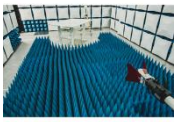
PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



MEASUREMENT REPORT
FCC PART 15.247 WLAN OFDMA

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

Date of Testing:
04/12/2021 - 06/04/2021
Test Site/Location:
PCTEST Lab. Columbia, MD USA
Test Report Serial No.:
1M2104130035-11.A3L

FCC ID:	**A3LSMF711B**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-F711B
EUT Type:	Portable Handset
Frequency Range:	2412 – 2472MHz
Modulation Type:	CCK/DSSS/OFDMA
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15 Subpart C (15.247)
Test Procedure(s):	ANSI C63.10-2013, KDB 558074 D01 v05r02, KDB 662911 D01 v02r01, KDB 648474 D03 v01r04

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.

Randy Ortanez
President

ACCREDITED
CERT #2041.01

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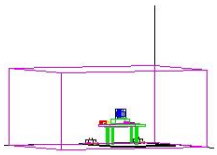
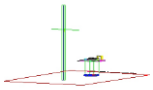


MEASUREMENT REPORT



Mode	Tones	Tx Frequency [MHz]	ANT1				ANT2				MIMO			
			Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted		Avg Conducted		Peak Conducted	
			Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)	Max. Power (mW)	Max. Power (dBm)
802.11ax OFDMA	26T	2412 - 2472	31.405	14.97	261.818	24.18	31.477	14.98	325.837	25.13	62.810	17.98	594.491	27.74
802.11ax OFDMA	52T	2412 - 2472	31.550	14.99	260.016	24.15	31.477	14.98	311.889	24.94	62.309	17.95	556.985	27.46
802.11ax OFDMA	106T	2412 - 2472	39.446	15.96	300.608	24.78	39.719	15.99	319.890	25.05	79.164	18.99	625.382	27.96
802.11ax OFDMA	242T	2412 - 2472	43.954	16.43	270.396	24.32	44.566	16.49	324.340	25.11	88.723	19.48	600.534	27.79

EUT Overview

1.0 INTRODUCTION

1.1 Scope

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

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 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.

- PCTEST 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).

- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISED.

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF711B**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

Test Device Serial No.: 0135M, 0148M, 0545M, 0837M, 0677M, 0649M, 0843M, 0059S, 0585S, 1600S

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 5G NR (n5, n66), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5GHz), Bluetooth (1x, EDR, LE), NFC, Wireless Power Transfer

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. Frequency/ Channel Operations

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 ANSI C63.10-2013 and KDB 558074 D01 v05r02. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Mode	Antenna	Tone	Duty Cycle (QORVO)	Duty Cycle (NXP)
802.11ax DTS RU	1	26T	99.7	99.7
		52T	99.8	99.7
		106T	99.7	99.7
		242T	99.7	99.7
802.11ax DTS RU	2	26T	99.7	99.7
		52T	99.8	99.7
		106T	99.7	99.7
		242T	99.7	99.7
802.11ax DTS RU	MIMO CDD	26T	99.7	99.7
		52T	99.8	99.7
		106T	99.7	99.7
		242T	99.7	99.7

Table 2-2. Measured Duty Cycles

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

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

Table 2-3. Frequency / Channel Operations

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

This device supports simultaneous transmission operation, which allows for two SISO channels to operate independent of one another in the 2.4GHz and 5GHz bands simultaneously on each antenna. The following tables show the worst case configurations determined during testing. The data for these configurations is contained in the UNII test report.

Configuration 1: ANT1 and ANT2 both transmitting in 2.4GHz and 5GHz modes simultaneously

Description	2.4 GHz Tx	5 GHz Tx
Antenna	1, 2	1, 2
Channel	11	120
Operating Frequency (MHz)	2462	5600
Data Rate (Mbps)	1	MCS0
Mode	802.11b	802.11ax

Table 2-4. Config-1 (MIMO 2.4GHz & MIMIO 5GHz)

Configuration 2: ANT1 and ANT2 both transmitting in 5GHz modes simultaneously, Antenna 1 is transmitting BT and Antenna 2 is transmitting 2.4GHz additionally

Description	Bluetooth	2.4 GHz Tx	5GHz Tx
Antenna	1	2	1, 2
Channel	0	11	36
Operating Frequency (MHz)	2402	2462	5180
Data Rate (Mbps)	1	1	MCS0
Mode	GFSK	802.11b	802.11ax

Table 2-5. Config-3 (ANT1 BT, ANT2 2.4GHz & MIMO 5GHz)

2.3 Test Configuration

The EUT was tested per the guidance of 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.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) EP-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The EUT is foldable and will be manufactured using two different wifi chipsets (N and Q) – samples with each chipset were tested both open and closed in order to determine the worst cases for radiated emissions. The worst case radiated emissions data is shown in this report.

2.4 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna Gain ANT1 [dBi]	Antenna Gain ANT2 [dBi]
2.4	-6.1	-6.2

Table 2-6. Antenna Peak Gain

2.5 Software and Firmware

The test was conducted with firmware version F711USQU0AUE1 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT**.**

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

3.2 Radiated Emissions

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

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

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

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

3.3 Environmental Conditions

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

4.0 ANTENNA REQUIREMENTS

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

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

Conclusion:

The EUT unit complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

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

Contribution	Expanded Uncertainty (±dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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
-	WL25-1	Conducted Cable Set (25GHz)	2/23/2021	Annual	2/23/2022	WL25-1
-	WL40-1	WLAN Cable Set (40GHz)	2/23/2021	Annual	2/23/2022	WL40-1
Agilent	N5183A	MXG Analog Signal Generator	1/21/2021	Annual	1/21/2022	MY50141900
Anritsu	ML2495A	Power Meter	1/18/2021	Annual	1/18/2022	941001
Anritsu	MA2411B	Pulse Power Sensor	2/5/2021	Annual	2/5/2022	846215
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2019	Biennial	10/10/2021	121034
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	8/7/2018	Triennial	8/7/2021	9203-2178
ETS-Lindgren	3816/2NM	LISN	7/9/2020	Biennial	7/9/2022	114451
Keysight Technologies	N9020A	MXA Signal Analyzer	8/14/2020	Annual	8/14/2021	US46470561
Keysight Technologies	N9038A	MXE EMI Receiver	8/11/2020	Annual	8/11/2021	MY51210133
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	8/17/2020	Annual	8/17/2021	MY52350166
Keysight Technologies	N9020A	MXA Signal Analyzer	9/22/2020	Annual	9/22/2021	MY54500644
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	2/25/2021	Annual	2/25/2022	NMLC-2
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	7/15/2020	Annual	7/15/2021	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/9/2020	Annual	9/9/2021	100348
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/10/2020	Annual	8/10/2021	103200
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	10/1/2019	Biennial	10/1/2021	310233
Sunol	DRH-118	Horn Antenna (1-18 GHz)	8/27/2019	Biennial	8/27/2021	A042511
Sunol Science	JB5	Bi-Log Antenna (30M - 5GHz)	7/27/2020	Biennial	7/27/2022	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMF711B

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
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

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 PCTEST "WLAN Automation," Version 3.5.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.3.1.
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.

7.2 6dB Bandwidth Measurement

§15.247(a.2); RSS-247 [5.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2
KDB 558074 D01 v05r02 – Section 8.2

Test Settings

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

Test Setup

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

Figure 7-1. Test Instrument & Measurement Setup

Test Notes

1. Based on preliminary measurements, it was determined that, of all the tone configurations, the 26T configuration produced the worst case 6dB Bandwidth measurement. Only the worst case data is included in this section.

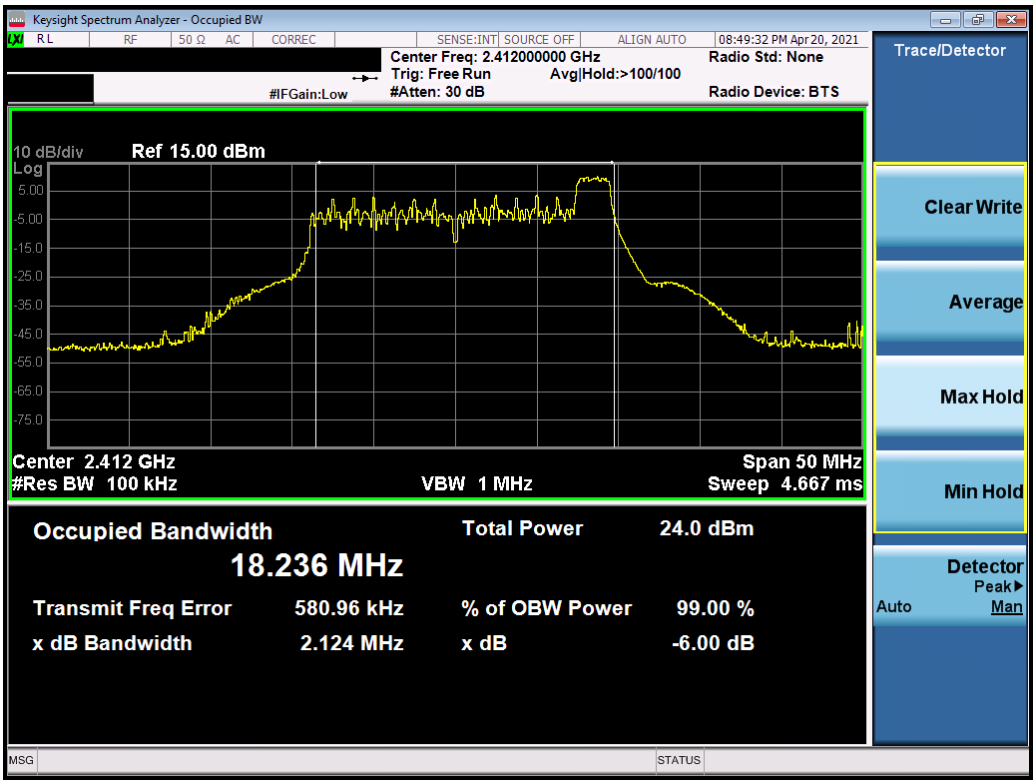
2. The 6dB bandwidth for each channel was measured with the RU index showing the highest conducted power.

3. This device will be manufactured using two different WIFI chipsets (N and Q). Both two chipsets are tested, and both conducted emissions data is shown in this report.

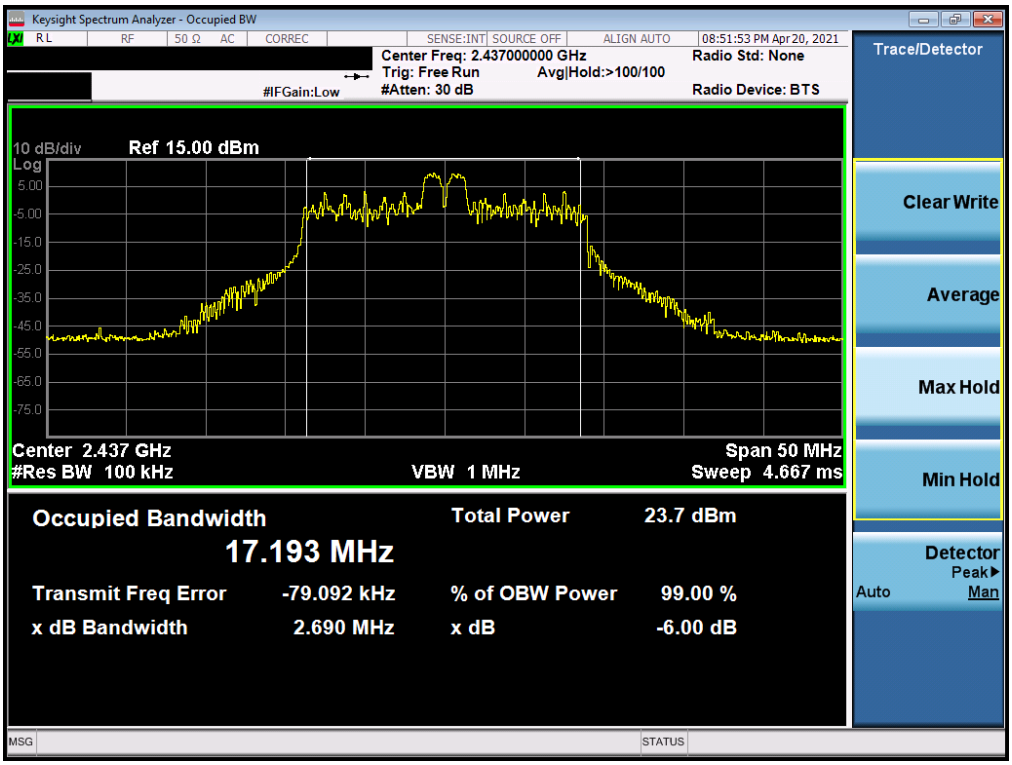
SISO Antenna-2 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Bandwidth [MHz] (QORVO)	Measured Bandwidth [MHz] (NXP)	Minimum Bandwidth [MHz]
2412	1	ax	26T	MCS0	2.124	2.694	0.500
2437	6	ax	26T	MCS0	2.690	2.144	0.500
2462	11	ax	26T	MCS0	2.121	2.136	0.500
2412	1	ax	242T	MCS0	19.02	19.08	0.500
2437	6	ax	242T	MCS0	19.12	19.06	0.500
2462	11	ax	242T	MCS0	19.09	19.09	0.500

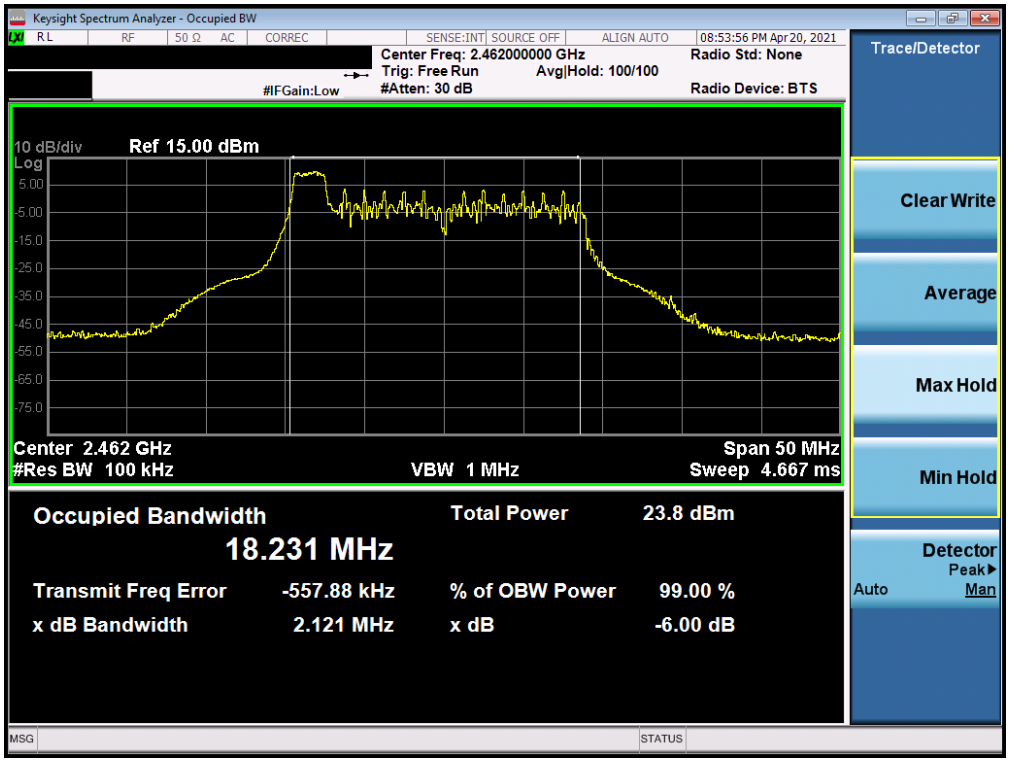
Table 7-2. Conducted Bandwidth Measurements SISO ANT2



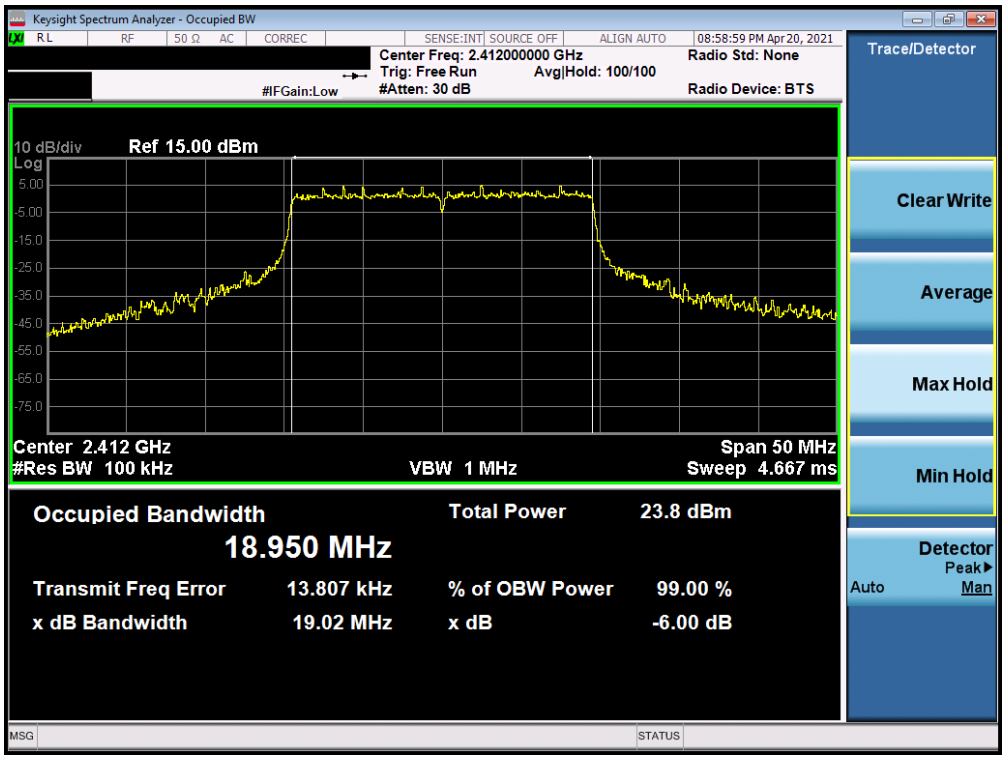
Plot 7-1. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q



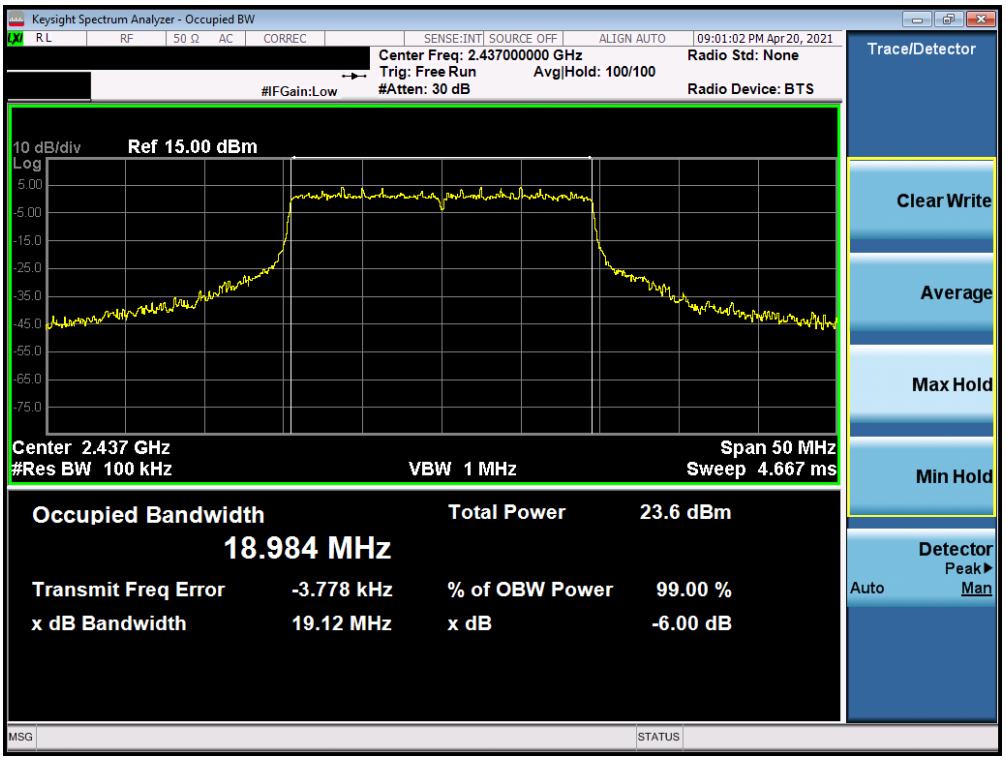
Plot 7-2. 6dB Bandwidth Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q



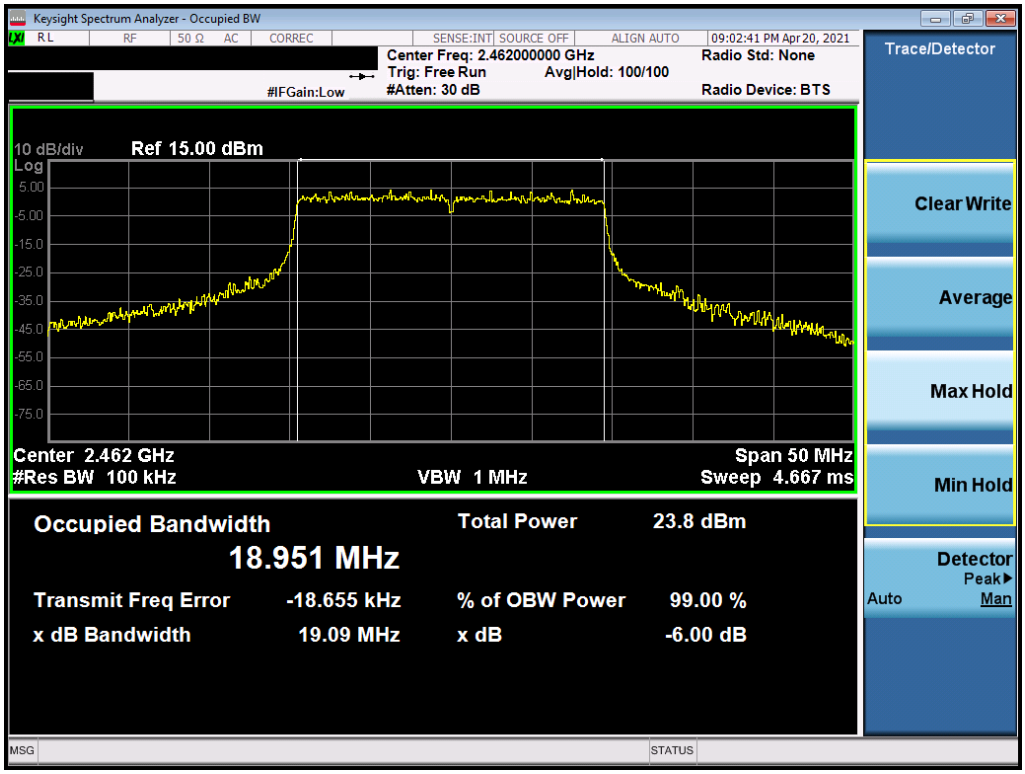
Plot 7-3. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q



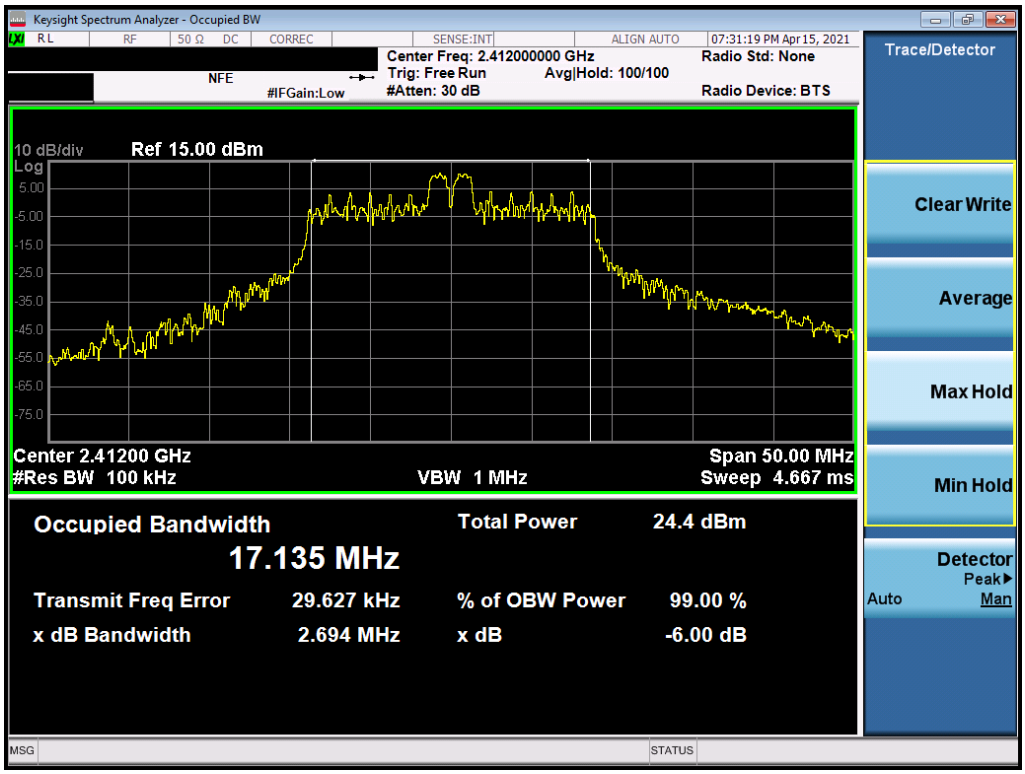
Plot 7-4. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q



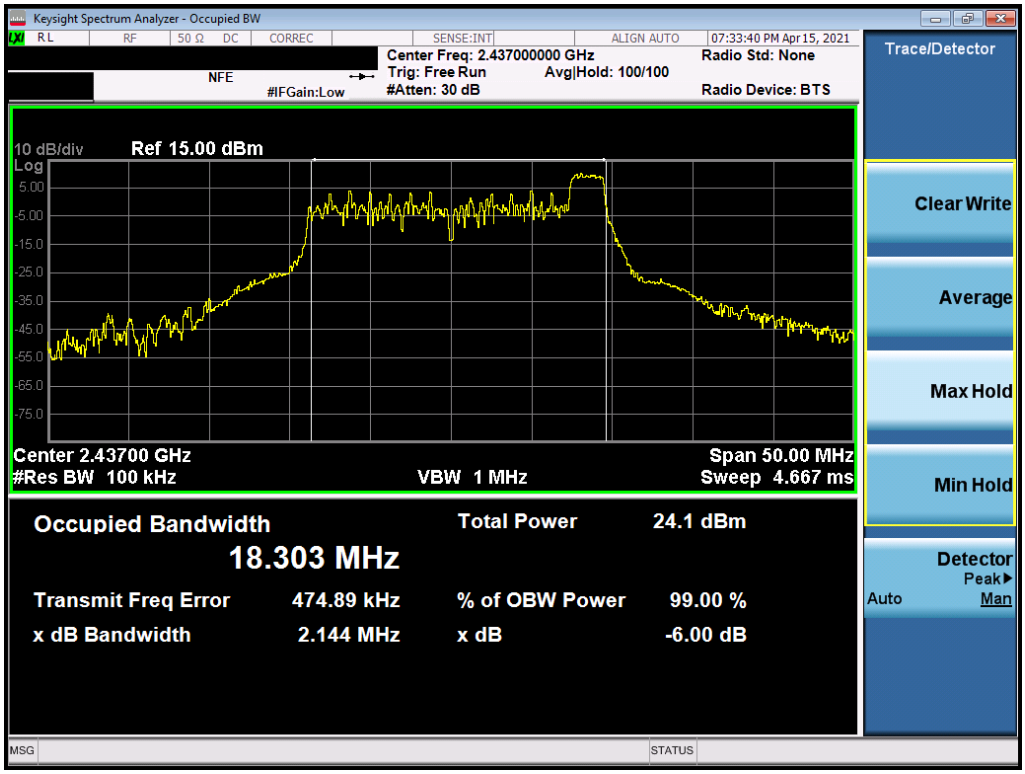
Plot 7-5. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



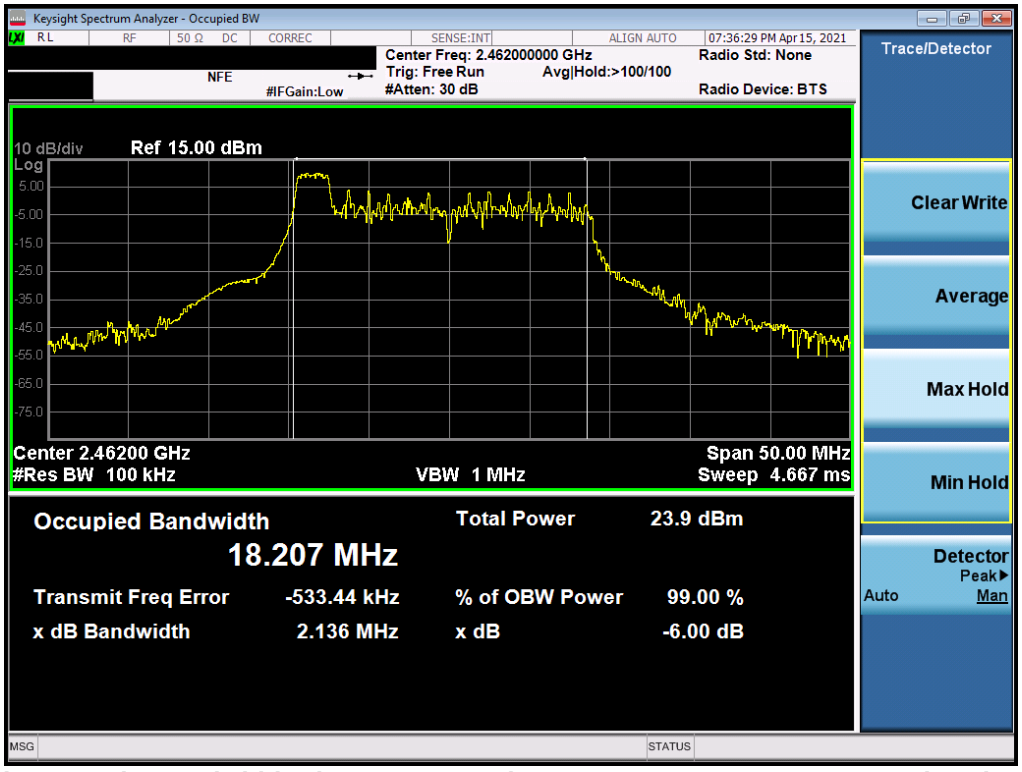
Plot 7-6. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11) - Q



