Element Materials Technology
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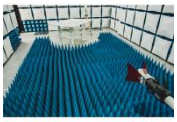

MEASUREMENT REPORT
FCC PART 15.247 / ISED RSS-247 WLAN OFDMA

Applicant Name:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
United States

Date of Testing:
11/28/2023 - 3/05/2024
Test Report Issue Date:
3/22/2024
Test Site/Location:
Element Materials Technology, Morgan Hill, CA, USA
Test Report Serial No.:
1C2311270064-17.BCG

FCC ID:	**BCGA2903**
IC:	**579C-A2903**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2903, A2904
EUT Type:	Tablet Device
Frequency Range:	2412 – 2467MHz
Modulation Type:	OFDMA
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C (15.247)
ISED Specification:	RSS-247 Issue 3
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01 v05r02, KDB 662911 D01 v02r01

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 and KDB 558074 D01 v05r02. 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.

RJ Ortanez
Executive Vice President

Prepared by: WKR0000005913

Reviewed by: WKR0000005805

ACCREDITED
CERT #2041.02

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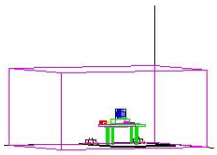
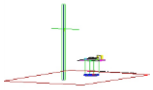


MEASUREMENT REPORT



802.11	RU	Tx Frequency [MHz]	Antenna 3a				Antenna 1a			
			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)
11ax OFDMA	26	2412 - 2467	17.527	12.44	208.641	23.19	17.604	12.46	220.445	23.43
11ax OFDMA	242	2412 - 2467	111.250	20.46	563.508	27.51	111.815	20.49	531.741	27.26

EUT Overview SISO (802.11ax – RU)

Mode	RU	Tx Frequency [MHz]	Antenna 3a				Antenna 1a				CDD			
			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)
11ax OFDMA	26	2412 - 2467	17.498	12.43	215.229	23.33	17.701	12.48	208.018	23.18	34.817	15.42	397.688	26.00
11ax OFDMA	242	2412 - 2467	86.636	19.38	481.948	26.83	95.433	19.80	486.407	26.87	182.070	22.60	952.959	29.79

EUT Overview CDD (802.11ax – RU)

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 Materials Technology Test Location

These measurement tests were conducted at the Element Materials Technology facility located at 18855 Adams Court, Morgan Hill, CA 95037. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element Materials Technology located in Morgan Hill, CA 95037, U.S.A.

- Element Materials Technology is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.02 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

- Element Materials Technology facility is a registered (22831) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2903, IC: 579C-A2903**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN 802.11ax – RU (DTS) transmitter.

Test Device Serial No.: W046C4WFF6, RH779H9653, J6RCW0M4FM, DLXGYH0000A0000EVL, DLXGYW0000B0000EVQ

2.2 Device Capabilities

This device contains the following capabilities:

850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (FR1), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, 802.11a/ax WIFI 6E, 802.15.4, Bluetooth (1x, EDR, LE1M, LE2M, HDR4, HDR8), WPT, NB UNII (1x, HDR4, HDR8)

This device supports BT Beamforming.

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13*	2472
7	2442		

Table 2-1. 802.11ax Frequency/ Channel Operations

*Channel 13 is disabled for DTS 802.11ax HE20.

Note: 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 KDB 558074 D01 v05r02 and ANSI C63.10-2013. 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:

Measured Duty Cycles				
802.11 Mode/Band		Duty Cycle [%]		
		Antenna 3a	Antenna 1a	CDD
2.4GHz	ax (RU26)	88.48	88.61	88.48
	ax (RU242)	92.03	91.69	92.21

Table 2-2. Measured Duty Cycles

The device employs CDD technology. Below are the possible configurations.

WiFi Configurations		SISO		SDM		CDD	
		Antenna 3a	Antenna 1a	Antenna 3a	Antenna 1a	Antenna 3a	Antenna 1a
2.4GHz	11ax	✓	✓	✓	✓	✓	✓

Table 2-3. WiFi Configurations

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

Data Rate(s) Supported: 8/8.6Mbps, 16/17.2Mbps, 24/25.8Mbps, 33/34.4Mbps, 49/51.6Mbps, 65/68.8Mbps, 73/77.4Mbps, 81/86.0Mbps, 98/103.2Mbps, 108/114.7Mbps (ax – 20MHz)
16/17.2 Mbps, 32/34.4 Mbps, 48/51.6 Mbps, 66/68.8 Mbps, 98/103.2 Mbps, 130/137.6 Mbps, 146/154.8 Mbps, 162/172 Mbps, 196/206.4 Mbps, 216/229.4Mbps (CDD ax – 20MHz)

This device supports simultaneous transmission operations, which allows for multiple transmitters to transmit simultaneously on the same antenna. The table below shows all configurations possible.

Antenna	Simultaneous Tx Config	Wifi 2GHz	Bluetooth	Thread	Wifi 5GHz	Wifi 6GHz	NB UNII	LTE/FR1 NR	
		802.11 b/g/n/ax	BDR, EDR, HDR4/8, LE1/2M	802.15.4	802.11 a/n/ac/ax	802.11 a/ax	BDR, HDR4/8	MB/HB	UHB
3a	Config 1	✗	✓	✗	✓	✗	✗	✓	✗
3a	Config 2	✗	✓	✗	✗	✓	✗	✓	✗
3a	Config 3	✓	✗	✗	✗	✗	✓	✓	✗
3a	Config 4	✗	✗	✓	✓	✗	✗	✓	✗
3a	Config 5	✗	✗	✓	✗	✓	✗	✓	✗
3a	Config 6	✓	✗	✗	✗	✗	✓	✗	✗
3a	Config 7	✓	✗	✗	✗	✗	✗	✓	✗
3a	Config 8	✗	✓	✗	✓	✗	✗	✗	✗
3a	Config 9	✗	✓	✗	✗	✓	✗	✗	✗
3a	Config 10	✗	✓	✗	✗	✗	✗	✓	✗
3a	Config 11	✗	✗	✓	✓	✗	✗	✗	✗
3a	Config 13	✗	✗	✓	✗	✓	✗	✗	✗
3a	Config 14	✗	✗	✓	✗	✗	✗	✓	✗
3a	Config 15	✗	✗	✗	✓	✗	✗	✓	✗
3a	Config 16	✗	✗	✗	✗	✓	✗	✓	✗
3a	Config 17	✗	✗	✗	✗	✗	✓	✓	✗
1a	Config 18	✓	✗	✗	✗	✗	✗	✗	✓
1a	Config 15	✗	✓	✗	✗	✗	✗	✗	✓
1a	Config 16	✗	✗	✓	✗	✗	✗	✗	✓
1b	Config 17	✗	✗	✗	✓	✗	✗	✓	✗
1b	Config 18	✗	✗	✗	✗	✓	✗	✓	✗
1b	Config 19	✗	✗	✗	✗	✗	✓	✓	✗

Table 2-4. Simultaneous Transmission Configurations

✓ = Support; × = Not Support

Note:

All the above simultaneous transmission configurations have been tested and the worst case configuration was found to be config 1 and reported in RF UNII, RF Bluetooth, RF FCC part 27b and RF RSS-199 test reports.

Specific 2.4GHz Wi-Fi antenna that can only transmit simultaneously with 2.4GHz Bluetooth antenna is listed in the SAR test report. For BT (2.4GHz) in connected mode and Wi-Fi (2.4GHz) - Wi-Fi max power will not exceed minimum of (13.5dBm, SAR max cap, Reg max cap) power. For BT (2.4GHz) in disconnected mode and Wi-Fi (2.4GHz) - BT will be using iPA only and Wi-Fi max power will not exceed minimum of (SAR max cap, Reg max cap) power. Bluetooth can simultaneously transmit with IEEE 802.11a/n/ac/ax 5/6 GHz on separate antenna.

2.3 Antenna Description

The following antenna gains provided by the manufacturer were used for testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Antenna 3a	Antenna 1a
2.4	2.6	1.5

Table 2-5. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook Pro	Model:	A2141	S/N:	C02H604EQ05D
	w/AC/DC Adapter	Model:	A2166	S/N:	C4H042705ZNPM0WA6
2	Apple USB-C Cable	Model:	Spartan	S/N:	GXK1336018XKTR024
3	USB-C Cable	Model:	A246C	S/N:	DWH80115BK826GV19
	w/ AC Adapter	Model:	A2305	S/N:	C4H95160004PF4F4V
4	Apple Pencil	Model:	A2538	S/N:	KJ26TCFXJW
5	DC Power Supply	Model:	KPS3010D	S/N:	N/A

Table 2-6. Test Support Equipment List

2.5 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing. See Sections 3.2 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

There are two vendors of the WiFi/Bluetooth radio modules, variant 1 and variant 2. Both radio modules have the same mechanical outline, same on-board antenna matching circuit, identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances. The worst case configuration was found between the two variants. The EUT was also investigated with and without charger.

For emissions from 1GHz – 18GHz, low, mid, and high channels were tested with highest power and worst case configuration. The emissions below 1GHz and above 18GHz were tested with the highest transmitting power and the worst case channel.

The EUT was manipulated through three orthogonal planes of X-orientation (flatbed), Y-orientation (landscape), and Z-orientation (portrait) during the testing. Only the worst case emissions are reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and EUT powered by AC/DC was the worst case.

- EUT powered by AC/DC adaptor via USB-C cable with wire charger
- EUT powered by host PC via USB-C cable with wire charger

802.11ax HE20 2Tx CDD mode test data provided in this report covers 802.11ax HE20 2Tx SDM.

For 802.11b/g/n/ax-SU test results, see separate WLAN report, 1C2311270064-16.BCG

2.6 Software and Firmware

The test was conducted with firmware version 21E8197 installed on the EUT.

2.7 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) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT**.**

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

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 7m x 3.66m x 2.7m shielded enclosure. The shielded enclosure is manufactured by AP Americas. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-6. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50µH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is EPCOS 2X60A Power Line Filter (100dB Attenuation, 14kHz-18GHz) and the two EPCOs 2X48A filters (100dB Minimum Insertion Loss, 14kHz - 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that the cables were not draped over the second LISN.

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 RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.9. Automated test software was used to perform the AC line conducted emissions testing. Automated measurement software utilized is Rohde & Schwarz EMC32, Version 10.50.40.

3.3 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.

Per KDB 414788 D01 v01r01, radiated emission test sites other than open-field test sites (e.g., shielded anechoic chambers), may be employed for emission measurements below 30MHz if characterized so that the measurements correspond to those obtained at an open-field test site. To determine test site equivalency, a reference sample transmitting at 149kHz was measured on an open field test site (asphalt with no ground plane) and then measured in the 3m semi-anechoic chamber. A calibrated 60cm loop antenna was rotated about its vertical axis while the reference device was rotated through the X, Y and Z axis in order to capture the worst case level. A maximum deviation of 2.77dB at 149kHz was measured when comparing the 3 meter semi-anechoic chamber to the open field site.

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.

3.4 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 C63.23-2012. 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	2.07
Line Conducted Disturbance	1.91
Radiated Disturbance (<30MHz)	4.12
Radiated Disturbance (30MHz - 1GHz)	4.85
Radiated Disturbance (1 - 18GHz)	5.08
Radiated Disturbance (>18GHz)	4.59

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 Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	6/21/2023	Annual	6/21/2024	MY49430244
ESPEC	SU-241	Tabletop Temperature Chamber	11/17/2023	Annual	11/17/2024	92009574
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/30/2023	Annual	3/30/2024	00218555
Keysight Technology	N9040B	UXA Signal Analyzer	3/10/2023	Annual	3/10/2024	MY57212015
Rohde & Schwarz	TS-PR18	Pre-Amplifier (1GHz - 18GHz)	8/31/2023	Annual	8/31/2024	100052
Rohde & Schwarz	FSV40	Signal Analyzer (10Hz-40GHz)	5/11/2023	Annual	5/11/2024	101619
Rohde & Schwarz	ESW44	EMI Test Receiver	6/6/2023	Annual	6/6/2024	101668
Rohde & Schwarz	TS-PR8	Pre-Amplifier (30MHz - 8GHz)	6/22/2023	Annual	6/22/2024	102356
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	11/30/2023	Annual	11/30/2024	161616
Rohde & Schwarz	CMW500	Wideband Radio Communication Tester	12/27/2023	Annual	12/27/2024	164715
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	6/2/2023	Annual	6/2/2024	100050
Rohde & Schwarz	HFH2-Z2	Loop Antenna	5/1/2023	Annual	5/1/2024	100519
Schwarzbeck	VULB 9162	Bilog Antenna (30MHz - 6GHz)	4/17/2023	Annual	4/17/2024	00304

Table 6-1. Test Equipment List

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: Apple Inc.

FCC ID: BCGA2903

IC: 579C-A2903

FCC Classification: Digital Transmission System (DTS)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
2.1049	RSS-Gen [6.7]	Occupied Bandwidth	N/A		N/A	Section 7.2
15.247(b)(3)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	RSS-Gen [8.9]	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	Sections 7.7, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	AC LINE CONDUCTED	PASS	Section 7.9

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 5.0.
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 3.0.0.
6. 802.11ax 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. Only one RU index could be selected at a time so no contiguous or non-contiguous RU's were considered for testing.

7.2 Bandwidth Measurement

§15.247(a.2); RSS-247 [5.2]; RSS-Gen [6.7]

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 occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Subclause 11.8.2 Option 2
KDB 558074 D01 v05r02 – Section 8.2
RSS-Gen [6.7]

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 99% occupied bandwidth and 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
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

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

Figure 7-1. Test Instrument & Measurement Setup

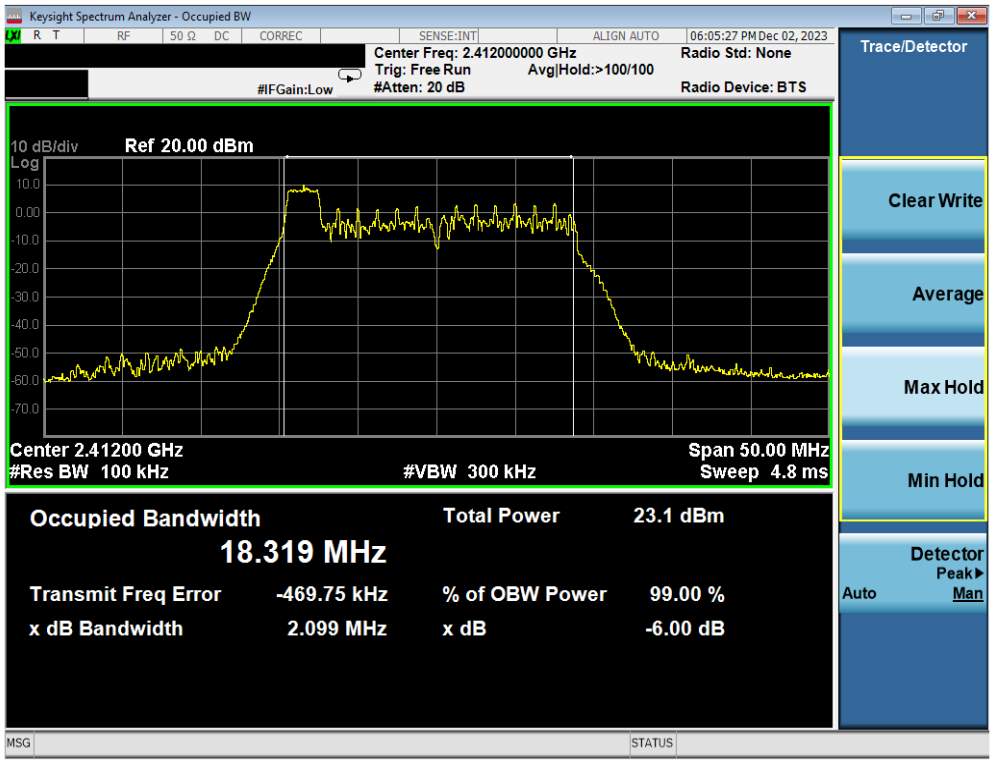
Test Notes

1. All antenna configurations and data rates were investigated and only the worst case is reported
2. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's are reported.

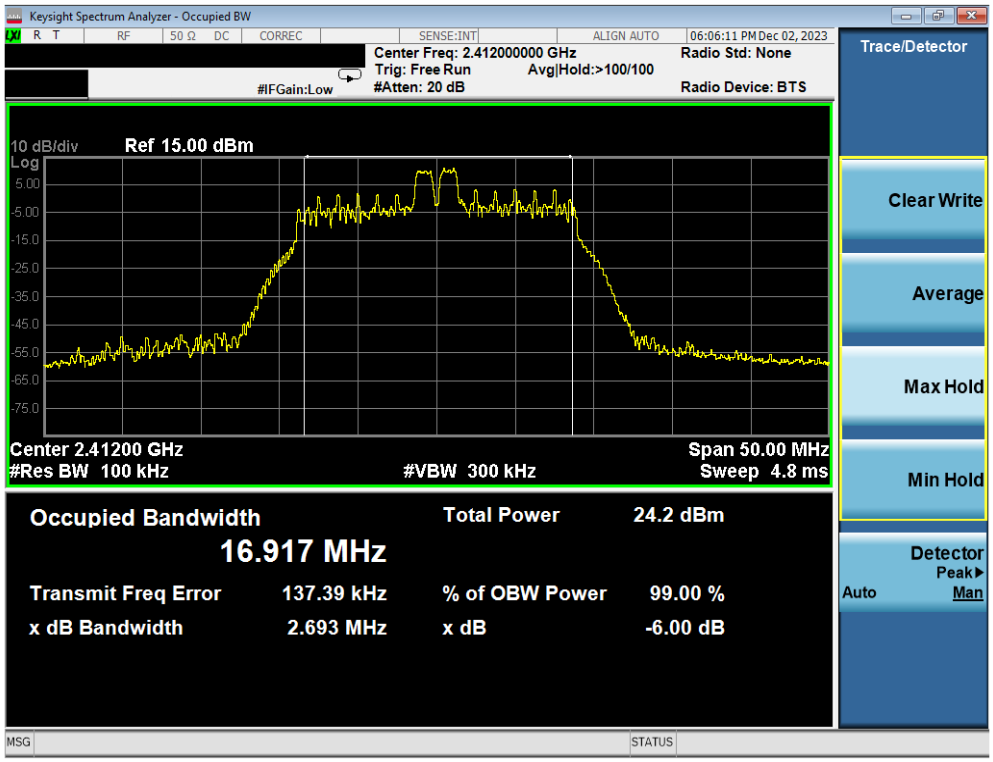
Antenna 3a Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 MODE	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass/Fail
2412	1	ax (20MHz)	26	0	10/11.8 (MCS9)	18.32	2.09	0.50	Pass
			26	4	10/11.8 (MCS9)	16.92	2.69	0.50	Pass
			26	8	10/11.8 (MCS9)	17.95	2.10	0.50	Pass
2437	6	ax (20MHz)	26	0	10/11.8 (MCS9)	18.17	2.11	0.50	Pass
			26	4	10/11.8 (MCS9)	17.17	2.71	0.50	Pass
			26	8	10/11.8 (MCS9)	18.32	2.12	0.50	Pass
2462	11	ax (20MHz)	26	0	10/11.8 (MCS9)	18.12	2.13	0.50	Pass
			26	4	10/11.8 (MCS9)	16.98	2.69	0.50	Pass
			26	8	10/11.8 (MCS9)	18.27	2.08	0.50	Pass
2412	1	ax (20MHz)	242	61	97.5/114.7 (MCS9)	18.94	19.04	0.50	Pass
2437	6	ax (20MHz)	242	61	97.5/114.7 (MCS9)	19.00	19.07	0.50	Pass
2462	11	ax (20MHz)	242	61	97.5/114.7 (MCS9)	18.93	19.06	0.50	Pass

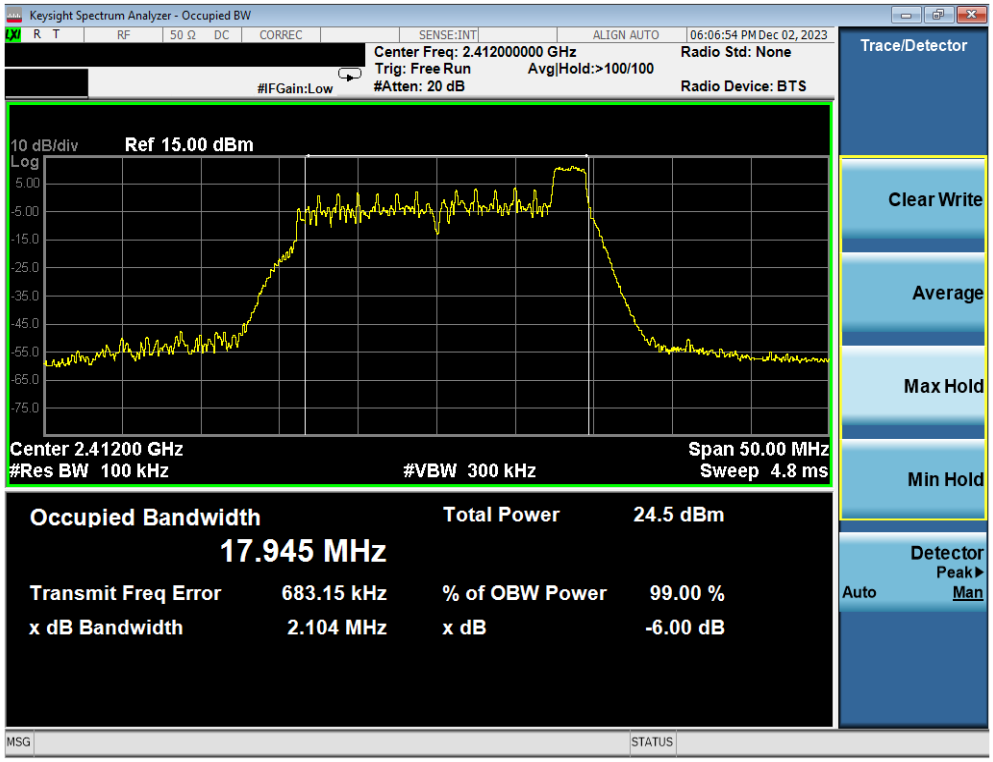
Table 7-2. 6dB BW & 99% OBW Measurements Antenna 3a



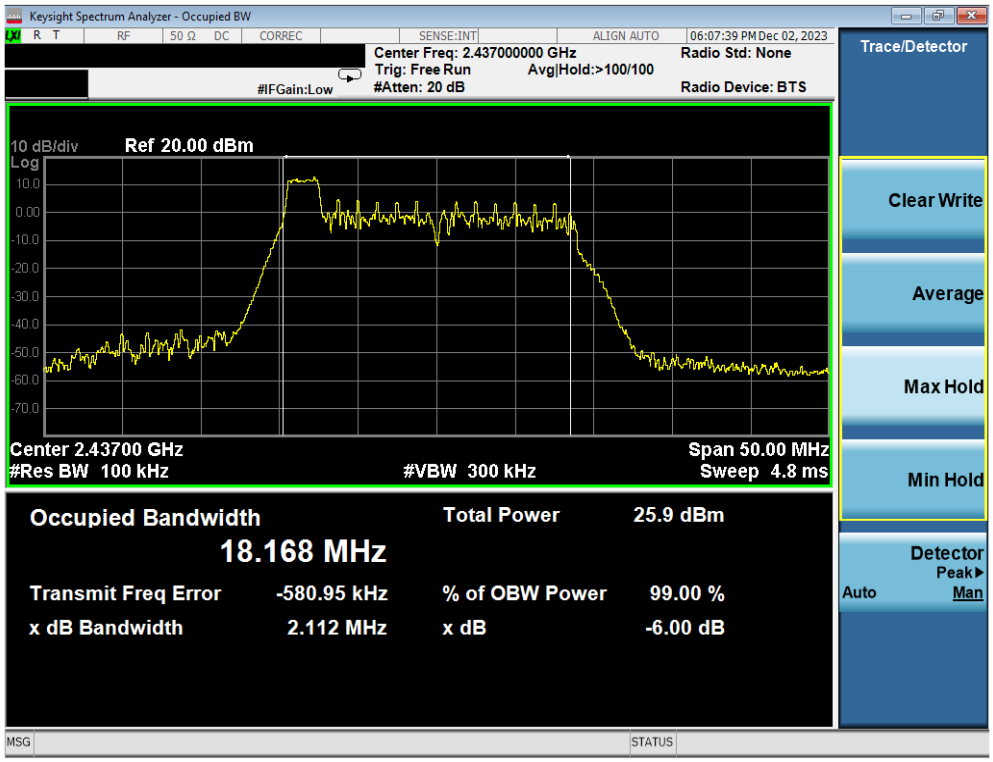
Plot 7-1. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



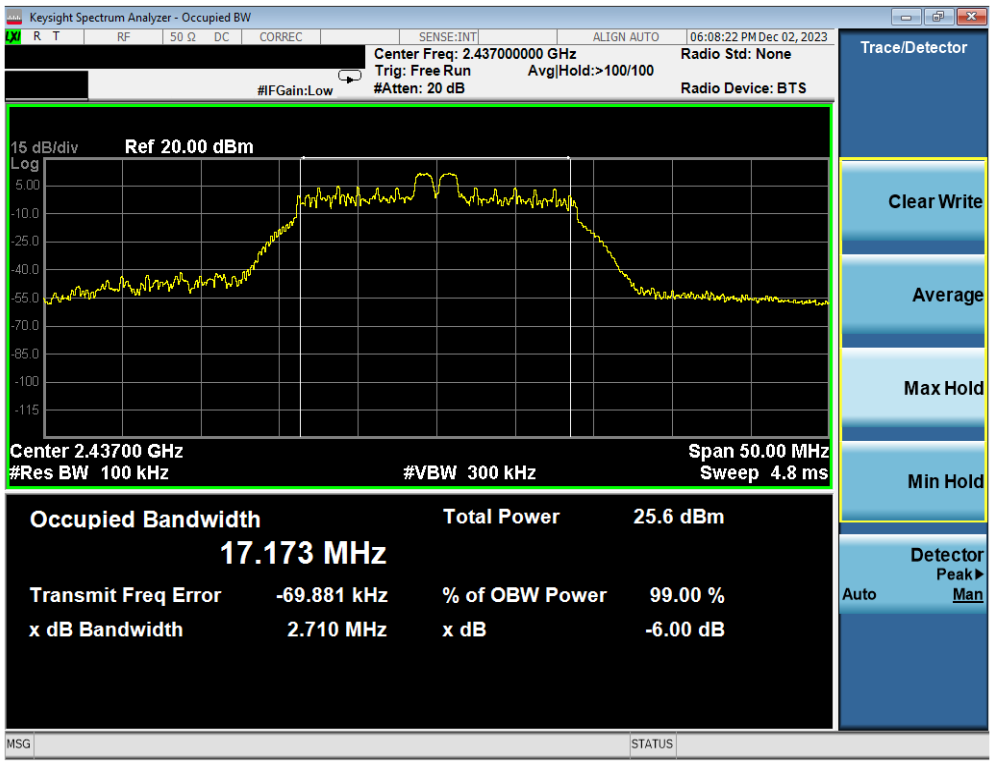
Plot 7-2. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



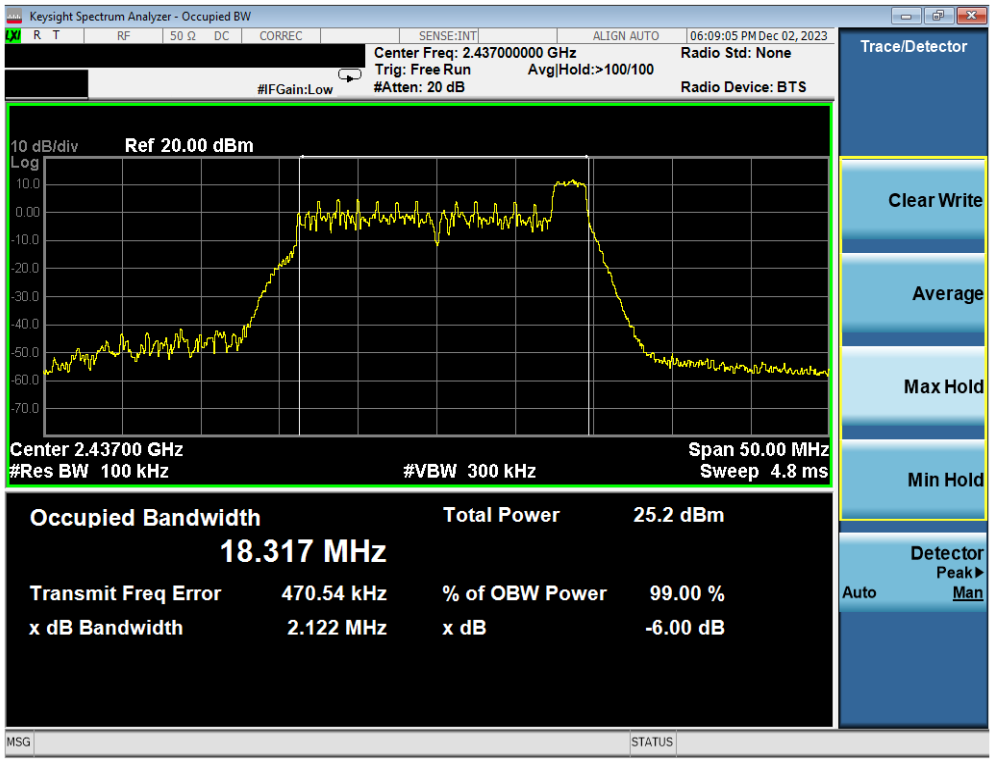
Plot 7-3. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



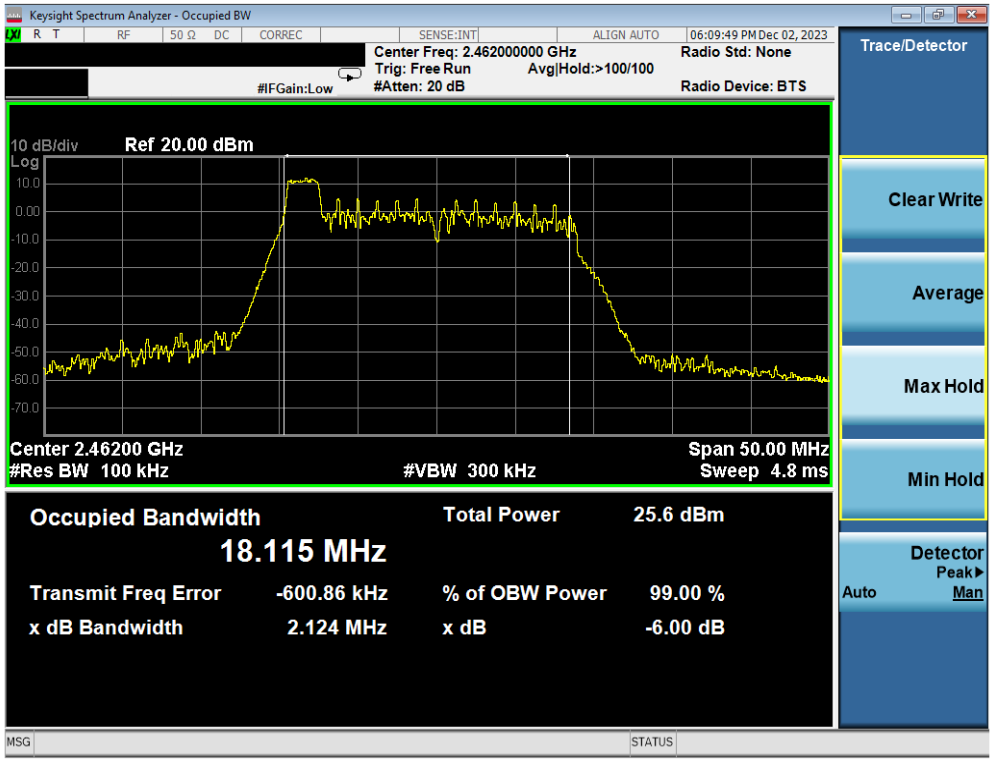
Plot 7-4. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



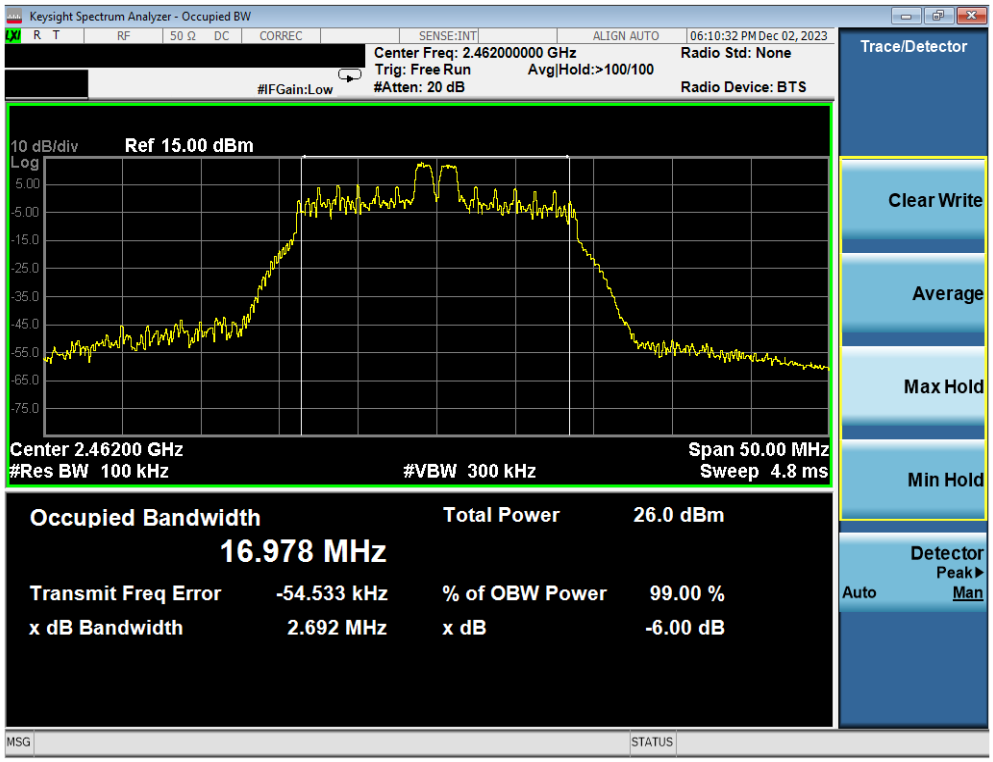
Plot 7-5. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



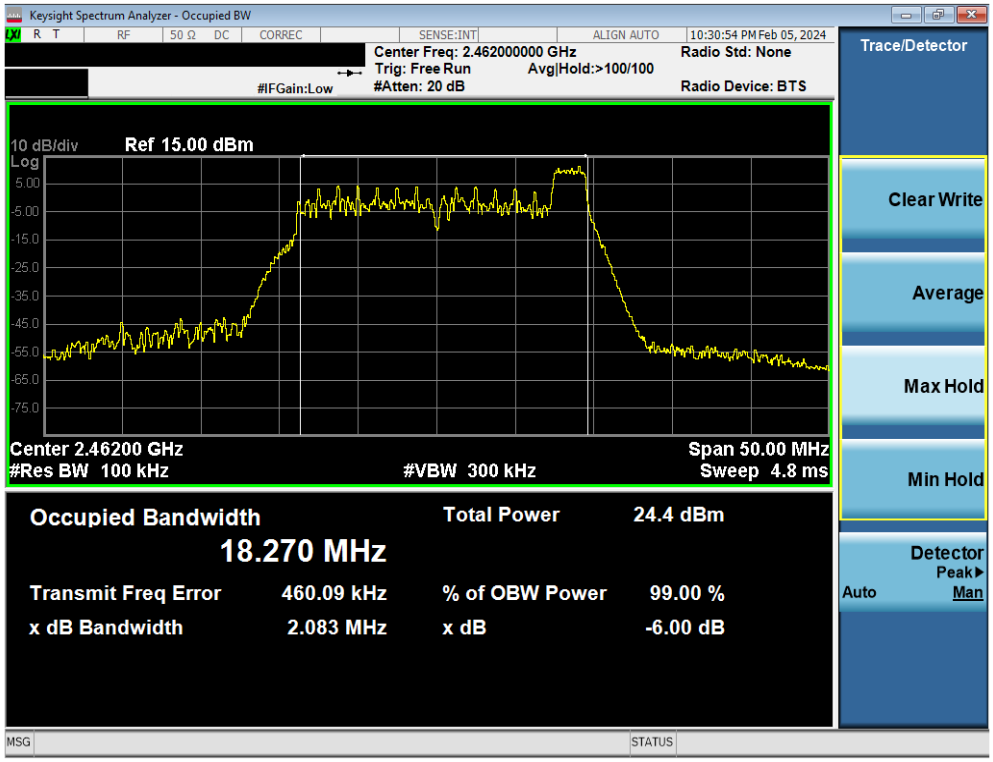
Plot 7-6. 6dB BW & 99% OBW Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



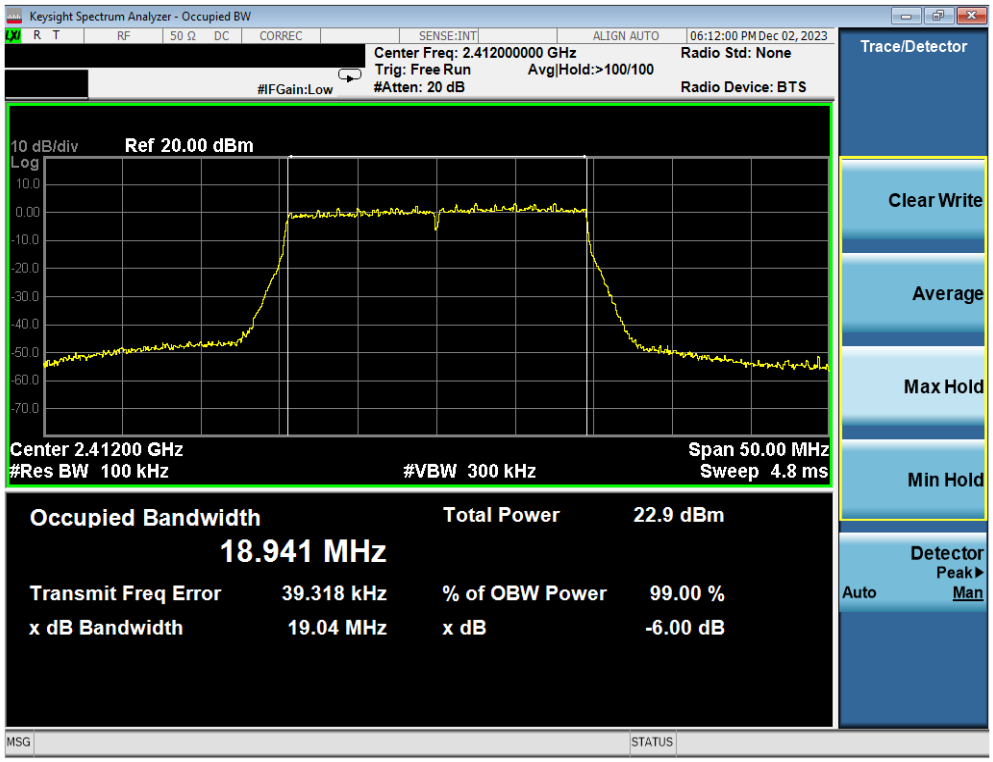
Plot 7-7. 6dB BW & 99% OBW Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



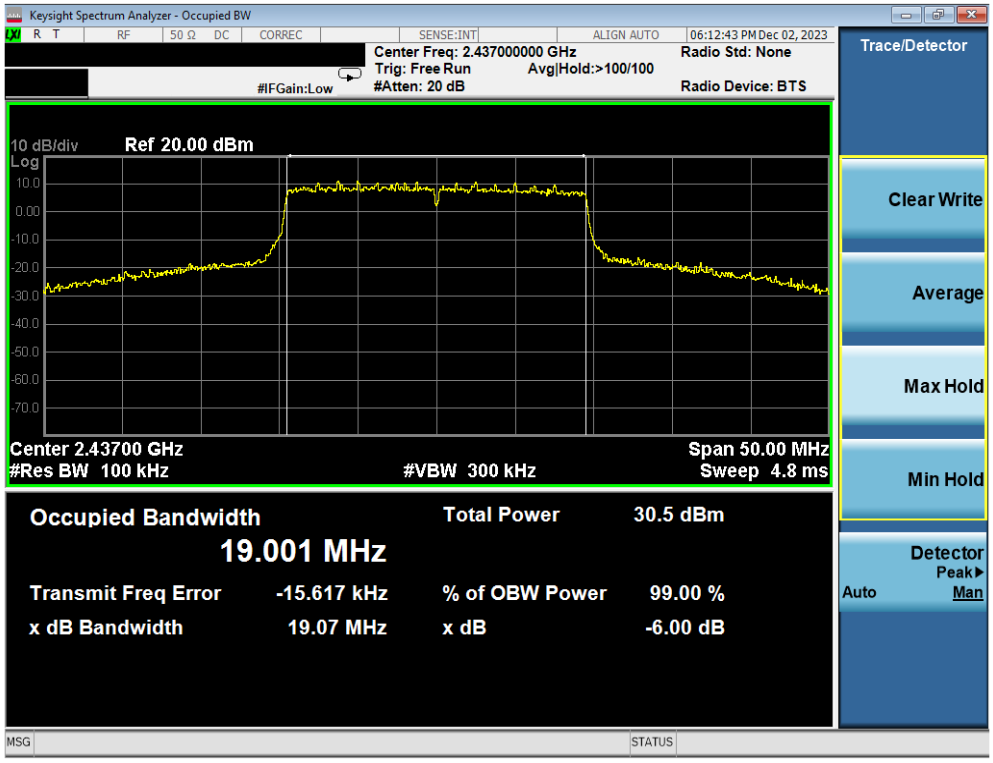
Plot 7-8. 6dB BW & 99% OBW Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



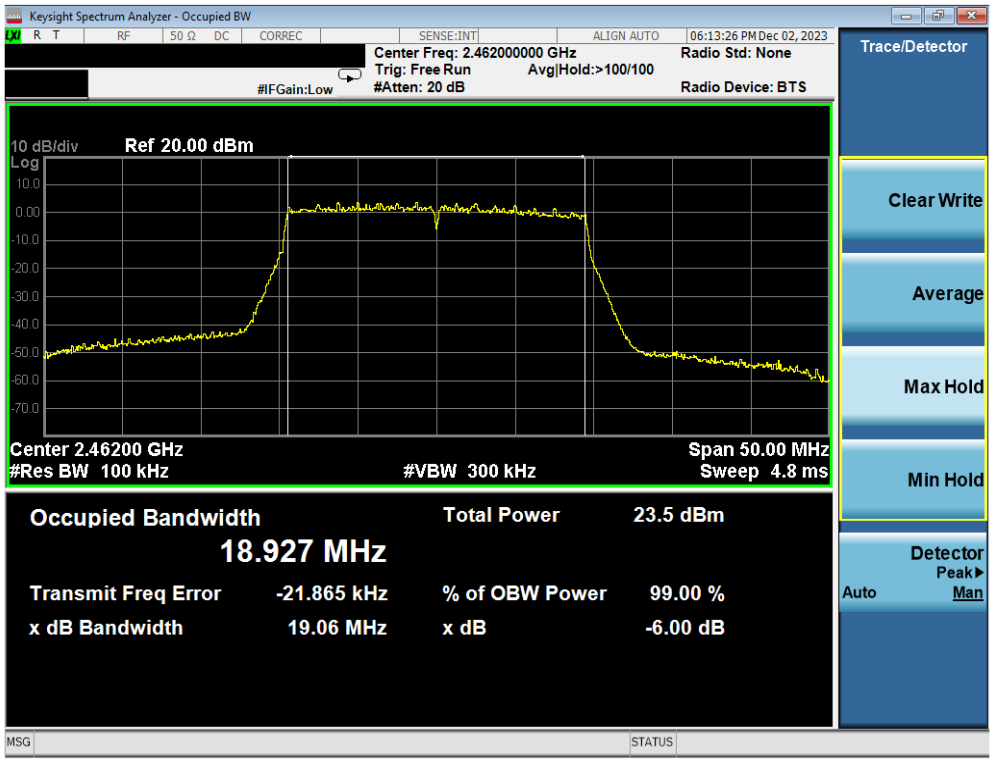
Plot 7-9. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-10. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



