



# TEST REPORT

**APPLICANT** : Thundercomm Technology Co., Ltd  
**PRODUCT NAME** : Turbox C404 SOM  
**MODEL NAME** : TurboX C404  
**BRAND NAME** : TurboX  
**FCC ID** : 2AOHHTURBOXC404  
**STANDARD(S)** : 47 CFR Part 15 Subpart E  
**RECEIPT DATE** : 2020-09-22  
**TEST DATE** : 2020-09-22 to 2021-01-20  
**ISSUE DATE** : 2021-02-08

Edited by: Zeng Xiaoying  
Zeng Xiaoying (Rapporteur)  
Approved by: Peng Huarui  
Peng Huarui(Supervisor)

**NOTE:** This document is issued by MORLAB, the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.





# DIRECTORY

- 1. Technical Information ..... 3
  - 1.1. Applicant and Manufacturer Information ..... 3
  - 1.2. Equipment Under Test (EUT) Description ..... 3
  - 1.3. Modulation Type and Data Rate of EUT ..... 5
  - 1.4. The Channel Number and Frequency ..... 6
  - 1.5. Test Standards and Results ..... 7
  - 1.6. Environmental Conditions ..... 8
- 2. 47 CFR Part 15E Requirements ..... 9
  - 2.1. Antenna Requirement ..... 9
  - 2.2. Duty Cycle of the Test Signal ..... 10
  - 2.3. Maximum Conducted Output Power ..... 15
  - 2.4. Emission Bandwidth ..... 21
  - 2.5. Peak Power Spectral Density ..... 60
  - 2.6. Frequency Stability ..... 101
  - 2.7. Conducted Emission ..... 104
  - 2.8. Restricted Frequency Bands ..... 108
  - 2.9. Radiated Emission ..... 128
- Annex A Test Uncertainty ..... 159
- Annex B Testing Laboratory Information ..... 160

Change History		
Version	Date	Reason for change
1.0	2021-02-08	First edition



# 1. Technical Information

Note: Provide by applicant.

## 1.1. Applicant and Manufacturer Information

<b>Applicant:</b>	Thundercomm Technology Co., Ltd
<b>Applicant Address:</b>	Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China
<b>Manufacturer:</b>	Thundercomm Technology Co., Ltd
<b>Manufacturer Address:</b>	Building 4, No. 99, Data Valley Middle Road, Xiantao District, Yubei District, Chongqing, China

## 1.2. Equipment Under Test (EUT) Description

<b>Product Name:</b>	Turbox C404 SOM	
<b>Serial No.:</b>	(N/A, marked #1 by test site)	
<b>Hardware Version:</b>	TurboX C404 SOM V06	
<b>Software Version:</b>	LE1	
<b>Modulation Technology:</b>	OFDM	
<b>Modulation Mode:</b>	802.11a, 802.11n (HT20), 802.11n (HT40) 802.11ac (VHT20), 802.11ac (VHT40), 802.11ac (VHT80),	
<b>Operating Frequency Range:</b>	5180MHz-5240MHz; 5260MHz-5320MHz; 5500MHz-5720MHz; 5745MHz-5825MHz	
<b>Channel Number:</b>	Refer to 1.3	
<b>Antenna Information:</b>	Antenna Type A	
	Antenna Type:	ANT1: Dipole Antenna
		ANT2: Dipole Antenna
	Antenna Gain:	ANT1: 4.00dBi
		ANT 2: 4.00dBi
	Antenna Type B	
	Antenna Type:	ANT1: PIFA Antenna
		ANT2: PIFA Antenna
Antenna Gain:	ANT1: 5.52dBi	
	ANT 2: 5.55dBi	
<b>Directional Gain:</b>	8.56dBi(Type B) <sub>Note 4</sub>	



**Note 1:** The EUT will not sell with antenna.

**Note 2:** The EUT supports two type of antenna and each type of antenna has two antennas. Two type of antenna were considered and evaluated respectively by performing full test, only the worst data(Type B) were recorded and reported.

**Note 3:** The EUT supports a MIMO function. Physically, the EUT provides two completed transmitters and two receivers for 802.11n and 802.11ac modulation mode.

Modulation Mode:	TX Function
802.11n	2TX
802.11ac	2TX

**Note 4:** According to KDB 662911 D01, the directional gain =  $G_{ANT} + 10\log(N_{ANT})$  dBi, where  $G_{ANT}$  is the maximum antenna gain in dBi,  $N_{ANT}$  is the number of outputs.

**Note 5:** For conducted test item Conducted Output Power and Peak Power Spectral Density of each modulation mode, we recorded the test result of two antennas separately, for other conducted test items both of the two antennas were tested separately, we only recorded the worst test result (ANT2) in this report.

**Note 6:** All radiation test items for 802.11n and 802.11ac modulation mode operate at MIMO mode during the test. Other modulation mode operate at SISO mode, both of the two antennas were tested separately, we only recorded the worst test result(ANT2) in this report.

**Note 7:** WIFI hotspot does not support U-NII band.

**Note 8:** We use the dedicated software to control the EUT continuous transmission.

**Note 9:** For a more detailed description, please refer to Specification or User’s Manual supplied by the applicant and/or manufacturer.



### 1.3. Modulation Type and Data Rate of EUT

Modulation Technology	Modulation Type	Data Rate (Mbps) <sup>Note1</sup>
OFDM (802.11a)	BPSK	<b>6/9</b>
	QPSK	12/18
	16QAM	24/36
	64QAM	48/54
OFDM (802.11n)	BPSK	<b>6.5</b>
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
OFDM (802.11ac)	BPSK	<b>6.5</b>
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
	256QAM	78

**Note1:** The worst-case mode (black bold) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.

## 1.4. The Channel Number and Frequency

Frequency Range: 5150MHz-5250MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>36</b>	<b>5180</b>	40	5200
	<b>44</b>	<b>5220</b>	<b>48</b>	<b>5240</b>
40MHz	<b>38</b>	<b>5190</b>	<b>46</b>	<b>5230</b>
80MHz	<b>42</b>	<b>5210</b>		
Frequency Range: 5250MHz-5350MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>52</b>	<b>5260</b>	56	5280
	<b>60</b>	<b>5300</b>	<b>64</b>	<b>5320</b>
40MHz	<b>54</b>	<b>5270</b>	<b>62</b>	<b>5310</b>
80MHz	<b>58</b>	<b>5290</b>		
Frequency Range: 5470MHz-5725MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>100</b>	<b>5500</b>	105	5520
			108	5540
			116	5580
			124	5620
			132	5660
			140	<b>144</b>
40MHz	<b>102</b>	<b>5510</b>	110	5550
			118	5590
			134	<b>142</b>
80MHz	<b>106</b>	<b>5530</b>	<b>122</b>	<b>5610</b>
	<b>138</b>	<b>5690</b>		
Frequency Range: 5725MHz-5825MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	<b>149</b>	<b>5745</b>	153	5765
	<b>157</b>	<b>5785</b>	161	5805
	<b>165</b>	<b>5825</b>		
40MHz	<b>151</b>	<b>5775</b>	<b>159</b>	<b>5795</b>
80MHz	<b>155</b>	<b>5775</b>		

**Note 1:** The black bold channels were selected for test.



## 1.5. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart E (U-NII band) for the EUT FCC ID Certification:

No.	Identity	Document Title
1	47 CFR Part 15(5-1-14 Edition)	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method determination /Remark
1	15.203	Antenna Requirement	N/A	N/A	PASS	No deviation
2	ANSI C63.10	Duty Cycle of the Test Signal	Jan 20, 2021	Tu Ya'nan	PASS	No deviation
3	15.407(a)	Maximum Conducted Output Power	Jan 20, 2021	Tu Ya'nan	PASS	No deviation
4	15.407(a)(e)	Emission Bandwidth	Nov 12, 2020	Tu Ya'nan	PASS	No deviation
5	15.407(a)	Peak Power Spectral Density	Nov 12, 2020	Tu Ya'nan	PASS	No deviation
6	15.407(g)	Frequency Stability	Nov 12, 2020	Tu Ya'nan	PASS	No deviation
7	15.207	Conducted Emission	Oct 17, 2020	Huang Zhiye	PASS	No deviation
8	15.407(b)	Restricted Frequency Bands	Jan 07&23, 2021	Gao Jianrou	PASS	No deviation
9	15.407(b)	Radiated Emission	Jan 22, 2021	Gao Jianrou	PASS	No deviation

**Note 1:** The DFS test report was documented in a separate report (Report No.: SZ20090290W05).

**Note 2:** The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.102013.

**Note 3:** These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 v01r03.



**Note 4:** The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The ref offset 12.5dB contains two parts that cable loss 2.5dB and Attenuator 10dB.

**Note 5:** Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

**Note 6:** When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% risk level.

## 1.6. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15-35
Relative Humidity (%):	30-60
Atmospheric Pressure (kPa):	86-106





## 2.47 CFR Part 15E Requirements

### 2.1. Antenna Requirement

#### 2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

#### 2.1.2. Test Result: Compliant

The EUT has a PIFA antenna coupled with the I-PEX connector. Please refer to the EUT internal photos.

## 2.2. Duty Cycle of the Test Signal

### 2.2.1. Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than  $\pm 2\%$ ; otherwise, the duty cycle is considered to be nonconstant.

### 2.2.2. Test Description

#### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.2.3. Test Procedure

KDB 789033 Section B was used in order to prove compliance.

