



REPORT No.: SZ21070280W04

TEST REPORT

APPLICANT : Thundercomm Technology Co., Ltd

PRODUCT NAME : Turbox C404 SOM

MODEL NAME : TurboX C404

BRAND NAME : TurboX

FCC ID : 2AOHH-TURBOXC404

STANDARD(S) : 47 CFR Part 15 Subpart E

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Edited by:

Zeng Xiaoying
Zeng Xiaoying (Rapporteur)

Approved by:

Shen Junsheng
Shen Junsheng (Supervisor)

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MORLAB

Shenzhen Morlab Communications Technology Co., Ltd.
FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road,
Block67, BaoAn District, ShenZhen, Guangdong Province, P. R. China

Tel: 86-755-36698555

Http://www.morlab.cn

Fax: 86-755-36698525

E-mail: service@morlab.cn





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Change History		
Version	Date	Reason for change
1.0	2021-10-14	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

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

1.2. Equipment Under Test (EUT) Description

Product Name:	Turbox C404 SOM	
Sample No.:	7#	
Hardware Version:	TurboX C404 SOM V06	
Software Version:	LE1	
Modulation Technology:	OFDM	
Modulation Mode:	802.11a, 802.11n (HT20), 802.11n (HT40) 802.11ac (VHT20), 802.11ac (VHT40), 802.11ac (VHT80),	
Operating Frequency Range:	5180MHz-5240MHz; 5260MHz-5320MHz; 5500MHz-5720MHz; 5745MHz-5825MHz	
Channel Number:	Refer to 1.3	
Antenna Information:	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
Directional Gain:	8.56dBi(Type B) _{Note 4}	



Note 1: This is a variant report of original report (Report No.: SZ20090290W04, FCC ID: 2AOHHTURBOXC404). Based on the similarity between before, made the following changes:

1. The Bluetooth function in the original ANT1 antenna port was changed to the ANT3 antenna port through software, and a new BT antenna was provided on the ANT3 port. The antenna gain is smaller than that of the original ANT1 port, and the antenna type is the same.
2. The back of the prototype PCB is optimized for heat dissipation, and some windows are added to the large area ground on the surface of the PCB.
3. Modify FCC ID number.

Except for the differences shown above, the other parts are the same as before. Their electrical circuit design, layout, components used and internal wiring are identical. No other changes.

Due to the above changes, we have evaluated and retested worst case of Restricted Frequency Bands and Radiated Emission, the test results are better than before. The changes do not affect the results in this report.

Note 2: The EUT will not sell with antenna.

Note 3: 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 4: 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 5: 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 6: For different operating modes, the limits listed in the report are the worst among them.

Note 7: 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 8: 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 9: WIFI hotspot only support U-NII-1 and U-NII-3 band.

Note 10: 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) ^{Note1}
OFDM (802.11a)	BPSK	6/9
	QPSK	12/18
	16QAM	24/36
	64QAM	48/54
OFDM (802.11n)	BPSK	6.5
	QPSK	13/19.5
	16QAM	26/39
	64QAM	52/58.5/65
OFDM (802.11ac)	BPSK	6.5
	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	36	5180	40	5200
	44	5220	48	5240
40MHz	38	5190	46	5230
80MHz	42	5210		
Frequency Range: 5250MHz-5350MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	52	5260	56	5280
	60	5300	64	5320
40MHz	54	5270	62	5310
80MHz	58	5290		
Frequency Range: 5470MHz-5725MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	100	5500	105	5520
	108	5540	112	5560
	116	5580	120	5600
	124	5620	128	5640
	132	5660	136	5680
	140	5700	144	5720
40MHz	102	5510	110	5550
	118	5590	126	5630
	134	5670	142	5710
80MHz	106	5530	122	5610
	138	5690		
Frequency Range: 5725MHz-5825MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	149	5745	153	5765
	157	5785	161	5805
	165	5825		
40MHz	151	5775	159	5795
80MHz	155	5775		

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 _{Note1}	No deviation
2	ANSI C63.10	Duty Cycle of the Test Signal	Jan 20, 2021	Tu Ya'nan	PASS _{Note1}	No deviation
3	15.407(a)	Maximum Conducted Output Power	Jan 20, 2021	Tu Ya'nan	PASS _{Note1}	No deviation
4	15.407(a) (e)	Emission Bandwidth	Nov 12, 2020	Tu Ya'nan	PASS _{Note1}	No deviation
5	15.407(a)	Peak Power Spectral Density	Nov 12, 2020	Tu Ya'nan	PASS _{Note1}	No deviation
6	15.407(g)	Frequency Stability	Nov 12, 2020	Tu Ya'nan	PASS _{Note1}	No deviation
7	15.207	Conducted Emission	Oct 17, 2020	Huang Zhiye	PASS _{Note1}	No deviation
8	15.407(b)	Restricted Frequency Bands	Jan 07&23, 2021	Gao Jianrou	PASS _{Note1}	No deviation
9	15.407(b)	Radiated Emission	Jan 22, 2021	Gao Jianrou	PASS _{Note1}	No deviation

Note 1: The test results of these test items in this report refer to the test report (Report No.: SZ20090290W04).

Note 2: The DFS test report was documented in a separate report (Report No.: SZ21070280W05).

Note 3: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.102013.



Note 4: These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 v01r03.

Note 5: 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 6: 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 7: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.

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

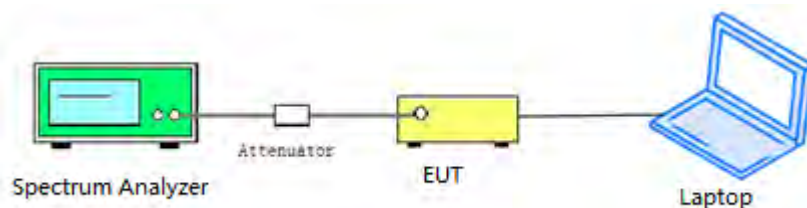
2.2.1. Requirement

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.

