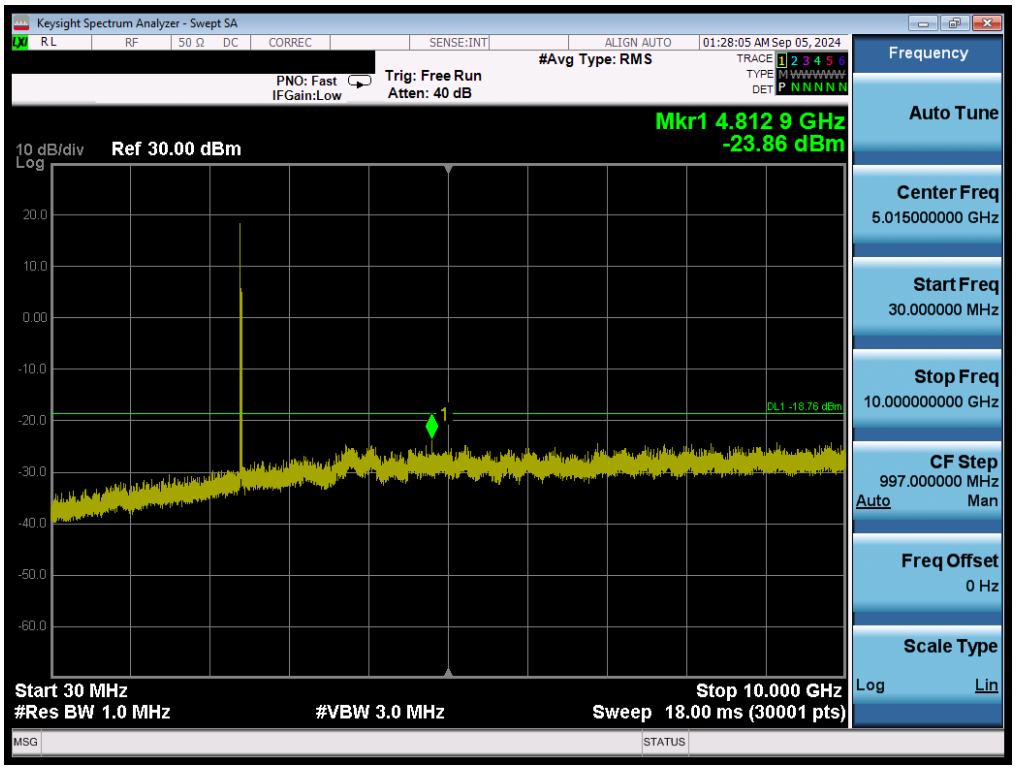
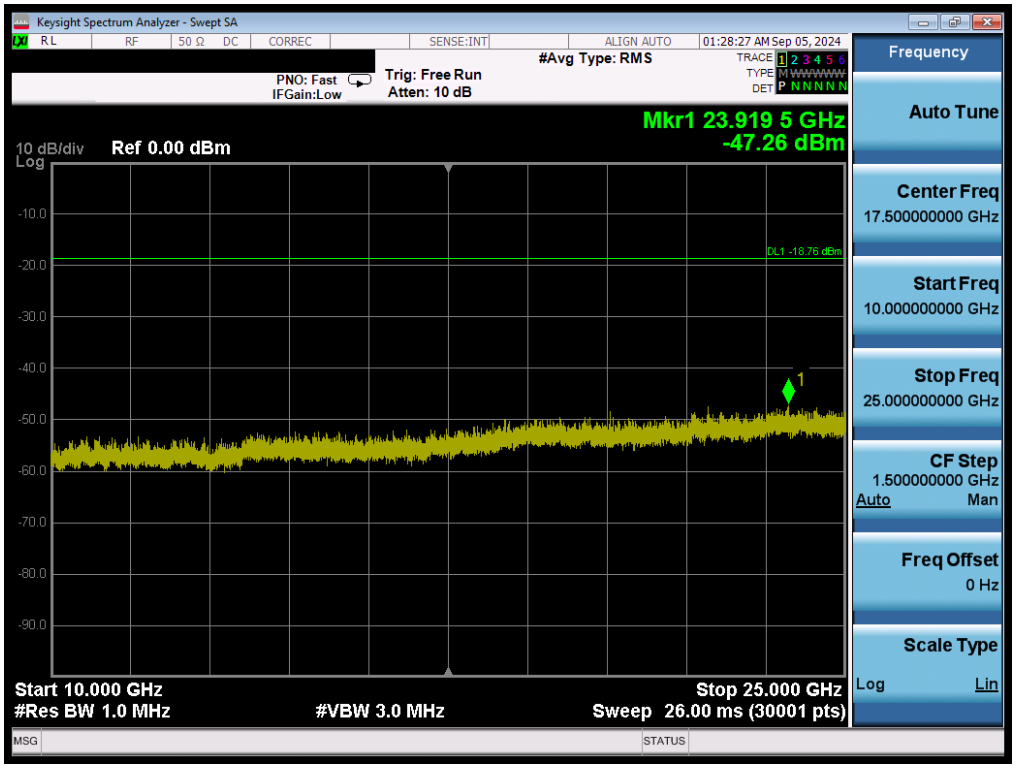
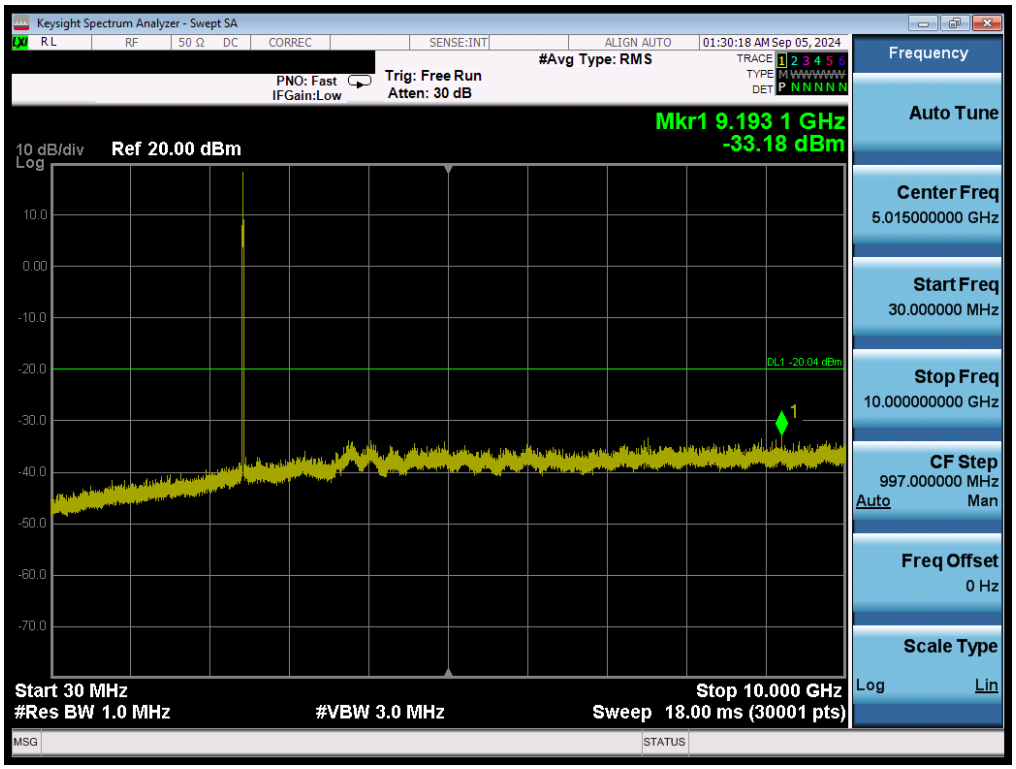
7.6.1 MIMO Conducted Spurious Emissions



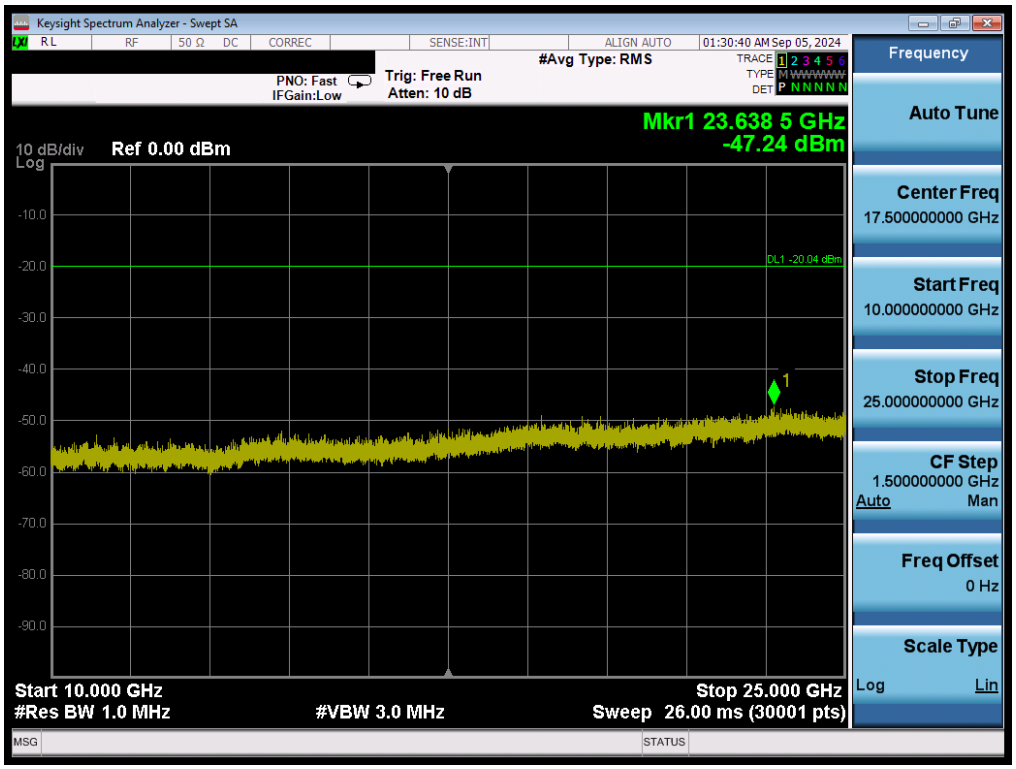
Plot 7-56. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 1)



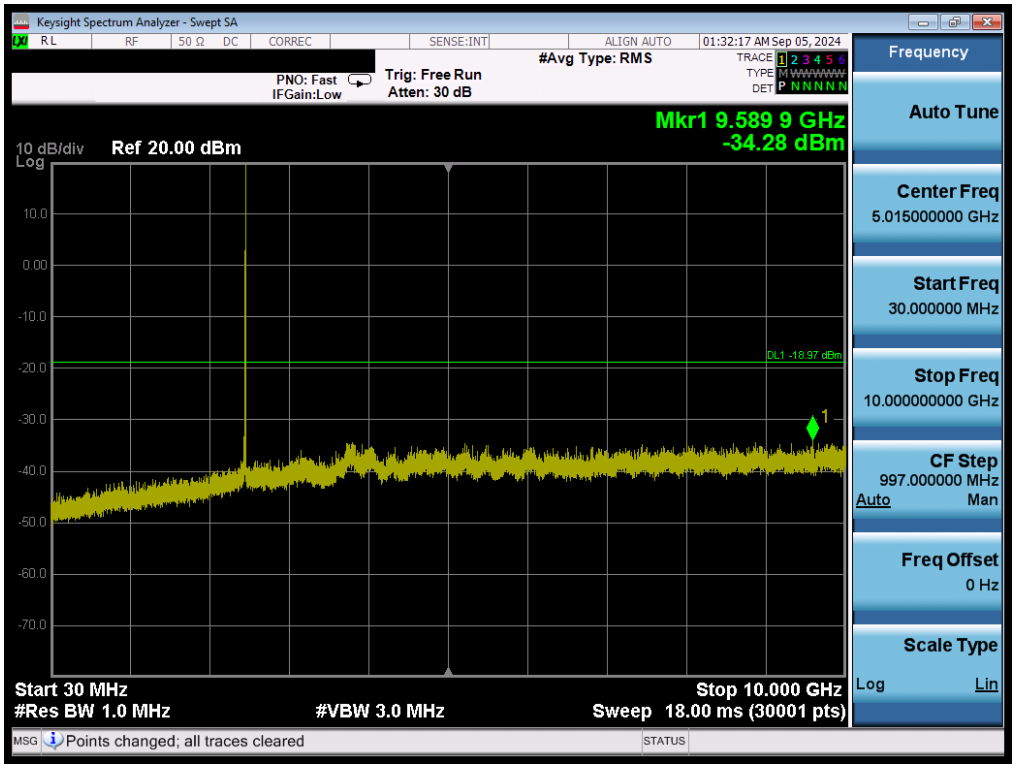
Plot 7-57. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 1)



