

# 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 : DRTFCC1801-0016

2. Customer

- Name : Bluebird Inc.
- Address : (Dogok-dong, SEI Tower 13,14) 39, Eonjuro30-gil, Gangnam-gu, Seoul South Korea

3. Use of Report : FCC Original Grant

4. Product Name / Model Name : Touch Mobile Computer / EF501R  
FCC ID : SS4EF501R

5. Test Method Used : KDB789033 D02v02r01

Test Specification : FCC Part 15.407 Subpart E

6. Date of Test : 2017.10.17 ~ 2017.11.03

7. Testing Environment : Refer to appended test report.

8. Test Result : Refer to the attached test result.

Affirmation	Tested by  Name : JungWoo Kim  <i>(Signature)</i>	Reviewed by  Name : Geunki Son  <i>(Signature)</i>
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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.

**2018 . 01 . 15.**

**DT&C Co., Ltd.**

If this report is required to confirmation of authenticity, please contact to [report@dtnc.net](mailto:report@dtnc.net)

## Test Report Version

Test Report No.	Date	Description
DRTFCC1801-0016	Jan. 15, 2018	Initial issue

## CONTENTS

<b>1. EUT DESCRIPTION.....</b>	<b>4</b>
<b>2. Information about test items .....</b>	<b>5</b>
2.1 Transmitting configuration of EUT .....	5
2.2 Tested Channel Information.....	5
2.3 Testing Environment.....	6
2.4 EMI Suppression Device(s)/Modifications .....	6
2.5 Measurement Uncertainty .....	6
<b>3. SUMMARY OF TESTS.....</b>	<b>7</b>
<b>4. TEST METHODOLOGY.....</b>	<b>8</b>
4.1 EUT configuration.....	8
4.2 EUT exercise.....	8
4.3 General test procedures .....	8
4.4 Description of test modes .....	8
<b>5. INSTRUMENT CALIBRATION.....</b>	<b>9</b>
<b>6. FACILITIES AND ACCREDITATIONS .....</b>	<b>9</b>
6.1 Facilities .....	9
6.2 Equipment .....	9
<b>7. ANTENNA REQUIREMENTS .....</b>	<b>9</b>
<b>8. TEST RESULT .....</b>	<b>10</b>
8.1 Emission Bandwidth (26 dB Bandwidth).....	10
8.2 Minimum Emission Bandwidth (6 dB Bandwidth) .....	28
8.3 Maximum Conducted Output Power.....	35
8.4 Maximum Power Spectral Density.....	40
8.5 Frequency Stability.....	66
8.6 Radiated Spurious Emission Measurements .....	68
8.7 AC Conducted Emissions.....	78
<b>9. LIST OF TEST EQUIPMENT .....</b>	<b>87</b>
<b>APPENDIX I.....</b>	<b>88</b>
<b>APPENDIX II .....</b>	<b>89</b>
<b>APPENDIX III.....</b>	<b>92</b>

## 1. EUT DESCRIPTION

FCC Equipment Class	Unlicensed National Information Infrastructure (UNII)
Product	Touch Mobile Computer
Model Name	EF501R
Add Model Name	NA
Power Supply	DC 3.8 V
Modulation type	OFDM
Antenna Specification	<b>Antenna type:</b> Internal Antenna <b>Antenna gain:</b> Refer to the clause 7 in test report.

5GHz Band	Mode	Tx frequency (MHz)	Max power(dBm)
U-NII 1	802.11a	5180 ~ 5240	<b>11.92</b>
	802.11n(HT20)	5180 ~ 5240	11.76
	802.11ac(VHT20)	5180 ~ 5240	9.70
	802.11n(HT40)	5190 ~ 5230	11.80
	802.11ac(VHT40)	5190 ~ 5230	9.60
	802.11ac(VHT80)	5210	9.58
U-NII 2A	802.11a	5260 ~ 5320	<b>11.96</b>
	802.11n(HT20)	5260 ~ 5320	11.65
	802.11ac(VHT20)	5260 ~ 5320	9.59
	802.11n(HT40)	5270 ~ 5310	11.67
	802.11ac(VHT40)	5270 ~ 5310	9.67
	802.11ac(VHT80)	5290	9.50
U-NII 2C	802.11a	5500 ~ 5580	<b>11.87</b>
	802.11n(HT20)	5500 ~ 5580	11.65
	802.11ac(VHT20)	5500 ~ 5580	9.67
	802.11n(HT40)	5510 ~ 5550	11.44
	802.11ac(VHT40)	5510 ~ 5550	9.69
	802.11ac(VHT80)	5530	9.49
	802.11a	5660 ~ 5700	<b>11.85</b>
	802.11n(HT20)	5660 ~ 5700	11.49
	802.11ac(VHT20)	5660 ~ 5700	9.67
	802.11n(HT40)	5670	11.62
U-NII 3	802.11ac(VHT40)	5670	9.65
	802.11a	5745 ~ 5825	<b>11.78</b>
	802.11n(HT20)	5745 ~ 5825	11.37
	802.11ac(VHT20)	5745 ~ 5825	9.88
	802.11n(HT40)	5755 ~ 5795	11.48
	802.11ac(VHT40)	5755 ~ 5795	9.56
U-NII 3	802.11ac(VHT80)	5775	9.54

## 2. Information about test items

### 2.1 Transmitting configuration of EUT

Mode	Data rate
802.11a	6~54Mbps
802.11n(HT20)	MCS 0 ~ 7
802.11ac(VHT20)	MCS 0 ~ 8
802.11n(HT40)	MCS 0 ~ 7
802.11ac(VHT40)	MCS 0 ~ 9
802.11ac(VHT80)	MCS 0 ~ 9

### 2.2 Tested Channel Information

5GHz Band	802.11a/n(HT20)		802.11n/ac(VHT40)		802.11n/ac(VHT80)	
	Channel	Frequency [MHz]	Channel	Frequency [MHz]	Channel	Frequency [MHz]
U-NII 1	36	5180	38	5190	42	5210
	40	5200	-	-	-	-
	48	5240	46	5230	-	-
U-NII 2A	52	5260	54	5270	58	5290
	60	5300	-	-	-	-
	64	5320	62	5310	-	-
U-NII 2C	100	5500	102	5510	106	5530
	116	5580	110	5550	-	-
	140	5700	134	5670	-	-
U-NII 3	149	5745	151	5755	155	5775
	157	5785	-	-	-	-
	165	5825	159	5795	-	-

## 2.3 Testing Environment

Temperature	: 20 °C ~ 24 °C
Relative humidity content	: 39 % ~ 44 % R.H.
Details of power supply	: DC 3.8 V

## 2.4 EMI Suppression Device(s)/Modifications

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

## 2.5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C 63.4-2014 and ANSI C 63.10-2013. All measurement uncertainty values are shown with a coverage factor of  $k = 2$  to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	± 0.7 dB (The confidence level is about 95 %, k = 2)
AC conducted emission	± 2.4 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)

### 3. SUMMARY OF TESTS

FCC Part Section(s)	Parameter	Limit	Test Condition	Status Note 1
<b>I. Transmitter Mode (TX)</b>				
15.407(a)	Emission Bandwidth (26 dB Bandwidth)	N/A		C
15.407(e)	Minimum Emission Bandwidth (6 dB Bandwidth)	> 500 kHz in 5725 ~ 5850 MHz		C
15.407(a)	Maximum Conducted Output Power	5150 ~ 5250 MHz : < 23.97 dBm 5250 ~ 5350 & 5470 ~ 5725 MHz : < 250 mW or < 11 + 10 log10(B) dBm, whichever power is less. (B is the 26dB BW.) 5725 ~ 5850 MHz : < 30 dBm	Conducted	C
15.407(a)	Peak Power Spectral Density	5150 ~ 5250 MHz : 11 dBm/MHz 5250 ~ 5350 MHz : 11 dBm/MHz 5470 ~ 5725 MHz : 11 dBm/MHz 5725 ~ 5850 MHz : 30 dBm/500kHz		C
15.407(g)	Frequency Stability	N/A		C
15.407(h)	Dynamic Frequency Selection	FCC 15.407(h)		C Note 2
15.407(b)	Undesirable Emissions	5150 ~ 5725 MHz: < -27 dBm/MHz EIRP 5725 ~ 5850 MHz: < -27 dBm/MHz or < 10 dBm/MHz or 15.6 dBm/MHz < 27dBm/MHz EIRP	Radiated	C Note 3
15.205 15.209 15.407(b)	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 3
15.207	AC Conducted Emissions	FCC 15.207	AC Line Conducted	C
15.203	Antenna Requirements	FCC 15.203	-	C

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

Note 2: Refer to the DFS test report.

Note 3: This test item was performed in each axis and the worst case data was reported.

Note 4: The sample was tested according to the following specification: **KDB789033 D02v02r01**

## 4. TEST METHODOLOGY

Generally the tests were performed according to the **KDB789033 D02v02r01**. 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 E.

### 4.3 General test procedures

#### Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB789033 D02v02r01. 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 D02v02r01. 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 D02v02r01.

The EUT is placed on a non-conductive table, which is 0.8 m above ground plane. For emission measurements above 1 GHz, the table height is 1.5 m. 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

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode with maximum fixed duty cycle.

## 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 equipment , which is traceable to recognized national standards.

## 6. FACILITIES AND ACCREDITATIONS

### 6.1 Facilities

#### DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The site is constructed in conformance with the requirements.

- FCC MRA Accredited Test Firm No. : KR0034

[www.dtnc.net](http://www.dtnc.net)

Telephone	:	+ 82-31-321-2664
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FAX	:	+ 82-31-321-1664
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### 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

### 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 is attached on the main PCB using the special spring tension. (Refer to Internal Photo file.) Therefore this E.U.T Complies with the requirement of §15.203**

**Directional antenna gain:**

Bands	ANT [dBi]
U-NII 1	1.159
U-NII 2A	1.765
U-NII 2C	0.678
U-NII 3	-2.412

## 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 D02v02r01**.

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	21.57
		40	5200	21.16
		48	5240	21.61
	U-NII 2A	52	5260	22.02
		60	5300	21.71
		64	5320	21.41
	U-NII 2C	100	5500	21.39
		116	5580	21.29
		140	5700	21.51
802.11n (HT20)	U-NII 1	36	5180	22.30
		40	5200	21.92
		48	5240	21.89
	U-NII 2A	52	5260	22.51
		60	5300	21.84
		64	5320	21.89
	U-NII 2C	100	5500	22.57
		116	5580	22.01
		140	5700	22.28
802.11n (HT40)	U-NII 1	38	5190	42.22
		46	5230	43.78
	U-NII 2A	54	5270	42.93
		62	5310	43.28
	U-NII 2C	102	5510	43.10
		110	5550	42.87
		134	5670	42.40
802.11ac (VHT80)	U-NII 1	42	5210	83.70
		-	-	-
	U-NII 2A	58	5290	83.11
		-	-	-
	U-NII 2C	106	5530	83.55

## ■ Result Plots

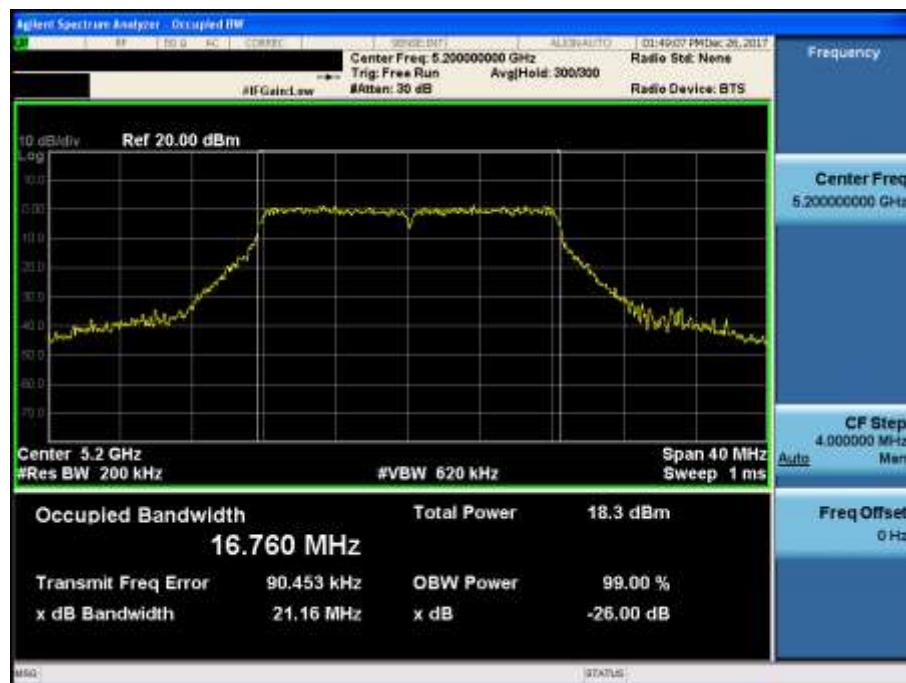
### 26 dB Bandwidth

Test Mode: 802.11a & Ch.36



### 26 dB Bandwidth

Test Mode: 802.11a & Ch.40

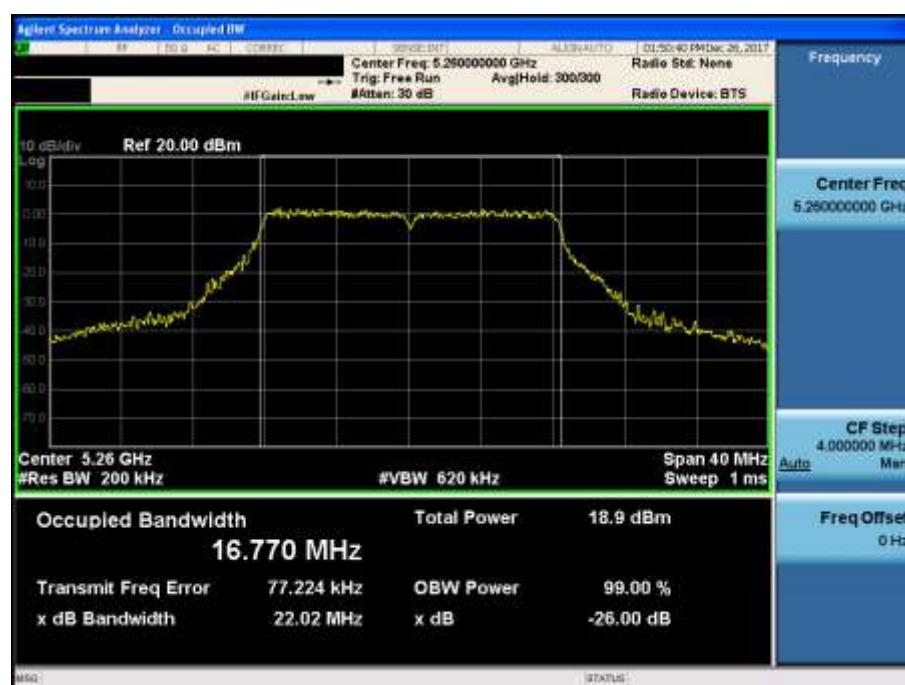


**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.48

**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.52

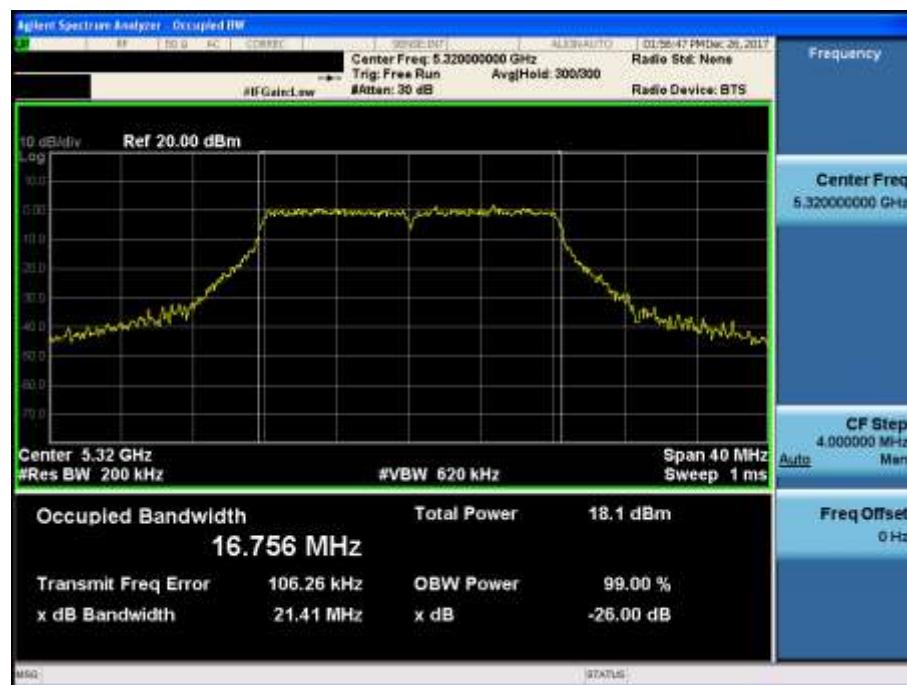


**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.60

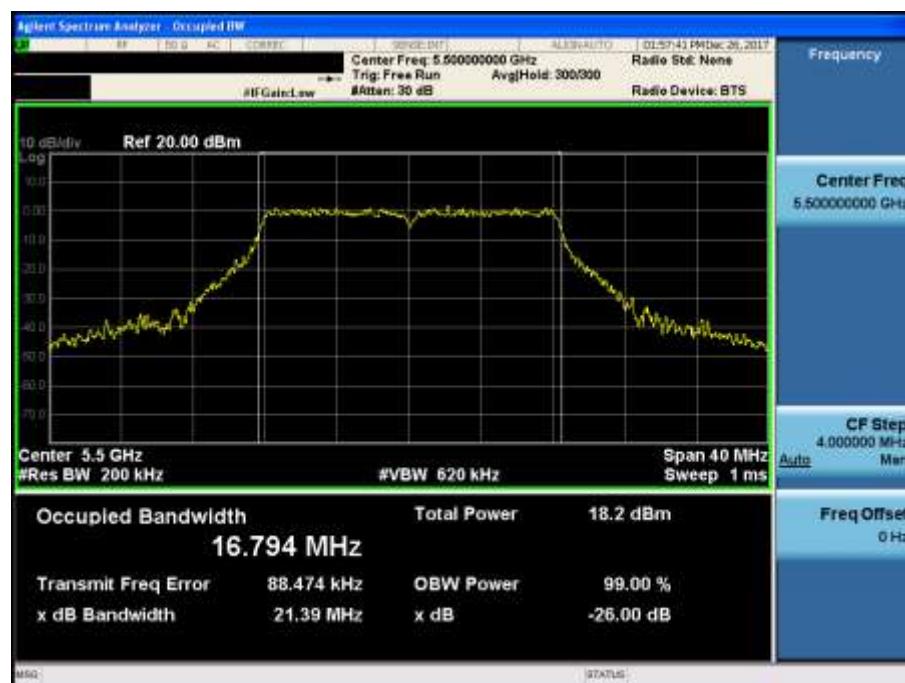
**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.64

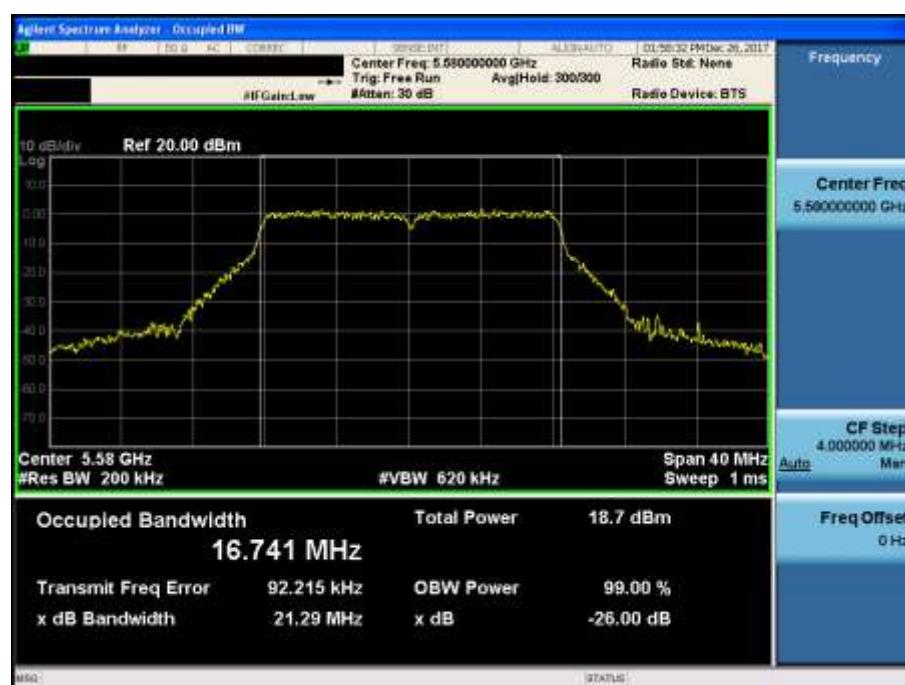


**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.100

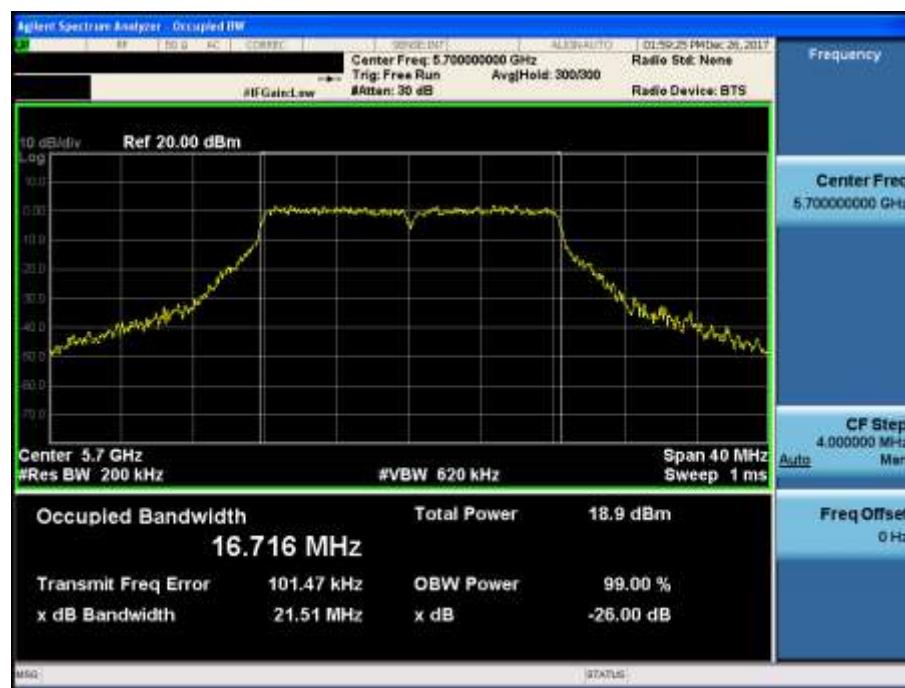
**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.116



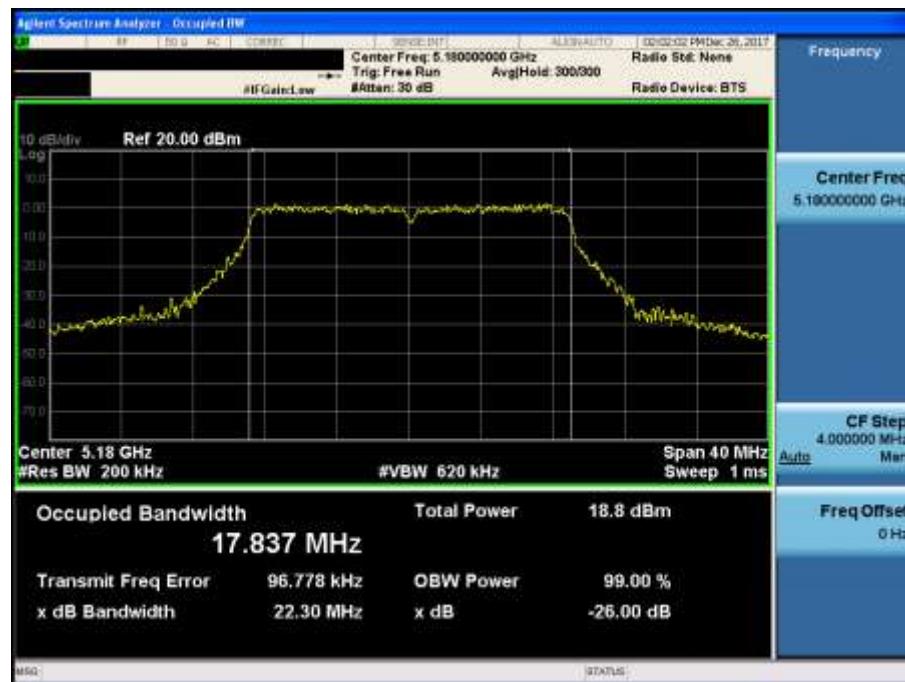
**26 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.140

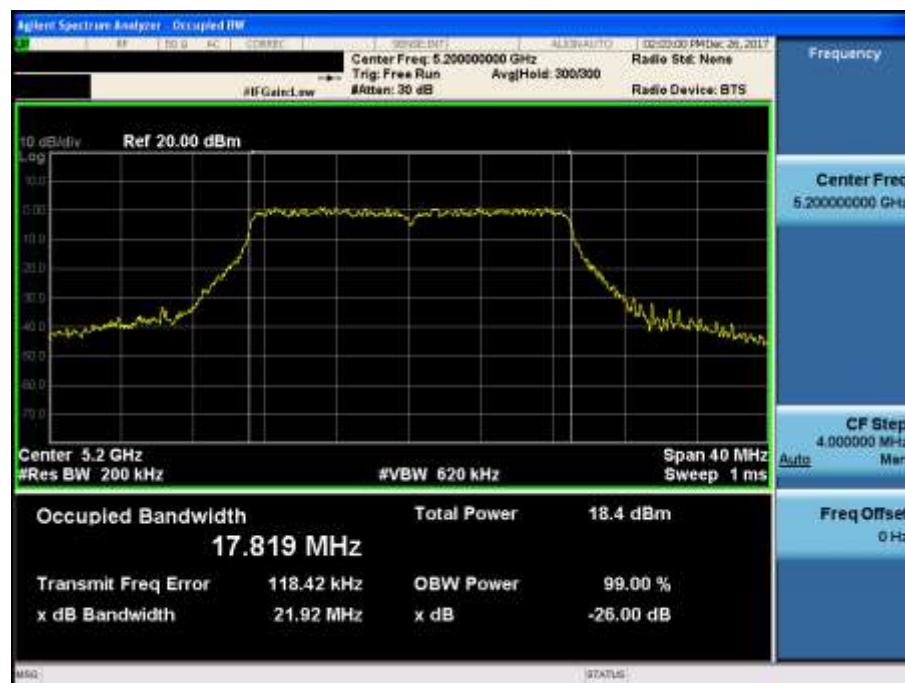


**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.36

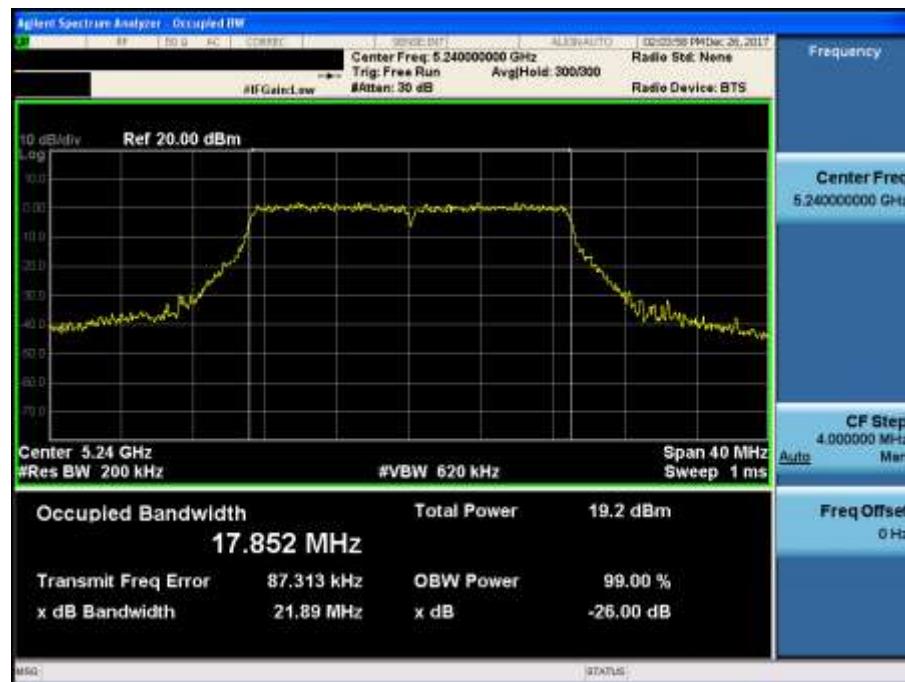
**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.40

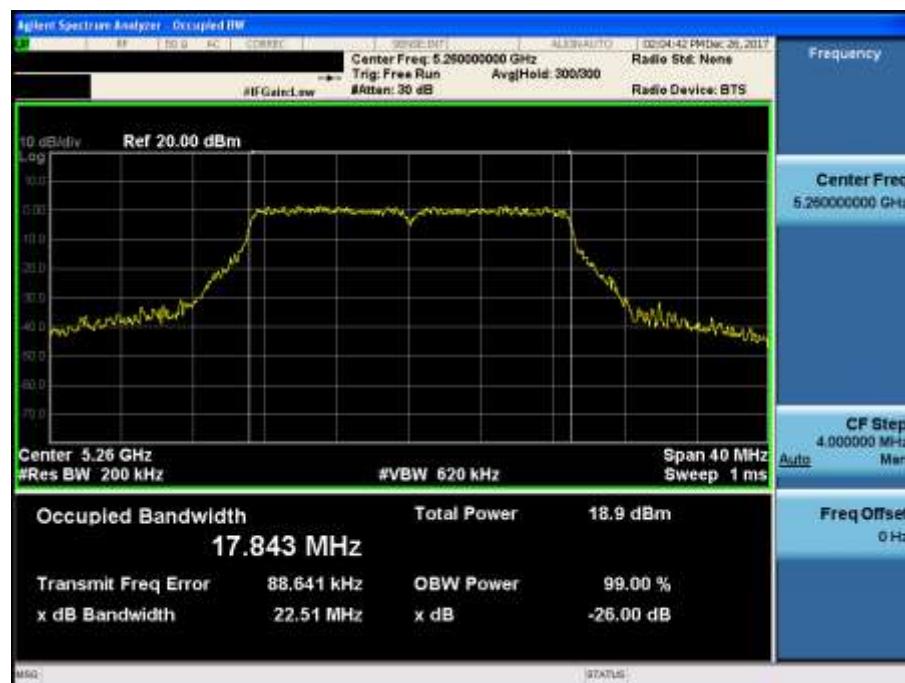


**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.48

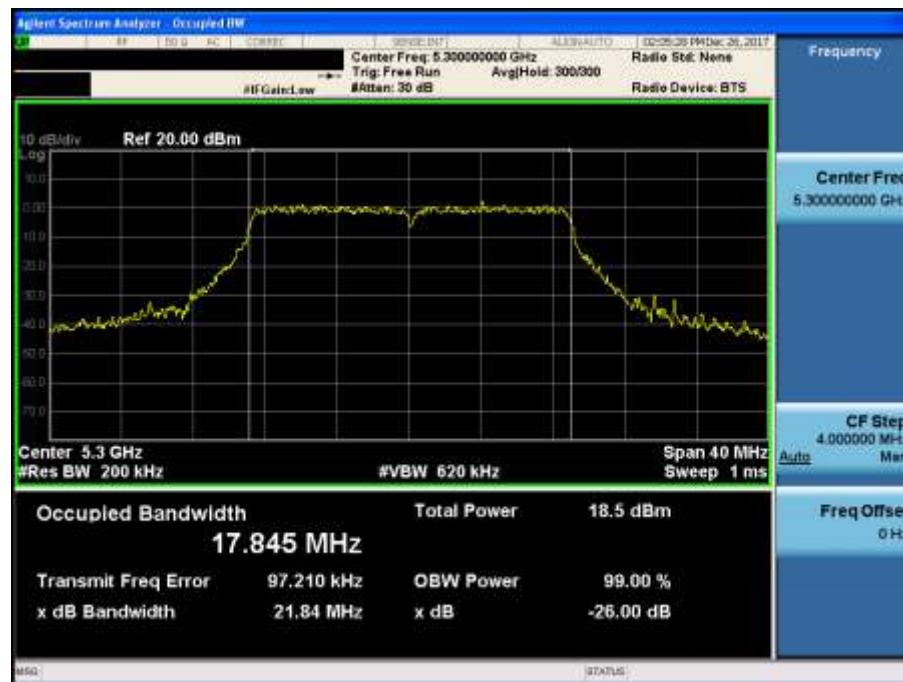
**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.52



**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.60

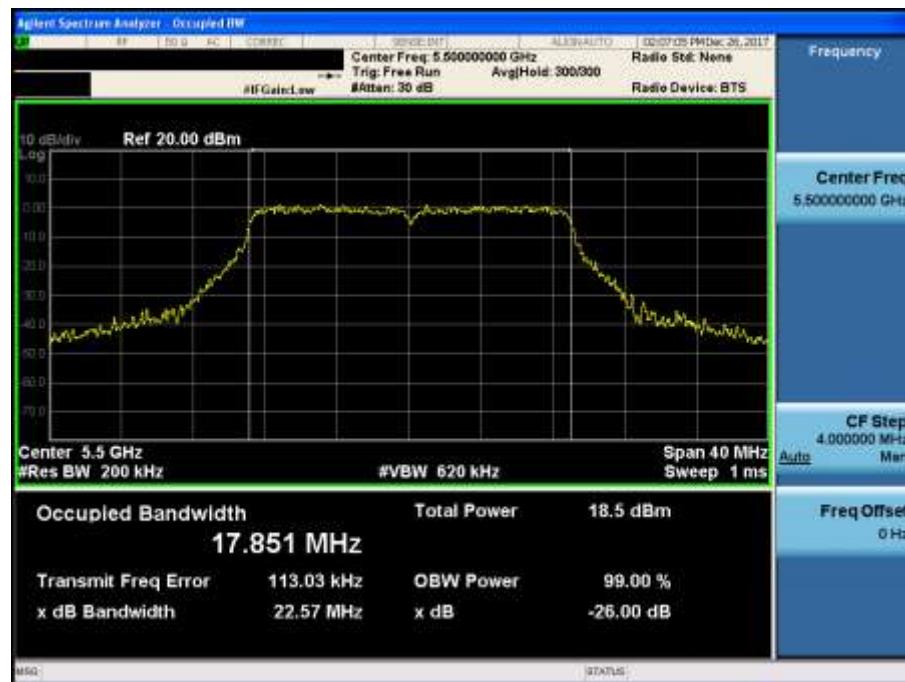
**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.64

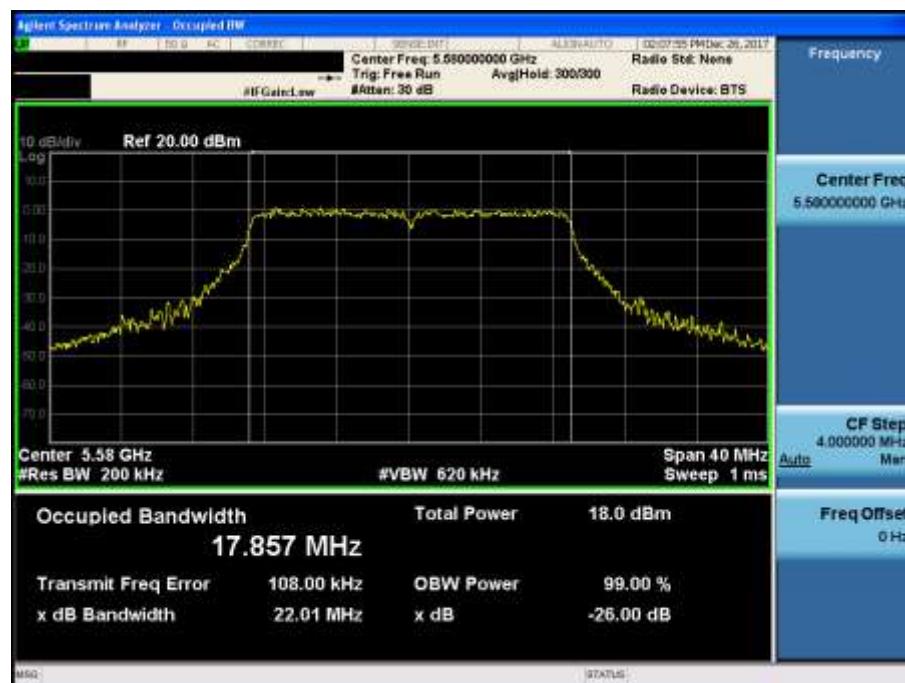


**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.100

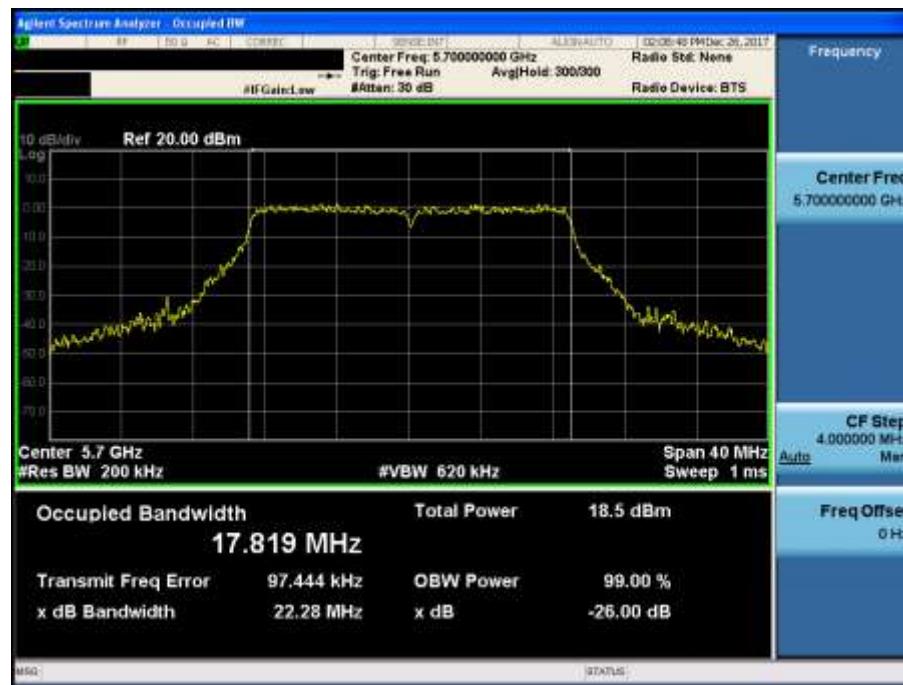
**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.116



