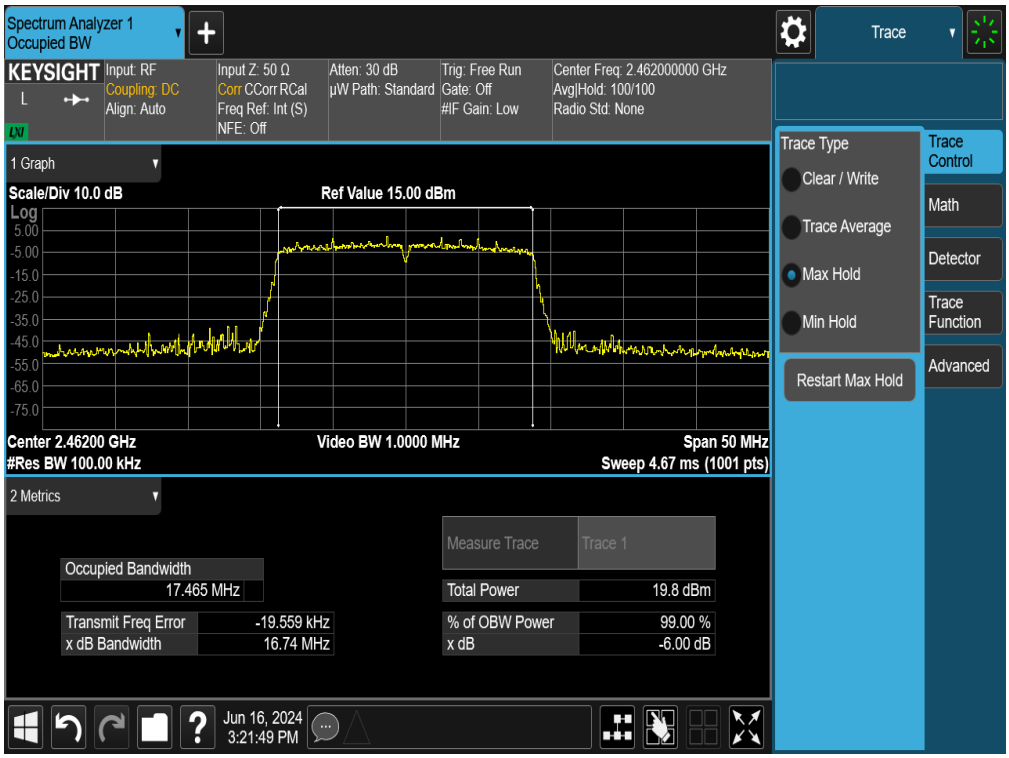
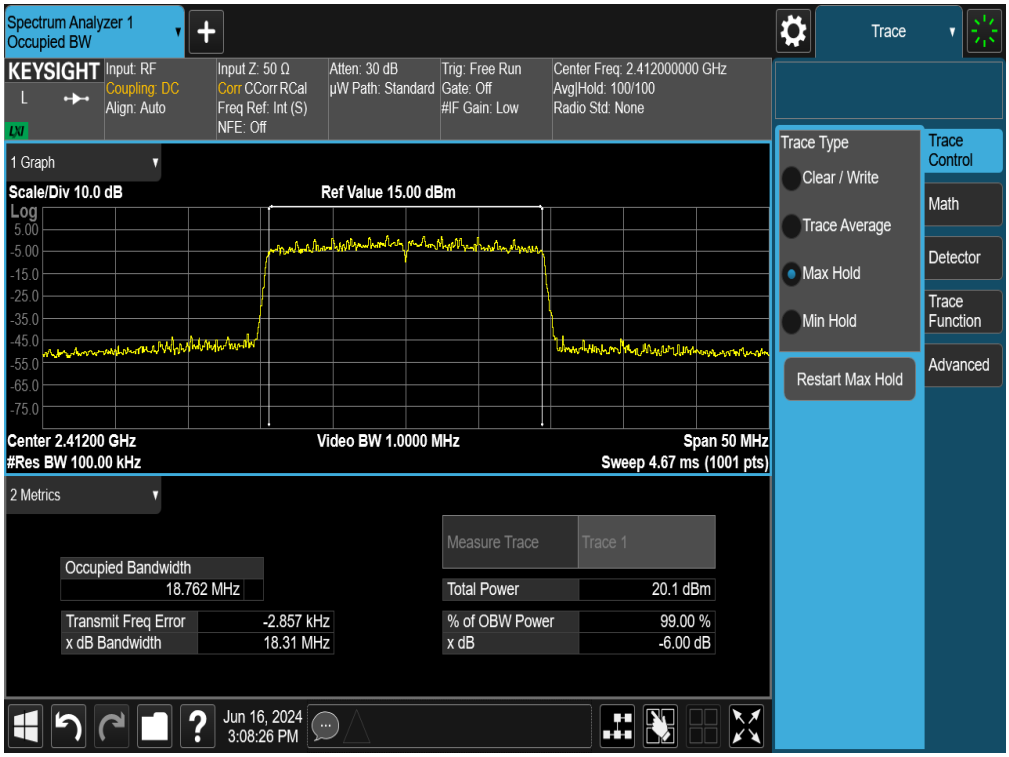
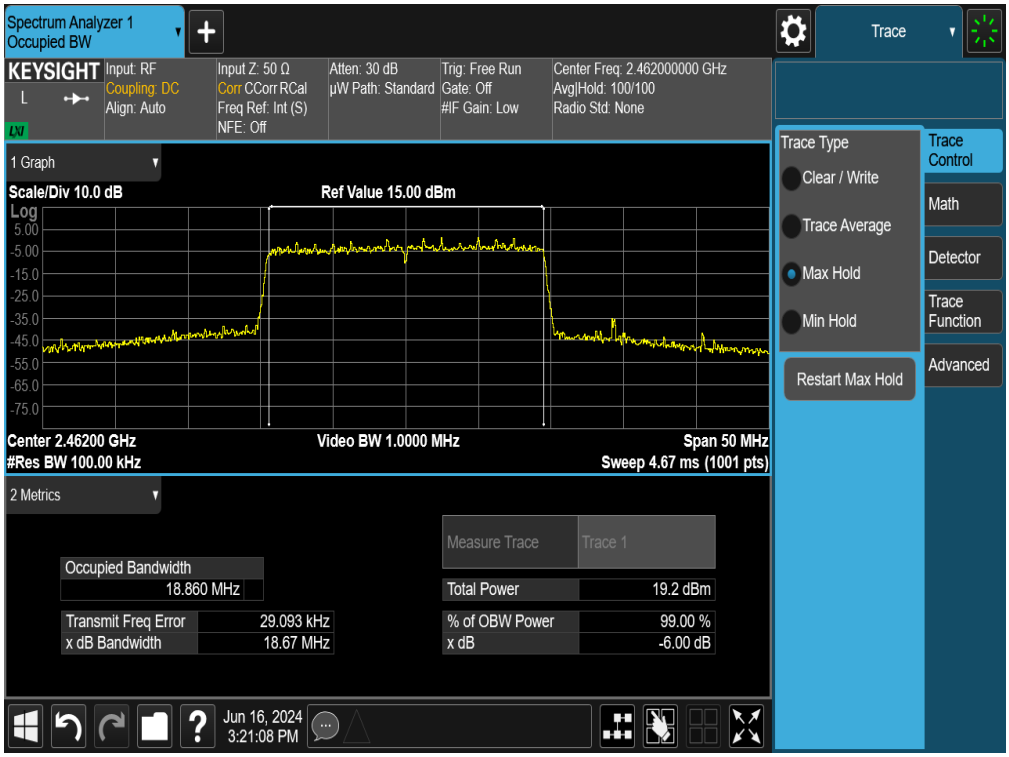


Plot 7-45. 6dB Bandwidth Plot MIMO ANT2 (802.11n (2.4GHz) – Ch. 11)



Plot 7-46. 6dB Bandwidth Plot MIMO ANT2 (802.11ax (2.4GHz) – Ch. 1)

Plot 7-47. 6dB Bandwidth Plot MIMO ANT2 (802.11ax (2.4GHz) – Ch. 6)



Plot 7-48. 6dB Bandwidth Plot MIMO ANT2 (802.11ax (2.4GHz) – Ch. 11)

7.3 Output Power Measurement

Test Overview and Limits

A transmitter antenna terminal of EUT is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt per 15.247.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.3 PKPM1 Peak Power Method
ANSI C63.10-2013 – Section 11.9.2.3.2 Method AVGPM-G
ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique

Test Settings

Method PKPM1 (Peak Power Measurement)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Average Power Measurement)

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

Test Setup

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

Figure 7-2. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

None.

	2.4GHz WIFI (20MHz 802.11b SISO ANT1)					
IEEE 802.11b	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
	2412	1	Average	18.41	30.00	-11.59
	2437	6		18.53	30.00	-11.47
	2462	11		18.64	30.00	-11.36
	2412	1	Peak	20.98	30.00	-9.02
	2437	6		21.07	30.00	-8.93
	2462	11		21.19	30.00	-8.81
	2.4GHz WIFI (20MHz 802.11g SISO ANT1)					
IEEE 802.11g	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
	2412	1	Average	16.83	30.00	-13.17
	2417	2		17.48	30.00	-12.52
	2437	6		17.43	30.00	-12.57
	2457	10		17.67	30.00	-12.33
	2462	11		17.64	30.00	-12.36
	2412	1	Peak	25.48	30.00	-4.52
	2417	2		25.75	30.00	-4.25
	2437	6		23.45	30.00	-6.55
	2457	10		25.72	30.00	-4.28
	2462	11		25.58	30.00	-4.42
	2.4GHz WIFI (20MHz 802.11n SISO ANT1)					
IEEE 802.11n	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
	2412	1	Average	16.18	30.00	-13.82
	2417	2		17.39	30.00	-12.61
	2437	6		17.39	30.00	-12.61
	2457	10		17.59	30.00	-12.41
	2462	11		16.81	30.00	-13.19
	2412	1	Peak	24.89	30.00	-5.11
	2417	2		25.74	30.00	-4.26
	2437	6		23.39	30.00	-6.61
	2457	10		25.56	30.00	-4.44
	2462	11		25.61	30.00	-4.39
	2.4GHz WIFI (20MHz 802.11ax SISO ANT1)					
IEEE 802.11ax SU	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
	2412	1	Average	14.42	30.00	-15.58
	2437	6		14.39	30.00	-15.61
	2462	11		14.46	30.00	-15.54
	2412	1	Peak	24.67	30.00	-5.33
	2437	6		23.15	30.00	-6.85
	2462	11		24.62	30.00	-5.38

Table 7-5. Conducted Output Power Measurements SISO ANT1

	2.4GHz WIFI (20MHz 802.11b SISO ANT2)				Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11b	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]		
	2412	1	Average	18.76	30.00	-11.24
	2437	6		18.45	30.00	-11.55
	2462	11		18.46	30.00	-11.54
	2412	1	Peak	21.43	30.00	-8.57
	2437	6		20.96	30.00	-9.04
	2462	11		21.02	30.00	-8.98
	2.4GHz WIFI (20MHz 802.11g SISO ANT2)				Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11g	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]		
	2412	1	Average	17.38	30.00	-12.62
	2417	2		17.49	30.00	-12.51
	2437	6		17.52	30.00	-12.48
	2457	10		17.65	30.00	-12.35
	2462	11		17.58	30.00	-12.42
	2412	1	Peak	23.48	30.00	-6.52
	2417	2		23.98	30.00	-6.02
	2437	6		23.96	30.00	-6.04
	2457	10		24.12	30.00	-5.88
	2462	11		24.13	30.00	-5.87
	2.4GHz WIFI (20MHz 802.11n SISO ANT2)				Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11n	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]		
	2412	1	Average	15.95	30.00	-14.05
	2417	2		17.39	30.00	-12.61
	2437	6		17.32	30.00	-12.68
	2457	10		17.47	30.00	-12.53
	2462	11		16.55	30.00	-13.45
	2412	1	Peak	24.56	30.00	-5.44
	2417	2		23.99	30.00	-6.01
	2437	6		23.94	30.00	-6.06
	2457	10		24.53	30.00	-5.47
	2462	11		23.92	30.00	-6.08
	2.4GHz WIFI (20MHz 802.11ax SISO ANT2)				Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11ax SU	Freq. [MHz]	Channel	Detector	Conducted Power [dBm]		
	2412	1	Average	14.72	30.00	-15.28
	2437	6		14.42	30.00	-15.58
	2462	11		14.53	30.00	-15.47
	2412	1	Peak	24.27	30.00	-5.73
	2437	6		23.61	30.00	-6.39
	2462	11		24.05	30.00	-5.95

Table 7-6. Conducted Output Power Measurements SISO ANT2

	2.4GHz WIFI (20MHz 802.11b MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11b	Freq [MHz]	Channel	Detector	Conducted Power [dBm]				
				ANT1	ANT2	MIMO		
	2412	1	Average	18.42	18.87	21.66	30.00	-8.34
	2437	6		18.47	18.41	21.45	30.00	-8.55
	2462	11		18.63	18.49	21.57	30.00	-8.43
	2412	1	Peak	21.12	21.49	24.32	30.00	-5.68
	2437	6		21.01	20.95	23.99	30.00	-6.01
	2462	11		21.25	21.12	24.20	30.00	-5.80
	2.4GHz WIFI (20MHz 802.11g MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11g	Freq [MHz]	Channel	Detector	Conducted Power [dBm]				
				ANT1	ANT2	MIMO		
	2412	1	Average	16.96	17.46	20.23	30.00	-9.77
	2417	2		17.50	17.73	20.63	30.00	-9.37
	2437	6		17.47	17.42	20.46	30.00	-9.54
	2457	10		17.57	17.84	20.72	30.00	-9.28
	2462	11		17.65	17.78	20.73	30.00	-9.27
	2412	1	Peak	23.58	24.43	27.04	30.00	-2.96
	2417	2		23.48	23.97	26.74	30.00	-3.26
	2437	6		23.04	23.53	26.30	30.00	-3.70
	2457	10		23.18	24.18	26.72	30.00	-3.28
	2462	11		23.11	23.78	26.47	30.00	-3.53
	2.4GHz WIFI (20MHz 802.11n MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11n	Freq [MHz]	Channel	Detector	Conducted Power [dBm]				
				ANT1	ANT2	MIMO		
	2412	1	Average	15.46	16.14	18.82	30.00	-11.18
	2417	2		17.44	17.58	20.52	30.00	-9.48
	2437	6		17.39	17.34	20.38	30.00	-9.62
	2457	10		17.42	17.83	20.64	30.00	-9.36
	2462	11		16.53	16.71	19.63	30.00	-10.37
	2412	1	Peak	23.18	24.05	26.65	30.00	-3.35
	2417	2		23.36	23.96	26.68	30.00	-3.32
	2437	6		23.01	23.51	26.28	30.00	-3.72
	2457	10		23.21	24.26	26.78	30.00	-3.22
	2462	11		23.16	23.73	26.46	30.00	-3.54
	2.4GHz WIFI (20MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]
IEEE 802.11ax SU	Freq [MHz]	Channel	Detector	Conducted Power [dBm]				
				ANT1	ANT2	MIMO		
	2412	1	Average	14.32	14.83	17.59	30.00	-12.41
	2437	6		14.22	14.43	17.34	30.00	-12.66
	2462	11		14.68	14.51	17.61	30.00	-12.39
	2412	1	Peak	23.27	23.84	26.57	30.00	-3.43
	2437	6		22.84	23.32	26.10	30.00	-3.90
	2462	11		23.14	23.48	26.32	30.00	-3.68

Table 7-7. Conducted Output Power Measurements MIMO

Note:

Per ANSI C63.10-2013 Section 14.2, the conducted powers at Antenna 1 and Antenna 2 were first measured separately during MIMO transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample MIMO Calculation:

At 2412MHz the average conducted output power was measured to be 18.42 dBm for Antenna 1 and 18.87 dBm for Antenna 2.