Plot 7-11. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6)

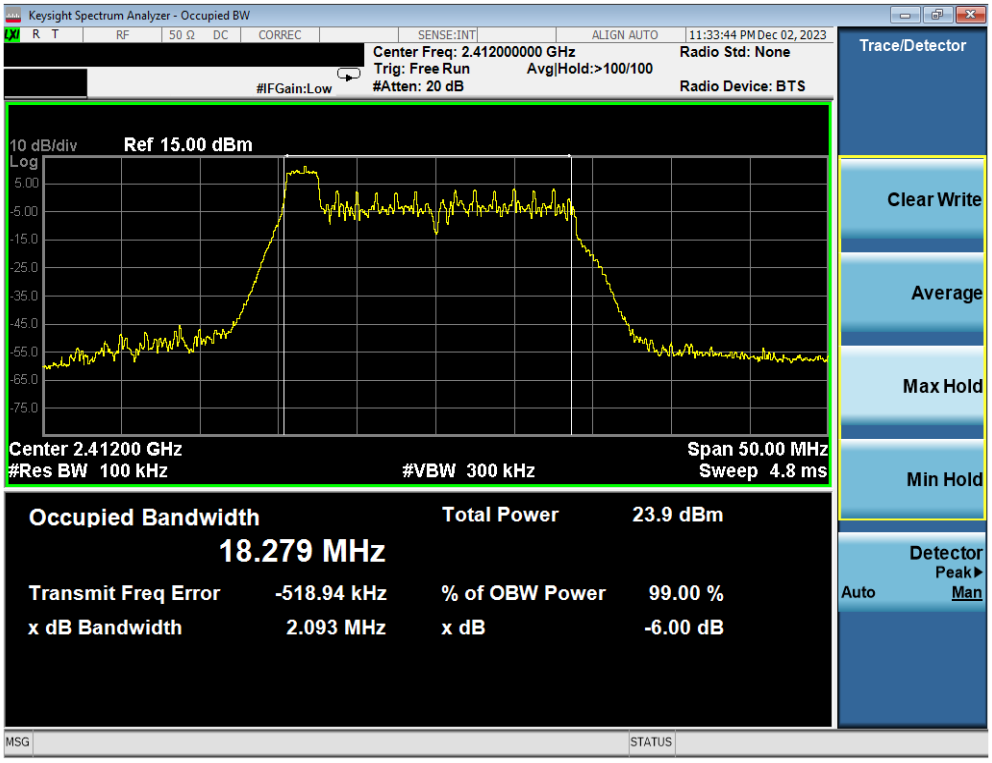


Plot 7-12. 6dB BW & 99% OBW Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)

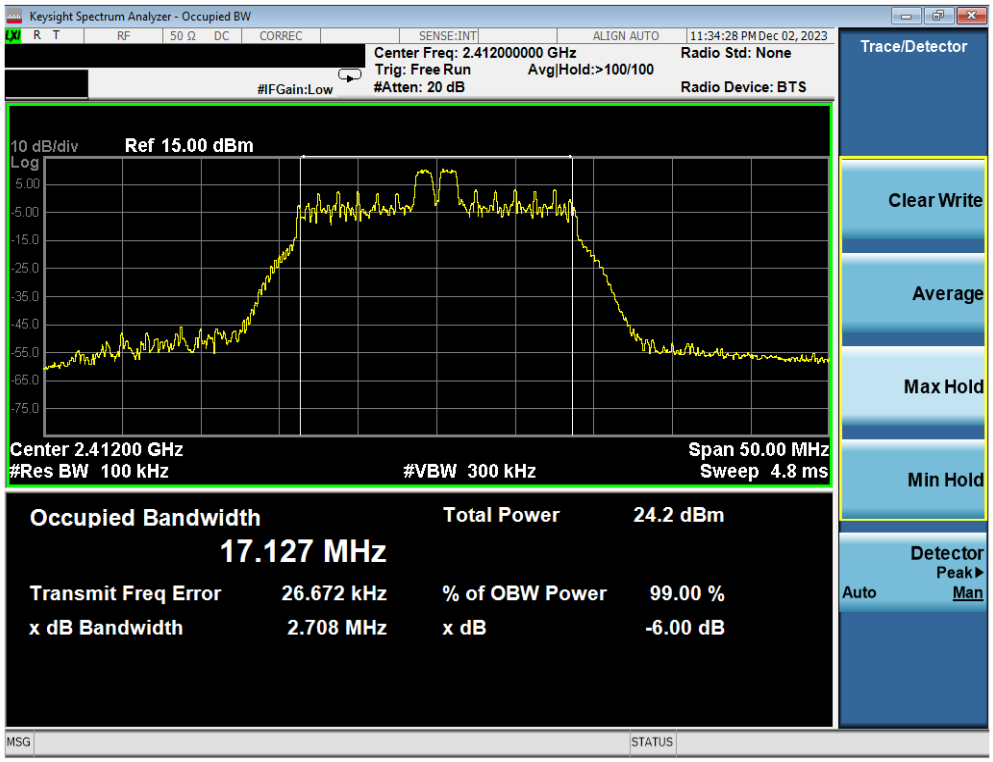
Antenna 1a Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 MODE	RU Size	RU Index	Data Rate [Mbps]	Measured 99% Occupied Bandwidth [MHz]	Measured 6dB Bandwidth [MHz]	Minimum 6dB Bandwidth [MHz]	Pass/Fail
2412	1	ax (20MHz)	26	0	10/11.8 (MCS9)	18.28	2.09	0.50	Pass
			26	4	10/11.8 (MCS9)	17.13	2.71	0.50	Pass
			26	8	10/11.8 (MCS9)	18.15	2.13	0.50	Pass
2437	6	ax (20MHz)	26	0	10/11.8 (MCS9)	18.13	2.12	0.50	Pass
			26	4	10/11.8 (MCS9)	17.04	2.71	0.50	Pass
			26	8	10/11.8 (MCS9)	18.30	2.09	0.50	Pass
2462	11	ax (20MHz)	26	0	10/11.8 (MCS9)	18.17	2.11	0.50	Pass
			26	4	10/11.8 (MCS9)	16.83	2.69	0.50	Pass
			26	8	10/11.8 (MCS9)	18.05	2.11	0.50	Pass
2412	1	ax (20MHz)	242	61	97.5/114.7 (MCS9)	18.99	19.13	0.50	Pass
2437	6	ax (20MHz)	242	61	97.5/114.7 (MCS9)	18.99	19.08	0.50	Pass
2462	11	ax (20MHz)	242	61	97.5/114.7 (MCS9)	18.91	19.03	0.50	Pass

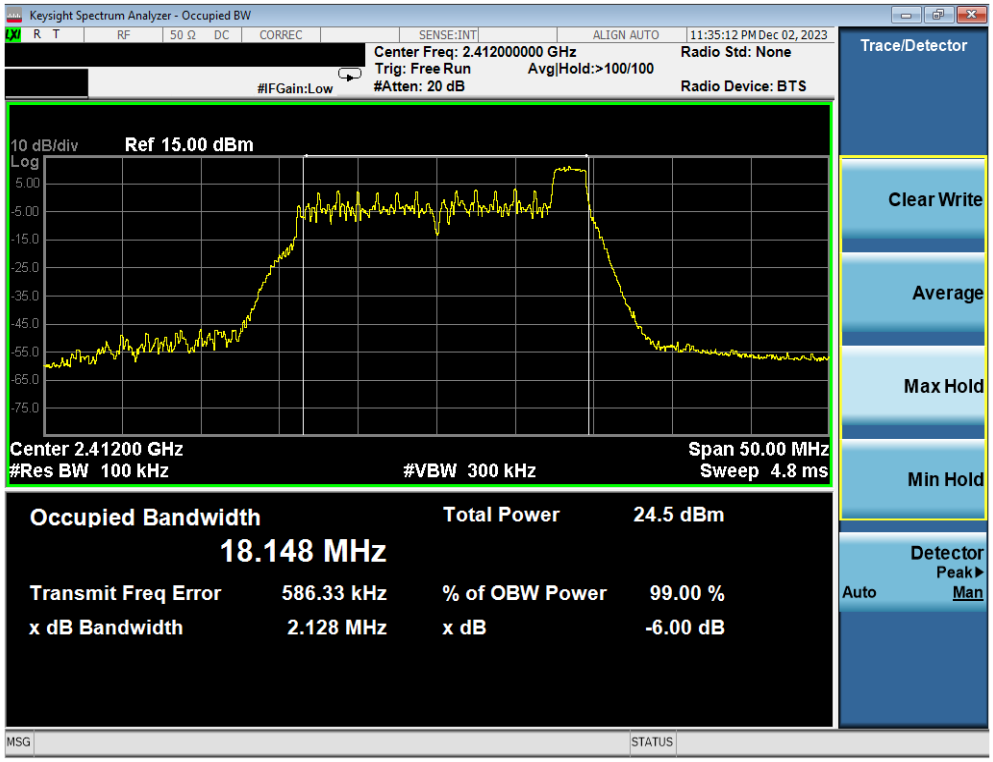
Table 7-3. 6dB BW & 99% OBW Measurements Antenna 1a



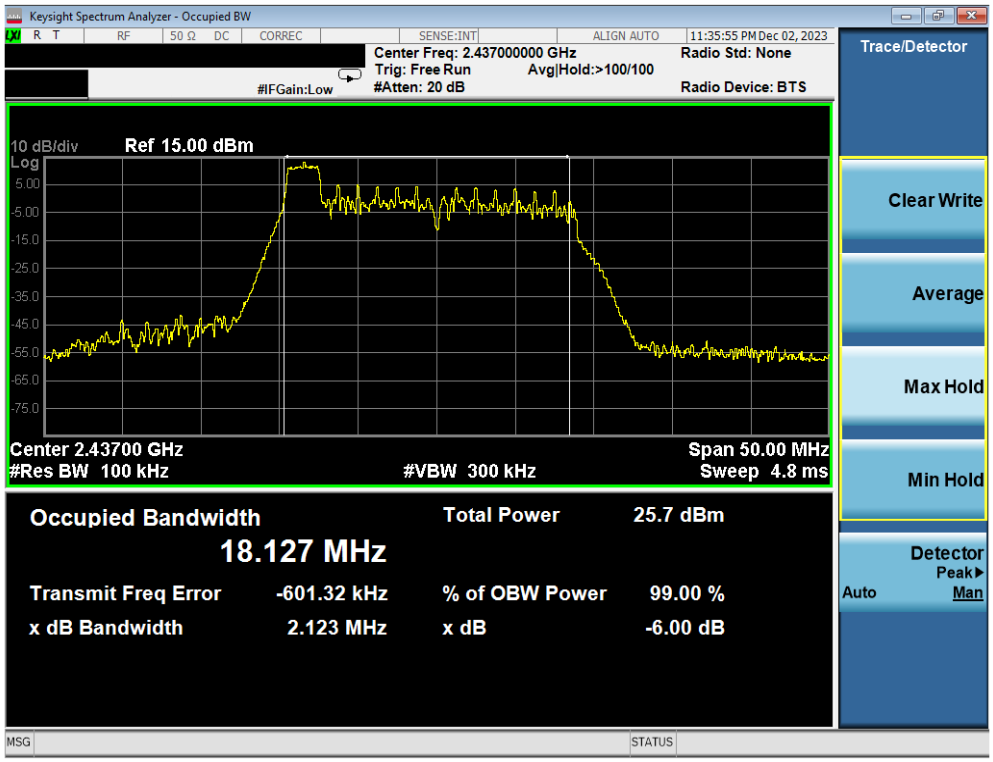
Plot 7-13. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



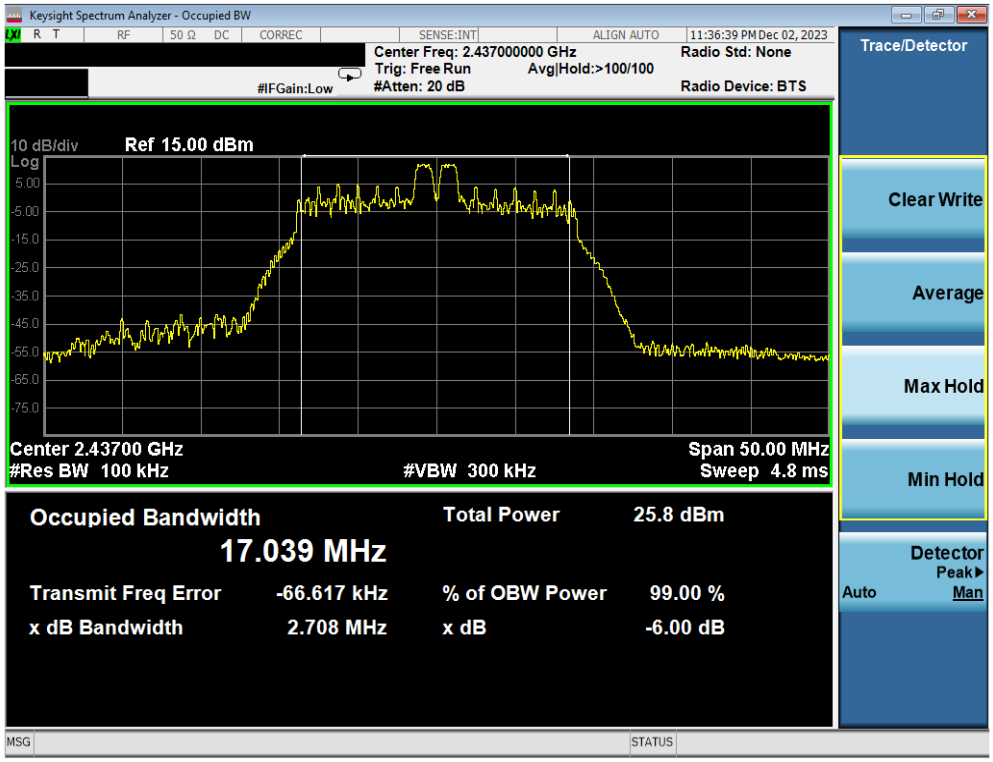
Plot 7-14. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



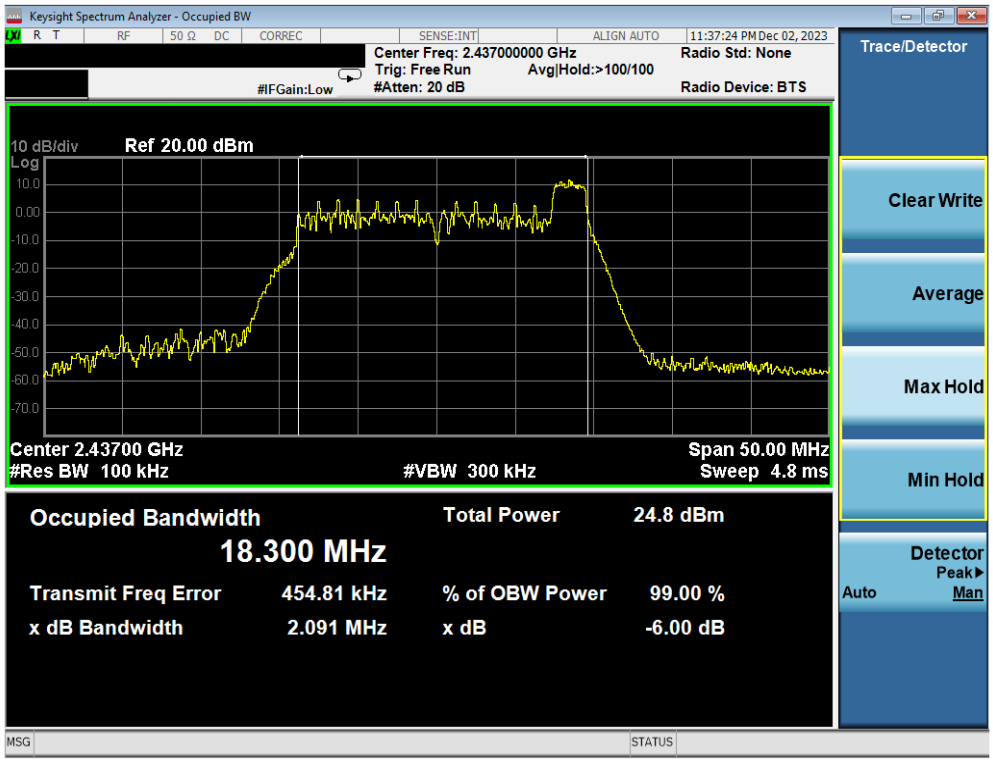
Plot 7-15. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



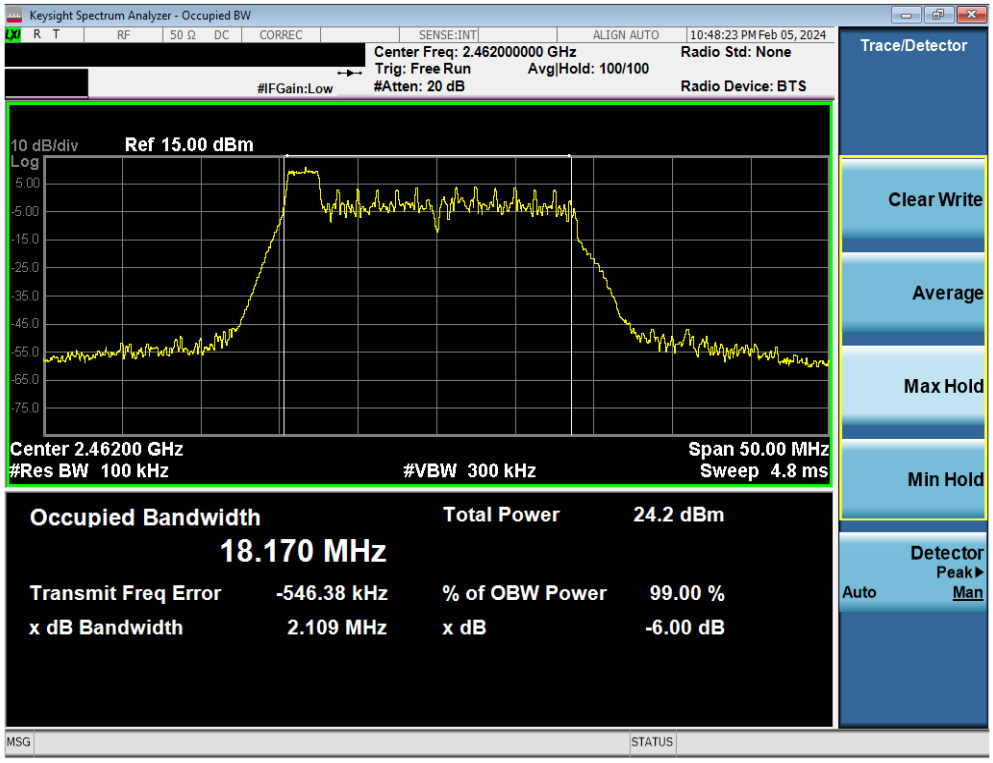
Plot 7-16. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



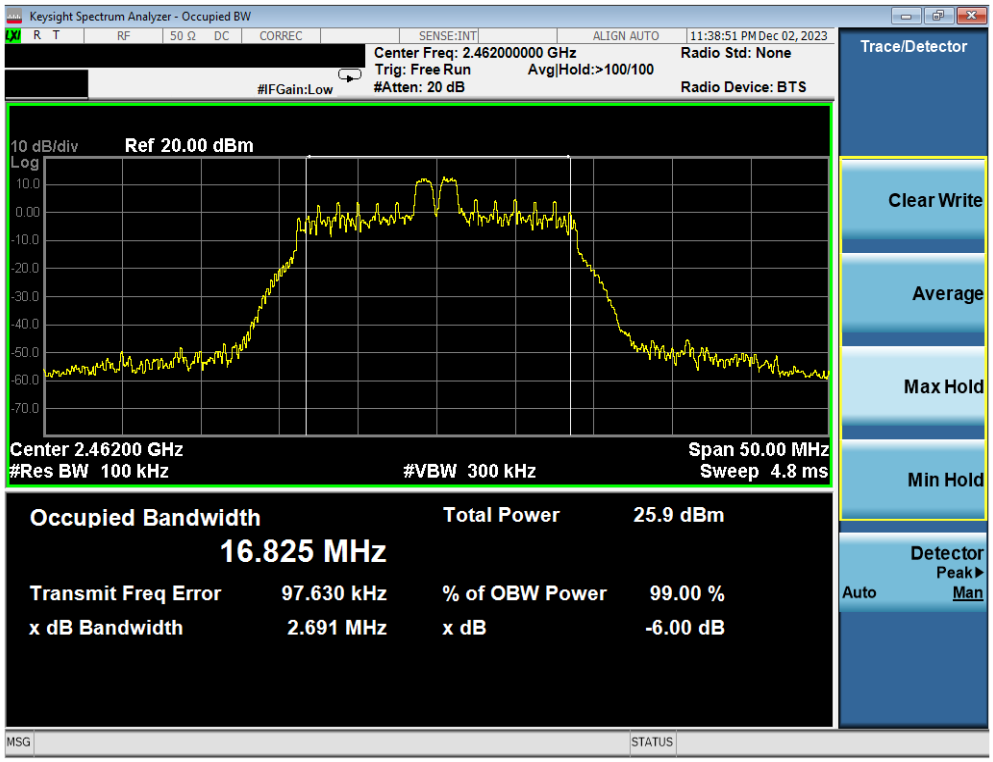
Plot 7-17. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



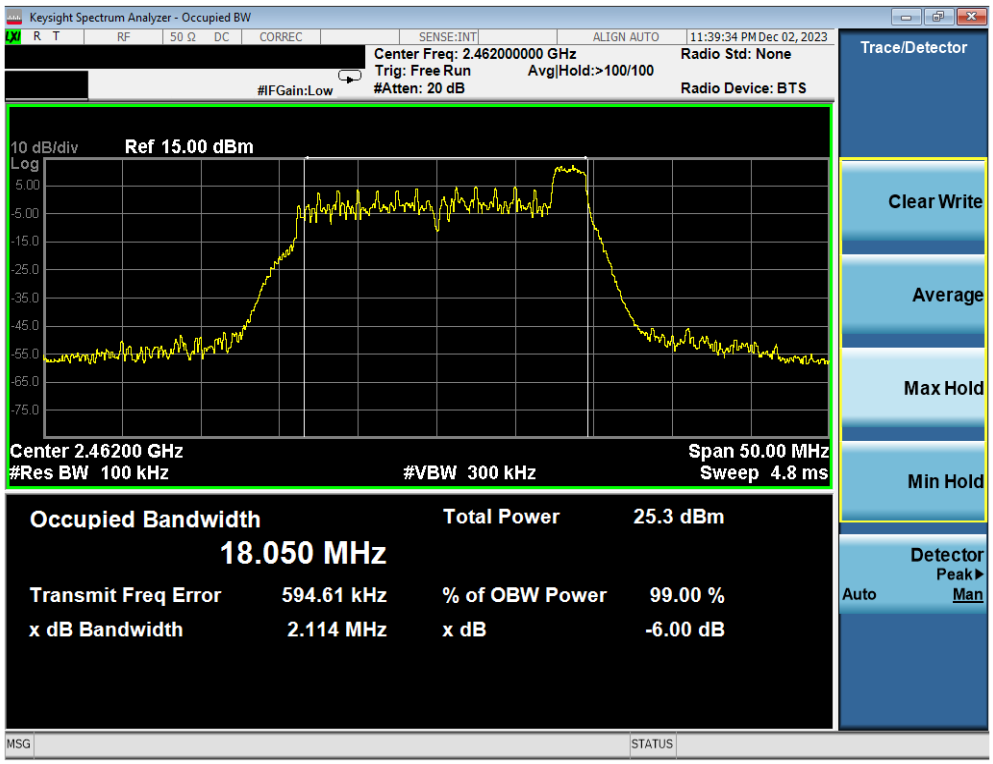
Plot 7-18. 6dB BW & 99% OBW Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



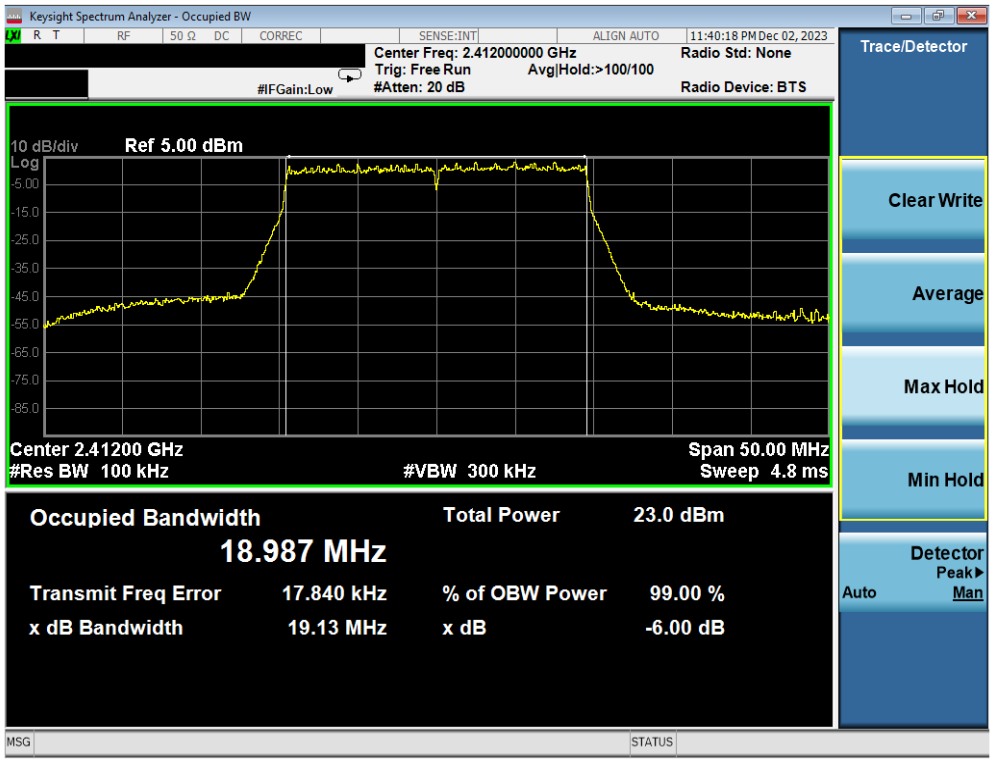
Plot 7-19. 6dB BW & 99% OBW Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



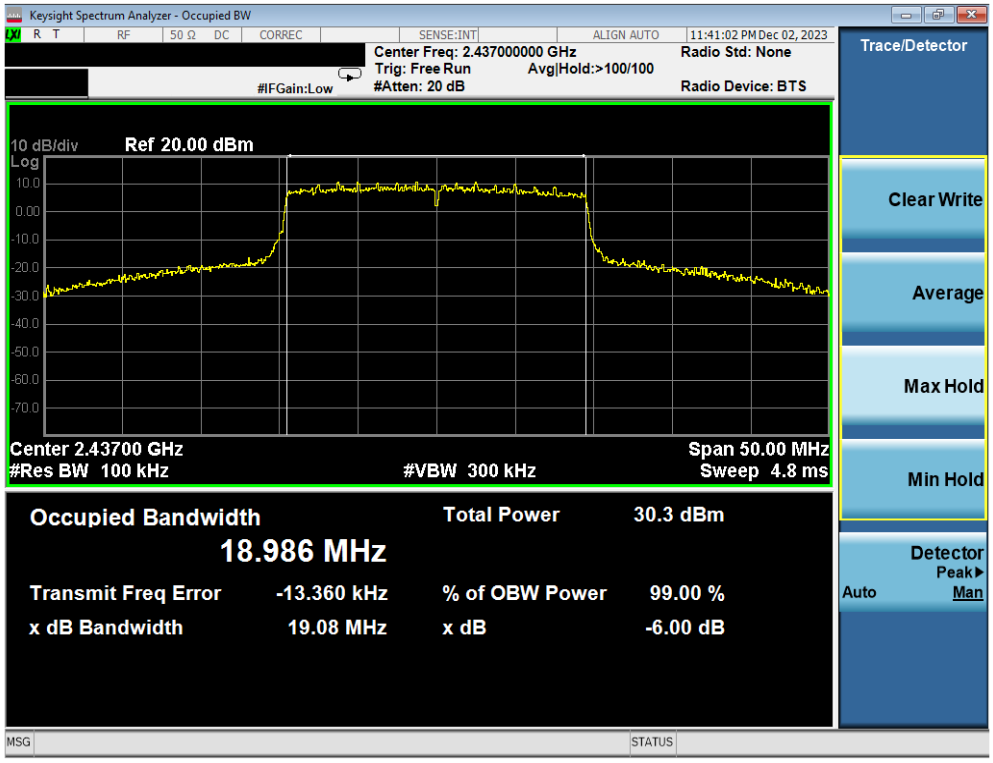
Plot 7-20. 6dB BW & 99% OBW Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



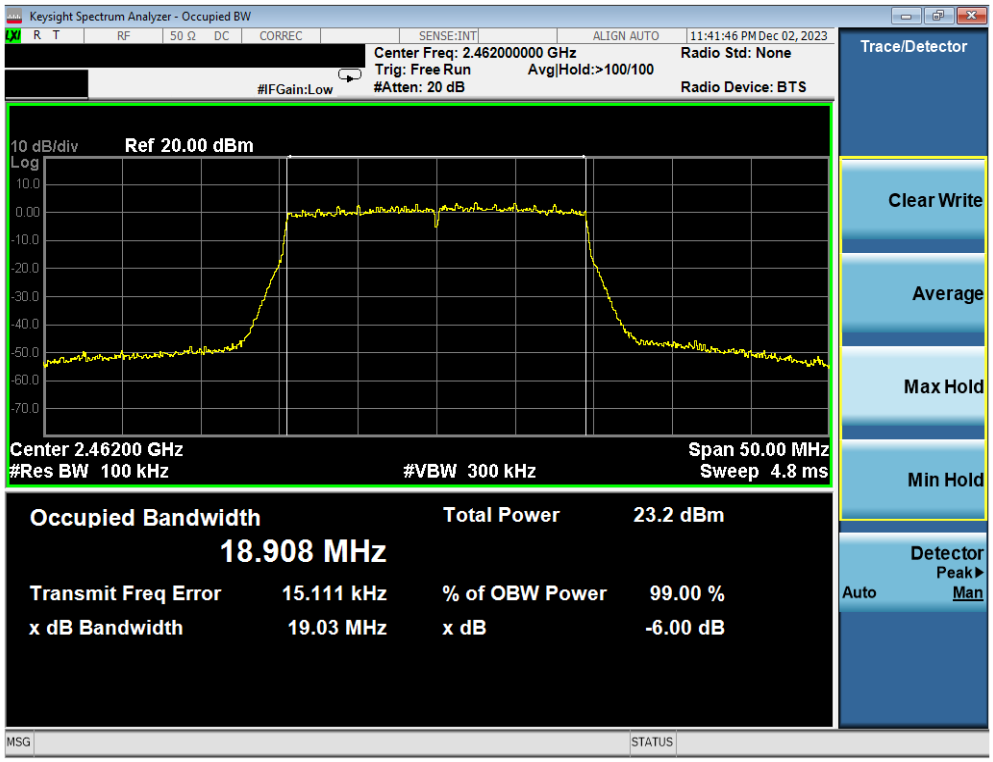
Plot 7-21. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-22. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 1)



Plot 7-23. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-24. 6dB BW & 99% OBW Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 11)

7.3 Output Power Measurement

§15.247(b.3); RSS-247 [5.4]

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 peak conducted output power of digital modulation systems operating in the 2400-2483.5 MHz band is 1 Watt.

The conducted output power limit on paragraph above is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

For DTSs employing digital modulation techniques operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W.

Test Procedure Used

ANSI C63.10-2013 – Subclause 11.9.1.3 PKPM1 Peak Power Method
KDB 558074 D01 v05r02 – Section 8.3.1.3 PKPM1 Peak-reading Power Meter Method
ANSI C63.10-2013 – Subclause 11.9.2.3.2 Method AVGPM-G
KDB 558074 D01 v05r02 – Section 8.3.2.3 Measurement using a Power Meter (PM)
ANSI C63.10-2013 – Subclause 14.2 Measure-and-Sum Technique
KDB 662911 D01 v02r01 – Section E)1) 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

1. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's are reported.
2. For 802.11ax-RU, the worst case data rate was found to be MCS9.

7.3.1 Average Output Power Measurement

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	26	0	10/11.8 (MCS9)	AVG	11.92	30.00	-18.08	2.60	14.52	36.02	-21.50
2412	1	26	4	10/11.8 (MCS9)	AVG	11.79	30.00	-18.21	2.60	14.39	36.02	-21.63
2412	1	26	8	10/11.8 (MCS9)	AVG	11.88	30.00	-18.12	2.60	14.48	36.02	-21.54
2417	2	26	0	10/11.8 (MCS9)	AVG	12.30	30.00	-17.70	2.60	14.90	36.02	-21.12
2417	2	26	4	10/11.8 (MCS9)	AVG	12.13	30.00	-17.87	2.60	14.73	36.02	-21.29
2417	2	26	8	10/11.8 (MCS9)	AVG	12.11	30.00	-17.89	2.60	14.71	36.02	-21.31
2437	6	26	0	10/11.8 (MCS9)	AVG	12.31	30.00	-17.69	2.60	14.91	36.02	-21.11
2437	6	26	4	10/11.8 (MCS9)	AVG	12.30	30.00	-17.70	2.60	14.90	36.02	-21.12
2437	6	26	8	10/11.8 (MCS9)	AVG	12.33	30.00	-17.67	2.60	14.93	36.02	-21.09
2462	11	26	0	10/11.8 (MCS9)	AVG	12.11	30.00	-17.90	2.60	14.71	36.02	-21.32
2462	11	26	4	10/11.8 (MCS9)	AVG	12.44	30.00	-17.56	2.60	15.04	36.02	-20.98
2462	11	26	8	10/11.8 (MCS9)	AVG	12.26	30.00	-17.74	2.60	14.86	36.02	-21.16
2467	12	26	0	10/11.8 (MCS9)	AVG	11.86	30.00	-18.14	2.60	14.46	36.02	-21.56
2467	12	26	4	10/11.8 (MCS9)	AVG	11.81	30.00	-18.19	2.60	14.41	36.02	-21.61
2467	12	26	8	10/11.8 (MCS9)	AVG	11.96	30.00	-18.04	2.60	14.56	36.02	-21.46

Table 7-4. Average Conducted Output Power Measurements Antenna 3a (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	242	61	97.5/114.7 (MCS9)	AVG	11.92	30.00	-18.08	2.60	14.52	36.02	-21.50
2417	2	242	61	97.5/114.7 (MCS9)	AVG	16.24	30.00	-13.76	2.60	18.84	36.02	-17.18
2422	3	242	61	97.5/114.7 (MCS9)	AVG	17.76	30.00	-12.24	2.60	20.36	36.02	-15.66
2427	4	242	61	97.5/114.7 (MCS9)	AVG	18.85	30.00	-11.15	2.60	21.45	36.02	-14.57
2432	5	242	61	97.5/114.7 (MCS9)	AVG	19.62	30.00	-10.39	2.60	22.22	36.02	-13.81
2437	6	242	61	97.5/114.7 (MCS9)	AVG	20.46	30.00	-9.54	2.60	23.06	36.02	-12.96
2442	7	242	61	97.5/114.7 (MCS9)	AVG	18.95	30.00	-11.05	2.60	21.55	36.02	-14.47
2447	8	242	61	97.5/114.7 (MCS9)	AVG	17.90	30.00	-12.10	2.60	20.50	36.02	-15.52
2452	9	242	61	97.5/114.7 (MCS9)	AVG	16.92	30.00	-13.08	2.60	19.52	36.02	-16.50
2457	10	242	61	97.5/114.7 (MCS9)	AVG	15.76	30.00	-14.24	2.60	18.36	36.02	-17.66
2462	11	242	61	97.5/114.7 (MCS9)	AVG	13.36	30.00	-16.64	2.60	15.96	36.02	-20.06
2467	12	242	61	97.5/114.7 (MCS9)	AVG	11.92	30.00	-18.08	2.60	14.52	36.02	-21.50

Table 7-5. Average Conducted Output Power Measurements Antenna 3a (RU242)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	26	0	10/11.8 (MCS9)	AVG	11.78	30.00	-18.22	1.50	13.28	36.02	-22.74
2412	1	26	4	10/11.8 (MCS9)	AVG	11.97	30.00	-18.03	1.50	13.47	36.02	-22.55
2412	1	26	8	10/11.8 (MCS9)	AVG	11.89	30.00	-18.11	1.50	13.39	36.02	-22.63
2417	2	26	0	10/11.8 (MCS9)	AVG	12.36	30.00	-17.64	1.50	13.86	36.02	-22.16
2417	2	26	4	10/11.8 (MCS9)	AVG	12.44	30.00	-17.57	1.50	13.94	36.02	-22.09
2417	2	26	8	10/11.8 (MCS9)	AVG	12.44	30.00	-17.56	1.50	13.94	36.02	-22.08
2437	6	26	0	10/11.8 (MCS9)	AVG	12.34	30.00	-17.66	1.50	13.84	36.02	-22.18
2437	6	26	4	10/11.8 (MCS9)	AVG	12.46	30.00	-17.54	1.50	13.96	36.02	-22.06
2437	6	26	8	10/11.8 (MCS9)	AVG	12.41	30.00	-17.59	1.50	13.91	36.02	-22.11
2462	11	26	0	10/11.8 (MCS9)	AVG	12.32	30.00	-17.69	1.50	13.82	36.02	-22.21
2462	11	26	4	10/11.8 (MCS9)	AVG	12.36	30.00	-17.64	1.50	13.86	36.02	-22.16
2462	11	26	8	10/11.8 (MCS9)	AVG	12.30	30.00	-17.70	1.50	13.80	36.02	-22.22
2467	12	26	0	10/11.8 (MCS9)	AVG	11.98	30.00	-18.02	1.50	13.48	36.02	-22.54
2467	12	26	4	10/11.8 (MCS9)	AVG	12.00	30.00	-18.00	1.50	13.50	36.02	-22.52
2467	12	26	8	10/11.8 (MCS9)	AVG	11.99	30.00	-18.01	1.50	13.49	36.02	-22.53

Table 7-6. Average Conducted Output Power Measurements Antenna 1a (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	242	61	97.5/114.7 (MCS9)	AVG	11.71	30.00	-18.29	1.50	13.21	36.02	-22.81
2417	2	242	61	97.5/114.7 (MCS9)	AVG	16.18	30.00	-13.82	1.50	17.68	36.02	-18.34
2422	3	242	61	97.5/114.7 (MCS9)	AVG	18.00	30.00	-12.00	1.50	19.50	36.02	-16.52
2427	4	242	61	97.5/114.7 (MCS9)	AVG	18.88	30.00	-11.12	1.50	20.38	36.02	-15.64
2432	5	242	61	97.5/114.7 (MCS9)	AVG	19.85	30.00	-10.16	1.50	21.35	36.02	-14.68
2437	6	242	61	97.5/114.7 (MCS9)	AVG	20.49	30.00	-9.52	1.50	21.99	36.02	-14.04
2442	7	242	61	97.5/114.7 (MCS9)	AVG	18.99	30.00	-11.01	1.50	20.49	36.02	-15.53
2447	8	242	61	97.5/114.7 (MCS9)	AVG	17.81	30.00	-12.19	1.50	19.31	36.02	-16.71
2452	9	242	61	97.5/114.7 (MCS9)	AVG	16.97	30.00	-13.03	1.50	18.47	36.02	-17.55
2457	10	242	61	97.5/114.7 (MCS9)	AVG	16.00	30.00	-14.00	1.50	17.50	36.02	-18.52
2462	11	242	61	97.5/114.7 (MCS9)	AVG	13.46	30.00	-16.54	1.50	14.96	36.02	-21.06
2467	12	242	61	97.5/114.7 (MCS9)	AVG	11.79	30.00	-18.21	1.50	13.29	36.02	-22.73

Table 7-7. Average Conducted Output Power Measurements Antenna 1a (RU242)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
						Antenna 3a	Antenna 1a	Summed						
2412	1	26	0	20/23.5 (MCS9)	AVG	11.83	11.96	14.91	30.00	-15.09	5.08	19.98	36.02	-16.04
2412	1	26	4	20/23.5 (MCS9)	AVG	11.84	11.99	14.92	30.00	-15.08	5.08	20.00	36.02	-16.02
2412	1	26	8	20/23.5 (MCS9)	AVG	11.89	12.00	14.96	30.00	-15.04	5.08	20.03	36.02	-15.99
2417	2	26	0	20/23.5 (MCS9)	AVG	12.39	12.26	15.34	30.00	-14.66	5.08	20.41	36.02	-15.61
2417	2	26	4	20/23.5 (MCS9)	AVG	12.26	12.48	15.38	30.00	-14.62	5.08	20.46	36.02	-15.56
2417	2	26	8	20/23.5 (MCS9)	AVG	12.34	12.27	15.31	30.00	-14.69	5.08	20.39	36.02	-15.63
2437	6	26	0	20/23.5 (MCS9)	AVG	12.28	12.44	15.37	30.00	-14.63	5.08	20.45	36.02	-15.57
2437	6	26	4	20/23.5 (MCS9)	AVG	12.27	12.47	15.38	30.00	-14.62	5.08	20.46	36.02	-15.56
2437	6	26	8	20/23.5 (MCS9)	AVG	12.31	12.32	15.32	30.00	-14.68	5.08	20.40	36.02	-15.62
2462	11	26	0	20/23.5 (MCS9)	AVG	12.26	12.31	15.29	30.00	-14.71	5.08	20.37	36.02	-15.65
2462	11	26	4	20/23.5 (MCS9)	AVG	12.29	12.31	15.31	30.00	-14.69	5.08	20.39	36.02	-15.63
2462	11	26	8	20/23.5 (MCS9)	AVG	12.43	12.39	15.42	30.00	-14.58	5.08	20.50	36.02	-15.53
2467	12	26	0	20/23.5 (MCS9)	AVG	11.99	11.97	14.99	30.00	-15.01	5.08	20.07	36.02	-15.95
2467	12	26	4	20/23.5 (MCS9)	AVG	11.89	11.89	14.90	30.00	-15.10	5.08	19.98	36.02	-16.04
2467	12	26	8	20/23.5 (MCS9)	AVG	11.97	11.77	14.88	30.00	-15.12	5.08	19.95	36.02	-16.07

