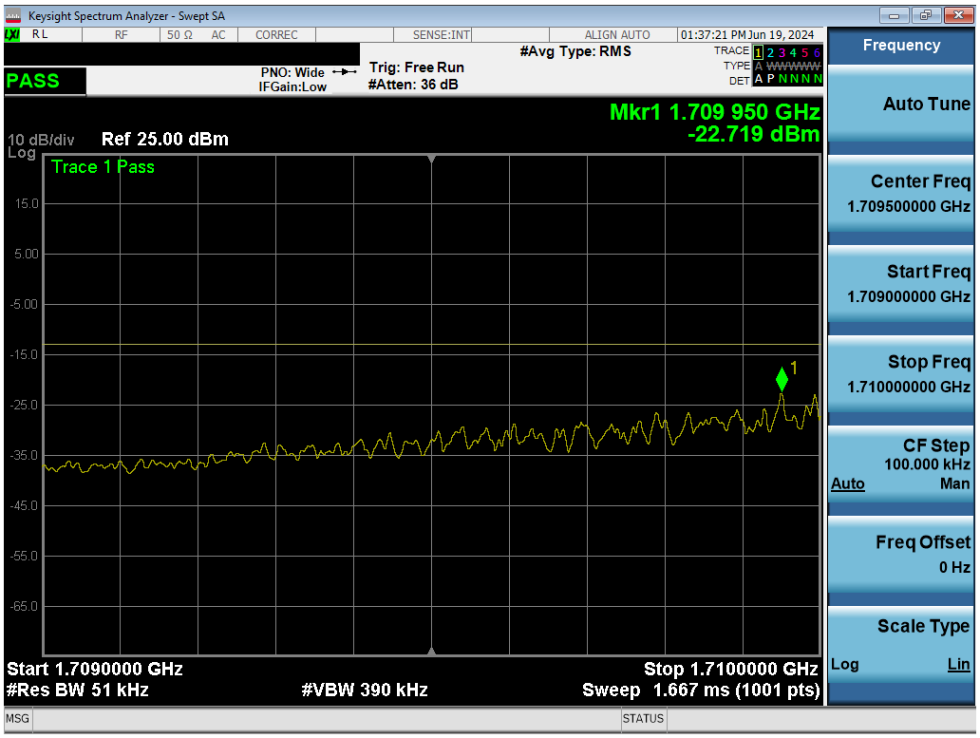
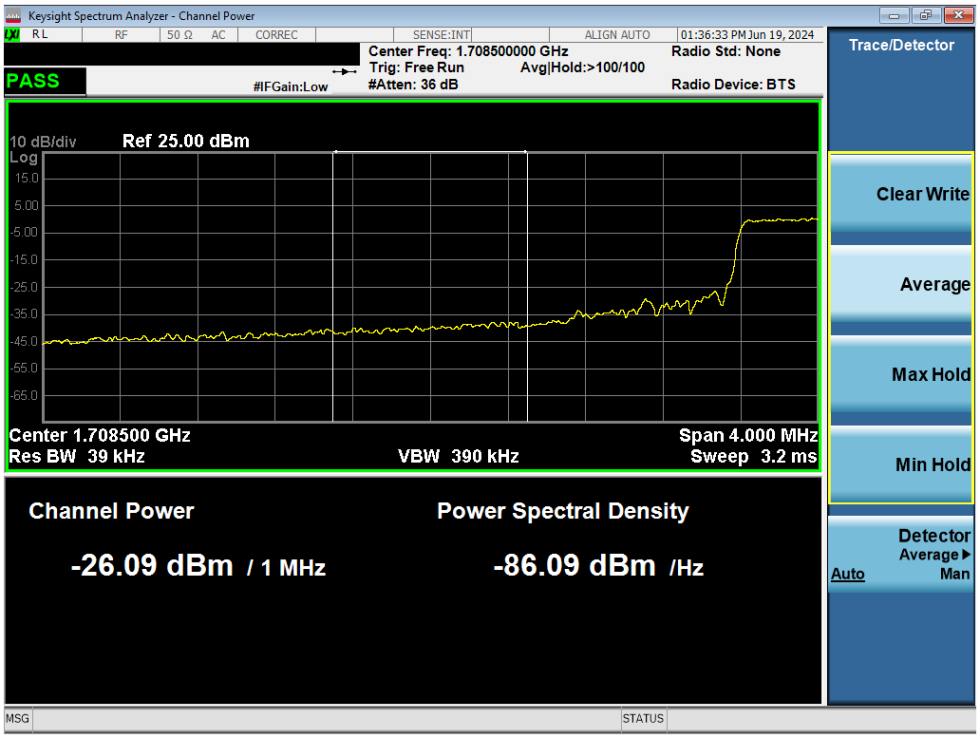
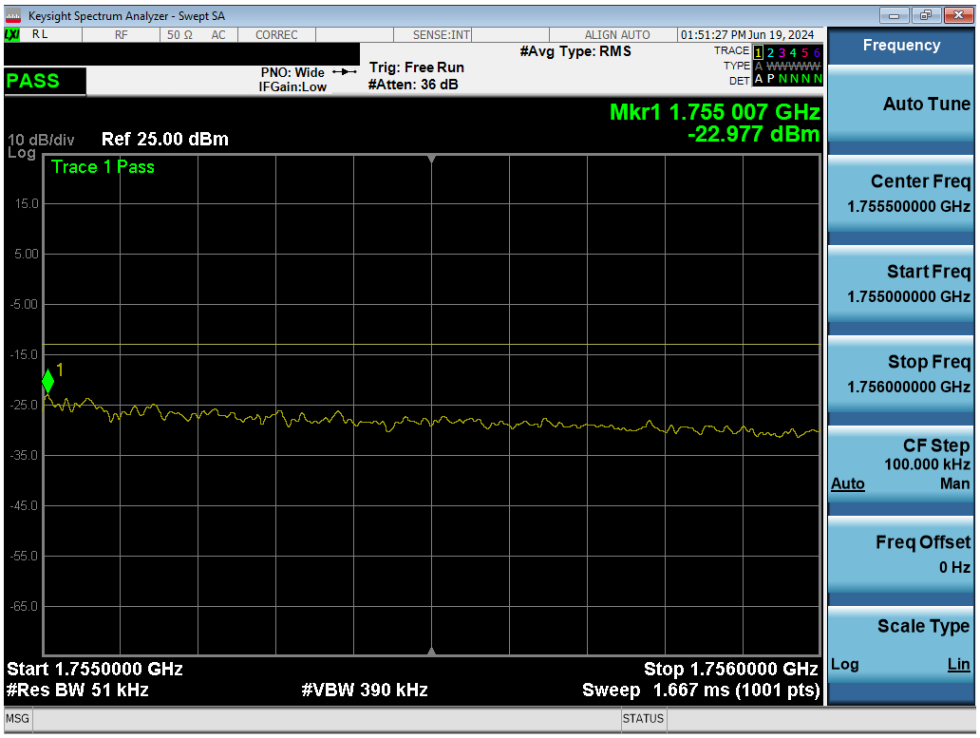


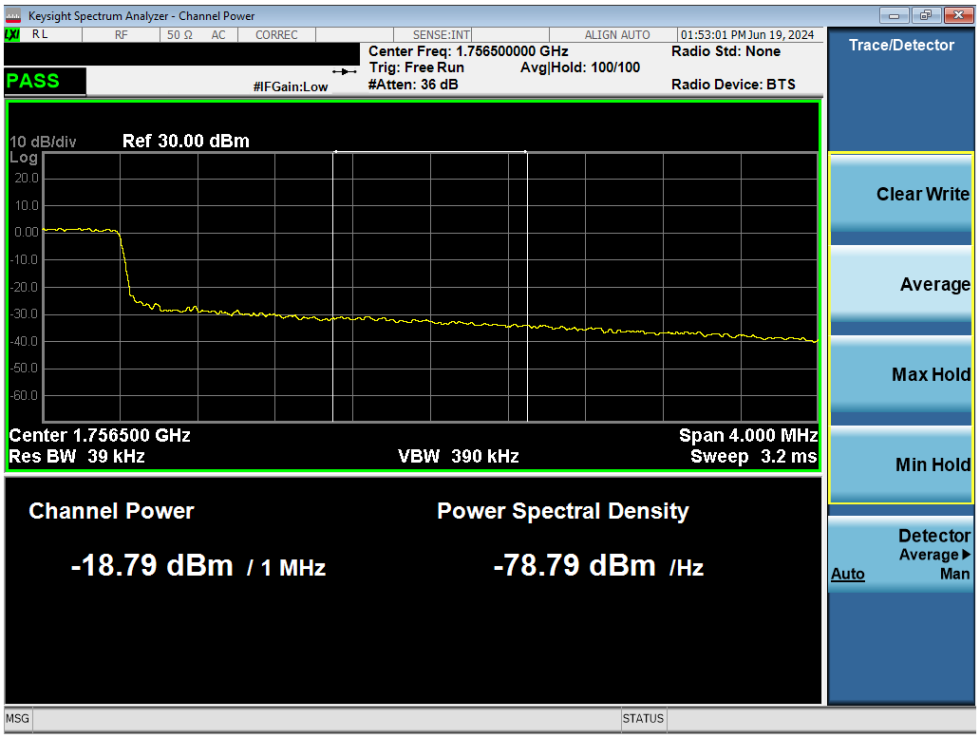
Plot 7-97. Out of Band Emissions – Band 4 UL Lower OOBE @ 10dB above AGC



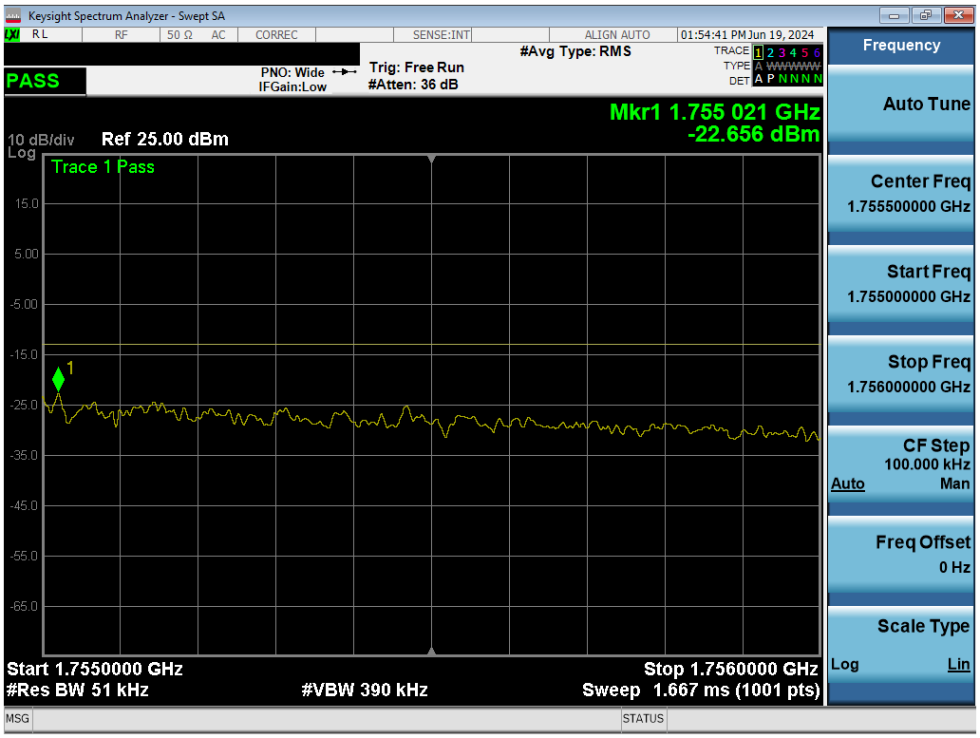
Plot 7-98. Out of Band Emissions – Band 4 UL Lower Extended OOBE @ 10dB above AGC



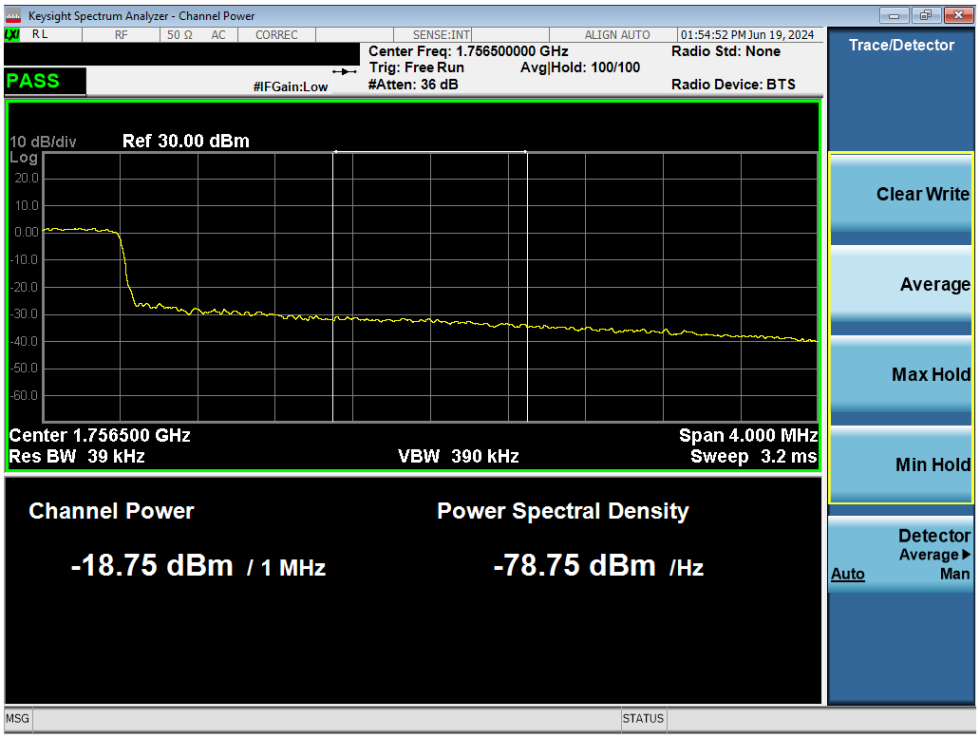
Plot 7-99. Out of Band Emissions – Band 4 UL Upper OOBE @ AGC



Plot 7-100. Out of Band Emissions – Band 4 UL Upper Extended OOBE @ AGC

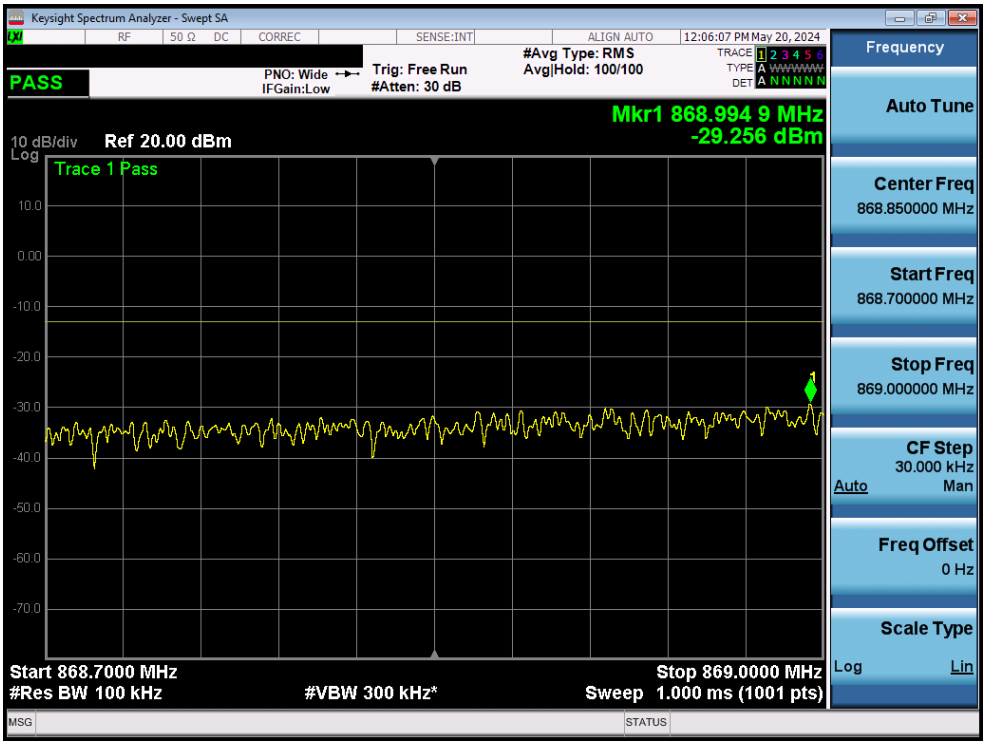


Plot 7-101. Out of Band Emissions – Band 4 UL Upper OOBE @ 10dB above AGC

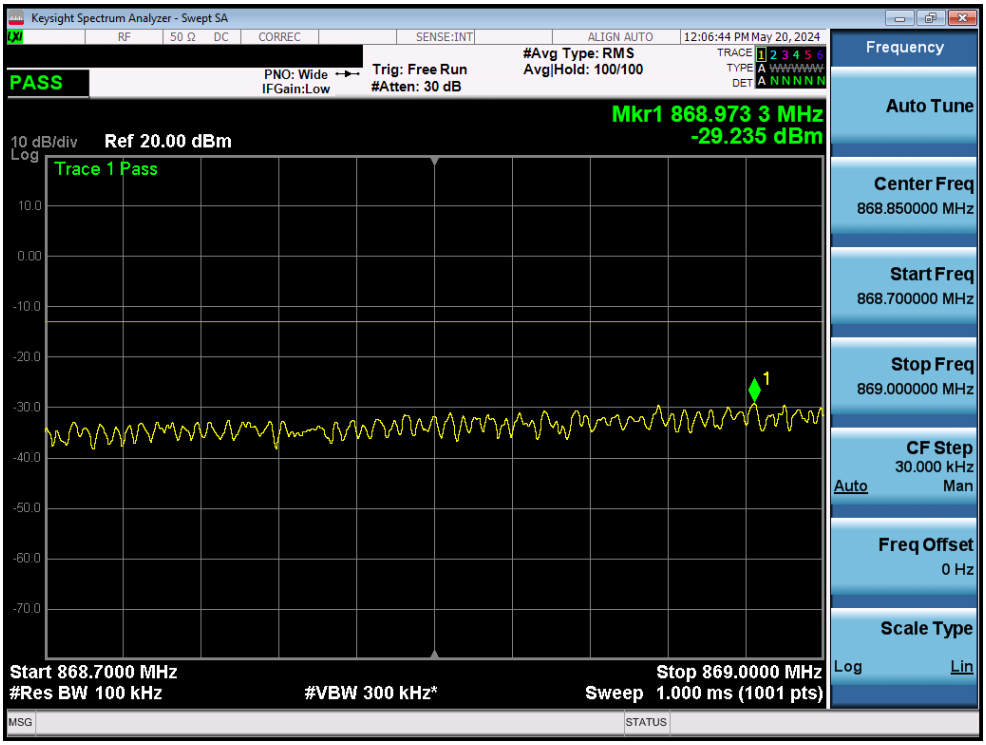


Plot 7-102. Out of Band Emissions – Band 4 UL Upper Extended OOBE @ 10dB above AGC

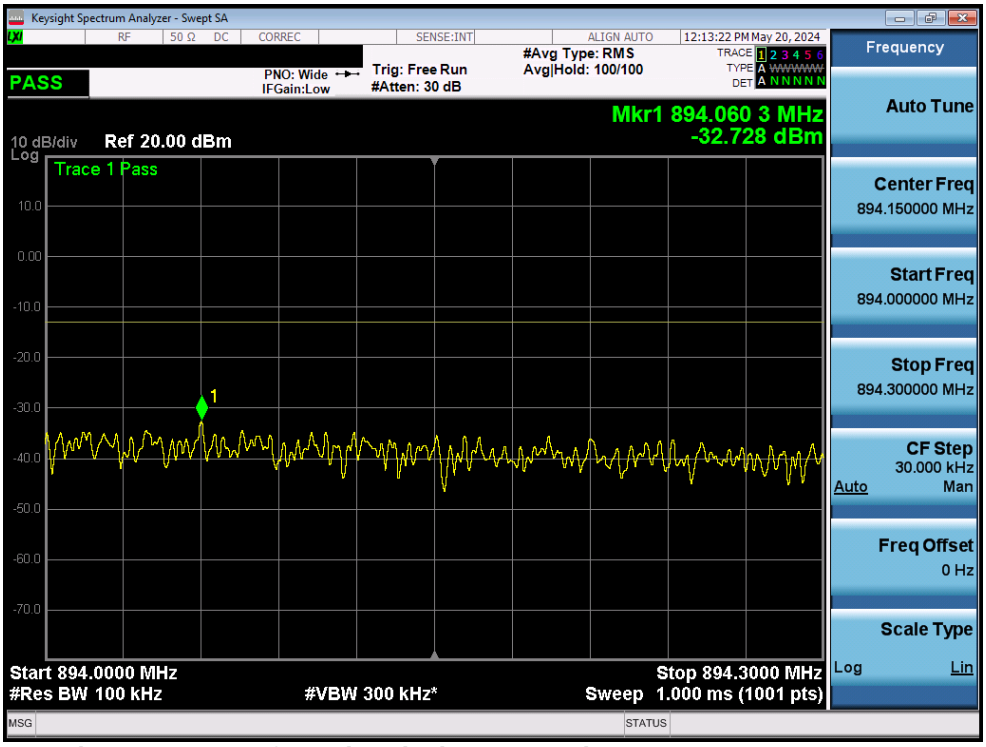
LTE Band 5



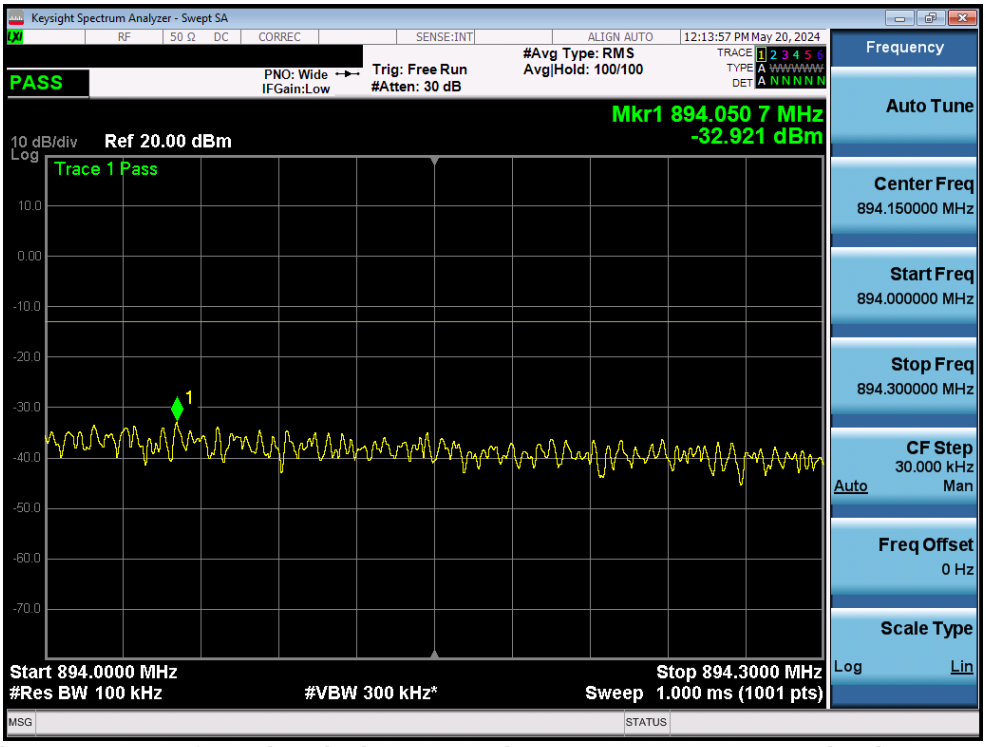
Plot 7-103. Out of Band Emissions – Band 5 DL Lower OOBE @ AGC



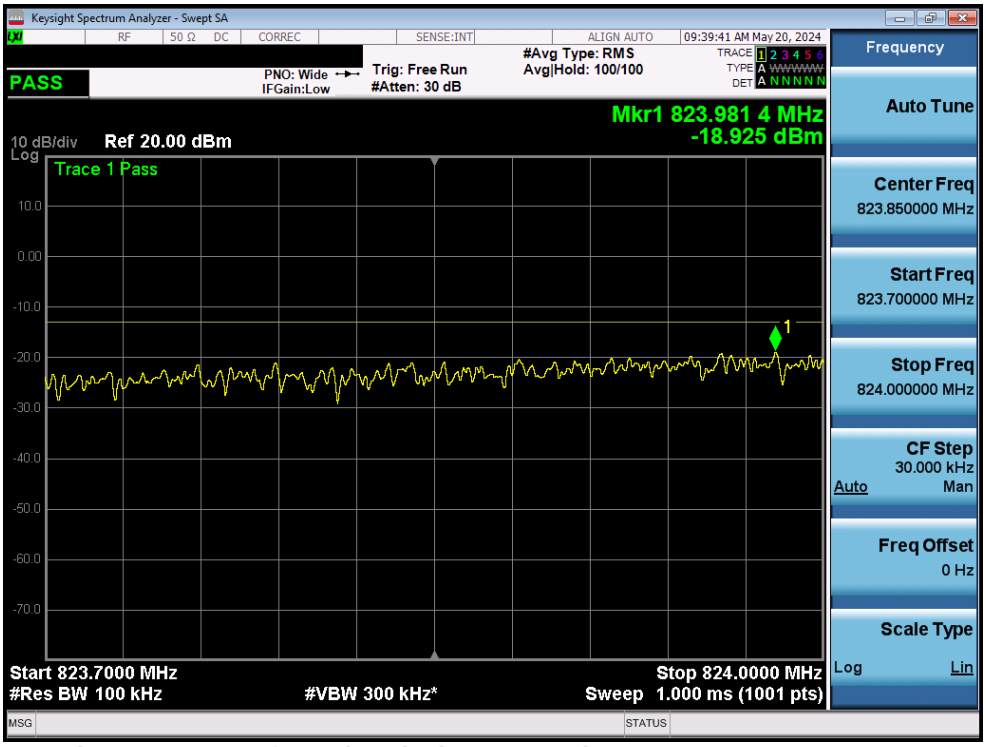
Plot 7-104. Out of Band Emissions – Band 5 DL Lower OOBE @ 10dB above AGC



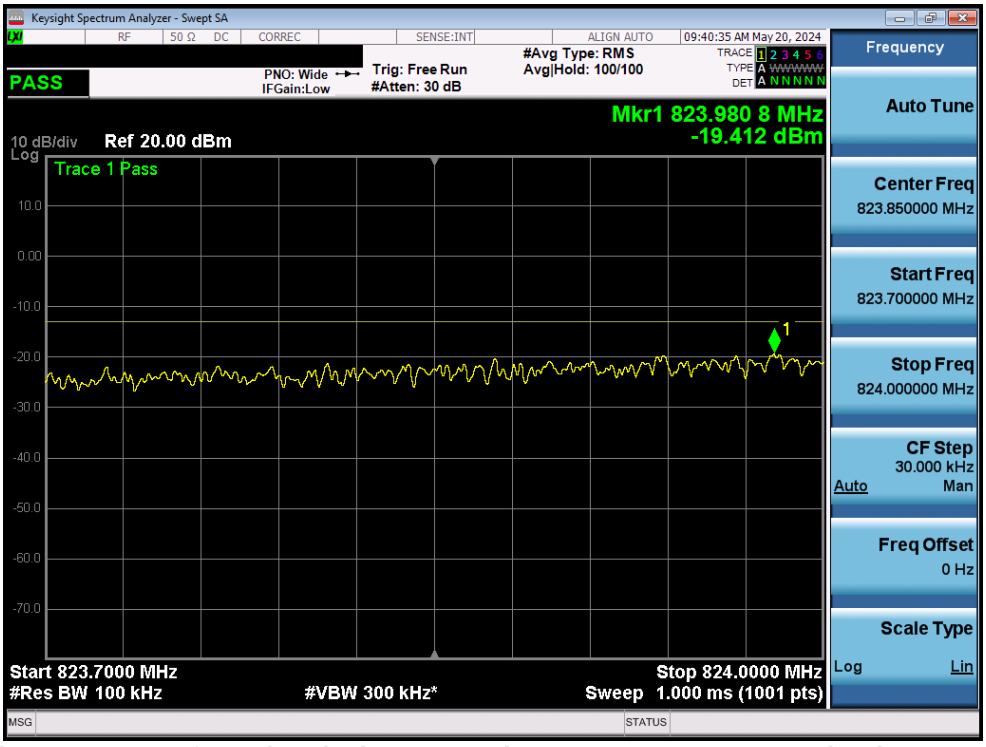
Plot 7-105. Out of Band Emissions – Band 5 DL Upper OOBE @ AGC



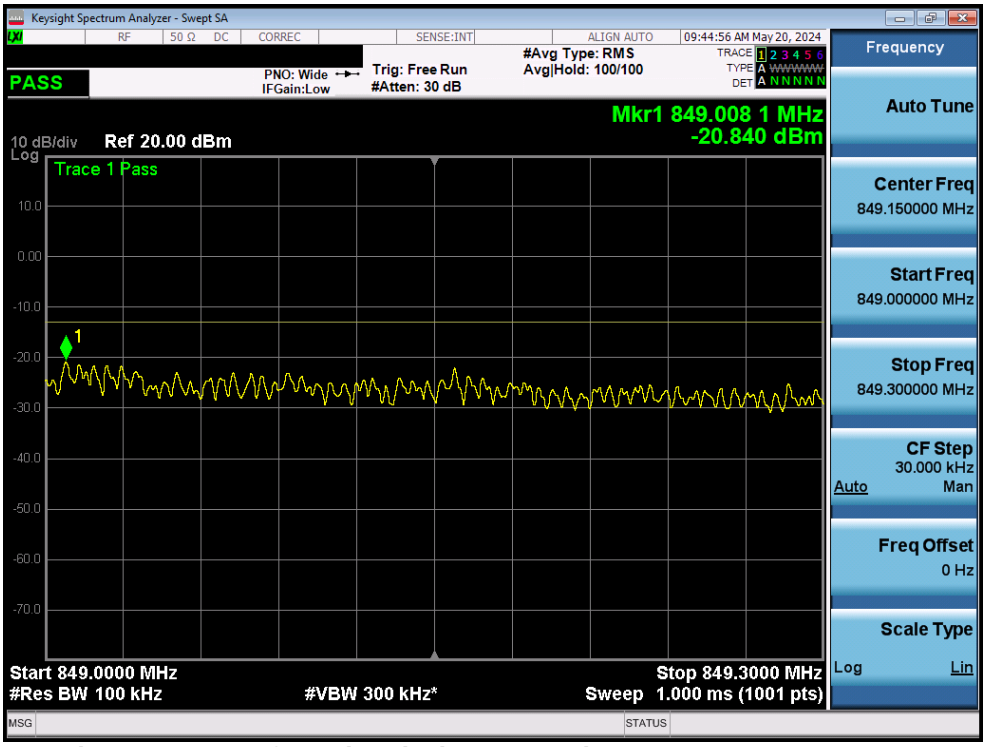
Plot 7-106. Out of Band Emissions – Band 5 DL Upper OOBE @ 10dB above AGC



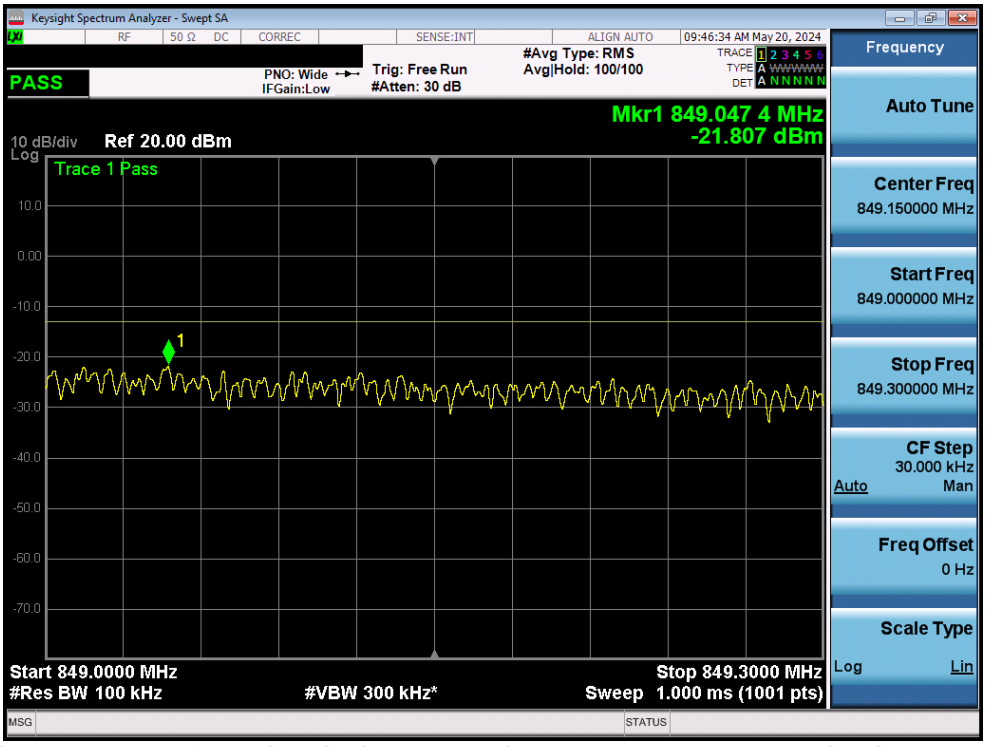
Plot 7-107. Out of Band Emissions – Band 5 UL Lower OOBE @ AGC



