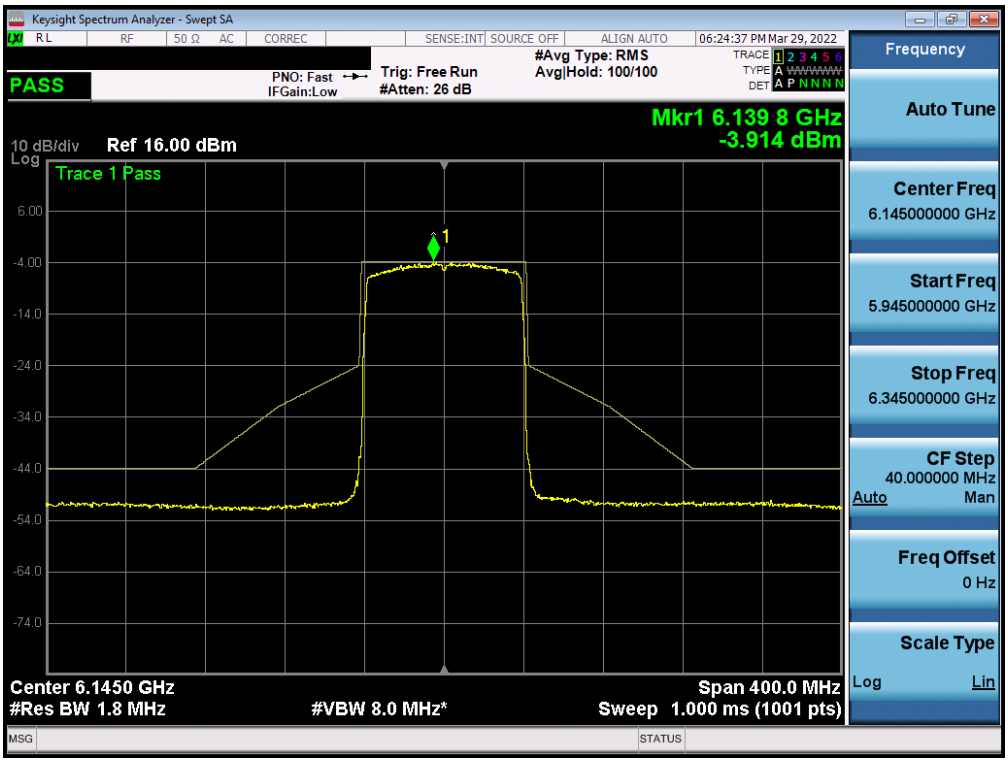
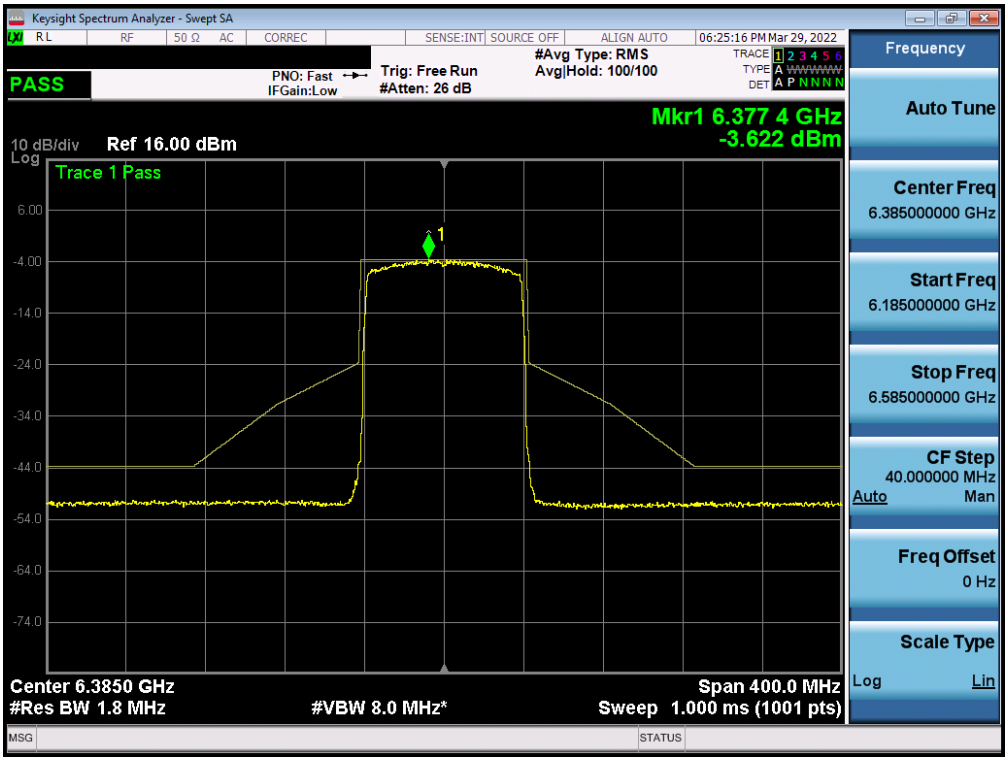
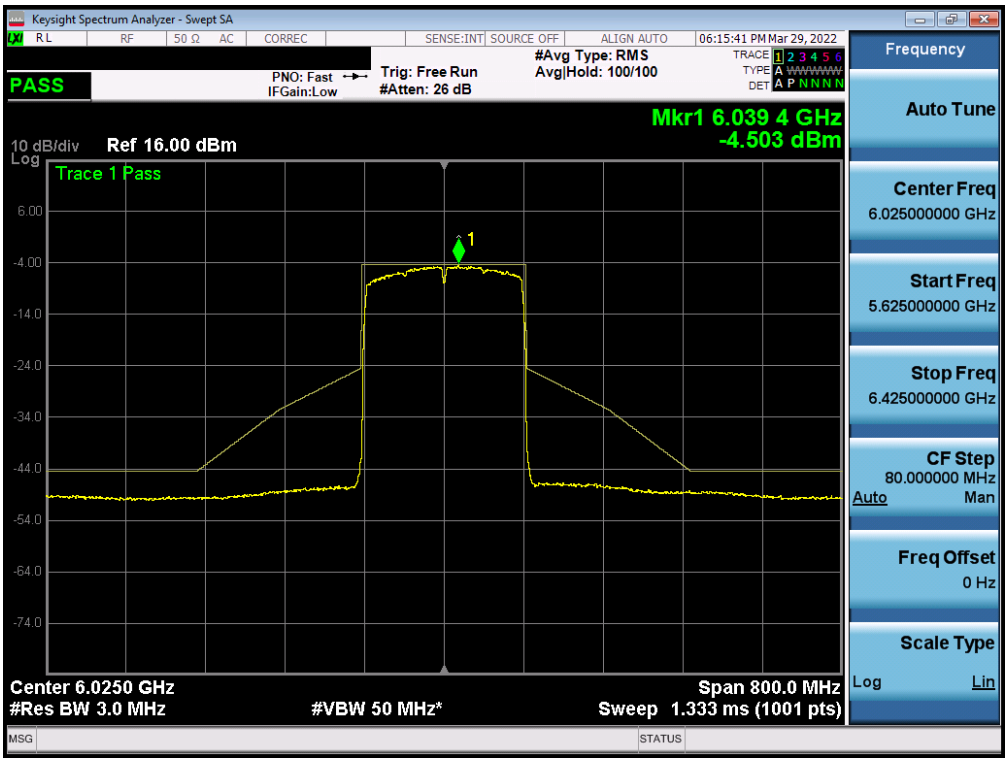


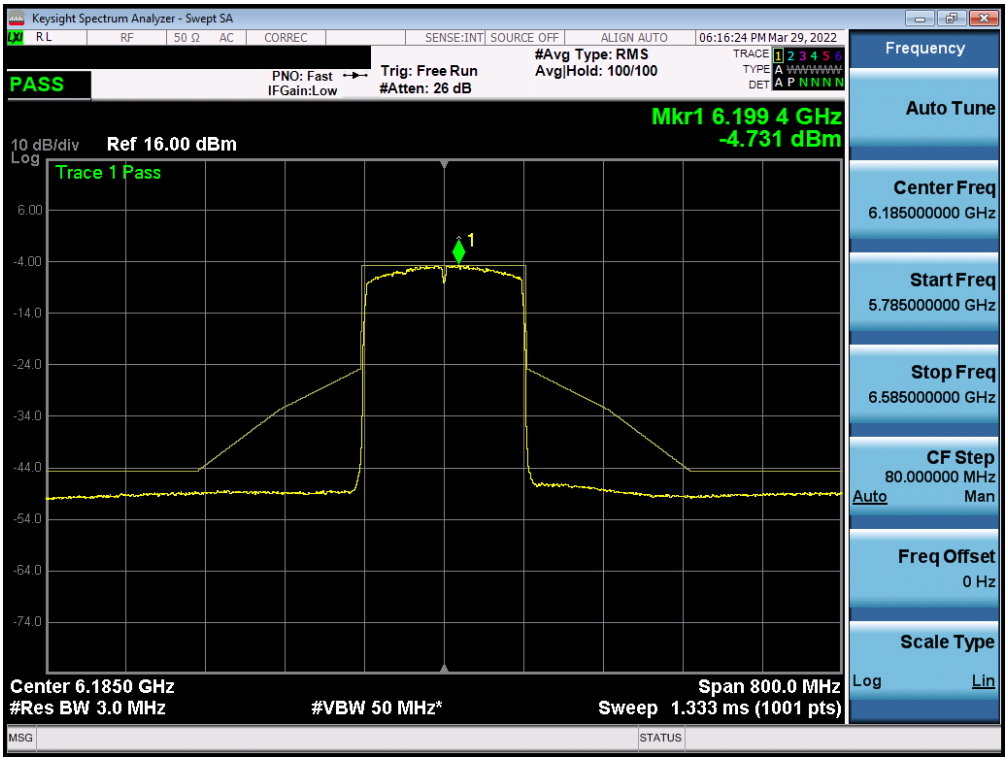
Plot 7-219. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



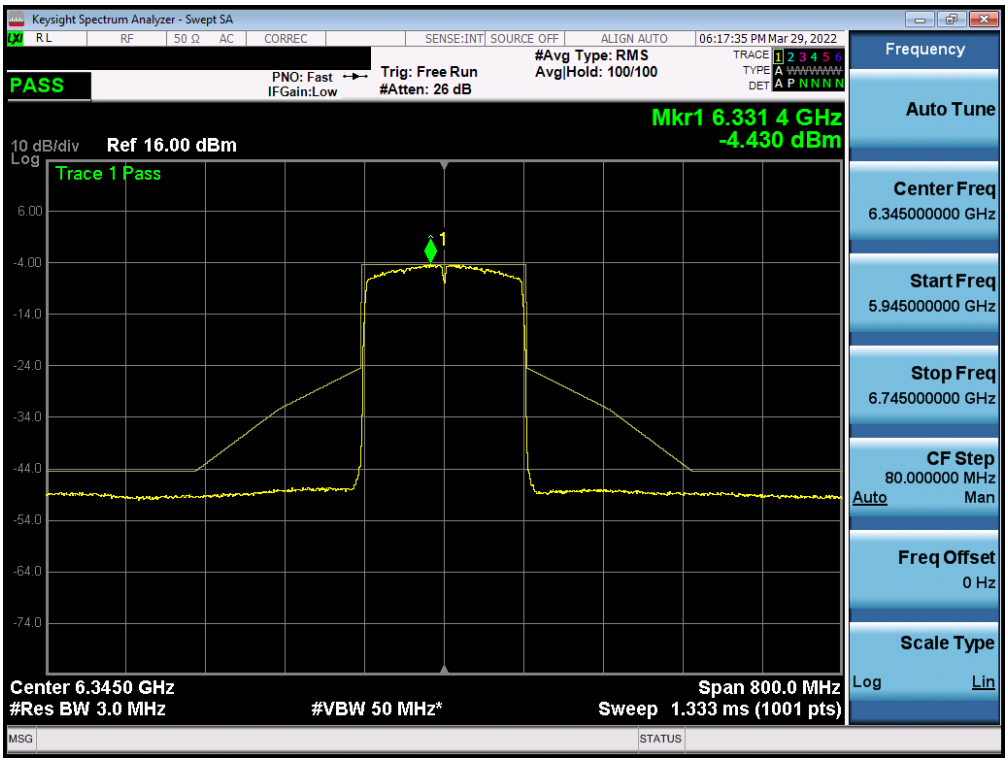
Plot 7-220. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-221. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 15)

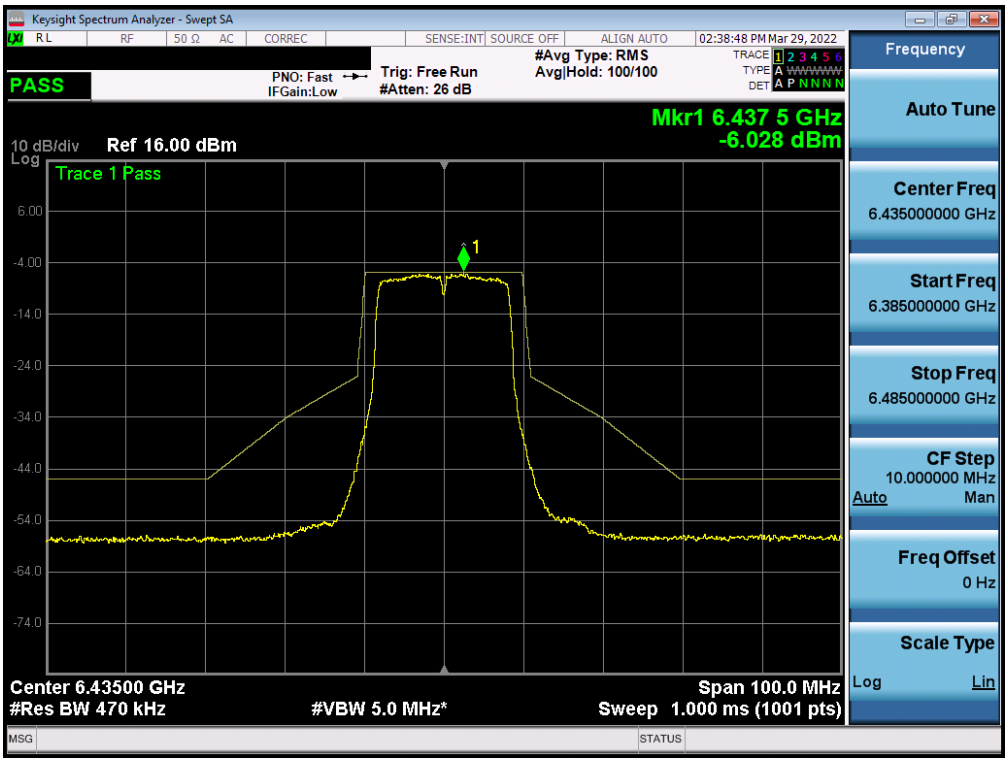


Plot 7-222. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

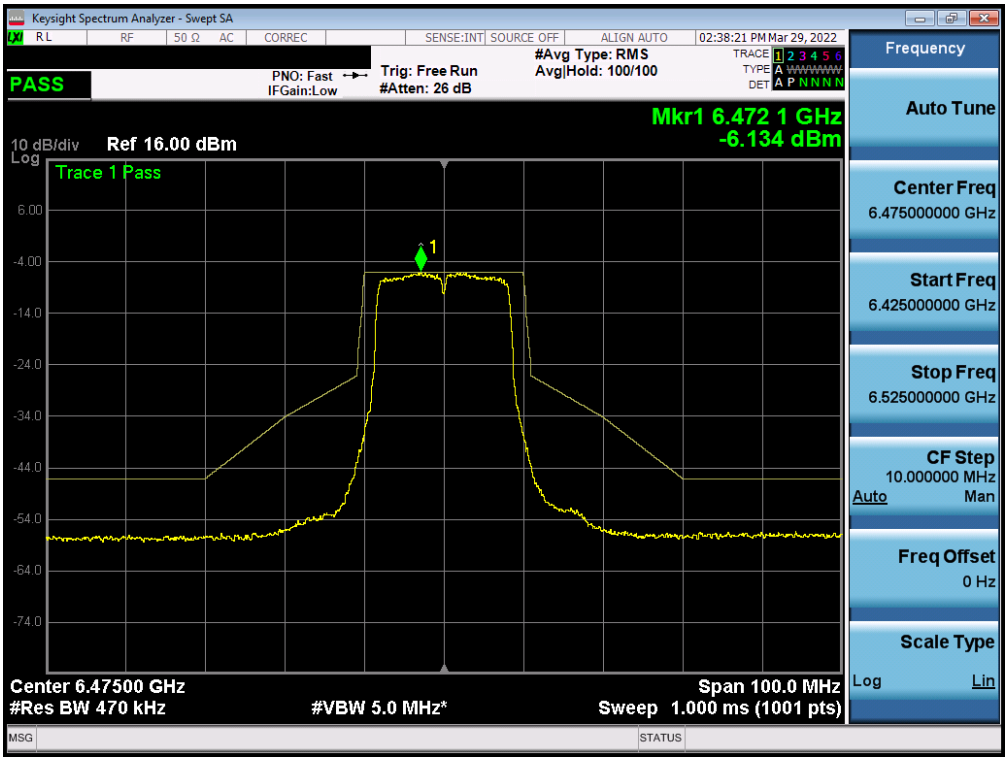


Plot 7-223. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

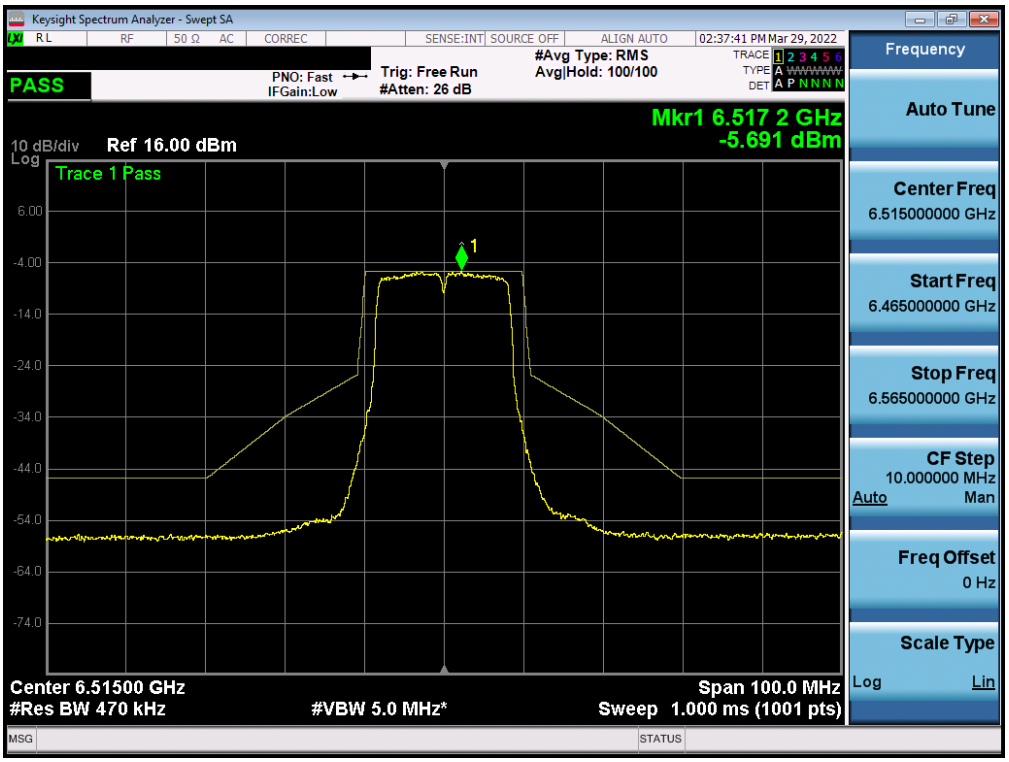
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 6)



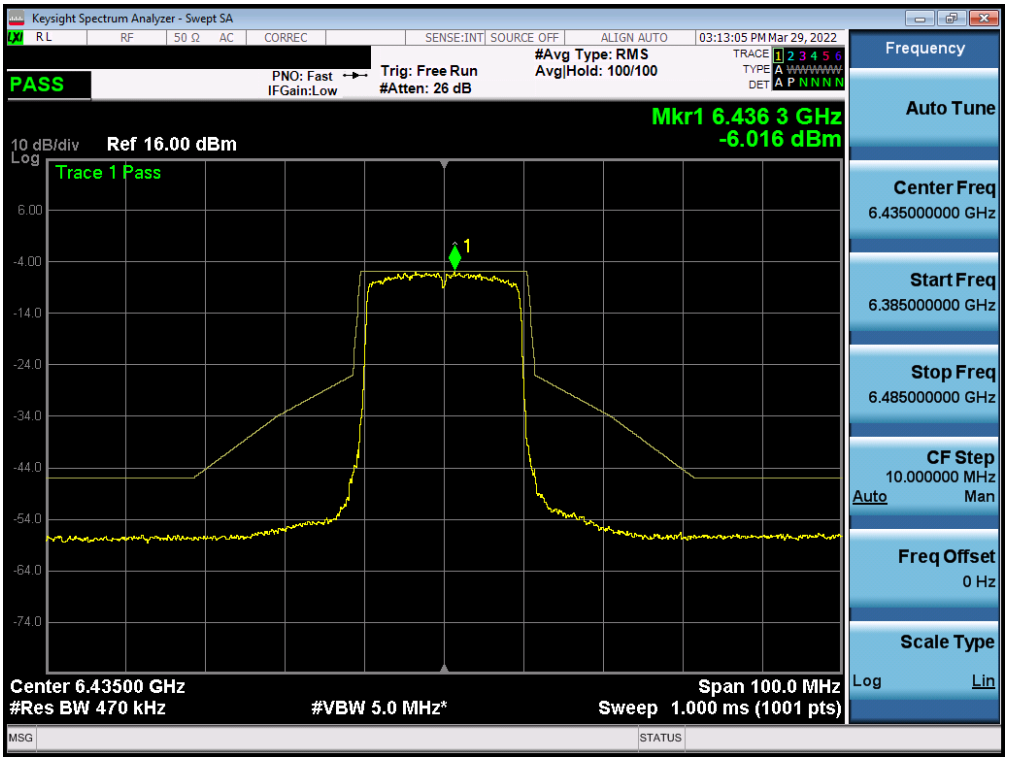
Plot 7-224. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 97)



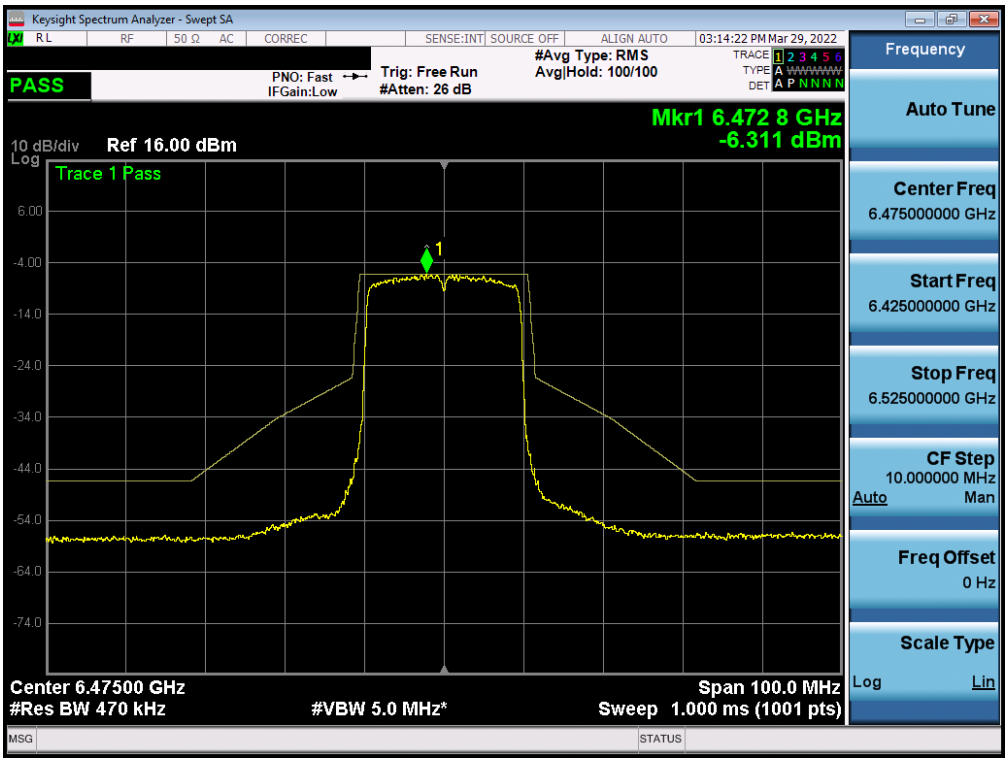
Plot 7-225. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 105)



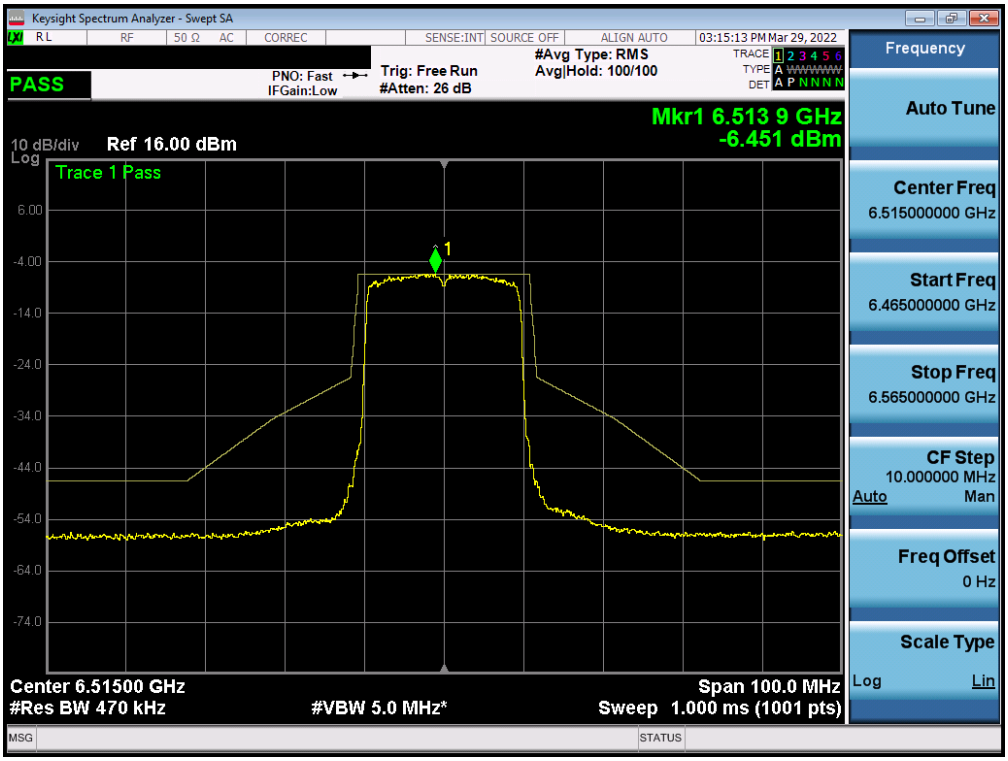
Plot 7-226. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 113)



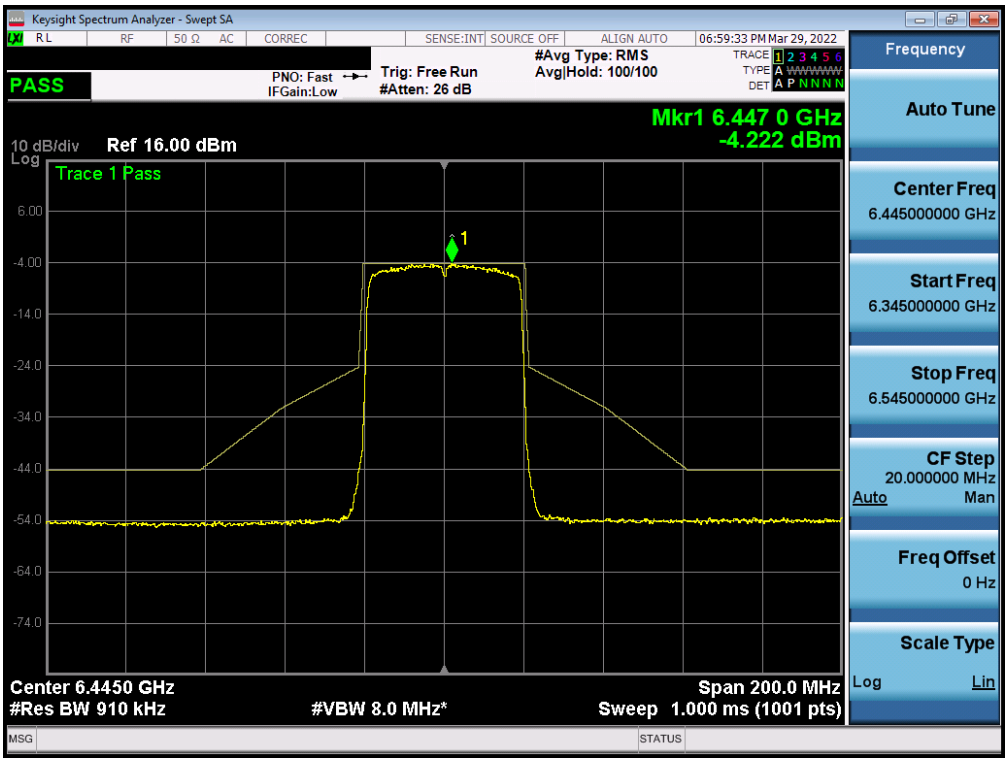
Plot 7-227. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



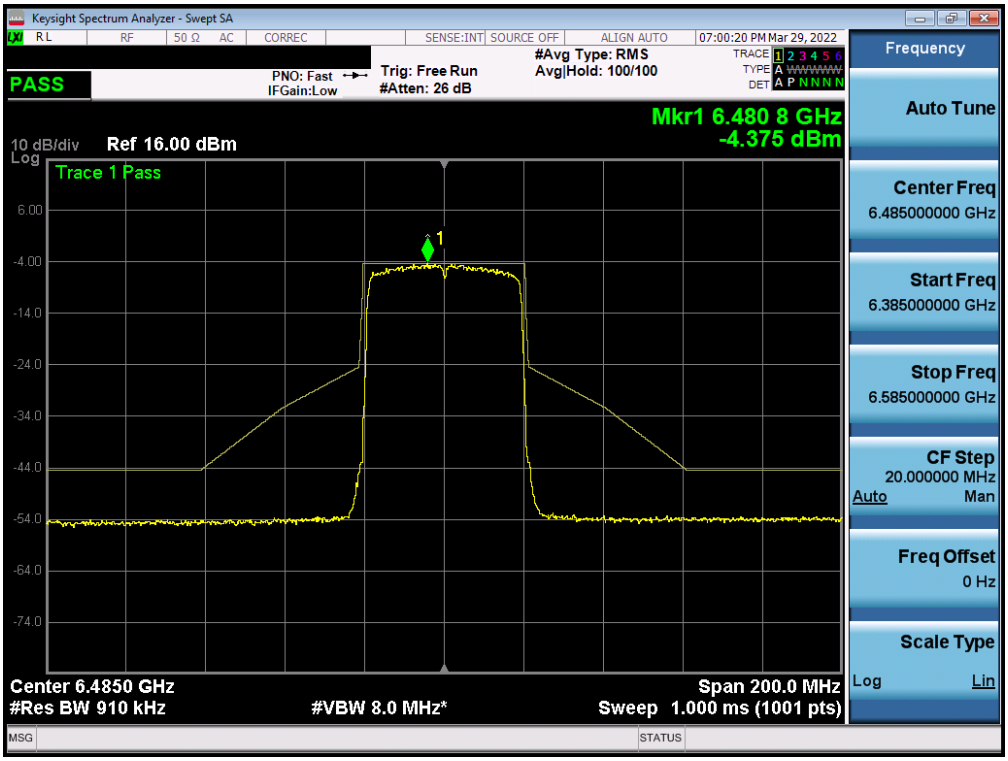
Plot 7-228. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