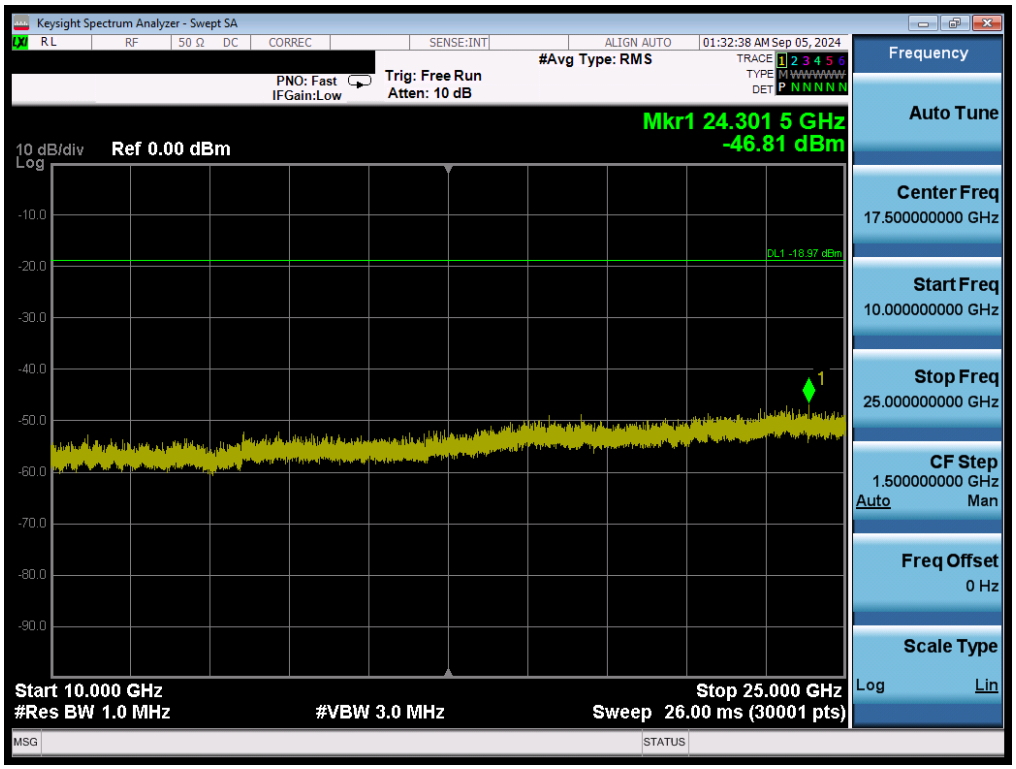
Plot 7-58. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 6)



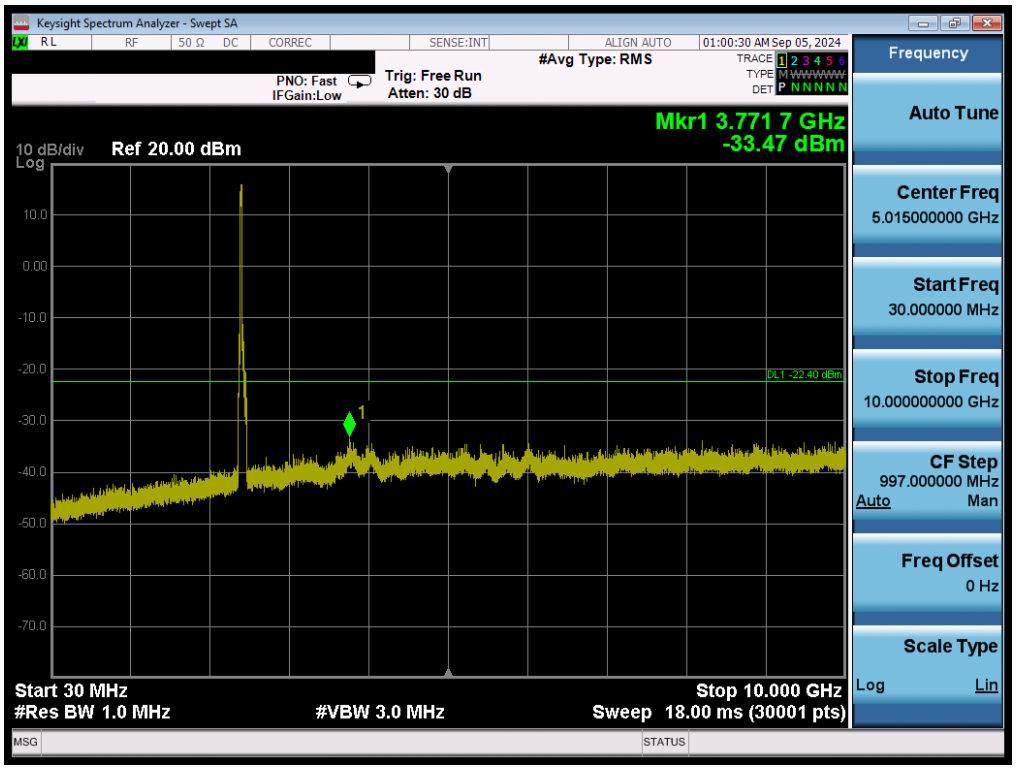
Plot 7-59. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 6)



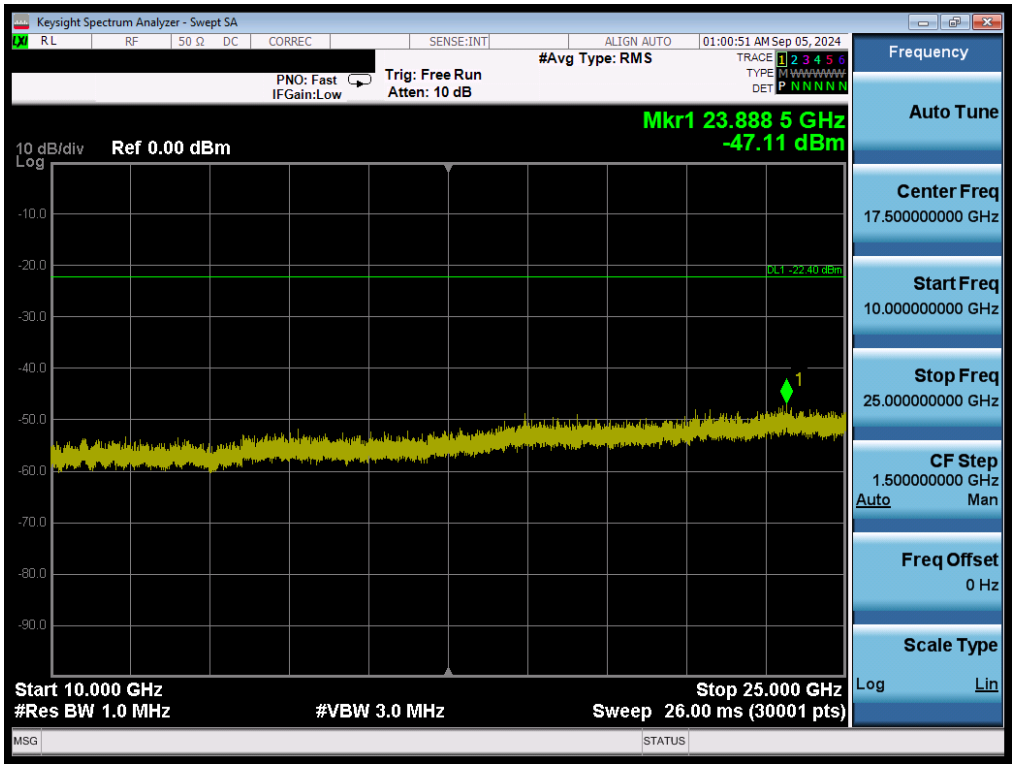
Plot 7-60. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 11)



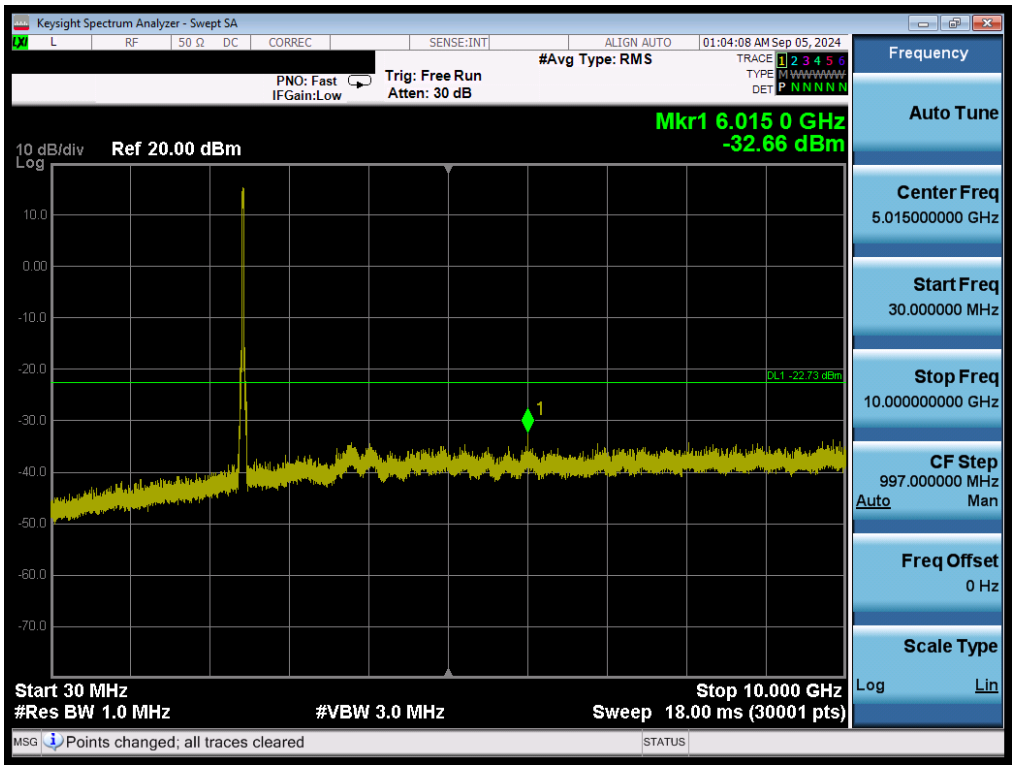
Plot 7-61. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 11)



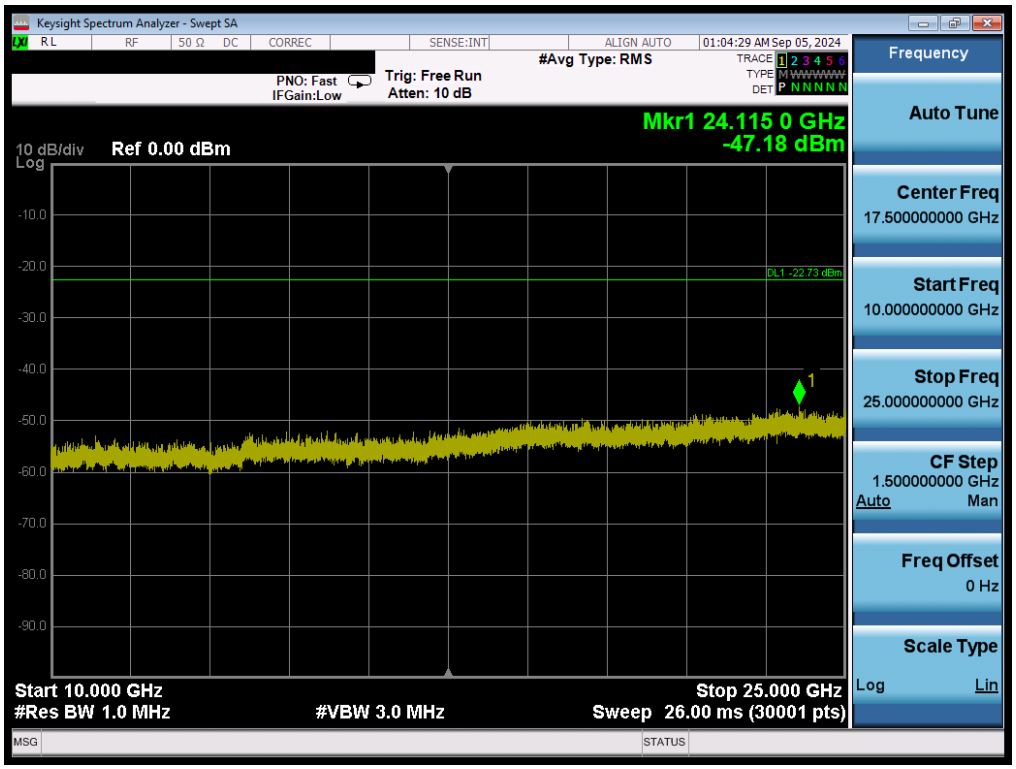
Plot 7-62. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 1)



