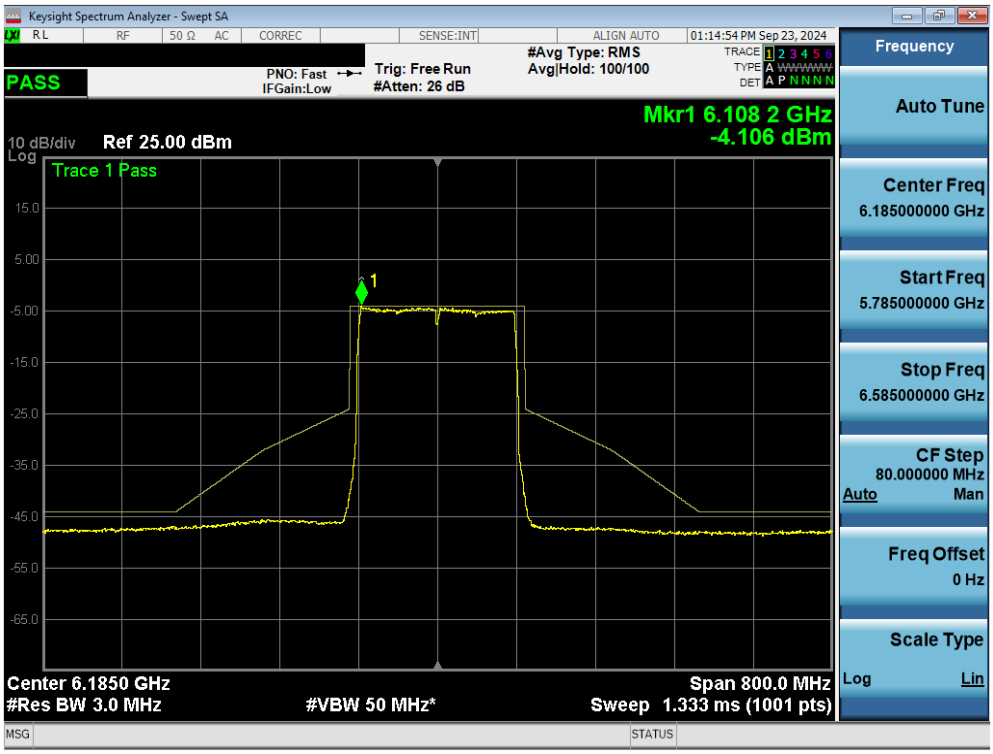
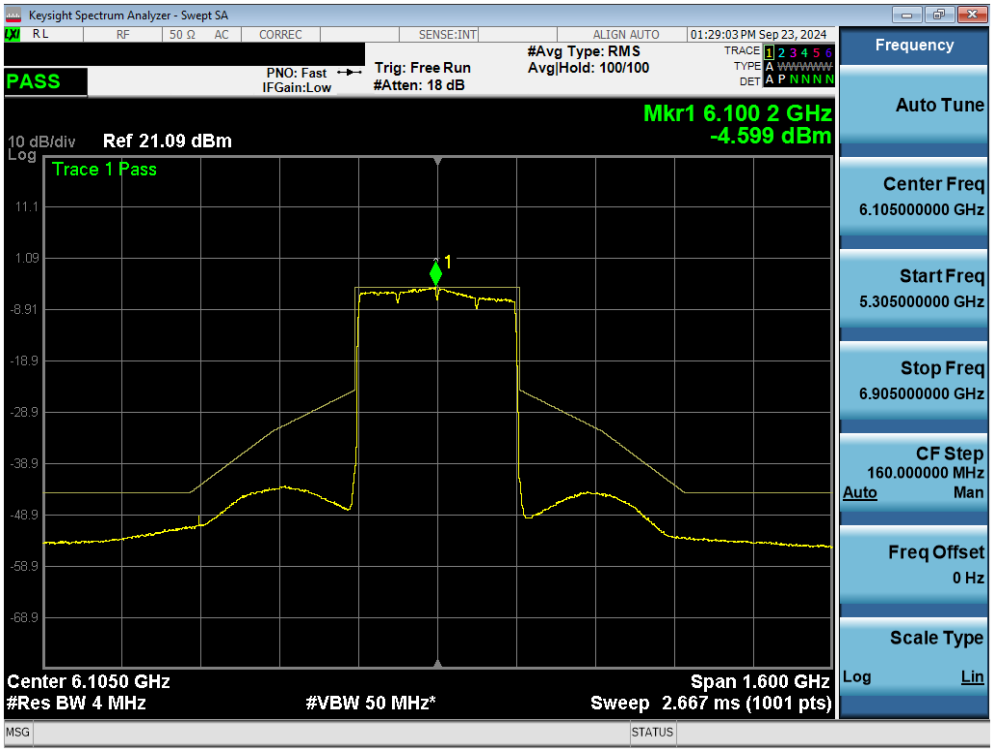
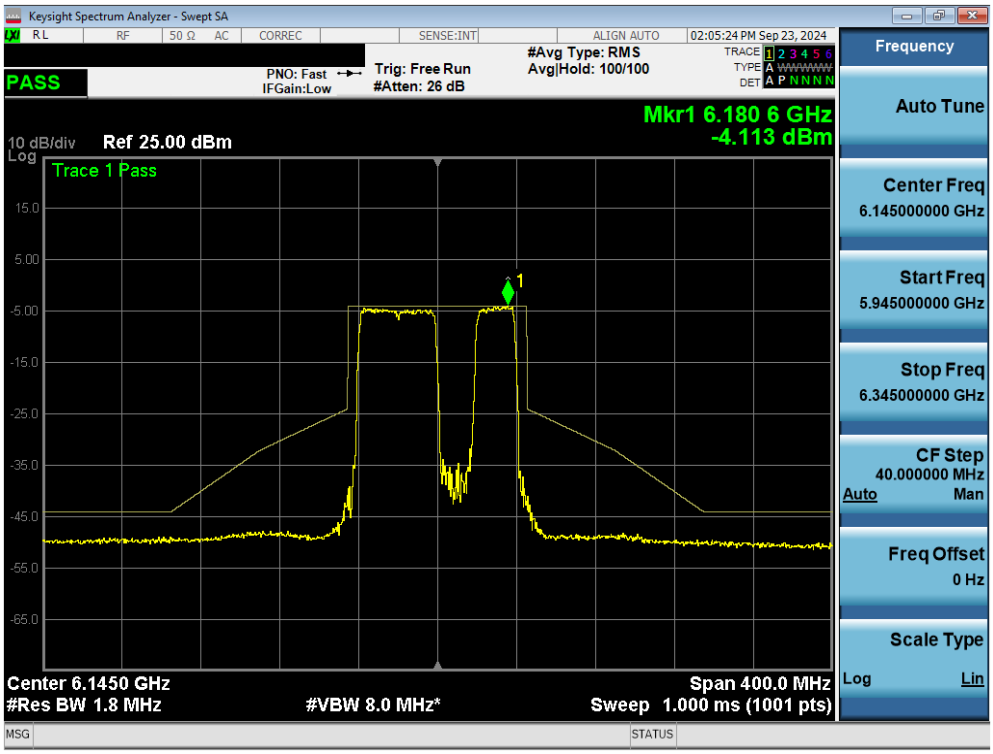


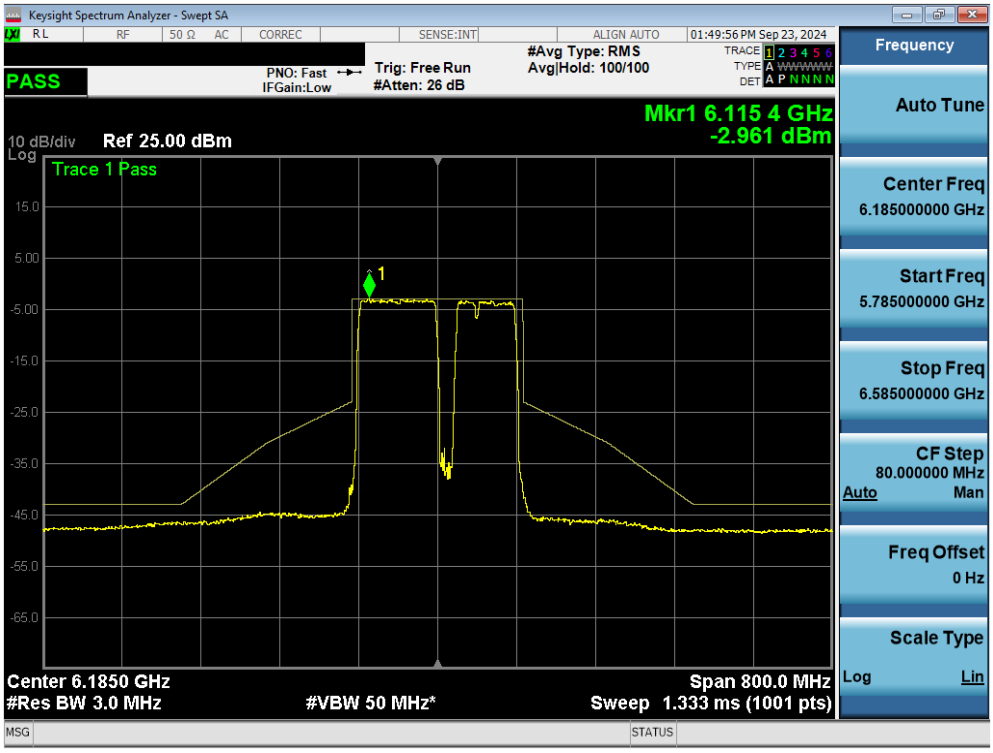

**Plot 7-57. In Band Emissions Plot MIMO ANT2 (160MHz 802.11ax/be (UNII Band 5) – Ch. 47) - VLP**



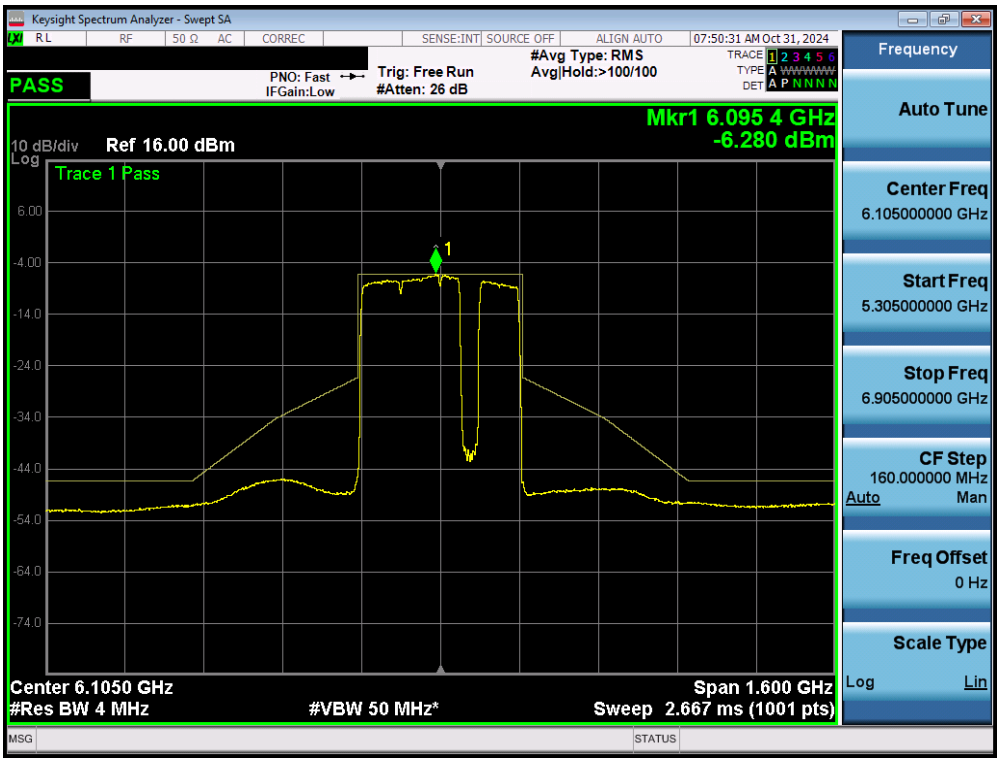

**Plot 7-58. In Band Emissions Plot MIMO ANT2 (320MHz 802.11ax/be (UNII Band 5) – Ch. 31) - VLP**




**Plot 7-59. In Band Emissions Plot MIMO ANT2 (80MHz 802.11be (UNII Band 5) – Ch. 39) – 20MHz Punctured - VLP**




**Plot 7-60. In Band Emissions Plot MIMO ANT2 (160MHz 802.11be (UNII Band 5) – Ch. 47) – 20MHz Punctured - VLP**




**Plot 7-61. In Band Emissions Plot MIMO ANT2 (320MHz 802.11be (UNII Band 5) – Ch. 31) – 40MHz Punctured - VLP**

## 7.7 Contention Based Protocol

**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 if 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**

KDB 987594 D02 v03

**Test Settings**

1. Configure the EUT to transmit with a constant duty cycle.
2. Set the operating parameters of the EUT including power level, operating frequency, modulation, and bandwidth.
3. Set the signal analyzer 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 the EUT. Connect the output port of the EUT to the signal analyzer 2. Ensure that the attenuator 2 provides enough attenuation to not overload the signal analyzer 2 receiver.
4. Monitoring the signal analyzer 2, verify the EUT is operating and transmitting with the parameters set at step two.
5. Using an 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.
6. Set the AWGN signal power to an extremely low level (more than 20 dB below the -62 dBm threshold). Connect the AWGN signal source, via a 3-dB splitter, to the signal analyzer 1 and the EUT as shown in Figure 2.
7. Transmit the AWGN signal (RF ON) and verify its characteristics on the signal analyzer 1.
8. Monitor the signal analyzer 2 to verify if the AWGN signal has been detected and the EUT has ceased transmission. If the EUT continues to transmit, then incrementally increase the AWGN signal power level until the EUT stops transmitting.
9. (Including all losses in the RF paths) Determine and record the AWGN signal power level (at the EUT's antenna port) at which the EUT ceased transmission. Repeat the procedure at least 10 times to verify the EUT can detect an AWGN signal with 90% (or better) level of certainty.
10. Refer to Table 1 of KDB 987594 D02 v01r01 to determine the number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step 5, 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.