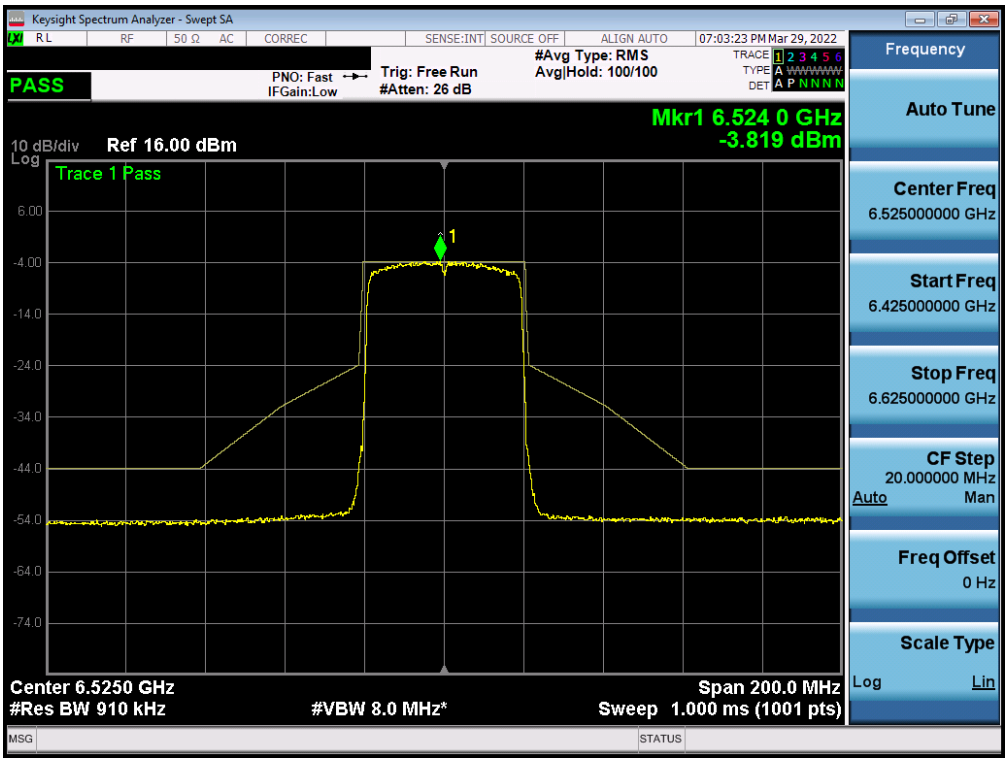
Plot 7-229. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 113)



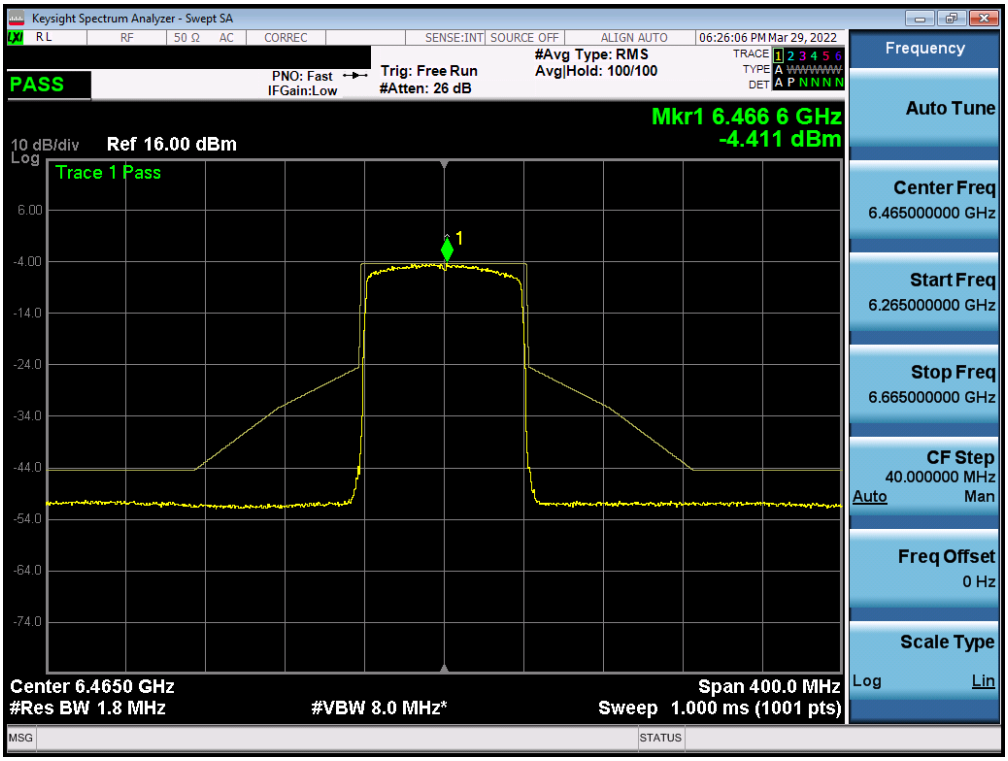
Plot 7-230. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 99)



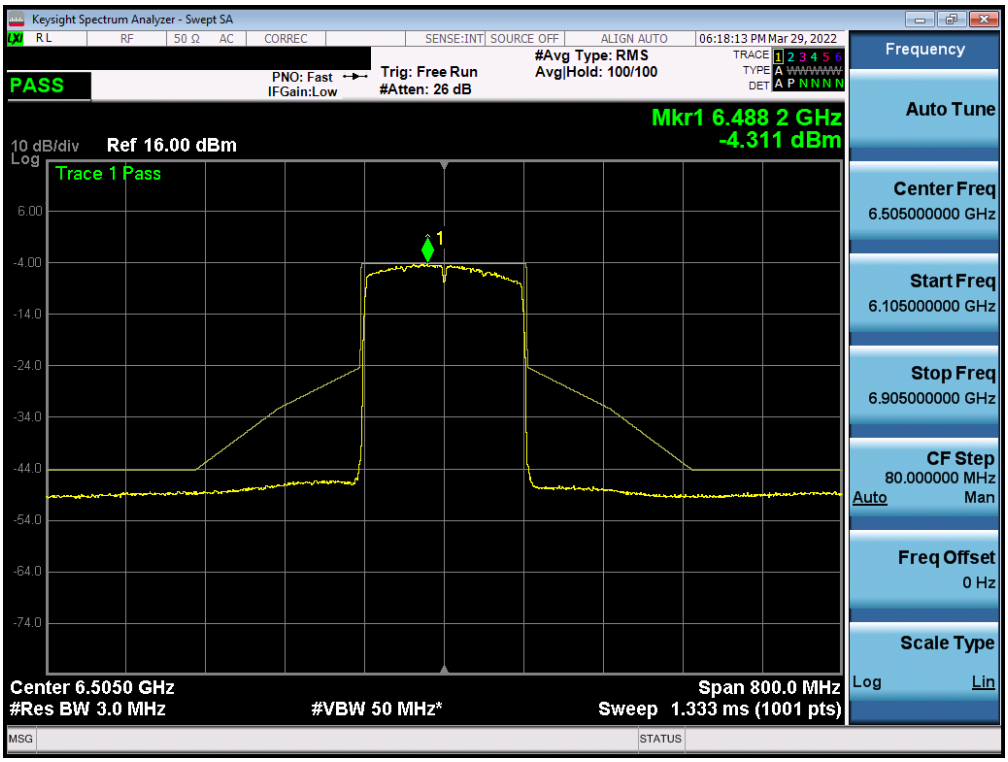
Plot 7-231. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 107)



Plot 7-232. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 115)

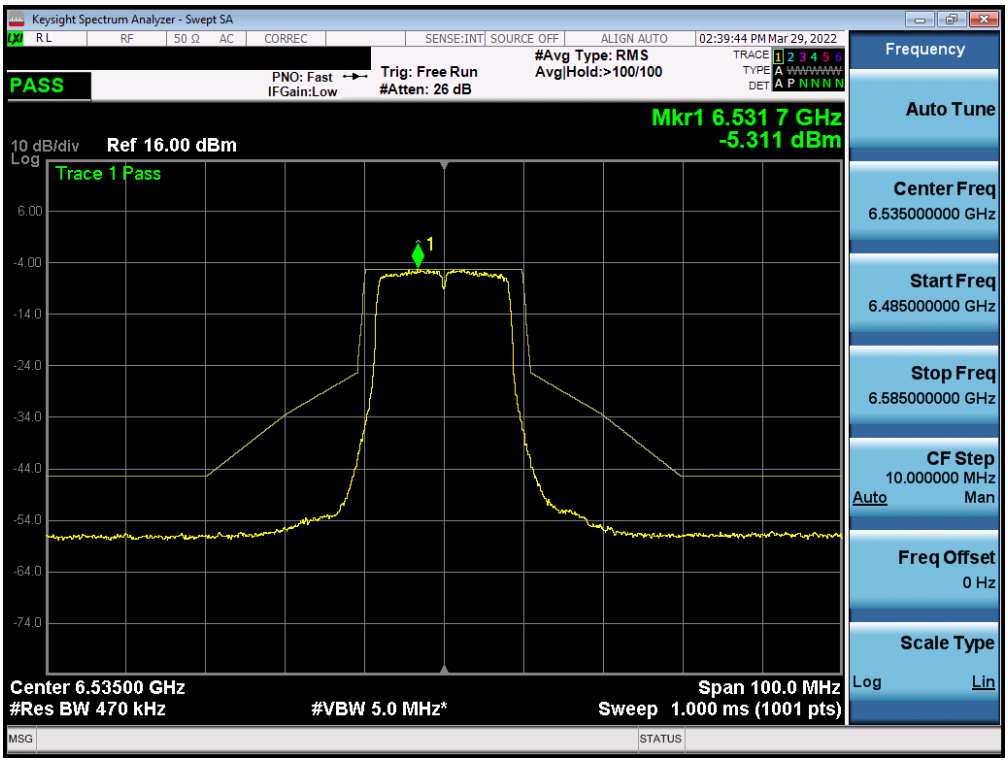


Plot 7-233. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 6) – Ch. 103)

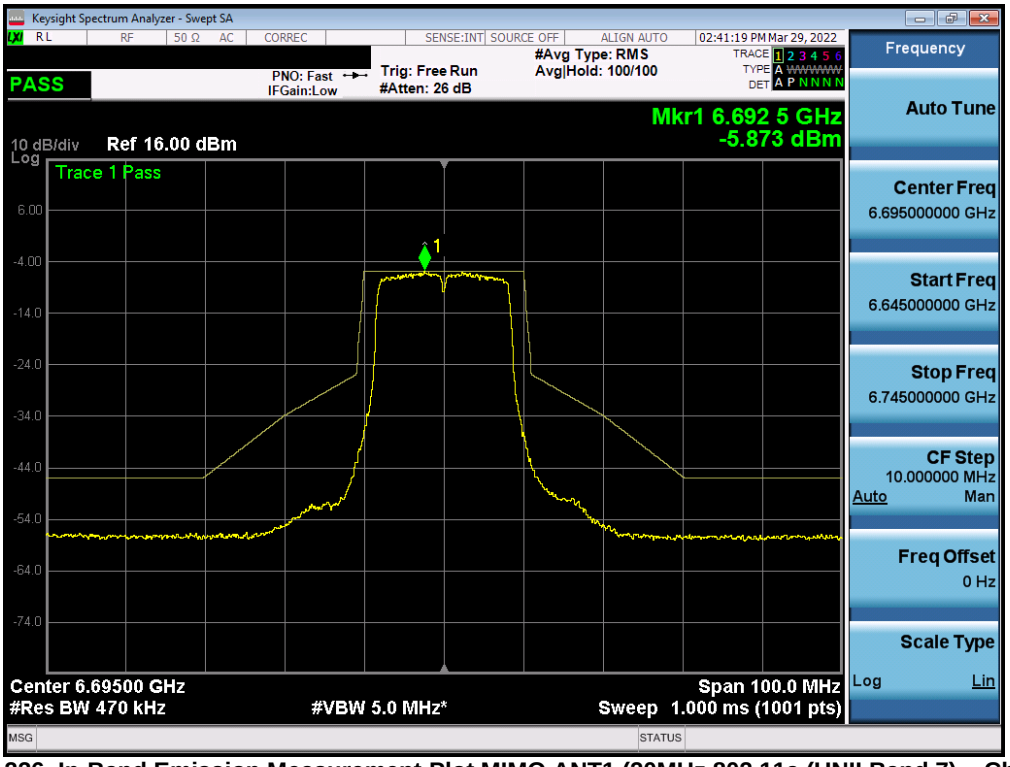


Plot 7-234. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 6) – Ch. 111)

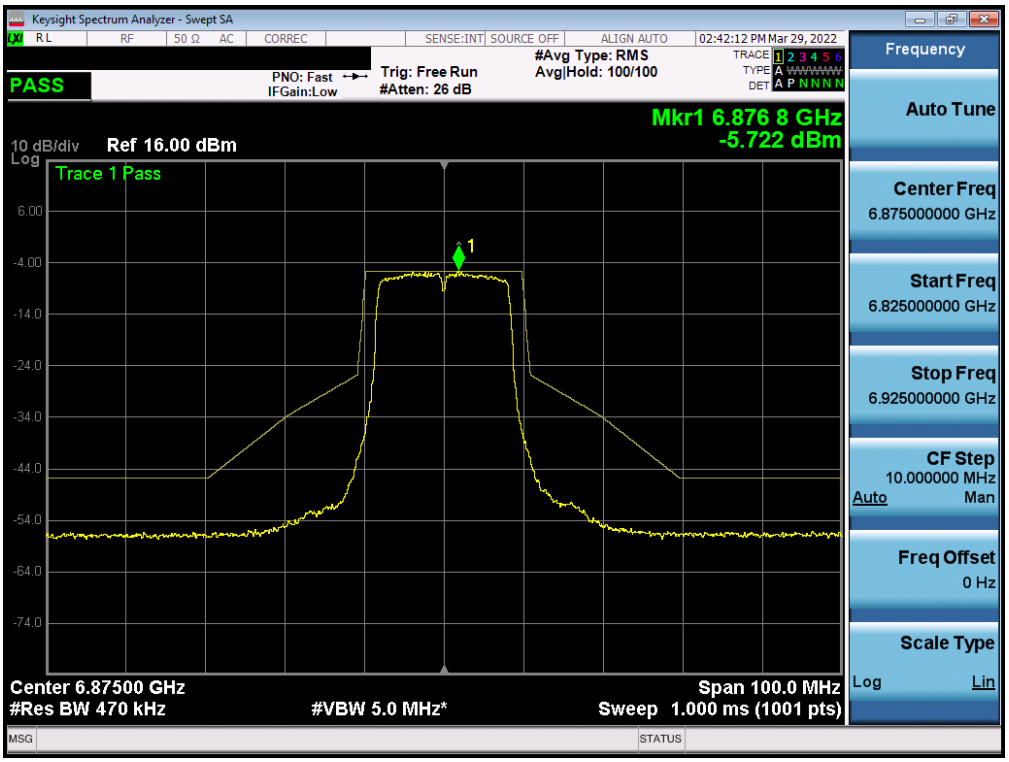
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 7)



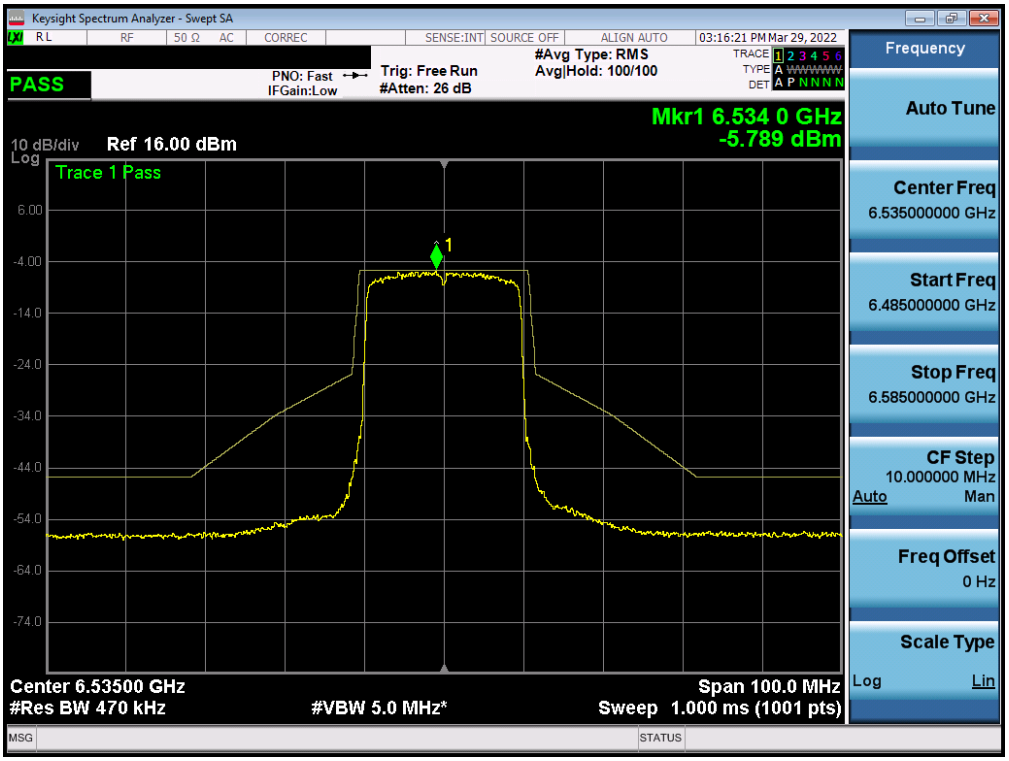
Plot 7-235. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 117)



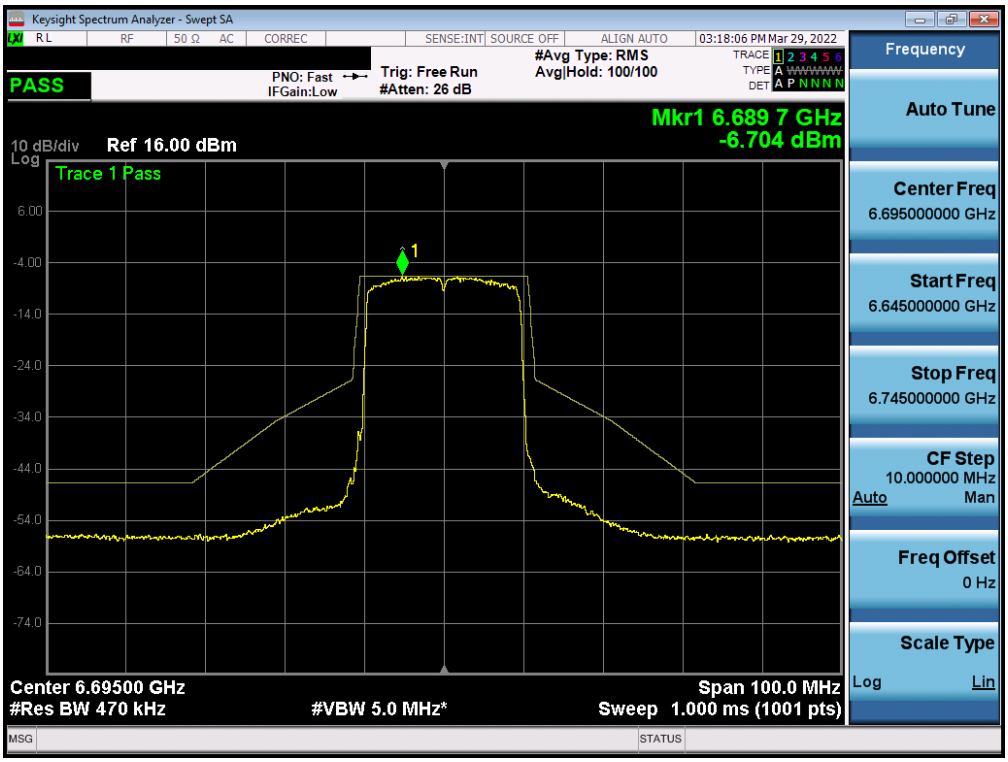
Plot 7-236. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 149)



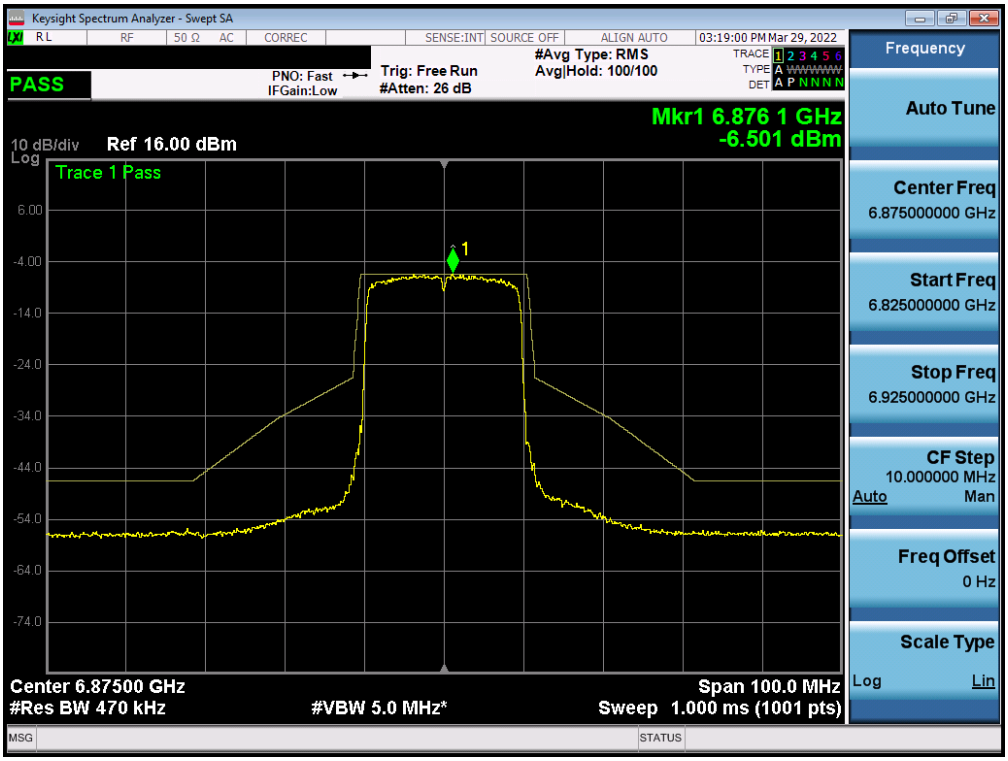
Plot 7-237. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 185)



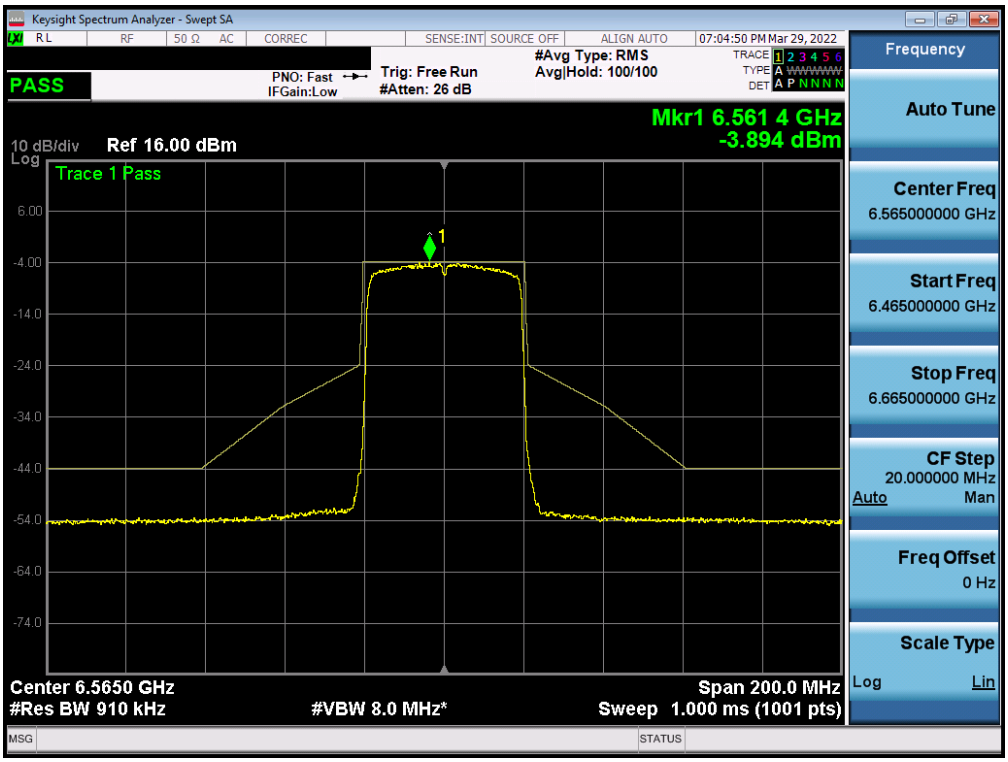
Plot 7-238. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 117)



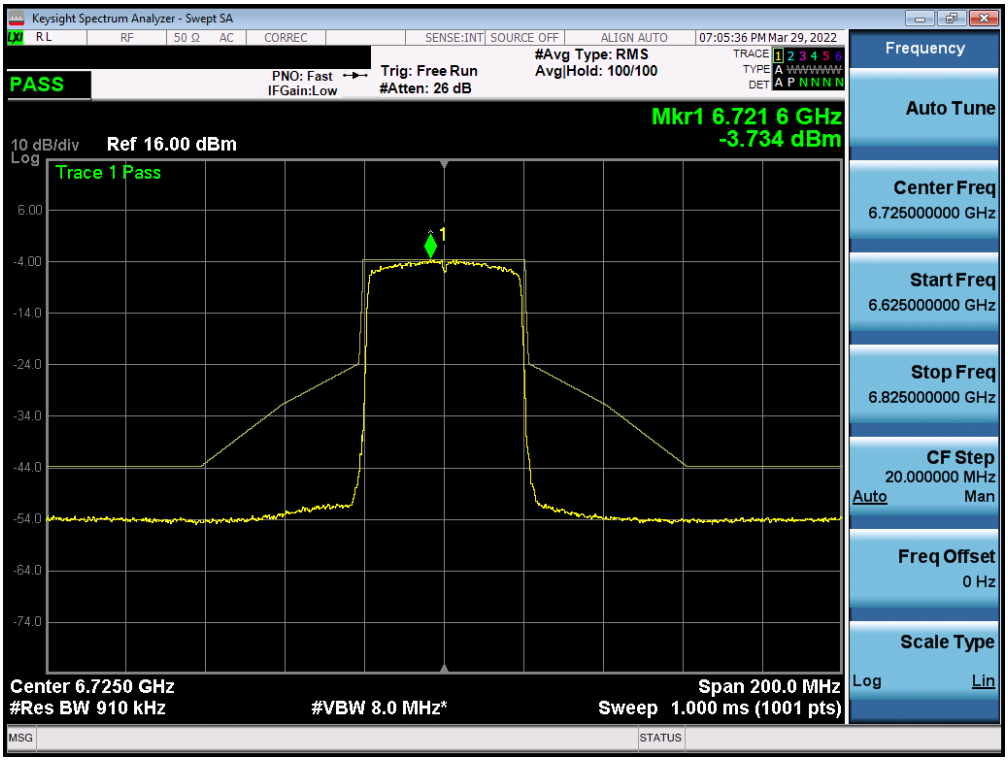
Plot 7-239. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



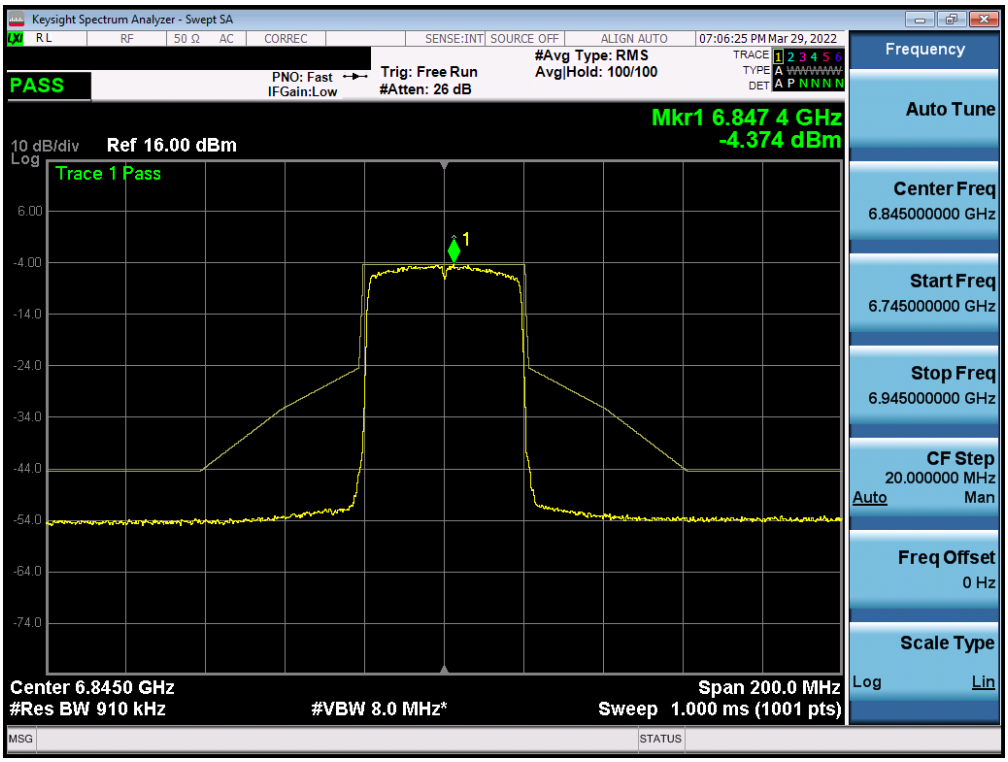
Plot 7-240. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 185)



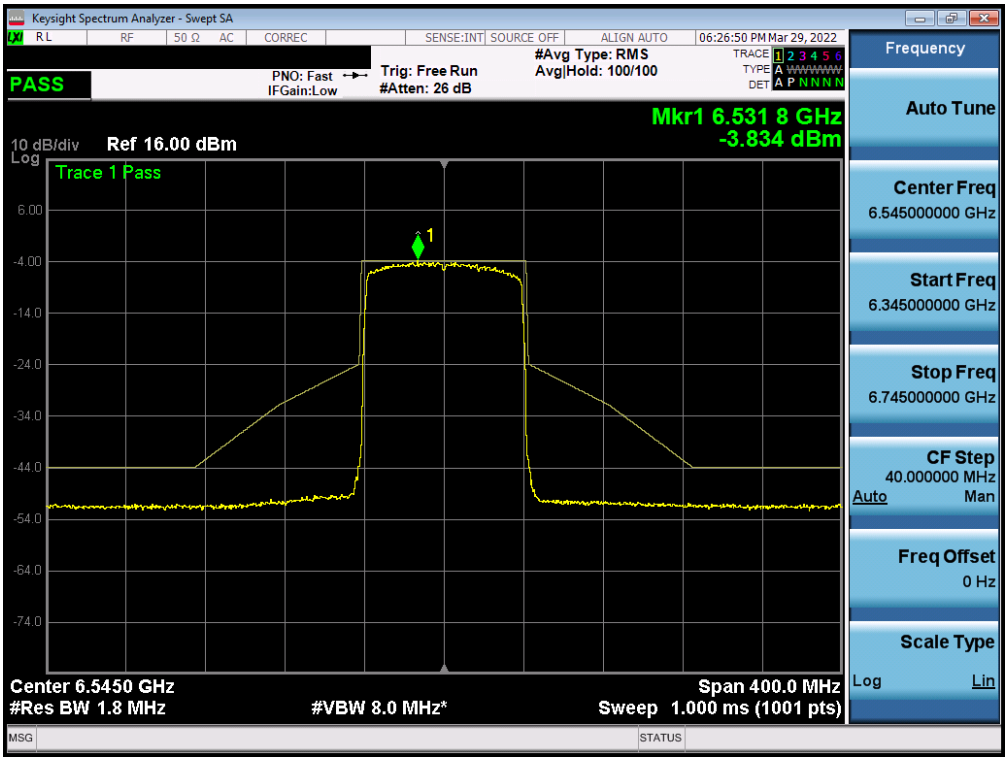
Plot 7-241. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 123)