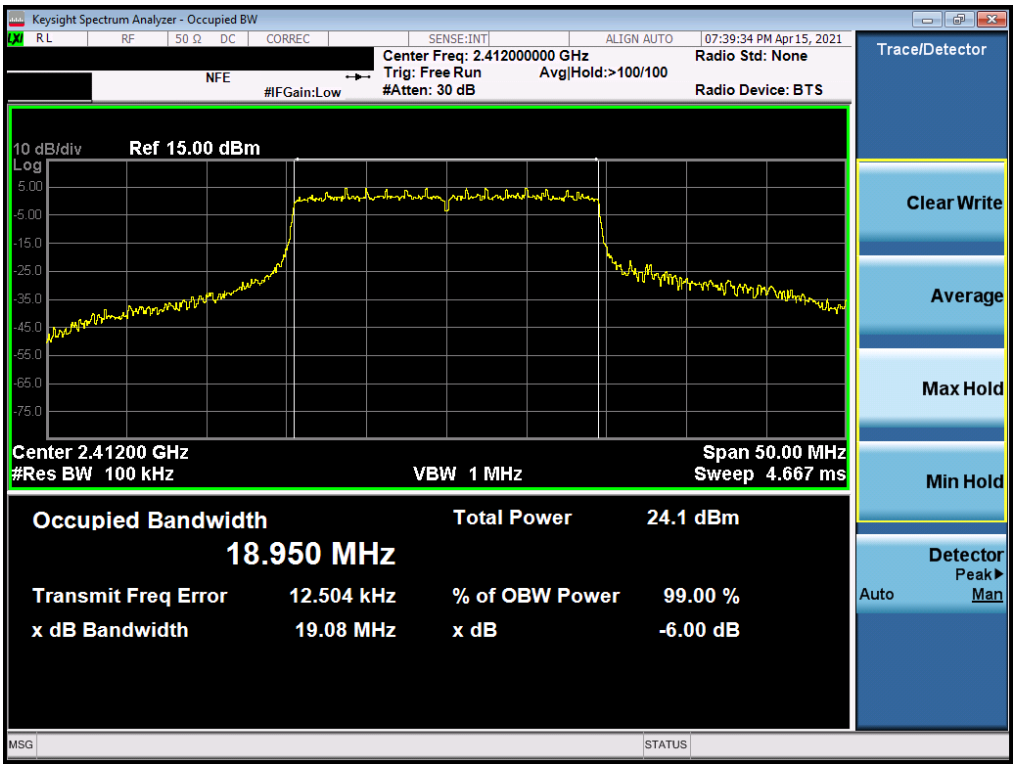
Plot 7-7. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



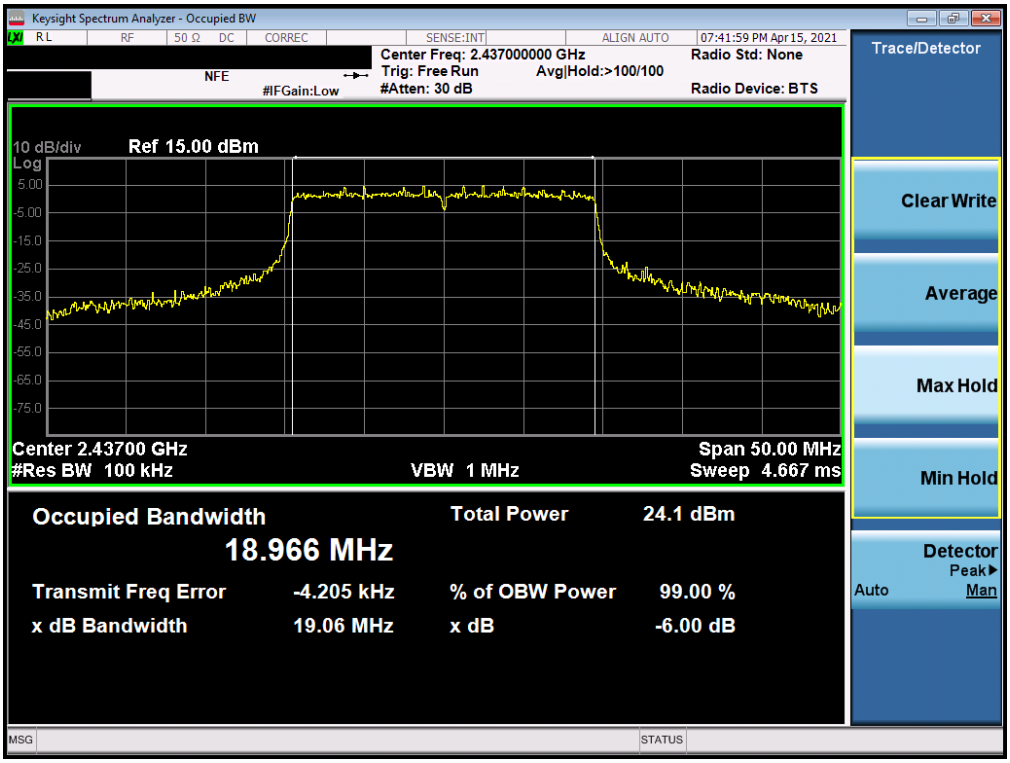
Plot 7-8. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



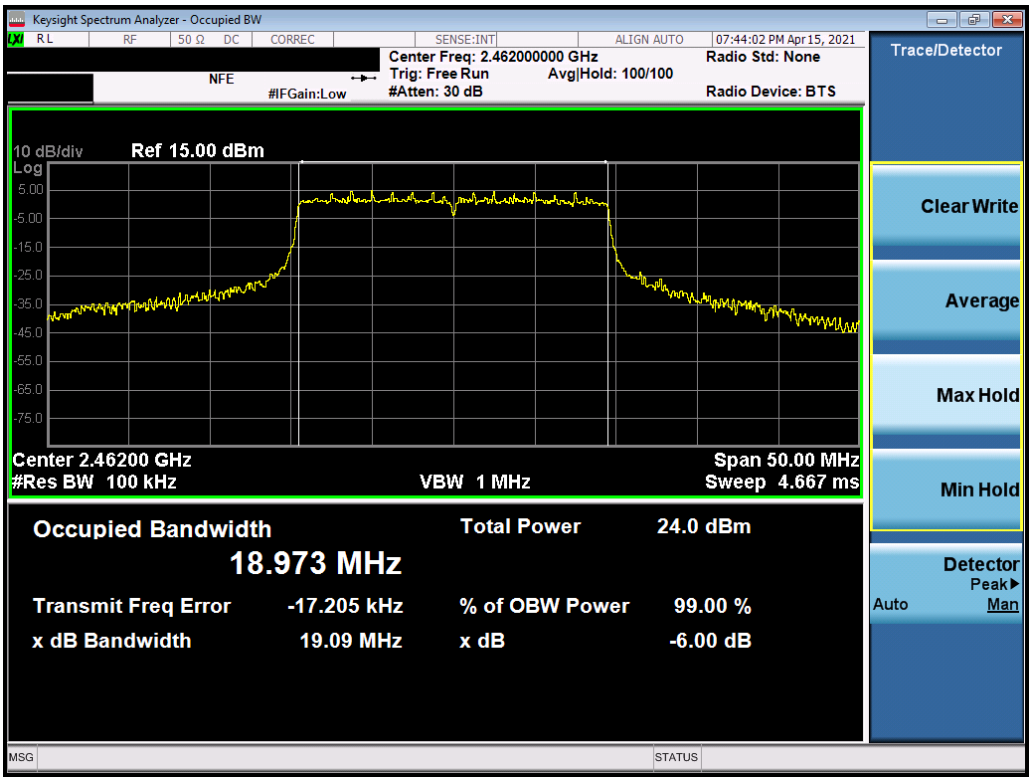
Plot 7-9. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



Plot 7-10. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



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



Plot 7-12. 6dB Bandwidth Plot SISO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11) - N

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 permissible conducted output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 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 – Section 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 – Section 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

This device will be manufactured using two different WIFI chipsets (N and Q). Both two chipsets are tested, and the worst case conducted emissions data is shown in this report.

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
2.4GHz	2412	1	26T	0	AVG	14.76	30.00	-15.24
					PEAK	24.34	30.00	-5.66
				4	AVG	14.98	30.00	-15.02
					PEAK	24.36	30.00	-5.64
				8	AVG	14.85	30.00	-15.15
					PEAK	24.37	30.00	-5.63
	2437	6	26T	0	AVG	14.83	30.00	-15.17
					PEAK	25.13	30.00	-4.87
				4	AVG	14.89	30.00	-15.11
					PEAK	24.48	30.00	-5.52
				8	AVG	14.98	30.00	-15.02
					PEAK	24.71	30.00	-5.29
	2462	11	26T	0	AVG	14.92	30.00	-15.08
					PEAK	24.94	30.00	-5.06
				4	AVG	14.88	30.00	-15.12
					PEAK	24.89	30.00	-5.11
				8	AVG	14.75	30.00	-15.25
					PEAK	24.97	30.00	-5.03
	2467	12	26T	0	AVG	5.30	30.00	-24.70
					PEAK	12.53	30.00	-17.47
				4	AVG	5.31	30.00	-24.69
					PEAK	12.50	30.00	-17.50
				8	AVG	5.62	30.00	-24.38
					PEAK	12.95	30.00	-17.05
	2472	13	26T	0	AVG	-0.14	30.00	-30.14
					PEAK	7.42	30.00	-22.58
				4	AVG	-0.32	30.00	-30.32
					PEAK	7.21	30.00	-22.79
				8	AVG	-0.49	30.00	-30.49
					PEAK	7.00	30.00	-23.00

Table 7-3. Conducted Output Power Measurements SISO ANT2 (26 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
2.4GHz	2412	1	52T	37	AVG	14.89	30.00	-15.11
					PEAK	24.41	30.00	-5.59
				38	AVG	14.79	30.00	-15.21
					PEAK	24.15	30.00	-5.85
				40	AVG	14.87	30.00	-15.13
					PEAK	24.18	30.00	-5.82
	2437	6	52T	37	AVG	14.88	30.00	-15.12
					PEAK	24.83	30.00	-5.17
				38	AVG	14.95	30.00	-15.05
					PEAK	24.52	30.00	-5.48
				40	AVG	14.72	30.00	-15.28
					PEAK	24.55	30.00	-5.45
	2462	11	52T	37	AVG	14.95	30.00	-15.05
					PEAK	24.93	30.00	-5.07
				38	AVG	14.98	30.00	-15.02
					PEAK	24.83	30.00	-5.17
				40	AVG	14.85	30.00	-15.15
					PEAK	24.94	30.00	-5.06
	2467	12	52T	37	AVG	5.32	30.00	-24.68
					PEAK	12.79	30.00	-17.21
				38	AVG	5.40	30.00	-24.60
					PEAK	12.57	30.00	-17.43
				40	AVG	5.25	30.00	-24.75
					PEAK	12.35	30.00	-17.65
	2472	13	52T	37	AVG	-0.50	30.00	-30.50
					PEAK	6.88	30.00	-23.12
				38	AVG	-0.47	30.00	-30.47
					PEAK	6.78	30.00	-23.22
				40	AVG	-0.60	30.00	-30.60
					PEAK	6.80	30.00	-23.20

Table 7-4. Conducted Output Power Measurements SISO ANT2 (52 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
2.4GHz	2412	1	106T	53	AVG	15.97	30.00	-14.03
					PEAK	24.38	30.00	-5.62
				54	AVG	15.78	30.00	-14.22
					PEAK	24.34	30.00	-5.66
	2437	6	106T	53	AVG	15.98	30.00	-14.02
					PEAK	25.05	30.00	-4.95
				54	AVG	15.82	30.00	-14.18
					PEAK	24.61	30.00	-5.39
	2462	11	106T	53	AVG	15.99	30.00	-14.01
					PEAK	24.89	30.00	-5.11
				54	AVG	15.67	30.00	-14.33
					PEAK	24.86	30.00	-5.14
	2467	12	106T	53	AVG	5.50	30.00	-24.50
					PEAK	12.76	30.00	-17.24
				54	AVG	5.52	30.00	-24.48
					PEAK	12.75	30.00	-17.25
	2472	13	106T	53	AVG	-0.42	30.00	-30.42
					PEAK	6.53	30.00	-23.47
				54	AVG	-0.32	30.00	-30.32
					PEAK	6.88	30.00	-23.12

Table 7-5. Conducted Output Power Measurements SISO ANT2 (106 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Powers (dBm)	Conducted Power Limit [dBm]	Conducted Power Margin [dB]
2.4GHz	2412	1	242T	61	AVG	16.39	30.00	-13.61
					PEAK	24.56	30.00	-5.44
	2437	6	242T	61	AVG	16.49	30.00	-13.51
					PEAK	25.05	30.00	-4.95
	2462	11	242T	61	AVG	16.47	30.00	-13.53
					PEAK	25.11	30.00	-4.89
	2467	12	242T	61	AVG	5.48	30.00	-24.52
					PEAK	12.23	30.00	-17.77
	2472	13	242T	61	AVG	-0.57	30.00	-30.57
					PEAK	6.24	30.00	-23.76

Table 7-6. Conducted Output Power Measurements SISO ANT2 (242 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
						ANT1	ANT2	MIMO		
2.4GHz	2412	1	26T	0	AVG	14.98	14.96	17.98	30.00	-12.02
					PEAK	24.83	24.63	27.74	30.00	-2.26
				4	AVG	14.72	14.95	17.85	30.00	-12.15
					PEAK	24.35	24.65	27.51	30.00	-2.49
				8	AVG	14.48	14.99	17.75	30.00	-12.25
					PEAK	24.05	24.75	27.42	30.00	-2.58
	2437	6	26T	0	AVG	14.98	14.62	17.81	30.00	-12.19
					PEAK	24.37	24.43	27.41	30.00	-2.59
				4	AVG	14.65	14.98	17.83	30.00	-12.17
					PEAK	24.18	24.77	27.50	30.00	-2.50
				8	AVG	14.69	14.77	17.74	30.00	-12.26
					PEAK	24.21	24.35	27.29	30.00	-2.71
	2462	11	26T	0	AVG	14.32	14.98	17.67	30.00	-12.33
					PEAK	24.01	24.82	27.44	30.00	-2.56
				4	AVG	14.39	14.97	17.70	30.00	-12.30
					PEAK	23.95	24.65	27.32	30.00	-2.68
				8	AVG	14.43	14.99	17.73	30.00	-12.27
					PEAK	24.05	24.85	27.48	30.00	-2.52
	2467	12	26T	0	AVG	5.76	5.29	8.54	30.00	-21.46
					PEAK	13.21	12.73	15.99	30.00	-14.01
				4	AVG	5.83	5.25	8.56	30.00	-21.44
					PEAK	13.36	12.65	16.03	30.00	-13.97
				8	AVG	5.87	5.44	8.67	30.00	-21.33
					PEAK	13.41	12.86	16.15	30.00	-13.85
	2472	13	26T	0	AVG	-0.15	-0.28	2.80	30.00	-27.20
					PEAK	7.25	6.79	10.04	30.00	-19.96
				4	AVG	-0.37	-0.46	2.60	30.00	-27.40
					PEAK	6.84	6.68	9.77	30.00	-20.23
				8	AVG	-0.46	-0.67	2.45	30.00	-27.55
					PEAK	6.78	6.44	9.62	30.00	-20.38

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

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
						ANT1	ANT2	MIMO		
2.4GHz	2412	1	52T	37	AVG	14.54	14.87	17.72	30.00	-12.28
					PEAK	24.05	24.56	27.32	30.00	-2.68
				38	AVG	14.89	14.98	17.95	30.00	-12.05
					PEAK	24.06	24.31	27.20	30.00	-2.80
				40	AVG	14.13	14.78	17.48	30.00	-12.52
					PEAK	23.11	24.15	26.67	30.00	-3.33
	2437	6	52T	37	AVG	14.73	14.98	17.87	30.00	-12.13
					PEAK	24.28	24.61	27.46	30.00	-2.54
				38	AVG	14.27	14.82	17.56	30.00	-12.44
					PEAK	23.29	23.96	26.65	30.00	-3.35
				40	AVG	14.79	14.86	17.84	30.00	-12.16
					PEAK	24.16	24.31	27.25	30.00	-2.75
	2462	11	52T	37	AVG	14.03	14.91	17.50	30.00	-12.50
					PEAK	23.19	24.35	26.82	30.00	-3.18
				38	AVG	14.06	14.98	17.55	30.00	-12.45
					PEAK	23.45	24.27	26.89	30.00	-3.11
				40	AVG	14.04	14.85	17.47	30.00	-12.53
					PEAK	23.36	24.18	26.80	30.00	-3.20
	2467	12	52T	37	AVG	5.86	5.45	8.67	30.00	-21.33
					PEAK	13.48	12.74	16.14	30.00	-13.86
				38	AVG	5.96	5.49	8.74	30.00	-21.26
					PEAK	13.27	12.68	16.00	30.00	-14.00
				40	AVG	5.92	5.21	8.59	30.00	-21.41
					PEAK	13.45	12.56	16.04	30.00	-13.96
	2472	13	52T	37	AVG	-0.15	-0.22	2.83	30.00	-27.17
					PEAK	7.27	6.90	10.10	30.00	-19.90
				38	AVG	-0.20	-0.21	2.81	30.00	-27.19
					PEAK	7.12	6.82	9.98	30.00	-20.02
				40	AVG	-0.24	-0.32	2.73	30.00	-27.27
					PEAK	7.21	6.95	10.09	30.00	-19.91

Table 7-8. Conducted Output Power Measurements MIMO (52 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
						ANT1	ANT2	MIMO		
2.4GHz	2412	1	106T	53	AVG	15.85	15.98	18.93	30.00	-11.07
					PEAK	24.85	25.05	27.96	30.00	-2.04
				54	AVG	15.45	15.94	18.71	30.00	-11.29
					PEAK	24.08	24.35	27.23	30.00	-2.77
	2437	6	106T	53	AVG	15.98	15.97	18.99	30.00	-11.01
					PEAK	24.77	24.91	27.85	30.00	-2.15
				54	AVG	15.42	15.85	18.65	30.00	-11.35
					PEAK	24.27	24.83	27.57	30.00	-2.43
	2462	11	106T	53	AVG	15.11	15.98	18.58	30.00	-11.42
					PEAK	23.79	24.88	27.38	30.00	-2.62
				54	AVG	15.05	15.83	18.47	30.00	-11.53
					PEAK	24.03	24.71	27.39	30.00	-2.61
	2467	12	106T	53	AVG	5.99	5.49	8.76	30.00	-21.24
					PEAK	13.39	12.76	16.10	30.00	-13.90
				54	AVG	6.18	5.46	8.85	30.00	-21.15
					PEAK	13.42	12.65	16.06	30.00	-13.94
	2472	13	106T	53	AVG	-0.06	-0.20	2.88	30.00	-27.12
					PEAK	6.87	6.80	9.85	30.00	-20.15
				54	AVG	-0.24	-0.40	2.69	30.00	-27.31
					PEAK	6.92	6.69	9.82	30.00	-20.18

Table 7-9. Conducted Output Power Measurements MIMO (106 Tones)

	Freq [MHz]	Channel	Tones	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]
						ANT1	ANT2	MIMO		
2.4GHz	2412	1	242T	61	AVG	16.27	16.03	19.16	30.00	-10.84
					PEAK	24.27	24.42	27.36	30.00	-2.64
	2437	6	242T	61	AVG	16.49	16.45	19.48	30.00	-10.52
					PEAK	24.56	24.98	27.79	30.00	-2.21
	2462	11	242T	61	AVG	15.73	16.48	19.13	30.00	-10.87
					PEAK	24.07	24.87	27.50	30.00	-2.50
	2467	12	242T	61	AVG	5.99	5.50	8.76	30.00	-21.24
					PEAK	12.85	12.29	15.59	30.00	-14.41
	2472	13	242T	61	AVG	-0.22	-0.38	2.71	30.00	-27.29
					PEAK	6.52	6.38	9.46	30.00	-20.54

Table 7-10. Conducted Output Power Measurements MIMO (242 Tones)

Note:

Per ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)1), the conducted powers at Antenna 1 and Antenna 2 were first measured separately during MIMO transmission as shown in the section above. The measured values were then summed in linear power units then converted back to dBm.

Sample MIMO Calculation:

At 2412MHz the average conducted output power was measured to be 17.68 dBm for Antenna-1 and 17.53 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(17.68 dBm + 17.53 dBm) = (58.61 mW + 56.62 mW) = 115.24 mW = 20.62 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, tones 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 – Section 11.10.2 Method PKPSD
KDB 558074 D01 v05r02 – Section 8.4 DTS Maximum Power Spectral Density level in the fundamental emission
ANSI C63.10-2013 – Section 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 = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

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

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

1. Based on preliminary measurements, it was determined that, of all of the tone configurations, the 26T configuration produced the worst case power spectral density measurement for partial loaded case. Therefore, only the 26 Tone configuration and 242 Tone data is included in this section.

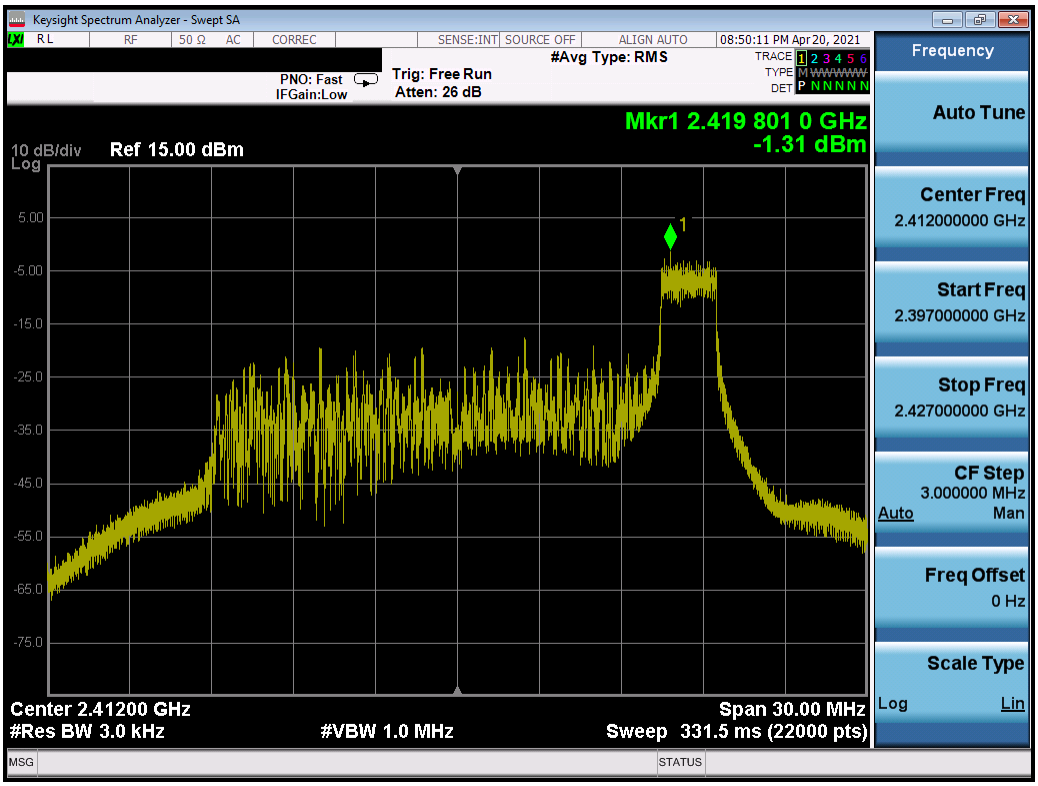
2. The power spectral density for each channel was measured with the RU index showing the highest conducted power.

3. This device will be manufactured using two different WIFI chipsets (N and Q). Both two chipsets are tested, and both conducted emissions data is shown in this report.

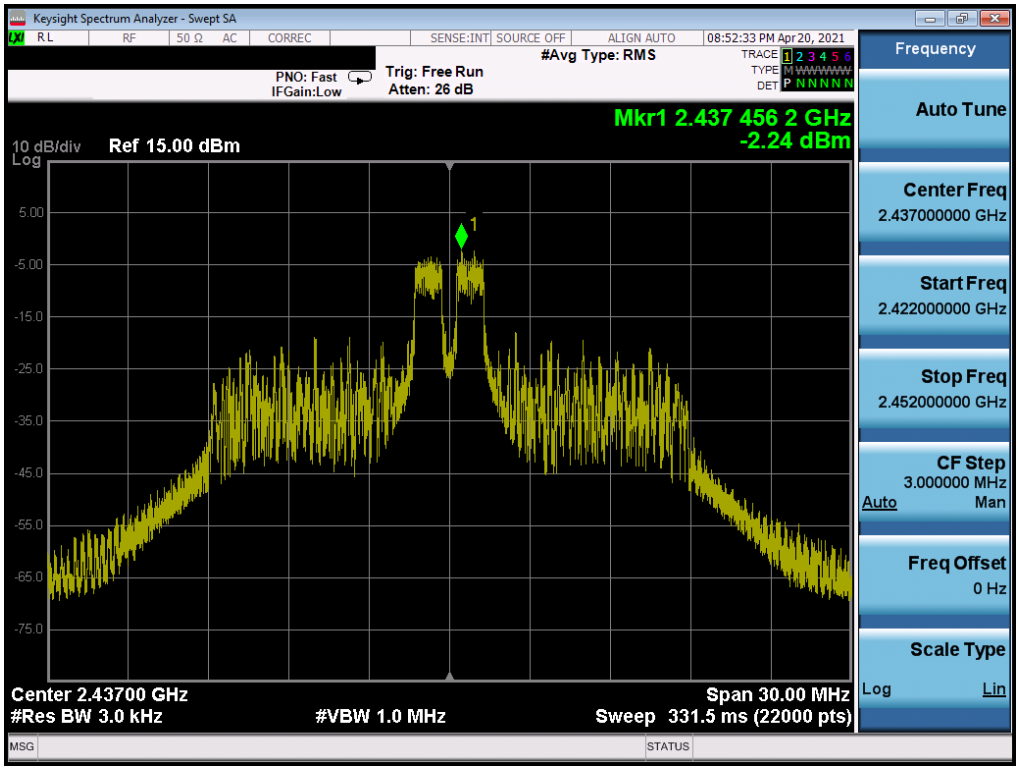
SISO Antenna-2 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-1.31	8.00	-9.31	Pass
2437	6	ax	26T	MCS0	-2.24	8.00	-10.24	Pass
2462	11	ax	26T	MCS0	-2.14	8.00	-10.14	Pass
2412	1	ax	242T	MCS0	-8.83	8.00	-16.83	Pass
2437	6	ax	242T	MCS0	-9.50	8.00	-17.50	Pass
2462	11	ax	242T	MCS0	-9.46	8.00	-17.46	Pass

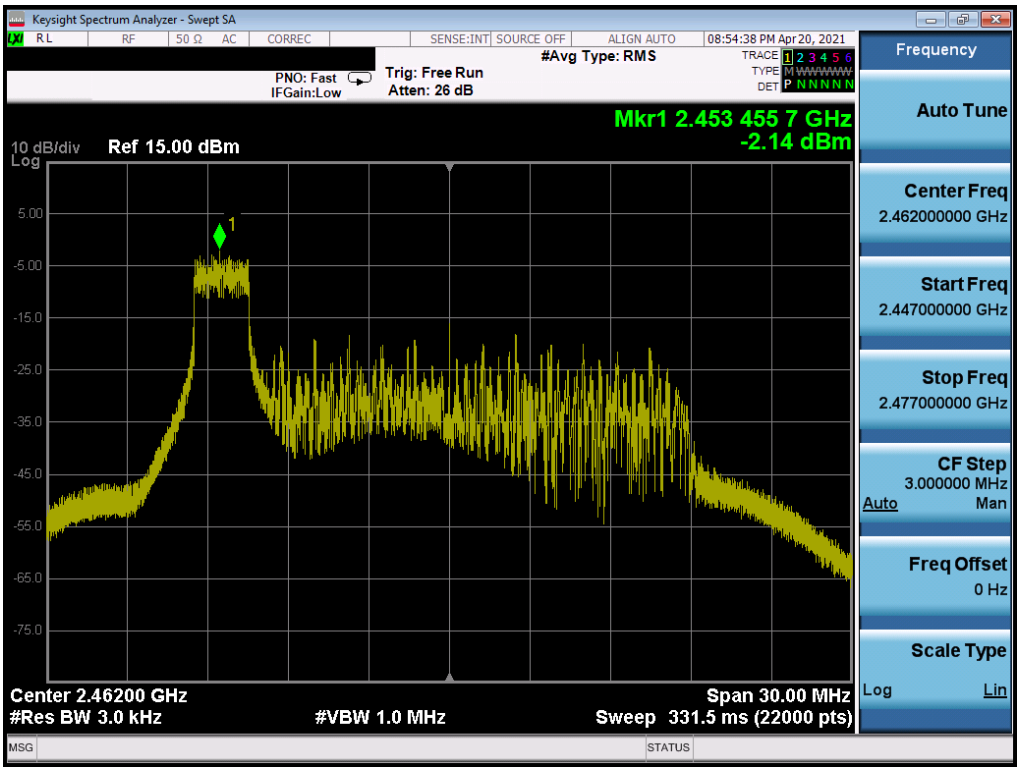
Table 7-11. Conducted Power Density Measurements SISO ANT2 - Q