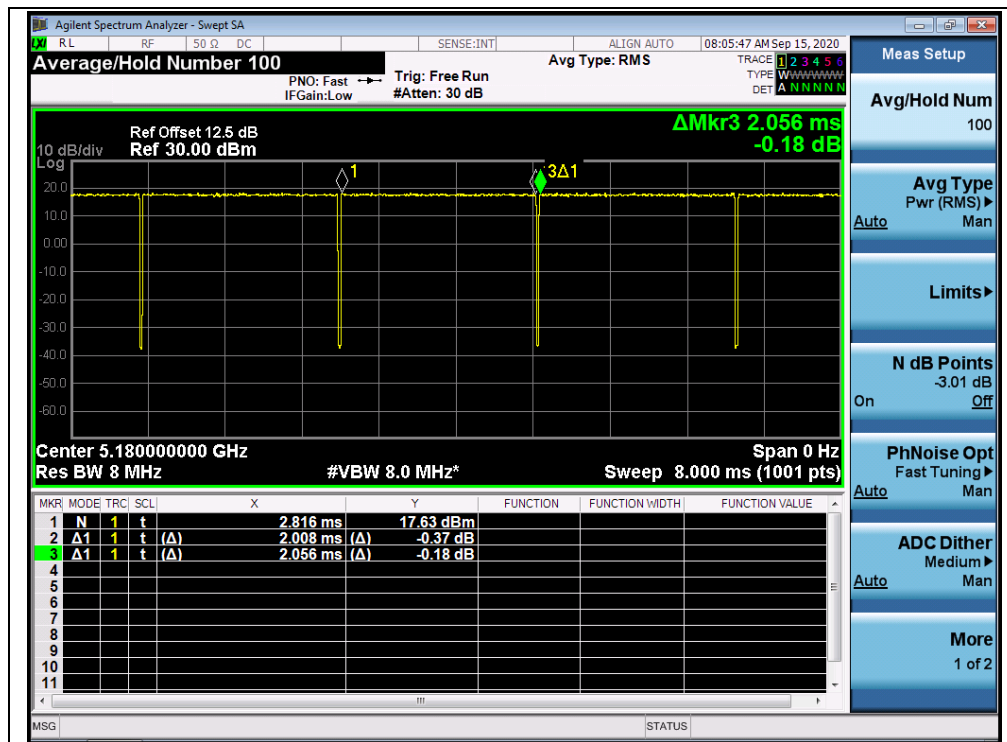


2.2.4. Test Result

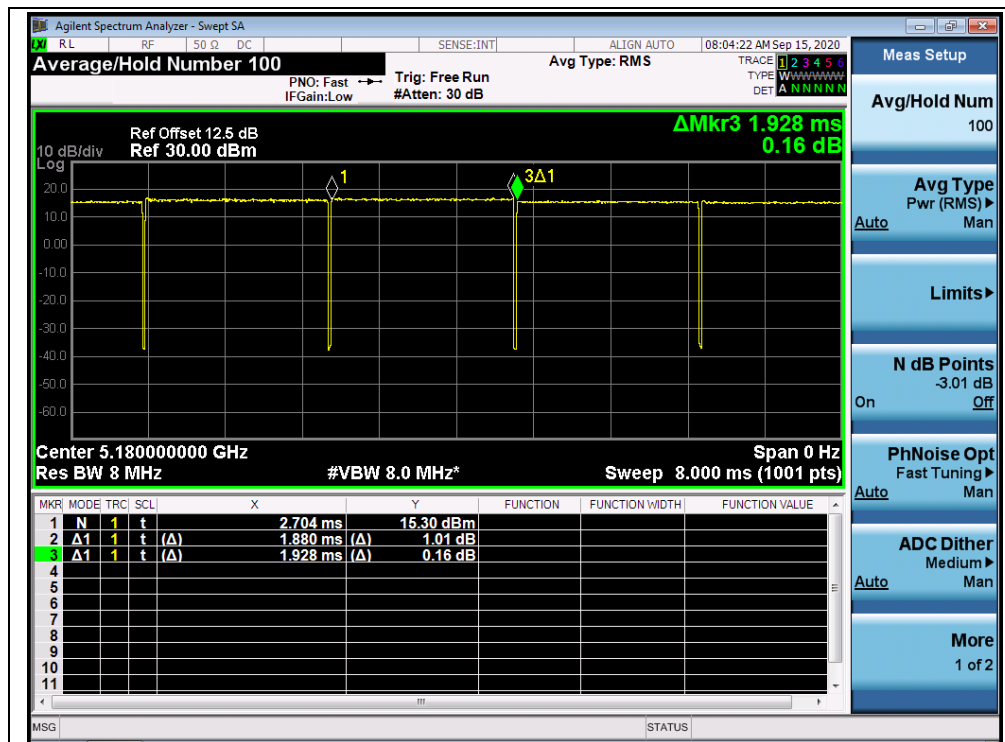
A. Test Verdict:

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

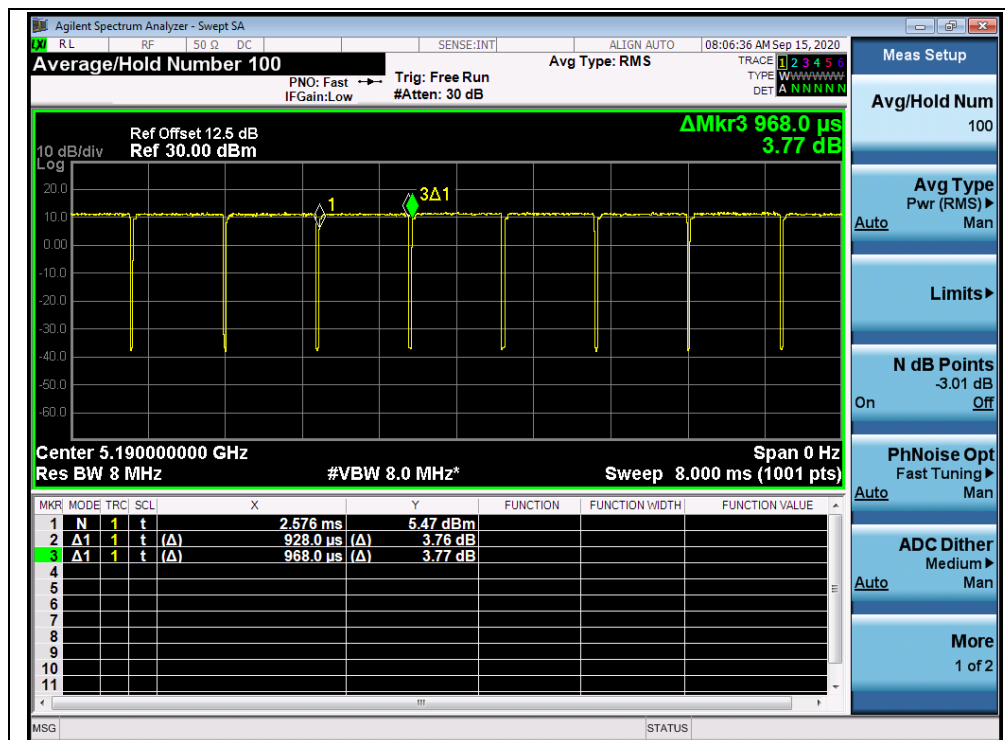
B. Test Plot:



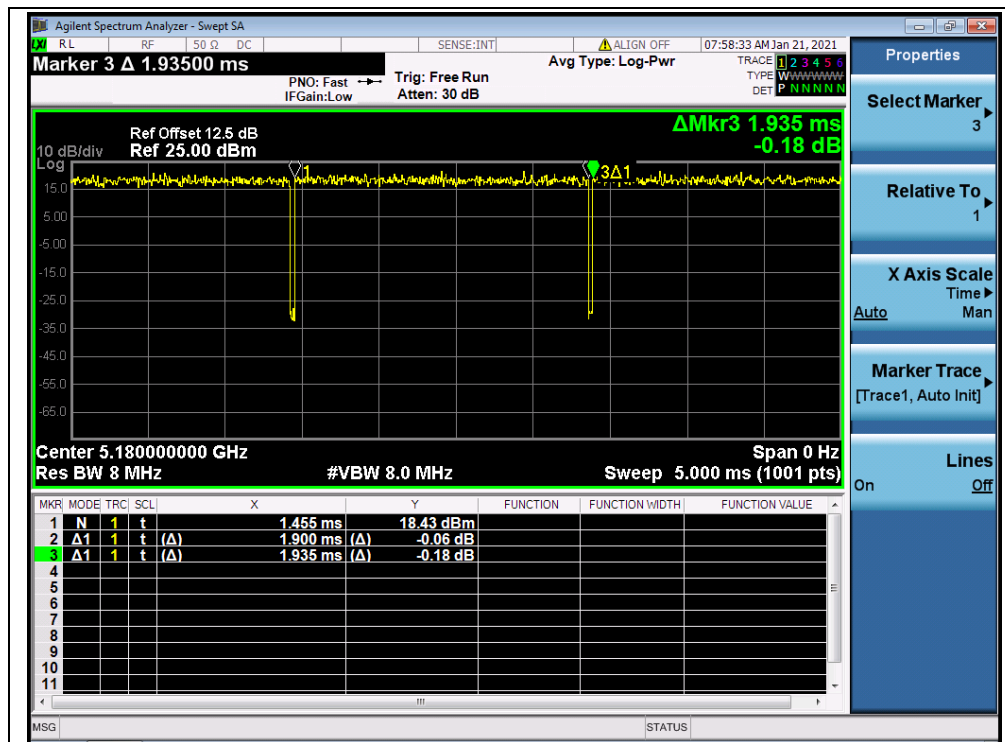
(Channel 36, 5180MHz, 802.11a)



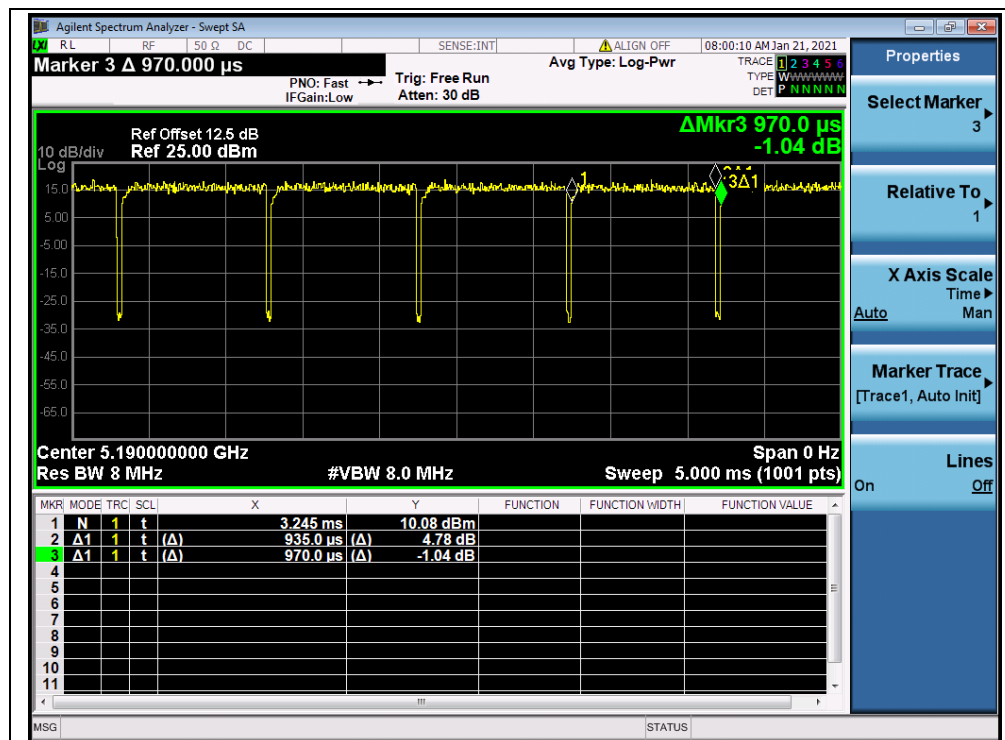
(Channel 36, 5180MHz, 802.11n (HT20))



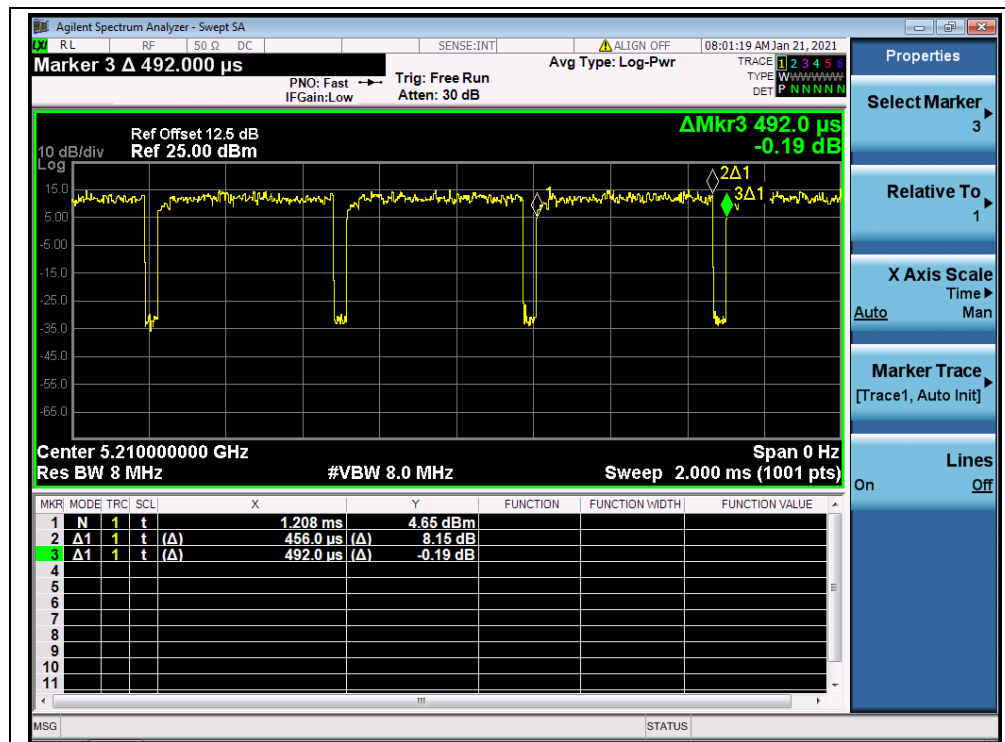
(Channel 38, 5190MHz, 802.11n (HT40))



(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.

