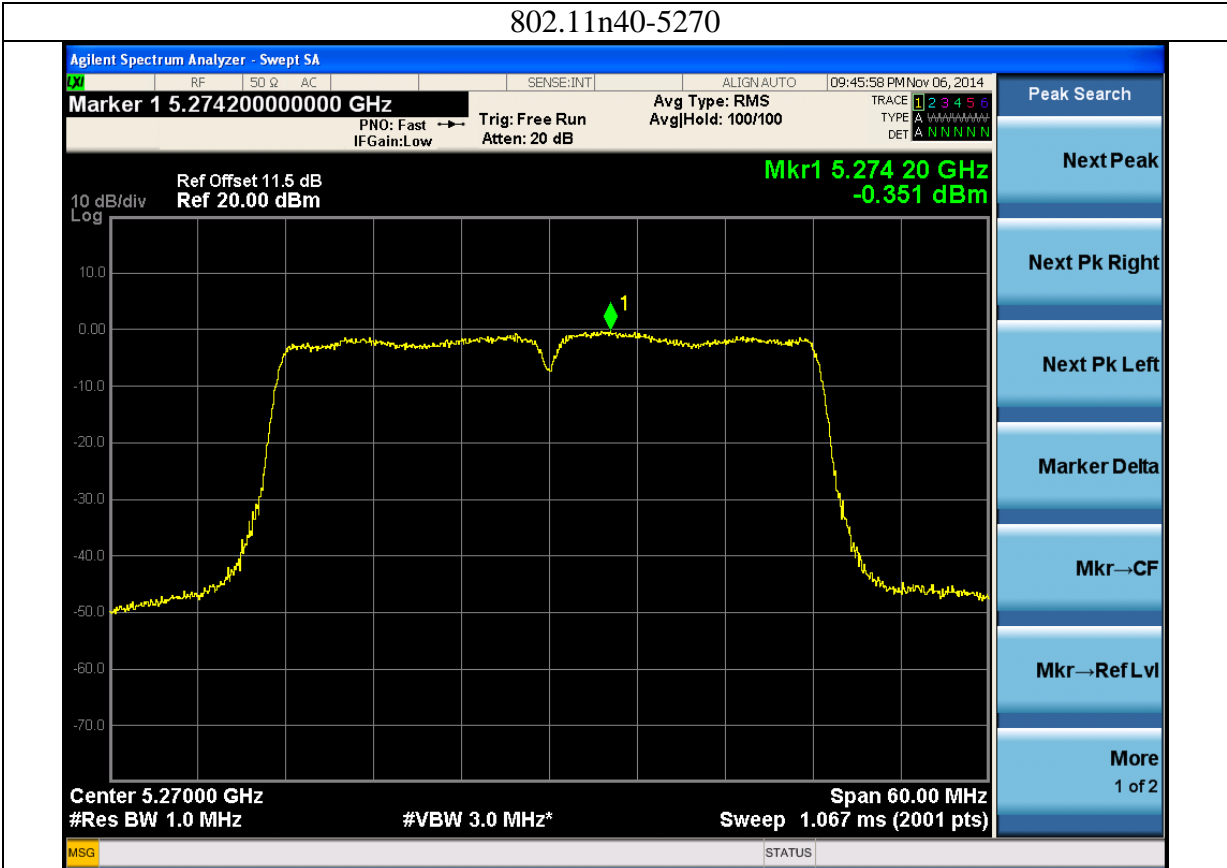
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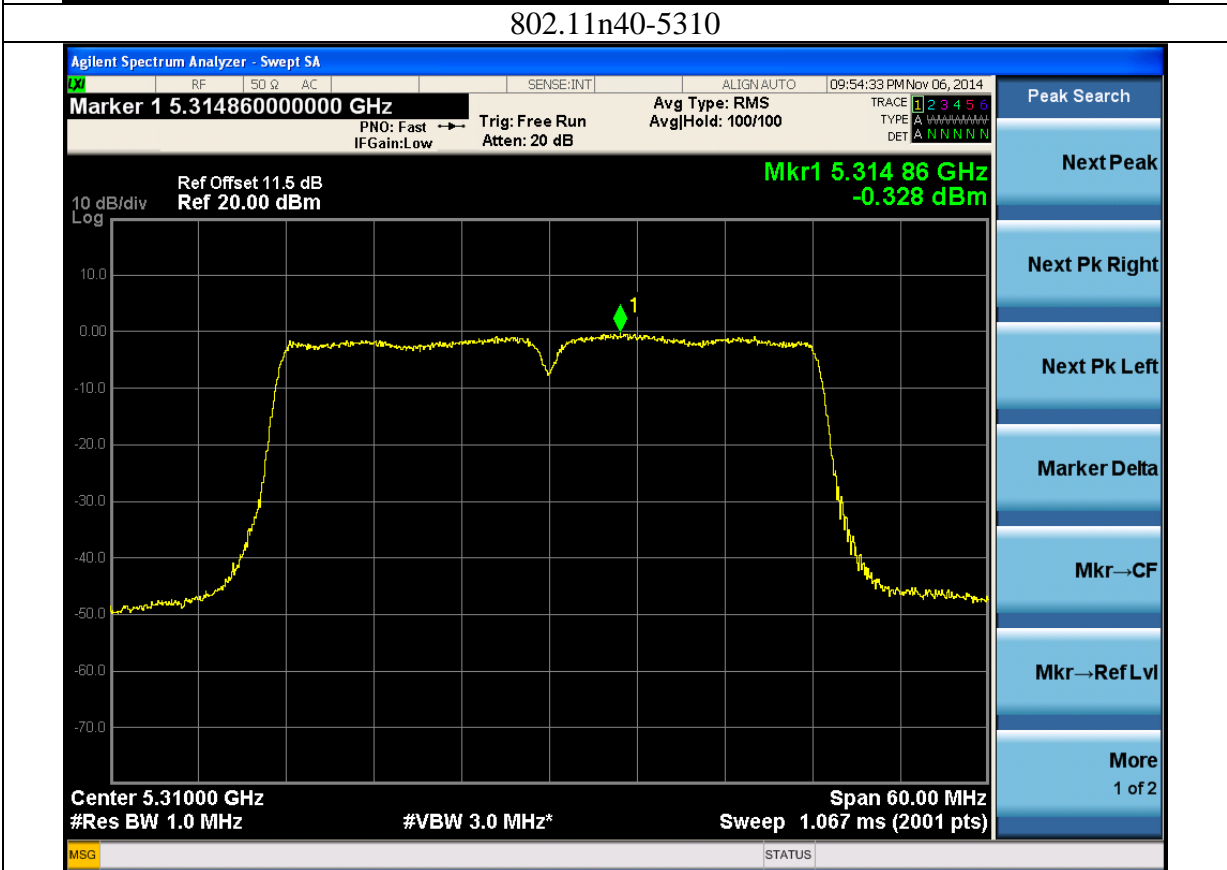
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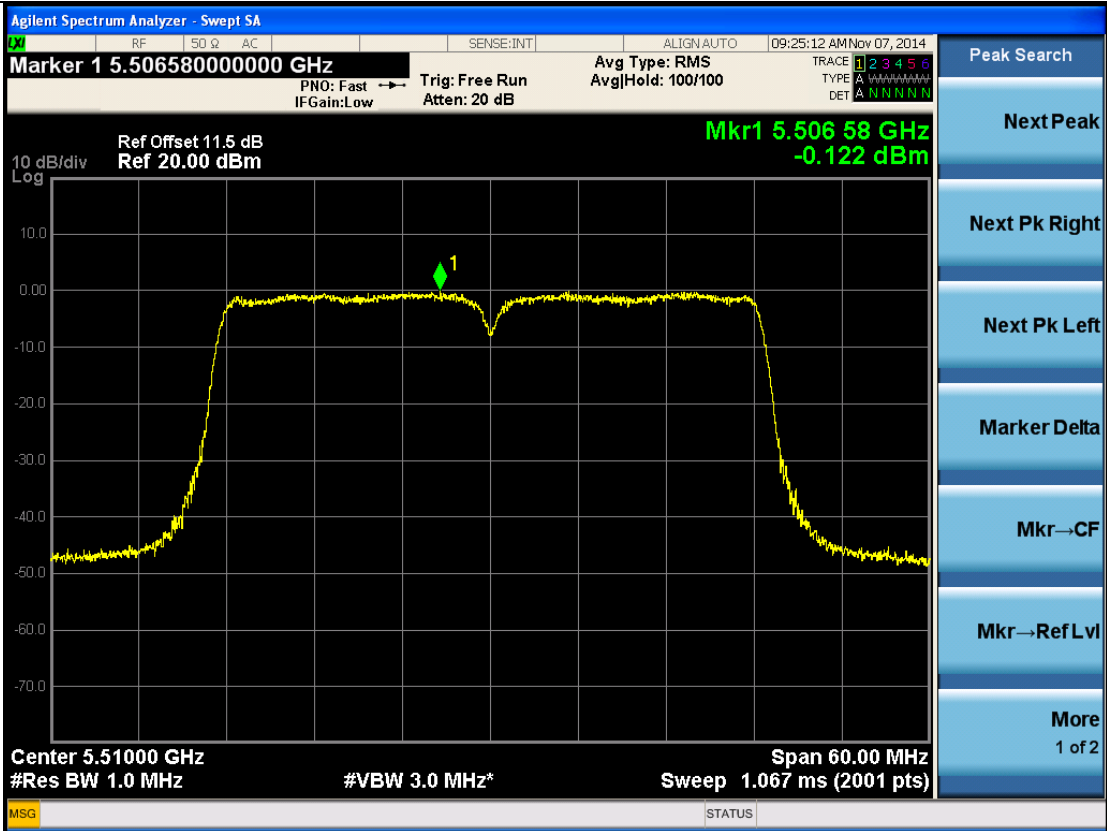
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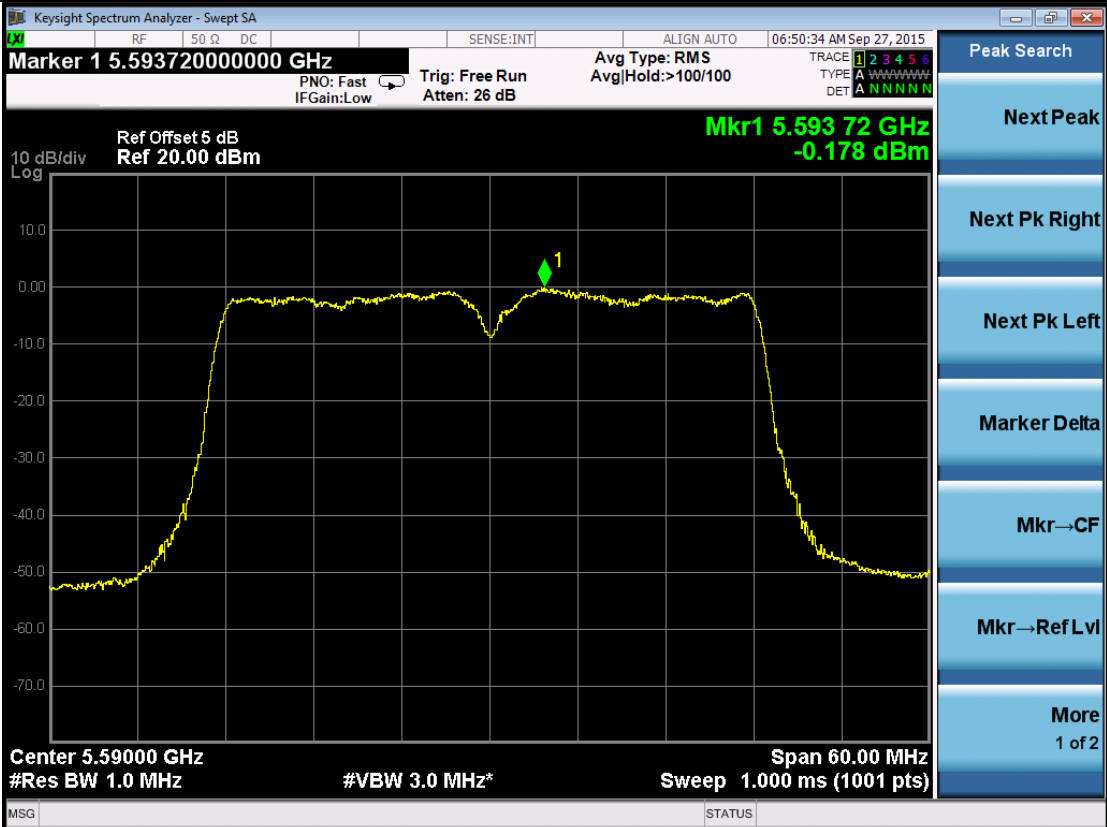
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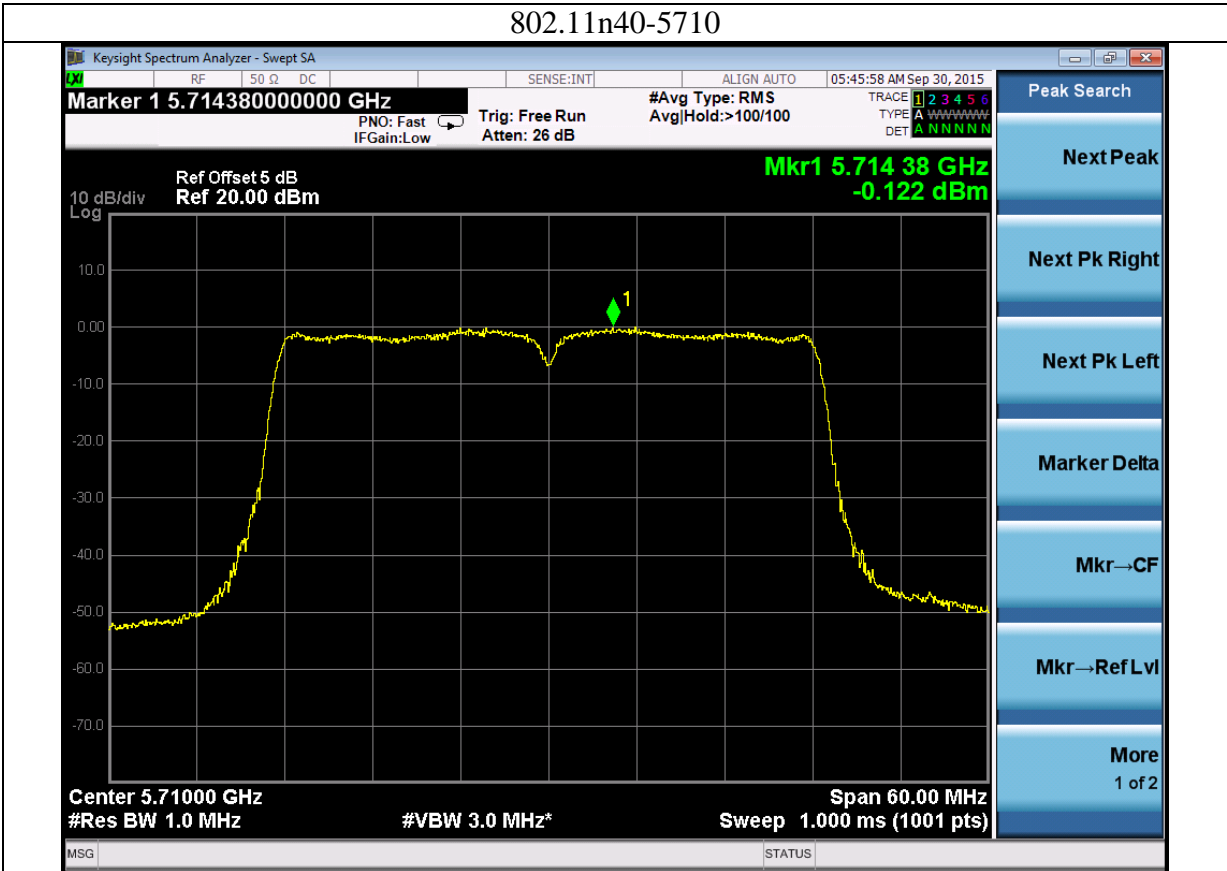
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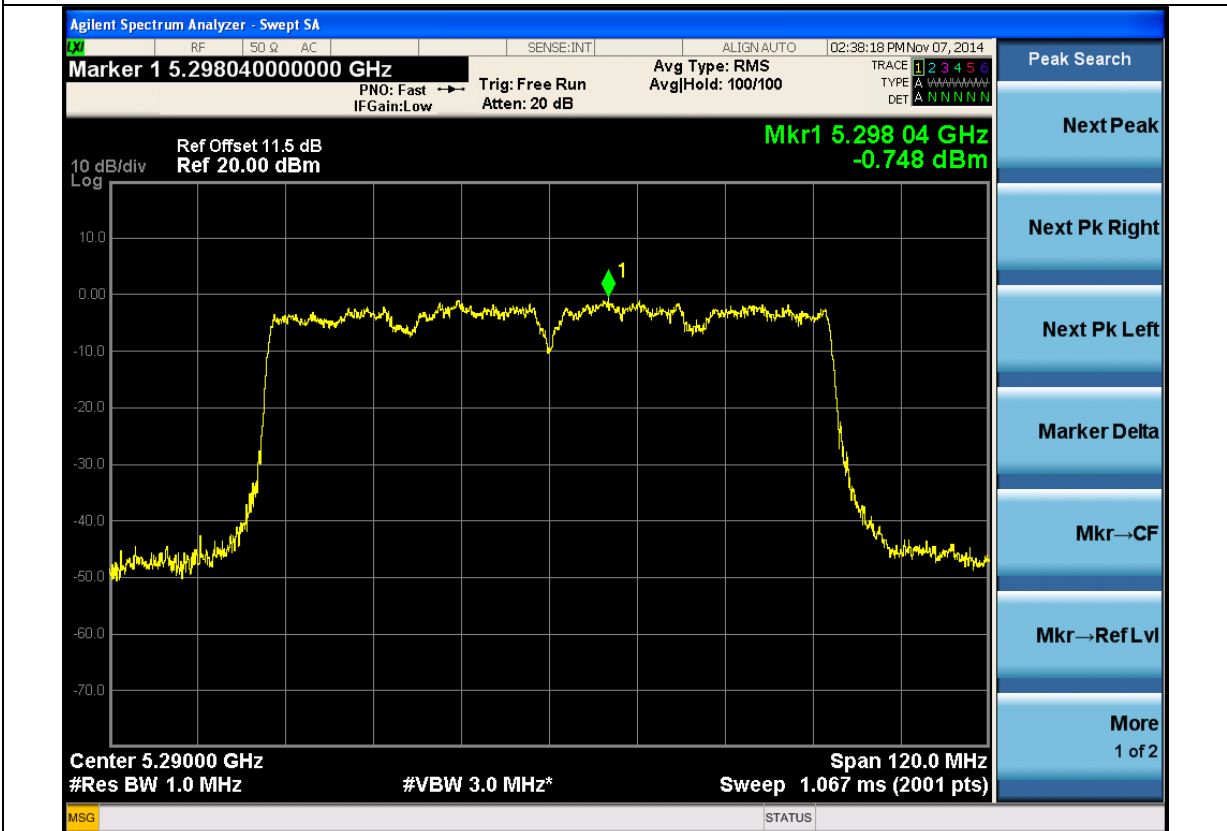
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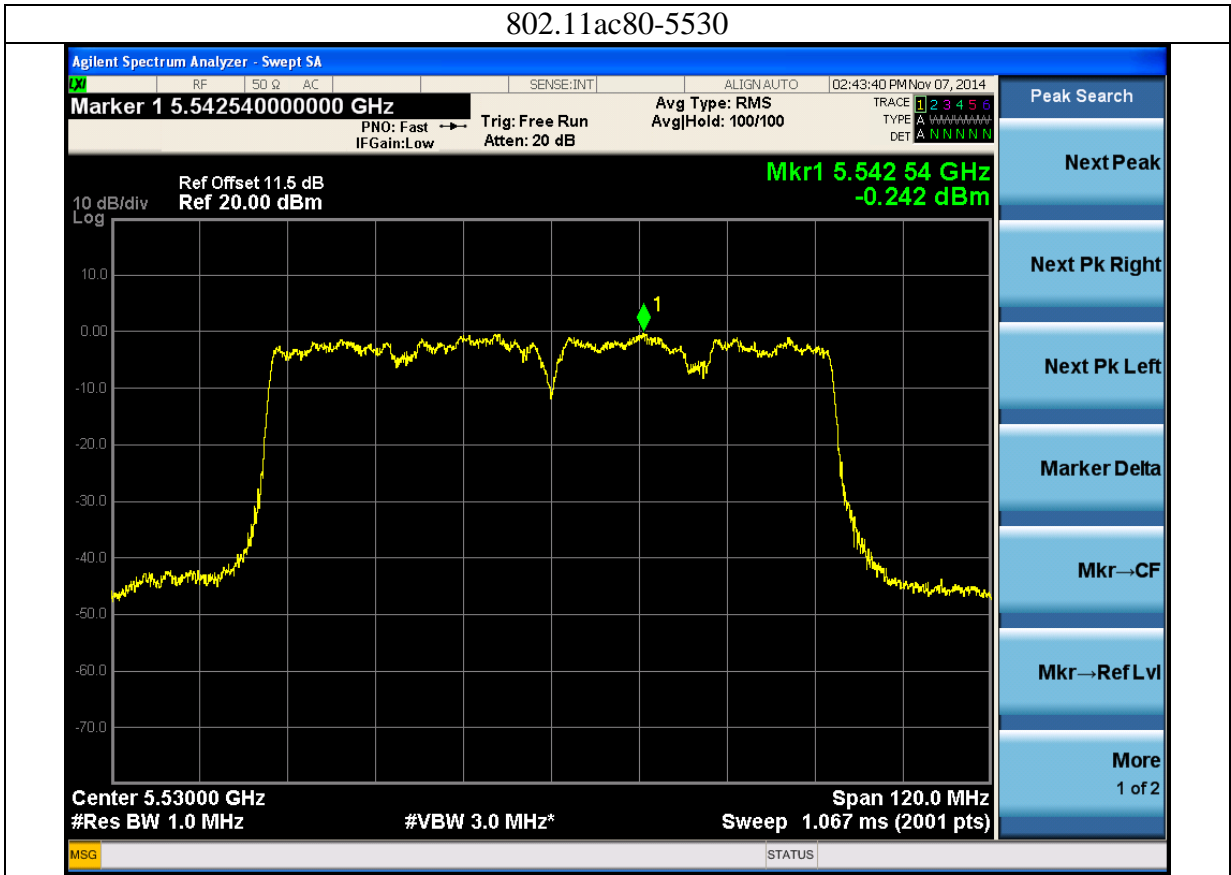
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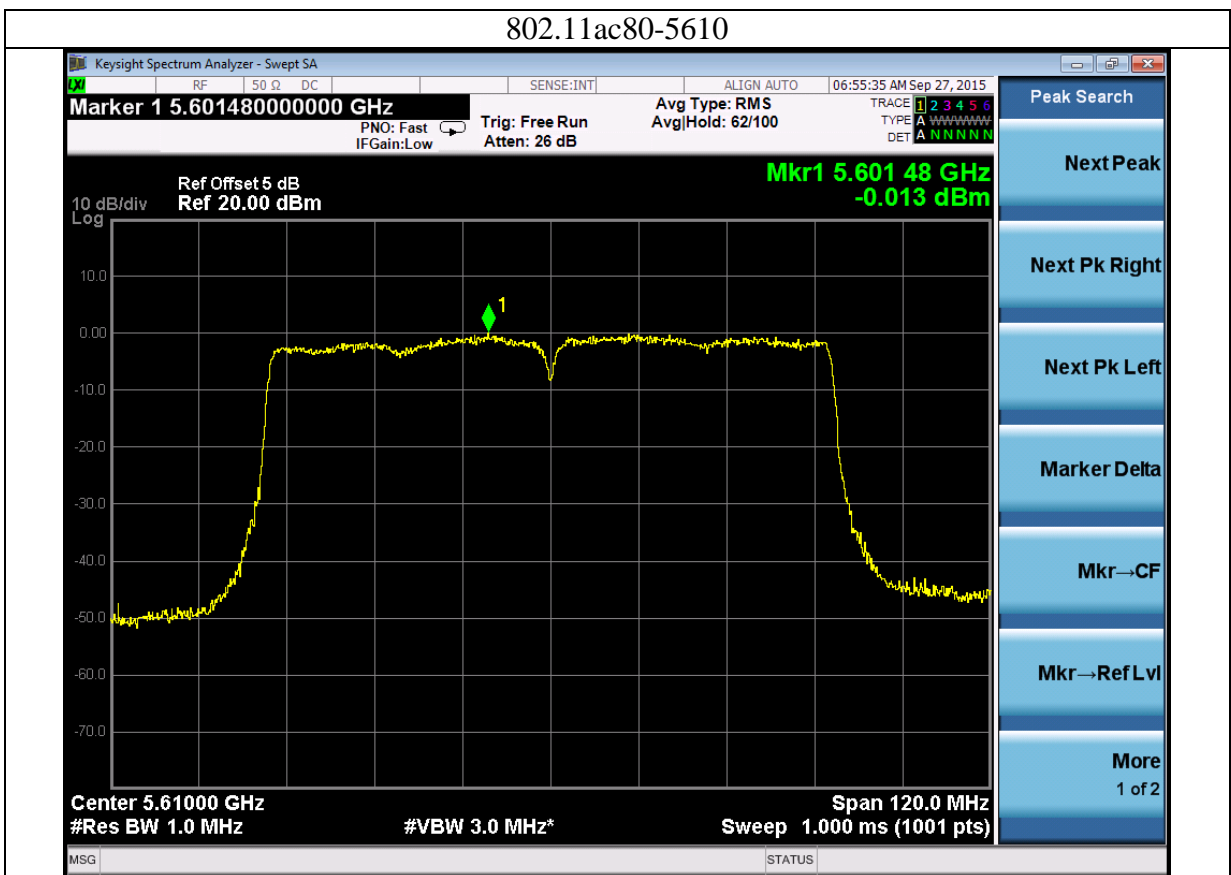
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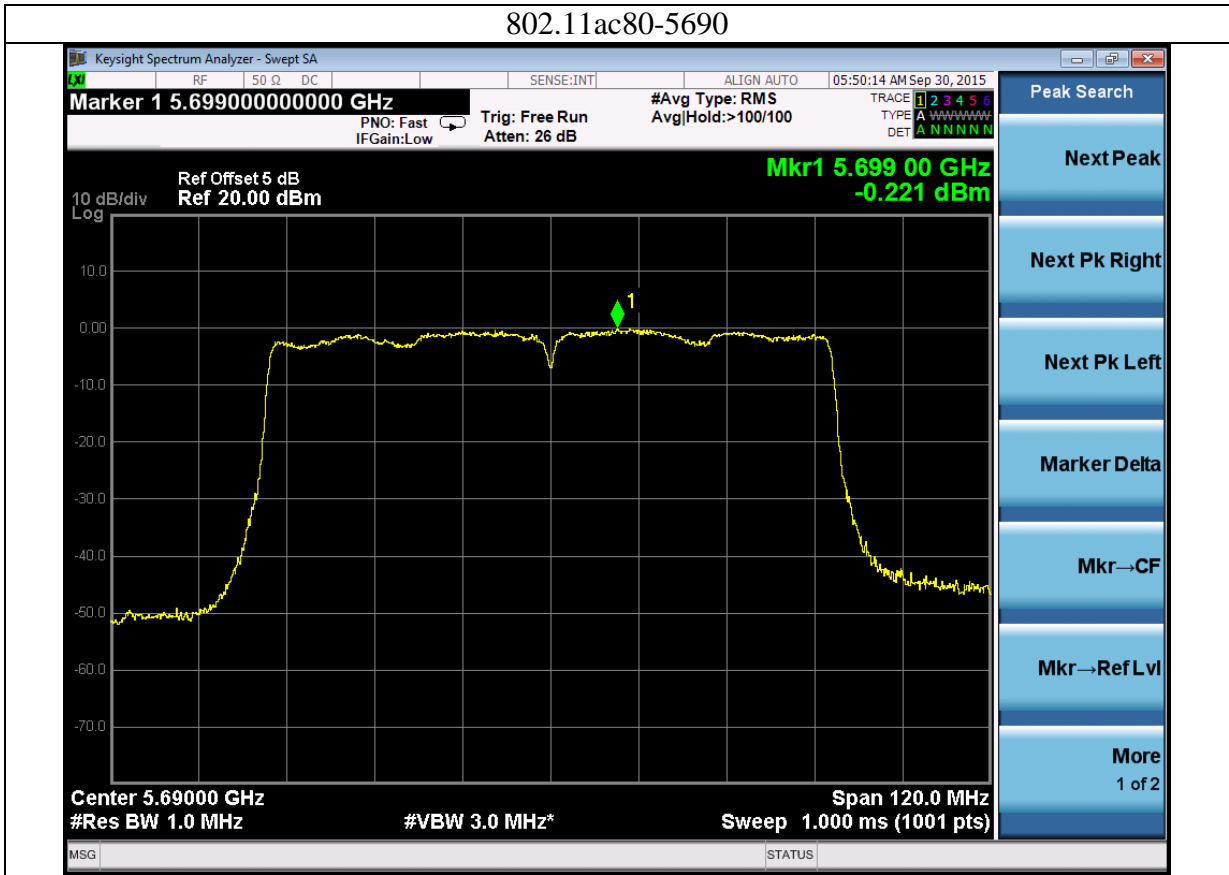