Plot 7-108. Out of Band Emissions – Band 5 UL Lower OOBE @ 10dB above AGC

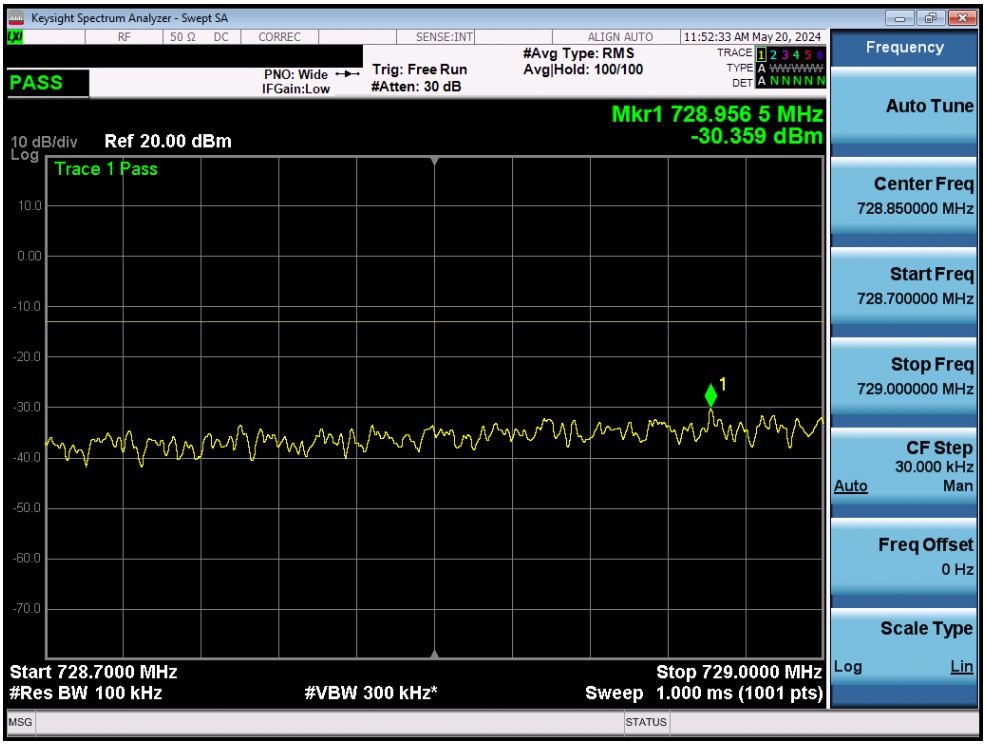


Plot 7-109. Out of Band Emissions – Band 5 UL Upper OOBE @ AGC

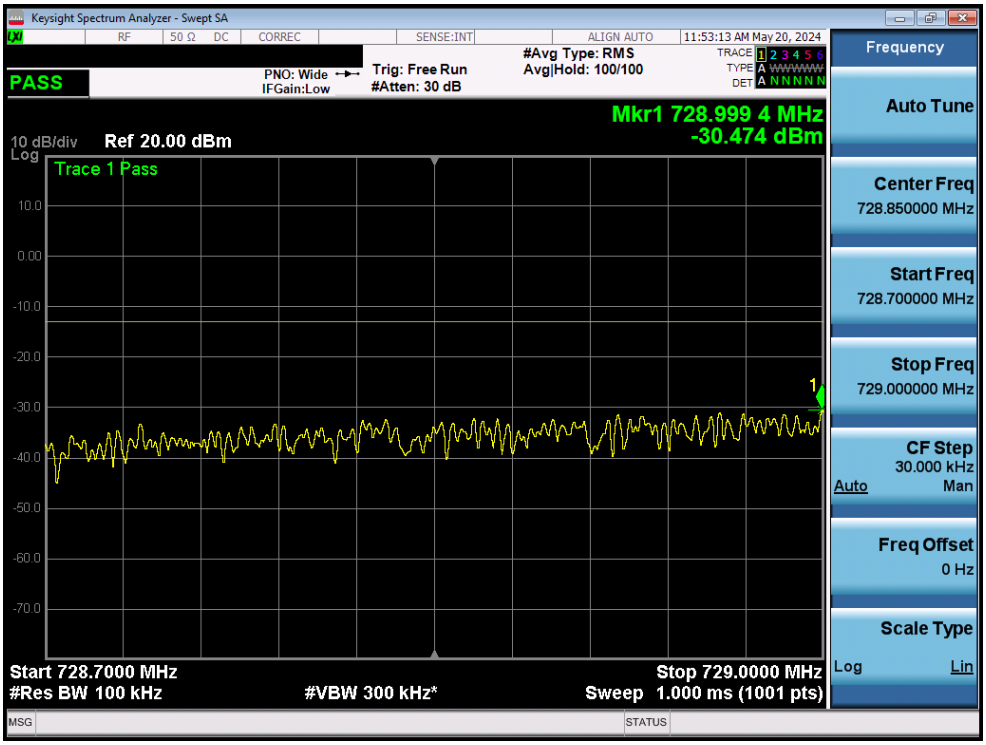


Plot 7-110. Out of Band Emissions – Band 5 UL Upper OOBE @ 10dB above AGC

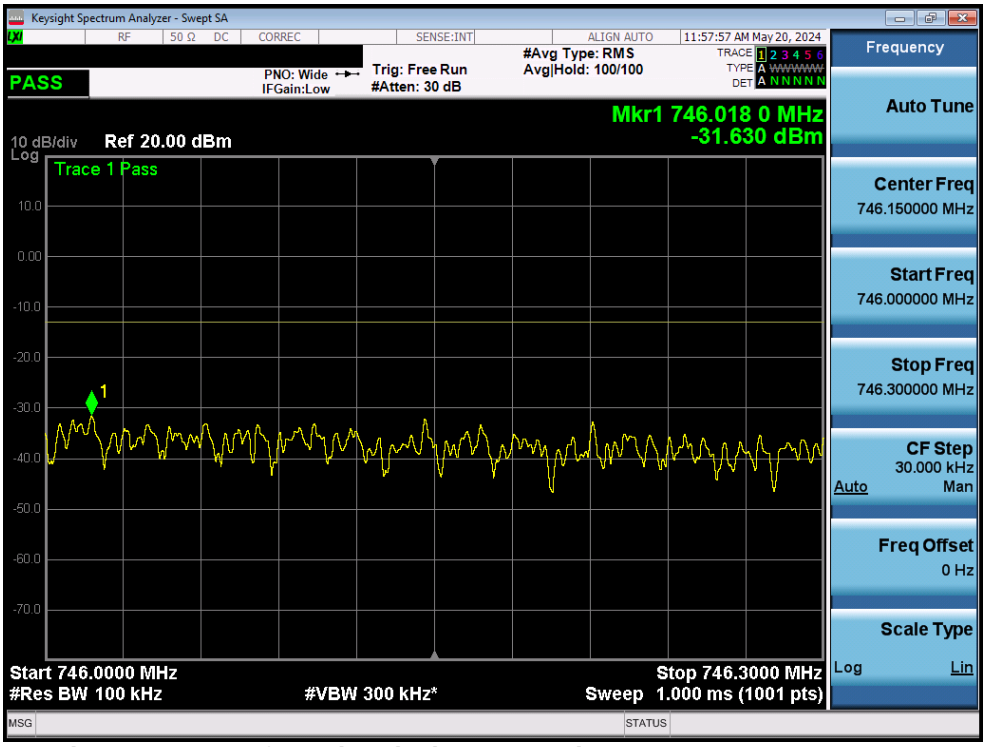
LTE Band 12



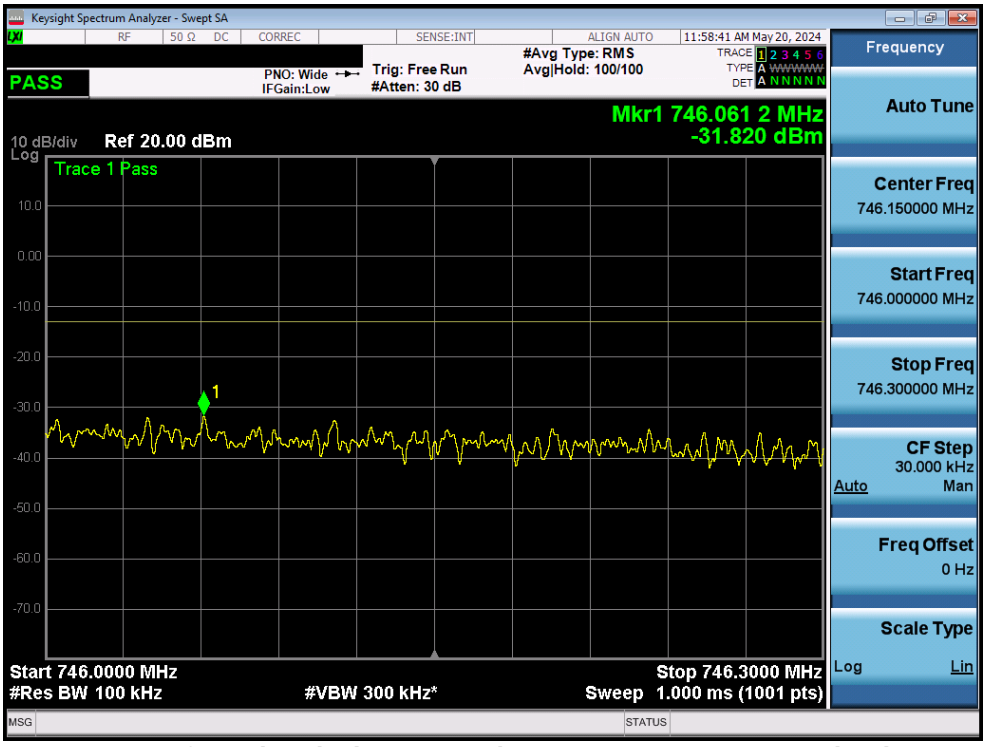
Plot 7-111. Out of Band Emissions – Band 12 DL Lower OOBE @ AGC



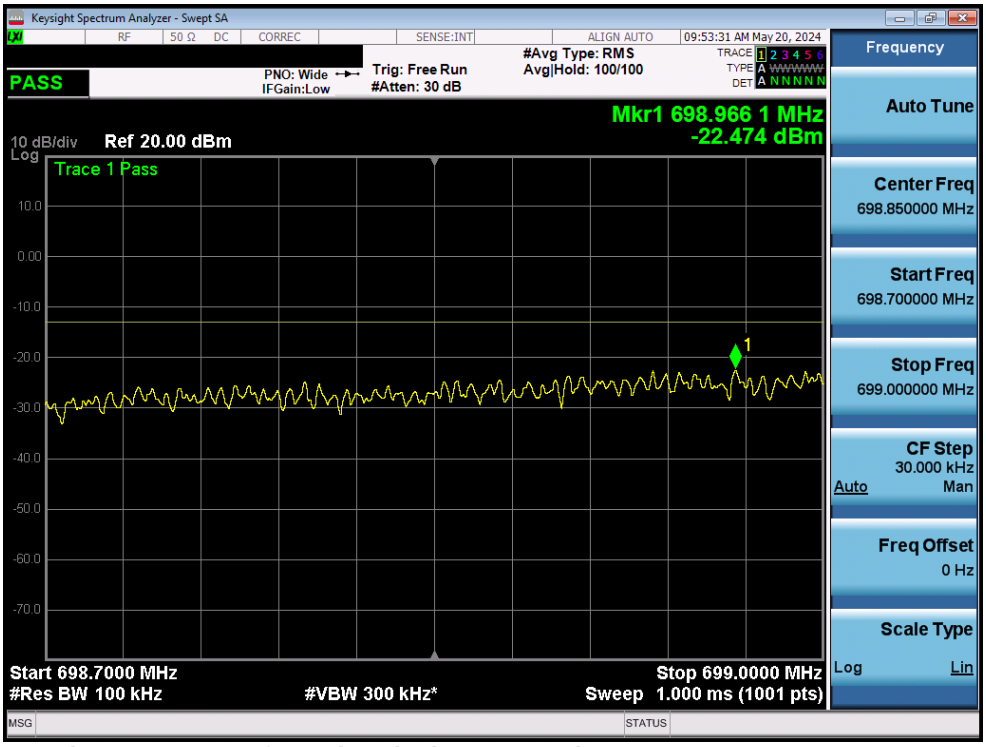
Plot 7-112. Out of Band Emissions – Band 12 DL Lower OOBE @ 10dB above AGC



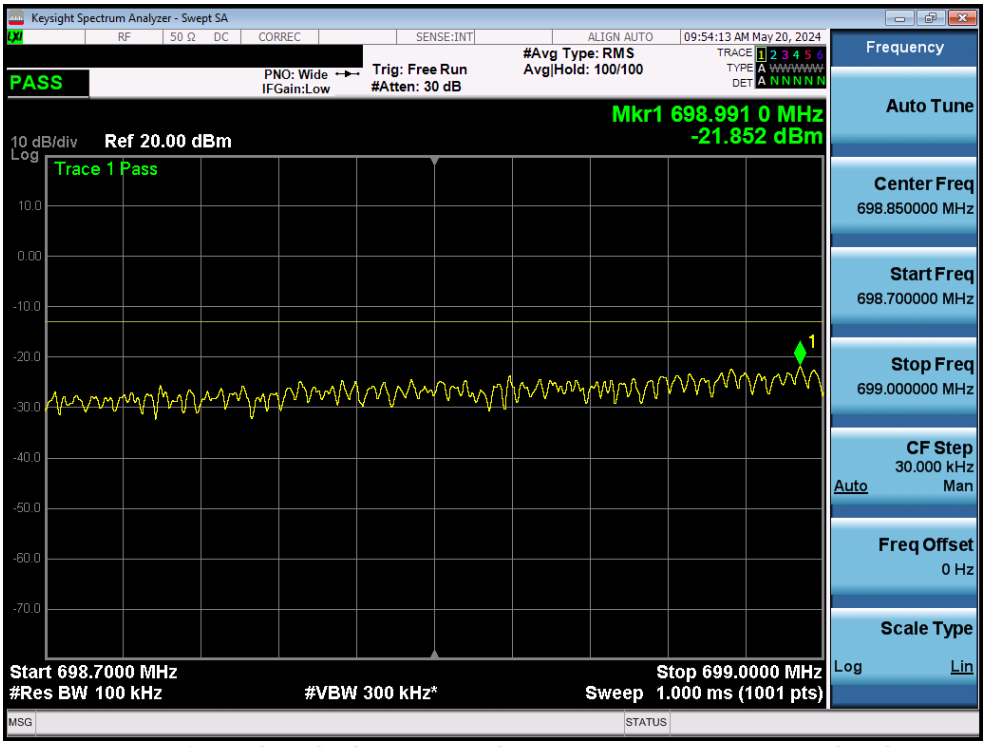
Plot 7-113. Out of Band Emissions – Band 12 DL Upper OOBE @ AGC



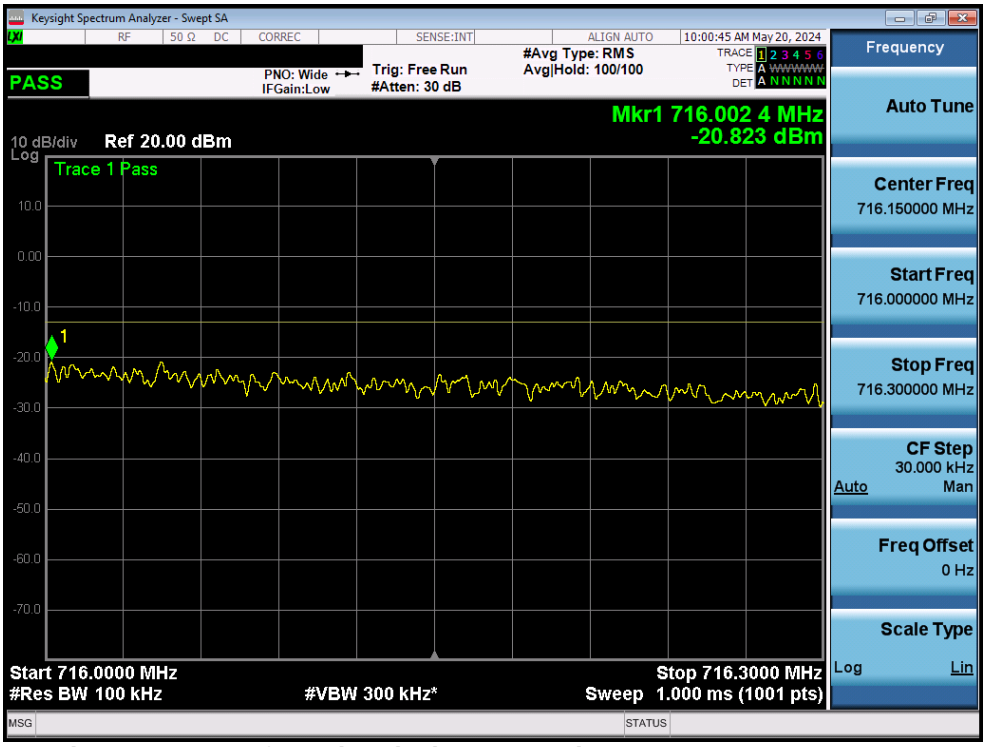
Plot 7-114. Out of Band Emissions – Band 12 DL Upper OOBE @ 10dB above AGC



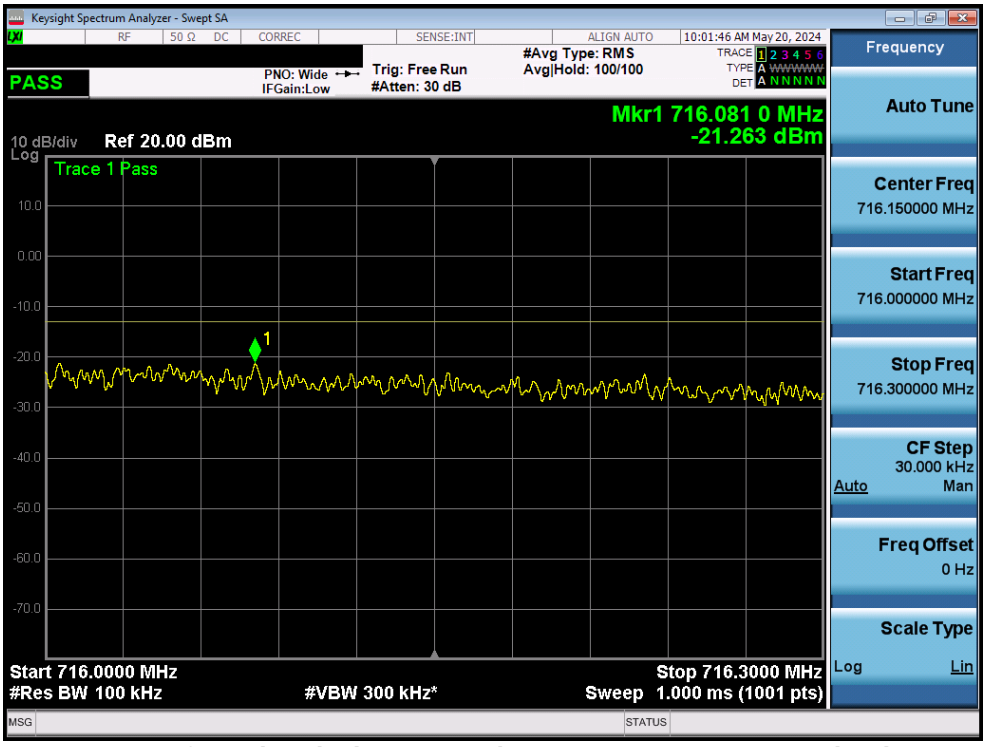
Plot 7-115. Out of Band Emissions – Band 12 UL Lower OOBE @ AGC



Plot 7-116. Out of Band Emissions – Band 12 UL Lower OOBE @ 10dB above AGC

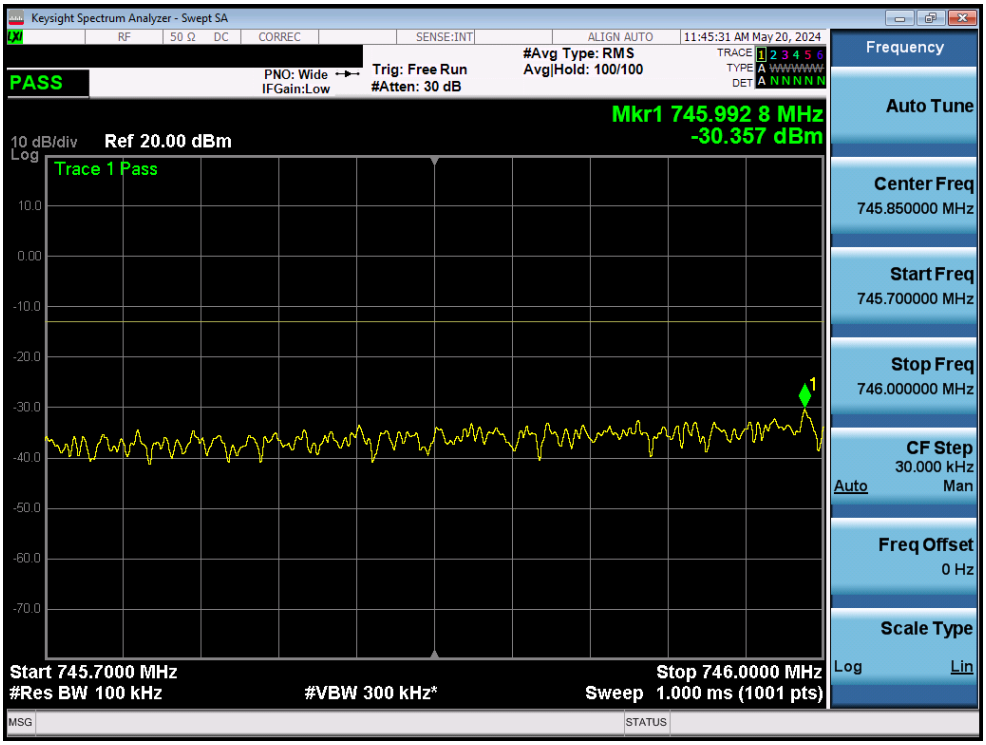


Plot 7-117. Out of Band Emissions – Band 12 UL Upper OOBE @ AGC

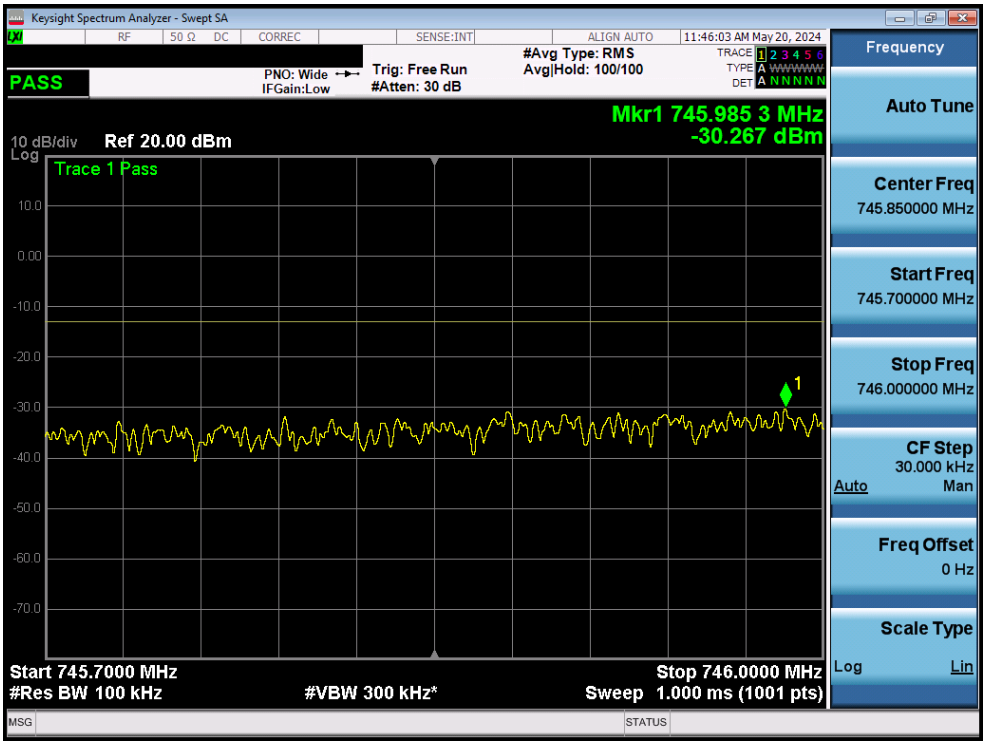


Plot 7-118. Out of Band Emissions – Band 12 UL Upper OOBE @ 10dB above AGC

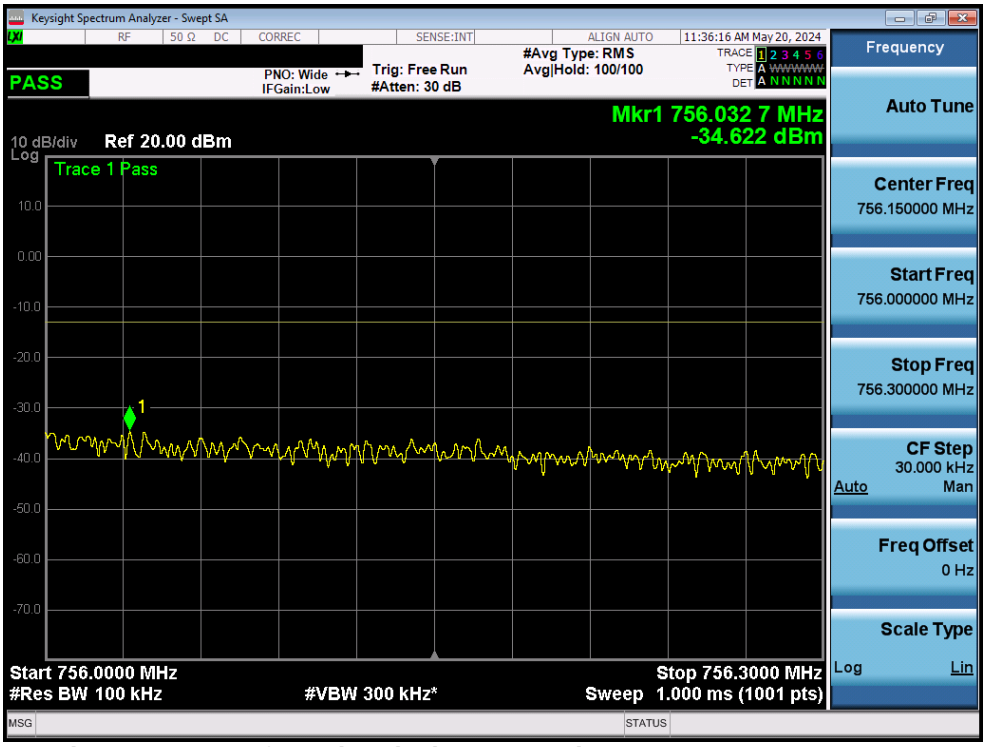
LTE Band 13



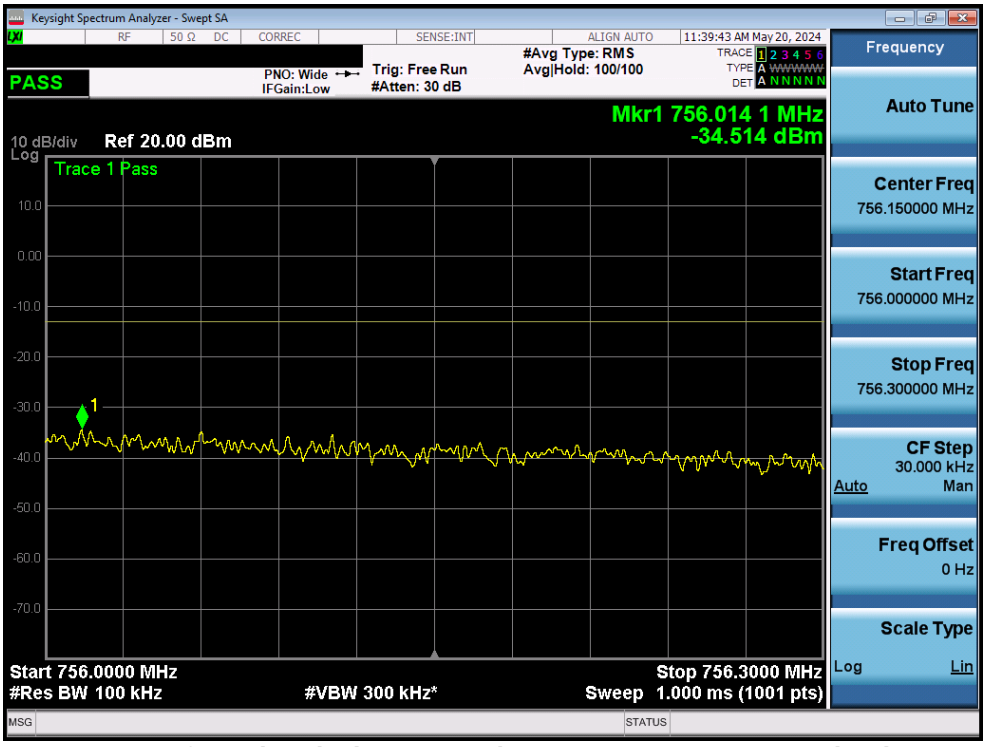
Plot 7-119. Out of Band Emissions – Band 13 DL Lower OOBE @ AGC



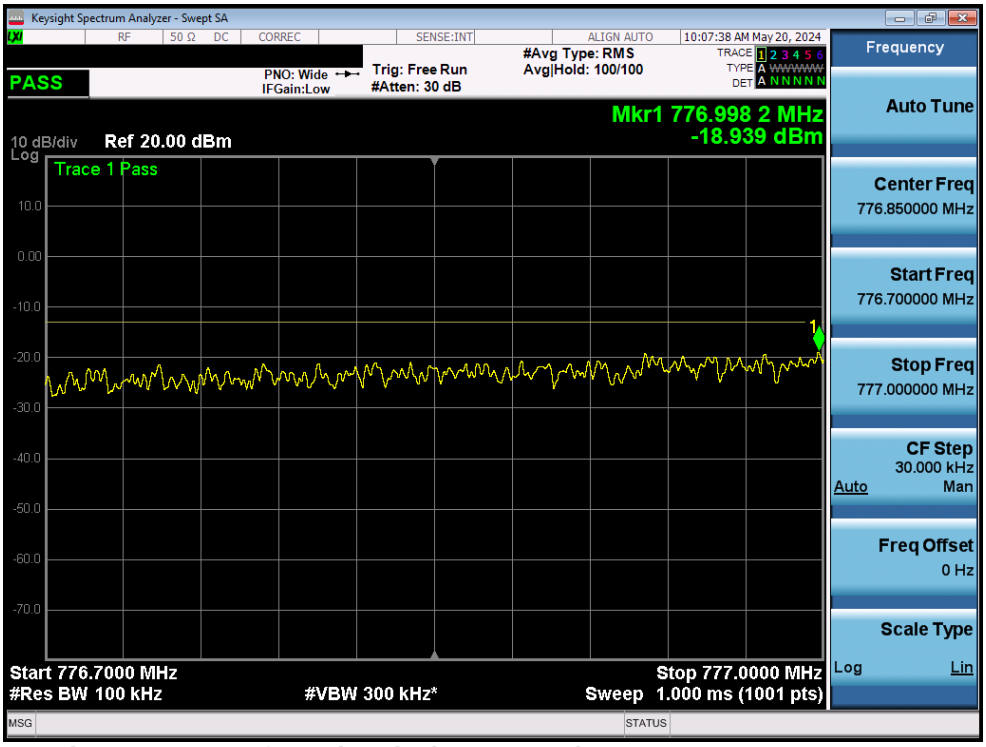
Plot 7-120. Out of Band Emissions – Band 13 DL Lower OOBE @ 10dB above AGC



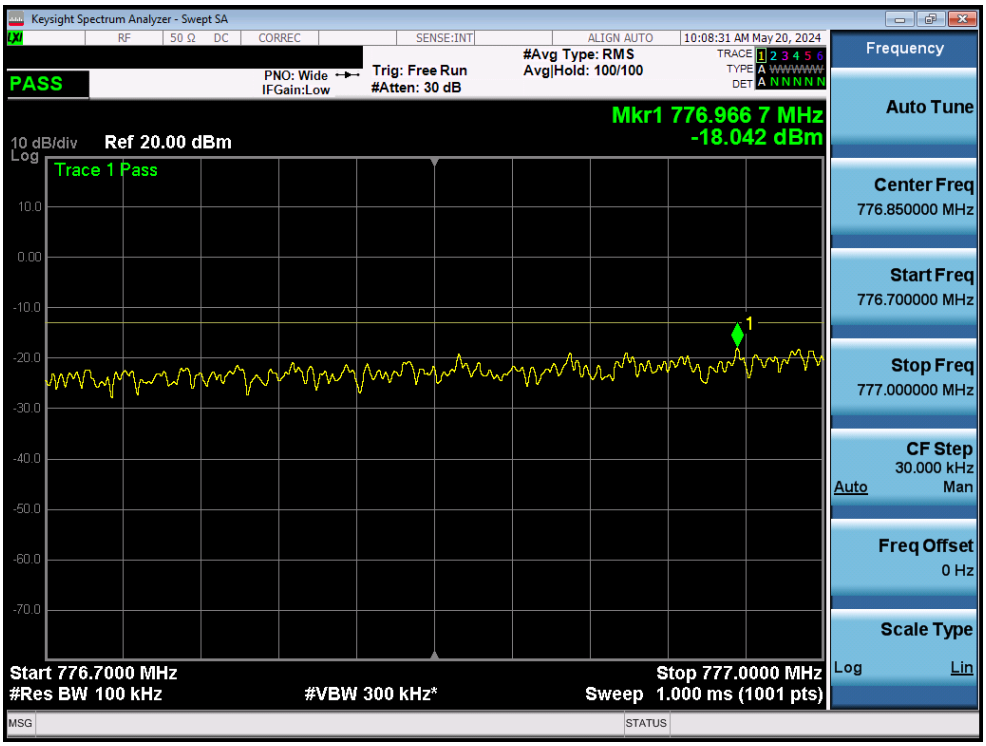
Plot 7-121. Out of Band Emissions – Band 13 DL Upper OOBE @ AGC



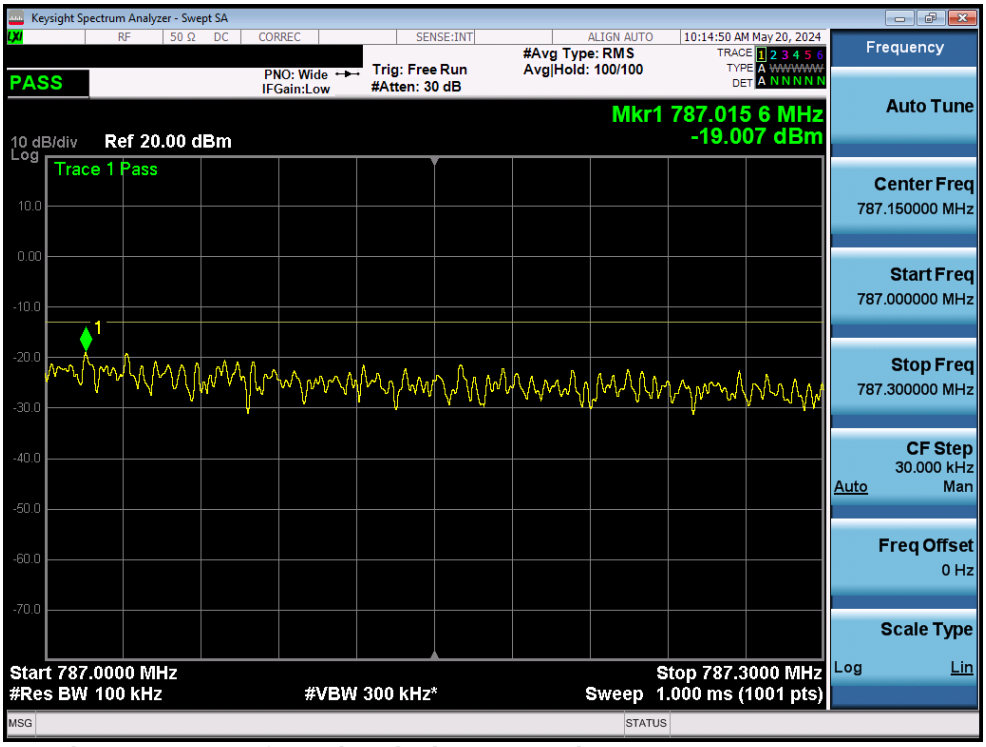
Plot 7-122. Out of Band Emissions – Band 13 DL Upper OOBE @ 10dB above AGC