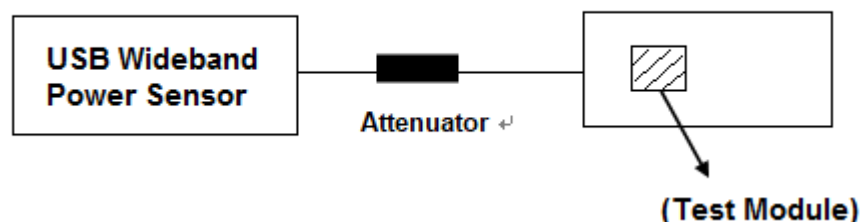
(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the 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_{ANT} is the antenna gain in dBi, N_{ANT} is the number of outputs.

2.3.2. Test Description

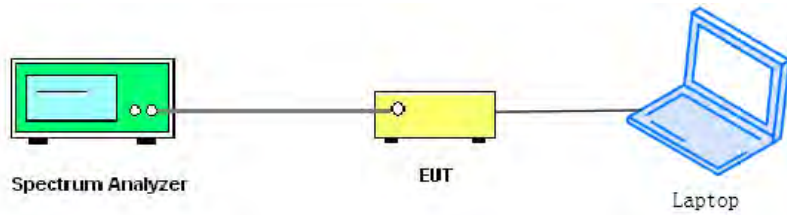
Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.

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

Mode	Band	Channel (MHz)	26dB BW (MHz)	$10+10\log(26\text{dB BW})$	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			PASS
5240	14.78	15.92		14.88	0.031	16.02	0.040			
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	1	
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				
	ANT1	ANT2			dBm	W		dBm
5180	14.99	15.42	0.11	18.33	0.068	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			
5720	14.48	15.53		18.13	0.065			
5745	14.19	15.25		17.85	0.061	27.44	0.55	
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				
	ANT1	ANT2		dBm	W	dBm	W	
5190	15.52	15.18	0.18	18.57	0.072	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	27.44	0.55	
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
5180	15.05	15.66	0.08	18.45	0.070	21.44	0.13	PASS
5220	14.90	15.73		18.45	0.070			PASS
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	dBm		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			PASS
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		18.69	0.074			
5710	15.35	15.40		18.57	0.072			
5755	14.86	15.76		18.51	0.071	27.44	0.55	
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 dBm	ANT1 dBm		W	dBm	dBm	W	
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		18.57	0.072			
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.								

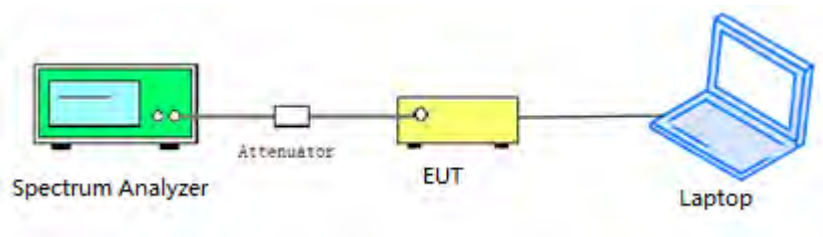
2.4. Emission Bandwidth

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, 5500 MHz, 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)



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

Agilent Spectrum Analyzer - Occupied BW

RF SQ AC SENSE/PULSE SOURCE OFF ALIGN AUTO 09:59:40 PM Nov 12, 2020

Center Freq 5.18000000 GHz Center Freq: 5.18000000 GHz Radio Std: None
 Trig: Free Run Avg/Hold: >10/10
 #IFGain: Low #Atten: 24 dB Radio Device: BTS

10 dB/div Ref 20.00 dBm

Center 5.18 GHz Span 30 MHz
 #Res BW 300 kHz #VBW 1 MHz Sweep 1 ms

Occupied Bandwidth		Total Power	
17.854 MHz		20.6 dBm	
Transmit Freq Error	55.885 kHz	OBW Power	99.00 %
x dB Bandwidth	23.84 MHz	x dB	-26.00 dB

Meas Setup

Avg/Hold Num 10
 On Off

Avg Mode Repeat
 Exp

OBW Power 99.00 %

x dB -26.00 dB

More 1 of 2

MSG STATUS

(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))

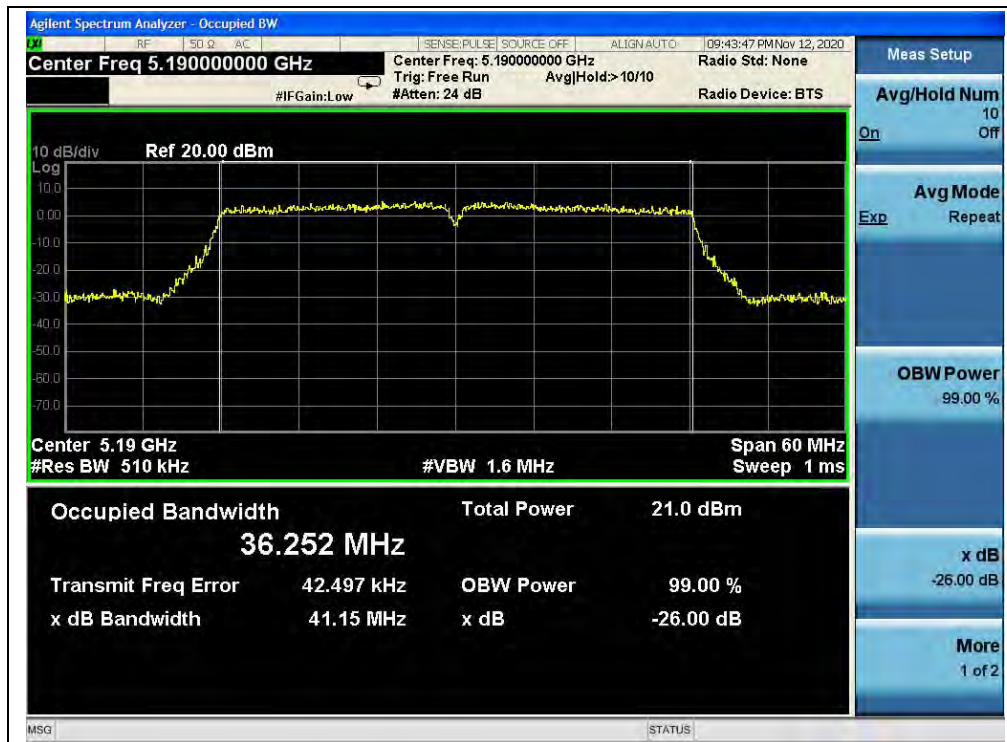


802.11n (HT40) Test mode

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))