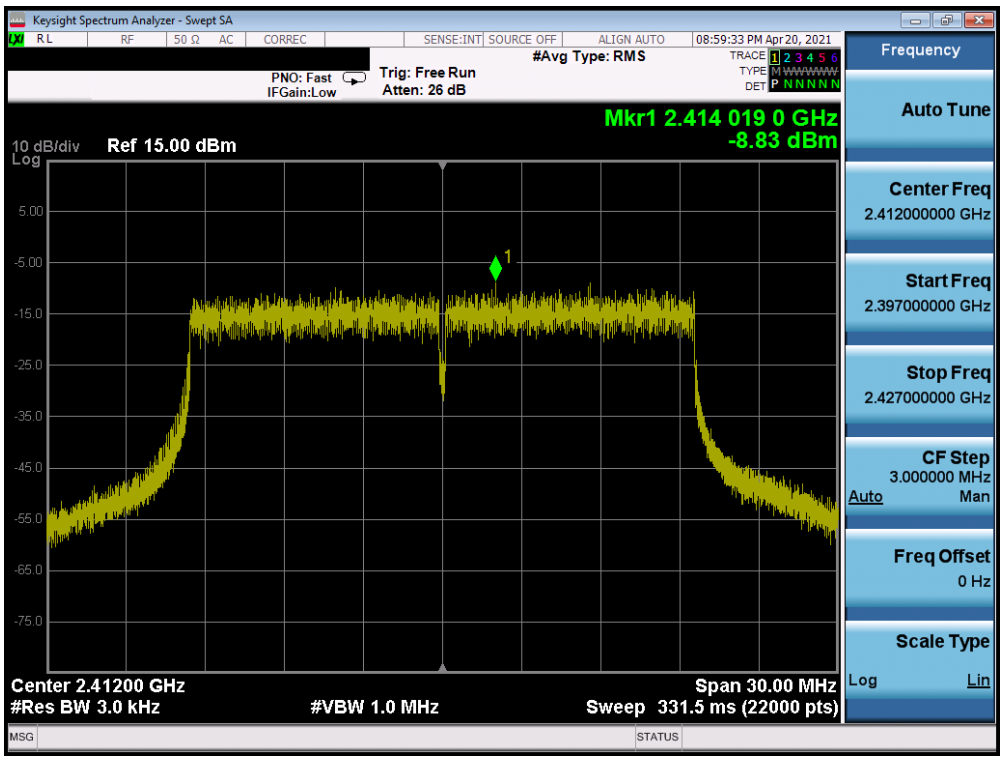
Plot 7-13. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q



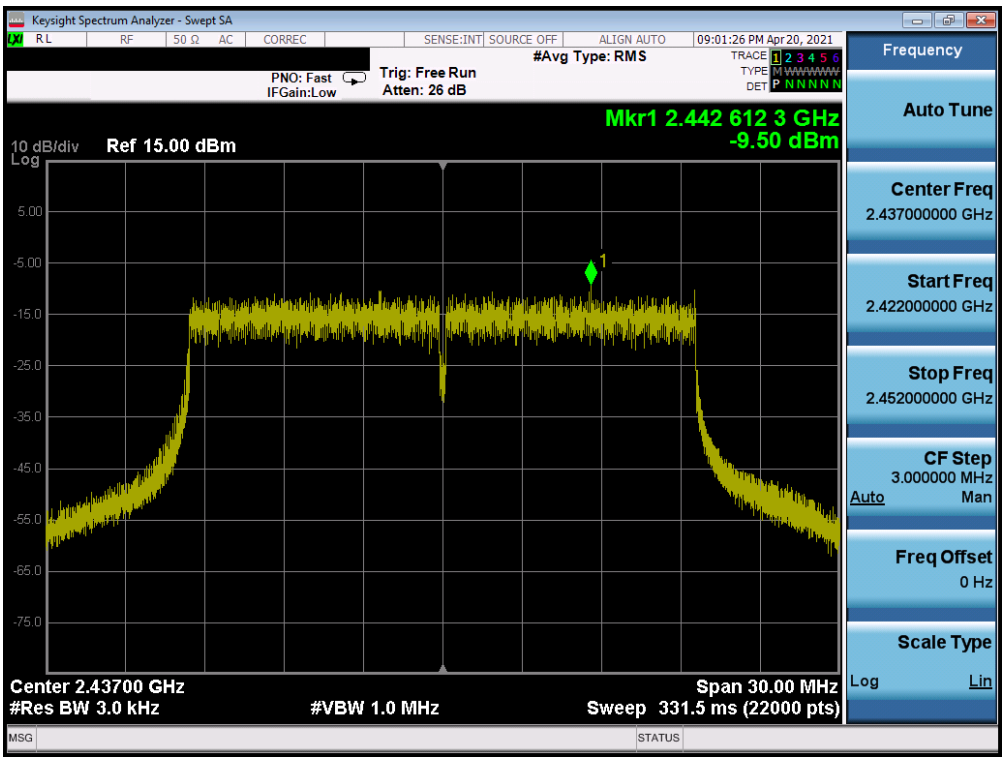
Plot 7-14. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q



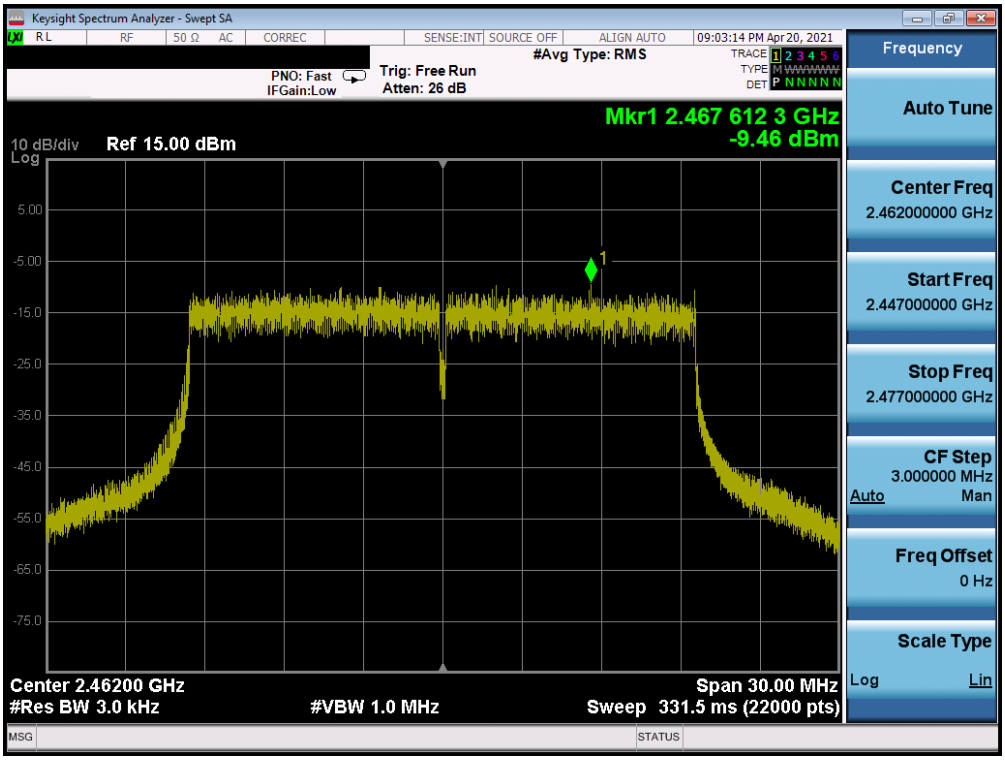
Plot 7-15. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q



Plot 7-16. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q



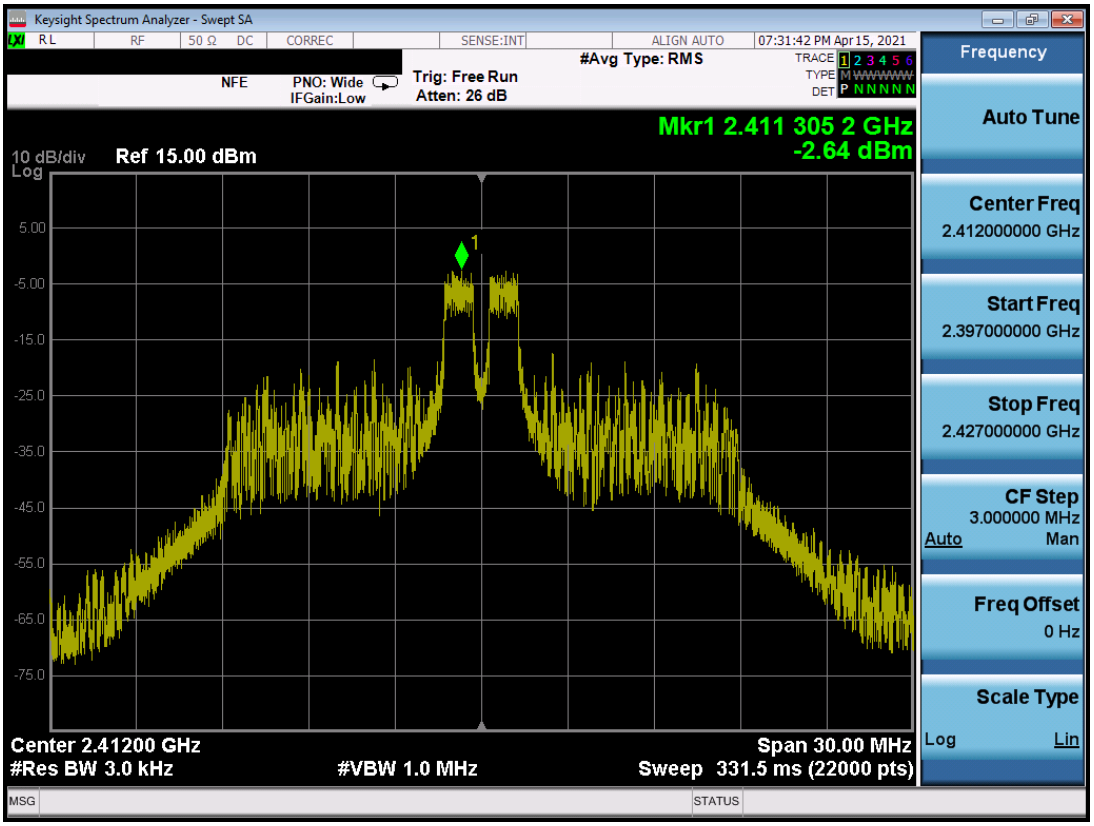
Plot 7-17. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



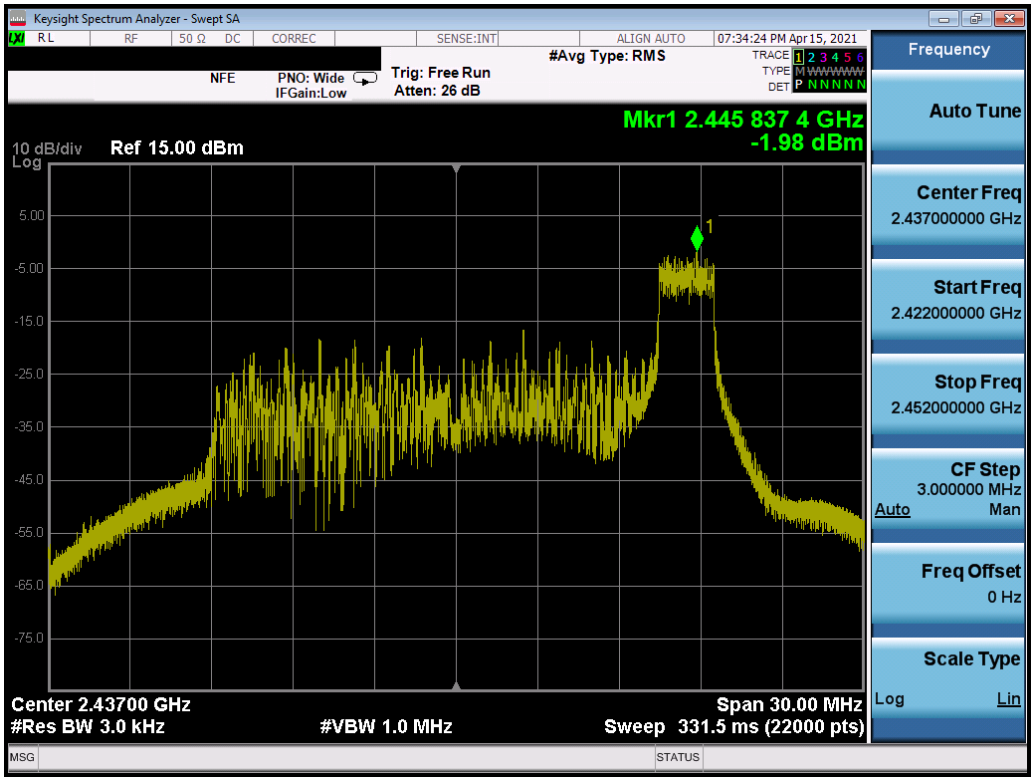
Plot 7-18. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - Q

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-2.64	8.00	-10.64	Pass
2437	6	ax	26T	MCS0	-1.98	8.00	-9.98	Pass
2462	11	ax	26T	MCS0	-2.55	8.00	-10.55	Pass
2412	1	ax	242T	MCS0	-8.97	8.00	-16.97	Pass
2437	6	ax	242T	MCS0	-9.77	8.00	-17.77	Pass
2462	11	ax	242T	MCS0	-9.34	8.00	-17.34	Pass

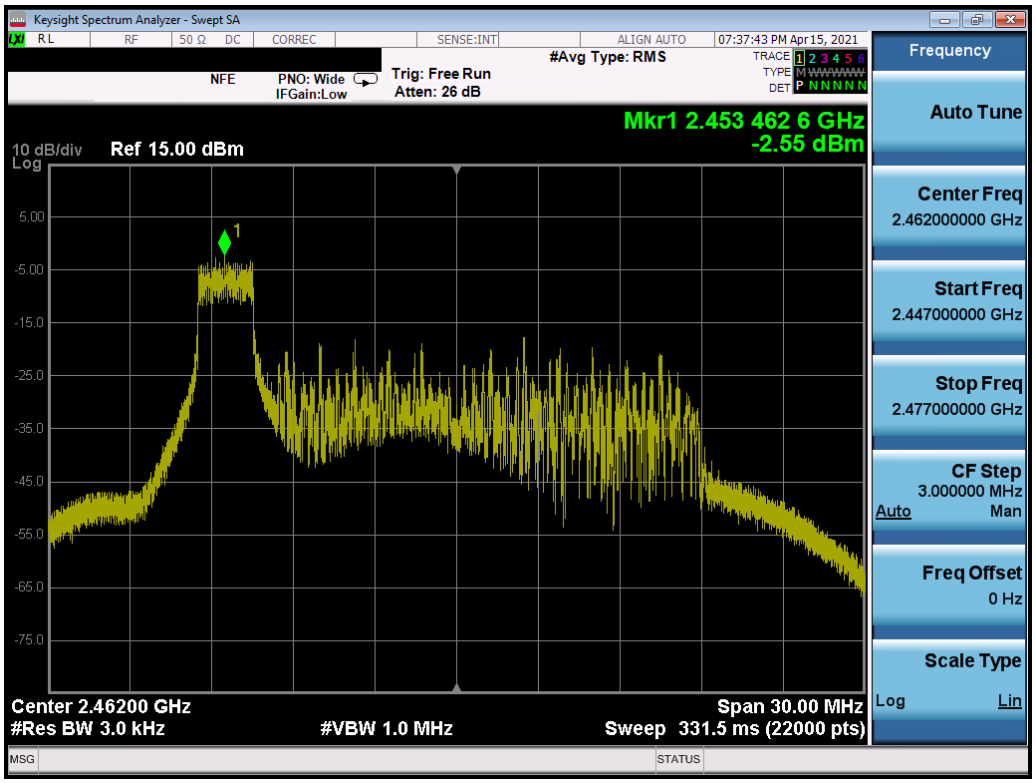
Table 7-12. Conducted Power Density Measurements SISO ANT2 - N



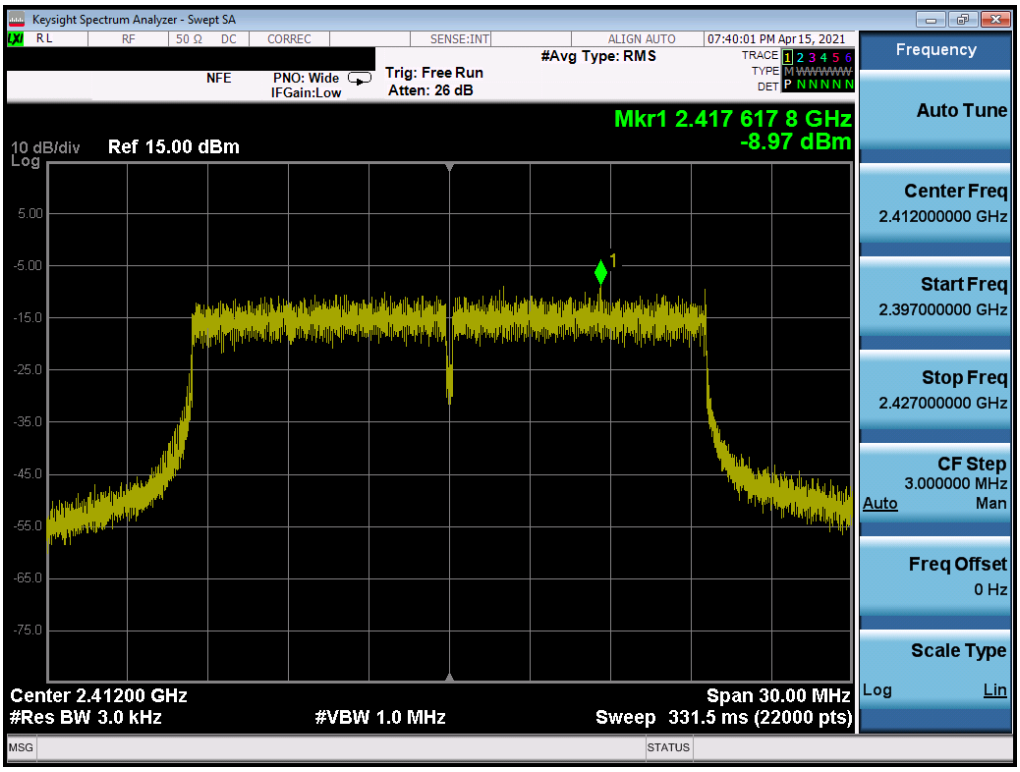
Plot 7-19. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



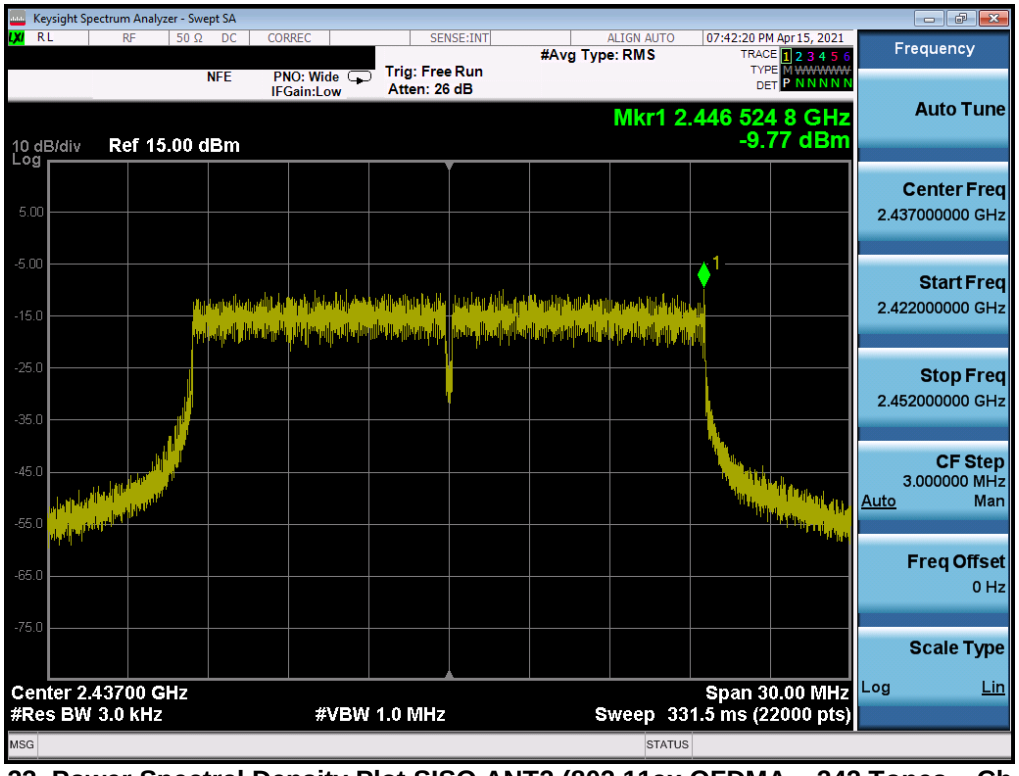
Plot 7-20. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



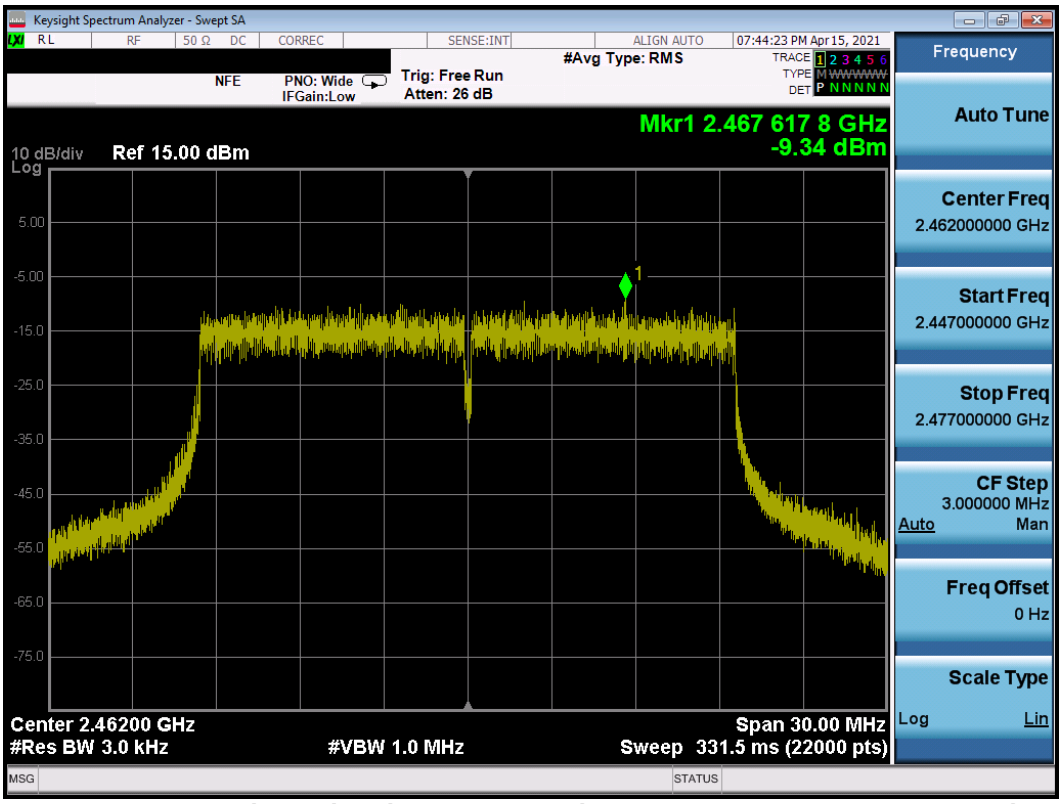
Plot 7-21. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



Plot 7-22. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



Plot 7-23. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - N

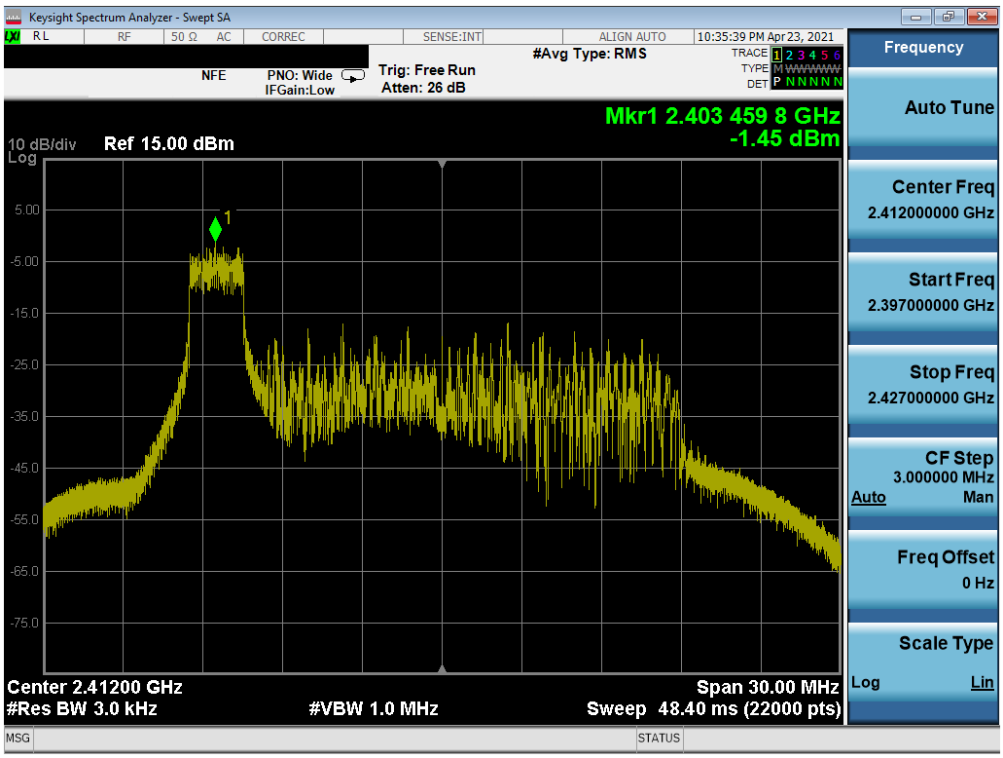


Plot 7-24. Power Spectral Density Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - N

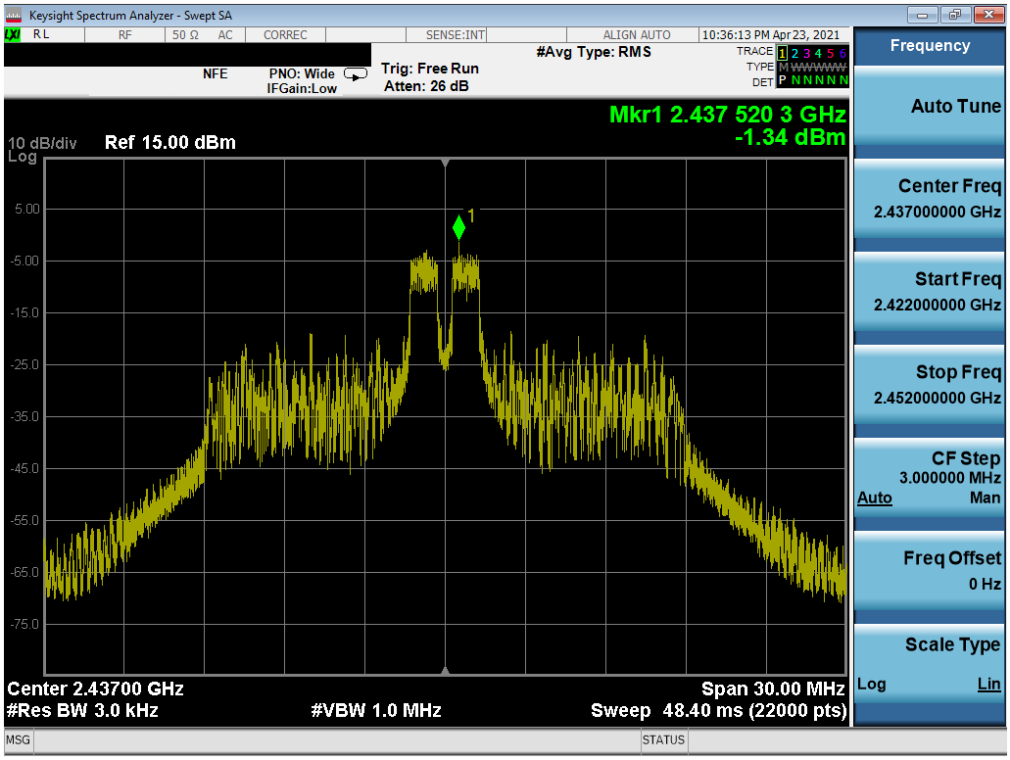
MIMO Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-1.45	-1.89	1.35	8.00	-6.65	Pass
2437	6	ax	26T	MCS0	-1.34	-1.66	1.51	8.00	-6.49	Pass
2462	11	ax	26T	MCS0	-2.55	-1.90	0.80	8.00	-7.20	Pass
2412	1	ax	242T	MCS0	-8.20	-8.50	-5.34	8.00	-13.34	Pass
2437	6	ax	242T	MCS0	-9.55	-9.29	-6.41	8.00	-14.41	Pass
2462	11	ax	242T	MCS0	-8.63	-9.34	-5.96	8.00	-13.96	Pass

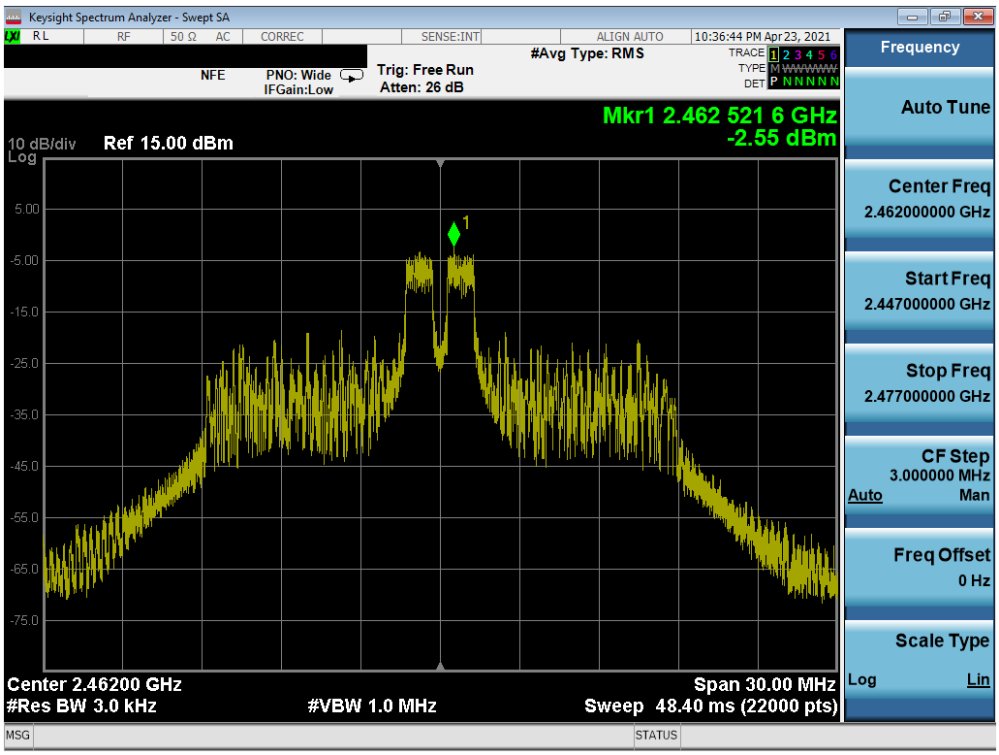
Table 7-13.MIMO Conducted Power Density Measurements - Q



