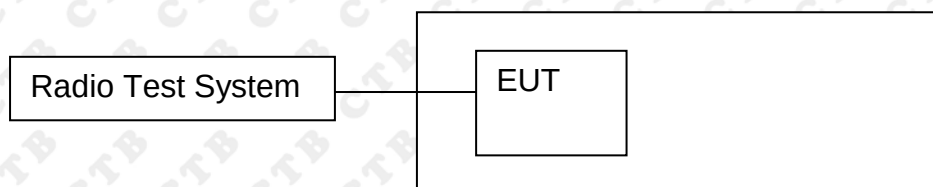


9. CONDUCTED OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 Limit

(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 mobile and portable 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.

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(5) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a

bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(h) Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS).

(1) Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

9.3 Test procedure

According to KDB789033 D02v02r01 sectionE, the following is the measurement procedure.

(i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(ii) Set RBW = 1 MHz.

(iii) Set VBW $\geq$ 3 MHz.

(iv) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This ensures that bin-to-bin spacing is $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)

(v) Sweep time = auto.

(vi) Detector = power averaging (rms), if available. Otherwise, use sample detector mode.

(vii) If transmit duty cycle $< 98\%$, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle $\geq 98\%$, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."

(viii) Trace average at least 100 traces in power averaging (rms) mode.

(ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

9.4 Test Result

ANT 1+ANT 2

Test mode1	Test Channel (MHz)	Output Power dBm ANT1	Output Power dBm ANT2	Output Power dBm Total	Limit dBm
802.11a	5180	14.187	14.753	/	23.98
	5200	14.527	14.698	/	23.98
	5240	14.845	15.247	/	23.98
802.11ac(VHT20)	5180	14.176	14.659	17.435	23.98
	5200	14.405	14.731	17.581	23.98
	5240	14.745	15.104	17.939	23.98
802.11ac(VHT40)	5190	14.219	14.738	17.497	23.98
	5230	14.819	15.237	18.043	23.98
802.11ac(VHT80)	5210	14.443	14.861	17.667	23.98
802.11n(HT20)	5180	14.198	14.608	17.418	23.98
	5200	14.356	14.622	17.501	23.98
	5240	14.818	15.142	17.993	23.98
802.11n(HT40)	5190	14.246	14.777	17.530	23.98
	5230	14.823	15.25	18.052	23.98
802.11ax(HE20)	5180	14.645	15.003	17.838	23.98
	5200	14.728	15.093	17.925	23.98
	5240	15.164	15.561	18.377	23.98
802.11ax(HE40)	5190	14.653	15.123	17.905	23.98
	5230	15.23	15.649	18.455	23.98
802.11ax(HE80)	5210	14.724	15.222	17.990	23.98

ANT 1+ANT 2

Test mode1	Test Channel (MHz)	Output Power dBm ANT1	Output Power dBm ANT2	Output Power dBm Total	Limit dBm
802.11a	5745	12.657	13.565	/	30
	5785	13.116	13.738	/	30
	5825	13.87	14.56	/	30
802.11ac(VHT20)	5745	12.754	12.836	15.805	30
	5785	13.041	13.013	16.037	30
	5825	13.728	13.871	16.810	30
802.11ac(VHT40)	5755	12.777	13.47	16.148	30
	5795	13.204	13.919	16.586	30
802.11ac(VHT80)	5775	12.775	13.356	16.086	30
802.11n(HT20)	5745	12.75	13.558	16.183	30
	5785	13.09	13.743	16.439	30
	5825	13.783	14.528	17.182	30
802.11n(HT40)	5755	12.798	13.469	16.157	30
	5795	13.288	13.945	16.639	30
802.11ax(HE20)	5745	13.09	13.88	16.513	30
	5785	13.496	14.124	16.832	30
	5825	14.106	14.767	17.459	30
802.11ax(HE40)	5755	13.188	13.885	16.561	30
	5795	13.661	15.772	17.854	30
802.11ax(HE80)	5775	13.083	13.74	16.434	30

