

## 5.46 DB BANDWIDTH

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

**Test Method:** KDB 789033 D02 v02r01Section 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:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW)  $\geq 3 * \text{RBW}$ .
- 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

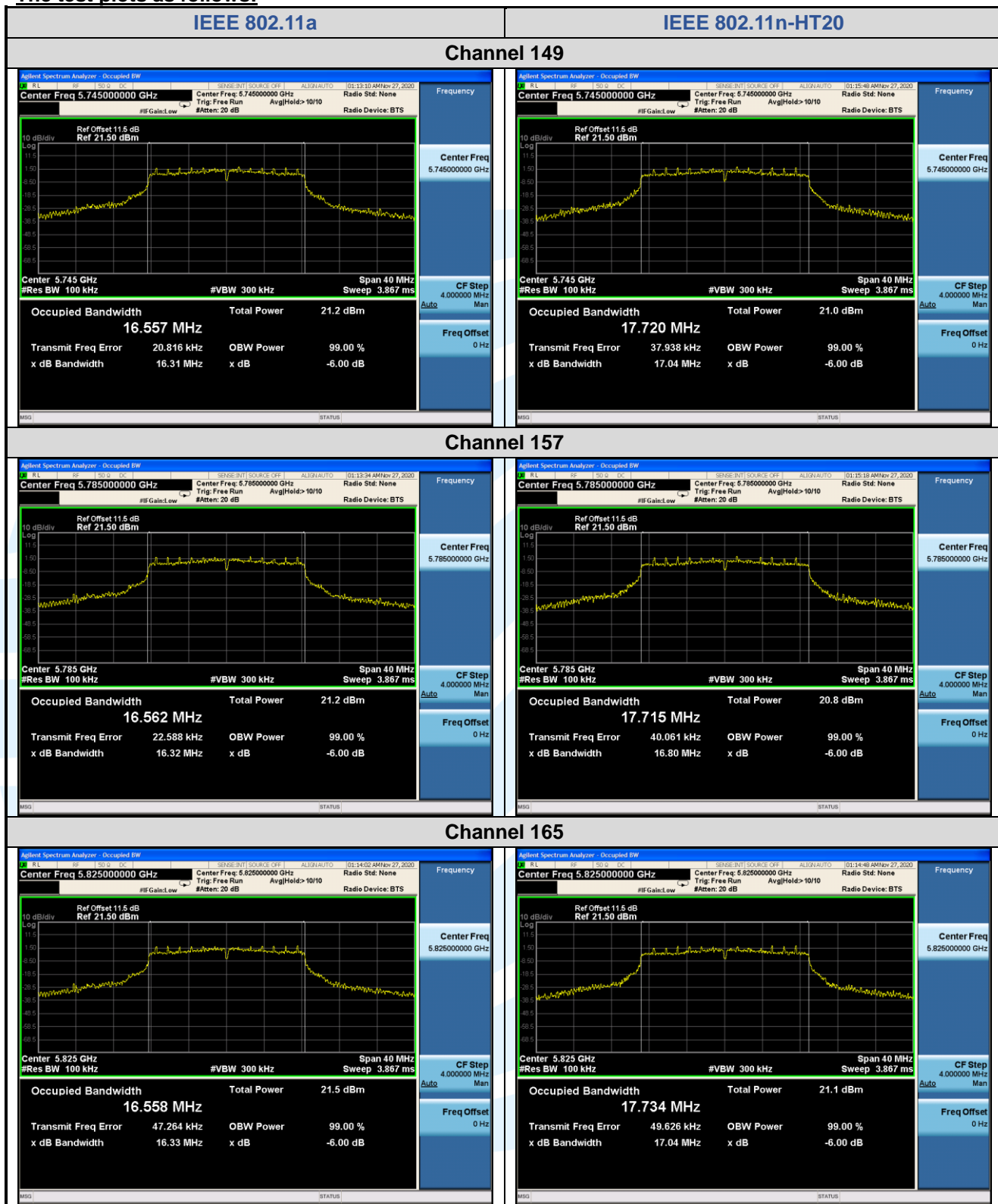
**Test Results:** Pass

**Test Data:**

Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Pass / Fail
IEEE 802.11a	149 (5745)	16.31	16.557	> 500 kHz	Pass
	157 (5785)	16.32	16.562	> 500 kHz	Pass
	165 (5825)	16.33	16.558	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	17.04	17.720	> 500 kHz	Pass
	157 (5785)	16.80	17.715	> 500 kHz	Pass
	165 (5825)	17.04	17.734	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	35.86	36.137	> 500 kHz	Pass
	159 (5795)	35.78	36.158	> 500 kHz	Pass
IEEE 802.11ac-VHT20	149 (5745)	16.94	17.736	> 500 kHz	Pass
	157 (5785)	17.34	17.699	> 500 kHz	Pass
	165 (5825)	17.57	17.700	> 500 kHz	Pass
IEEE 802.11ac-VHT40	151 (5755)	36.06	36.185	> 500 kHz	Pass
	159 (5795)	36.08	36.197	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	75.41	75.516	> 500 kHz	Pass



The test plots as follows:



