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MEASUREMENT REPORT
FCC PART 15.247 WLAN OFDMA

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
06/10/2024 – 07/30/2024
Test Report Issue Date:
07/30/2024
Test Site/Location:
Element lab., Gyeonggi-do, South Korea
Test Report Serial No.:
1M2405140039-11.A3L

FCC ID:	**A3LSMX828U**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-X828U
EUT Type:	Portable Tablet
Frequency Range:	2412 – 2462MHz
Modulation Type:	OFDMA
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C (15.247)
Test Procedure(s):	ANSI C63.10-2013, , KDB 484596 D01 v02r03

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Prepared by

Reviewed by

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Channel Bandwidth [MHz]	IEEE Mode	Tones	Tx Frequency [MHz]	Antenna-1				Antenna-2				MIMO			
				Avg. Conducted		Peak Conducted		Avg. Conducted		Peak Conducted		Avg. Conducted		Peak Conducted	
				Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]
20	802.11ax OFDMA	26T	2412 - 2462	15.78	11.98	188.80	22.76	15.78	11.98	196.79	22.94	30.70	14.87	385.19	25.86
	802.11ax OFDMA	52T	2412 - 2462	25.00	13.98	224.39	23.51	23.33	13.68	236.59	23.74	48.48	16.86	451.92	26.55
	802.11ax OFDMA	106T	2412 - 2462	30.55	14.85	282.49	24.51	31.05	14.92	271.64	24.34	61.54	17.89	532.07	27.26
	802.11ax OFDMA	242T	2412 - 2462	31.33	14.96	252.93	24.03	30.76	14.88	255.86	24.08	56.46	17.52	492.76	26.93

EUT Overview

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Test Location

These measurement tests were conducted at the Element Suwon Laboratory located at 13, Heungdeok 1-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 16954, South Korea. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology Suwon, Ltd. located in Yongin-si, Gyeonggi-do, 16954, South Korea.

- Element Materials Technology Suwon, Ltd. is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation(A2LA) with Certificate number 2041.04 for Specific Absorption Rate (SAR), and Electromagnetic Compatibility (EMC) & Telecommunications testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Materials Technology Suwon, Ltd. facility is accredited, designated, and recognized in accordance with the provision of Radio Wave Act and International Standard ISO/IEC 17025:2017 under the National Radio Research Agency.

  - Designation Number / CABID: KR0169
  - Test Firm Registration Number of FCC: 417945
  - Test Firm Registration Number of ISED: 26168

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Tablet FCC ID: A3LSMX828U**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

Test Device Serial No.: 2003M, 030Y, 0240M, 2065M,

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 5G NR (FR1 and FR2), 802.11b/g/n/ac/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), Wireless Power Transfer.

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

Table 2-1. Frequency/ Channel Operations

Notes:

1. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of ANSI C63.10-2013 and KDB 558074 D01 v05r02. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Bandwidth	Tone Type	Tone Size	ANT1	ANT2	MIMO (1+2)
			Duty Cycle [%]	Duty Cycle [%]	Duty Cycle [%]
20MHz	RU	26T	98.49	98.47	98.97
		52T	99.37	99.38	98.85
		106T	98.21	98.17	97.67
		242T	96.82	96.64	94.74

Table 2-2. Measured Duty Cycles

2. The device employs MIMO technology. Below are the possible configurations.

WiFi Configurations		SISO		SDM		CDD	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
2.4GHz	11ax	✓	✓	✓	✓	✓	✓
	11be	✓	✓	✓	✓	✓	✓

Table 2-3. Antenna Configuration

✓= Support ; × = NOT Support
SISO = Single Input Single Output
SDM = Spatial Diversity Multiplexing – MIMO function
CDD = Cyclic Delay Diversity - 2Tx Function

3. The device supports the following data rates (shown in Mbps):

MCS Index		Spatial Stream	OFDMA (802.11ax/be)												OFDMA (802.11be)					
			26T			52T			106T			242T			52+26T			106+26T		
HE	EHT		0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI
0	0	1	0.9	0.8	0.8	1.8	1.7	1.5	3.8	3.5	3.2	8.6	8.1	7.3	17.2	16.3	14.6	2.6	2.5	2.3
1	1	1	1.8	1.7	1.5	3.5	3.3	3	7.5	7.1	6.4	17.2	16.3	14.6	34.4	32.5	29.3	5.3	5	4.5
2	2	1	2.6	2.5	2.3	5.3	5	4.5	11.3	10.6	9.6	25.8	24.4	21.9	51.6	48.8	43.9	7.9	7.5	6.8
3	3	1	3.5	3.3	3	7.1	6.7	6	15	14.2	12.8	34.4	32.5	29.3	68.8	65	58.5	10.6	10	9
4	4	1	5.3	5	4.5	10.6	10	9	22.5	21.3	19.1	51.6	48.8	43.9	103.2	97.5	87.8	15.9	15	13.5
5	5	1	7.1	6.7	6	14.1	13.3	12	30	28.3	25.5	68.8	65	58.5	137.6	130	117	21.2	20	18
6	6	1	7.9	7.5	6.8	15.9	15	13.5	33.8	31.9	28.7	77.4	73.1	65.8	154.9	146.3	131.6	23.8	22.5	20.3
7	7	1	8.8	8.3	7.5	17.6	16.7	15	37.5	35.4	31.9	86	81.3	73.1	172.1	162.5	146.3	26.5	25	22.5
8	8	1	10.6	10	9	21.2	20	18	45	42.5	38.3	103.2	97.5	87.8	206.5	195	175.5	31.8	30	27
9	9	1	11.8	11.1	10	23.5	22.2	20	50	47.2	42.5	114.7	108.3	97.5	229.4	216.7	195	35.3	33.3	30
10	10	1	13.2	12.5	11.3	26.5	25	22.5	56.3	53.1	47.8	129	121.9	109.7	258.1	243.8	219.4	39.7	37.5	33.8
11	11	1	14.7	13.9	12.5	29.4	27.8	25	62.5	59	53.1	143.4	135.4	121.9	286.8	270.8	243.8	44.1	41.7	37.5
	12	1	15.9	15	13.5	31.8	30	27	67.5	63.8	57.4	154.9	146.3	131.6	309.7	292.5	263.3	47.6	45	40.5
	13	1	17.6	16.7	15	35.3	33.3	30	75	70.8	63.8	172.1	162.5	146.3	344.1	325	292.5	52.9	50	45
0	0	2	1.8	1.7	1.5	3.5	3.3	3	7.5	7.1	6.4	17.2	16.3	14.6	34.4	32.5	29.3	5.3	5	4.5
1	1	2	3.5	3.3	3	7.1	6.7	6	15	14.2	12.8	34.4	32.5	29.3	68.8	65	58.5	10.6	10	9
2	2	2	5.3	5	4.5	10.6	10	9	22.5	21.3	19.1	51.6	48.8	43.9	103.2	97.5	87.8	15.9	15	13.5
3	3	2	7.1	6.7	6	14.1	13.3	12	30	28.3	25.5	68.8	65	58.5	137.6	130	117	21.2	20	18
4	4	2	10.6	10	9	21.2	20	18	45	42.5	38.3	103.2	97.5	87.8	206.5	195	175.5	31.8	30	27
5	5	2	14.1	13.3	12	28.2	26.7	24	60	56.7	51	137.6	130	117	275.3	260	234	42.4	40	36
6	6	2	15.9	15	13.5	31.8	30	27	67.5	63.8	57.4	154.9	146.3	131.6	309.7	292.5	263.3	47.6	45	40.5
7	7	2	17.6	16.7	15	35.3	33.3	30	75	70.8	63.8	172.1	162.5	146.3	344.1	325	292.5	52.9	50	45
8	8	2	21.2	20	18	42.4	40	36	90	85	76.5	206.5	195	175.5	412.9	390	351	63.5	60	54
9	9	2	23.5	22.2	20	47.1	44.4	40	100	94.4	85	229.4	216.7	195	458.8	433.3	390	70.6	66.7	60
10	10	2	26.5	25	22.5	52.9	50	45	112.5	106.3	95.6	258.1	243.8	219.4	516.2	487.5	438.8	79.4	75	67.5
11	11	2	29.4	27.8	25	58.8	55.6	50	125	118.1	106.3	286.8	270.8	243.8	573.5	541.7	487.5	88.2	83.3	75
	12	2	31.8	30	27	63.5	60	54	135	127.5	114.8	309.7	292.5	263.3	619.4	585	526.5	95.3	90	81
	13	2	35.3	33.3	30	70.6	66.7	60	150	141.7	127.5	344.1	325	292.5	688.2	650	585	105.9	100	90

Table 2-4. Supported Data Rates

2.3 Test Configuration

ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing. See Sections 7.5 for radiated emissions test setups, and 7.2, 7.3 and 7.4 for antenna port conducted emissions test setups.

2.4 Antenna Description

This device is only used with its integral antennas as shown in the documentation of this filing. The antenna gains for this device are as shown in the table below:

Frequency [GHz]	Antenna-1 Gain [dBi]	Antenna-2 Gain [dBi]	Directional Gain [dBi]
2.4	-5.20	-5.60	-2.39

Table 2-5. Antenna Peak Gain

2.5 Software and Firmware

Testing was performed on device(s) using software/firmware version X828UUSQU0AXFE installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

Deviation from measurement procedure…….....None

3.2 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

3.3 Environmental Conditions

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antennas of the EUT are **permanently attached.**
- There are no provisions for connections to an external antenna.

Conclusion:

The EUT unit complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.95
Radiated Disturbance (<1GHz)	4.10
Radiated Disturbance (>1GHz)	4.82
Radiated Disturbance (>18GHz)	4.96

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	N9030A	PXA Signal Analyzer	7/9/2024	Annual	7/9/2025	MY49432391
Anritsu	S820E	Cable and Antenna Analyzer	7/9/2024	Annual	7/9/2025	1839097
Anritsu	TOSLKF50A-40	Calibration Kit	N/A	-	N/A	1825024
Com-Power	AL-130R	Active Loop Antenna	10/21/2022	Biennial	10/20/2024	10160045
Fairview Microwave	FM2CP1122-10	Coupler	7/10/2024	Annual	7/10/2025	1946
Keysight Technologies	N9030B	PXA Signal Analyzer	7/8/2024	Annual	7/8/2025	MY57143276
Mini-Circuits	BW-N10W5+	Attenuator	1/11/2024	Annual	1/10/2025	TEMPNO.01-151
NARDA	180-442A-KF	Horn Antenna (Small)	1/16/2024	Annual	1/15/2025	T058701-03
Rohde & Schwarz	TS-PR1840	Preamplifier	7/10/2024	Annual	7/10/2025	100049
Rohde & Schwarz	ESW43	EMI TEST Receiver	7/9/2024	Annual	7/9/2025	101761
Rohde & Schwarz	TS-SFUNIT-Rx	Shielded Filter Unit	1/11/2024	Annual	1/10/2025	102151
Schwarzbeck	VULB9162	Broadband TRILOG Antenna	6/1/2023	Biennial	5/31/2025	9162-217
Sunol Sciences	DRH-118	Horn Antenna	7/16/2024	Biennial	7/16/2025	A102416-1
Sunol Sciences	DRH-118	Horn Antenna	1/16/2024	Biennial	1/16/2025	A060215

Table 6-1. Test Equipment

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics CO., Ltd.

FCC ID: A3LSMX828U

FCC Classification: Digital Transmission System (DTS)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz.	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	Transmitter Output Power	shall not exceed 1 W		PASS	Section 7.3
15.247(e)	Transmitter Power Spectral Density	shall not be greater than 8 dBm in any 3 kHz band		PASS	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Section 7.5, 7.6
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	RADIATED	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst-case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "WLAN Automation," Version 3.5 .
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 1.6.4.
6) 802.11ax/be OFDMA testing was performed for all signal tone configurations as specified by the 802.11ax standard. Worst case results are determined and reported per the guidance provided at the October 2018 TCB Workshop.

7.2 6dB Bandwidth Measurement

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter 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 were investigated and the worst case configuration results are reported in this section.

