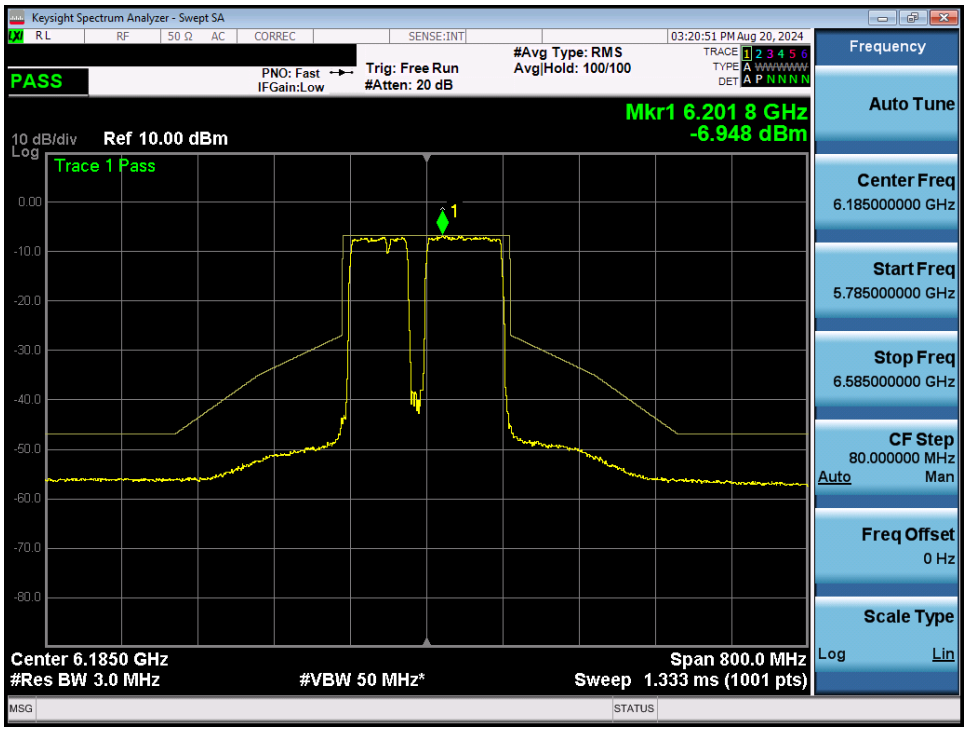
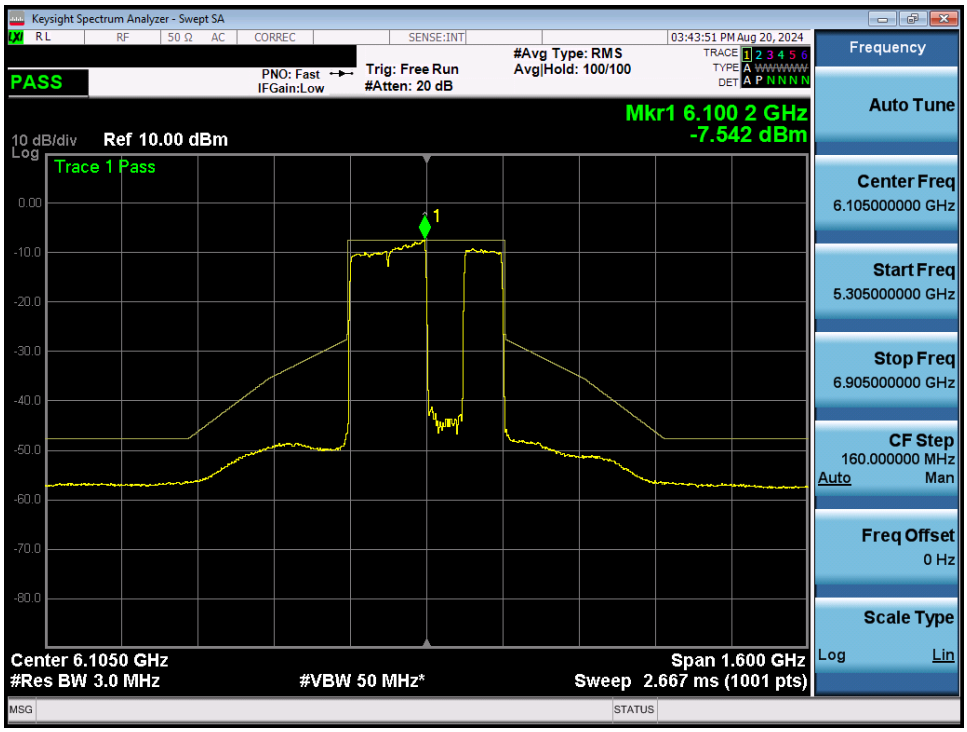
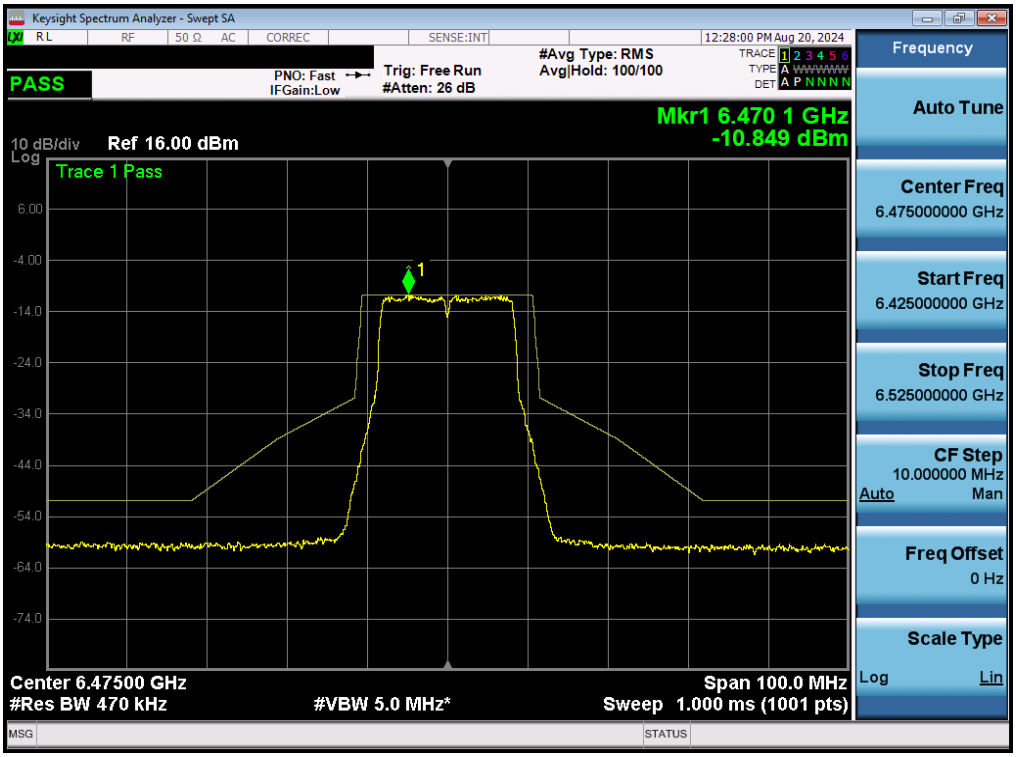


Plot 7-174. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 5) – Ch. 47) – 20MHz Punctured

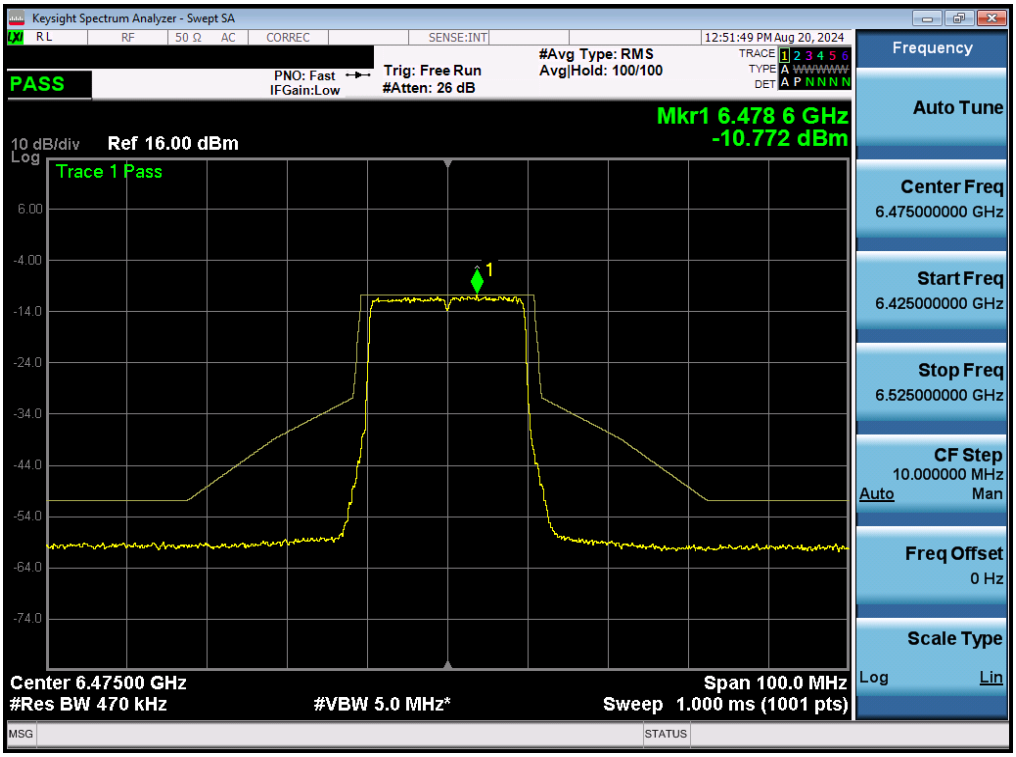


Plot 7-175. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 5) – Ch. 31) – 80MHz Punctured

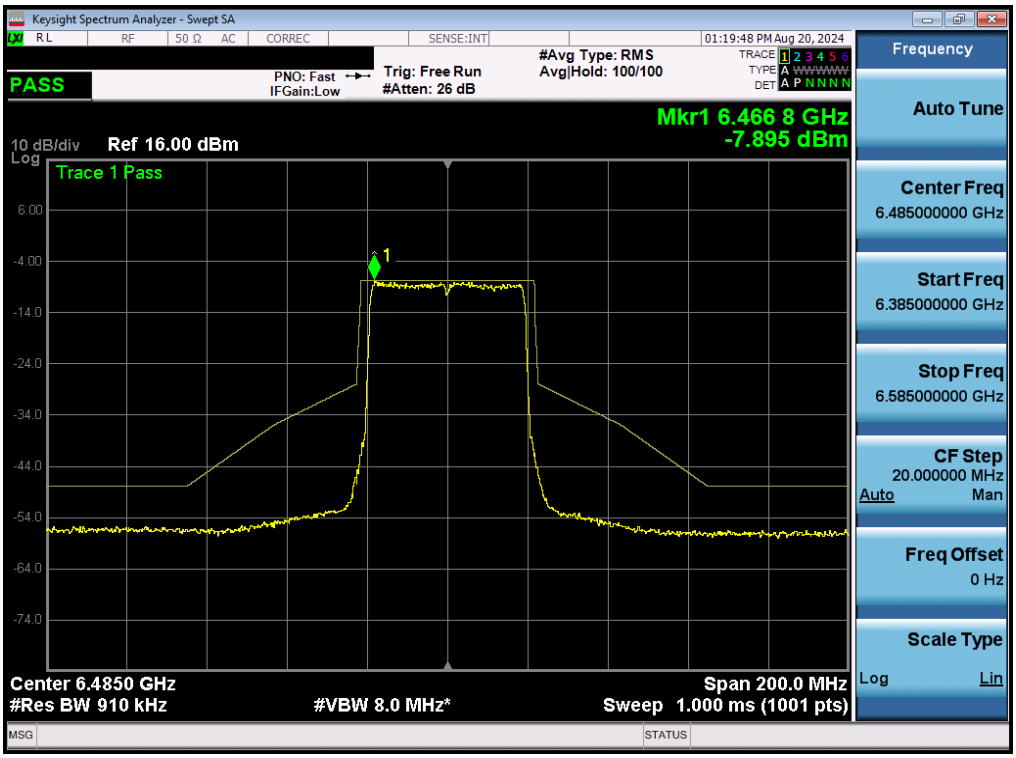
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 6)



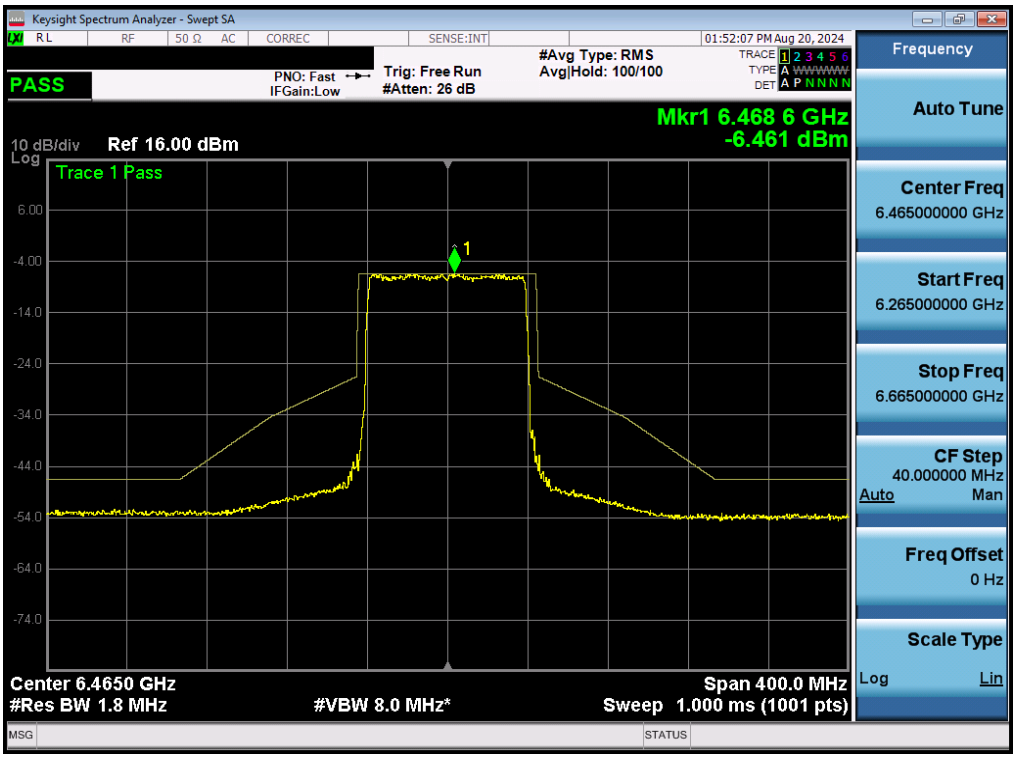
Plot 7-176. In-Band Emission MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 105) – LPI



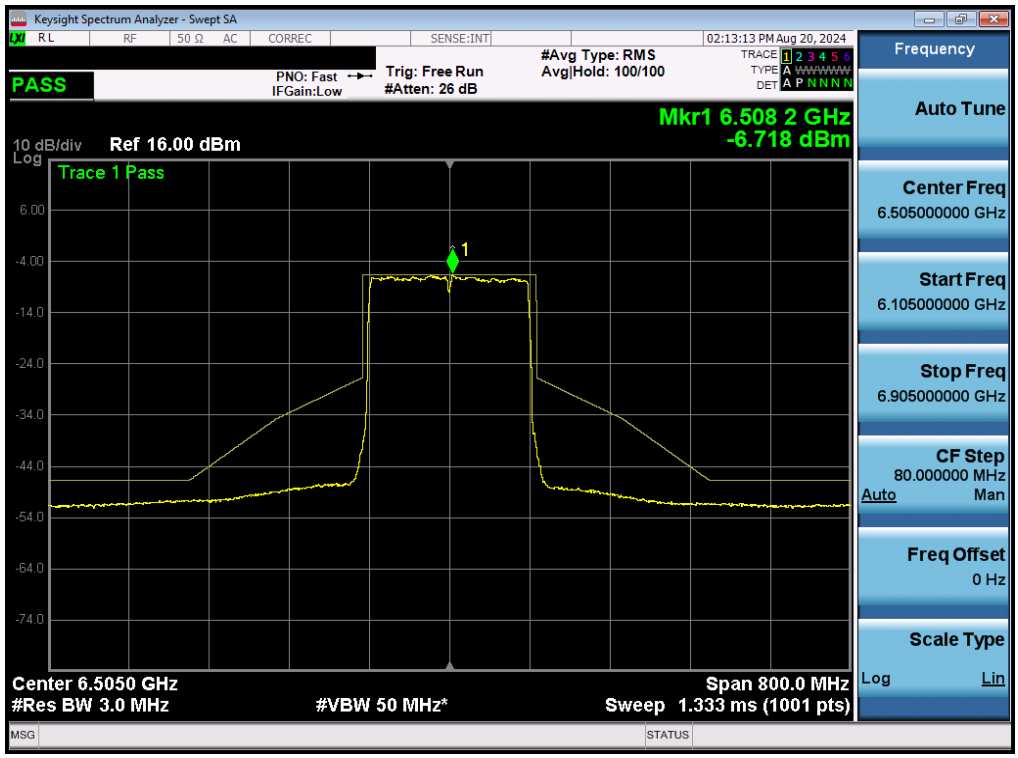
Plot 7-177. In-Band Emission MIMO ANT1 (20MHz 802.11be (UNII Band 6) – Ch. 105) – LPI



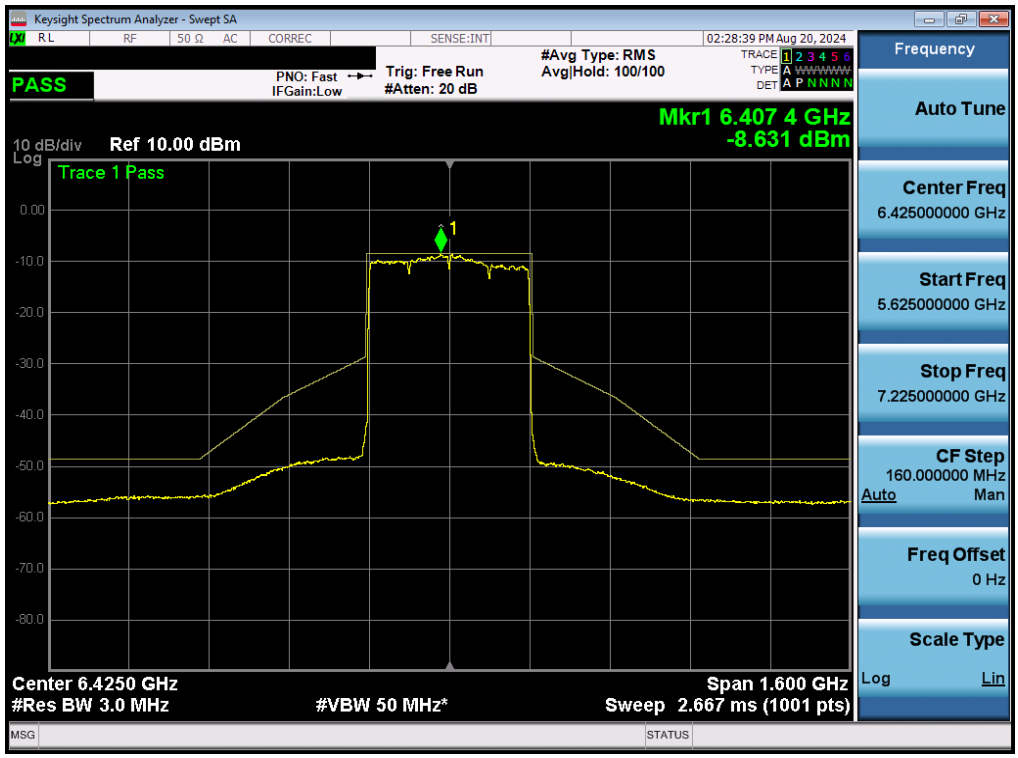
Plot 7-178. In-Band Emission MIMO ANT1 (40MHz 802.11be (UNII Band 6) – Ch. 107) – LPI



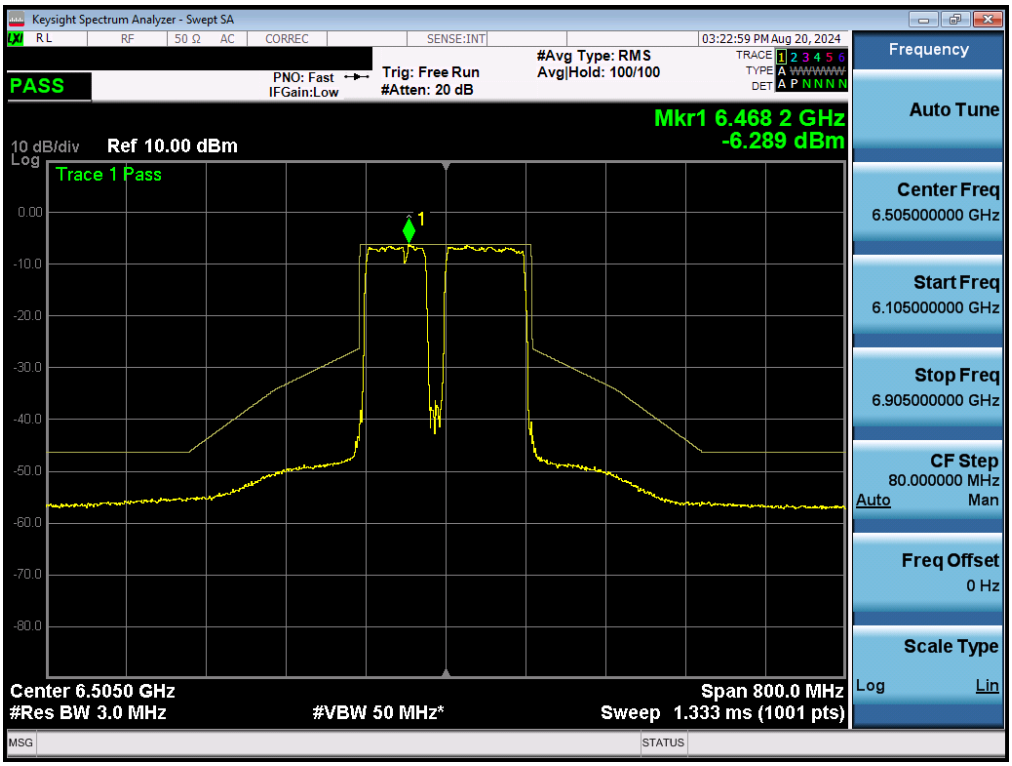
Plot 7-179. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 6) – Ch. 103) – LPI



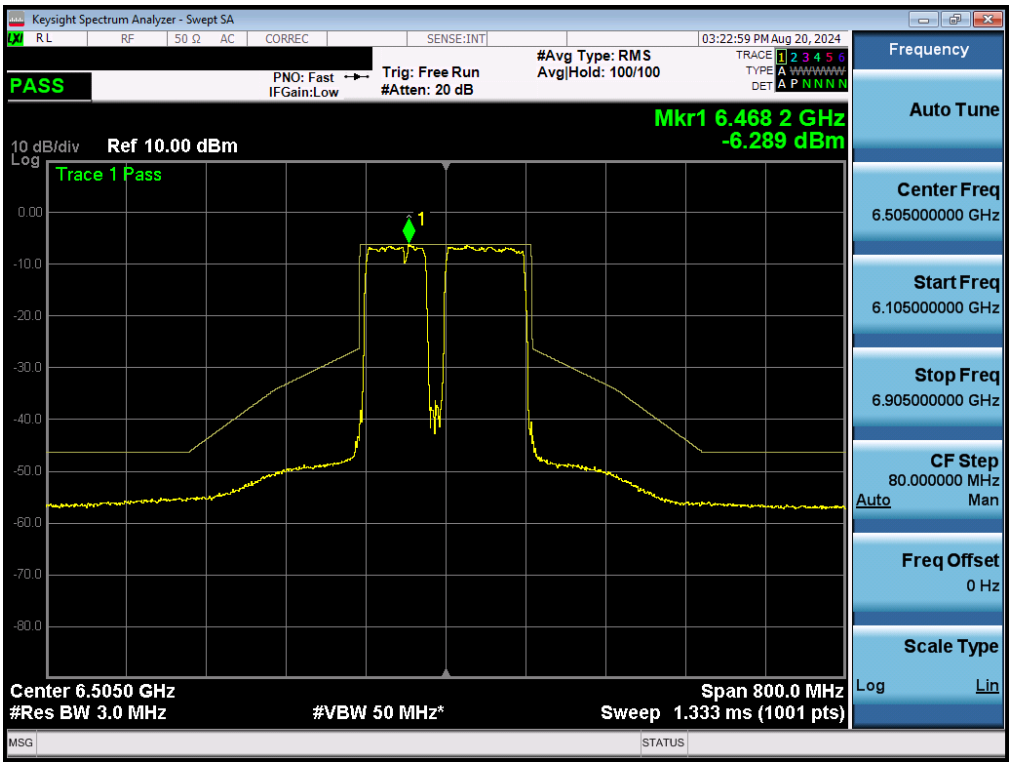
Plot 7-180. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 6) – Ch. 111) – LPI