**26 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.140



**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.38

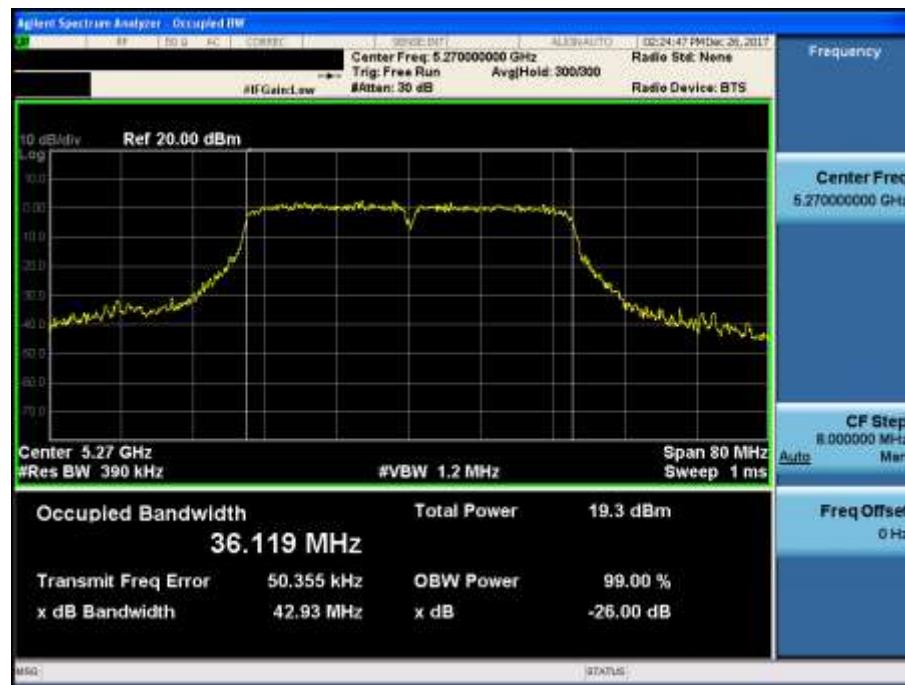
**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.46

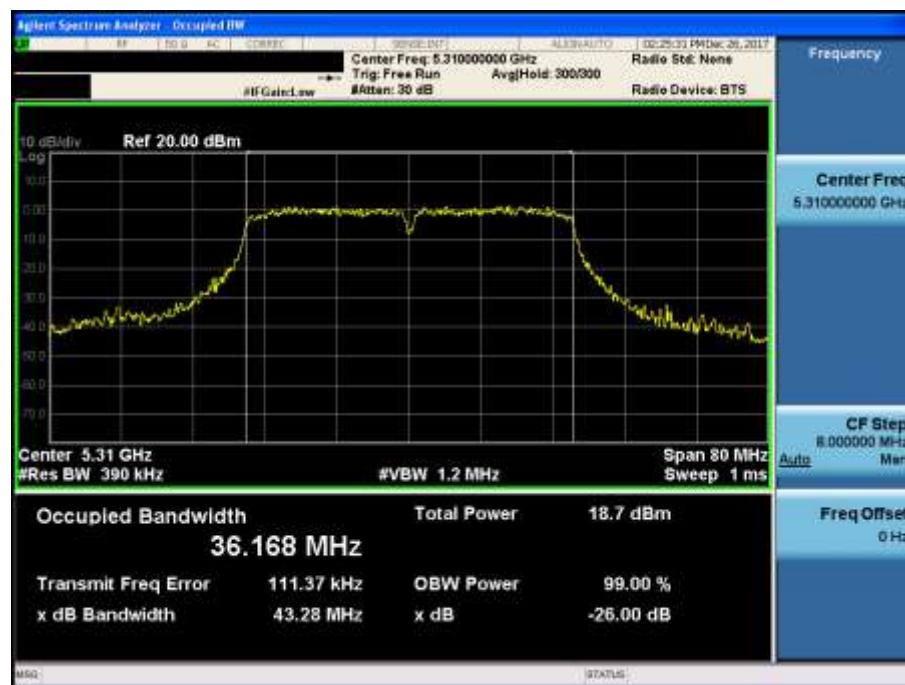


**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.54

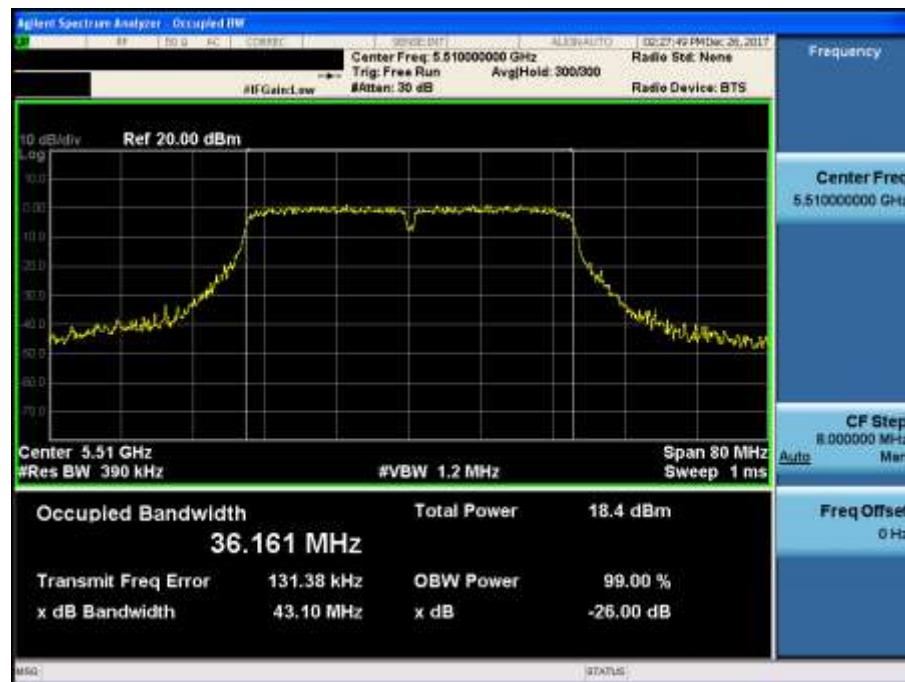
**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.62

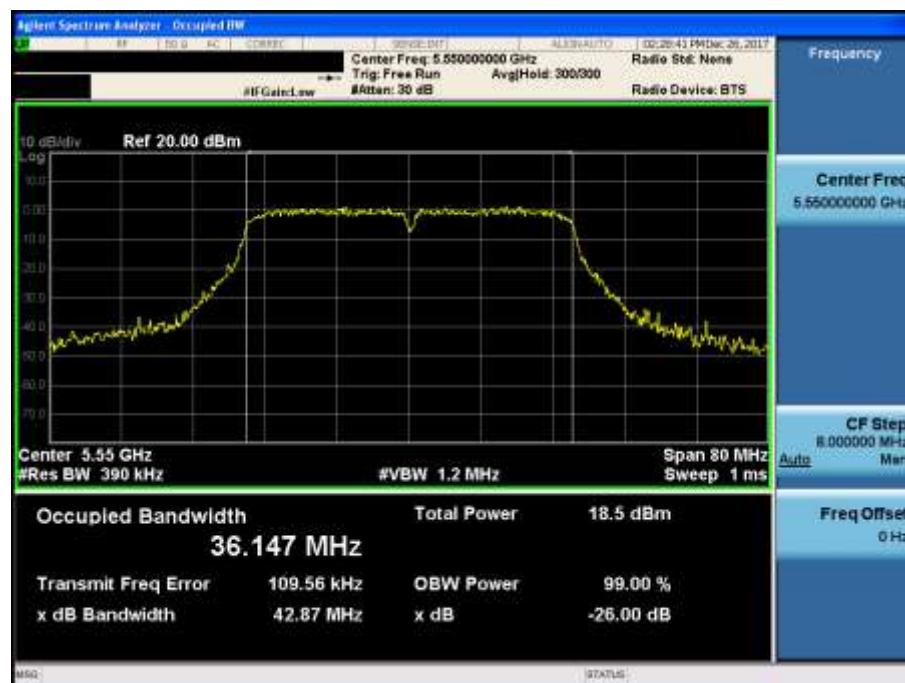


**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.102

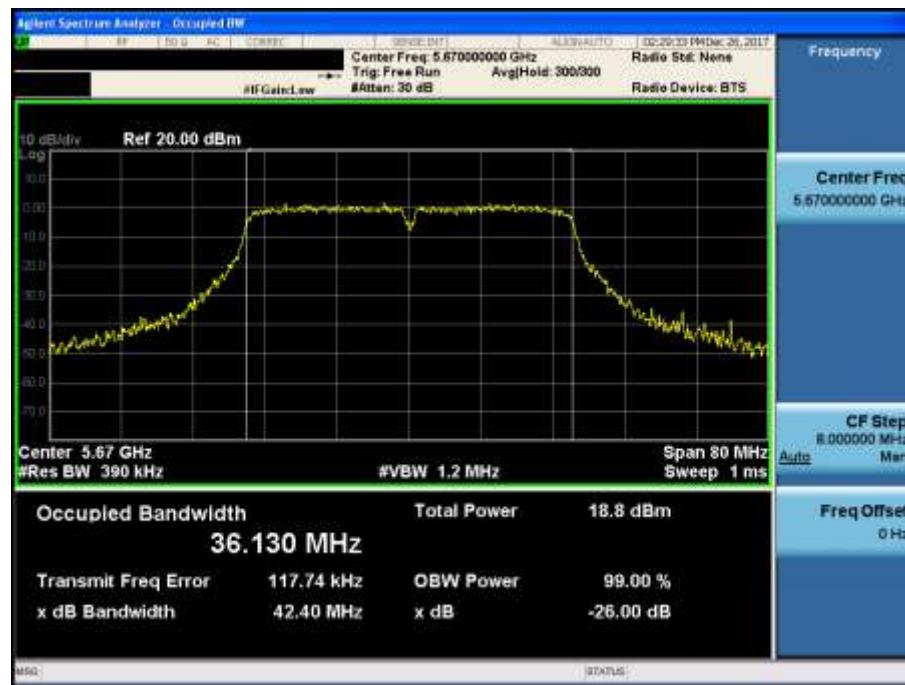
**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.110



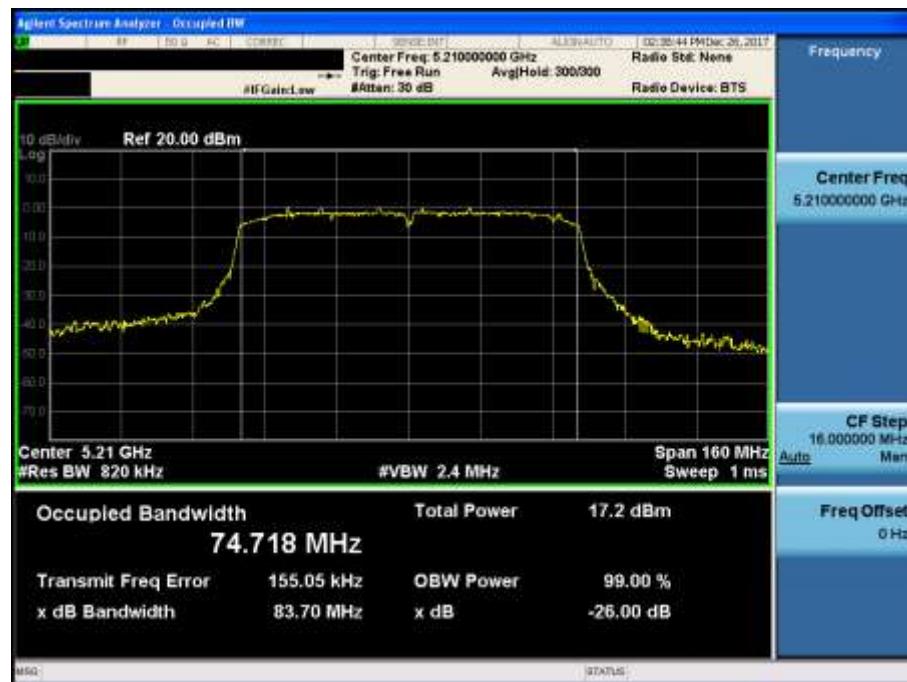
**26 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.134

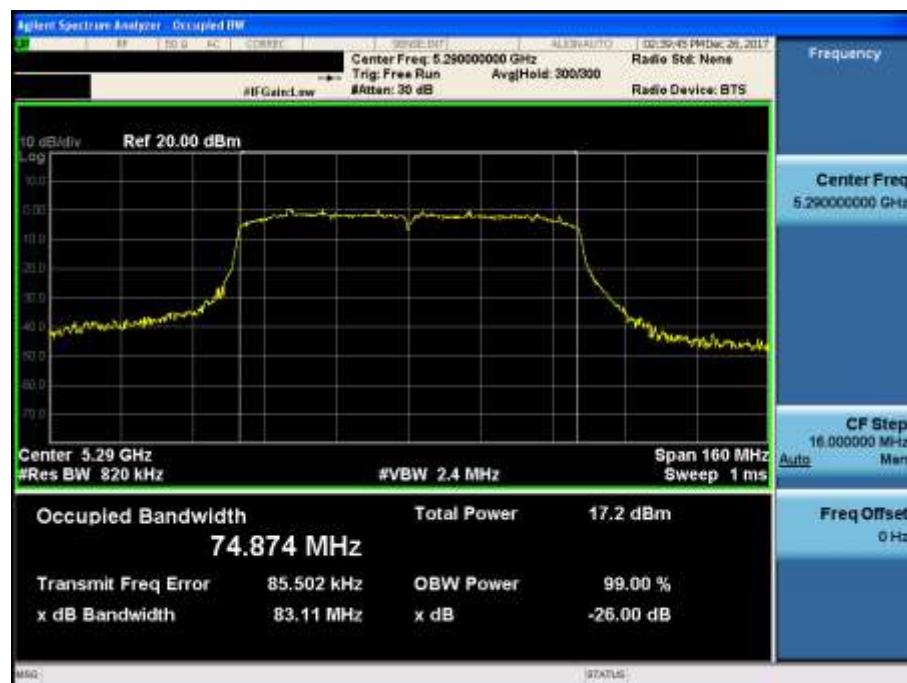


**26 dB Bandwidth**

Test Mode: 802.11ac VHT80 &amp; Ch.42

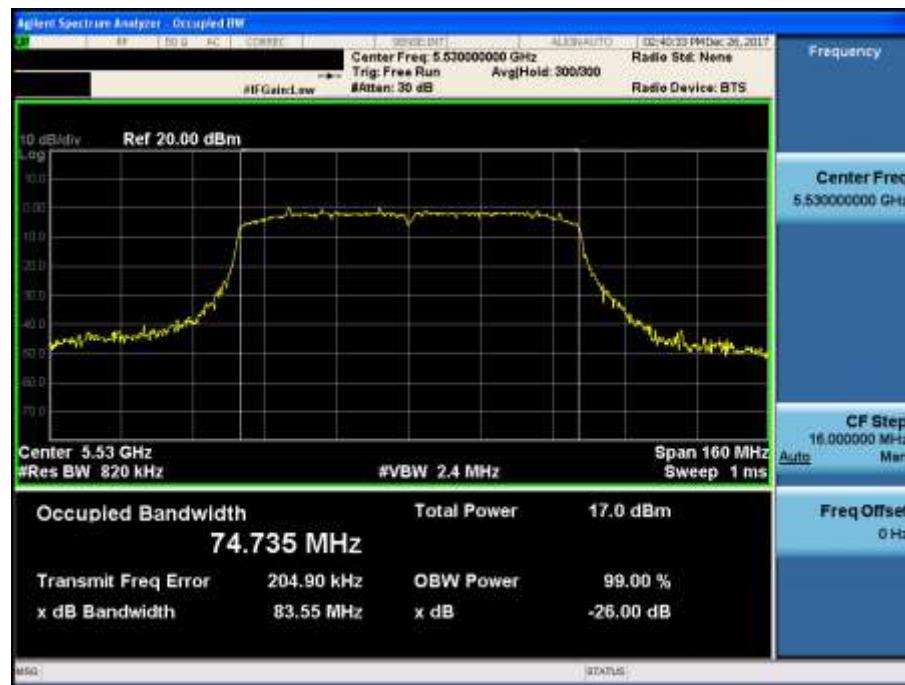
**26 dB Bandwidth**

Test Mode: 802.11ac VHT80 &amp; Ch.58



**26 dB Bandwidth**

Test Mode: 802.11ac VHT80 &amp; Ch.106



## 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 D02v02r01**.

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.

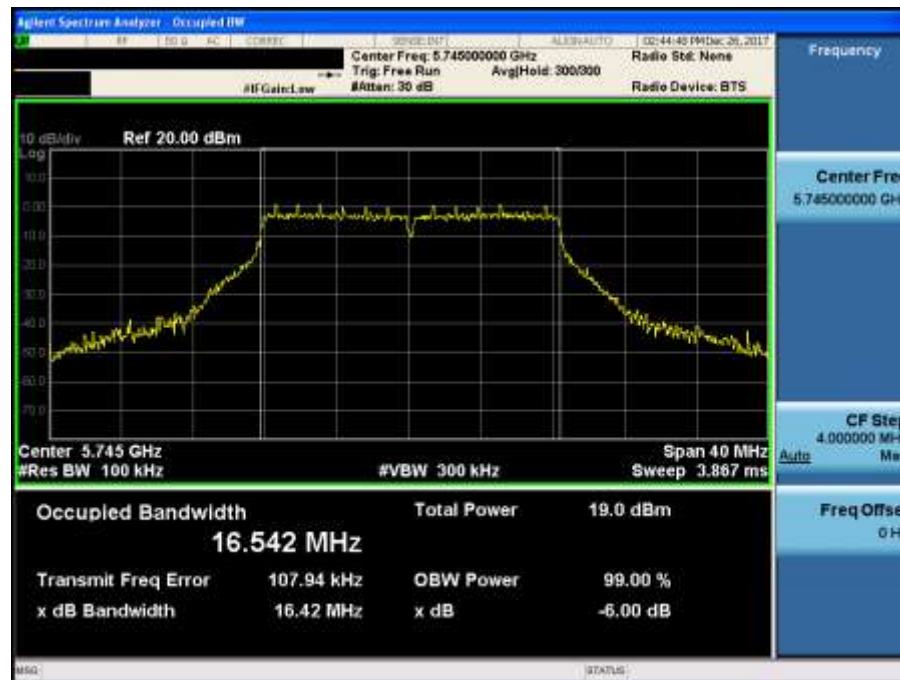
### TEST RESULTS: **Comply**

Mode	Band	Channel	Frequency [MHz]	Test Result [MHz]
802.11a	U-NII 3	149	5745	16.42
		157	5785	16.43
		165	5825	16.42
802.11n (HT20)	U-NII 3	149	5745	17.62
		157	5785	17.63
		165	5825	17.68
802.11 n (HT40)	U-NII 3	151	5755	35.24
		159	5795	35.52
802.11ac (VHT80)	U-NII 3	155	5775	74.02

## □ RESULT PLOTS

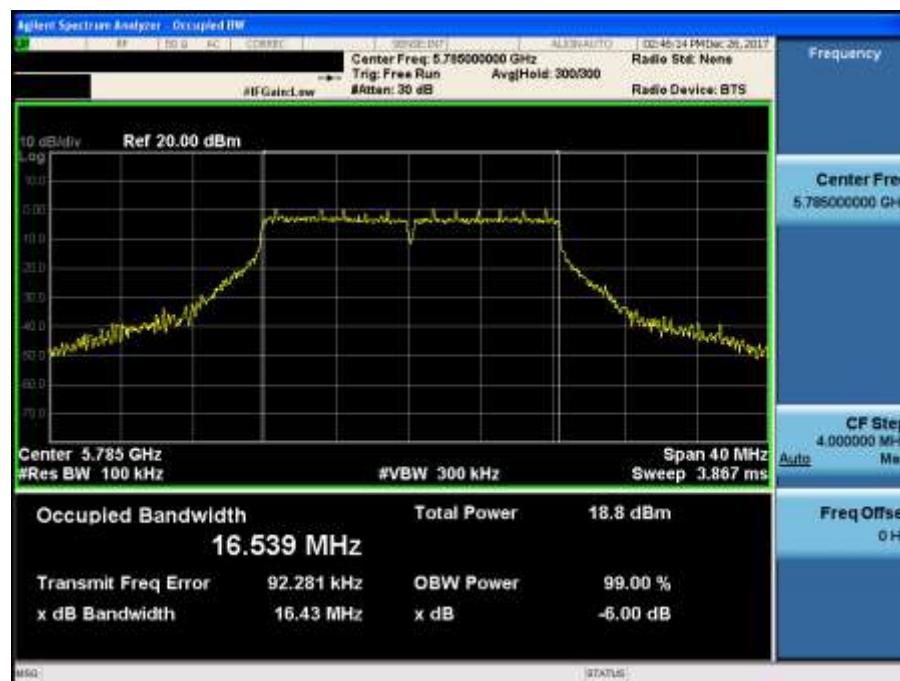
### 6 dB Bandwidth

Test Mode: 802.11a & Ch.149



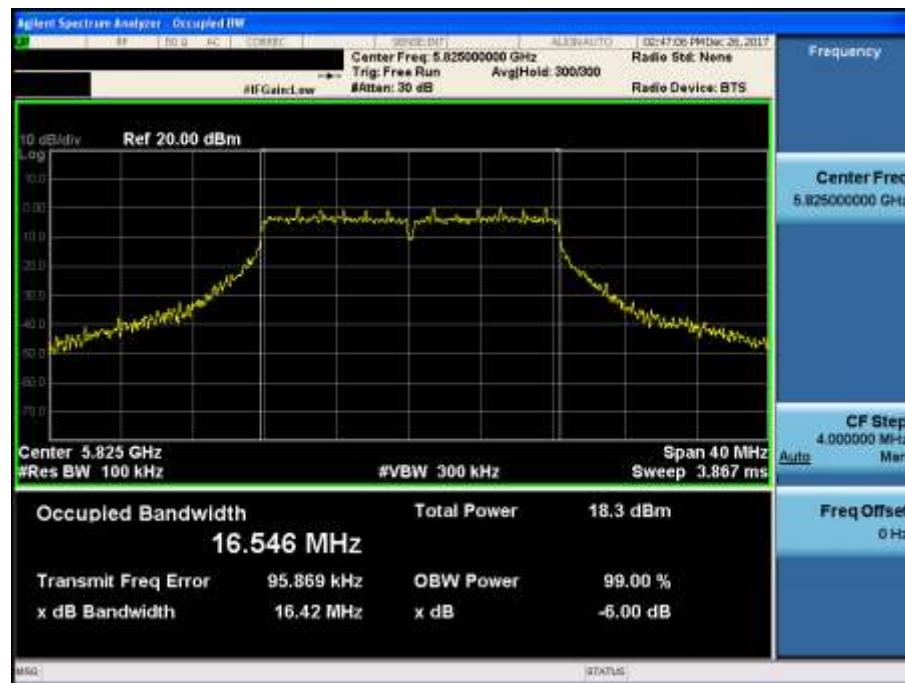
### 6 dB Bandwidth

Test Mode: 802.11a & Ch.157



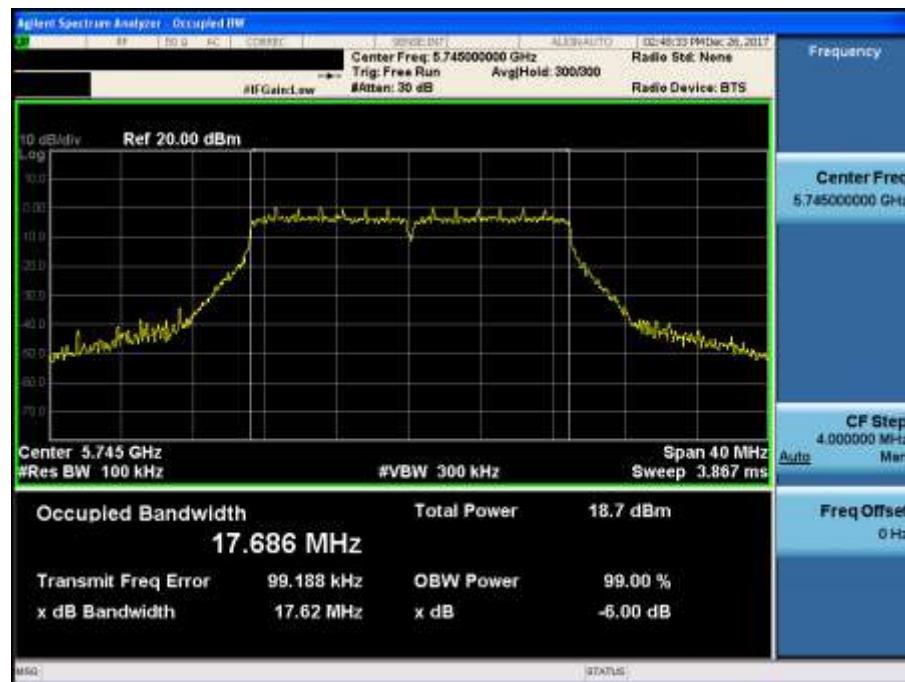
**6 dB Bandwidth**

Test Mode: 802.11a &amp; Ch.165

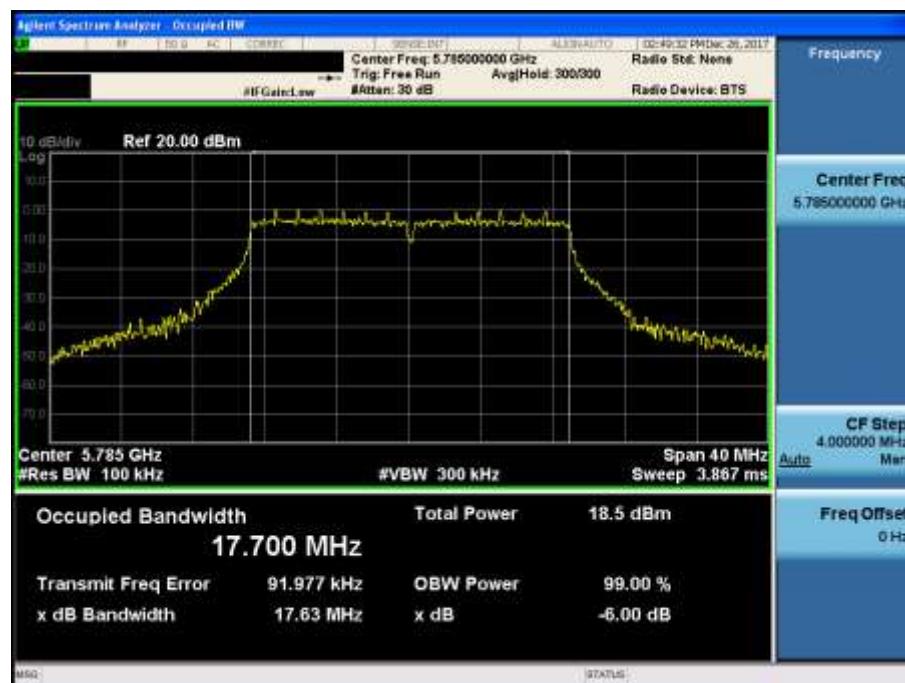


**6 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.149

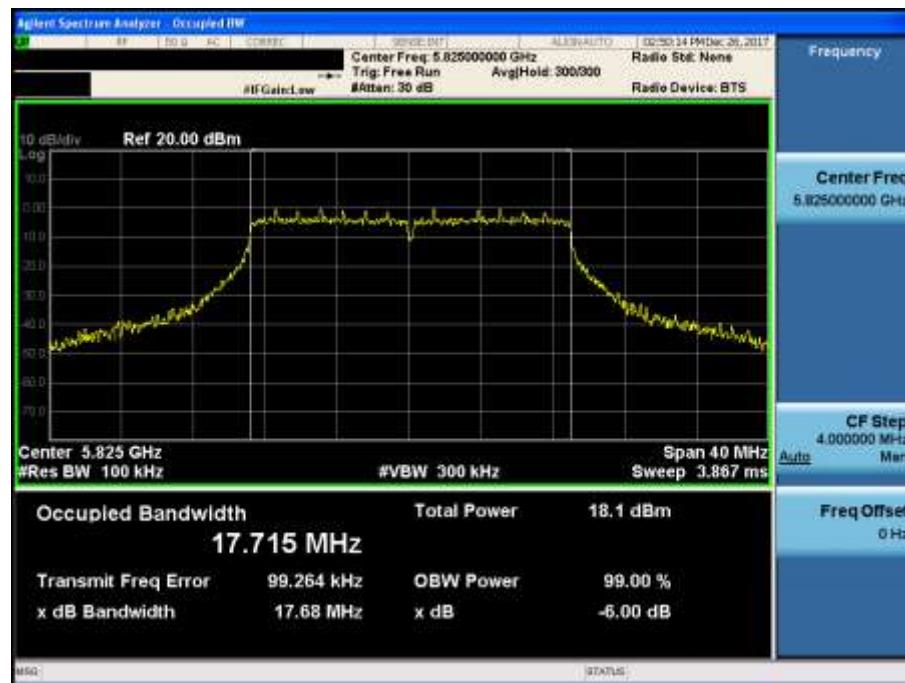
**6 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.157



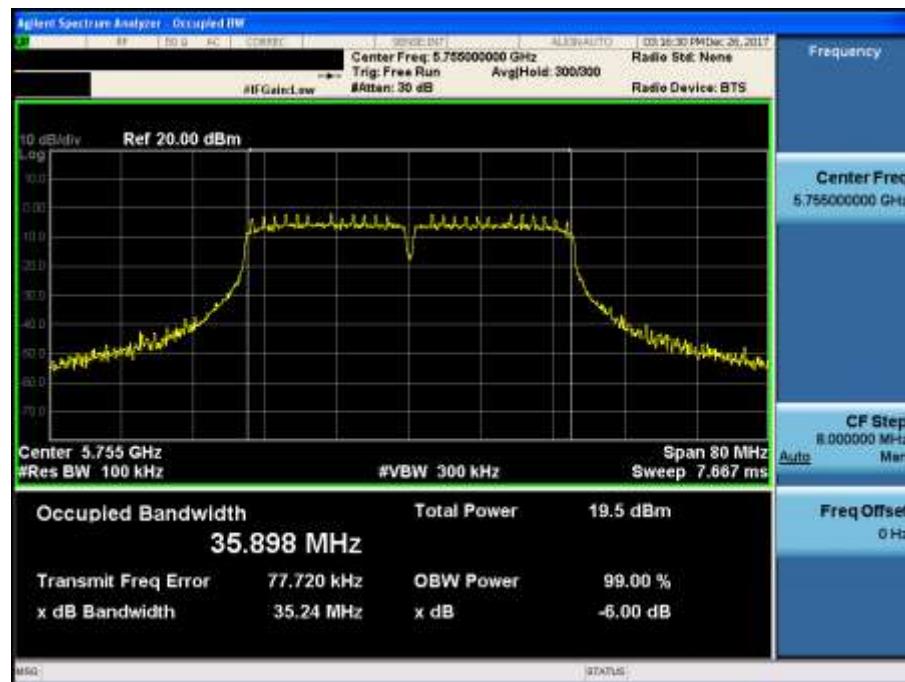
**6 dB Bandwidth**

Test Mode: 802.11n HT20 &amp; Ch.165

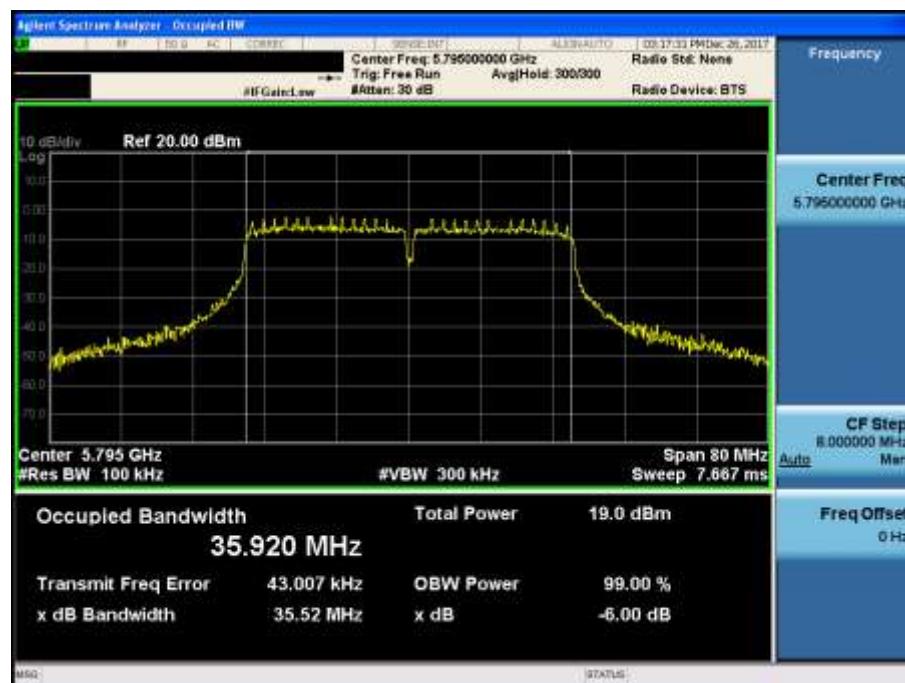


**6 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.151

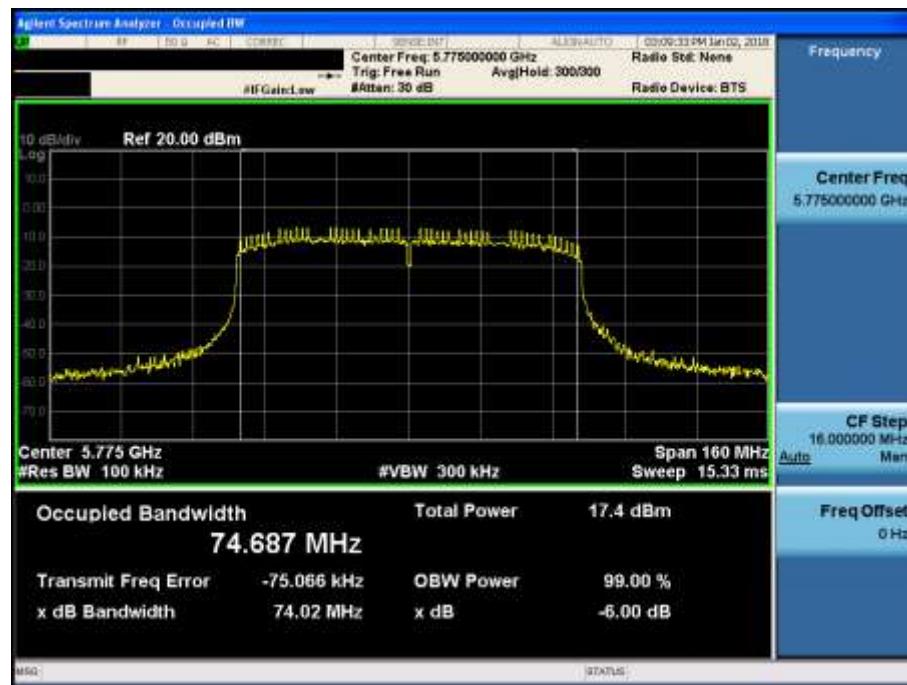
**6 dB Bandwidth**

Test Mode: 802.11n HT40 &amp; Ch.159



**6 dB Bandwidth**

Test Mode: 802.11ac VHT80 &amp; 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

Band	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case) [dBi]	Determined Limit [dBm]
U-NII 1	250	23.97	1.159	23.97

Band	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain (Worst case) [dBi]	Determined Limit [dBm]
	Least 26 dBc BW [MHz]			
U-NII 2A	250	23.97	1.765	23.97
	21.41	24.30		
U-NII 2C	250	23.97	0.678	23.97
	21.29	24.28		

Band	Power Limit [mW]	Calculated Limit [dBm]	Antenna Gain [dBi]	Determined Limit [dBm]
U-NII 3	1000	30.00	-2.412	30.00

■ Test Configuration



Method PM-G

■ Test Configuration

**Method PM-G of KDB789033 D02v02r01**

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

**Test Results: Comply****- Output Power**

Mode	CH	Freq.[MHz]	Test Result [dBm]
802.11a	36	5180	11.850
	40	5200	11.660
	48	5240	11.920
	52	5260	11.930
	60	5300	11.810
	64	5320	11.890
	100	5500	11.830
	116	5580	11.870
	140	5700	11.850
	149	5745	11.760
	157	5785	11.740
	165	5825	11.680

Mode	CH	Freq.[MHz]	Test Result [dBm]
802.11n (HT20)	36	5180	11.550
	40	5200	11.250
	48	5240	11.760
	52	5260	11.280
	60	5300	11.610
	64	5320	11.650
	100	5500	11.650
	116	5580	11.100
	140	5700	11.490
	149	5745	11.220
	157	5785	11.230
	165	5825	11.370

Mode	CH	Freq.[MHz]	Test Result[dBm]
802.11n(HT40)	38	5190	11.800
	46	5230	11.340
	54	5270	11.670
	62	5310	11.560
	102	5510	11.420
	110	5550	11.440
	134	5670	11.620
	151	5755	11.440
	159	5795	11.480

Mode	CH	Freq.[MHz]	Test Result[dBm]
802.11ac(VHT20)	36	5180	9.550
	40	5200	9.380
	48	5240	9.700
	52	5260	9.500
	60	5300	9.570
	64	5320	9.590
	100	5500	9.670
	116	5580	9.510
	140	5700	9.670
	149	5745	9.880
	157	5785	9.480
	165	5825	9.650

Mode	CH	Freq.[MHz]	Test Result[dBm]
802.11ac(VHT40)	38	5190	9.600
	46	5230	9.580
	54	5270	9.540
	62	5310	9.670
	102	5510	9.680
	110	5550	9.690
	134	5670	9.650
	151	5755	9.530
	159	5795	9.560

Mode	CH	Freq.[MHz]	Test Result[dBm]
802.11ac(VHT80)	42	5210	9.580
	58	5290	9.500
	106	5530	9.490
	155	5775	9.540

## 8.4 Maximum Power Spectral Density

### ■ 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 power spectral density shall not exceed 17 dBm in any 1 MHz band. <sup>note1</sup>

(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 1 MHz band. <sup>note1</sup>

(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 1 MHz band. <sup>note1</sup>

##### (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. <sup>note1</sup>

##### (3) For the band 5.725 - 5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. <sup>note1,note2</sup>

**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) [dBi]	Determined Limit [dBm]
U-NII 1	11	1.159	11
U-NII 2A	11	1.765	11
U-NII 2C	11	0.678	11
U-NII 3	30	-2.412	30

### ■ Test Configuration

Refer to the APPENDIX I.