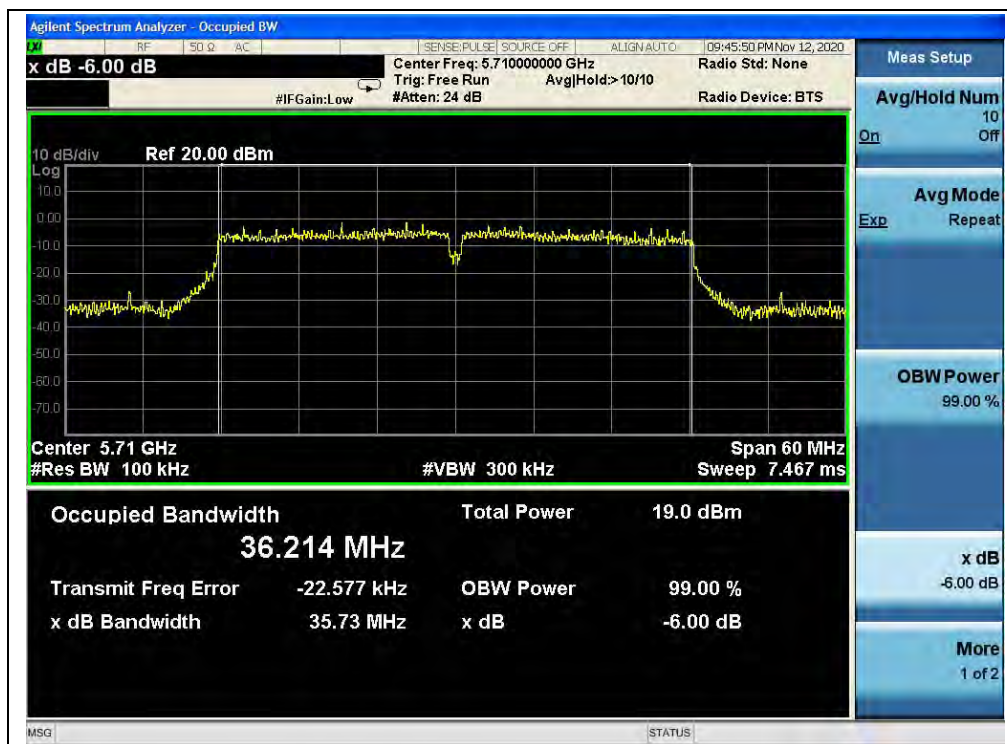
(Channel 102, 5510MHz, 802.11n (HT40))



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



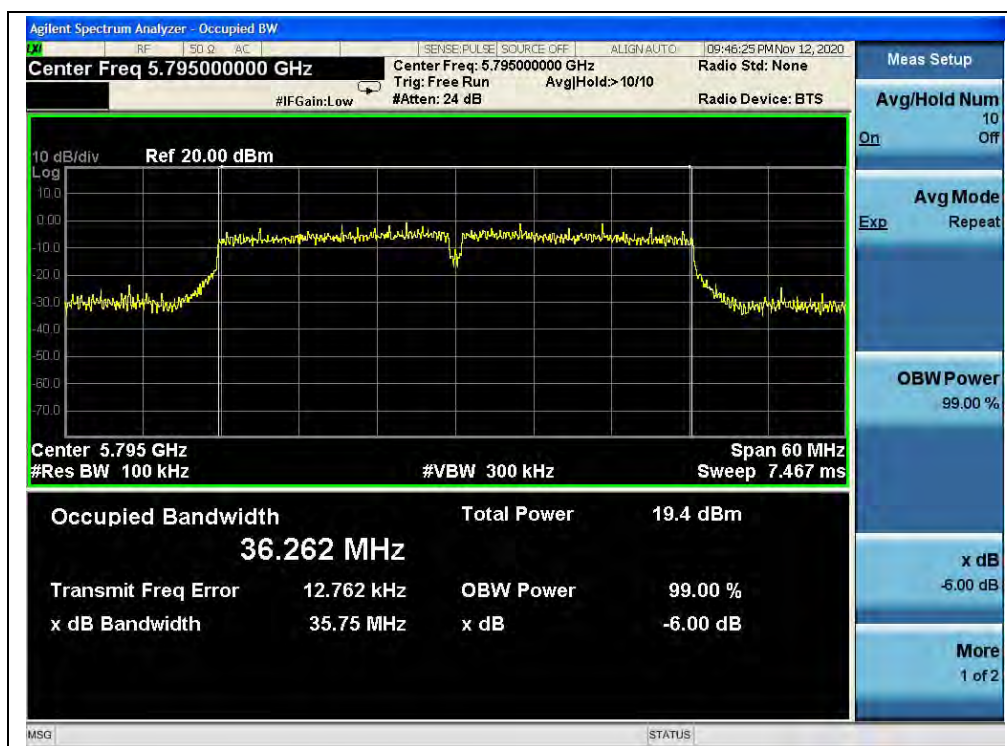
(Channel 142, 5710MHz, 802.11n (HT40))



(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))