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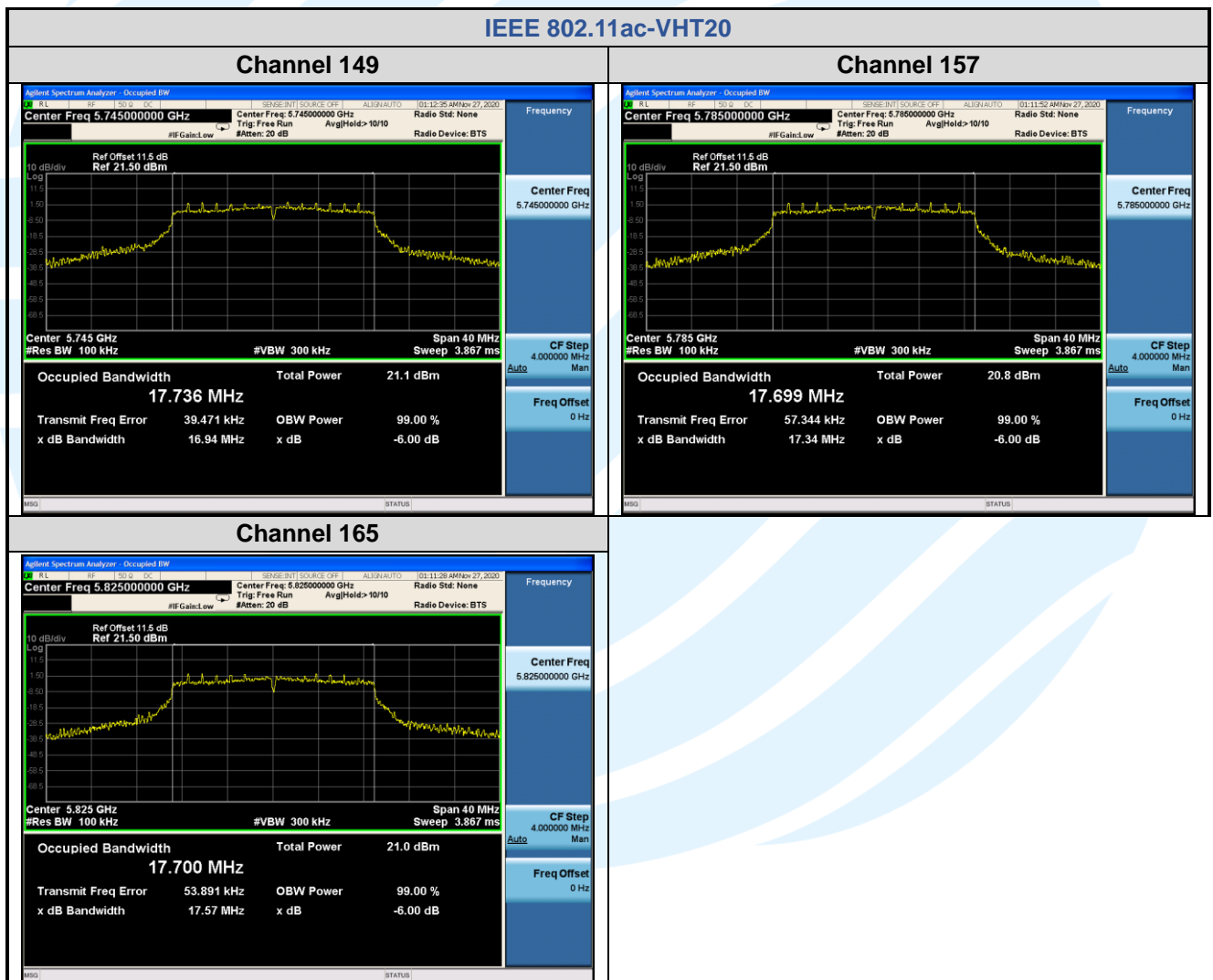
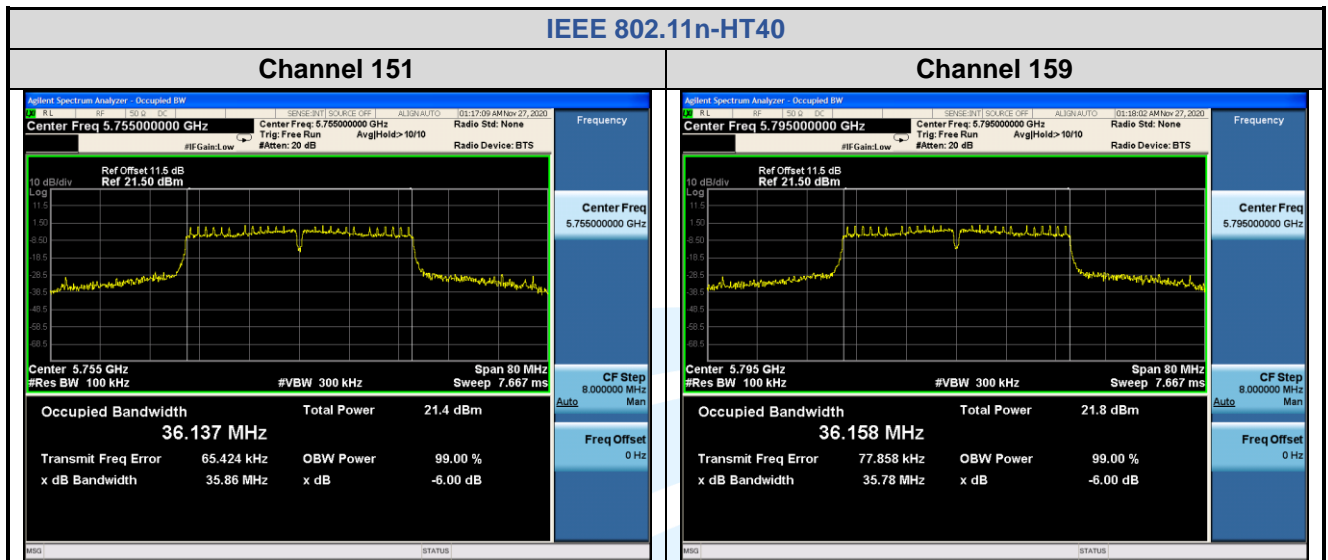
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