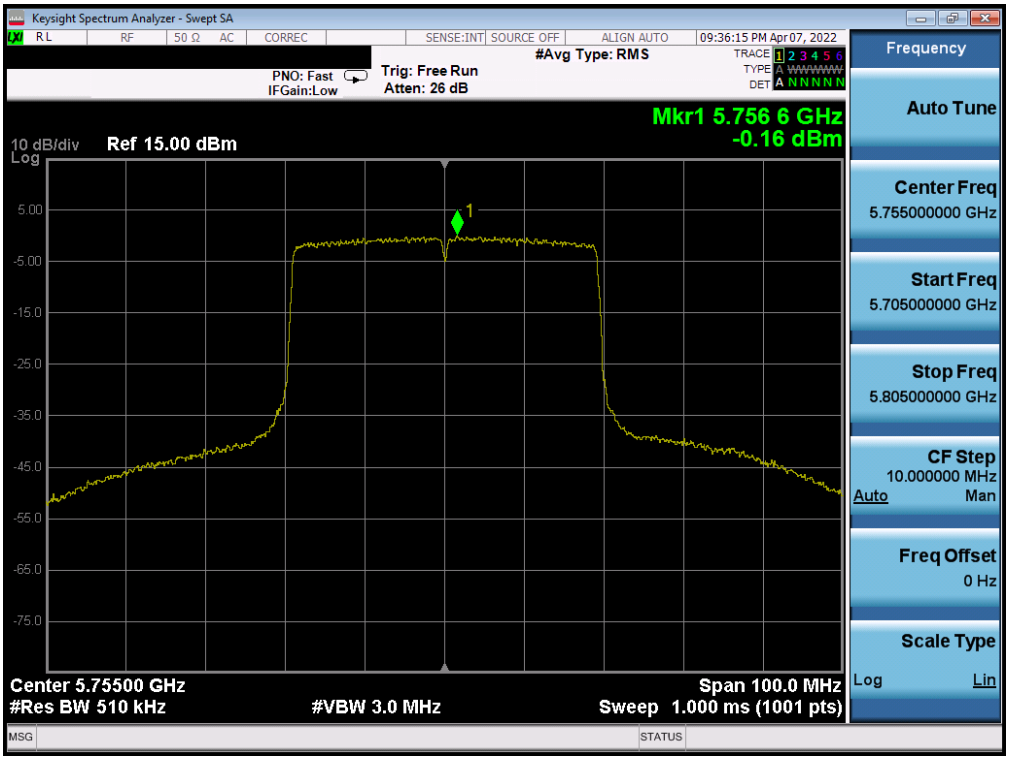
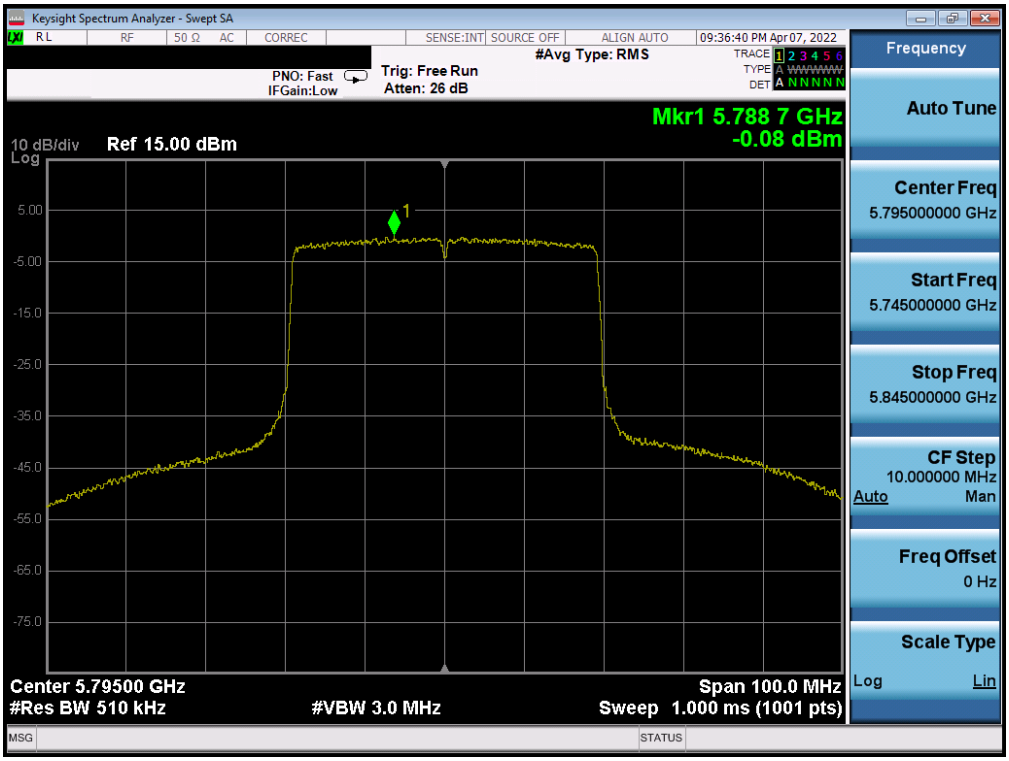
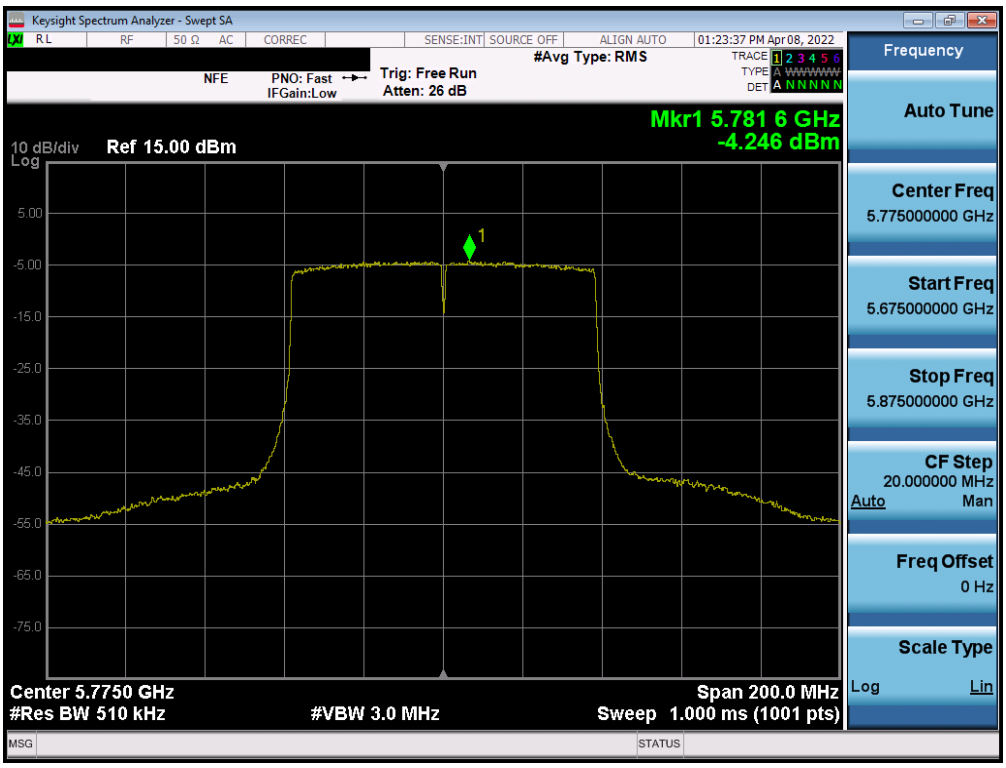


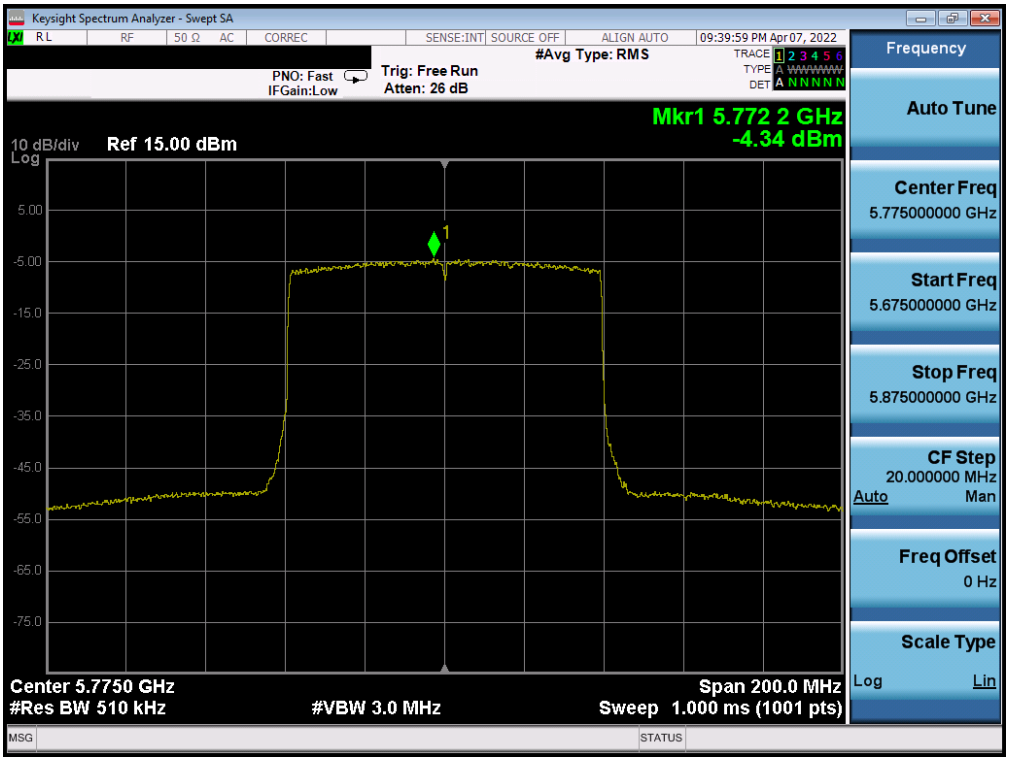
Plot 7-328. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3) – Ch. 151)



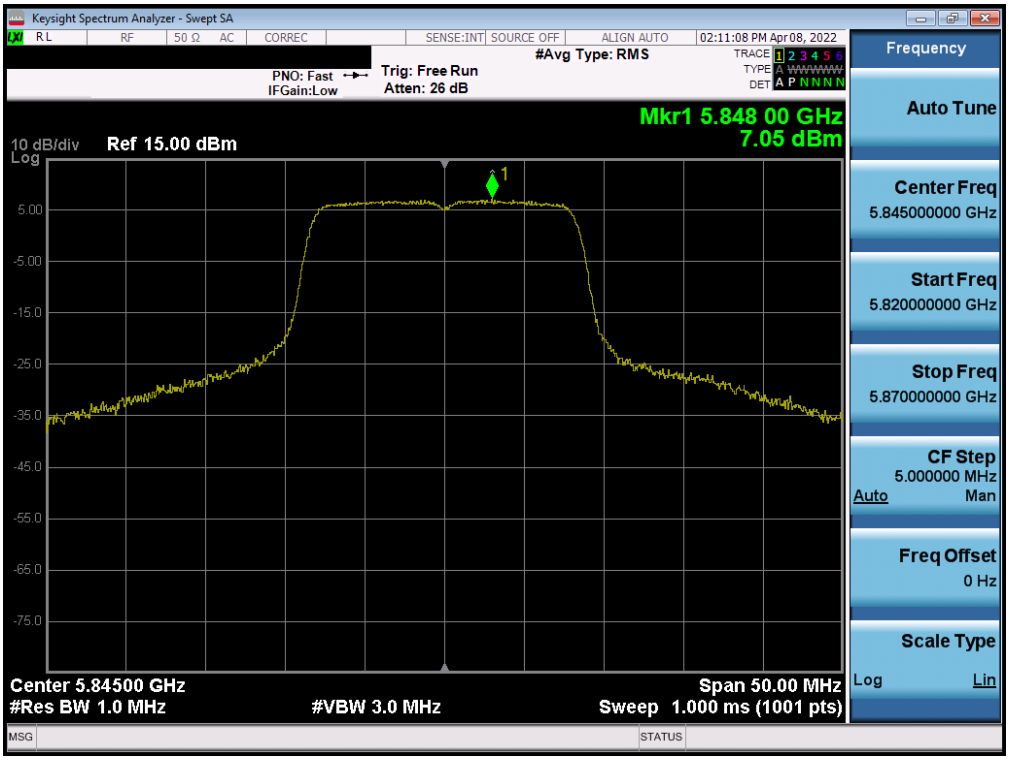
Plot 7-329. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3) – Ch. 159)



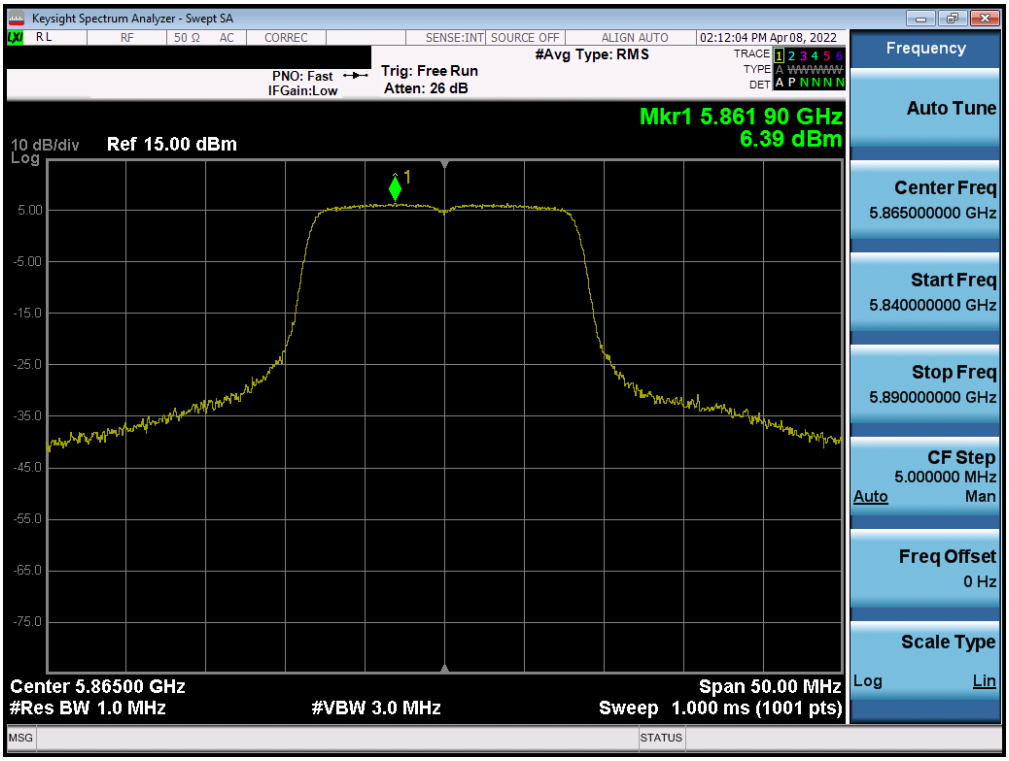
Plot 7-330. Power Spectral Density Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)



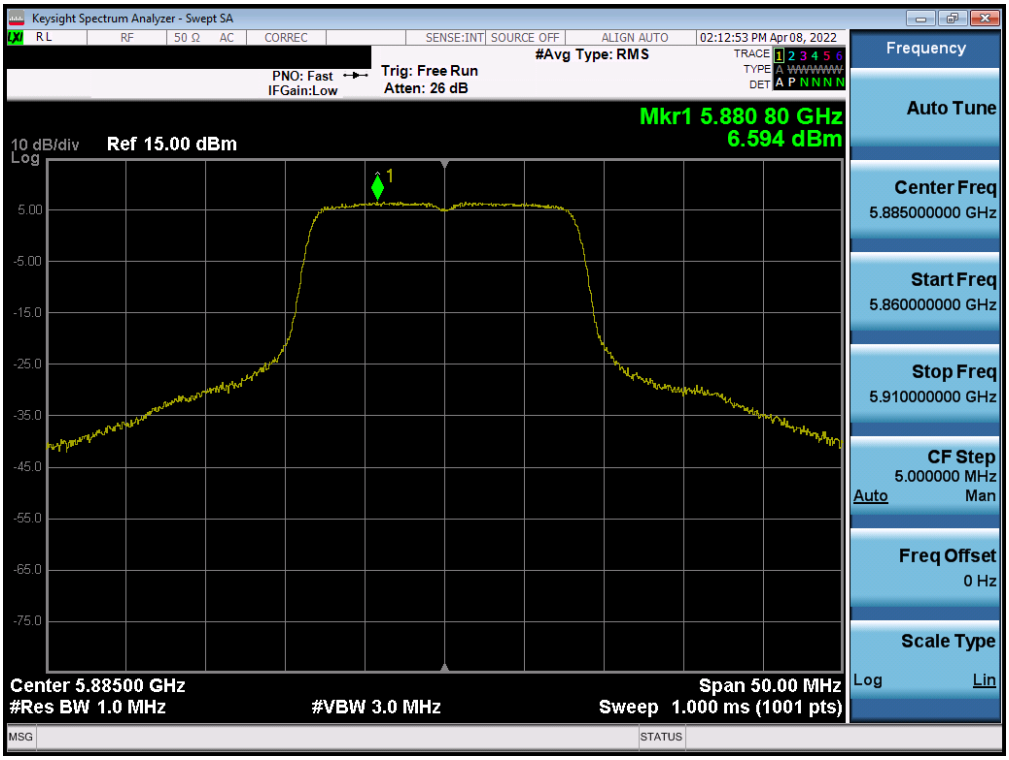
Plot 7-331. Power Spectral Density Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3) – Ch. 155)



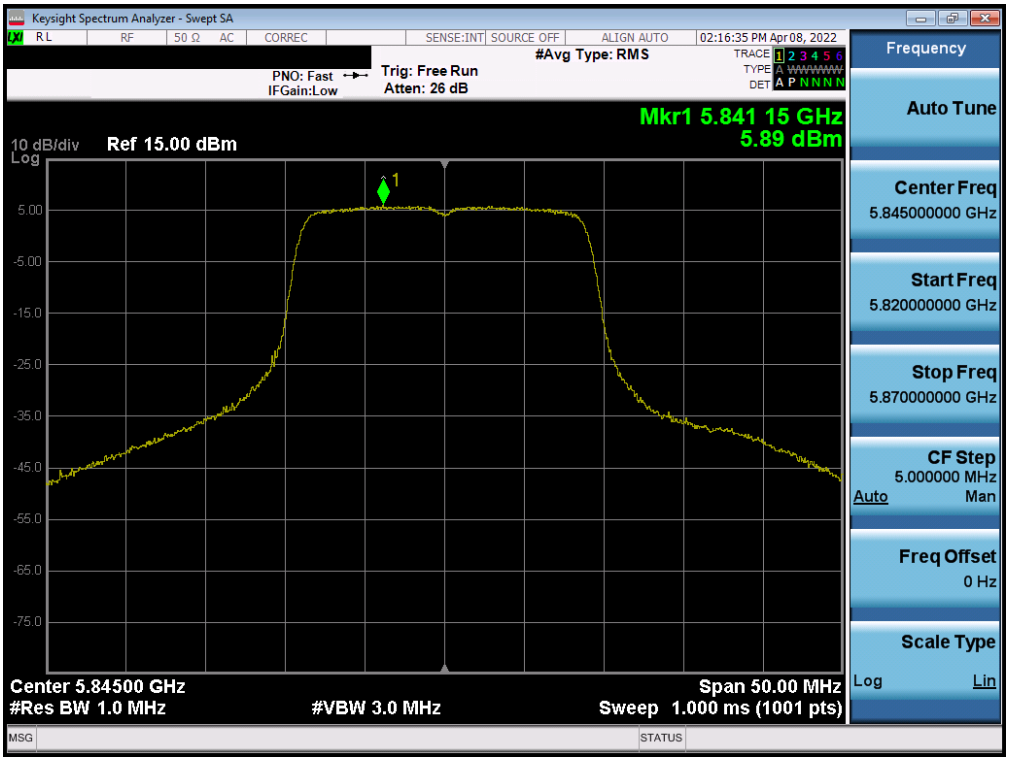
Plot 7-332. Power Spectral Density Plot MIMO ANT2 (802.11a (UNII Band 3/4) – Ch. 169)



