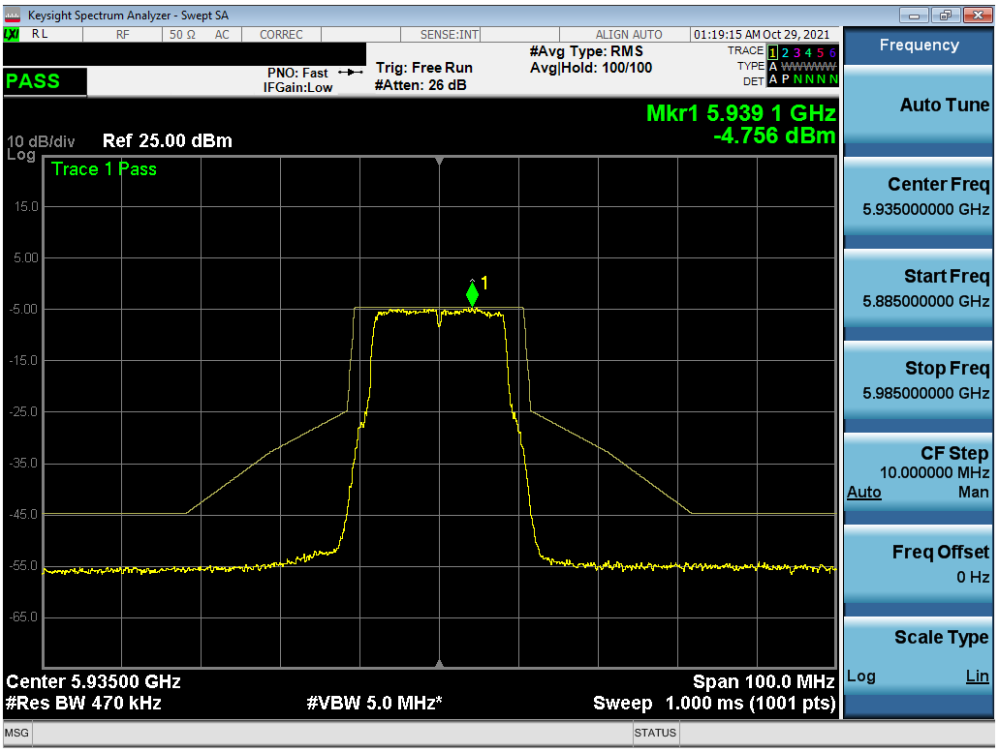
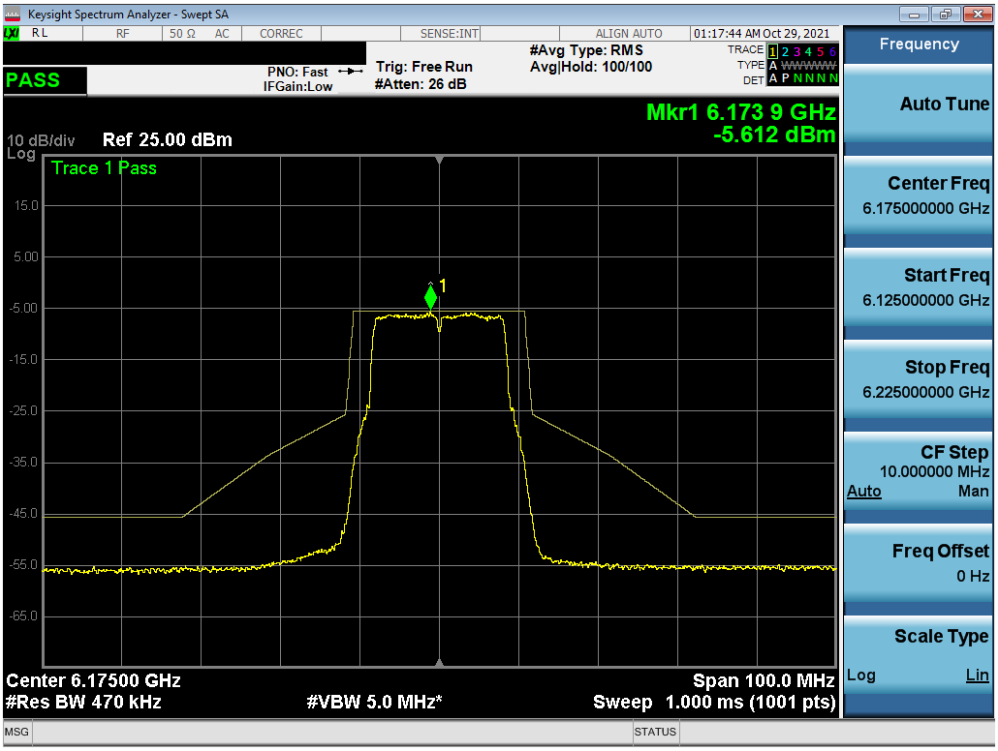
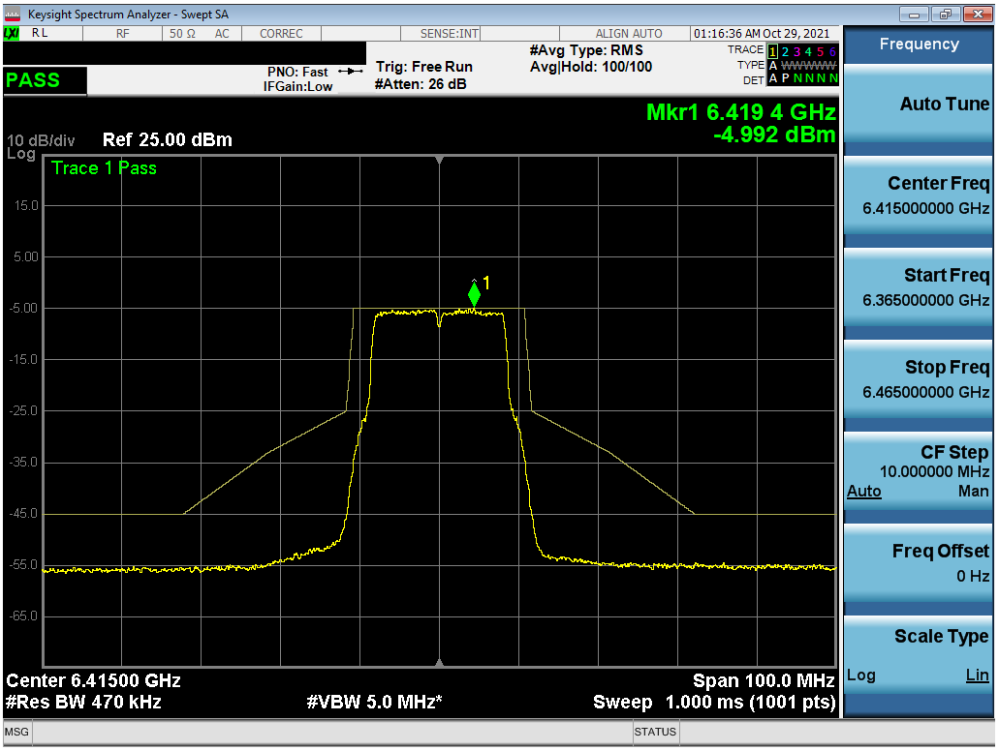
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 5)



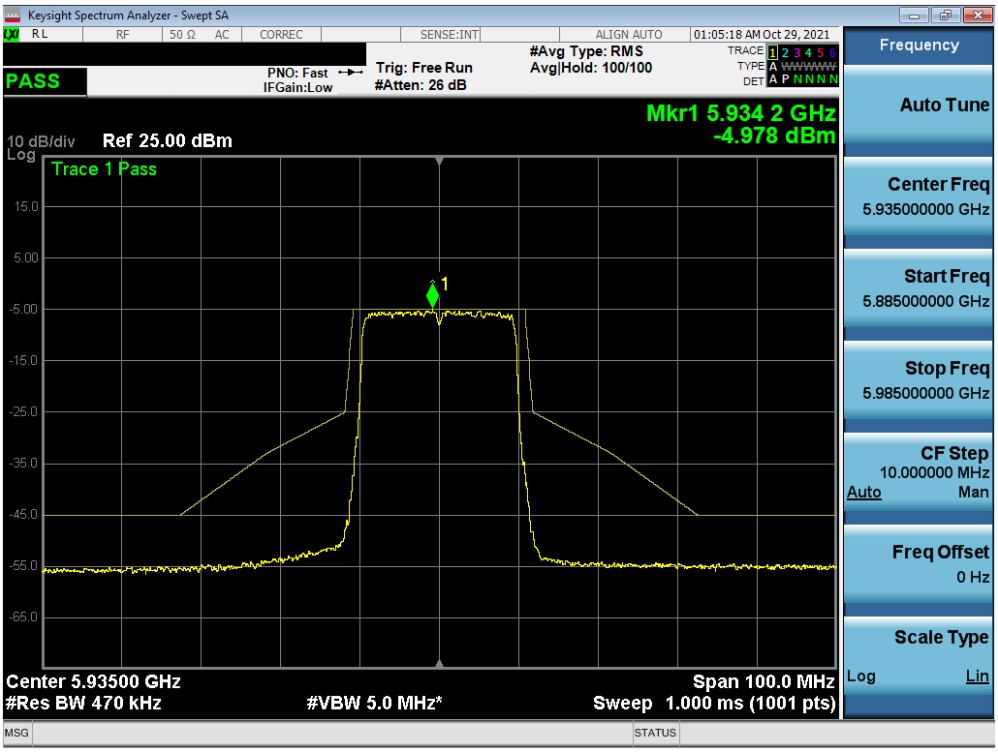
Plot 7-261. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 2)



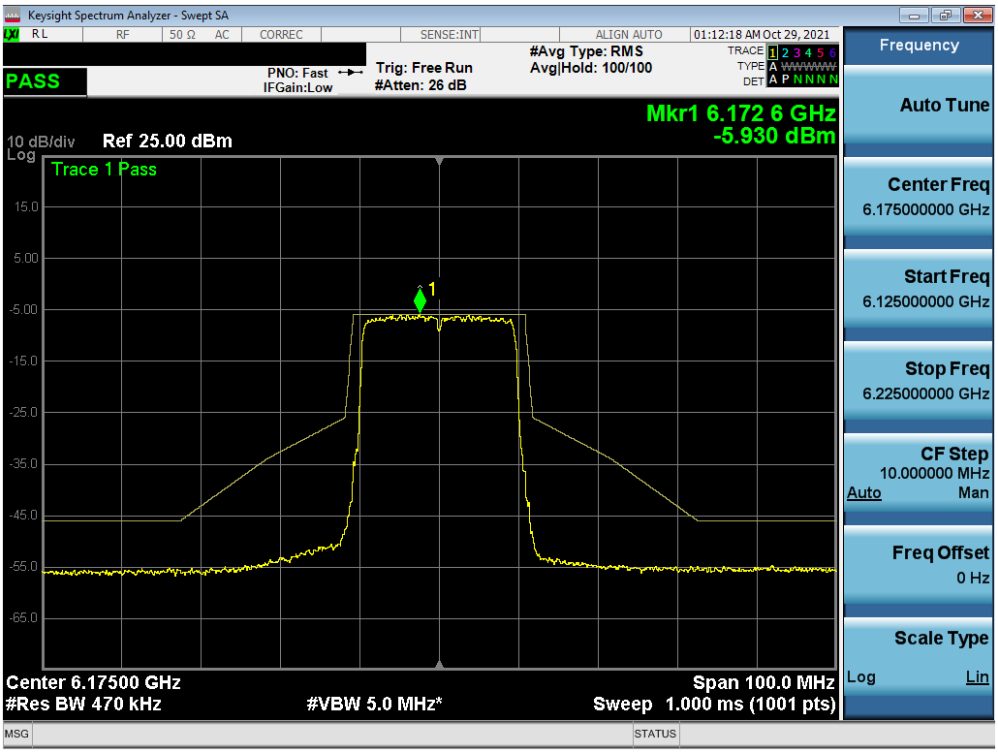
Plot 7-262. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 45)



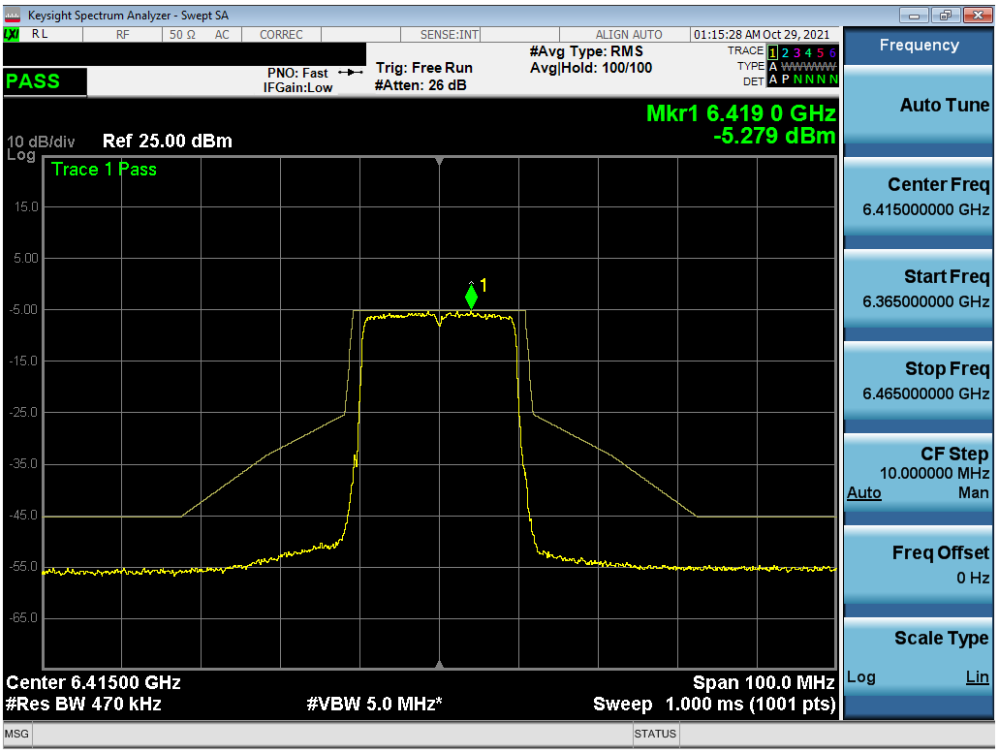
Plot 7-263. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 93



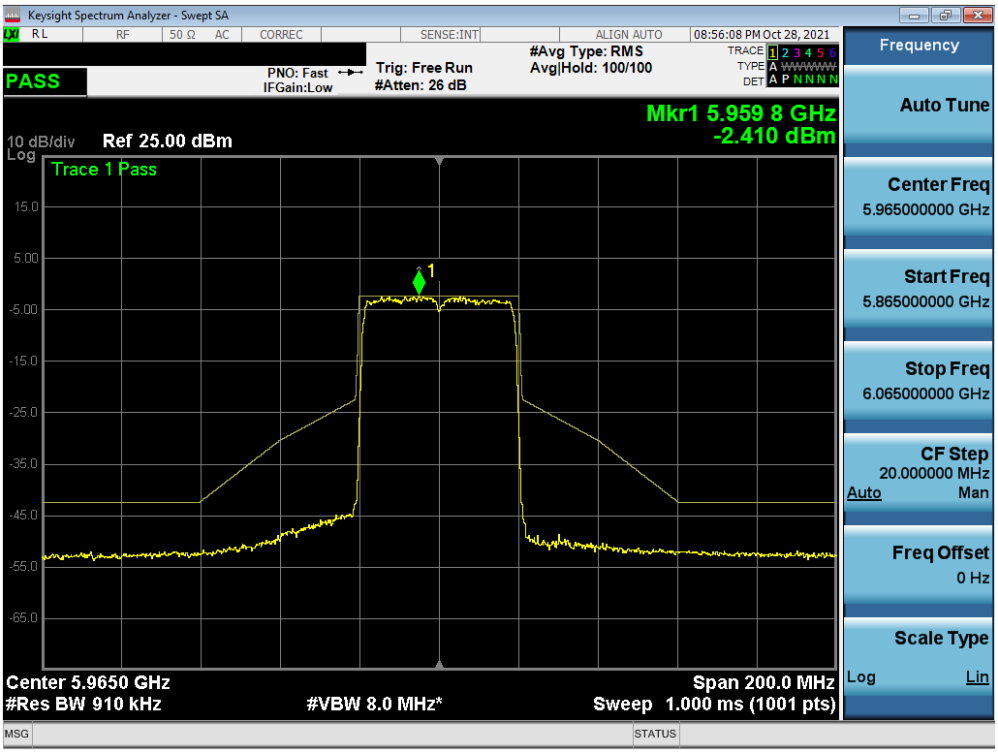
Plot 7-264. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 2)



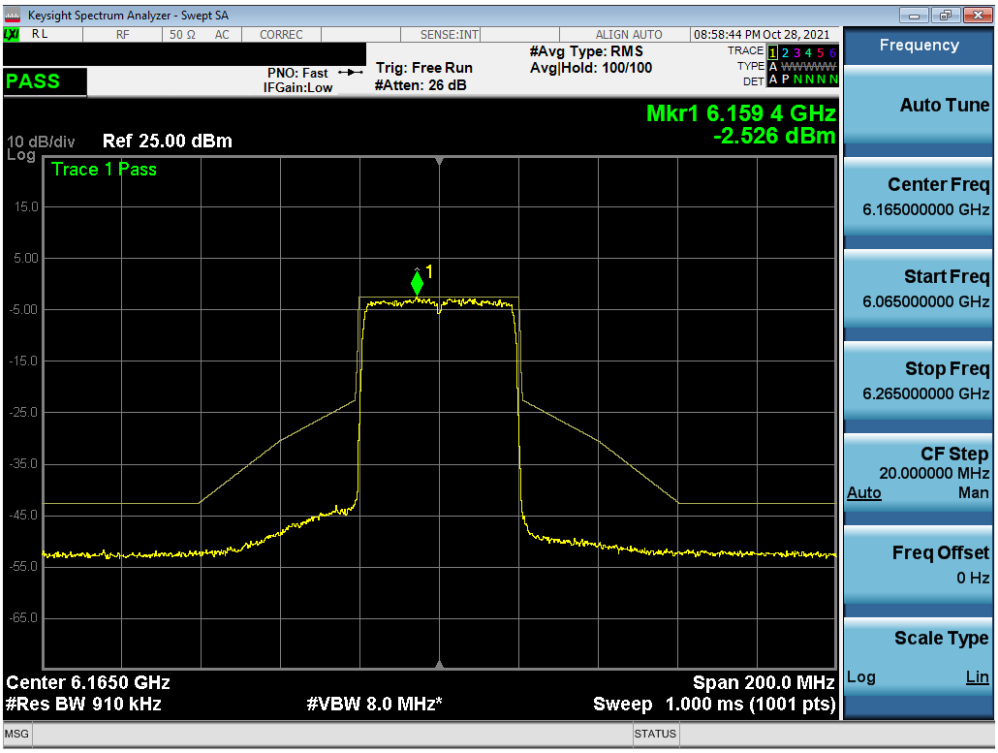
Plot 7-265. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 45)



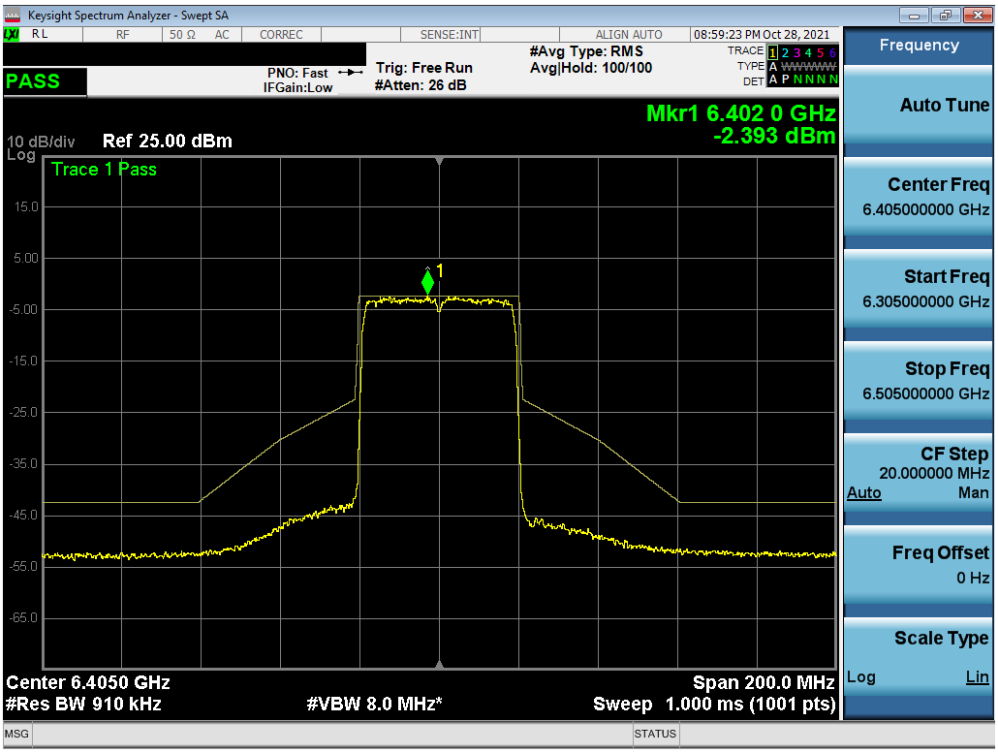
Plot 7-266. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 93



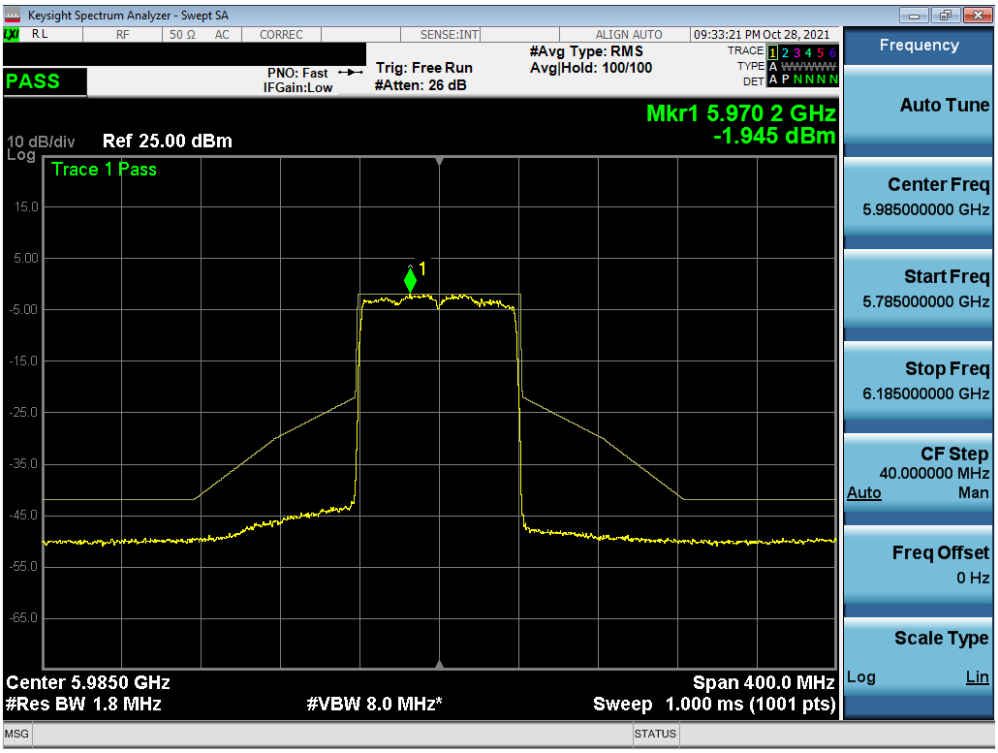
Plot 7-267. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 3)



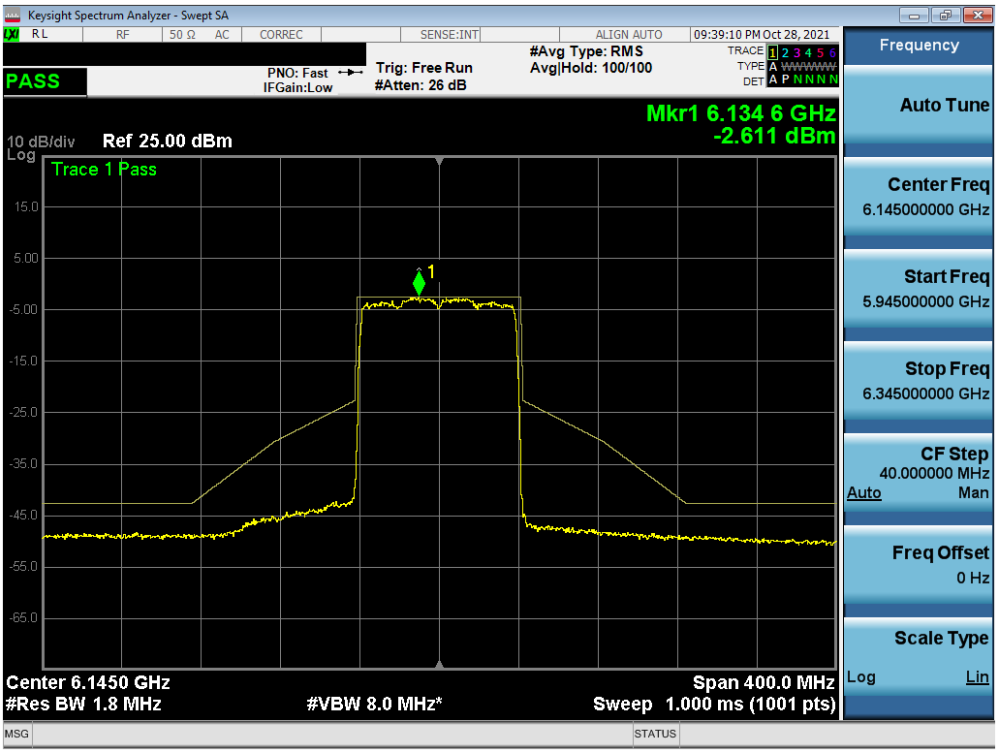
Plot 7-268. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 43)