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Setup

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

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

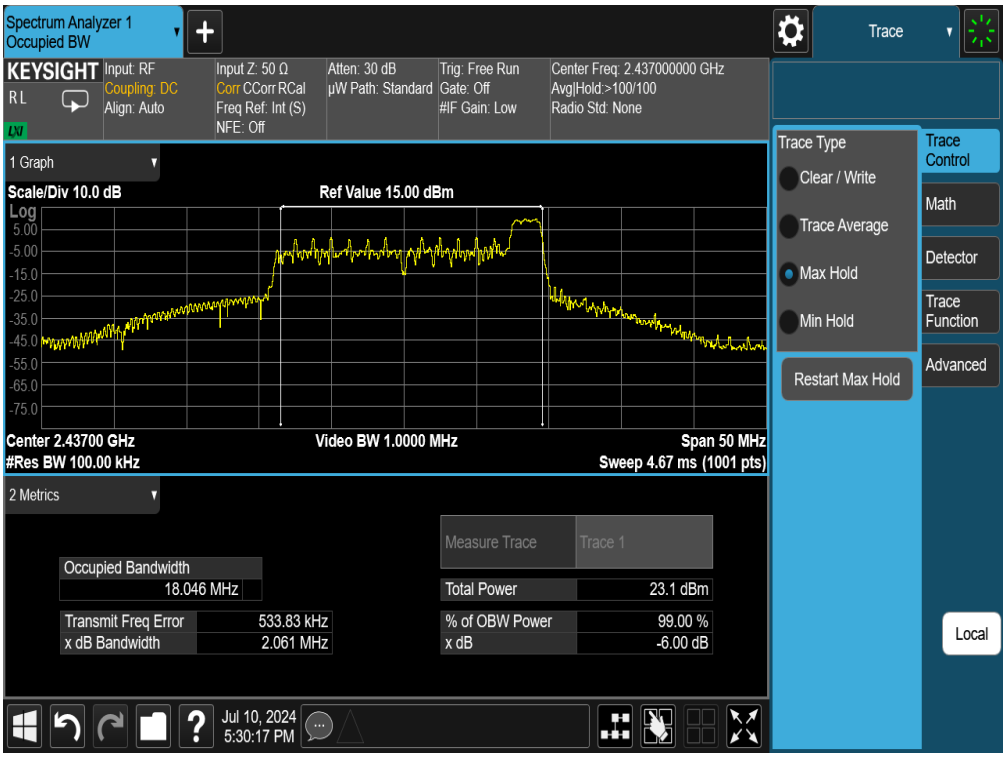
1. Based on preliminary measurements, it was determined that, of all the tone configurations, the 26T configuration produced the worst case 6dB Bandwidth measurement. Only the worst case data is included in this section.
2. The 6dB bandwidth for each channel was measured with the RU index showing the highest conducted power.

7.2.1 SISO Antenna-1 6dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	ax	26T	MCS0	2.664	0.500
2437	6	ax	26T	MCS0	2.061	0.500
2462	11	ax	26T	MCS0	2.061	0.500
2412	1	ax	242T	MCS0	18.85	0.500
2437	6	ax	242T	MCS0	18.52	0.500
2462	11	ax	242T	MCS0	18.77	0.500

Table 7-2. Conducted 6dB Bandwidth Measurements SISO ANT1

Plot 7-1. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1)



Plot 7-2. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 6)

Plot 7-3. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11)

Plot 7-4. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1)

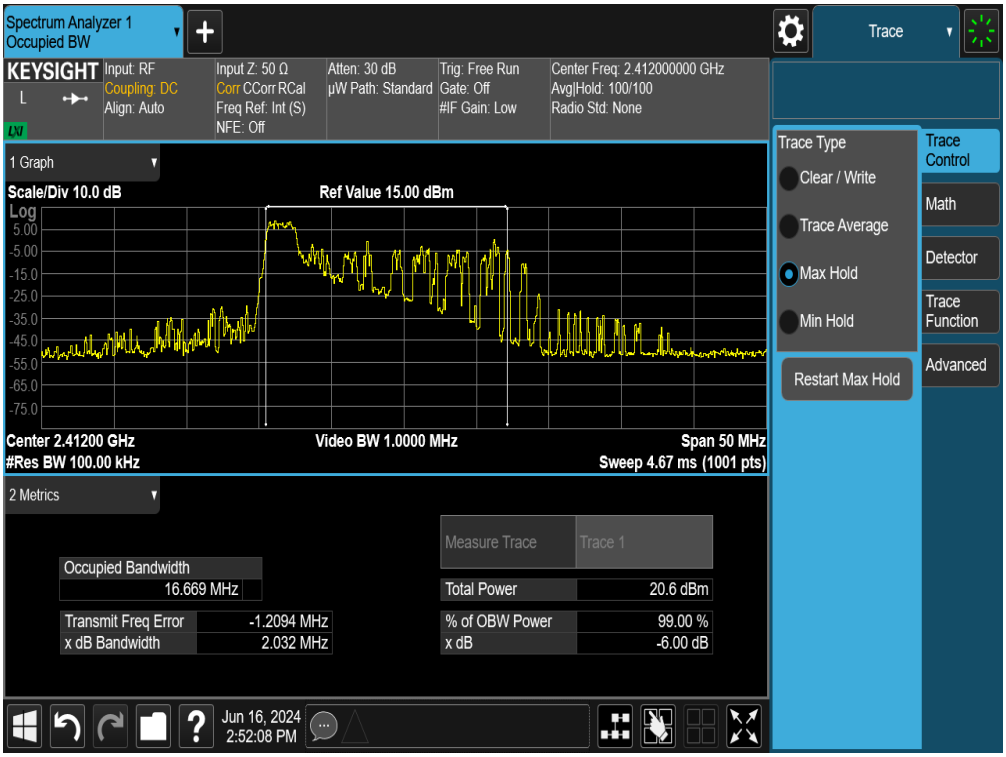
Plot 7-5. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 6)

Plot 7-6. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11)

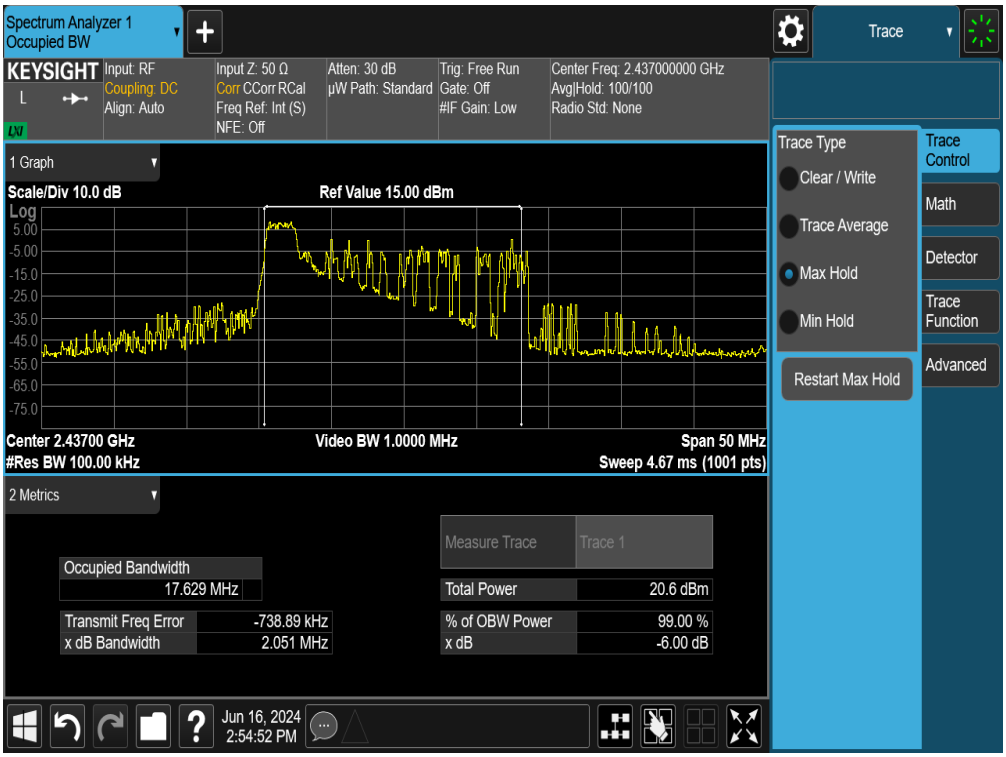
7.2.2 SISO Antenna-2 6dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	ax	26T	MCS0	2.032	0.500
2437	6	ax	26T	MCS0	2.051	0.500
2462	11	ax	26T	MCS0	2.061	0.500
2412	1	ax	242T	MCS0	18.74	0.500
2437	6	ax	242T	MCS0	15.97	0.500
2462	11	ax	242T	MCS0	18.25	0.500

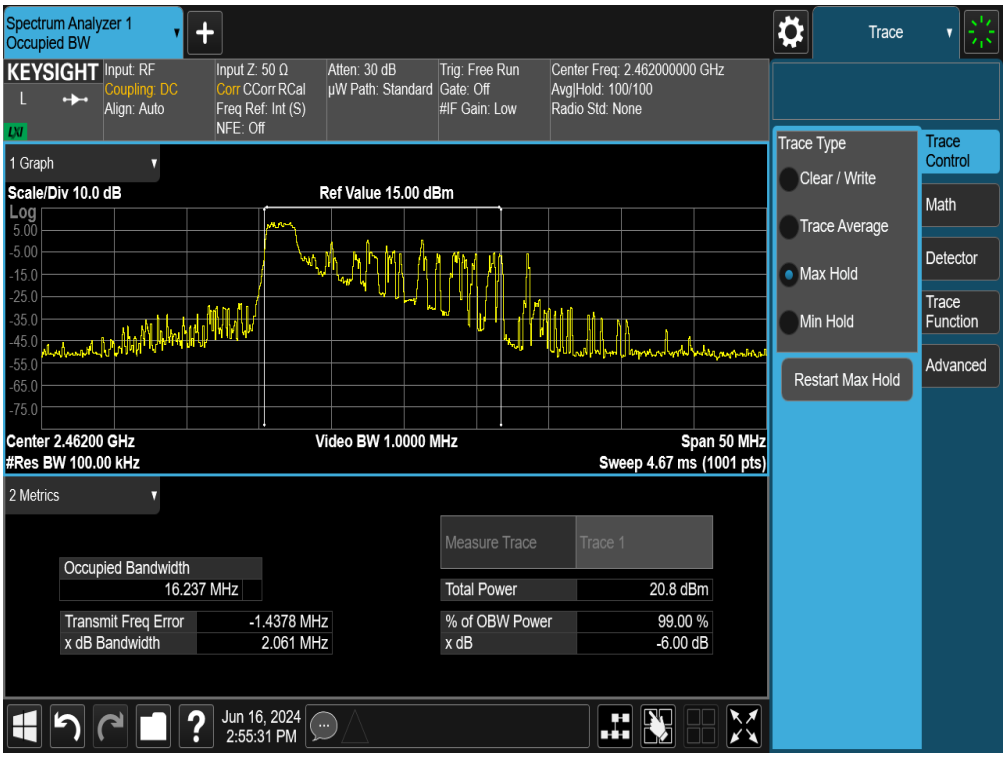
Table 7-3. Conducted 6dB Bandwidth Measurements SISO ANT2



Plot 7-7. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1)



Plot 7-8. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6)



Plot 7-9. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11)

Plot 7-10. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1)