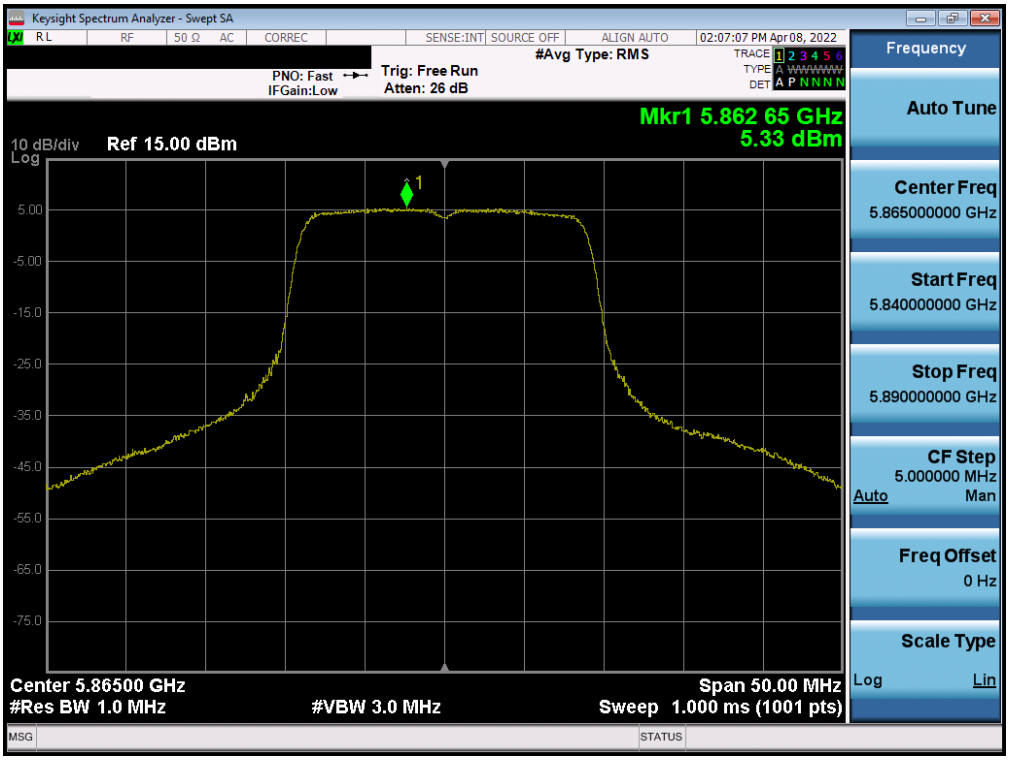
Plot 7-333. Power Spectral Density Plot MIMO ANT2 (802.11a (UNII Band 4) – Ch. 173)



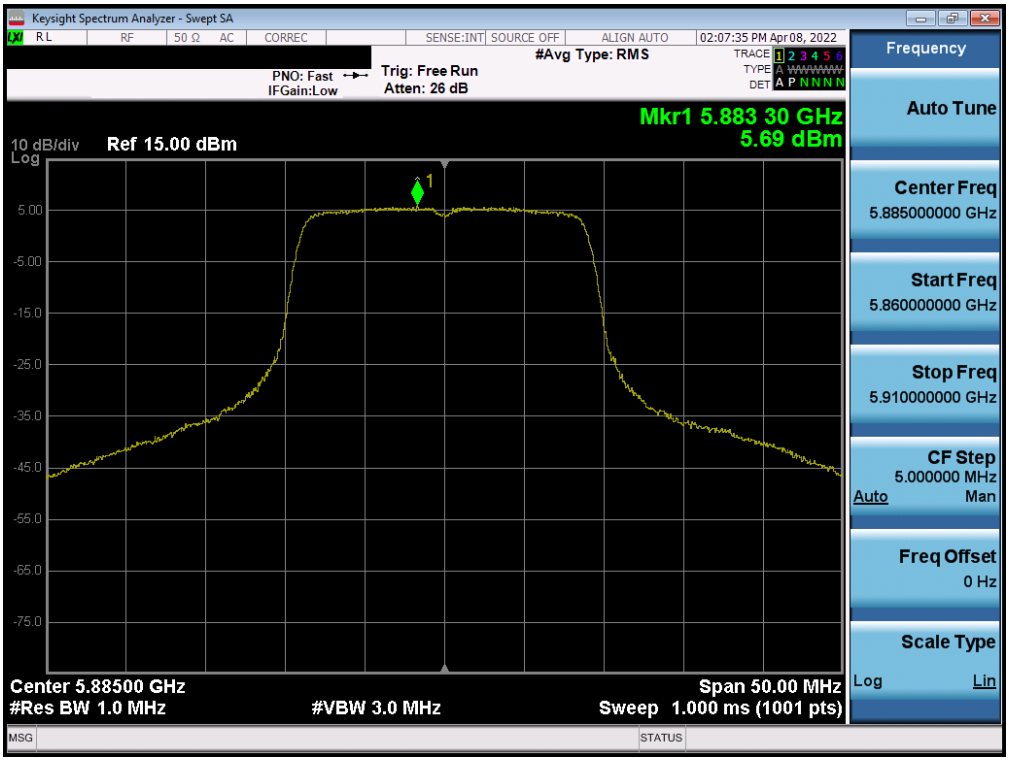
Plot 7-334. Power Spectral Density Plot MIMO ANT2 (802.11a (UNII Band 4) – Ch. 177)



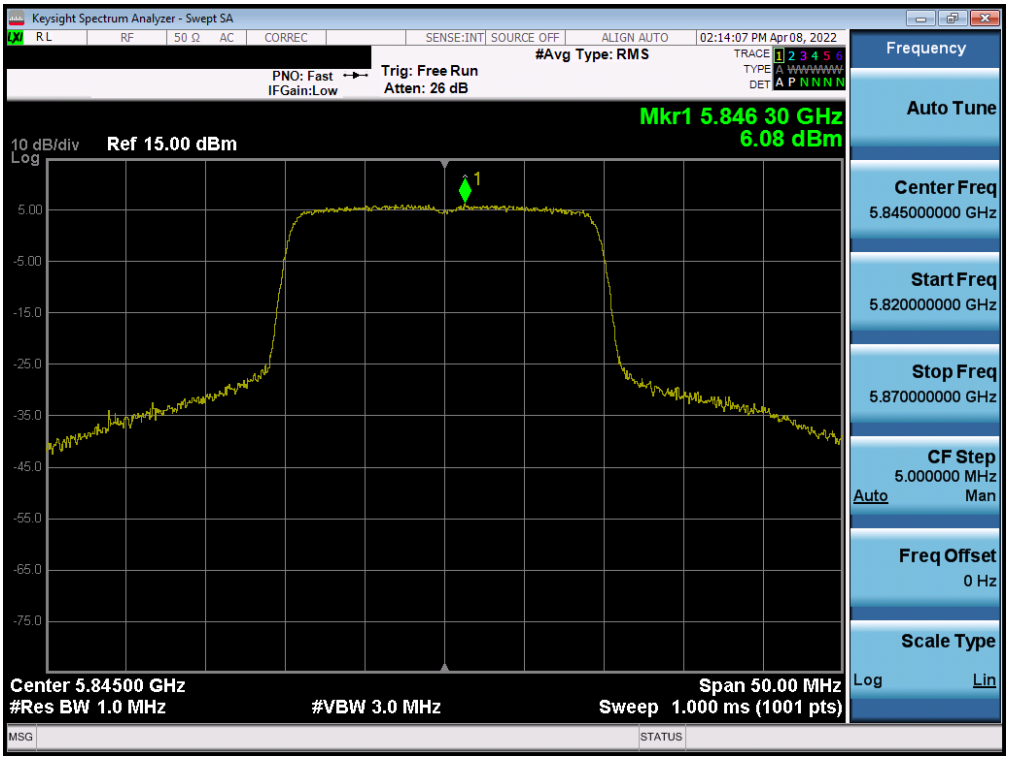
Plot 7-335. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 3/4) – Ch. 169)



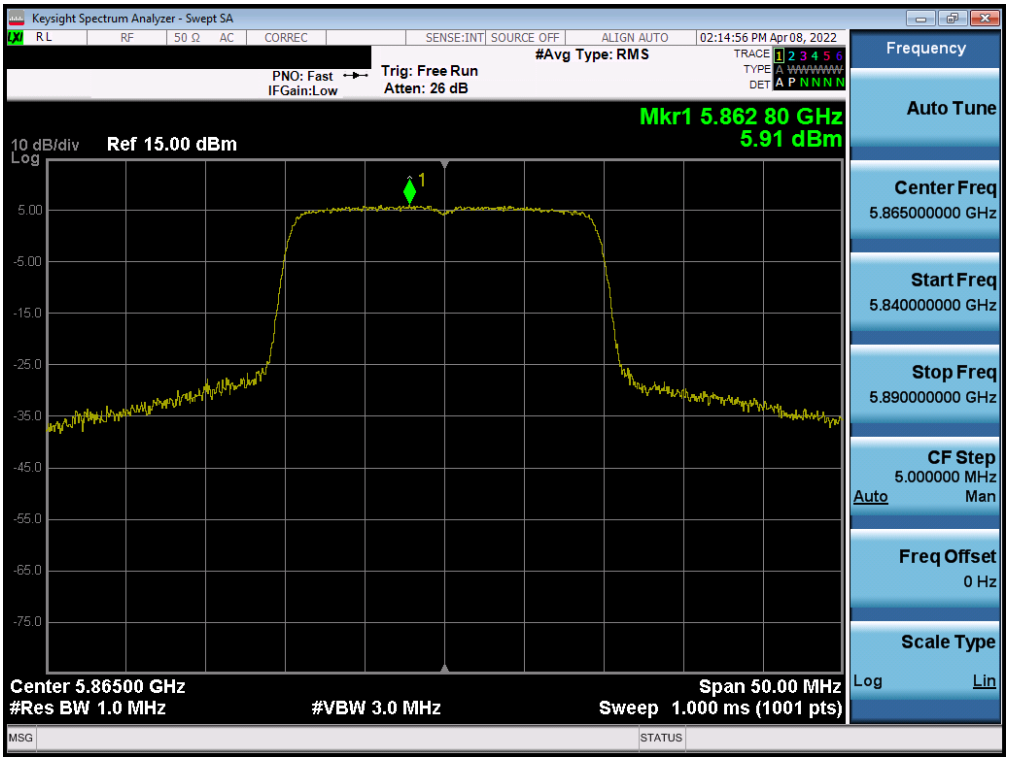
Plot 7-336. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 4) – Ch. 173)



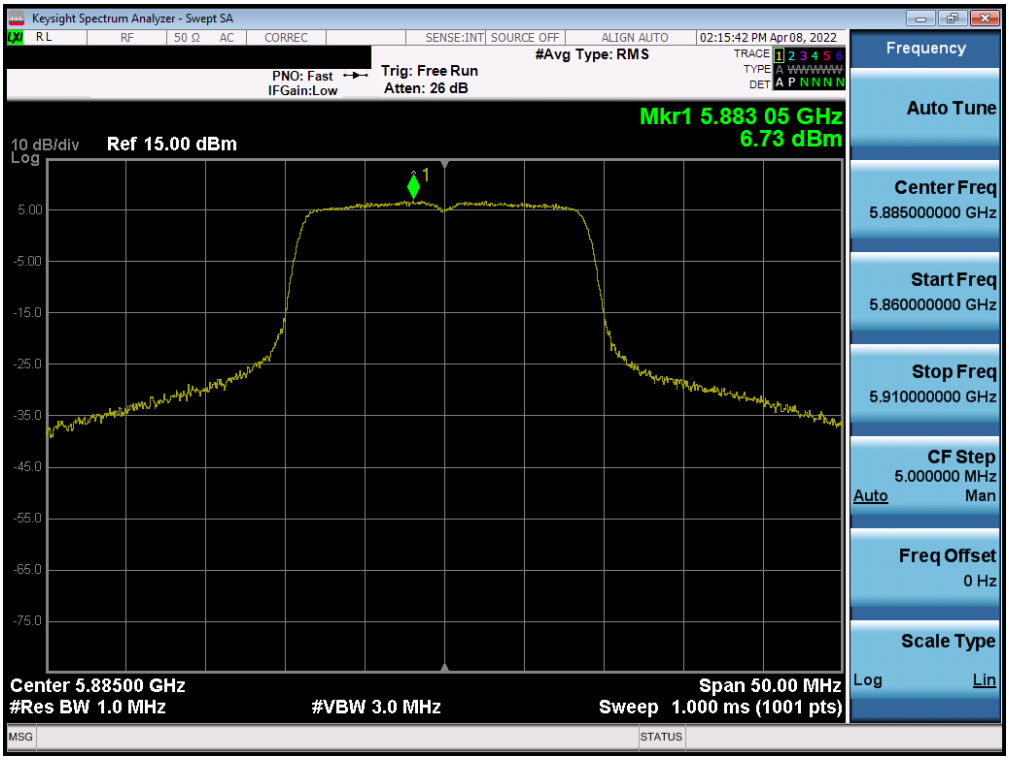
Plot 7-337. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 4) – Ch. 177)



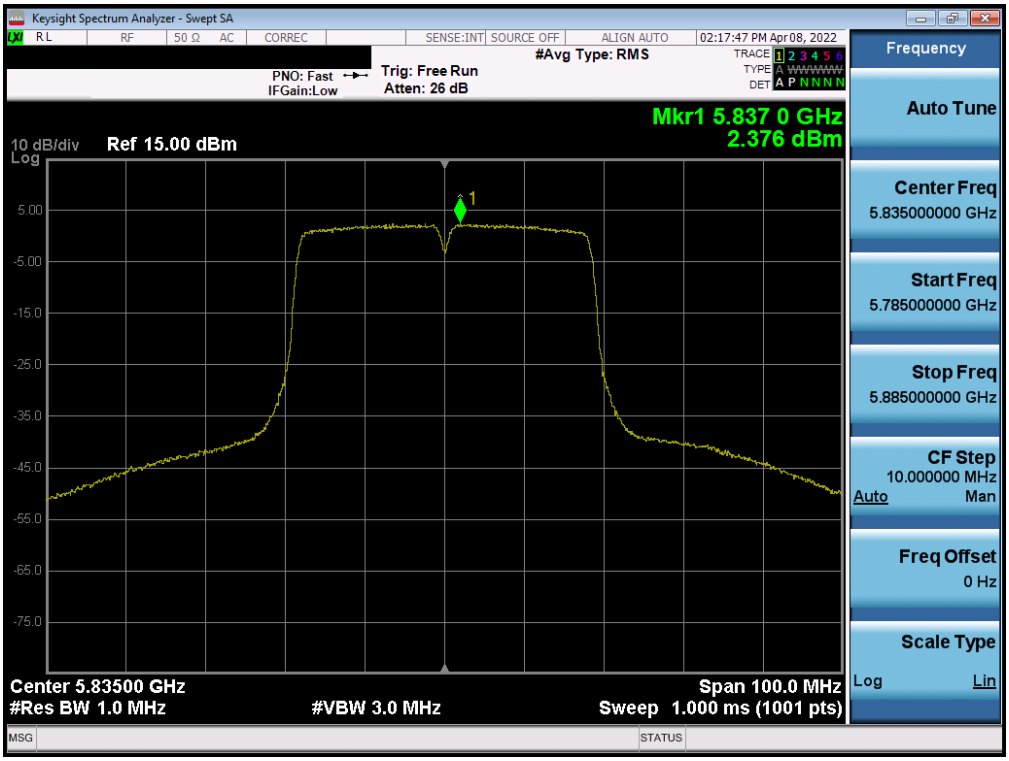
Plot 7-338. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 3/4) – Ch. 169)



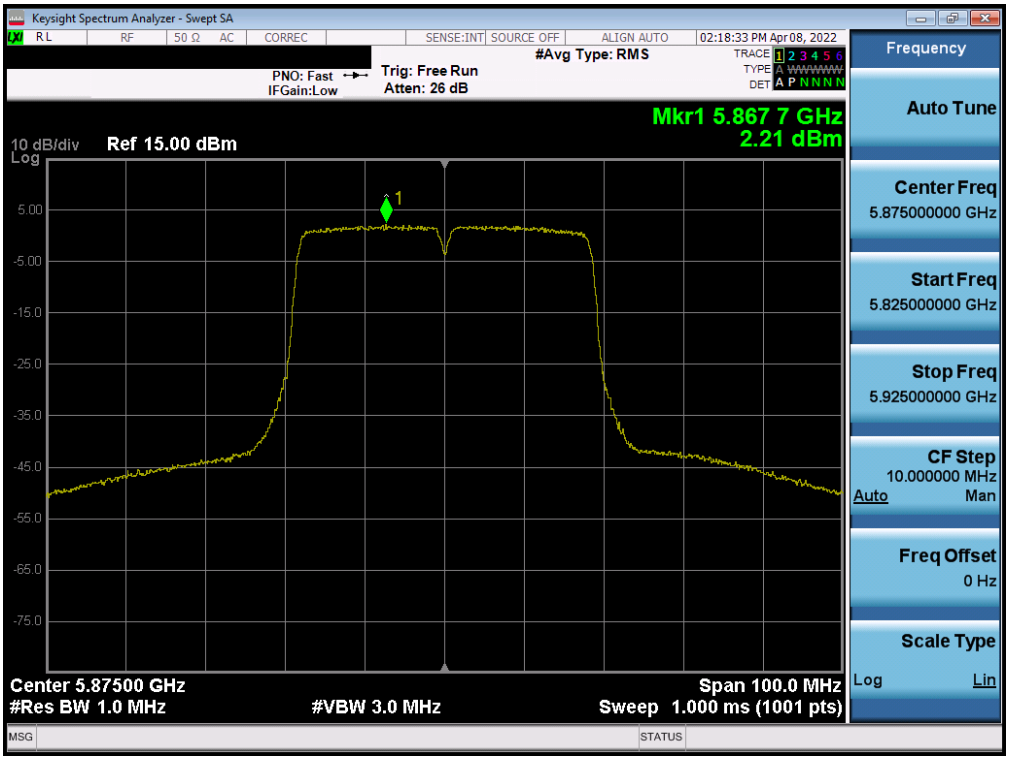
Plot 7-339. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 4) – Ch. 173)



