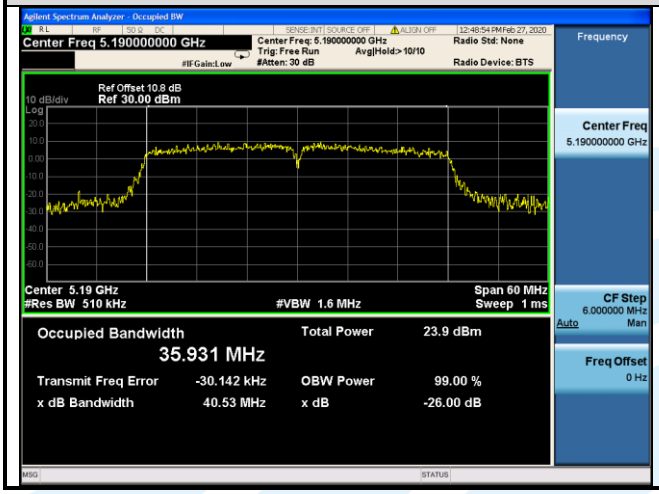
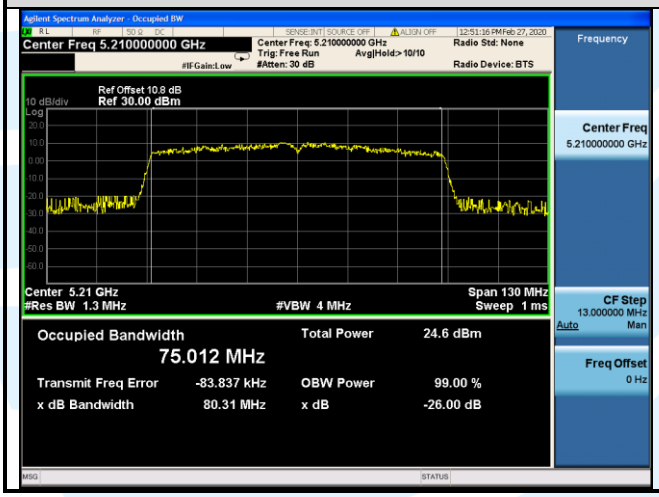
Chain 2	
IEEE 802.11ac-VHT40	
Channel 38	Channel 46
	

Chain 2 IEEE 802.11ac-VHT80	
Channel 42	
	\

5.46 DB BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (e)

Test Method: KDB 789033 D02 v02r01 Section C.2

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

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

6dB Bandwidth

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 * 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.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

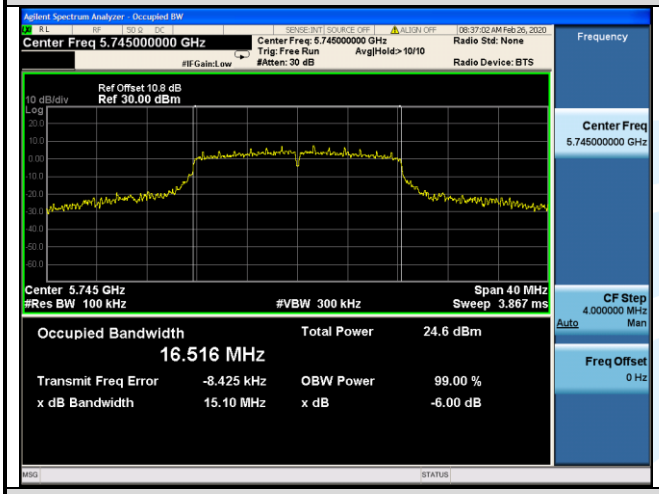
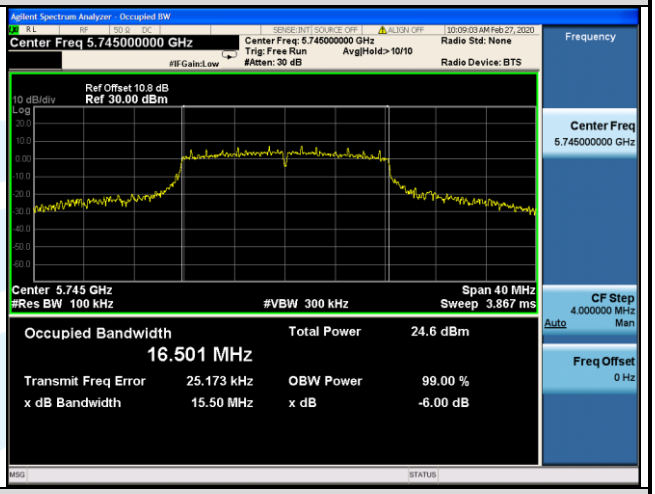
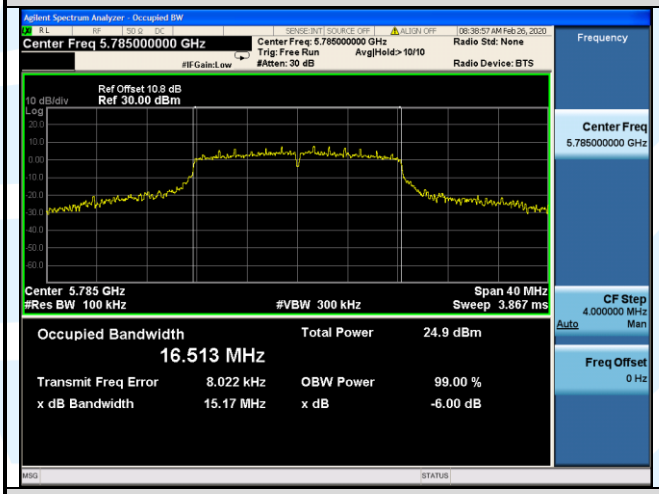
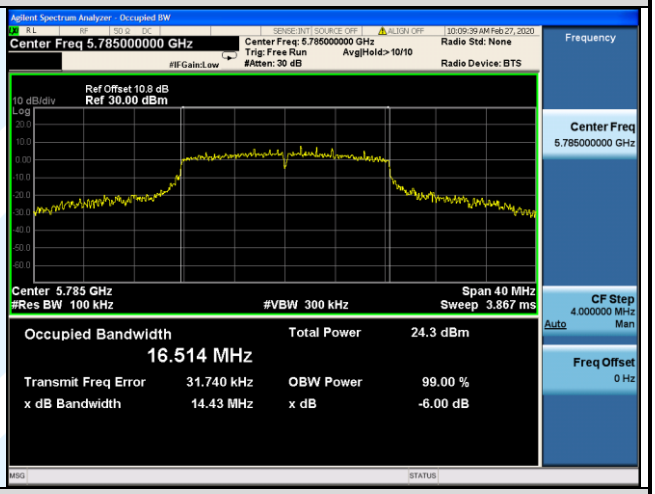
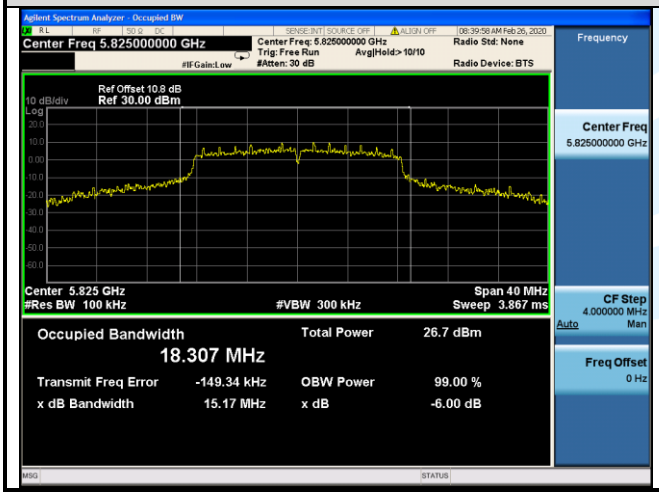
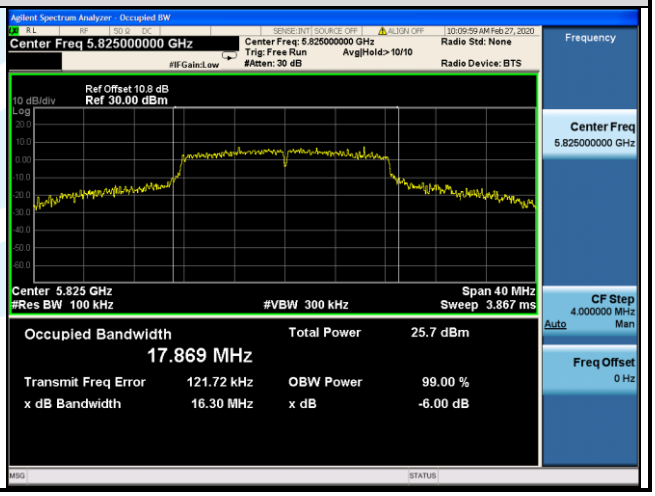
Test Results: Pass