Table 7-8. Average Conducted Output Power Measurements CDD (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
						Antenna 3a	Antenna 1a	Summed						
2412	1	242	61	195/229.4 (MCS9)	AVG	11.61	11.95	14.79	30.00	-15.21	5.08	19.87	36.02	-16.15
2417	2	242	61	195/229.4 (MCS9)	AVG	15.95	15.74	18.85	30.00	-11.15	5.08	23.93	36.02	-12.09
2422	3	242	61	195/229.4 (MCS9)	AVG	17.90	17.97	20.94	30.00	-9.06	5.08	26.02	36.02	-10.00
2427	4	242	61	195/229.4 (MCS9)	AVG	18.71	18.79	21.76	30.00	-8.24	5.08	26.84	36.02	-9.18
2432	5	242	61	195/229.4 (MCS9)	AVG	18.85	19.14	22.01	30.00	-7.99	5.08	27.08	36.02	-8.94
2437	6	242	61	195/229.4 (MCS9)	AVG	19.38	19.80	22.60	30.00	-7.40	5.08	27.68	36.02	-8.34
2442	7	242	61	195/229.4 (MCS9)	AVG	18.79	18.85	21.83	30.00	-8.17	5.08	26.91	36.02	-9.11
2447	8	242	61	195/229.4 (MCS9)	AVG	17.26	17.46	20.37	30.00	-9.63	5.08	25.45	36.02	-10.57
2452	9	242	61	195/229.4 (MCS9)	AVG	16.77	16.70	19.74	30.00	-10.26	5.08	24.82	36.02	-11.20
2457	10	242	61	195/229.4 (MCS9)	AVG	15.39	15.50	18.46	30.00	-11.54	5.08	23.53	36.02	-12.49
2462	11	242	61	195/229.4 (MCS9)	AVG	13.28	13.42	16.36	30.00	-13.64	5.08	21.44	36.02	-14.58
2467	12	242	61	195/229.4 (MCS9)	AVG	11.84	11.77	14.82	30.00	-15.18	5.08	19.90	36.02	-16.12

Table 7-9. Average Conducted Output Power Measurements CDD (RU242)

7.3.3 Peak Output Power Measurement

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	26	0	10/11.8 (MCS9)	PEAK	21.68	30.00	-8.32	2.60	24.28	36.02	-11.74
2412	1	26	4	10/11.8 (MCS9)	PEAK	21.06	30.00	-8.94	2.60	23.66	36.02	-12.36
2412	1	26	8	10/11.8 (MCS9)	PEAK	21.29	30.00	-8.71	2.60	23.89	36.02	-12.13
2417	2	26	0	10/11.8 (MCS9)	PEAK	22.66	30.00	-7.34	2.60	25.26	36.02	-10.76
2417	2	26	4	10/11.8 (MCS9)	PEAK	21.36	30.00	-8.64	2.60	23.96	36.02	-12.06
2417	2	26	8	10/11.8 (MCS9)	PEAK	21.46	30.00	-8.54	2.60	24.06	36.02	-11.96
2437	6	26	0	10/11.8 (MCS9)	PEAK	21.65	30.00	-8.35	2.60	24.25	36.02	-11.77
2437	6	26	4	10/11.8 (MCS9)	PEAK	21.53	30.00	-8.47	2.60	24.13	36.02	-11.89
2437	6	26	8	10/11.8 (MCS9)	PEAK	22.42	30.00	-7.58	2.60	25.02	36.02	-11.00
2462	11	26	0	10/11.8 (MCS9)	PEAK	21.72	30.00	-8.28	2.60	24.32	36.02	-11.70
2462	11	26	4	10/11.8 (MCS9)	PEAK	21.73	30.00	-8.28	2.60	24.33	36.02	-11.70
2462	11	26	8	10/11.8 (MCS9)	PEAK	23.19	30.00	-6.81	2.60	25.79	36.02	-10.23
2467	12	26	0	10/11.8 (MCS9)	PEAK	21.29	30.00	-8.71	2.60	23.89	36.02	-12.13
2467	12	26	4	10/11.8 (MCS9)	PEAK	21.22	30.00	-8.78	2.60	23.82	36.02	-12.20
2467	12	26	8	10/11.8 (MCS9)	PEAK	22.83	30.00	-7.17	2.60	25.43	36.02	-10.59

Table 7-10. Peak Conducted Output Power Measurements Antenna 3a (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	242	61	97.5/114.7 (MCS9)	PEAK	21.62	30.00	-8.38	2.60	24.22	36.02	-11.80
2417	2	242	61	97.5/114.7 (MCS9)	PEAK	25.58	30.00	-4.42	2.60	28.18	36.02	-7.84
2422	3	242	61	97.5/114.7 (MCS9)	PEAK	26.60	30.00	-3.40	2.60	29.20	36.02	-6.82
2427	4	242	61	97.5/114.7 (MCS9)	PEAK	27.05	30.00	-2.95	2.60	29.65	36.02	-6.37
2432	5	242	61	97.5/114.7 (MCS9)	PEAK	27.32	30.00	-2.69	2.60	29.92	36.02	-6.11
2437	6	242	61	97.5/114.7 (MCS9)	PEAK	27.51	30.00	-2.49	2.60	30.11	36.02	-5.91
2442	7	242	61	97.5/114.7 (MCS9)	PEAK	27.08	30.00	-2.92	2.60	29.68	36.02	-6.34
2447	8	242	61	97.5/114.7 (MCS9)	PEAK	26.65	30.00	-3.36	2.60	29.25	36.02	-6.78
2452	9	242	61	97.5/114.7 (MCS9)	PEAK	26.08	30.00	-3.92	2.60	28.68	36.02	-7.34
2457	10	242	61	97.5/114.7 (MCS9)	PEAK	25.22	30.00	-4.78	2.60	27.82	36.02	-8.20
2462	11	242	61	97.5/114.7 (MCS9)	PEAK	23.02	30.00	-6.98	2.60	25.62	36.02	-10.40
2467	12	242	61	97.5/114.7 (MCS9)	PEAK	21.59	30.00	-8.41	2.60	24.19	36.02	-11.83

Table 7-11. Peak Conducted Output Power Measurements Antenna 3a (RU242)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	26	0	10/11.8 (MCS9)	PEAK	21.19	30.00	-8.81	1.50	22.69	36.02	-13.33
2412	1	26	4	10/11.8 (MCS9)	PEAK	21.34	30.00	-8.66	1.50	22.84	36.02	-13.18
2412	1	26	8	10/11.8 (MCS9)	PEAK	21.20	30.00	-8.80	1.50	22.70	36.02	-13.32
2417	2	26	0	10/11.8 (MCS9)	PEAK	22.51	30.00	-7.49	1.50	24.01	36.02	-12.01
2417	2	26	4	10/11.8 (MCS9)	PEAK	21.60	30.00	-8.40	1.50	23.10	36.02	-12.92
2417	2	26	8	10/11.8 (MCS9)	PEAK	21.73	30.00	-8.27	1.50	23.23	36.02	-12.79
2437	6	26	0	10/11.8 (MCS9)	PEAK	21.62	30.00	-8.38	1.50	23.12	36.02	-12.90
2437	6	26	4	10/11.8 (MCS9)	PEAK	21.61	30.00	-8.39	1.50	23.11	36.02	-12.91
2437	6	26	8	10/11.8 (MCS9)	PEAK	23.07	30.00	-6.93	1.50	24.57	36.02	-11.45
2462	11	26	0	10/11.8 (MCS9)	PEAK	22.62	30.00	-7.39	1.50	24.12	36.02	-11.91
2462	11	26	4	10/11.8 (MCS9)	PEAK	21.52	30.00	-8.48	1.50	23.02	36.02	-13.00
2462	11	26	8	10/11.8 (MCS9)	PEAK	22.40	30.00	-7.60	1.50	23.90	36.02	-12.12
2467	12	26	0	10/11.8 (MCS9)	PEAK	22.00	30.00	-8.00	1.50	23.50	36.02	-12.52
2467	12	26	4	10/11.8 (MCS9)	PEAK	21.32	30.00	-8.68	1.50	22.82	36.02	-13.20
2467	12	26	8	10/11.8 (MCS9)	PEAK	23.43	30.00	-6.57	1.50	24.93	36.02	-11.09

Table 7-12. Peak Conducted Output Power Measurements Antenna 1a (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
2412	1	242	61	97.5/114.7 (MCS9)	PEAK	21.37	30.00	-8.63	1.50	22.87	36.02	-13.15
2417	2	242	61	97.5/114.7 (MCS9)	PEAK	25.49	30.00	-4.51	1.50	26.99	36.02	-9.03
2422	3	242	61	97.5/114.7 (MCS9)	PEAK	26.43	30.00	-3.57	1.50	27.93	36.02	-8.09
2427	4	242	61	97.5/114.7 (MCS9)	PEAK	26.81	30.00	-3.19	1.50	28.31	36.02	-7.71
2432	5	242	61	97.5/114.7 (MCS9)	PEAK	27.12	30.00	-2.88	1.50	28.62	36.02	-7.40
2437	6	242	61	97.5/114.7 (MCS9)	PEAK	27.26	30.00	-2.74	1.50	28.76	36.02	-7.26
2442	7	242	61	97.5/114.7 (MCS9)	PEAK	26.91	30.00	-3.09	1.50	28.41	36.02	-7.61
2447	8	242	61	97.5/114.7 (MCS9)	PEAK	26.50	30.00	-3.50	1.50	28.00	36.02	-8.02
2452	9	242	61	97.5/114.7 (MCS9)	PEAK	26.02	30.00	-3.99	1.50	27.52	36.02	-8.51
2457	10	242	61	97.5/114.7 (MCS9)	PEAK	25.28	30.00	-4.72	1.50	26.78	36.02	-9.24
2462	11	242	61	97.5/114.7 (MCS9)	PEAK	23.02	30.00	-6.98	1.50	24.52	36.02	-11.50
2467	12	242	61	97.5/114.7 (MCS9)	PEAK	21.50	30.00	-8.50	1.50	23.00	36.02	-13.02

Table 7-13. Peak Conducted Output Power Measurements Antenna 1a (RU242)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
						Antenna 3a	Antenna 1a	Summed						
2412	1	26	0	20/23.5 (MCS9)	PEAK	21.57	21.22	24.40	30.00	-5.60	5.08	29.48	36.02	-6.54
2412	1	26	4	20/23.5 (MCS9)	PEAK	21.02	21.16	24.10	30.00	-5.90	5.08	29.18	36.02	-6.84
2412	1	26	8	20/23.5 (MCS9)	PEAK	21.28	21.44	24.37	30.00	-5.63	5.08	29.45	36.02	-6.57
2417	2	26	0	20/23.5 (MCS9)	PEAK	22.71	22.29	25.52	30.00	-4.48	5.08	30.59	36.02	-5.43
2417	2	26	4	20/23.5 (MCS9)	PEAK	21.50	21.64	24.58	30.00	-5.42	5.08	29.66	36.02	-6.36
2417	2	26	8	20/23.5 (MCS9)	PEAK	21.68	21.57	24.63	30.00	-5.37	5.08	29.71	36.02	-6.31
2437	6	26	0	20/23.5 (MCS9)	PEAK	21.57	21.70	24.64	30.00	-5.36	5.08	29.72	36.02	-6.30
2437	6	26	4	20/23.5 (MCS9)	PEAK	21.45	21.59	24.53	30.00	-5.47	5.08	29.61	36.02	-6.41
2437	6	26	8	20/23.5 (MCS9)	PEAK	22.32	22.90	25.63	30.00	-4.37	5.08	30.71	36.02	-5.31
2462	11	26	0	20/23.5 (MCS9)	PEAK	21.89	22.62	25.28	30.00	-4.72	5.08	30.36	36.02	-5.66
2462	11	26	4	20/23.5 (MCS9)	PEAK	21.50	21.46	24.49	30.00	-5.51	5.08	29.57	36.02	-6.45
2462	11	26	8	20/23.5 (MCS9)	PEAK	23.33	22.50	25.94	30.00	-4.06	5.08	31.02	36.02	-5.00
2467	12	26	0	20/23.5 (MCS9)	PEAK	21.30	21.85	24.59	30.00	-5.41	5.08	29.67	36.02	-6.35
2467	12	26	4	20/23.5 (MCS9)	PEAK	21.23	21.03	24.14	30.00	-5.86	5.08	29.22	36.02	-6.80
2467	12	26	8	20/23.5 (MCS9)	PEAK	22.78	23.18	26.00	30.00	-4.00	5.08	31.07	36.02	-4.95

Table 7-14. Peak Conducted Output Power Measurements CDD (RU26)

Freq [MHz]	Channel	RU Size	RU Index	Data Rate [Mbps]	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
						Antenna 3a	Antenna 1a	Summed						
2412	1	242	61	195/229.4 (MCS9)	PEAK	21.24	21.71	24.49	30.00	-5.51	5.08	29.57	36.02	-6.45
2417	2	242	61	195/229.4 (MCS9)	PEAK	25.42	25.18	28.31	30.00	-1.69	5.08	33.39	36.02	-2.63
2422	3	242	61	195/229.4 (MCS9)	PEAK	26.63	26.44	29.55	30.00	-0.45	5.08	34.63	36.02	-1.39
2427	4	242	61	195/229.4 (MCS9)	PEAK	26.83	26.57	29.71	30.00	-0.29	5.08	34.79	36.02	-1.23
2432	5	242	61	195/229.4 (MCS9)	PEAK	26.76	26.63	29.70	30.00	-0.30	5.08	34.78	36.02	-1.24
2437	6	242	61	195/229.4 (MCS9)	PEAK	26.69	26.87	29.79	30.00	-0.21	5.08	34.87	36.02	-1.15
2442	7	242	61	195/229.4 (MCS9)	PEAK	26.76	26.78	29.78	30.00	-0.22	5.08	34.86	36.02	-1.16
2447	8	242	61	195/229.4 (MCS9)	PEAK	25.97	26.25	29.12	30.00	-0.88	5.08	34.20	36.02	-1.82
2452	9	242	61	195/229.4 (MCS9)	PEAK	25.97	25.83	28.91	30.00	-1.09	5.08	33.98	36.02	-2.04
2457	10	242	61	195/229.4 (MCS9)	PEAK	24.95	24.94	27.96	30.00	-2.04	5.08	33.03	36.02	-2.99
2462	11	242	61	195/229.4 (MCS9)	PEAK	22.98	23.00	26.00	30.00	-4.00	5.08	31.08	36.02	-4.94
2467	12	242	61	195/229.4 (MCS9)	PEAK	21.52	21.44	24.49	30.00	-5.51	5.08	29.57	36.02	-6.45

Table 7-15. Peak Conducted Output Power Measurements CDD (RU242)

Note:

Per ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)1), the conducted powers at Antenna 3a and Antenna 1a were first measured separately during CDD transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Per ANSI C63.10-2013 Subclause 14.4.3, the directional gain is calculated using the following formula, where G_N is the gain of the nth antenna and N_{ANT}, the total number of antennas used.

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}] \text{ dBi}$$

Sample CDD Calculation:

At 2412MHz the average conducted output power was measured to be 11.83 dBm for Antenna 3a and 12.03 dBm for Antenna 1a.

Antenna 3a + Antenna 1a = CDD

(11.83 dBm + 12.03 dBm) = (15.241 mW + 15.959 mW) = 31.189 mW = 14.94 dBm

Sample e.i.r.p. Calculation:

At 2412MHz, the average conducted output power was calculated to be 14.94 dBm with antenna gain of 5.08 dBi.

e.i.r.p. (dBm) = Conducted Power (dBm) + Ant gain (dBi)

14.94 dBm + 5.08 dBi = 20.02 dBm

7.4 Power Spectral Density

§15.247(e); RSS-247 [5.2]

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, RU configurations, and RU indices were investigated and the worst case configuration results are reported in this section.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Subclause 11.10.3 Method AVGPSD
KDB 558074 D01 v05r02 – Section 8.4 DTS Maximum Power Spectral Density level in the fundamental emission
ANSI C63.10-2013 – Subclause 14.3.2.2 Measure-and-Sum Technique
KDB 662911 D01 v02r01 – Section E)2) Measure-and-Sum Technique

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span set to at least 1.5 times the OBW
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = power averaging (rms)
6. Number of sweep points ≥ [2 x span/ RBW]
7. Sweep time = auto couple
8. Trace mode = Averaging (RMS) over a minimum of 100 traces
9. 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

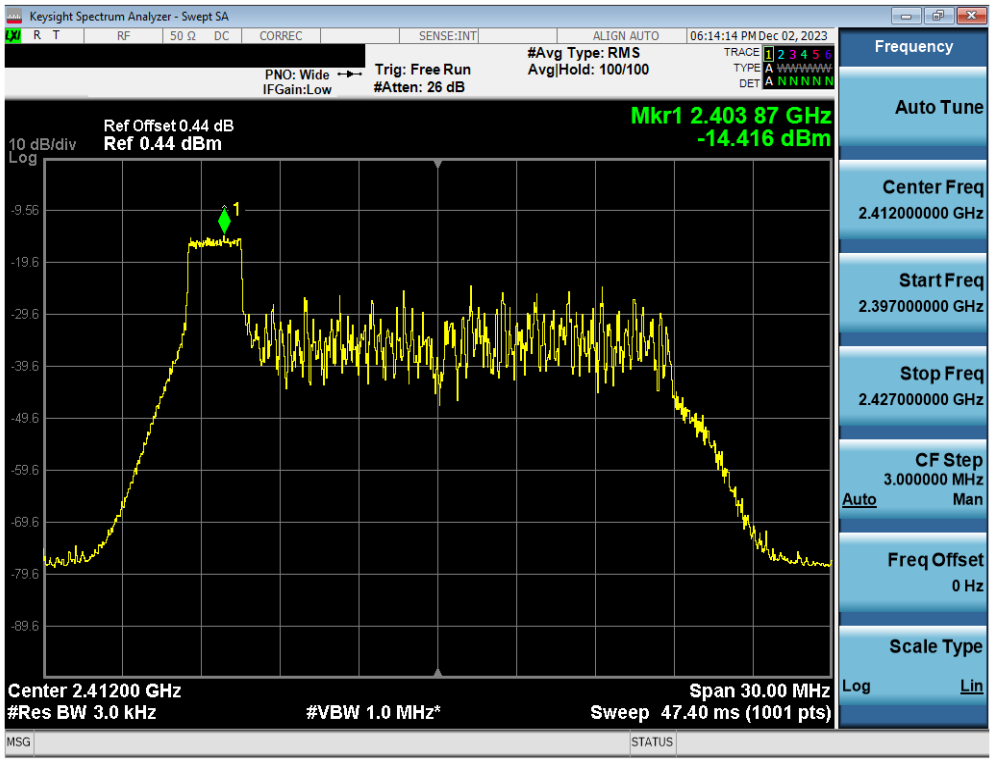
Test Notes

1. All data rates were investigated and only the worst case is reported.
2. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's are reported.

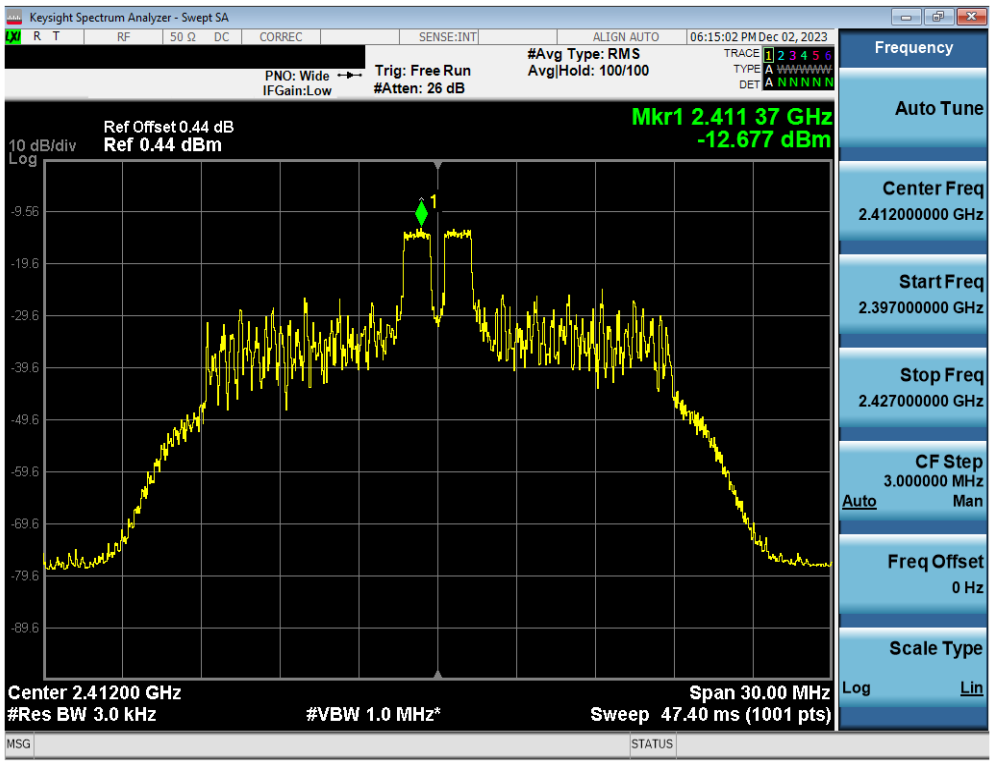
Antenna 3a Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 MODE	RU Size	RU Index	Data Rate [Mbps]	Measured Power Density [dBm/3kHz]	Max Power Density [dBm/3kHz]	Margin [dB]	Pass/Fail
2412	1	ax (20MHz)	26	0	10/11.8 (MCS9)	-14.42	8.0	-22.42	Pass
			26	4	10/11.8 (MCS9)	-12.68	8.0	-20.68	Pass
			26	8	10/11.8 (MCS9)	-12.51	8.0	-20.51	Pass
2437	6	ax (20MHz)	26	0	10/11.8 (MCS9)	-11.31	8.0	-19.31	Pass
			26	4	10/11.8 (MCS9)	-11.13	8.0	-19.13	Pass
			26	8	10/11.8 (MCS9)	-12.40	8.0	-20.40	Pass
2462	11	ax (20MHz)	26	0	10/11.8 (MCS9)	-11.55	8.0	-19.55	Pass
			26	4	10/11.8 (MCS9)	-10.52	8.0	-18.52	Pass
			26	8	10/11.8 (MCS9)	-13.40	8.0	-21.40	Pass
2412	1	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-19.06	8.0	-27.06	Pass
2437	6	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-11.45	8.0	-19.45	Pass
2462	11	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-18.12	8.0	-26.12	Pass

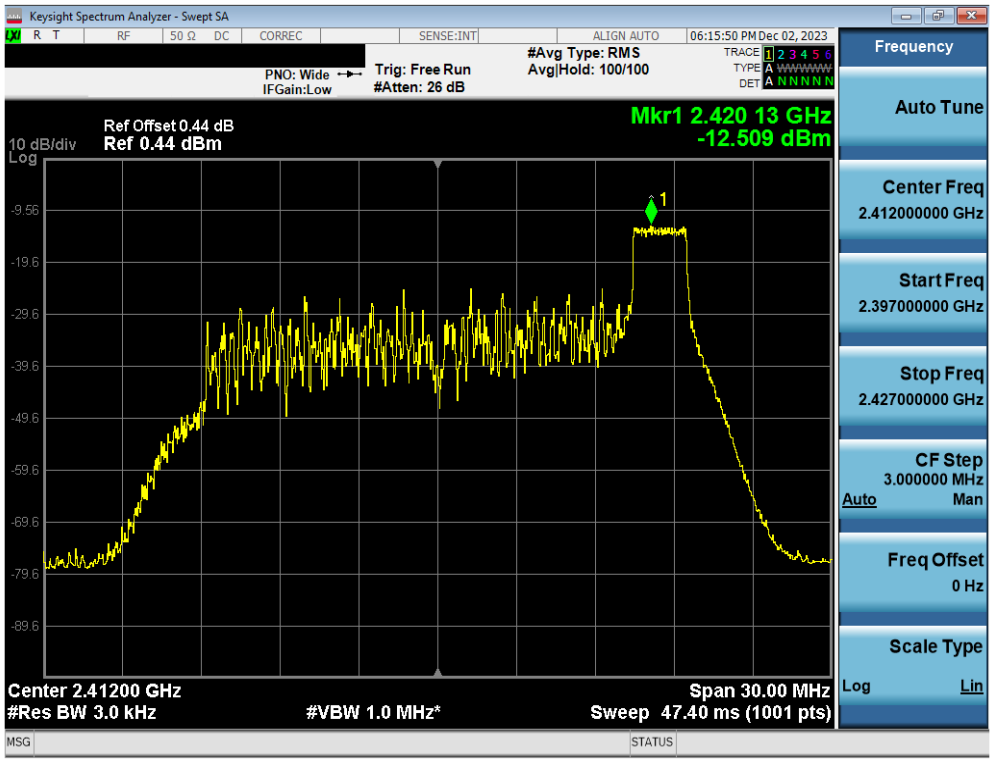
Table 7-16. Conducted Power Density Measurements Antenna 3a



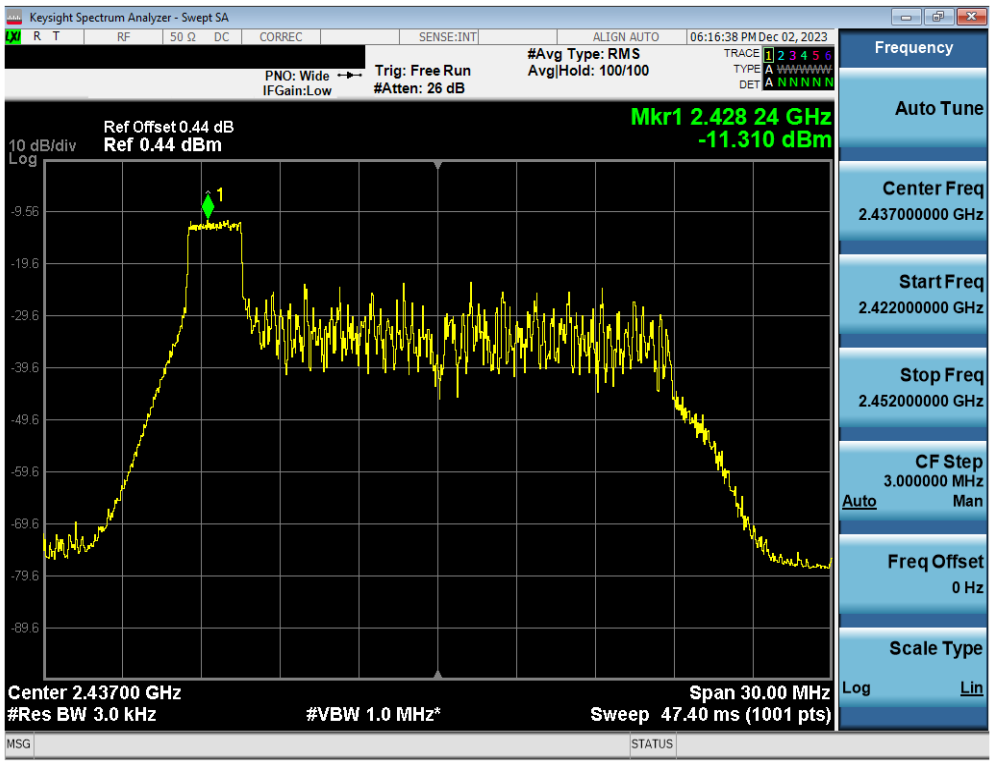
Plot 7-25. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



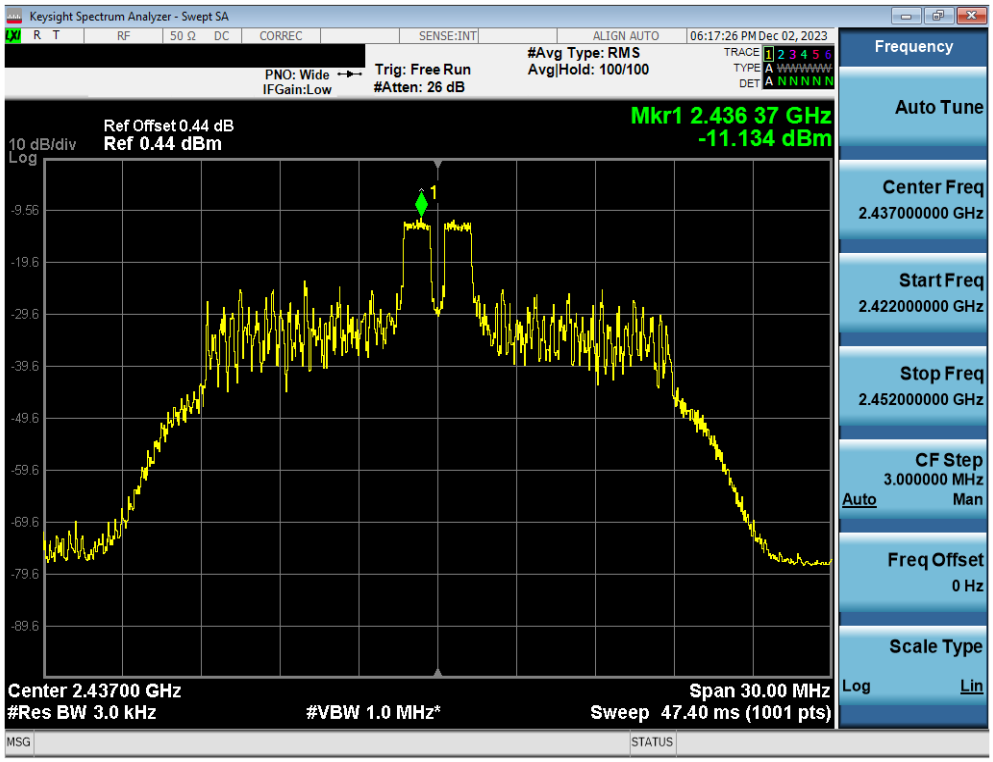
Plot 7-26. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



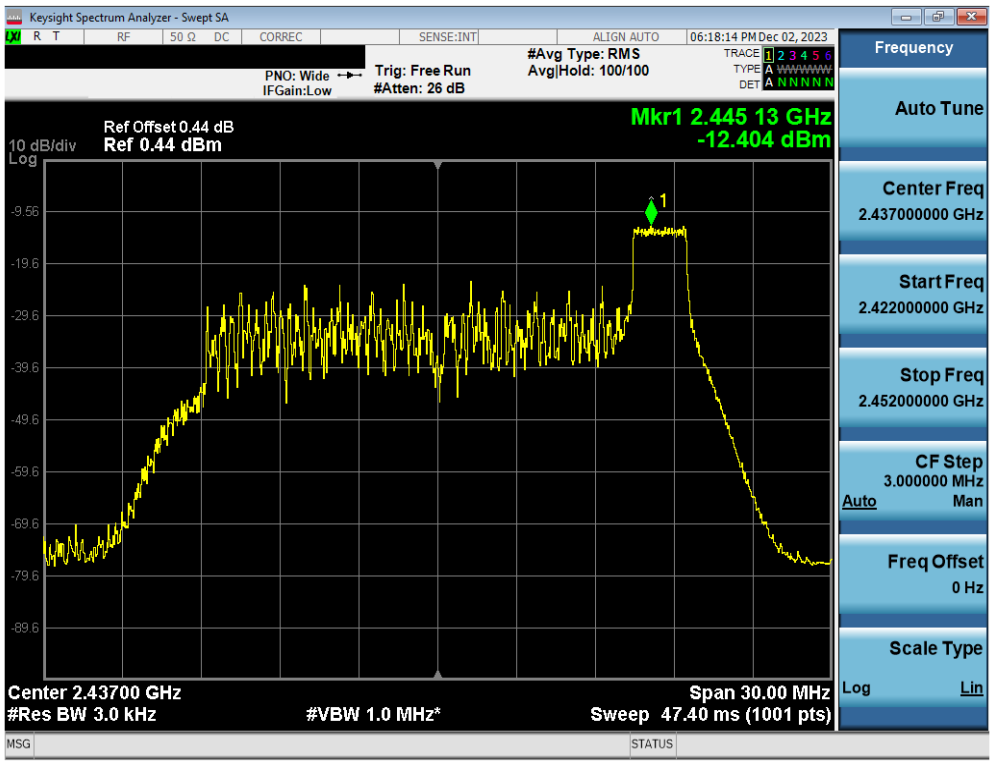
Plot 7-27. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



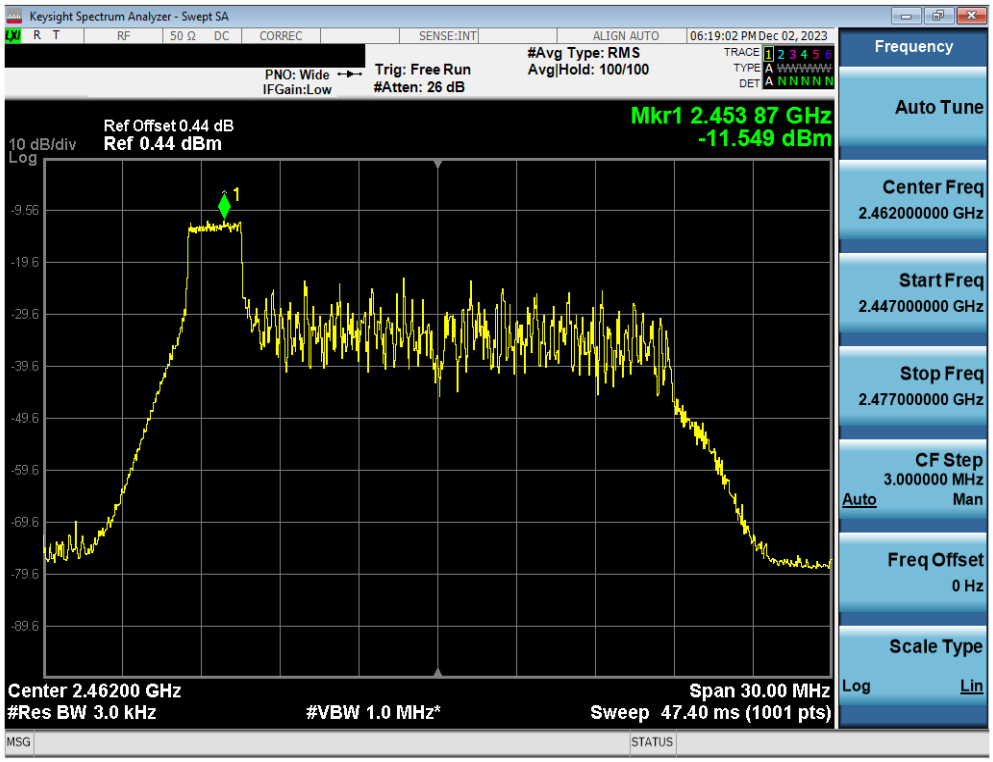
Plot 7-28. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



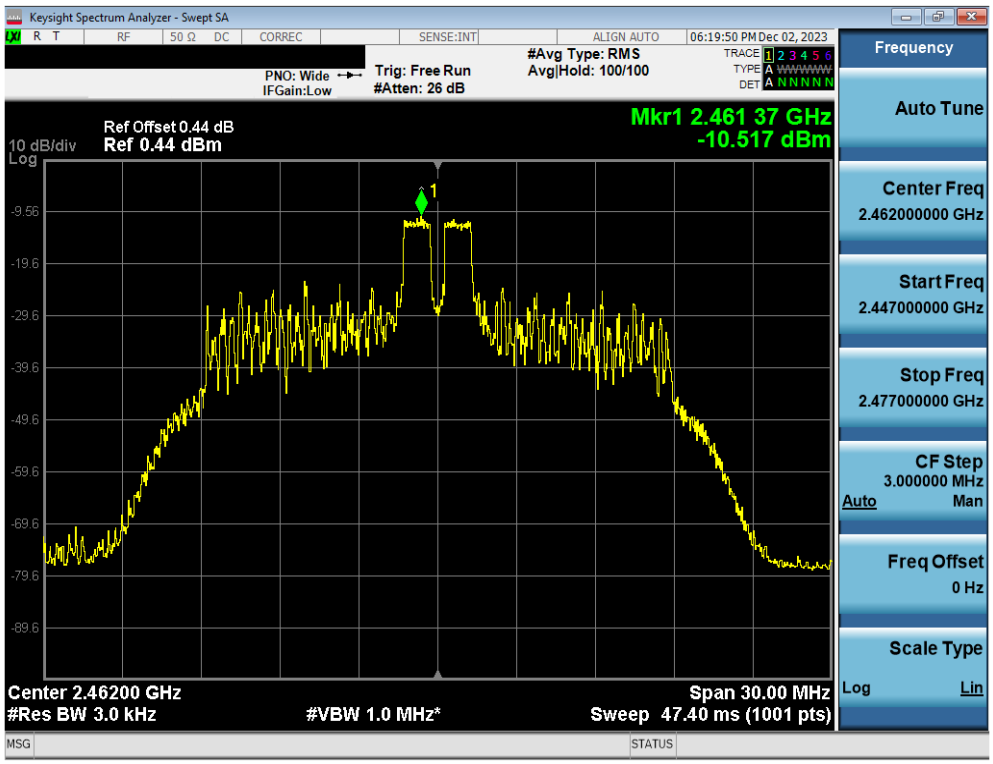
Plot 7-29. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



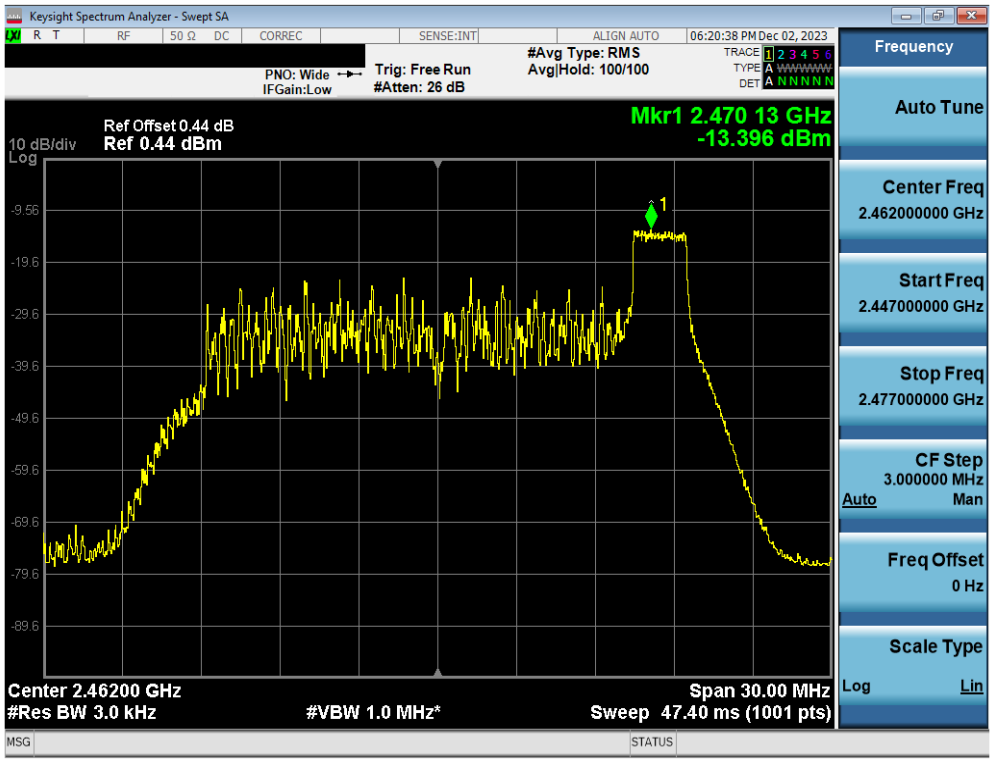
Plot 7-30. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



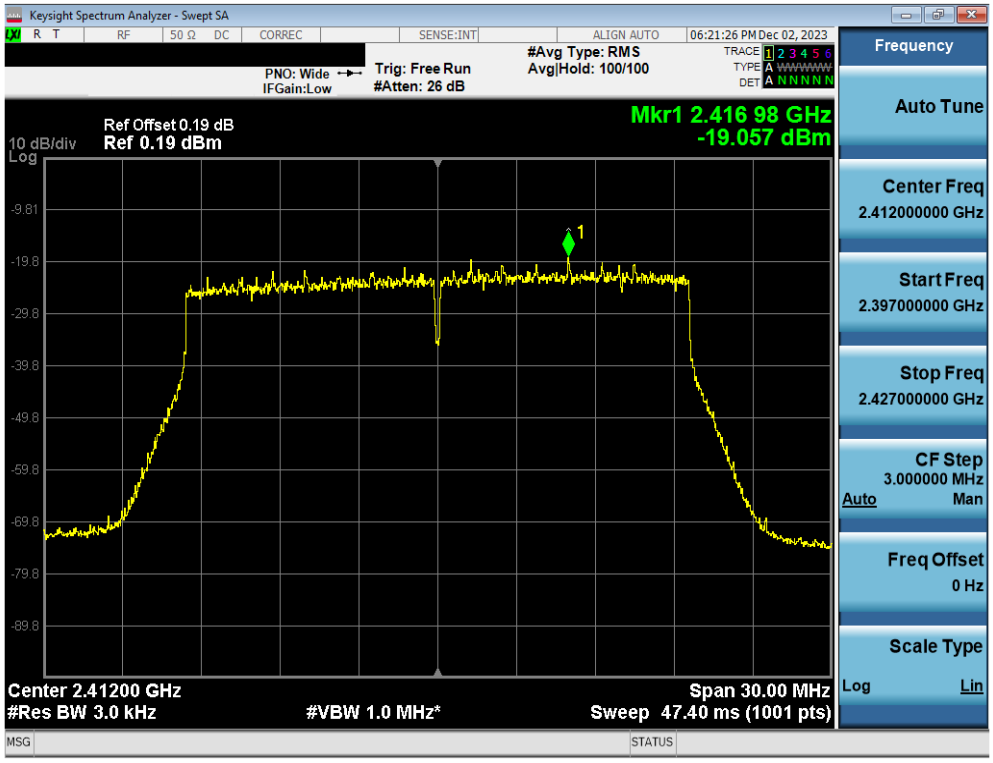
Plot 7-31. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



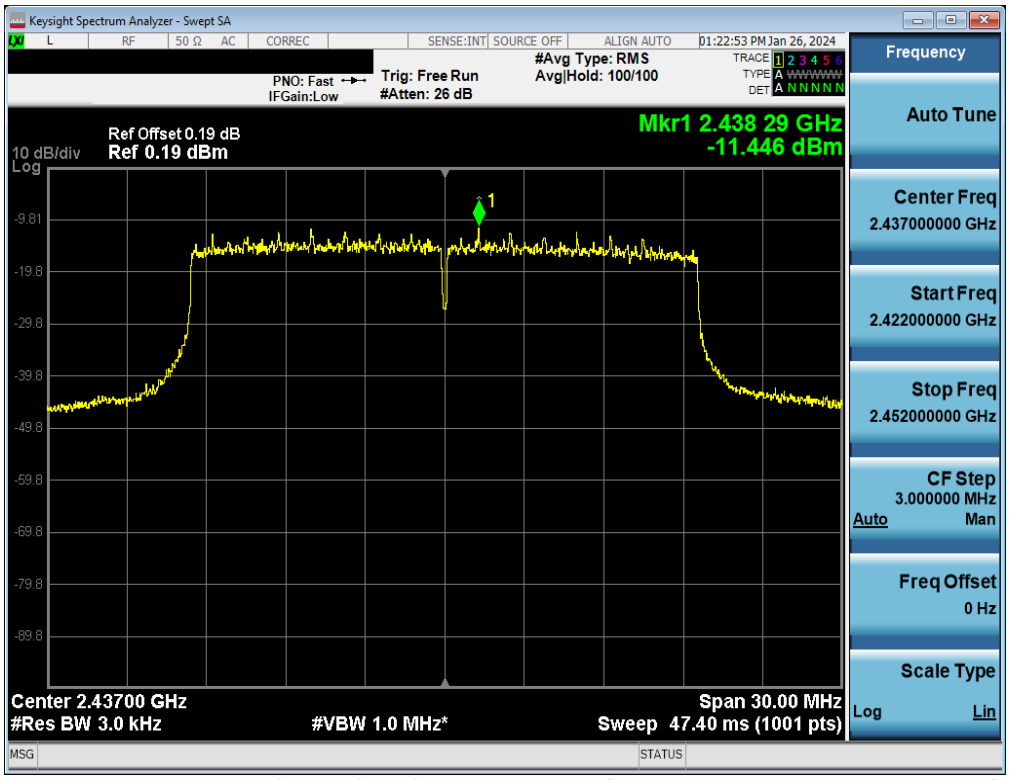
Plot 7-32. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