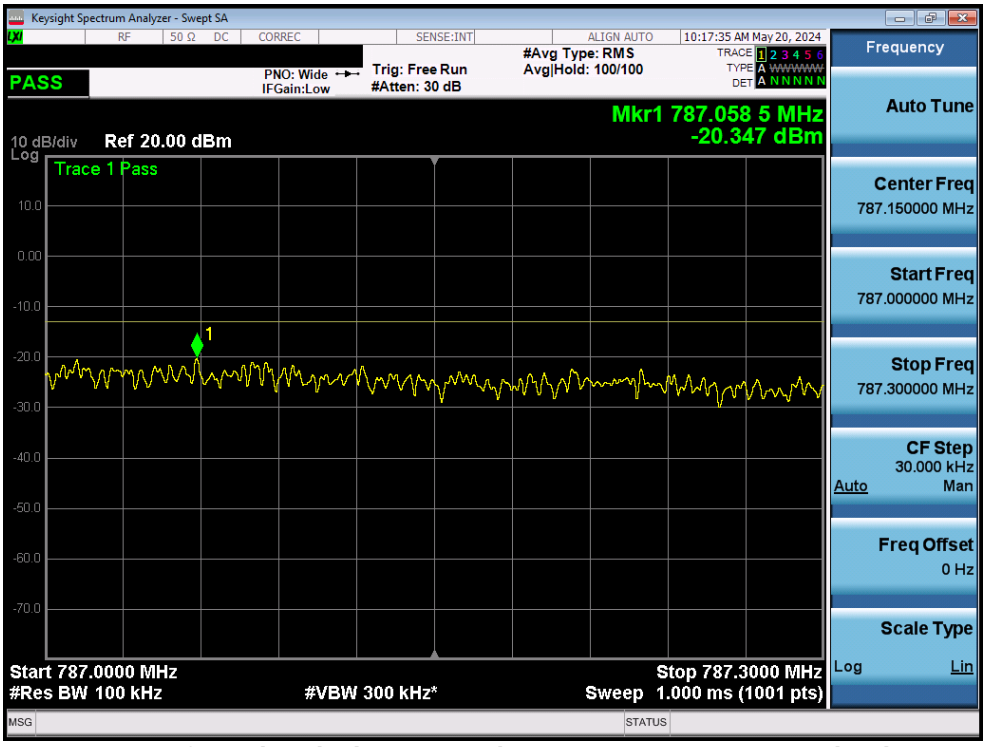
Plot 7-123. Out of Band Emissions – Band 13 UL Lower OOBE @ AGC



Plot 7-124. Out of Band Emissions – Band 13 UL Lower OOBE @ 10dB above AGC



Plot 7-125. Out of Band Emissions – Band 13 UL Upper OOBE @ AGC

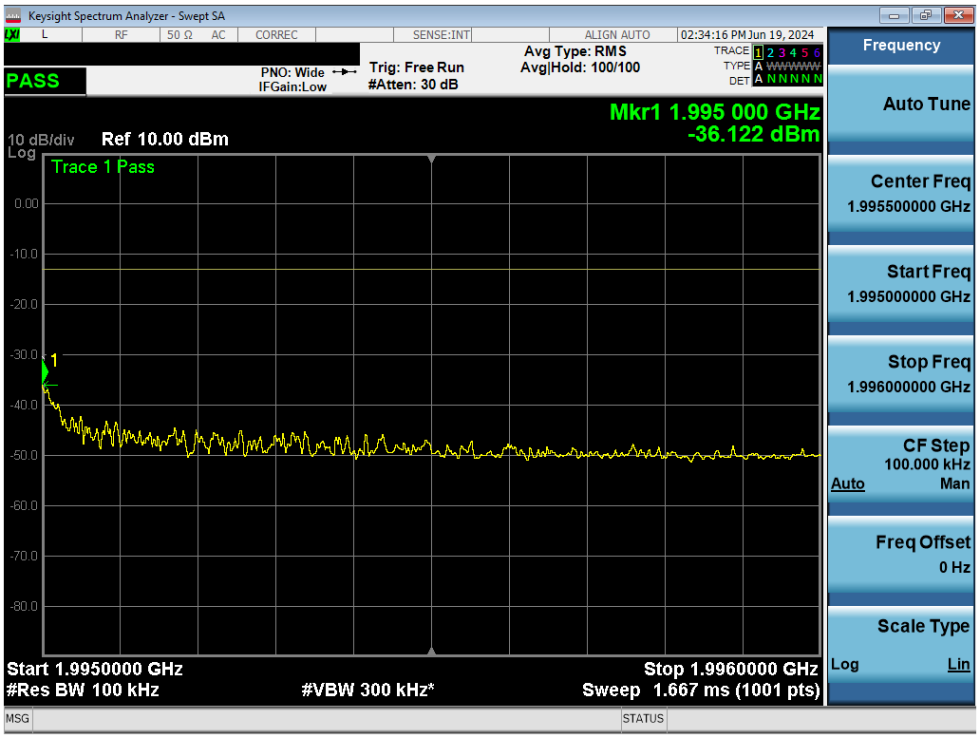


Plot 7-126. Out of Band Emissions – Band 13 UL Upper OOBE @ 10dB above AGC

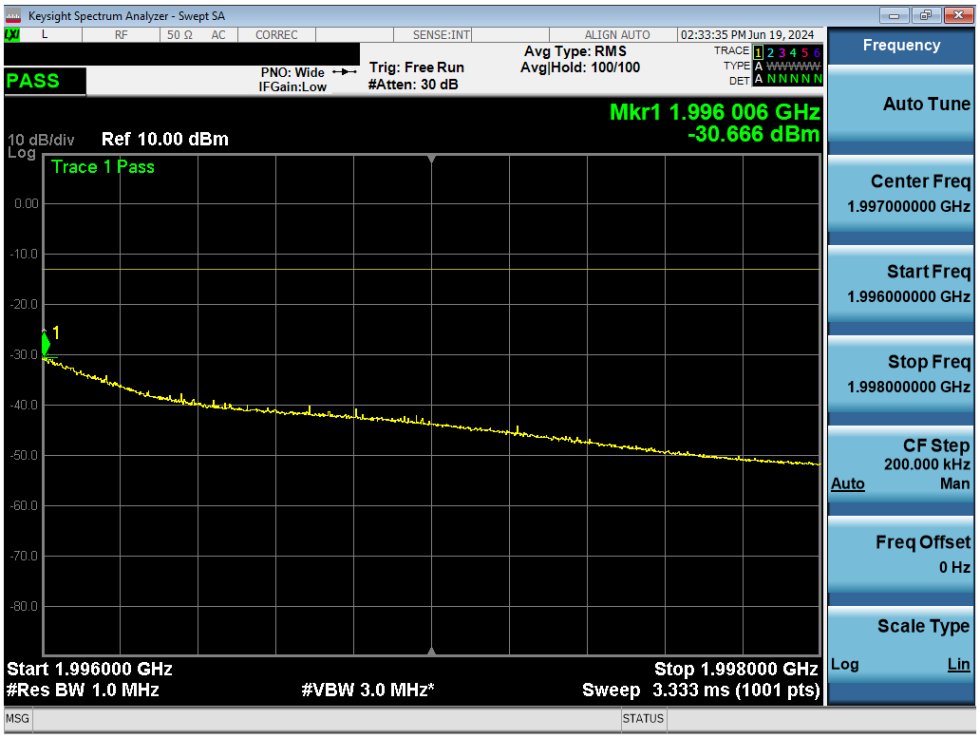
LTE Band 25/2

Plot 7-127. Out of Band Emissions – Band 25/2 DL Lower OOBE @ AGC

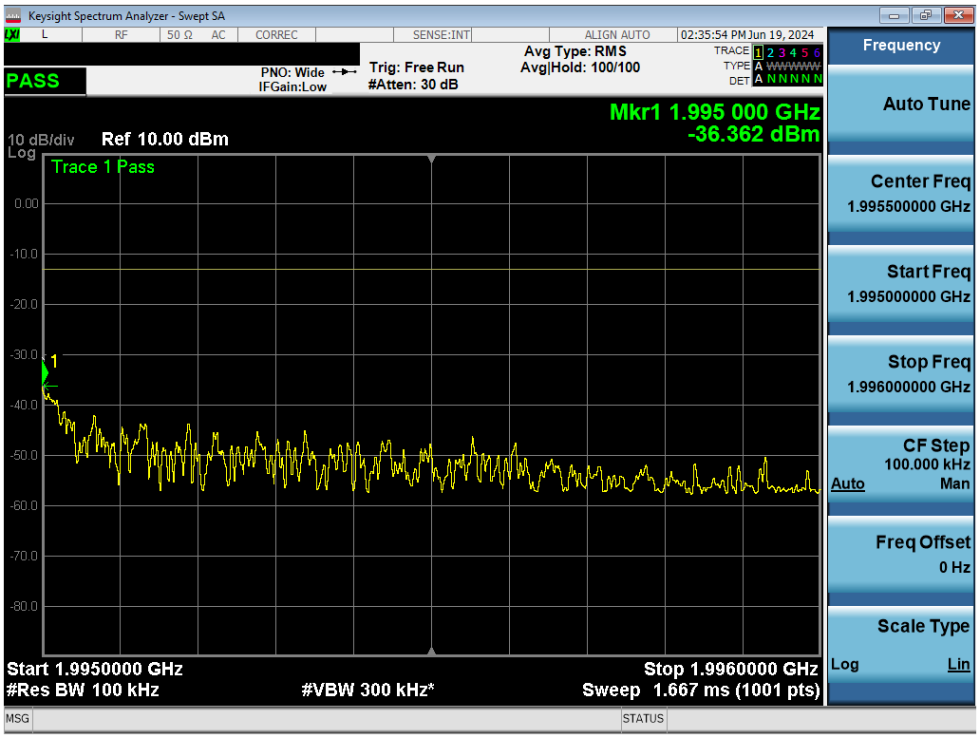
Plot 7-128. Out of Band Emissions – Band 25/2 DL Lower OOBE @ 10dB above AGC



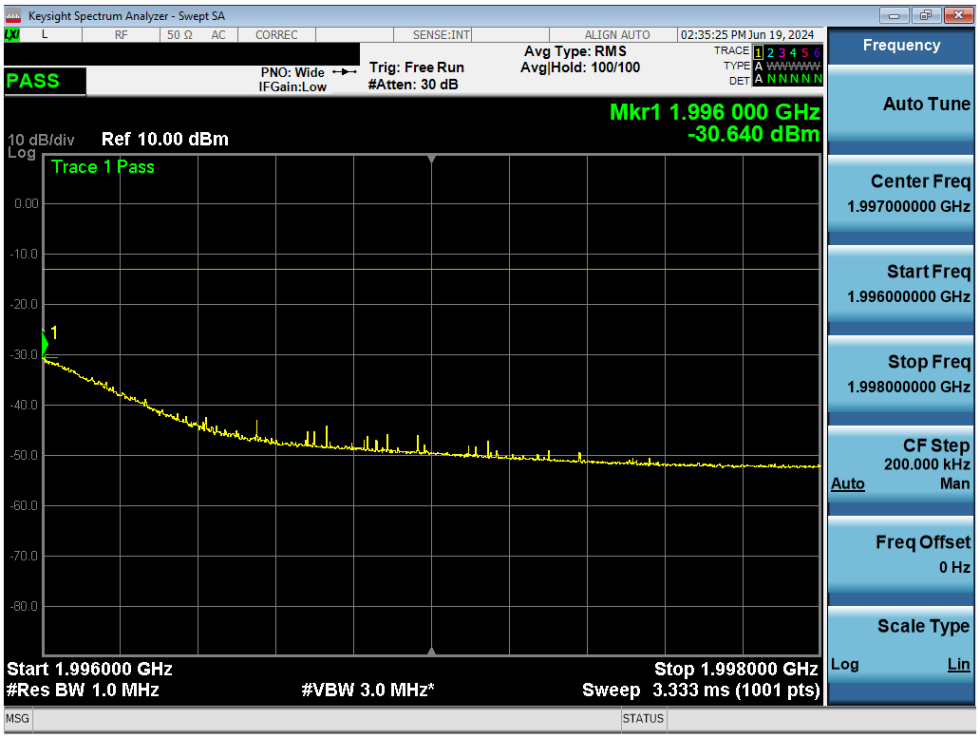
Plot 7-129. Out of Band Emissions – Band 25 DL Upper OOBE @ AGC



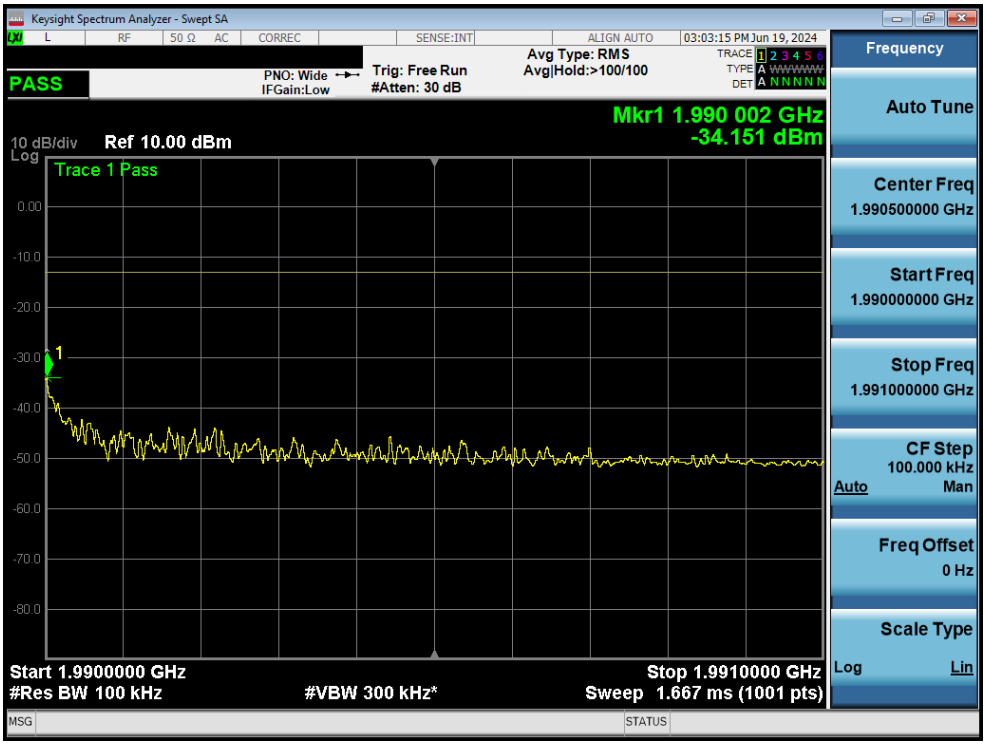
Plot 7-130. Out of Band Emissions – Band 25 DL Upper Extended OOBE @ AGC



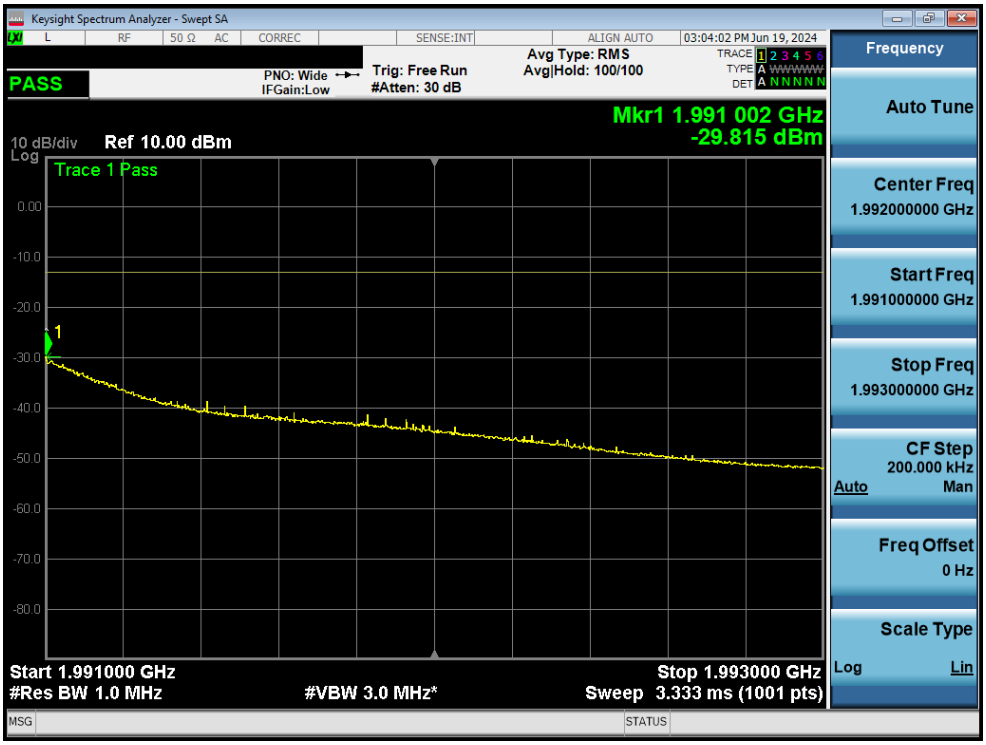
Plot 7-131. Out of Band Emissions – Band 25 DL Upper OOBE @ 10dB above AGC



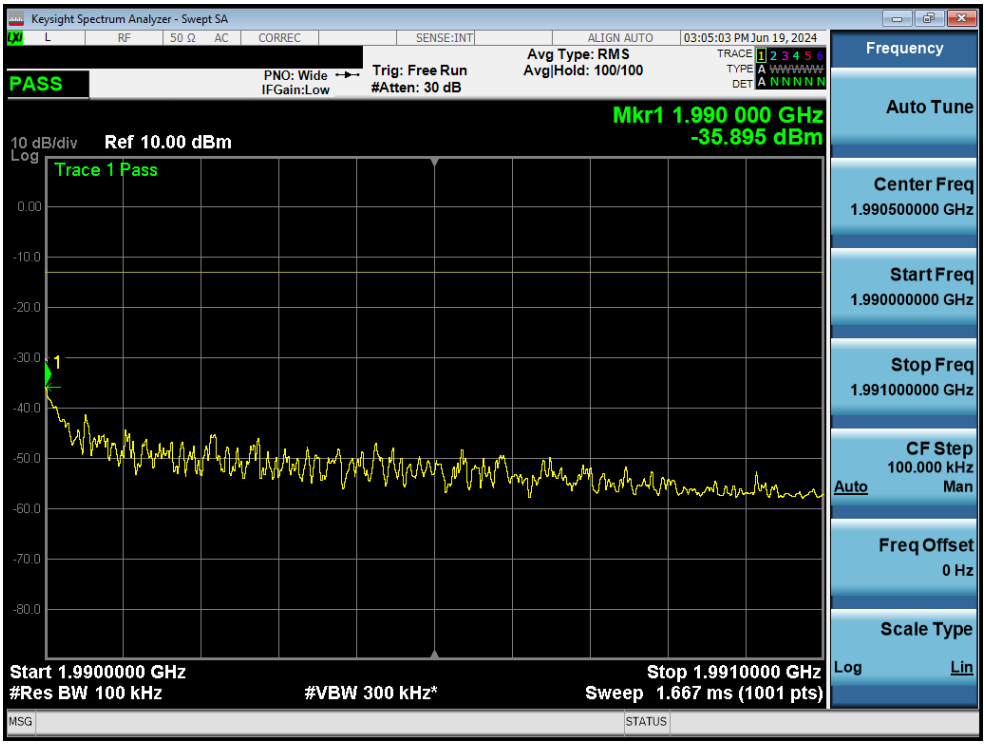
Plot 7-132. Out of Band Emissions – Band 25 DL Upper Extended OOBE @ 10dB above AGC



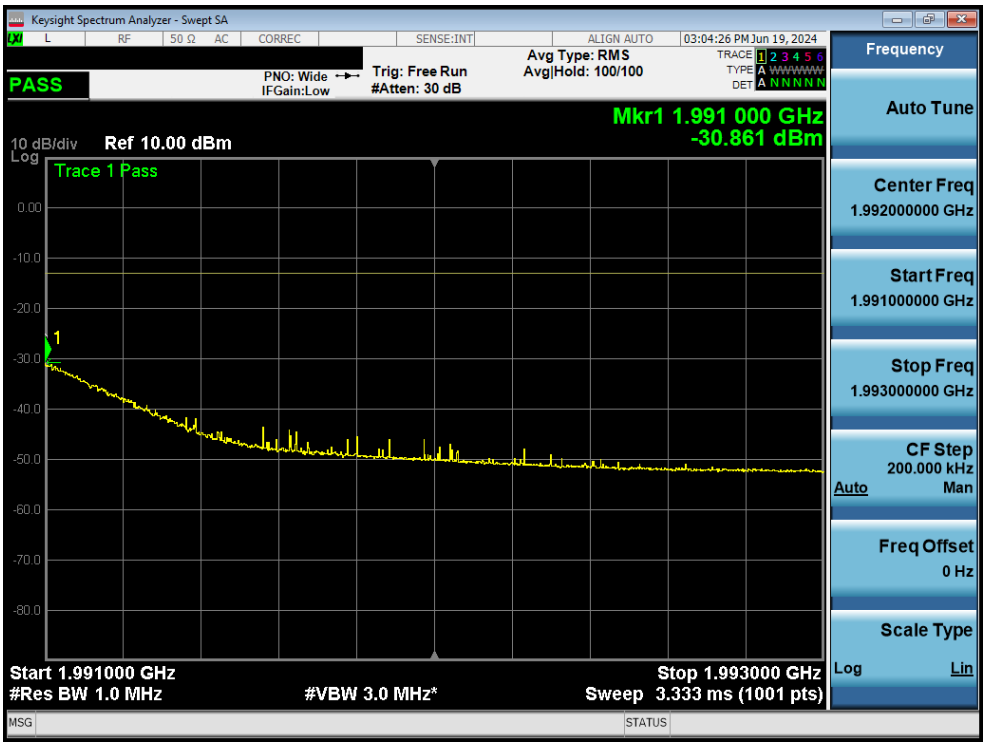
Plot 7-133. Out of Band Emissions – Band 2 DL Upper OOBE @ AGC



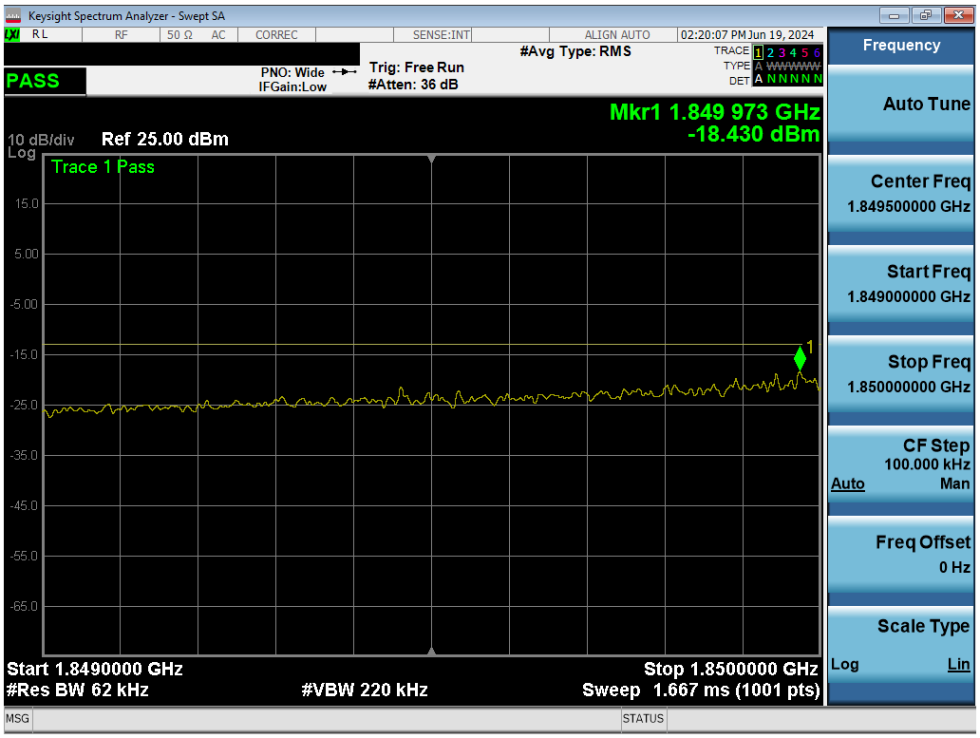
Plot 7-134. Out of Band Emissions – Band 2 DL Extended Upper OOBE @ AGC



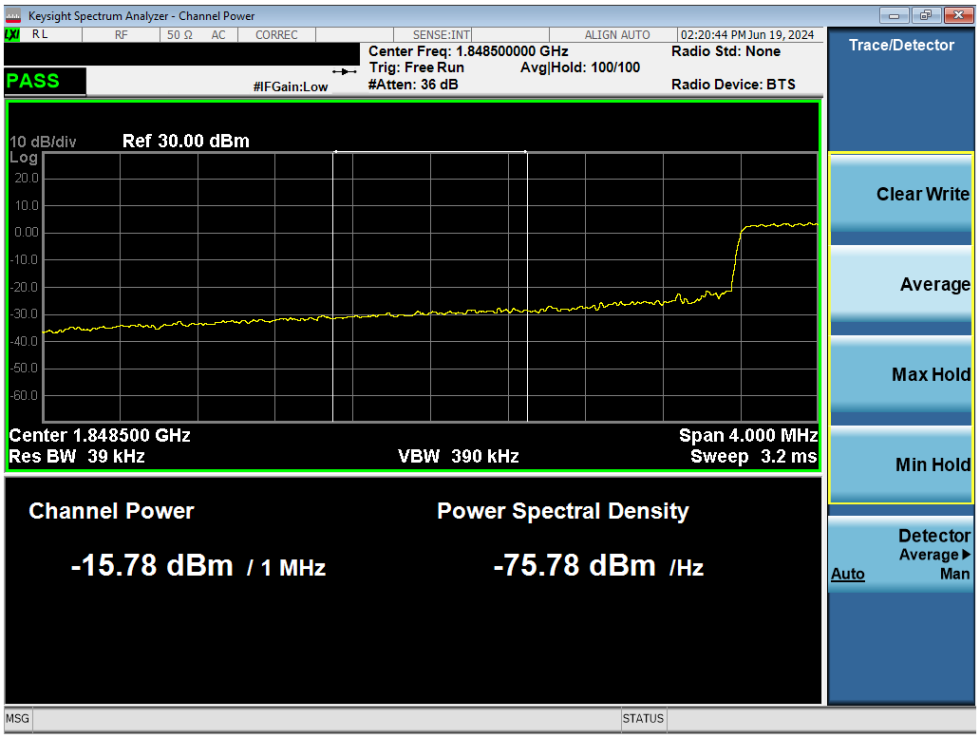
Plot 7-135. Out of Band Emissions – Band 2 DL Upper OOBE @ 10dB above AGC



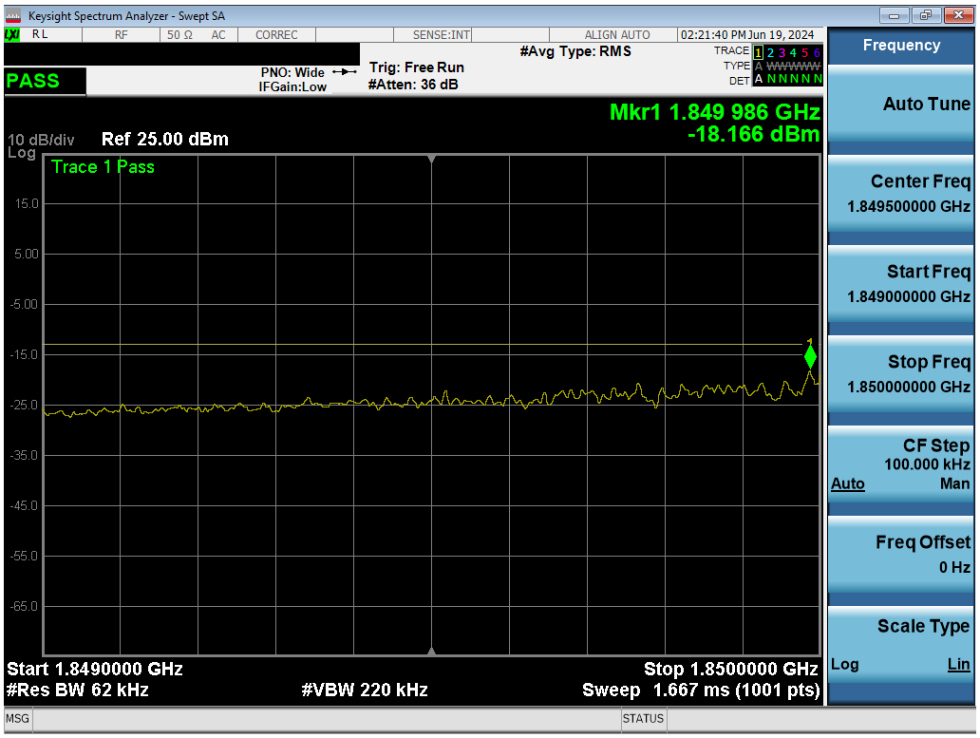
Plot 7-136. Out of Band Emissions – Band 2 DL Upper Extended OOBE @ 10dB above AGC



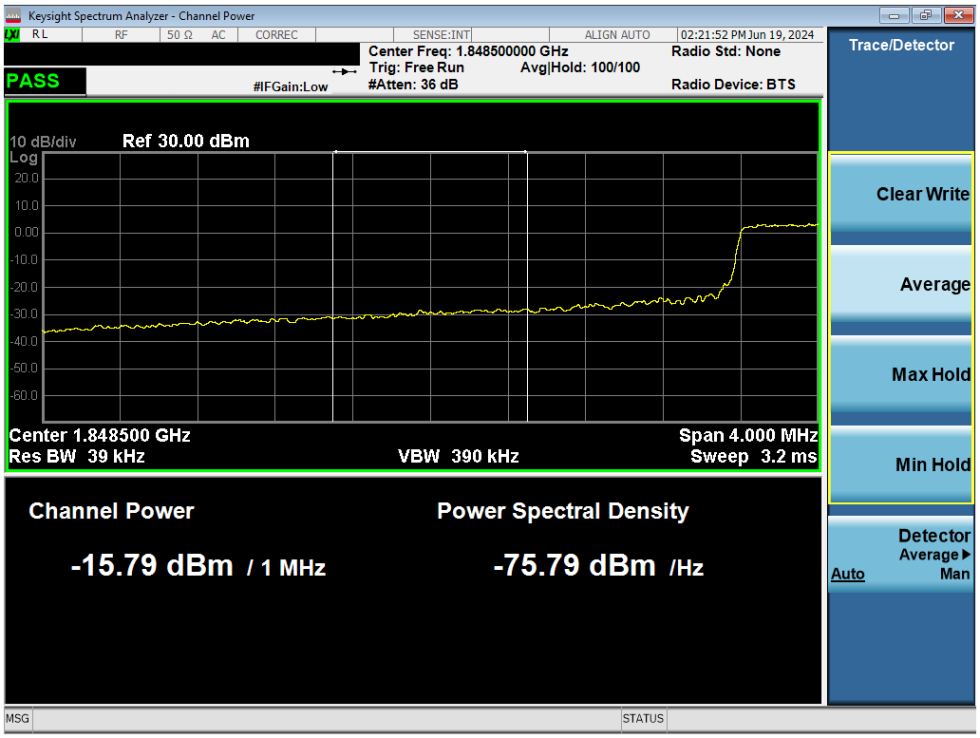
Plot 7-137. Out of Band Emissions – Band 25/2 UL Lower OOBE @ AGC



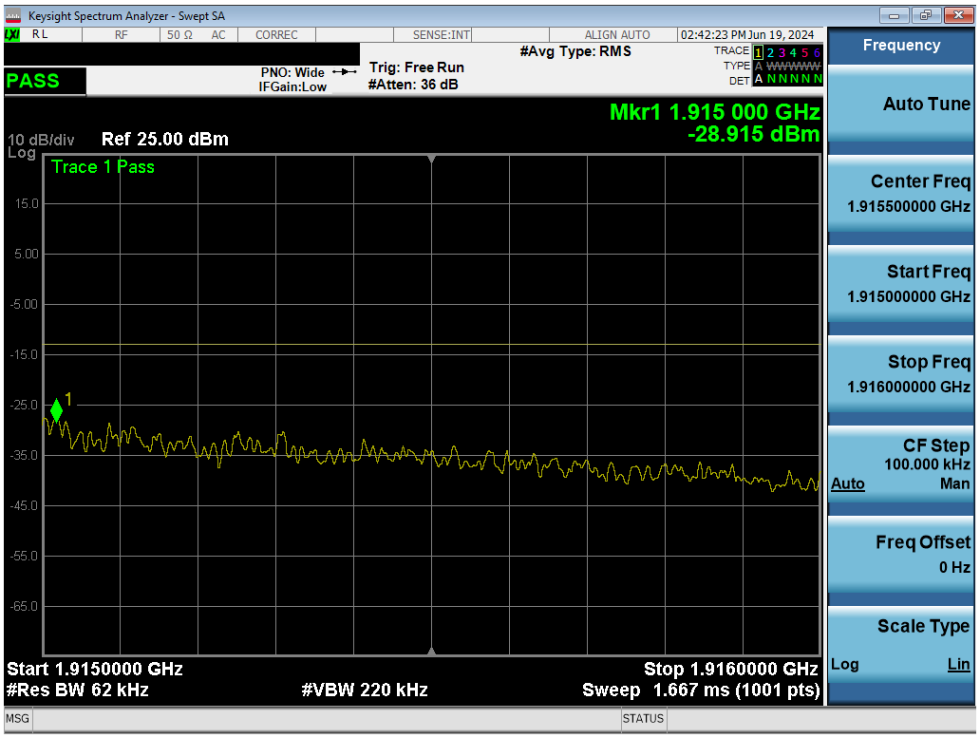
Plot 7-138. Out of Band Emissions – Band 25/2 UL Lower Extended OOBE @ AGC