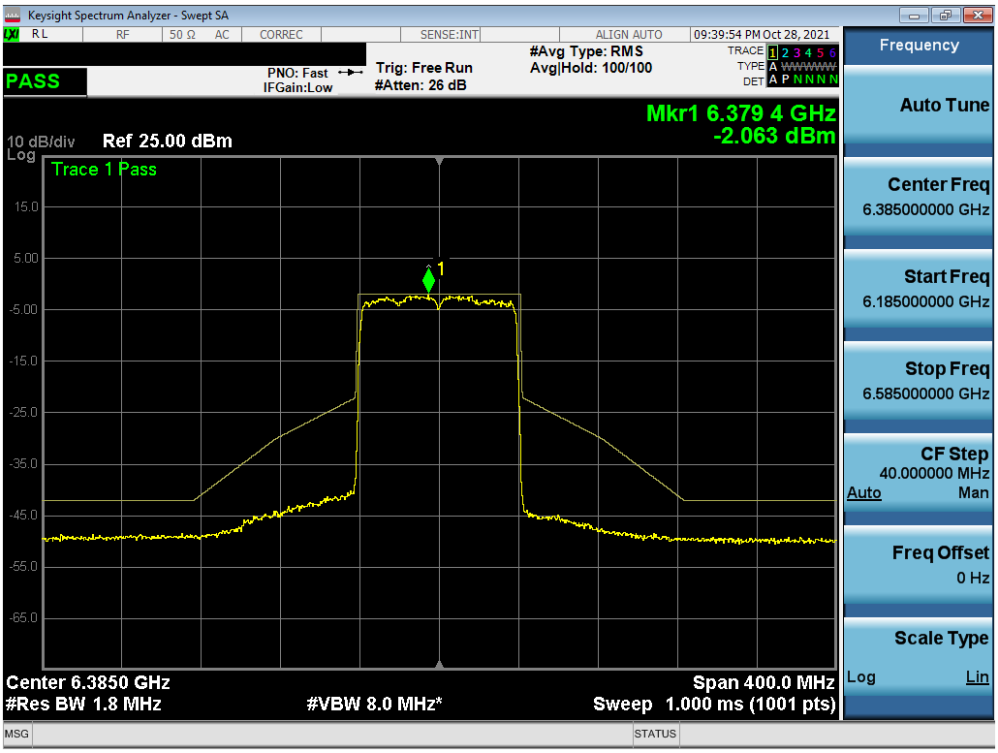
Plot 7-269. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



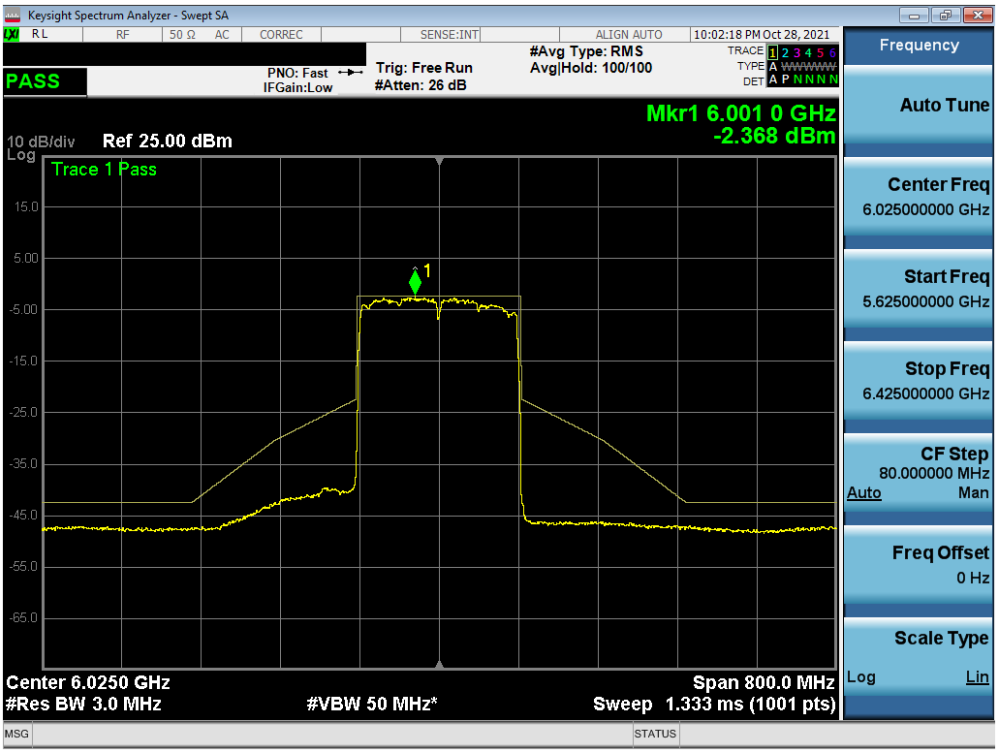
Plot 7-270. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 7)



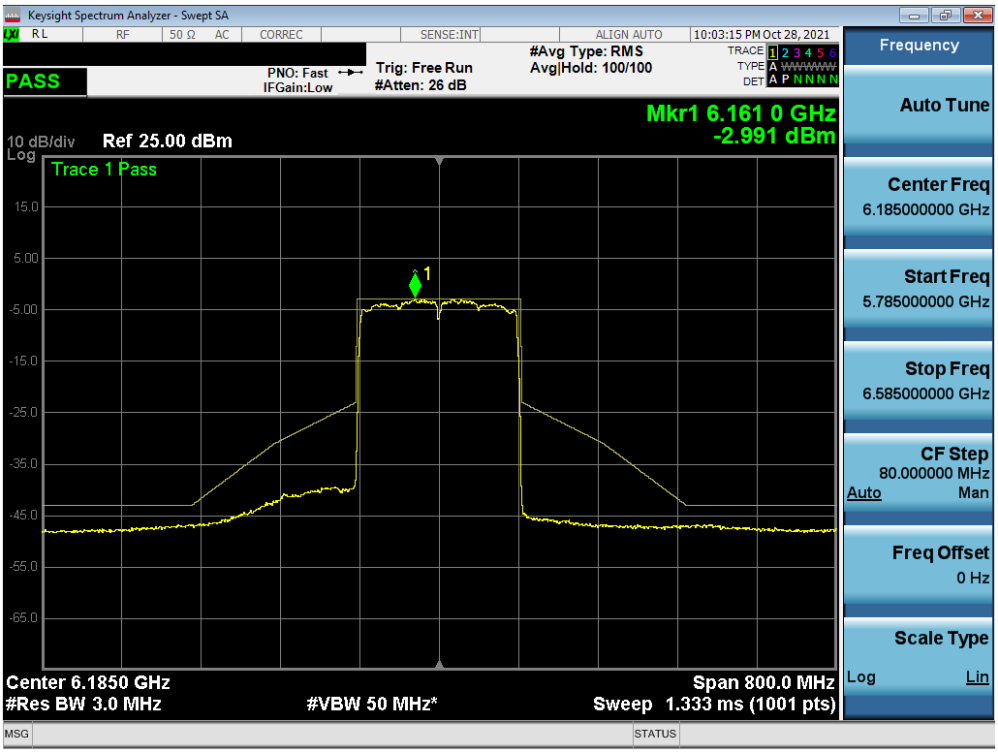
Plot 7-271. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



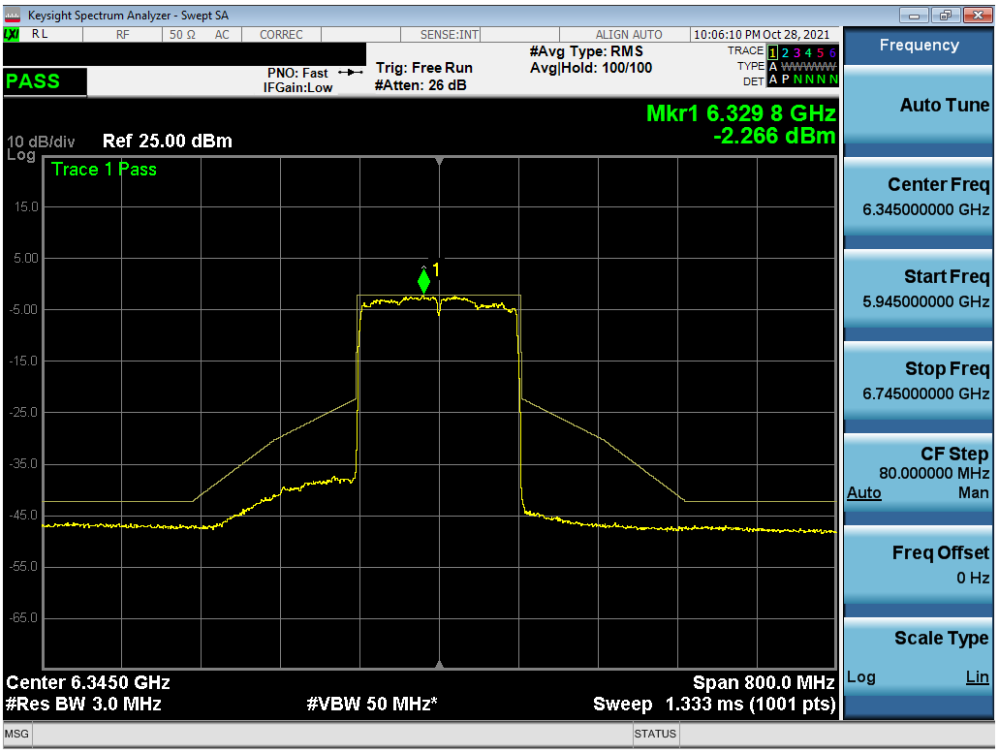
Plot 7-272. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-273. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 15)

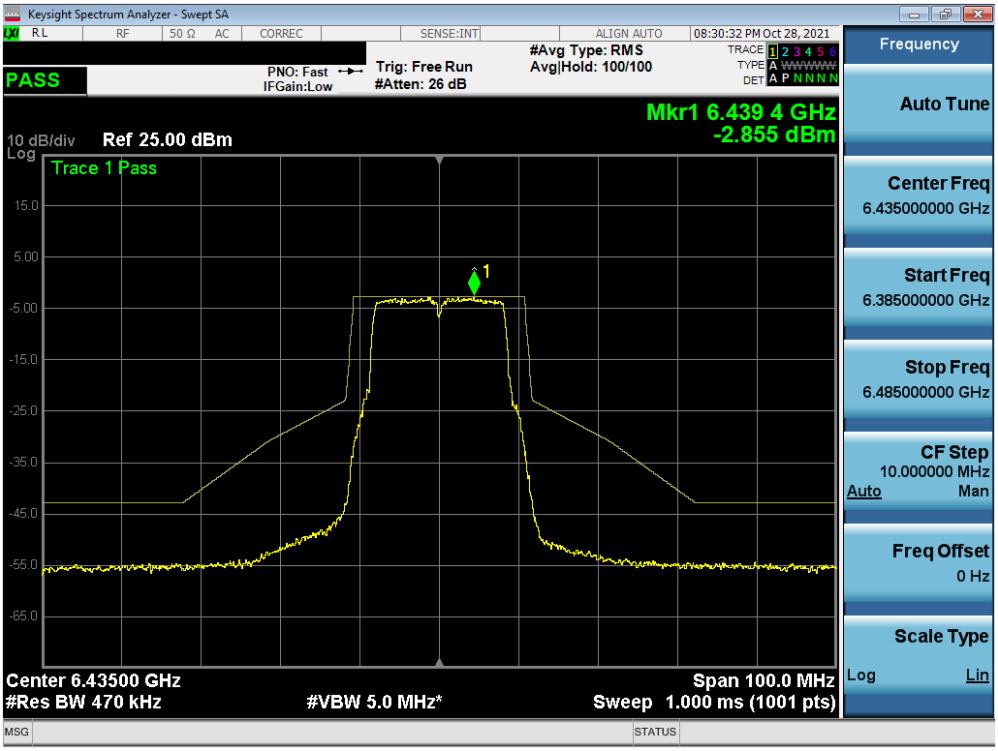


Plot 7-274. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

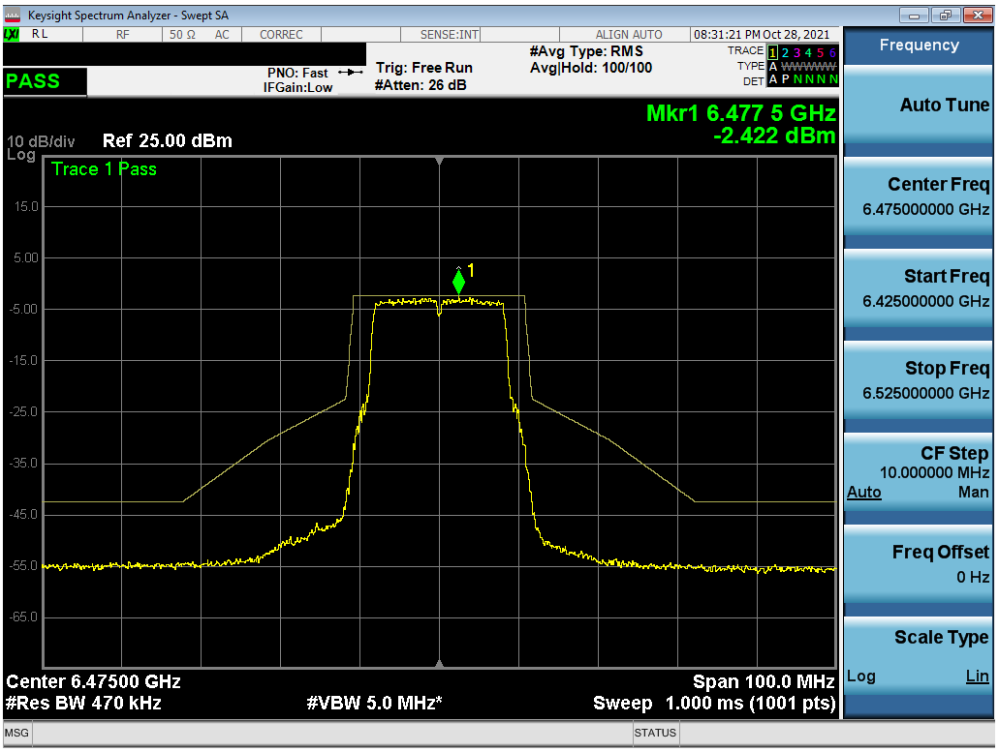


Plot 7-275. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

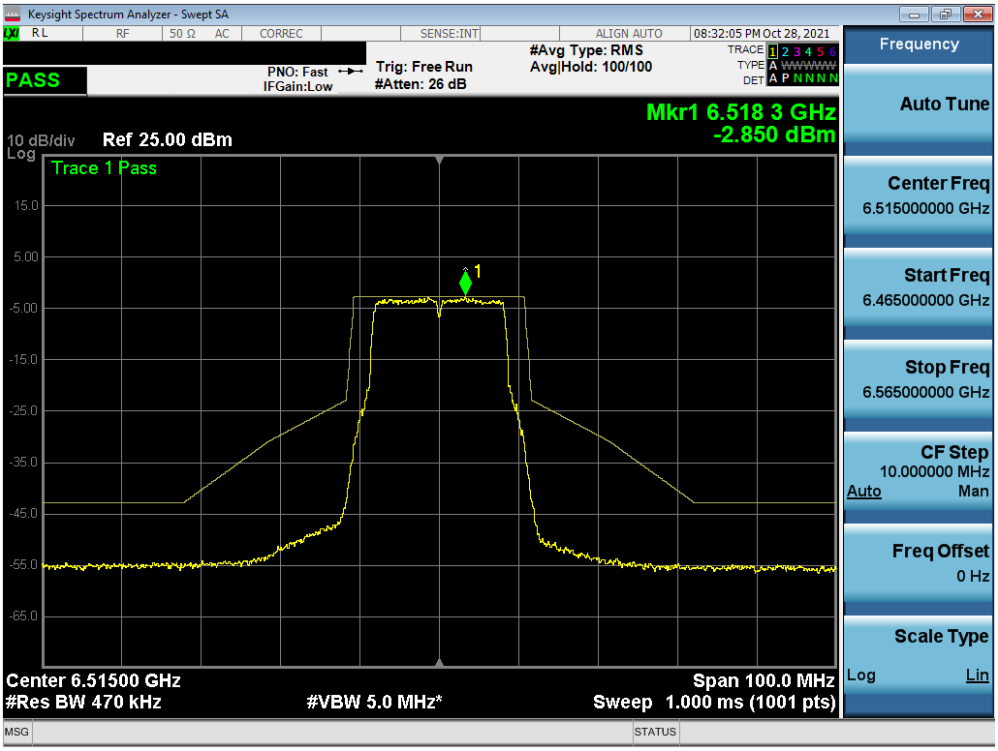
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 6)



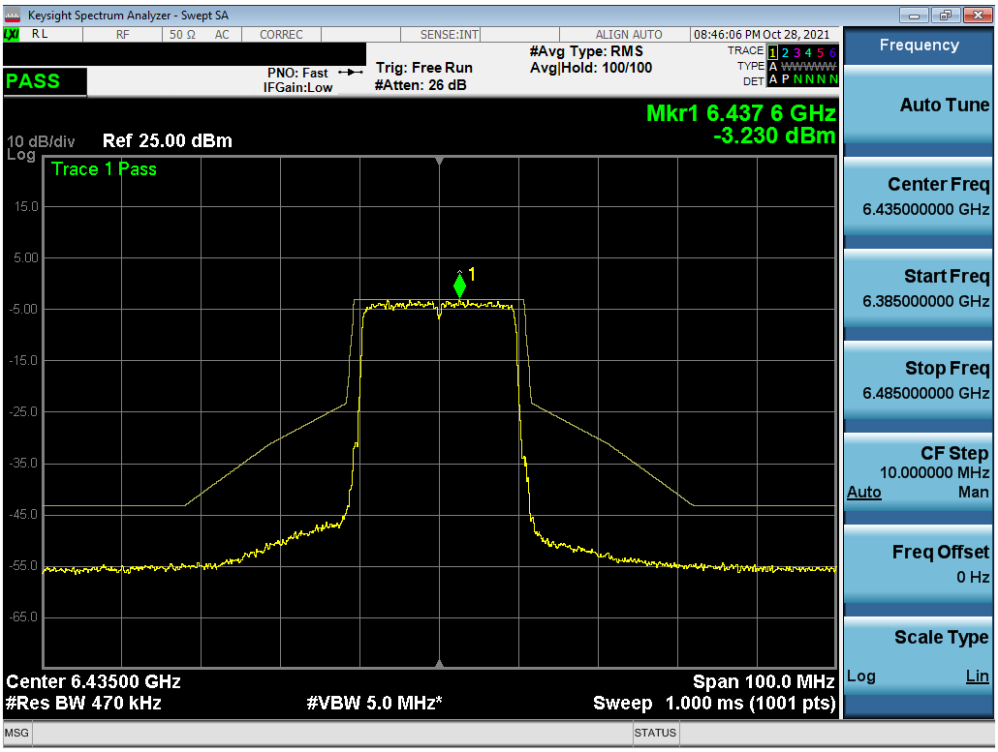
Plot 7-276. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 97)



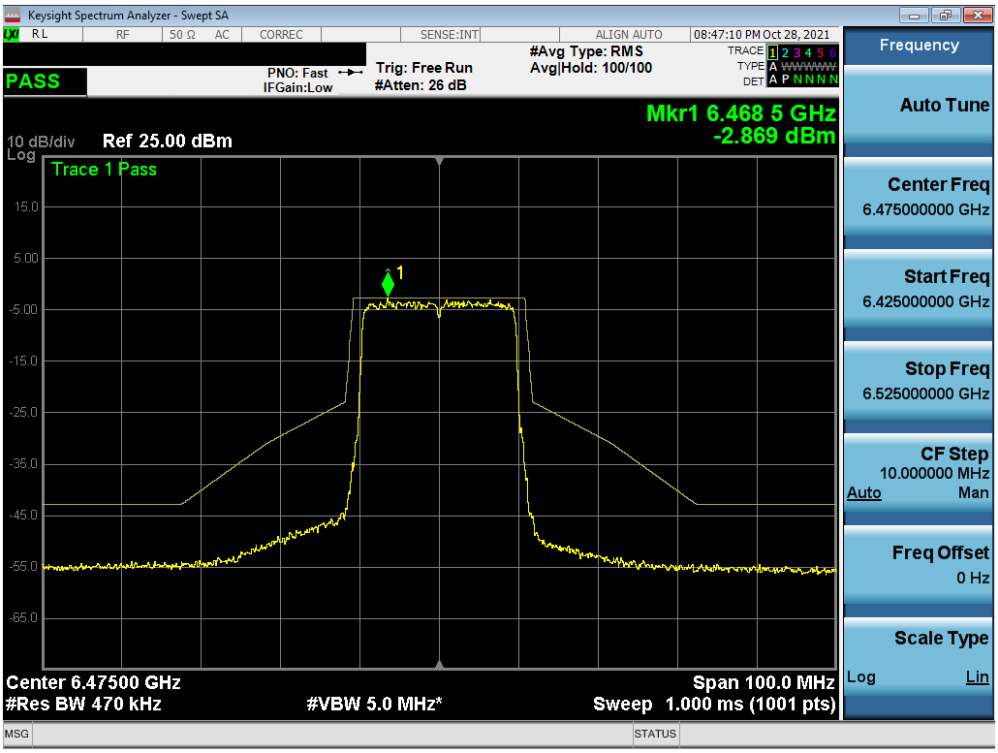
Plot 7-277. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 105)



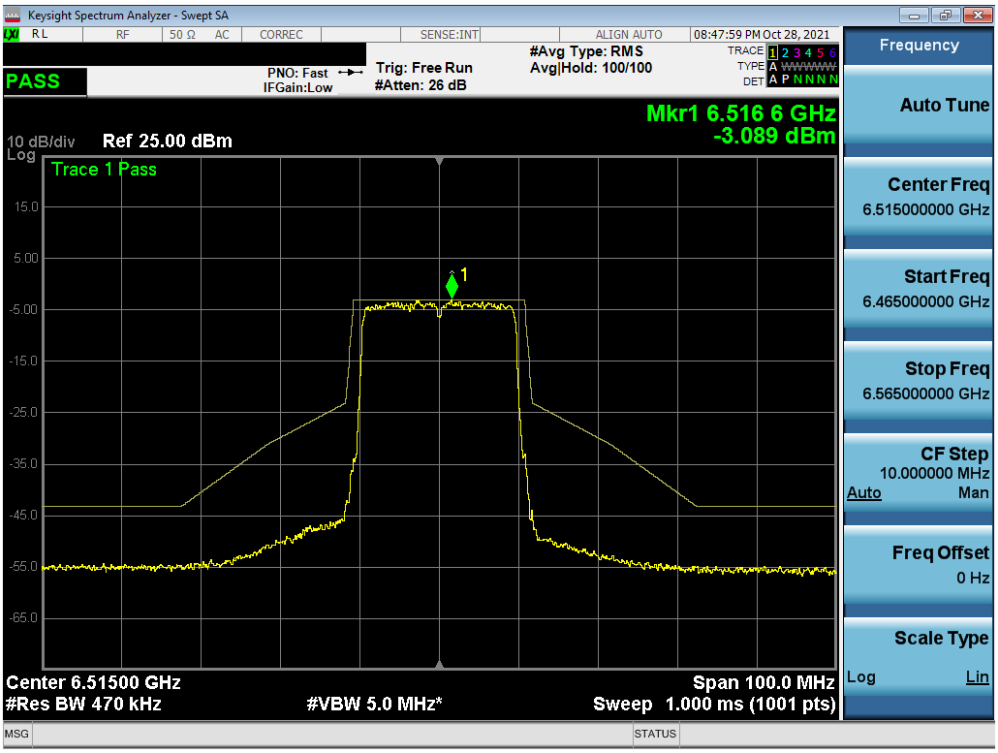
Plot 7-278. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 113)



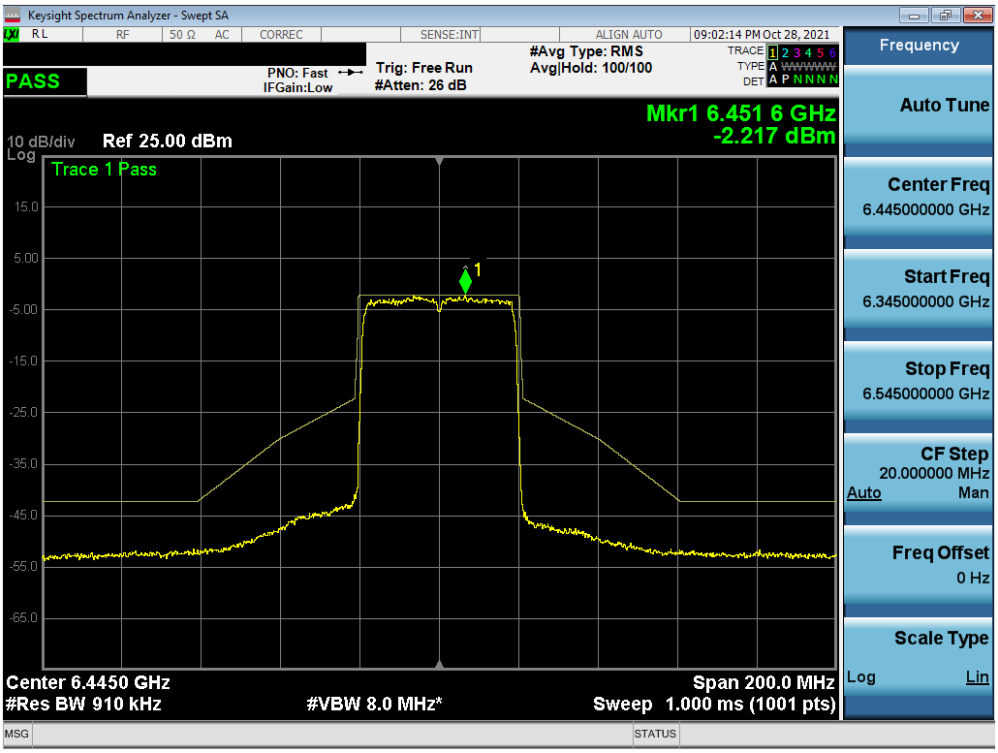
Plot 7-279. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



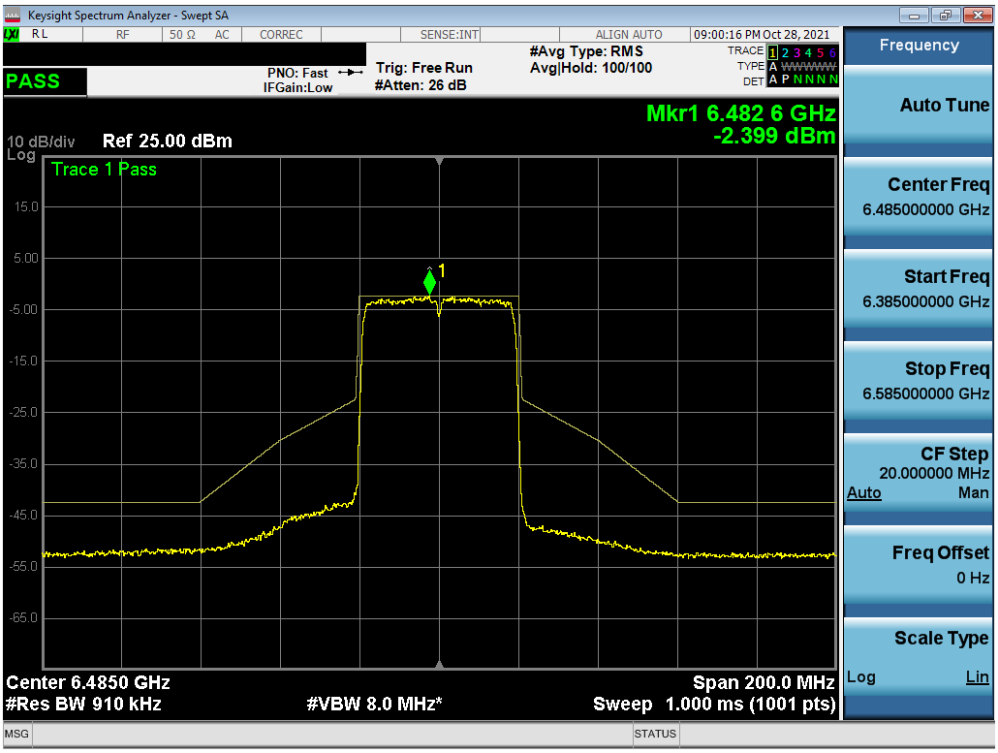
Plot 7-280. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