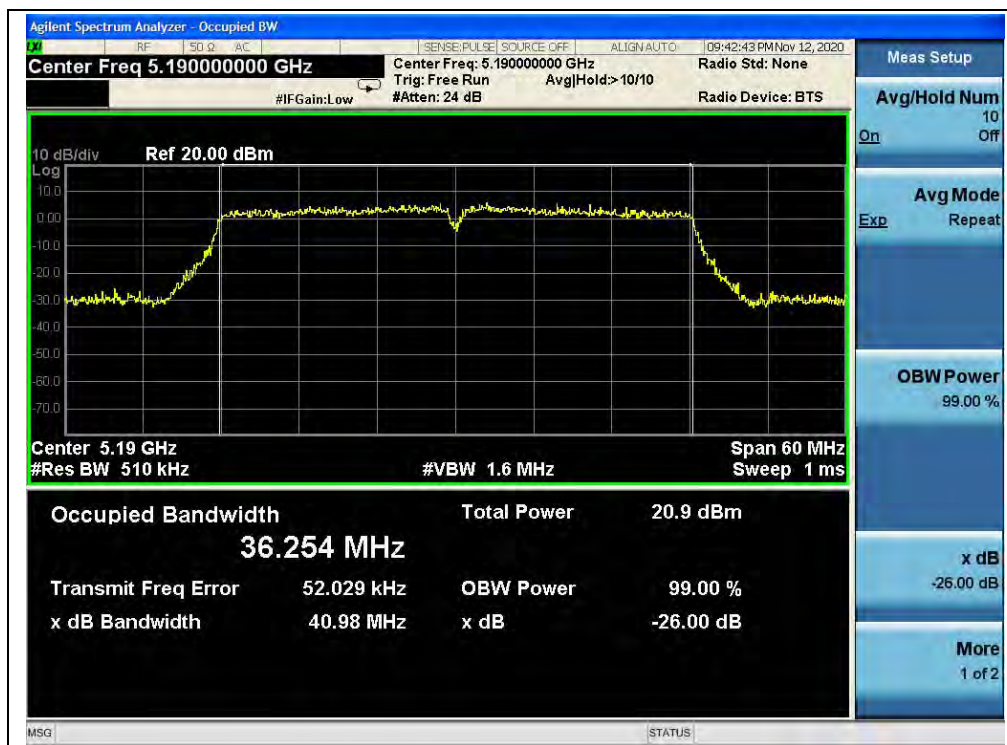


802.11ac (VHT40) Mode

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:



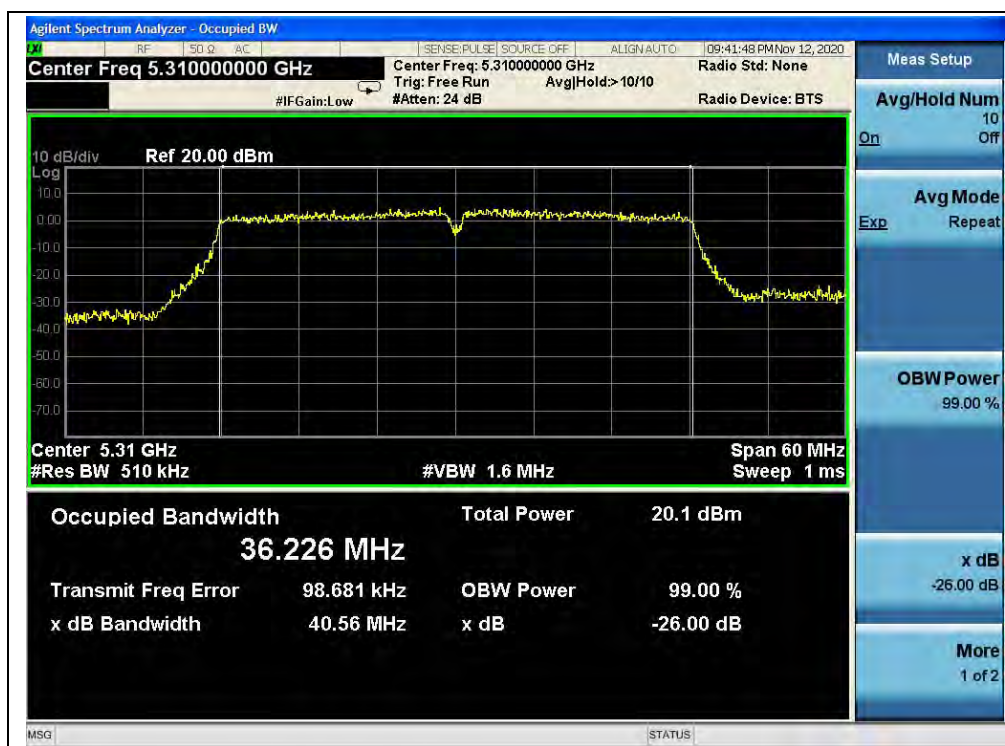
(Channel 38, 5190MHz, 802.11ac (VHT40))



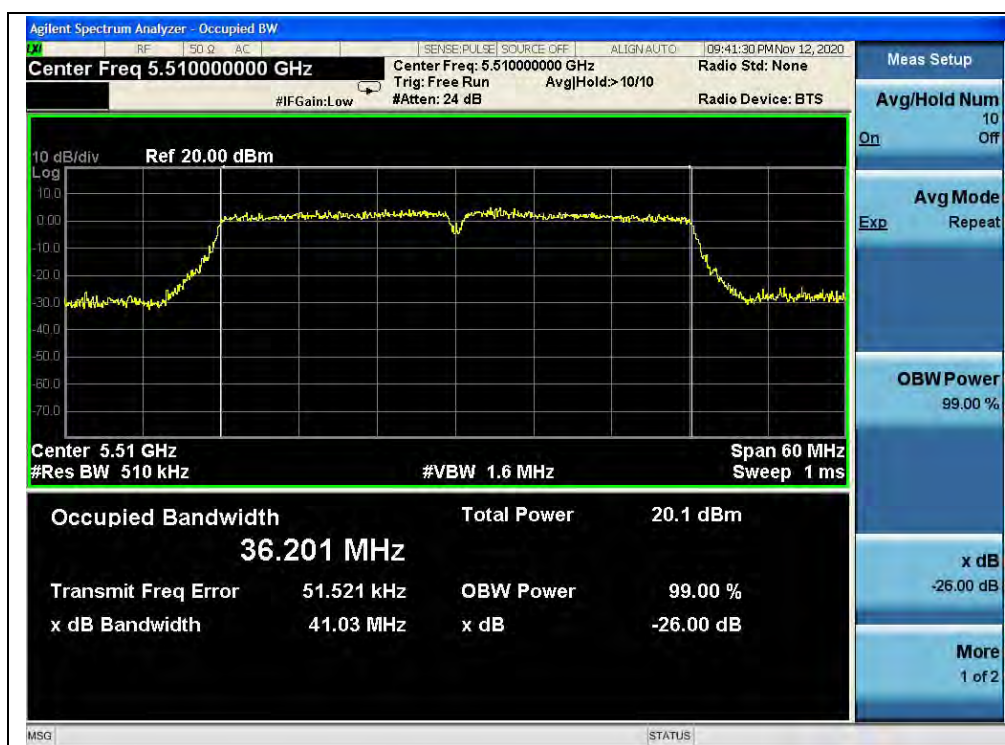
(Channel 46, 5230MHz, 802.11ac (VHT40))