## ■ Test procedure

Maximum Power Spectral Density is measured using Measurement Procedure **of KDB789033 D02v02r01**

- 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  $10 \log(500 \text{ kHz} / \text{RBW})$  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  $10 \log(1 \text{ MHz} / \text{RBW})$  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.

**Test results: Comply**

- Power spectral density: Single

Mode	Channel	Frequency [MHz]	Reading [dBm]	T.F <small>Note 1</small> [dB]	Test Result [dBm]
802.11a	36	5180	0.57	0.76	1.33
	40	5200	0.13		0.89
	48	5240	1.28		2.04
	52	5260	1.14		1.90
	60	5300	-0.03		0.73
	64	5320	0.10		0.86
	100	5500	0.12		0.88
	116	5580	0.53		1.29
	140	5700	0.82		1.58
	149	5745	-2.43		-1.67
	157	5785	-2.46		-1.70
	165	5825	-3.23		-2.47
802.11n (HT20)	36	5180	0.45	0.81	1.26
	40	5200	-0.21		0.60
	48	5240	0.55		1.36
	52	5260	0.69		1.50
	60	5300	-0.02		0.79
	64	5320	0.11		0.92
	100	5500	-0.09		0.72
	116	5580	-0.40		0.41
	140	5700	-0.03		0.78
	149	5745	-3.29		-2.48
	157	5785	-3.43		-2.62
	165	5825	-3.81		-3.00
802.11n (HT40)	38	5190	-2.72	1.50	-1.22
	46	5230	-2.79		-1.29
	54	5270	-2.20		-0.70
	62	5310	-3.05		-1.55
	102	5510	-3.62		-2.12
	110	5550	-3.48		-1.98
	134	5670	-3.21		-1.71
	151	5755	-5.98		-4.48
	159	5795	-6.33		-4.83
802.11ac (VHT80)	42	5210	-9.24	2.57	-6.67
	58	5290	-9.30		-6.73
	106	5530	-9.24		-6.67
	155	5775	-12.09		-9.52
	-	-	-		-

Note 1: "U-NII 1, 2A, 2C, 3 [T.F] = DCCF"

For DCCF(Duty Cycle Correction Factor) please refer to appendix II.

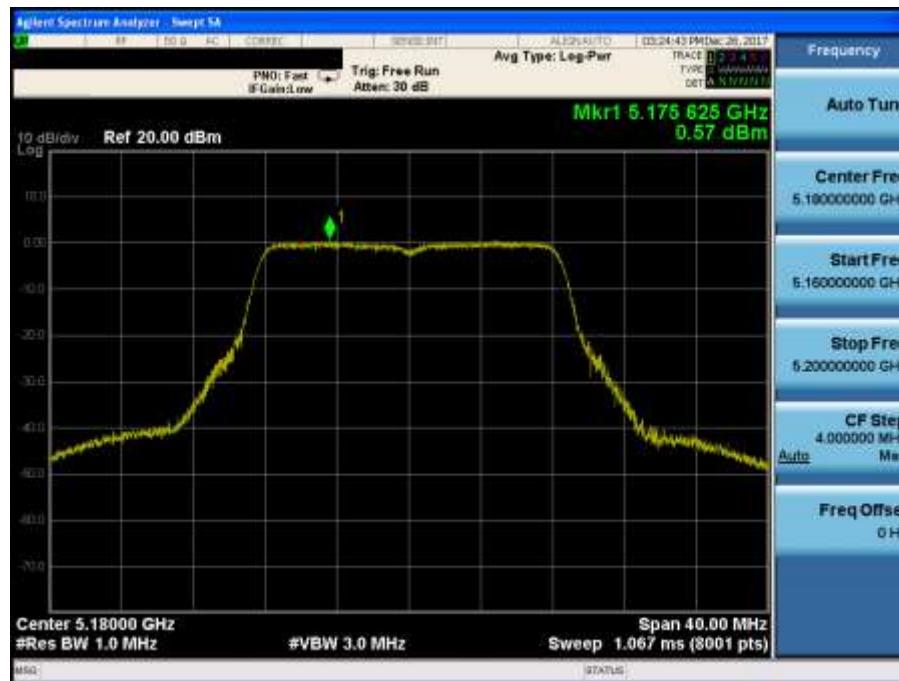
Note 2: Test Result = Measurement Data + T.F

## □ RESULT PLOTS

### - Power spectral density

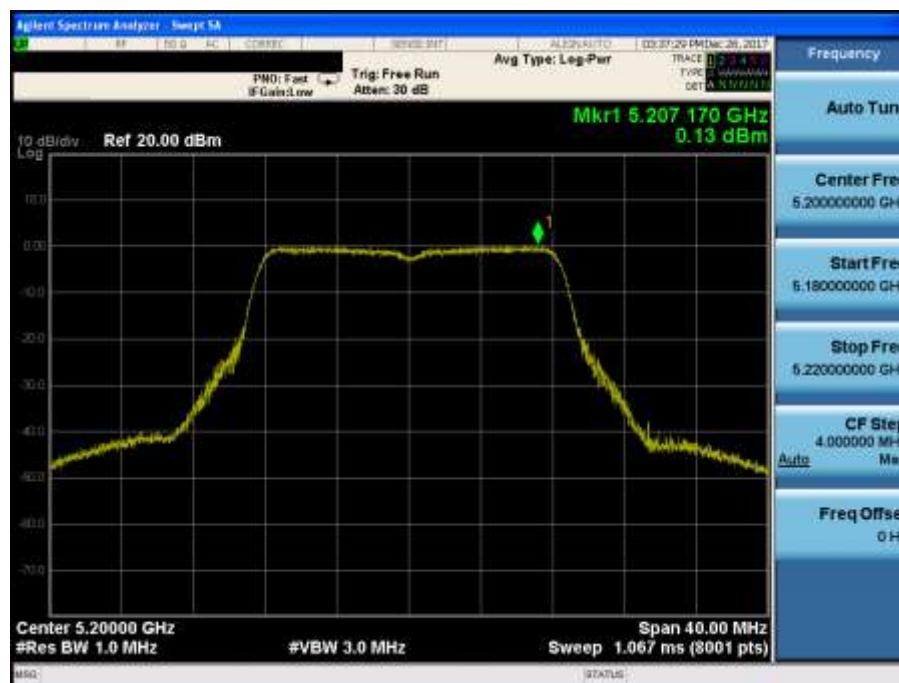
#### Maximum Power Spectral Density

Test Mode: 802.11a & Ch.36



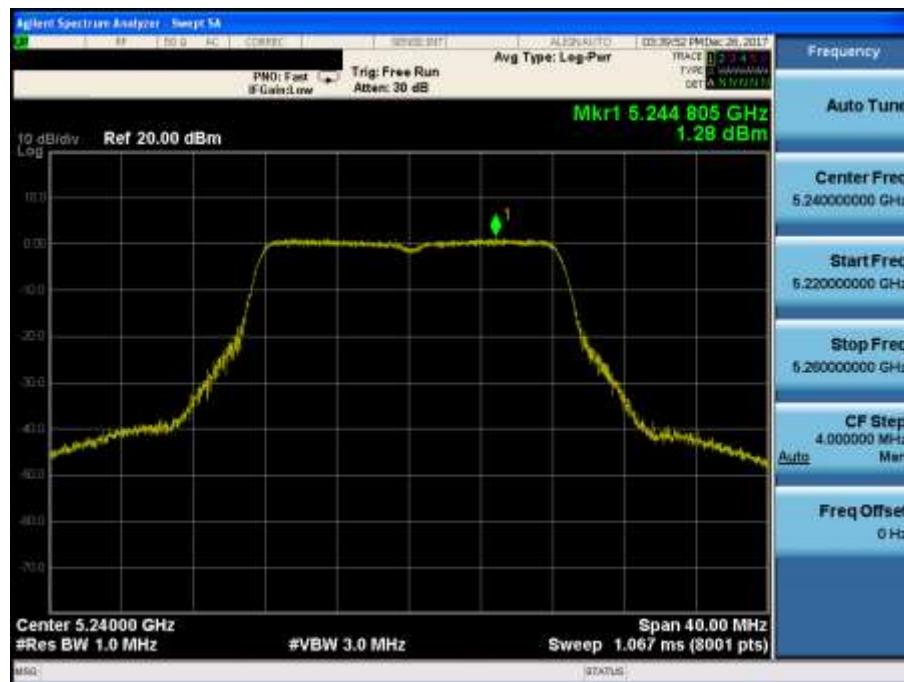
#### Maximum Power Spectral Density

Test Mode: 802.11a & Ch.40



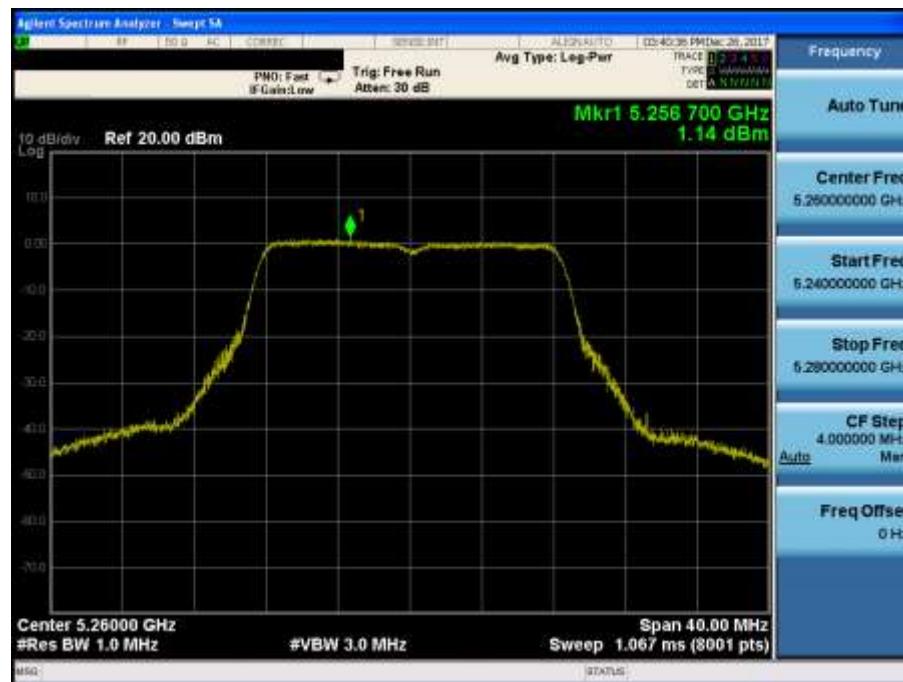
## Maximum Power Spectral Density

Test Mode: 802.11a &amp; Ch.48

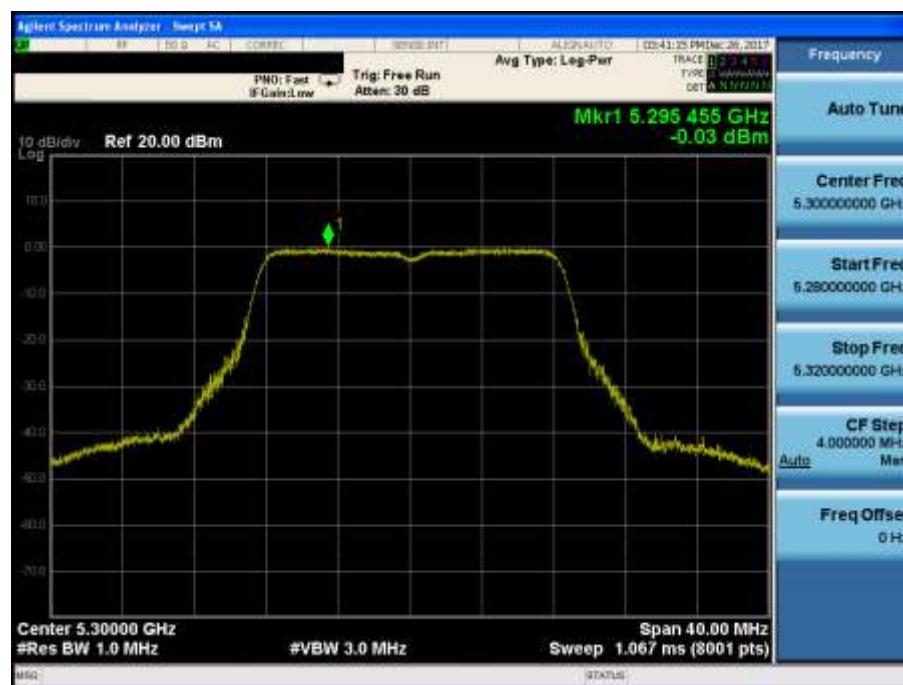


**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.52

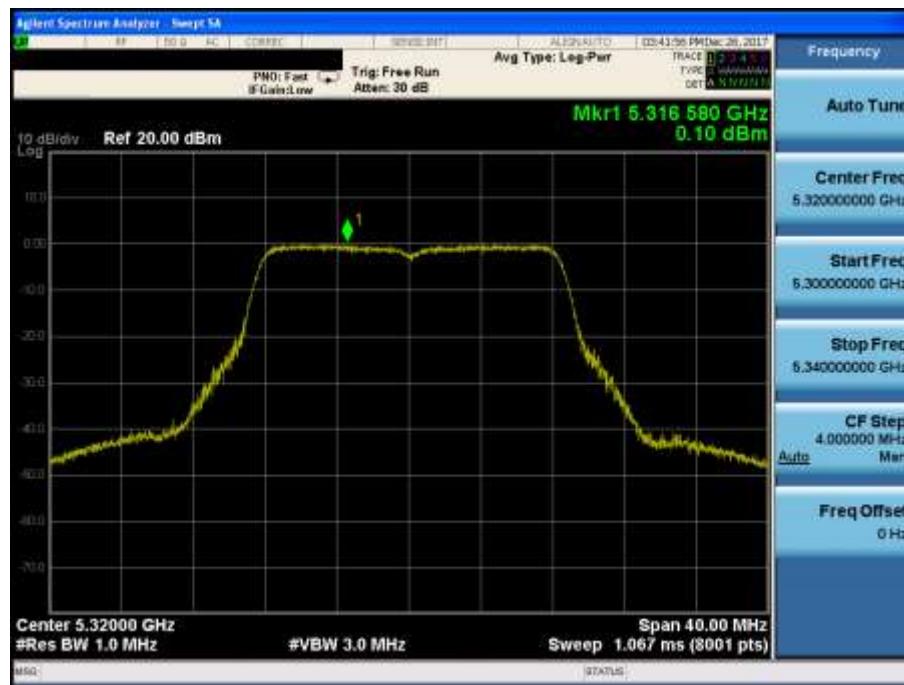
**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.60



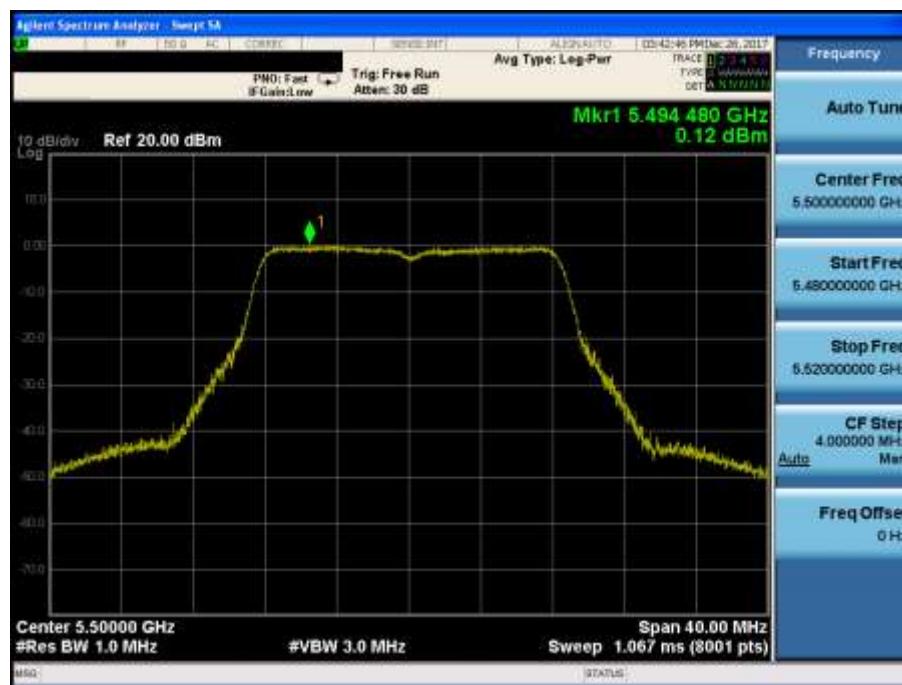
## Maximum Power Spectral Density

Test Mode: 802.11a &amp; Ch.64

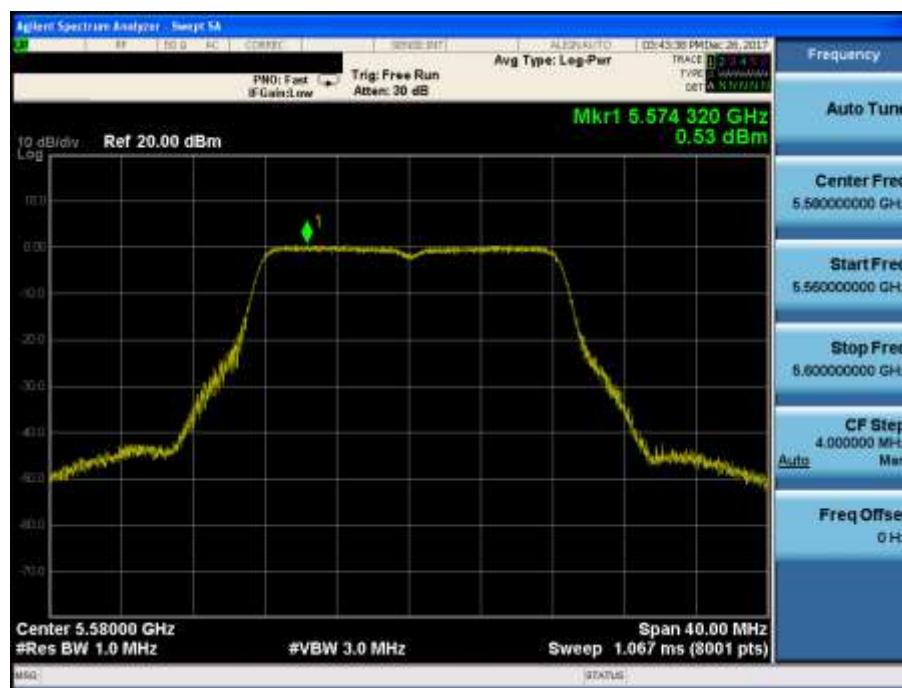


**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.100

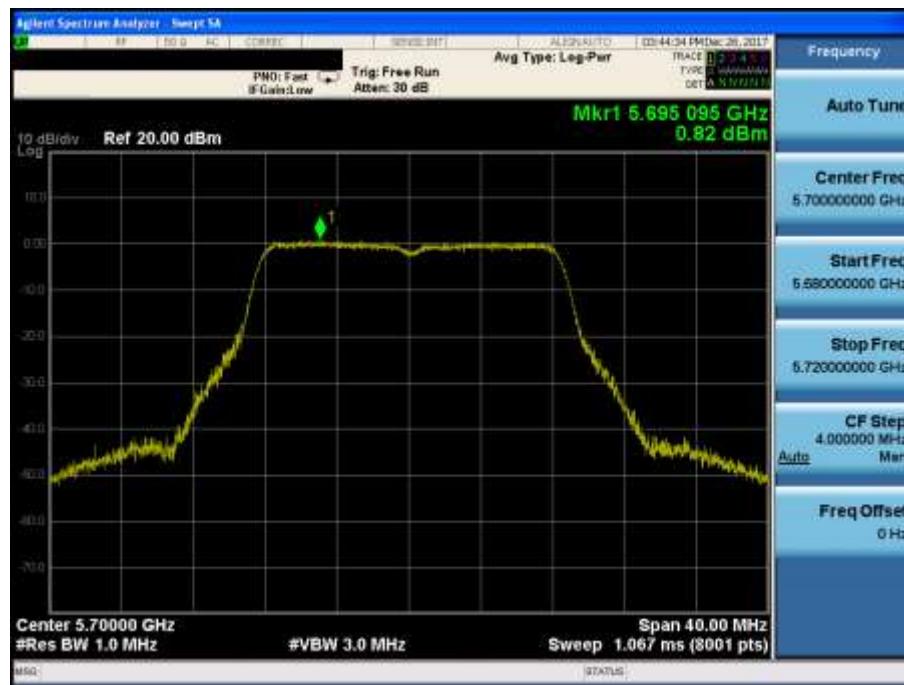
**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.116



## Maximum Power Spectral Density

Test Mode: 802.11a &amp; Ch.140

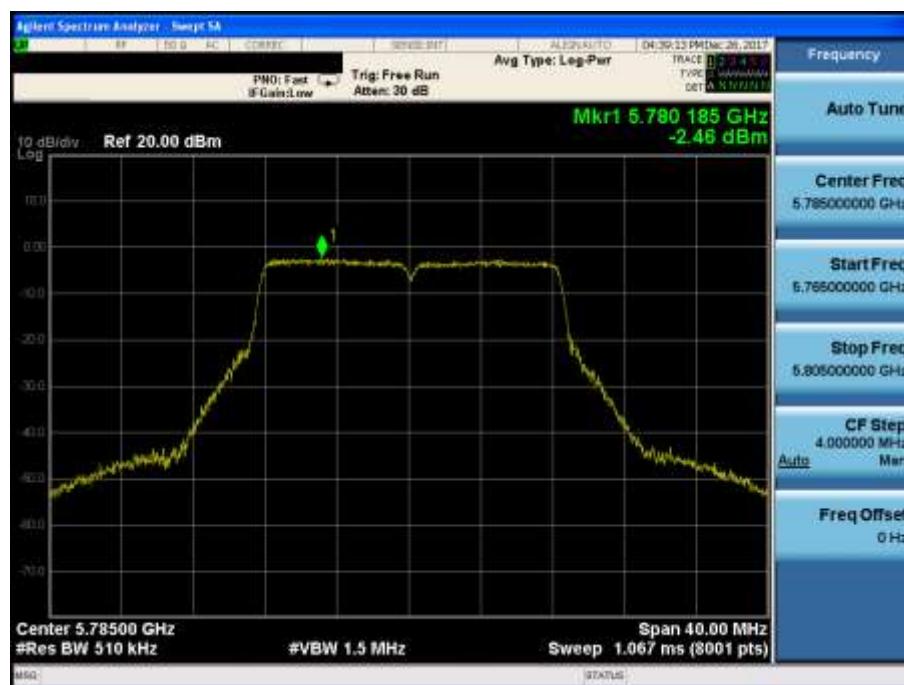


**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.149

**Maximum Power Spectral Density**

Test Mode: 802.11a &amp; Ch.157



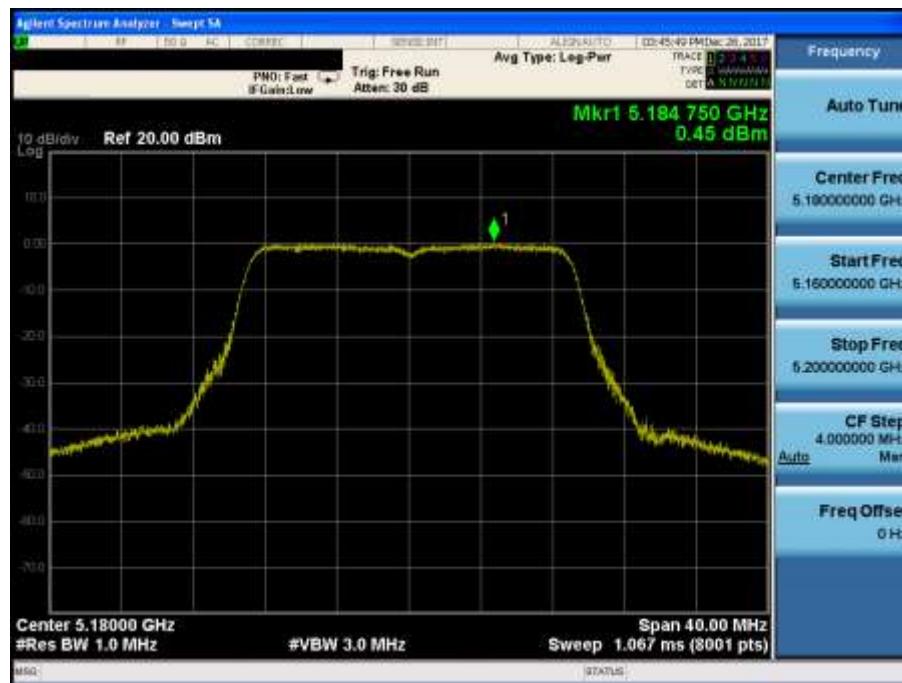
## Maximum Power Spectral Density

Test Mode: 802.11a &amp; Ch.165

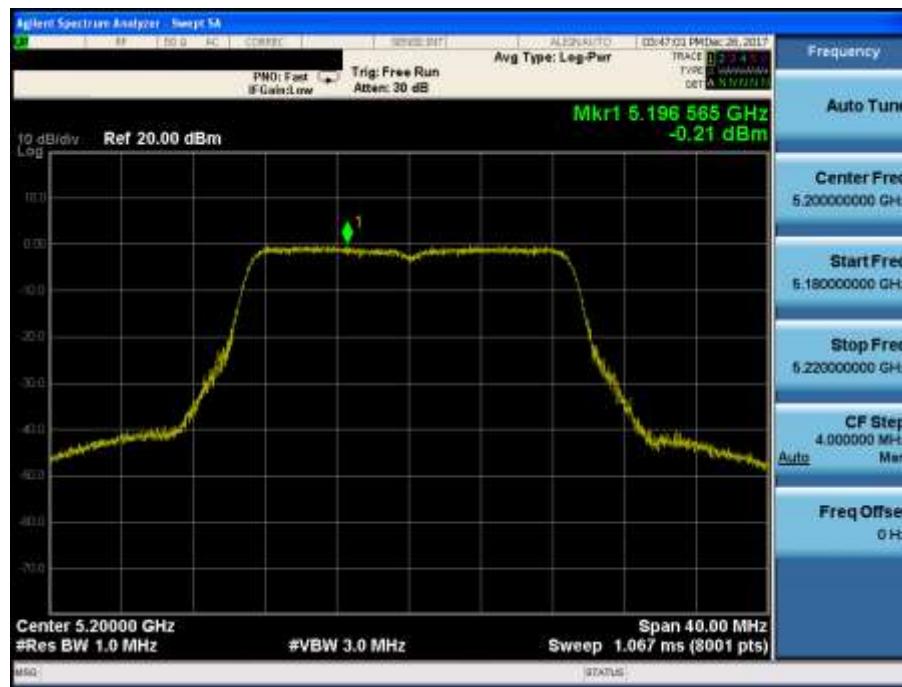


**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.36

**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.40



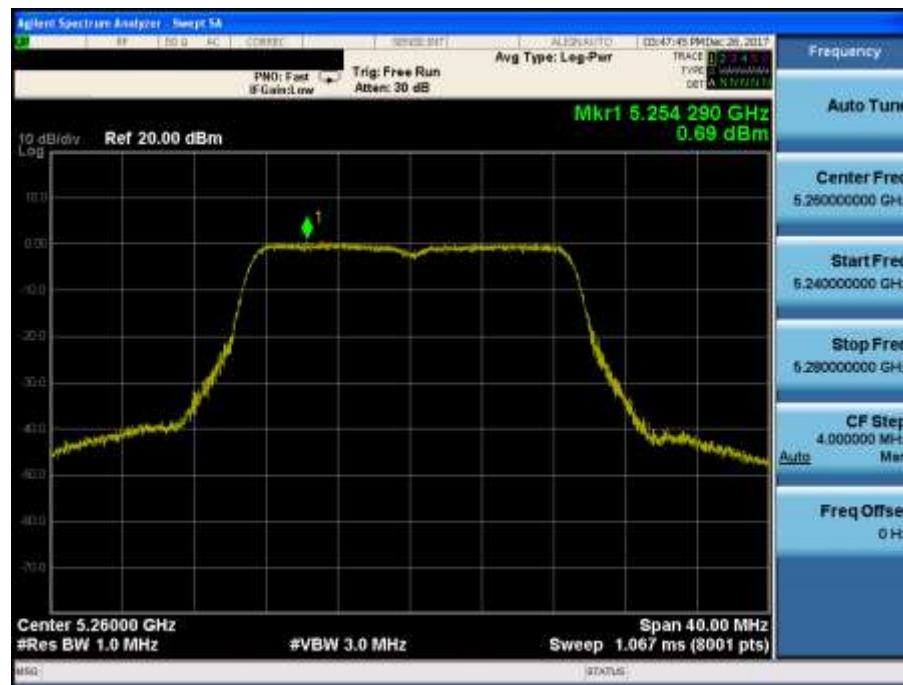
## Maximum Power Spectral Density

Test Mode: 802.11n HT20 &amp; Ch.48

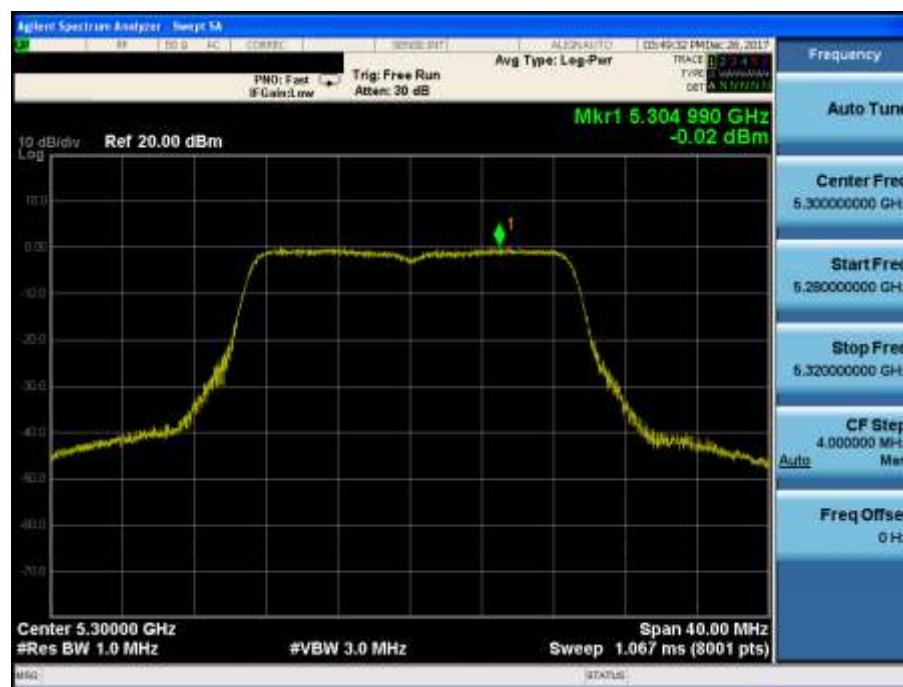


**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.52

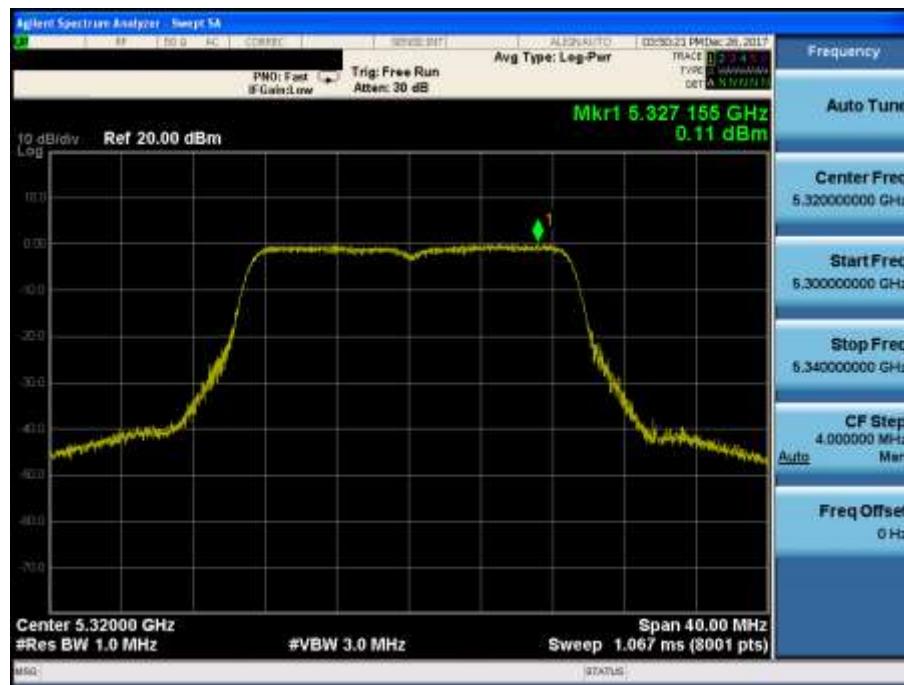
**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.60



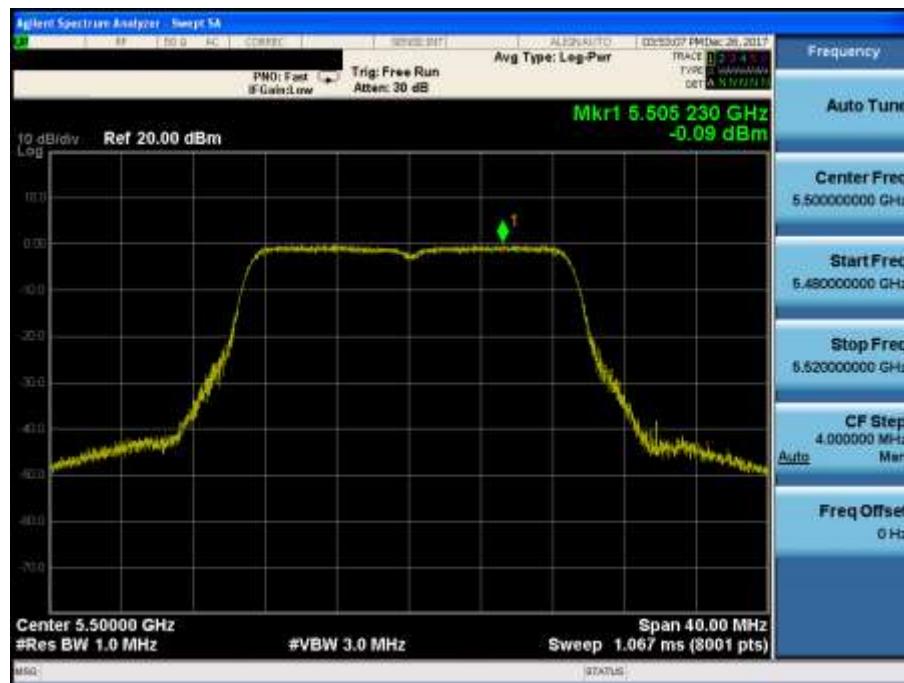
## Maximum Power Spectral Density

Test Mode: 802.11n HT20 &amp; Ch.64

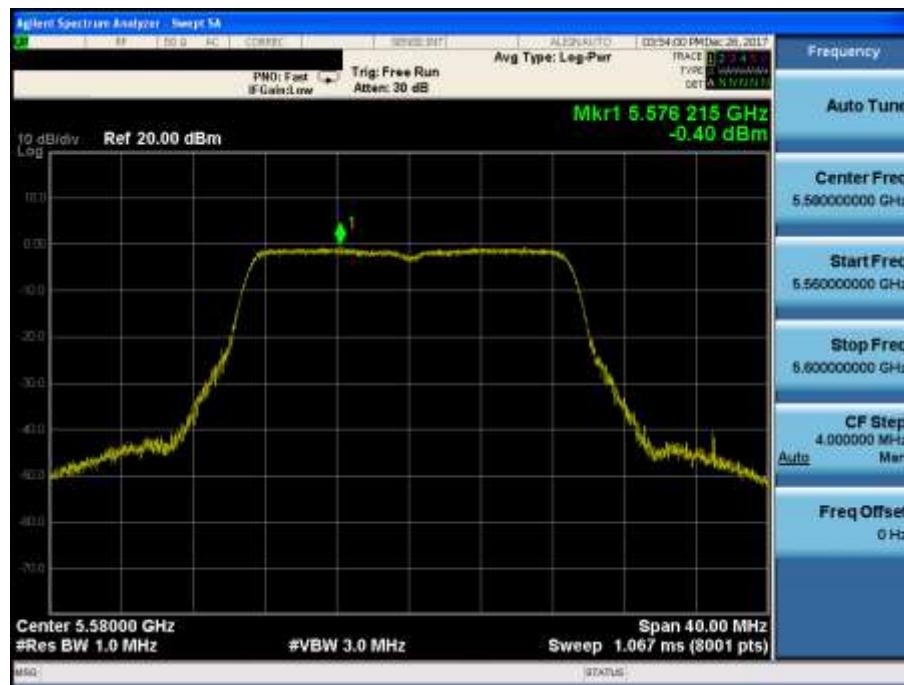


**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.100

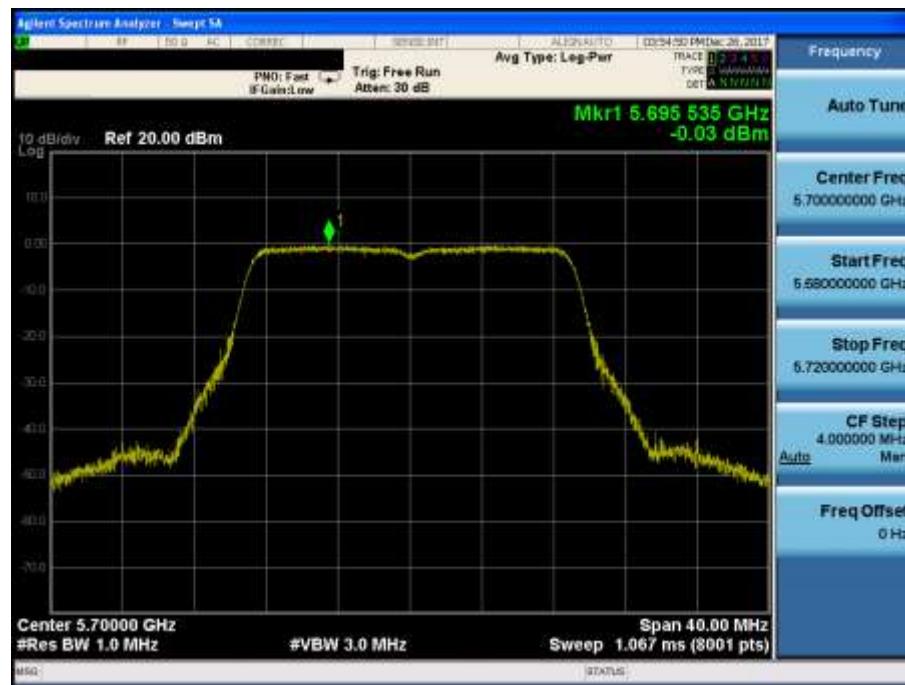
**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.116



