



TEST REPORT

APPLICANT : Thundercomm Technology Co., Ltd

PRODUCT NAME : Smart Module

MODEL NAME : C865C, C2130C, C5165C

BRAND NAME : TurboX

FCC ID : 2AOHHTURBOXC865C

STANDARD(S) : 47 CFR Part 15 Subpart E

RECEIPT DATE : 2022-11-11

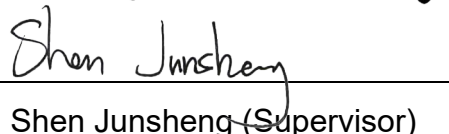
TEST DATE : 2022-11-27 to 2022-12-05

ISSUE DATE : 2022-12-27

Edited by:


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Change History		
Version	Date	Reason for change
1.0	2022-12-27	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:	Smart Module	
Sample No.:	1#, 2#	
Hardware Version:	DT865_DEq_LA-IOB V03	
Software Version:	FlatBuild_Turbox-QCS8250_xx.xx_la1.0.D.userdebug.202210 24.1345	
Modulation Technology:	OFDM	
Modulation Mode:	802.11a, 802.11n (HT20), 802.11n (HT40) 802.11ac (VHT20), 802.11ac (VHT40),802.11ac (VHT80) 802.11ax (HEW20), 802.11ax (HEW40),802.11ax (HEW80)	
Operating Frequency Range:	5180MHz-5240MHz; 5260MHz-5320MHz; 5500MHz-5720MHz; 5745MHz-5825MHz	
Channel Number:	Refer to 1.3	
Antenna Information:	Antenna Type A	
	Antenna Type:	Dipole Antenna
	Antenna Gain:	ANT0: 2.7dBi; ANT1: 2.7dBi
	Part No.:	1461531100
	Manufacturer:	MOLEX
	Antenna Type B	
	Antenna Type:	PIFA Antenna
	Antenna Gain:	ANT0: 3.91dBi; ANT1: 3.42dBi
	Part No.:	ANT0: F-0G-JV-0211-002-00 ANT1: F-0G-JV-0211-001-00



	Manufacturer:	Speed Wireless Technical Co., LTD.
Directional Gain:	6.92dBi _{Note 4}	

Note1: This is a variant report of original report (Report No.: SZ22030287W04, FCC ID: 2AOHHTURBOXC865C). Based on the similarity between before, made the following changes:

1. A new antenna is added.
2. Change the C11201 capacitor, the role is BT power supply filter, does not change the power control, does not affect the RF.
3. Change the shelf under the shield cover.
4. Update software version number.
5. Reduce 2.4G WiFi and 5G WiFi conducted output power.

Except for the differences shown above, the other parts are the same as before. No other changes.

We have evaluated those changes in restricted frequency bands and radiated emissions and added the test results for antenna B in this report.

Due to the above changes, we have evaluated and retested the conducted output power, the test results were recorded in this report.

Note2: The EUT will not sell with the antenna.

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

Modulation Mode:	TX Function
802.11a	1TX
802.11n	2TX
802.11ac	2TX
802.11ax	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 (ANT0) in this report.

Note 6: All radiation test items for 802.11n, 802.11ac and 802.11ax 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(ANT0) in this report.

Note 7: 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

Mode	Bandwidth (MHz)	Modulation Technology	Modulation Type	Data Rate	RU Size
802.11a	20	OFDM	DBPSK	1/2/5.5/11Mbps	N/A
			DQPSK		
			CCK		
802.11n	20/40 (HT20/40)	OFDM	BPSK	MCS0~MCS7	N/A
			QPSK		
			16QAM		
			64QAM		
802.11ac	20/40/80 (VHT20/40/80)	OFDM	BPSK	MSC0~MCS9	N/A
			QPSK		
			16QAM		
			64QAM		
			256QAM		
802.11ax	20/40/80 (HEW20/40/80)	OFDMA	BPSK	MSC0~MCS11	26/52/106/242/484/996
			QPSK		
			16QAM		
			64QAM		
			256QAM		
			1024QAM		

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

(U-NII-1) 5180MHz-5240MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	36	5180	40	5200
	44	5220	48	5240
40MHz	38	5190	46	5230
80MHz	42	5210		
(U-NII-2A) 5260MHz-5320MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	52	5260	56	5280
	60	5300	64	5320
40MHz	54	5270	62	5310
80MHz	58	5290		
(U-NII-2C) 5500MHz-5720MHz				
Bandwidth	Channel	Frequency (MHz)	Channel	Frequency (MHz)
20MHz	100	5500	105	5520
		5540	112	5560
		5580	120	5600
		5620	128	5640
		5660	136	5680
		5700	144	5720
40MHz	102	5510	110	5550
		5590	126	5630
		5670	142	5710
80MHz	106	5530	122	5610
	138	5690		
(U-NII-3) 5745MHz-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	Mar. 31, 2022	Su Xiaoxian	PASS _{Note1}	No deviation
3	15.407(a)	Maximum Conducted Output Power	Nov. 17, 2022	Su Xiaoxian	PASS	No deviation
4	15.407(a)(e)	Emission Bandwidth	Apr. 19, 2022	Su Xiaoxian	PASS _{Note1}	No deviation
5	15.407(a)	Peak Power Spectral Density	Apr. 19, 2022	Su Xiaoxian	PASS _{Note1}	No deviation
6	15.407(g)	Frequency Stability	Apr. 20, 2022	Su Xiaoxian	PASS _{Note1}	No deviation
7	15.207	Conducted Emission	Apr. 27, 2022	Wu Zhaoling	PASS _{Note1}	No deviation
8	15.407(b)	Restricted Frequency Bands	Nov. 27&30, 2022 Dec. 01, 2022	Lin Jiayong	PASS	No deviation
9	15.407(b)	Radiated Emission	Nov. 29&30, 2022	Lin Jiayong	PASS	No deviation

Note1: The test results of these test items in this report refer to the test report (Report No.: SZ22030287W04).

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 v02r01 and KDB662911 D01 v02r01.



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 12.0dB contains two parts that cable loss 2.0dB 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% 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

Inside of the EUT has a permanently attached Dipole antenna fixed to PCB with solder. 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.

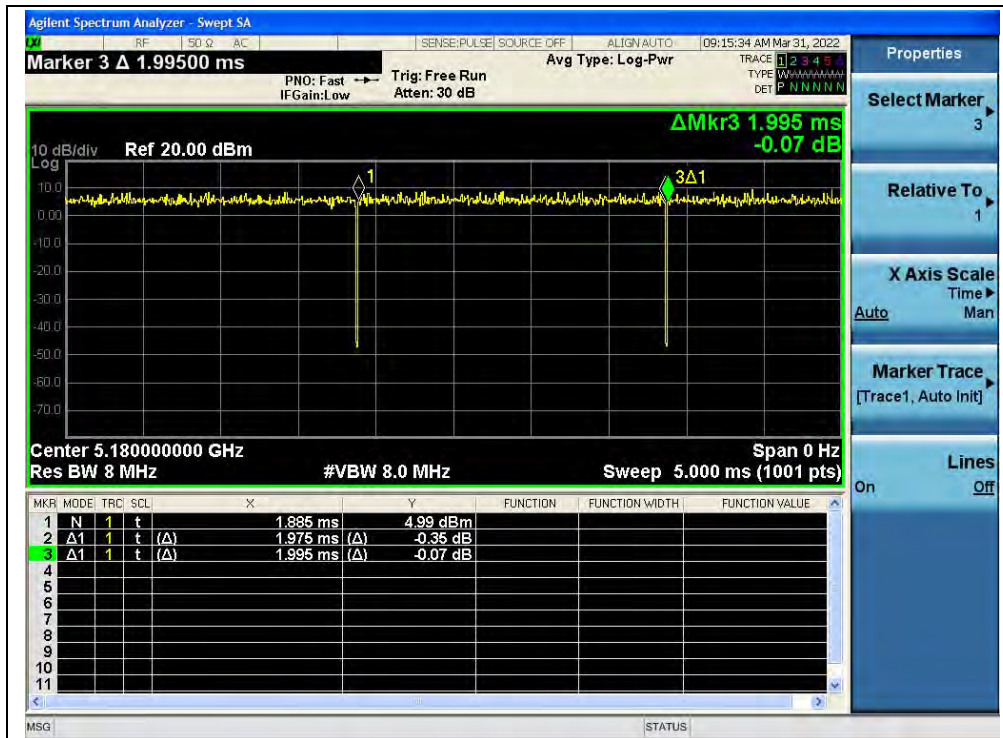


2.2.4. Test Result

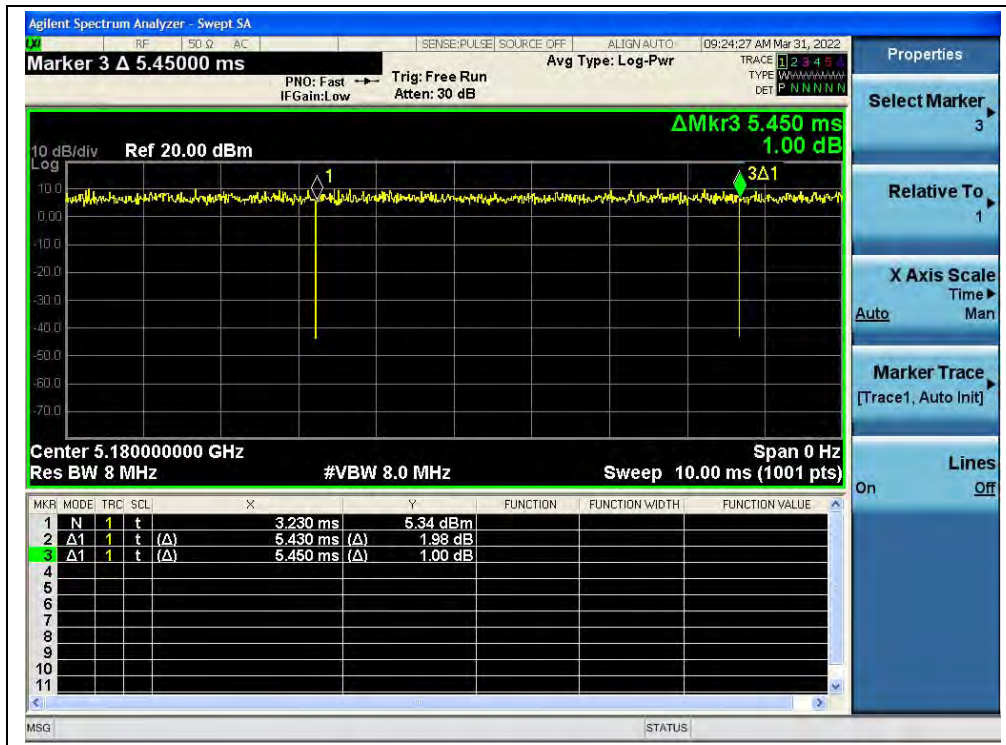
A. Test Verdict:

Test Mode	Duty Cycle (%) (D)	Duty Factor (10*log[1/D])
802.11a	99.00	0.04
802.11n(HT20)	99.63	0.02
802.11n(HT40)	99.63	0.02
802.11ac(VHT20)	99.63	0.02
802.11ac(VHT40)	99.63	0.02
802.11ac(VHT80)	100.00	0.00
802.11ax(HEW20)	99.63	0.02
802.11ax(HEW40)	99.63	0.02
802.11ax(HEW80)	100.00	0.00
802.11ax(HEW20) RU26	100.00	0.00
802.11ax(HEW20) RU52	100.00	0.00
802.11ax(HEW20) RU106	100.00	0.00

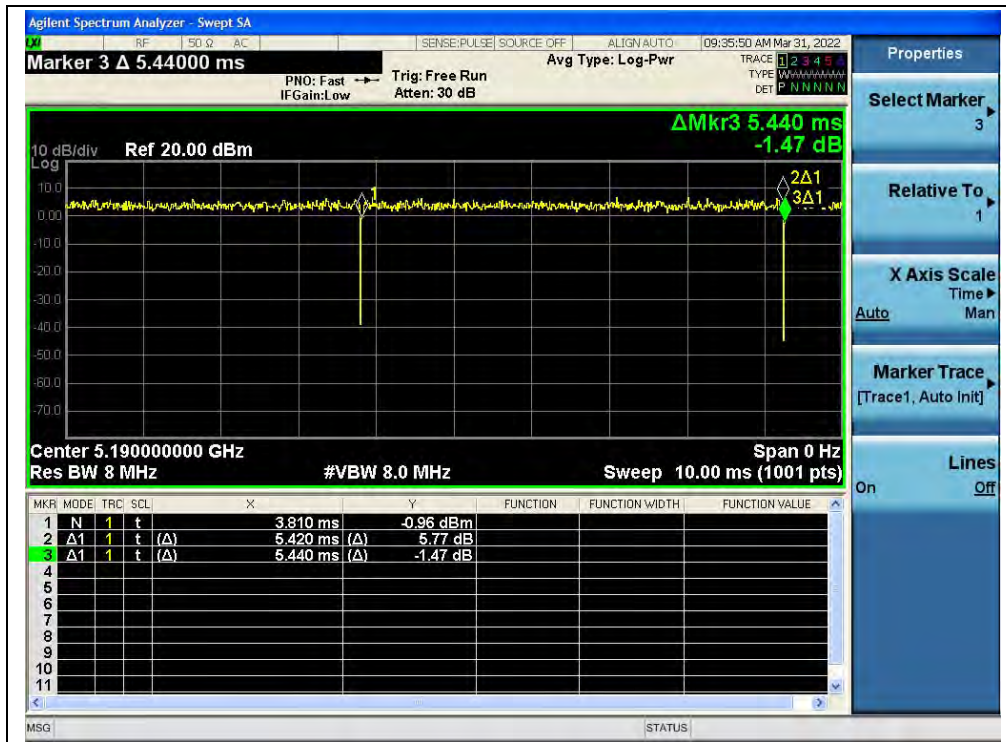
B. Test Plot:



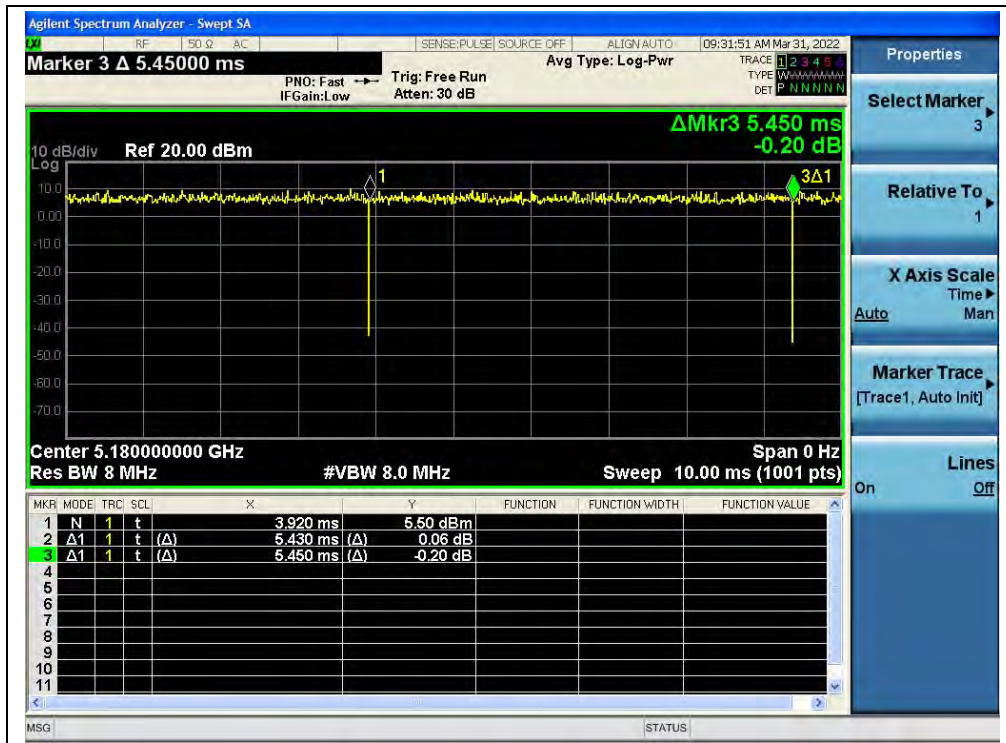
(Channel 36, 5180MHz, 802.11a)