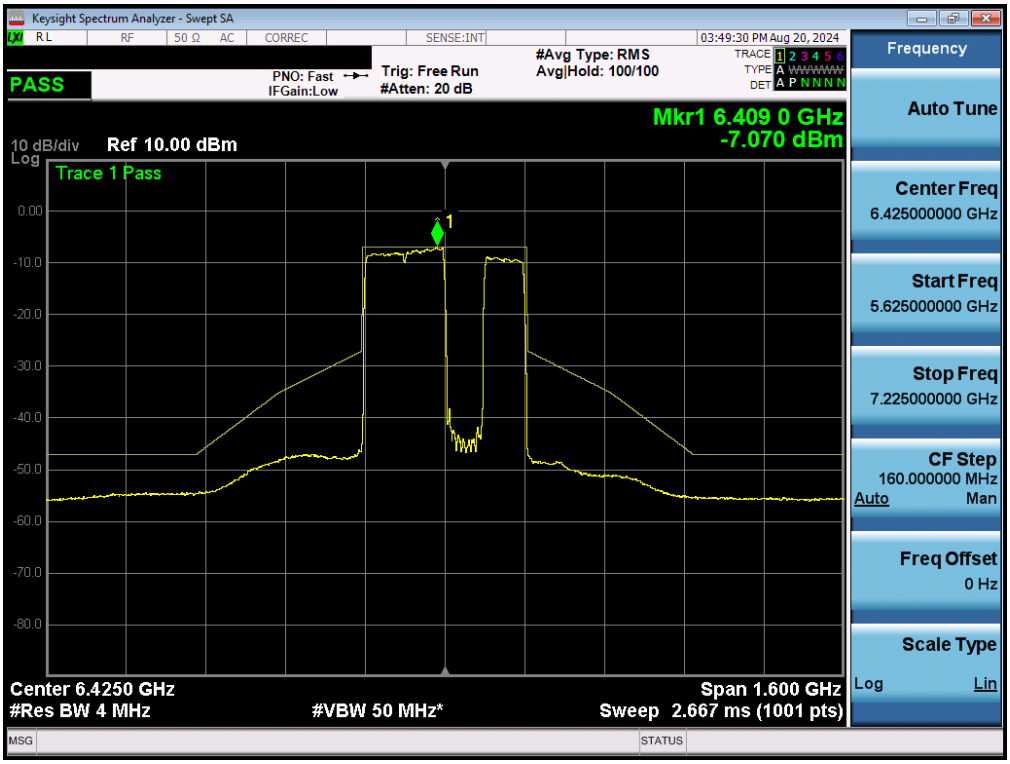
Plot 7-181. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 5/6/7) – Ch. 95) – LPI



Plot 7-182. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 6) – Ch. 103) – 20MHz Punctured

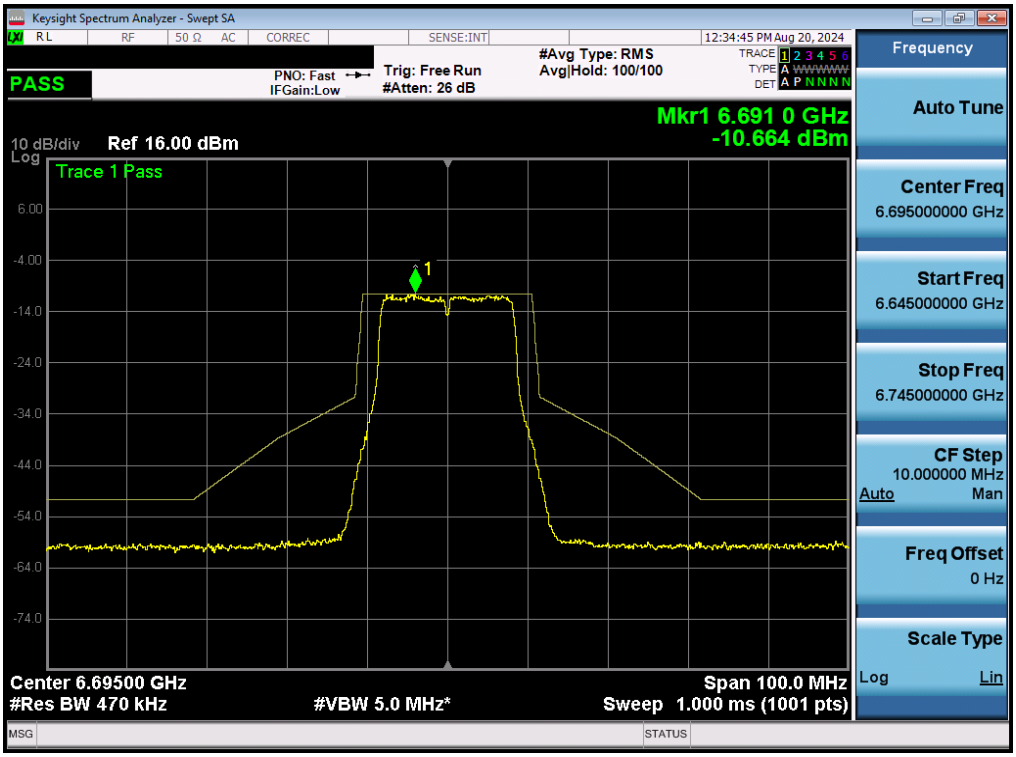


Plot 7-183. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 6) – Ch. 111) – 20MHz Punctured

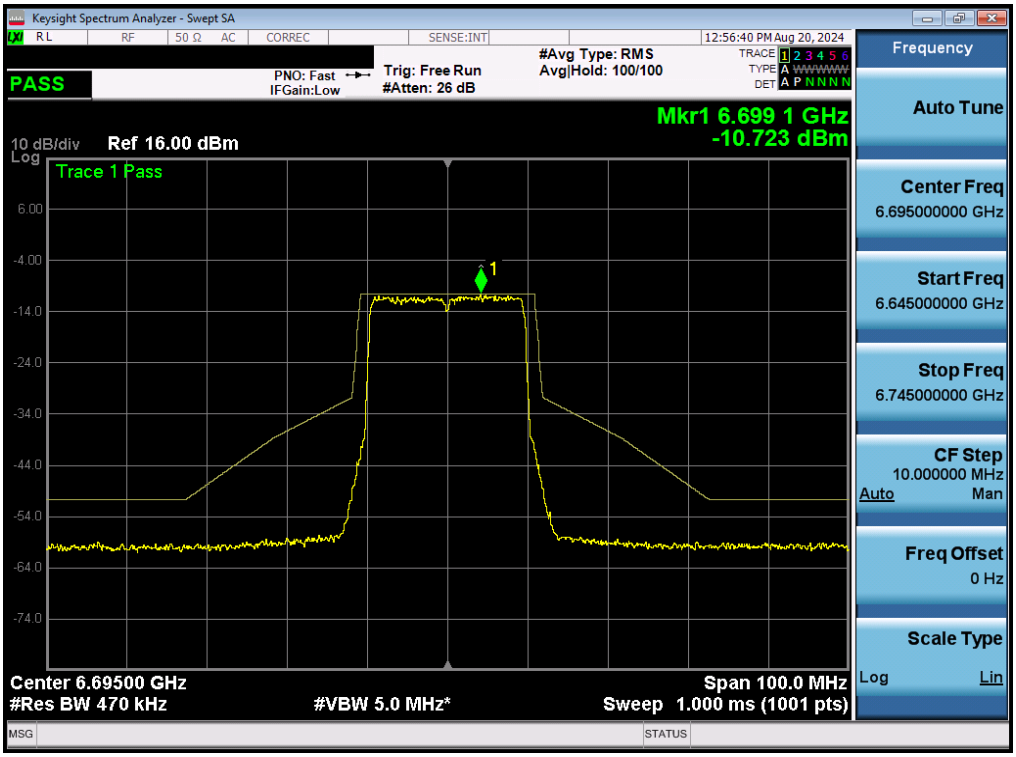


Plot 7-184. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 6) – Ch. 95) – 80MHz Punctured

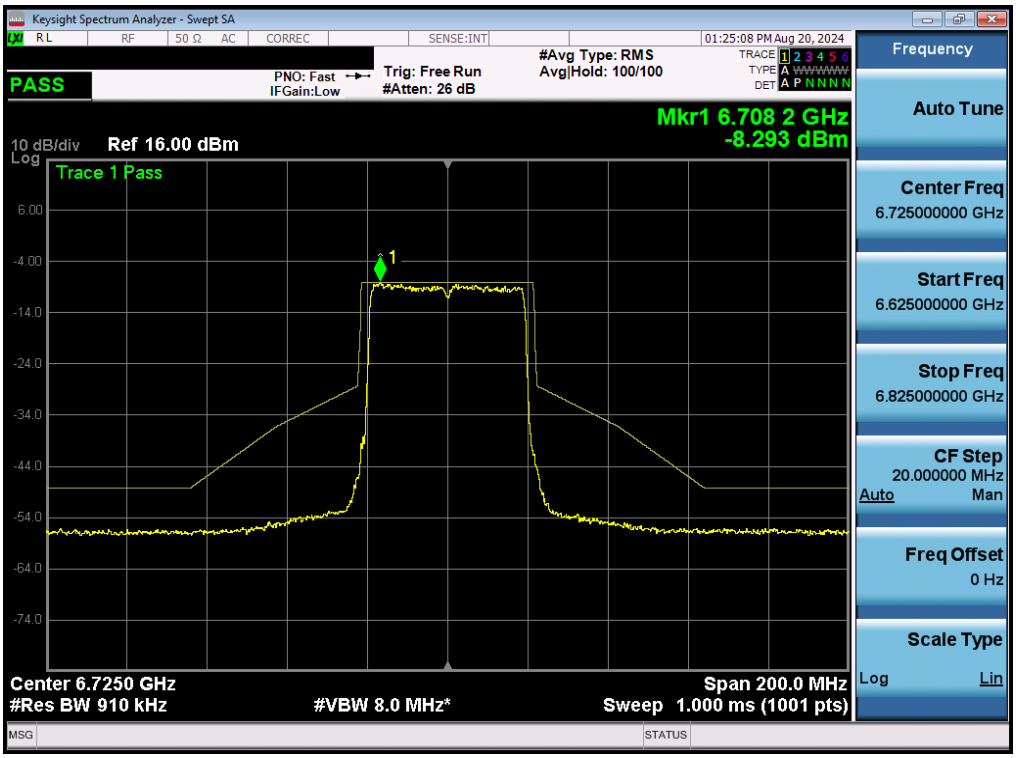
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 7)



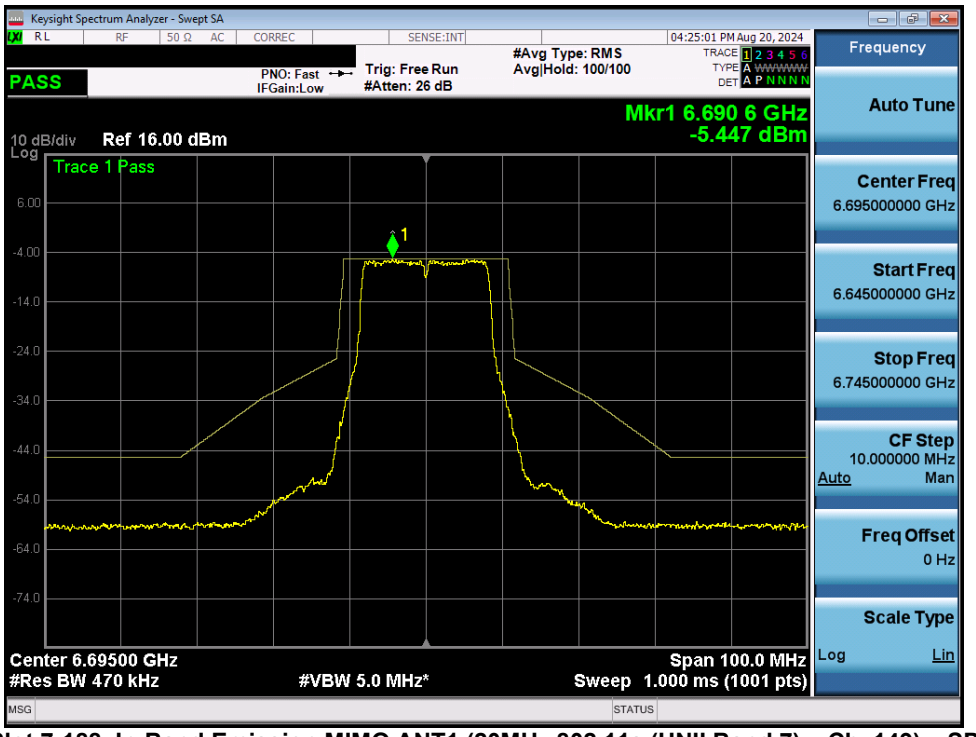
Plot 7-185. In-Band Emission MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 149) – LPI



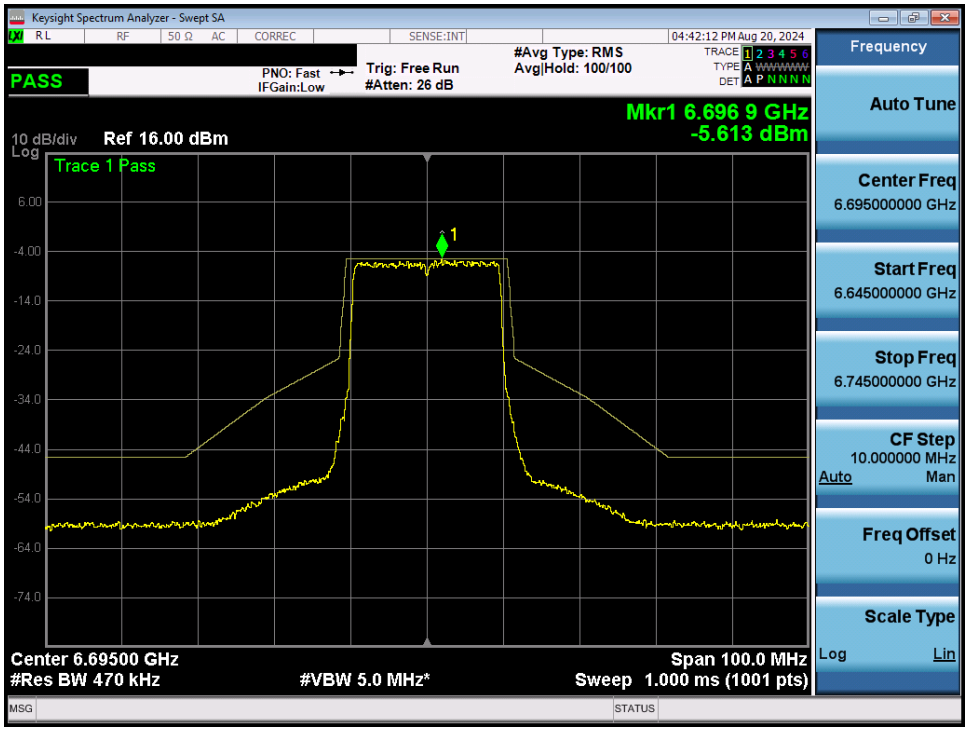
Plot 7-186. In-Band Emission MIMO ANT1 (20MHz 802.11be (UNII Band 7) – Ch. 149) – LPI



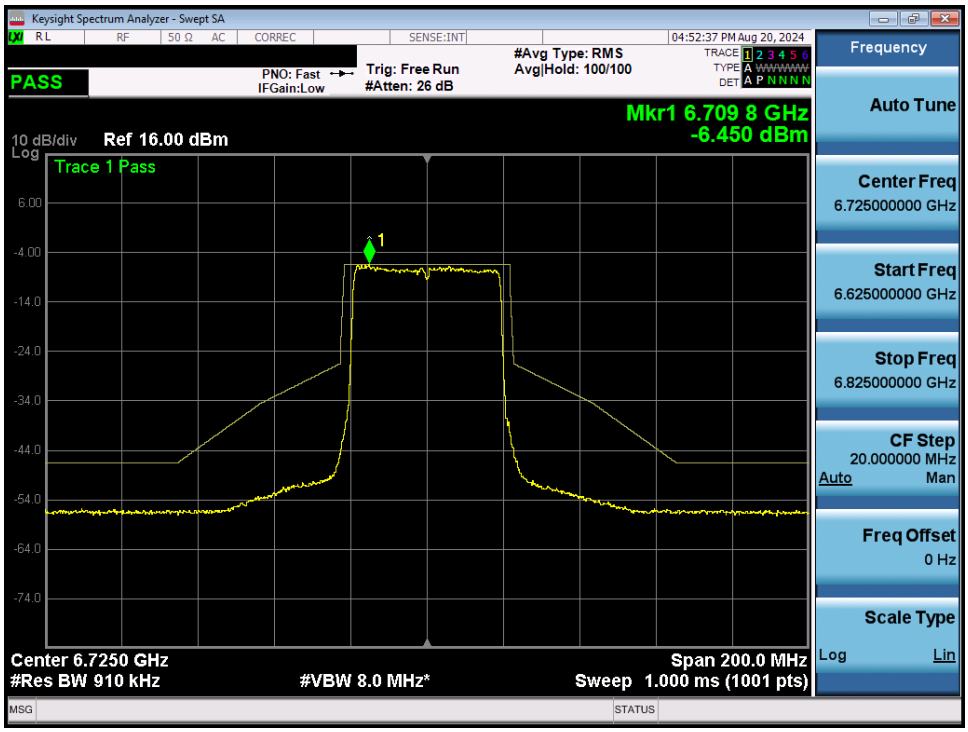
Plot 7-187. In-Band Emission MIMO ANT1 (40MHz 802.11be (UNII Band 7) – Ch. 155) – LPI



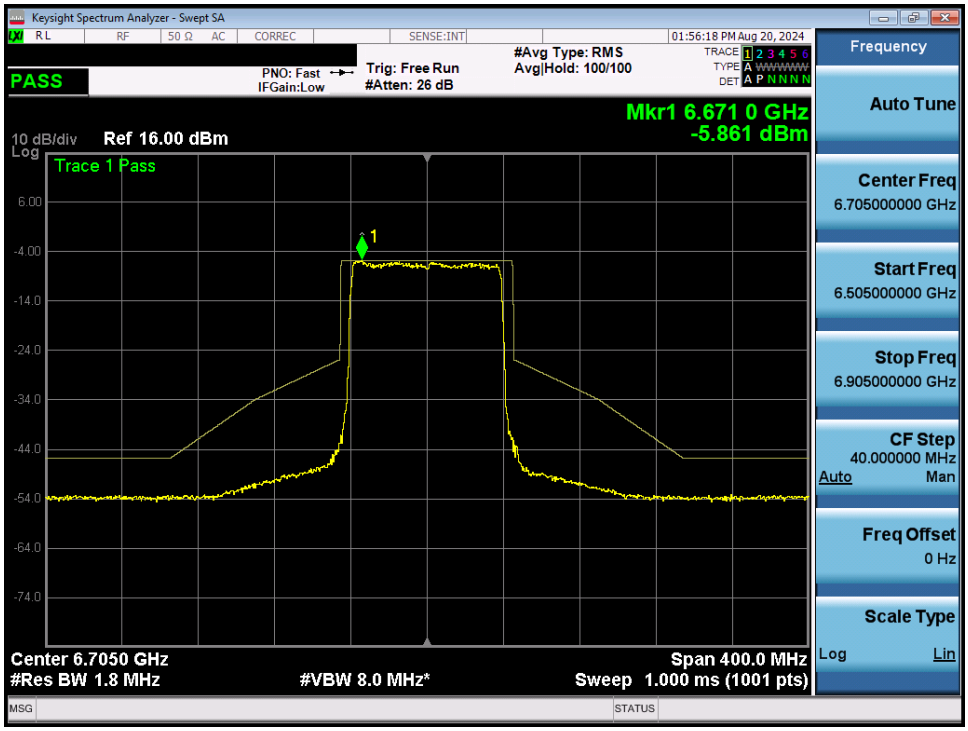
Plot 7-188. In-Band Emission MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 149) – SP



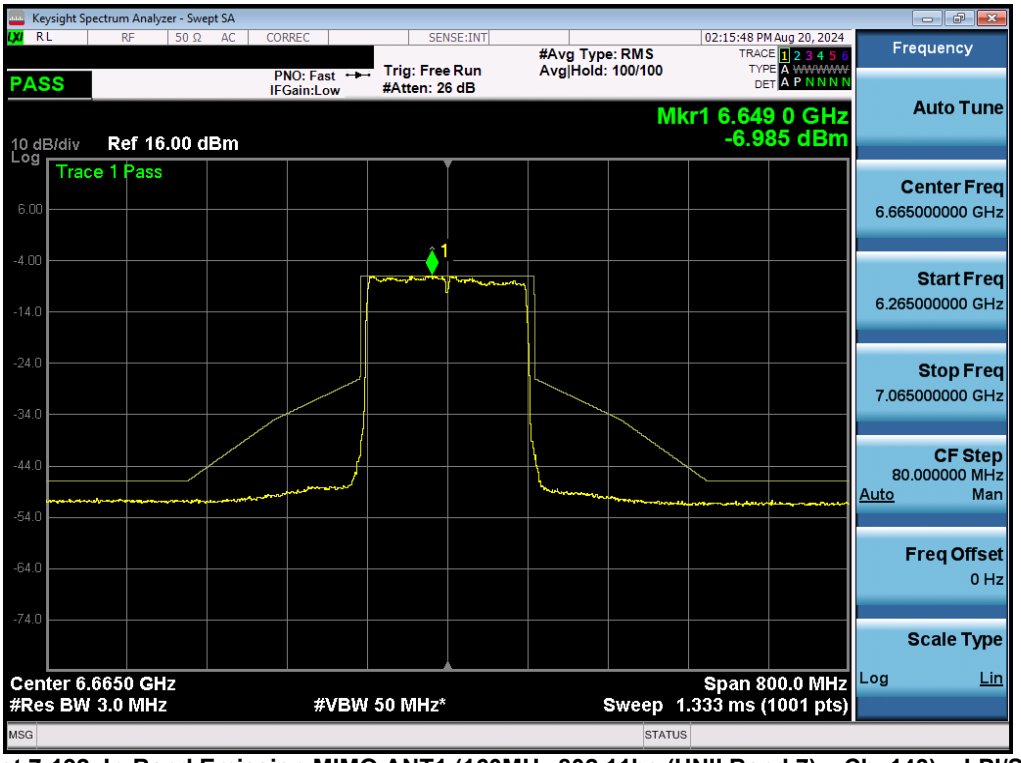
Plot 7-189. In-Band Emission MIMO ANT1 (20MHz 802.11be (UNII Band 7) – Ch. 149) – SP



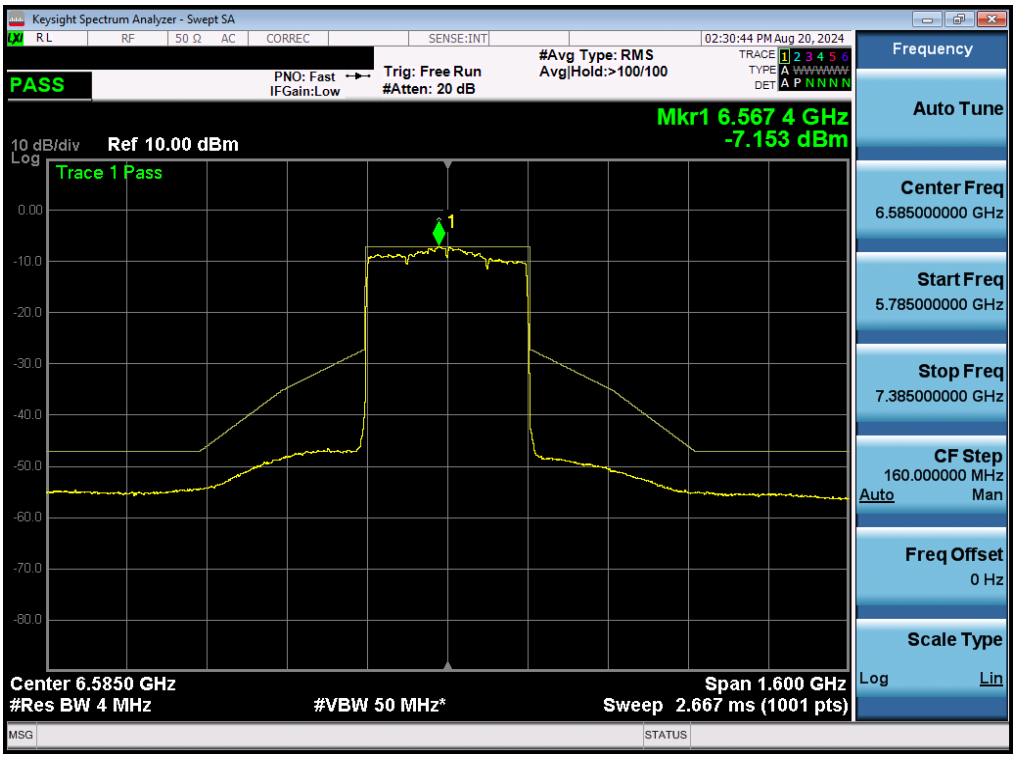
Plot 7-190. In-Band Emission MIMO ANT1 (40MHz 802.11be (UNII Band 7) – Ch. 155) – SP



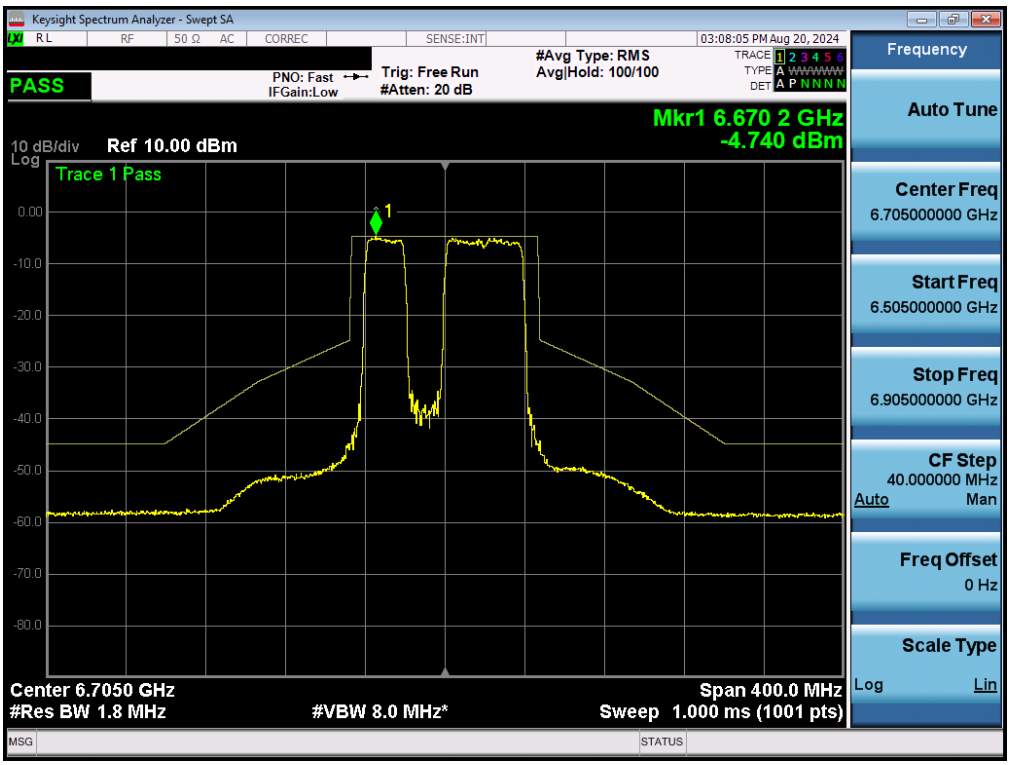
Plot 7-191. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 7) – Ch. 151) – LPI/SP