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



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



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



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



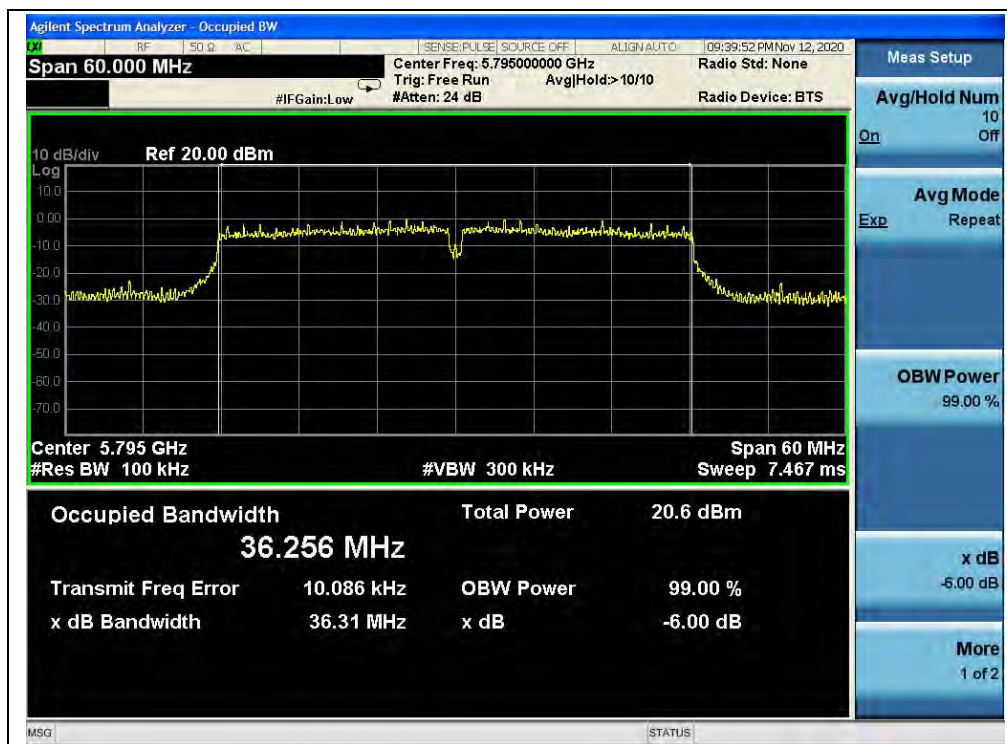
(Channel 142, 5710MHz, 802.11ac (VHT40))



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



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



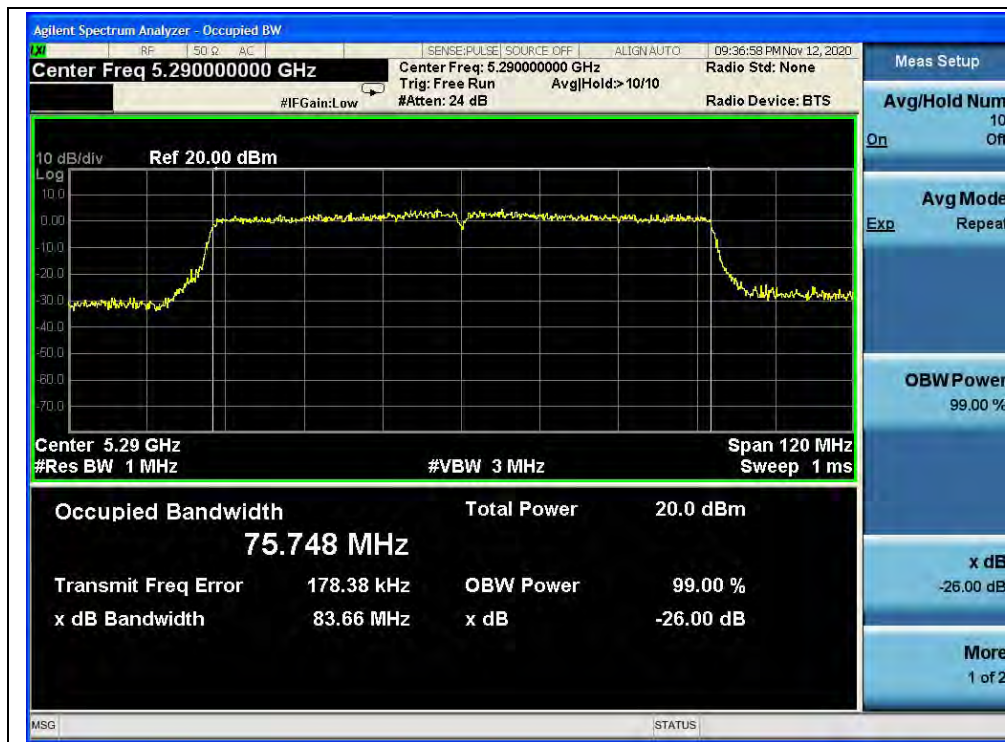
(Channel 159, 5795MHz, 802.11ac (VHT40))

**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:

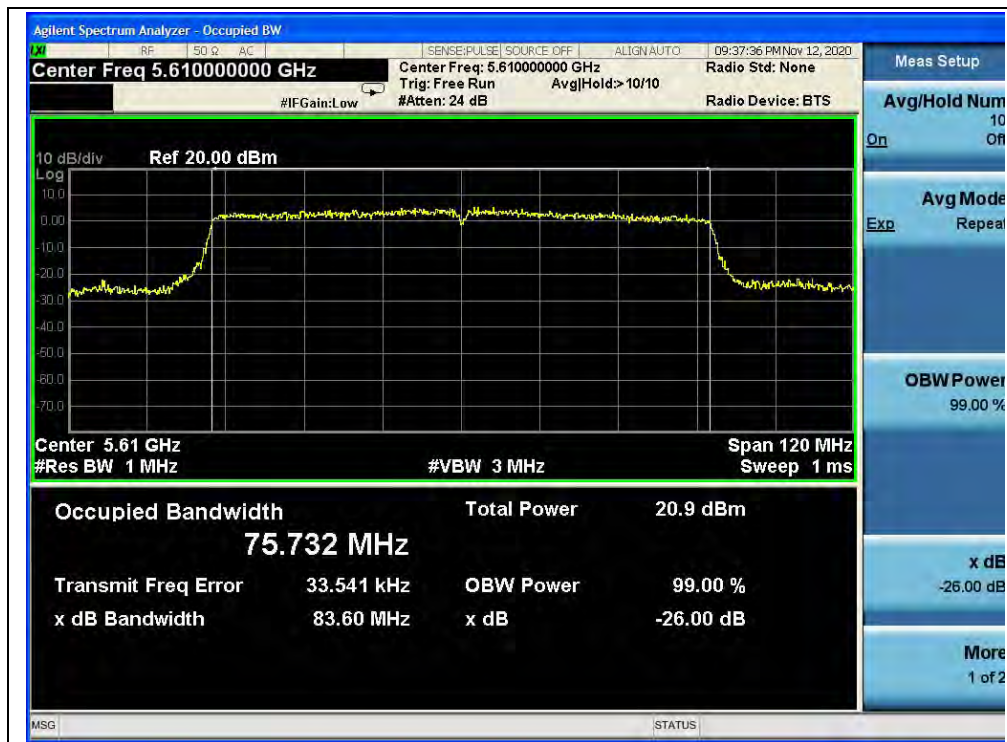
(Channel 42, 5210MHz, 802.11ac (VHT80))