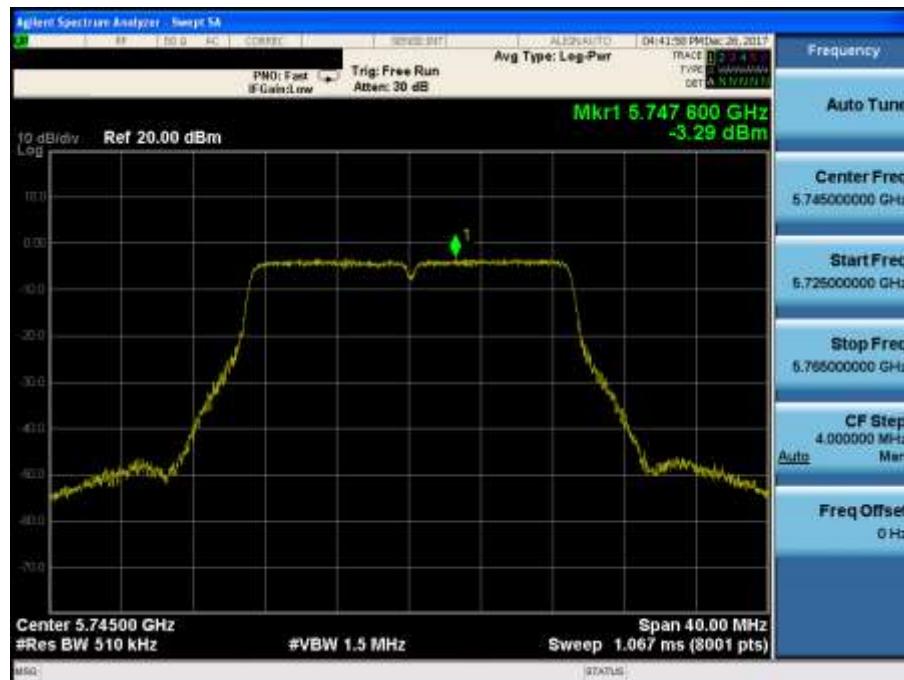
## Maximum Power Spectral Density

Test Mode: 802.11n HT20 &amp; Ch.140



**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.149

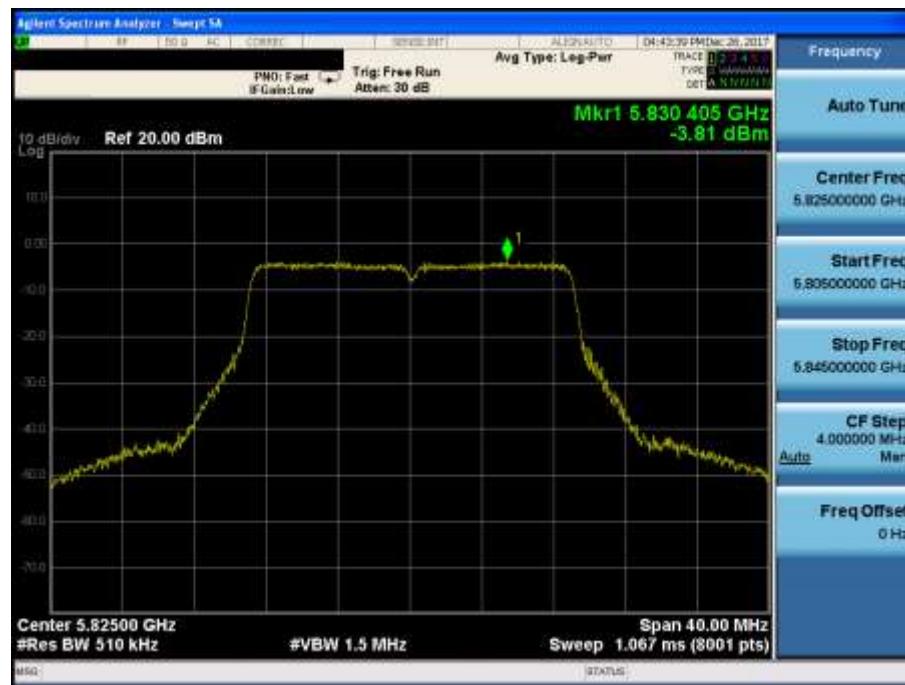
**Maximum Power Spectral Density**

Test Mode: 802.11n HT20 &amp; Ch.157



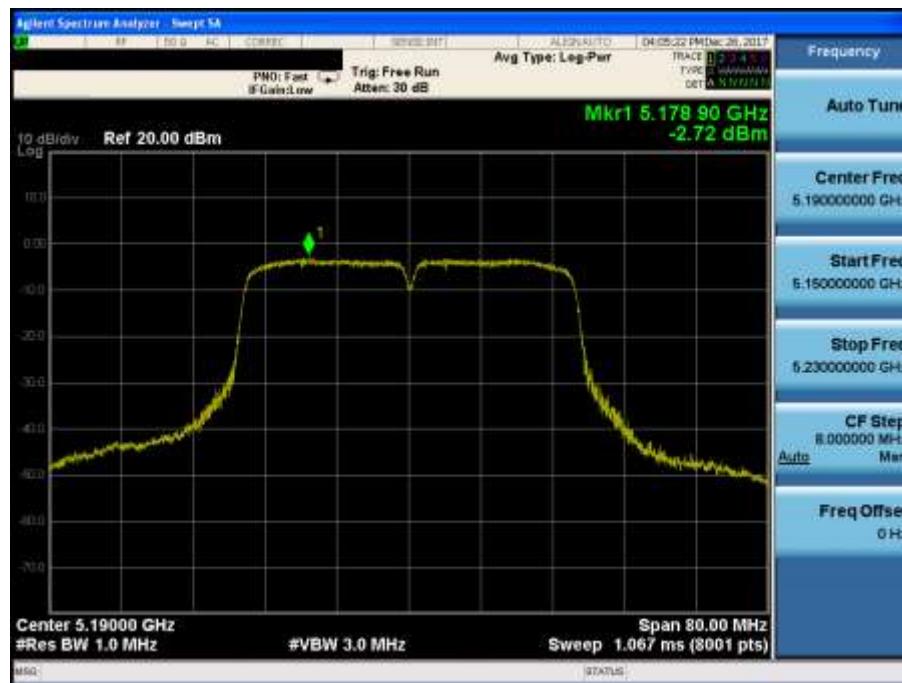
## Maximum Power Spectral Density

Test Mode: 802.11n HT20 &amp; Ch.165

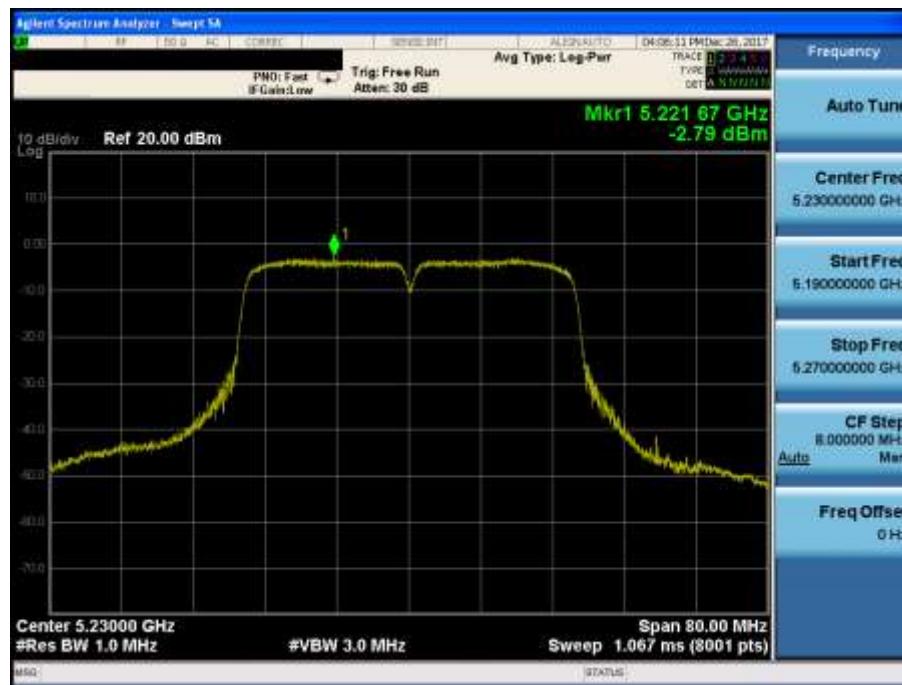


**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.38

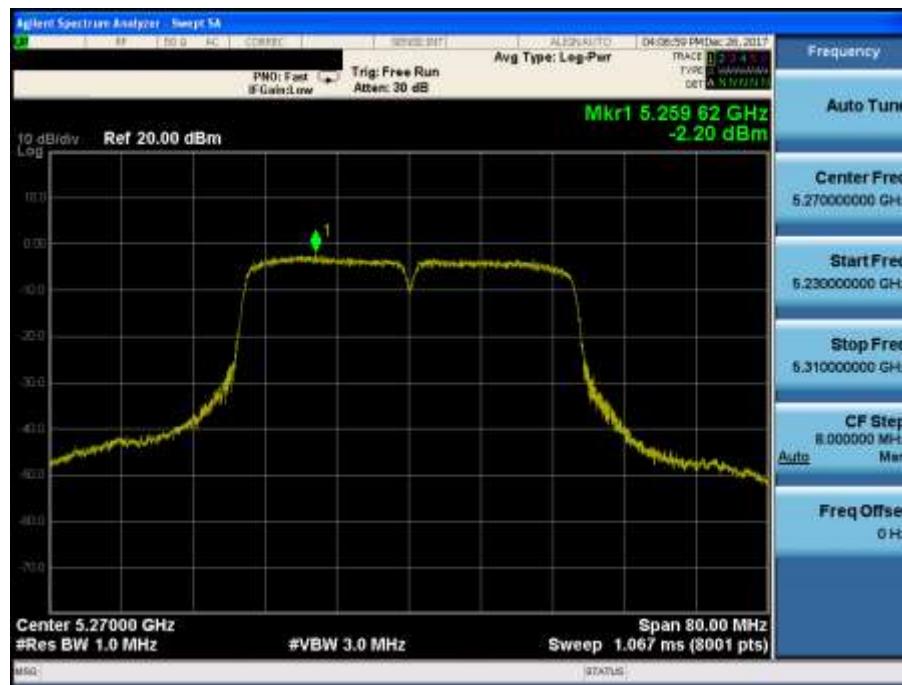
**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.46

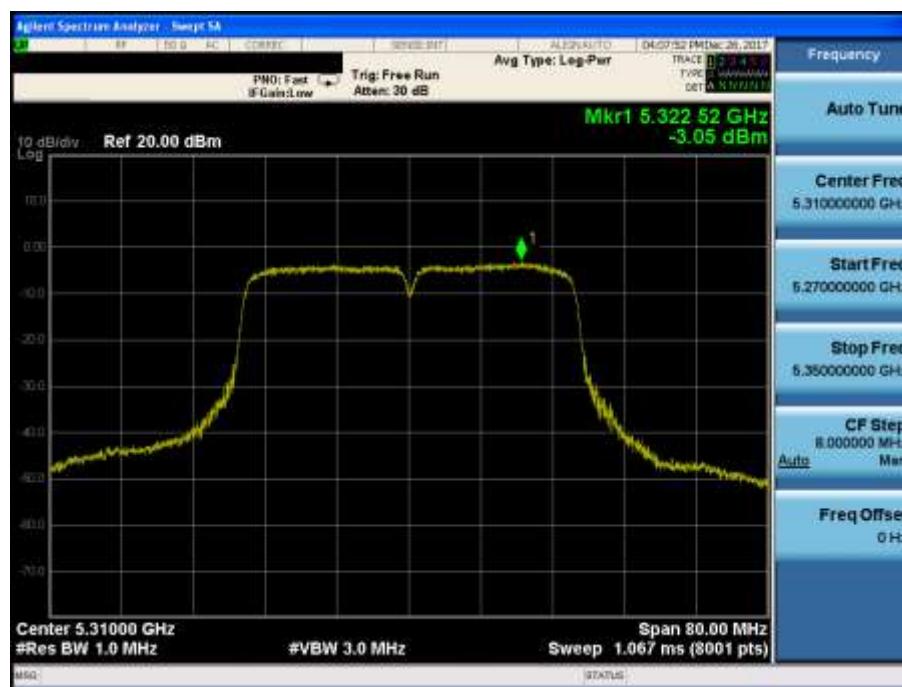


**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.54

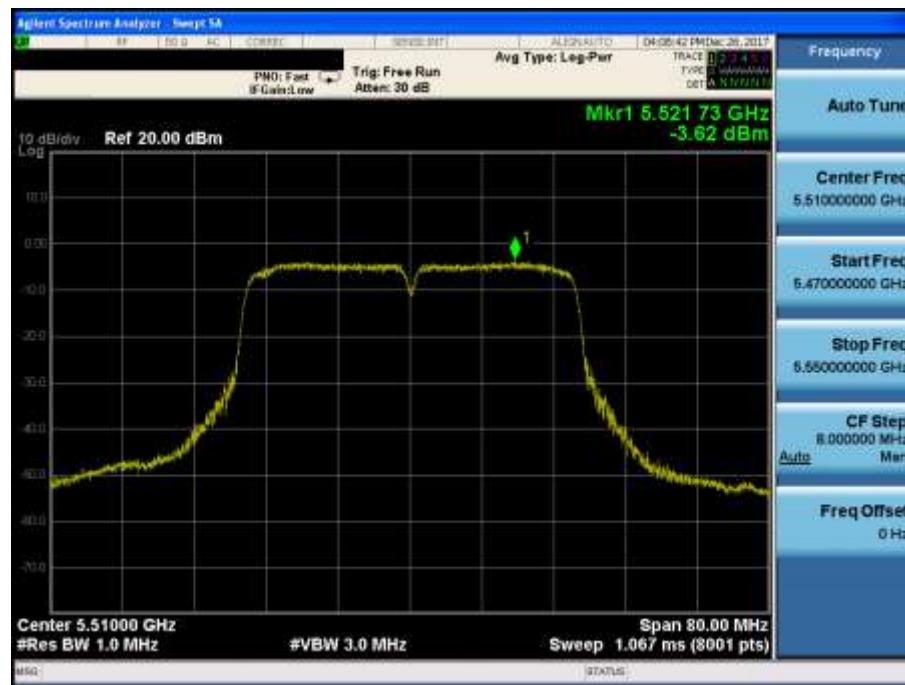
**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.62

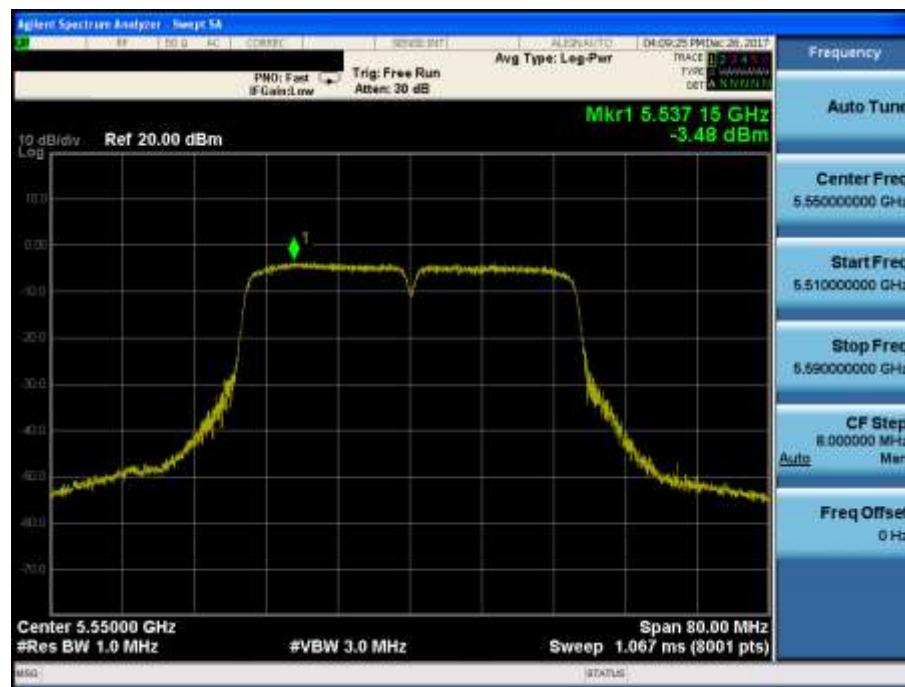


**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.102

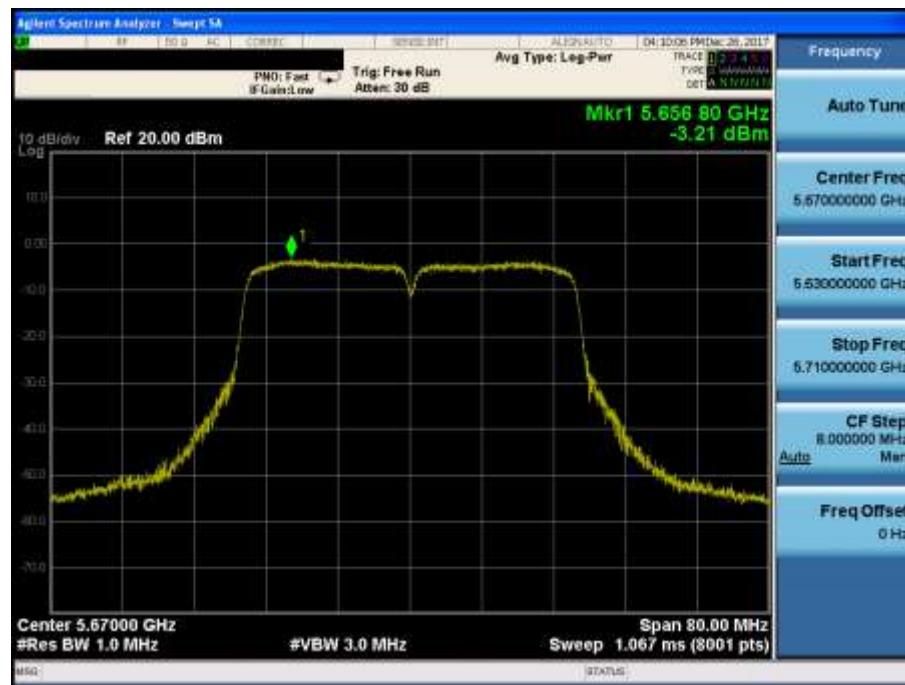
**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.110



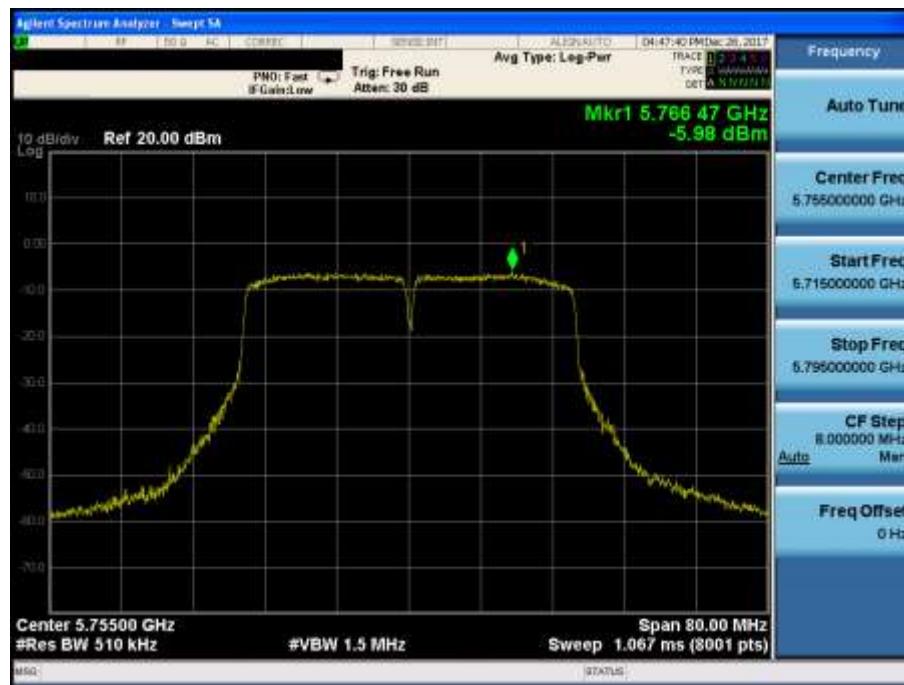
## Maximum Power Spectral Density

Test Mode: 802.11n HT40 &amp; Ch.134

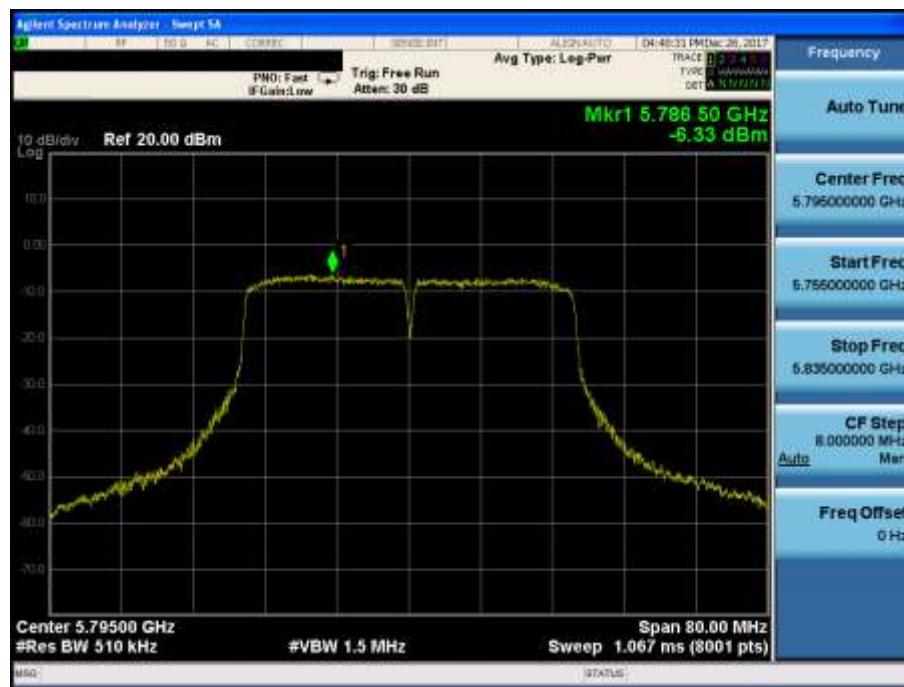


**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.151

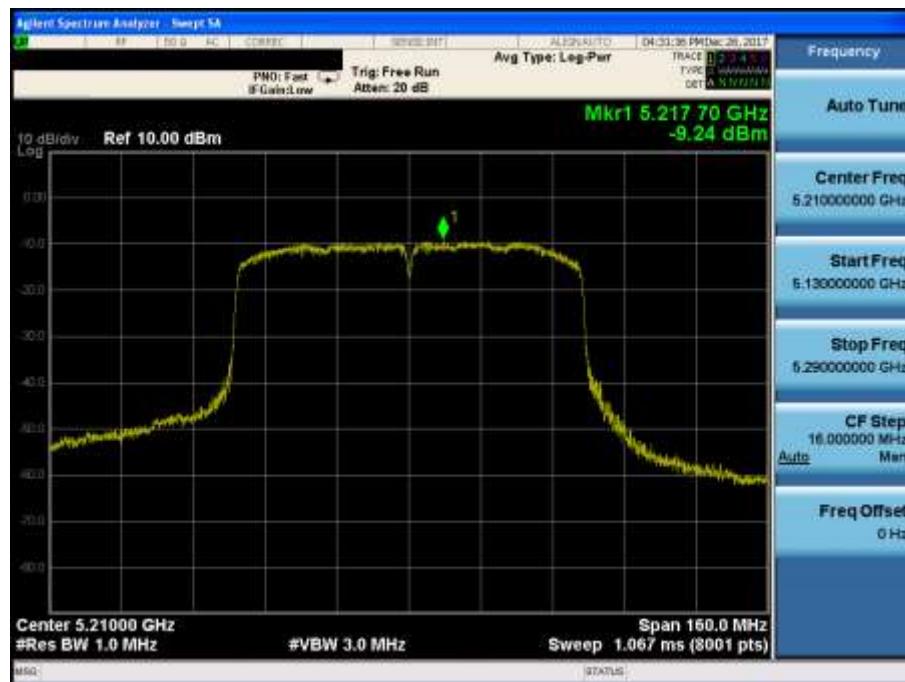
**Maximum Power Spectral Density**

Test Mode: 802.11n HT40 &amp; Ch.159

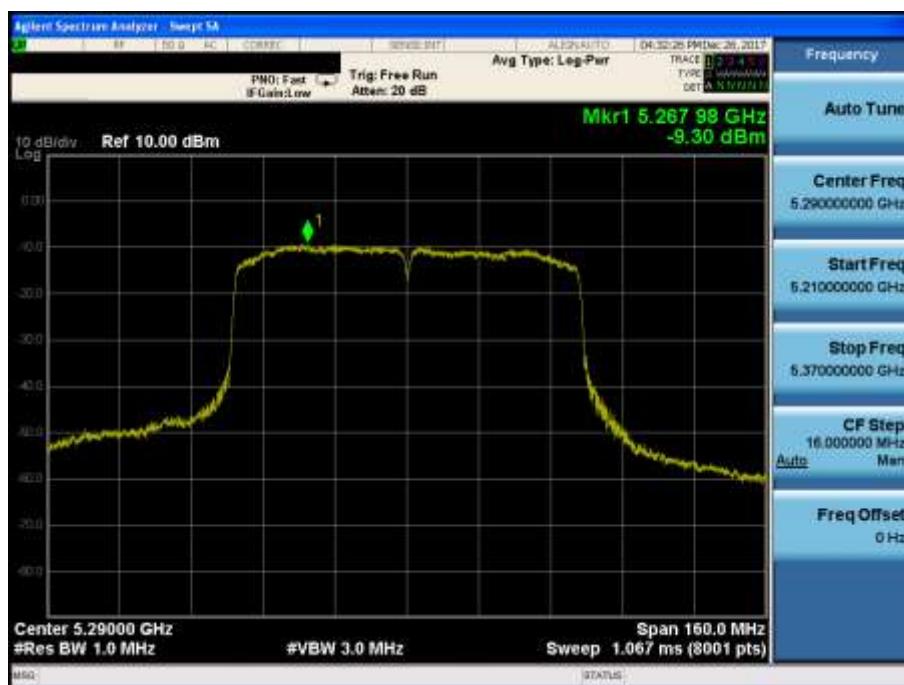


**Maximum Power Spectral Density**

Test Mode: 802.11ac VHT80 &amp; Ch.42

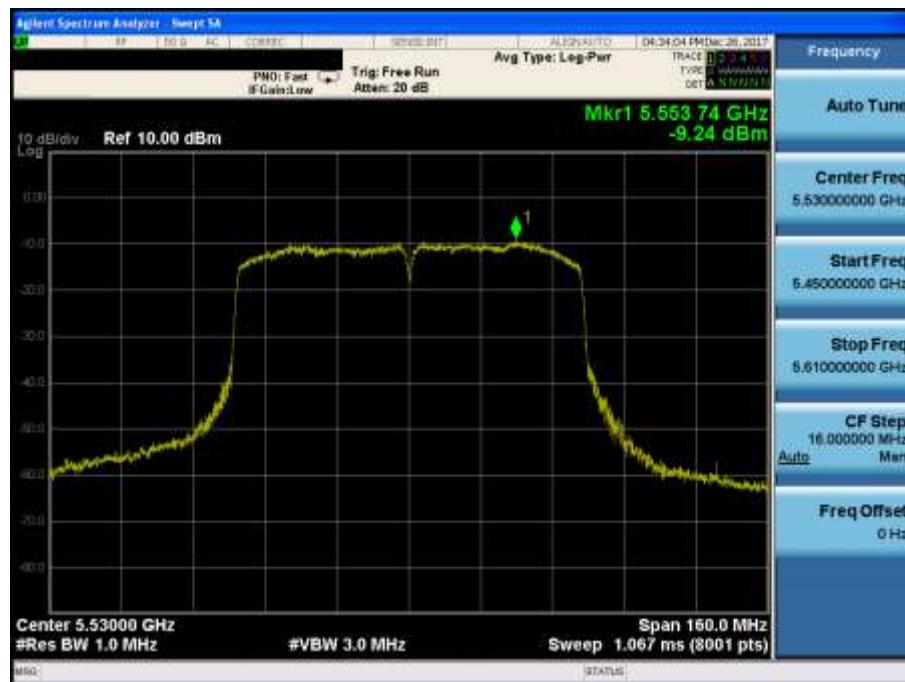
**Maximum Power Spectral Density**

Test Mode: 802.11ac VHT80 &amp; Ch.58



**Maximum Power Spectral Density**

Test Mode: 802.11ac VHT80 &amp; Ch.106

**Maximum Power Spectral Density**

Test Mode: 802.11ac VHT80 &amp; Ch.155



## 8.5 Frequency Stability

### ■ Test requirements

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

### ■ Test Procedure

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -20°C and +50°C. The temperature was incremented by 10°C intervals and the unit was allowed to stabilize at each measurement. And the edge point of EBW (26dB or 6dB bandwidth) was reported.

### ■ Test Results: Comply

#### U-NII 1 & U-NII 2A : (5150 MHz ~ 5350 MHz)

Supply Voltage (V DC)	TEMP (°C)	Operating Frequency	
		5180 MHz	5320 MHz
		26dBc low edge (Hz)	26dBc High edge(Hz)
3.800	+20(Ref)	5,169,477,000	5,330,679,000
	+50	5,169,576,000	5,330,780,000
	+40	5,169,770,000	5,330,385,000
	+30	5,169,581,000	5,330,971,000
	+20	5,169,477,000	5,330,679,000
	+10	5,169,269,000	5,330,464,000
	0	5,169,383,000	5,330,581,000
	-10	5,169,560,000	5,330,159,000
	-20	5,169,357,000	5,330,555,000
3.400	+20	5,169,371,000	5,330,374,000
4.370	+20	5,169,459,000	5,330,671,000

## U-NII 2C : (5470 MHz ~ 5725 MHz)

Supply Voltage (V DC)	TEMP (°C)	Operating Frequency	
		5500 MHz	5700 MHz
		26dBc low edge (Hz)	26dBc High edge(Hz)
3.800	+20(Ref)	5,489,543,000	5,710,692,000
	+50	5,489,131,000	5,710,881,000
	+40	5,489,428,000	5,710,982,000
	+30	5,489,648,000	5,710,590,000
	+20	5,489,543,000	5,710,692,000
	+10	5,489,234,000	5,170,794,000
	0	5,489,141,000	5,710,585,000
	-10	5,489,422,000	5,710,280,000
	-20	5,489,749,000	5,710,394,000
	3.400	5,489,350,000	5,710,899,000
4.370	+20	5,489,541,000	5,710,686,000

## U-NII 3 : (5725 MHz ~ 5850 MHz)

Supply Voltage (V DC)	TEMP (°C)	Operating Frequency	
		5745 MHz	5825 MHz
		6dBc low edge (Hz)	6dBc low edge (Hz)
3.800	+20(Ref)	5,736,917,000	5,833,301,000
	+50	5,736,410,000	5,833,000,000
	+40	5,736,604,000	5,833,285,000
	+30	5,736,808,000	5,833,491,000
	+20	5,736,917,000	5,833,301,000
	+10	5,736,811,000	5,833,405,000
	0	5,736,999,000	5,833,211,000
	-10	5,736,909,000	5,833,091,000
	-20	5,736,703,000	5,833,684,000
	3.400	5,736,841,000	5,833,506,000
4.370	+20	5,736,920,000	5,833,297,000

## 8.6 Radiated Spurious Emission Measurements

### ■ Test Procedure

- FCC Part 15.209(a) and (b)

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
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 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

\*\* Except as provided in 15.209(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. 15.231 and 15.241.

- FCC Part 15.205 (a): Only spurious emissions are permitted in any of the frequency bands listed below:

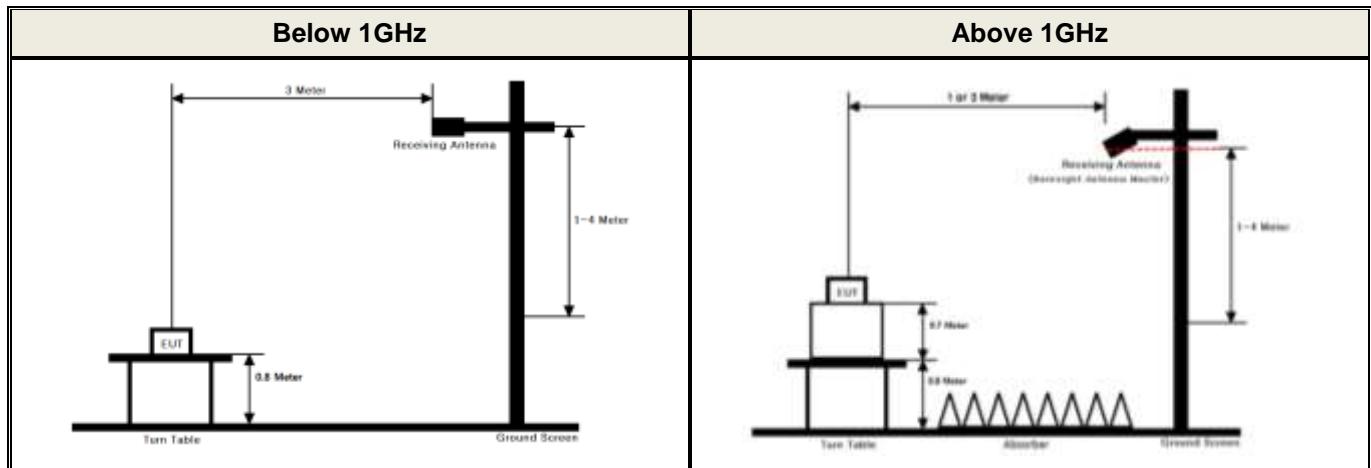
MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	160.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	160.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	160.7 ~ 160.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4000		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ FCC Part 15.205(b): The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

▪ FCC Part 15.407 (b): Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the **5.15-5.25 GHz band**: all emissions outside of the **5.15-5.35 GHz band** shall not exceed an **EIRP of -27 dBm/MHz**.
- (2) For transmitters operating in the **5.25-5.35 GHz band**: all emissions outside of the **5.15-5.35 GHz band** shall not exceed an **EIRP of -27 dBm/MHz**.
- (3) For transmitters operating in the **5.47-5.725 GHz band**: all emissions outside of the **5.47-5.725 GHz band** shall not exceed an **EIRP of -27 dBm/MHz**.
- (4) For transmitters operating in the **5.725-5.85 GHz band**: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
- (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 **Section 15.209**. Further, any U-NII devices using an **AC power line** are required to comply also with the conducted limits set forth in **Section 15.207**.
- (7) The provisions of §15.205 apply to intentional radiators operating under this section
- (8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

## ■ Test Procedure



## ■ Test Procedure

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turn table shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 1m or 3 m away from the receiving antenna, which is varied from 1m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Radiated spurious emission measured using following Measurement Procedure of **KDB789033 D02v02r01**

### ► General Requirements for Unwanted Emissions Measurements

The following requirements apply to all unwanted emissions measurements, both in and outside of the restricted bands:

- EUT Duty Cycle
  - (1) The EUT shall be configured or modified to **transmit continuously** except as stated in (ii), below. The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (**to no lower than 98 percent**) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.
  - (2) If **continuous transmission (or at least 98 percent duty cycle)** cannot be achieved due to hardware limitations of the EUT (e.g., overheating), the following additions to the measurement and reporting procedures are required:
    - The EUT shall be configured to operate at the maximum achievable duty cycle.
    - Measure the duty cycle, x, of the transmitter output signal.
    - Adjustments to measurement procedures (e.g., increasing test time and number of traces averaged) shall be performed as described in the procedures below.
    - The test report shall include the following additional information:
      - The reason for the duty cycle limitation.
      - The duty cycle achieved for testing and the associated transmit duration and interval between transmissions.
      - The sweep time and the amount of time used for trace stabilization during max-hold measurements for peak emission measurements.
  - (3) Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

**► 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.

**► Measurements Above 1000 MHz (Peak)**

- a) Follow the requirements in section II.G.3, "General Requirements for Unwanted Emissions Measurements".
- b) Peak emission levels are measured by setting the analyzer as follows:

- (i) **RBW = 1 MHz.**
- (ii) **VBW  $\geq$  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.