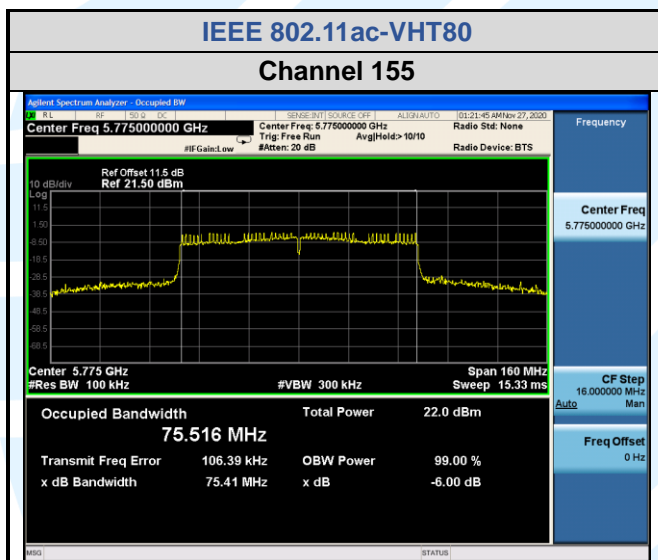
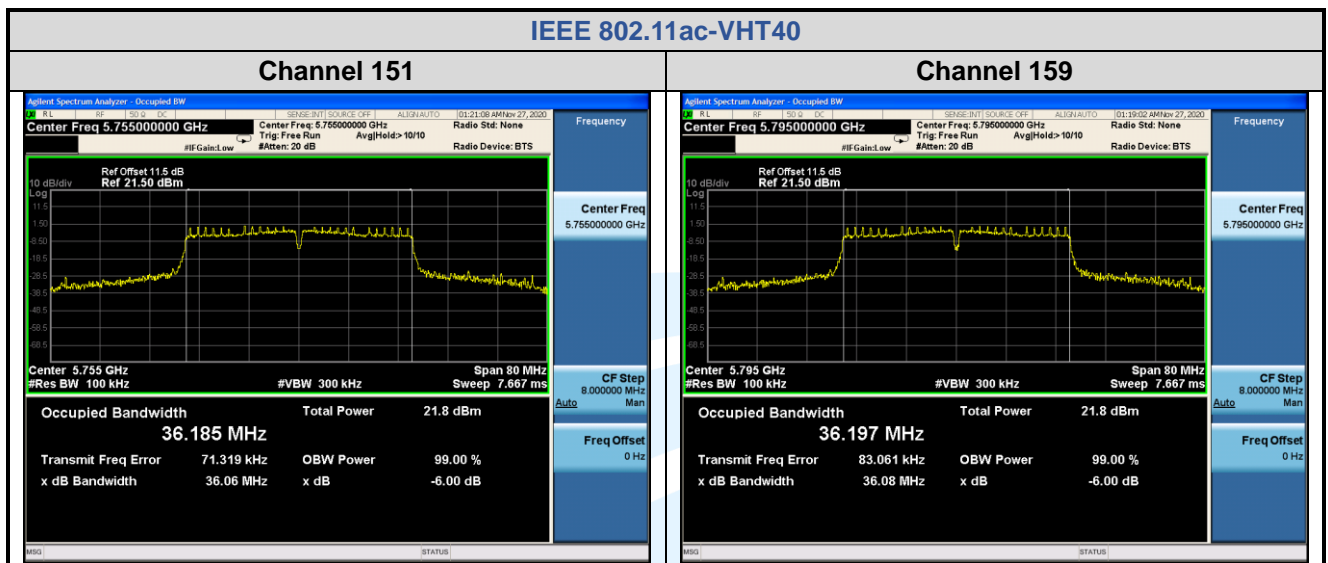
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## 5.5 MAXIMUM CONDUCTED OUTPUT POWER