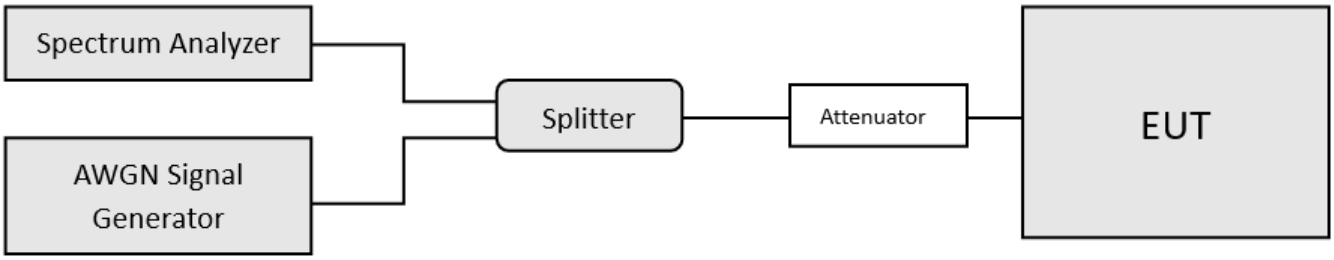



**Figure 7-5. Contention-based protocol test setup conducted method.**

## 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 7-55). The amplitude of the signal was increased until detected by the EUT, signaled by the ceasing of transmission (see Plot 7-56), M1 indicates the point at which the AWGN signal is introduced. D1 indicates where the AWGN signal is terminated, at least 10 seconds following M1.
2. 15 trials were run to assure that at least 90% of certainty was met.
3. Per Guidance from KDB 987594 D04 v01, contention-based protocol was tested with receiver with the lowest antenna gain.
4. All CBP Timing Plots shown are for the ceased condition. Some spikes that may be shown are from adjacent portions of the spectrum that are still transmitting.
5. In the presence of an AWGN signal, the EUT was shown to either completely move out of the channel or to reduce its bandwidth for the purpose of incumbent avoidance. Representative channel move plots are included for one sub-band to show how the channel reduces when the AWGN is injected at the lower edge, the center, and the upper edge of a channel.
6. This device only punctures to optimize network performance and never to avoid licensed incumbents.
7. For the channel move demonstration in Section 7.6.3, only plots from UNII-5 band are included. Additionally, the AWGN signal is not visible because the AWGN level is well below the noise floor.

Detection Level = Injected AWGN Power (dBm) – Antenna Gain (dBi) + Path Loss (dB)

**Equation 7-1. Detection Level Calculation**

| Band | Channel | Channel Freq [MHz] | Channel BW [MHz] | Incumbent Freq [MHz] | Injected (AWGN) [dBm] | Antenna Gain [dBi] | Path Loss (dB) | Adjusted Power Level [dBm] | Detection Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| UNII Band 5 | 53 | 6215 | 20 | 6215 | -74.74 | -6.49 | 1.03 | -67.22 | -62.0 | -5.22 |
| | 95 | 6425 | 320 | 6270 | -73.06 | -6.49 | 1.03 | -65.54 | -62.0 | -3.54 |
| | | | | 6425 | -73.57 | -6.49 | 1.03 | -66.05 | -62.0 | -4.05 |
| | | | | 6580 | -73.05 | -6.49 | 1.03 | -65.53 | -62.0 | -3.53 |
| UNII Band 7 | 149 | 6695 | 20 | 6695 | -75.96 | -6.97 | 1.03 | -67.96 | -62.0 | -5.96 |
| | 159 | 6745 | 320 | 6590 | -75.66 | -6.97 | 1.03 | -67.66 | -62.0 | -5.66 |
| | | | | 6745 | -75.96 | -6.97 | 1.03 | -67.96 | -62.0 | -5.96 |
| | | | | 6900 | -75.65 | -6.97 | 1.03 | -67.65 | -62.0 | -5.65 |

**Table 7-48. Contention Based Protocol – Incumbent Detection Results**

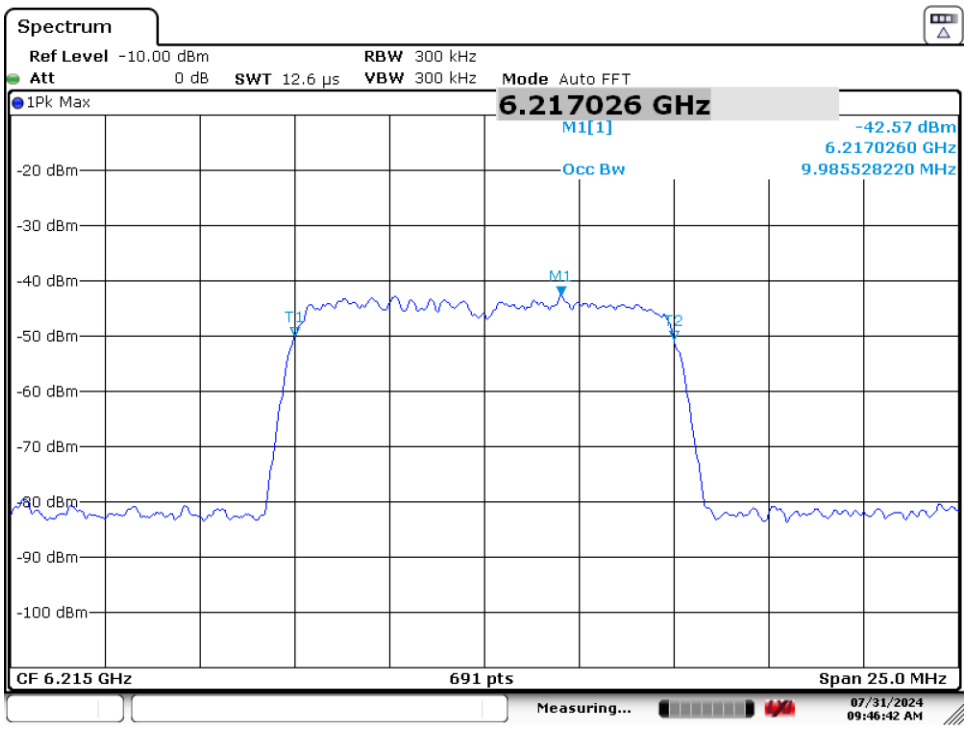
| Band | Channel | Channel Freq [MHz] | Channel BW [MHz] | Incumbent Freq [MHz] | Antenna Gain [dBi] | EUT Transmission Status Adjusted AWGN Power (dBm) | | | Detection Limit [dBm] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Normal | Minimal | Ceased | | |
| UNII Band 5 | 53 | 6215 | 20 | 6215 | -6.49 | -70.70 | -68.62 | -67.22 | -62.0 | -5.22 |
| | 95 | 6425 | 320 | 6270 | -6.49 | -69.64 | -66.57 | -65.54 | -62.0 | -3.54 |
| | | | | 6425 | -6.49 | -68.50 | -67.10 | -66.05 | -62.0 | -4.05 |
| | | | | 6580 | -6.49 | -67.78 | -66.76 | -65.53 | -62.0 | -3.53 |
| UNII Band 7 | 149 | 6695 | 20 | 6695 | -6.97 | -70.01 | -68.91 | -67.96 | -62.0 | -5.96 |
| | 159 | 6745 | 320 | 6590 | -6.97 | -71.52 | -70.33 | -67.66 | -62.0 | -5.66 |
| | | | | 6745 | -6.97 | -70.52 | -69.35 | -67.96 | -62.0 | -5.96 |
| | | | | 6900 | -6.97 | -70.19 | -68.84 | -67.65 | -62.0 | -5.65 |

**Table 7-49. Contention Based Protocol – Detection Results – All Tx Cases**

| CBP Detection (1 = Detection, Blank = No Detection) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | Channel | Channel Freq [MHz] | Channel BW [MHz] | Incumbent Freq [MHz] | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | Detection Rate (%) |
| UNII Band 5 | 53 | 6215 | 20 | 6215 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | 95 | 6425 | 320 | 6270 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | | | | 6425 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | | | | 6580 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| UNII Band 7 | 149 | 6695 | 20 | 6695 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | 159 | 6745 | 320 | 6590 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | | | | 6745 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |
| | | | | 6900 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 100 |

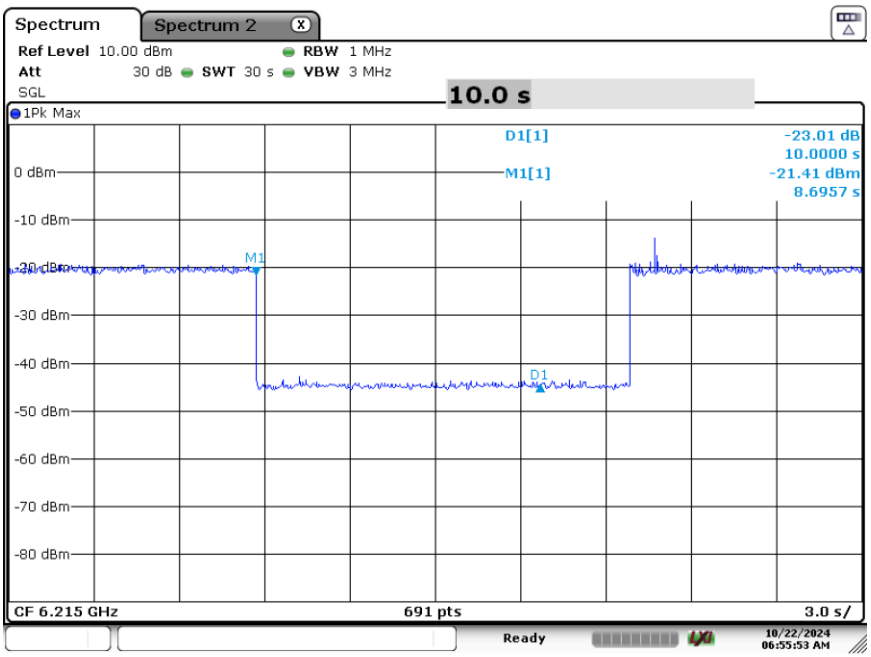
**Table 7-50. Contention Based Protocol – Incumbent Detection Trial Results**