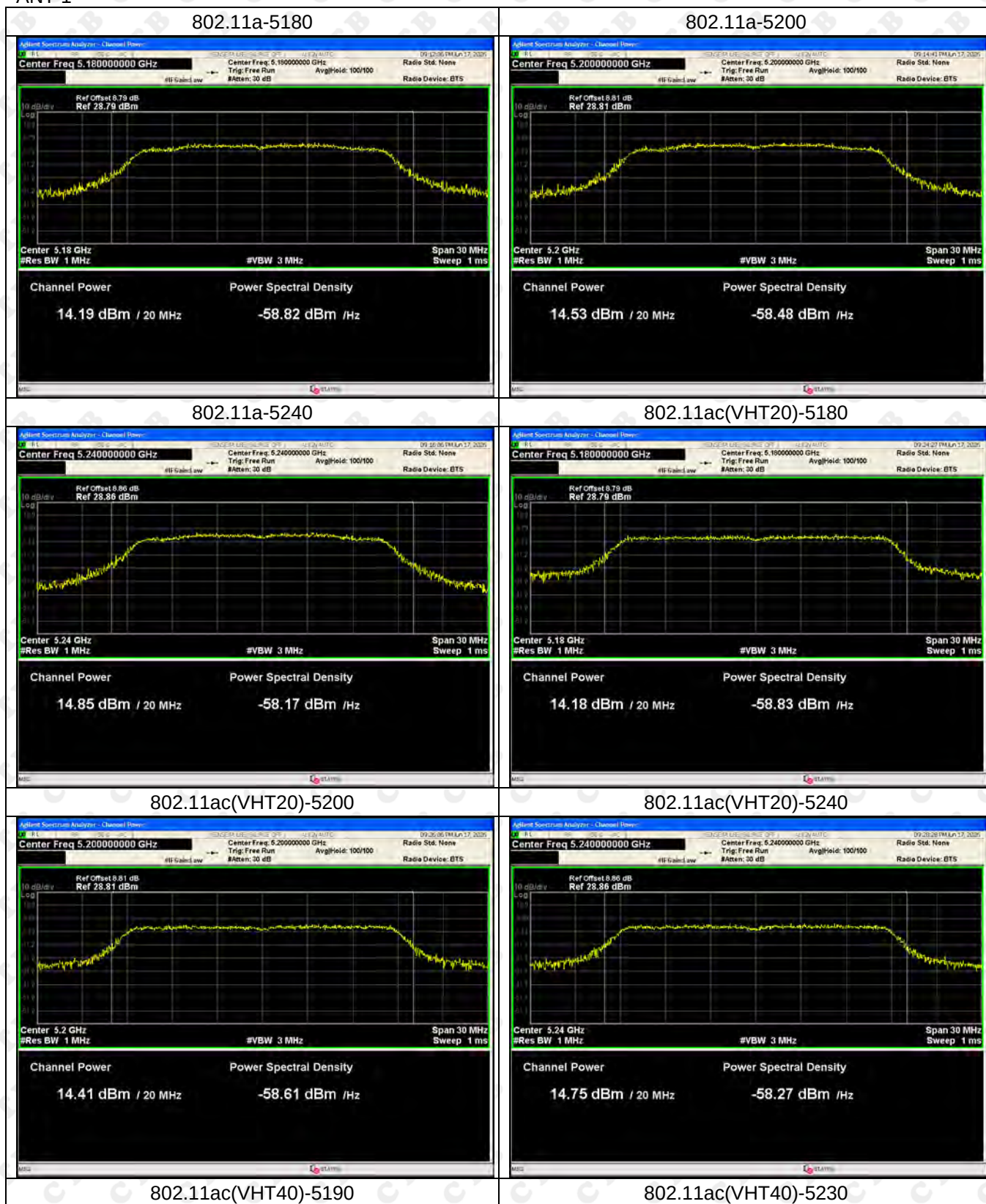
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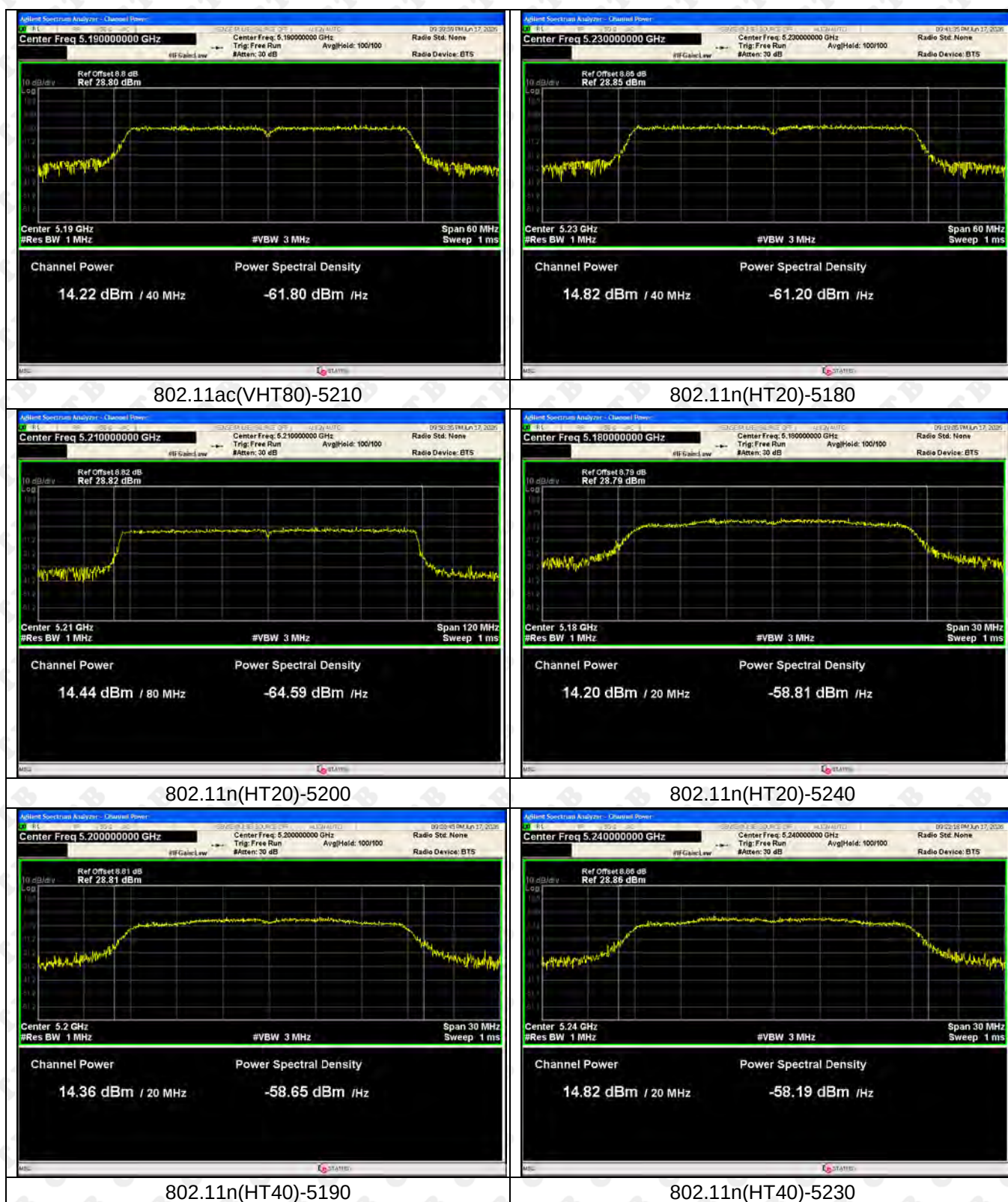
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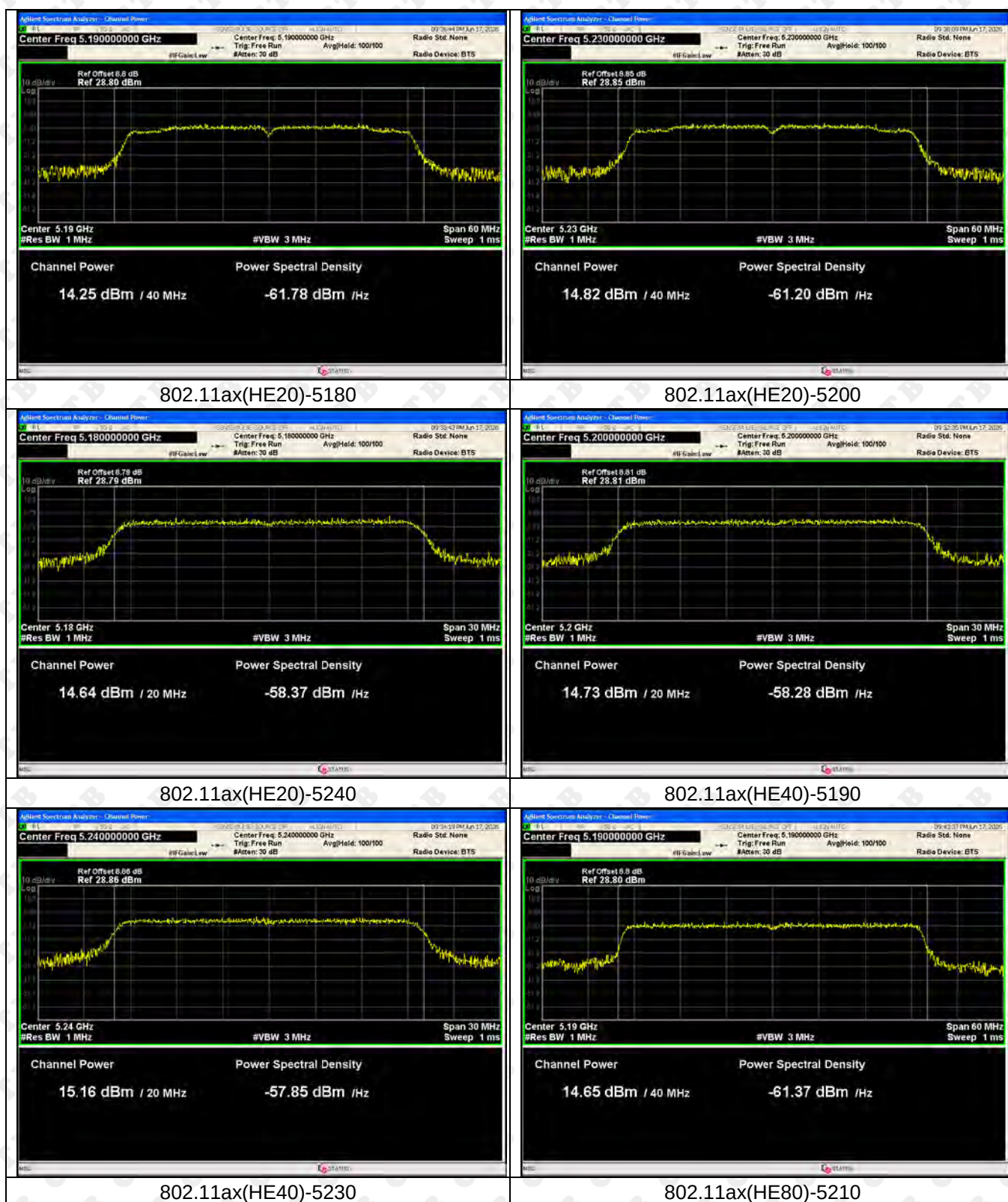
	Test Channel (MHz)	On time(ms)	Period (ms)	Duty Cycle(%)
802.11a	5180	100	100	100
	5200	100	100	100
	5240	100	100	100
802.11ac20	5180	100	100	100
	5200	100	100	100
	5240	100	100	100
802.11ac40	5190	100	100	100
	5230	100	100	100
802.11ac80	5210	100	100	100
802.11n(HT20)	5180	100	100	100
	5200	100	100	100
	5240	100	100	100
802.11n(HT40)	5190	100	100	100
	5230	100	100	100
802.11ax(HE20)	5180	100	100	100
	5200	100	100	100
	5240	100	100	100
802.11ax(HE40)	5190	100	100	100
	5230	100	100	100
802.11ax(HE80)	5210	100	100	100

Test mode1	Test Channel (MHz)	On time(ms)	Period (ms)	Duty Cycle(%)
802.11a	5745	100	100	100
	5785	100	100	100
	5825	100	100	100
802.11ac20	5745	100	100	100
	5785	100	100	100
	5825	100	100	100
802.11ac40	5755	100	100	100
	5795	100	100	100
802.11ac80	5775	100	100	100
802.11n(HT20)	5745	100	100	100
	5785	100	100	100
	5825	100	100	100
802.11n(HT40)	5755	100	100	100
	5795	100	100	100
802.11ax(HE20)	5745	100	100	100
	5785	100	100	100
	5825	100	100	100
802.11ax(HE40)	5755	100	100	100
	5795	100	100	100
802.11ax(HE80)	5775	100	100	100