Antenna 1 + Antenna 2 = MIMO

(18.42dBm + 18.87 dBm) = (69.50 mW + 77.09 mW) = 146.59 mW = 21.66 dBm

7.4 Power Spectral Density

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates are investigated and the worst-case configuration results are reported in this section.

The maximum permissible power spectral density shall not be greater than 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Section 11.10.2 Method PKPSD
ANSI C63.10-2013 – Section 14.3.1 Measure-and-Sum Technique

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 10kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

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

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None.

Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-0.90	8.00	-8.90	Pass
2437	6	b	1	-1.11	8.00	-9.11	Pass
2462	11	b	1	-1.38	8.00	-9.38	Pass
2412	1	g	6	-4.45	8.00	-12.45	Pass
2437	6	g	6	-4.34	8.00	-12.34	Pass
2462	11	g	6	-4.34	8.00	-12.34	Pass
2412	1	n	6.5/7.2 (MCS0)	-5.39	8.00	-13.39	Pass
2437	6	n	6.5/7.2 (MCS0)	-4.36	8.00	-12.36	Pass
2462	11	n	6.5/7.2 (MCS0)	-4.38	8.00	-12.38	Pass
2412	1	ax	6.5/7.2 (MCS0)	-7.24	8.00	-15.24	Pass
2437	6	ax	6.5/7.2 (MCS0)	-6.77	8.00	-14.77	Pass
2462	11	ax	6.5/7.2 (MCS0)	-6.73	8.00	-14.73	Pass

Table 7-8. Conducted Power Spectral Density Measurements SISO ANT1

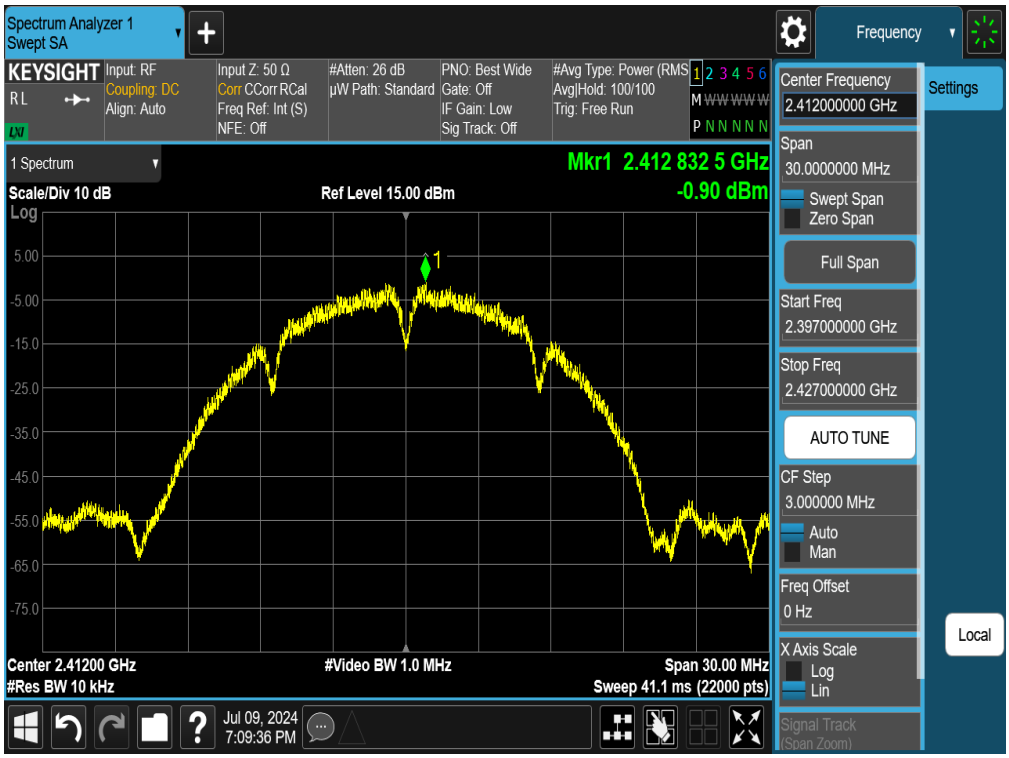
Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-0.82	8.00	-8.82	Pass
2437	6	b	1	-1.78	8.00	-9.78	Pass
2462	11	b	1	-2.34	8.00	-10.34	Pass
2412	1	g	6	-5.19	8.00	-13.19	Pass
2437	6	g	6	-4.75	8.00	-12.75	Pass
2462	11	g	6	-4.45	8.00	-12.45	Pass
2412	1	n	6.5/7.2 (MCS0)	-6.04	8.00	-14.04	Pass
2437	6	n	6.5/7.2 (MCS0)	-3.26	8.00	-11.26	Pass
2462	11	n	6.5/7.2 (MCS0)	-6.30	8.00	-14.30	Pass
2412	1	ax	6.5/7.2 (MCS0)	-8.29	8.00	-16.29	Pass
2437	6	ax	6.5/7.2 (MCS0)	-6.03	8.00	-14.03	Pass
2462	11	ax	6.5/7.2 (MCS0)	-8.31	8.00	-16.31	Pass

Table 7-9. Conducted Power Spectral Density Measurements SISO ANT2

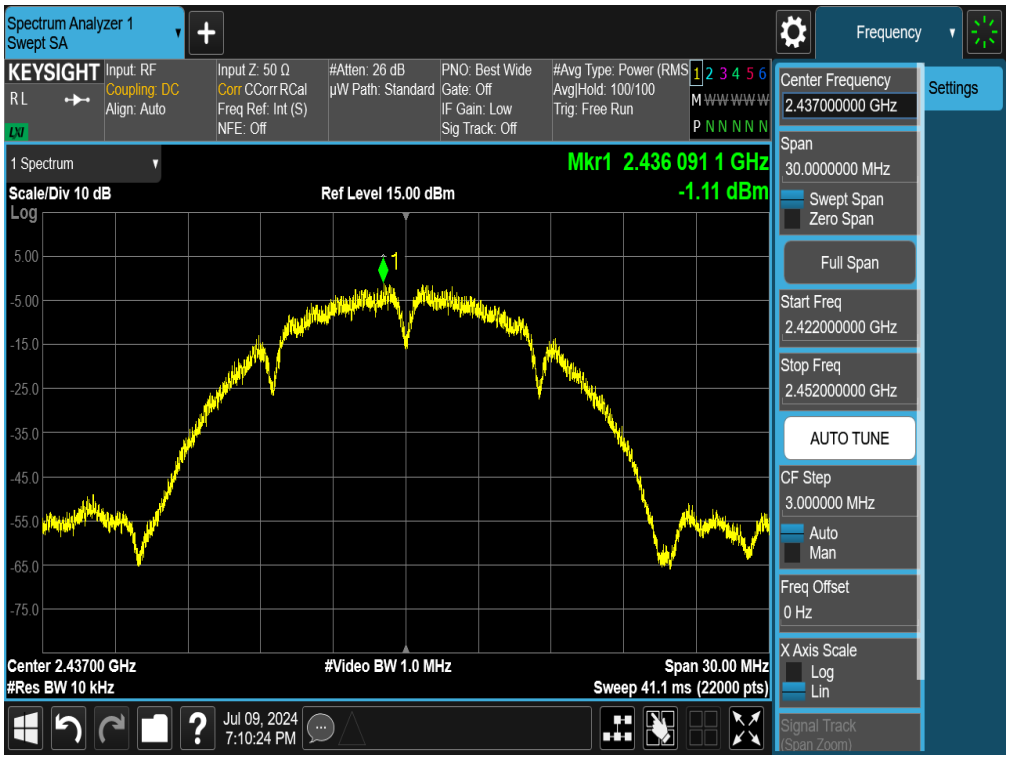
Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	-2.88	-1.73	0.74	8.00	-7.26	Pass
2437	6	b	1	-2.23	-2.07	0.86	8.00	-7.14	Pass
2462	11	b	1	-1.74	-0.97	1.67	8.00	-6.33	Pass
2412	1	g	6	-8.65	-7.53	-5.04	8.00	-13.04	Pass
2437	6	g	6	-4.93	-3.47	-1.13	8.00	-9.13	Pass
2462	11	g	6	-7.64	-6.83	-4.21	8.00	-12.21	Pass
2412	1	n	6.5/7.2 (MCS0)	-6.93	-6.61	-3.76	8.00	-11.76	Pass
2437	6	n	6.5/7.2 (MCS0)	-3.01	-2.76	0.13	8.00	-7.87	Pass
2462	11	n	6.5/7.2 (MCS0)	-6.12	-6.31	-3.20	8.00	-11.20	Pass
2412	1	ax	6.5/7.2 (MCS0)	-8.26	-6.06	-4.01	8.00	-12.01	Pass
2437	6	ax	6.5/7.2 (MCS0)	-7.38	-5.96	-3.60	8.00	-11.60	Pass
2462	11	ax	6.5/7.2 (MCS0)	-8.19	-7.81	-4.99	8.00	-12.99	Pass

Table 7-10. Conducted Power Spectral Density Measurements MIMO

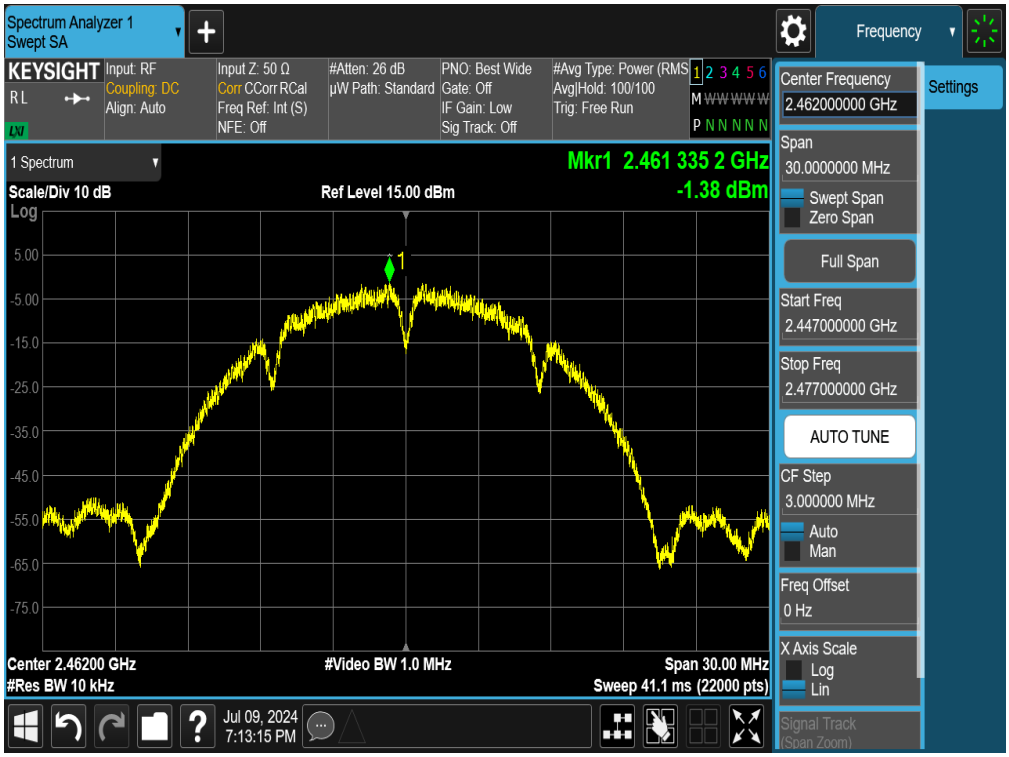
7.4.1 SISO Antenna-1 Power Spectral Density Measurements



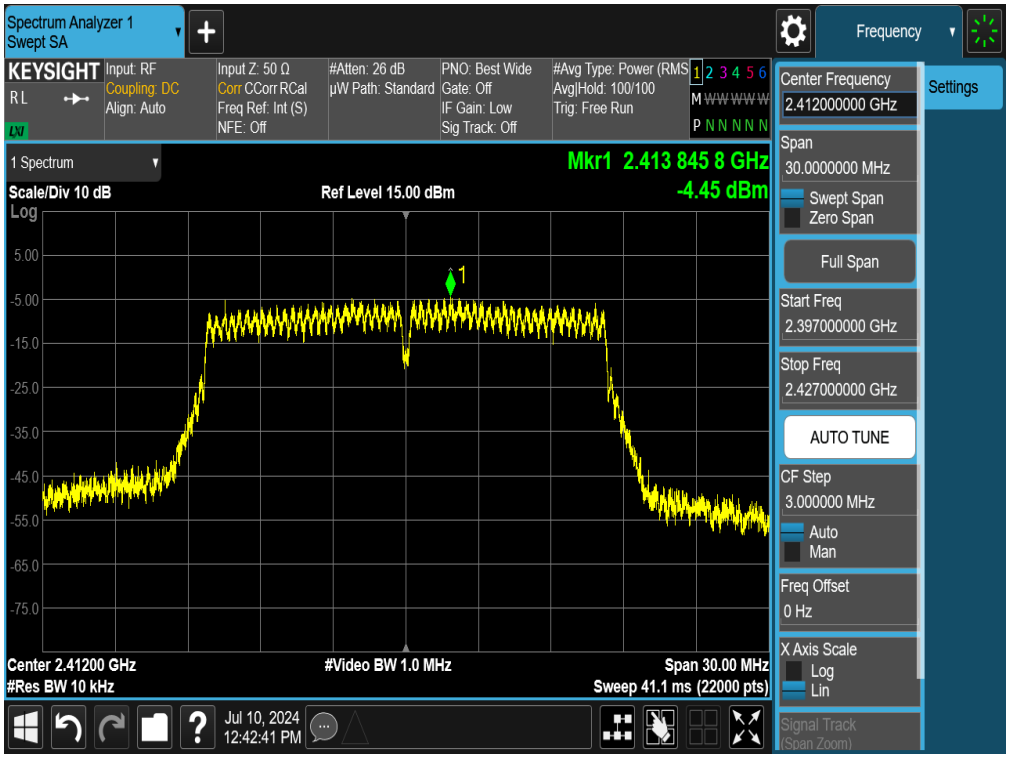
Plot 7-49. Power Spectral Density Plot SISO ANT1 (802.11b – Ch. 1)



