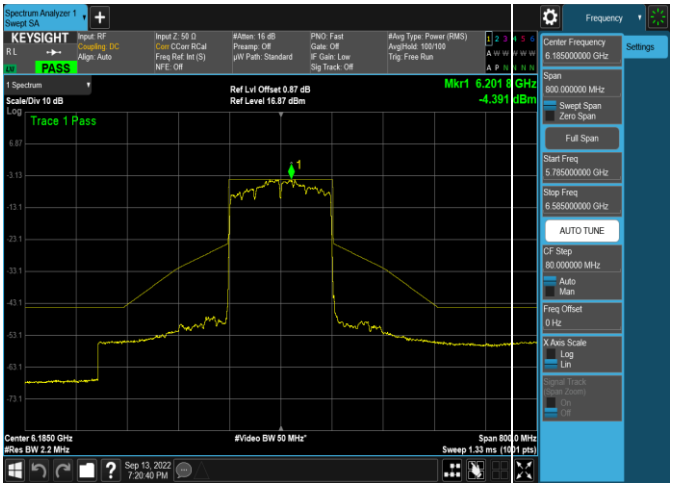
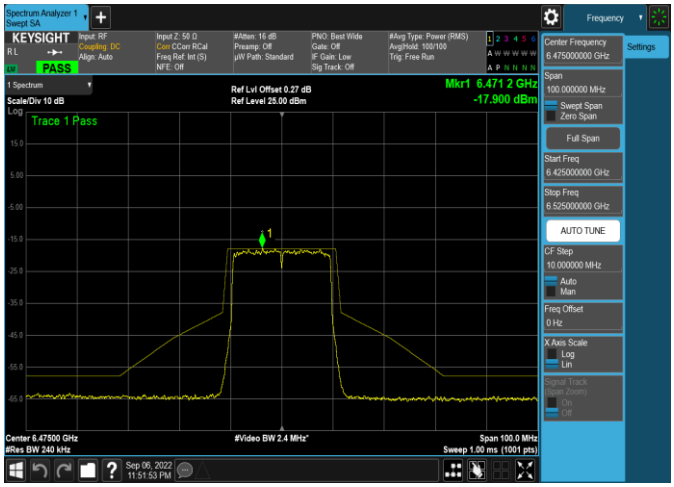
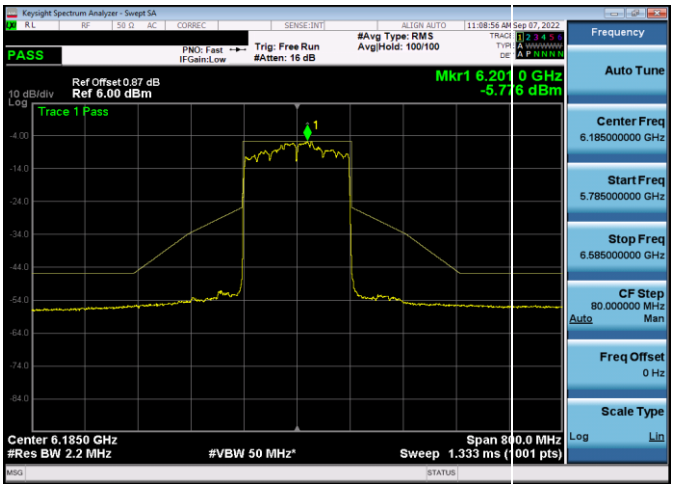


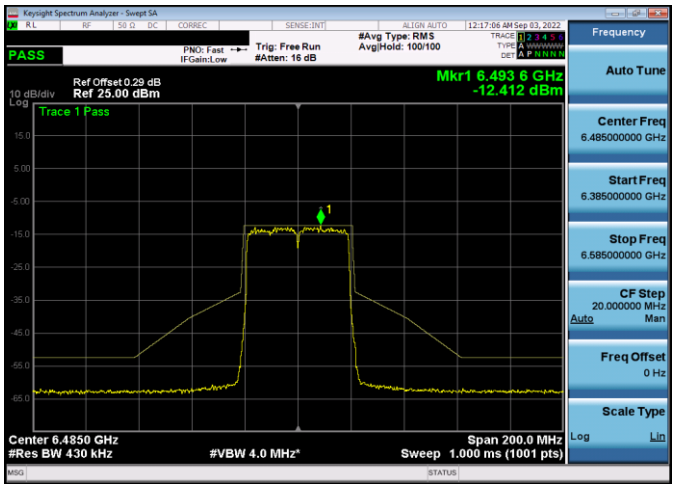
Plot 7-495. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 5) – Ch. 47, MCS4)



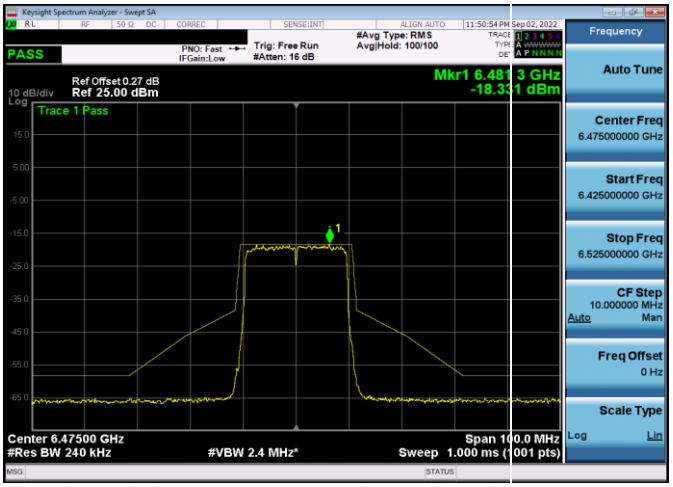
Plot 7-498. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 6) – Ch. 105, MCS4)



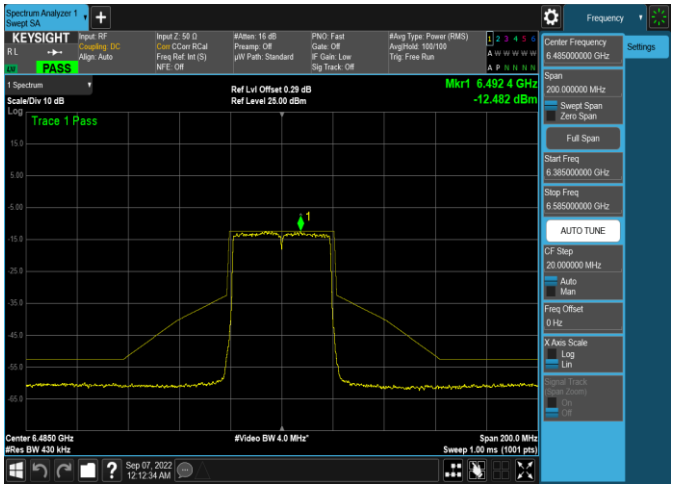
Plot 7-496. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 5) – Ch. 47, MCS4)



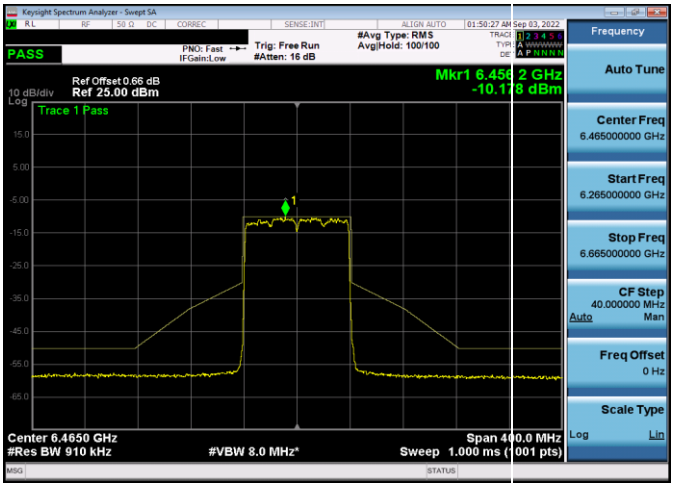
Plot 7-499. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 6) – Ch. 107, MCS4)



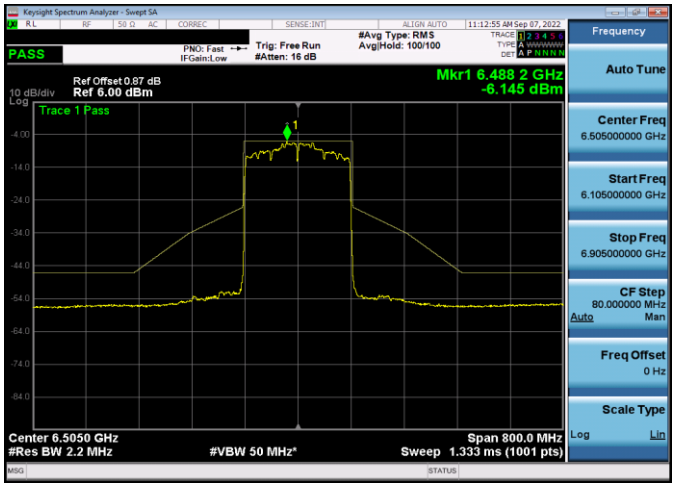
Plot 7-497. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 6) – Ch. 105, MCS4)