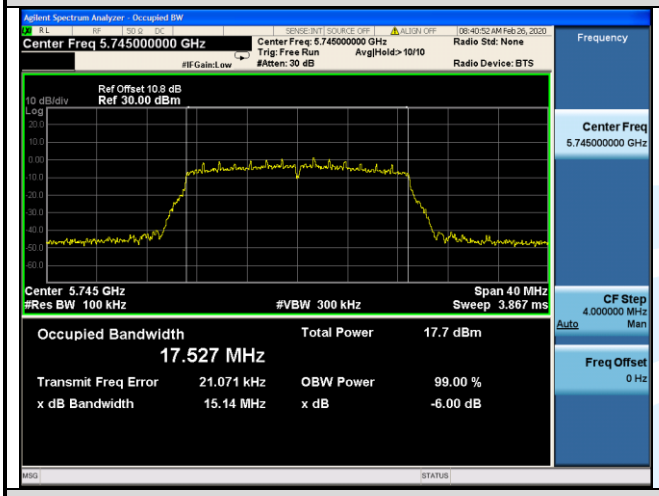
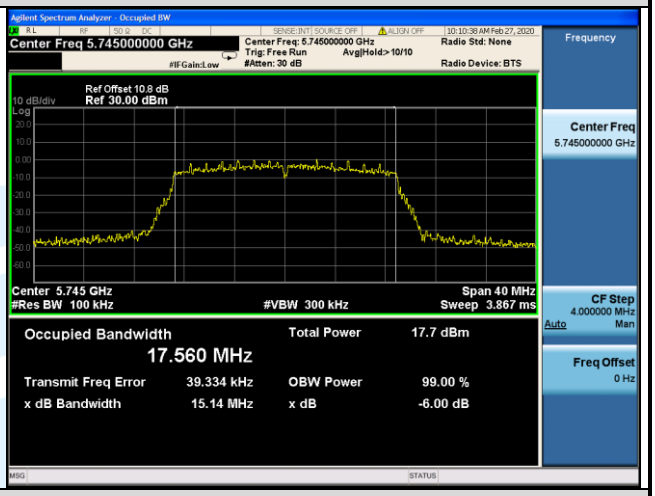
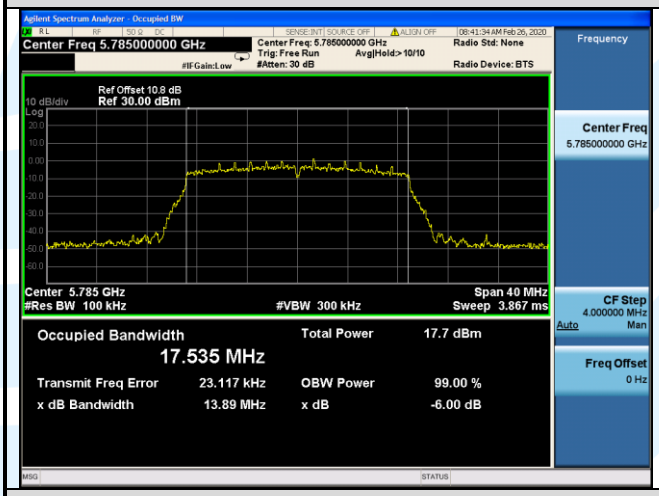
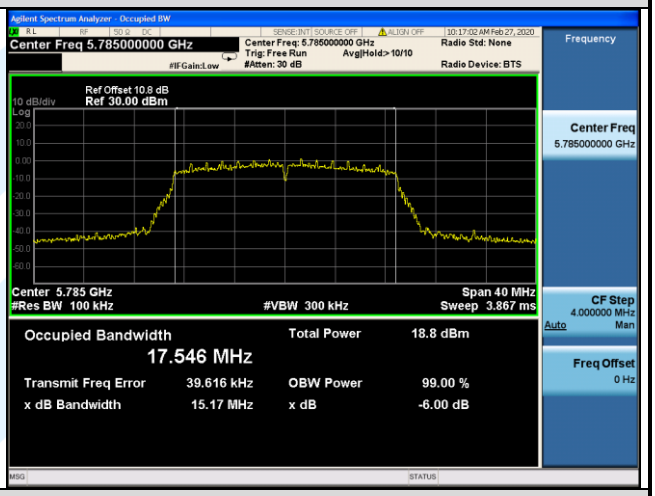
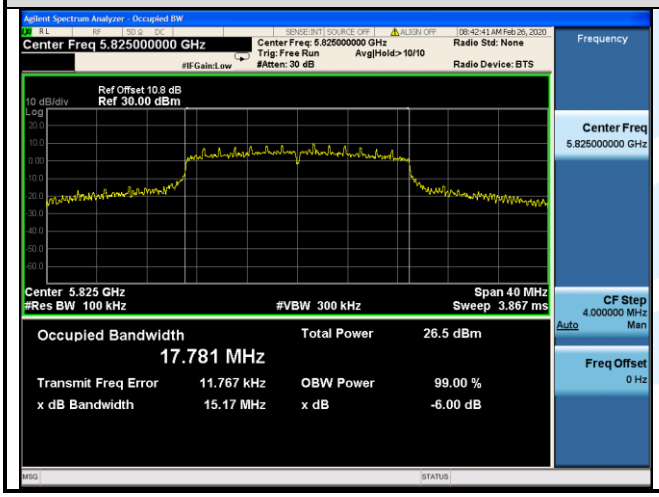
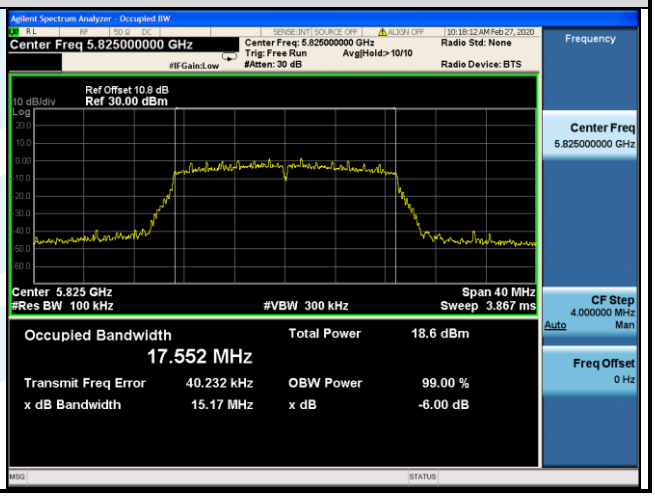
Test Data:

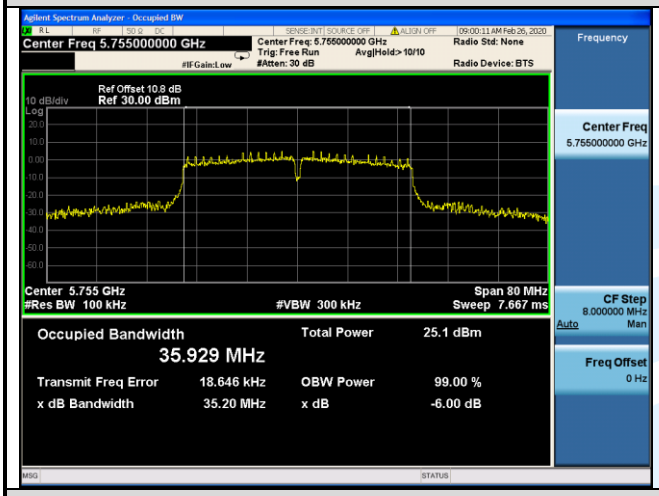
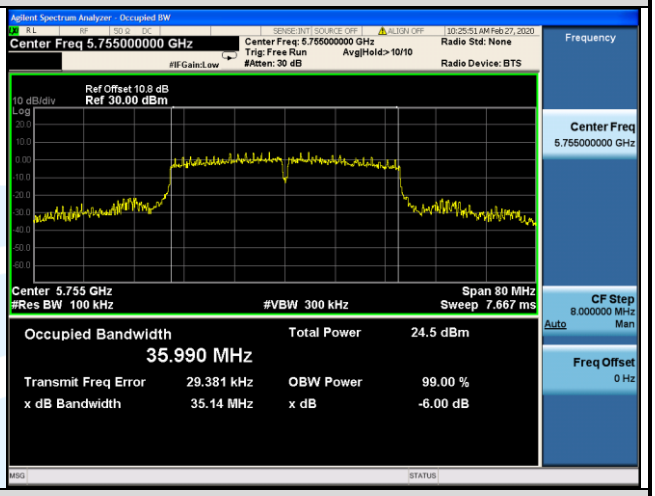
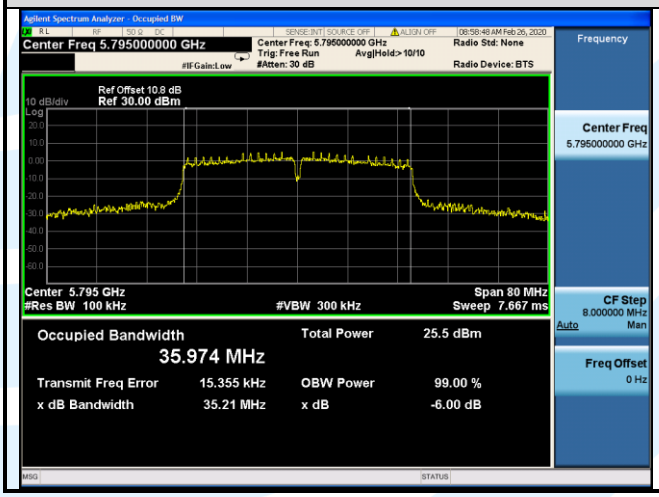
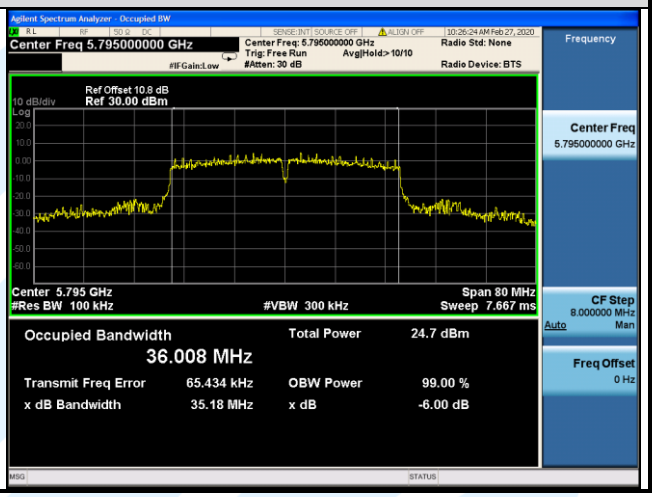
Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)			99% Bandwidth (MHz)			6 dB Bandwidth Limit	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 0	Chain 1	Chain 2		
IEEE 802.11a	149 (5745)	15.10	15.50	15.70	16.516	16.501	16.474	> 500 kHz	Pass
	157 (5785)	15.17	14.43	15.48	16.513	16.514	16.461	> 500 kHz	Pass
	165 (5825)	15.17	16.30	13.27	18.307	17.869	16.466	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	15.14	15.14	15.20	17.527	17.560	17.524	> 500 kHz	Pass
	157 (5785)	13.89	15.17	15.10	17.535	17.546	17.514	> 500 kHz	Pass
	165 (5825)	15.17	15.17	15.16	17.781	17.552	17.507	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	35.20	35.14	35.19	35.929	35.990	35.996	> 500 kHz	Pass
	159 (5795)	35.21	35.18	35.17	35.974	36.008	35.984	> 500 kHz	Pass
IEEE 802.11ac-VHT20	149 (5745)	15.72	15.73	15.11	17.584	17.593	17.563	> 500 kHz	Pass
	157 (5785)	15.16	15.12	15.17	17.613	17.631	17.573	> 500 kHz	Pass
	165 (5825)	15.18	15.12	16.29	17.876	17.630	17.569	> 500 kHz	Pass
IEEE 802.11ac-VHT40	151 (5755)	35.18	35.14	35.18	35.946	35.987	35.982	> 500 kHz	Pass
	159 (5795)	35.20	35.21	33.17	35.917	36.013	35.975	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	75.14	75.17	75.16	75.071	75.125	75.255	> 500 kHz	Pass