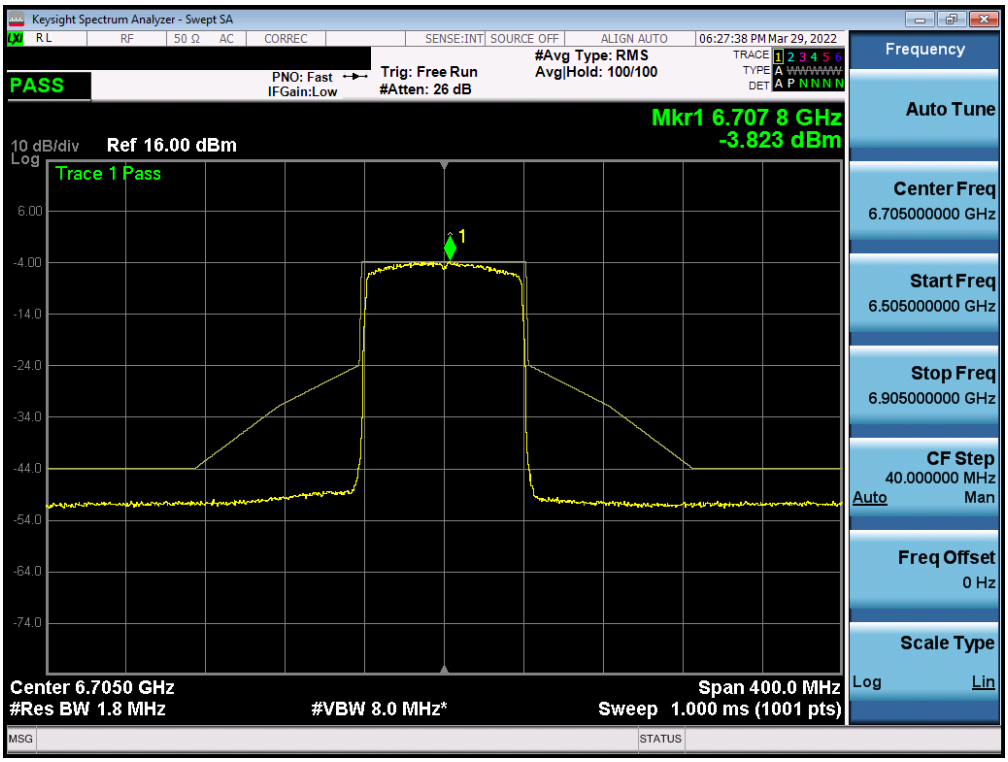
Plot 7-242. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



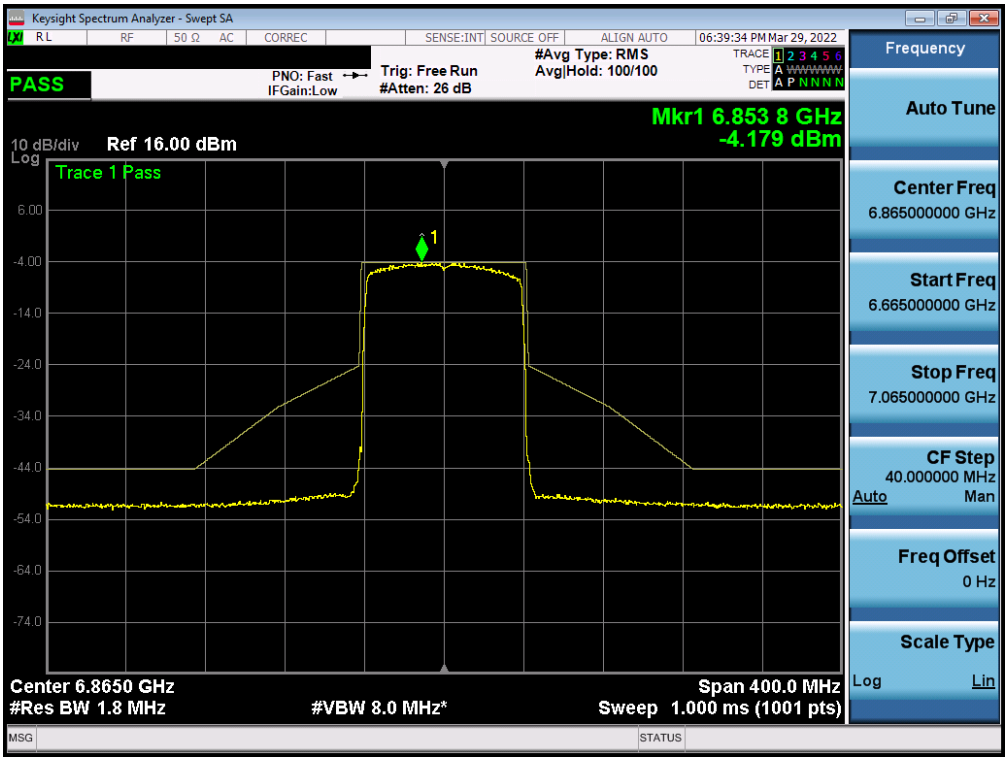
Plot 7-243. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



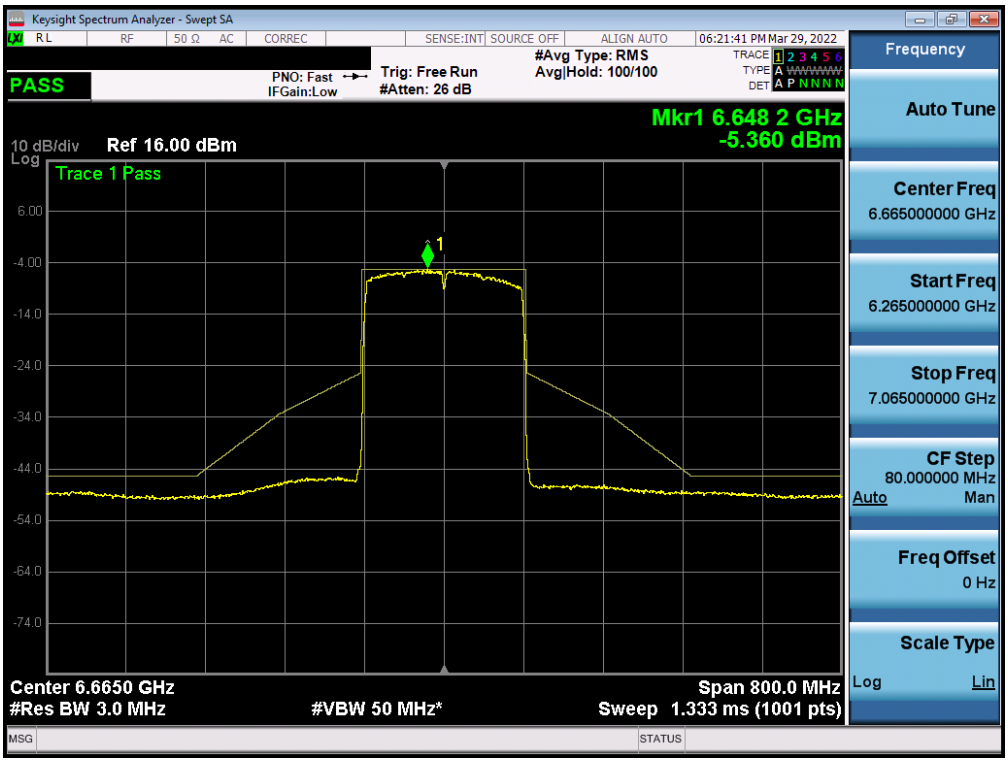
Plot 7-244. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 119)



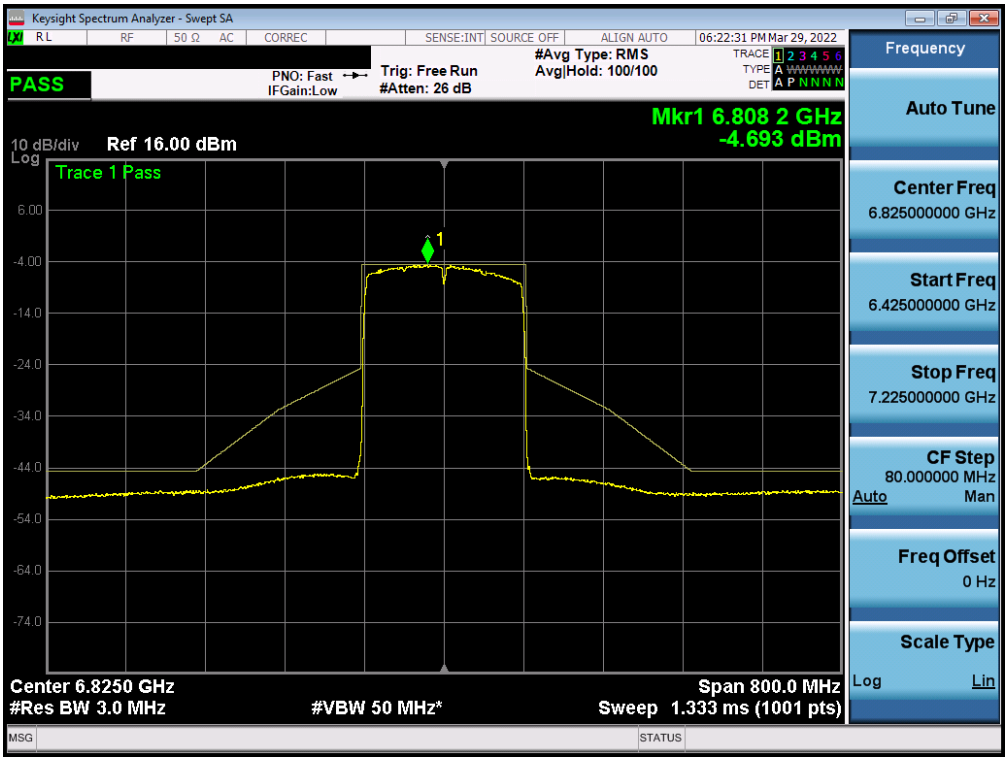
Plot 7-245. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-246. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 183)

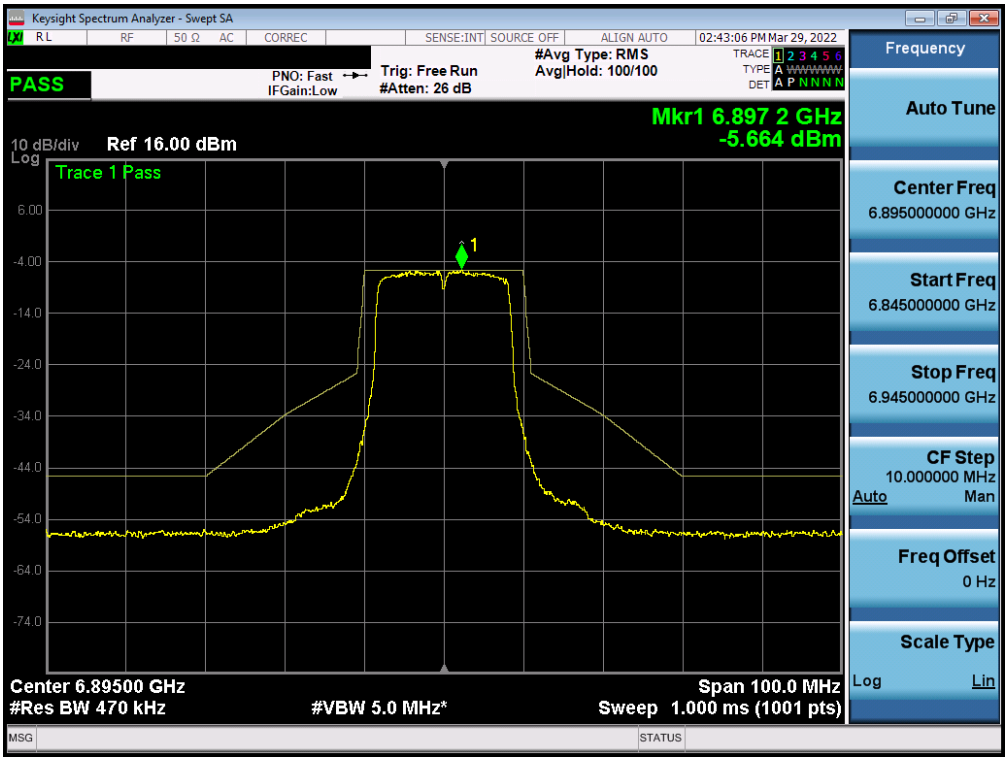


Plot 7-247. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

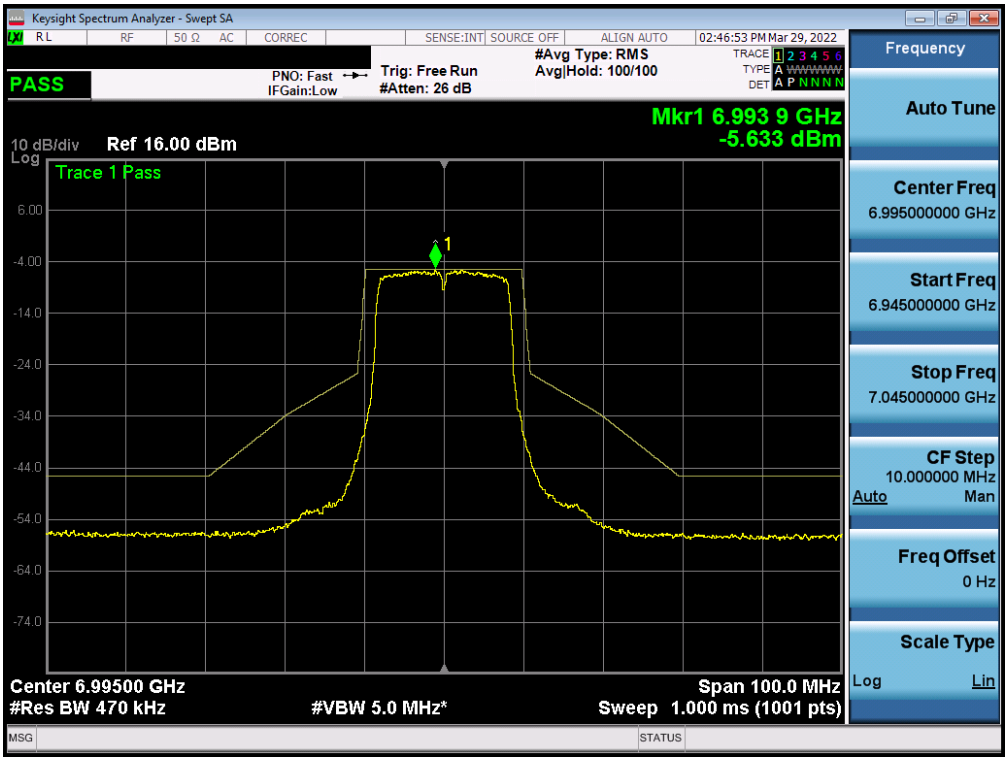


Plot 7-248. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 7) – Ch. 175)

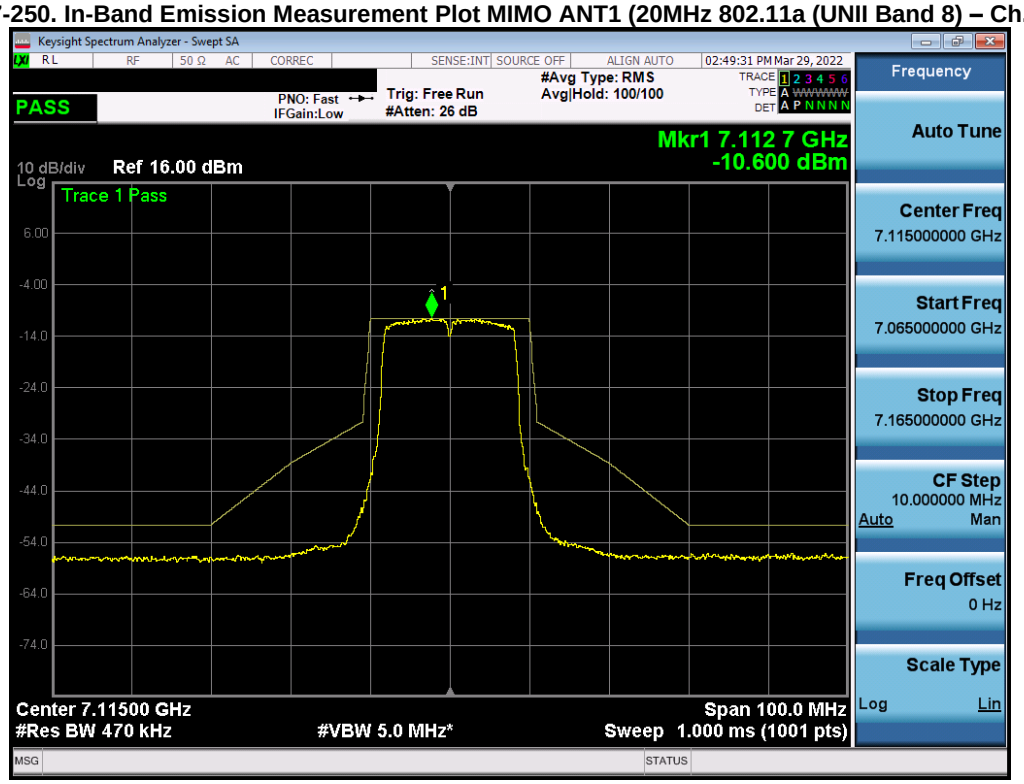
MIMO Antenna-1 In-Band Emission Measurements - (UNII Band 8)



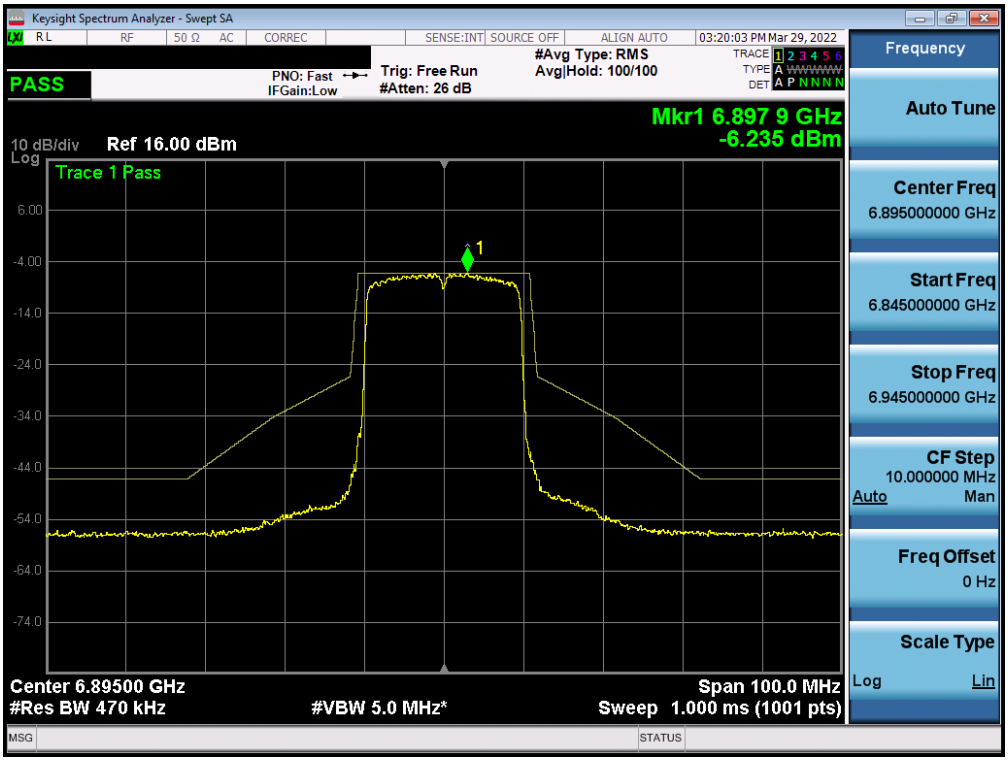
Plot 7-249. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 189)



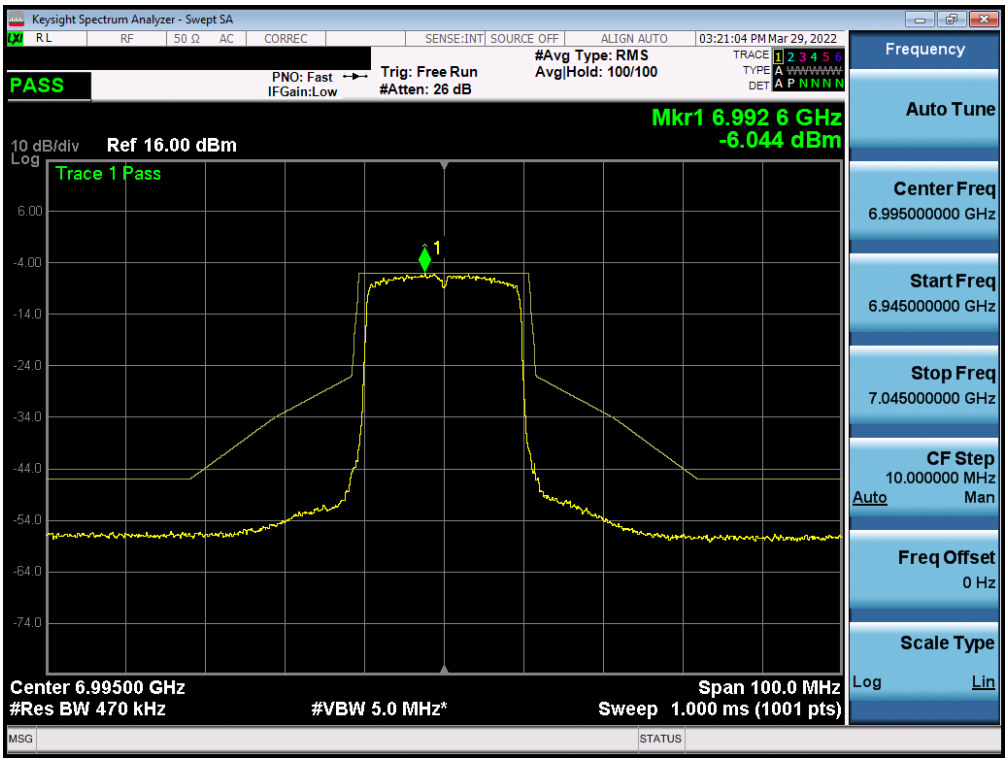
Plot 7-250. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 209)



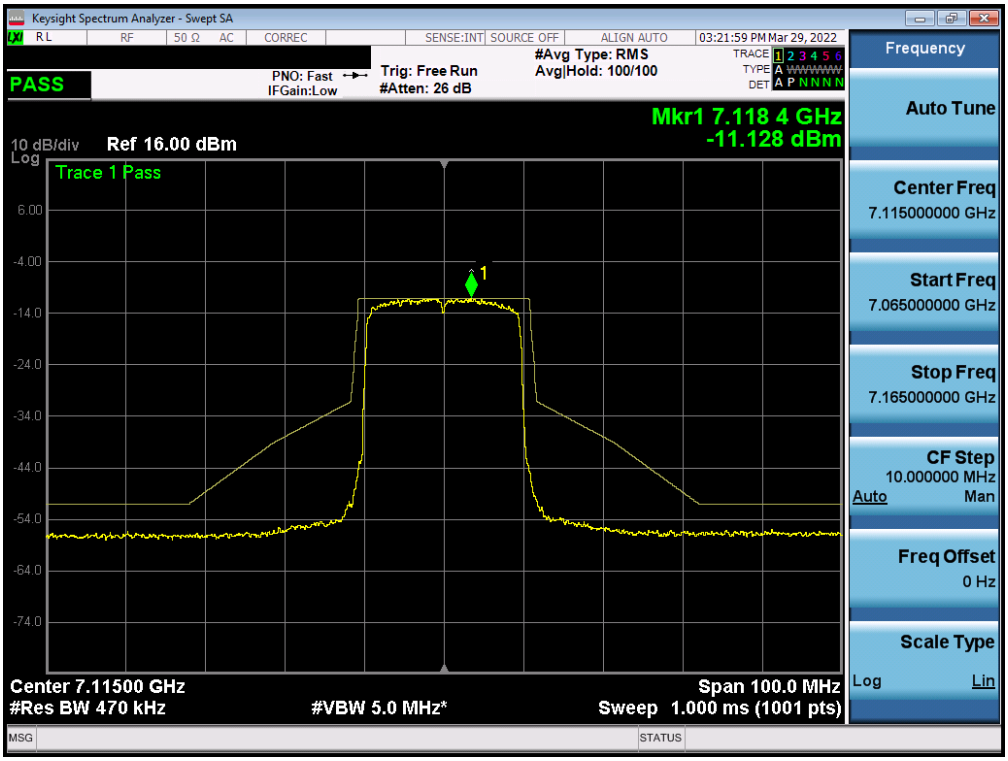
Plot 7-251. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 233)



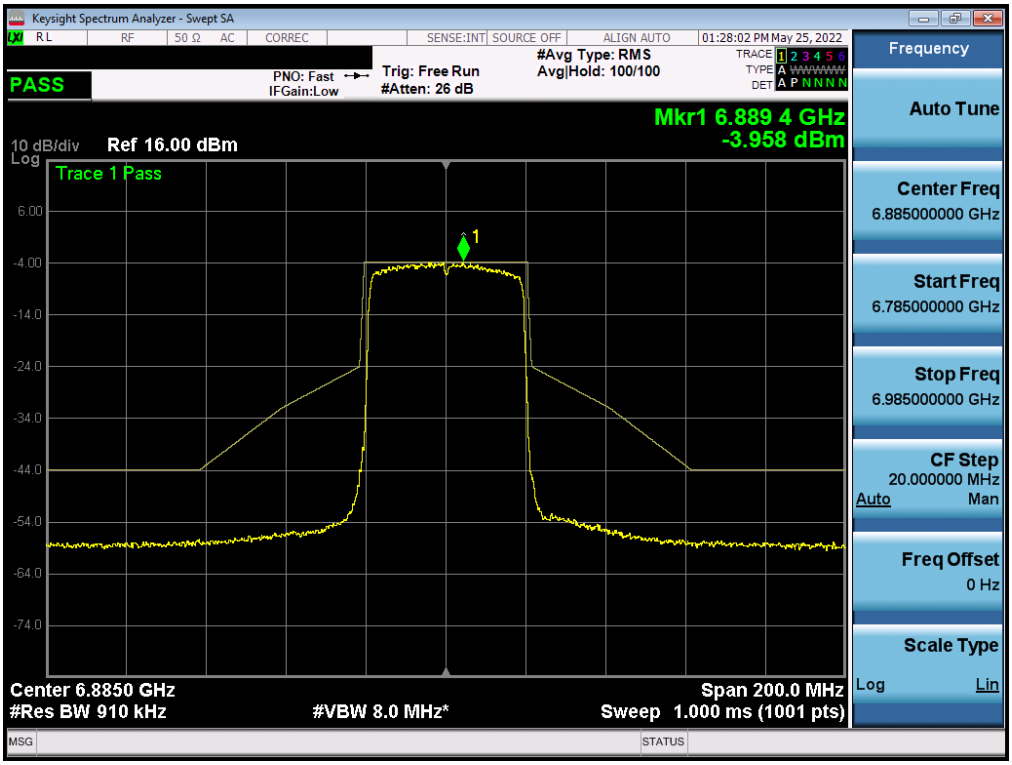
Plot 7-252. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 189)



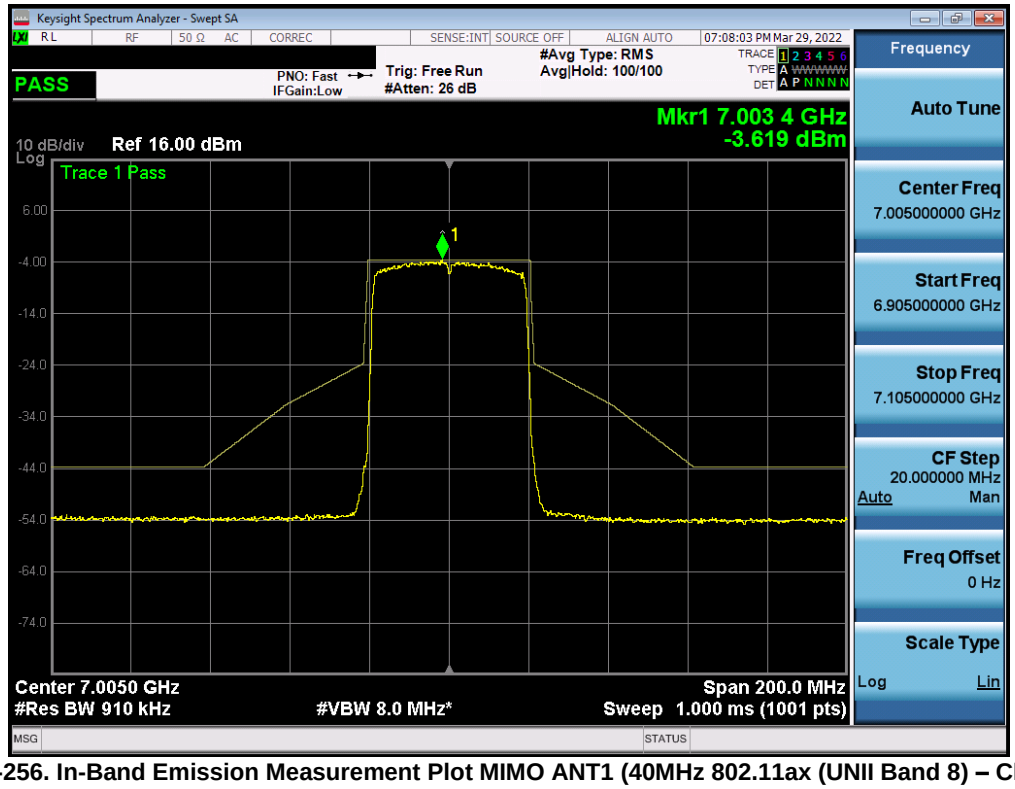
Plot 7-253. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 209)