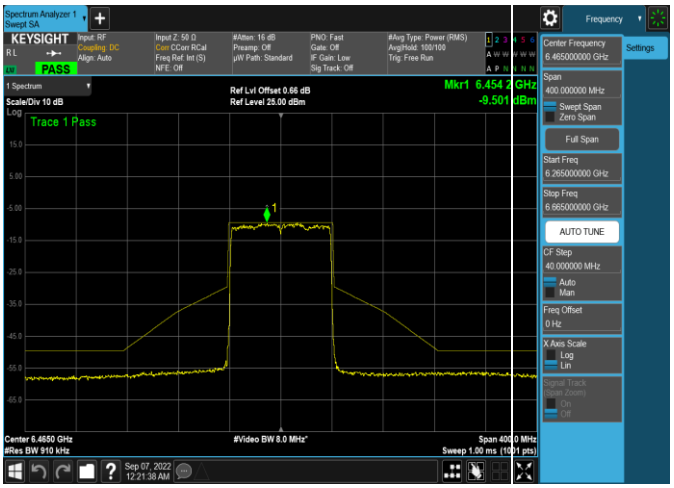
Plot 7-500. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 6) – Ch. 107, MCS4)



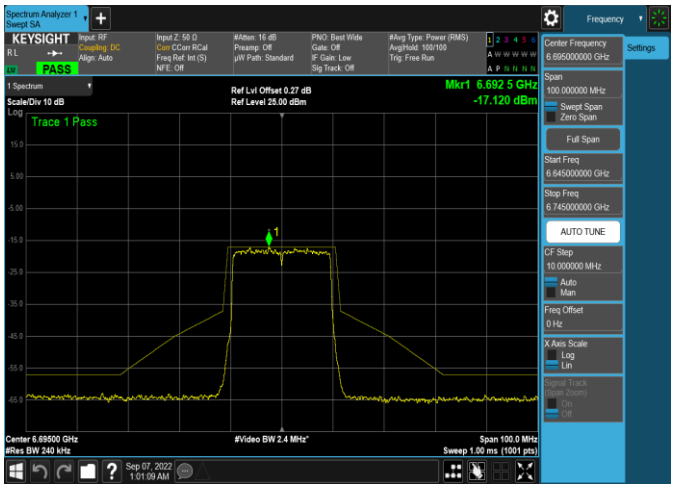
Plot 7-501. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 6) – Ch. 103, MCS4)



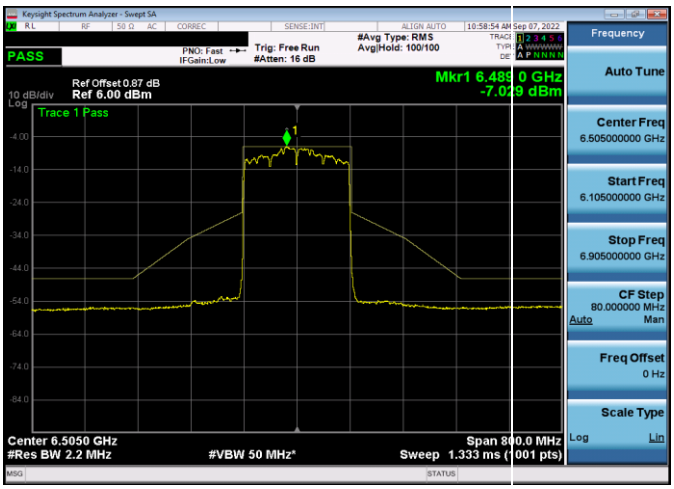
Plot 7-504. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 6) – Ch. 111, MCS4)



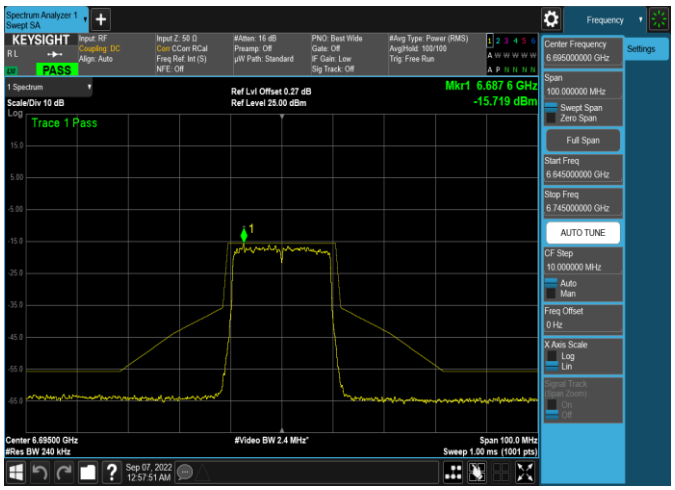
Plot 7-502. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 6) – Ch. 103, MCS4)



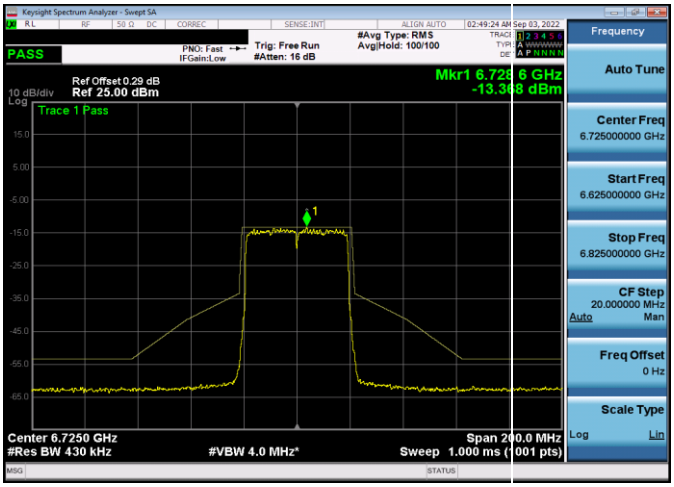
Plot 7-505. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 7) – Ch. 149, MCS4)



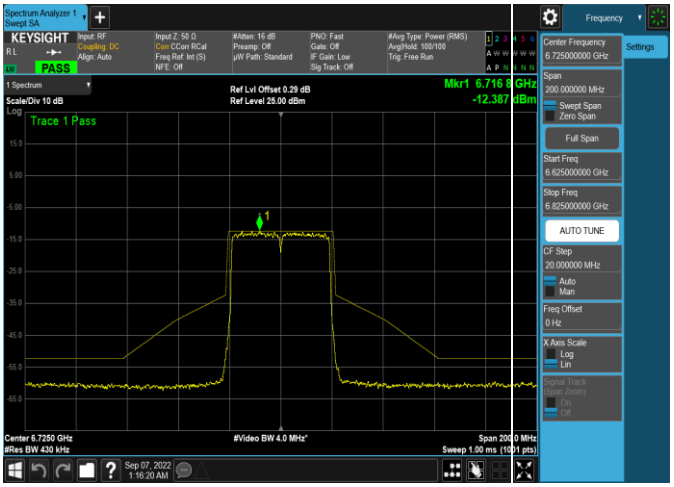
Plot 7-503. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 6) – Ch. 111, MCS4)



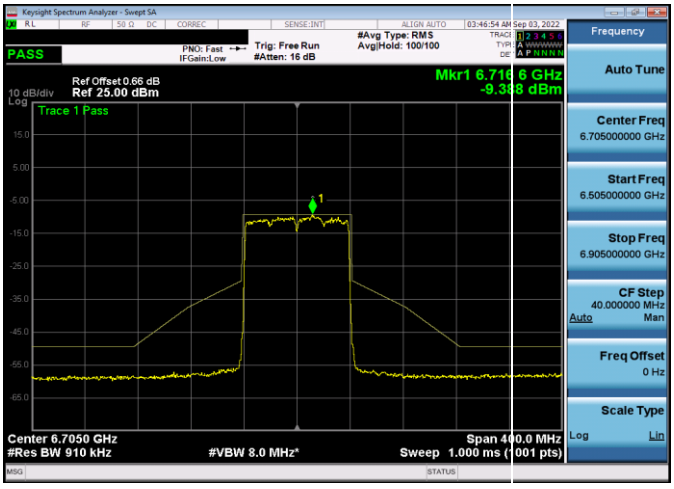
Plot 7-506. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 7) – Ch. 149, MCS4)



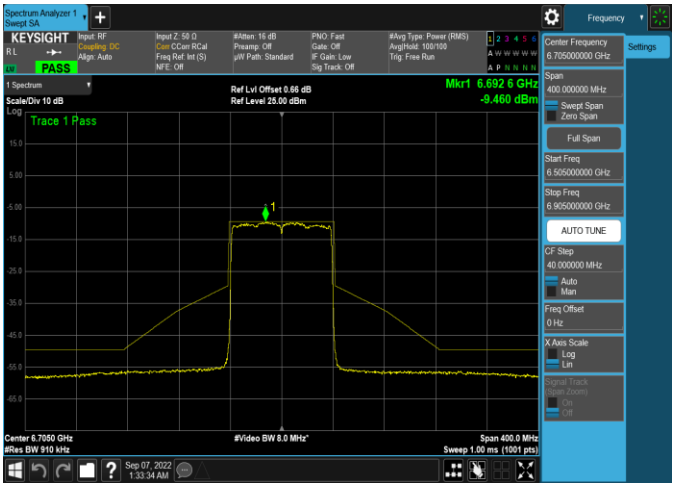
Plot 7-507. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 7) – Ch. 155, MCS4)



Plot 7-508. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 7) – Ch. 155, MCS4)

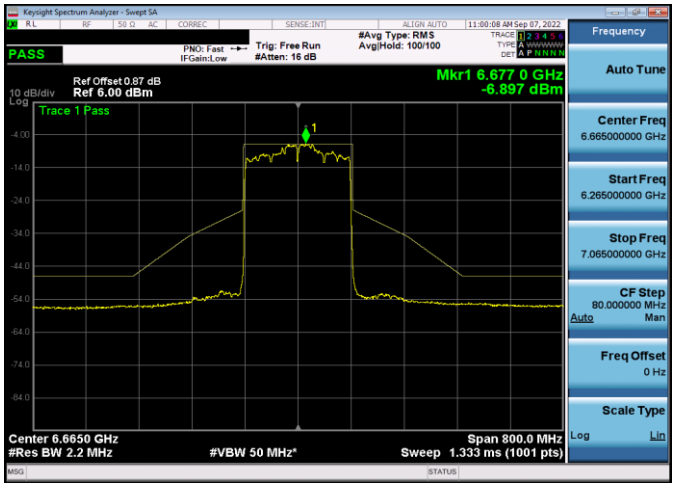


Plot 7-509. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 7) – Ch. 151, MCS4)