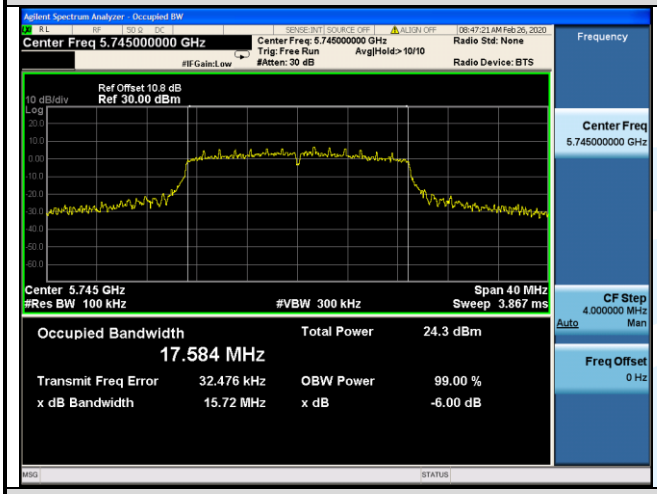
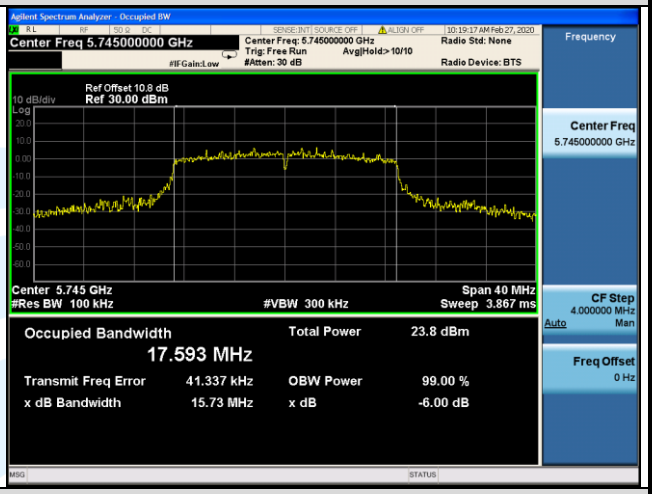
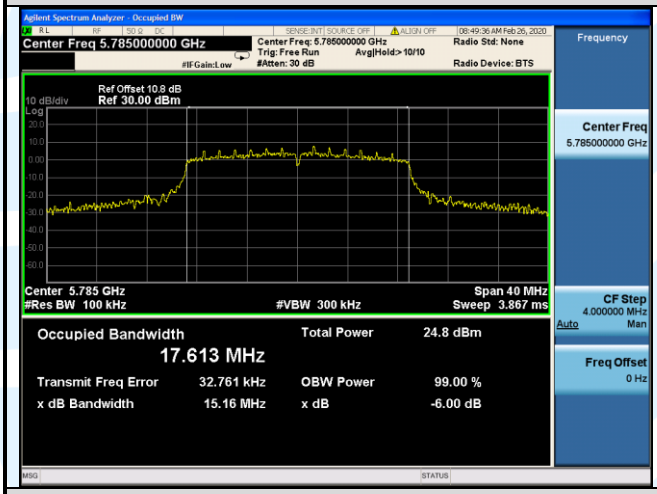
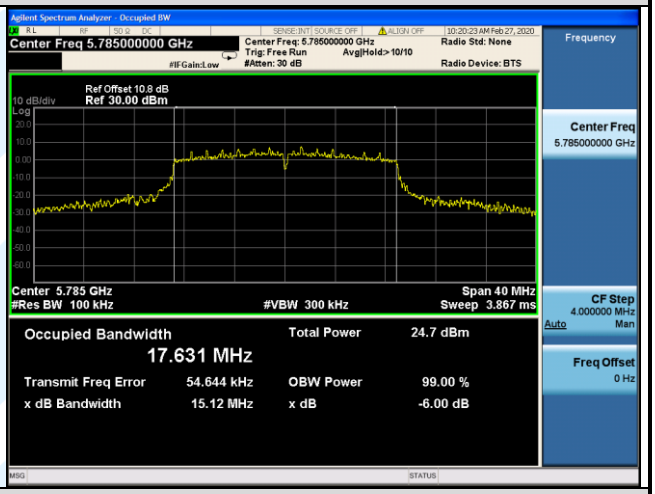
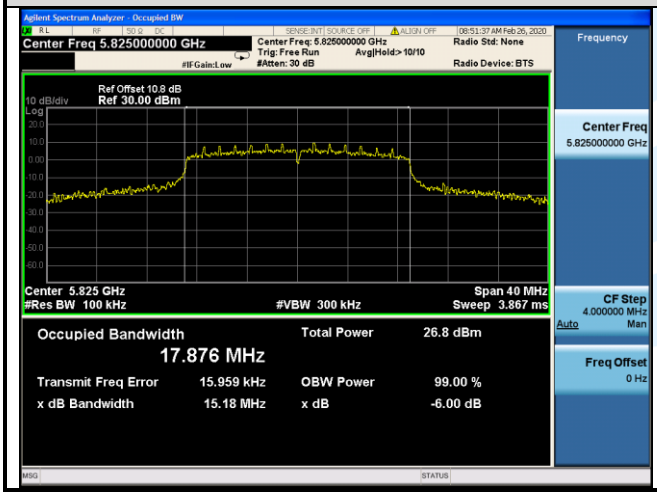
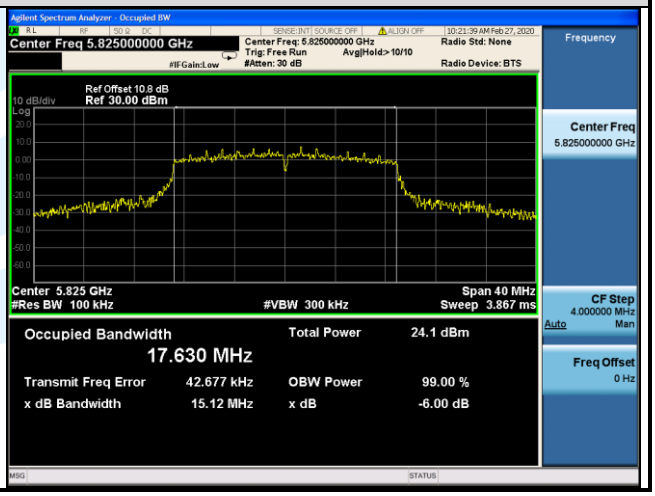
The test plots as follows:

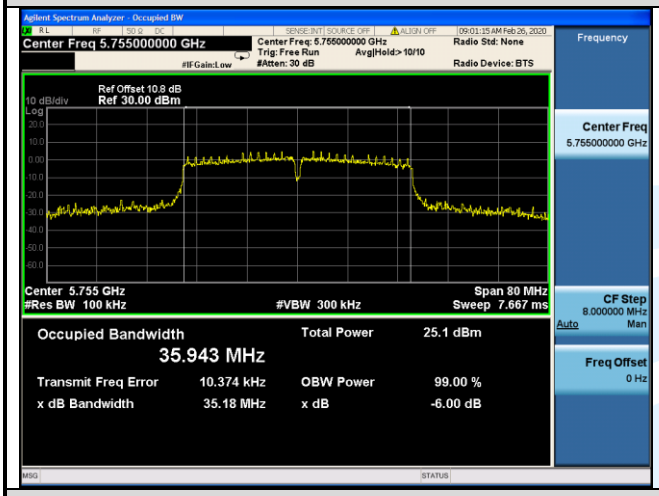
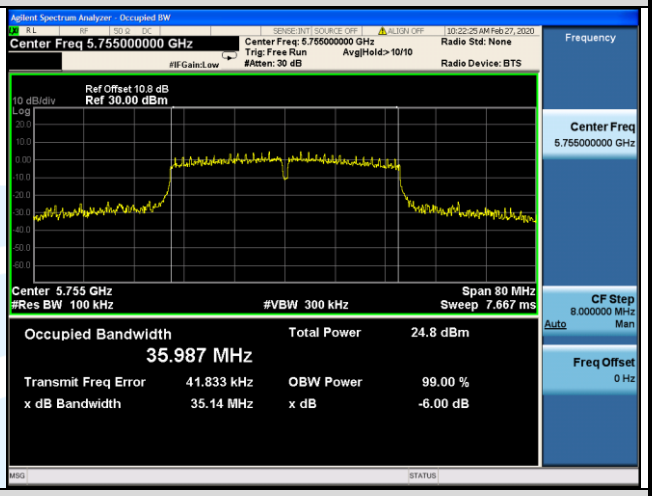
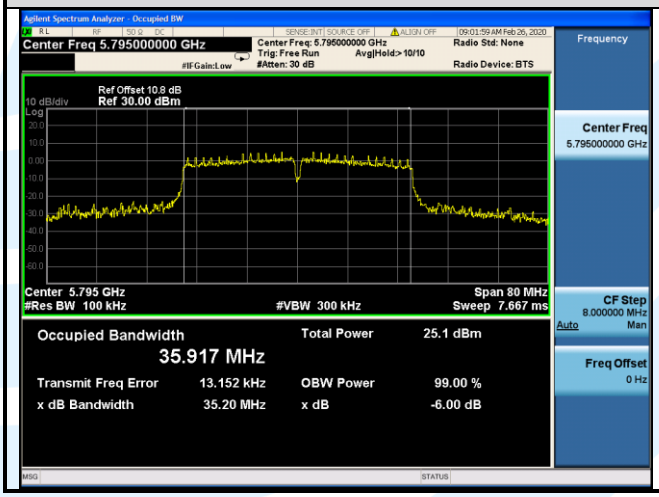
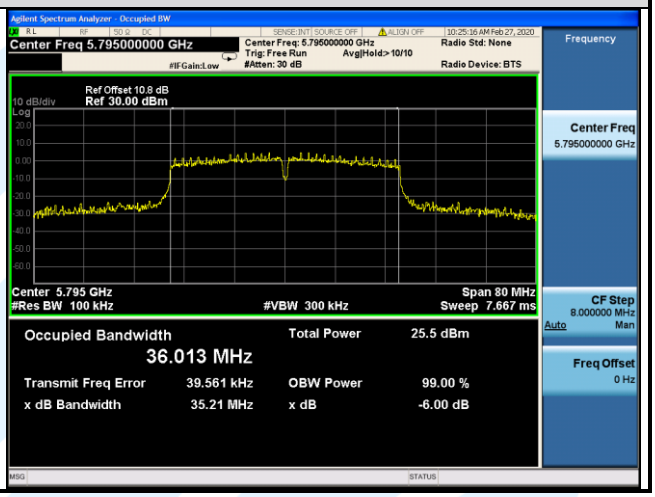
6 dB Bandwidth