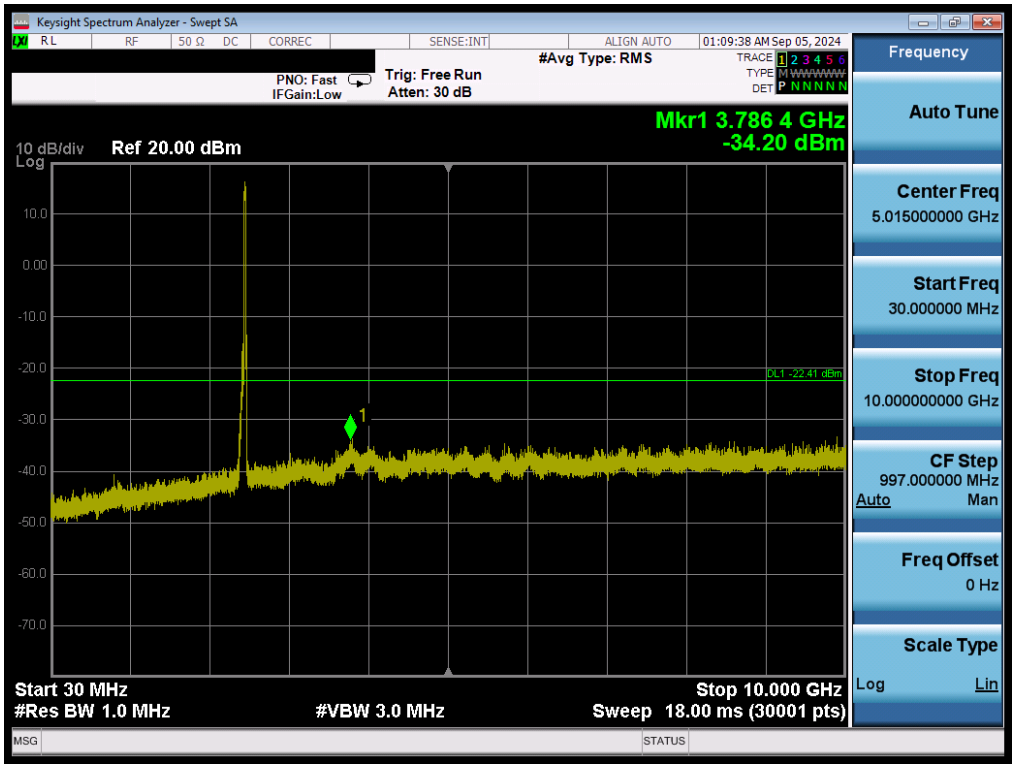
Plot 7-63. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 1)



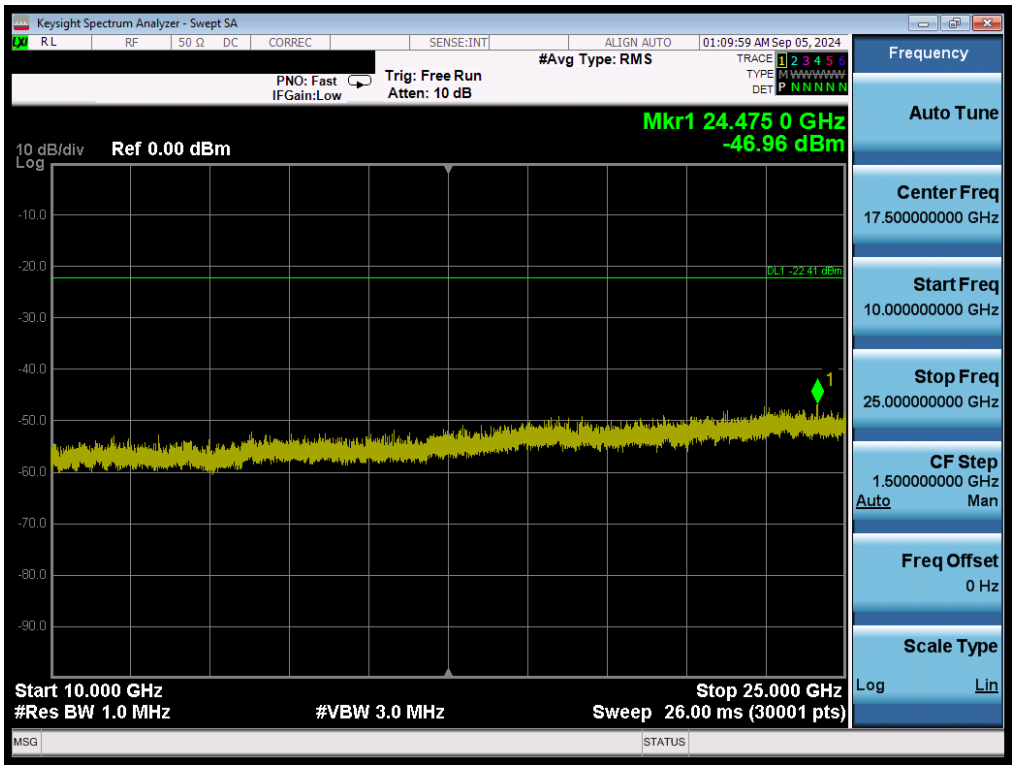
Plot 7-64. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 6)



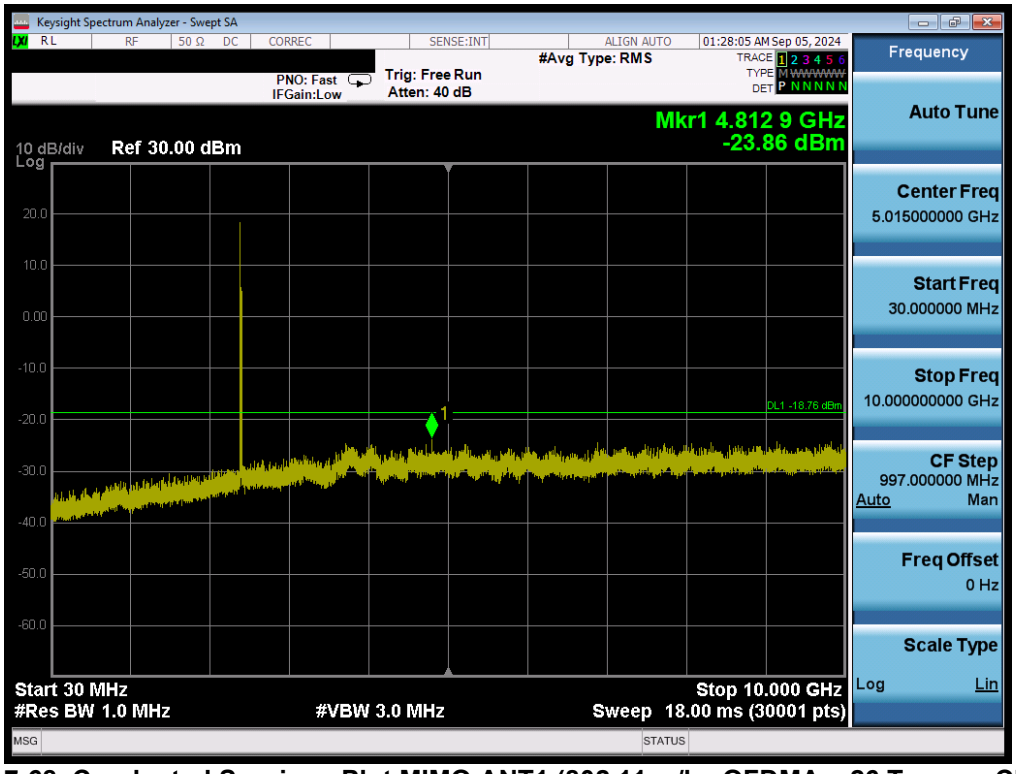
Plot 7-65. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 6)



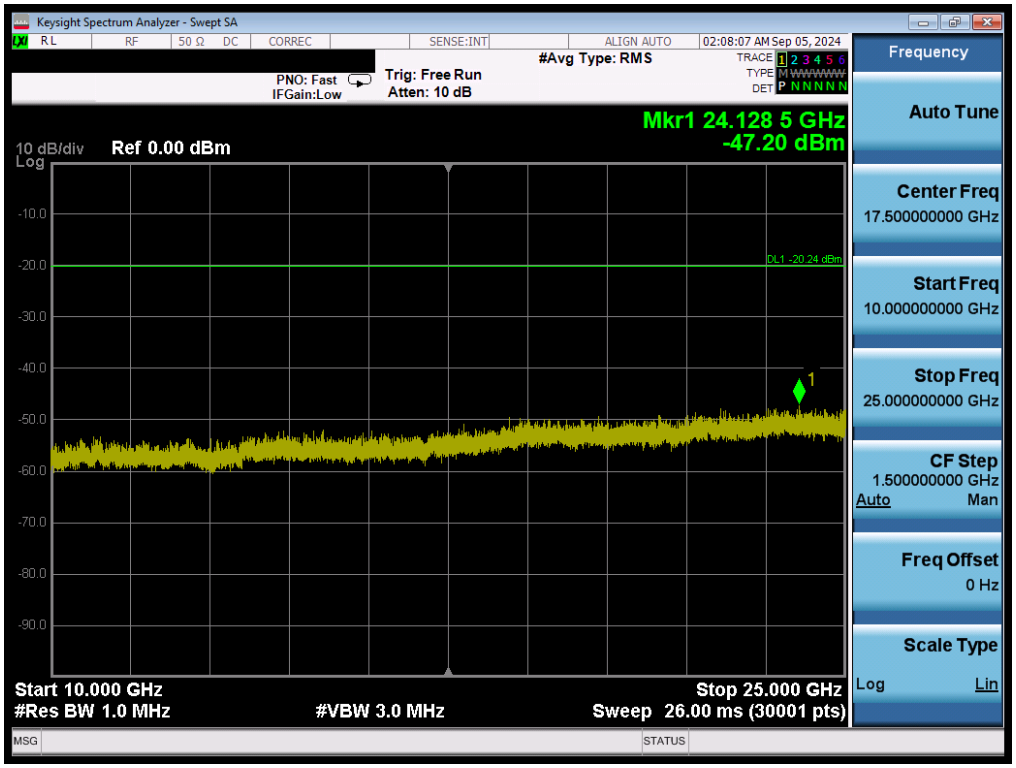
Plot 7-66. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 11)



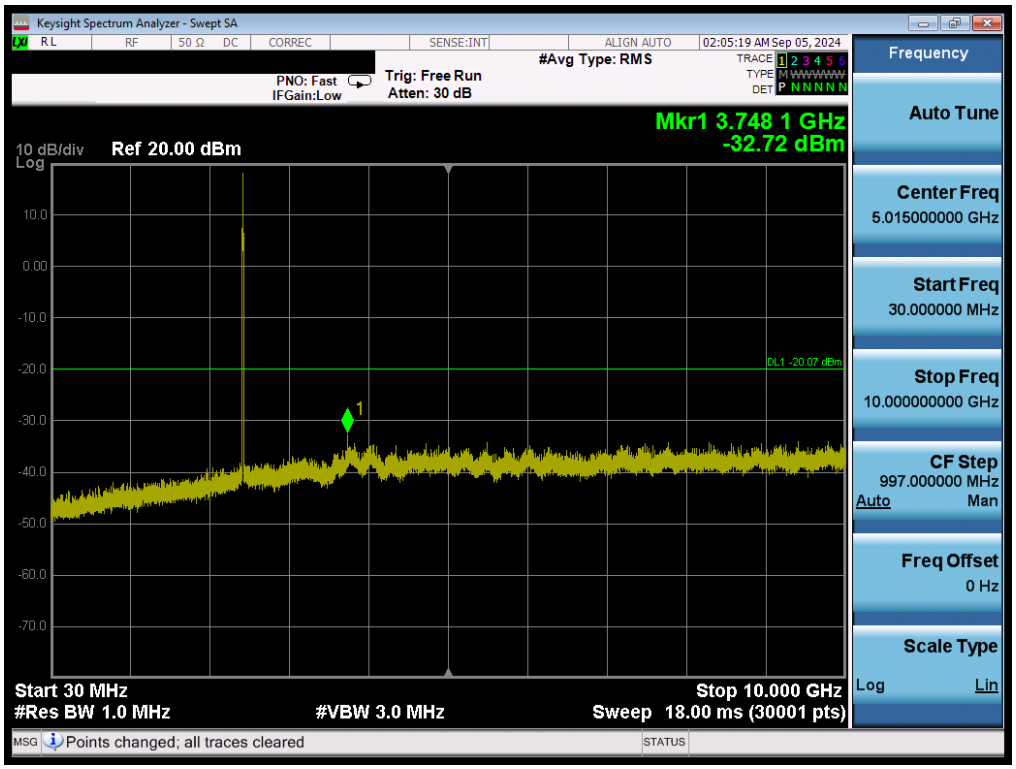
Plot 7-67. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 242 Tones – Ch. 11)