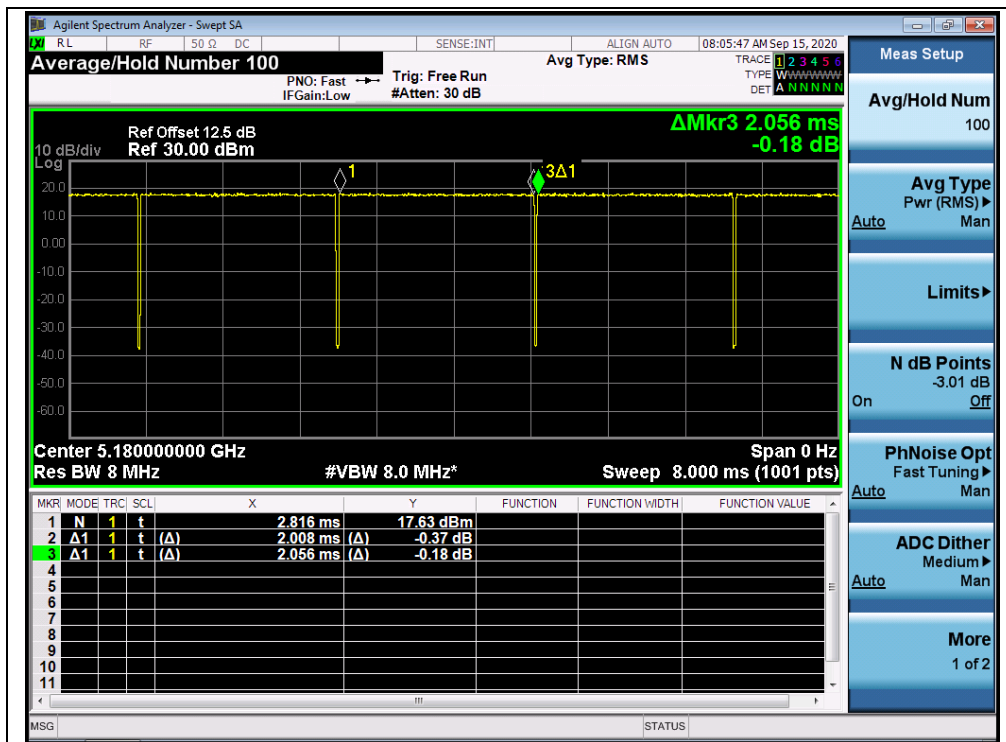


2.2.4. Test Result

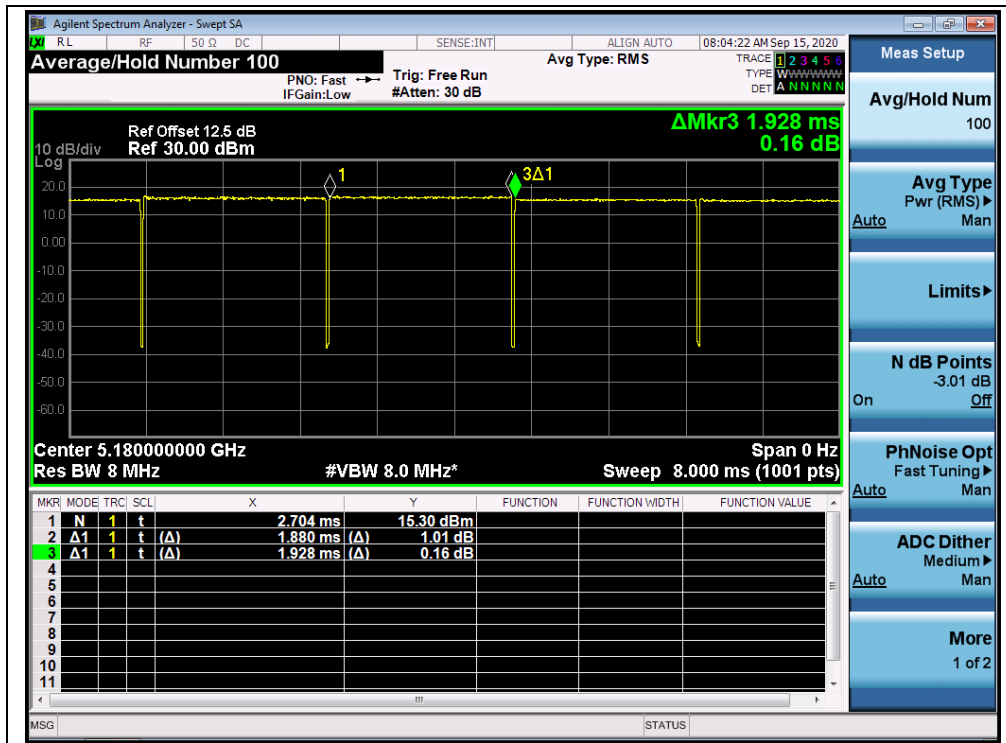
A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*log[1/D])
802.11a	97.67	0.10
802.11n (HT20)	97.51	0.11
802.11n (HT40)	95.87	0.18
802.11ac (VHT20)	98.19	0.08
802.11ac (VHT40)	96.39	0.16
802.11ac (VHT80)	92.68	0.33

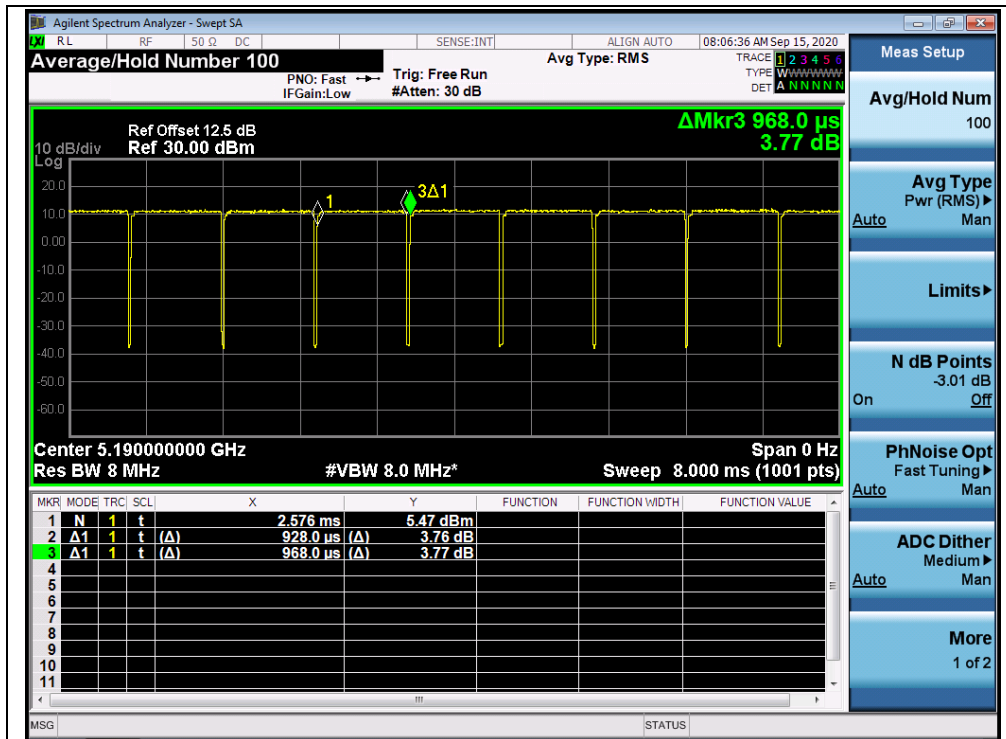
B. Test Plot:



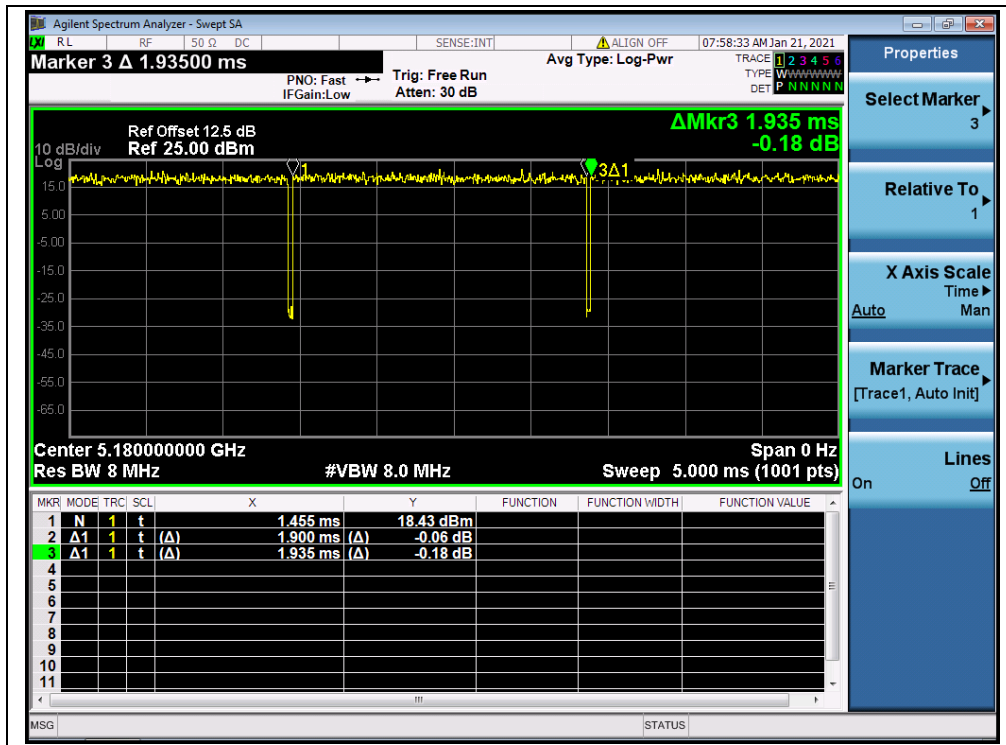
(Channel 36, 5180MHz, 802.11a)



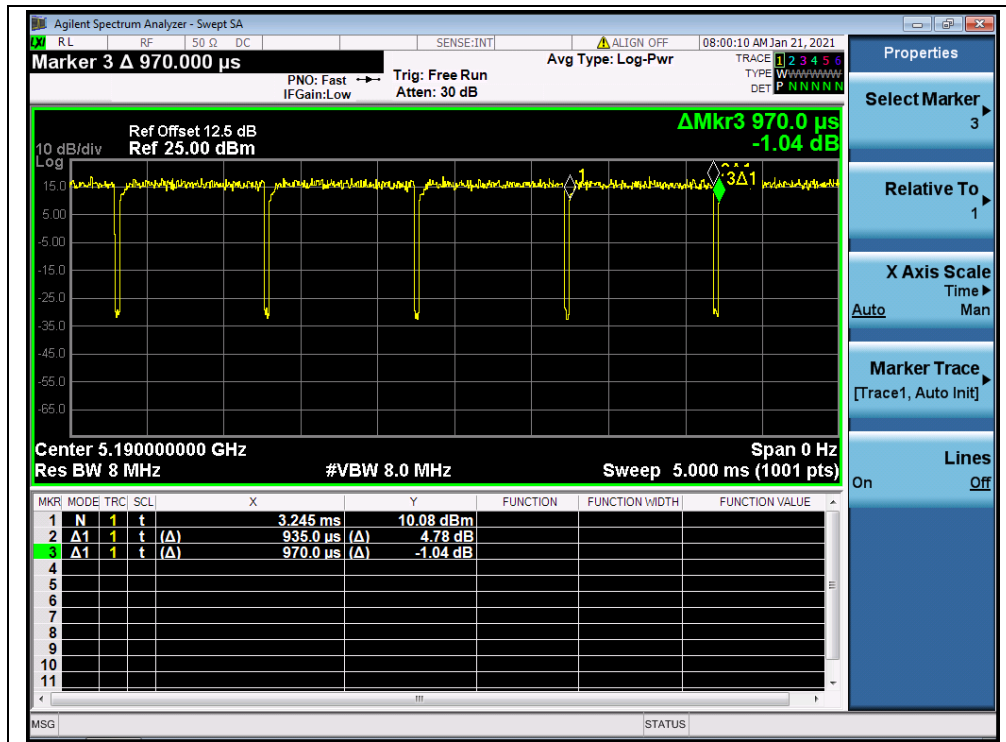
(Channel 36, 5180MHz, 802.11n (HT20))



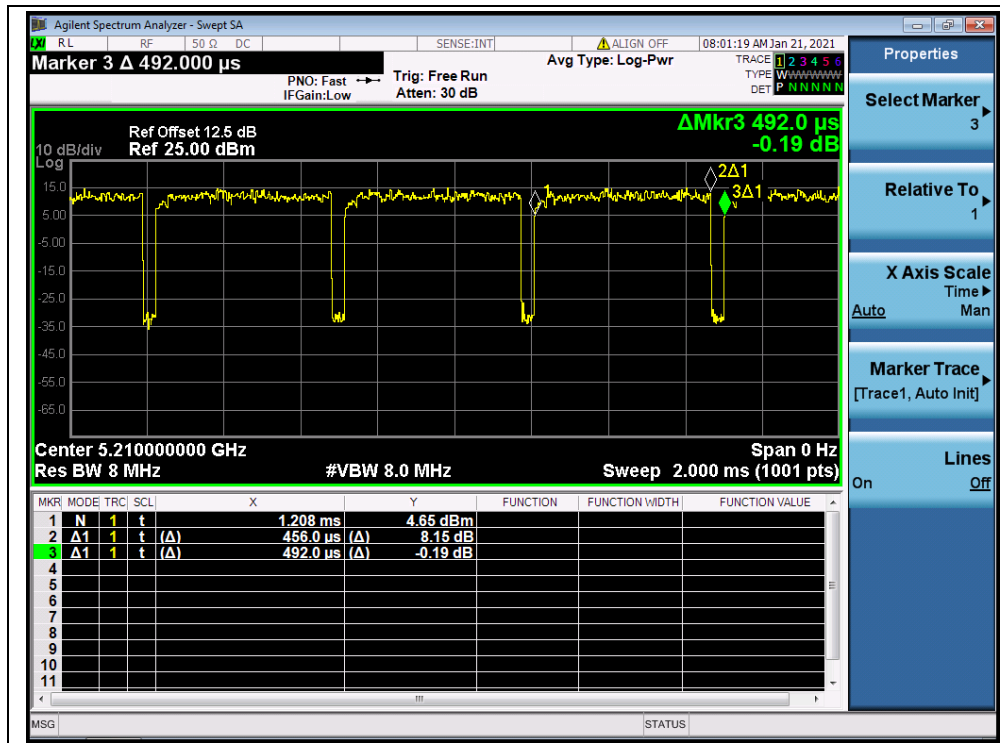
(Channel 38, 5190MHz, 802.11n (HT40))