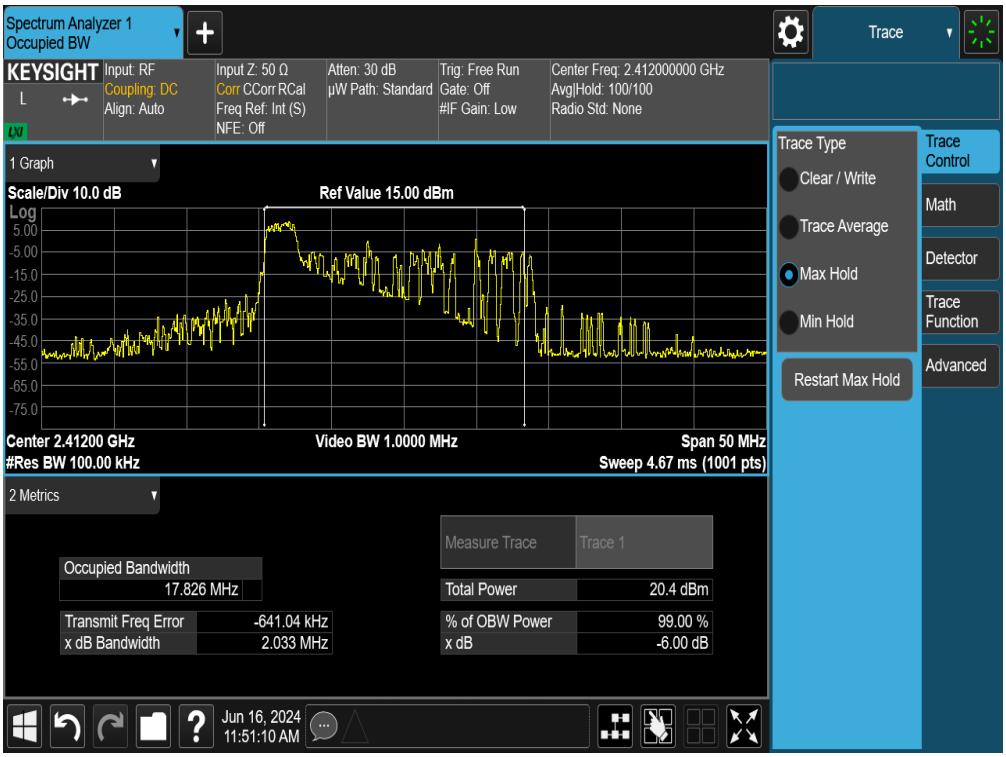
Plot 7-11. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6)

Plot 7-12. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11)

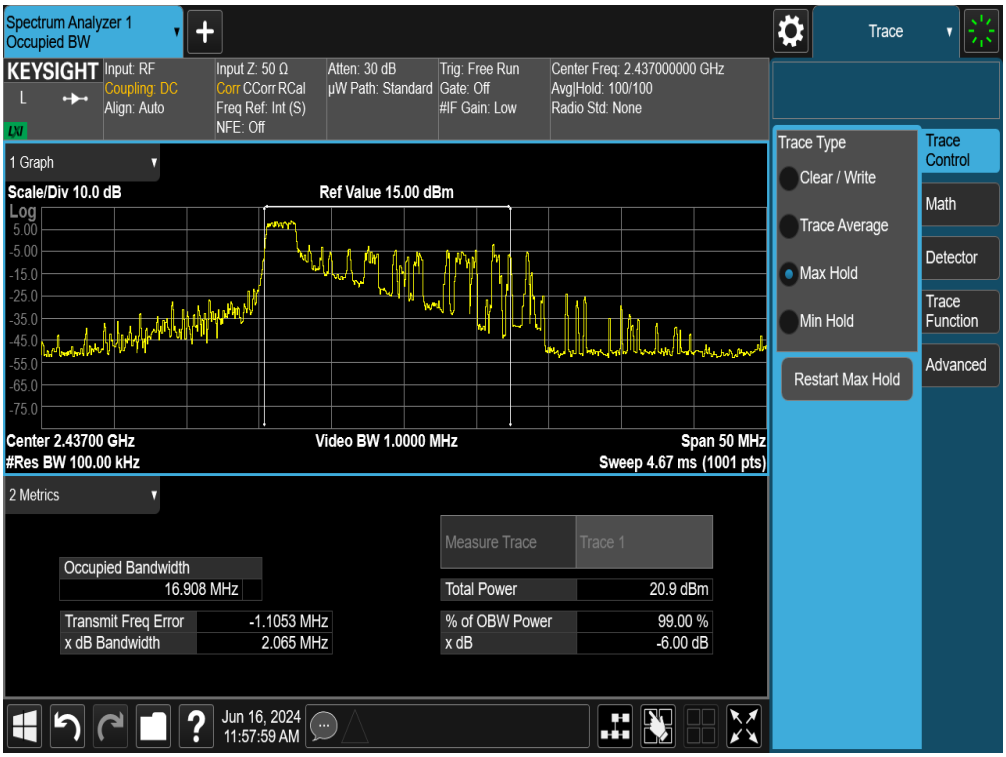
7.2.3 MIMO 6dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Bandwidth [MHz] - Ant1	Measured Bandwidth [MHz] - Ant2	Minimum Bandwidth [MHz]
2412	1	ax	26T	MCS0	2.033	2.033	0.500
2437	6	ax	26T	MCS0	2.065	2.044	0.500
2462	11	ax	26T	MCS0	2.027	2.028	0.500
2412	1	ax	242T	MCS0	18.16	18.82	0.500
2437	6	ax	242T	MCS0	17.06	14.83	0.500
2462	11	ax	242T	MCS0	16.55	18.82	0.500

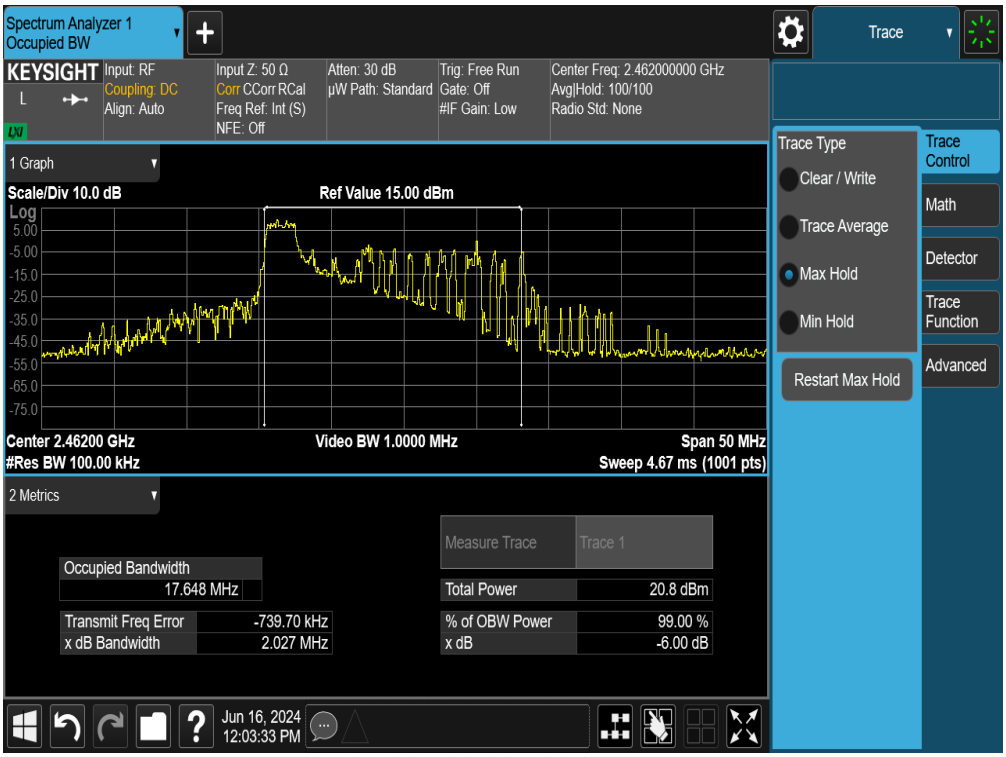
Table 7-4. Conducted 6dB Bandwidth Measurements MIMO



Plot 7-13. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 26Tones – Ch. 1)



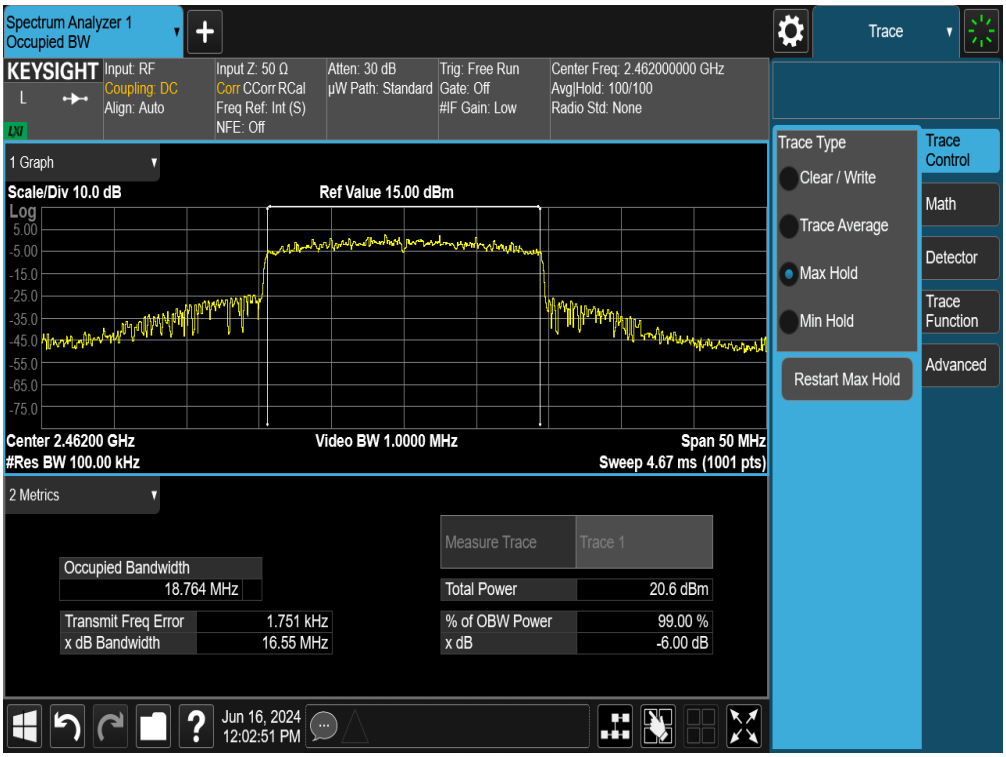
Plot 7-14. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 26Tones – Ch. 6)



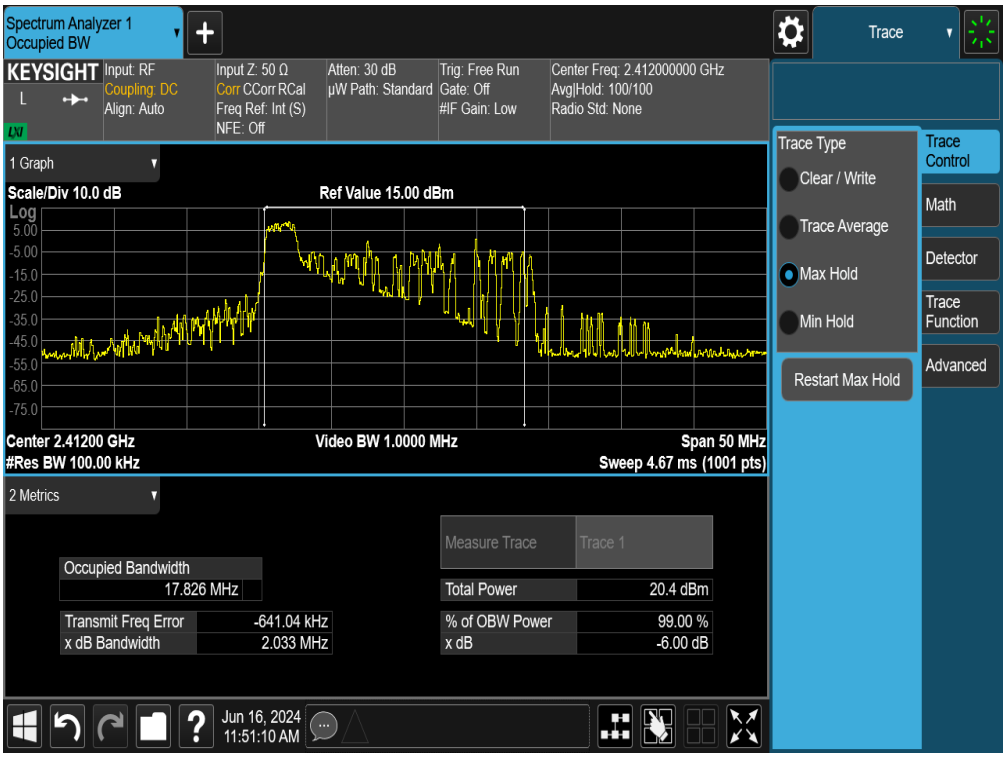
Plot 7-15. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 26Tones – Ch. 11)