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)

**Test Method:** KDB 789033 D02 v02r01 Section E.3.a(Method PM)

**Limits:**

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 colocated 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 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. 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.
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. 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 colocated 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:**

**Antenna gain and the maximum output power limit.**

Frequency Band	Antenna Gain (dBi)	Peak Power Limits (dBm)
U-NII-1	0.80	24.00
U-NII-2A	0.60	24.00
U-NII-2C	0.80	24.00
U-NII-3	0.70	30.00

**For U-NII-1 Band:**

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Limit (dBm)	Pass / Fail
		Meas Power	Corr'd Power		
IEEE 802.11a	36 (5180)	13.24	13.47	24	Pass
	44 (5220)	15.50	15.73	24	Pass
	48 (5240)	15.49	15.72	24	Pass
IEEE 802.11n-HT20	36 (5180)	12.84	13.04	24	Pass
	44 (5220)	15.16	15.36	24	Pass
	48 (5240)	15.16	15.36	24	Pass
IEEE 802.11n-HT40	38 (5190)	12.99	13.54	24	Pass
	46 (5230)	15.06	15.61	24	Pass
IEEE 802.11ac-VHT20	36 (5180)	12.88	13.06	24	Pass
	44 (5220)	15.22	15.40	24	Pass
	48 (5240)	15.16	15.34	24	Pass
IEEE 802.11ac-VHT40	38 (5190)	12.95	13.48	24	Pass
	46 (5230)	15.03	15.56	24	Pass
IEEE 802.11ac-VHT80	42 (5210)	11.33	11.90	24	Pass