(Channel 36, 5180MHz, 802.11ac (VHT20))



(Channel 38, 5190MHz, 802.11ac (VHT40))



(Channel 42, 5210MHz, 802.11ac (VHT80))

## 2.3. Maximum Conducted Output Power

### 2.3.1. Requirement

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

(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 250mW or  $11\text{dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

(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 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

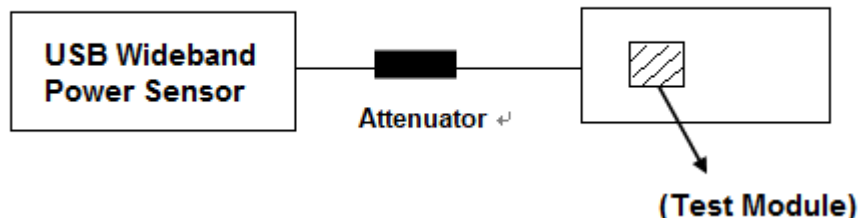
(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain =  $G_{\text{ANT}} + 10\log(N_{\text{ANT}})\text{dBi}$ , where  $G_{\text{ANT}}$  is the antenna gain in dBi,  $N_{\text{ANT}}$  is the number of outputs.

### 2.3.2. Test Description

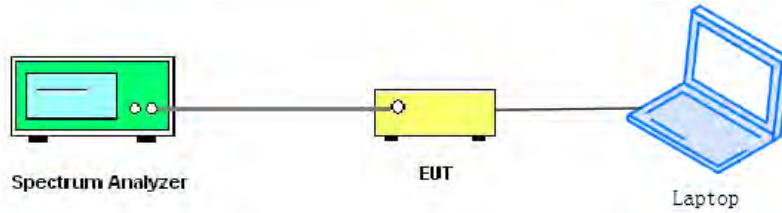
Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.

#### Test Setup:



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in USB Wideband Power Sensor.

**For ac (VHT80) mode power**



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.

**2.3.3.Limits**

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 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz.

Mode	Band	Channel (MHz)	26dB BW (MHz)	10+10log(26dB BW)	Limits (dBm)
a	UNII-2a	5260	22.35	24.49	24.00
		5300	22.53	24.53	24.00
		5320	22.65	24.55	24.00
	UNII-2c	5500	23.62	24.73	24.00
		5600	25.22	25.02	24.00
		5720	25.37	25.04	24.00
n20	UNII-2a	5260	24.23	24.84	24.00
		5300	23.60	24.73	24.00
		5320	23.92	24.79	24.00
	UNII-2c	5500	25.64	25.09	24.00
		5600	25.97	25.14	24.00
		5720	26.70	25.27	24.00
ac20	UNII-2a	5260	24.59	24.91	24.00
		5300	24.65	24.92	24.00
		5320	23.82	24.77	24.00
	UNII-2c	5500	26.35	25.21	24.00
		5600	25.49	25.06	24.00
		5720	27.19	25.34	24.00





2.3.4. Test Result

Maximum Average Conducted Output Power  
802.11a Mode

Frequency (MHz)	Average Power							Limit		Verdict
	Measured		Duty Factor	Duty factor Calculated						
	ANT1	ANT2		ANT1		ANT2				
	dBm	dBm		dBm	W	dBm	W	dBm	W	
5180	15.15	15.72	0.10	15.25	0.033	15.82	0.038	24	0.25	PASS
5220	14.96	15.33		15.06	0.032	15.43	0.035			
5240	14.78	15.92		14.88	0.031	<b>16.02</b>	<b>0.040</b>			
5260	14.69	15.26		14.79	0.030	15.36	0.034			
5300	14.71	15.40		14.81	0.030	15.50	0.035			
5320	14.56	15.35		14.66	0.029	15.45	0.035			
5500	14.60	15.60		14.70	0.030	15.70	0.037			
5600	14.78	15.28		14.88	0.031	15.38	0.035			
5720	14.80	15.40		14.90	0.031	15.50	0.035			
5745	14.29	15.35		14.39	0.027	15.45	0.035			30
5785	14.66	15.08		14.76	0.030	15.18	0.033			
5825	15.07	15.50		15.17	0.033	15.60	0.036			



**802.11n (HT20) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT1	ANT2		dBm	W			
5180	14.99	15.42	0.11	<b>18.33</b>	<b>0.068</b>	21.44	0.13	PASS
5220	14.82	15.37		18.20	0.066			PASS
5240	14.64	15.68		18.33	0.068			
5260	14.53	15.29		18.06	0.064			
5300	15.02	15.41		18.33	0.068			
5320	14.86	15.45		18.26	0.067			
5500	14.66	15.35		18.13	0.065			
5600	14.70	15.46		18.20	0.066	27.44	0.55	
5720	14.48	15.53		18.13	0.065			
5745	14.19	15.25		17.85	0.061			
5785	14.48	15.31		18.06	0.064			
5825	14.95	15.18		18.20	0.066			

**Note:** Directional gain = 5.55dBi +10log(2) = 8.56dBi > 6dBi, so the power limit shall be reduced to 24-(8.56-6) = 21.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.

**802.11n (HT40) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT1	ANT2		dBm	W			
5190	15.52	15.18	0.18	<b>18.57</b>	<b>0.072</b>	21.44	0.13	PASS
5230	15.21	15.31		18.45	0.070			PASS
5270	14.79	15.62		18.39	0.069			
5310	14.64	15.43		18.26	0.067			
5510	14.58	15.50		18.26	0.067			
5630	14.64	15.61		18.33	0.068			
5710	14.71	15.34		18.20	0.066			
5755	14.77	15.12		18.13	0.065			
5795	15.17	15.32		18.45	0.070			

**Note:** Directional gain = 5.55dBi +10log(2) = 8.56dBi > 6dBi, so the power limit shall be reduced to 24-(8.56-6) = 21.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.



**802.11ac (VHT20) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT1	ANT2		dBm	W	dBm		W
5180	15.05	15.66	0.08	<b>18.45</b>	<b>0.070</b>	21.44	0.13	PASS
5220	14.90	15.73		18.45	0.070			
5240	14.66	15.75		18.33	0.068			
5260	14.54	15.49		18.13	0.065			
5300	14.60	15.28		18.06	0.064			
5320	14.71	15.16		18.06	0.064			
5500	14.46	15.43		18.06	0.064			
5600	14.50	15.28		17.99	0.063			
5720	14.37	15.43		17.99	0.063			
5745	14.24	15.38		17.92	0.062	27.44	0.55	
5785	14.41	15.65		18.20	0.066			
5825	14.87	15.53		18.33	0.068			

**Note:** Directional gain = 5.55dBi +10log(2) = 8.56dBi > 6dBi, so the power limit shall be reduced to 24-(8.56-6) = 21.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.

**802.11ac (VHT40) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT1	ANT2		dBm	W	dBm		W
5190	15.50	15.19	0.16	18.51	0.071	21.44	0.13	PASS
5230	15.21	15.31		18.45	0.070			
5270	15.16	15.26		18.39	0.069			
5310	15.23	15.34		18.45	0.070			
5510	15.34	15.20		18.45	0.070			
5630	15.44	15.61		<b>18.69</b>	<b>0.074</b>			
5710	15.35	15.40		18.57	0.072	27.44	0.55	
5755	14.86	15.76		18.51	0.071			
5795	15.18	15.64		18.57	0.072			

**Note:** Directional gain = 5.55dBi +10log(2) = 8.56dBi > 6dBi, so the power limit shall be reduced to 24-(8.56-6) = 21.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.



**802.11ac (VHT80) Mode**

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		W	dBm	dBm		W
	dBm	dBm						
5210	14.91	15.38	0.33	18.51	0.071	21.44	0.13	PASS
5290	14.63	14.83		18.06	0.064			
5530	15.19	15.30		<b>18.57</b>	<b>0.072</b>			
5610	14.77	15.39		18.45	0.070			
5690	14.12	15.29		18.06	0.064			
5775	14.11	14.39		17.56	0.057	27.44	0.55	

**Note:** Directional gain = 5.55dBi + 10log(2) = 8.56dBi > 6dBi, so the power limit shall be reduced to 24-(8.56-6) = 21.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.

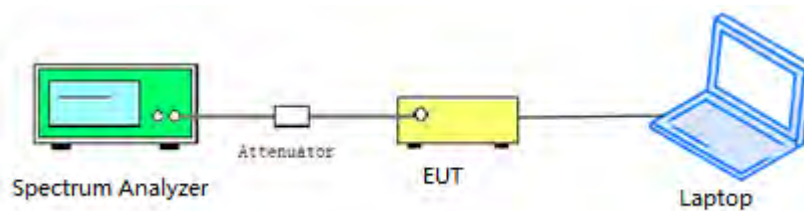
## 2.4. Emission Bandwidth

### 2.4.1. Requirement

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement. Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

### 2.4.2. Test Description

#### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading.