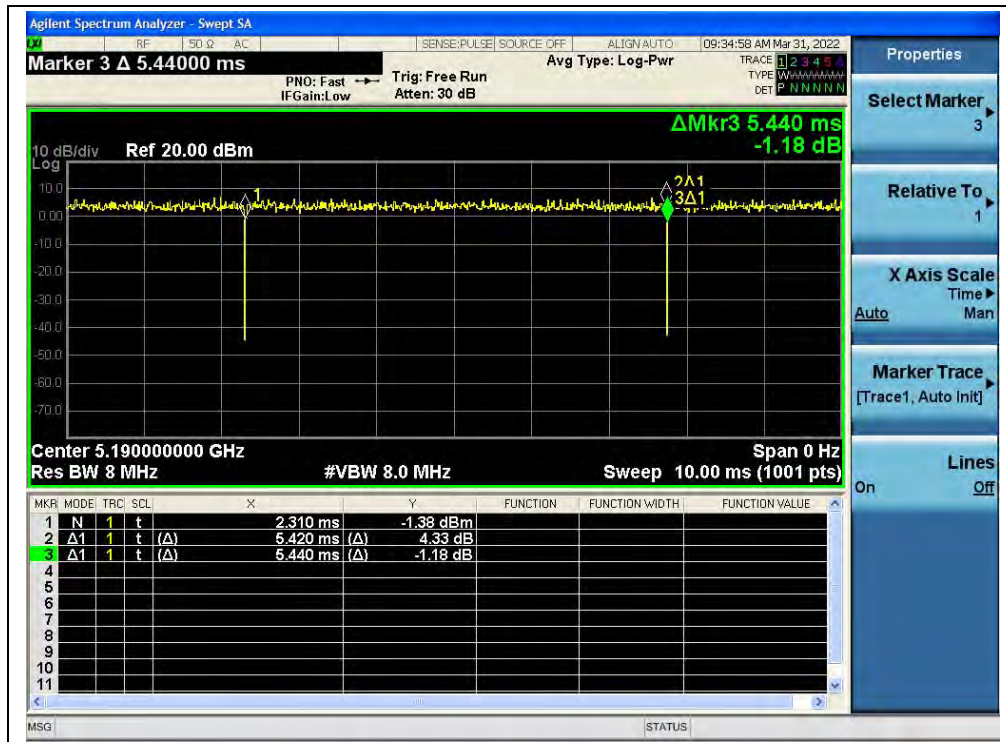
(Channel 36, 5180MHz, 802.11n (HT20))



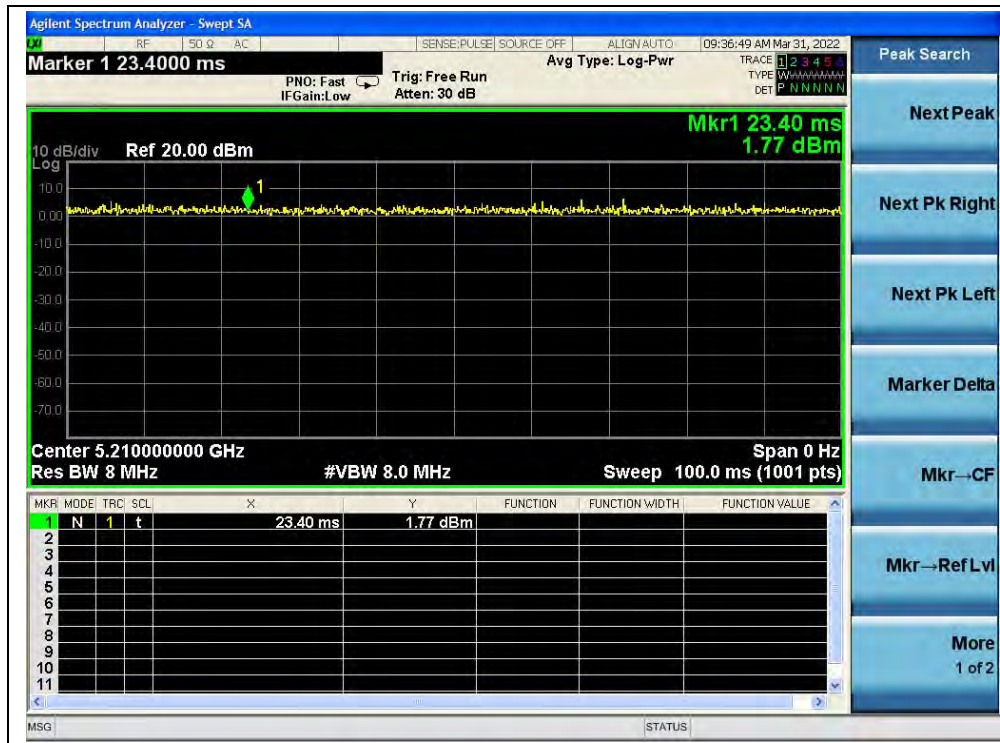
(Channel 38, 5190MHz, 802.11n (HT40))



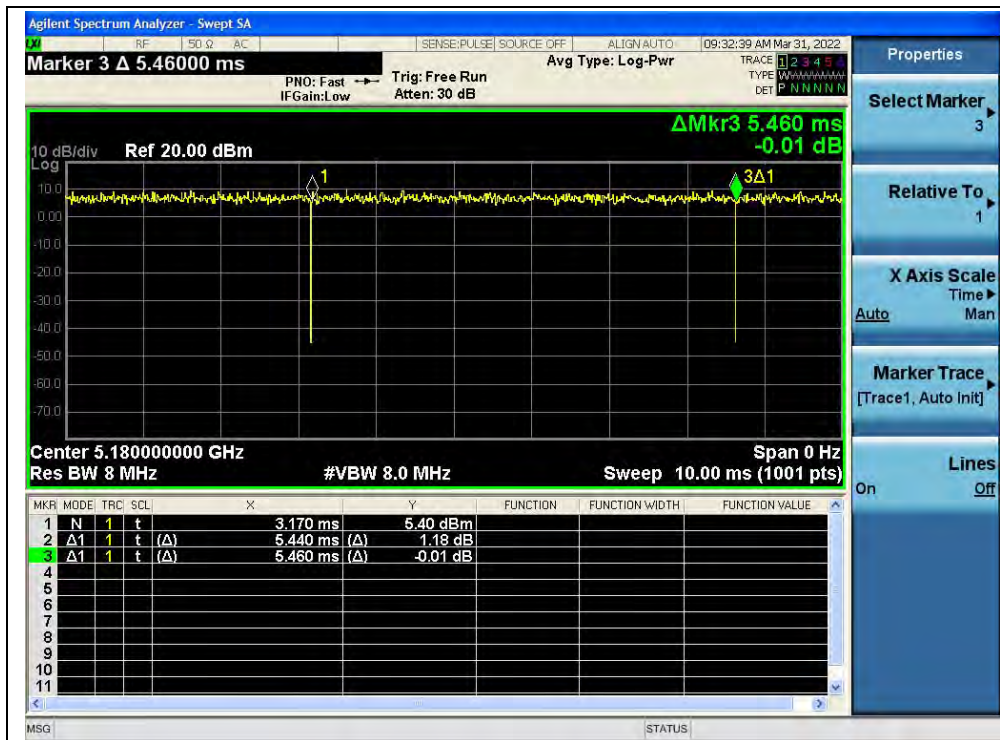
(Channel 36, 5180MHz, 802.11ac (VHT20))



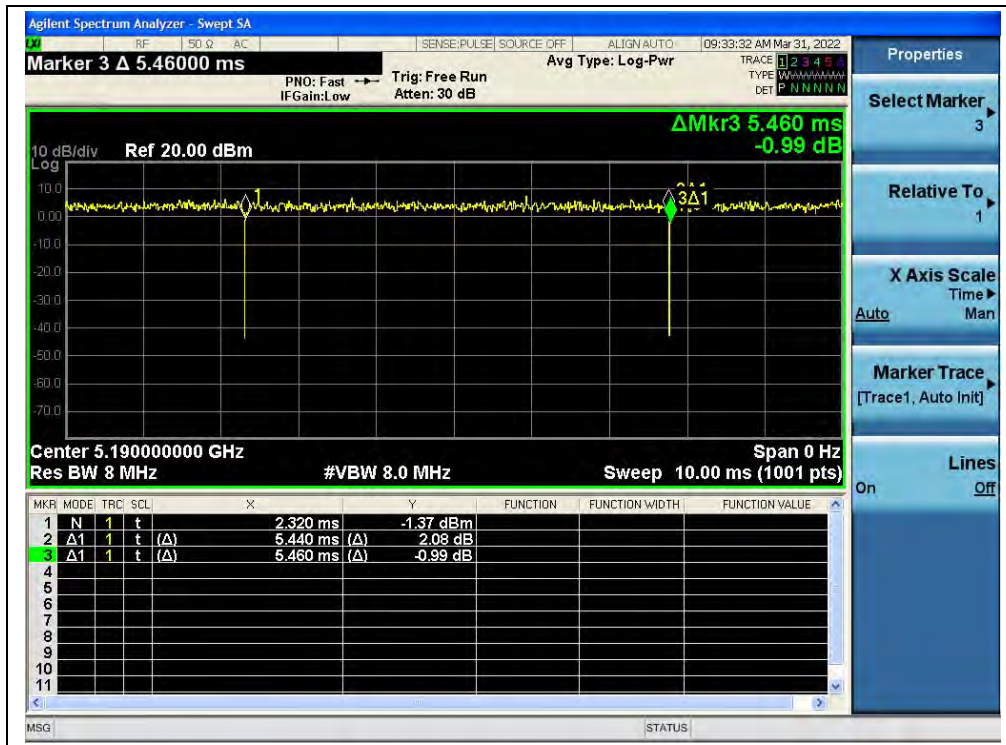
(Channel 38, 5190MHz, 802.11ac (VHT40))



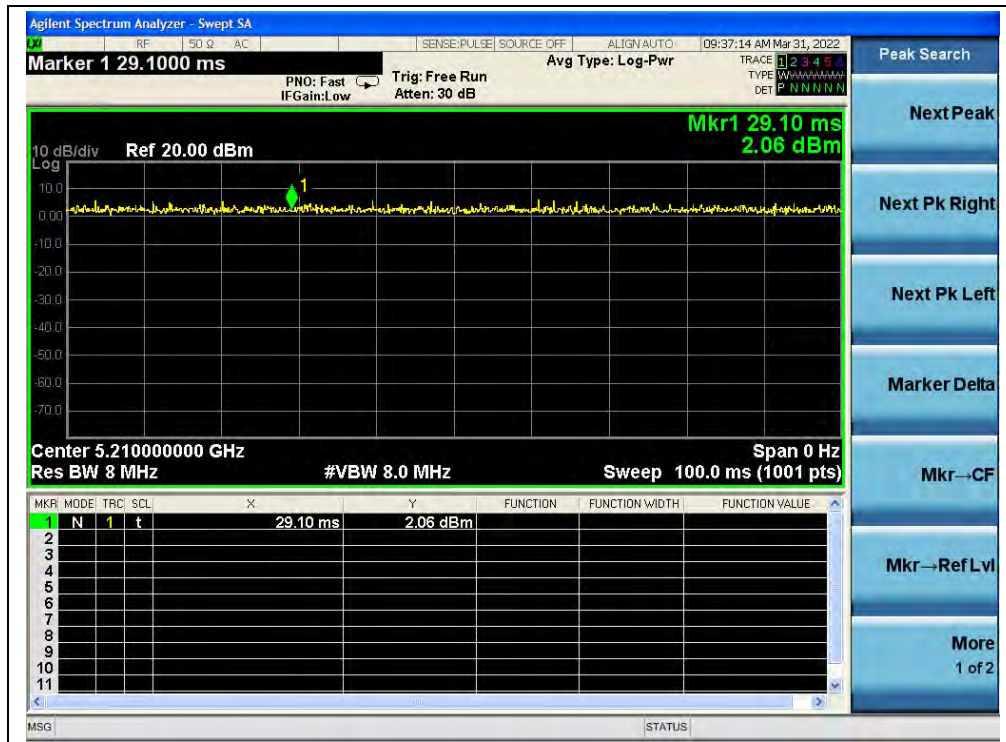
(Channel 42, 5210MHz, 802.11ac (VHT80))



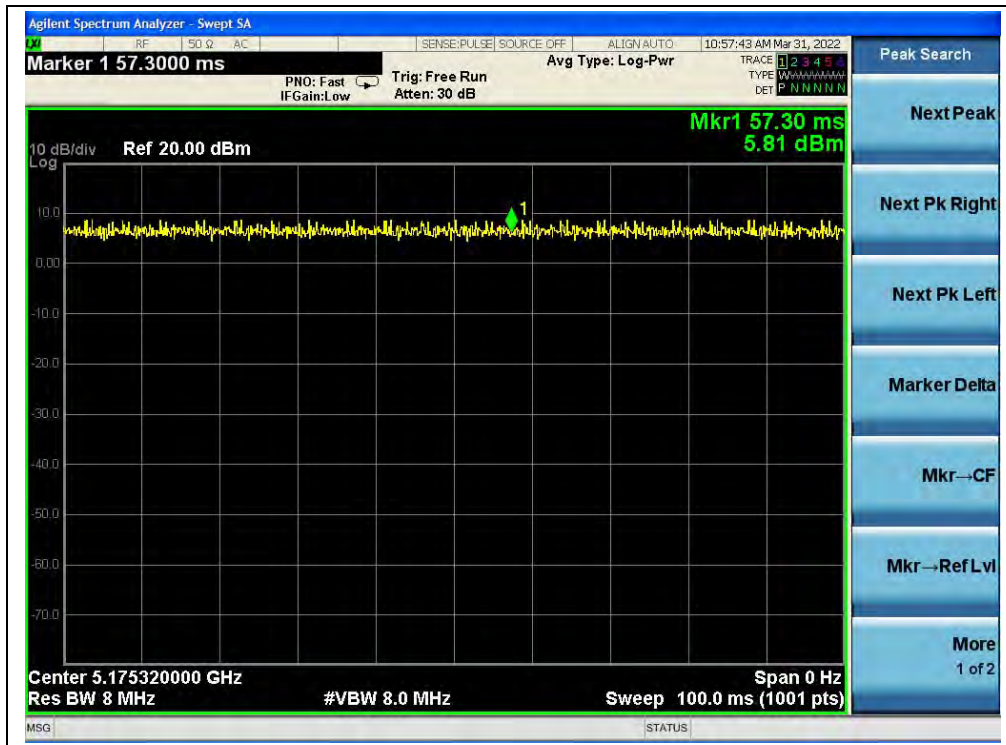
(CH36, 5180MHz, 802.11ax (HEW20))



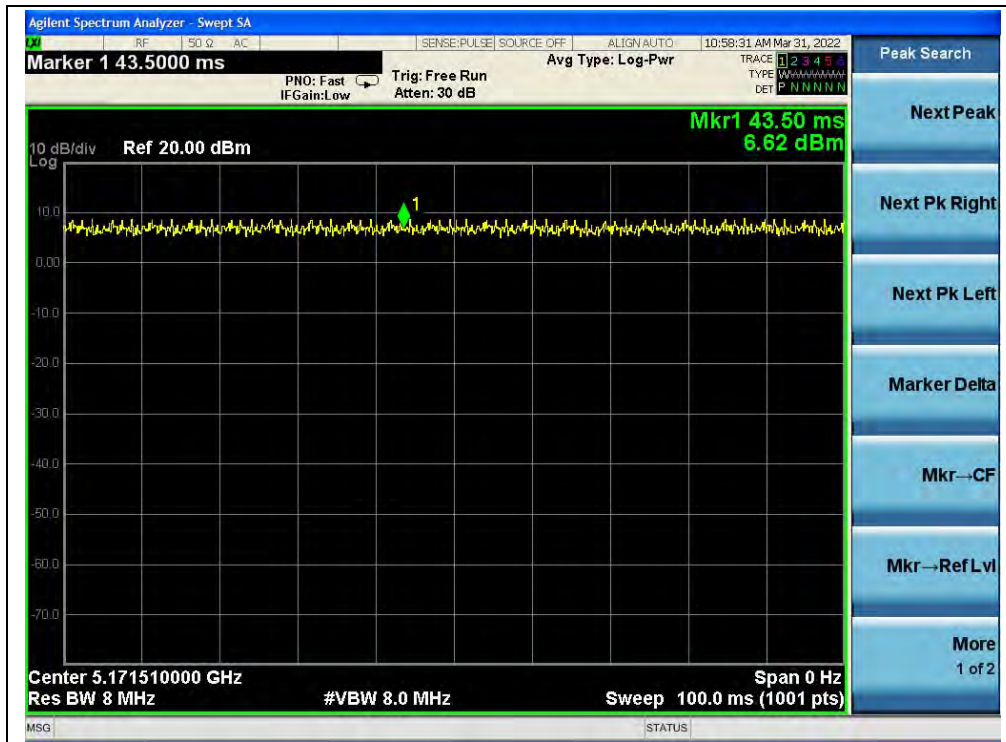
(CH38, 5190MHz, 802.11ax (HEW40))



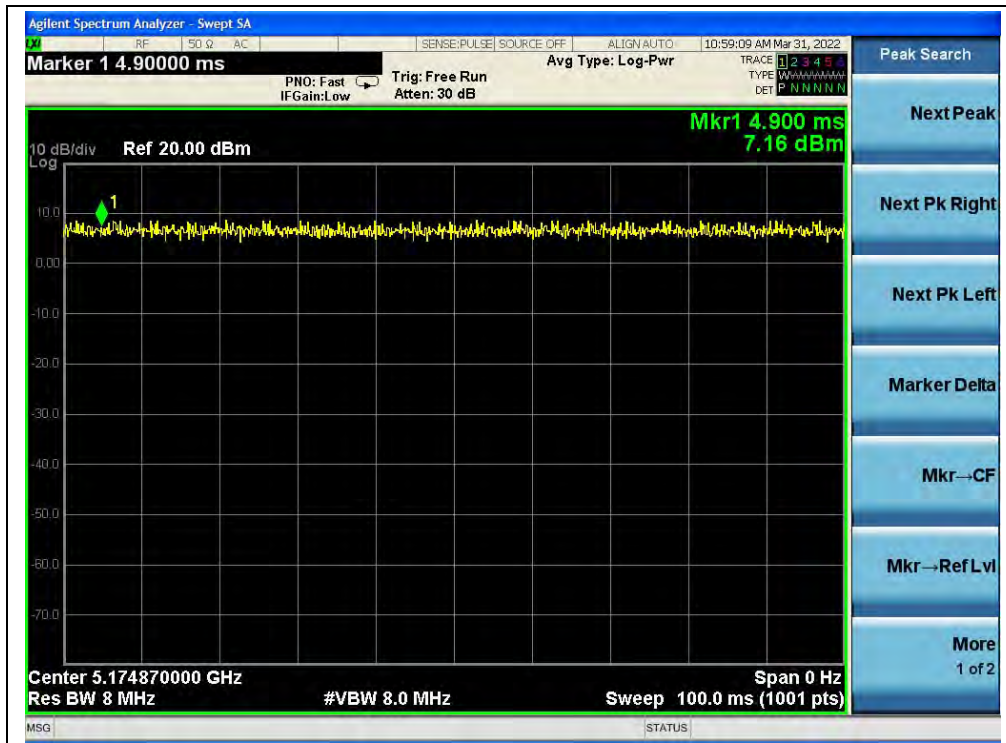
(CH42, 5210MHz, 802.11ax (HEW80))



(CH36, 5180MHz, 802.11ax (HEW20) RU26)



(CH36, 5180MHz, 802.11ax (HEW20) RU52)



(CH36, 5180MHz, 802.11ax (HEW20) RU106)

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.