ANT 1



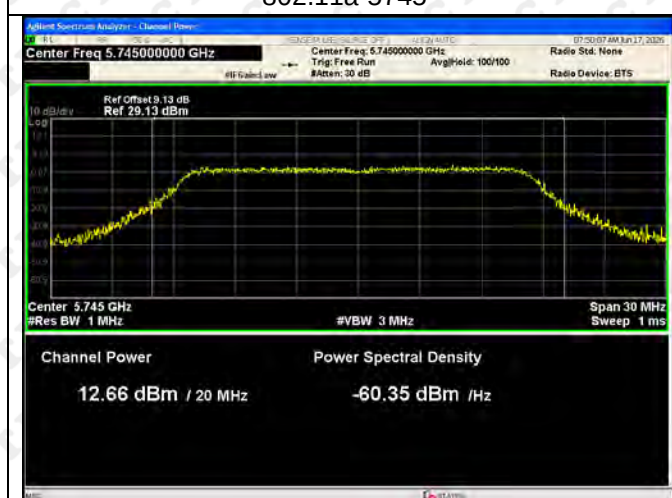




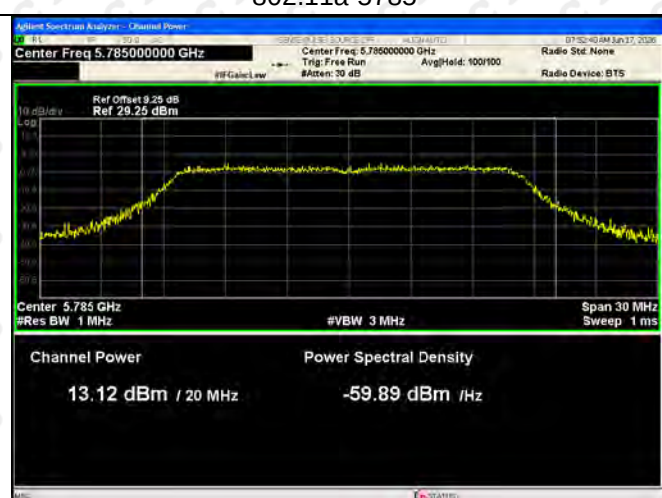


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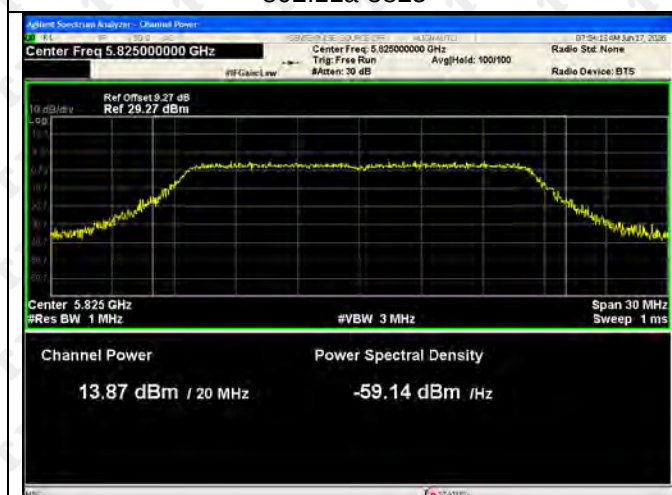
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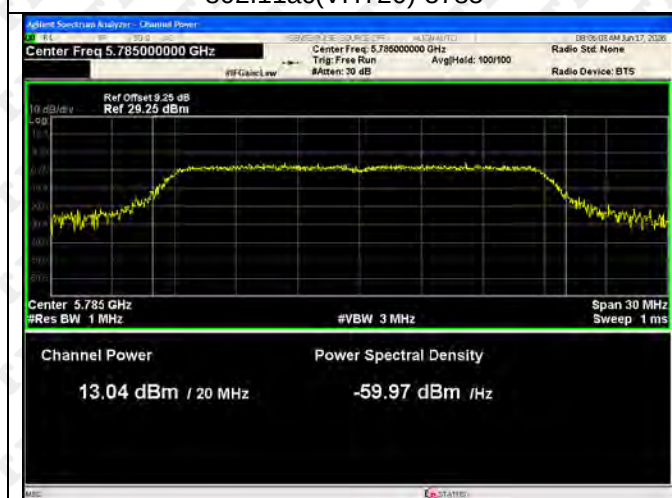
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802.11ac(VHT20)-5745



802.11ac(VHT20)-5785



802.11ac(VHT20)-5825

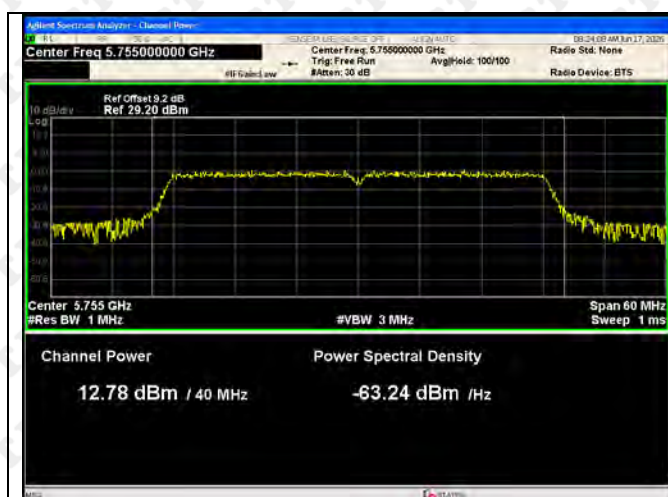


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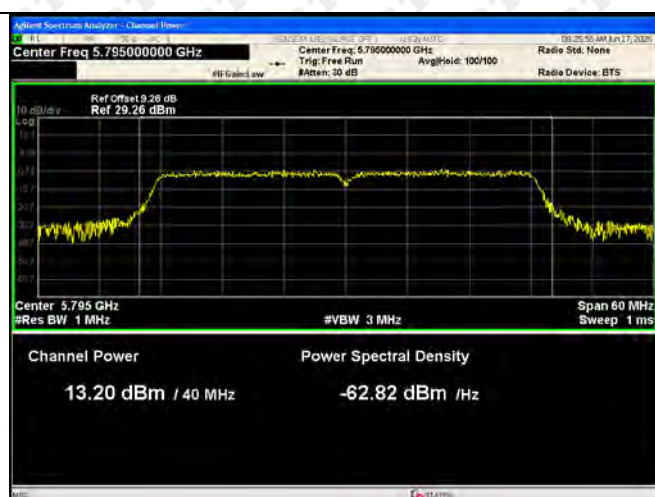


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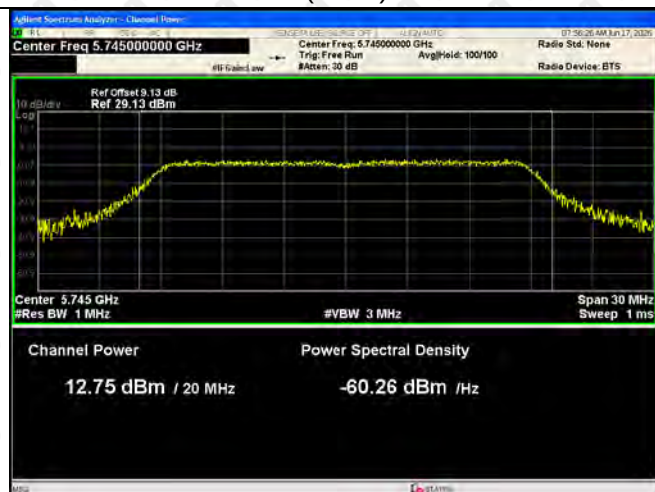
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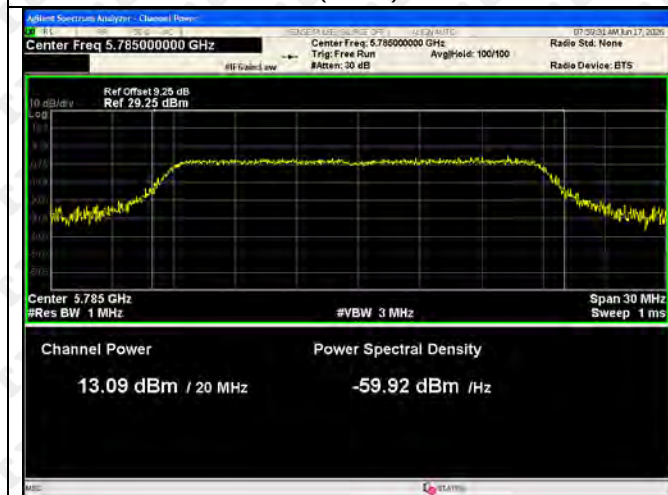
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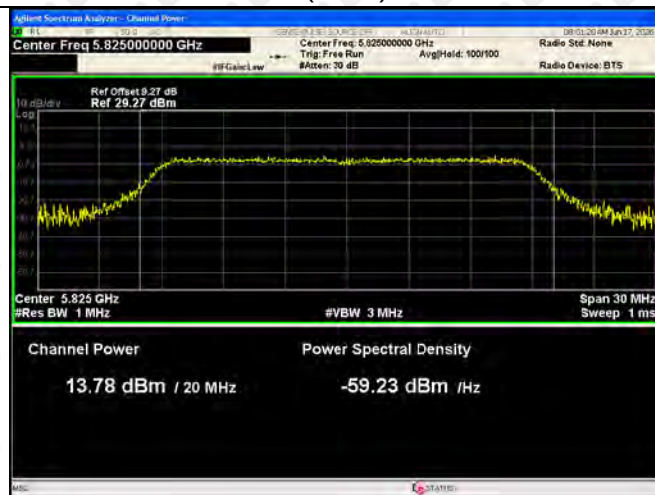
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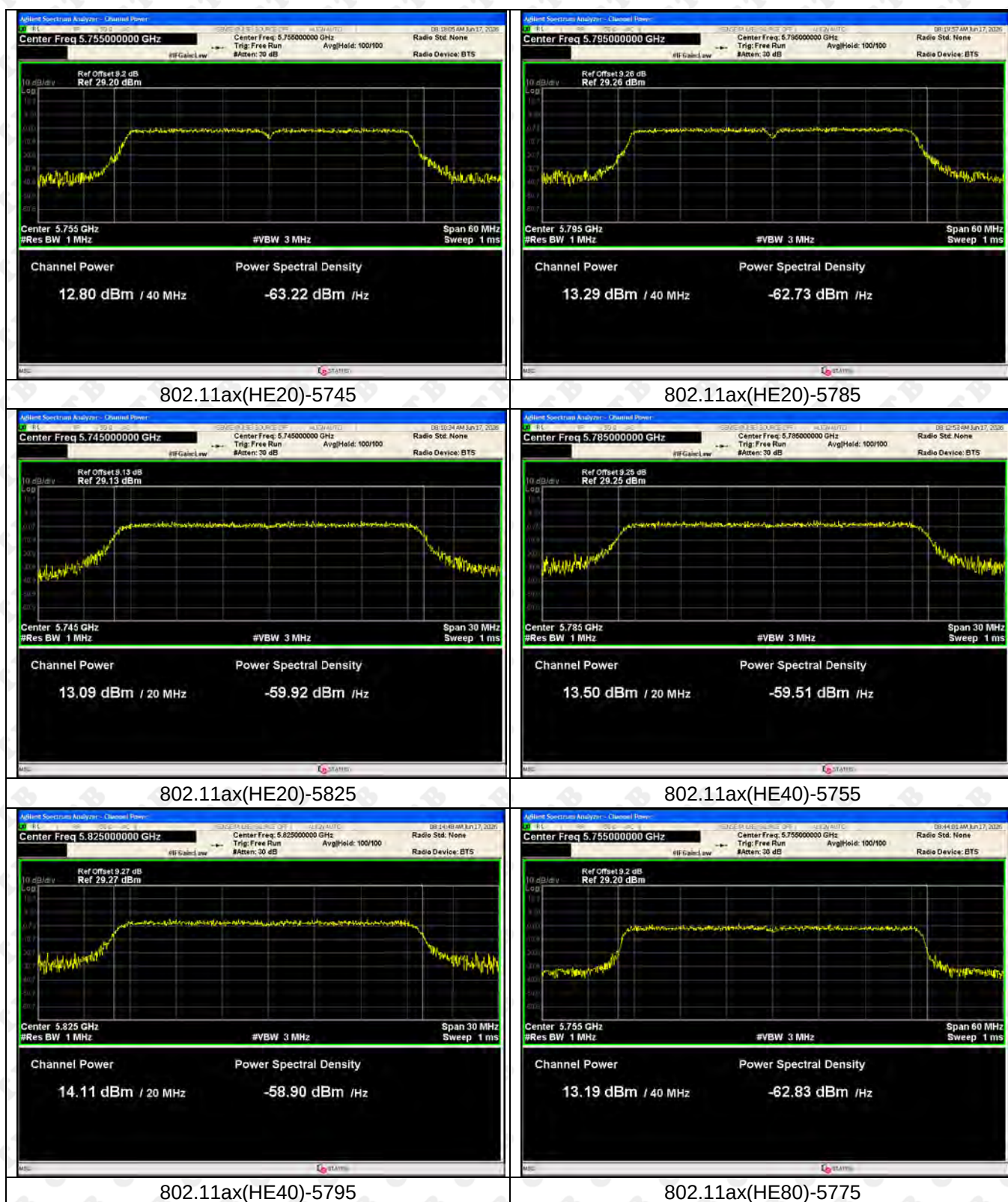
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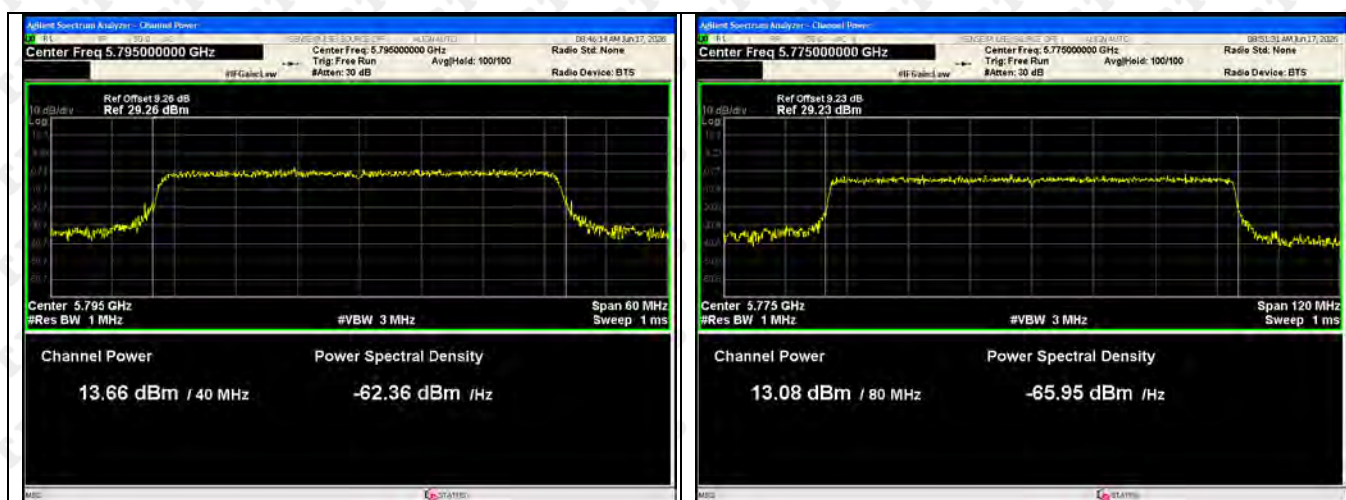