## 7.7.1 AWGN Plots



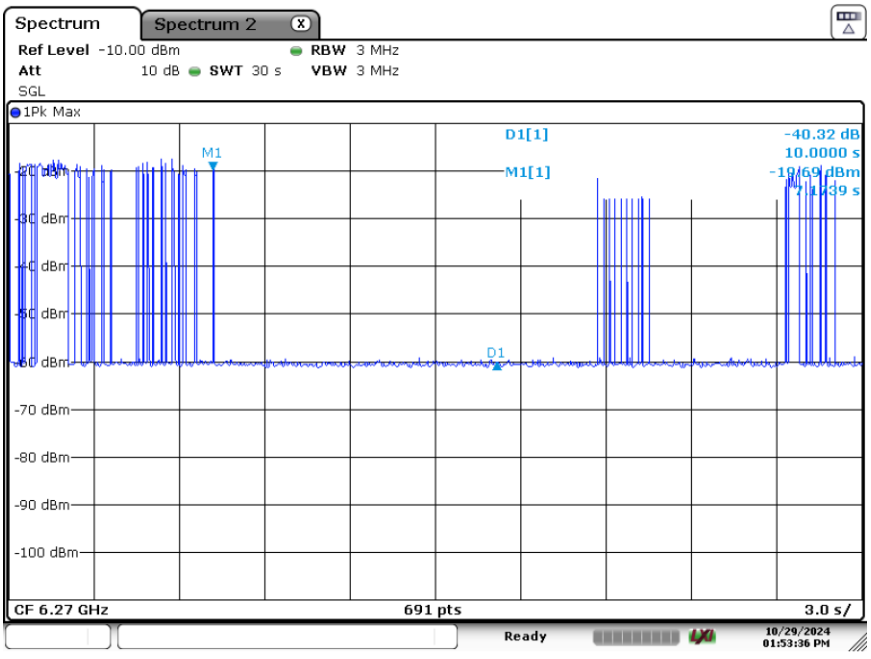

**Plot 7-62. AWGN Signal (Demonstration)**

## 7.7.2 CBP Timing Plots



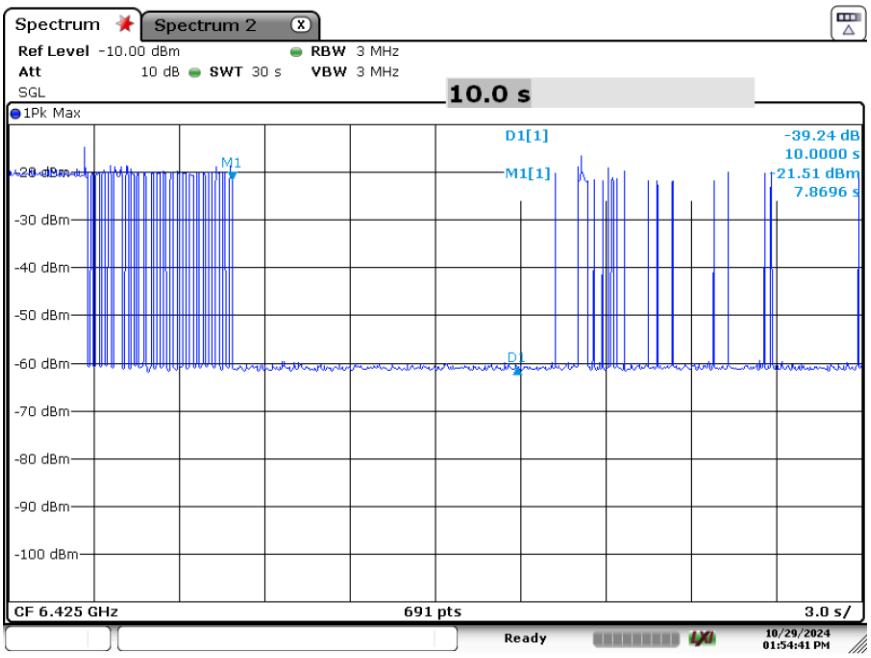

Date: 22.OCT.2024 06:55:53

**Plot 7-63. Contention Based Protocol Timing Plot (20MHz (UNII Band 5) – Ch. 53)**



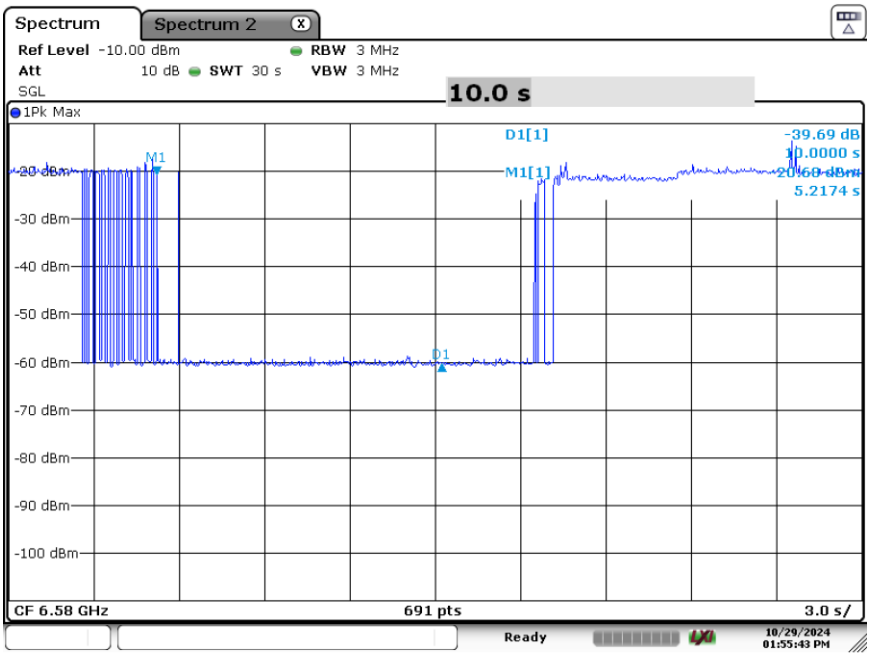

Date: 29.OCT.2024 13:53:36

**Plot 7-64. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 47 Low)**



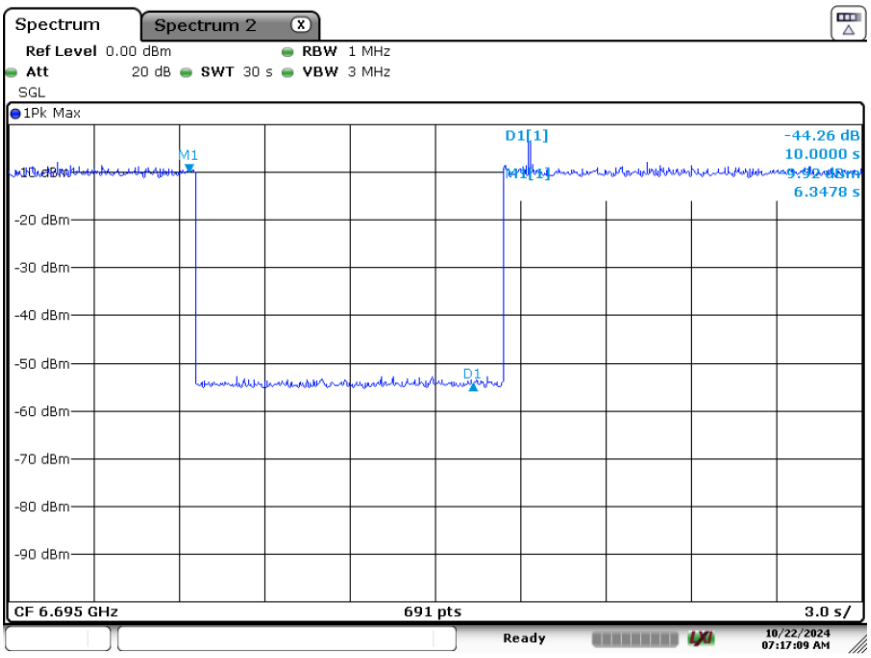

Date: 29.OCT.2024 13:54:41

**Plot 7-65. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 47 Mid)**



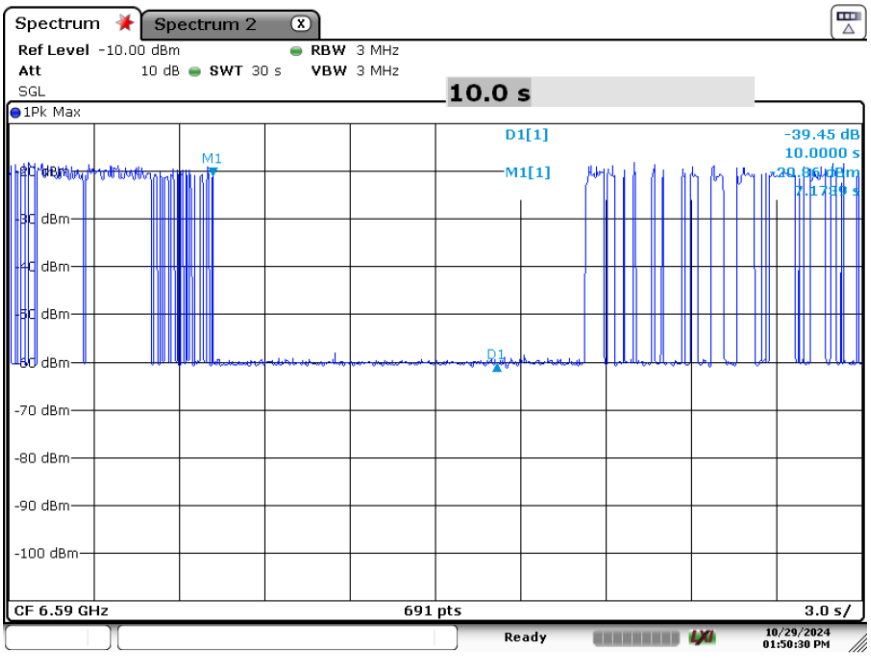

Date: 29.OCT.2024 13:55:43

**Plot 7-66. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 47 High)**



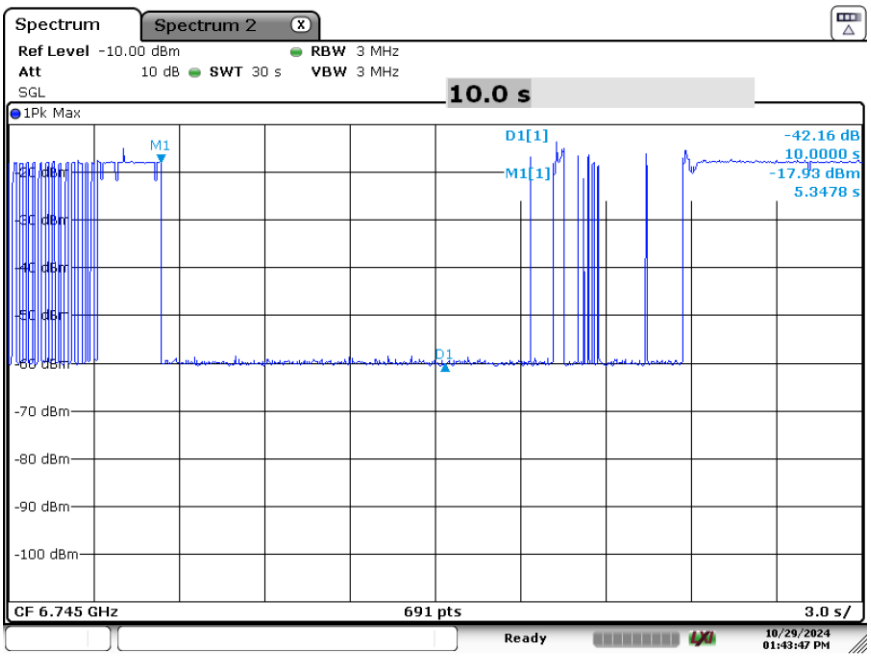

Date: 22.OCT.2024 07:17:09

**Plot 7-67. Contention Based Protocol Timing Plot (20MHz (UNII Band 7) – Ch. 149)**



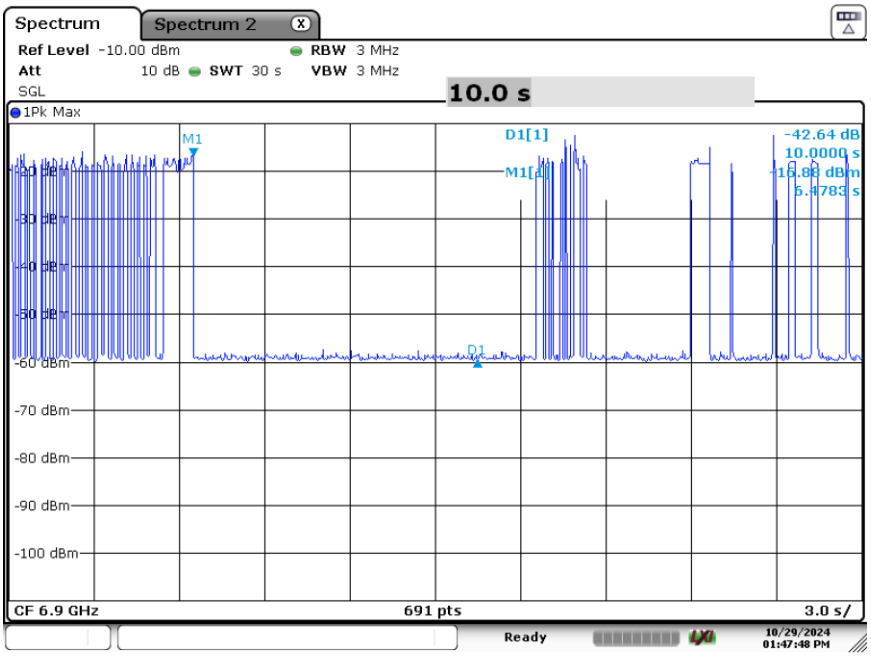

Date: 29.OCT.2024 13:50:29

**Plot 7-68. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 175 Low)**




Date: 29.OCT.2024 13:43:46

**Plot 7-69. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 175 Mid)**



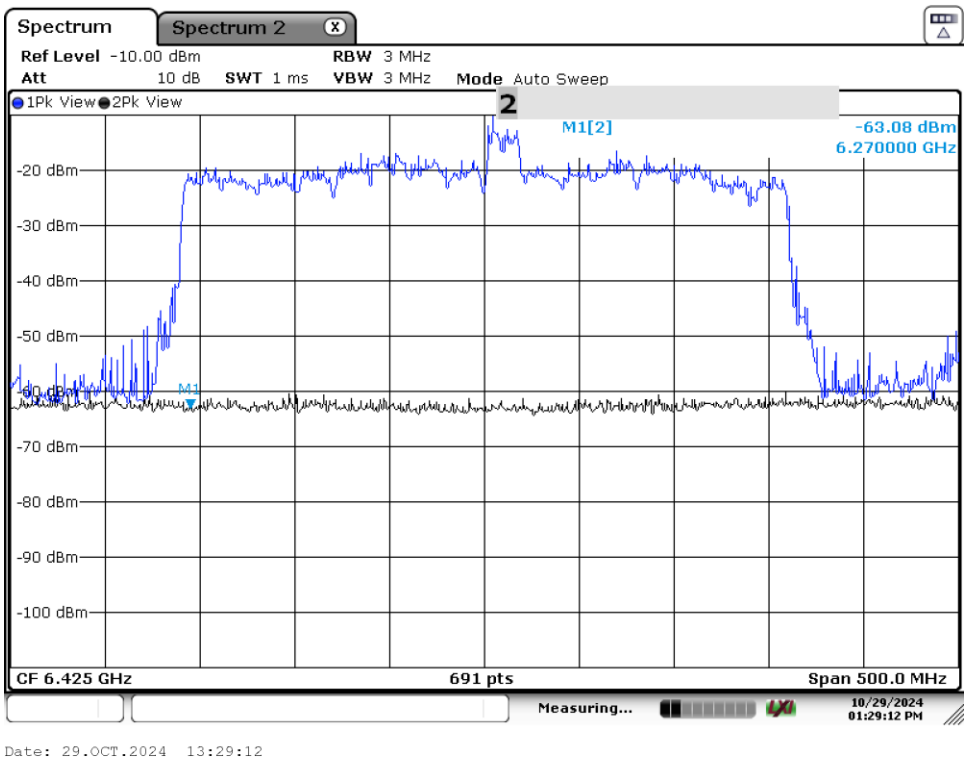

Date: 29.OCT.2024 13:47:48

**Plot 7-70. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 175 High)**

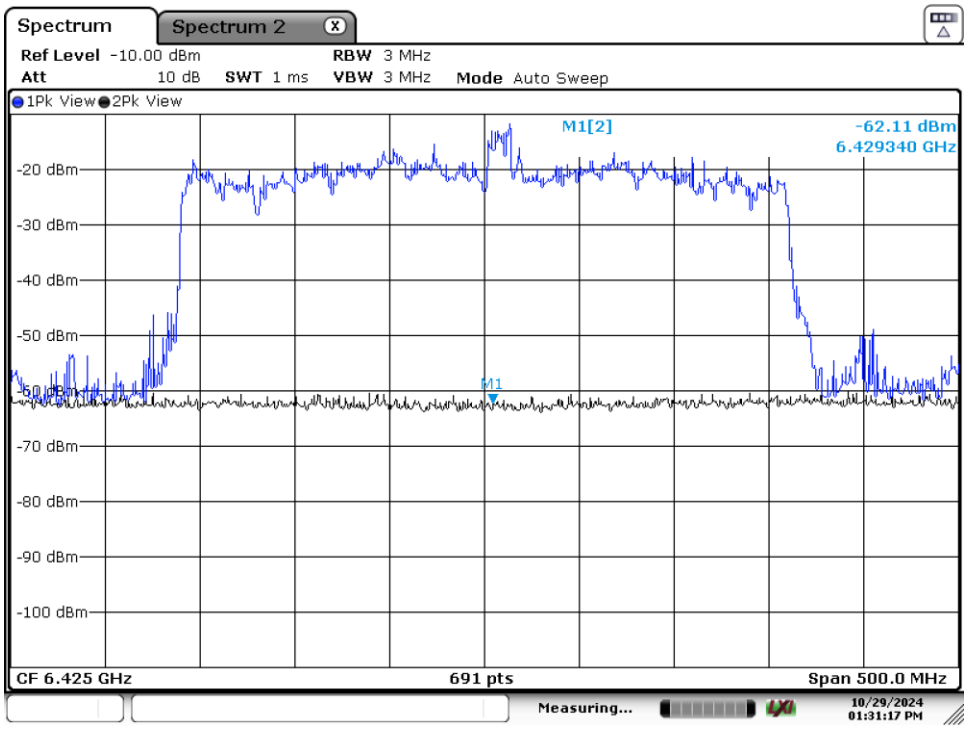
## 7.7.3 Channel Move Plots

This section demonstrates the effect of injecting the AWGN signal at various locations throughout the 802.11be 320MHz signal. The blue trace shows the full 320MHz signal prior to AWGN injection while the black trace shows the spectrum following AWGN injection. The following items were observed as demonstrated in the three plots shown below:

- When a 10 MHz AWGN signal centered at 6270 MHz (lower edge of channel) is injected, the channel completely stops transmitting.
- When a 10 MHz AWGN signal centered at 6425 MHz (middle of channel) is injected, the channel completely stops transmitting.
- When a 10 MHz AWGN signal centered at 6580 MHz (upper edge of channel) is injected, the channel completely stops transmitting.