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

**For U-NII-2A Band:**

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Limit (dBm)	Pass / Fail
		Meas Power	Corr'd Power		
IEEE 802.11a	52 (5260)	15.22	15.45	24	Pass
	60 (5300)	15.30	15.53	24	Pass
	64 (5320)	15.22	15.45	24	Pass
IEEE 802.11n-HT20	52 (5260)	15.11	15.31	24	Pass
	60 (5300)	14.97	15.17	24	Pass
	64 (5320)	14.89	15.09	24	Pass
IEEE 802.11n-HT40	54 (5270)	14.63	15.18	24	Pass
	62 (5310)	12.30	12.85	24	Pass
IEEE 802.11ac-VHT20	52 (5260)	15.11	15.29	24	Pass
	60 (5300)	14.96	15.14	24	Pass
	64 (5320)	14.89	15.07	24	Pass
IEEE 802.11ac-VHT40	54 (5270)	14.67	15.20	24	Pass
	62 (5310)	12.34	12.87	24	Pass
IEEE 802.11ac-VHT80	58 (5290)	11.23	11.80	24	Pass

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

**Note:**

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 27.54MHz

$11 \text{ dBm} + 10\log_{10}(27.54) = 25.40 \text{ dBm} > 24 \text{ dBm} (250\text{mW})$

So the 24 dB limit applicable

**For U-NII-2C Band:**

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Limit (dBm)	Pass / Fail
		Meas Power	Corr'd Power		
IEEE 802.11a	100 (5500)	15.44	15.67	24	Pass
	116 (5580)	15.08	15.31	24	Pass
	140 (5700)	15.23	15.46	24	Pass
IEEE 802.11n-HT20	100 (5500)	15.09	15.29	24	Pass
	116 (5580)	14.76	14.96	24	Pass
	140 (5700)	14.76	14.96	24	Pass
IEEE 802.11n-HT40	102 (5510)	12.47	13.02	24	Pass
	110 (5550)	14.76	15.31	24	Pass
	134 (5670)	14.55	15.10	24	Pass
IEEE 802.11ac-VHT20	100 (5500)	15.07	15.25	24	Pass
	116 (5580)	14.76	14.94	24	Pass
	140 (5700)	14.83	15.01	24	Pass
IEEE 802.11ac-VHT40	102 (5510)	12.47	13.00	24	Pass
	110 (5550)	14.72	15.25	24	Pass
	134 (5670)	14.51	15.04	24	Pass
IEEE 802.11ac-VHT80	106 (5530)	11.34	11.91	24	Pass
	122 (5610)	14.15	14.72	24	Pass

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

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**Note:**

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 25.27 MHz

$11 \text{ dBm} + 10\log_{10}(25.27) = 25.03 \text{ dBm} > 24 \text{ dBm} (250\text{mW})$

So the 24 dB limit applicable

**For U-NII-3 Band:**

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Limit (dBm)	Pass / Fail
		Meas Power	Corr'd Power		
IEEE 802.11a	149 (5745)	12.69	12.92	30	Pass
	157 (5785)	12.54	12.77	30	Pass
	165 (5825)	12.95	13.18	30	Pass
IEEE 802.11n-HT20	149 (5745)	12.19	12.39	30	Pass
	157 (5785)	12.10	12.30	30	Pass
	165 (5825)	12.41	12.61	30	Pass
IEEE 802.11n-HT40	151 (5755)	11.85	12.40	30	Pass
	159 (5795)	11.95	12.50	30	Pass
IEEE 802.11ac-VHT20	149 (5745)	12.22	12.40	30	Pass
	157 (5785)	12.11	12.29	30	Pass
	165 (5825)	12.38	12.56	30	Pass
IEEE 802.11ac-VHT40	151 (5755)	11.80	12.33	30	Pass
	159 (5795)	11.87	12.40	30	Pass
IEEE 802.11ac-VHT80	155 (5775)	11.68	12.25	30	Pass

**Remark:**

1. Corr'd Power = Meas Power + Duty Cycle Factor

## 5.6 PEAK POWER SPECTRAL DENSITY

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)

**Test Method:** KDB 789033 D02 v02r01 Section F

**Limits:**

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 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. 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.
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. 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  $\geq$  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  $\geq$  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:**

**Antenna gain and the maximum output power limit.**

Frequency Band	Antenna Gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	0.80	11.00
U-NII-2A	0.60	11.00
U-NII-2C	0.80	11.00
U-NII-3	0.70	30.00