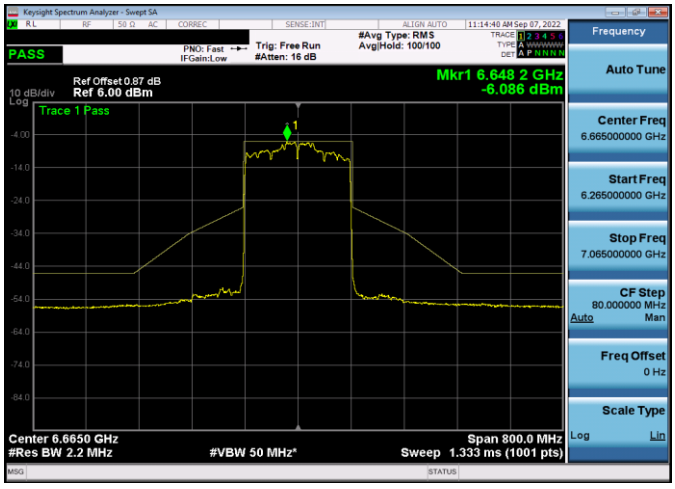


Plot 7-510. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 7) – Ch. 151, MCS4)

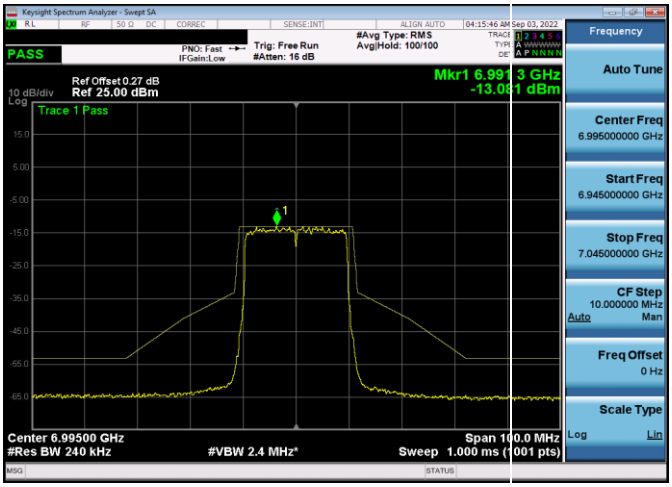
Plot 7-508. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 7) – Ch. 155, MCS4)



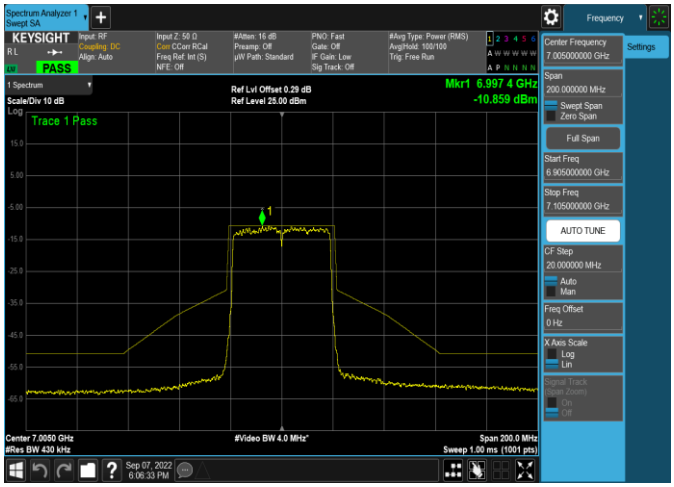
Plot 7-511. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 7) – Ch. 143, MCS4)



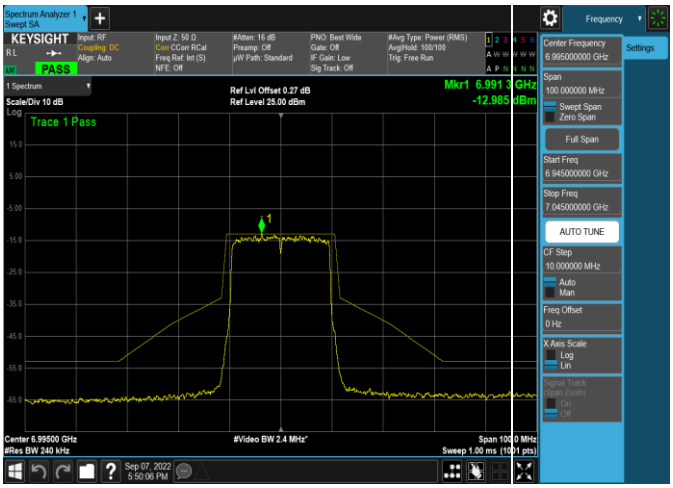
Plot 7-512. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 7) – Ch. 143, MCS4)



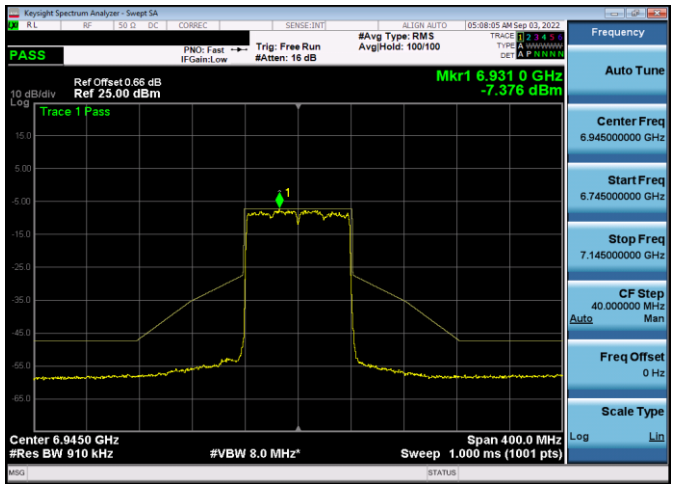
Plot 7-513. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 8) – Ch. 209, MCS4)



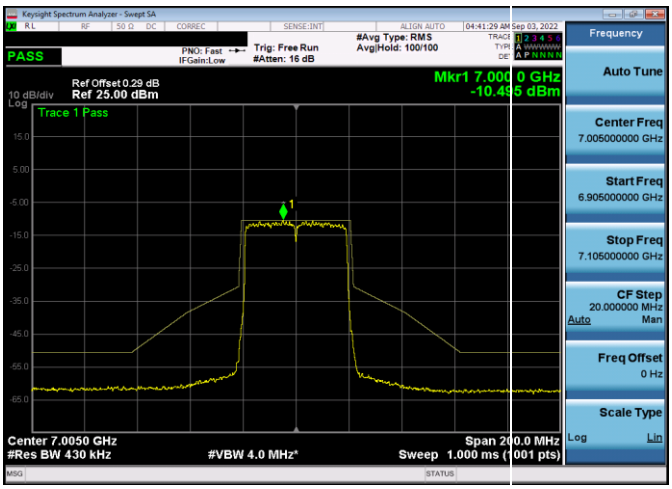
Plot 7-516. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 8) – Ch. 211, MCS4)



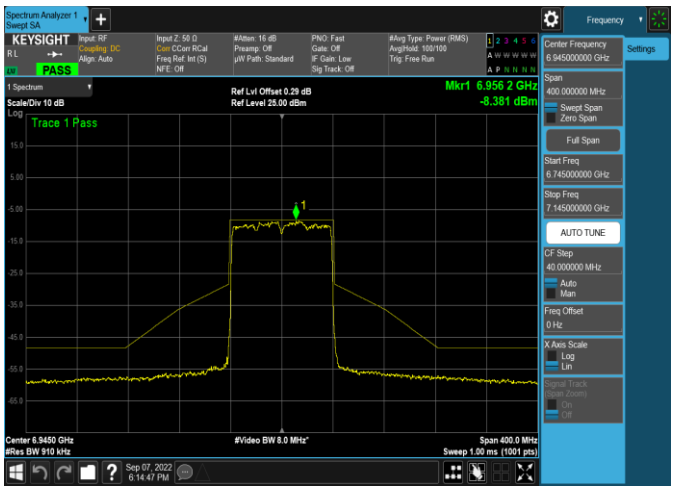
Plot 7-514. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 8) – Ch. 209, MCS4)



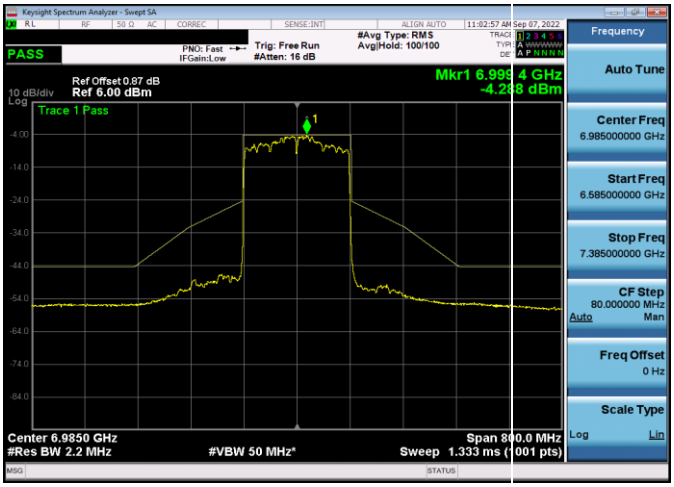
Plot 7-517. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 8) – Ch. 199, MCS4)