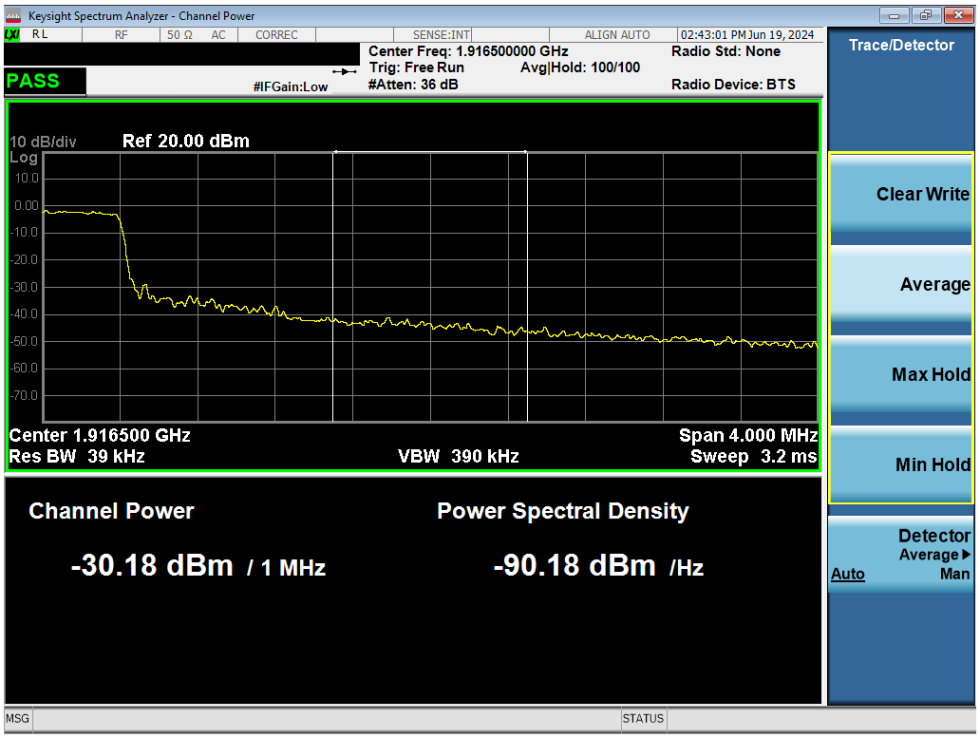
Plot 7-139. Out of Band Emissions – Band 25/2 UL Lower OOBE @ 10dB above AGC



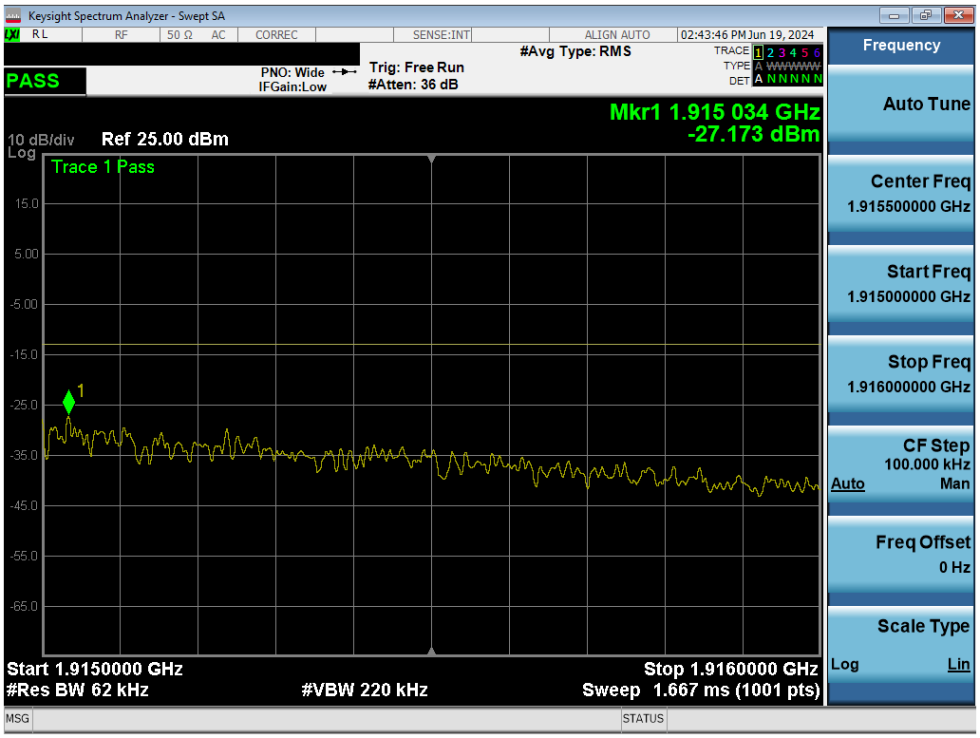
Plot 7-140. Out of Band Emissions – Band 25/2 UL Lower Extended OOBE @ 10dB above AGC



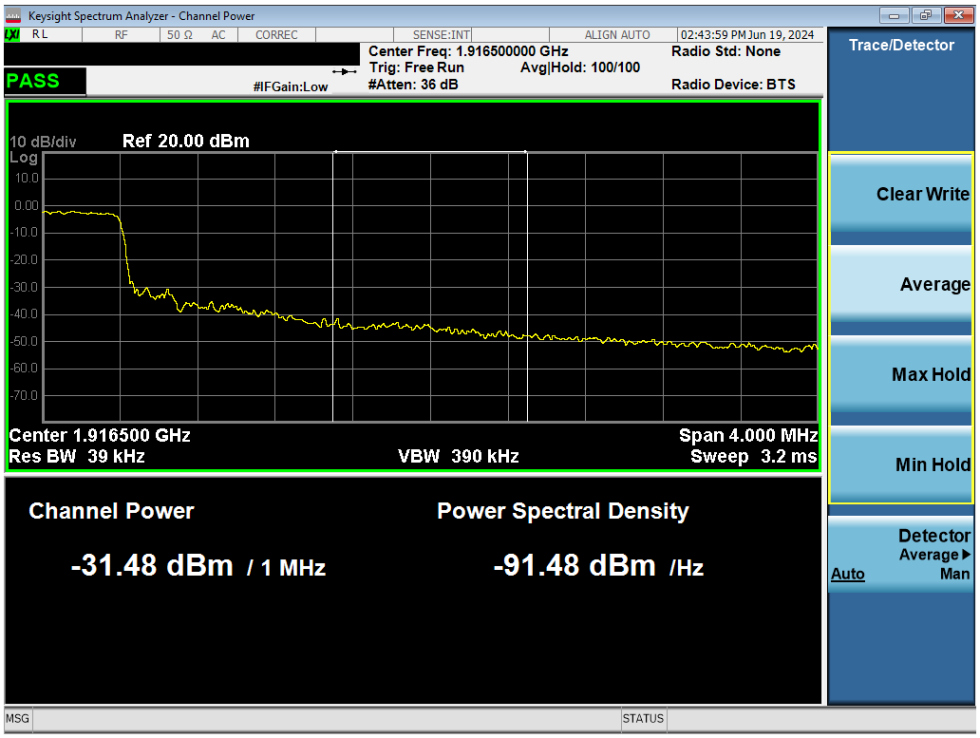
Plot 7-141. Out of Band Emissions – Band 25 UL Upper OOBE @ AGC



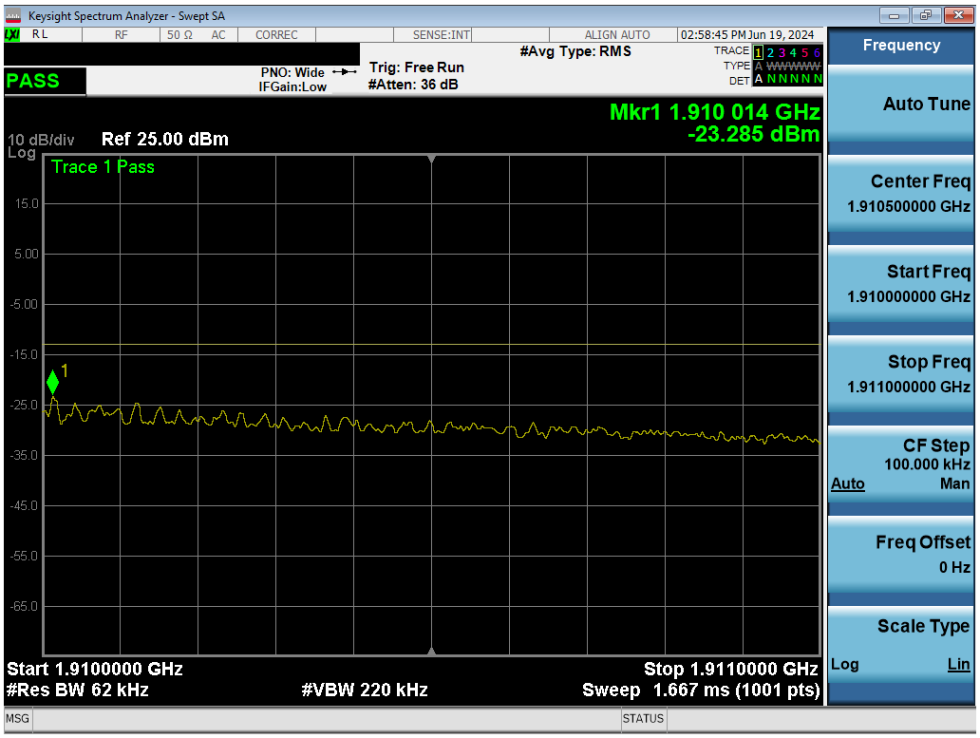
Plot 7-142. Out of Band Emissions – Band 25 UL Upper Extended OOBE @ AGC



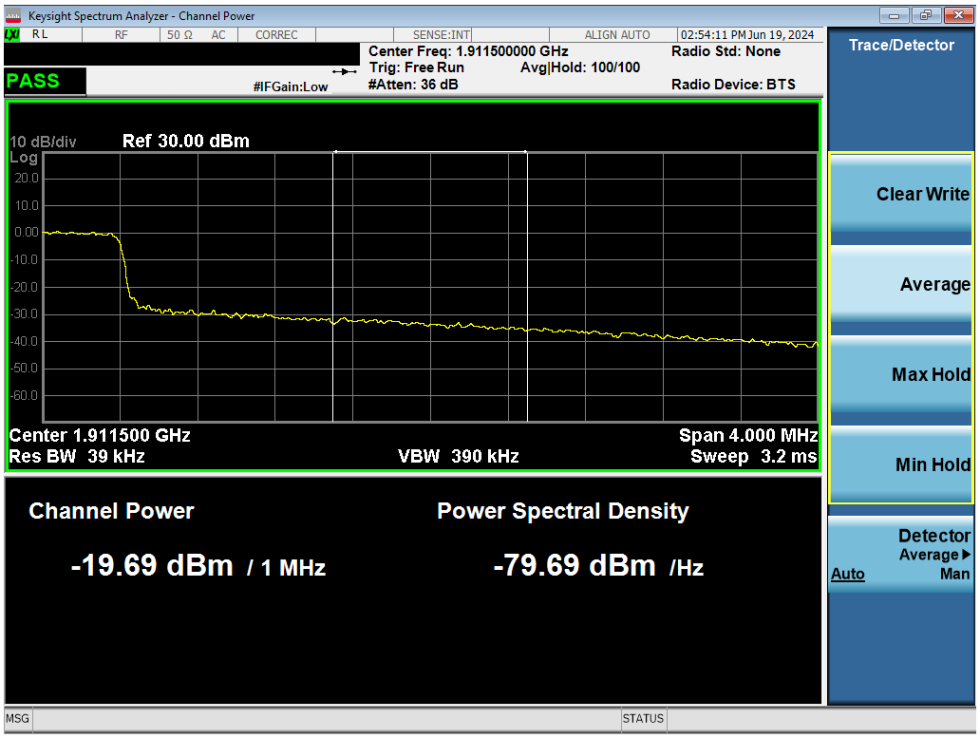
Plot 7-143. Out of Band Emissions – Band 25 UL Upper OOBE @ 10dB above AGC



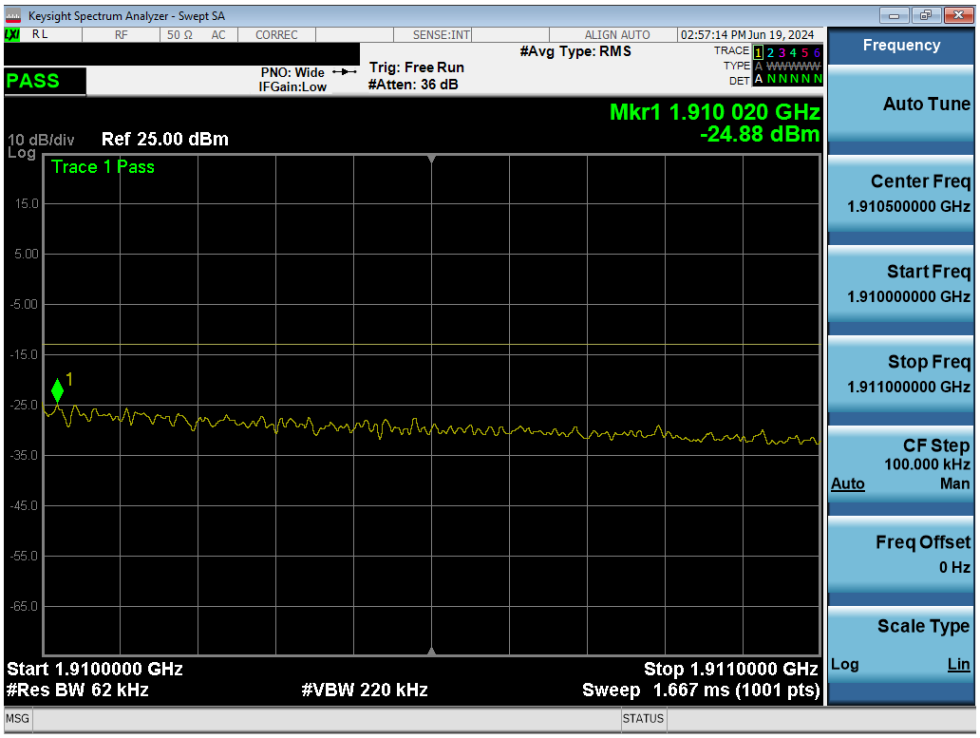
Plot 7-144. Out of Band Emissions – Band 25 UL Upper OOBE Extended @ 10dB above AGC



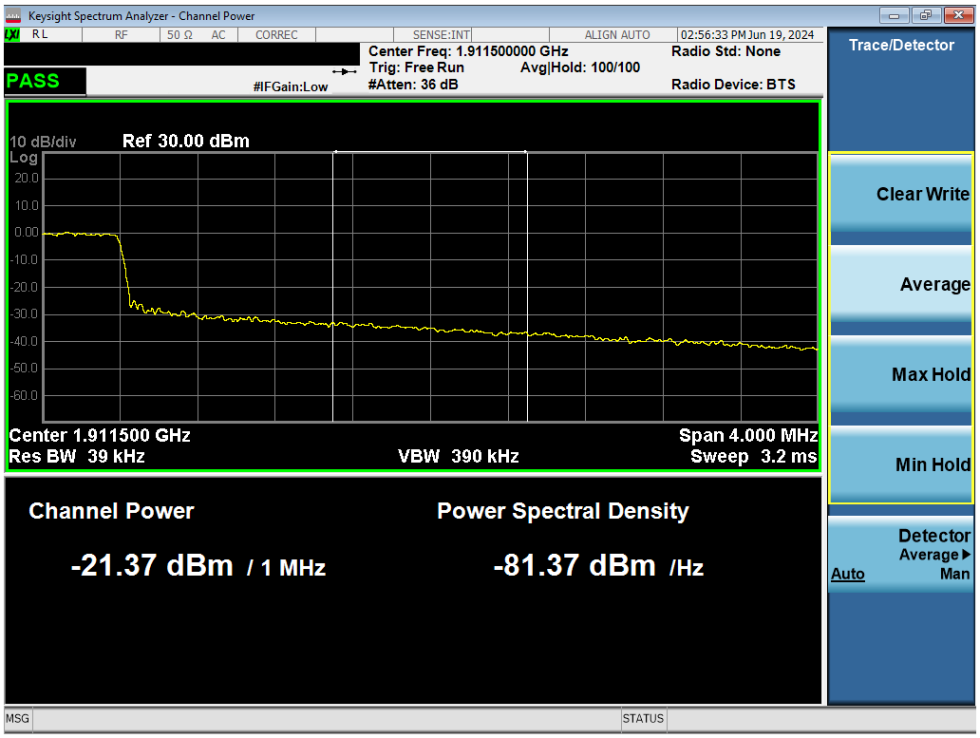
Plot 7-145. Out of Band Emissions – Band 2 UL Upper OOBE @ AGC



Plot 7-146. Out of Band Emissions – Band 2 UL Upper Extended OOBE @ AGC



Plot 7-147. Out of Band Emissions – Band 2 UL Upper OOBE @ 10dB above AGC



Plot 7-148. Out of Band Emissions – Band 2 UL Upper Extended OOBE @ 10dB above AGC

7.8 Conducted Spurious Emissions

Test Overview

The booster will be configured to operate on frequencies associated with the highest and lowest spectrum blocks within the CMRS band under test. The out-of-band emissions are referenced to the licensee spectrum block. Booster conducted spurious emission shall meet the FCC's mobile emission limits for the supported bands of operation.

Test Procedures Used

KDB 935210 D04 Section 7.6

Test Settings

1. Connect the EUT in normal or test mode as shown in Figures 1 to 3.
2. Configure the signal generator for AWGN with a 99% OBW of 4.1 MHz operation with a center frequency corresponding to the center of the CMRS band under test.
3. Set the signal generator amplitude to the pre-AGC threshold level as determined in 7.2.2.
4. Turn on the signal generator RF output and measure the spurious emission power levels with an appropriate measuring instrument as follows.

    1) Set RBW = measurement bandwidth specified in the applicable rule section for the operational frequency band under consideration (see Appendix A for relevant cross-references). Note that many of the individual rule sections permit the use of a narrower RBW [typically ≥ 1% of the emission bandwidth (EBW)] to enhance measurement accuracy, but the result must then be integrated over the specified measurement bandwidth.

    2) Set VBW = 3 x RBW.

    3) Select the power averaging (rms) detector. (See above NOTE regarding the use of a peak detector for preliminary measurements.)

    4) Sweep time = auto-couple.

    5) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. Note that the number of measurement points in each sweep must be ≥ (2 x span/RBW) which may require that the measurement range defined by the preceding start and stop frequencies be subdivided, depending on the available number of measurement points of the spectrum analyzer. Trace average at least 10 traces in power averaging (rms) mode.

    6) Use the peak marker function to identify the highest amplitude level over each measured frequency range. Record the frequency and amplitude and capture a plot for inclusion in the test report.

    7) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest

frequency of the fundamental emission. Note that the number of measurement points in each sweep must be ≥ (2 x span/RBW) which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.

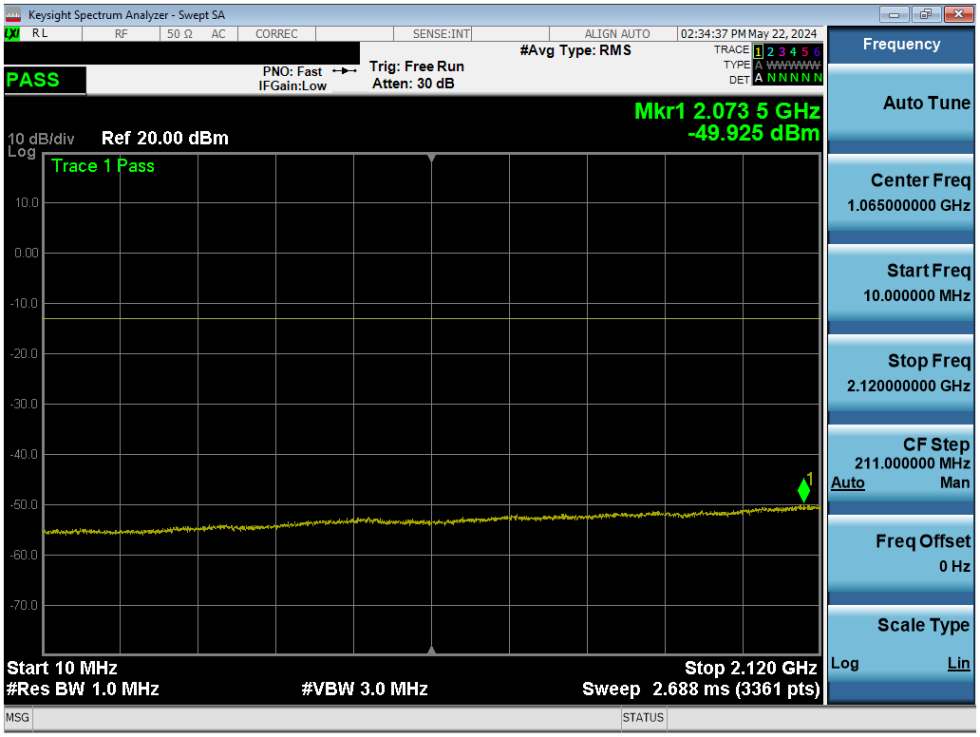
8) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a plot for inclusion in the test report.

5. Repeat Step 2 through 4 for each supported frequency band of operation.

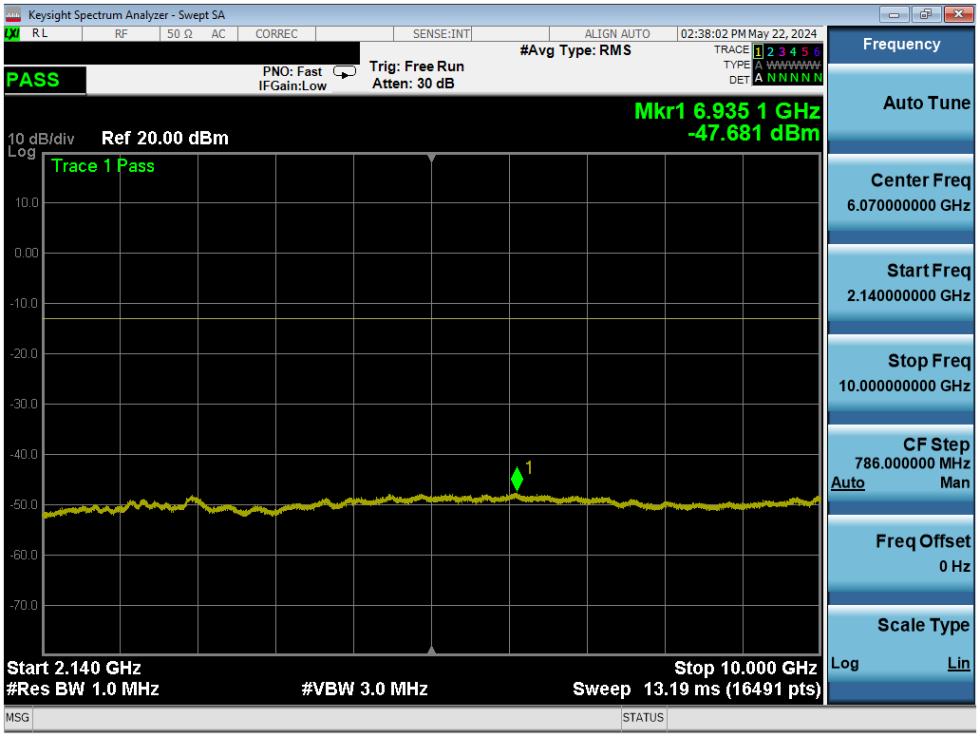
Test Notes

For bands operating <1GHz, a more conservative RBW of 1MHz was used for measurements >1GHz to increase measurement speed.

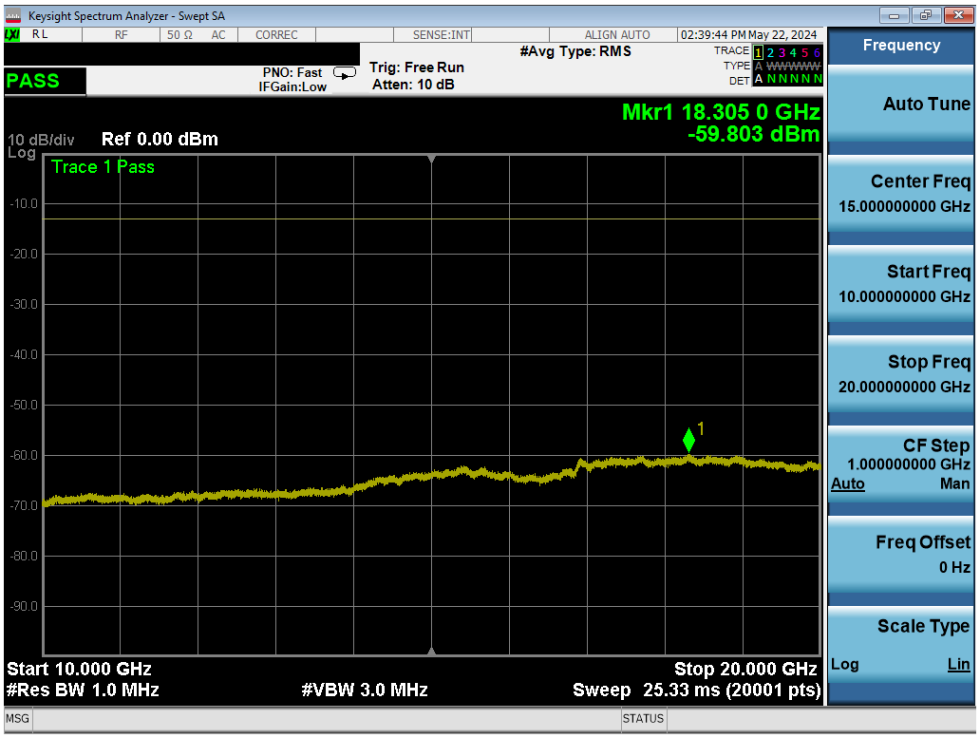
LTE Band 4



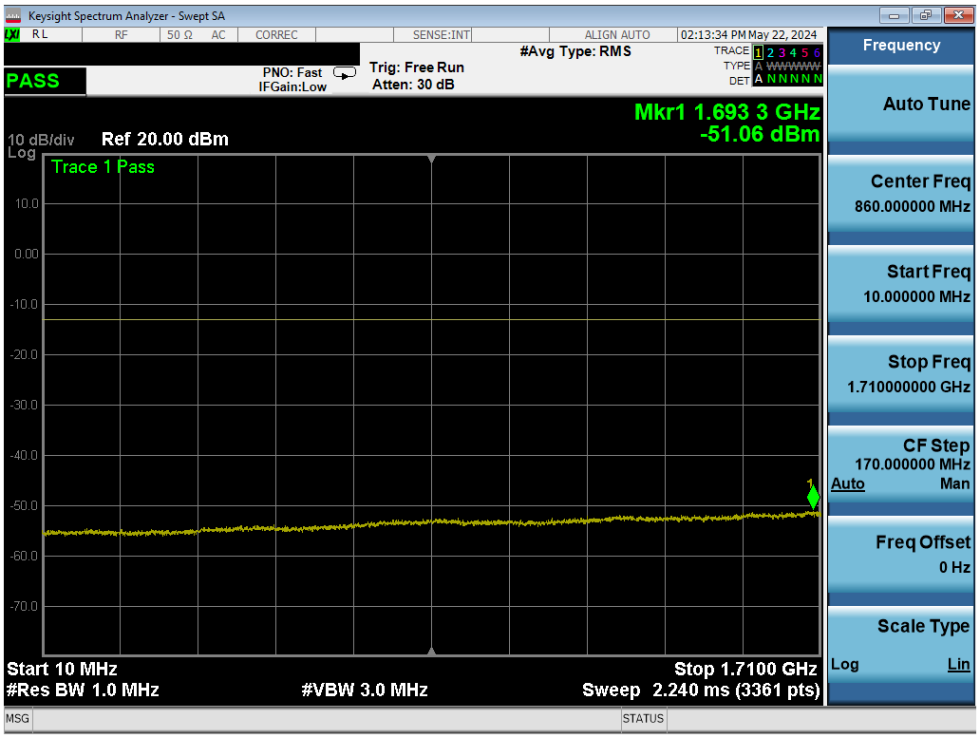
Plot 7-149. Conducted Spurious Emission – Band 4 DL



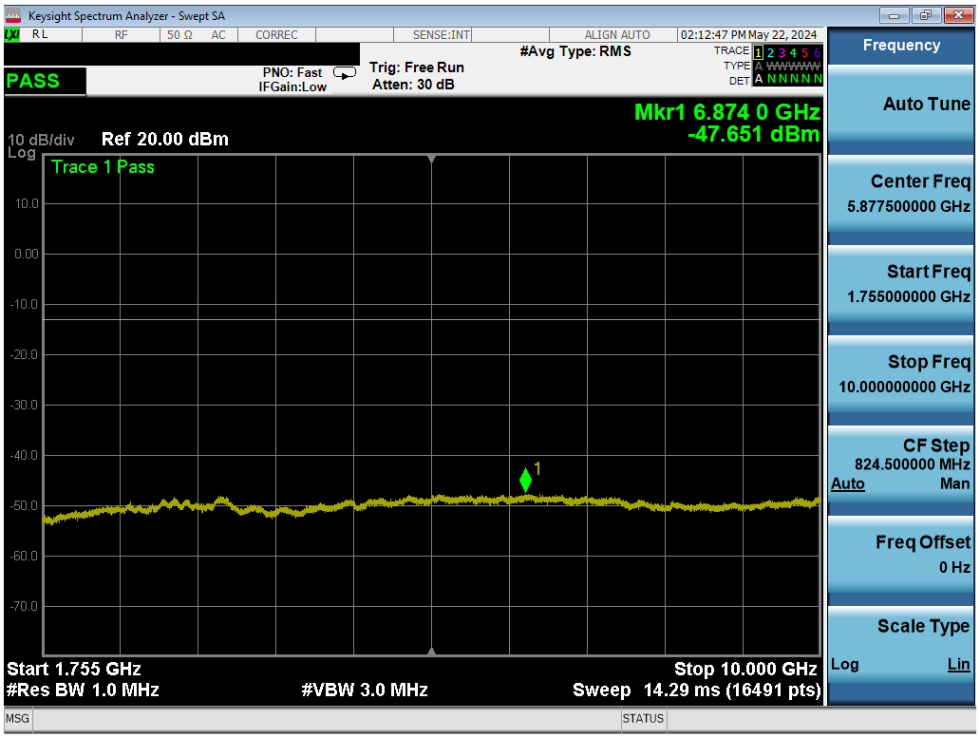
Plot 7-150. Conducted Spurious Emission – Band 4 DL



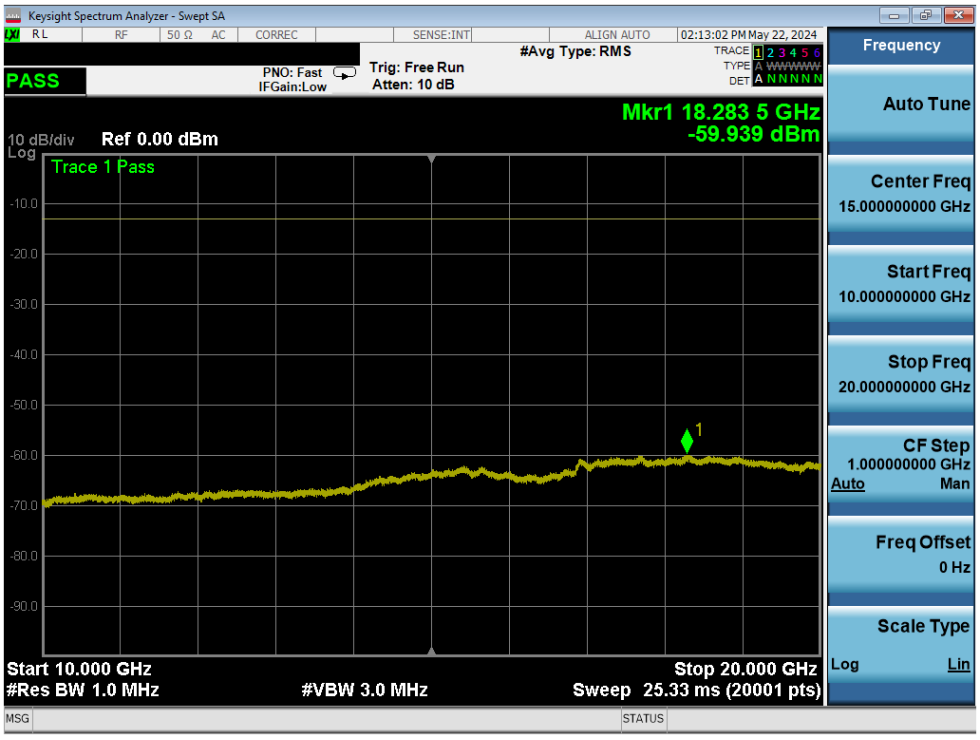
Plot 7-151. Conducted Spurious Emission – Band 4 DL