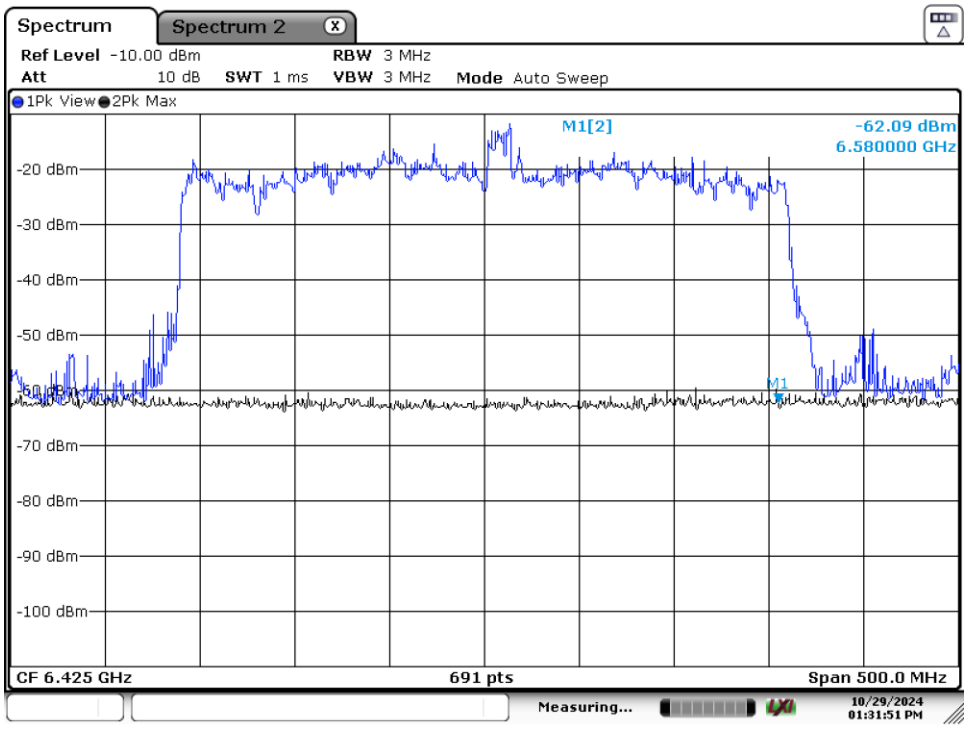



**Plot 7-71. CBP 320MHz Channel - Injection Lower Edge – [6270 MHz]**




Date: 29.OCT.2024 13:31:17

**Plot 7-72. CBP 320MHz Channel - Injection Center – [6425 MHz]**




Date: 29.OCT.2024 13:31:51

**Plot 7-73. CBP 320MHz Channel - Injection Upper Edge – [6580 MHz]**

## 7.8 Transmit Power Control

**Test Overview and Limit**

Very low-power devices operating in the 5.925–6.425 and 6.525-6.875 GHz bands shall employ a TPC mechanism. A very low-power device must demonstrate the capability to operate at least 6 dB below the maximum EIRP PSD value of -5 dBm/MHz.

**Test Procedures Used**

KDB 987594 D02 v03
ANSI C63.10-2013 Section 12.5 (Using Method SA-3)

**Test Settings**

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points = 1001
6. Sweep time = 2s (i.e. sweep time < # points x T, per Section 12.3.2.6)
7. Detector = power averaging (RMS)
8. Trace was set to max hold to allow the trace to stabilize
9. Trigger was set to free run for all modes
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

**Test Setup**

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

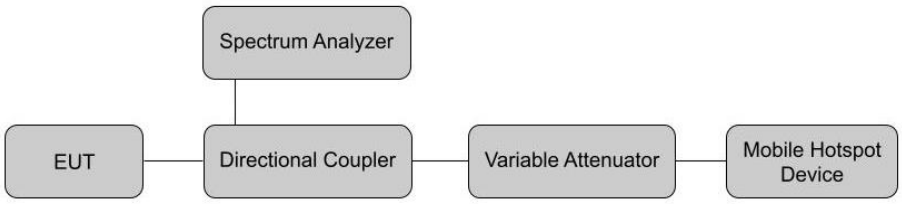



**Figure 7-6. Test Instrument & Measurement Setup**

This test demonstrates the ability of the device to increase and decrease power by the required 6dB as the RSSI is decreased and increased via attenuation from a variable attenuator.

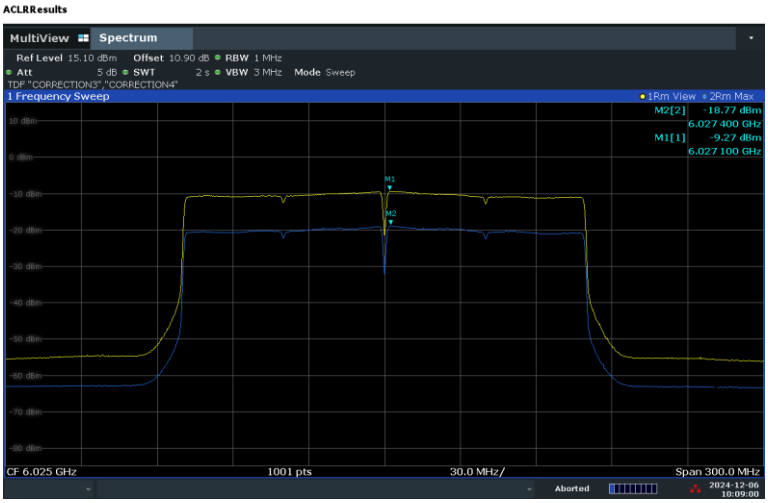
1. Configure EUT and Mobile Hotspot Device for connection as shown in figure above
2. Set variable attenuator to 0dB (noise free spectral environment, high RSSI simulation)
3. Establish connection between EUT and Mobile Hotspot Device
4. Capture PSD on Spectrum analyzer
5. Adjust attenuator to set high attenuation (noisy spectral environment, low RSSI simulation)
6. Capture PSD on Spectrum analyzer
7. Compare the highest PSD captured in step 4 to the highest PSD on step 6

## Test Notes

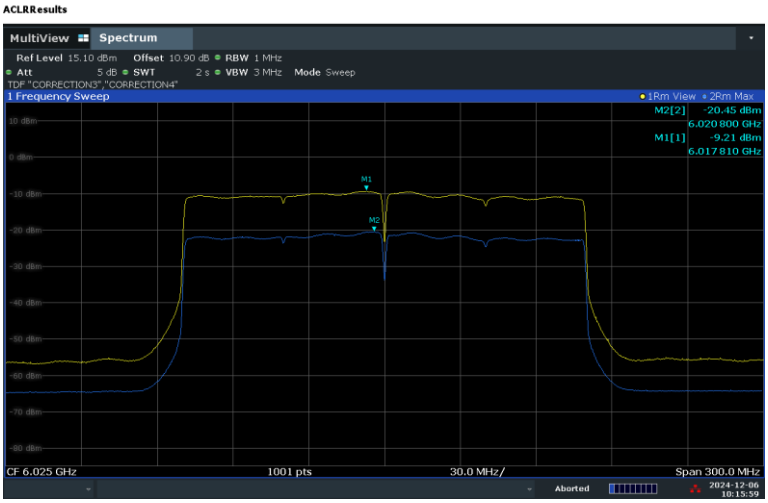
1. TPC is triggered when high RSSI condition is detected. As RSSI decreases via an increase in channel attenuation, the transmitters' output power will increase back to maximum allowed power
2. Implementation Expectation: Tx power Backoff is enabled at -26dBm or higher RSSI level. Backoff is disabled at -35dBm or lower RSSI Level.
3. The e.i.r.p. density is measured across both antenna ports and accounting for directional gain as shown below.

| Frequency [MHz] | Channel | 802.11 MODE | RSSI Level [dBm] | Antenna-1 Power Density [dBm] | Antenna-2 Power Density [dBm] | Antenna-1 Gain [dBi] | Antenna-2 Gain [dBi] | Summed MIMO Power Density [dBm/MHz] | Directional Gain [dBi] | e.i.r.p Density [dBm/MHz] | Max EIRP Density [dBm/MHz] | Margin [dB] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6025 | 15 | ax (160MHz) | -45 | -9.27 | -9.21 | -6.12 | -5.01 | -6.23 | -2.54 | -8.77 | -5 | -3.77 |
| | | | -33 | -18.77 | -20.45 | -6.12 | -5.01 | -16.52 | -2.54 | -19.06 | -11 | -8.06 |
| | | | -20 | -18.95 | -20.25 | -6.12 | -5.01 | -16.54 | -2.54 | -19.08 | -11 | -8.08 |

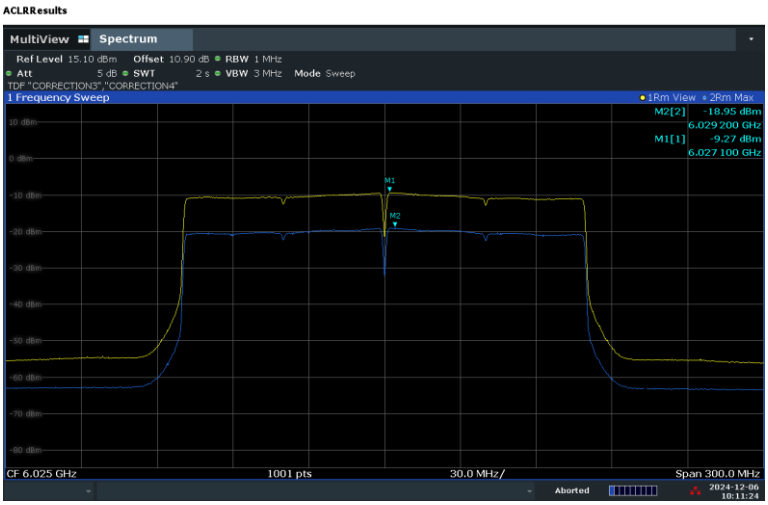
**Table 7-51. e.i.r.p. Power Spectral Density Measurements**



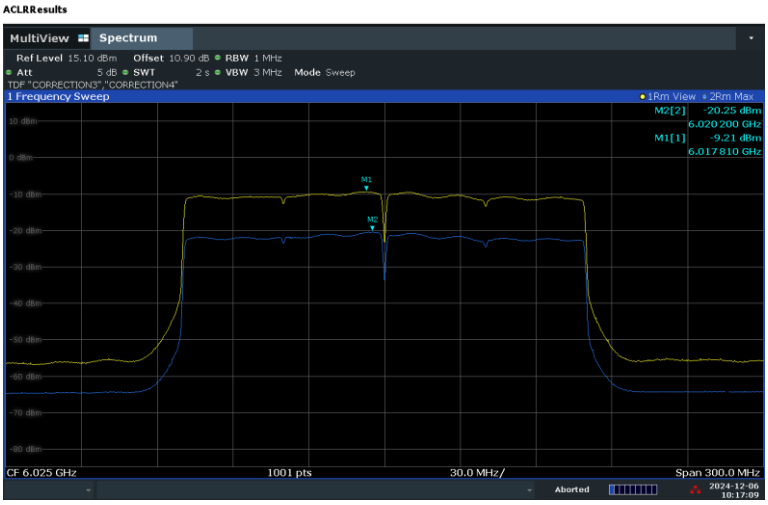

**Plot 7-74. Power Spectral Density Plot –**
**ANT1 (160MHz Bandwidth, RSSI level at -45dBm (yellow) and -33dBm (blue))**




**Plot 7-75. Power Spectral Density Plot –**
**ANT2 (160MHz Bandwidth, RSSI level at -45dBm (yellow) and -33dBm (blue))**




**Plot 7-76. Power Spectral Density Plot –**
**ANT1 (160MHz Bandwidth, RSSI level at -45dBm (yellow) and -20dBm (blue))**




**Plot 7-77. Power Spectral Density Plot –**
**ANT2 (160MHz Bandwidth, RSSI level at -45dBm (yellow) and -20dBm (blue))**

## 7.9 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 its maximum power control level, as defined in ANSI C63.10-2013, 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 -27dBm/MHz (68.2dBuV/m at a 3m distance). Emissions found in a restricted band are subject to the limits of 15.209 as shown in the table below.***