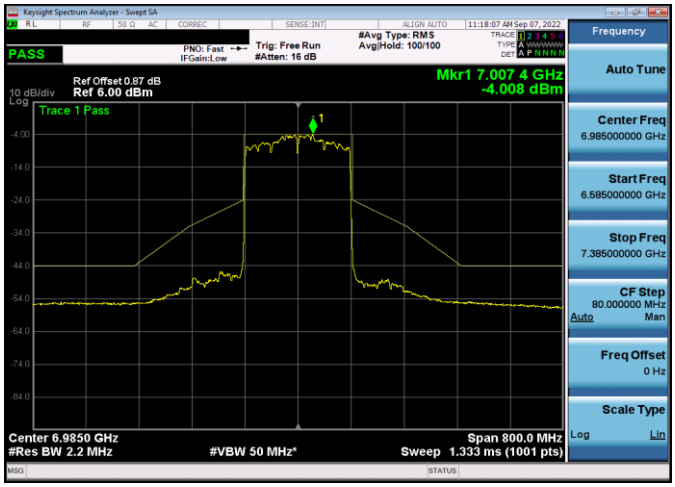
Plot 7-515. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 8) – Ch. 211, MCS4)



Plot 7-518. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 8) – Ch. 199, MCS4)

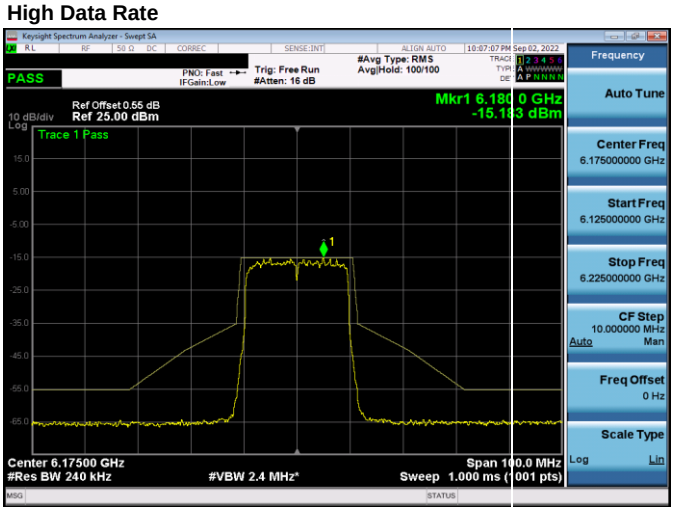


Plot 7-519. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 8) – Ch. 207, MCS4)

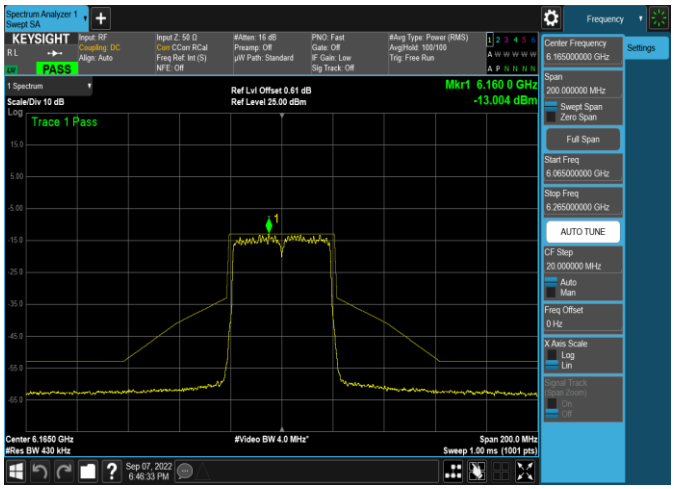


Plot 7-520. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 8) – Ch. 207, MCS4)

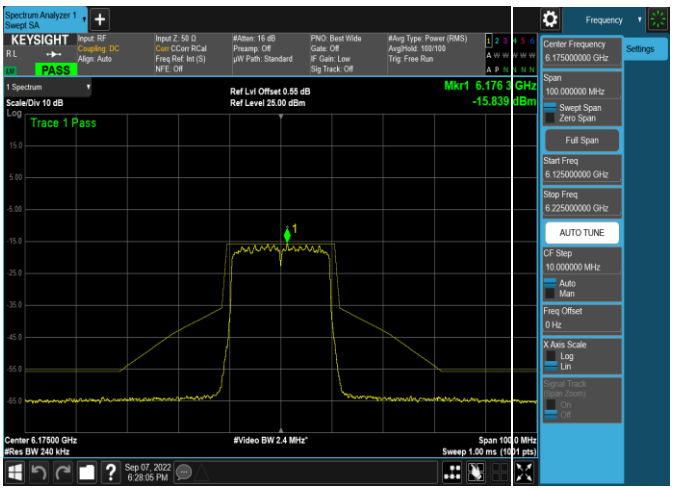
High Data Rate



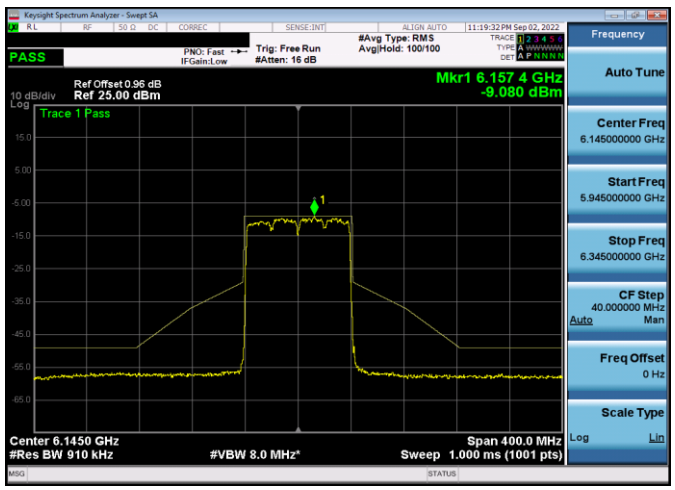
Plot 7-521. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 5) – Ch. 47, MCS11)



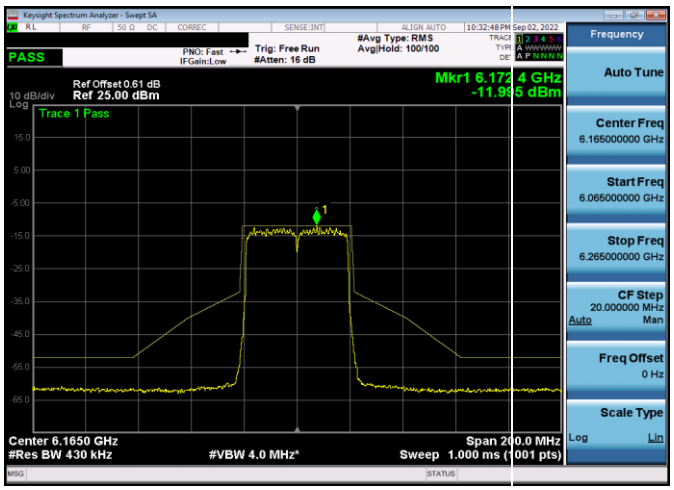
Plot 7-524. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 5) – Ch. 43, MCS11)



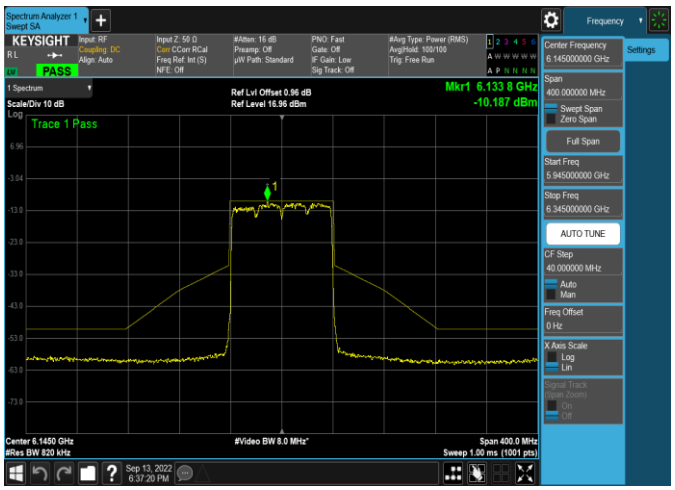
Plot 7-522. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 5) – Ch. 47, MCS11)



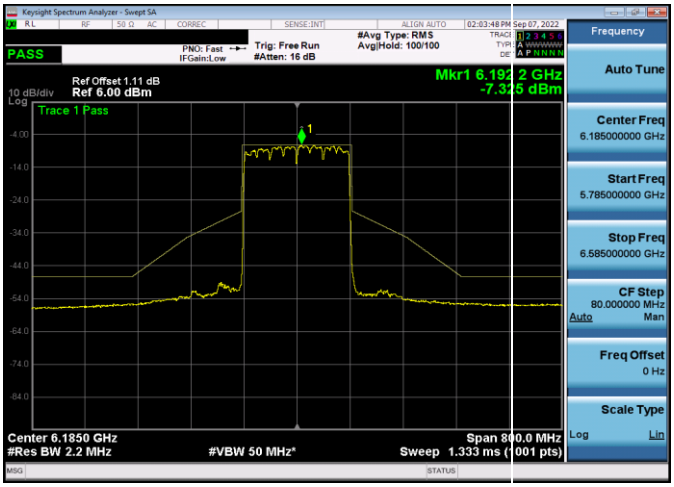
Plot 7-525. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 5) – Ch. 39, MCS11)