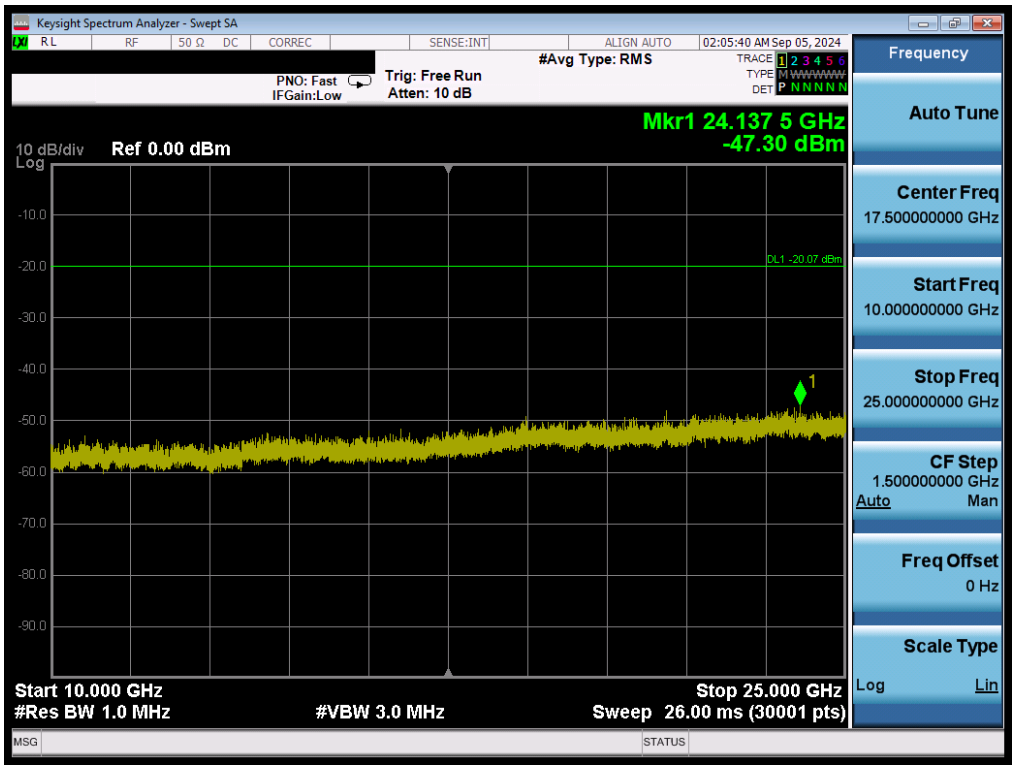
Plot 7-68. Conducted Spurious Plot MIMO ANT1 (802.11ax/be OFDMA – 26 Tones – Ch. 1)



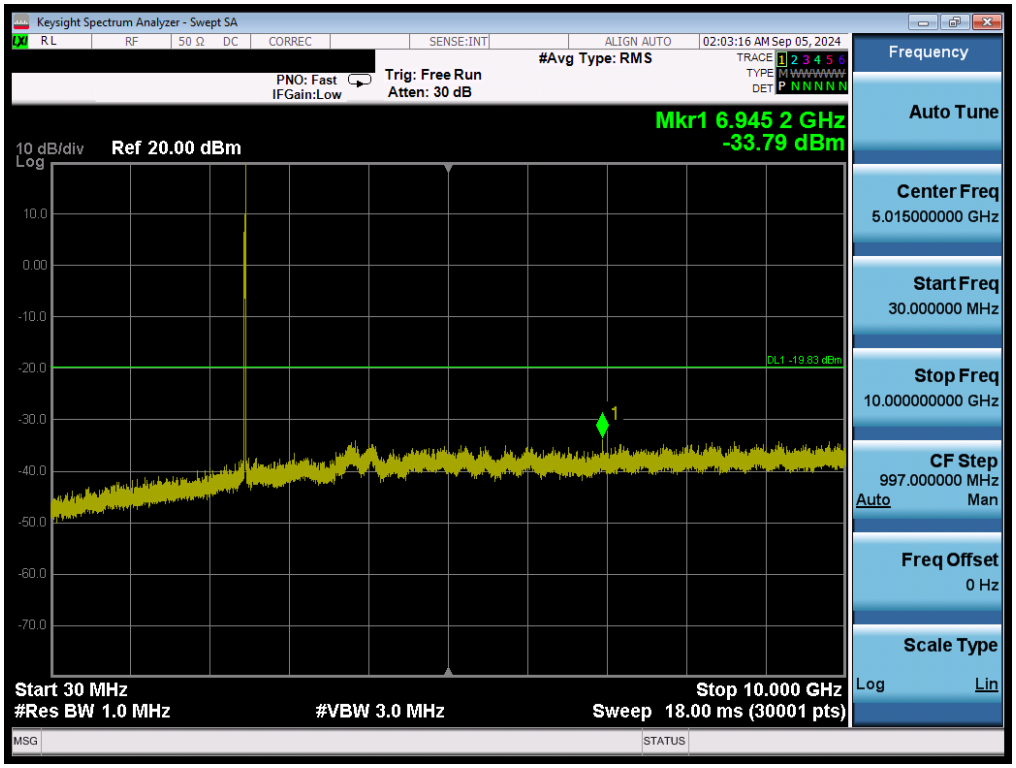
Plot 7-69. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 26 Tones – Ch. 1)



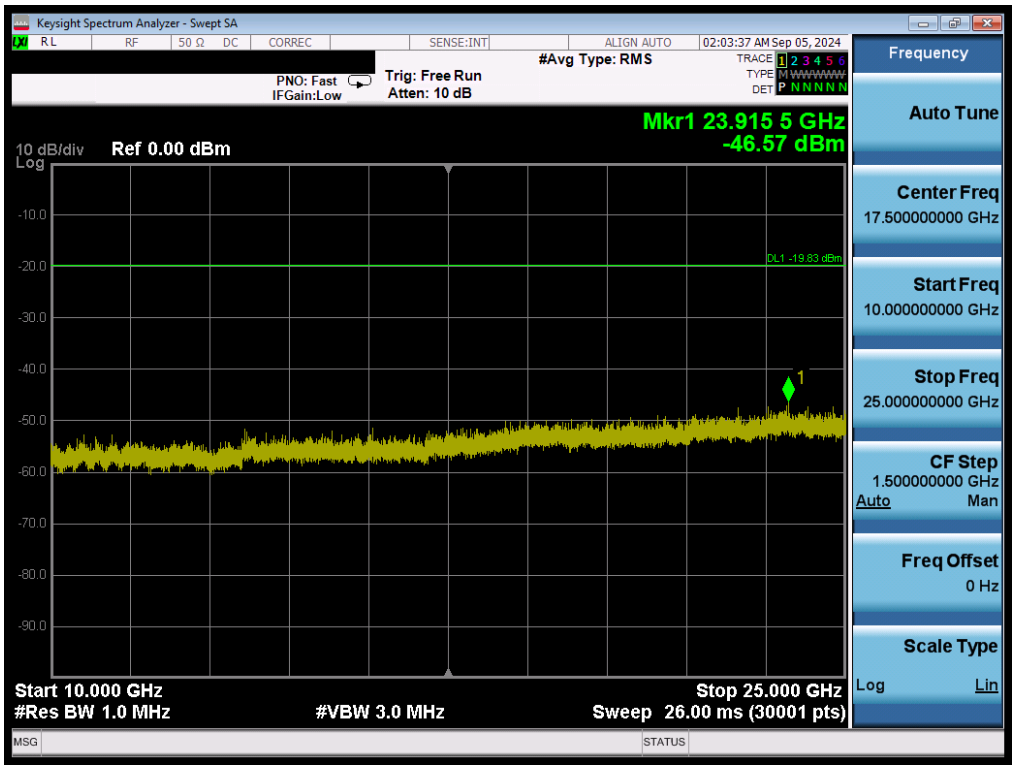
Plot 7-70. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 26 Tones – Ch. 6)



Plot 7-71. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 26 Tones – Ch. 6)

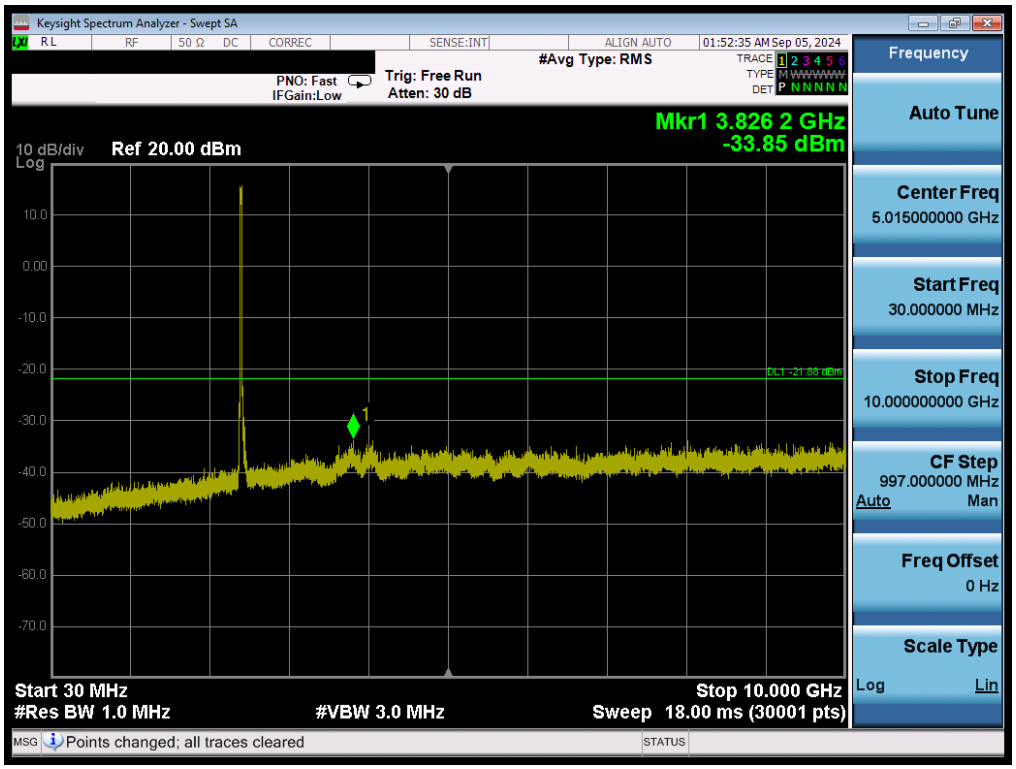


Plot 7-72. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 26 Tones – Ch. 11)

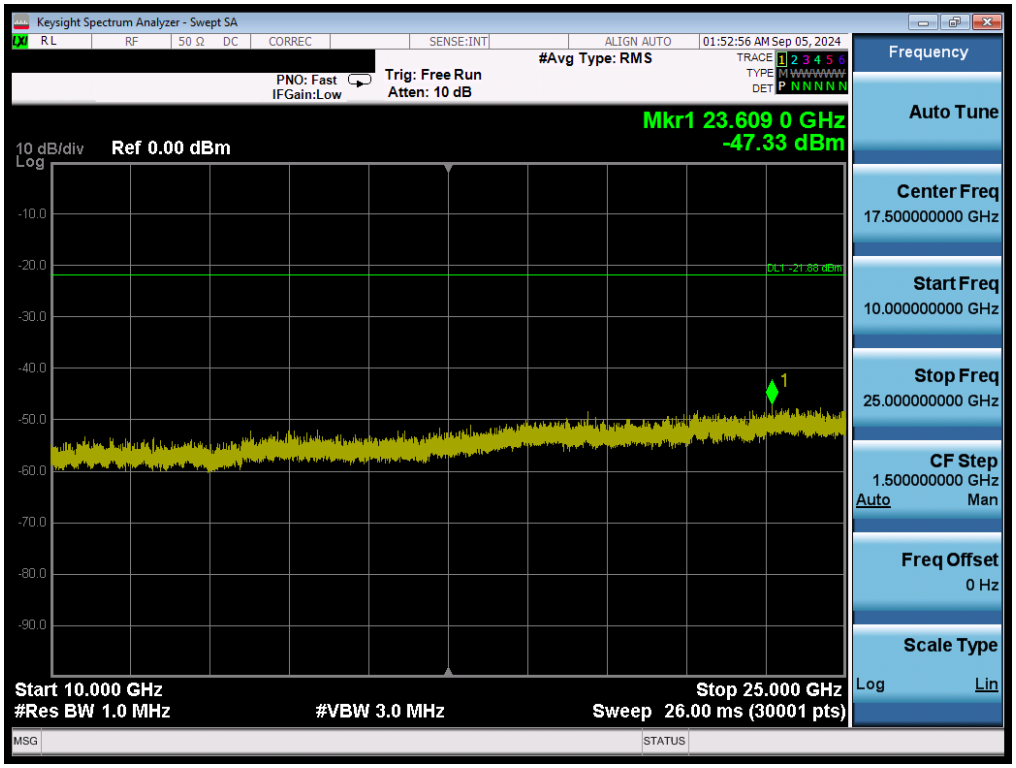


Plot 7-73. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 26 Tones – Ch. 11)