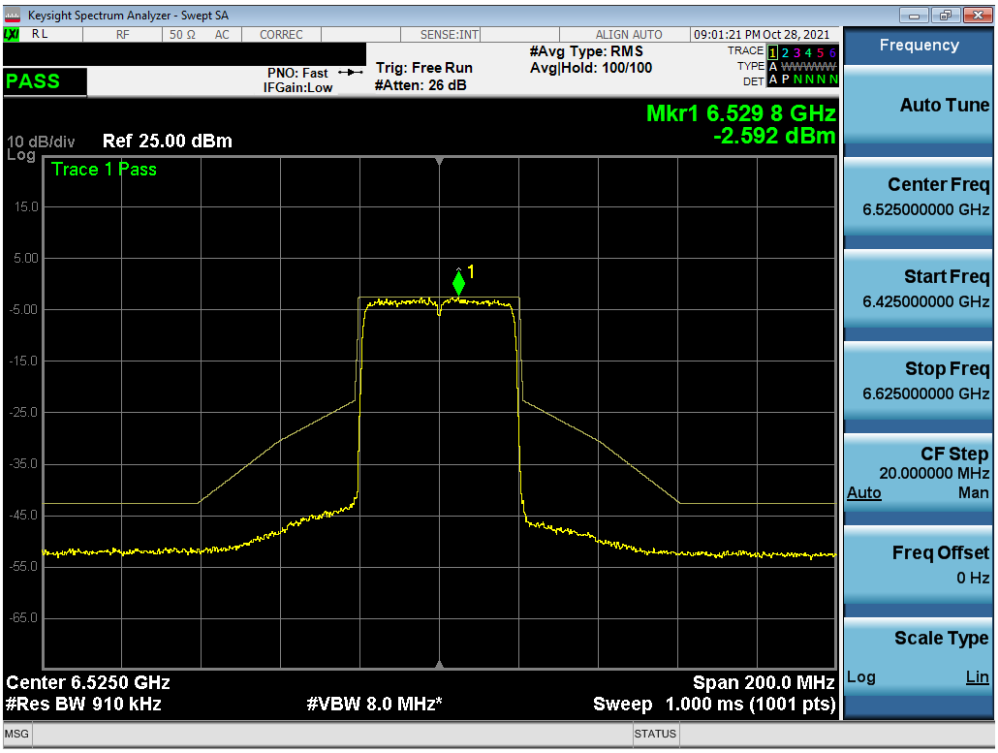
Plot 7-281. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 113)



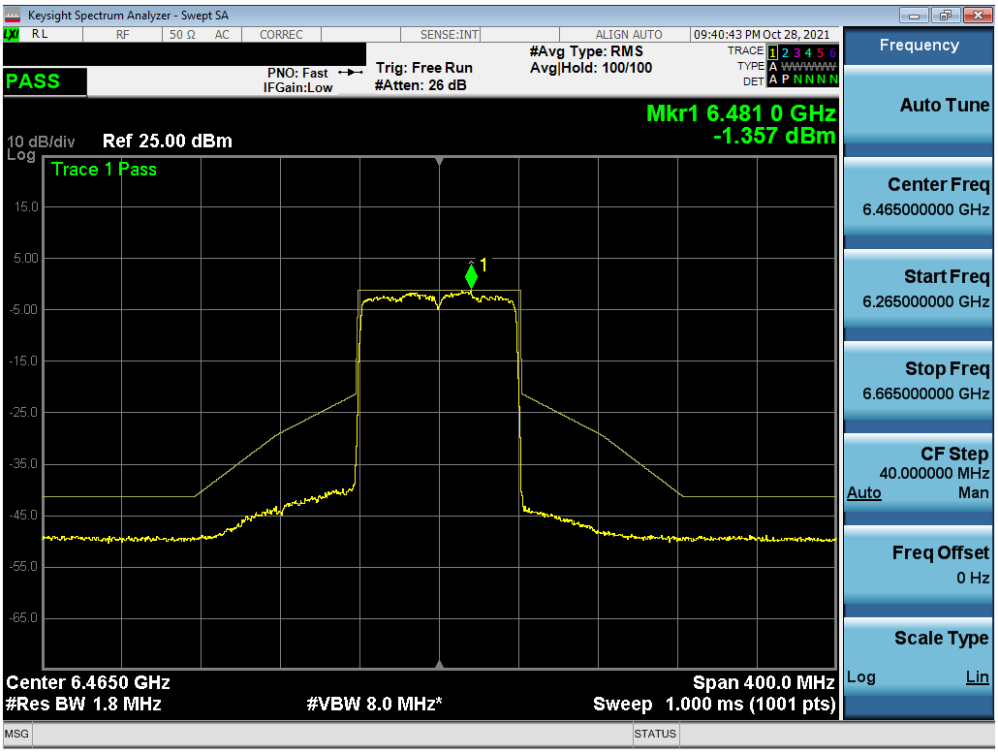
Plot 7-282. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 99)



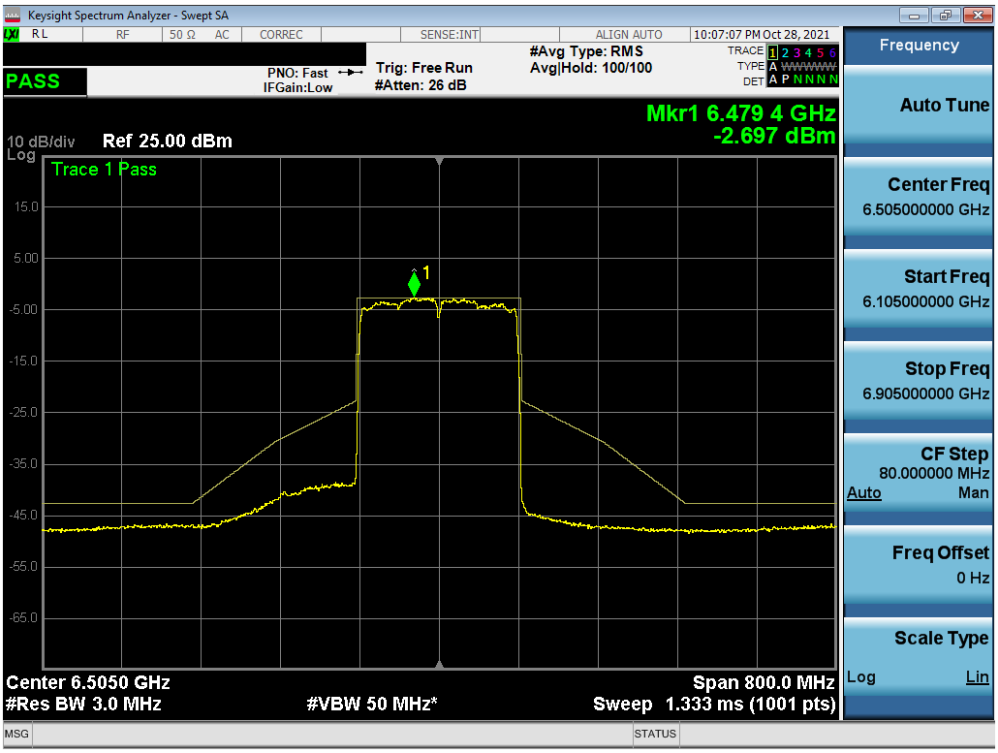
Plot 7-283. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 107)



Plot 7-284. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 115)

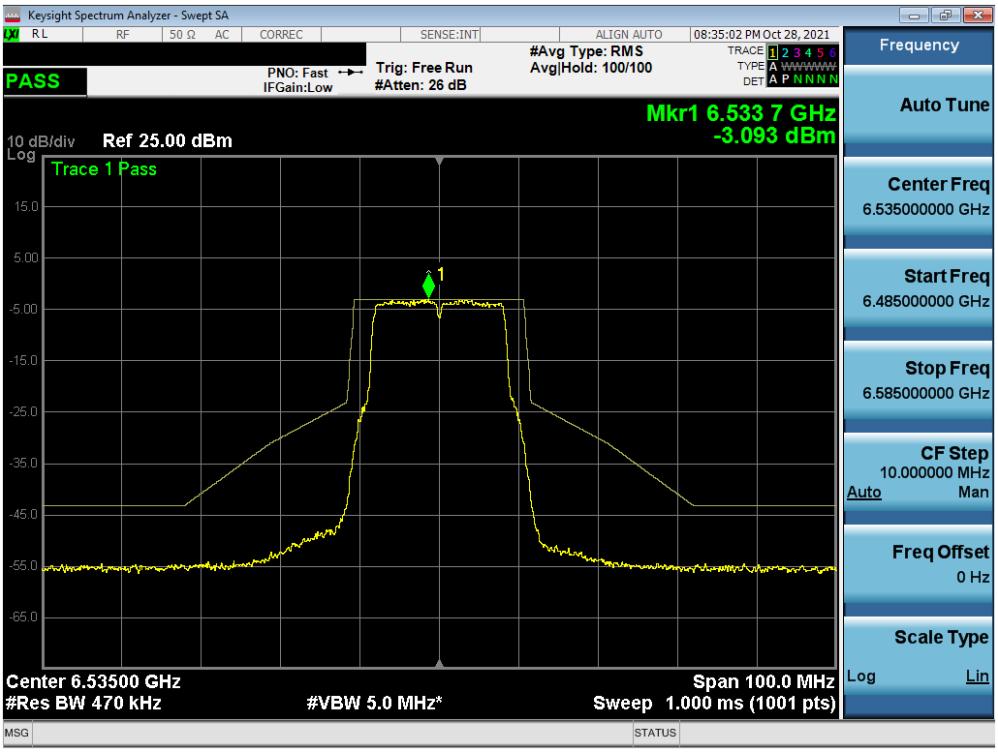


Plot 7-285. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 6) – Ch. 103)

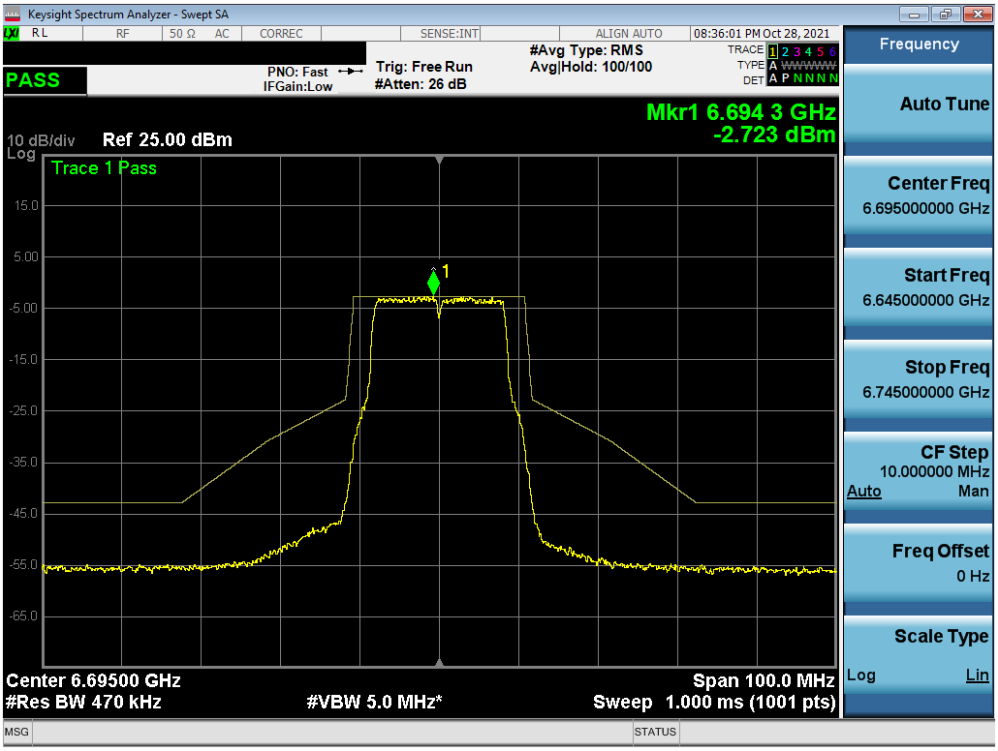


Plot 7-286. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 6) – Ch. 111)

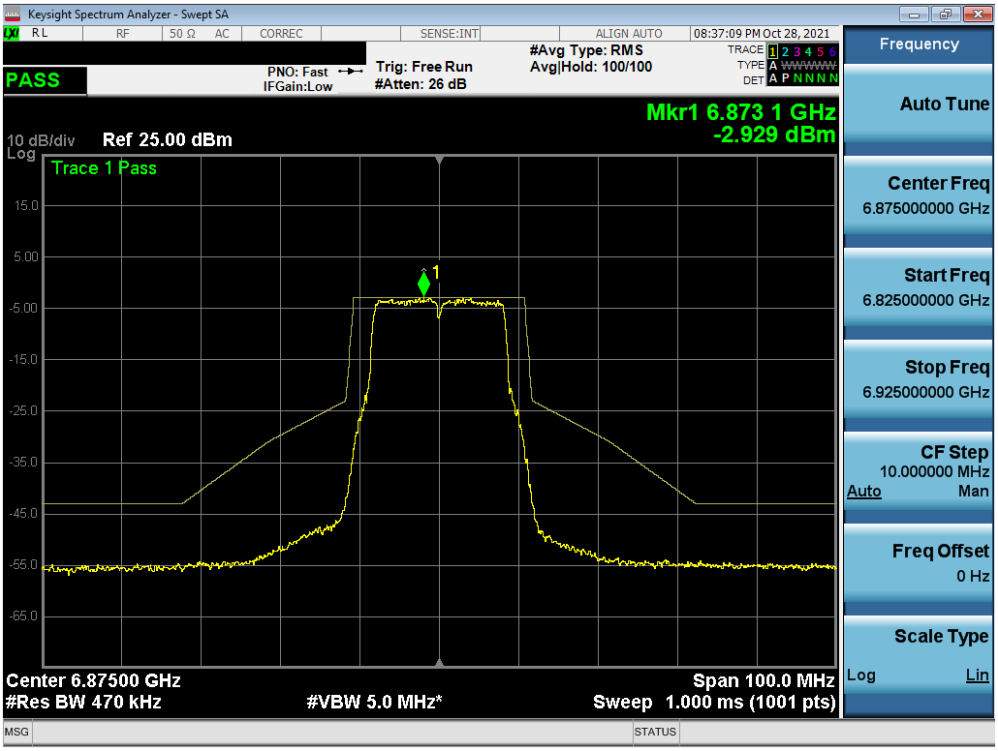
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 7)



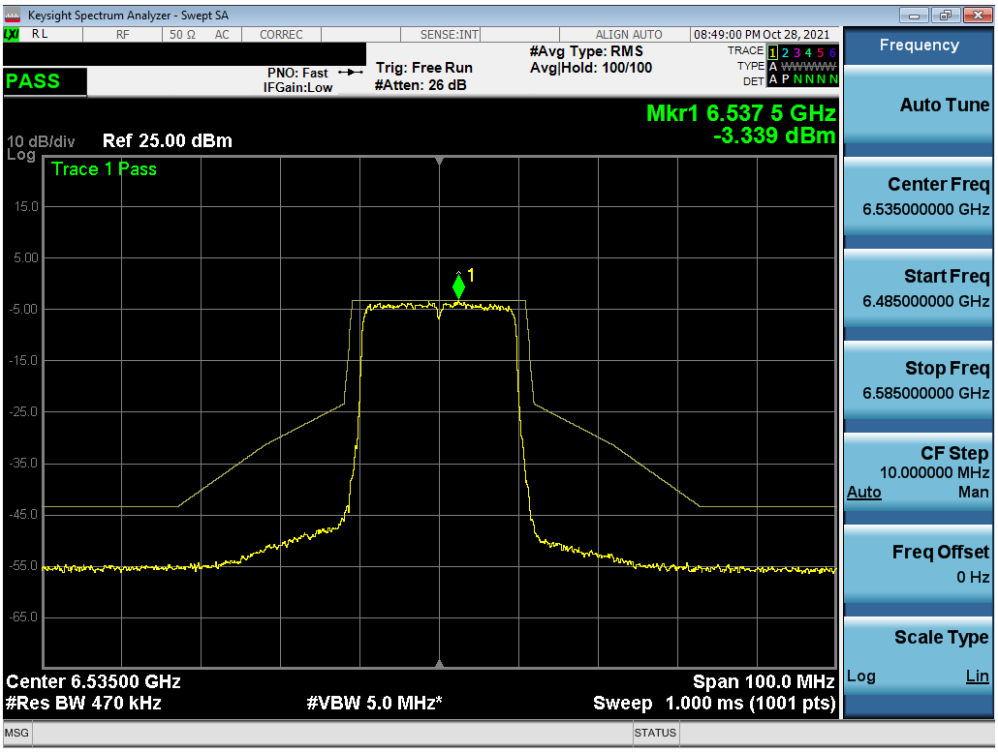
Plot 7-287. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 117)



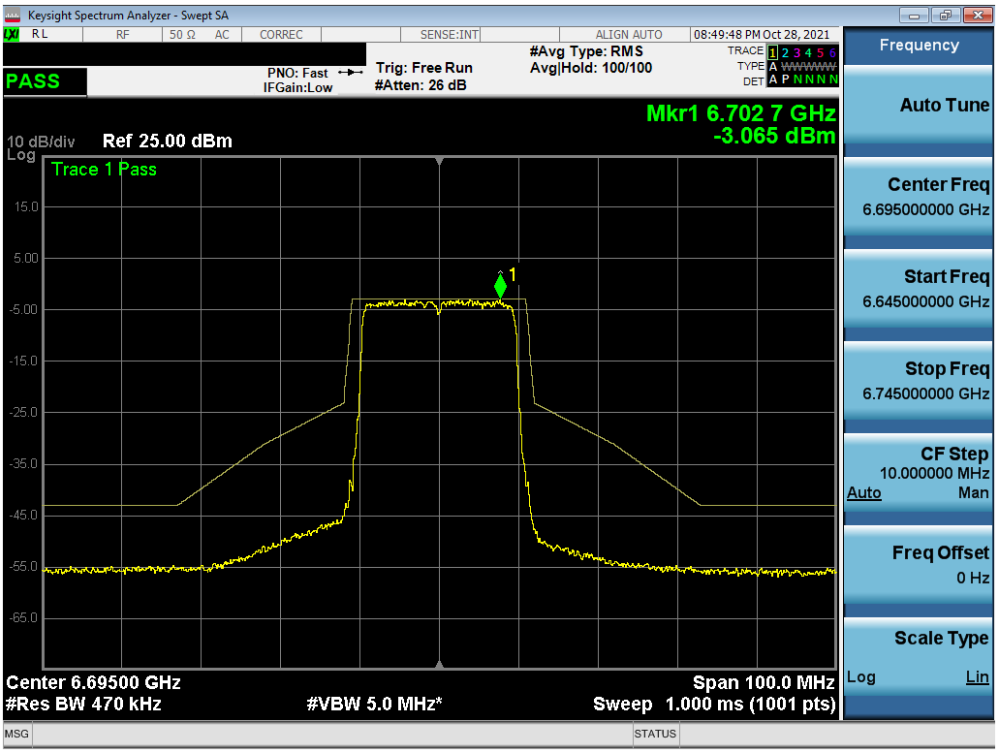
Plot 7-288. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 149)



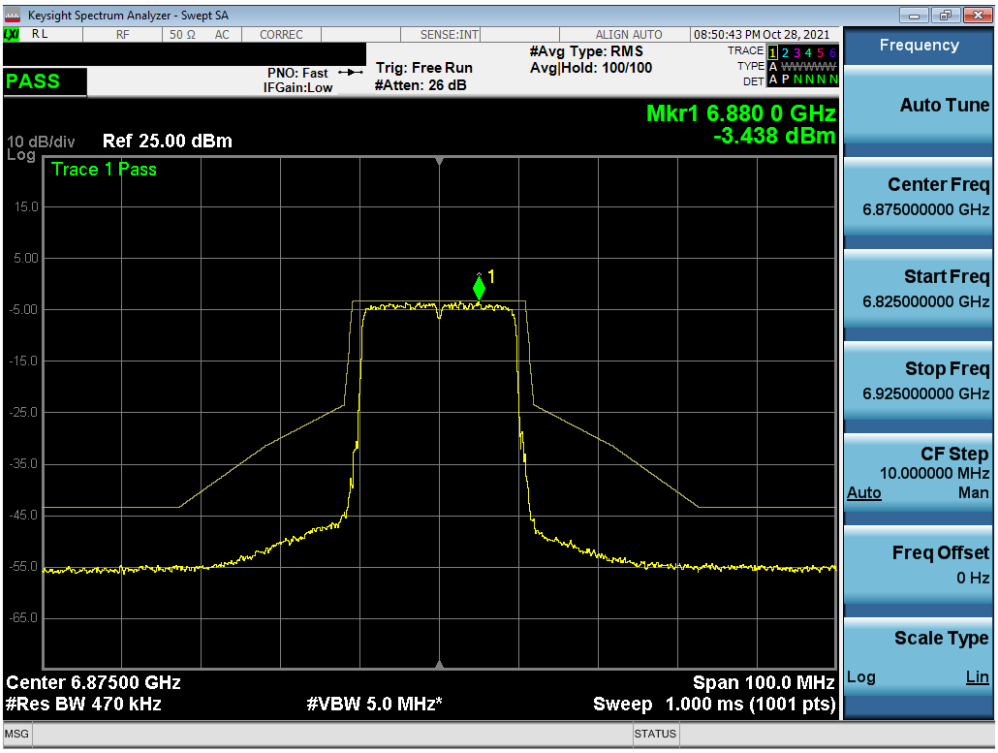
Plot 7-289. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 185)



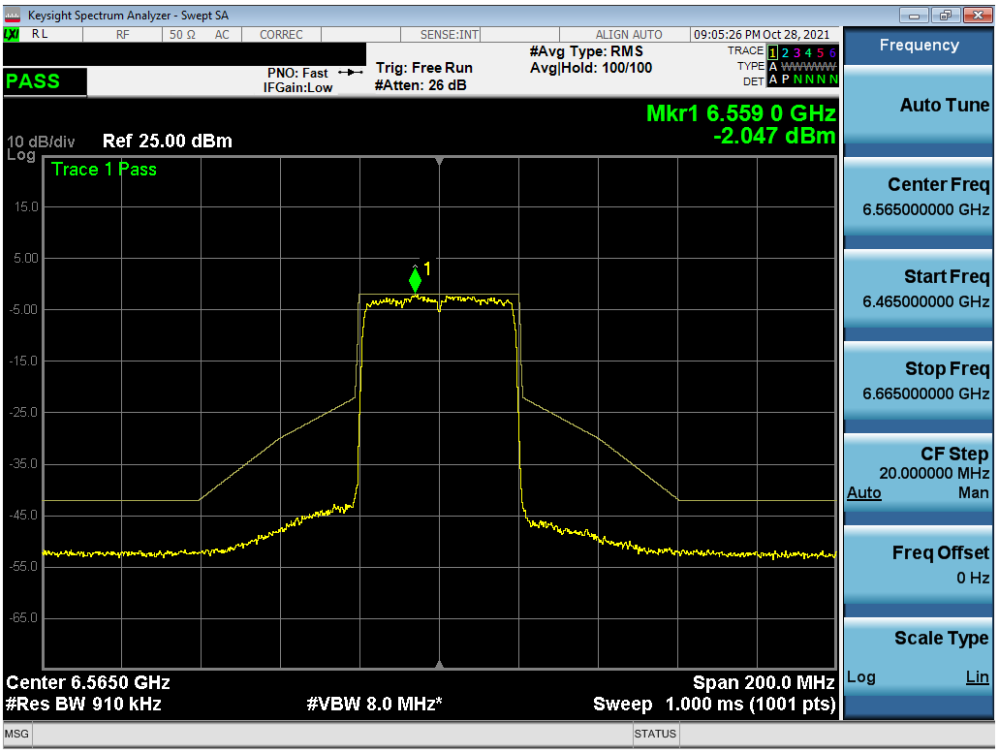
Plot 7-290. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 117)



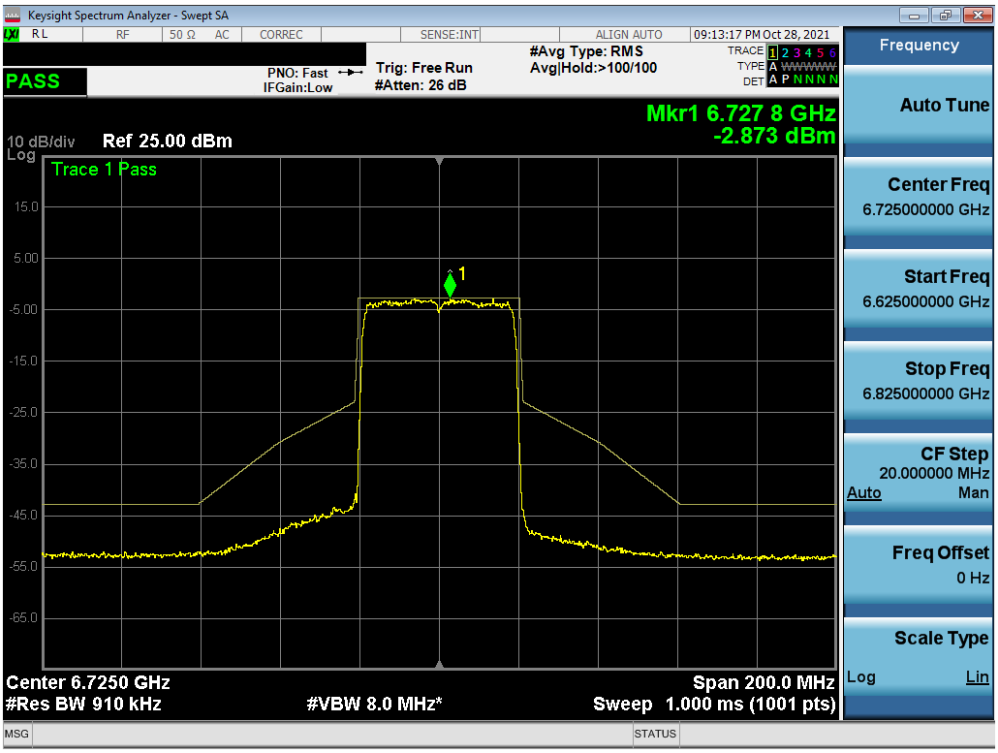
Plot 7-291. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