**► Measurements Above 1000 MHz (Method AD)**

- (i) **RBW = 1 MHz.**
- (ii) **VBW  $\geq$  3 MHz.**
- (iii) **Detector = RMS**, if  $\text{span} / (\# \text{ of points in sweep}) \leq \text{RBW} / 2$ . Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, the detector mode shall be set to peak.
- (iv) Averaging type = power (i.e., RMS)
  - As an alternative, the detector and averaging type may be set for linear voltage averaging. Some analyzers require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- (v) Sweep time = Auto.
- (vi) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, the number of traces shall be increased by a factor of  $1/x$ , where  $x$  is the duty cycle. For example, with 50 percent duty cycle, at least 200 traces shall be averaged.
- (vii) If tests are performed with the EUT transmitting at a duty cycle less than 98 percent, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
  - **If power averaging (RMS) mode was used in step (iv) above, the correction factor is  $10 \log(1/x)$ , where  $x$  is the duty cycle.** For example, if the transmit duty cycle was 50 percent, then 3 dB must be added to the measured emission levels.
  - If linear voltage averaging mode was used in step (iv) above, the correction factor is  $20 \log(1/x)$ , where  $x$  is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 6 dB must be added to the measured emission levels.
  - If a specific emission is demonstrated to be continuous (100 percent duty cycle) rather than turning on and off with the transmit cycle, no duty cycle correction is required for that emission.

Please refer to Appendix II for the duty correction factor

**■ Measurement Data:****Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11a**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	36 (5180 MHz)	5127.13	H	X	PK	47.96	4.99	N/A	N/A	52.95	74.00	21.05
		5127.93	H	X	AV	38.43	4.99	0.76	N/A	44.18	54.00	9.82
		10359.97	H	Y	PK	45.44	10.66	N/A	N/A	56.10	68.20	12.10
		-	-	-	-	-	-	-	-	-	-	-
	40 (5200 MHz)	10400.66	H	Y	PK	45.06	10.76	N/A	N/A	55.82	68.20	12.38
		-	-	-	-	-	-	-	-	-	-	-
	48 (5240 MHz)	10479.92	H	Y	PK	46.29	10.94	N/A	N/A	57.23	68.20	10.97
		-	-	-	-	-	-	-	-	-	-	-
U-NII 2A	52 (5260 MHz)	10519.95	H	Y	PK	45.73	11.05	N/A	N/A	56.78	68.20	11.42
		-	-	-	-	-	-	-	-	-	-	-
	60 (5300 MHz)	10599.83	H	Y	PK	44.82	11.30	N/A	N/A	56.12	68.20	12.08
		10600.24	H	Y	PK	45.05	11.30	N/A	N/A	56.35	74.00	17.65
		10600.11	H	Y	AV	34.70	11.30	0.76	N/A	46.76	54.00	7.24
	64 (5320 MHz)	5350.64	H	X	PK	49.79	5.11	N/A	N/A	54.90	74.00	19.10
		5350.48	H	X	AV	36.74	5.11	0.76	N/A	42.61	54.00	11.39
		10640.00	H	Y	PK	45.17	11.42	N/A	N/A	56.59	74.00	17.41
		10640.07	H	Y	AV	34.83	11.42	0.76	N/A	47.01	54.00	6.99

**Note.**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : -  $9.54 \text{ dB} = 20 \log(1m/3m)$

4. The limit is converted to field strength.

$$E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : **802.11a**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 2C	100 (5500 MHz)	5447.64	H	X	PK	48.12	5.14	N/A	N/A	53.26	74.00	20.74
		5447.75	H	X	AV	39.90	5.14	0.76	N/A	45.80	54.00	8.20
		5469.89	H	X	PK	45.99	5.14	N/A	N/A	51.13	68.20	17.07
		11000.18	H	Y	PK	44.85	12.54	N/A	N/A	57.39	74.00	16.61
		10999.95	H	Y	AV	35.17	12.54	0.76	N/A	48.47	54.00	5.53
	116 (5580 MHz)	11160.12	H	Y	PK	45.46	12.67	N/A	N/A	58.13	74.00	15.87
		11160.11	H	Y	AV	35.96	12.67	0.76	N/A	49.39	54.00	4.61
		-	-	-	-	-	-	-	-	-	-	-
	140 (5700 MHz)	5725.16	H	X	PK	48.51	5.63	N/A	N/A	54.14	68.20	14.06
		11399.98	H	Y	PK	45.40	12.86	N/A	N/A	58.26	74.00	15.74
		11399.96	H	Y	AV	36.11	12.86	0.76	N/A	49.73	54.00	4.27
U-NII 3	149 (5745 MHz)	5646.43	V	Y	PK	46.15	5.34	N/A	N/A	51.49	68.20	16.71
		11489.79	H	Y	PK	46.06	12.93	N/A	N/A	58.99	74.00	15.01
		11490.02	H	Y	AV	37.40	12.93	0.76	N/A	51.09	54.00	2.91
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
	157 (5785 MHz)	11570.19	H	Y	PK	46.42	12.99	N/A	N/A	59.41	74.00	14.59
		11569.84	H	Y	AV	38.19	12.99	0.76	N/A	51.94	54.00	2.06
		-	-	-	-	-	-	-	-	-	-	-
	165 (5825 MHz)	5925.42	V	Y	PK	45.80	6.18	N/A	N/A	51.98	68.20	16.22
		11650.01	H	Y	PK	47.01	13.05	N/A	N/A	60.06	74.00	13.94
		11649.91	H	Y	AV	38.59	13.05	0.76	N/A	52.40	54.00	1.60
		-	-	-	-	-	-	-	-	-	-	-

**Note:**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,  
DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : -  $9.54 \text{ dB} = 20 \log(1\text{m}/3\text{m})$

4. The limit is converted to field strength.

$$E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11n(HT20)

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	36 (5180 MHz)	5128.20	H	X	PK	47.22	4.99	N/A	N/A	52.21	74.00	21.79
		5128.27	H	X	AV	38.52	4.99	0.81	N/A	44.32	54.00	9.68
		10360.06	H	Y	PK	45.11	10.66	N/A	N/A	55.77	68.20	12.43
		-	-	-	-	-	-	-	-	-	-	-
	40 (5200 MHz)	10400.24	H	Y	PK	45.96	10.76	N/A	N/A	56.72	68.20	11.48
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
	48 (5240 MHz)	10480.19	H	Y	PK	45.79	10.94	N/A	N/A	56.73	68.20	11.47
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
U-NII 2A	52 (5260 MHz)	10520.11	H	Y	PK	46.56	11.05	N/A	N/A	57.61	68.20	10.59
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
	60 (5300 MHz)	10599.84	H	Y	PK	44.39	11.30	N/A	N/A	55.69	68.20	12.51
		10600.26	H	Y	PK	45.09	11.30	N/A	N/A	56.39	74.00	17.61
		10600.02	H	Y	AV	34.99	11.30	0.81	N/A	47.10	54.00	6.90
	64 (5320 MHz)	5372.16	H	X	PK	50.75	5.11	N/A	N/A	55.86	74.00	18.14
		5371.73	H	X	AV	41.35	5.11	0.81	N/A	47.27	54.00	6.73
		10640.24	H	Y	PK	45.22	11.42	N/A	N/A	56.64	74.00	17.36
		10640.14	H	Y	AV	35.08	11.42	0.81	N/A	47.31	54.00	6.69

**Note.**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : -  $9.54 \text{ dB} = 20 \log(1\text{m}/3\text{m})$

4. The limit is converted to field strength.

$$\text{E[dBuV/m]} = \text{EIRP[dBm]} + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

**Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11n(HT20)**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 2C	100 (5500 MHz)	5448.09	H	X	PK	47.87	5.14	N/A	N/A	53.01	74.00	20.99
		5448.15	H	X	AV	39.29	5.14	0.81	N/A	45.24	54.00	8.76
		5469.43	H	X	PK	45.14	5.14	N/A	N/A	50.28	68.20	17.92
		11000.15	H	Y	PK	45.81	12.54	N/A	N/A	58.35	74.00	15.65
		10999.91	H	Y	AV	35.35	12.54	0.81	N/A	48.70	54.00	5.30
	116 (5580 MHz)	11159.82	H	Y	PK	45.39	12.67	N/A	N/A	58.06	74.00	15.94
		11159.96	H	Y	AV	35.60	12.67	0.81	N/A	49.08	54.00	4.92
		-	-	-	-	-	-	-	-	-	-	-
	140 (5700 MHz)	5725.72	H	X	PK	47.23	5.63	N/A	N/A	52.86	68.20	15.34
		11399.90	H	Y	PK	45.73	12.86	N/A	N/A	58.59	74.00	15.41
		11400.07	H	Y	AV	36.56	12.86	0.81	N/A	50.23	54.00	3.77
U-NII 3	149 (5745 MHz)	5648.69	V	Y	PK	46.21	5.34	N/A	N/A	51.55	68.20	22.45
		11489.72	H	Y	PK	46.12	12.93	N/A	N/A	59.05	74.00	14.95
		11490.09	H	Y	AV	37.42	12.93	0.81	N/A	51.16	54.00	2.84
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
	157 (5785 MHz)	11570.21	H	Y	PK	46.83	12.99	N/A	N/A	59.82	74.00	14.18
		11570.15	H	Y	AV	37.62	12.99	0.81	N/A	51.42	54.00	2.58
		-	-	-	-	-	-	-	-	-	-	-
	165 (5825 MHz)	5925.17	V	Y	PK	46.89	6.18	N/A	N/A	53.07	68.20	20.93
		11650.18	H	Y	PK	46.38	13.05	N/A	N/A	59.43	74.00	14.57
		11649.85	H	Y	AV	37.98	13.05	0.81	N/A	51.84	54.00	2.16
		-	-	-	-	-	-	-	-	-	-	-

**Note**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : - 9.54 dB =  $20 \log(1m/3m)$

4. The limit is converted to field strength.

$$E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

**Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11n(HT40)**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	38 (5190 MHz)	5148.75	H	X	PK	51.02	4.99	N/A	N/A	56.01	74.00	17.99
		5149.41	H	X	AV	36.71	4.99	1.50	N/A	43.20	54.00	10.80
		10380.19	H	Y	PK	45.32	10.71	N/A	N/A	56.03	68.20	12.17
		-	-	-	-	-	-	-	-	-	-	-
	46 (5230 MHz)	10459.95	H	Y	PK	46.22	10.89	N/A	N/A	57.11	68.20	11.09
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
U-NII 2A	54 (5270 MHz)	10540.23	H	Y	PK	46.39	11.11	N/A	N/A	57.50	68.20	10.70
		-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-
	62 (5310 MHz)	5350.66	H	X	PK	56.61	5.11	N/A	N/A	61.72	74.00	12.28
		5351.14	H	X	AV	39.80	5.11	1.50	N/A	46.41	54.00	7.59
		10620.26	H	Y	PK	45.35	11.36	N/A	N/A	56.71	74.00	17.29
		10620.03	H	Y	AV	35.34	11.36	1.50	N/A	48.20	54.00	5.80

**Note.**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} \quad / \quad \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} \quad / \quad \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : - 9.54 dB =  $20 \times \log(1m/3m)$

4. The limit is converted to field strength.

$$E[\text{dBuV/m}] = \text{EIRP[dBm]} + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

**Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11n(HT40)**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 2C	102 (5510 MHz)	5459.63	H	X	PK	46.04	5.14	N/A	N/A	51.18	74.00	22.82
		5459.94	H	X	AV	36.95	5.14	1.50	N/A	43.59	54.00	10.41
		5469.95	H	X	PK	54.98	5.14	N/A	N/A	60.12	68.20	8.08
		11020.09	H	Y	PK	45.14	12.56	N/A	N/A	57.70	74.00	16.30
		11020.14	H	Y	AV	35.57	12.56	1.50	N/A	49.63	54.00	4.37
	110 (5550 MHz)	11100.06	H	Y	PK	45.85	12.62	N/A	N/A	58.47	74.00	15.53
		11100.09	H	Y	AV	35.76	12.62	1.50	N/A	49.88	54.00	4.12
	134 (5670 MHz)	-	-	-	-	-	-	-	-	-	-	-
		5728.70	H	X	PK	46.05	5.63	N/A	N/A	51.68	68.20	16.52
		11340.27	H	Y	PK	45.31	12.81	N/A	N/A	58.12	74.00	15.88
		11340.00	H	Y	AV	36.02	12.81	1.50	N/A	50.33	54.00	3.67
U-NII 3	151 (5755 MHz)	5645.96	V	Y	PK	45.66	5.34	N/A	N/A	51.00	68.20	17.20
		11510.15	H	Y	PK	45.28	12.95	N/A	N/A	58.23	74.00	15.77
		11510.00	H	Y	AV	36.88	12.95	1.50	N/A	51.33	54.00	2.67
		-	-	-	-	-	-	-	-	-	-	-
	159 (5795 MHz)	5937.78	V	Y	PK	45.87	6.21	N/A	N/A	52.08	68.20	16.12
		11590.45	H	Y	PK	46.57	13.01	N/A	N/A	59.58	74.00	14.42
		11589.96	H	Y	AV	38.17	13.01	1.50	N/A	52.68	54.00	1.32
		-	-	-	-	-	-	-	-	-	-	-

**Note:**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : - 9.54 dB =  $20 \log(1m/3m)$

4. The limit is converted to field strength.

$$E[\text{dBuV}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV}/\text{m}$$

**Radiated Spurious Emissions data(9 kHz ~ 40 GHz) : 802.11ac(VHT80)**

Band	Tested Channel	Freq. (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	DCCF (dB)	DCF (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
U-NII 1	42 (5210 MHz)	5149.67	H	X	PK	50.91	4.99	N/A	N/A	55.90	74.00	18.10
		5149.75	H	X	AV	36.82	4.99	2.57	N/A	44.38	54.00	9.62
		10419.82	H	Y	PK	45.26	10.80	N/A	N/A	56.06	68.20	12.14
		-	-	-	-	-	-	-	-	-	-	-
U-NII 2A	58 (5290 MHz)	5358.85	H	X	PK	51.82	5.11	N/A	N/A	56.93	74.00	17.07
		5851.99	H	X	AV	36.69	5.11	2.57	N/A	44.37	54.00	9.63
		10580.33	H	Y	PK	45.19	11.23	N/A	N/A	56.42	68.20	11.78
		-	-	-	-	-	-	-	-	-	-	-
U-NII 2C	106 (5530 MHz)	5457.87	H	X	PK	51.94	5.14	N/A	N/A	57.08	74.00	16.92
		5458.53	H	X	AV	38.70	5.14	2.57	N/A	46.41	54.00	7.59
		5465.87	H	X	PK	53.13	5.14	N/A	N/A	58.27	68.20	9.93
		11060.21	H	Y	PK	45.94	12.59	N/A	N/A	58.53	74.00	15.47
		11060.07	H	Y	AV	35.95	12.59	2.57	N/A	51.11	54.00	2.89
U-NII 3	155 (5775 MHz)	5635.53	V	Y	PK	44.69	5.32	N/A	N/A	50.01	68.20	18.19
		5936.81	V	Y	PK	43.66	6.21	N/A	N/A	49.87	68.20	18.33
		11550.02	H	Y	PK	46.20	12.98	N/A	N/A	59.18	74.00	14.82
		11550.00	H	Y	AV	37.63	12.98	2.57	N/A	53.18	54.00	0.82

**Note.**

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} / \text{Result} = \text{Reading} + \text{T.F} + \text{DCCF} + \text{DCF} / \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor

3. Measurement Distance = 3 m for below 18 GHz, Measurement Distance = 1 m for above 18 GHz.

Therefore Distance Correction Factor(DCF) : -  $9.54 \text{ dB} = 20 \times \log(1\text{m}/3\text{m})$

4. The limit is converted to field strength.

$$E[\text{dBuV/m}] = \text{EIRP}[\text{dBm}] + 95.2 \text{ dB} = -27 \text{ dBm} + 95.2 = 68.2 \text{ dBuV/m}$$

## 8.7 AC Conducted Emissions

### ■ Test Requirements and limit, §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

\* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### ■ Test Configuration

See test photographs for the actual connections between EUT and support equipment.

### ■ Test Procedure

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m  $\times$  3.5 m  $\times$  3.5 m (L  $\times$  W  $\times$  H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W)  $\times$  1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

### ■ Measurement Data: Comply

Note 1: See next pages for actual measured spectrum plots and data for worst case result.

**AC Line Conducted Emissions (Graph)**

Test Mode: U-NII 1 &amp; 802.11a &amp; 5240 MHz

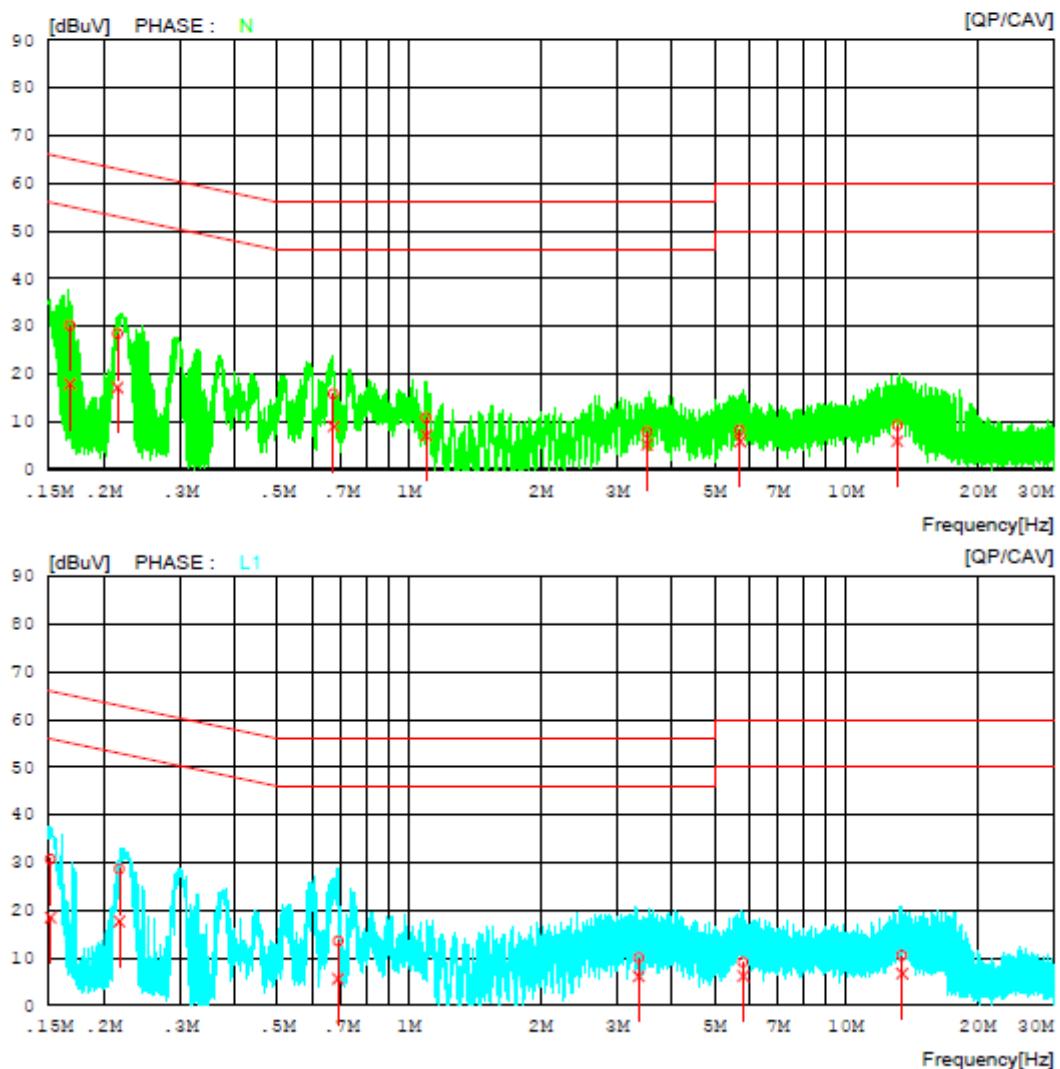
AC Line Conducted Emission

DT&amp;C

Date 2017-12-29

Model	EF501R
Power Supply	120 V / 60Hz
Temp/Humi/Atm	24°C / 39%
Test Condition	5.1G WLAN

Note

LIMIT : FCC P15.207 QP  
FCC P15.207 AV

**AC Line Conducted Emissions (Data List)**

Test Mode: U-NII 1 &amp; 802.11a &amp; 5240 MHz

**AC Line Conducted Emission**

DT&amp;C

Date 2017-12-29

Model EF501R  
 Power Supply 120 V / 60Hz  
 Temp/Humi/Atm 24'C / 39%  
 Test Condition 5.1G WLAN

Note

LIMIT : FCC P15.207 QP  
 FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.16752	20.51	8.26	9.64	30.15	17.90	65.08	55.08	34.93	37.18	N
2	0.21550	18.73	7.51	9.64	28.37	17.15	62.99	52.99	34.62	35.84	N
3	0.67250	6.15	-0.68	9.65	15.80	8.97	56.00	46.00	40.20	37.03	N
4	1.09602	1.18	-2.59	9.66	10.84	7.07	56.00	46.00	45.16	38.93	N
5	3.51106	-1.79	-4.47	9.69	7.90	5.22	56.00	46.00	48.10	40.78	N
6	5.72996	-1.61	-3.88	9.76	8.15	5.88	60.00	50.00	51.85	44.12	N
7	13.13096	-0.65	-3.96	9.87	9.22	5.91	60.00	50.00	50.78	44.09	N
8	0.15122	20.90	8.66	9.74	30.64	18.40	65.93	55.93	35.29	37.53	L1
9	0.21750	18.87	7.88	9.74	28.61	17.62	62.91	52.91	34.30	35.29	L1
10	0.68847	3.78	-4.17	9.75	13.53	5.58	56.00	46.00	42.47	40.42	L1
11	3.36028	0.15	-3.71	9.79	9.94	6.08	56.00	46.00	46.06	39.92	L1
12	5.82981	-0.80	-3.65	9.82	9.02	6.17	60.00	50.00	50.98	43.83	L1
13	13.46288	0.42	-3.29	9.94	10.36	6.65	60.00	50.00	49.64	43.35	L1

**AC Line Conducted Emissions (Graph)**

Test Mode: U-NII 2A &amp; 802.11a &amp; 5260 MHz

**AC Line Conducted Emission**

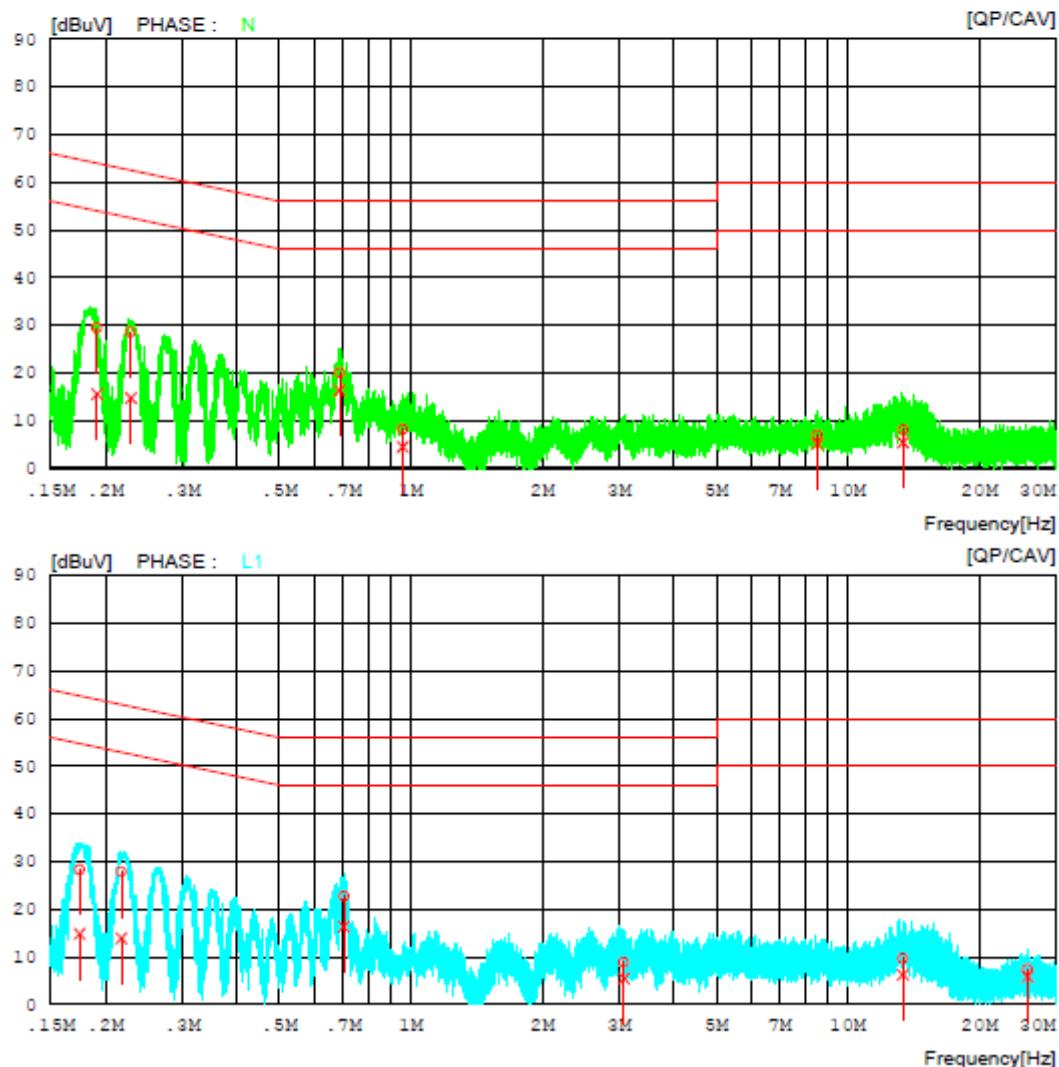
DT&amp;C

Date 2017-12-29

Model EF501R  
Power Supply 120 V / 60Hz  
Temp/Humi/Atm 24°C / 30%  
Test Condition 5.3G WLAN

## Note

LIMIT : FCC P15.207 QP  
FCC P15.207 AV



**AC Line Conducted Emissions (Data List)**

Test Mode: U-NII 2A &amp; 802.11a &amp; 5260 MHz

**AC Line Conducted Emission**

DT&amp;C

Date 2017-12-29

Model EF501R  
Power Supply 120 V / 60Hz  
Temp/Humi/Atm 24'C / 39%  
Test Condition 5.3G WLAN

Note

LIMIT : FCC P15.207 QP  
FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT [dBuV]		LIMIT [dBuV]		MARGIN [dBuV]		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.19136	19.83	5.81	9.64	29.47	15.45	63.98	53.98	34.51	38.53	N
2	0.22850	18.84	5.07	9.64	28.48	14.71	62.50	52.50	34.02	37.79	N
3	0.68631	10.33	6.64	9.65	19.98	16.29	56.00	46.00	36.02	29.71	N
4	0.95774	-1.52	-5.17	9.66	8.14	4.49	56.00	46.00	47.86	41.51	N
5	8.51623	-2.90	-4.72	9.84	6.94	5.12	60.00	50.00	53.06	44.88	N
6	13.38736	-1.80	-4.52	9.87	8.07	5.35	60.00	50.00	51.93	44.65	N
7	0.17450	18.56	5.07	9.74	28.30	14.81	64.74	54.74	36.44	39.93	L1
8	0.21750	18.04	4.10	9.74	27.78	13.84	62.91	52.91	35.13	39.07	L1
9	0.70297	12.90	6.50	9.75	22.65	16.25	56.00	46.00	33.35	29.75	L1
10	3.07086	-0.95	-4.30	9.78	8.83	5.48	56.00	46.00	47.17	40.52	L1
11	13.38074	-0.27	-3.74	9.94	9.67	6.20	60.00	50.00	50.33	43.80	L1
12	25.79500	-2.64	-4.23	9.98	7.34	5.75	60.00	50.00	52.66	44.25	L1

**AC Line Conducted Emissions (Graph)**

Test Mode: U-NII 2C &amp; 802.11a &amp; 5580 MHz

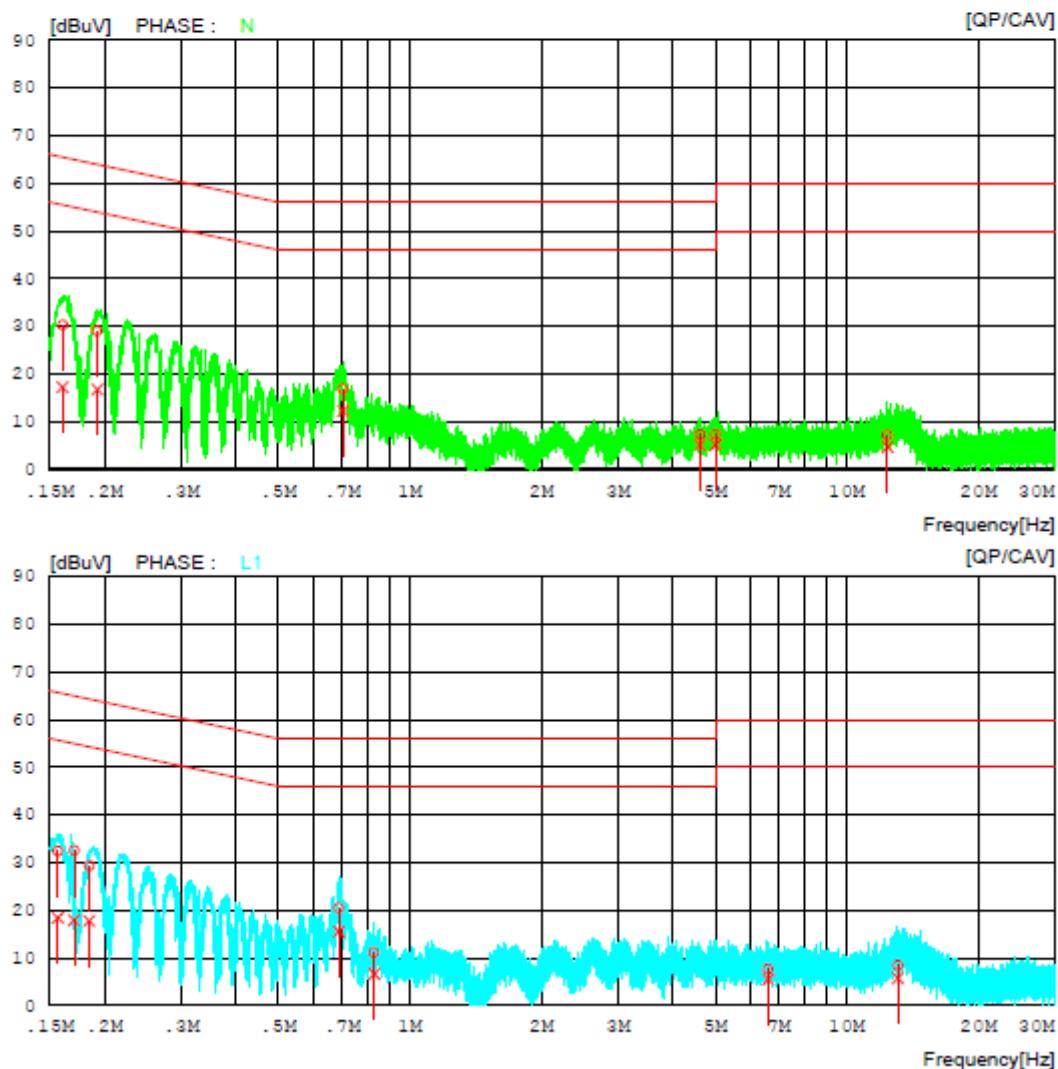
**AC Line Conducted Emission**

DT&amp;C

Date 2017-12-29

Model	EF501R
Power Supply	120 V / 60Hz
Temp/Humi/Atm	24°C / 39%
Test Condition	5.5G WLAN

## Note

LIMIT : FCC P15.207 QP  
FCC P15.207 AV

**AC Line Conducted Emissions (Data List)**

Test Mode: U-NII 2C &amp; 802.11a &amp; 5580 MHz

**AC Line Conducted Emission**

DT&amp;C

Date 2017-12-29

Model EF501R  
 Power Supply 120 V / 60Hz  
 Temp/Humi/Atm 24°C / 39%  
 Test Condition 5.5G WLAN

Note

LIMIT : FCC P15.207 QP  
 FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.16050	20.62	7.56	9.64	30.26	17.20	65.44	55.44	35.18	38.24	N
2	0.19250	19.38	7.14	9.64	29.02	16.78	63.93	53.93	34.91	37.15	N
3	0.70372	7.20	2.54	9.65	16.85	12.19	56.00	46.00	39.15	33.81	N
4	4.61374	-2.47	-4.63	9.70	7.23	5.07	56.00	46.00	48.77	40.93	N
5	5.00990	-2.48	-4.49	9.71	7.23	5.22	60.00	50.00	52.77	44.78	N
6	12.38374	-2.70	-5.12	9.86	7.16	4.74	60.00	50.00	52.84	45.26	N
7	0.15650	22.61	8.62	9.74	32.35	18.36	65.65	55.65	33.30	37.29	L1
8	0.17050	22.69	8.09	9.74	32.43	17.83	64.94	54.94	32.51	37.11	L1
9	0.18450	19.52	7.99	9.74	29.26	17.73	64.28	54.28	35.02	36.55	L1
10	0.68761	10.69	5.67	9.75	20.44	15.42	56.00	46.00	35.56	30.58	L1
11	0.82850	1.36	-3.11	9.75	11.11	6.64	56.00	46.00	44.89	39.36	L1
12	6.61012	-2.28	-4.40	9.83	7.55	5.43	60.00	50.00	52.45	44.57	L1
13	13.08729	-1.53	-4.22	9.92	8.39	5.70	60.00	50.00	51.61	44.30	L1

**AC Line Conducted Emissions (Graph)**

Test Mode: U-NII 3 &amp; 802.11a &amp; 5745 MHz

**AC Line Conducted Emission**

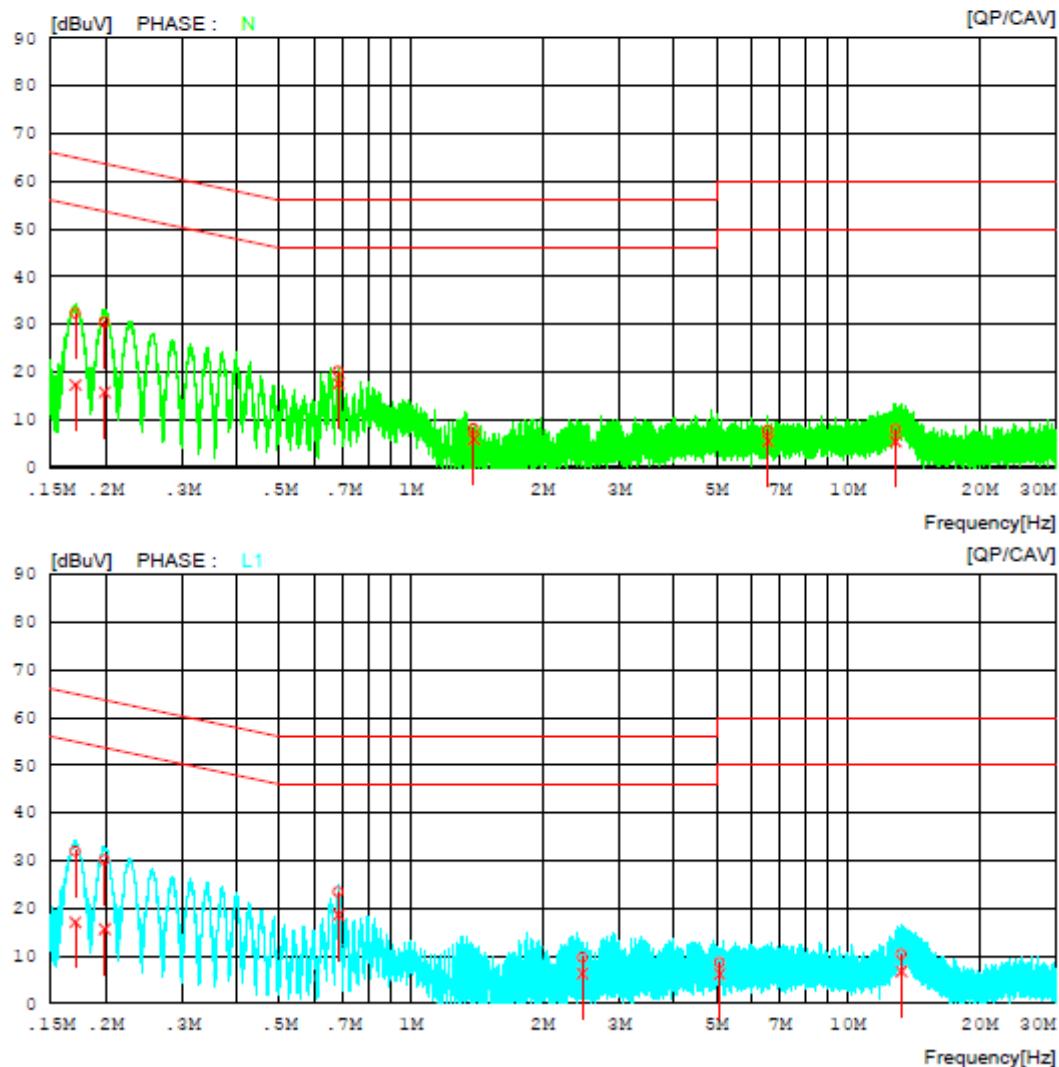
DT&amp;C

Date 2017-12-29

Model EF501R  
Power Supply 120 V / 60Hz  
Temp/Humi/Atm 24°C / 39%  
Test Condition 5.7G WLAN

Note

LIMIT : FCC P15.207 QP  
FCC P15.207 AV



**AC Line Conducted Emissions (Data List)**

Test Mode: U-NII 3 &amp; 802.11a &amp; 5745 MHz

**AC Line Conducted Emission**

DT&amp;C

Date 2017-12-29

Model EF501R  
 Power Supply 120 V / 60Hz  
 Temp/Humi/Atm 24'C / 39%  
 Test Condition 5.7G WLAN

Note

LIMIT : FCC P15.207 QP  
 FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.17063	22.63	7.62	9.64	32.27	17.26	64.93	54.93	32.66	37.67	N
2	0.19911	20.84	6.07	9.64	30.48	15.71	63.65	53.65	33.17	37.94	N
3	0.68205	10.43	7.92	9.65	20.08	17.57	56.00	46.00	35.92	28.43	N
4	1.39376	-1.55	-3.82	9.66	8.11	5.84	56.00	46.00	47.89	40.16	N
5	6.56352	-2.10	-4.31	9.81	7.71	5.50	60.00	50.00	52.29	44.50	N
6	12.87167	-1.87	-4.50	9.86	7.99	5.36	60.00	50.00	52.01	44.64	N
7	0.17056	22.13	7.27	9.74	31.87	17.01	64.93	54.93	33.06	37.92	L1
8	0.19919	20.29	5.85	9.74	30.03	15.59	63.64	53.64	33.61	38.05	L1
9	0.68215	13.66	8.75	9.75	23.41	18.50	56.00	46.00	32.59	27.50	L1
10	2.47207	-0.21	-3.56	9.78	9.57	6.22	56.00	46.00	46.43	39.78	L1
11	5.08933	-1.26	-3.69	9.81	8.55	6.12	60.00	50.00	51.45	43.88	L1
12	13.26716	0.39	-3.25	9.94	10.33	6.69	60.00	50.00	49.67	43.31	L1

## 9. LIST OF TEST EQUIPMENT

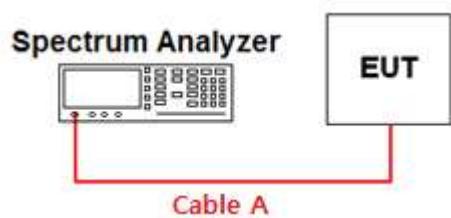
Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	17/09/06	18/09/06	MY48011075
Spectrum Analyzer	Agilent Technologies	N9020A	17/09/05	18/09/05	MY46471251
Multimeter	FLUKE	17B	17/04/12	18/04/12	26030065WS
DC Power Supply	SM techno	SDP30-5D	17/09/08	18/09/08	305DMG304
Signal Generator	Rohde Schwarz	SMBV100A	17/01/04	18/01/04	255571
Signal Generator	Rohde Schwarz	SMF100A	17/04/21	18/04/21	102341
Thermohygrometer	BODYCOM	BJ5478	17/04/11	18/04/11	120612-2
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	17/01/25	18/01/25	SJ-TH-S50-120203
50W 10dB ATT	SMAJK	SMAJK-50-10	17/09/06	18/09/06	2-50-10
Loop Antenna	Schwarzbeck	FMZB1513	16/04/22	18/04/22	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	16/08/05	18/08/05	9160-3362
Horn Antenna	ETS-LINDGREN	3117	16/05/03	18/05/03	00140394
Horn Antenna	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
PreAmplifier	Agilent	8449B	17/09/05	18/09/05	3008A02108
PreAmplifier	TSJ	MLA-010K01-B01-27	17/03/06	18/03/06	1844539
PreAmplifier	A.H.Systems Inc.	PAM-1840VH	17/09/17	18/09/17	163
EMI Test Receiver	Rohde Schwarz	ESR7	17/02/16	18/02/16	101061
EMI Test Receiver	Rohde Schwarz	ESR7	17/11/16	18/11/16	101109
High-pass filter	Wainwright	WHNX6-6320-8000-26500-40CC	17/09/05	18/09/05	1
TRANSIENT LIMITER	EMCIS	TL-B0930A	17/09/07	18/09/07	11002
SINGLE-PHASE MASTER	NF	4420	17/09/01	18/09/01	3049354420023
TWO-LINE V-NETWORK	Rohde Schwarz	ENV216	17/10/10	18/10/10	101979
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	17/04/11	18/04/11	1338004 1306053

Note: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.