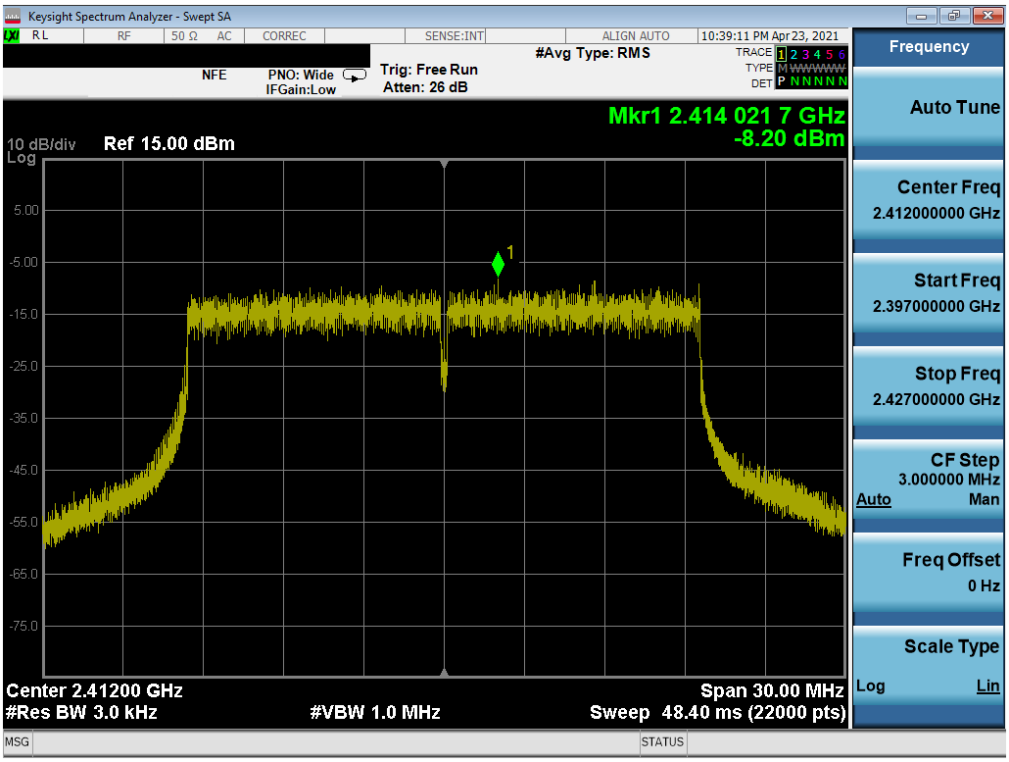
Plot 7-25. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q



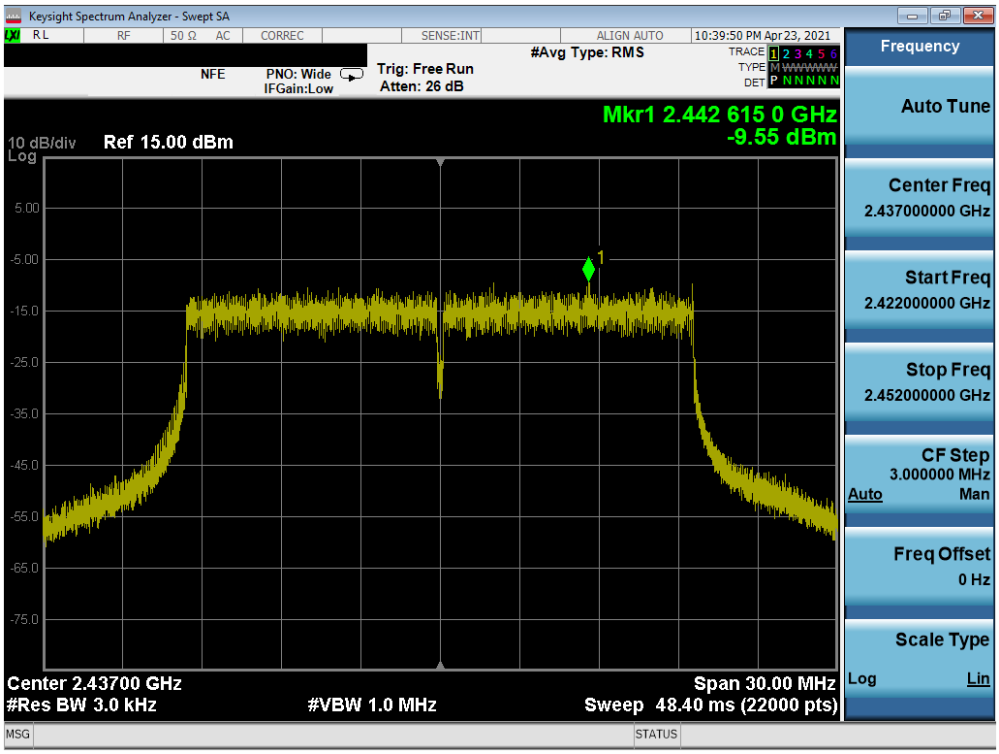
Plot 7-26. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q



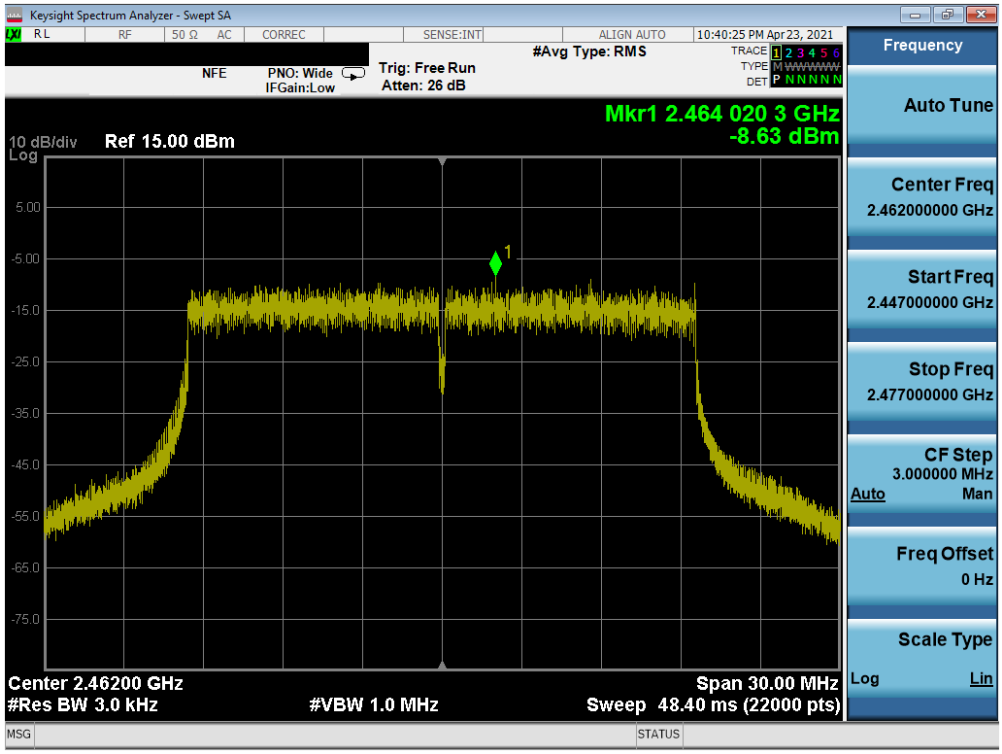
Plot 7-27. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q



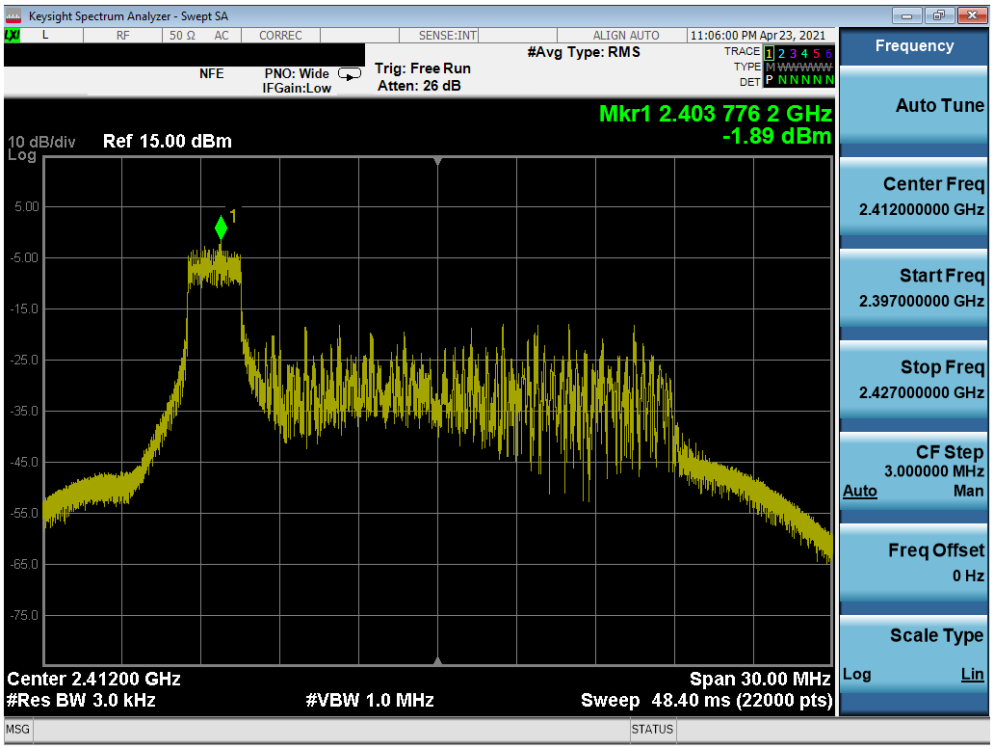
Plot 7-28. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q



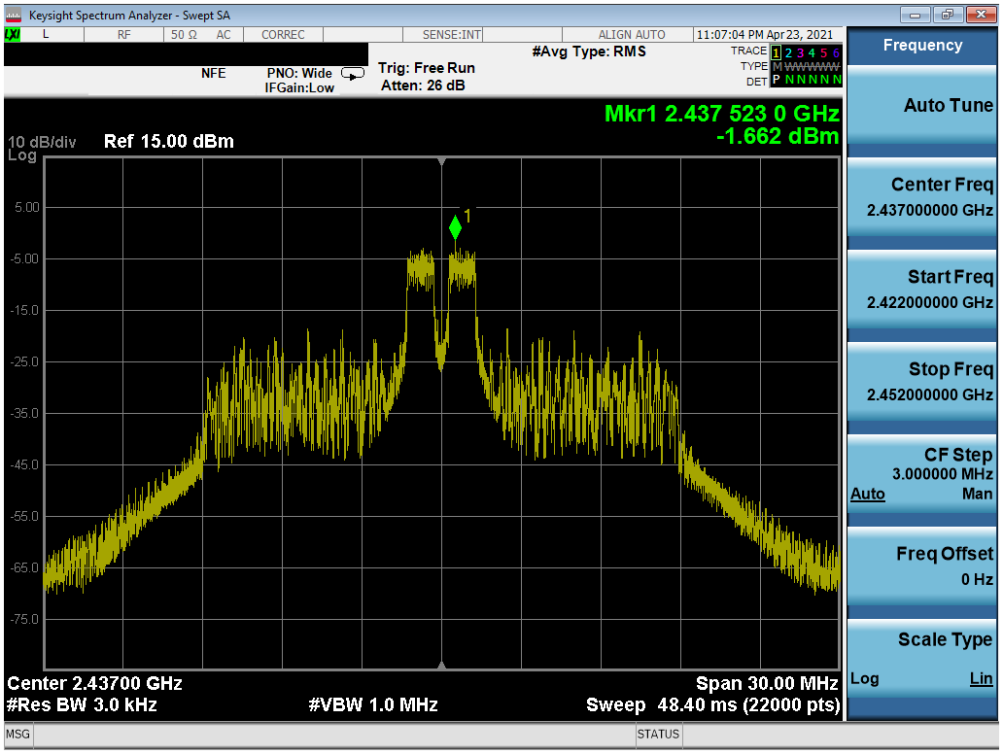
Plot 7-29. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



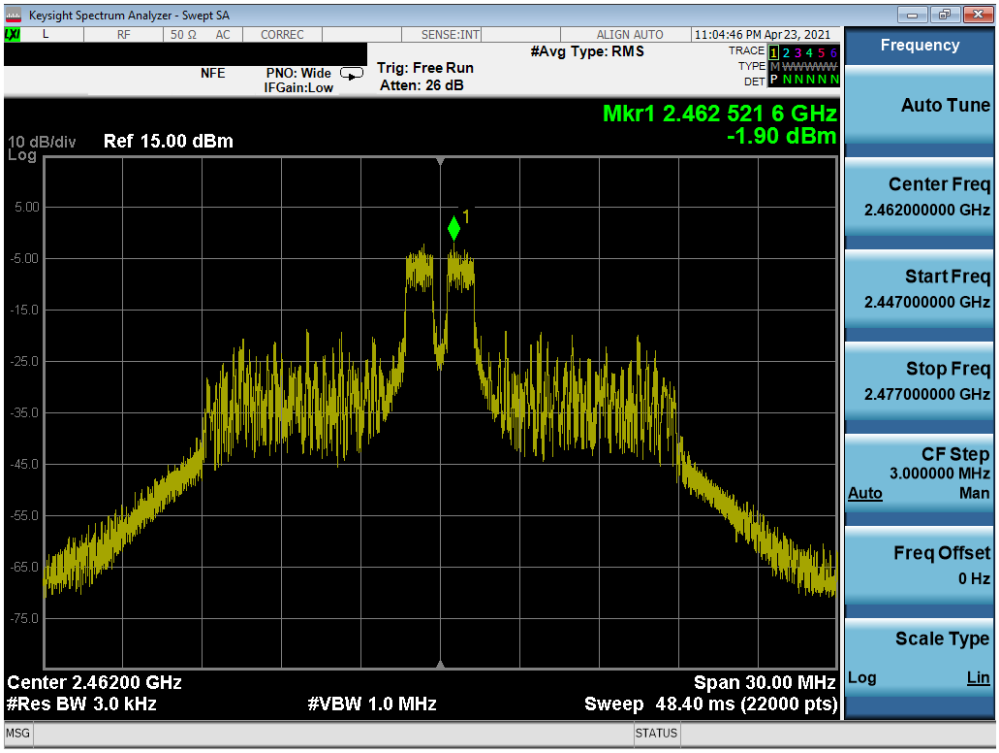
Plot 7-30. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11) - Q



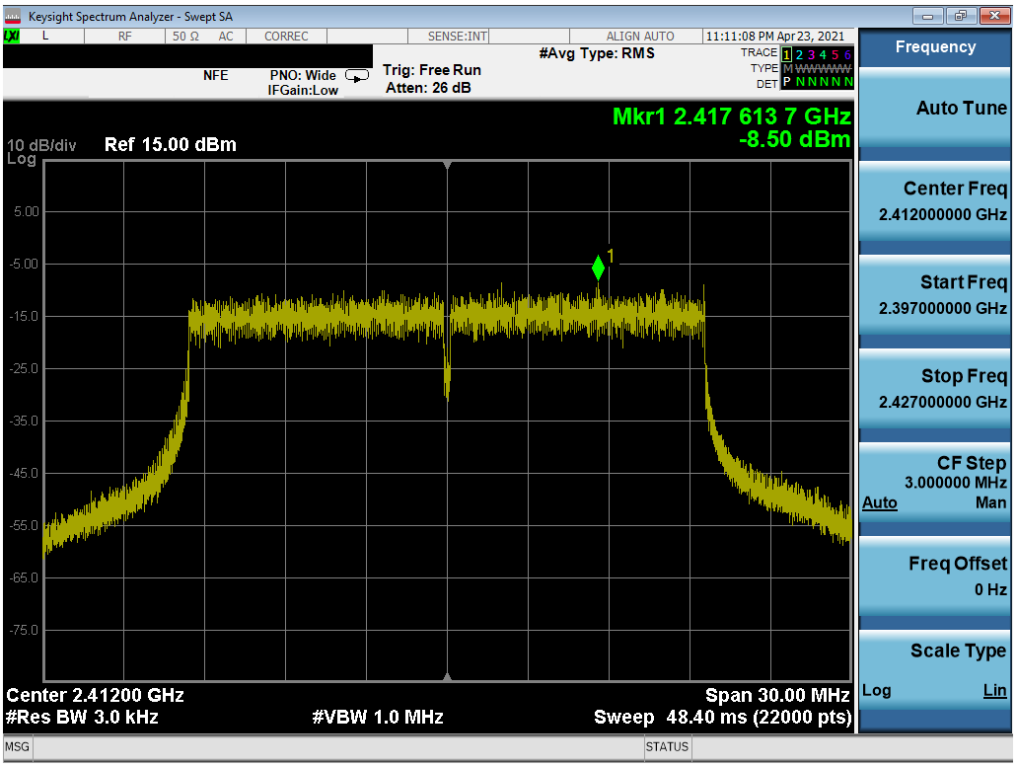
Plot 7-31. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q



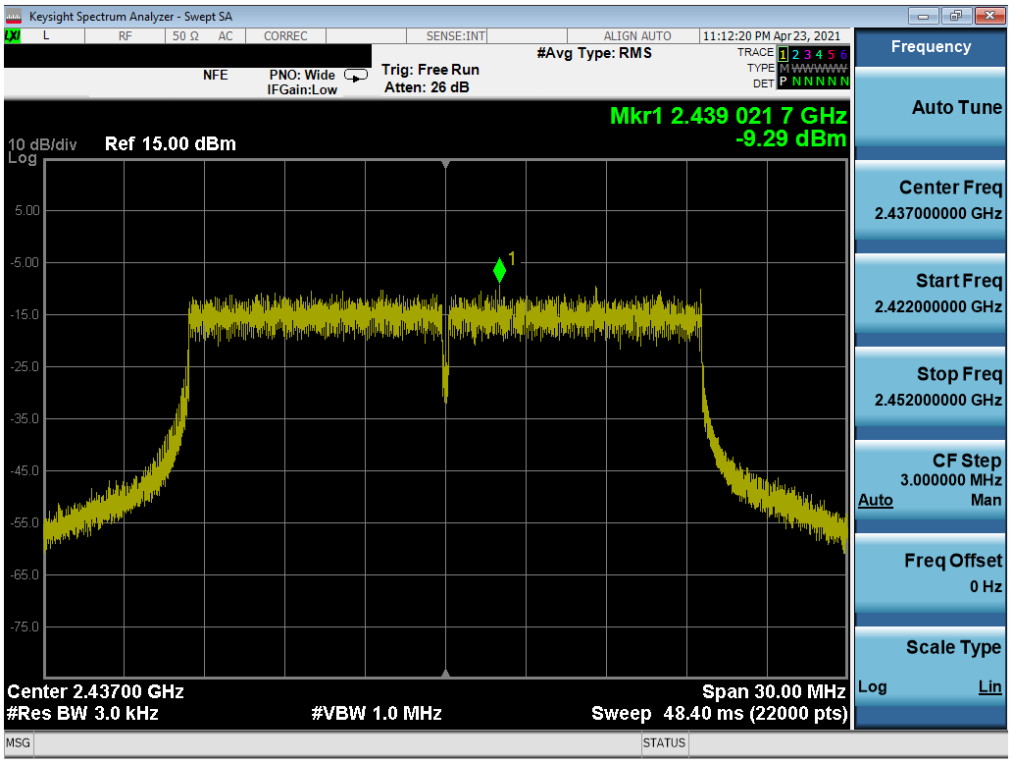
Plot 7-32. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q



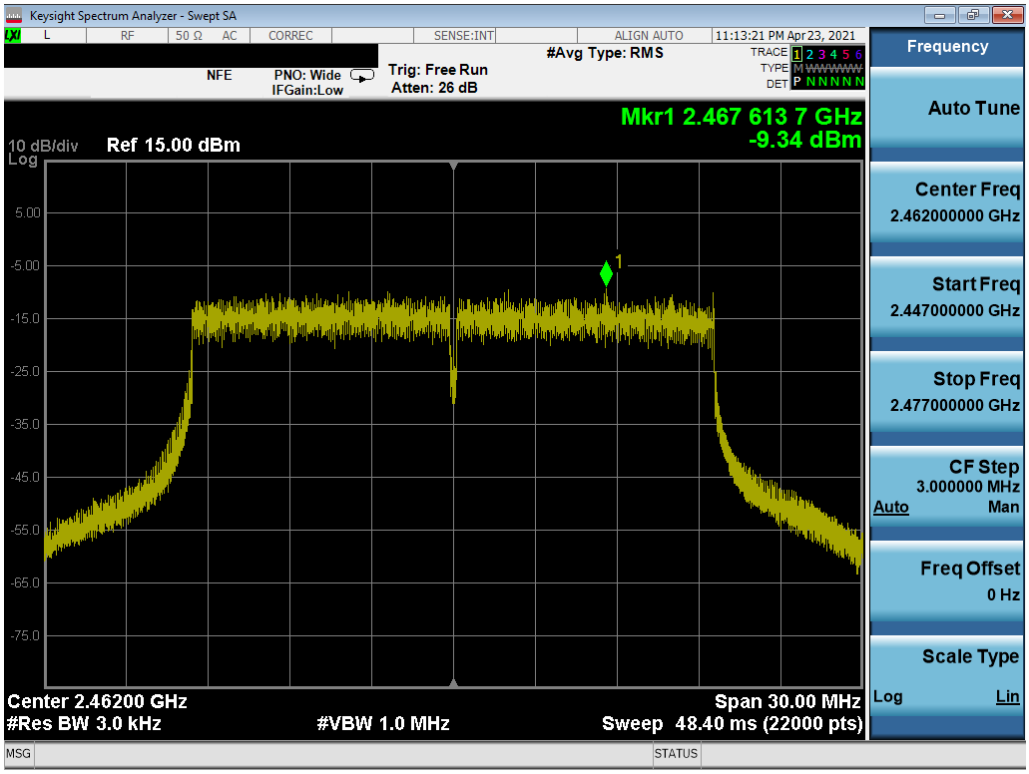
Plot 7-33. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q



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



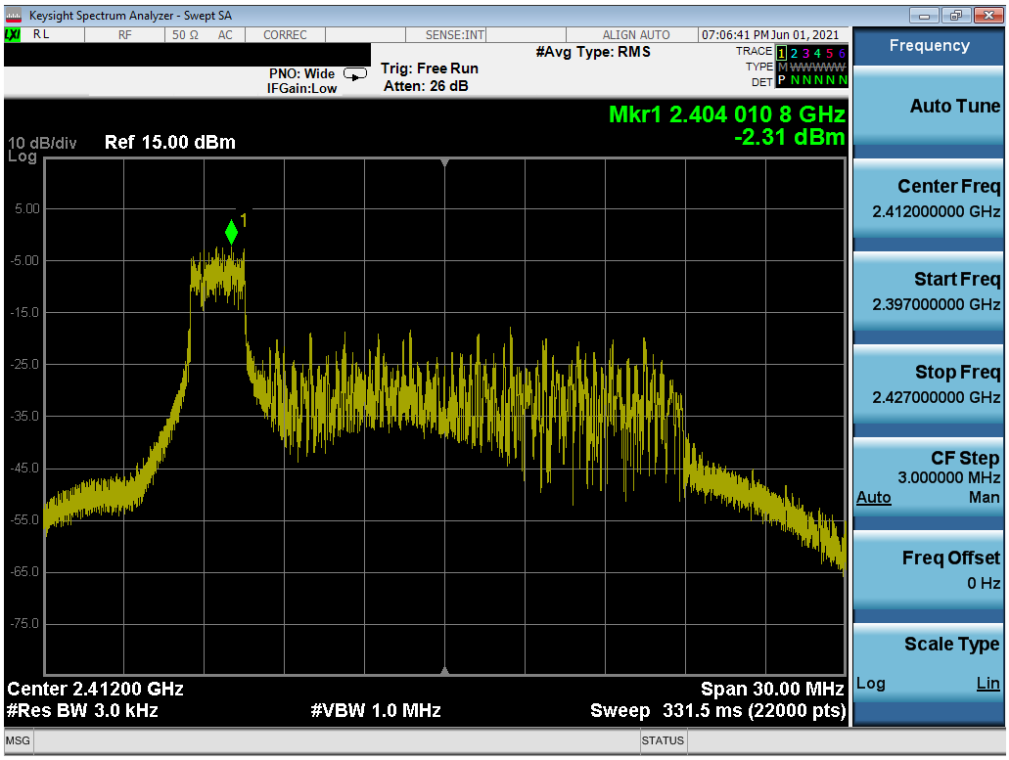
Plot 7-35. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



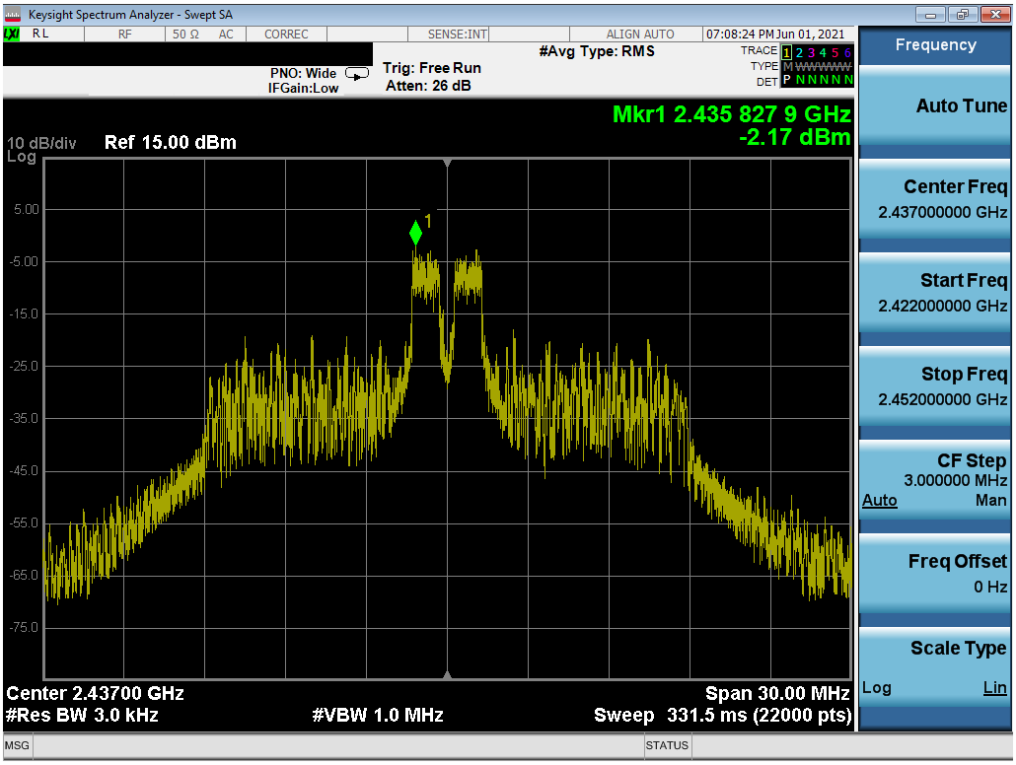
Plot 7-36. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) – Q

Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26T	MCS0	-2.31	-2.32	0.69	8.00	-7.31	Pass
2437	6	ax	26T	MCS0	-2.17	-2.59	0.64	8.00	-7.36	Pass
2462	11	ax	26T	MCS0	-3.39	-2.88	-0.12	8.00	-8.12	Pass
2412	1	ax	242T	MCS0	-8.83	-9.81	-6.28	8.00	-14.28	Pass
2437	6	ax	242T	MCS0	-9.11	-8.06	-5.54	8.00	-13.54	Pass
2462	11	ax	242T	MCS0	-8.81	-9.42	-6.09	8.00	-14.09	Pass

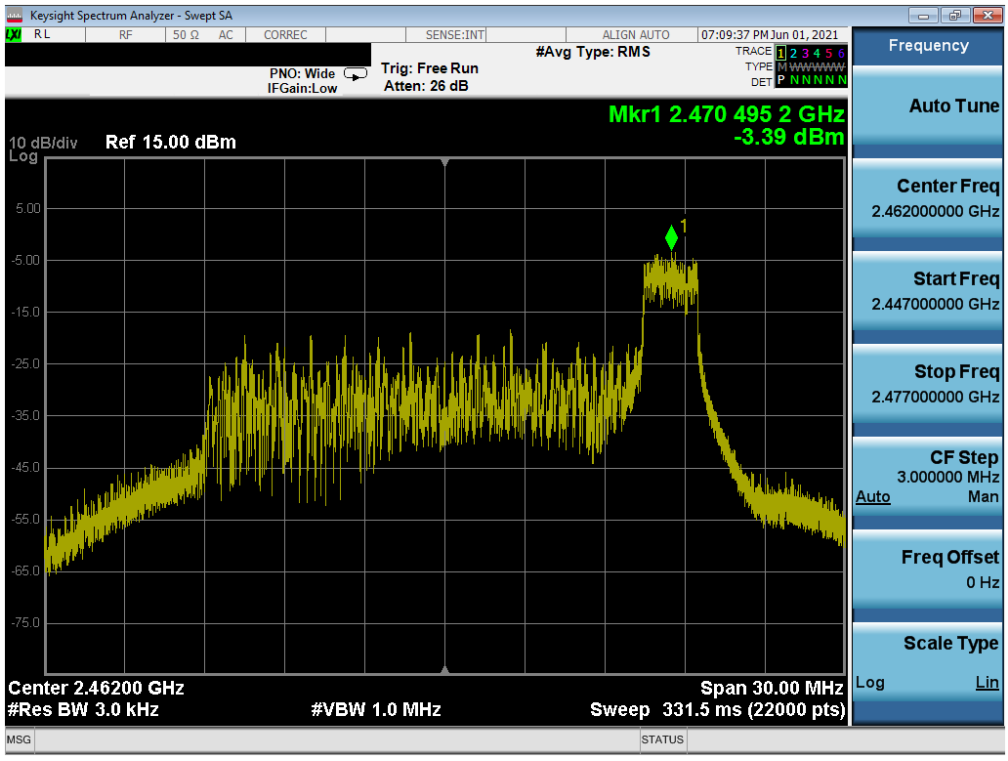
Table 7-14.MIMO Conducted Power Density Measurements - N