**For U-NII-1 Band:**

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Limit (dBm/MHz)	Pass / Fail
		Meas PSD	Corr'd PSD		
IEEE 802.11a	36 (5180)	1.986	2.786	11	Pass
	44 (5220)	4.084	4.884	11	Pass
	48 (5240)	4.482	5.282	11	Pass
IEEE 802.11n-HT20	36 (5180)	1.083	1.883	11	Pass
	44 (5220)	3.515	4.315	11	Pass
	48 (5240)	4.435	5.235	11	Pass
IEEE 802.11n-HT40	38 (5190)	-1.948	-1.148	11	Pass
	46 (5230)	0.698	1.498	11	Pass
IEEE 802.11ac-VHT20	36 (5180)	1.042	1.842	11	Pass
	44 (5220)	3.616	4.416	11	Pass
	48 (5240)	3.979	4.779	11	Pass
IEEE 802.11ac-VHT40	38 (5190)	-1.553	-0.753	11	Pass
	46 (5230)	0.571	1.371	11	Pass
IEEE 802.11ac-VHT80	42 (5210)	-5.981	-5.181	11	Pass

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**For U-NII-2A Band:**

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Limit (dBm/MHz)	Pass / Fail
		Meas PSD	Meas PSD		
IEEE 802.11a	52 (5260)	4.450	5.050	11	Pass
	60 (5300)	3.922	4.522	11	Pass
	64 (5320)	4.400	5.000	11	Pass
IEEE 802.11n-HT20	52 (5260)	4.161	4.761	11	Pass
	60 (5300)	3.391	3.991	11	Pass
	64 (5320)	3.775	4.375	11	Pass
IEEE 802.11n-HT40	54 (5270)	0.258	0.858	11	Pass
	62 (5310)	-1.805	-1.205	11	Pass
IEEE 802.11ac-VHT20	52 (5260)	3.802	4.402	11	Pass
	60 (5300)	3.735	4.335	11	Pass
	64 (5320)	3.566	4.166	11	Pass
IEEE 802.11ac-VHT40	54 (5270)	0.563	1.163	11	Pass
	62 (5310)	-1.700	-1.100	11	Pass
IEEE 802.11ac-VHT80	58 (5290)	-5.417	-4.817	11	Pass

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

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**For U-NII-2C Band:**

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Limit (dBm/MHz)	Pass / Fail
		Meas PSD	Meas PSD		
IEEE 802.11a	100 (5500)	3.955	4.755	11	Pass
	116 (5580)	3.493	4.293	11	Pass
	140 (5700)	4.140	4.940	11	Pass
IEEE 802.11n-HT20	100 (5500)	3.498	4.298	11	Pass
	116 (5580)	3.390	4.190	11	Pass
	140 (5700)	3.327	4.127	11	Pass
IEEE 802.11n-HT40	102 (5510)	-1.797	-0.997	11	Pass
	110 (5550)	0.299	1.099	11	Pass
	134 (5670)	0.341	1.141	11	Pass
IEEE 802.11ac-VHT20	100 (5500)	3.411	4.211	11	Pass
	116 (5580)	3.032	3.832	11	Pass
	140 (5700)	3.532	4.332	11	Pass
IEEE 802.11ac-VHT40	102 (5510)	-1.957	-1.157	11	Pass
	110 (5550)	-0.090	0.710	11	Pass
	134 (5670)	0.009	0.809	11	Pass
IEEE 802.11ac-VHT80	106 (5530)	-6.251	-5.451	11	Pass
	122 (5610)	-2.883	-2.083	11	Pass

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

**For U-NII-3 Band:**

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/500KHz)		Limit (dBm/500KHz)	Pass / Fail
		Meas PSD	Meas PSD		
IEEE 802.11a	149 (5745)	0.797	1.497	30	Pass
	157 (5785)	1.401	2.101	30	Pass
	165 (5825)	1.524	2.224	30	Pass
IEEE 802.11n-HT20	149 (5745)	0.233	0.933	30	Pass
	157 (5785)	0.478	1.178	30	Pass
	165 (5825)	0.876	1.576	30	Pass
IEEE 802.11n-HT40	151 (5755)	-3.184	-2.484	30	Pass
	159 (5795)	-2.943	-2.243	30	Pass
IEEE 802.11ac-VHT20	149 (5745)	0.320	1.020	30	Pass
	157 (5785)	0.504	1.204	30	Pass
	165 (5825)	0.639	1.339	30	Pass
IEEE 802.11ac-VHT40	151 (5755)	-2.824	-2.124	30	Pass
	159 (5795)	-2.850	-2.150	30	Pass
IEEE 802.11ac-VHT80	155 (5775)	-5.729	-5.029	30	Pass