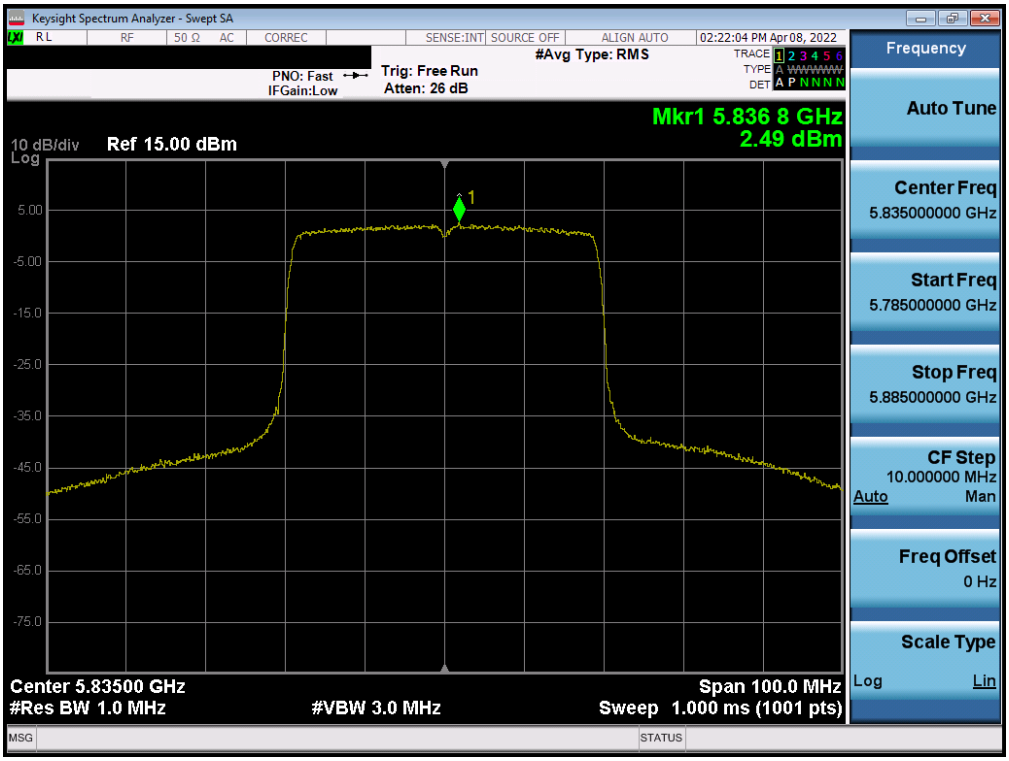
Plot 7-340. Power Spectral Density Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 4) – Ch. 177)



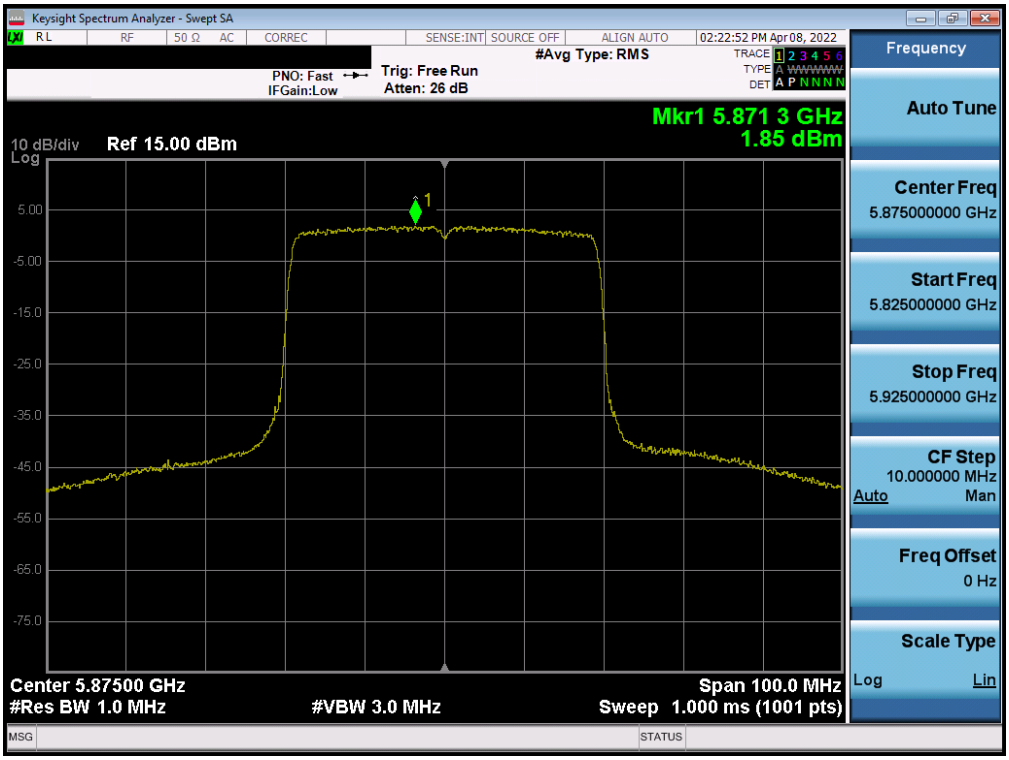
Plot 7-341. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 3/4) – Ch. 167)



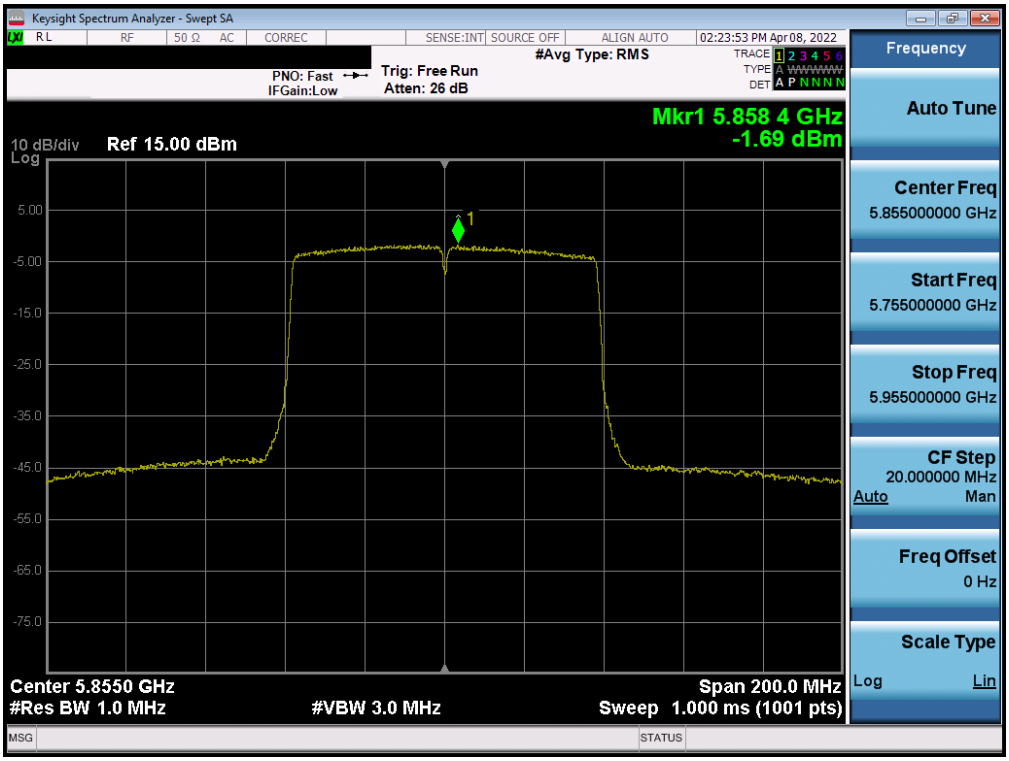
Plot 7-342. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 4) – Ch. 175)



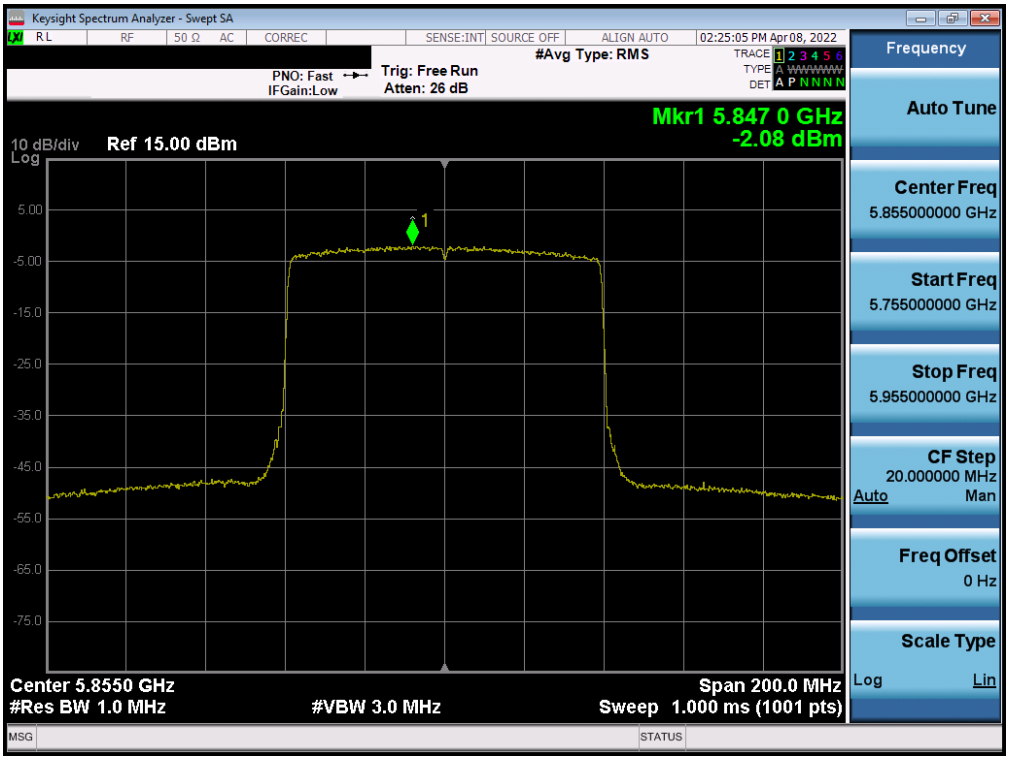
Plot 7-343. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3/4) – Ch. 167)



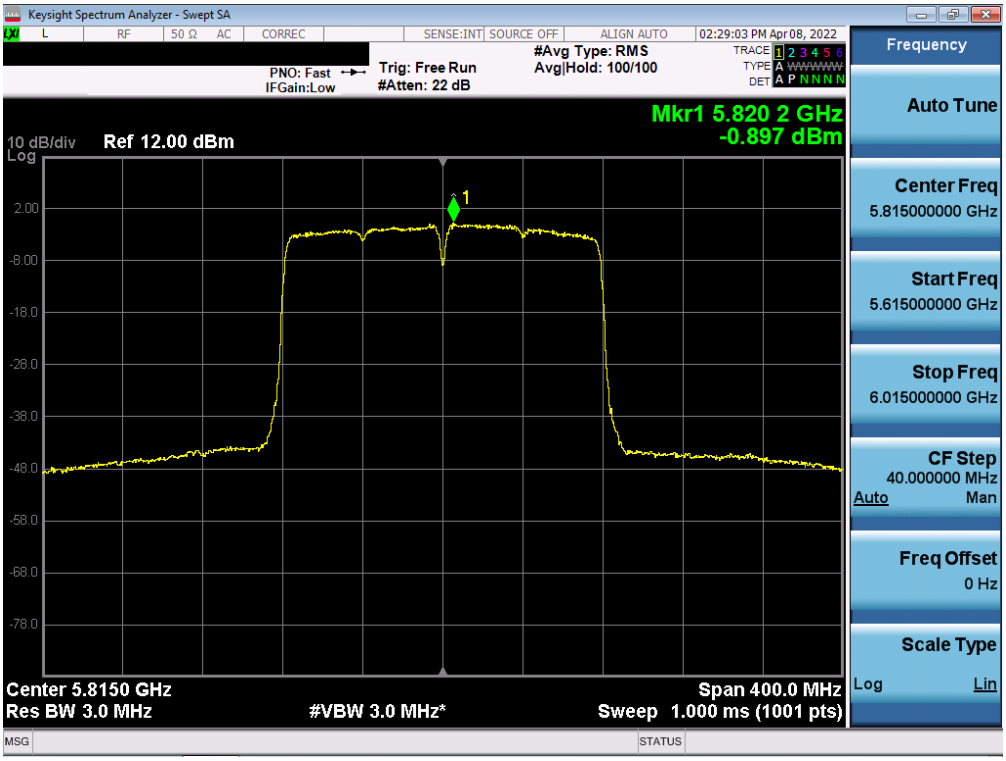
Plot 7-344. Power Spectral Density Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 4) – Ch. 175)



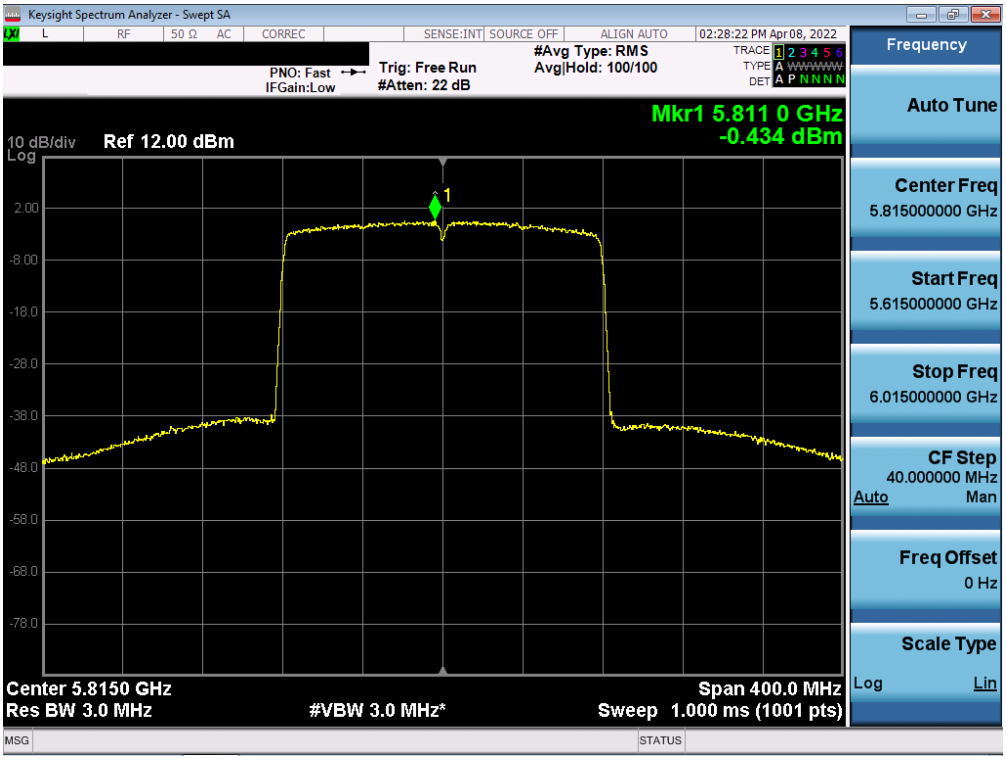
Plot 7-345. Power Spectral Density Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3/4) – Ch. 171)



Plot 7-346. Power Spectral Density Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3/4) – Ch. 171)



Plot 7-347. Power Spectral Density Plot MIMO ANT2 (160MHz BW 802.11ac (UNII Band 3/4) – Ch. 163)



Plot 7-348. Power Spectral Density Plot MIMO ANT2 (160MHz BW 802.11ax (UNII Band 3/4) – Ch. 163)

Note:

Per ANSI C63.10-2013 Section 14.3.2.2 and KDB 662911 v02r01 Section E)2), the power spectral density at Antenna-1 and Antenna-2 were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample MIMO Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average conducted power spectral density was measured to be 6.71 dBm for Antenna 1 and 7.50 dBm for Antenna 2.

Antenna 1 + Antenna 2 = MIMO

(6.71 dBm + 7.50 dBm) = (4.688 mW + 5.623 mW) = 10.311 mW = 10.13 dBm

Sample e.i.r.p Power Spectral Density Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average MIMO power density was calculated to be 10.13 dBm with directional gain of -1.96 dBi.

e.i.r.p. Power Spectral Density(dBm) = Power Spectral Density (dBm) + Ant gain (dBi)

10.13 dBm + -1.96 dBi = 8.17dBm

7.6 Radiated Spurious Emission Measurements – Above 1GHz

§15.407(b) §15.205 §15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, and at the appropriate frequencies. All channels, modes (e.g. 802.11a, 802.11n (20MHz BW), 802.11n (40MHz BW), and 802.11ac (80MHz)), and modulations/data rates were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

For transmitters operating in the 5.15-5.25 GHz and 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-22 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-22. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Sections 12.7.7.2, 12.7.6, 12.7.5
KDB 789033 D02 v02r01 – Section G

Test Settings

Average Measurements above 1GHz (Method AD)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Averaging type = power (RMS)
7. Sweep time = auto couple
8. Trace was averaged over 100 sweeps

Peak Measurements above 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = 120kHz
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

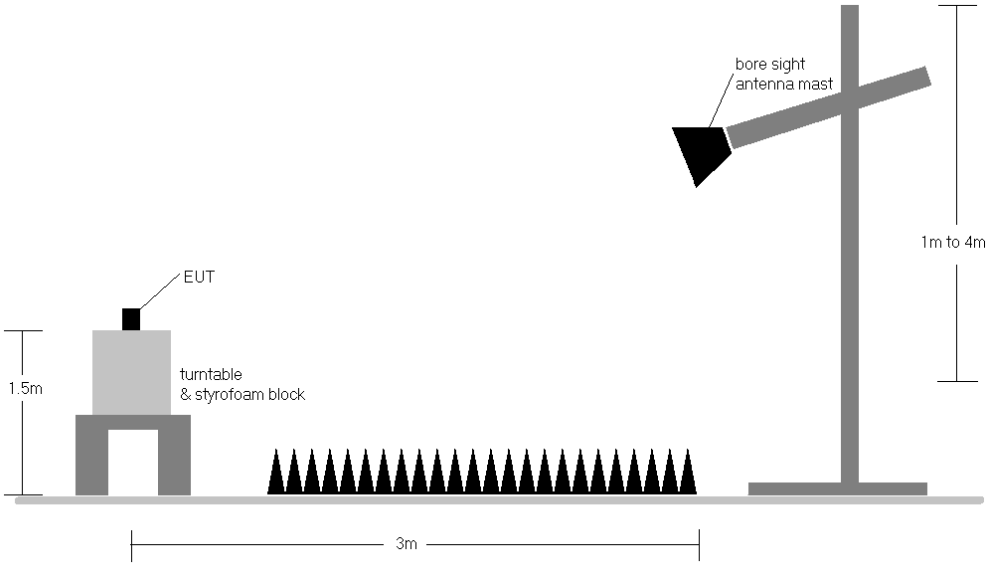


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

1. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-22.
2. All spurious emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-22. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dBμV/m.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. Radiated spurious emissions were investigated while operating in MIMO mode, however, it was determined that single antenna operation produced the worst case emissions. Since the emissions produced from MIMO operation were found to be more than 20dB below the limit, the MIMO emissions are not reported.
8. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
9. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