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802.11n(HT40)-5795





ANT 2

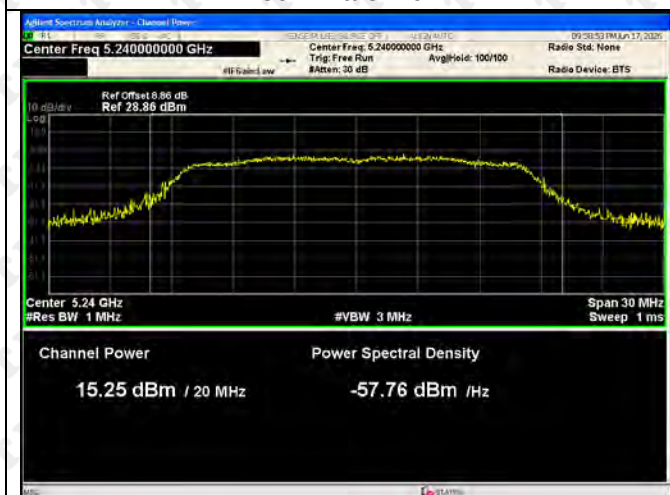
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802.11a-5200



802.11a-5240



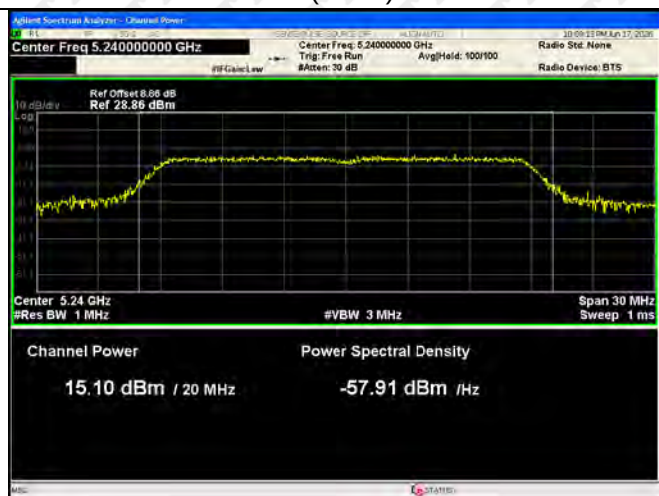
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802.11ac(VHT20)-5200

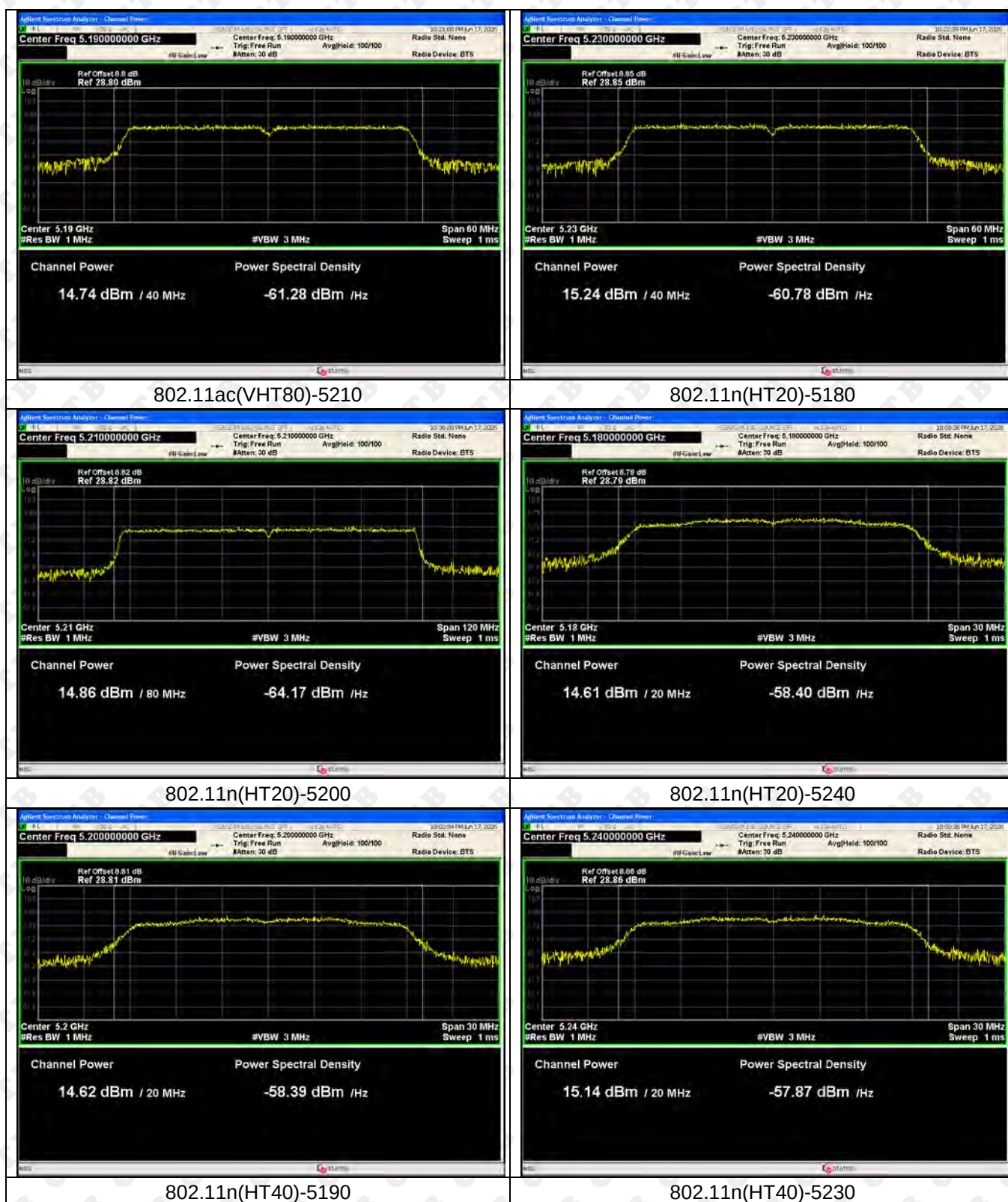


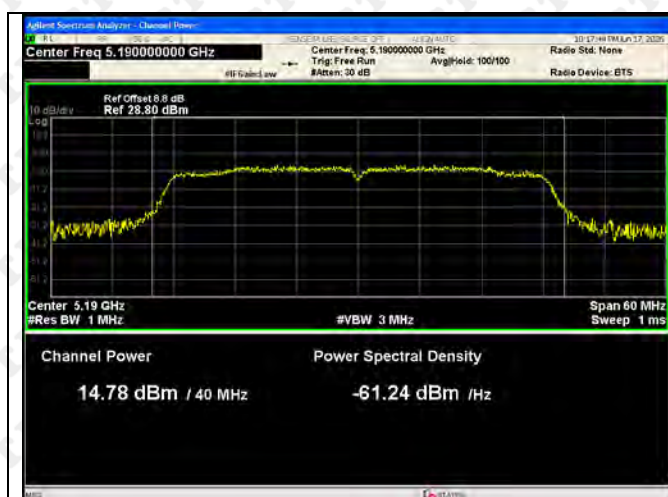
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802.11ac(VHT40)-5190