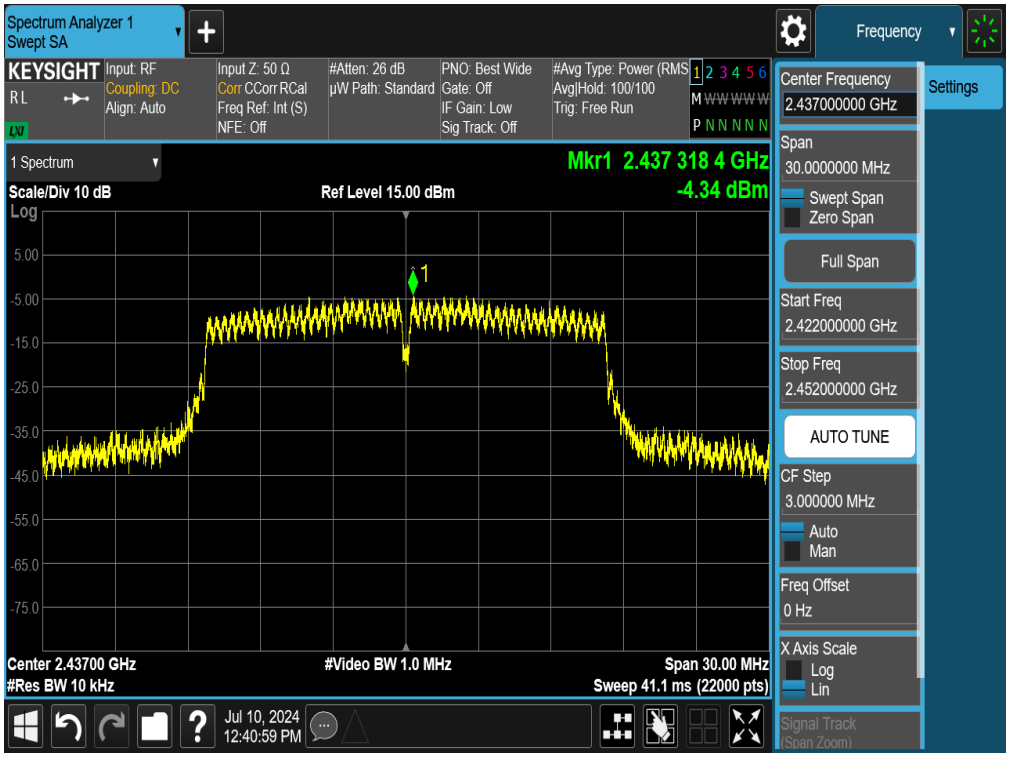
Plot 7-50. Power Spectral Density Plot SISO ANT1 (802.11b – Ch. 6)



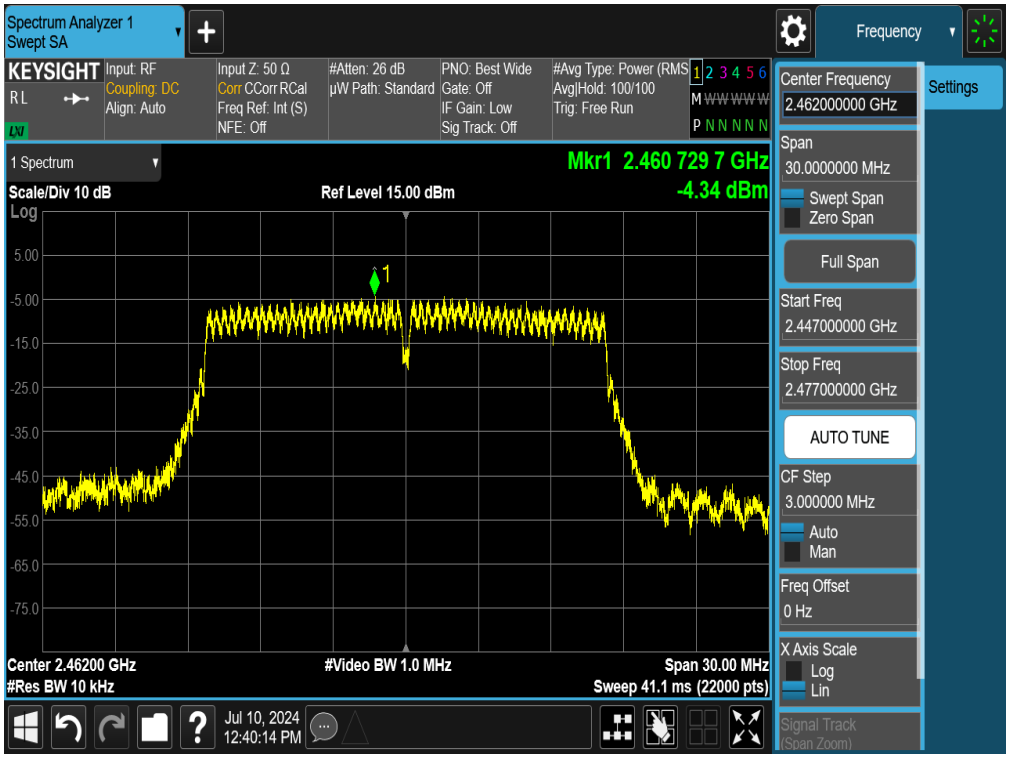
Plot 7-51. Power Spectral Density Plot SISO ANT1 (802.11b – Ch. 11)



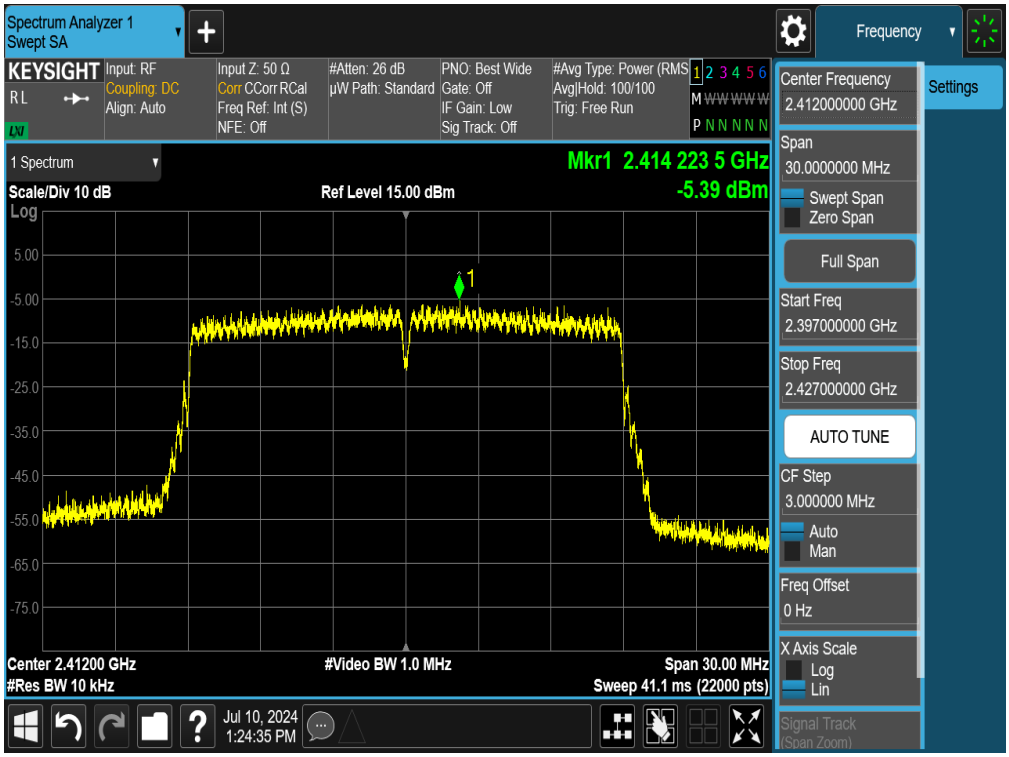
Plot 7-52. Power Spectral Density Plot SISO ANT1 (802.11g – Ch. 1)



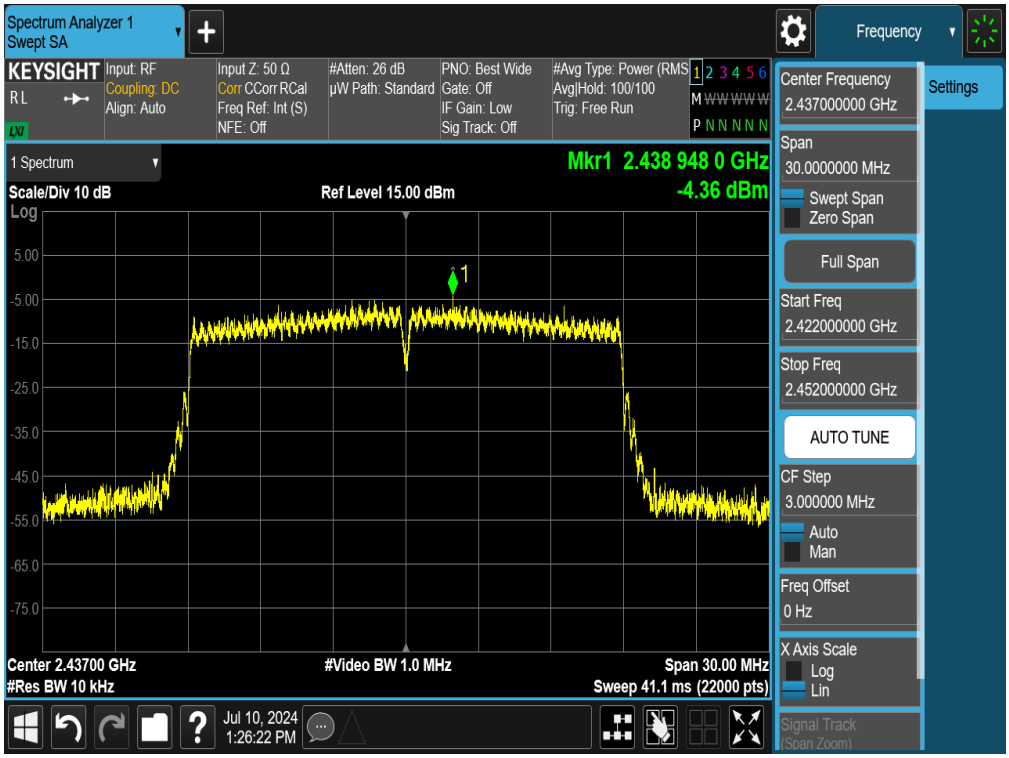
Plot 7-53. Power Spectral Density Plot SISO ANT1 (802.11g – Ch. 6)



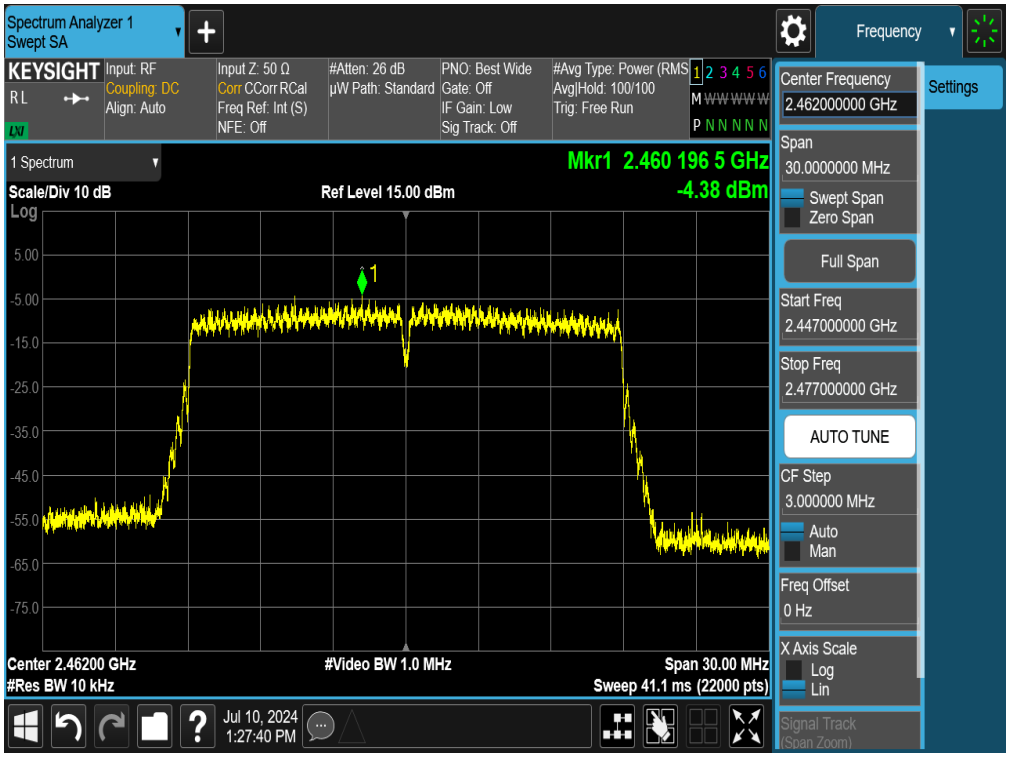
Plot 7-54. Power Spectral Density Plot SISO ANT1 (802.11g – Ch. 11)