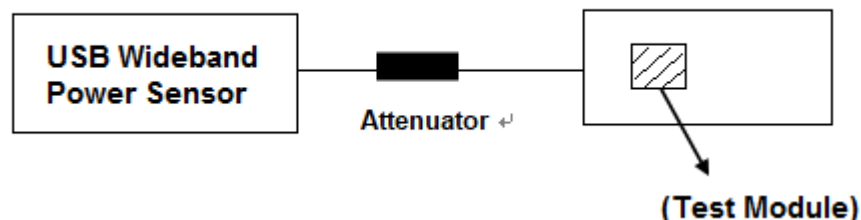
(4) According to KDB662911D01 Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the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

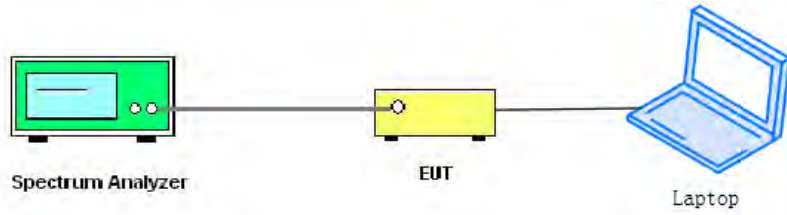
Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor.

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 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	18.55	23.68	23.68
		5300	18.55	23.68	23.68
		5320	18.80	23.74	23.74
	UNII-2c	5500	18.48	23.67	23.67
		5600	18.86	23.76	23.76
		5720	18.61	23.70	23.70
n20	UNII-2a	5260	19.55	23.91	23.91
		5300	19.82	23.97	23.97
		5320	19.85	23.98	23.98
	UNII-2c	5500	19.77	23.96	23.96
		5600	20.21	24.06	24.00
		5720	19.86	23.98	23.98
ac20	UNII-2a	5260	19.98	24.01	24.00
		5300	19.97	24.00	24.00
		5320	20.06	24.02	24.00
	UNII-2c	5500	19.70	23.94	23.94
		5600	20.05	24.02	24.00
		5720	19.92	23.99	23.99
ax20	UNII-2a	5260	20.72	24.16	24.00
		5300	20.63	24.14	24.00
		5320	20.36	24.09	24.00
	UNII-2c	5500	20.45	24.11	24.00
		5600	20.76	24.17	24.00
		5720	20.84	24.19	24.00
ax_RU26	UNII-2a	5260	19.81	23.97	23.97
		5300	20.01	24.01	24.00
		5320	19.80	23.97	23.97
	UNII-2c	5500	19.84	23.98	23.98
		5600	20.12	24.04	24.00
		5720	19.95	24.00	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					
	ANT0	ANT1		ANT0		ANT1			
	dBm	dBm		dBm	W	dBm	W	dBm	
5180	16.26	15.89	0.04	16.30	0.043	15.93	0.039	24	0.25
5220	16.31	16.11		16.35	0.043	16.15	0.041		
5240	16.23	15.96		16.27	0.042	16.00	0.040		
5260	16.25	16.13		16.29	0.043	16.17	0.041	23.68	0.23
5300	16.39	16.28		16.43	0.044	16.32	0.043	23.68	0.23
5320	16.35	16.21		16.39	0.044	16.25	0.042	23.74	0.24
5500	13.61	12.58		13.65	0.023	12.62	0.018	23.67	0.23
5600	14.22	11.98		14.26	0.027	12.02	0.016	23.76	0.24
5720	15.41	13.70		15.45	0.035	13.74	0.024	23.70	0.23
5745	16.45	16.07		16.49	0.045	16.11	0.041	30	1
5785	16.42	16.05		16.46	0.044	16.09	0.041		
5825	16.02	16.15		16.06	0.040	16.19	0.042		



802.11n (HT20) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5180	16.26	15.71	0.02	19.03	0.080	23.08	0.20	PASS
5220	16.28	15.85		19.08	0.081			
5240	16.20	15.74		19.03	0.080			
5260	16.22	15.98		19.14	0.082			
5300	16.37	16.27		19.34	0.086			
5320	16.33	15.88		19.14	0.082			
5500	14.59	14.31		17.48	0.056			
5600	15.35	15.07		18.26	0.067			
5720	16.13	16.07		19.14	0.082			
5745	16.39	16.33		19.40	0.087	29.08	0.80	
5785	16.23	16.14		19.19	0.083			
5825	16.01	15.55		18.81	0.076			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.

802.11n (HT40) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5190	15.17	14.31	0.02	17.78	0.060	23.08	0.20	PASS
5230	15.35	14.45		17.92	0.062			
5270	14.51	14.92		17.78	0.060			
5310	14.40	14.24		17.32	0.054			
5510	14.39	14.33		17.40	0.055			
5630	14.67	14.59		17.63	0.058			
5710	14.61	14.50		17.56	0.057			
5755	16.95	16.86		19.96	0.099	29.08	0.80	
5795	16.67	16.25		19.49	0.089			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ac (VHT20) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5180	15.34	15.09	0.02	18.26	0.067	23.08	0.20	PASS
5220	15.41	15.22		18.33	0.068			
5240	15.22	15.15		18.20	0.066			
5260	15.13	15.02		18.13	0.065			
5300	15.25	15.23		18.26	0.067			
5320	15.23	15.16		18.20	0.066			
5500	13.64	13.25		16.43	0.044			
5600	14.30	14.24		17.32	0.054			
5720	15.25	14.89		18.13	0.065			
5745	15.44	14.95		18.26	0.067			
5785	15.37	15.37		18.39	0.069			
5825	15.09	15.06		18.13	0.065			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.

802.11ac (VHT40) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5190	15.66	15.52	0.02	18.63	0.073	23.08	0.20	PASS
5230	15.39	15.33		18.39	0.069			
5270	15.10	14.98		18.06	0.064			
5310	15.63	15.39		18.51	0.071			
5510	14.39	13.97		17.24	0.053			
5630	15.23	14.93		18.13	0.065			
5710	15.83	15.53		18.69	0.074			
5755	15.97	15.79		18.92	0.078	29.08	0.80	
5795	15.78	15.54		18.69	0.074			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ac (VHT80) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		dBm	W	dBm		W
5210	13.75	13.43	0.00	16.63	0.046	23.08	0.20	PASS
5290	15.02	14.49		17.78	0.060			
5530	12.47	12.04		15.31	0.034			
5610	12.75	12.24		15.56	0.036			
5690	13.51	13.15		16.33	0.043			
5775	15.71	15.23		18.51	0.071	29.08	0.80	

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.

802.11ax (HEW20) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		dBm	W	dBm		W
5180	15.29	15.09	0.02	18.20	0.066	23.08	0.20	PASS
5220	15.37	15.17		18.33	0.068			
5240	15.19	14.76		17.99	0.063			
5260	15.23	14.74		17.99	0.063			
5300	15.27	15.04		18.20	0.066			
5320	15.22	15.17		18.20	0.066			
5500	12.69	11.92		15.31	0.034			
5600	13.12	11.59		15.44	0.035			
5720	14.08	12.97		16.63	0.046			
5745	15.33	15.18		18.26	0.067	29.08	0.80	
5785	15.20	15.00		18.13	0.065			
5825	15.05	14.71		17.92	0.062			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ax (HEW20) RU26 Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		dBm	W			
	dBm	dBm				dBm		W
5180	7.02	7.78	0.00	10.41	0.011	23.08	0.20	PASS
5220	7.45	8.26		10.79	0.012			
5240	8.29	8.64		11.46	0.014			
5260	8.06	7.68		10.79	0.012			
5300	8.52	8.35		11.46	0.014			
5320	7.47	7.32		10.41	0.011			
5500	5.70	7.08		9.54	0.009			
5600	5.43	7.06		9.54	0.009			
5720	8.22	7.77		11.14	0.013			
5745	8.93	7.64		11.46	0.014			
5785	8.25	7.39		10.79	0.012			
5825	7.81	7.11		10.41	0.011			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ax (HEW20) RU52 Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		dBm	W	dBm		W
	dBm	dBm						
5180	10.62	9.81	0.00	13.22	0.021	23.08	0.20	PASS
5220	10.77	9.31		13.01	0.020			
5240	10.73	9.44		13.22	0.021			
5260	10.64	9.52		13.22	0.021			
5300	10.90	9.64		13.42	0.022			
5320	10.83	9.77		13.42	0.022			
5500	9.56	8.96		12.30	0.017			
5600	9.66	8.99		12.30	0.017			
5720	10.39	9.58		13.01	0.020			
5745	11.27	9.89		13.62	0.023			
5785	11.28	10.17		13.80	0.024			
5825	11.39	10.22		13.80	0.024			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ax (HEW20) RU106 Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor				
	ANT0	ANT1		dBm	W	dBm		W
	dBm	dBm						
5180	12.23	11.51	0.00	14.91	0.031	23.08	0.20	PASS
5220	12.42	12.41		15.44	0.035			
5240	12.44	12.30		15.44	0.035			
5260	12.31	12.28		15.31	0.034			
5300	12.04	11.10		14.62	0.029			
5320	12.49	11.72		15.19	0.033			
5500	10.21	10.91		13.62	0.023			
5600	10.59	9.78		13.22	0.021			
5720	10.65	10.21		13.42	0.022			
5745	11.21	11.06		14.15	0.026			
5785	12.18	11.82		15.05	0.032			
5825	12.36	11.39		14.91	0.031			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.



802.11ax (HEW40) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5190	13.56	12.97	0.02	16.33	0.043	23.08	0.20	PASS
5230	13.70	13.12		16.43	0.044			
5270	14.77	13.42		17.16	0.052			
5310	14.57	13.38		17.08	0.051			
5510	14.18	13.78		16.99	0.050			
5630	15.10	15.02		18.06	0.064			
5710	15.75	15.43		18.63	0.073			
5755	15.95	15.84		18.92	0.078	29.08	0.80	
5795	15.57	15.26		18.45	0.070			

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.

802.11ax (HEW80) Mode

Frequency (MHz)	Average Power				Limit		Verdict	
	Measured		Duty Factor	Total Power with Duty Factor		dBm		W
	ANT0	ANT1		dBm	W			
5210	13.56	13.33	0.00	16.43	0.044	23.08	0.20	PASS
5290	13.57	13.25		16.43	0.044			
5530	11.22	11.17		14.15	0.026			
5610	11.71	11.42		14.62	0.029			
5690	11.37	11.15		14.31	0.027			
5775	15.78	15.72		18.75	0.075	29.08	0.80	

Note: Directional gain = 3.91dBi + 10log(2) = 6.92dBi > 6dBi, so the power limit shall be reduced to 24-(6.92-6) = 23.08dBm for 5.18-5.24GHz, 5.260-5.320GHz, 5.500-5.720GHz band and reduced to 30-(6.92-6) = 29.08dBm for 5.745-5.825GHz band.

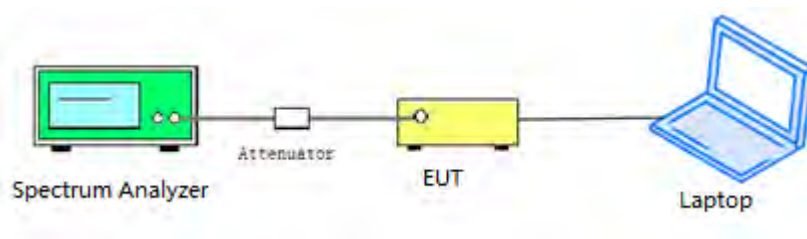
2.4. Emission Bandwidth

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

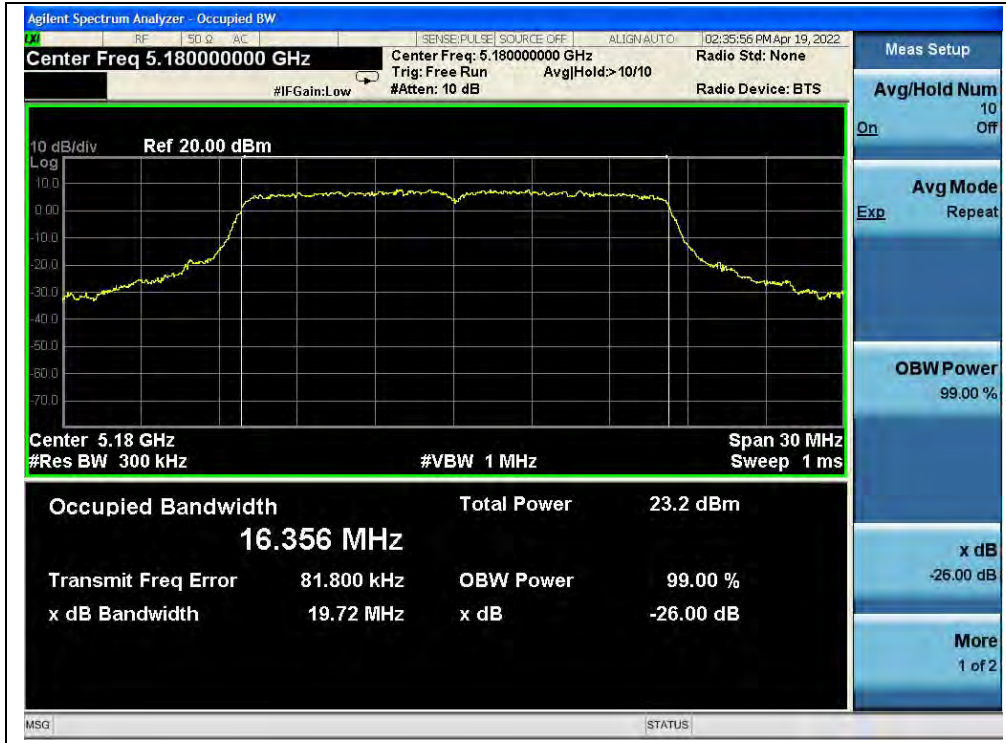
802.11a Mode

A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	19.72
44	5220	18.49
48	5240	18.54
52	5260	18.55
60	5300	18.55
64	5320	18.80
100	5500	18.48
120	5600	18.86
144	5720	18.61
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	16.02
149	5745	16.30
157	5785	16.32
165	5825	16.30



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)