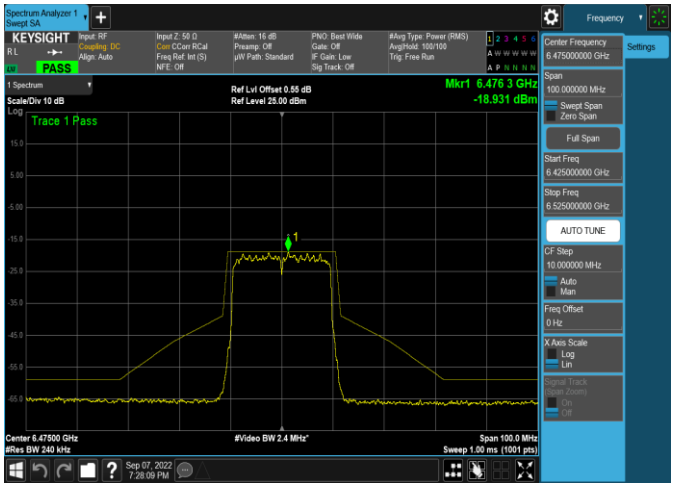
Plot 7-523. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 5) – Ch. 43, MCS11)



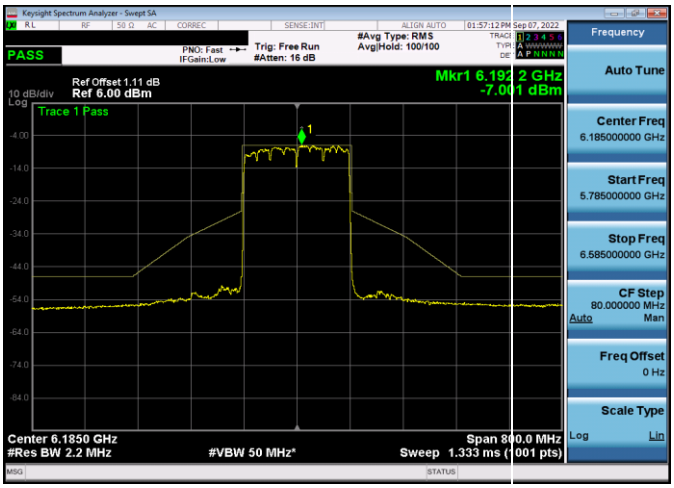
Plot 7-526. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 5) – Ch. 39, MCS11)



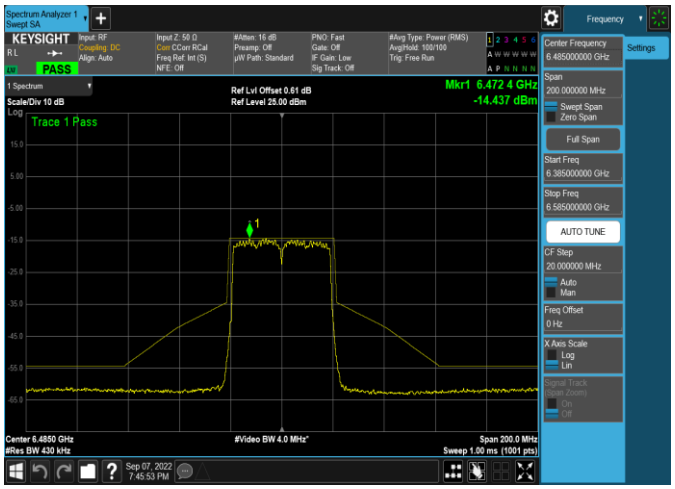
Plot 7-527. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 5) – Ch. 47, MCS11)



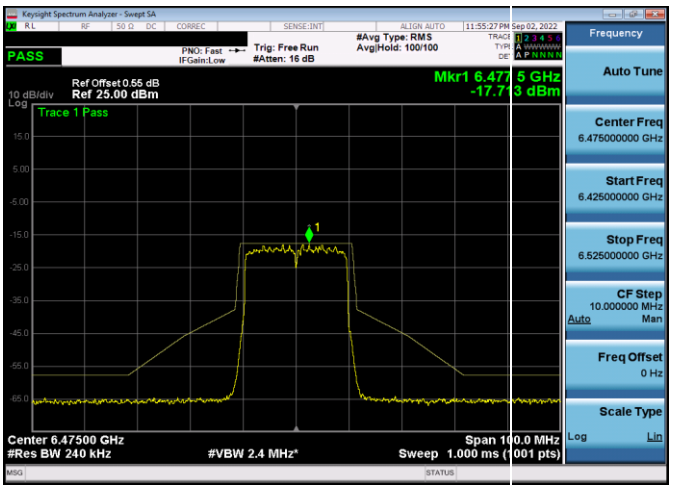
Plot 7-530. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 6) – Ch. 105, MCS11)



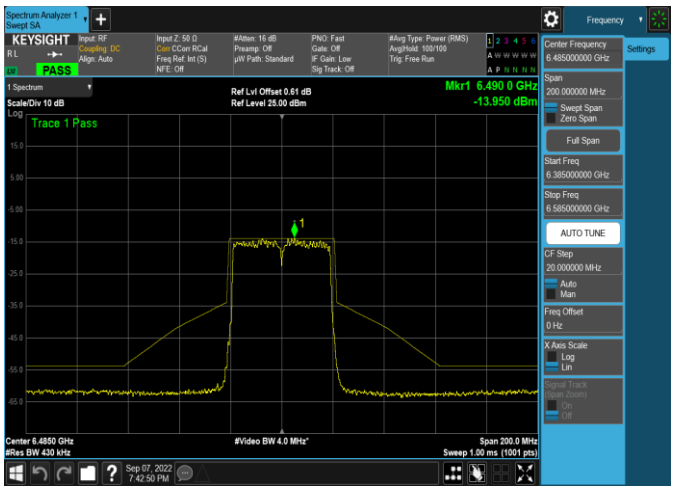
Plot 7-528. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 5) – Ch. 47, MCS11)



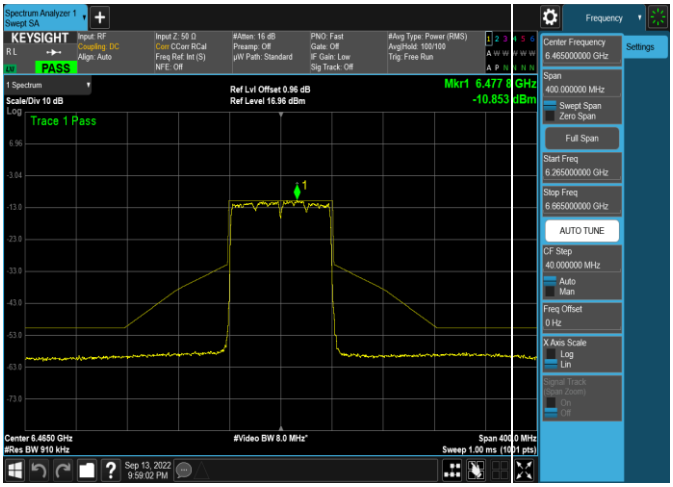
Plot 7-531. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 6) – Ch. 107, MCS11)



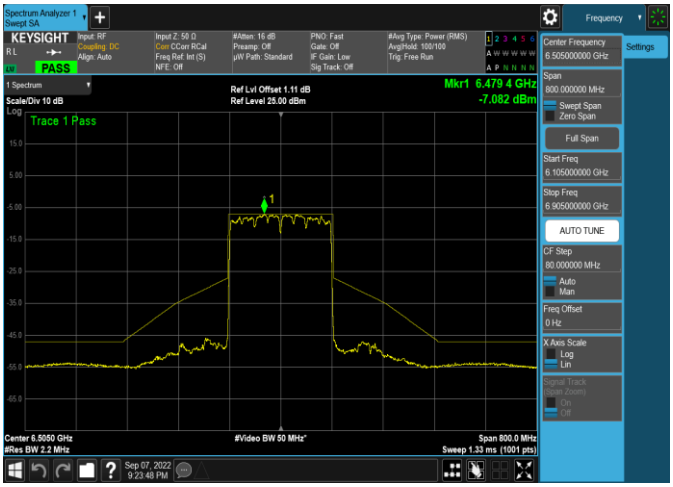
Plot 7-529. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 6) – Ch. 105, MCS11)



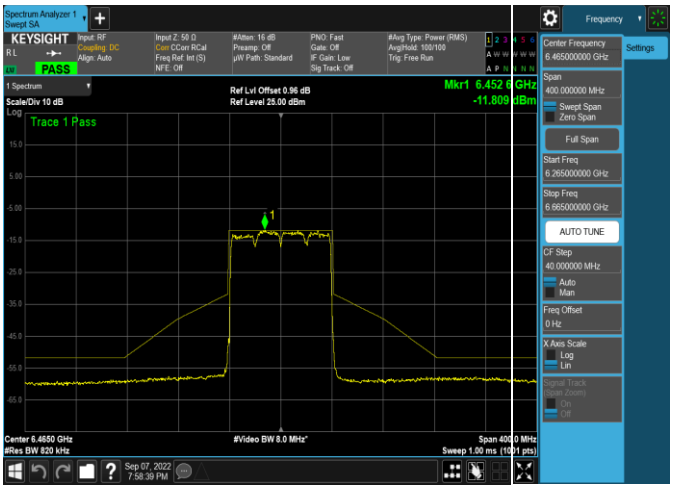
Plot 7-532. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 6) – Ch. 107, MCS11)



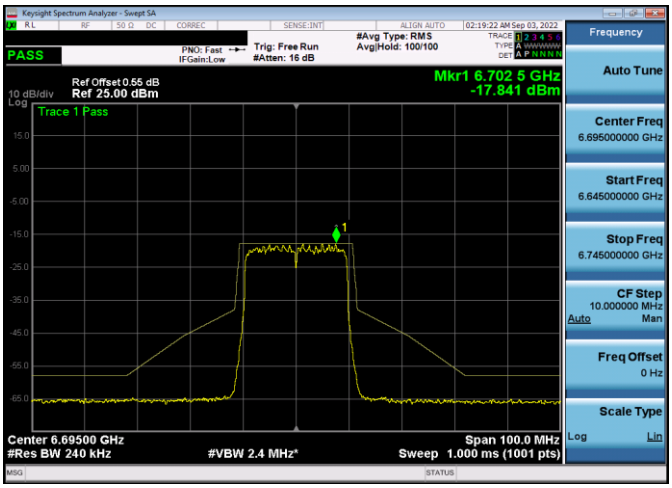
Plot 7-533. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 6) – Ch. 103, MCS11)