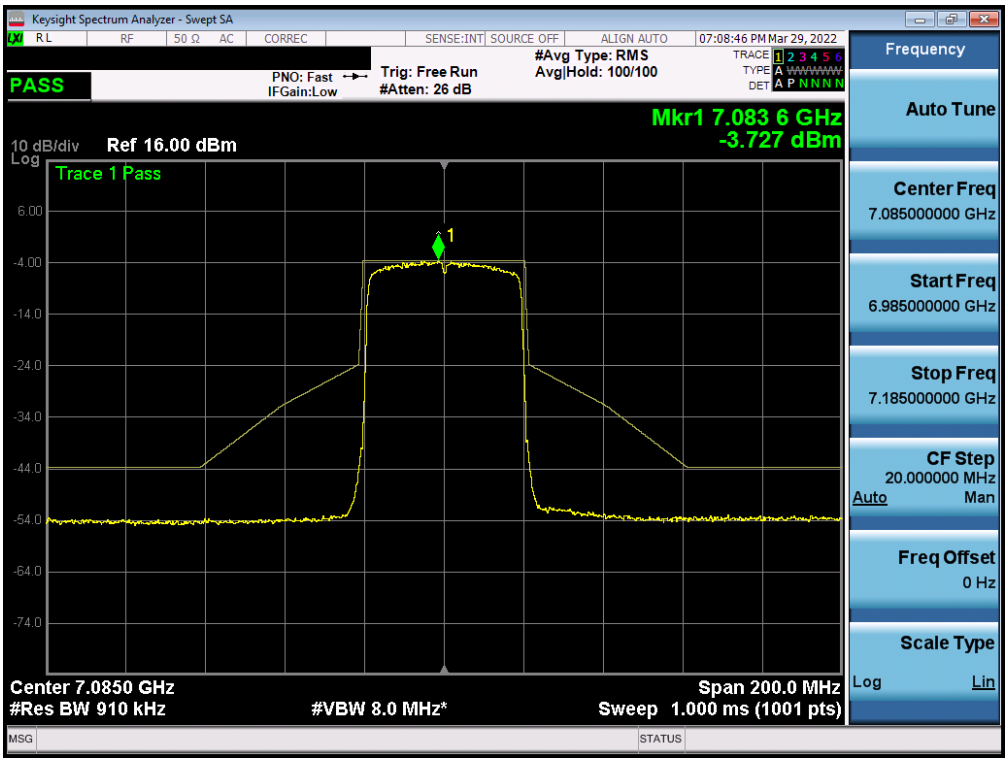
Plot 7-254. In-Band Emission Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 233)



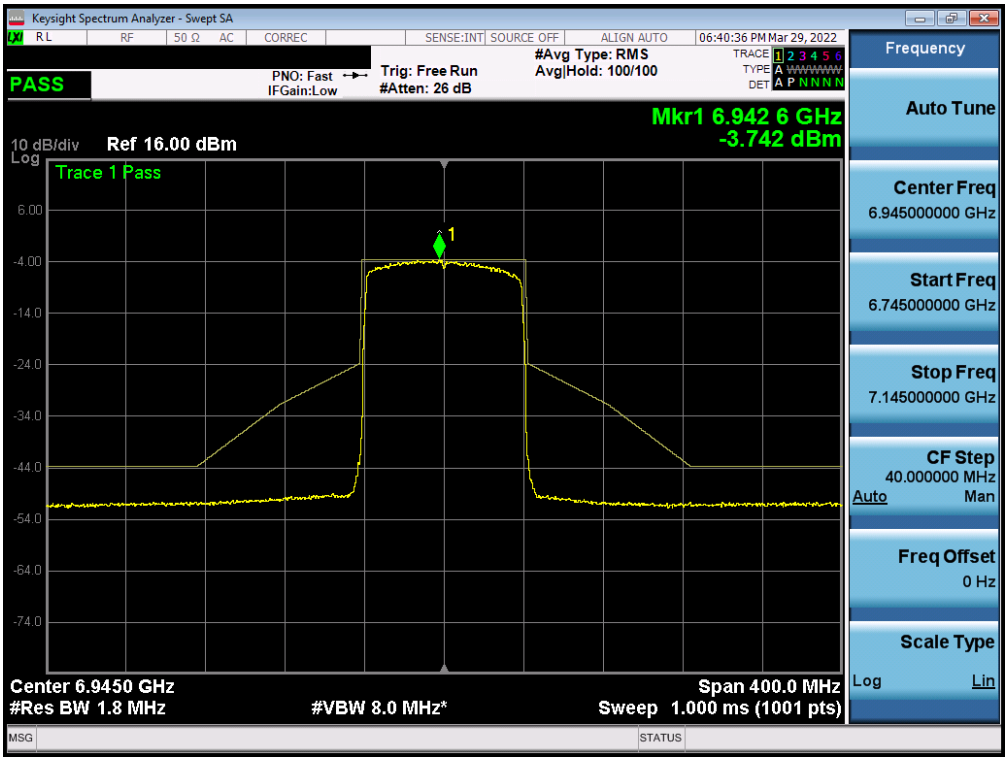
Plot 7-255. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 187)



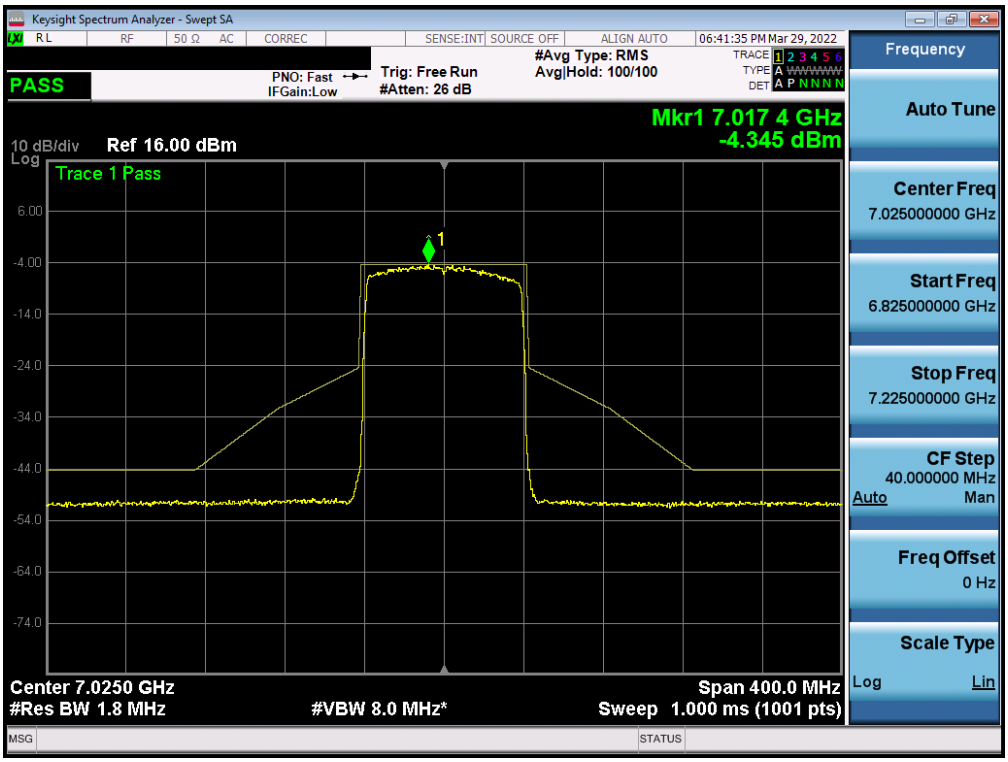
Plot 7-256. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 211)



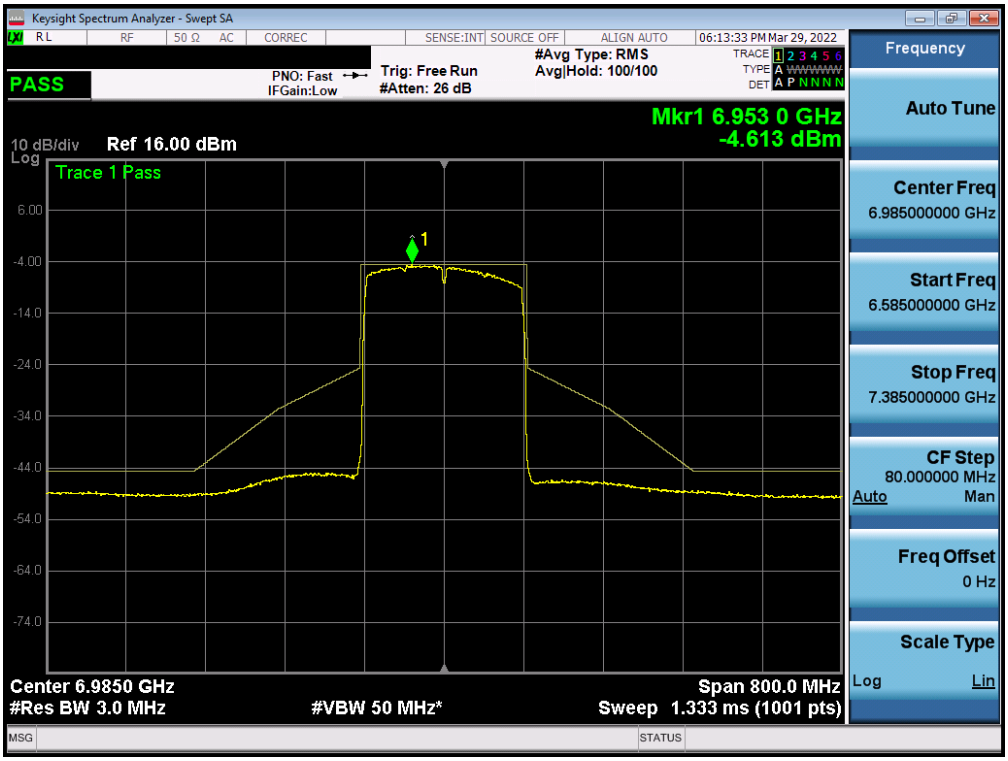
Plot 7-257. In-Band Emission Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 227)



Plot 7-258. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 8) – Ch. 199)

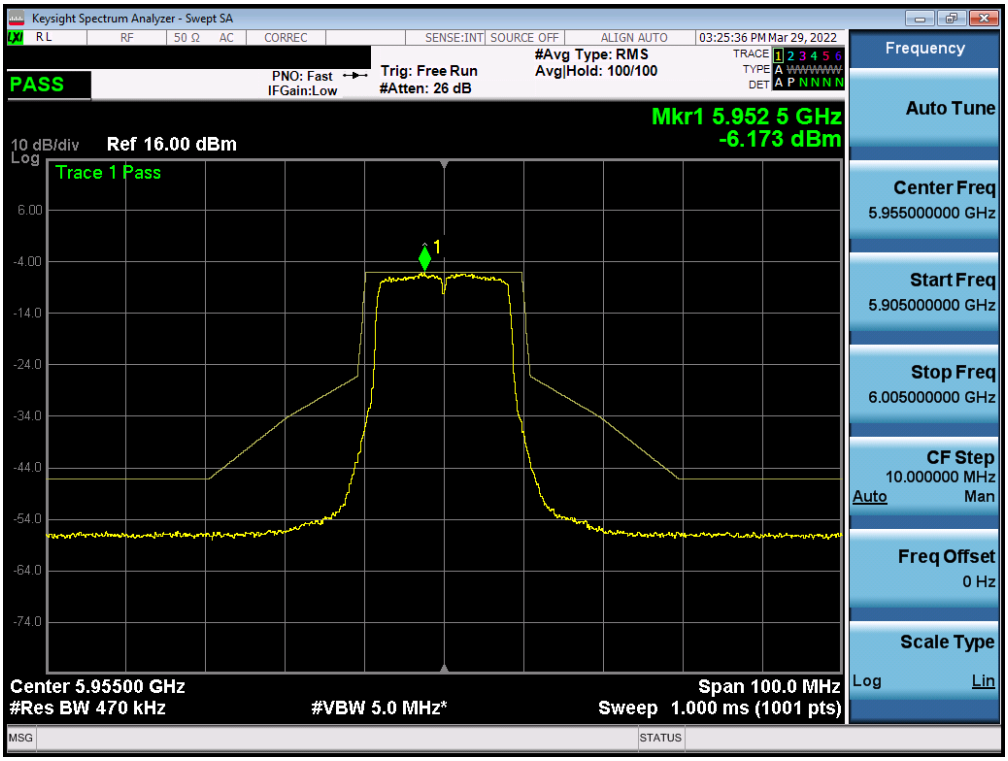


Plot 7-259. In-Band Emission Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 8) – Ch. 215)

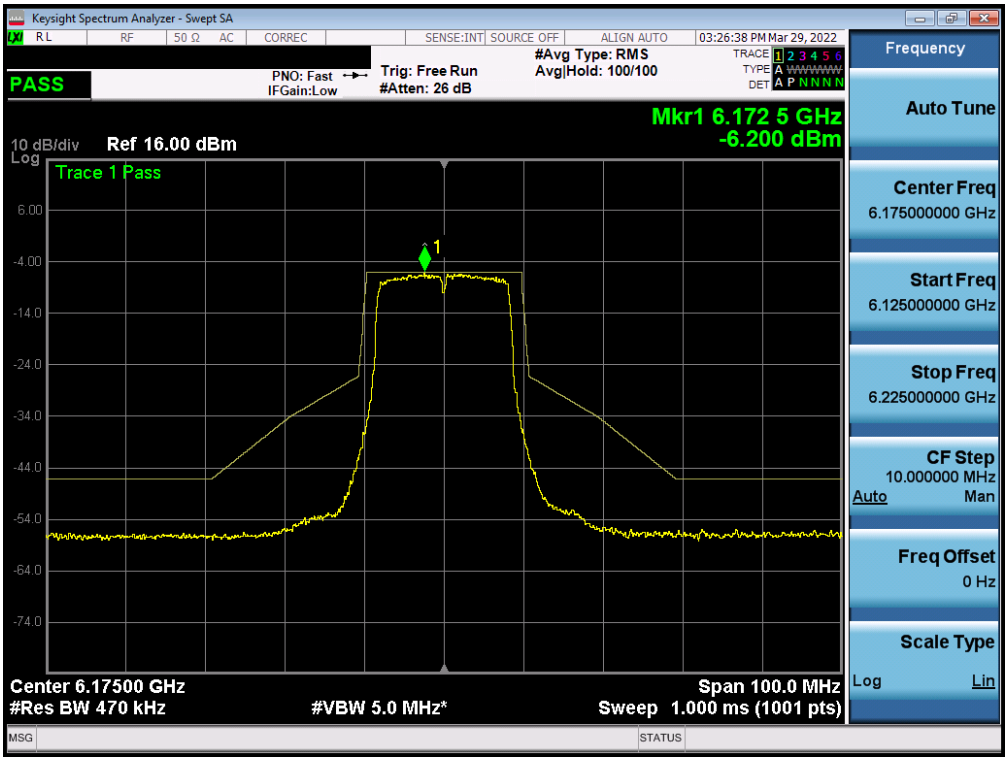


Plot 7-260. In-Band Emission Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 8) Ch.207)

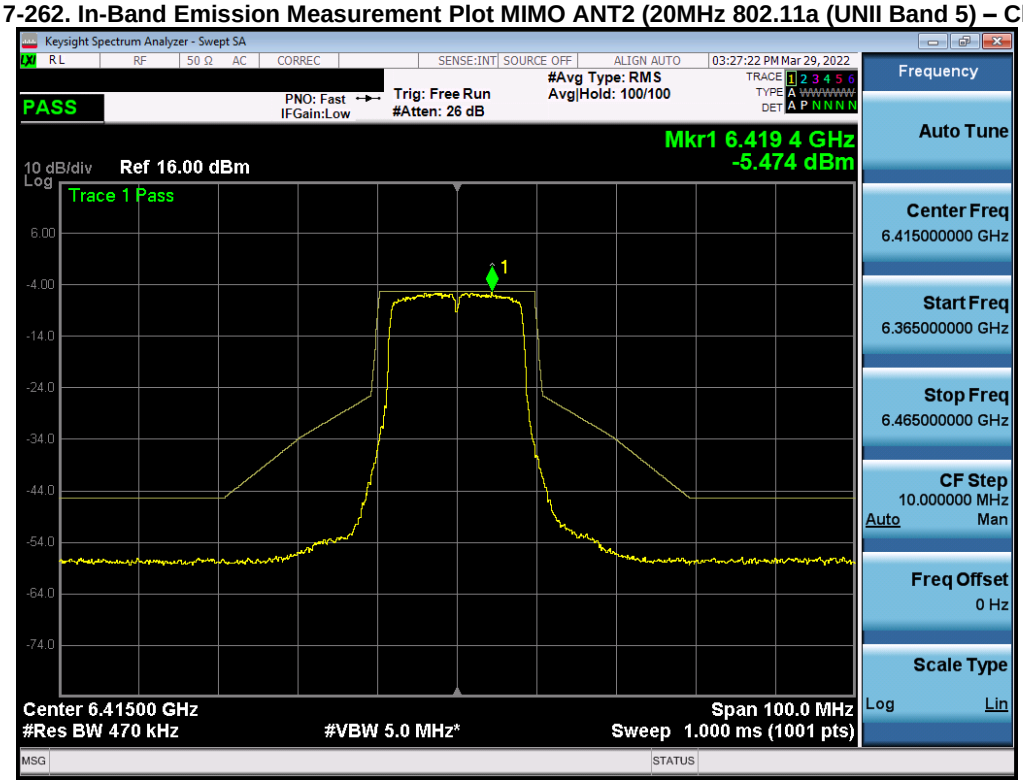
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 5)



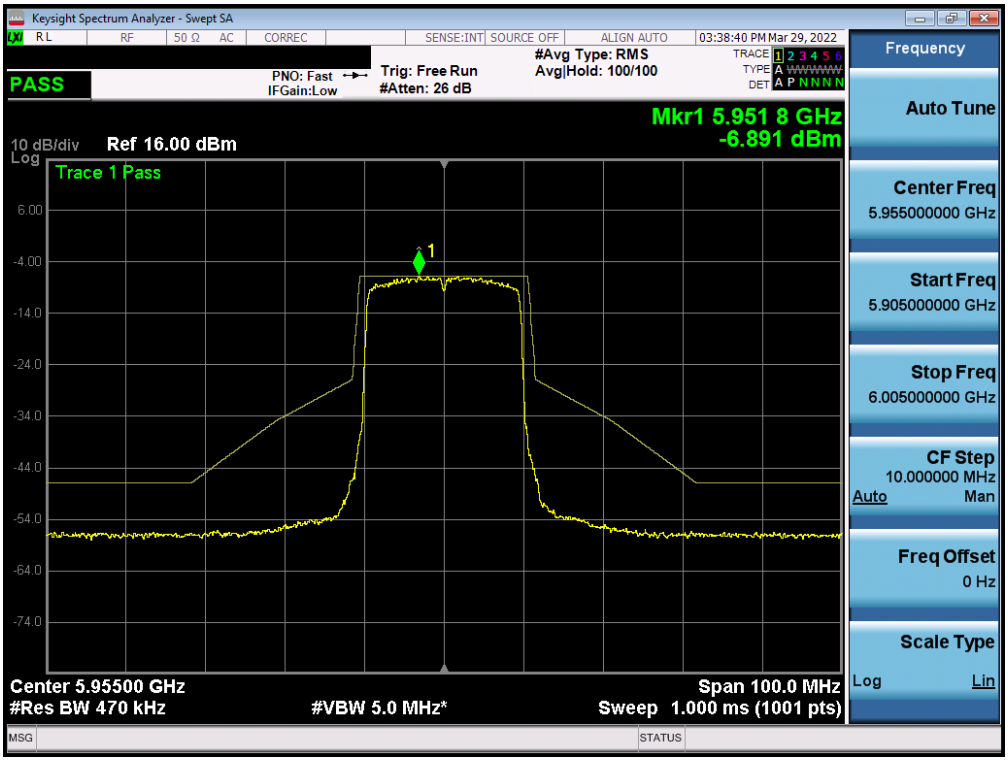
Plot 7-261. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 1)



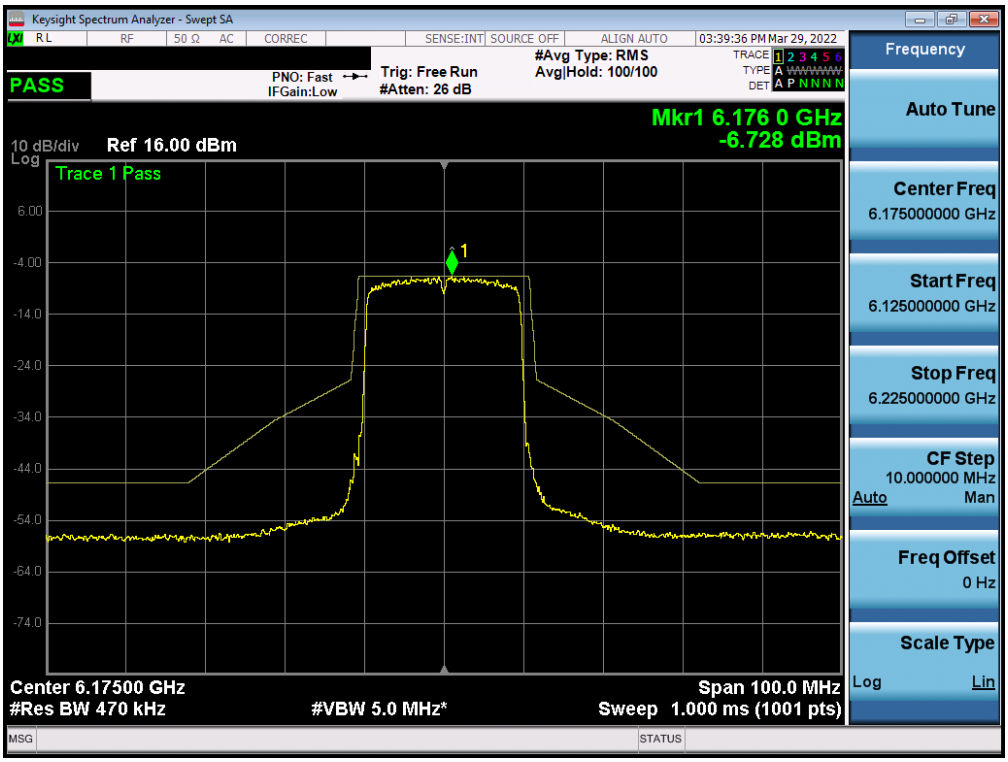
Plot 7-262. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 45)



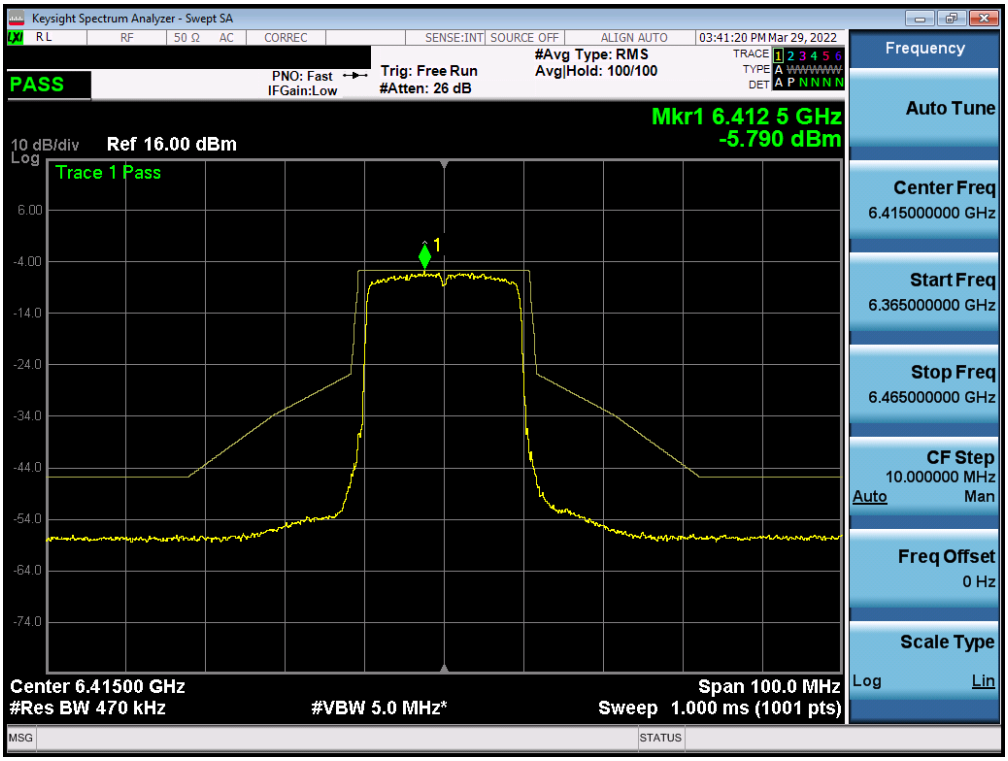
Plot 7-263. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 93)



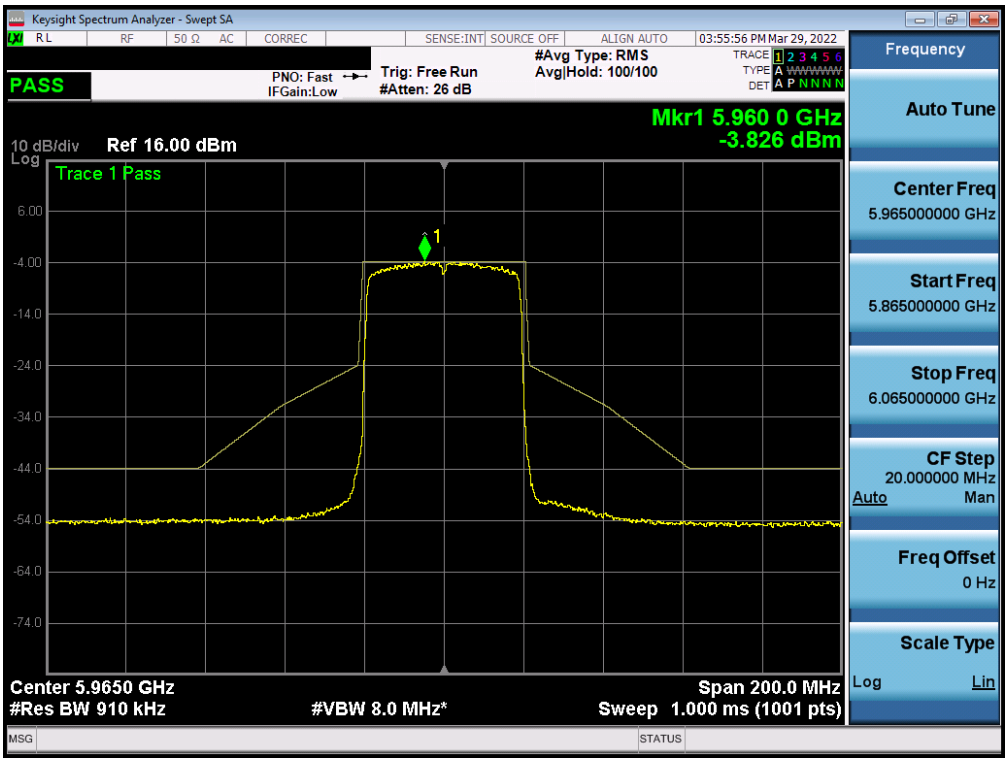
Plot 7-264. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 1)



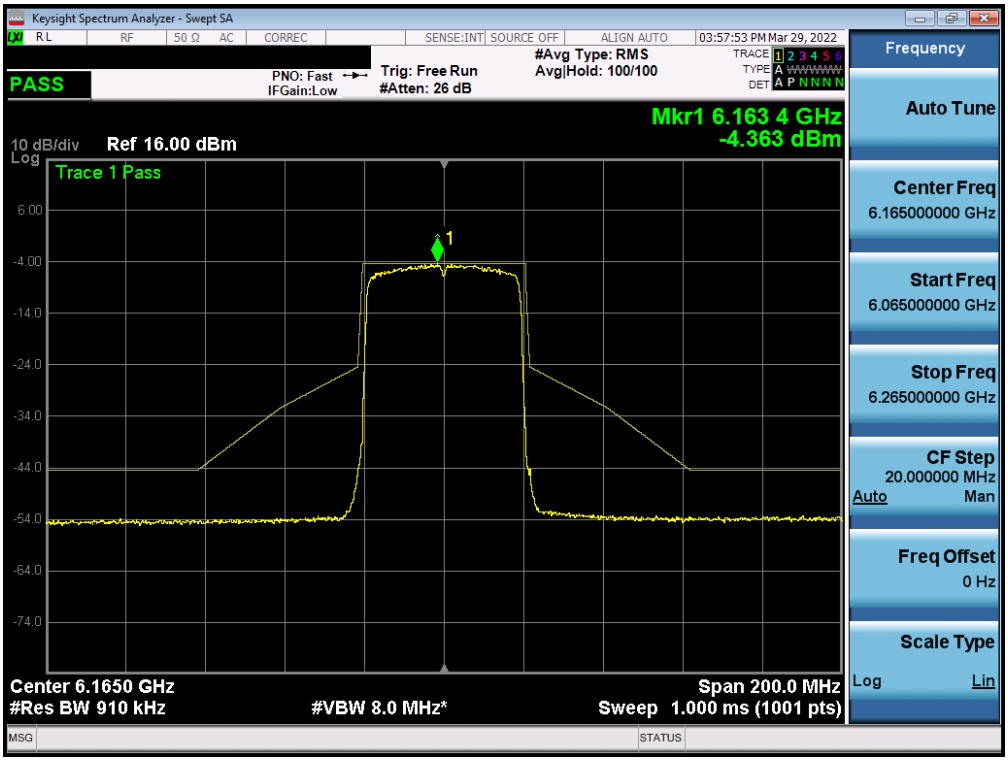
Plot 7-265. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 45)



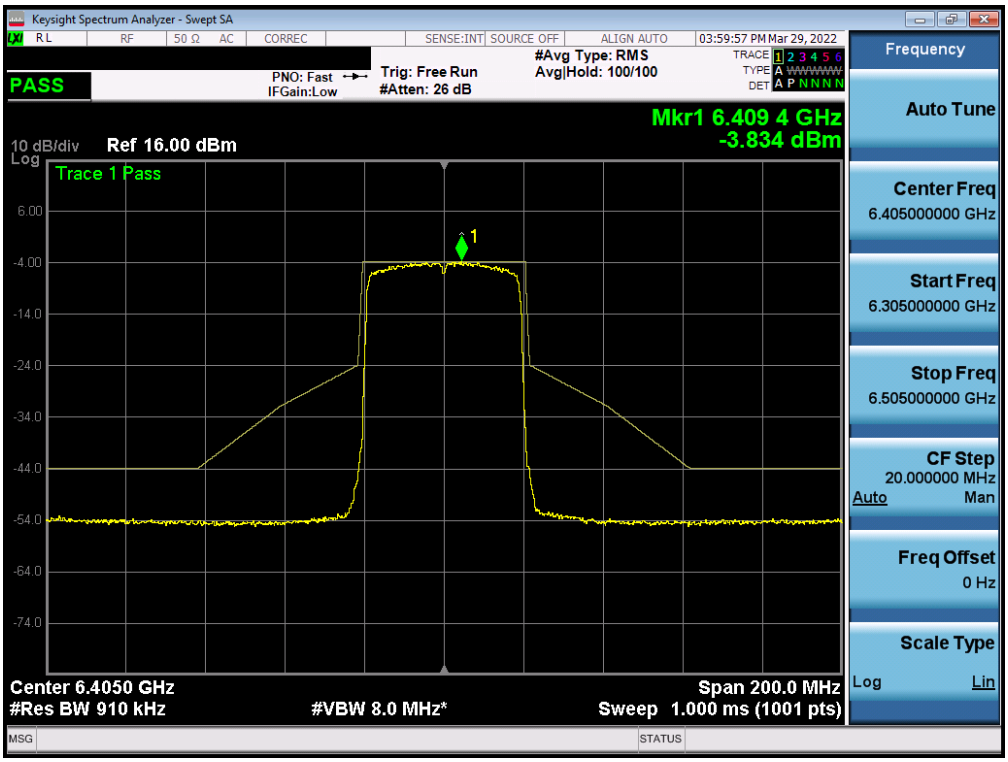
Plot 7-266. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 93)