Plot 7-152. Conducted Spurious Emission – Band 4 UL

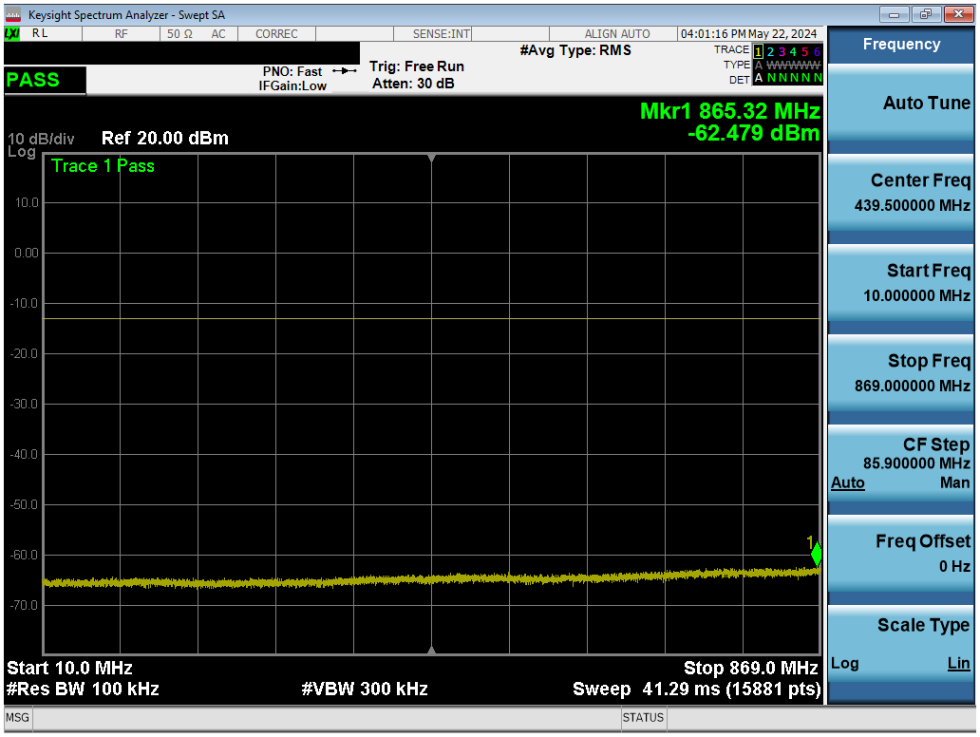


Plot 7-153. Conducted Spurious Emission – Band 4 UL

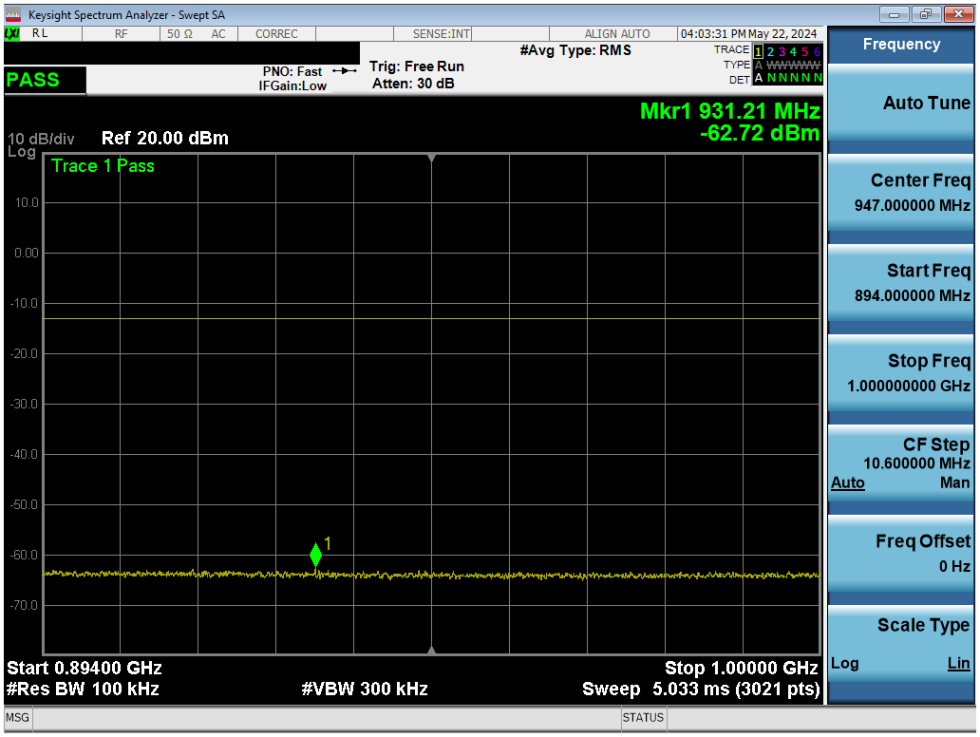


Plot 7-154. Conducted Spurious Emission – Band 4 UL

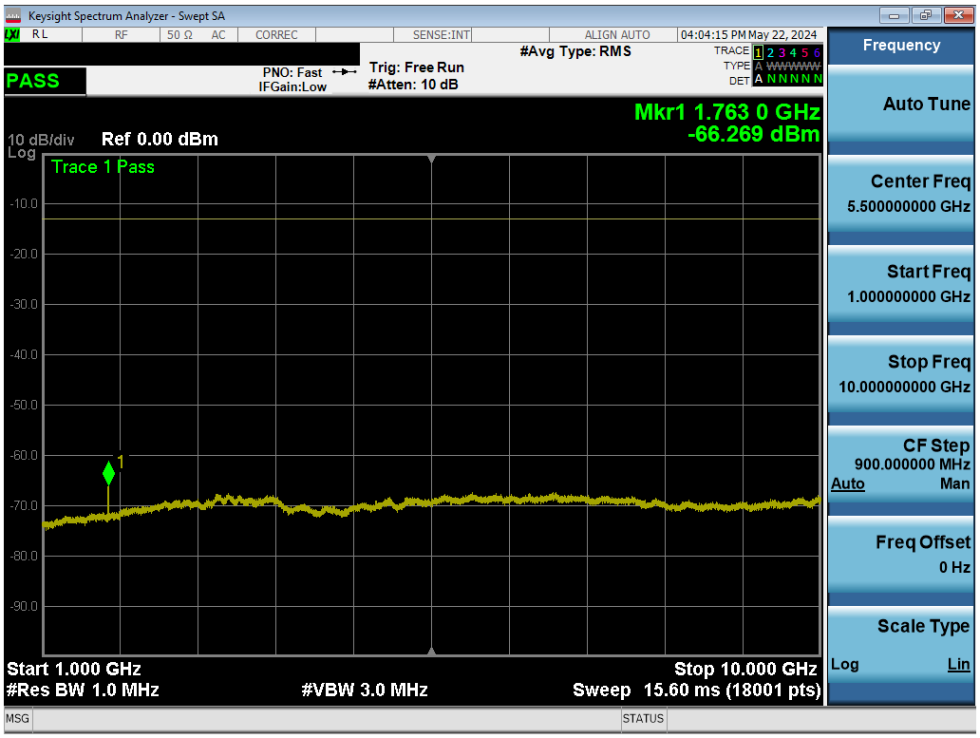
LTE Band 5



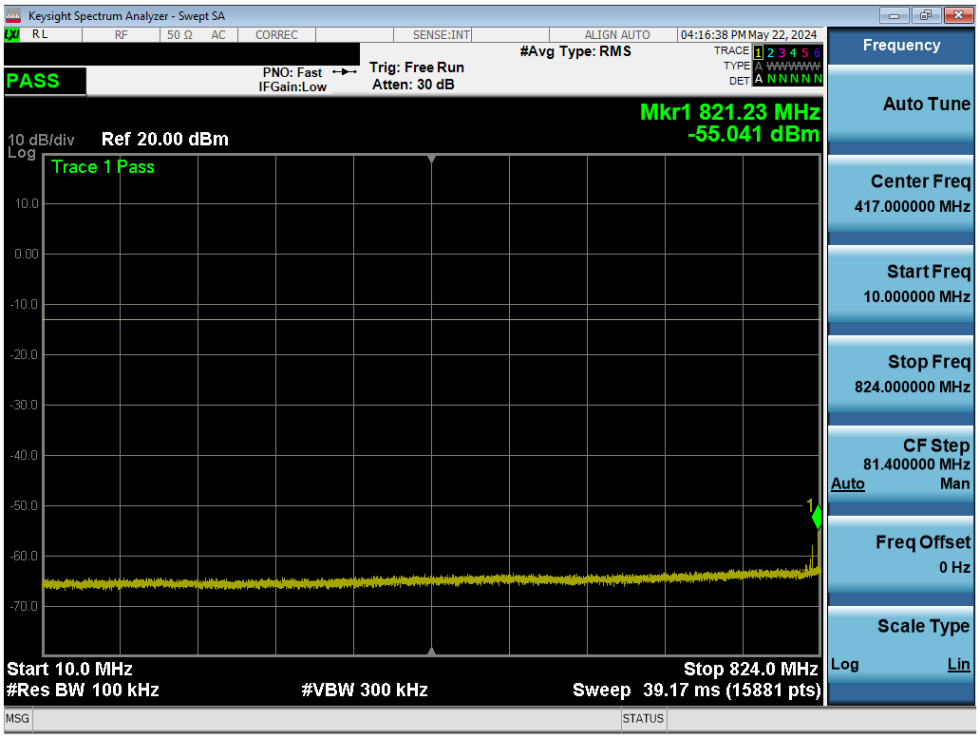
Plot 7-155. Conducted Spurious Emission – Band 5 DL



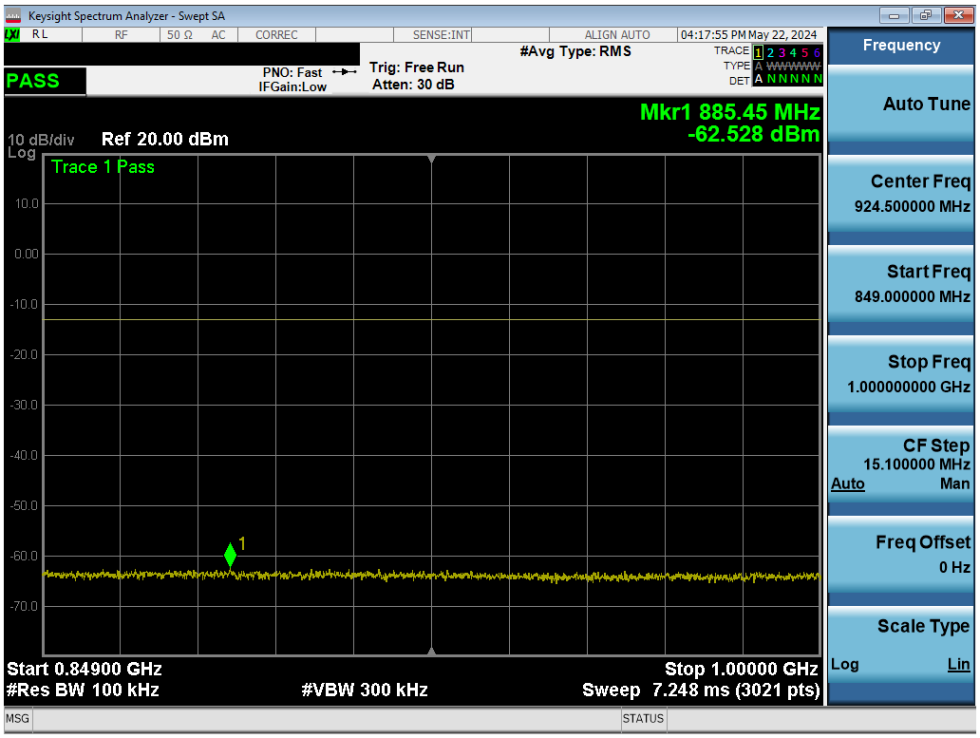
Plot 7-156. Conducted Spurious Emission – Band 5 DL



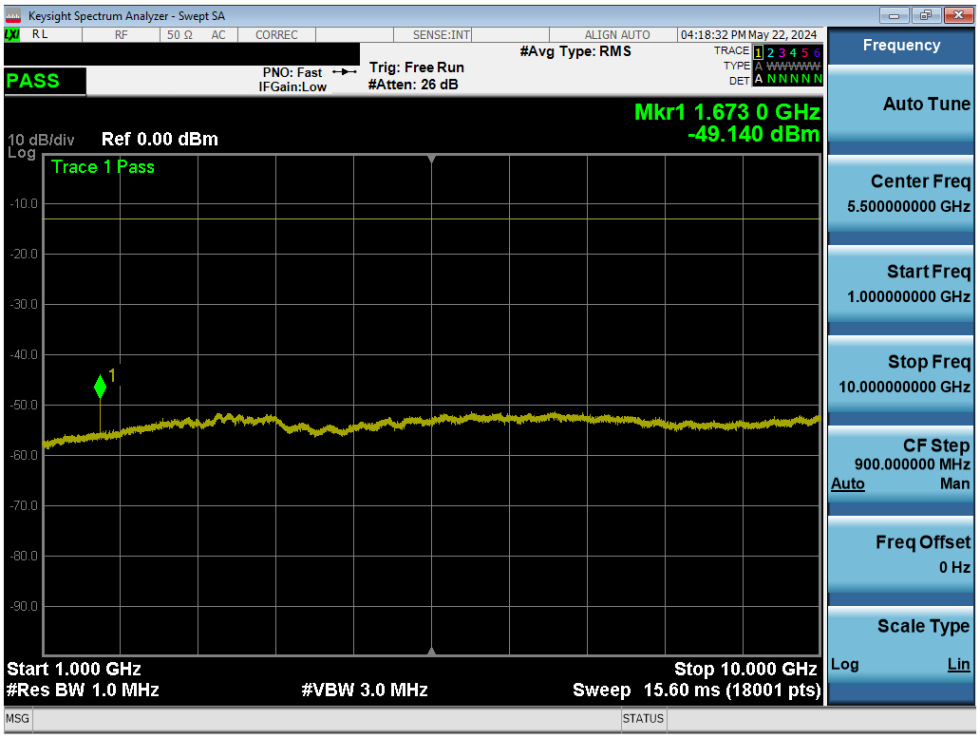
Plot 7-157. Conducted Spurious Emission – Band 5 DL



Plot 7-158. Conducted Spurious Emission – Band 5 UL

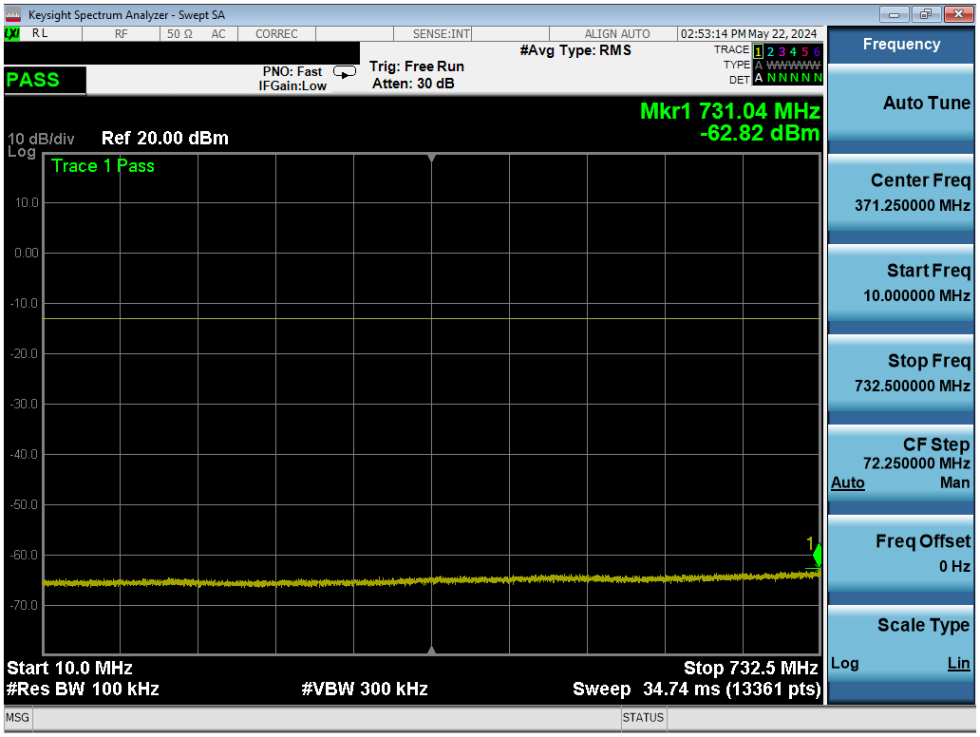


Plot 7-159. Conducted Spurious Emission – Band 5 UL

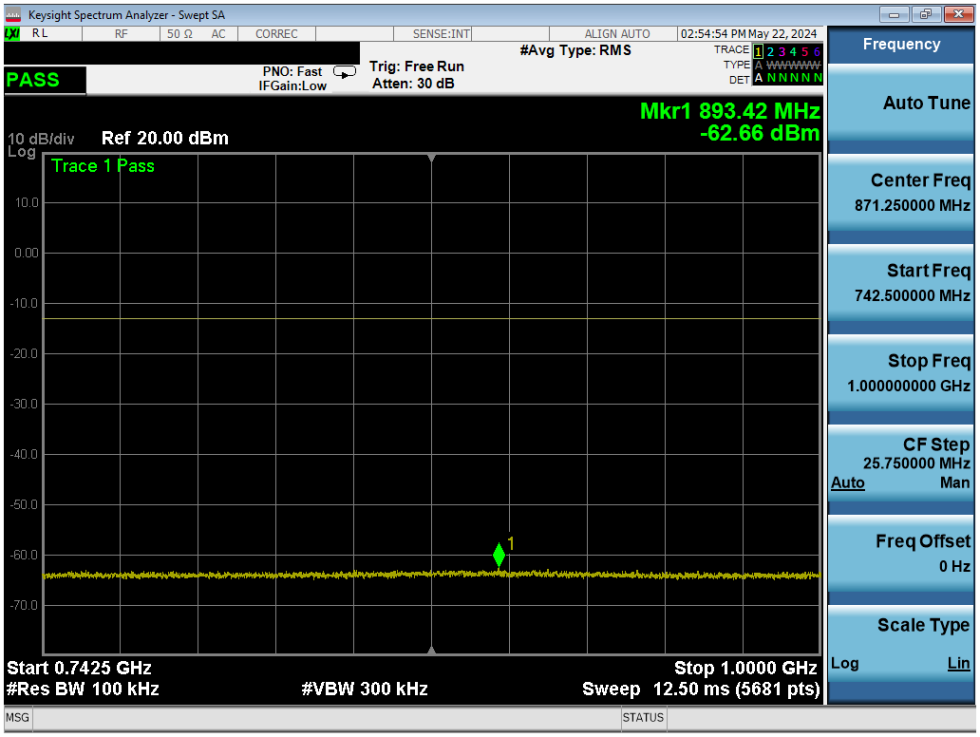


Plot 7-160. Conducted Spurious Emission – Band 5 UL

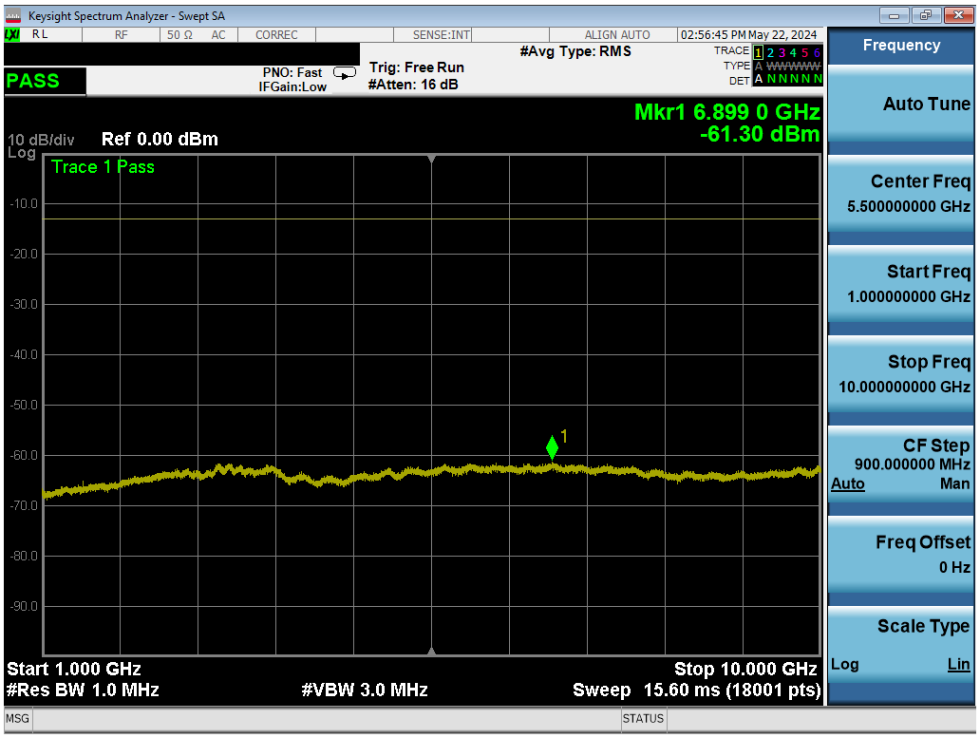
LTE Band 12



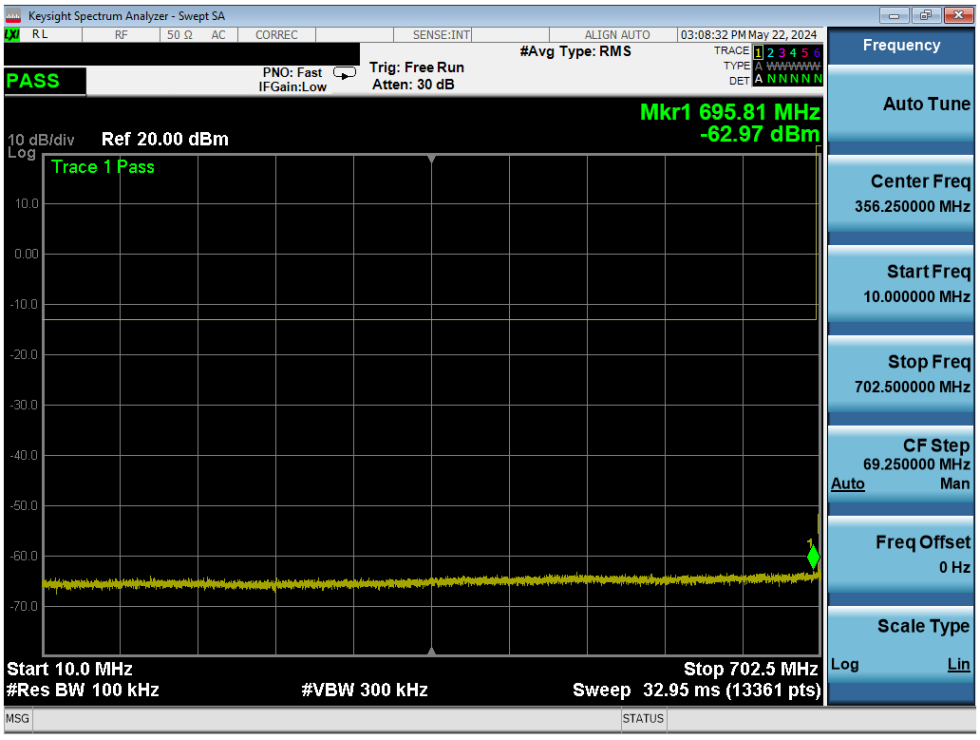
Plot 7-161. Conducted Spurious Emission – Band 12 DL



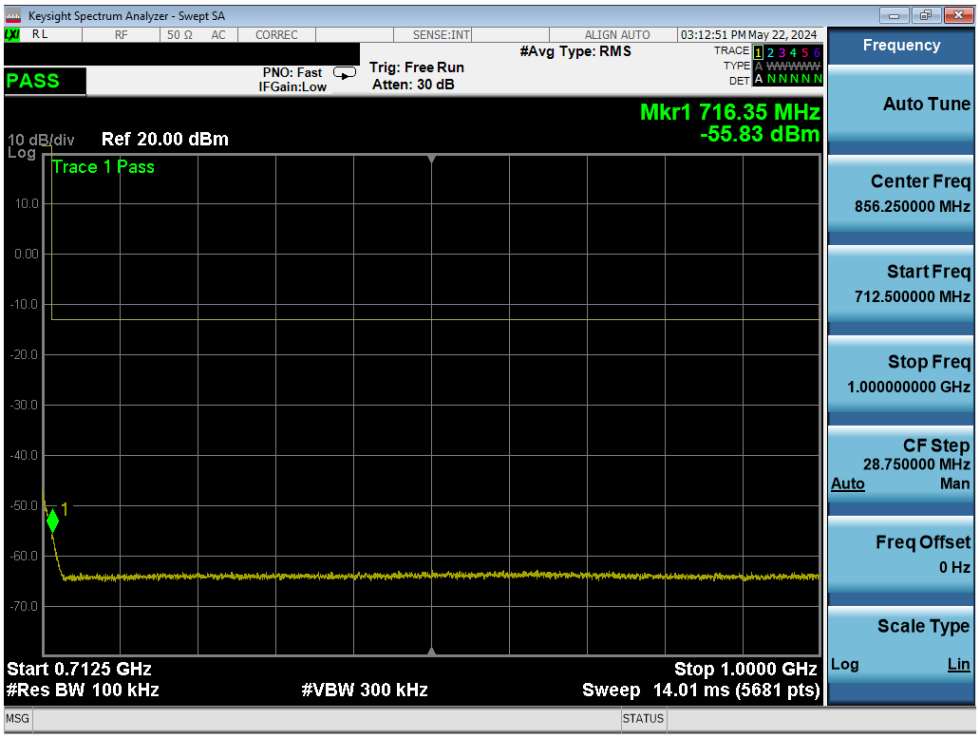
Plot 7-162. Conducted Spurious Emission – Band 12 DL



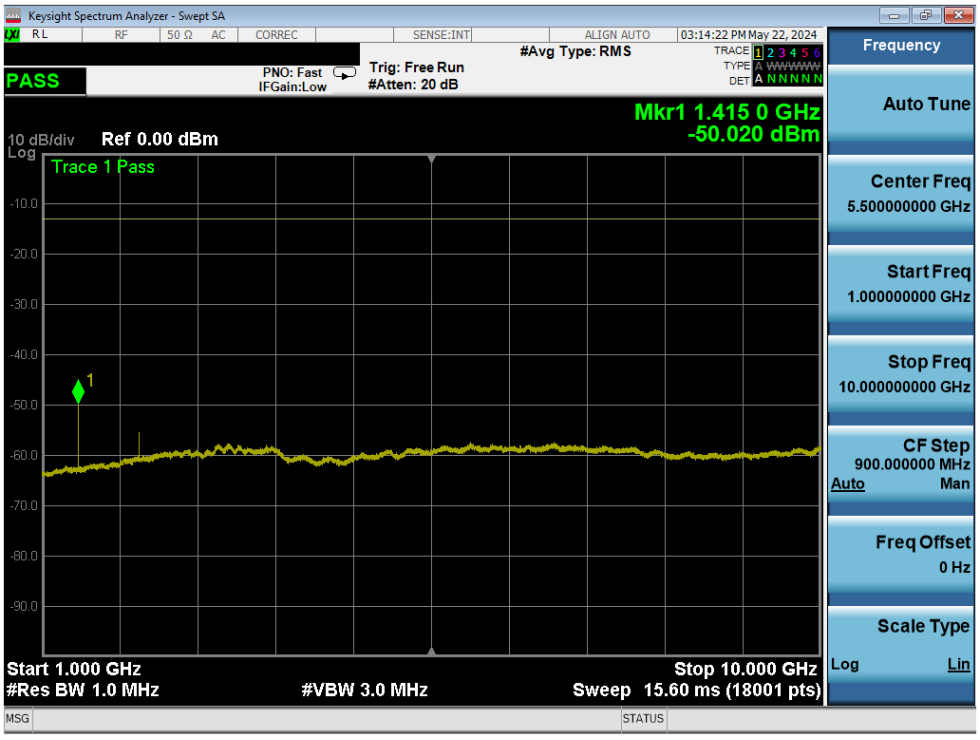
Plot 7-163. Conducted Spurious Emission – Band 12 DL



Plot 7-164. Conducted Spurious Emission – Band 12 UL

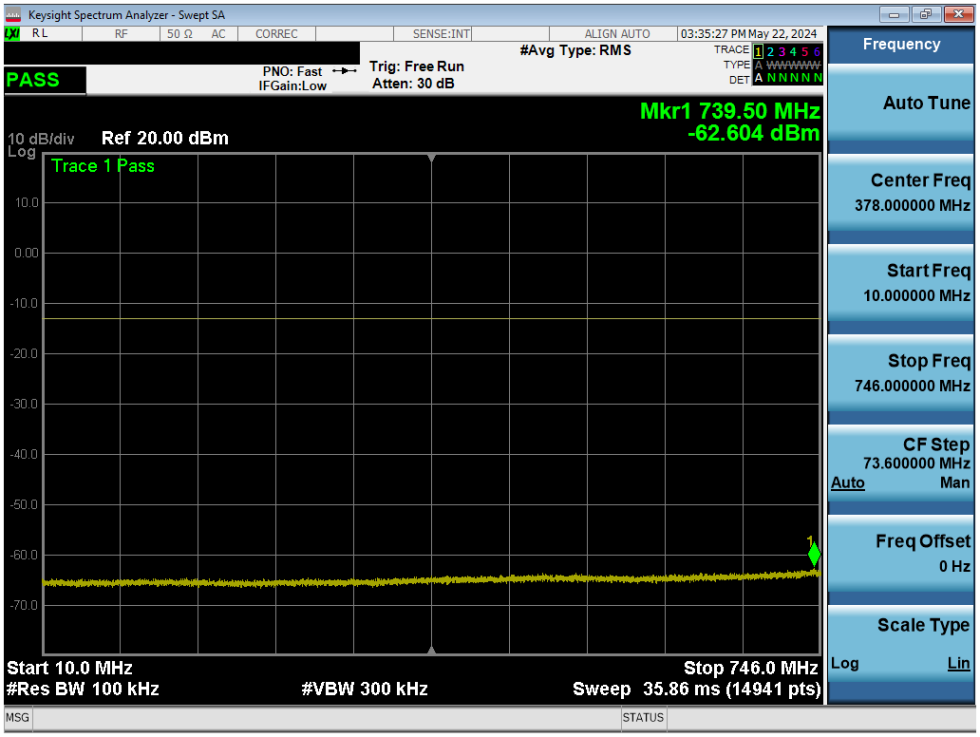


Plot 7-165. Conducted Spurious Emission – Band 12 UL

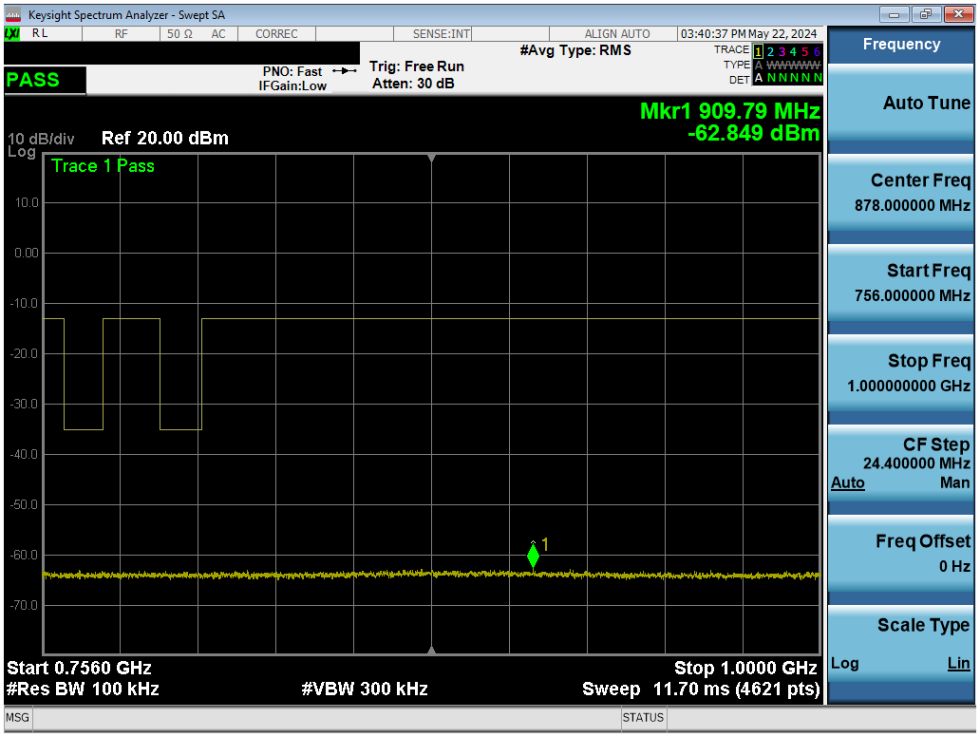


Plot 7-166. Conducted Spurious Emission – Band 12 UL

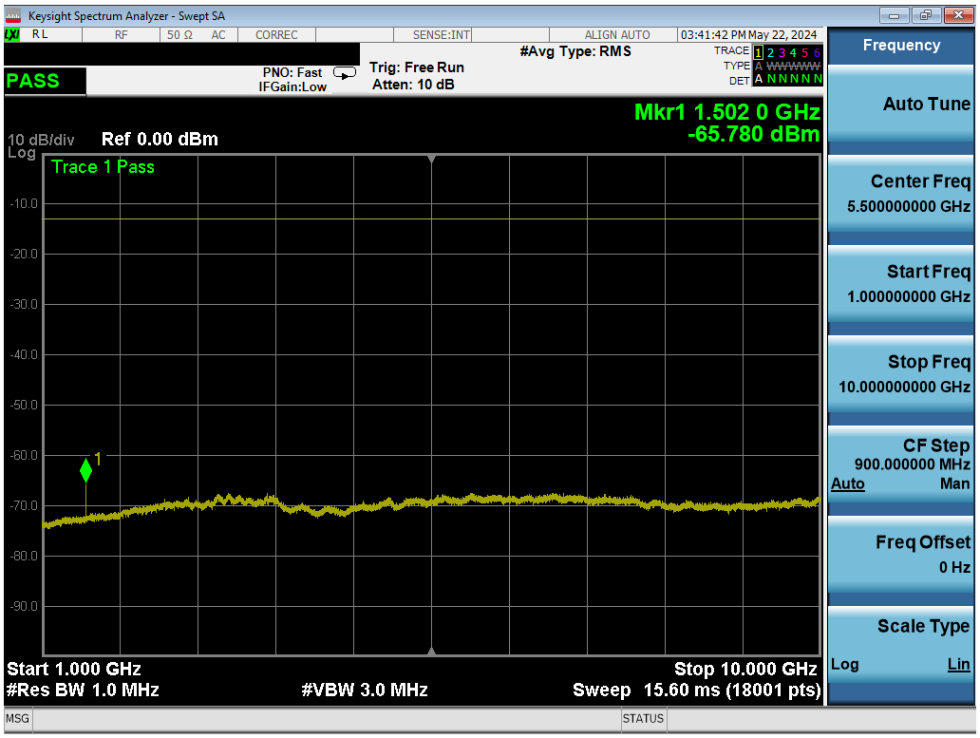
LTE Band 13



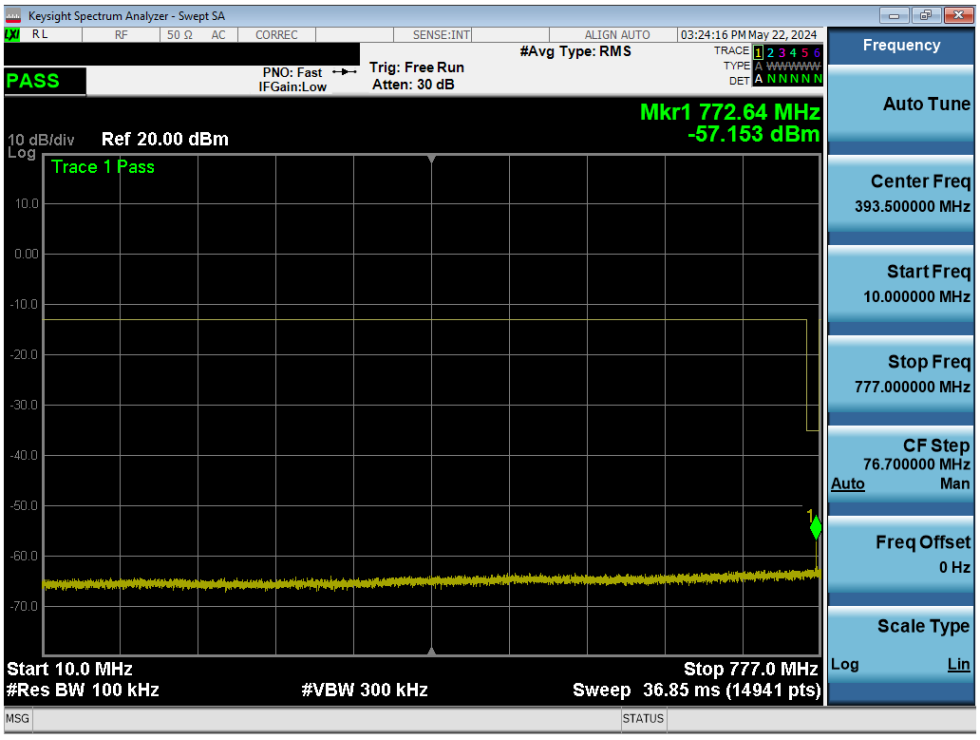
Plot 7-167. Conducted Spurious Emission – Band 13 DL