## APPENDIX I

### Conducted Test set up Diagram

- Conducted Measurement



## APPENDIX II

### Duty Cycle Information

#### ■ Test Procedure

**Duty Cycle [X = On Time / ( On + Off time )]** is measured using Measurement Procedure of **KDB789033 D02v02r01**

1. Set the center frequency of the spectrum analyzer to the center frequency of the transmission.
2. Set RBW  $\geq$  EBW if possible; otherwise, set RBW to the largest available value.
3. Set VBW  $\geq$  RBW. Set detector = peak.
4. Note : The zero-span measurement method shall not be used unless both **RBW and VBW are  $> 50/T$** , where  $T$  is defined in section II.B.1.a), and **the number of sweep points across duration  $T$  exceeds 100**. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if  $T \leq 16.7$  microseconds.)

$T$ : The minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

( $T$ = On time of the above table since the EUT operates with above fixed Duty Cycle and it is the minimum On time)

#### ■ Test Results:

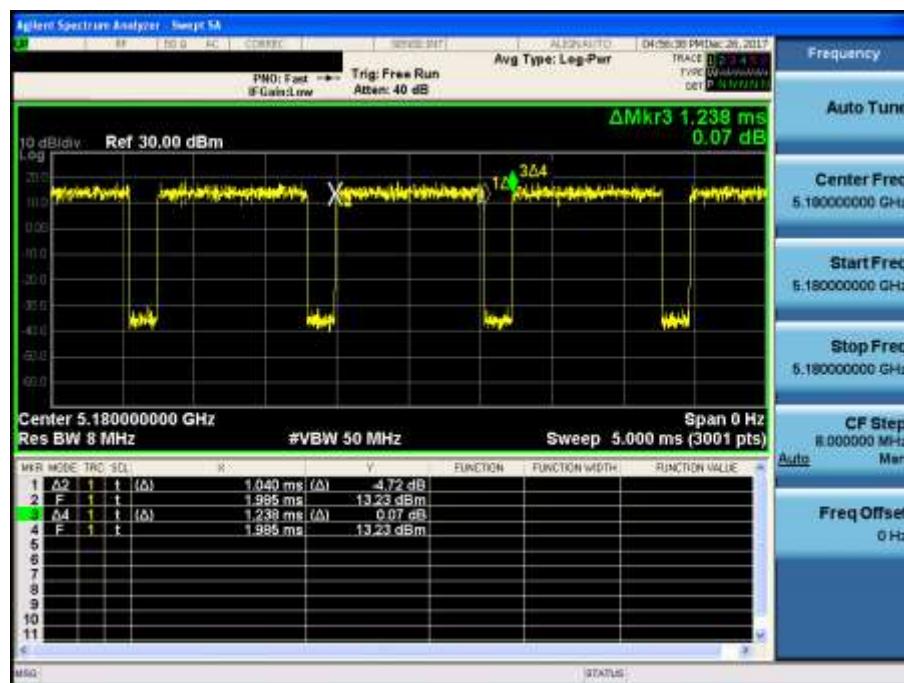
##### Duty cycle

Mode	Data Rate	Tested Frequency [MHz]	Maximum Achievable Duty Cycle ( $x$ ) = On / (On+Off)			Duty Cycle Correction Factor [dB]	$50/T$ [kHz]
			On Time [ms]	(On+Off) Time [ms]	$x$		
802.11a	6Mbps	5180	1.04	1.24	84.01	0.76	48.08
802.11n (HT20)	MCS0	5180	0.98	1.17	83.12	0.81	51.28
802.11n (HT40)	MCS0	5190	0.49	0.69	70.89	1.50	102.67
802.11ac (VHT80)	MCS0	5210	0.25	0.45	55.36	2.57	201.61

## Single Transmit

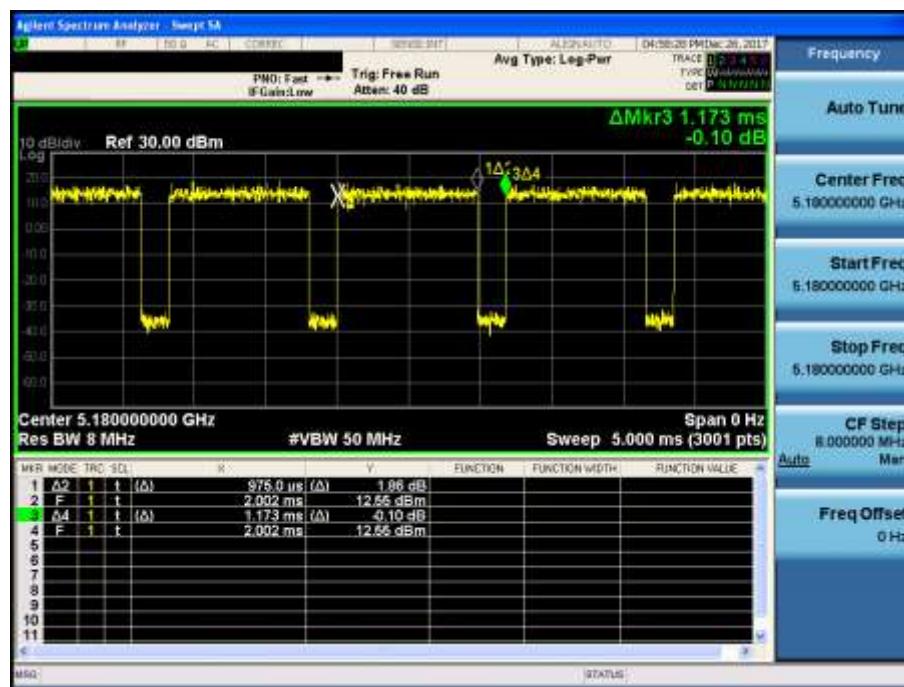
### Duty Cycle

Test Mode: 802.11a & Ch.36



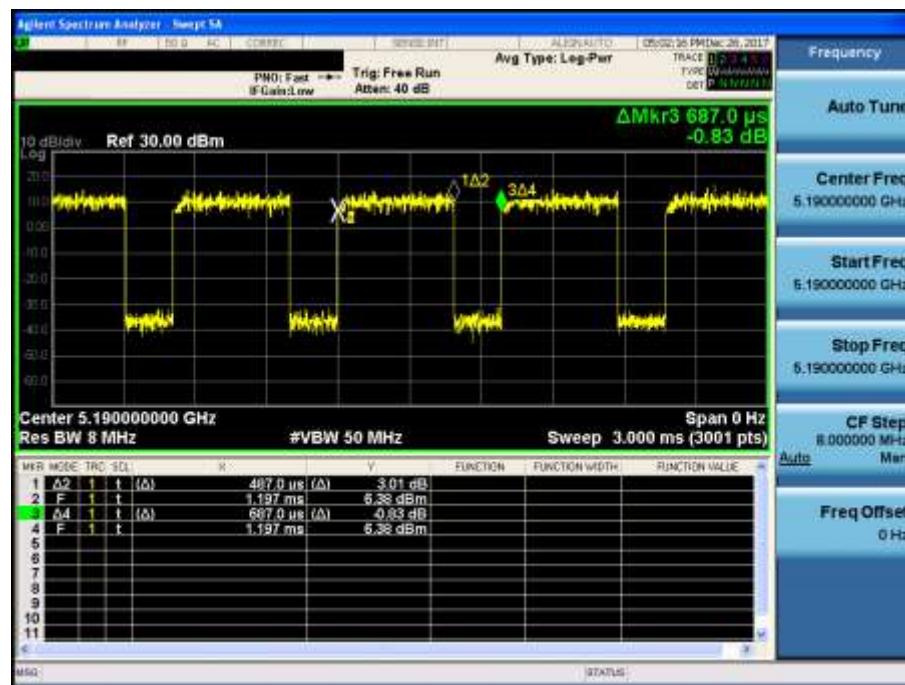
### Duty Cycle

Test Mode: 802.11n HT20 & Ch.36

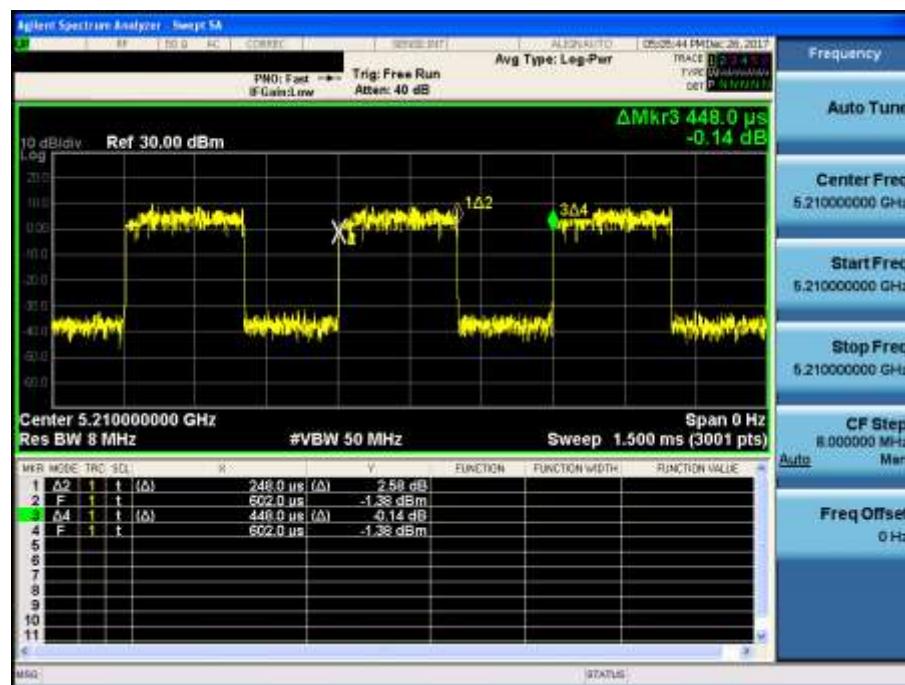


**Duty Cycle**

Test Mode: 802.11n HT40 &amp; Ch.38

**Duty Cycle**

Test Mode: 802.11ac VHT80 &amp; Ch.42

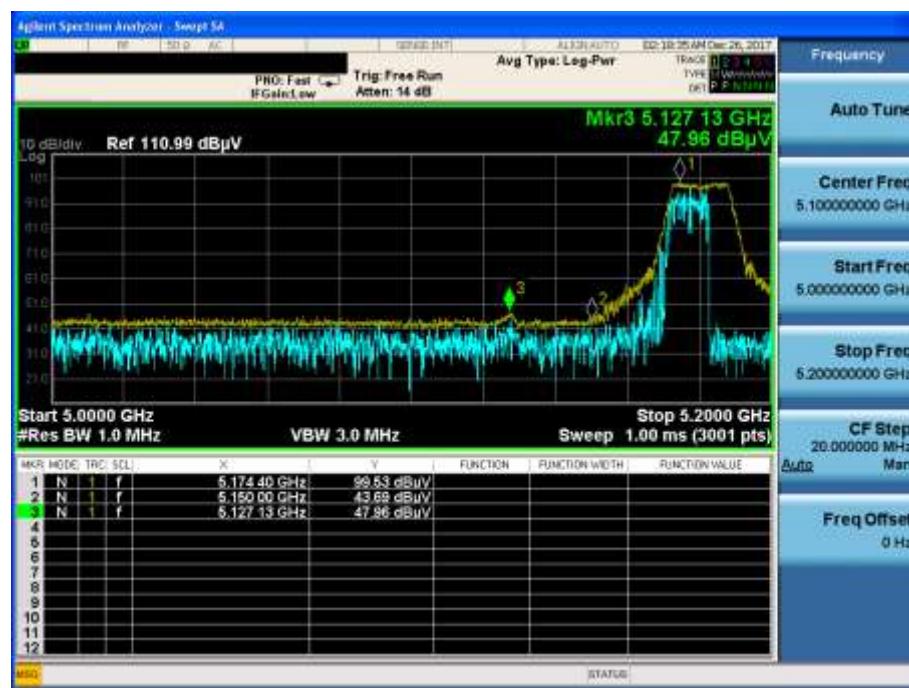


## APPENDIX III

### Unwanted Emissions (Radiated) Test Plot

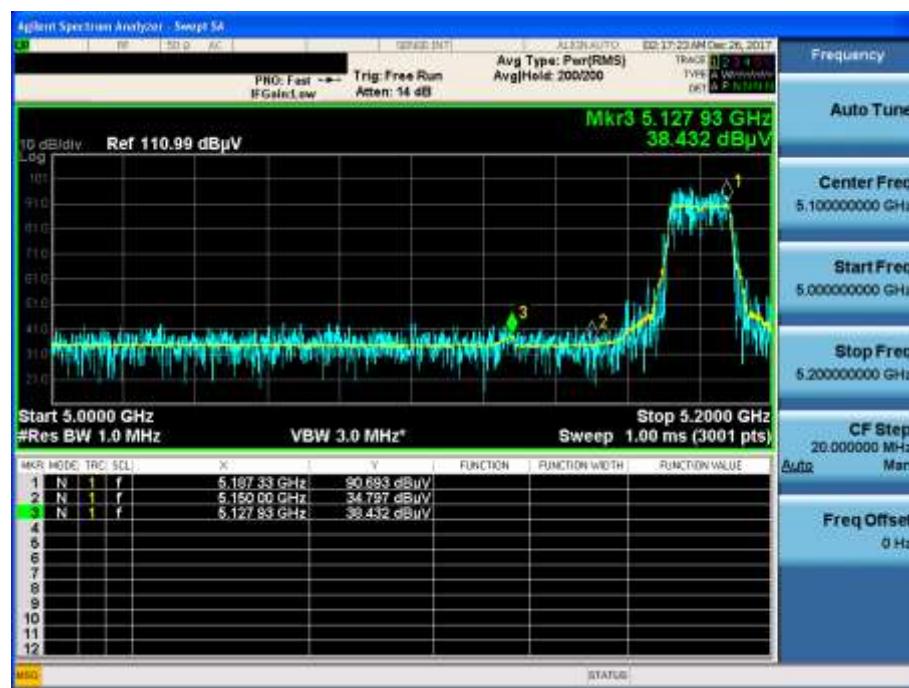
802.11a & U-NII 1 & Ch.36 & X axis & Hor

Detector Mode : PK



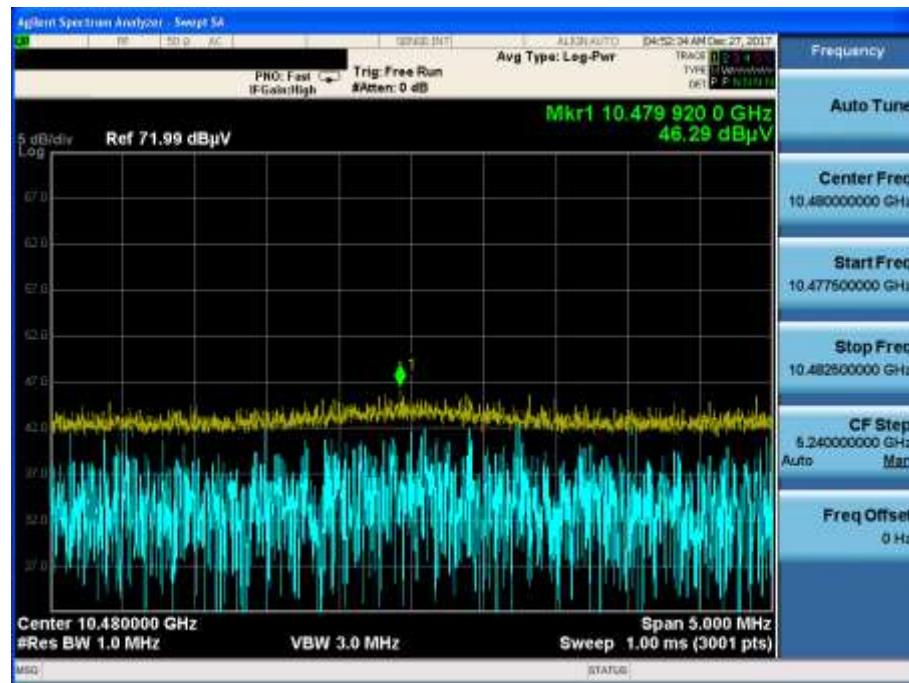
802.11a & U-NII 1 & Ch.36 & X axis & Hor

Detector Mode : AV



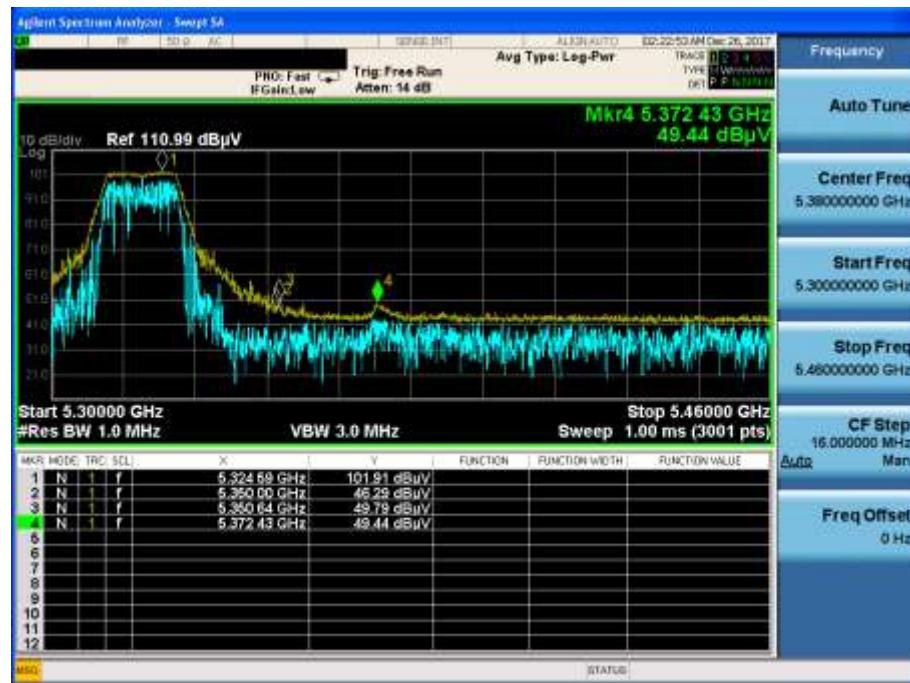
802.11a &amp; U-NII 1 &amp; Ch.48 &amp; Yaxis &amp; Hor

Detector Mode : PK



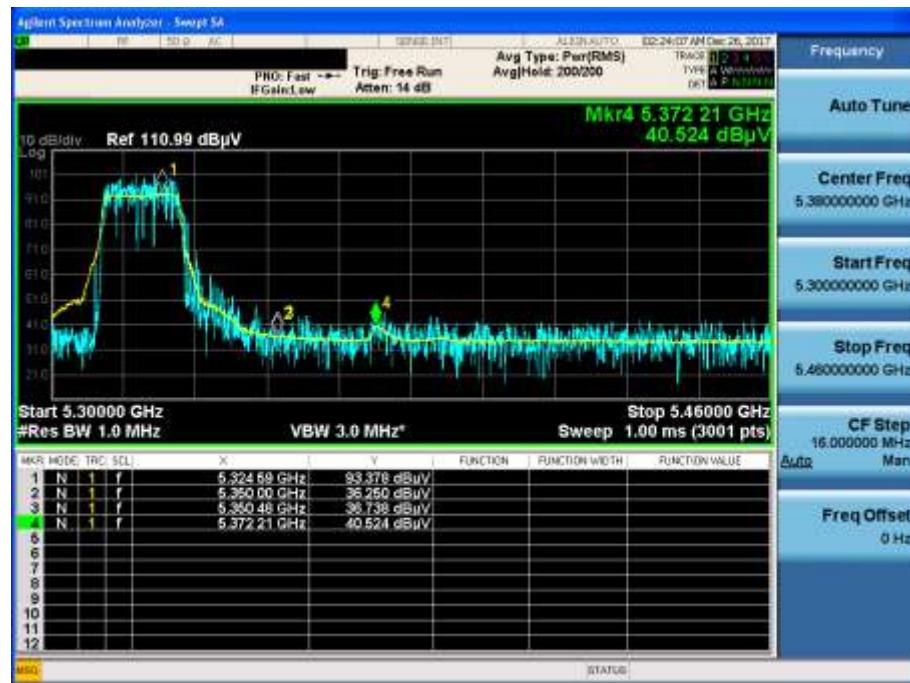
802.11a &amp; U-NII 2A &amp; Ch.64 &amp; X axis &amp; Hor

Detector Mode : PK



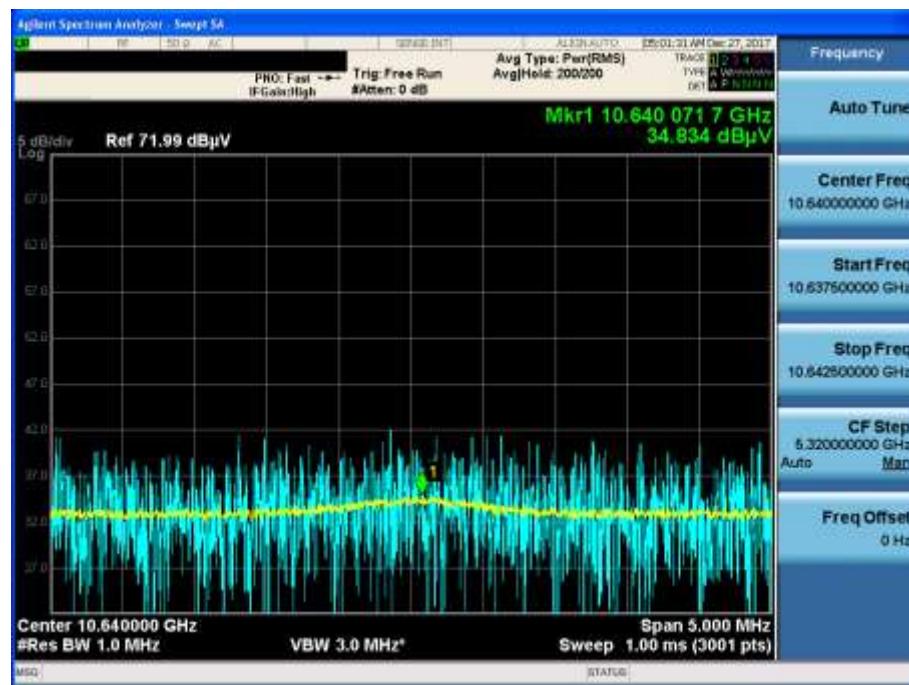
802.11a &amp; U-NII 2A &amp; Ch.64 &amp; X axis &amp; Hor

Detector Mode : AV



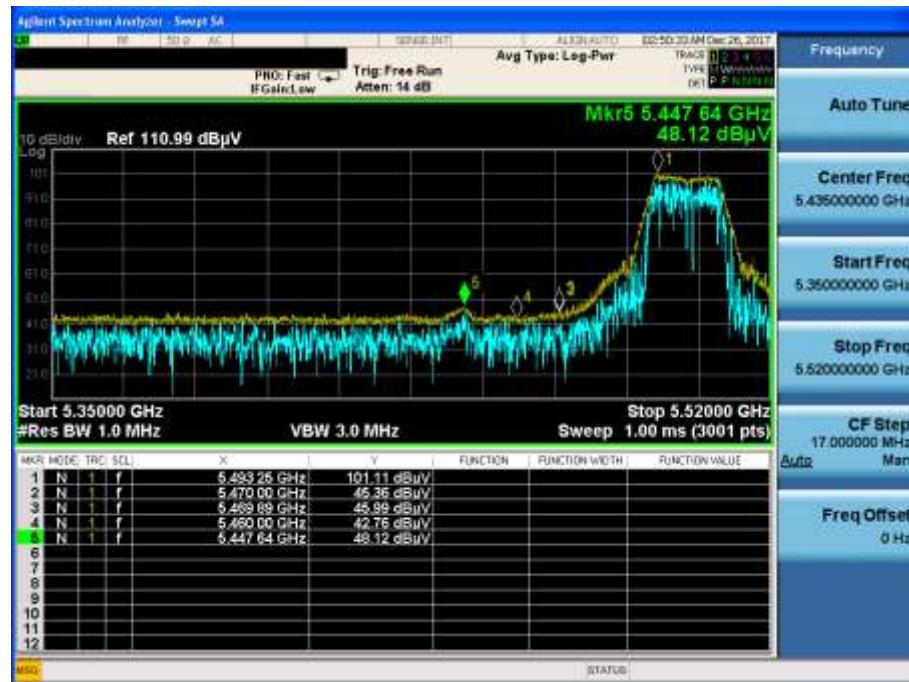
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Detector Mode : AV



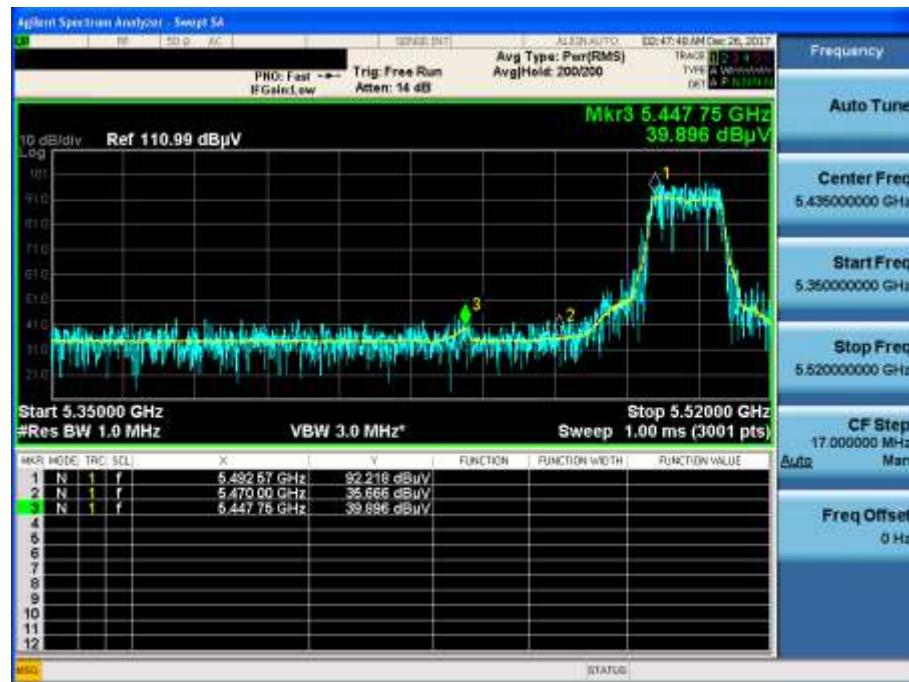
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Detector Mode : PK



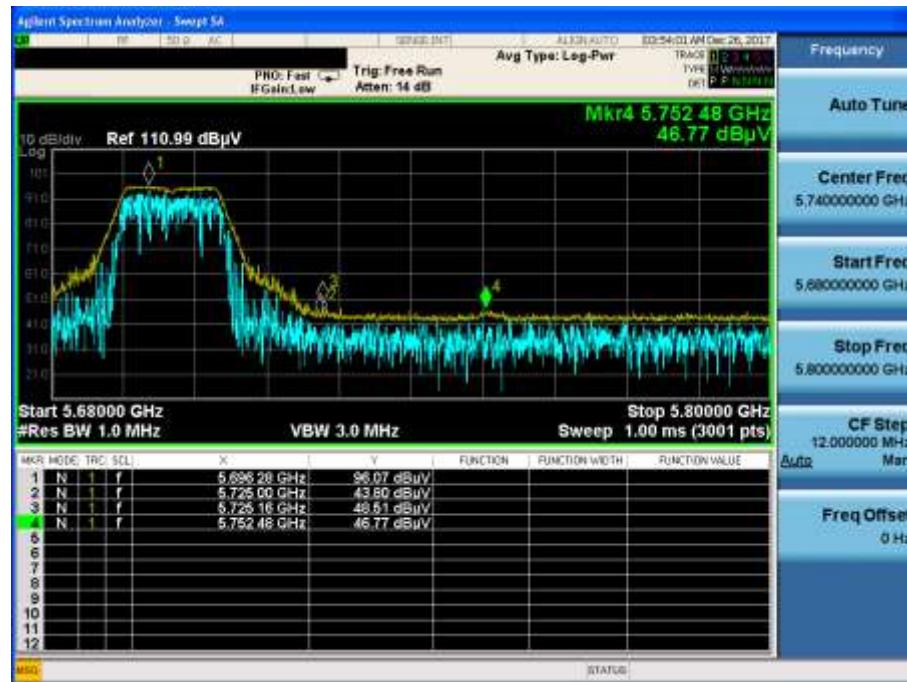
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Detector Mode : AV



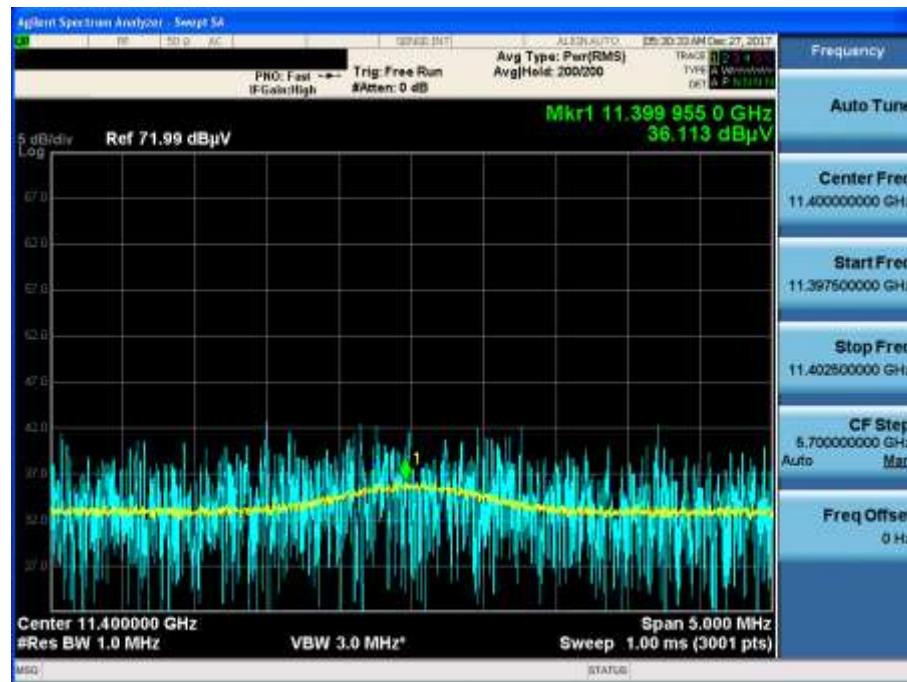
802.11a &amp; U-NII 2C &amp; Ch.140 &amp; X axis &amp; Hor

Detector Mode : PK



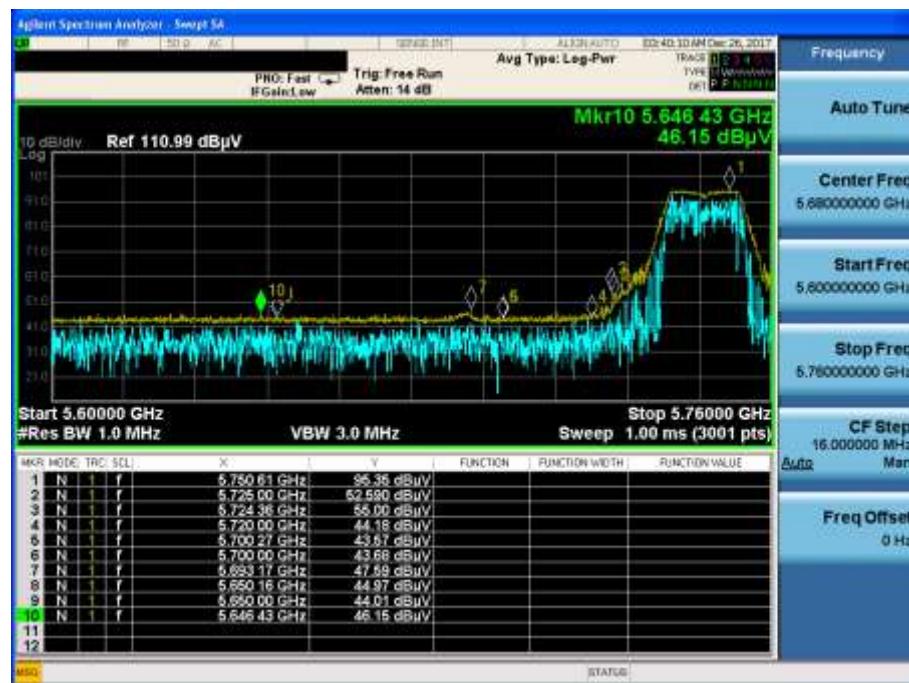
802.11a &amp; U-NII 2C &amp; Ch.140 &amp; Y axis &amp; Hor

Detector Mode : AV



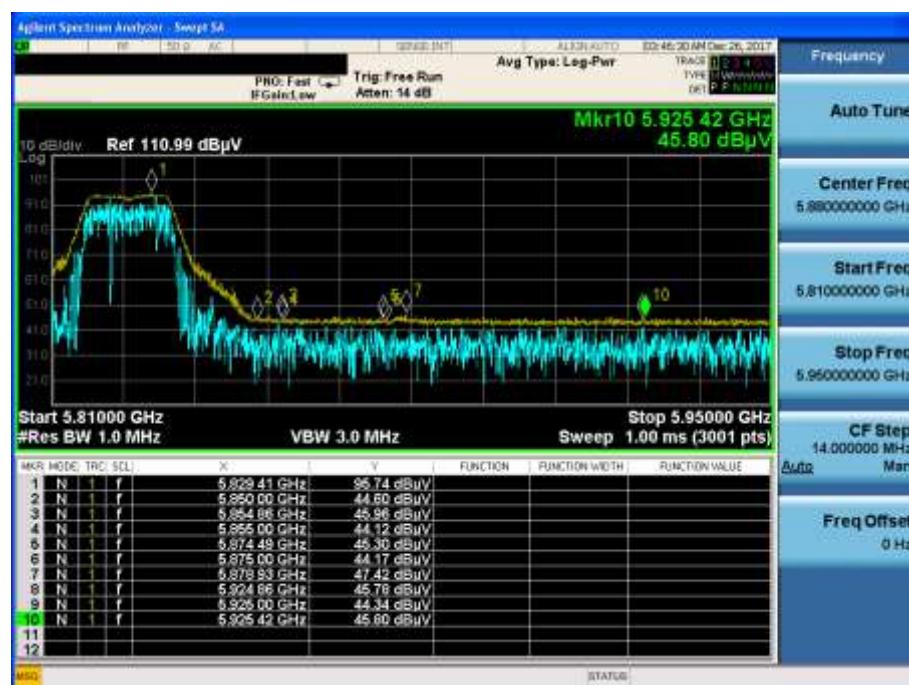
802.11a &amp; U-NII 3 &amp; Ch.149 &amp; Y axis &amp; Ver