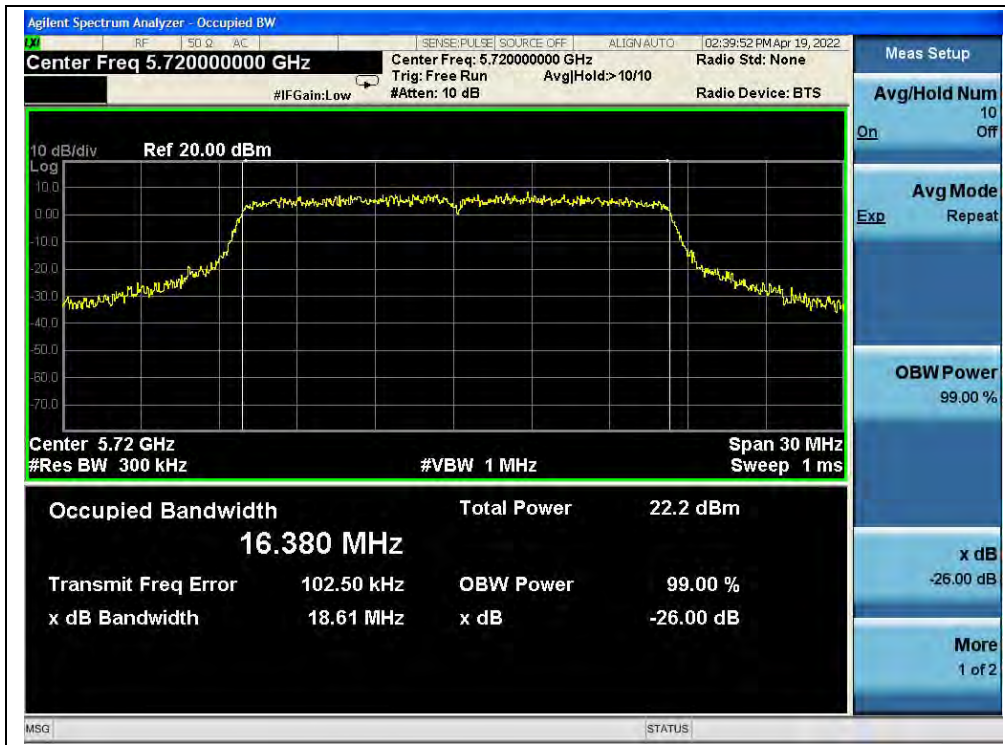
(Channel 64, 5320MHz, 802.11a)



(Channel 100,5500MHz, 802.11a)



(Channel 120,5600 MHz, 802.11a)



(Channel 144, 5720MHz, 802.11a)



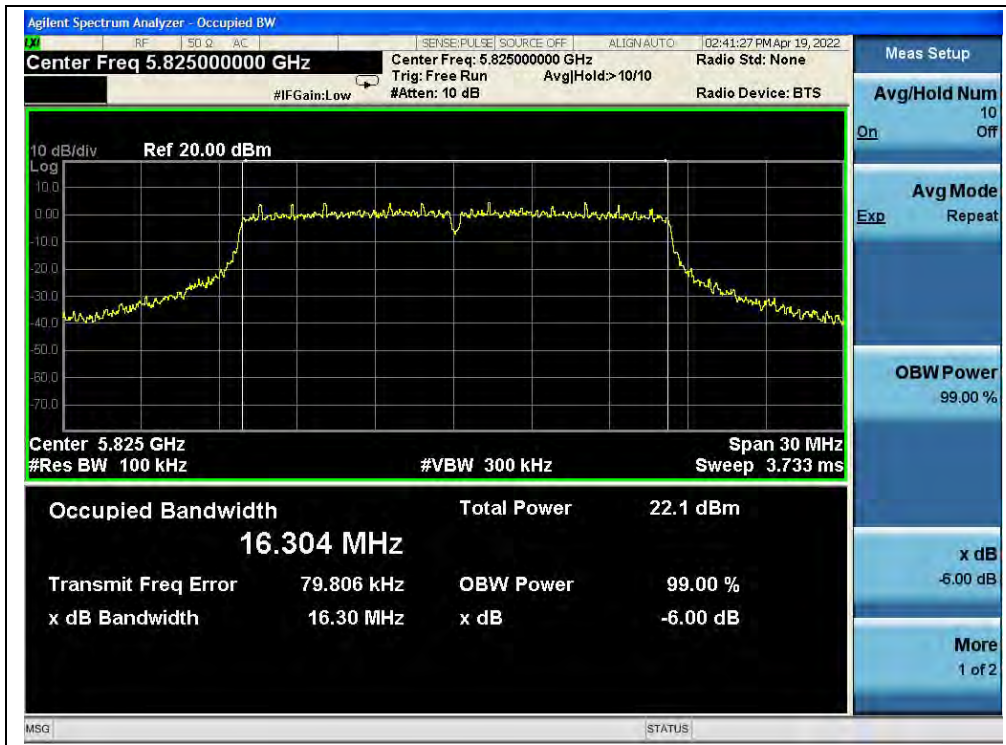
(Channel 144, 5720MHz, 802.11a)



(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	19.70
44	5220	19.73
48	5240	19.67
52	5260	19.55
60	5300	19.82
64	5320	19.85
100	5500	19.77
120	5600	20.21
144	5720	19.86
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	17.56
149	5745	16.30
157	5785	17.54
165	5825	17.65

B. Test Plot:



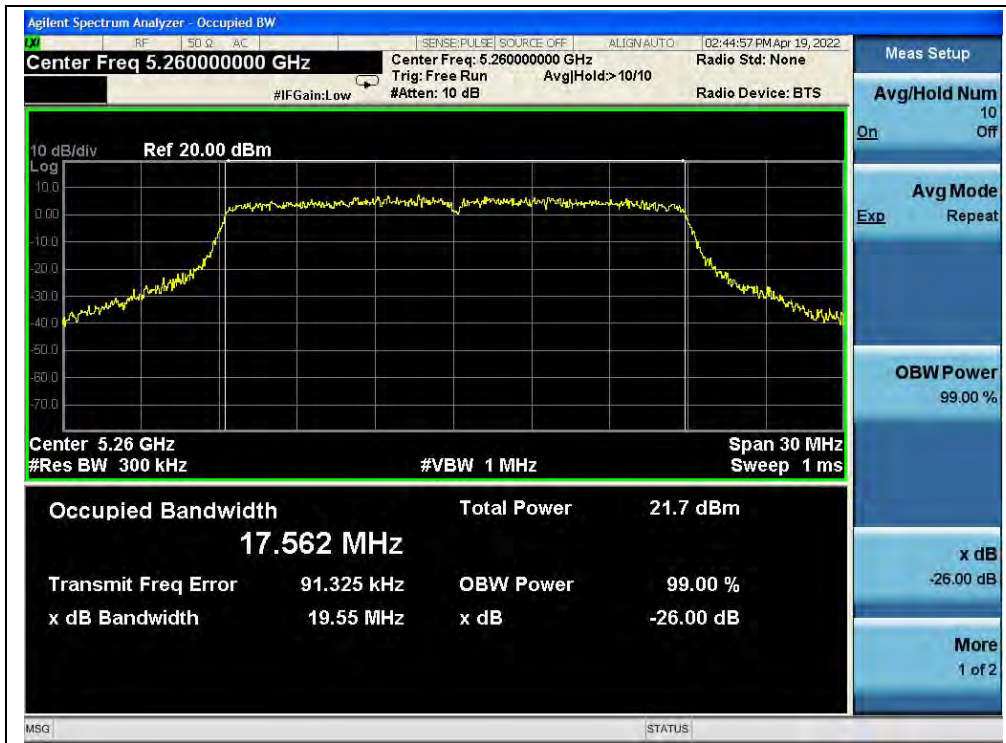
(Channel 36, 5180MHz, 802.11n (HT20))



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



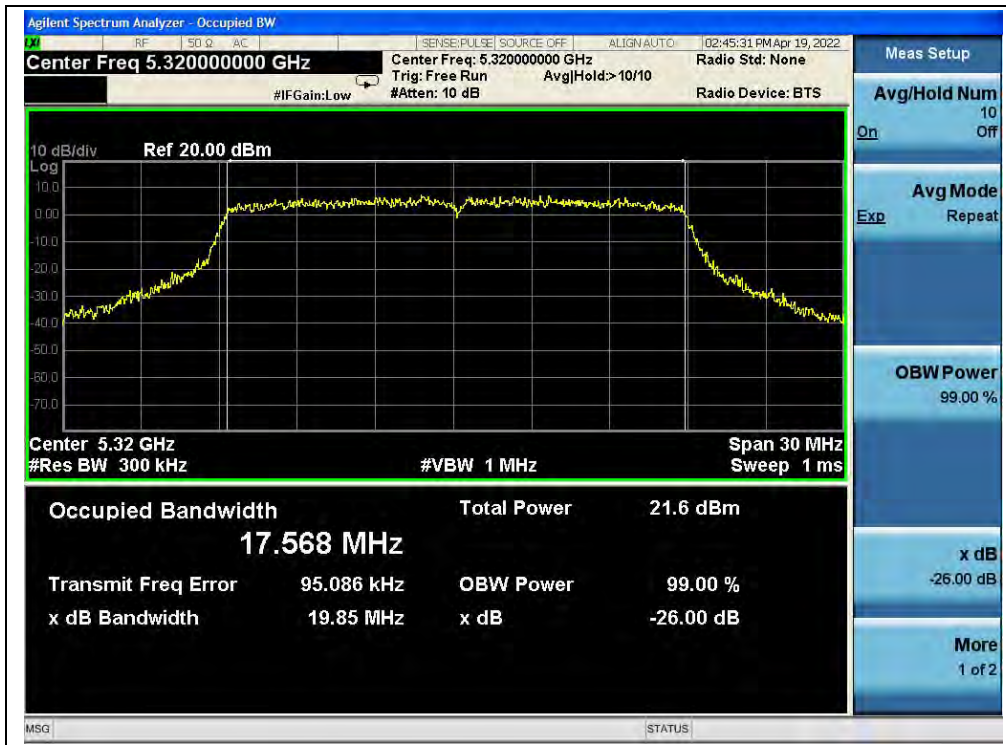
(Channel 48, 5240MHz, 802.11n (HT20))



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



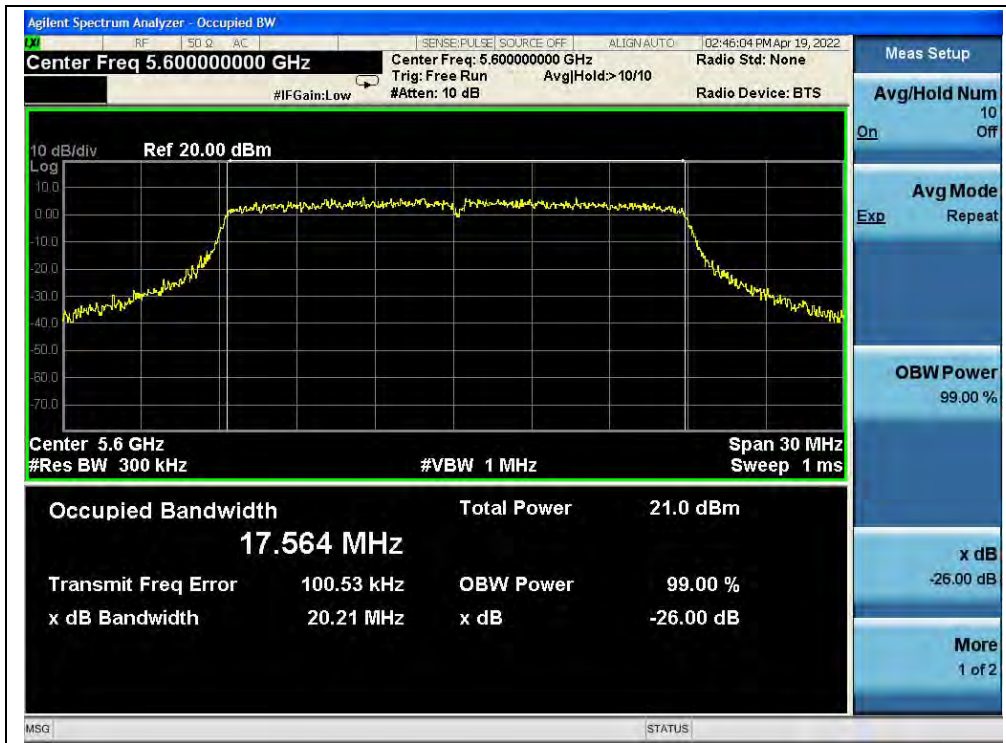
(Channel 60, 5300MHz, 802.11n (HT20))



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



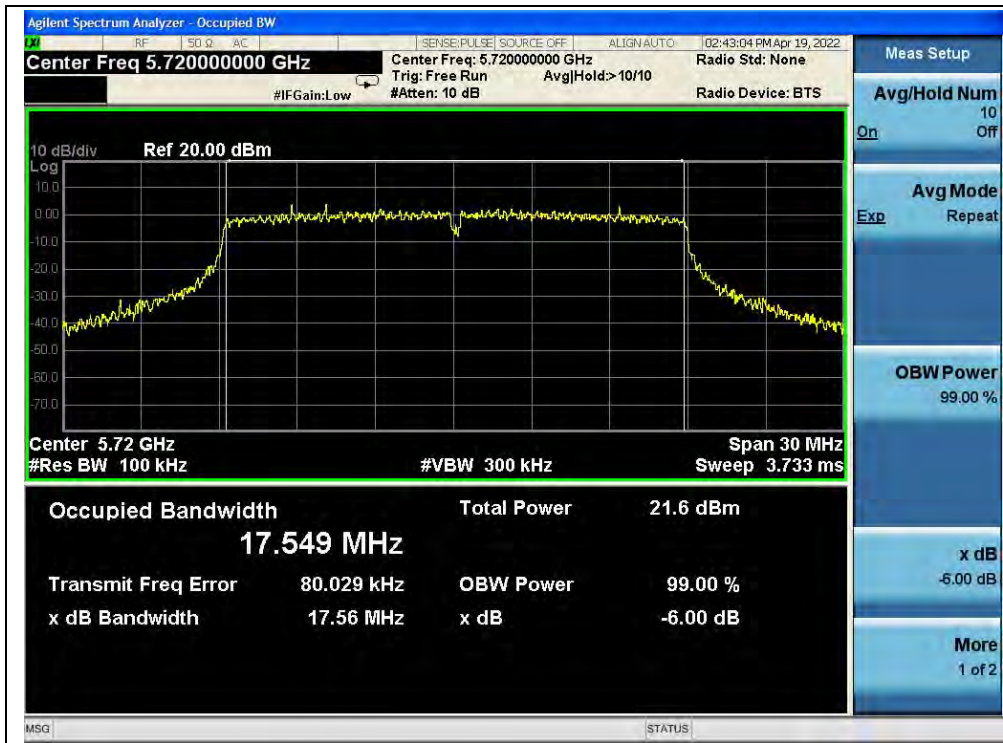
(Channel 100, 5500MHz, 802.11n (HT20))



(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))