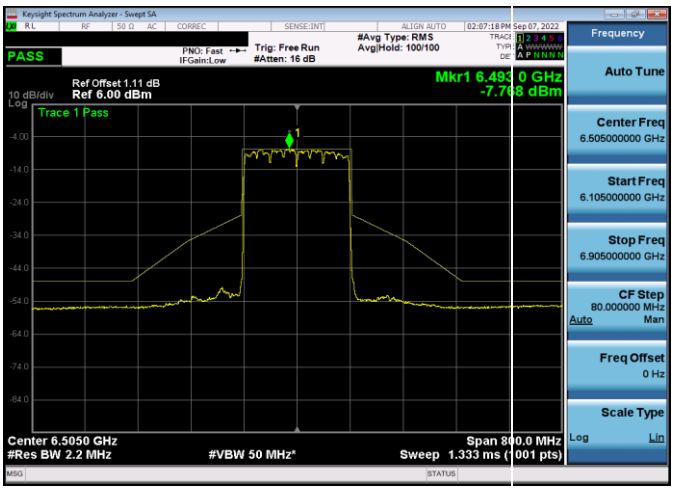
Plot 7-536. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 6) – Ch. 111, MCS11)



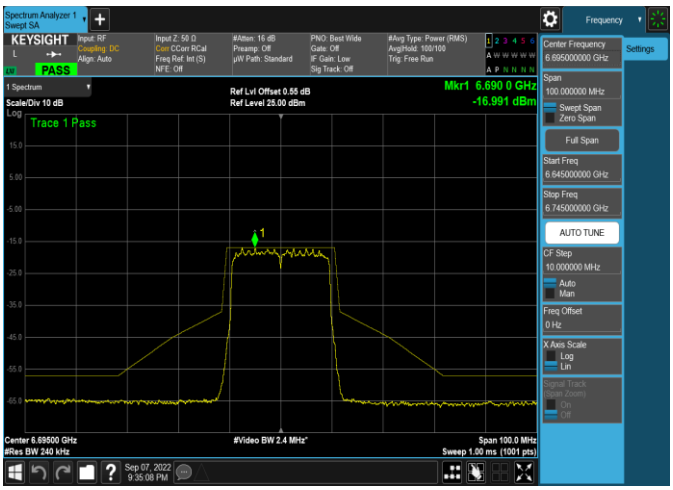
Plot 7-534. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 6) – Ch. 103, MCS11)



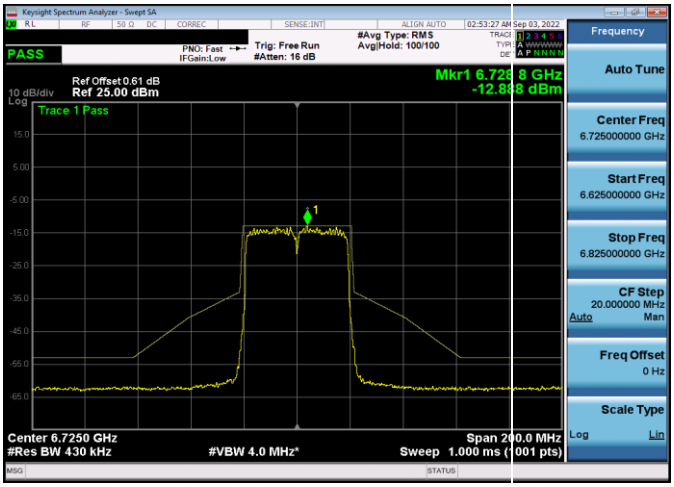
Plot 7-537. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 7) – Ch. 149, MCS11)



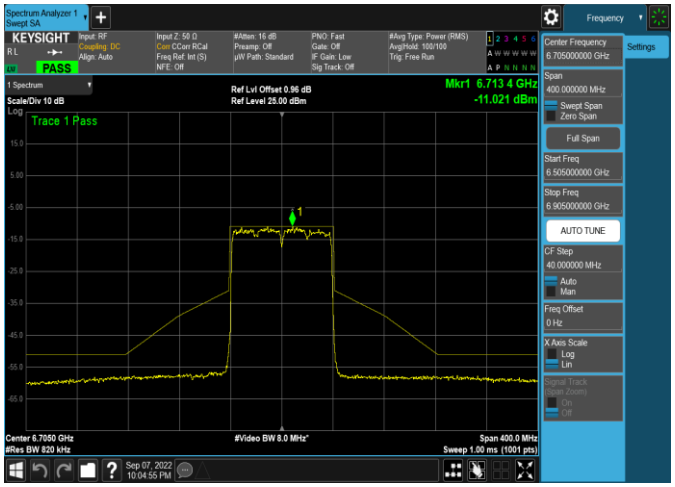
Plot 7-535. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 6) – Ch. 111, MCS11)



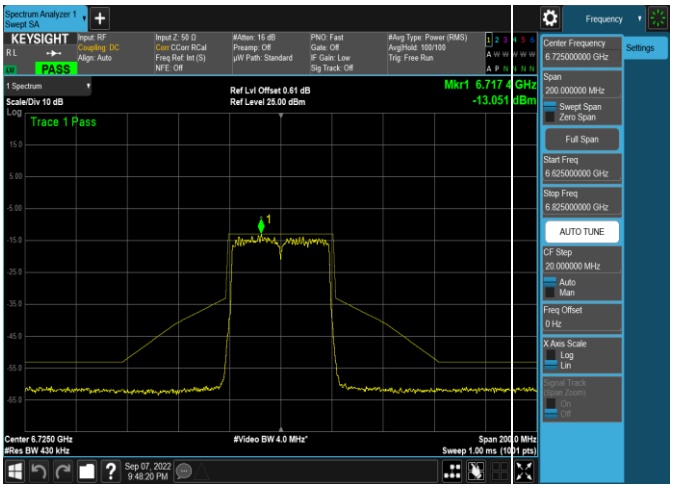
Plot 7-538. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 7) – Ch. 149, MCS11)



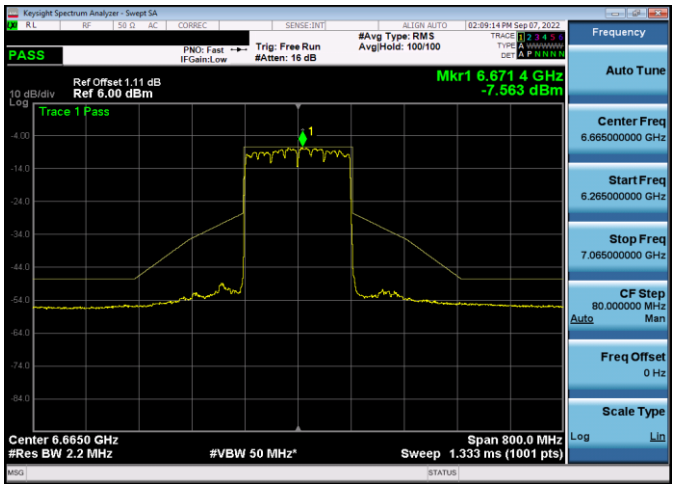
Plot 7-539. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 7) – Ch. 155, MCS11)



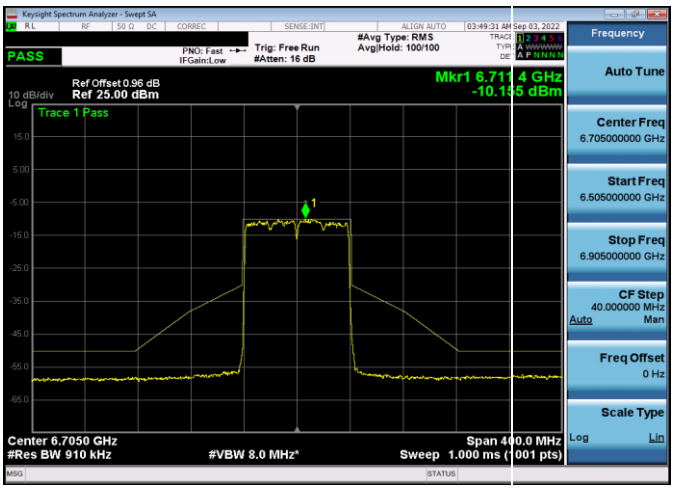
Plot 7-542. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 7) – Ch. 151, MCS11)



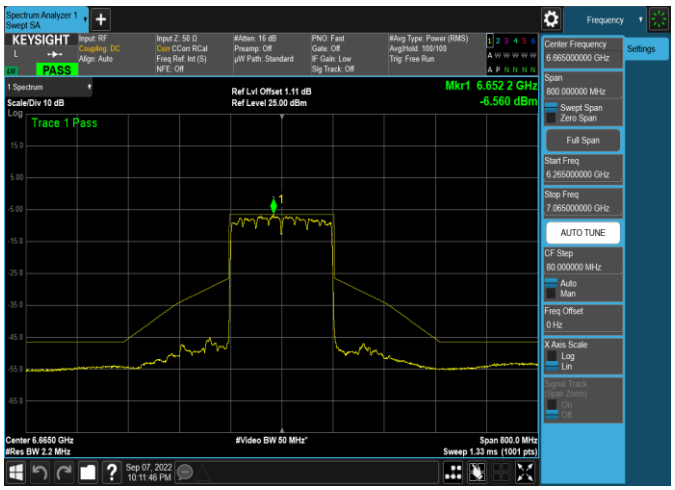
Plot 7-540. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 7) – Ch. 155, MCS11)