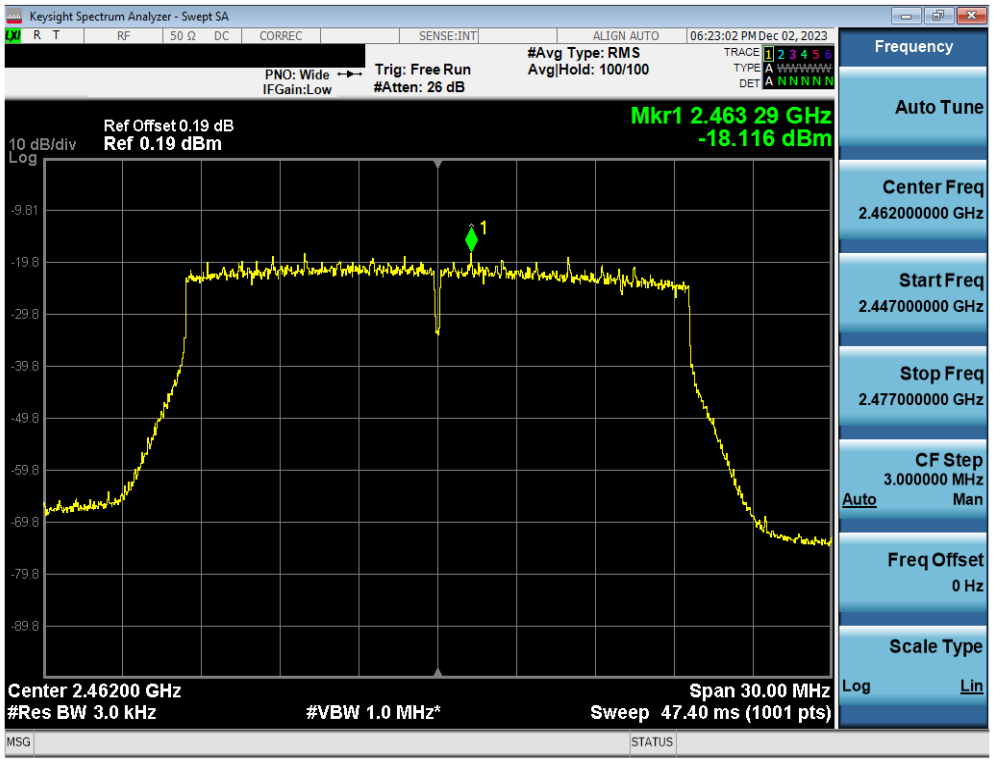
Plot 7-33. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-34. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



Plot 7-35. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6)

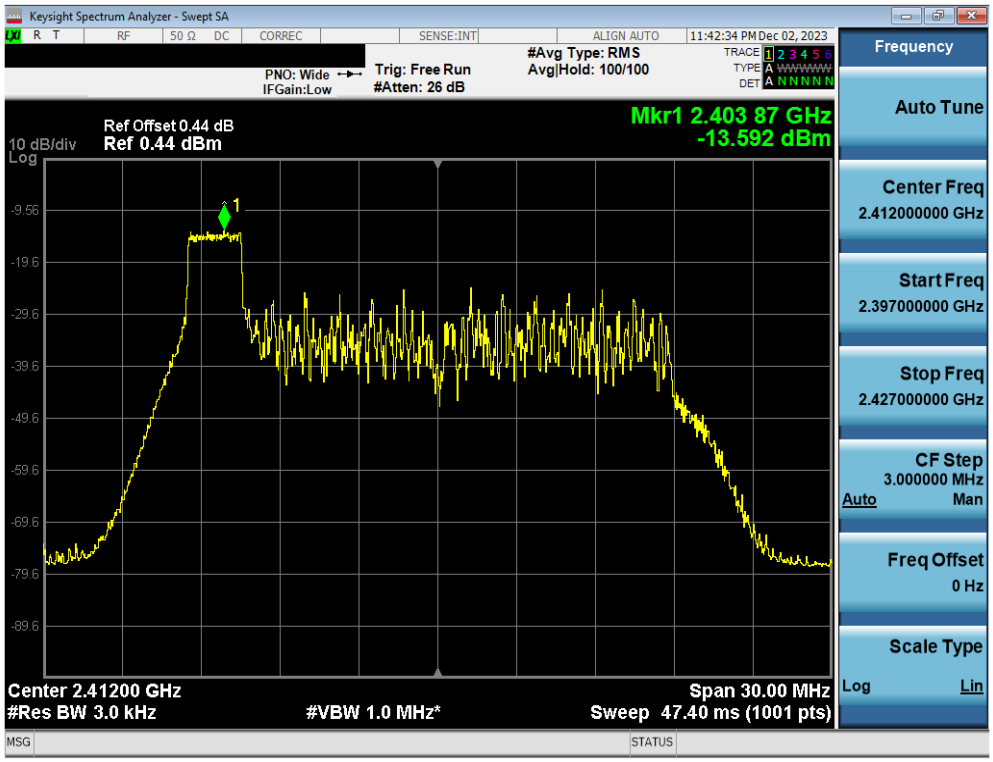


Plot 7-36. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)

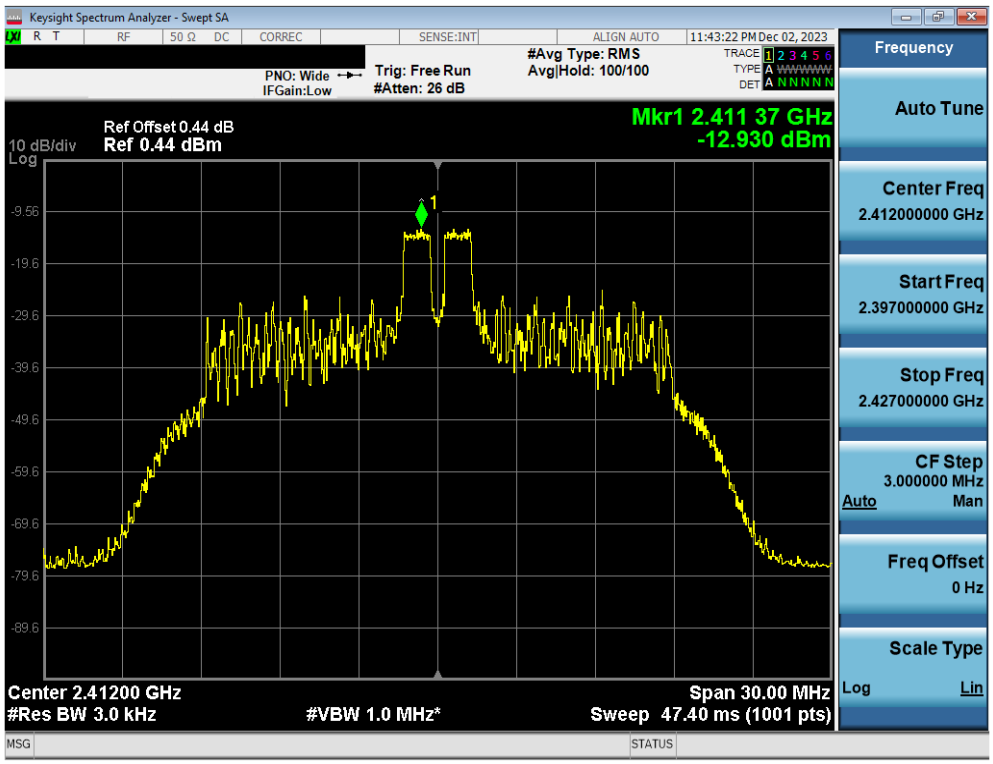
Antenna 1a Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 MODE	RU Size	RU Index	Data Rate [Mbps]	Measured Power Density [dBm/3kHz]	Max Power Density [dBm/3kHz]	Margin [dB]	Pass/Fail
2412	1	ax (20MHz)	26	0	10/11.8 (MCS9)	-13.59	8.0	-21.59	Pass
			26	4	10/11.8 (MCS9)	-12.93	8.0	-20.93	Pass
			26	8	10/11.8 (MCS9)	-12.85	8.0	-20.85	Pass
2437	6	ax (20MHz)	26	0	10/11.8 (MCS9)	-11.16	8.0	-19.16	Pass
			26	4	10/11.8 (MCS9)	-10.76	8.0	-18.76	Pass
			26	8	10/11.8 (MCS9)	-13.14	8.0	-21.14	Pass
2462	11	ax (20MHz)	26	0	10/11.8 (MCS9)	-13.09	8.0	-21.09	Pass
			26	4	10/11.8 (MCS9)	-11.04	8.0	-19.04	Pass
			26	8	10/11.8 (MCS9)	-12.36	8.0	-20.36	Pass
2412	1	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-19.45	8.0	-27.45	Pass
2437	6	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-11.76	8.0	-19.76	Pass
2462	11	ax (20MHz)	242	61	97.5/114.7 (MCS9)	-17.74	8.0	-25.74	Pass

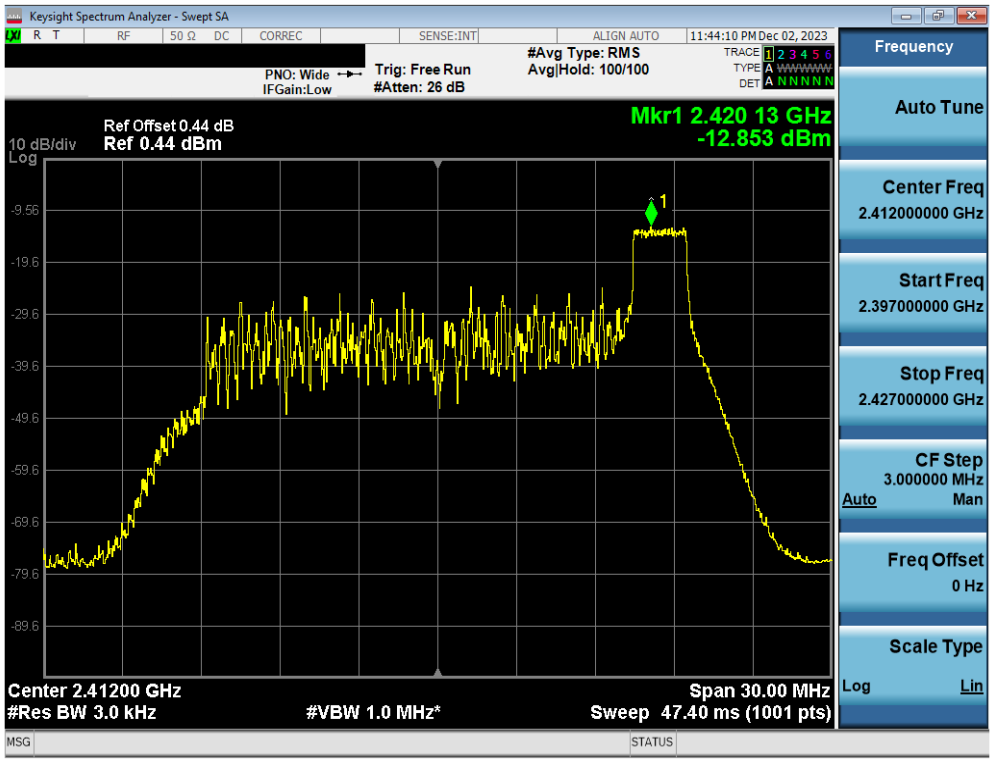
Table 7-17. Conducted Power Density Measurements Antenna 1a



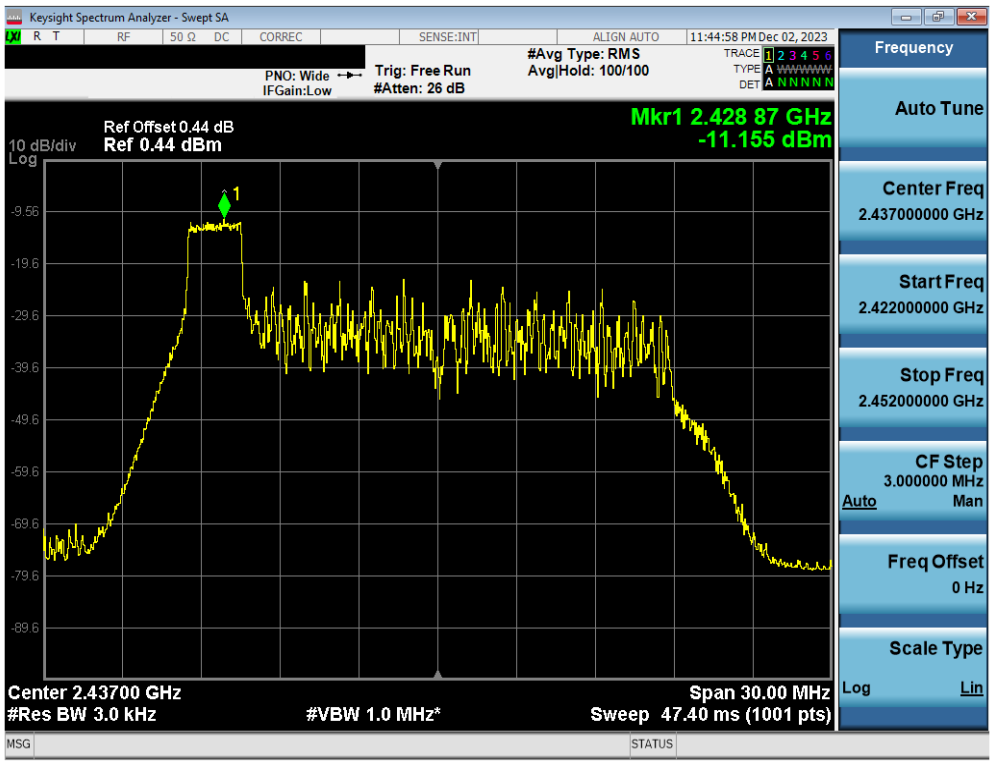
Plot 7-37. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



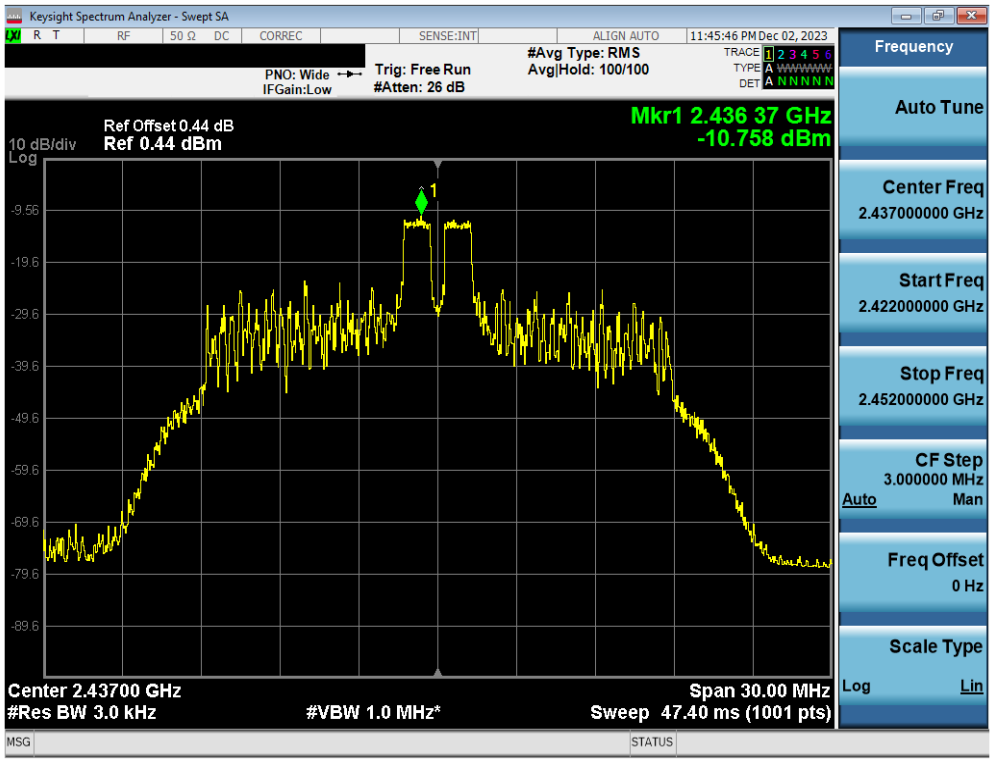
Plot 7-38. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



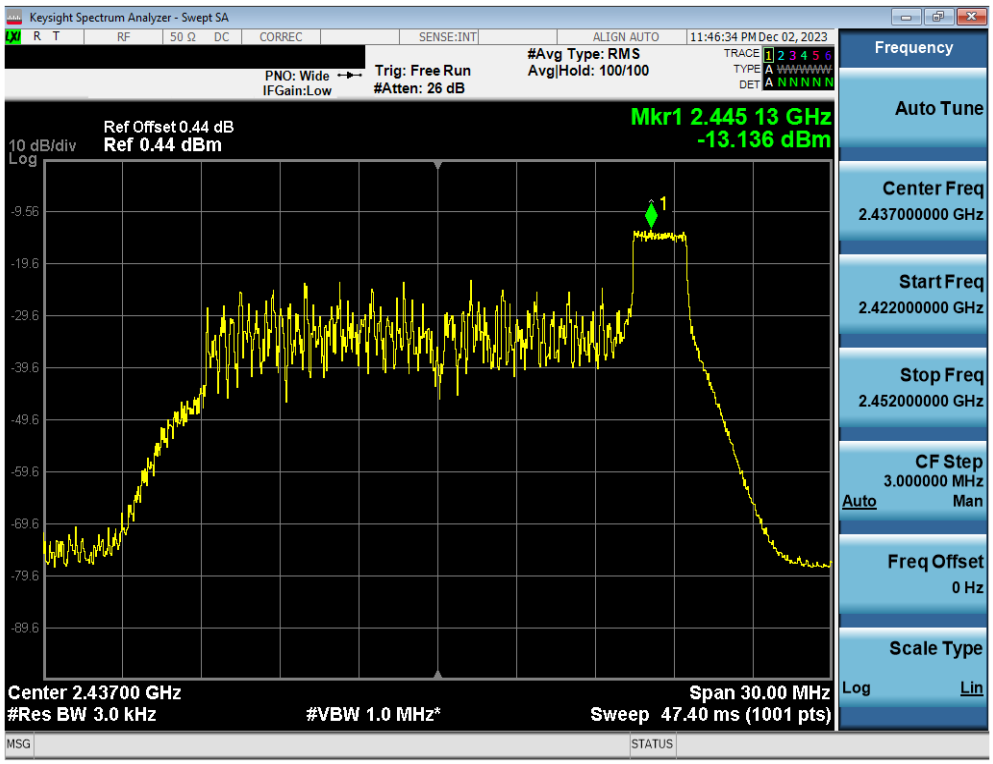
Plot 7-39. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



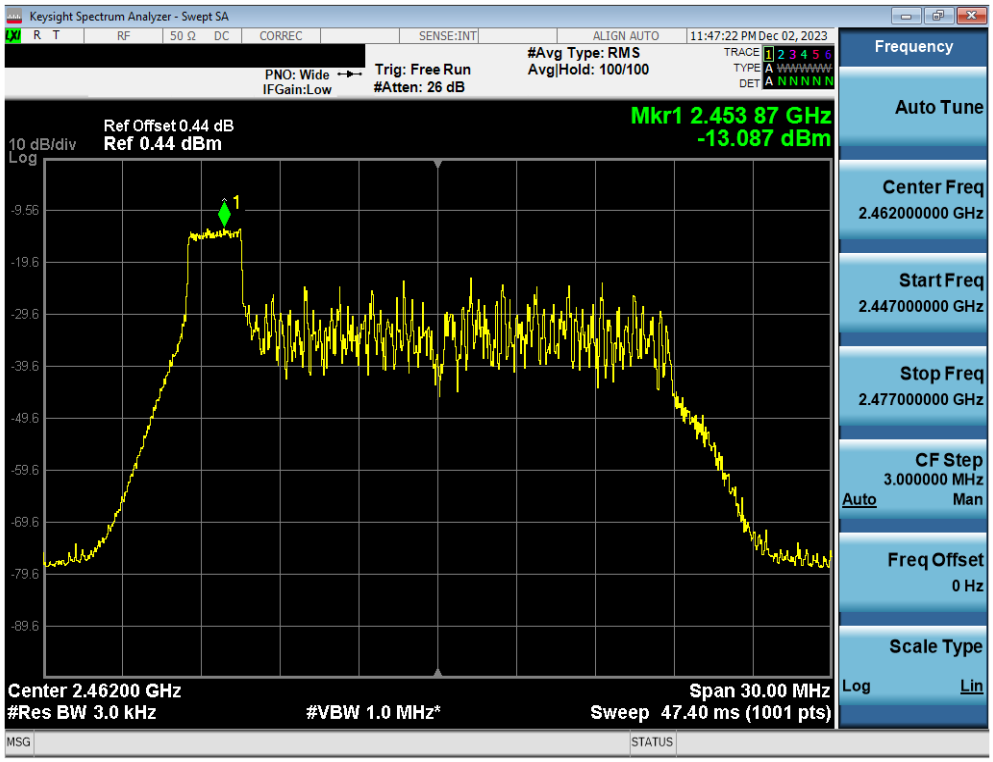
Plot 7-40. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



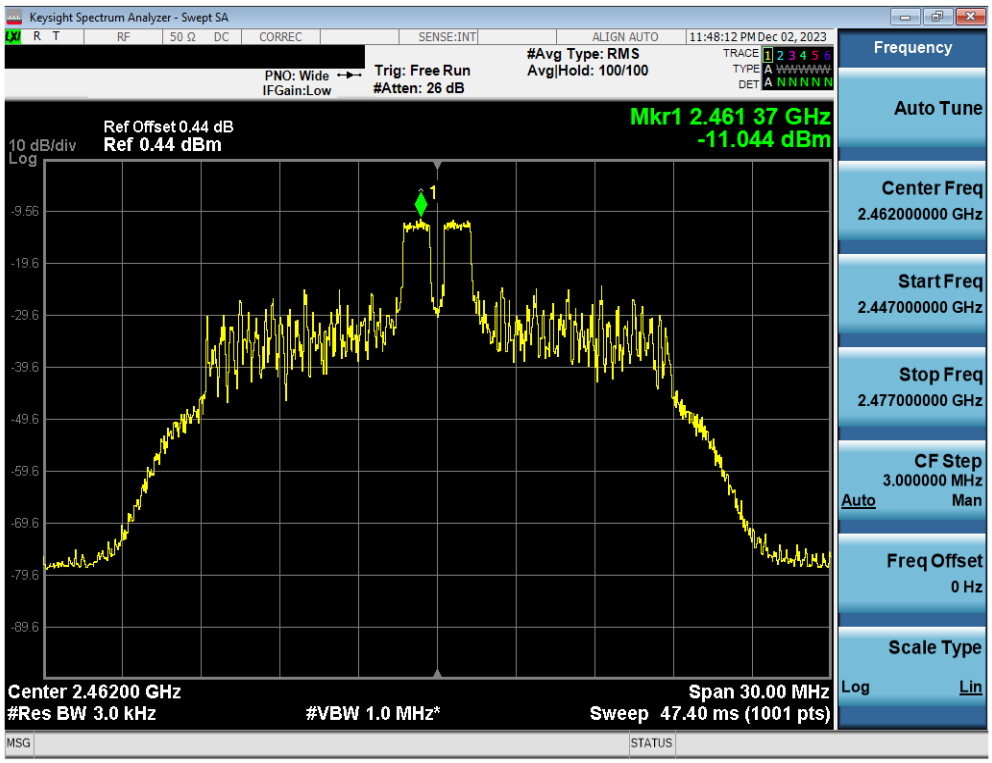
Plot 7-41. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



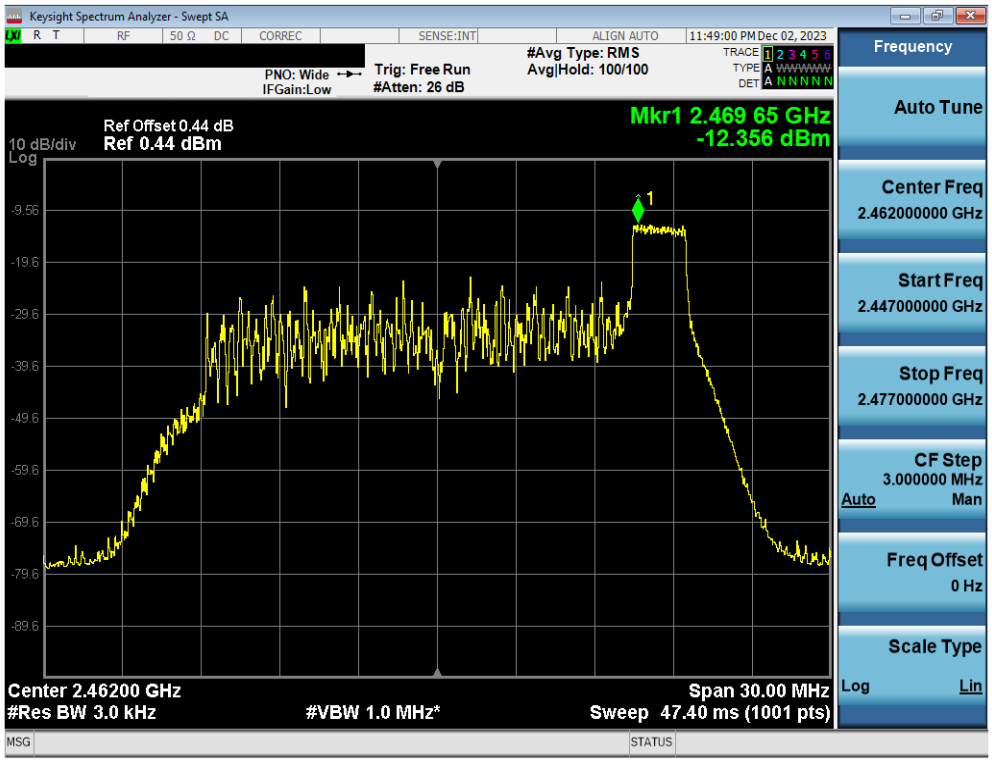
Plot 7-42. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



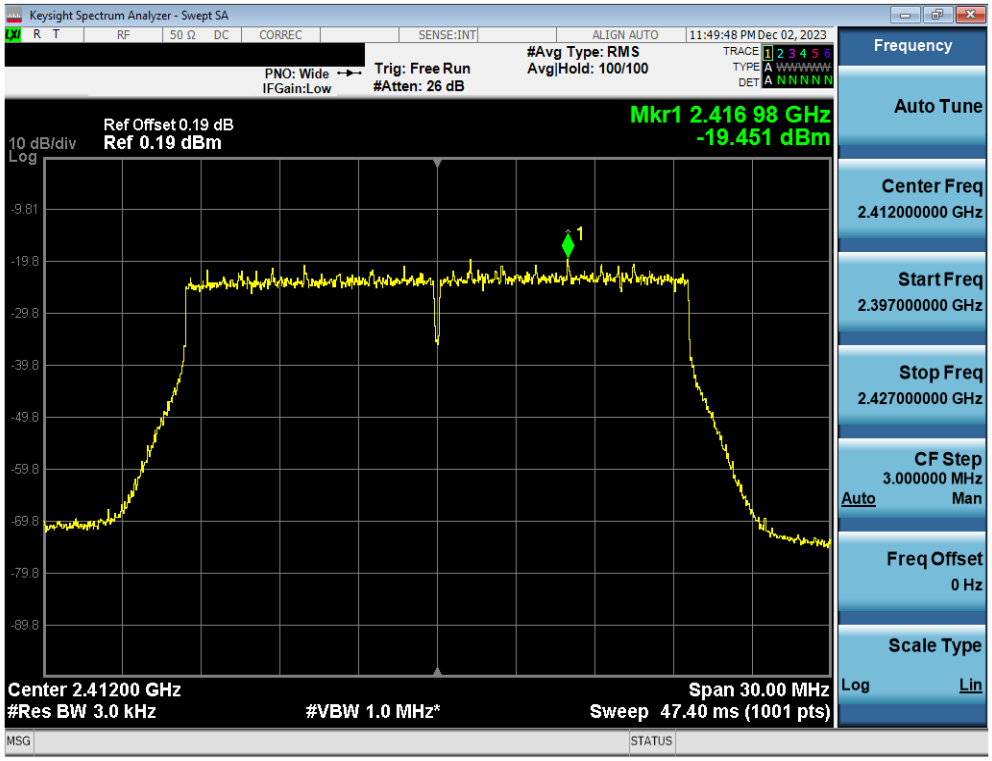
Plot 7-43. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



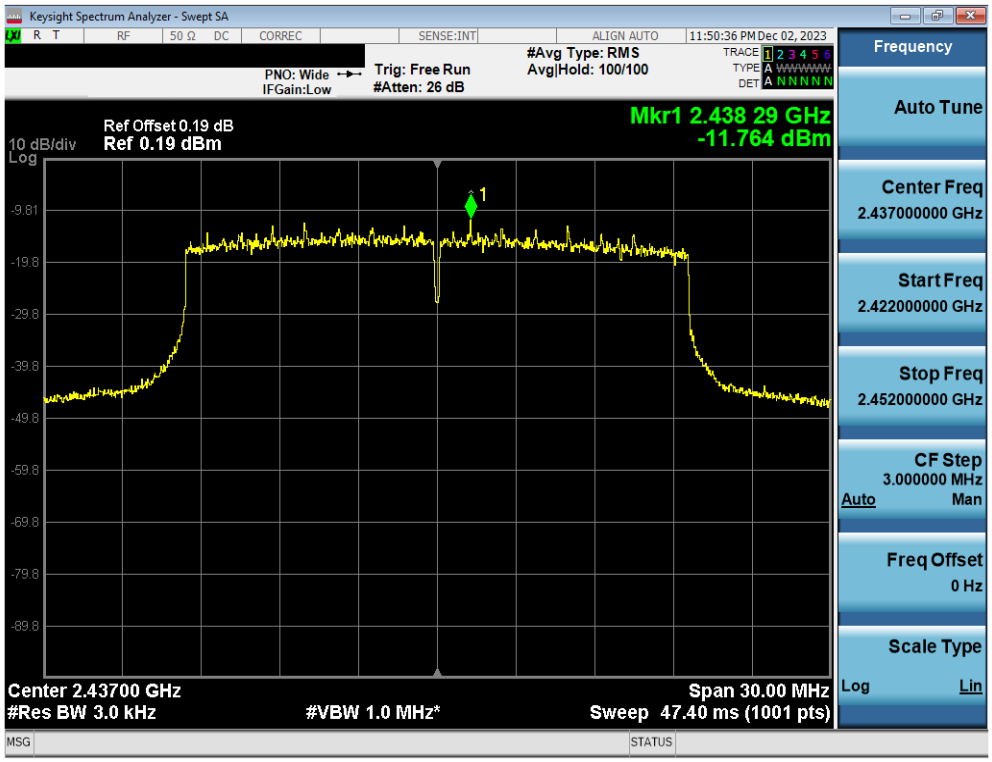
Plot 7-44. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



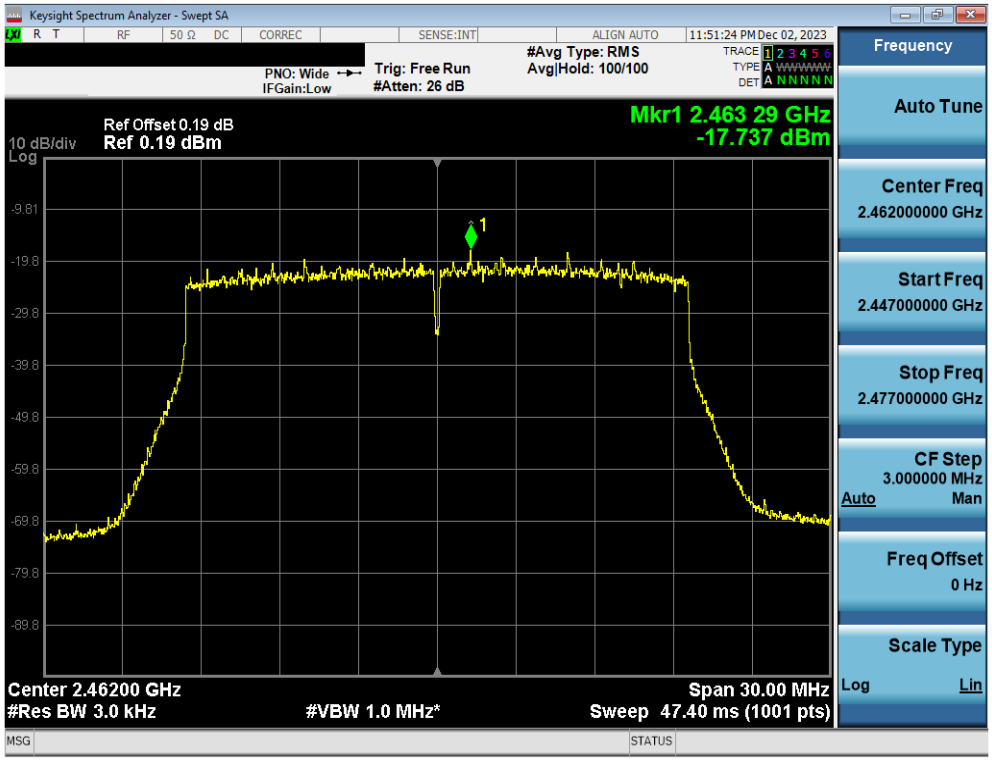
Plot 7-45. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-46. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 1)



Plot 7-47. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 6)

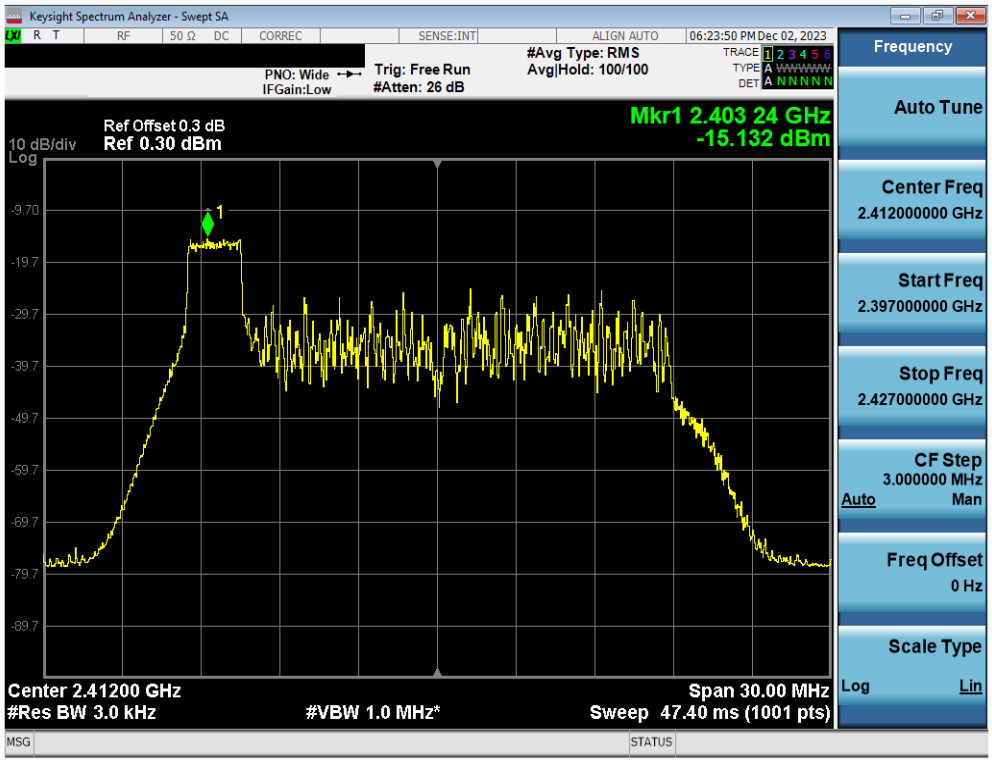


Plot 7-48. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 11)

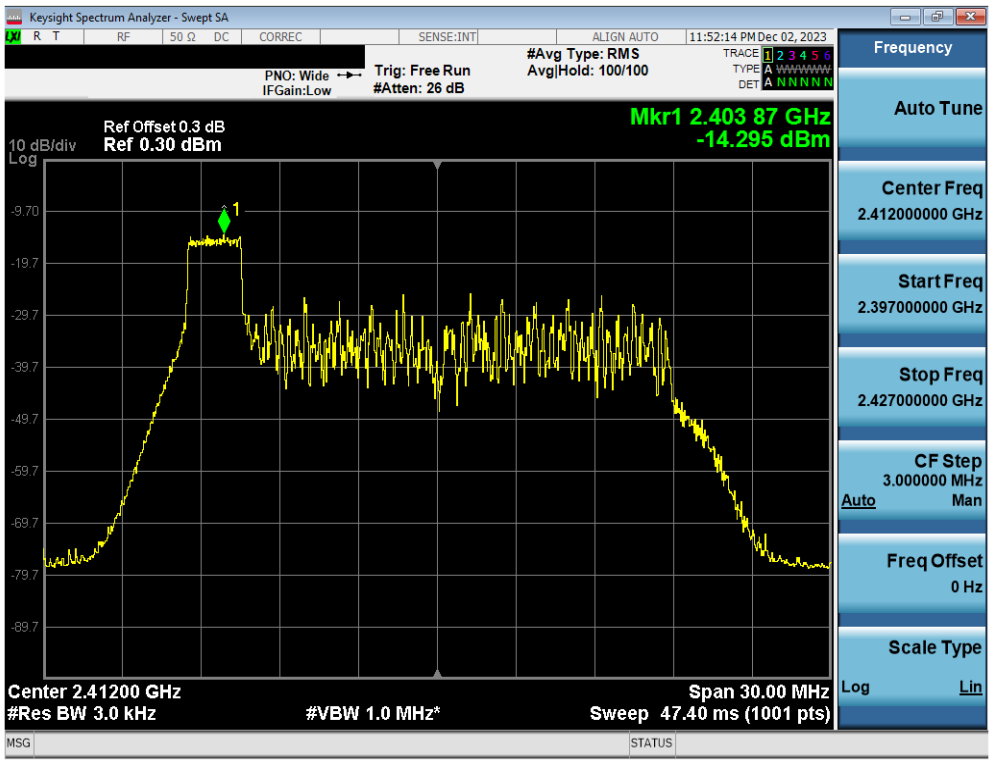
CDD Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 MODE	RU Size	RU Index	Data Rate [Mbps]	Antenna 3a Power Density [dBm/MHz]	Antenna 1a Power Density [dBm/MHz]	Summed Power Density [dBm/MHz]	Max Power Density [dBm/MHz]	Margin [dB]	Pass/Fail
2412	1	ax (20MHz)	26	0	20/23.5 (MCS9)	-15.13	-14.30	-11.68	8.0	-22.30	Pass
			26	4	20/23.5 (MCS9)	-13.29	-13.71	-10.48	8.0	-21.71	Pass
			26	8	20/23.5 (MCS9)	-13.28	-13.51	-10.38	8.0	-21.51	Pass
2437	6	ax (20MHz)	26	0	20/23.5 (MCS9)	-10.68	-11.47	-8.05	8.0	-19.47	Pass
			26	4	20/23.5 (MCS9)	-11.13	-11.01	-8.06	8.0	-19.01	Pass
			26	8	20/23.5 (MCS9)	-12.43	-13.38	-9.87	8.0	-21.38	Pass
2462	11	ax (20MHz)	26	0	20/23.5 (MCS9)	-11.99	-13.60	-9.71	8.0	-21.60	Pass
			26	4	20/23.5 (MCS9)	-11.19	-11.51	-8.34	8.0	-19.51	Pass
			26	8	20/23.5 (MCS9)	-14.07	-12.80	-10.38	8.0	-20.80	Pass
2412	1	ax (20MHz)	242	61	195/229.4 (MCS9)	-19.44	-20.02	-16.71	8.0	-28.02	Pass
2437	6	ax (20MHz)	242	61	195/229.4 (MCS9)	-11.70	-11.96	-8.82	8.0	-19.96	Pass
2462	11	ax (20MHz)	242	61	195/229.4 (MCS9)	-18.27	-18.40	-15.32	8.0	-26.40	Pass

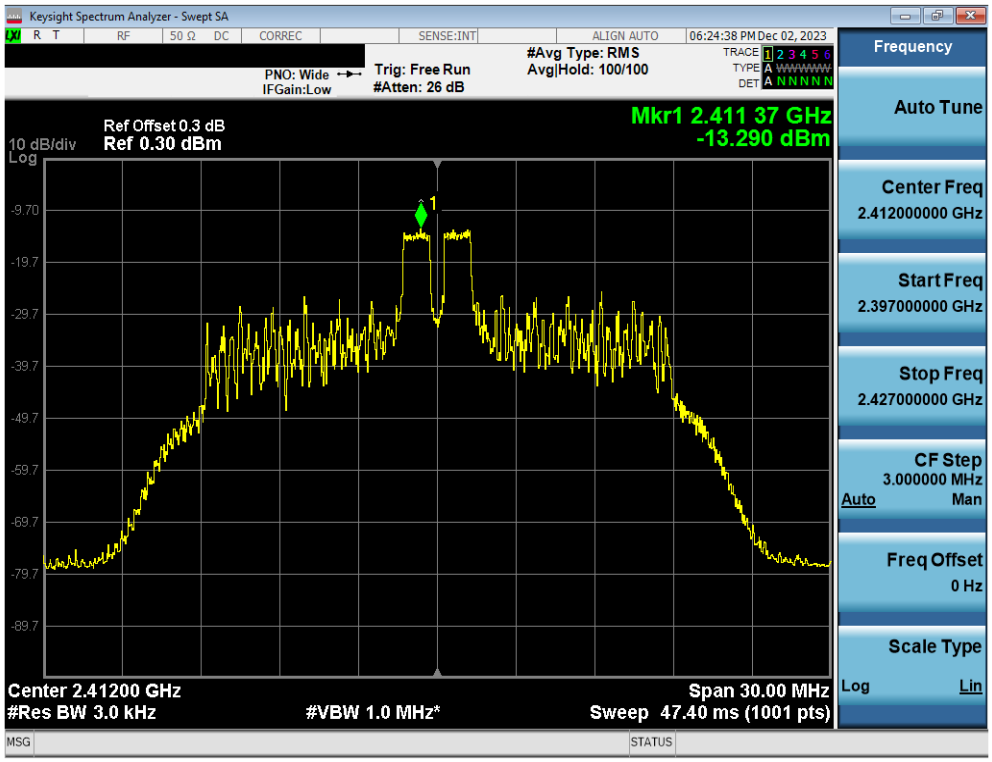
Table 7-18.CDD Conducted Power Density Measurements