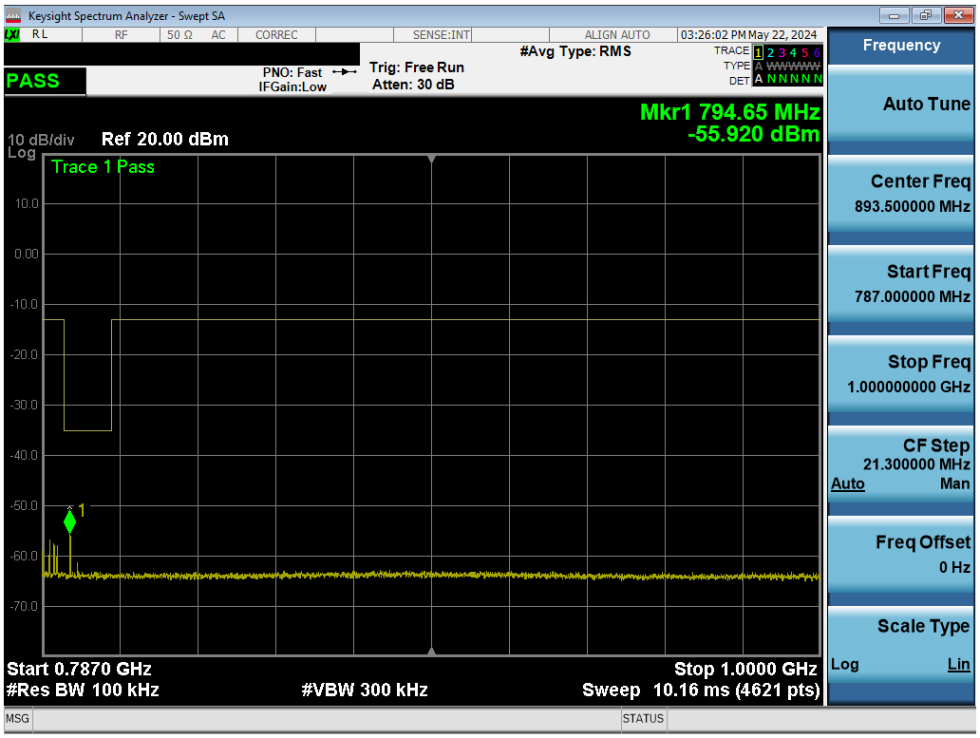
Plot 7-168. Conducted Spurious Emission – Band 13 DL



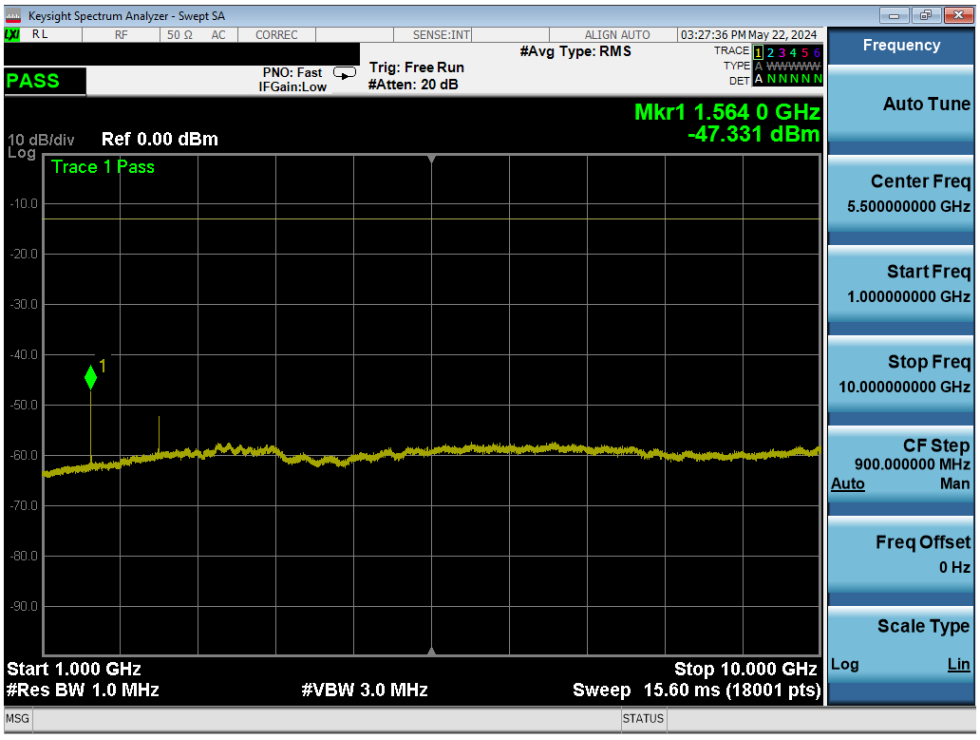
Plot 7-169. Conducted Spurious Emission – Band 13 DL



Plot 7-170. Conducted Spurious Emission – Band 13 UL

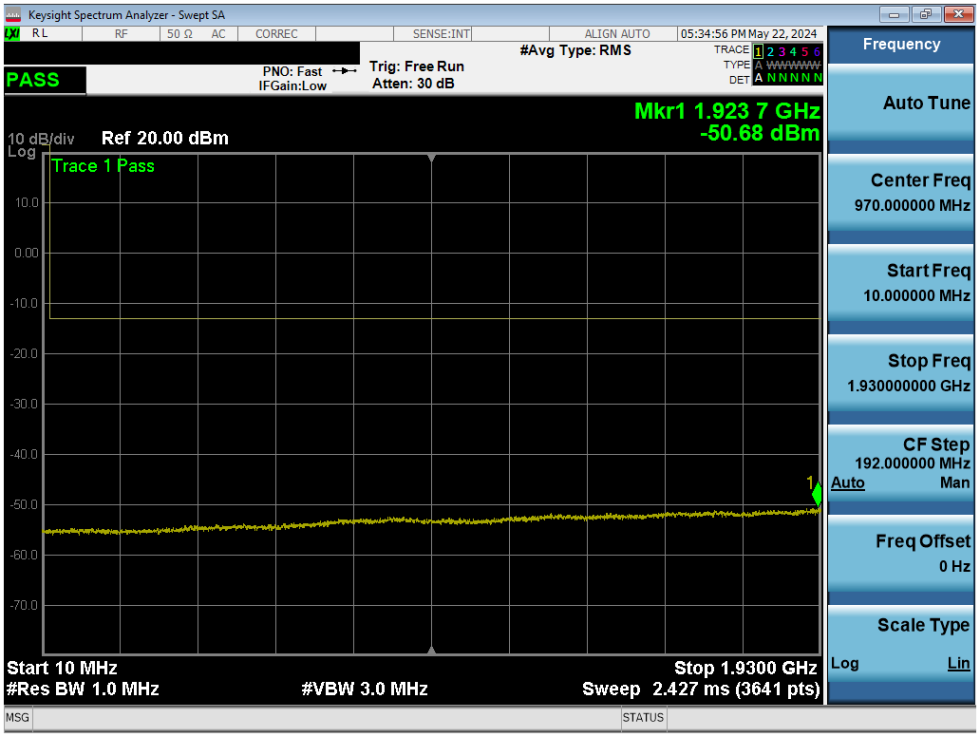


Plot 7-171. Conducted Spurious Emission – Band 13 UL

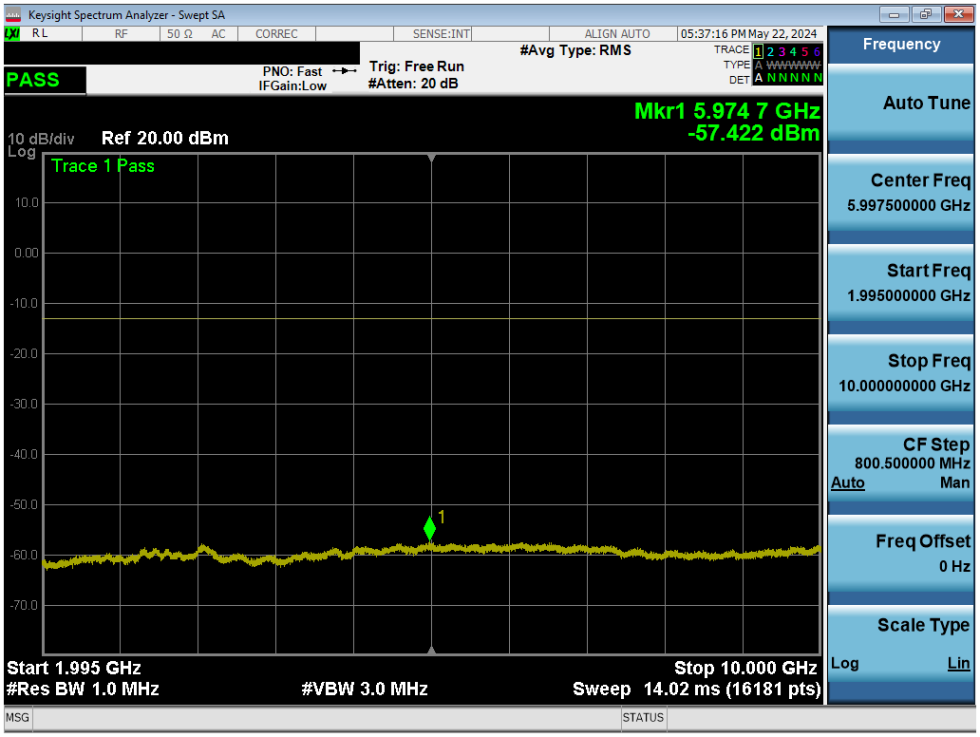


Plot 7-172. Conducted Spurious Emission – Band 13 UL

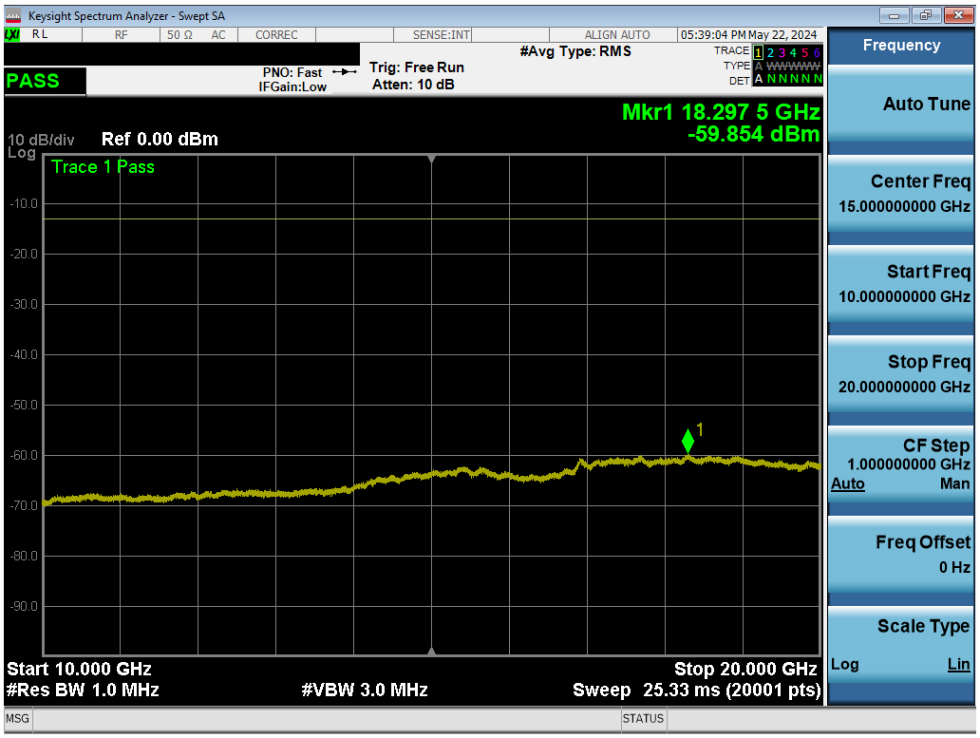
LTE Band 25/2



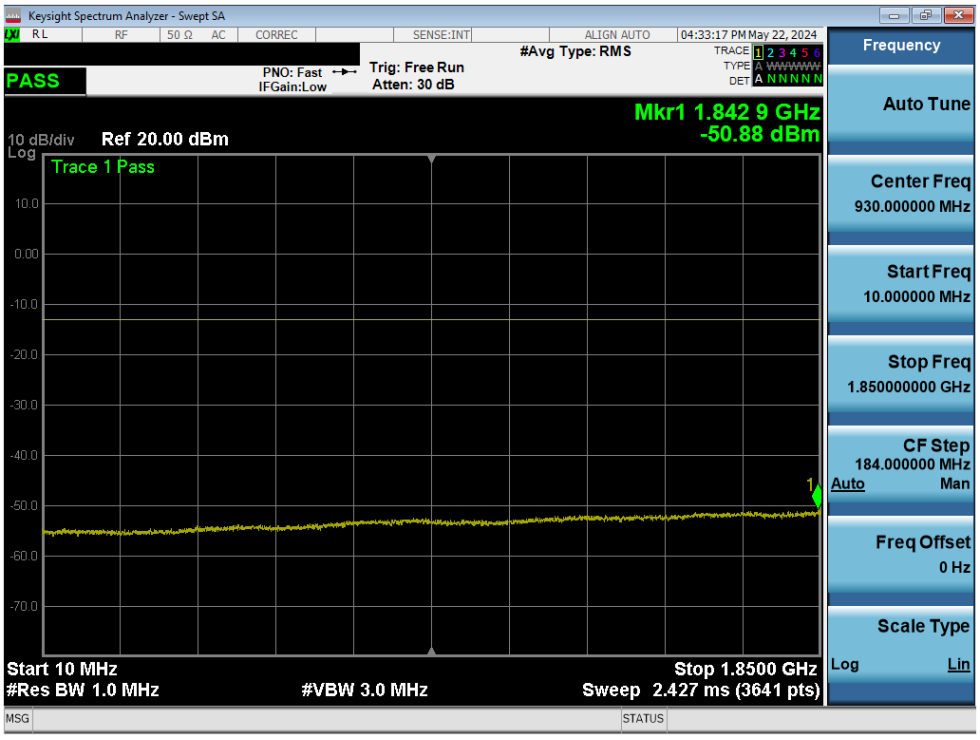
Plot 7-173. Conducted Spurious Emission – Band 25/2 DL



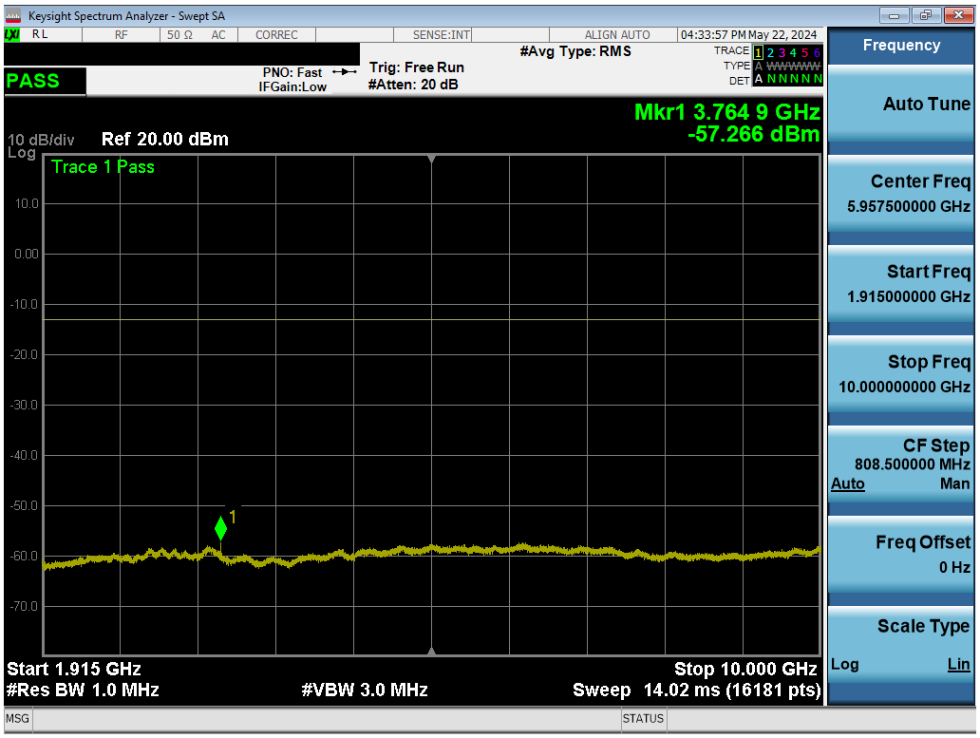
Plot 7-174. Conducted Spurious Emission – Band 25/2 DL



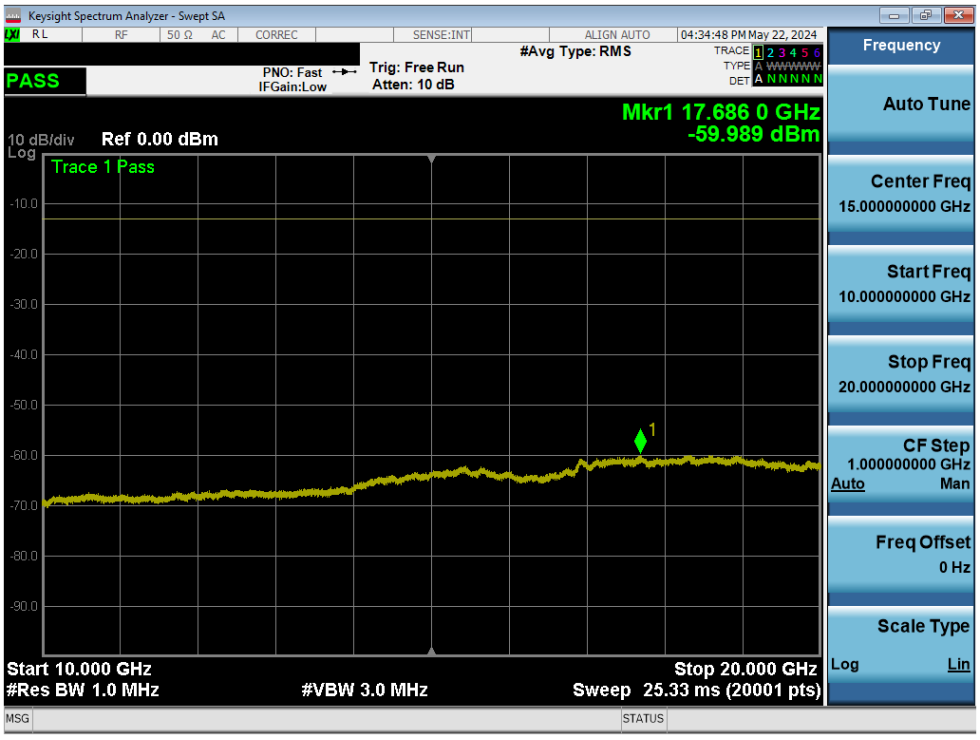
Plot 7-175. Conducted Spurious Emission – Band 25/2 DL



Plot 7-176. Conducted Spurious Emission – Band 25/2 UL



Plot 7-177. Conducted Spurious Emission – Band 25/2 UL



Plot 7-178. Conducted Spurious Emission – Band 25/2 UL

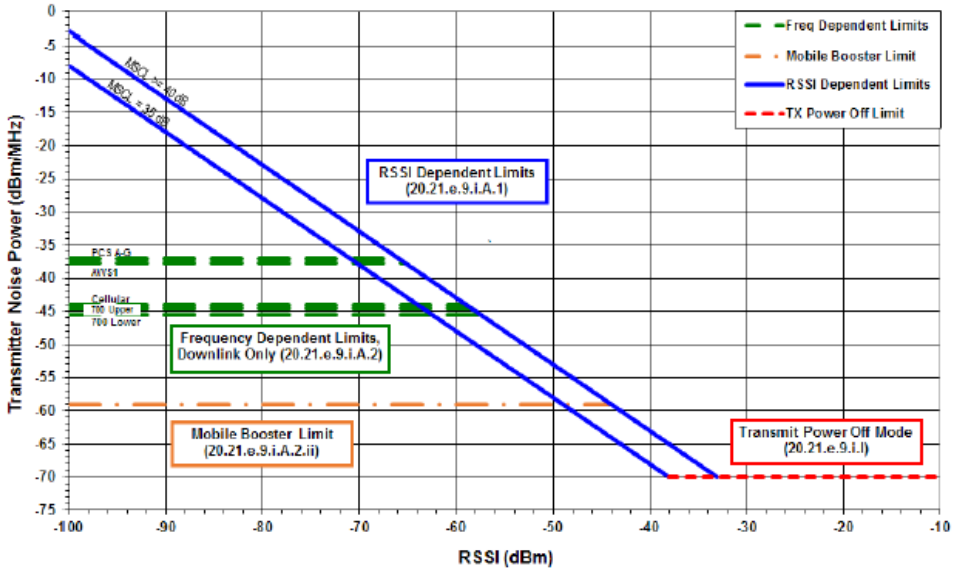
7.9 Noise Limit & Transmit Power Off Mode & Variable Noise Response Time

Test Overview

The transmitted noise power in dBm/MHz of frequency selective consumer boosters outside the licensee's spectrum blocks at their uplink and downlink ports shall not exceed the following limits: **−103 dBm/MHz−RSSI**
(i) Where RSSI is the downlink composite signal power received in dBm for frequencies in the band of operation outside the licensee's spectrum block as measured after spectrum block filtering is applied and is referenced to the booster's donor port for each band of operation. RSSI is expressed in negative dB units relative to 1 mW.
(ii) Boosters with MSCL less than 40 dB, shall reduce the Noise output in (A) by 40 dB−MSCL, where MSCL is the minimum coupling loss in dB between the wireless device and booster's server port. MSCL must be calculated or measured for each band of operation and provided in compliance test reports.
Fixed booster maximum downlink noise power shall **not exceed −102.5 dBm/MHz + 20 Log10 (Frequency)**, where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in "Transmit Power OFF Mode." In this mode of operation, the uplink and downlink noise power **shall not exceed −70 dBm/MHz** and uplink gain shall not exceed the lesser of 23 dB or MSCL.

The following chart is from KDB 935210 D04 Appendix D Figure D1 – Provider-specific consumer signal booster variable noise limits.



Test Procedures Used

KDB 935210 D04 Section 7.7
KDB 935210 D04 Section 7.7.1
KDB 935210 D04 Section 7.7.2

Test Settings

Maximum transmitter noise power level

1. Connect the EUT to the test equipment as shown in Figure 7-9, and use the test mode to set to maximum gain and minimum passband bandwidth.
2. Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 MHz.
3. Select the power averaging (rms) detector and trace average over at least 100 traces.
4. Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 x the CMRS band.
5. Measure the transmitter noise power spectral density over the CMRS band and use a marker to identify the maximum noise power within the CMRS band but outside of the authorized licensee spectrum block(s).
6. Save the spectrum analyzer plot as necessary for inclusion in the final test report.
7. Repeat Step 2 to 6 for all operational downlink bands.
8. Connect the EUT to the test equipment as shown in Figure 7-10 or Figure 7-11 as appropriate for uplink or downlink directions.
9. Configure the signal generator for AWGN with a 99% OBW of 4.1 MHz.
10. Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 MHz. Select the power averaging (rms) detector and average over at least 100 traces.
11. Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with a span setting ≥ 2 x the CMRS band. The span shall include all spectrum blocks in the particular CMRS band under test (see Appendix A).
12. For uplink noise measurements, set the spectrum analyzer center frequency for the uplink band under test and tune the signal generator to the center of the paired downlink band.
13. For downlink noise measurements, set the spectrum analyzer to the center of the downlink band and tune the signal generator to the upper or lower band-edge of the same band, ensuring that the maximum noise power is being measured.
14. Set the passband of the EUT and the RF filter frequencies to the other edge of the CMRS band. Ensure that the signal generator does not contribute to the in-band noise level of the booster.

    1) Filter 1 in Figure 11 should be configured as needed to ensure that no additional noise is present within or outside the passband of the booster at its donor port. Filter 2 should be configured such that an accurate measurement of the noise power outside of the CMRS licensee's block can be made on the spectrum analyzer.

    2) Any filter effects that may reduce the measured transmit noise level outside of the CMRS licensee's band of the EUT must be accounted for, to ensure that an accurate noise measurement is taken. The test report shall indicate the type and characteristics of the filters used.

15. Measure the maximum transmitter noise power level while varying the downlink signal generator output level from −90 dBm to −20 dBm in 1 dB steps within the RSSI-dependent region, and in 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit, with at least two points included from within the RSSI-dependent region of the limit. See Appendix D for noise limits graphs. The EUT response time shall be less than 3 seconds.
16. Repeat Step 8 through 15 for all operational uplink and downlink bands.

Variable noise response time

1. Set the spectrum analyzer to the uplink frequency to be measured.
2. Set the span to 0 Hz with a sweep time of 10 seconds.
3. Set the power level of signal generator to the lowest level of the RSSI-dependent noise.
4. Select MAX HOLD and increase the power level of signal generator by 20 dB for fixed boosters, and by 10 dB for mobile boosters.
5. Affirm that the uplink noise decreases to the specified level within 3 seconds for fixed boosters, and within 1 second for mobile boosters.
6. Repeat Step 1 through 5 for all operational uplink and downlink bands.
7. Include plots and summary table in test report.

Test Setup

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

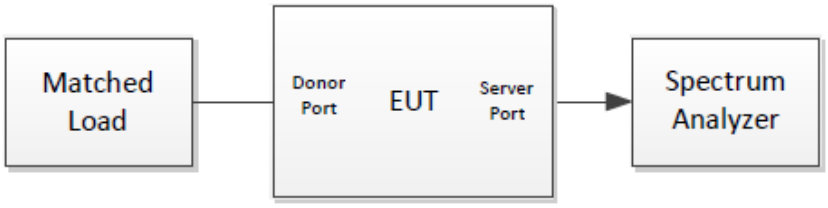


Figure 7-9. Maximum downlink noise limit test configuration

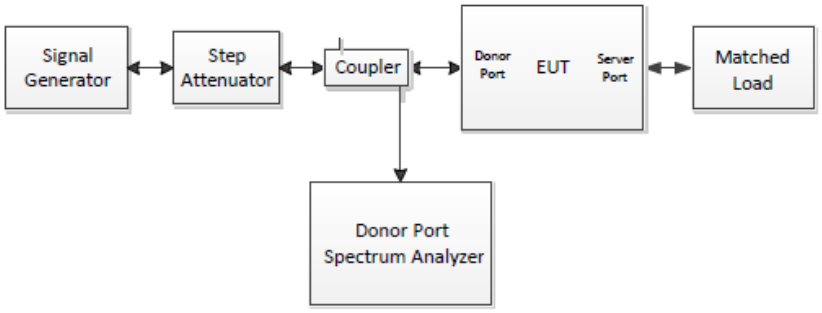


Figure 7-10. Uplink RSSI-dependent noise limit test configuration

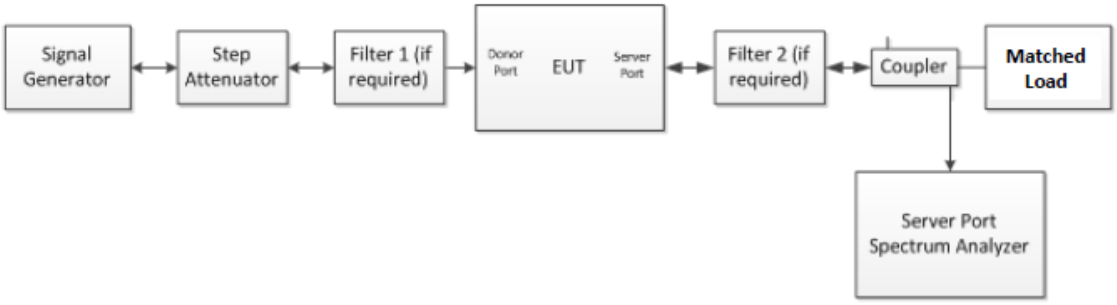


Figure 7-11. Downlink RSSI-dependent noise limit test configuration

Test Notes

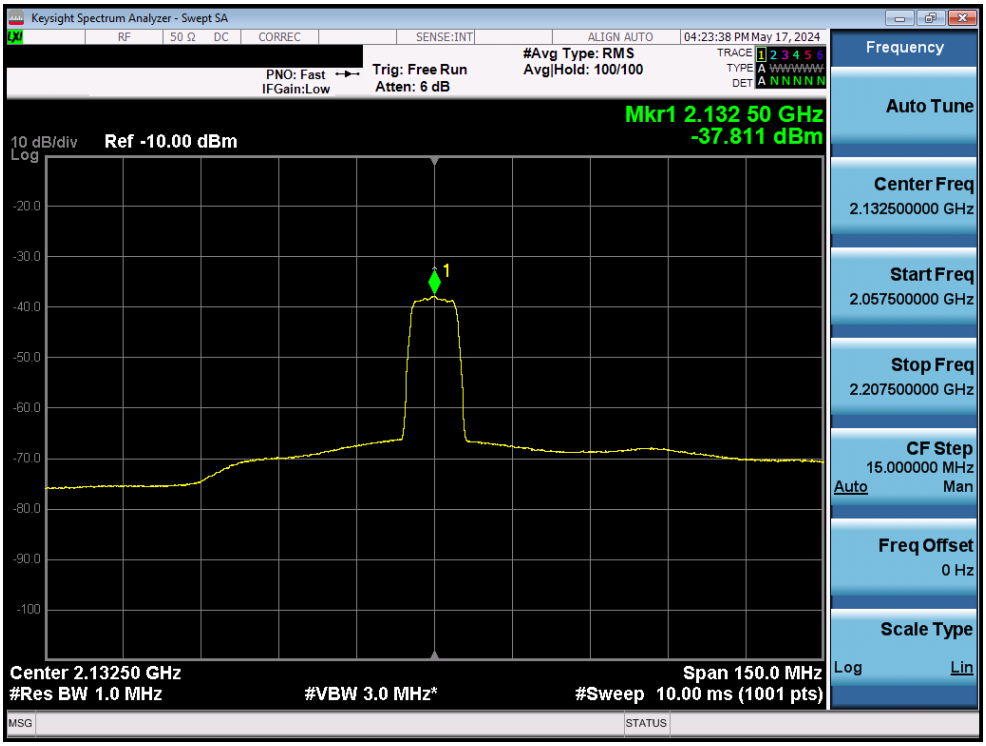
According to the declaration from the manufacturer, the lowest MSCL(Mobile Station Coupling Loss) values at the distance of 6ft for each bands were calculated as following:

Band	Uplink Center Frequency (MHz)	Path Loss (dB)	Polarity Loss (dB)	Inside Antenna Gain with Coax Loss (dBi)	MSCL
LTE Band 4	1732.5	42.49	3	-0.33	45.82
LTE Band 5	836.5	36.16	3	-2.79	41.95
LTE Band 12	707.5	34.72	3	-2.43	40.15
LTE Band 13	782	35.58	3	-1.69	40.27
LTE Band 25/2	1882.5	43.2	3	-1.29	47.49

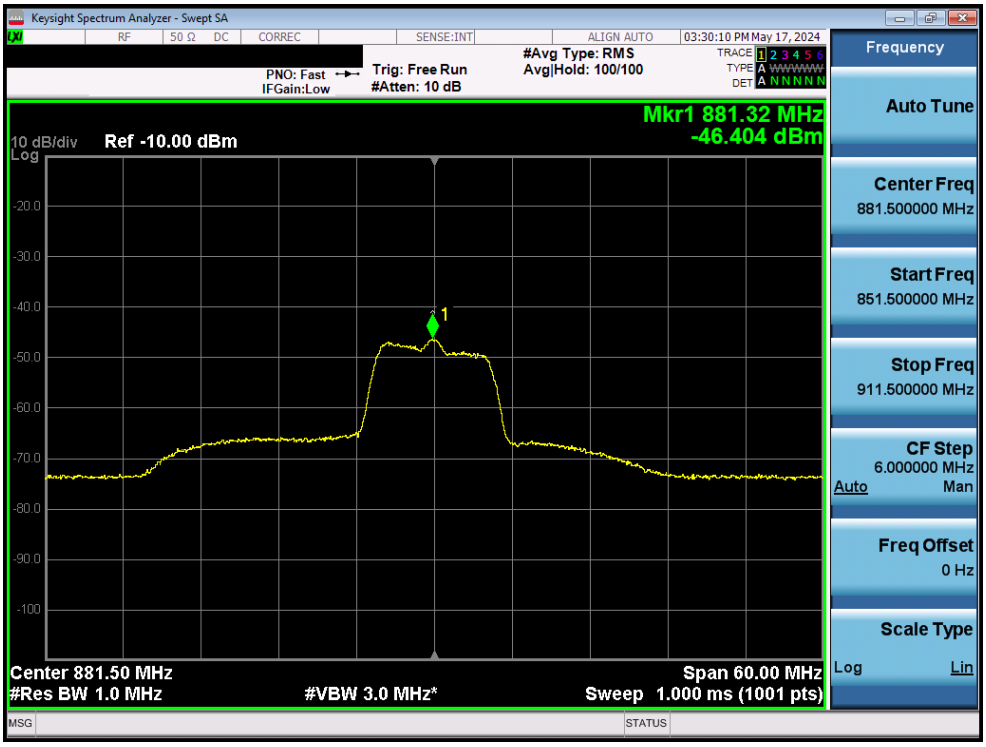
Table 7-20. Mobile Station Coupling Loss

Band	Frequency Range (MHz)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 4 (DL)	2110-2155	-37.81	-37.73	-0.08
LTE Band 5 (DL)	869-894	-46.40	-44.05	-2.35
LTE Band 12 (DL)	729-746	-45.82	-45.51	-0.32
LTE Band 13 (DL)	746-756	-45.29	-44.64	-0.65
LTE Band 25/2 (DL)	1930-1995	-37.18	-37.01	-0.18

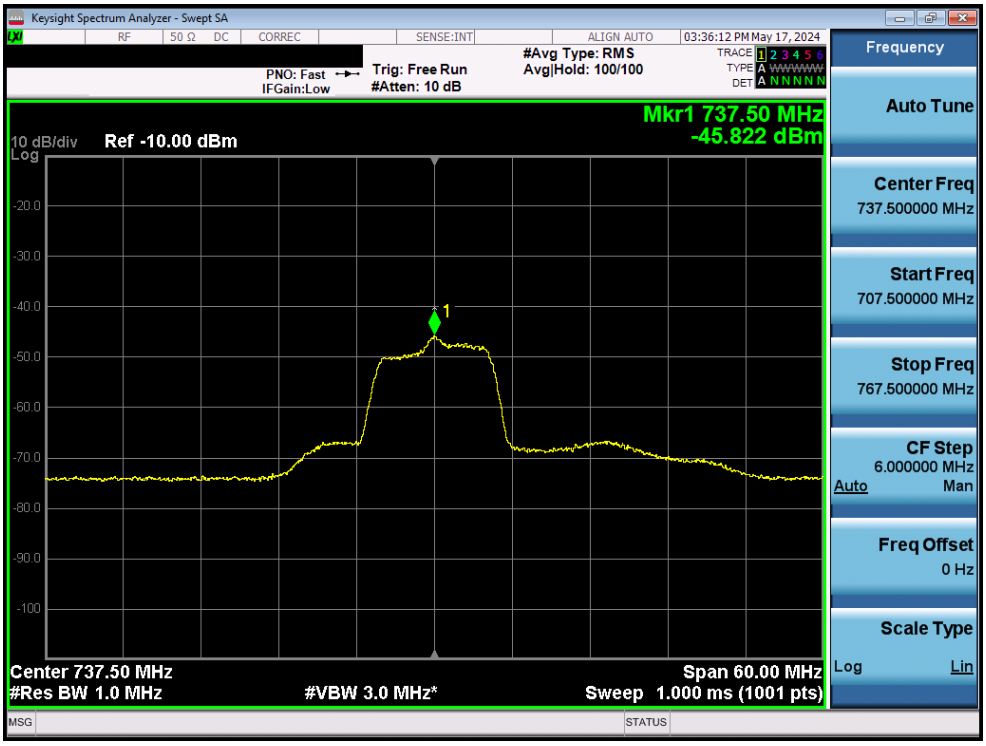
Table 7-21. Summary of Maximum downlink noise limit