Detector Mode : PK



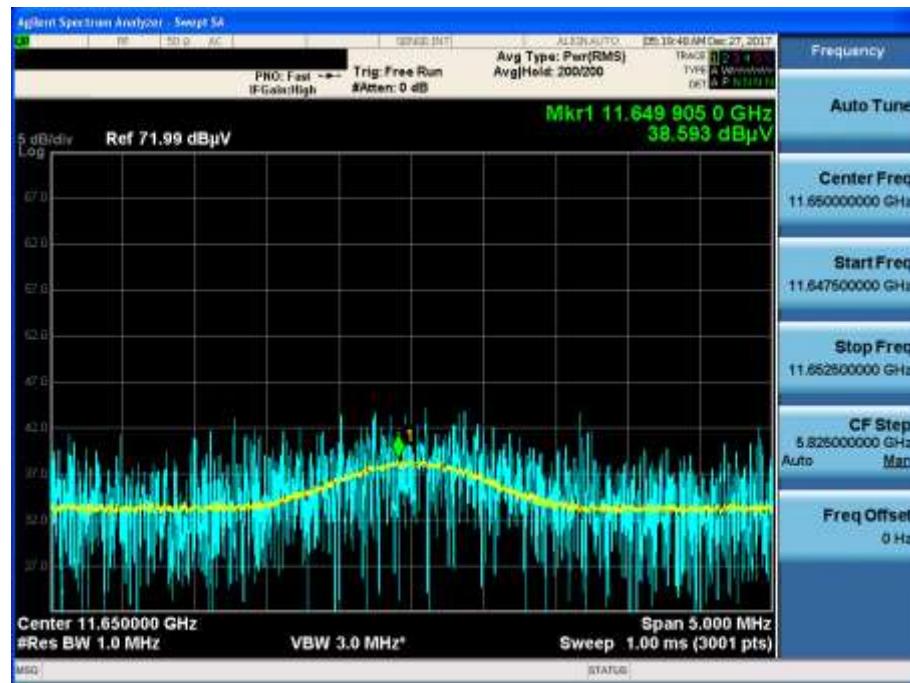
802.11a &amp; U-NII 3 &amp; Ch.165 &amp; Y axis &amp; Ver

Detector Mode : PK



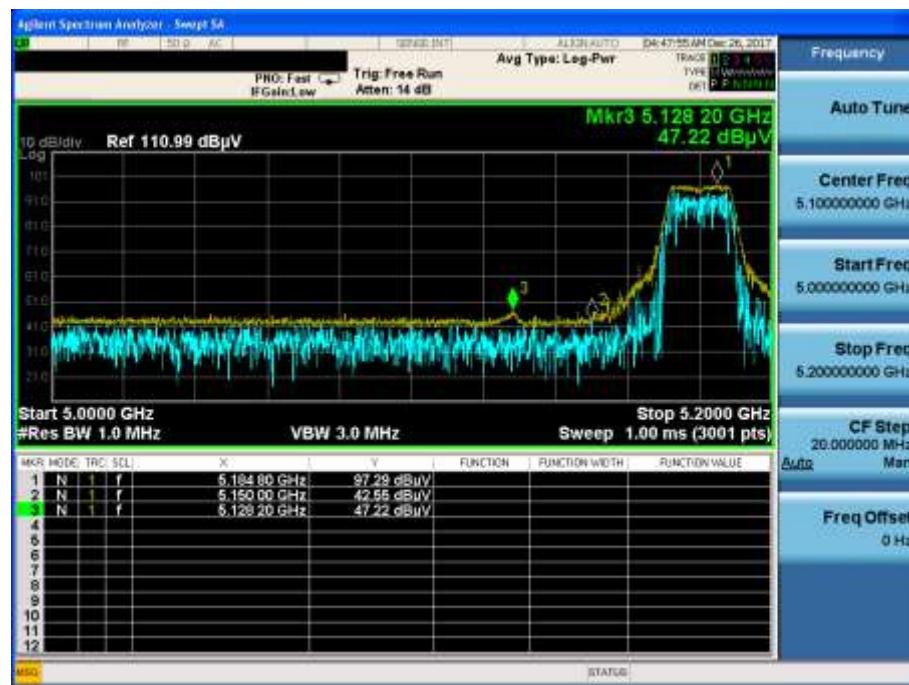
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Detector Mode : AV



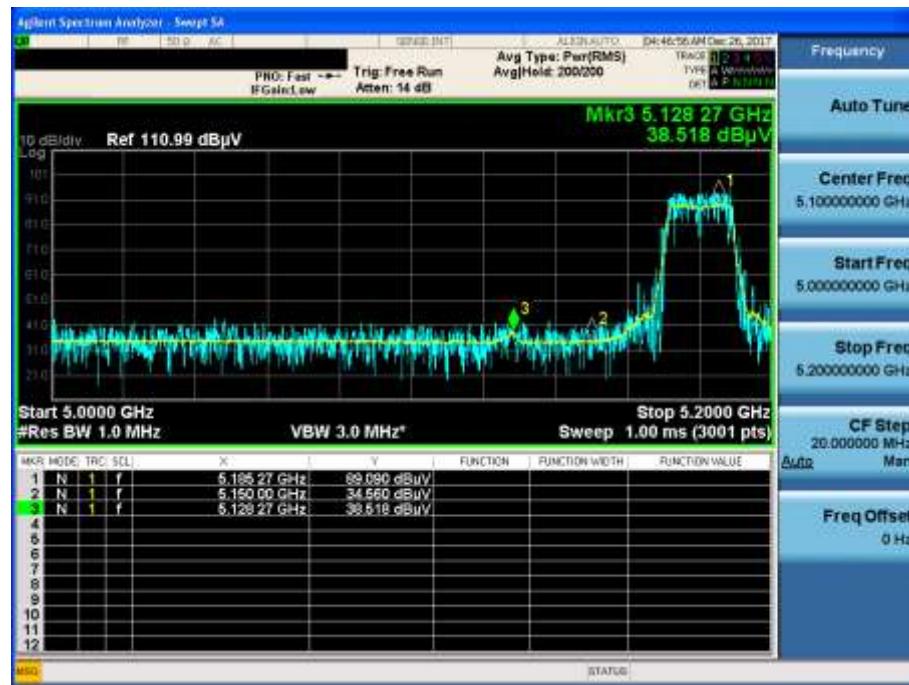
802.11n(HT20) &amp; U-NII 1 &amp; Ch.36 &amp; X axis &amp; Hor

Detector Mode : PK



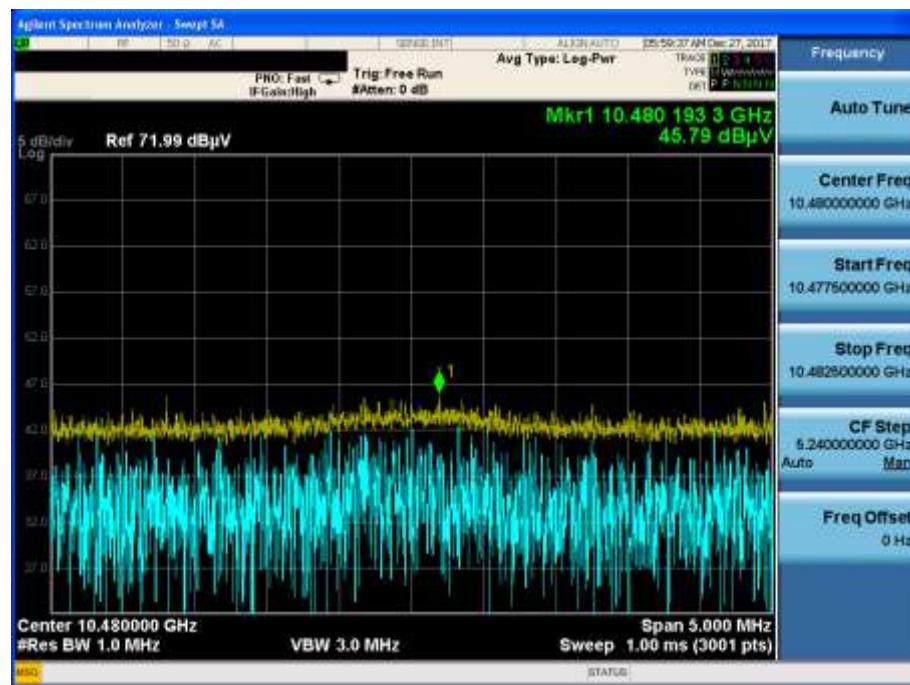
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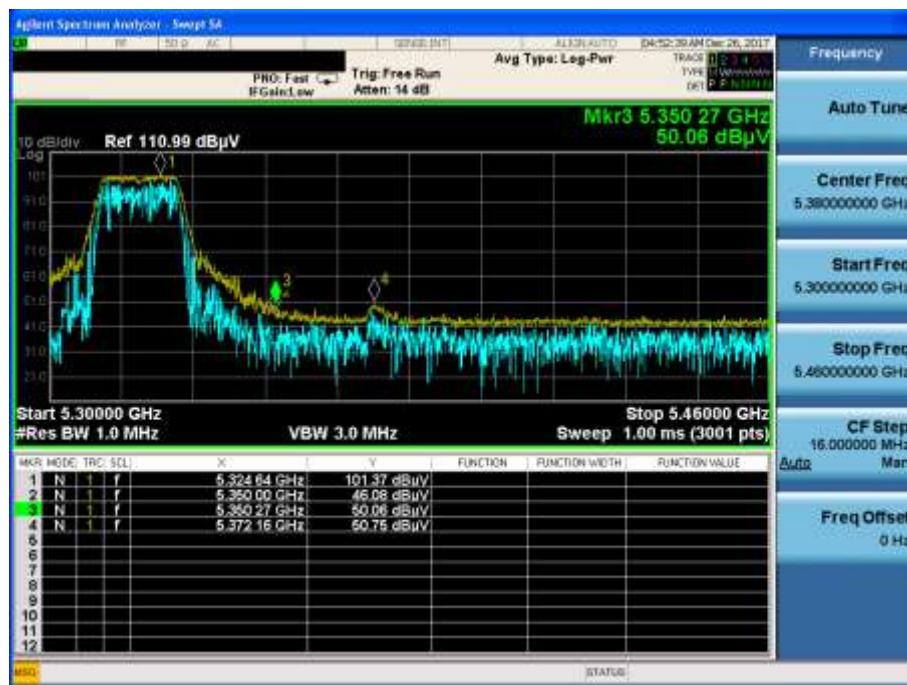
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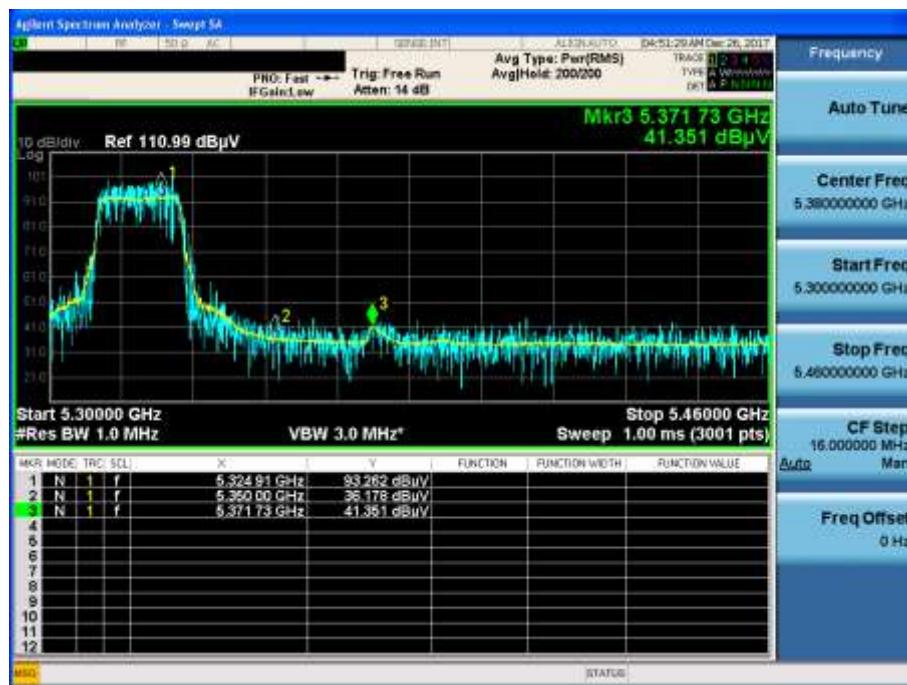
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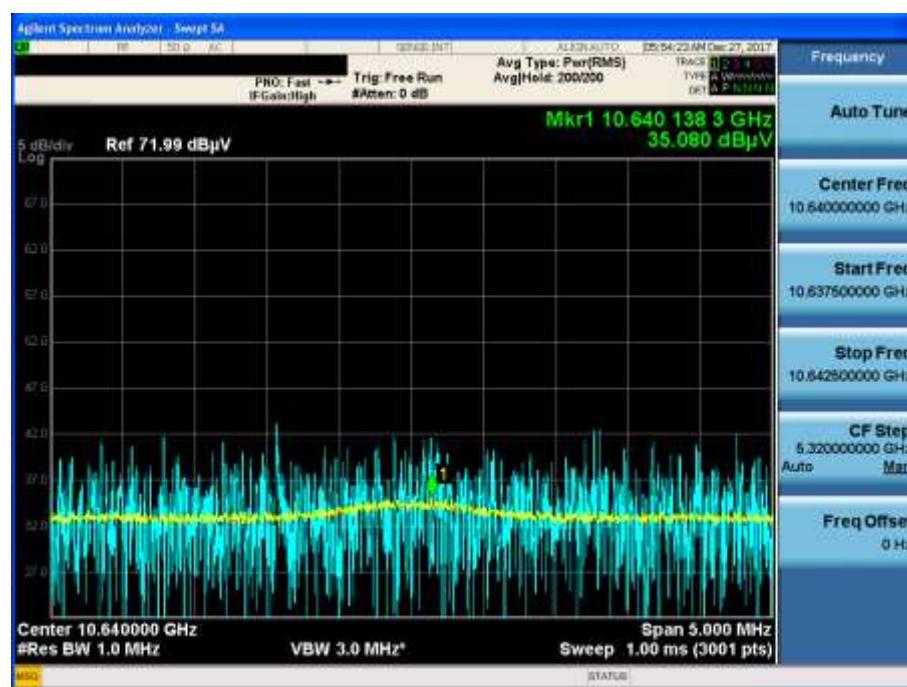
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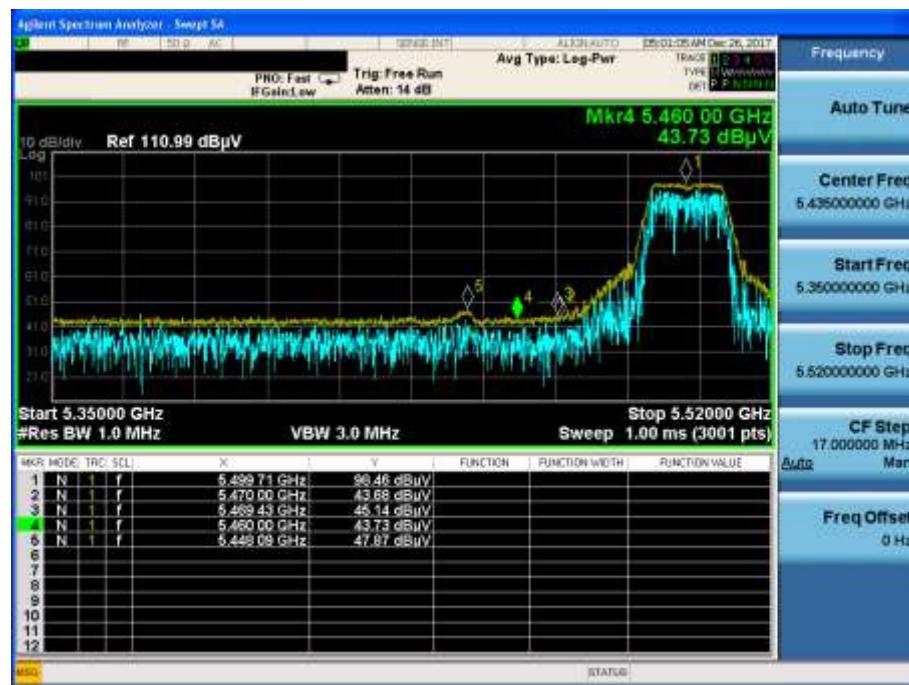
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Detector Mode : AV



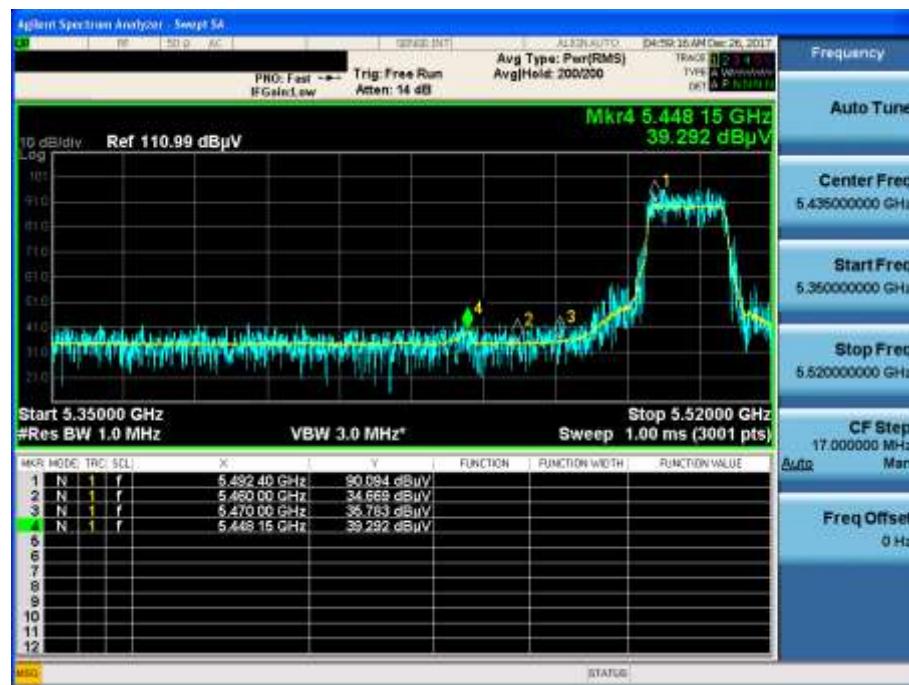
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Detector Mode : PK



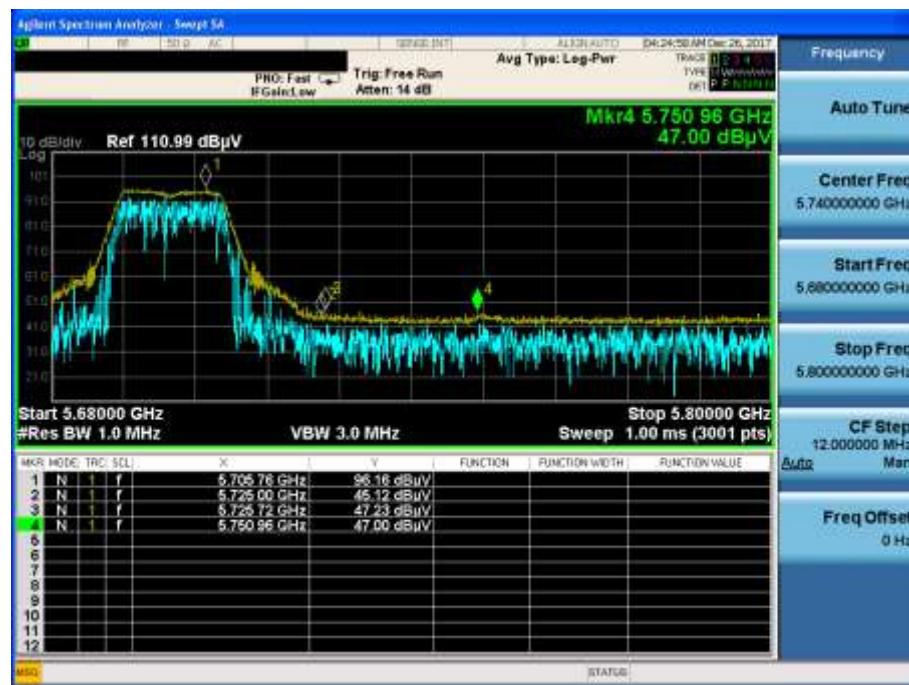
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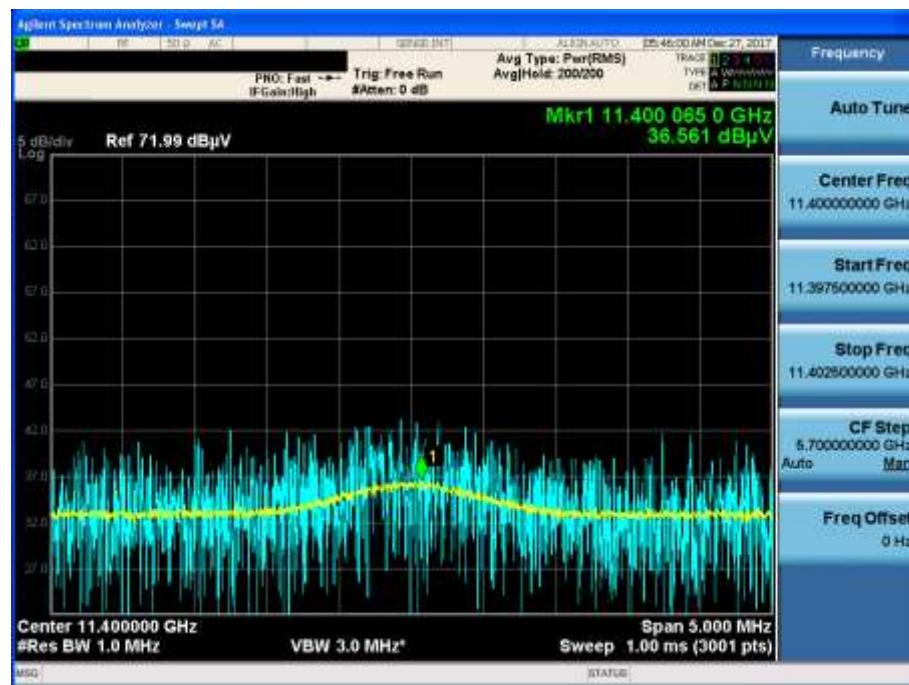
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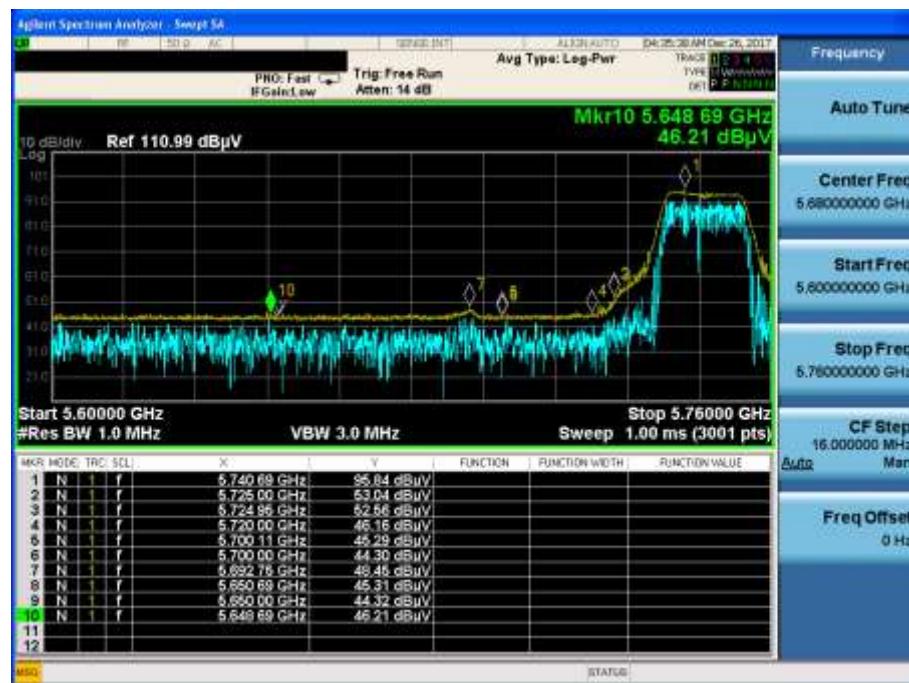
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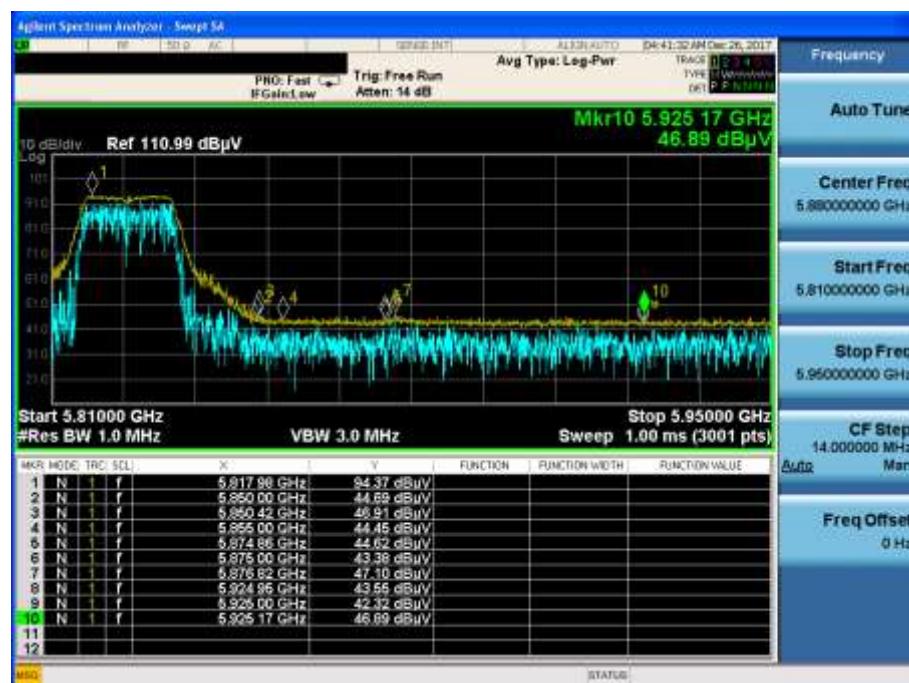
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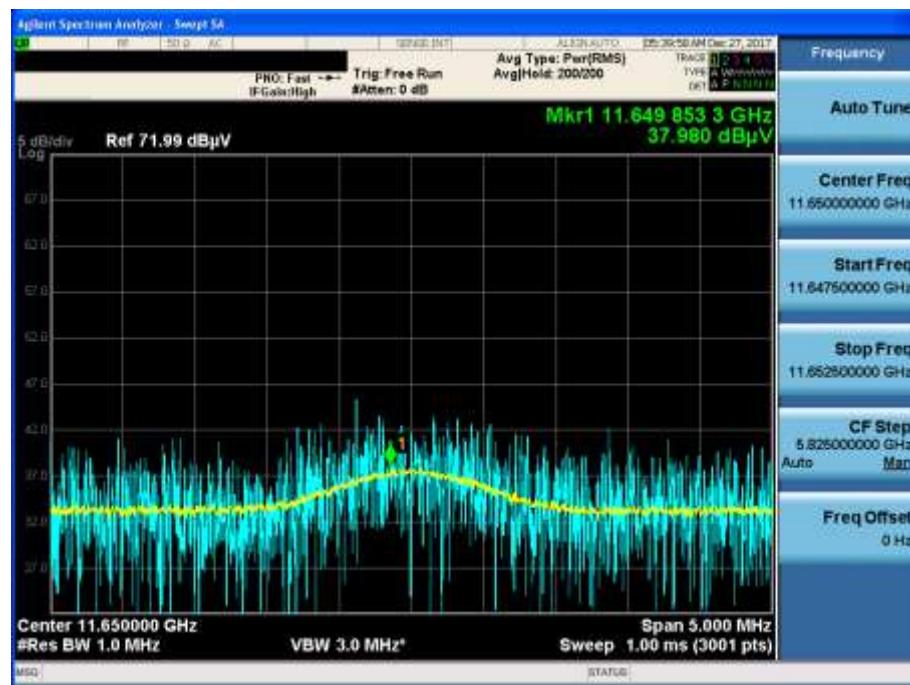
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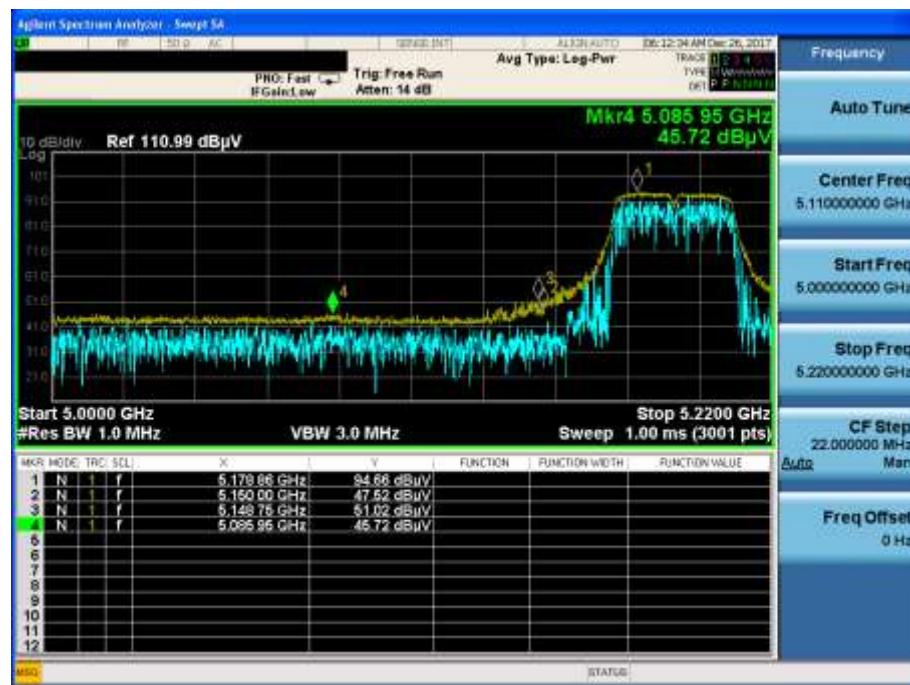
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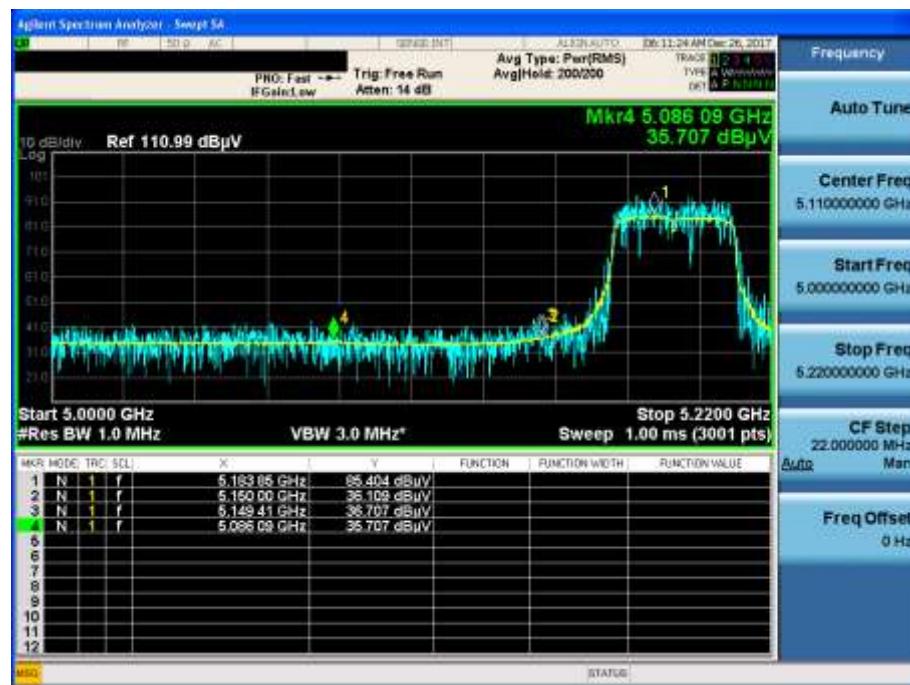
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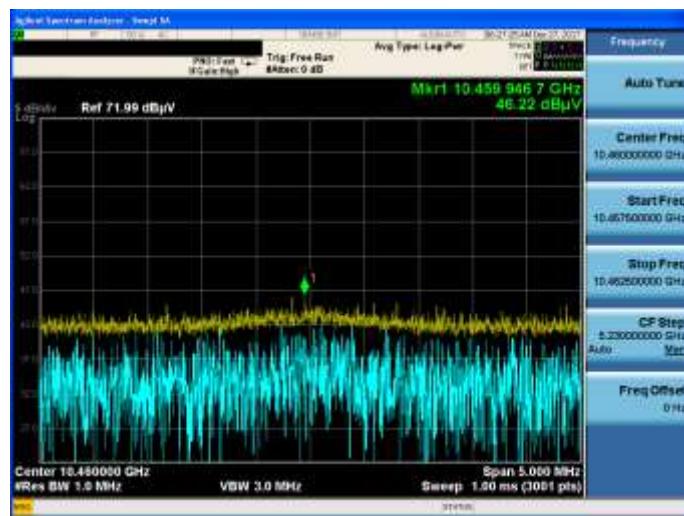
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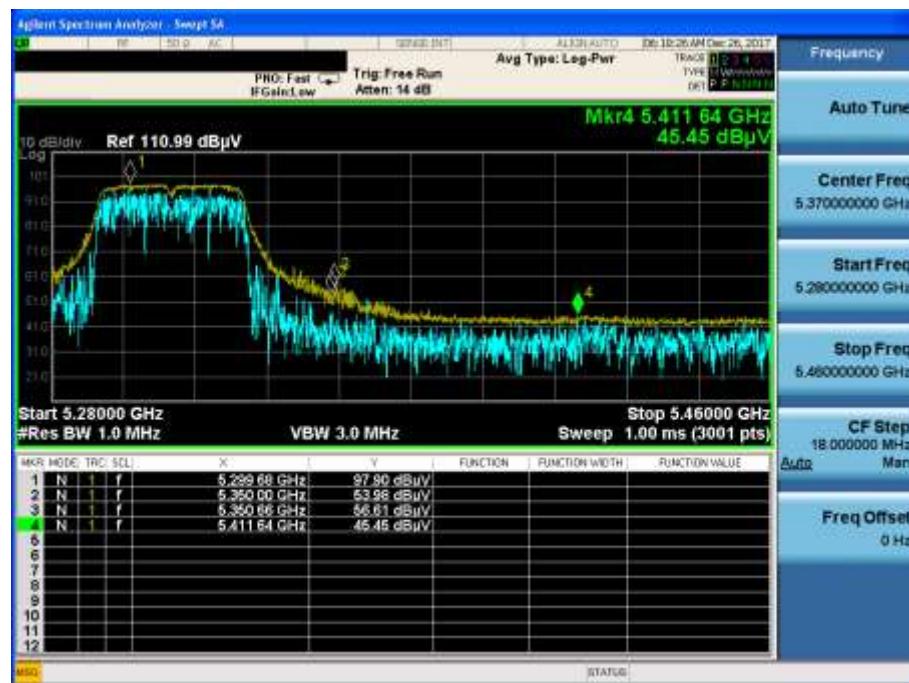
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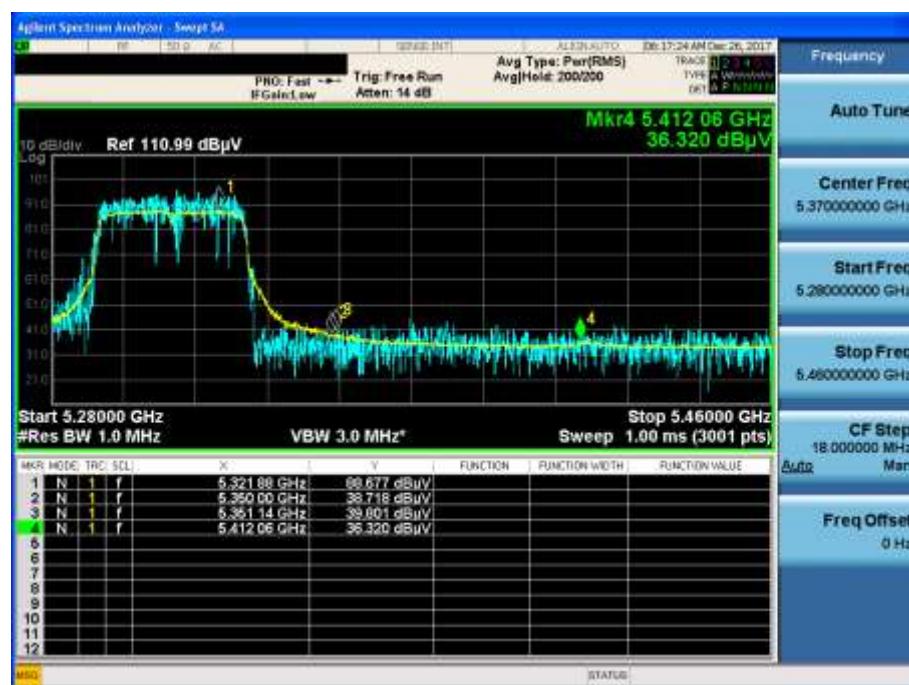
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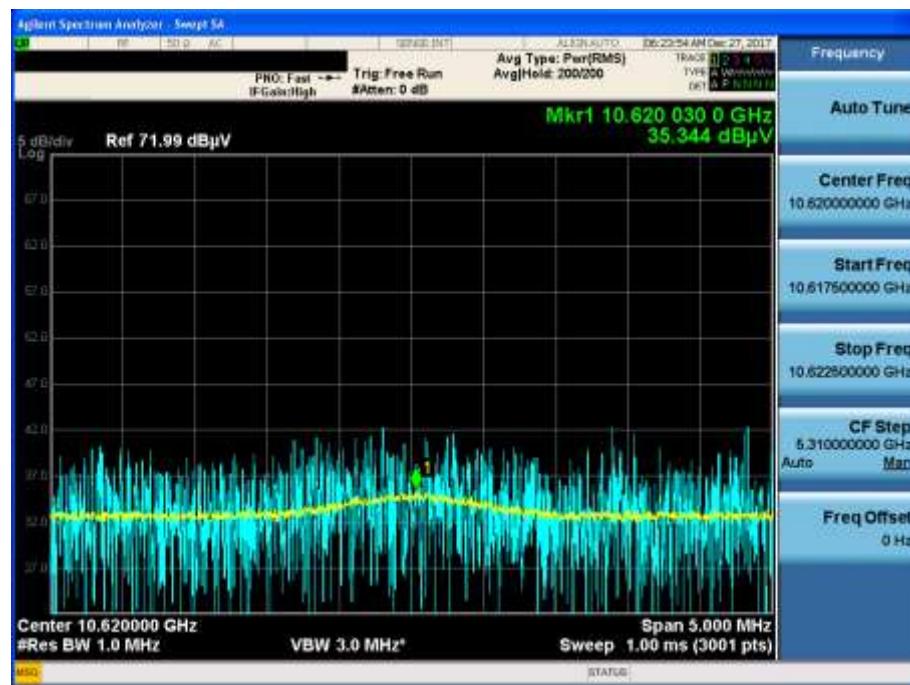
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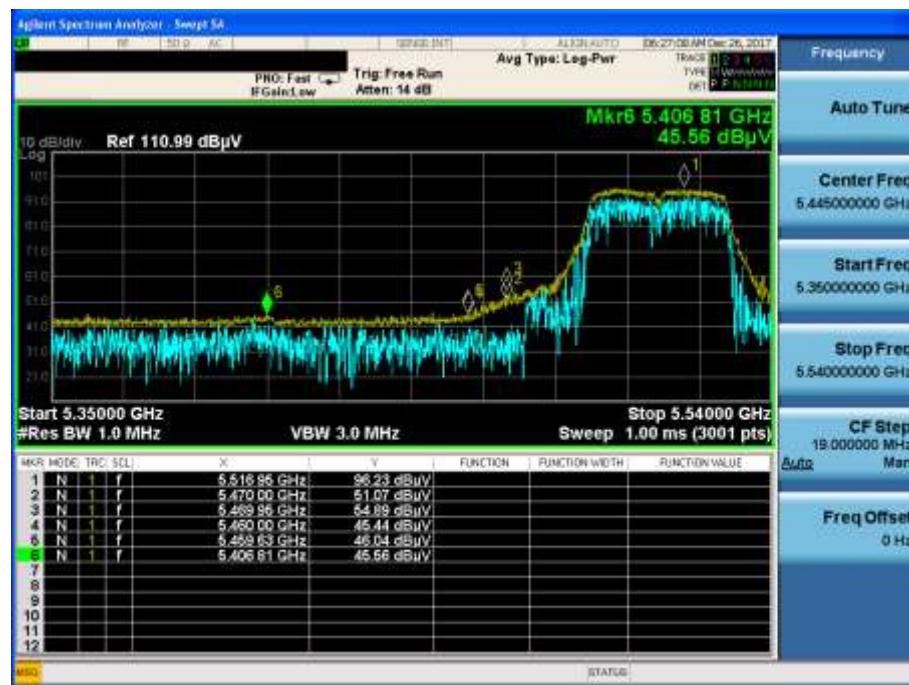
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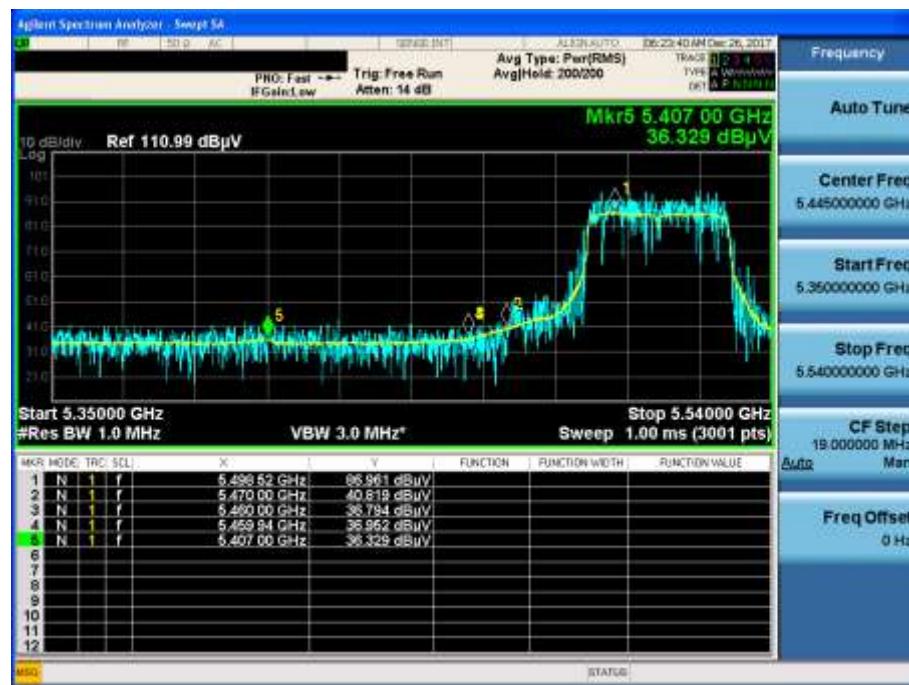
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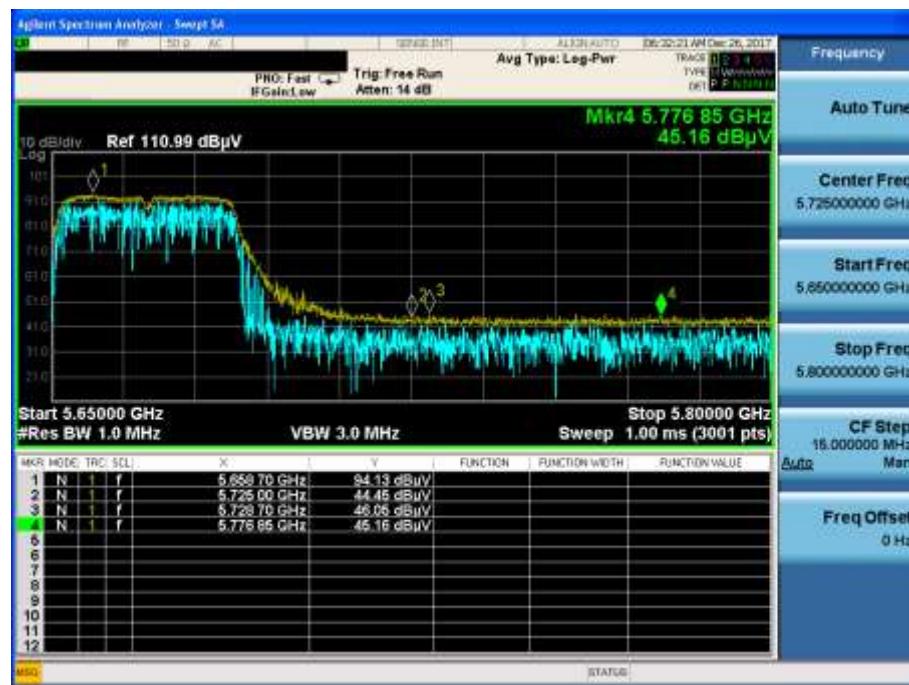
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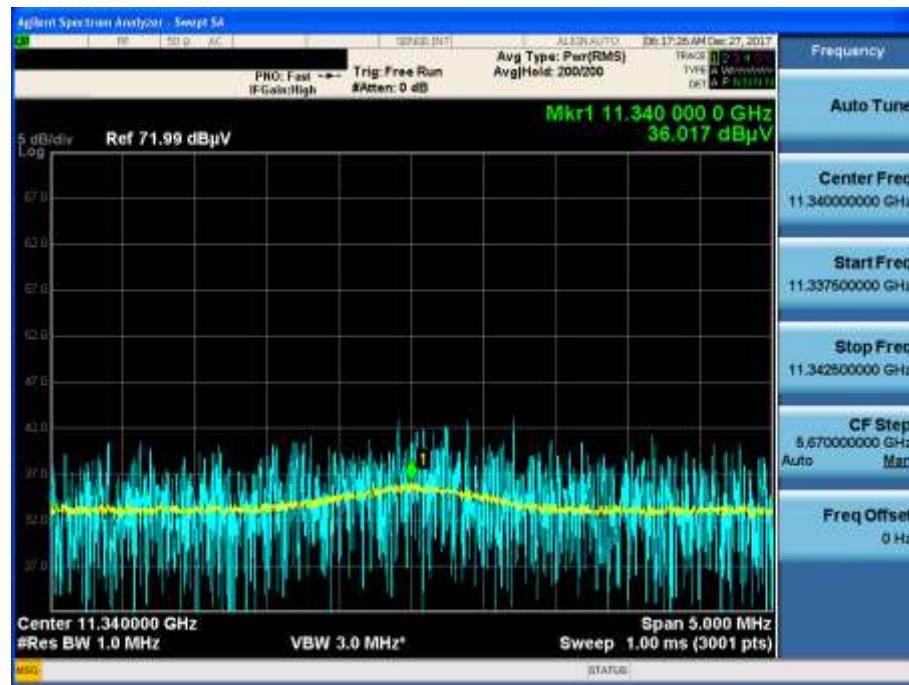
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Detector Mode : PK