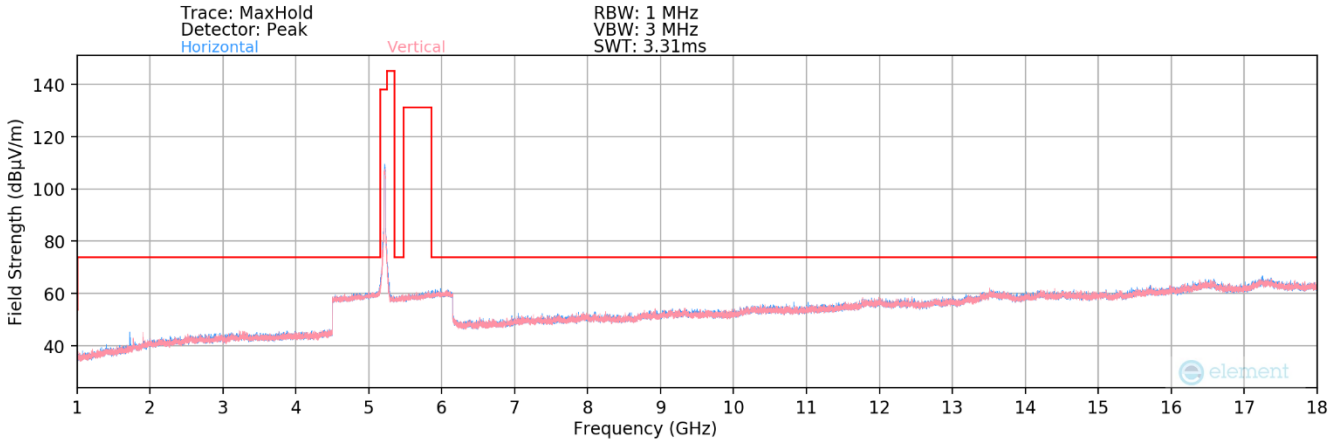
Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

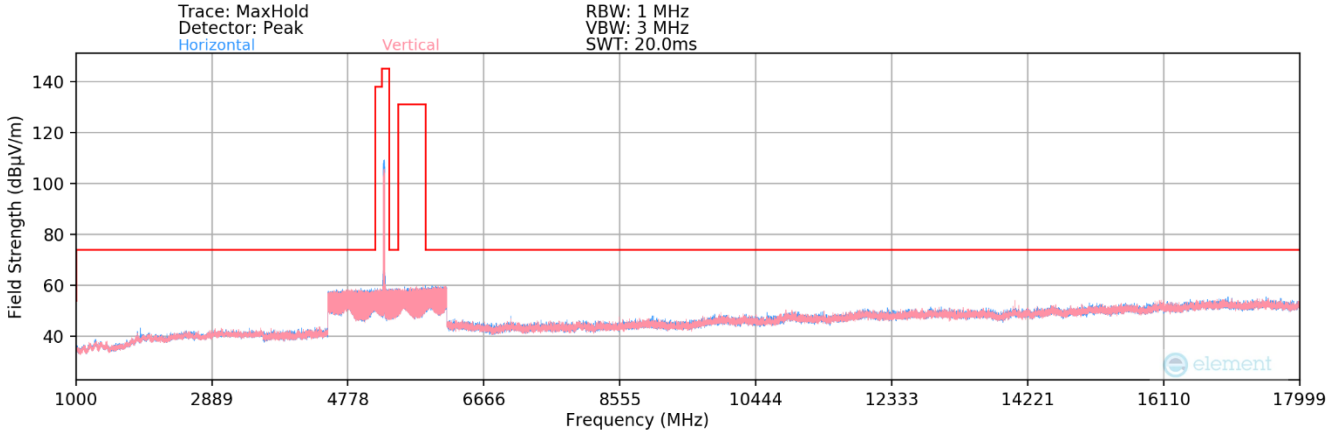
Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots was calculated using the formula: Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

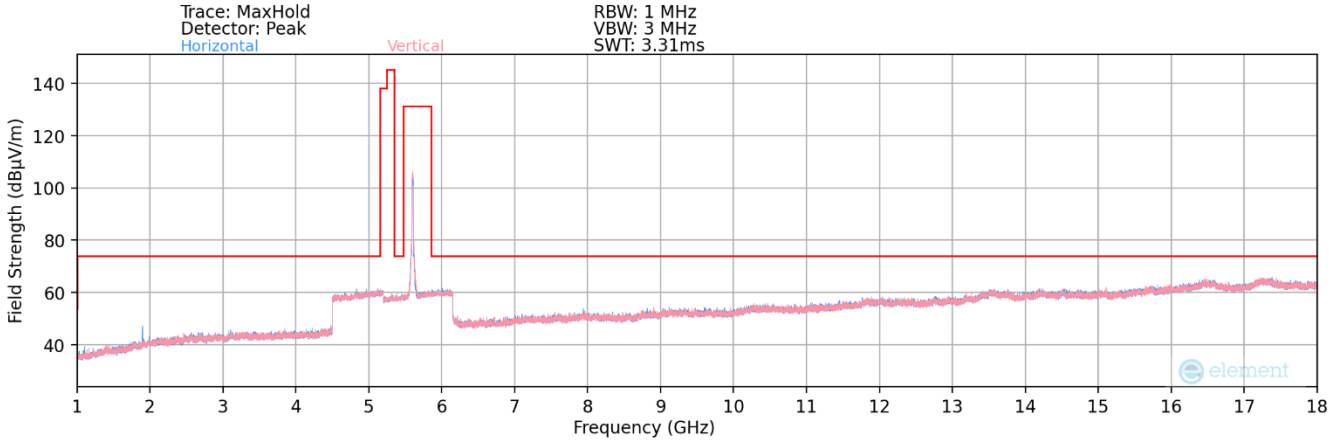
7.6.1 MIMO Radiated Spurious Emission Measurements



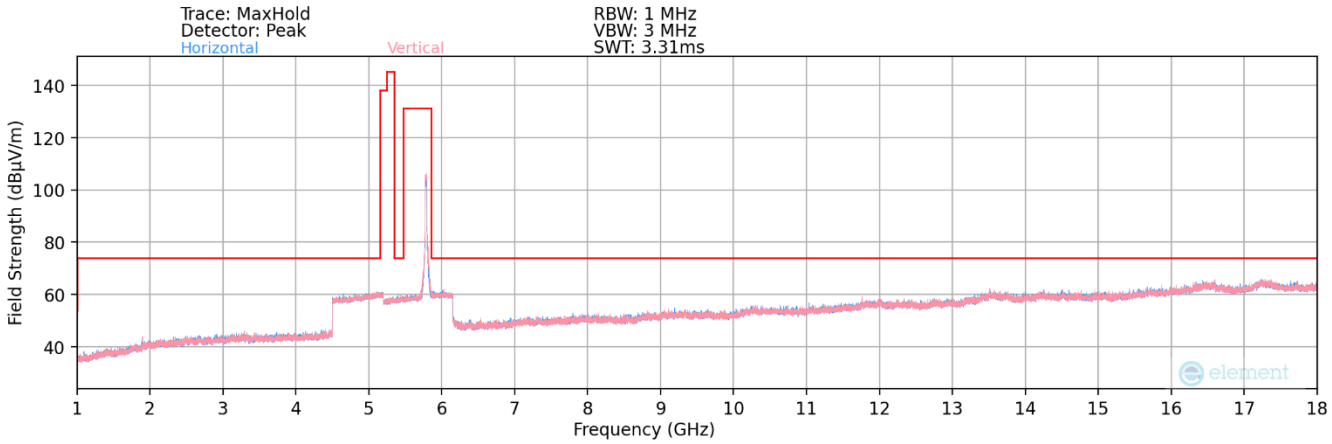
Plot 7-349. Radiated Spurious Plot above 1GHz MIMO (802.11a – U1 Ch. 40)



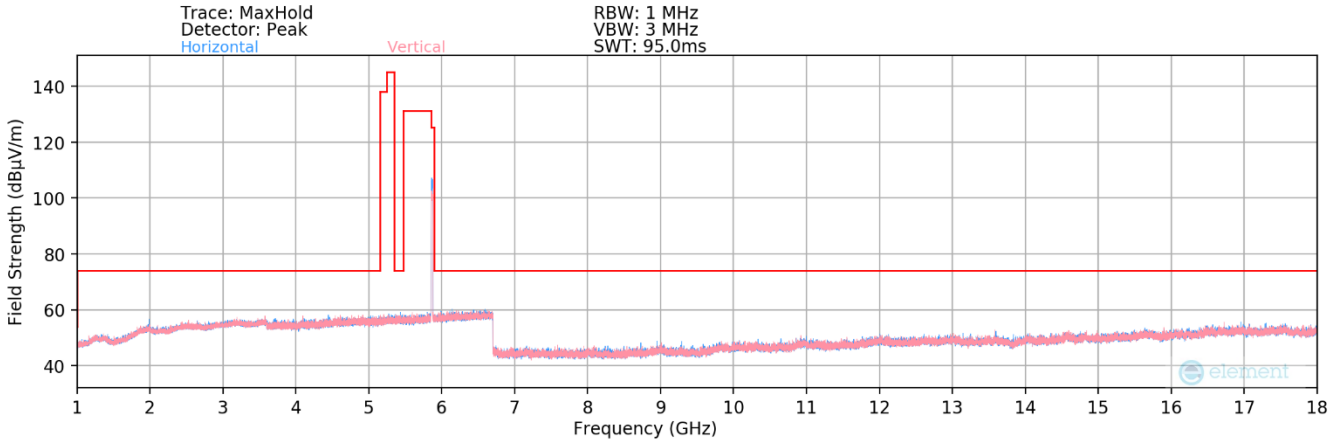
Plot 7-350. Radiated Spurious Plot above 1GHz MIMO (802.11a – U2A Ch. 56)



Plot 7-351. Radiated Spurious Plot above 1GHz MIMO (802.11a – U2C Ch. 120)

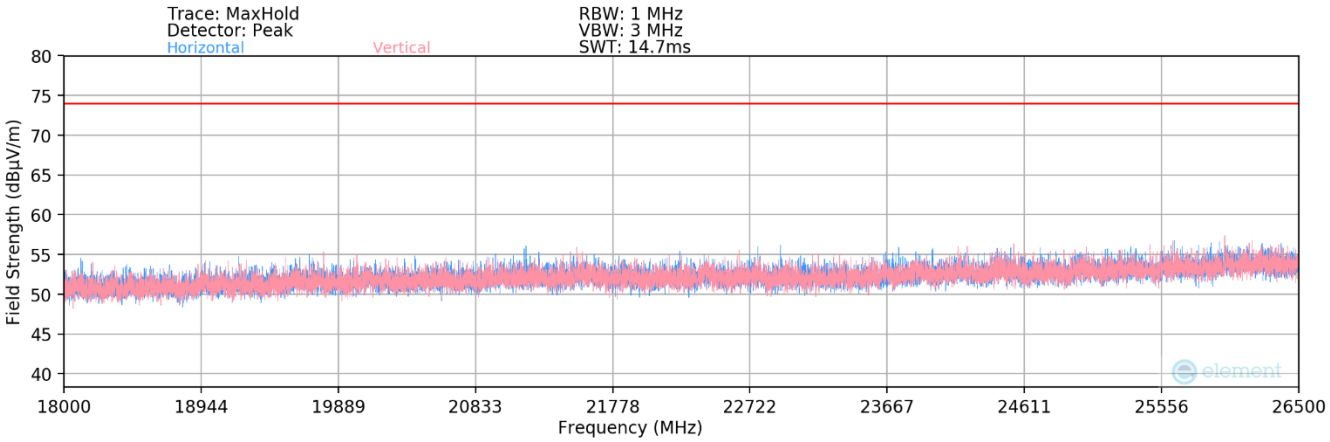


Plot 7-352. Radiated Spurious Plot above 1GHz MIMO (802.11a – U3 Ch. 157)

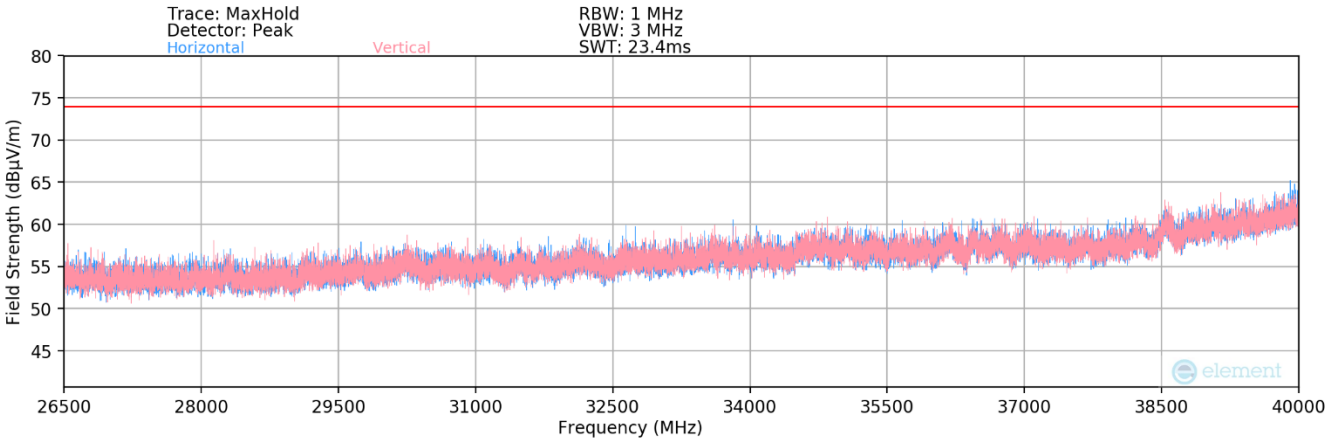


Plot 7-353. Radiated Spurious Plot above 1GHz MIMO (802.11a – U4 Ch. 173)

MIMO Radiated Spurious Emissions Measurements (Above 18GHz)



Plot 7-354. Radiated Spurious Plot 18GHz - 26.5GHz MIMO (802.11a)



Plot 7-355. Radiated Spurious Plot 26.5GHz - 40GHz MIMO (802.11a)

MIMO Radiated Spurious Emission Measurements

§15.407(b) §15.205 & §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5180MHz
Channel:	36

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10360.00	Peak	V	-	-	-73.04	20.16	0.00	54.12	68.20	-14.08
*	15540.00	Average	V	-	-	-88.42	29.71	0.00	48.29	53.98	-5.69
*	15540.00	Peak	V	-	-	-73.08	29.71	0.00	63.63	73.98	-10.35
*	20720.00	Average	V	-	-	-66.79	3.16	-9.54	33.82	53.98	-20.16
*	20720.00	Peak	V	-	-	-58.75	3.16	-9.54	41.86	73.98	-32.12
	25900.00	Peak	V	-	-	-58.04	4.77	-9.54	44.19	68.20	-24.01

Table 7-23. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5200MHz
Channel:	40

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10400.00	Peak	V	-	-	-73.00	20.83	0.00	54.83	68.20	-13.37
*	15600.00	Average	V	-	-	-87.66	28.68	0.00	48.02	53.98	-5.96
*	15600.00	Peak	V	-	-	-73.82	28.68	0.00	61.86	73.98	-12.12
*	20800.00	Average	V	-	-	-67.63	3.48	-9.54	33.31	53.98	-20.67
*	20800.00	Peak	V	-	-	-57.50	3.48	-9.54	43.44	73.98	-30.54
	26000.00	Peak	V	-	-	-57.14	5.16	-9.54	45.48	68.20	-22.72

Table 7-24. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5240MHz
Channel:	48

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10480.00	Peak	V	-	-	-72.89	20.81	0.00	54.92	68.20	-13.28
*	15720.00	Average	V	-	-	-86.98	29.48	0.00	49.50	53.98	-4.48
*	15720.00	Peak	V	-	-	-74.01	29.48	0.00	62.47	73.98	-11.51
*	20960.00	Average	V	-	-	-67.45	3.47	-9.54	33.48	53.98	-20.50
*	20960.00	Peak	V	-	-	-58.52	3.47	-9.54	42.41	73.98	-31.57
	26200.00	Peak	V	-	-	-58.89	4.78	-9.54	43.35	68.20	-24.85

Table 7-25. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5260MHz
Channel:	52

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10520.00	Peak	V	-	-	-72.65	20.70	0.00	55.05	68.20	-13.15
*	15780.00	Average	V	-	-	-86.11	28.85	0.00	49.74	53.98	-4.24
*	15780.00	Peak	V	-	-	-74.16	28.85	0.00	61.69	73.98	-12.29
*	21040.00	Average	V	-	-	-68.20	3.53	-9.54	32.79	53.98	-21.19
*	21040.00	Peak	V	-	-	-58.88	3.53	-9.54	42.11	73.98	-31.87
	26300.00	Peak	V	-	-	-57.74	4.64	-9.54	44.36	68.20	-23.84

Table 7-26. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5280MHz
Channel:	56

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10560.00	Peak	V	-	-	-72.20	20.89	0.00	55.69	68.20	-12.51
	10560.00	Peak	V	-	-	-72.20	20.89	0.00	55.69	68.20	-12.51
*	15840.00	Average	V	-	-	-86.32	29.33	0.00	50.01	53.98	-3.97
*	15840.00	Peak	V	-	-	-73.95	29.33	0.00	62.38	73.98	-11.60
*	21120.00	Average	V	-	-	-67.41	3.68	-9.54	33.73	53.98	-20.25
*	21120.00	Peak	V	-	-	-57.79	3.68	-9.54	43.35	73.98	-30.63
	26400.00	Peak	V	-	-	-58.43	4.78	-9.54	43.81	68.20	-24.39

Table 7-27. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5320MHz
Channel:	64

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	10640.00	Average	V	-	-	-84.13	20.73	0.00	43.60	53.98	-10.38
*	10640.00	Peak	V	-	-	-71.01	20.73	0.00	56.72	73.98	-17.26
*	15960.00	Average	V	-	-	-86.36	29.29	0.00	49.93	53.98	-4.04
*	15960.00	Peak	V	-	-	-73.30	29.29	0.00	62.99	73.98	-10.98
*	21280.00	Average	V	-	-	-67.87	3.72	-9.54	33.31	53.98	-20.67
*	21280.00	Peak	V	-	-	-58.39	3.72	-9.54	42.79	73.98	-31.19
	26600.00	Peak	V	-	-	-58.07	4.72	-9.54	44.11	68.20	-24.09

Table 7-28. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5500MHz
Channel:	100

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11000.00	Average	V	-	-	-84.11	21.48	0.00	44.37	53.98	-9.61
*	11000.00	Peak	V	-	-	-84.03	21.48	0.00	44.45	73.98	-29.53
	16500.00	Peak	V	-	-	-84.61	30.98	0.00	53.37	68.20	-14.83
	22000.00	Peak	V	-	-	-58.63	3.83	-9.54	42.67	68.20	-25.53
	27500.00	Peak	V	-	-	-56.39	4.97	-9.54	46.04	68.20	-22.16

Table 7-29. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5600MHz
Channel:	120

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11200.00	Average	V	-	-	-86.33	21.36	0.00	42.03	53.98	-11.95
*	11200.00	Peak	V	-	-	-69.77	21.36	0.00	58.59	73.98	-15.39
	16800.00	Peak	V	-	-	-75.11	30.54	0.00	62.43	68.20	-5.77
*	22400.00	Average	V	-	-	-67.25	3.79	-9.54	34.00	53.98	-19.98
*	22400.00	Peak	V	-	-	-58.43	3.79	-9.54	42.82	73.98	-31.16
	28000.00	Peak	V	-	-	-58.34	4.94	-9.54	44.06	68.20	-24.14

Table 7-30. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5720MHz
Channel:	144

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11440.00	Average	V	-	-	-84.41	22.14	0.00	44.73	53.98	-9.25
*	11440.00	Peak	V	-	-	-73.73	22.14	0.00	55.41	73.98	-18.57
	17160.00	Peak	V	-	-	-84.27	31.03	0.00	53.76	68.20	-14.44
*	22880.00	Average	V	-	-	-67.84	3.79	-9.54	33.41	53.98	-20.57
*	22880.00	Peak	V	-	-	-57.87	3.79	-9.54	43.38	73.98	-30.60
	28600.00	Peak	V	-	-	-57.49	5.27	-9.54	45.24	68.20	-22.96