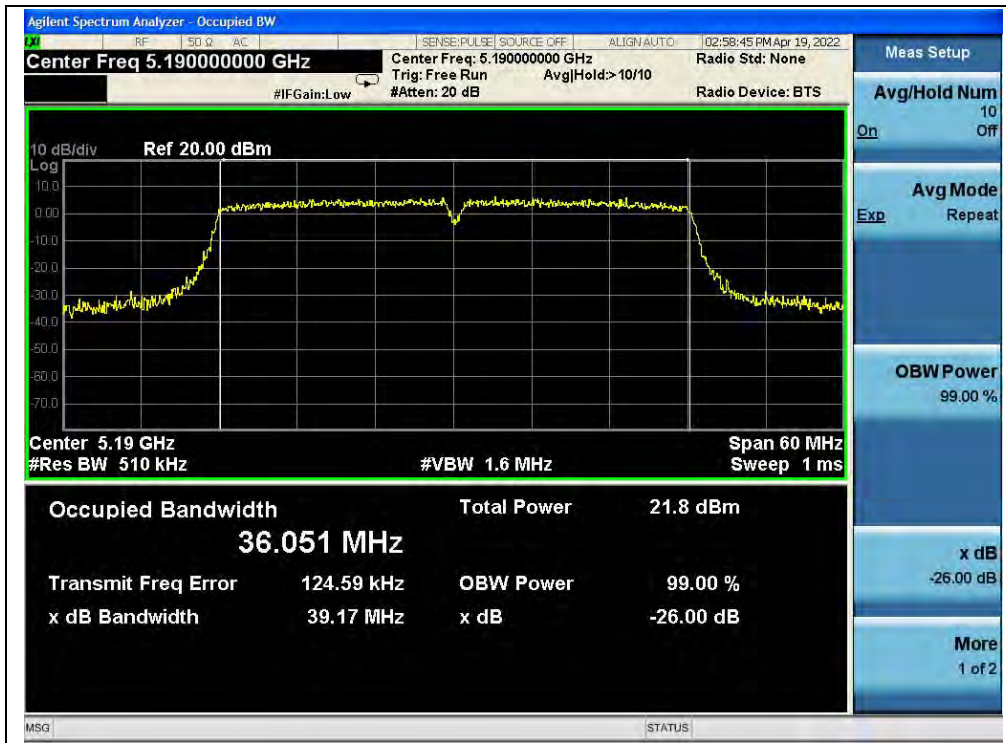


802.11n (HT40) Test mode

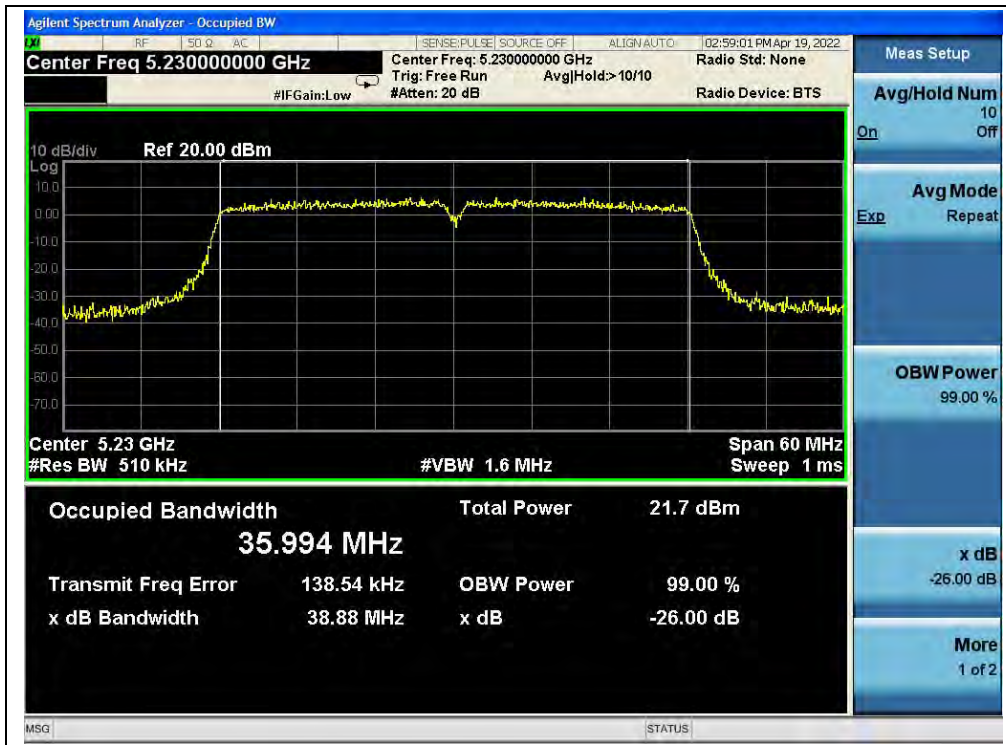
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	39.17
46	5230	38.88
54	5270	39.17
62	5310	39.41
102	5510	38.92
126	5630	39.37
142	5710	39.48
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
142	5710	35.27
151	5755	36.39
159	5795	36.29

B. Test Plot:



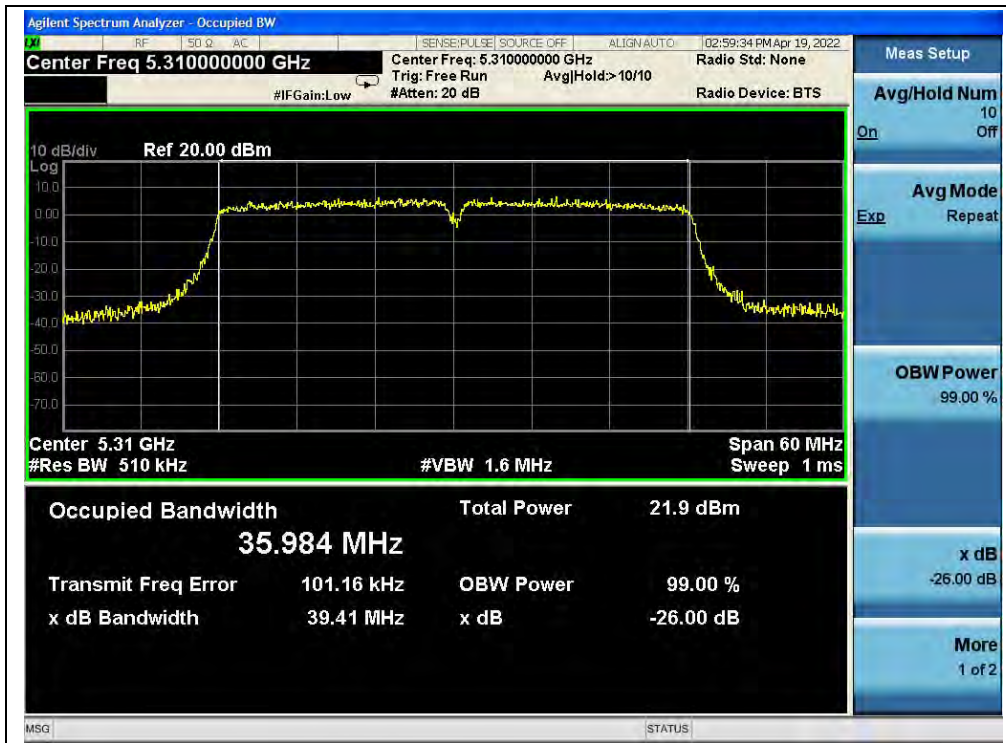
(Channel 38, 5190MHz, 802.11n (HT40))



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



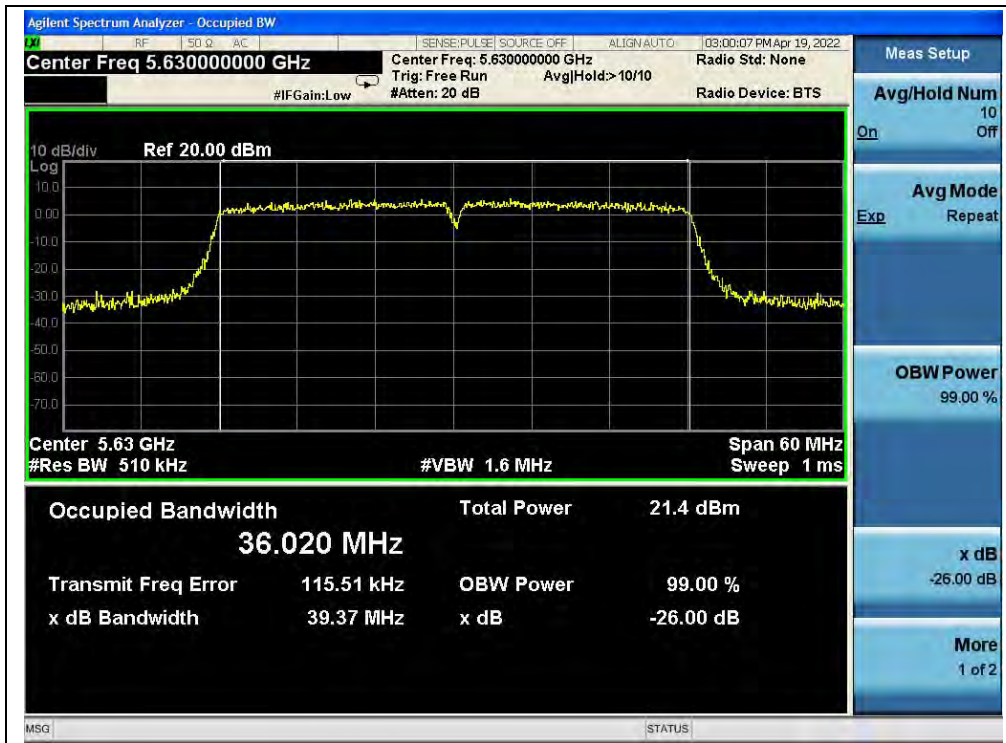
(Channel 54, 5270MHz, 802.11n (HT40))



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



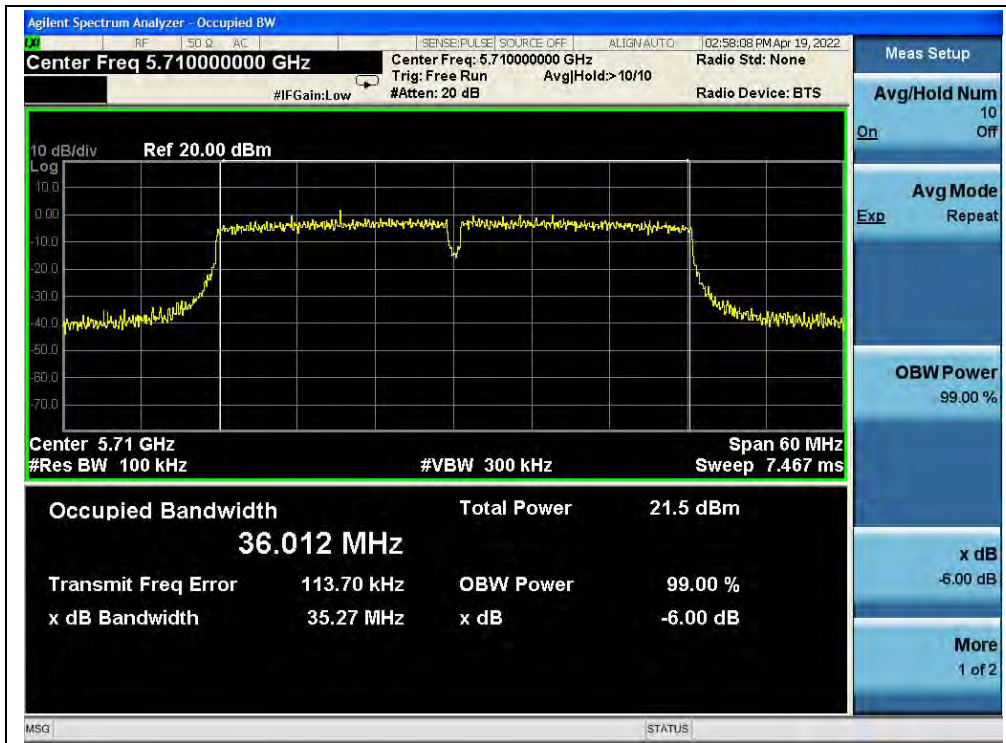
(Channel 102, 5510MHz, 802.11n (HT40))



(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

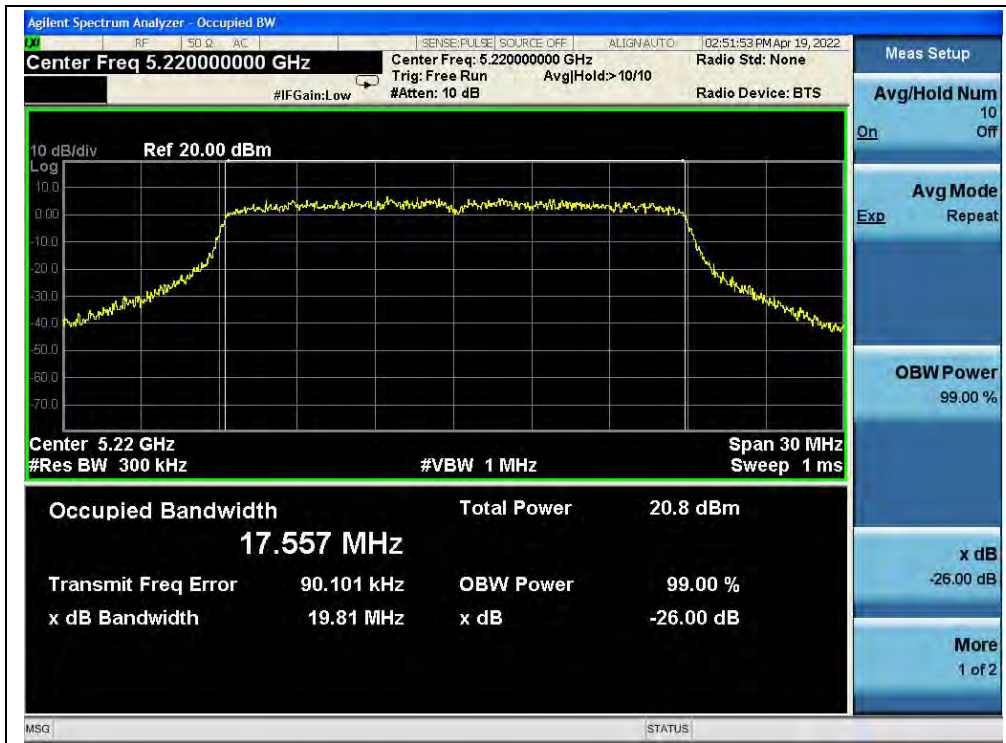
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	20.05
44	5220	19.81
48	5240	19.74
52	5260	19.98
60	5300	19.97
64	5320	20.06
100	5500	19.70
120	5600	20.05
144	5720	19.92
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	17.03
149	5745	17.57
157	5785	17.55
165	5825	17.59

B. Test Plot:



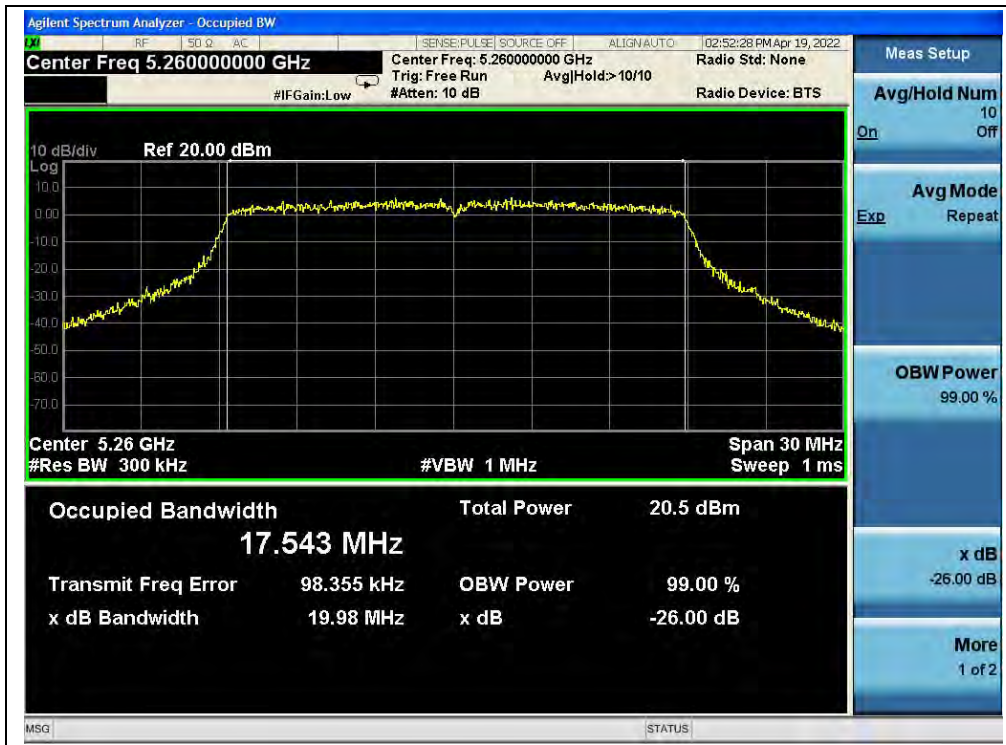
(Channel 36, 5180MHz, 802.11ac (VHT20))



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



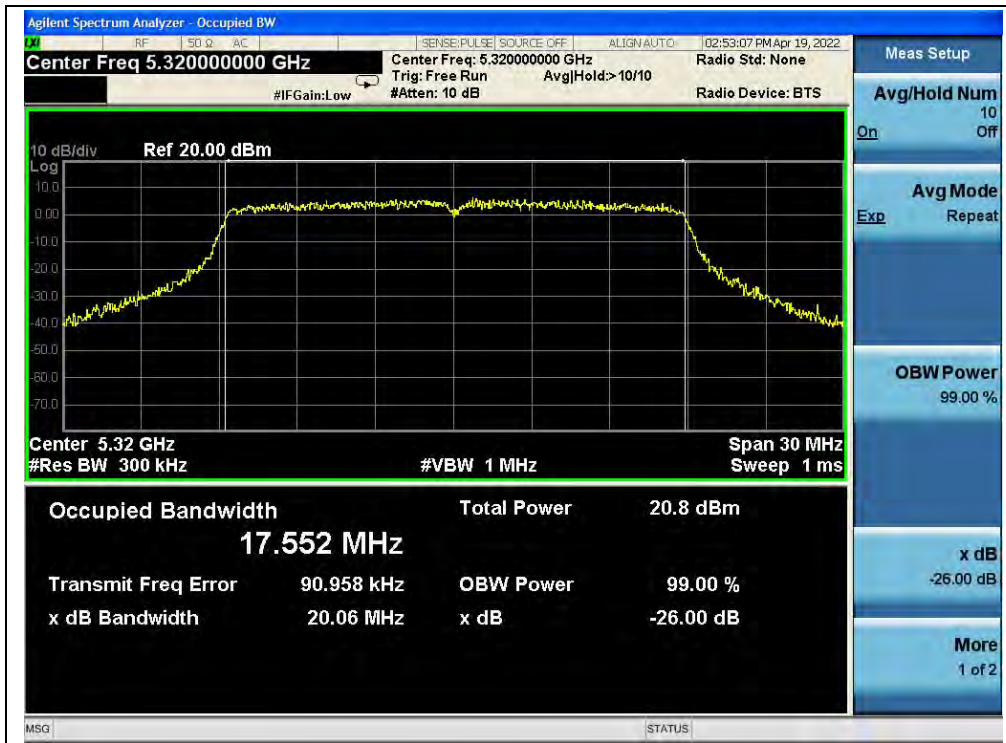
(Channel 48, 5240MHz, 802.11ac (VHT20))