Plot 7-16. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 242Tones – Ch. 1)

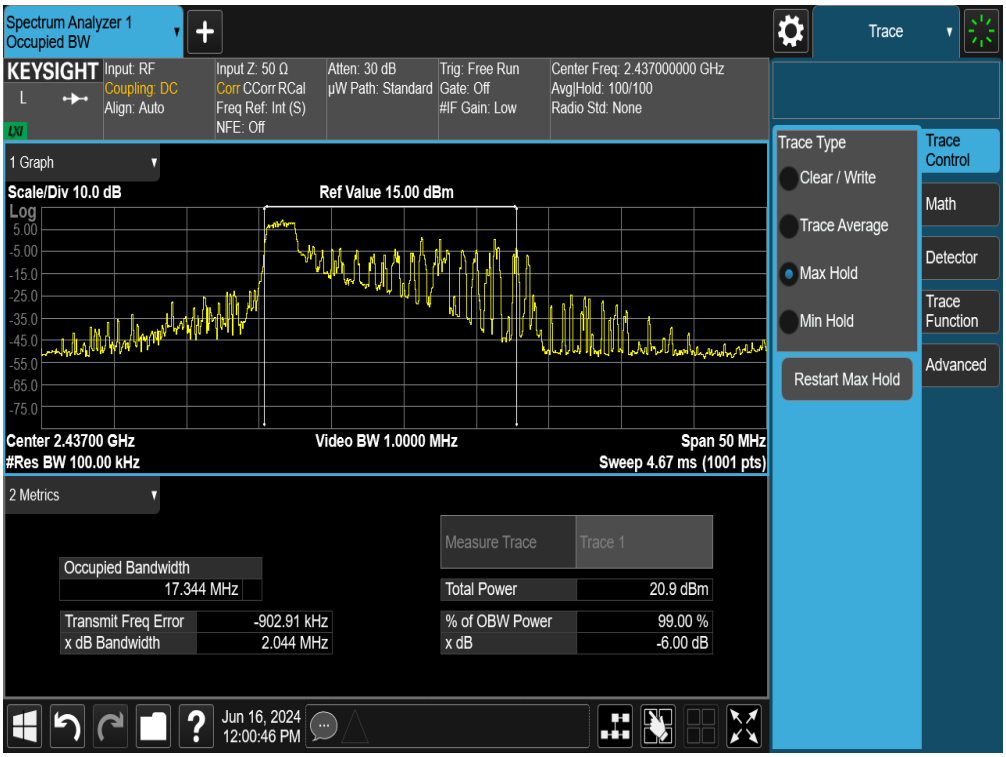
Plot 7-17. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 242Tones – Ch. 6)



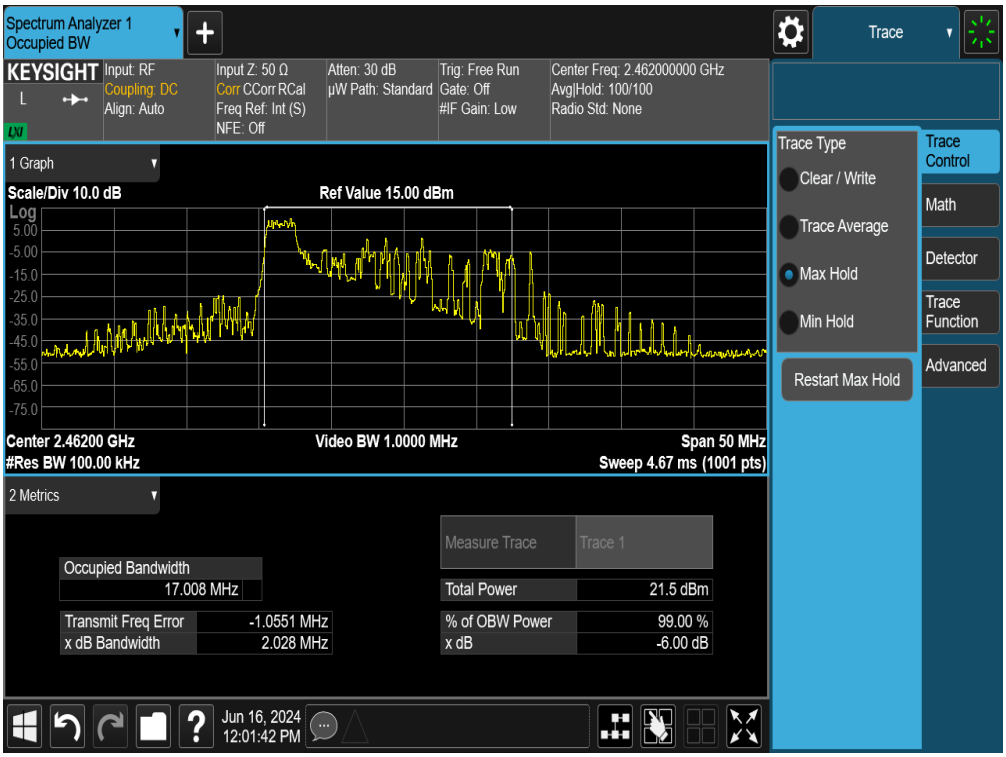
Plot 7-18. 6dB Bandwidth Plot MIMO ANT1 (802.11ax OFDMA – 242Tones – Ch. 11)



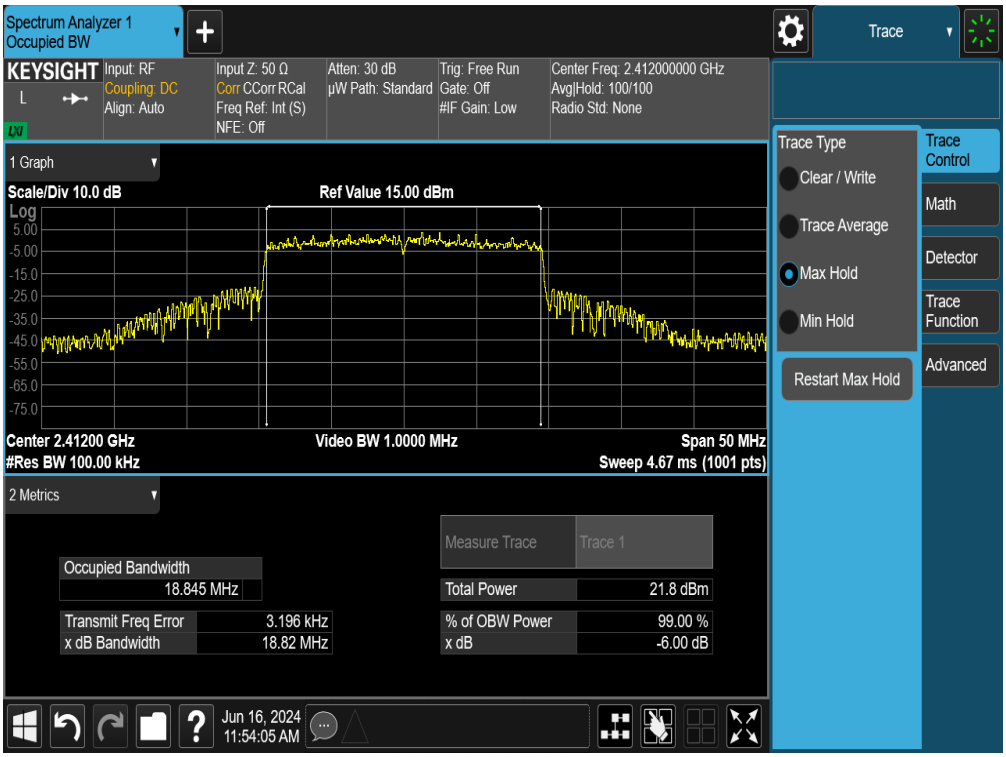
Plot 7-19. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 26Tones – Ch. 1)



Plot 7-20. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 26Tones – Ch. 6)

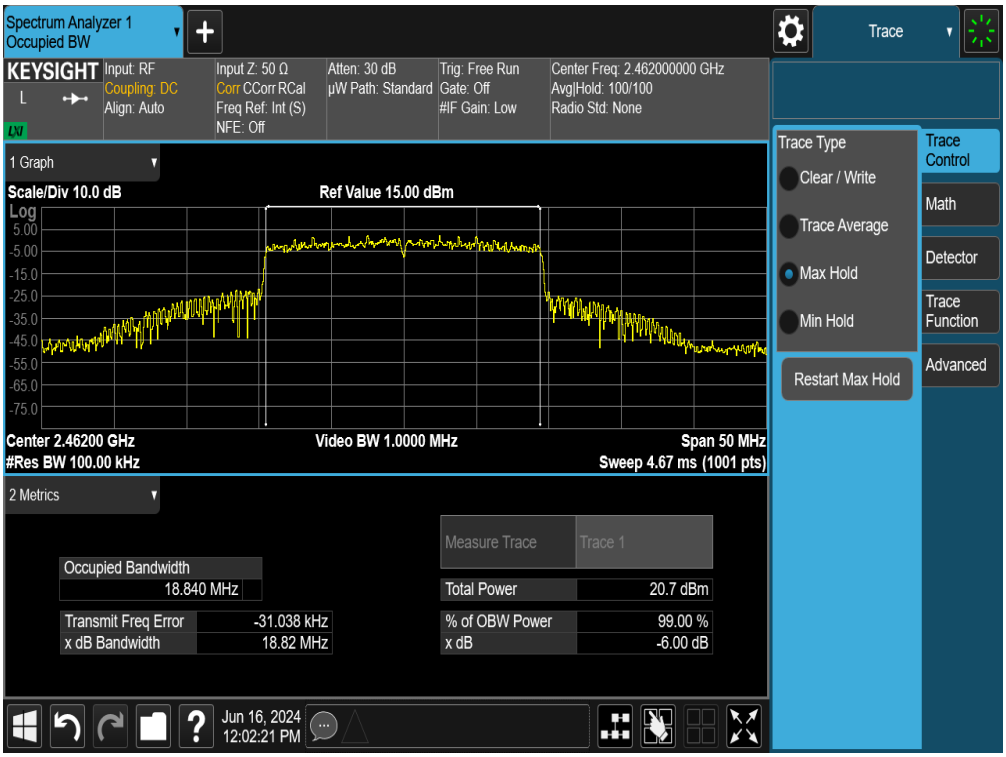


Plot 7-21. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 26Tones – Ch. 11)



Plot 7-22. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 242Tones – Ch. 1)

Plot 7-23. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 242Tones – Ch. 6)



Plot 7-24. 6dB Bandwidth Plot MIMO ANT2 (802.11ax OFDMA – 242Tones – 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.