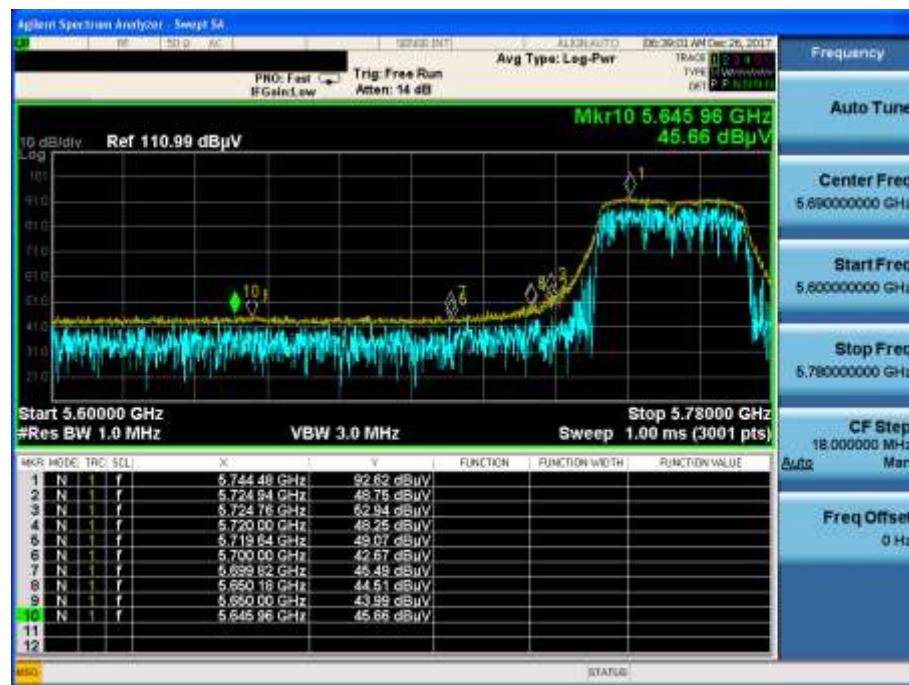
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Detector Mode : AV



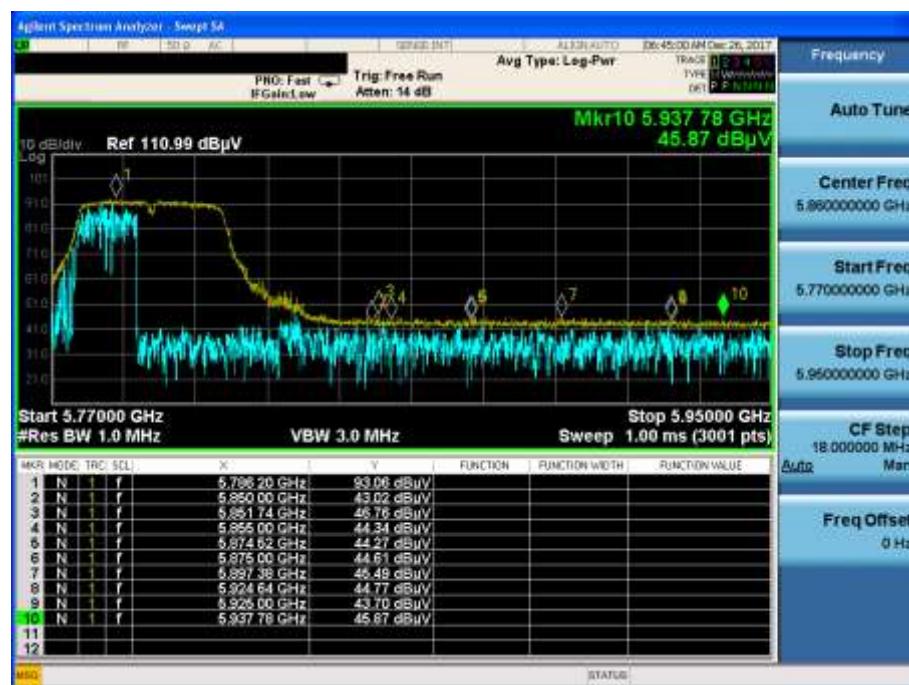
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Detector Mode : PK



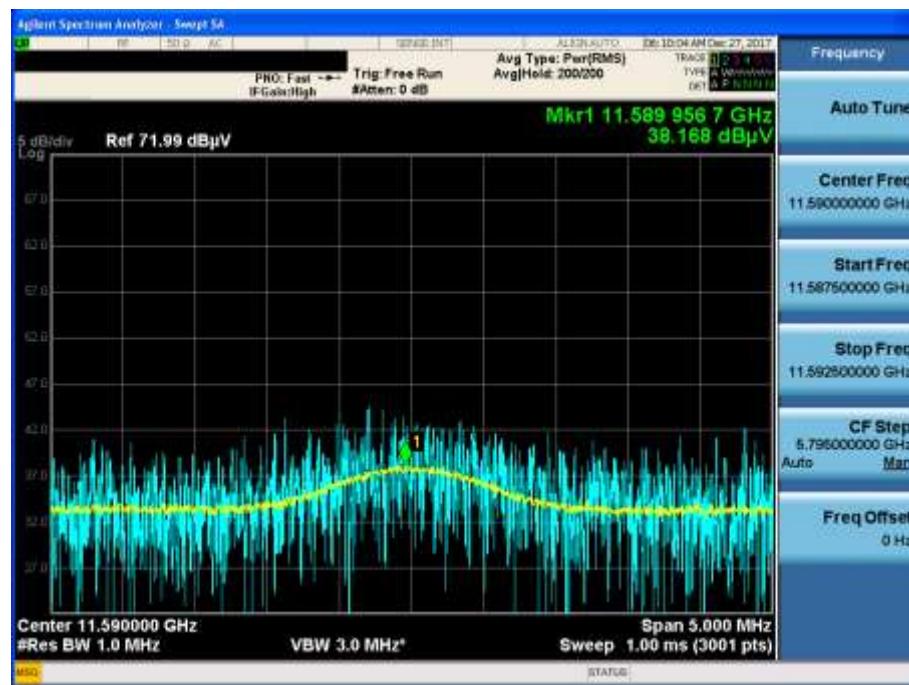
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Detector Mode : PK



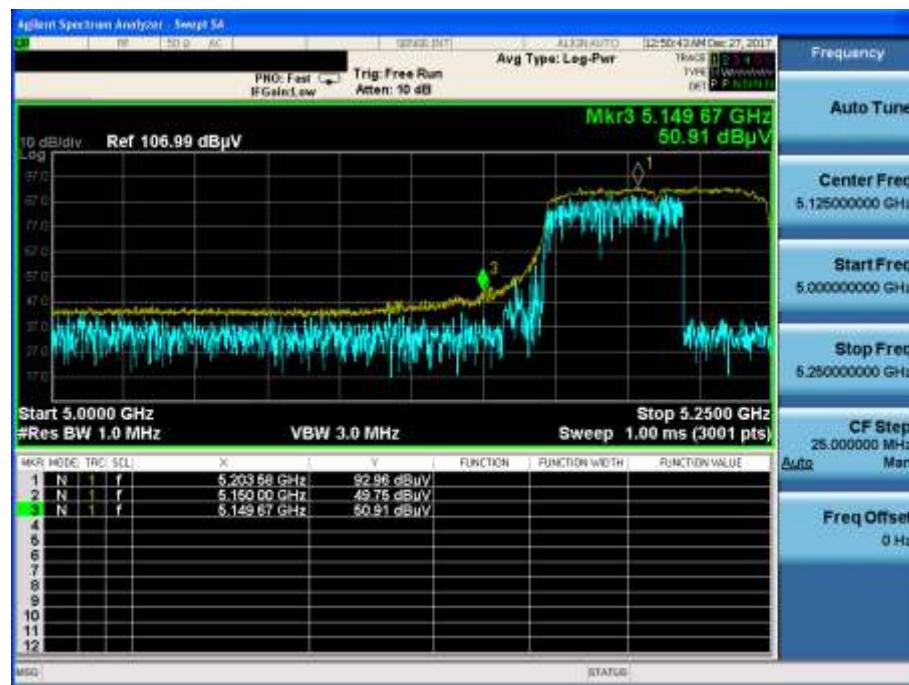
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Detector Mode : AV



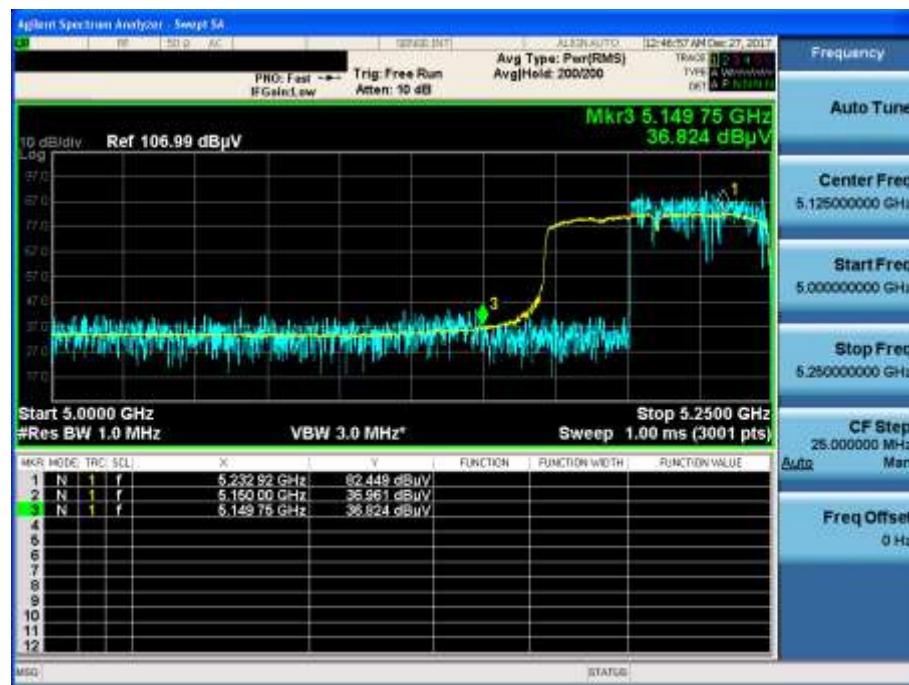
802.11ac(VHT80) &amp; U-NII 1 &amp; Ch.42 &amp; X axis &amp; Hor

Detector Mode : PK



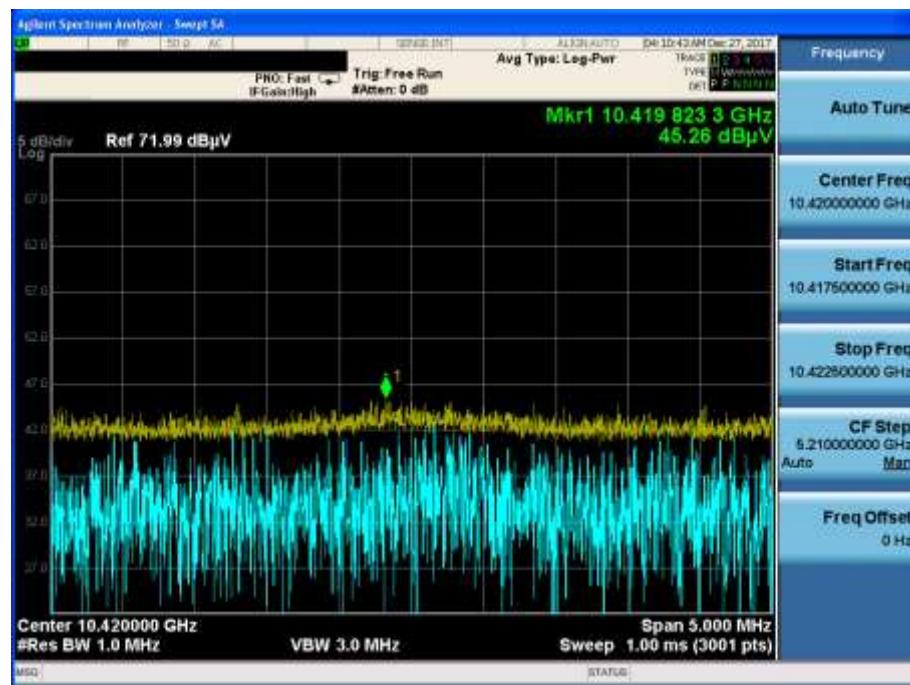
802.11ac(VHT80) &amp; U-NII 1 &amp; Ch.42 &amp; X axis &amp; Hor

Detector Mode : AV



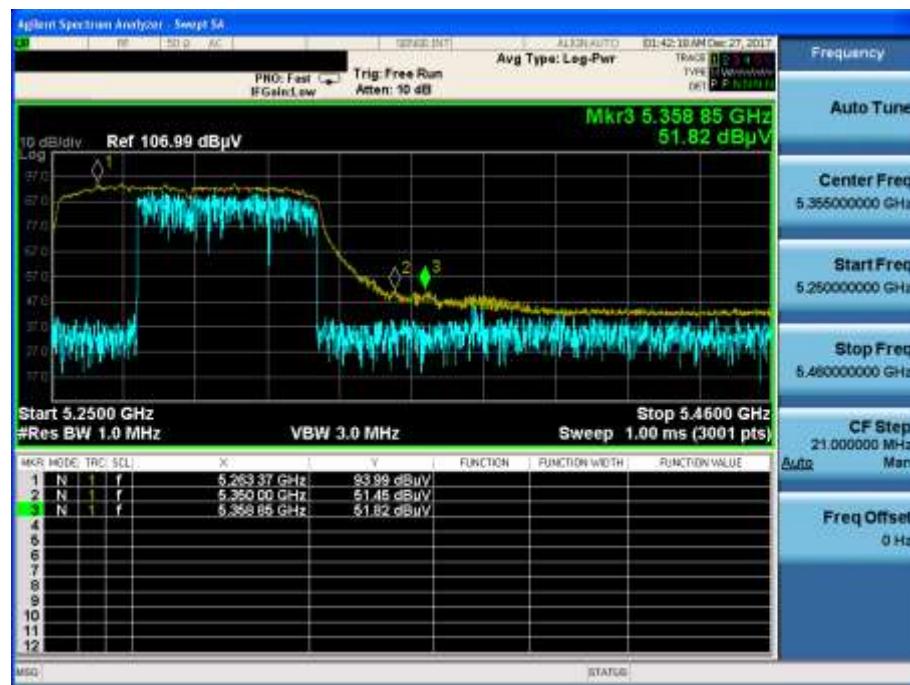
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Detector Mode : PK



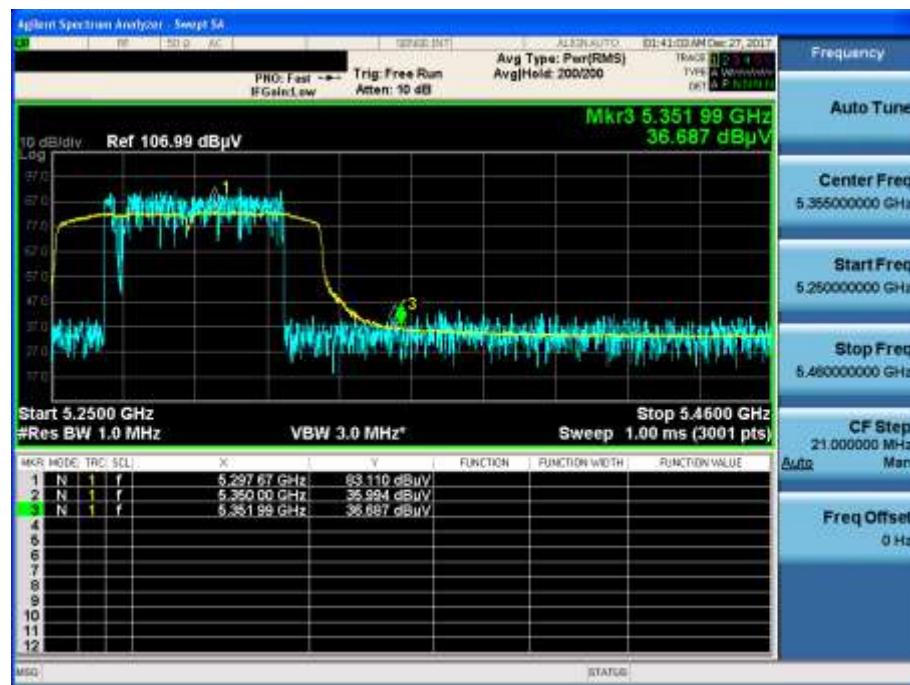
802.11ac(VHT80) &amp; U-NII 2A &amp; Ch.58 &amp; X axis &amp; Hor

Detector Mode : PK



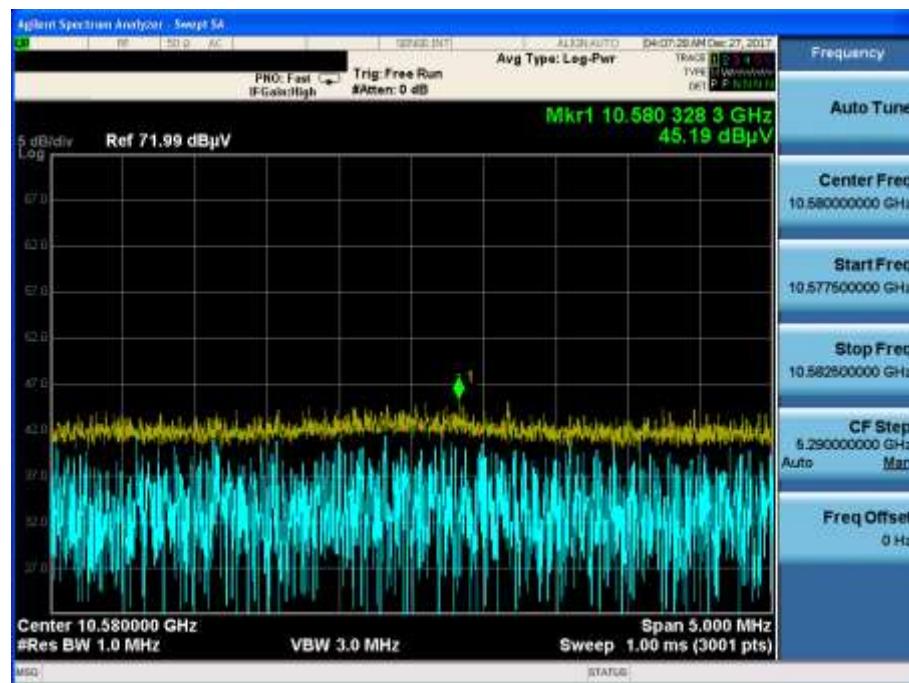
802.11ac(VHT80) &amp; U-NII 2A &amp; Ch.58 &amp; X axis &amp; Hor

Detector Mode : AV



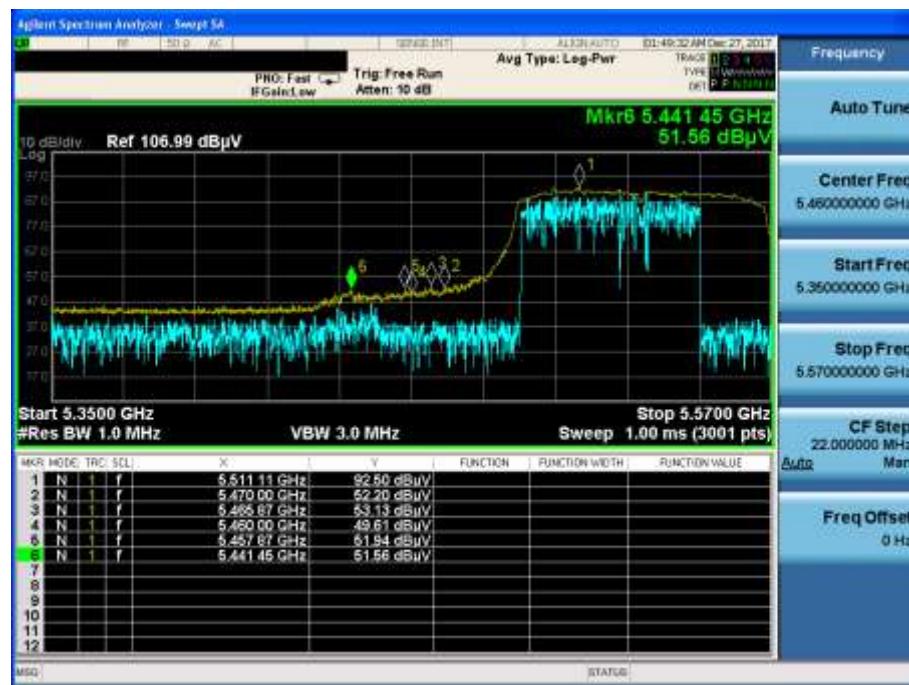
802.11ac(VHT80) &amp; U-NII 2A &amp; Ch.58 &amp; Y axis &amp; Hor

Detector Mode : PK



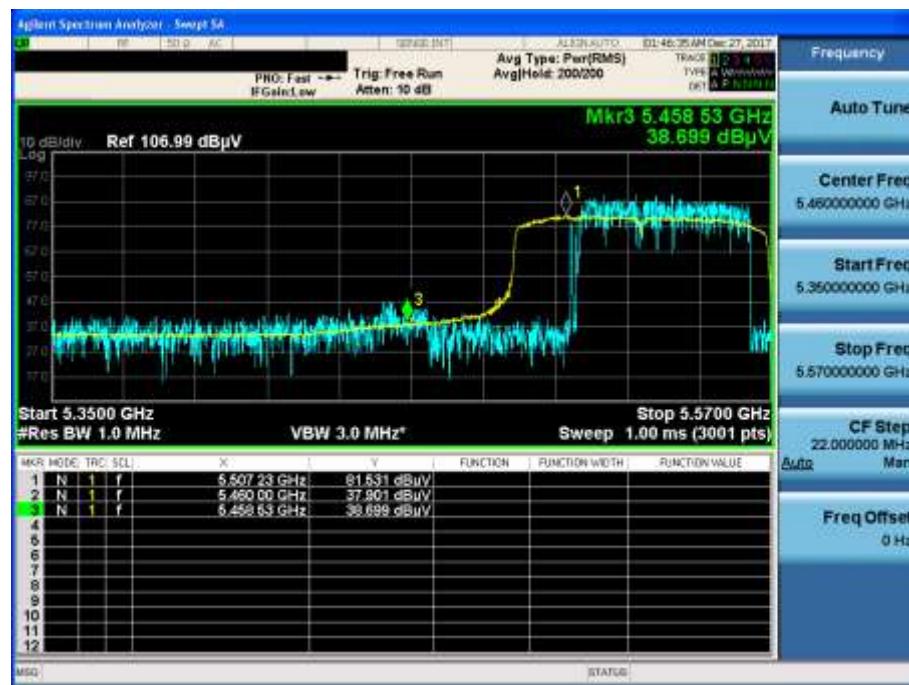
802.11ac(VHT80) &amp; U-NII 2C &amp; Ch.106 &amp; X axis &amp; Hor

Detector Mode : PK



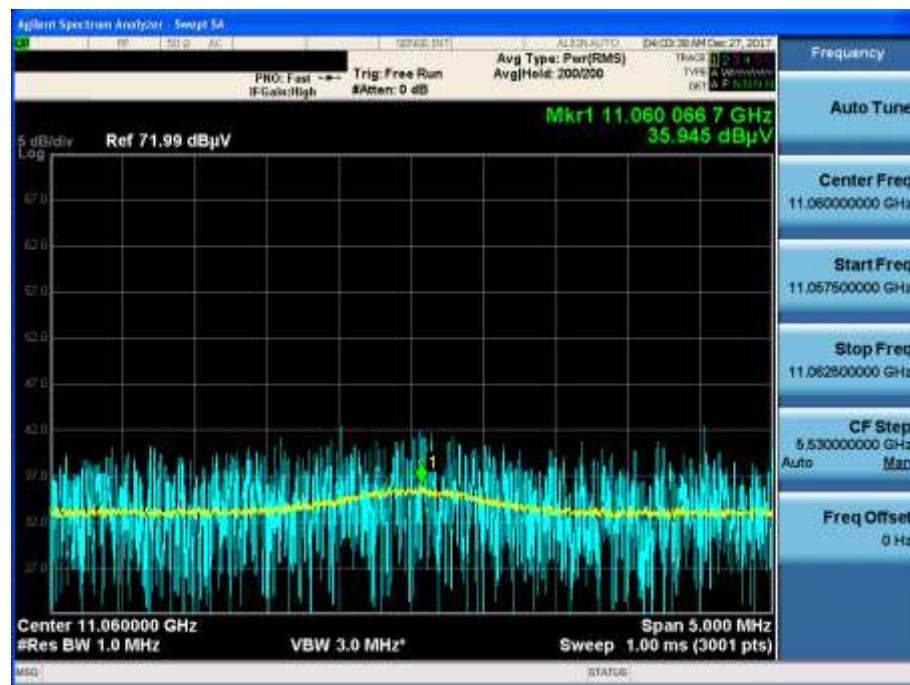
802.11ac(VHT80) &amp; U-NII 2C &amp; Ch.106 &amp; X axis &amp; Hor

Detector Mode : AV



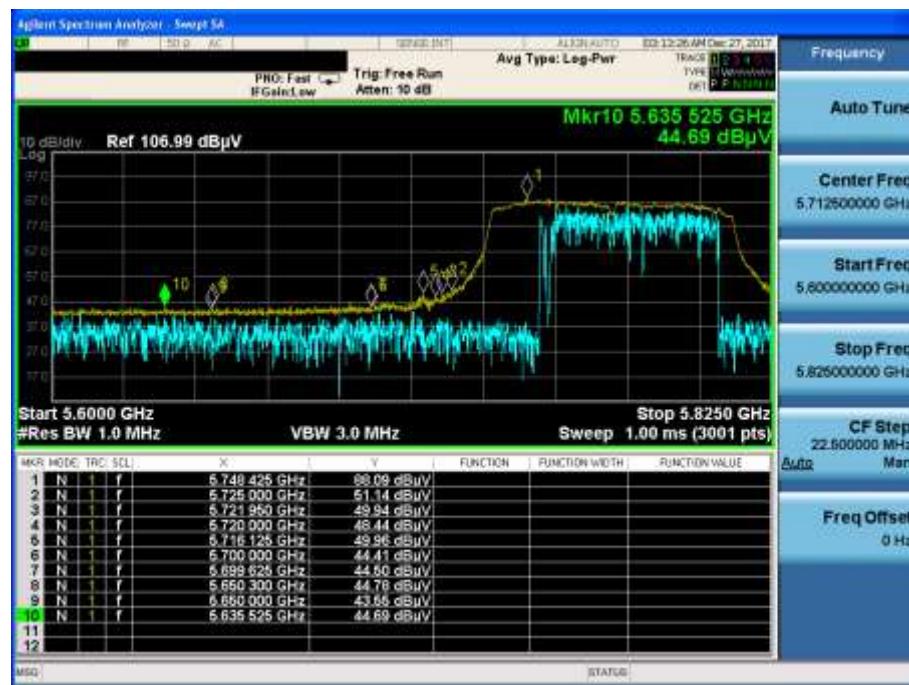
802.11ac(VHT80) &amp; U-NII 2C &amp; Ch.106 &amp; Y axis &amp; Hor

Detector Mode : AV



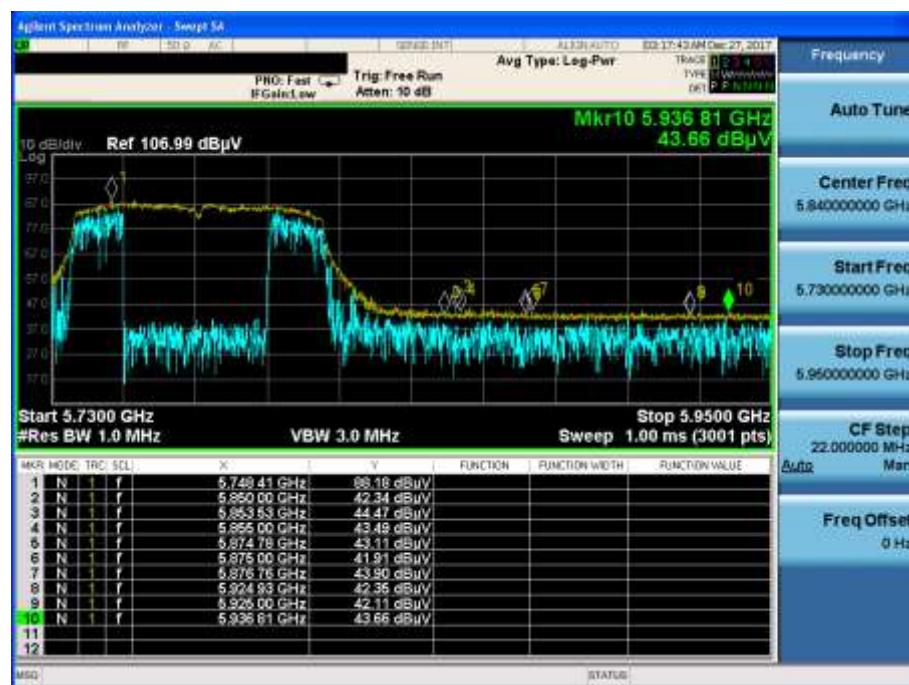
802.11ac(VHT80) &amp; U-NII 3 &amp; Ch.155 &amp; Y axis &amp; Ver

Detector Mode : PK



802.11ac(VHT80) &amp; U-NII 3 &amp; Ch.155 &amp; Y axis &amp; Ver

Detector Mode : PK



802.11ac(VHT80) &amp; U-NII 3 &amp; Ch.155 &amp; Y axis &amp; Hor

Detector Mode : AV