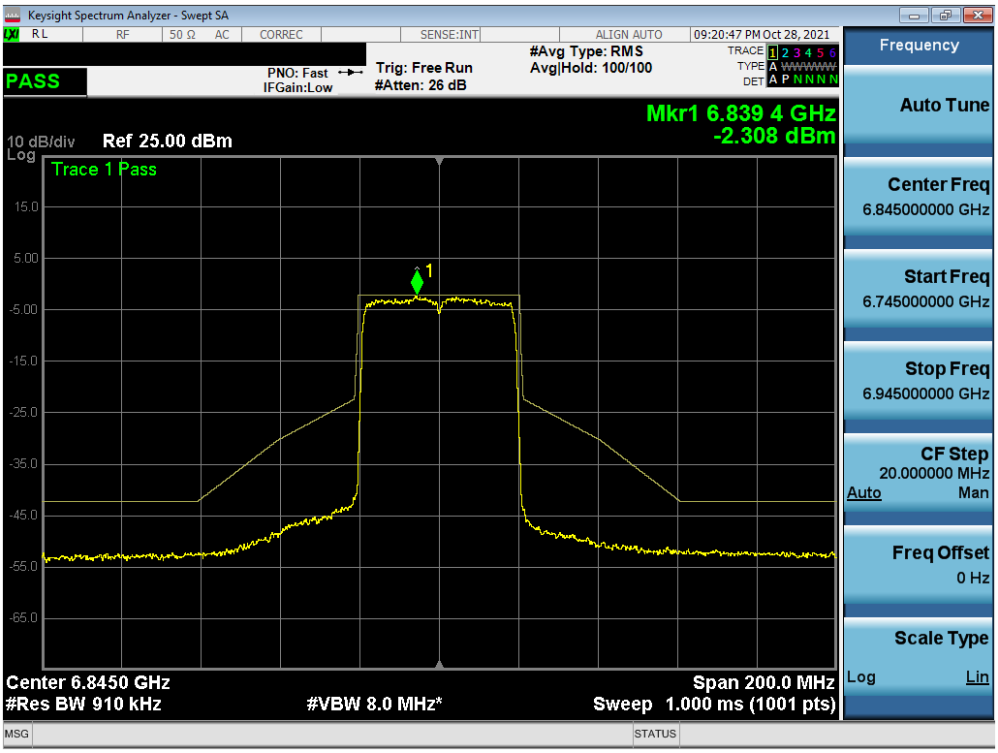
Plot 7-292. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 185)



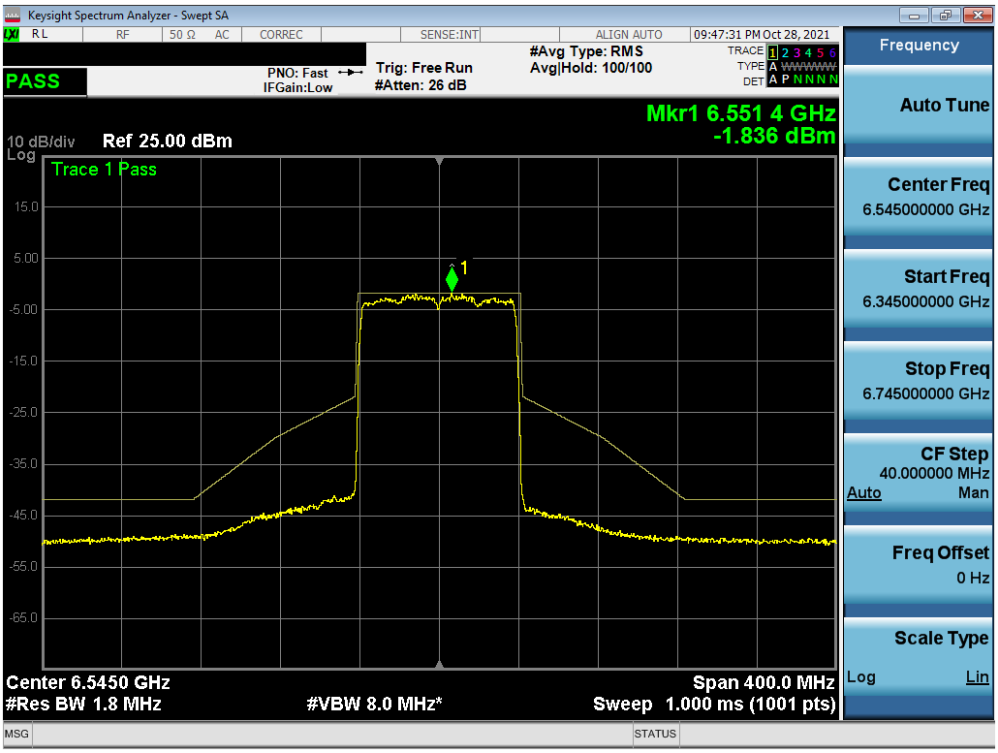
Plot 7-293. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 123)



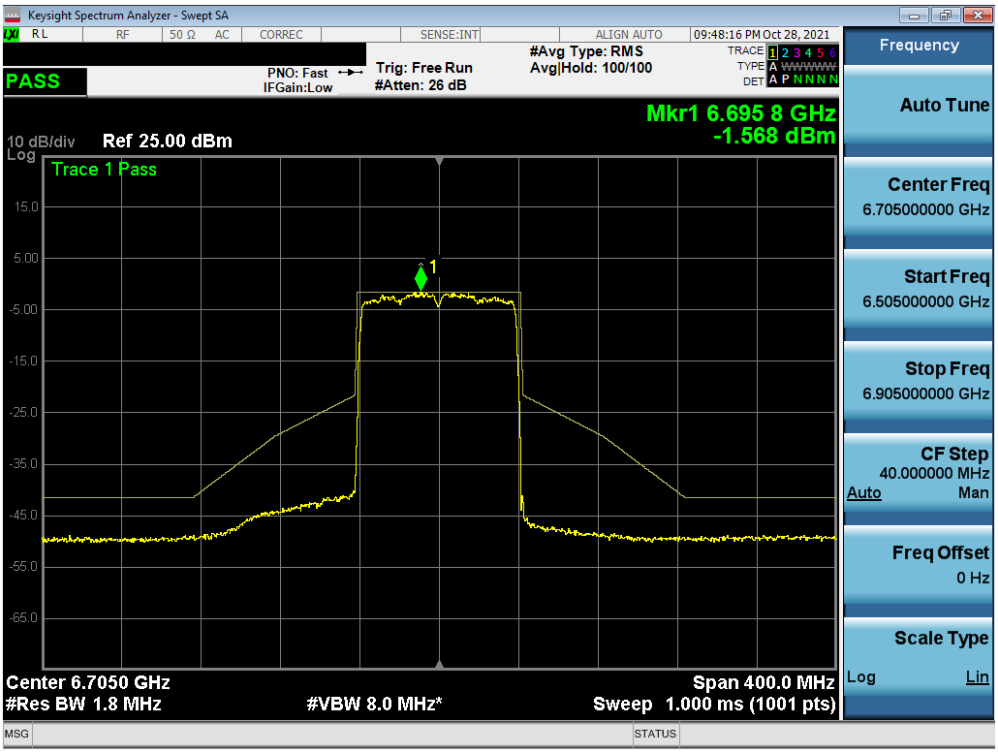
Plot 7-294. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



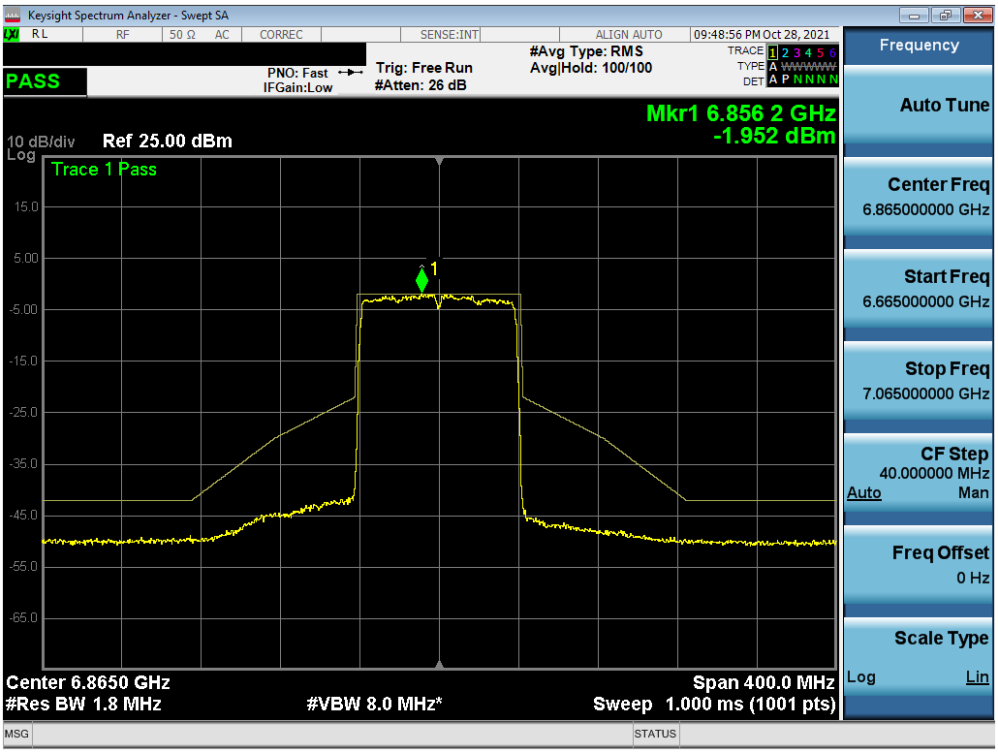
Plot 7-295. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



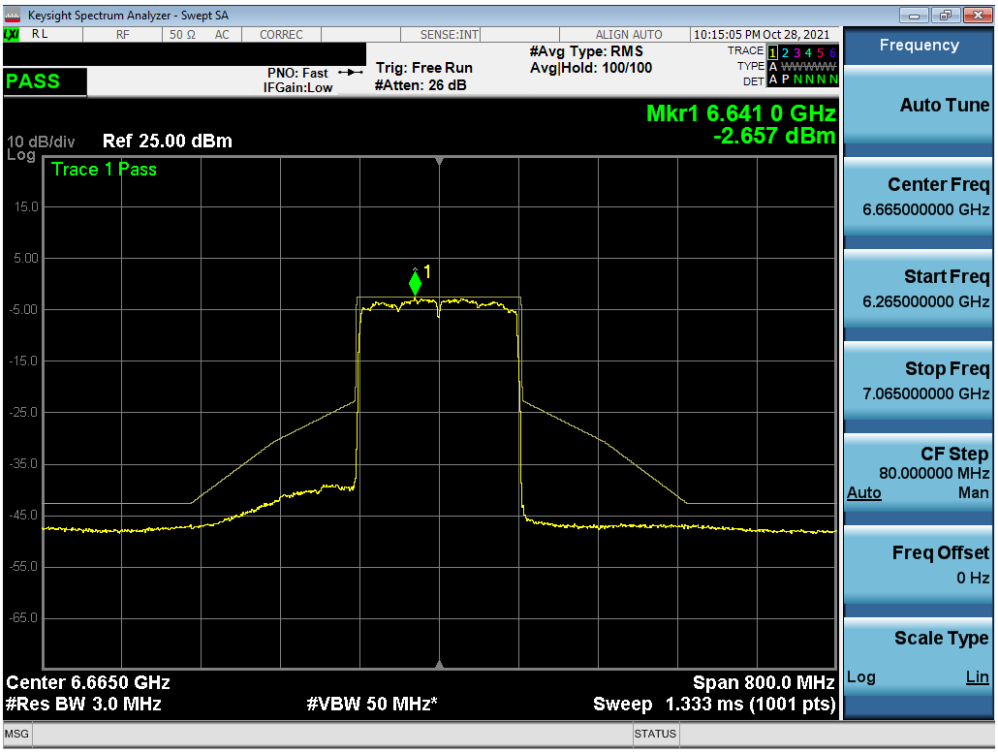
Plot 7-296. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 119)



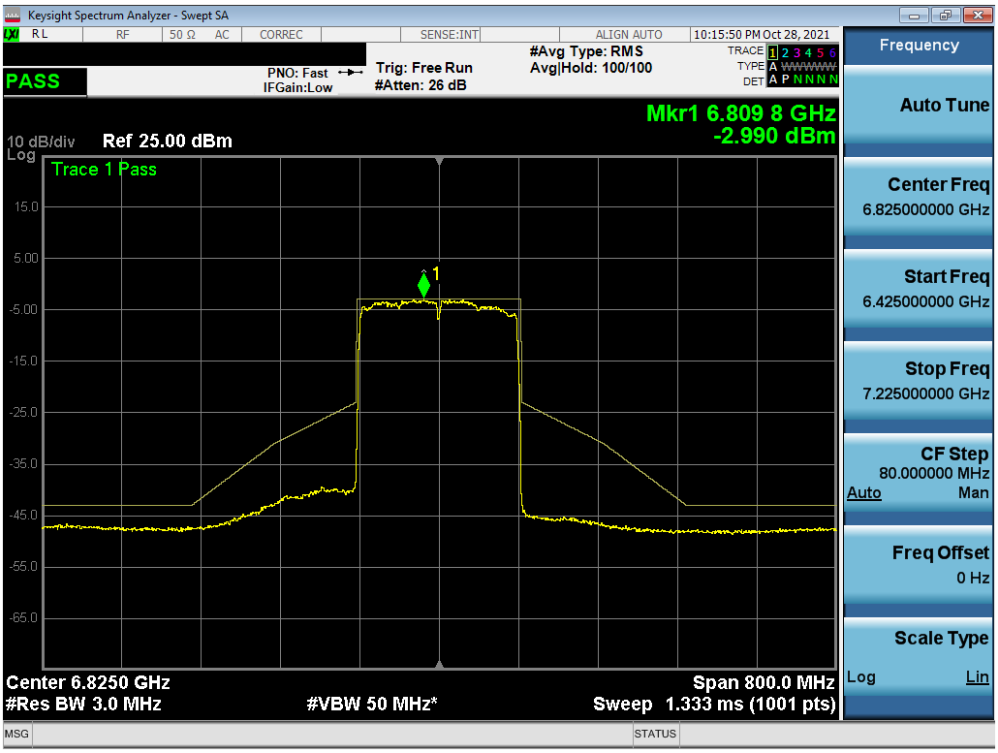
Plot 7-297. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-298. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 183)

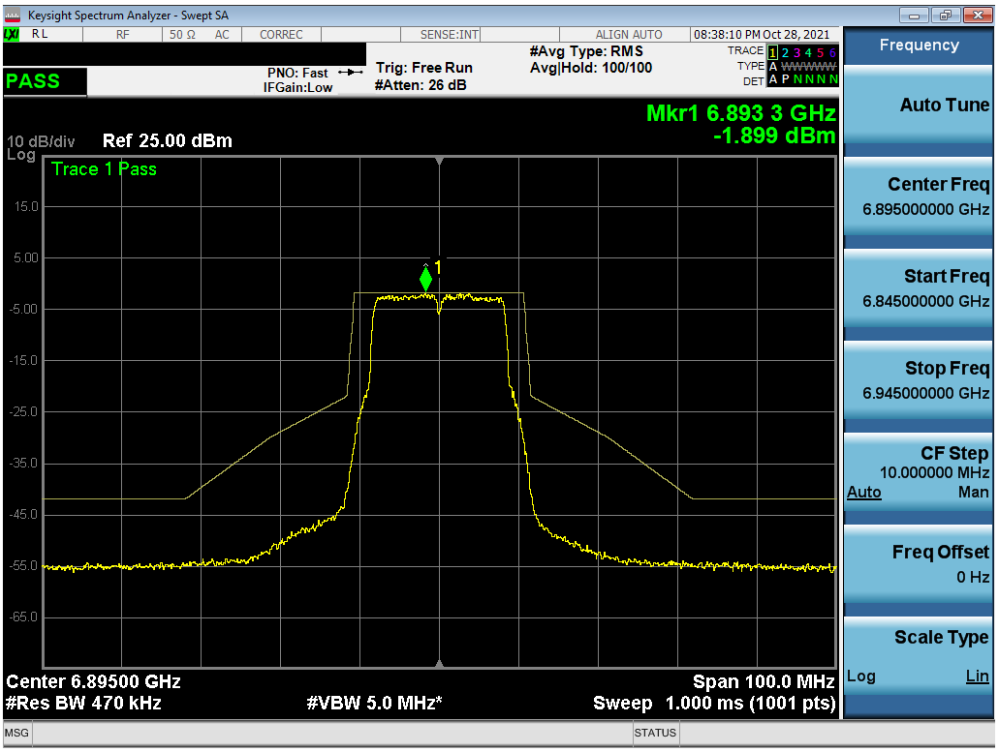


Plot 7-299. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

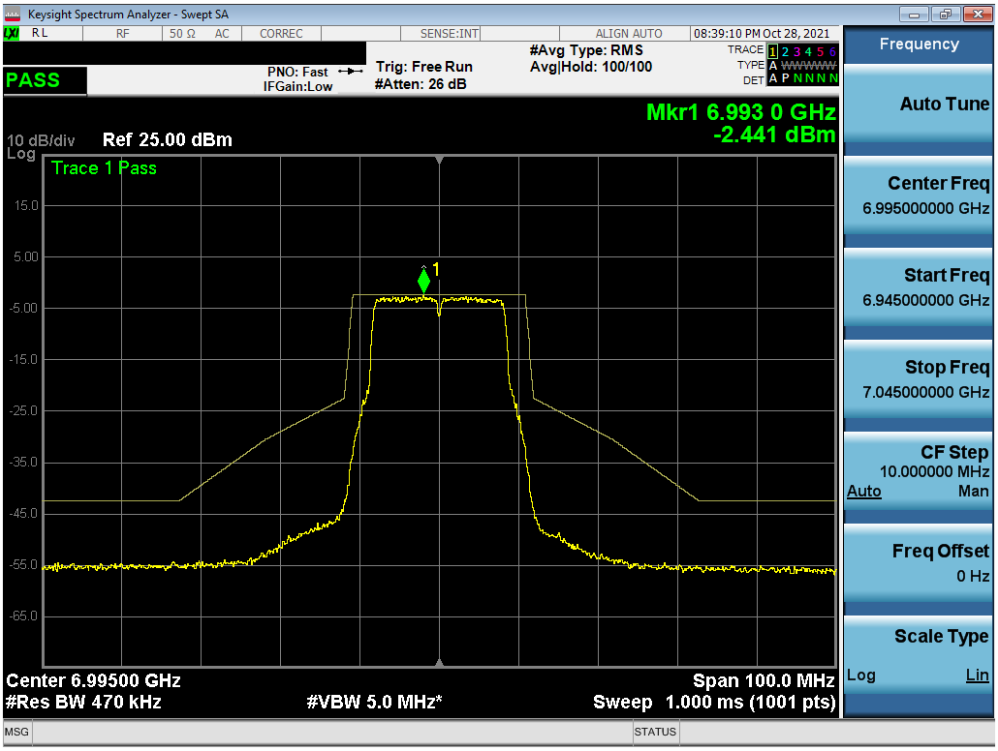


Plot 7-300. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 175)

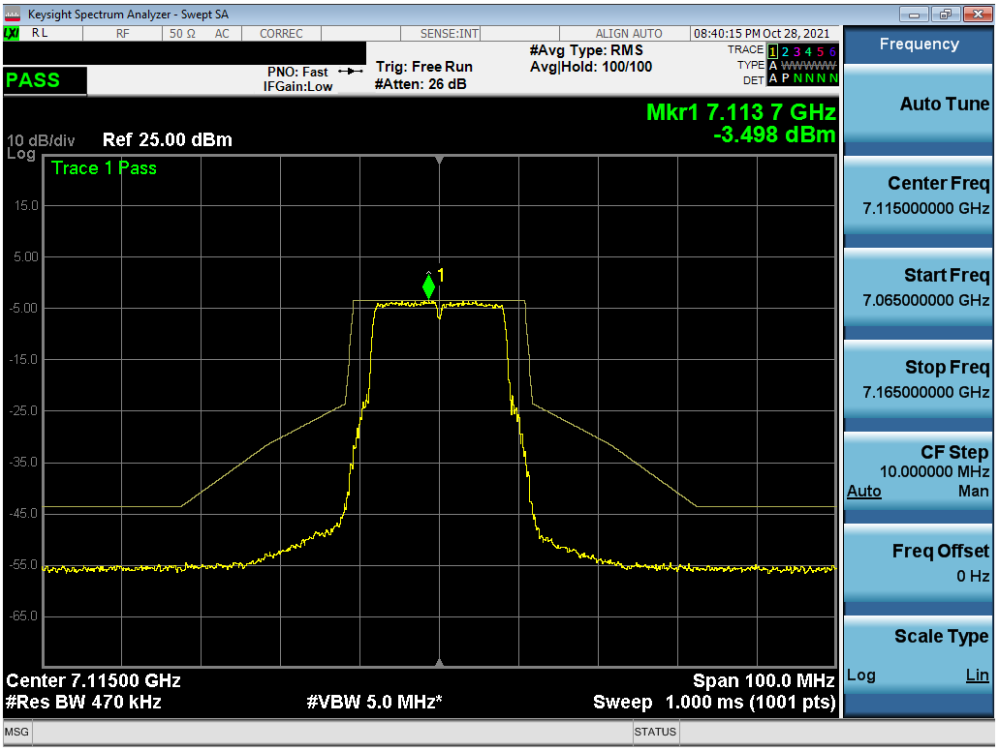
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 8)



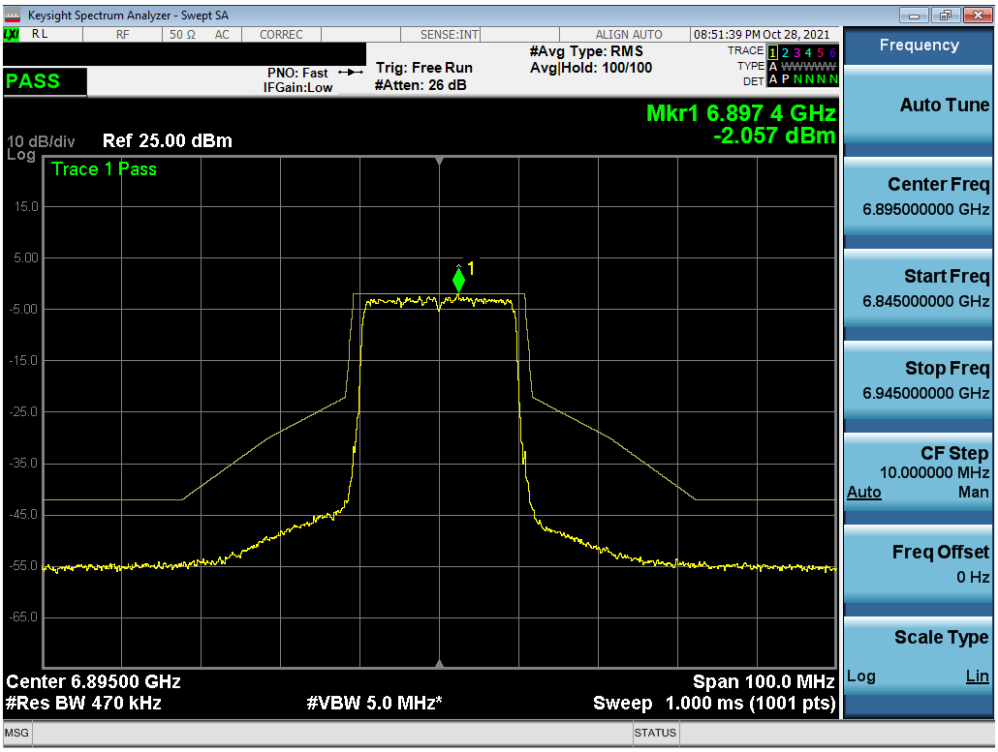
Plot 7-301. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 189)



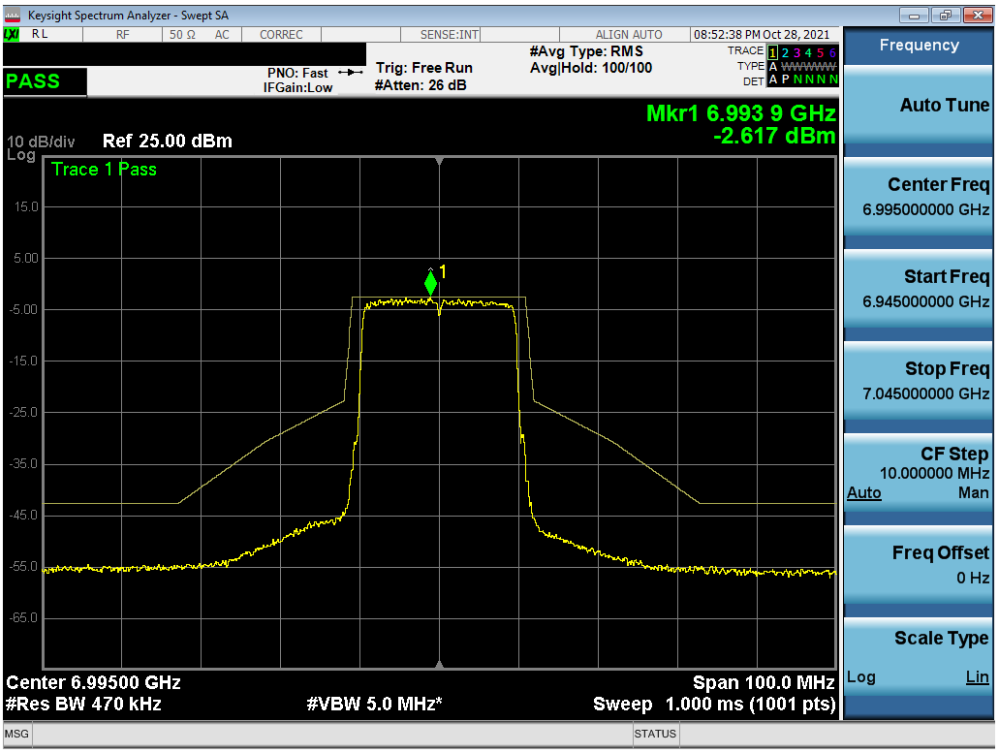
Plot 7-302. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 209)