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	26T	0	11.13	22.76	30.00	-18.87	-7.24
			4	11.18	22.65	30.00	-18.82	-7.35
			8	11.57	22.57	30.00	-18.43	-7.43
2437	6	26T	0	11.34	22.45	30.00	-18.66	-7.55
			4	11.67	22.35	30.00	-18.33	-7.65
			8	11.73	22.38	30.00	-18.27	-7.62
2462	11	26T	0	11.98	22.62	30.00	-18.02	-7.38
			4	11.62	22.54	30.00	-18.38	-7.46
			8	11.34	22.47	30.00	-18.66	-7.53

Table 7-5. Conducted Output Power Measurements SISO ANT1 (26 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	52T	37	13.27	23.17	30.00	-16.73	-6.83
			38	13.24	23.12	30.00	-16.76	-6.88
			40	13.31	23.16	30.00	-16.69	-6.84
2437	6	52T	37	13.51	23.46	30.00	-16.49	-6.54
			38	13.67	23.46	30.00	-16.33	-6.54
			40	13.78	23.48	30.00	-16.22	-6.52
2462	11	52T	37	13.98	23.51	30.00	-16.02	-6.49
			38	13.67	23.42	30.00	-16.33	-6.58
			40	13.31	23.41	30.00	-16.69	-6.59

Table 7-6. Conducted Output Power Measurements SISO ANT1 (52 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)	Peak Conducted Powers (dBm)	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	106T	53	14.11	24.30	30.00	-5.70	-5.70
			54	14.48	24.23	30.00	-5.77	-5.77
2437	6	106T	53	14.24	24.51	30.00	-5.49	-5.49
			54	14.38	24.27	30.00	-5.73	-5.73
2462	11	106T	53	14.85	24.16	30.00	-5.84	-5.84
			54	14.28	24.32	30.00	-5.68	-5.68

Table 7-7. Conducted Output Power Measurements SISO ANT1 (106 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	242T	61	14.43	23.84	30.00	-6.16	-6.16
2437	6	242T	61	14.89	23.71	30.00	-6.29	-6.29
2462	11	242T	61	14.96	24.03	30.00	-5.97	-5.97

Table 7-8. Conducted Output Power Measurements SISO ANT1 (242 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	26T	0	11.98	22.91	30.00	-18.02	-7.09
			4	11.88	22.87	30.00	-18.12	-7.13
			8	11.93	22.94	30.00	-18.07	-7.06
2437	6	26T	0	11.72	22.64	30.00	-18.28	-7.36
			4	11.94	22.71	30.00	-18.06	-7.29
			8	11.71	22.63	30.00	-18.29	-7.37
2462	11	26T	0	11.98	22.54	30.00	-18.02	-7.46
			4	11.61	22.27	30.00	-18.39	-7.73
			8	11.31	22.39	30.00	-18.69	-7.61

Table 7-9. Conducted Output Power Measurements SISO ANT2 (26 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	52T	37	13.52	23.31	30.00	-16.48	-6.69
			38	13.61	23.74	30.00	-16.39	-6.26
			40	13.45	23.11	30.00	-16.55	-6.89
2437	6	52T	37	13.42	23.12	30.00	-16.58	-6.88
			38	13.54	23.02	30.00	-16.46	-6.98
			40	13.43	23.34	30.00	-16.57	-6.66
2462	11	52T	37	13.68	23.46	30.00	-16.32	-6.54
			38	13.45	23.42	30.00	-16.55	-6.58
			40	13.02	23.15	30.00	-16.98	-6.85

Table 7-10. Conducted Output Power Measurements SISO ANT2 (52 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers (dBm)	Peak Conducted Powers (dBm)	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	106T	53	14.66	24.14	30.00	-15.34	-5.86
			54	14.62	24.34	30.00	-15.38	-5.66
2437	6	106T	53	14.63	23.26	30.00	-15.37	-6.74
			54	14.33	23.15	30.00	-15.67	-6.85
2462	11	106T	53	14.92	24.02	30.00	-15.08	-5.98
			54	14.22	24.15	30.00	-15.78	-5.85

Table 7-11. Conducted Output Power Measurements SISO ANT2 (106 Tones)

Freq [MHz]	Channel	Tones	RU Index	Avg Conducted Powers [dBm]	Peak Conducted Powers [dBm]	Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
2412	1	242T	61	14.88	24.08	30.00	-5.92	-5.92
2437	6	242T	61	14.77	23.37	30.00	-6.63	-6.63
2462	11	242T	61	14.72	24.01	30.00	-5.99	-5.99

Table 7-12. Conducted Output Power Measurements SISO ANT2 (242 Tones)

Freq [MHz]	Channel	Tones	RU Index	Conducted Power [dBm]						Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
				Antenna-1		Antenna-2		MIMO				
				AVG	PEAK	AVG	PEAK	AVG	PEAK			
2412	1	26T	0	11.02	22.52	11.98	23.15	14.54	25.86	30.00	-15.46	-4.14
			4	11.25	21.88	11.97	22.04	14.64	24.97	30.00	-15.36	-5.03
			8	11.46	22.75	11.41	22.52	14.45	25.65	30.00	-15.55	-4.35
2437	6	26T	0	11.25	22.24	11.99	22.27	14.65	25.27	30.00	-15.35	-4.73
			4	11.41	21.46	11.98	22.04	14.71	24.77	30.00	-15.29	-5.23
			8	11.75	22.61	11.97	22.76	14.87	25.70	30.00	-15.13	-4.30
2462	11	26T	0	11.63	22.61	11.56	22.65	14.61	25.64	30.00	-15.39	-4.36
			4	11.65	20.82	11.98	21.67	14.83	24.28	30.00	-15.17	-5.72
			8	11.51	21.45	11.65	22.15	14.59	24.82	30.00	-15.41	-5.18

Table 7-13. Conducted Output Power Measurements MIMO (26 Tones)

Freq [MHz]	Channel	Tones	RU Index	Conducted Power [dBm]						Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
				Antenna-1		Antenna-2		MIMO				
				AVG	PEAK	AVG	PEAK	AVG	PEAK			
2412	1	52T	37	13.37	22.85	13.98	22.74	16.70	25.81	30.00	-13.30	-4.19
			38	13.08	23.15	13.72	22.81	16.42	25.99	30.00	-13.58	-4.01
			40	13.24	22.79	13.61	23.13	16.44	25.97	30.00	-13.56	-4.03
2437	6	52T	37	13.57	22.51	13.75	22.72	16.67	25.63	30.00	-13.33	-4.37
			38	13.74	23.10	13.81	23.08	16.79	26.10	30.00	-13.21	-3.90
			40	13.87	23.19	13.82	23.18	16.86	26.20	30.00	-13.14	-3.80
2462	11	52T	37	13.54	23.16	13.78	23.89	16.67	26.55	30.00	-13.33	-3.45
			38	13.52	22.84	13.53	23.14	16.54	26.00	30.00	-13.46	-4.00
			40	13.34	22.78	13.45	23.01	16.41	25.91	30.00	-13.59	-4.09

Freq [MHz]	Channel	Tones	RU Index	Conducted Power [dBm]						Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
				Antenna-1		Antenna-2		MIMO				
				AVG	PEAK	AVG	PEAK	AVG	PEAK			
2412	1	106T	53	14.21	23.81	14.87	24.13	17.56	26.98	30.00	-12.44	-3.02
			54	14.56	24.05	14.98	24.44	17.79	27.26	30.00	-12.21	-2.74
2437	6	106T	53	14.98	23.12	14.78	23.31	17.89	26.23	30.00	-12.11	-3.77
			54	14.64	23.21	14.15	23.28	17.41	26.26	30.00	-12.59	-3.74
2462	11	106T	53	14.56	24.03	14.89	24.12	17.74	27.09	30.00	-12.26	-2.91
			54	14.52	24.02	14.46	24.01	17.50	27.03	30.00	-12.50	-2.97

Table 7-15. Conducted Output Power Measurements MIMO (106 Tones)

Freq [MHz]	Channel	Tones	RU Index	Conducted Power [dBm]						Conducted Power Limit [dBm]	Avg Conducted Power Margin [dB]	Peak Conducted Power Margin [dB]
				Antenna-1		Antenna-2		MIMO				
				AVG	PEAK	AVG	PEAK	AVG	PEAK			
2412	1	242T	61	14.08	23.68	14.87	24.14	17.50	26.93	30.00	-12.50	-3.07
2437	6	242T	61	14.63	23.02	14.38	23.37	17.52	26.21	30.00	-12.48	-3.79
2462	11	242T	61	14.38	23.56	14.57	23.75	17.49	26.67	30.00	-12.51	-3.33

Table 7-16. Conducted Output Power Measurements MIMO (242 Tones)

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 11.02 dBm for Antenna 1 and 11.98 dBm for Antenna 2.

Antenna 1 + Antenna 2 = MIMO

(11.02 dBm + 11.98 dBm) = (12.65 mW + 15.78 mW) = 28.42 mW = 14.54 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, tones configurations, and RU indices were 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 = 3kHz
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

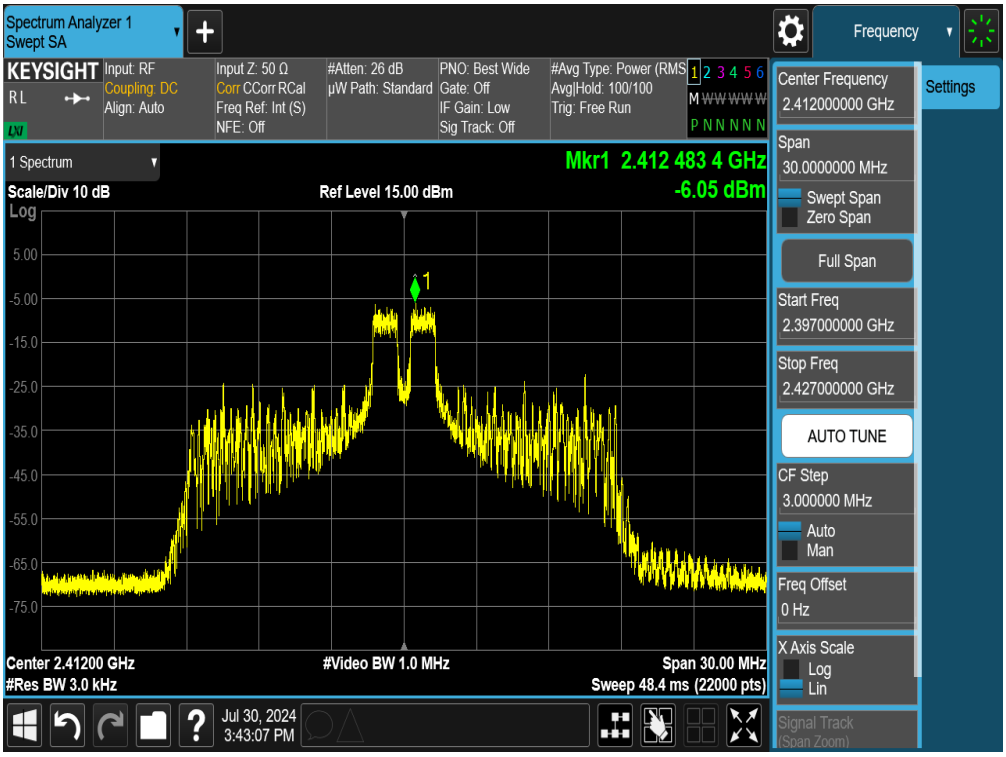
Test Notes

1. Based on preliminary measurements, it was determined that, of all of the tone configurations, the 26T configuration produced the worst case power spectral density measurement for partial loaded case. Therefore, only the 26 Tone configuration and 242 Tone data is included in this section.
2. The power spectral density for each channel was measured with the RU index showing the highest conducted power.