Table 7-31. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5745MHz
Channel:	149

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11490.00	Average	V	-	-	-84.57	22.12	0.00	44.55	53.98	-9.43
*	11490.00	Peak	V	-	-	-71.52	22.12	0.00	57.60	73.98	-16.38
	17235.00	Peak	V	-	-	-73.22	31.14	0.00	64.92	68.20	-3.28
*	22980.00	Average	V	-	-	-67.84	3.79	-9.54	33.41	53.98	-20.57
*	22980.00	Peak	V	-	-	-57.21	3.79	-9.54	44.04	73.98	-29.94
	28725.00	Peak	V	-	-	-57.42	5.41	-9.54	45.45	69.20	-23.75

Table 7-32. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5785MHz
Channel:	157

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11570.00	Average	V	-	-	-84.77	22.50	0.00	44.73	53.98	-9.24
*	11570.00	Peak	V	-	-	-72.11	22.50	0.00	57.39	73.98	-16.58
	17355.00	Peak	V	-	-	-73.62	31.16	0.00	64.54	68.20	-3.66
	23140.00	Peak	V	-	-	-57.88	3.75	-9.54	43.33	68.20	-24.87
	28925.00	Peak	V	-	-	-57.92	5.46	-9.54	44.99	68.20	-23.21

Table 7-33. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5825MHz
Channel:	165

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11650.00	Average	V	-	-	-84.88	22.36	0.00	44.48	53.98	-9.50
*	11650.00	Peak	V	-	-	-72.89	22.36	0.00	56.47	73.98	-17.51
	17475.00	Peak	V	-	-	-73.24	30.92	0.00	64.68	68.20	-3.52
	23300.00	Peak	V	-	-	-58.44	3.76	-9.54	42.78	68.20	-25.42
	29125.00	Peak	V	-	-	-58.21	5.54	-9.54	44.78	68.20	-23.42

Table 7-34. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5845MHz
Channel:	169

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11690.00	Average	V	-	-	-85.46	18.45	0.00	39.99	53.98	-13.99
*	11690.00	Peak	V	-	-	-70.86	18.45	0.00	54.59	73.98	-19.39
	17535.00	Peak	V	-	-	-74.48	26.24	0.00	58.76	68.20	-9.44
	23380.00	Peak	V	-	-	-59.86	3.85	-9.54	50.99	68.20	-17.21
	29225.00	Peak	V	-	-	-58.55	5.60	-9.54	54.05	68.20	-14.15
	35070.00	Peak	V	-	-	-59.41	8.11	-9.54	55.70	68.20	-12.50

Table 7-35. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5865MHz
Channel:	173

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11730.00	Average	V	-	-	-86.22	18.22	0.00	39.00	53.98	-14.97
*	11730.00	Peak	V	-	-	-70.11	18.22	0.00	55.11	73.98	-18.86
	17595.00	Peak	V	-	-	-73.29	26.24	0.00	59.95	68.20	-8.25
	23460.00	Peak	V	-	-	-58.44	3.85	-9.54	52.41	68.20	-15.79
	29325.00	Peak	V	-	-	-58.72	5.60	-9.54	53.88	68.20	-14.32
	35190.00	Peak	V	-	-	-59.41	8.11	-9.54	55.70	68.20	-12.50

Table 7-36. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5885MHz
Channel:	177

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11770.00	Average	V	-	-	-87.41	18.30	0.00	37.89	53.98	-16.09
*	11770.00	Peak	V	-	-	-72.22	18.30	0.00	53.08	73.98	-20.90
	17655.00	Peak	V	-	-	-74.01	26.11	0.00	59.10	68.20	-9.10
	23540.00	Peak	V	-	-	-59.11	3.84	-9.54	51.73	68.20	-16.47
	29425.00	Peak	V	-	-	-59.24	5.87	-9.54	53.63	68.20	-14.57
	35310.00	Peak	V	-	-	-58.66	8.04	-9.54	56.38	68.20	-11.82

Table 7-37. Radiated Measurements MIMO

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5280MHz
Channel:	56

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	7039.88	Peak	V	-	-	-65.01	7.75	0.00	49.74	68.20	-18.46
	10560.00	Peak	V	-	-	-69.11	12.39	0.00	50.28	68.20	-17.92
*	15840.00	Average	V	-	-	-80.55	16.71	0.00	43.16	53.98	-10.82
*	15840.00	Peak	V	-	-	-68.88	16.71	0.00	54.83	73.98	-19.15
*	21120.00	Average	V	-	-	-67.21	3.68	-9.54	33.93	53.98	-20.05
*	21120.00	Peak	V	-	-	-57.45	3.68	-9.54	43.69	73.98	-30.29
	26400.00	Peak	V	-	-	-58.23	4.78	-9.54	44.01	68.20	-24.19

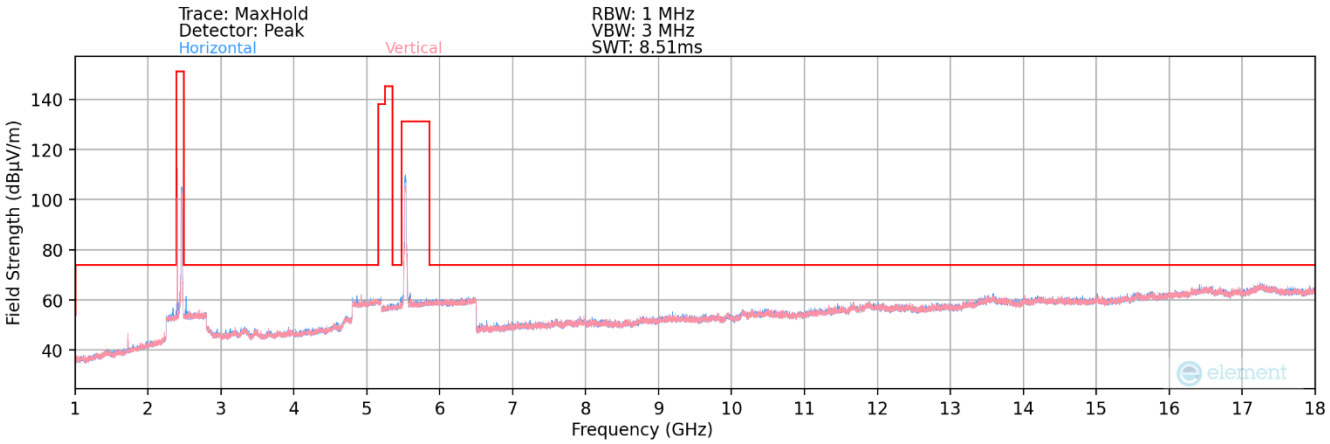
Table 7-38. Radiated Measurements MIMO with WCP

7.6.2 Simultaneous Tx Radiated Spurious Emissions Measurements

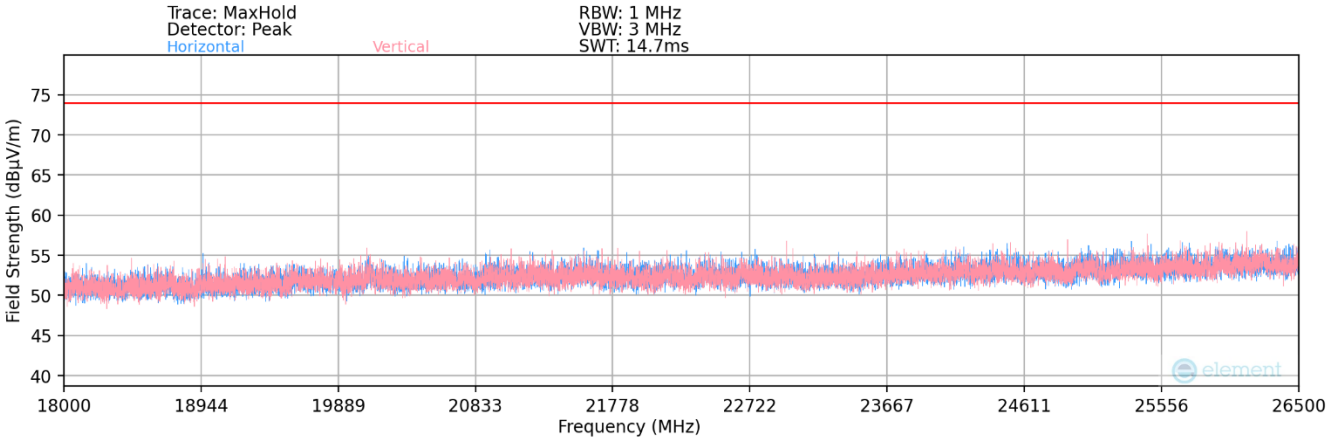
§15.407(b) §15.205 & §15.209

Description	2.4 GHz Emission	5 GHz Emission
Antenna	1	1,2
Channel	6	100
Operating Frequency (MHz)	2437	5500
Data Rate (Mbps)	1	6
Mode	802.11b	802.11a

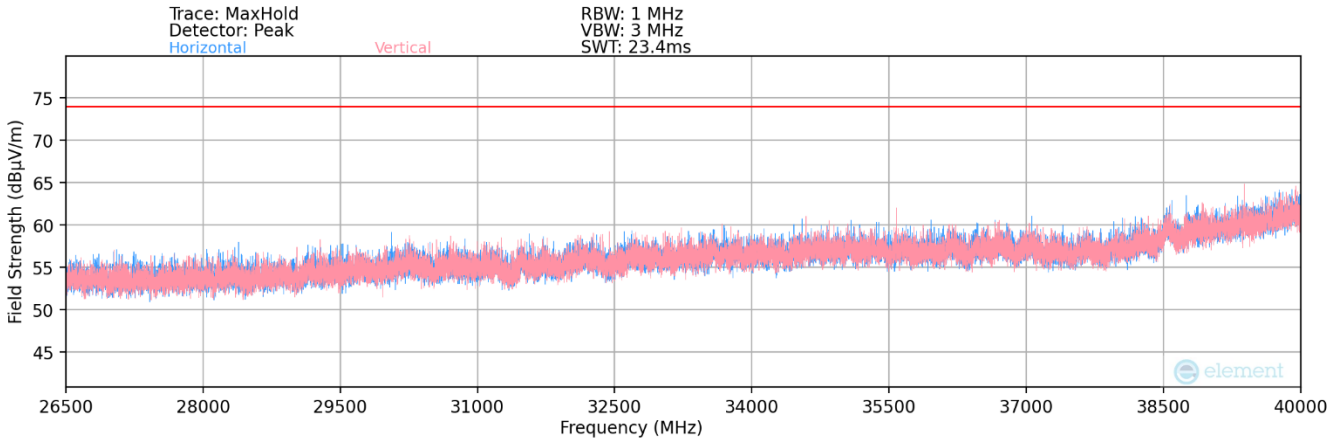
Table 7-39. Simultaneous Transmission Config-1



Plot 7-356. Radiated Spurious Plot above 1GHz (2.4GHz – 5GHz)



Plot 7-357. Radiated Spurious Plot 18GHz – 26.5GHz (2.4GHz – 5GHz)



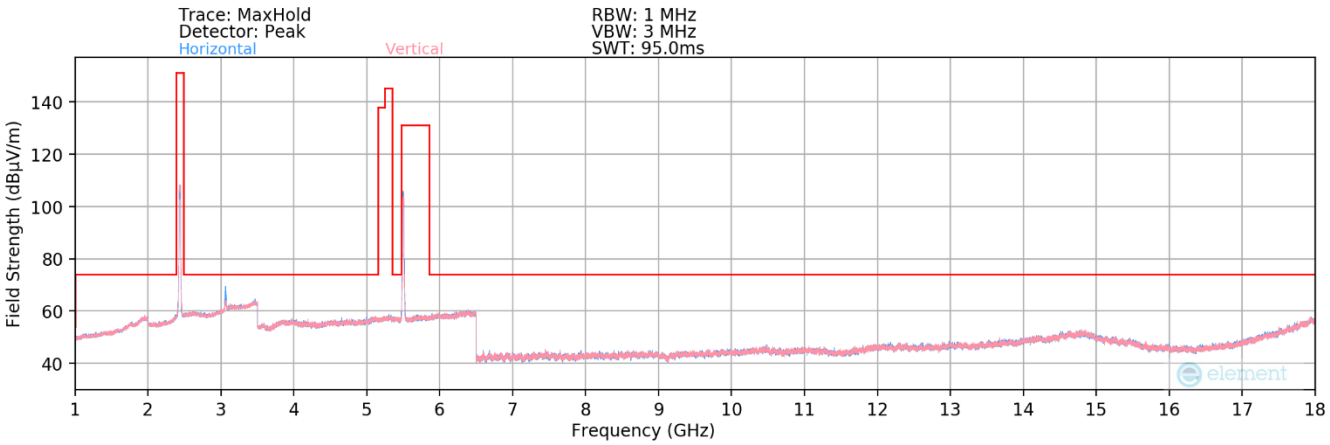
Plot 7-358. Radiated Spurious Plot above 26.5GHz (2.4GHz – 5GHz)

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	3814.00	Avg	H	-	-	-78.00	8.61	37.61	53.98	-16.37
*	3814.00	Peak	H	-	-	-65.21	8.61	50.40	73.98	-23.58
	6952.00	Peak	H	-	-	-78.99	15.75	43.76	68.20	-24.44
	8738.00	Peak	H	-	-	-74.69	18.75	51.06	68.20	-17.14

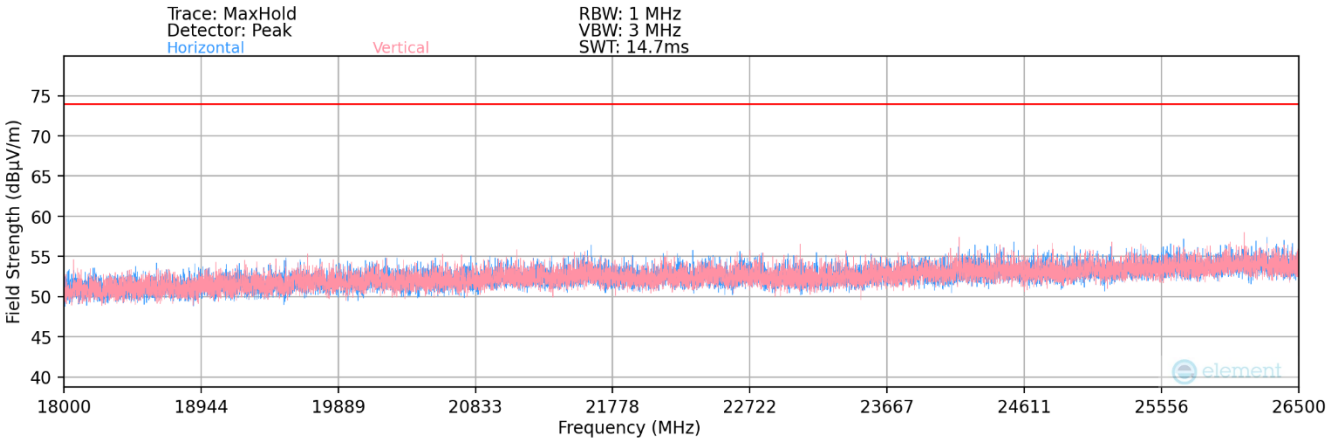
Table 7-40. Radiated Measurements (2.4GHz – 5GHz)

Description	2.4 GHz Emission	5 GHz Emission
Antenna	1,2	1,2
Channel	6	120
Operating Frequency (MHz)	2437	5600
Data Rate (Mbps)	1Mbps	6Mbps
Mode	b	a

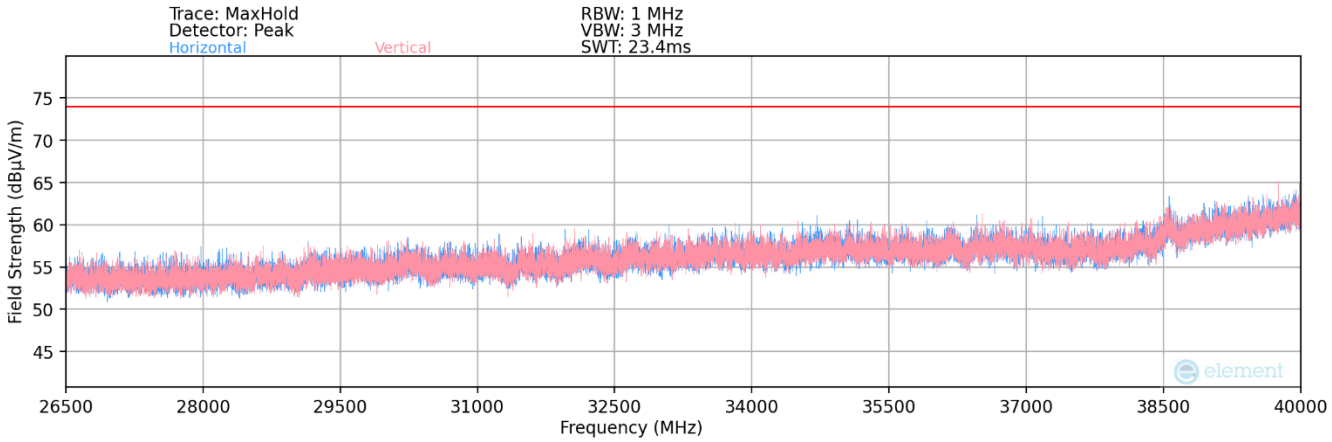
Table 7-41. Dual Band Simultaneous Transmission



Plot 7-359. Radiated Spurious Plot above 1GHz (Dual Band Simult. Tx)



Plot 7-360. Radiated Spurious Plot 18GHz – 26.5GHz (Dual Band Simult. Tx)



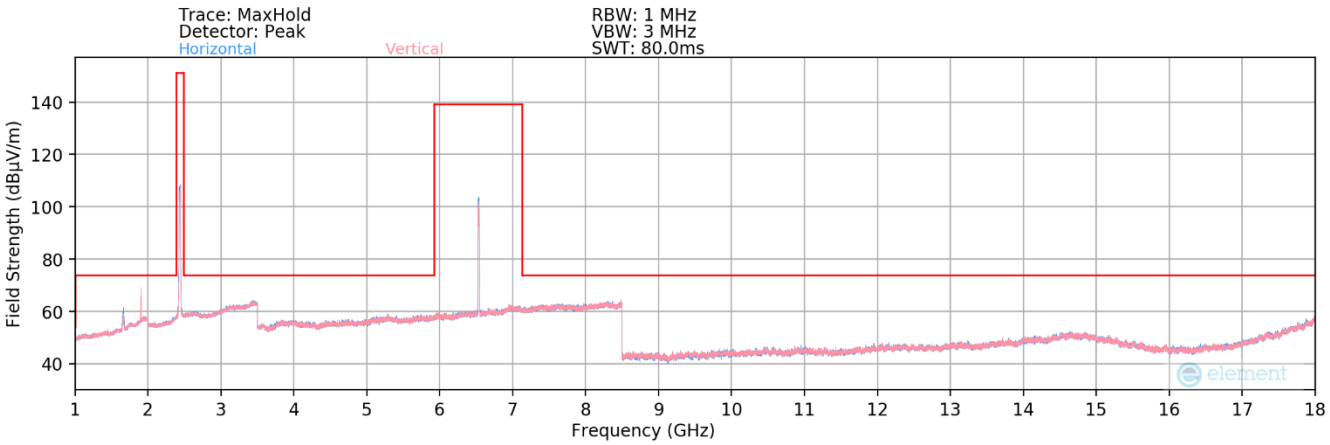
Plot 7-361. Radiated Spurious Plot above 26.5GHz (Dual Band Simult. Tx)