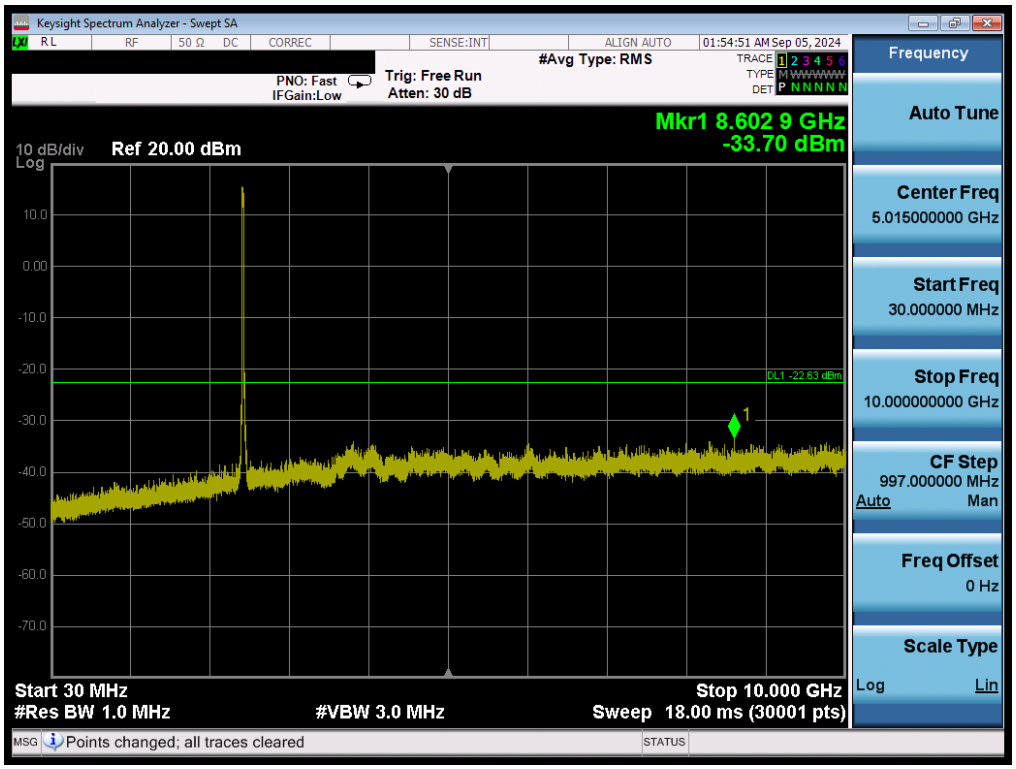
S



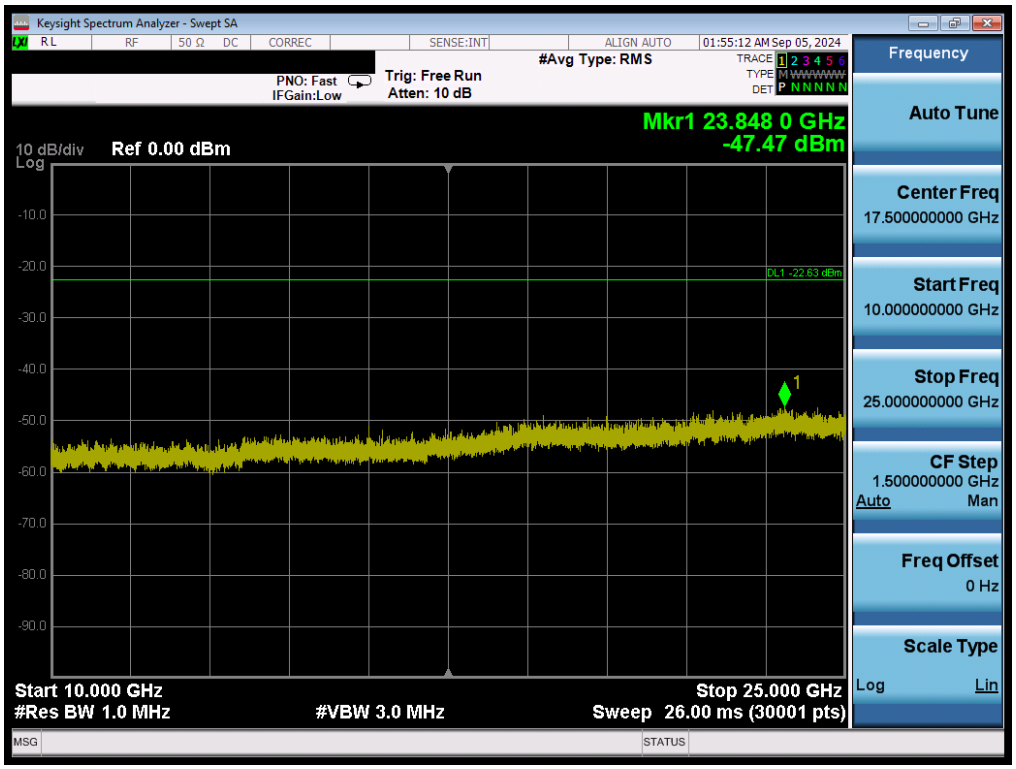
Plot 7-74. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 1)



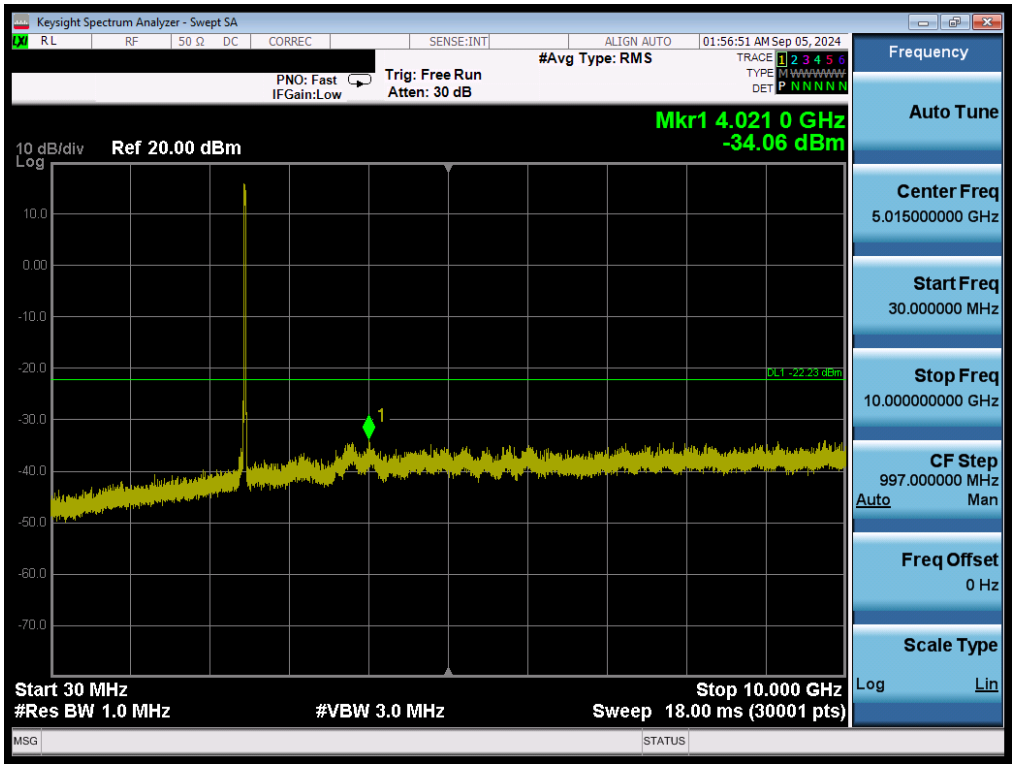
Plot 7-75. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 1)



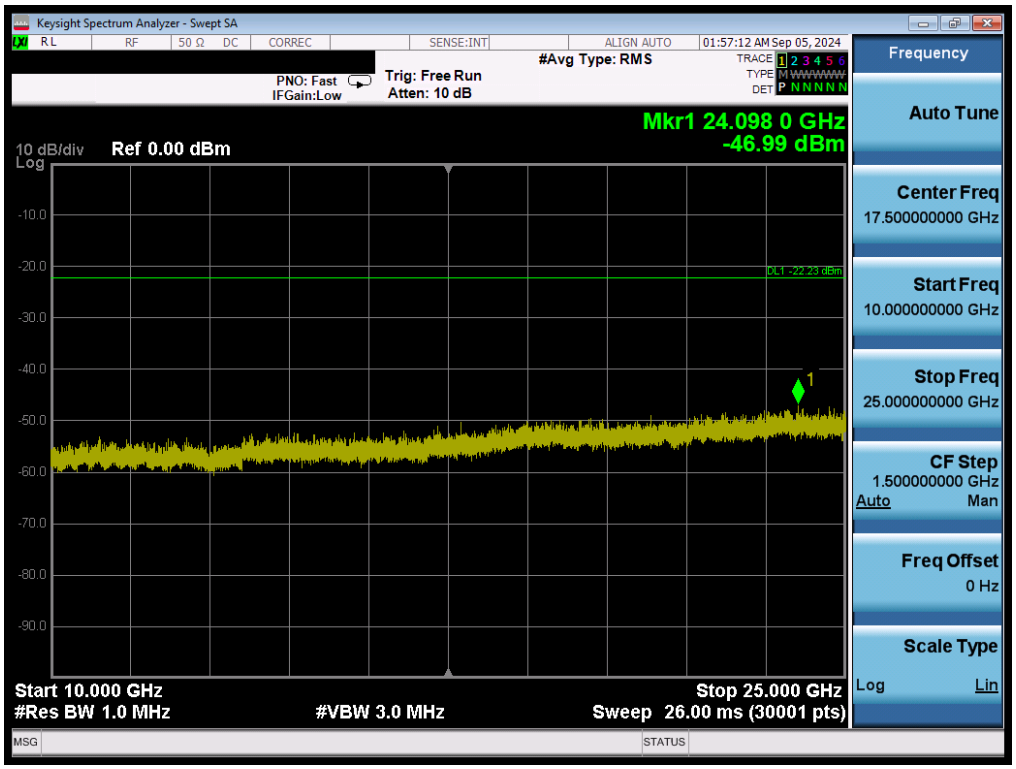
Plot 7-76. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 6)



Plot 7-77. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 6)



Plot 7-78. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 11)



Plot 7-79. Conducted Spurious Plot MIMO ANT2 (802.11ax/be OFDMA – 242 Tones – Ch. 11)

7.7 Radiated Emission Measurements

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 FCC §15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown FCC §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 7-21. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.6.4.3

Test Settings

Average Field Strength Measurements

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. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements

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

Test Setup

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

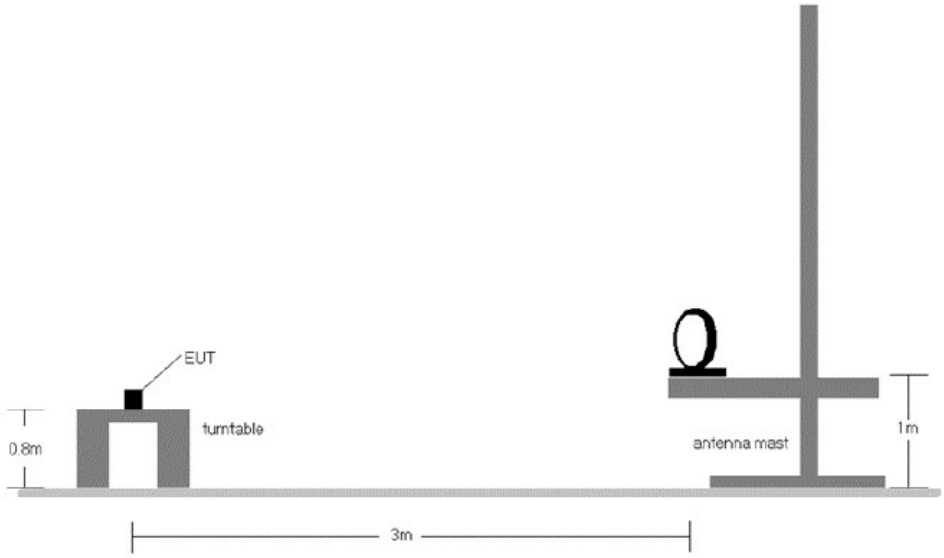


Figure 7-6. Radiated Test Setup < 30MHz

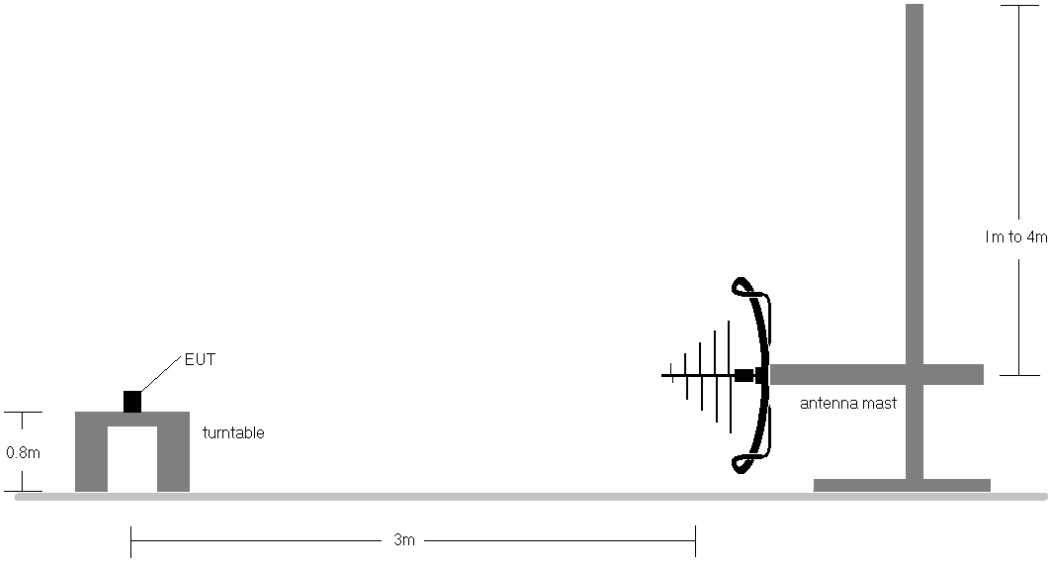


Figure 7-7. Radiated Test Setup < 1GHz

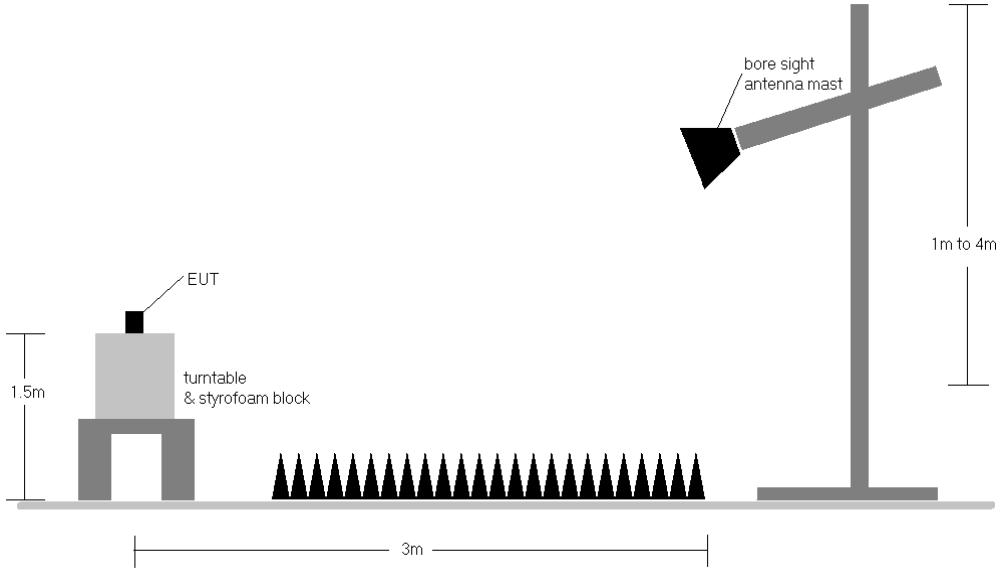


Figure 7-8. Test Instrument & Measurement Setup

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of ANSI C63.10-2013 Section 11.3 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limits shown in §15.209.
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. 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.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
9. Some band edge measurements were performed using a channel integration method to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v05r02 Section 13.3, a measurement was performed using a RBW of 100kHz at the frequency with highest emission outside of band edge. For integration that does not start at 2483.5MHz, consideration was taken to ensure the worst-case emission is in the 1MHz spectrum. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.
10. For radiated measurements, emissions were investigated for the fully-loaded RU configuration and for all the partially-loaded RU configurations. Among all of the available partially-loaded RU configurations, only the configuration with the worst case emissions is reported.

Sample Calculations

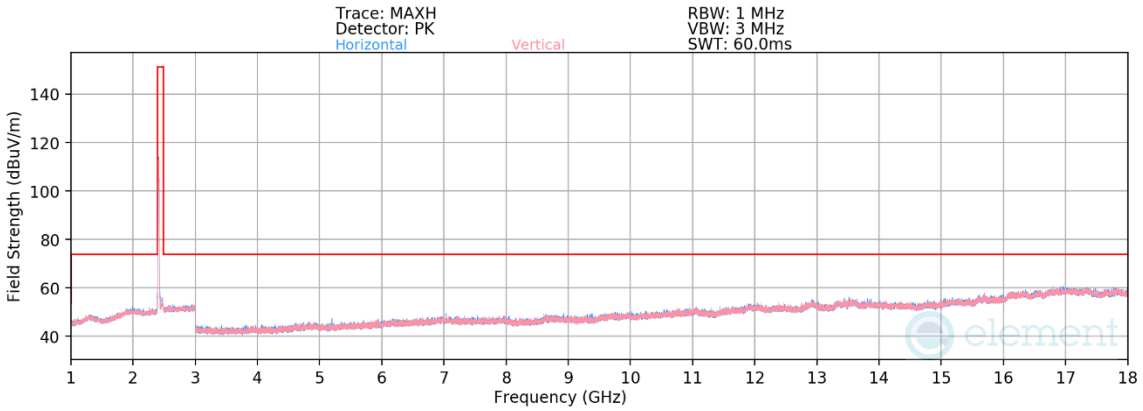
Determining Spurious Emissions Levels

- 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 $_{[dB\mu V/m]}$

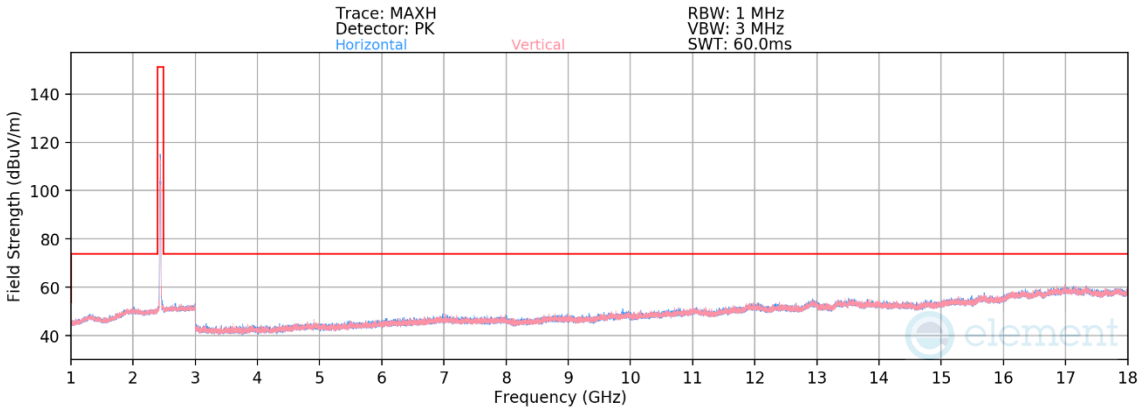
Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 0 was calculated using the formula:
  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

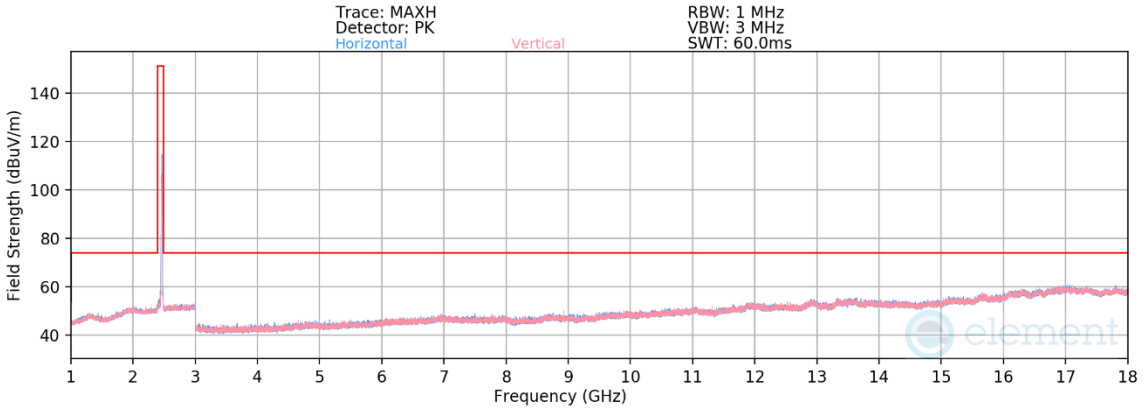
7.7.2 MIMO Radiated Spurious Emission Measurements



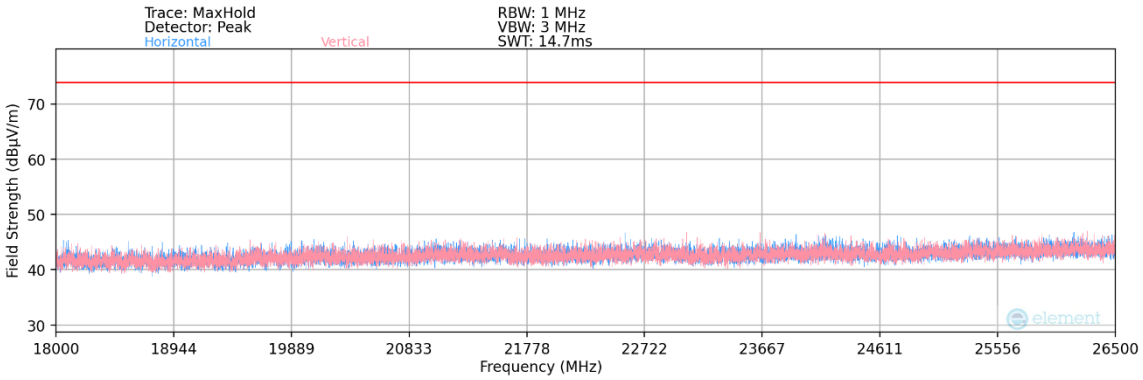
Plot 7-80. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 26 Tones – Ch. 1)



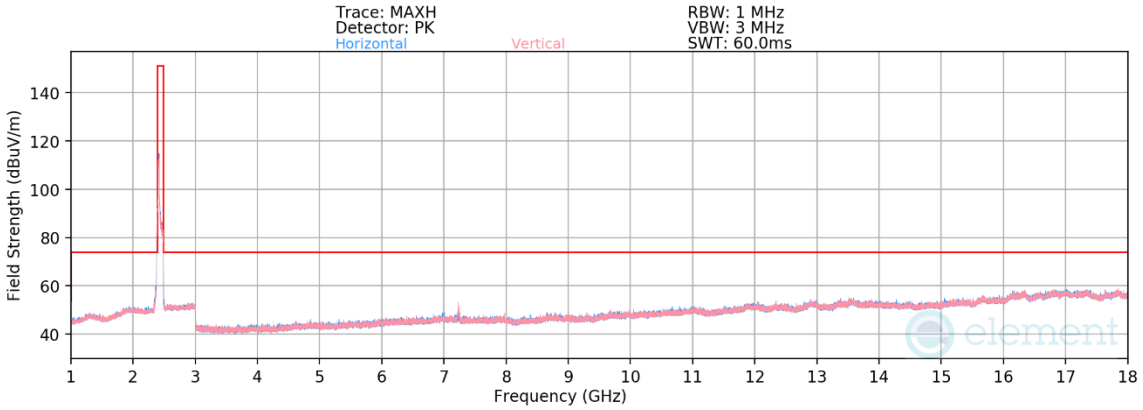
Plot 7-81. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 26 Tones – Ch. 6)



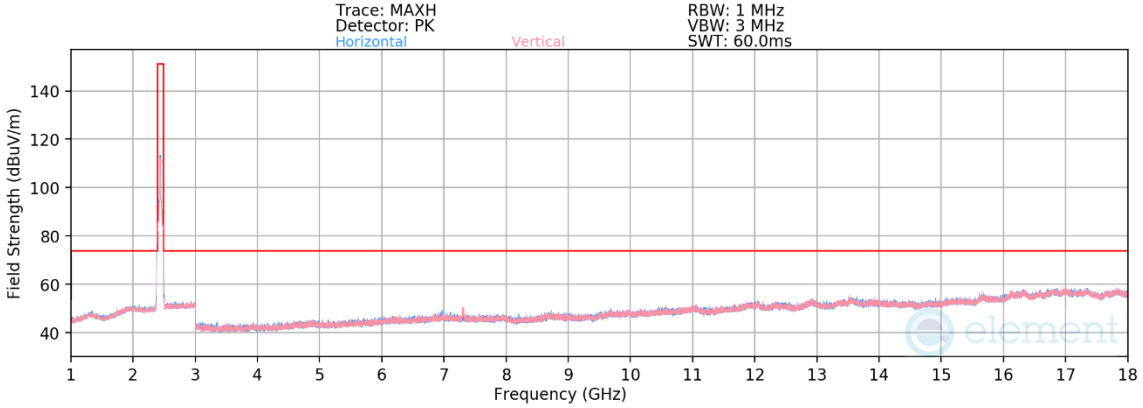
Plot 7-82. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 26 Tones – Ch. 11)



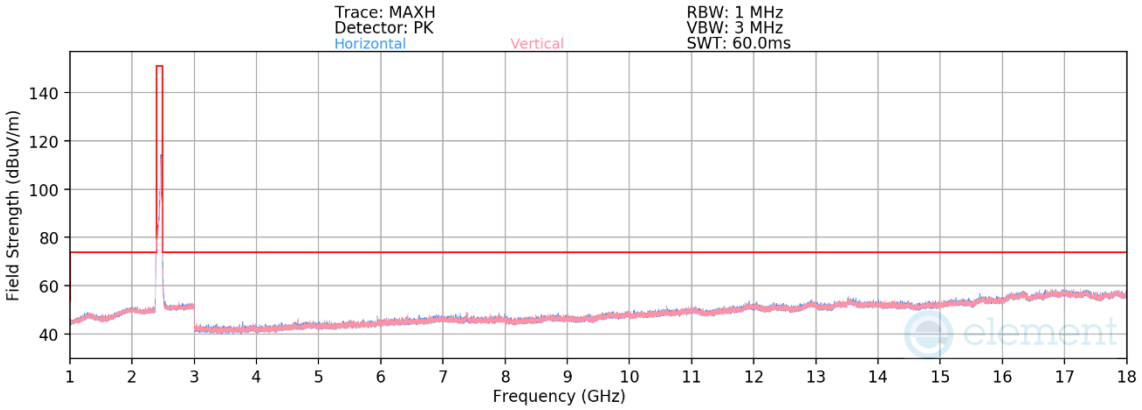
Plot 7-83. Radiated Spurious Plot above 18GHz MIMO (802.11ax OFDMA – 26 Tones)