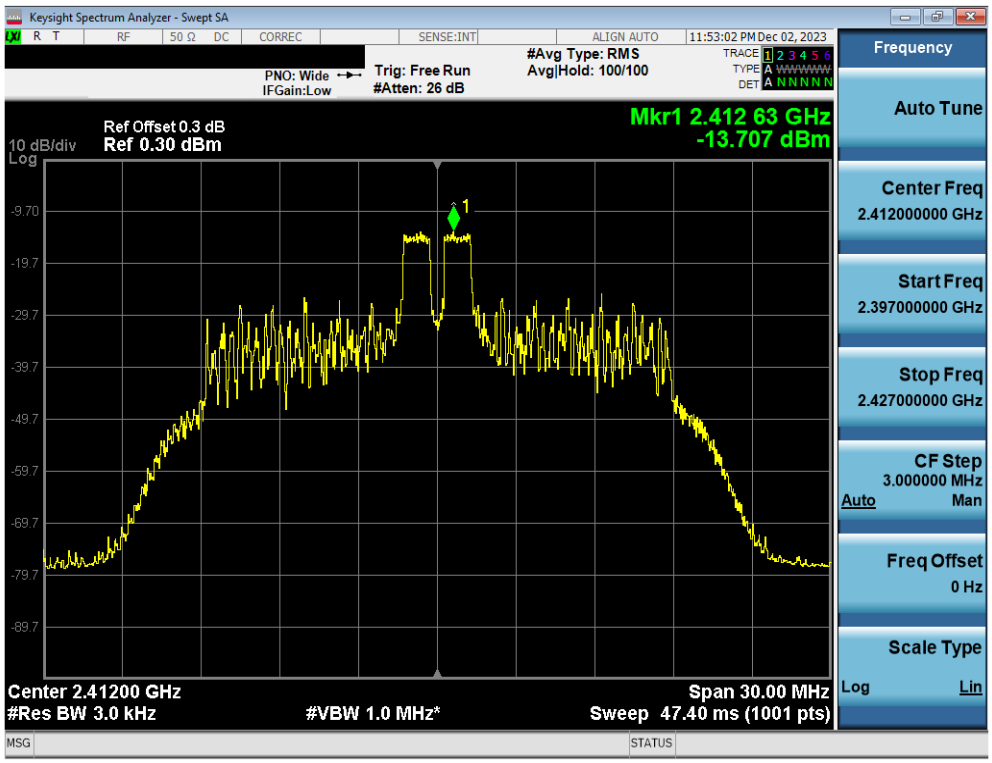
Plot 7-49. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



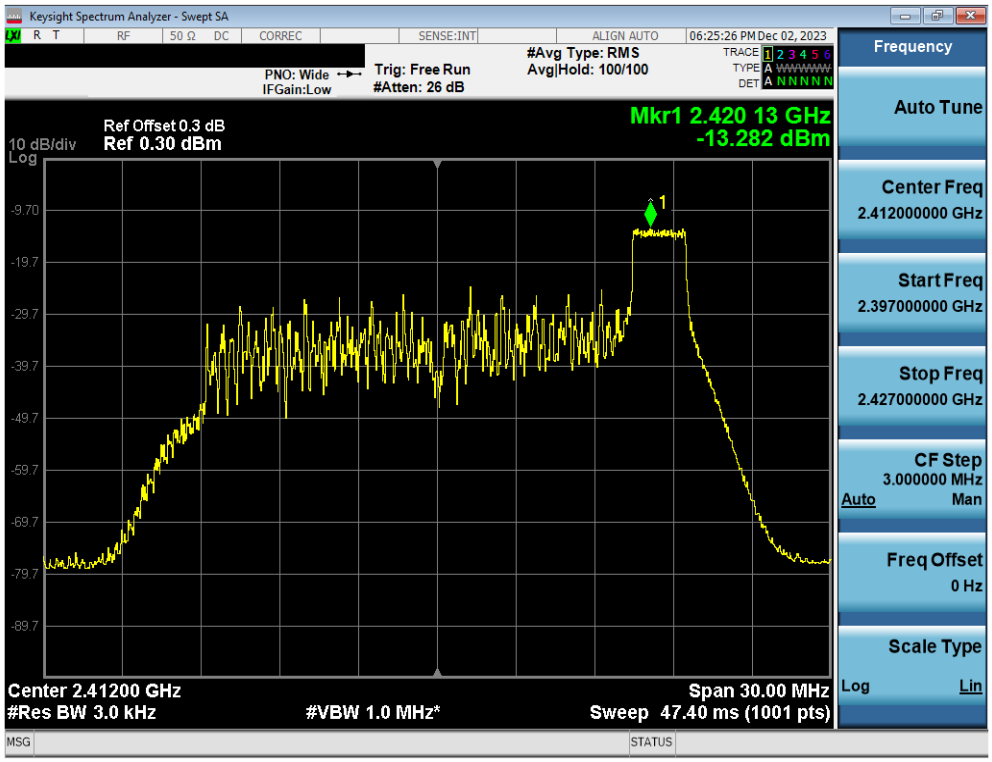
Plot 7-50. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



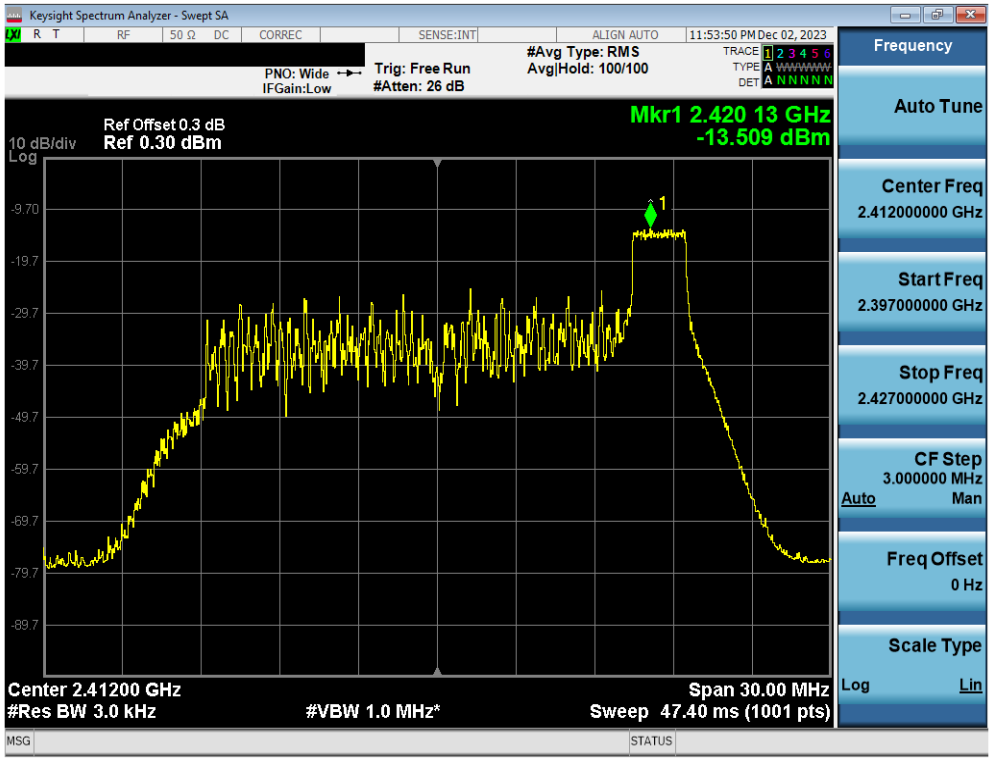
Plot 7-51. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



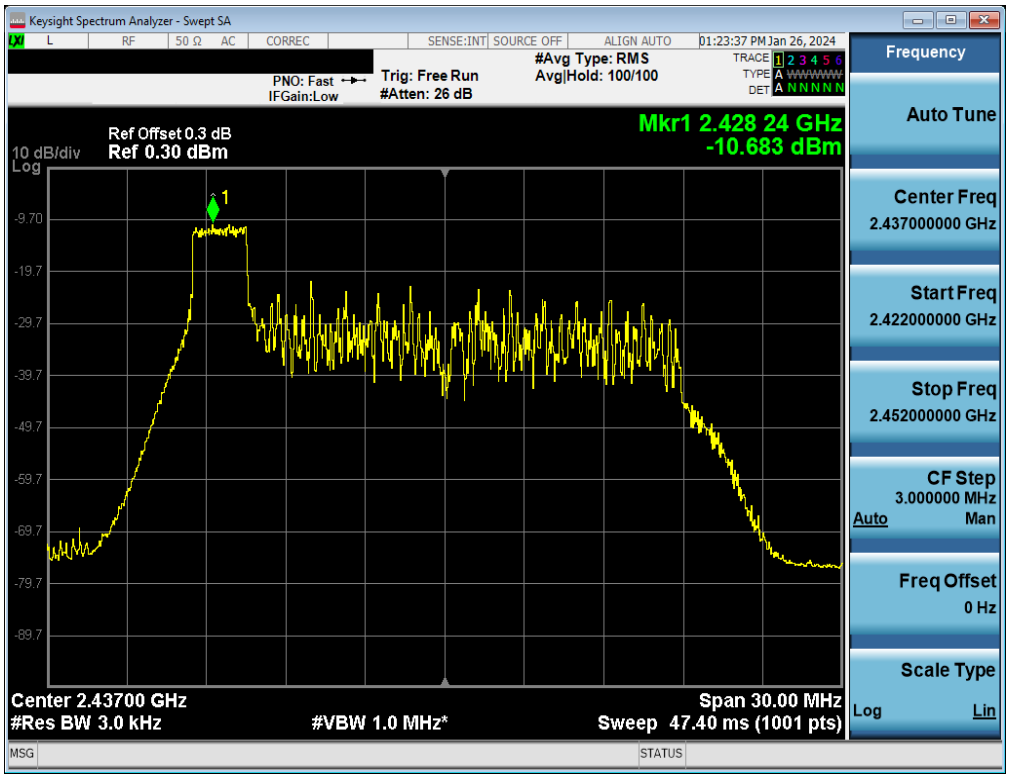
Plot 7-52. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



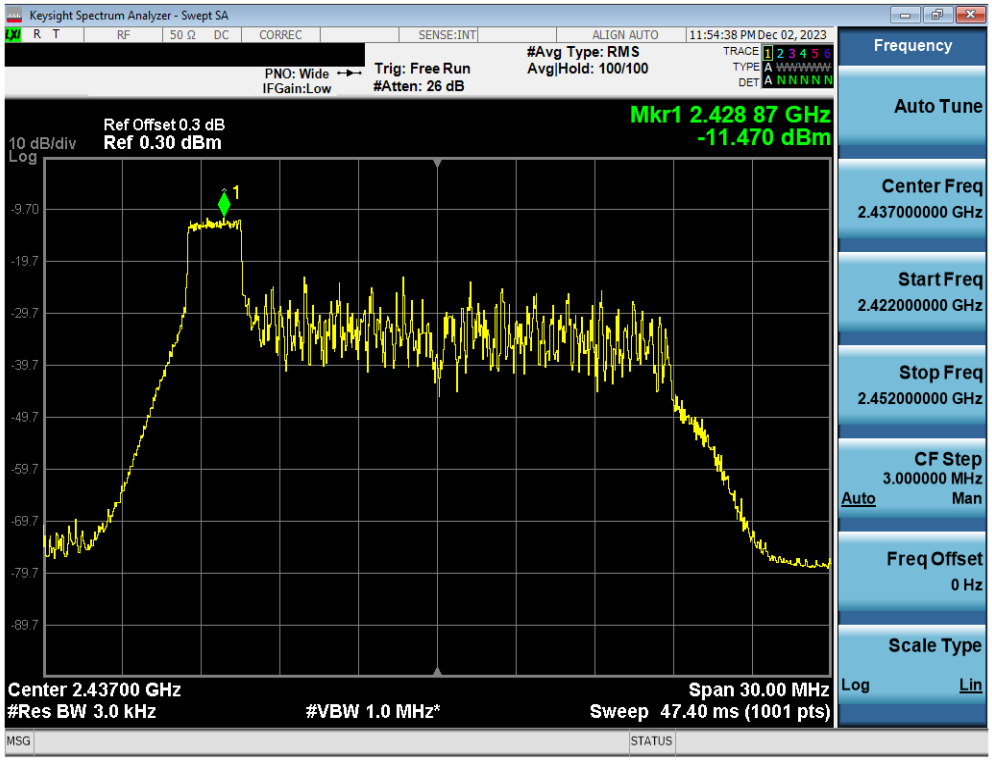
Plot 7-53. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



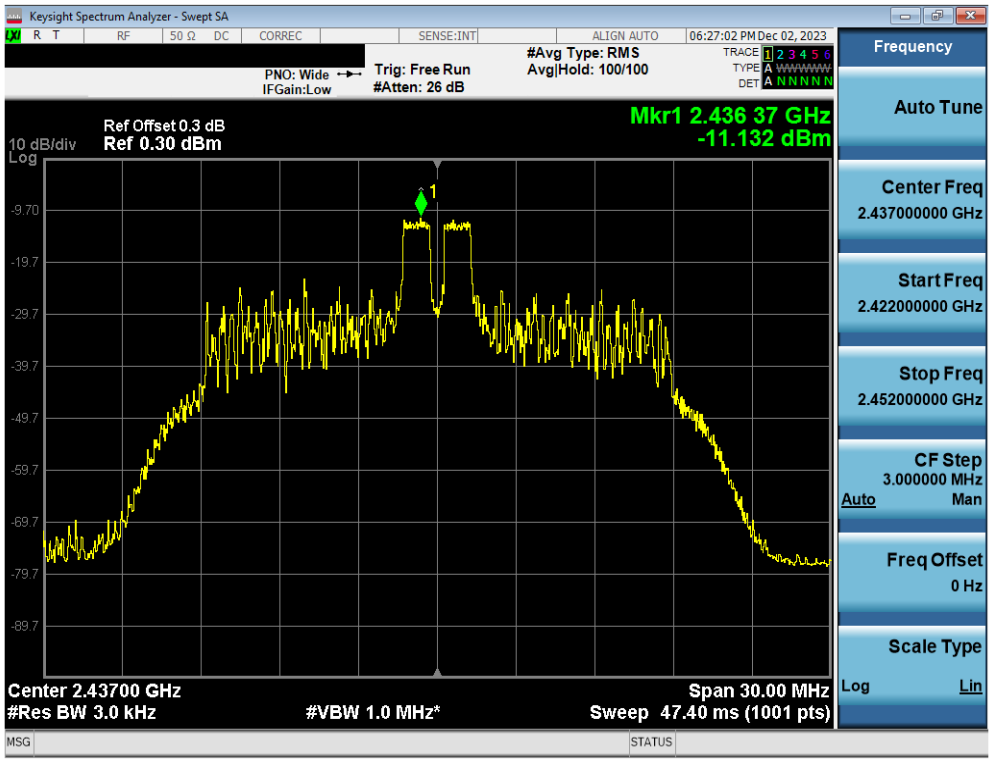
Plot 7-54. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



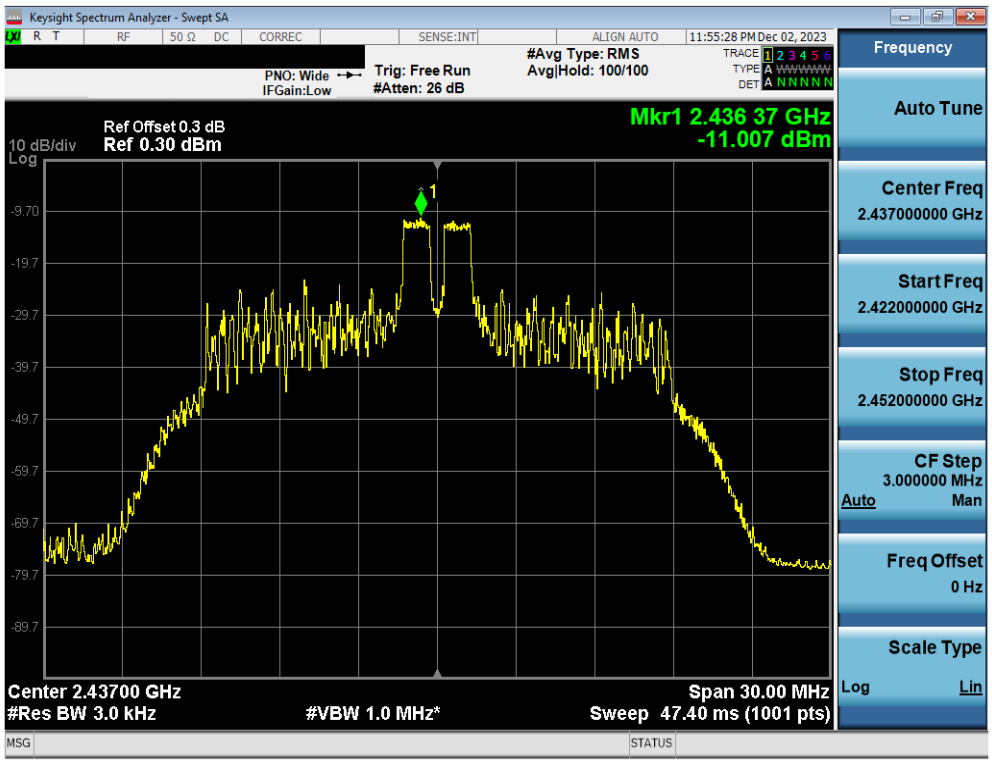
Plot 7-55. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



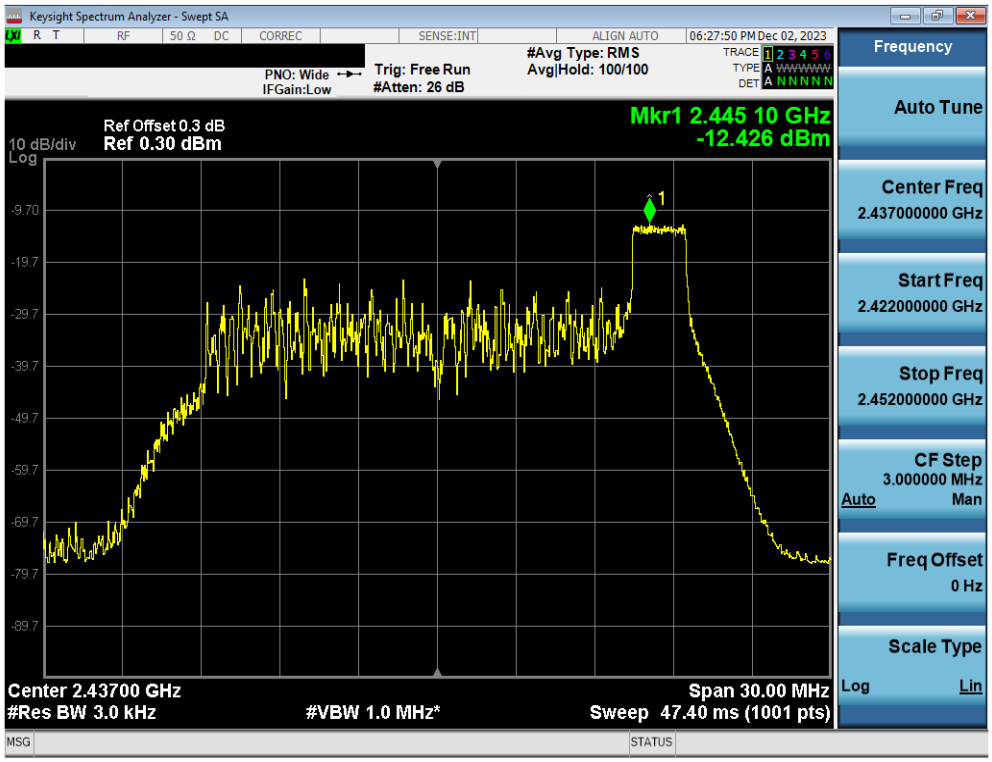
Plot 7-56. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



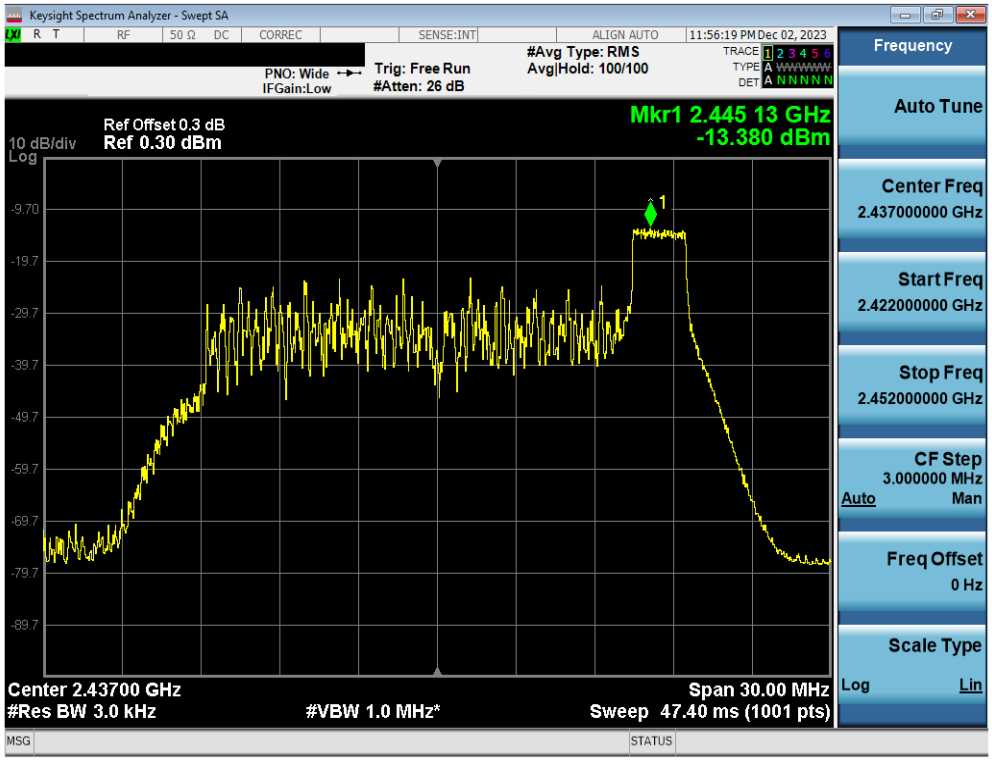
Plot 7-57. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



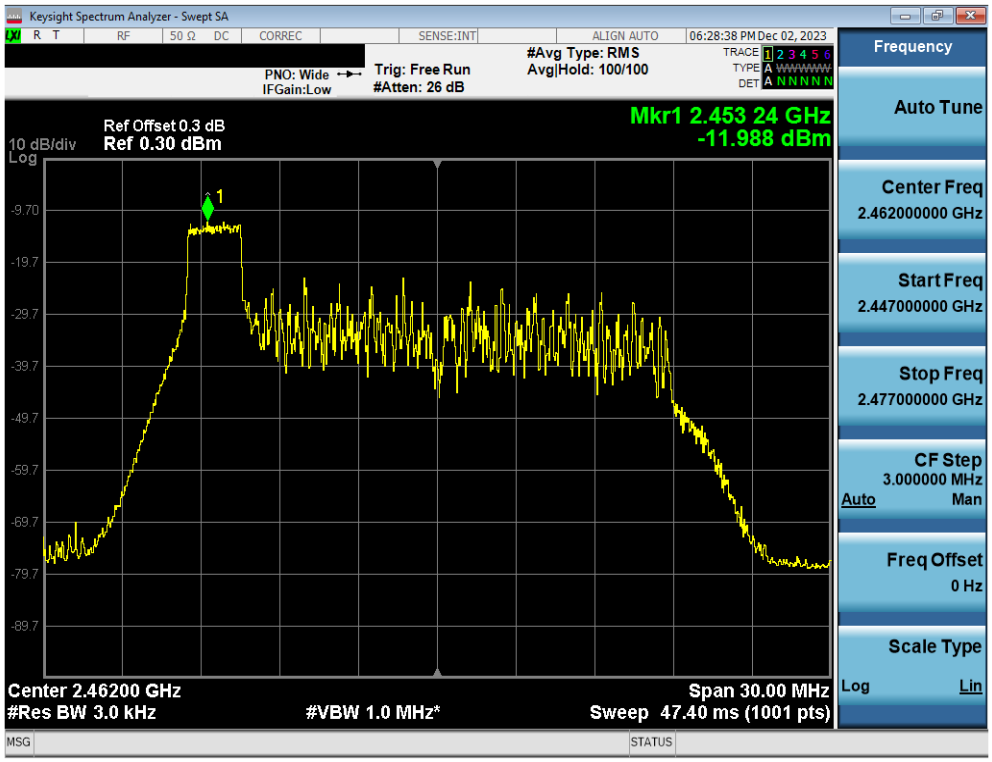
Plot 7-58. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



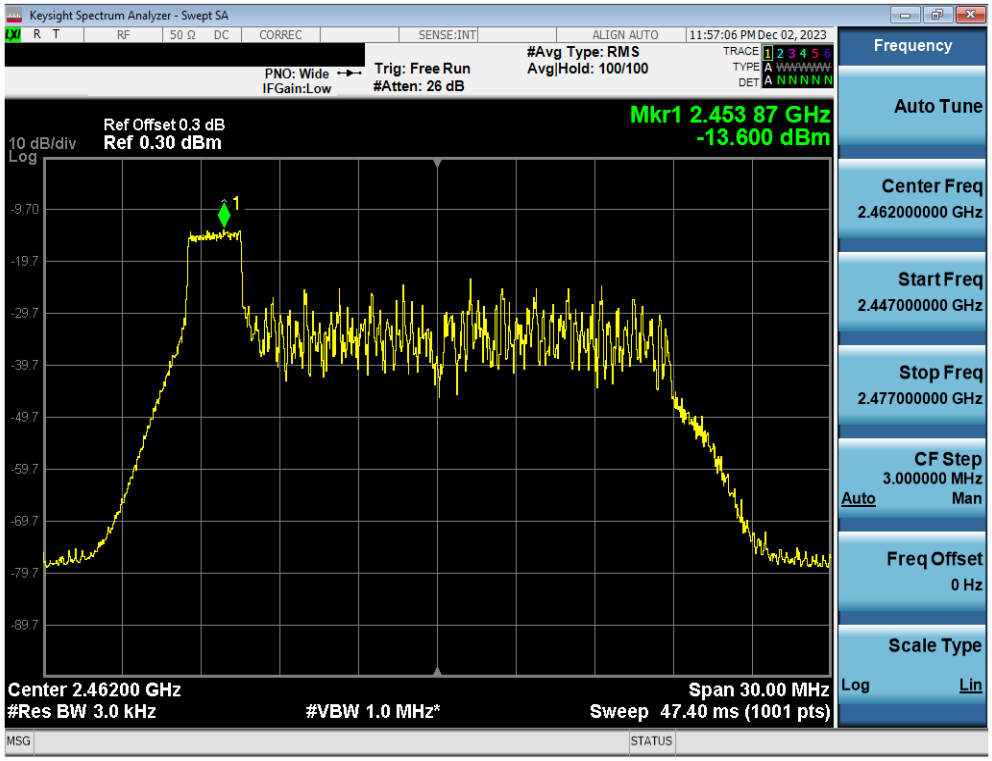
Plot 7-59. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



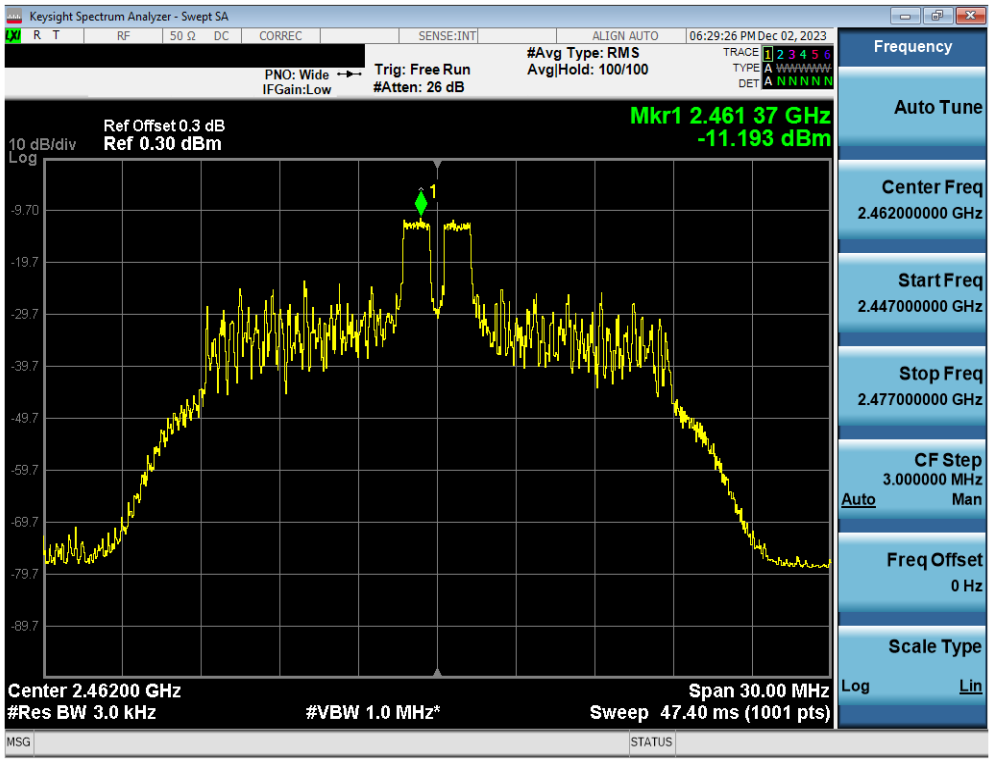
Plot 7-60. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



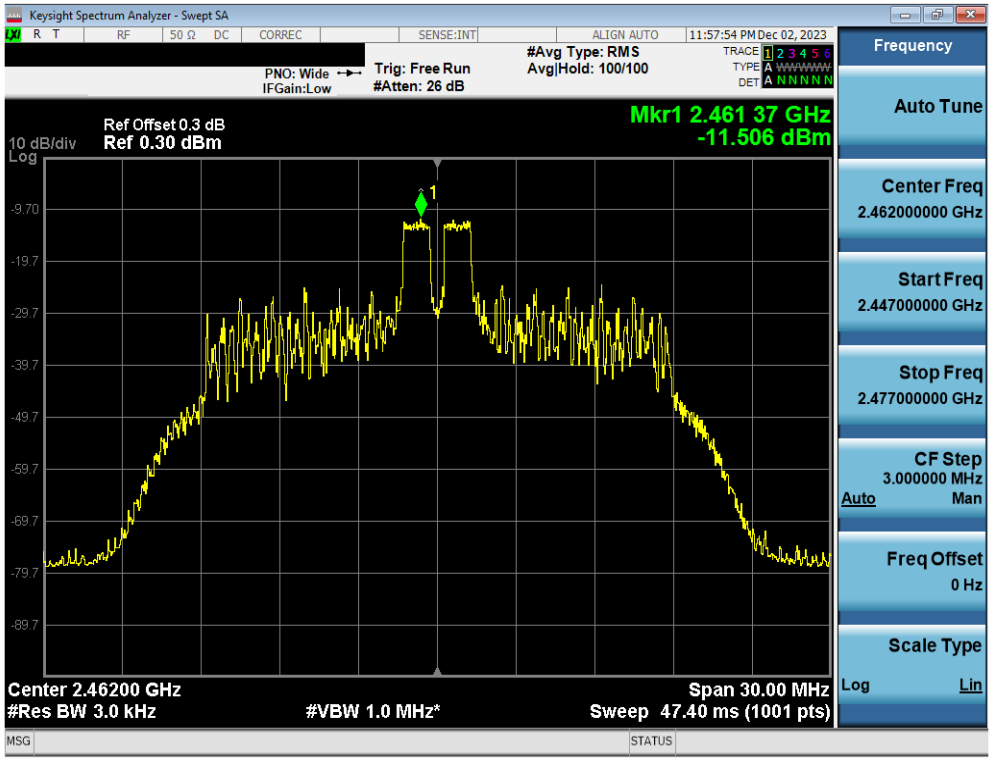
Plot 7-61. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



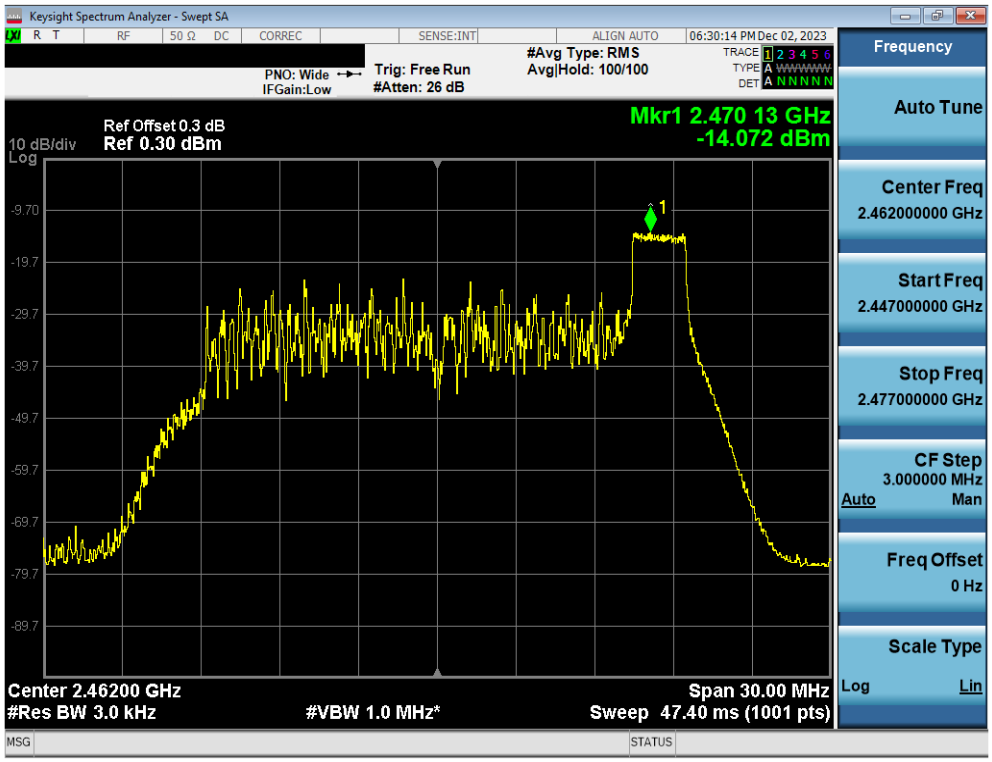
Plot 7-62. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



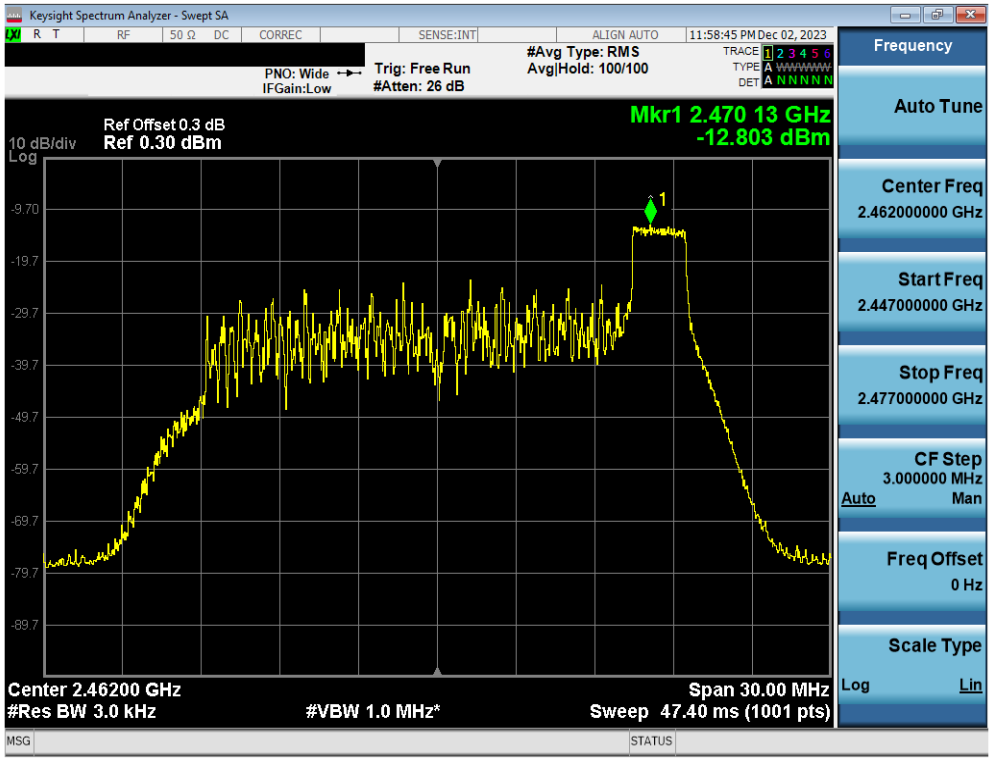
Plot 7-63. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



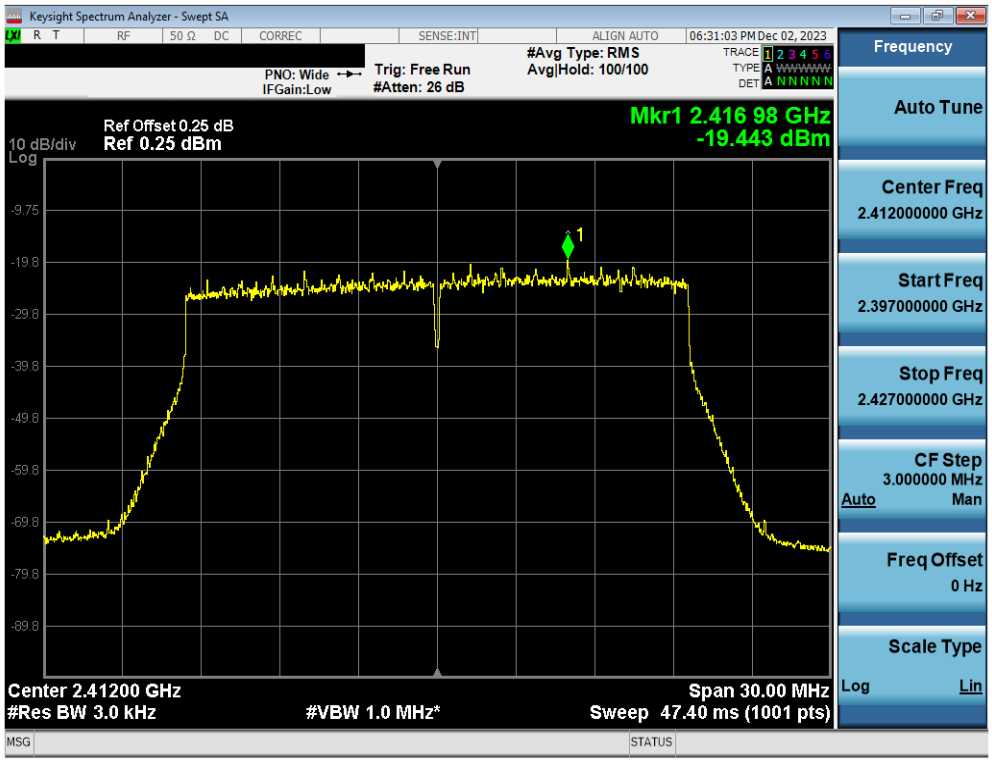
Plot 7-64. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



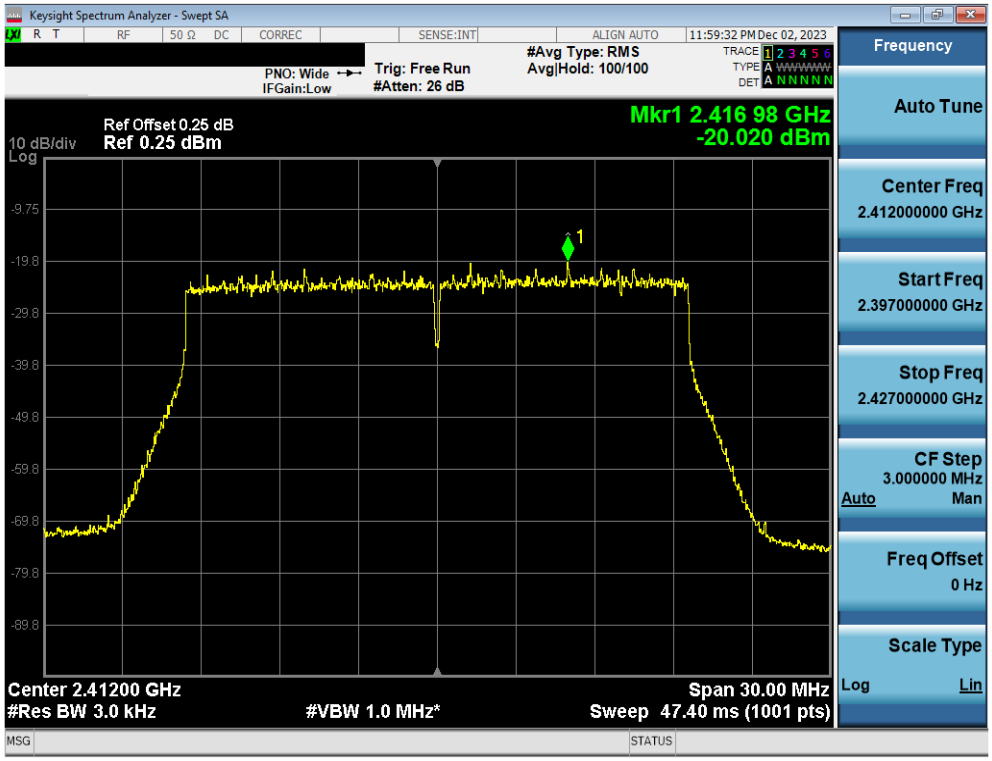
Plot 7-65. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