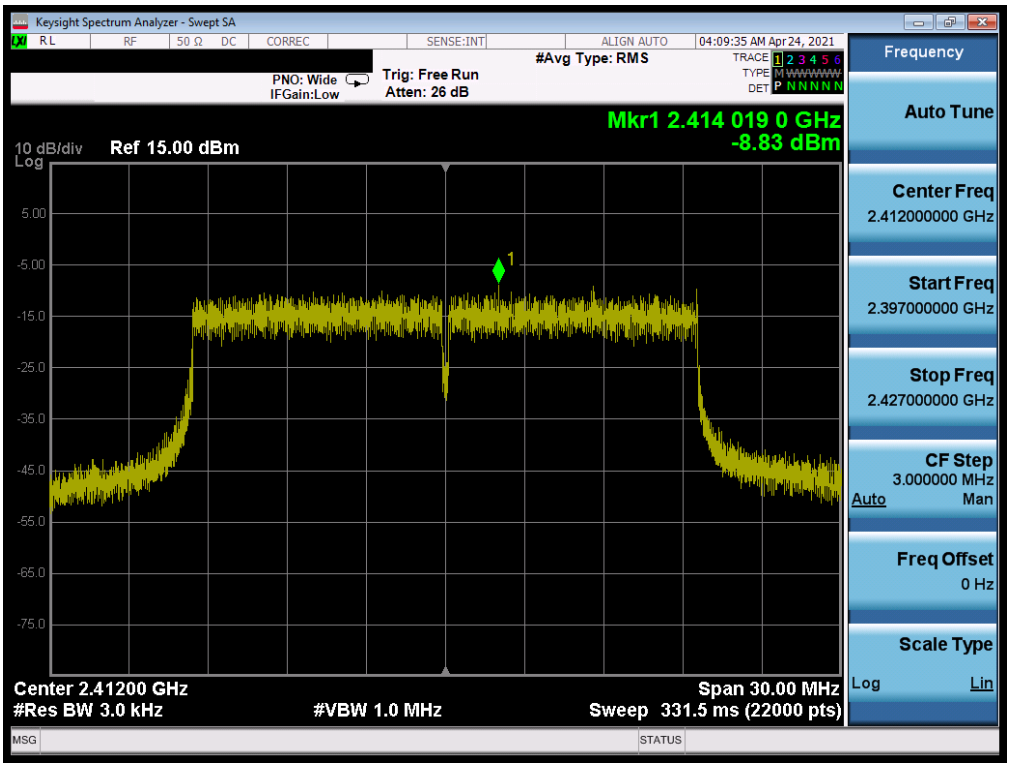
Plot 7-37. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



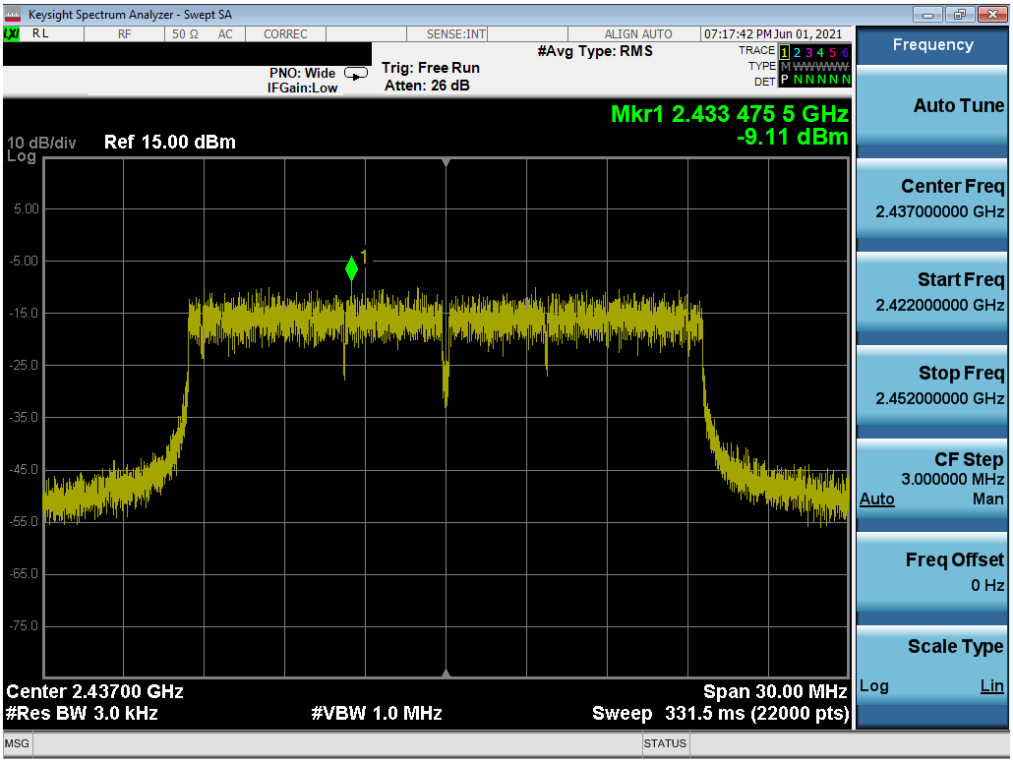
Plot 7-38. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



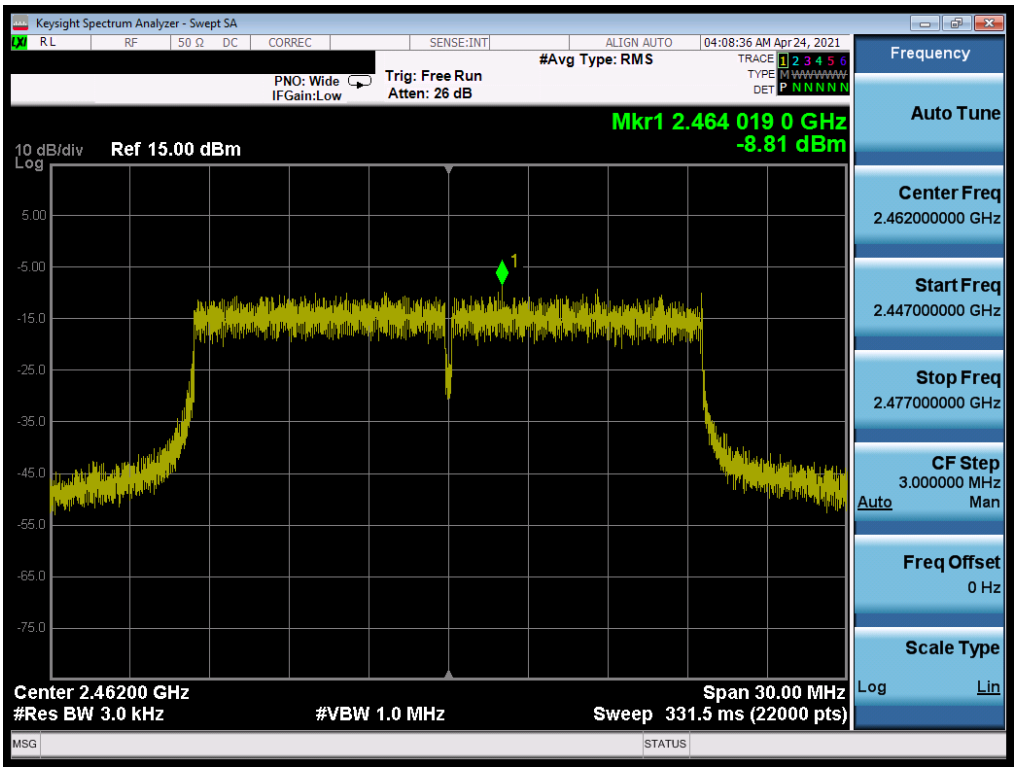
Plot 7-39. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



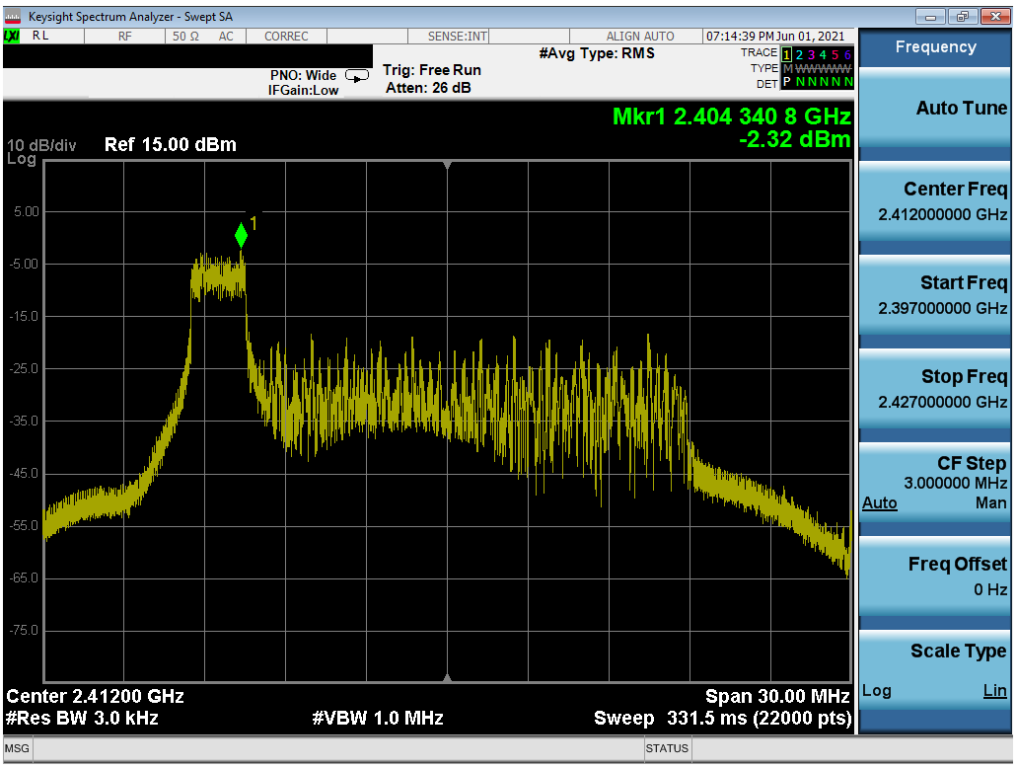
Plot 7-40. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



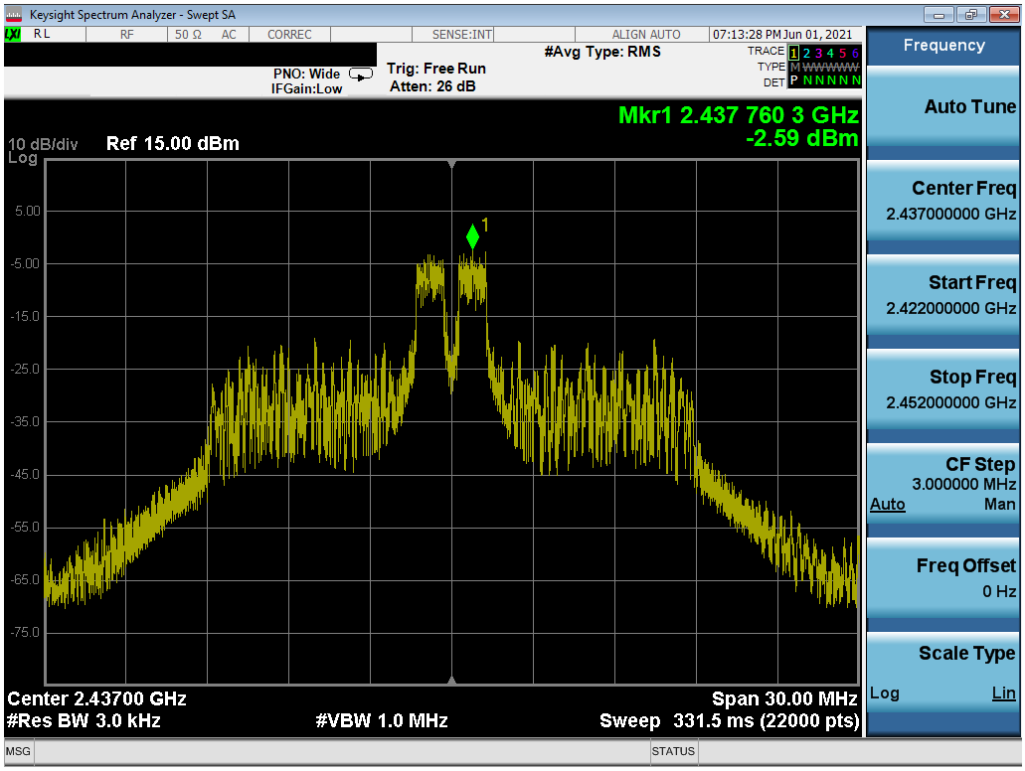
Plot 7-41. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 6) - N



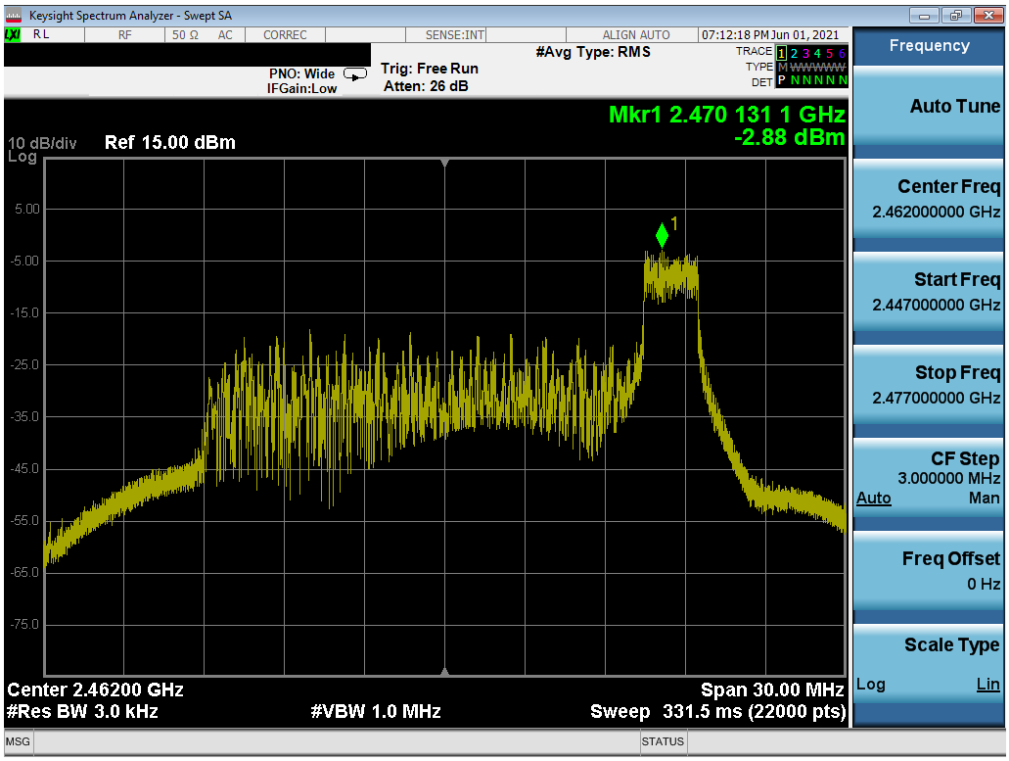
Plot 7-42. Power Spectral Density Plot MIMO ANT1 (802.11ax OFDMA – 242 Tones – Ch. 11) - N



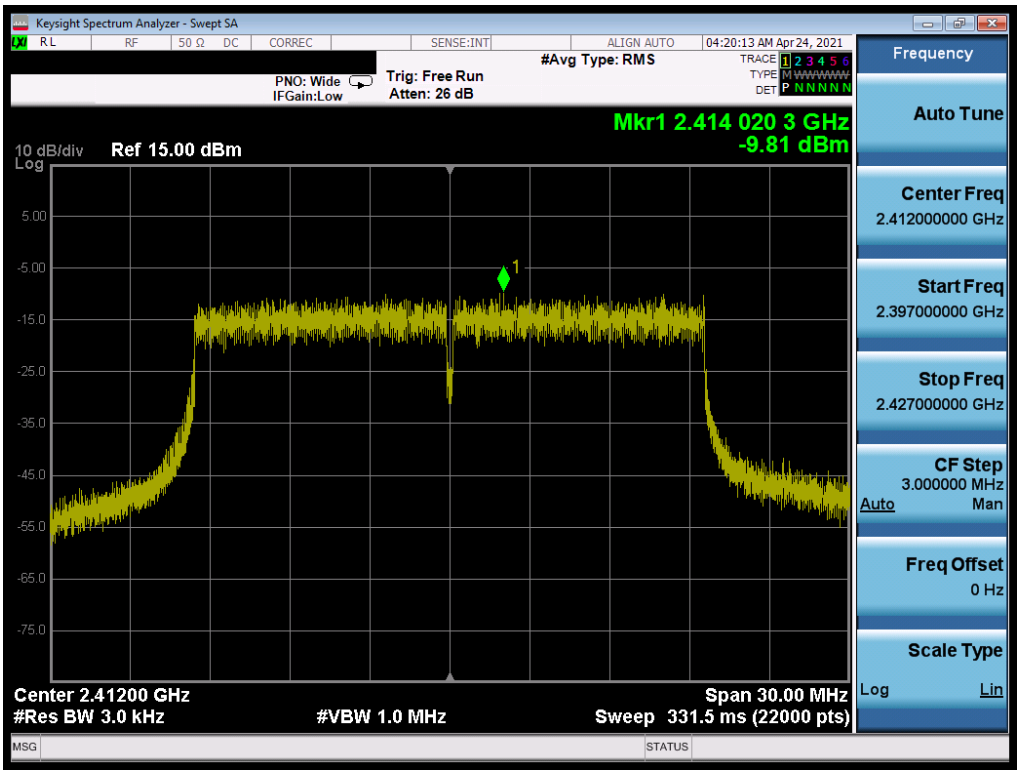
Plot 7-43. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



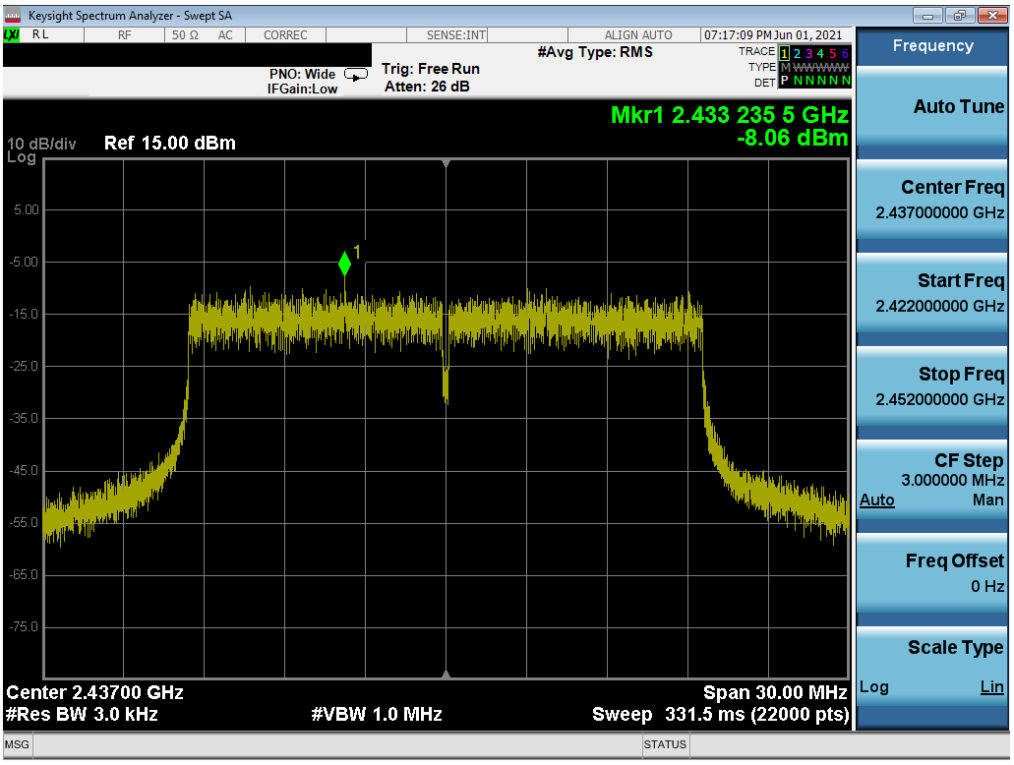
Plot 7-44. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



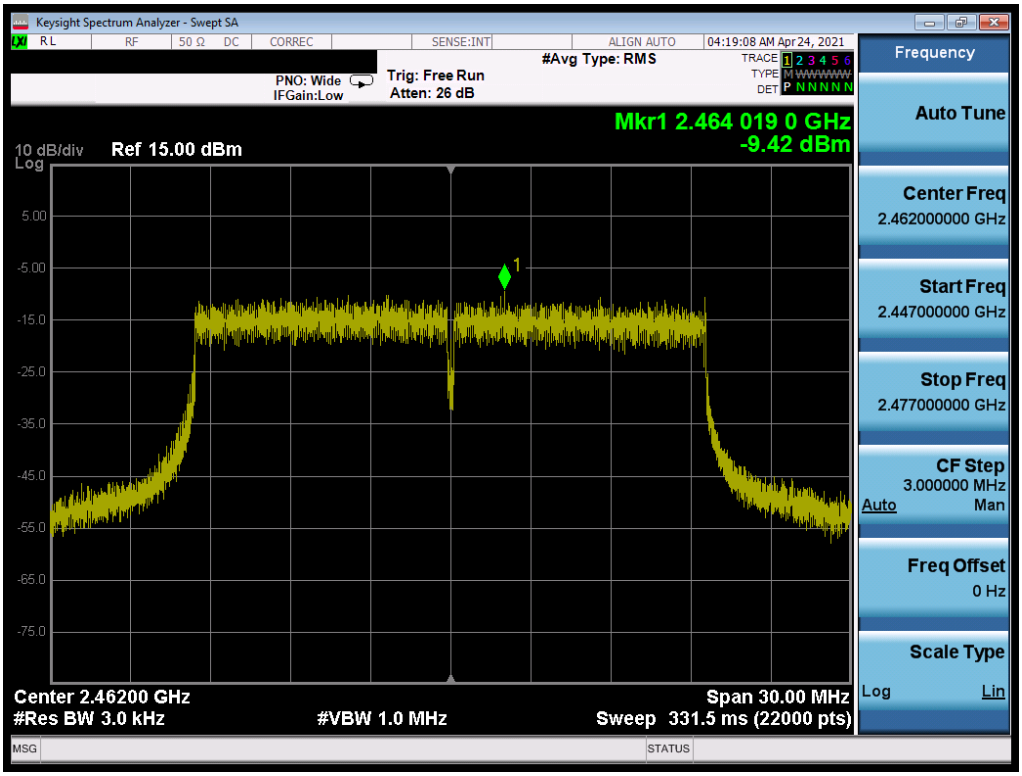
Plot 7-45. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



Plot 7-46. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



Plot 7-47. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - N



Plot 7-48. Power Spectral Density Plot MIMO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - N

Note:

Per ANSI C63.10-2013 Section 14.3.2.2 and KDB 662911 D01 v02r01 Section E)2), the power spectral density at Antenna 1 and Antenna 2 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 MIMO Calculation:

At 2412MHz the average conducted power spectral density was measured to be -3.31 dBm for Antenna-1 and -2.73 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(-3.31 dBm + -2.73 dBm) = (0.47 mW + 0.53 mW) = 1.00 mW = 0.00 dBm

7.5 Conducted Emissions at the 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 MCS0 in 802.11ax mode as this setting produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 30dB 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 – Section 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

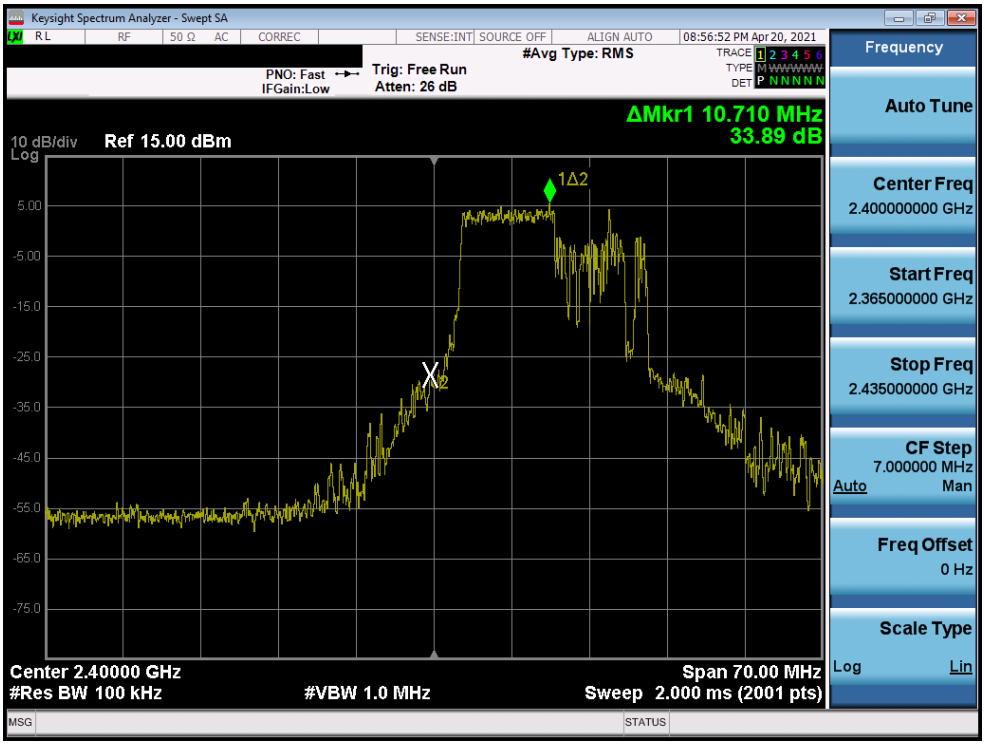
The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-4. Test Instrument & Measurement Setup

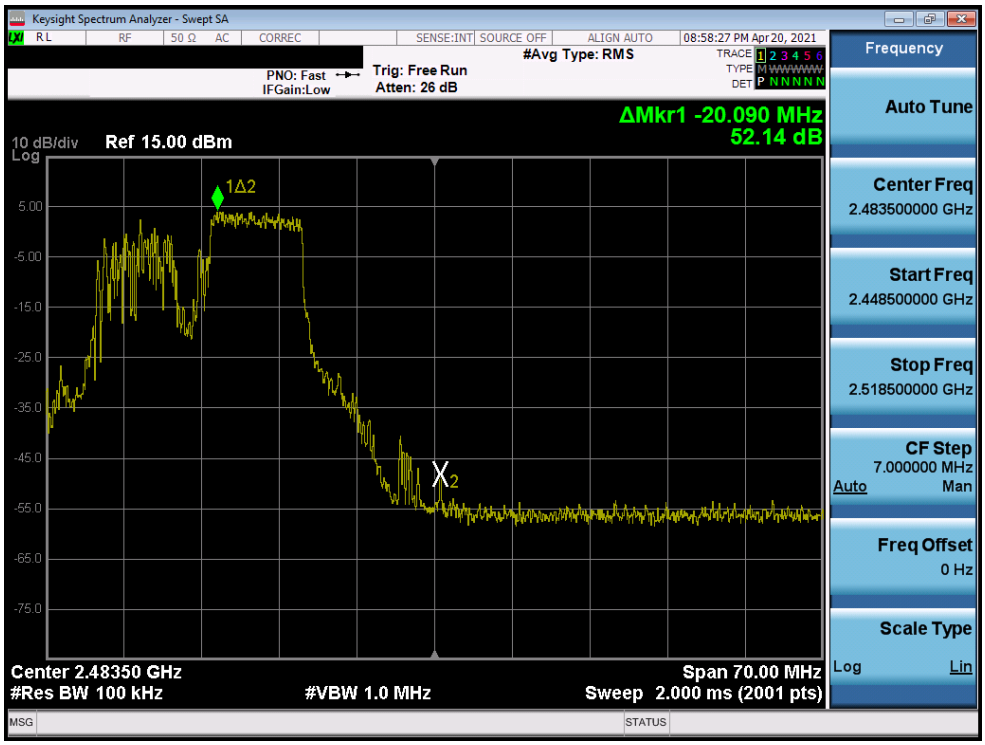
Test Notes

This device will be manufactured using two different WIFI chipsets (N and Q). Both two chipsets are tested, and both conducted emissions data is shown in this report.