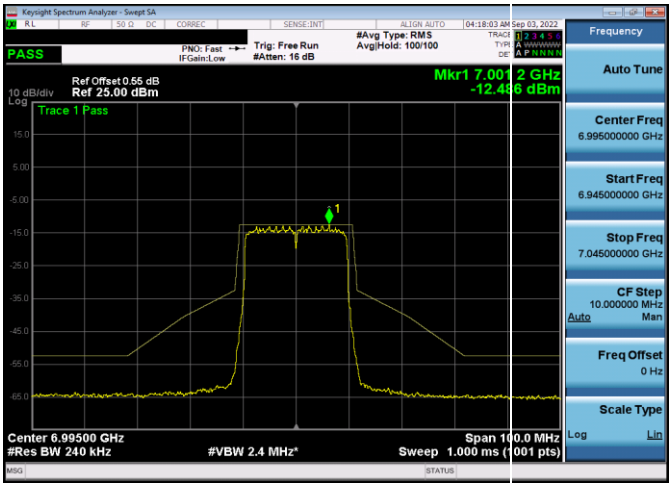
Plot 7-543. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 7) – Ch. 143, MCS11)



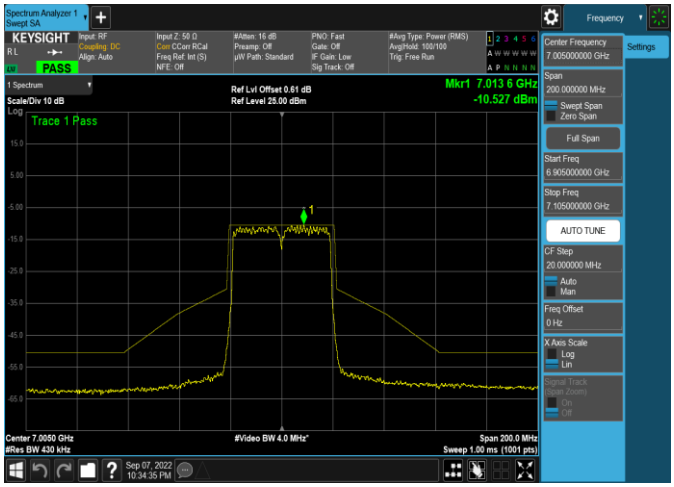
Plot 7-541. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 7) – Ch. 151, MCS11)



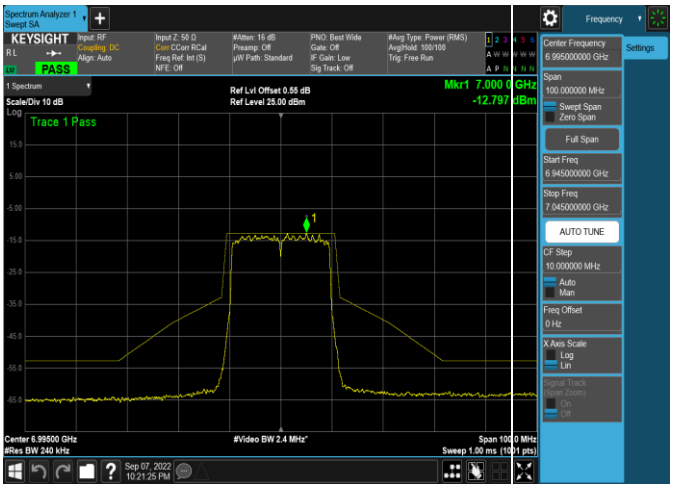
Plot 7-544. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 7) – Ch. 143, MCS11)



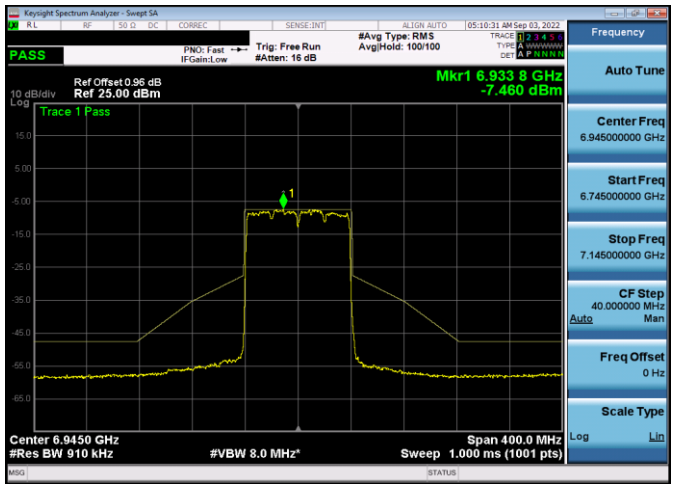
Plot 7-545. In-Band Emission Plot SDM Antenna WF5t (20MHz 802.11ax (UNII Band 8) – Ch. 209, MCS11)



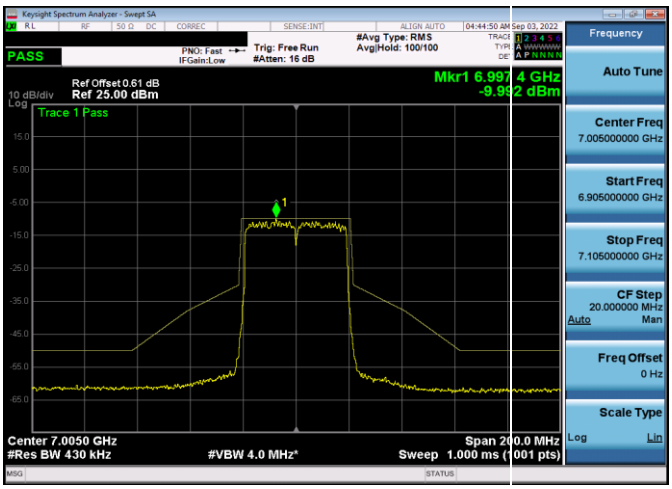
Plot 7-548. In-Band Emission Plot SDM Antenna WF5b (40MHz 802.11ax (UNII Band 8) – Ch. 211, MCS11)



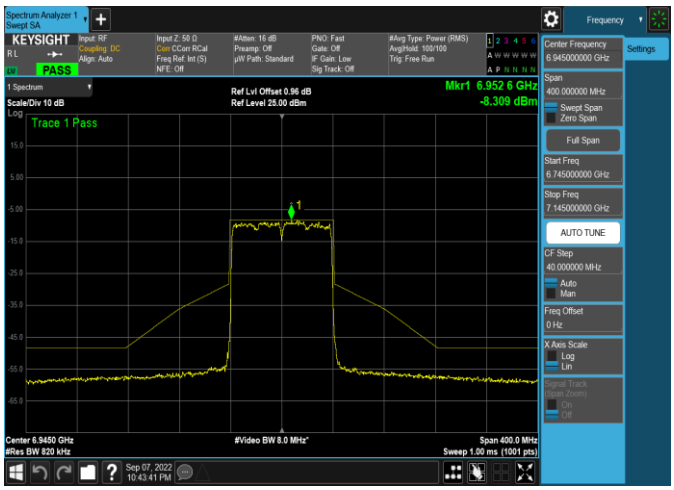
Plot 7-546. In-Band Emission Plot SDM Antenna WF5b (20MHz 802.11ax (UNII Band 8) – Ch. 209, MCS11)



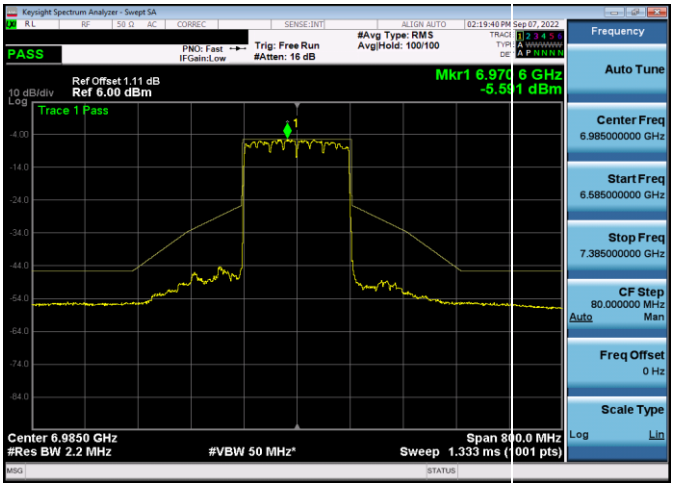
Plot 7-549. In-Band Emission Plot SDM Antenna WF5t (80MHz 802.11ax (UNII Band 8) – Ch. 199, MCS11)



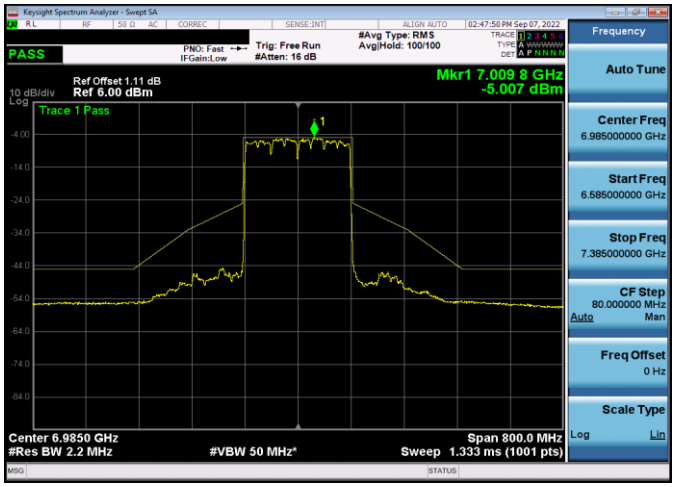
Plot 7-547. In-Band Emission Plot SDM Antenna WF5t (40MHz 802.11ax (UNII Band 8) – Ch. 211, MCS11)



Plot 7-550. In-Band Emission Plot SDM Antenna WF5b (80MHz 802.11ax (UNII Band 8) – Ch. 199, MCS11)