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



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



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



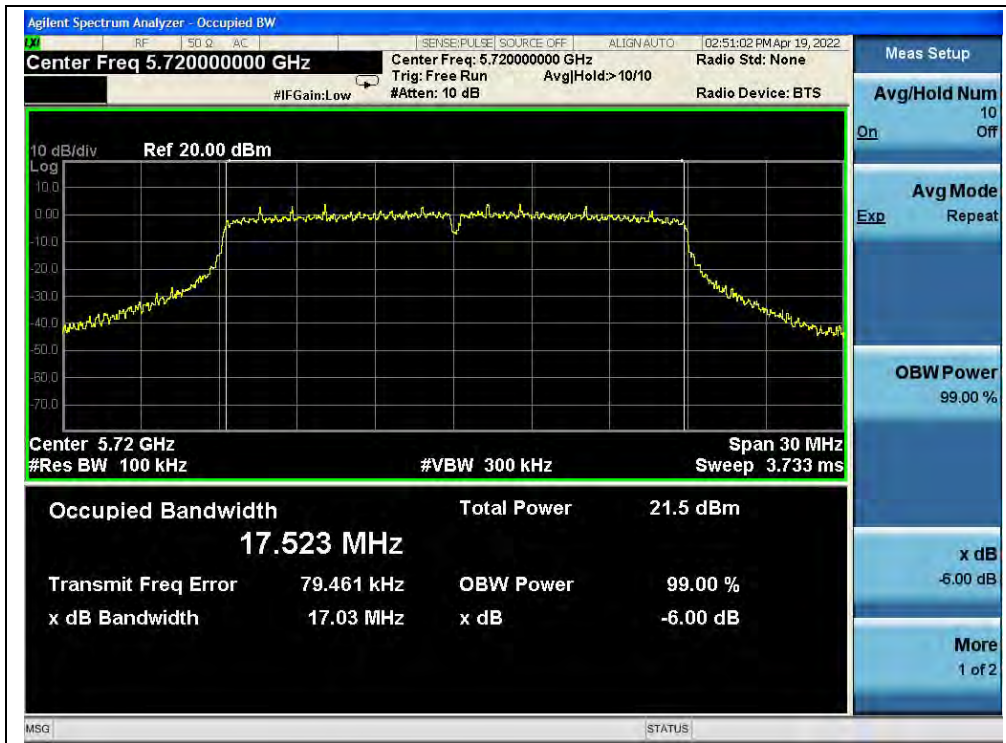
(Channel 100, 5500MHz, 802.11ac (VHT20))



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



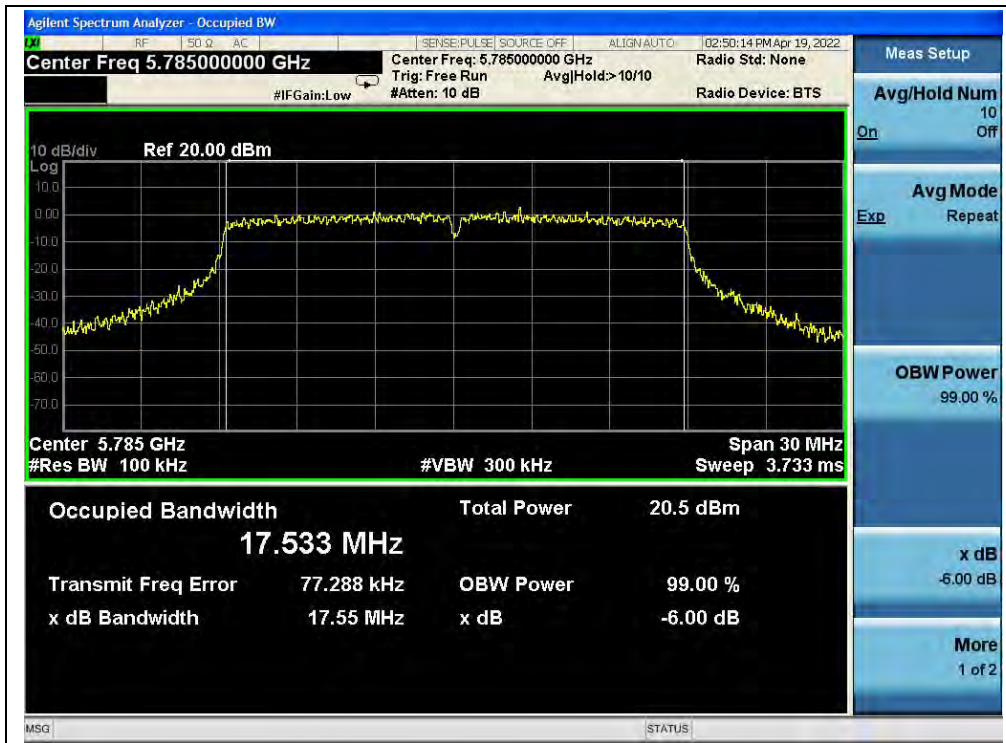
(Channel 144, 5720MHz, 802.11ac (VHT20))



(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))

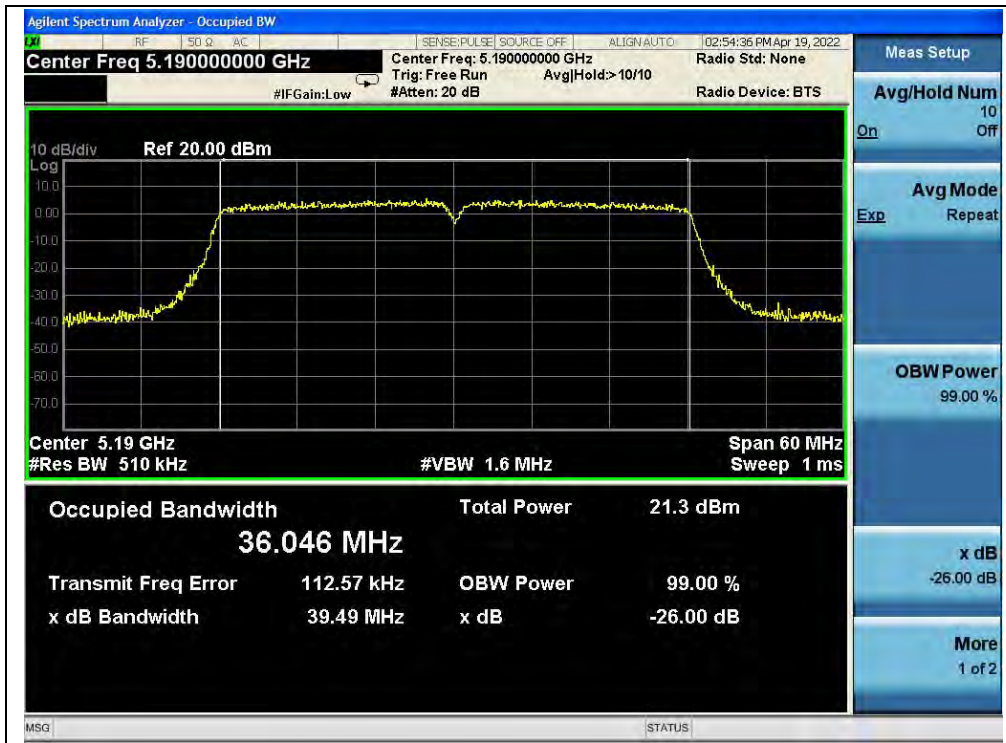


802.11ac (VHT40) Mode

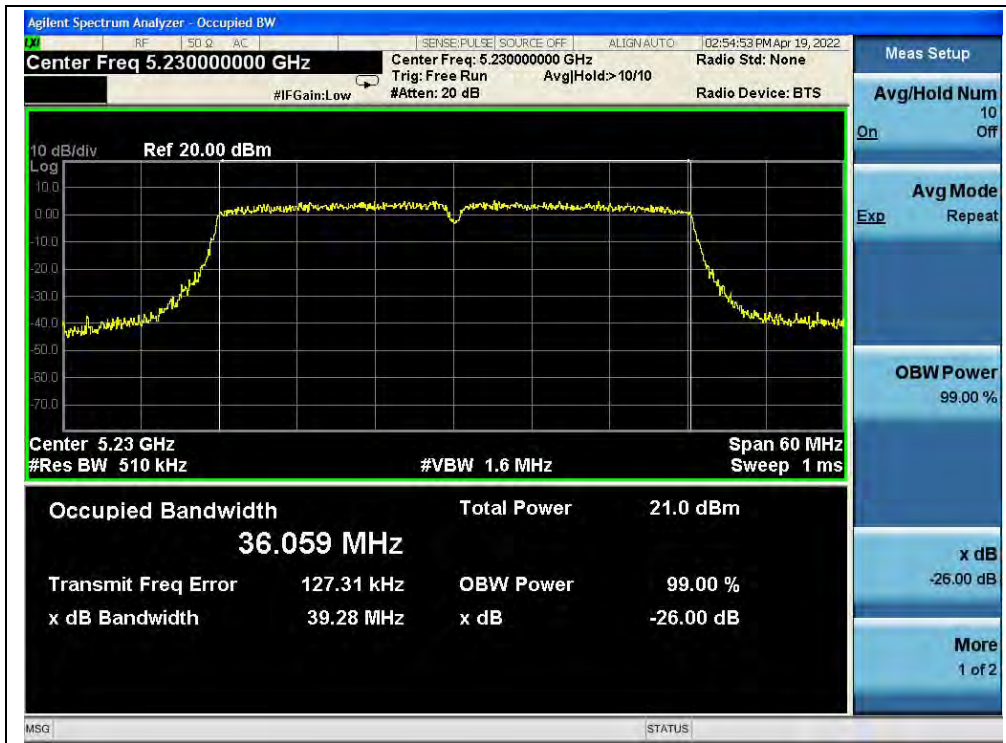
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
38	5190	39.49
46	5230	39.28
54	5270	38.99
62	5310	38.99
102	5510	39.52
126	5630	38.89
142	5710	39.37
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
142	5710	35.35
151	5755	34.76
159	5795	36.36

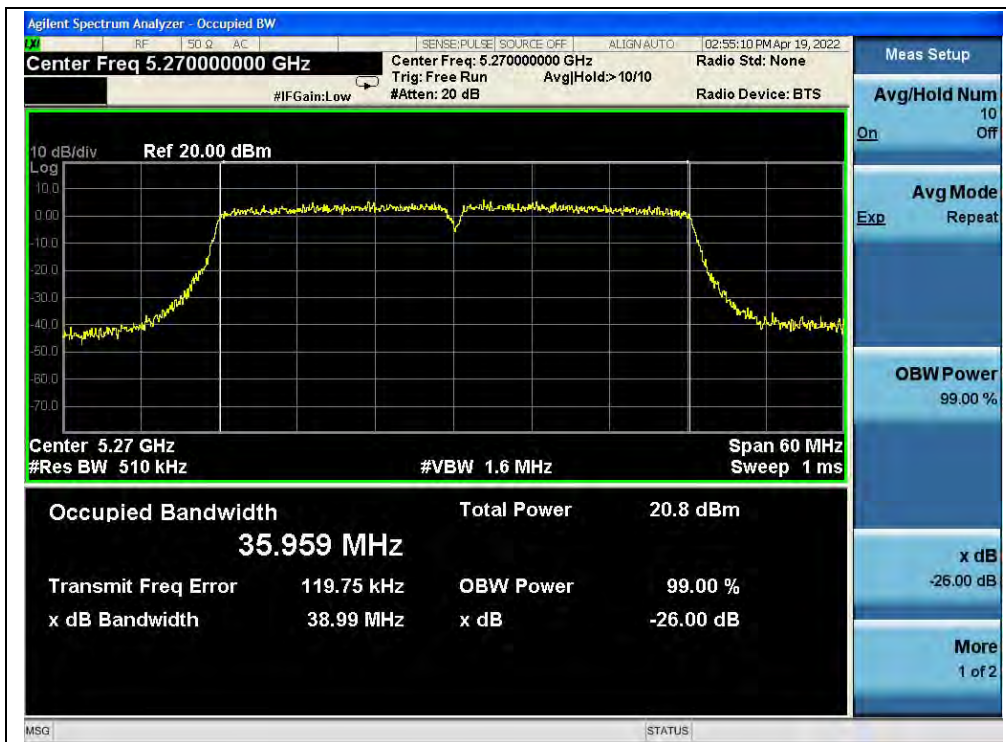
B. Test Plot:



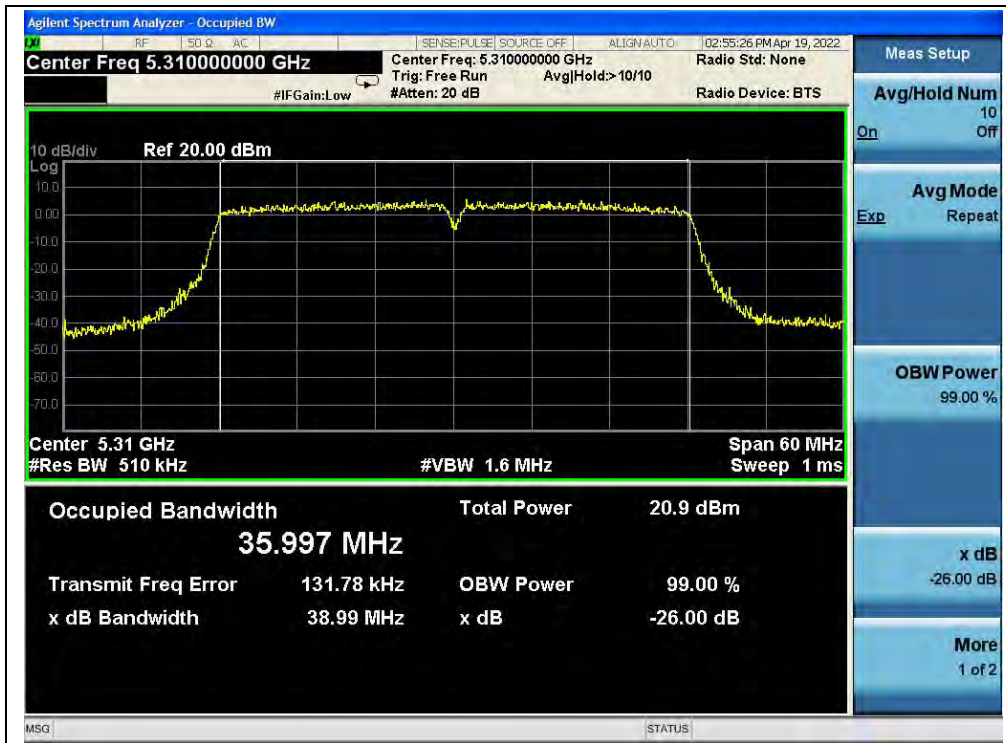
(Channel 38, 5190MHz, 802.11ac (VHT40))