### 2.4.3. Test Procedure

1. KDB 789033 Section C) 1) Emission Bandwidth was used in order to prove compliance
  - a) Set RBW = approximately 1% of the emission bandwidth.
  - b) Set VBW > RBW.
  - c) Detector = Peak.
  - d) Trace mode = max hold.
  - e) 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%.
2. KDB 789033 Section C) 2) minimum emission bandwidth for the band 5.725-5.85GHz was used in order to prove compliance.  
Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:



- a) Set RBW = 100 kHz.
- b) Set video bandwidth (VBW)  $\geq 3 \times$  RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### 2.4.4. Test Result

#### 802.11a Mode

##### A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	24.00
44	5220	23.27
48	5240	23.04
52	5260	22.35
60	5300	22.53
64	5320	22.65
100	5500	23.62
120	5600	25.22
144	5720	25.37
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	15.89
149	5745	16.32
157	5785	16.32
165	5825	16.32



**B.Test Plot:**

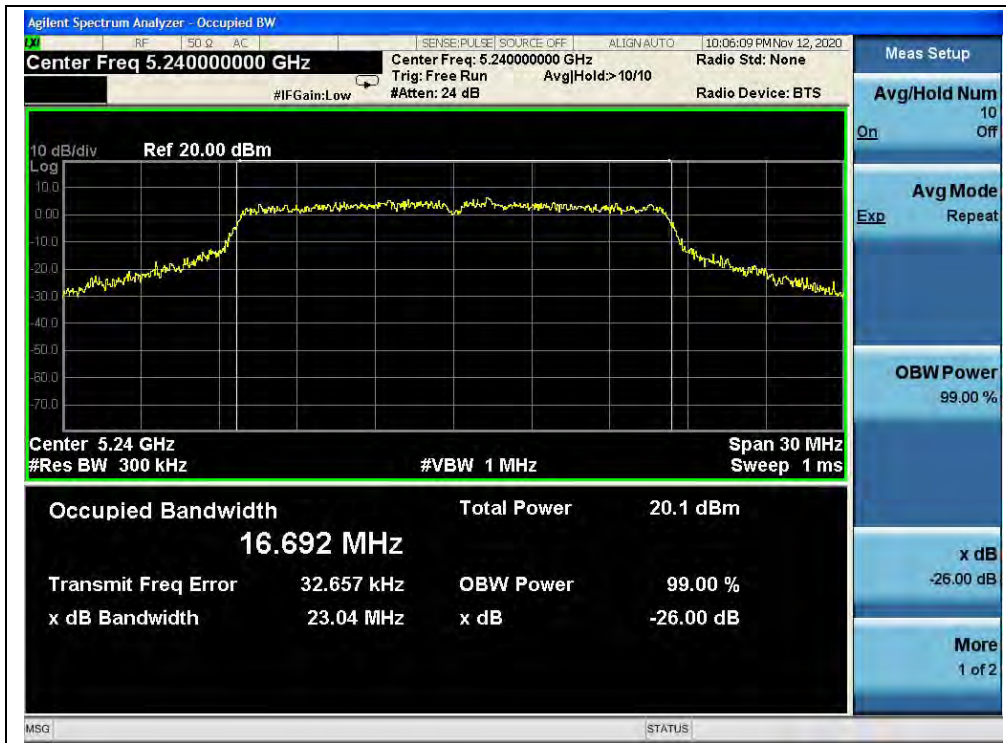


(Channel 36, 5180MHz, 802.11a)



(Channel 44, 5220 MHz, 802.11a)



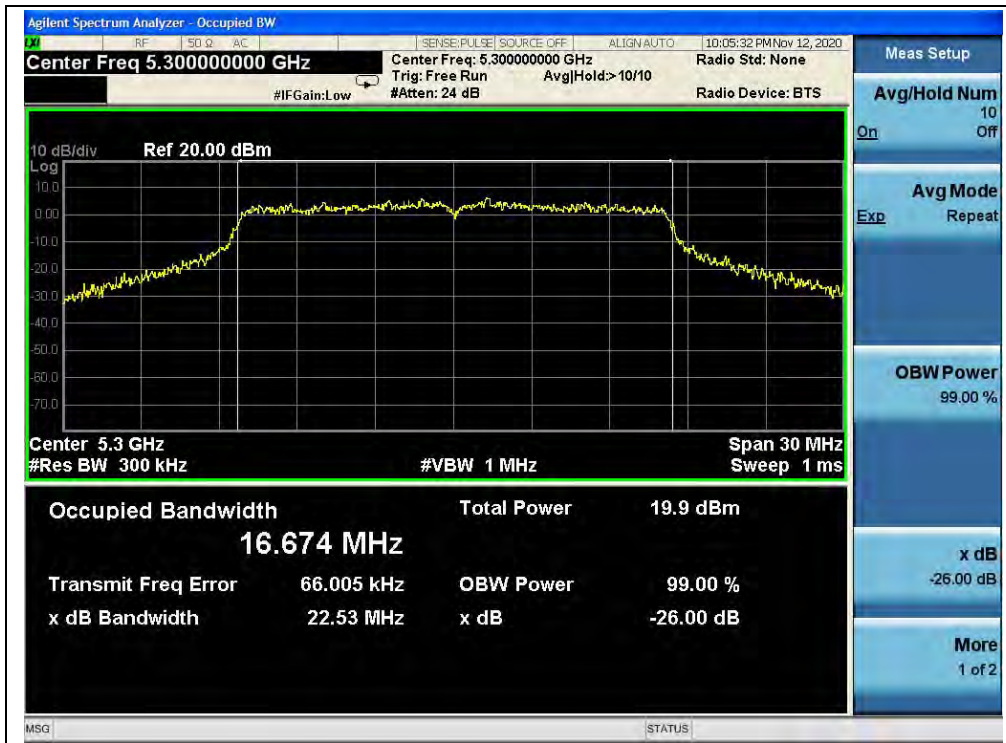


(Channel 48, 5240MHz, 802.11a)



(Channel 52, 5260MHz, 802.11a)

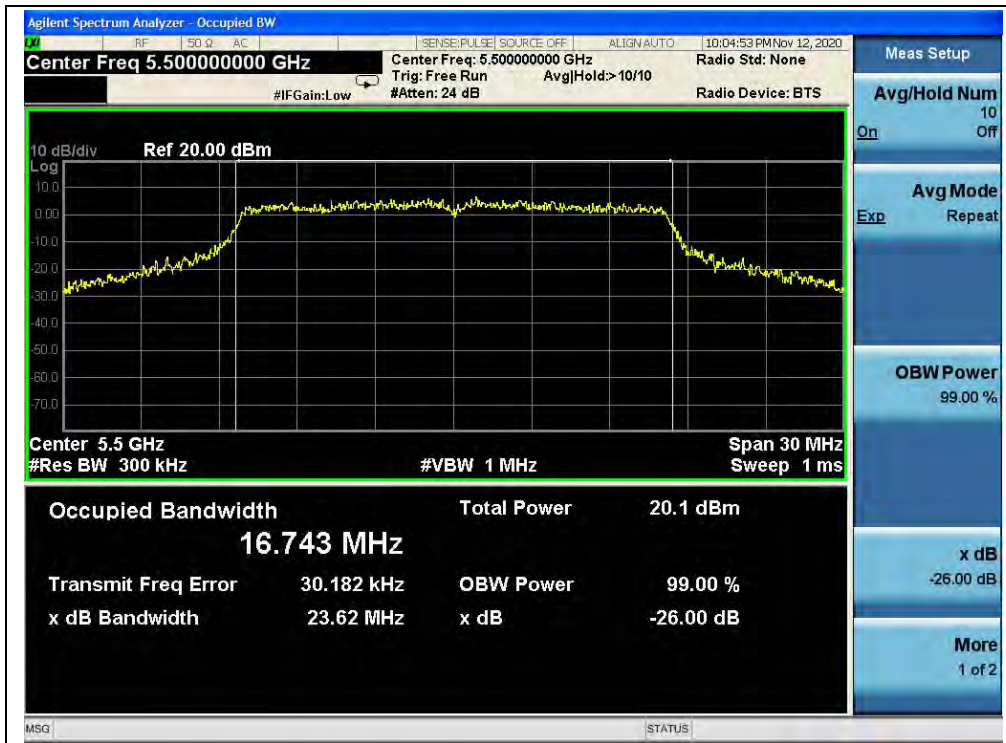




(Channel 60, 5300 MHz, 802.11a)



(Channel 64, 5320MHz, 802.11a)



(Channel 100,5500MHz, 802.11a)



(Channel 120,5600 MHz, 802.11a)



(Channel 144, 5720MHz, 802.11a)



(Channel 144, 5720MHz, 802.11a)





(Channel 149,5745MHz, 802.11a)



(Channel 157,5785MHz, 802.11a)



(Channel 165, 5825MHz, 802.11a)



802.11n (HT20) Mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	23.84
44	5220	23.85
48	5240	24.94
52	5260	24.23
60	5300	23.60
64	5320	23.92
100	5500	25.64
120	5600	25.97
144	5720	26.70
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	16.93
149	5745	16.90
157	5785	17.58
165	5825	15.89

B. Test Plot:



(Channel 36, 5180MHz, 802.11n (HT20))

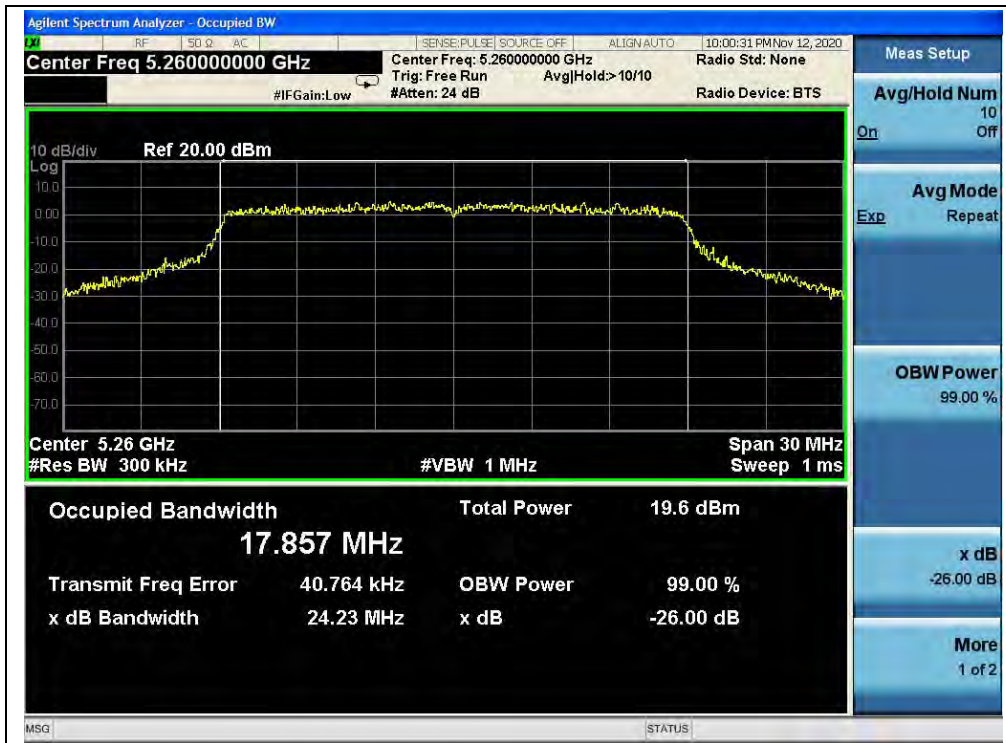




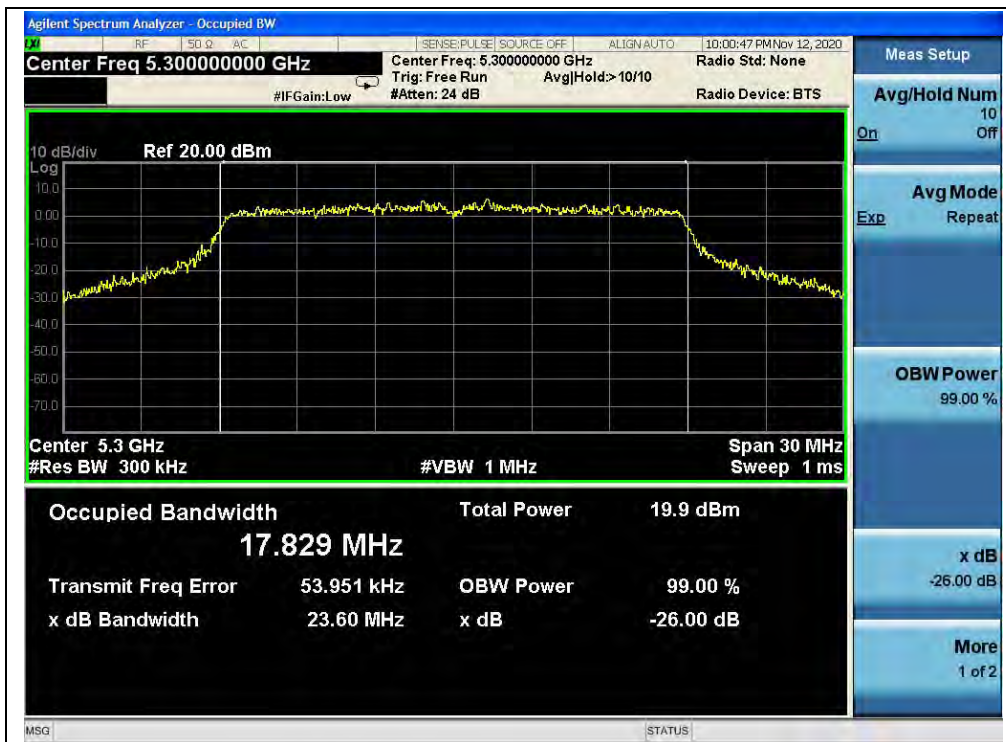
(Channel 44, 5220MHz, 802.11n (HT20))