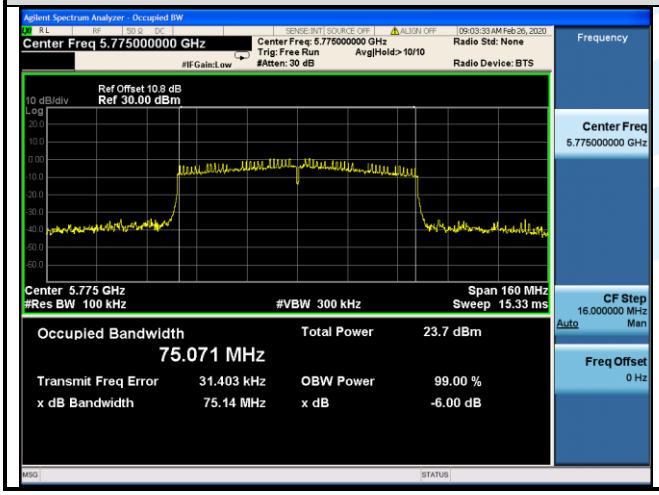
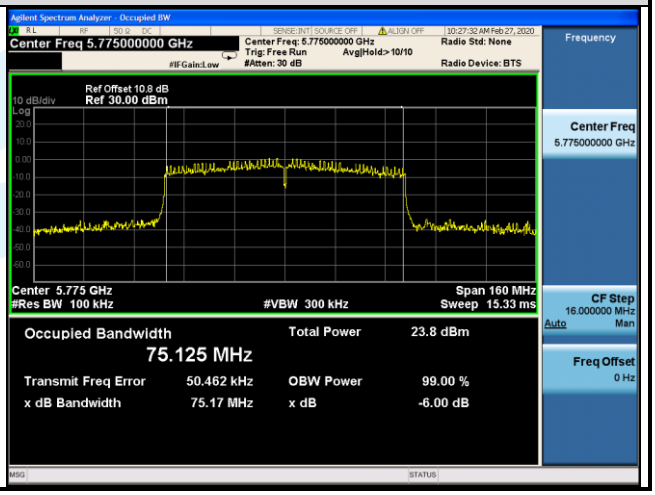
IEEE 802.11a	
Chain 0	**Chain 1**
Channel 149	
	
Channel 157	
	
Channel 165	
	

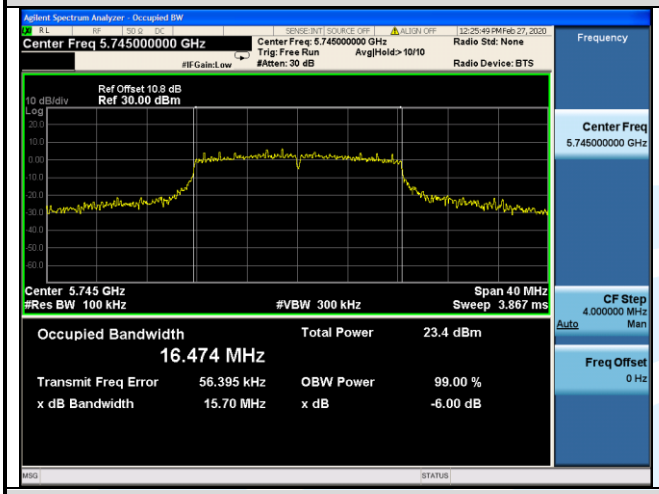
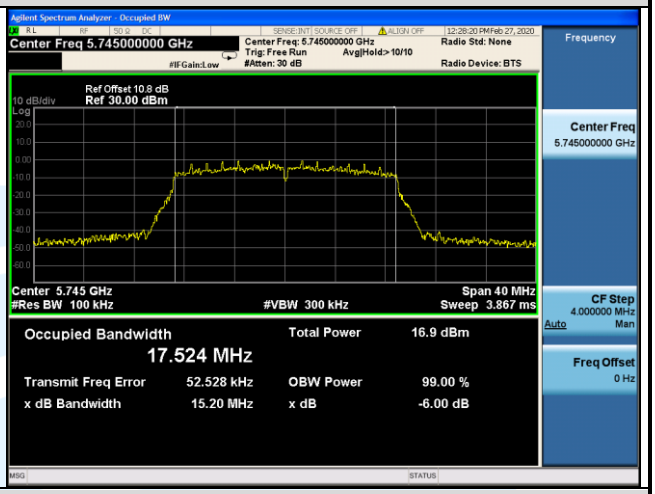
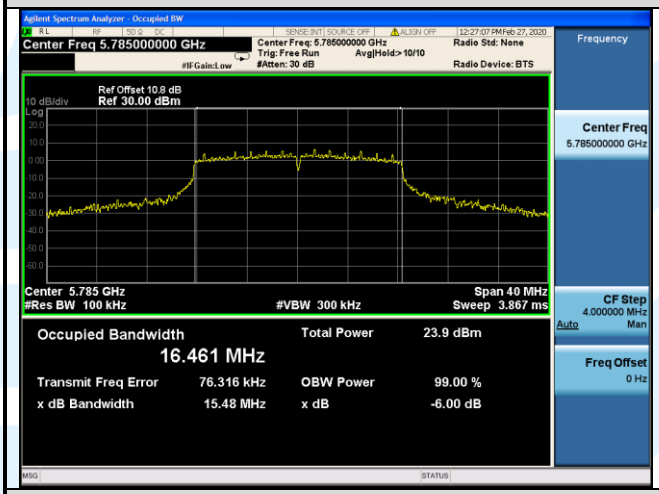
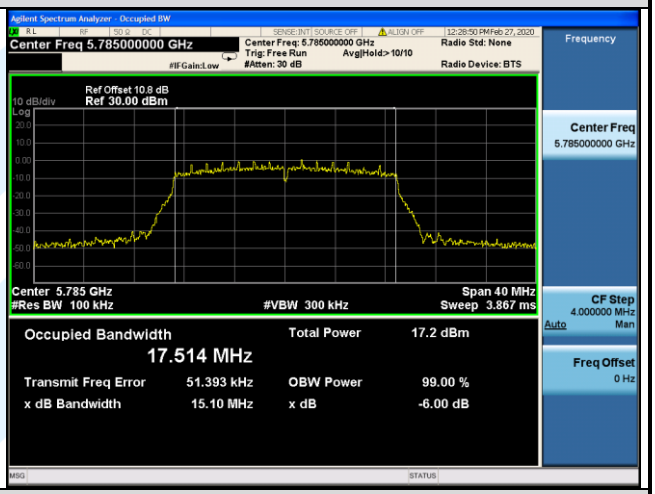
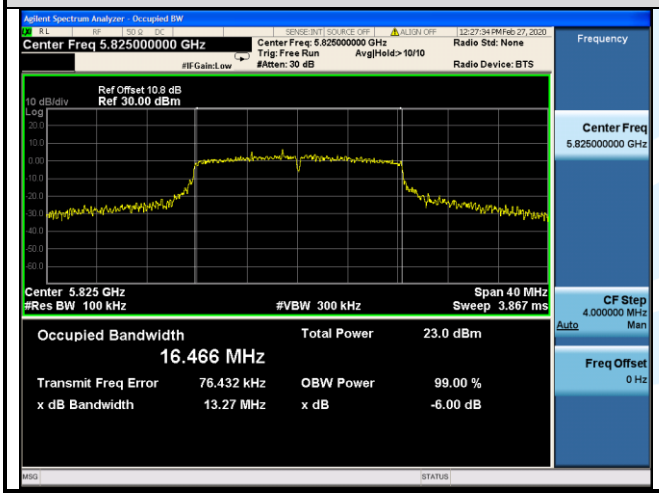
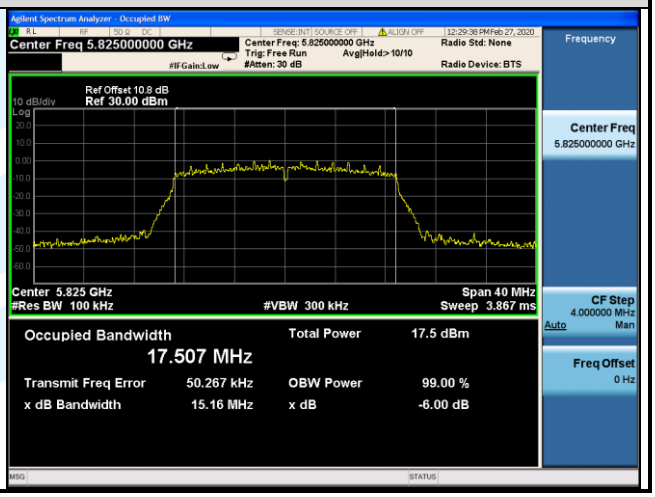
IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