SISO Antenna-2 Conducted Emissions at the Band Edge

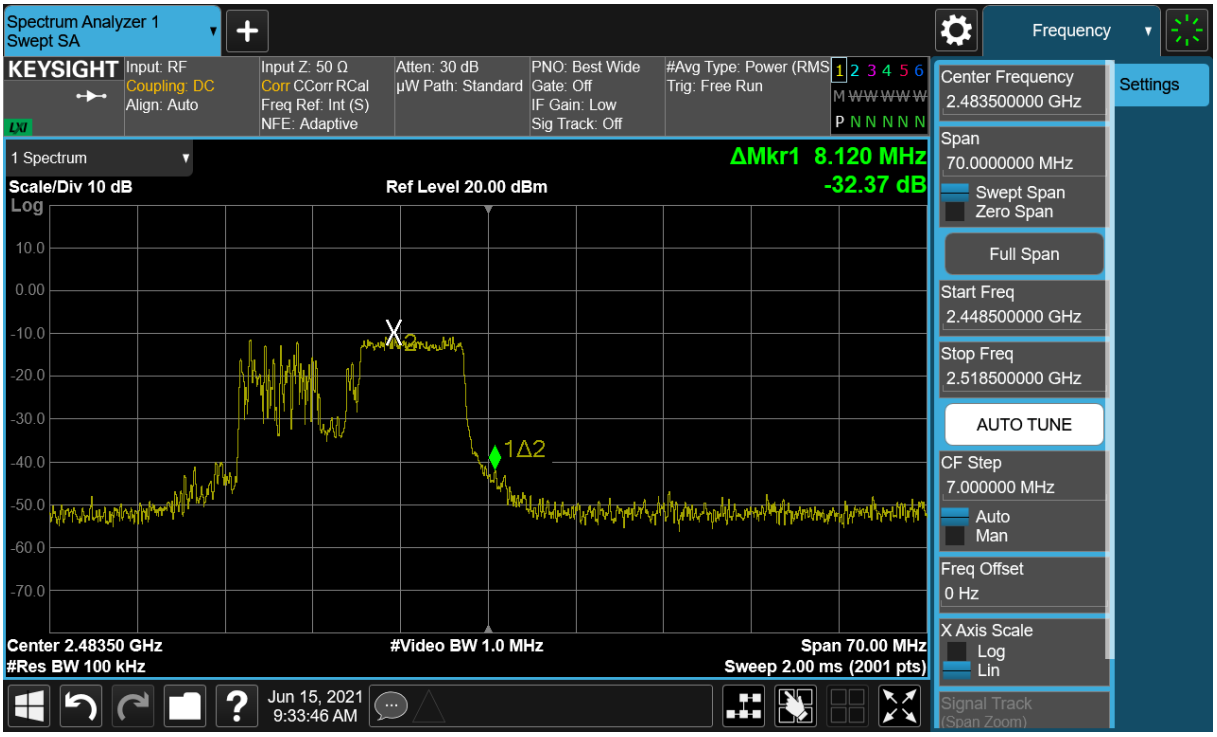


Plot 7-49. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 1) - Q

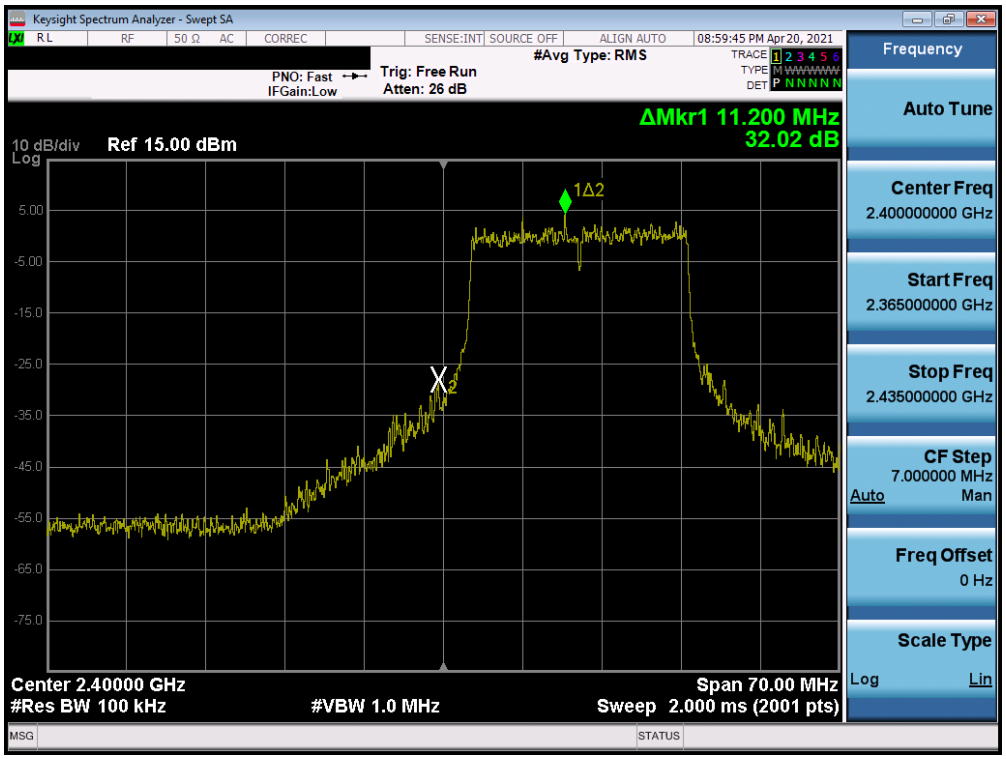


Plot 7-50. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 11) – Q

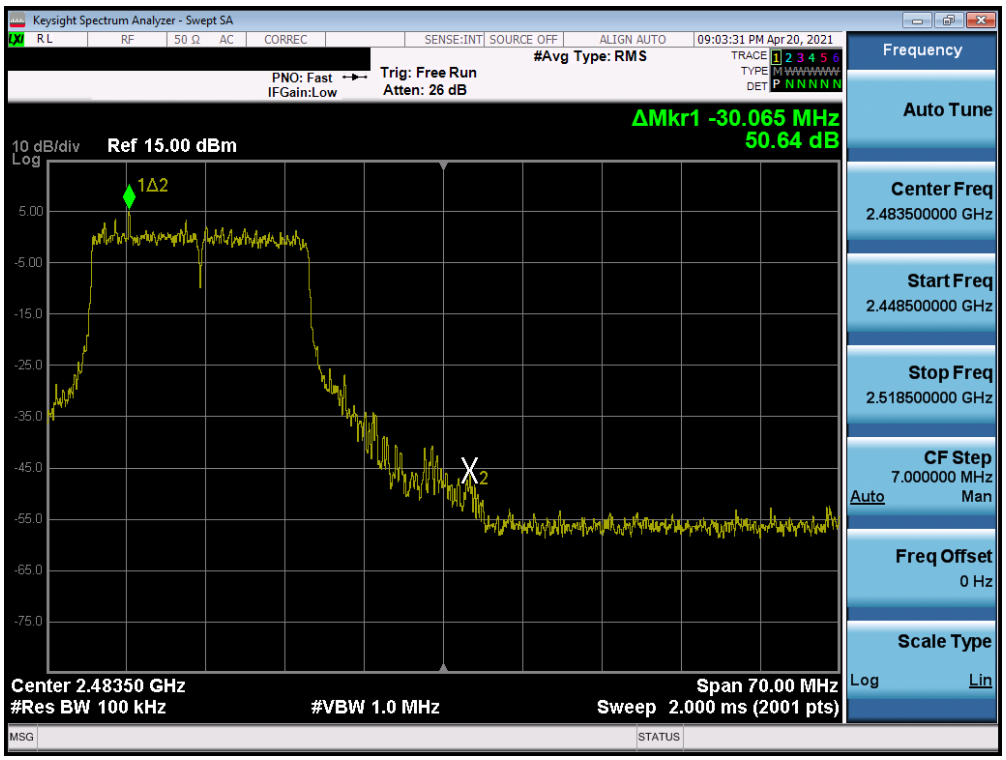
Plot 7-51. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 12) - Q



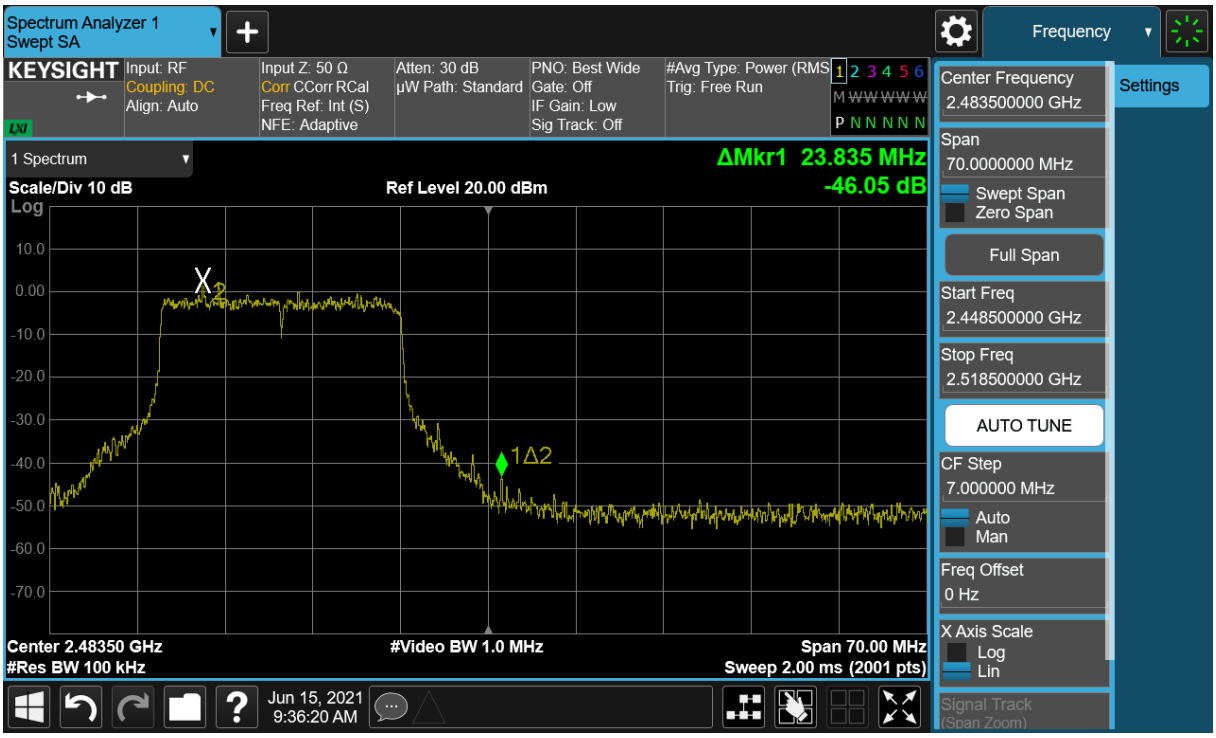
Plot 7-52. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 13) - Q



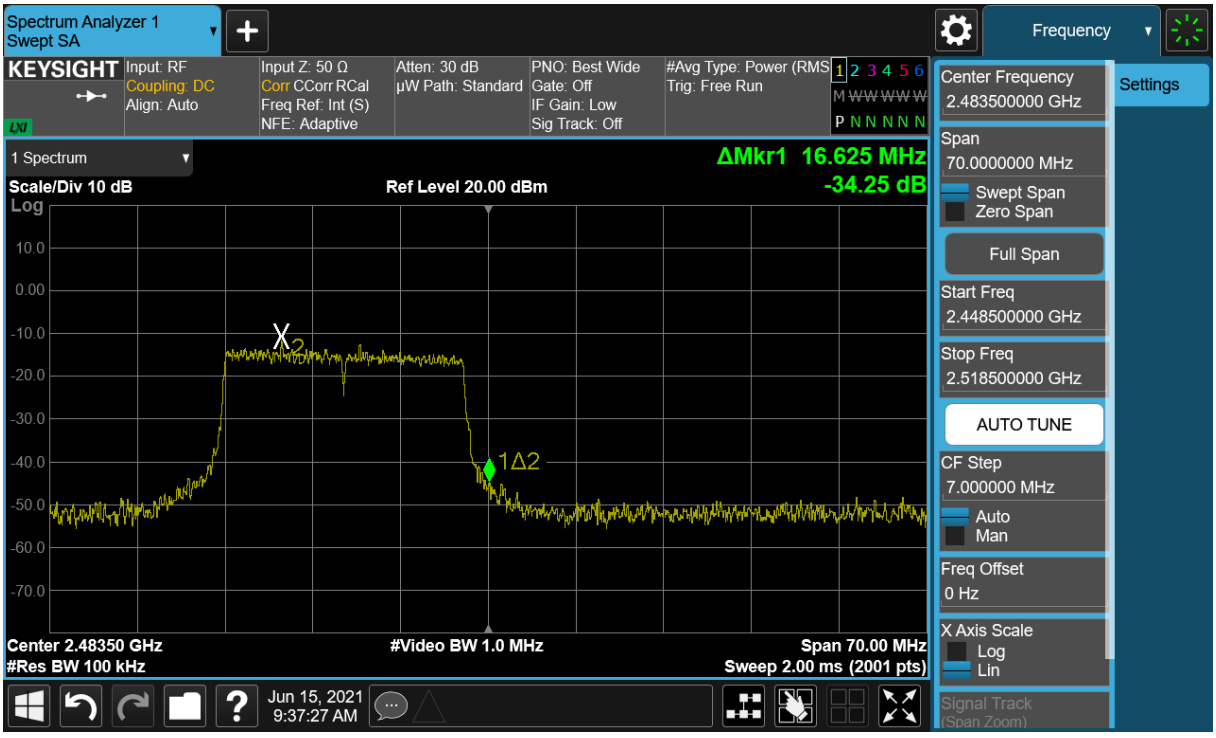
Plot 7-53. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q



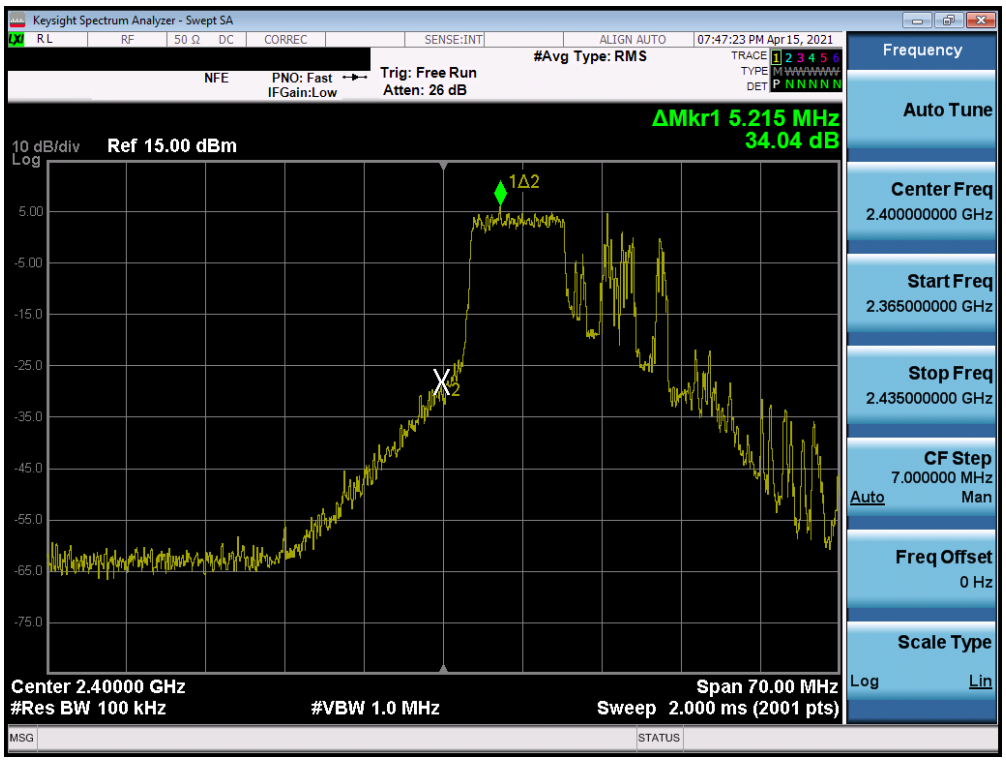
Plot 7-54. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) – Q



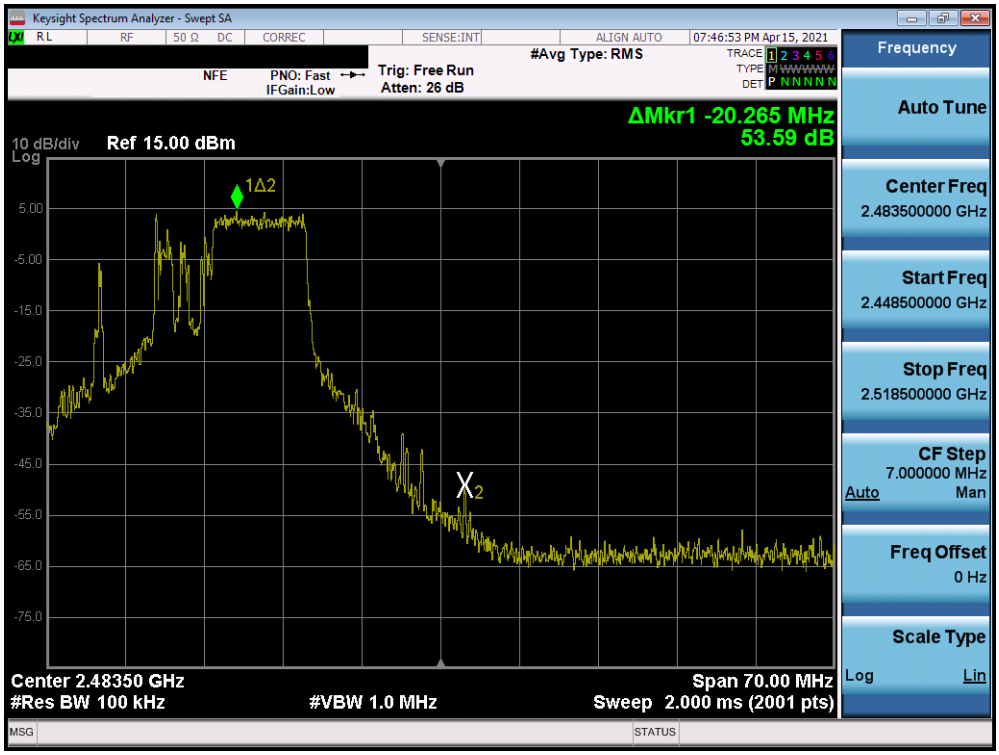
Plot 7-55. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 12) - Q



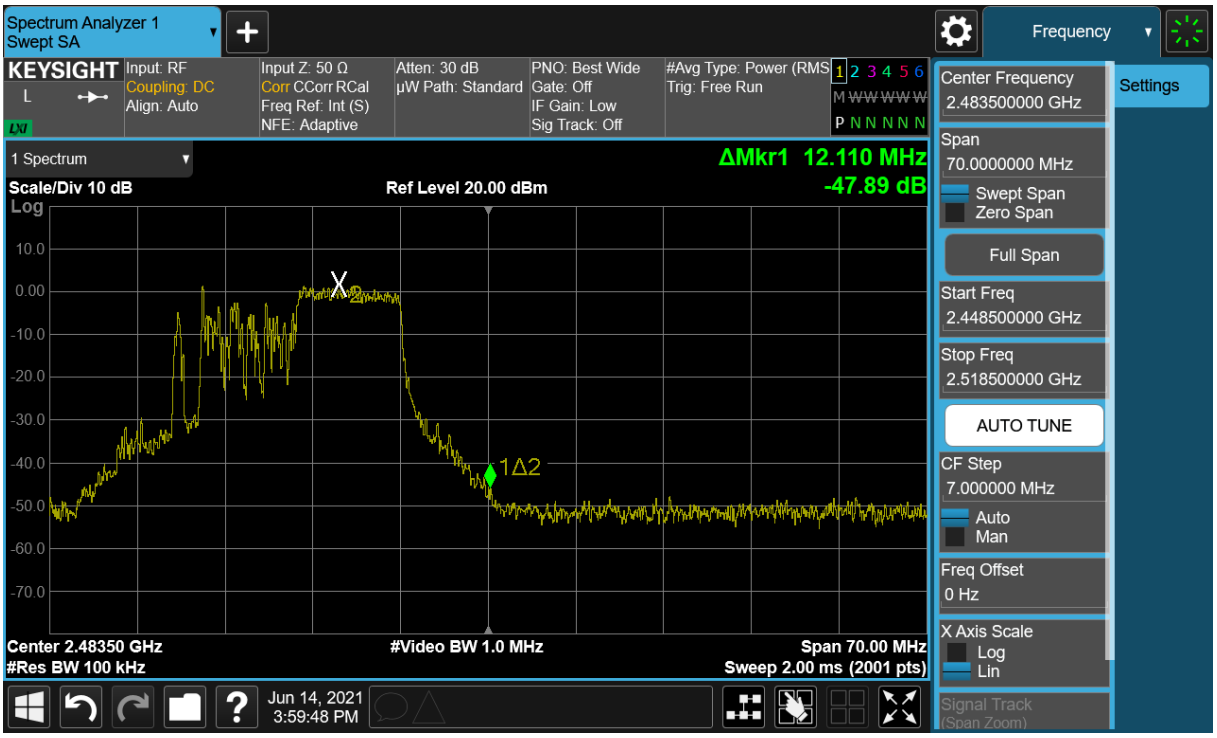
Plot 7-56. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 13) - Q



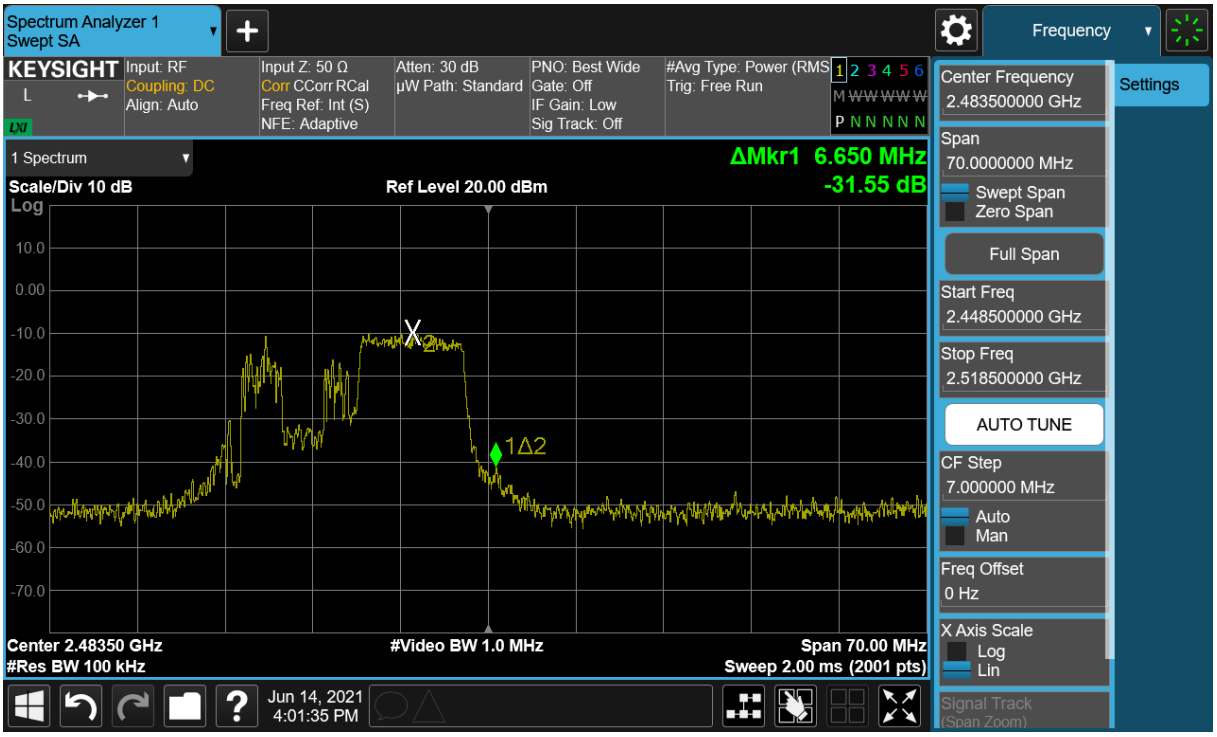
Plot 7-57. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 1) - N



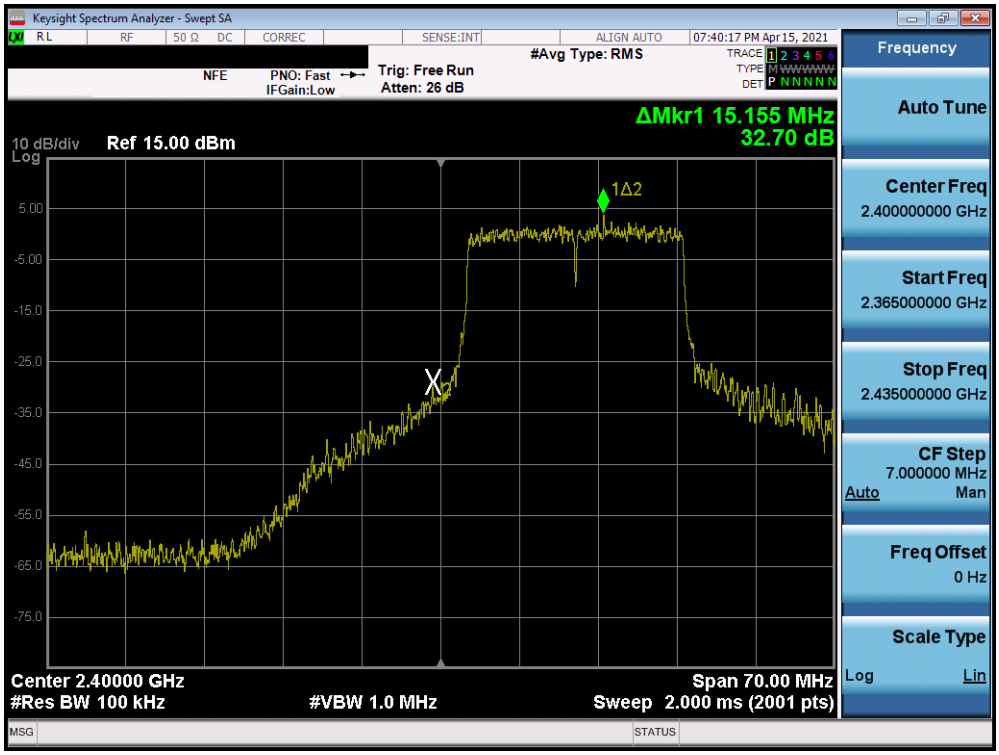
Plot 7-58. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 11) – N



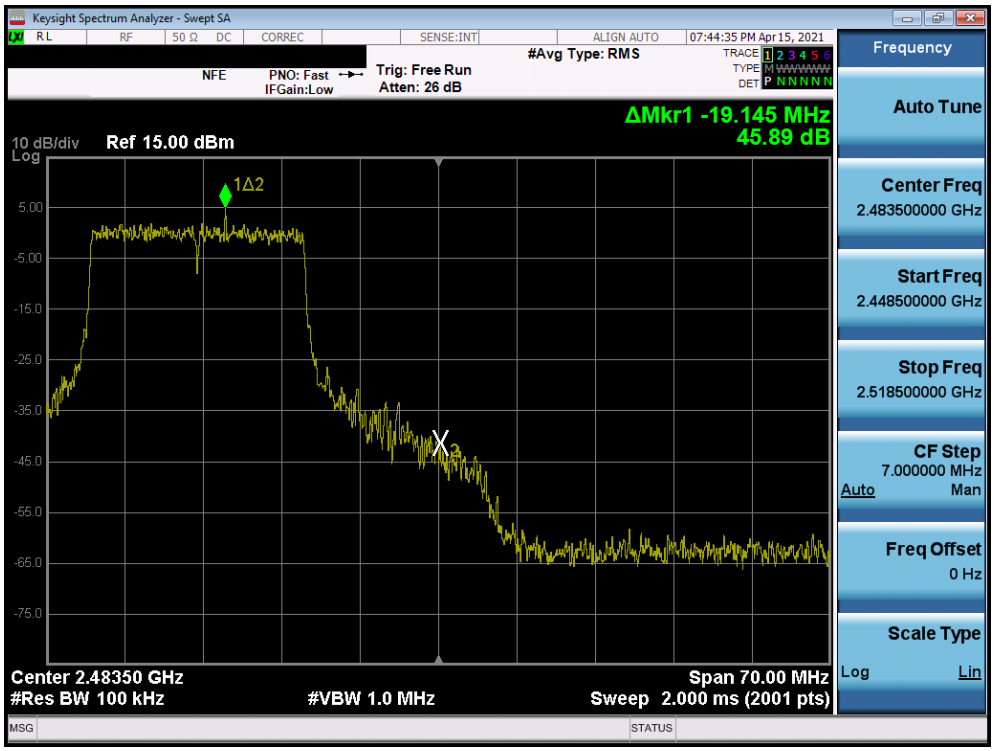
Plot 7-59. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 12) - N



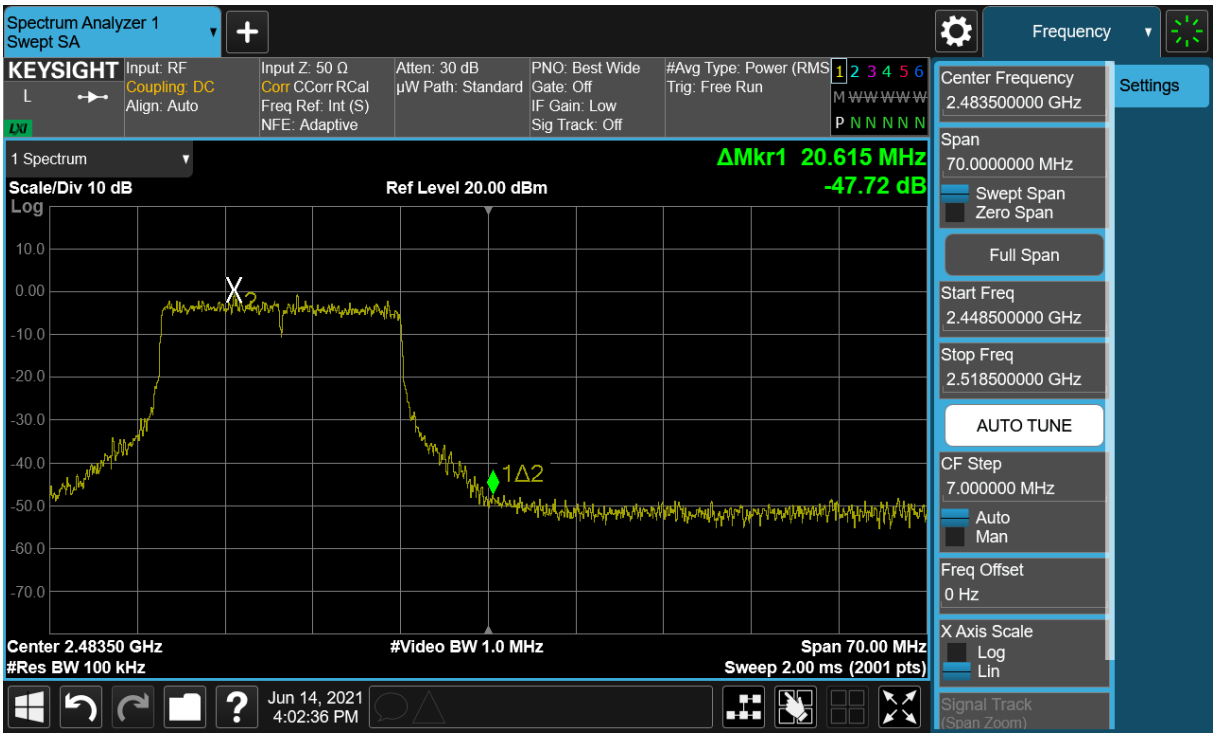
Plot 7-60. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 106 Tones – Ch. 13) - N