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



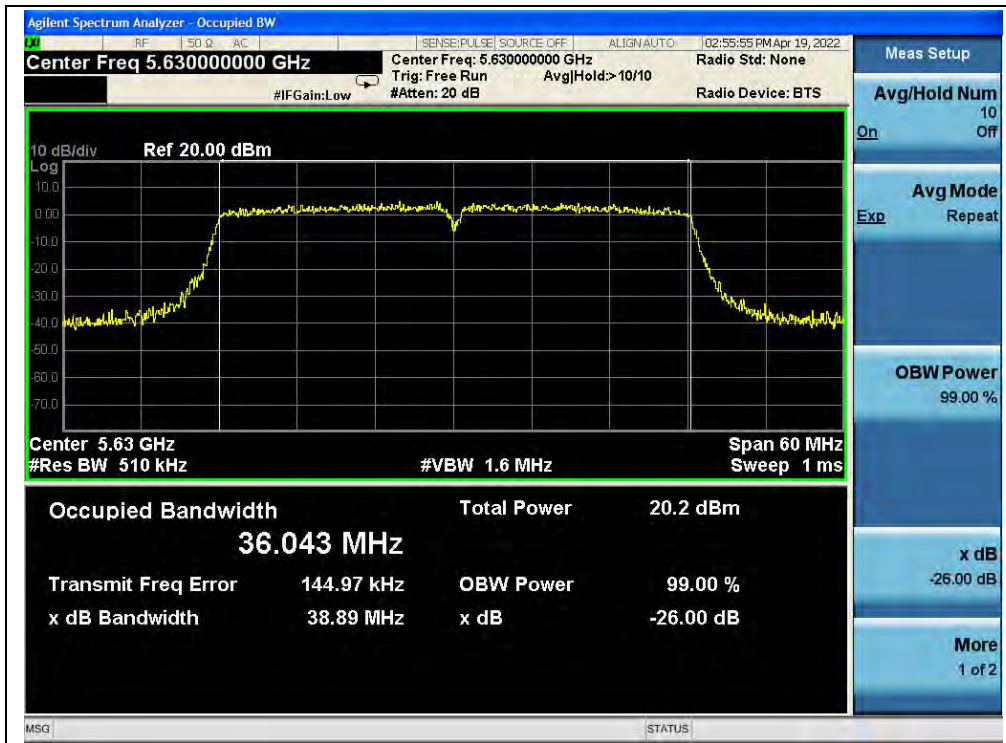
(Channel 54, 5270MHz, 802.11ac (VHT40))



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



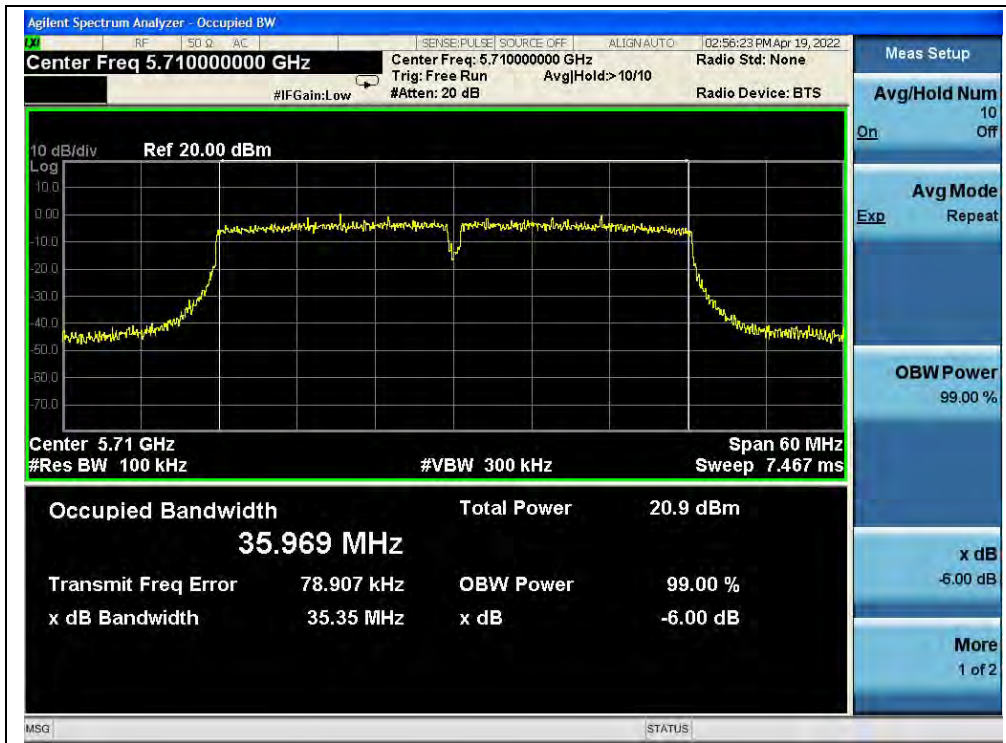
(Channel 102, 5510MHz, 802.11ac (VHT40))



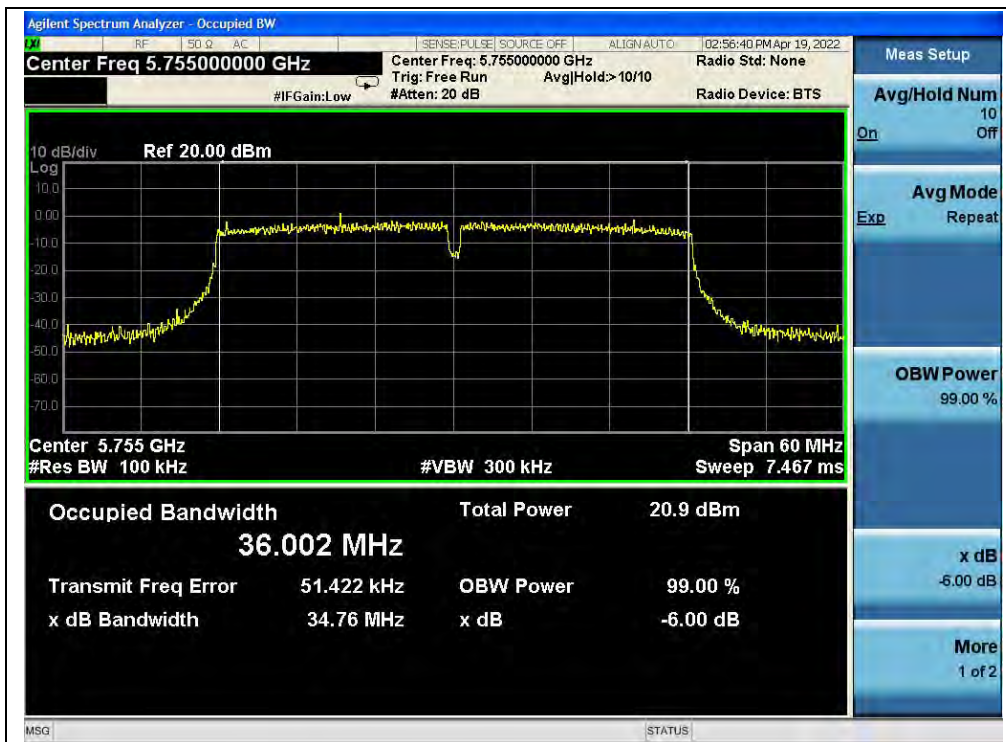
(Channel 126, 5630MHz, 802.11ac (VHT40))



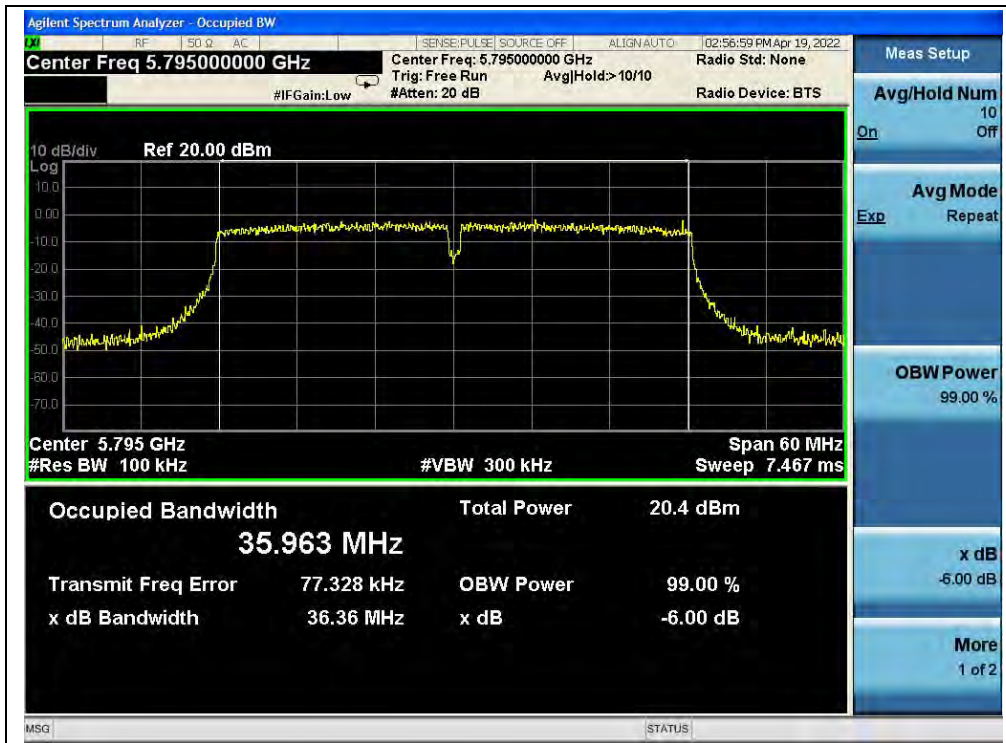
(Channel 142, 5710MHz, 802.11ac (VHT40))



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



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



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

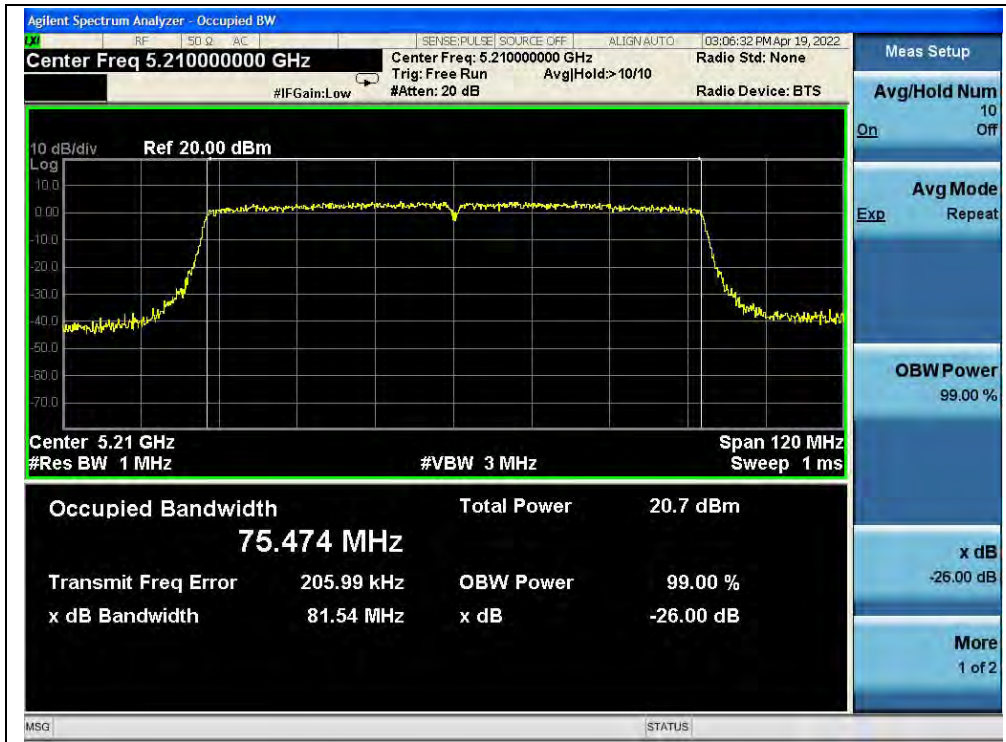


802.11ac (VHT80) Mode

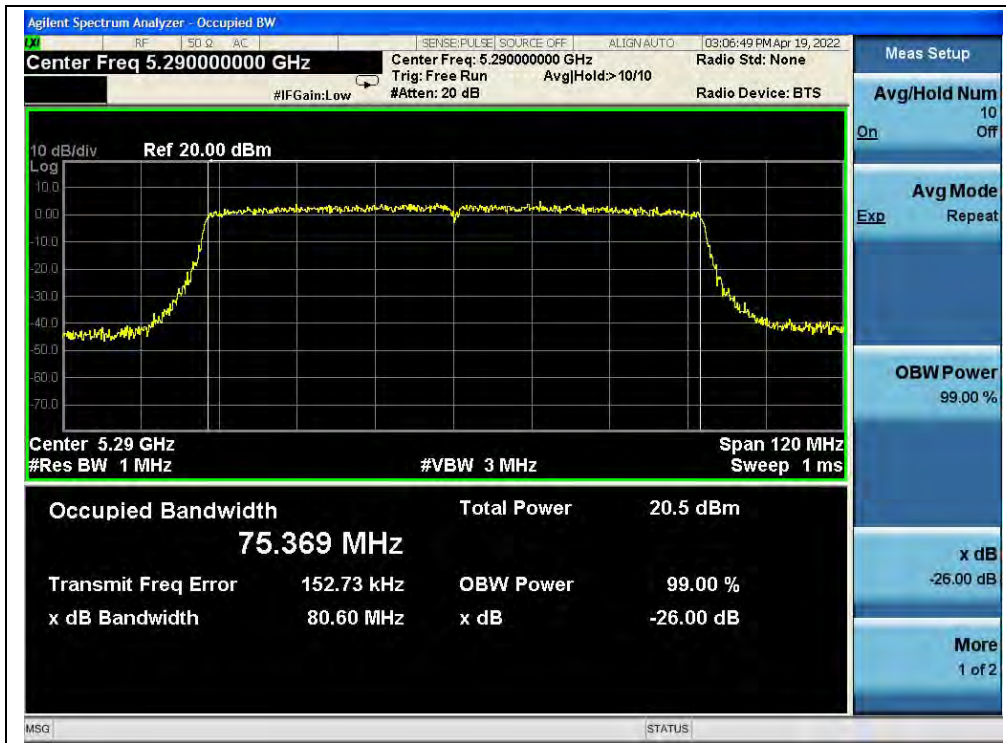
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
42	5210	81.54
58	5290	80.60
106	5530	81.43
122	5610	80.84
138	5690	80.87
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
138	5690	75.67
155	5775	75.70

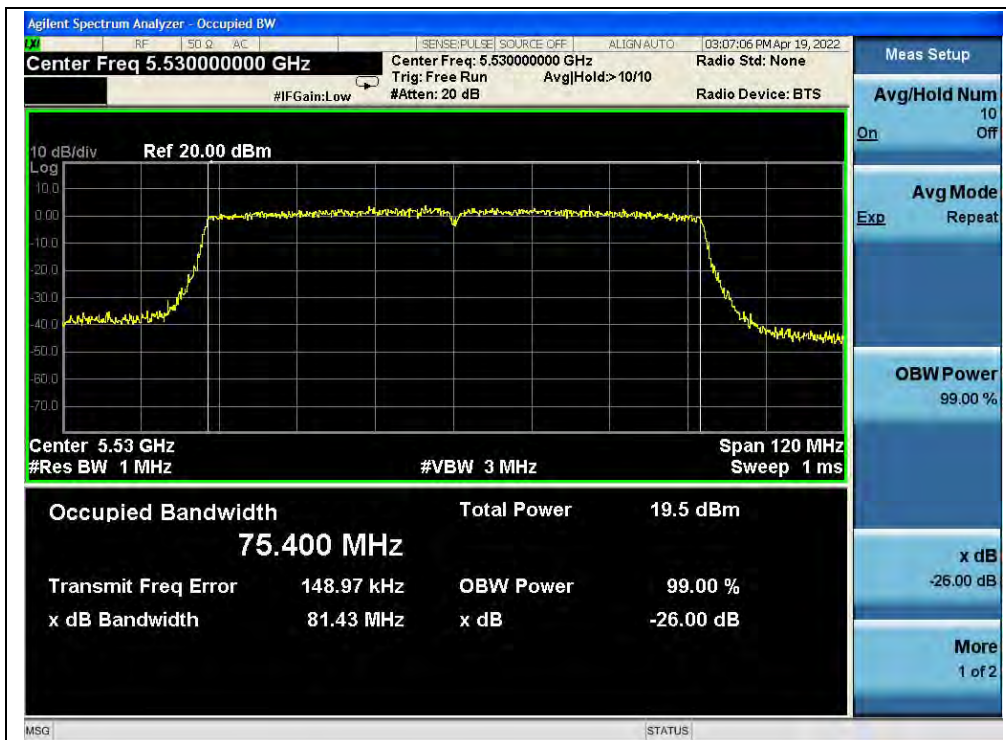
B. Test Plot:



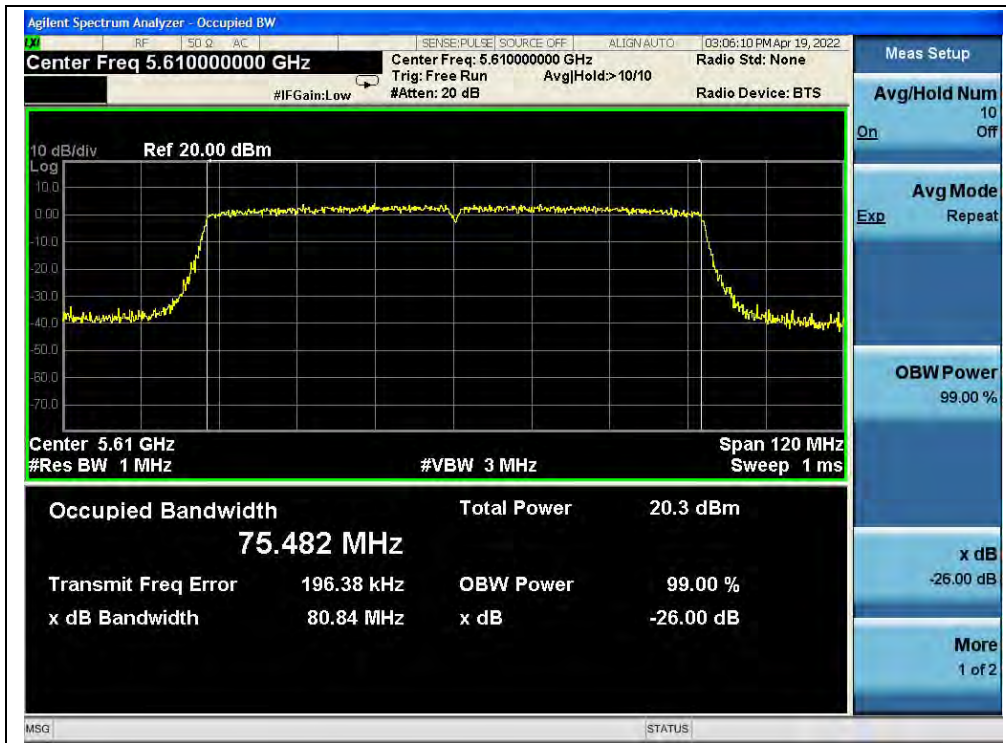
(Channel 42, 5210MHz, 802.11ac (VHT80))



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



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



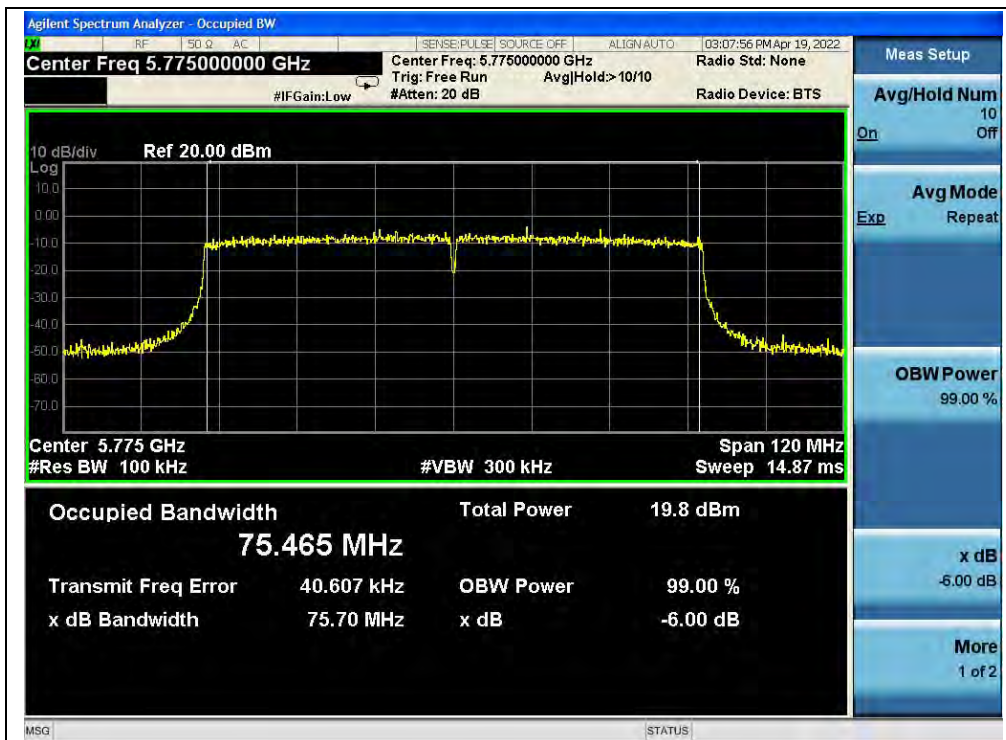
(Channel 122, 5610MHz, 802.11ac (VHT80))



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



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



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



802.11ax (HEW20) Mode

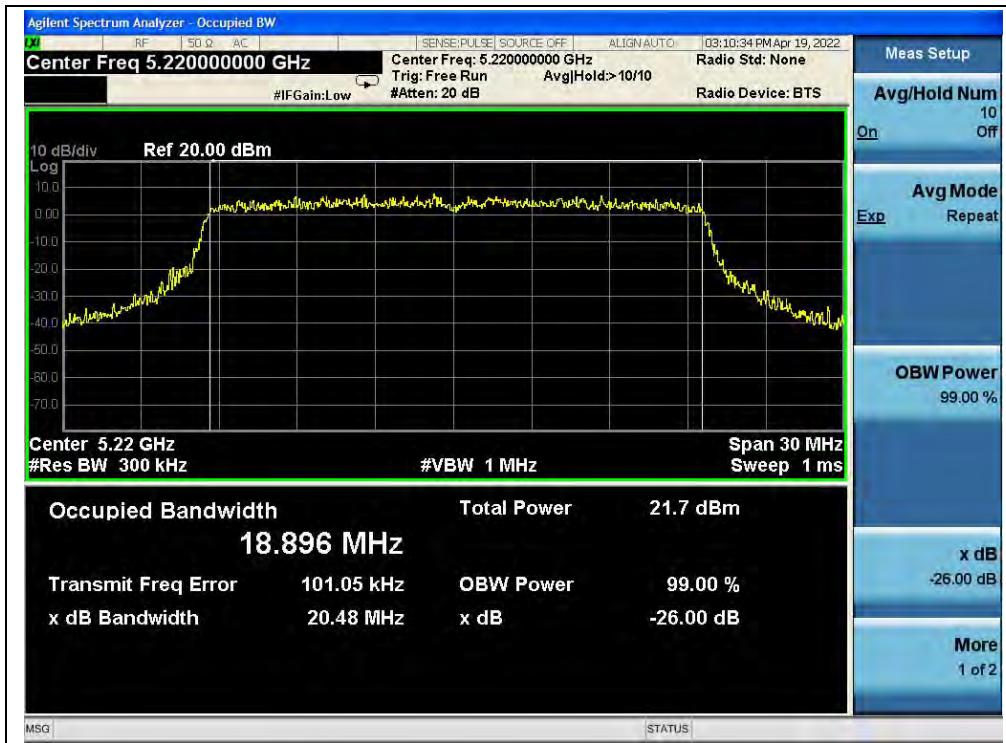
A. Test Verdict:

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
36	5180	20.55
44	5220	20.48
48	5240	20.59
52	5260	20.72
60	5300	20.63
64	5320	20.36
100	5500	20.45
120	5600	20.76
144	5720	20.84
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
144	5720	18.83
149	5745	18.23
157	5785	17.55
165	5825	18.22

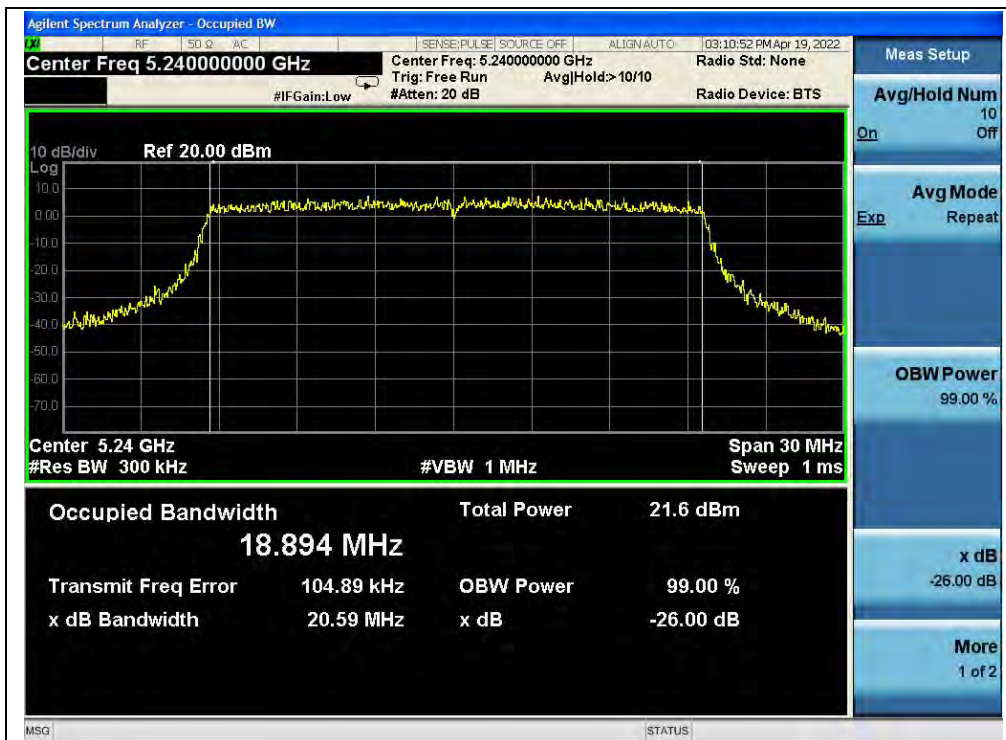
B. Test Plot:



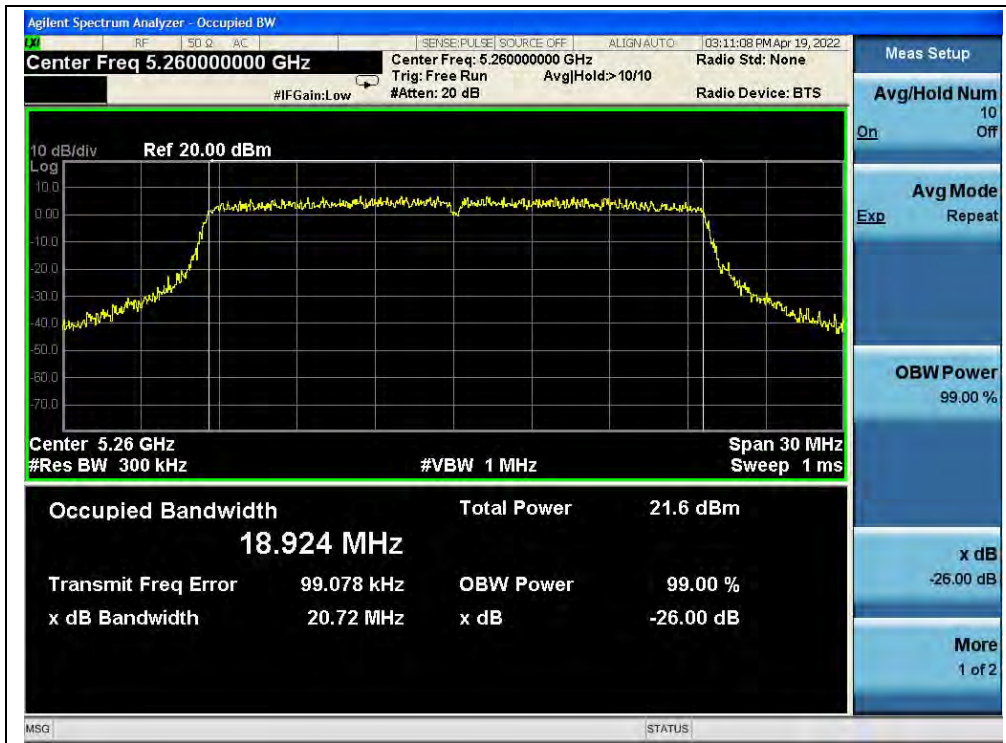
(Channel 36, 5180MHz, 802.11ax (HEW20))



(Channel 44, 5220MHz, 802.11ax (HEW20))



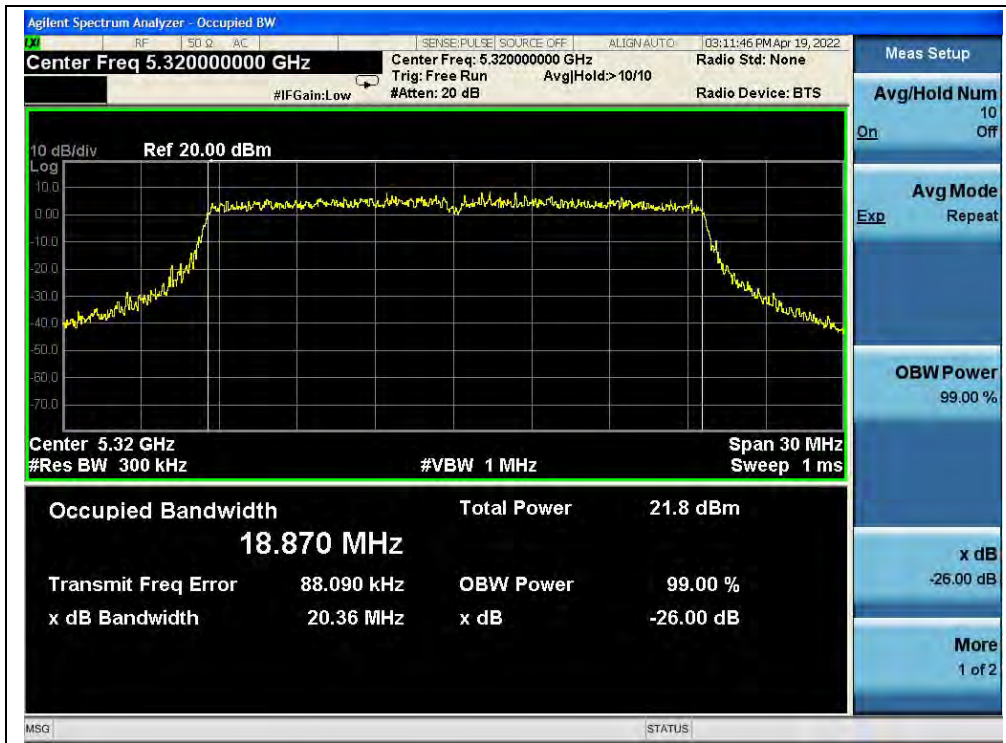
(Channel 48, 5240MHz, 802.11ax (HEW20))



(Channel 52, 5260MHz, 802.11ax (HEW20))



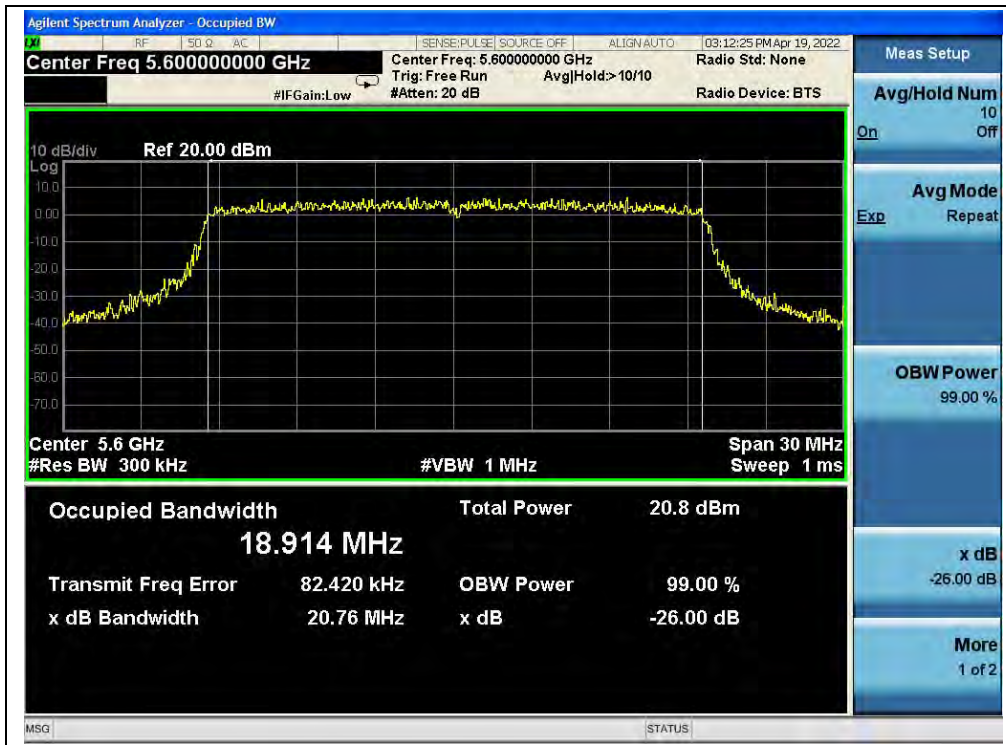
(Channel 60, 5300MHz, 802.11ax (HEW20))



(Channel 64, 5320MHz, 802.11ax (HEW20))



(Channel 100, 5500MHz, 802.11ax (HEW20))



(Channel 120, 5600MHz, 802.11ax (HEW20))



(Channel 144, 5720MHz, 802.11ax (HEW20))