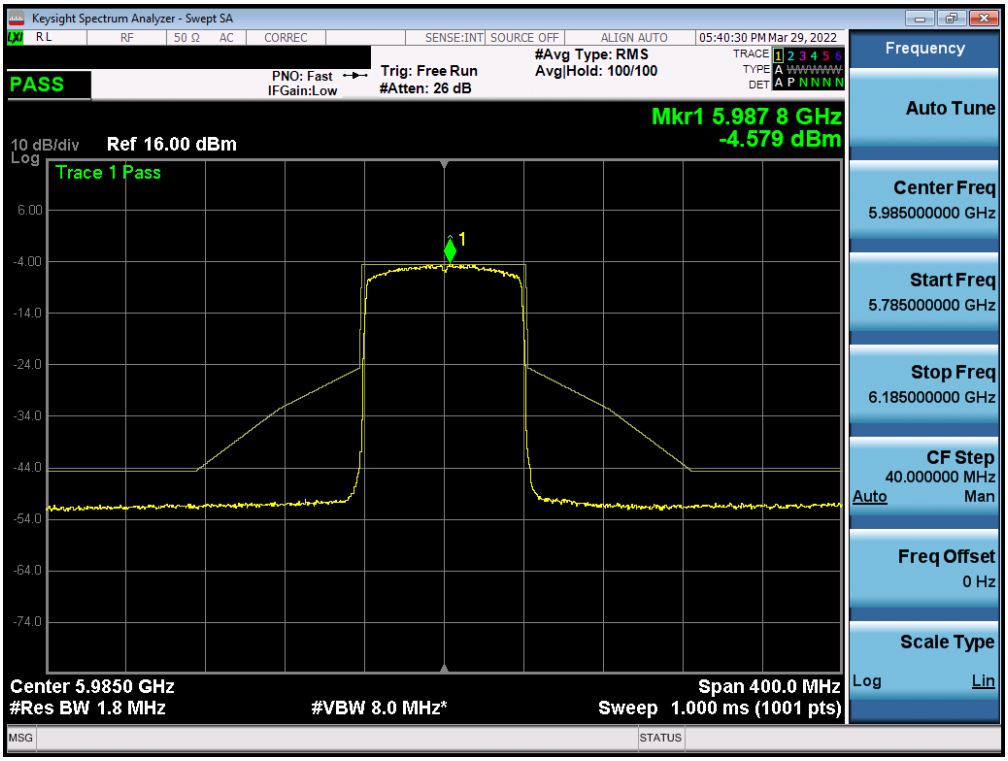
Plot 7-267. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 3)



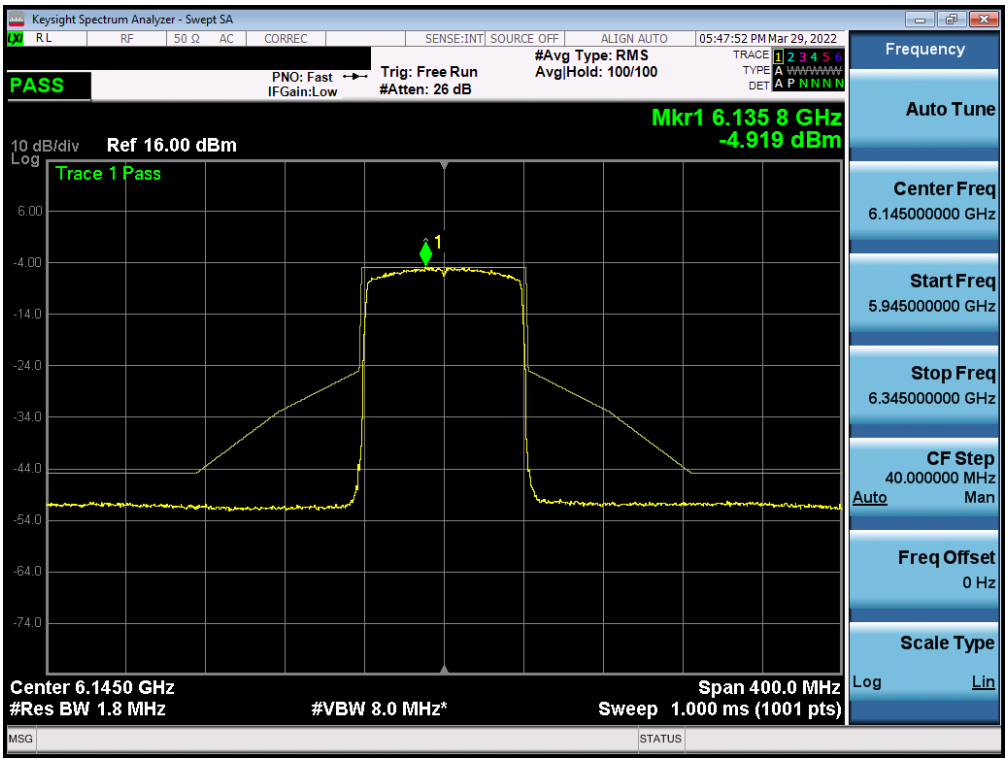
Plot 7-268. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 43)



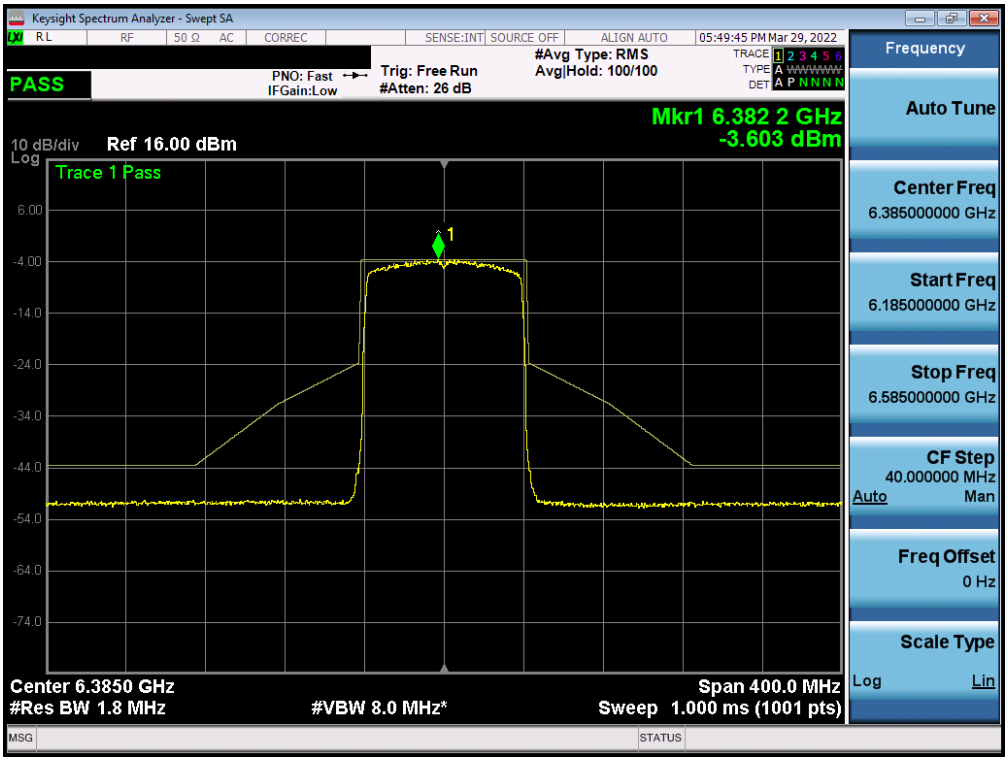
Plot 7-269. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



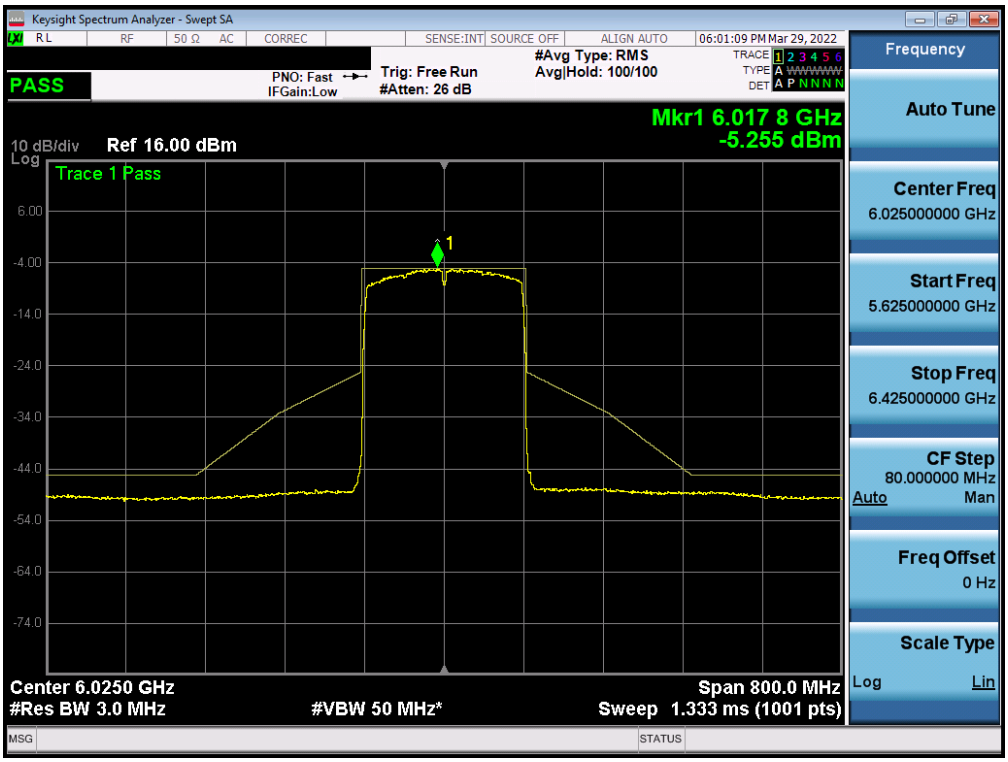
Plot 7-270. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 7)



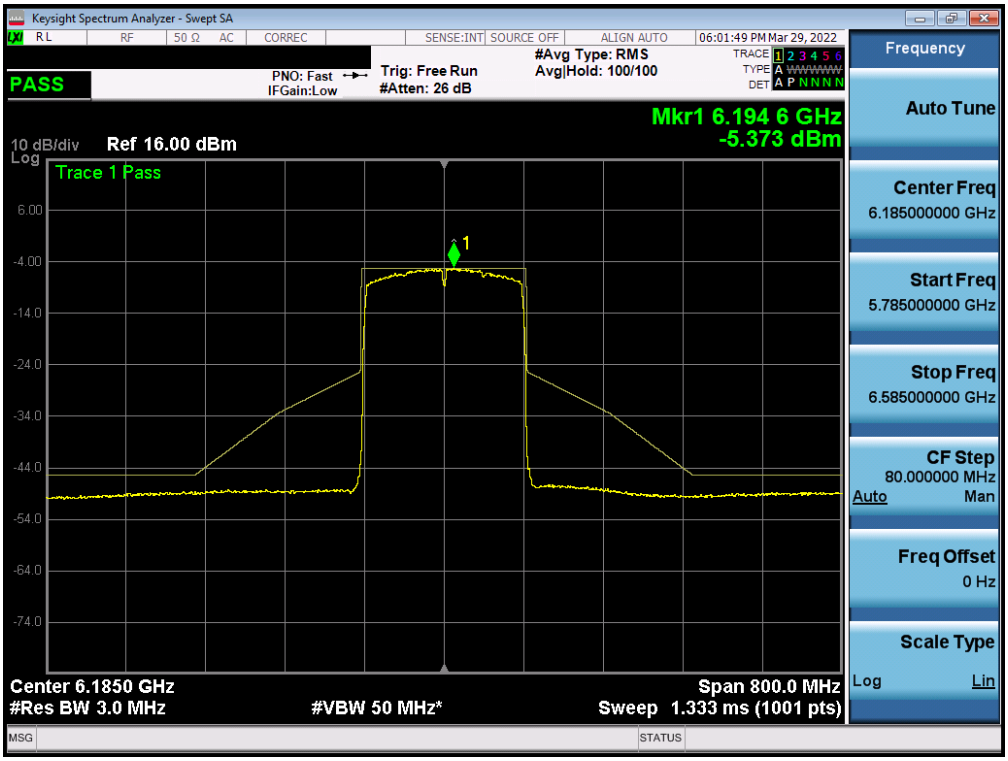
Plot 7-271. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



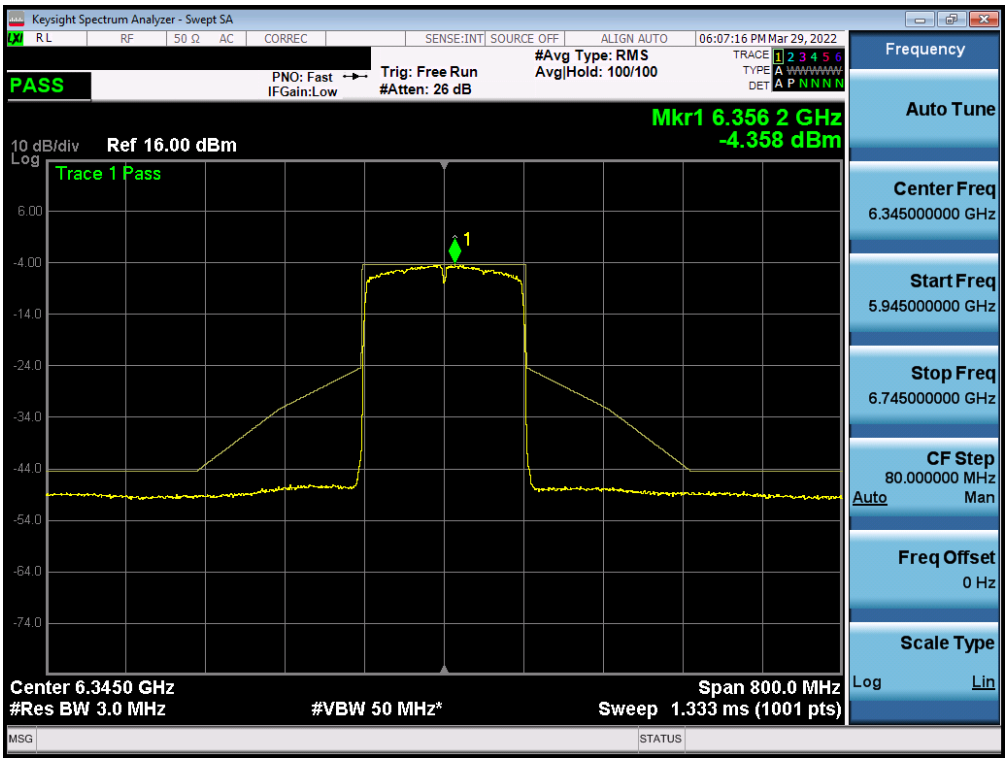
Plot 7-272. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



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

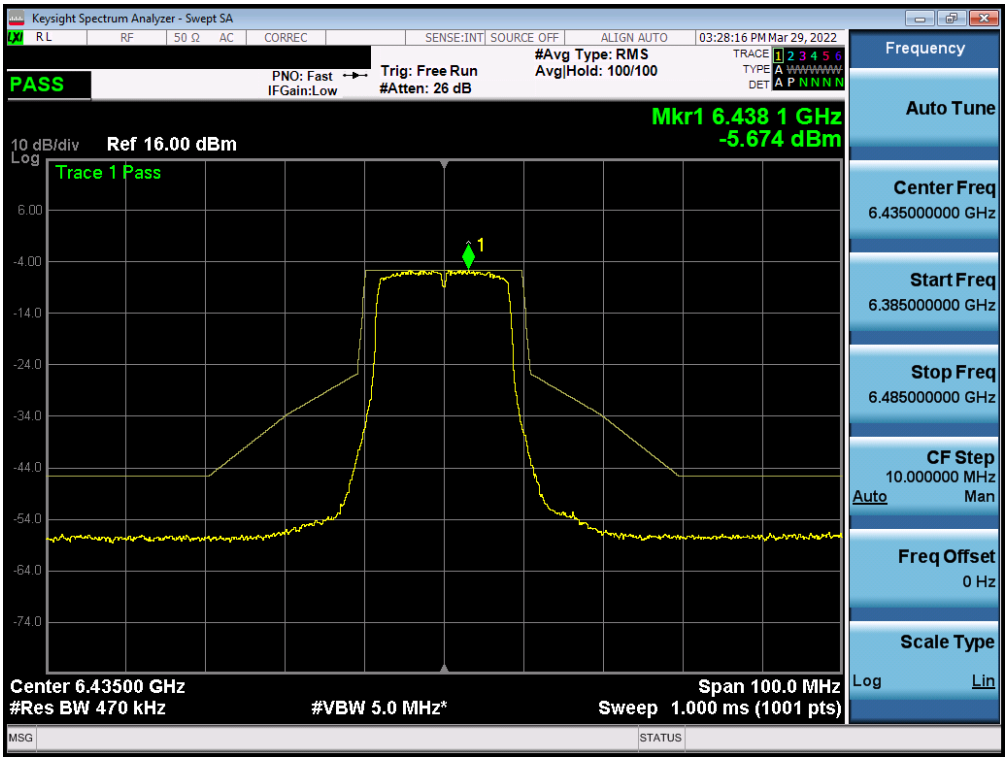


Plot 7-274. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

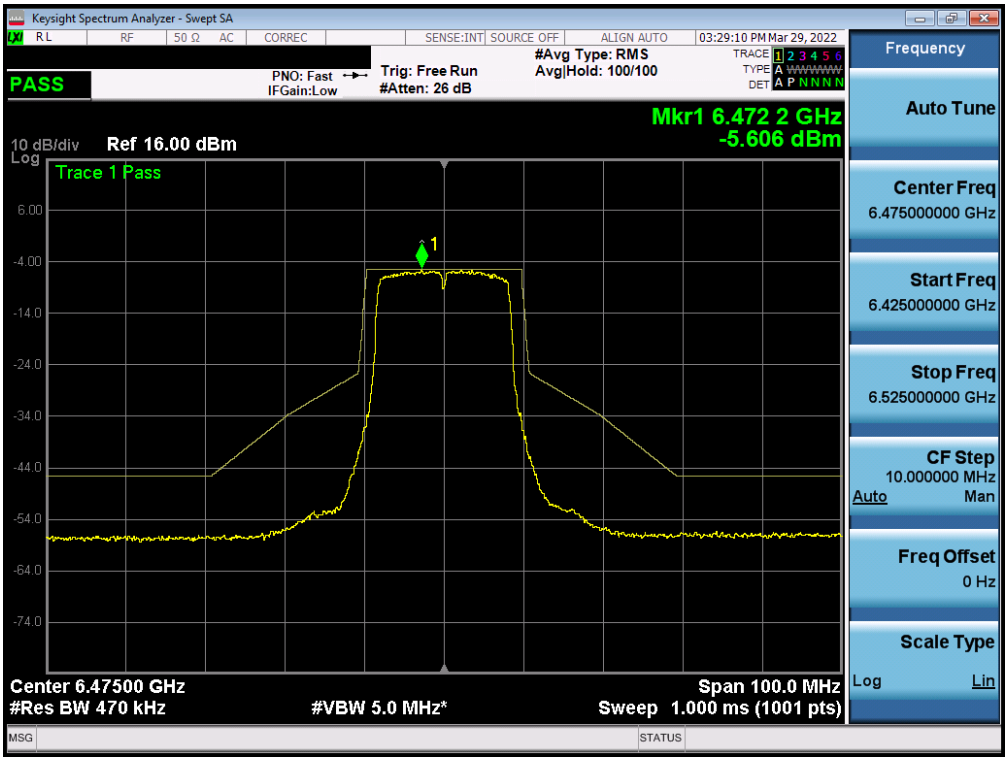


Plot 7-275. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

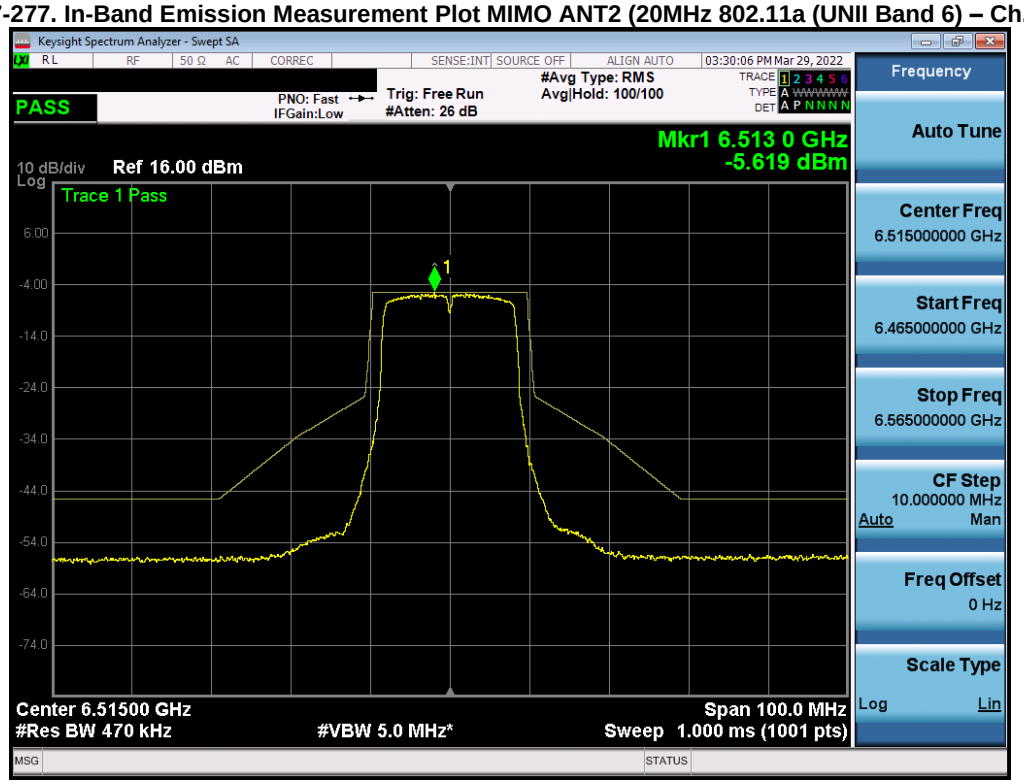
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 6)



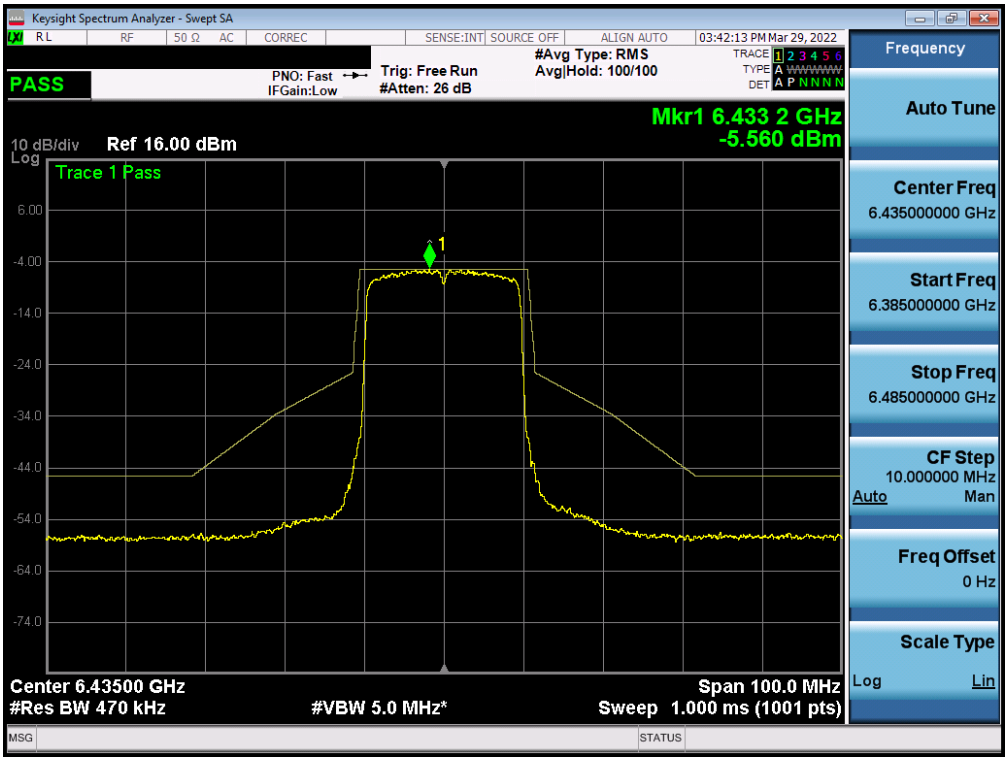
Plot 7-276. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 97)



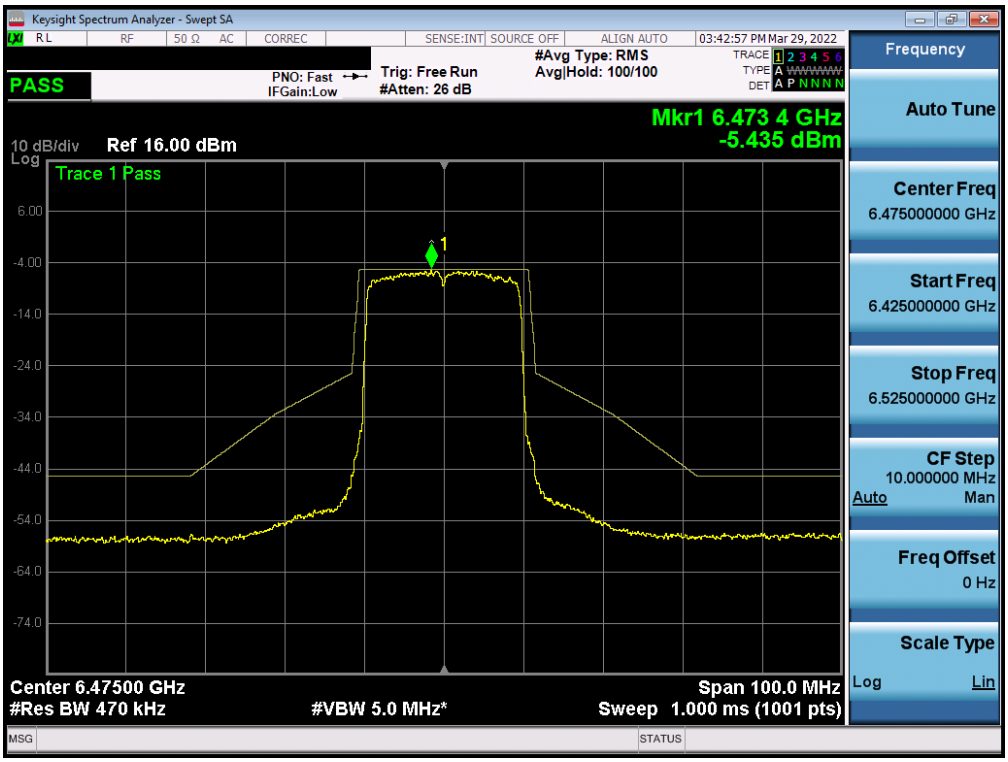
Plot 7-277. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 105)



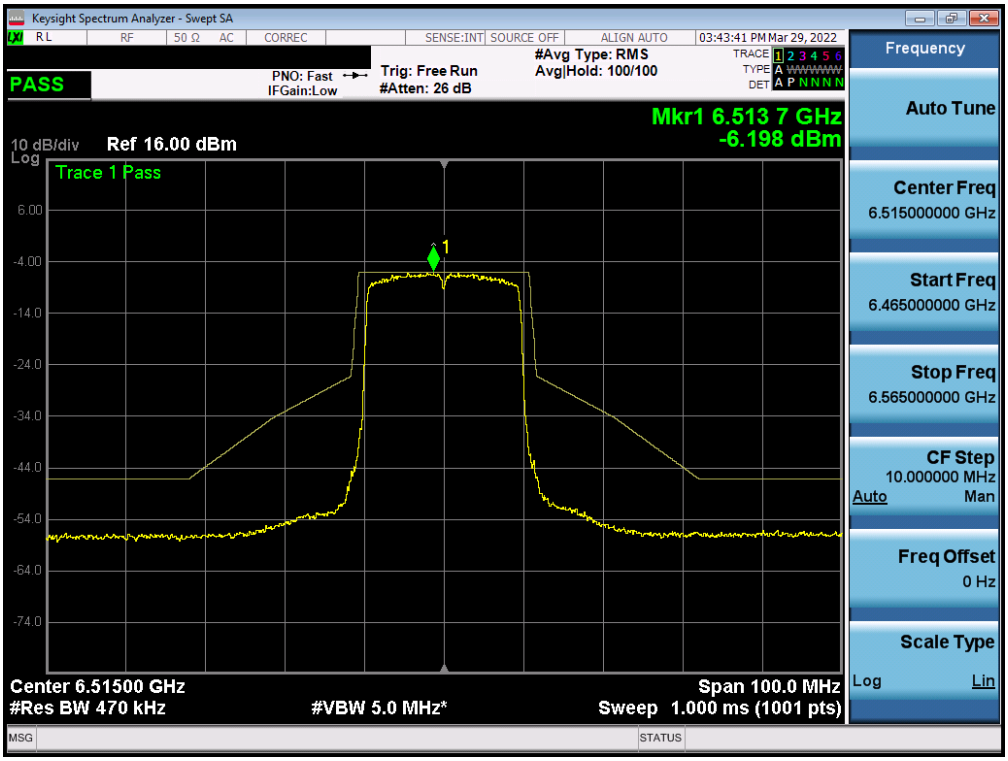
Plot 7-278. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 113)



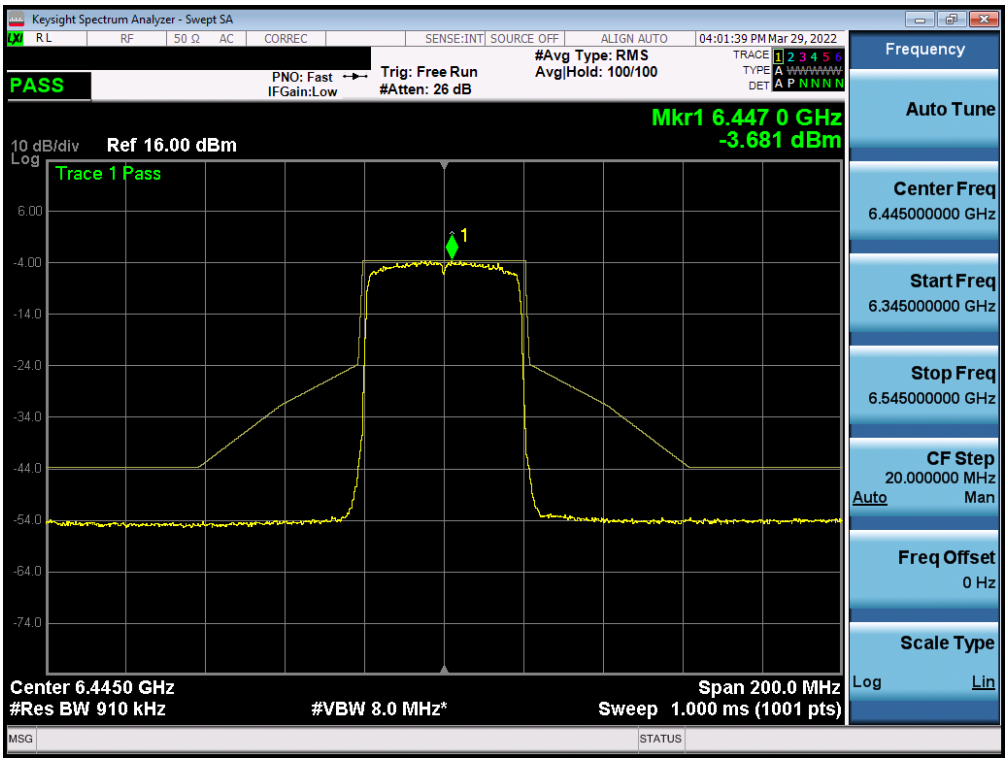
Plot 7-279. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