Plot 7-551. In-Band Emission Plot SDM Antenna WF5t (160MHz 802.11ax (UNII Band 8) – Ch. 207, MCS11)



Plot 7-552. In-Band Emission Plot SDM Antenna WF5b (160MHz 802.11ax (UNII Band 8) – Ch. 207, MCS11)

7.6 Contention Based Protocol – 802.11a/ax(SU)

§15.407(d)(6), RSS-248 [4.8]

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

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.
4. 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.
5. Monitoring the signal analyzer 2, verify the EUT is operating and transmitting with the parameters set at step two.
6. 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.
7. 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.
8. Transmit the AWGN signal (RF ON) and verify its characteristics on the signal analyzer 1.
9. 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.
10. 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.
11. 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

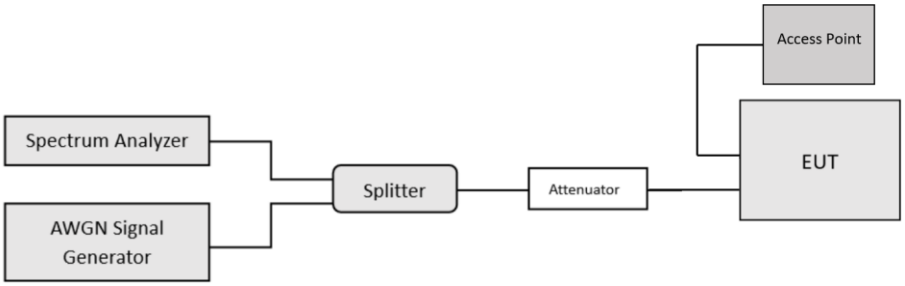


Figure 7-5. Contention-based protocol test setup, conducted method

Test Notes

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

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

Equation 7-1. Incumbent Detection Level Calculation

Band	Channel	Channel Frquency [MHz]	Channel BW [MHz]	Incumbent Frequency [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	-59.70	-1.20	-7.65	-66.15	-62.0	-4.15
	47	6185	160	6110	-59.20	-1.20	-7.65	-65.65	-62.0	-3.65
				6185	-59.30	-1.20	-7.65	-65.75	-62.0	-3.75
				6260	-58.00	-0.70	-7.65	-64.95	-62.0	-2.95
UNII Band 6	101	6455	20	6455	-58.70	-0.40	-7.99	-66.29	-62.0	-4.29
	111	6505	160	6430	-58.90	0.10	-7.99	-66.99	-62.0	-4.99
				6505	-59.00	-0.40	-7.99	-66.59	-62.0	-4.59
				6580	-57.20	-2.00	-7.99	-63.19	-62.0	-1.19
UNII Band 7	149	6695	20	6695	-62.80	-2.00	-7.88	-68.68	-62.0	-6.68
	143	6665	160	6590	-60.70	-2.00	-7.88	-66.58	-62.0	-4.58
				6665	-60.50	-2.00	-7.88	-66.38	-62.0	-4.38
				6740	-58.00	-2.50	-7.88	-63.38	-62.0	-1.38
UNII Band 8	197	6935	20	6935	-61.00	-2.60	-7.97	-66.37	-62.0	-4.37
	207	6985	160	6910	-60.50	-2.60	-7.97	-65.87	-62.0	-3.87
				6985	-63.60	-2.80	-7.97	-68.77	-62.0	-6.77
				7060	-59.80	-3.90	-7.97	-63.87	-62.0	-1.87

Table 7-53. Contention Based Protocol – Incumbent Detection Results

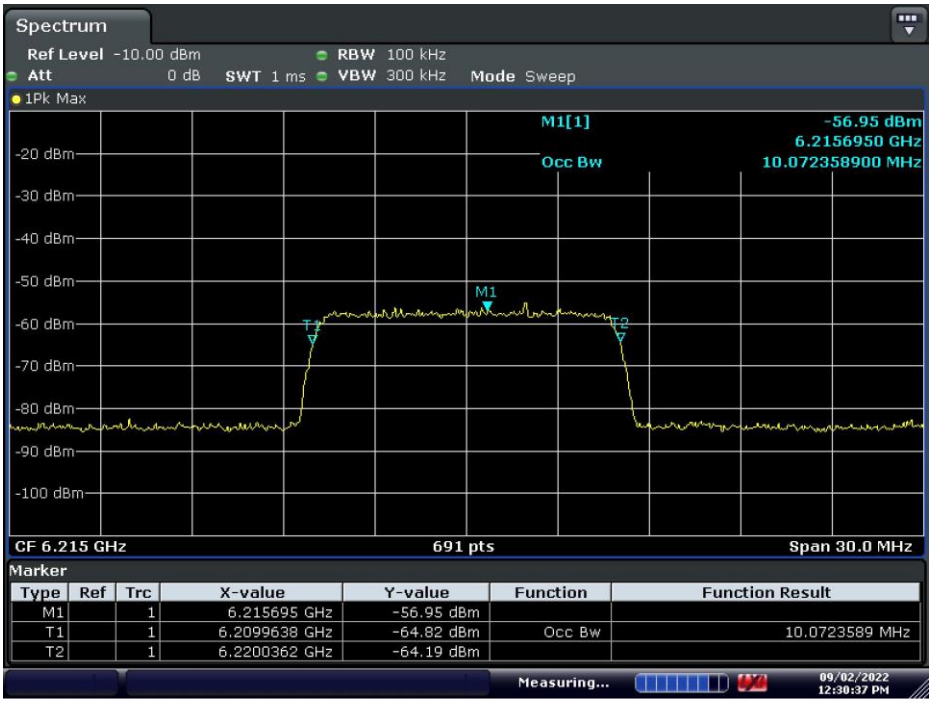
Band	Channel	Channel Frquency [MHz]	Channel BW [MHz]	Incumbent Frequency [MHz]	EUT Transmission Status Adjusted AWGN Power (dBm)		
					Normal	Minimal	Ceased
UNII Band 5	53	6215	20	6215	-78.15	-68.65	-66.15
	47	6185	160	6110	-77.65	-68.15	-65.65
				6185	-77.75	-68.25	-65.75
				6260	-76.95	-67.45	-64.95
UNII Band 6	101	6455	20	6455	-78.29	-68.79	-66.29
	111	6505	160	6430	-78.99	-69.49	-66.99
				6505	-78.59	-69.09	-66.59
				6580	-75.19	-65.69	-63.19
UNII Band 7	149	6695	20	6695	-80.68	-71.18	-68.68
	175	6825	160	6750	-78.58	-69.08	-66.58
				6825	-78.38	-68.88	-66.38
				6900	-75.38	-65.88	-63.38
UNII Band 8	197	6935	20	6935	-78.37	-68.87	-66.37
	207	6985	160	6910	-77.87	-68.37	-65.87
				6985	-80.77	-71.27	-68.77
				7060	-75.87	-66.37	-63.87

Table 7-54. Contention Based Protocol – Detection Results – All Tx Cases

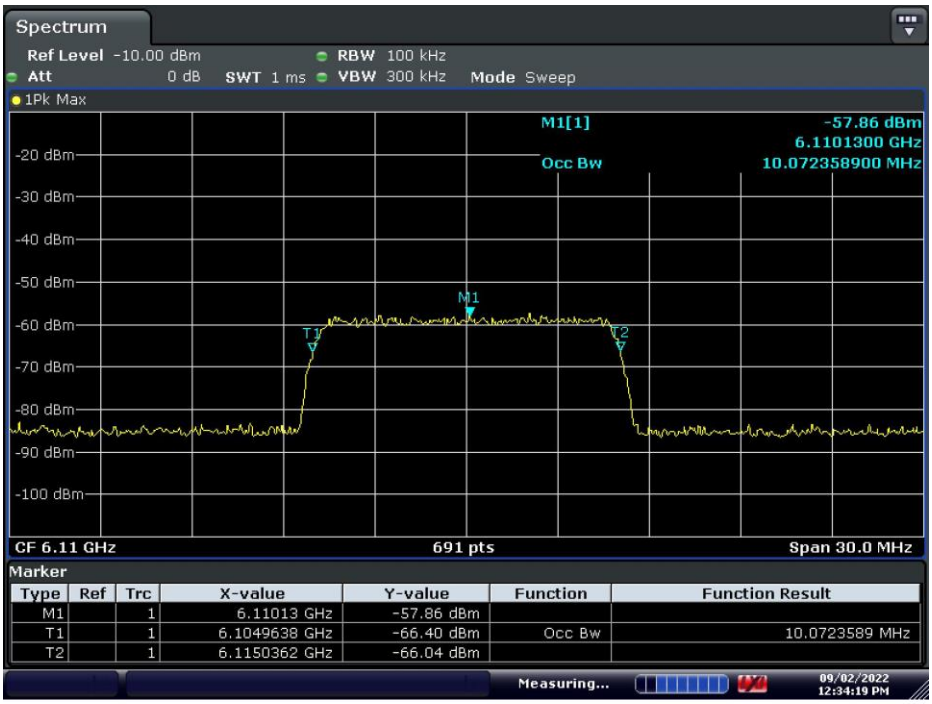
CBP Detection (1 = Detection, Blank = No Detection)																					
Band	Channel	Channel Frquency [MHz]	Channel BW [MHz]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Detection Rate [%]	Limit [%]	Pass/Fail
UNII Band 5	53	6215	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
	47	6185	160	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
UNII Band 6	101	6455	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
	111	6505	160	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
UNII Band 7	149	6695	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
	175	6665	160	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
UNII Band 8	197	6935	20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
	207	6985	160	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass
				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100.0	90	Pass

Table 7-55. Contention Based Protocol – Incumbent Detection Trial Results

AWGN Plots



Plot 7-553. AWGN Signal – UNII 5 – 20MHz



Plot 7-554. AWGN Signal – UNII 5 – 160MHz - Low