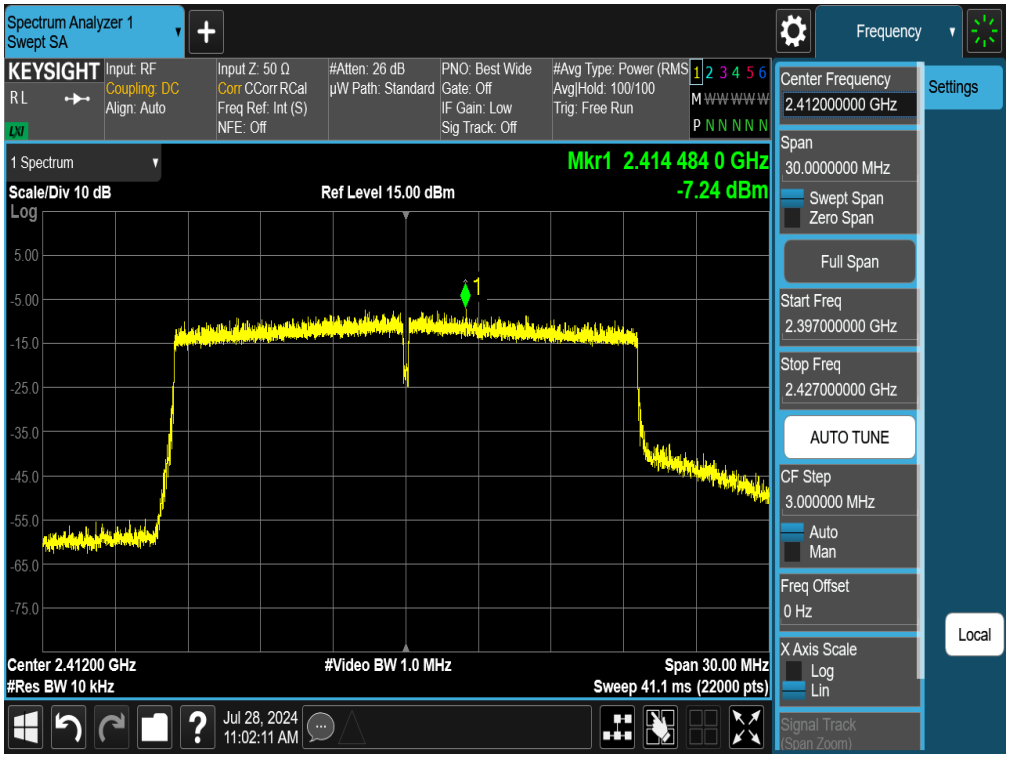
Plot 7-55. Power Spectral Density Plot SISO ANT1 (802.11n (2.4GHz) – Ch. 1)



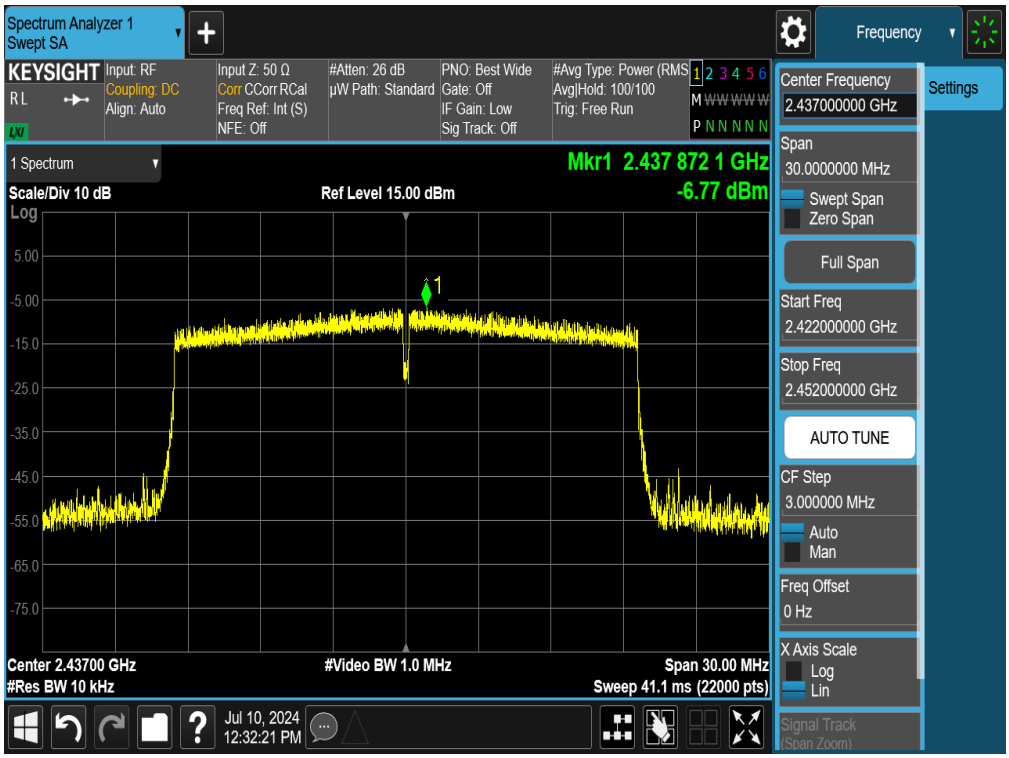
Plot 7-56. Power Spectral Density Plot SISO ANT1 (802.11n (2.4GHz) – Ch. 6)



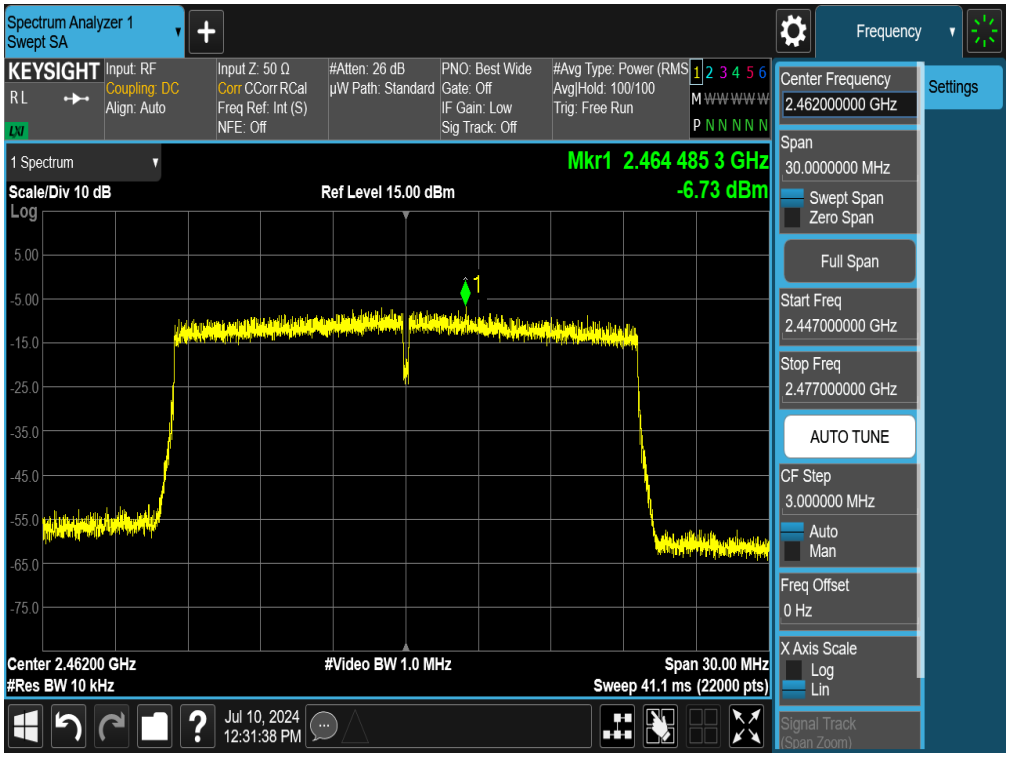
Plot 7-57. Power Spectral Density Plot SISO ANT1 (802.11n (2.4GHz) – Ch. 11)



Plot 7-58. Power Spectral Density Plot SISO ANT1 (802.11ax (2.4GHz) – Ch. 1)

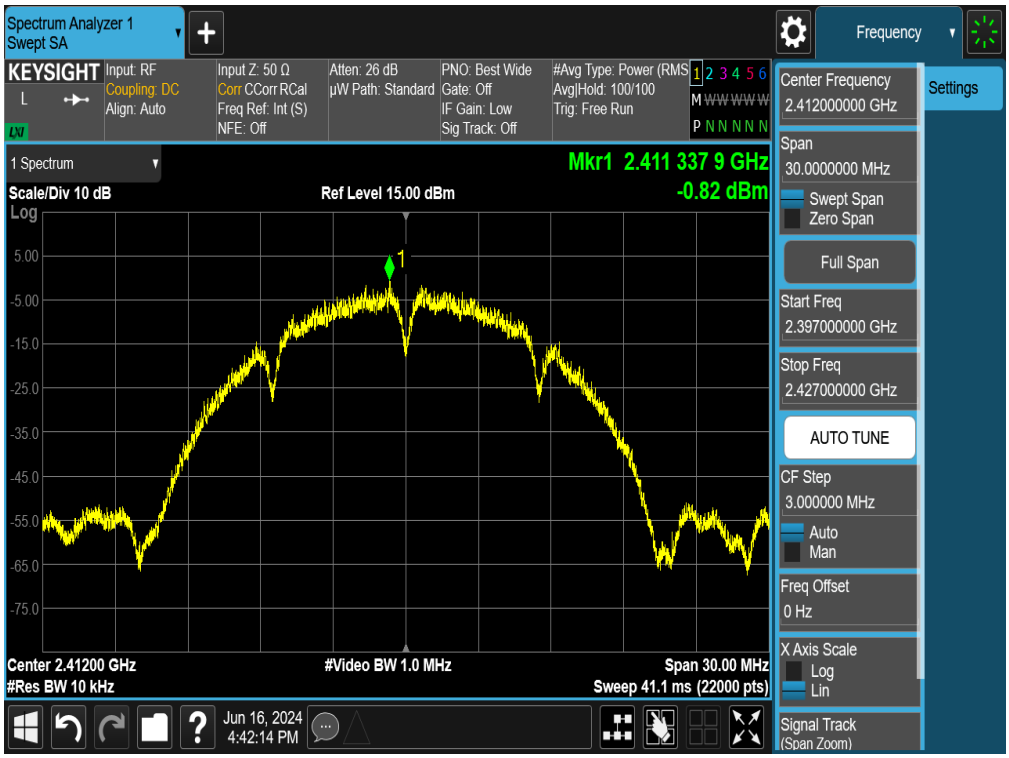


Plot 7-59. Power Spectral Density Plot SISO ANT1 (802.11ax (2.4GHz) – Ch. 6)

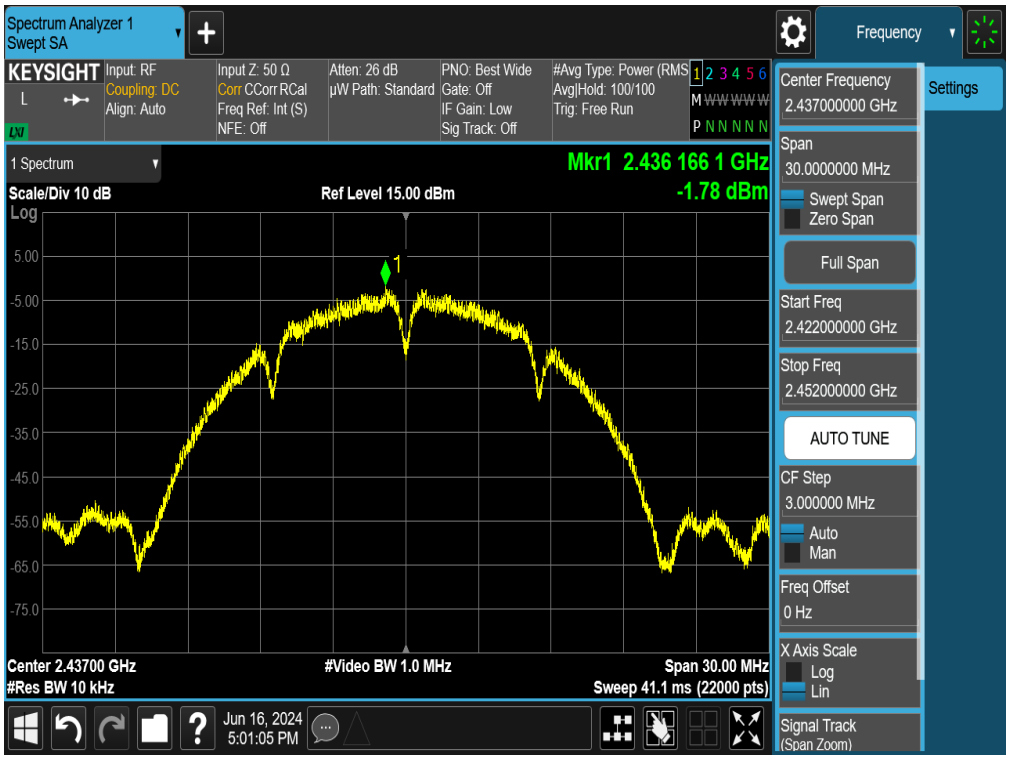


Plot 7-60. Power Spectral Density Plot SISO ANT1 (802.11ax (2.4GHz) – Ch. 11)