**Remark:**

1. Corr'd PSD = Meas PSD + Duty Cycle Factor

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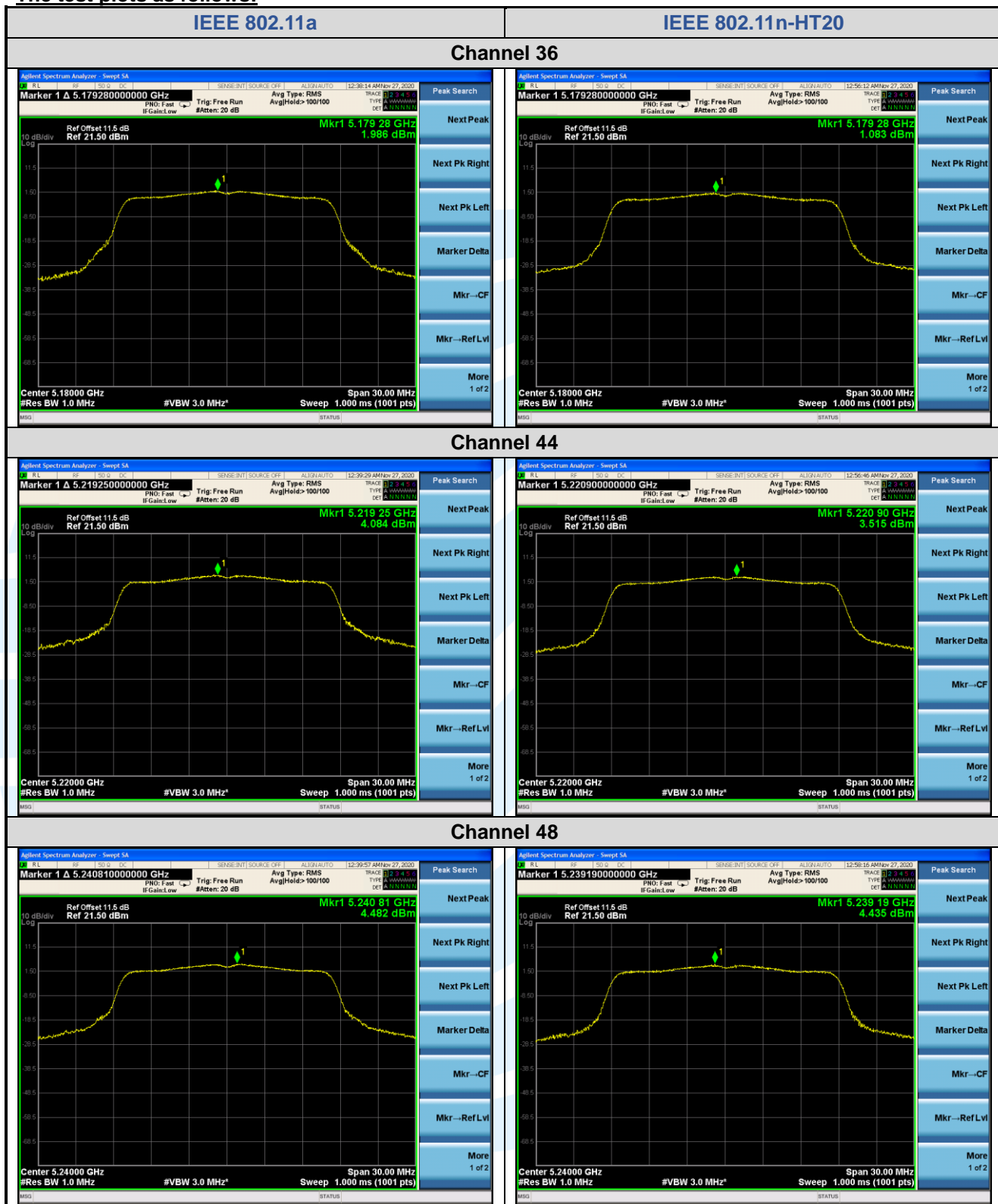
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The test plots as follows:



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