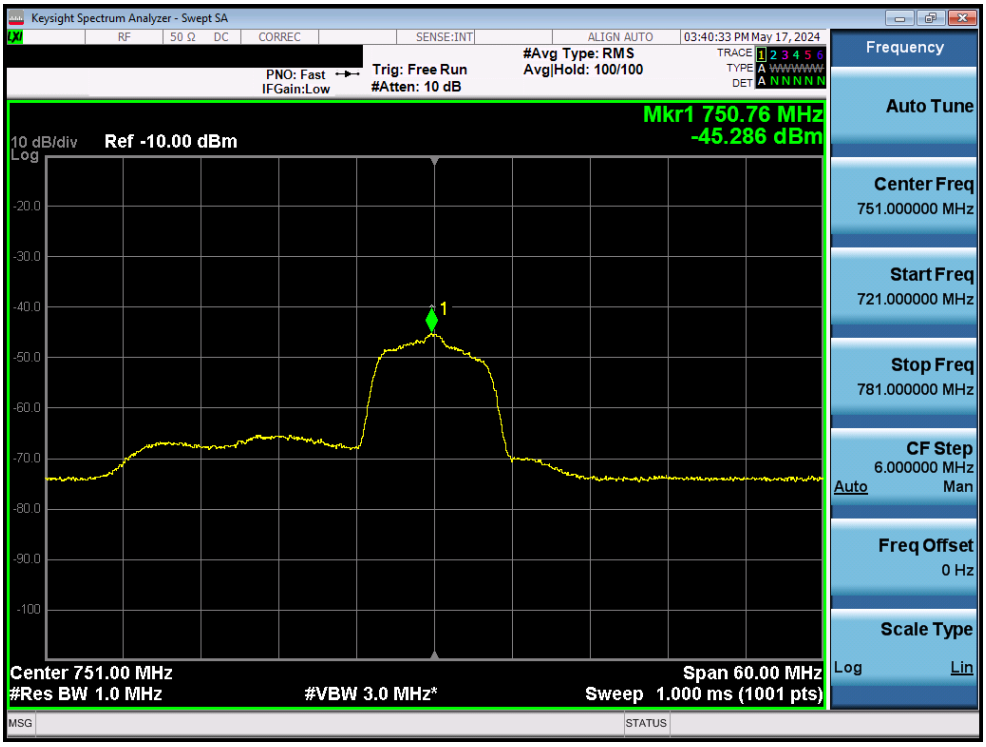
Plot 7-179. Maximum downlink noise limit – Band 4



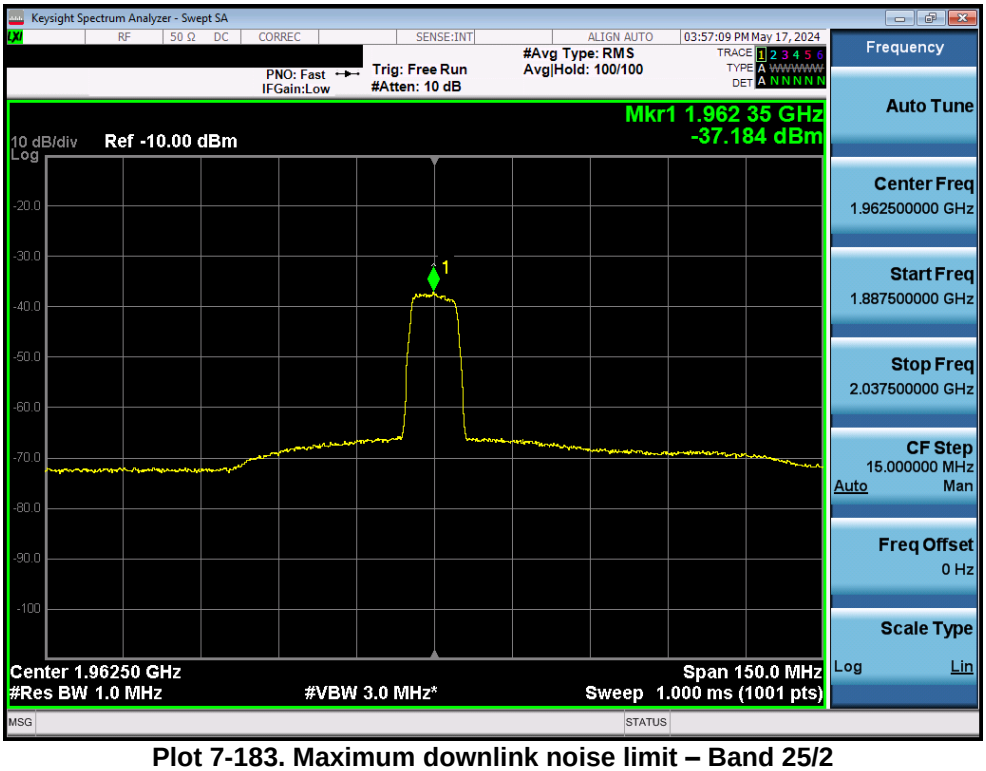
Plot 7-180. Maximum downlink noise limit – Band 5



Plot 7-181. Maximum downlink noise limit – Band 12



Plot 7-182. Maximum downlink noise limit – Band 13



Plot 7-183. Maximum downlink noise limit – Band 25/2

Maximum Noise (RSSI Dependent and Transmit Power off Mode)					
Band	Frequency Range (MHz)	RSSI Level (dBm)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 4 (DL)	2110-2155	-90.00	-70.45	-37.73	-32.72
		-68.00	-70.29	-37.73	-32.56
		-60.00	-70.16	-43.00	-27.16
		-52.00	-70.56	-51.00	-19.56
		-45.00	-70.19	-58.00	-12.19
		-39.00	-70.21	-64.00	-6.21
		-33.00	-70.38	-70.00	-0.38
		-32.00	-70.20	-70.00	-0.20
		-28.00	-70.12	-70.00	-0.12
LTE Band 4 (UL)	1710-1755	-90.00	-38.48	-37.70	-0.77
		-70.00	-38.63	-37.70	-0.93
		-62.00	-44.68	-41.00	-3.68
		-57.00	-48.81	-46.00	-2.81
		-52.00	-55.99	-51.00	-4.99
		-39.00	-67.77	-64.00	-3.77
		-29.00	-74.70	-70.00	-4.70
		-24.00	-75.56	-70.00	-5.56

Table 7-22. Maximum Noise – Band 4

Maximum Noise (RSSI Dependent and Transmit Power off Mode)					
Band	Frequency Range (MHz)	RSSI Level (dBm)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 5 (DL)	869-894	-90.00	-71.86	-44.05	-27.81
		-69.00	-71.70	-44.05	-27.65
		-55.00	-71.66	-48.00	-23.66
		-49.00	-71.53	-54.00	-17.53
		-46.00	-71.64	-57.00	-14.64
		-40.00	-71.69	-63.00	-8.69
		-33.00	-71.67	-70.00	-1.67
		-25.00	-74.48	-70.00	-4.48
LTE Band 5 (UL)	824-849	-90.00	-44.77	-44.00	-0.77
		-70.00	-44.91	-44.00	-0.91
		-54.00	-52.91	-49.00	-3.91
		-50.00	-53.54	-53.00	-0.54
		-45.00	-59.27	-58.00	-1.27
		-40.00	-64.09	-63.00	-1.09
		-32.00	-71.06	-70.00	-1.06
		-25.00	-73.97	-70.00	-3.97

Table 7-23. Maximum Noise – Band 5

Maximum Noise (RSSI Dependent and Transmit Power off Mode)					
Band	Frequency Range (MHz)	RSSI Level (dBm)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 12 (DL)	729-746	-90.00	-70.95	-45.51	-25.44
		-72.00	-71.04	-45.51	-25.54
		-55.00	-70.92	-48.00	-22.92
		-52.00	-71.24	-51.00	-20.24
		-48.00	-70.84	-55.00	-15.84
		-40.00	-71.00	-63.00	-8.00
		-33.00	-70.86	-70.00	-0.86
		-28.00	-71.03	-70.00	-1.03
LTE Band 12 (UL)	699-716	-85.00	-45.84	-45.50	-0.34
		-72.00	-46.80	-45.50	-1.30
		-52.00	-52.01	-51.00	-1.01
		-47.00	-56.63	-56.00	-0.63
		-44.00	-60.66	-59.00	-1.66
		-39.00	-65.83	-64.00	-1.83
		-27.00	-73.99	-70.00	-3.99
		-22.00	-75.42	-70.00	-5.42

Table 7-24. Maximum Noise – Band 12

Maximum Noise (RSSI Dependent and Transmit Power off Mode)					
Band	Frequency Range (MHz)	RSSI Level (dBm)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 13 (DL)	746-756	-87.00	-71.31	-44.64	-26.68
		-73.00	-71.39	-44.64	-26.75
		-53.00	-71.51	-50.00	-21.51
		-47.00	-70.37	-56.00	-14.37
		-41.00	-70.17	-62.00	-8.17
		-38.00	-70.27	-65.00	-5.27
		-33.00	-70.18	-70.00	-0.18
		-28.00	-70.22	-70.00	-0.22
LTE Band 13 (UL)	777-787	-88.00	-45.29	-44.60	-0.69
		-74.00	-45.74	-44.60	-1.14
		-53.00	-50.72	-50.00	-0.72
		-48.00	-55.28	-55.00	-0.28
		-42.00	-61.56	-61.00	-0.56
		-38.00	-65.17	-65.00	-0.17
		-28.00	-73.30	-70.00	-3.30
		-23.00	-75.88	-70.00	-5.88

Table 7-25. Maximum Noise – Band 13

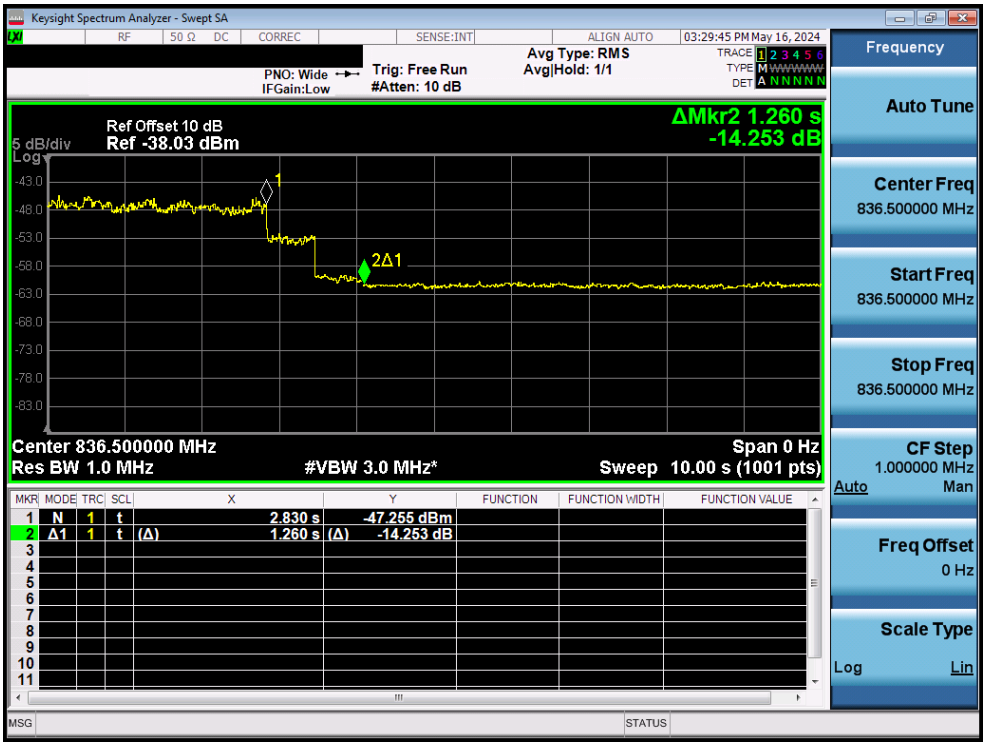
Maximum Noise (RSSI Dependent and Transmit Power off Mode)					
Band	Frequency Range (MHz)	RSSI Level (dBm)	Max Noise (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
LTE Band 25/2 (DL)	1930-1995	-90.00	-70.61	-37.01	-33.61
		-80.00	-70.59	-37.01	-33.58
		-70.00	-71.12	-37.01	-34.11
		-58.00	-70.50	-45.00	-25.50
		-53.00	-70.40	-50.00	-20.40
		-50.00	-70.85	-53.00	-17.85
		-46.00	-70.50	-57.00	-13.50
		-43.00	-70.76	-60.00	-10.76
		-40.00	-70.69	-63.00	-7.69
		-35.00	-70.36	-68.00	-2.36
		-33.00	-70.18	-70.00	-0.17
		-28.00	-70.32	-70.00	-0.32
		-26.00	-70.25	-70.00	-0.25
LTE Band 25/2 (UL)	1850-1915	-90.00	-40.21	-37.00	-3.21
		-80.00	-40.27	-37.00	-3.27
		-70.00	-40.28	-37.00	-3.28
		-60.00	-48.16	-43.00	-5.16
		-59.00	-49.42	-44.00	-5.42
		-50.00	-58.46	-53.00	-5.46
		-40.00	-67.96	-63.00	-4.96
		-35.00	-71.31	-68.00	-3.31
		-31.00	-79.98	-70.00	-9.98
		-26.00	-74.99	-70.00	-4.99
		-21.00	-80.41	-70.00	-10.41
		-20.00	-80.96	-70.00	-10.96

Table 7-26. Maximum Noise – Band 25/2

Band	Frequency Range (MHz)	Noise Response Time (s)	Limit (s)	Margin (s)
LTE Band 4 (UL)	1710-1755	1.29	3	1.71
LTE Band 5 (UL)	824-849	1.26	3	1.74
LTE Band 12 (UL)	699-716	1.27	3	1.73
LTE Band 13 (UL)	777-787	0.64	3	2.36
LTE Band 25/2 (UL)	1850-1915	0.64	3	2.36

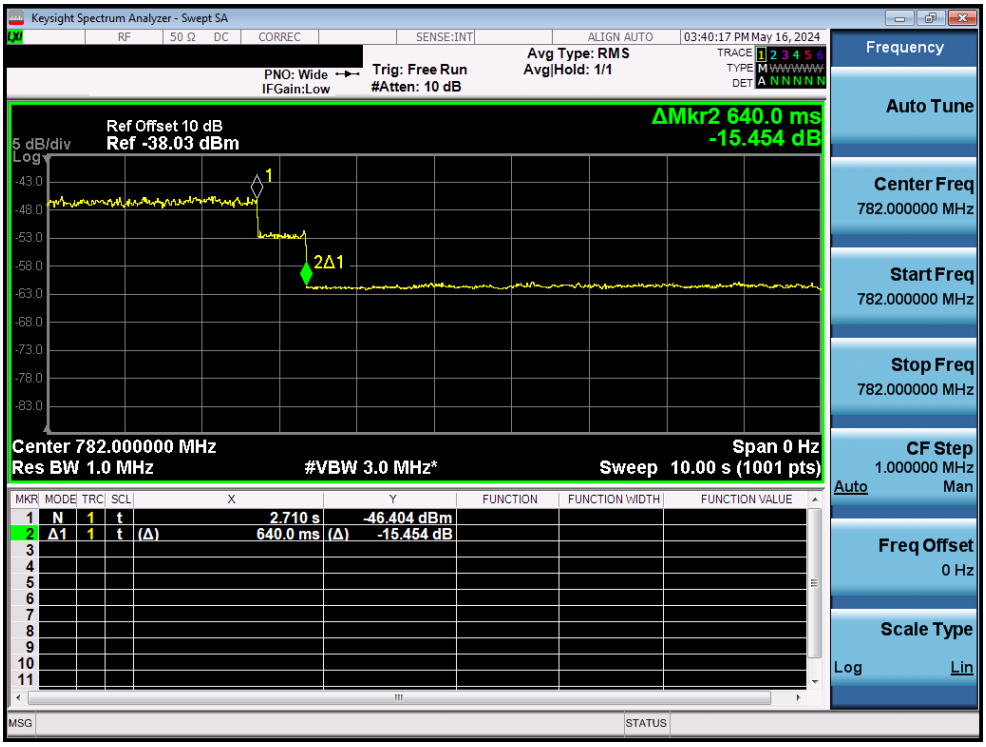
Table 7-27. Summary of Variable Noise Response Time

Plot 7-184. Variable Noise Response Time – Band 4



Plot 7-185. Variable Noise Response Time – Band 5

Plot 7-186. Variable Noise Response Time – Band 12



Plot 7-187. Variable Noise Response Time – Band 13

Plot 7-188. Variable Noise Response Time – Band 25/2

7.10 Uplink Inactivity

Test Overview

When a consumer booster is not serving an active device connection after 5 seconds the uplink noise power shall not exceed −70 dBm/MHz. For ISED Canada approval, the limit is 5 minutes. The test data in this section applies the more conservative 5 second limit to assess compliance.

Test Procedures Used

KDB 935210 D04 Section 7.8

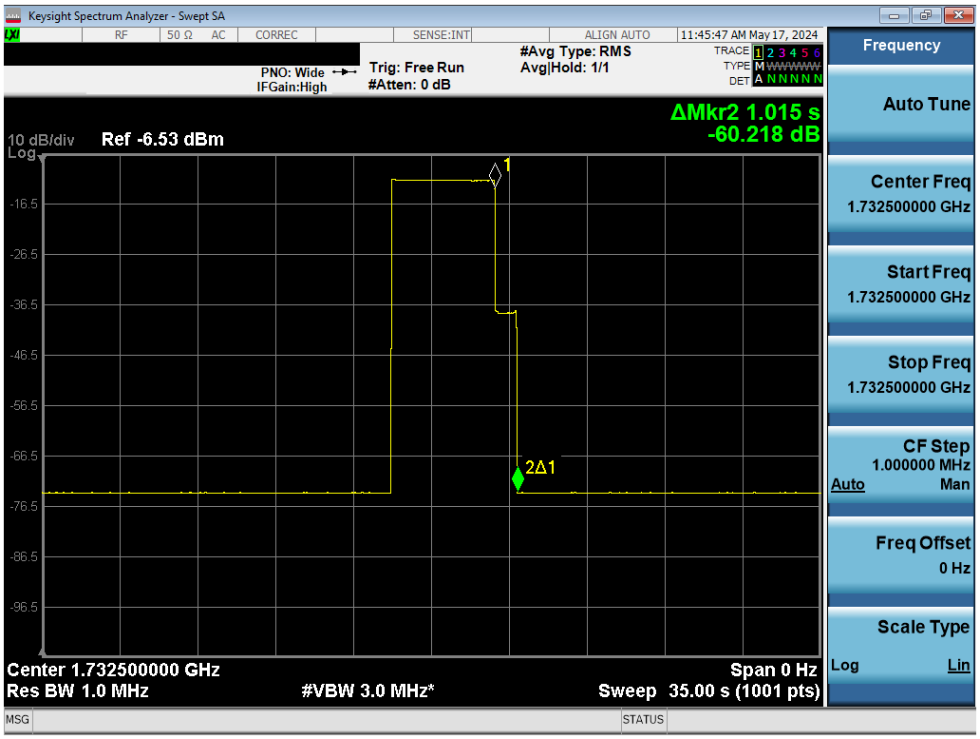
Test Settings

1. Connect the EUT to the test equipment as shown in Figure 7-1 (normal operational mode).
2. Select the power averaging (rms) detector.
3. Set the spectrum analyzer RBW for 1 MHz with the VBW ≥ 3 MHz.
4. Set the center frequency of the spectrum analyzer to the center of the uplink operational band.
5. Set the span for 0 Hz, then initiate a single sweep with a sweep time of at least 30 seconds.
6. Start to capture a new trace using MAX HOLD.
7. After approximately 15 seconds, turn on the Signal Generator Output.
8. After approximately 5 seconds, turn off the Signal Generator Output.
9. After the full-sweep time-domain trace is complete, place a MARKER on the leading edge of the pulse then use the DELTA MARKER function to determine the elapsed time until the uplink becomes inactive.
10. Measure the noise power level using the procedures of 7.7.1a) to 7.7.1e), then demonstrate that the results are below the applicable uplink inactivity noise power limit.
11. Capture the plot for inclusion in the test report.
12. Repeat Step 4 to 11 for all operational uplink bands.

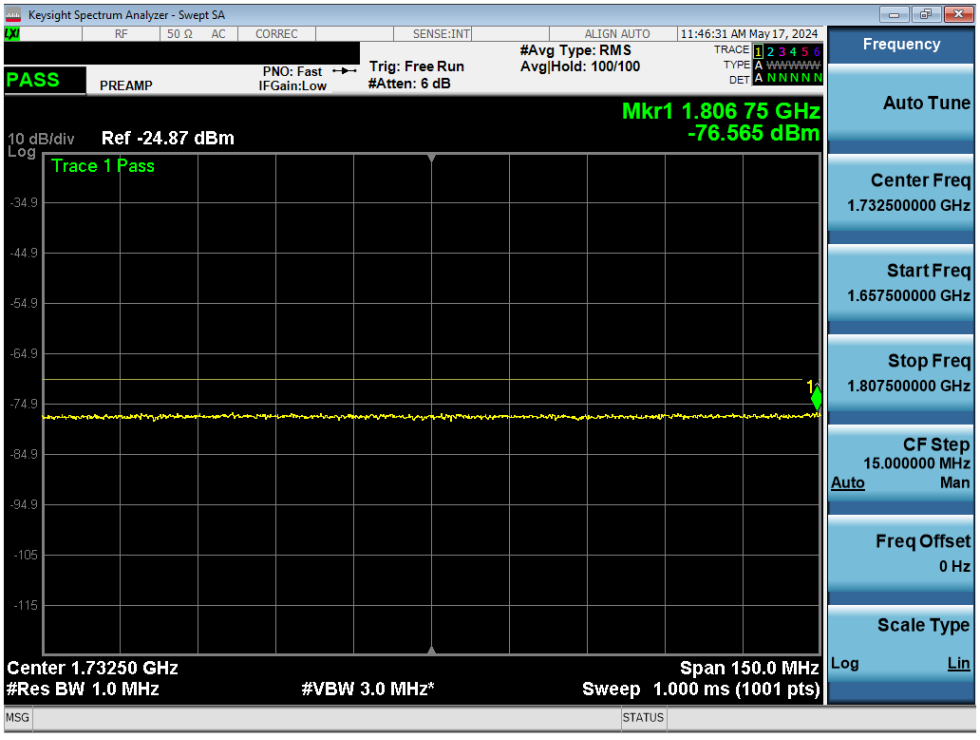
Test Notes

Uplink Inactivity							
Band	Frequency Range (MHz)	Measured Time (sec)	Limit (sec)	Margin (sec)	Noise Power Level (dBm/MHz)	Limit (dBm/MHz)	Margin (dBm/MHz)
LTE Band 4 (UL)	1710-1755	1.015	5	-3.985	-76.565	-70	-6.565
LTE Band 5 (UL)	824-849	1.05	5	-3.95	-77.992	-70	-7.992
LTE Band 12 (UL)	699-716	0.735	5	-4.265	-78.287	-70	-8.287
LTE Band 13 (UL)	777-787	0.84	5	-4.16	-84.177	-70	-14.177
LTE Band 25/2 (UL)	1850-1915	0.945	5	-4.055	-76.258	-70	-6.258

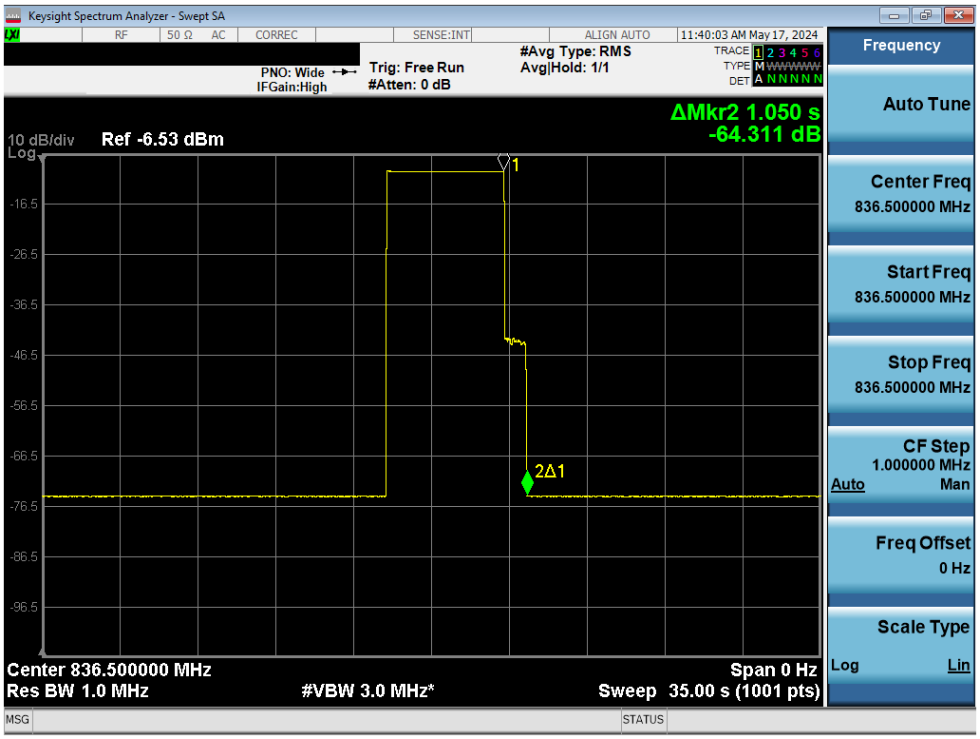
Table 7-28. Summary of Uplink Inactivity



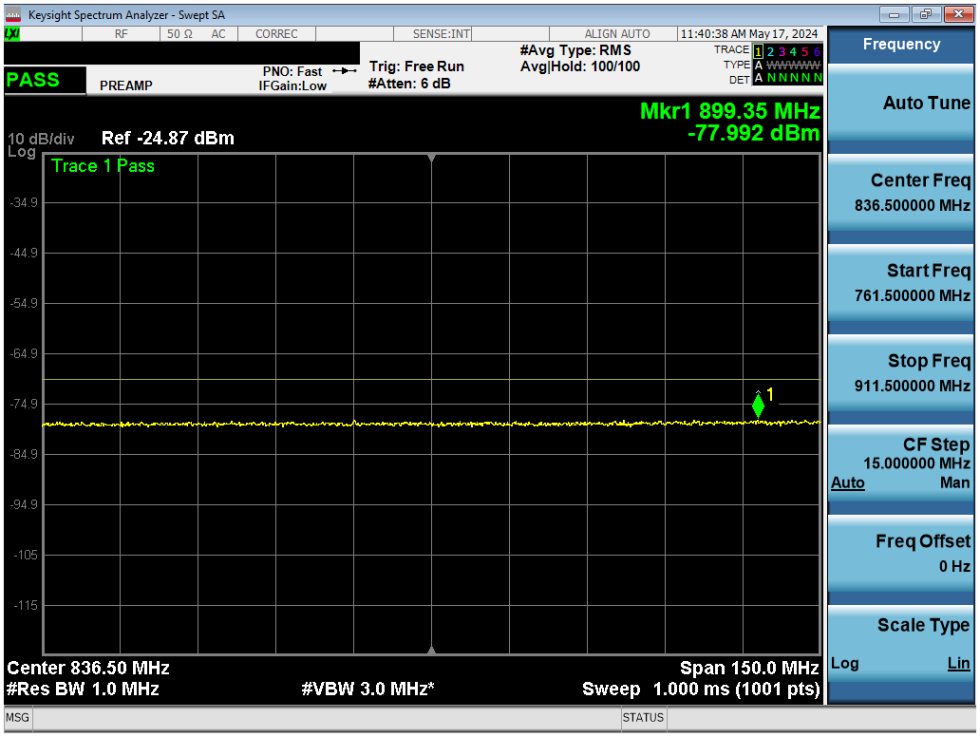
Plot 7-189. Uplink Inactivity – Band 4 – Inactive Time



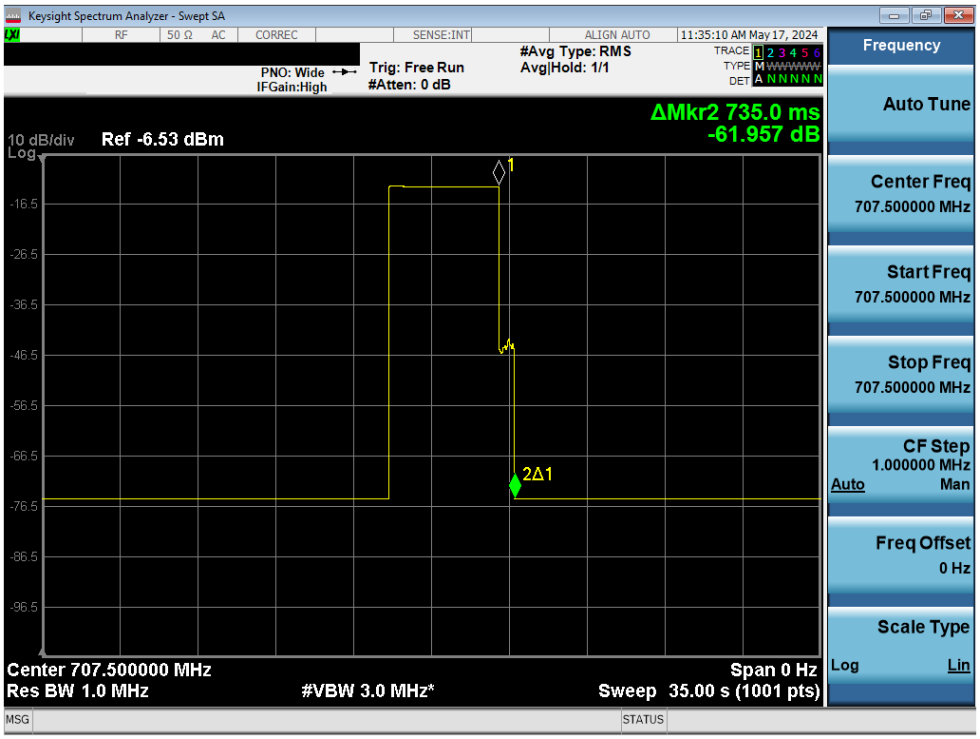
Plot 7-190. Uplink Inactivity – Band 4 – Noise Level



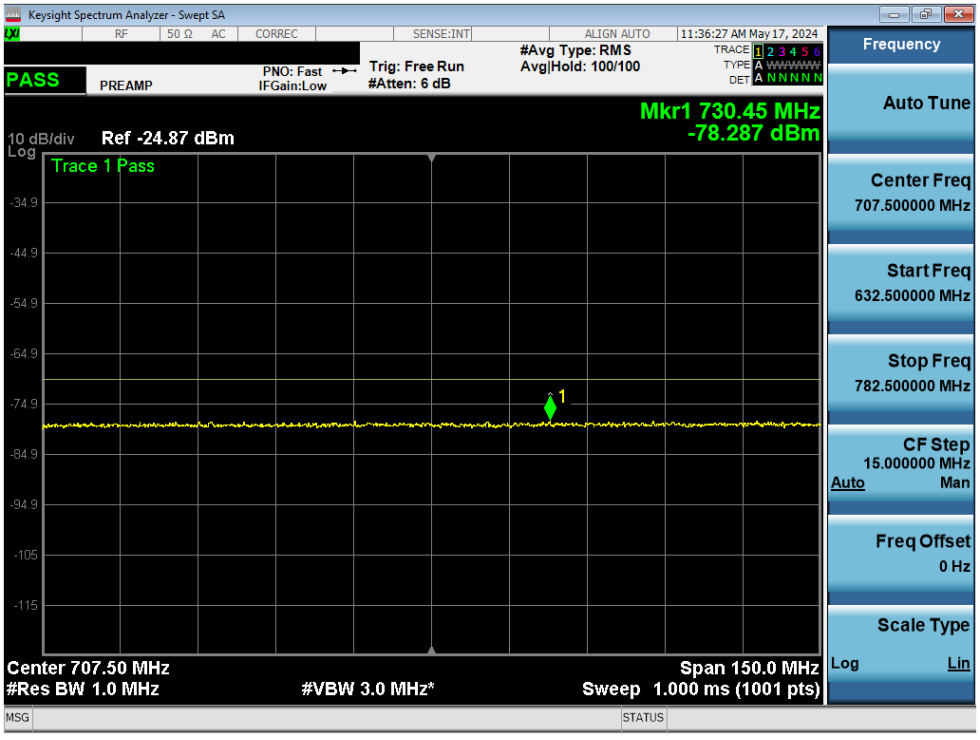
Plot 7-191. Uplink Inactivity – Band 5 – Inactive Time



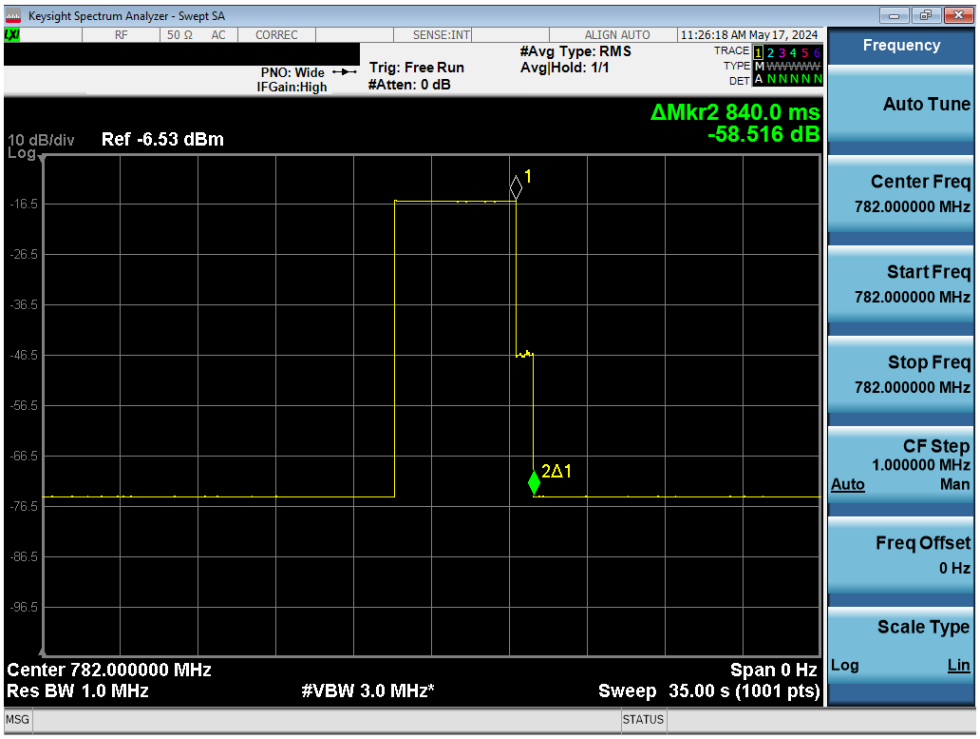
Plot 7-192. Uplink Inactivity – Band 5 – Noise Level