(Channel 48, 5240MHz, 802.11n (HT20))

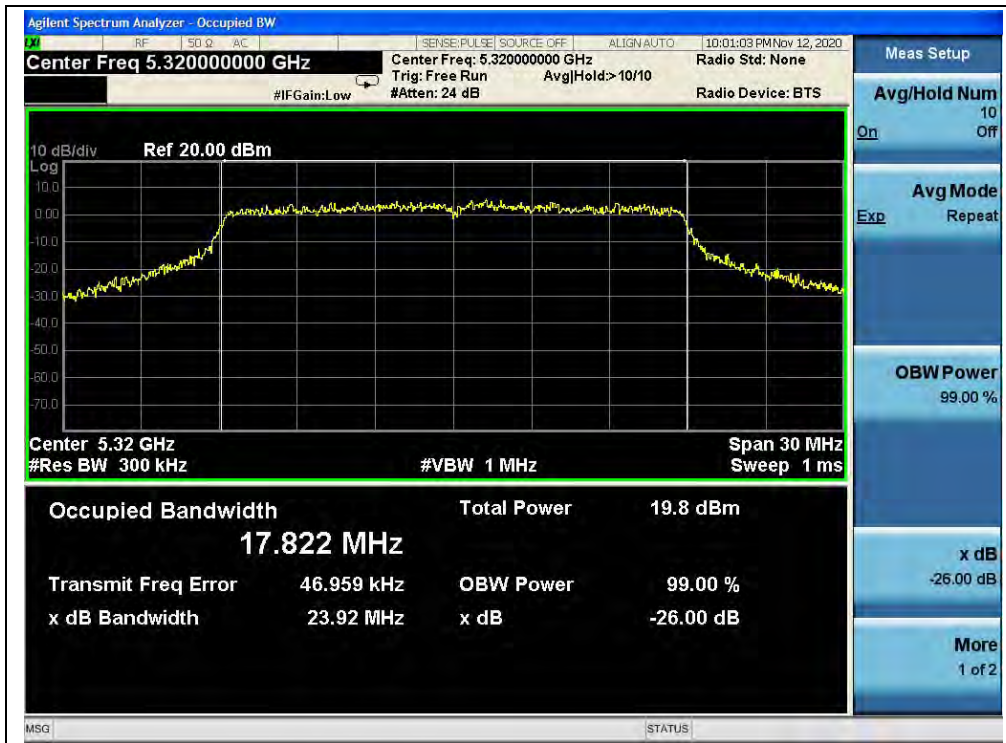


(Channel 52, 5260MHz, 802.11n (HT20))



(Channel 60, 5300MHz, 802.11n (HT20))

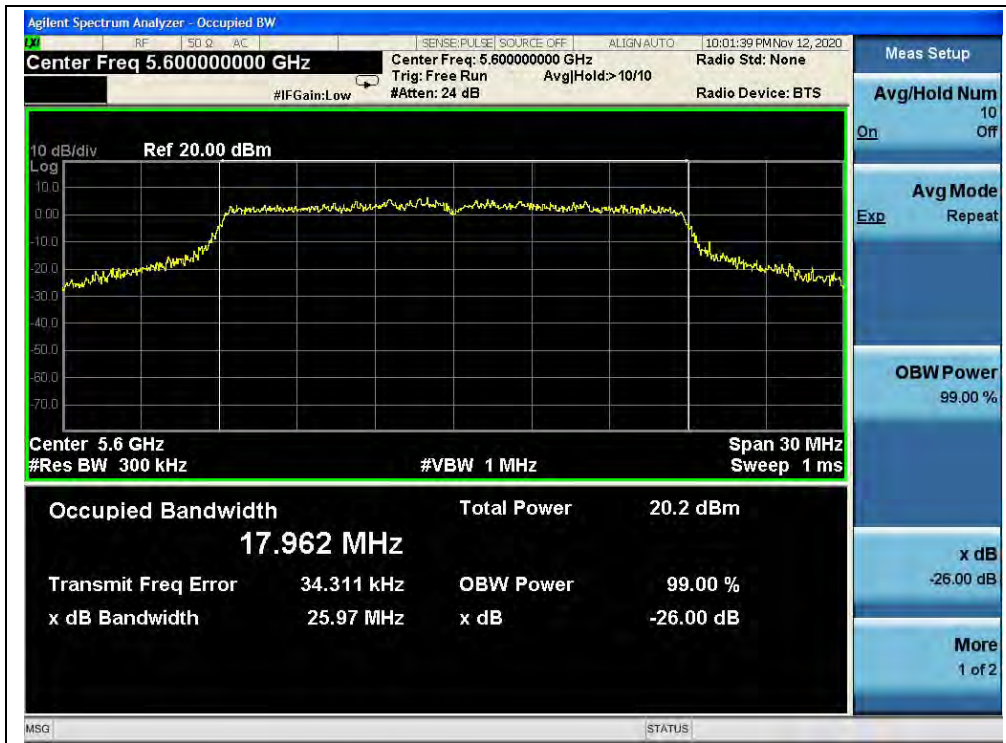




(Channel 64, 5320MHz, 802.11n (HT20))



(Channel 100, 5500MHz, 802.11n (HT20))



(Channel 120, 5600MHz, 802.11n (HT20))



(Channel 144, 5720MHz, 802.11n (HT20))

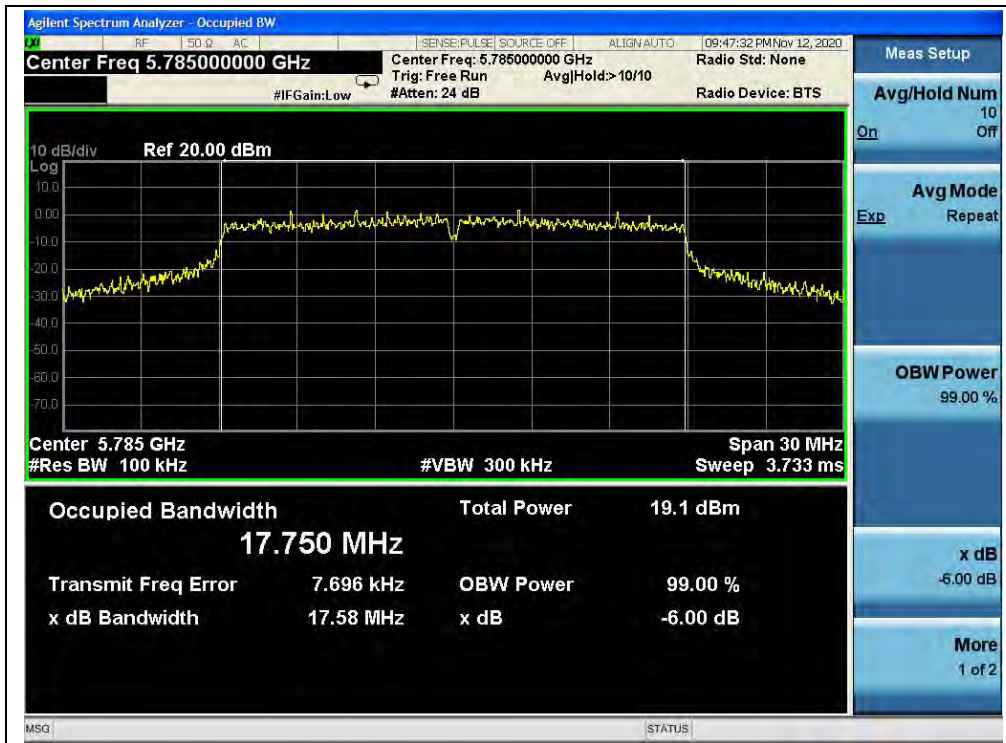


(Channel 144, 5720MHz, 802.11 n (HT20))



(Channel 149, 5745MHz, 802.11 n (HT20))





(Channel 157, 5785MHz, 802.11 n (HT20))



(Channel 165, 5825MHz, 802.11 n (HT20))



802.11n (HT40) Test mode

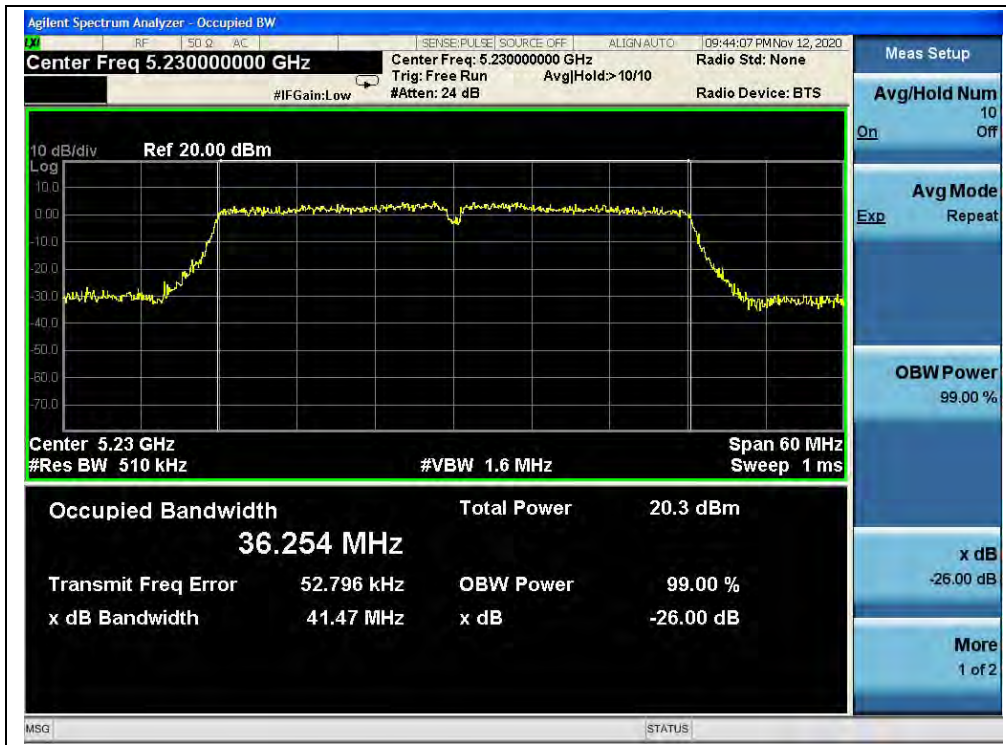
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	41.15
46	5230	41.47
54	5270	41.26
62	5310	41.23
102	5510	41.42
126	5630	41.42
142	5710	47.35
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
142	5710	35.73
151	5755	35.93
159	5795	35.75

B. Test Plot:



(Channel 38, 5190MHz, 802.11n (HT40))