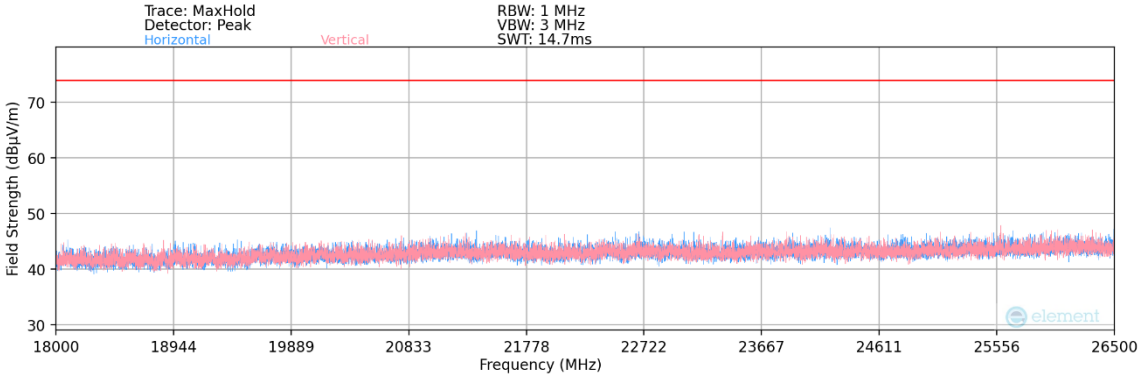
Plot 7-84. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 242 Tones – Ch. 1)



Plot 7-85. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 242 Tones – Ch. 6)



Plot 7-86. Radiated Spurious Plot above 1GHz MIMO (802.11ax OFDMA – 242 Tones – Ch. 11)



Plot 7-87. Radiated Spurious Plot above 18GHz MIMO (802.11ax OFDMA – 242 Tones)

MIMO Radiated Spurious Emission Measurements

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	4
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

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]
4824.00	Avg	H	-	-	-80.79	8.12	34.33	53.98	-19.65
4824.00	Peak	H	-	-	-69.49	8.12	45.63	73.98	-28.35
7236.00	Avg	H	-	-	-81.31	11.43	37.12	53.98	-16.86
7236.00	Peak	H	-	-	-70.38	11.43	48.05	73.98	-25.93
12060.00	Avg	H	-	-	-83.09	17.98	41.89	53.98	-12.09
12060.00	Peak	H	-	-	-71.74	17.98	53.24	73.98	-20.74

Table 7-22. Radiated Measurements MIMO (26 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	4
Distance of Measurements:	3 Meters
Operating Frequency:	2437MHz
Channel:	6

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]
4874.00	Avg	H	-	-	-80.65	8.25	34.60	53.98	-19.38
4874.00	Peak	H	-	-	-69.25	8.25	46.00	73.98	-27.98
7311.00	Avg	H	-	-	-81.78	11.43	36.65	53.98	-17.33
7311.00	Peak	H	-	-	-70.68	11.55	47.87	73.98	-26.11
12185.00	Avg	H	-	-	-82.54	17.33	41.79	53.98	-12.19
12185.00	Peak	H	-	-	-71.31	17.26	52.95	73.98	-21.03

Table 7-23. Radiated Measurements MIMO (26 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	4
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11

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]
4924.00	Avg	H	-	-	-80.43	7.97	34.54	53.98	-19.44
4924.00	Peak	H	-	-	-68.94	8.16	46.22	73.98	-27.76
7386.00	Avg	H	-	-	-81.60	11.32	36.72	53.98	-17.26
7386.00	Peak	H	-	-	-70.62	11.56	47.94	73.98	-26.04
12310.00	Avg	H	-	-	-83.08	18.27	42.19	53.98	-11.79
12310.00	Peak	H	-	-	-71.60	18.27	53.67	73.98	-20.31

Table 7-24. Radiated Measurements MIMO (26 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

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]
4824.00	Avg	H	-	-	-80.55	7.81	34.26	53.98	-19.72
4824.00	Peak	H	-	-	-69.42	7.81	45.39	73.98	-28.59
7236.00	Avg	V	100	312	-75.48	10.75	42.27	53.98	-11.71
7236.00	Peak	V	100	312	-63.61	10.75	54.14	73.98	-19.84
12060.00	Avg	H	-	-	-82.63	17.08	41.45	53.98	-12.53
12060.00	Peak	H	-	-	-70.66	17.08	53.42	73.98	-20.56

Table 7-25. Radiated Measurements MIMO (242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2437MHz
Channel:	6

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]
4874.00	Avg	H	-	-	-80.80	7.94	34.14	53.98	-19.84
4874.00	Peak	H	-	-	-69.25	7.94	45.69	73.98	-28.29
7311.00	Avg	V	100	307	-76.62	10.90	41.28	53.98	-12.70
7311.00	Peak	V	100	307	-64.30	10.90	53.60	73.98	-20.38
12185.00	Avg	H	-	-	-82.24	16.49	41.25	53.98	-12.73
12185.00	Peak	H	-	-	-71.09	16.49	52.40	73.98	-21.58

Table 7-26. Radiated Measurements MIMO (242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11

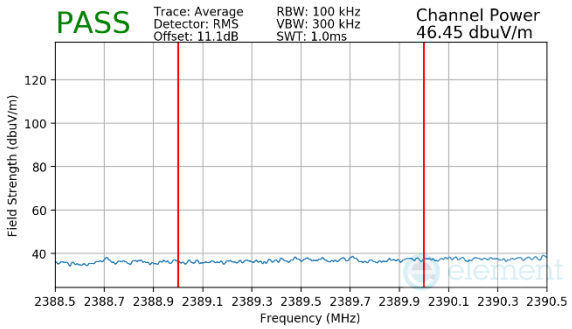
Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4924.00	Avg	H	-	-	-80.20	7.62	34.42	53.98	-19.56
4924.00	Peak	H	-	-	-68.82	7.62	45.80	73.98	-28.18
7386.00	Avg	V	251	319	-78.54	10.99	39.45	53.98	-14.53
7386.00	Peak	V	251	319	-66.06	10.99	51.93	73.98	-22.05
12310.00	Avg	H	-	-	-83.12	17.91	41.79	53.98	-12.19
12310.00	Peak	H	-	-	-71.94	17.91	52.97	73.98	-21.01

Table 7-27. Radiated Measurements MIMO (242 Tones)

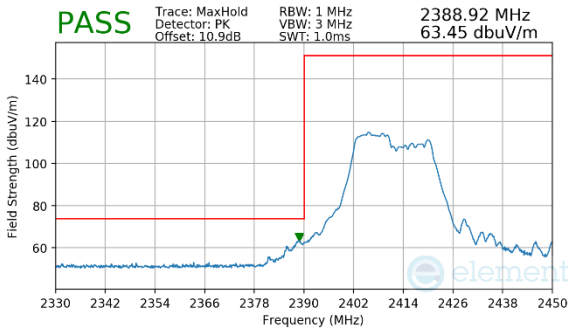
7.7.3 MIMO Radiated Restricted Band Edge Measurements

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	53
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

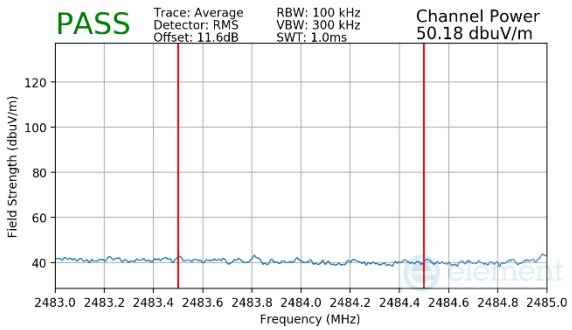


Plot 7-88. Radiated Restricted Lower Band Edge Measurement MIMO (Average – 106 Tones)

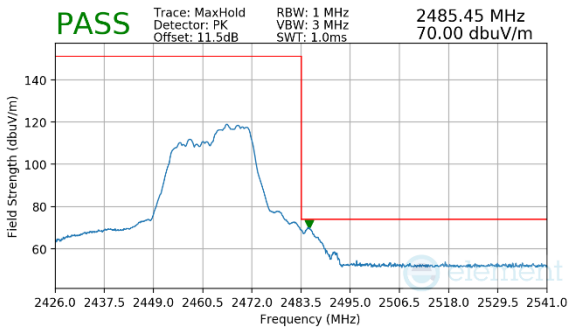


Plot 7-89. Radiated Restricted Lower Band Edge Measurement MIMO (Peak – 106 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	54
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11

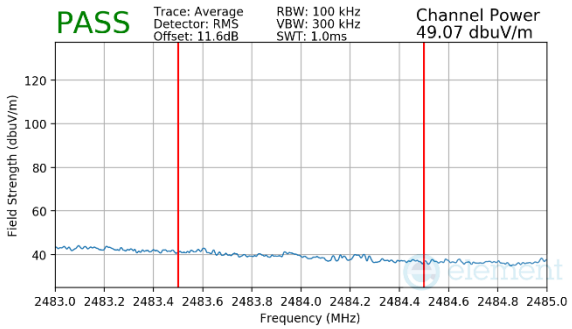


Plot 7-90. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106 Tones)

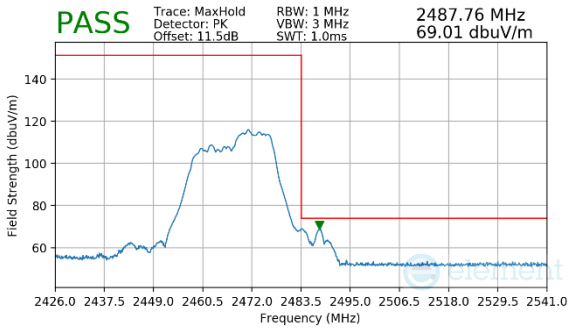


Plot 7-91. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	54
Distance of Measurements:	3 Meters
Operating Frequency:	2467MHz
Channel:	12

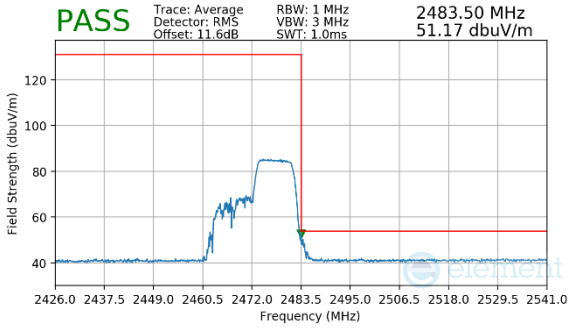


Plot 7-92. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106 Tones)

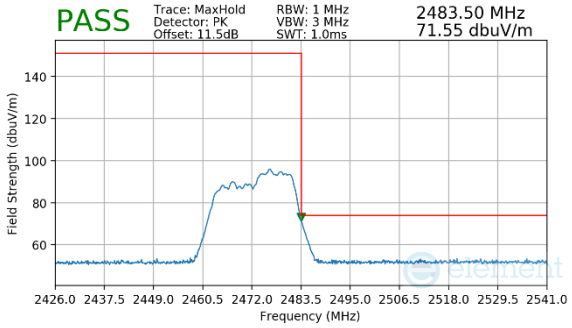


Plot 7-93. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	54
Distance of Measurements:	3 Meters
Operating Frequency:	2472MHz
Channel:	13

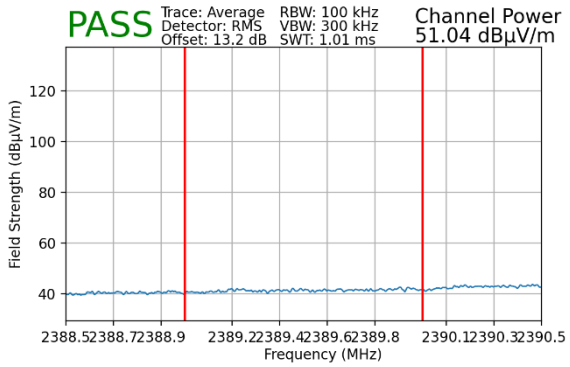


Plot 7-94. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106 Tones)

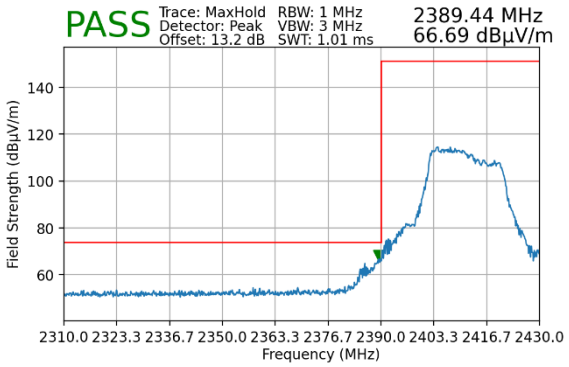


Plot 7-95. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106 Tones)

Worst Case Mode:	802.11be OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	82
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

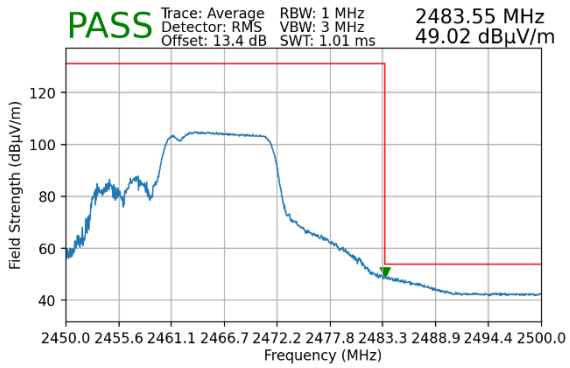


Plot 7-96. Radiated Restricted Lower Band Edge Measurement MIMO (Average – 106+26 Tones)