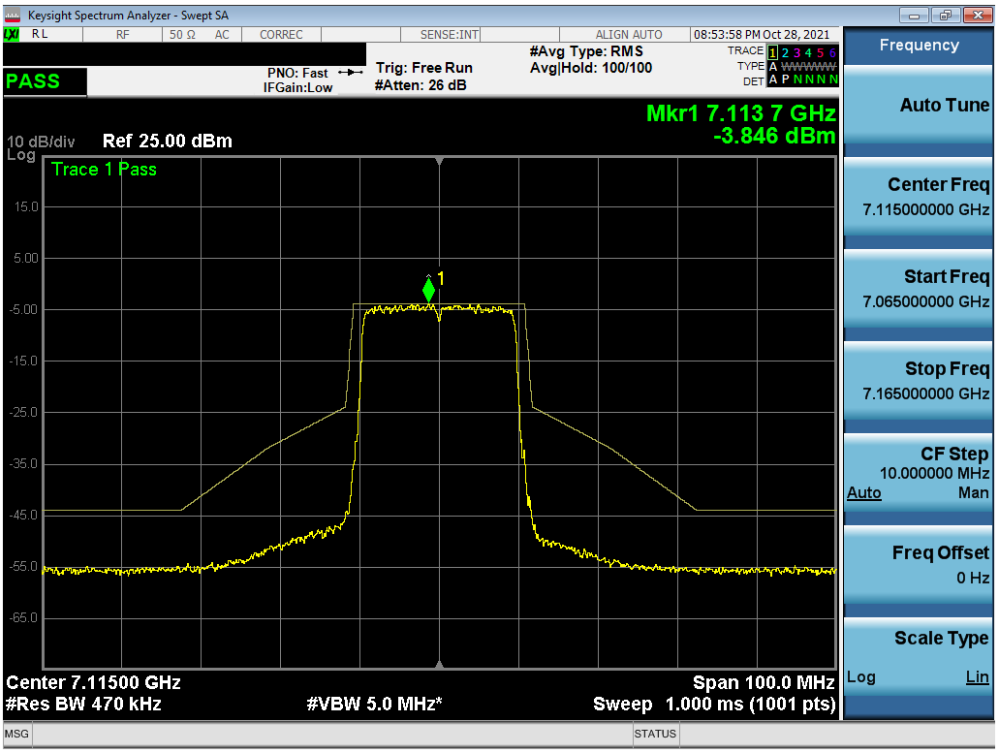
Plot 7-303. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 233)



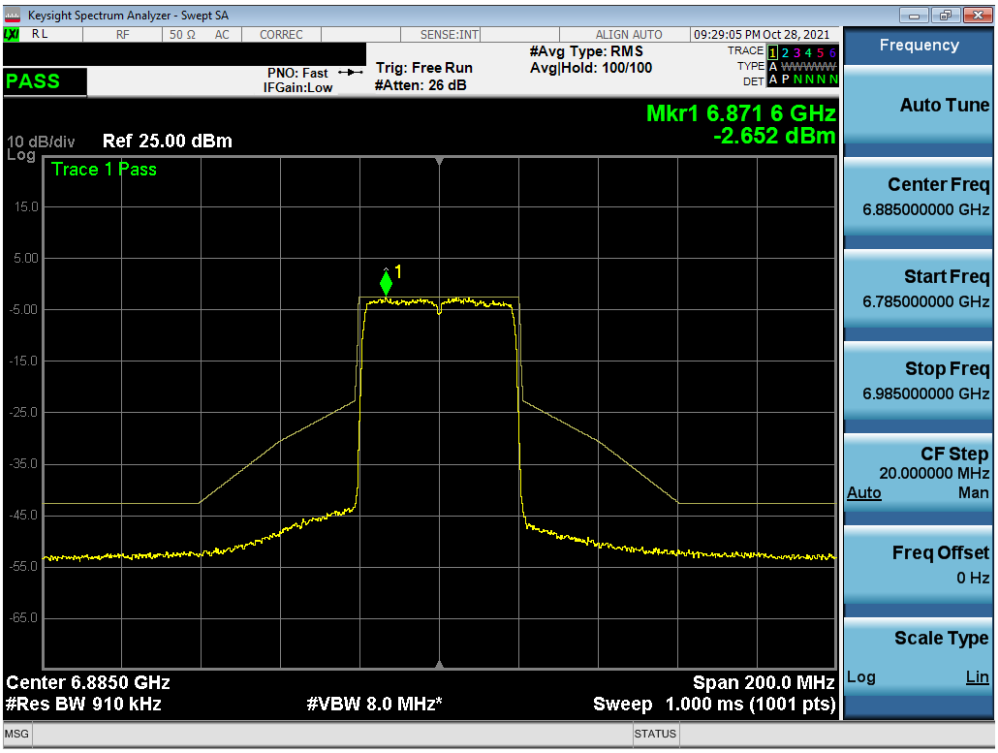
Plot 7-304. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 189)



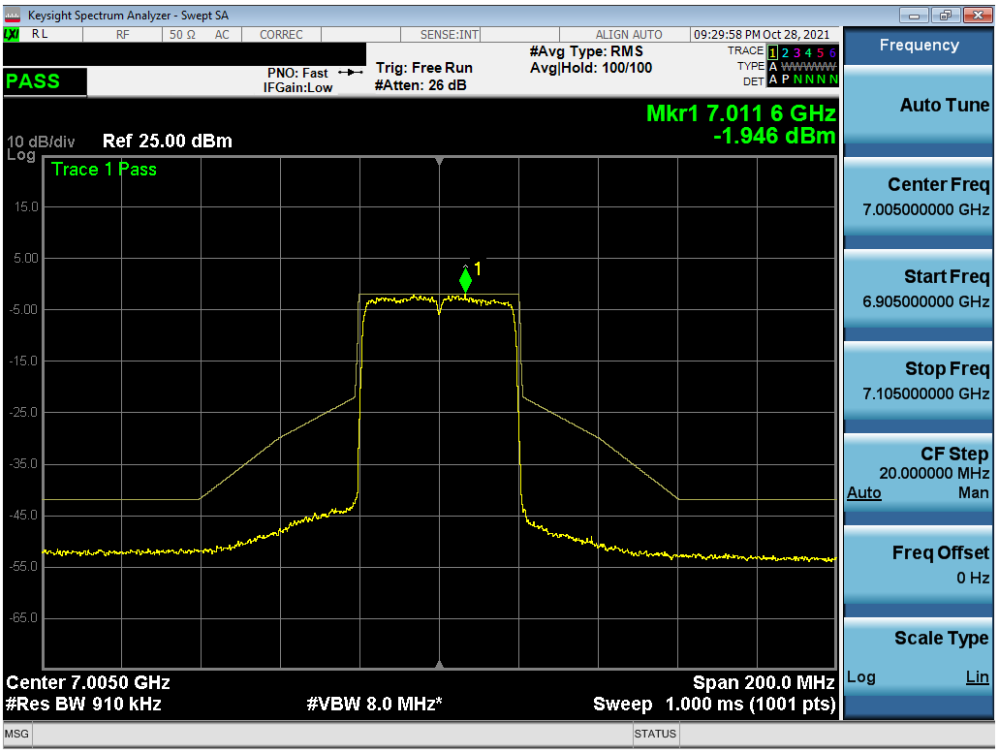
Plot 7-305. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 209)



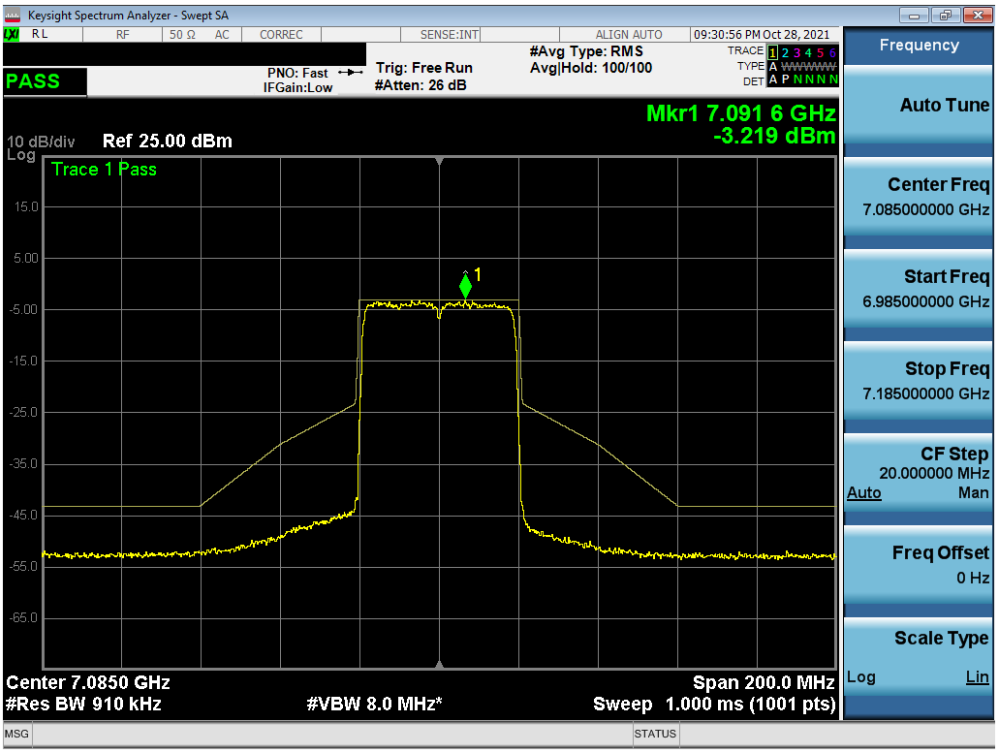
Plot 7-306. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 233)



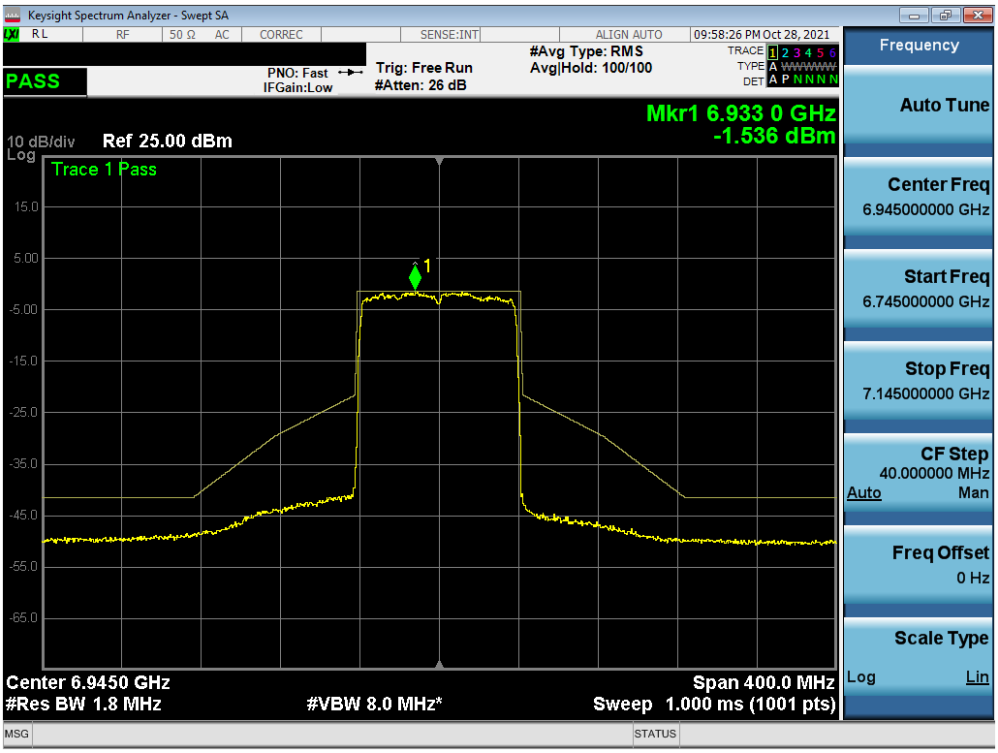
Plot 7-307. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 187)



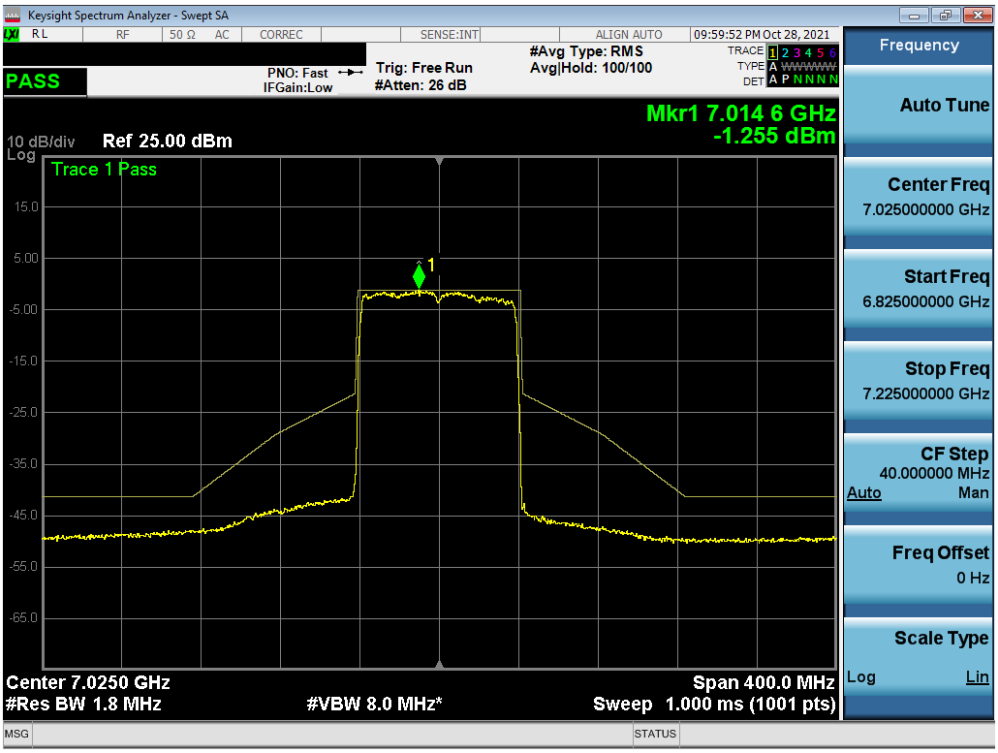
Plot 7-308. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 211)



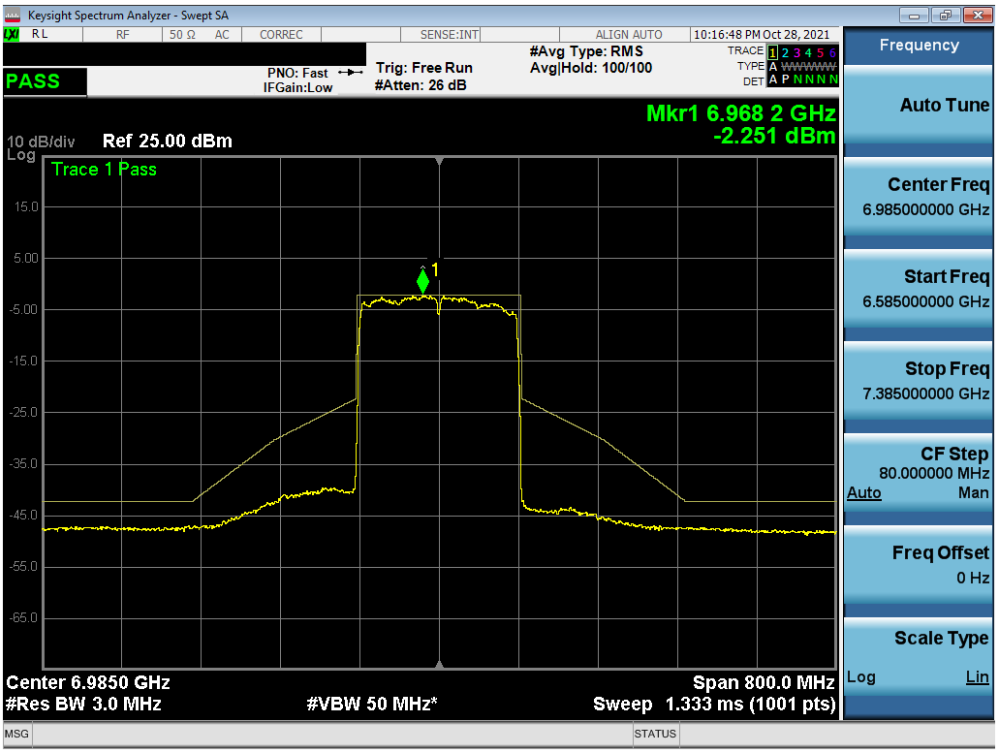
Plot 7-309. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 227)



Plot 7-310. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 8) – Ch. 199)



Plot 7-311. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 8) – Ch. 215)



Plot 7-312. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 8) – Ch. 207)

7.6 Contention Based Protocol – 802.11a/ax

§15.407(d)(6)

Test Overview and Limit

Indoor access points, subordinate devices and client devices operating in the 5.925-7.125 GHz band (herein referred to as unlicensed devices) are required to use technologies that include a contention-based protocol to avoid co-channel interference with incumbent devices sharing the band. To ensure incumbent co-channel operations are detected in a technology-agnostic manner, unlicensed devices are required to detect co-channel radio frequency energy (energy detect) and avoid simultaneous transmission.

Unlicensed indoor low-power devices must detect co-channel radio frequency power that is at least -62 dBm or lower. Upon detection of energy in the band, unlicensed low power indoor devices must vacate the channel and stay off the channel as long as detected radio frequency power is equal to or greater than the threshold (-62 dBm). The -62 dBm (or lower) threshold is referenced to a 0 dBi antenna gain.

To ensure incumbent operations are reliably detected in the band, low power indoor devices must detect RF energy throughout their intended operating channel.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2
KDB 987594 D02 V01R01

Test Settings

1. Using the AWGN signal source, generate (but do not transmit, i.e., RF OFF) a 10 MHz-wide AWGN signal. Use Table 1 to determine the center frequency of the 10 MHz AWGN signal relative to the EUT's channel bandwidth and center frequency.
2. Connect the AWGN signal source to antenna 1, as shown in Figure 3, and transmit the signal (RF ON).
3. Using signal analyzer 1 and antenna 2, measure the AWGN signal power level. Align antenna 2 and antenna 1 to maximize emission.
4. Using equation 1, correct the measured power P_{meas} by the gain of antenna 2, G_2 and all cable losses and attenuations L to obtain the AWGN signal power level at antenna 2, P_2.
5. Set the corrected power P_2 to an extremely low level (more than 20 dB below the -62 dBm threshold).
6. Place the EUT exactly where antenna 2 was. Configure the EUT to transmit a constant duty cycle.
7. Set the operating parameters of the EUT including power level, operating frequency, modulation and bandwidth.
8. Set the signal analyzer 1 center frequency to the nominal EUT channel center frequency. The span range of the signal analyzer shall be between two times and five times the OBW of EUT.
9. Monitor the signal analyzer 1 to verify if AWGN signal has been detected and EUT has ceased transmission. If the EUT continues to transmit, then incrementally increase the AWGN signal power level until the EUT stops transmitting.
10. Determine and record the AWGN signal power level at which the EUT ceased transmission. Repeat the procedure at least 10 times to verify the EUT can detect the AWGN signal with 90% (or better) level of certainty.
11. Refer to Table 1 in KDB 987594 D02 Section I)b) to determine number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step 1, choose a different center frequency for the AWGN signal and repeat the process.

Test Setup

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

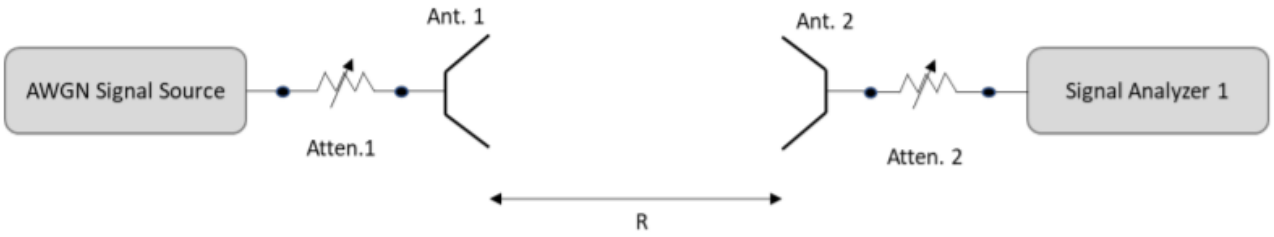


Figure 7-5. Contention-based protocol test setup, radiated method, power measurement

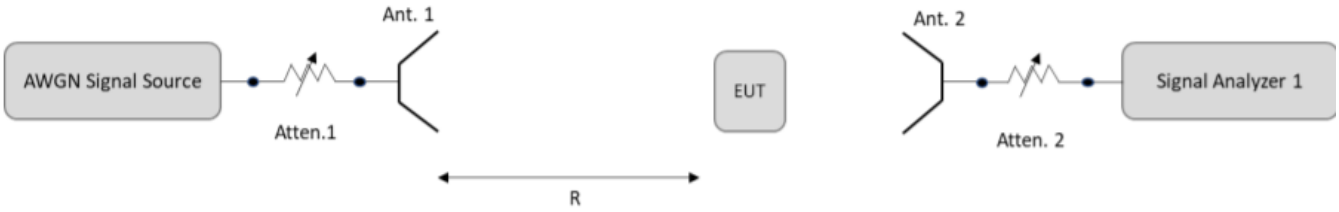


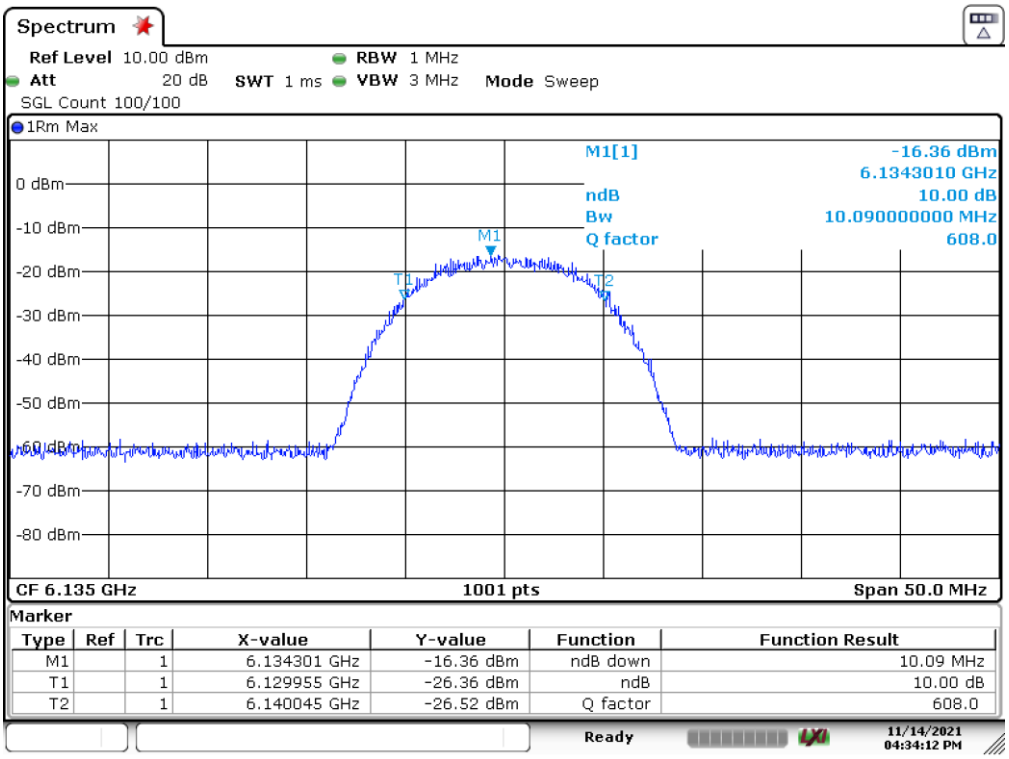
Figure 7-6. Contention-based protocol test setup, radiated method, detection threshold measurement

Test Notes

1. Per guidance from KDB 987594 D02 V01R01, contention based protocol was tested using an AWGN signal with a bandwidth of 10MHz (see Plot 7-313). The amplitude of the signal was increased until detected by the EUT, signaled by the ceasing of transmission (see Plot 7-314), marker indicates the point at which the AWGN signal is introduced.
2. 15 trials were ran in order to assure that at least 90% of certainty was met.

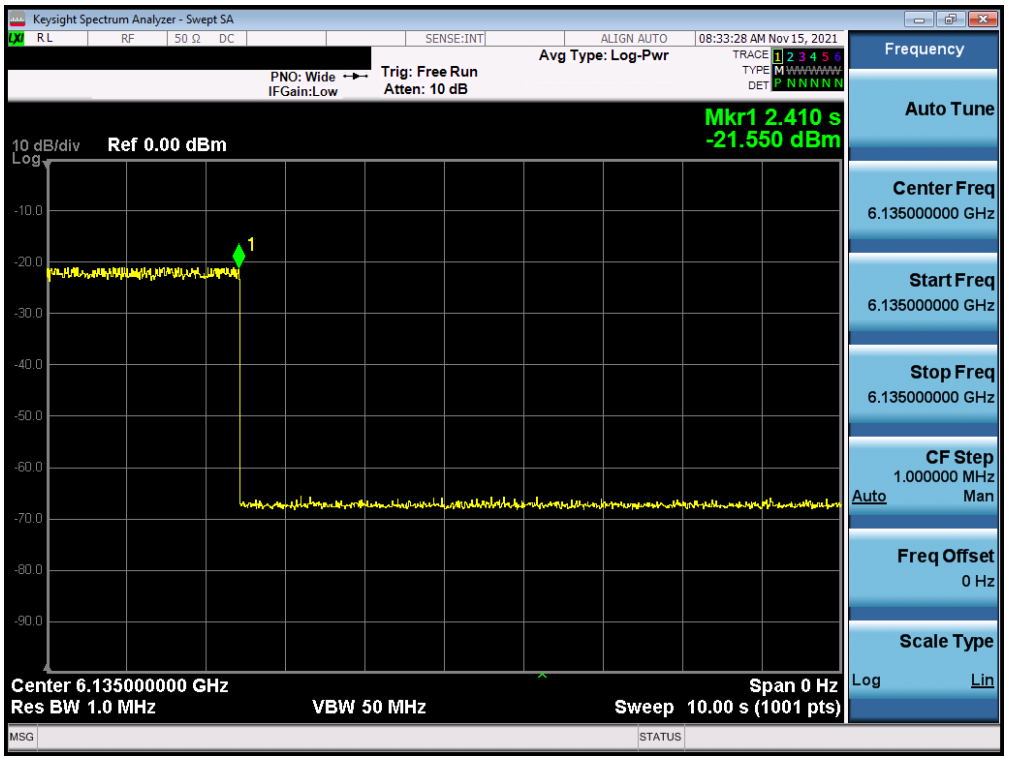
$$P2 = Pmeas + L - G2$$
$$P2 = -53.21 + 1.92 - 10.72$$
$$P2 = -62.01 dBm$$

Equation 7-1. Incumbent Detection Level Calculation



Date: 14.NOV.2021 16:34:11

Plot 7-313. AWGN Sample Signal



Plot 7-314. Contention Based Protocol Timing Plot

Band	Channel	Channel Freq [MHz]	Channel BW [MHz]	Incumbent Freq [MHz]	Detection Power Level [dBm]	Detection Limit [dBm]	Margin [dB]
UNII Band 5	37	6135	20	6135	-68.89	-62.0	-6.89
	47	6185	160	6110	-66.27	-62.0	-4.27
				6175	-65.90	-62.0	-3.90
				6240	-64.94	-62.0	-2.94
UNII Band 6	101	6455	20	6455	-68.86	-62.0	-6.86
	111	6505	160	6435	-65.00	-62.0	-3.00
				6495	-63.78	-62.0	-1.78
				6575	-64.43	-62.0	-2.43
UNII Band 7	149	6695	20	6695	-68.26	-62.0	-6.26
	143	6665	160	6595	-65.46	-62.0	-3.46
				6655	-64.52	-62.0	-2.52
				6735	-63.79	-62.0	-1.79
UNII Band 8	213	7015	20	7015	-68.27	-62.0	-6.27
	207	6985	160	6915	-65.07	-62.0	-3.07
				6975	-63.50	-62.0	-1.50
				7055	-63.49	-62.0	-1.49

Table 7-8. Contention Based Protocol – Incumbent Detection Results

Band	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Detection Rate (%)
UNII Band 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
UNII Band 6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
UNII Band 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
UNII Band 8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100

Table 7-9. Contention Based Protocol – Incumbent Detection Trial Results

7.7 Radiated Spurious Emission Measurements – Above 1GHz

§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, 802.11ax (20/40/80/160MHz), 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 5.925-7.125 GHz band: All emissions outside of the 5.925-7.125 GHz band shall not exceed an EIRP of −27 dBm/MHz.