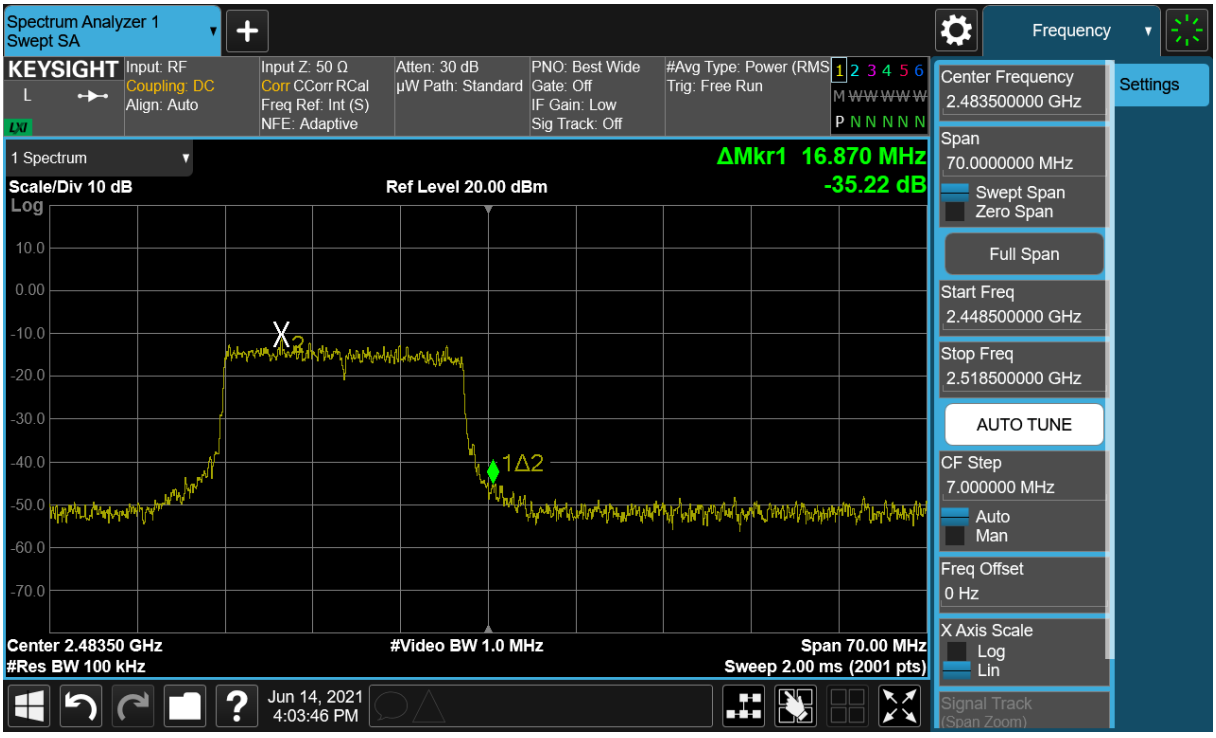
Plot 7-61. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



Plot 7-62. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) – N



Plot 7-63. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 12) - N



Plot 7-64. Band Edge Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 13) - N

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 MCS0 in 802.11ax mode as this setting produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 30dB 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 Section 11.1 of ANSI C63.10-2013 and KDB 558074 D01 v05r02.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3
KDB 558074 D01 v05r02 – Section 8.5
ANSI C63.10-2013 – Section 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

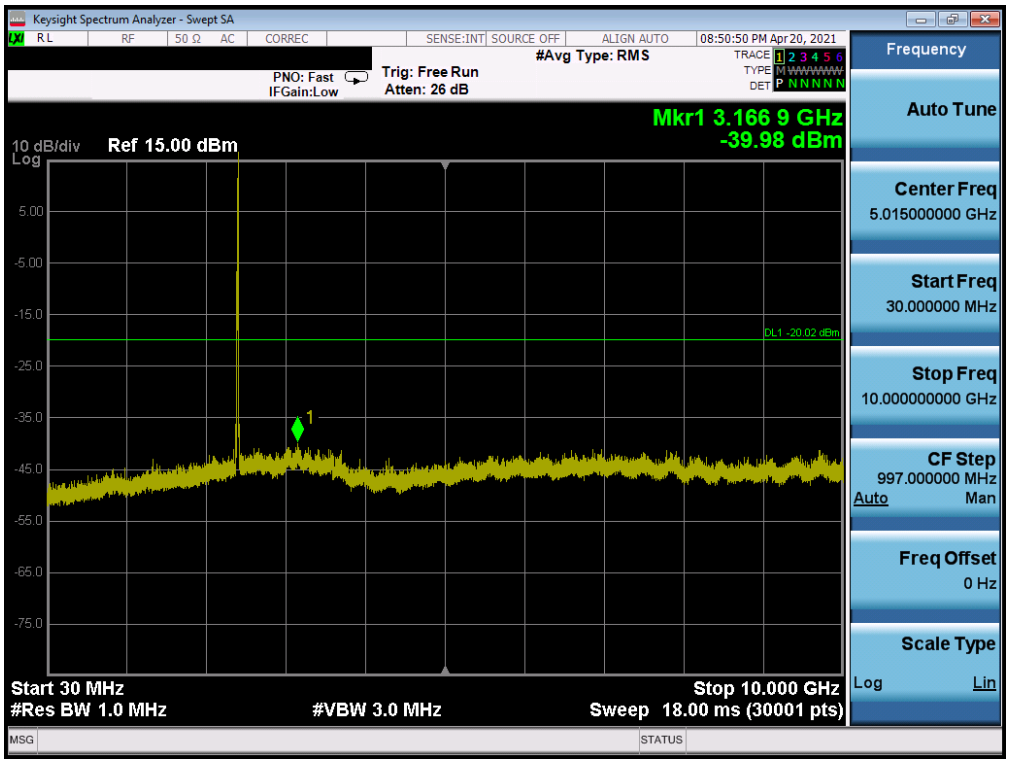
1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.

2. The display line shown in the following plots denotes the limit at 30dB 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 30dB 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.

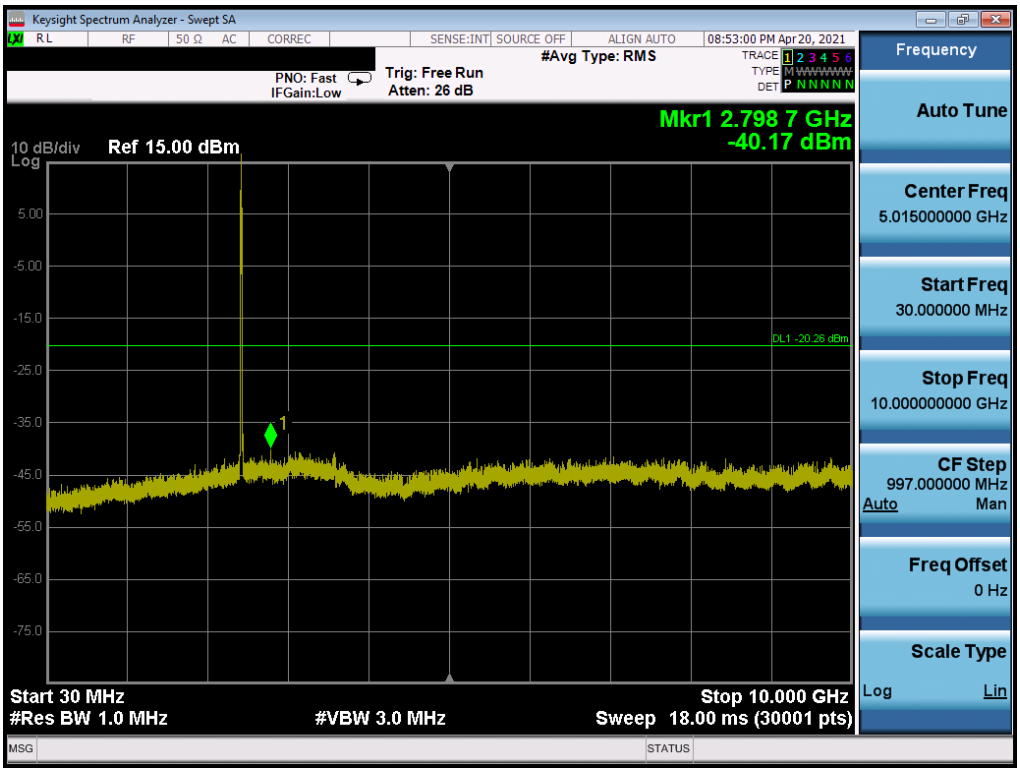
4. The conducted spurious emissions were measured to relative limits. Therefore, in accordance with ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)3)b), it was unnecessary to show compliance through the summation of test results of the individual outputs.

SISO Antenna-2 Conducted Spurious Emissions

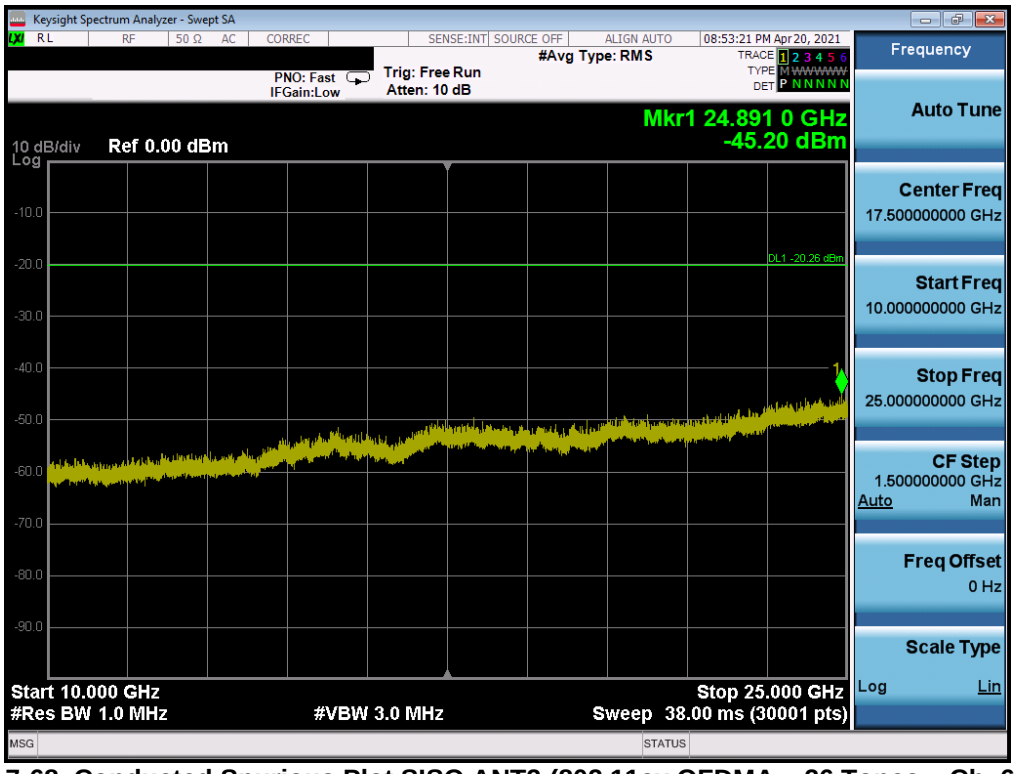


Plot 7-65. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q

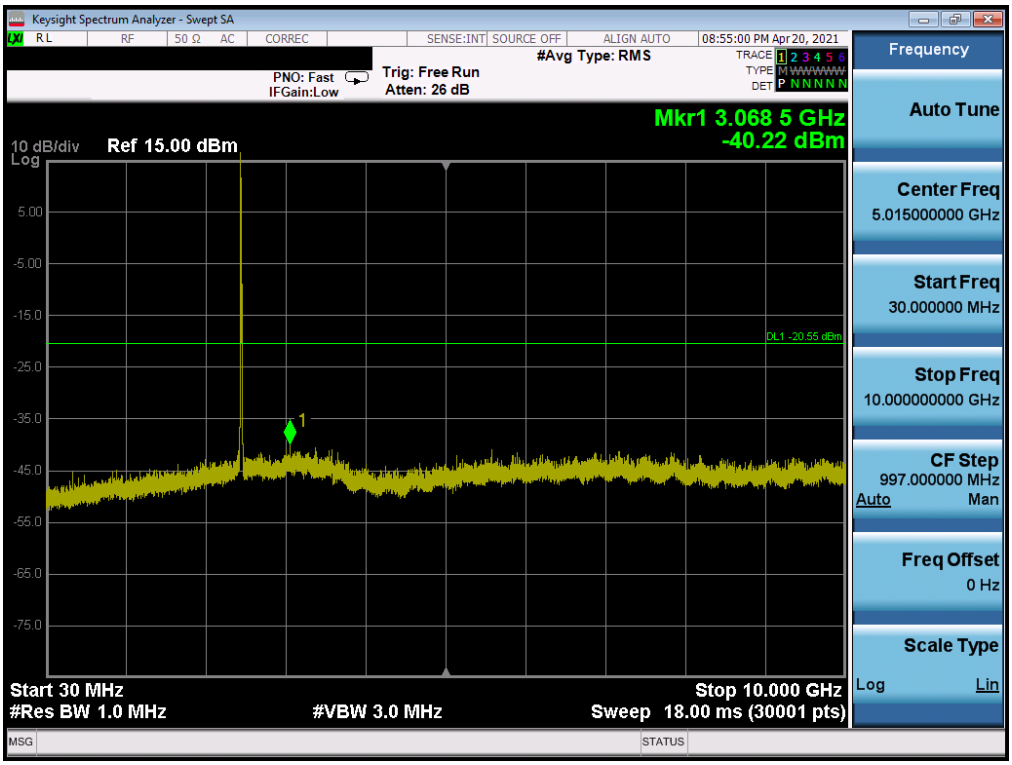
Plot 7-66. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - Q



Plot 7-67. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q

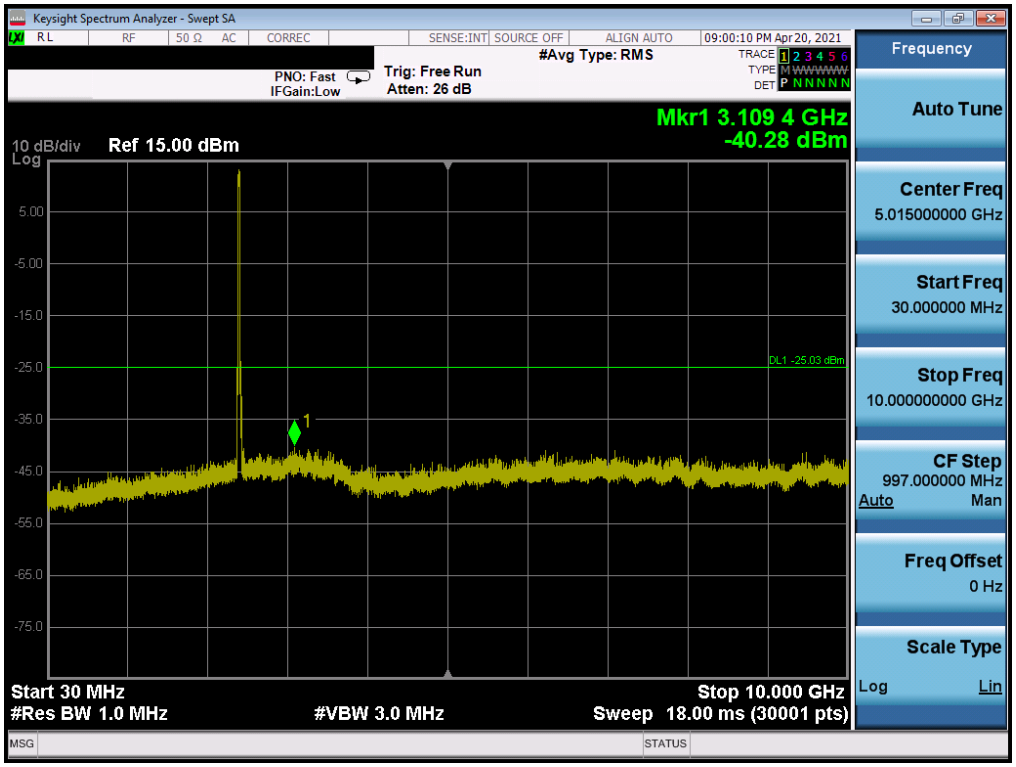


Plot 7-68. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - Q



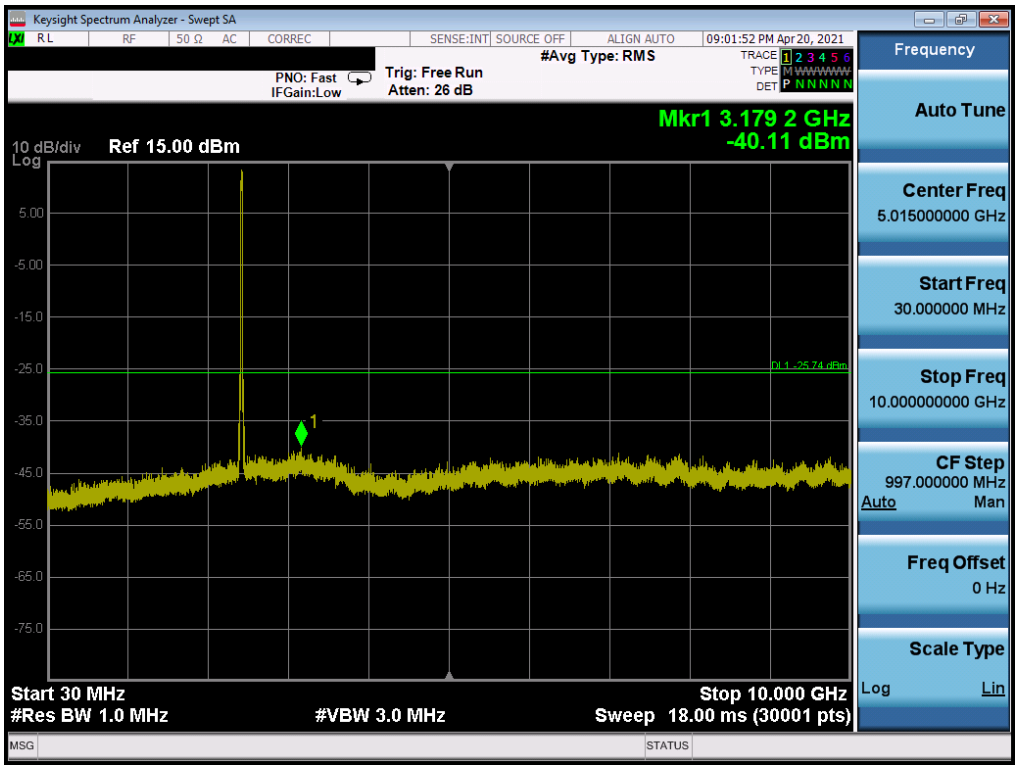
Plot 7-69. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q

Plot 7-70. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - Q

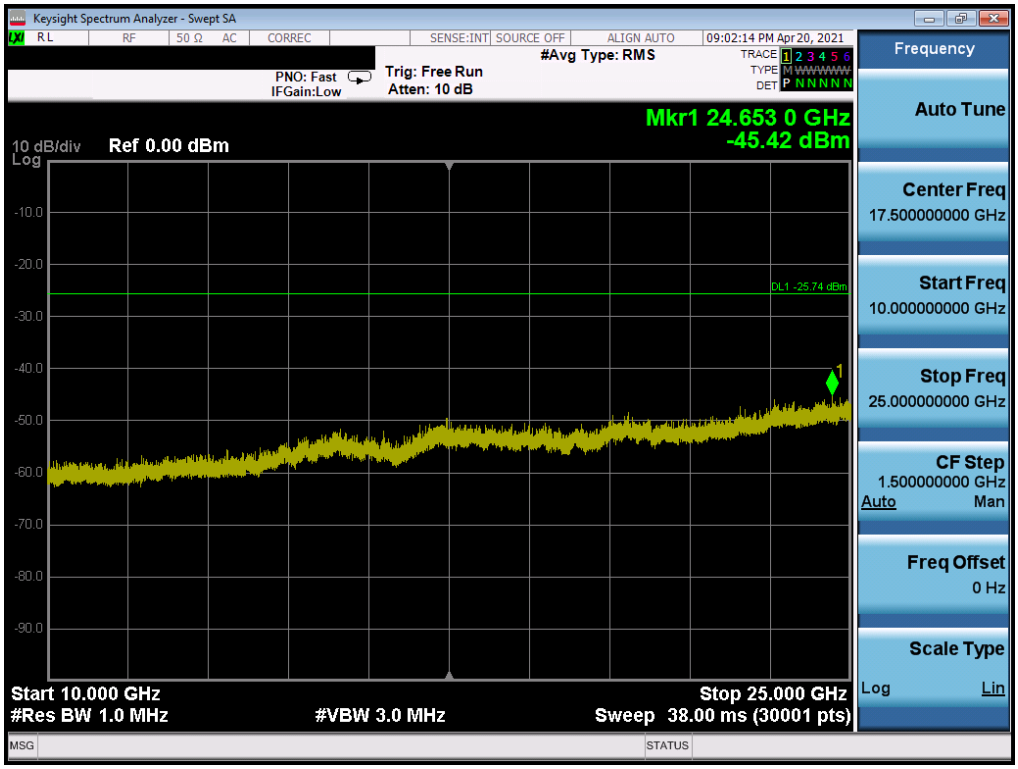


Plot 7-71. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q

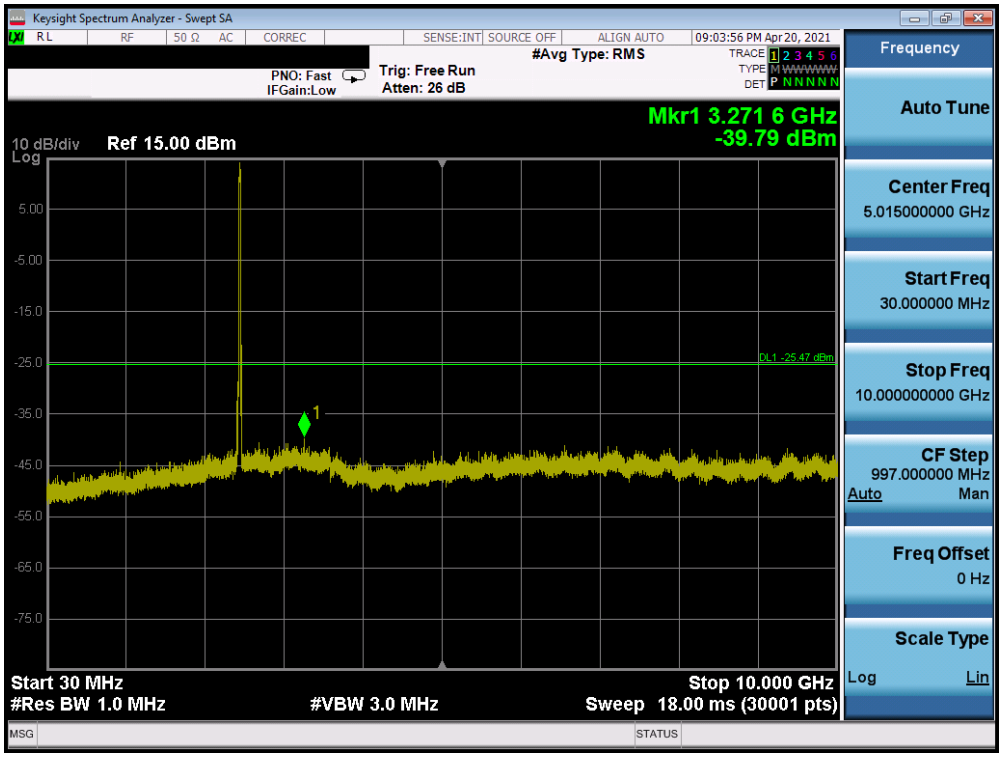
Plot 7-72. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - Q



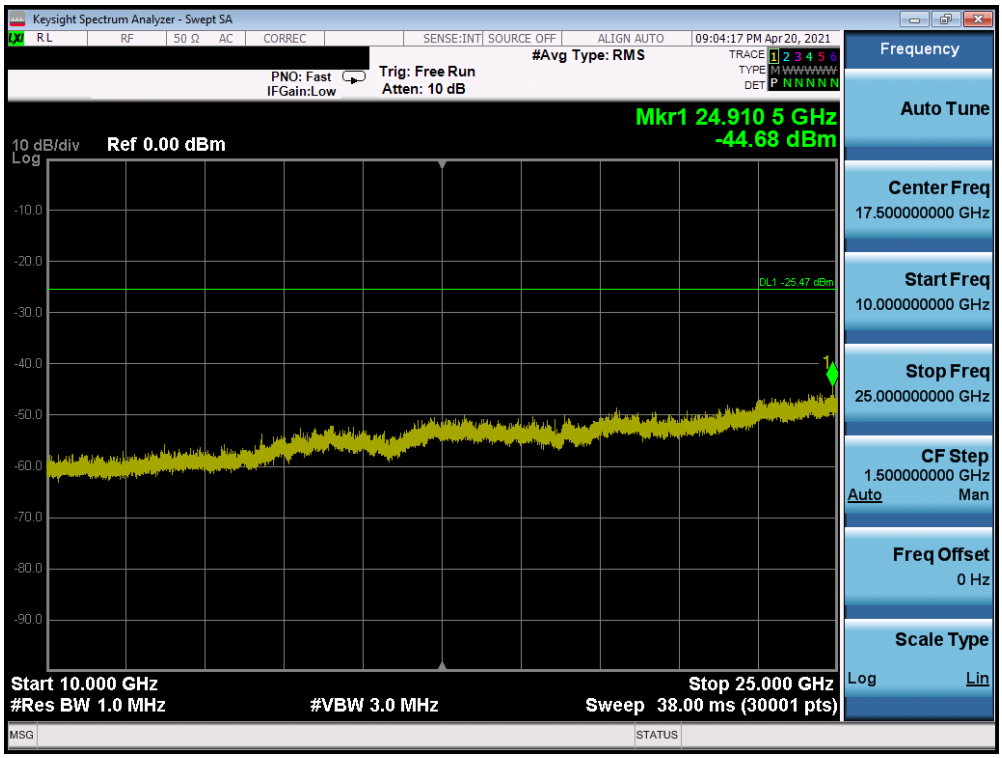
Plot 7-73. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



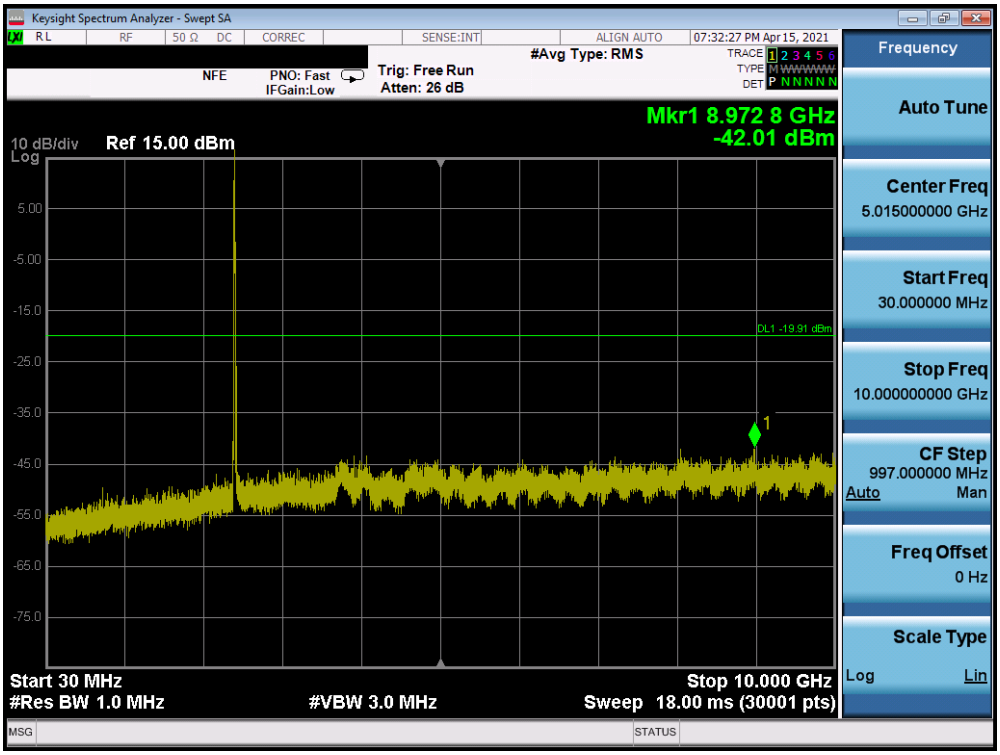
Plot 7-74. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - Q