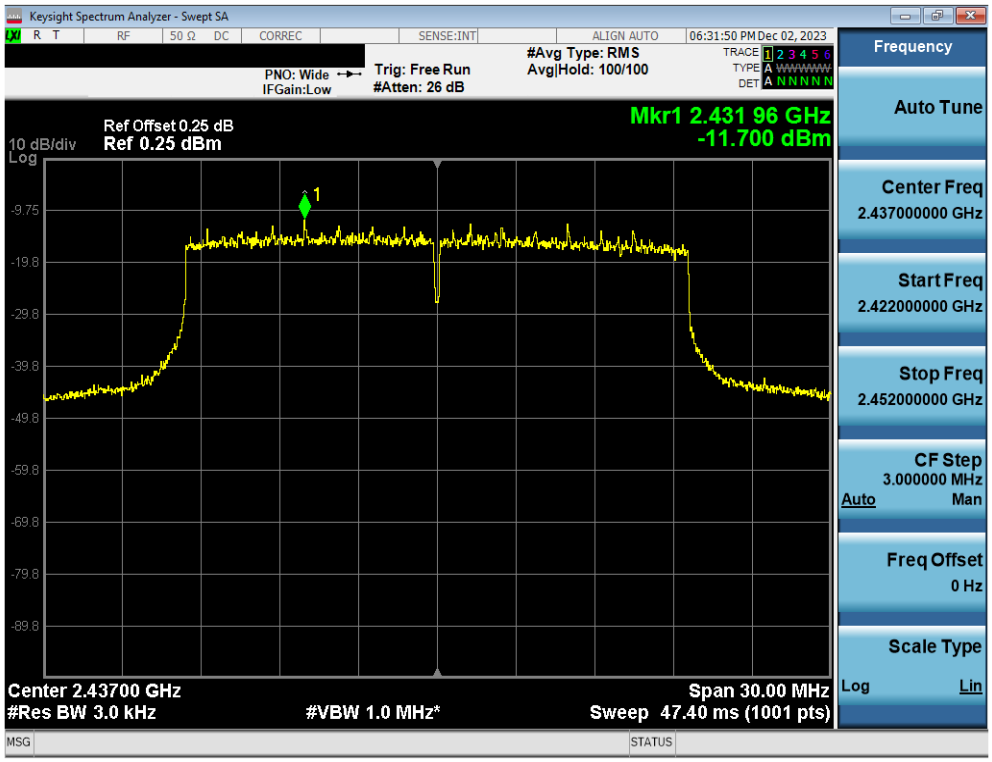
Plot 7-66. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



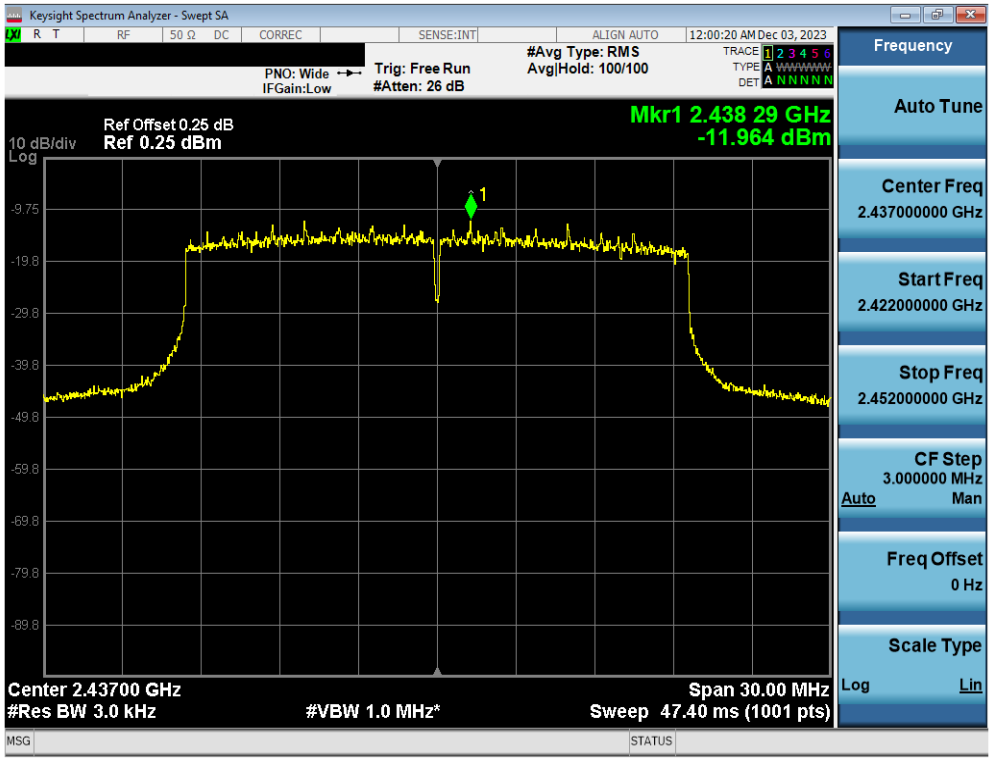
Plot 7-67. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



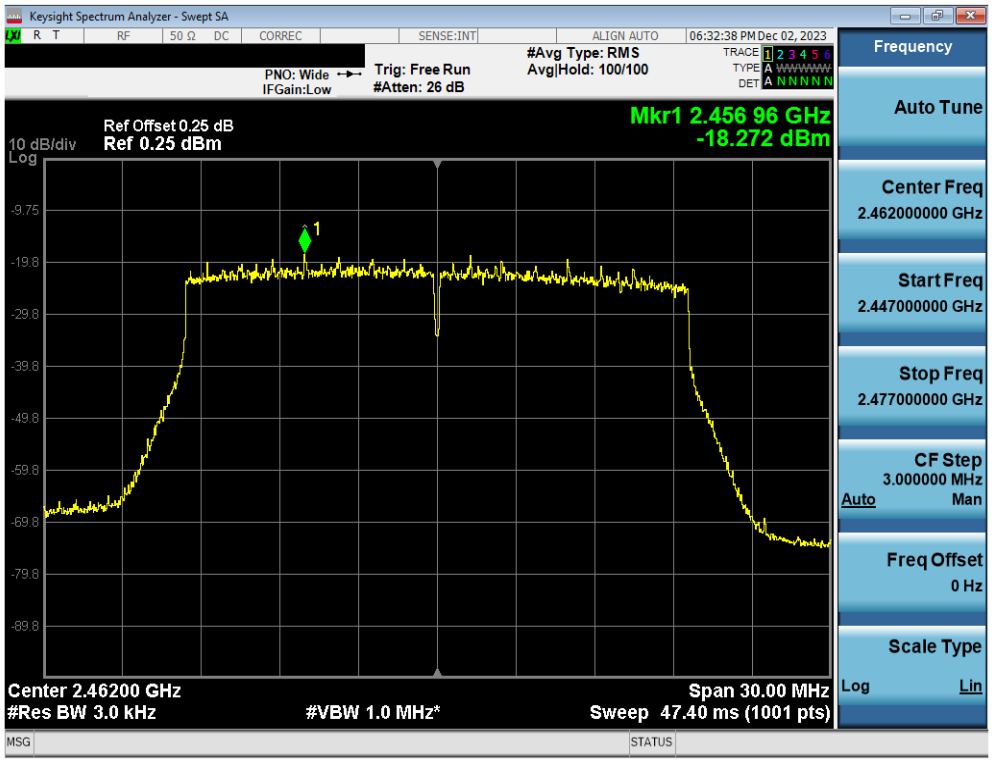
Plot 7-68. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 1)



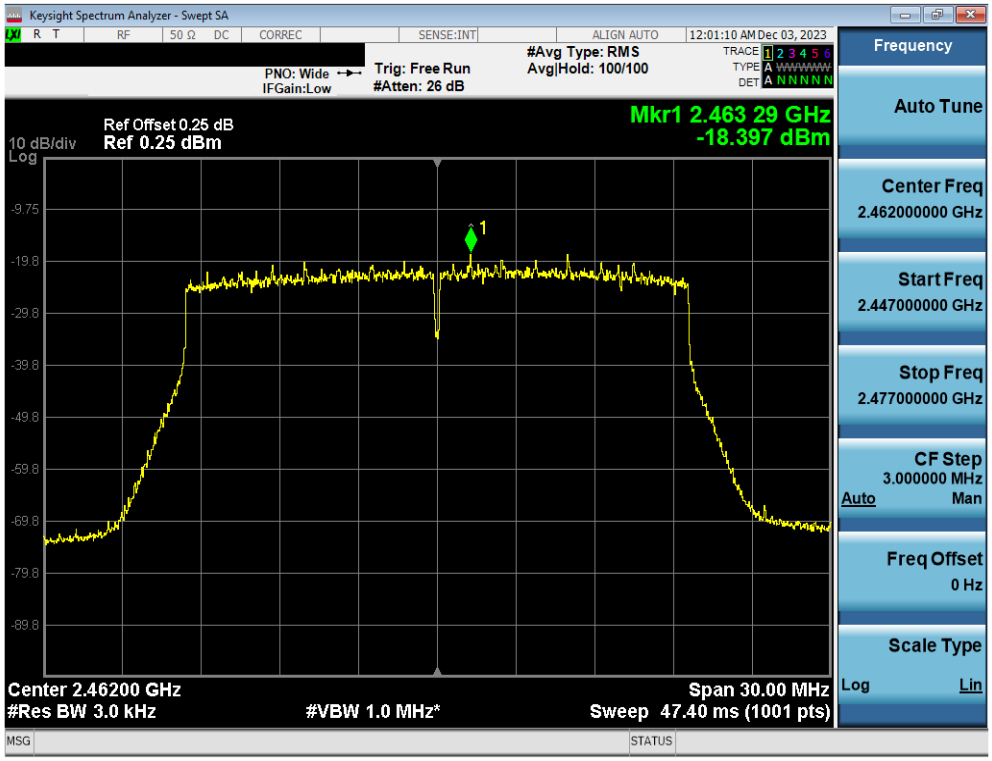
Plot 7-69. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-70. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-71. Power Spectral Density Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)



Plot 7-72. Power Spectral Density Plot Antenna 1a (802.11ax OFDMA – RU242 – Ch. 11)

Note:

Per ANSI C63.10-2013 Subclause 14.3.2.2 and KDB 662911 D01 v02r01 Section E)2), the power spectral density at Antenna 3a and Antenna 1a were first measured separately as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample CDD Calculation:

At 2412MHz the average conducted power spectral density was measured to be -13.29 dBm for Antenna 3a and -13.71 dBm for Antenna 1a.

Antenna 3a + Antenna 1a = CDD

(-13.29 dBm + -13.71 dBm) = (0.047 mW + 0.043 mW) = 0.09 mW = -10.48 dBm

7.5 Conducted Authorized Band Edge

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

All out of band emissions are 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, tone configurations, and RU indices were investigated to determine the worst case configuration. For the following out of band conducted emissions plots at the band edge, the EUT was set to a data rate of MCS9 in 802.11ax-RU mode as this setting produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure (Section 7.4).

Test Procedure Used

ANSI C63.10-2013 – Subclause 11.11.3
KDB 558074 D01 v05r02 – Section 8.7.2

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 1MHz
5. Detector = Peak
6. Number of sweep points ≥ 2 x Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

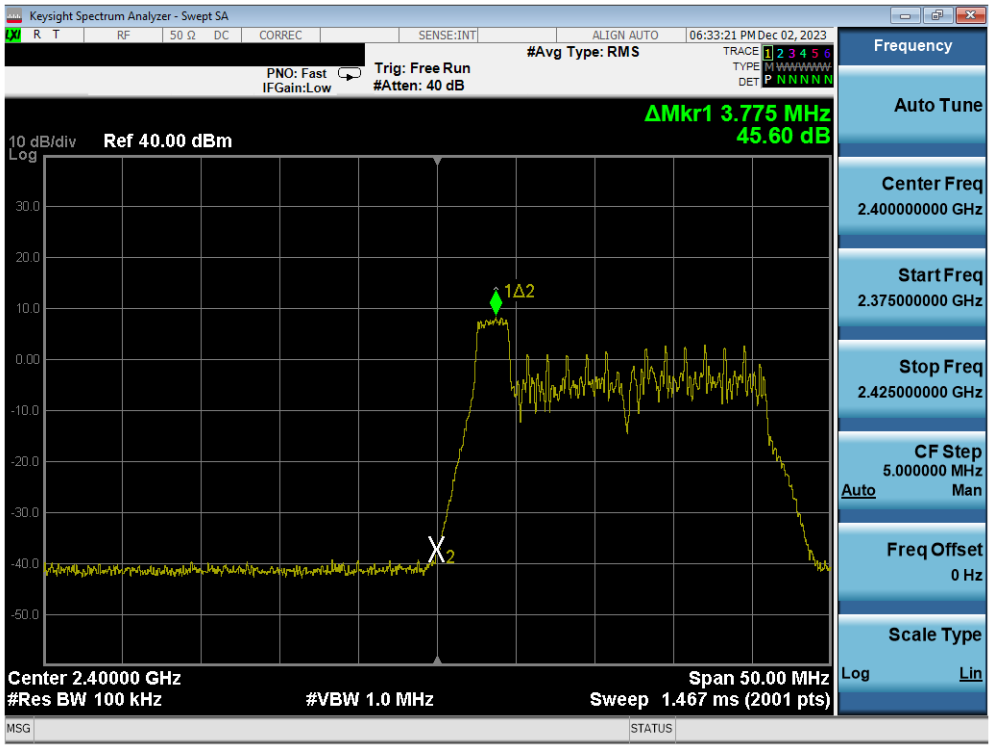
The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-4. Test Instrument & Measurement Setup

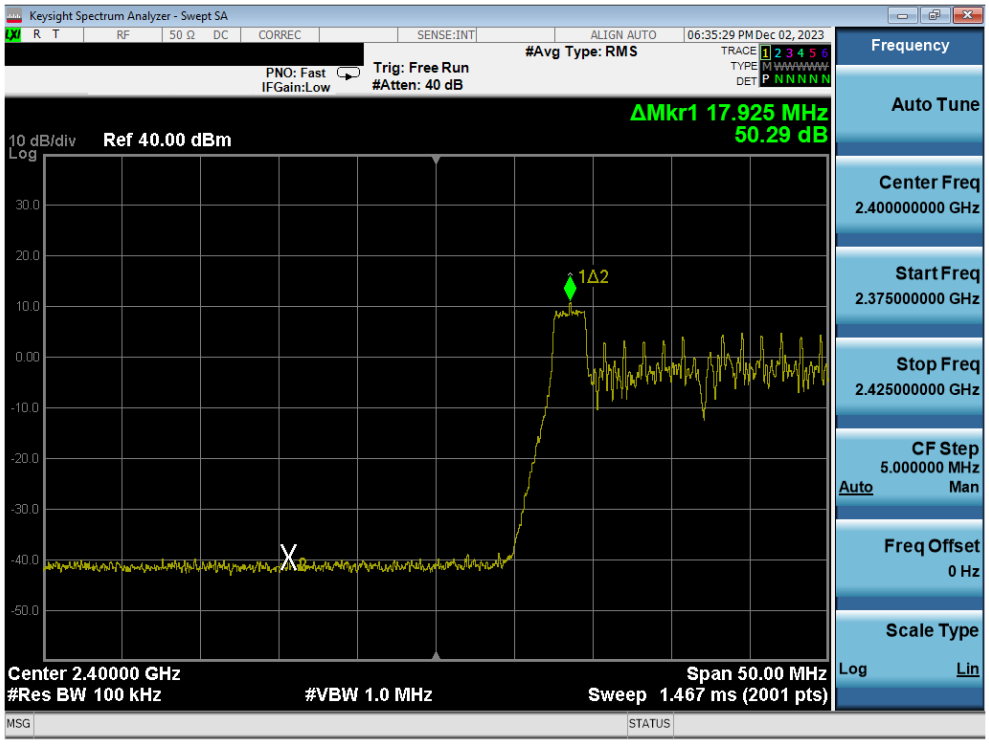
Test Notes

1. All antenna configurations and data rates were investigated and only the worst case are reported.
2. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's are reported.

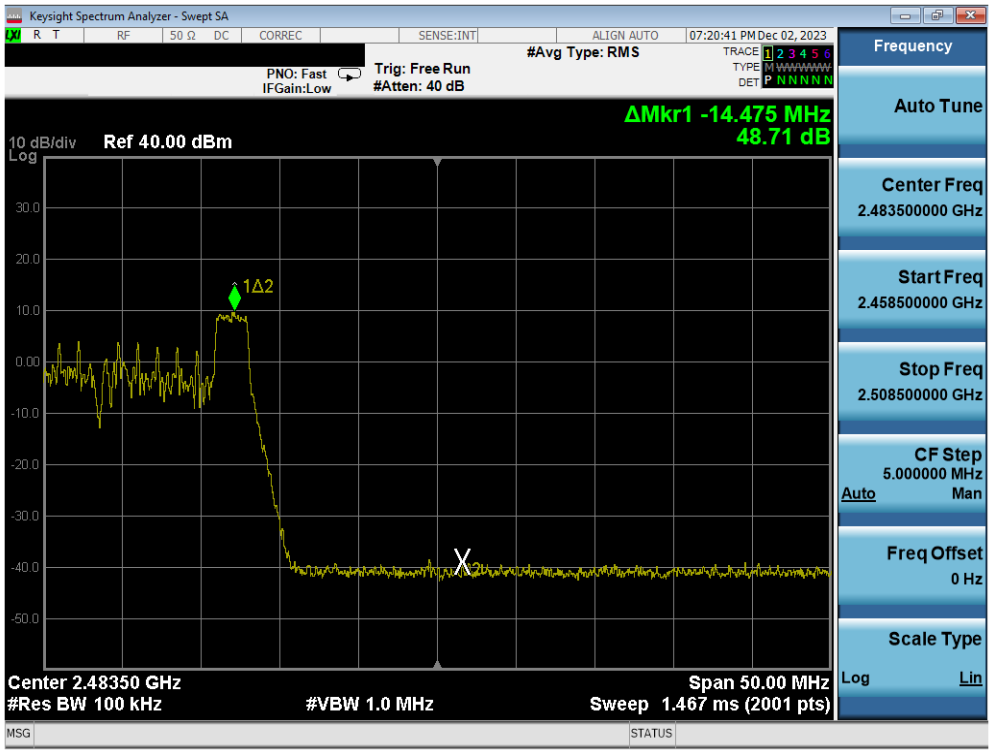
Antenna 3a Conducted Emissions at the Band Edge



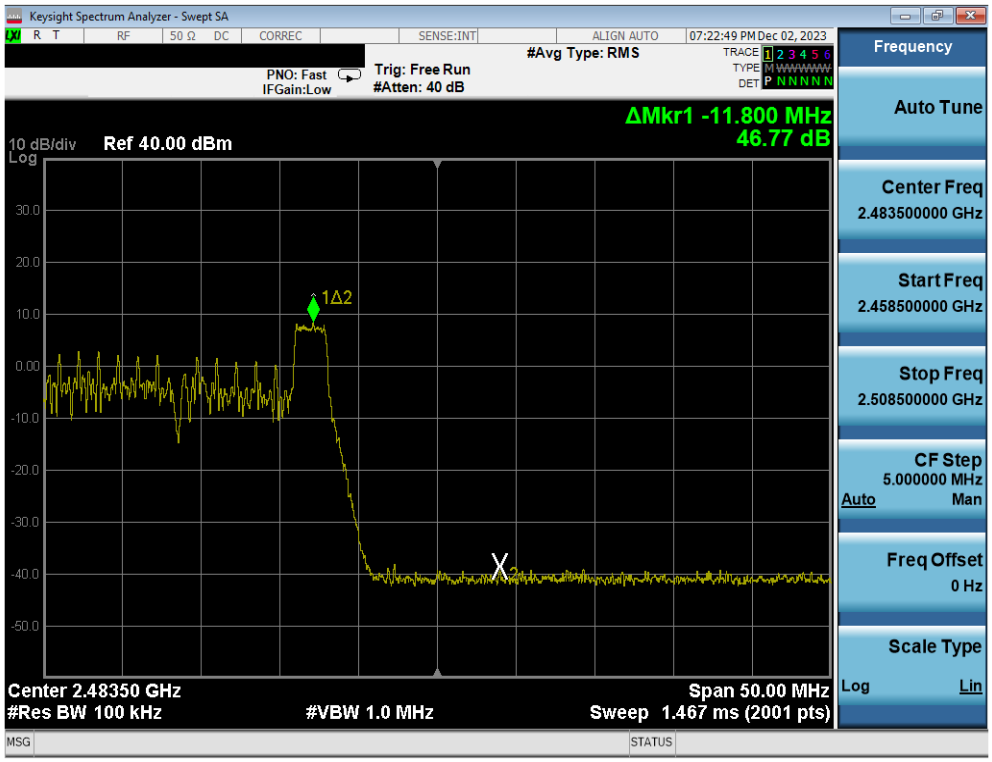
Plot 7-73. Band Edge Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



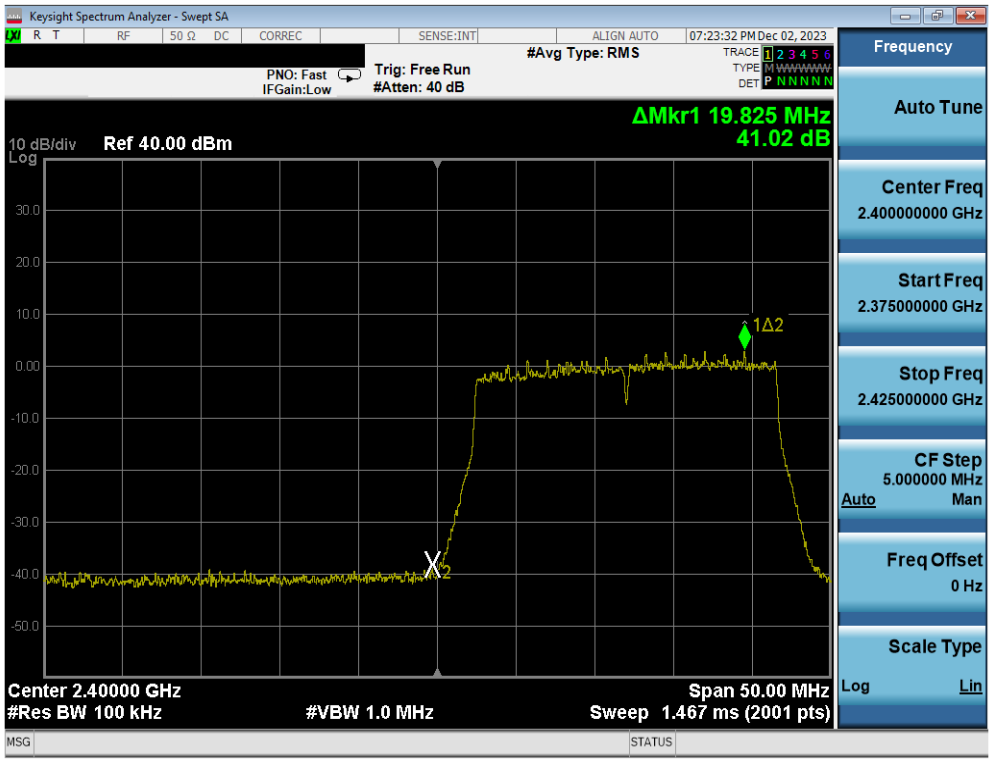
Plot 7-74. Band Edge Antenna 3a (802.11ax OFDMA – RU26 Index 0 – Ch. 2)



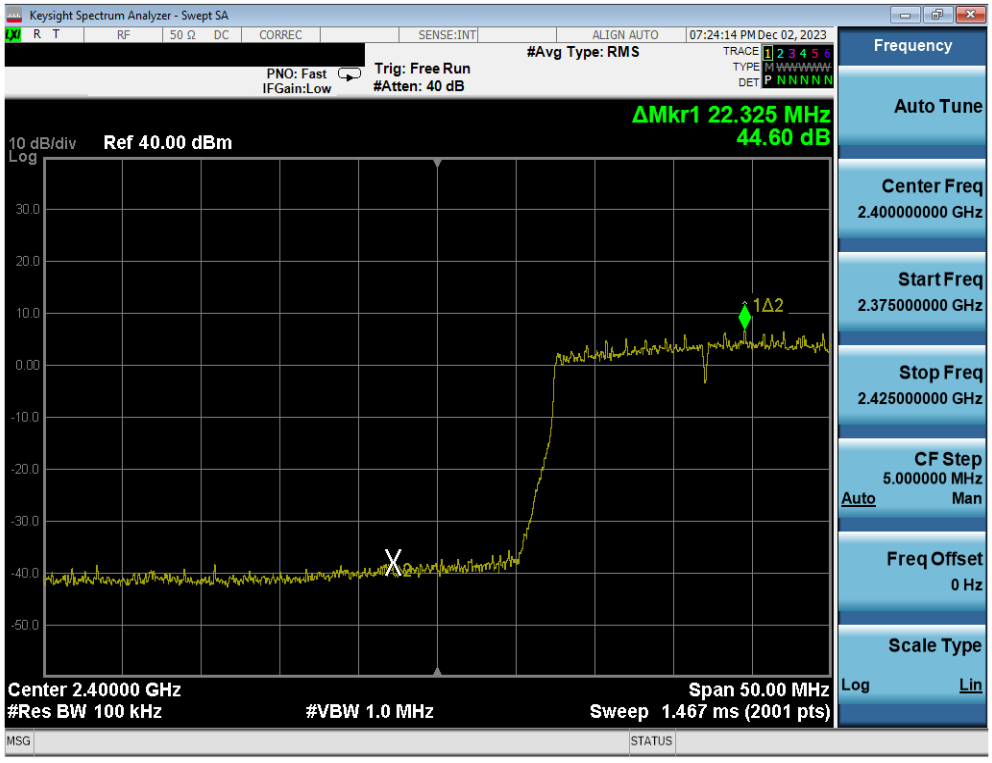
Plot 7-75. Band Edge Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



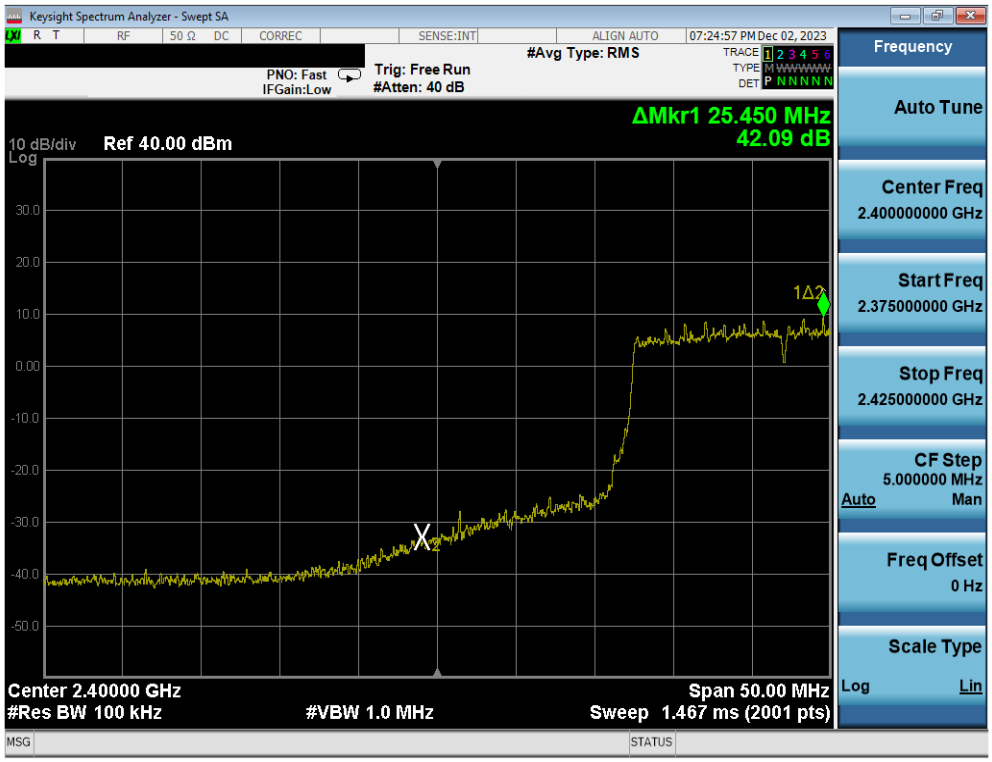
Plot 7-76. Band Edge Antenna 3a (802.11ax OFDMA – RU26 Index 8 – Ch. 12)



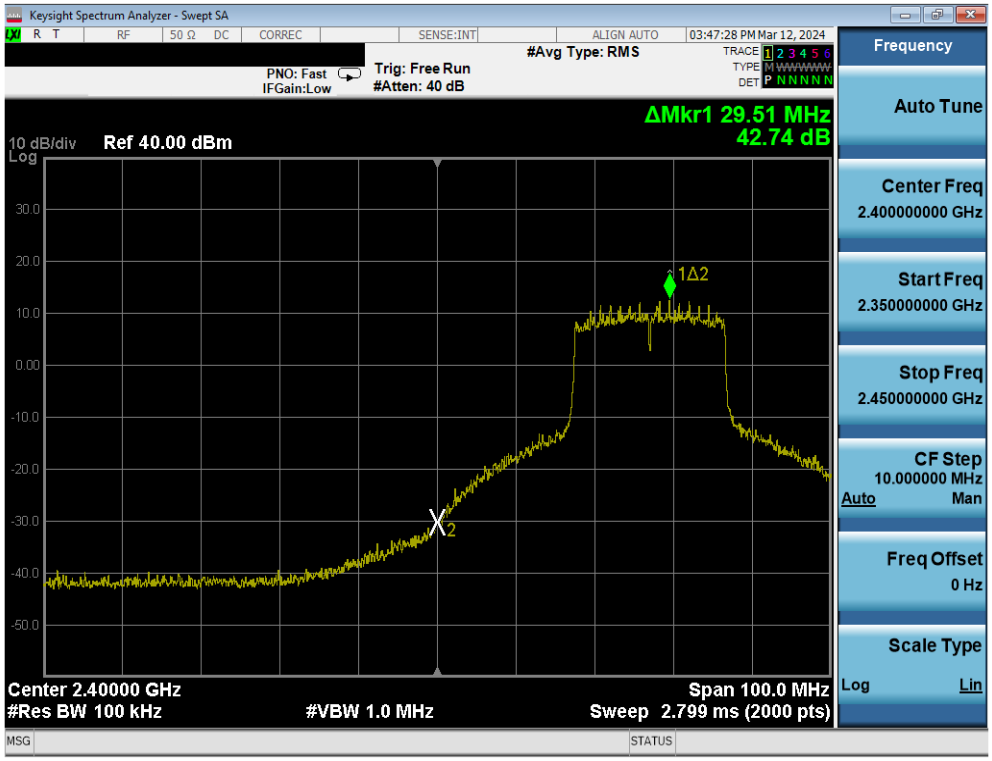
Plot 7-77. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



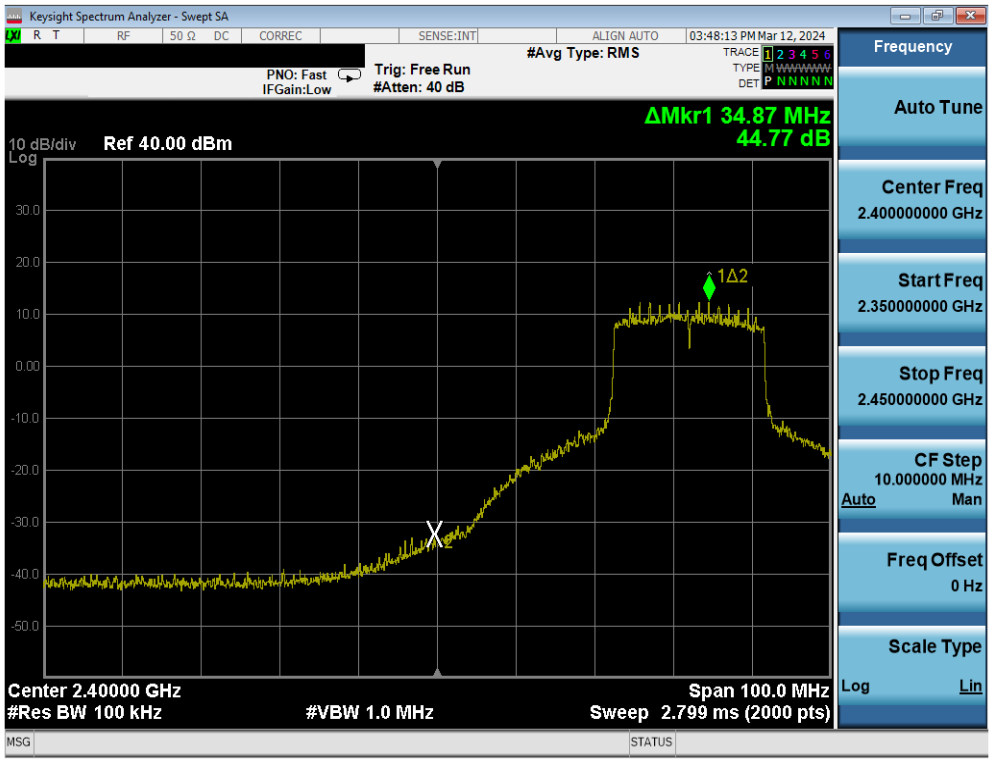
Plot 7-78. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 2)



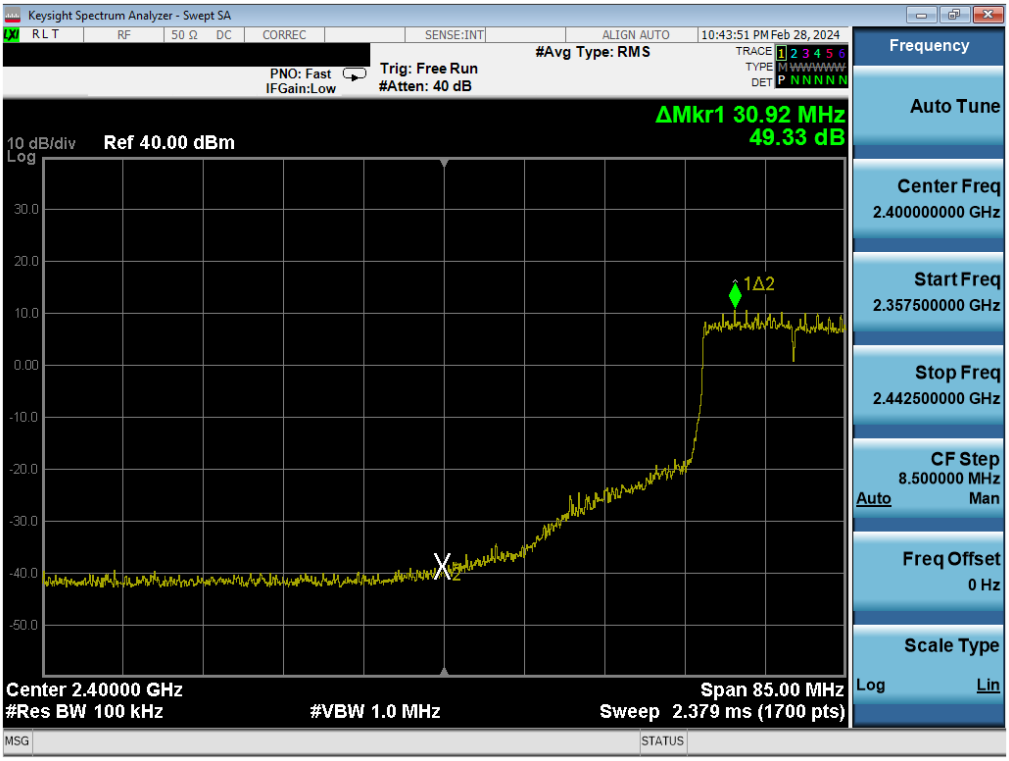
Plot 7-79. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 3)



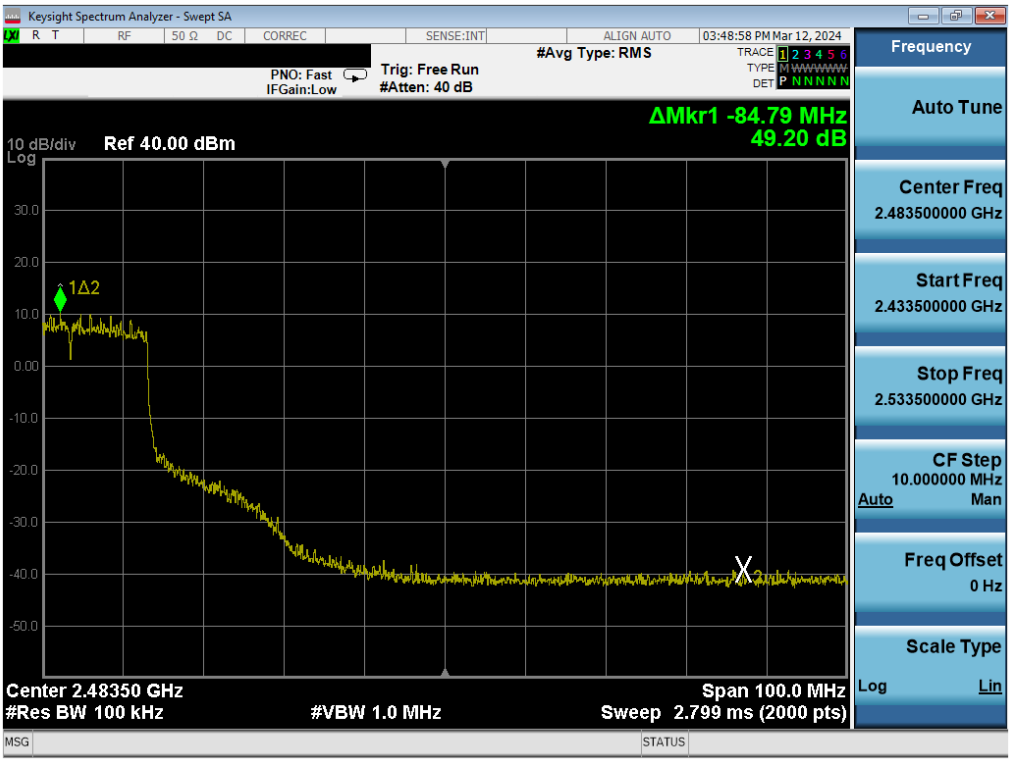
Plot 7-80. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 4)



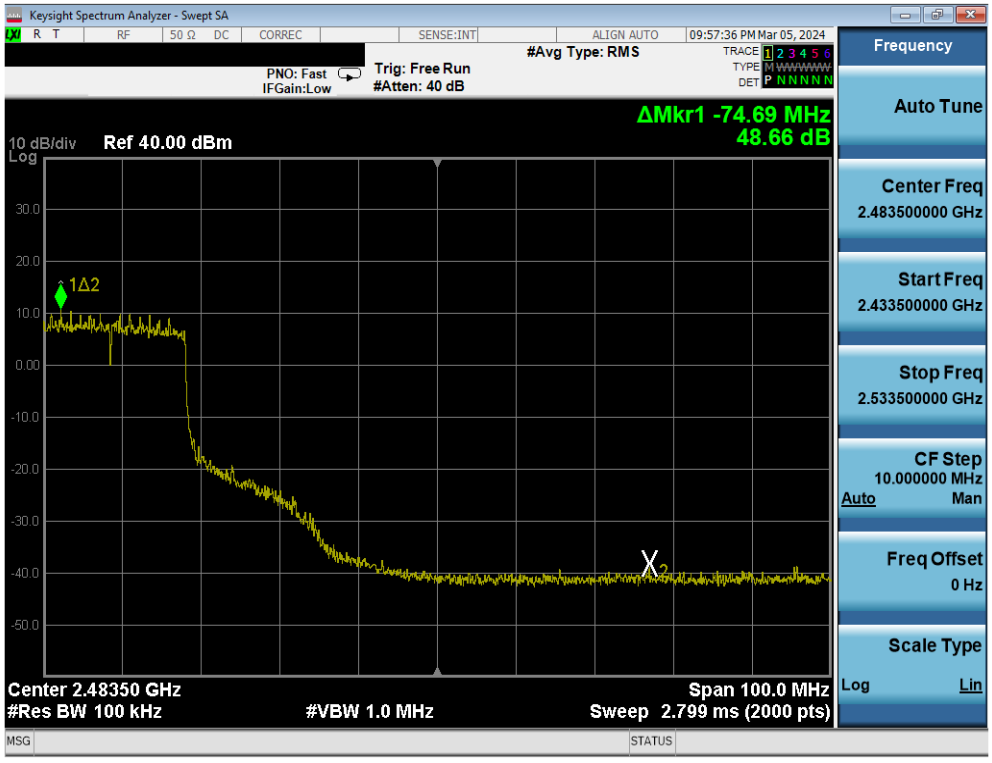
Plot 7-81. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 5)



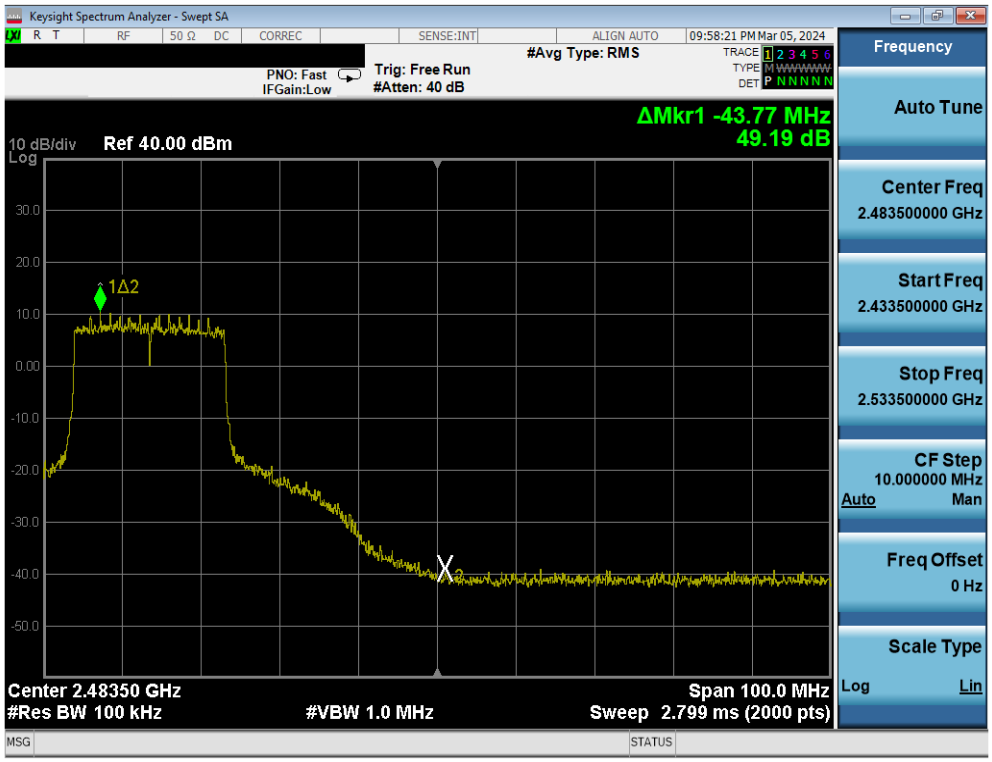
Plot 7-82. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6(low))



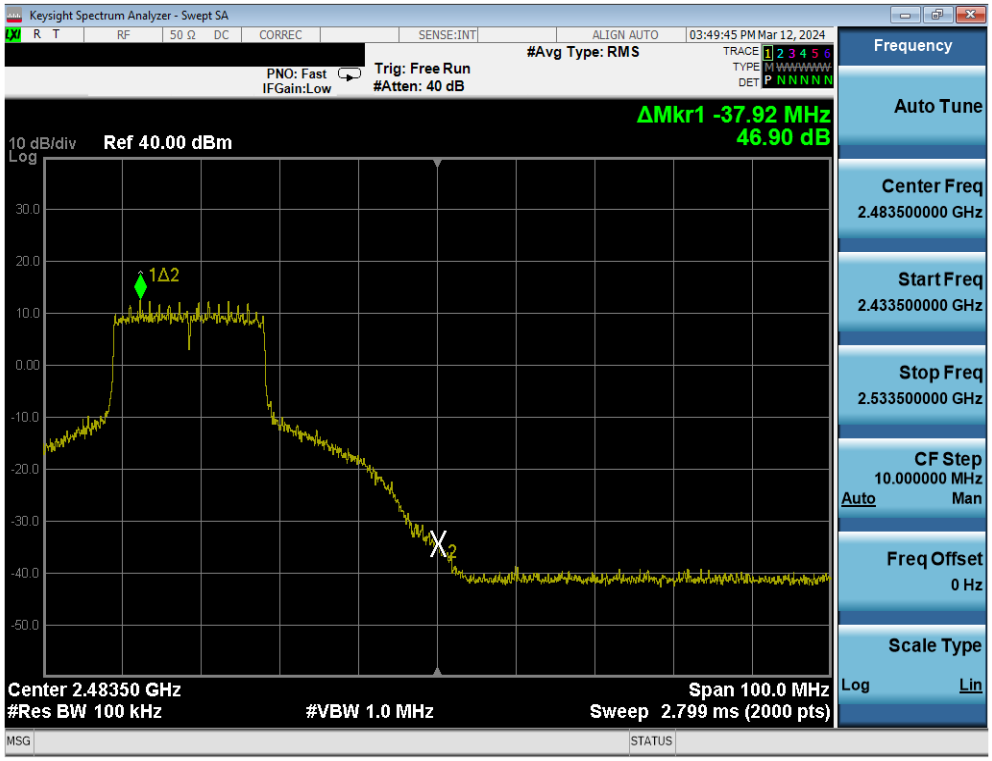
Plot 7-83. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6(high))