802.11ac(VH40)-5230

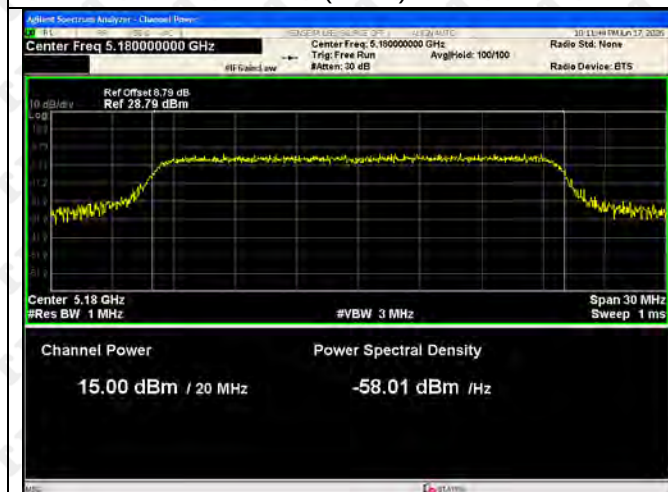




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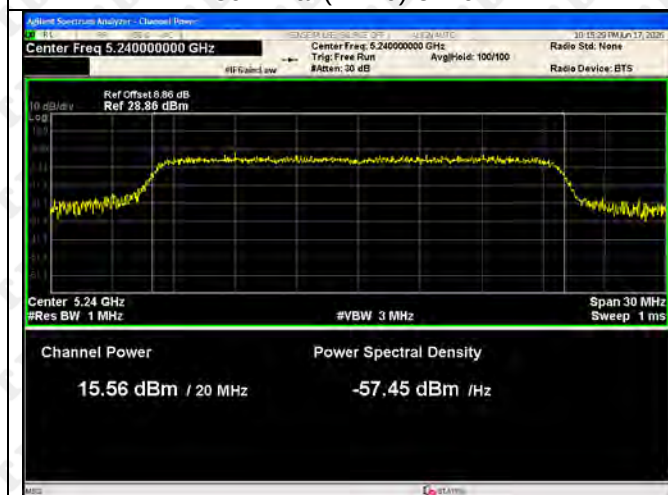
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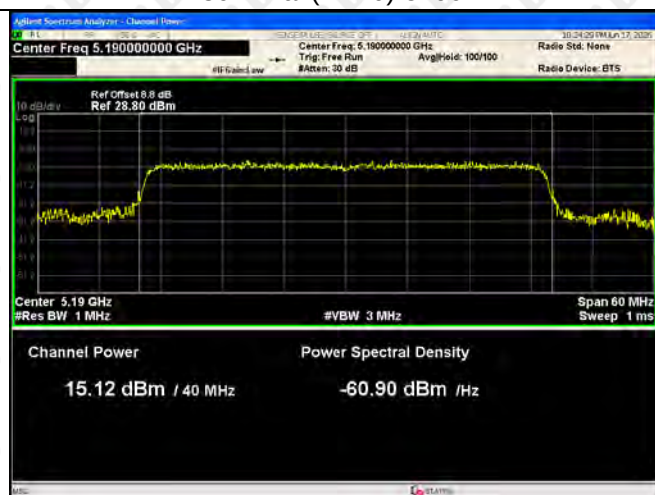
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802.11ax(HE40)-5190



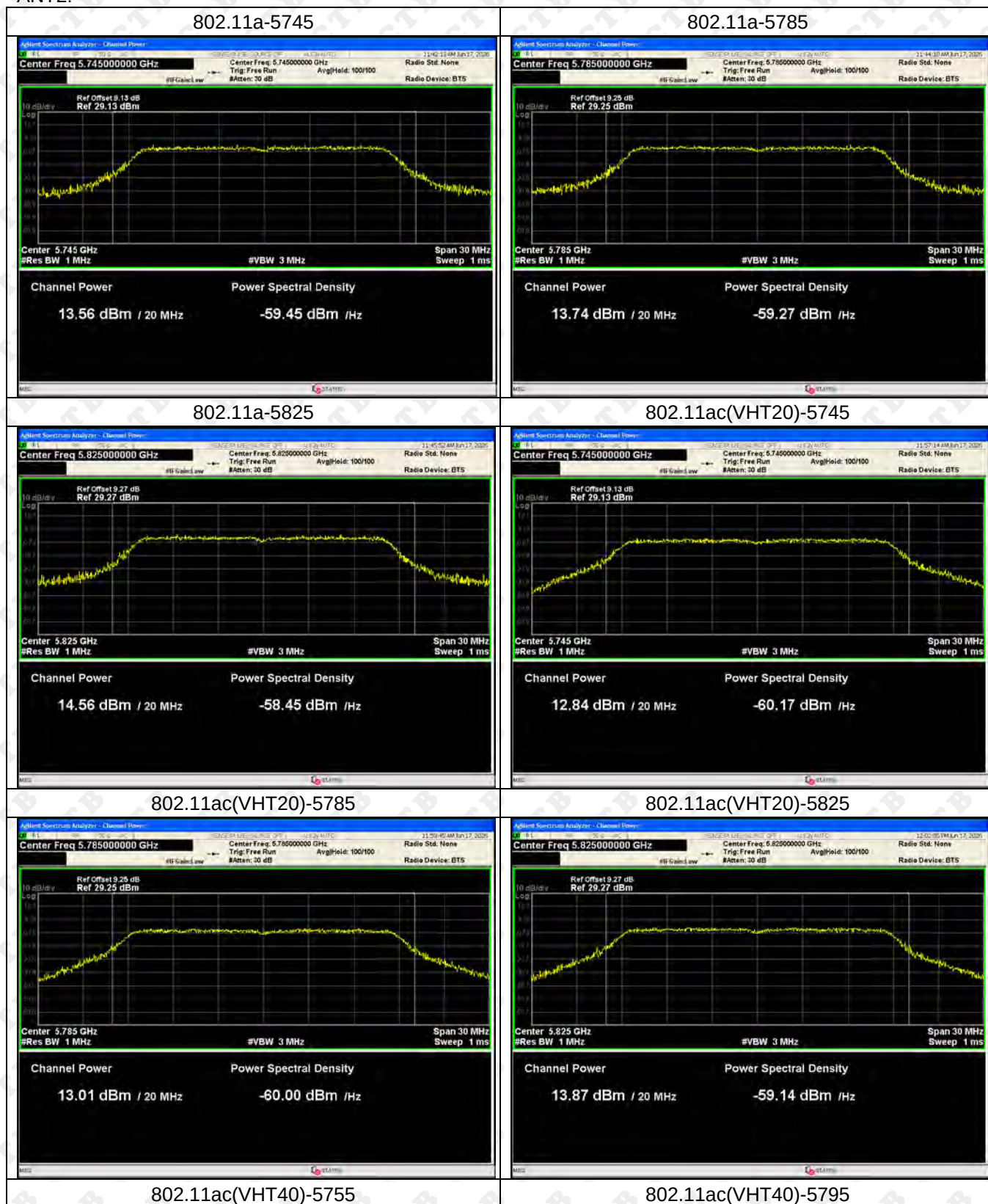
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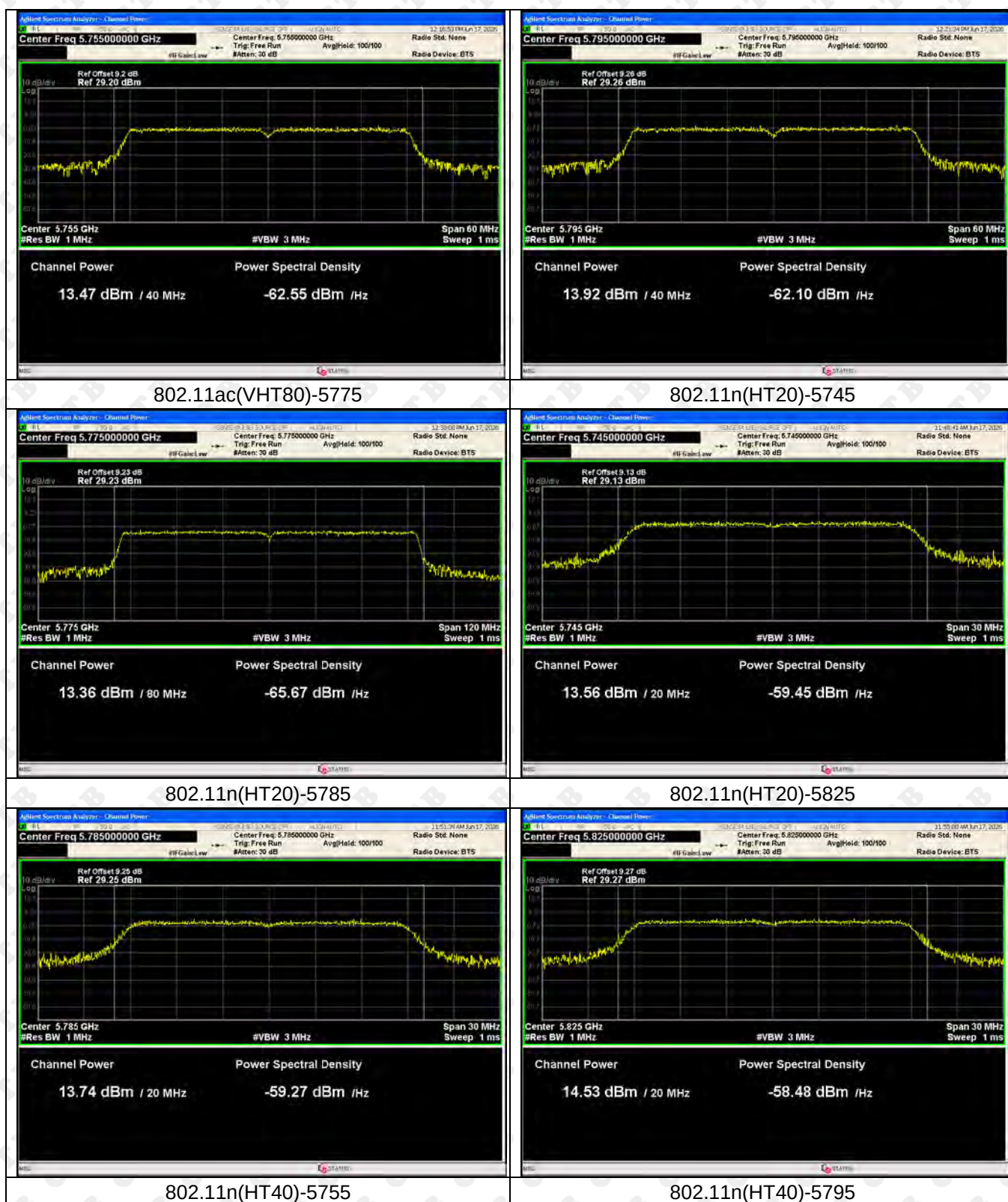