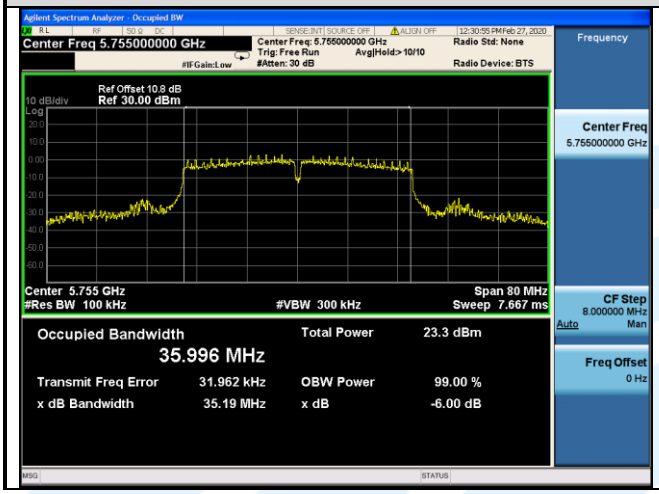
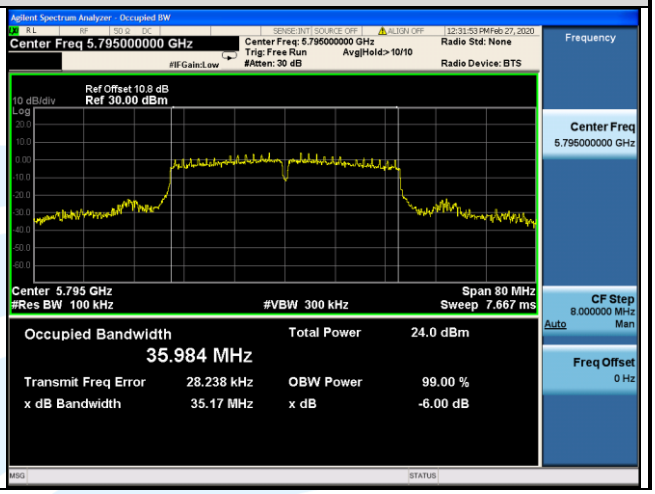
IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

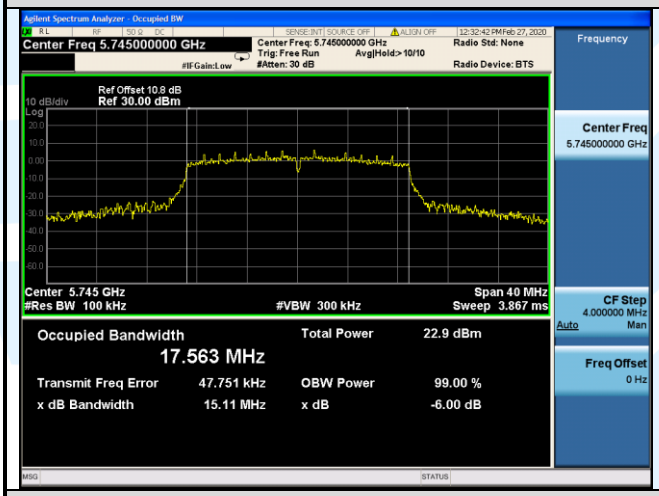
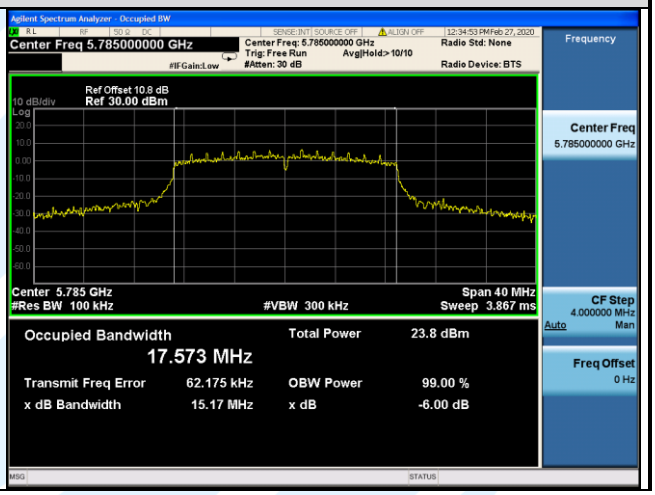
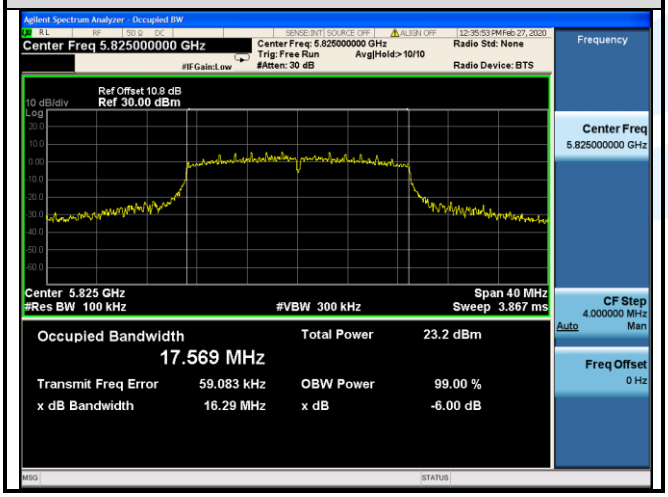
IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