| 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 7-52. Radiated Limits**

**Test Procedures Used**

ANSI C63.10-2013 – Sections 12.7.7.2, 12.7.6, 12.7.5

**Test Settings – Above 1GHz**

**Average Field Strength Measurements (Method AD – Average Detection)**

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 Settings – Below 1GHz

### 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 diagram below.

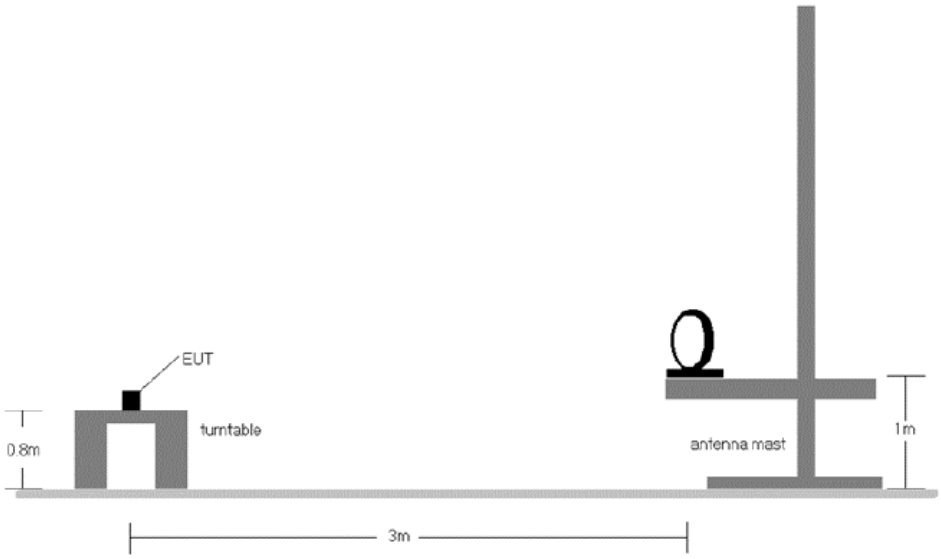



**Figure 7-7. Radiated Test Setup < 30MHz**

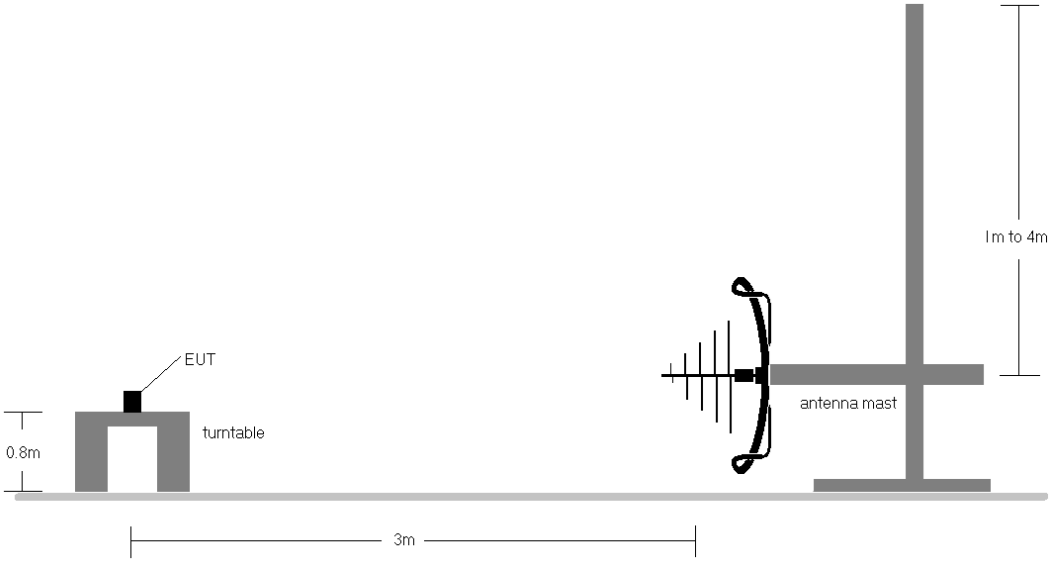



**Figure 7-8. Radiated Test Setup < 1GHz**

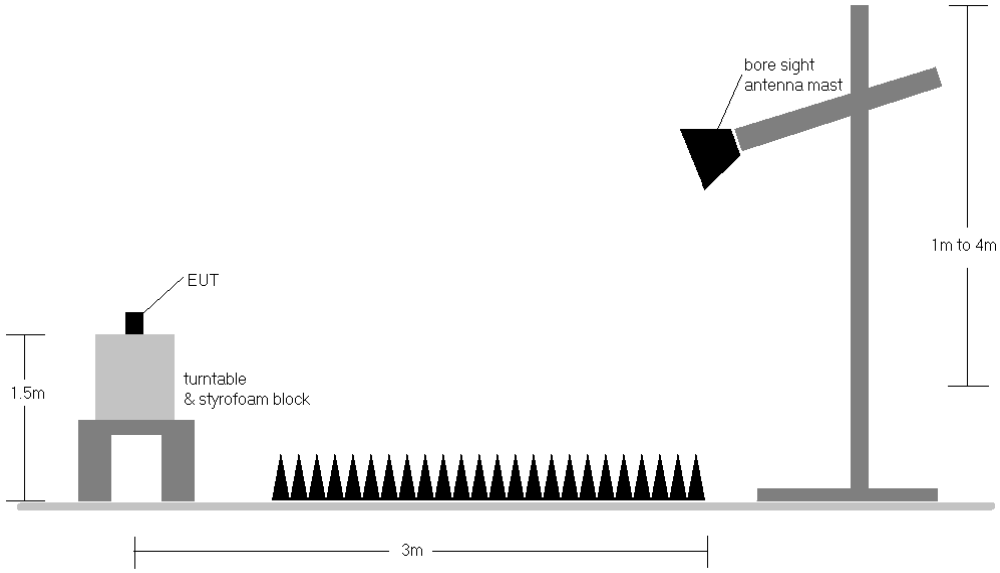



**Figure 7-9. Radiated Test Setup > 1GHz**

## Test Notes

1. All spurious emissions lying in restricted bands specified in §15.205 are below the limits specified in §15.209. All spurious emissions that do not lie in a restricted band are subject to an average limit of -27dBm/MHz. At 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.
2. 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.
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. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
8. In the case where a peak-detector measurement passed the given RMS limit it was determined sufficient to demonstrate compliance.
9. The results recorded using the broadband antenna are 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.

## Sample Calculations

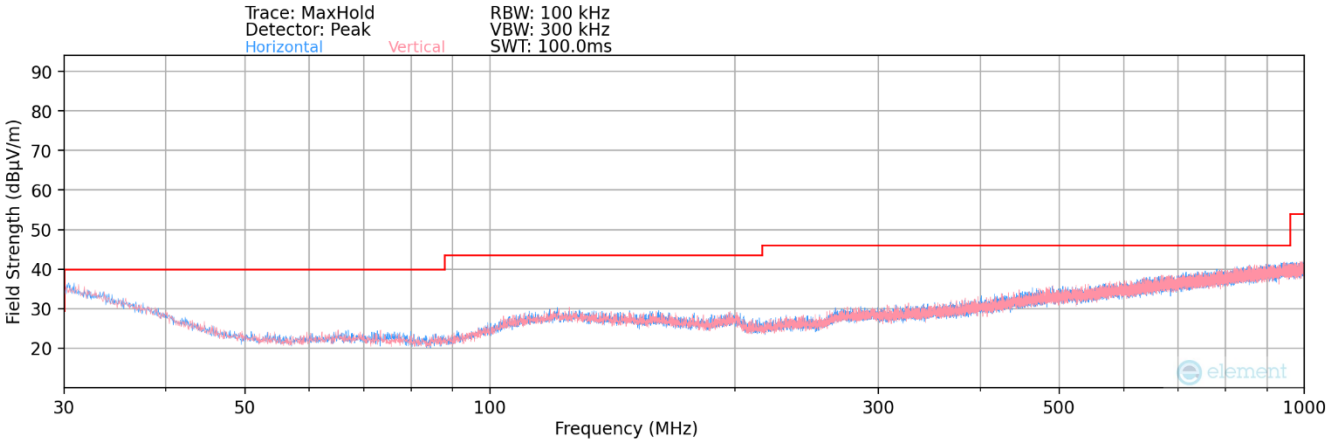
### Determining Spurious Emissions Levels

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

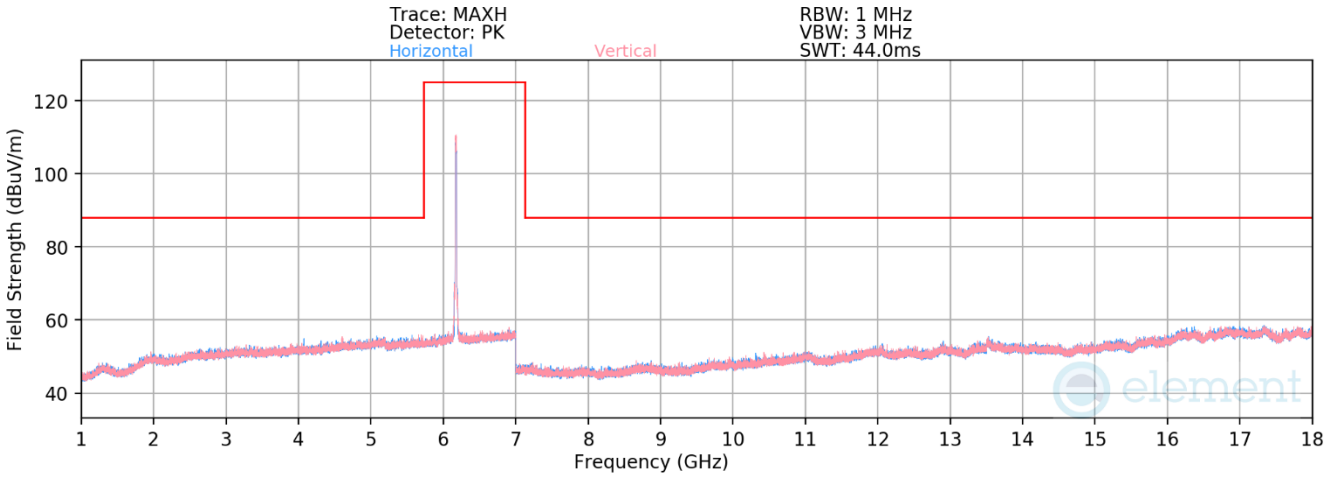
### Radiated Band Edge Measurement Offset

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

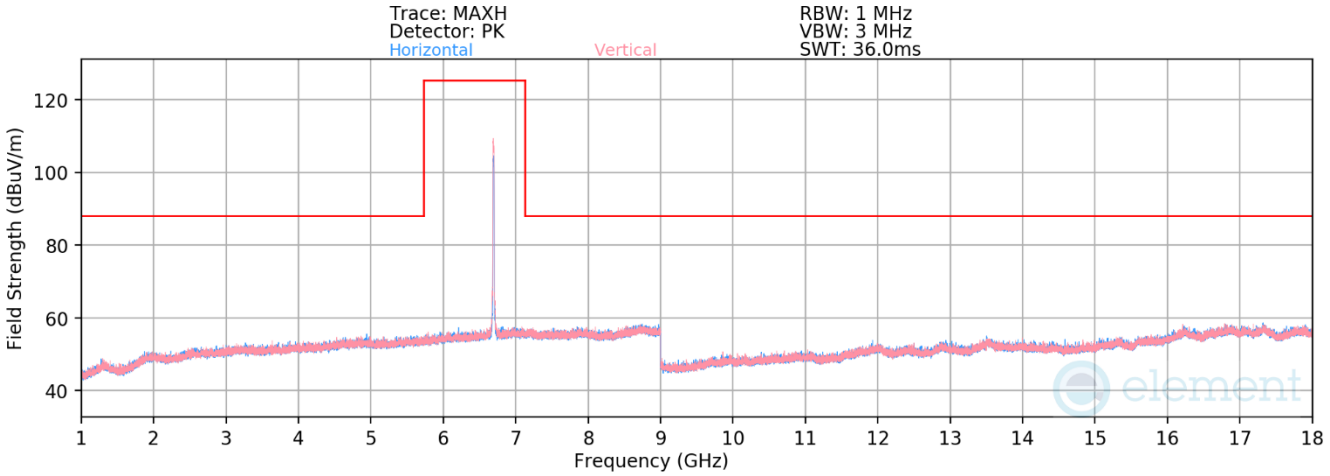
## 7.9.1 MIMO Radiated Spurious Emission Measurements