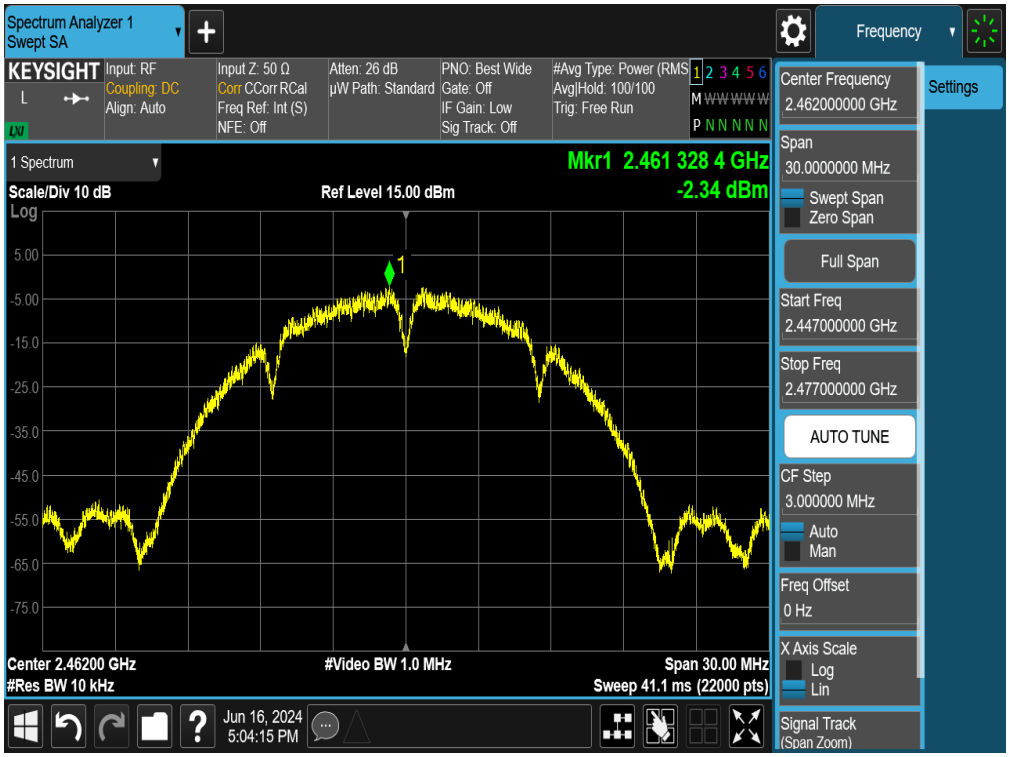
7.4.2 SISO Antenna-2 Power Spectral Density Measurements



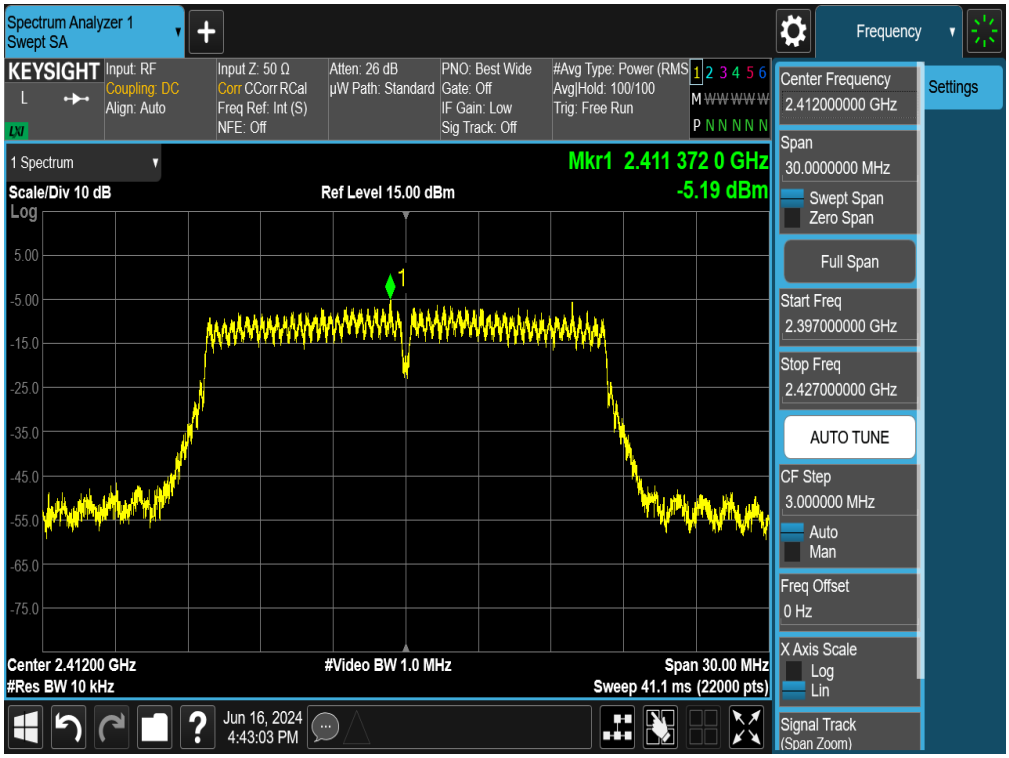
Plot 7-61. Power Spectral Density Plot SISO ANT2 (802.11b – Ch. 1)



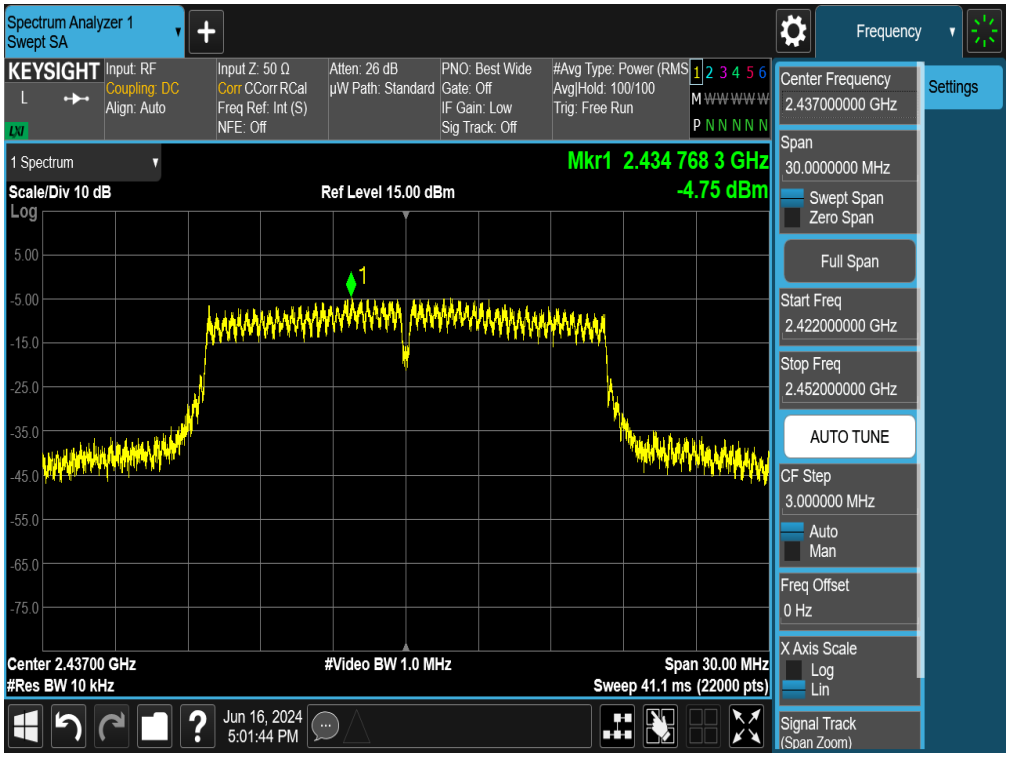
Plot 7-62. Power Spectral Density Plot SISO ANT2 (802.11b – Ch. 6)



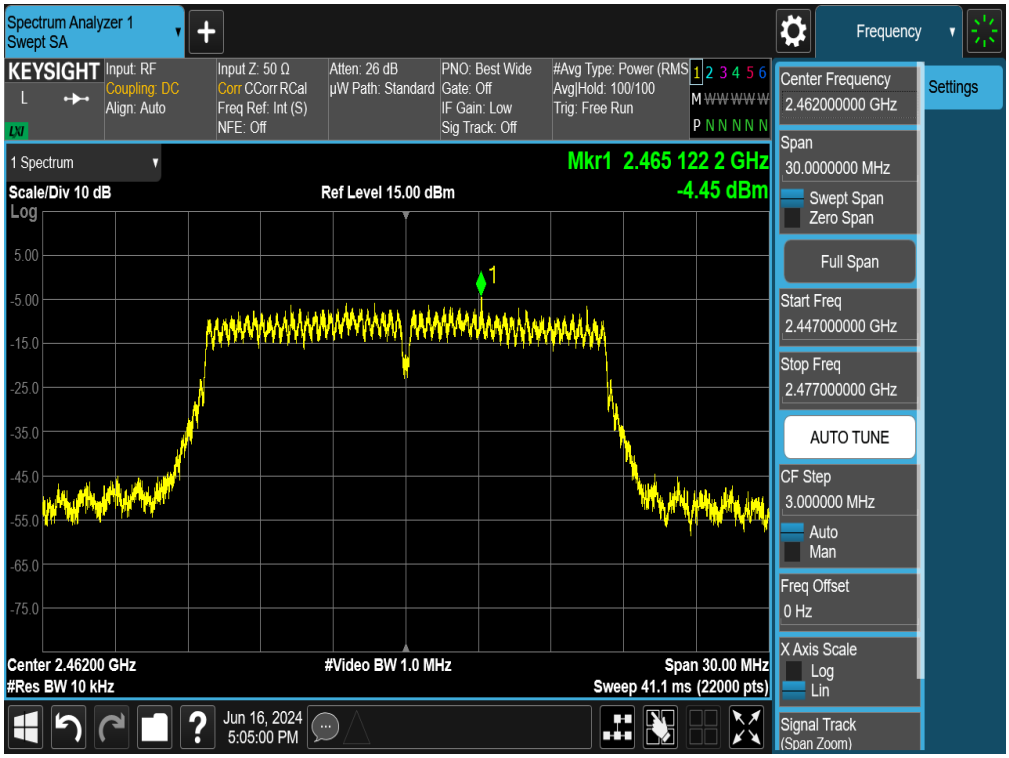
Plot 7-63. Power Spectral Density Plot SISO ANT2 (802.11b – Ch. 11)



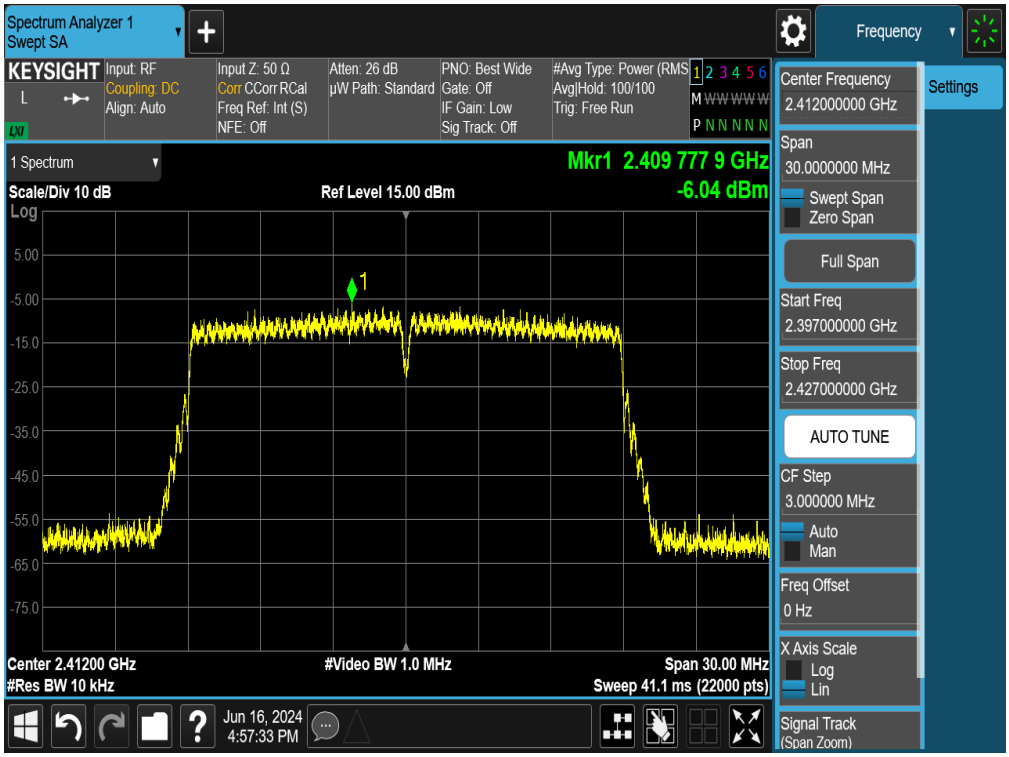
Plot 7-64. Power Spectral Density Plot SISO ANT2 (802.11g – Ch. 1)



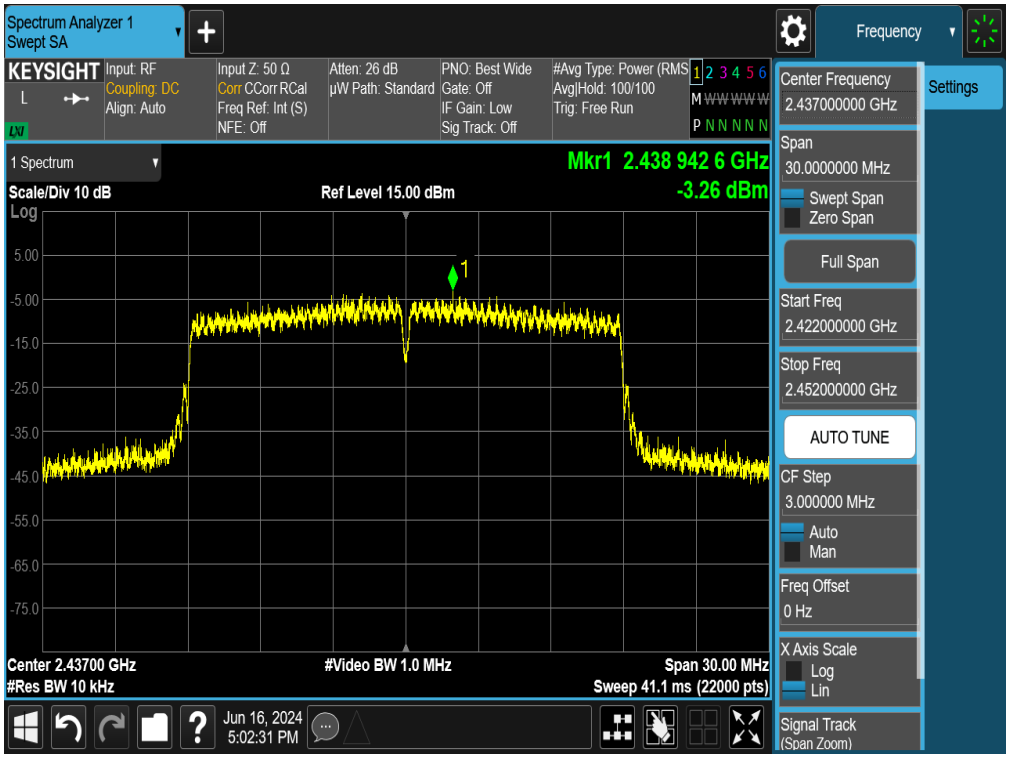
Plot 7-65. Power Spectral Density Plot SISO ANT2 (802.11g – Ch. 6)