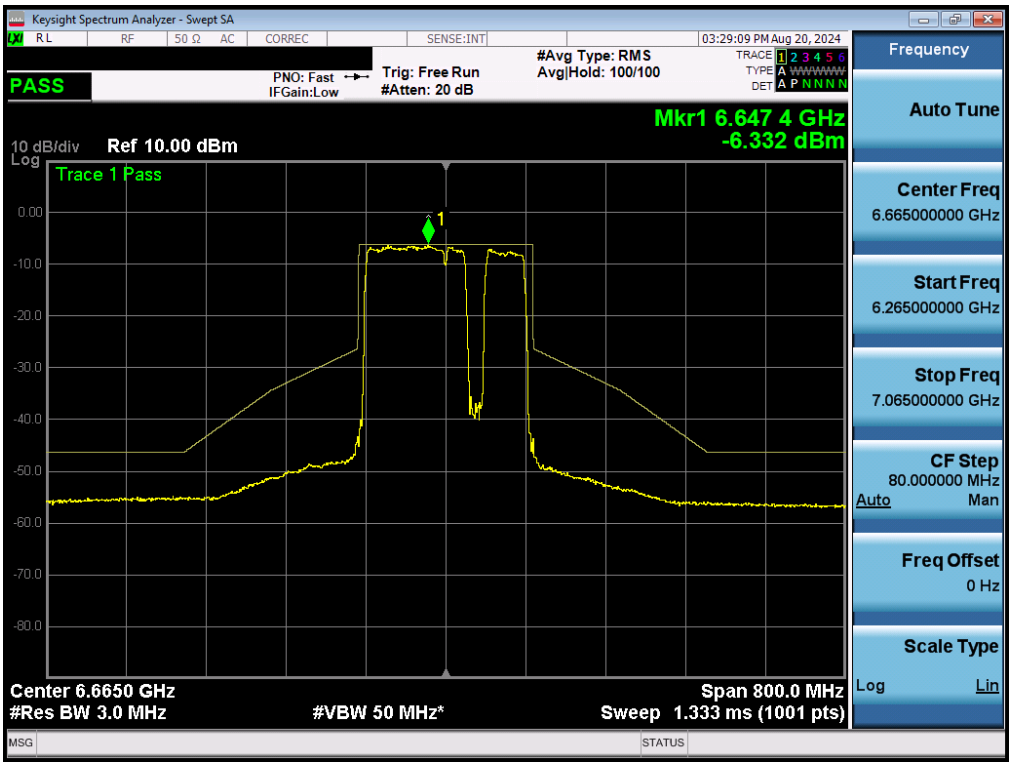
Plot 7-192. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 7) – Ch. 143) – LPI/SP



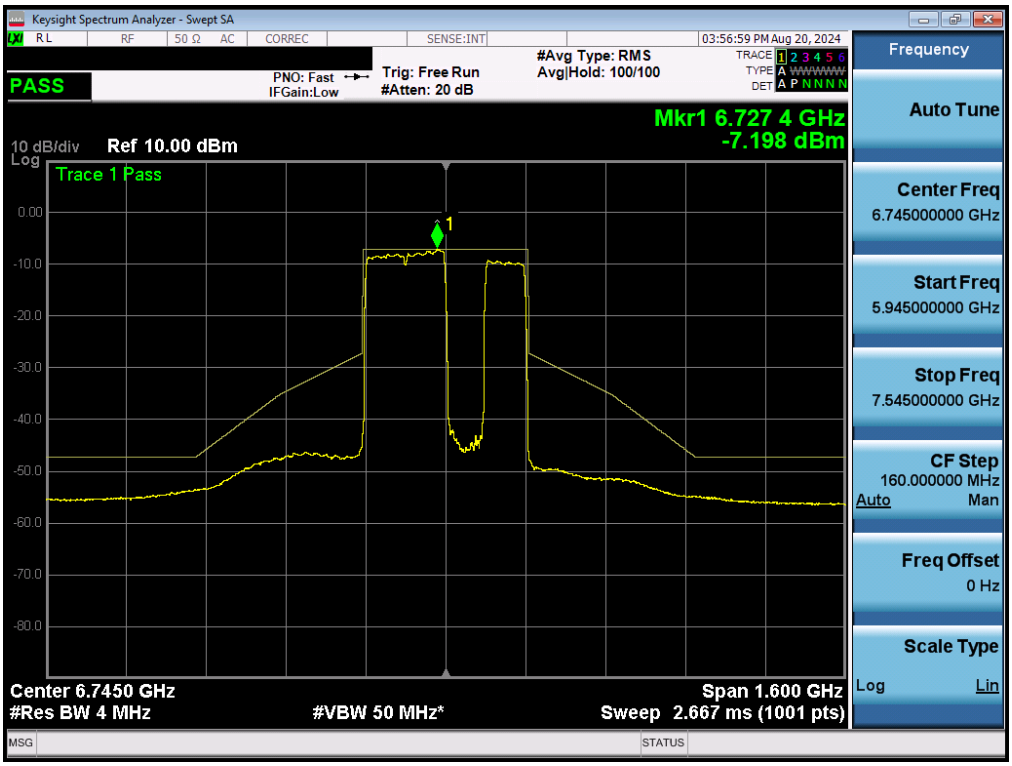
Plot 7-193. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 7) – Ch. 127) – LPI/SP



Plot 7-194. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 7) – Ch. 151) – 20MHz Punctured

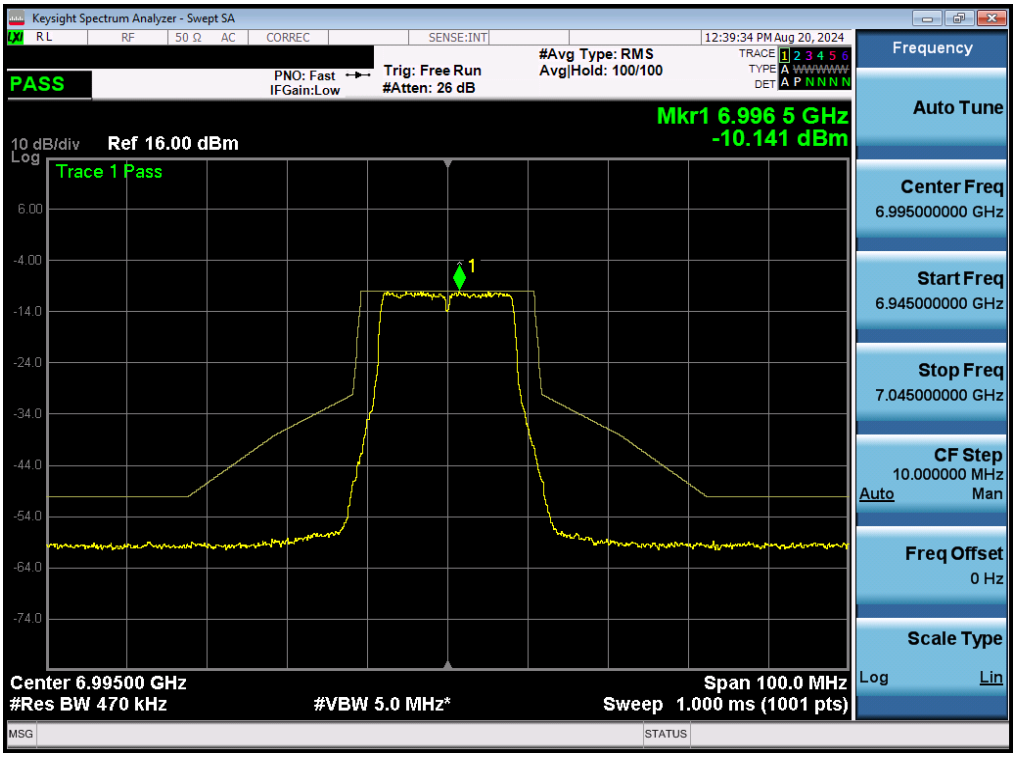


Plot 7-195. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 7) – Ch. 143) – 20MHz Punctured

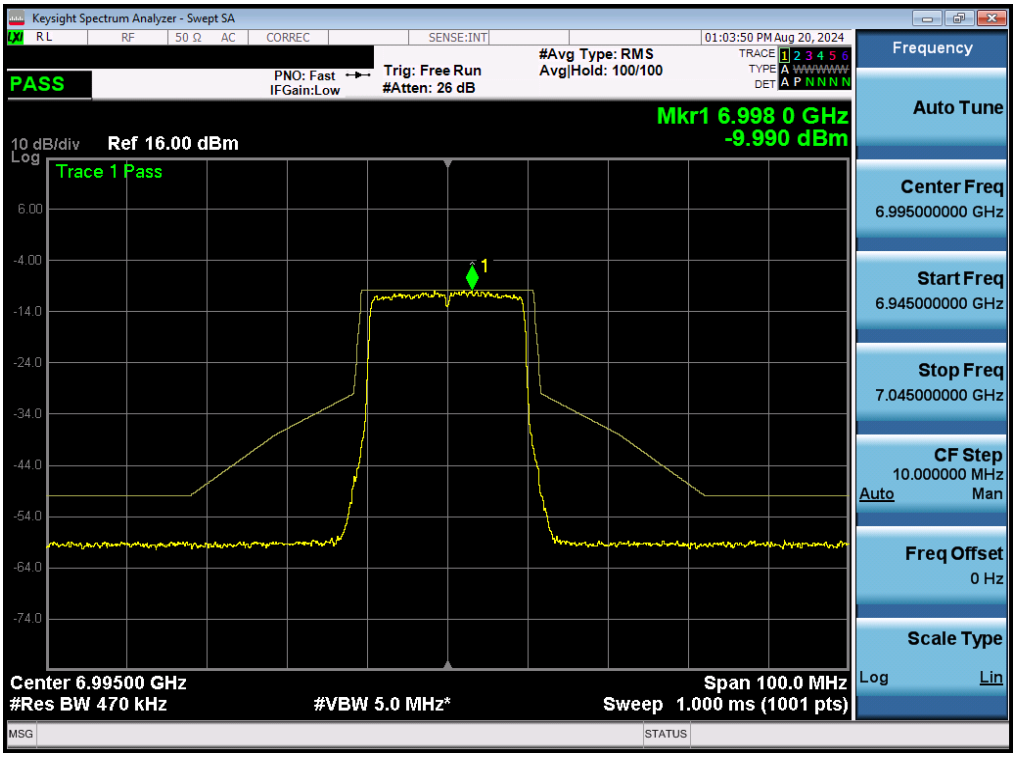


Plot 7-196. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 7) – Ch. 159) – 80MHz Punctured

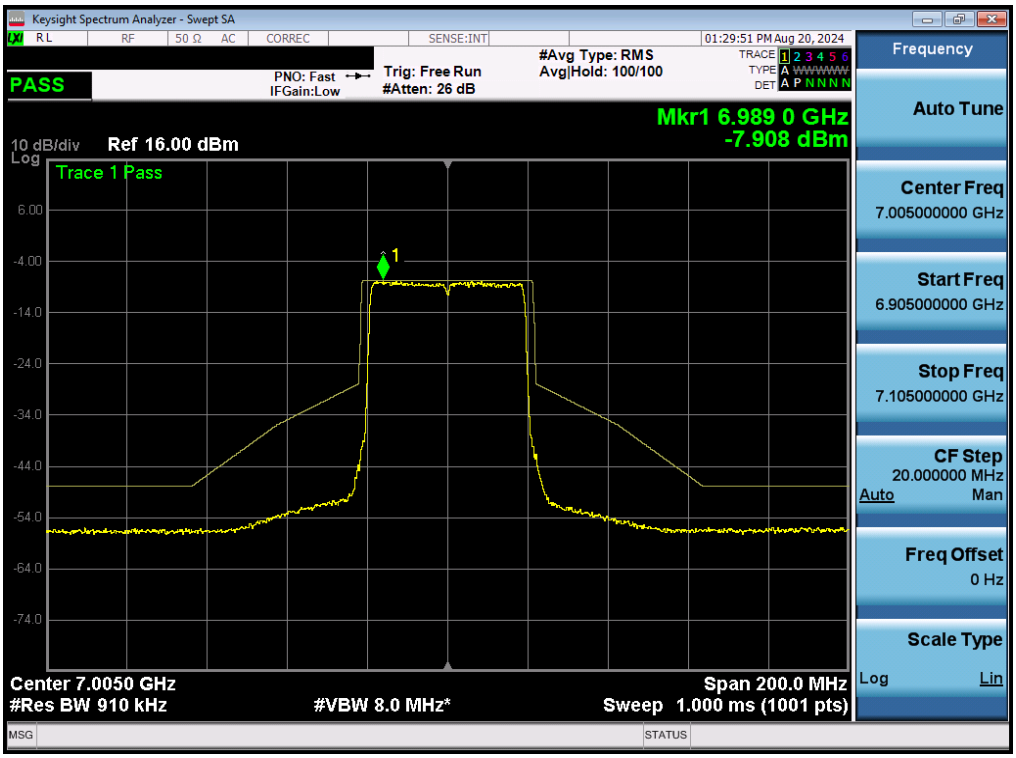
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 8)



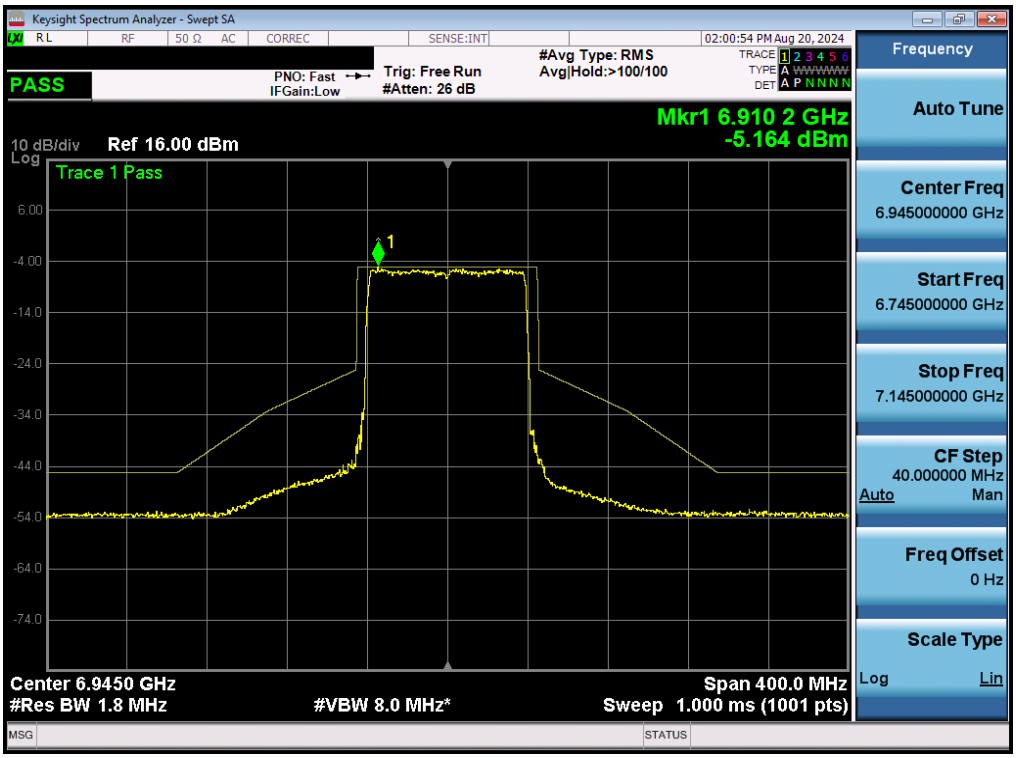
Plot 7-197. In-Band Emission MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 209) – LPI



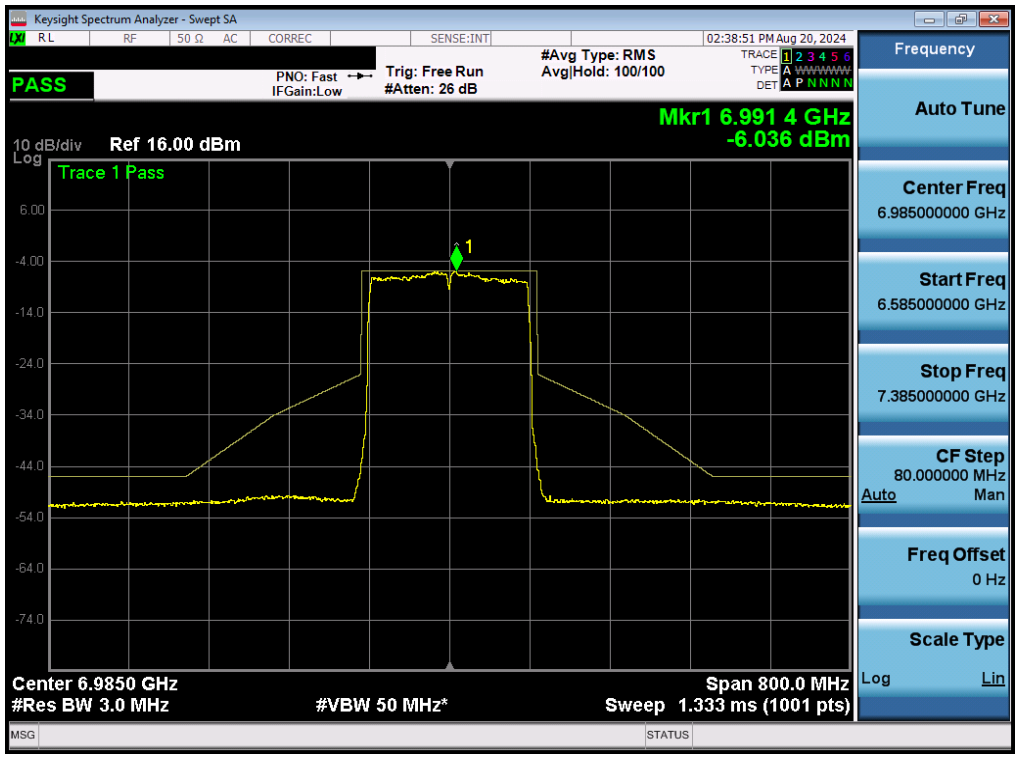
Plot 7-198. In-Band Emission MIMO ANT1 (20MHz 802.11be (UNII Band 8) – Ch. 209) – LPI



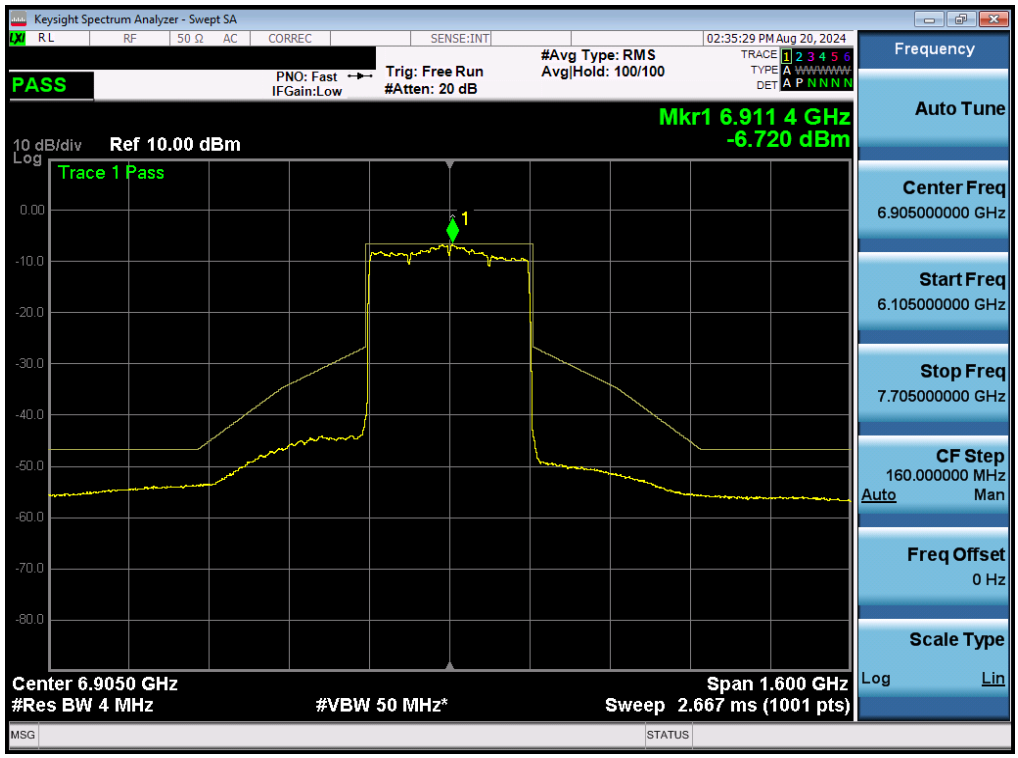
Plot 7-199. In-Band Emission MIMO ANT1 (40MHz 802.11be (UNII Band 8) – Ch. 211) – LPI



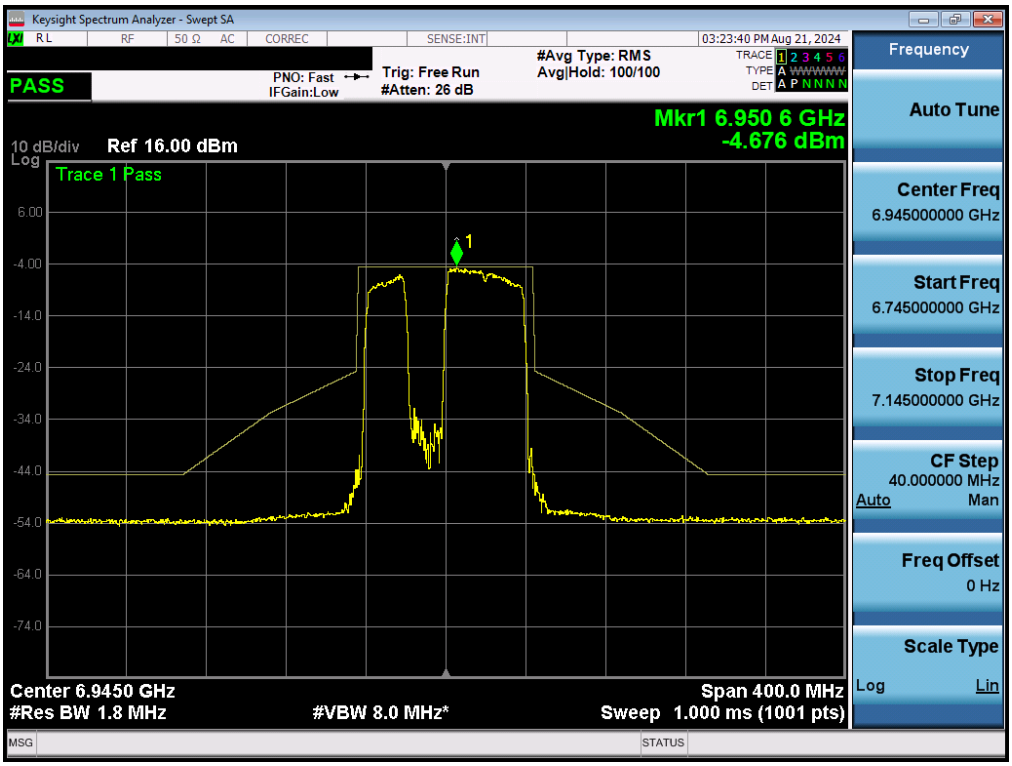
Plot 7-200. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 8) – Ch. 199) – LPI



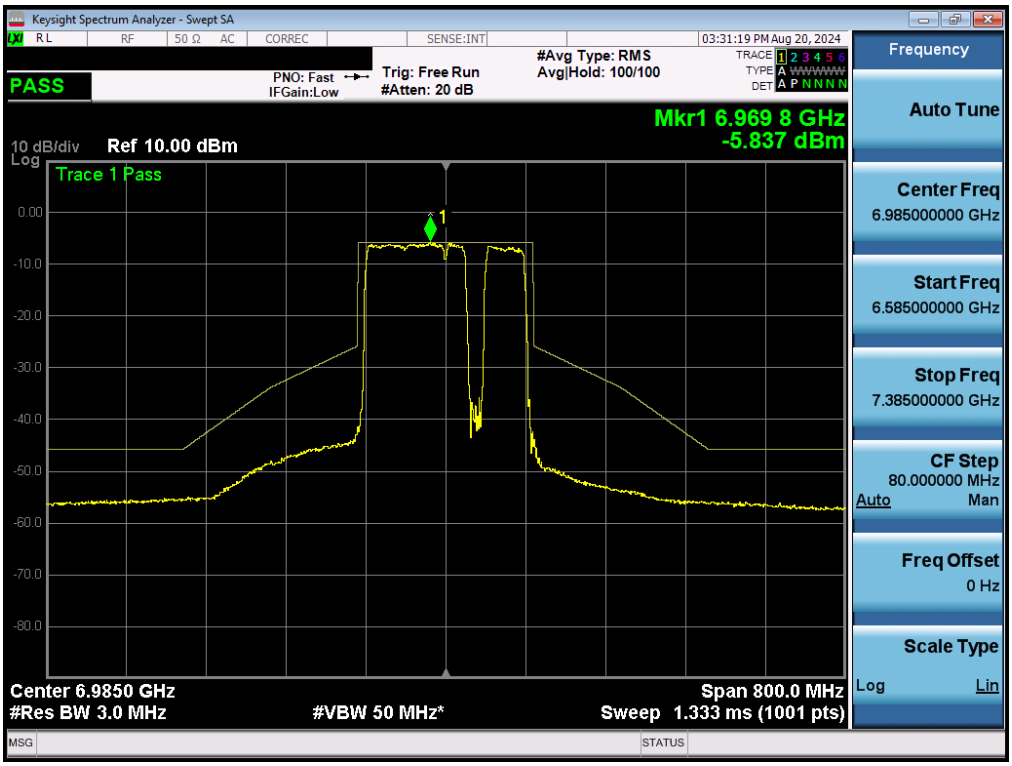
Plot 7-201. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 8) – Ch. 207) – LPI



Plot 7-202. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 7/8) – Ch. 191) – LPI