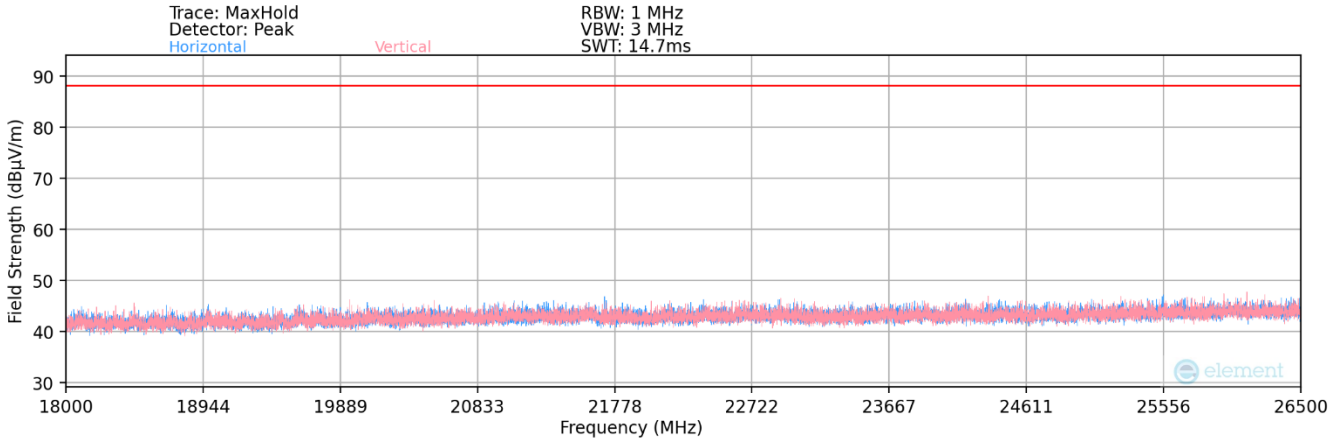

**Plot 7-78. Radiated Spurious Plot below 1GHz MIMO (802.11a)**



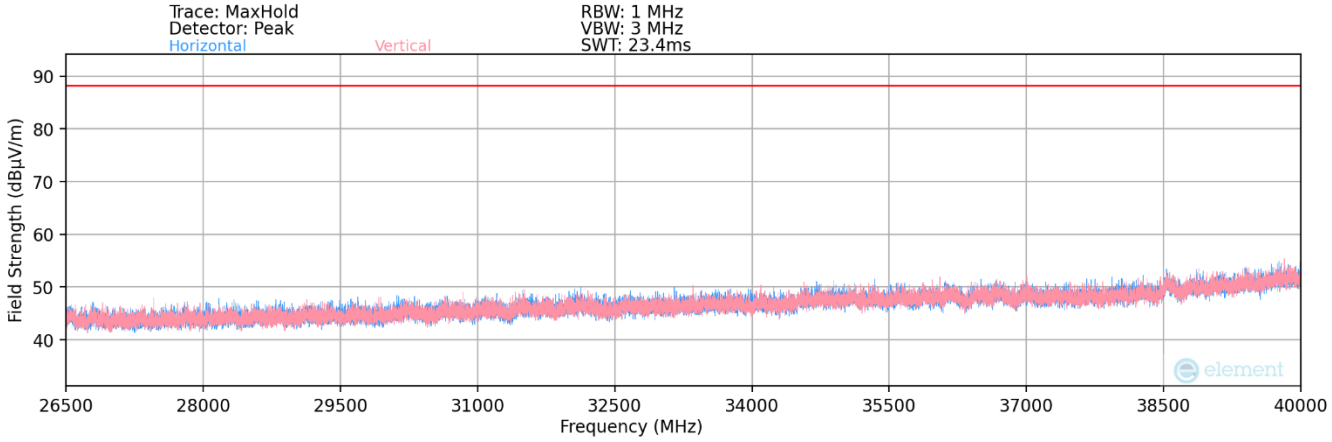

**Plot 7-79. Radiated Spurious Plot 1GHz – 18GHz MIMO (802.11a – UNII Band 5 Ch. 45)**




**Plot 7-80. Radiated Spurious Plot 1GHz – 18GHz MIMO (802.11a – UNII Band 7 Ch. 149)**




**Plot 7-81. Radiated Spurious Plot 18GHz - 26.5GHz (802.11a)**




**Plot 7-82. Radiated Spurious Plot 26.5GHz - 40GHz (802.11a)**

# MIMO Radiated Spurious Emission Measurements – UNII Band 5

Worst Case Mode: 802.11a

Worst Case Transfer Rate: 6Mbps

Distance of Measurements: 1 & 3 Meters

| Mode | Antenna | UNII Band | Channel | Test Channel Freq. [MHz] | Restricted | 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] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11a | MIMO | 5 | 2 | 5935 | * | 11870.00 | Average | H | - | - | -82.71 | 16.47 | 0.00 | 40.76 | 53.98 | -13.22 |
| | | | | | * | 11870.00 | Peak | H | - | - | -71.51 | 16.47 | 0.00 | 51.96 | 73.98 | -22.02 |
| | | | | | * | 17805.00 | Average | V | - | - | -84.26 | 24.15 | 0.00 | 46.89 | 53.98 | -7.09 |
| | | | | | * | 17805.00 | Peak | V | - | - | -72.93 | 24.15 | 0.00 | 58.22 | 73.98 | -15.76 |
| | | | | | * | 23740.00 | Average | V | - | - | -66.15 | 3.58 | -9.54 | 34.89 | 53.98 | -19.09 |
| | | | | | * | 23740.00 | Peak | V | - | - | -56.36 | 3.58 | -9.54 | 44.68 | 73.98 | -29.30 |
| | | | | | | 29675.00 | Peak | V | - | - | -55.37 | 5.33 | -9.54 | 47.42 | 68.20 | -20.78 |
| | | | 45 | 6175 | * | 12350.00 | Average | V | - | - | -83.05 | 17.23 | 0.00 | 41.18 | 53.98 | -12.80 |
| | | | | | * | 12350.00 | Peak | V | - | - | -71.26 | 17.23 | 0.00 | 52.97 | 73.98 | -21.01 |
| | | | | | * | 18525.00 | Average | V | - | - | -64.74 | 1.16 | -9.54 | 33.88 | 53.98 | -20.10 |
| | | | | | * | 18525.00 | Peak | V | - | - | -55.18 | 1.16 | -9.54 | 43.44 | 73.98 | -30.54 |
| | | | | | | 24700.00 | Peak | V | - | - | -56.25 | 3.72 | -9.54 | 44.93 | 68.20 | -23.27 |
| | | | | | | 30875.00 | Peak | V | - | - | -55.90 | 6.32 | -9.54 | 47.88 | 68.20 | -20.32 |
| | | | 93 | 6415 | | 12830.00 | Peak | V | - | - | -72.07 | 17.82 | 0.00 | 52.75 | 68.20 | -15.45 |
| | | | | | * | 19245.00 | Average | V | - | - | -65.22 | 1.84 | -9.54 | 34.08 | 53.98 | -19.90 |
| | | | | | * | 19245.00 | Peak | V | - | - | -54.12 | 1.84 | -9.54 | 45.18 | 73.98 | -28.80 |
| | | | | | | 25660.00 | Peak | V | - | - | -54.66 | 3.90 | -9.54 | 46.70 | 68.20 | -21.50 |
| | | | | | | 32075.00 | Peak | V | - | - | -56.84 | 6.64 | -9.54 | 47.26 | 68.20 | -20.94 |

**Table 7-53. Radiated Measurements MIMO**

# MIMO Radiated Spurious Emission Measurements – UNII Band 7

Worst Case Mode: 802.11a

Worst Case Transfer Rate: 6Mbps

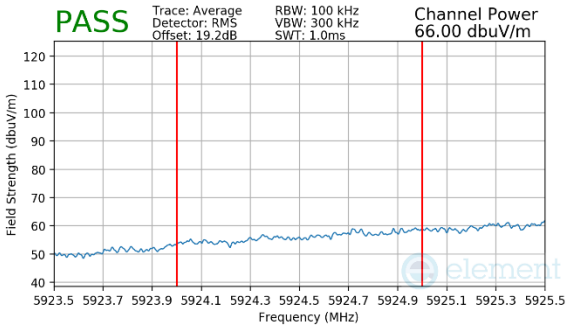
Distance of Measurements: 1 & 3 Meters

| Mode | Antenna | UNII Band | Channel | Test Channel Freq. [MHz] | Restricted | 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] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11a | MIMO | 7 | 117 | 6535 | | 13070.00 | Peak | V | - | - | -71.75 | 18.33 | 0.00 | 53.58 | 68.20 | -14.62 |
| | | | | | * | 19605.00 | Average | V | - | - | -65.41 | 2.38 | -9.54 | 34.43 | 53.98 | -19.55 |
| | | | | | * | 19605.00 | Peak | V | - | - | -54.68 | 2.38 | -9.54 | 45.16 | 73.98 | -28.82 |
| | | | | | | 26140.00 | Peak | V | - | - | -56.48 | 4.03 | -9.54 | 45.01 | 68.20 | -23.19 |
| | | | | | | 32675.00 | Peak | V | - | - | -56.56 | 6.46 | -9.54 | 47.36 | 68.20 | -20.84 |
| | | | 149 | 6695 | * | 13390.00 | Average | V | - | - | -83.55 | 17.66 | 0.00 | 41.11 | 53.98 | -12.87 |
| | | | | | * | 13390.00 | Peak | V | - | - | -72.47 | 17.68 | 0.00 | 52.21 | 73.98 | -21.77 |
| | | | | | * | 20085.00 | Average | V | - | - | -65.64 | 2.58 | -9.54 | 34.40 | 53.98 | -19.58 |
| | | | | | * | 20085.00 | Average | V | - | - | -55.24 | 2.58 | -9.54 | 44.80 | 73.98 | -29.18 |
| | | | | | | 26780.00 | Average | V | - | - | -56.91 | 4.33 | -9.54 | 44.88 | 68.20 | -23.32 |
| | | | | | | 33475.00 | Peak | V | - | - | -56.60 | 6.96 | -9.54 | 47.82 | 68.20 | -20.38 |
| | | | 185 | 6875 | | 13750.00 | Peak | H | - | - | -70.91 | 17.56 | 0.00 | 53.65 | 68.20 | -14.55 |
| | | | | | * | 20625.00 | Average | V | - | - | -65.87 | 3.01 | -9.54 | 34.60 | 53.98 | -19.38 |
| | | | | | * | 20625.00 | Peak | V | - | - | -55.09 | 3.01 | -9.54 | 45.38 | 73.98 | -28.60 |
| | | | | | | 27500.00 | Peak | V | - | - | -56.70 | 3.97 | -9.54 | 44.73 | 68.20 | -23.47 |
| | | | | | | 34375.00 | Peak | V | - | - | -56.52 | 7.33 | -9.54 | 48.27 | 68.20 | -19.93 |

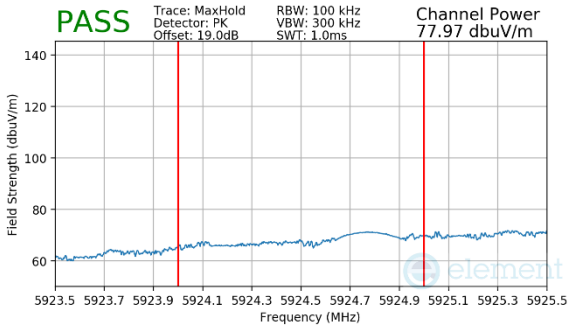
**Table 7-54. Radiated Measurements MIMO**

## 7.9.2 MIMO Radiated Band Edge Measurements (20MHz BW)

| | |
|---|---|
| Worst Case Mode: | 802.11a |
| Worst Case Transfer Rate: | 6Mbps |
| Distance of Measurements: | 3 Meters |
| Operating Frequency: | 5935MHz |
| Channel: | 2 |

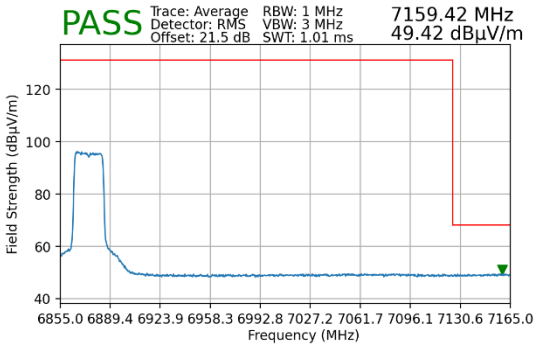



**Plot 7-83. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**

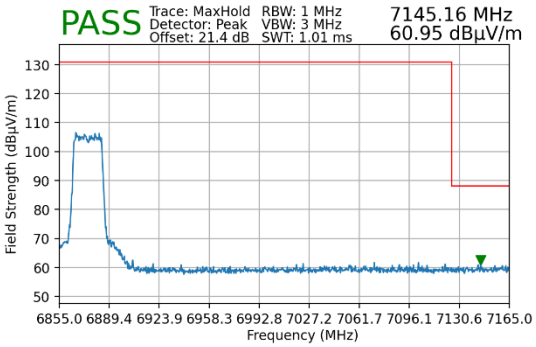



**Plot 7-84. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

| | |
|---|---|
| Worst Case Mode: | 802.11be |
| Worst Case Transfer Rate: | MCS0 |
| Distance of Measurements: | 3 Meters |
| Operating Frequency: | 6875MHz |
| Channel: | 185 |




**Plot 7-85. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 7)**



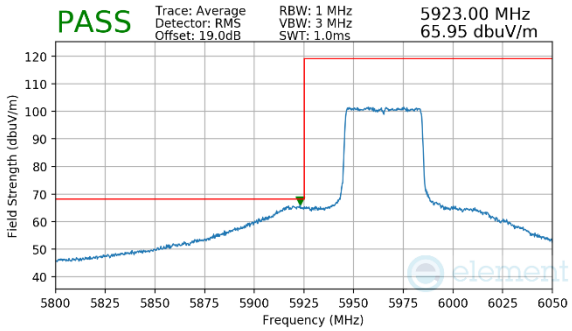

**Plot 7-86. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 7)**

Note:

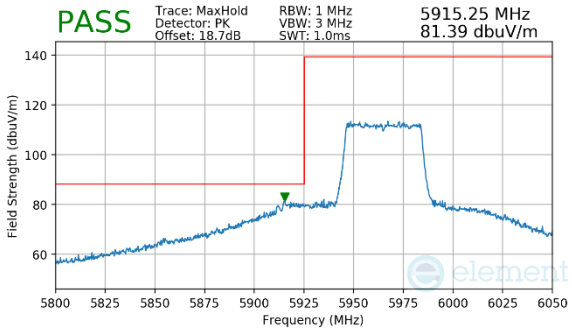
The highest channel of operation for VLP mode lies within the UNII-7 band (6525 - 6875MHz) which is far from the band edge at 7125MHz. We have investigated the band edge emissions at the upper edge of 7125MHz and are only including the worst-case upper band edge measurements as shown on this page.

## 7.9.3 MIMO Radiated Band Edge Measurements (40MHz BW)

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



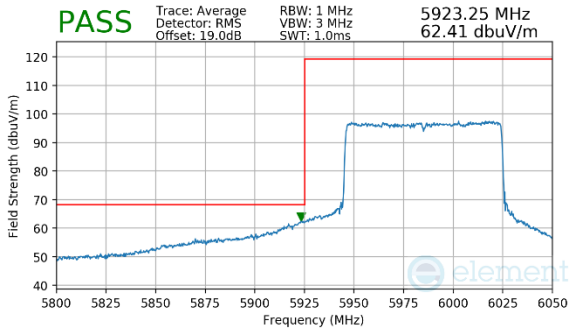

**Plot 7-87. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**



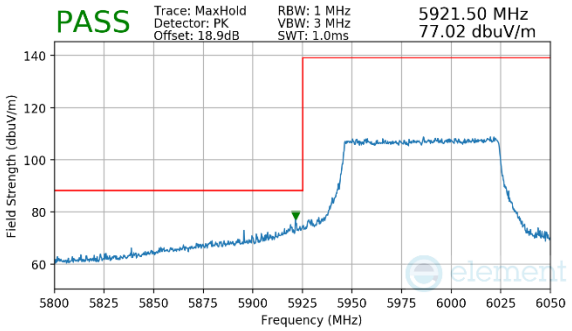

**Plot 7-88. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.9.4 MIMO Radiated Band Edge Measurements (80MHz BW)

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



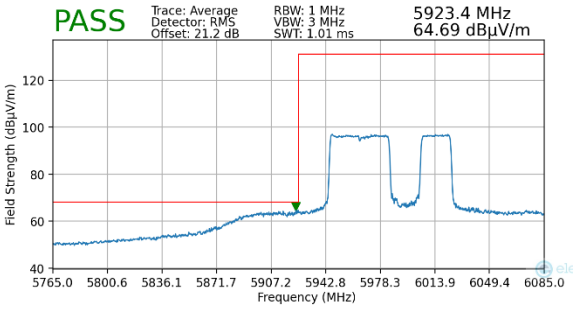

**Plot 7-89. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**



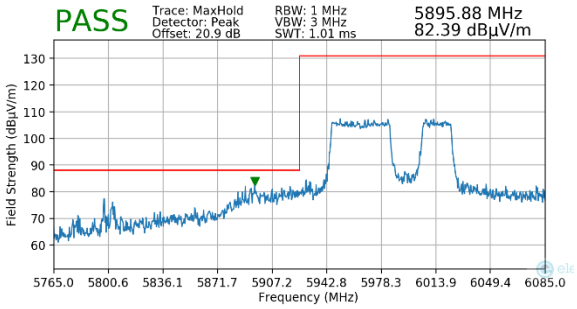

**Plot 7-90. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.9.5 MIMO Radiated Band Edge Measurements (80MHz BW - Punctured)