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

Table 7-10. 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.

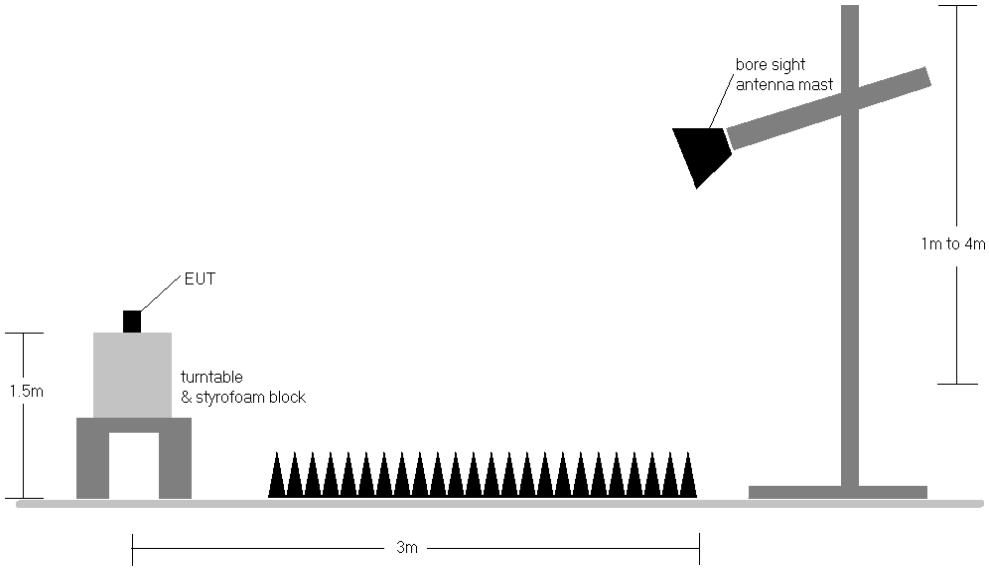


Figure 7-7. Test Instrument & Measurement Setup

Test Notes

1. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 the limit shown in Table 7-10.
2. All spurious emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-10. All spurious emissions that do not lie in a restricted band are subject to an average 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. All spurious emissions that do not lie in a restricted band are subject to a peak limit not to exceed 20dB of the average limit [68.2dBμV/m]. If a peak measurement passes the average limit it was determined no further investigation is necessary.
4. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
5. This unit was tested with its standard battery.
6. 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.
7. 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.
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.
10. In the case where a peak-detector measurement passed the given RMS limit it was determined sufficient to demonstrate compliance.

Sample Calculations

Determining Spurious Emissions Levels

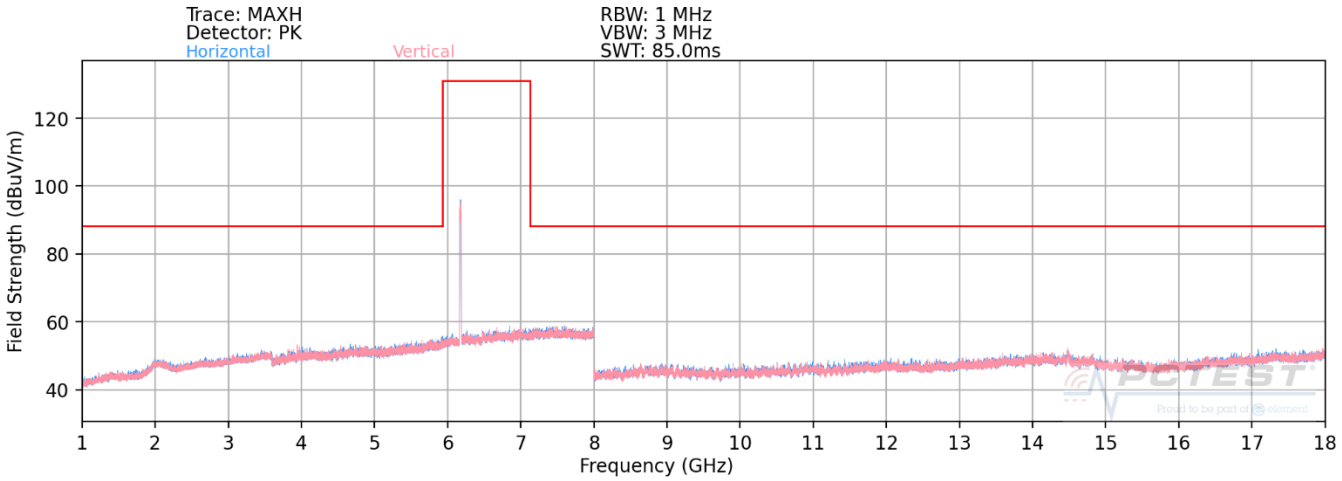
- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

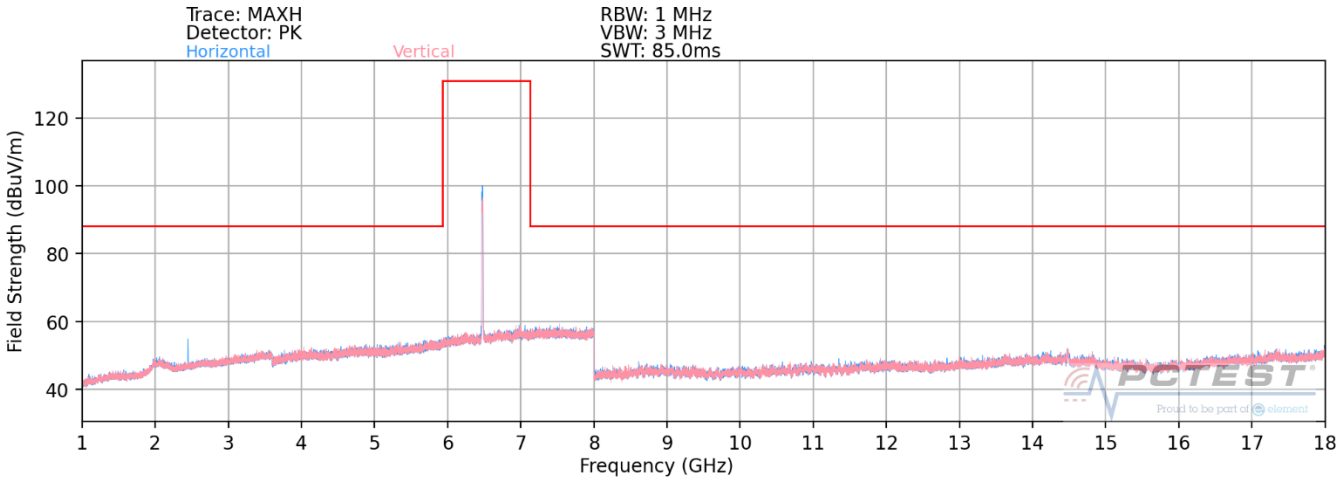
- The amplitude offset shown in the radiated restricted band edge plots was calculated using the formula:

  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

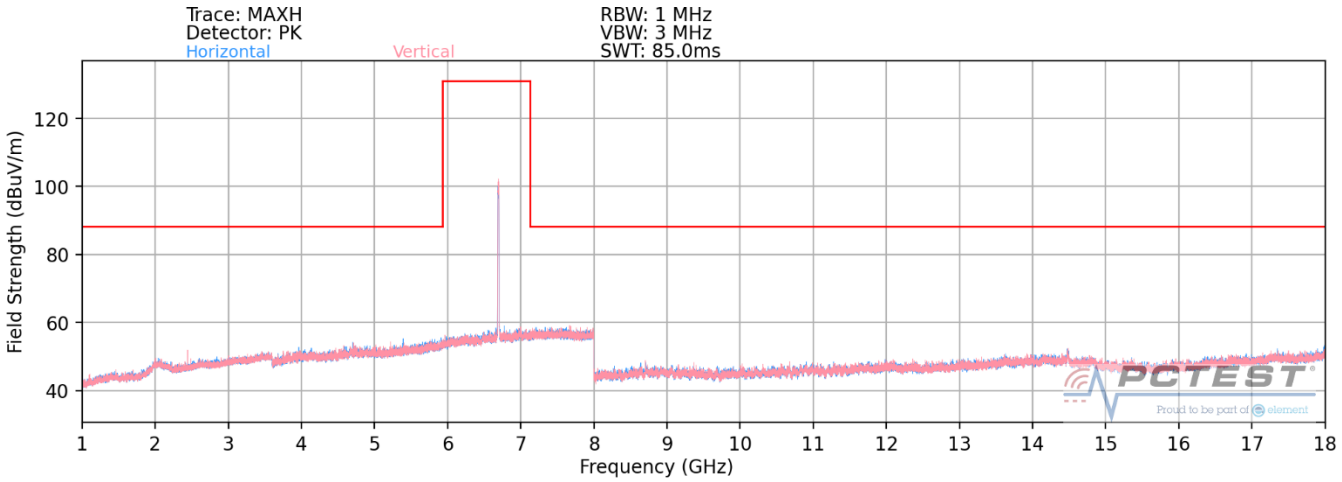
6.6.1 MIMO Radiated Spurious Emission Measurements



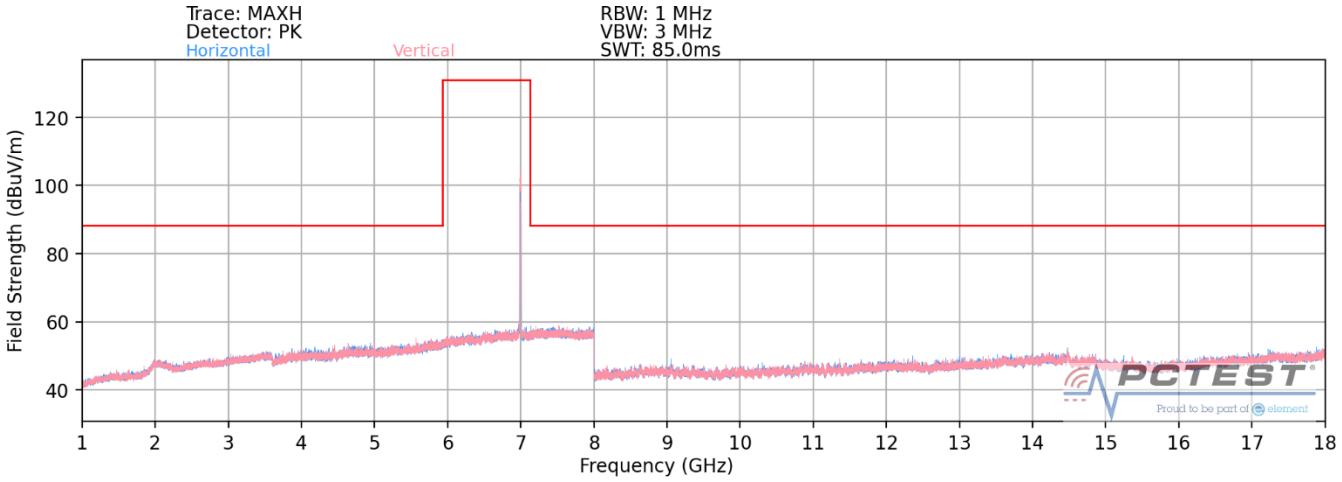
Plot 7-315. Radiated Spurious Plot above 1GHz MIMO (802.11ax – UNII Band 5)



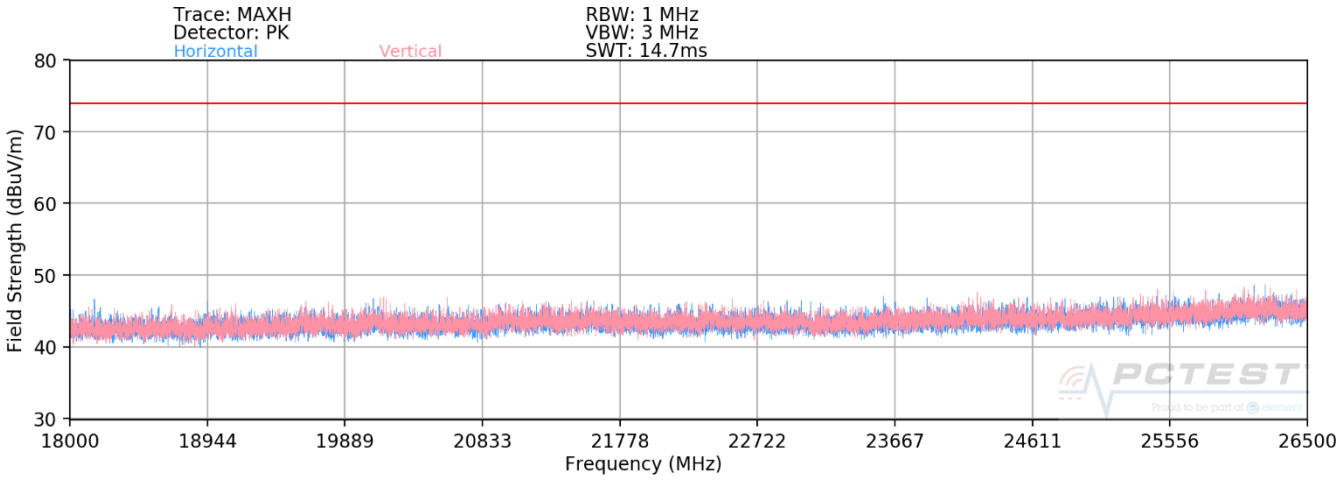
Plot 7-316. Radiated Spurious Plot above 1GHz MIMO (802.11ax– UNII Band 6)



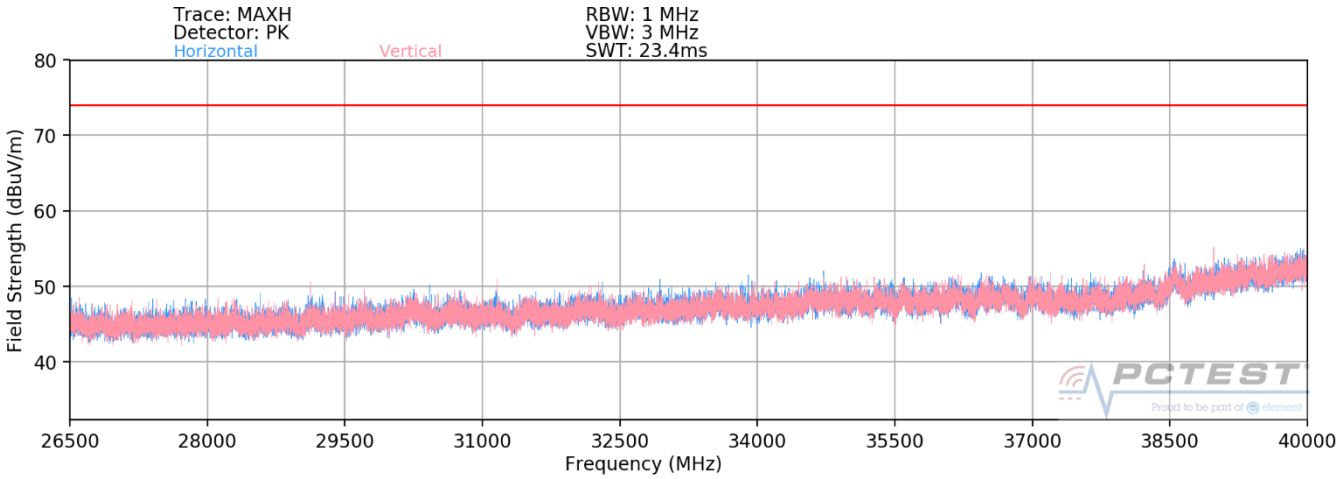
Plot 7 314. Radiated Spurious Plot above 1GHz MIMO (802.11ax– UNII Band 7)



Plot 7 314. Radiated Spurious Plot above 1GHz MIMO (802.11ax– UNII Band 8)



Plot 7-317. Radiated Spurious Plot above 18GHz - 26.5GHz MIMO (802.11ax)



Plot 7-318. Radiated Spurious Plot 26.5GHz - 40GHz MIMO (802.11ax)

MIMO Radiated Spurious Emission Measurements

§15.407(b) §15.205 & §15.209

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5935MHz
Channel:	2

	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]
*	11870.00	Average	H	-	-	-82.17	20.44	0.00	45.27	53.98	-8.71
*	11870.00	Peak	H	-	-	-70.38	20.44	0.00	57.06	73.98	-16.92
*	17805.00	Average	H	-	-	-83.81	26.31	0.00	49.50	53.98	-4.48
*	17805.00	Peak	H	-	-	-72.32	26.31	0.00	60.99	73.98	-12.99
*	23740.00	Average	H	-	-	-68.29	4.79	-9.54	33.95	53.98	-20.02
*	23740.00	Peak	H	-	-	-56.98	4.79	-9.54	45.26	73.98	-28.72
	29675.00	Peak	H	-	-	-57.31	7.24	-9.54	47.39	68.20	-20.81

Table 7-11. Radiated Measurements MIMO (UNII Band 5 – Low Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6175MHz
Channel:	45

	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]
*	12350.00	Average	H	128	3	-80.61	21.02	0.00	47.41	53.98	-6.57
*	12350.00	Peak	H	128	3	-67.97	21.02	0.00	60.05	73.98	-13.93
*	18525.00	Average	H	-	-	-67.98	3.17	-9.54	32.64	53.98	-21.34
*	18525.00	Peak	H	-	-	-58.46	3.17	-9.54	42.17	73.98	-31.81
	24700.00	Peak	H	-	-	-56.93	5.18	-9.54	45.71	68.20	-22.49
	30875.00	Peak	H	-	-	-58.71	7.86	-9.54	46.60	68.20	-21.60

Table 7-12. Radiated Measurements MIMO (UNII Band 5 – Mid Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6415MHz
Channel:	93

	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]
	12830.00	Peak	H	-	-	-70.64	21.25	0.00	57.61	68.20	-10.59
*	19245.00	Average	H	-	-	-68.20	3.55	-9.54	32.81	53.98	-21.17
*	19245.00	Peak	H	-	-	-57.40	3.55	-9.54	43.61	73.98	-30.37
	25660.00	Peak	H	-	-	-57.91	5.47	-9.54	45.01	68.20	-23.19
	32075.00	Peak	H	-	-	-57.99	8.18	-9.54	47.65	68.20	-20.55

Table 7-13. Radiated Measurements MIMO (UNII Band 5 – High Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6435MHz
Channel:	97

	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]
	12870.00	Peak	H	-	-	-71.04	21.23	0.00	57.19	68.20	-11.01
*	19305.00	Average	H	-	-	-67.60	3.78	-9.54	33.64	53.98	-20.34
*	19305.00	Peak	H	-	-	-56.99	3.78	-9.54	44.25	73.98	-29.73
	25740.00	Peak	H	-	-	-57.44	5.73	-9.54	45.74	68.20	-22.46
	32175.00	Peak	H	-	-	-59.25	8.19	-9.54	46.40	68.20	-21.80

Table 7-14. Radiated Measurements MIMO (UNII Band 6 – Low Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6475MHz
Channel:	105

	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]
	12950.00	Peak	H	-	-	-70.24	20.86	0.00	57.62	68.20	-10.58
*	19425.00	Average	H	-	-	-67.87	3.82	-9.54	33.41	53.98	-20.57
*	19425.00	Peak	H	-	-	-58.78	3.82	-9.54	42.50	73.98	-31.48
	25900.00	Peak	H	-	-	-57.75	5.87	-9.54	45.58	68.20	-22.62
	32375.00	Peak	H	-	-	-58.52	7.89	-9.54	46.83	68.20	-21.37

Table 7-15. Radiated Measurements MIMO (UNII Band 6 – Mid Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6515MHz
Channel:	113

	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]
	13030.00	Peak	H	-	-	-71.24	21.08	0.00	56.84	68.20	-11.36
*	19545.00	Average	H	-	-	-67.62	3.89	-9.54	33.72	53.98	-20.26
*	19545.00	Peak	H	-	-	-56.80	3.89	-9.54	44.54	73.98	-29.44
	26060.00	Peak	H	-	-	-57.08	5.87	-9.54	46.24	68.20	-21.96
	32575.00	Peak	H	-	-	-57.28	7.72	-9.54	47.90	68.20	-20.30

Table 7-16. Radiated Measurements MIMO (UNII Band 6 – High Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6535MHz
Channel:	117

	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]
	13070.00	Peak	H	-	-	-71.11	21.38	0.00	57.27	68.20	-10.93
*	19605.00	Average	H	-	-	-67.73	4.03	-9.54	33.76	53.98	-20.22
*	19605.00	Peak	H	-	-	-57.47	4.03	-9.54	44.02	73.98	-29.96
	26140.00	Peak	H	-	-	-58.46	6.01	-9.54	45.01	68.20	-23.19
	32675.00	Peak	H	-	-	-59.30	7.97	-9.54	46.13	68.20	-22.07

Table 7-17. Radiated Measurements MIMO (UNII Band 7 – Low Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6695MHz
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]
*	13390.00	Average	H	-	-	-83.24	21.13	0.00	44.89	53.98	-9.09
*	13390.00	Peak	H	-	-	-71.21	21.13	0.00	56.92	73.98	-17.06
*	20085.00	Average	H	-	-	-67.64	4.30	-9.54	34.12	53.98	-19.86
*	20085.00	Peak	H	-	-	-57.46	4.30	-9.54	44.30	73.98	-29.68
	26780.00	Peak	H	-	-	-58.37	5.85	-9.54	44.94	68.20	-23.26
	33475.00	Peak	H	-	-	-57.99	8.43	-9.54	47.90	68.20	-20.30

Table 7-18. Radiated Measurements MIMO (UNII Band 7 – Mid Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6875MHz
Channel:	185

	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]
	13750.00	Peak	H	-	-	-71.52	21.83	0.00	57.31	68.20	-10.89
*	20625.00	Average	H	-	-	-68.80	4.46	-9.54	33.12	53.98	-20.86
*	20625.00	Peak	H	-	-	-58.94	4.46	-9.54	42.98	73.98	-31.00
	27500.00	Peak	H	-	-	-57.60	5.93	-9.54	45.79	68.20	-22.41
	34375.00	Peak	H	-	-	-58.60	8.44	-9.54	47.30	68.20	-20.90

Table 7-19. Radiated Measurements MIMO (UNII Band 7 – High Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6895MHz
Channel:	189

	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]
	13790.00	Peak	H	-	-	-71.40	22.57	0.00	58.17	68.20	-10.03
*	20685.00	Average	H	-	-	-68.48	4.36	-9.54	33.33	53.98	-20.65
*	20685.00	Peak	H	-	-	-58.02	4.36	-9.54	43.80	73.98	-30.18
	27580.00	Peak	H	-	-	-57.37	5.96	-9.54	46.05	68.20	-22.15
	34475.00	Peak	H	-	-	-56.36	8.49	-9.54	49.58	68.20	-18.62

Table 7-20. Radiated Measurements MIMO (UNII Band 8 – Low Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6995MHz
Channel:	209

	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]
	13990.00	Peak	H	-	-	-71.40	22.11	0.00	57.71	68.20	-10.49
*	20985.00	Average	H	-	-	-68.65	4.70	-9.54	33.51	53.98	-20.47
*	20985.00	Peak	H	-	-	-58.51	4.70	-9.54	43.65	73.98	-30.33
	27980.00	Peak	H	-	-	-57.38	6.11	-9.54	46.19	68.20	-22.01
	34975.00	Peak	H	-	-	-57.76	8.62	-9.54	48.31	68.20	-19.89

Table 7-21. Radiated Measurements MIMO (UNII Band 8 – Mid Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	7115MHz
Channel:	233

	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]
	14230.00	Peak	H	-	-	-71.25	21.73	0.00	57.48	68.20	-10.72
*	21345.00	Average	H	-	-	-68.10	4.89	-9.54	34.25	53.98	-19.73
*	21345.00	Peak	H	-	-	-57.62	4.89	-9.54	44.73	73.98	-29.24
	28460.00	Peak	H	-	-	-58.95	6.26	-9.54	44.77	68.20	-23.43
	35575.00	Peak	H	-	-	-57.64	8.54	-9.54	48.36	68.20	-19.84

Table 7-22. Radiated Measurements MIMO (UNII Band 8 – High Channel – 20MHz)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6175
Channel:	45

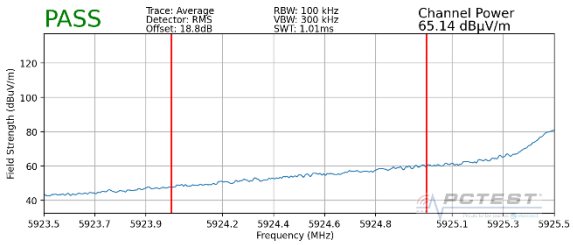
	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	12350.00	Average	H	119	67	-81.72	21.02	0.00	46.30	53.98	-7.68
*	12350.00	Peak	H	119	67	-70.57	21.02	0.00	57.45	73.98	-16.53
*	18525.00	Average	H	-	-	-68.01	3.17	-9.54	32.62	53.98	-21.36
*	18525.00	Peak	H	-	-	-58.52	3.17	-9.54	42.11	73.98	-31.87
*	24700.00	Peak	H	-	-	-56.97	5.18	-9.54	45.67	53.98	-8.31
	30875.00	Peak	H	-	-	-58.73	7.86	-9.54	46.58	73.98	-27.40

Table 7-23. Radiated Measurements MIMO with WCP

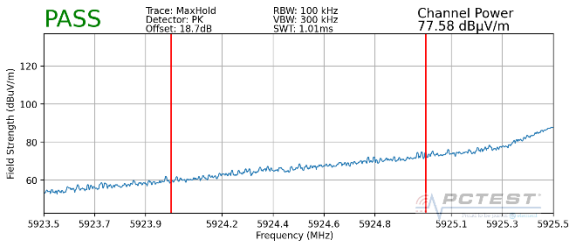
6.6.3 MIMO Radiated Band Edge Measurements (20MHz BW)