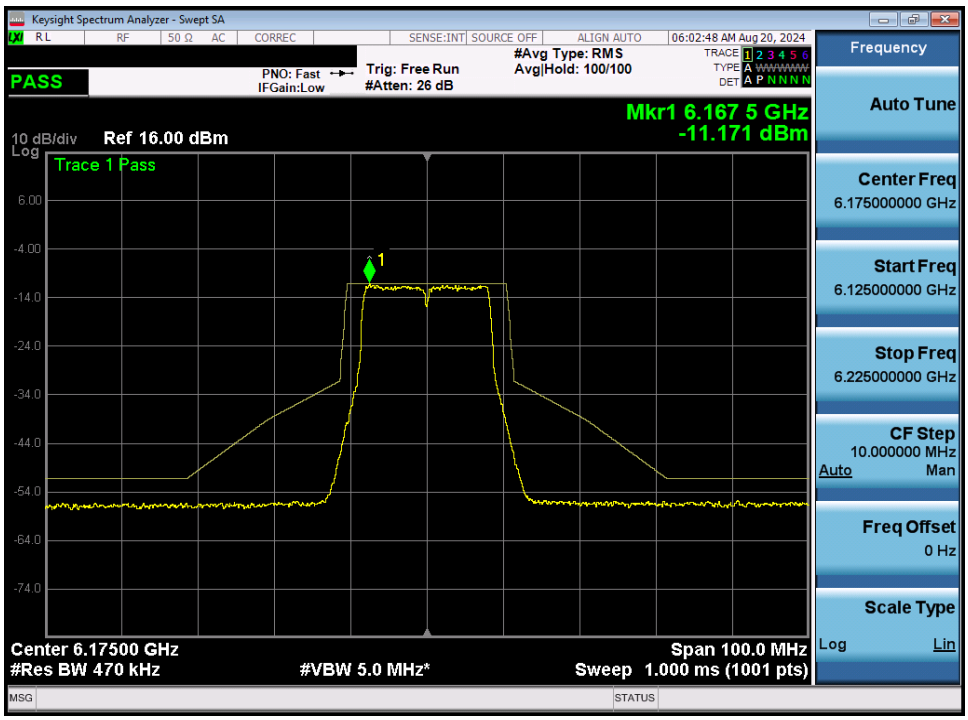
Plot 7-203. In-Band Emission MIMO ANT1 (80MHz 802.11be (UNII Band 8) – Ch. 199) – 20MHz Punctured – LPI



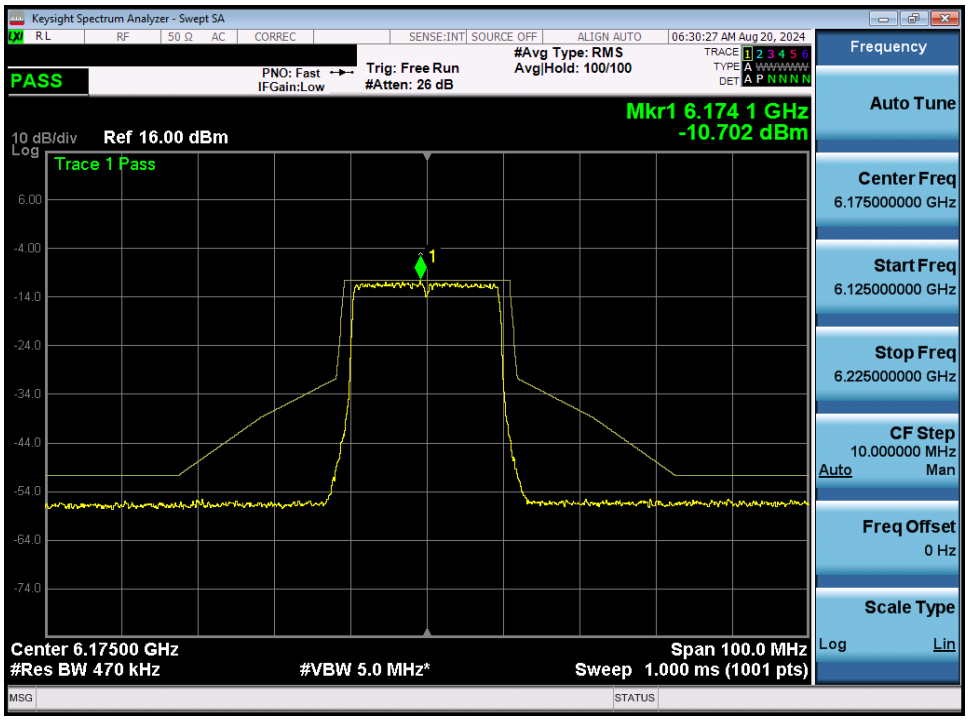
Plot 7-204. In-Band Emission MIMO ANT1 (160MHz 802.11be (UNII Band 8) – Ch. 207) – 20MHz Punctured – LPI

Plot 7-205. In-Band Emission MIMO ANT1 (320MHz 802.11be (UNII Band 8) – Ch. 191) – 80MHz Punctured – LPI

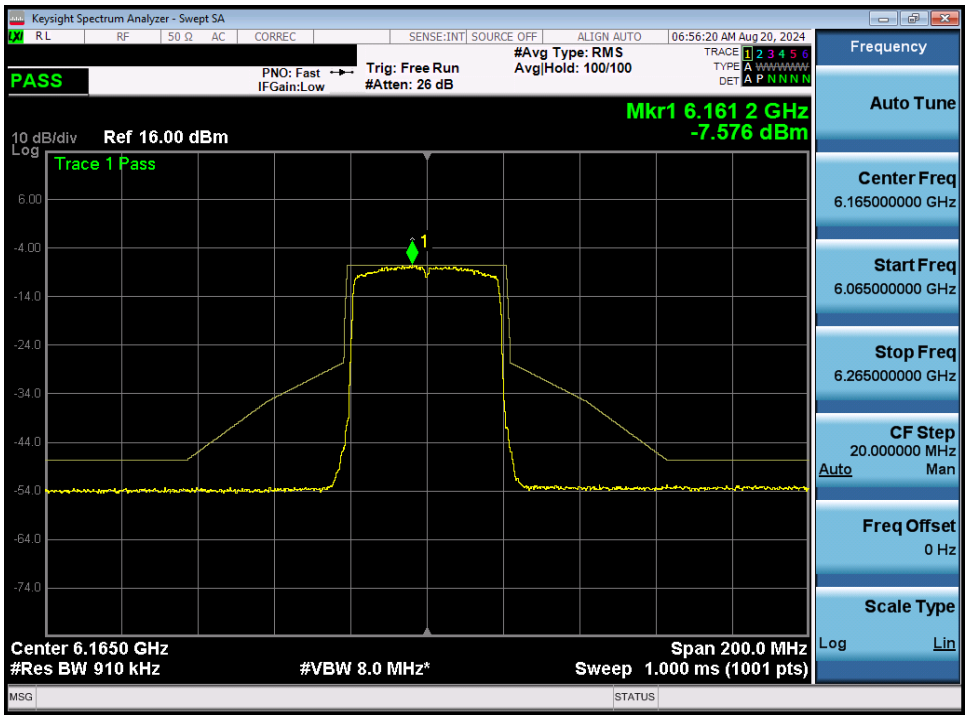
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 5)



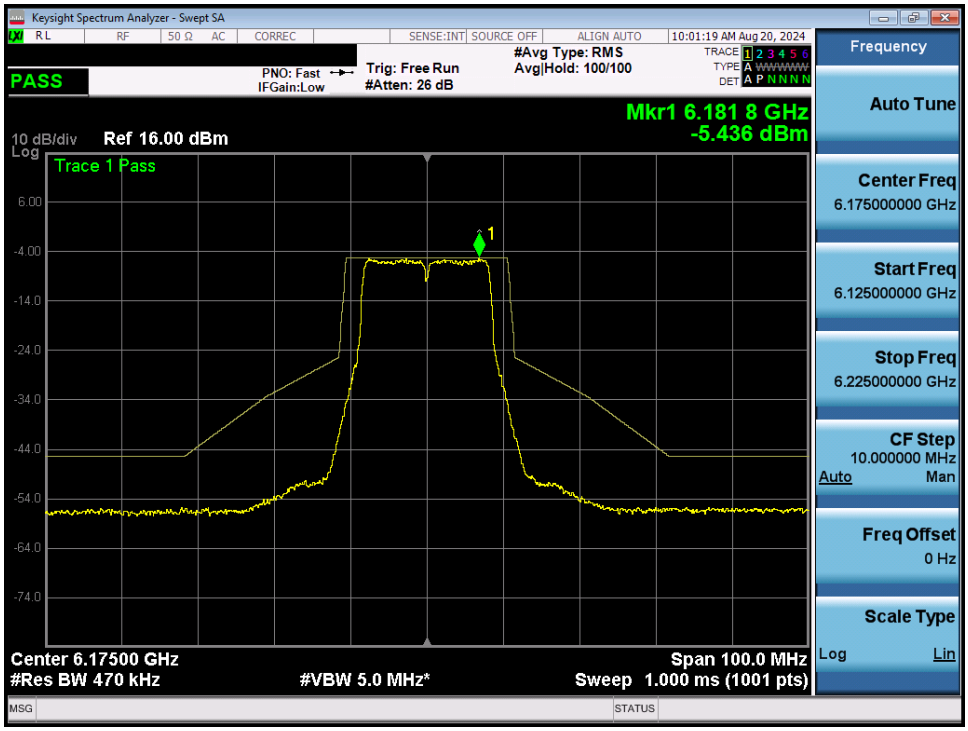
Plot 7-206. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 45) – LPI



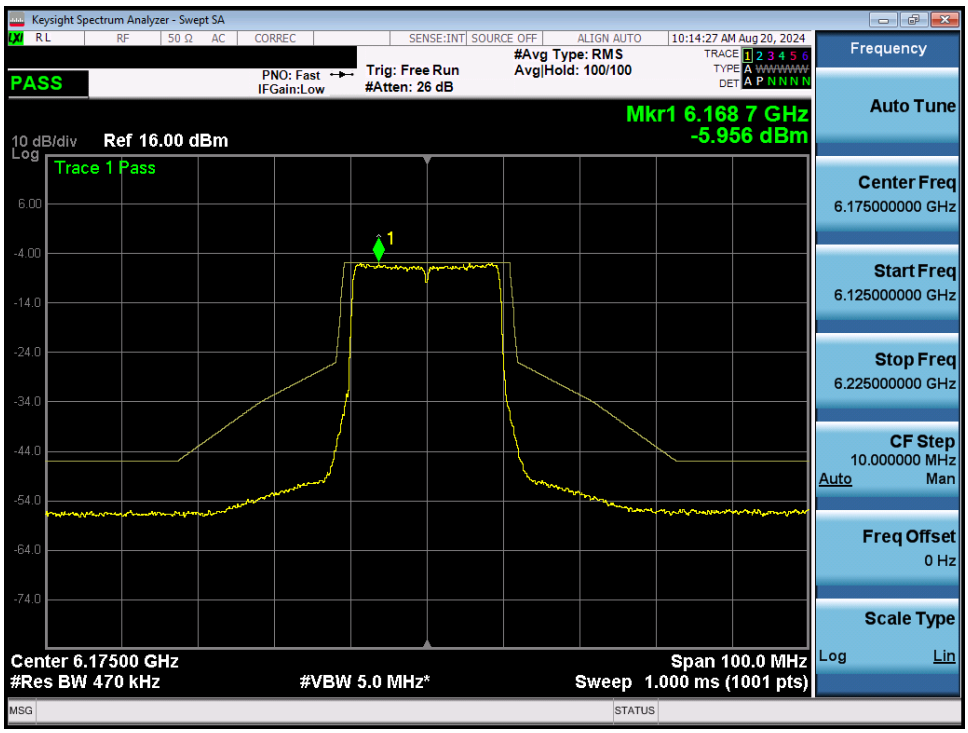
Plot 7-207. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 5) – Ch. 45) – LPI



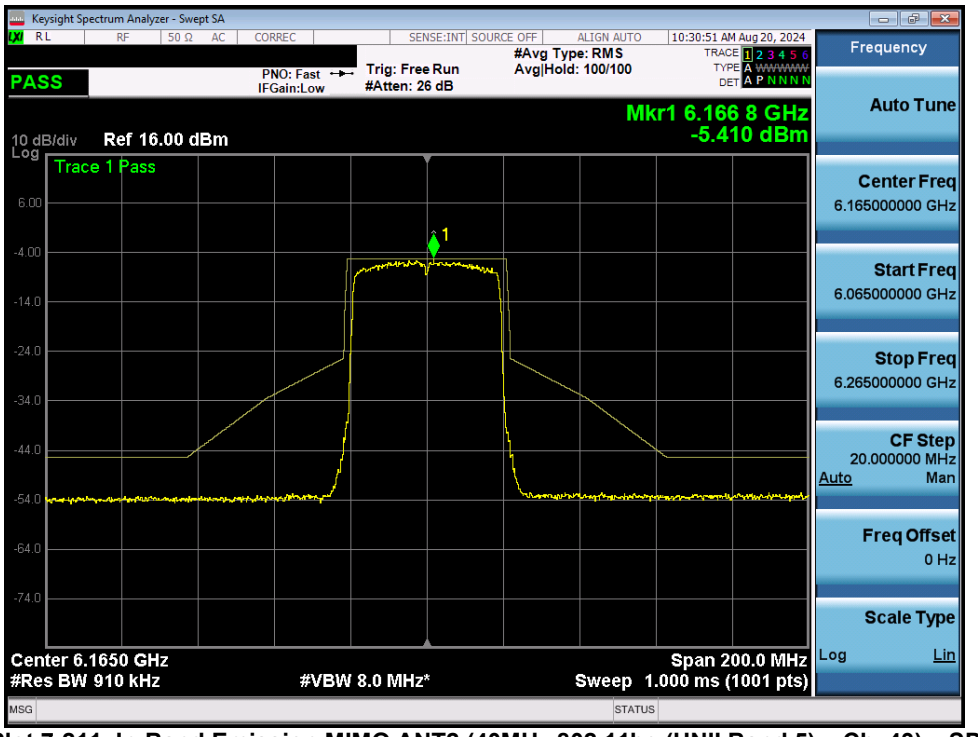
Plot 7-208. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 5) – Ch. 43) – LPI



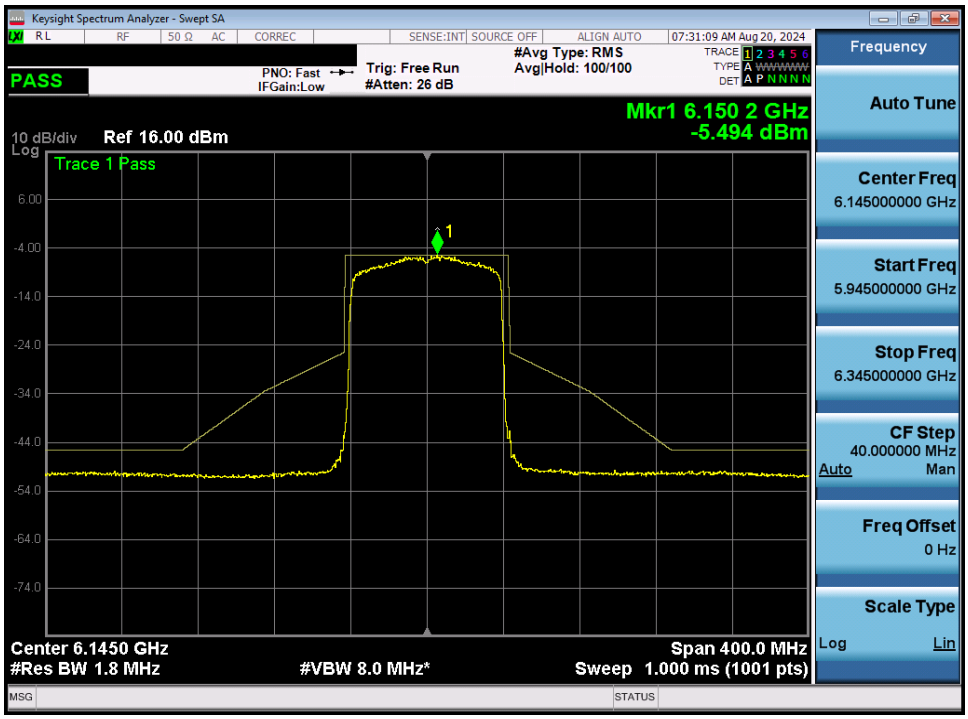
Plot 7-209. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 45) – SP



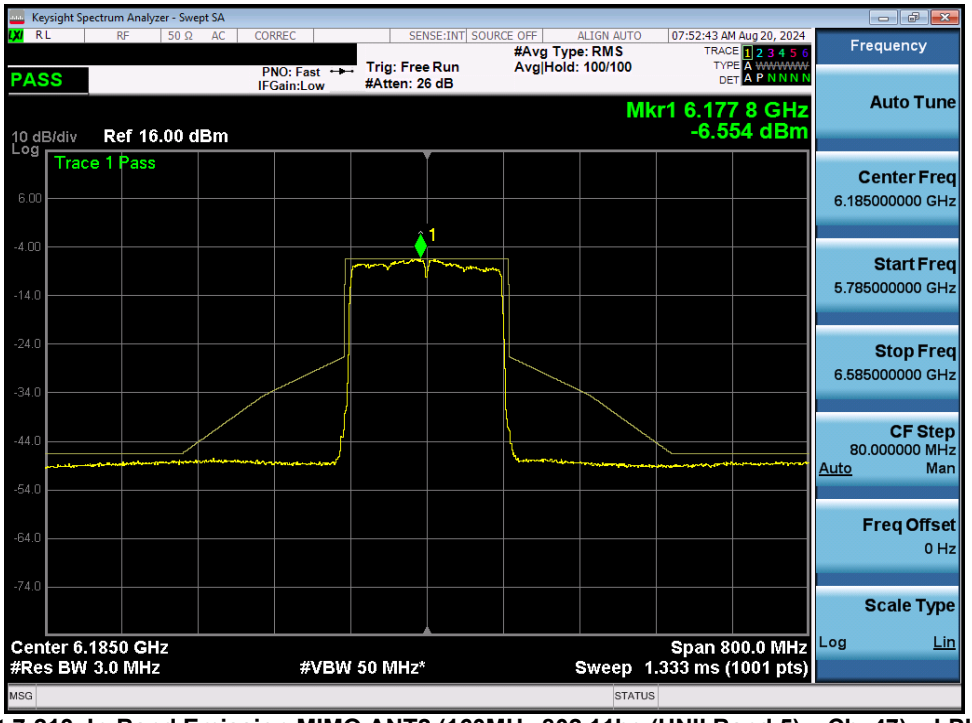
Plot 7-210. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 5) – Ch. 45) – SP



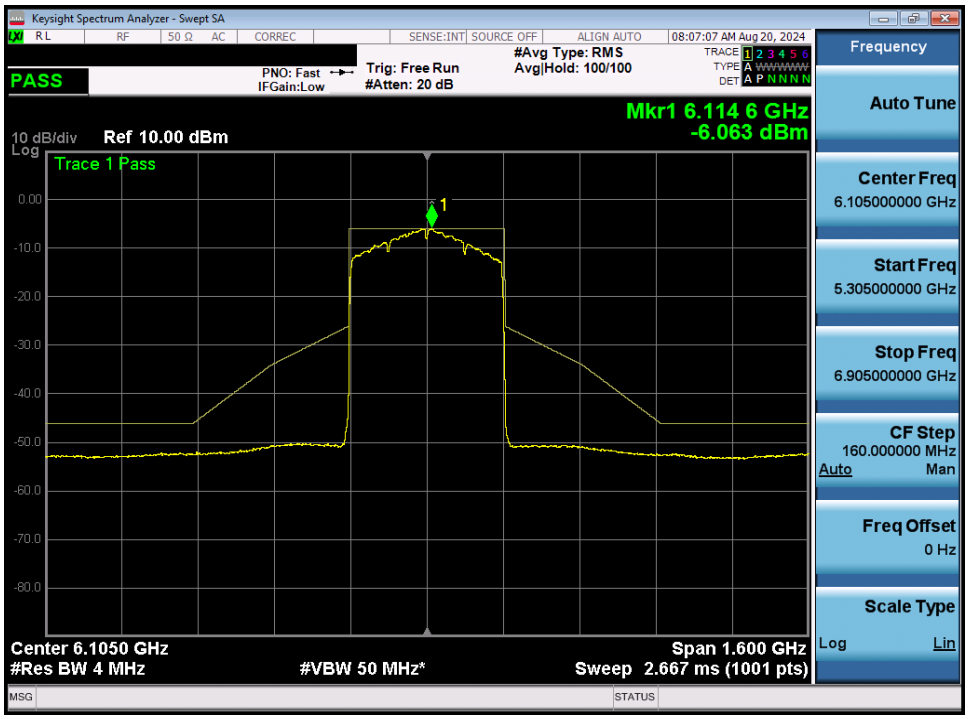
Plot 7-211. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 5) – Ch. 43) – SP



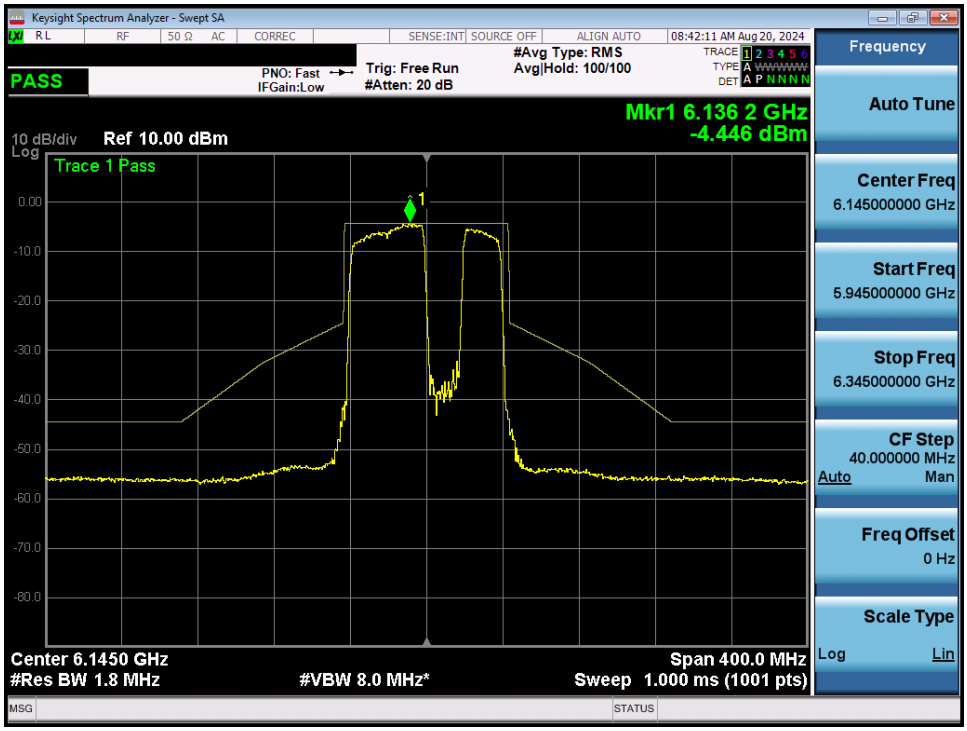
Plot 7-212. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 5) – Ch. 39) – LPI/SP



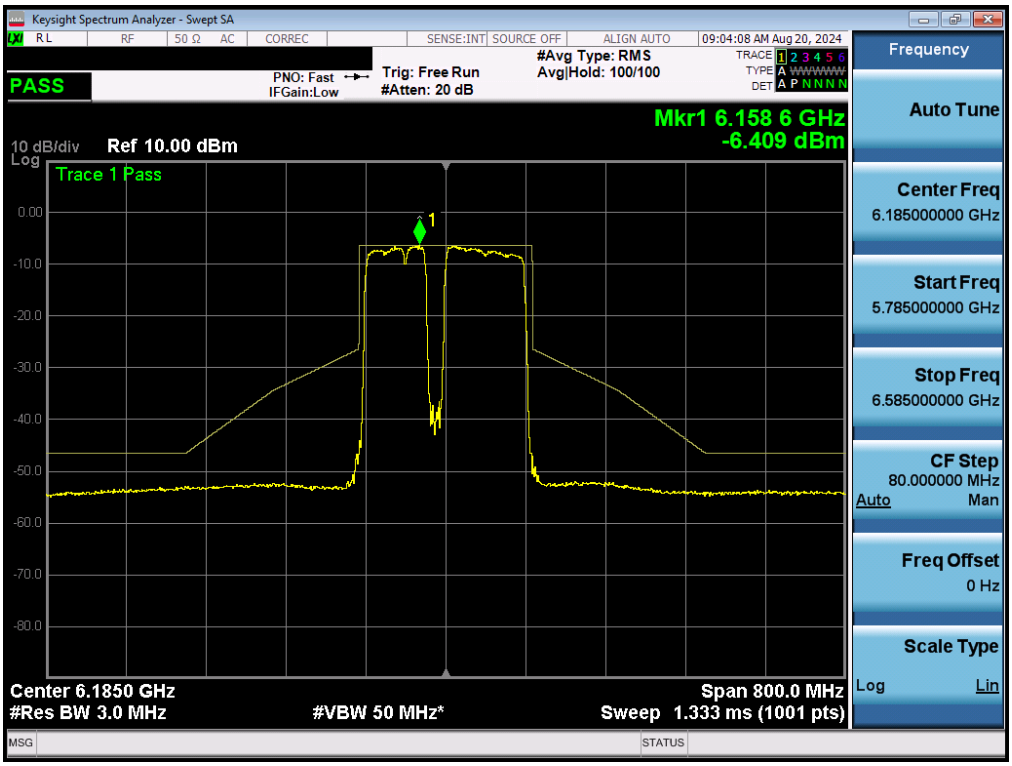
Plot 7-213. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 5) – Ch. 47) – LPI/SP