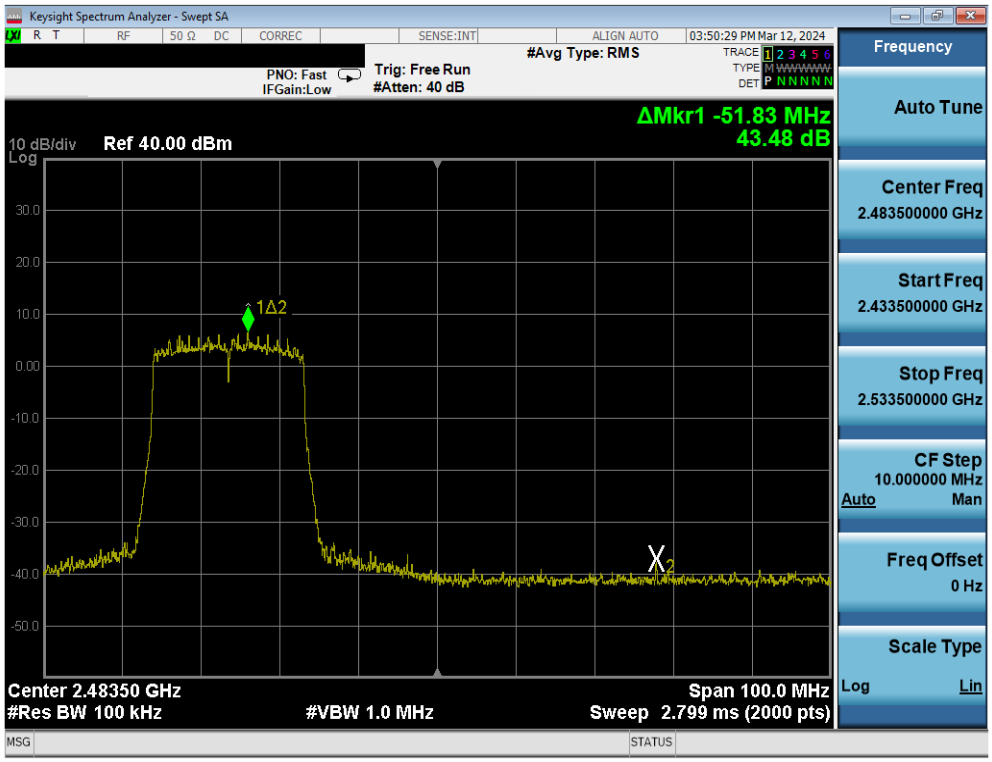
Plot 7-84. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 7)



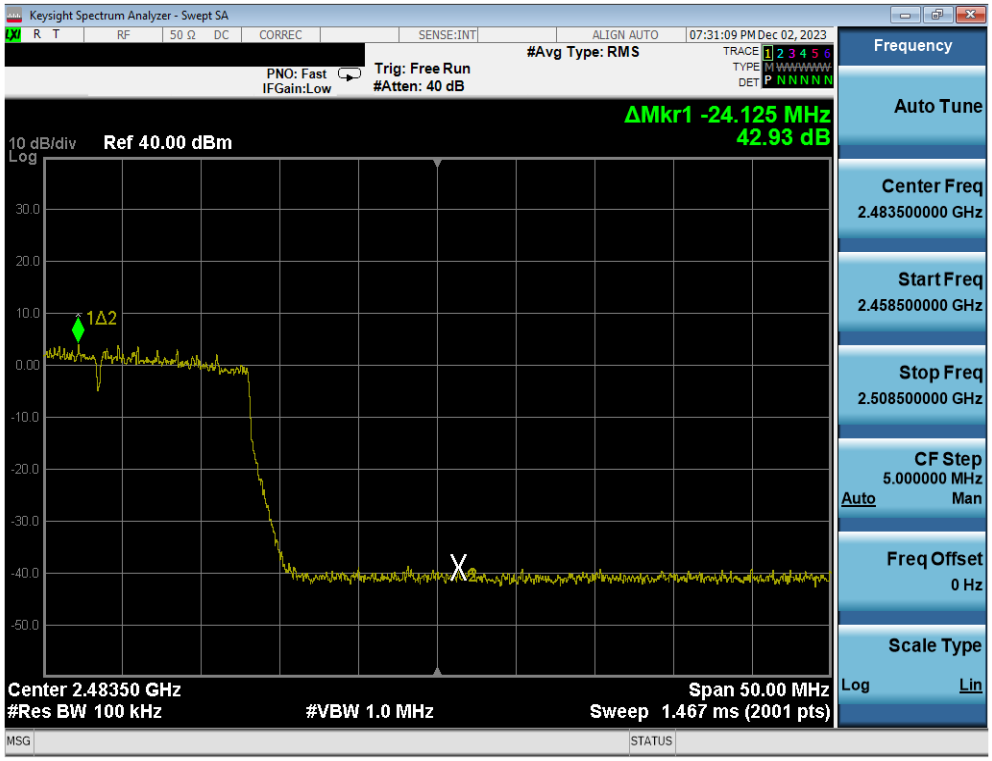
Plot 7-85. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 8)



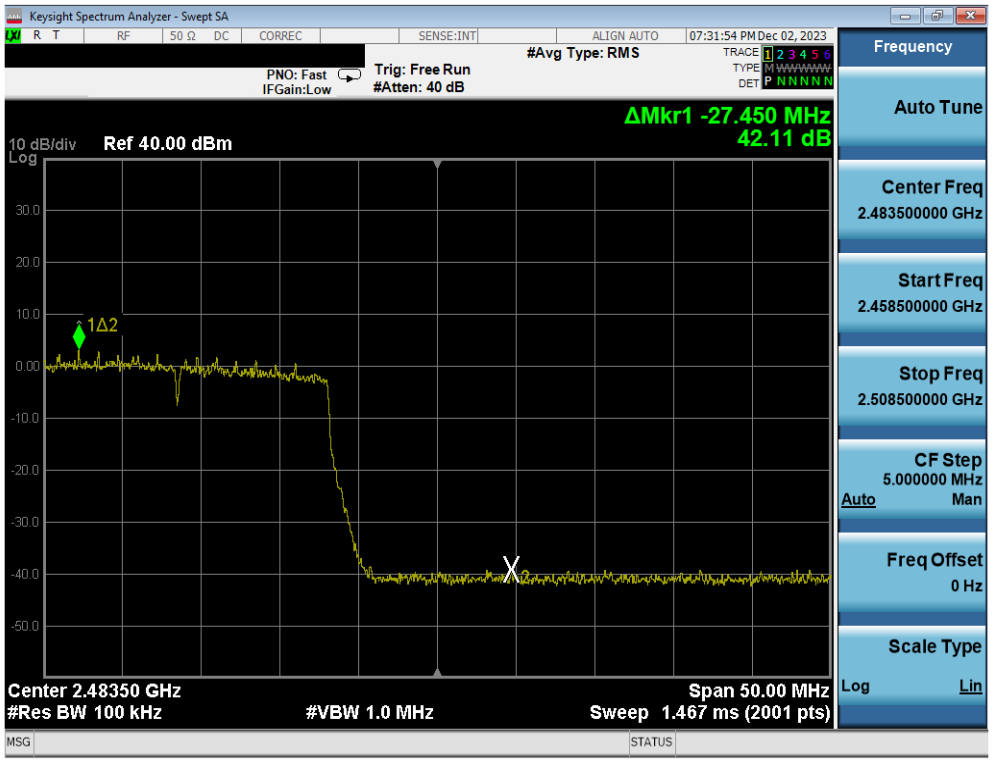
Plot 7-86. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 9)



Plot 7-87. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 10)

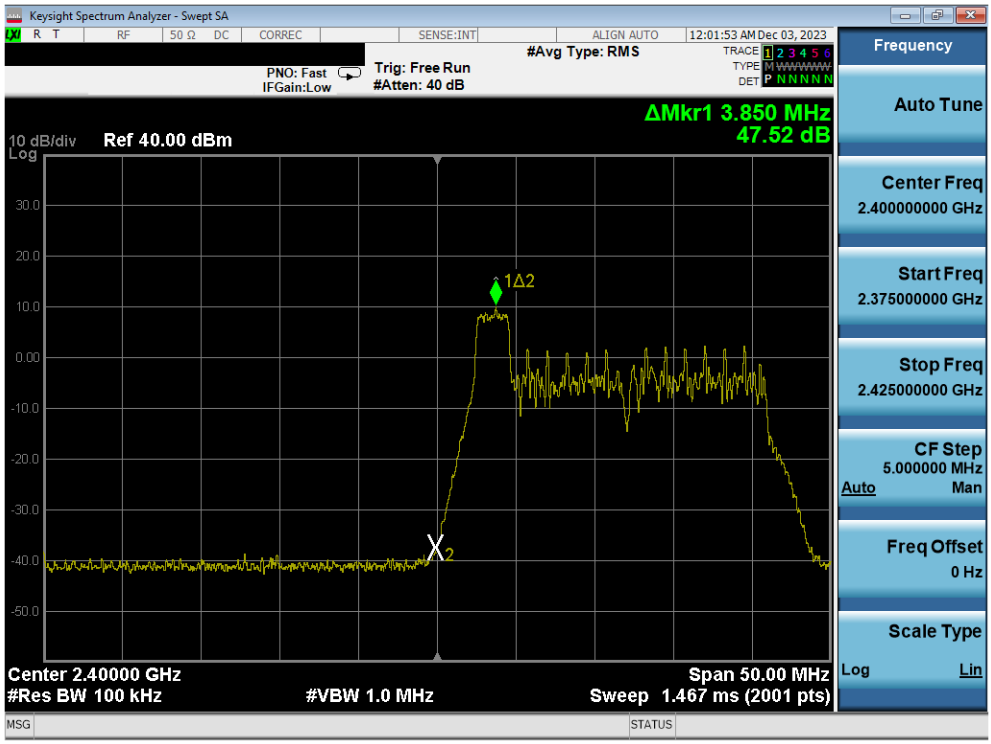


Plot 7-88. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)

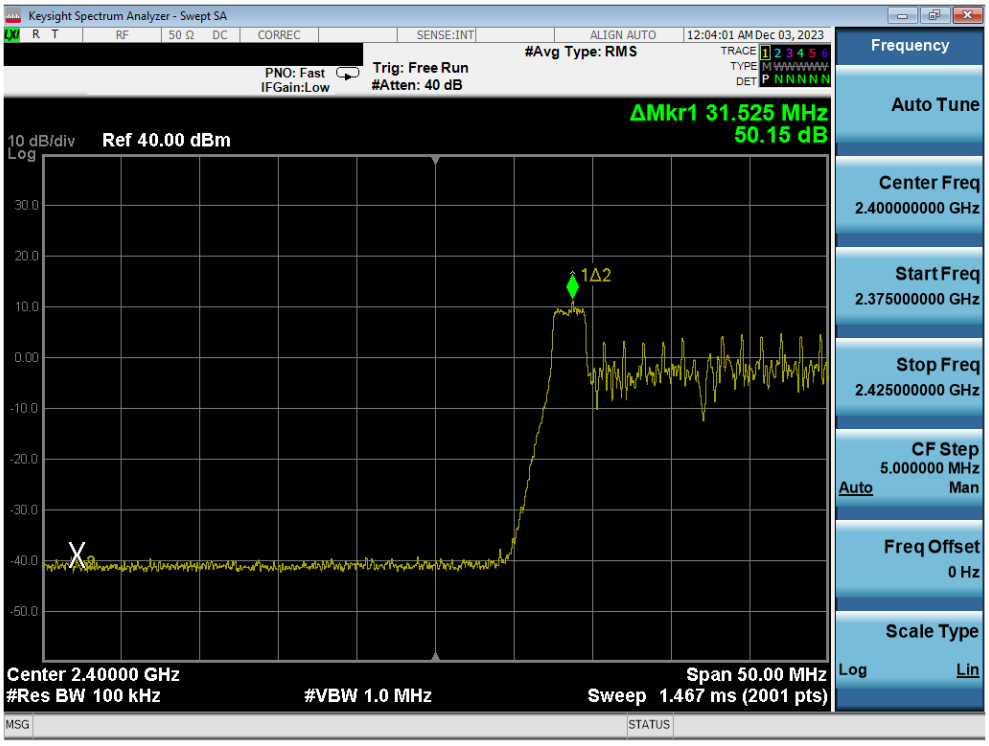


Plot 7-89. Band Edge Antenna 3a (802.11ax OFDMA – RU242 – Ch. 12)

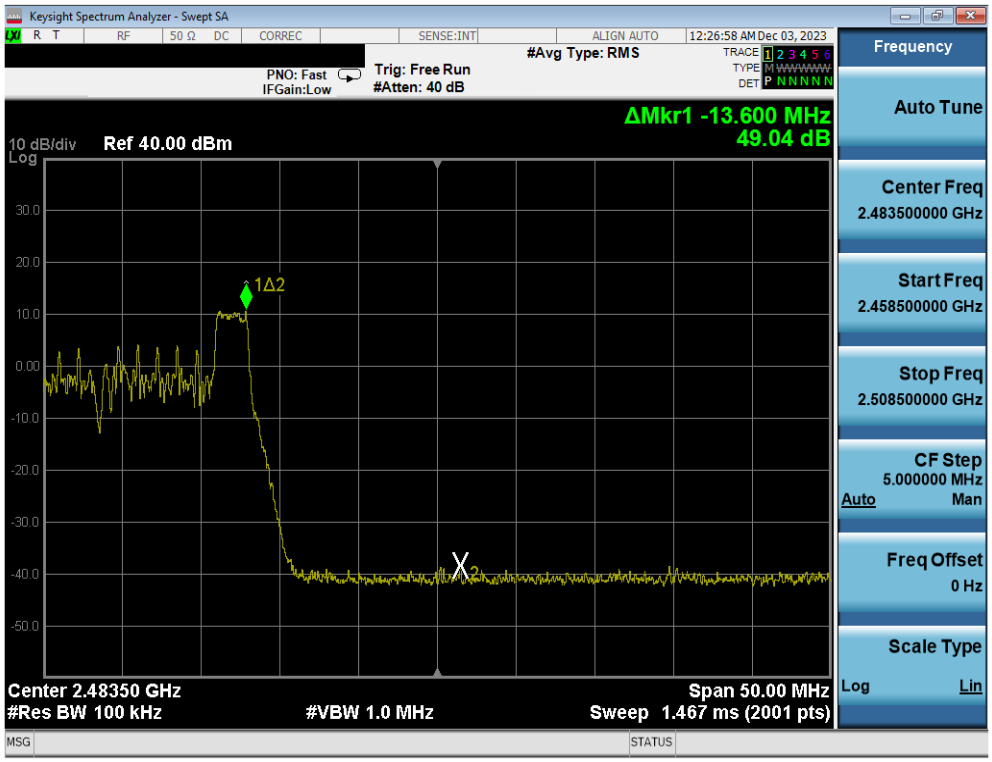
Antenna 1a Conducted Emissions at the Band Edge



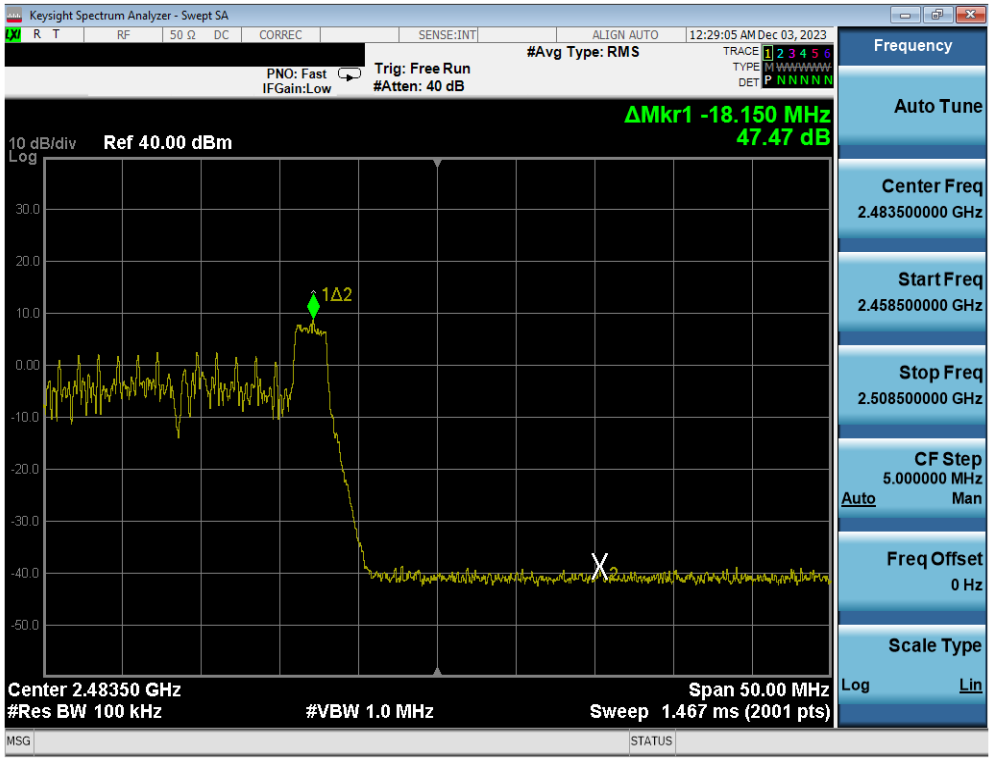
Plot 7-90. Band Edge Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



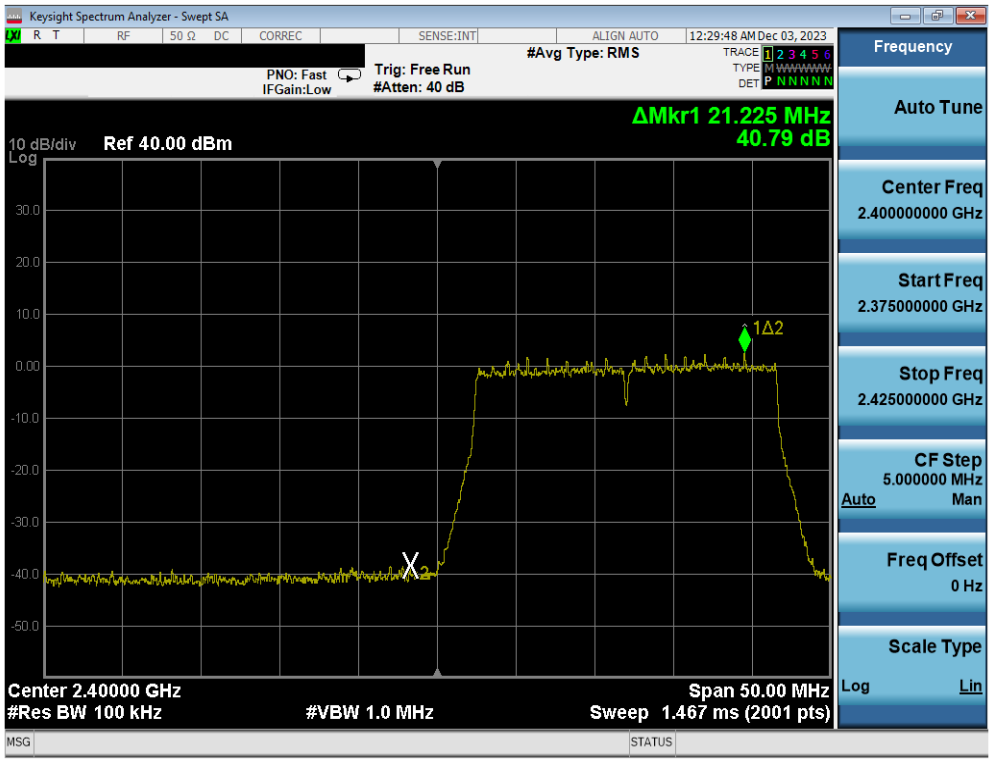
Plot 7-91. Band Edge Antenna 1a (802.11ax OFDMA – RU26 Index 0 – Ch. 2)



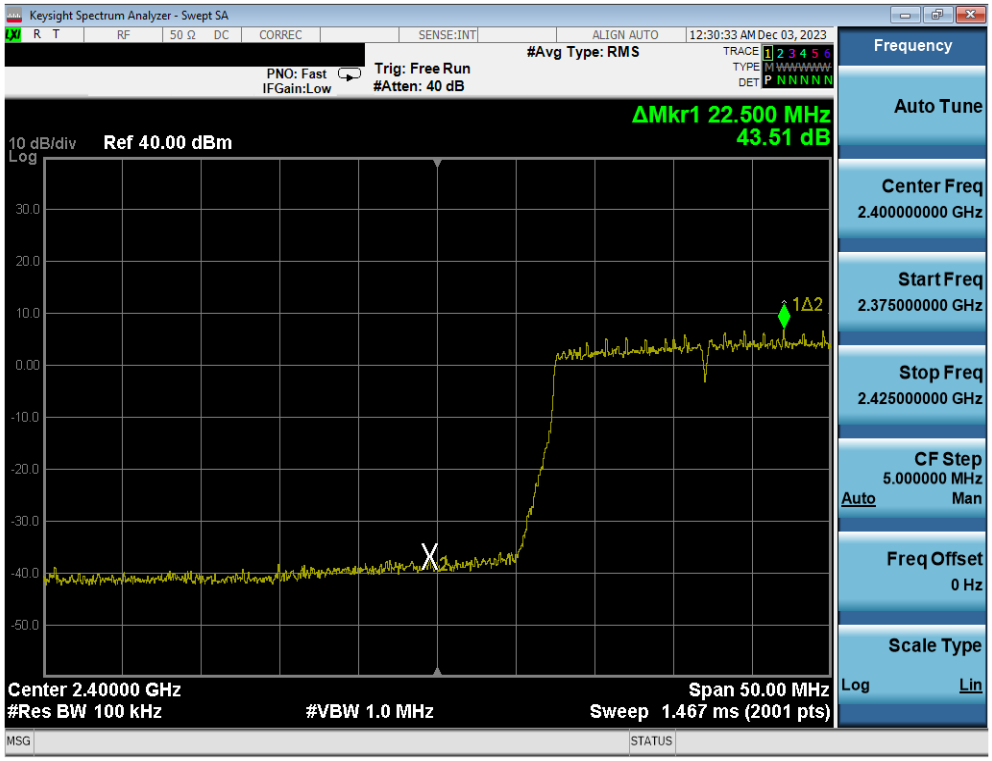
Plot 7-92. Band Edge Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



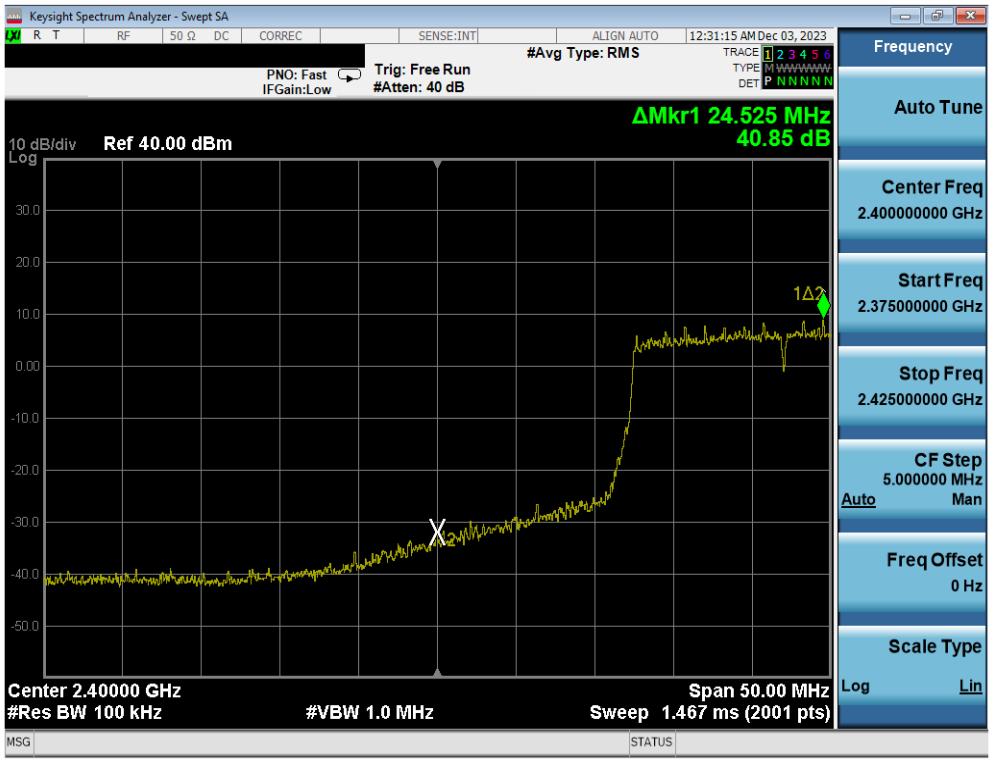
Plot 7-93. Band Edge Antenna 1a (802.11ax OFDMA – RU26 Index 8 – Ch. 12)



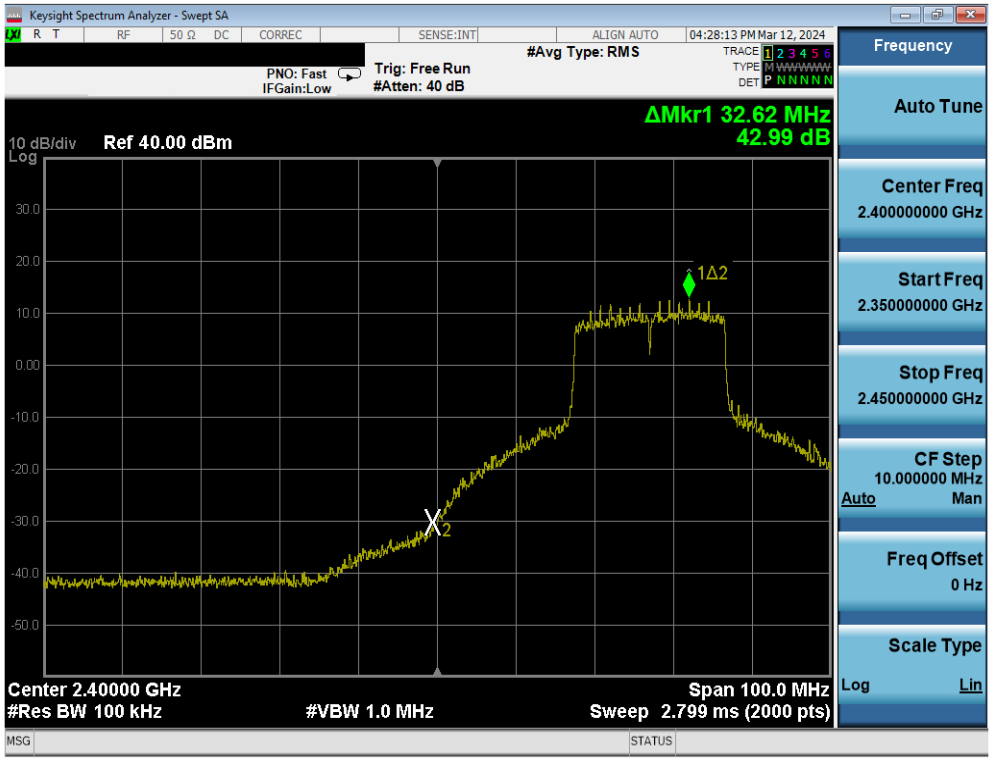
Plot 7-94. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 1)



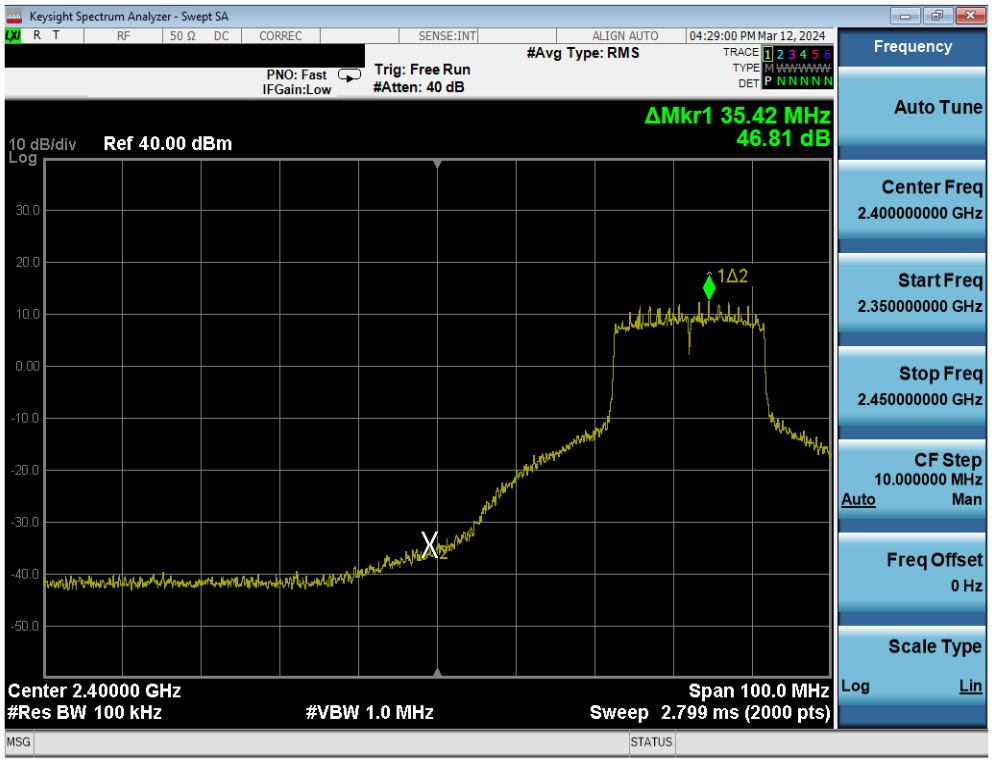
Plot 7-95. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 2)



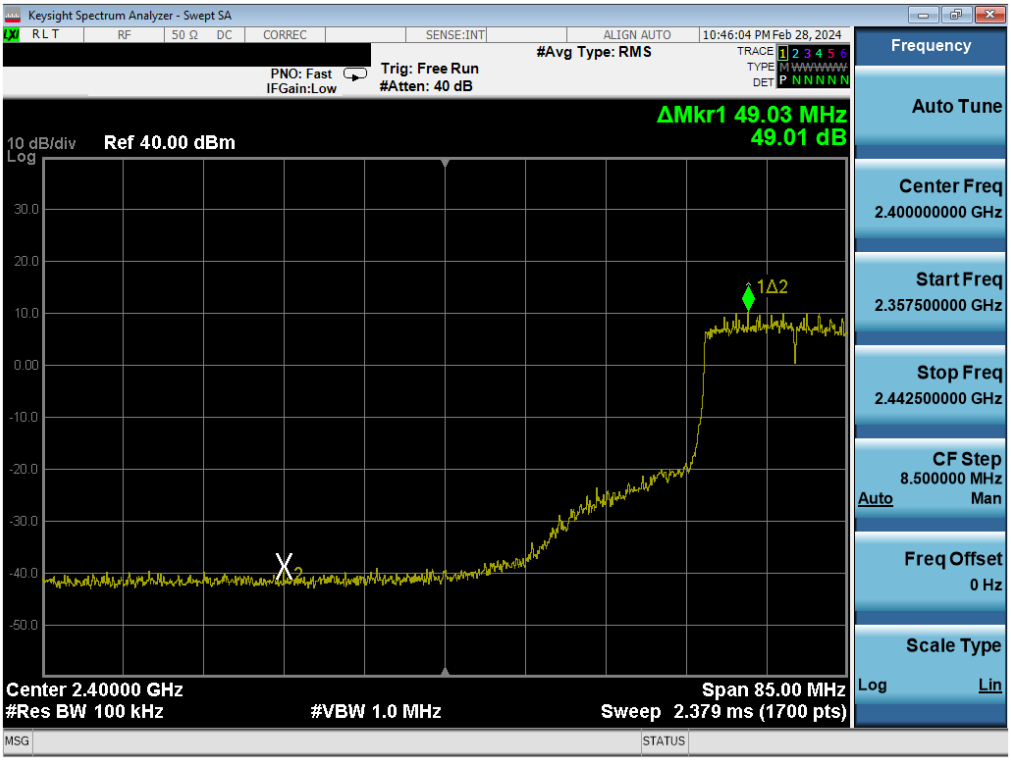
Plot 7-96. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 3)



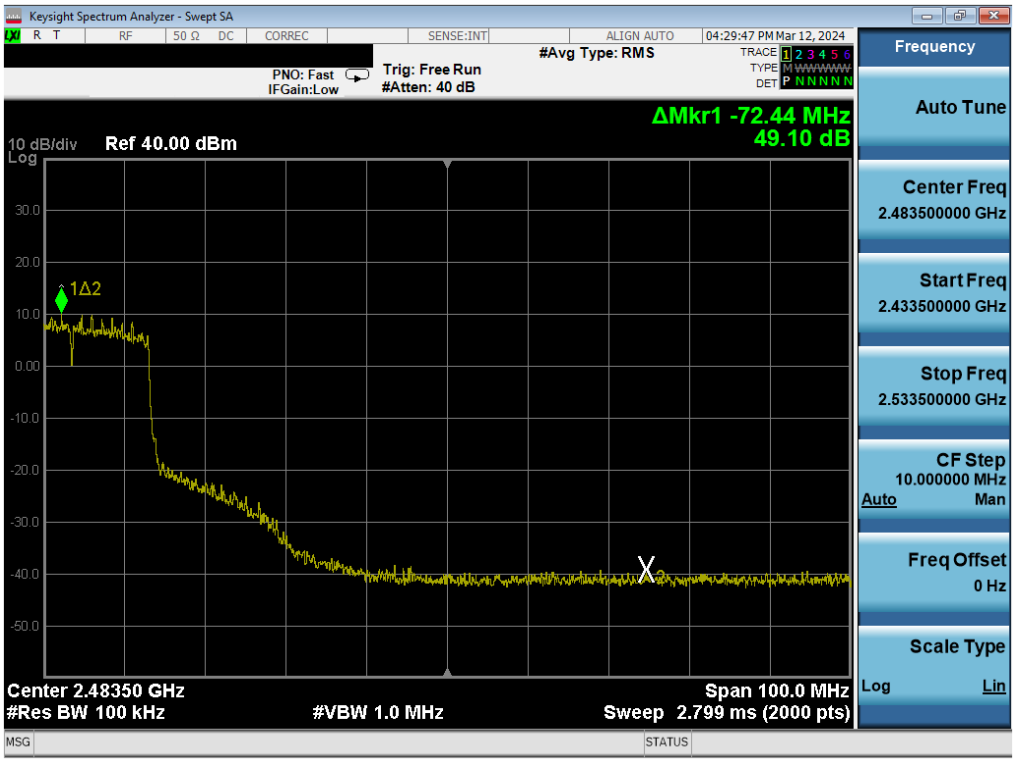
Plot 7-97. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 4)



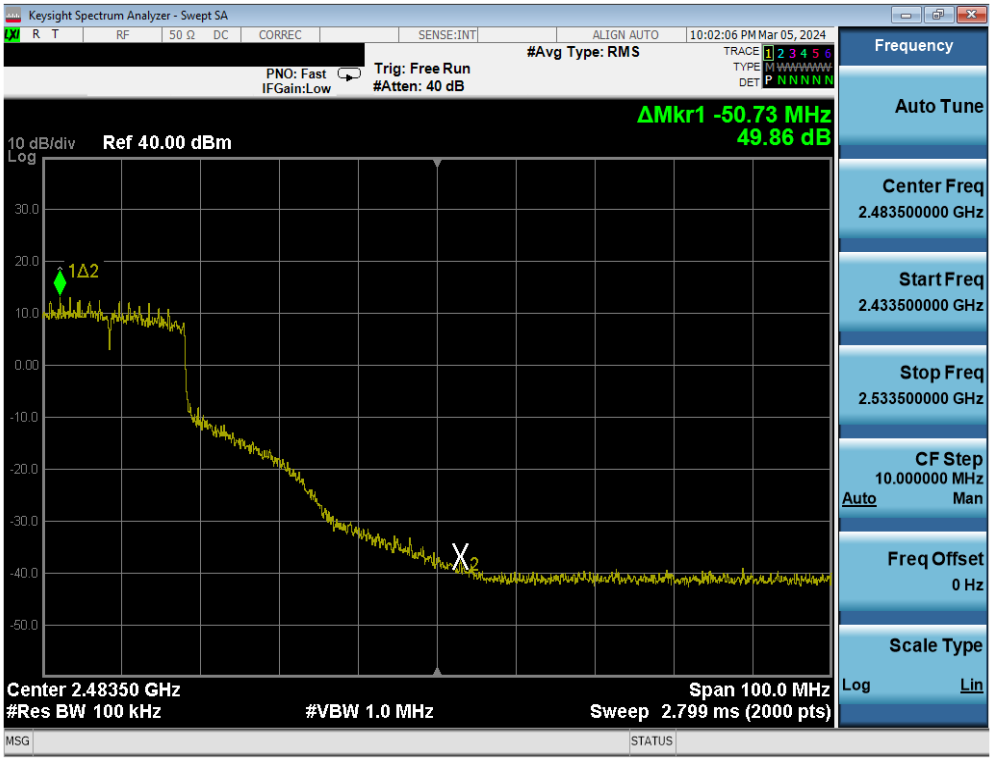
Plot 7-98. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 5)



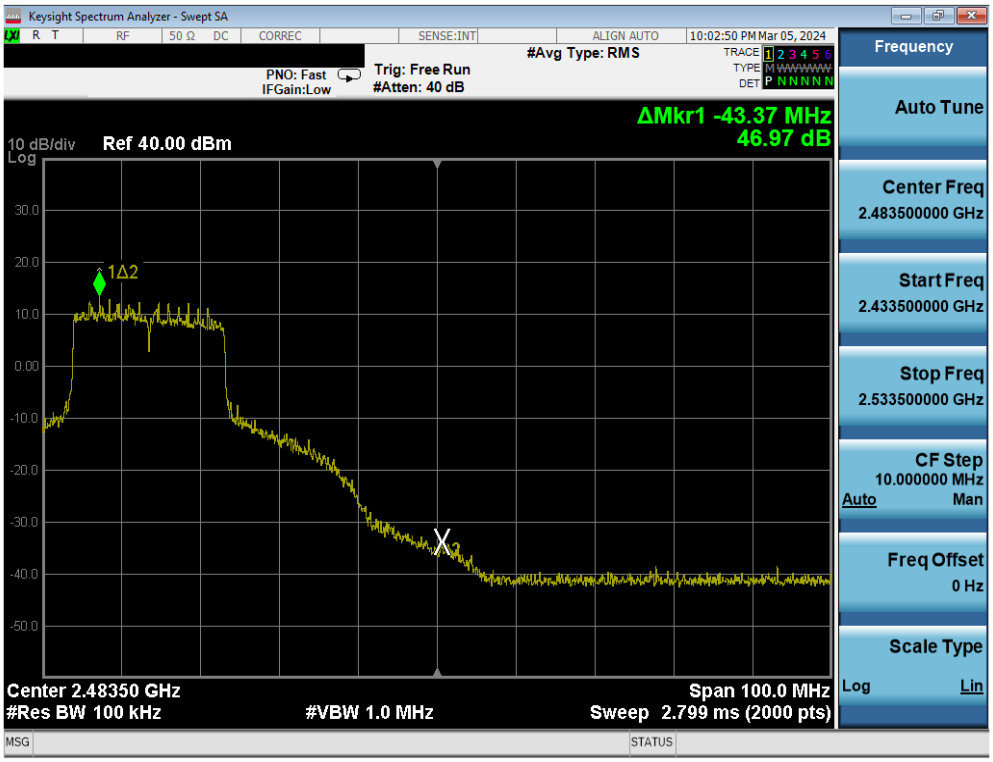
Plot 7-99. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 6(low))



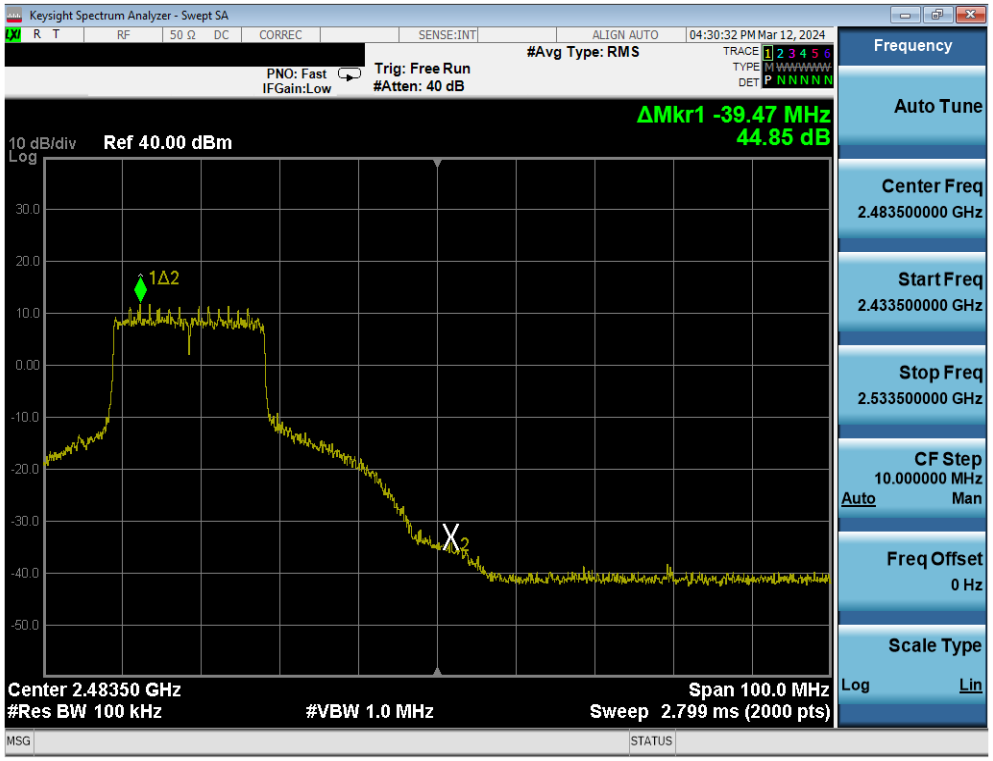
Plot 7-100. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 6(high))