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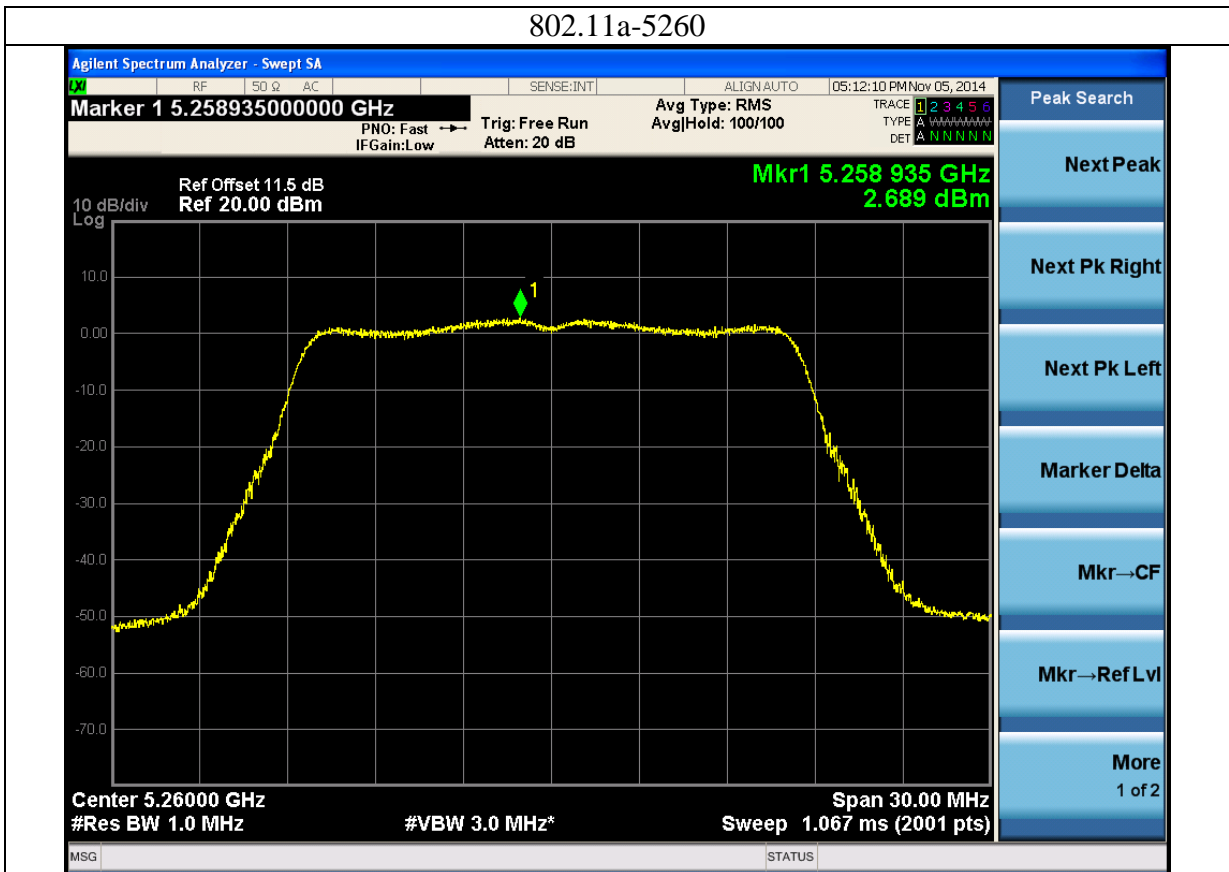


802.11ac80-5610

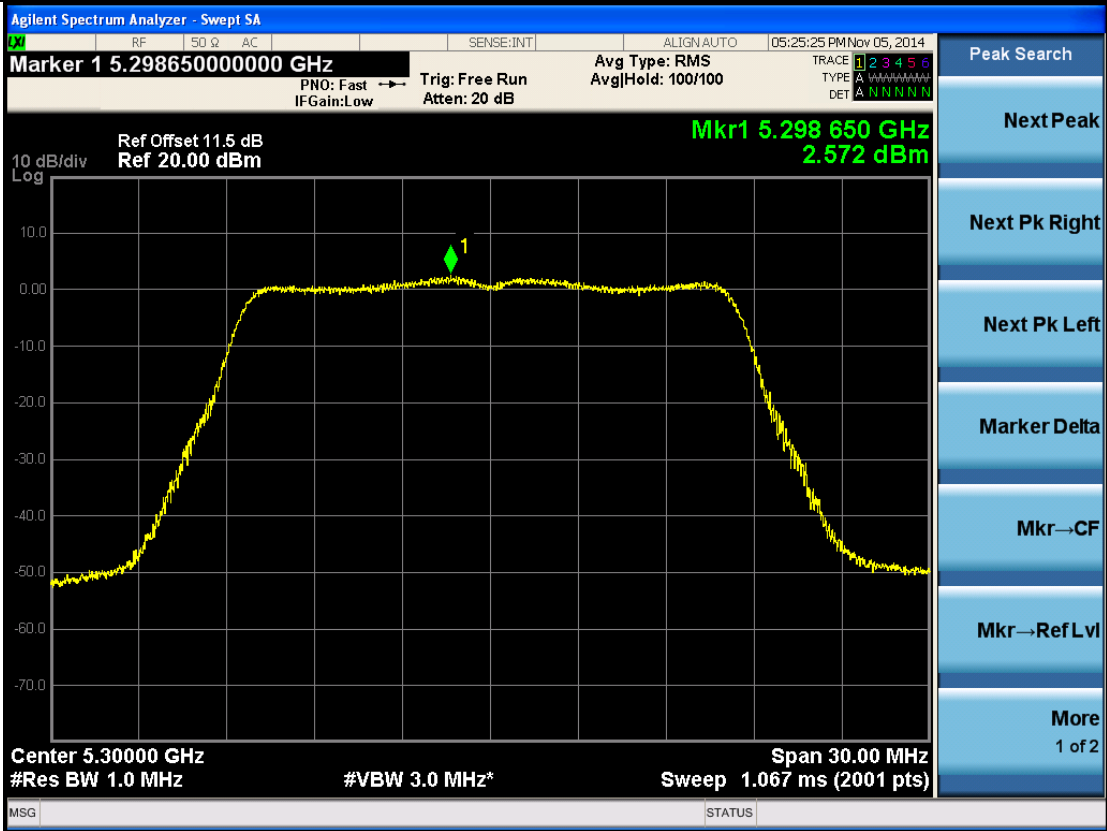




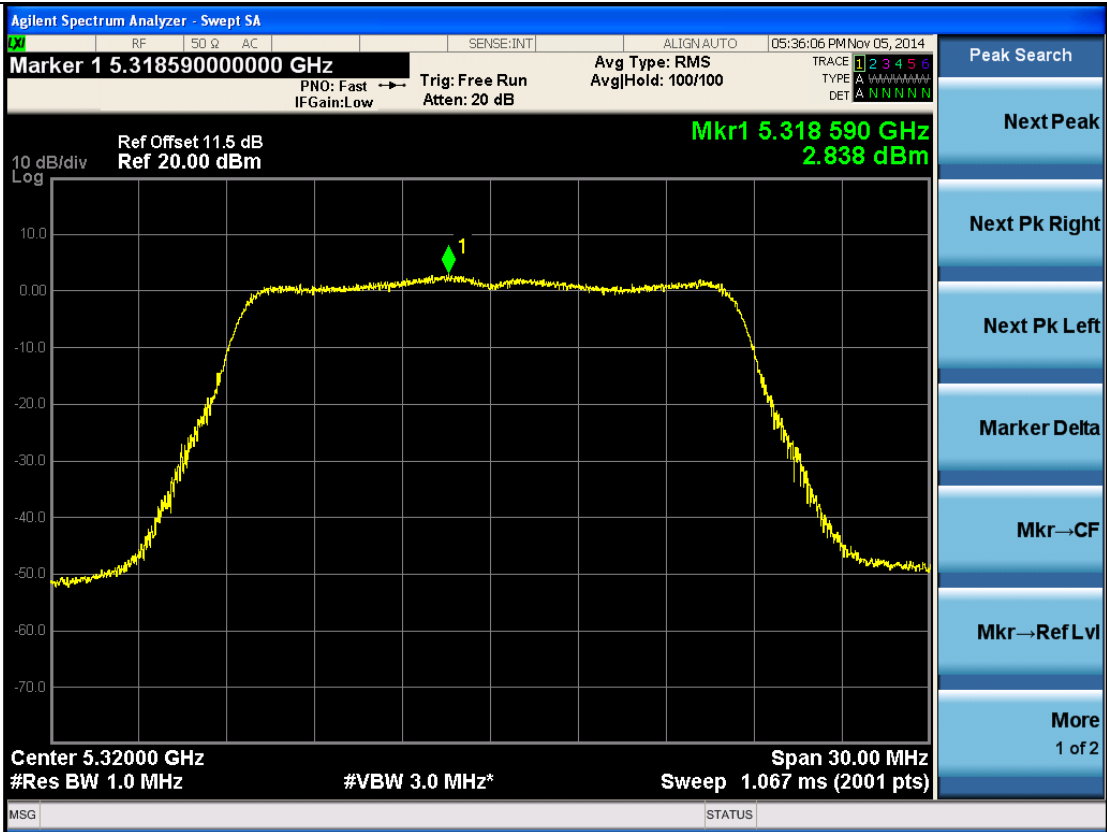
Port 1



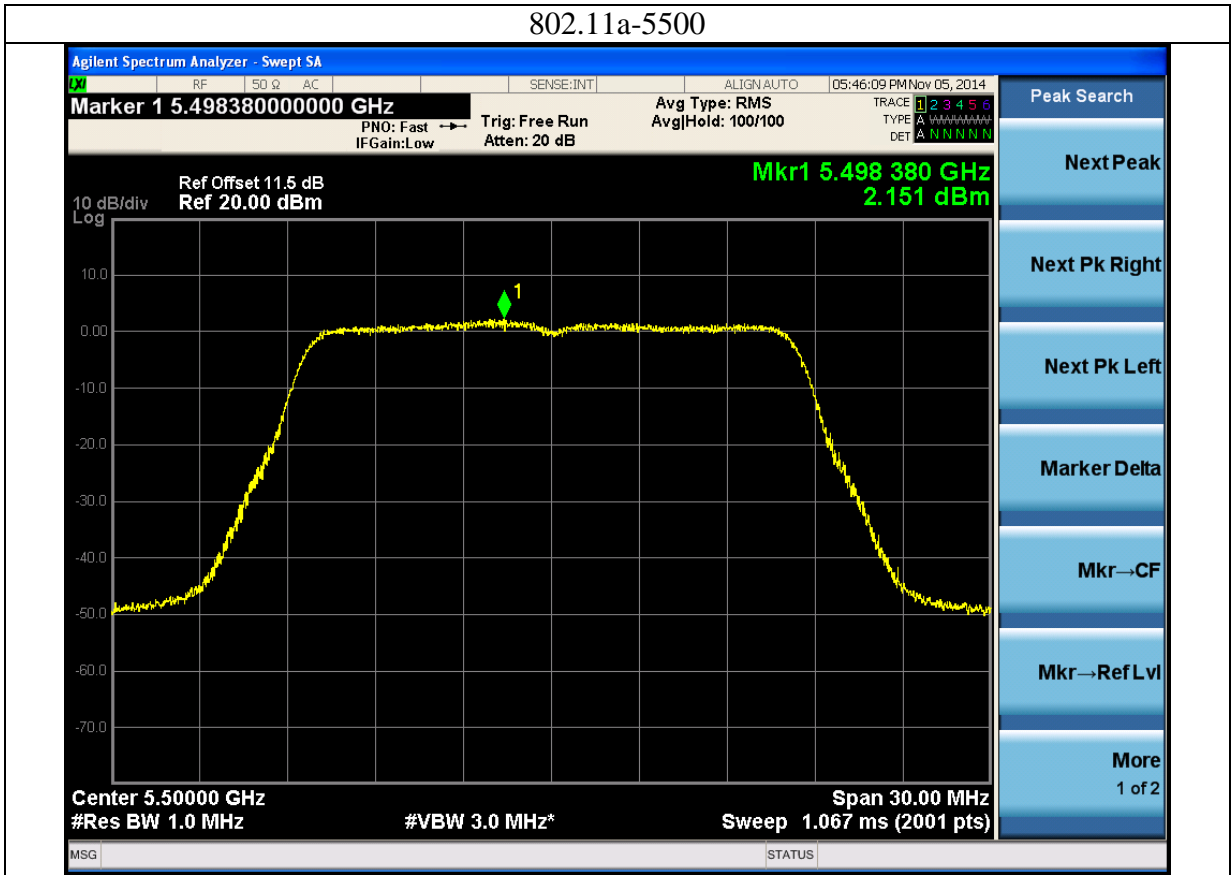
802.11a-5300



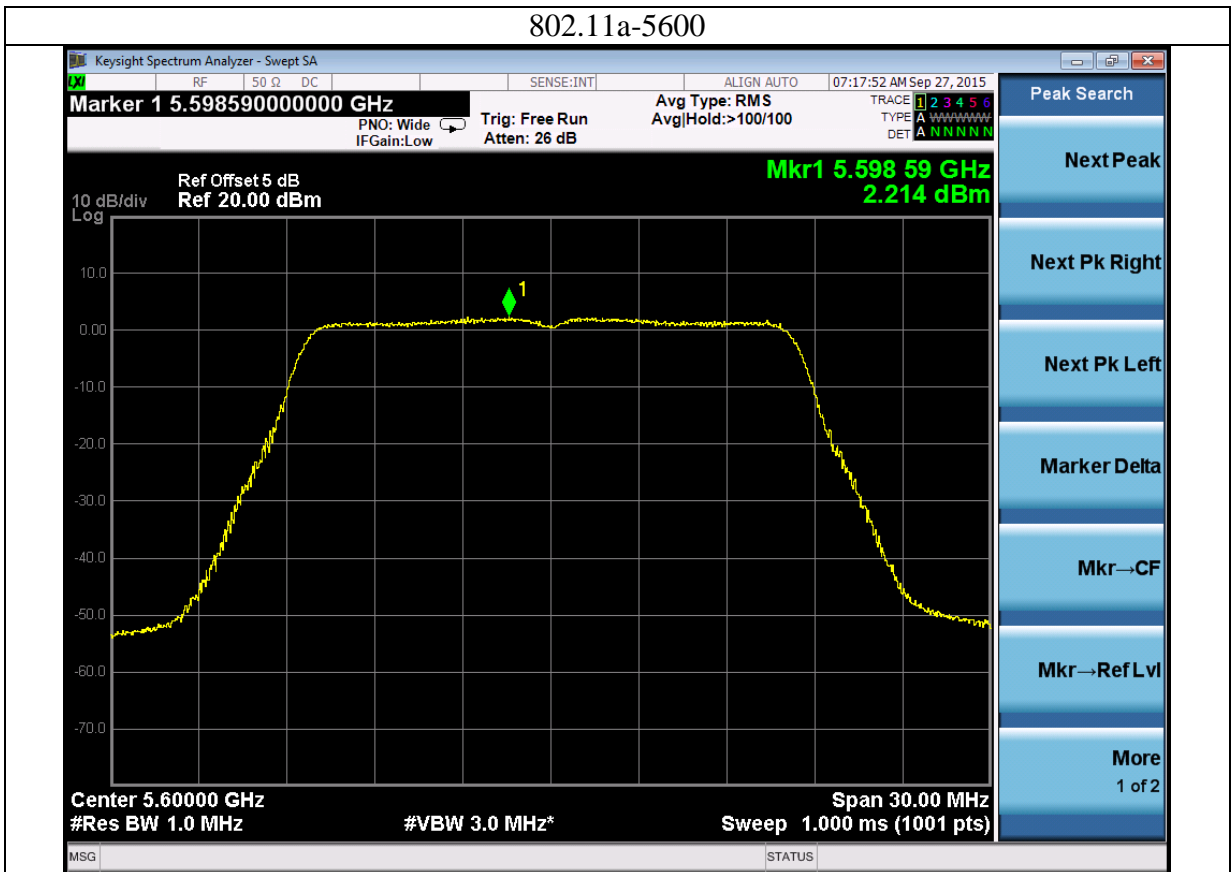
802.11a-5320



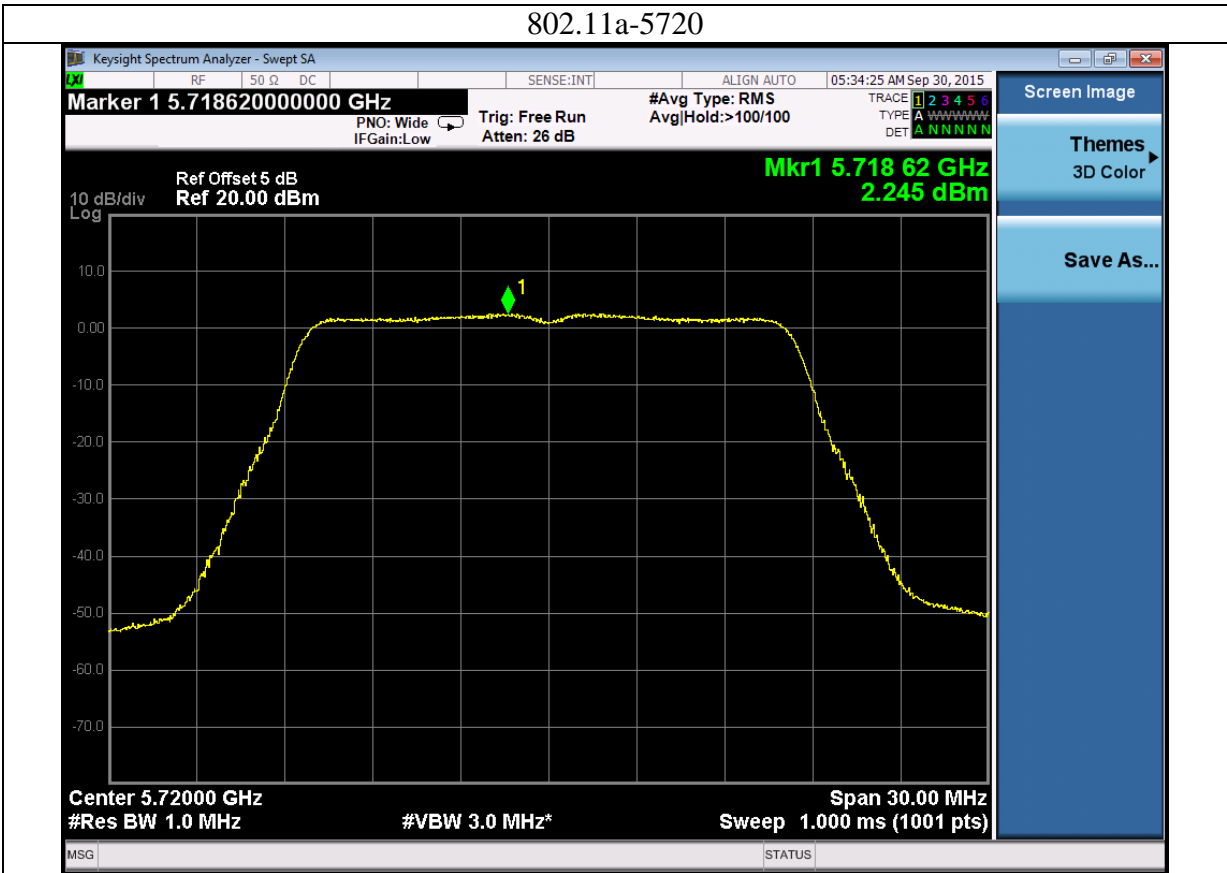
802.11a-5500



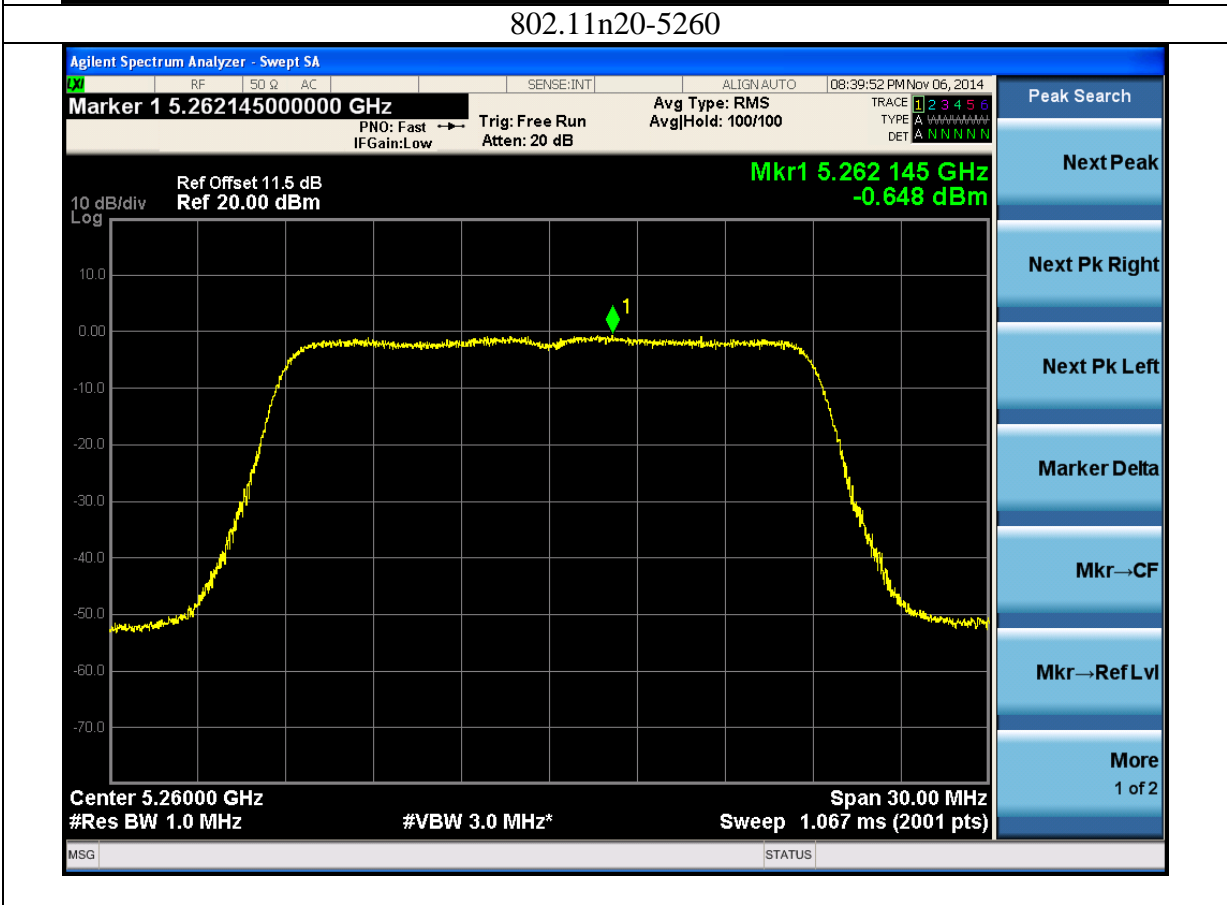
802.11a-5600

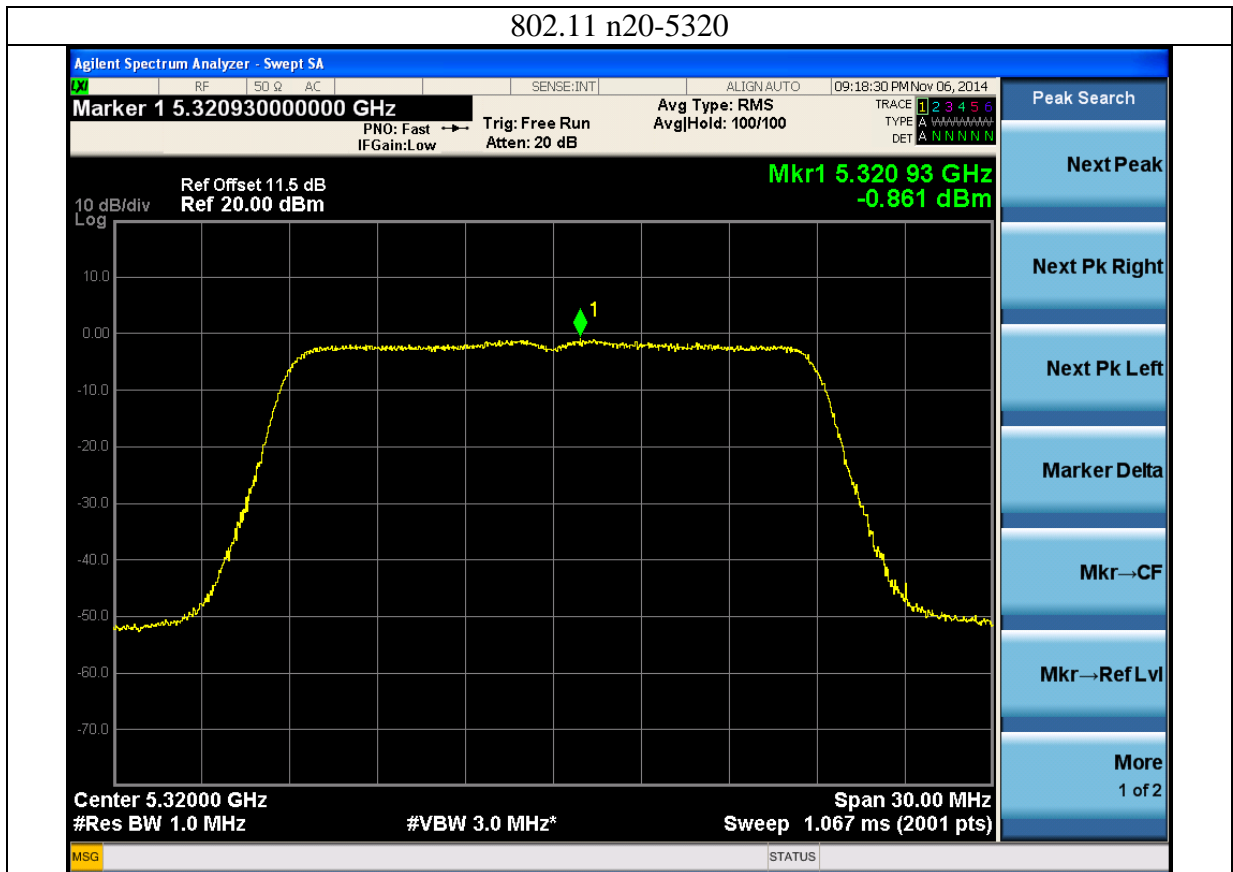
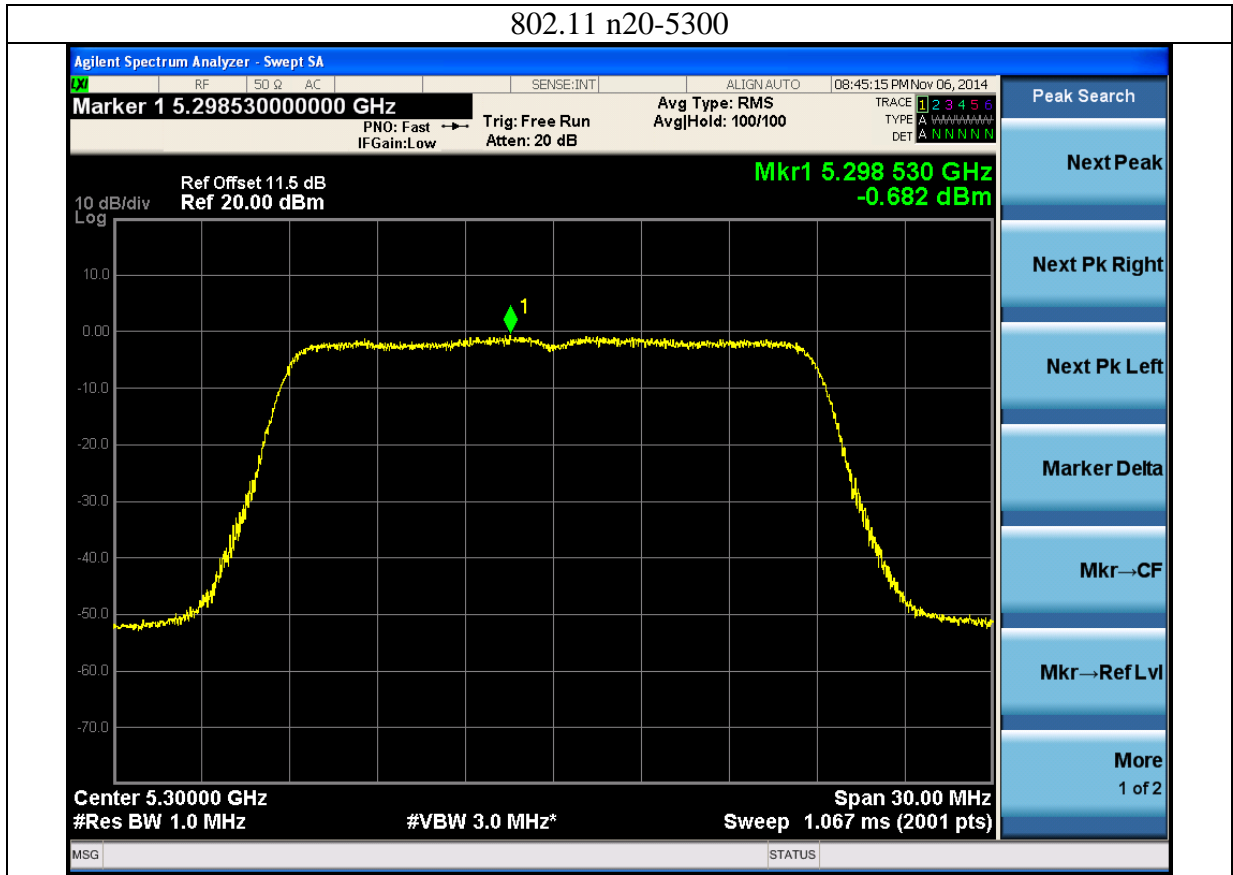


802.11a-5720

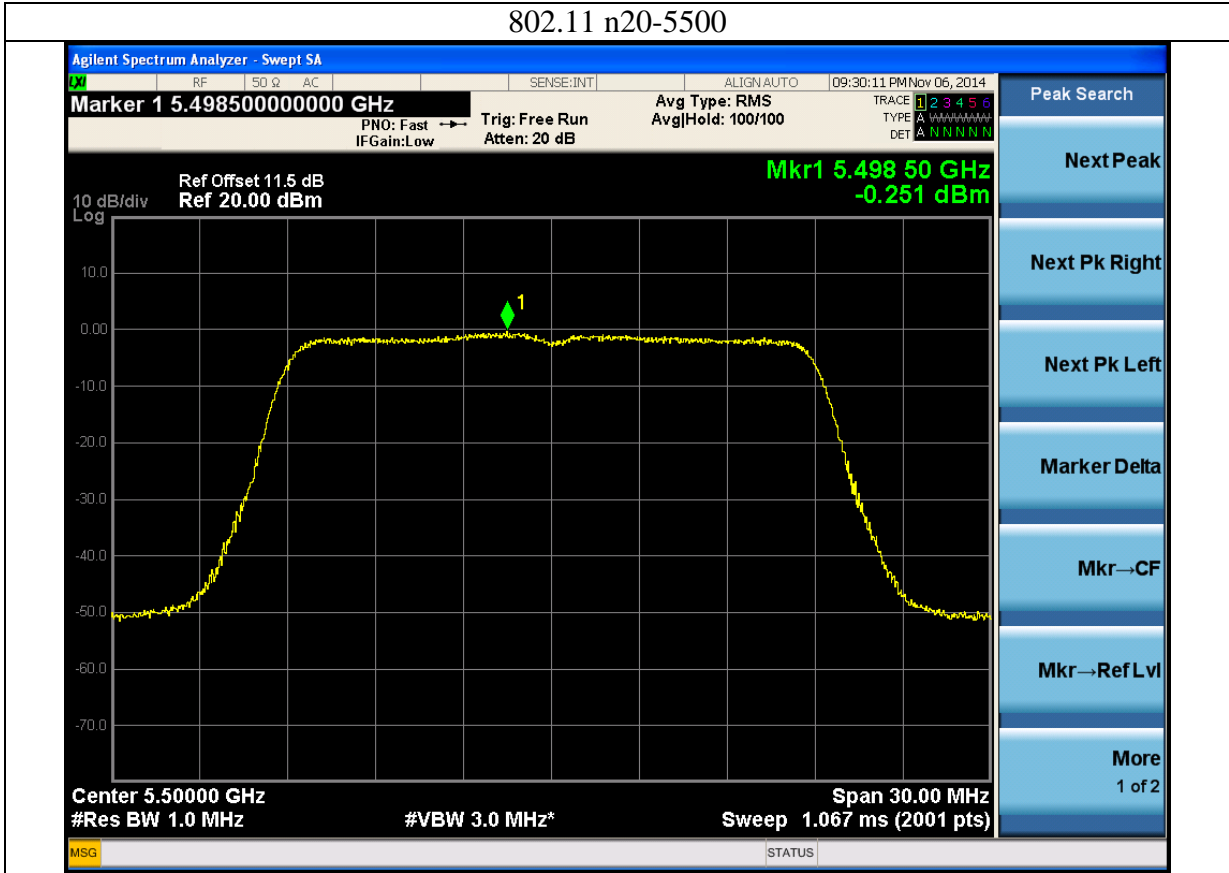


802.11n20-5260

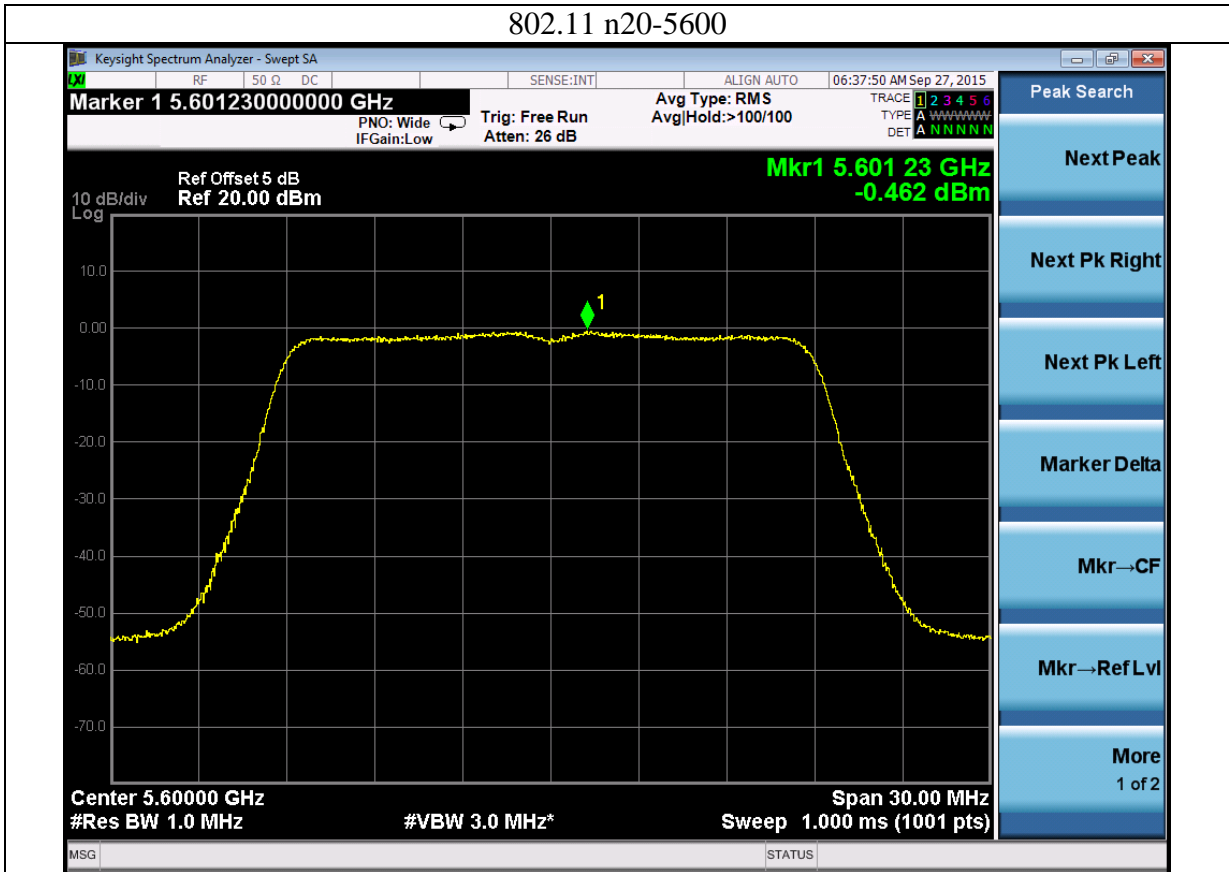




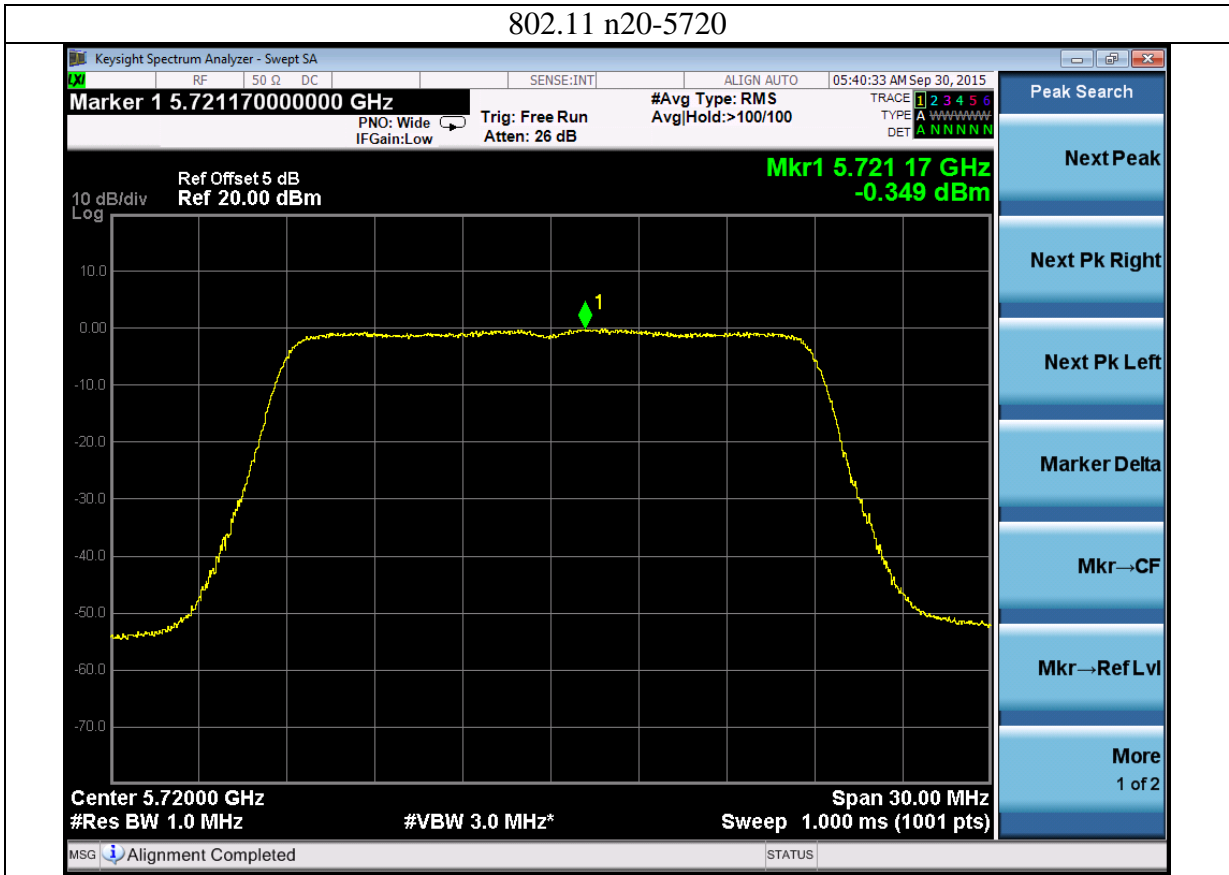
802.11 n20-5500



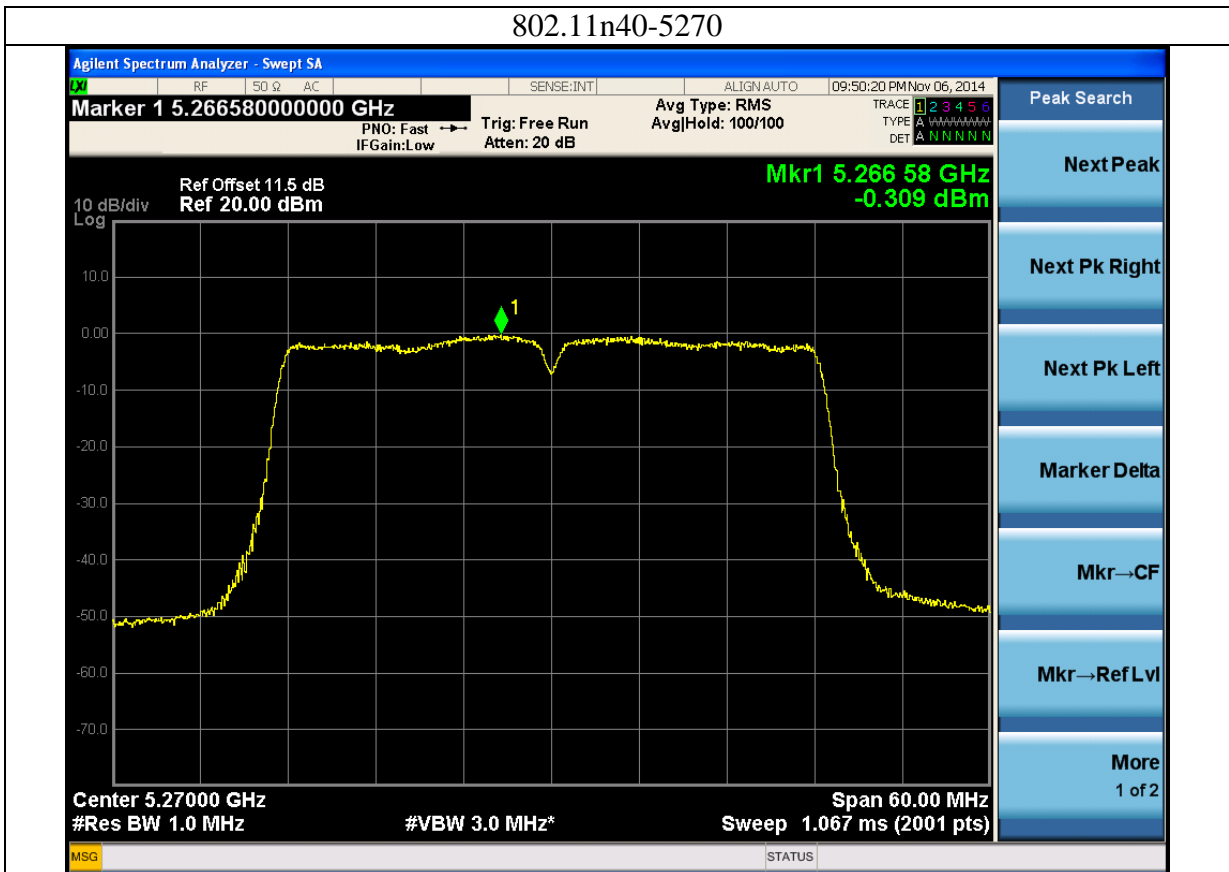
802.11 n20-5600



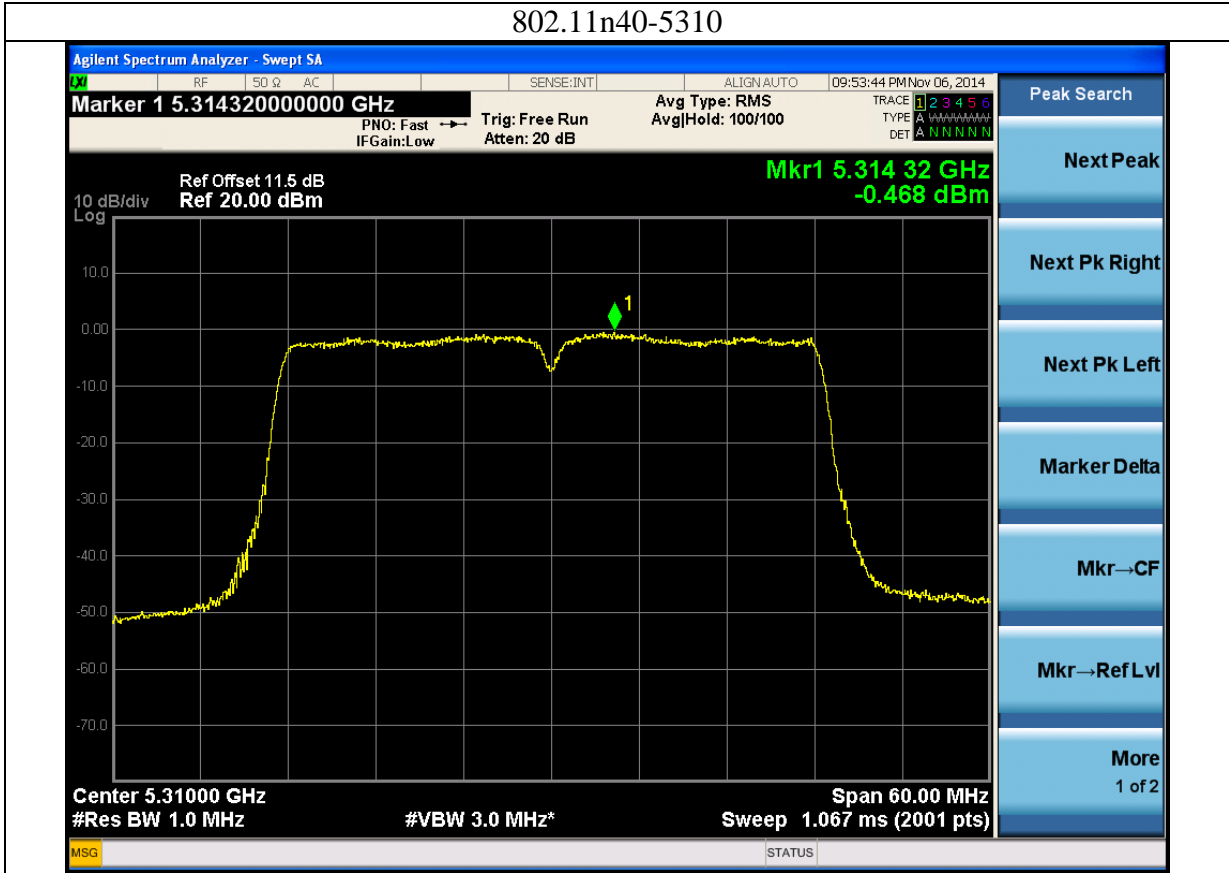
802.11 n20-5720



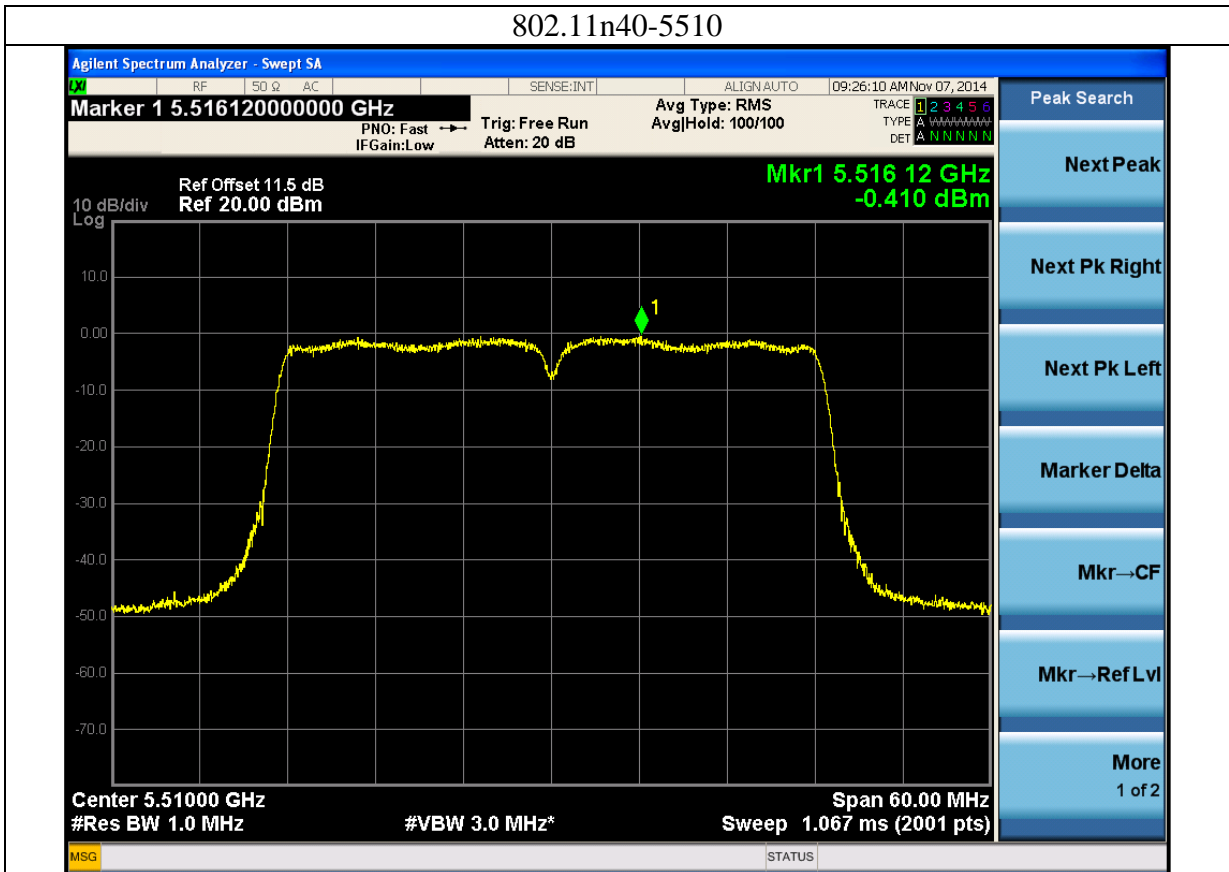
802.11n40-5270



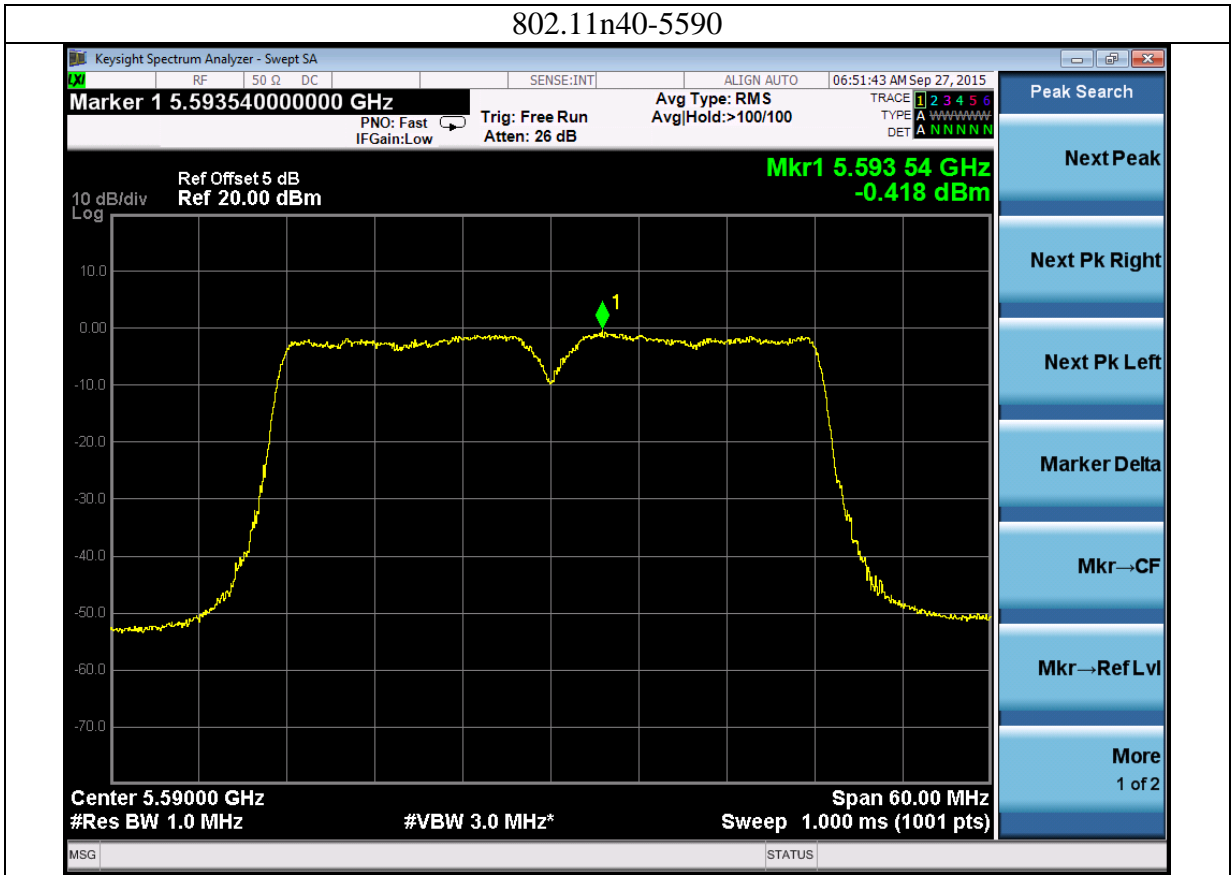
802.11n40-5310



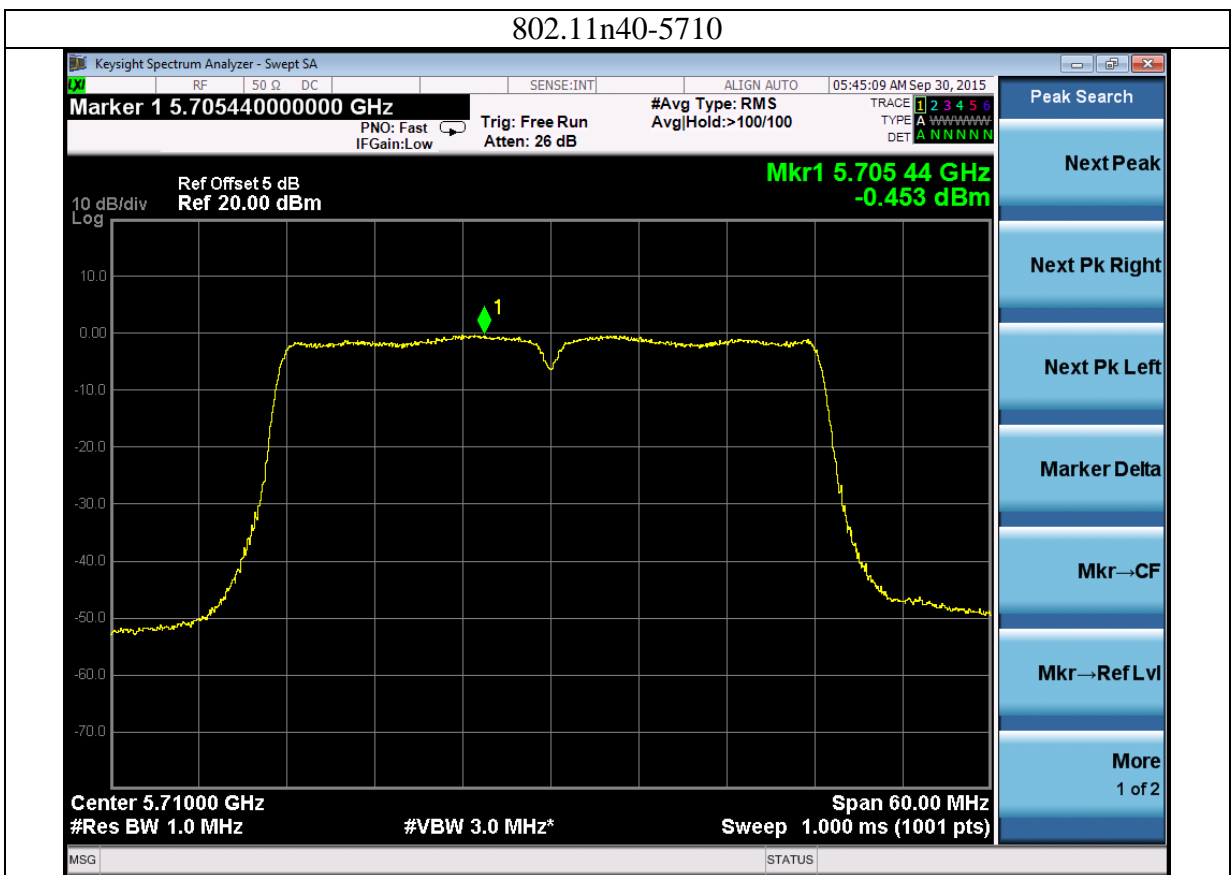
802.11n40-5510



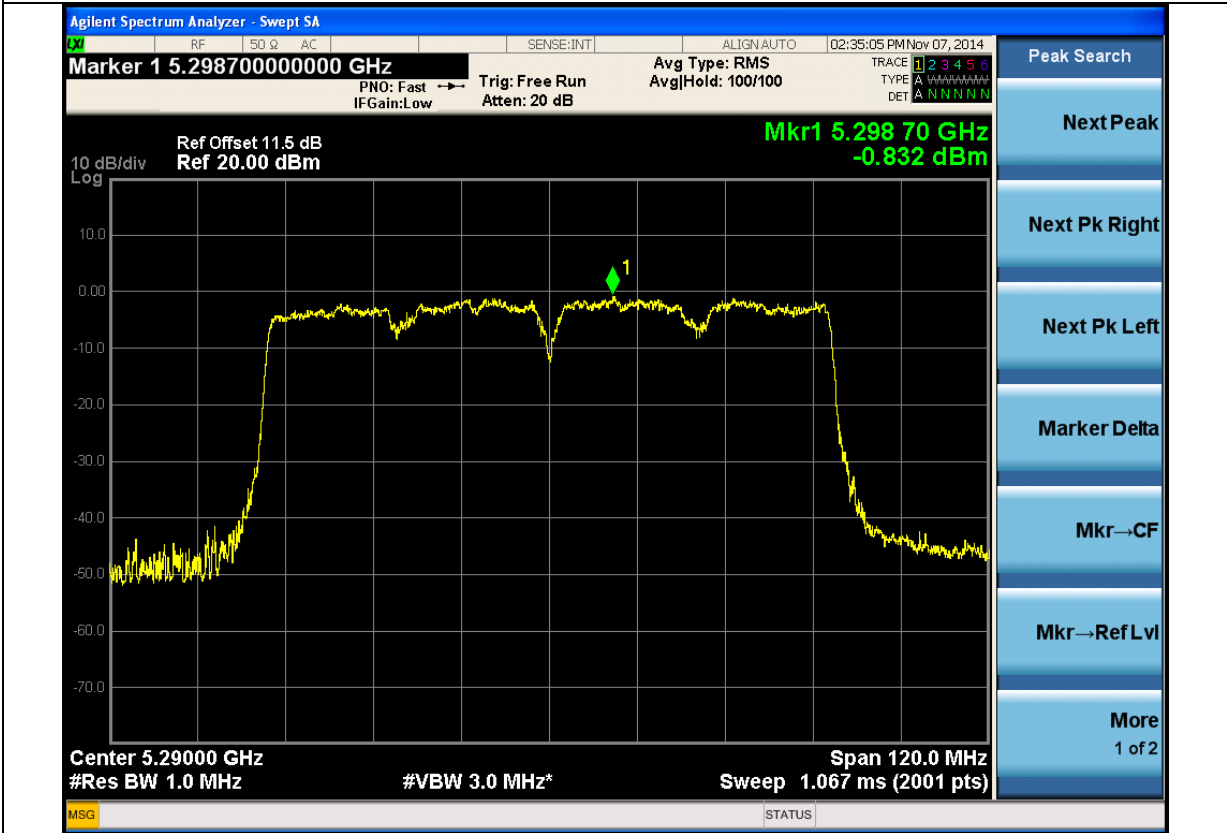
802.11n40-5590



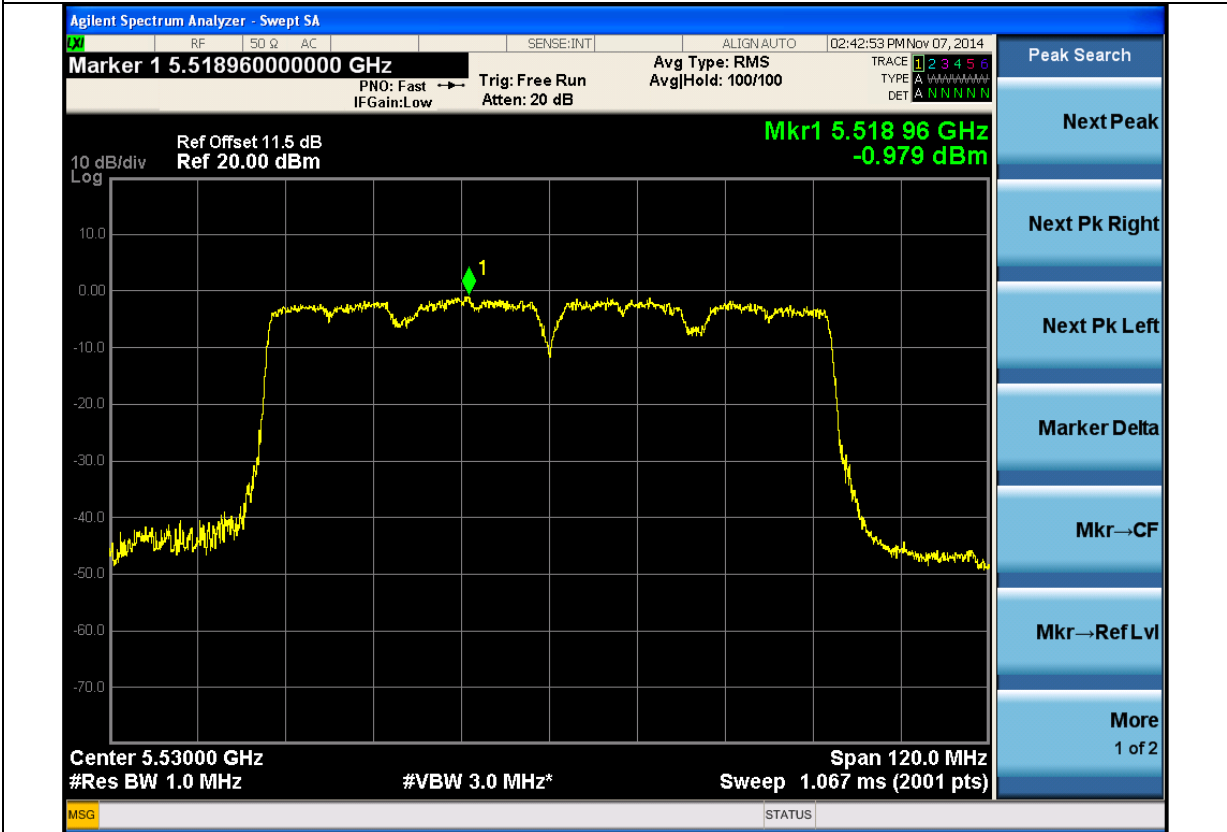
802.11n40-5710



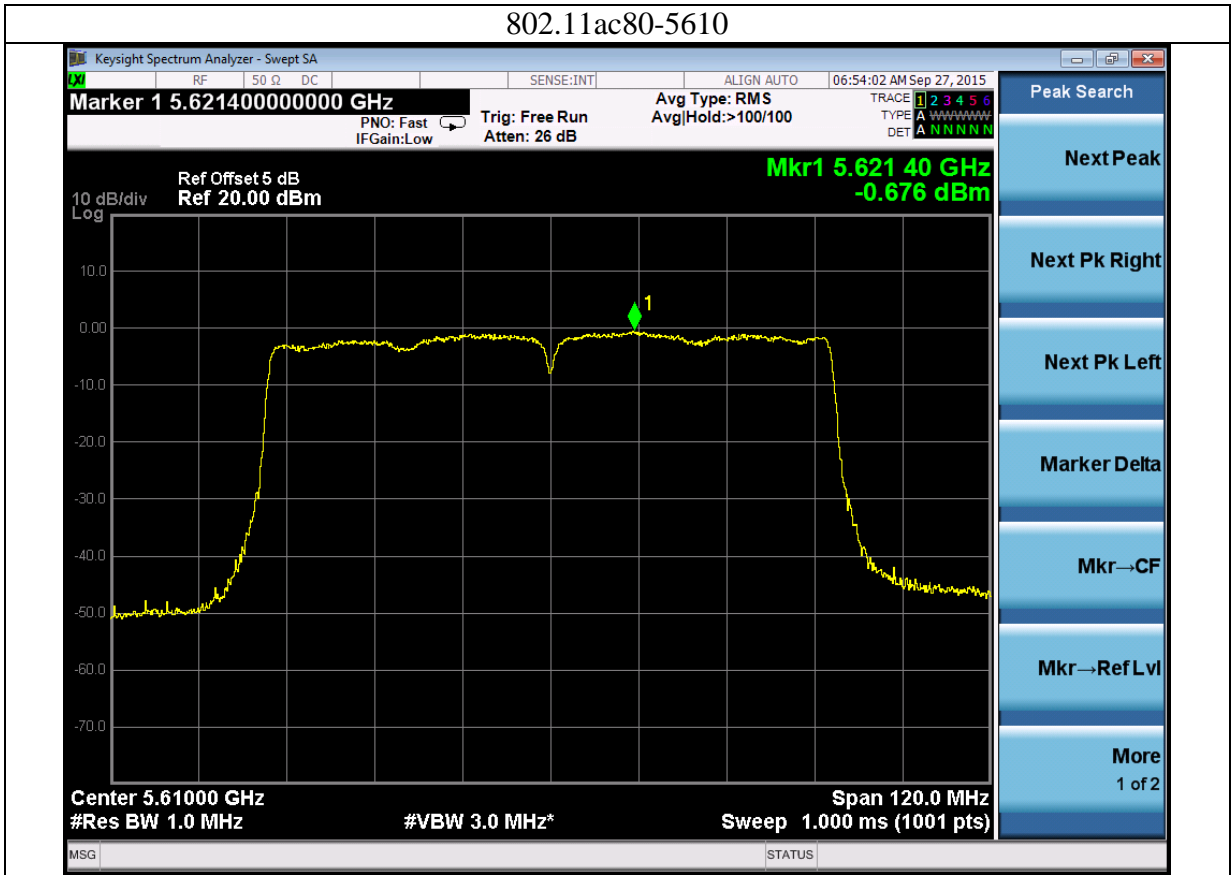
802.11ac80-5290



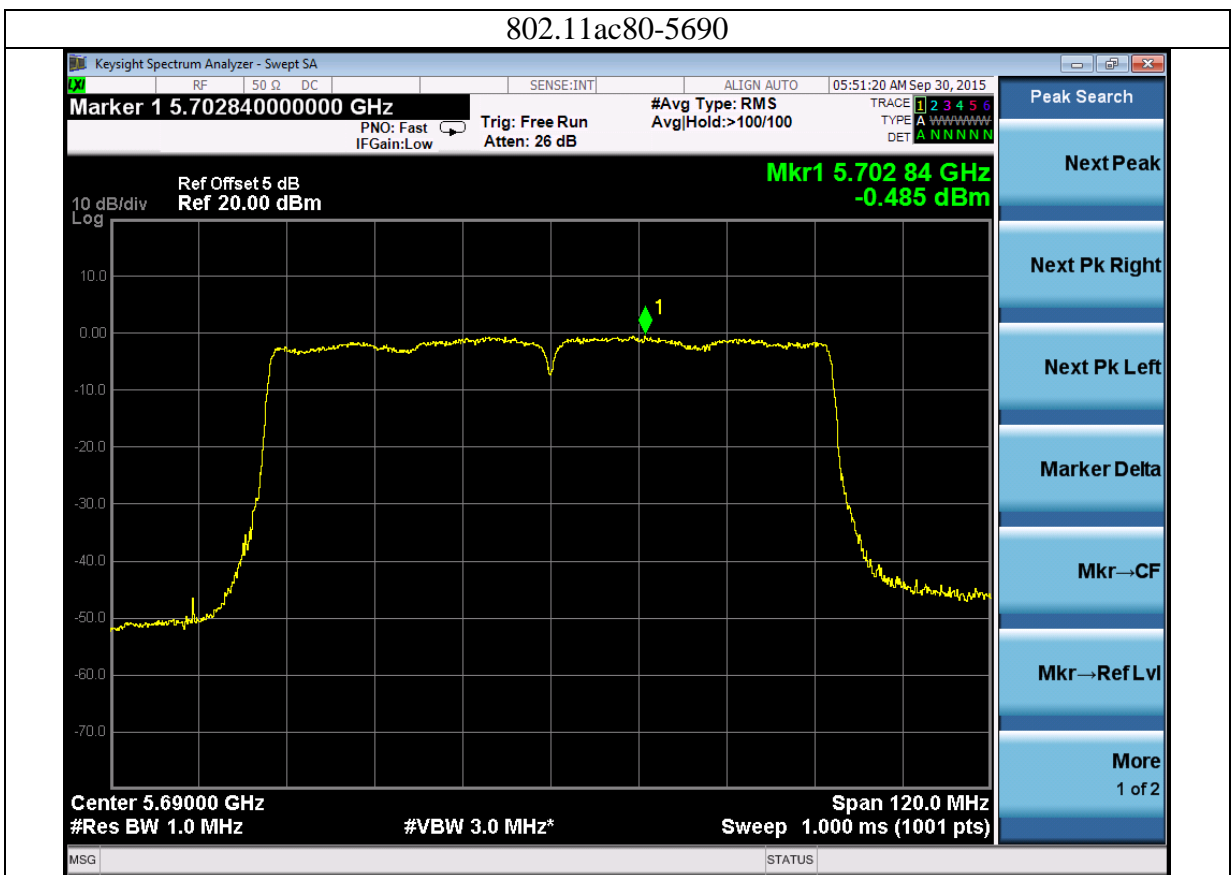
802.11ac80-5530



802.11ac80-5610

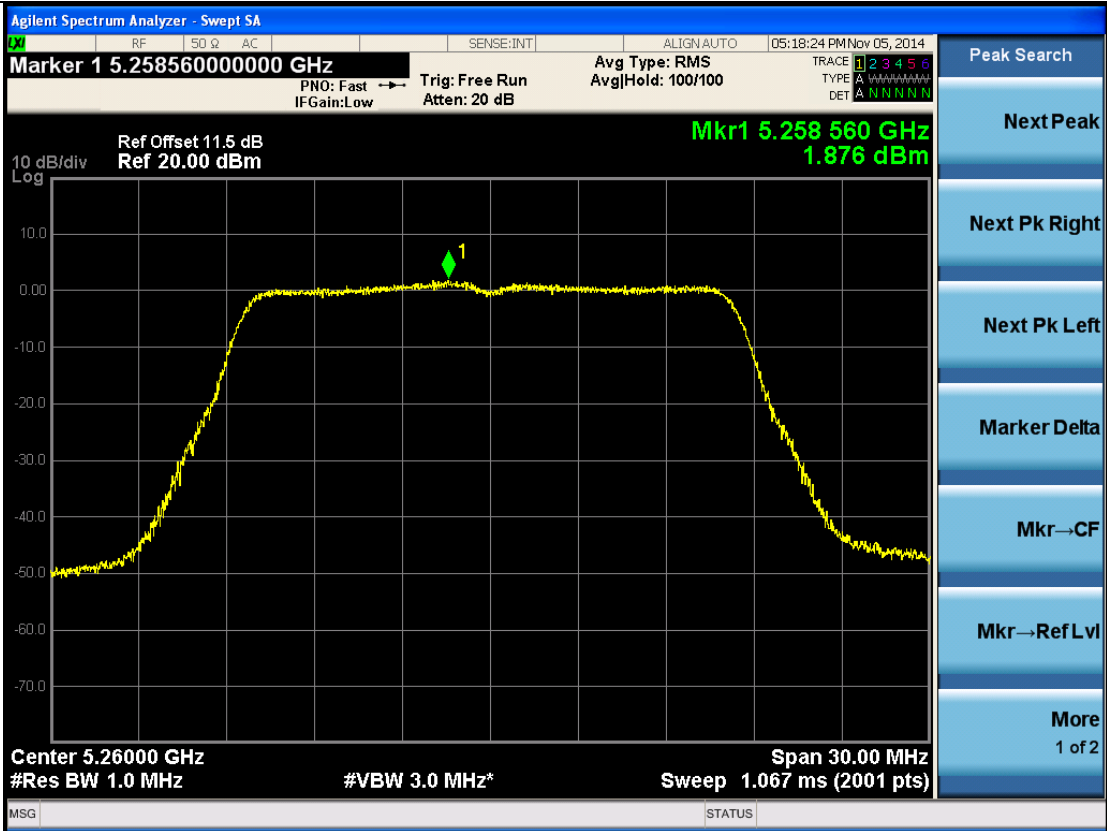


802.11ac80-5690

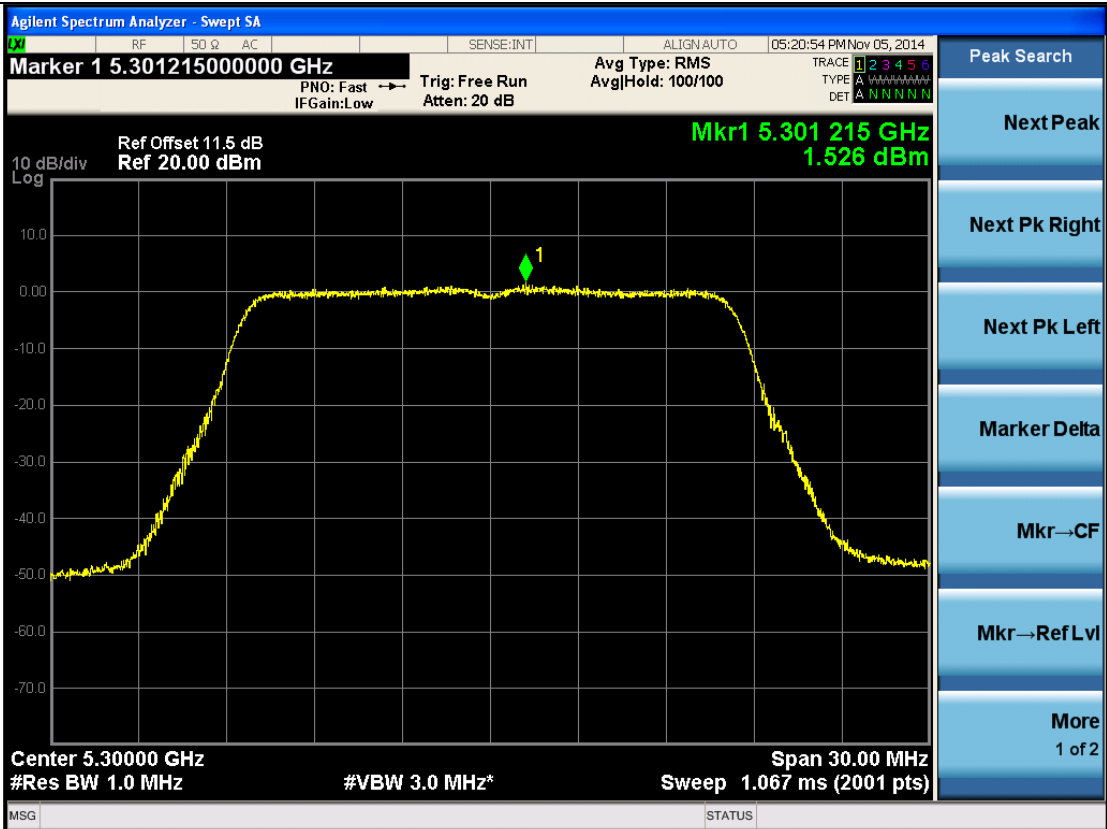


Port 2

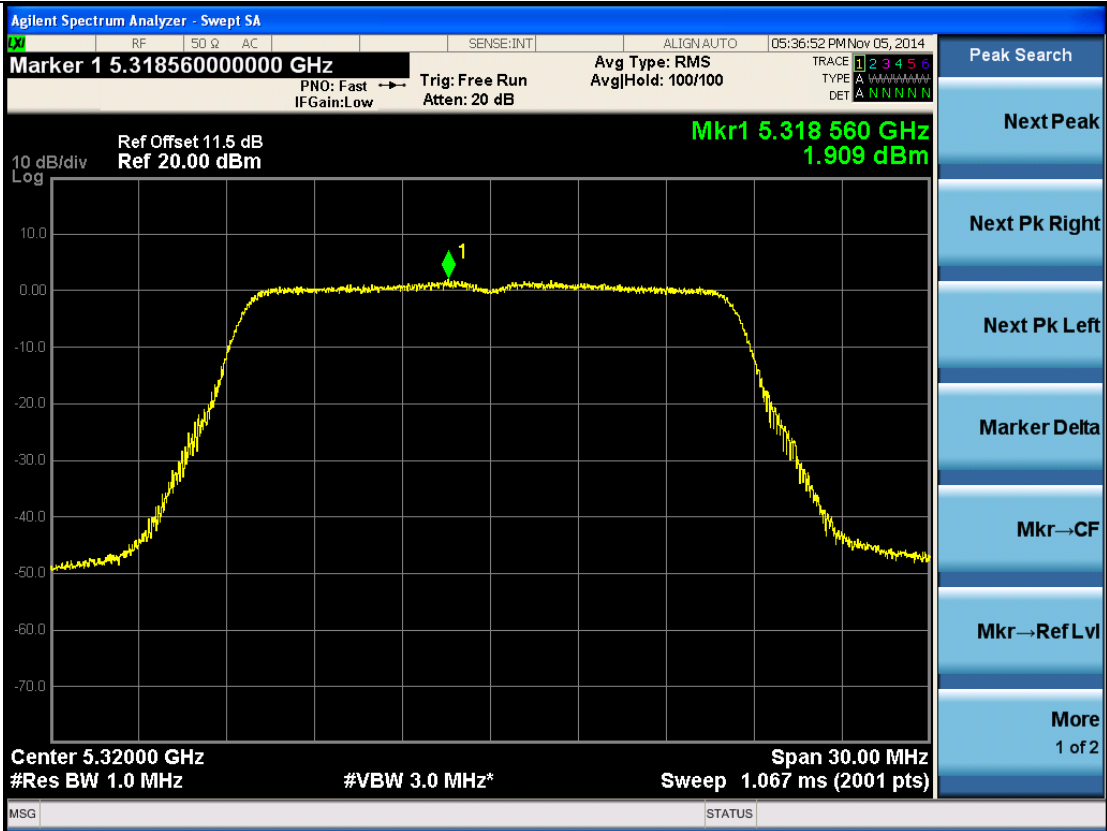
802.11a-5260



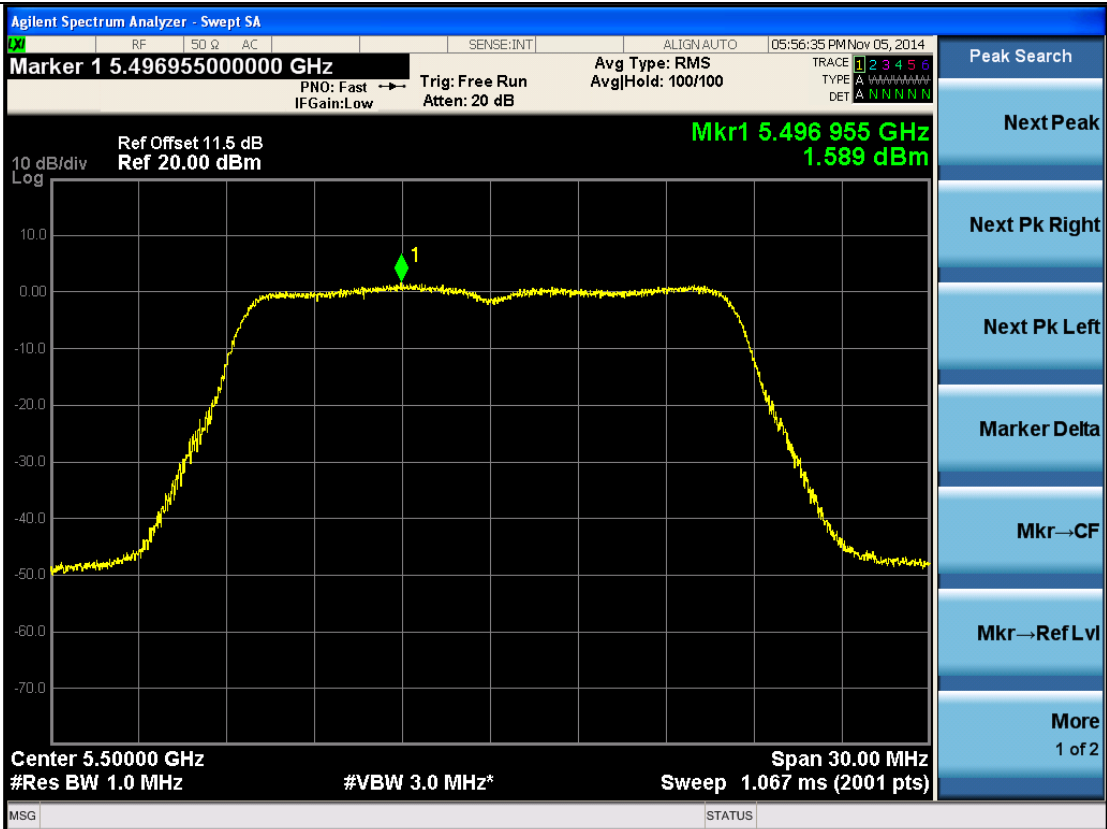
802.11a-5300



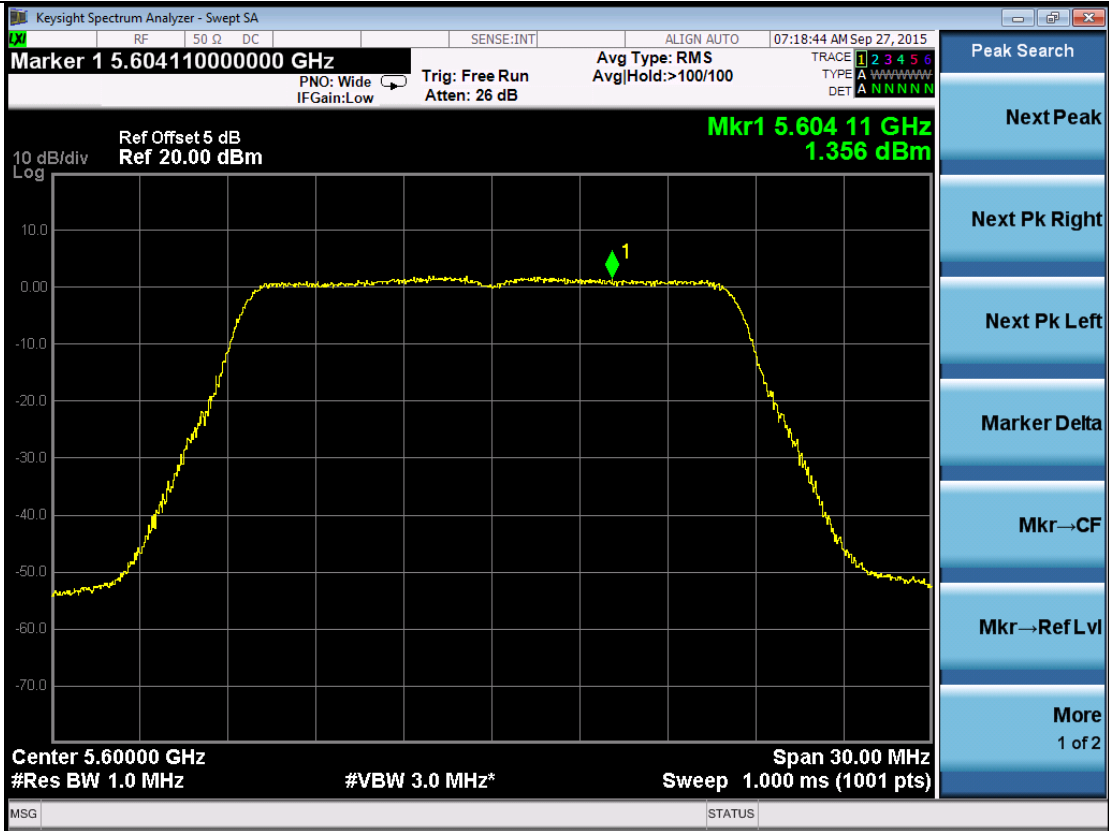
802.11a-5320



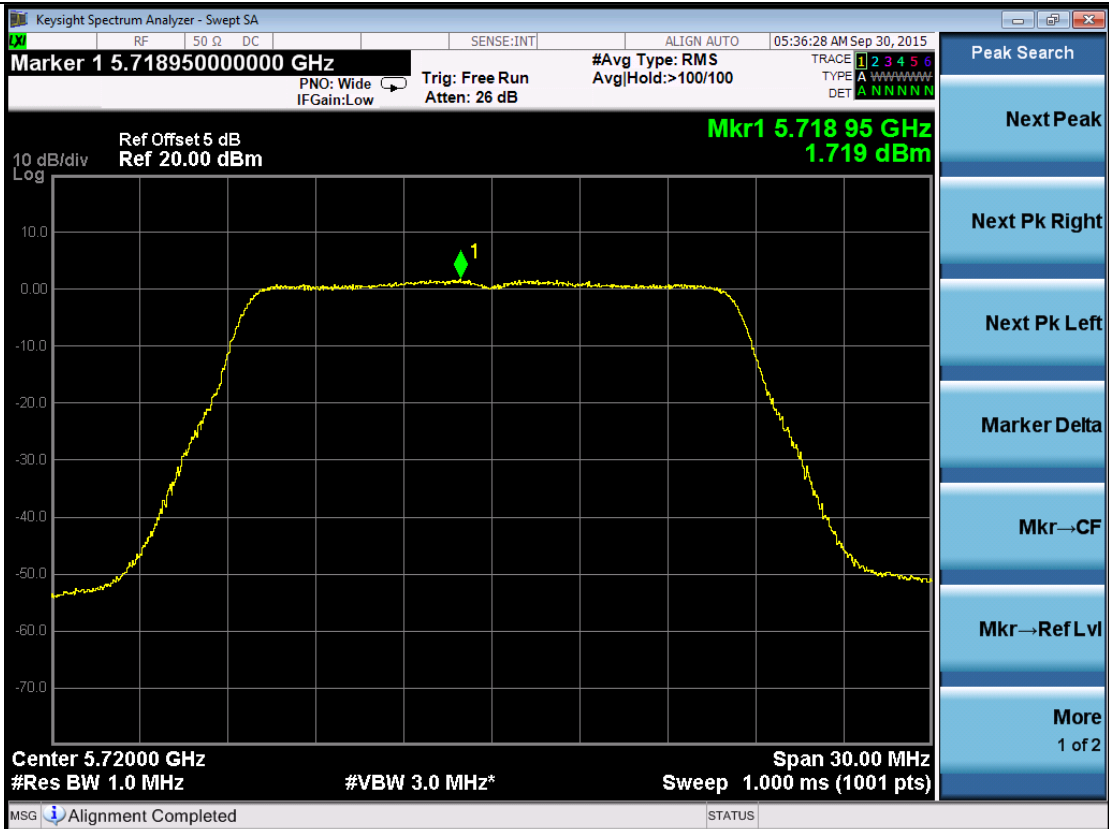
802.11a-5500



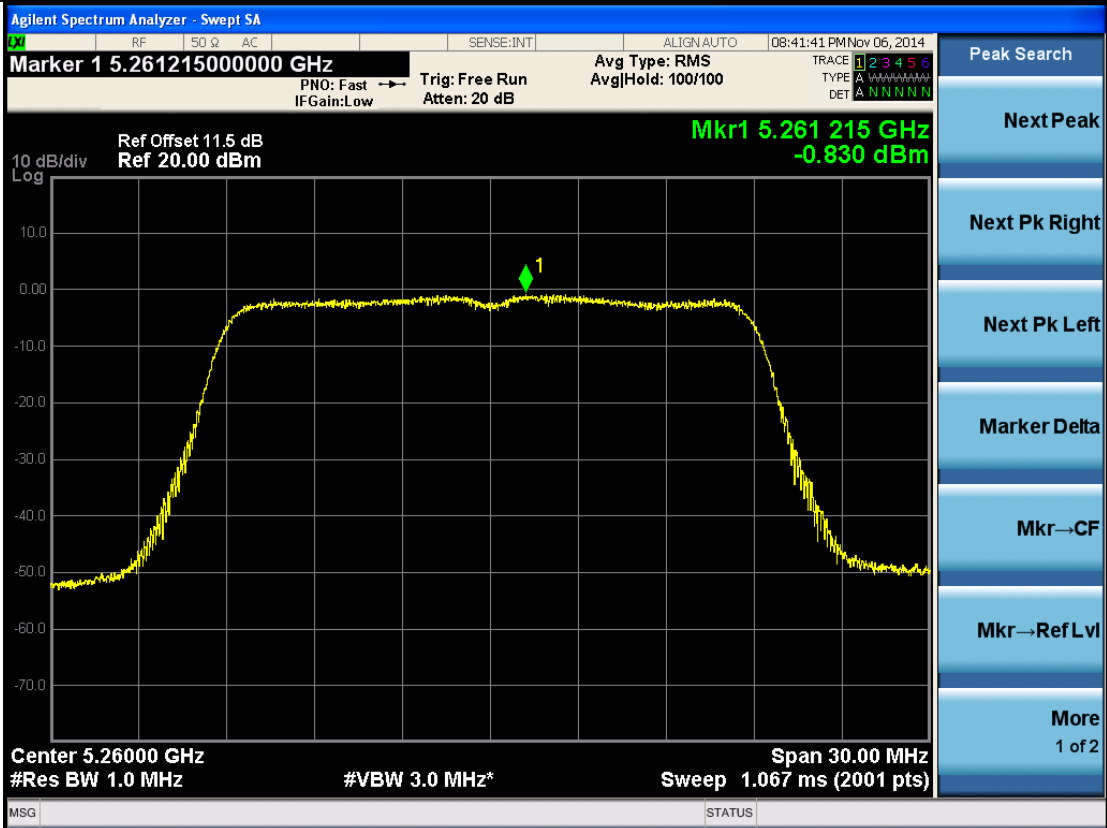
802.11a-5600



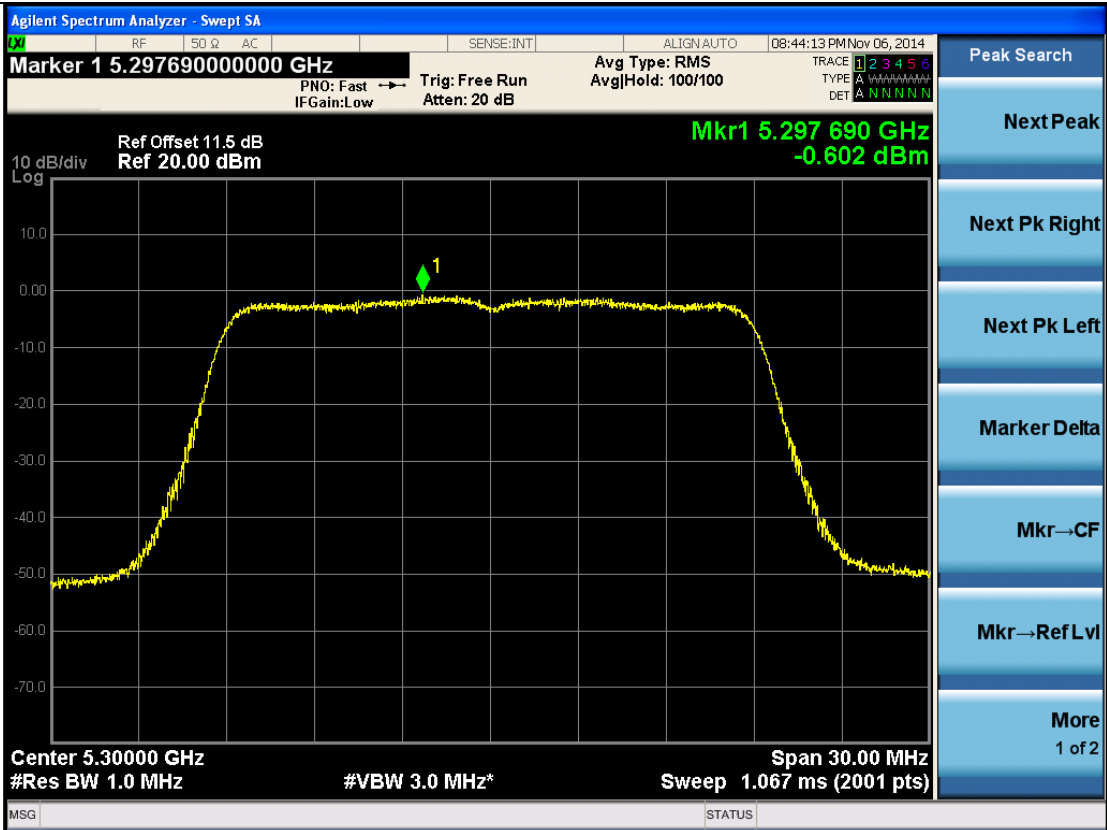
802.11a-5720



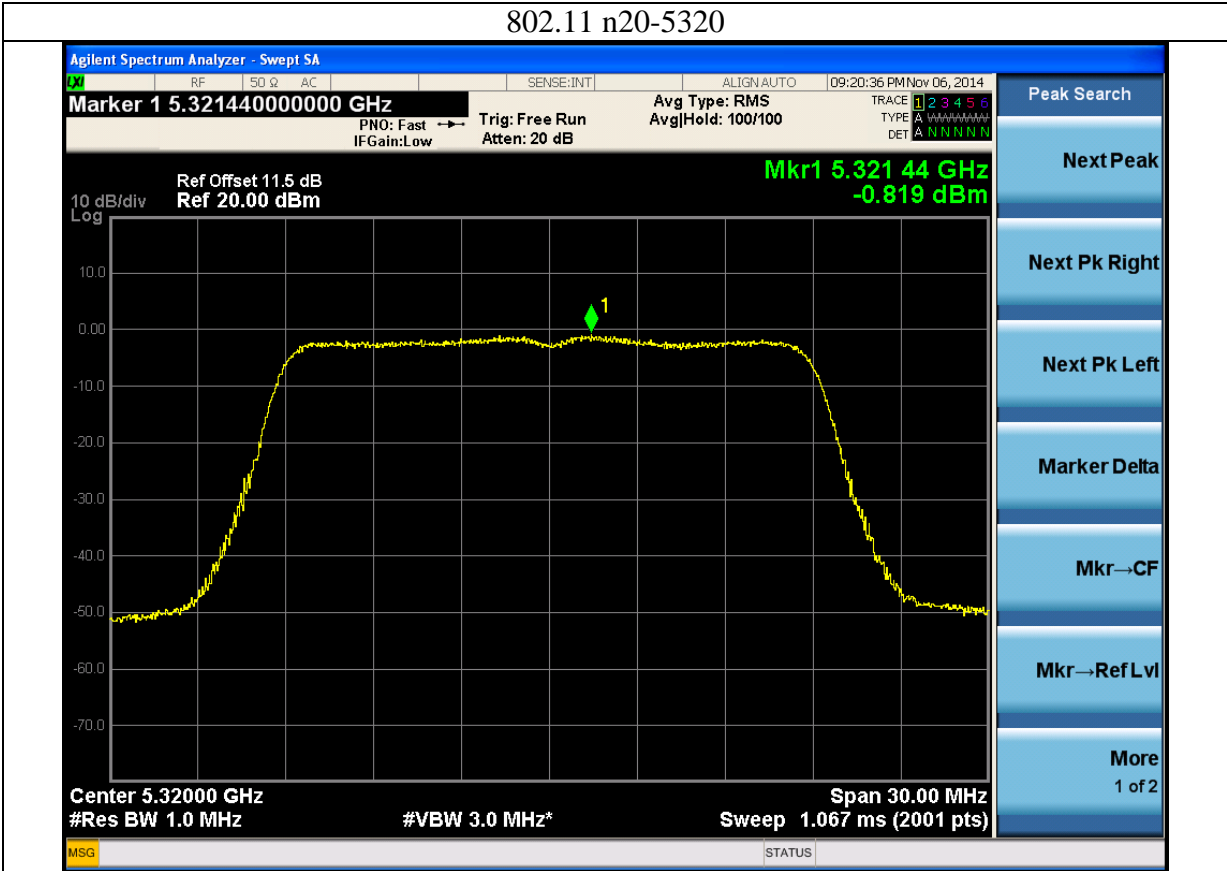
802.11n20-5260



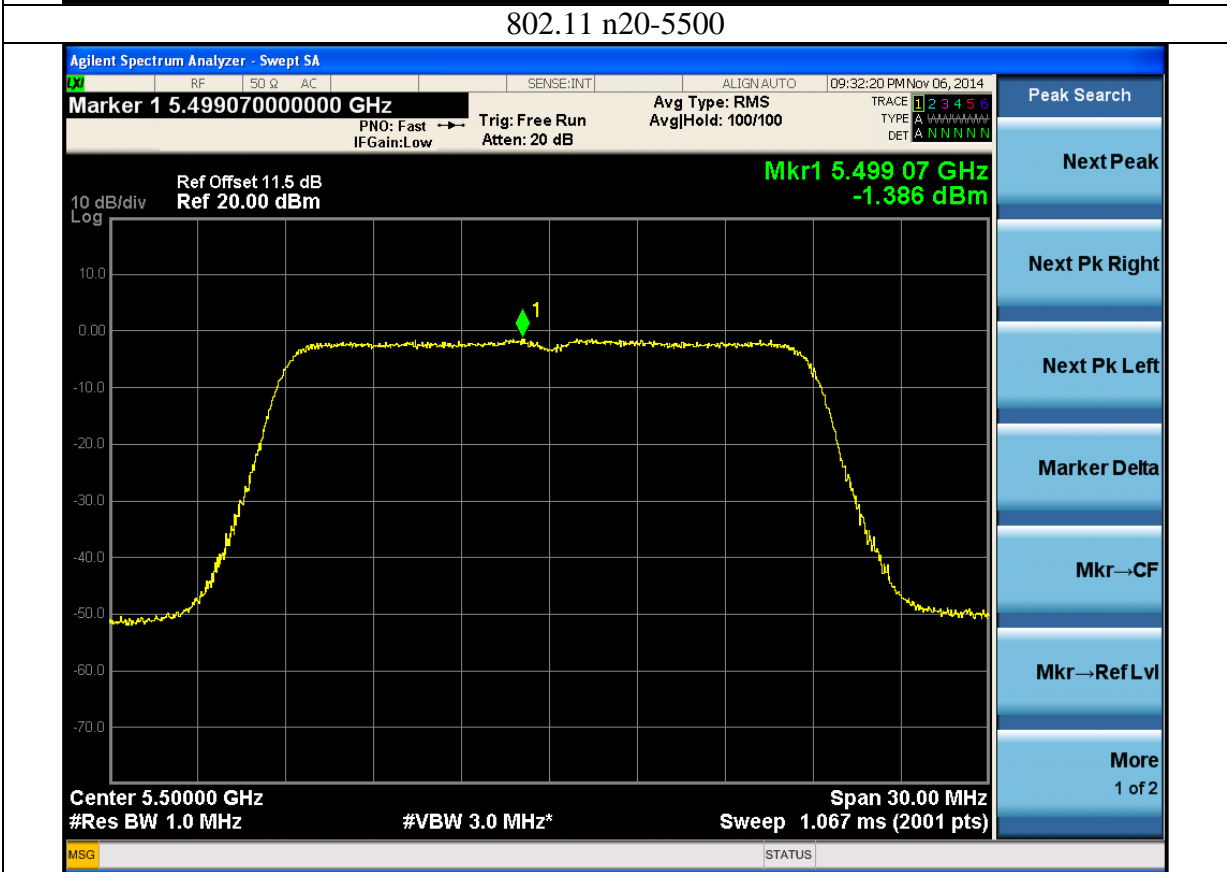
802.11 n20-5300



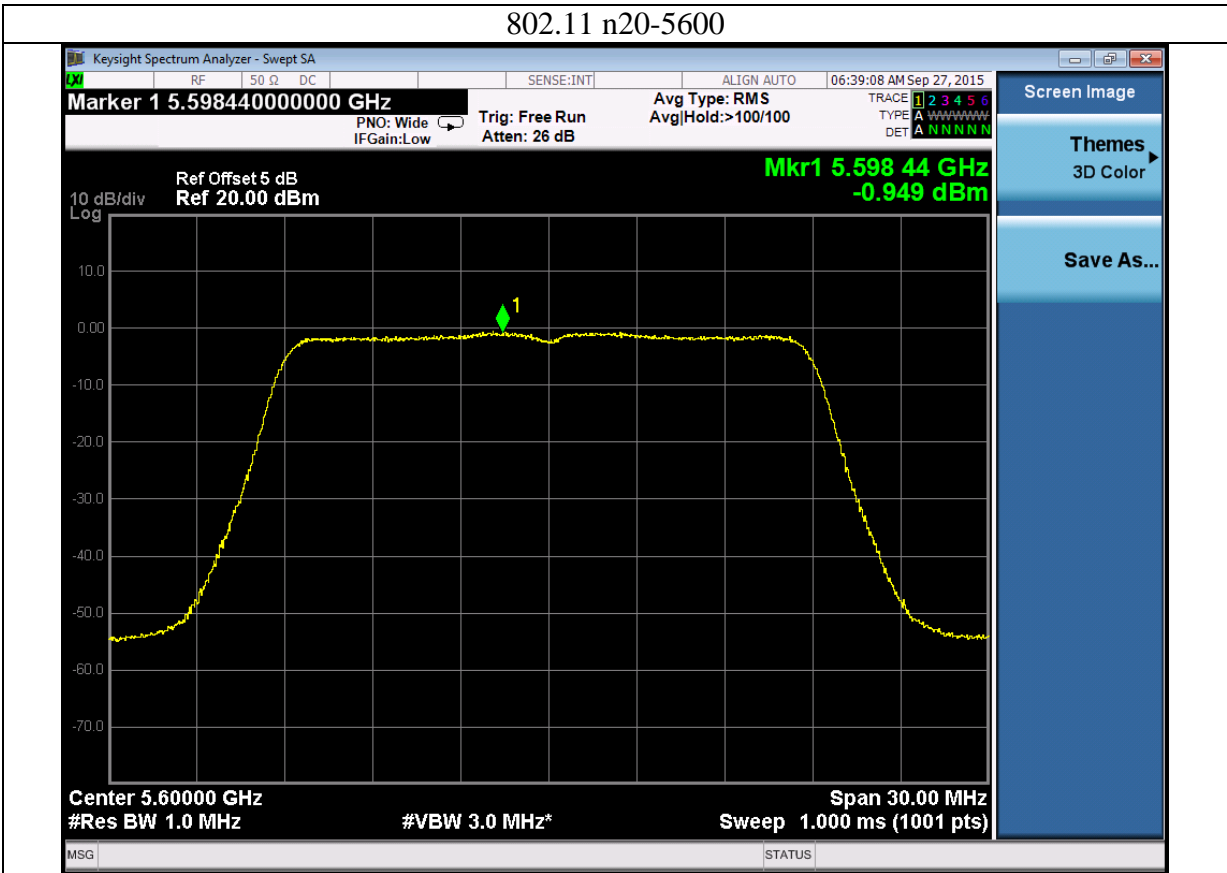
802.11 n20-5320



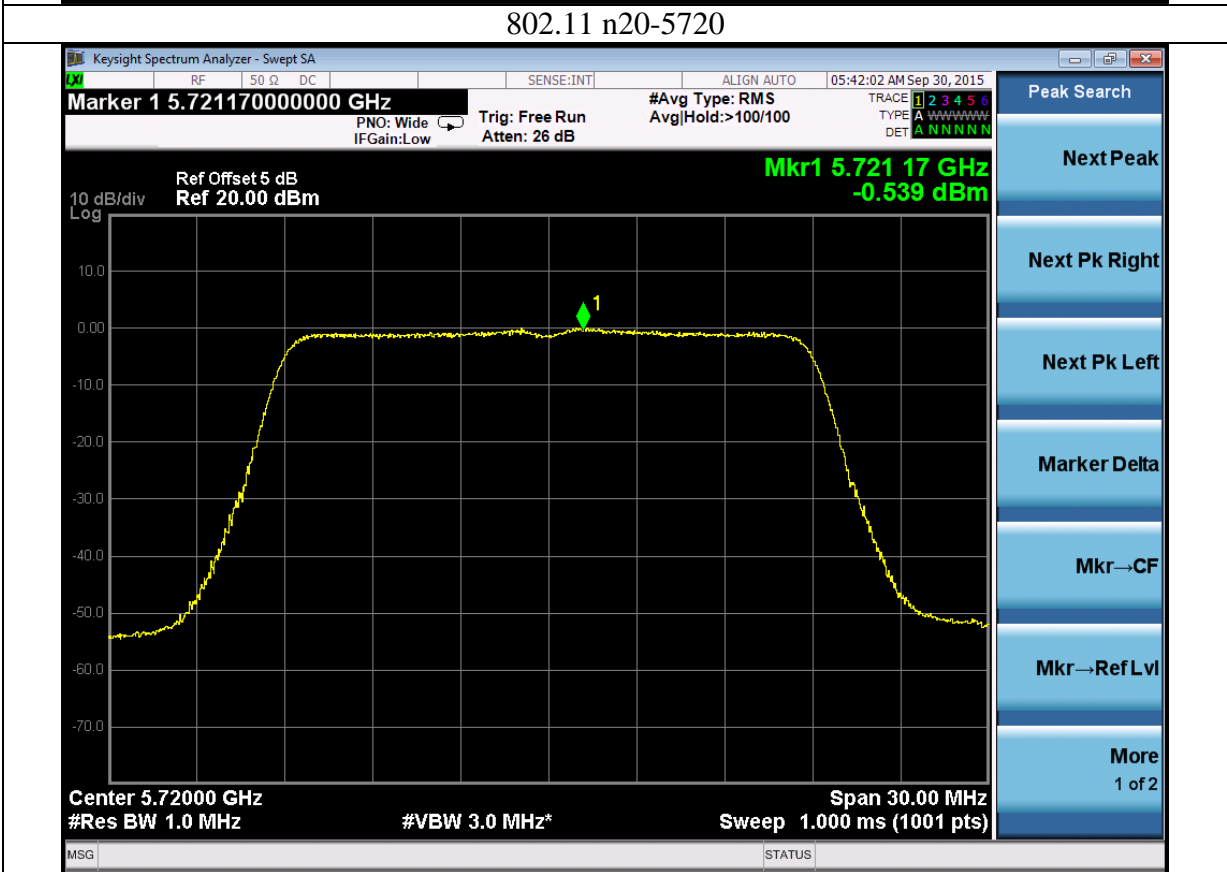
802.11 n20-5500



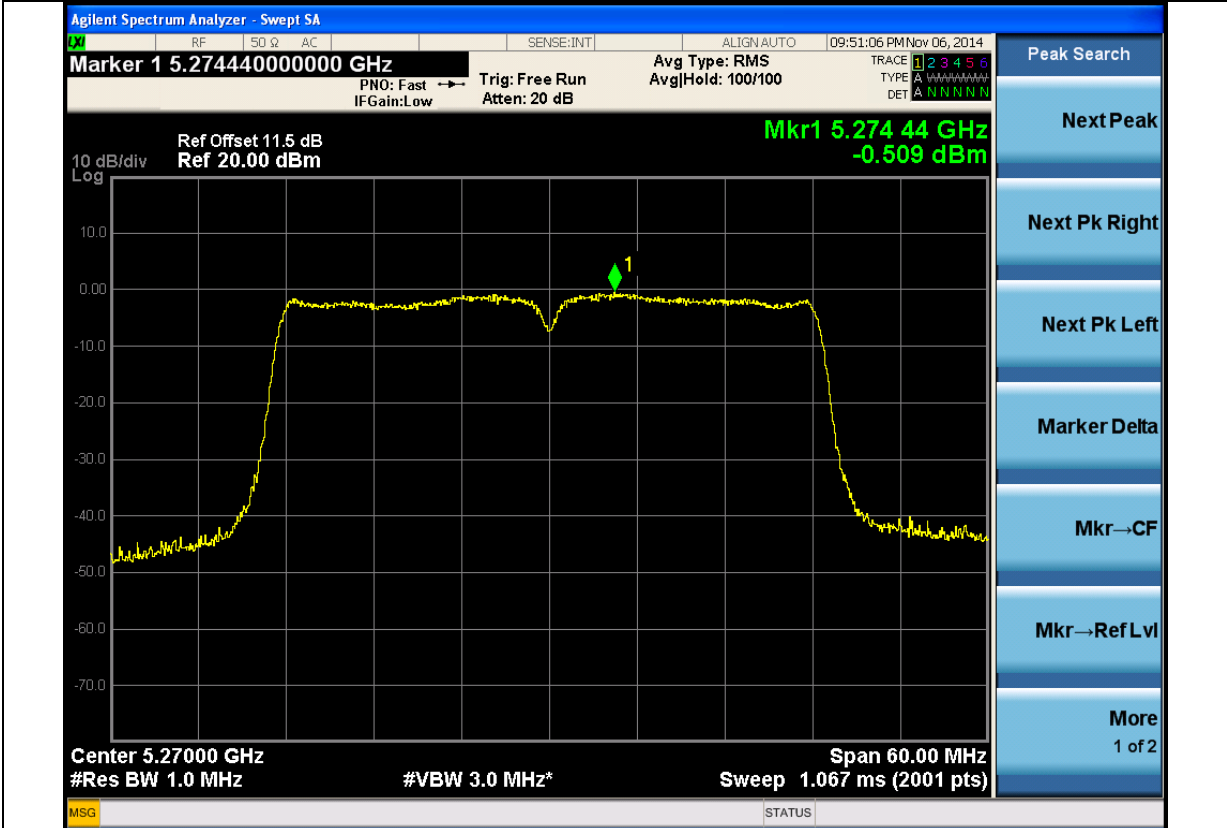
802.11 n20-5600



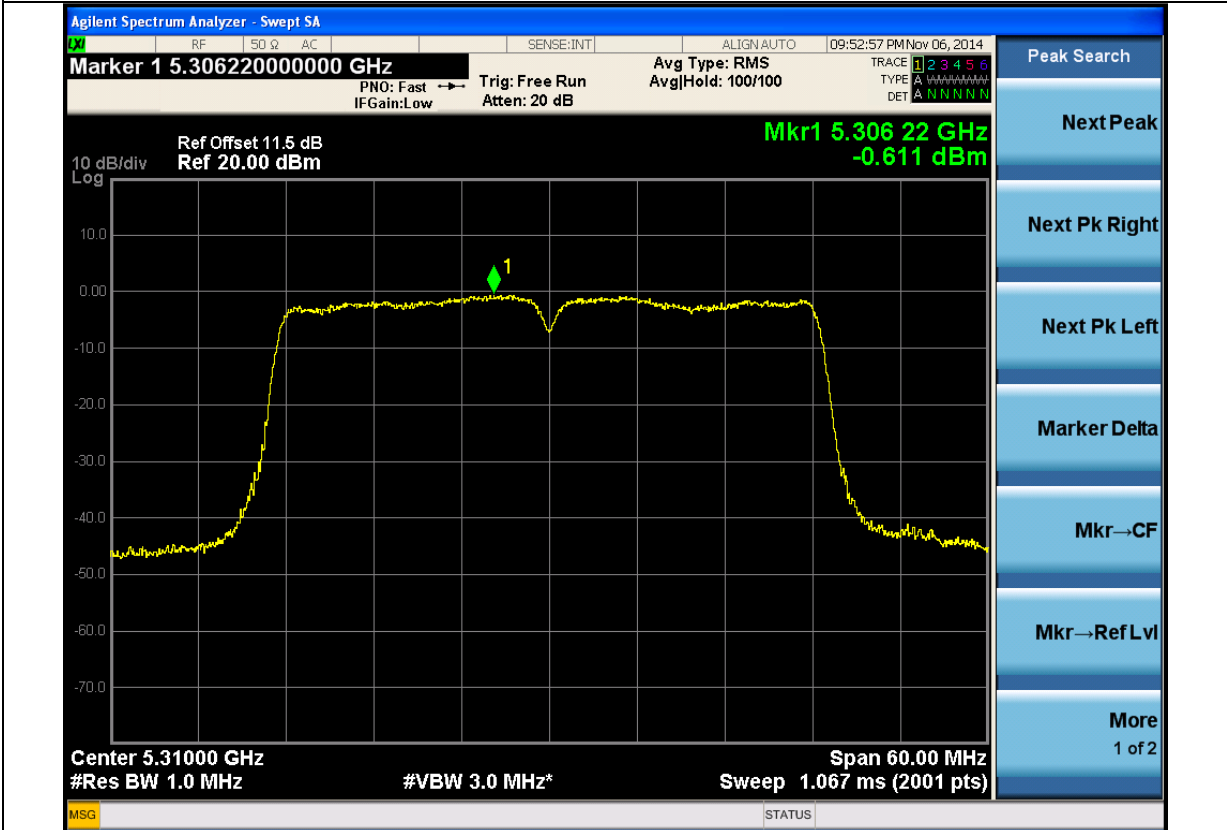
802.11 n20-5720



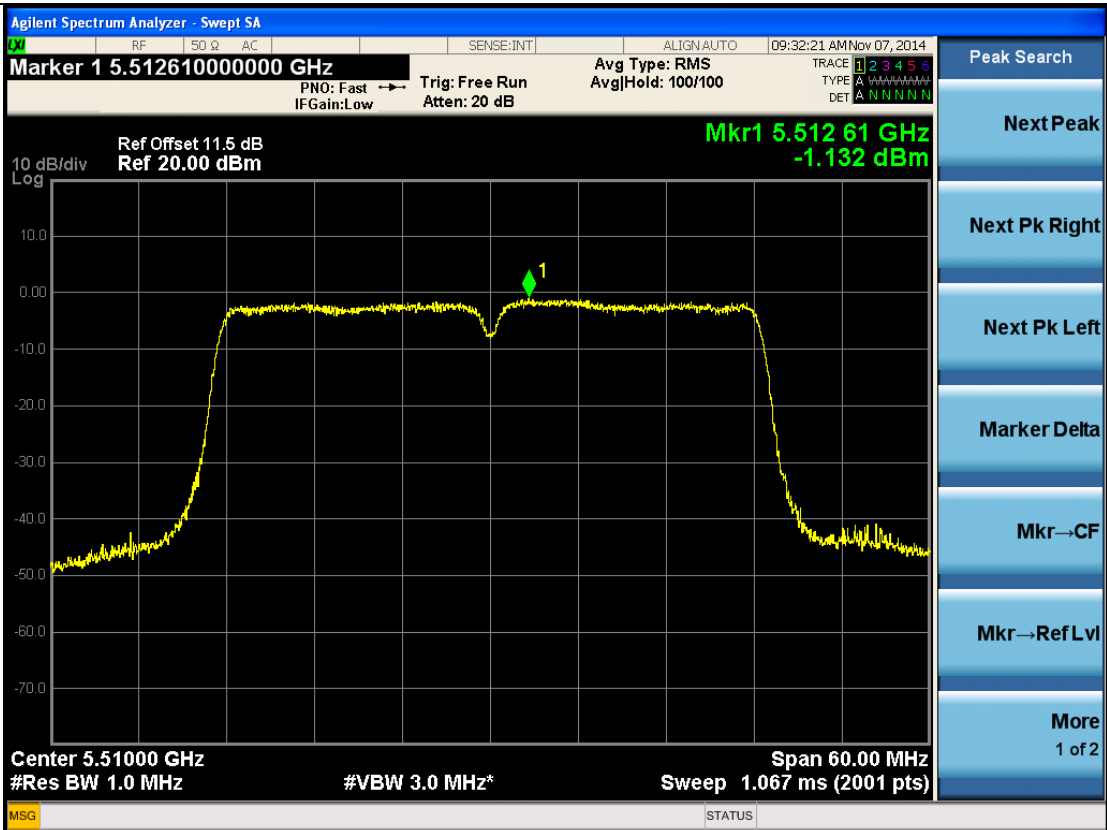
802.11n40-5270



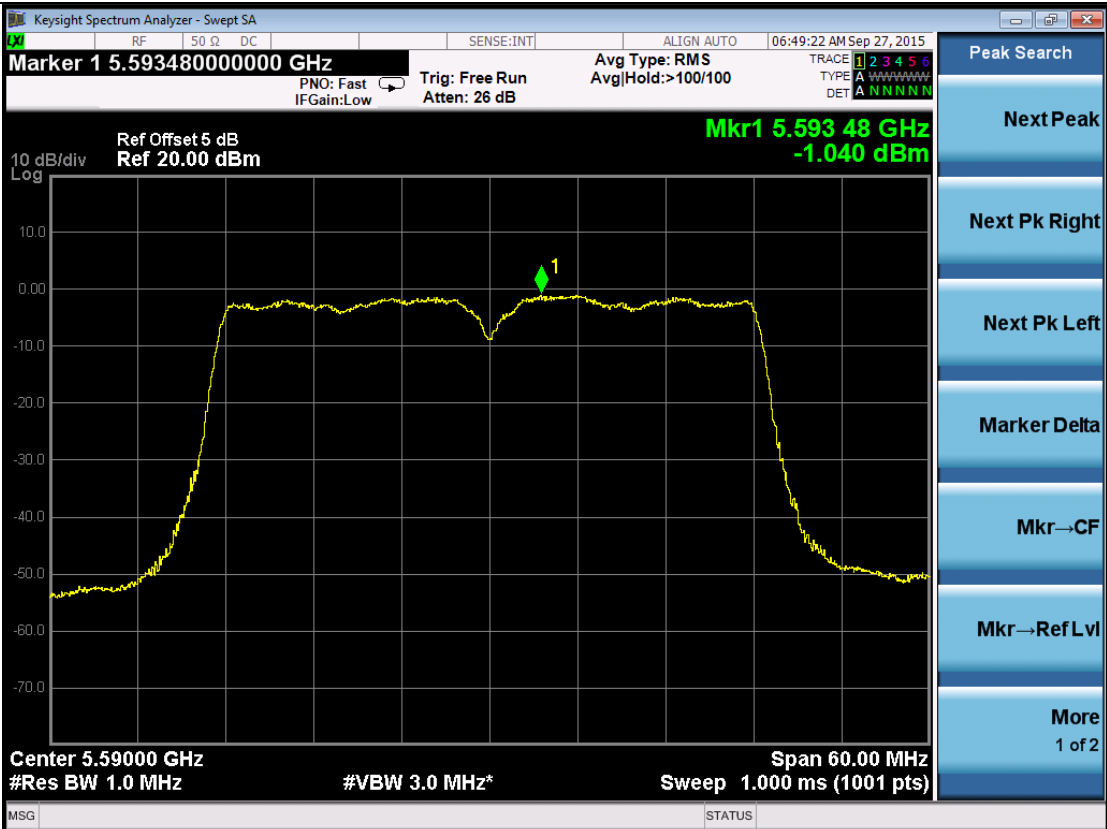
802.11n40-5310

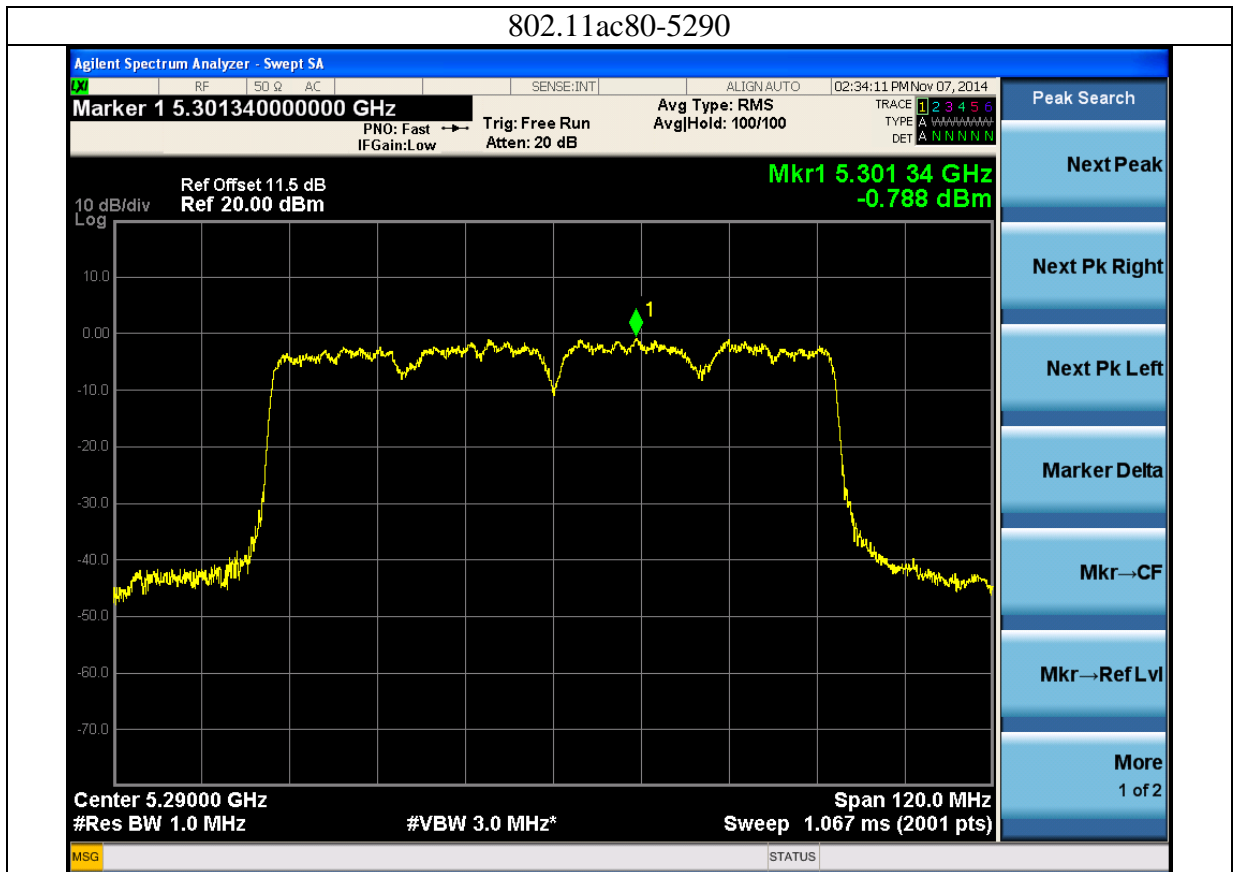
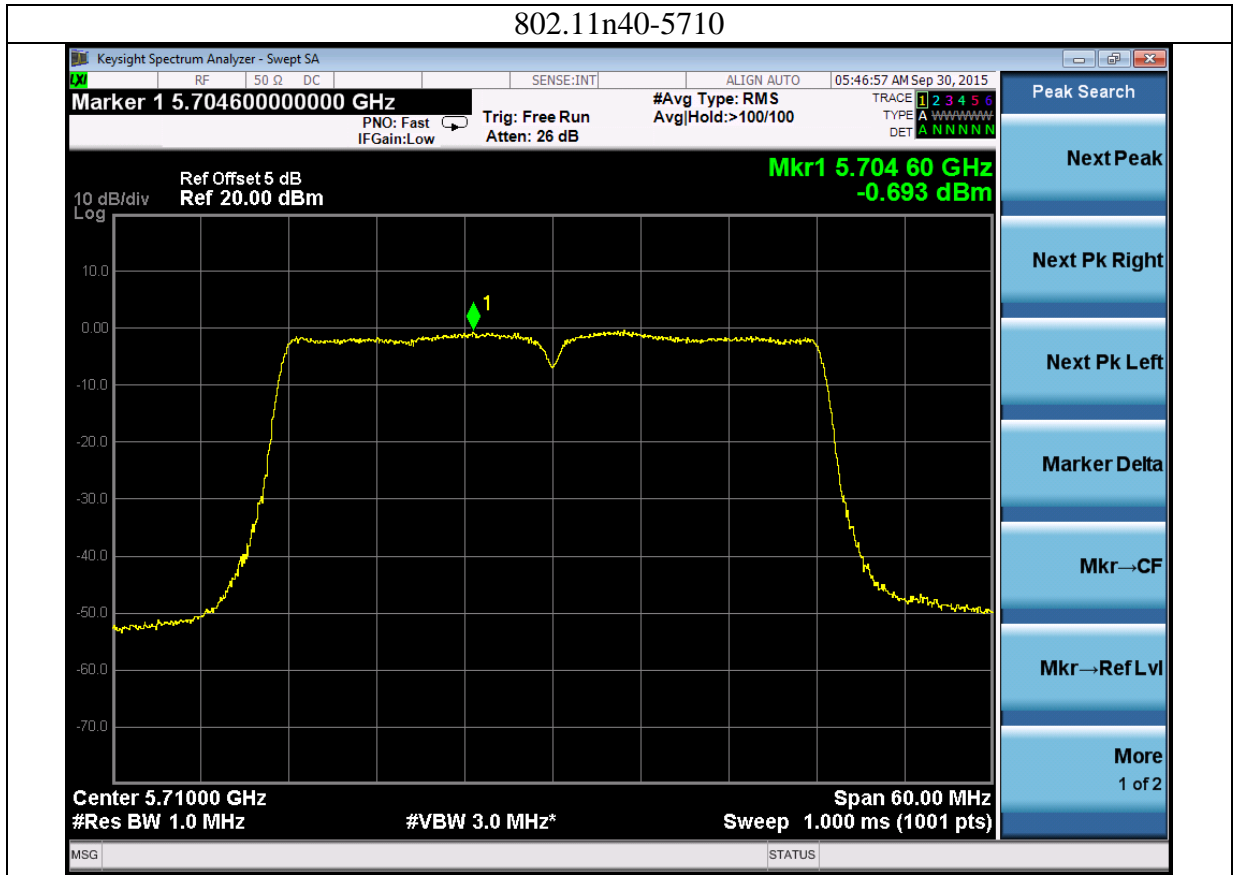


802.11n40-5510

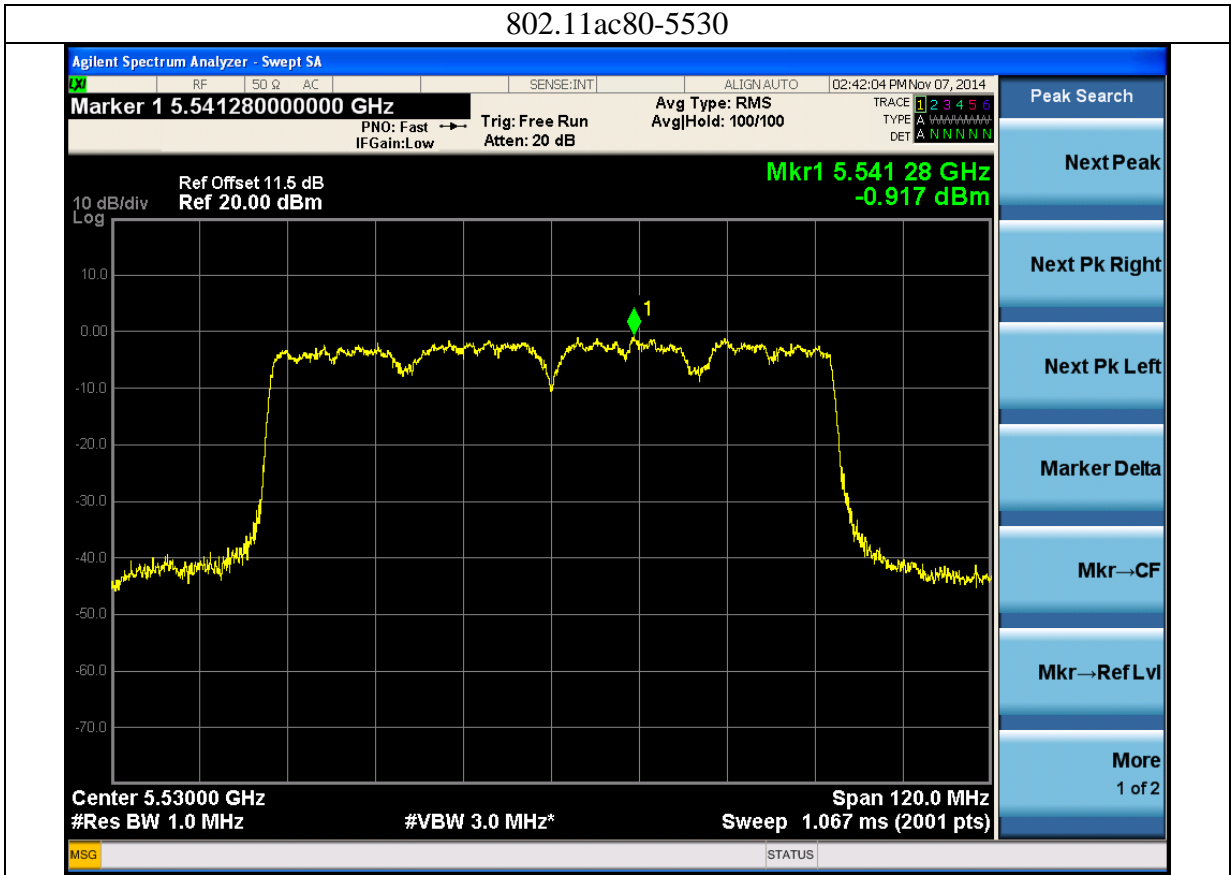


802.11n40-5590

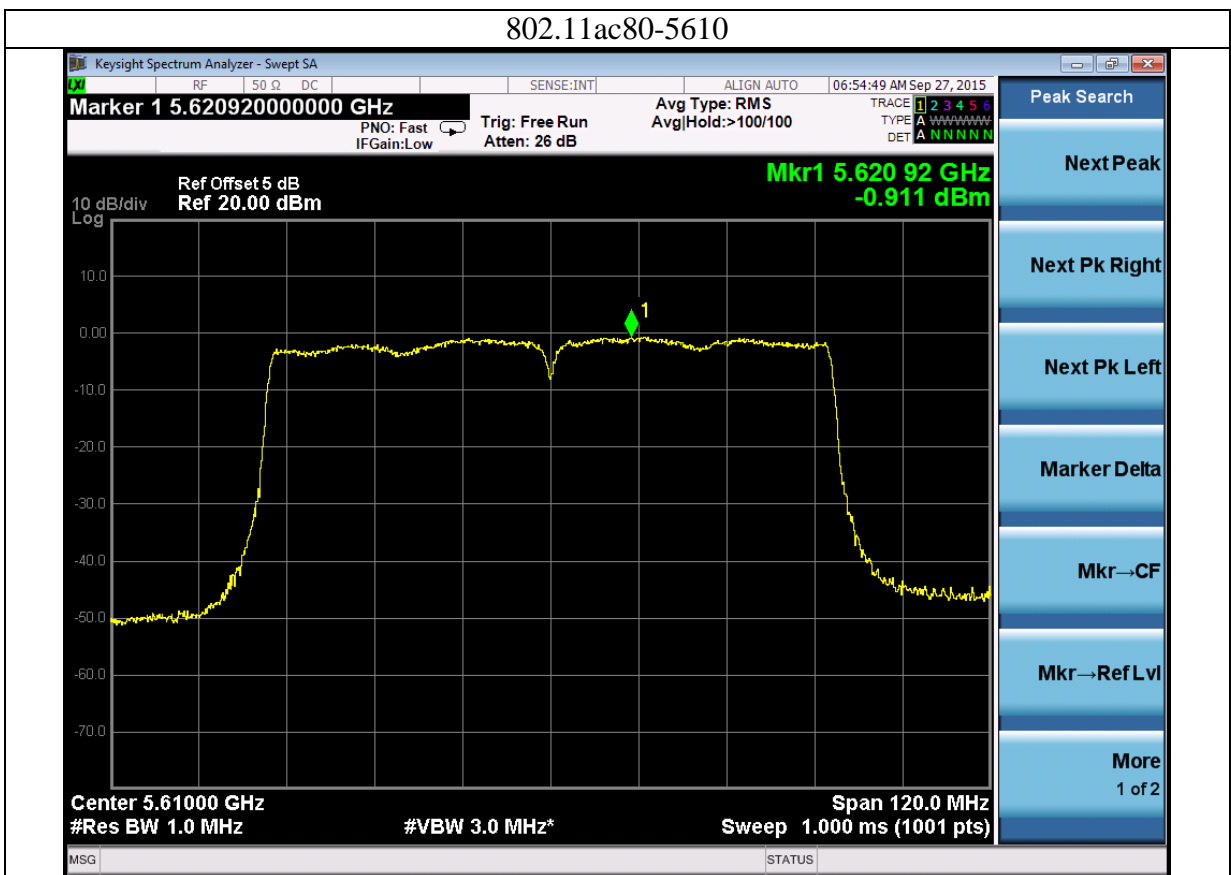




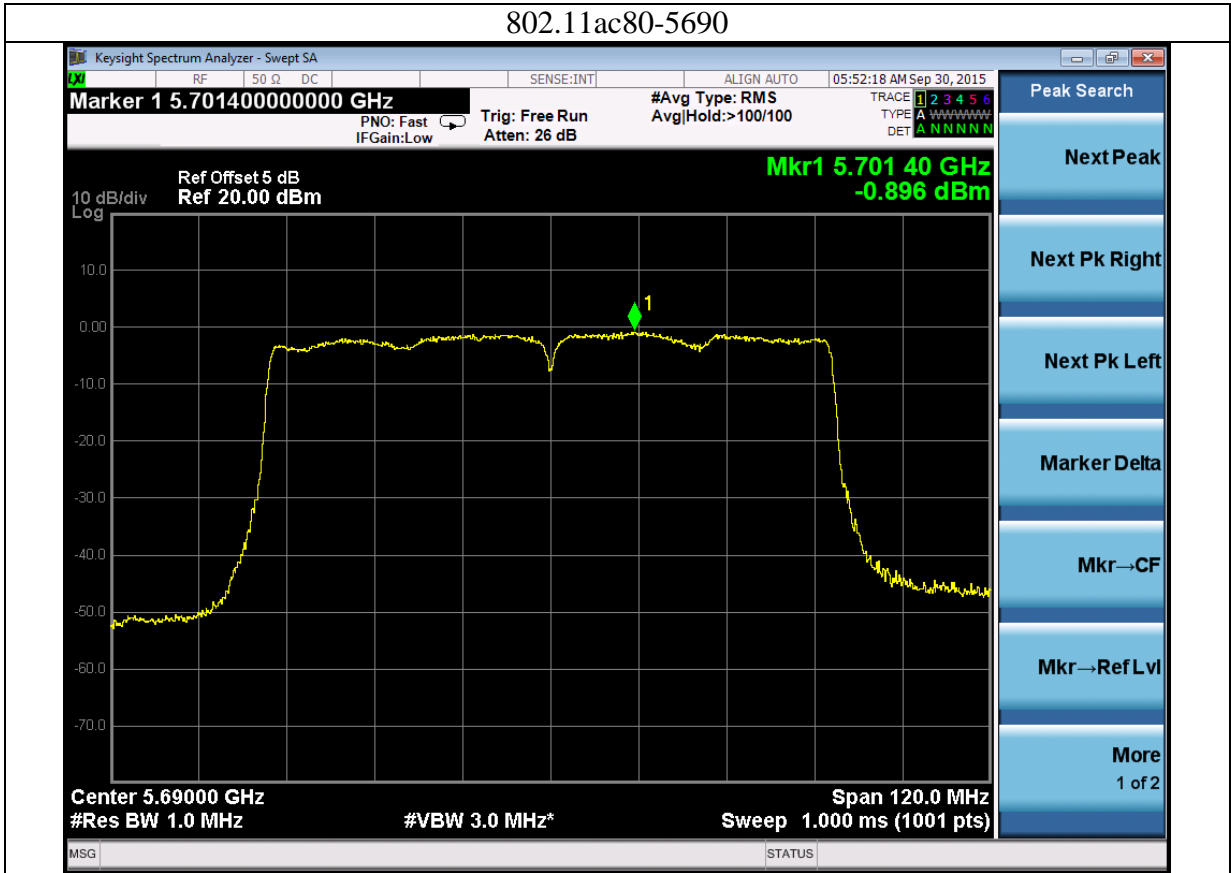
802.11ac80-5530



802.11ac80-5610



802.11ac80-5690



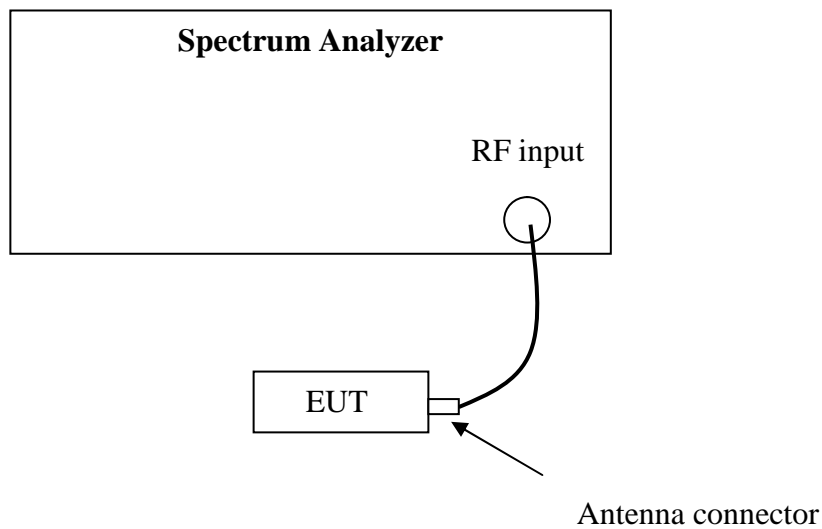
5. Minimum 6dB Bandwidth

Test result: NA

5.1 Limit

For systems using digital modulation techniques that may operate in the 5725 - 5850 MHz band, the minimum 6 dB bandwidth shall be at least 500 kHz.

5.2 Test Configuration



5.3 Test Procedure and test setup

The power spectrum density per FCC §15.407(a)(6) was measured from the antenna port of the EUT. Using a 50ohm spectrum analyzer (measurement method refers to KDB 789033D02: Section C).

5.4 Test Protocol

Temperature : °C
Relative Humidity : %

Modulation	Frequency (MHz)	Minimum 6dB Bandwidth (MHz)			Limits (MHz)
		Port0	Port 1	Port 2	
802.11a	/	/	/	/	> 0.5
	/	/	/	/	> 0.5
	/	/	/	/	> 0.5
802.11n20	/	/	/	/	> 0.5
	/	/	/	/	> 0.5
	/	/	/	/	> 0.5
802.11n40	/	/	/	/	> 0.5
	/	/	/	/	> 0.5
802.11ac80	/	/	/	/	> 0.5