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



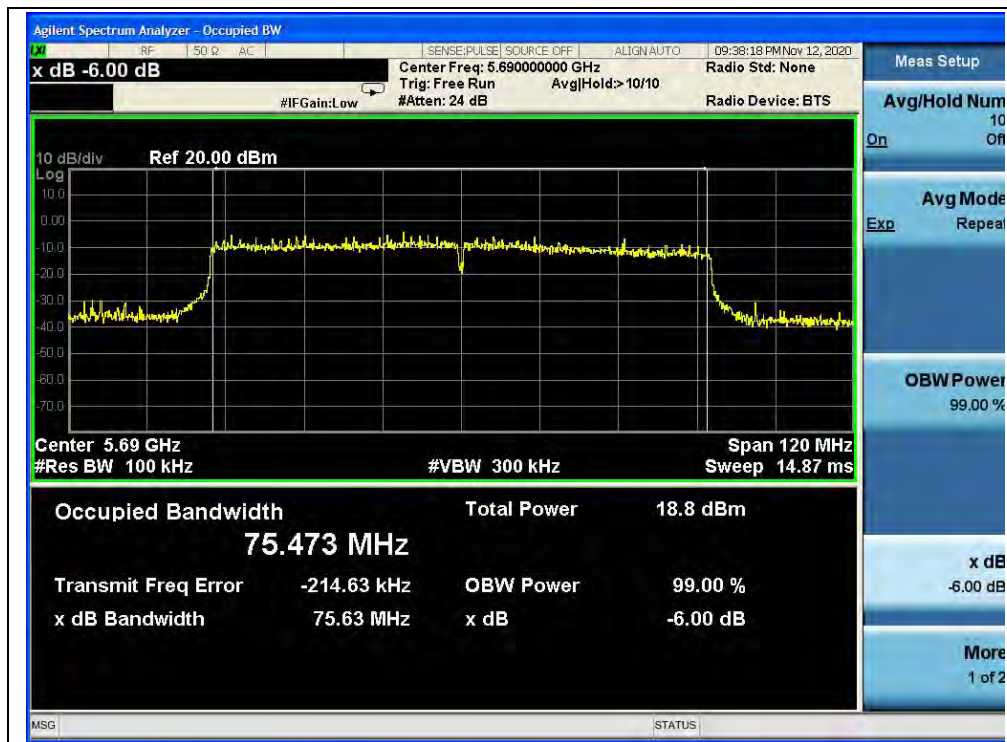
(Channel 106, 5530MHz, 802.11ac (VHT80))



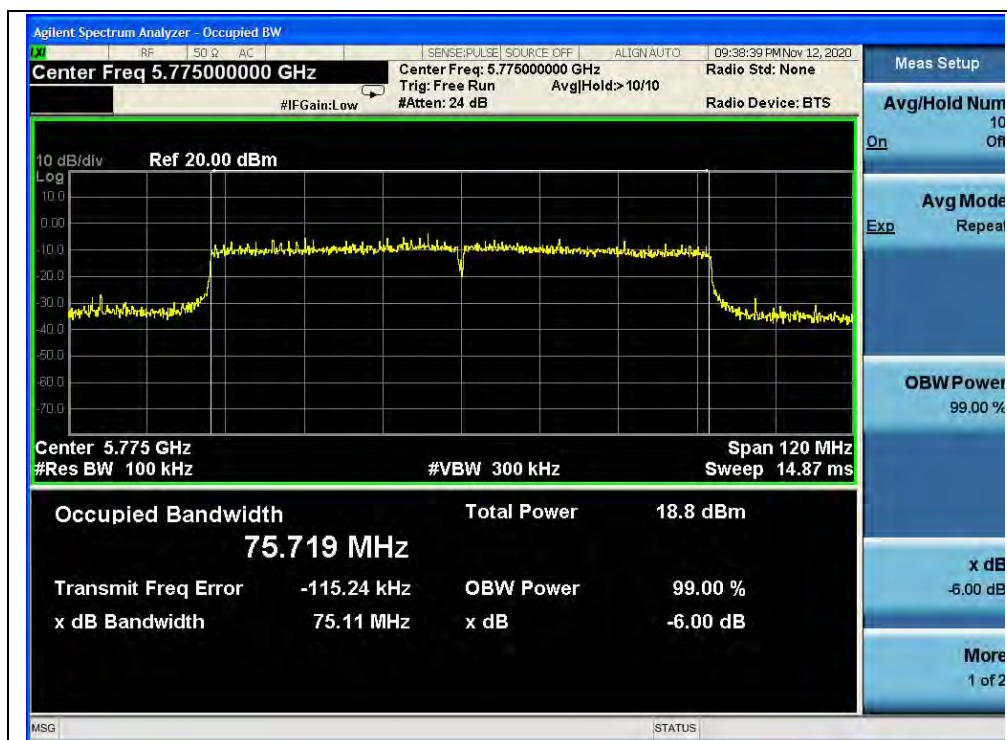
(Channel 122, 5610MHz, 802.11ac (VHT80))



(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.

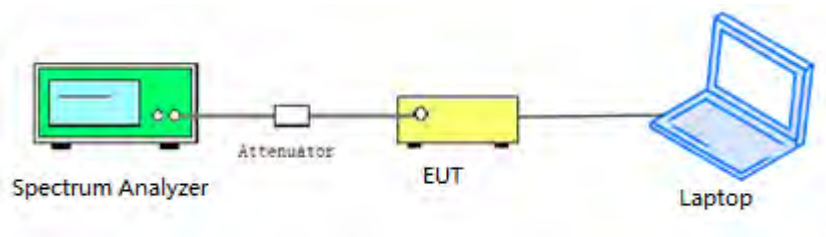
If transmitting antennas of directional gain greater than 6dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

(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 $\geq$ 3MHz
- 3) Number of points in sweep $\geq$ 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		
Note: Directional gain = 5.55dBi +10log(2) = 8.56dBi>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.						



B.Test Plot:



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



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