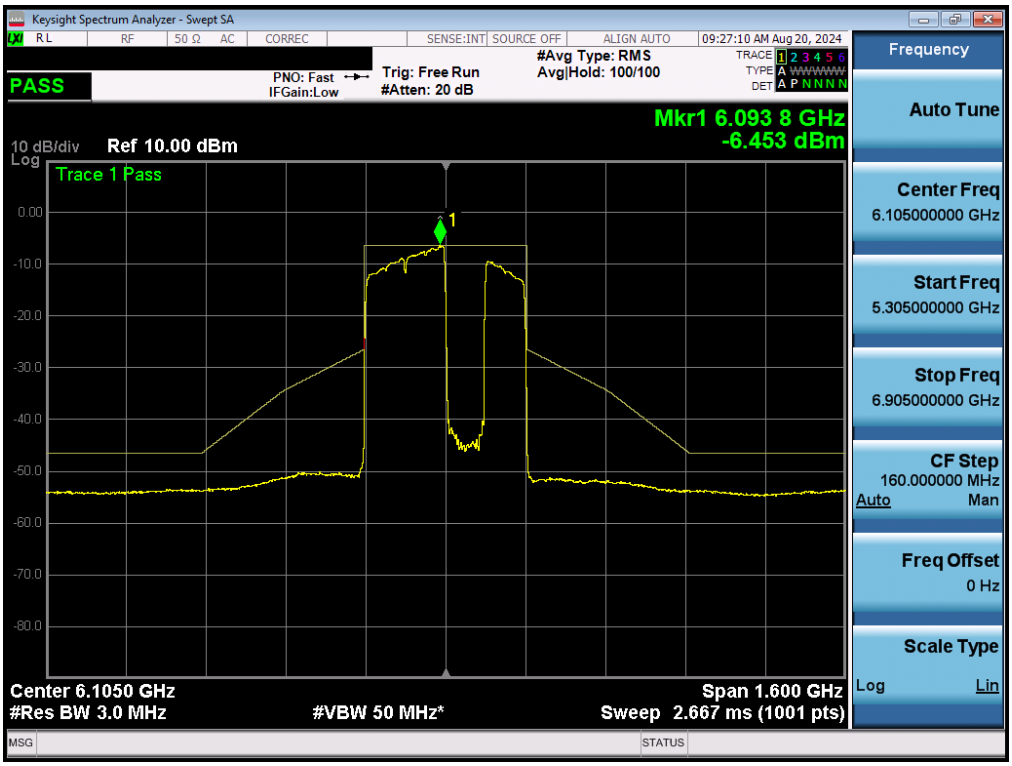
Plot 7-214. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 5) – Ch. 31) – LPI/SP



Plot 7-215. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 5) – Ch. 39) – 20MHz Punctured

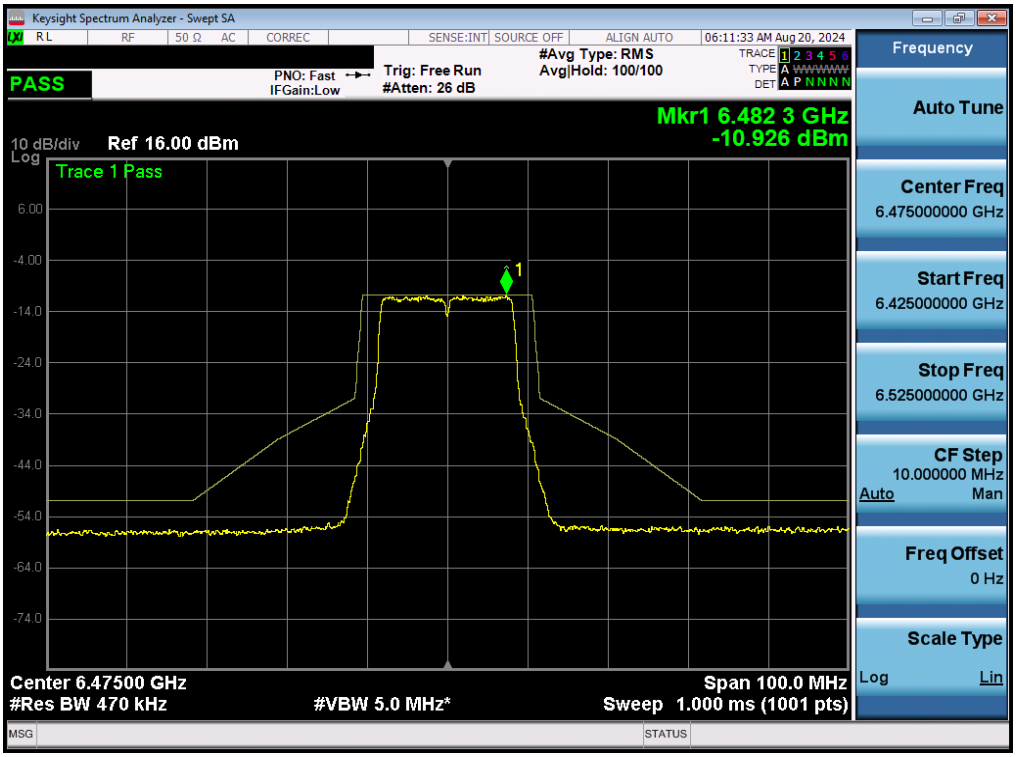


Plot 7-216. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 5) – Ch. 47) – 20MHz Punctured

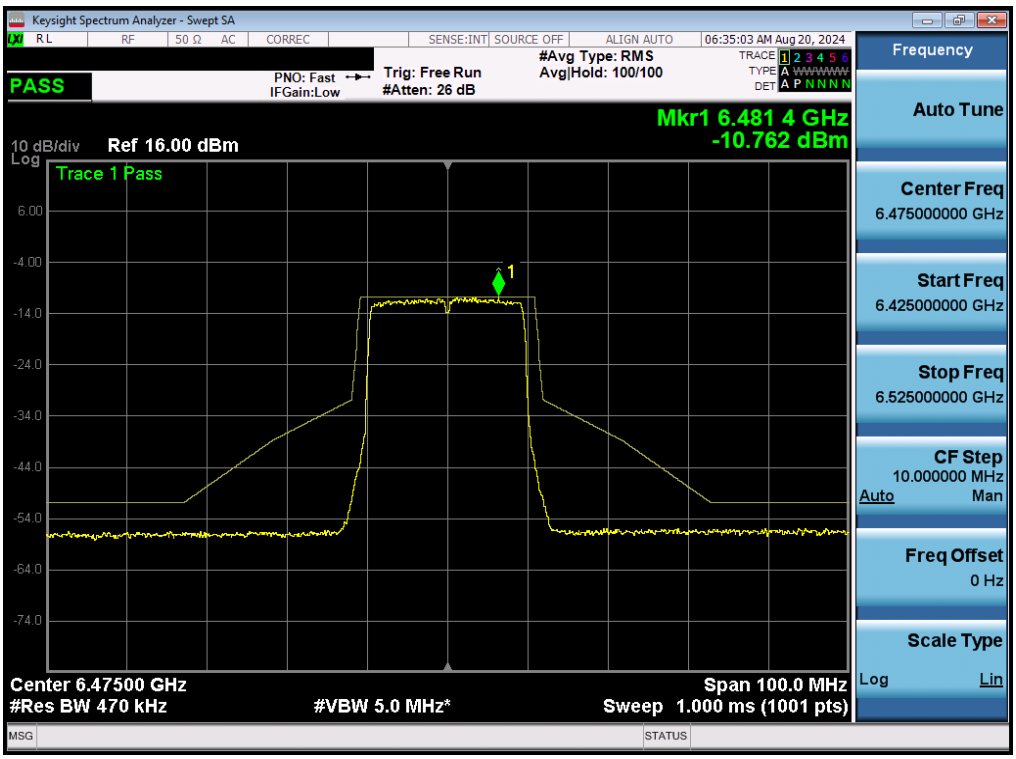


Plot 7-217. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 5) – Ch. 31) – 80MHz Punctured

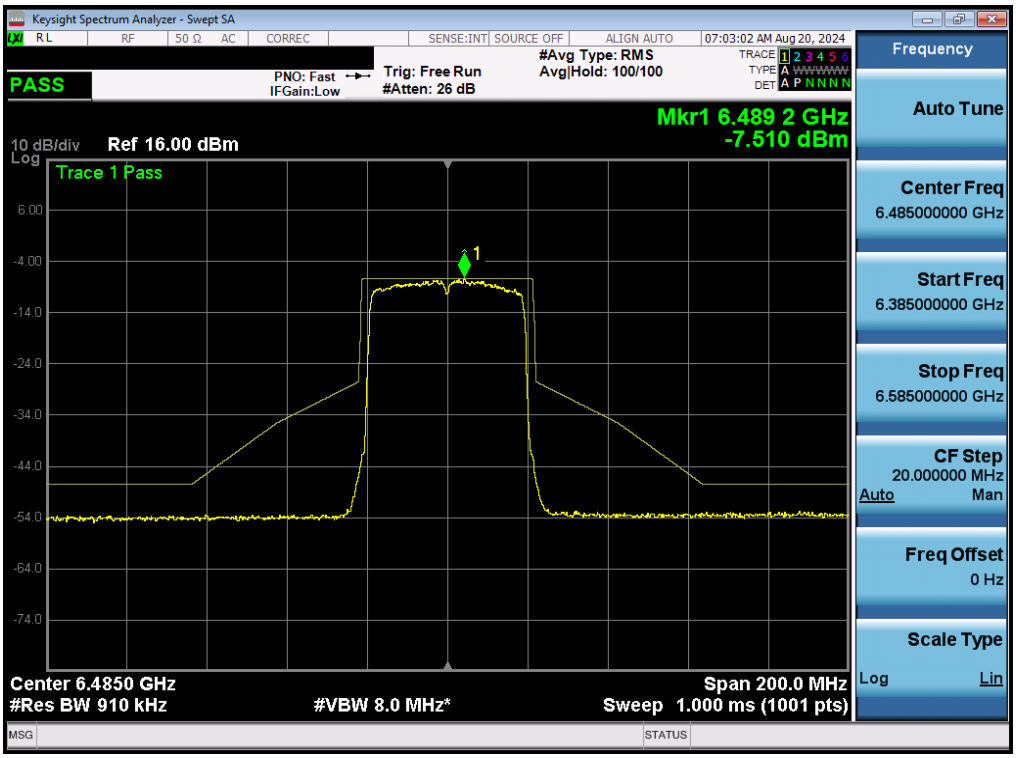
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 6)



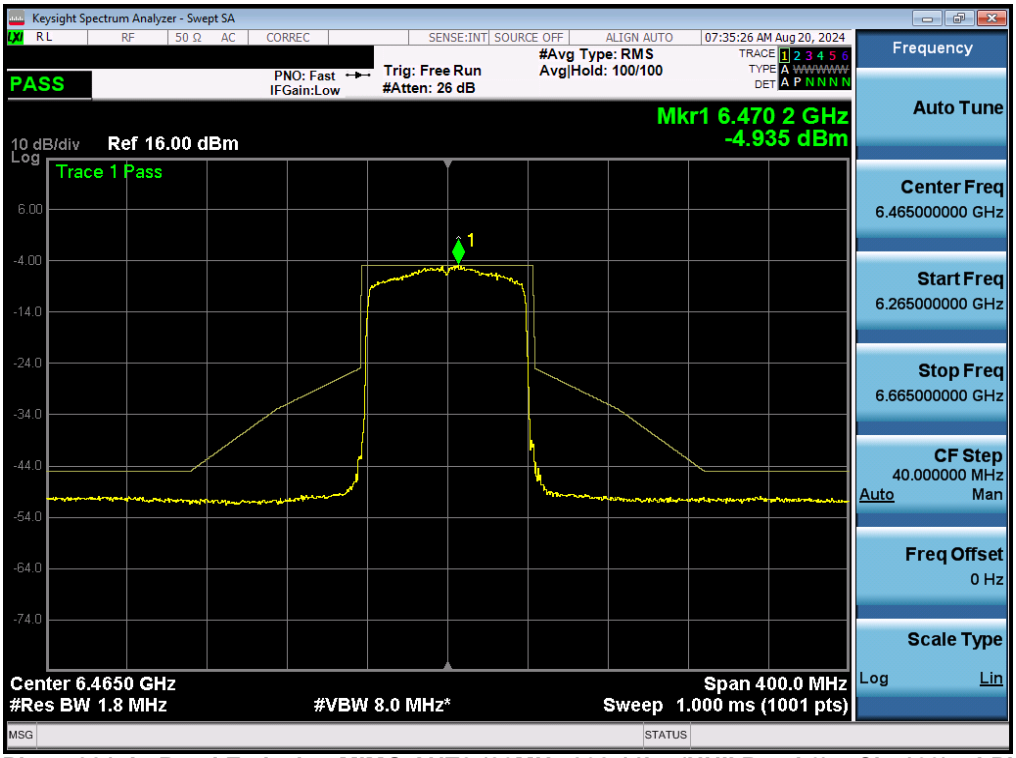
Plot 7-218. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 105) – LPI



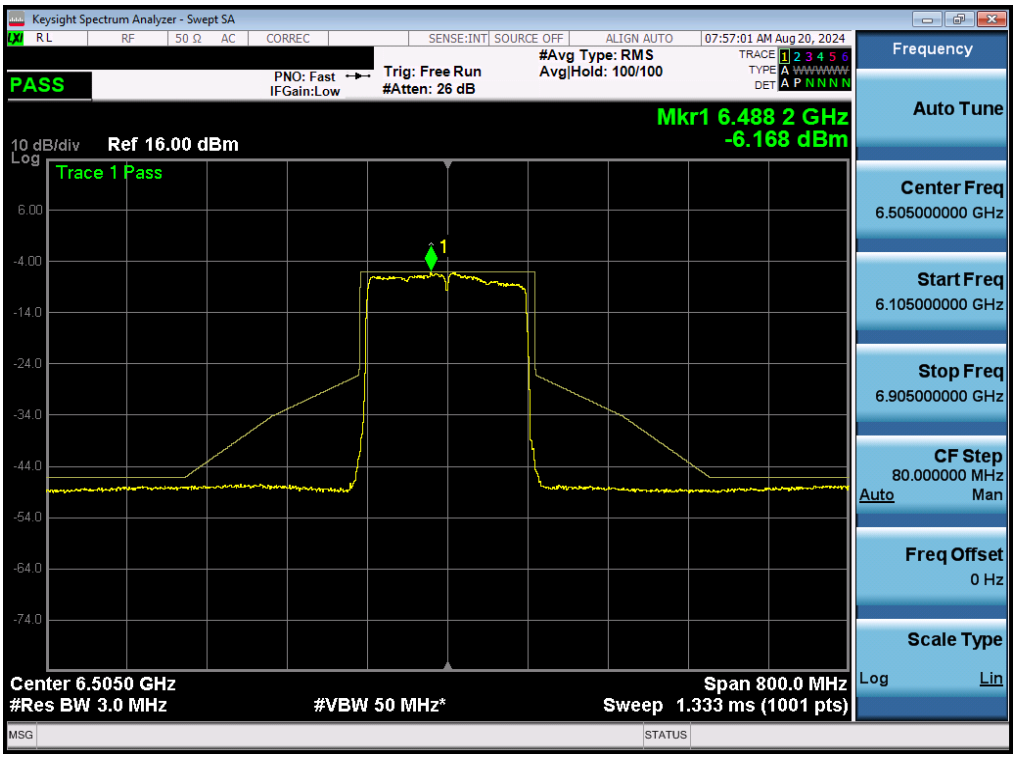
Plot 7-219. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 6) – Ch. 105) – LPI



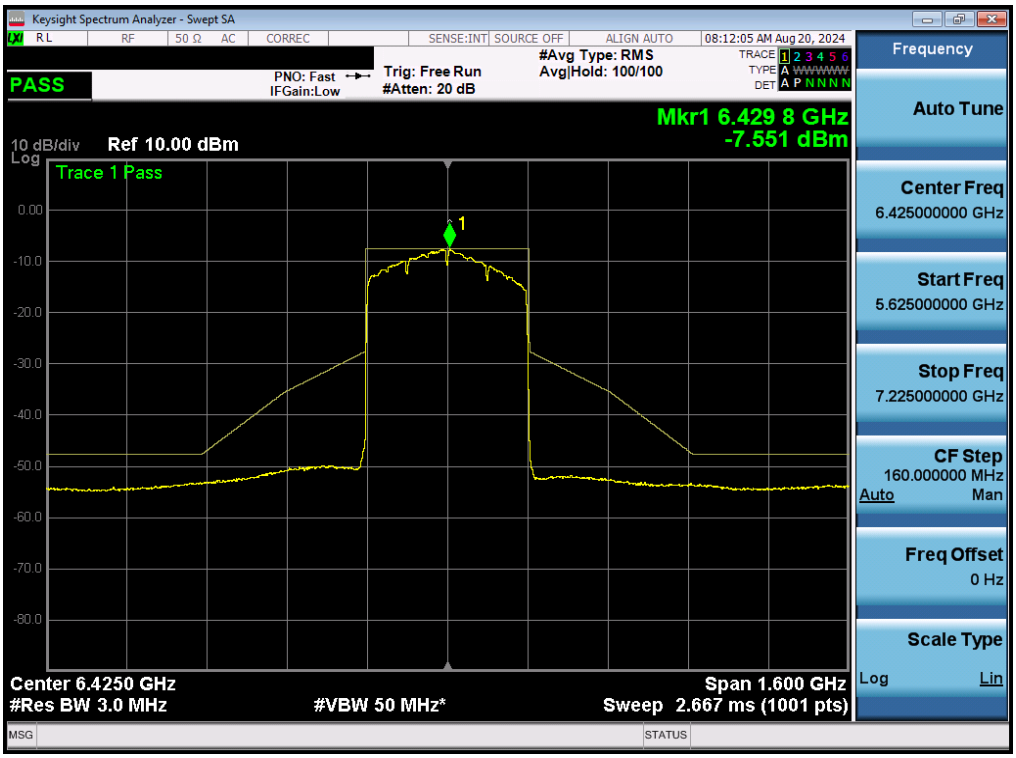
Plot 7-220. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 6) – Ch. 107) – LPI



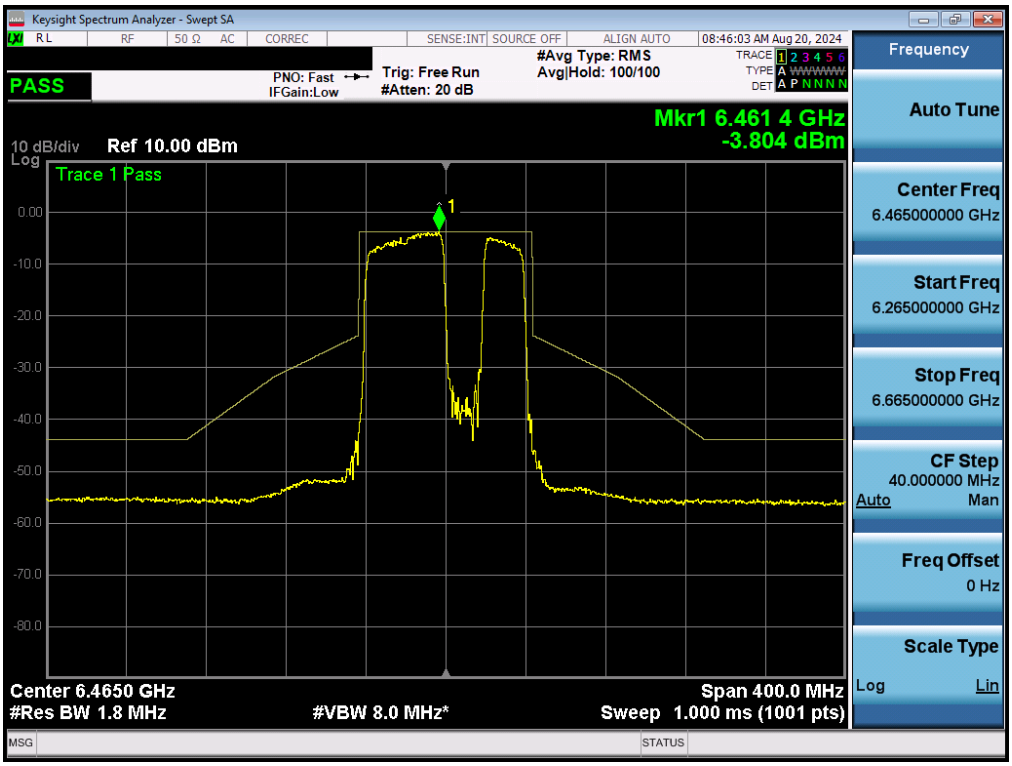
Plot 7-221. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 6) – Ch. 103) – LPI



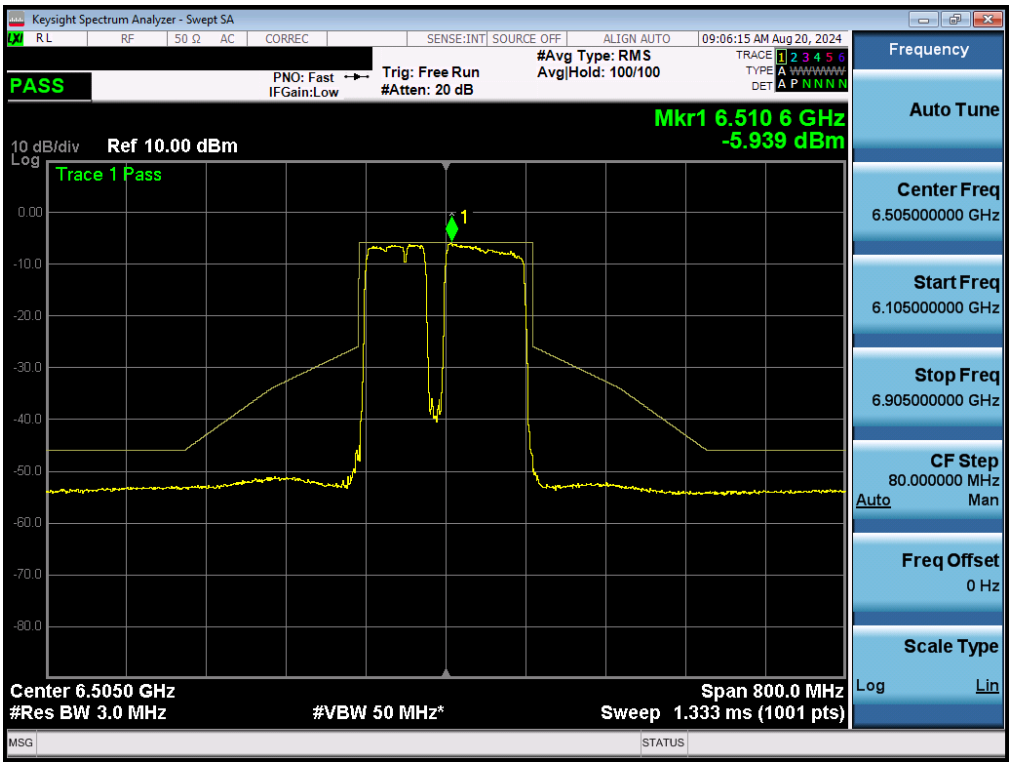
Plot 7-222. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 6) – Ch. 111) – LPI



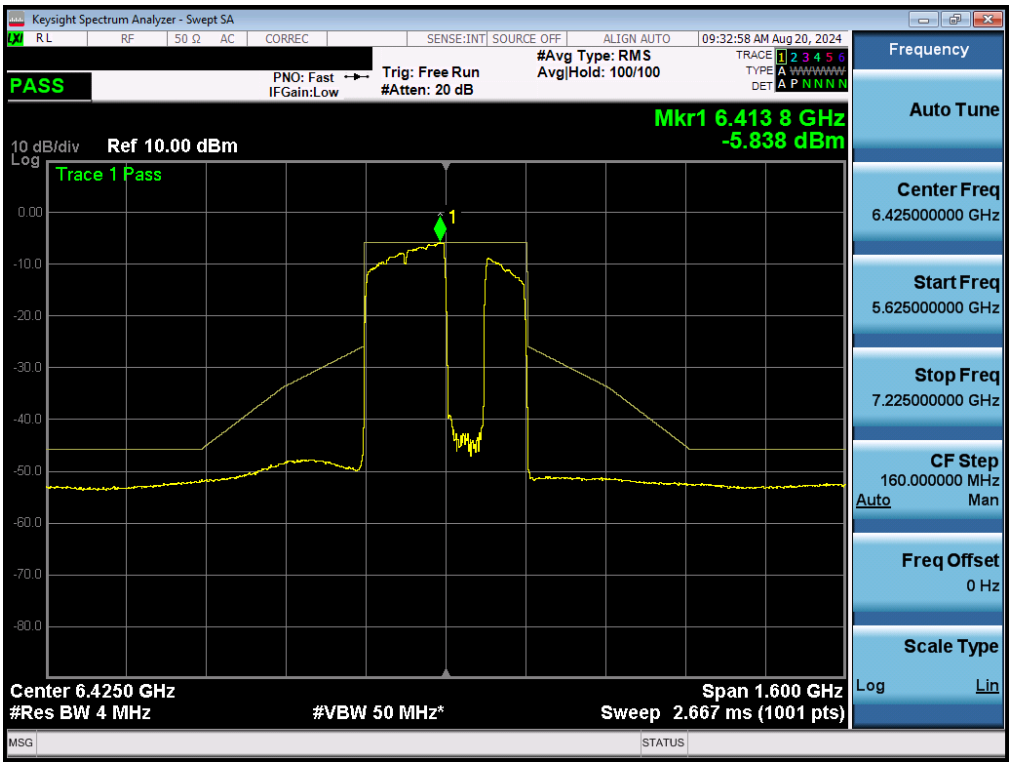
Plot 7-223. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 5/6/7) – Ch. 95) – LPI



Plot 7-224. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 6) – Ch. 103) – 20MHz Punctured

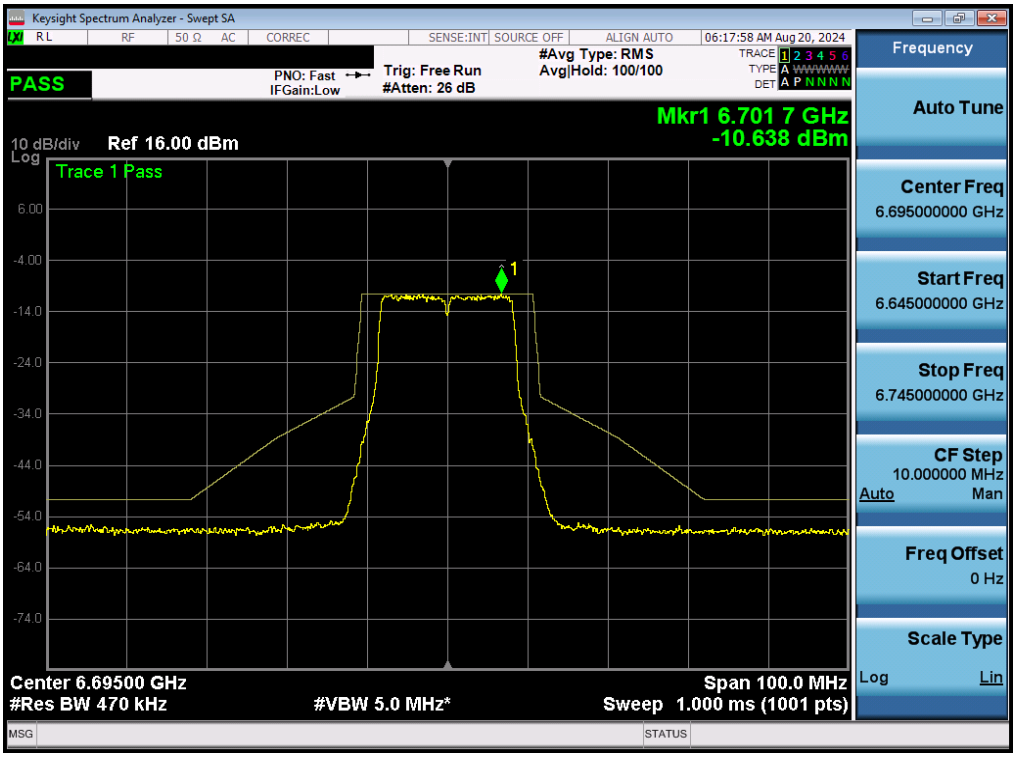


Plot 7-225. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 6) – Ch. 111) – 20MHz Punctured