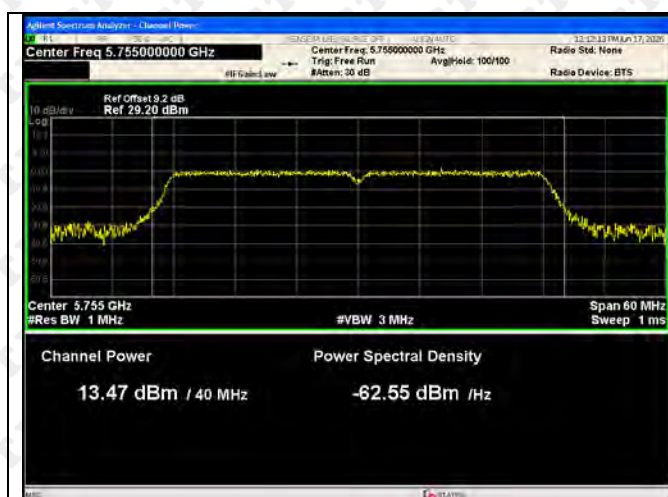
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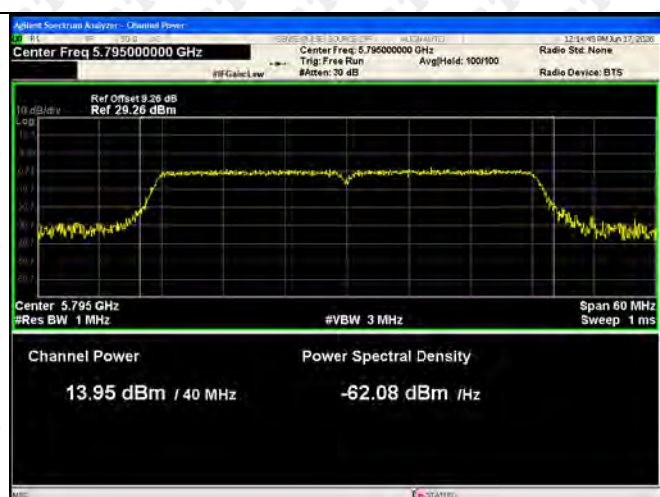
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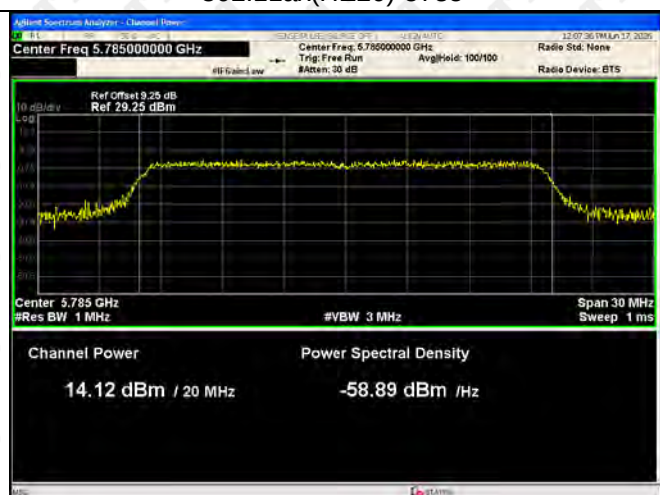
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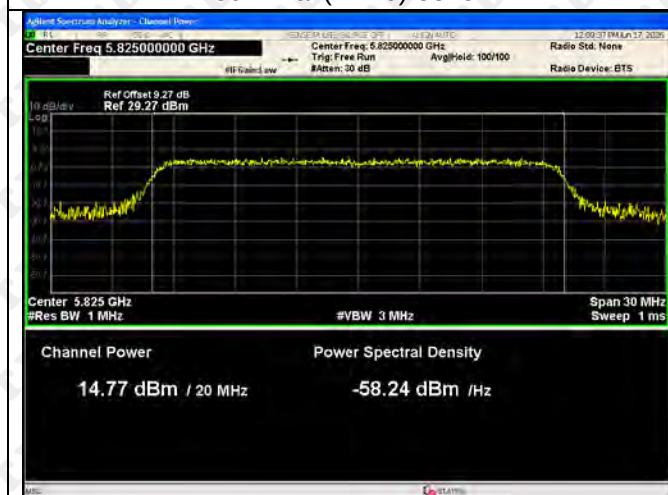
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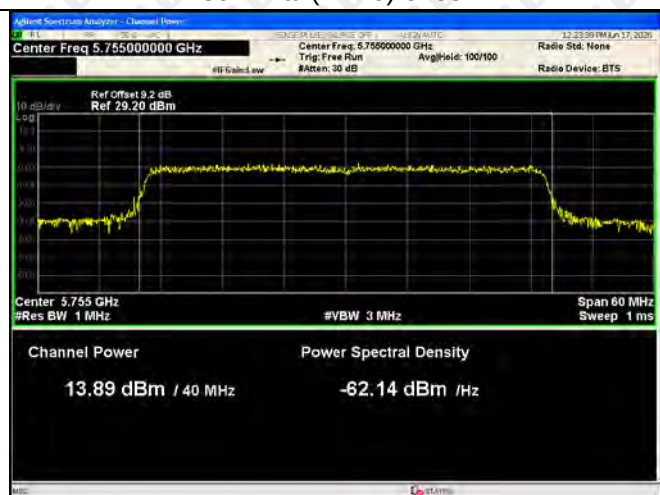
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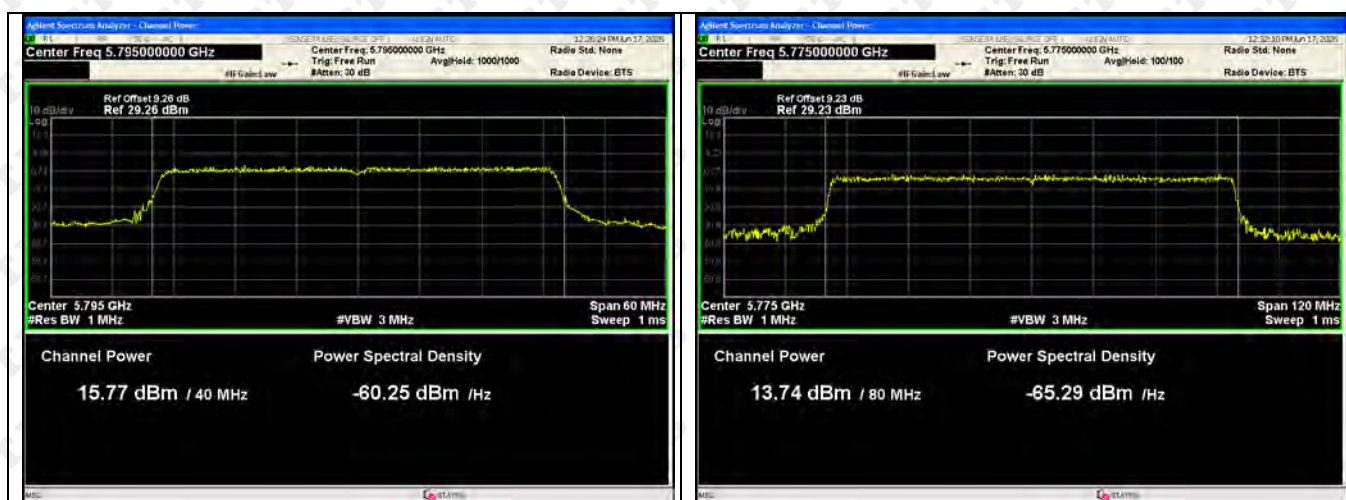
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802.11ax(HE40)-5795