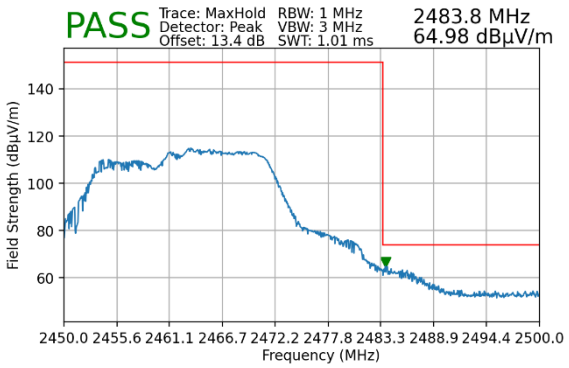


Plot 7-97. Radiated Restricted Lower Band Edge Measurement MIMO (Peak – 106+26 Tones)

Worst Case Mode:	802.11be OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	83
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11

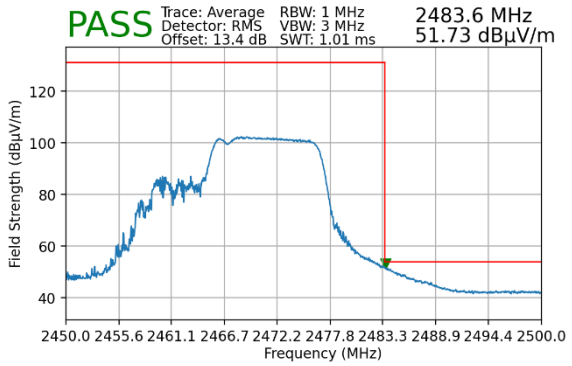


Plot 7-98. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106+26 Tones)

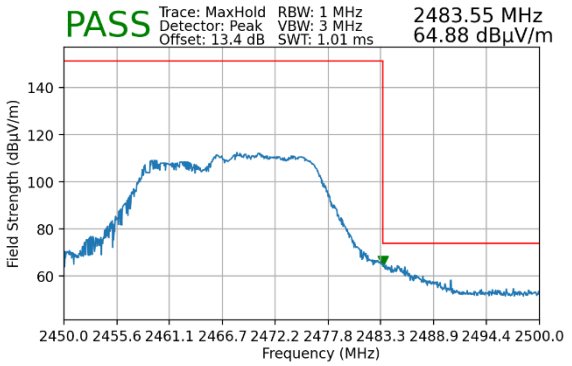


Plot 7-99. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106+26 Tones)

Worst Case Mode:	802.11be OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	83
Distance of Measurements:	3 Meters
Operating Frequency:	2467MHz
Channel:	12

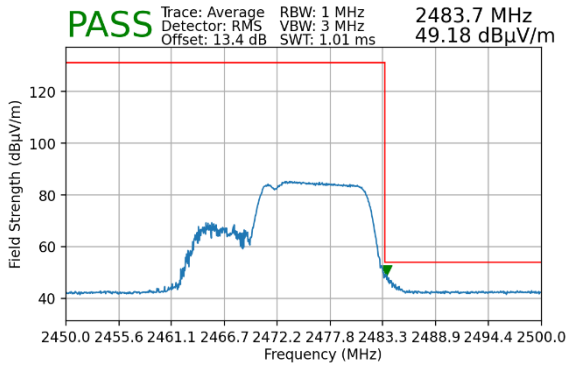


Plot 7-100. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106+26 Tones)

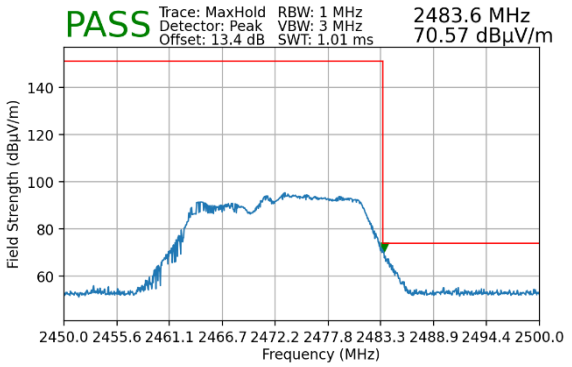


Plot 7-101. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106+26 Tones)

Worst Case Mode:	802.11be OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	83
Distance of Measurements:	3 Meters
Operating Frequency:	2472MHz
Channel:	13

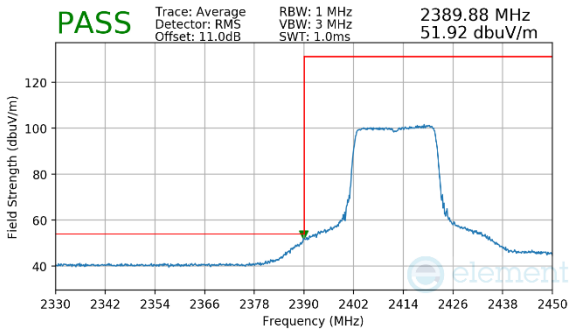


Plot 7-102. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 106+26 Tones)

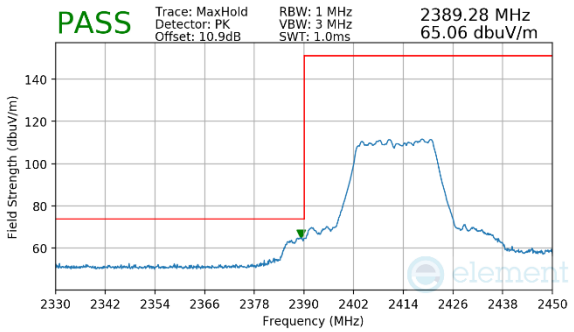


Plot 7-103. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 106+26 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

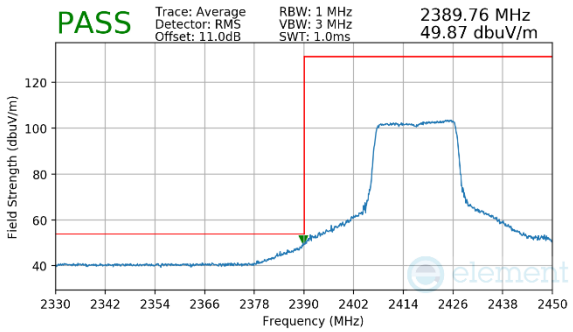


Plot 7-104. Radiated Restricted Lower Band Edge Measurement MIMO (Average – 242 Tones)

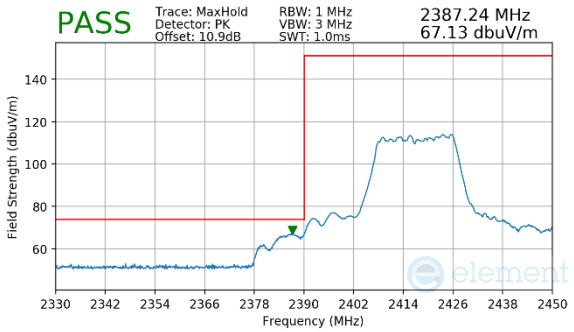


Plot 7-105. Radiated Restricted Lower Band Edge Measurement MIMO (Peak – 242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2417MHz
Channel:	2

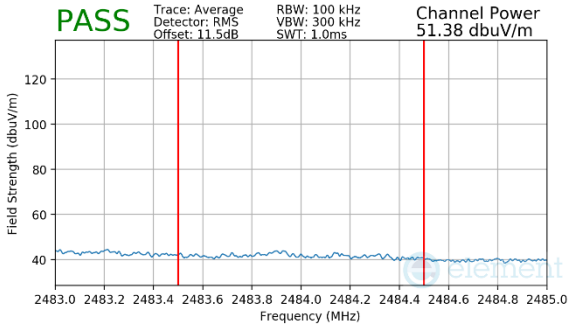


Plot 7-106. Radiated Restricted Lower Band Edge Measurement MIMO (Average – 242 Tones)

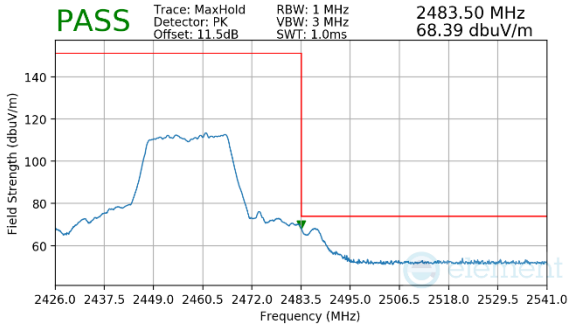


Plot 7-107. Radiated Restricted Lower Band Edge Measurement MIMO (Peak – 242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2457MHz
Channel:	10

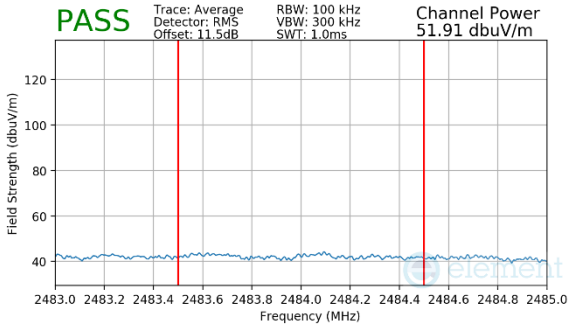


Plot 7-108. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 242 Tones)

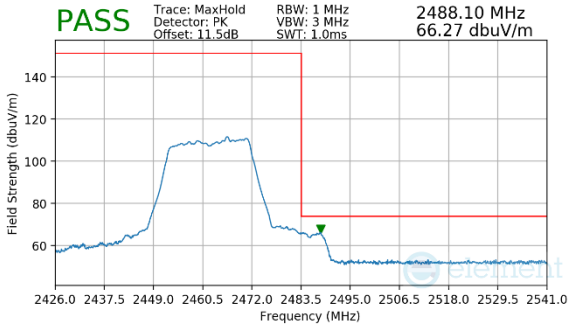


Plot 7-109. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2462MHz
Channel:	11

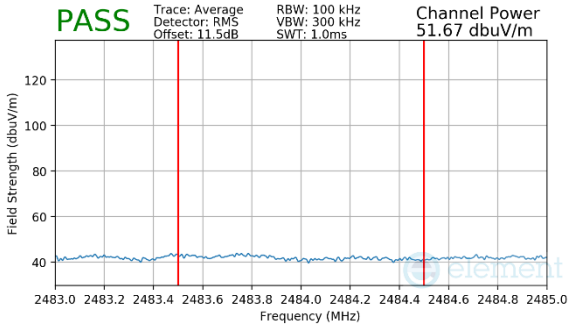


Plot 7-110. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 242 Tones)

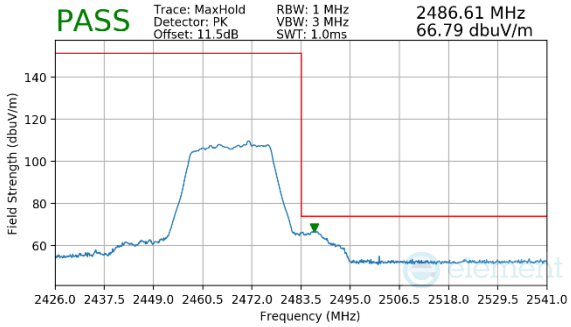


Plot 7-111. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2467MHz
Channel:	12

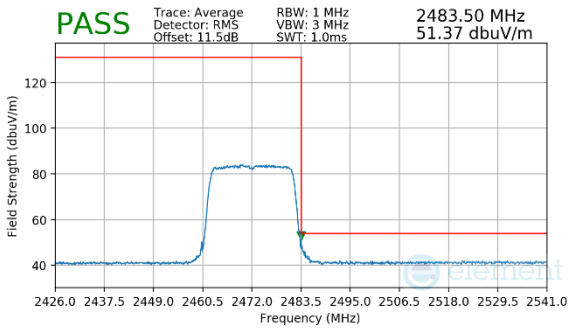


Plot 7-112. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 242 Tones)

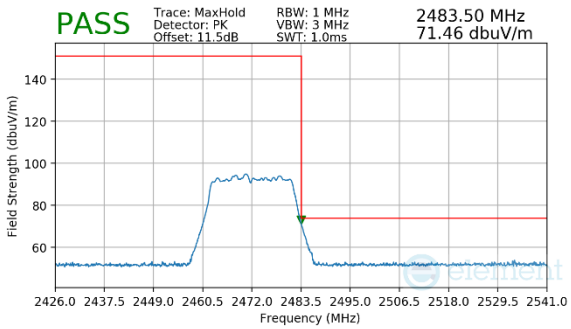


Plot 7-113. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 242 Tones)

Worst Case Mode:	802.11ax OFDMA
Worst Case Transfer Rate:	MCS0
RU Index:	61
Distance of Measurements:	3 Meters
Operating Frequency:	2472MHz
Channel:	13



Plot 7-114. Radiated Restricted Upper Band Edge Measurement MIMO (Average – 242 Tones)



Plot 7-115. Radiated Restricted Upper Band Edge Measurement MIMO (Peak – 242 Tones)

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMS938JPN** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.