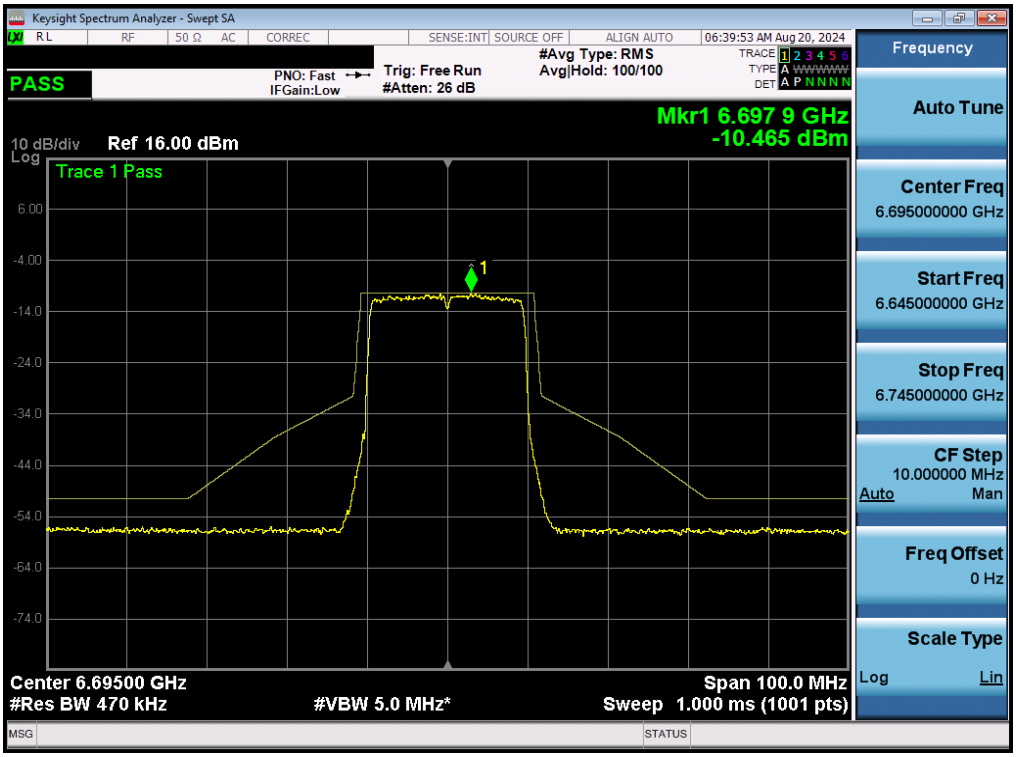


Plot 7-226. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 6) – Ch. 95) – 80MHz Punctured

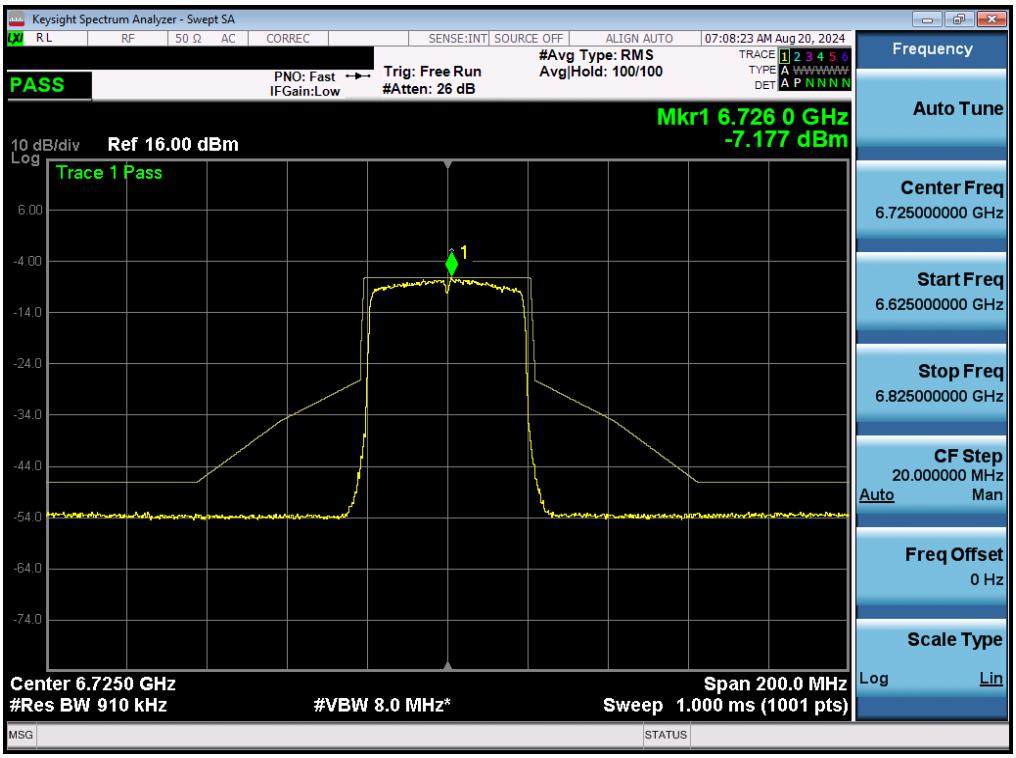
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 7)



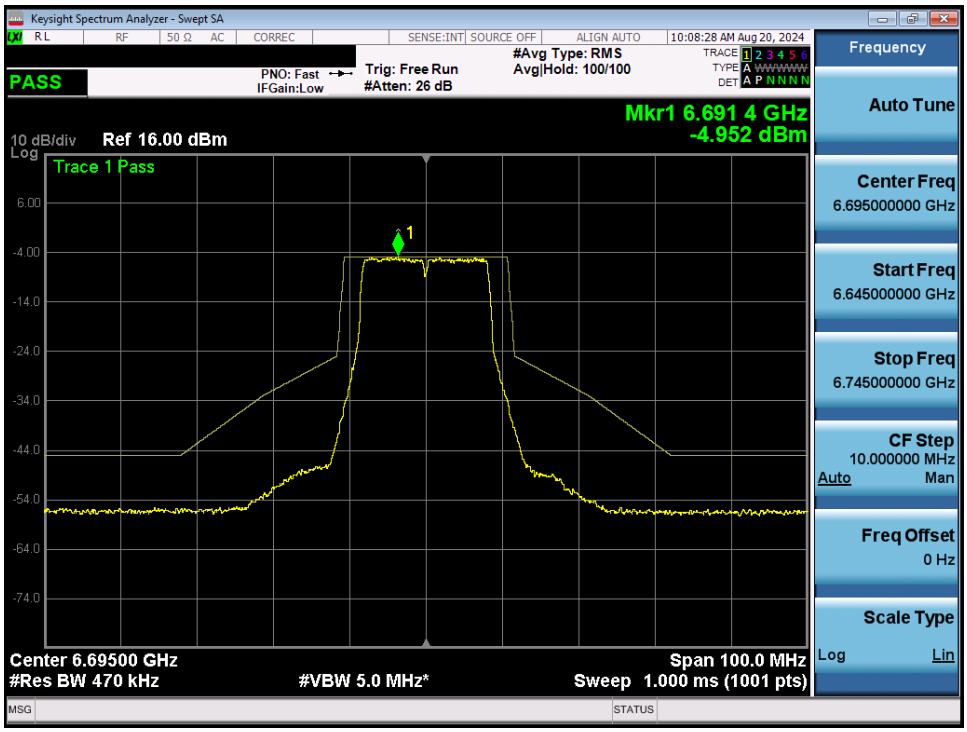
Plot 7-227. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 149) – LPI



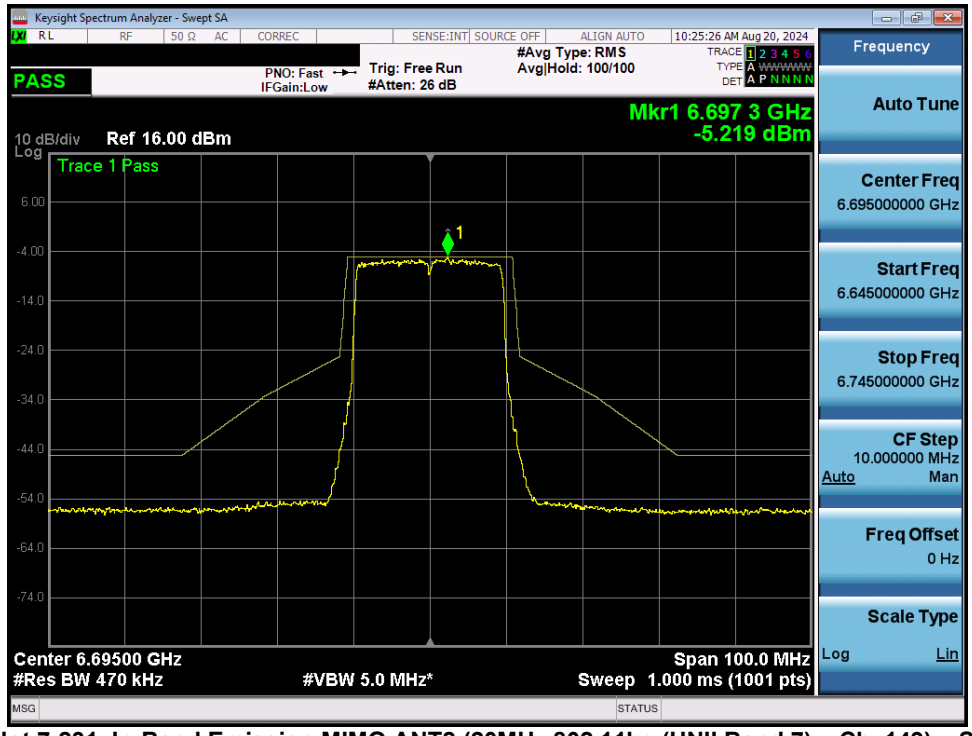
Plot 7-228. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 7) – Ch. 149) – LPI



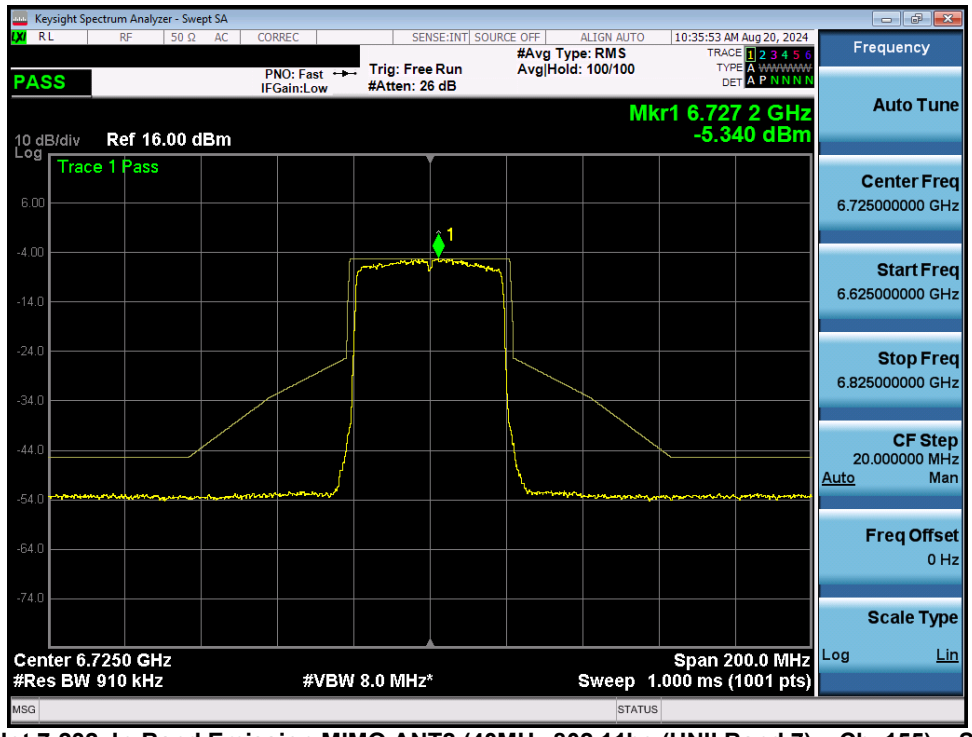
Plot 7-229. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 7) – Ch. 155) – LPI



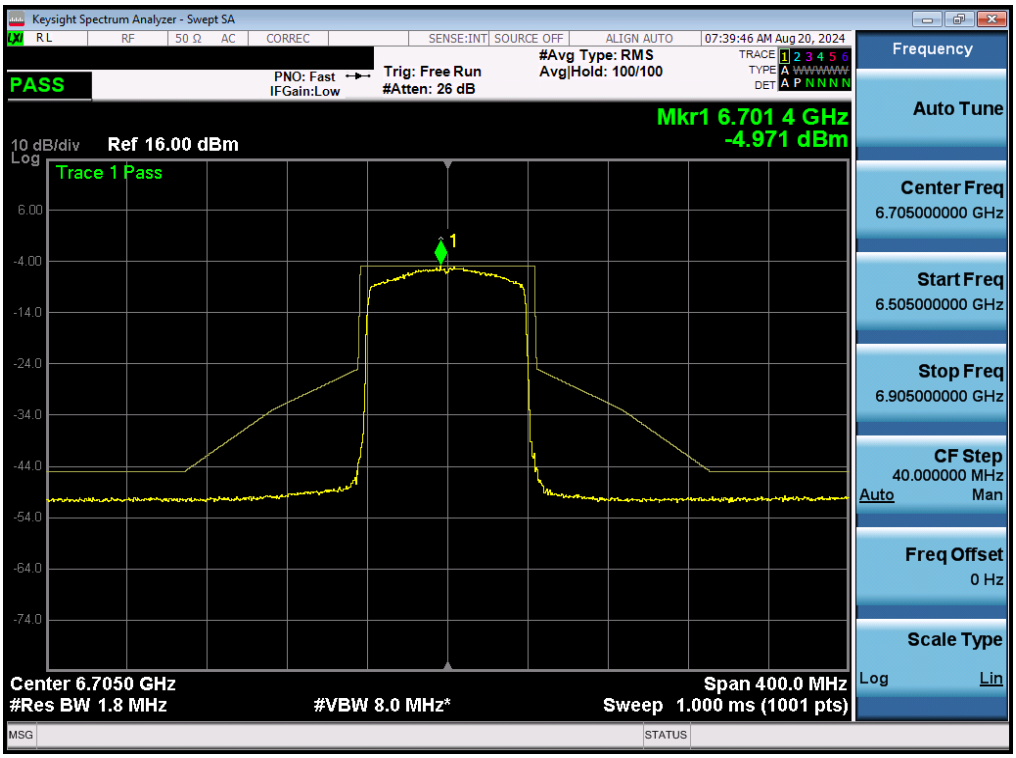
Plot 7-230. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 149) – SP



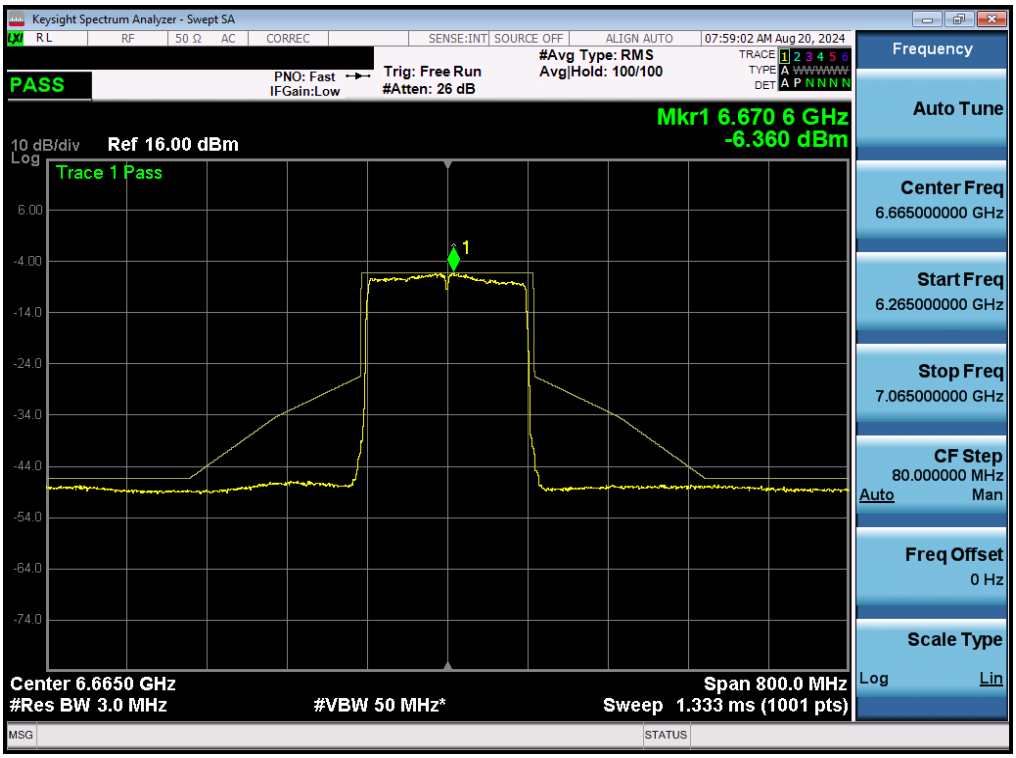
Plot 7-231. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 7) – Ch. 149) – SP



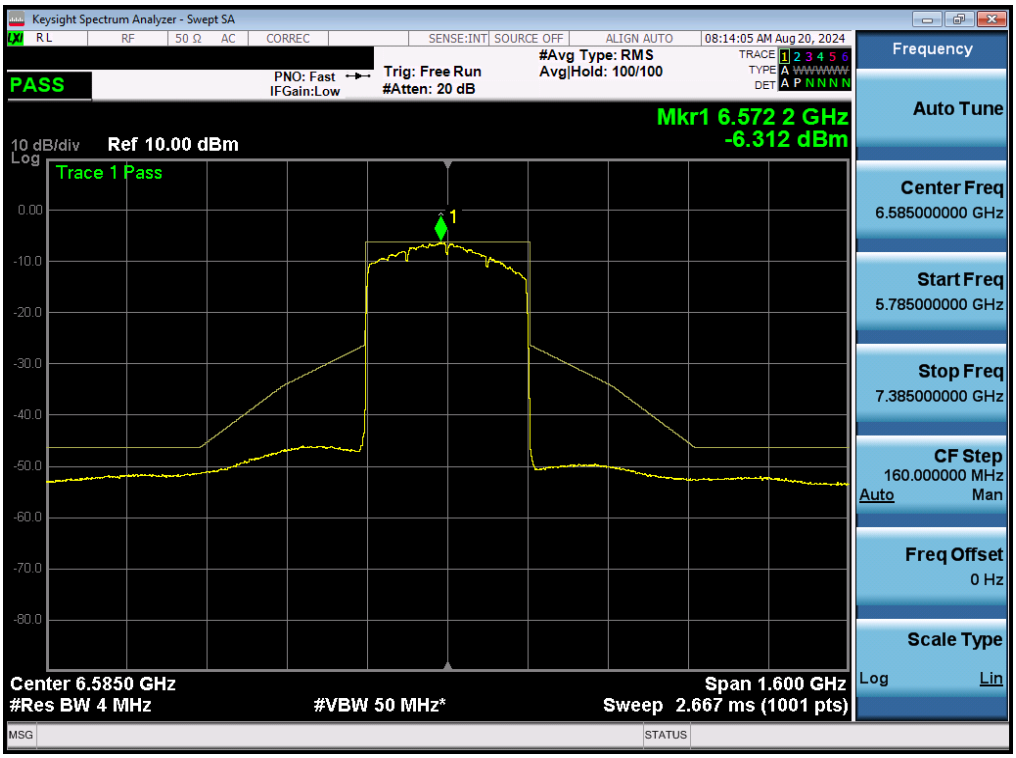
Plot 7-232. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 7) – Ch. 155) – SP



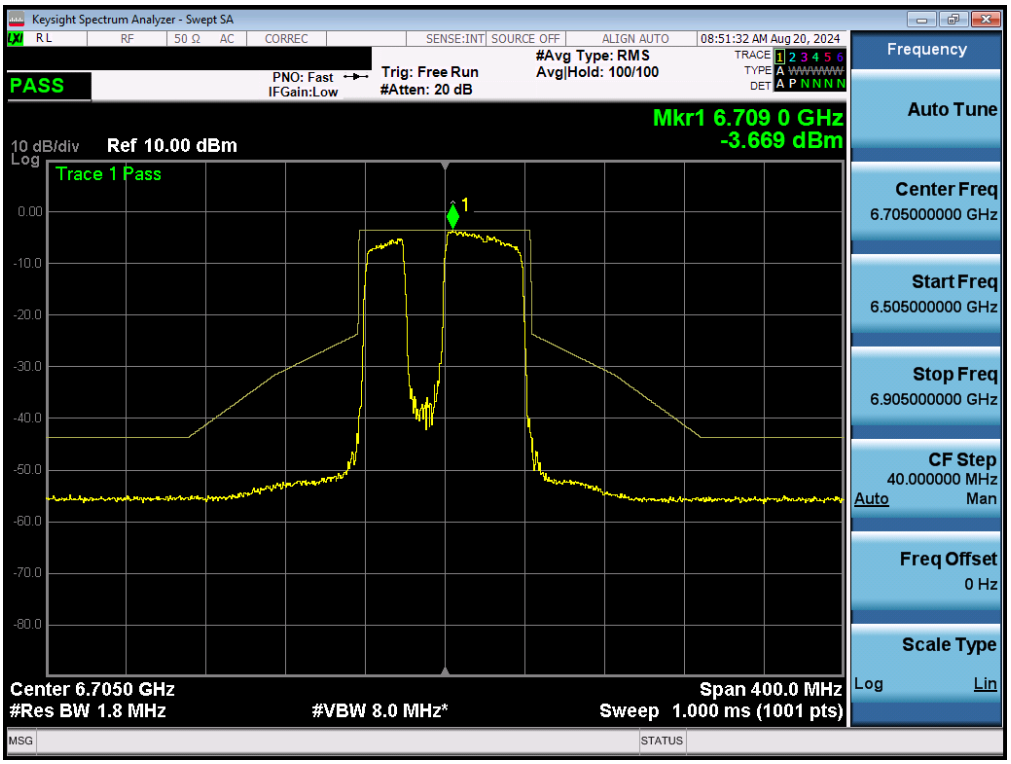
Plot 7-233. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 7) – Ch. 151) – LPI/SP



Plot 7-234. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 7) – Ch. 143) – LPI/SP

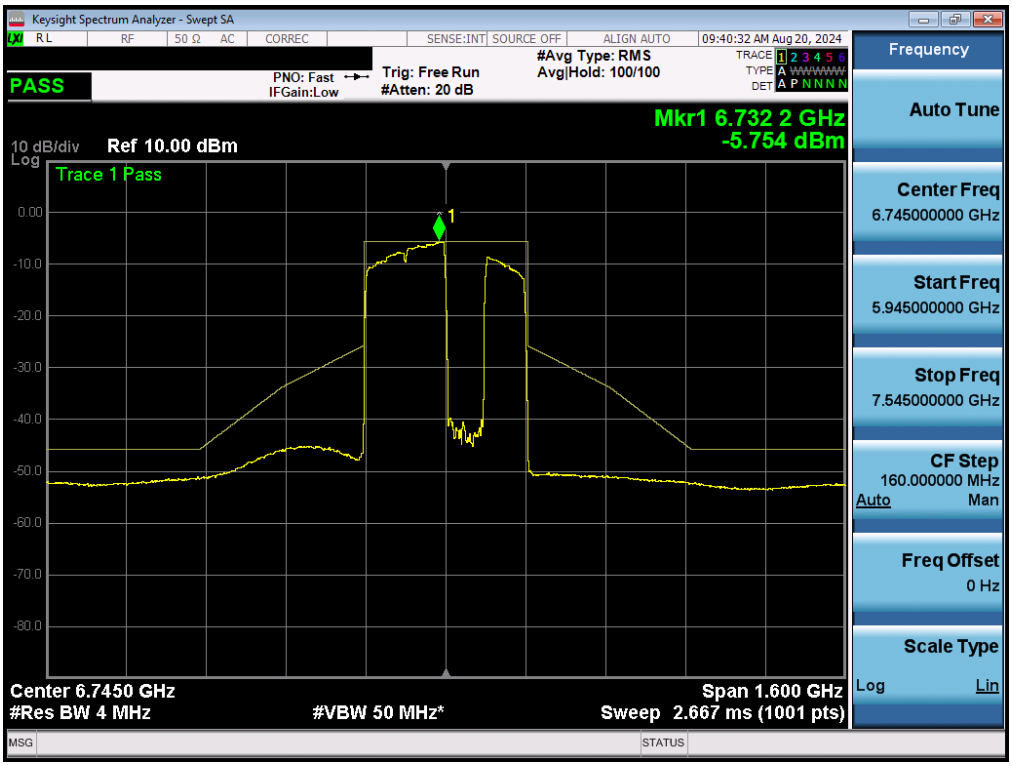


Plot 7-235. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 7) – Ch. 127) – LPI/SP