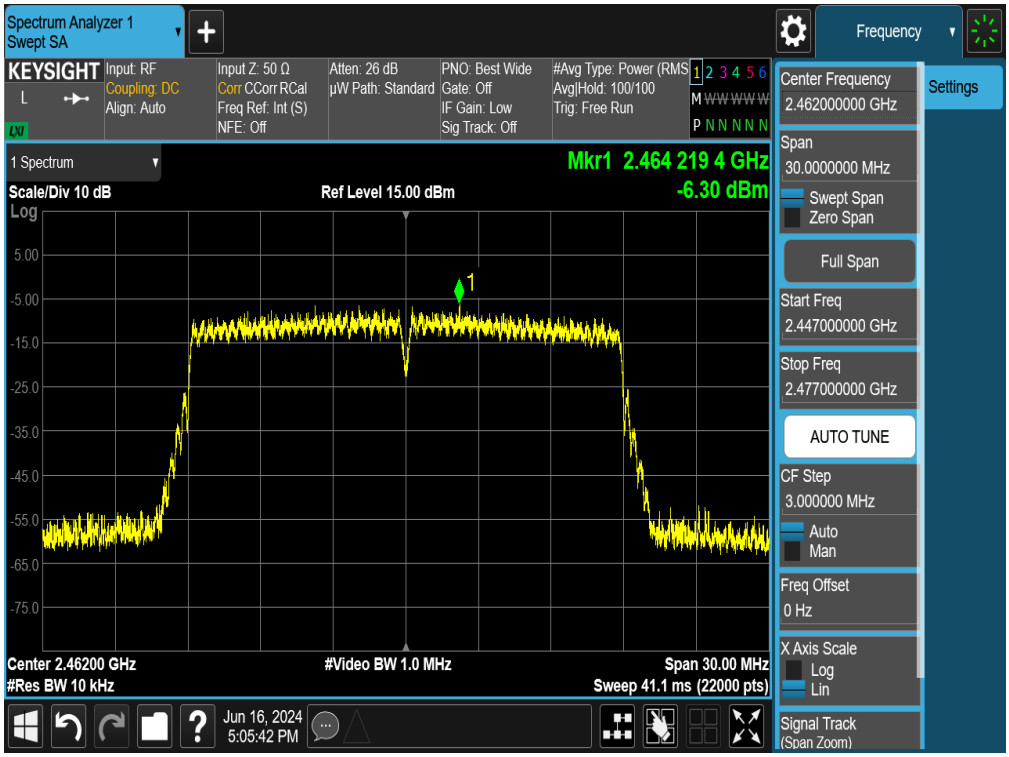
Plot 7-66. Power Spectral Density Plot SISO ANT2 (802.11g – Ch. 11)



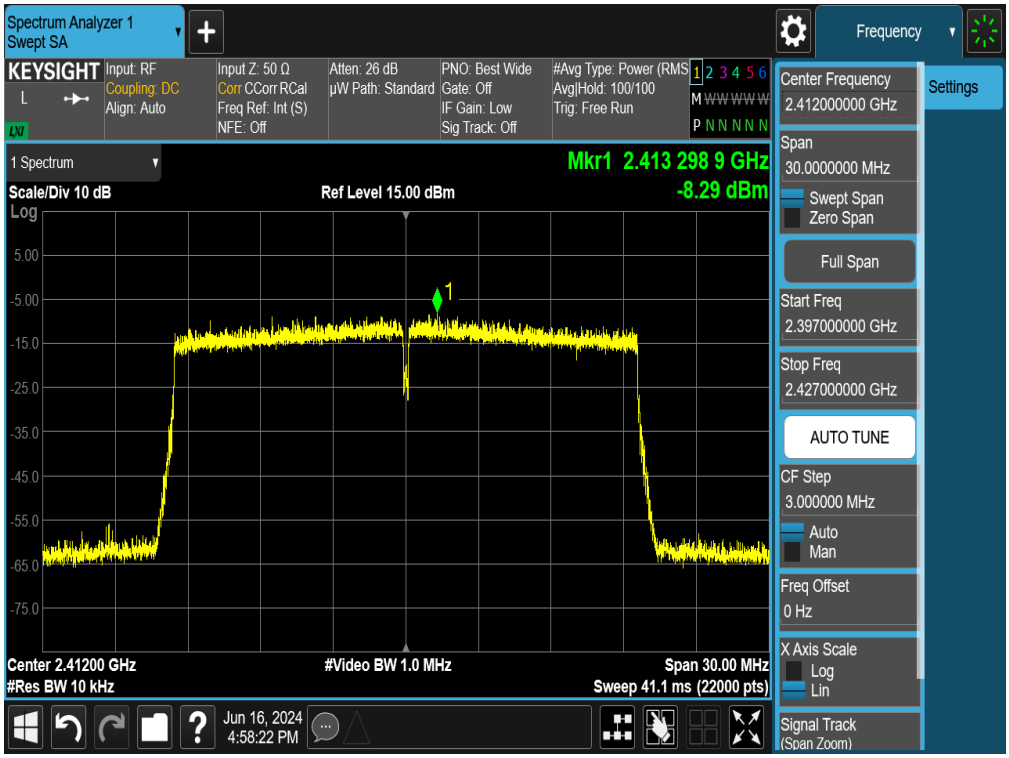
Plot 7-67. Power Spectral Density Plot SISO ANT2 (802.11n (2.4GHz) – Ch. 1)



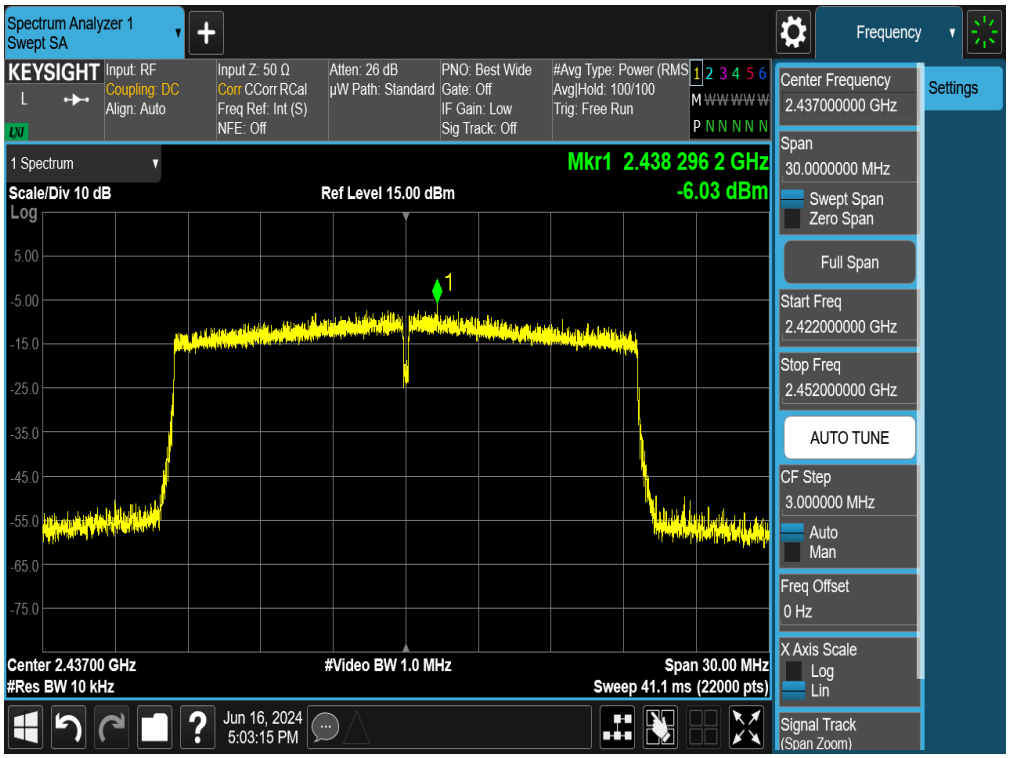
Plot 7-68. Power Spectral Density Plot SISO ANT2 (802.11n (2.4GHz) – Ch. 6)



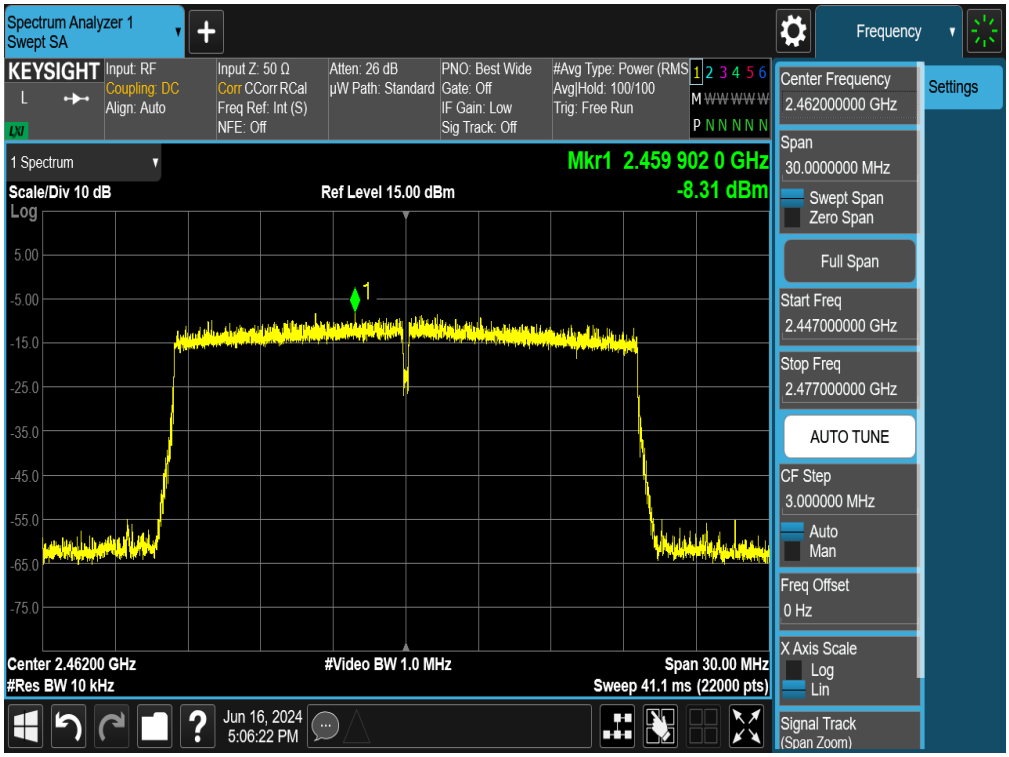
Plot 7-69. Power Spectral Density Plot SISO ANT2 (802.11n (2.4GHz) – Ch. 11)



Plot 7-70. Power Spectral Density Plot SISO ANT2 (802.11ax (2.4GHz) – Ch. 1)

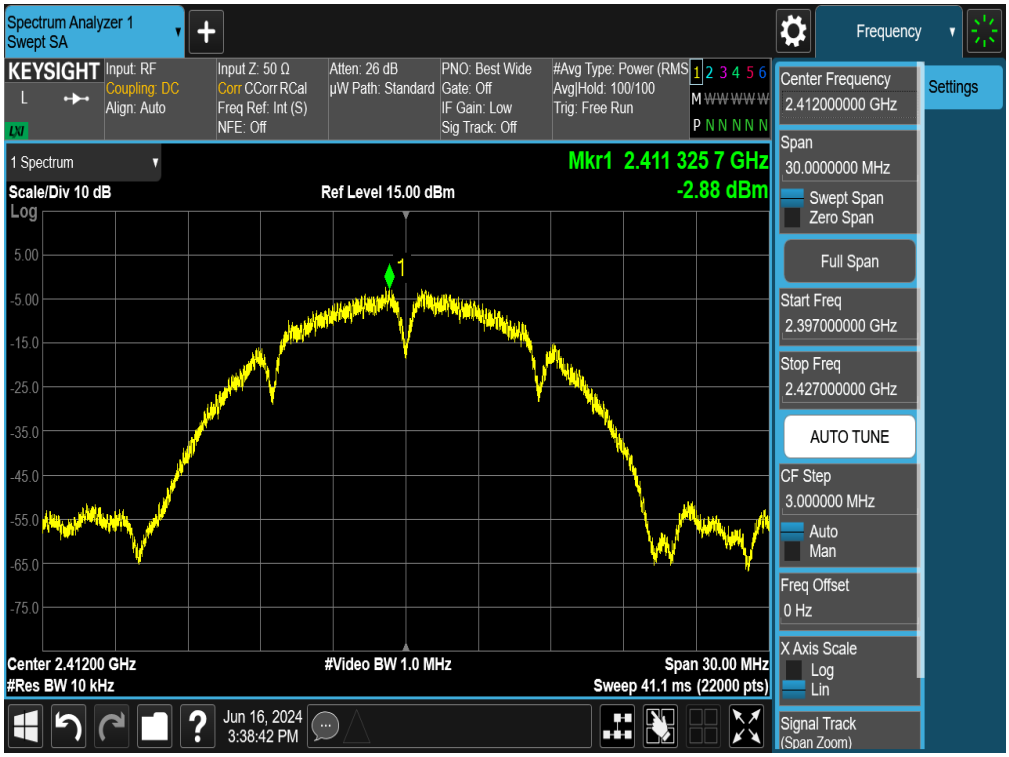


Plot 7-71. Power Spectral Density Plot SISO ANT2 (802.11ax (2.4GHz) – Ch. 6)