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	4524.00	Avg	H	-	-	-77.69	9.71	39.02	53.98	-14.96
*	4524.00	Peak	H	-	-	-66.01	9.71	50.70	73.98	-23.28
*	9448.00	Avg	H	-	-	-84.99	19.65	41.66	53.98	-12.32
*	9448.00	Peak	H	-	-	-78.48	19.65	48.17	73.98	-25.81
*	11510.00	Avg	H	-	-	-84.39	23.89	46.50	53.98	-7.48
*	11510.00	Peak	H	-	-	-75.21	23.89	55.68	73.98	-18.30

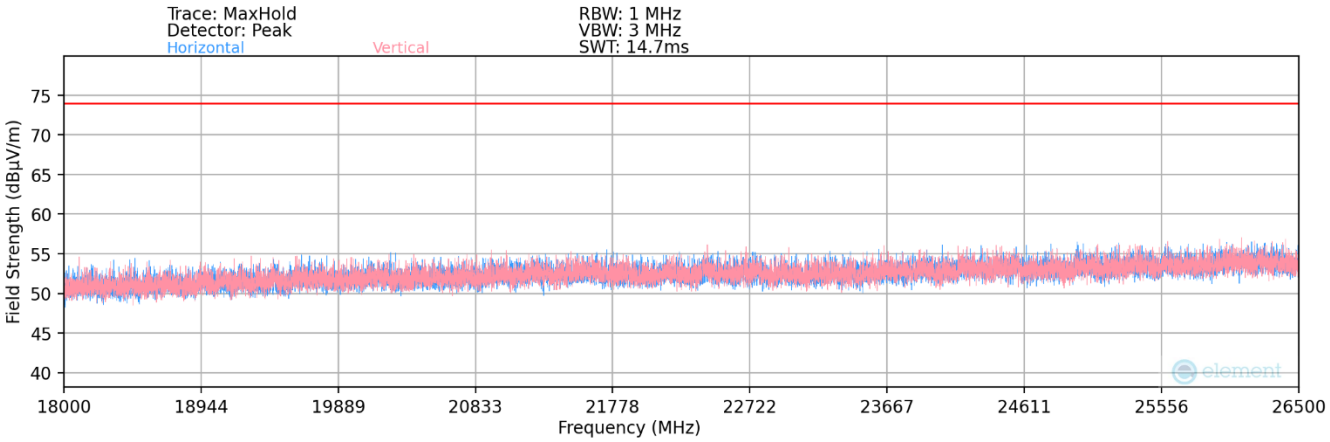
Table 7-42. Radiated Measurements (Dual Band Simult. Tx)

Description	2.4 GHz Emission	6 GHz Emission
Antenna	1,2	1,2
Channel	6	117
Operating Frequency (MHz)	2437	6535
Data Rate (Mbps)	1Mbps	6Mbps
Mode	b	a

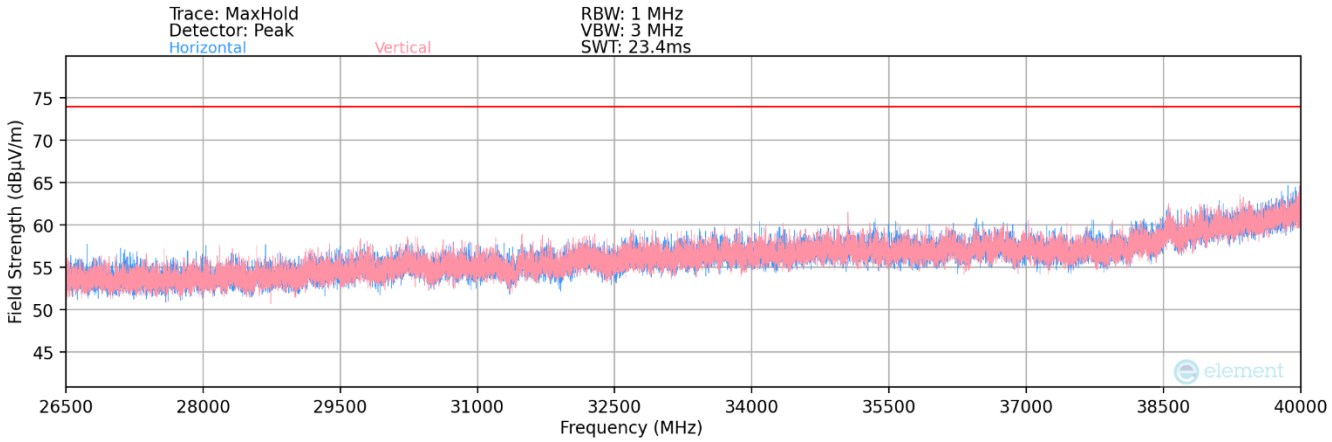
Table 7-43. Dual Band Simultaneous Transmission



Plot 7-362. Radiated Spurious Plot above 1GHz (Dual Band Simult. Tx)



Plot 7-363. Radiated Spurious Plot 18GHz – 26.5GHz (Dual Band Simult. Tx)



Plot 7-364. Radiated Spurious Plot above 26.5GHz (Dual Band Simult. Tx)

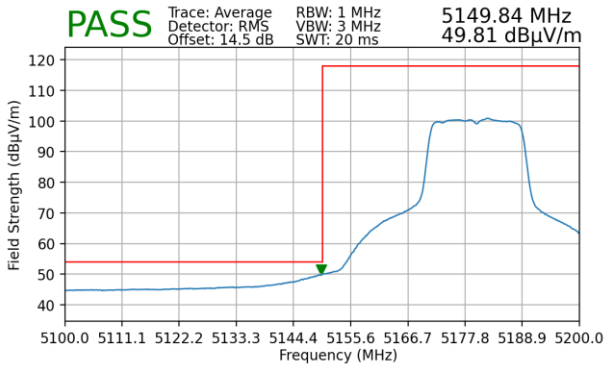
	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	3094.00	Peak	H	-	-	-65.13	7.95	49.82	68.20	-18.38
	7898.00	Peak	H	-	-	-73.27	16.45	50.18	68.20	-18.02
*	10676.00	Avg	H	-	-	-85.99	20.30	41.31	53.98	-12.67
*	10676.00	Peak	H	-	-	-70.65	20.30	56.65	73.98	-17.33

Table 7-44. Radiated Measurements (Dual Band Simult. Tx)

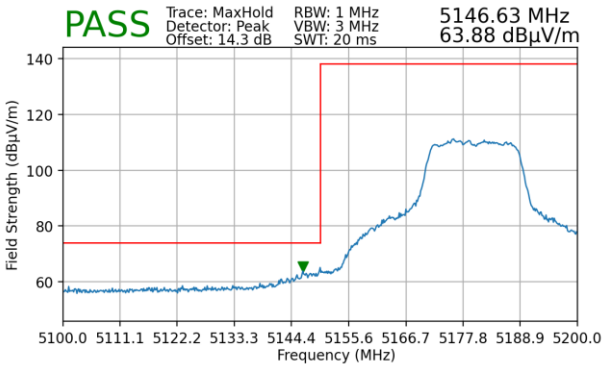
7.6.3 MIMO/CDD Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	36

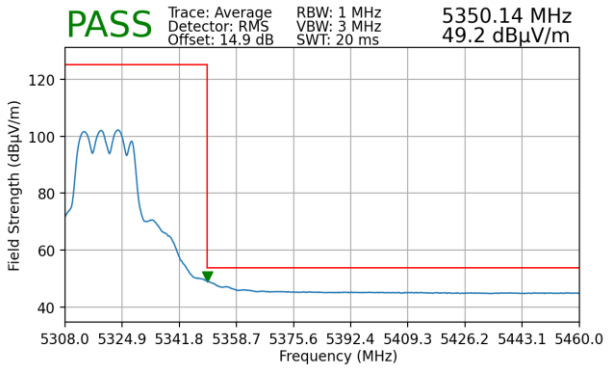


Plot 7-365. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 1)

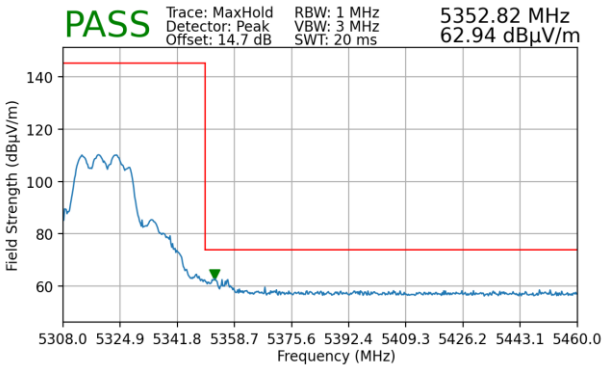


Plot 7-366. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 1)

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5320MHz
Channel:	64

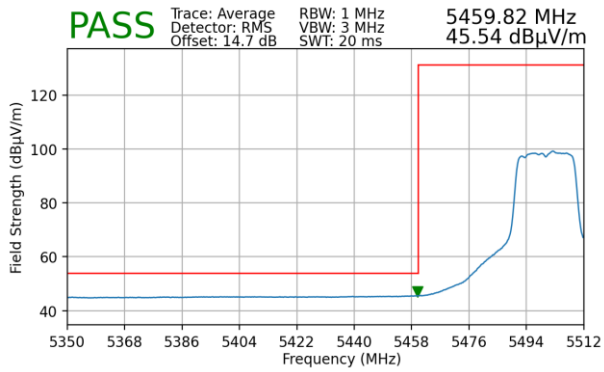


Plot 7-367. Radiated Upper Band Edge Plot CDD (Average – UNII Band 2A)

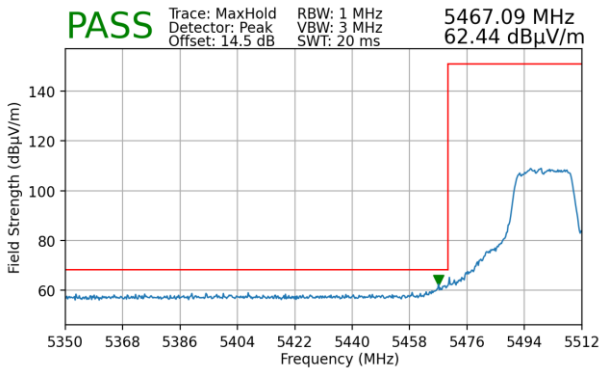


Plot 7-368. Radiated Upper Band Edge Plot CDD (Peak – UNII Band 2A)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5500MHz
Channel:	100

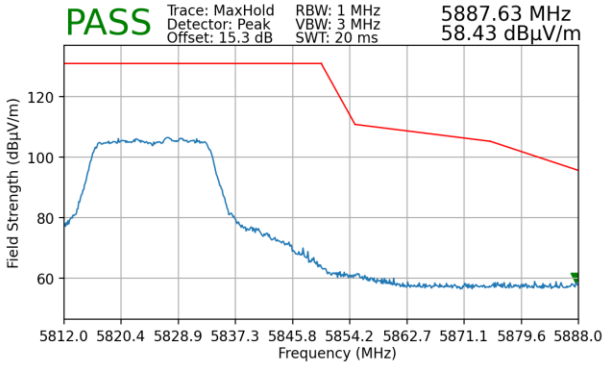


Plot 7-369. Radiated Lower Band Edge Plot CDD (Average – UNII Band 2C)



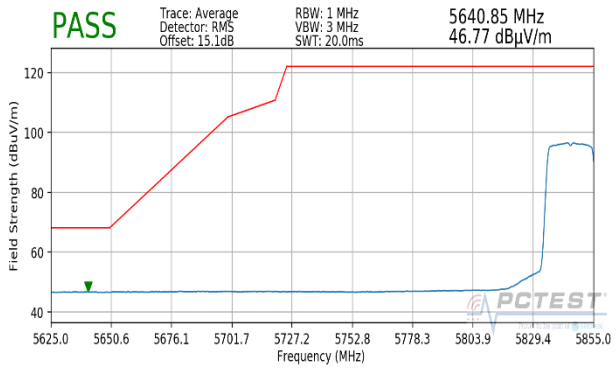
Plot 7-370. Radiated Lower Band Edge Plot CDD (Peak – UNII Band 2C)

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5825MHz
Channel:	165

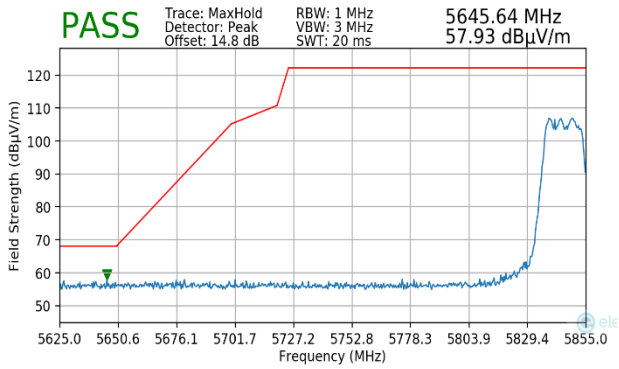


Plot 7-371. Radiated Upper Band Edge Plot CDD (Peak – UNII Band 3)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5845MHz
Channel:	169

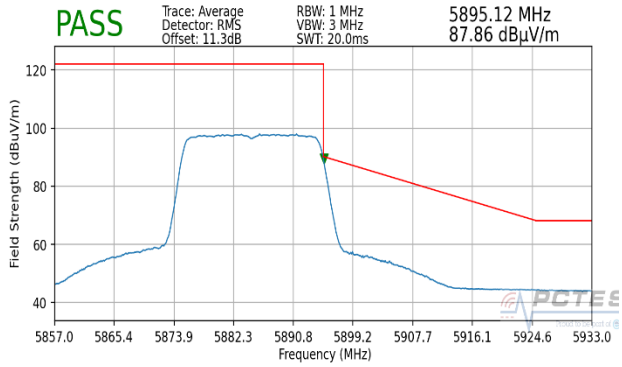


Plot 7-372. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 4)

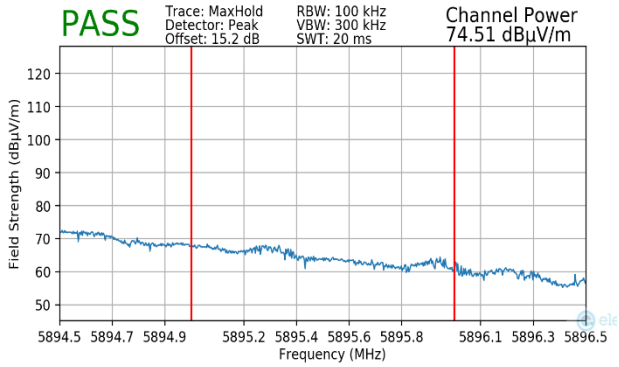


Plot 7-373. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 4)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5885MHz
Channel:	177



Plot 7-374. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 4)

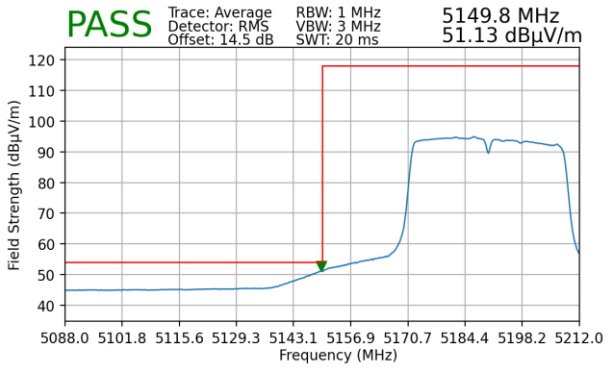


Plot 7-375. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 4)

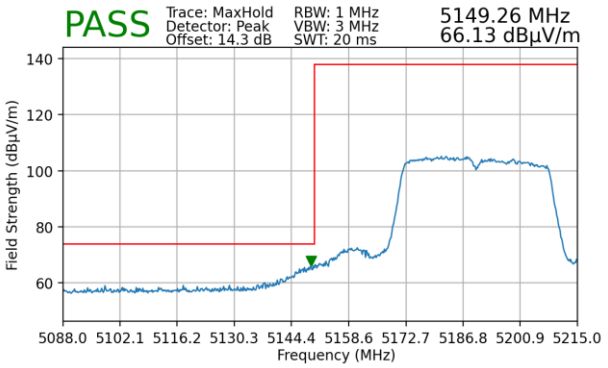
7.6.4 MIMO Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5190MHz
Channel:	38

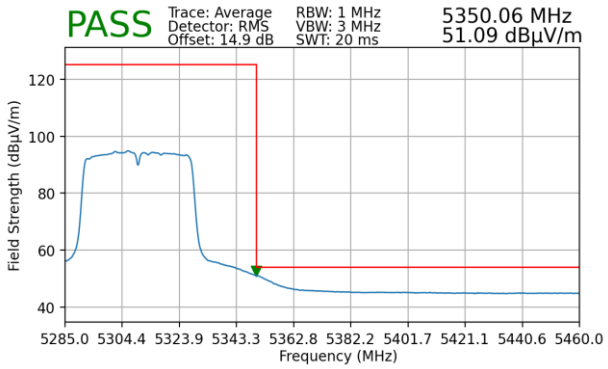


Plot 7-376. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 1)

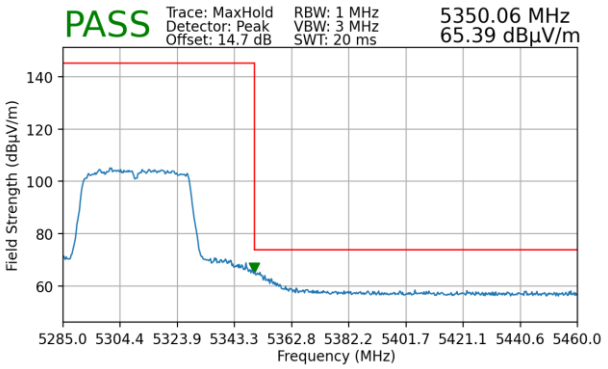


Plot 7-377. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 1)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5310MHz
Channel:	62

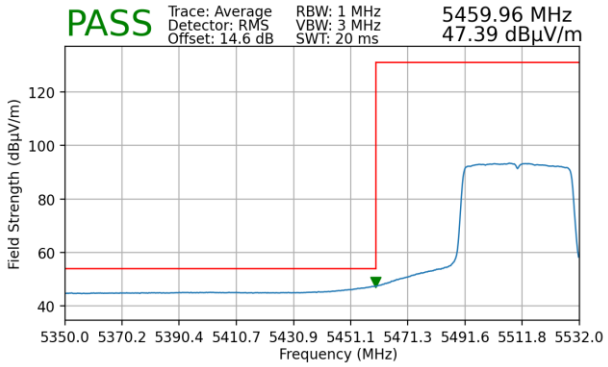


Plot 7-378. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 2A)

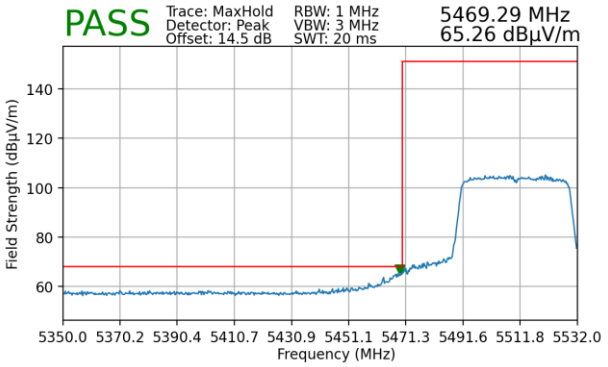


Plot 7-379. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 2A)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5510MHz
Channel:	102