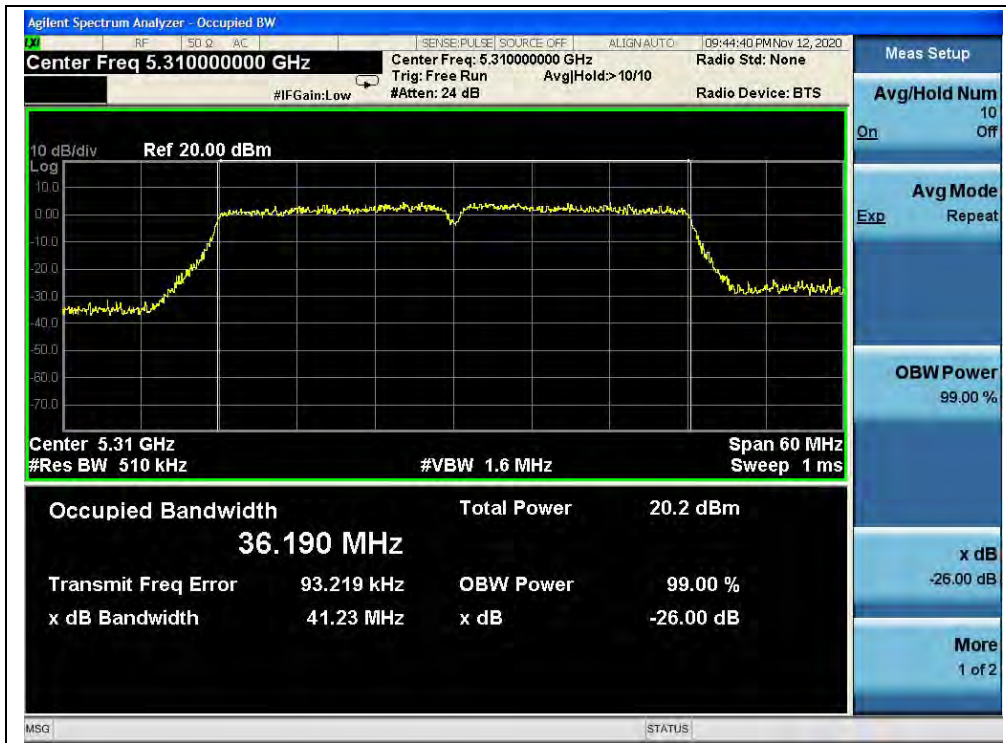


(Channel 46, 5230MHz, 802.11n (HT40))



(Channel 54, 5270MHz, 802.11n (HT40))

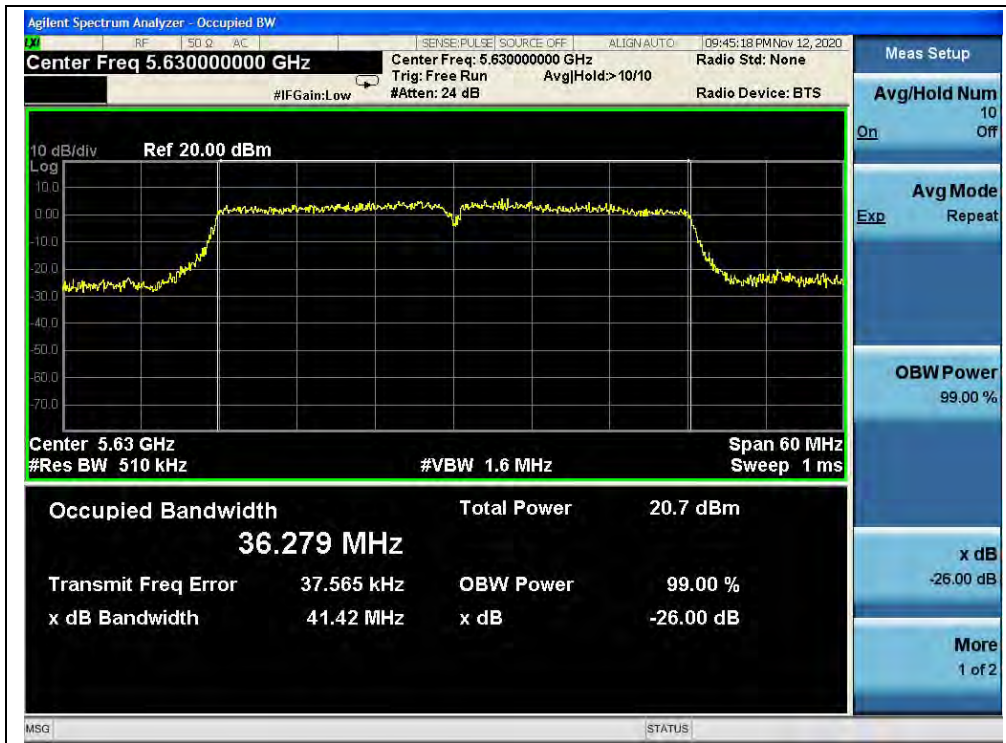




(Channel 62, 5310MHz, 802.11n (HT40))



(Channel 102, 5510MHz, 802.11n (HT40))



(Channel 126, 5630MHz, 802.11n (HT40))



(Channel 142, 5710MHz, 802.11n (HT40))

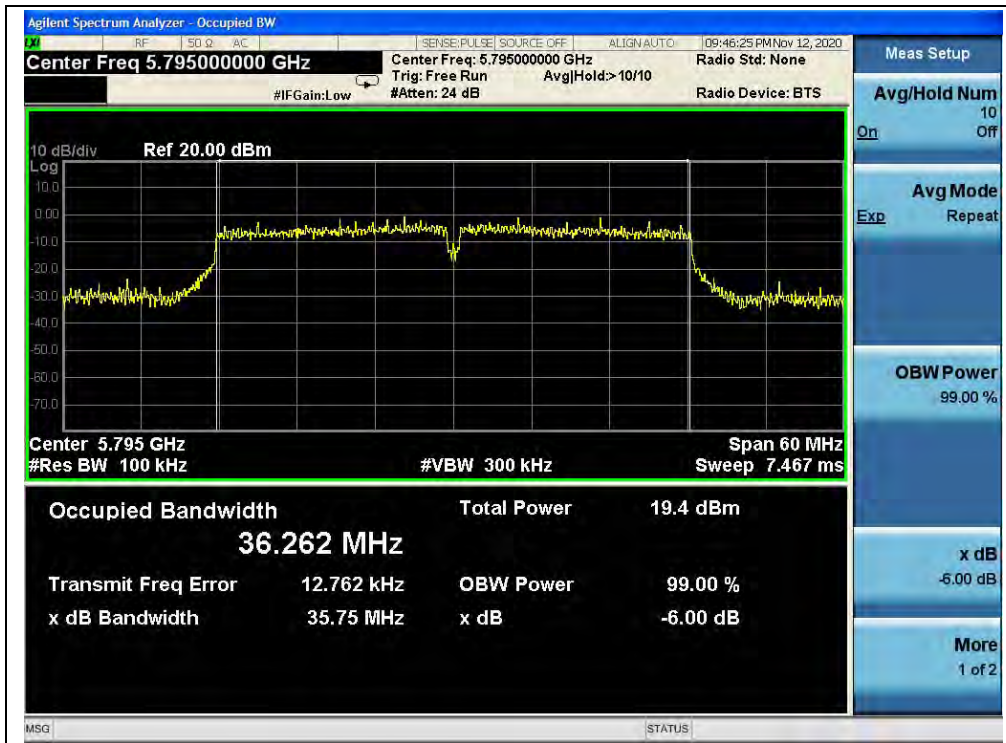




(Channel 142, 5710MHz, 802.11n (HT40))



(Channel 151, 5755MHz, 802.11n (HT40))



(Channel 159, 5795MHz, 802.11n (HT40))

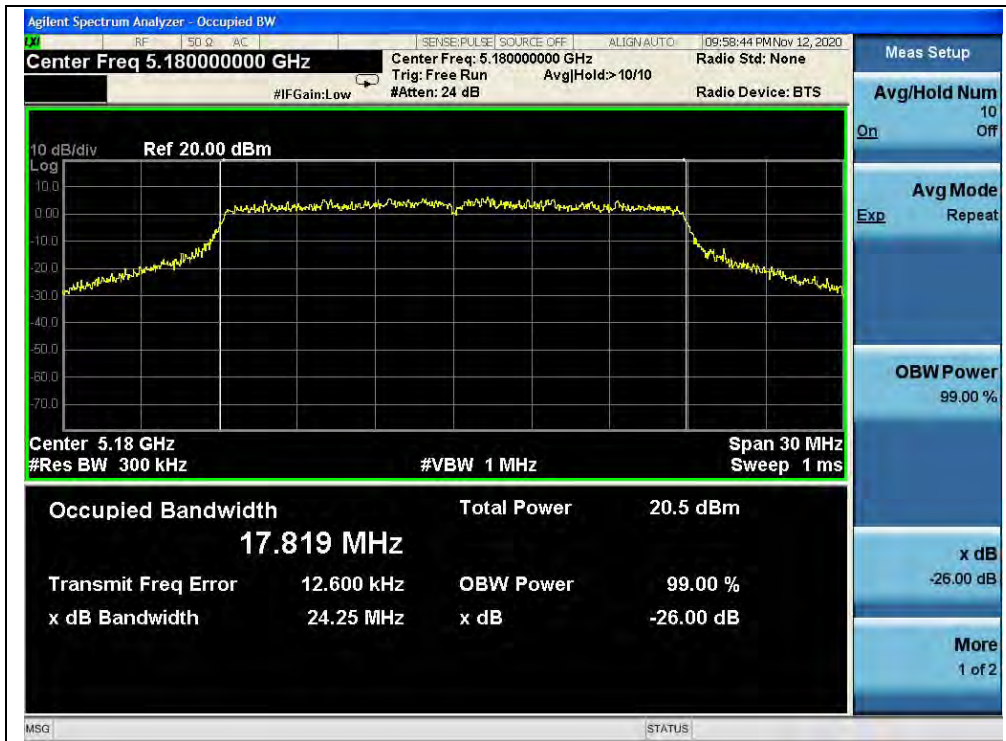


802.11ac (VHT20) Mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	24.25
44	5220	23.95
48	5240	24.52
52	5260	24.59
60	5300	24.65
64	5320	23.82
100	5500	26.35
120	5600	25.49
144	5720	27.19
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	15.69
149	5745	16.90
157	5785	16.04
165	5825	17.55

B. Test Plot:



(Channel 36, 5180MHz, 802.11ac (VHT20))





(Channel 44, 5220MHz, 802.11ac (VHT20))