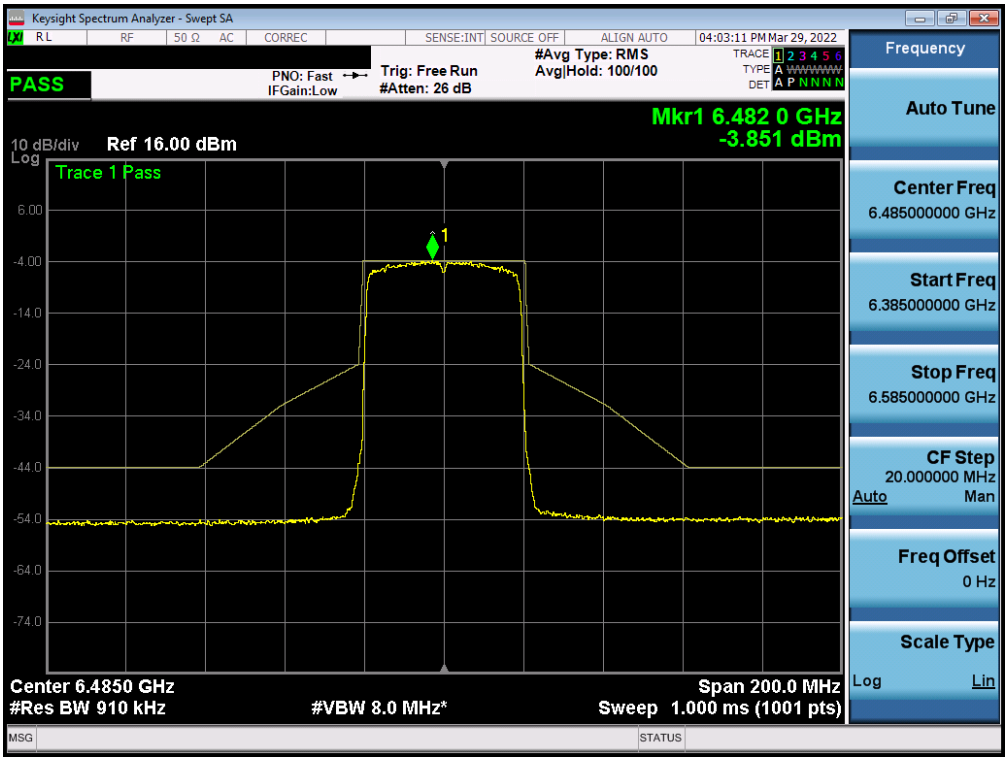
Plot 7-280. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



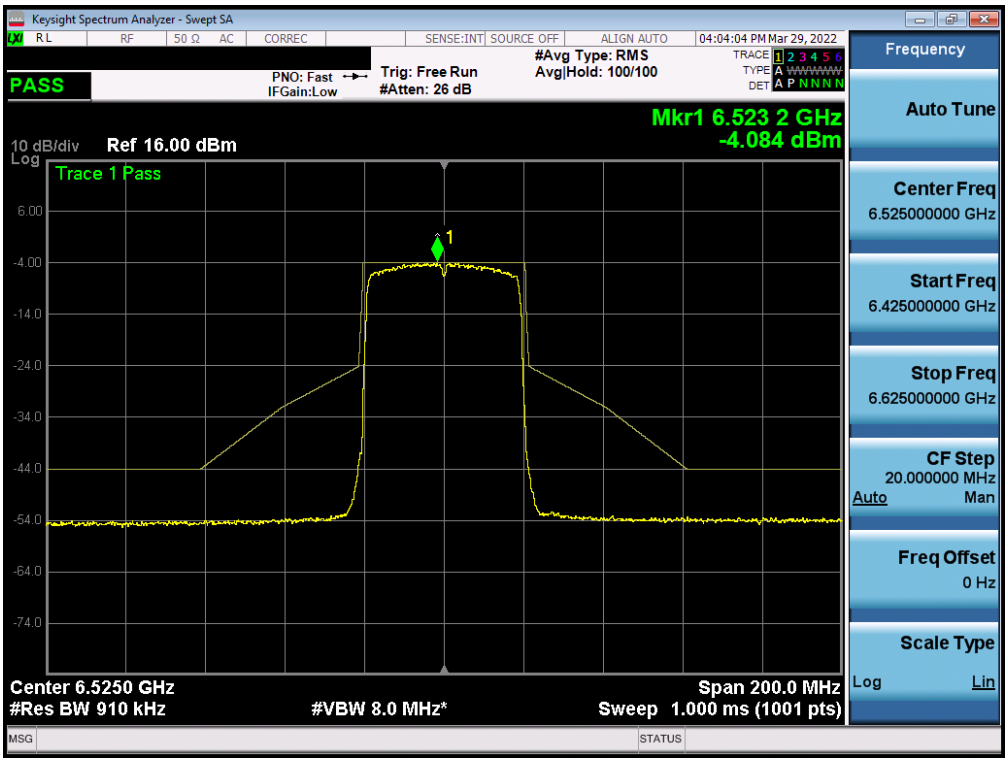
Plot 7-281. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 113)



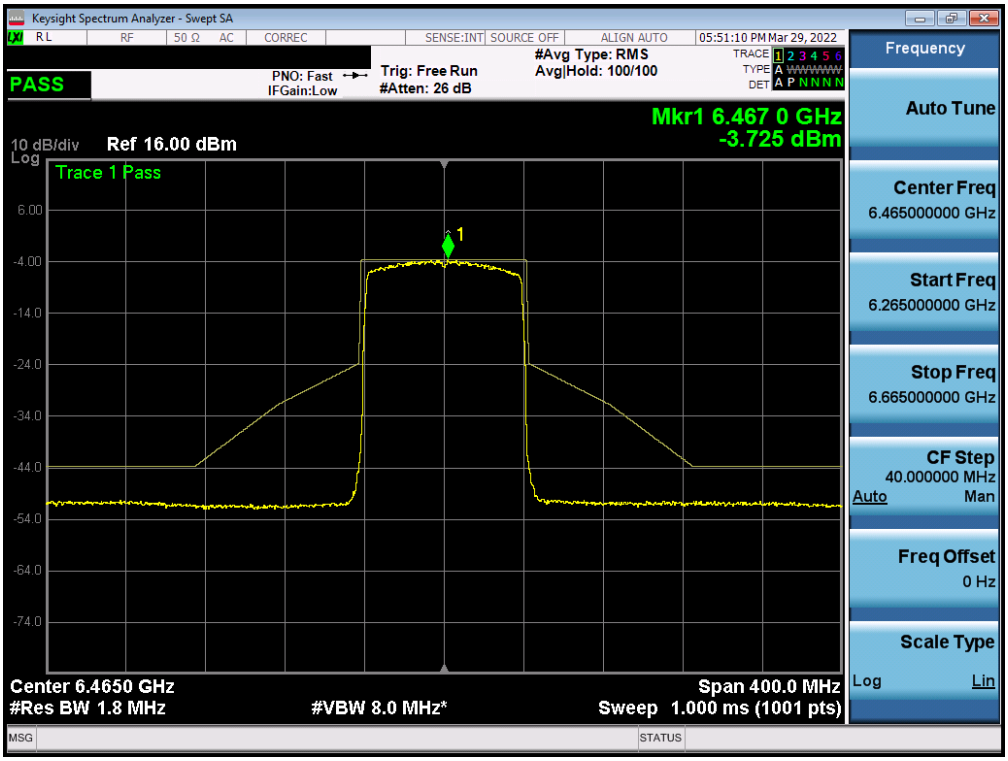
Plot 7-282. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 99)



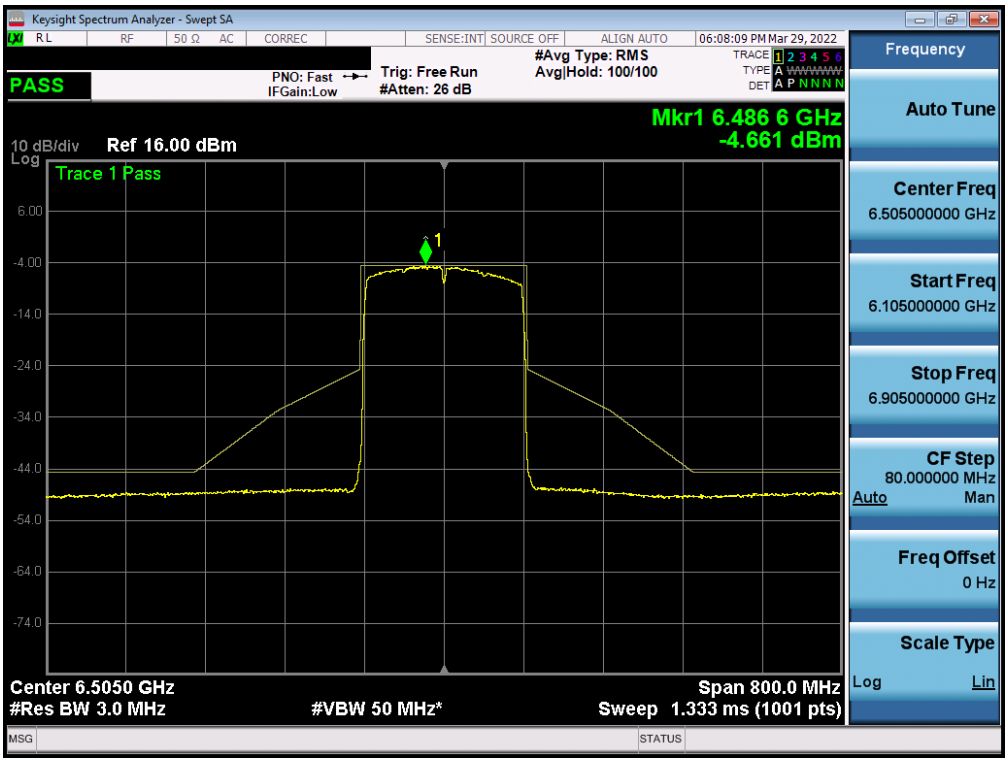
Plot 7-283. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 107)



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

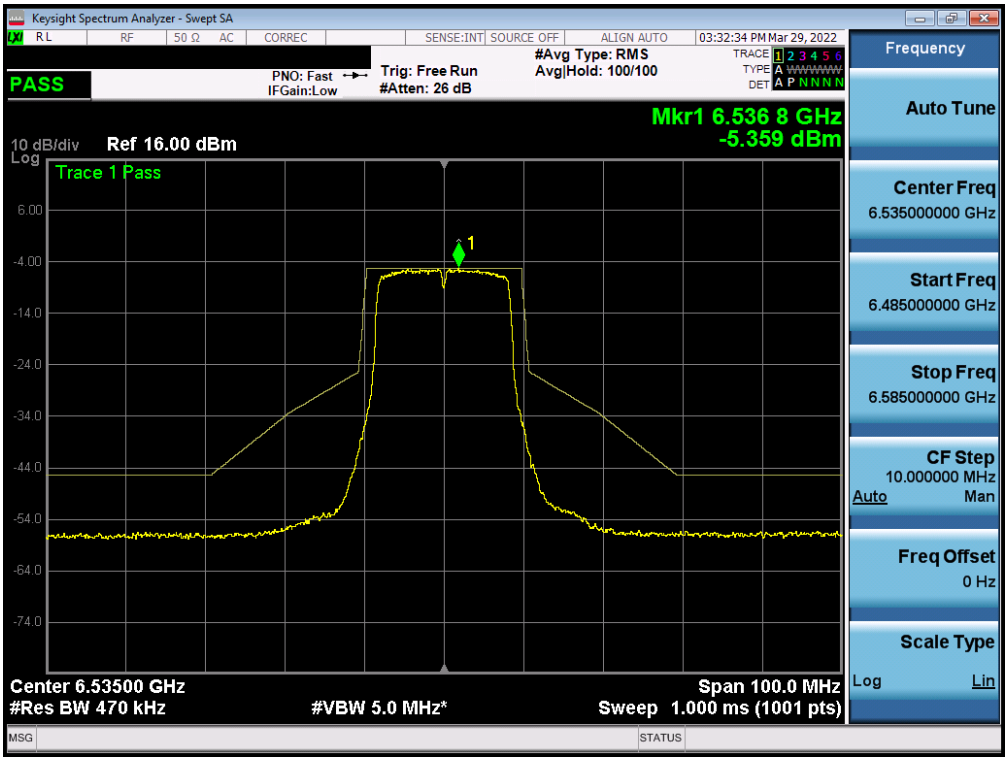


Plot 7-285. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 6) – Ch. 103)

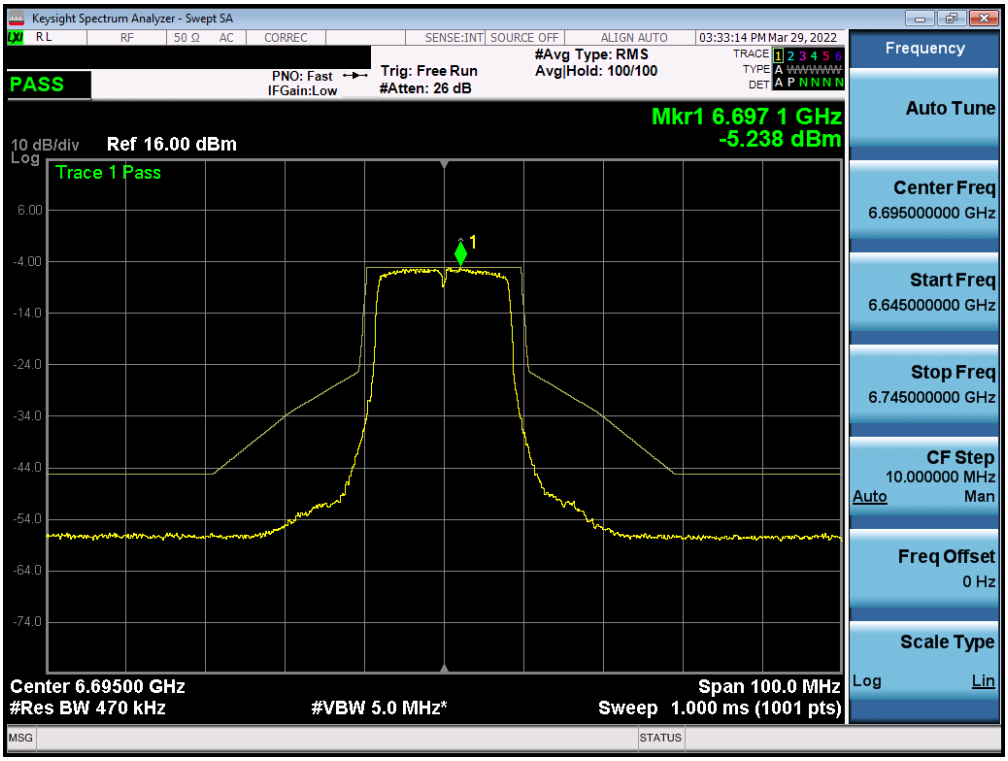


Plot 7-286. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 6) – Ch. 111)

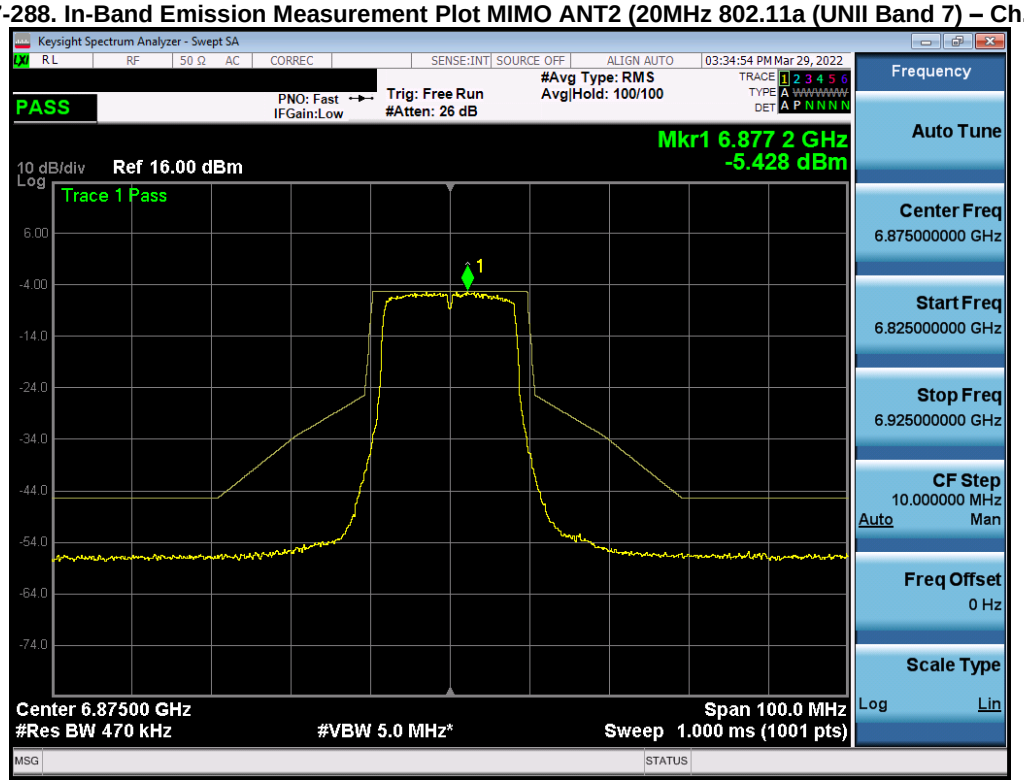
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 7)



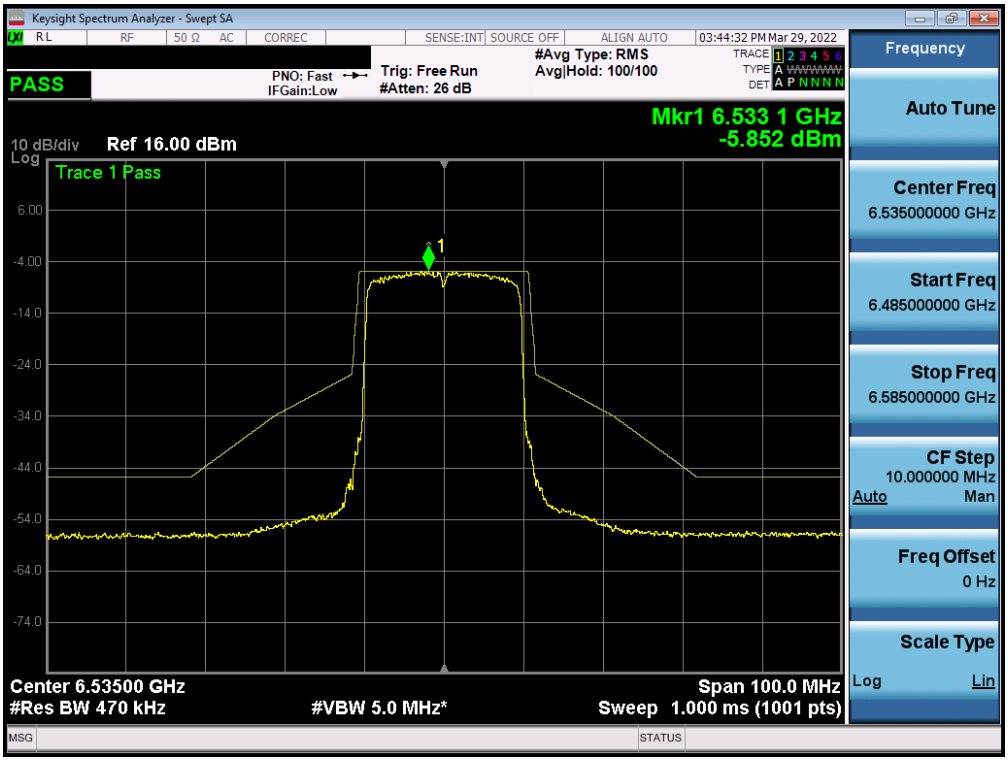
Plot 7-287. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 117)



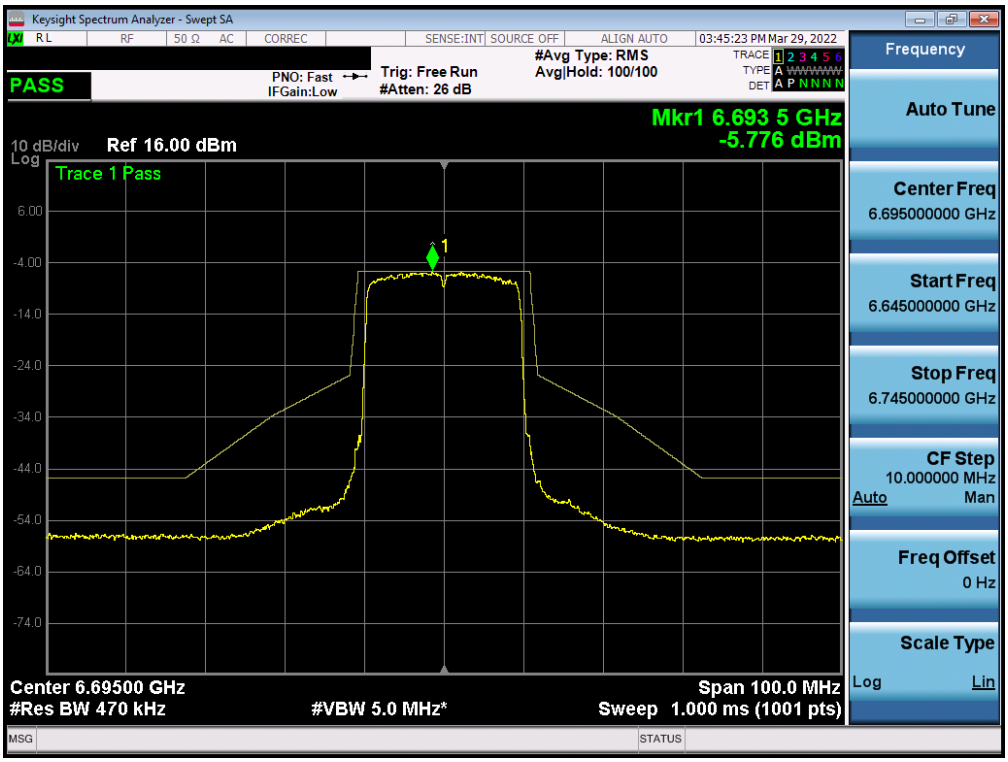
Plot 7-288. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 149)



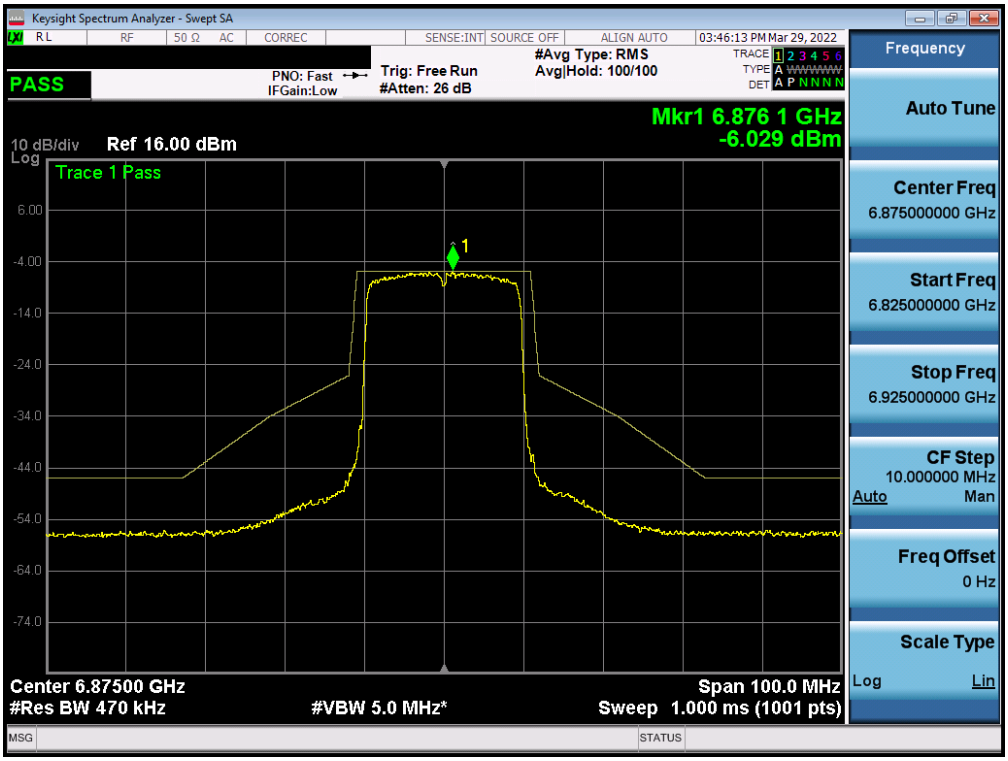
Plot 7-289. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 185)



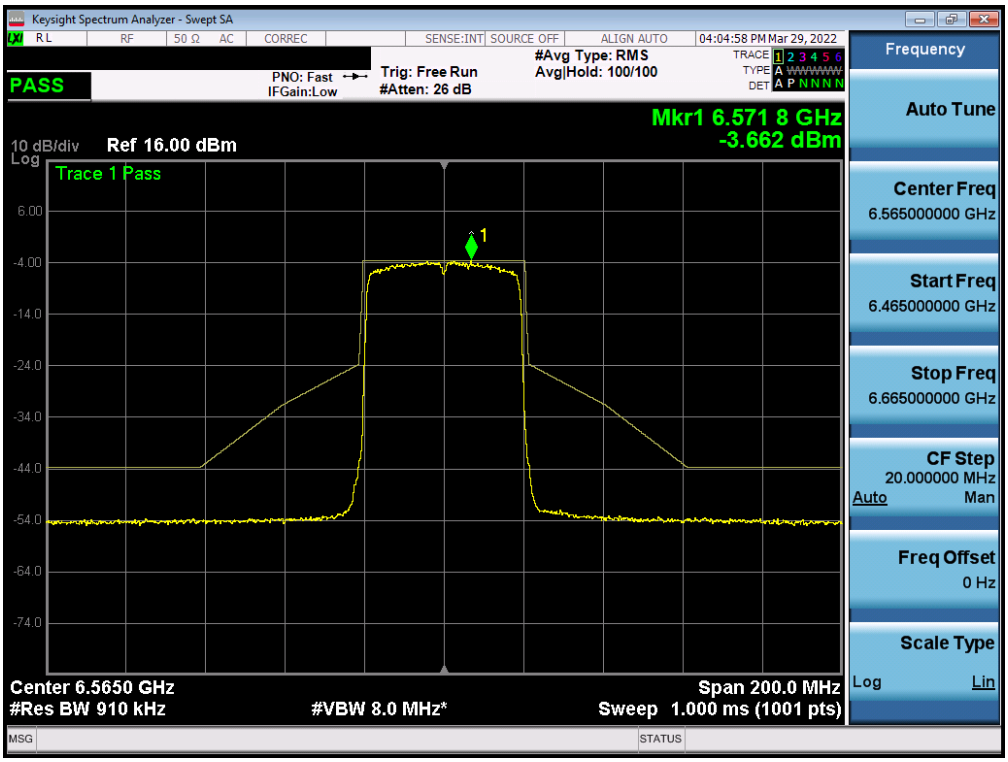
Plot 7-290. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 117)



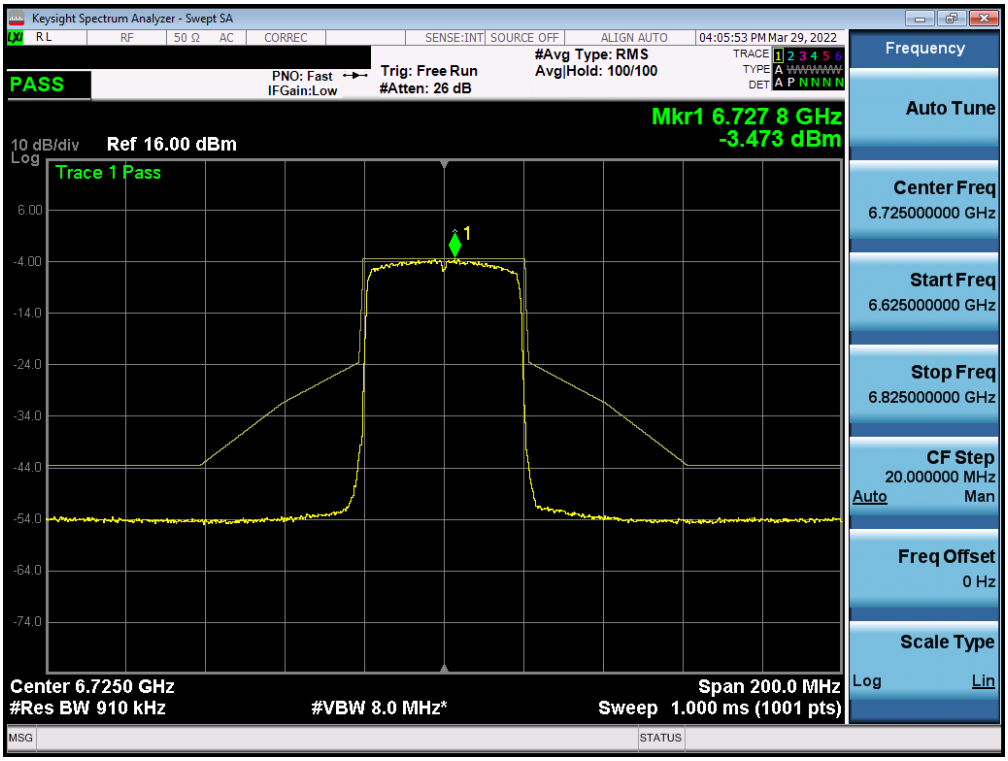
Plot 7-291. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



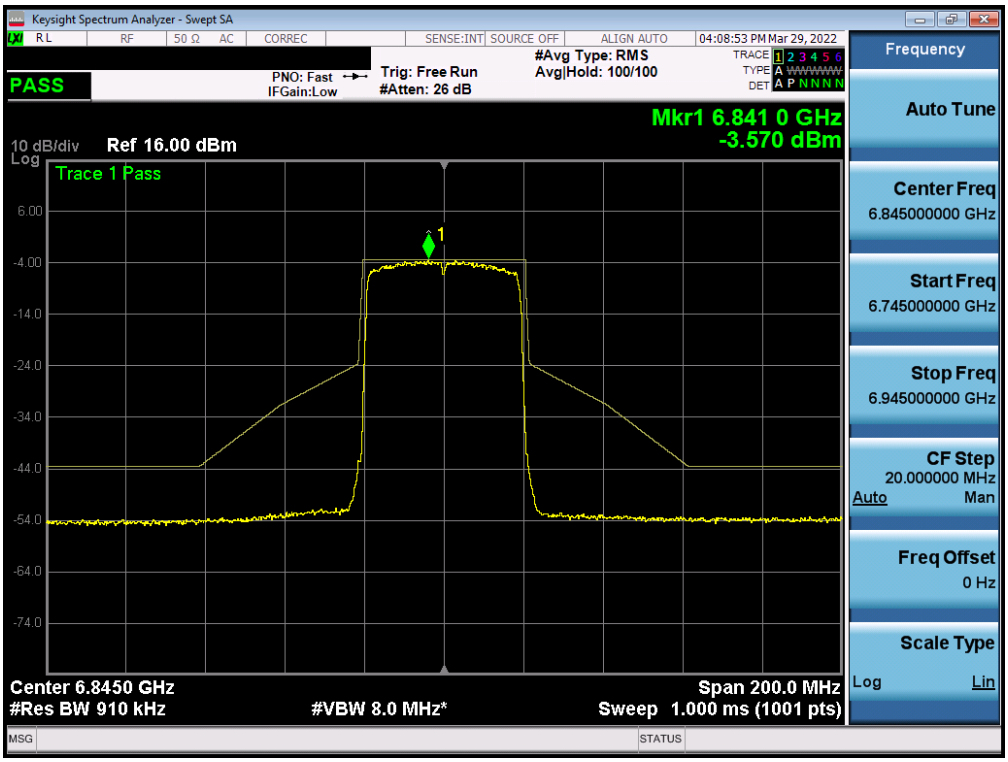
Plot 7-292. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 185)