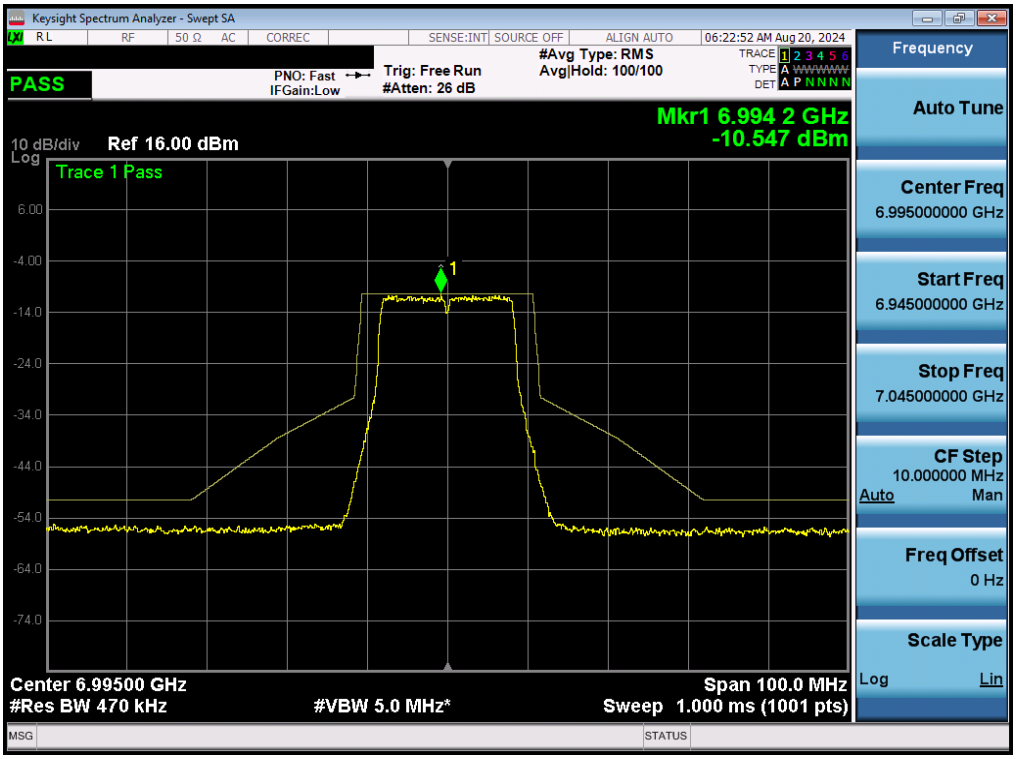
Plot 7-236. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 7) – Ch. 151) – 20MHz Punctured

Plot 7-237. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 7) – Ch. 143) – 20MHz Punctured

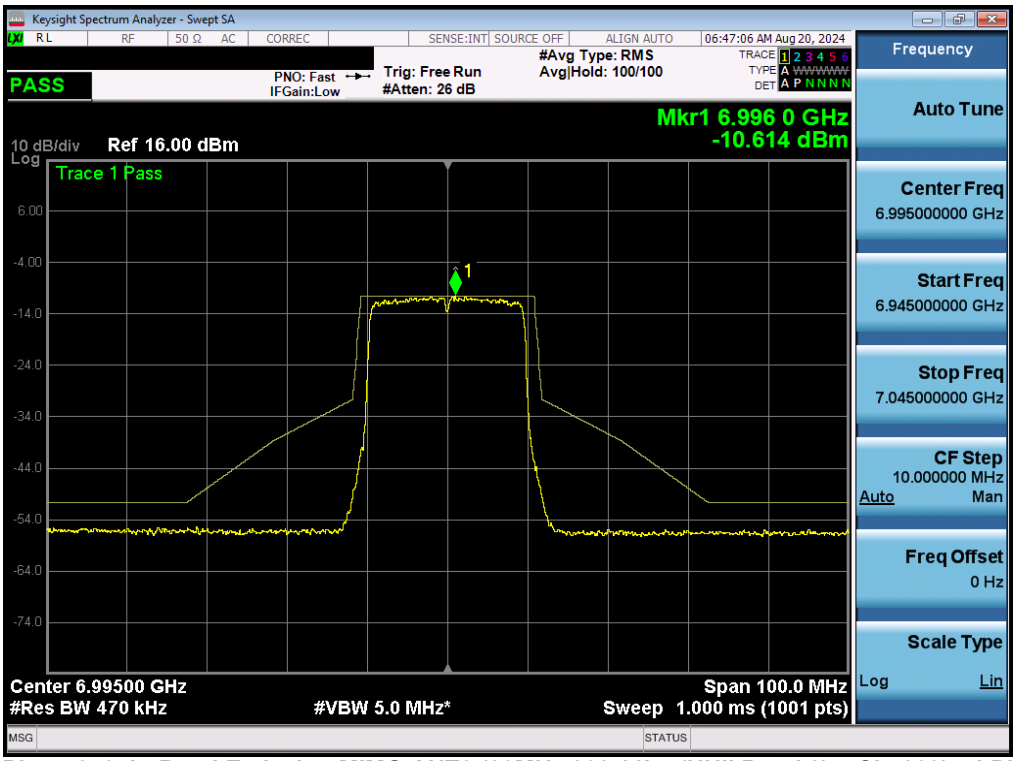


Plot 7-238. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 7) – Ch. 159) – 80MHz Punctured

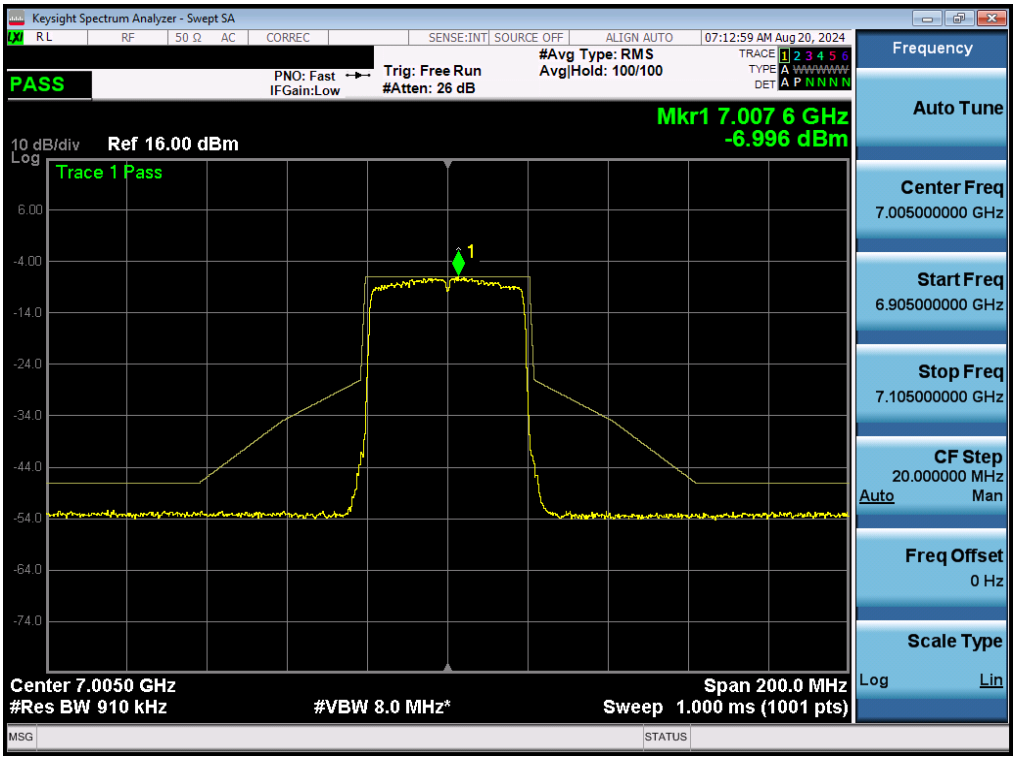
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 8)



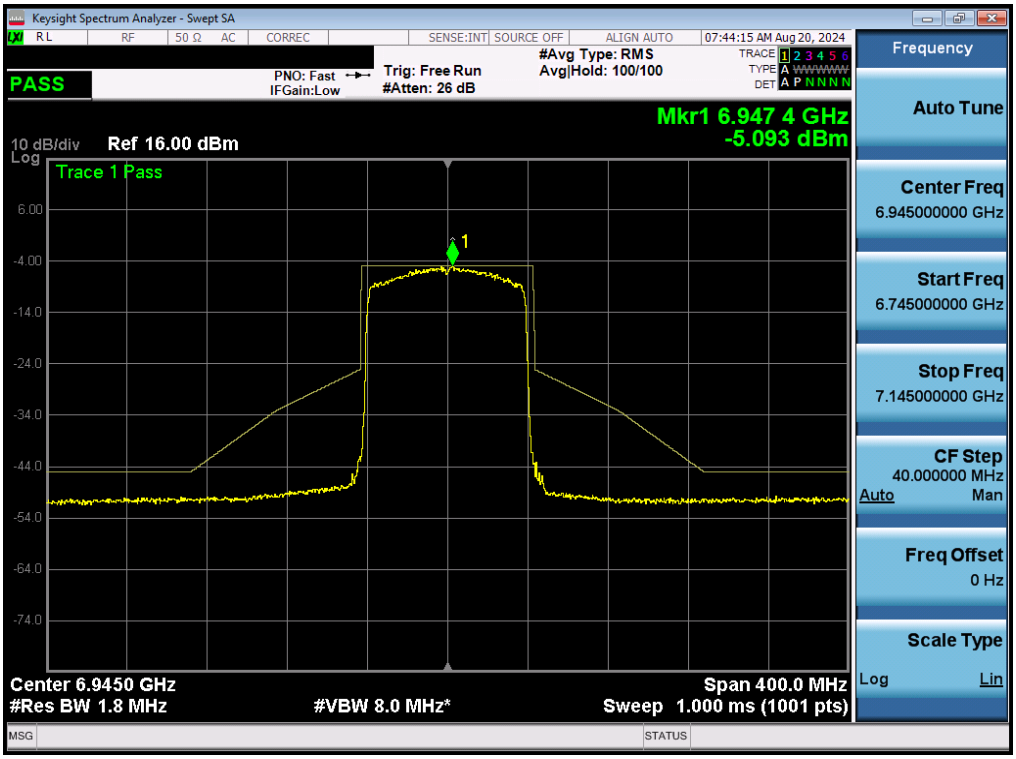
Plot 7-239. In-Band Emission MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 209) – LPI



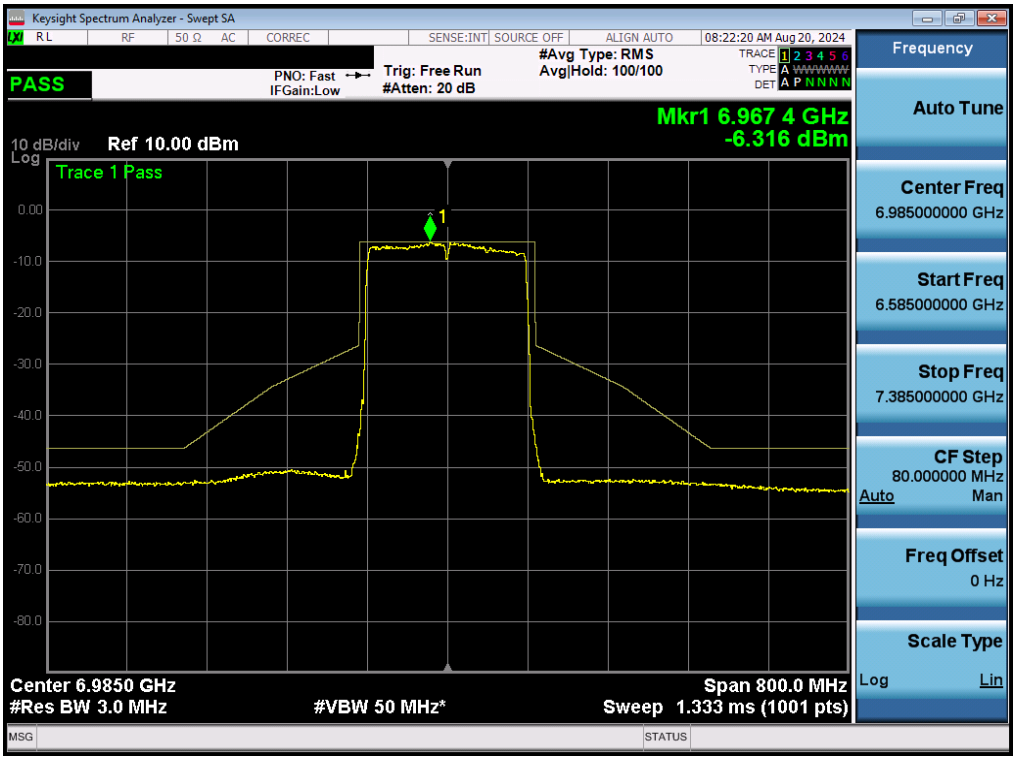
Plot 7-240. In-Band Emission MIMO ANT2 (20MHz 802.11be (UNII Band 8) – Ch. 209) – LPI



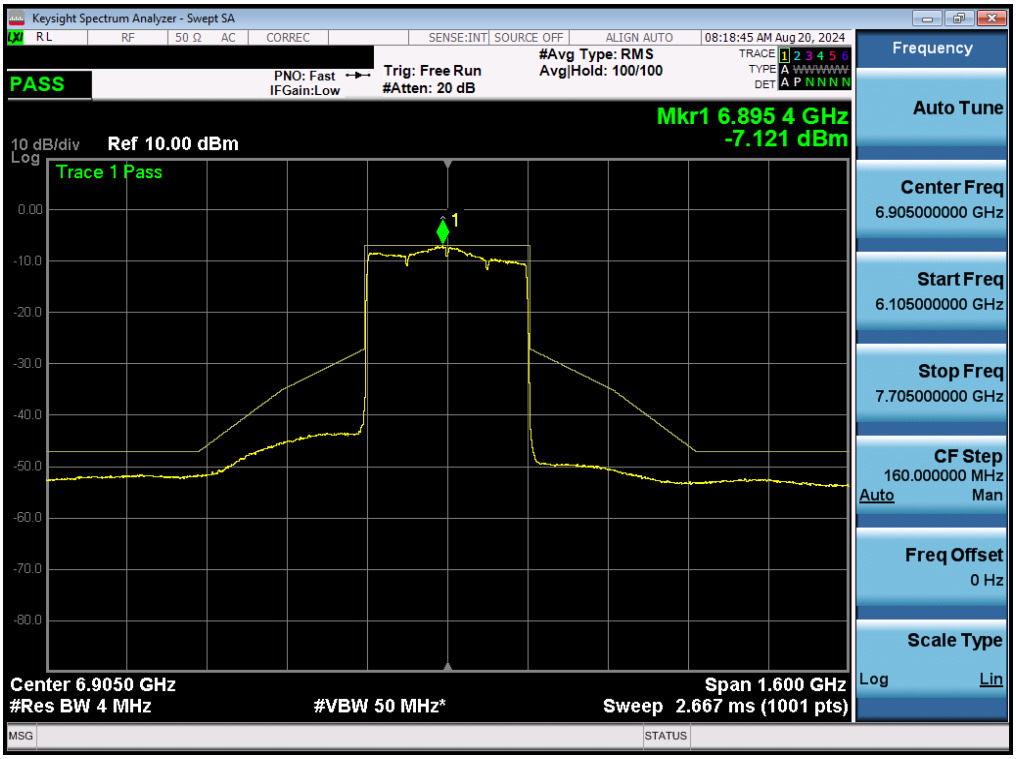
Plot 7-241. In-Band Emission MIMO ANT2 (40MHz 802.11be (UNII Band 8) – Ch. 211) – LPI



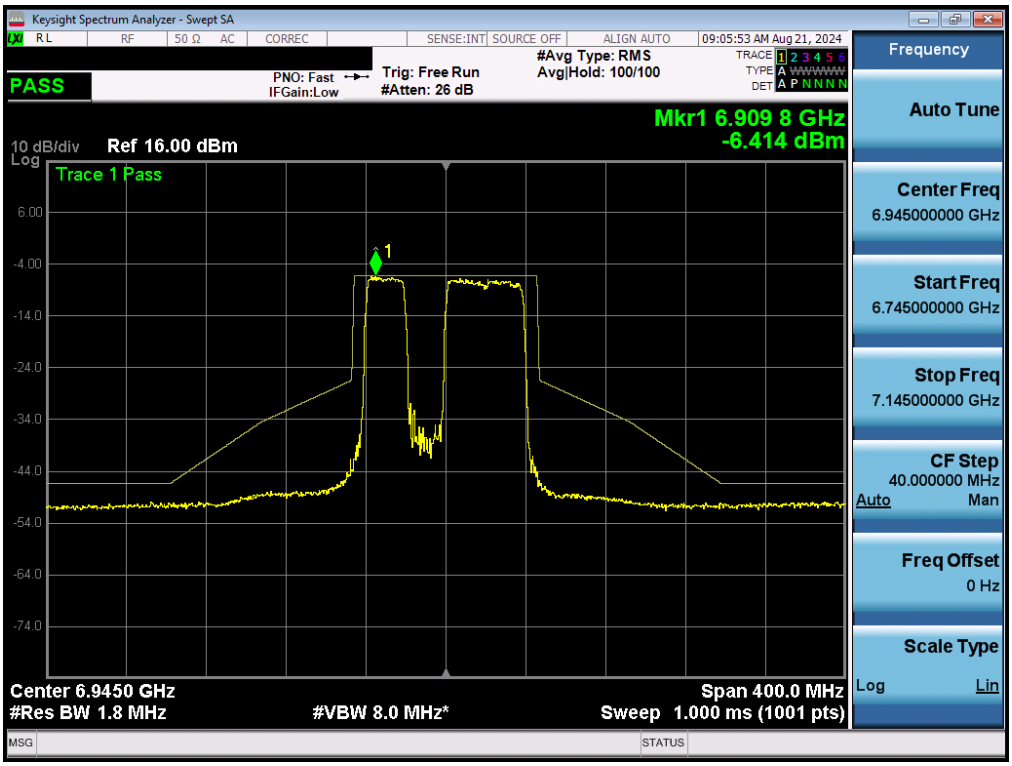
Plot 7-242. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 8) – Ch. 199) – LPI



Plot 7-243. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 8) – Ch. 207) – LPI

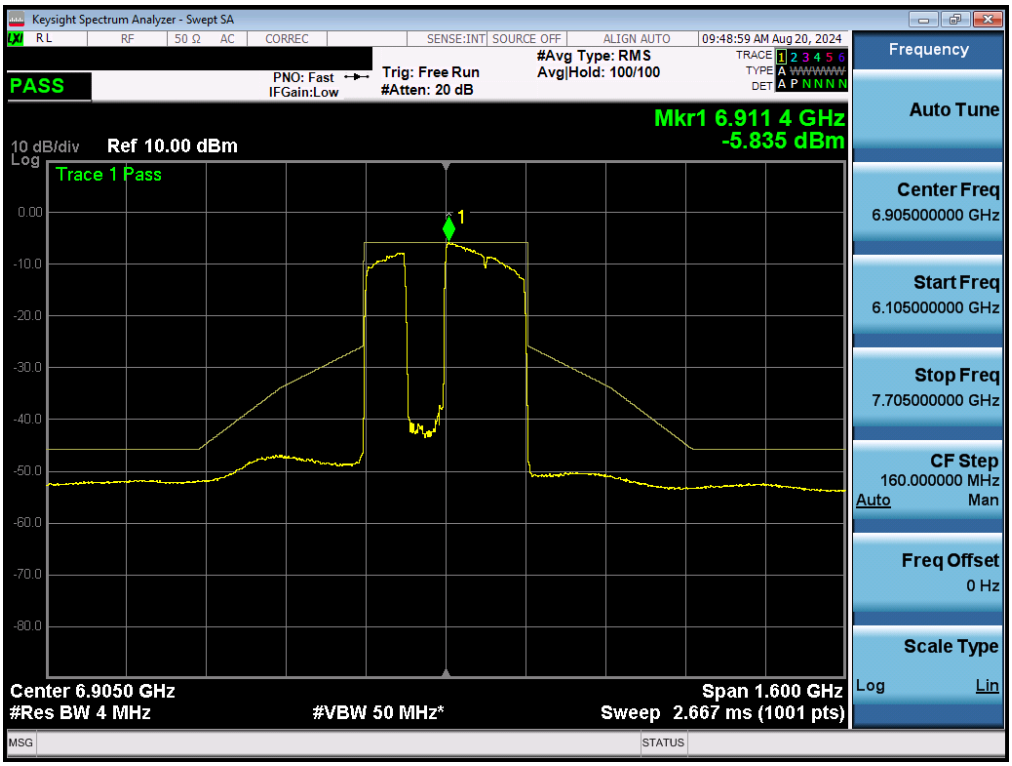


Plot 7-244. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 7/8) – Ch. 191) – LPI



Plot 7-245. In-Band Emission MIMO ANT2 (80MHz 802.11be (UNII Band 8) – Ch. 199) – 20MHz Punctured

Plot 7-246. In-Band Emission MIMO ANT2 (160MHz 802.11be (UNII Band 8) – Ch. 207) – 20MHz Punctured



Plot 7-247. In-Band Emission MIMO ANT2 (320MHz 802.11be (UNII Band 8) – Ch. 191) – 80MHz Punctured

7.6 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 v02r01

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 v02r01 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.

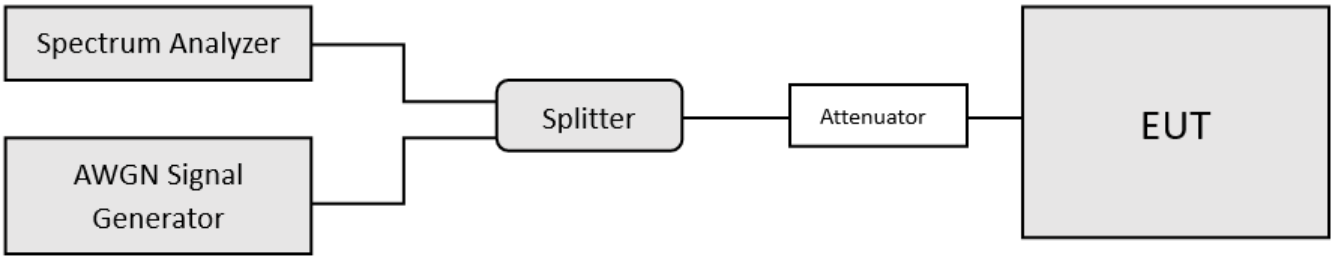


Figure 7-5. Contention-based protocol test setup conducted method.

Test Notes

1. Per guidance from KDB 987594 D02 v02r01, contention-based protocol was tested using an AWGN signal with a bandwidth of 10MHz (see Plot 7-215). The amplitude of the signal was increased until detected by the EUT, signaled by the ceasing of transmission (see Plot 7-216), 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]	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	-0.82	-76.76	-76.04	-75.31	-62.0	-13.31
	31	6265	320	6110	-0.82	-71.02	-70.78	-70.05	-62.0	-8.05
				6265	-0.82	-72.46	-71.74	-71.01	-62.0	-9.01
				6420	-0.82	-68.49	-68.12	-67.88	-62.0	-5.88
UNII Band 6	101	6455	20	6455	-0.86	-77.27	-76.67	-75.94	-62.0	-13.94
	95	6425	320	6270	-0.86	-70.80	-70.44	-69.83	-62.0	-7.83
				6425	-0.86	-74.62	-74.02	-73.29	-62.0	-11.29
				6580	-0.86	-72.59	-72.22	-71.86	-62.0	-9.86
UNII Band 7	149	6695	20	6695	-0.87	-67.10	-66.38	-65.65	-62.0	-3.65
	159	6745	320	6590	-0.87	-70.95	-70.34	-69.98	-62.0	-7.98
				6745	-0.87	-74.42	-74.17	-73.69	-62.0	-11.69
				6900	-0.87	-73.04	-72.79	-72.31	-62.0	-10.31
UNII Band 8	197	6935	20	6935	-1.29	-78.11	-77.38	-77.02	-62.0	-15.02
	191	6905	320	6750	-1.29	-79.10	-78.62	-78.01	-62.0	-16.01
				6905	-1.29	-69.53	-69.04	-68.56	-62.0	-6.56
				7060	-1.29	-73.40	-72.67	-72.19	-62.0	-10.19

Table 7-31. Contention Based Protocol – Incumbent Detection Results

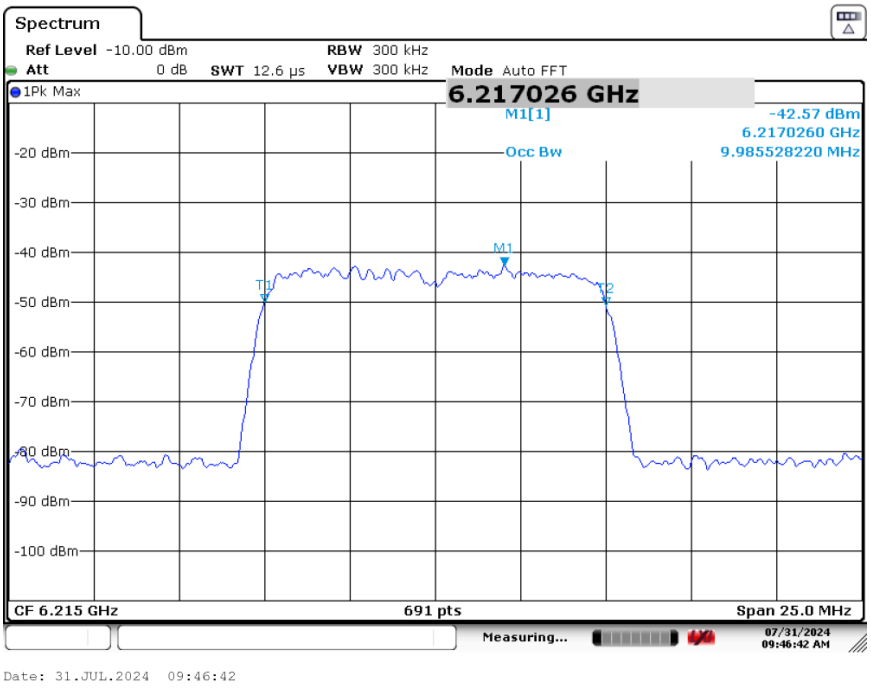
Band	Channel	Channel Freq [MHz]	Channel BW [MHz]	Incumbent Freq [MHz]	Injected (AWGN) [dBm]	Antenna Gain [dBi]	Path Loss (dB)	Adjusted Power Level [dBm]	Detection Limit [dBm]	Margin [dB]
UNII Band 5	53	6215	20	6215	-77.16	-0.82	1.03	-75.31	-62.0	-13.31
	31	6265	320	6110	-71.90	-0.82	1.03	-70.05	-62.0	-8.05
				6265	-72.86	-0.82	1.03	-71.01	-62.0	-9.01
				6420	-69.73	-0.82	1.03	-67.88	-62.0	-5.88
UNII Band 6	101	6455	20	6455	-77.83	-0.86	1.03	-75.94	-62.0	-13.94
	95	6425	320	6270	-71.72	-0.86	1.03	-69.83	-62.0	-7.83
				6425	-75.18	-0.86	1.03	-73.29	-62.0	-11.29
				6580	-73.75	-0.86	1.03	-71.86	-62.0	-9.86
UNII Band 7	149	6695	20	6695	-67.55	-0.87	1.03	-65.65	-62.0	-3.65
	159	6745	320	6590	-71.88	-0.87	1.03	-69.98	-62.0	-7.98
				6745	-75.59	-0.87	1.03	-73.69	-62.0	-11.69
				6900	-74.21	-0.87	1.03	-72.31	-62.0	-10.31
UNII Band 8	197	6935	20	6935	-79.34	-1.29	1.03	-77.02	-62.0	-15.02
	191	6905	320	6750	-80.33	-1.29	1.03	-78.01	-62.0	-16.01
				6905	-70.88	-1.29	1.03	-68.56	-62.0	-6.56
				7060	-74.51	-1.29	1.03	-72.19	-62.0	-10.19