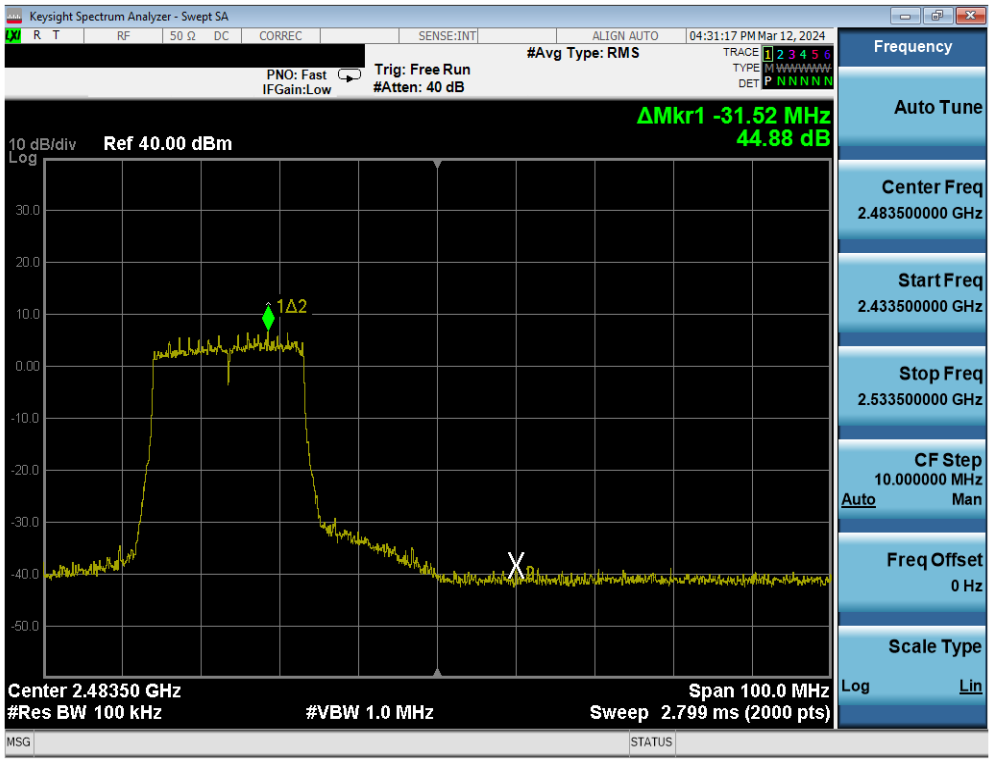
Plot 7-101. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 7)



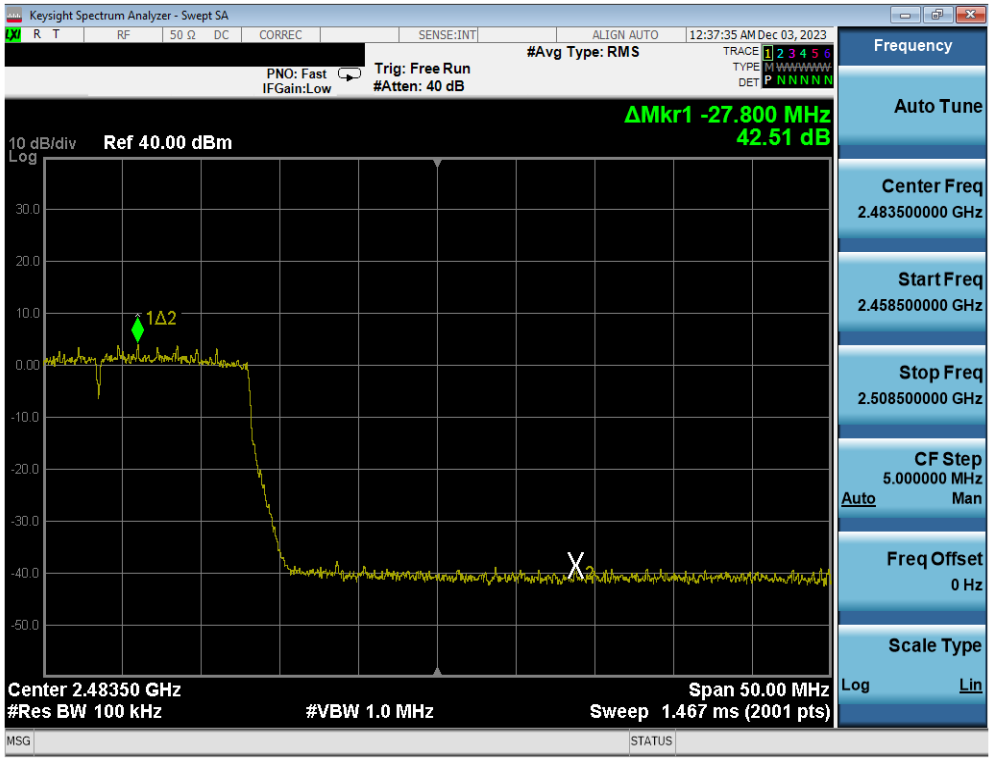
Plot 7-102. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 8)



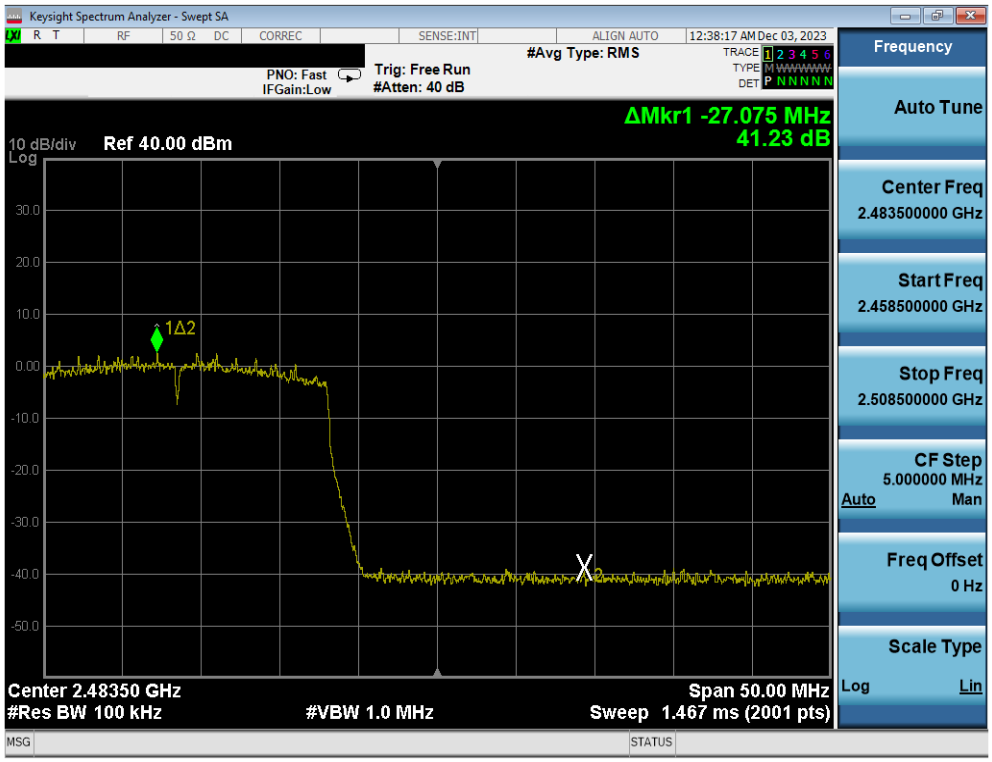
Plot 7-103. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 9)



Plot 7-104. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 10)



Plot 7-105. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 11)



Plot 7-106. Band Edge Antenna 1a (802.11ax OFDMA – RU242 – Ch. 12)

7.6 Conducted Spurious Emissions

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

All out of band emissions are 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, tone configurations, and RU indices were investigated to determine the worst case configuration. For the following out of band conducted emissions plots, the EUT was set to a data rate of MCS9 in 802.11ax-RU mode as this setting produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the procedure in Subclause 11.11 of ANSI C63.10-2013 and KDB 558074 D01 v05r02.

Test Procedure Used

ANSI C63.10-2013 – Subclause 11.11.3
KDB 558074 D01 v05r02 – Section 8.5
ANSI C63.10-2013 – Subclause 14.3.3
KDB 662911 D01 v02r01 – Section E)3)b)

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = 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 7-5. Test Instrument & Measurement Setup

Test Notes

1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.

2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1MHz RBW, the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.

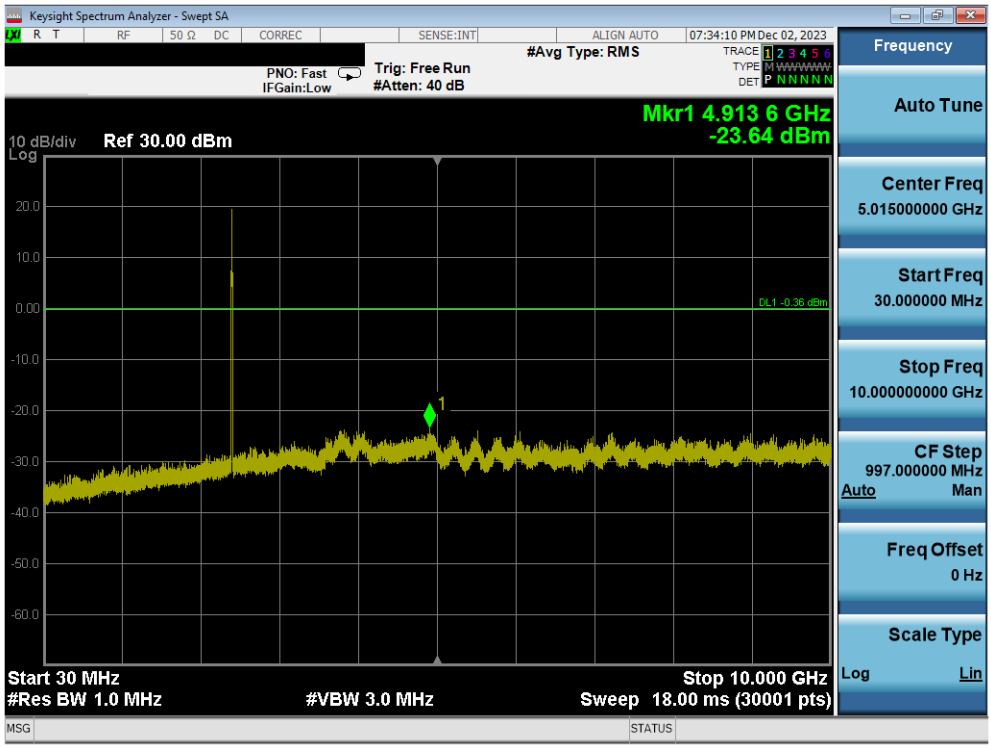
3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

4. The conducted spurious emissions were measured to relative limits. Therefore, in accordance with ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)3)b), it was unnecessary to show compliance through the summation of test results of the individual outputs.

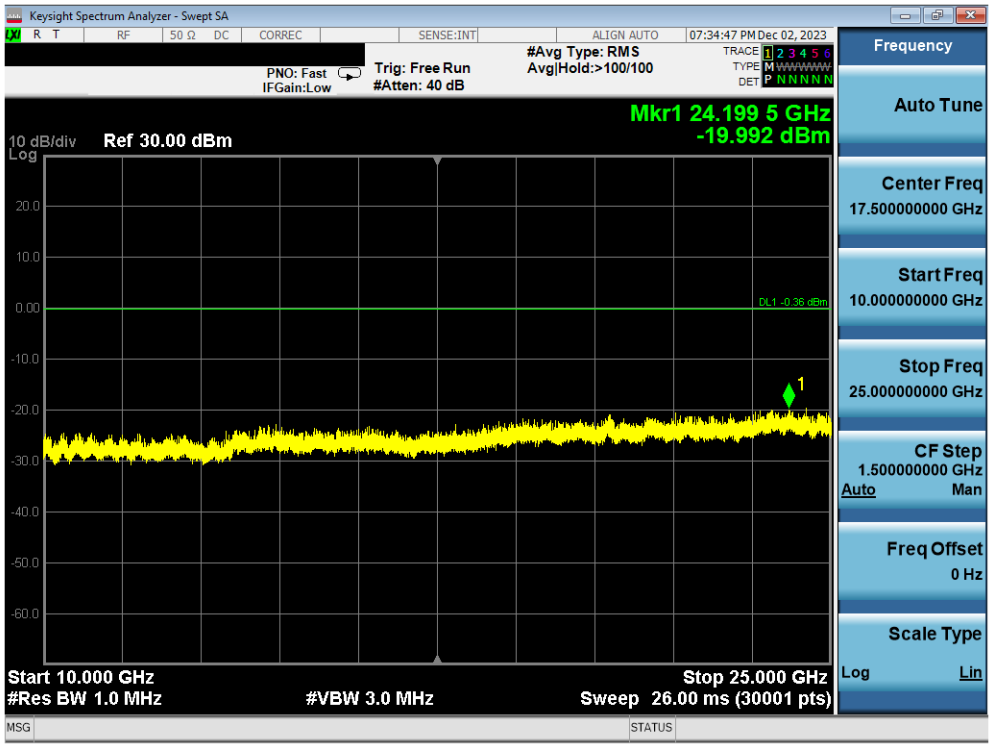
5. All antenna configurations and data rates were investigated and only the worst case are reported.

6. All RU's were investigated and only worst case partially-loaded and fully-loaded RU's are reported.

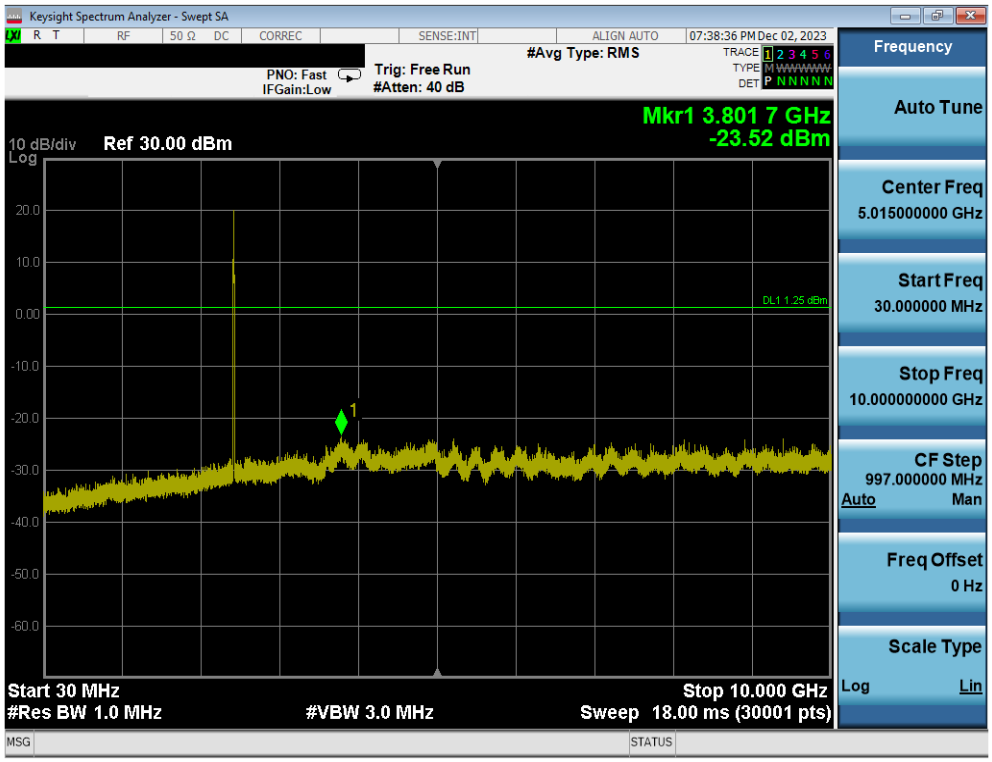
Antenna 3a Conducted Spurious Emission



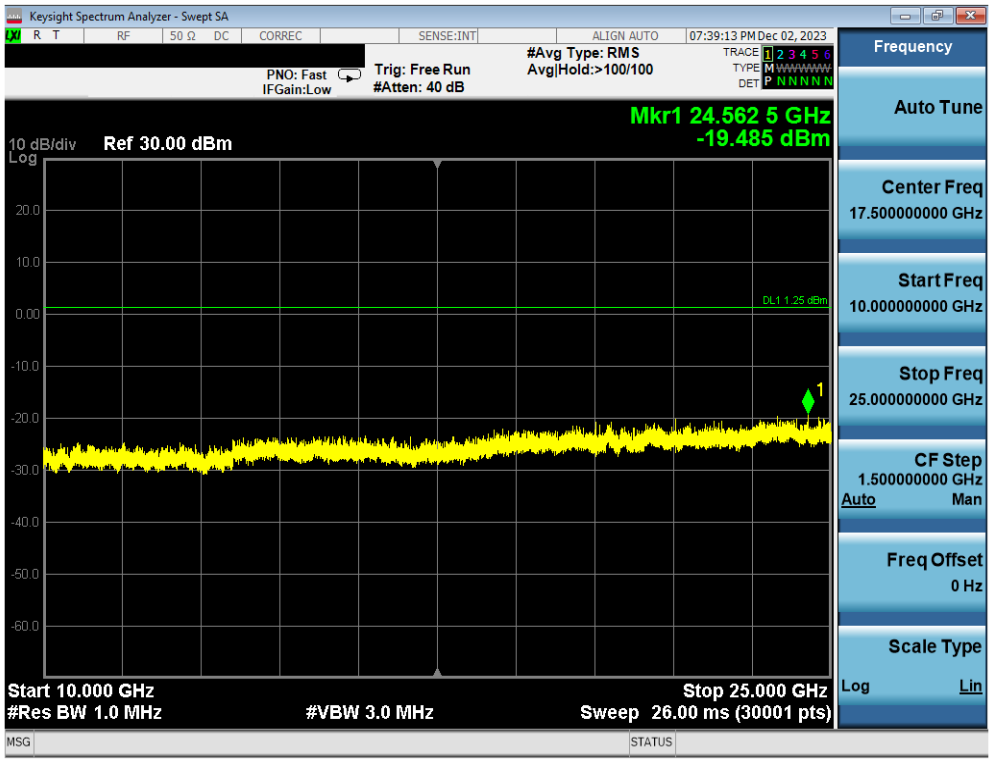
Plot 7-107. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 1)



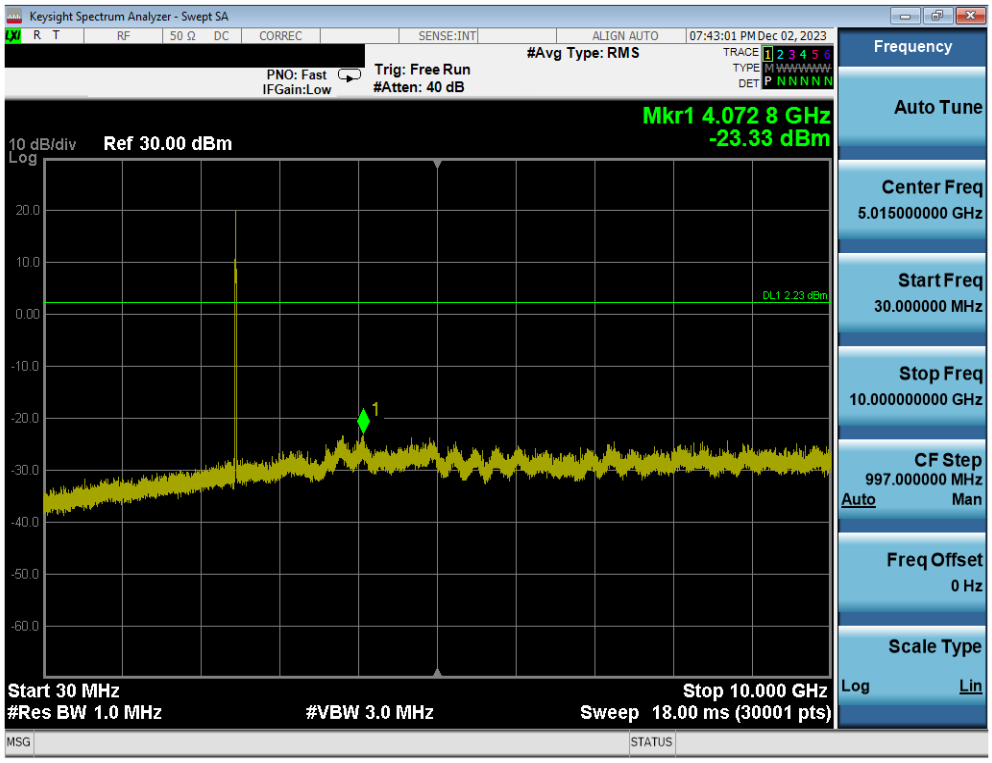
Plot 7-108. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 1)



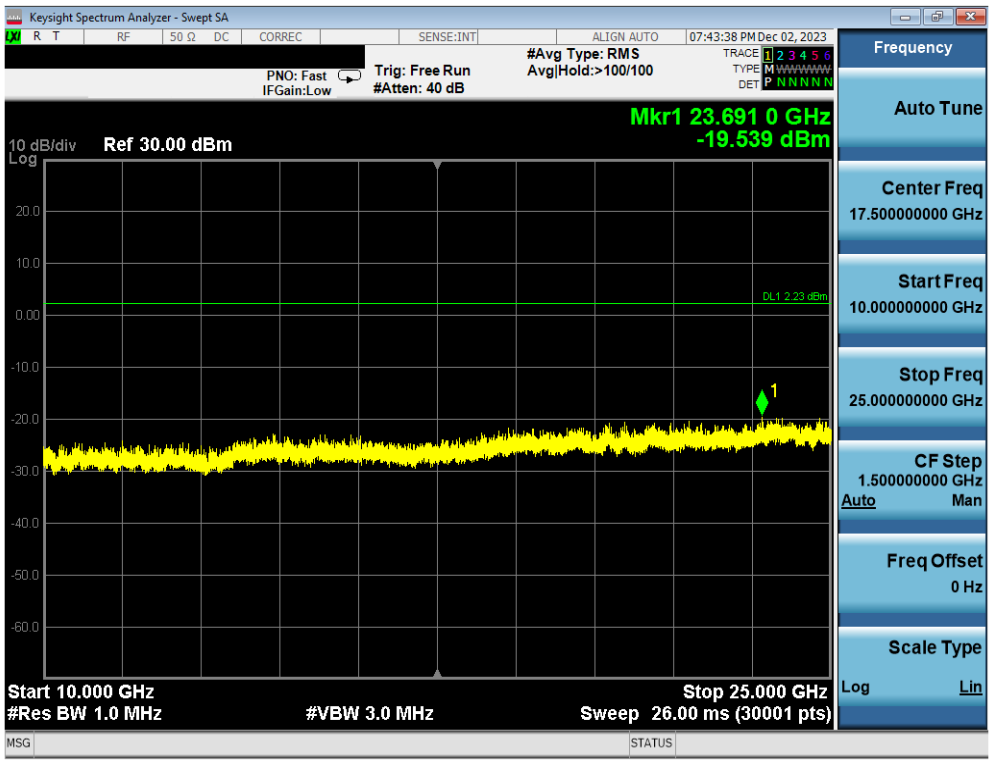
Plot 7-109. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 6)



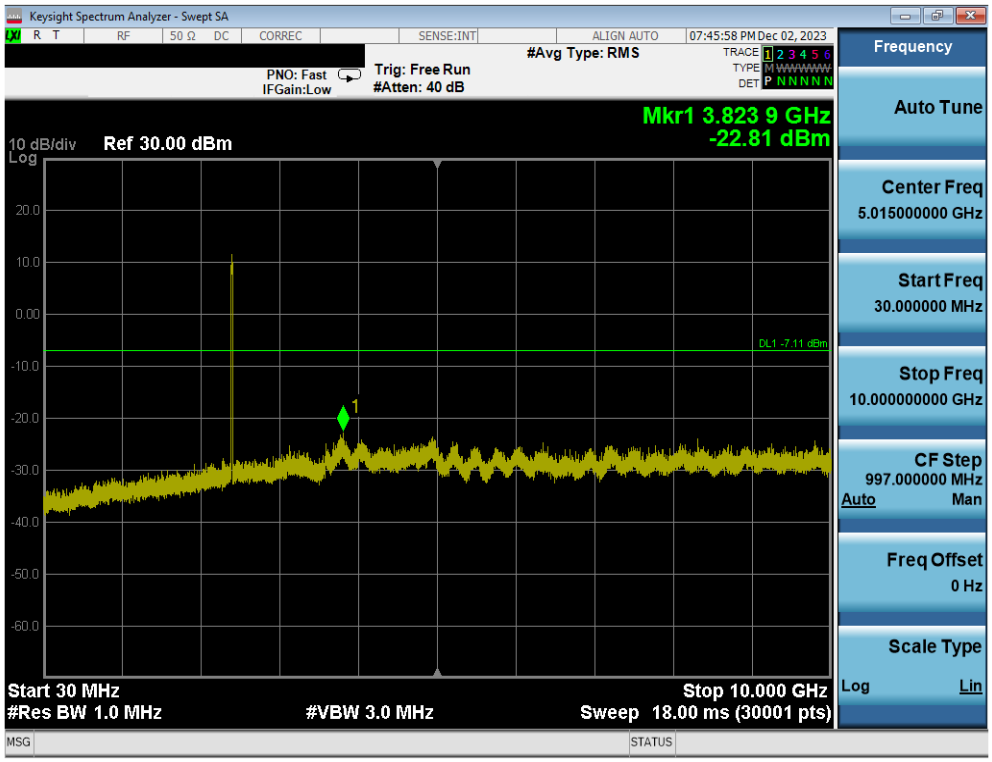
Plot 7-110. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 6)



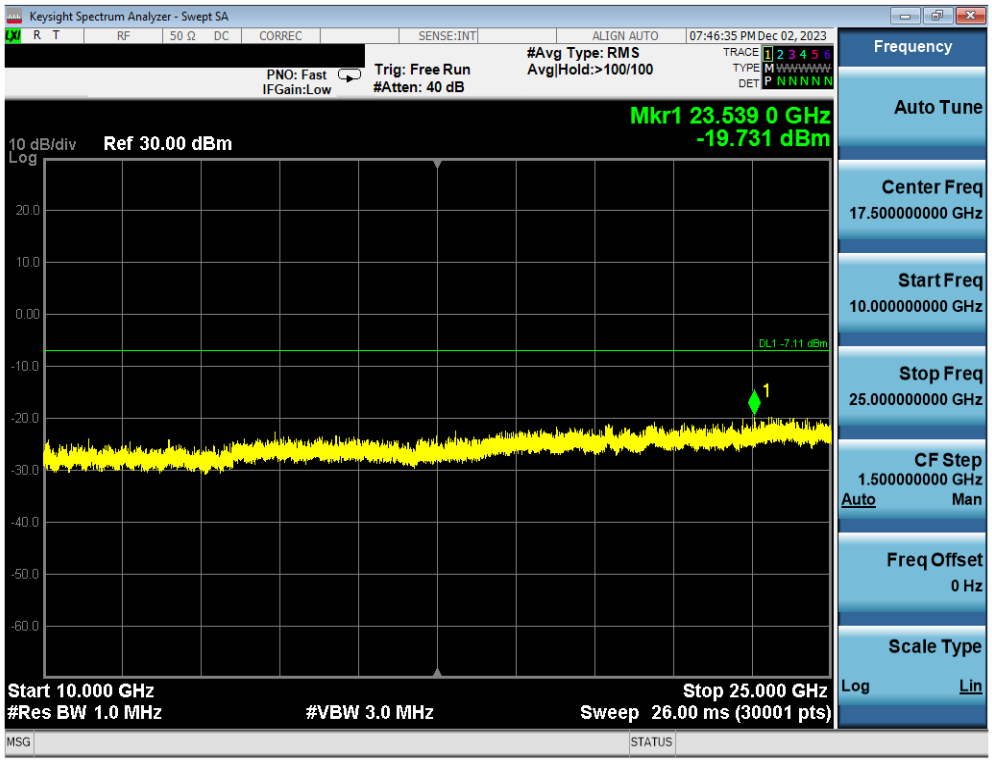
Plot 7-111. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 11)



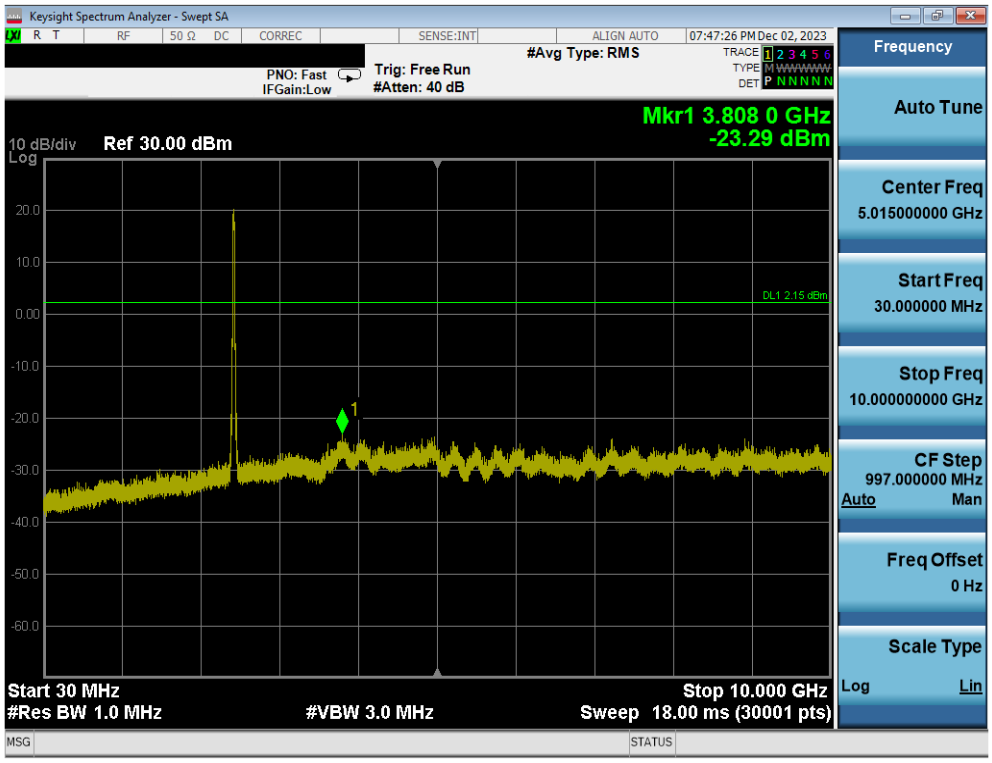
Plot 7-112. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU26 – Ch. 11)



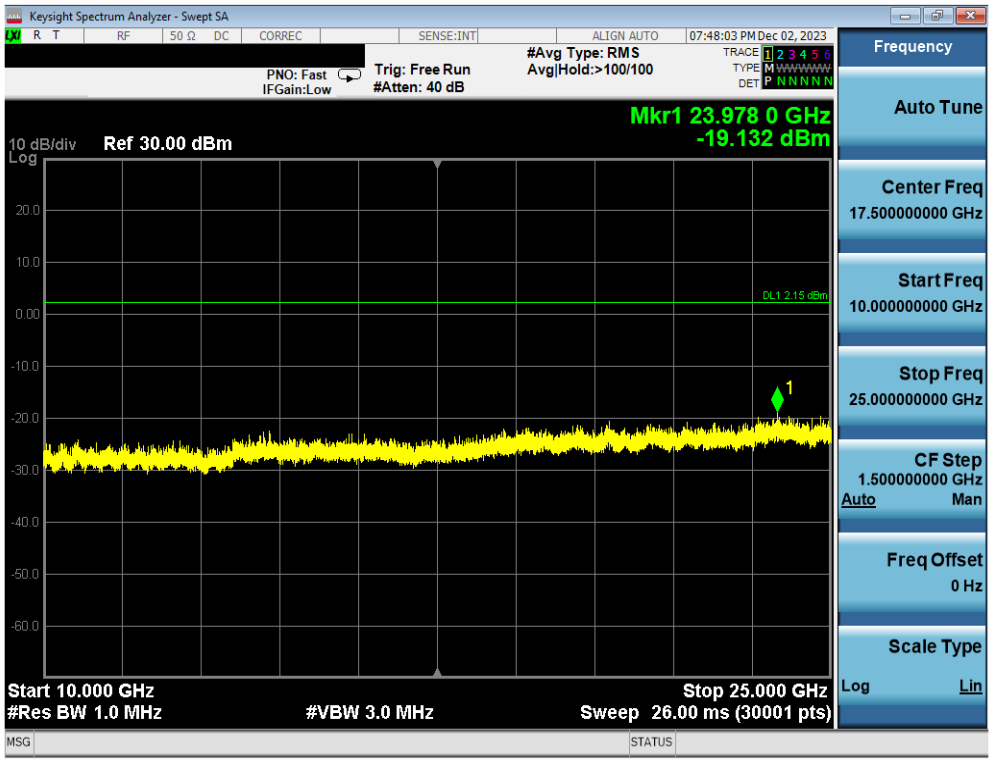
Plot 7-113. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



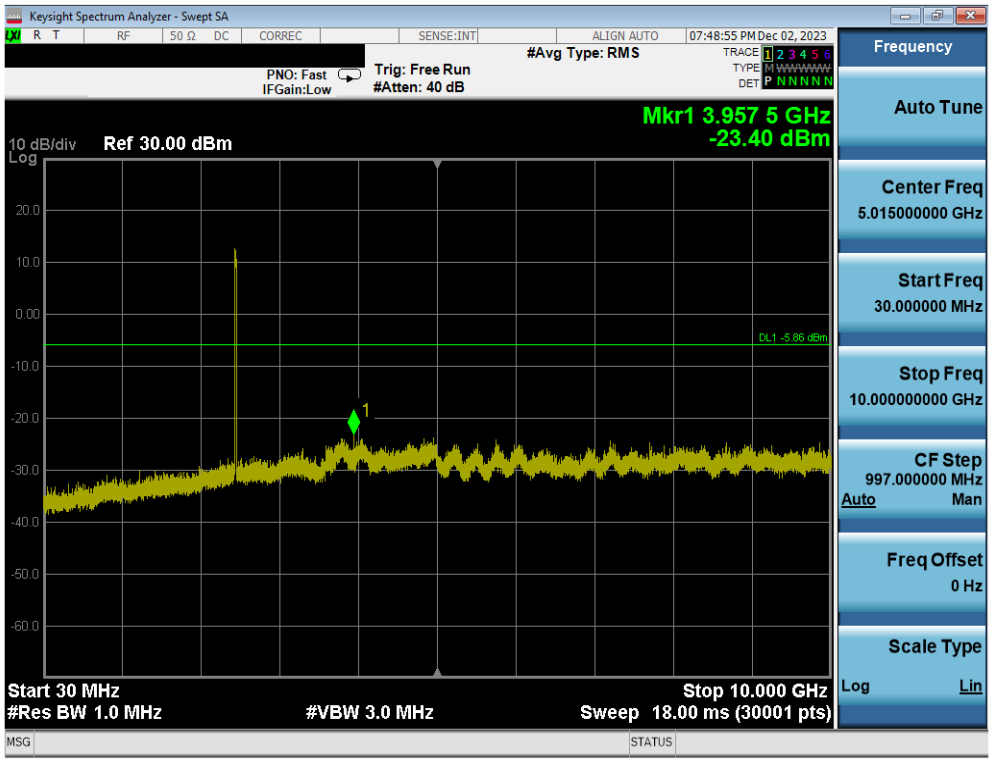
Plot 7-114. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 1)



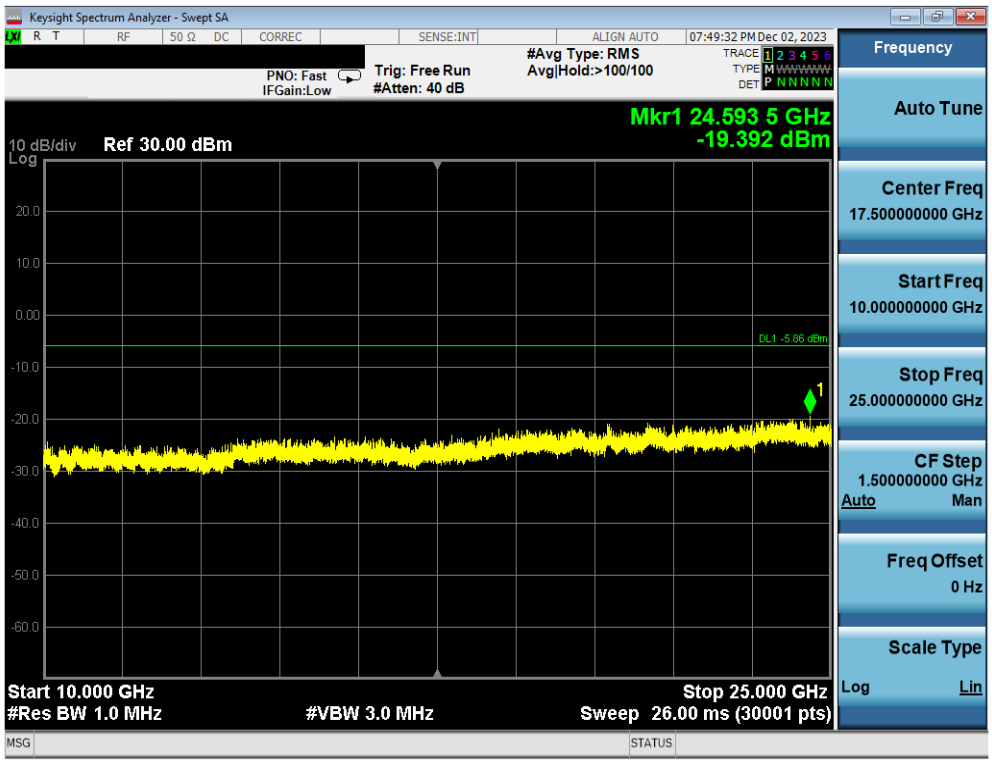
Plot 7-115. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-116. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 6)

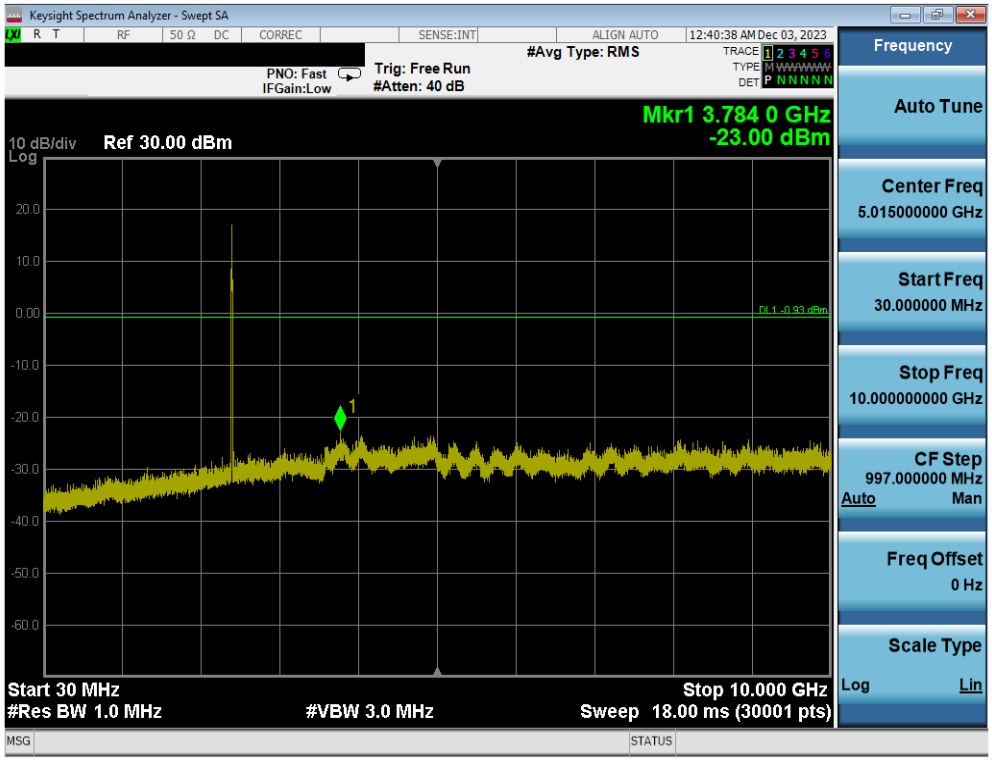


Plot 7-117. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)

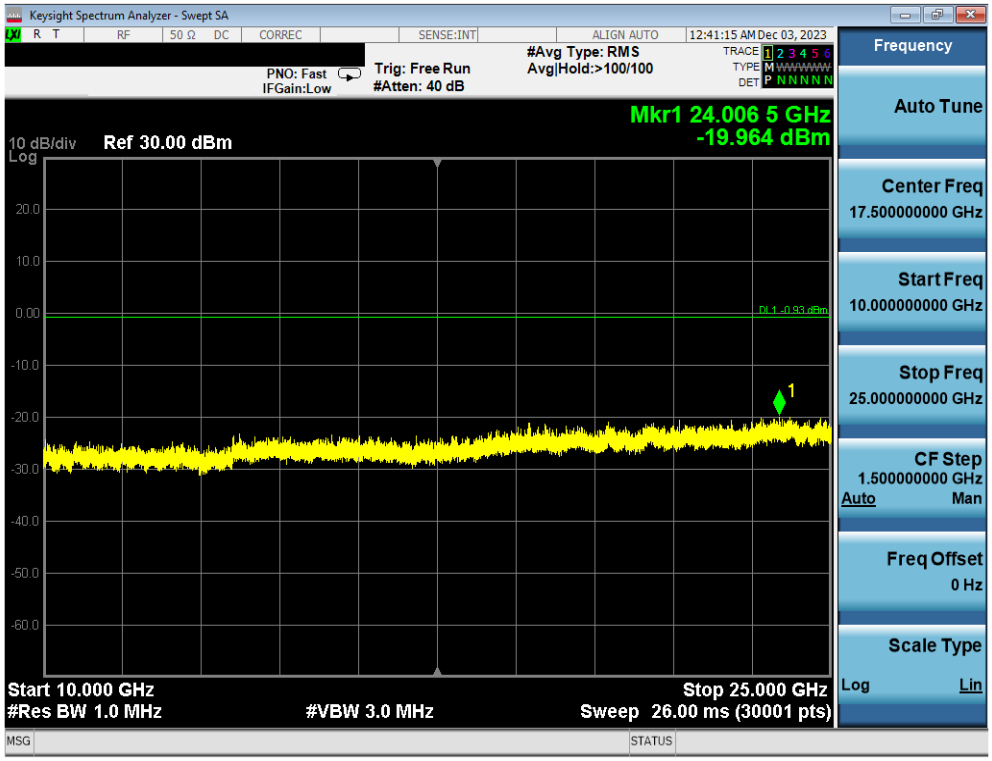


Plot 7-118. Conducted Spurious Plot Antenna 3a (802.11ax OFDMA – RU242 – Ch. 11)

Antenna 1a Conducted Spurious Emissions



Plot 7-119. Conducted Spurious Plot Antenna 1a (802.11ax OFDMA – RU26 – Ch. 1)



Plot 7-120. Conducted Spurious Plot Antenna 1a (802.11ax OFDMA – RU26 – Ch. 1)