

TEST REPORT



DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1611-0156
2. Customer
 - Name : HYUNDAI MOBIS CO., LTD
 - Address : 203 Teheran-ro, Gangnam-gu, Seoul, Korea, 135-977
3. Use of Report : FCC Original Grant
4. Product Name / Model Name : DIGITAL CAR AVN SYSTEM / AVB40D5AN
FCC ID : TQ8-AVB40D5AN
5. Test Method Used : FCC Part 15.407 Subpart E
6. Date of Test : 2016-11-16 ~ 2016-11-25
7. Testing Environment : See appended test report
8. Test Result : Refer to the attached Test Result

Affirmation	Tested by	Technical Manager
	Name : Chulmin Kim  (Signature)	Name : Geunki Son  (Signature)

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2016 . 11 . 30 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRTFCC1611-0156	Nov, 30. 2016	Initial issue

CONTENTS

1. EUT DESCRIPTION	5
2. Information about test items.....	6
2.1 Test mode / Channel Information.....	6
2.2 Tested Channel Information.....	6
2.3 Auxiliary equipment	7
2.4 Tested environment	7
2.5 EMI Suppression Device(s)/Modifications	7
3. SUMMARY OF TESTS.....	8
4. TEST METHODOLOGY	9
4.1 EUT configuration	9
4.2 EUT exercise.....	9
4.3 General test procedures.....	9
4.4 Description of test modes	9
4.5 Measurement Uncertainty	9
5. INSTRUMENT CALIBRATION.....	10
6. FACILITIES AND ACCREDITATIONS.....	10
6.1 Facilities	10
6.2 Equipment.....	10
7. ANTENNA REQUIREMENTS.....	10
8. TEST RESULT	11
8.1 Emission Bandwidth (26 dB Bandwidth).....	11
8.2 Minimum Emission Bandwidth (6 dB Bandwidth).....	32
8.3 Maximum Conducted Output Power.....	40
8.4 Maximum Power Spectral Density	44
8.5 Frequency Stability	72
8.6 Radiated Spurious Emission Measurements.....	75
8.7 AC Conducted Emissions.....	82

8.8 Occupied Bandwidth	83
9. LIST OF TEST EQUIPMENT.....	84
APPENDIX I	85
APPENDIX II	88

1. EUT DESCRIPTION

FCC Equipment Class	Unlicensed National Information Infrastructure (UNII)
Product	DIGITAL CAR AVN SYSTEM
Model Name	AVB40D5AN
Add Model Name	N/A
Power Supply	DC 14.4 V
Hardware version	1.0
Software version	1.0
Frequency Range	U-NII 1(5150 ~ 5250 MHz) ▪ 802.11a/n(HT20)/ac(VHT20): 5180 ~ 5240 MHz ▪ 802.11n(HT40)/ac(VHT40): 5190 ~ 5230 MHz ▪ 802.11ac(VHT80): 5210 MHz U-NII 2A(5250 ~ 5350 MHz) ▪ 802.11a/n(HT20)/ac(VHT20): 5260 ~ 5320 MHz ▪ 802.11n(HT40)/ac(VHT40): 5270 ~ 5310 MHz ▪ 802.11ac(VHT80): 5290 MHz U-NII 2C(5470 ~ 5725 MHz) ▪ 802.11a/n(HT20)/ac(VHT20): 5500 ~ 5720 MHz ▪ 802.11n(HT40)/ac(VHT40): 5510 ~ 5710 MHz ▪ 802.11ac(VHT80): 5530, 5690 MHz U-NII 3(5725 ~ 5850MHz) ▪ 802.11a/n(HT20)/ac(VHT20): 5745 ~ 5825 MHz ▪ 802.11n(HT40)/ac(VHT40): 5755 ~ 5795 MHz ▪ 802.11ac(VHT80): 5775 MHz
Modulation type	OFDM
Antenna Specification	Antenna type: Internal Antenna Antenna gain ▪ U-NII-1: 1.420 dBi ▪ U-NII 2A: 1.420 dBi ▪ U-NII 2C: -0.850 dBi ▪ U-NII-3: -2.390dBi

2. Information about test items

2.1 Test mode / Channel Information

5GHz Band	Mode	Data Rate
		Multiple transmitting
U-NII 1	802.11a	6Mbps
	802.11n(HT20)	MCS 0
	802.11n(HT40)	MCS 0
	802.11ac(VHT80)	NSS2 MCS 0
U-NII 2A	802.11a	6Mbps
	802.11n(HT20)	MCS 0
	802.11n(HT40)	MCS 0
	802.11ac(VHT80)	NSS2 MCS 0
U-NII 2C	802.11a	6Mbps
	802.11n(HT20)	MCS 0
	802.11n(HT40)	MCS 0
	802.11ac(VHT80)	NSS2 MCS 0
U-NII 3	802.11a	6Mbps
	802.11n(HT20)	MCS 0
	802.11n(HT40)	MCS 0
	802.11ac(VHT80)	NSS2 MCS 0

The worst case data rate for each modulation is determined as above table. And all tests conducted in this report were made at the worst case data rate of each modulation.

2.2 Tested Channel Information

5GHz Band	802.11a/n(HT20)		802.11n(HT40)		802.11ac(VHT80)	
	Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
U-NII 1	36	5180	38	5190	-	-
	40	5200	-	-	42	5210
	48	5240	46	5230	-	-
U-NII 2A	52	5260	54	5270	-	-
	60	5300	-	-	58	5290
	64	5320	62	5310	-	-
U-NII 2C	100	5500	102	5510	106	5530
	120	5600	118	5590	122	5610
	144	5720	142	5710	138	5690
U-NII 3	149	5745	151	5755	-	-
	157	5785	-	-	155	5775
	165	5825	159	5795	-	-

2.3 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-

2.4 Tested environment

Temperature	: 22 °C ~ 25 °C
Relative humidity content	: 40 % ~ 44 % R.H.
Details of power supply	: DC 14.4 V

2.5 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)					
15.407(a)	N/A	Emission Bandwidth (26 dB Bandwidth)	N/A	Conducted	C
15.407(e)	RSS-210 [A8.2]	Minimum Emission Bandwidth (6 dB Bandwidth)	> 500 kHz (5725-5850)		C
15.407(a)	RSS-210 [A9.2]	Maximum Conducted Output Power	5150 ~ 5250MHz : < 30 dBm or < 23.97 dBm 5250 ~ 5350MHz & 5470 ~ 5725MHz : 250mW or <11 + 10log ₁₀ (B) dBm, whichever power is less. 5725 ~ 5850MHz : < 30 dBm		C Note 3
15.407(a)	RSS-210 [A9.2]	Peak Power Spectral Density	5150 ~ 5250MHz : 11dBm/MHz or 17dBm/MHz 5250 ~ 5350MHz & 5470 ~ 5725MHz: 11dBm/MHz 5725 ~ 5850MHz: 30dBm/500kHz		C Note 4
15.407(g)	RSS Gen [6.11]	Frequency Stability	N/A		C
RSS Gen[6.6]	RSS Gen [6.6]	Occupied Bandwidth (99%)	RSS Gen [6.6]		NA
15.407(b)	RSS-210 [A9.2]	Undesirable Emissions	5150 ~ 5725MHz: < -27 dBm/MHz EIRP 5725 ~ 5850MHz: < -17 dBm/MHz EIRP or < -27 dBm/MHz EIRP	Radiated	C Note 5
15.205 15.209 15.407(b)	RSS-Gen [8.9&8.10]	General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		C Note 6
15.407(h)	RSS-210 [A9.3]	Dynamic Frequency Selection	FCC 15.407(h)	Conducted	C Note 7
15.207	RSS-Gen [8.8]	AC Conducted Emissions	FCC 15.207	AC Line Conducted	NA Note 8
15.203	RSS-Gen [6.7]	Antenna Requirements	FCC 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: The test items were performed according to the KDB789033 D02 V01 and ANSI C63.10-2013.

Note 3: (i) For access point operating in the band 5.15-5.25 GHz: < 30 dBm

(ii) For mobile and portable client devices in the 5.15-5.25 GHz band: < 23.97 dBm

Note 4: (i) For access point operating in the band 5.15-5.25 GHz: < 17 dBm/MHz

(ii) For mobile and portable client devices in the 5.15-5.25 GHz band: < 11 dBm/MHz

Note 5: 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

Note 6: These test items were performed in each axis and the worst case data was reported.

Note 7: For DFS testing, please refer to DFS test report.

Note 8: This device is installed in a car. Therefore the power source is a battery of car.

4. TEST METHODOLOGY

Generally the tests were performed according to the KDB789033 D02 v01r02. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing

4.1 EUT configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT exercise

The EUT was operated in the test mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart C.

4.3 General test procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB789033 D02. So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB789033 D02. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on KDB789033 D02.

The EUT is placed on a non-conductive table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 1 or 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axis.

4.4 Description of test modes

A test program is used to control the EUT for staying in continuous transmitting mode with maximum fixed duty cycle.

4.5 Measurement Uncertainty

Test items	Measurement uncertainty
Transmitter Output Power	0.71 dB (The confidence level is about 95 %, k = 2)
Conducted spurious emission	0.93 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)

5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 Facilities

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number: 165783 (FCC)

6.2 Equipment

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, loop, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

7. ANTENNA REQUIREMENTS

7.1 According to FCC 47 CFR §15.203:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 internal antenna was Permanently attached. (Refer to Internal Photo file.)

Therefore this DIGITAL CAR AVN SYSTEM complies with the requirement of §15.203

8. TEST RESULT

8.1 Emission Bandwidth (26 dB Bandwidth)

■ Test Requirements

The bandwidth at 26 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies. The 26 dB bandwidth is used to determine the conducted output power limit.

■ Test Configuration

Refer to the APPENDIX I.

■ Test Procedure

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02**.

1. Set resolution bandwidth (RBW) = approximately **1 %** of the EBW.
2. Set the video bandwidth (**VBW**) > **RBW**.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

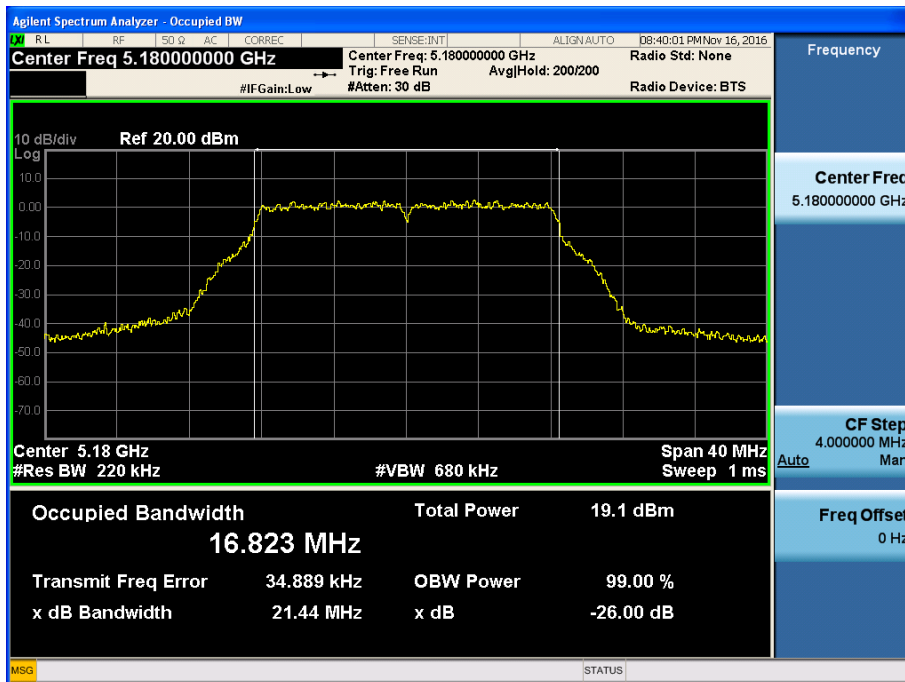
■ TEST RESULTS: **Comply**

Mode	Band	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 1	36	5180	21.440
		40	5200	21.560
		48	5240	21.540
	U-NII 2A	52	5260	21.590
		60	5300	21.580
		64	5320	21.490
	U-NII 2C	100	5500	21.590
		120	5600	21.610
		144	5720	15.640
802.11n (HT20)	U-NII 1	36	5180	21.770
		40	5200	21.690
		48	5240	21.570
	U-NII 2A	52	5260	21.750
		60	5300	21.800
		64	5320	21.730
	U-NII 2C	100	5500	21.610
		120	5600	21.640
		144	5720	15.760
802.11n (HT40)	U-NII 1	38	5190	40.370
		46	5230	39.750
	U-NII 2A	54	5270	40.020
		62	5310	40.100
	U-NII 2C	102	5510	40.090
		118	5590	40.300
802.11ac (VHT80)	U-NII 1	142	5710	35.200
		42	5210	81.730
	U-NII 2A	-	-	-
		58	5290	81.620
	U-NII 2C	-	-	-
		106	5530	81.700
		122	5610	81.630
		138	5690	75.840

Result Plots

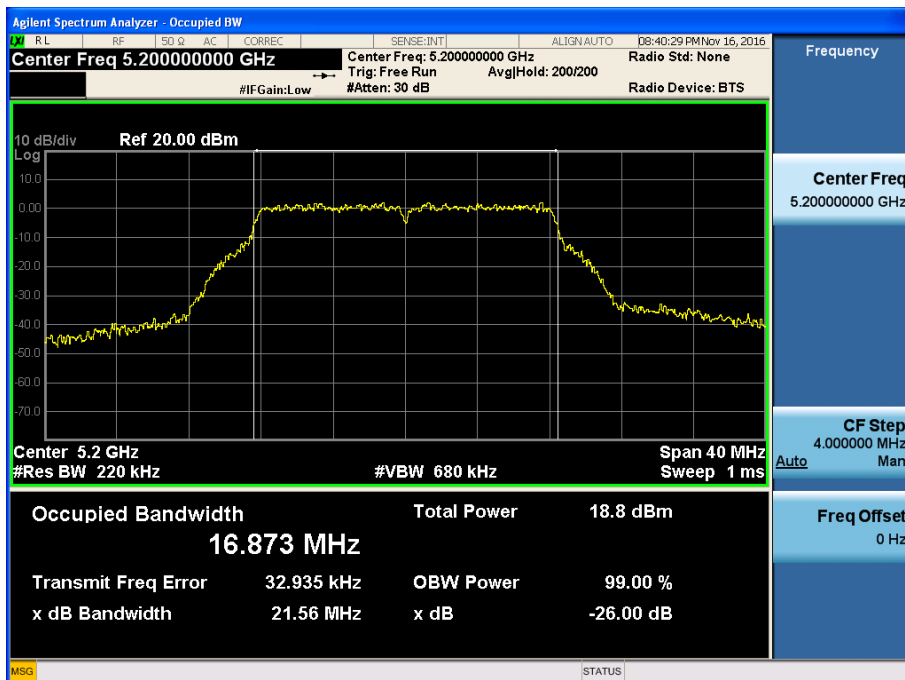
26 dB Bandwidth

Test Mode: 802.11a & Ch.36



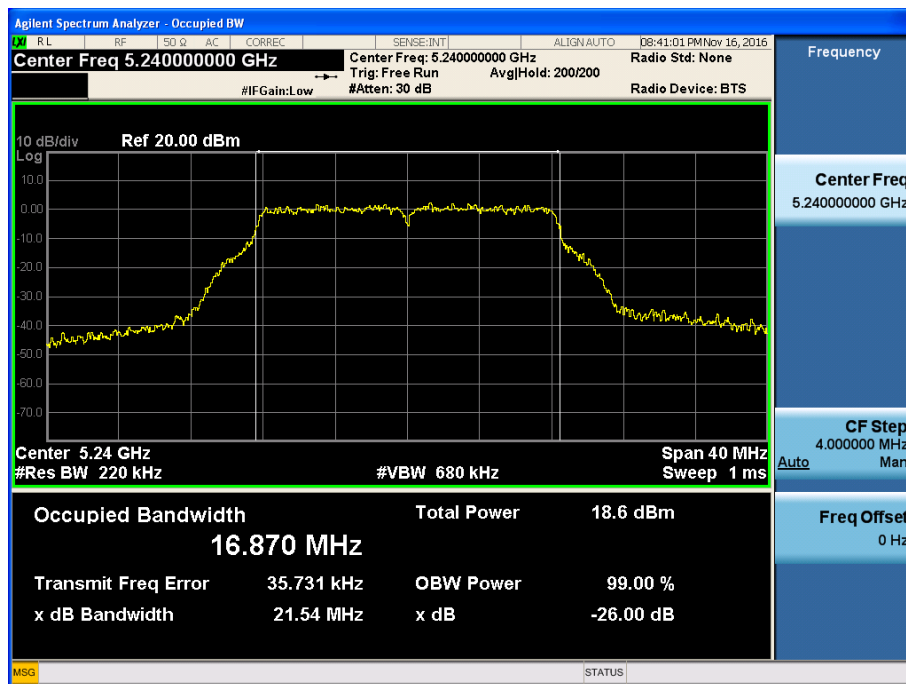
26 dB Bandwidth

Test Mode: 802.11a & Ch.40



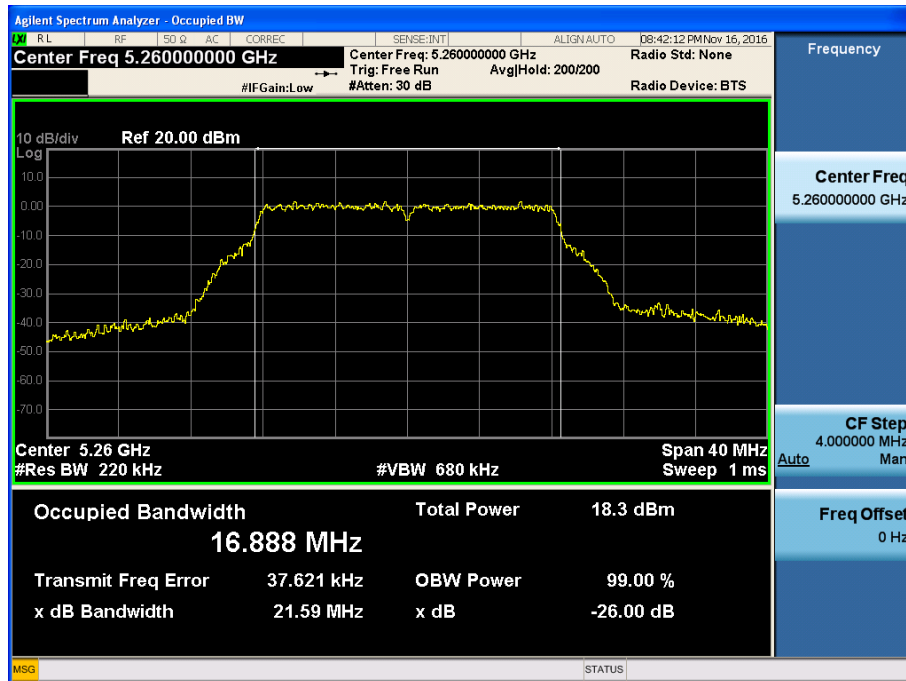
26 dB Bandwidth

Test Mode: 802.11a & Ch.48



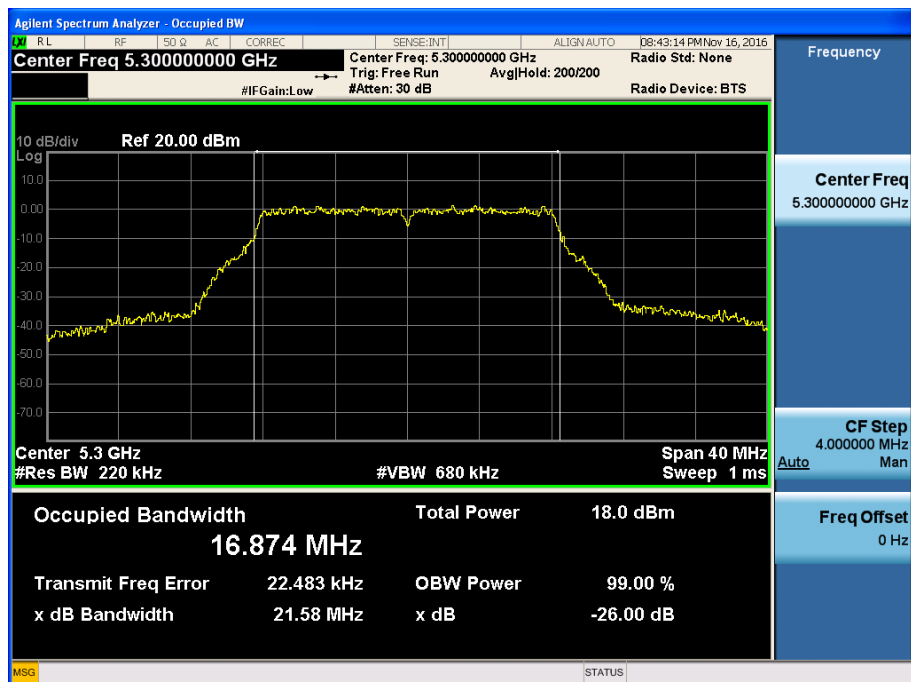
26 dB Bandwidth

Test Mode: 802.11a & Ch.52



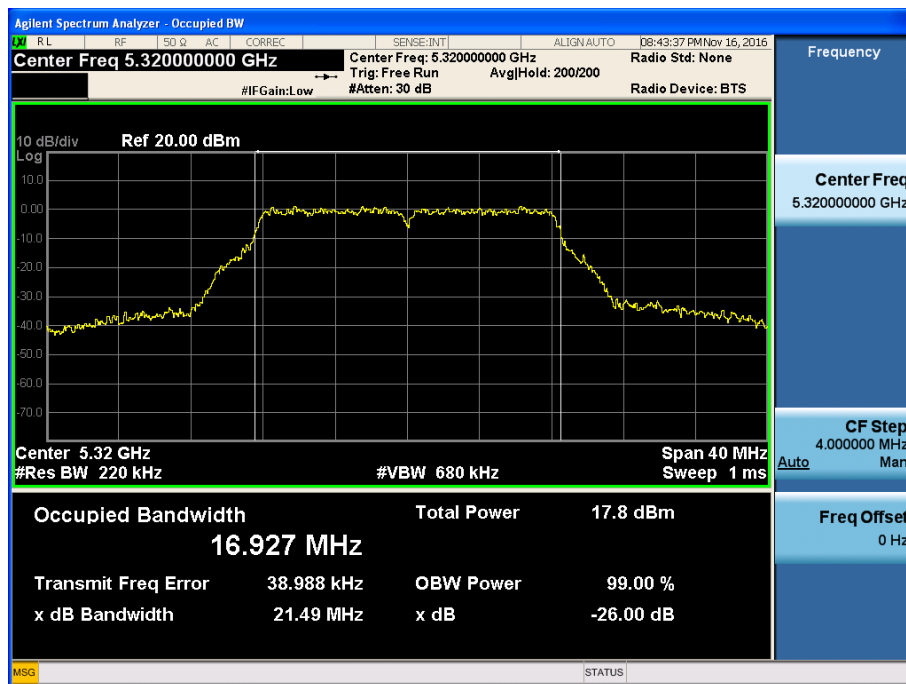
26 dB Bandwidth

Test Mode: 802.11a & Ch.60



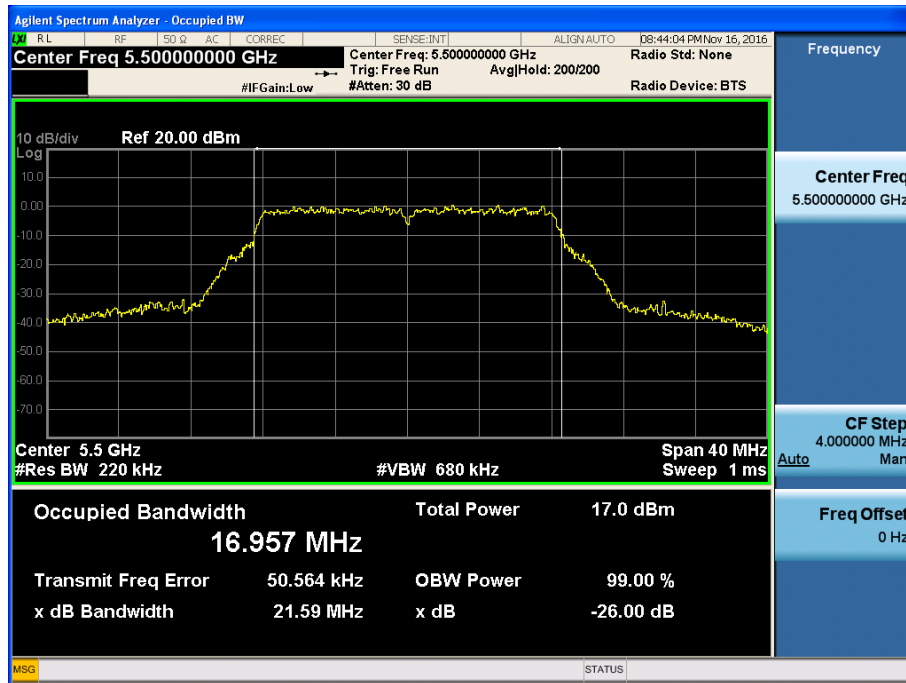
26 dB Bandwidth

Test Mode: 802.11a & Ch.64



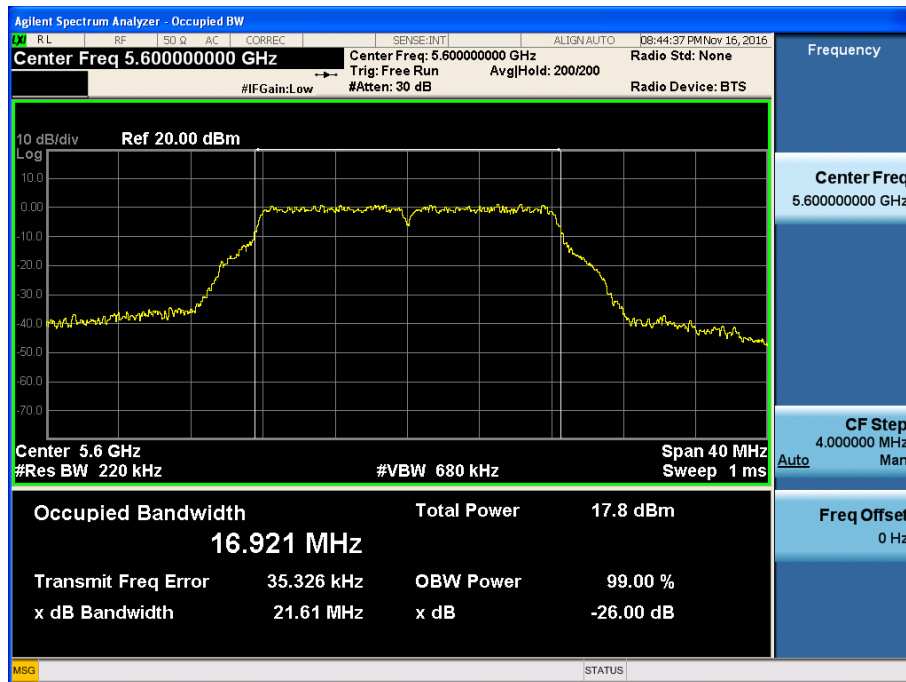
26 dB Bandwidth

Test Mode: 802.11a & Ch.100



26 dB Bandwidth

Test Mode: 802.11a & Ch.120



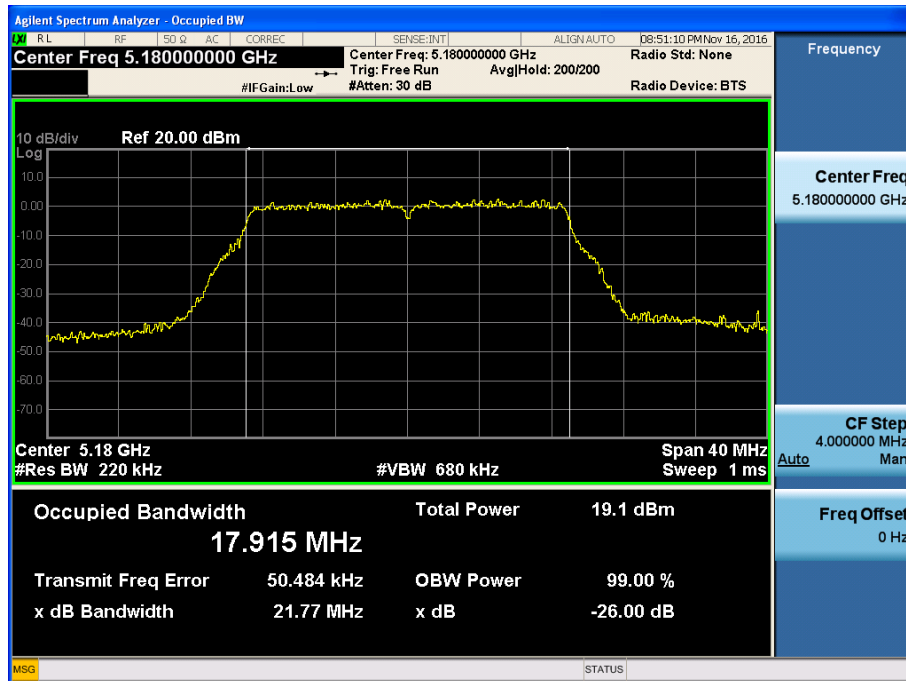
26 dB Bandwidth

Test Mode: 802.11a & Ch.144



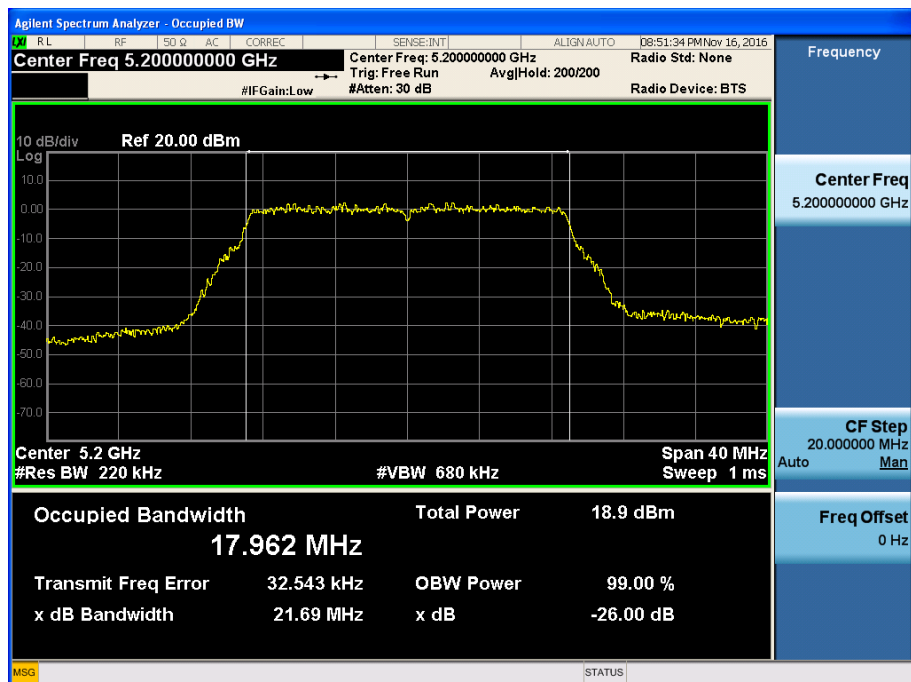
26 dB Bandwidth

Test Mode: 802.11n(HT20) & Ch.36



26 dB Bandwidth

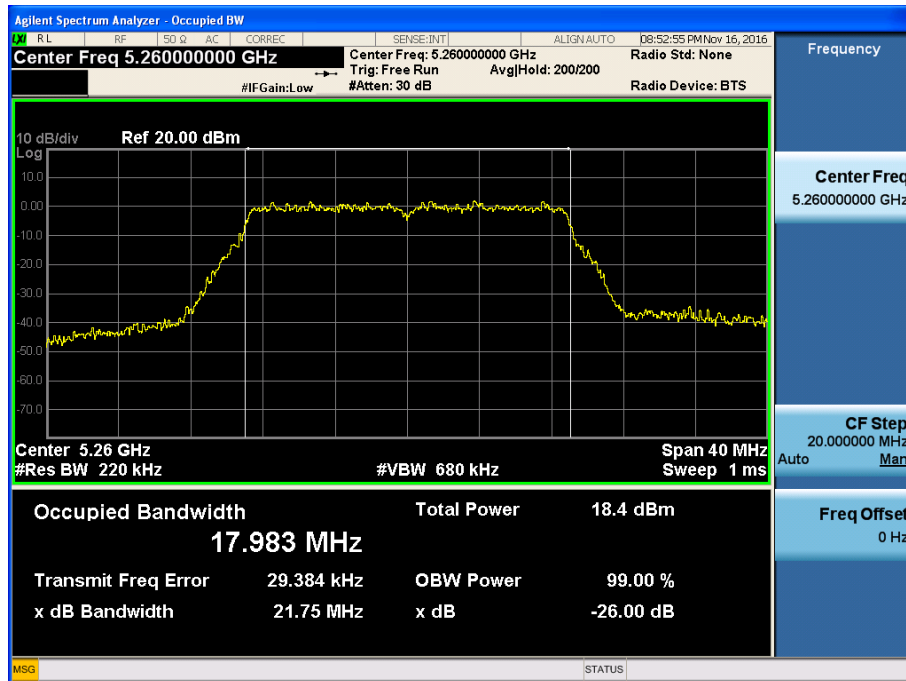
Test Mode: 802.11n(HT20) & Ch.40



Test Mode: 802.11n(HT20) & Ch.48

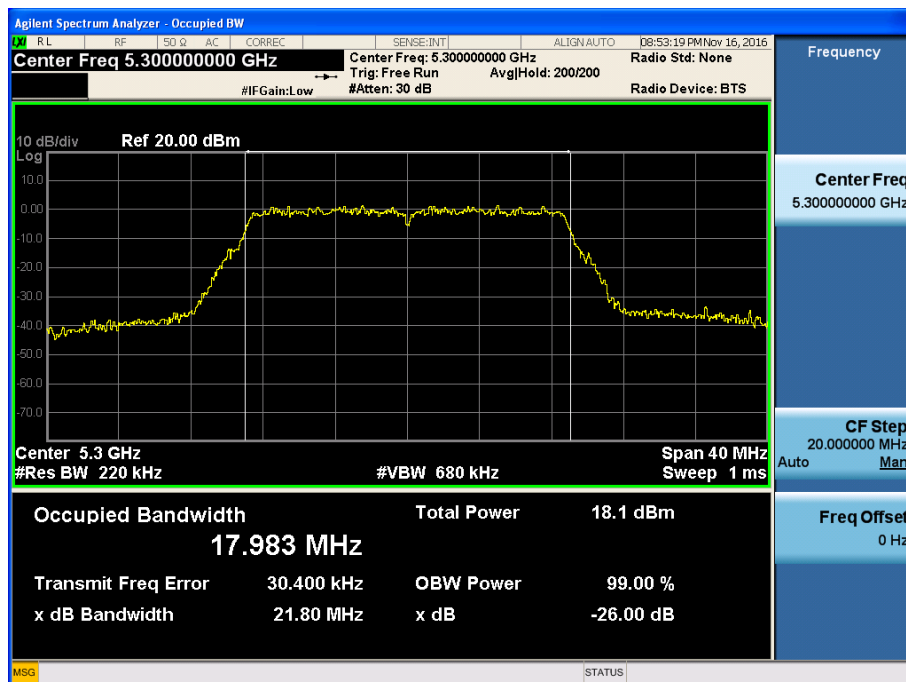
26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.52



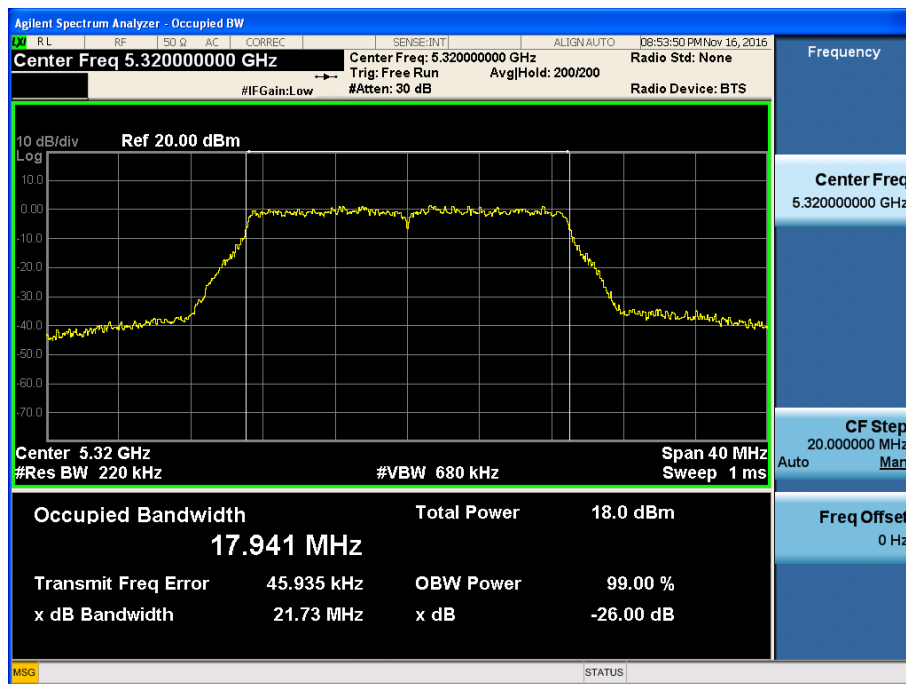
26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.60



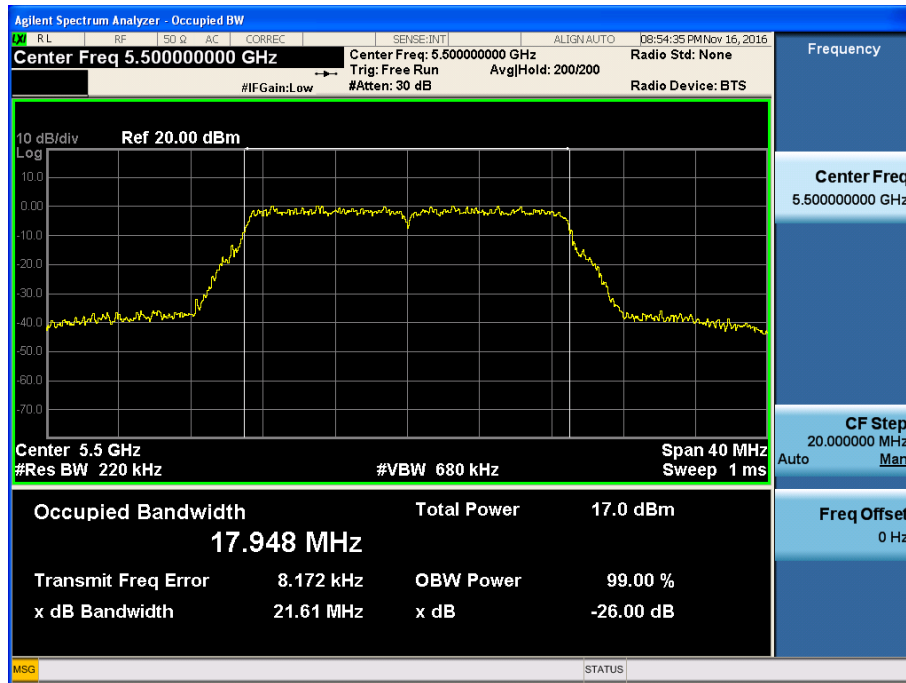
26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.64



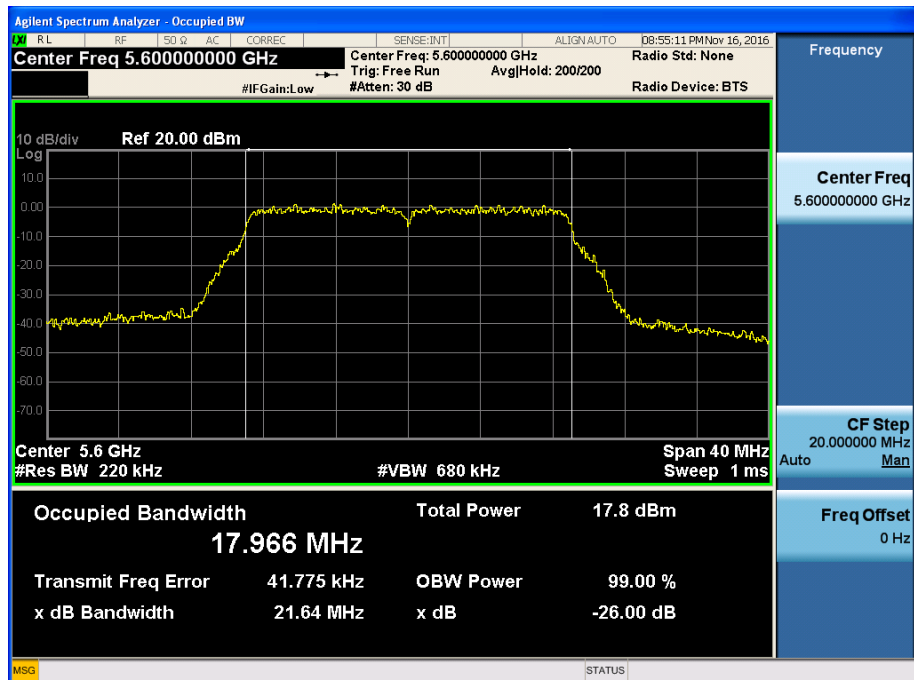
26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.100



26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.120



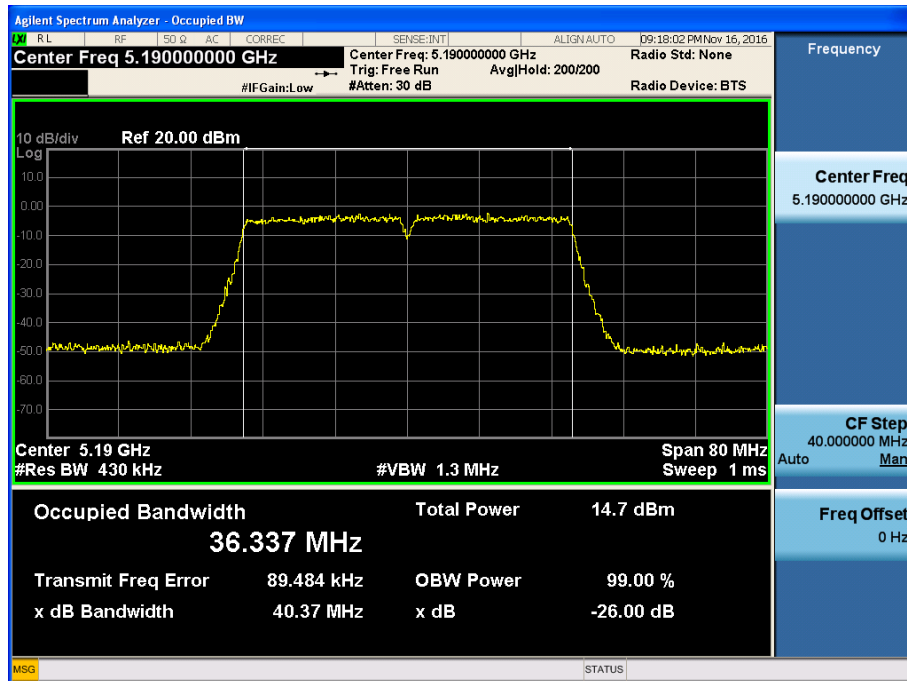
26 dB Bandwidth

Test Mode: 802.11n HT20 & Ch.144



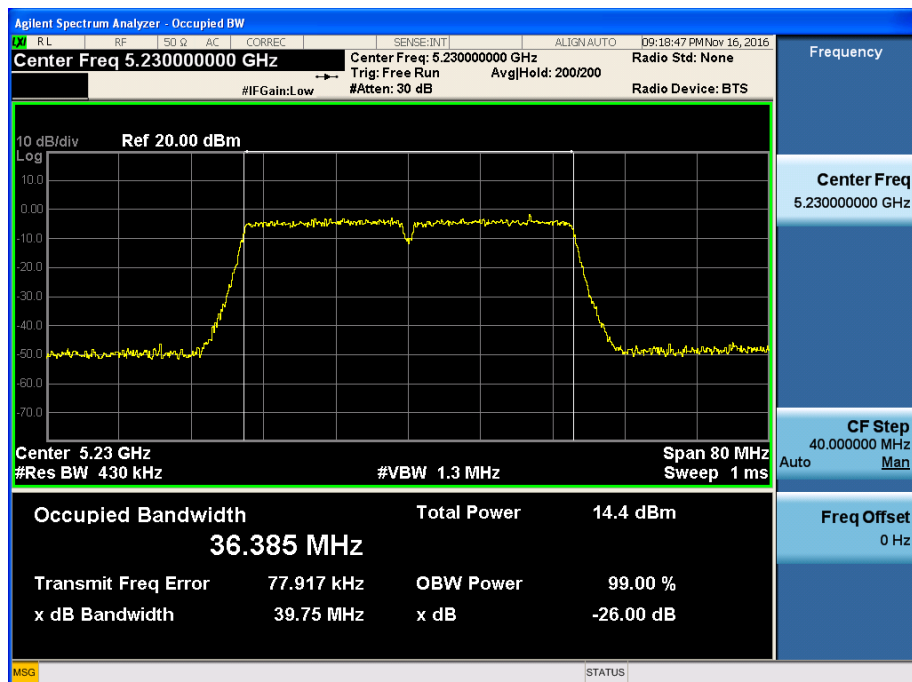
26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.38



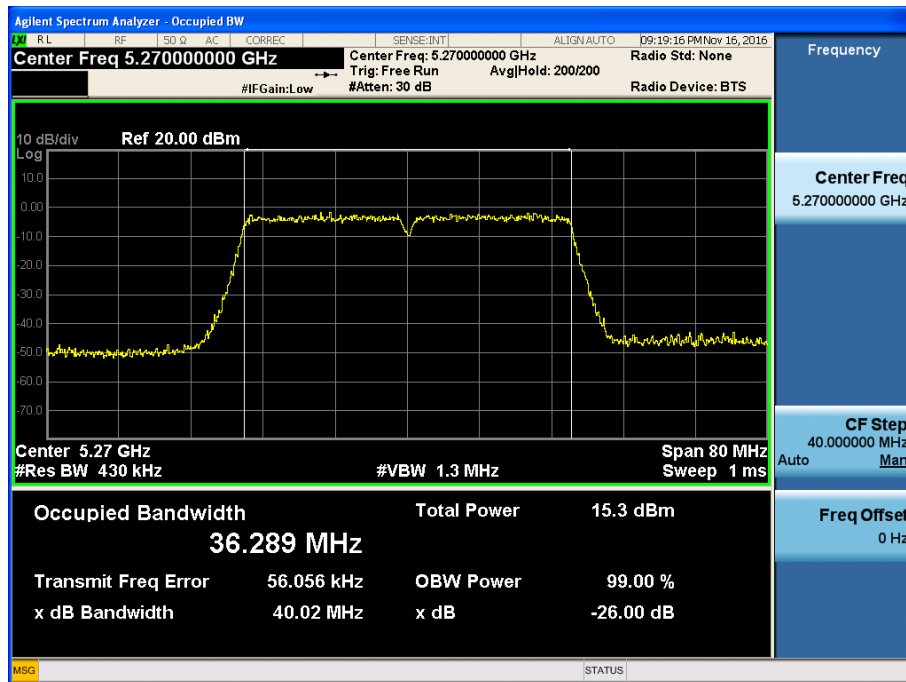
26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.46



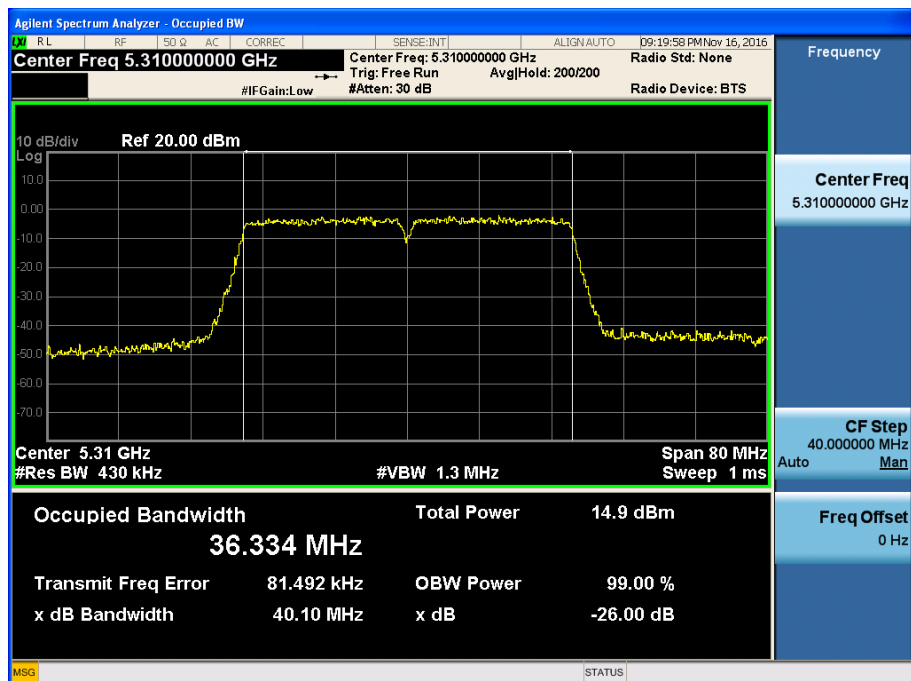
26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.54



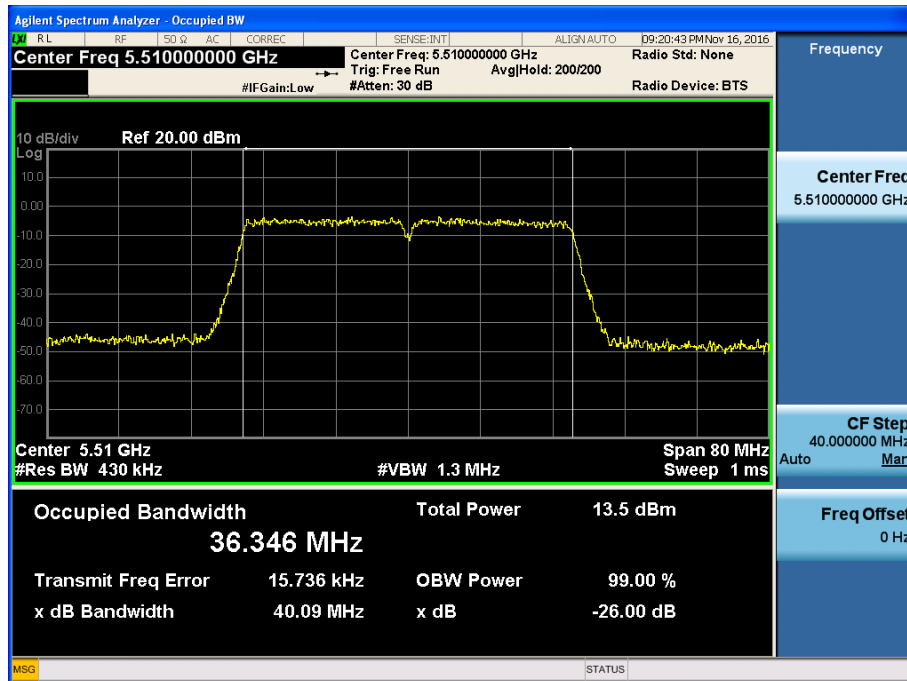
26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.62



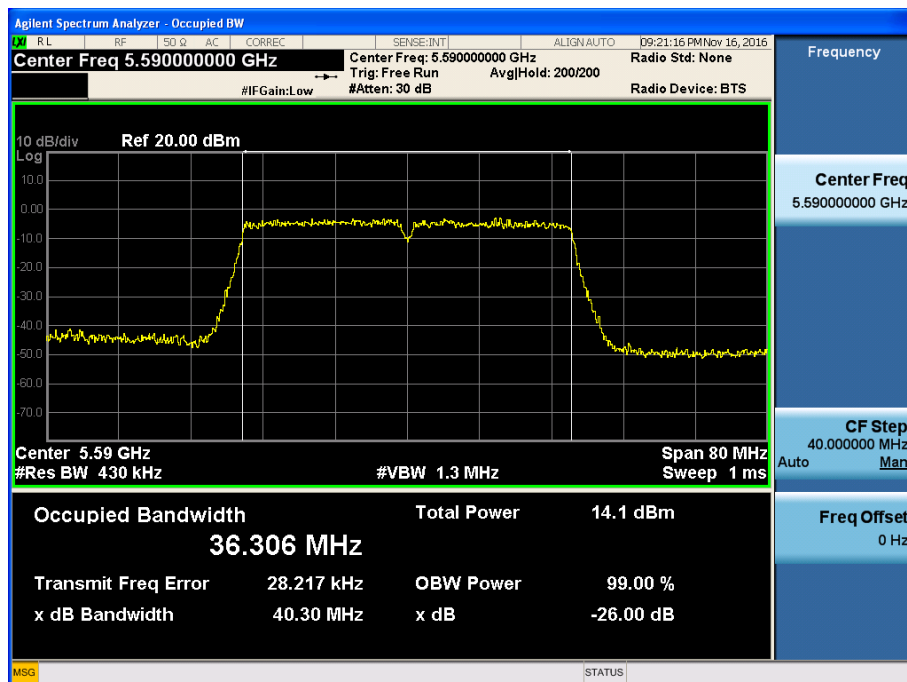
26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.102



26 dB Bandwidth

Test Mode: 802.11n HT40 & Ch.118

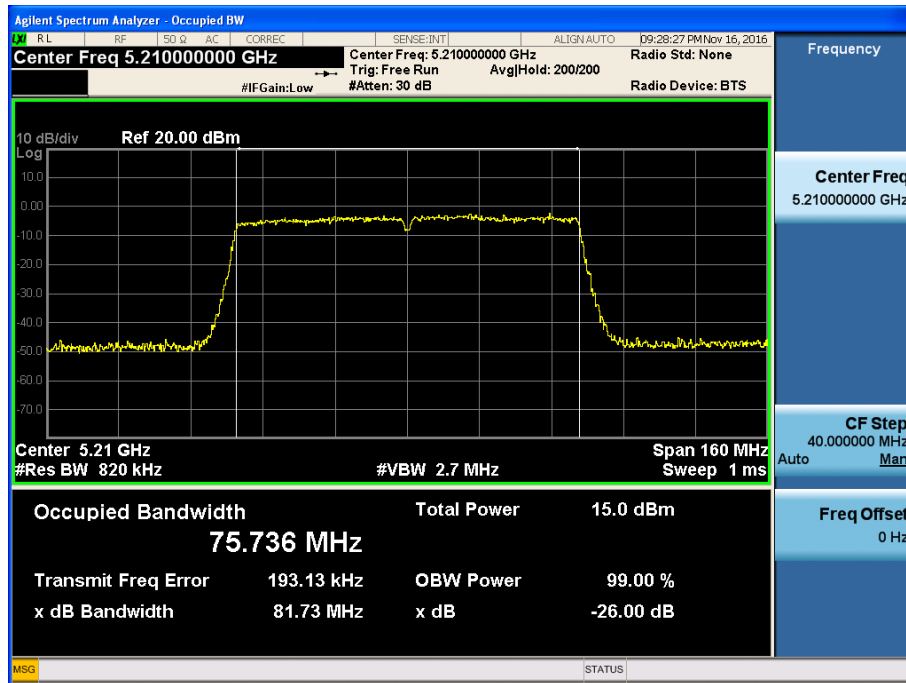


Test Mode: 802.11n HT40 & Ch.142

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	5.707 04 GHz	-1.86 dBm			
2	Δ3	1	f (Δ)	35.20 MHz	(Δ) -25.82 dB			
3	F	1	f	5.725 00 GHz	-3.41 dBm			
4								
6								
7								
8								
9								
10								
11								
12								

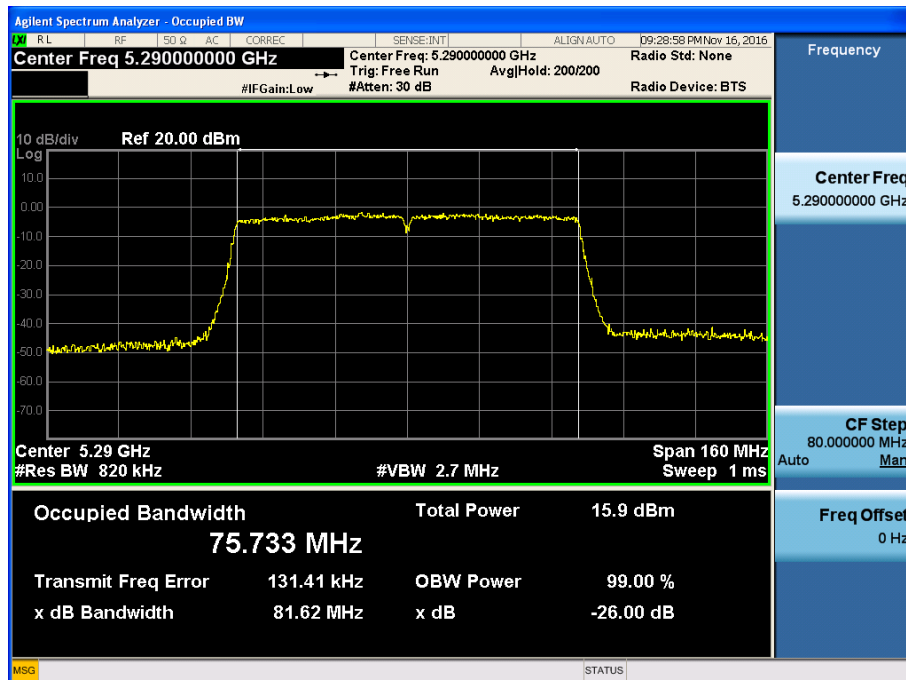
26 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.42



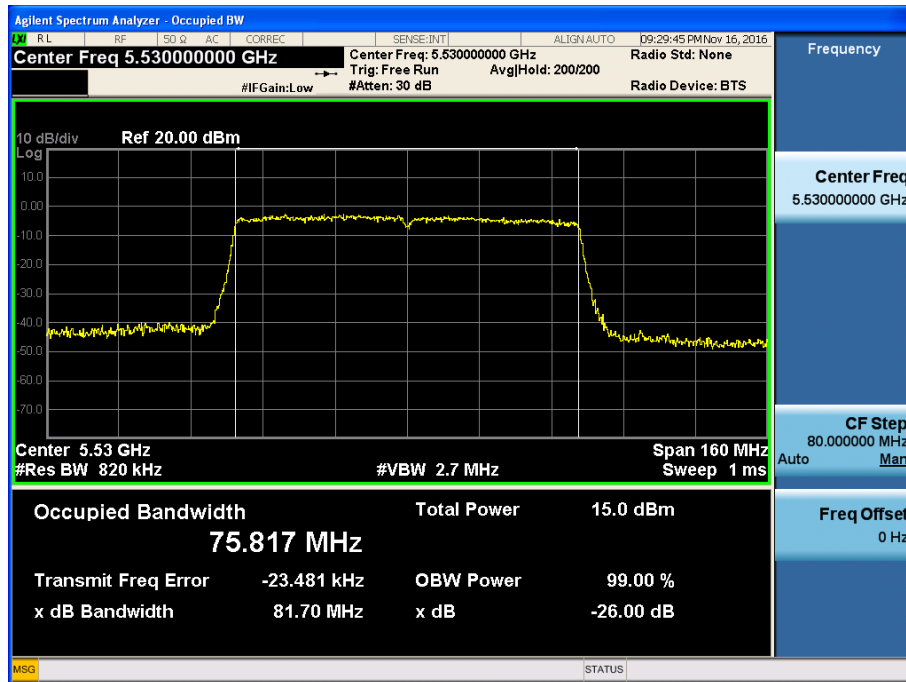
26 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.58



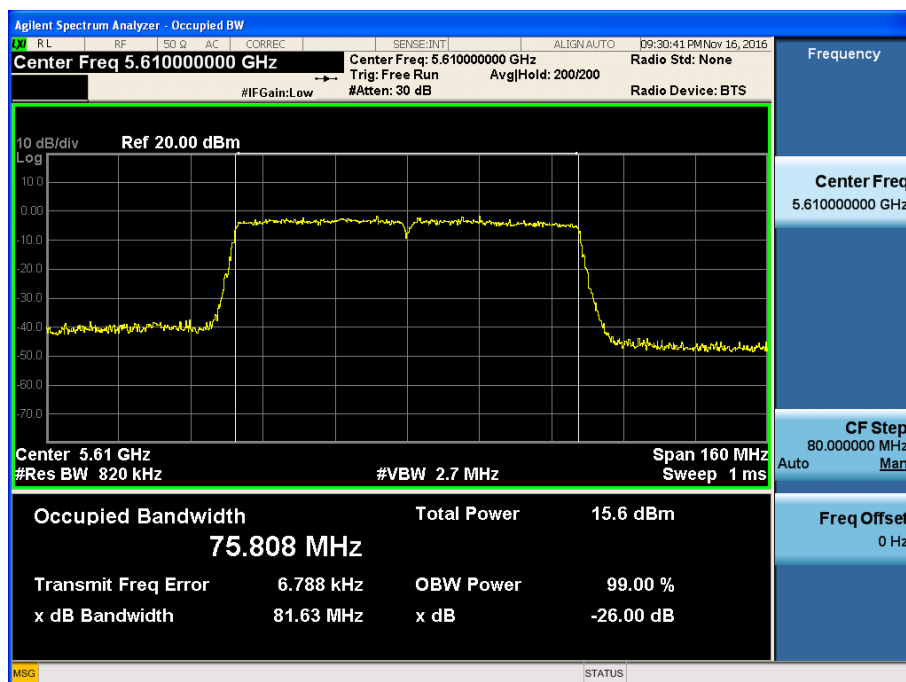
26 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.106



26 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.122



26 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.138



8.2 Minimum Emission Bandwidth (6 dB Bandwidth)

■ Test Requirements

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

■ Test Configuration

Refer to the APPENDIX I.

■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02**.

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth $\geq 3 \times \text{RBW}$.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

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.

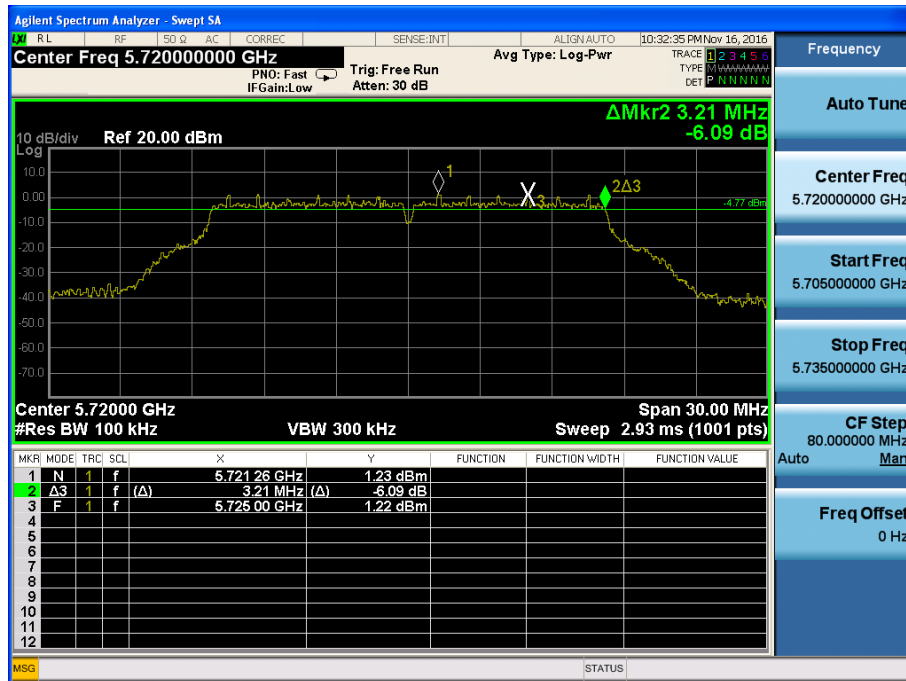
■ TEST RESULTS: **Comply**

Mode	Band	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 3	144	5720	3.210
		149	5745	16.570
		157	5785	16.100
		165	5825	16.360
802.11n (HT20)	U-NII 3	144	5720	3.840
		149	5745	17.600
		157	5785	17.590
		165	5825	17.600
802.11n (HT40)	U-NII 3	142	5710	3.240
		151	5755	35.700
		159	5795	36.100
802.11ac (VHT80)	U-NII 3	138	5690	2.880
		155	5775	75.480

■ RESULT PLOTS

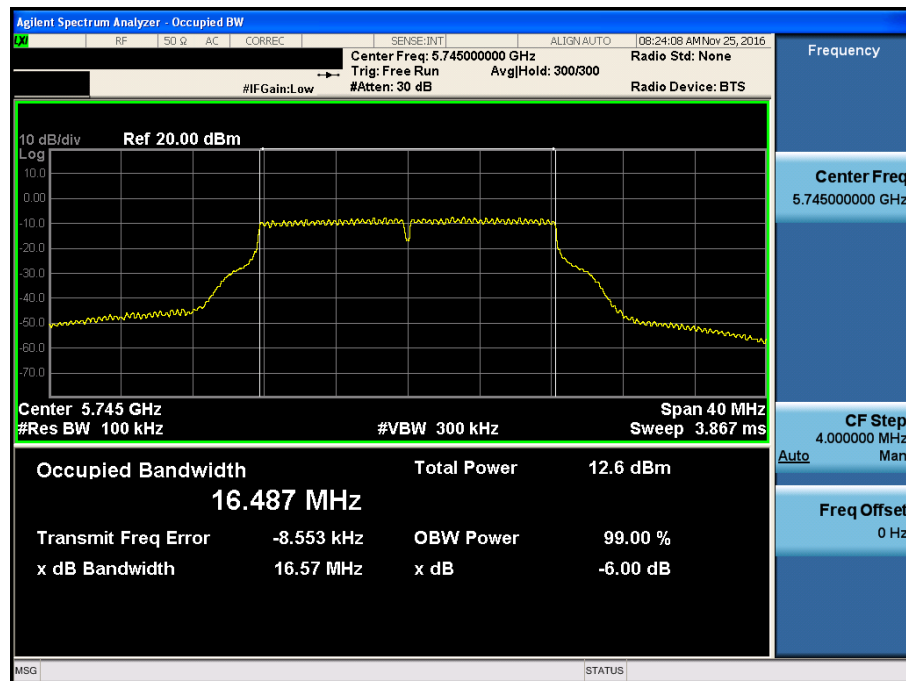
6 dB Bandwidth

Test Mode: 802.11a & Ch.144



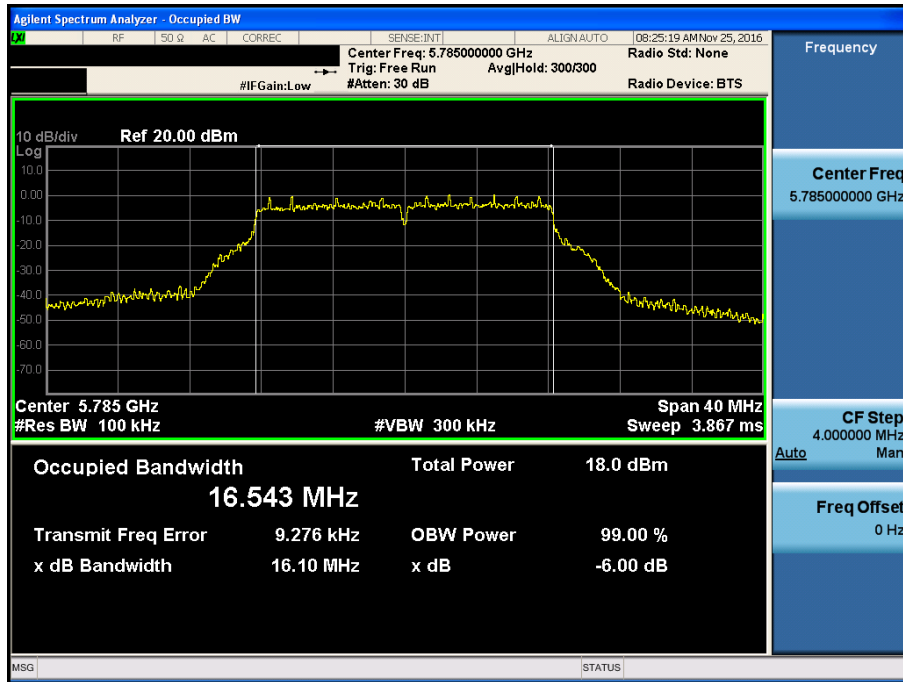
6 dB Bandwidth

Test Mode: 802.11a & Ch.149



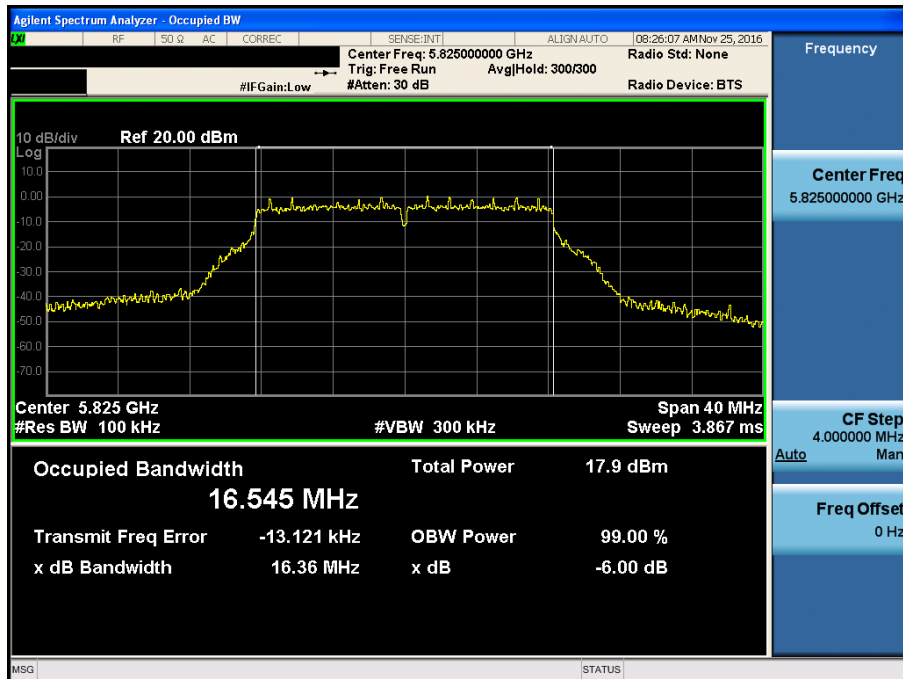
6 dB Bandwidth

Test Mode: 802.11a & Ch.157



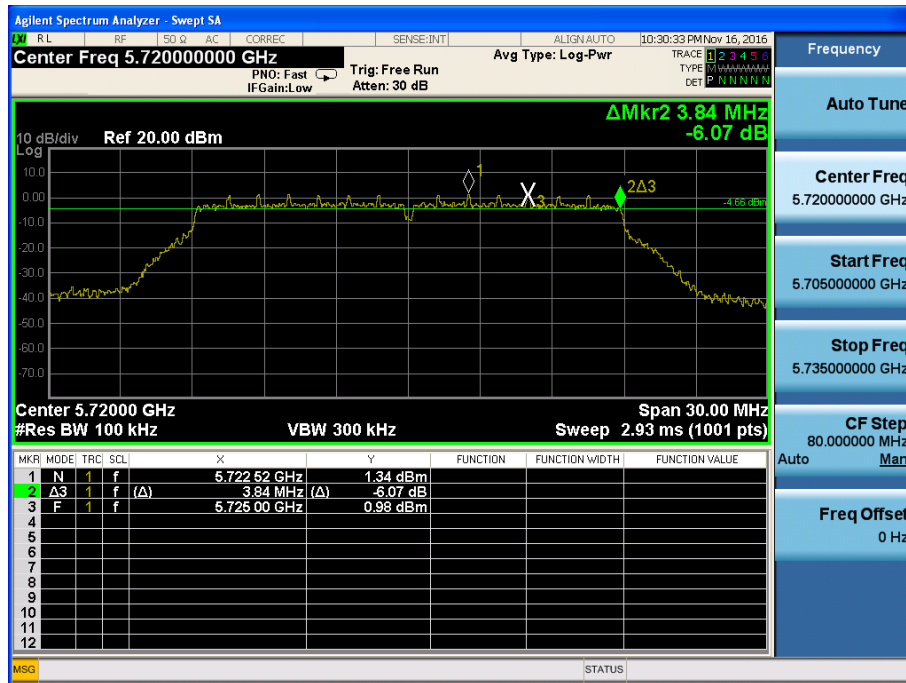
6 dB Bandwidth

Test Mode: 802.11a & Ch.165



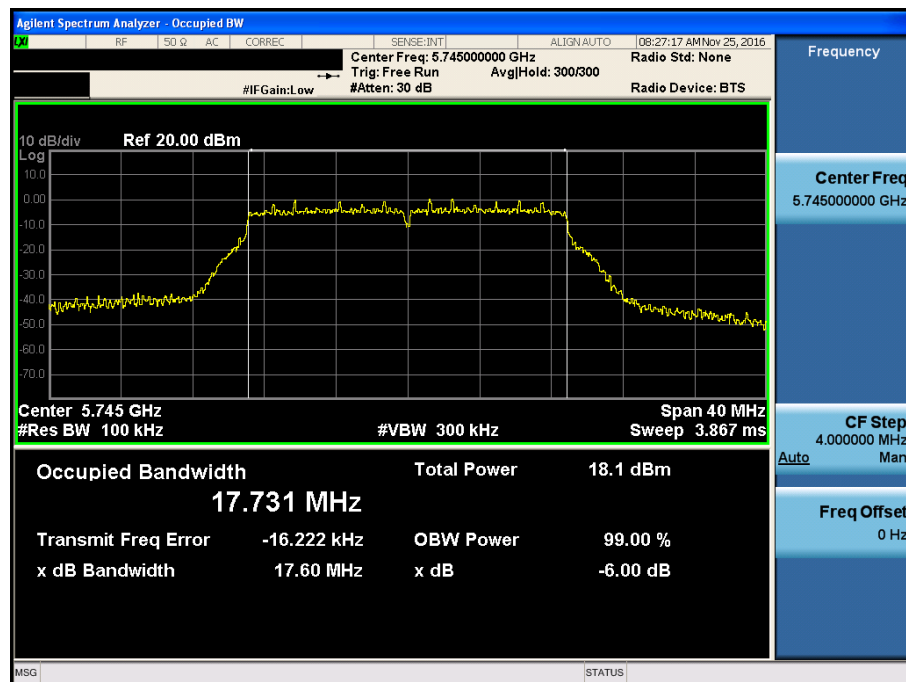
6 dB Bandwidth

Test Mode: 802.11n(HT20) & Ch.144



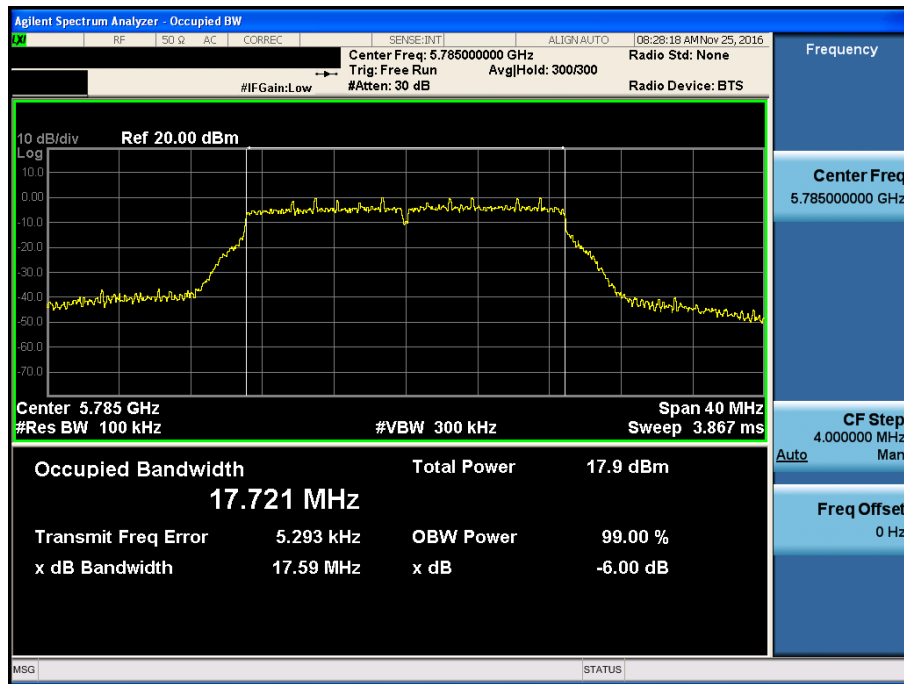
6 dB Bandwidth

Test Mode: 802.11n(HT20) & Ch.149



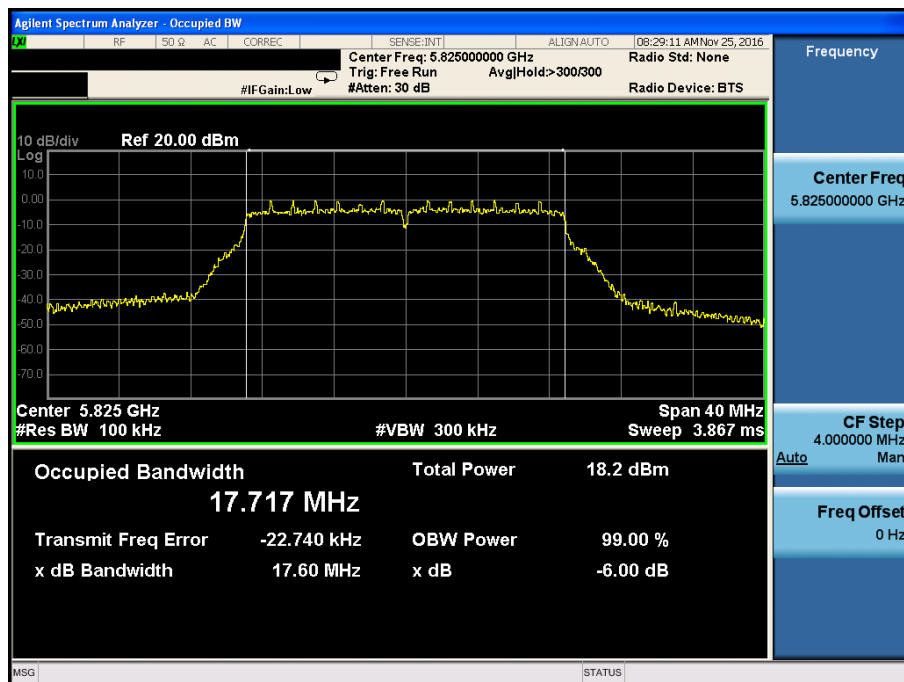
6 dB Bandwidth

Test Mode: 802.11n(HT20) & Ch.157



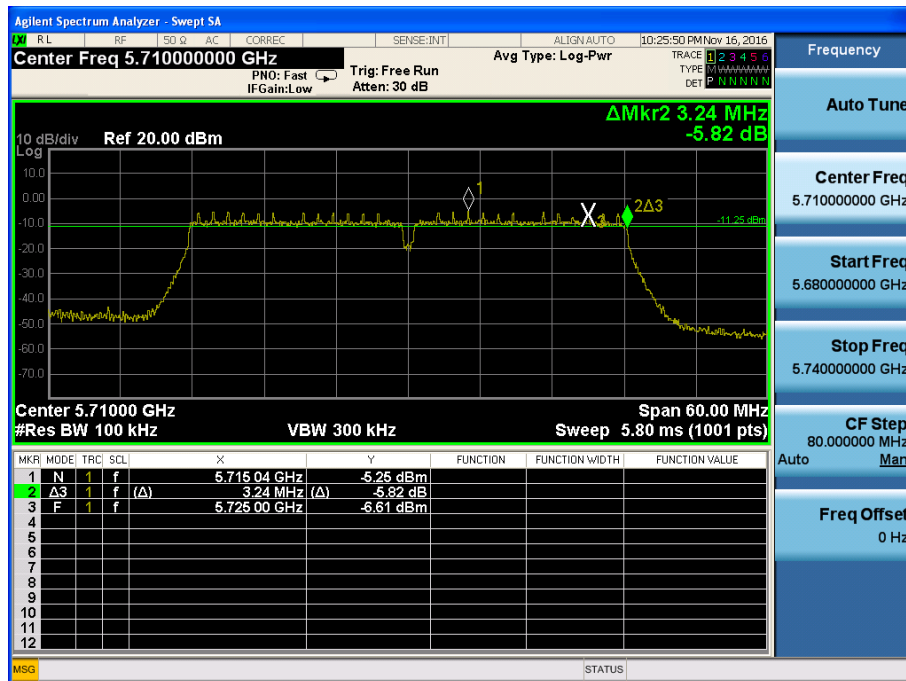
6 dB Bandwidth

Test Mode: 802.11n(HT20) & Ch.165



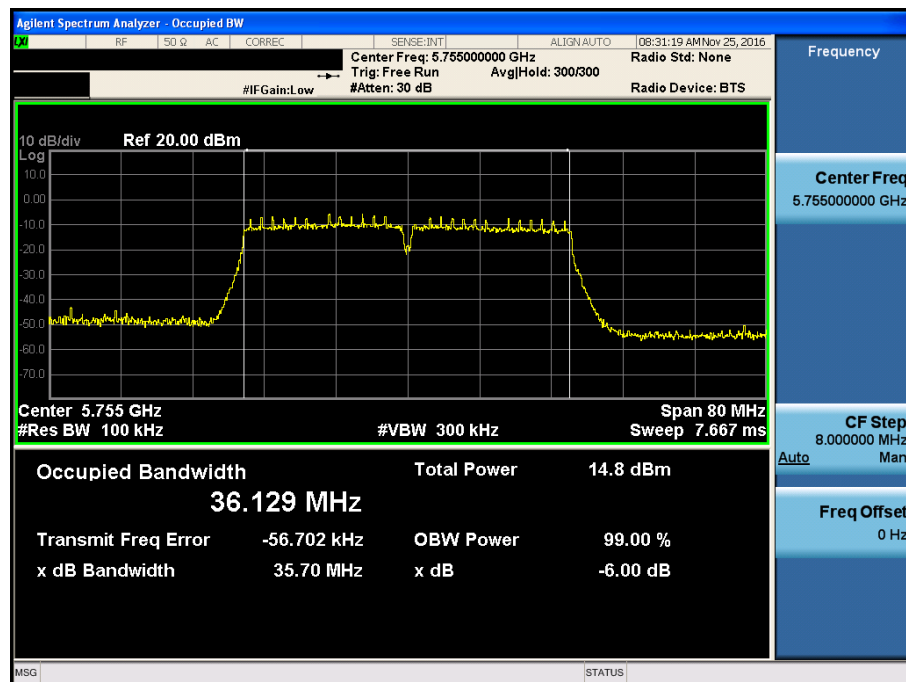
6 dB Bandwidth

Test Mode: 802.11n(HT40) & Ch.142



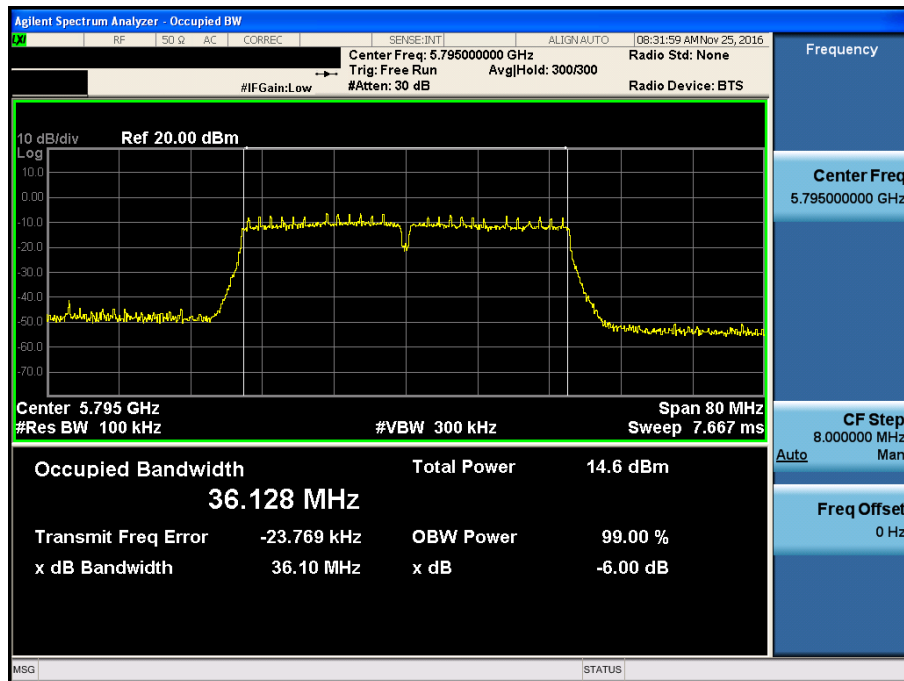
6 dB Bandwidth

Test Mode: 802.11n(HT40) & Ch.151



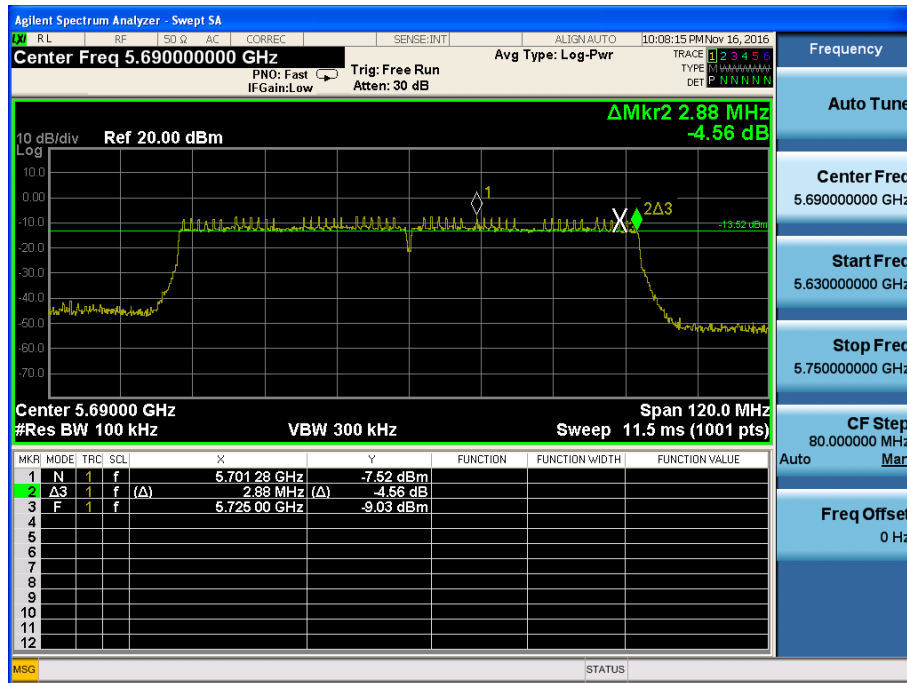
6 dB Bandwidth

Test Mode: 802.11n(HT40) & Ch.159



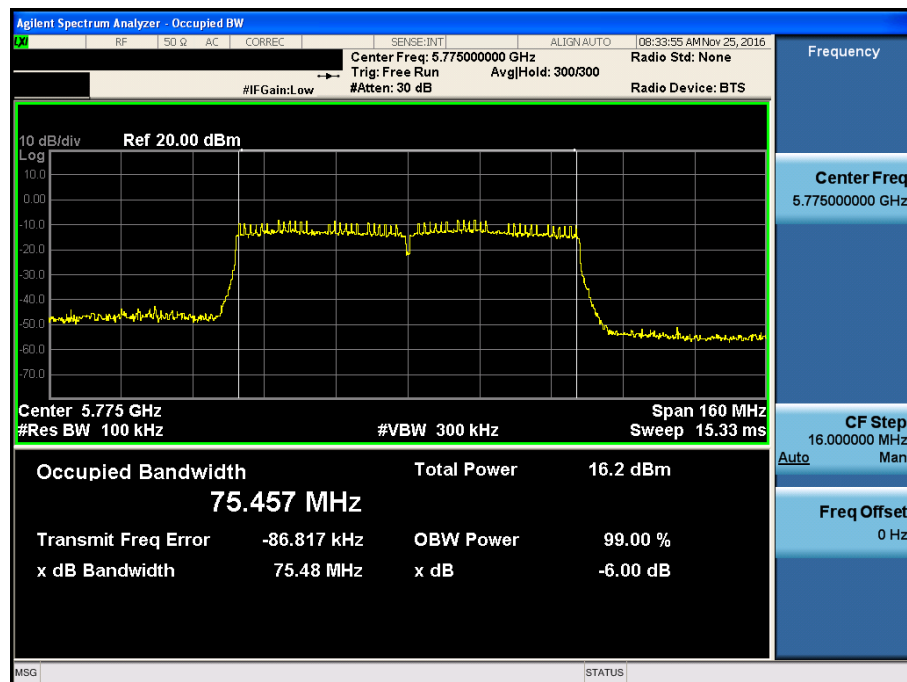
6 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.138



6 dB Bandwidth

Test Mode: 802.11ac(VHT80) & Ch.155



8.3 Maximum Conducted Output Power

■ Test Requirements

Part. 15.407(a)

(1) For the band 5.15 - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

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

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. 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.

(2) For the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. 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.

(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. 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.

- Output power Limit Calculation(FCC)

Bands	Mode	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case)	Determined Limit [dBm]
U-NII 1	802.11a	250	23.97	1.420	23.97
	802.11n(HT20)/ 802.1ac(VHT20)				
	802.11n(HT40) / 802.1ac(VHT40)				
	802.11ac(VHT80)				

Bands	Mode	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case)	Determined Limit [dBm]
		Least 26 dBc BW [MHz]			
U-NII 2A	802.11a	250	23.97	1.420	23.97
		21.49	24.32		
	802.11n(HT20)/ 802.1ac(VHT20)	250	23.97		
		21.73	24.37		
	802.11n(HT20)/ 802.1ac(VHT20)	250	23.97		
		40.02	27.02		
	802.11ac(VHT80)	250	23.97		
		81.62	30.11		

Bands	Mode	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case)	Determined Limit [dBm]
		Least 26 dBc BW [MHz]			
U-NII 2C	802.11a	250	23.97	-0.850	22.94
		15.64	22.94		22.97
	802.11n(HT20)/ 802.1ac(VHT20)	250	23.97		23.97
		15.76	22.97		23.97
	802.11n(HT20)/ 802.1ac(VHT20)	250	23.97		23.97
		35.20	26.46		23.97
	802.11ac(VHT80)	250	23.97		23.97
		75.84	29.79		23.97

Bands	Mode	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case)	Determined Limit [dBm]
U-NII 3	802.11a	1000	30.00	-2.390	30.00
	802.11n(HT20)/ 802.1ac(VHT20)				
	802.11n(HT40) / 802.1ac(VHT40)				
	802.11ac(VHT80)				

■ Test Results: **Comply**

Mode	Bands	Channel	Frequency [MHz]	Test Result [dBm]
802.11a	U-NII 1	36	5180	11.940
		40	5200	11.020
		48	5240	11.210
	U-NII 2A	52	5260	9.980
		60	5300	9.270
		64	5320	9.220
	U-NII 2C	100	5500	11.150
		120	5600	10.950
		144	5720	9.670
	U-NII 3	149	5745	8.510
		157	5785	8.660
		165	5825	9.590
802.11n HT20	U-NII 1	36	5180	11.850
		40	5200	11.420
		48	5240	10.540
	U-NII 2A	52	5260	9.760
		60	5300	9.260
		64	5320	9.240
	U-NII 2C	100	5500	11.490
		120	5600	10.970
		144	5720	9.660
	U-NII 3	149	5745	8.260
		157	5785	8.660
		165	5825	9.470
802.11n HT40	U-NII 1	38	5190	7.250
		46	5230	6.330
	U-NII 2A	54	5270	6.590
		62	5310	6.060
	U-NII 2C	102	5510	7.840
		118	5590	7.930
		142	5710	6.050
	U-NII 3	151	5755	5.050
		159	5795	5.580

■ Test Results: **Comply**

Mode	Bands	Channel	Frequency [MHz]	Test Result [dBm]
802.11ac VHT20	U-NII 1	36	5180	11.640
		40	5200	11.380
		48	5240	10.130
	U-NII 2A	52	5260	9.630
		60	5300	9.310
		64	5320	8.870
	U-NII 2C	100	5500	11.410
		120	5600	10.770
		144	5720	9.190
	U-NII 3	149	5745	8.240
		157	5785	8.530
		165	5825	9.380
802.11ac VHT40	U-NII 1	38	5190	7.060
		46	5230	6.270
	U-NII 2A	54	5270	6.590
		62	5310	6.040
	U-NII 2C	102	5510	7.810
		118	5590	7.910
		142	5710	5.940
	U-NII 3	151	5755	4.650
		159	5795	5.510
802.11ac VHT80	U-NII 1	42	5210	6.290
		-	-	-
	U-NII 2A	58	5290	6.440
		-	-	-
	U-NII 2C	106	5530	8.250
		122	5610	6.640
		138	5690	5.890
	U-NII 3	155	5755	5.890
		-	-	-

8.4 Maximum Power Spectral Density

■ Test requirements

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1MHz band. ^{note1}

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1MHz band. ^{note1}

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1MHz band. ^{note1}

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. ^{note1}

(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. ^{note1,note2}

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: 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.

- Peak Power Spectral Density Limit Calculation

Band	Limit [dBm]	Antenna Gain (Worst case)	Determined Limit [dBm]
U-NII 1	11	1.420	11
U-NII 2A	11	1.420	11
U-NII 2C	11	-0.850	11
U-NII 3	30	-2.390	30

■ Test configuration

Refer to the APPENDIX I.

■ Test procedure

Maximum Power Spectral Density is measured using Measurement Procedure of **KDB789033 D02 V01**

- 1) Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power...". (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
- 2) Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- 3) Make the following adjustments to the peak value of the spectrum, if applicable:
 - a) **If Method SA-2 or SA-2 Alternative was used, add $10 \log(1/x)$, where x is the duty cycle, to the peak of the spectrum.**
 - b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- 4) The result is the Maximum PSD over 1 MHz reference bandwidth.
- 5) 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 $RBW \geq 1/T$, where T is defined in section II.B.1.a). (Refer to Appendix II)
 - b) Set $VBW \geq 3 RBW$.
 - c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/RBW)$ to the measured result, whereas $RBW (< 500 \text{ kHz})$ 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 $10\log(1\text{MHz}/RBW)$ to the measured result, whereas $RBW (< 1 \text{ MHz})$ 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.

■ Test result: **Comply**

Mode	Channel	Frequency [MHz]	Reading [dBm]	T.F [dB] Note 1	Test Result [dBm]
802.11a	36	5180	1.374	-	1.374
	40	5200	1.059		1.059
	48	5240	0.925		0.925
	52	5260	0.473		0.473
	60	5300	0.010		0.010
	64	5320	0.097		0.097
	100	5500	-0.865		-0.865
	120	5600	-0.055		-0.055
	144	5720	1.104		1.104
	149	5745	-8.600	7.290	-1.310
	157	5785	-9.122		-1.832
	165	5825	-8.945		-1.655
802.11n HT20	36	5180	0.988	-	0.988
	40	5200	0.637		0.637
	48	5240	0.583		0.583
	52	5260	0.035		0.035
	60	5300	-0.100		-0.100
	64	5320	-0.339		-0.339
	100	5500	-1.284		-1.284
	120	5600	-0.487		-0.487
	144	5720	0.635		0.635
	149	5745	-9.810	7.310	-2.500
	157	5785	-9.718		-2.408
	165	5825	-9.166		-1.856
802.11n HT40	38	5190	-6.596	-	-6.596
	46	5230	-7.052		-7.052
	54	5270	-6.173		-6.173
	62	5310	-6.585		-6.585
	102	5510	-7.935		-7.935
	118	5590	-7.066		-7.066
	142	5710	-6.634		-6.634
	151	5755	-15.414	7.630	-7.784
	159	5795	-15.909		-8.279
802.11ac VHT80	42	5210	-10.404	-	-10.404
	-	-	-		-
	58	5290	-9.498		-9.498
	-	-	-		-
	106	5530	-10.273		-10.273
	122	5610	-10.007		-10.007
	138	5690	-9.599		-9.599
	155	5775	-18.694	8.430	-10.264
	-	-	-		-

Note 1: "Band 4 [T.F] = 10*LOG(500/100) + D.C.F"

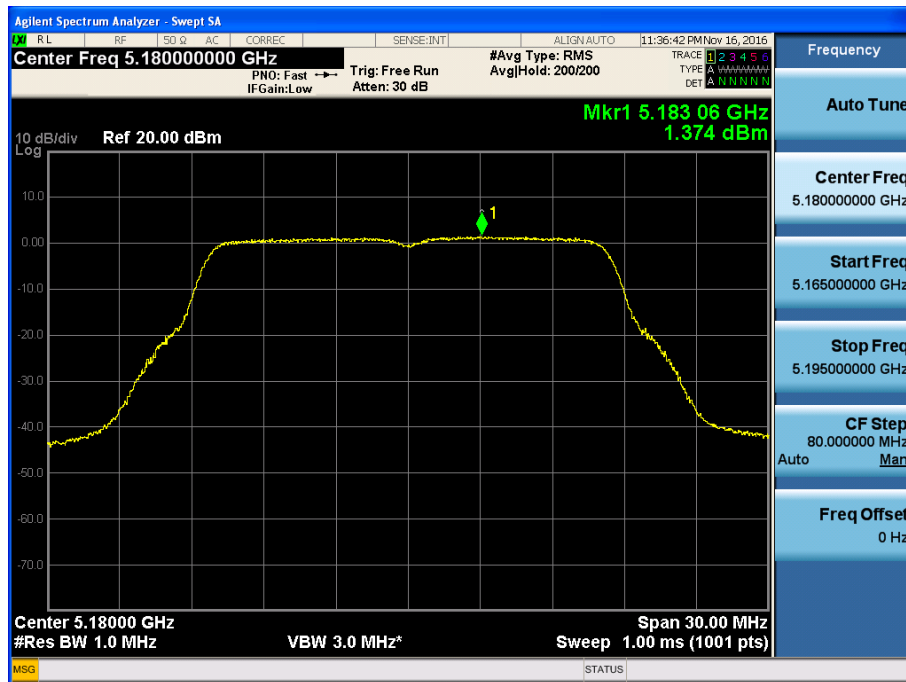
For D.C.F., please refer to appendix II.

Note 2: Test Result = Measurement Data + T.F

■ RESULT PLOTS

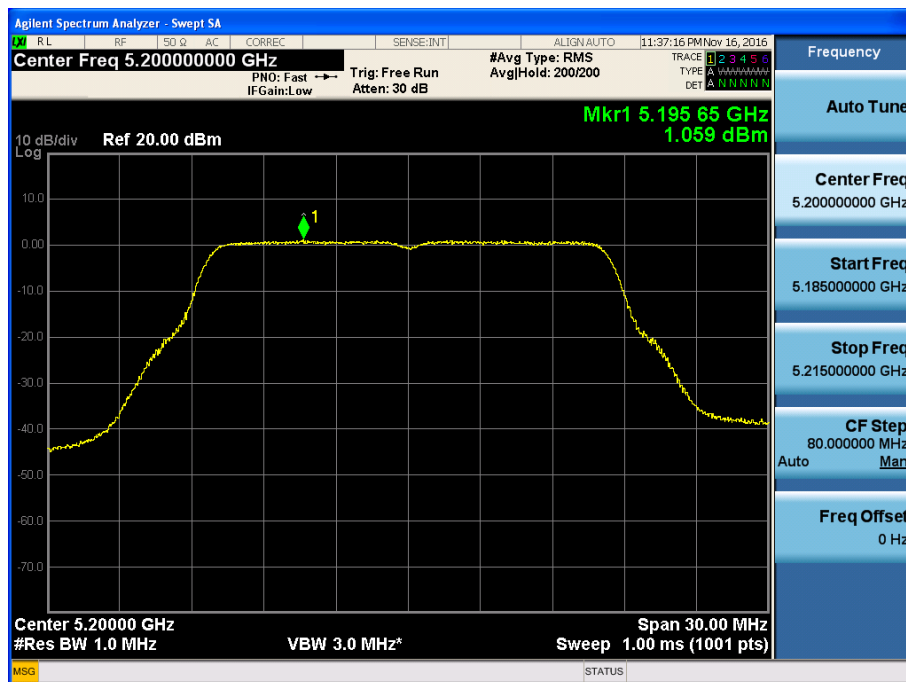
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.36



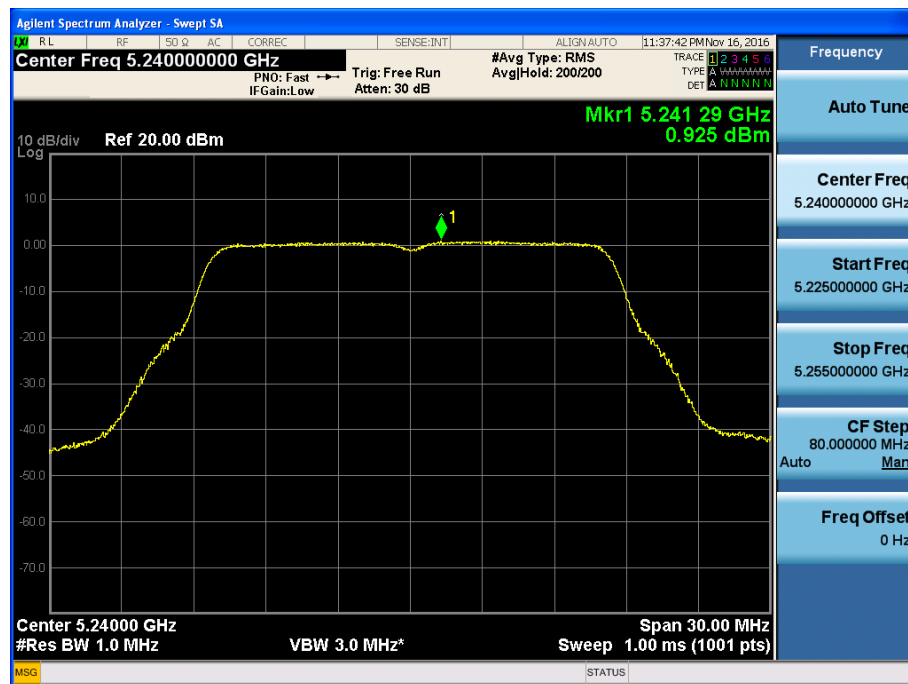
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.40



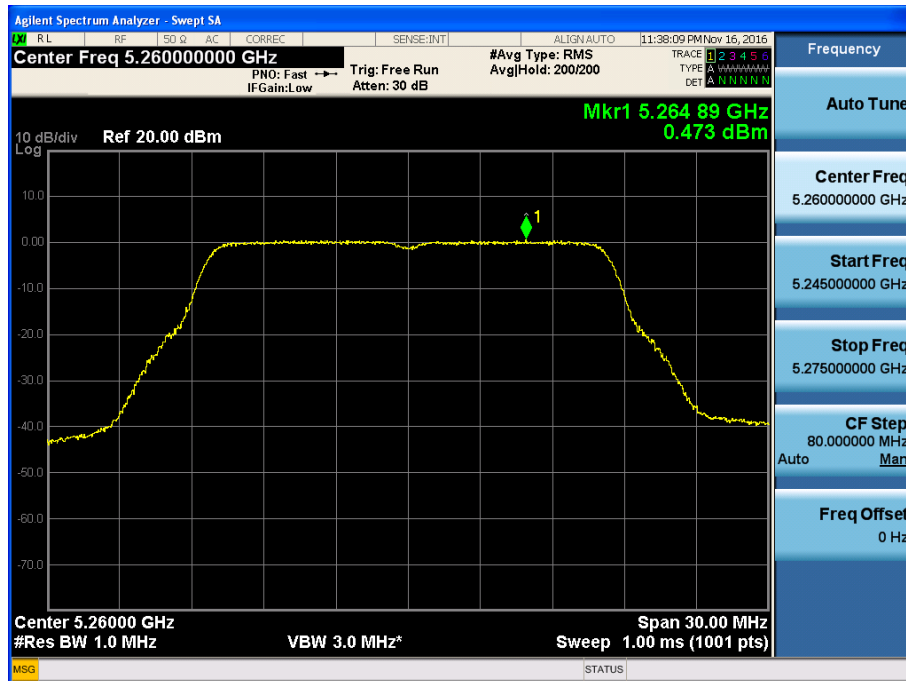
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.48



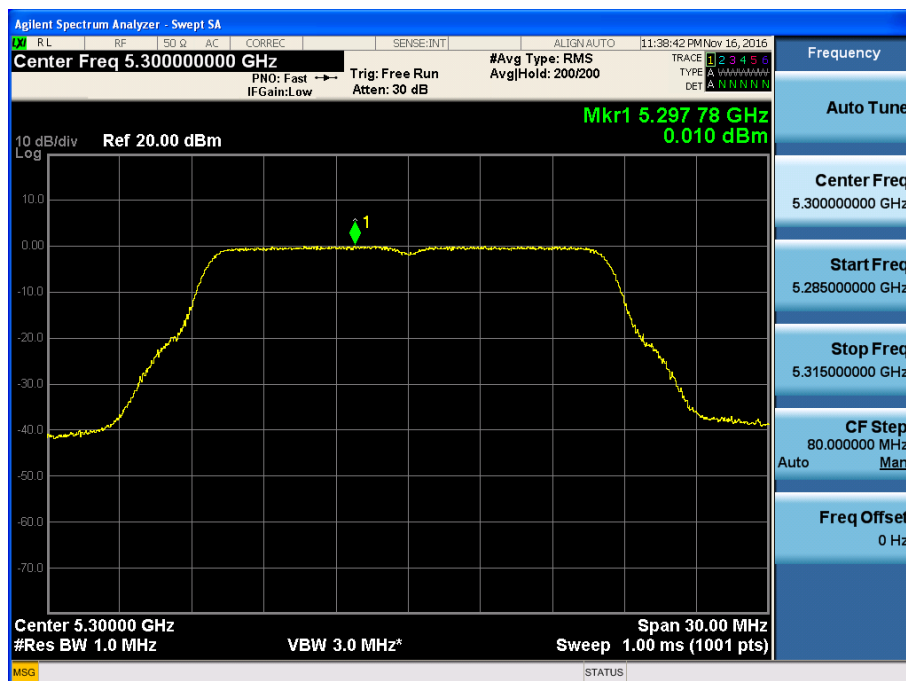
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.52



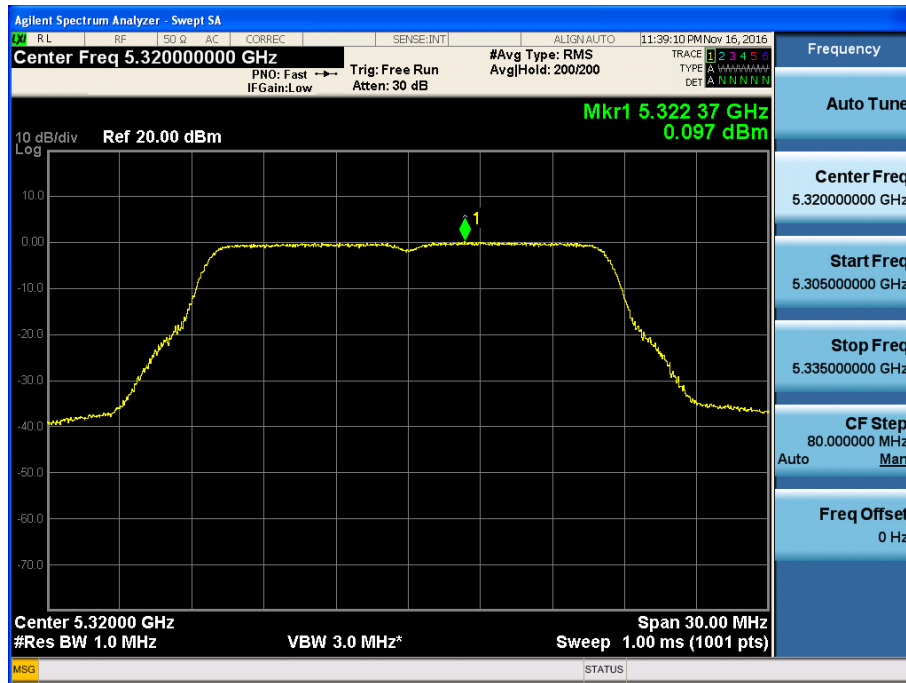
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.60



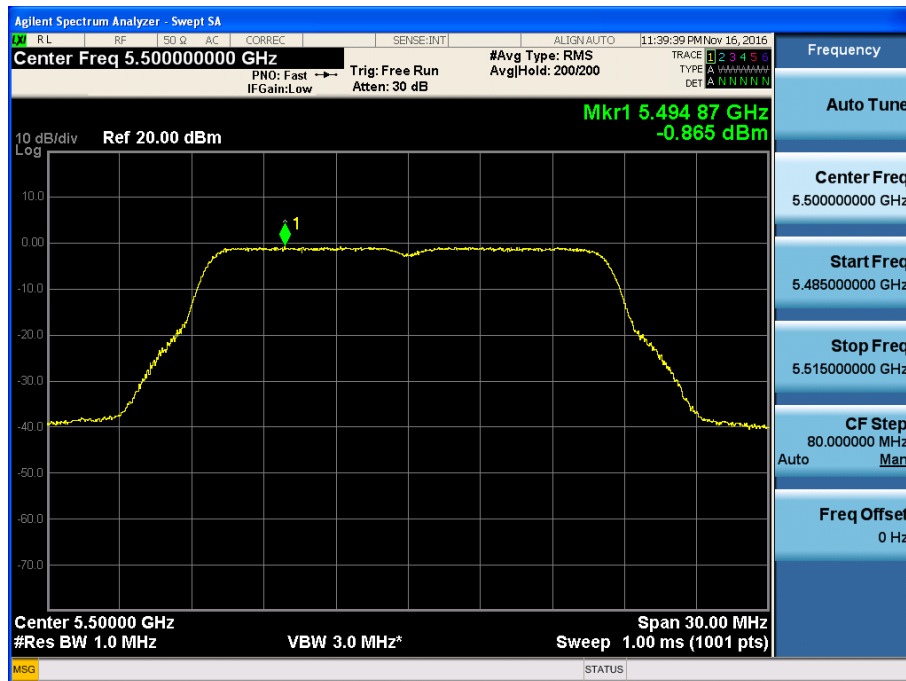
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.64



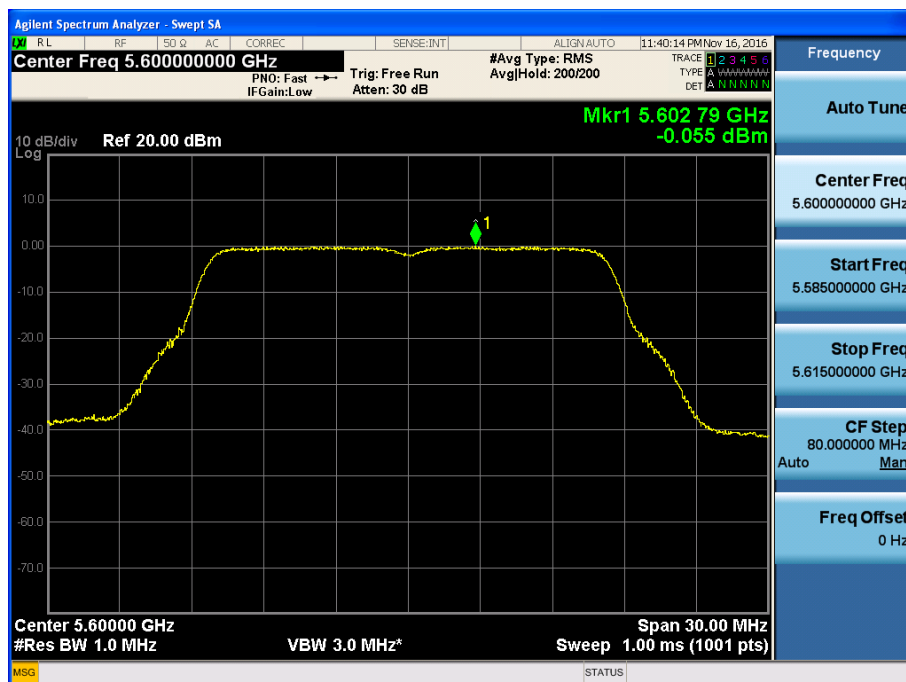
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.100



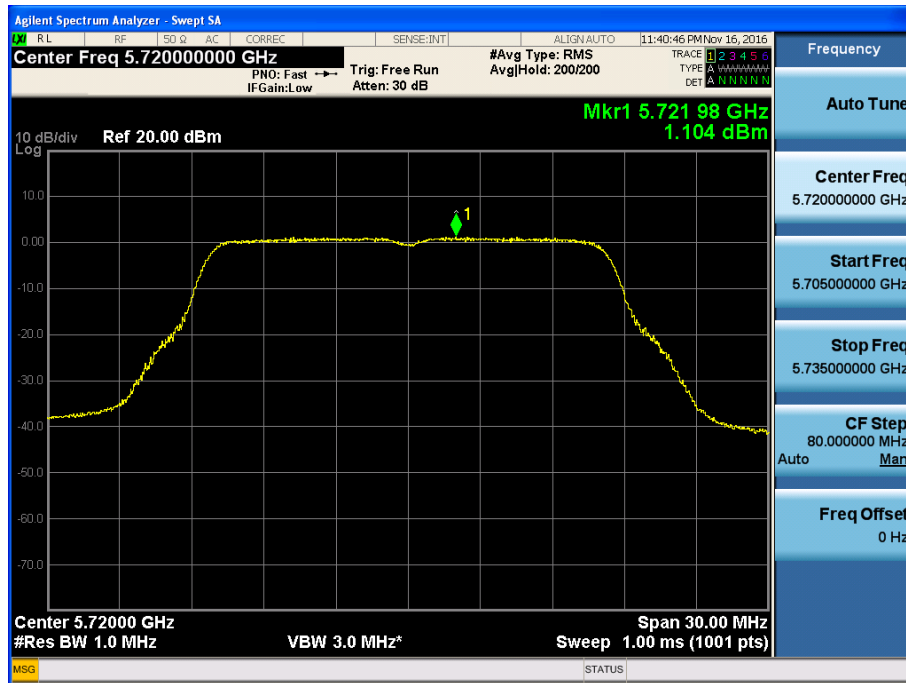
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.120



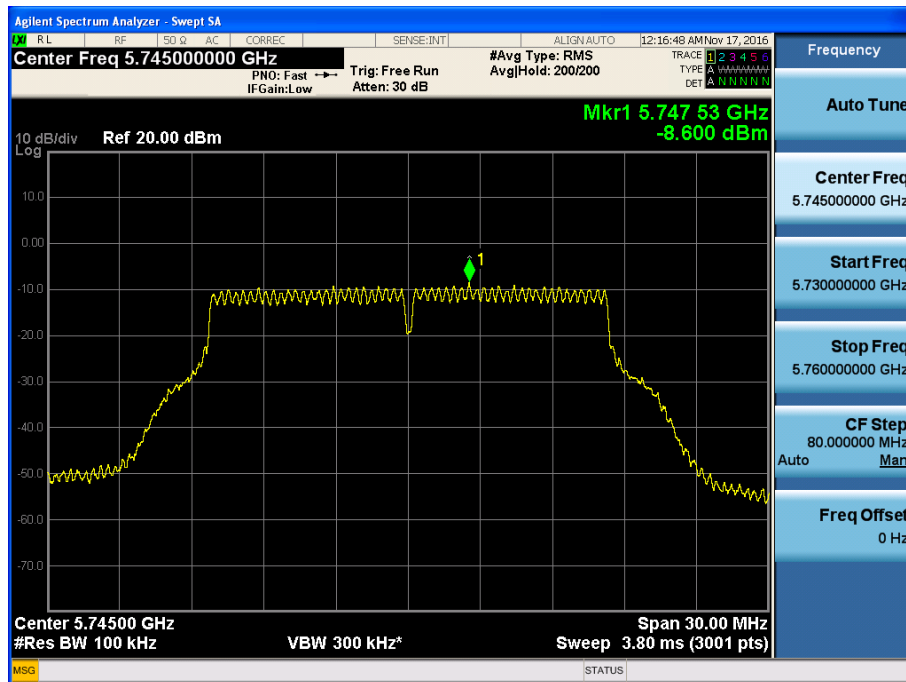
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.144



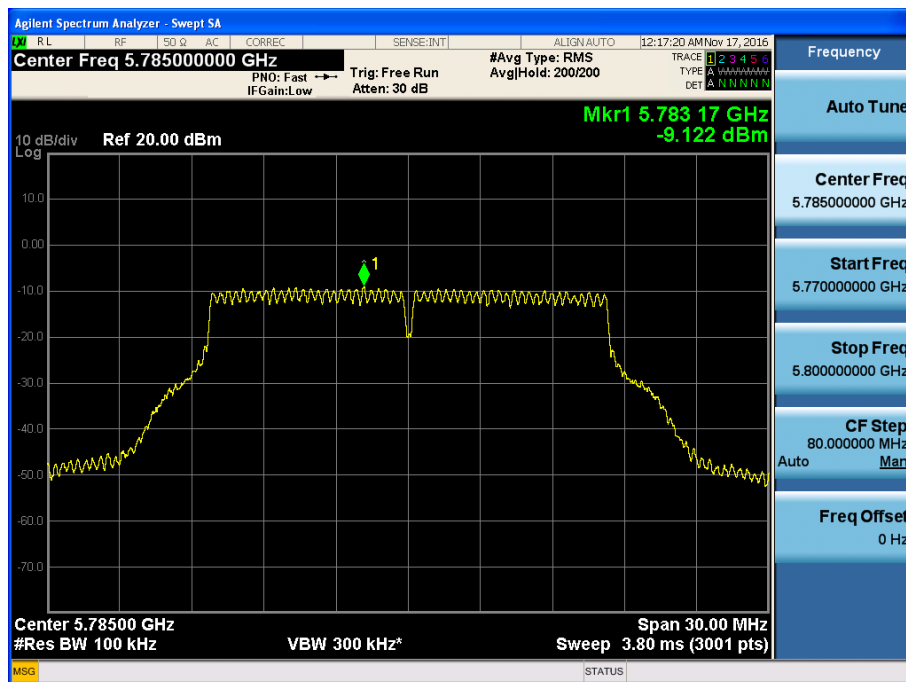
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.149



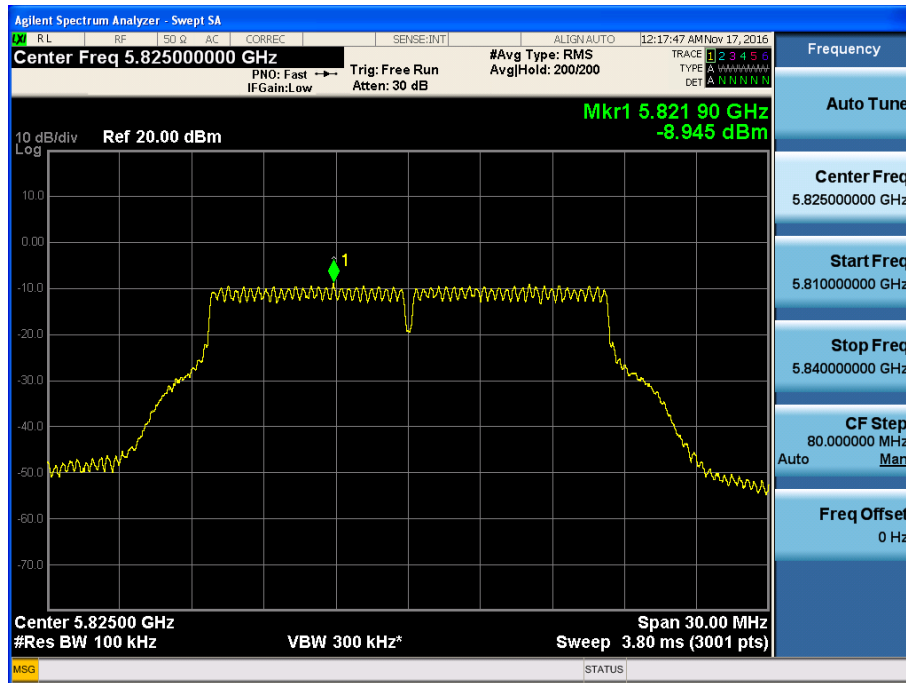
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.157



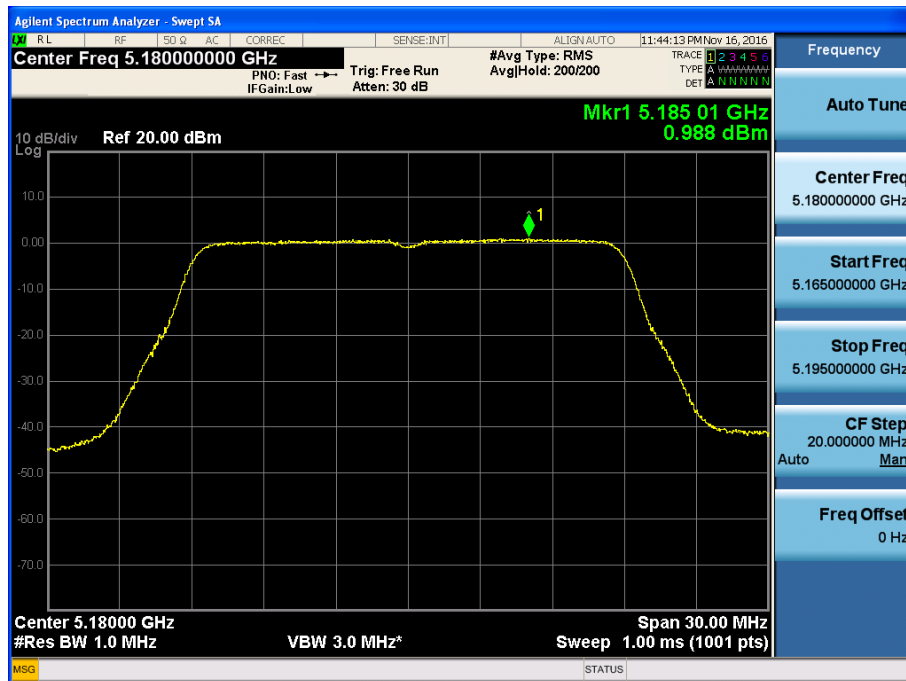
Maximum Power Spectral Density

Test Mode: 802.11a & Ch.165



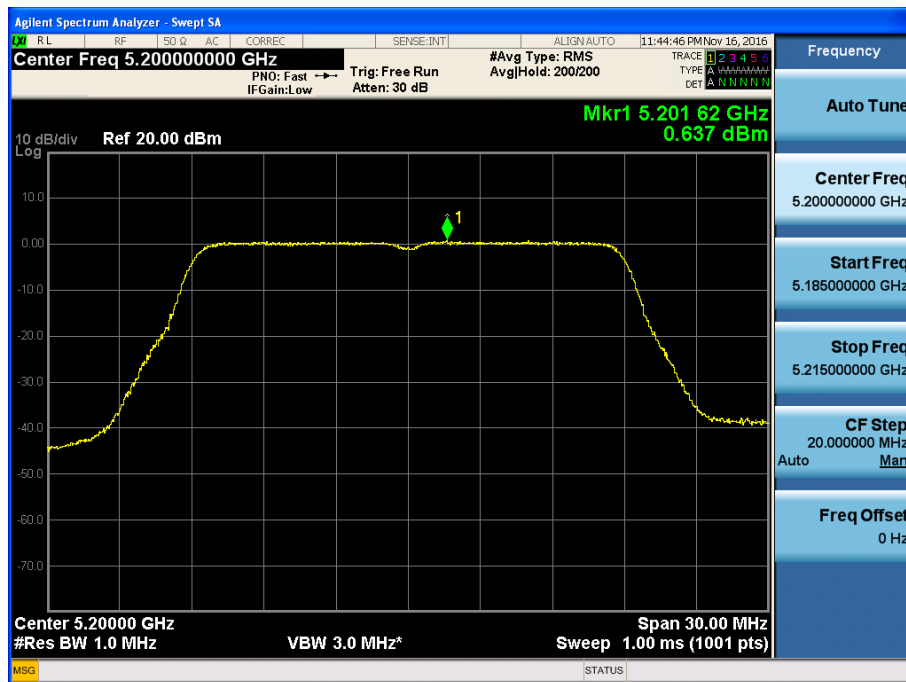
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.36



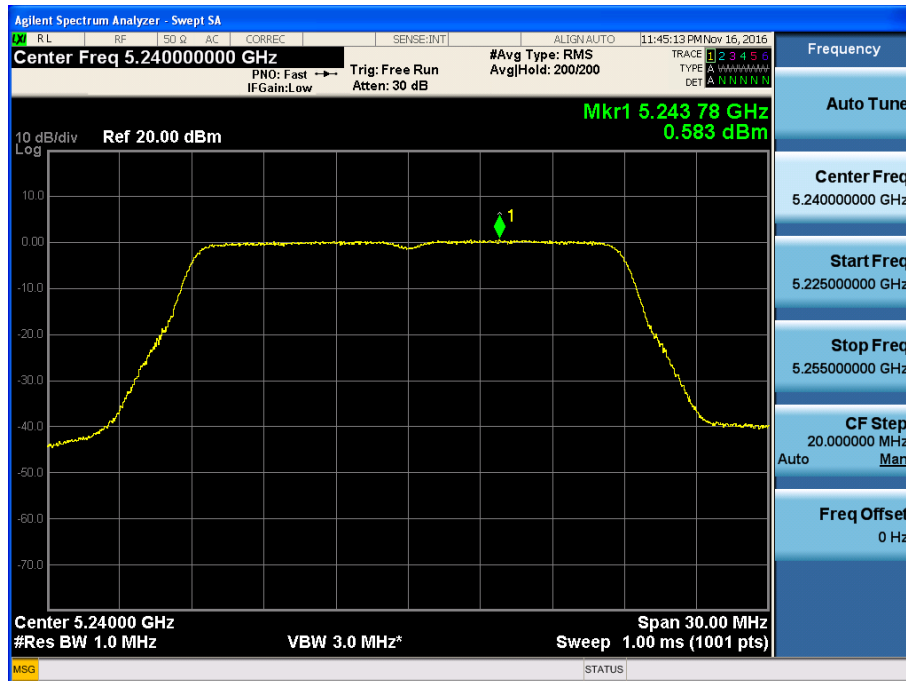
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.40



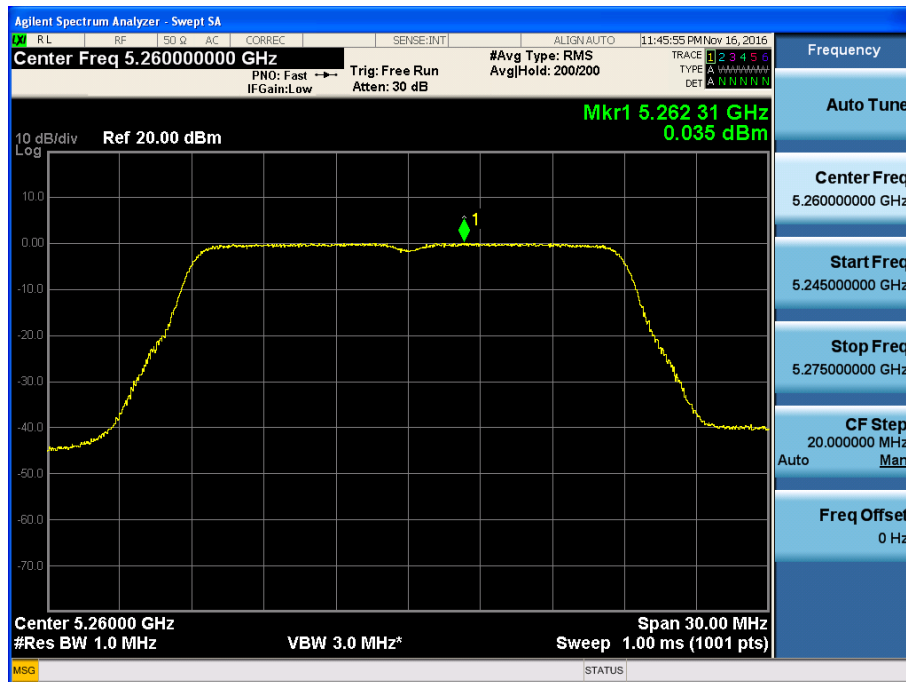
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.48



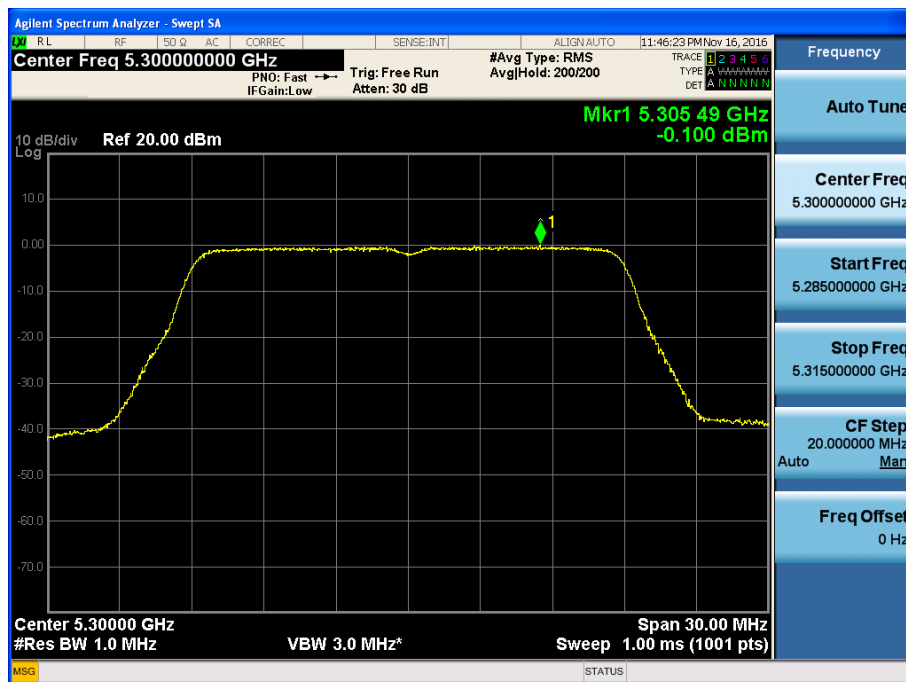
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.52



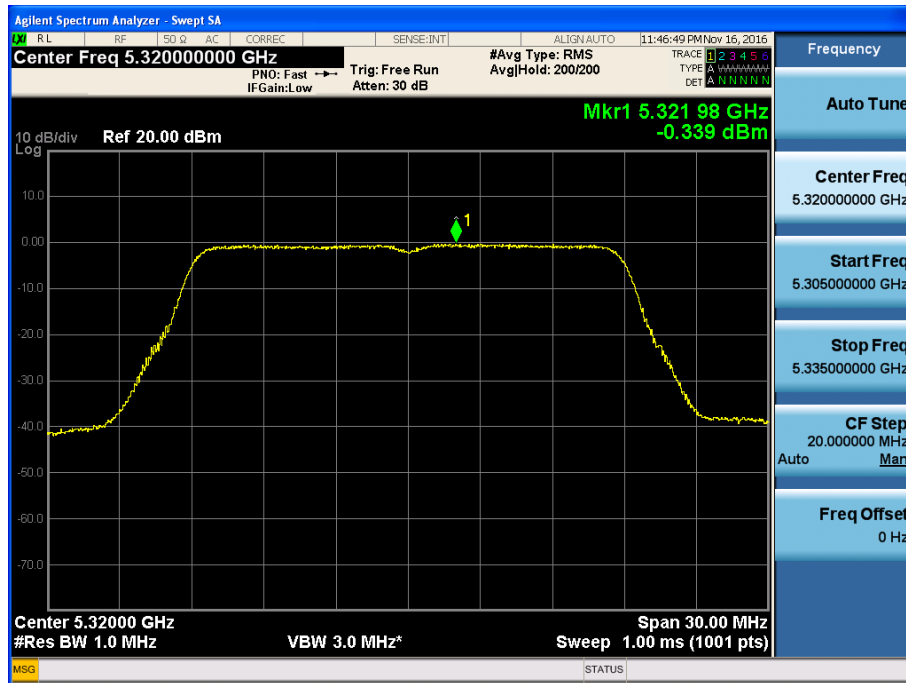
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.60



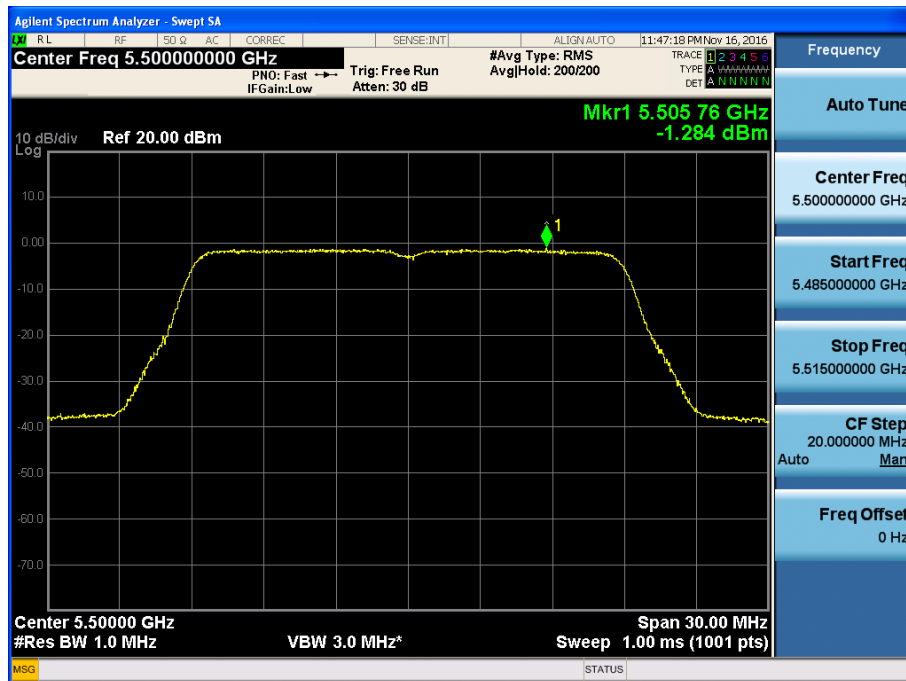
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.64



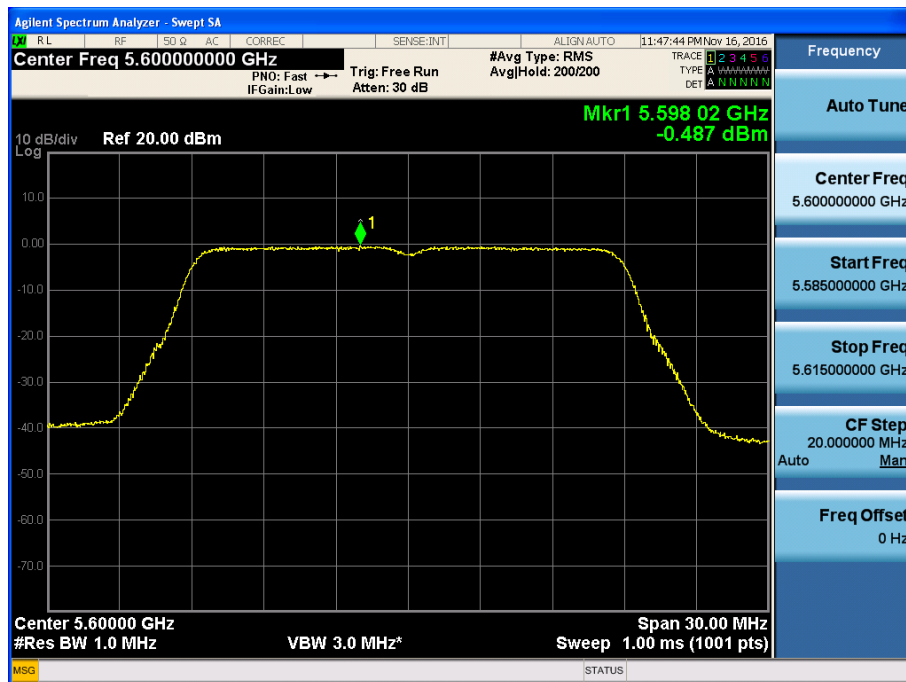
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.100



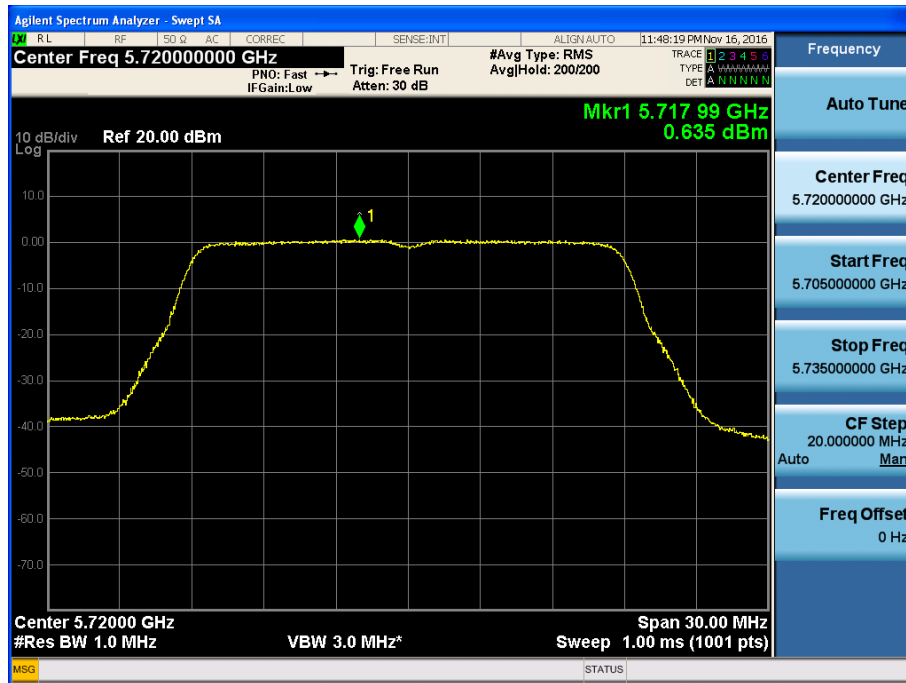
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.120



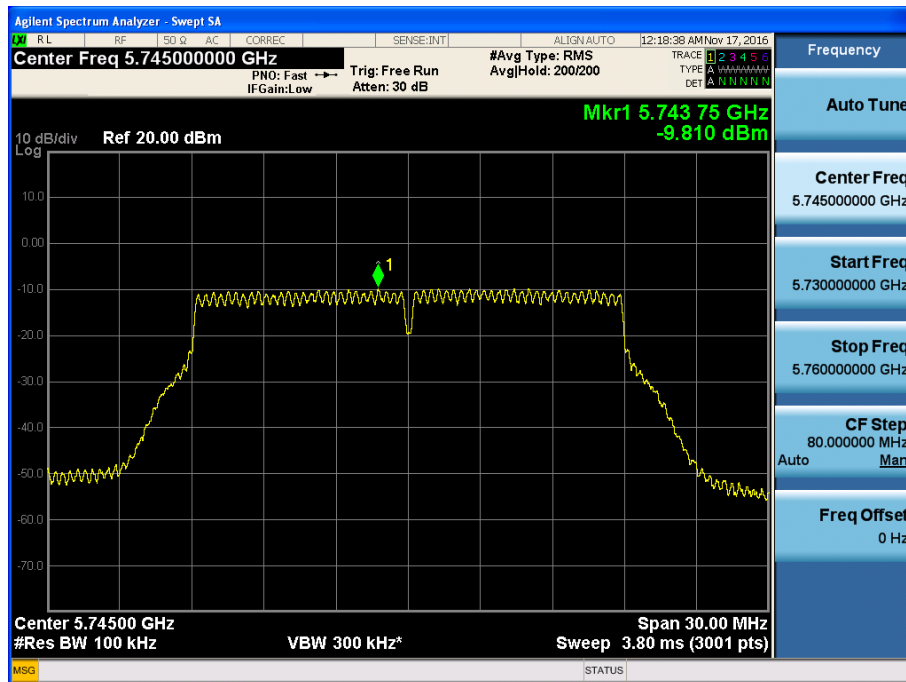
Maximum Power Spectral Density

Test Mode: 802.11n HT20 & Ch.144



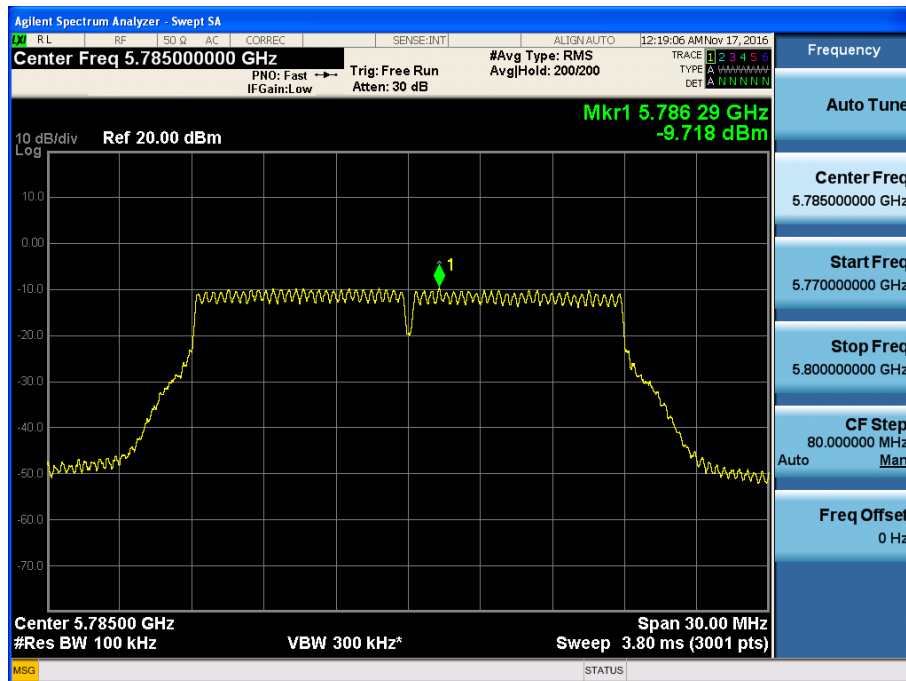
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.149



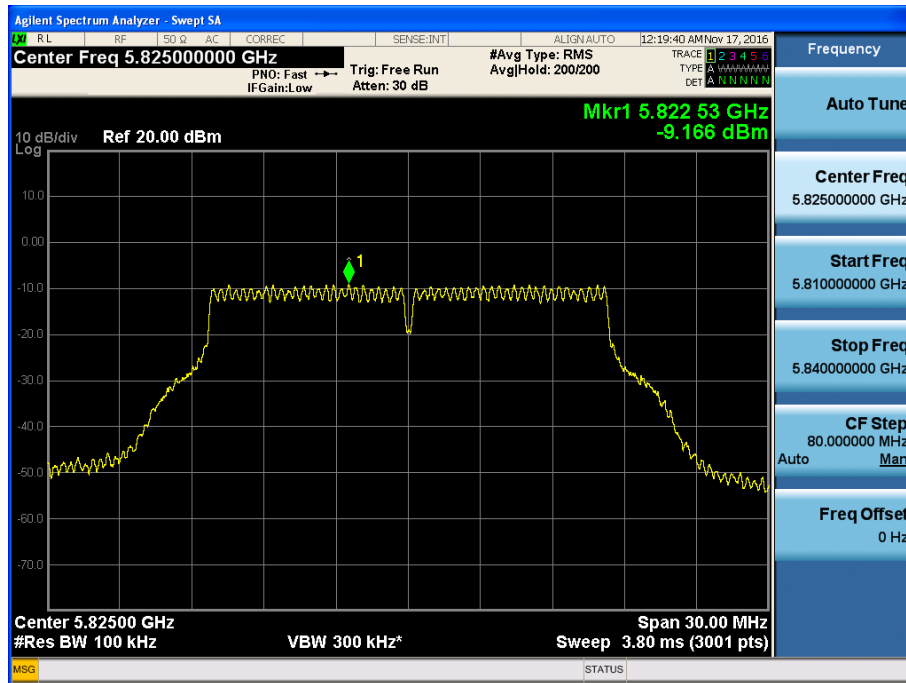
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.157



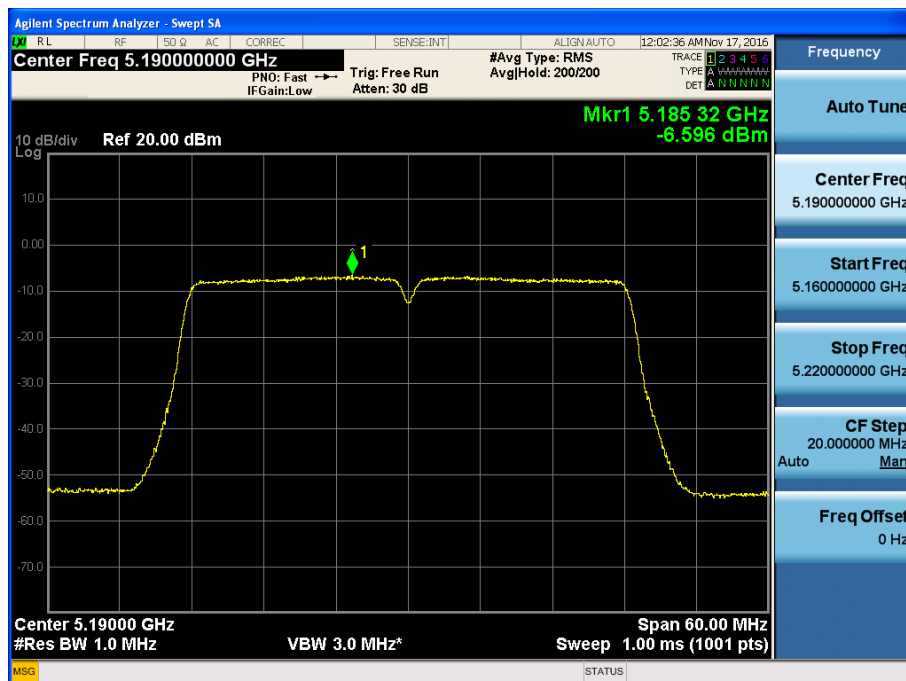
Maximum Power Spectral Density

Test Mode: 802.11n(HT20) & Ch.165



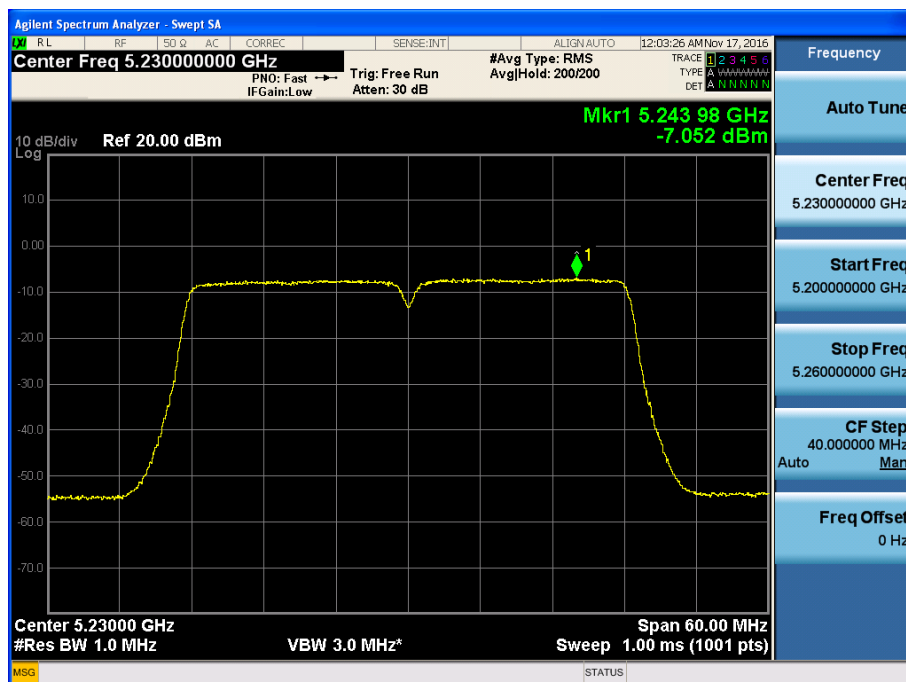
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.38



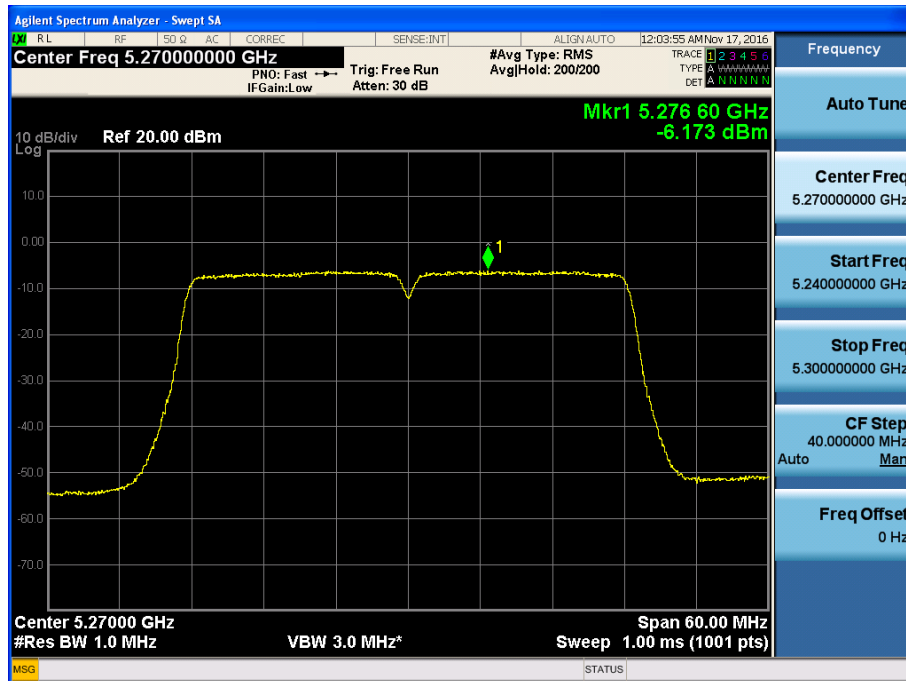
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.46



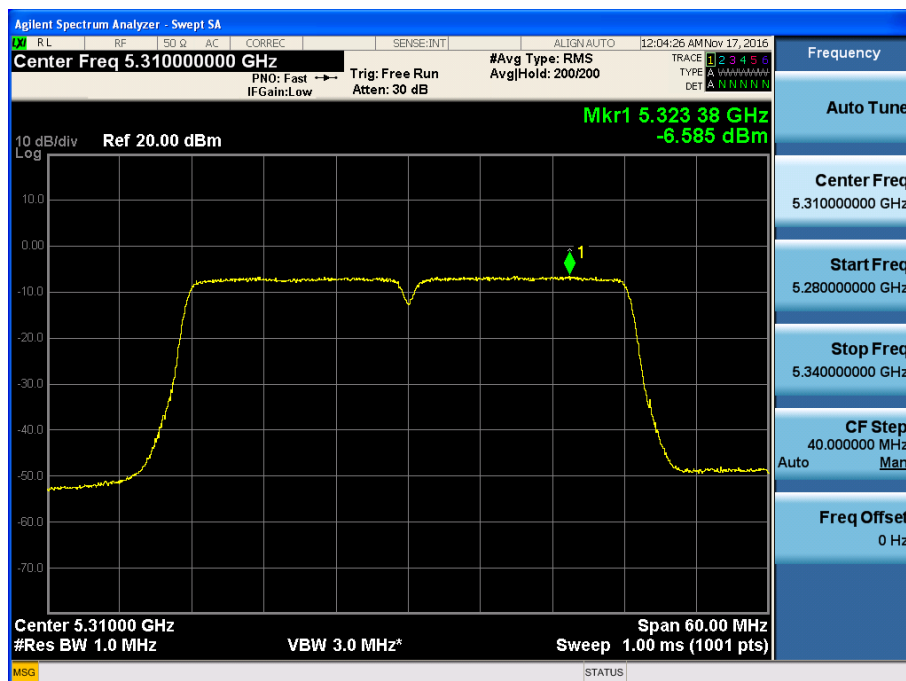
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.54



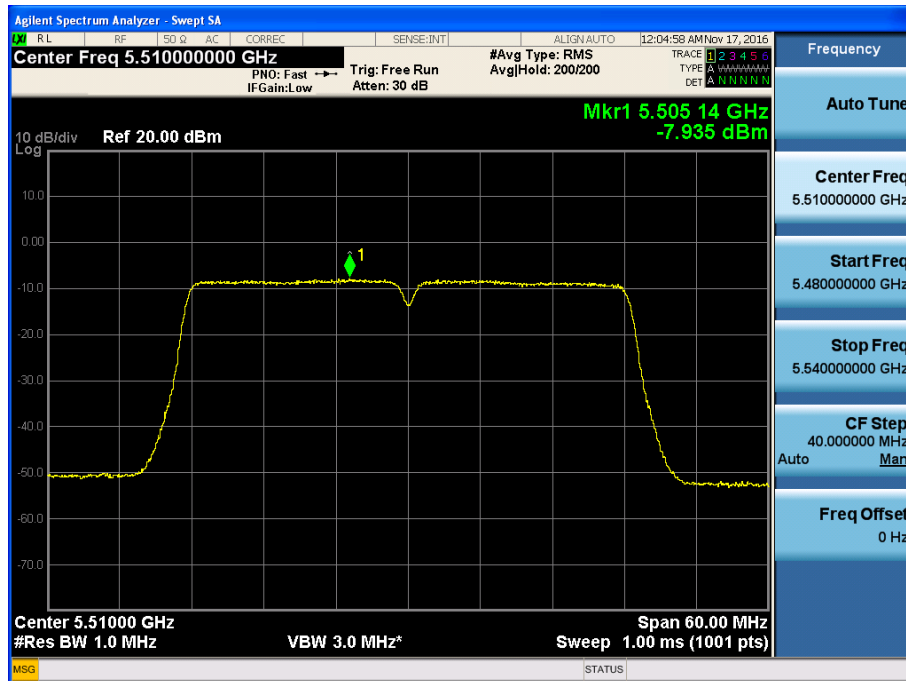
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.62



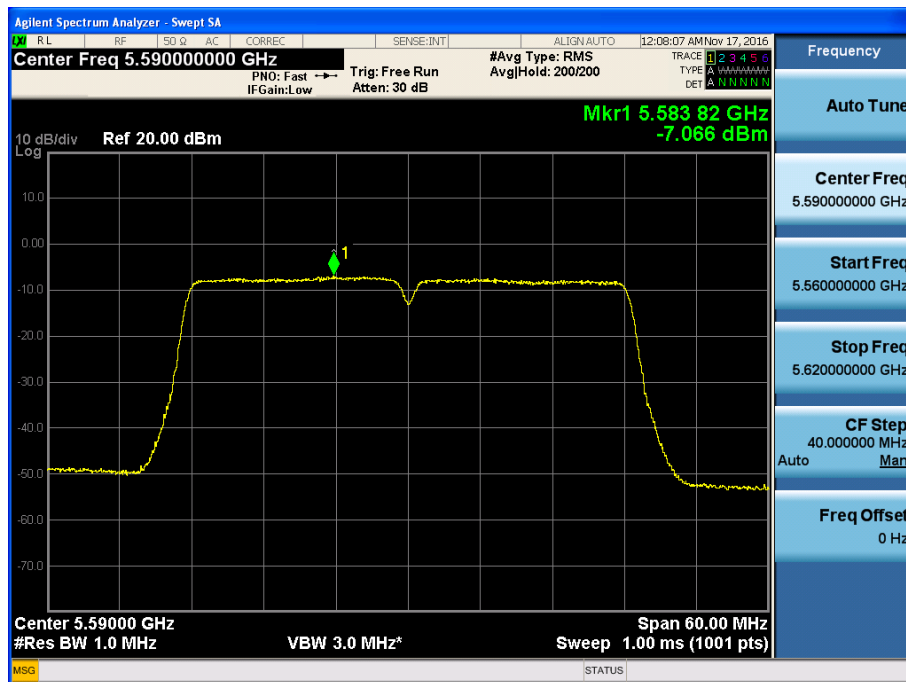
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.102



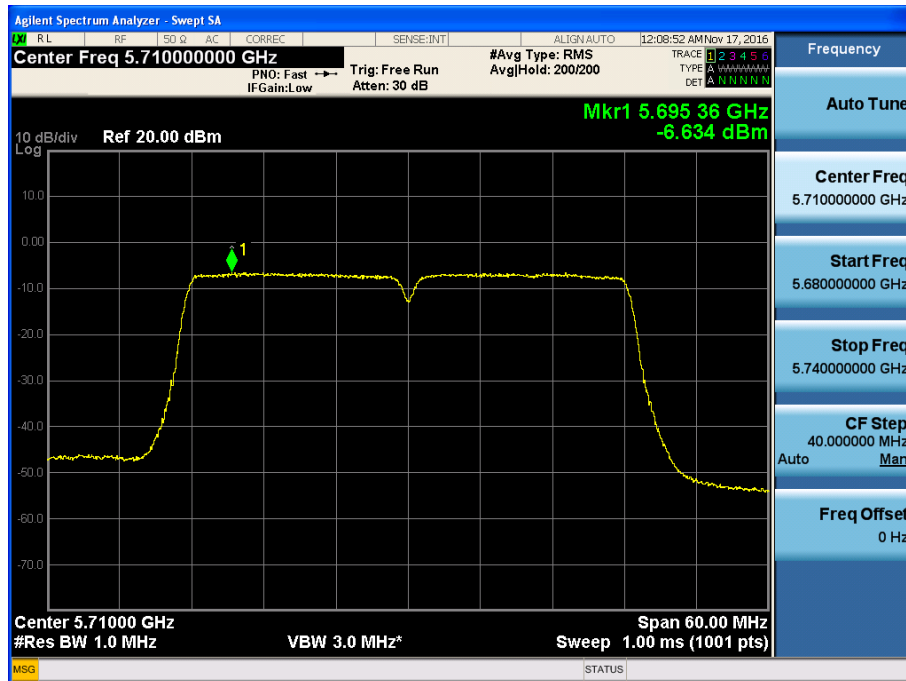
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.118



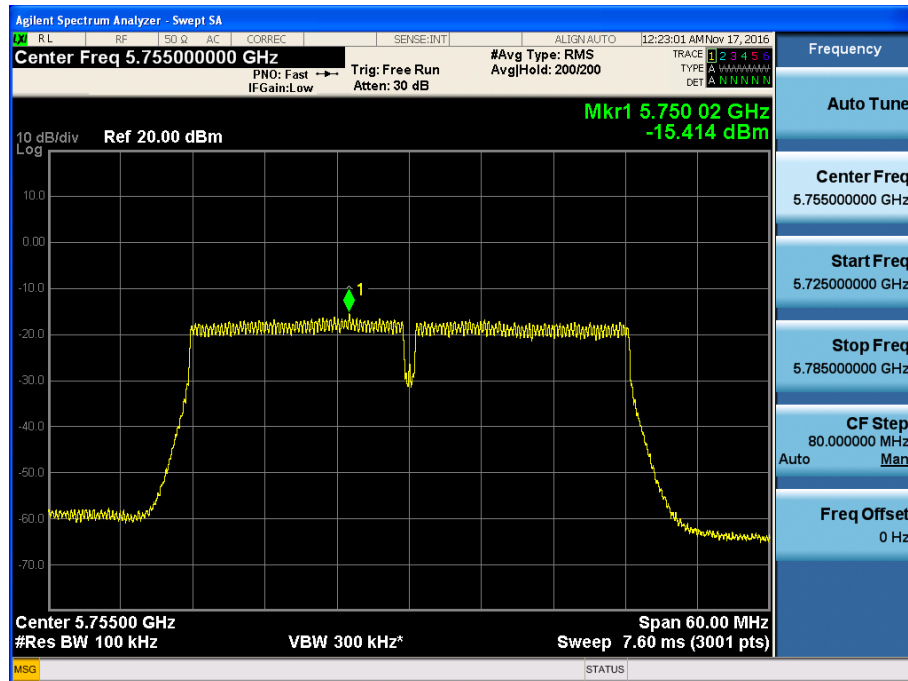
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.142



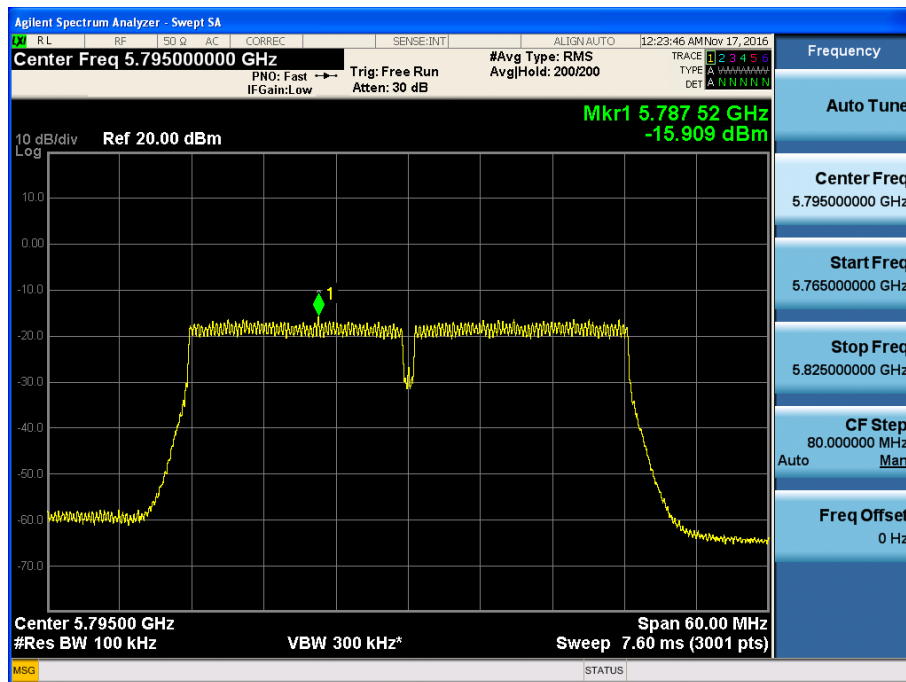
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.151



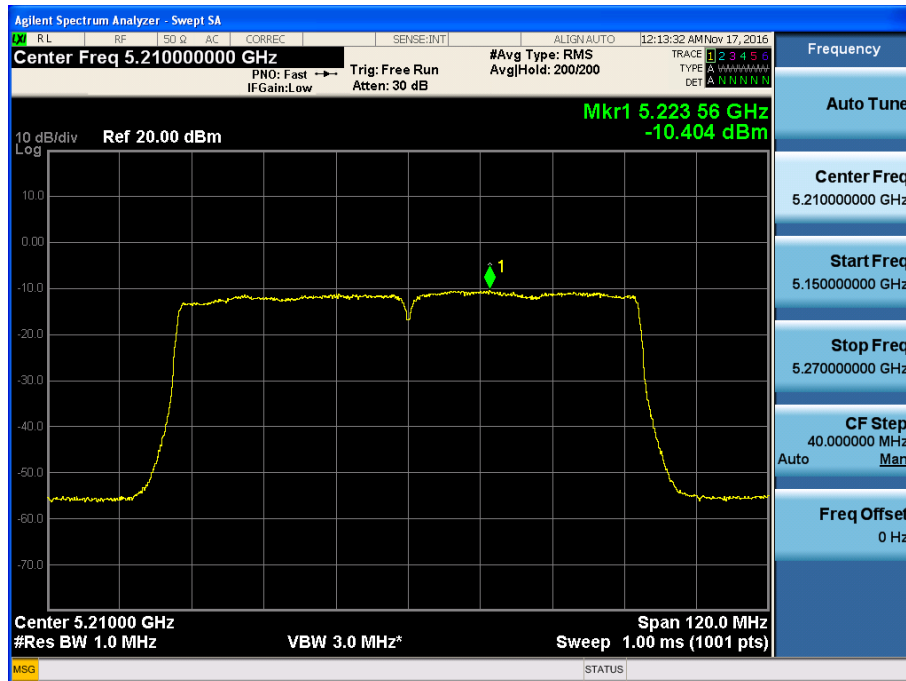
Maximum Power Spectral Density

Test Mode: 802.11n HT40 & Ch.159



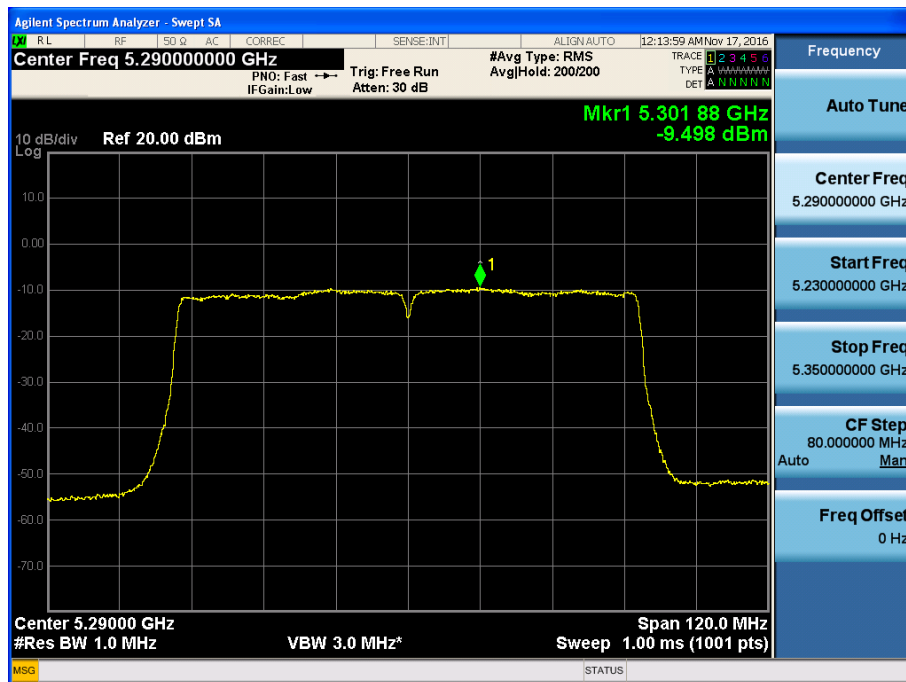
Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.42



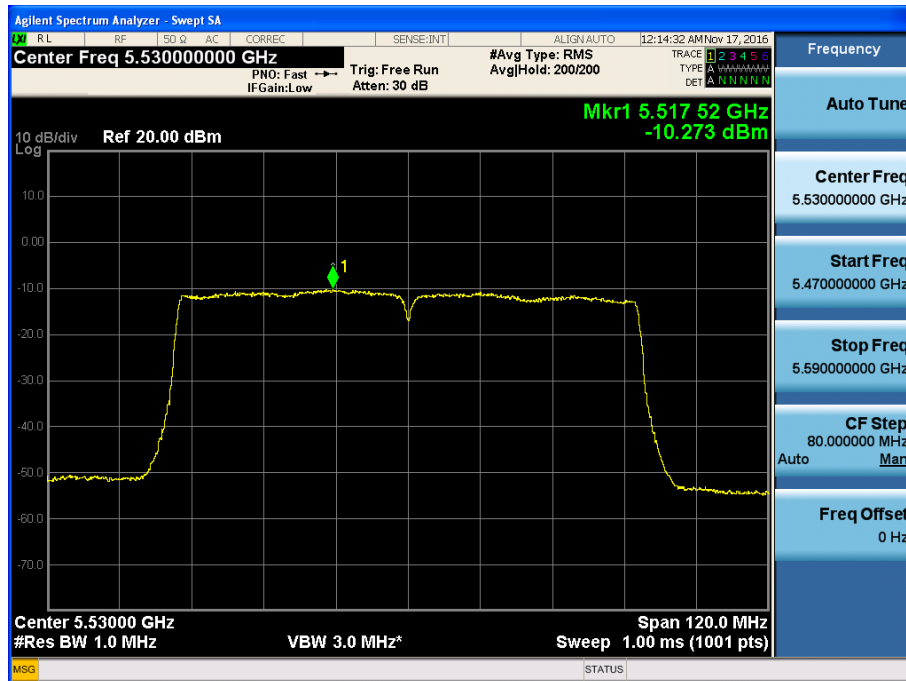
Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.58



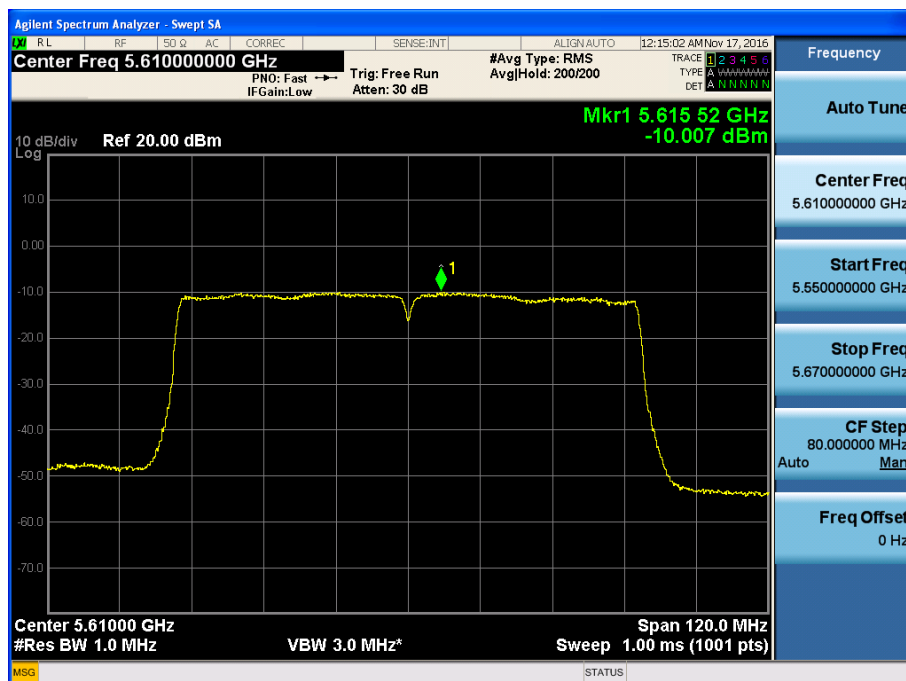
Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.106



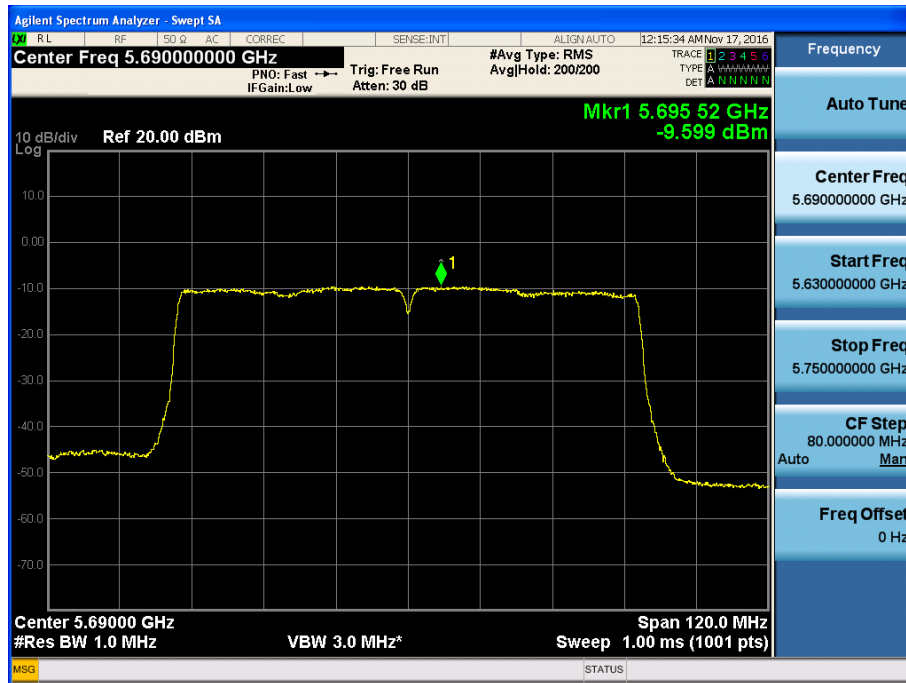
Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.122



Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.138



Maximum Power Spectral Density

Test Mode: 802.11ac VHT80 & Ch.155