§15.407(b.5) §15.205 §15.209

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5935MHz
Channel:	2

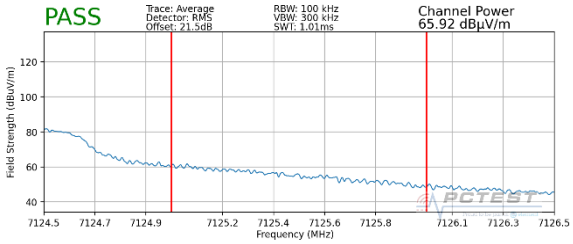


Plot 7-319. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)

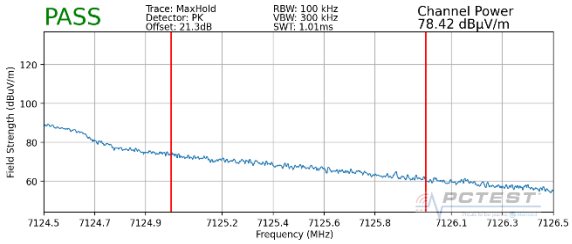


Plot 7-320. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	7115MHz
Channel:	233



Plot 7-321. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 8)

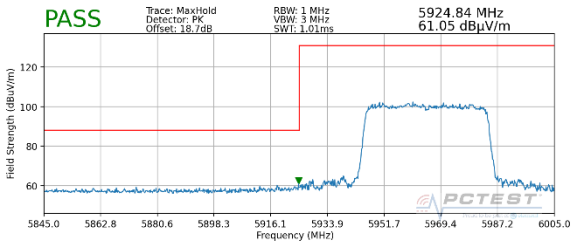


Plot 7-322. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 8)

6.6.4 MIMO Radiated Band Edge Measurements (40MHz BW)

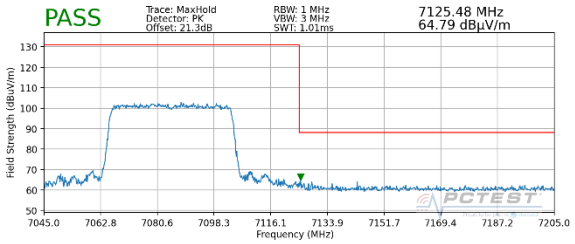
§15.407(b.5) §15.205 §15.209

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5965MHz
Channel:	3



Plot 7-323. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	7085MHz
Channel:	227

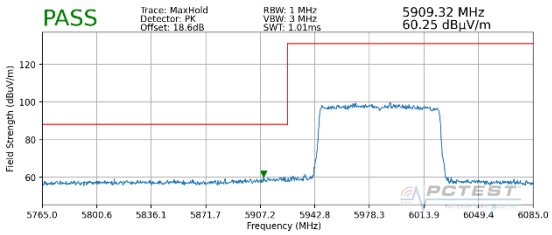


Plot 7-324. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 8)

6.6.5 MIMO Radiated Band Edge Measurements (80MHz BW)

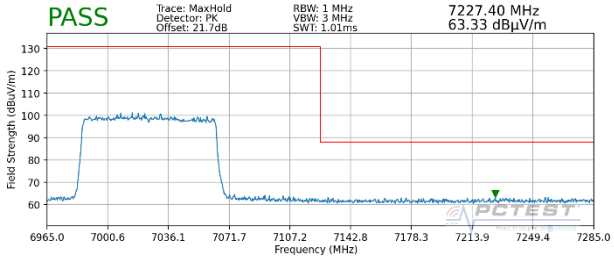
§15.407(b.5) §15.205 §15.209

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5985MHz
Channel:	7



Plot 7-325. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	7025MHz
Channel:	215

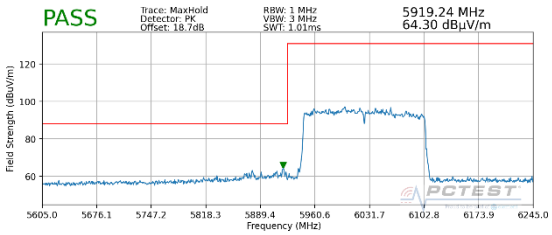


Plot 7-326. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 8)

6.6.6 MIMO Radiated Band Edge Measurements (160MHz BW)

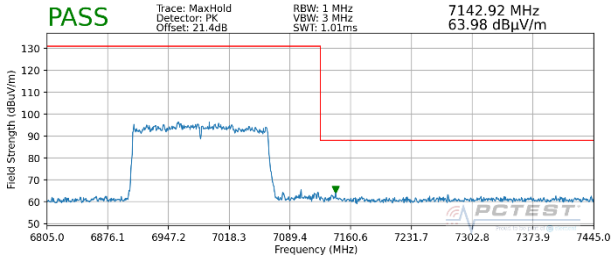
§15.407(b.5) §15.205 §15.209

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	6025MHz
Channel:	15



Plot 7-327. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11ax
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	6985MHz
Channel:	207



Plot 7-328. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 8)

7.8 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 emissions <1GHz must not exceed the limit shown in* Table 7-24 *per Section 15.209

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 7-24. 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.

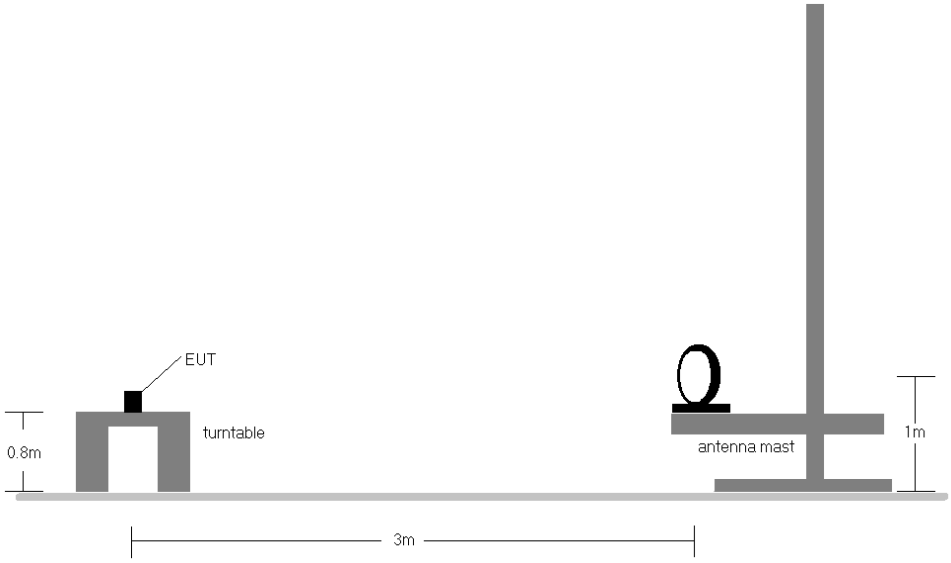


Figure 7-8. Radiated Test Setup < 30MHz

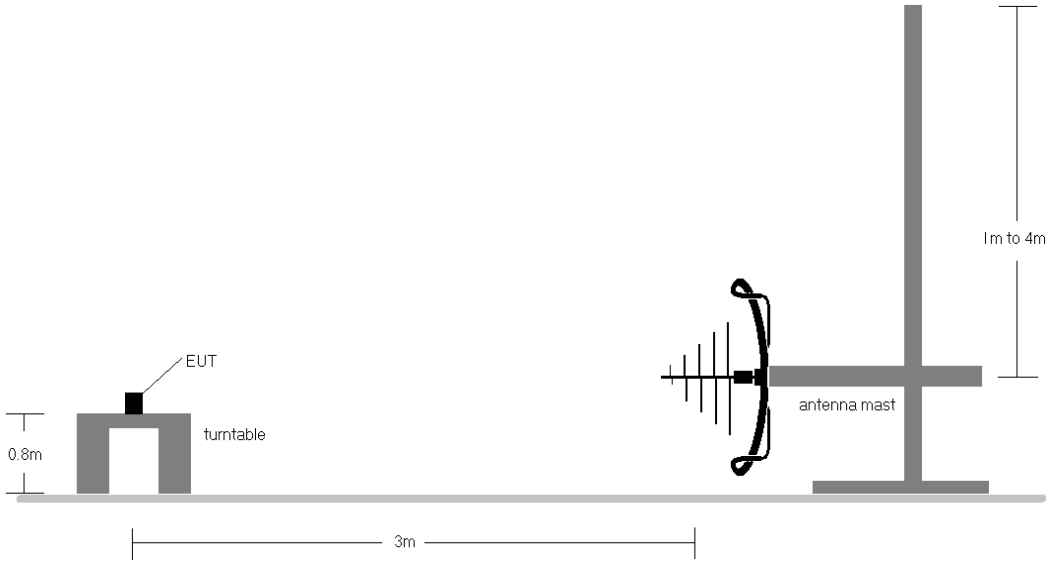


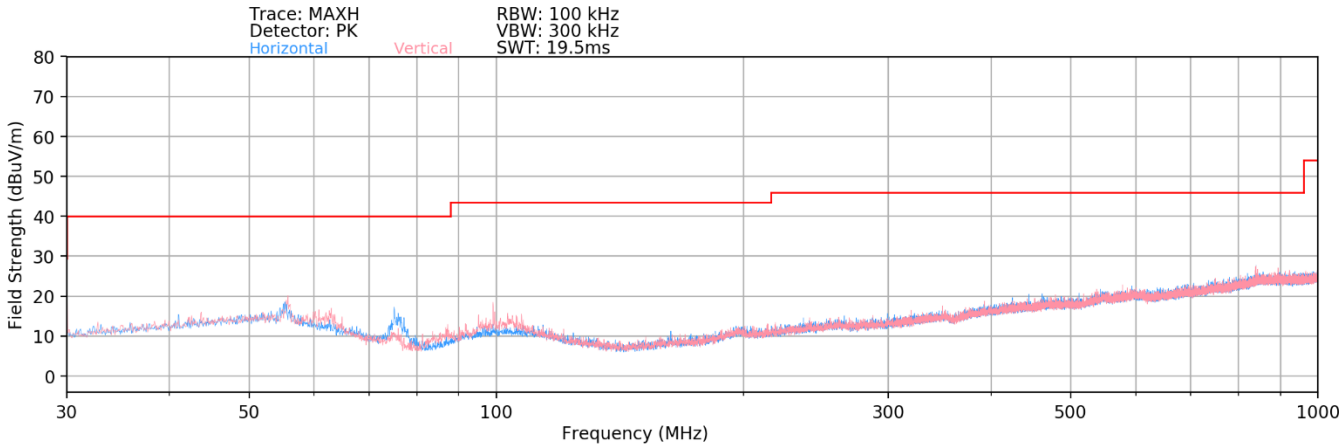
Figure 7-9. Radiated Test Setup < 1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-24.
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.

Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 7-329. Radiated Spurious Plot below 1GHz

7.9 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).

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 7-25. 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.

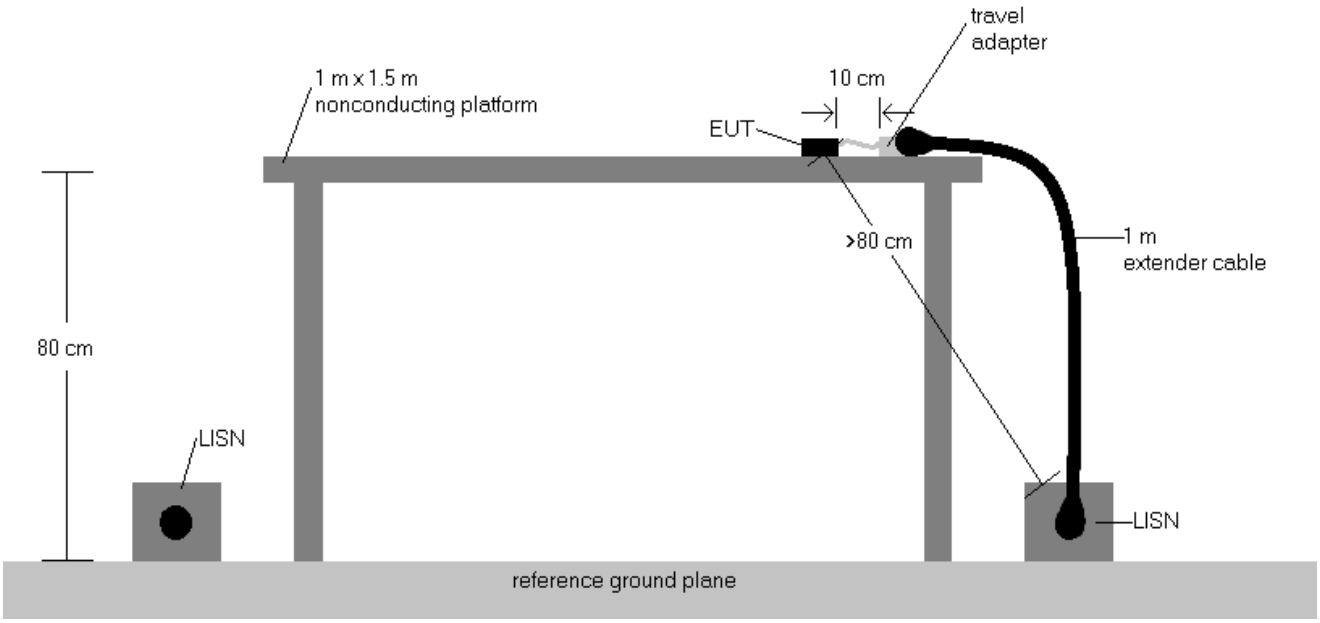
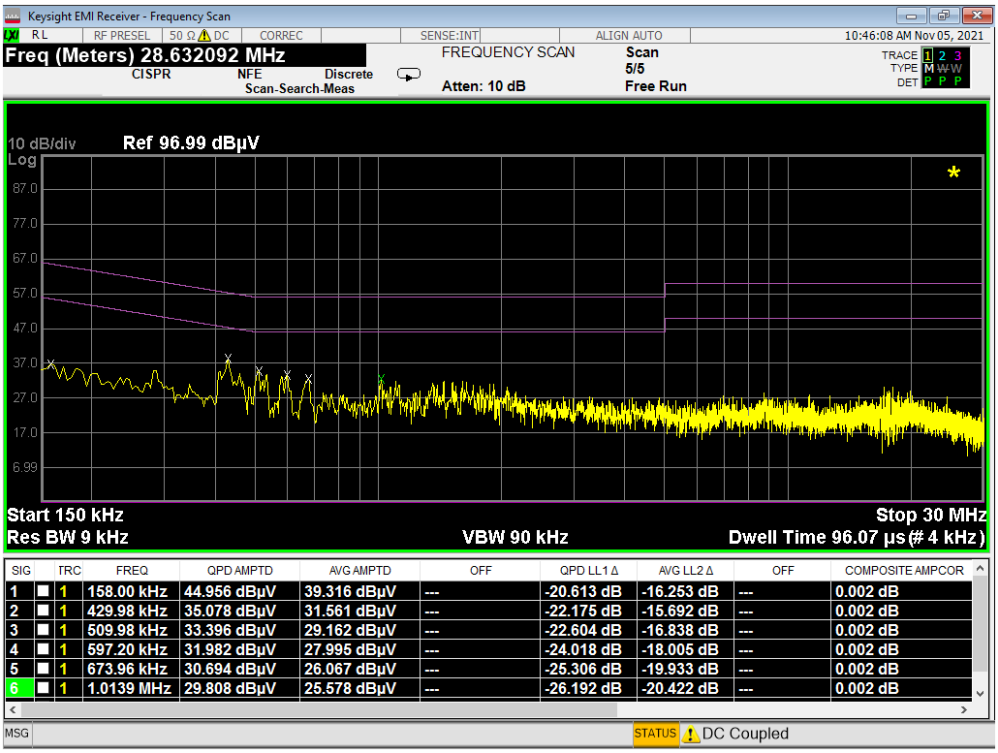


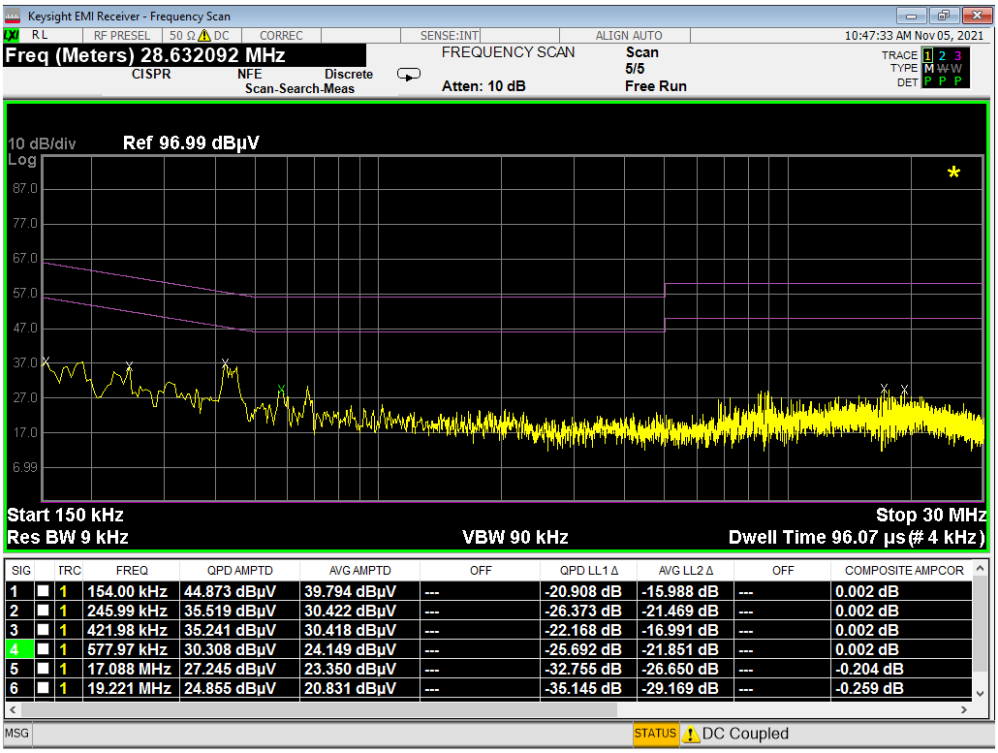
Figure 7-10. Test Instrument & Measurement Setup

Test Notes

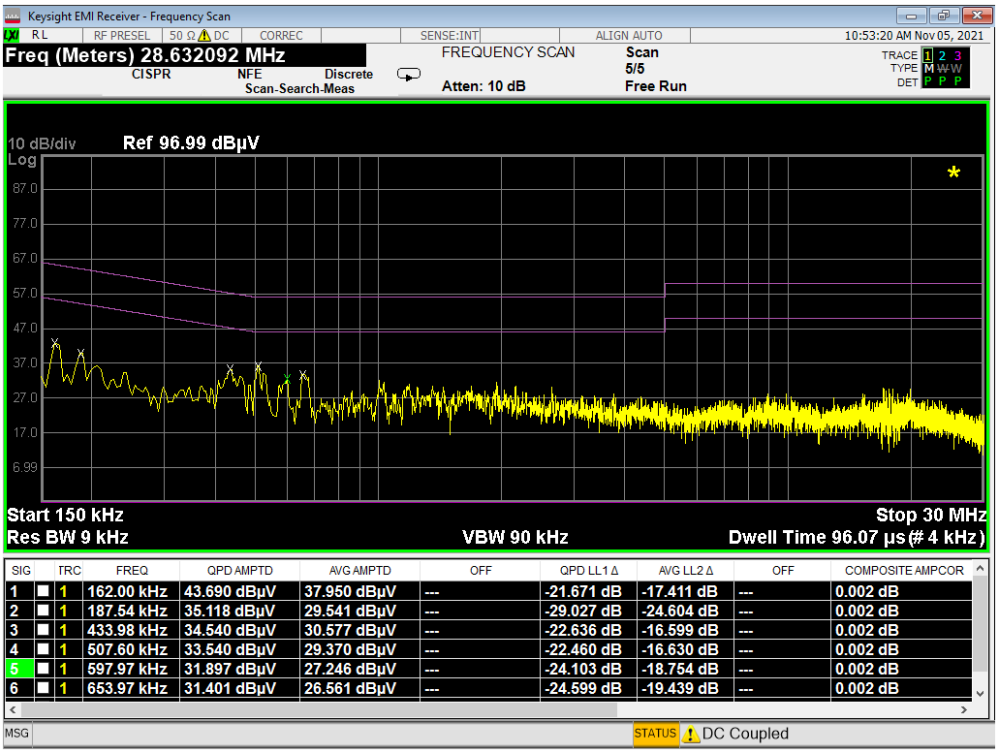
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207.
3. Corr. (dB) = Cable loss (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.



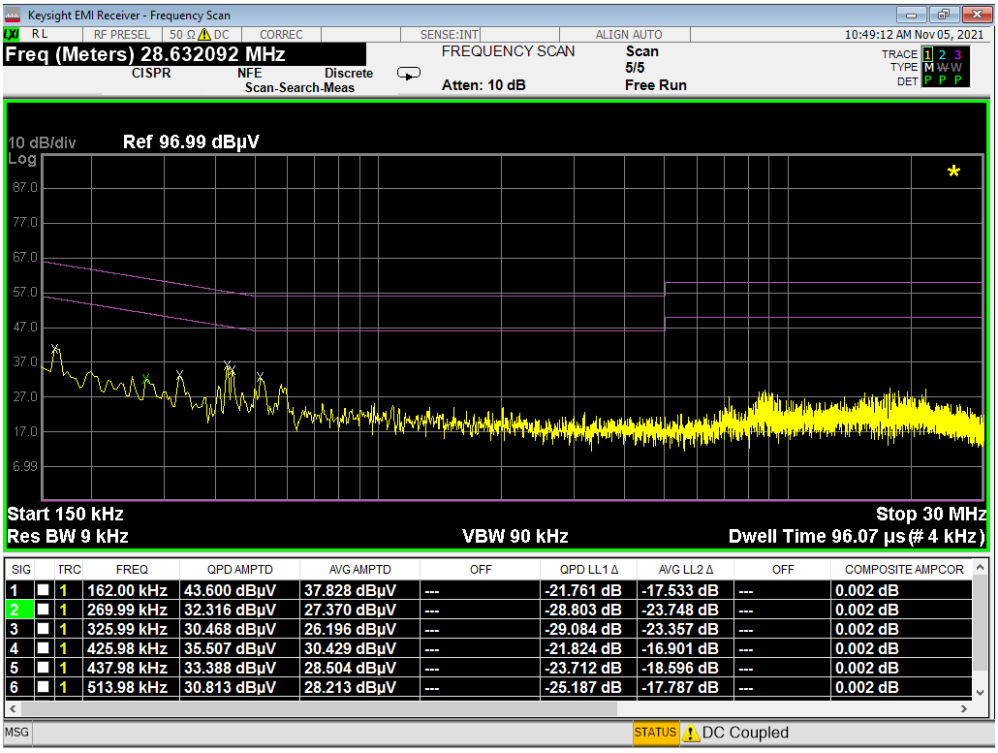
Plot 7-330. Line Conducted Plot with 802.11a UNII Band 5 (L1)



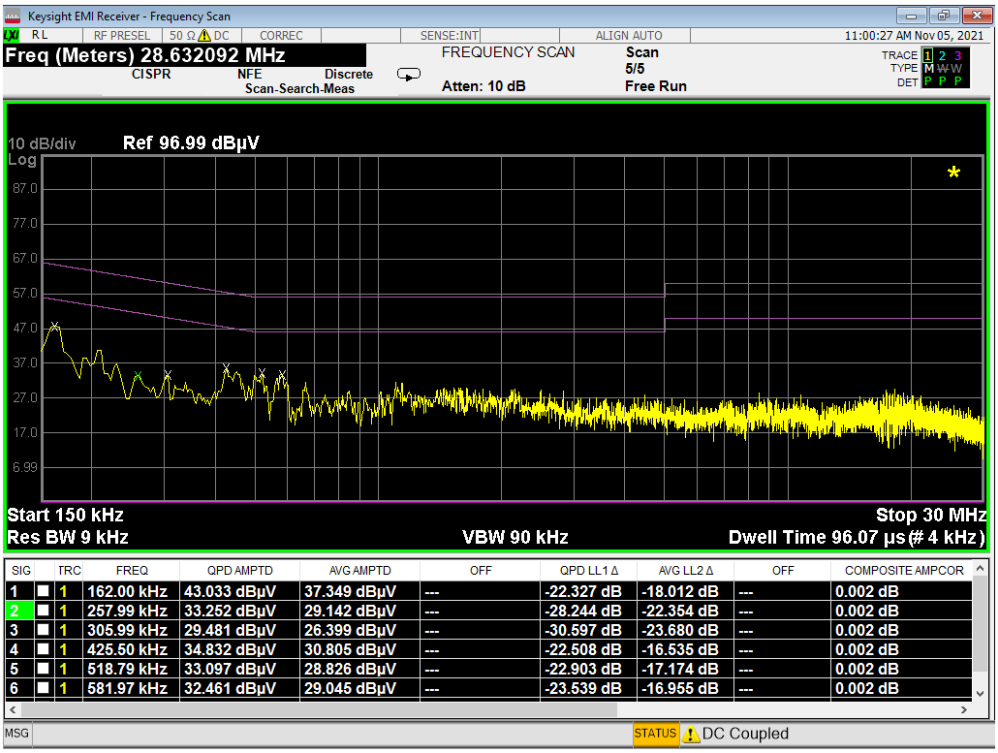
Plot 7-331. Line Conducted Plot with 802.11a UNII Band 5 (N)



Plot 7-332. Line Conducted Plot with 802.11a UNII Band 6 (L1)

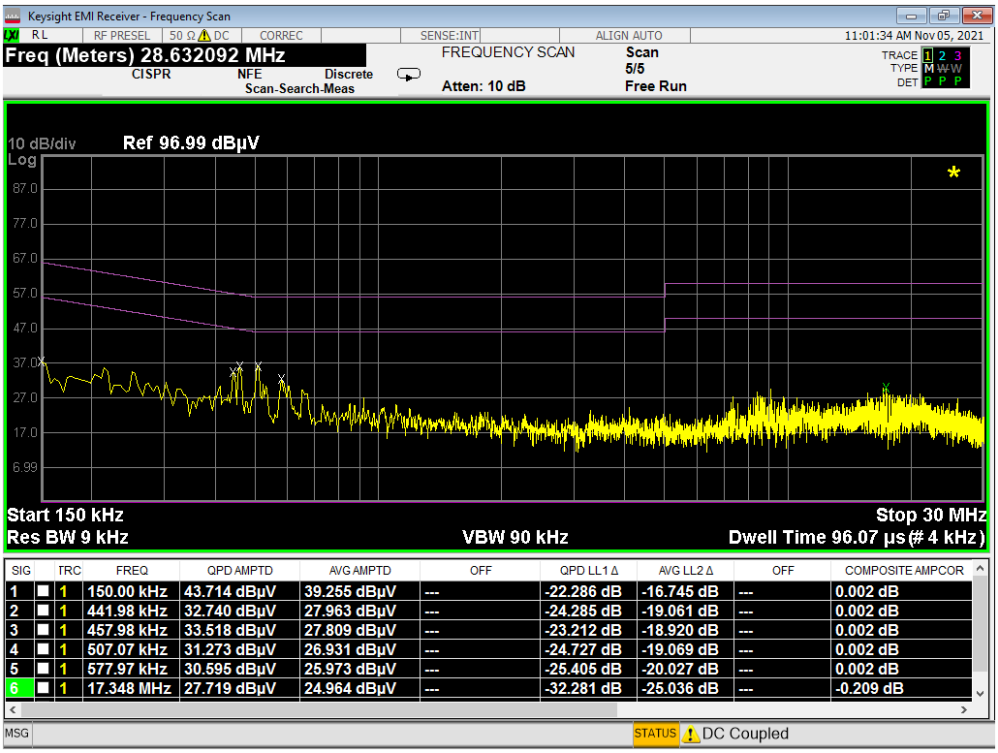


Plot 7-333. Line Conducted Plot with 802.11a UNII Band 6 (N)