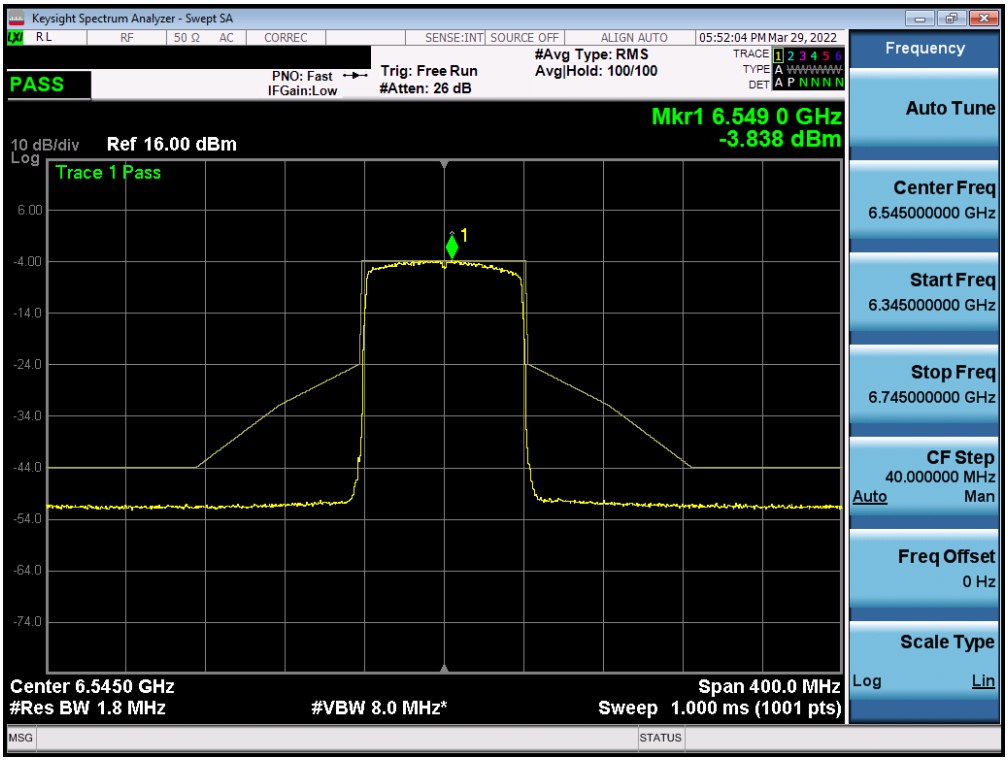
Plot 7-293. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 123)



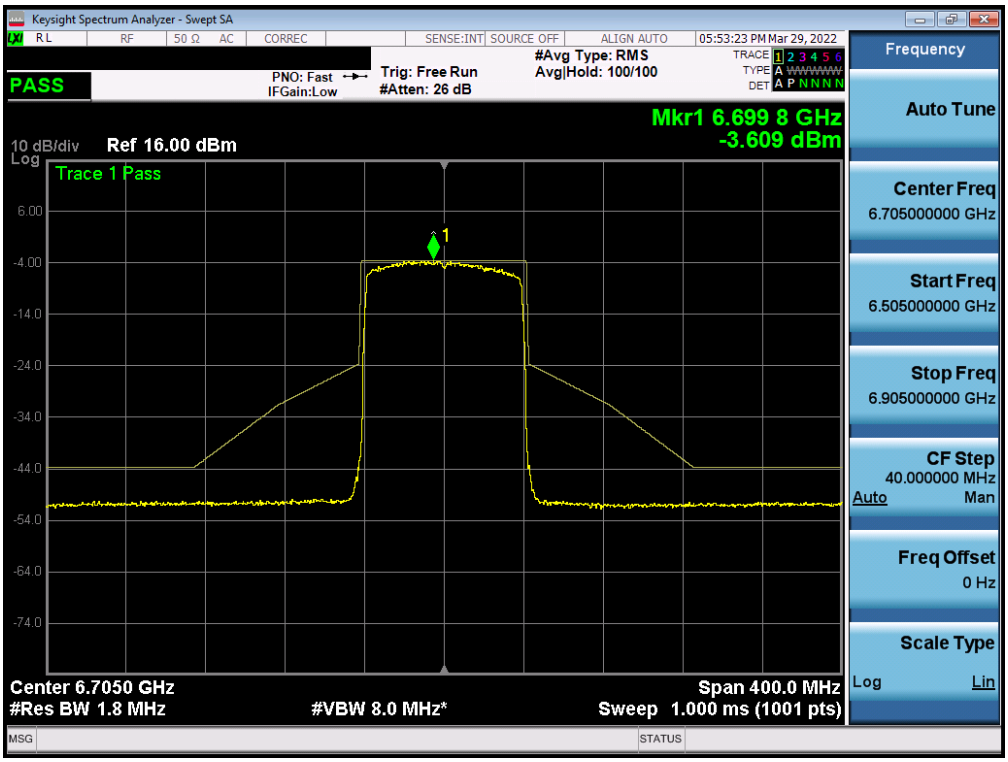
Plot 7-294. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



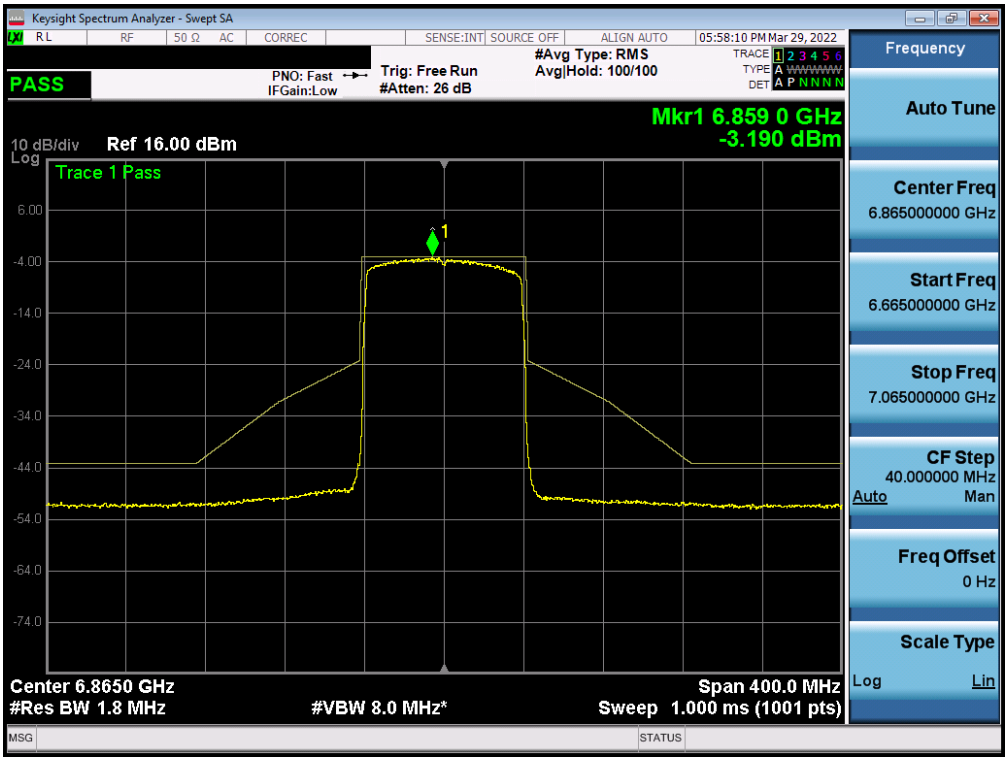
Plot 7-295. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



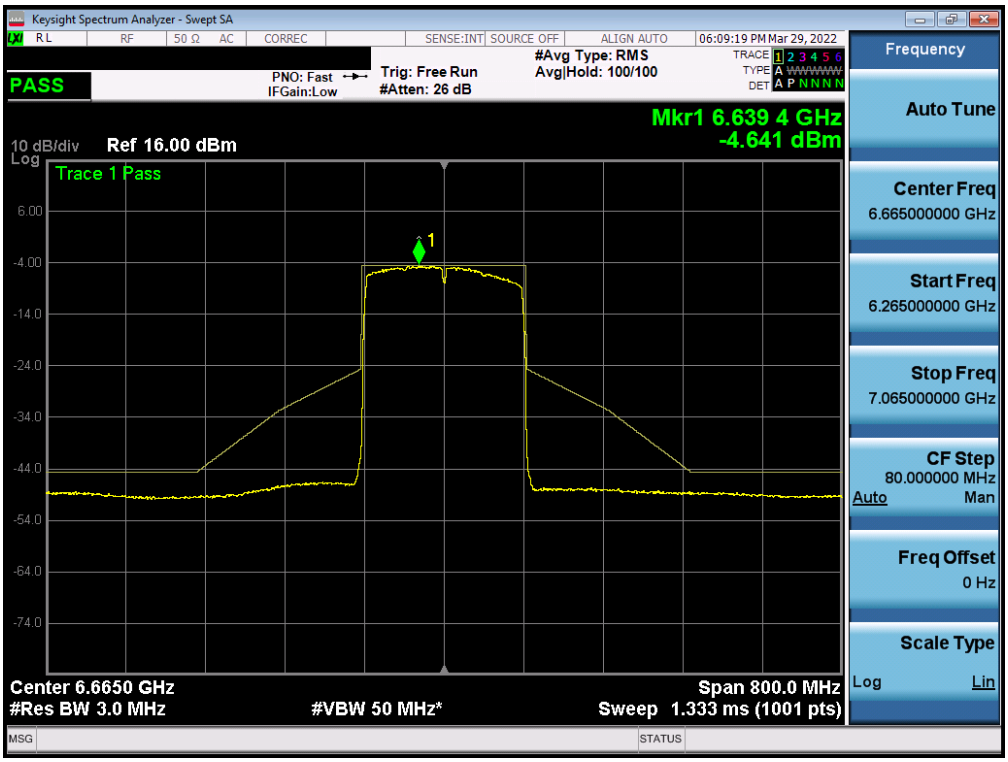
Plot 7-296. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 119)



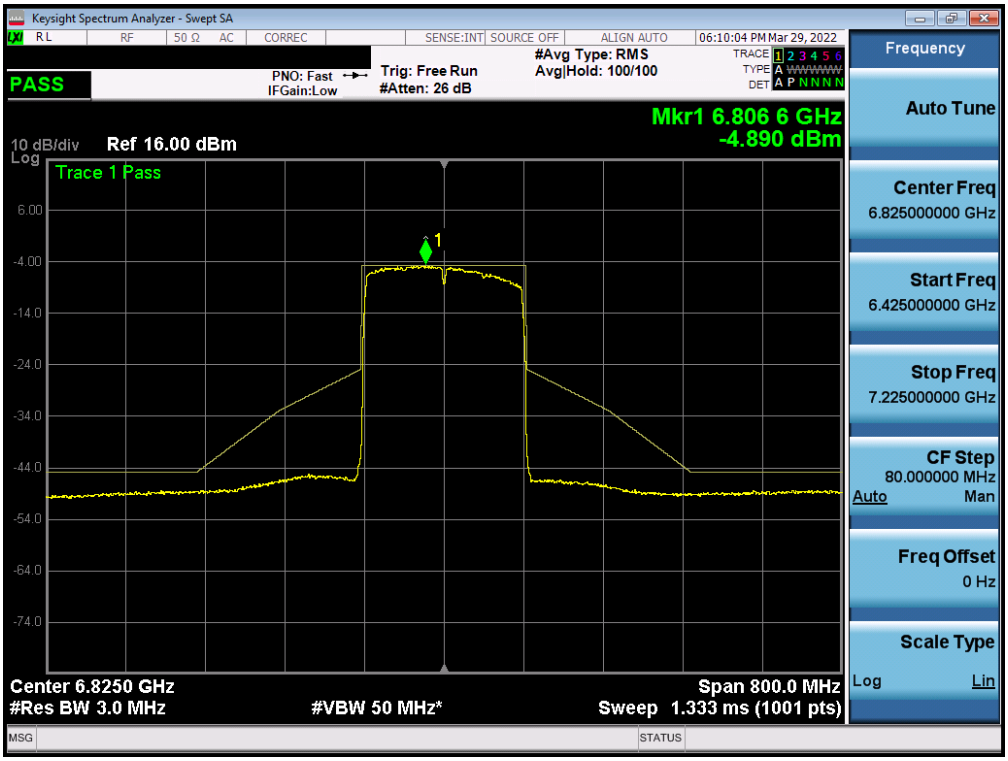
Plot 7-297. In-Band Emission Measurement Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



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

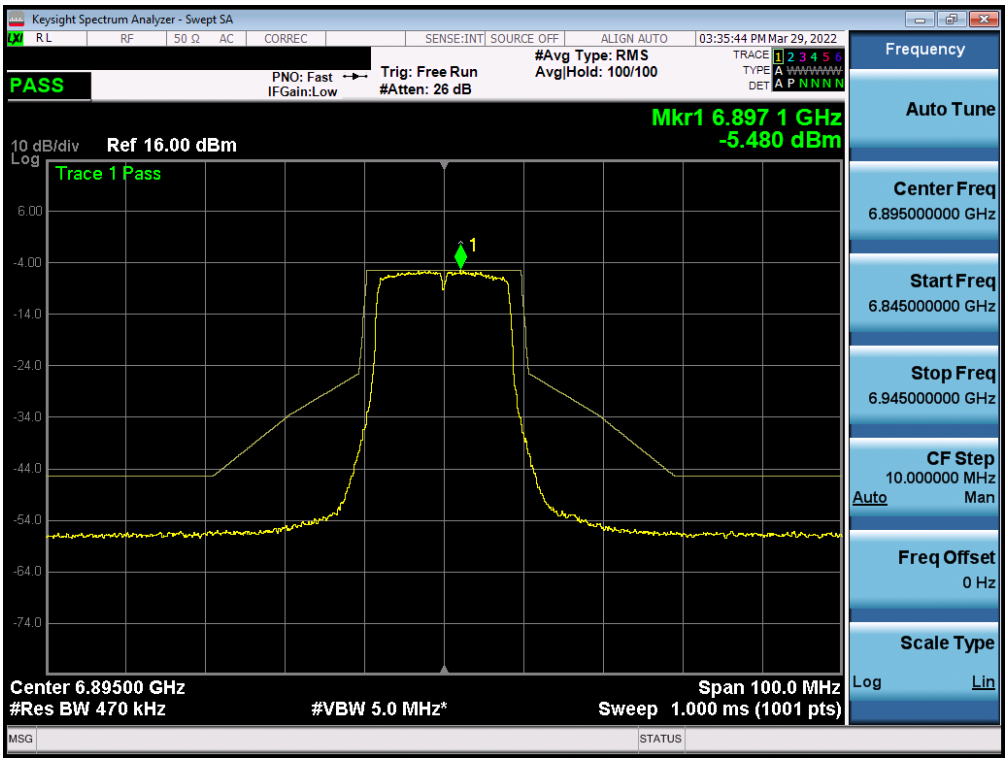


Plot 7-299. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

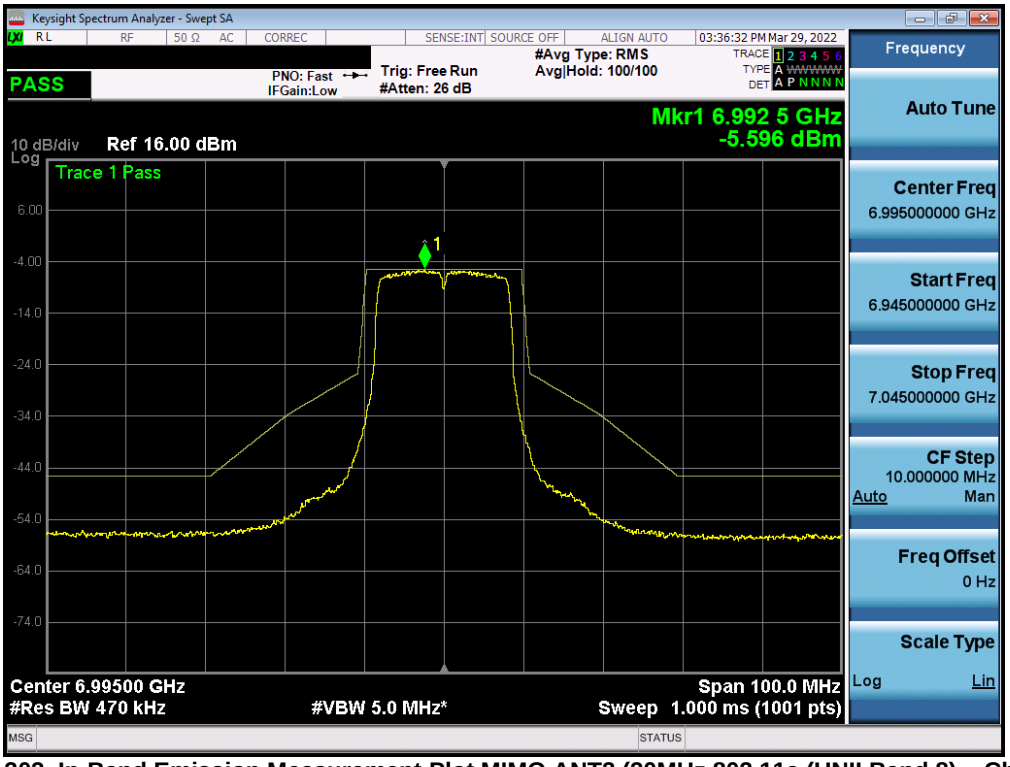


Plot 7-300. In-Band Emission Measurement Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 175)

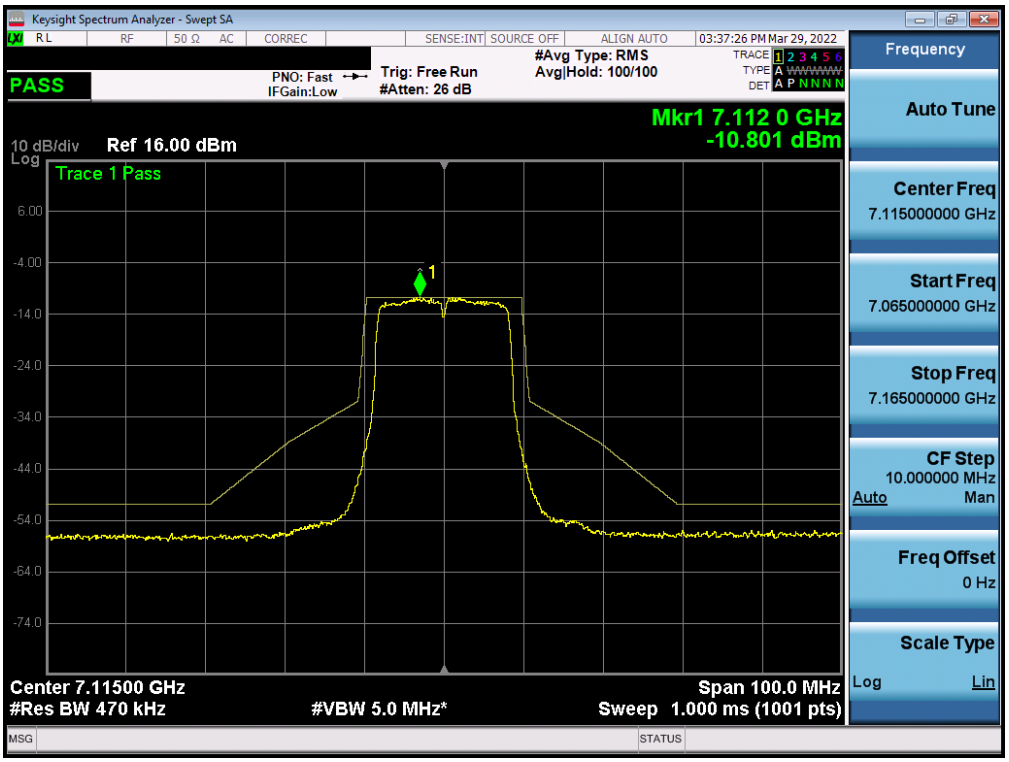
MIMO Antenna-2 In-Band Emission Measurements - (UNII Band 8)



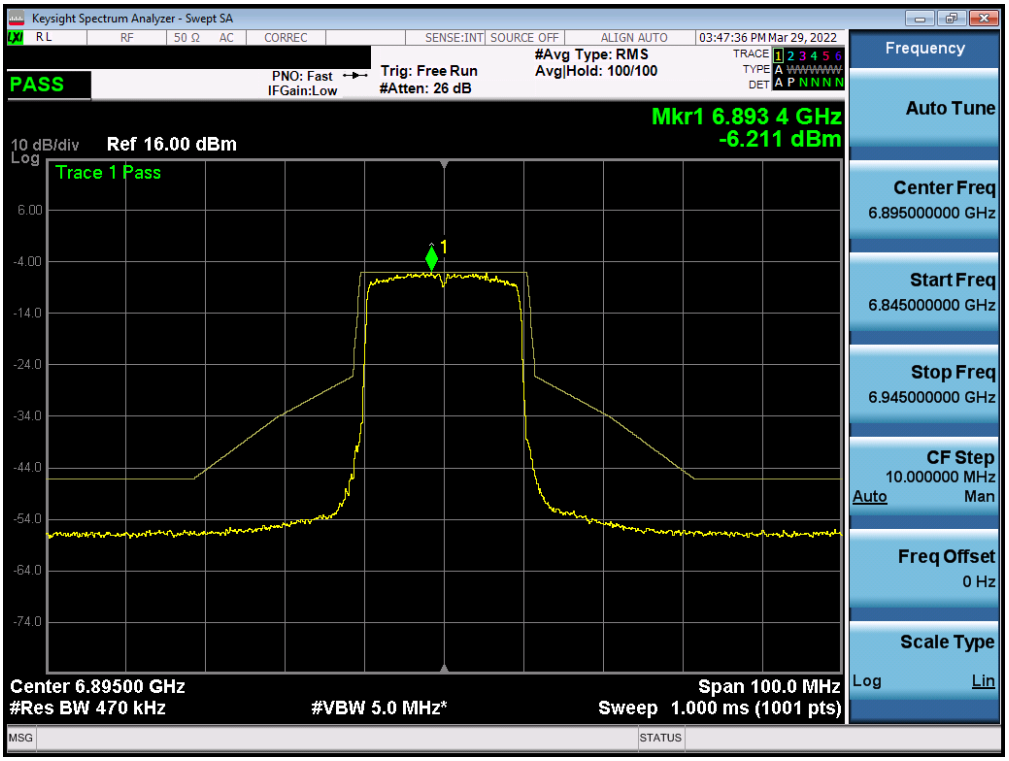
Plot 7-301. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 189)



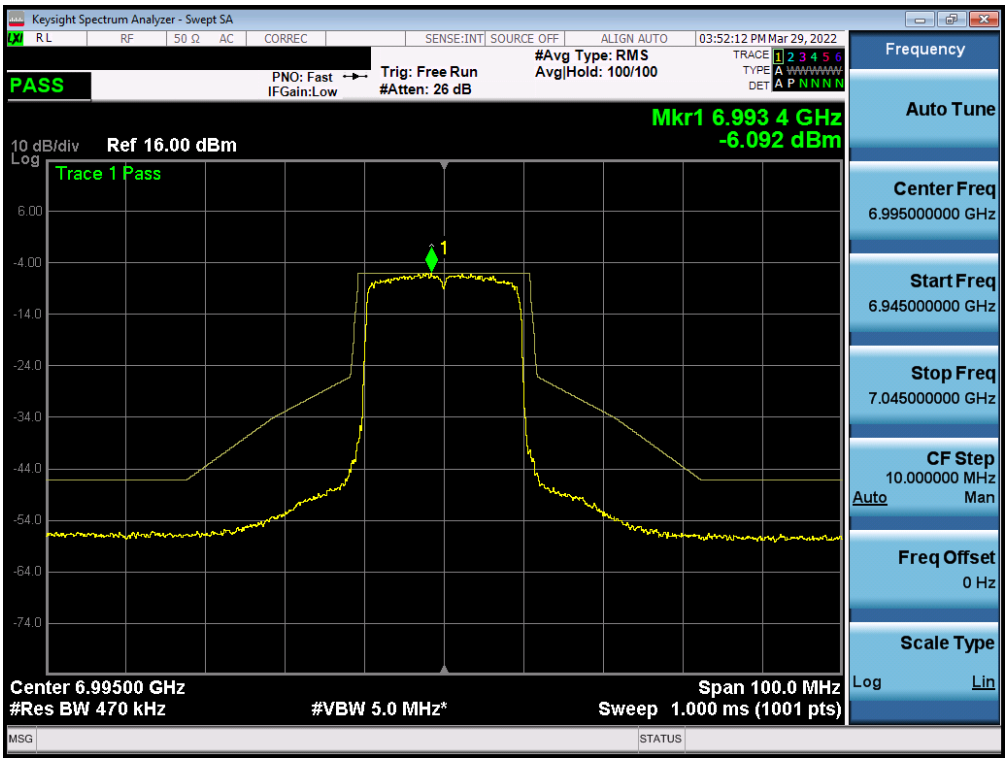
Plot 7-302. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 209)



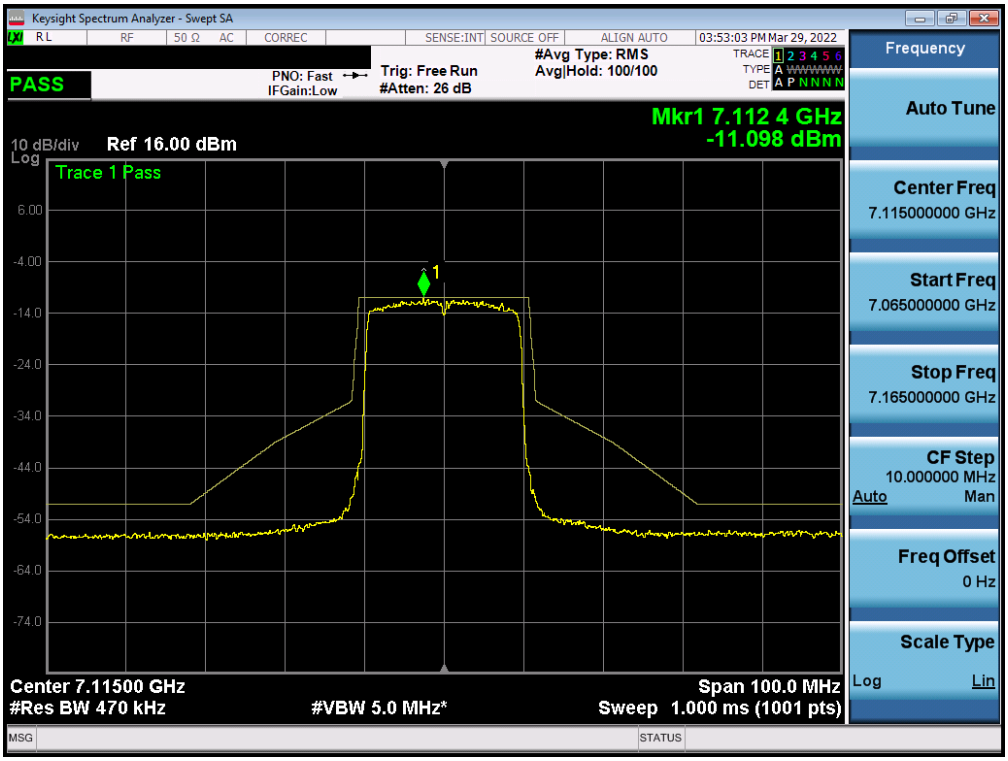
Plot 7-303. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 233)



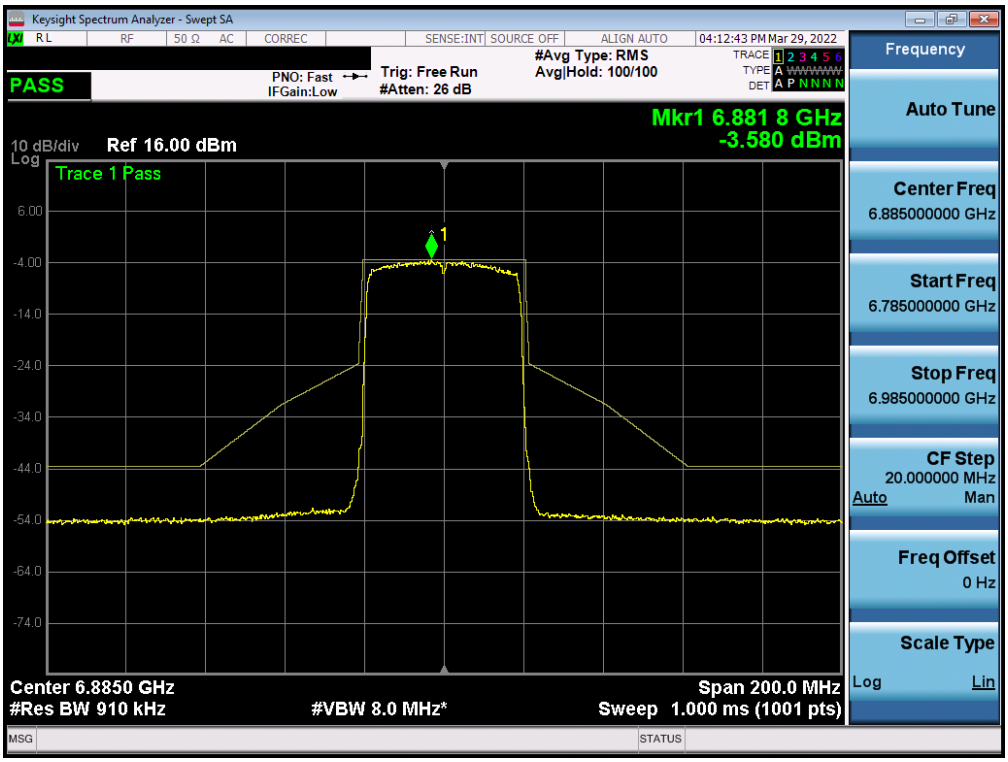
Plot 7-304. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 189)



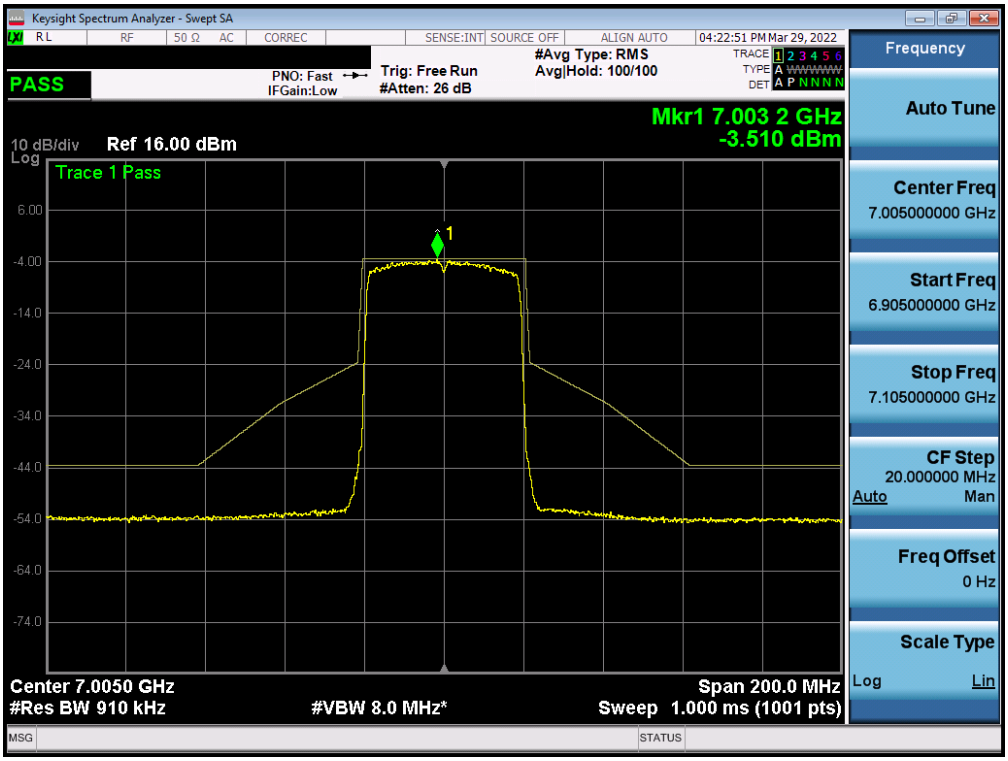
Plot 7-305. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 209)