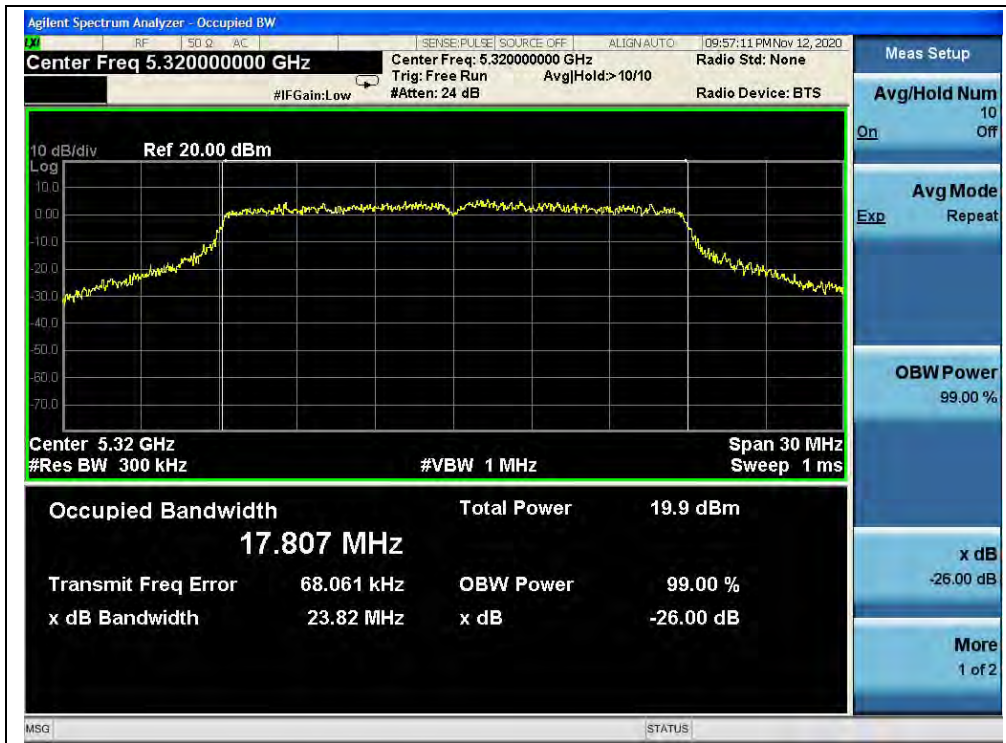
(Channel 48, 5240MHz, 802.11ac (VHT20))



(Channel 52, 5260MHz, 802.11ac (VHT20))



(Channel 60, 5300MHz, 802.11ac (VHT20))



(Channel 64, 5320MHz, 802.11ac (VHT20))



(Channel 100, 5500MHz, 802.11ac (VHT20))





(Channel 120, 5600MHz, 802.11ac (VHT20))



(Channel 144, 5720MHz, 802.11ac (VHT20))



(Channel 144, 5720MHz, 802.11ac (VHT20))



(Channel 149, 5745MHz, 802.11 ac (VHT20))



(Channel 157, 5785MHz, 802.11 ac (VHT20))



(Channel 165, 5825MHz, 802.11 ac (VHT20))





802.11ac (VHT40) Mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	40.98
46	5230	40.64
54	5270	41.00
62	5310	40.56
102	5510	41.03
126	5630	41.67
142	5710	41.48
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
142	5710	35.94
151	5755	36.27
159	5795	36.31

B. Test Plot:



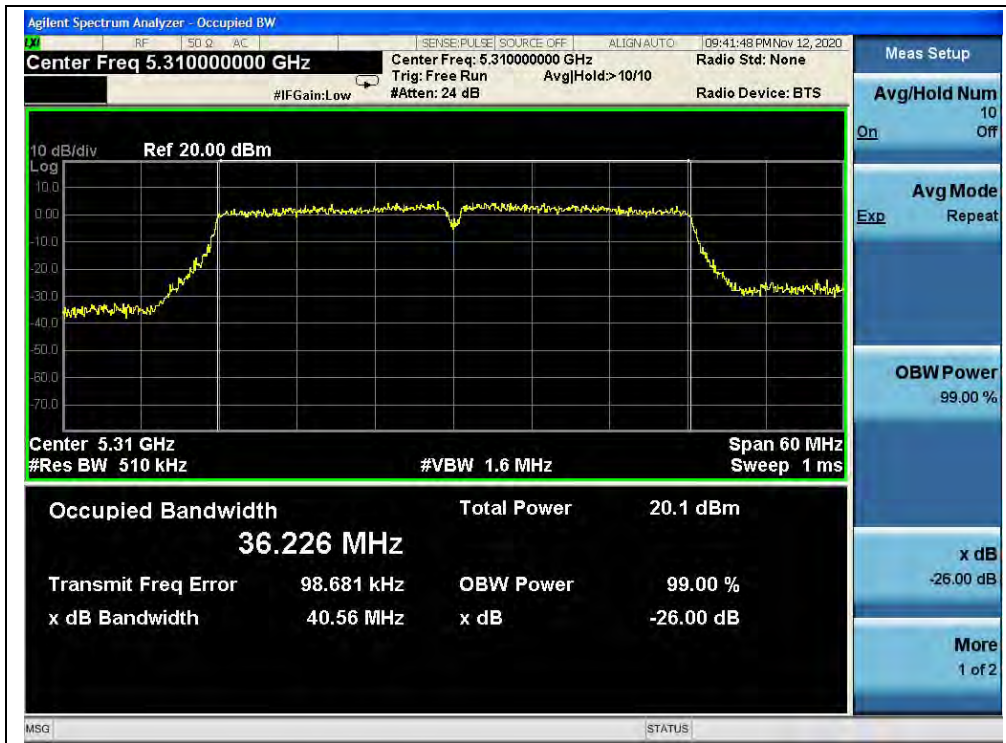
(Channel 38, 5190MHz, 802.11ac (VHT40))



(Channel 46, 5230MHz, 802.11ac (VHT40))



(Channel 54, 5270MHz, 802.11ac (VHT40))

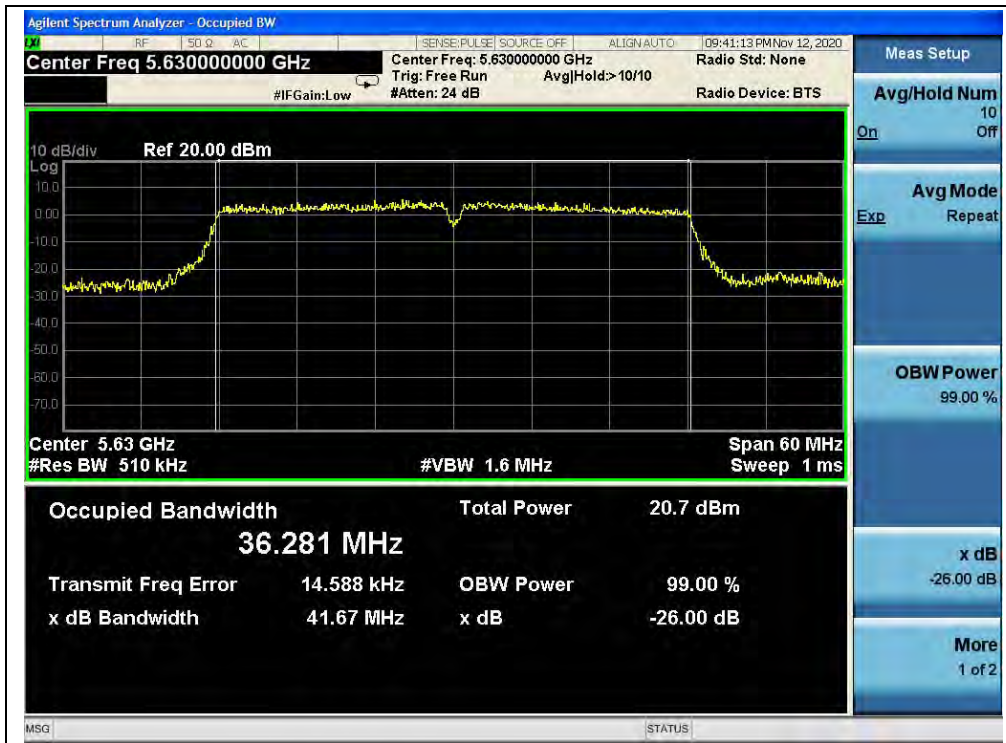


(Channel 62, 5310MHz, 802.11ac (VHT40))



(Channel 102, 5510MHz, 802.11ac (VHT40))

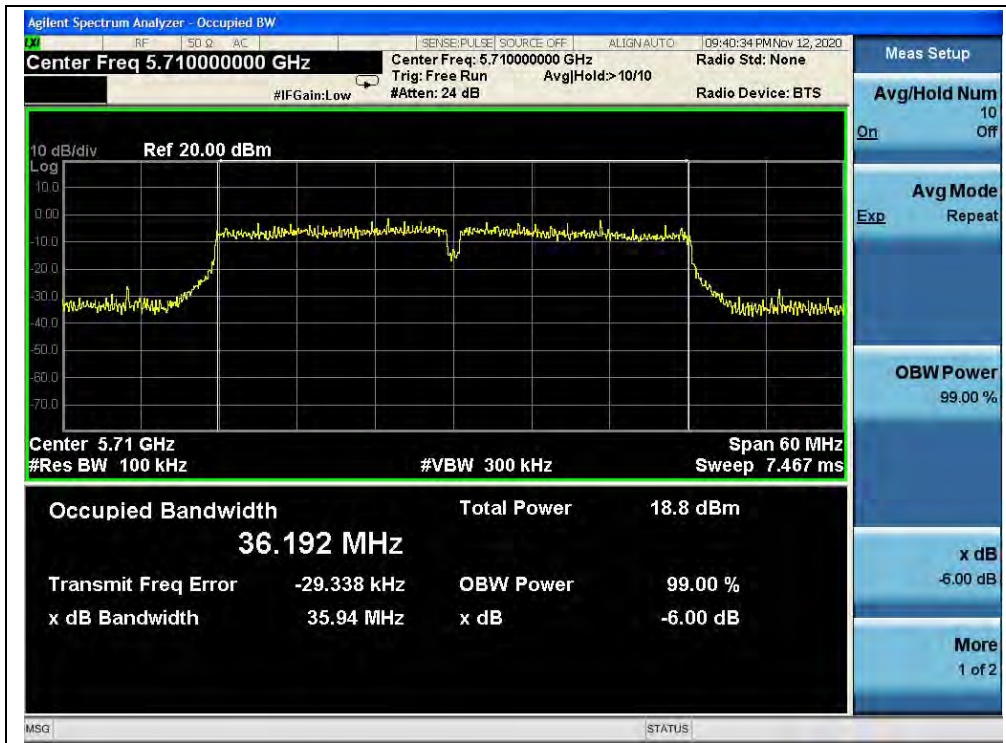




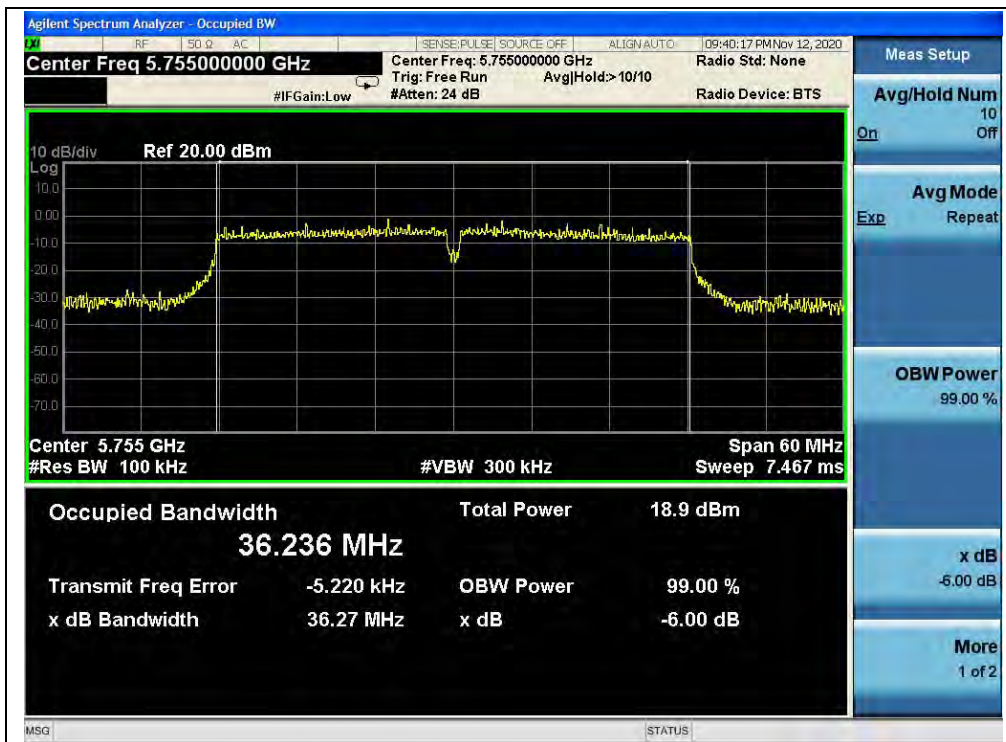
(Channel 126, 5630MHz, 802.11ac (VHT40))