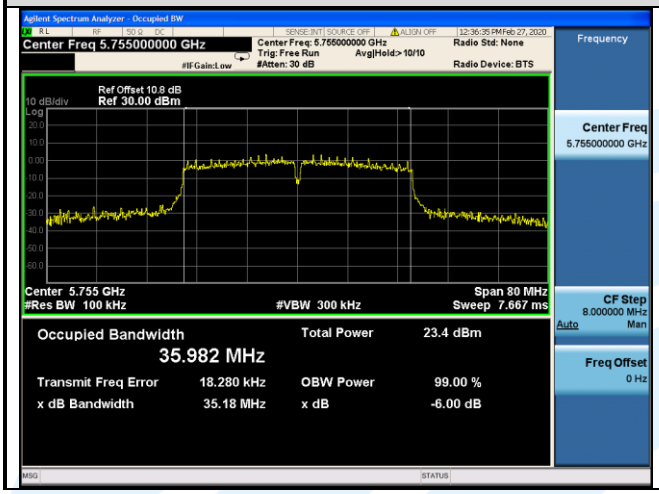
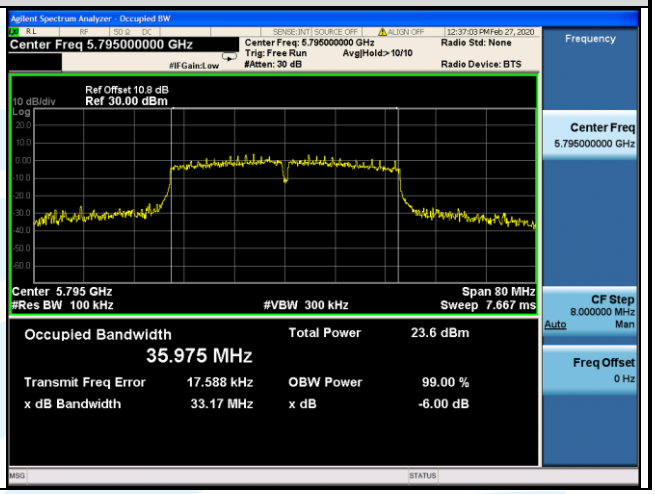
IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

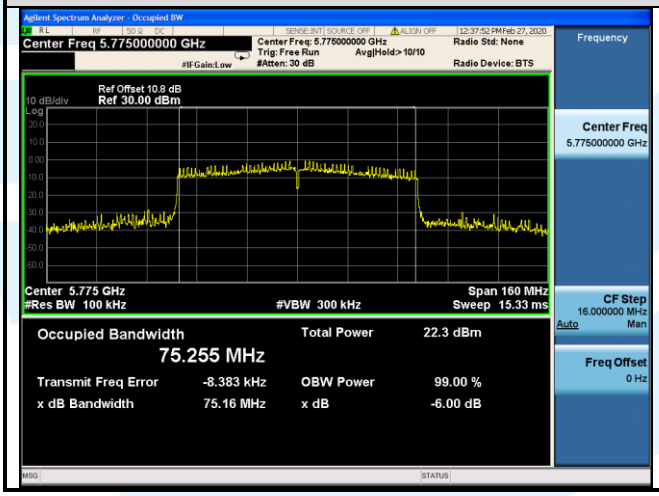
IEEE 802.11ac-VHT80	
Chain 0	Chain 1
Channel 151	
	

Chain 2	
IEEE 802.11a	IEEE 802.11n-HT20
Channel 149	
	
Channel 157	
	
Channel 165	
	

Chain 2	
IEEE 802.11n-HT40	
Channel 151	Channel 159
	

Chain 2	
IEEE 802.11ac-VHT20	
Channel 149	Channel 157
	
Channel 165	
	

Chain 2	
IEEE 802.11ac-VHT40	
Channel 151	Channel 159
	

Chain 2	
IEEE 802.11ac-VHT80	
Channel 151	
	\

5.5 MAXIMUM CONDUCTED OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(3)
Test Method: KDB 789033 D02 v02r01 Section E.3.a (Method PM)
Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details
Test Mode: Transmitter mode
Test Results: Pass
Test Data:

Directional gain and the maximum output power limit.

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Power Limits (dBm)
U-NII-1	3.00	3.00	3.00	7.77	28.23
U-NII-3	3.00	3.00	3.00	7.77	28.23
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:					
If *any* transmit signals are *correlated* with each other,					
Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi					

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)			Total Power MIMO_ Chain 0+1+2 (dBm)	Limit (dBm)	Pass / Fail
		SISO					
		Chain 0	Chain 1	Chain 2			
IEEE 802.11a	36 (5180)	17.12	16.93	16.73	21.70	28.23	Pass
	44 (5220)	17.11	17.09	16.91	21.81	28.23	Pass
	48 (5240)	17.20	17.11	16.84	21.83	28.23	Pass
IEEE 802.11n-HT20	36 (5180)	12.19	11.92	12.53	17.00	28.23	Pass
	44 (5220)	12.34	12.04	12.45	17.06	28.23	Pass
	48 (5240)	12.38	12.18	12.49	17.13	28.23	Pass
IEEE 802.11n-HT40	38 (5190)	16.14	15.99	15.80	20.75	28.23	Pass
	46 (5230)	16.08	16.03	15.68	20.71	28.23	Pass
IEEE 802.11ac-VHT20	36 (5180)	11.93	11.66	11.85	16.59	28.23	Pass
	44 (5220)	12.12	11.93	11.84	16.74	28.23	Pass
	48 (5240)	12.01	11.96	11.89	16.73	28.23	Pass
IEEE 802.11ac-VHT40	38 (5190)	16.33	15.97	15.90	20.84	28.23	Pass
	46 (5230)	16.34	16.09	15.93	20.90	28.23	Pass
IEEE 802.11ac-VHT80	42 (5210)	16.88	16.57	16.42	21.39	28.23	Pass

Remark:

1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power (Chain 0+1+2) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$

Frequency band 5725-5850 MHz

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)			Total Power MIMO_ Chain 0+1+2 (dBm)	Limit (dBm)	Pass / Fail
		SISO					
		Chain 0	Chain 1	Chain 2			
IEEE 802.11a	149 (5745)	19.17	19.91	19.12	24.19	28.23	Pass
	157 (5785)	19.22	19.96	19.09	24.22	28.23	Pass
	165 (5825)	19.40	20.03	19.12	24.31	28.23	Pass
IEEE 802.11n-HT20	149 (5745)	17.80	18.23	18.20	22.86	28.23	Pass
	157 (5785)	17.78	18.28	18.09	22.83	28.23	Pass
	165 (5825)	18.15	18.54	18.08	23.04	28.23	Pass
IEEE 802.11n-HT40	151 (5755)	18.76	19.23	18.46	23.60	28.23	Pass
	159 (5795)	18.92	19.26	18.56	23.70	28.23	Pass
IEEE 802.11ac-VHT20	149 (5745)	17.64	18.11	17.59	22.56	28.23	Pass
	157 (5785)	17.77	18.25	17.49	22.62	28.23	Pass
	165 (5825)	17.93	18.42	17.51	22.75	28.23	Pass
IEEE 802.11ac-VHT40	151 (5755)	18.94	19.30	18.69	23.76	28.23	Pass
	159 (5795)	19.08	19.36	18.68	23.82	28.23	Pass
IEEE 802.11ac-VHT80	155 (5775)	18.38	18.07	17.92	22.89	28.23	Pass

Remark:

1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power(Chain 0+1) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$

5.6 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(3)

Test Method: KDB 789033 D02 v02r01 Section F

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

1. For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-2

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Sweep time = auto, trigger set to “free run”.
d) Trace average at least 100 traces in power averaging mode.
e) Record the max value and add 10 log (1/duty cycle)

2. For U-NII-3 band:

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 500 kHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
d) Sweep time = auto, trigger set to “free run”.
e) Trace average at least 100 traces in power averaging mode.
f) Record the max value and add 10 log (1/duty cycle)

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.
Instruments Used: Refer to section 3 for details
Test Mode: Transmitter mode
Test Results: Pass
Test Data:

Directional gain and the maximum output power limit.