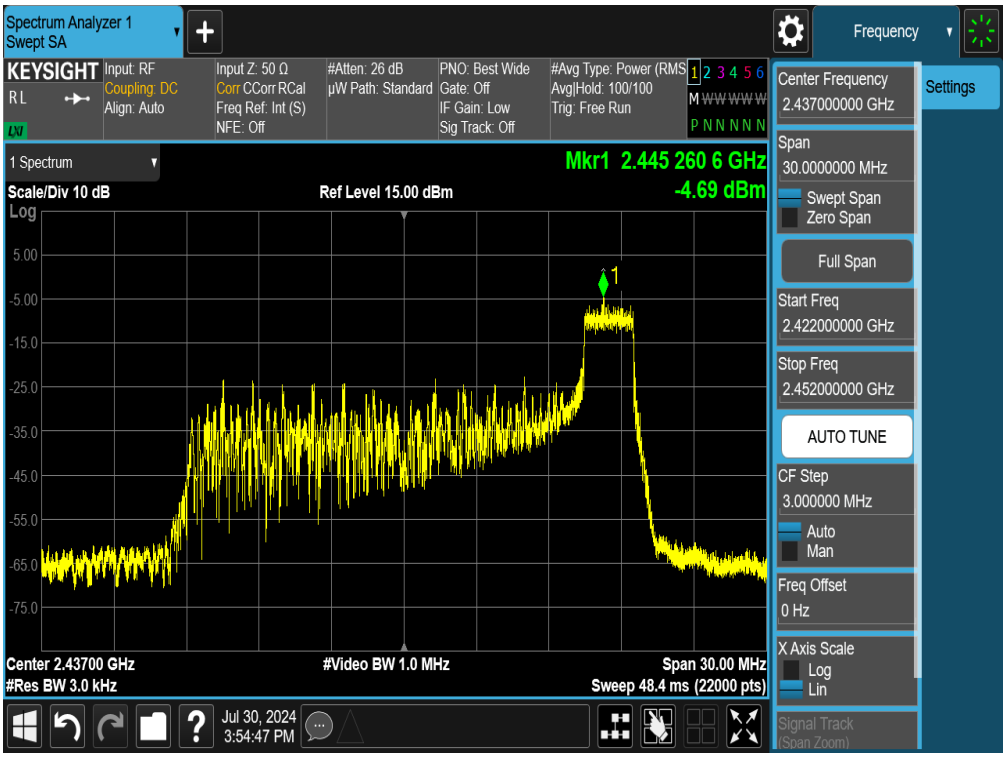
7.4.1 SISO Antenna-1 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-6.05	8.00	-14.05	Pass
2437	6	ax	26T	MCS0	-4.69	8.00	-12.69	Pass
2462	11	ax	26T	MCS0	-4.96	8.00	-12.96	Pass
2412	1	ax	242T	MCS0	-9.65	8.00	-17.65	Pass
2437	6	ax	242T	MCS0	-8.77	8.00	-16.77	Pass
2462	11	ax	242T	MCS0	-9.35	8.00	-17.35	Pass

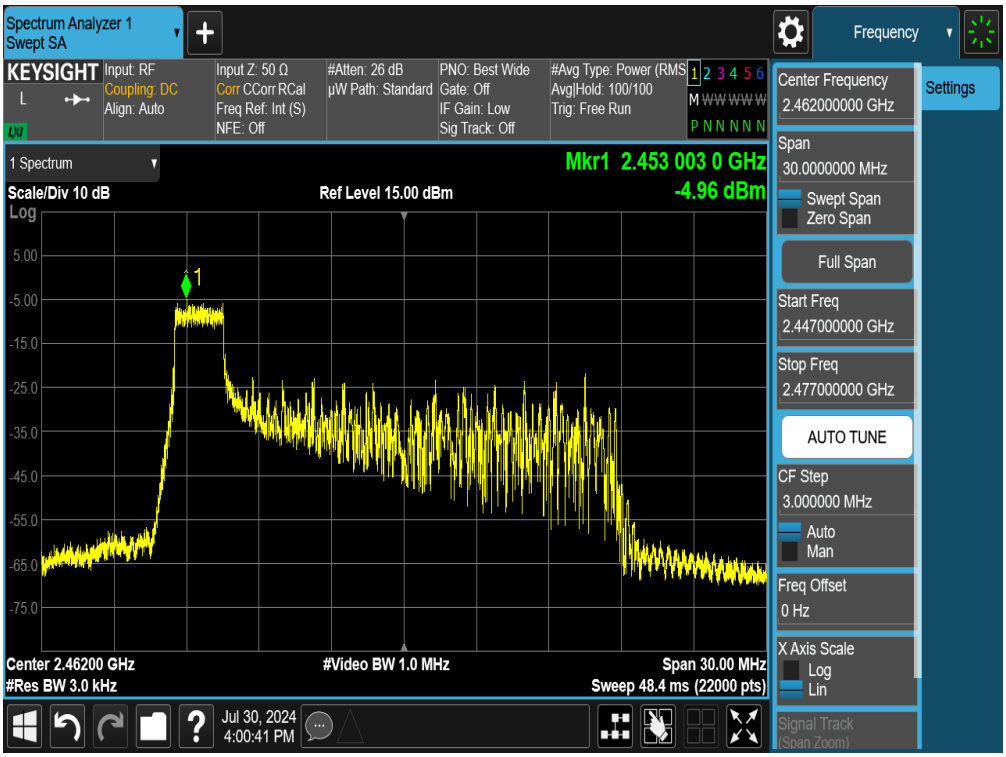
Table 7-17. Conducted Power Spectral Density Measurements SISO ANT1



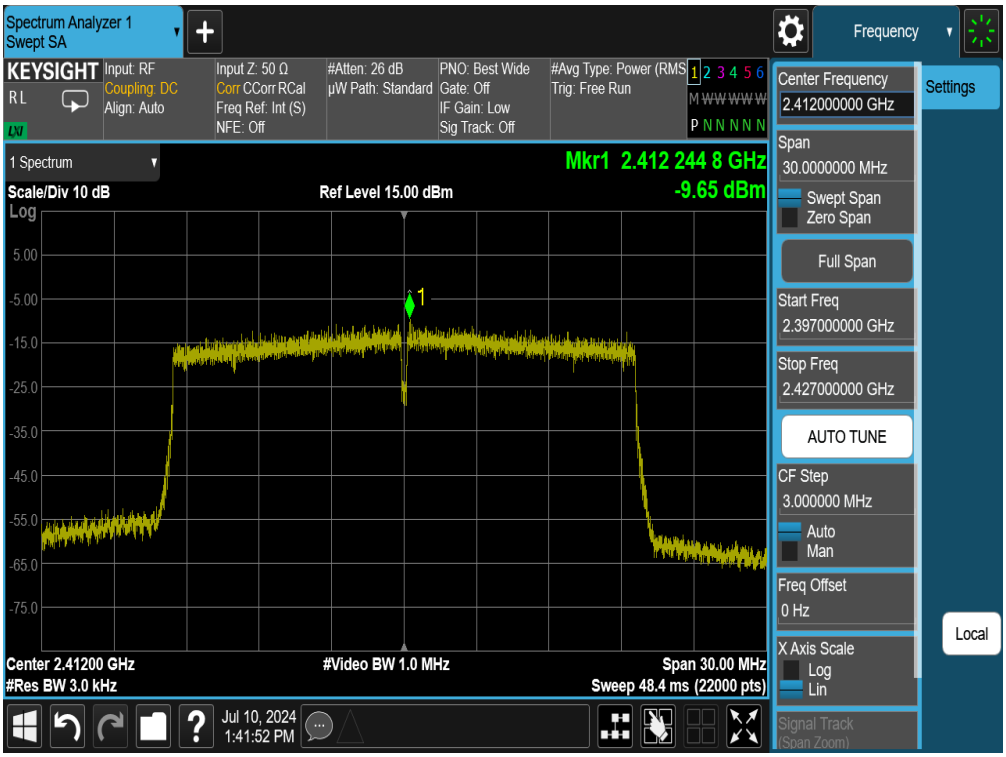
Plot 7-25. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1)



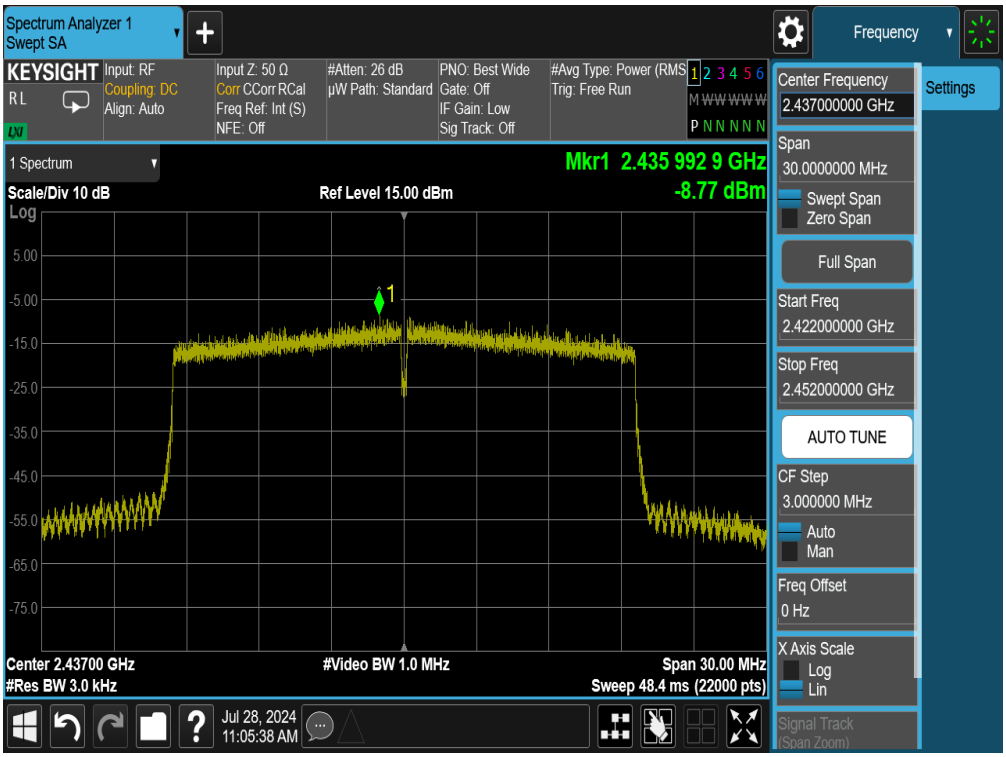
Plot 7-26. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 6)



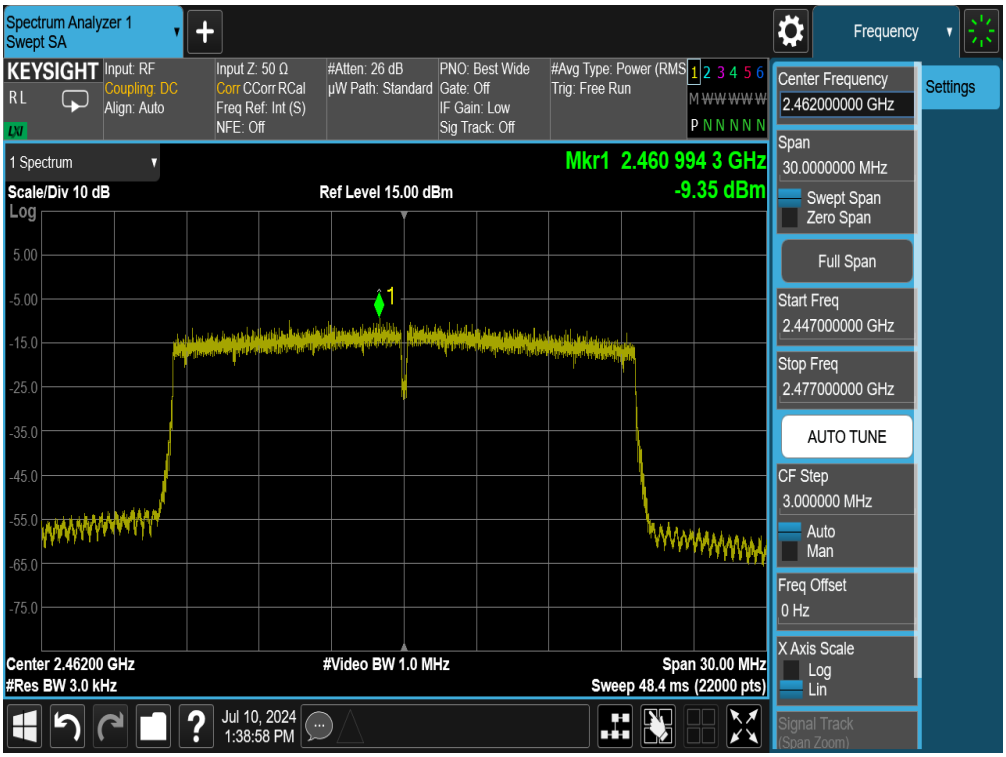
Plot 7-27. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11)