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



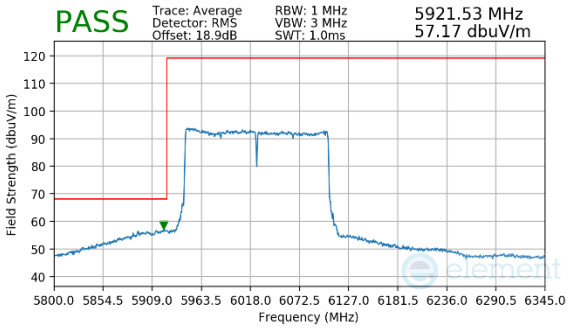

**Plot 7-91. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**



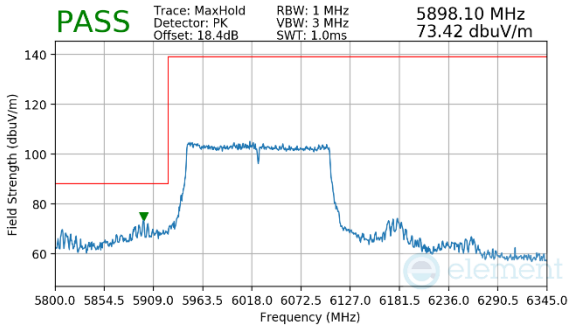

**Plot 7-92. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.9.6 MIMO Radiated Band Edge Measurements (160MHz BW)

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



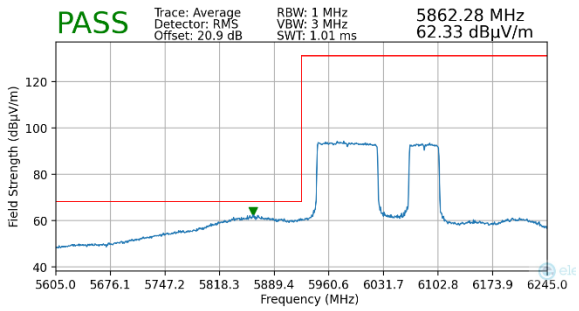

**Plot 7-93. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**



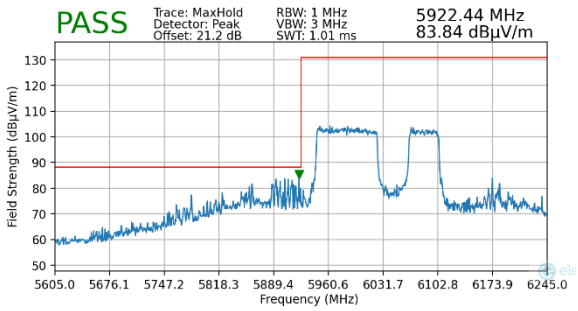

**Plot 7-94. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.9.7 MIMO Radiated Band Edge Measurements (160MHz BW - Punctured)

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



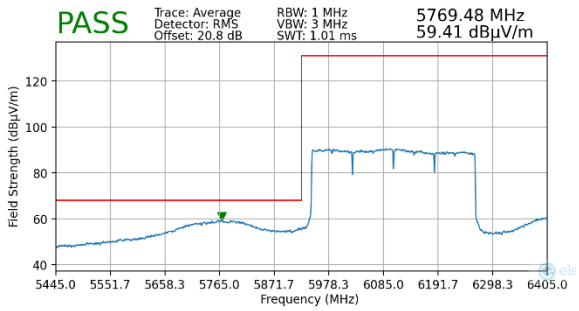

**Plot 7-95. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**



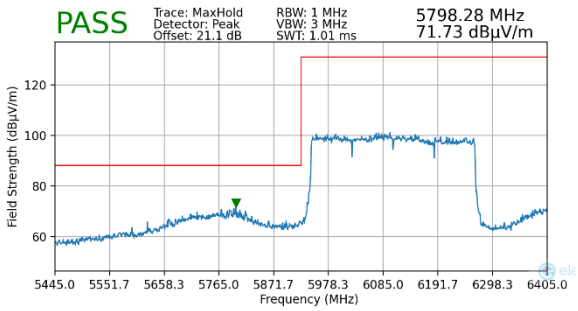

**Plot 7-96. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.9.8 MIMO Radiated Band Edge Measurements (320MHz BW)

| | |
|---|---|
| Worst Case Mode: | 802.11be |
| Worst Case Transfer Rate: | MCS0 |
| Distance of Measurements: | 3 Meters |
| Operating Frequency: | 6105MHz |
| Channel: | 31 |

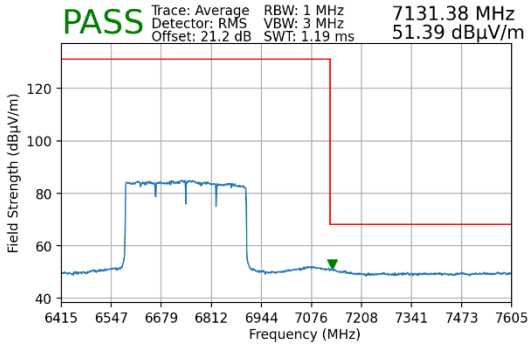



**Plot 7-97. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**

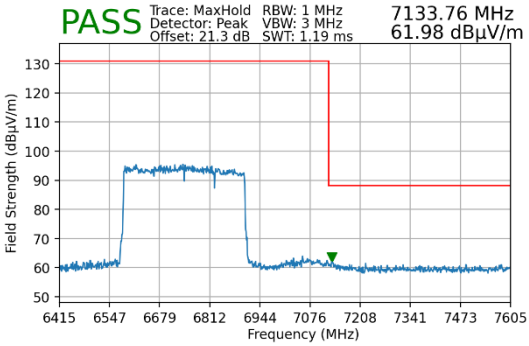



**Plot 7-98. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

| | |
|---|---|
| Worst Case Mode: | 802.11be |
| Worst Case Transfer Rate: | MCS0 |
| Distance of Measurements: | 3 Meters |
| Operating Frequency: | 6745MHz |
| Channel: | 159 |




**Plot 7-99. Radiated Upper Band Edge Plot MIMO (Average – UNII Band 7)**



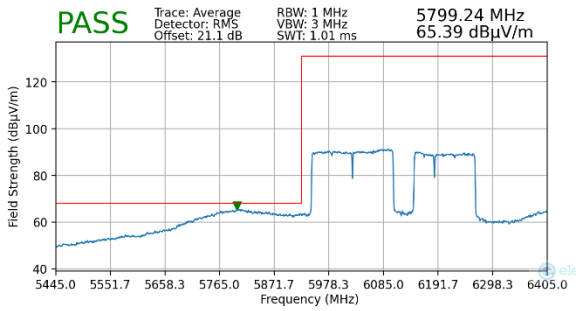

**Plot 7-100. Radiated Upper Band Edge Plot MIMO (Peak – UNII Band 7)**

Note:

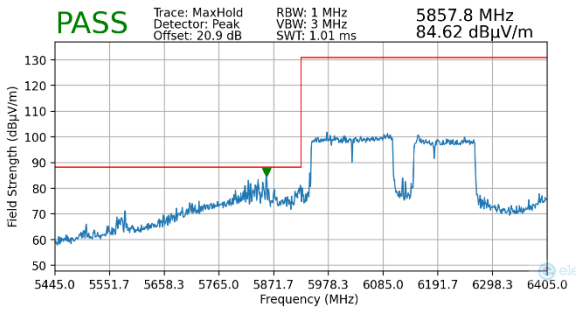
The highest channel of operation for VLP mode lies within the UNII-7 band (6525 - 6875MHz) which is far from the band edge at 7125MHz. We have investigated the band edge emissions at the upper edge of 7125MHz and are only including the worst-case upper band edge measurements as shown on this page.

## 7.9.9 MIMO Radiated Band Edge Measurements (320MHz BW – Punctured)

| | |
|---|---|
| Worst Case Mode: | 802.11be |
| Worst Case Transfer Rate: | MCS0 |
| Distance of Measurements: | 3 Meters |
| Operating Frequency: | 6105MHz |
| Channel: | 31 |




**Plot 7-101. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 5)**




**Plot 7-102. Radiated Lower Band Edge Plot MIMO (Peak – UNII Band 5)**

## 7.10 Line Conducted Test Data

**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 7-55. 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.

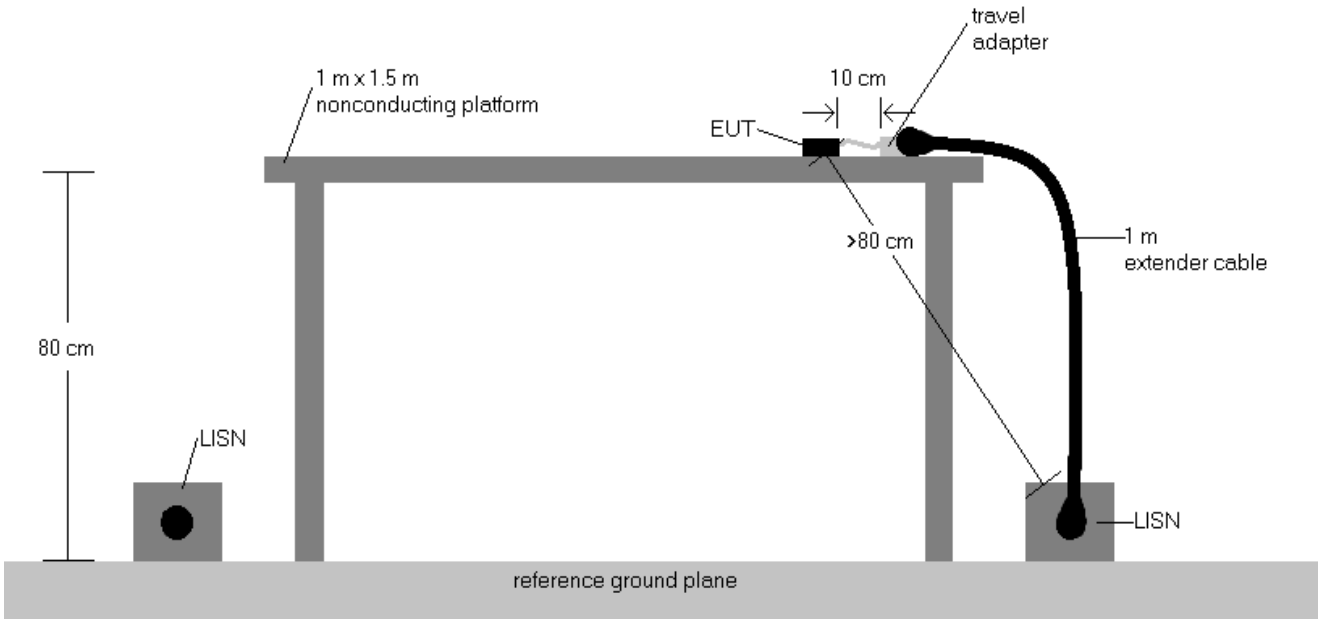
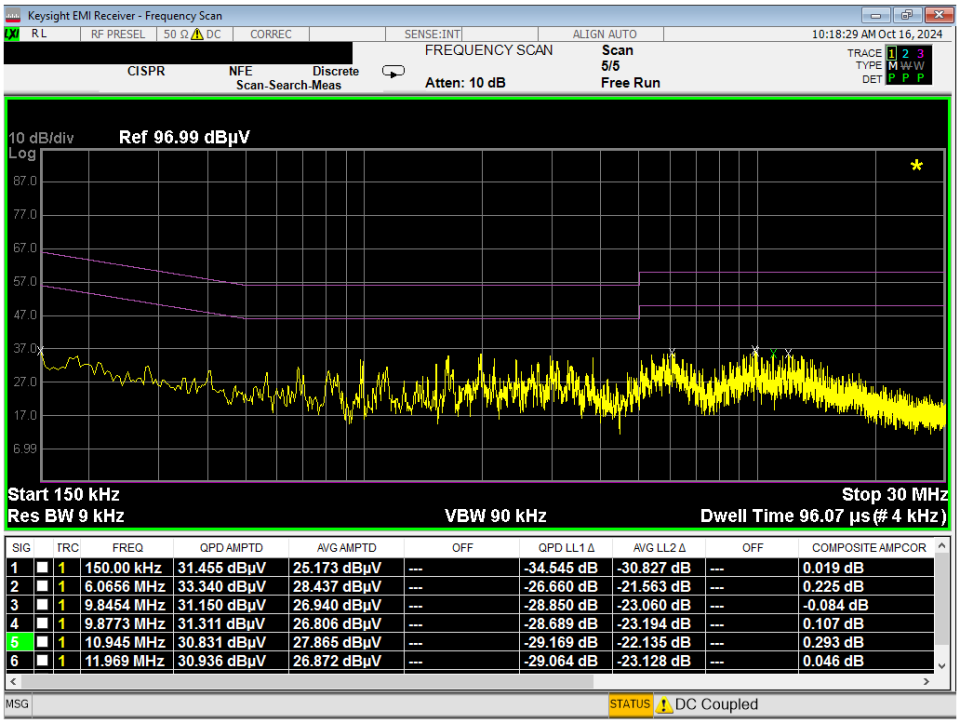