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Power Limits (dBm)
U-NII-1	3.00	3.00	3.00	7.77	15.23
U-NII-3	3.00	3.00	3.00	7.77	28.23
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N_{ANT} transmitter outputs of equal power. Directional gain is to be computed as follows:					
If *any* transmit signals are *correlated* with each other,					
Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi					

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)			Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO					
		Chain 0	Chain 1	Chain 2			
IEEE 802.11a	36 (5180)	7.99	7.23	7.57	12.38	15.23	Pass
	44 (5220)	8.82	7.25	7.84	12.79	15.23	Pass
	48 (5240)	8.80	7.77	7.77	12.91	15.23	Pass
IEEE 802.11n-HT20	36 (5180)	7.78	0.43	1.57	9.31	15.23	Pass
	44 (5220)	7.91	0.63	1.49	9.42	15.23	Pass
	48 (5240)	8.08	0.76	1.27	9.52	15.23	Pass
IEEE 802.11n-HT40	38 (5190)	5.80	4.45	4.98	9.88	15.23	Pass
	46 (5230)	5.65	4.53	5.20	9.92	15.23	Pass
IEEE 802.11ac-VHT20	36 (5180)	7.79	6.59	7.15	11.97	15.23	Pass
	44 (5220)	7.92	6.83	7.25	12.13	15.23	Pass
	48 (5240)	8.09	6.79	7.00	12.10	15.23	Pass
IEEE 802.11ac-VHT40	38 (5190)	6.00	4.22	5.31	10.01	15.23	Pass
	46 (5230)	5.97	4.77	4.86	10.00	15.23	Pass
IEEE 802.11ac-VHT80	42 (5210)	1.05	1.07	1.15	5.86	15.23	Pass

Remark:

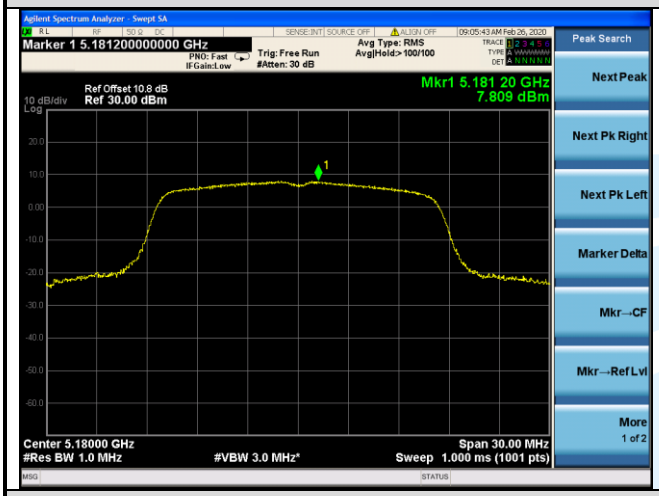
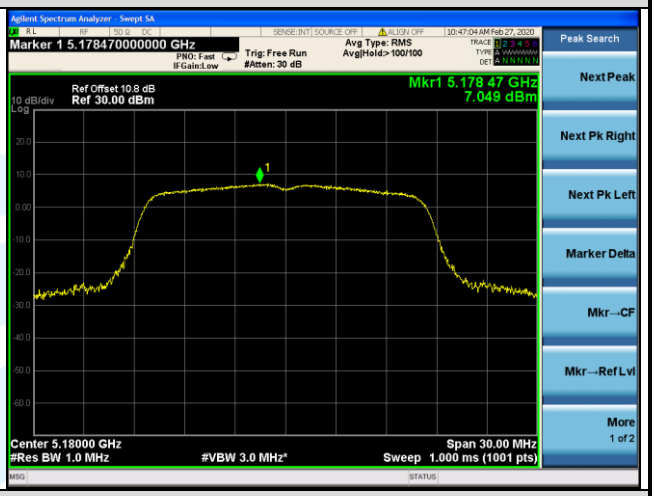
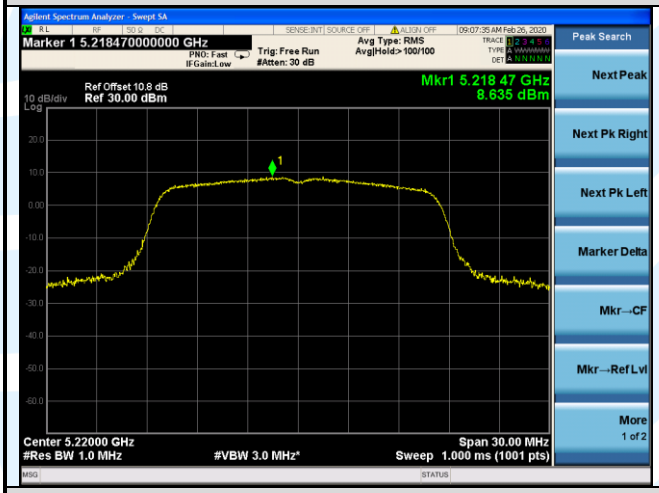
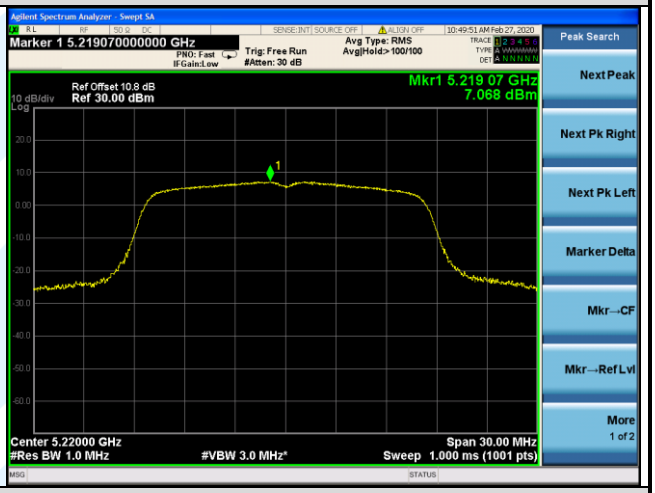
1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1+2) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})+(10^{\text{Chain 2}/10})]$

Frequency band 5725-5850 MHz

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz) SISO			Total power spectral density MIMO_ Chain 0+1+2 (dBm/500KHz)	Limit (dBm/500KHz)	Pass / Fail
		Chain 0	Chain 1	Chain 2			
IEEE 802.11a	149 (5745)	5.73	5.59	5.71	10.45	28.23	Pass
	157 (5785)	6.42	5.66	5.51	10.65	28.23	Pass
	165 (5825)	6.27	5.79	5.40	10.60	28.23	Pass
IEEE 802.11n-HT20	149 (5745)	5.41	-1.13	-1.01	7.03	28.23	Pass
	157 (5785)	5.80	-1.69	-0.89	7.24	28.23	Pass
	165 (5825)	5.92	-1.15	-1.10	7.37	28.23	Pass
IEEE 802.11n-HT40	151 (5755)	2.17	2.68	2.62	7.27	28.23	Pass
	159 (5795)	2.53	2.77	2.17	7.27	28.23	Pass
IEEE 802.11ac-VHT20	149 (5745)	5.42	4.96	4.96	9.89	28.23	Pass
	157 (5785)	5.81	5.15	4.93	10.08	28.23	Pass
	165 (5825)	5.93	4.91	4.84	10.03	28.23	Pass
IEEE 802.11ac-VHT40	151 (5755)	2.42	2.81	2.57	7.38	28.23	Pass
	159 (5795)	2.47	2.89	2.50	7.40	28.23	Pass
IEEE 802.11ac-VHT80	155 (5775)	-0.69	-1.09	-1.16	3.80	28.23	Pass

Remark:
1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1+2) = 10*log[(10Chain 0/10)+(10Chain 1/10) +($10^{\text{Chain 2/10}}$)]

The test plots as follows:

IEEE 802.11a	
Chain 0	**Chain 1**
Channel 36	
	
Channel 44	
	
Channel 48