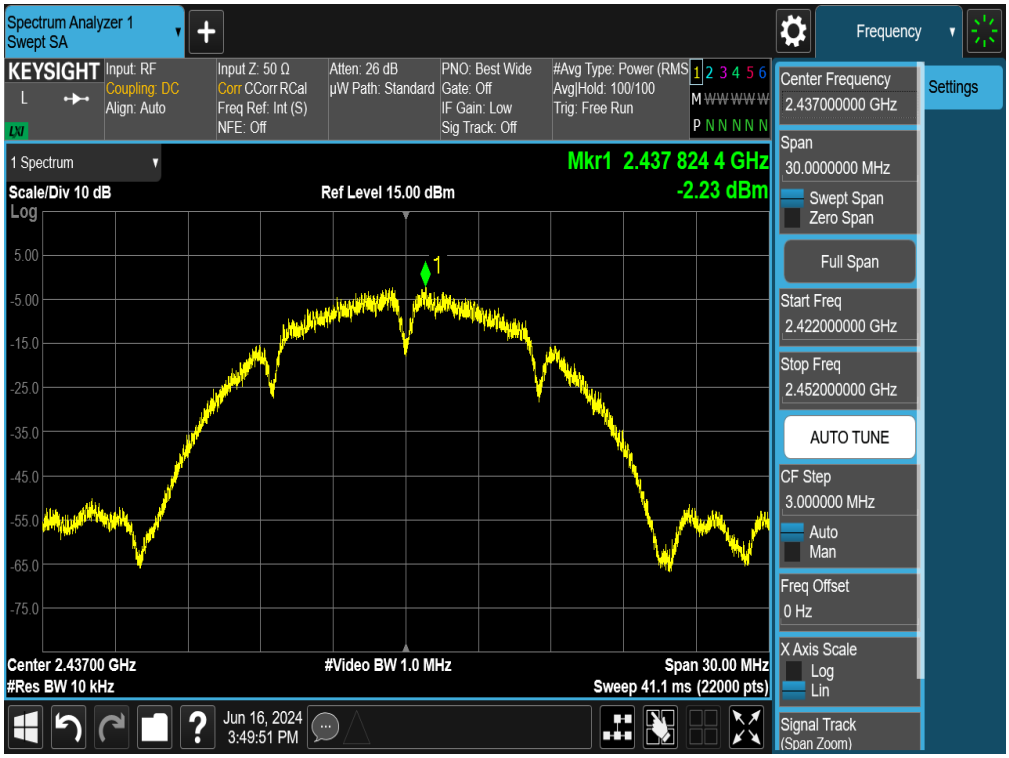


Plot 7-72. Power Spectral Density Plot SISO ANT2 (802.11ax (2.4GHz) – Ch. 11)

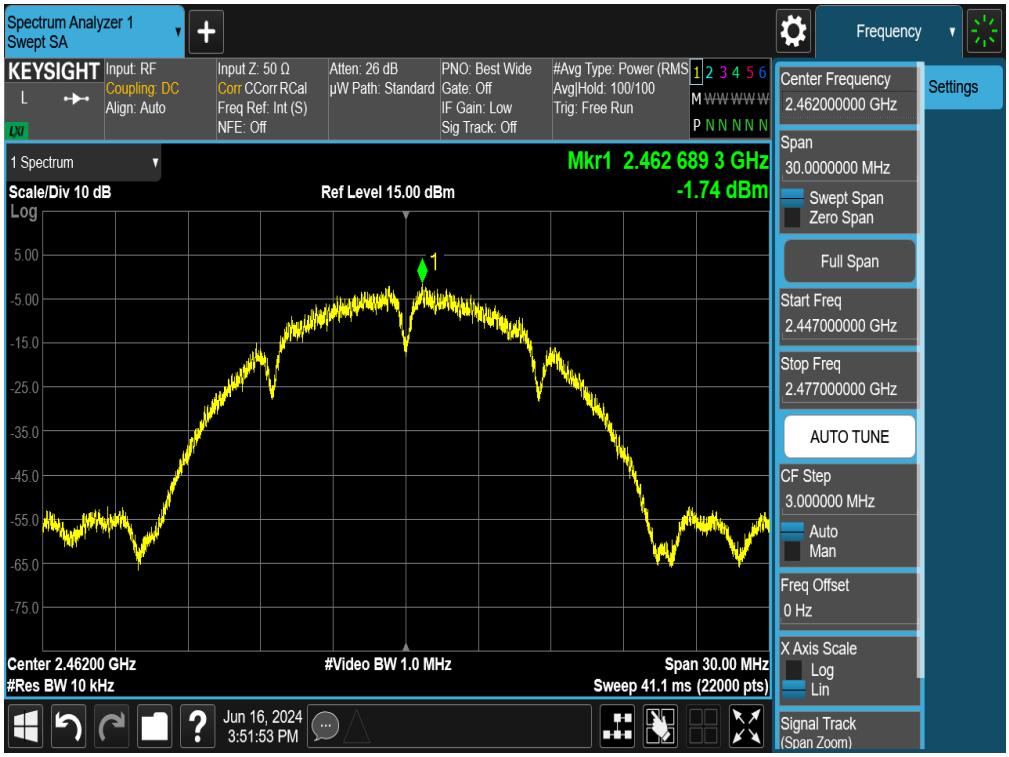
7.4.3 MIMO Power Spectral Density Measurements



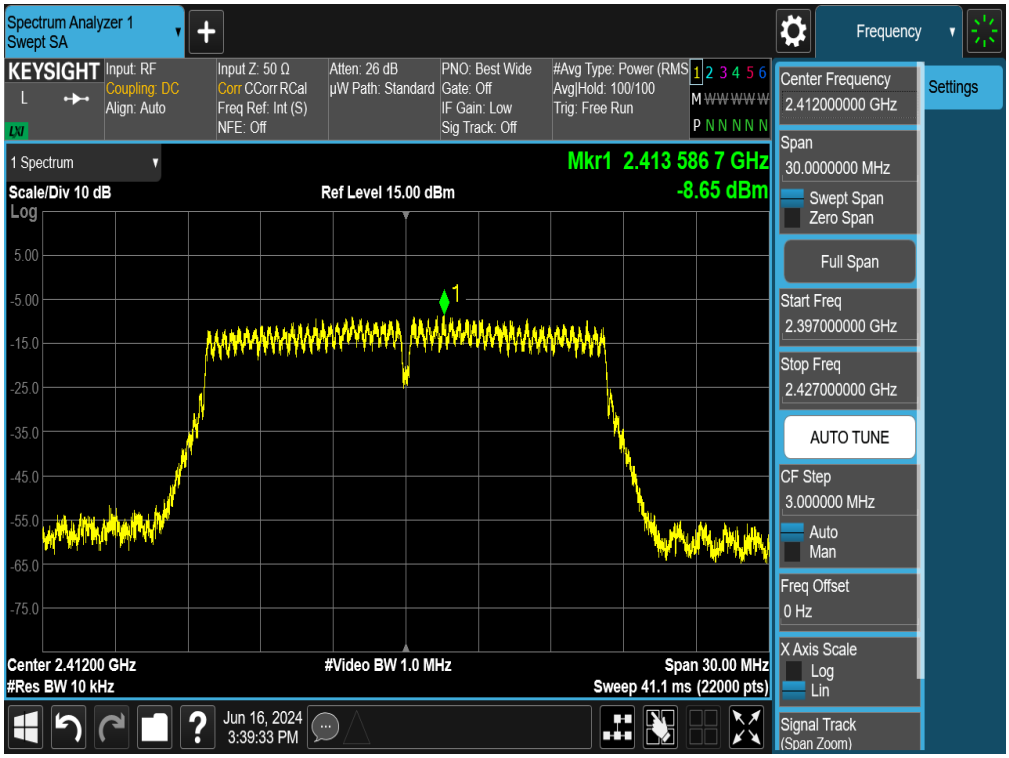
Plot 7-73. Power Spectral Density Plot MIMO ANT1 (802.11b – Ch. 1)



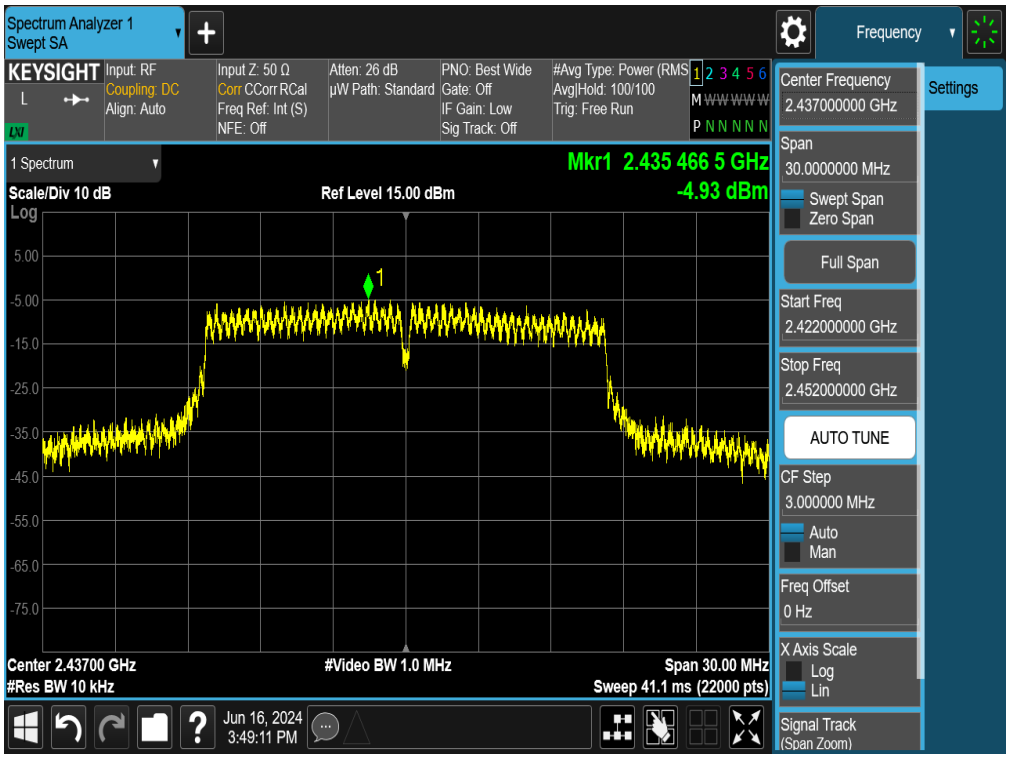
Plot 7-74. Power Spectral Density Plot MIMO ANT1 (802.11b – Ch. 6)



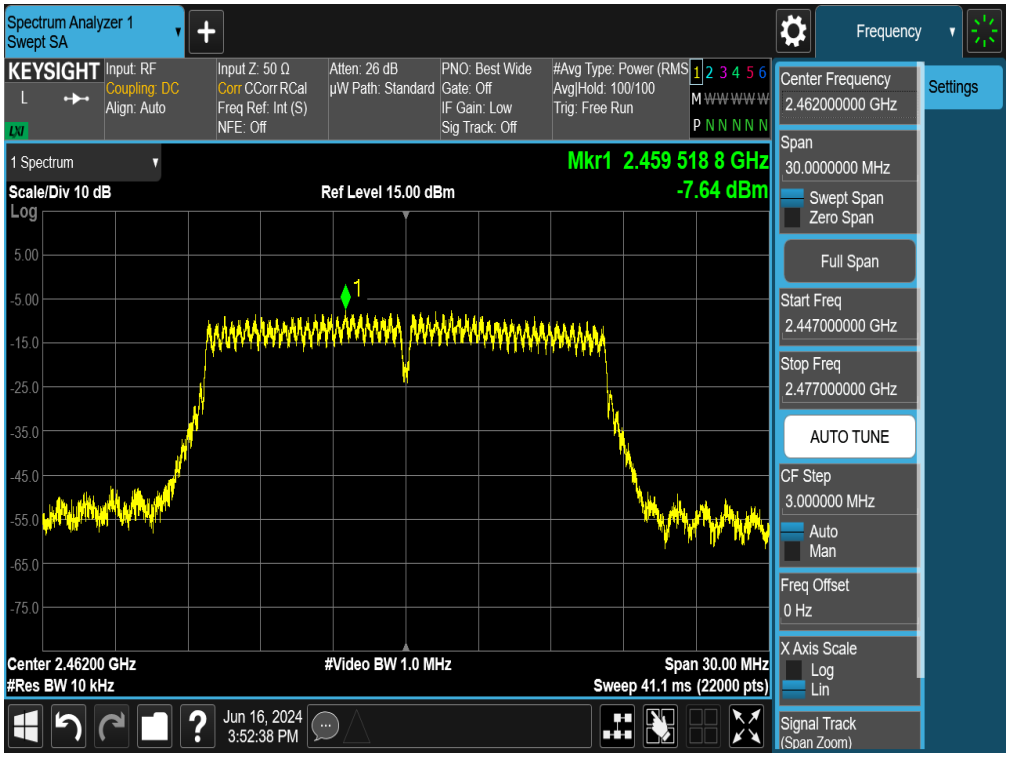
Plot 7-75. Power Spectral Density Plot MIMO ANT1 (802.11b – Ch. 11)



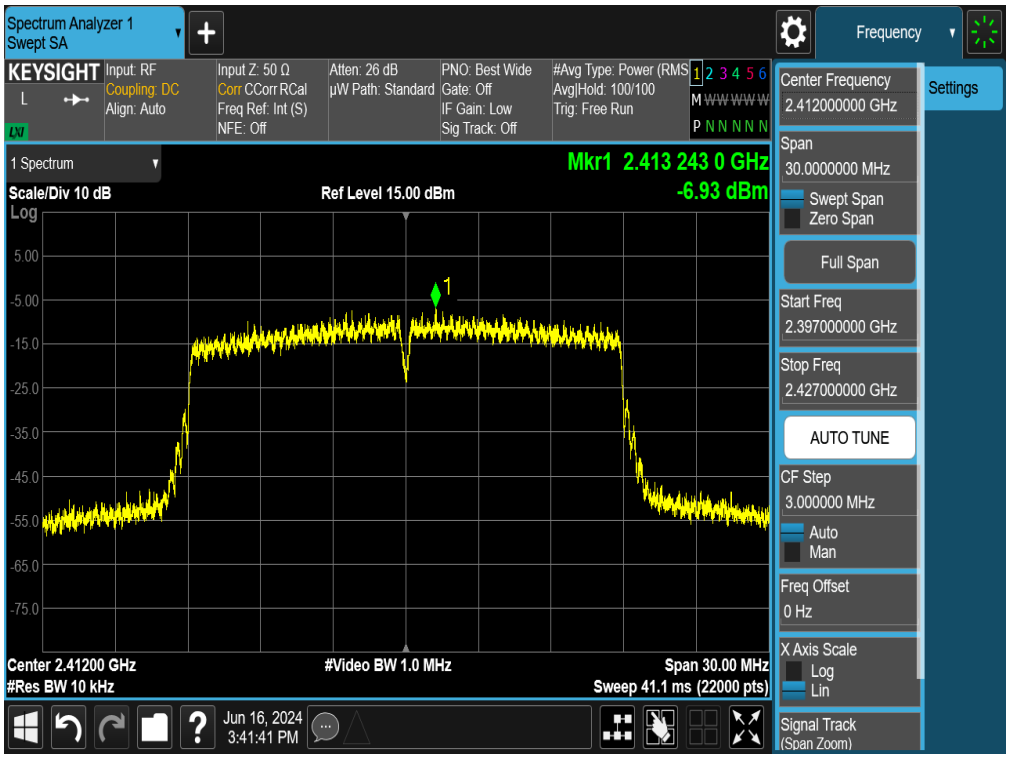
Plot 7-76. Power Spectral Density Plot MIMO ANT1 (802.11g – Ch. 1)