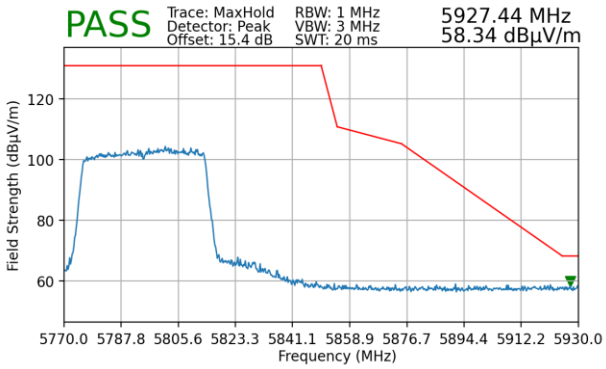


Plot 7-380. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 2C)



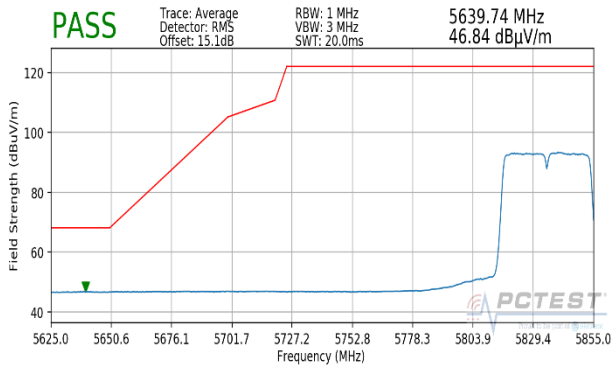
Plot 7-381. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 2C)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	5795MHz
Channel:	159

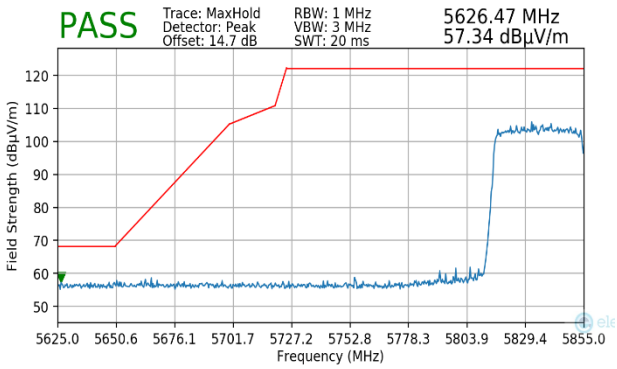


Plot 7-382. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 3)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5835MHz
Channel:	167

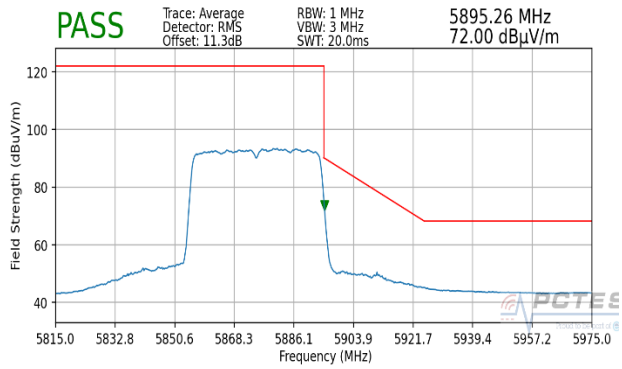


Plot 7-383. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 4)

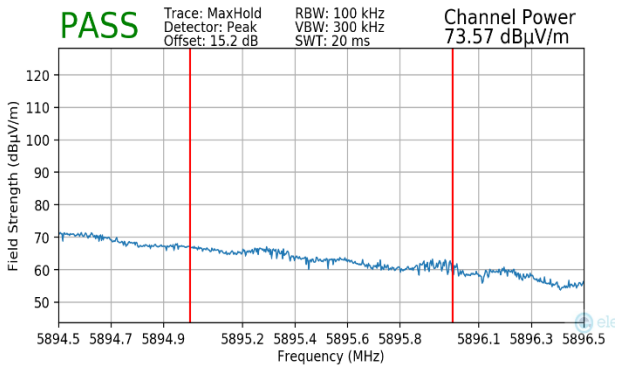


Plot 7-384. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 4)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5875MHz
Channel:	175



Plot 7-385. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 4)

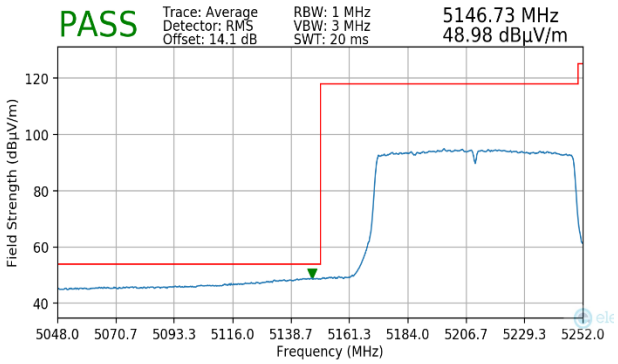


Plot 7-386. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 4)

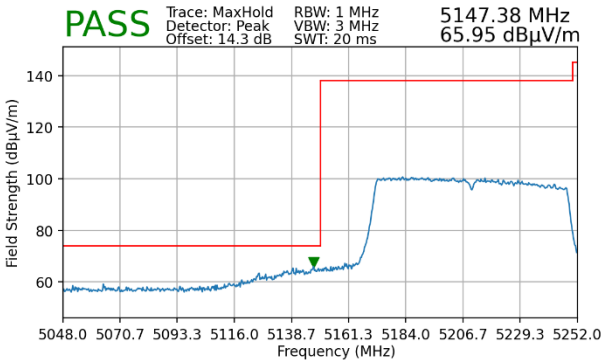
7.6.5 MIMO Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11ac
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5210MHz
Channel:	42

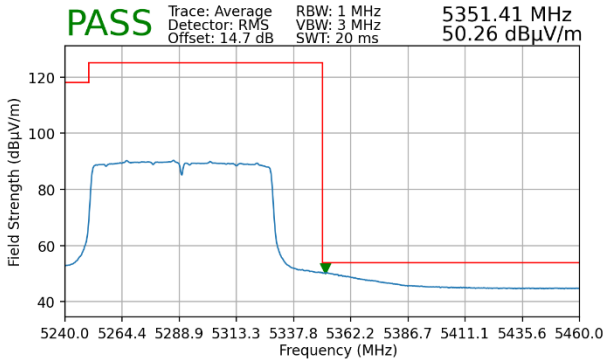


Plot 7-387. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 1)

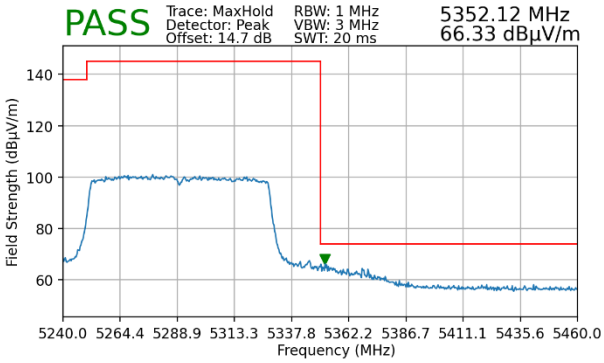


Plot 7-388. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 1)

Worst Case Mode:	802.11ac
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5290MHz
Channel:	58

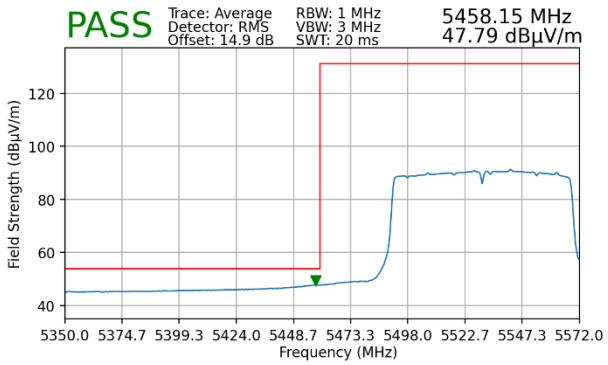


Plot 7-389. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 2A)

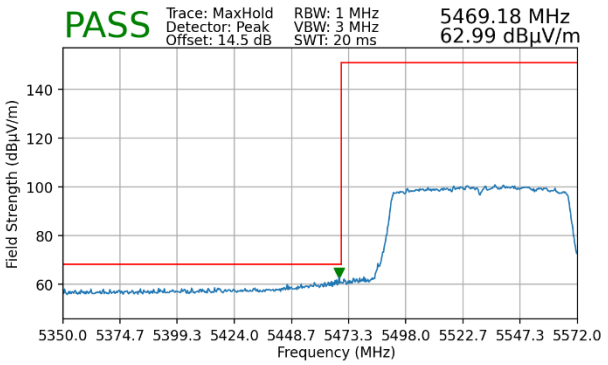


Plot 7-390. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 2A)

Worst Case Mode:	802.11ac
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5530MHz
Channel:	106

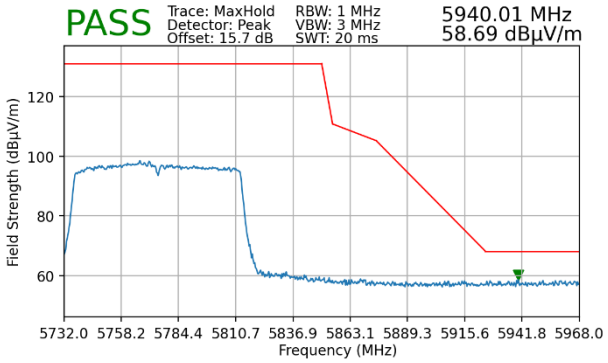


Plot 7-391. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 2C)



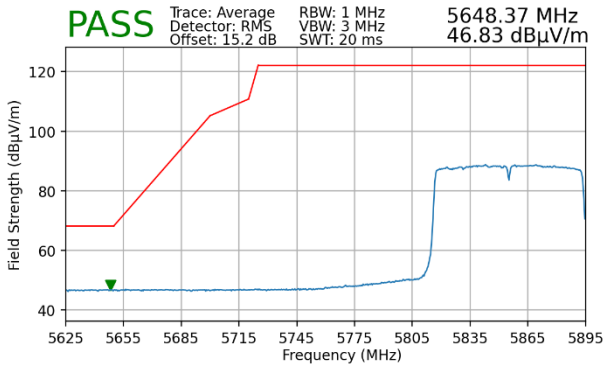
Plot 7-392. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 2C)

Worst Case Mode:	802.11ac
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5775MHz
Channel:	155

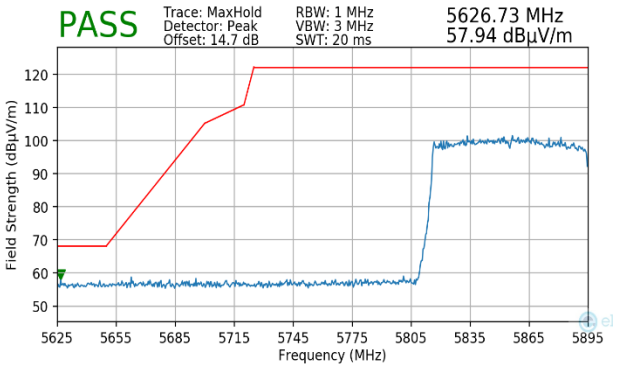


Plot 7-393. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 3)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5855MHz
Channel:	171

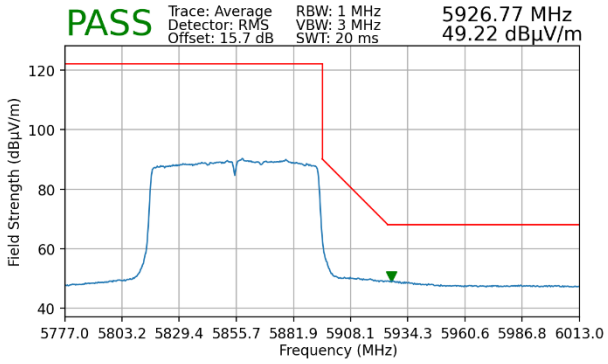


Plot 7-394. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 4)

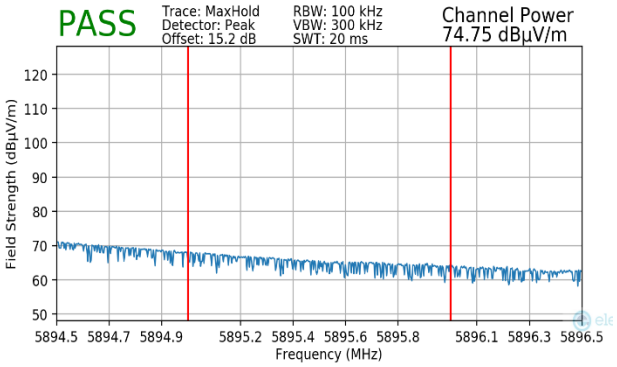


Plot 7-395. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 4)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5855MHz
Channel:	171



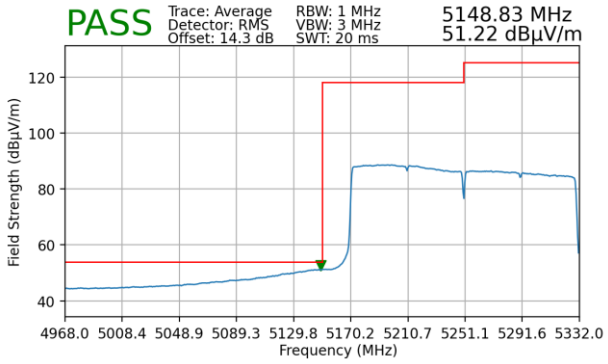
Plot 7-396. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 4)



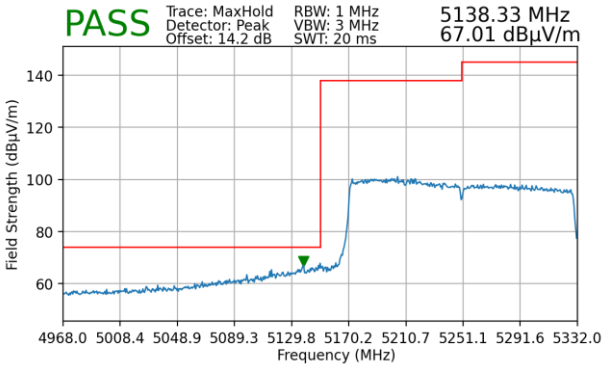
Plot 7-397. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 4)

7.6.6 MIMO Radiated Band Edge Measurements (160MHz BW)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5250MHz
Channel:	50

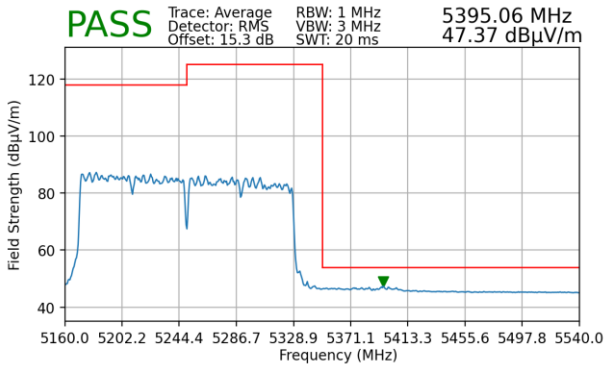


Plot 7-398. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 1)

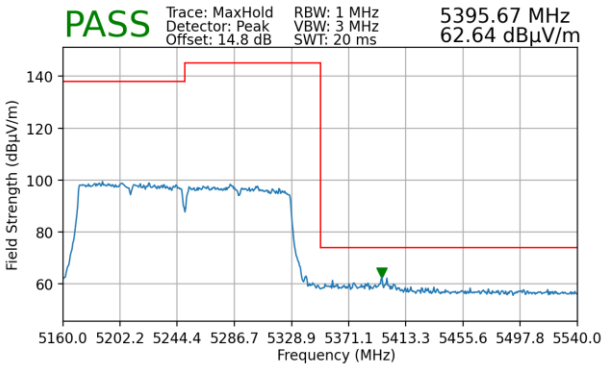


Plot 7-399. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 1)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5250MHz
Channel:	50

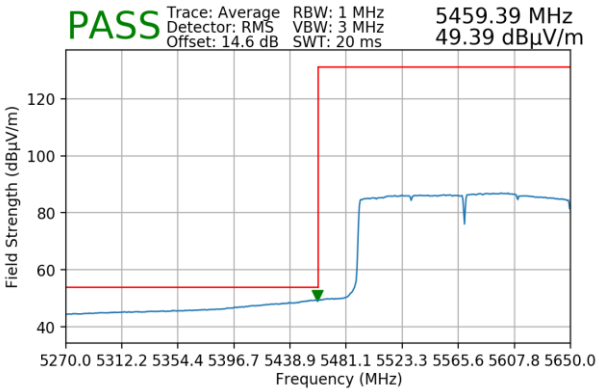


Plot 7-400. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 2A)

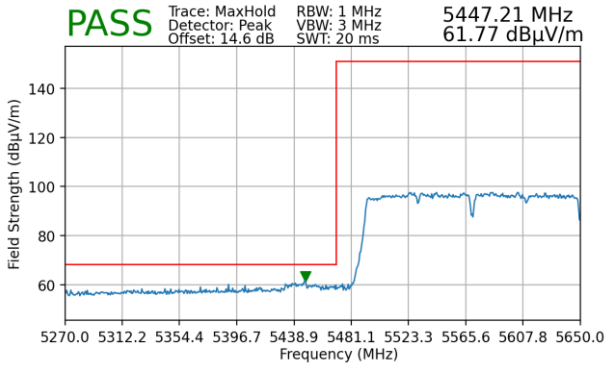


Plot 7-401. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 2A)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5570MHz
Channel:	114

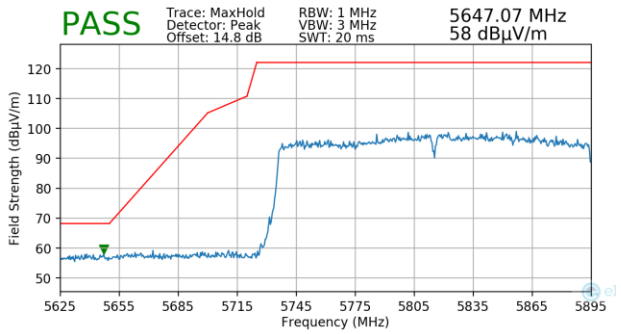


Plot 7-402. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 2C)



Plot 7-403. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 2C)

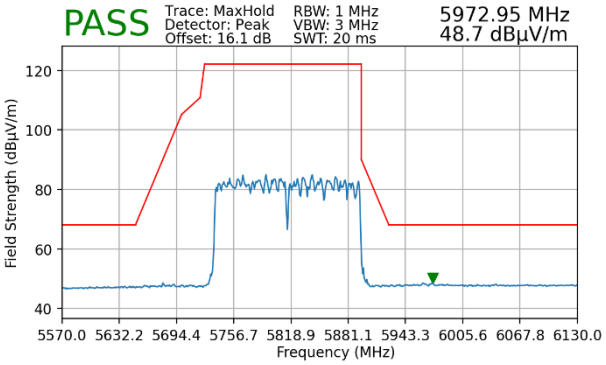
Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5815MHz
Channel:	163