Table 7-32. Contention Based Protocol – Detection Results – All Tx Cases

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
	31	6265	320	6110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6265	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6420	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
UNII Band 6	101	6455	20	6455	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
UNII Band 8	197	6935	20	6935	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	191	6905	320	6750	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6905	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				7060	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100

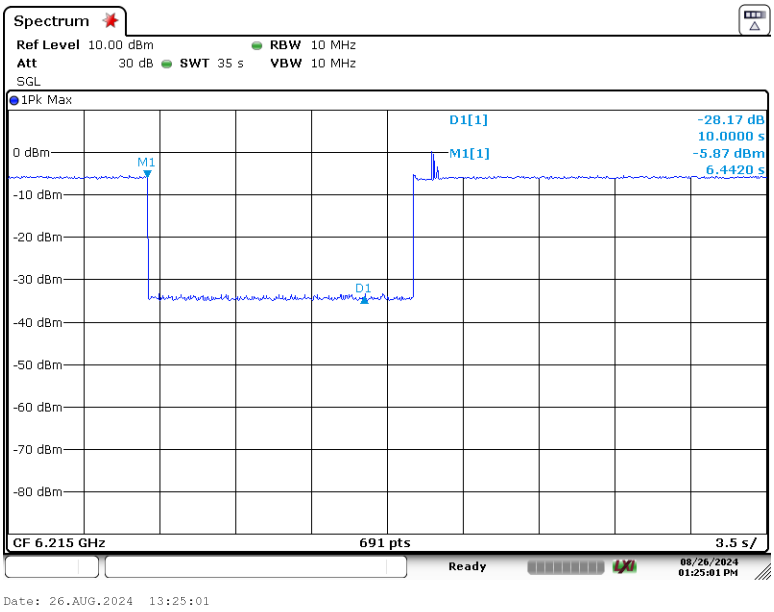
Table 7-33. Contention Based Protocol – Incumbent Detection Trial Results

7.6.1 AWGN Plots

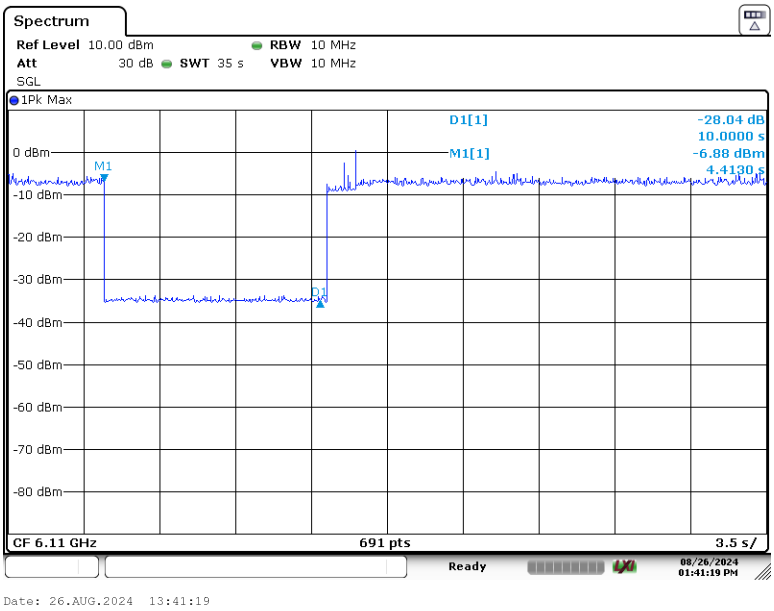


Plot 7-248. AWGN Signal (Demonstration)

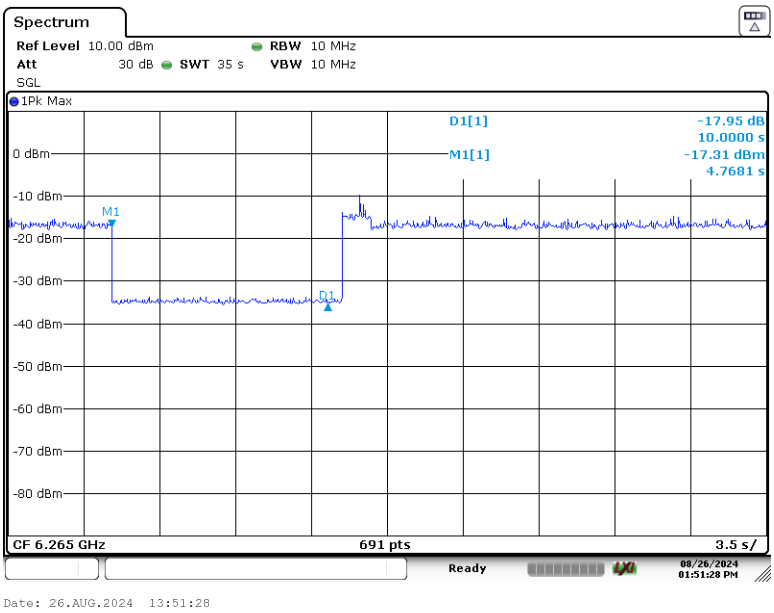
7.6.2 CBP Timing Plots



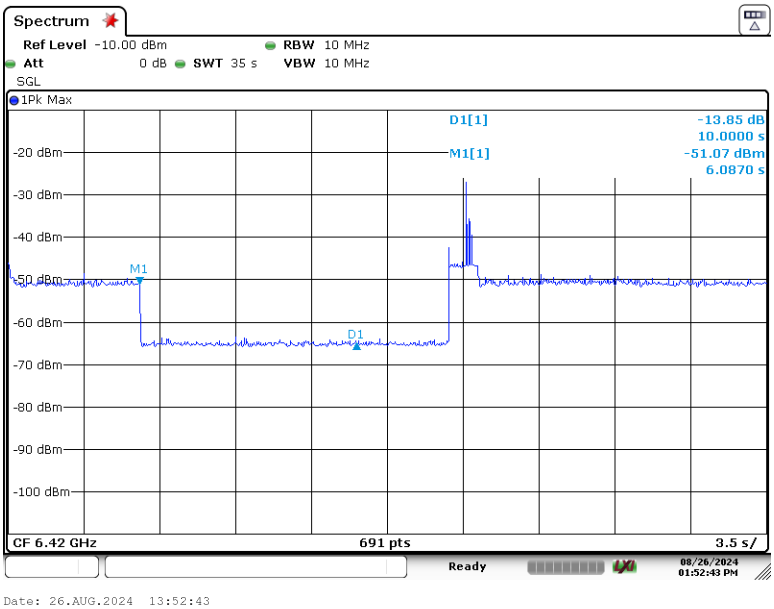
Plot 7-249. Contention Based Protocol Timing Plot (20MHz (UNII Band 5) – Ch. 53)



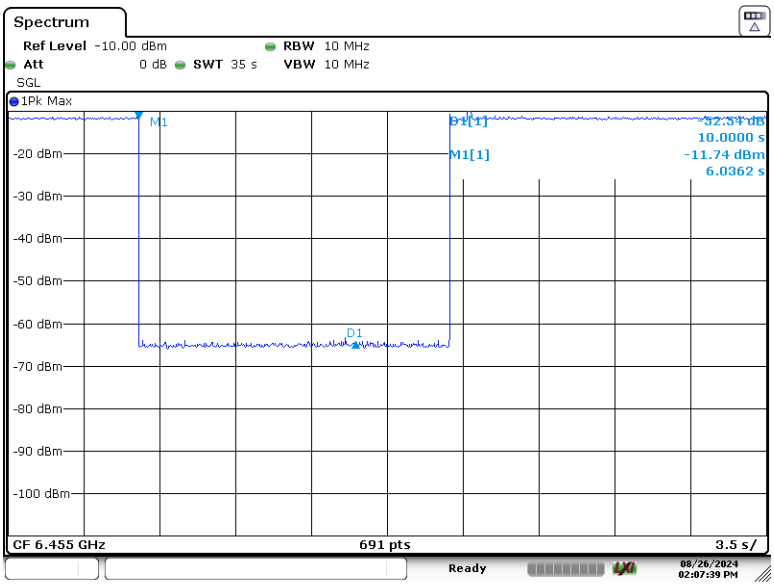
Plot 7-250. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 31 Low)



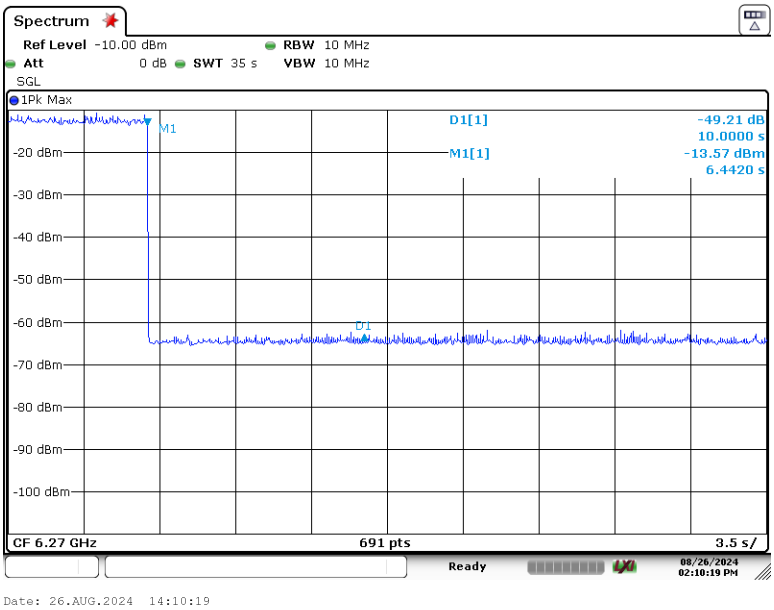
Plot 7-251. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 31 Mid)



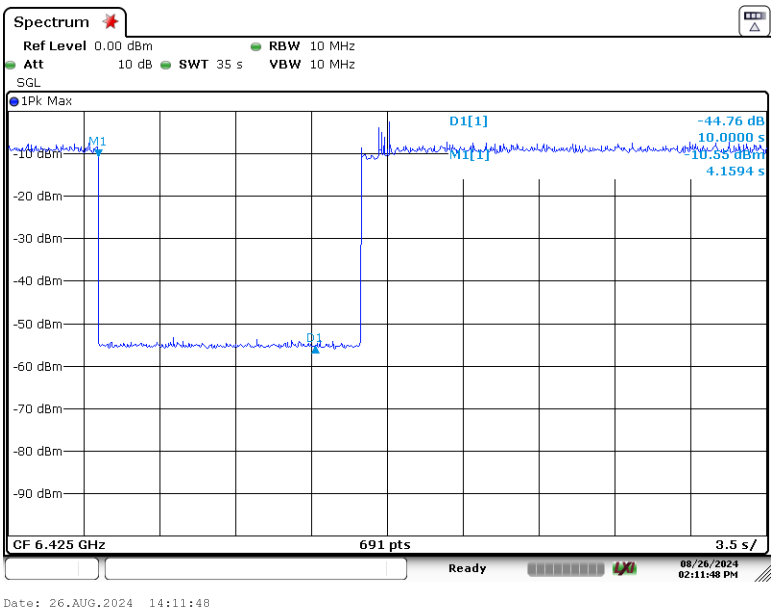
Plot 7-252. Contention Based Protocol Timing Plot (320MHz (UNII Band 5) – Ch. 31 High)



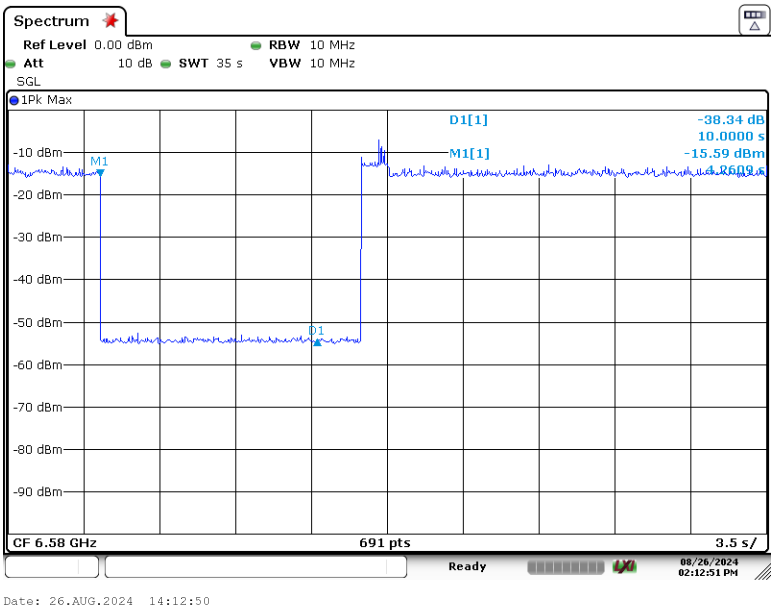
Plot 7-253. Contention Based Protocol Timing Plot (20MHz (UNII Band 6) – Ch. 101)



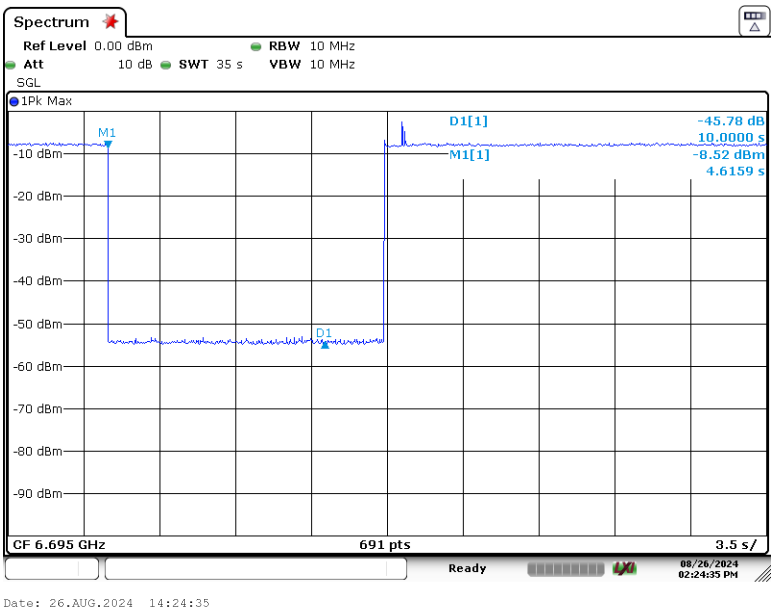
Plot 7-254. Contention Based Protocol Timing Plot (320MHz (UNII Band 6) – Ch. 95 Low)



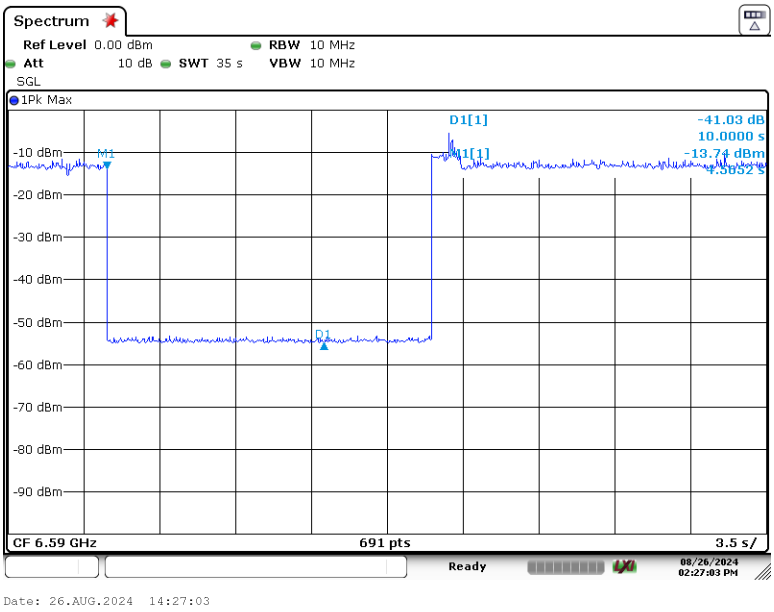
Plot 7-255. Contention Based Protocol Timing Plot (320MHz (UNII Band 6) – Ch. 95 Mid)



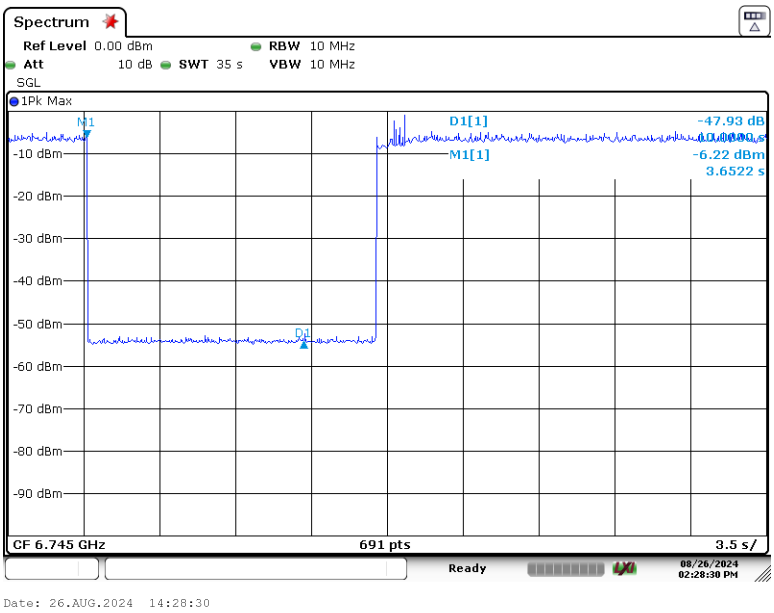
Plot 7-256. Contention Based Protocol Timing Plot (320MHz (UNII Band 6) – Ch. 95 High)



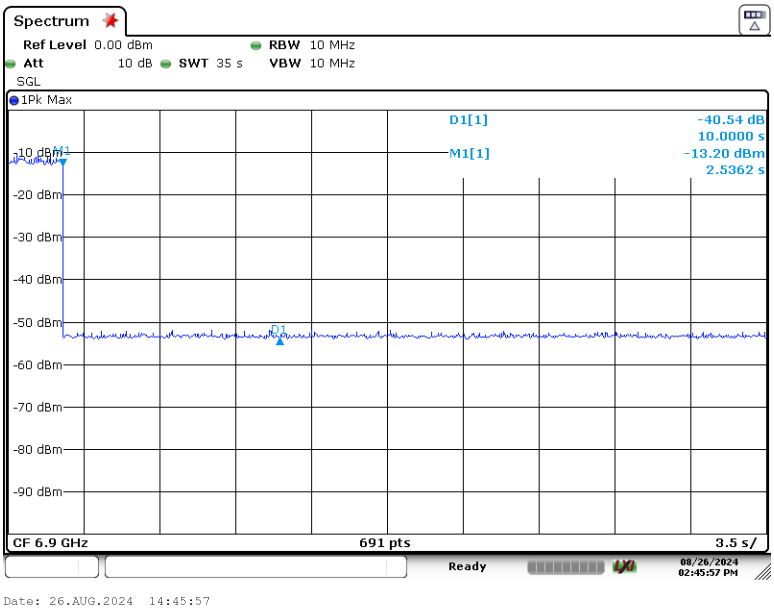
Plot 7-257. Contention Based Protocol Timing Plot (20MHz (UNII Band 7) – Ch. 149)



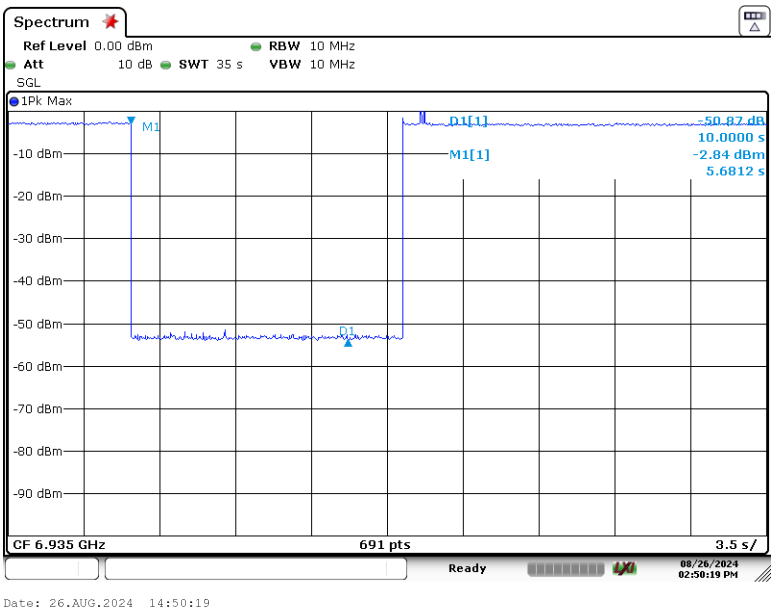
Plot 7-258. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 159 Low)



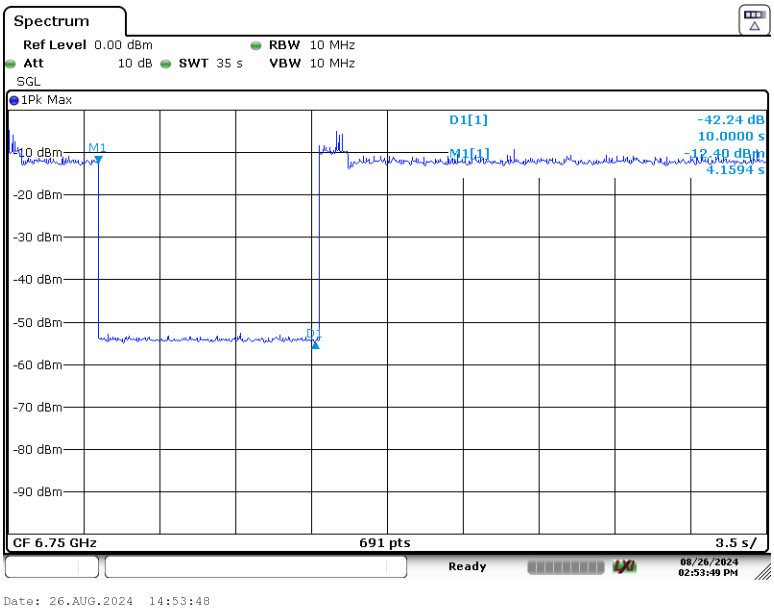
Plot 7-259. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 159 Mid)



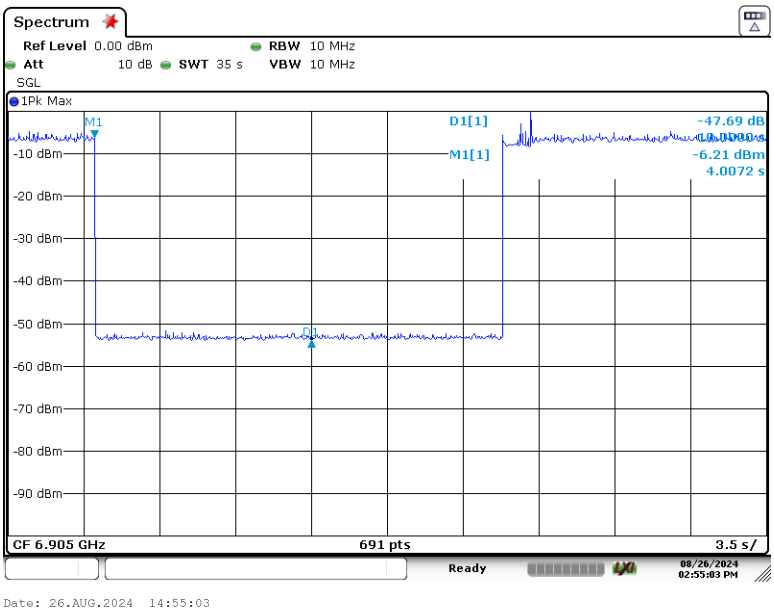
Plot 7-260. Contention Based Protocol Timing Plot (320MHz (UNII Band 7) – Ch. 159 High)



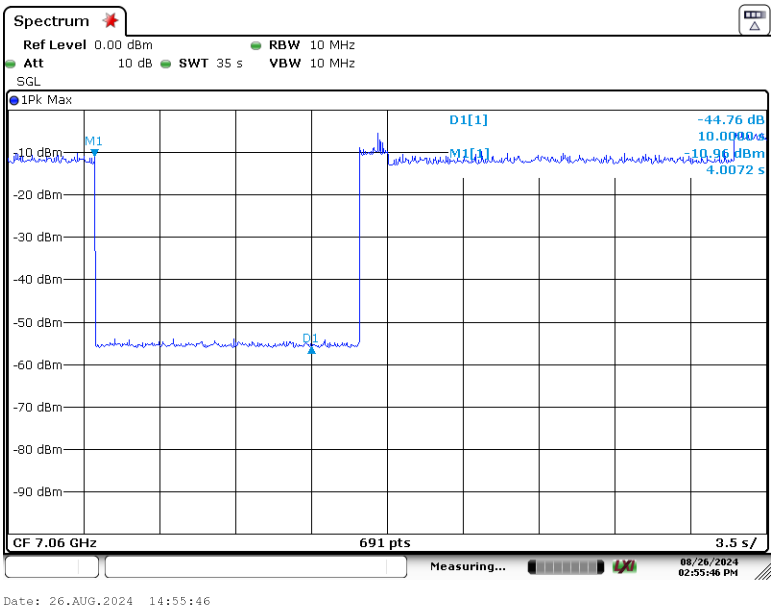
Plot 7-261. Contention Based Protocol Timing Plot (20MHz (UNII Band 8) – Ch. 197)



Plot 7-262. Contention Based Protocol Timing Plot (320MHz (UNII Band 8) – Ch. 191 Low)



Plot 7-263. Contention Based Protocol Timing Plot (320MHz (UNII Band 8) – Ch. 191 Mid)



Plot 7-264. Contention Based Protocol Timing Plot (320MHz (UNII Band 8) – Ch. 191 High)