Plot 7-28. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1)



Plot 7-29. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 6)

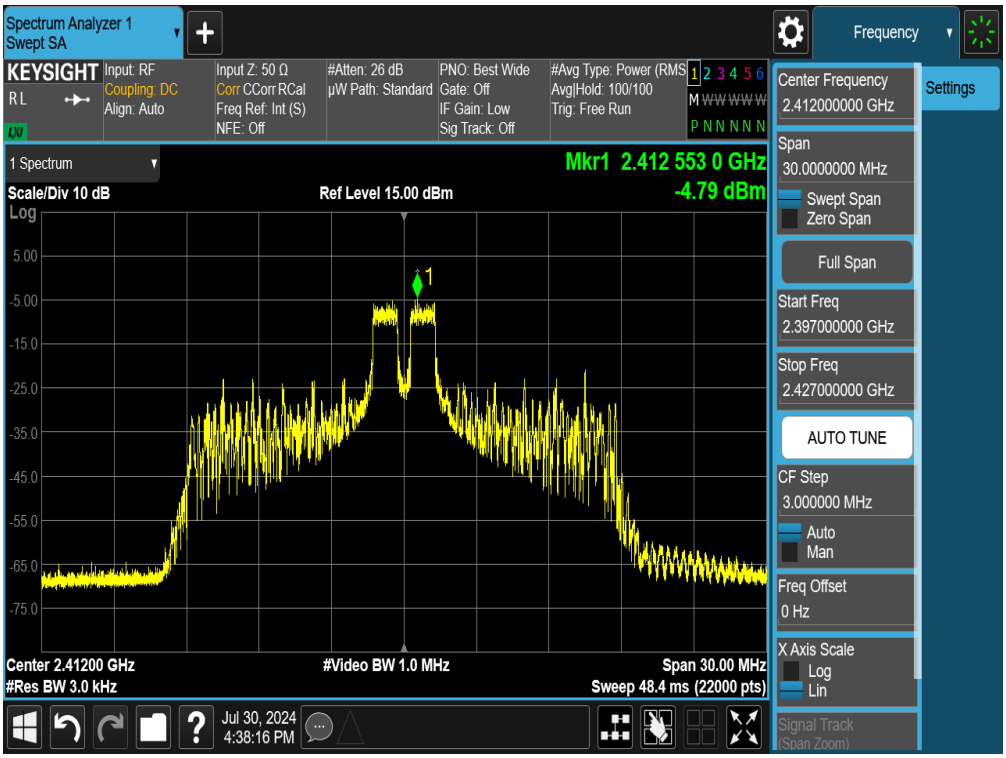


Plot 7-30. Power Spectral Density Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11)

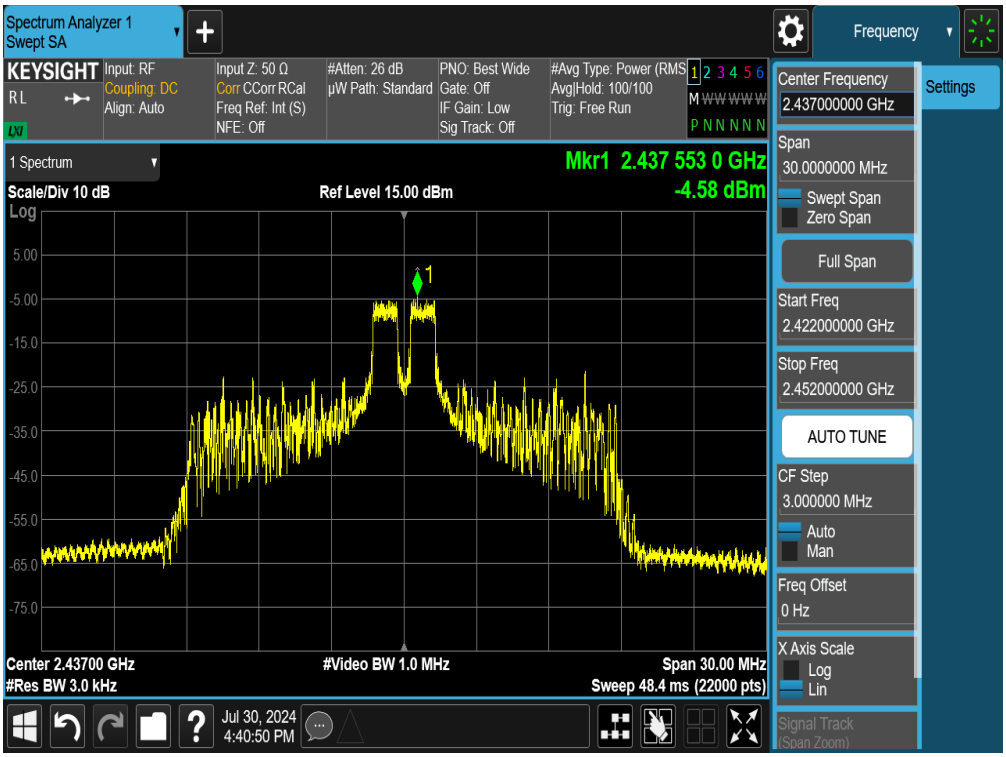
7.4.2 SISO Antenna-2 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-4.79	8.00	-12.79	Pass
2437	6	ax	26T	MCS0	-4.58	8.00	-12.58	Pass
2462	11	ax	26T	MCS0	-3.60	8.00	-11.60	Pass
2412	1	ax	242T	MCS0	-9.55	8.00	-17.55	Pass
2437	6	ax	242T	MCS0	-8.88	8.00	-16.88	Pass
2462	11	ax	242T	MCS0	-9.03	8.00	-17.03	Pass

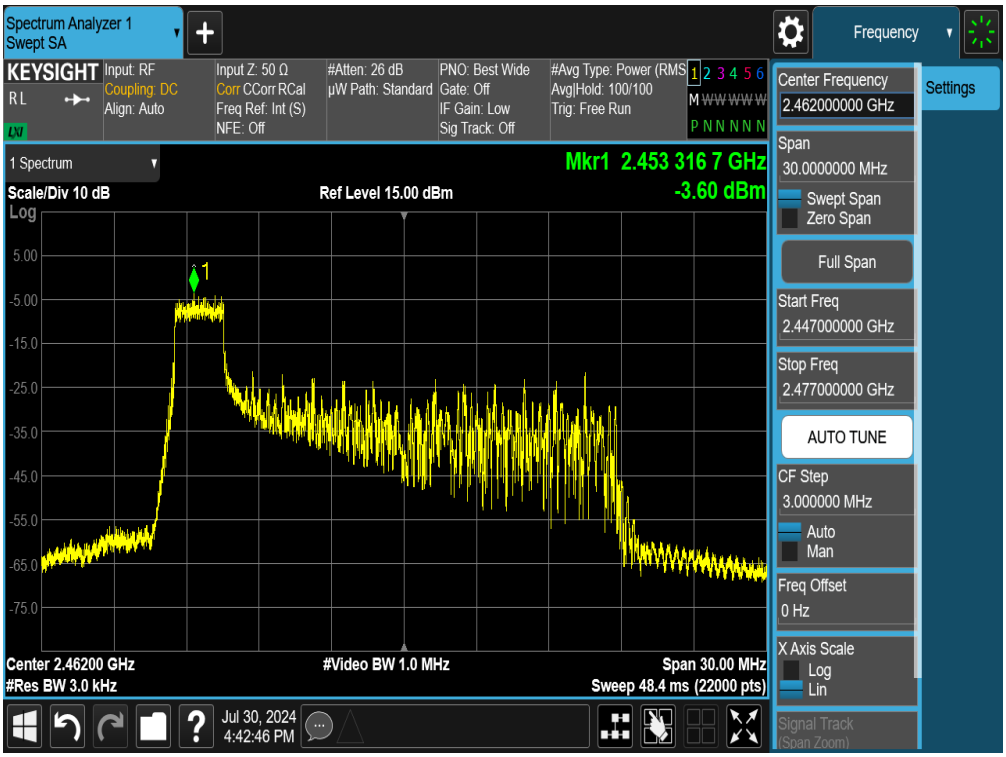
Table 7-18. Conducted Power Spectral Density Measurements SISO ANT2



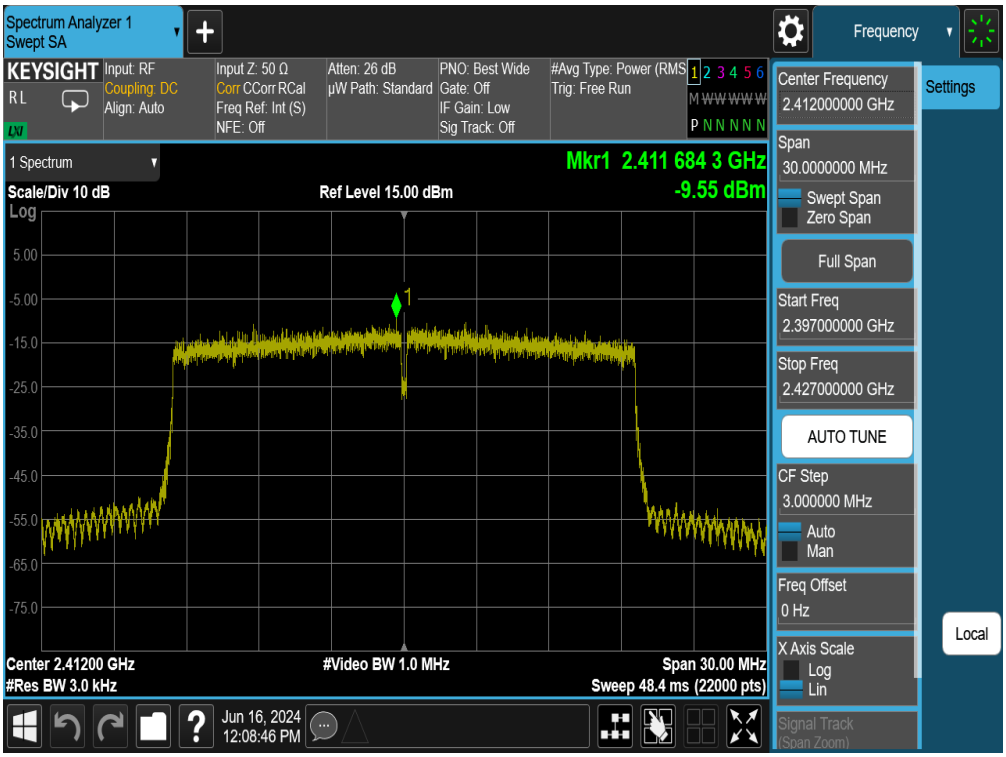
Plot 7-31. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1)



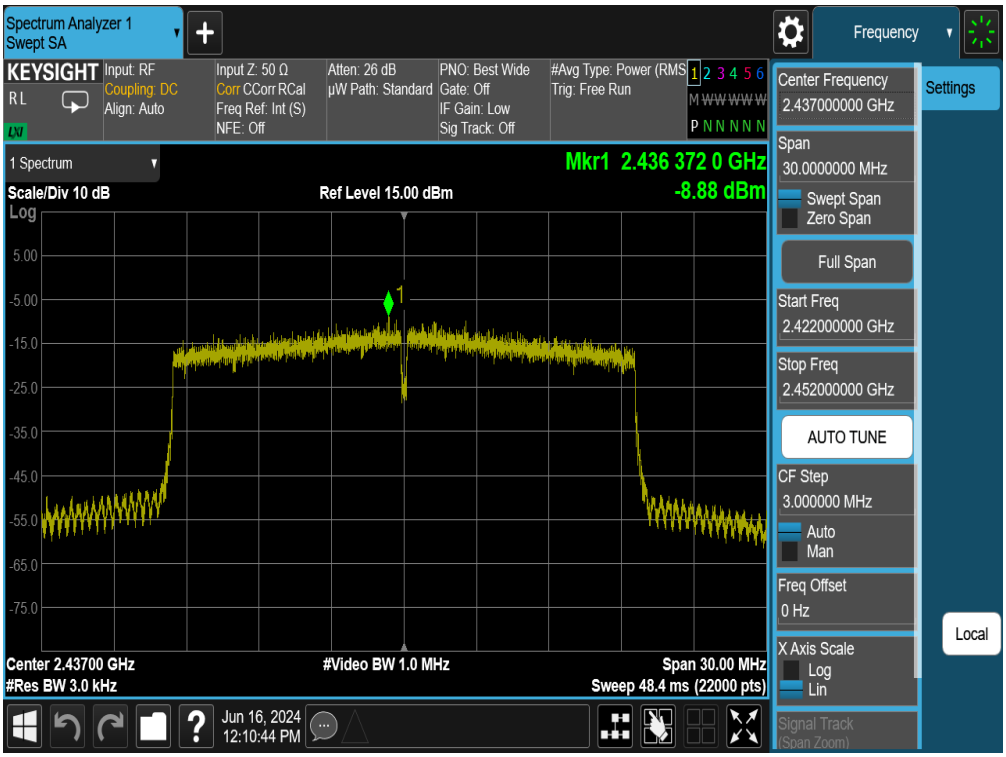
Plot 7-32. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6)