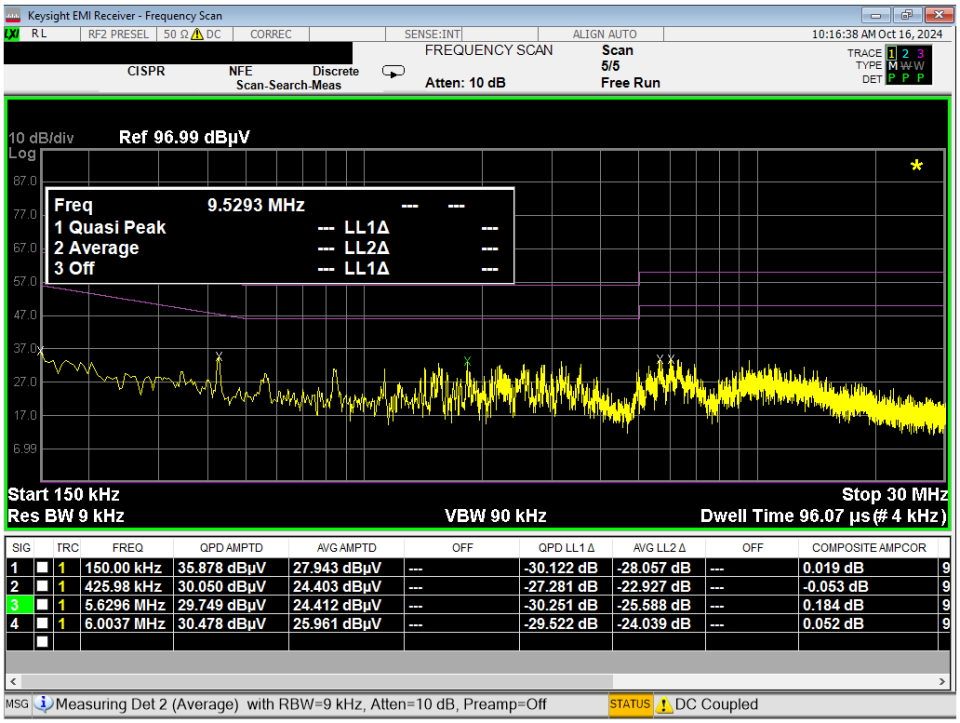

**Figure 7-10. Test Instrument & Measurement Setup**

## Test Notes

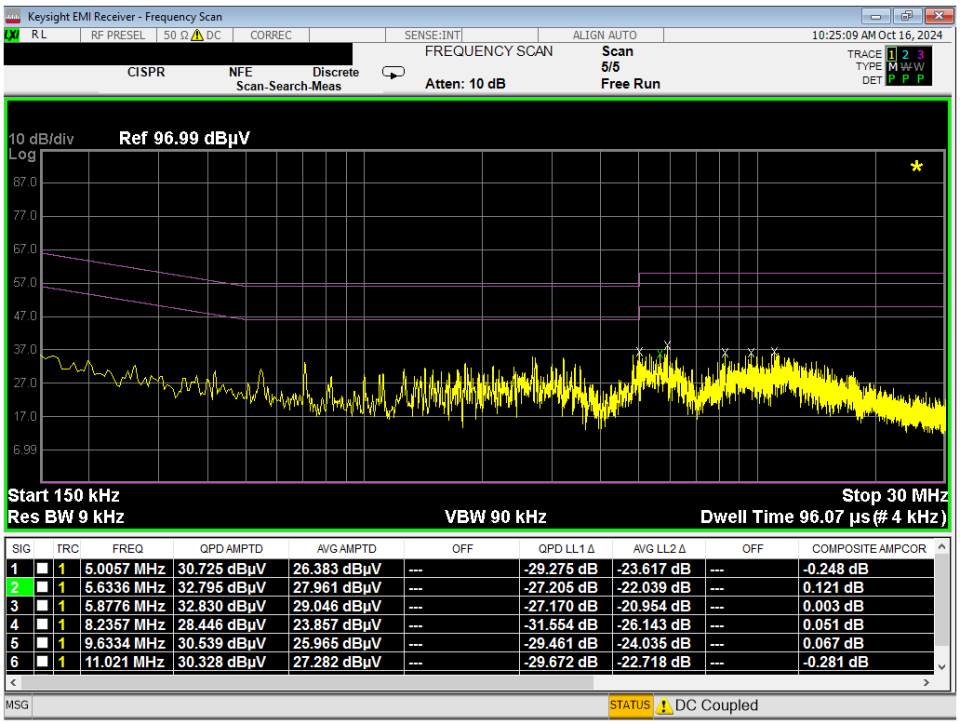
1. All modes of operation were investigated, and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz is specified in 15.207.
3. Corr. (dB) = Cable loss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



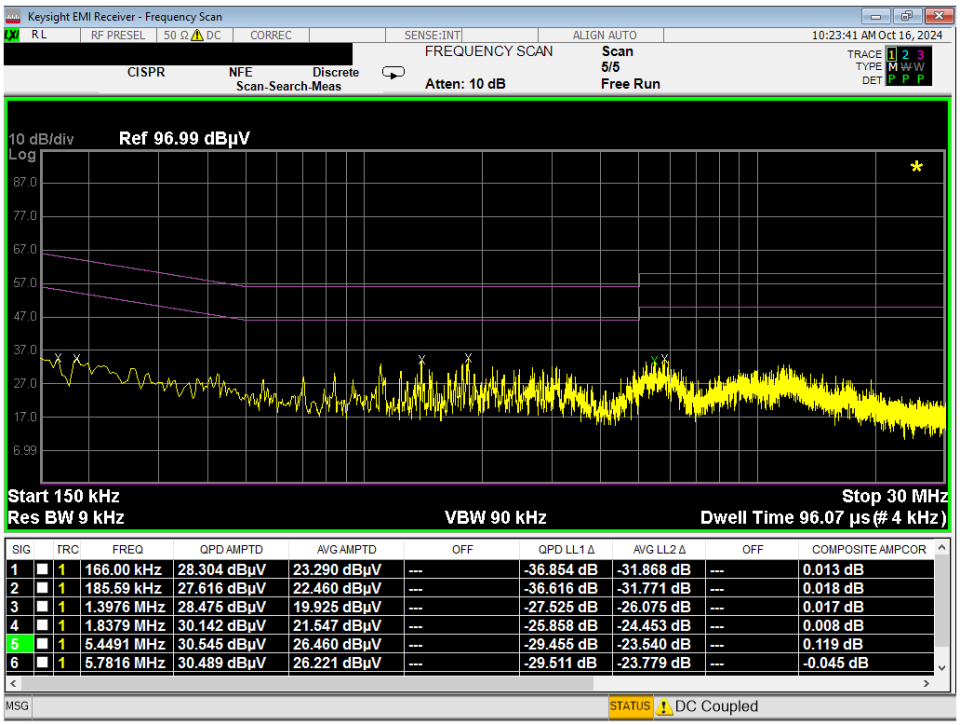

**Plot 7-103. Line Conducted Plot with 802.11a UNII Band 5 (L1)**



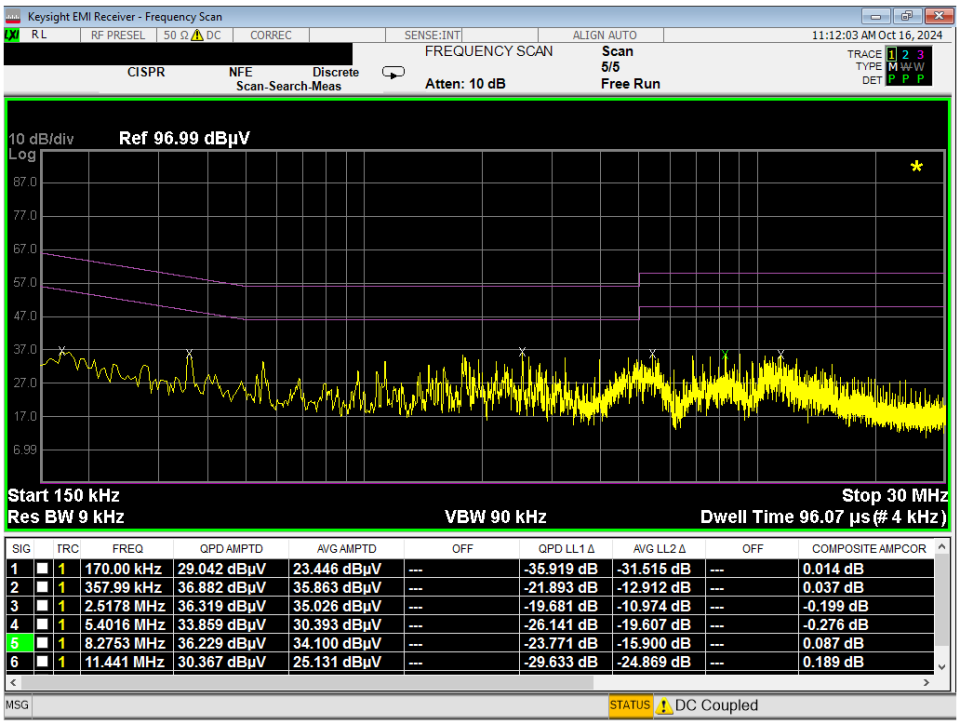

**Plot 7-104. Line Conducted Plot with 802.11a UNII Band 5 (N)**



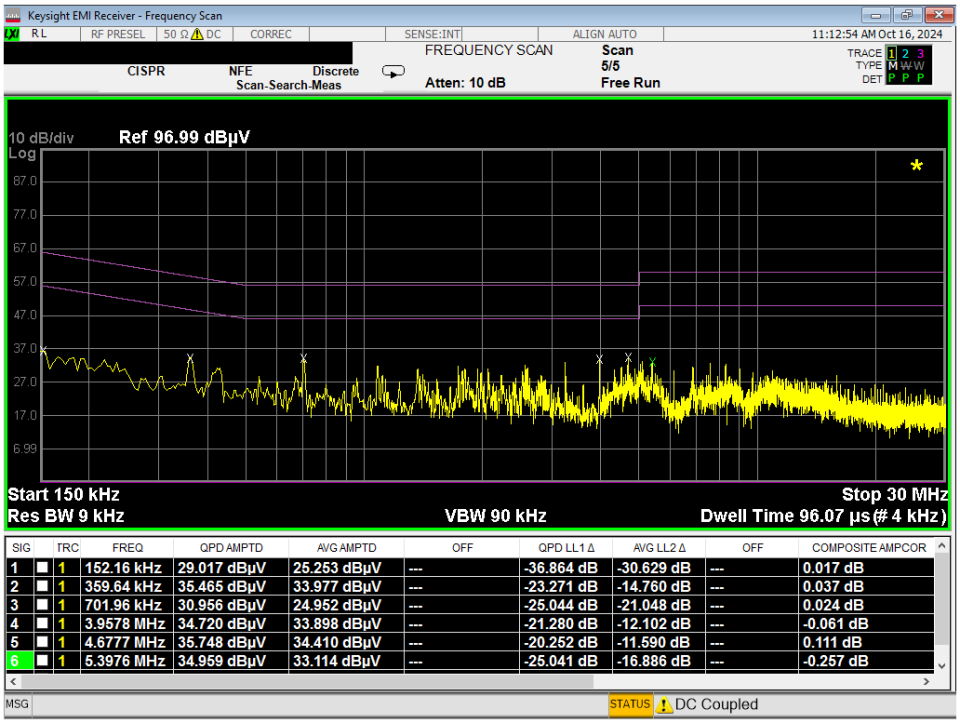

**Plot 7-105. Line Conducted Plot with 802.11a UNII Band 7 (L1)**



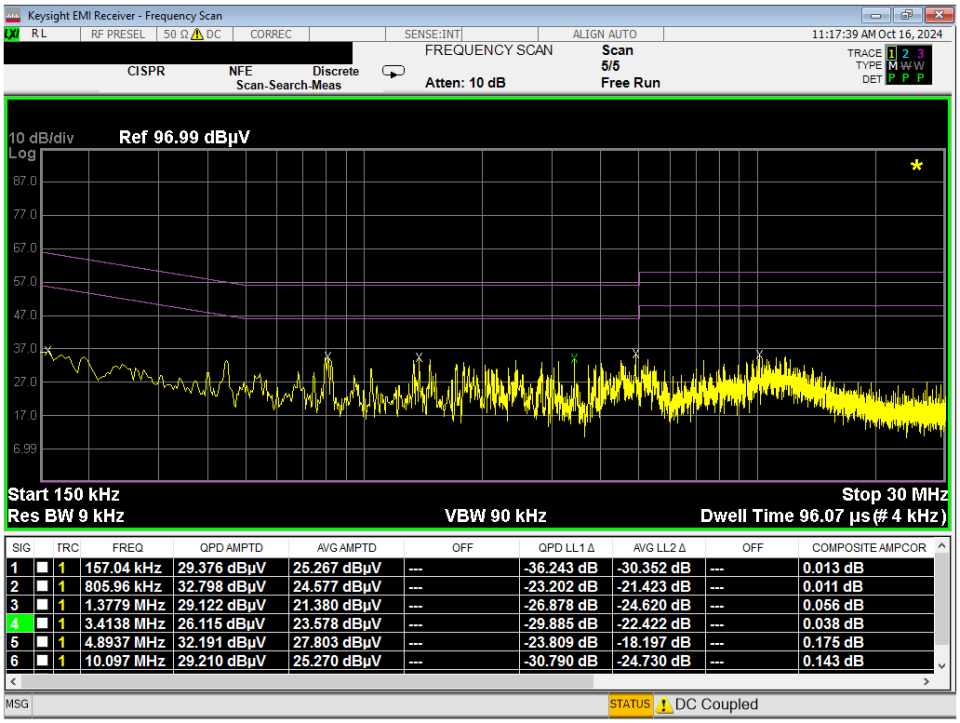

**Plot 7-106. Line Conducted Plot with 802.11a UNII Band 7 (N)**



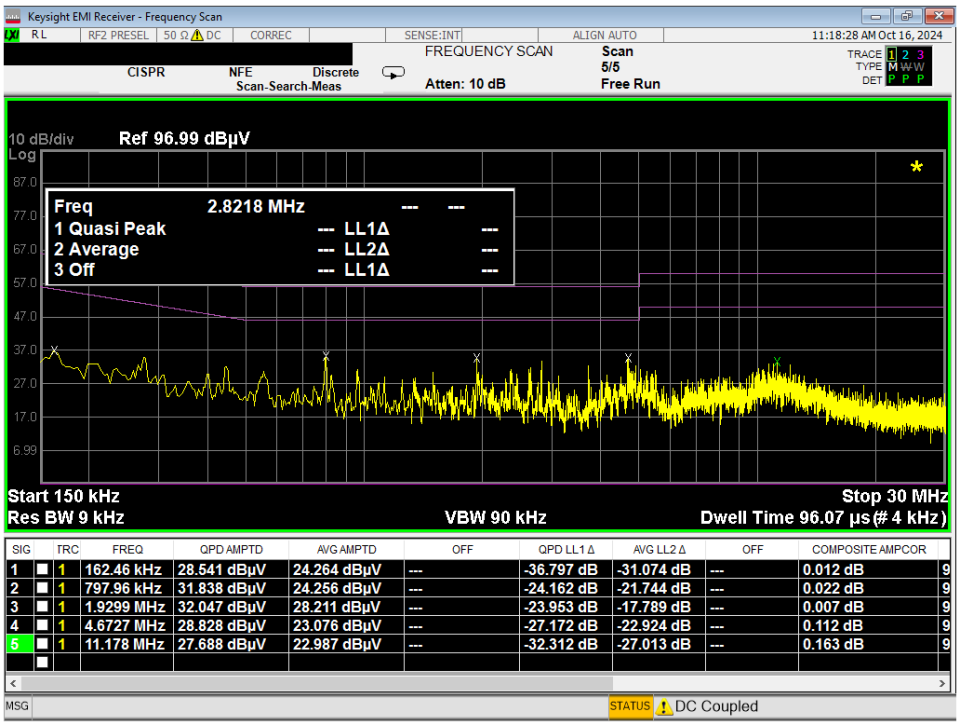

**Plot 7-107. Line Conducted Plot with 802.11a UNII Band 5 (L1) with WCP**




**Plot 7-108. Line Conducted Plot with 802.11a UNII Band 5 (N) with WCP**




**Plot 7-109. Line Conducted Plot with 802.11a UNII Band 7 (L1) with WCP**




**Plot 7-110. Line Conducted Plot with 802.11a UNII Band 7 (N) with WCP**

# 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 FCC Part Subpart E (15.407) of the FCC rules for operation as a Very Low Power Device.