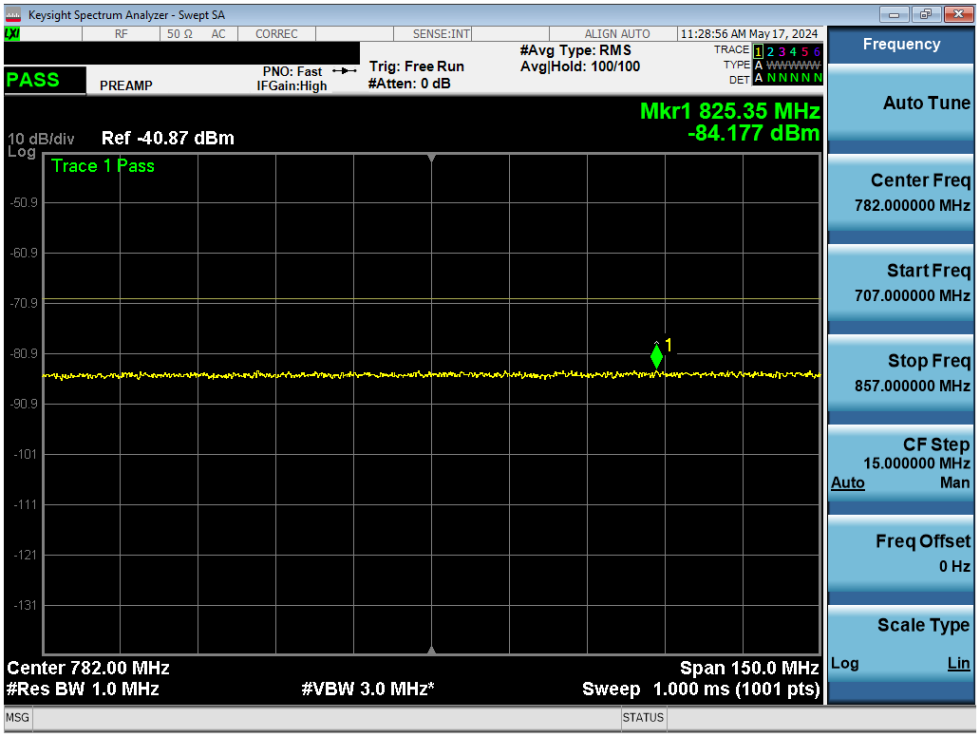
Plot 7-193. Uplink Inactivity – Band 12 – Inactive Time



Plot 7-194. Uplink Inactivity – Band 12 – Noise Level

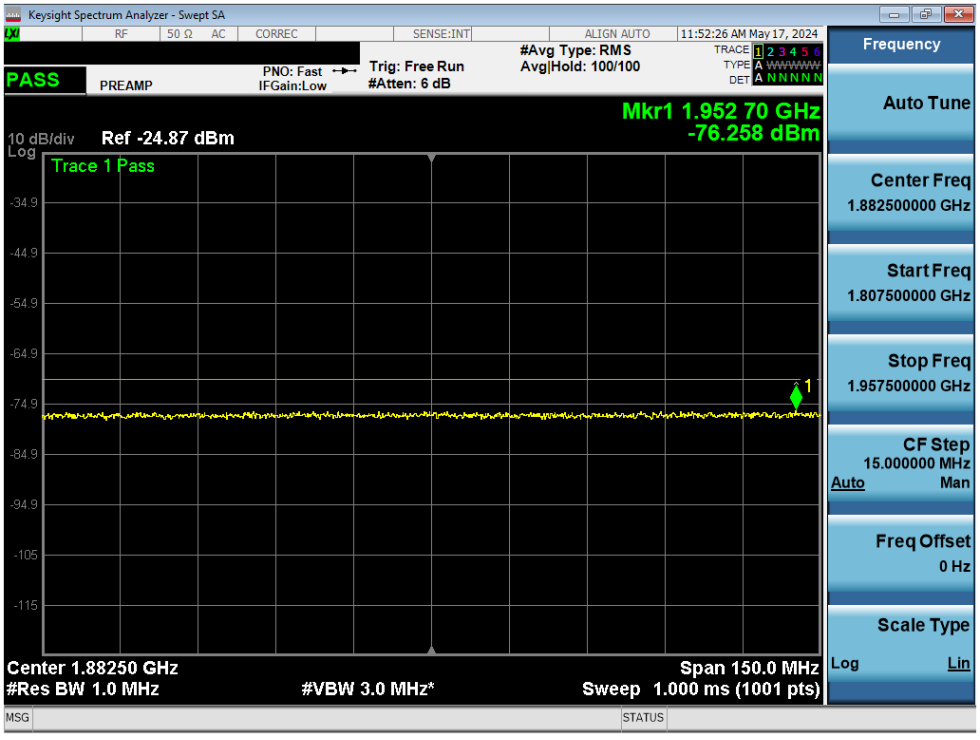


Plot 7-195. Uplink Inactivity – Band 13 – Inactive Time



Plot 7-196. Uplink Inactivity – Band 13 – Noise Level

Plot 7-197. Uplink Inactivity – Band 25/2 – Inactive Time



Plot 7-198. Uplink Inactivity – Band 25/2 – Noise Level

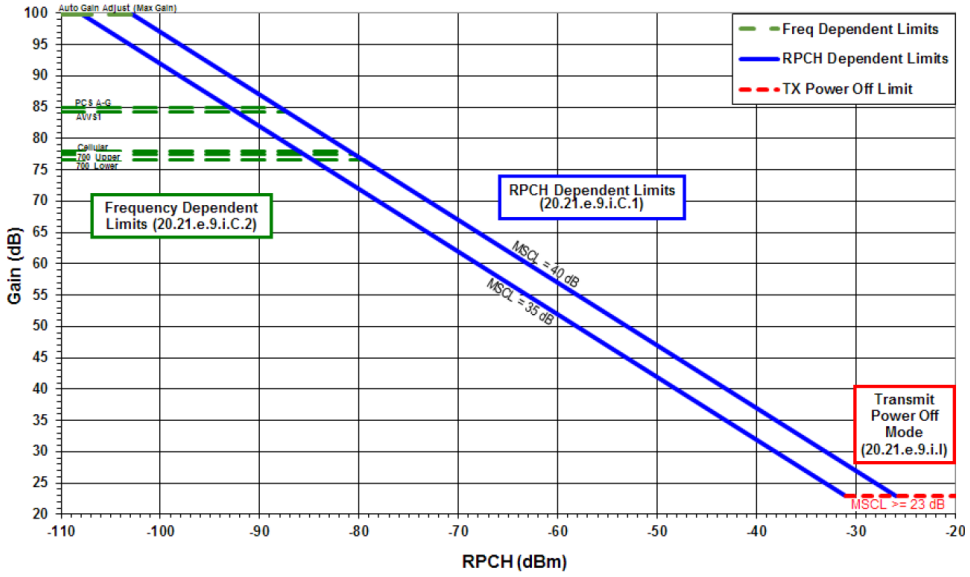
7.11 Variable Booster Gain & Variable Gain Timing

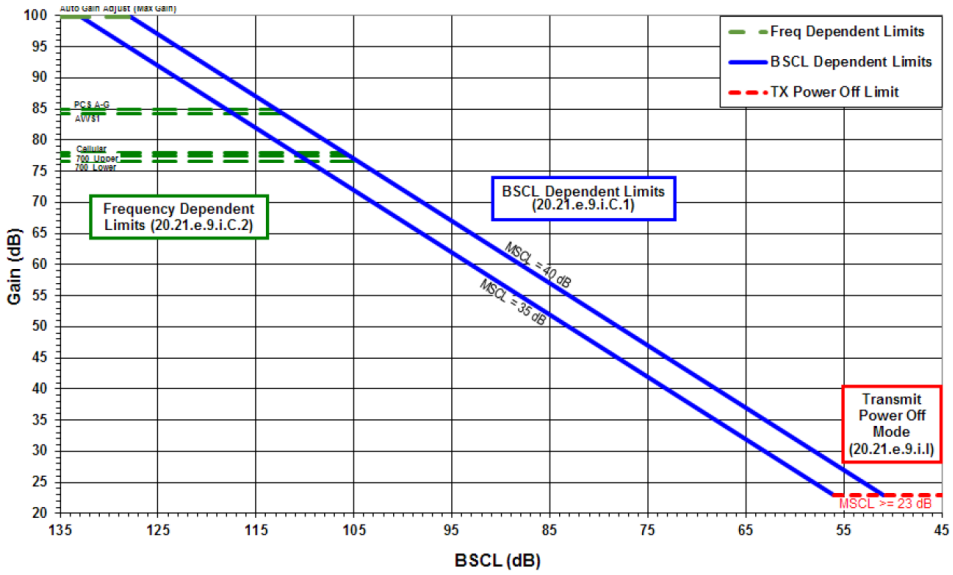
Test Overview

The gain of the frequency selective consumer booster shall meet the limits below.
(1) The uplink and downlink gain in dB of a frequency selective consumer booster referenced to its input and output ports **shall not exceed BSCL−28 dB−(40 dB−MSCL)**.
(i) Where BSCL is the coupling loss between the booster's donor port and the base station's input port, and MSCL is the minimum coupling loss in dB between the wireless device and the booster's server port. MSCL must be calculated or measured for each band of operation and provided in compliance test reports.
(ii) In order of preference, BSCL is determined as follows: determine path loss between the base station and the booster; such measurement shall be based on measuring the received forward pilot/control channel power at the booster and reading the pilot/control channel transmit power from the base station as defined in the system information messages sent by the base station; estimate BSCL by assuming that the base station is transmitting at a level of + 25 dBm per channel and measuring the total received signal power level within the channel in dBm (RPCH) received at the booster input port. BSCL is then calculated as 25-RPCH; or assume that the BSCL is 70 dB without performing any measurement.
(2) The uplink and downlink maximum gain of a frequency selective consumer booster referenced to its input and output ports shall not exceed the following limits:
(i) Fixed Booster maximum gain shall **not exceed 19.5 dB + 20 Log10 (Uplink Mid Band Frequency)**, or 100 dB for systems having automatic gain adjustment based on isolation measurements between booster donor and server antennas.

When the consumer booster cannot otherwise meet the noise and gain limits defined herein it must operate in “Transmit Power OFF Mode.” In this mode of operation, the uplink and downlink noise power shall **not exceed −70 dBm/MHz** and uplink gain shall not exceed the lesser of 23 dB or MSCL.

Following charts is from KDB 935210 D04 Appendix D Figure D2 & D3 – Provider-specific consumer signal booster variable gain limits





Test Procedures Used

KDB 935210 D04 Section 7.9.1
KDB 935210 D04 Section 7.9.2

Test Settings

Variable gain

1. Connect the EUT to the test equipment as shown in Figure 7-1 (normal operational mode).
2. Configure the base station simulator for the transmission of a valid base station signal for the standard being tested (e.g., W-CDMA or LTE), and set the base station forward pilot/control channel TX power to a fixed value that is able to achieve the dynamic range indicated in the following procedure.
3. Set the power level and frequency of the signal generator to a value 5 dB below the AGC threshold level as determined in 7.2.2 with the booster operating at maximum gain. The uplink signal type is AWGN with a 99% OBW of 4.1 MHz.
4. Set RBW = 100 kHz on the donor and server port spectrum analyzers.
5. Set VBW ≥ 300 kHz on the donor and server port spectrum analyzers.
6. Select the CHANNEL POWER measurement mode on the donor and server port spectrum analyzers.
7. Select the power averaging (rms) detector on the donor and server port spectrum analyzers.
8. Set number of measurement points per sweep ≥ (2 x span)/RBW.
9. Sweep time = auto couple or as necessary (but no less than auto couple value).
10. Trace average at least 10 traces in power averaging (rms) mode.
11. Measure the maximum channel power in the uplink and downlink directions, and compute maximum gain, when varying the variable attenuator to achieve a received signal channel power level (RPCH) at the booster port of from −90 dBm to −20 dBm, in 1 dB steps inside the RPCH dependent region, and in 10 dB

steps outside the RPCH dependent region. Report the six values closest to the limit, including at least two points from within the RPCH dependent region of operation. See gain limit charts in Appendix D.

12. Repeat Step 1 to 11 for all uplink and downlink bands.

Variable gain timing

1. Set the spectrum analyzer to the uplink frequency to be measured.
2. Set the span to 0 Hz with a sweep time of 10 seconds.
3. Set the BSCL to obtain the maximum booster gain within the BSCL dependent gain region.
4. Select MAX HOLD and decrease the BSCL by decreasing the variable attenuator in 20 dB steps for fixed boosters, and in 10 dB steps for mobile boosters. The signal generator output power remains fixed at the level determined in 7.9.1c).
5. Ensure that the uplink gain decreases to the specified levels within 3 seconds for fixed boosters, and within 1 second for mobile boosters
6. Repeat Step 1 to 5 for all operational uplink bands.

Test Notes

According to the declaration from the manufacturer, the lowest MSCL(Mobile Station Coupling Loss) values at the distance of 6ft for each bands were calculated as following:

Band	Uplink Center Frequency (MHz)	Path Loss (dB)	Polarity Loss (dB)	Inside Antenna Gain with Coax Loss (dBi)	MSCL
LTE Band 4	1732.5	42.49	3	-0.33	45.82
LTE Band 5	836.5	36.16	3	-2.79	41.95
LTE Band 12	707.5	34.72	3	-2.43	40.15
LTE Band 13	782	35.58	3	-1.69	40.27
LTE Band 25/2	1882.5	43.2	3	-1.29	47.49

Table 7-29. Mobile Station Coupling Loss

Gain vs RPCH and BSCL - Mid Channel						
Band	RPCH Power (dBm)	BSCL (dB)	Measured Power (dBm)	Gain (dB)	Limit (dB)	Margin (dB)
LTE B4 DL	-100	125	-27.76	72.24	84.27	-12.03
	-92	117	-21.68	70.32	84.27	-13.95
	-77	102	-7.16	69.84	79.82	-9.98
	-74	99	-4.02	69.98	76.82	-6.84
	-69	94	-2.12	66.88	71.82	-4.94
	-58	83	-2.48	55.52	60.82	-5.30
	-48	73	-2.32	45.68	50.82	-5.14
	-30	55	-2.48	27.52	32.82	-5.30
	-24	49	-2.76	21.24	23.00	-1.76
	-20	45	-2.79	17.21	23.00	-5.79
LTE B4 UL	-100	125	16.62	64.10	84.27	-20.18
	-90	115	16.62	64.10	84.27	-20.18
	-75	100	14.29	61.77	77.82	-16.05
	-67	92	6.38	53.86	69.82	-15.96
	-62	87	1.44	48.92	64.82	-15.90
	-47	72	-13.86	33.62	49.82	-16.20
	-30	55	-30.31	17.17	32.82	-15.65
	-25	50	-35.37	12.11	23.00	-10.89
	-20	45	-36.76	10.72	23.00	-12.28

Table 7-30. Variable Booster Gain – Band 4

Gain vs RPCH and BSCL - Mid Channel						
Band	RPCH Power (dBm)	BSCL (dB)	Measured Power (dBm)	Gain (dB)	Limit (dB)	Margin (dB)
LTE B5 DL	-100	125	-37.58	62.42	77.95	-15.53
	-82	107	-22.53	59.47	77.95	-18.48
	-72	97	-12.51	59.49	70.95	-11.46
	-65	90	-5.46	59.54	63.95	-4.41
	-62	87	-2.97	59.03	60.95	-1.92
	-61	86	-2.95	58.05	59.95	-1.90
	-60	85	-2.73	57.27	58.95	-1.68
	-42	67	-2.81	39.19	40.95	-1.76
	-34	59	-3.23	30.77	32.95	-2.18
	-26	51	-3.06	22.94	24.95	-2.01
	-25	50	-3.07	21.93	23.00	-1.07
	-20	45	-3.03	16.97	23.00	-6.03
LTE B5 UL	-100	125	15.70	58.06	77.95	-19.89
	-86	111	15.69	58.05	77.95	-19.90
	-78	103	15.69	58.05	76.95	-18.90
	-62	87	10.14	52.50	60.95	-8.45
	-52	77	-0.30	42.06	50.95	-8.89
	-42	67	-10.64	31.72	40.95	-9.23
	-34	59	-18.56	23.80	32.95	-9.15
	-26	51	-26.51	15.85	24.95	-9.10
	-25	50	-27.41	14.95	23.00	-8.05
	-20	45	-32.45	9.91	23.00	-13.09

Table 7-31. Variable Booster Gain – Band 5

Gain vs RPCH and BSCL - Mid Channel						
Band	RPCH Power (dBm)	BSCL (dB)	Measured Power (dBm)	Gain (dB)	Limit (dB)	Margin (dB)
LTE B12 DL	-95	120	-34.37	60.63	76.49	-15.86
	-86	111	-26.33	59.67	76.49	-16.82
	-74	99	-14.38	59.62	71.15	-11.53
	-64	89	-4.34	59.66	61.15	-1.49
	-62	87	-3.87	58.13	59.15	-1.02
	-60	85	-3.84	56.16	57.15	-0.99
	-46	71	-3.83	42.17	43.15	-0.98
	-33	58	-3.77	29.23	30.15	-0.92
	-25	50	-3.56	21.44	23.00	-1.56
	-20	45	-3.56	16.44	23.00	-6.56
LTE B12 UL	-90	115	15.30	55.51	76.49	-20.99
	-83	108	15.30	55.51	76.49	-20.99
	-78	103	15.28	55.49	75.15	-19.66
	-68	93	15.31	55.52	65.15	-9.63
	-60	85	15.30	55.51	57.15	-1.64
	-57	82	12.85	53.06	54.15	-1.09
	-55	80	10.40	50.61	52.15	-1.54
	-53	78	7.91	48.12	50.15	-2.03
	-37	62	-7.83	32.38	34.15	-1.77
	-25	50	-22.18	18.03	23.00	-4.97
	-22	47	-25.64	14.57	23.00	-8.43

Table 7-32. Variable Booster Gain – Band 12

Gain vs RPCH and BSCL - Mid Channel						
Band	RPCH Power (dBm)	BSCL (dB)	Measured Power (dBm)	Gain (dB)	Limit (dB)	Margin (dB)
LTE B13 DL	-95	120	-33.36	61.64	77.36	-15.72
	-87	112	-26.24	60.76	77.36	-16.60
	-72	97	-11.35	60.65	69.27	-8.62
	-66	91	-6.27	59.73	63.27	-3.54
	-65	90	-5.25	59.75	62.27	-2.52
	-63	88	-4.74	58.26	60.27	-2.01
	-61	86	-4.77	56.23	58.27	-2.04
	-46	71	-4.73	41.27	43.27	-2.00
	-32	57	-4.63	27.37	29.27	-1.90
	-25	50	-4.44	20.56	23.00	-2.44
	-23	48	-4.53	18.47	23.00	-4.53
LTE B13 UL	-95	120	16.60	57.66	77.36	-19.70
	-82	107	16.63	57.69	77.36	-19.67
	-70	95	16.61	57.67	67.27	-9.60
	-61	86	16.12	57.18	58.27	-1.09
	-60	85	15.62	56.68	57.27	-0.59
	-50	75	5.30	46.36	47.27	-0.91
	-43	68	-1.56	39.50	40.27	-0.77
	-30	55	-14.46	26.60	27.27	-0.67
	-25	50	-21.82	19.24	23.00	-3.76
	-24	49	-22.30	18.76	23.00	-4.24

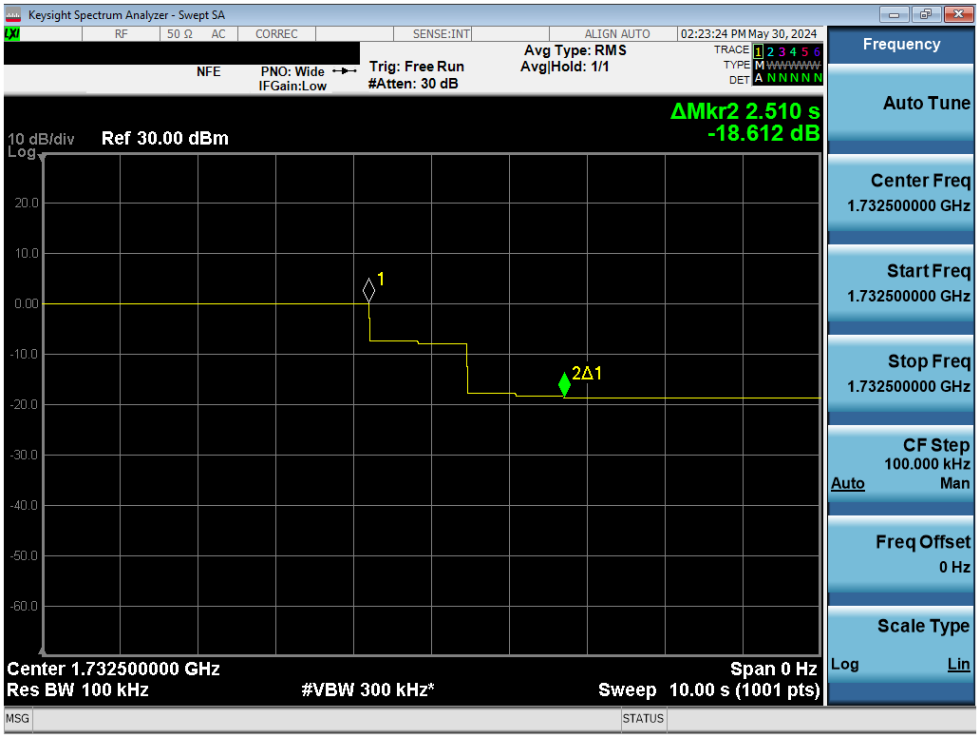
Table 7-33. Variable Booster Gain – Band 13

Gain vs RPCH and BSCL - Mid Channel						
Band	RPCH Power (dBm)	BSCL (dB)	Measured Power (dBm)	Gain (dB)	Limit (dB)	Margin (dB)
LTE B25/2 DL	-100	75	-26.27	23.73	84.99	-61.26
	-89	114	-17.48	71.52	84.99	-13.47
	-73	98	-1.71	71.29	77.49	-6.20
	-68	93	-0.91	67.09	72.49	-5.40
	-59	84	-0.84	58.16	63.49	-5.33
	-49	74	-0.64	48.36	53.49	-5.13
	-43	68	-0.68	42.32	47.49	-5.17
	-38	63	-1.10	36.90	42.49	-5.59
	-30	55	-1.87	28.13	34.49	-6.36
	-26	51	-2.34	23.66	30.49	-6.83
	-25	50	-2.89	22.11	23.00	-0.89
	-21	46	-3.55	17.45	23.00	-5.55
LTE B25/2 UL	-100	125	17.17	64.14	84.99	-20.85
	-93	118	17.17	64.14	84.99	-20.85
	-80	105	17.13	64.10	84.49	-20.39
	-78	103	15.74	62.71	82.49	-19.78
	-68	93	6.26	53.23	72.49	-19.26
	-57	82	-4.96	42.01	61.49	-19.48
	-45	70	-16.82	30.15	49.49	-19.34
	-25	50	-38.12	8.85	23.00	-14.15
	-21	46	-38.11	8.86	23.00	-14.14

Table 7-34. Variable Booster Gain – Band 25/2

Band	Frequency Range (MHz)	Gain Response Time (s)	Limit (s)	Margin (s)
LTE Band 4 (UL)	1710-1755	2.510	3	0.490
LTE Band 5 (UL)	824-849	2.252	3	0.748
LTE Band 12 (UL)	699-716	1.260	3	1.740
LTE Band 13 (UL)	777-787	0.640	3	2.360
LTE Band 25/2 (UL)	1850-1915	2.510	3	0.490

Table 7-35. Summary of Variable Gain Timing



Plot 7-199. Variable Gain Timing – Band 4

Plot 7-200. Variable Gain Timing – Band 5

Plot 7-201. Variable Gain Timing – Band 12

Plot 7-202. Variable Gain Timing – Band 13

Plot 7-203. Variable Gain Timing – Band 25/2

7.12 Occupied Bandwidth

Test Overview

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers measured are each equal to 0.5 percent of the total mean power measured for a given emission. All modes of operation were investigated and the worst case configuration results are reported in this section.

Test Procedure Used

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Test Settings

1. Connect the test equipment as shown in Figure 7-12 to firstly measure the characteristics of the test signals produced by the signal generator.
2. Set the center frequency of the spectrum analyzer to the center of the operational band. The span will be adjusted for each modulation type and OBW as necessary for accurately viewing the signals.
3. Set the signal generator for power level to match the values obtained from the tests of 7.2.
4. Set the signal generator modulation type for GSM with a PRBS pattern, and allow the trace on the signal generator to stabilize, adjusting the span as necessary.
5. Set the spectrum analyzer RBW for 1% to 5% of the EBW.
6. Set VBW ≥ 3 x RBW.
7. Capture the spectrum analyzer trace for inclusion in the test report.
8. Repeat Step 3 to 7 for CDMA and W-CDMA modulation, adjusting the span as necessary, for all uplink and downlink operational bands. AWGN or LTE may be used in place of W-CDMA, as an option.
9. Connect the test equipment as shown in Figure 7-1 (normal operational mode).
10. Repeat Step 3 to 8 in this new configuration using signal types as appropriate for the signal type being transmitted in a specific CMRS band.

Test Setup

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

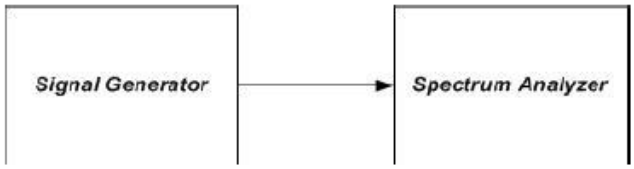


Figure 7-12. Test Setup for Measuring characteristics of test signls used fo subsequent EUT occupied bandwith testing

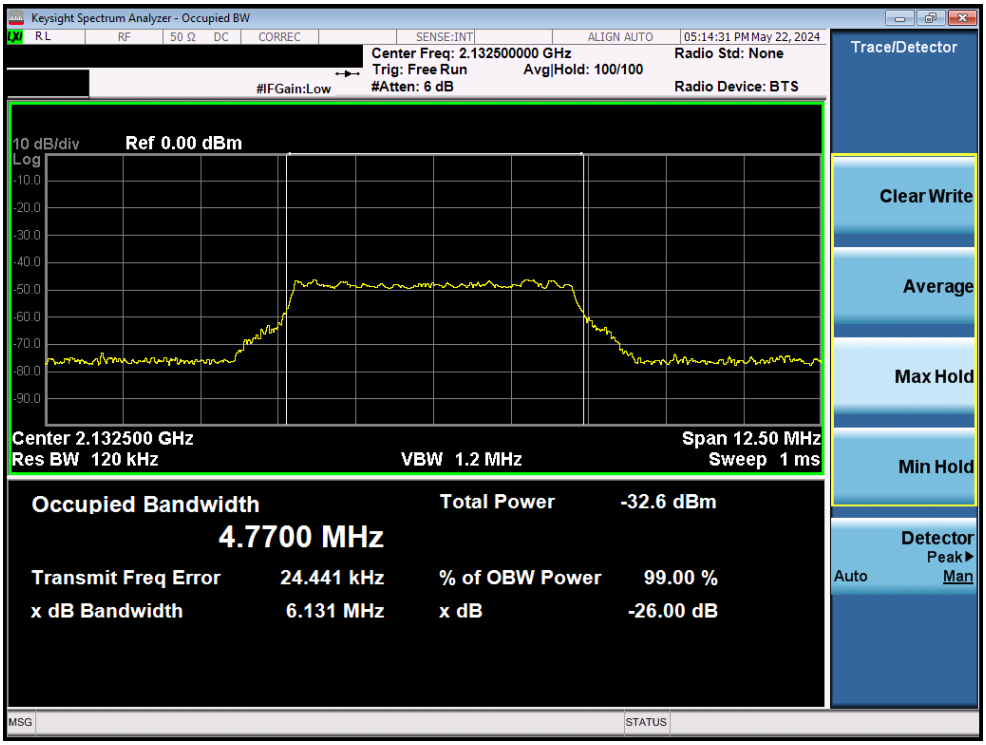
Test Notes

None

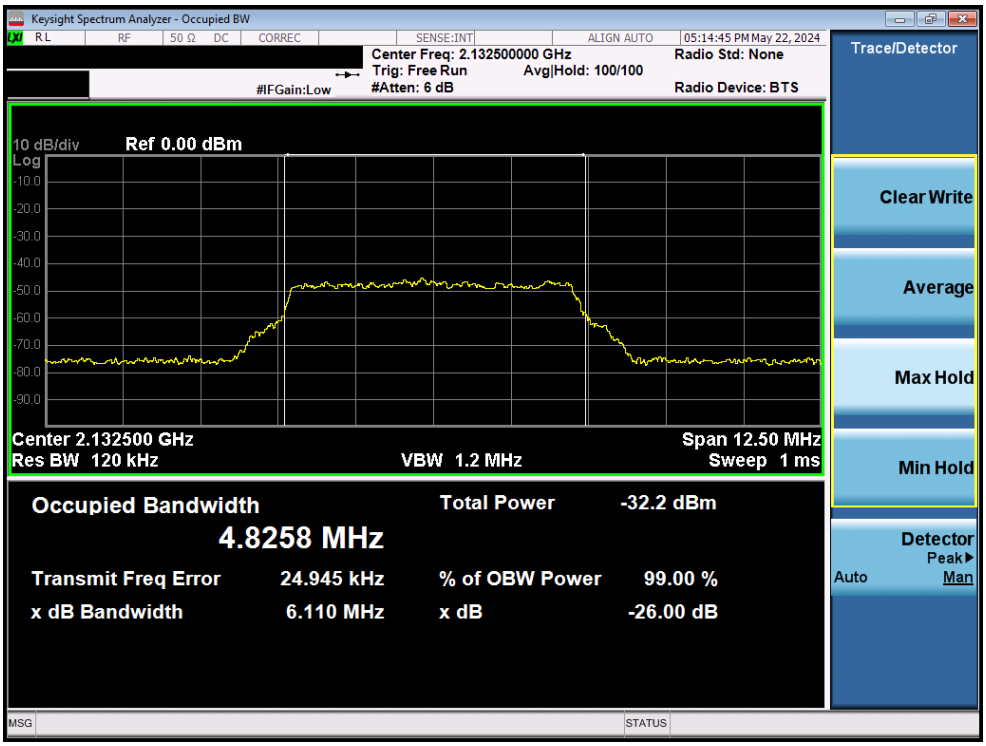
Band	Bandwidth (MHz)	Channels	Frequency (MHz)	Modulation	Input OBW (MHz)	Output OBW (MHz)
LTE Band 4 (DL)	5	2175	2132.5	QPSK	4.77	4.67
				256-QAM	4.83	4.74
LTE Band 4 (UL)		20175	1732.5	QPSK	4.69	4.67
				256-QAM	4.74	4.73
LTE Band 5 (DL)	5	2525	881.5	QPSK	4.74	4.69
				256-QAM	4.81	4.75
LTE Band 5 (UL)		20525	836.5	QPSK	4.69	4.65
				256-QAM	4.74	4.72
LTE Band 12 (DL)	5	5095	737.5	QPSK	4.72	4.67
				256-QAM	4.77	4.72
LTE Band 12 (UL)		23095	707.5	QPSK	4.63	4.67
				256-QAM	4.77	4.71
LTE Band 13 (DL)	5	5230	751	QPSK	4.72	4.61
				256-QAM	4.79	4.66
LTE Band 13 (UL)		23230	782	QPSK	4.70	4.64
				256-QAM	4.73	4.69
LTE Band 25/2 (DL)	5	8365	1962.5	QPSK	4.70	4.67
				256-QAM	4.82	4.72
LTE Band 25/2 (UL)		26365	1882.5	QPSK	4.70	4.67
				256-QAM	4.75	4.73

Table 7-36. Summary of Occupied Bandwidths

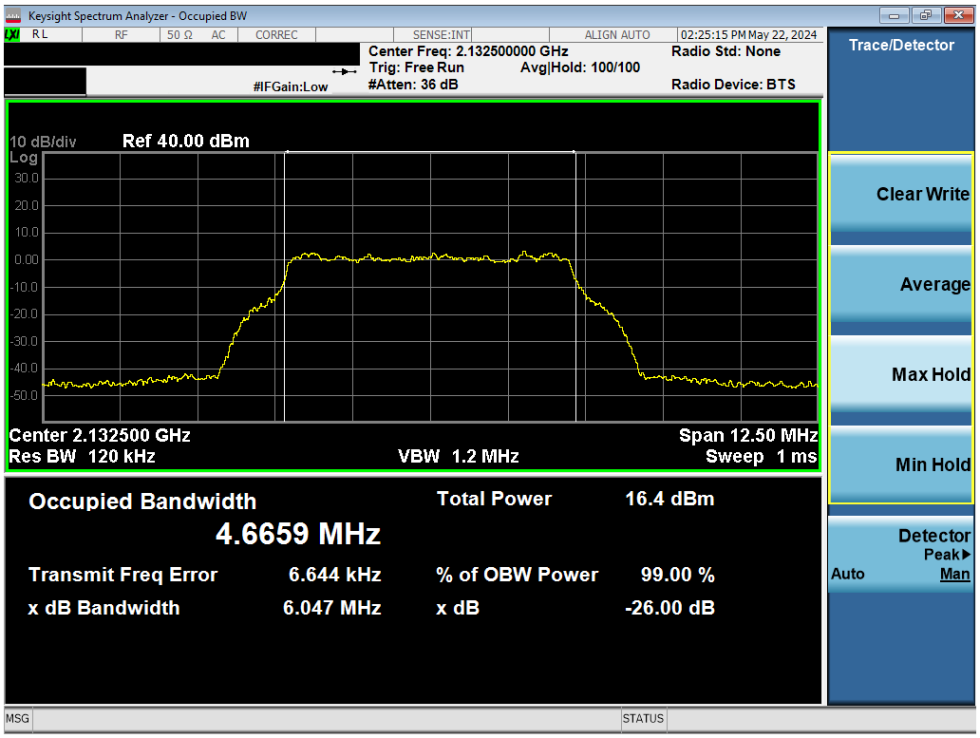
LTE Band 4



Plot 7-204. Occupied Bandwidth – BAND 4 DL QPSK (Input)



Plot 7-205. Occupied Bandwidth – BAND 4 DL 256-QAM (Input)



Plot 7-206. Occupied Bandwidth – BAND 4 DL QPSK (Output)

Plot 7-207. Occupied Bandwidth – BAND 4 DL 256-QAM (Output)