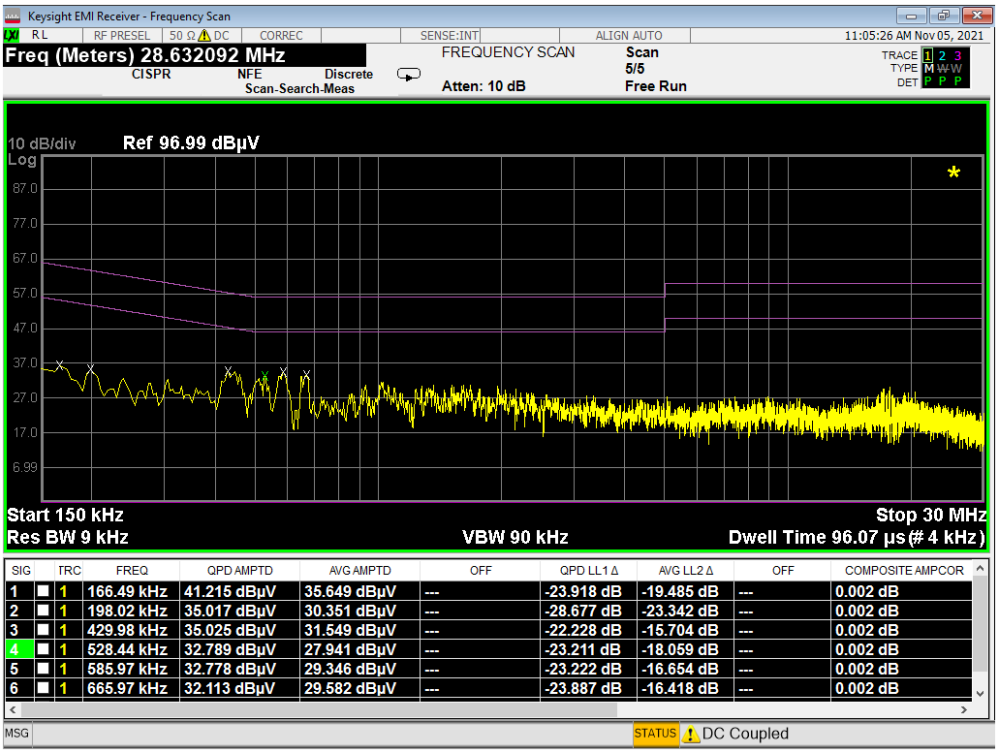
SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR
1	1	162.00 kHz	43.033 dBµV	37.349 dBµV	---	-22.327 dB	-18.012 dB	---	0.002 dB
2	1	257.99 kHz	33.252 dBµV	29.142 dBµV	---	-28.244 dB	-22.354 dB	---	0.002 dB
3	1	305.99 kHz	29.481 dBµV	26.399 dBµV	---	-30.597 dB	-23.680 dB	---	0.002 dB
4	1	425.50 kHz	34.832 dBµV	30.805 dBµV	---	-22.508 dB	-16.535 dB	---	0.002 dB
5	1	518.79 kHz	33.097 dBµV	28.826 dBµV	---	-22.903 dB	-17.174 dB	---	0.002 dB
6	1	581.97 kHz	32.461 dBµV	29.045 dBµV	---	-23.539 dB	-16.955 dB	---	0.002 dB

Plot 7-334. Line Conducted Plot with 802.11a UNII Band 7 (L1)

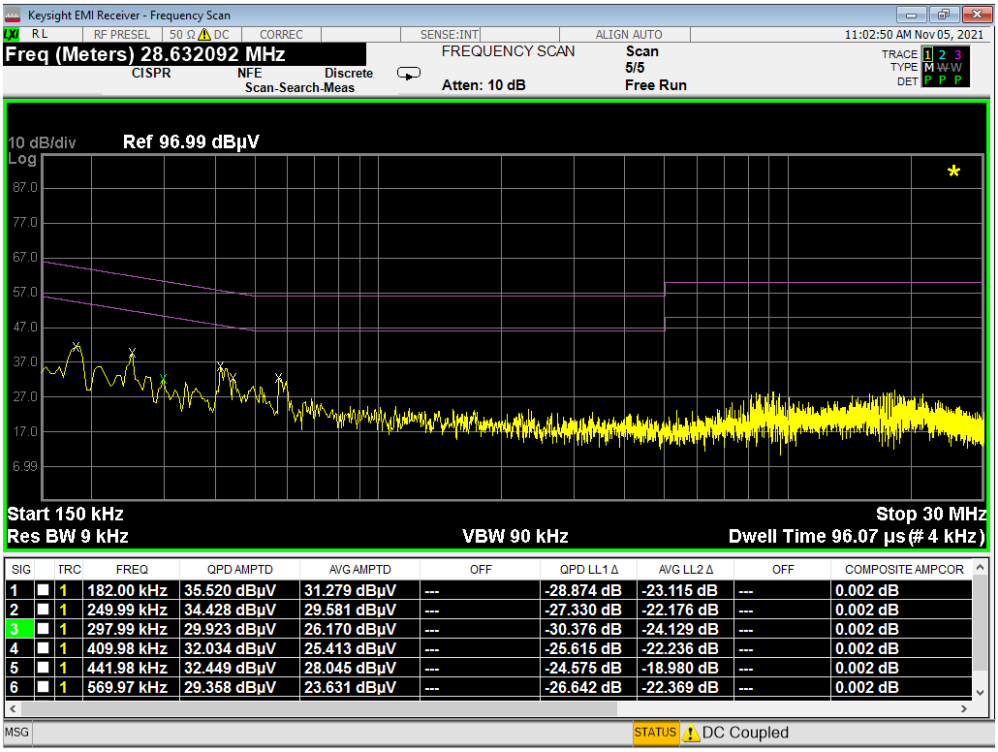


SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR
1	1	150.00 kHz	43.714 dBµV	39.255 dBµV	---	-22.286 dB	-16.745 dB	---	0.002 dB
2	1	441.98 kHz	32.740 dBµV	27.963 dBµV	---	-24.285 dB	-19.061 dB	---	0.002 dB
3	1	457.98 kHz	33.518 dBµV	27.809 dBµV	---	-23.212 dB	-18.920 dB	---	0.002 dB
4	1	507.07 kHz	31.273 dBµV	26.931 dBµV	---	-24.727 dB	-19.069 dB	---	0.002 dB
5	1	577.97 kHz	30.595 dBµV	25.973 dBµV	---	-25.405 dB	-20.027 dB	---	0.002 dB
6	1	17.348 MHz	27.719 dBµV	24.964 dBµV	---	-32.281 dB	-25.036 dB	---	-0.209 dB

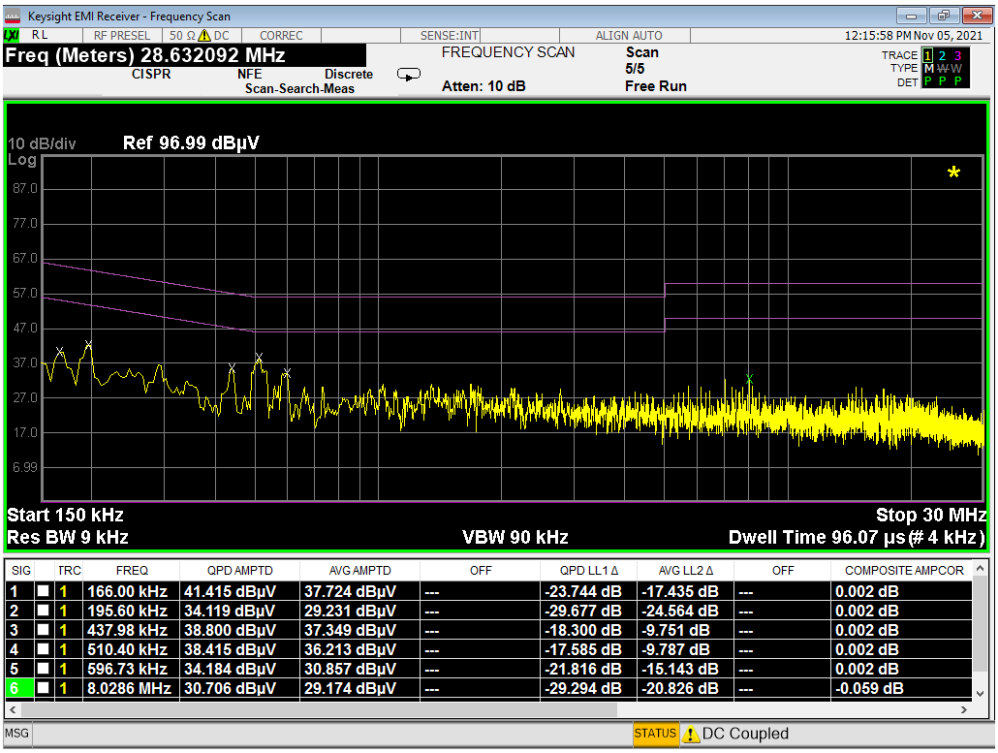
Plot 7-335. Line Conducted Plot with 802.11a UNII Band 7 (N)



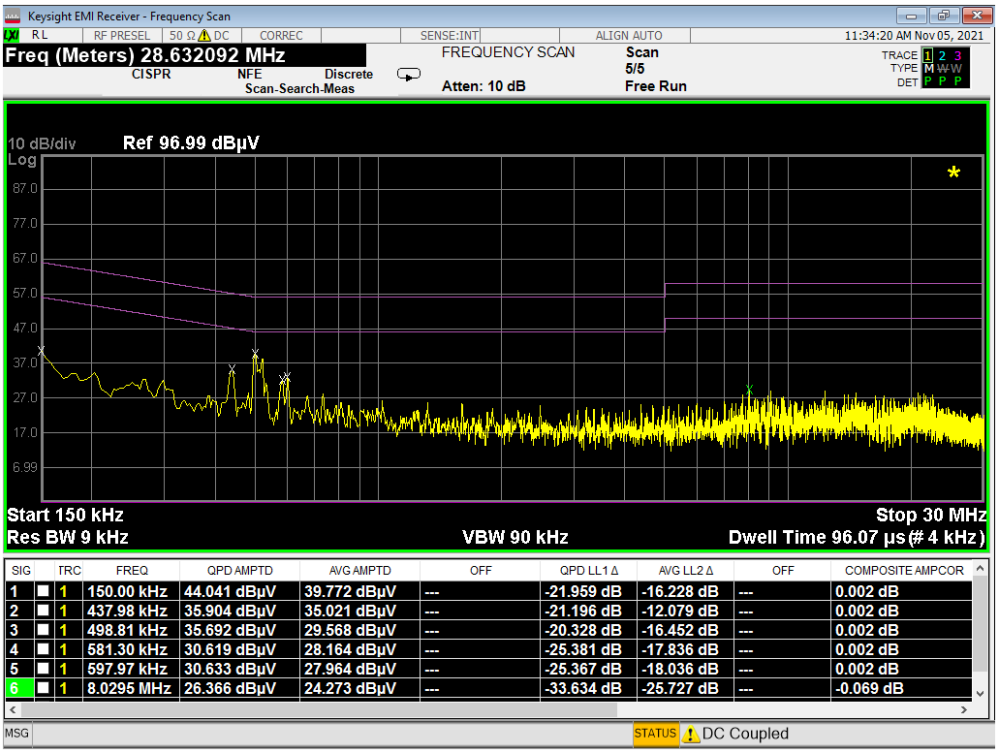
Plot 7-336. Line Conducted Plot with 802.11a UNII Band 8 (L1)



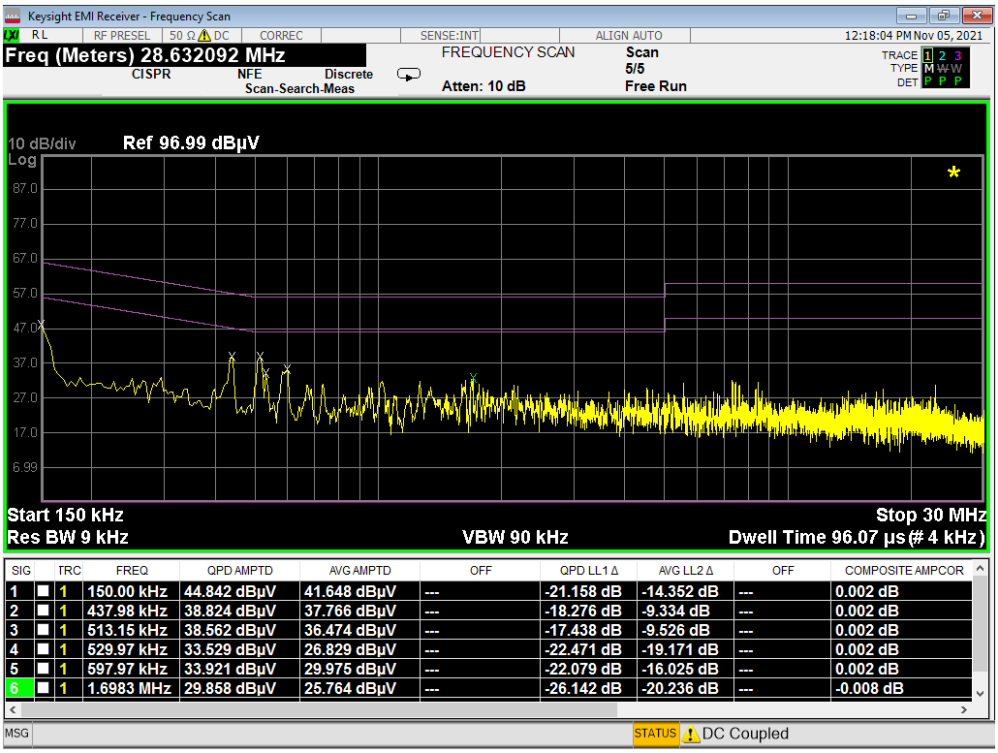
Plot 7-337. Line Conducted Plot with 802.11a UNII Band 8 (N)



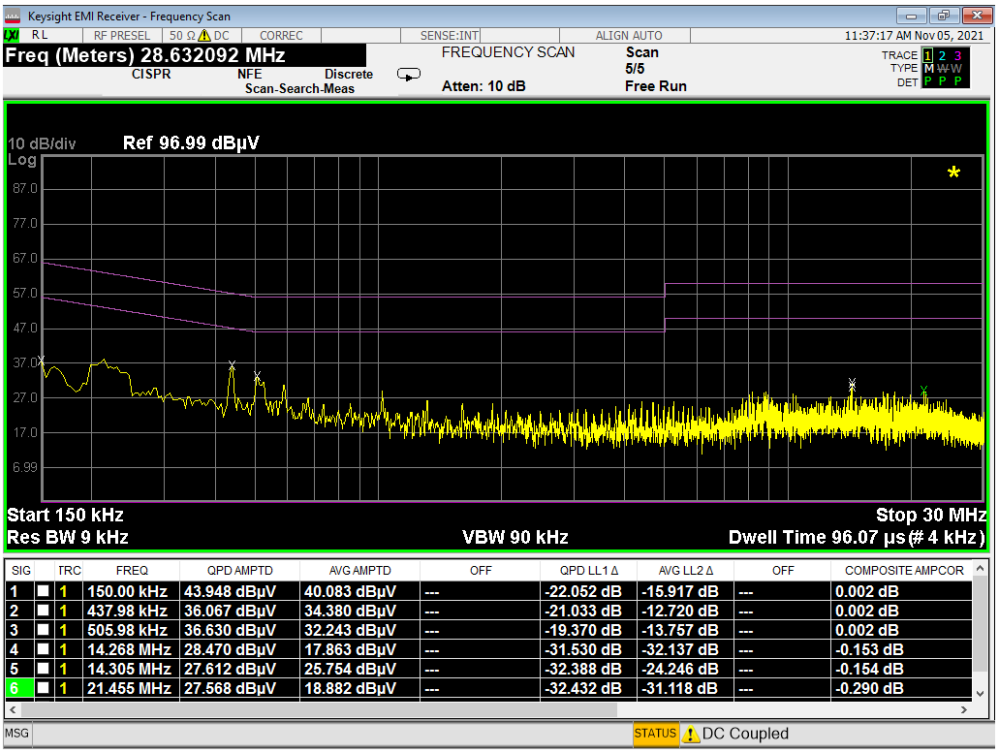
Plot 7-338. Line Conducted Plot with 802.11a UNII Band 5 (L1) with WCP



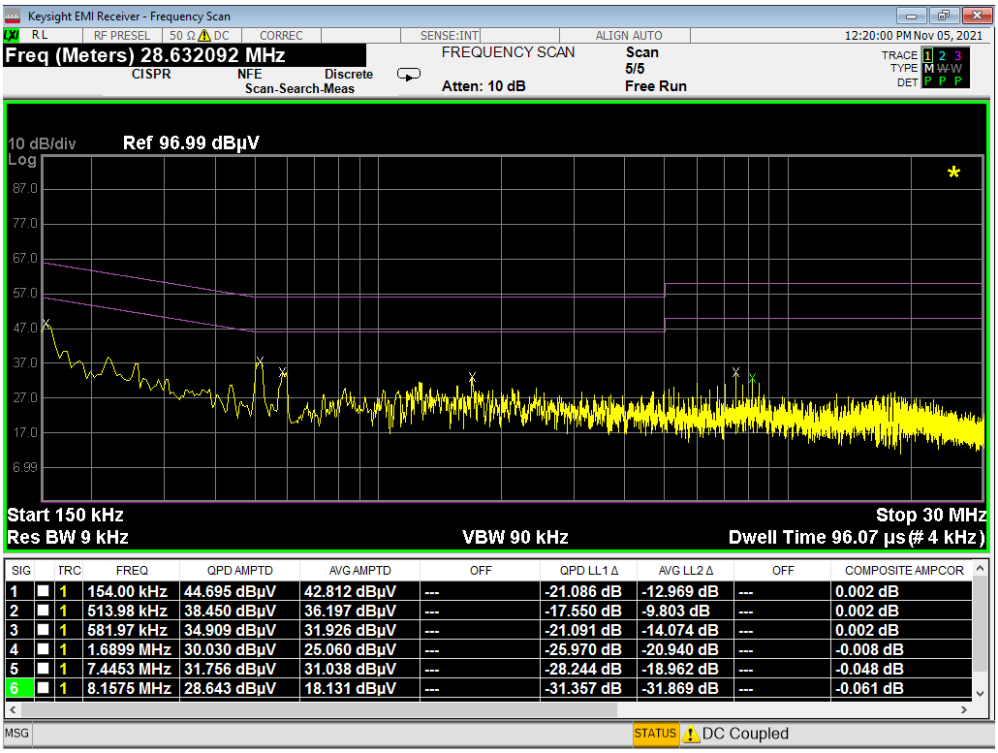
Plot 7-339. Line Conducted Plot with 802.11a UNII Band 5 (N) with WCP



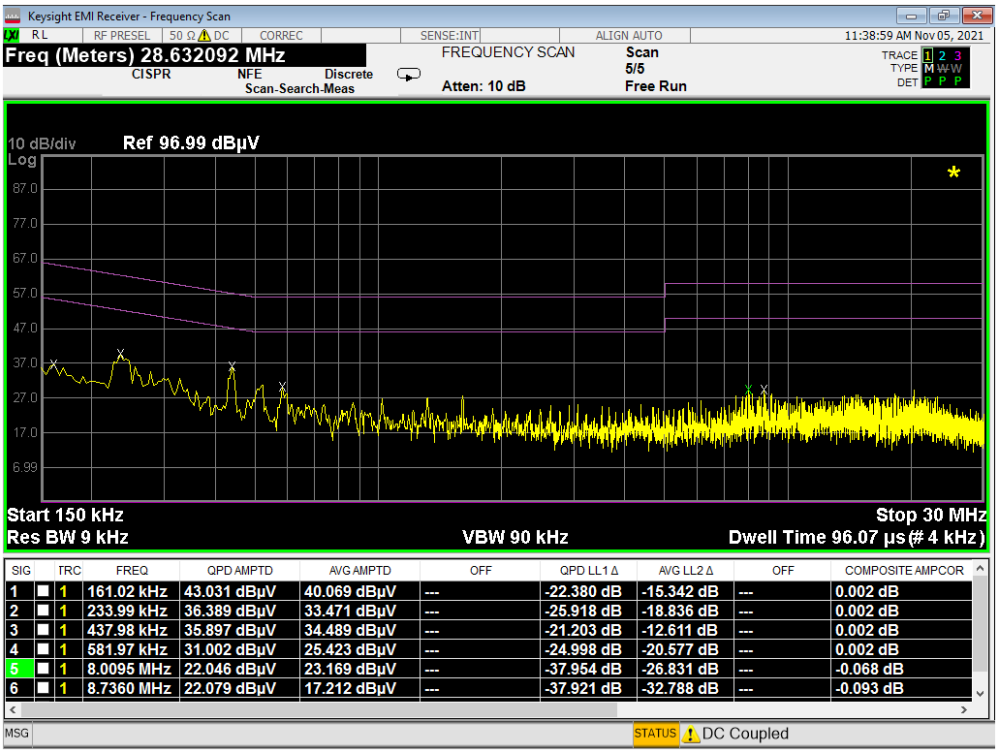
Plot 7-340. Line Conducted Plot with 802.11a UNII Band 6 (L1) with WCP



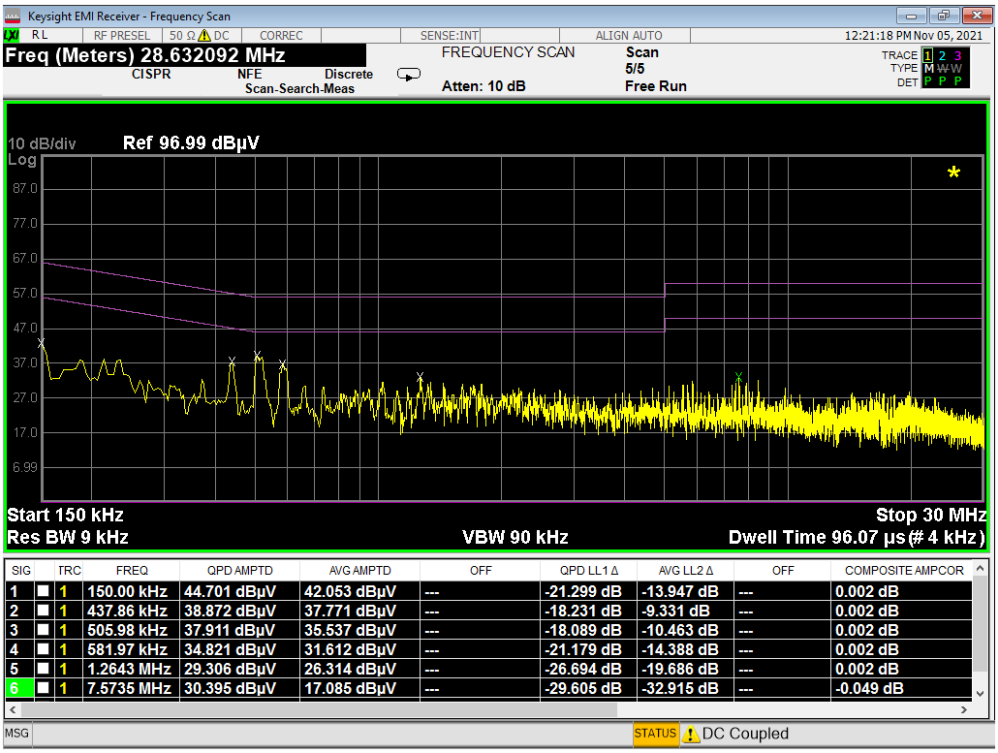
Plot 7-341. Line Conducted Plot with 802.11a UNII Band 6 (N) with WCP



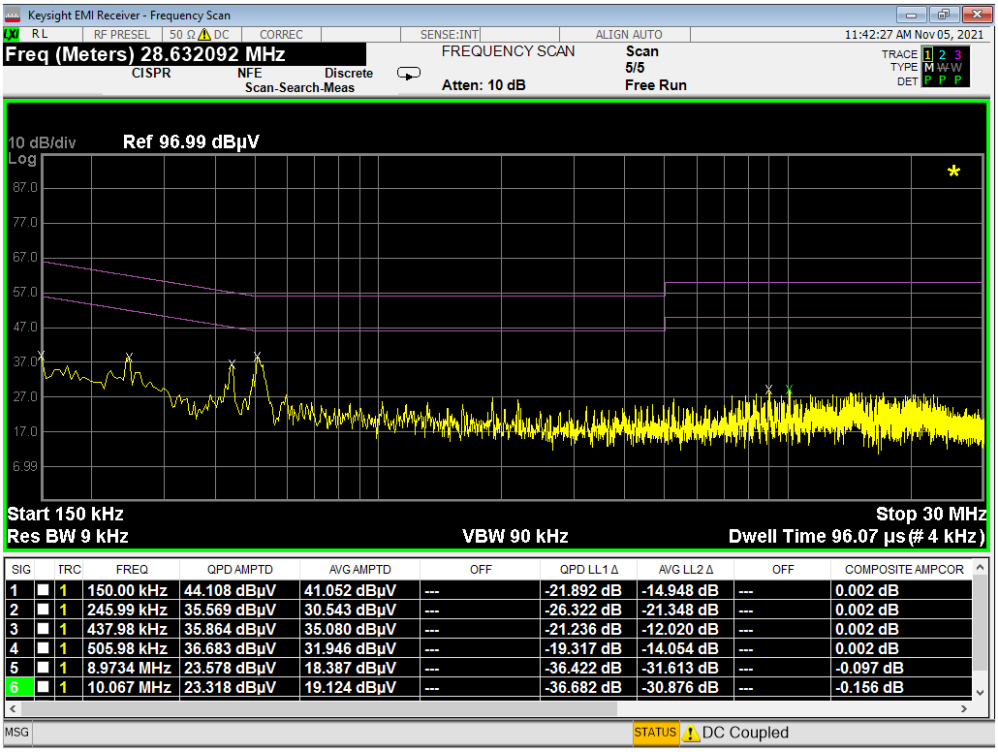
Plot 7-342. Line Conducted Plot with 802.11a UNII Band 7 (L1) with WCP



Plot 7-343. Line Conducted Plot with 802.11a UNII Band 7 (N) with WCP



Plot 7-344. Line Conducted Plot with 802.11a UNII Band 8 (L1) with WCP



Plot 7-345. Line Conducted Plot with 802.11a UNII Band 8 (N) with WCP

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMS908JPN** is in compliance with FCC Part 15.407 for operation as a client device.