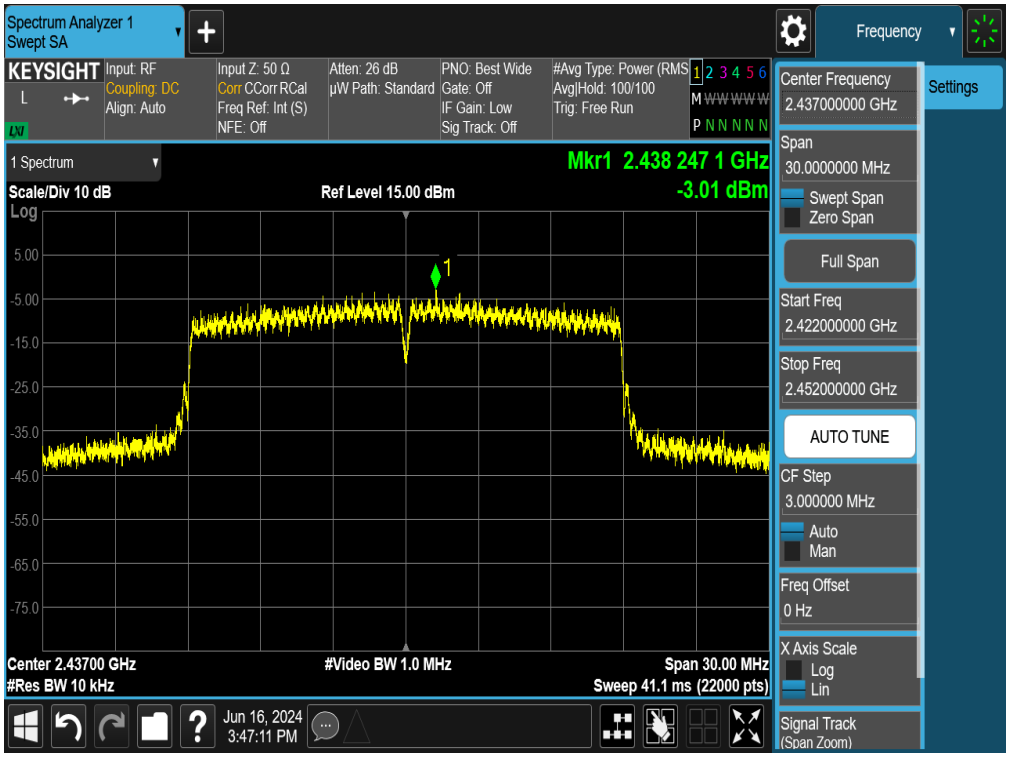
Plot 7-77. Power Spectral Density Plot MIMO ANT1 (802.11g – Ch. 6)



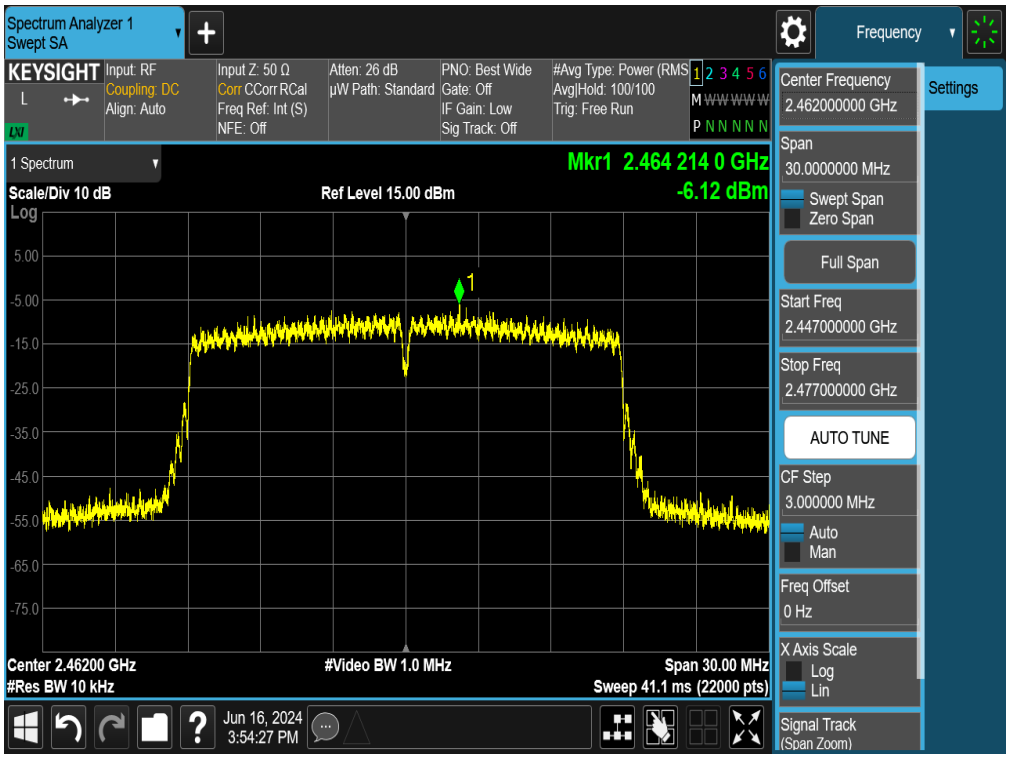
Plot 7-78. Power Spectral Density Plot MIMO ANT1 (802.11g – Ch. 11)



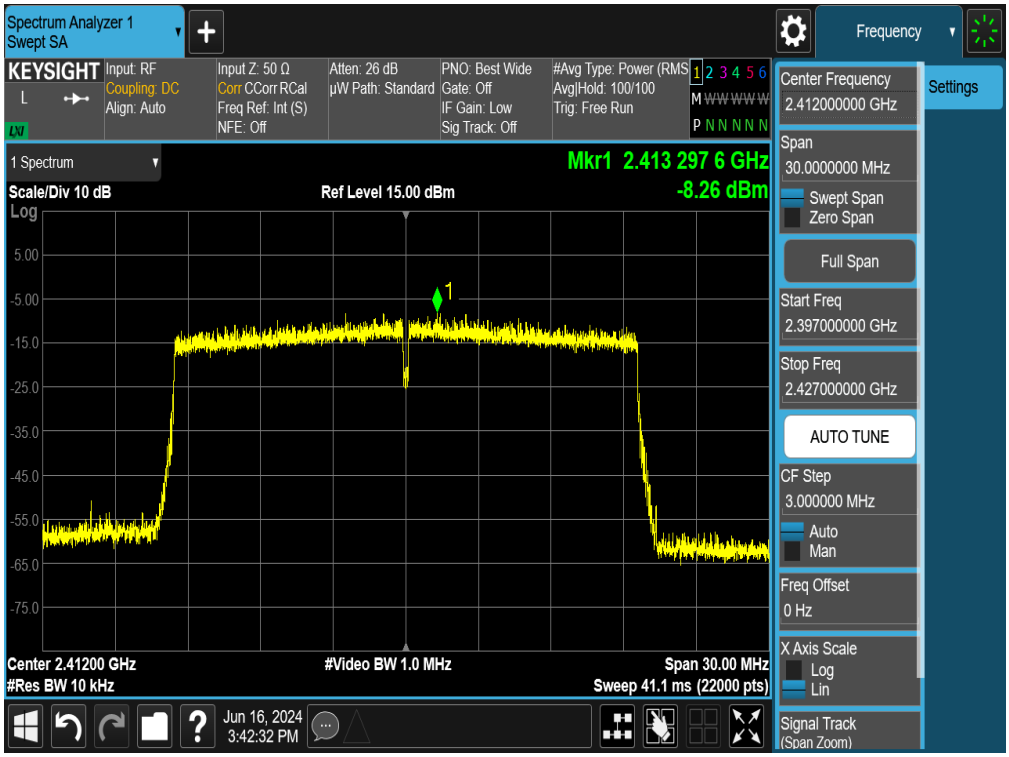
Plot 7-79. Power Spectral Density Plot MIMO ANT1 (802.11n (2.4GHz) – Ch. 1)



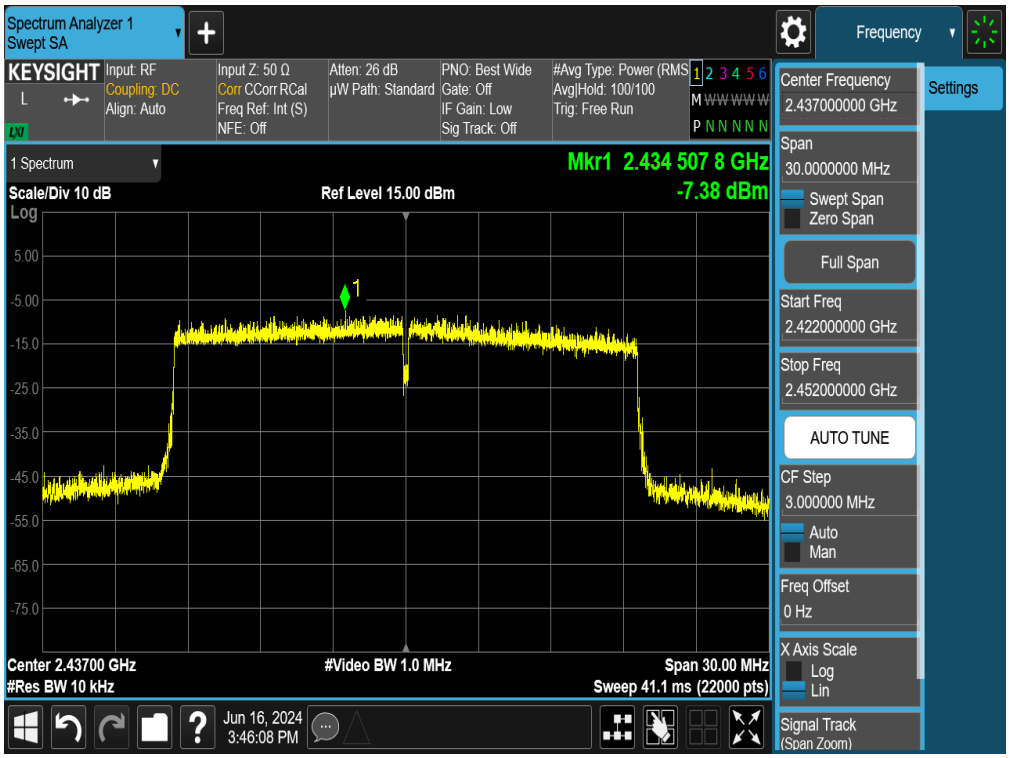
Plot 7-80. Power Spectral Density Plot MIMO ANT1 (802.11n (2.4GHz) – Ch. 6)



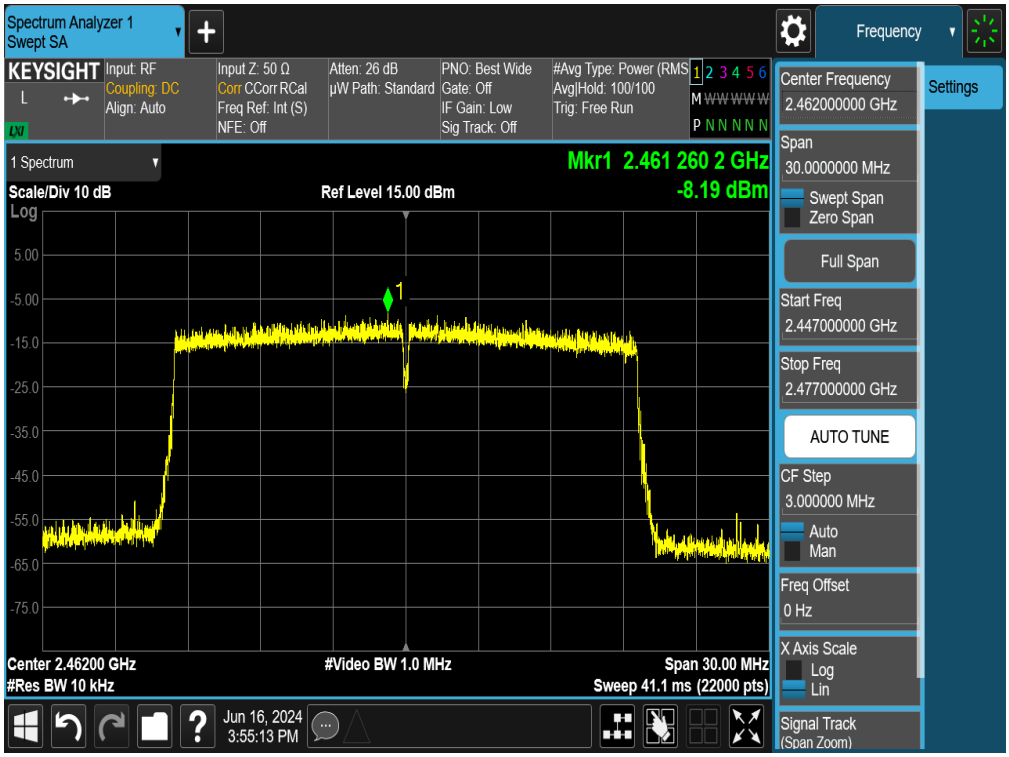
Plot 7-81. Power Spectral Density Plot MIMO ANT1 (802.11n (2.4GHz) – Ch. 11)



Plot 7-82. Power Spectral Density Plot MIMO ANT1 (802.11ax (2.4GHz) – Ch. 1)



Plot 7-83. Power Spectral Density Plot MIMO ANT1 (802.11ax (2.4GHz) – Ch. 6)



Plot 7-84. Power Spectral Density Plot MIMO ANT1 (802.11ax (2.4GHz) – Ch. 11)