802.11ax(HE80)-5775

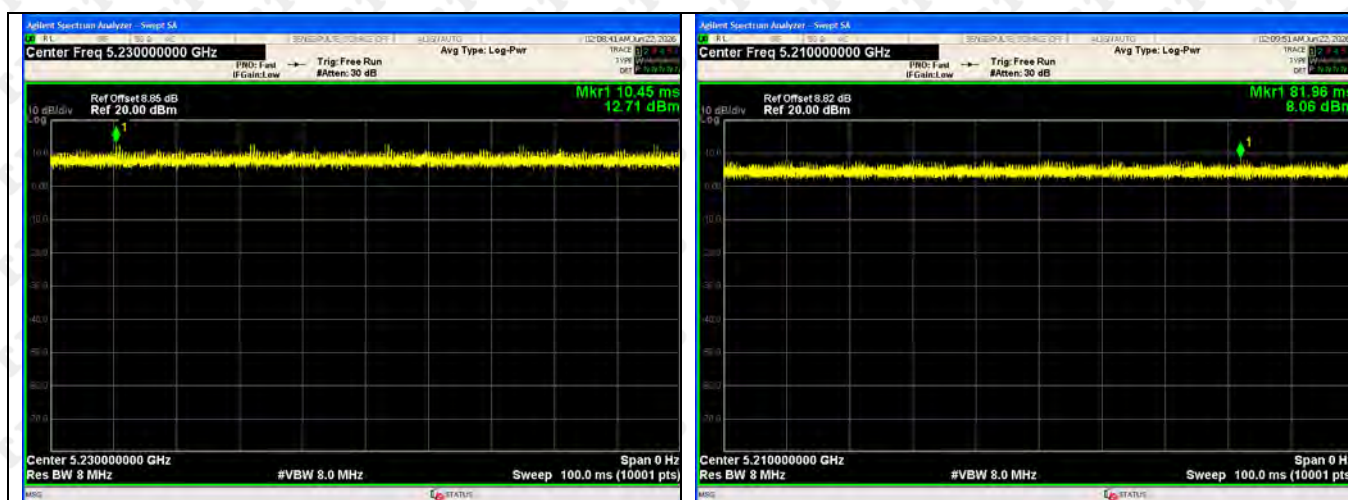


Duty cycle ANT1:









Duty cycle ANT1:









Duty cycle ANT2:









Duty cycle ANT2:



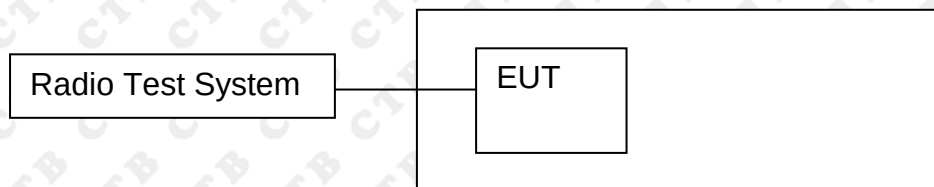






10. EMISSION BANDWIDTH& OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limits

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable 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 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.

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

10.3 Test Procedure

According to KDB789033 D02v02r01 sectionE, the following is the measurement procedure.

1. Emission Bandwidth (EBW)

- Set RBW = approximately 1% of the emission bandwidth.
- Set the VBW > RBW.
- Detector = Peak.
- Trace mode = max hold.
- Measure the maximum width of the emission that is 26 dB down from the maximum 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. Minimum Emission Bandwidth for the band 5.725–5.85 GHz

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725–5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- Set RBW = 100 kHz.
- 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 automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described in this section. For devices that use channel aggregation refer to III.A and III.C for determining emission bandwidth.

D. 99% Occupied Bandwidth

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. Measurement of the 99% occupied bandwidth is *required* only as a condition for using the optional band-edge measurement techniques described in II.G.3.d). Measurements of 99% occupied bandwidth may also optionally be used in lieu of the EBW to define the minimum frequency range over which the 789033 D02 General UNII Test Procedures New Rules v02r01 Page 4 spectrum is integrated when measuring maximum conducted output power as described in II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with Section 15.407(a).

The following procedure shall be used for measuring (99%) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW $\geq 3 * RBW$
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99% power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

10.4 Test Results

5150-5250MHz

Test mode Ant 1	Test Channel (MHz)	26dB Bandwidth (MHz)
802.11a	5180	20.179
	5200	19.547
	5240	20.149
802.11ac(VHT20)	5180	21.453
	5200	23.111
	5240	21.547
802.11ac(VHT40)	5190	40.426
	5230	40.719
802.11ac(VHT80)	5210	80.984
802.11n(HT20)	5180	20.507
	5200	20.506
	5240	21.001
802.11n(HT40)	5190	38.862
	5230	39.088
802.11ax(HE20)	5180	25.475
	5200	21.25
	5240	21.472
802.11ax(HE40)	5190	40.987
	5230	40.545
802.11ax(HE80)	5210	80.334

Test mode Ant 2	Test Channel (MHz)	26dB Bandwidth (MHz)
802.11a	5180	19.954
	5200	19.592
	5240	19.193
802.11ac(VHT20)	5180	21.828
	5200	23.414
	5240	25.233
802.11ac(VHT40)	5190	40.834
	5230	40.669
802.11ac(VHT80)	5210	82.648
802.11n(HT20)	5180	20.535
	5200	20.926
	5240	21.675
802.11n(HT40)	5190	39.01
	5230	39.143
802.11ax(HE20)	5180	21.578
	5200	21.958
	5240	21.941
802.11ax(HE40)	5190	40.325
	5230	40.272
802.11ax(HE80)	5210	80.908

5725-5850 MHz

Test mode Ant 1	Test Channel (MHz)	6dB Bandwidth (MHz)	Result
802.11a	5745	16.506	Pass
	5785	16.484	Pass
	5825	16.447	Pass
802.11ac(VHT20)	5745	17.667	Pass
	5785	17.695	Pass
	5825	17.693	Pass
802.11ac(VHT40)	5755	36.48	Pass
	5795	36.46	Pass
802.11ac(VHT80)	5775	76.359	Pass
802.11n(HT20)	5745	17.739	Pass
	5785	17.747	Pass
	5825	17.672	Pass
802.11n(HT40)	5755	36.475	Pass
	5795	36.464	Result
802.11ax(HE20)	5745	18.908	Pass
	5785	18.996	Pass
	5825	18.998	Pass
802.11ax(HE40)	5755	38.085	Pass
	5795	38.12	Pass
802.11ax(HE80)	5775	78.016	Pass

Test mode Ant 2	Test Channel (MHz)	6dB Bandwidth (MHz)	Result
802.11a	5745	16.447	Pass
	5785	16.49	Pass
	5825	16.483	Pass
802.11ac(VHT20)	5745	17.568	Pass
	5785	17.552	Pass
	5825	17.574	Pass
802.11ac(VHT40)	5755	36.453	Pass
	5795	36.446	Pass
802.11ac(VHT80)	5775	76.48	Pass
802.11n(HT20)	5745	17.739	Pass
	5785	17.75	Pass
	5825	17.712	Pass
802.11n(HT40)	5755	36.484	Pass
	5795	36.475	Result
802.11ax(HE20)	5745	18.977	Pass
	5785	19.007	Pass
	5825	18.873	Pass
802.11ax(HE40)	5755	38.098	Pass
	5795	37.958	Pass
802.11ax(HE80)	5775	77.973	Pass

Test Graph 5150MHz ~5250MHz

ANT 1:





802.11ac(VHT80)-5210



802.11n(HT20)-5180



802.11n(HT20)-5200



802.11n(HT20)-5240



802.11n(HT40)-5190



802.11n(HT40)-5230



802.11ax(HE20)-5180



802.11ax(HE20)-5200



802.11ax(HE20)-5240



802.11ax(HE40)-5190



802.11ax(HE40)-5230

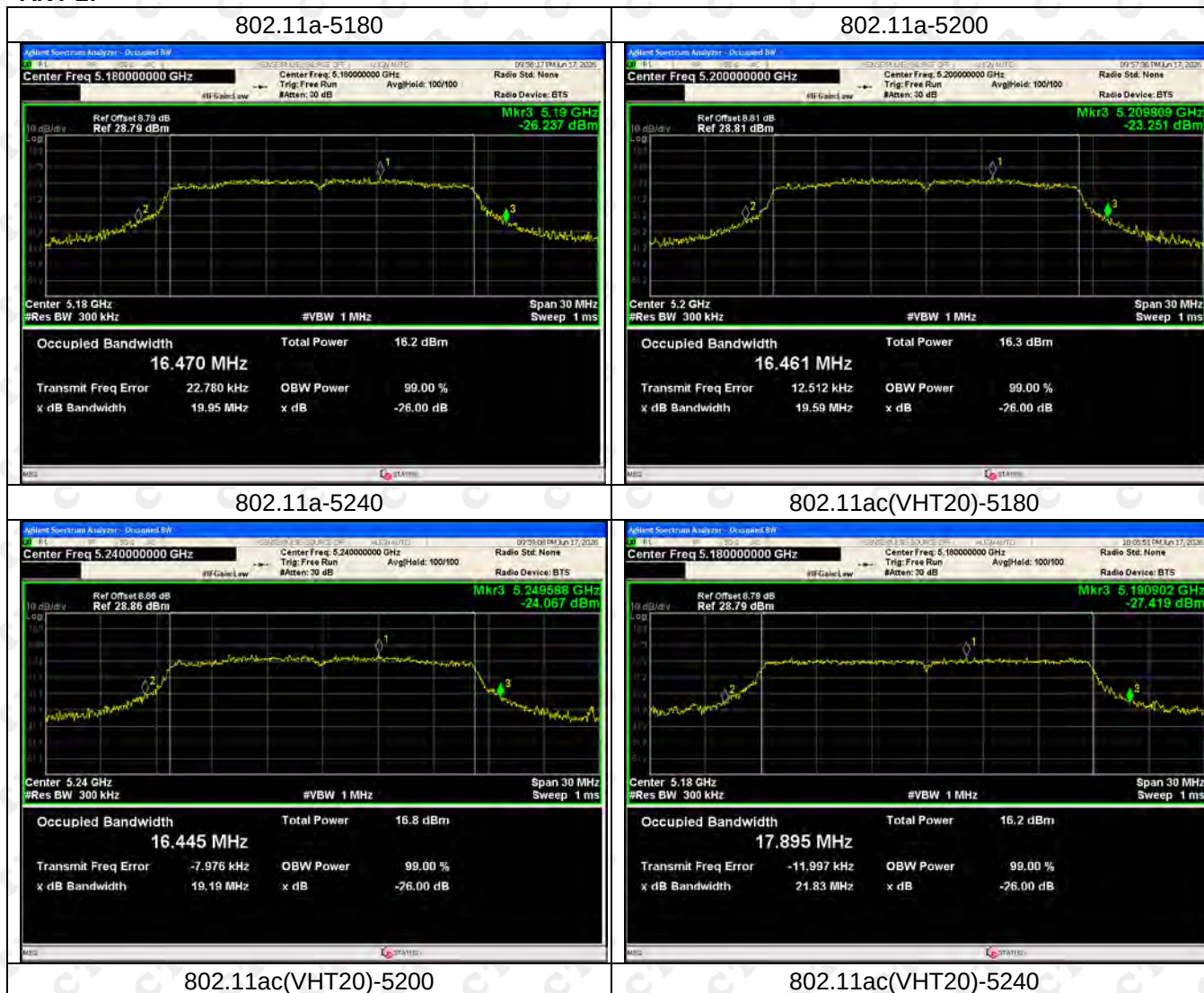


802.11ax(HE80)-5210



5150MHz ~5250MHz

ANT 2:





802.11ac(VHT40)-5190



802.11ac(VHT40)-5230



802.11ac(VHT80)-5210



802.11ac(VHT80)-5230

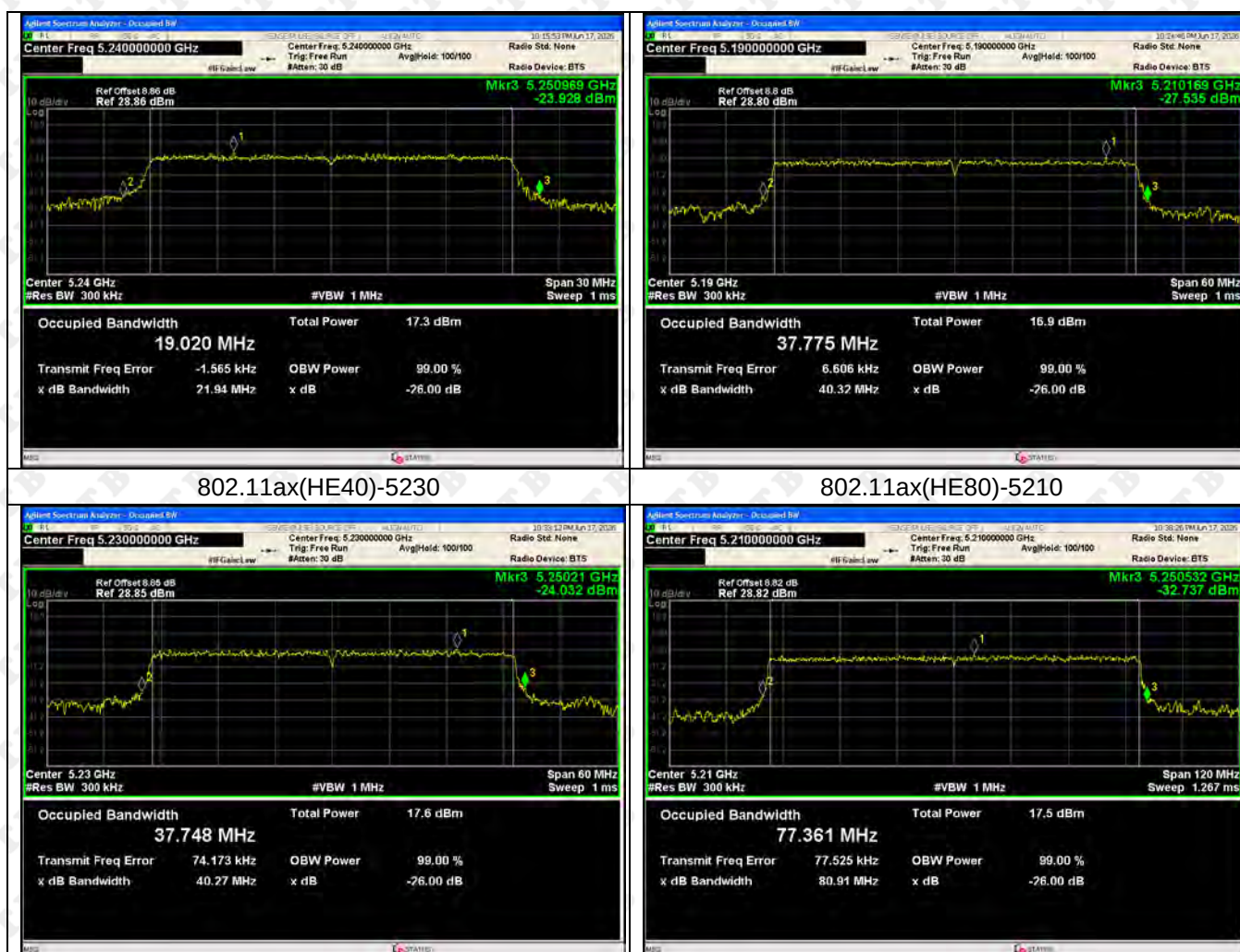


802.11n(HT20)-5180



802.11n(HT20)-5240





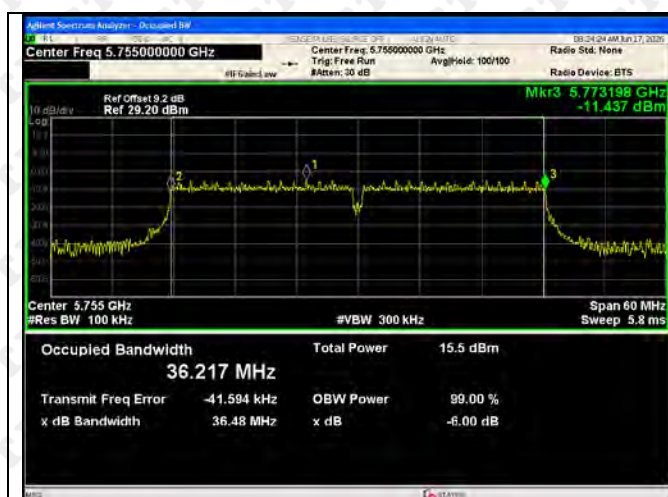
802.11ax(HE40)-5230

802.11ax(HE80)-5210

5725-5850MHz

ANT1:





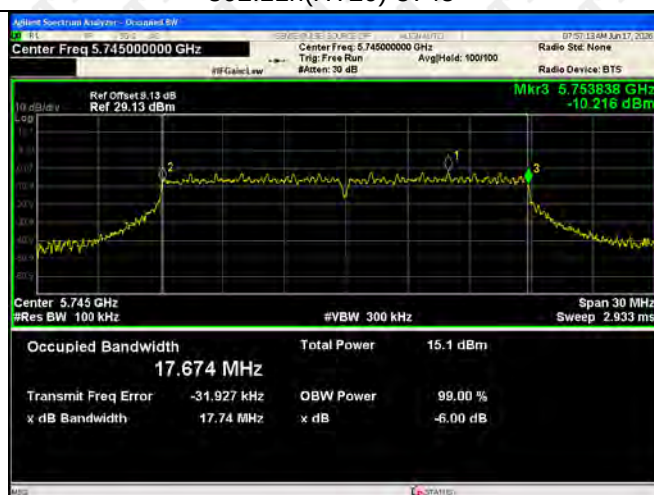
802.11ac(VHT80)-5775



802.11n(HT20)-5745



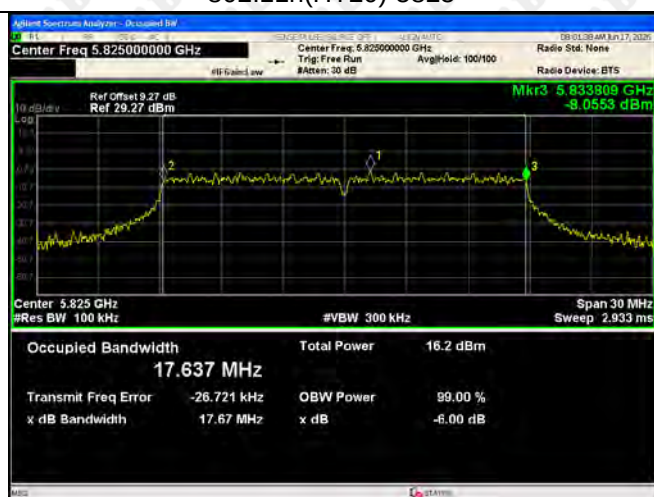
802.11n(HT20)-5785



802.11n(HT20)-5825



802.11n(HT40)-5755



802.11n(HT40)-5795



802.11ax(HE20)-5745



802.11ax(HE20)-5785



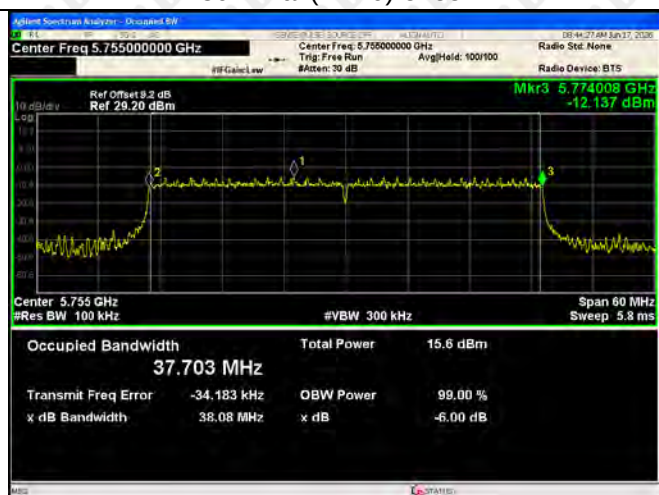
802.11ax(HE20)-5825



802.11ax(HE40)-5755



802.11ax(HE40)-5795



802.11ax(HE80)-5775