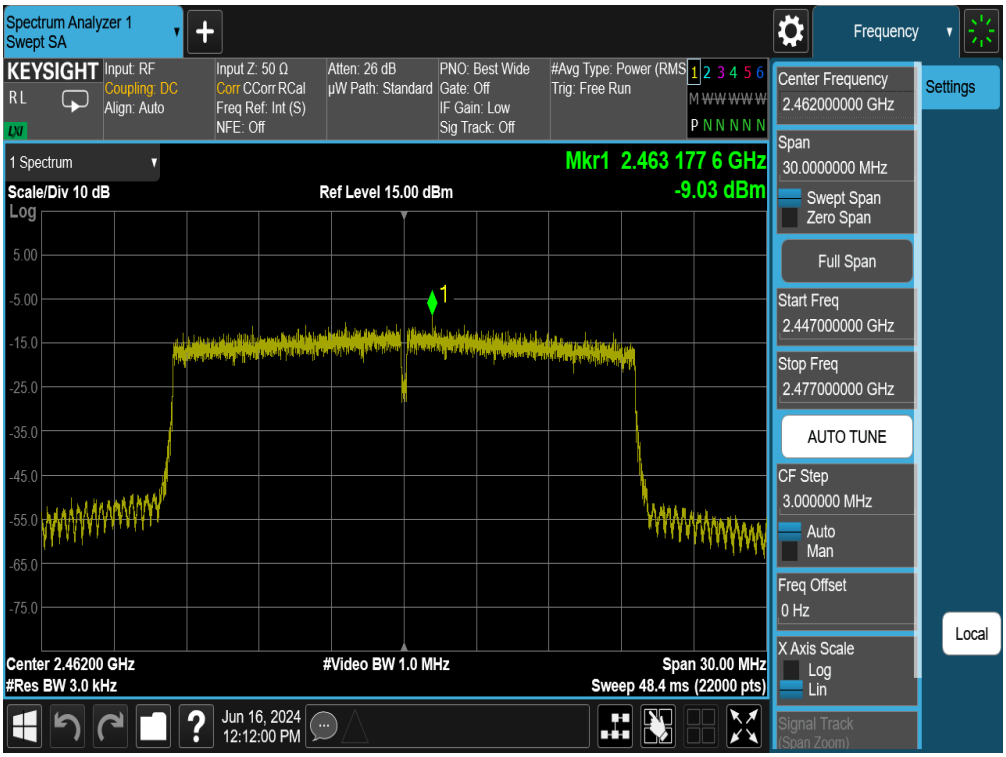
Plot 7-33. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11)



Plot 7-34. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1)



Plot 7-35. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6)

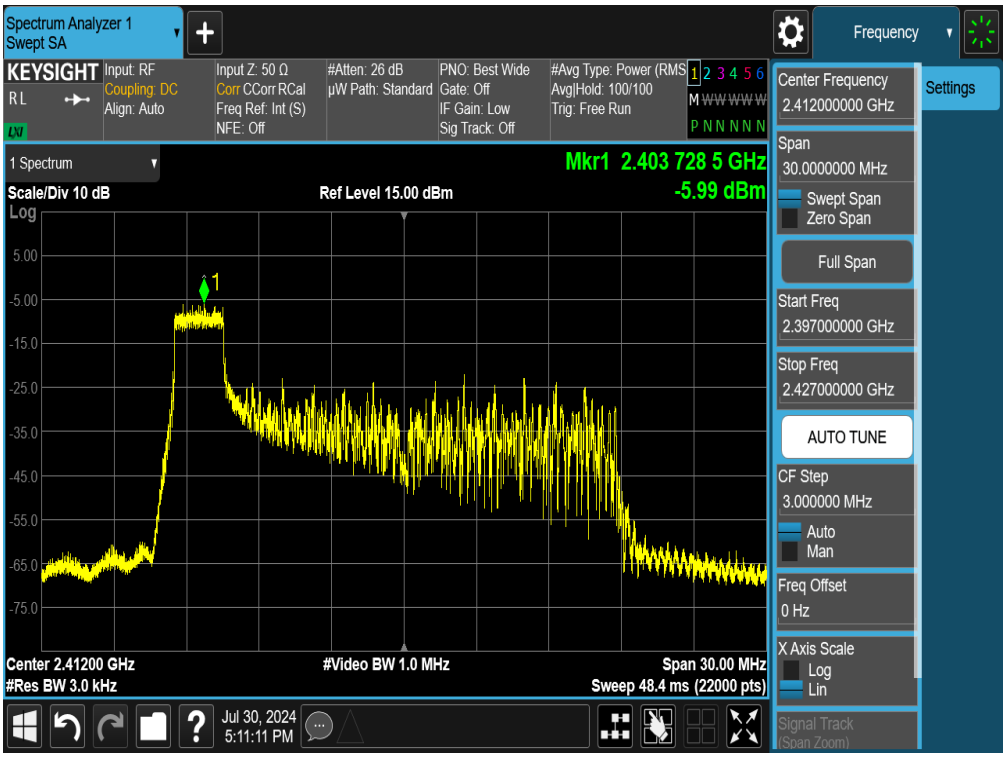


Plot 7-36. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11)

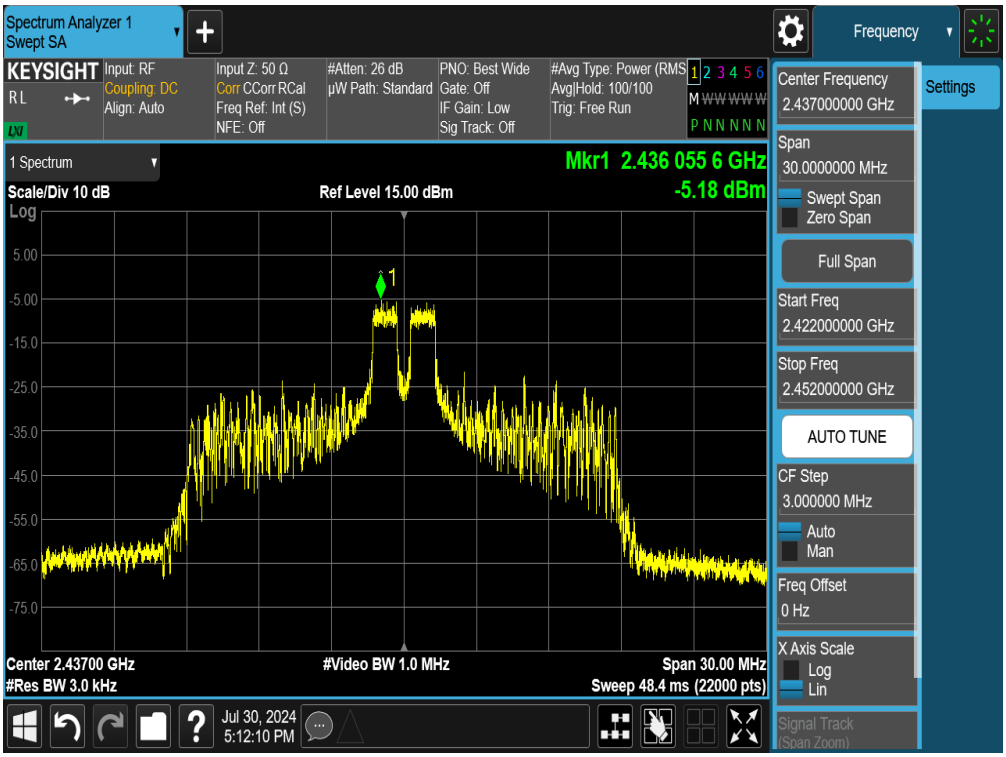
7.4.3 MIMO Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	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	ax	26T	MCS0	-5.99	-3.29	-1.42	8.00	-9.42	Pass
2437	6	ax	26T	MCS0	-5.18	-3.40	-1.19	8.00	-9.19	Pass
2462	11	ax	26T	MCS0	-6.16	-5.90	-3.02	8.00	-11.02	Pass
2412	1	ax	242T	MCS0	-9.83	-10.02	-6.91	8.00	-14.91	Pass
2437	6	ax	242T	MCS0	-10.69	-9.73	-7.17	8.00	-15.17	Pass
2462	11	ax	242T	MCS0	-9.90	-9.76	-6.82	8.00	-14.82	Pass

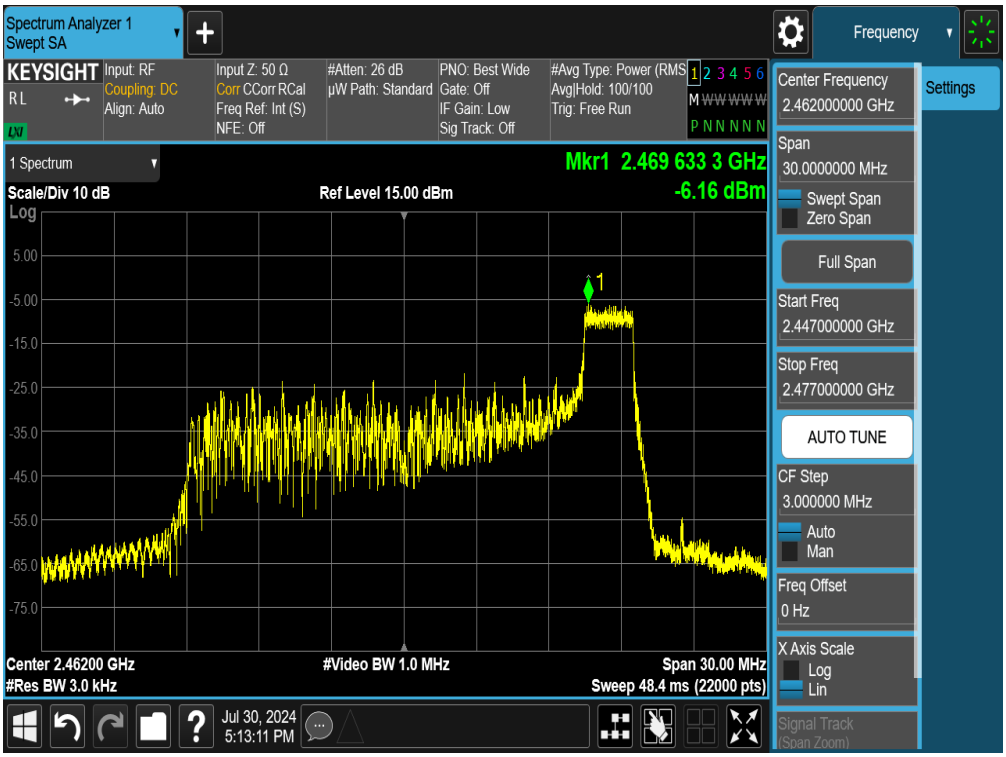
Table 7-19. Conducted Power Spectral Density Measurements MIMO



Plot 7-37. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1)



Plot 7-38. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6)



Plot 7-39. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11)