(Channel 142, 5710MHz, 802.11ac (VHT40))



(Channel 142, 5710MHz, 802.11ac (VHT40))



(Channel 151, 5755MHz, 802.11ac (VHT40))



(Channel 159, 5795MHz, 802.11ac (VHT40))





802.11ac (VHT80) Mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
42	5210	83.17
58	5290	83.66
106	5530	82.95
122	5610	83.60
138	5690	96.36
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
138	5690	75.63
155	5775	75.11

B. Test Plot:



(Channel 42, 5210MHz, 802.11ac (VHT80))



(Channel 58, 5290MHz, 802.11ac (VHT80))



(Channel 106, 5530MHz, 802.11ac (VHT80))





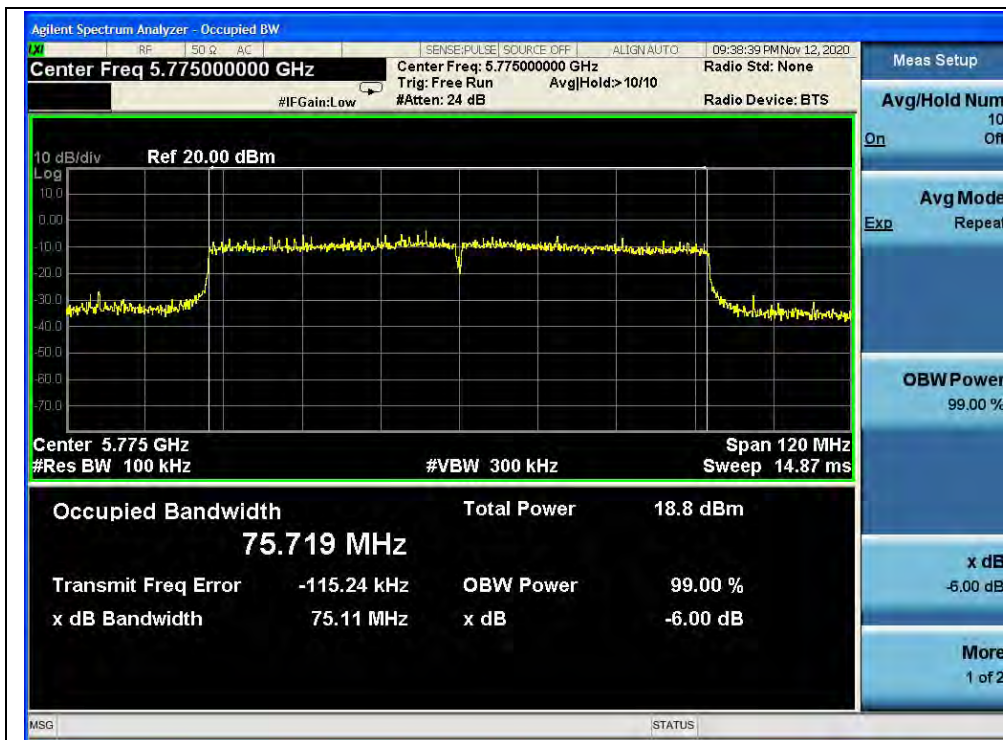
(Channel 122, 5610MHz, 802.11ac (VHT80))



(Channel 138, 5690MHz, 802.11ac (VHT80))



(Channel 138, 5690MHz, 802.11ac (VHT80))



(Channel 155, 5775MHz, 802.11ac (VHT80))

## 2.5. Peak Power Spectral Density

### 2.5.1. Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

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

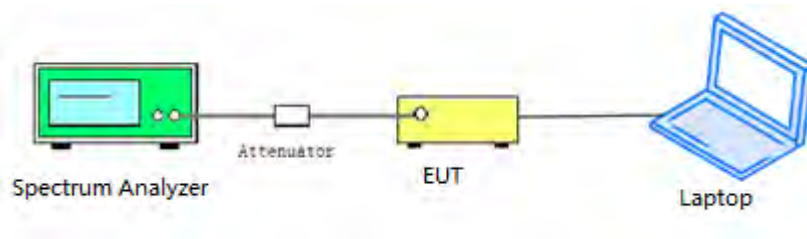
If transmitting antennas of directional gain greater than 6dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain =  $G_{ANT} + 10\log(N_{ANT})$  dBi, where  $G_{ANT}$  is the antenna gain in dBi,  $N_{ANT}$  is the number of outputs.

### 2.5.2. Test Description

#### Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.



**2.5.3. Test Procedure**

KDB 789033 Section F) Maximum Power Spectral Density (PSD) Method SA-3 was used in order to prove compliance

- 1) Set span to encompass the entire 26-dB emission bandwidth
- 2) Set RBW = 1MHz. Set VBW ≥ 3MHz
- 3) Number of points in sweep ≥ 2 Span / RBW. Sweep time = auto
- 4) Detector = Average
- 5) Trace mode=Max hold
- 6) Record the max value

**2.5.4. Test Result**

**802.11a Mode**

**A. Test Verdict:**

Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Corrected PPSD (dBm/MHz)		Limit (dBm/MHz)	Verdict
	ANT1	ANT2		ANT1	ANT2		
5180	4.21	4.58	0.10	4.31	4.68	11	PASS
5220	4.24	4.22		4.34	4.32		
5240	4.08	4.22		4.18	4.32		
5260	3.76	4.15		3.86	4.25		
5300	3.74	3.85		3.84	3.95		
5320	3.78	3.96		3.88	4.06		
5500	4.27	4.20		4.37	4.30		
5600	4.07	4.50		4.17	4.60		
5720	3.08	3.05		3.18	3.15		
Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)		Limit (dBm/500KHz)	Verdict
	ANT1	ANT2		ANT1	ANT2		
5720	0.30	0.29	0.10	0.40	0.39	30	PASS
5745	0.42	0.28		0.52	0.38		
5785	0.94	0.79		1.04	0.89		
5825	1.24	1.15		1.34	1.25		



**B.Test Plot:**



(Channel 36, 5180MHz, 802.11a, ANT2)



(Channel 44, 5220MHz, 802.11a, ANT2)



(Channel 48, 5240MHz, 802.11a, ANT2)



(Channel 52, 5260MHz, 802.11a, ANT2)



(Channel 60, 5300MHz, 802.11a, ANT2)



(Channel 64, 5320MHz, 802.11a, ANT2)





(Channel 100, 5500MHz, 802.11a, ANT2)



(Channel 120, 5600MHz, 802.11a, ANT2)





(Channel 144, 5720MHz, 802.11a, ANT2)



(Channel 144, 5720MHz, 802.11a, ANT2)



(Channel 149, 5745MHz, 802.11a, ANT2)



(Channel 157, 5785MHz, 802.11a, ANT2)



(Channel 165, 5825MHz, 802.11a, ANT2)



**802.11n (HT20) Mode**

**A.Test Verdict:**

Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
	ANT1	ANT2				
5180	3.65	4.10	0.11	7.00	8.44	PASS
5220	3.84	3.84		6.96		
5240	3.65	3.89		6.89		
5260	3.24	3.65		6.57		
5300	3.34	3.40		6.49		
5320	3.37	3.46		6.54		
5500	3.91	3.78		6.97		
5600	3.81	4.07		7.06		
5720	2.81	2.68		5.87		
Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
	ANT1	ANT2				
5720	0.01	-0.34	0.11	2.96	27.44	PASS
5745	0.32	-0.12		3.23		
5785	0.59	0.19		3.51		
5825	1.03	0.81		4.04		
<p><b>Note:</b> Directional gain = 5.55dBi + 10log(2) = 8.56dBi &gt; 6dBi, so the limit shall be reduced to 11-(8.56-6) = 8.44dBm for 5.18-5.24 GHz band and reduced to 30-(8.56-6) = 27.44dBm for 5.745-5.825 GHz band.</p>						





B.Test Plot:



(Channel 36, 5180MHz, 802.11n (HT20), ANT2)



(Channel 44, 5220MHz, 802.11n (HT20), ANT2)



(Channel 48, 5240MHz, 802.11n (HT20), ANT2)



(Channel 52, 5260MHz, 802.11n (HT20), ANT2)



(Channel 60, 5300MHz, 802.11n (HT20), ANT2)



(Channel 64, 5320MHz, 802.11n (HT20), ANT2)





(Channel 100, 5500MHz, 802.11n (HT20), ANT2)



(Channel 120, 5600MHz, 802.11n (HT20), ANT2)





(Channel 144, 5720MHz, 802.11n (HT20), ANT2)



(Channel 144, 5720MHz, 802.11n (HT20), ANT2)



(Channel 149, 5745MHz, 802.11n (HT20), ANT2)



(Channel 157, 5785MHz, 802.11n (HT20), ANT2)





**802.11n (HT40) Mode**

**A.Test Verdict:**

Frequency (MHz)	Measured PPSD (dBm/MHz)		Duty Factor	Total PPSD (dBm/MHz)	Limit (dBm/MHz)	Verdict
	ANT1	ANT2				
5190	1.50	1.92	0.18	4.91	8.44	PASS
5230	1.41	1.62		4.71		
5270	0.79	1.12		4.15		
5310	0.86	1.35		4.30		
5510	1.55	1.46		4.70		
5630	1.40	2.15		4.98		
5710	0.55	0.67		3.80		
Frequency (MHz)	Measured PPSD (dBm/500KHz)		Duty Factor	Total PPSD (dBm/500KHz)	Limit (dBm/500KHz)	Verdict
	ANT A	ANT B				
5710	-2.32	-2.16	0.18	0.95	27.44	PASS
5755	-2.16	-2.05		1.09		
5795	-1.82	-1.59		1.49		
<p><b>Note:</b> Directional gain = <math>5.55\text{dBi} + 10\log(2) = 8.56\text{dBi} &gt; 6\text{dBi}</math>, so the limit shall be reduced to <math>11 - (8.56 - 6) = 8.44\text{dBm}</math> for 5.18-5.24 GHz band and reduced to <math>30 - (8.56 - 6) = 27.44\text{dBm}</math> for 5.745-5.825 GHz band.</p>						





B.Test Plot:



(Channel 38, 5190MHz, 802.11n (HT40), ANT2)



(Channel 46, 5230MHz, 802.11n (HT40), ANT2)



(Channel 54, 5270MHz, 802.11n (HT40), ANT2)



(Channel 62, 5310MHz, 802.11n (HT40), ANT2)



(Channel 102, 5510MHz, 802.11n (HT40), ANT2)



(Channel 126, 5630 MHz, 802.11n (HT40), ANT2)





(Channel 142, 5710MHz, 802.11n (HT40), ANT2)



(Channel 142, 5710MHz, 802.11n (HT40), ANT2)





(Channel 151, 5755MHz, 802.11n (HT40), ANT2)



(Channel 159, 5795MHz, 802.11n (HT40), ANT2)