Plot 7-404. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 4)

Worst Case Mode:

Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5815MHz
Channel:	163



Plot 7-405. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 4)

7.6.7 Radiated Spurious Emissions Measurements – Below 1GHz

§15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-45 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-45. Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

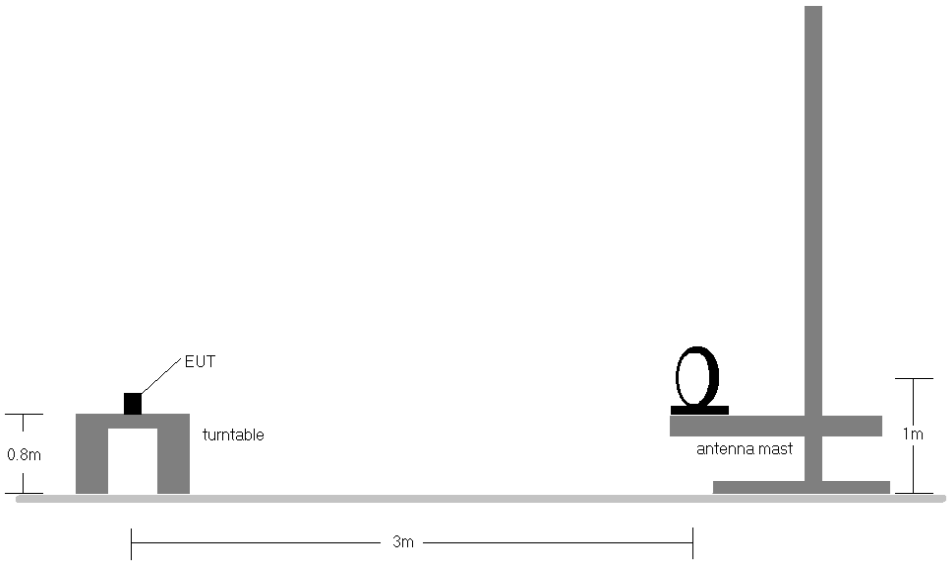


Figure 7-6. Radiated Test Setup < 30MHz

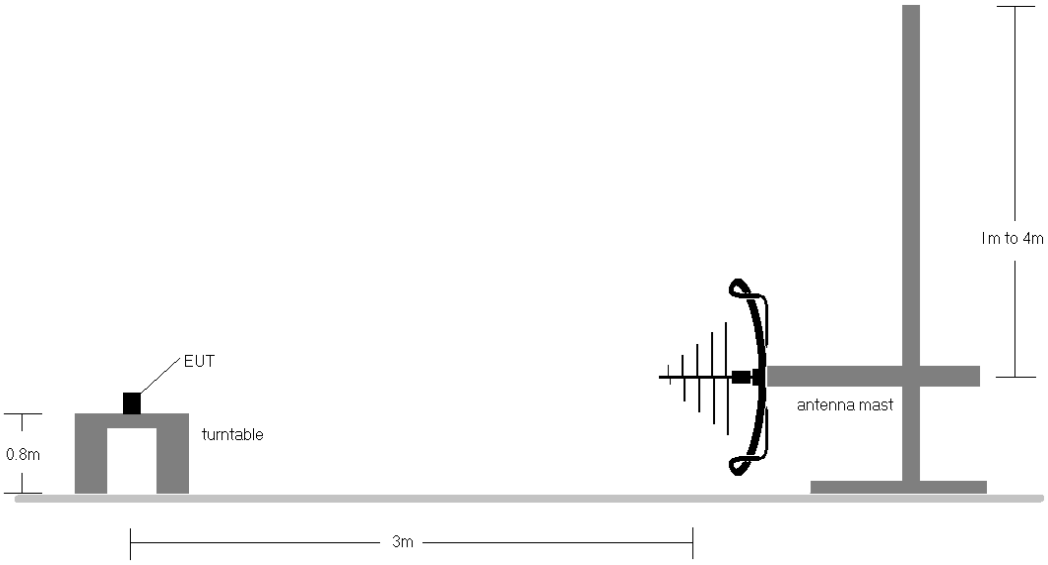


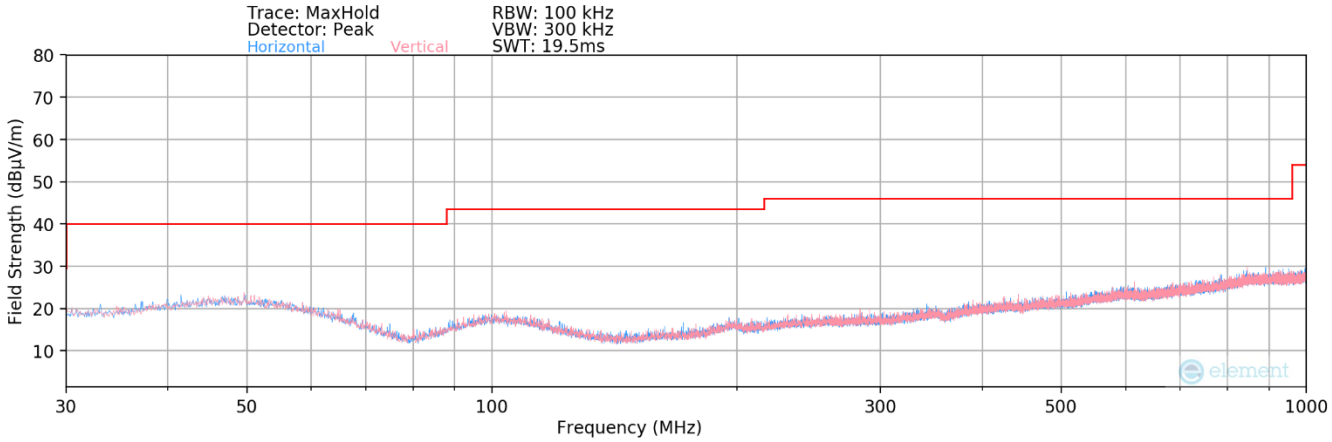
Figure 7-7. Radiated Test Setup < 1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen (8.10) are below the limit shown in Table 7-45.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested with its standard battery.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

MIMO Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 7-406. Radiated Spurious Plot below 1GHz MIMO (802.11a – U3 Ch. 157)

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
32.36	Quasi-Peak	V	-	-	-96.96	25.75	35.79	40.00	-4.21
35.98	Quasi-Peak	V	-	-	-98.32	23.21	31.89	40.00	-8.11
81.00	Quasi-Peak	V	-	-	-96.47	14.23	24.76	40.00	-15.24
711.00	Quasi-Peak	V	-	-	-95.24	28.83	40.59	46.02	-5.43

Table 7-46. Radiated Spurious Emissions below 1GHz MIMO

7.7 Line-Conducted Test Data

§15.407

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-47. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

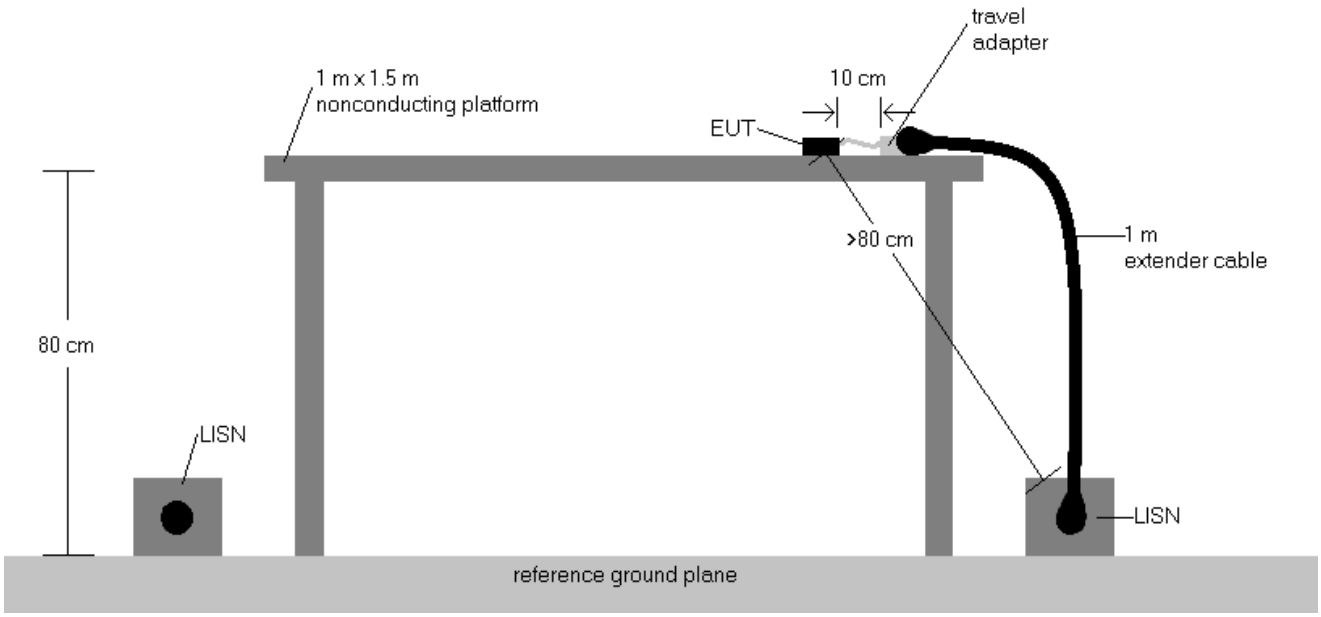
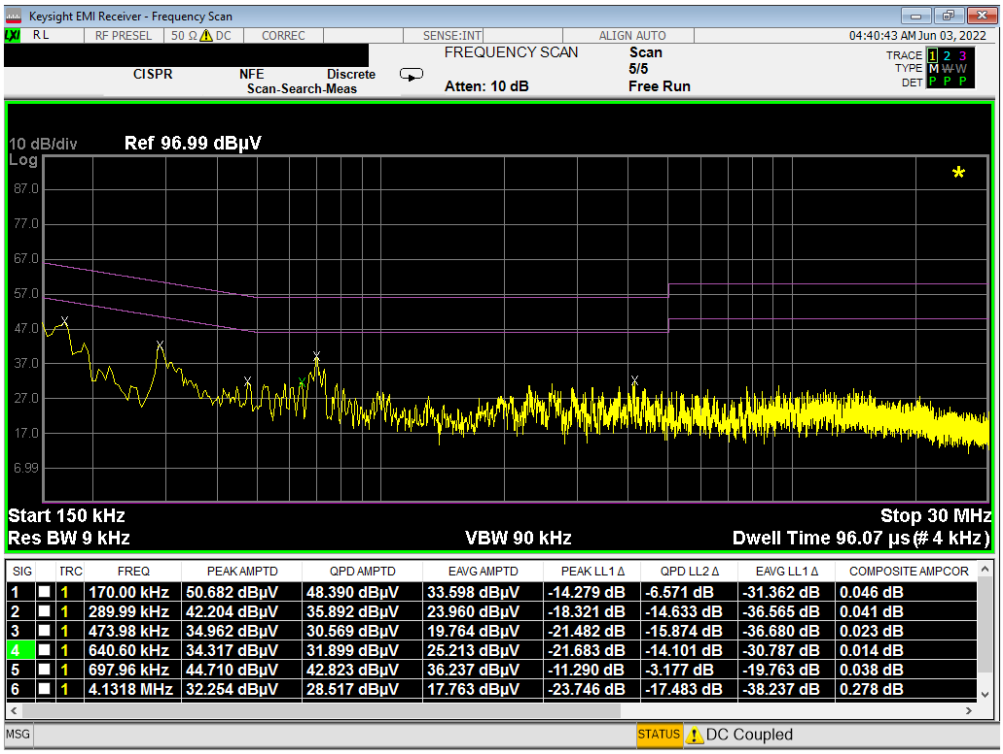


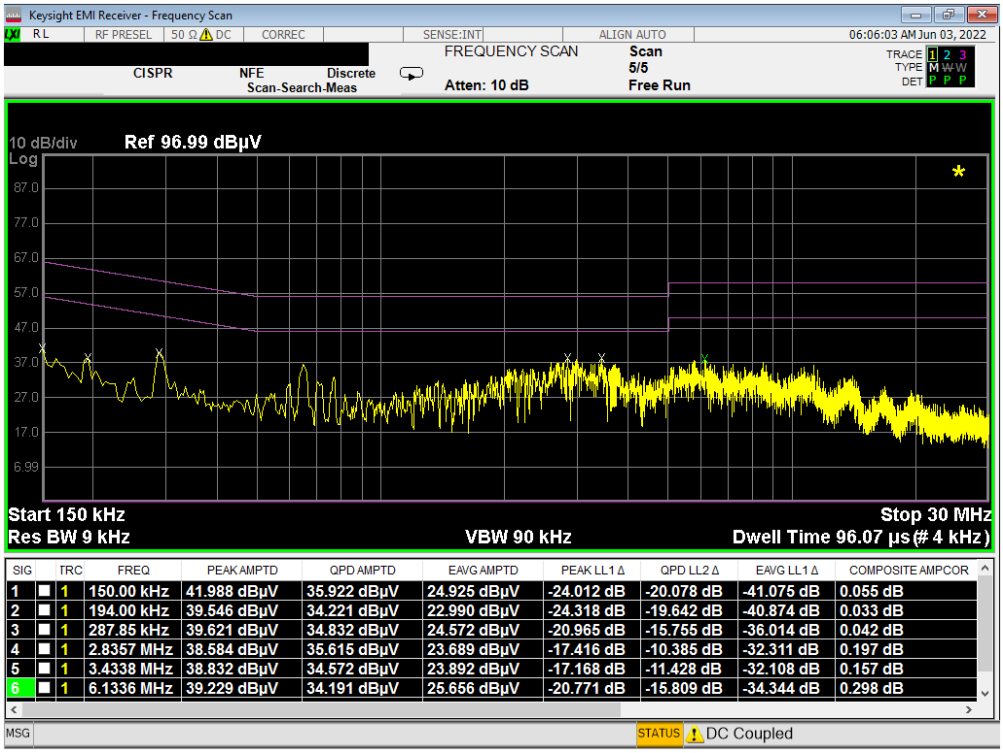
Figure 7-8. Test Instrument & Measurement Setup

Test Notes

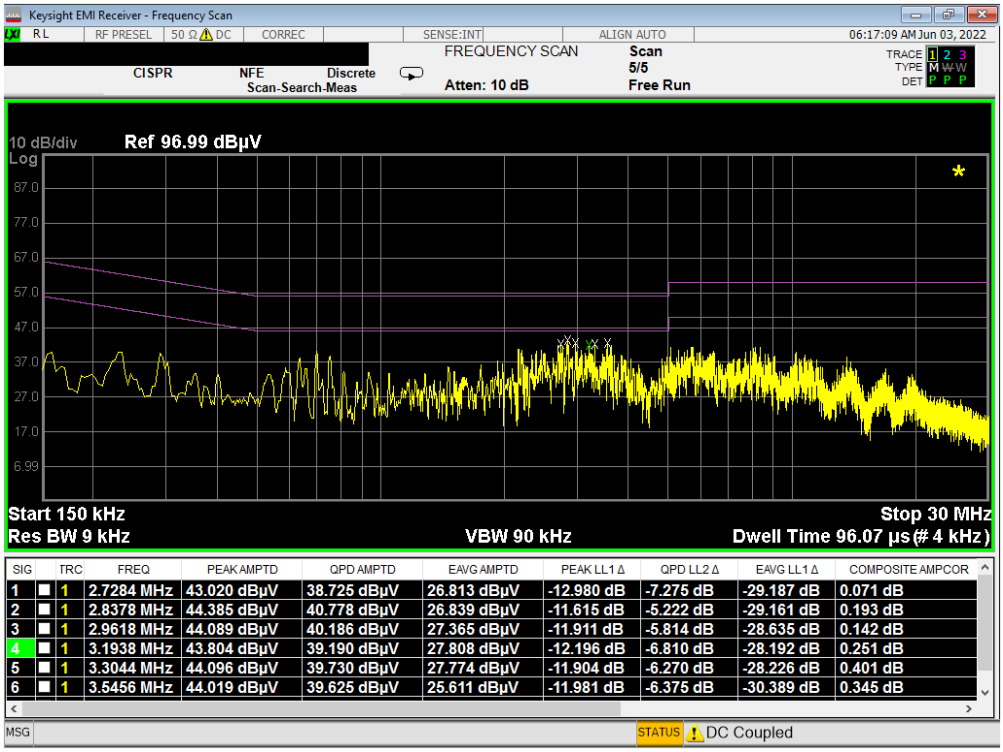
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207 and RSS-Gen (8.8).
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Limit (dBμV) - QP/AV Level (dBμV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.



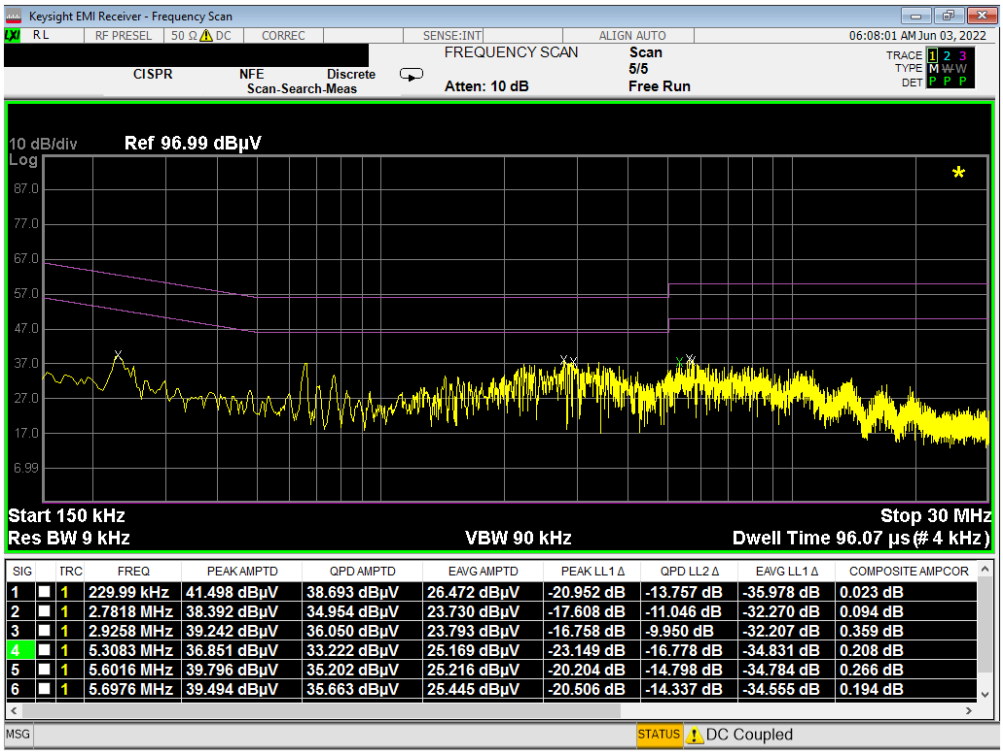
Plot 7-407. Line Conducted Plot with 802.11a UNII Band 1 (L1) - Open



Plot 7-408. Line Conducted Plot with 802.11a UNII Band 1 (N) - Open



Plot 7-409. Line Conducted Plot with 802.11a UNII Band 2A (L1) - Open



Plot 7-410. Line Conducted Plot with 802.11a UNII Band 2A (N) - Open