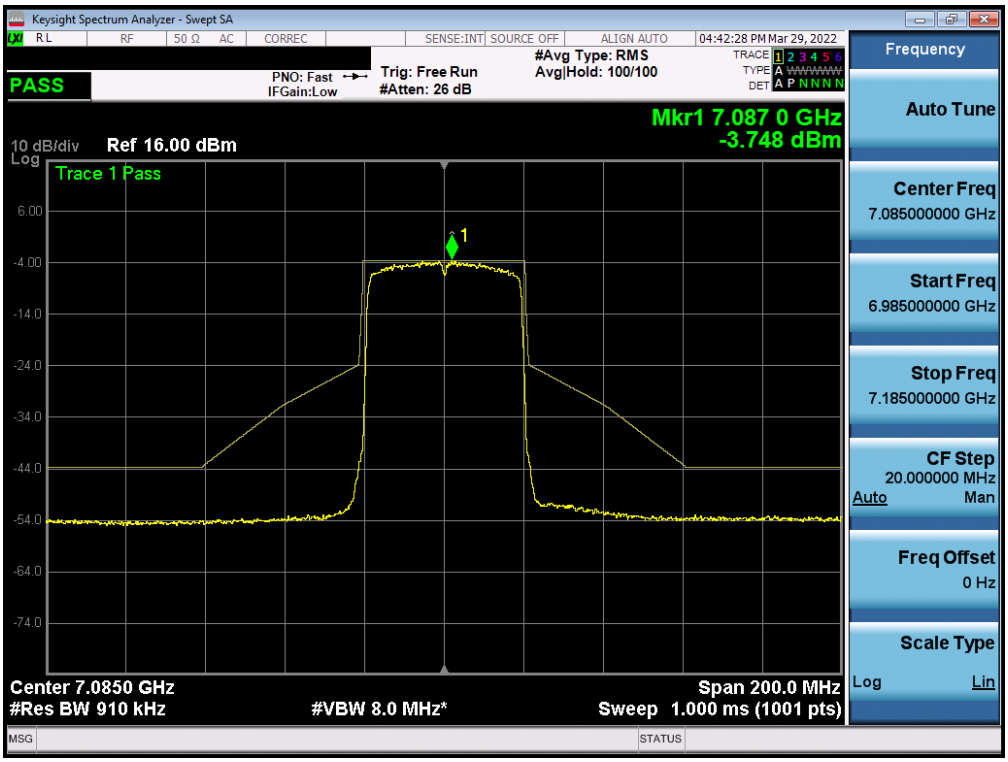
Plot 7-306. In-Band Emission Measurement Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 233)



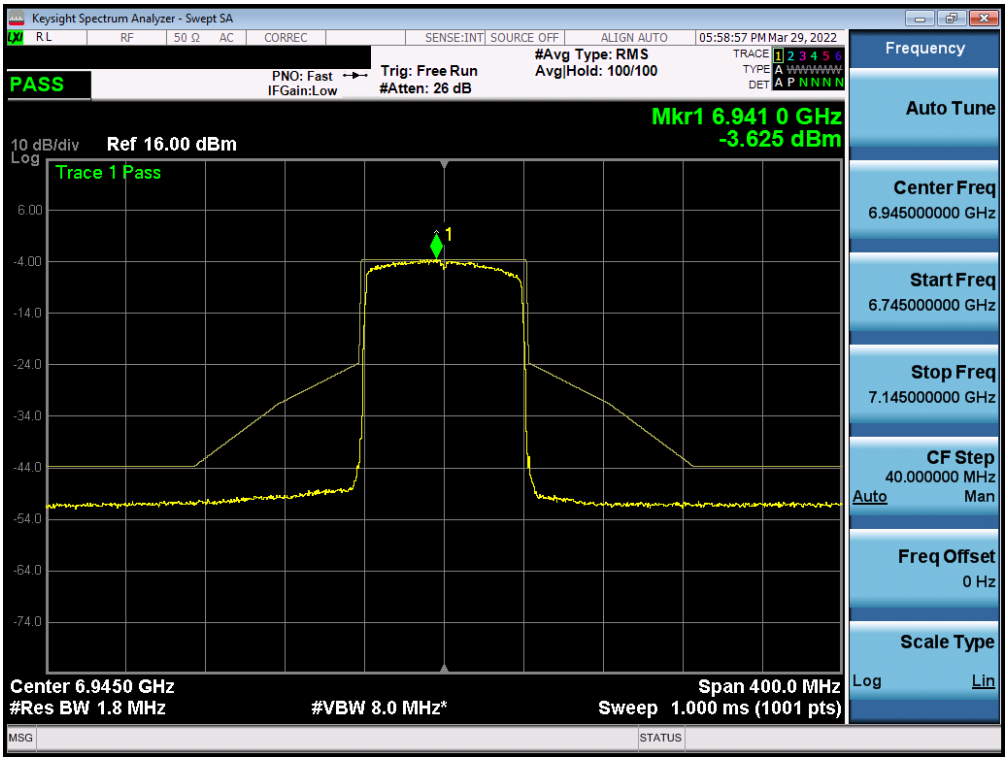
Plot 7-307. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 187)



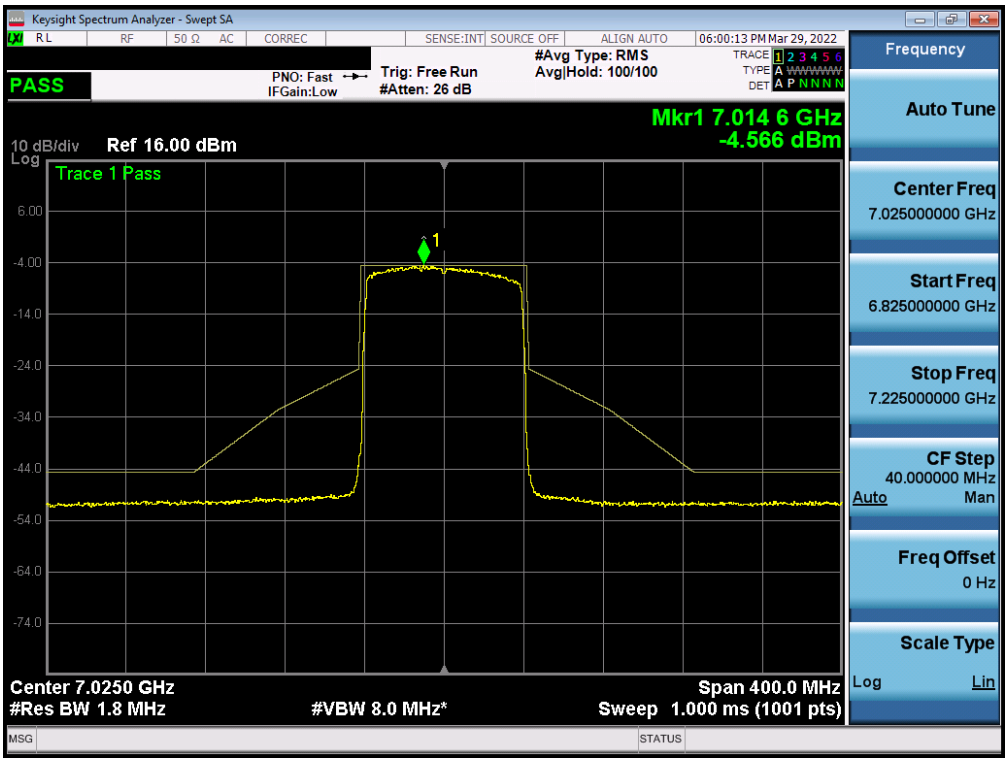
Plot 7-308. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 211)



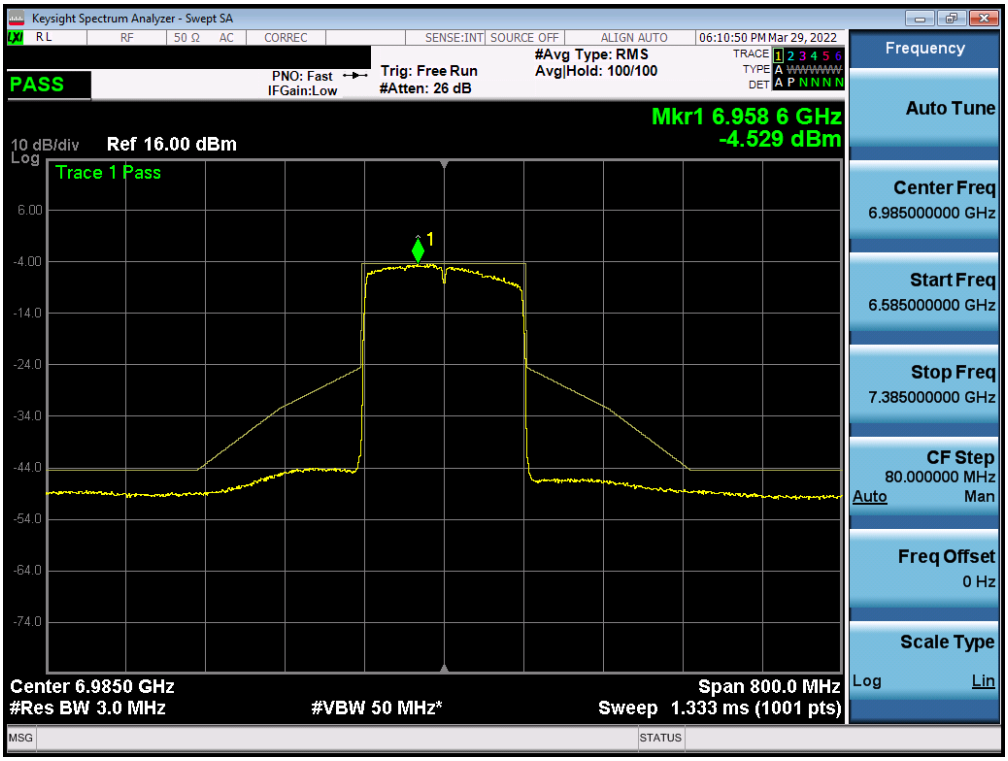
Plot 7-309. In-Band Emission Measurement Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 227)



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



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



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

7.6 Contention Based Protocol – 802.11a/ax

§15.407(d)(6)

Test Overview and Limit

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

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

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

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2
KDB 987594 D02 v01r01
KDB 987594 D04 v01

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 EEUT 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, as shown in Figure 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 to determine number of times the detection threshold testing needs to be repeated. If testing is required more than once, then go back to step 5, choose a different center frequency for the AWGN signal and repeat the process.

Test Setup

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

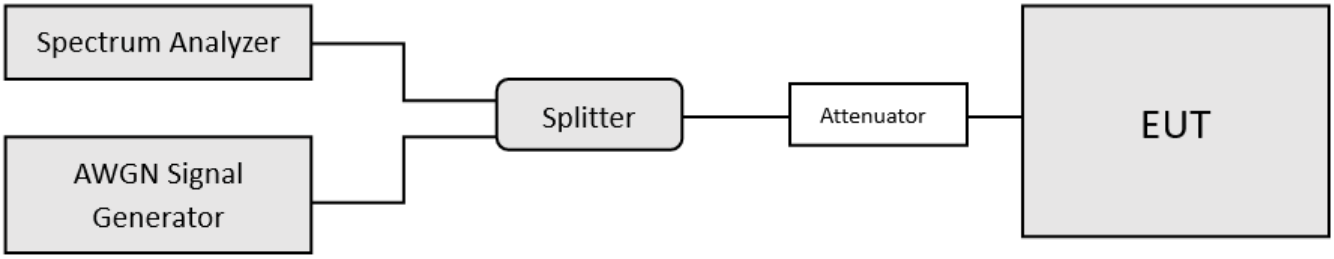


Figure 7-5. Contention-based protocol test setup, conducted method

Test Notes

1. Per guidance from KDB 987594 D02 v01r01, contention based protocol was tested using an AWGN signal with a bandwidth of 10MHz (see Plot 7-313). The amplitude of the signal was increased until detected by the EUT, signaled by the ceasing of transmission (see Plot 7-329), marker indicates the point at which the AWGN signal is introduced.
2. 15 trials were ran in order to assure that at least 90% of certainty was met.
3. Per Guidance from KDB 987594 D04 v01, contention based protocol was tested with receiver with the lowest antenna gain.

	Min. Gain [dBi]
5925 – 6425 MHz	-10.5
6425 – 6525 MHz	-12.0
6525 – 6875 MHz	-12.4
6875 – 7125 MHz	-11.7

Table 7-8. Antenna Lowest Gain

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

Equation 7-1. Detection Level Calculation

Band	Channel	Channel Freq [MHz]	Channel BW [MHz]	Incumbent Freq [MHz]	Injected (AWGN) [dBm]	Antenna Gain [dBi]	Path Loss (dB)	Adjusted Power Level [dBm]	Detection Limit [dBm]	Margin [dB]
UNII Band 5	53	6215	20	6215	-74.12	-10.50	0.49	-63.13	-62.0	-1.13
	47	6185	160	6110	-74.60	-10.50	0.46	-63.64	-62.0	-1.64
				6185	-74.18	-10.50	0.48	-63.20	-62.0	-1.20
				6260	-74.64	-10.50	0.50	-63.64	-62.0	-1.64
UNII Band 6	101	6455	20	6455	-76.33	-12.00	0.54	-63.79	-62.0	-1.79
	111	6505	160	6430	-76.20	-12.00	0.53	-63.67	-62.0	-1.67
				6505	-75.60	-12.00	0.55	-63.05	-62.0	-1.05
				6580	-75.58	-12.00	0.57	-63.01	-62.0	-1.01
UNII Band 7	149	6695	20	6695	-76.07	-12.40	0.59	-63.08	-62.0	-1.08
	175	6825	160	6750	-76.03	-12.40	0.60	-63.03	-62.0	-1.03
				6825	-76.25	-12.40	0.62	-63.23	-62.0	-1.23
				6900	-76.22	-12.40	0.63	-63.19	-62.0	-1.19
UNII Band 8	197	6935	20	6935	-75.79	-11.70	0.64	-63.45	-62.0	-1.45
	207	6985	160	6910	-75.80	-11.70	0.64	-63.46	-62.0	-1.46
				6985	-75.38	-11.70	0.65	-63.03	-62.0	-1.03
				7060	-75.39	-11.70	0.66	-63.03	-62.0	-1.03

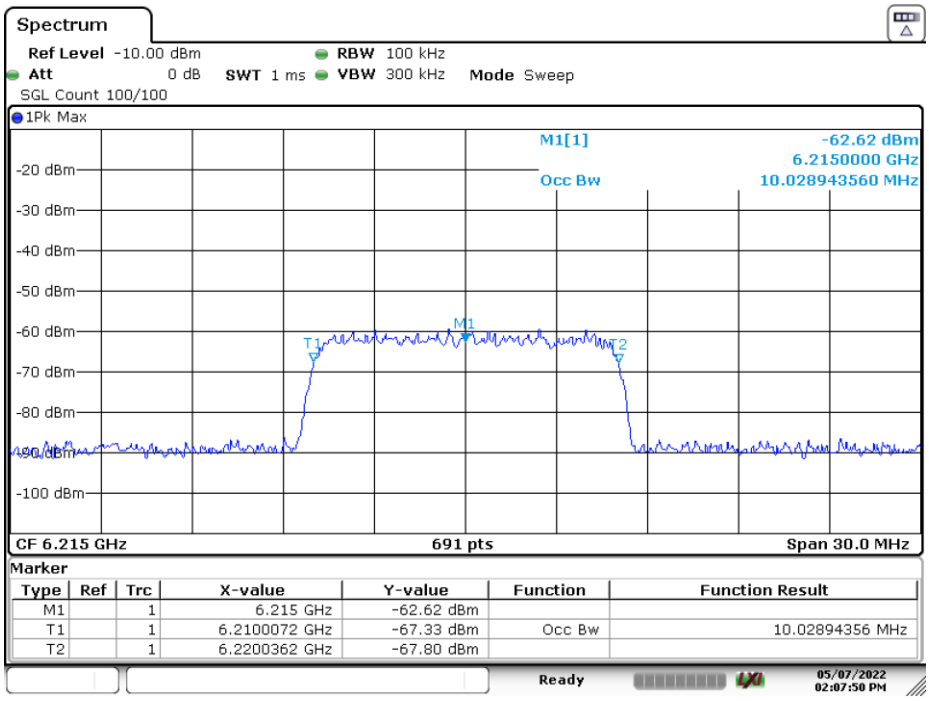
Table 7-9. Contention Based Protocol – Incumbent Detection Results

Band	Channel	Channel Freq [MHz]	Channel BW [MHz]	Incumbent Freq [MHz]	EUT Transmission Status		
					Adjusted AWGN Power (dBm)		
					Normal	Minimal	Ceased
UNII Band 5	53	6215	20	6215	-79.62	-65.44	-63.13
	47	6185	160	6110	-79.69	-65.98	-63.64
				6185	-79.36	-65.47	-63.20
				6260	-78.99	-65.83	-63.64
UNII Band 6	101	6455	20	6455	-78.88	-65.14	-63.79
	111	6505	160	6430	-78.83	-65.21	-63.67
				6505	-78.79	-65.19	-63.05
				6580	-78.92	-65.39	-63.01
UNII Band 7	149	6695	20	6695	-79.63	-66.01	-63.08
	175	6825	160	6750	-79.48	-65.89	-63.03
				6825	-79.16	-65.57	-63.23
				6900	-79.02	-65.44	-63.19
UNII Band 8	197	6935	20	6935	-78.96	-65.36	-63.45
	207	6985	160	6910	-79.28	-65.69	-63.46
				6985	-79.60	-66.01	-63.03
				7060	-79.48	-65.89	-63.03

Table 7-10. Contention Based Protocol – Detection Results – All Tx Cases

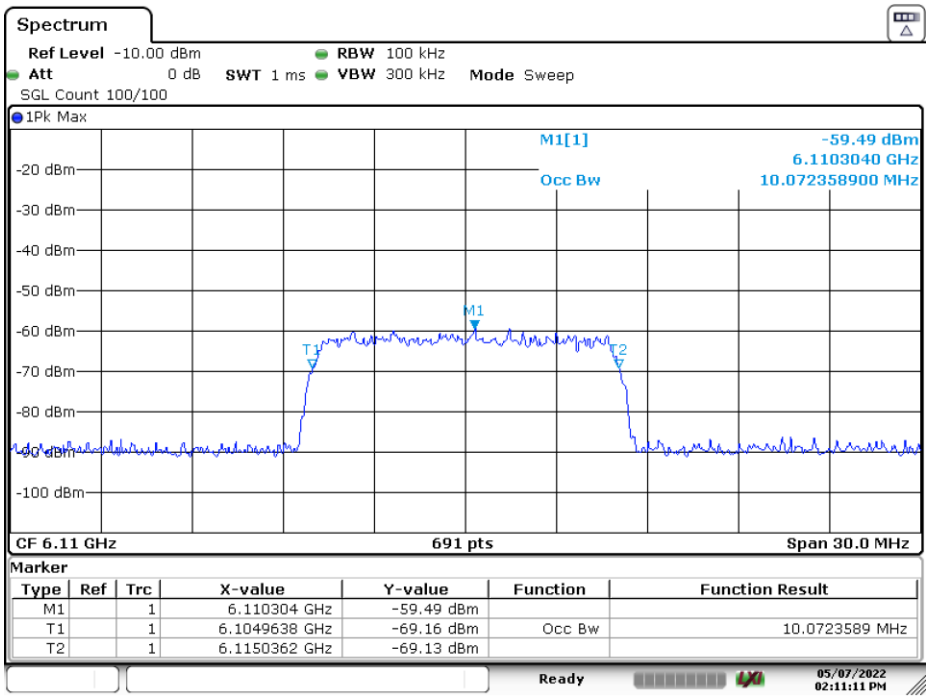
Band	Channel	Channel Freq [MHz]	Channel BW [MHz]	Incumbent Freq [MHz]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Detection Rate (%)
UNII Band 5	53	6215	20	6215	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
	47	6185	160	6110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6185	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6260	1	1	1	1	1	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
	111	6505	160	6430	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6505	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
	175	6825	160	6750	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6825	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
	207	6985	160	6910	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
				6985	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 7-11. Contention Based Protocol – Incumbent Detection Trial Results



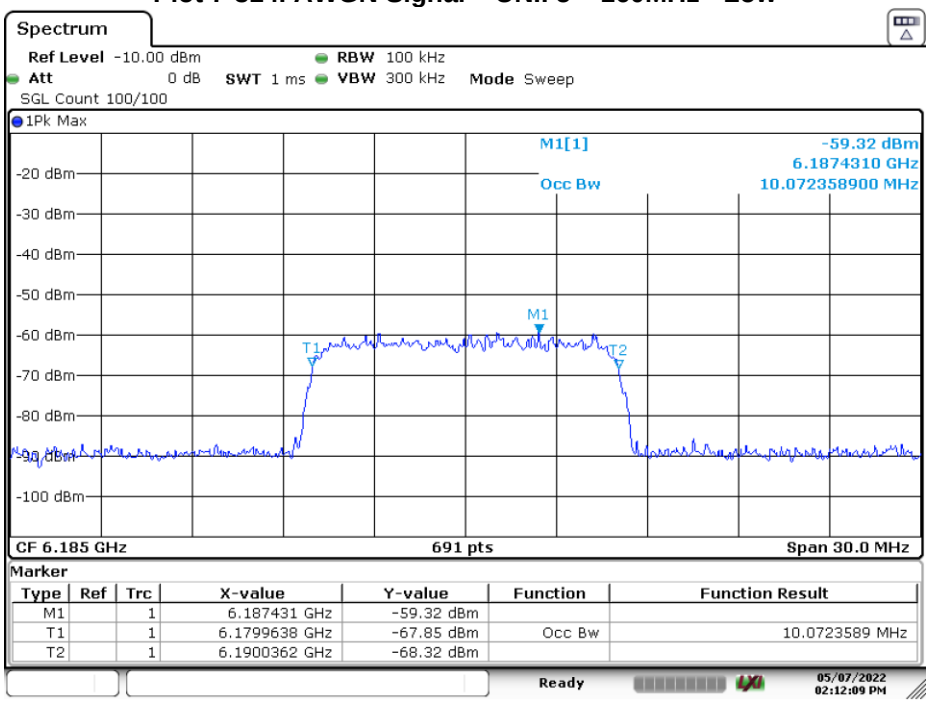
Date: 7.MAY.2022 14:07:50

Plot 7-313. AWGN Signal – UNII 5 – 20MHz



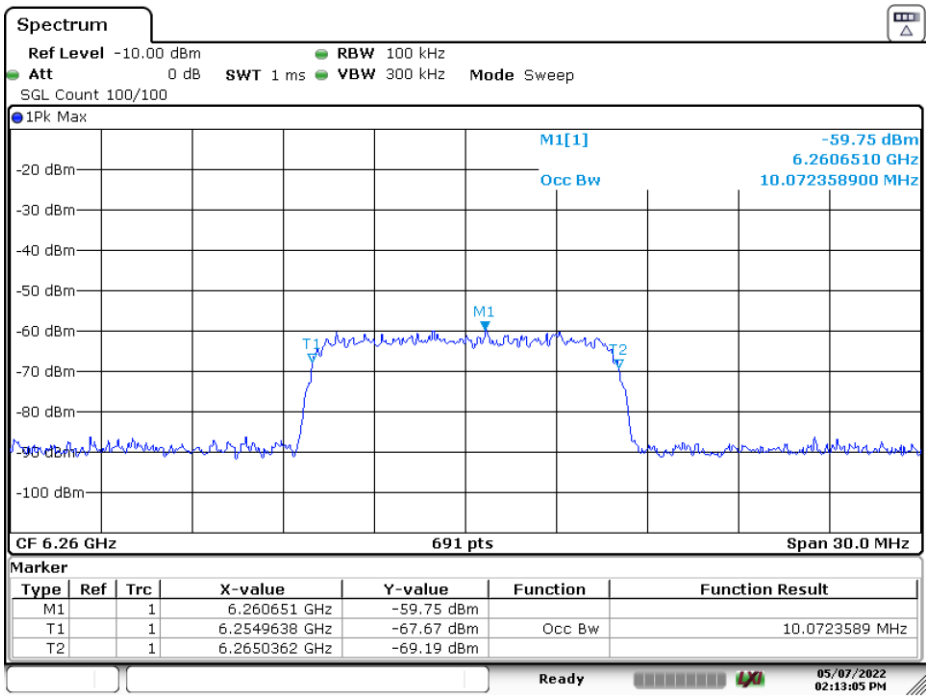
Date: 7.MAY.2022 14:11:11

Plot 7-314. AWGN Signal – UNII 5 – 160MHz - Low



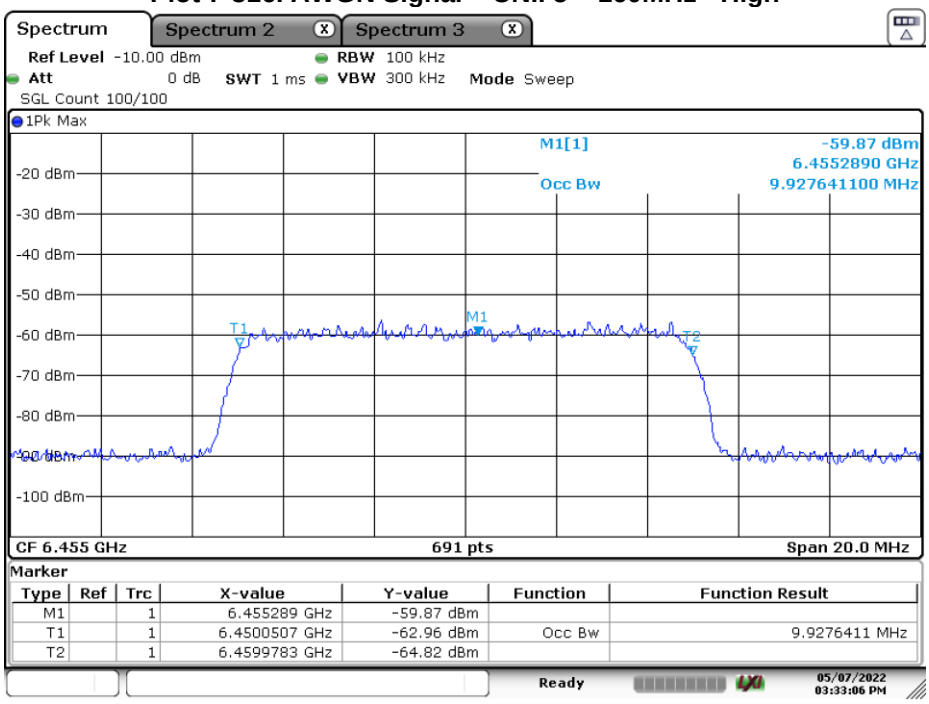
Date: 7.MAY.2022 14:12:09

Plot 7-315. AWGN Signal – UNII 5 – 160MHz - Mid



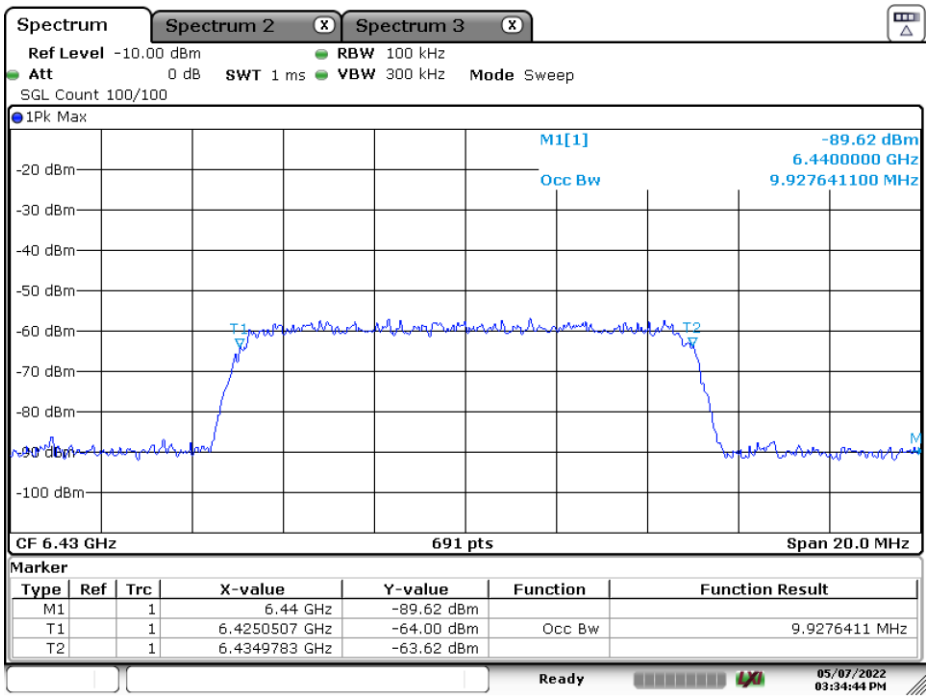
Date: 7.MAY.2022 14:13:05

Plot 7-316. AWGN Signal – UNII 5 – 160MHz - High



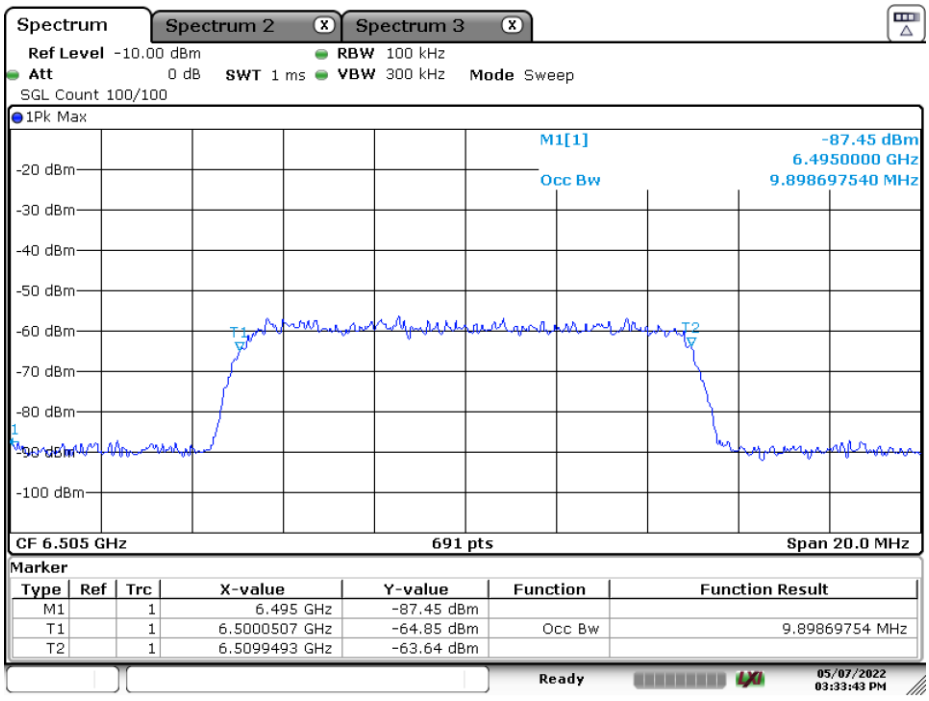
Date: 7.MAY.2022 15:33:06

Plot 7-317. AWGN Signal – UNII 6 – 20MHz



Date: 7.MAY.2022 15:34:43

Plot 7-318. AWGN Signal – UNII 6 – 160MHz - Low



Date: 7.MAY.2022 15:33:43

Plot 7-319. AWGN Signal – UNII 6 – 160MHz - Mid