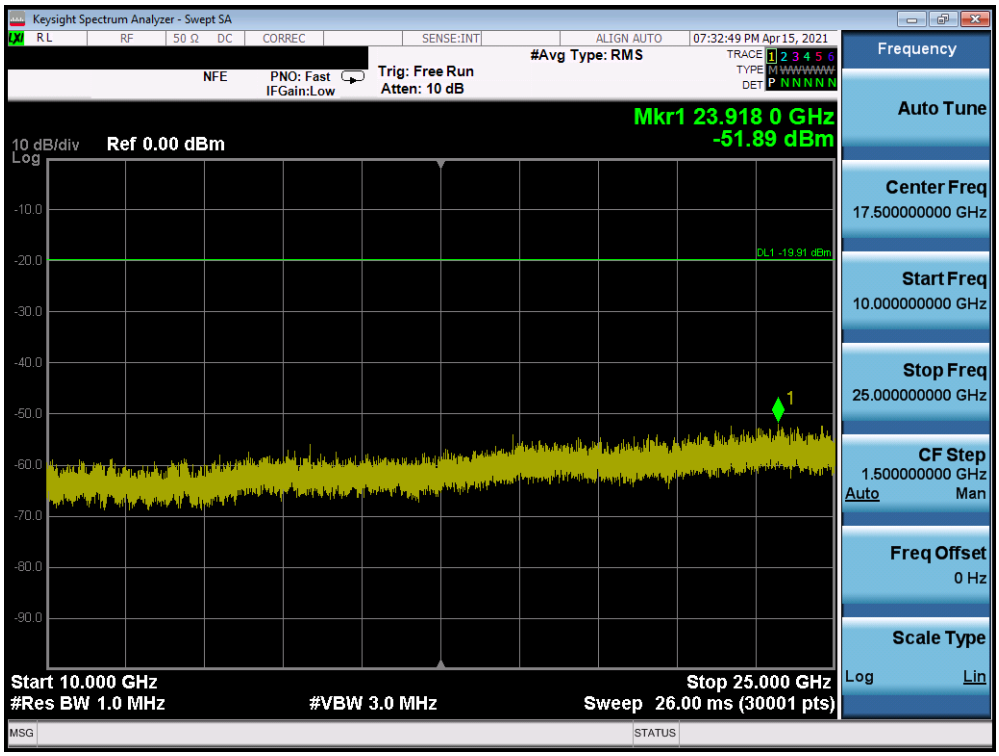
Plot 7-75. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - Q



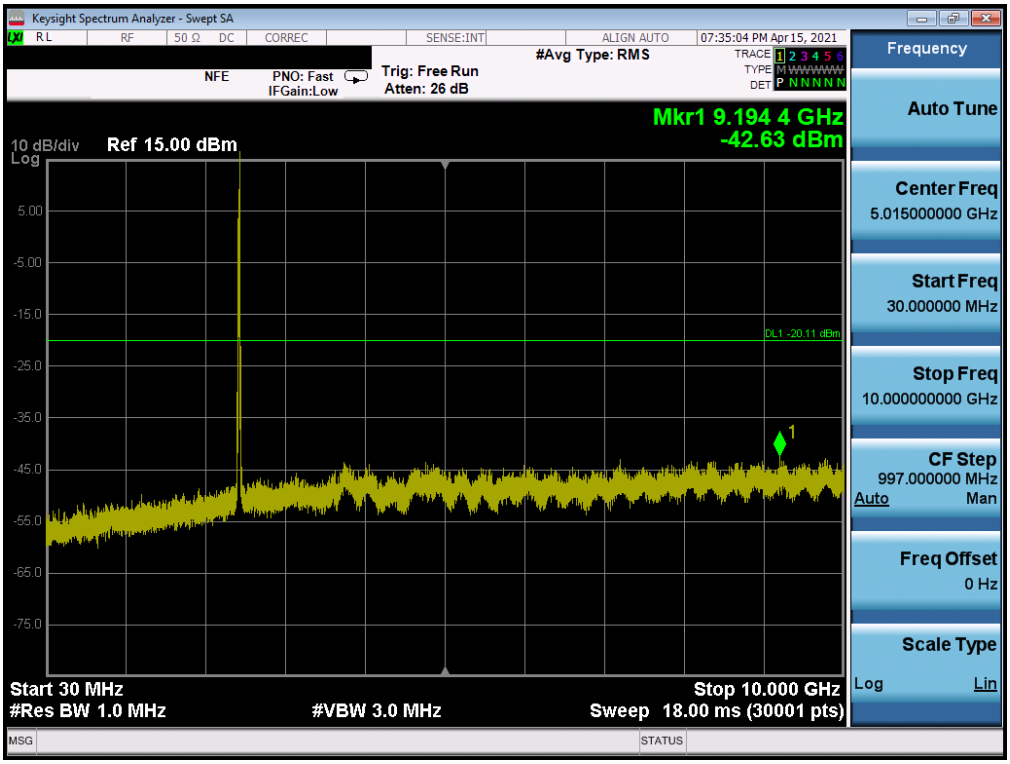
Plot 7-76. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - Q



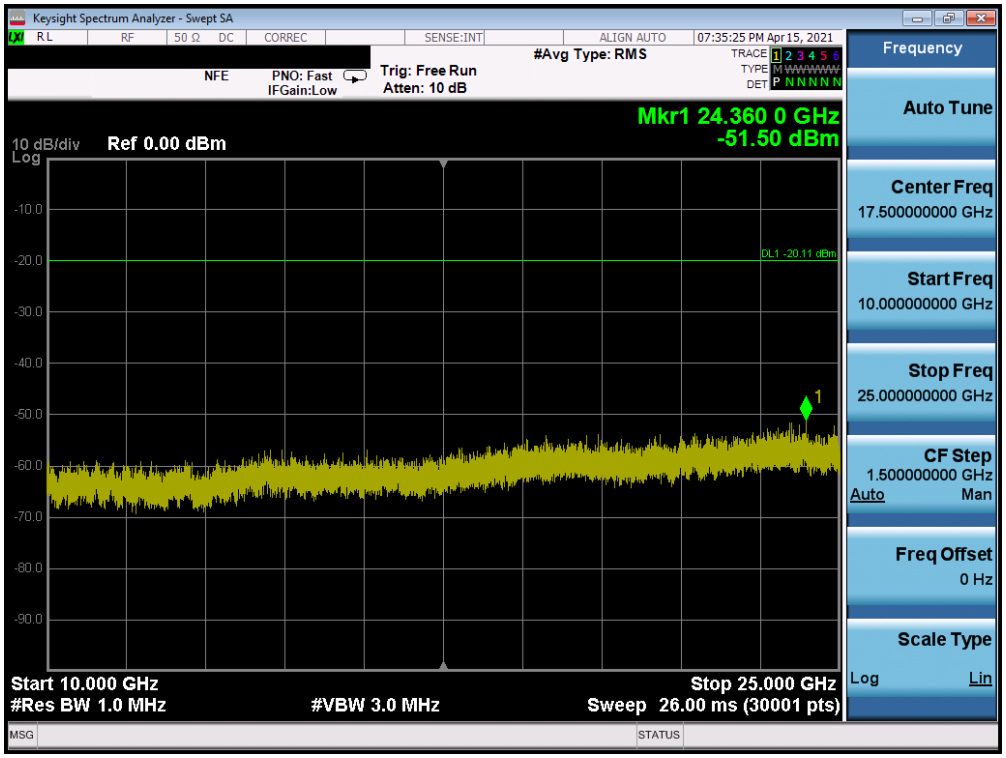
Plot 7-77. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



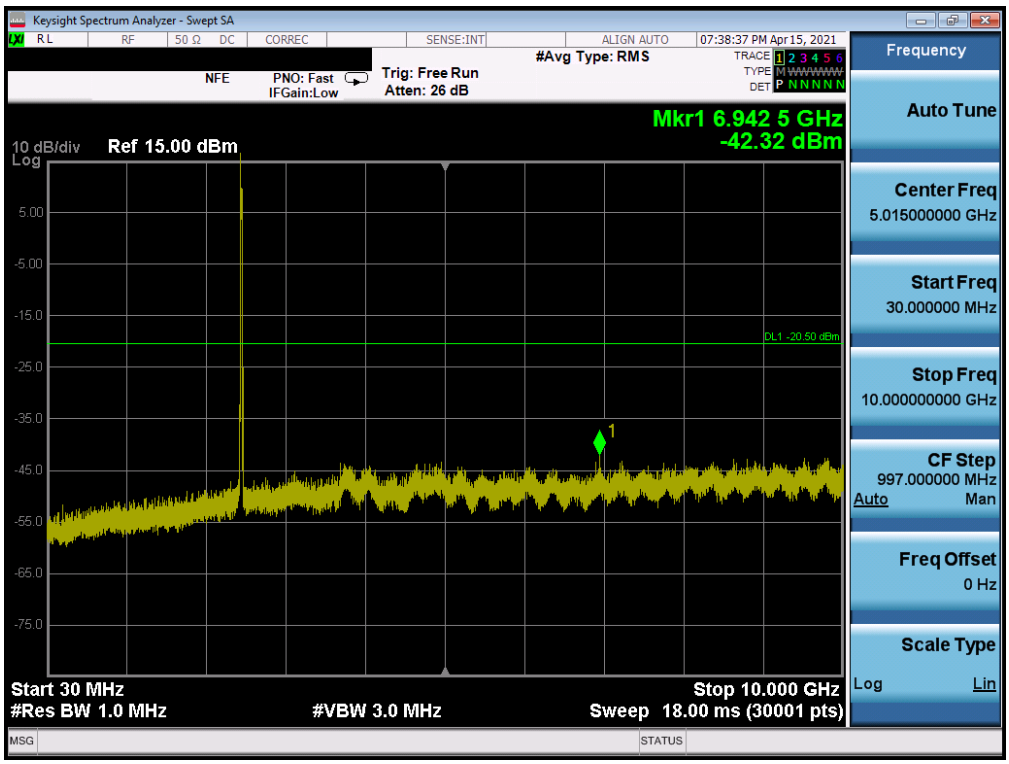
Plot 7-78. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 1) - N



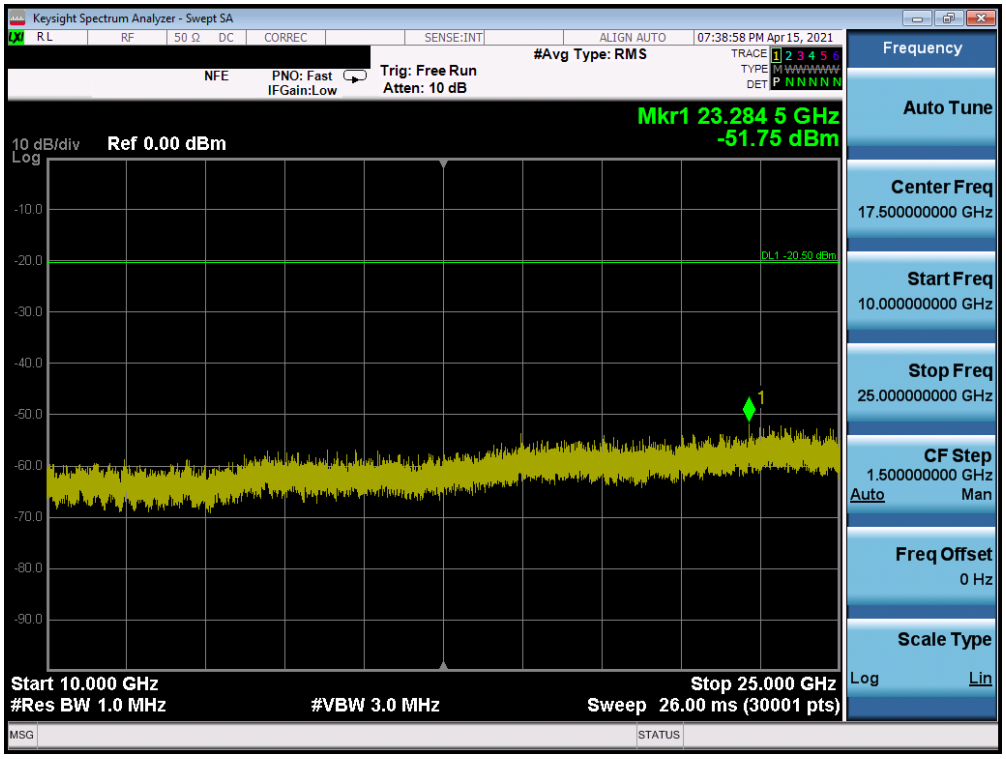
Plot 7-79. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



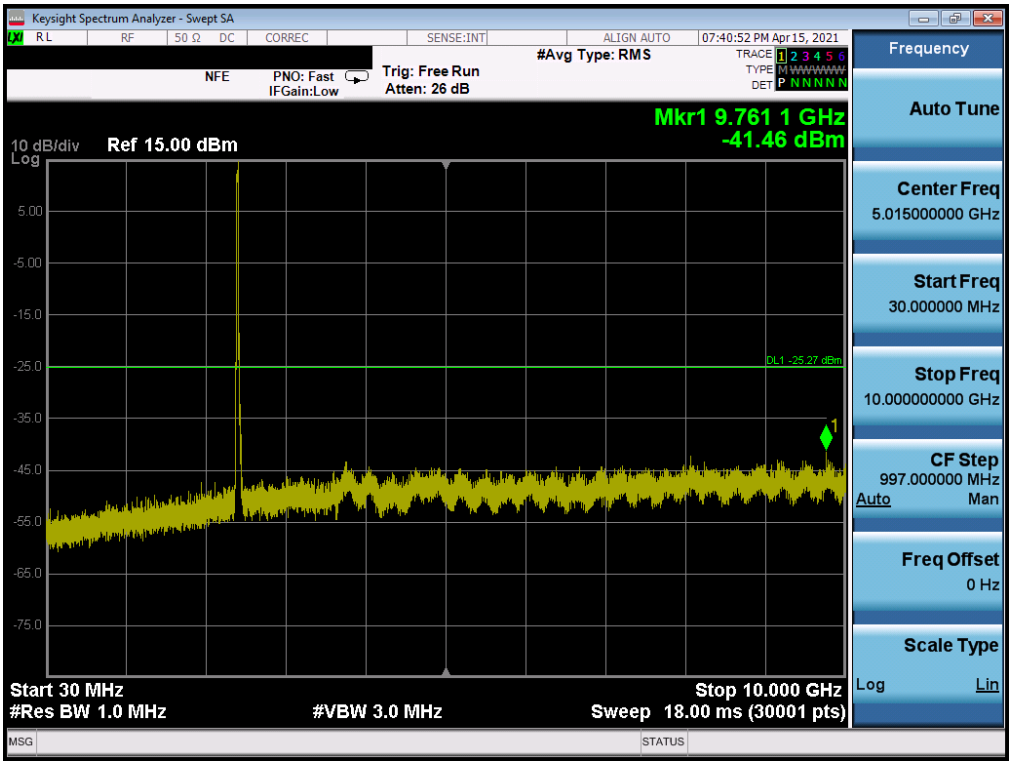
Plot 7-80. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 6) - N



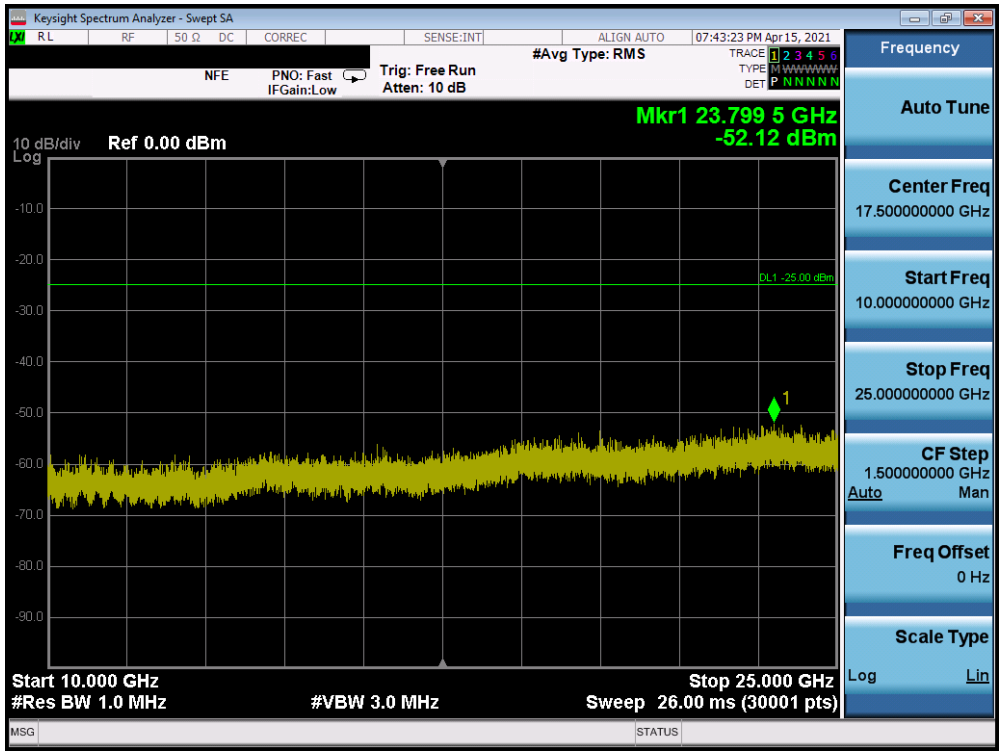
Plot 7-81. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



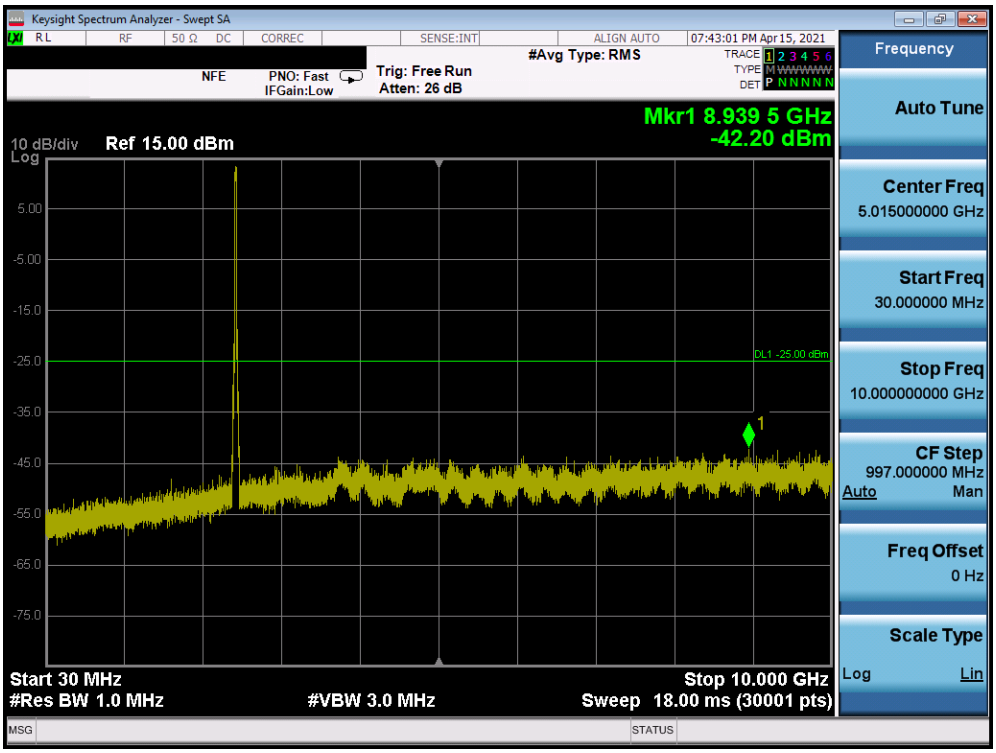
Plot 7-82. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 26 Tones – Ch. 11) - N



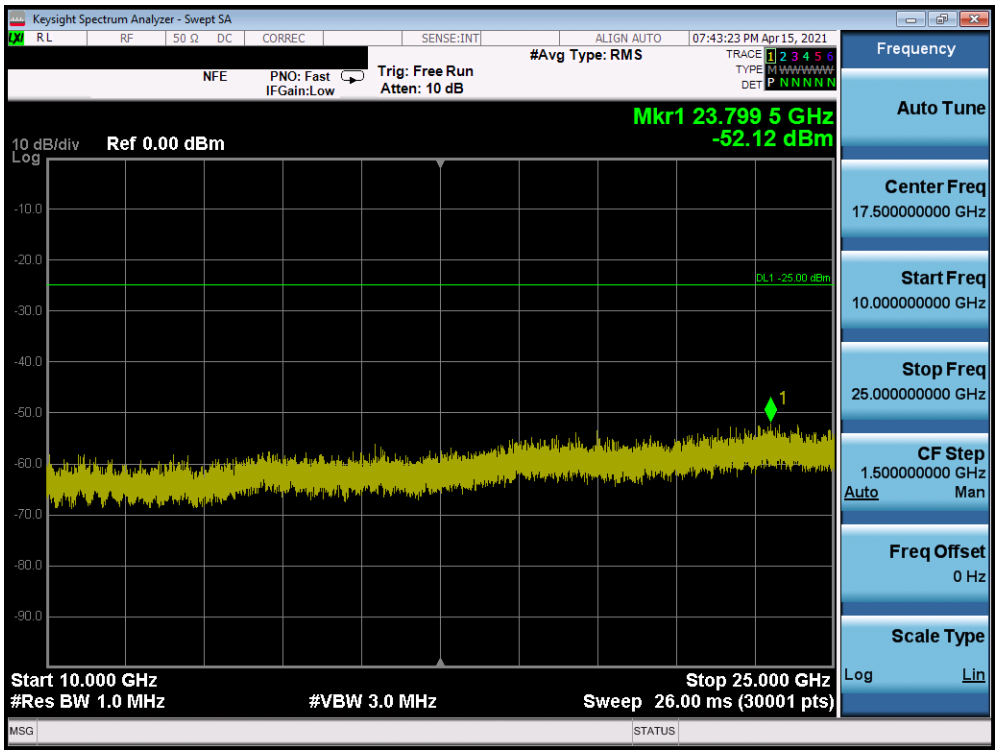
Plot 7-83. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



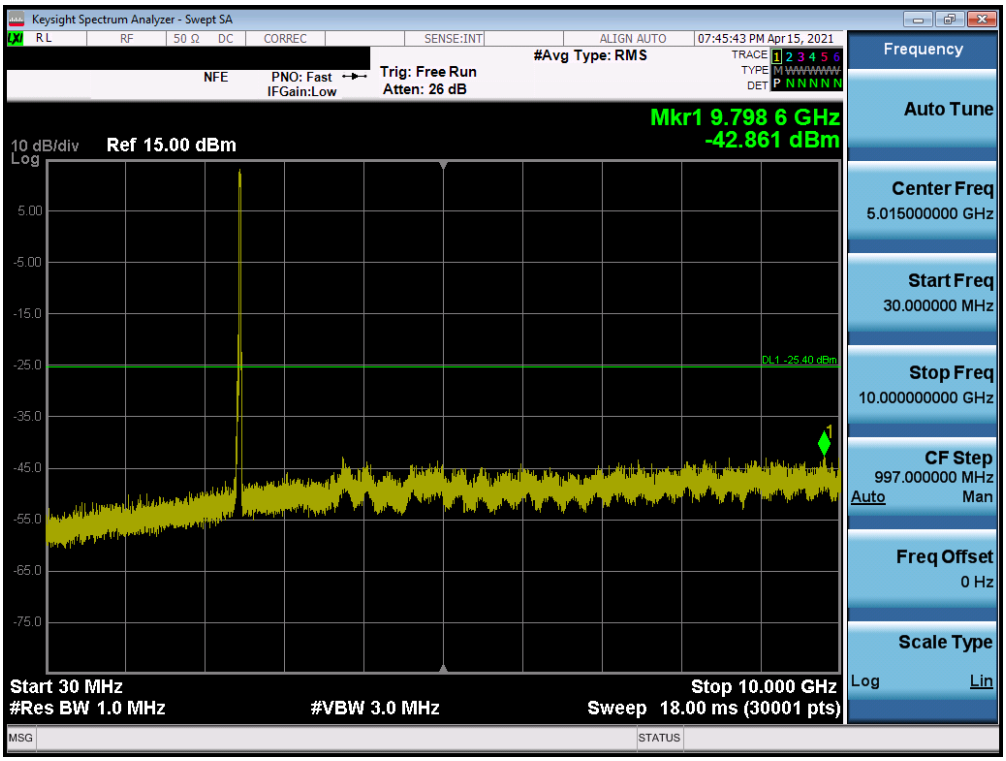
Plot 7-84. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 1) - N



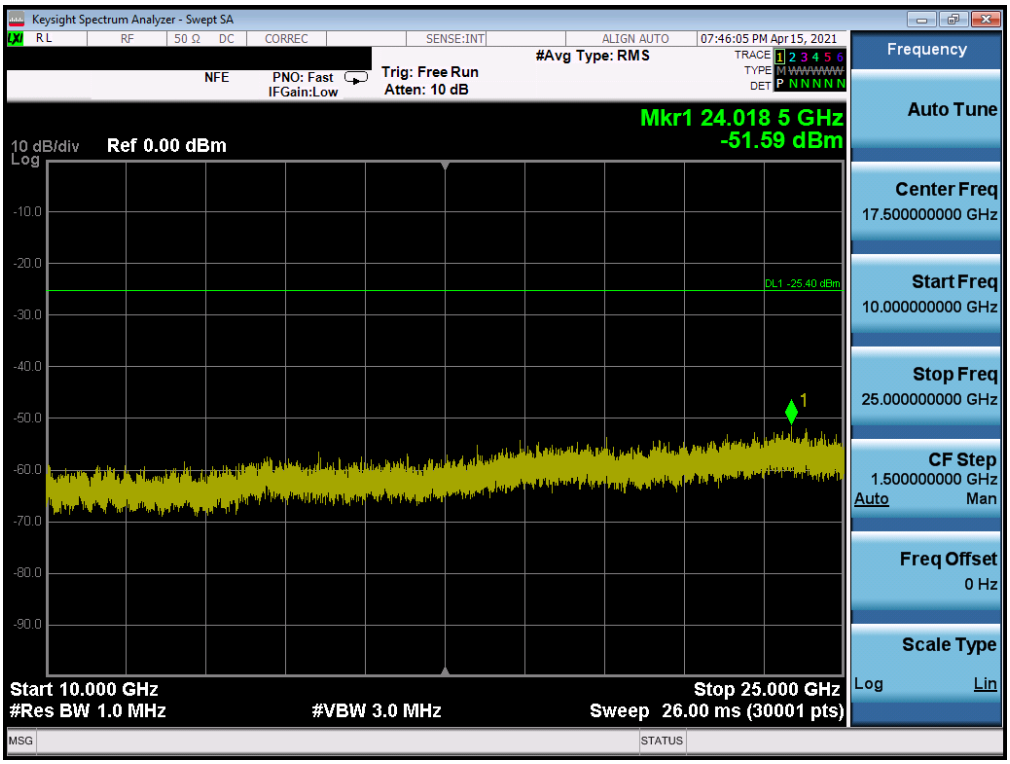
Plot 7-85. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - N



Plot 7-86. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 6) - N



Plot 7-87. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - N



Plot 7-88. Conducted Spurious Plot SISO ANT2 (802.11ax OFDMA – 242 Tones – Ch. 11) - N

7.7 Radiated Spurious Emission Measurements – Above 1 GHz

§15.247(d) §15.205 & §15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-15 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-15. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.6.4.3
KDB 558074 D01 v05r02 – Sections 8.6, 8.7

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Setup

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

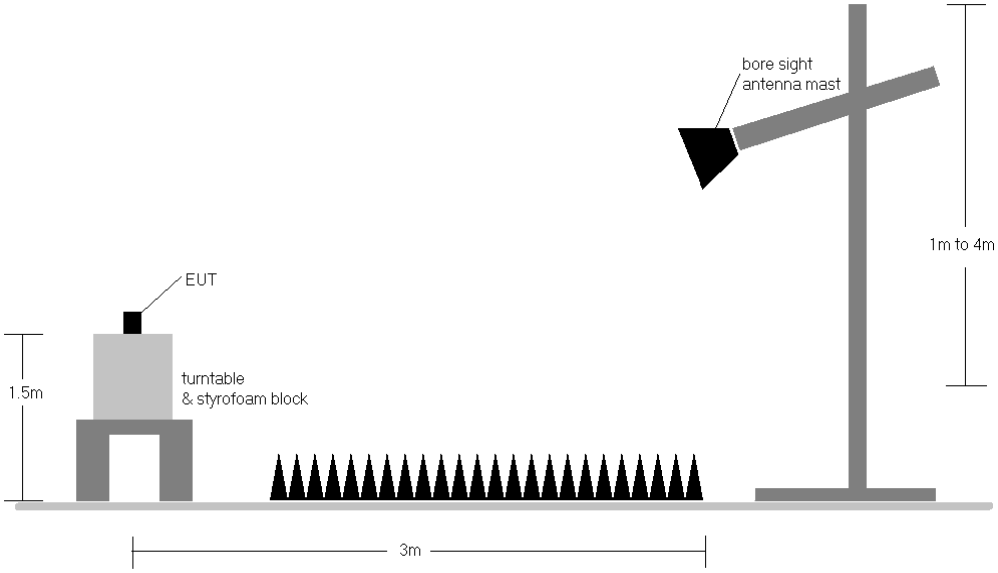


Figure 7-6. Test Instrument & Measurement Setup

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 D01 v05r02 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in Section 15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-15.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

9. Some band edge measurements were performed using a channel integration method to determine compliance with the out of band average radiated spurious emissions limit in the 2483.5 – 2500MHz band. Per KDB 558074 D01 v05r02 Section 13.3, a measurement was performed using a RBW of 100kHz at the frequency with highest emission outside of band edge. For integration that does not start at 2483.5MHz, consideration was taken to ensure the worst case emission is in the 1MHz spectrum. The results were integrated up to the 1MHz reference bandwidth to show compliance with the 15.209 radiated limit for emissions greater than 1GHz.
10. For radiated measurements, emissions were investigated for the fully-loaded RU configuration and for all the partially-loaded RU configurations. Among all of the available partially-loaded RU configurations, only the configuration with the worst case emissions is reported.
11. This device will be manufactured using two different WIFI chipsets (N and Q) and each chipset supports two configurations: one is with screen open, and one is with screen closed. Both configurations for each chipset are tested, and the worst case radiated emissions data is shown in this report.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.7 was calculated using the formula:
  Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain