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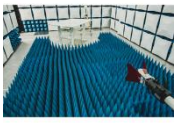

MEASUREMENT REPORT
WLAN 802.11ax OFDMA

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

Date of Testing:
12/10/2019 - 02/26/2020
Test Site/Location:
PCTEST. Morgan Hill, CA, USA
Test Report Serial No.:
1C1912170055-07.BCG

FCC ID:	**BCGA2232**
IC:	**579C-A2232**
APPLICANT:	**Apple Inc.**

Application Type:	Certification
Model/HVIN:	A2232, A2233
EUT Type:	Tablet Device
Frequency Range:	2412 – 2467MHz
FCC Classification:	Digital Transmission System (DTS)
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.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.02

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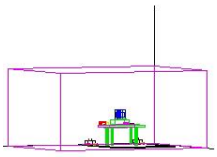
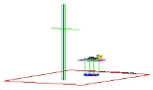


MEASUREMENT REPORT



Mode	RU	Tx Frequency [MHz]	Core 0				Core 1			
			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)
802.11ax OFDMA	26	2412 - 2467	23.714	13.75	164.059	22.15	25.061	13.99	151.008	21.79
802.11ax OFDMA	242	2412 - 2467	23.714	13.75	143.880	21.58	25.119	14.00	147.231	21.68

EUT Overview SISO

Mode	RU	Tx Frequency [MHz]	Core 0				Core 1				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)
802.11ax OFDMA	26	2412 - 2467	23.714	13.75	157.398	21.97	25.119	14.00	158.125	21.99	48.778	16.88	306.036	24.86
802.11ax OFDMA	242	2412 - 2467	23.714	13.75	143.880	21.58	25.119	14.00	147.571	21.69	48.778	16.88	291.451	24.65

EUT Overview CDD

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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 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 PCTEST located in Morgan Hill, CA 95037, U.S.A.

- PCTEST is an ISO 17025-2005 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.

- 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 (22831) test laboratory with the site description on file with ISED.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Apple Tablet Device FCC ID: BCGA2232**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

Test Device Serial No.: DLXZN00JP57G, DLXZN002P57G

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (1x, EDR, LE, 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. Frequency/ Channel Operations

*****Channel 13 is disabled for DTS 802.11ax HE20.

Note:

1. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of 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 [%]		
		CORE 0	CORE 1	CDD
2.4GHz	ax	98.9	98.7	99.0

Table 2-2. Measured Duty Cycles

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2. Ant 4a is correlating to Core 0 and Ant 2a is correlating to Core 1.
3. The device employs CDD technology. Below are the possible configurations.

WiFi Configurations		SISO		SDM		CCD	
		CORE 0	CORE 1	CORE 0	CORE 1	CORE 0	CORE 1
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

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

Simultaneous Tx	Antenna							
	4a				2a			
	Config 1	Config 2	Config 3	Config 4	Config 5	Config 6	Config 7	Config 8
WIFI 2.4GHz	✓	✓	×	×	✓	✓	×	×
Bluetooth (1x, EDR, LE, HDR4, HDR8)	×	×	✓	✓	×	×	✓	✓
LTE Mid Bands	✓	×	✓	×	✓	×	✓	×
LTE High Bands	×	✓	×	✓	×	✓	×	✓

Table 2-4. Simultaneous Tx Configurations

✓= Support; × = NOT Support

a. The worst simultaneous Tx configuration was found to be Bluetooth BDR and LTE High Band transmitting on antenna 4a. These results can be found in the RF Bluetooth and RF LTE FCC reports.

2.3 Antenna Description

Following antennas were used for the testing.

Frequency [GHz]	Antenna Gain (dBi)	
	Ant 4a	Ant 2a
2.4	-0.5	0.6

Table 2-5. Highest Antenna Gain

2.4 Test Support Equipment

1	Apple MacBook	Model:	A1398	S/N:	C2QKP008F6F3
	w/ AC/DC Adapter	Model:	A1435	S/N:	C04325505K1F288BG
2	Apple USB-C Cable	Model:	Chimp	S/N:	304523
3	USB-C Cable	Model:	A1997	S/N:	N/A
	w / AC/DC Adapter	Model:	A1720	S/N:	C3D9274B06YLHDAE
4	Apple Pencil	Model:	A2051	S/N:	GQXYGSXCJKM9
5	DC Power Supply	Model:	KPS3010D	S/N	N/A

Table 2-6. Test Support Equipment Used

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2.5 Test Configuration

The EUT was tested per the guidance of KDB 558074 D01 v05. 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 channel and the worst case configuration.

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 were reported in this test report.

For AC line conducted and radiated test below 1GHz, following configuration were investigated and worst case was reported.

- 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

For 802.11b/g/n test results, see separate WLAN report, 1C1912170055-06.BCG.

2.6 Software and Firmware

The test was conducted with firmware version 17E228 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.

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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.

Per KDB 414788, 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 used 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.

3.3 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).

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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.

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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	1.29
Line Conducted Disturbance	2.48
Radiated Disturbance (<1GHz)	4.15
Radiated Disturbance (>1GHz)	4.70
Radiated Disturbance (>18GHz)	5.01

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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	3/13/2019	Annual	3/13/2020	MY49430244
Anritsu	ML2496A	Power Meter	10/29/2019	Annual	10/29/2020	184005
Anritsu	MA2411B	Pulse Power Sensor	10/29/2019	Annual	10/29/2020	1726261
Anritsu	MA2411B	Pulse Power Sensor	10/29/2019	Annual	10/29/2020	1726262
ATM	180-442A-KF	20dB Nominal Gain Horn Antenna	10/29/2019	Annual	10/29/2020	T058701-02
COM-POWER	LIN-120A	LISN	3/13/2019	Annual	3/13/2020	241297
ETS-Lindgren	3142E–PA	Pre-Amplifier (30MHz - 6GHz)	9/19/2019	Annual	9/19/2020	213236
ETS-Lindgren	3142E	BiConiLog Antenna (30MHz - 6GHz)	8/14/2019	Annual	8/14/2020	224569
ETS-Lindgren	3117	Double Ridged Guide Antenna (1-18 GHz)	3/12/2019	Annual	3/12/2020	205956
Rohde & Schwarz	ESW26	EMI Test Receiver	5/21/2019	Annual	5/21/2020	101299
Rohde & Schwarz	ESW44	EMI Test Receiver	7/27/2019	Annual	7/27/2020	101668
Rohde & Schwarz	TS-PR1840	Pre-Amplifier (18GHz - 40GHz)	9/19/2019	Annual	9/19/2020	100051
Rohde & Schwarz	TC-TA18	Cross Polarized Vivaldi Antenna (400MHz-18GHz)	11/14/2019	Annual	11/14/2020	101057
Rohde & Schwarz	HFH2-Z2	Loop Antenna	3/21/2019	Annual	3/21/2020	100519

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Apple Inc.

FCC ID: BCGA2232

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, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	See WLAN Test Report (1C1912170055-06.BCG)

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 RU 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.

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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 v05 – 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. All antenna configurations 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 were reported.

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SISO Core 0 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	ax	26	0	2.106	0.500
2412	1	ax	26	4	2.707	0.500
2412	1	ax	26	8	2.111	0.500
2437	6	ax	26	0	2.118	0.500
2437	6	ax	26	4	2.705	0.500
2437	6	ax	26	8	2.102	0.500
2462	11	ax	26	0	2.115	0.500
2462	11	ax	26	4	2.698	0.500
2462	11	ax	26	8	15.830	0.500
2412	1	ax	242	61	18.560	0.500
2437	6	ax	242	61	19.010	0.500
2462	11	ax	242	61	18.670	0.500

Table 7-2. Conducted Bandwidth Measurements SISO CORE 0

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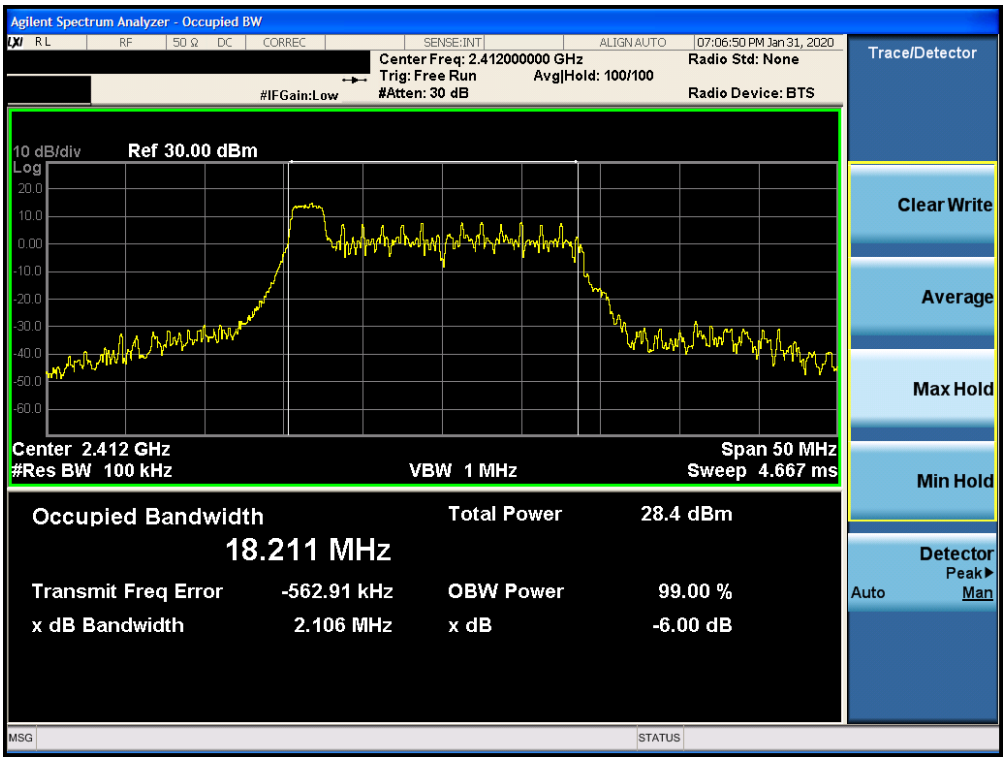
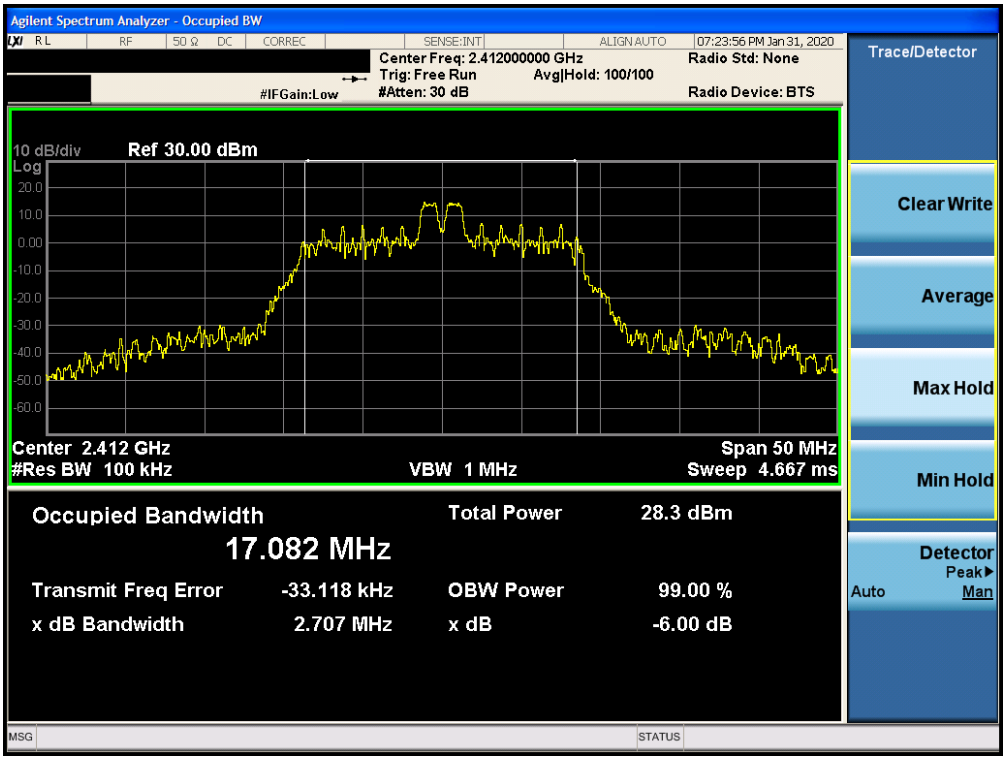


Plot 7-1. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



Plot 7-2. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 1)

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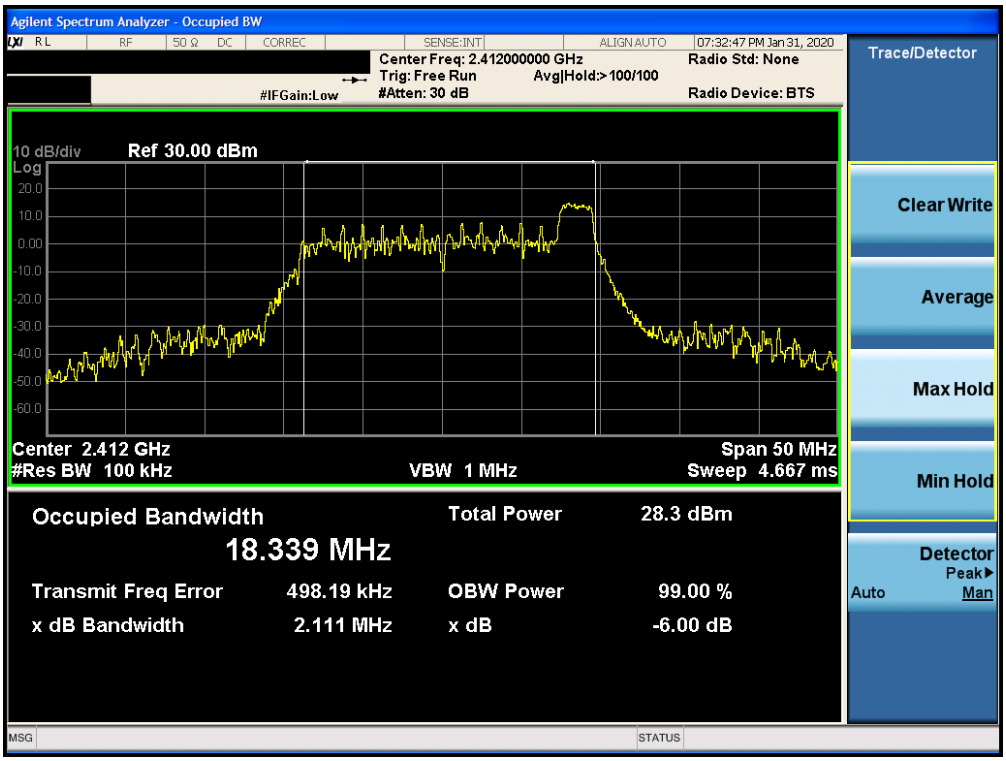
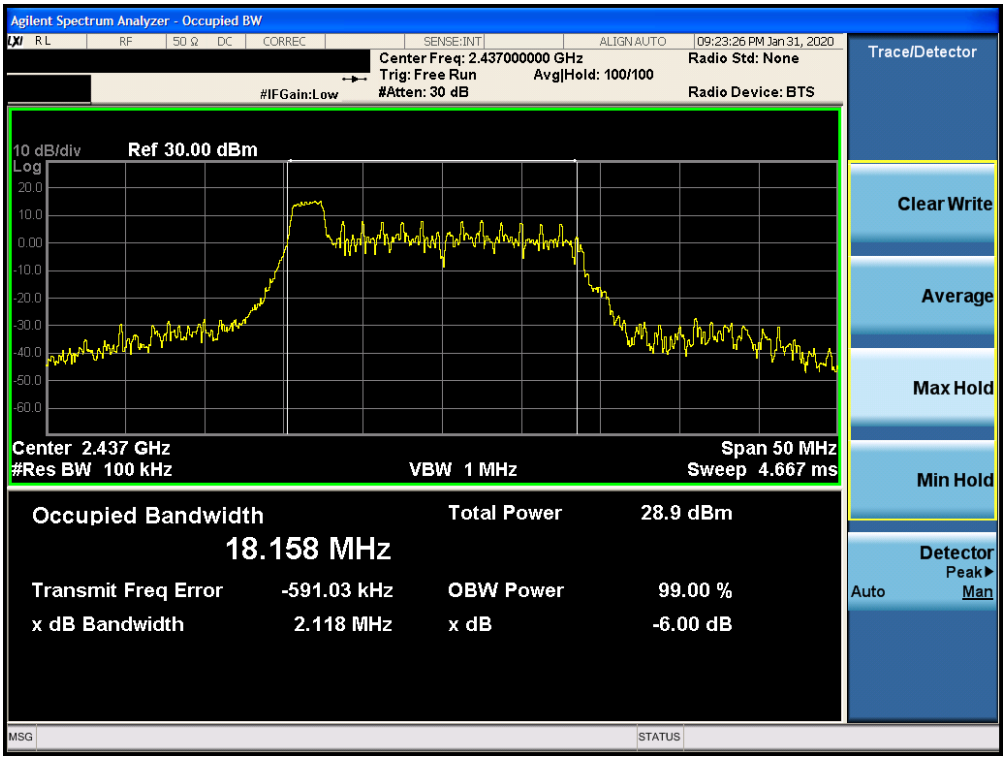


Plot 7-3. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



Plot 7-4. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 6)

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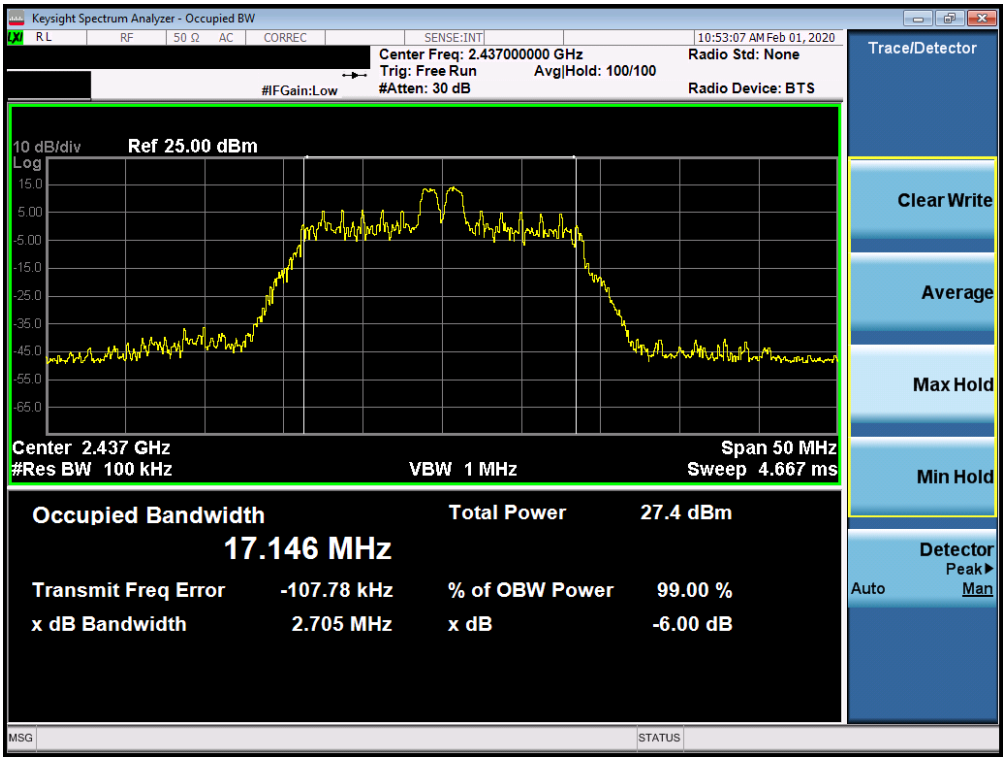
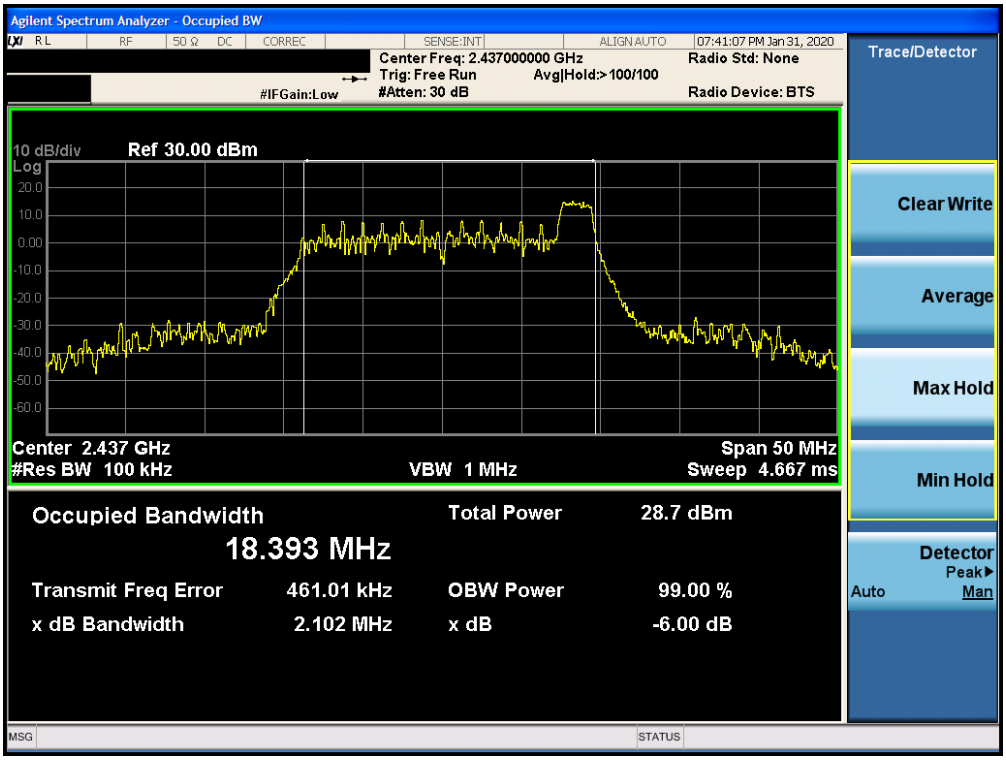


Plot 7-5. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



Plot 7-6. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 6)

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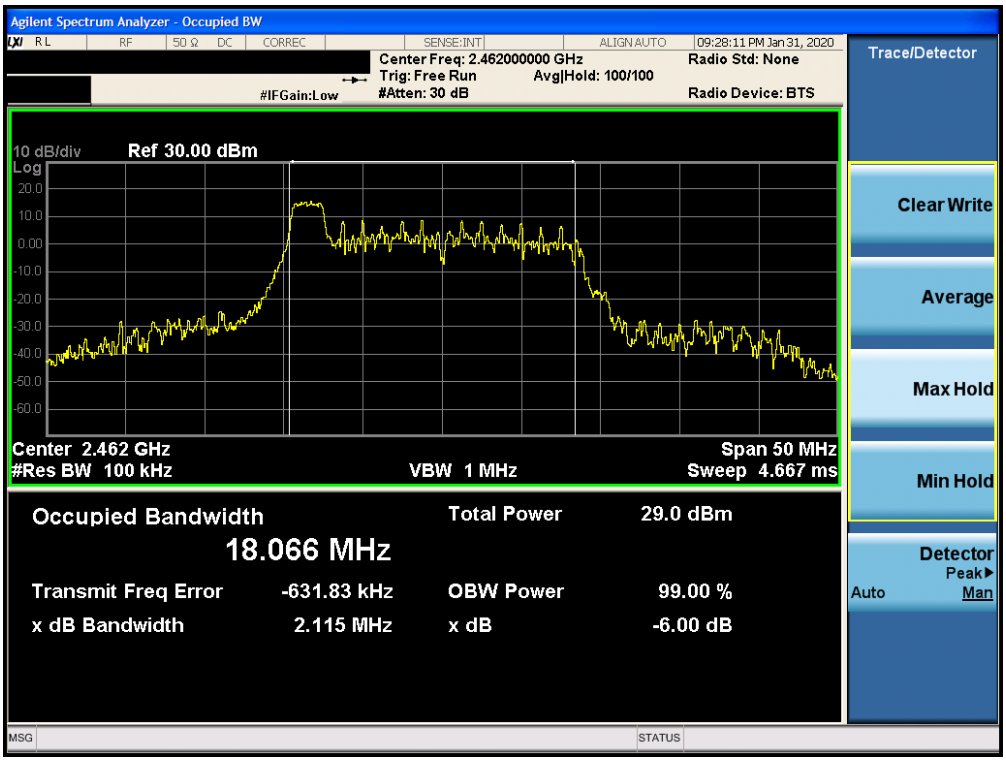
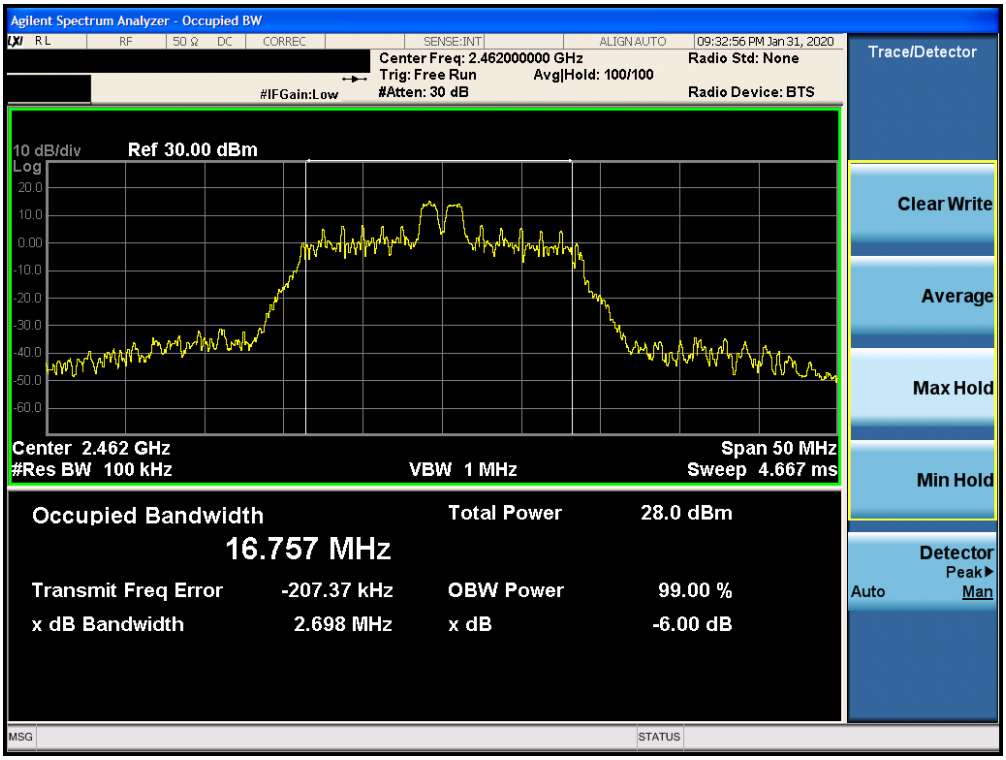


Plot 7-7. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



Plot 7-8. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 11)

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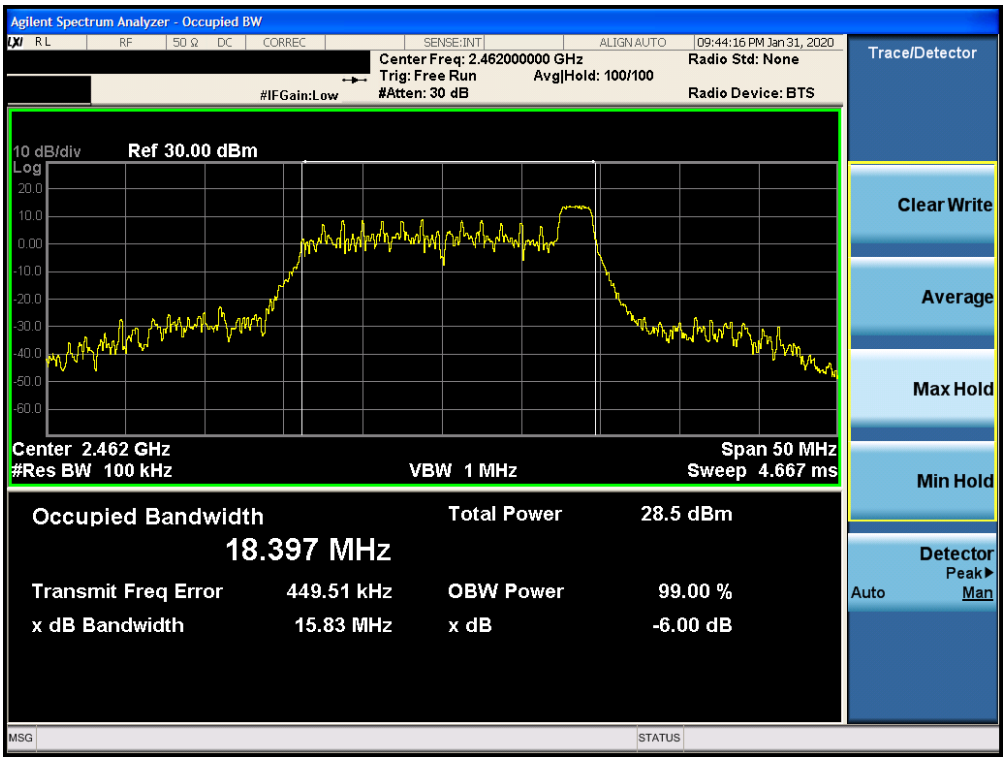
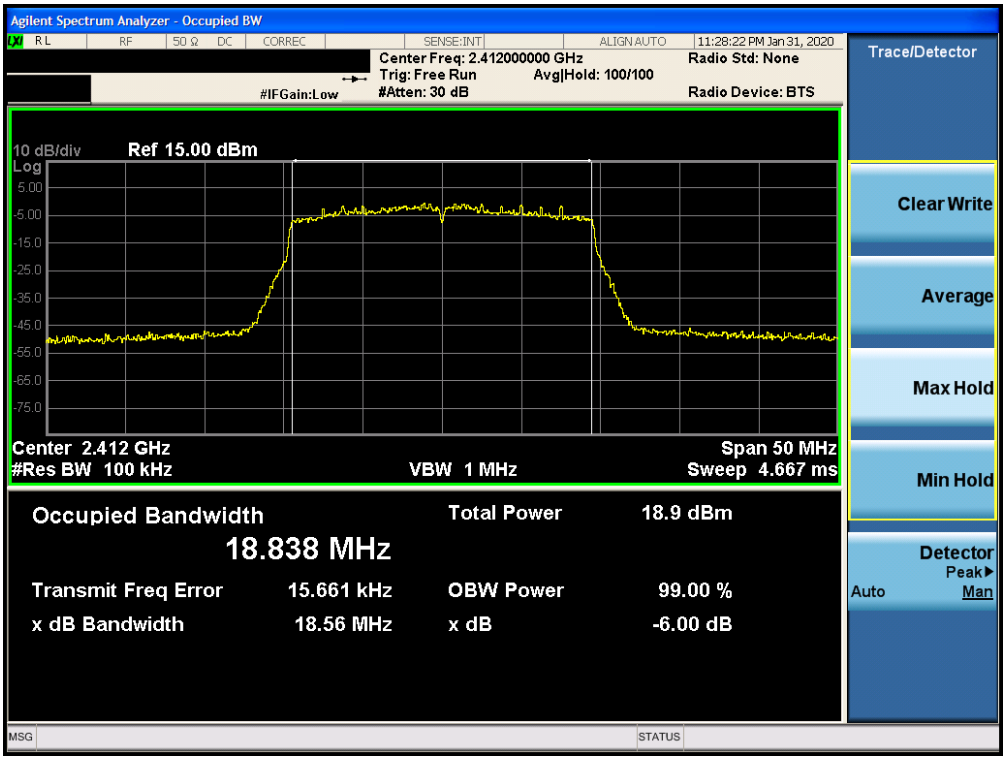


Plot 7-9. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-10. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 1)

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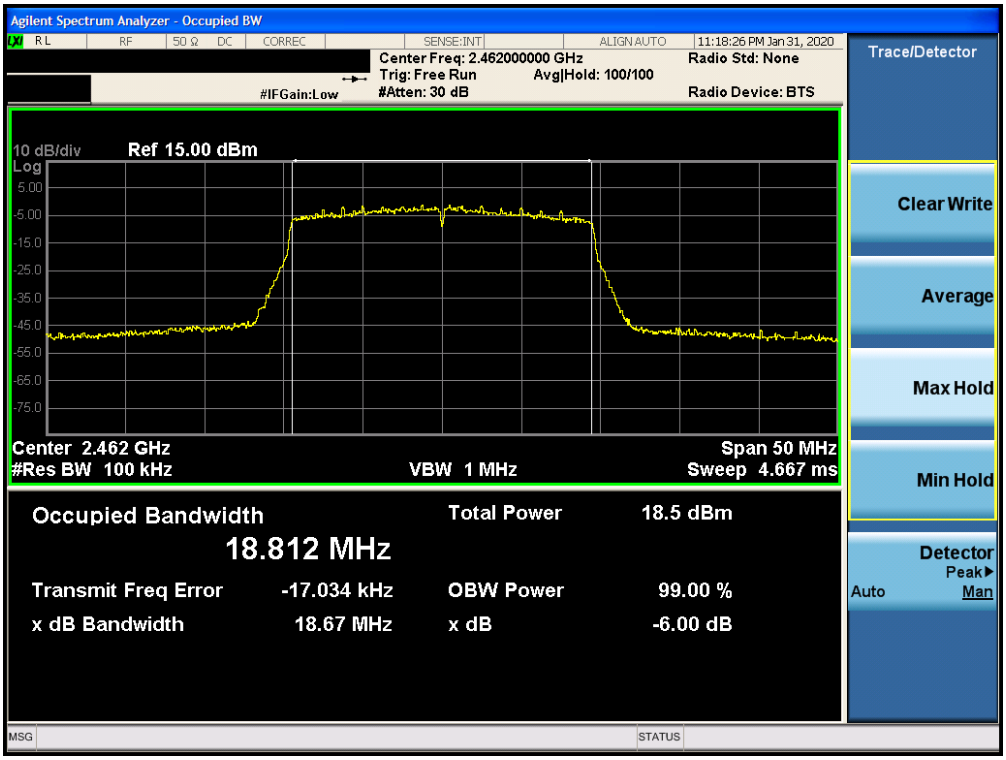
Plot 7-11. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-12. 6dB Bandwidth Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 11)

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SISO Core 1 6 dB Bandwidth Measurements

Frequency [MHz]	Channel No.	802.11 Mode	RU Size	RU Index	Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	ax	26	0	11.990	0.500
2412	1	ax	26	4	2.672	0.500
2412	1	ax	26	8	2.151	0.500
2437	6	ax	26	0	2.096	0.500
2437	6	ax	26	4	2.692	0.500
2437	6	ax	26	8	2.159	0.500
2462	11	ax	26	0	2.078	0.500
2462	11	ax	26	4	2.701	0.500
2462	11	ax	26	8	15.790	0.500
2412	1	ax	242	61	18.800	0.500
2437	6	ax	242	61	18.940	0.500
2462	11	ax	242	61	18.800	0.500

Table 7-3. Conducted Bandwidth Measurements SISO CORE 1

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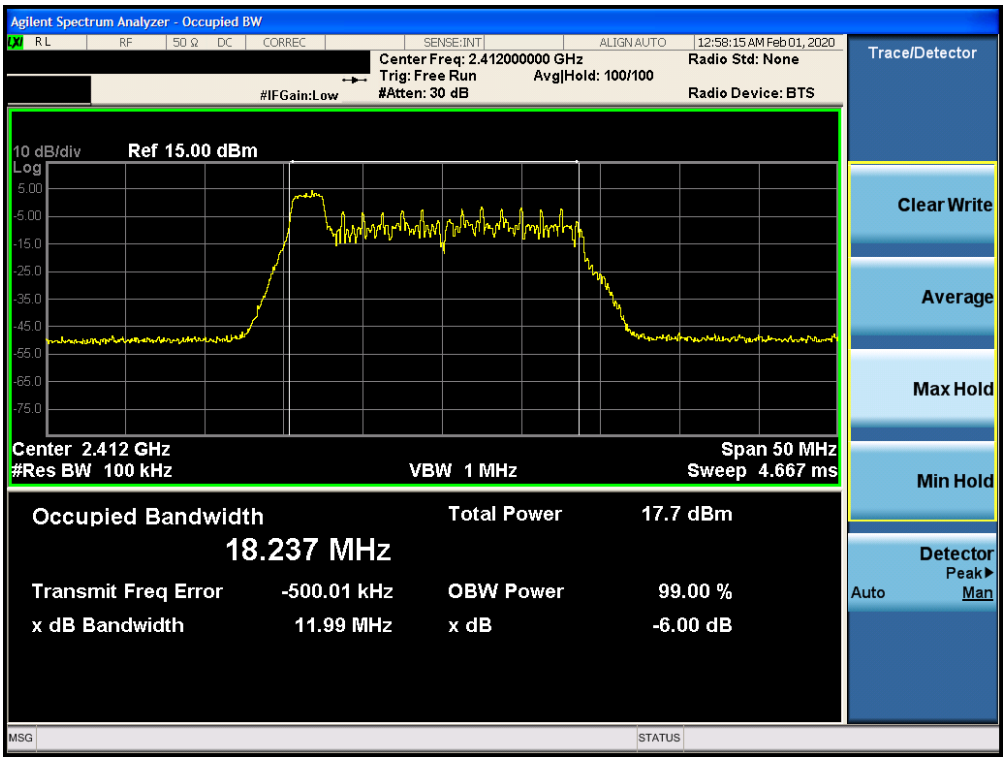
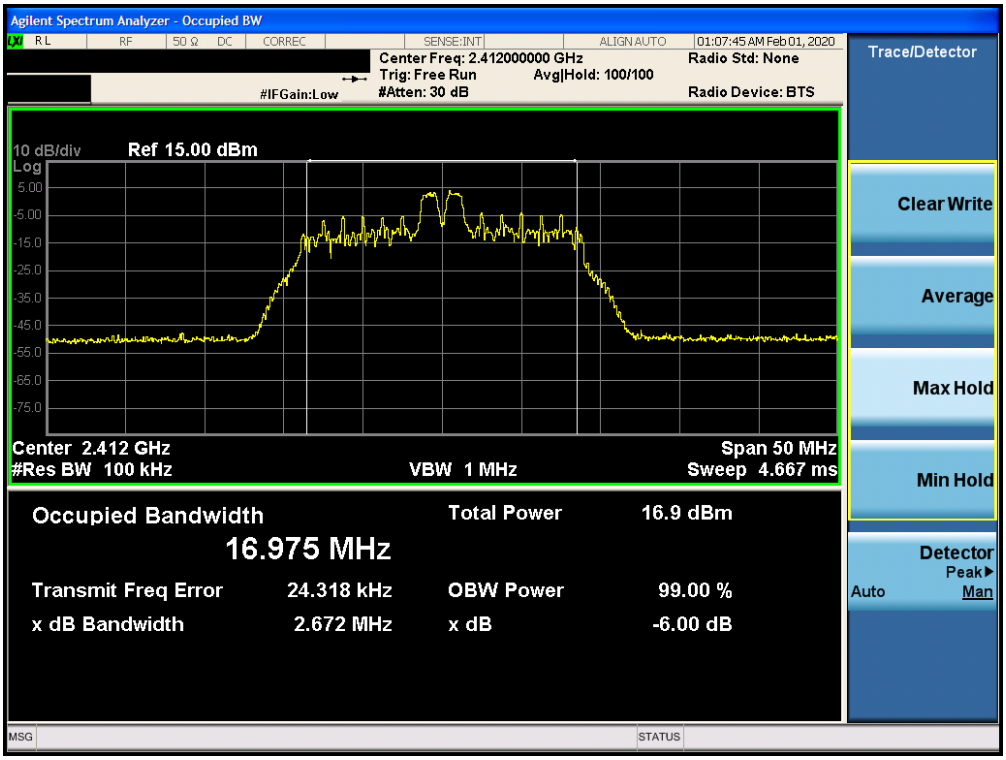


Plot 7-13. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



Plot 7-14. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 4 – Ch. 1)

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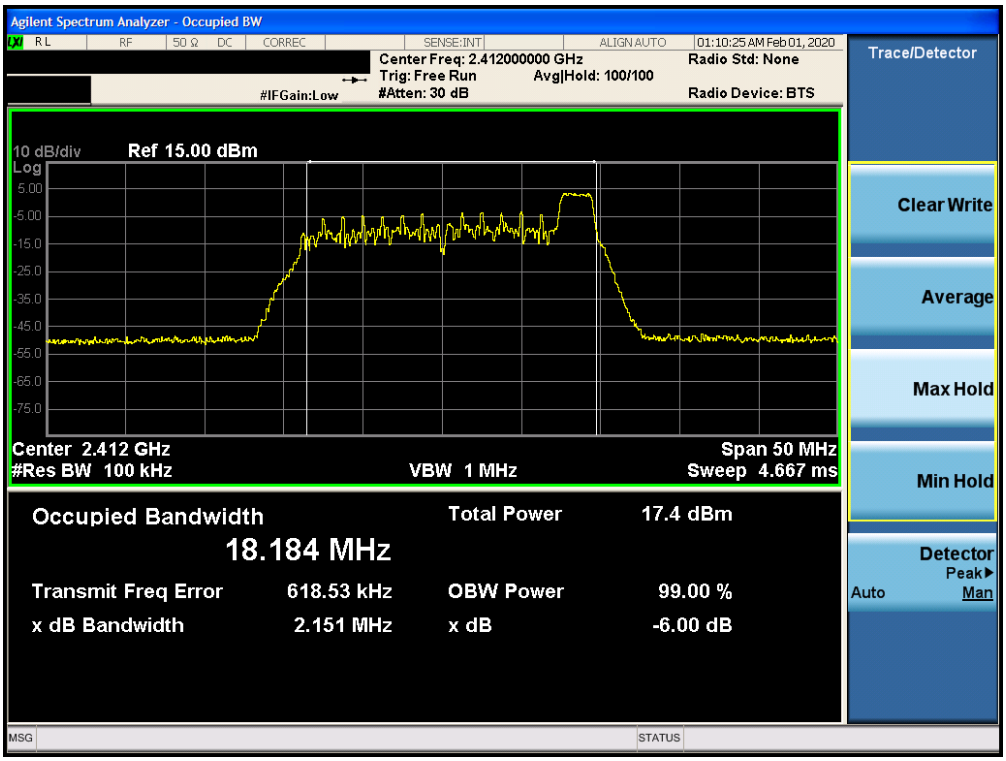
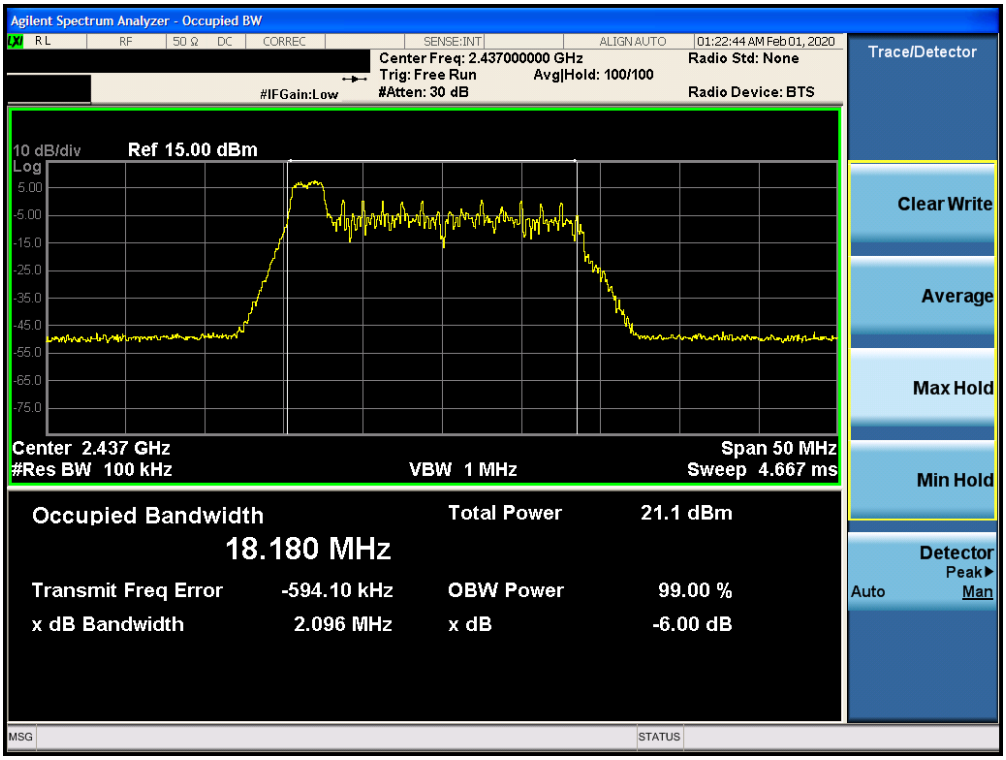


Plot 7-15. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



Plot 7-16. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 0 – Ch. 6)

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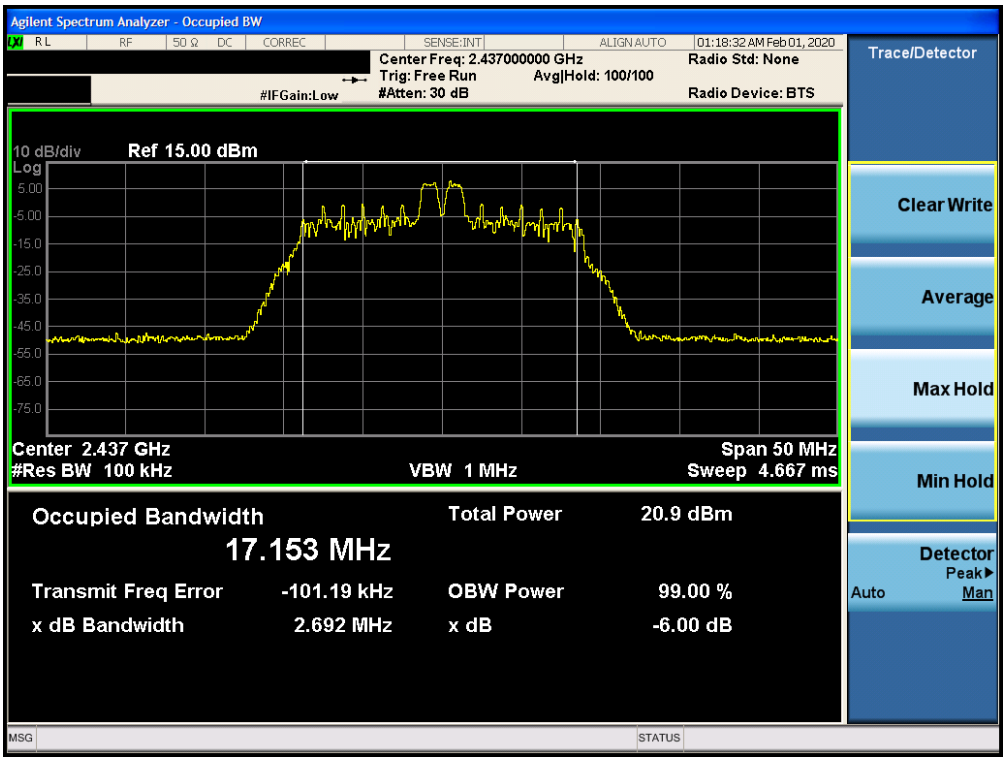
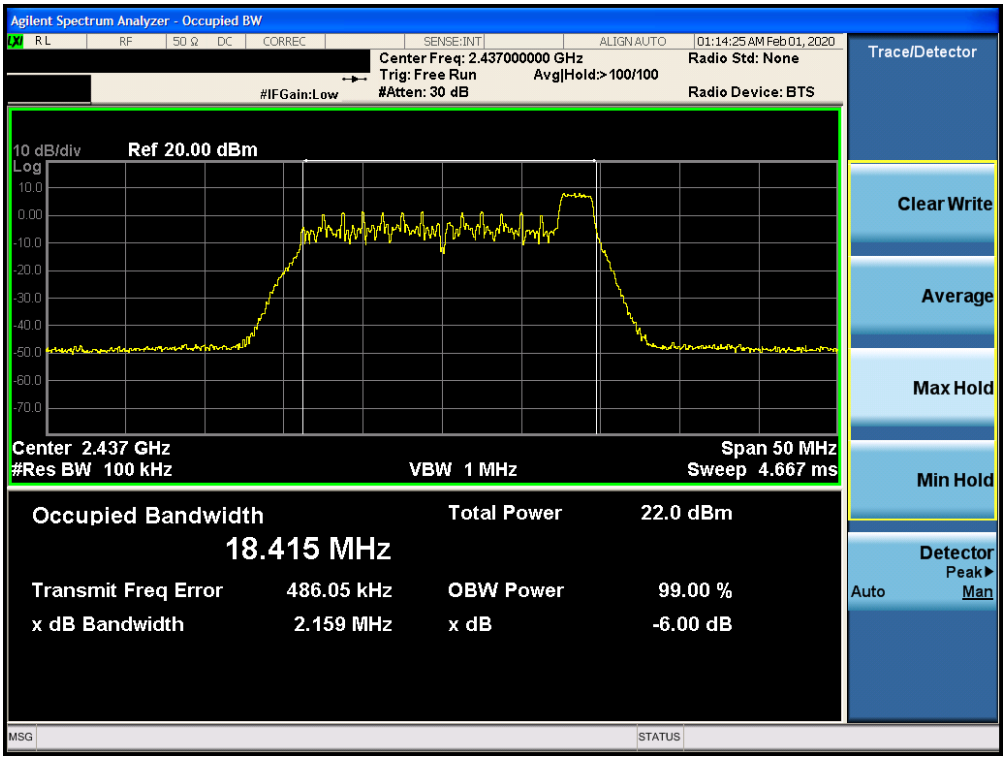


Plot 7-17. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



Plot 7-18. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 8 – Ch. 6)

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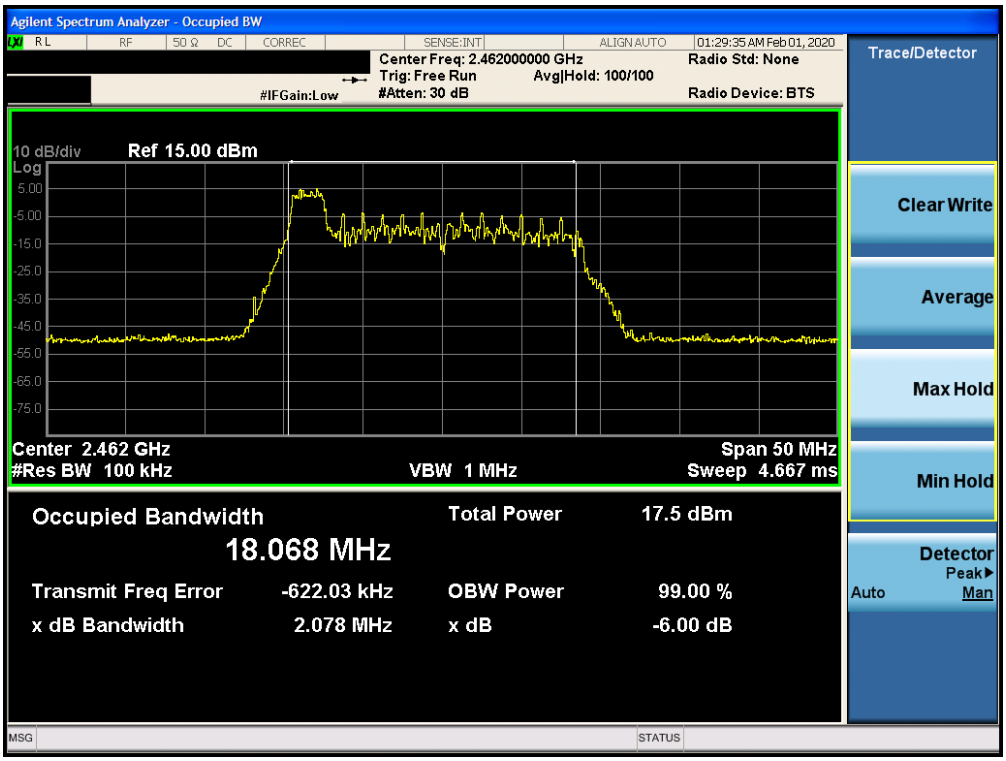
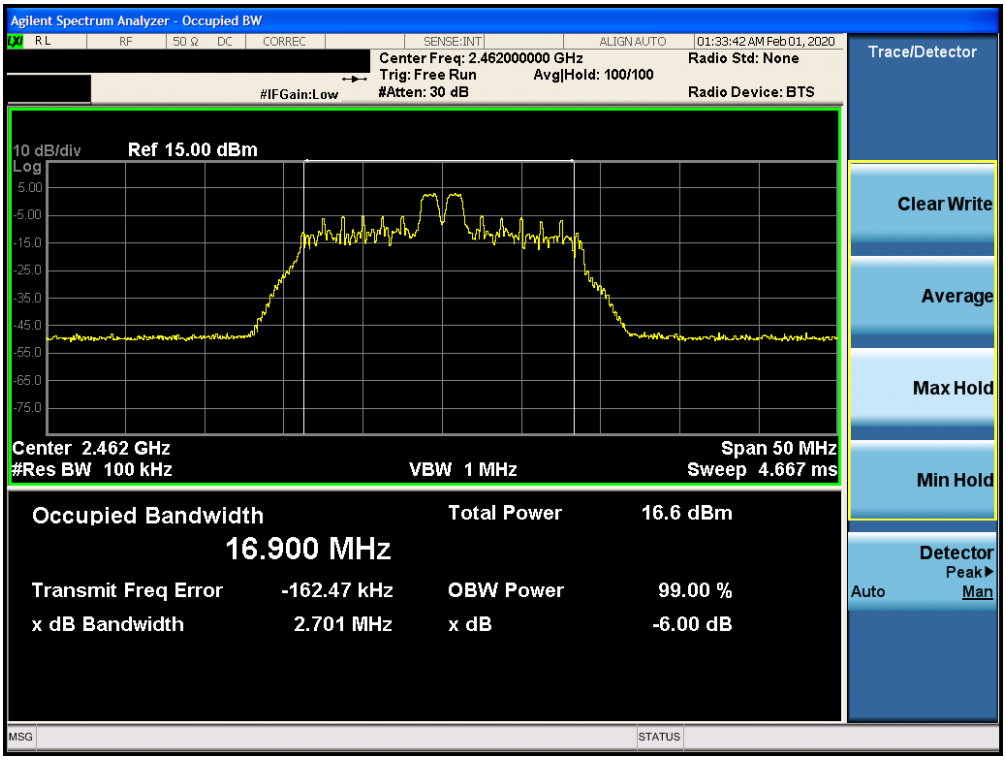


Plot 7-19. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



Plot 7-20. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 4 – Ch. 11)

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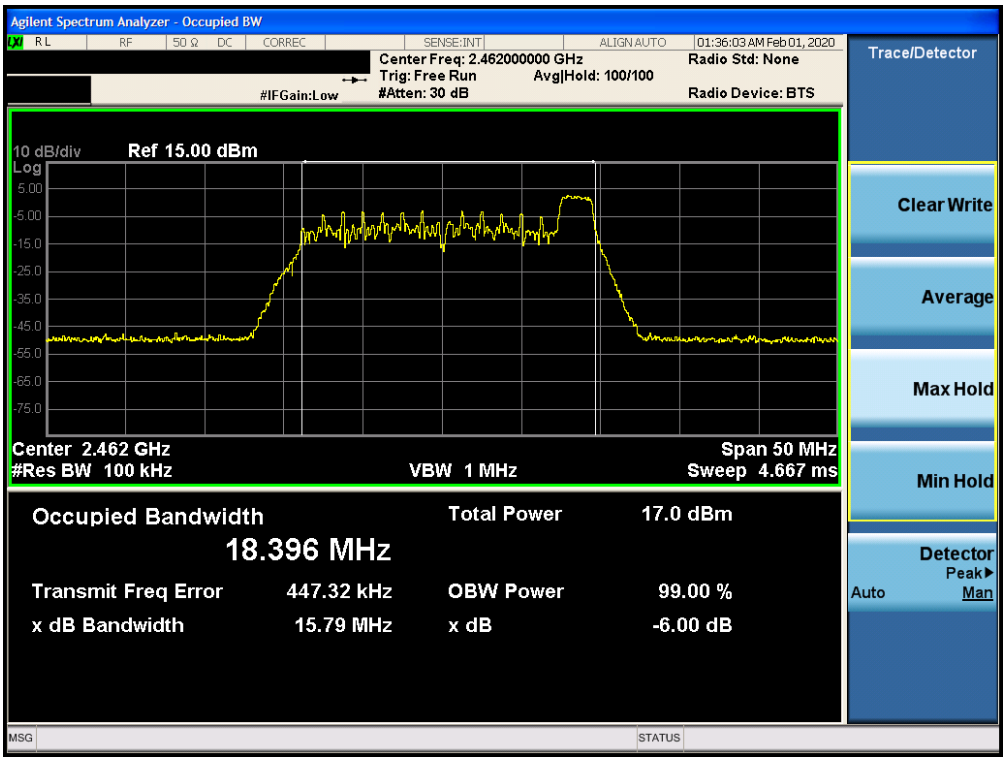
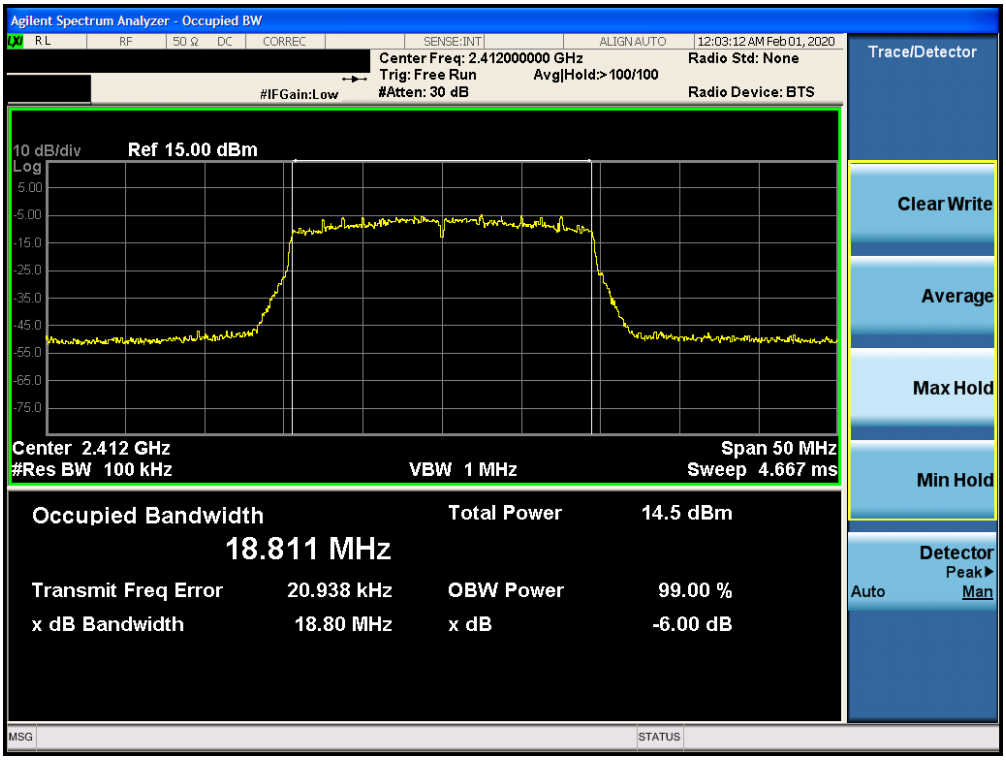


Plot 7-21. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-22. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU242 – Ch. 1)

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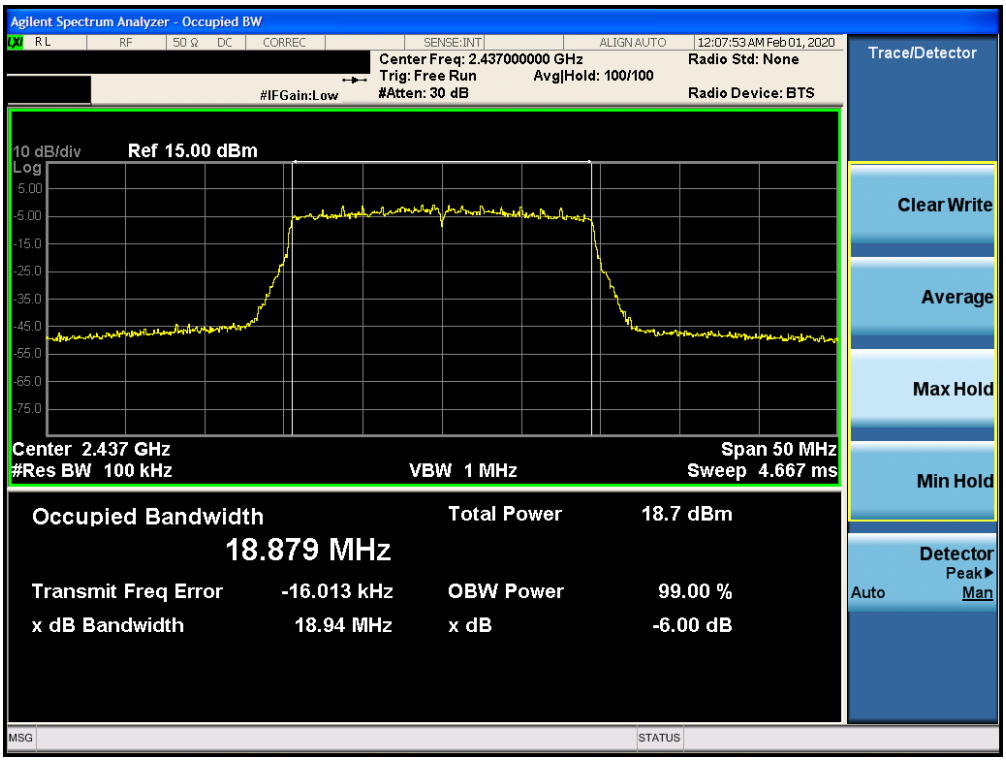
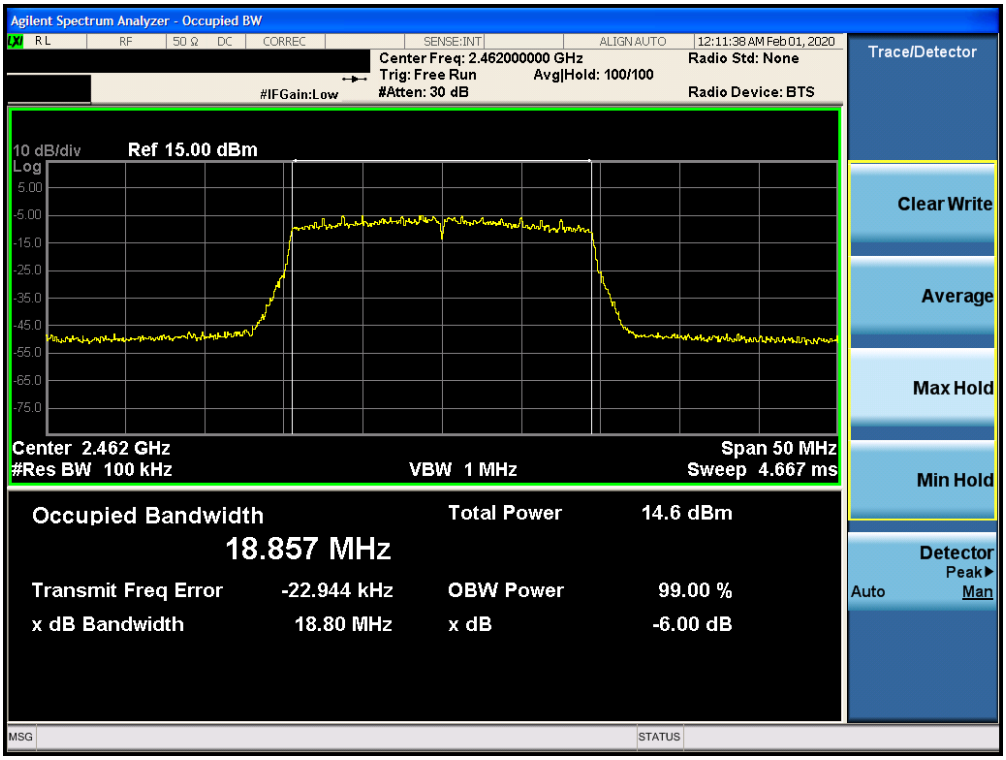


Plot 7-23. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-24. 6dB Bandwidth Plot SISO CORE 1 (802.11ax OFDMA – RU242 – Ch. 11)

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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 v05 – 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 v05 – 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

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

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7.3.1 Average Output Power Measurement

Freq [MHz]	Channel	RU Size	RU Index	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	AVG	12.45	30.00	-17.55	-0.50	11.95	36.02	-24.07
2412	1	26	4	AVG	12.50	30.00	-17.50	-0.50	12.00	36.02	-24.02
2412	1	26	8	AVG	12.40	30.00	-17.60	-0.50	11.90	36.02	-24.12
2417	2	26	0	AVG	12.48	30.00	-17.52	-0.50	11.98	36.02	-24.04
2417	2	26	4	AVG	13.28	30.00	-16.72	-0.50	12.78	36.02	-23.24
2417	2	26	8	AVG	13.75	30.00	-16.25	-0.50	13.25	36.02	-22.77
2437	6	26	0	AVG	13.66	30.00	-16.34	-0.50	13.16	36.02	-22.86
2437	6	26	4	AVG	13.64	30.00	-16.36	-0.50	13.14	36.02	-22.88
2437	6	26	8	AVG	13.75	30.00	-16.25	-0.50	13.25	36.02	-22.77
2452	9	26	0	AVG	11.12	30.00	-18.88	-0.50	10.62	36.02	-25.40
2452	9	26	4	AVG	13.48	30.00	-16.52	-0.50	12.98	36.02	-23.04
2452	9	26	8	AVG	13.66	30.00	-16.34	-0.50	13.16	36.02	-22.86
2457	10	26	0	AVG	13.46	30.00	-16.54	-0.50	12.96	36.02	-23.06
2457	10	26	4	AVG	13.20	30.00	-16.80	-0.50	12.70	36.02	-23.32
2457	10	26	8	AVG	12.91	30.00	-17.09	-0.50	12.41	36.02	-23.61
2462	11	26	0	AVG	12.00	30.00	-18.00	-0.50	11.50	36.02	-24.52
2462	11	26	4	AVG	11.90	30.00	-18.10	-0.50	11.40	36.02	-24.62
2462	11	26	8	AVG	11.83	30.00	-18.17	-0.50	11.33	36.02	-24.69
2467	12	26	0	AVG	9.87	30.00	-20.13	-0.50	9.37	36.02	-26.65
2467	12	26	4	AVG	10.00	30.00	-20.00	-0.50	9.50	36.02	-26.52
2467	12	26	8	AVG	9.96	30.00	-20.04	-0.50	9.46	36.02	-26.56

Table 7-4. Average Conducted Output Power Measurements SISO CORE 0 (RU26)

Freq [MHz]	Channel	RU Size	RU Index	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	AVG	12.49	30.00	-17.51	-0.50	11.99	36.02	-24.03
2417	2	242	61	AVG	13.64	30.00	-16.36	-0.50	13.14	36.02	-22.88
2437	6	242	61	AVG	13.75	30.00	-16.25	-0.50	13.25	36.02	-22.77
2452	9	242	61	AVG	13.71	30.00	-16.29	-0.50	13.21	36.02	-22.81
2457	10	242	61	AVG	13.49	30.00	-16.51	-0.50	12.99	36.02	-23.03
2462	11	242	61	AVG	12.00	30.00	-18.00	-0.50	11.50	36.02	-24.52
2467	12	242	61	AVG	9.95	30.00	-20.05	-0.50	9.45	36.02	-26.57

Table 7-5. Average Conducted Output Power Measurements SISO CORE 0 (RU242)

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Freq [MHz]	Channel	RU Size	RU Index	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	AVG	9.61	30.00	-20.39	0.60	10.21	36.02	-25.81
2412	1	26	4	AVG	10.15	30.00	-19.85	0.60	10.75	36.02	-25.27
2412	1	26	8	AVG	10.47	30.00	-19.53	0.60	11.07	36.02	-24.95
2417	2	26	0	AVG	13.06	30.00	-16.94	0.60	13.66	36.02	-22.36
2417	2	26	4	AVG	13.65	30.00	-16.35	0.60	14.25	36.02	-21.77
2417	2	26	8	AVG	13.98	30.00	-16.02	0.60	14.58	36.02	-21.44
2437	6	26	0	AVG	13.70	30.00	-16.30	0.60	14.30	36.02	-21.72
2437	6	26	4	AVG	13.56	30.00	-16.44	0.60	14.16	36.02	-21.86
2437	6	26	8	AVG	13.91	30.00	-16.09	0.60	14.51	36.02	-21.51
2452	9	26	0	AVG	12.32	30.00	-17.68	0.60	12.92	36.02	-23.10
2452	9	26	4	AVG	13.99	30.00	-16.01	0.60	14.59	36.02	-21.43
2452	9	26	8	AVG	12.89	30.00	-17.11	0.60	13.49	36.02	-22.53
2457	10	26	0	AVG	11.50	30.00	-18.50	0.60	12.10	36.02	-23.92
2457	10	26	4	AVG	11.01	30.00	-18.99	0.60	11.61	36.02	-24.41
2457	10	26	8	AVG	10.28	30.00	-19.72	0.60	10.88	36.02	-25.14
2462	11	26	0	AVG	9.95	30.00	-20.05	0.60	10.55	36.02	-25.47
2462	11	26	4	AVG	9.98	30.00	-20.02	0.60	10.58	36.02	-25.44
2462	11	26	8	AVG	9.90	30.00	-20.10	0.60	10.50	36.02	-25.52
2467	12	26	0	AVG	7.91	30.00	-22.09	0.60	8.51	36.02	-27.51
2467	12	26	4	AVG	8.00	30.00	-22.00	0.60	8.60	36.02	-27.42
2467	12	26	8	AVG	6.02	30.00	-23.98	0.60	6.62	36.02	-29.40

Table 7-6. Average Conducted Output Power Measurements SISO CORE 1 (RU26)

Freq [MHz]	Channel	RU Size	RU Index	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	AVG	10.45	30.00	-19.55	0.60	11.05	36.02	-24.97
2417	2	242	61	AVG	13.90	30.00	-16.10	0.60	14.50	36.02	-21.52
2437	6	242	61	AVG	14.00	30.00	-16.00	0.60	14.60	36.02	-21.42
2452	9	242	61	AVG	13.93	30.00	-16.07	0.60	14.53	36.02	-21.49
2457	10	242	61	AVG	11.40	30.00	-18.60	0.60	12.00	36.02	-24.02
2462	11	242	61	AVG	9.74	30.00	-20.26	0.60	10.34	36.02	-25.68
2467	12	242	61	AVG	8.00	30.00	-22.00	0.60	8.60	36.02	-27.42

Table 7-7. Average Conducted Output Power Measurements SISO CORE 1 (RU242)

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Freq [MHz]	Channel	RU Size	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
					Core 0	Core 1	Summed						
2412	1	26	0	AVG	11.76	9.43	13.76	30.00	-16.24	3.10	16.86	36.02	-19.16
2412	1	26	4	AVG	12.00	9.89	14.08	30.00	-15.92	3.10	17.18	36.02	-18.84
2412	1	26	8	AVG	11.98	10.00	14.11	30.00	-15.89	3.10	17.21	36.02	-18.81
2417	2	26	0	AVG	12.77	13.06	15.93	30.00	-14.07	3.10	19.03	36.02	-16.99
2417	2	26	4	AVG	13.59	13.70	16.66	30.00	-13.34	3.10	19.76	36.02	-16.26
2417	2	26	8	AVG	13.72	13.92	16.83	30.00	-13.17	3.10	19.93	36.02	-16.09
2437	6	26	0	AVG	13.23	13.80	16.53	30.00	-13.47	3.10	19.63	36.02	-16.39
2437	6	26	4	AVG	13.63	13.98	16.82	30.00	-13.18	3.10	19.92	36.02	-16.10
2437	6	26	8	AVG	13.74	14.00	16.88	30.00	-13.12	3.10	19.98	36.02	-16.04
2452	9	26	0	AVG	11.36	12.23	14.83	30.00	-15.17	3.10	17.93	36.02	-18.09
2452	9	26	4	AVG	13.67	13.91	16.80	30.00	-13.20	3.10	19.90	36.02	-16.12
2452	9	26	8	AVG	13.75	13.00	16.40	30.00	-13.60	3.10	19.50	36.02	-16.52
2457	10	26	0	AVG	13.00	11.00	15.12	30.00	-14.88	3.10	18.22	36.02	-17.80
2457	10	26	4	AVG	12.97	10.55	14.94	30.00	-15.06	3.10	18.04	36.02	-17.98
2457	10	26	8	AVG	12.66	9.79	14.47	30.00	-15.53	3.10	17.57	36.02	-18.45
2462	11	26	0	AVG	11.36	9.45	13.52	30.00	-16.48	3.10	16.62	36.02	-19.40
2462	11	26	4	AVG	11.24	9.11	13.31	30.00	-16.69	3.10	16.41	36.02	-19.61
2462	11	26	8	AVG	10.81	8.64	12.87	30.00	-17.13	3.10	15.97	36.02	-20.05
2467	12	26	0	AVG	9.00	6.92	11.09	30.00	-18.91	3.10	14.19	36.02	-21.83
2467	12	26	4	AVG	8.78	6.30	10.72	30.00	-19.28	3.10	13.82	36.02	-22.20
2467	12	26	8	AVG	7.84	4.37	9.45	30.00	-20.55	3.10	12.55	36.02	-23.47

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

Freq [MHz]	Channel	RU Size	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
					Core 0	Core 1	Summed						
2412	1	242	61	AVG	12.00	9.98	14.12	30.00	-15.88	3.10	17.22	36.02	-18.80
2417	2	242	61	AVG	13.75	13.93	16.85	30.00	-13.15	3.10	19.95	36.02	-16.07
2437	6	242	61	AVG	13.72	14.00	16.87	30.00	-13.13	3.10	19.97	36.02	-16.05
2452	9	242	61	AVG	13.74	14.00	16.88	30.00	-13.12	3.10	19.98	36.02	-16.04
2457	10	242	61	AVG	13.00	11.00	15.12	30.00	-14.88	3.10	18.22	36.02	-17.80
2462	11	242	61	AVG	11.43	9.50	13.58	30.00	-16.42	3.10	16.68	36.02	-19.34
2467	12	242	61	AVG	8.92	7.00	11.08	30.00	-18.92	3.10	14.18	36.02	-21.85

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

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7.3.2 Peak Output Power Measurement

Freq [MHz]	Channel	RU Size	RU Index	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	PEAK	21.69	30.00	-8.31	-0.50	21.19	36.02	-14.83
2412	1	26	4	PEAK	20.32	30.00	-9.68	-0.50	19.82	36.02	-16.20
2412	1	26	8	PEAK	20.28	30.00	-9.72	-0.50	19.78	36.02	-16.24
2417	2	26	0	PEAK	21.76	30.00	-8.24	-0.50	21.26	36.02	-14.76
2417	2	26	4	PEAK	21.05	30.00	-8.95	-0.50	20.55	36.02	-15.47
2417	2	26	8	PEAK	21.62	30.00	-8.38	-0.50	21.12	36.02	-14.90
2437	6	26	0	PEAK	21.61	30.00	-8.39	-0.50	21.11	36.02	-14.91
2437	6	26	4	PEAK	21.44	30.00	-8.56	-0.50	20.94	36.02	-15.08
2437	6	26	8	PEAK	21.83	30.00	-8.17	-0.50	21.33	36.02	-14.69
2452	9	26	0	PEAK	19.64	30.00	-10.36	-0.50	19.14	36.02	-16.88
2452	9	26	4	PEAK	21.25	30.00	-8.75	-0.50	20.75	36.02	-15.27
2452	9	26	8	PEAK	21.54	30.00	-8.46	-0.50	21.04	36.02	-14.98
2457	10	26	0	PEAK	22.15	30.00	-7.85	-0.50	21.65	36.02	-14.37
2457	10	26	4	PEAK	20.97	30.00	-9.03	-0.50	20.47	36.02	-15.55
2457	10	26	8	PEAK	20.86	30.00	-9.14	-0.50	20.36	36.02	-15.66
2462	11	26	0	PEAK	20.66	30.00	-9.34	-0.50	20.16	36.02	-15.86
2462	11	26	4	PEAK	19.77	30.00	-10.23	-0.50	19.27	36.02	-16.75
2462	11	26	8	PEAK	20.00	30.00	-10.00	-0.50	19.50	36.02	-16.52
2467	12	26	0	PEAK	18.11	30.00	-11.89	-0.50	17.61	36.02	-18.41
2467	12	26	4	PEAK	17.78	30.00	-12.22	-0.50	17.28	36.02	-18.74
2467	12	26	8	PEAK	18.17	30.00	-11.83	-0.50	17.67	36.02	-18.35

Table 7-10. Peak Conducted Output Power Measurements SISO CORE 0 (RU26)

Freq [MHz]	Channel	RU Size	RU Index	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	PEAK	20.45	30.00	-9.55	-0.50	19.95	36.02	-16.07
2417	2	242	61	PEAK	21.50	30.00	-8.50	-0.50	21.00	36.02	-15.02
2437	6	242	61	PEAK	21.58	30.00	-8.42	-0.50	21.08	36.02	-14.94
2452	9	242	61	PEAK	21.52	30.00	-8.48	-0.50	21.02	36.02	-15.00
2457	10	242	61	PEAK	21.44	30.00	-8.56	-0.50	20.94	36.02	-15.08
2462	11	242	61	PEAK	20.08	30.00	-9.92	-0.50	19.58	36.02	-16.44
2467	12	242	61	PEAK	17.76	30.00	-12.24	-0.50	17.26	36.02	-18.76

Table 7-11. Peak Conducted Output Power Measurements SISO CORE 0 (RU242)

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Freq [MHz]	Channel	RU Size	RU Index	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	PEAK	18.32	30.00	-11.68	0.60	18.92	36.02	-17.10
2412	1	26	4	PEAK	17.96	30.00	-12.04	0.60	18.56	36.02	-17.46
2412	1	26	8	PEAK	18.25	30.00	-11.75	0.60	18.85	36.02	-17.17
2417	2	26	0	PEAK	21.57	30.00	-8.43	0.60	22.17	36.02	-13.85
2417	2	26	4	PEAK	21.34	30.00	-8.66	0.60	21.94	36.02	-14.08
2417	2	26	8	PEAK	21.79	30.00	-8.21	0.60	22.39	36.02	-13.63
2437	6	26	0	PEAK	21.46	30.00	-8.54	0.60	22.06	36.02	-13.96
2437	6	26	4	PEAK	21.27	30.00	-8.73	0.60	21.87	36.02	-14.15
2437	6	26	8	PEAK	21.71	30.00	-8.29	0.60	22.31	36.02	-13.71
2452	9	26	0	PEAK	20.29	30.00	-9.71	0.60	20.89	36.02	-15.13
2452	9	26	4	PEAK	21.66	30.00	-8.34	0.60	22.26	36.02	-13.76
2452	9	26	8	PEAK	20.92	30.00	-9.08	0.60	21.52	36.02	-14.50
2457	10	26	0	PEAK	19.42	30.00	-10.58	0.60	20.02	36.02	-16.00
2457	10	26	4	PEAK	18.68	30.00	-11.32	0.60	19.28	36.02	-16.74
2457	10	26	8	PEAK	18.51	30.00	-11.49	0.60	19.11	36.02	-16.91
2462	11	26	0	PEAK	17.96	30.00	-12.04	0.60	18.56	36.02	-17.46
2462	11	26	4	PEAK	17.81	30.00	-12.19	0.60	18.41	36.02	-17.61
2462	11	26	8	PEAK	18.16	30.00	-11.84	0.60	18.76	36.02	-17.26
2467	12	26	0	PEAK	15.88	30.00	-14.12	0.60	16.48	36.02	-19.54
2467	12	26	4	PEAK	15.77	30.00	-14.23	0.60	16.37	36.02	-19.65
2467	12	26	8	PEAK	14.63	30.00	-15.37	0.60	15.23	36.02	-20.79

Table 7-12. Peak Conducted Output Power Measurements SISO CORE 1 (RU26)

Freq [MHz]	Channel	RU Size	RU Index	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	PEAK	18.26	30.00	-11.74	0.60	18.86	36.02	-17.16
2417	2	242	61	PEAK	21.63	30.00	-8.37	0.60	22.23	36.02	-13.79
2437	6	242	61	PEAK	21.68	30.00	-8.32	0.60	22.28	36.02	-13.74
2452	9	242	61	PEAK	21.63	30.00	-8.37	0.60	22.23	36.02	-13.79
2457	10	242	61	PEAK	19.06	30.00	-10.94	0.60	19.66	36.02	-16.36
2462	11	242	61	PEAK	17.46	30.00	-12.54	0.60	18.06	36.02	-17.96
2467	12	242	61	PEAK	15.82	30.00	-14.18	0.60	16.42	36.02	-19.60

Table 7-13. Peak Conducted Output Power Measurements SISO CORE 1 (RU242)

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Freq [MHz]	Channel	RU Size	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
					Core 0	Core 1	Summed						
2412	1	26	0	PEAK	19.82	17.38	21.78	30.00	-8.22	3.10	24.88	36.02	-11.14
2412	1	26	4	PEAK	19.88	17.71	21.94	30.00	-8.06	3.10	25.04	36.02	-10.98
2412	1	26	8	PEAK	19.92	17.90	22.04	30.00	-7.96	3.10	25.14	36.02	-10.88
2417	2	26	0	PEAK	21.97	21.62	24.81	30.00	-5.19	3.10	27.91	36.02	-8.11
2417	2	26	4	PEAK	21.25	21.32	24.30	30.00	-5.70	3.10	27.40	36.02	-8.63
2417	2	26	8	PEAK	21.56	21.53	24.56	30.00	-5.44	3.10	27.66	36.02	-8.37
2437	6	26	0	PEAK	21.10	21.72	24.43	30.00	-5.57	3.10	27.53	36.02	-8.49
2437	6	26	4	PEAK	21.38	21.71	24.56	30.00	-5.44	3.10	27.66	36.02	-8.36
2437	6	26	8	PEAK	21.70	21.99	24.86	30.00	-5.14	3.10	27.96	36.02	-8.06
2452	9	26	0	PEAK	19.85	20.19	23.03	30.00	-6.97	3.10	26.13	36.02	-9.89
2452	9	26	4	PEAK	21.40	21.57	24.50	30.00	-5.50	3.10	27.60	36.02	-8.42
2452	9	26	8	PEAK	21.64	20.88	24.29	30.00	-5.71	3.10	27.39	36.02	-8.63
2457	10	26	0	PEAK	21.73	18.86	23.54	30.00	-6.46	3.10	26.64	36.02	-9.38
2457	10	26	4	PEAK	20.72	18.16	22.64	30.00	-7.36	3.10	25.74	36.02	-10.28
2457	10	26	8	PEAK	20.63	17.92	22.49	30.00	-7.51	3.10	25.59	36.02	-10.43
2462	11	26	0	PEAK	19.84	17.10	21.69	30.00	-8.31	3.10	24.79	36.02	-11.23
2462	11	26	4	PEAK	19.00	16.67	21.00	30.00	-9.00	3.10	24.10	36.02	-11.92
2462	11	26	8	PEAK	18.91	17.05	21.09	30.00	-8.91	3.10	24.19	36.02	-11.83
2467	12	26	0	PEAK	17.30	14.58	19.16	30.00	-10.84	3.10	22.26	36.02	-13.76
2467	12	26	4	PEAK	16.54	13.92	18.43	30.00	-11.57	3.10	21.53	36.02	-14.49
2467	12	26	8	PEAK	16.11	13.16	17.89	30.00	-12.11	3.10	20.99	36.02	-15.03

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

Freq [MHz]	Channel	RU Size	RU Index	Detector	Conducted Power [dBm]			Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
					Core 0	Core 1	Summed						
2412	1	242	61	PEAK	19.96	17.78	22.02	30.00	-7.98	3.10	25.12	36.02	-10.90
2417	2	242	61	PEAK	21.57	21.64	24.62	30.00	-5.38	3.10	27.72	36.02	-8.31
2437	6	242	61	PEAK	21.50	21.68	24.60	30.00	-5.40	3.10	27.70	36.02	-8.32
2452	9	242	61	PEAK	21.58	21.69	24.65	30.00	-5.35	3.10	27.75	36.02	-8.27
2457	10	242	61	PEAK	21.05	18.70	23.04	30.00	-6.96	3.10	26.14	36.02	-9.88
2462	11	242	61	PEAK	19.36	17.19	21.42	30.00	-8.58	3.10	24.52	36.02	-11.50
2467	12	242	61	PEAK	16.75	14.82	18.90	30.00	-11.10	3.10	22.00	36.02	-14.02

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

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Note:

Per ANSI C63.10-2013 and KDB 662911 D01 v02r01 Section E)1), the conducted powers at Core 0 and Core 1 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.

Sample CDD Calculation:

At 2412MHz the average conducted output power was measured to be 12 dBm for Core 0 and 9.98 dBm for Core 1.

Core0 + Core1 = CDD

(12 dBm + 9.98 dBm) = (15.849 mW + 9.954 mW) = 25.803 mW = 14.12 dBm

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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 – Section 11.10.2 Method PKPSD
KDB 558074 D01 v05 – 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

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

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SISO Core 0 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	RU Size	Index	Data Rate [Mbps]	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26	0	MCS0	-6.26	8.00	-14.26	Pass
2412	1	ax	26	4	MCS0	-5.68	8.00	-13.68	Pass
2412	1	ax	26	8	MCS0	-4.97	8.00	-12.97	Pass
2437	6	ax	26	0	MCS0	-4.41	8.00	-12.41	Pass
2437	6	ax	26	4	MCS0	-3.21	8.00	-11.21	Pass
2437	6	ax	26	8	MCS0	-2.82	8.00	-10.82	Pass
2462	11	ax	26	0	MCS0	-5.25	8.00	-13.25	Pass
2462	11	ax	26	4	MCS0	-5.33	8.00	-13.33	Pass
2462	11	ax	26	8	MCS0	-6.19	8.00	-14.19	Pass
2412	1	ax	242	61	MCS0	-13.30	8.00	-21.30	Pass
2437	6	ax	242	61	MCS0	-11.60	8.00	-19.60	Pass
2462	11	ax	242	61	MCS0	-12.63	8.00	-20.63	Pass

Table 7-16. Conducted Power Density Measurements SISO CORE 0

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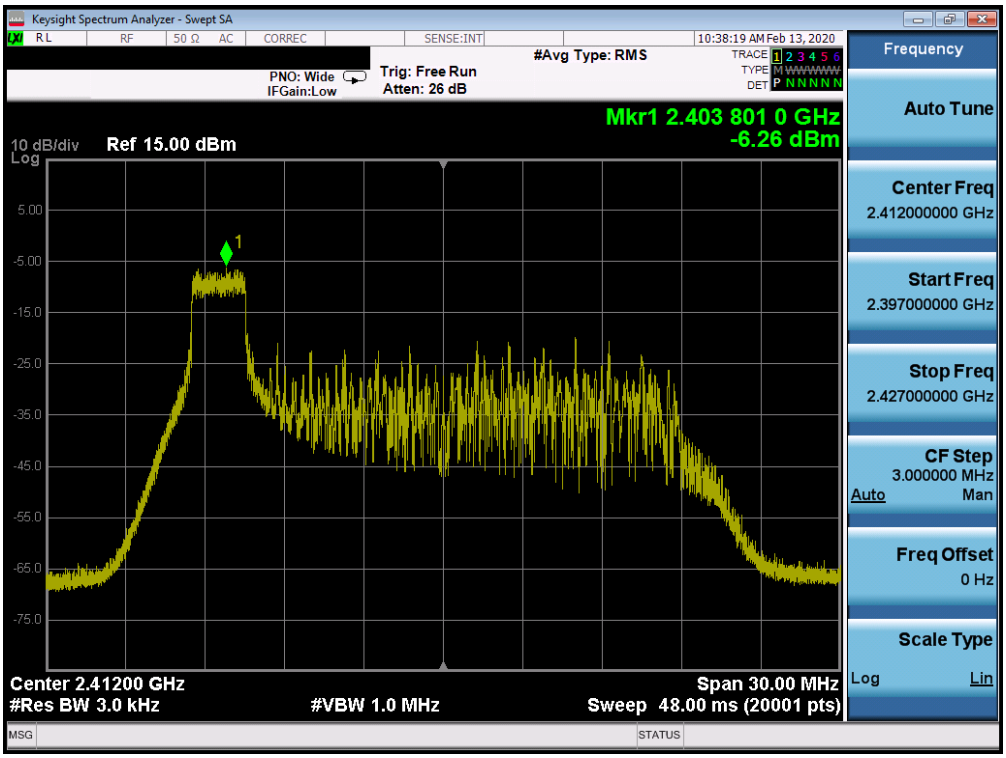
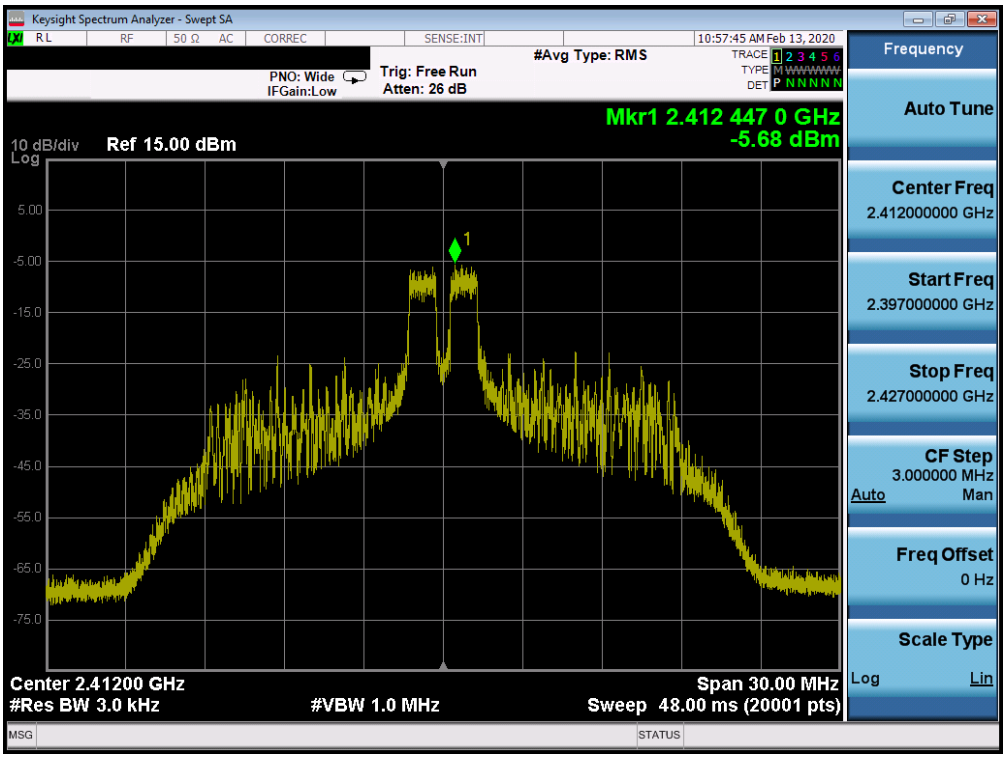


Plot 7-25. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



Plot 7-26. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 1)

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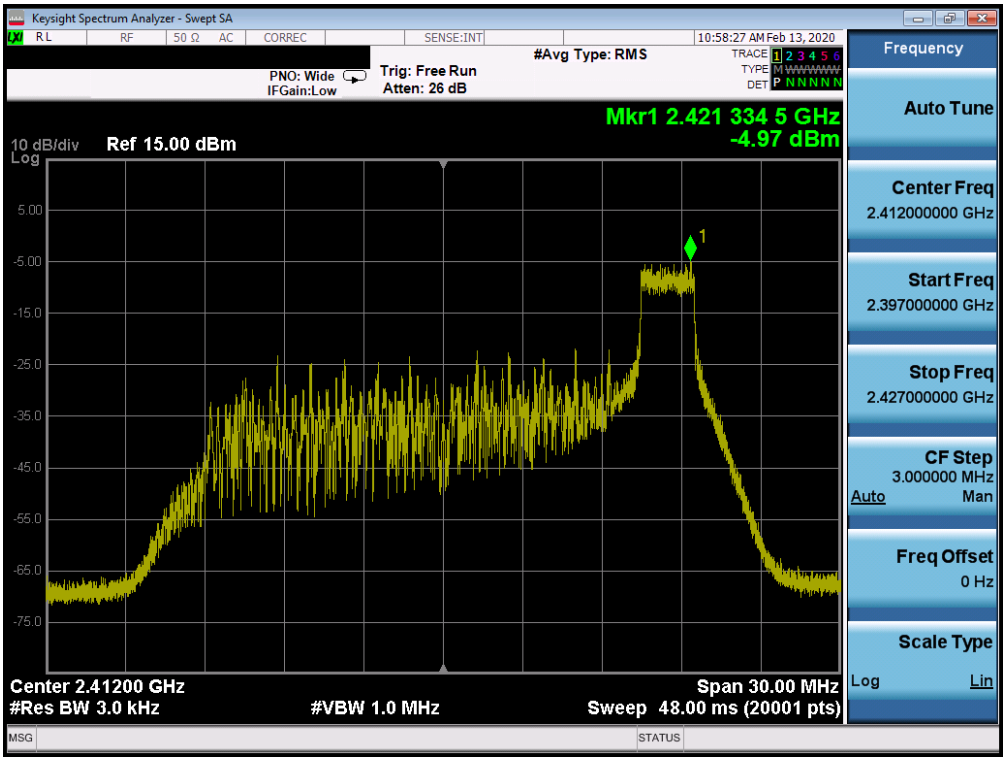
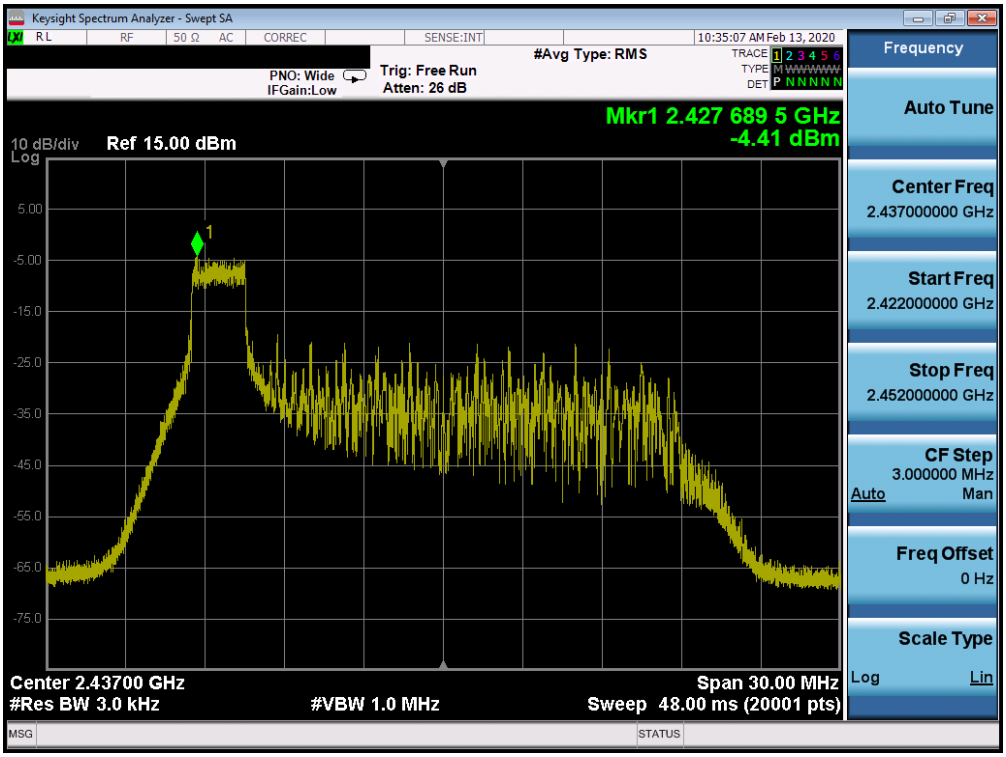


Plot 7-27. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



Plot 7-28. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 6)

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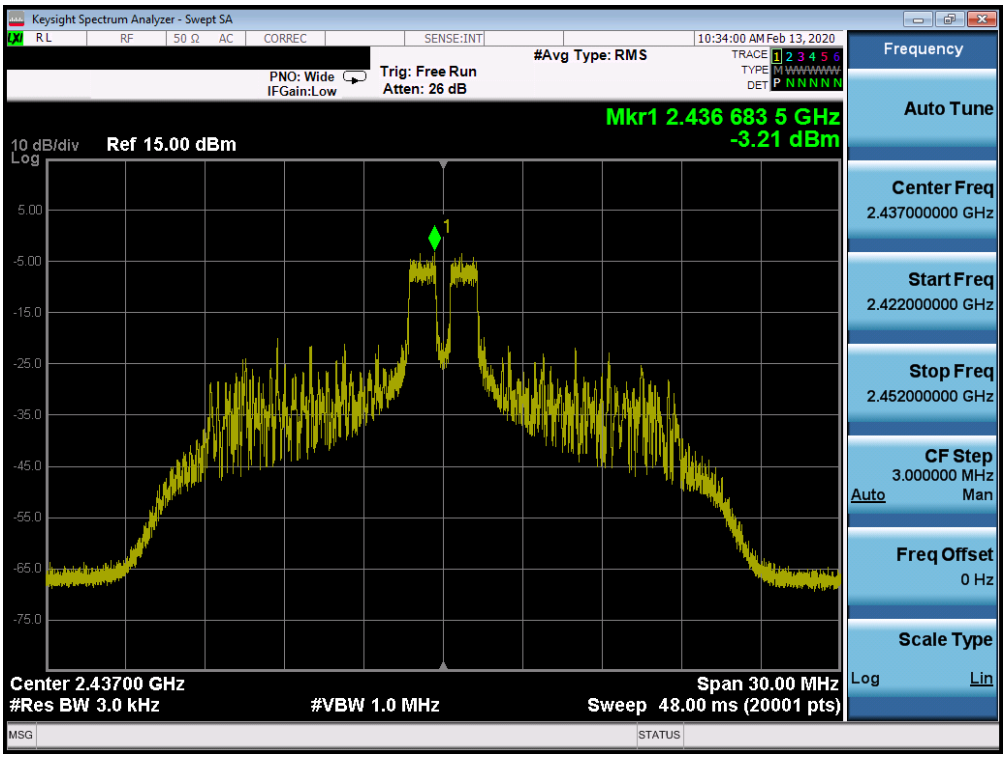
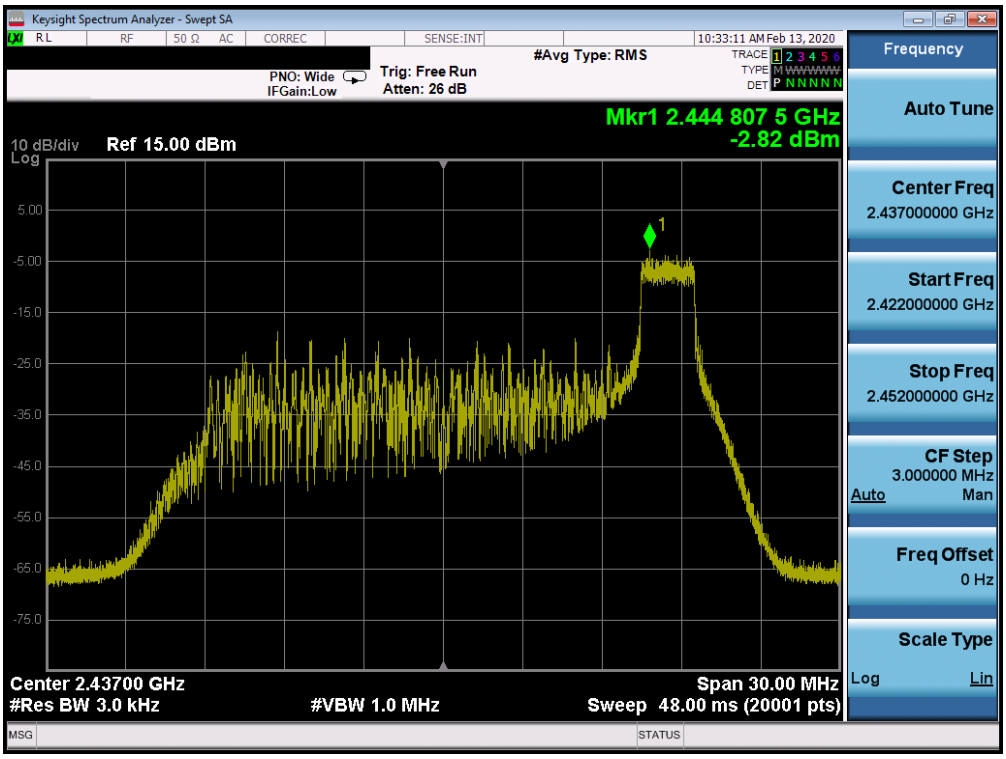


Plot 7-29. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



Plot 7-30. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 6)

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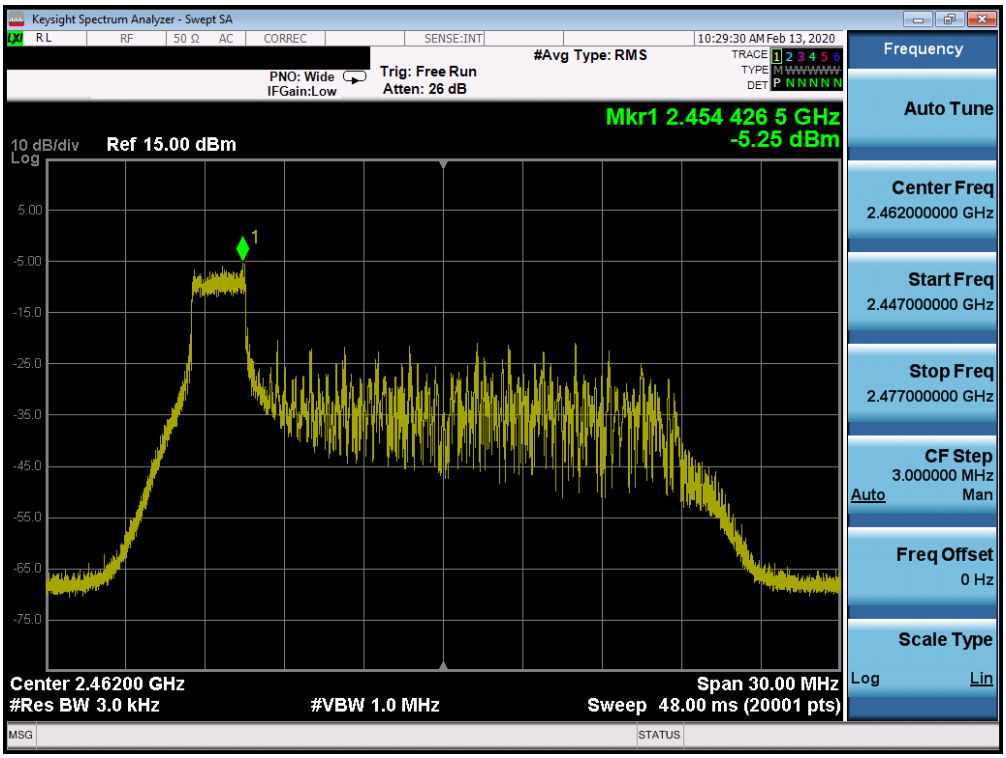
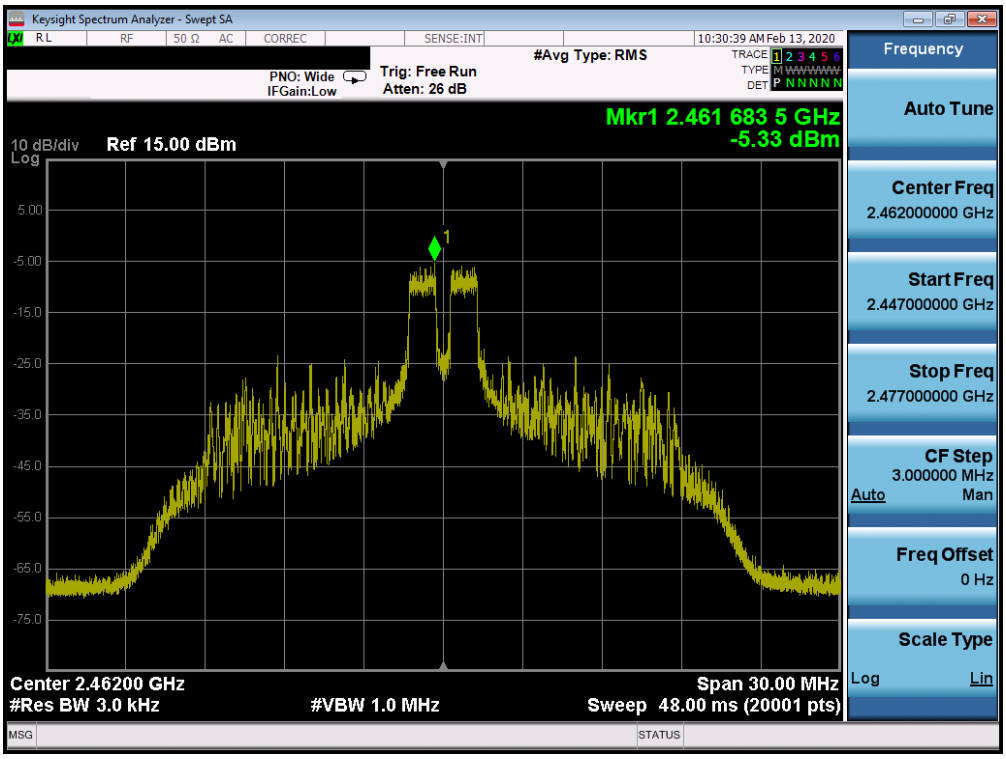


Plot 7-31. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



Plot 7-32. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 11)

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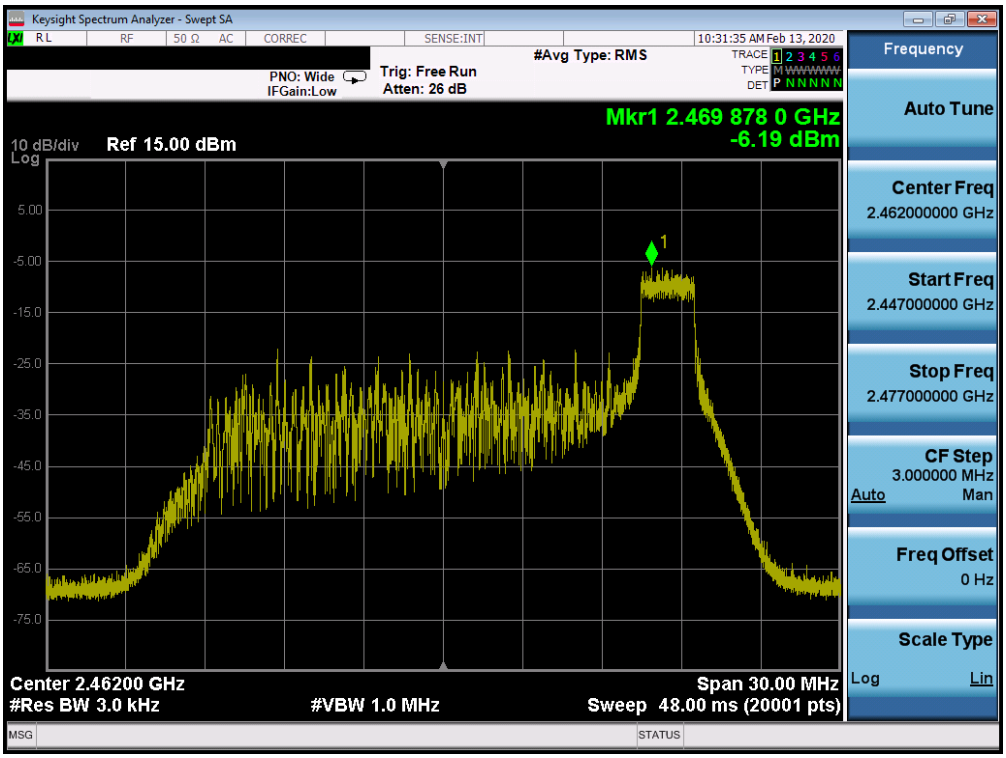
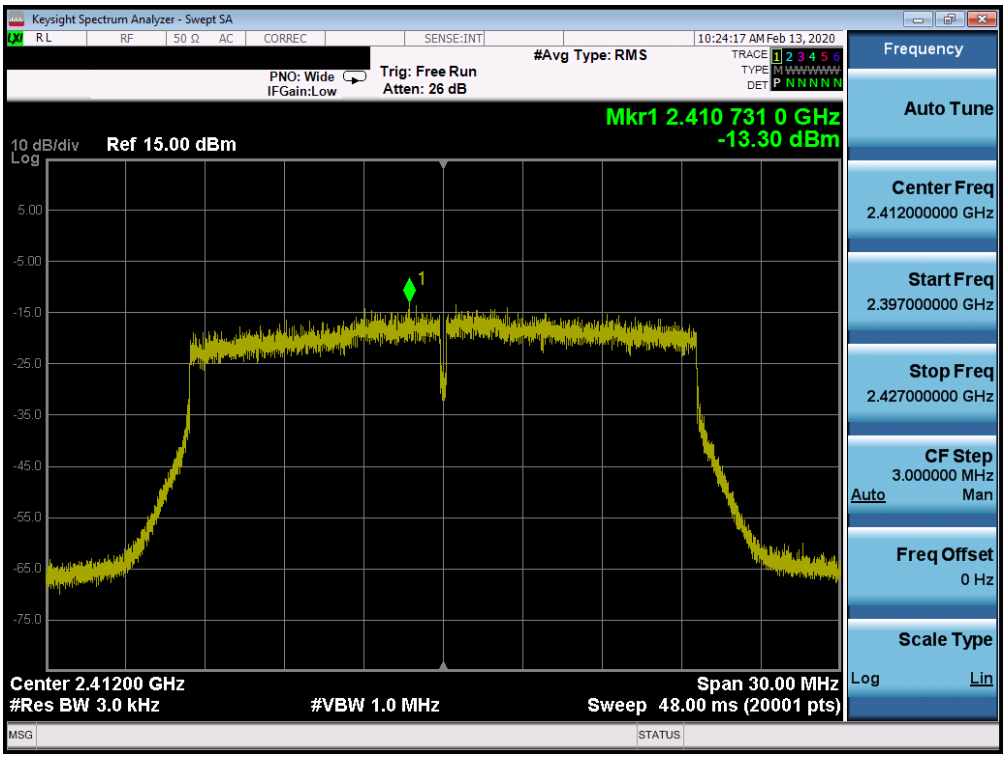


Plot 7-33. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-34. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 1)

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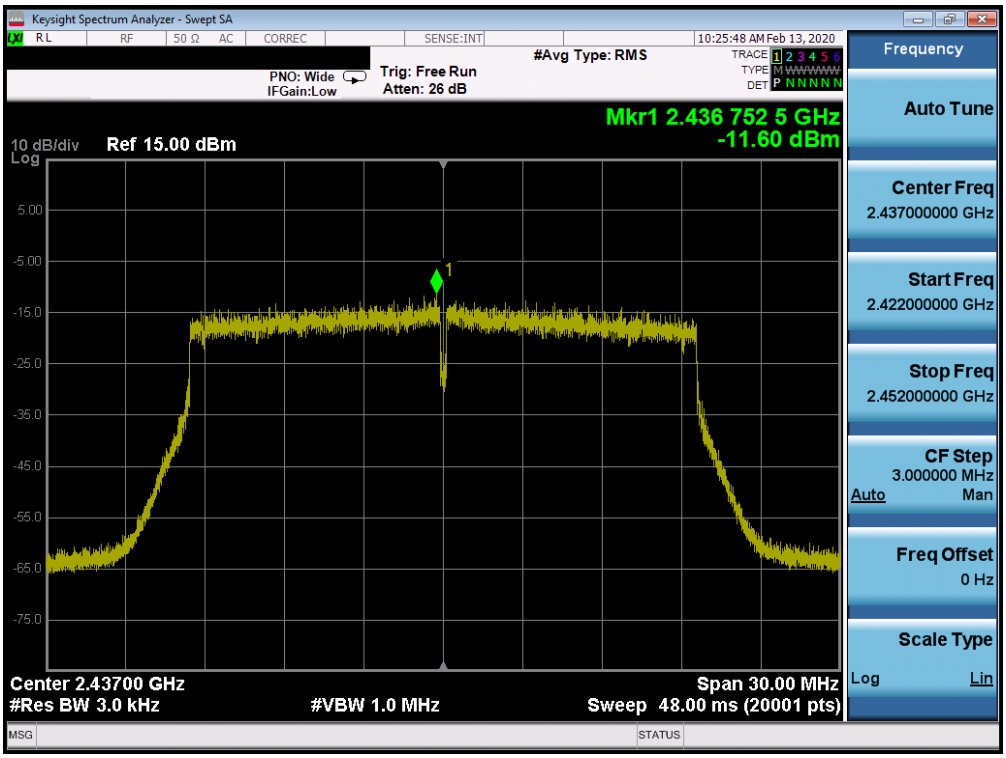
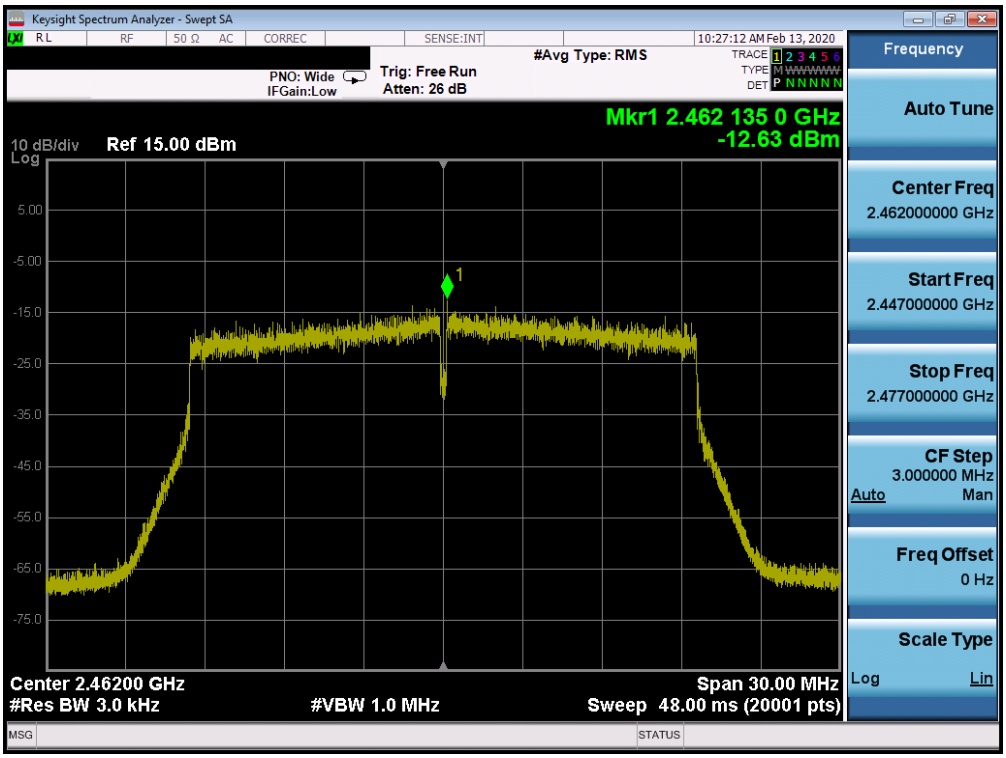


Plot 7-35. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 6)



Plot 7-36. Power Spectral Density Plot SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 11)

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SISO Core 1 Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	RU Size	Index	Data Rate [Mbps]	Measured Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26	0	MCS0	-8.29	8.00	-16.29	Pass
2412	1	ax	26	4	MCS0	-7.53	8.00	-15.53	Pass
2412	1	ax	26	8	MCS0	-7.54	8.00	-15.54	Pass
2437	6	ax	26	0	MCS0	-4.37	8.00	-12.37	Pass
2437	6	ax	26	4	MCS0	-4.04	8.00	-12.04	Pass
2437	6	ax	26	8	MCS0	-4.63	8.00	-12.63	Pass
2462	11	ax	26	0	MCS0	-8.16	8.00	-16.16	Pass
2462	11	ax	26	4	MCS0	-8.18	8.00	-16.18	Pass
2462	11	ax	26	8	MCS0	-9.70	8.00	-17.70	Pass
2412	1	ax	242	61	MCS0	-15.38	8.00	-23.38	Pass
2437	6	ax	242	61	MCS0	-12.83	8.00	-20.83	Pass
2462	11	ax	242	61	MCS0	-16.38	8.00	-24.38	Pass

Table 7-17. Conducted Power Density Measurements SISO CORE 1

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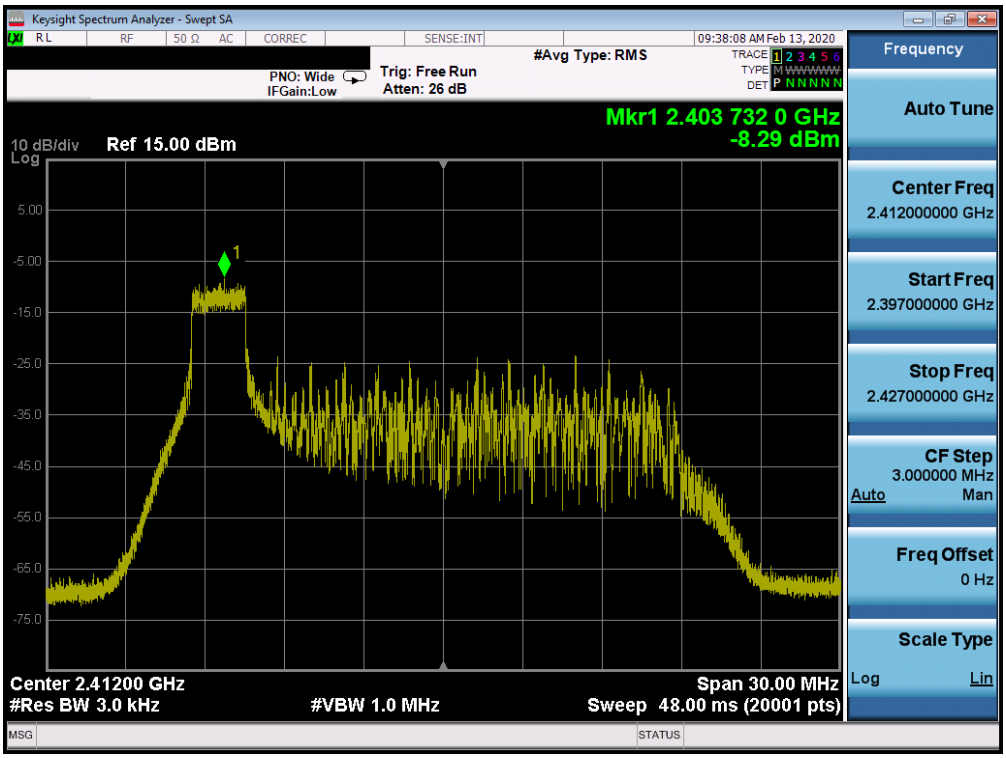
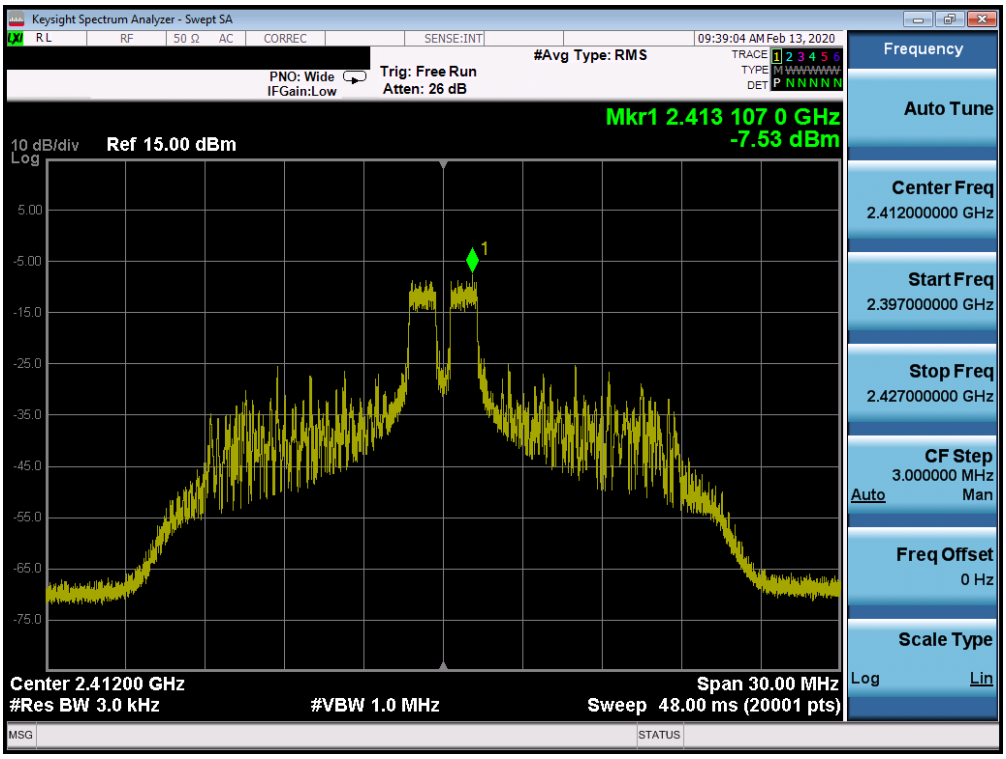


Plot 7-37. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



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

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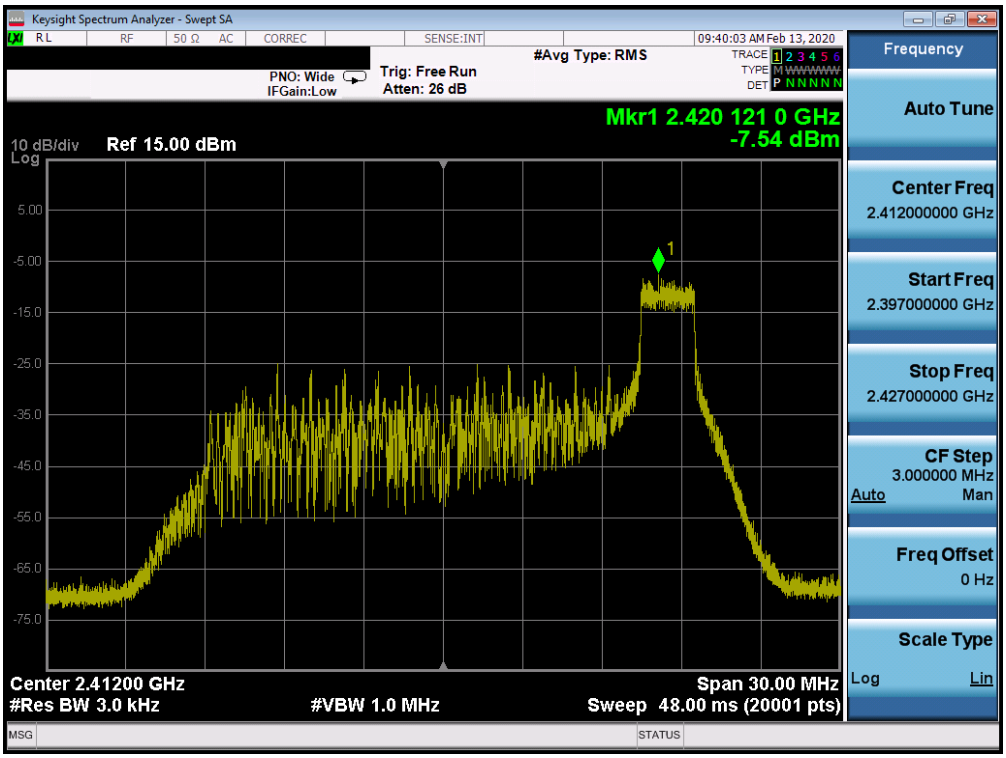
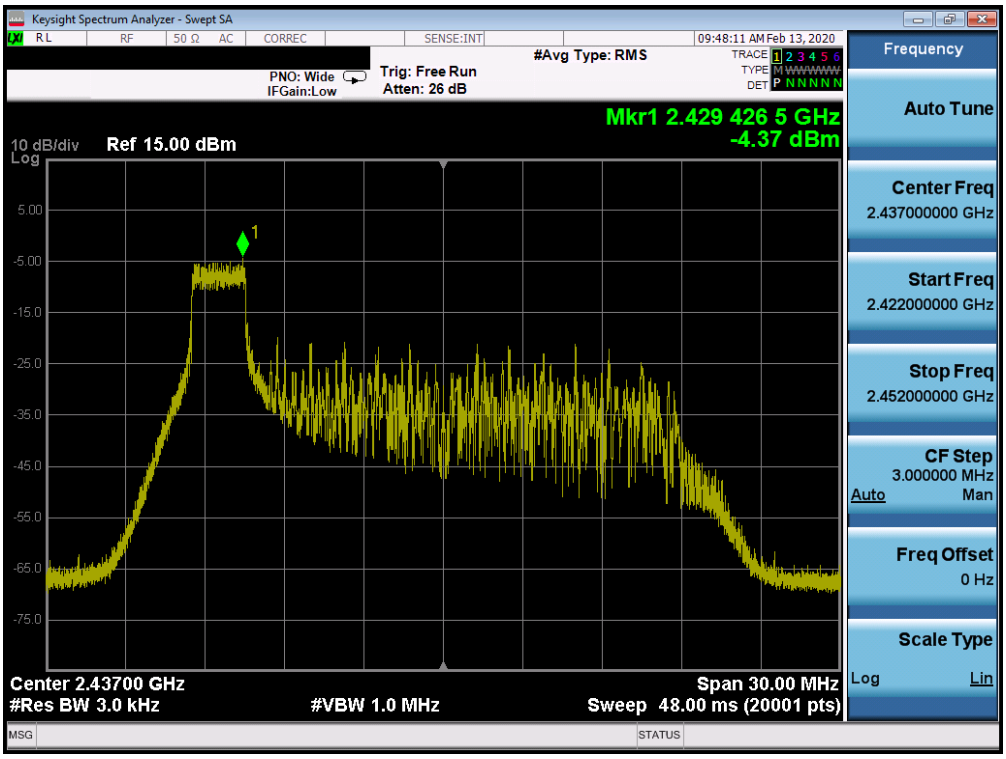


Plot 7-39. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



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

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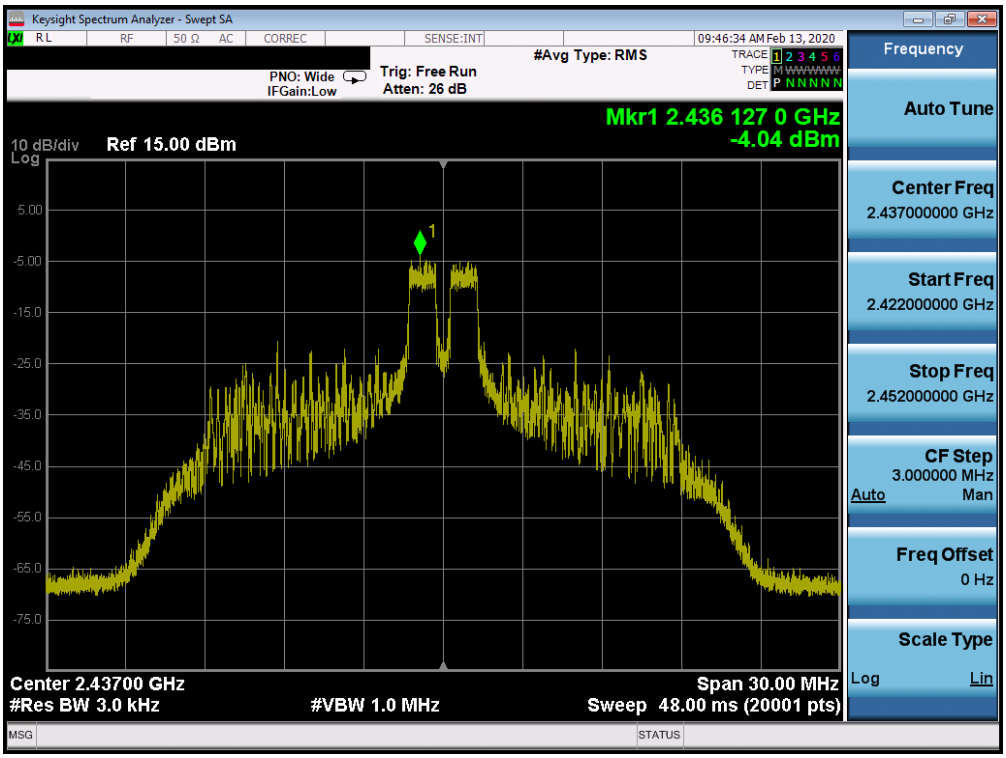
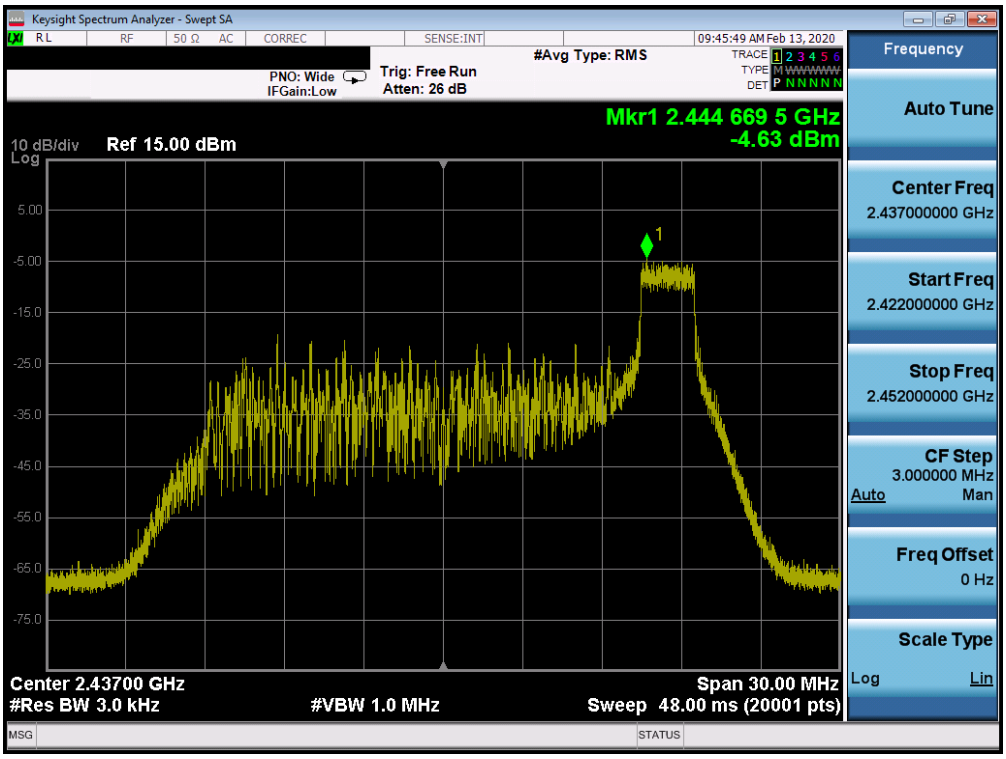


Plot 7-41. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



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

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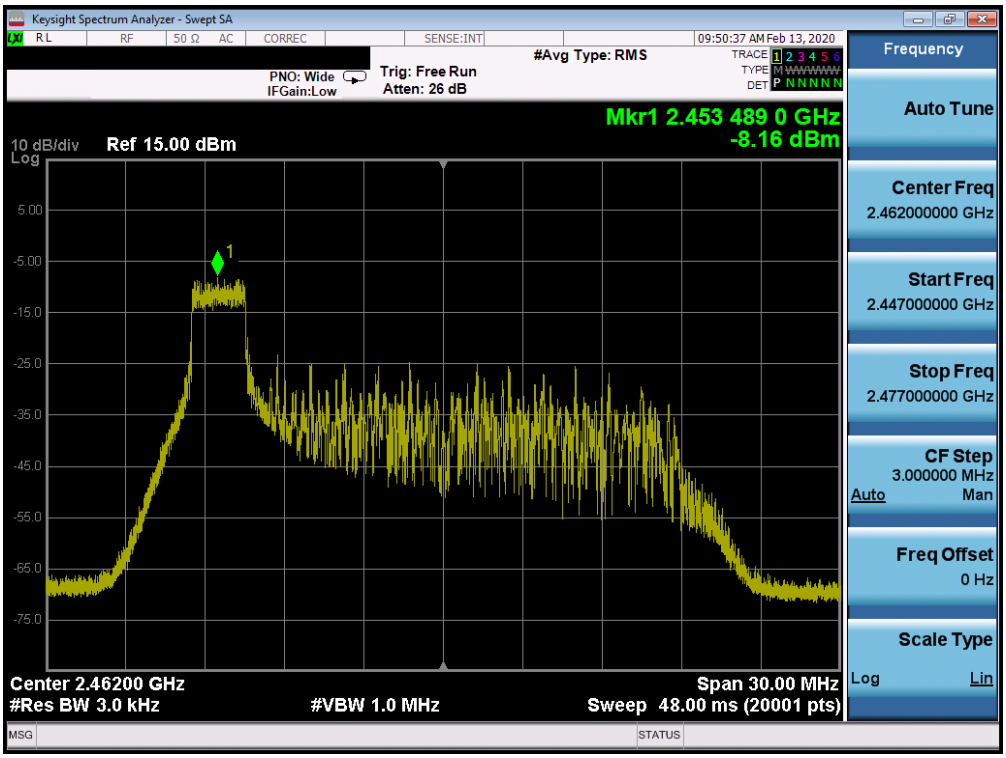
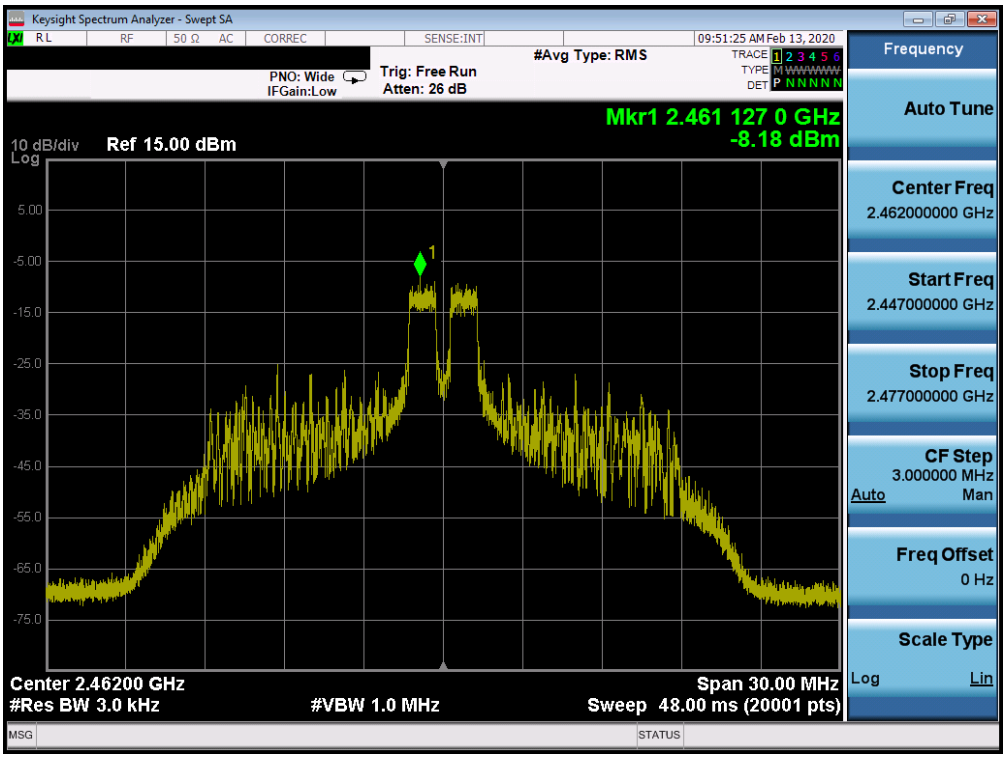


Plot 7-43. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



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

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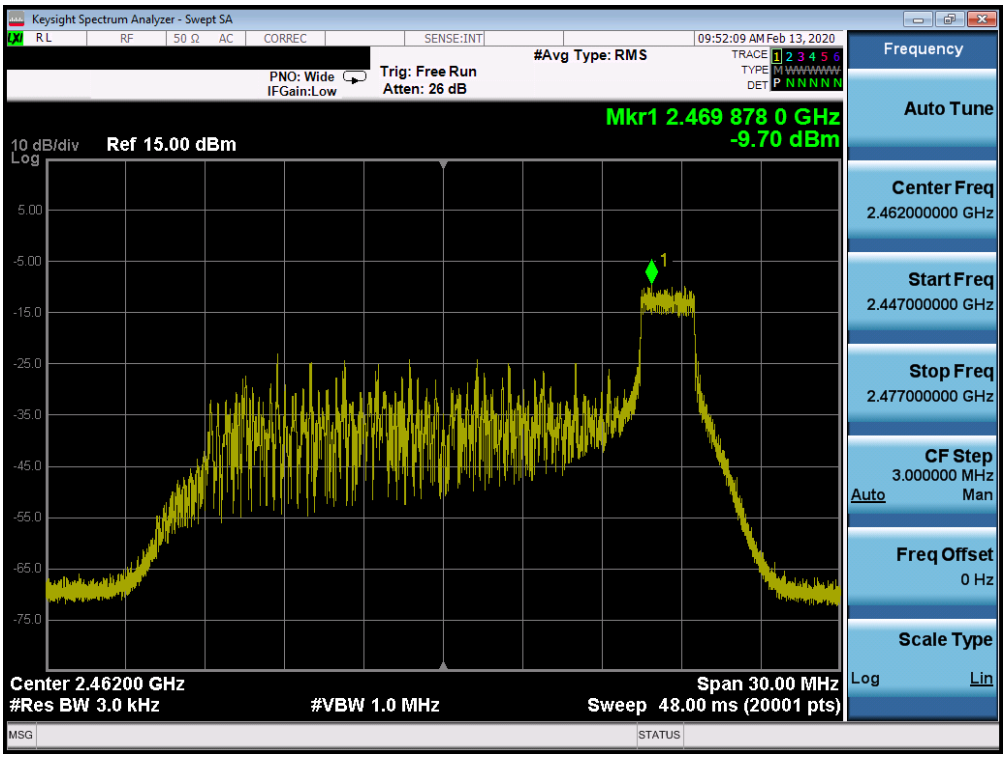
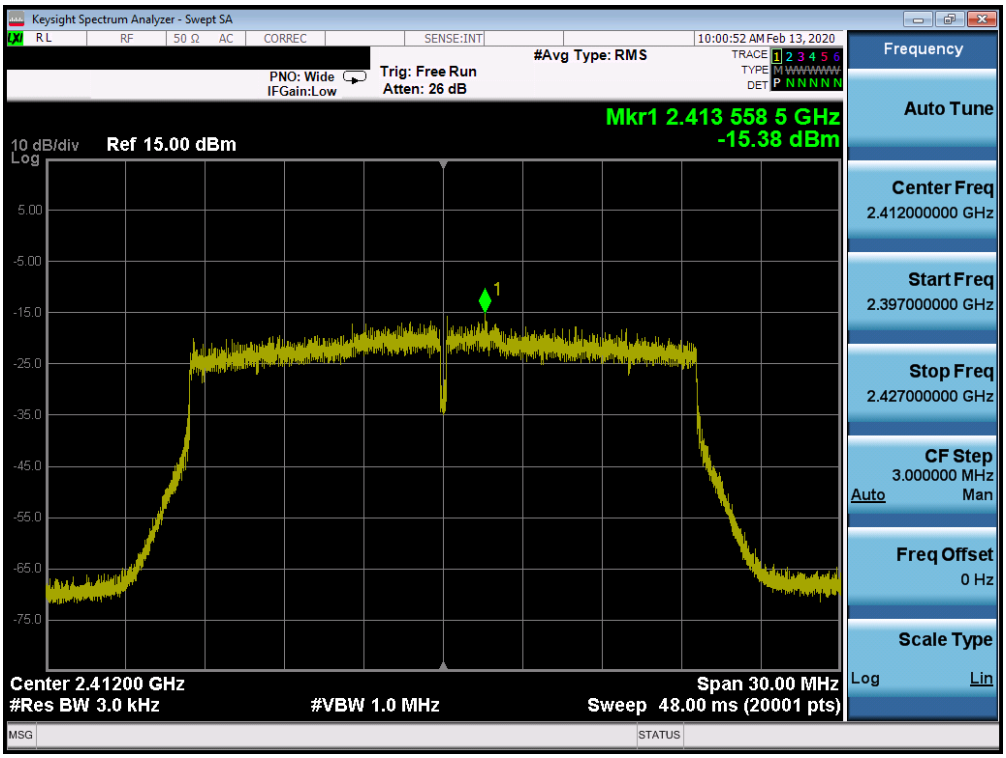


Plot 7-45. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



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

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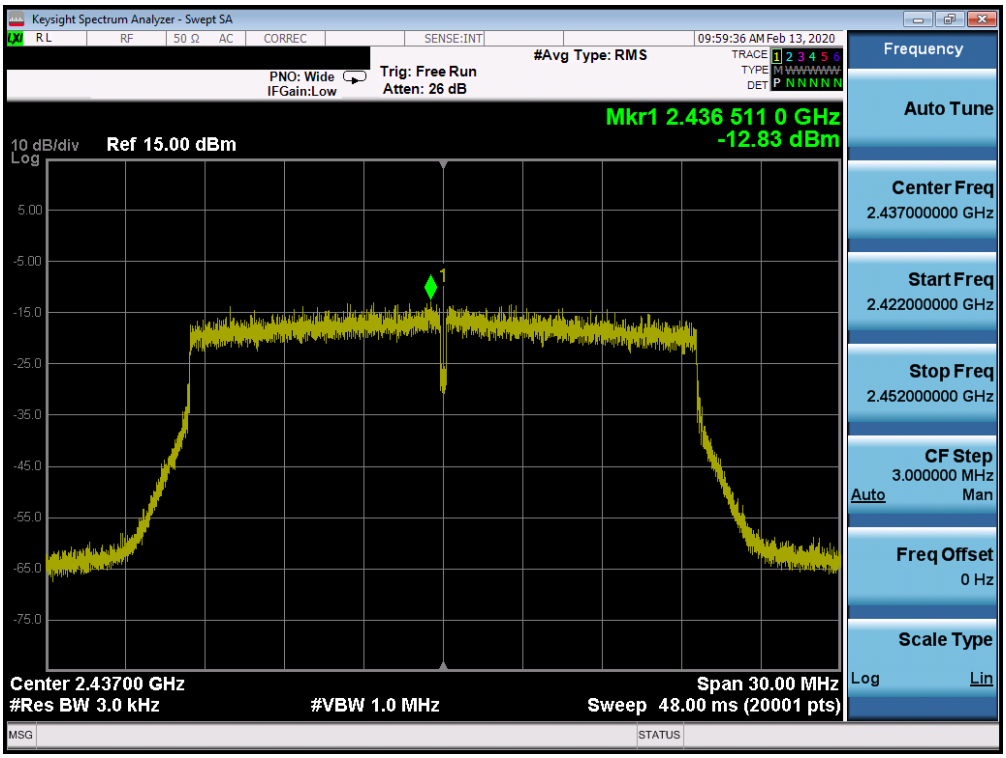
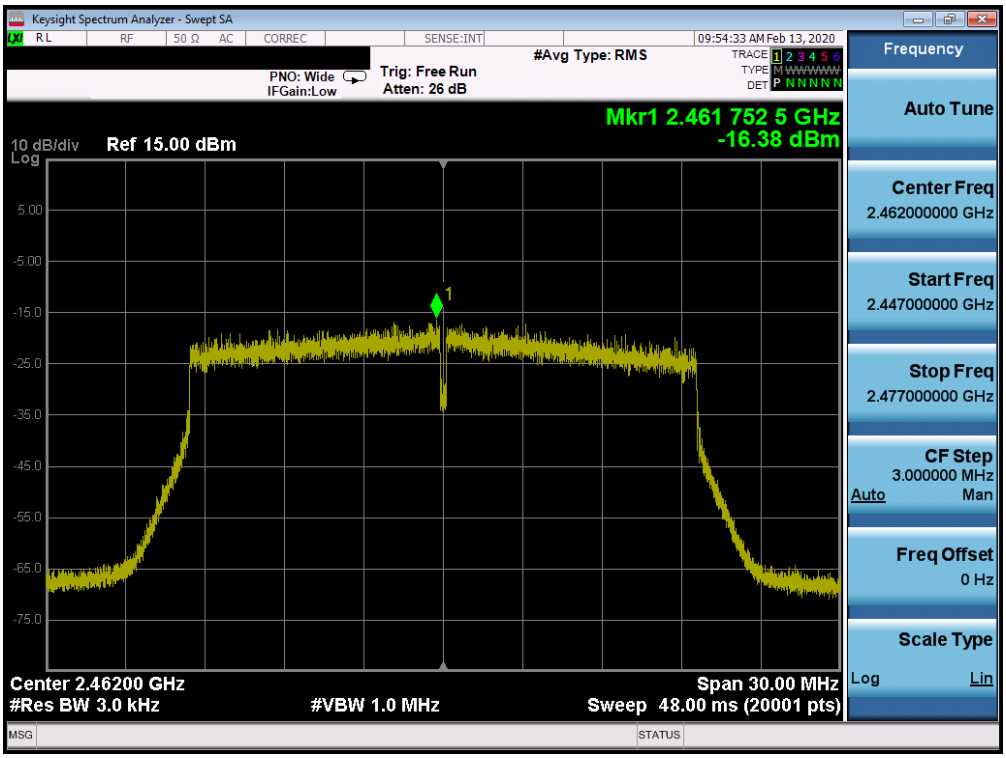


Plot 7-47. Power Spectral Density Plot SISO CORE 1 (802.11ax OFDMA – RU242 – Ch. 6)



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

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CDD Power Spectral Density Measurements

Frequency [MHz]	Channel No.	802.11 Mode	RU Size	Index	Data Rate [Mbps]	Core 0 Power Spectral Density [dBm / 3kHz]	Core 1 Power Spectral Density [dBm / 3kHz]	Summed Power Spectral Density [dBm / 3kHz]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	ax	26	0	MCS0	-6.18	-8.24	-4.08	8.00	-12.08	Pass
2412	1	ax	26	4	MCS0	-5.81	-7.85	-3.70	8.00	-11.70	Pass
2412	1	ax	26	8	MCS0	-5.52	-7.28	-3.30	8.00	-11.30	Pass
2437	6	ax	26	0	MCS0	-4.47	-2.69	-0.48	8.00	-8.48	Pass
2437	6	ax	26	4	MCS0	-3.67	-3.30	-0.47	8.00	-8.47	Pass
2437	6	ax	26	8	MCS0	-2.95	-3.48	-0.20	8.00	-8.20	Pass
2462	11	ax	26	0	MCS0	-6.34	-9.06	-4.48	8.00	-12.48	Pass
2462	11	ax	26	4	MCS0	-6.29	-8.49	-4.24	8.00	-12.24	Pass
2462	11	ax	26	8	MCS0	-6.13	-8.18	-4.02	8.00	-12.02	Pass
2412	1	ax	242	61	MCS0	-13.39	-15.62	-11.35	8.00	-19.35	Pass
2437	6	ax	242	61	MCS0	-11.45	-10.95	-8.18	8.00	-16.18	Pass
2462	11	ax	242	61	MCS0	-13.83	-16.60	-11.99	8.00	-19.99	Pass

Table 7-18.CDD Conducted Power Density Measurements

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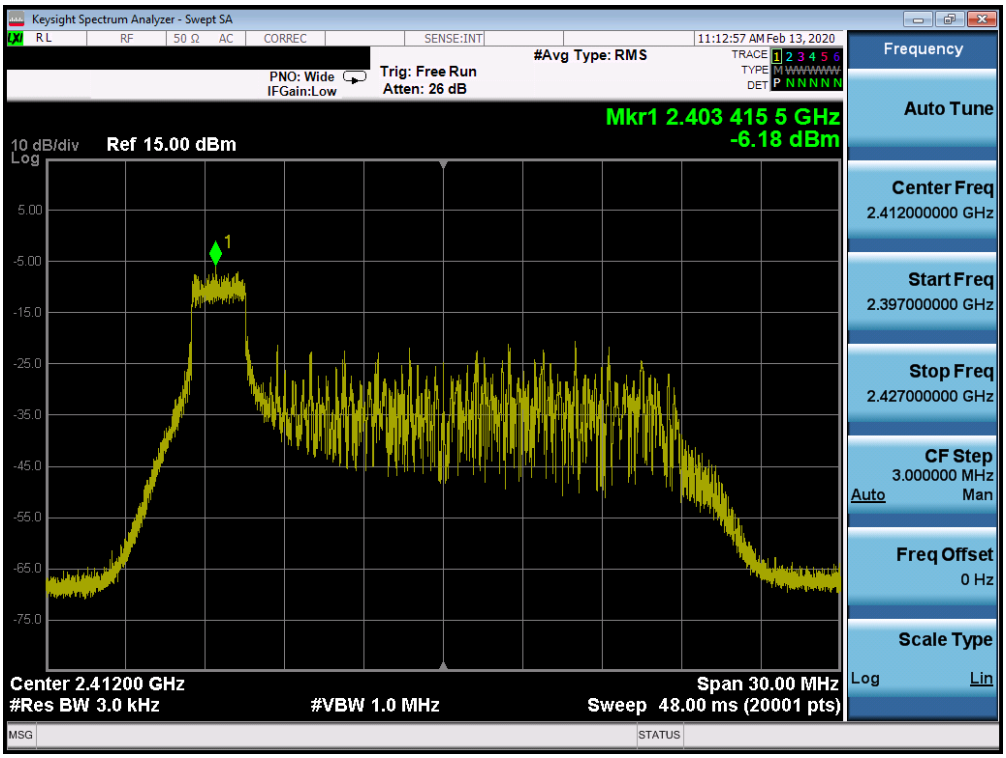
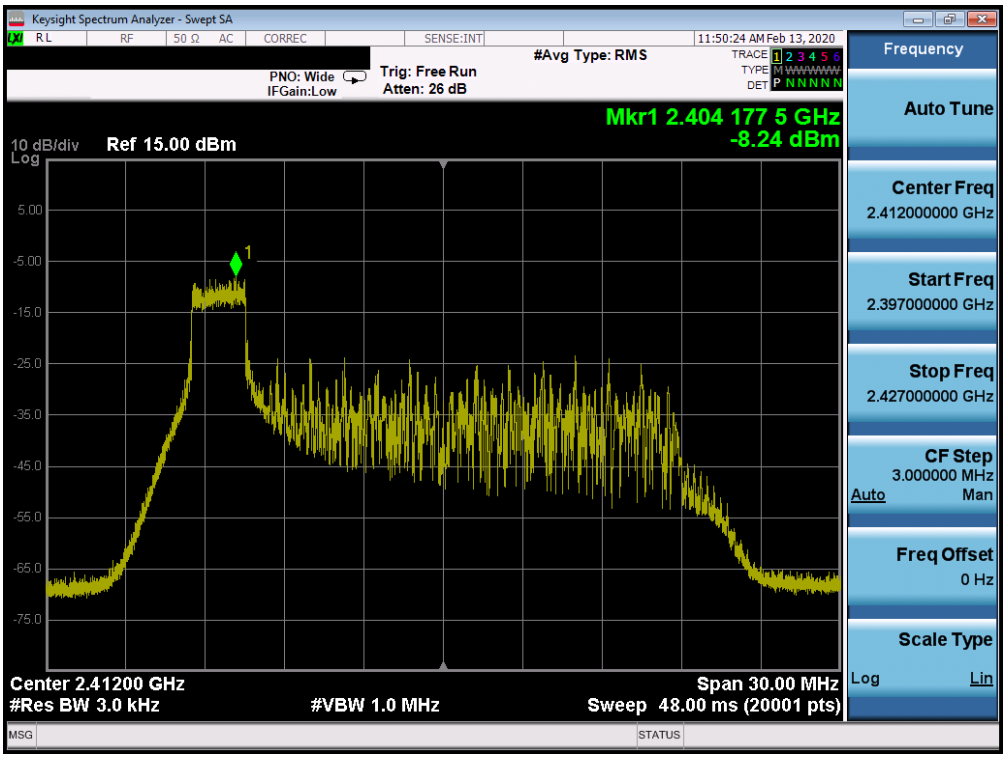


Plot 7-49. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



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

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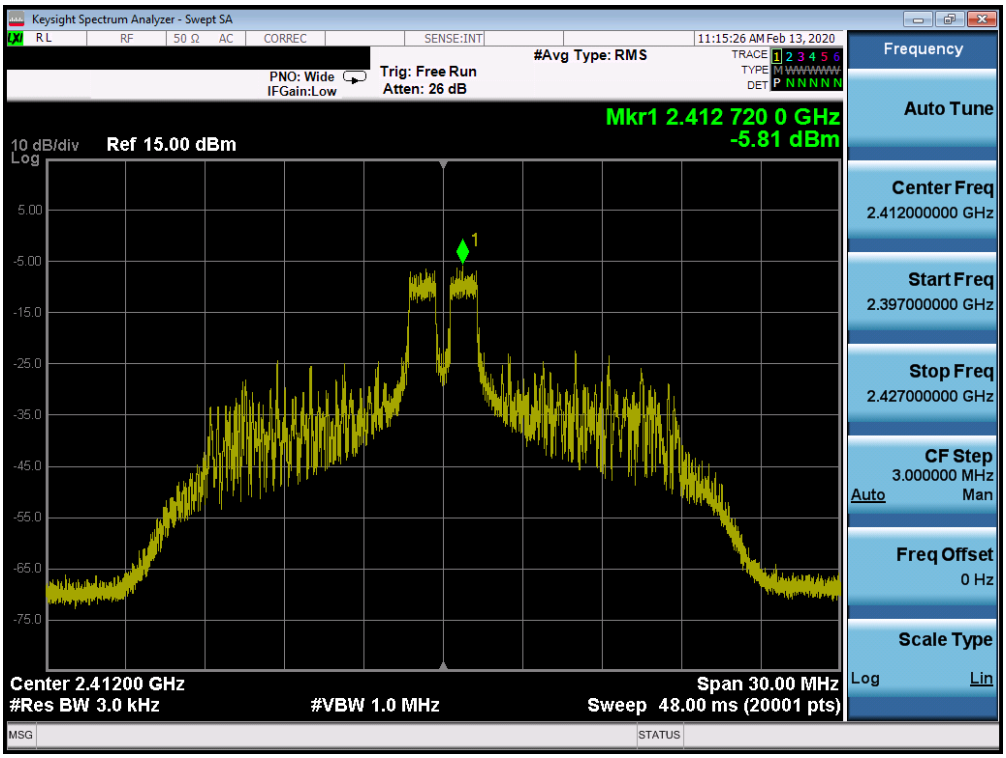
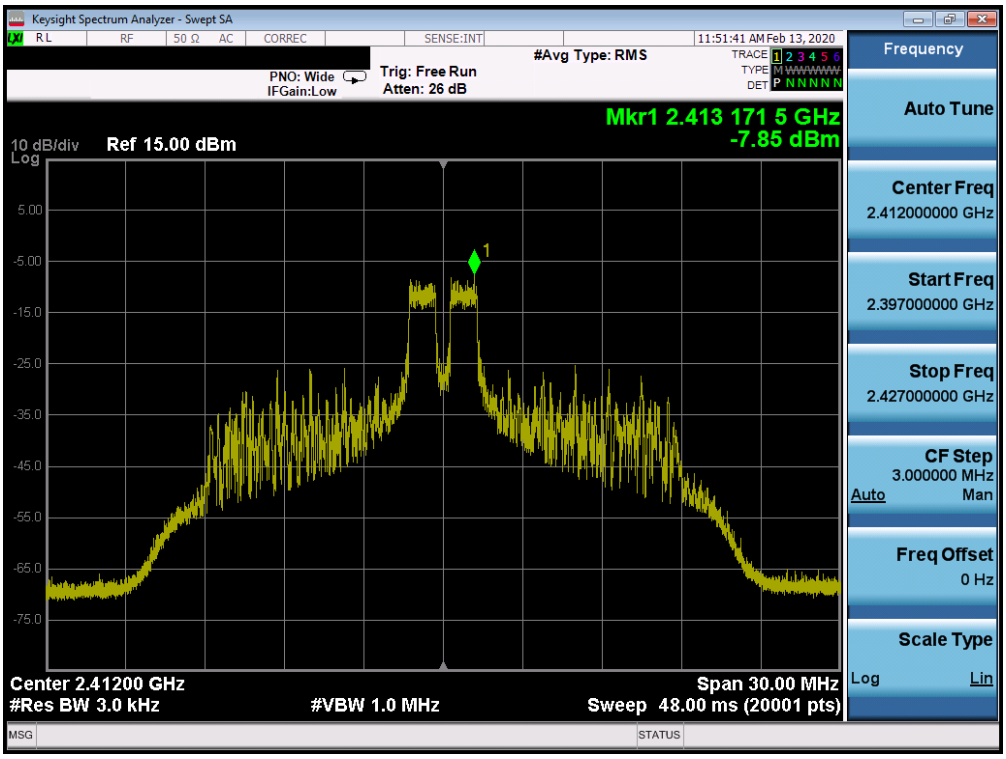


Plot 7-51. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 1)



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

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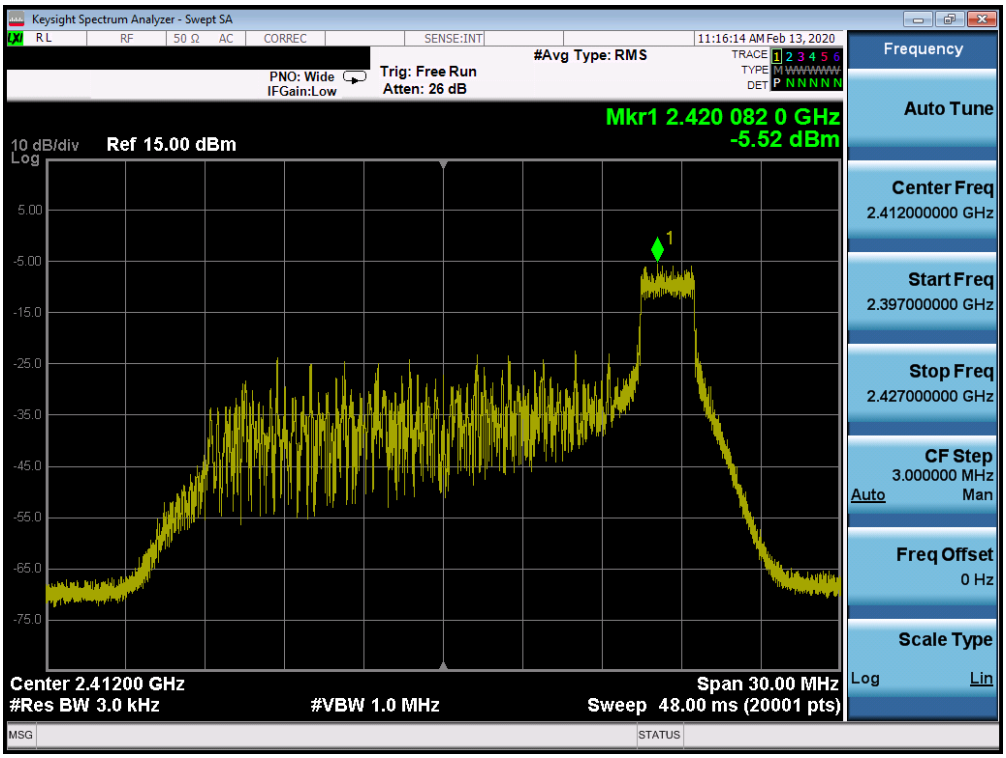
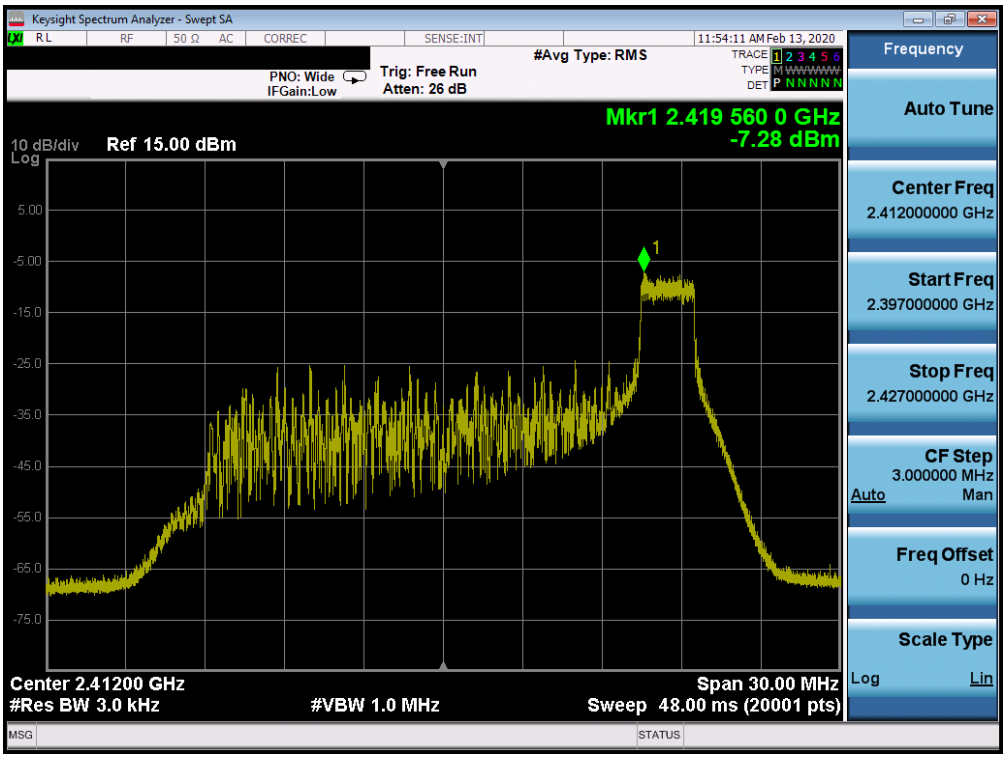


Plot 7-53. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 1)



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

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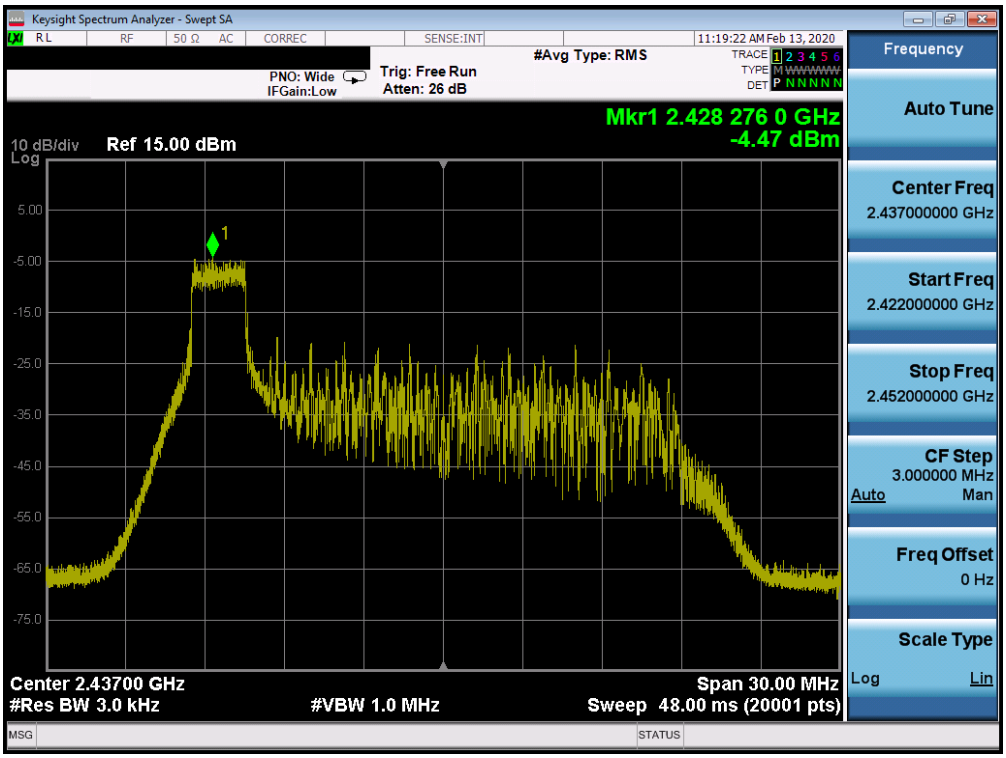
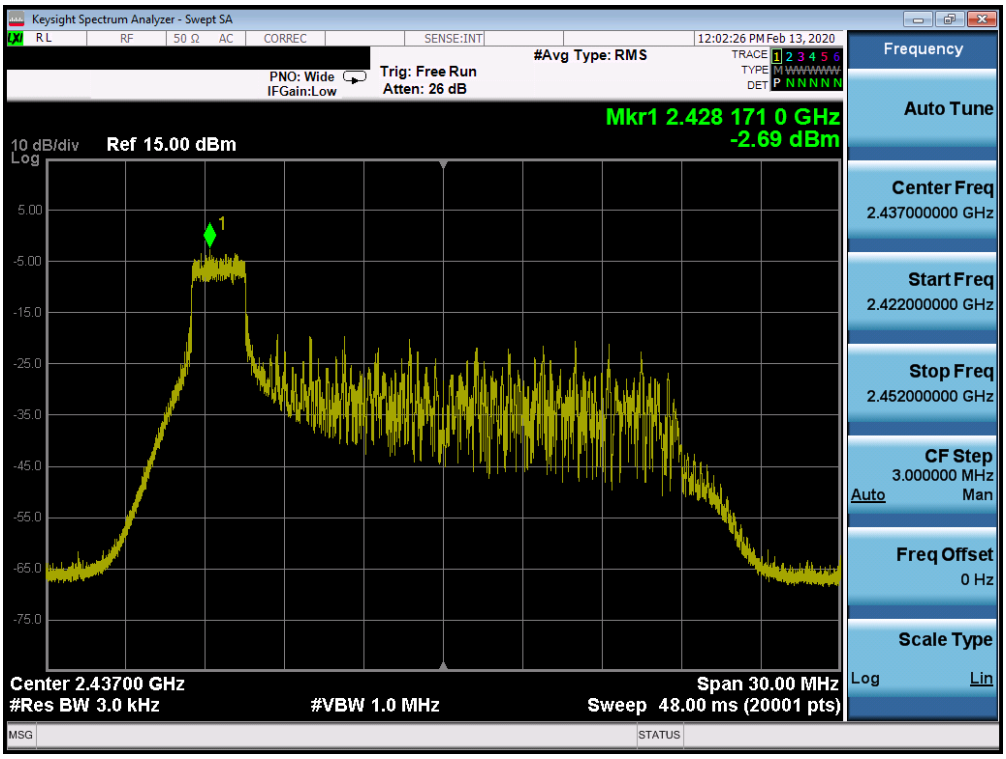


Plot 7-55. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 6)



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

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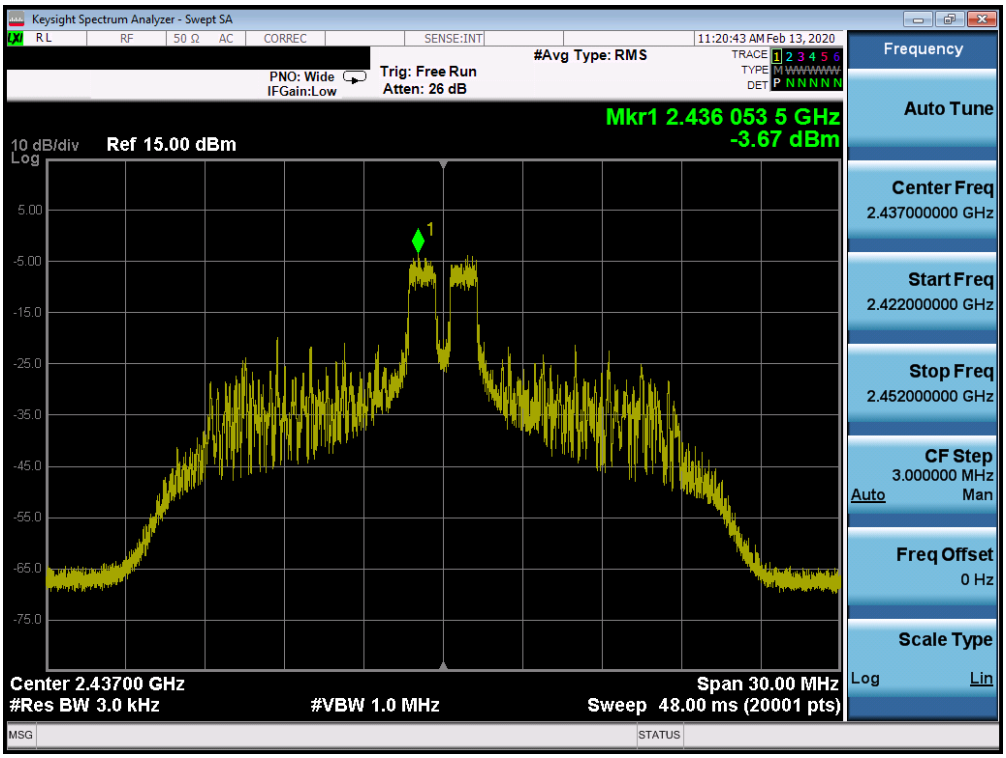
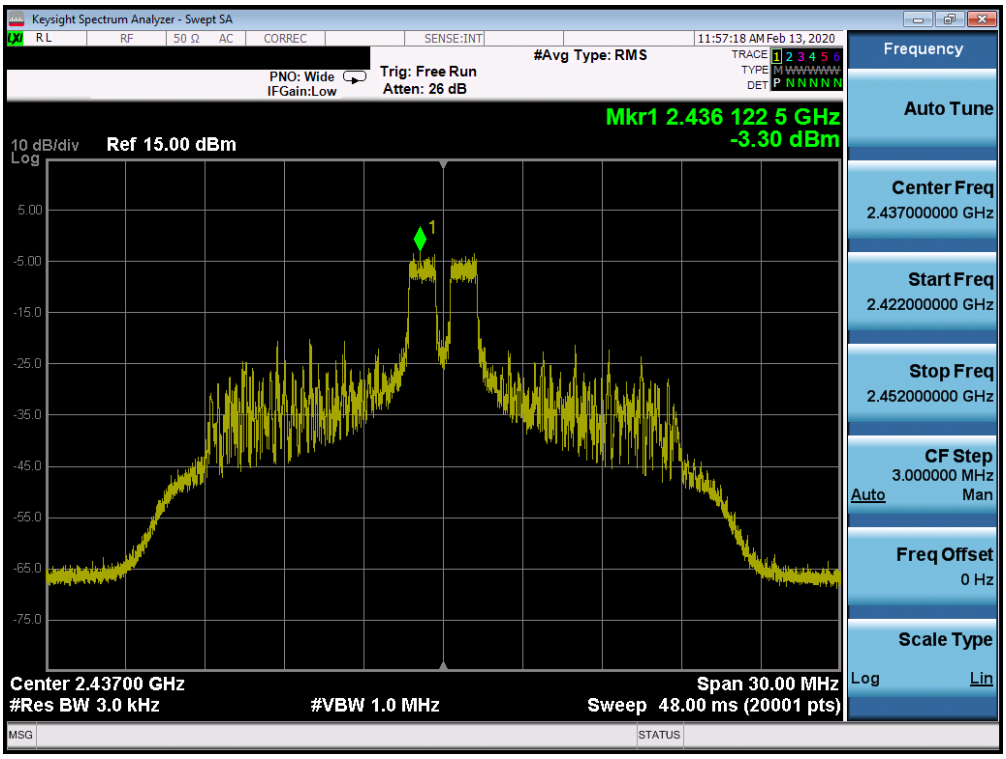


Plot 7-57. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 6)



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

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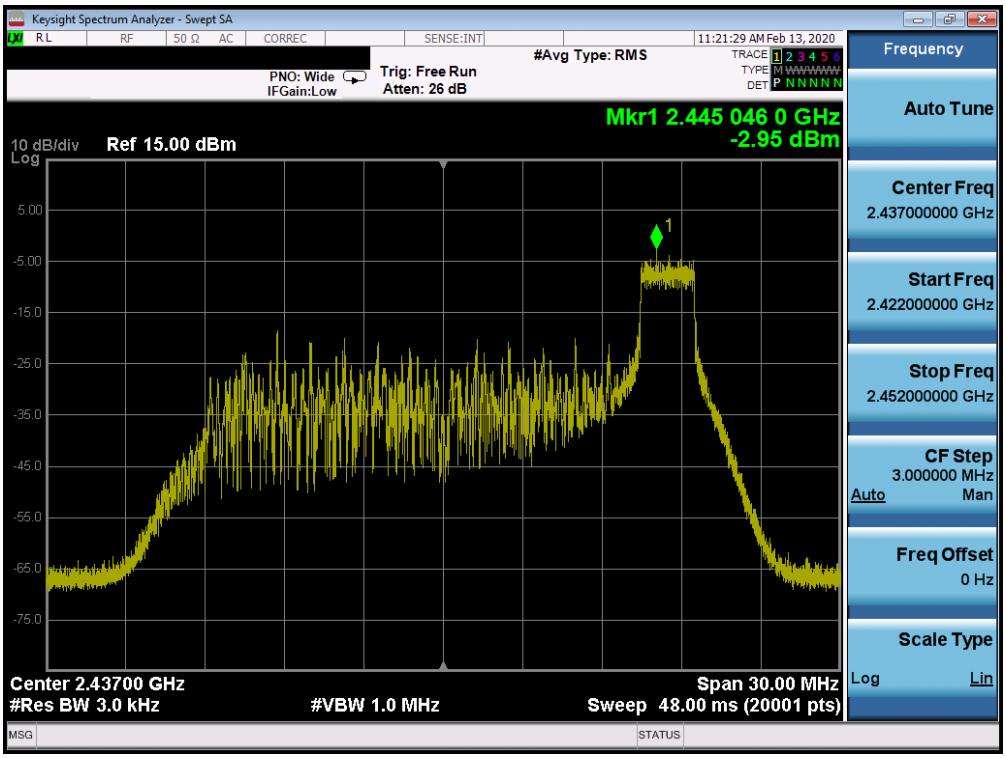
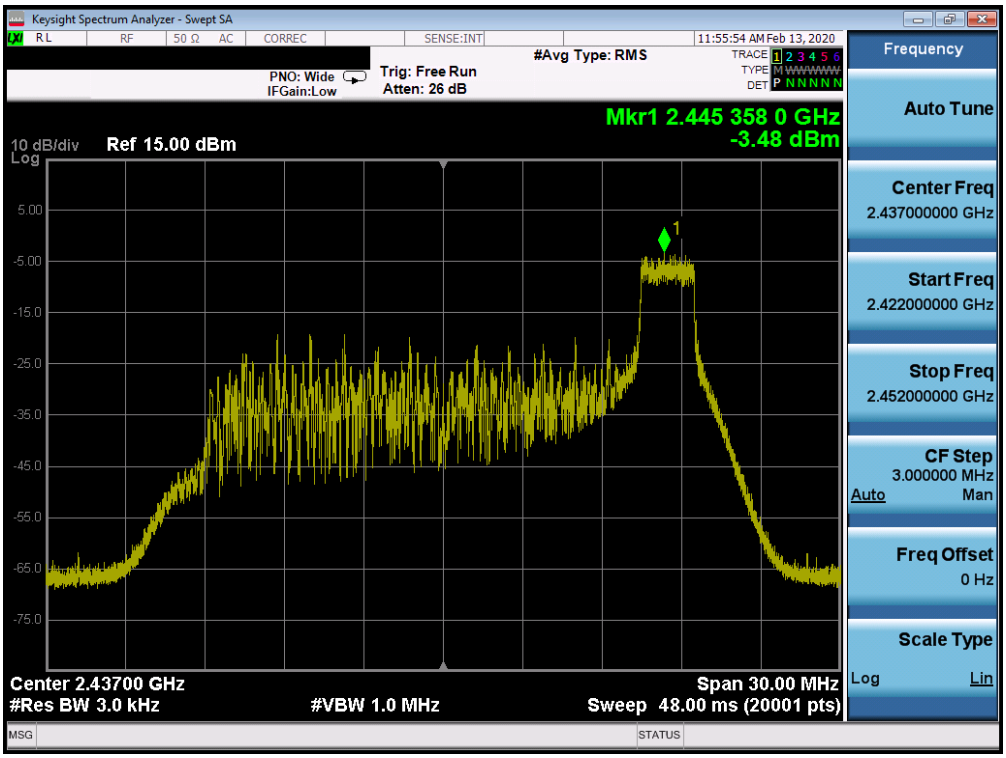


Plot 7-59. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 6)



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

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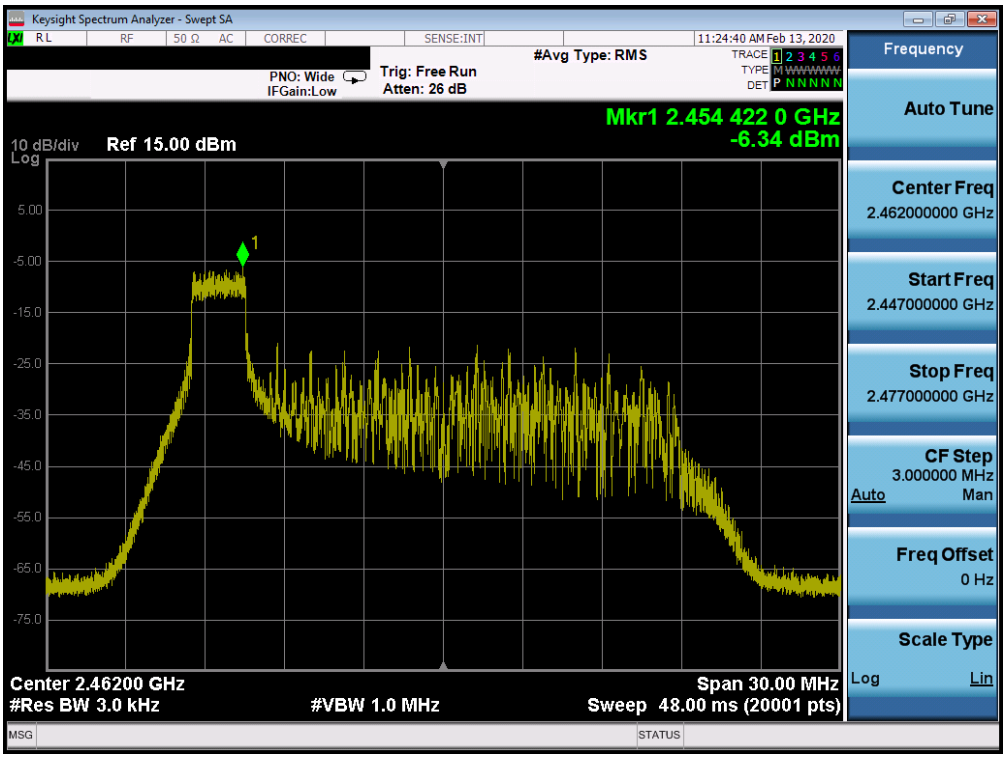
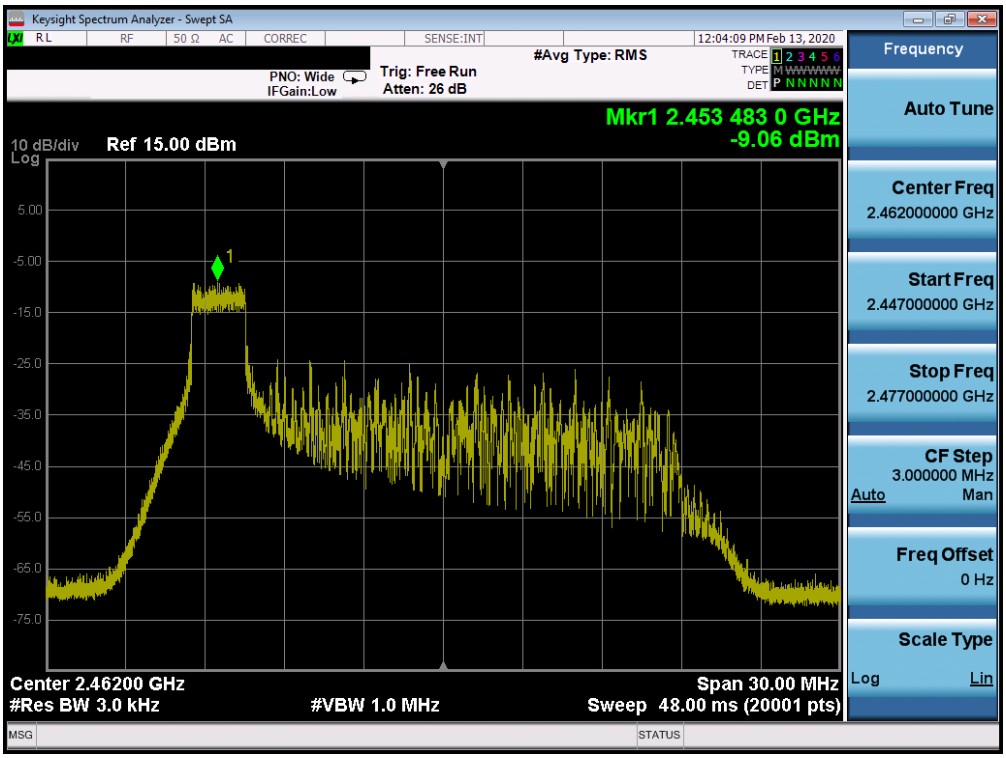


Plot 7-61. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 11)



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

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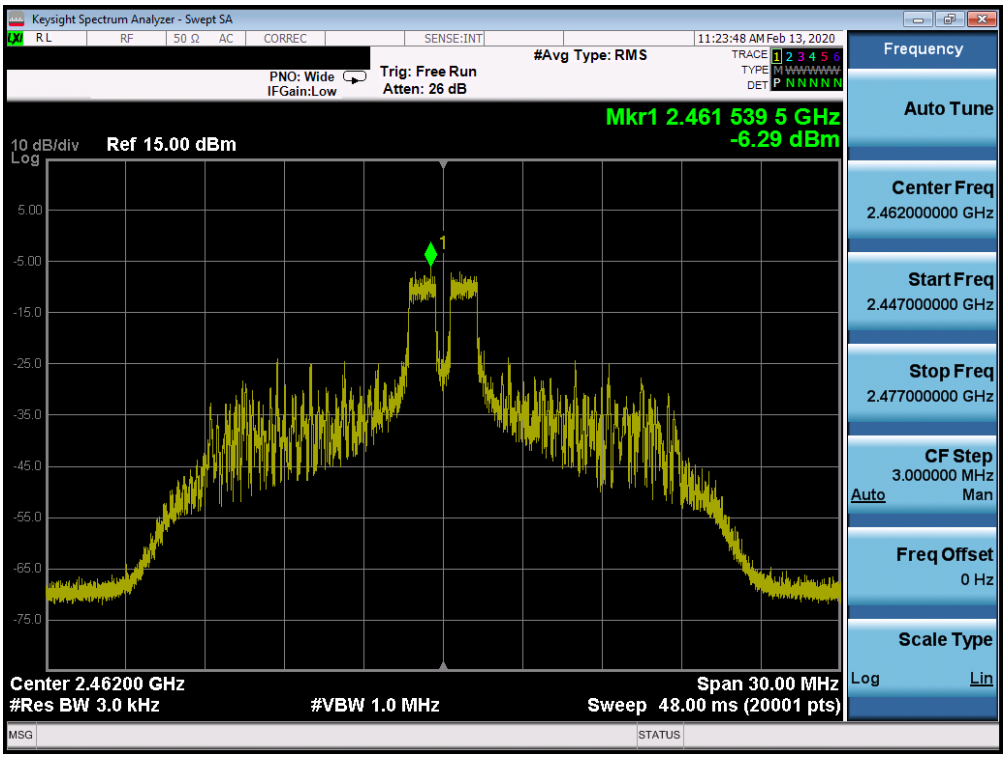
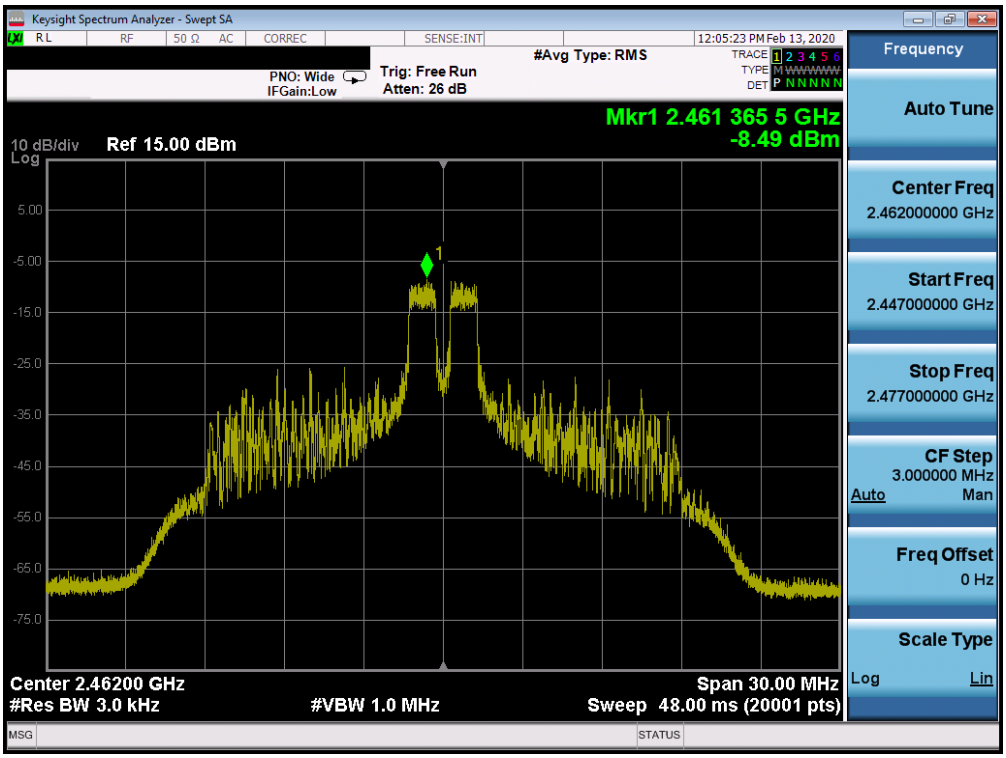


Plot 7-63. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 4 – Ch. 11)



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

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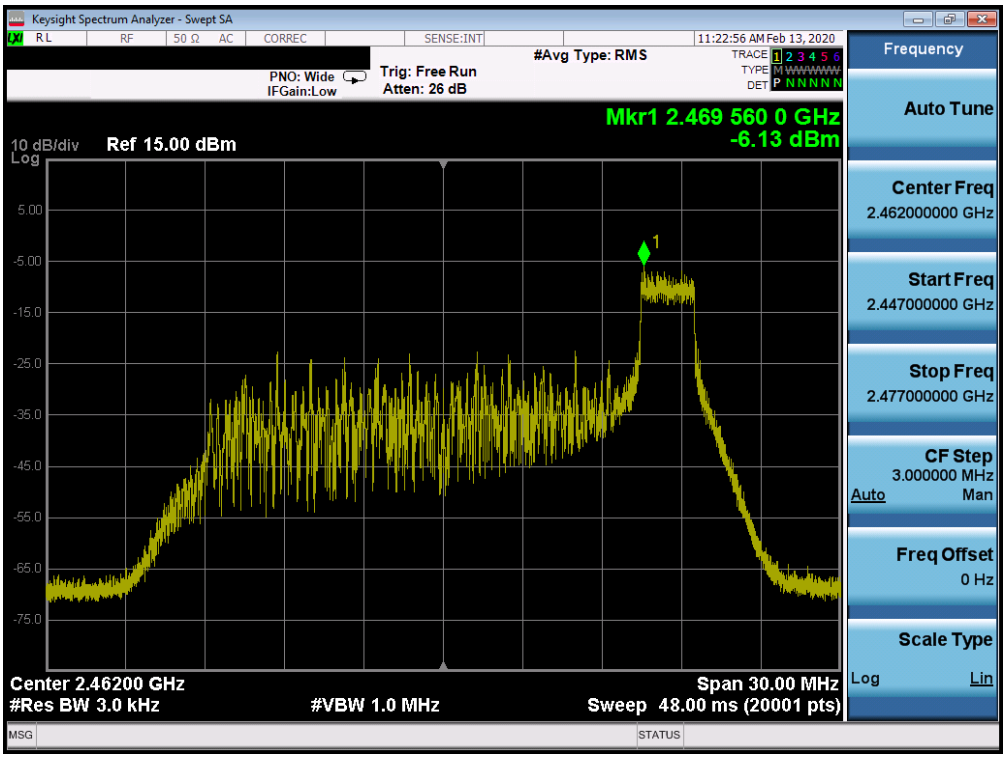
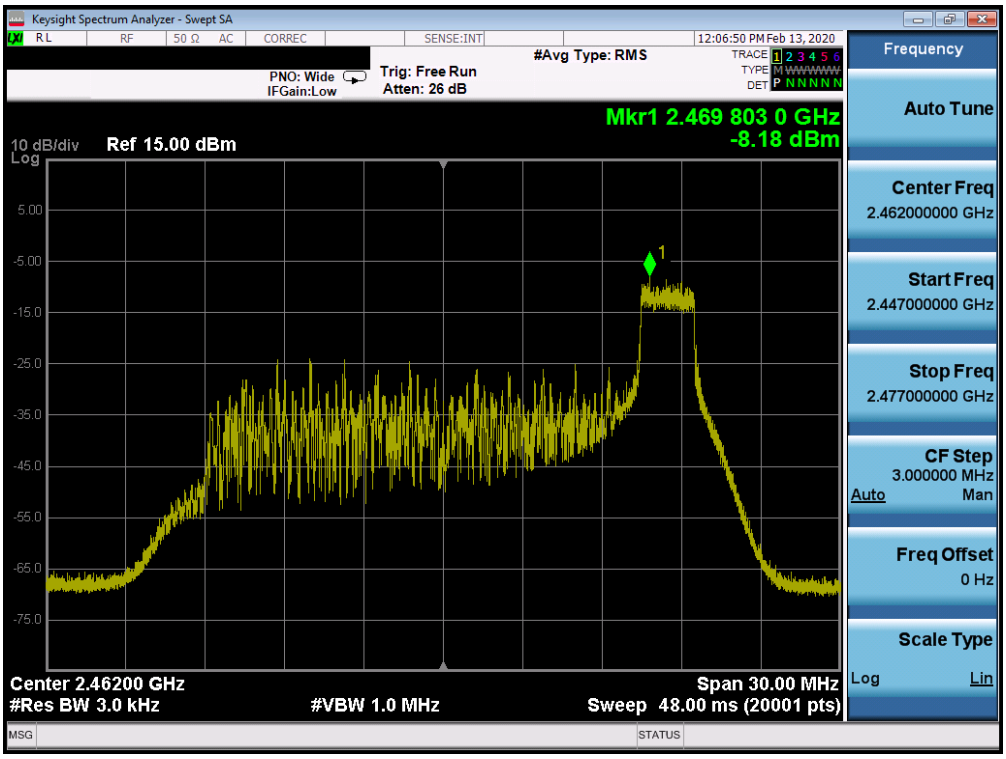


Plot 7-65. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



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

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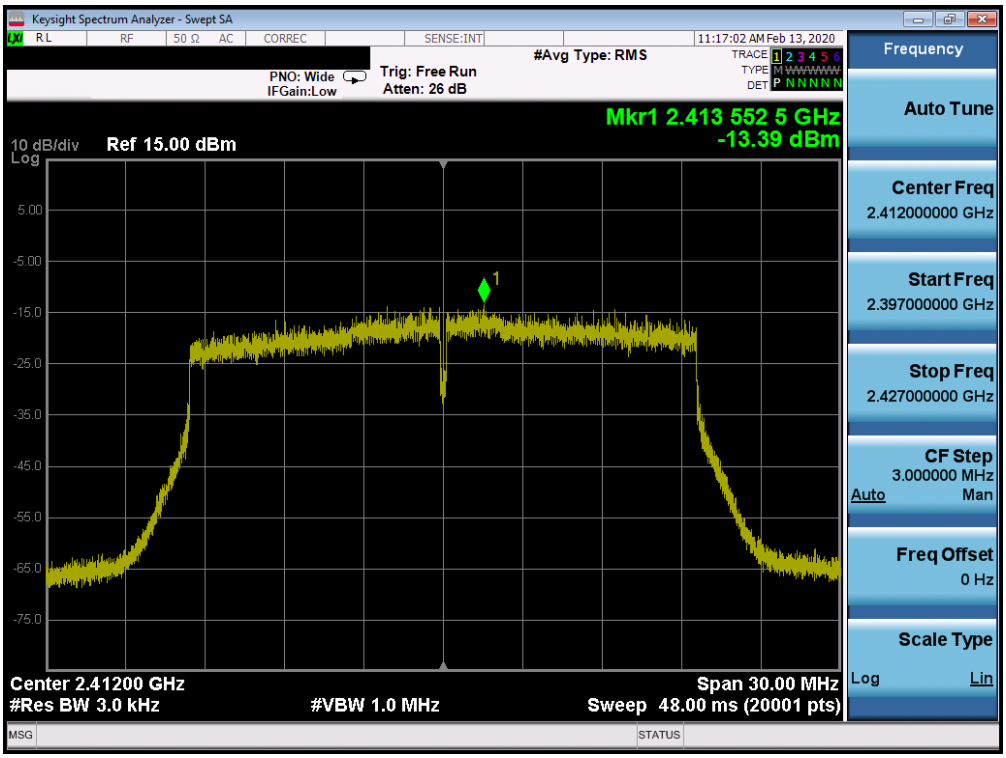
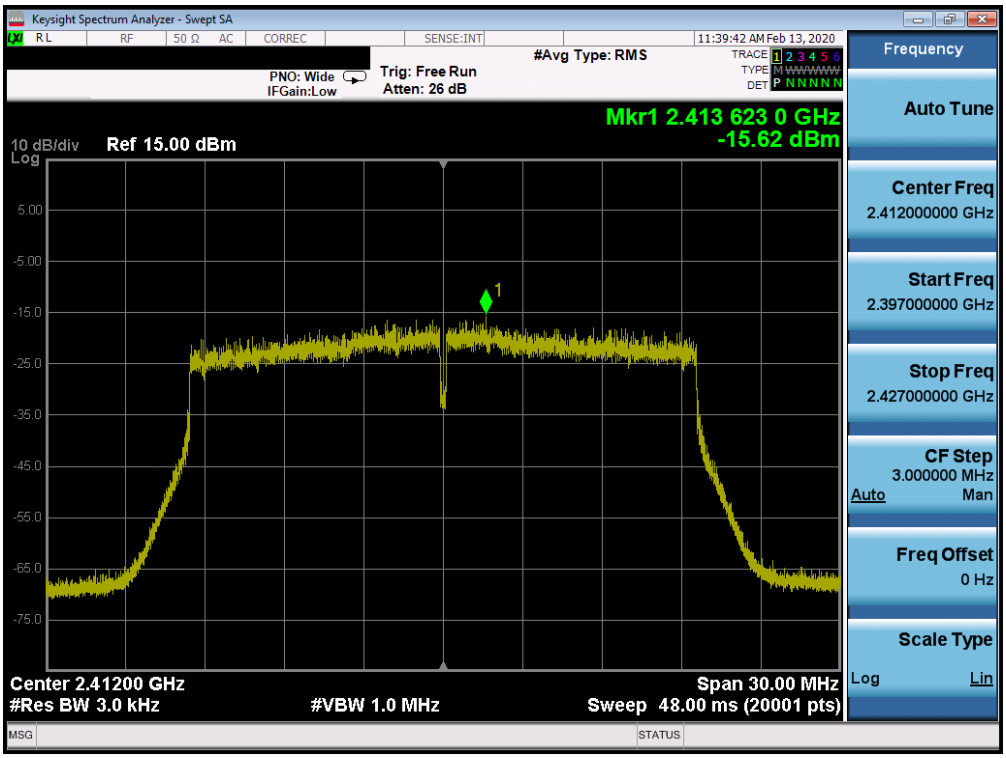


Plot 7-67. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU242 – Ch. 1)



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

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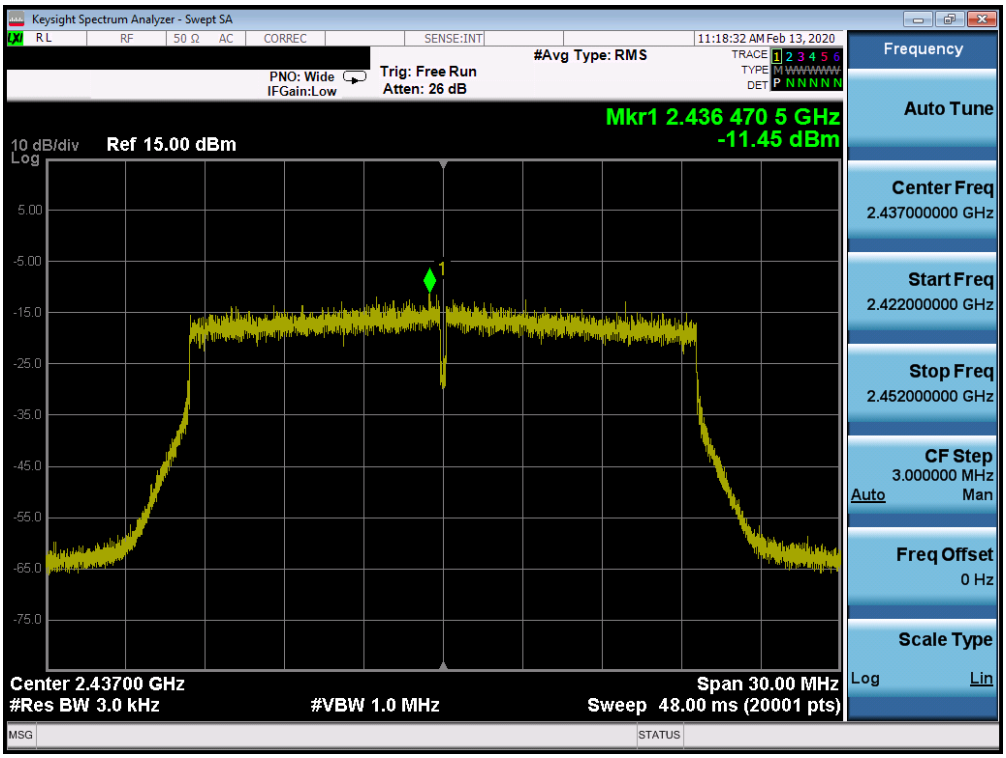
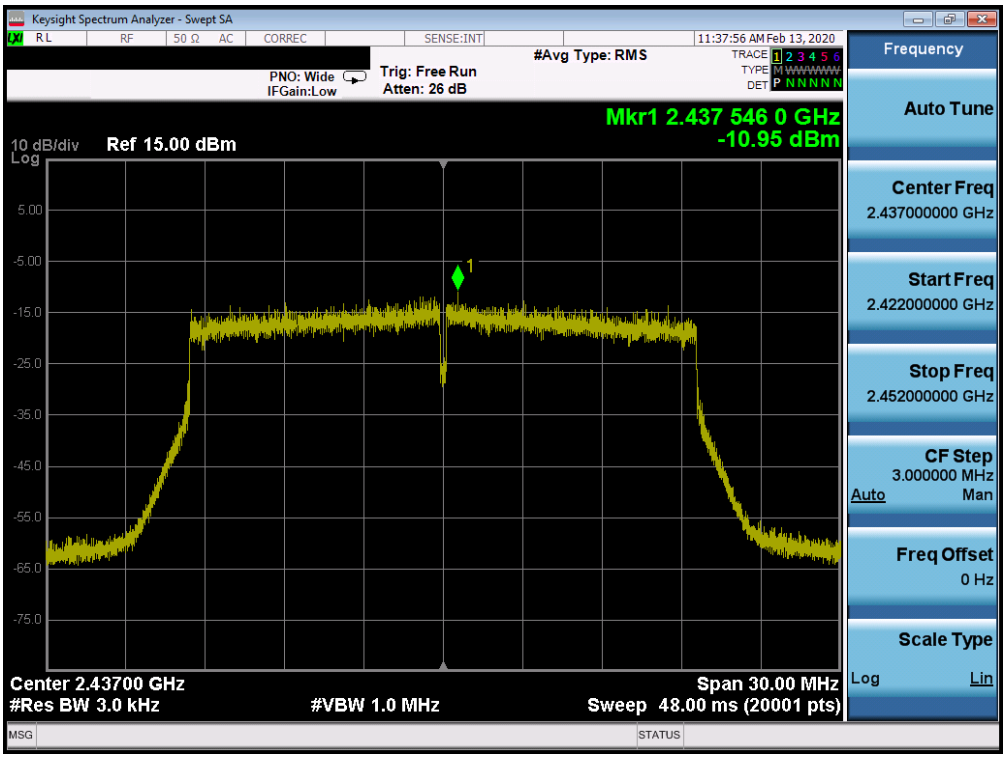


Plot 7-69. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU242 – Ch. 6)



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

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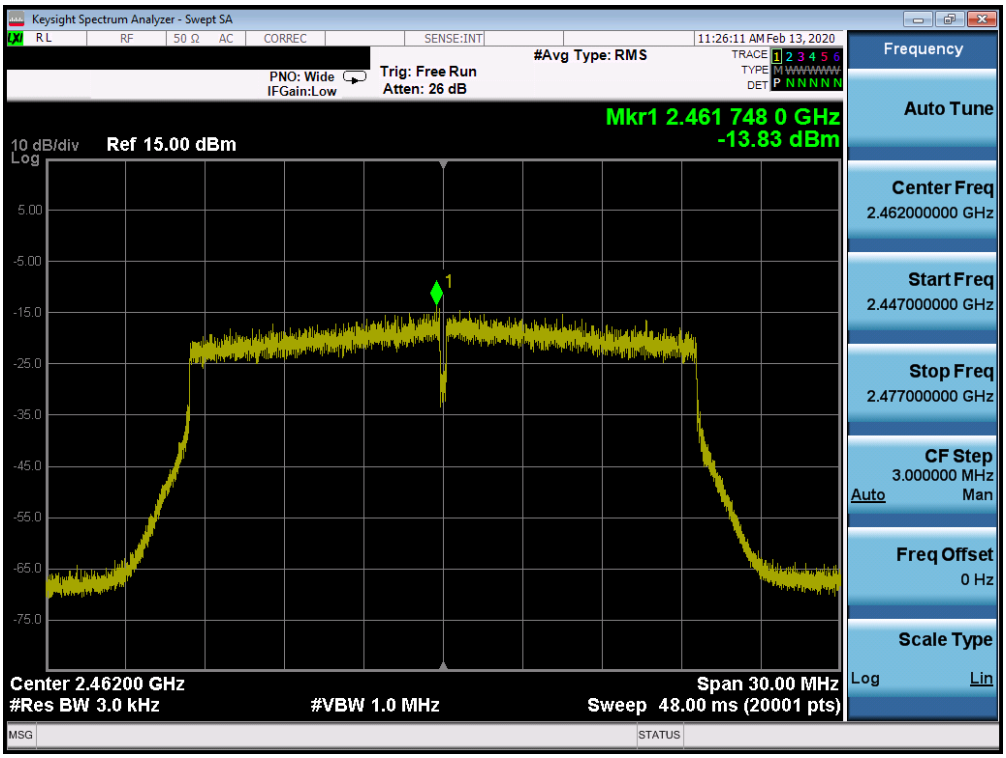
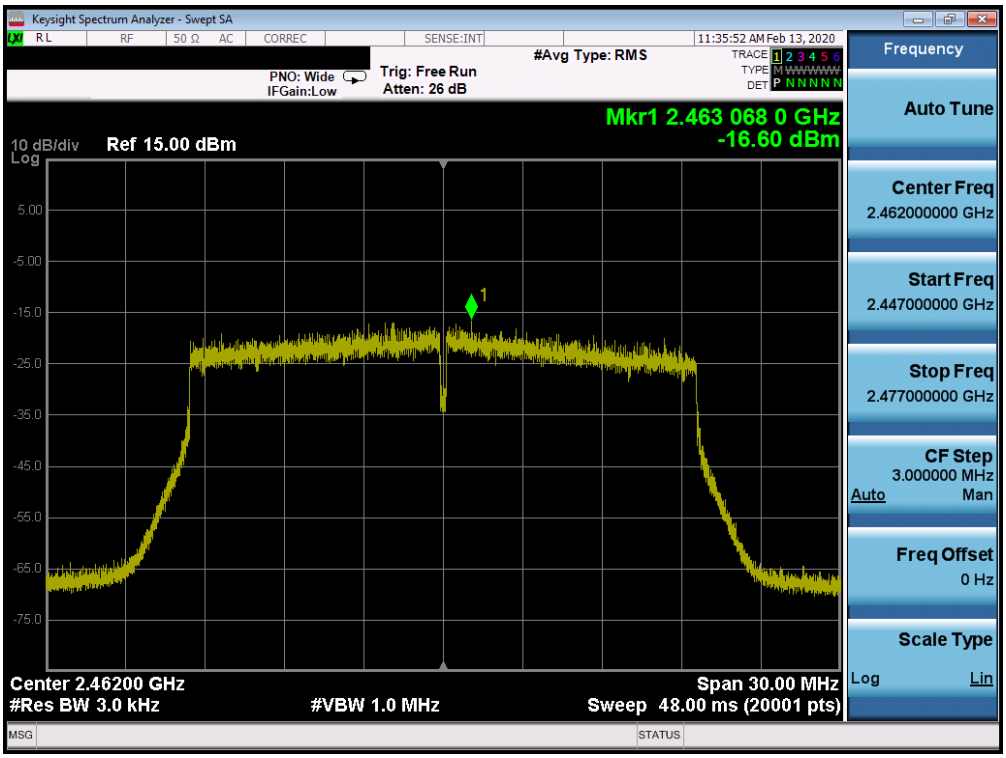


Plot 7-71. Power Spectral Density Plot CDD CORE 0 (802.11ax OFDMA – RU242 – Ch. 11)



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

Note:

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Per ANSI C63.10-2013 Section 14.3.2.2 and KDB 662911 D01 v02r01 Section E)2), the power spectral density at Core 0 and Core 1 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 -6.18 dBm for Core 0 and -8.24 dBm for Core 1.

Core 0 + Core 1 = CDD

(-6.18 dBm + -8.24 dBm) = (0.241 mW + 0.150 mW) = 0.391 mW = -4.08 dBm

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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, RU 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 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 – Section 11.11.3
KDB 558074 D01 v05 – 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 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 were reported.

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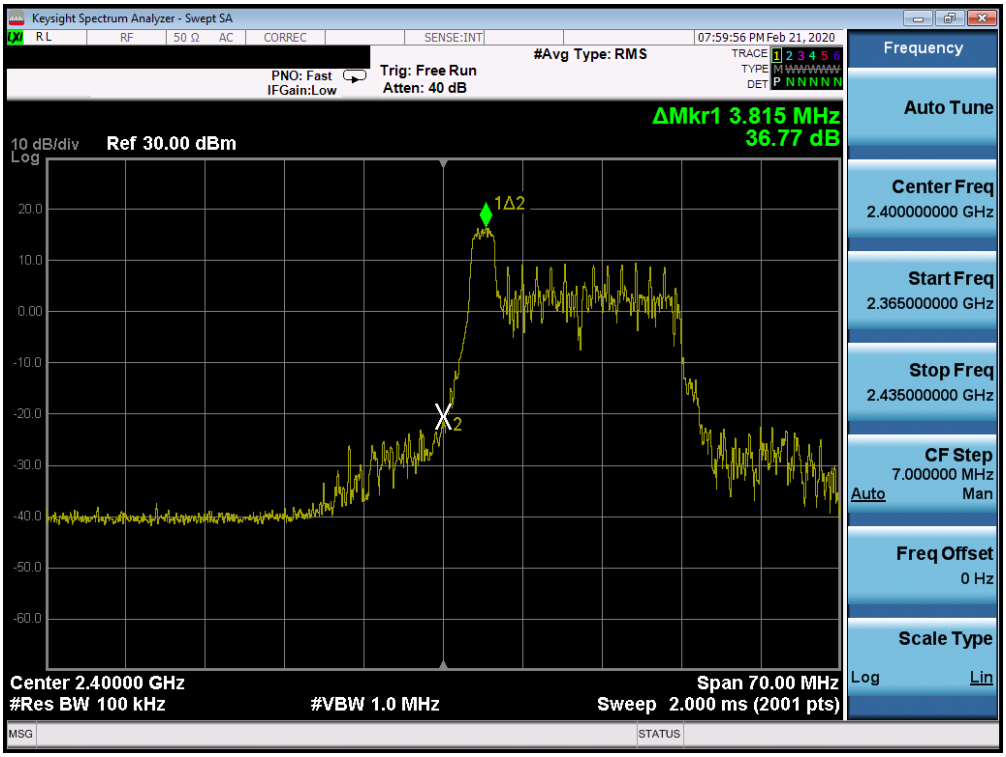
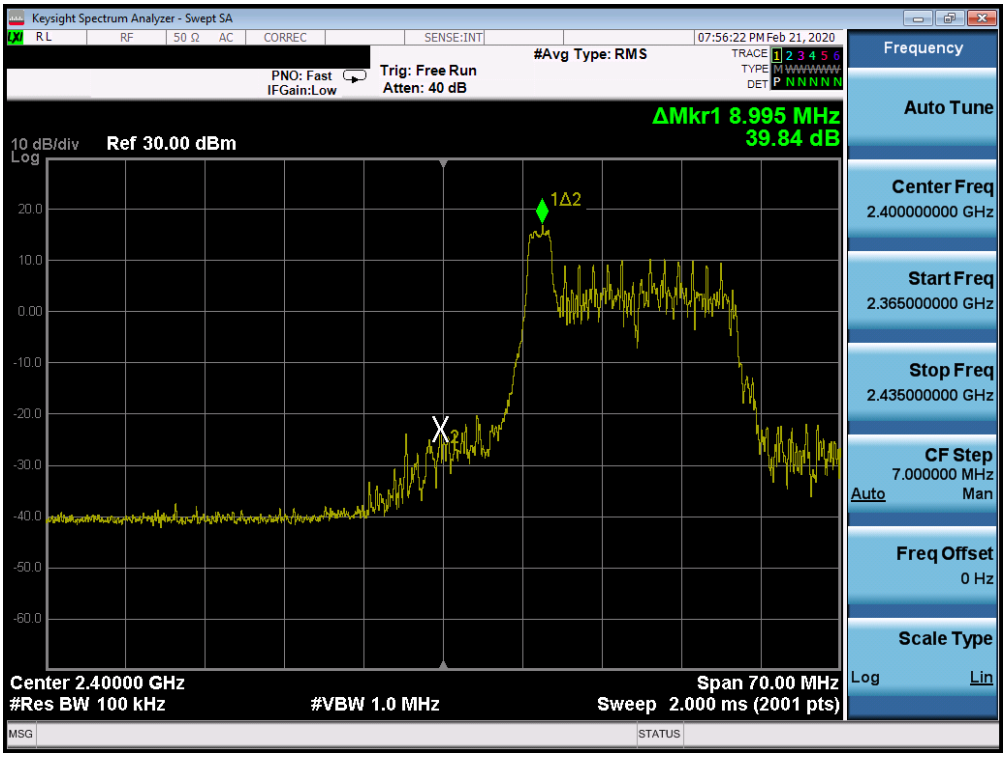
SISO Core 0 Conducted Emissions at the Band Edge



Plot 7-73. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 1)



Plot 7-74. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 0 – Ch. 2)

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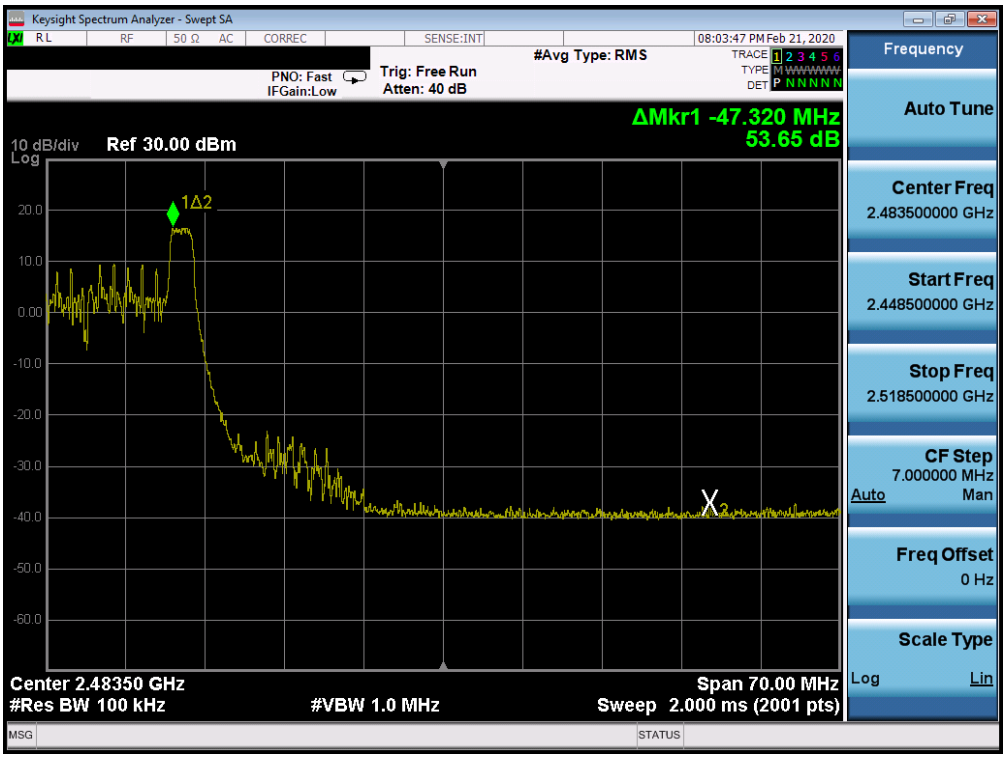
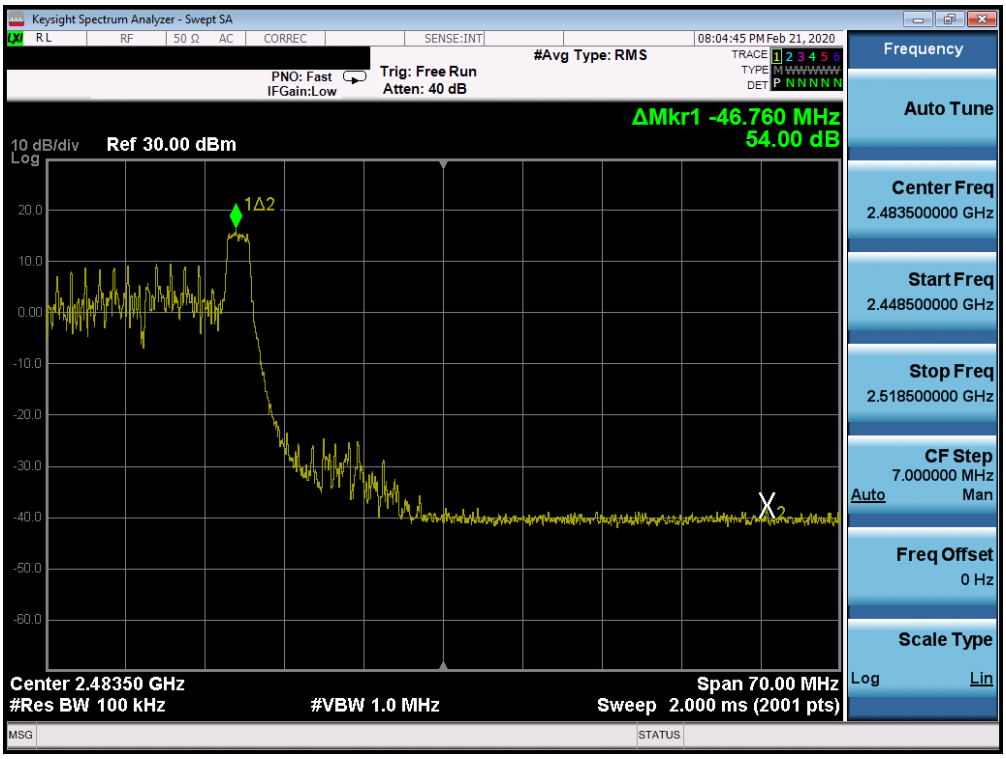


Plot 7-75. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 9)



Plot 7-76. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 10)

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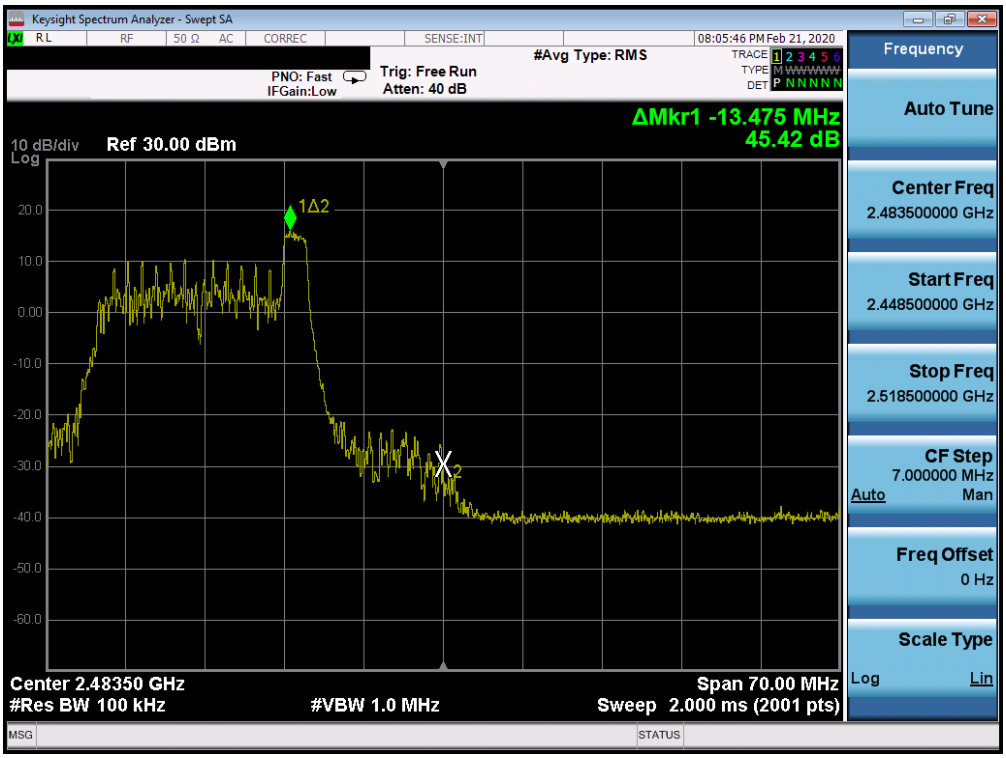
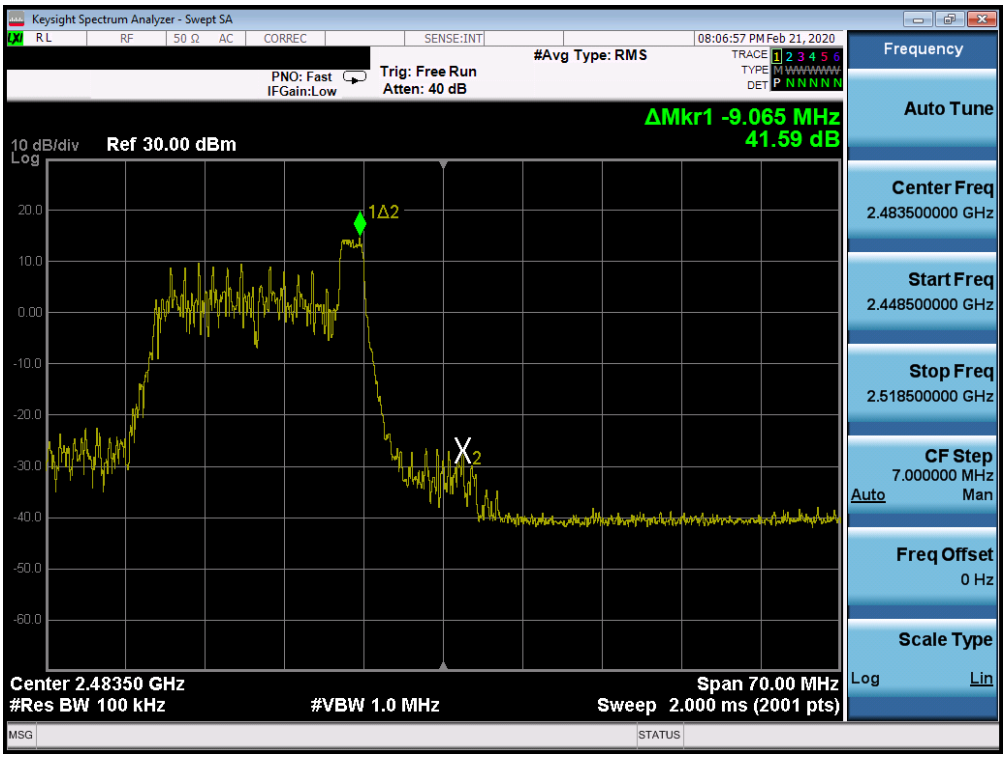


Plot 7-77. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 11)



Plot 7-78. Band Edge SISO CORE 0 (802.11ax OFDMA – RU26 Index 8 – Ch. 12)

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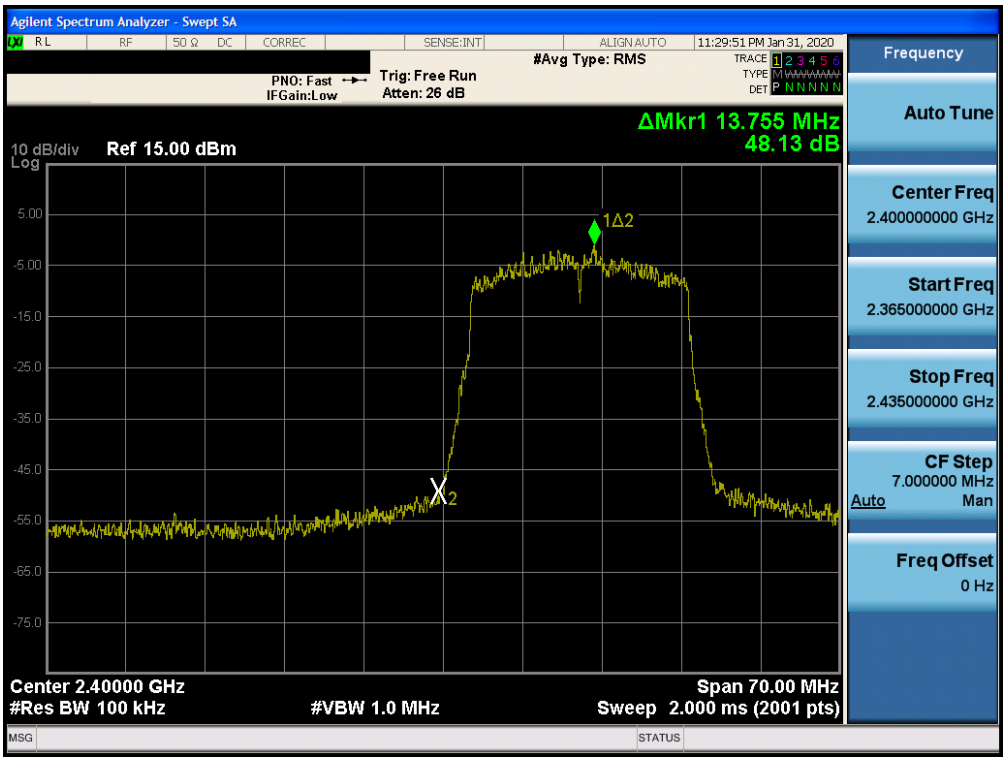
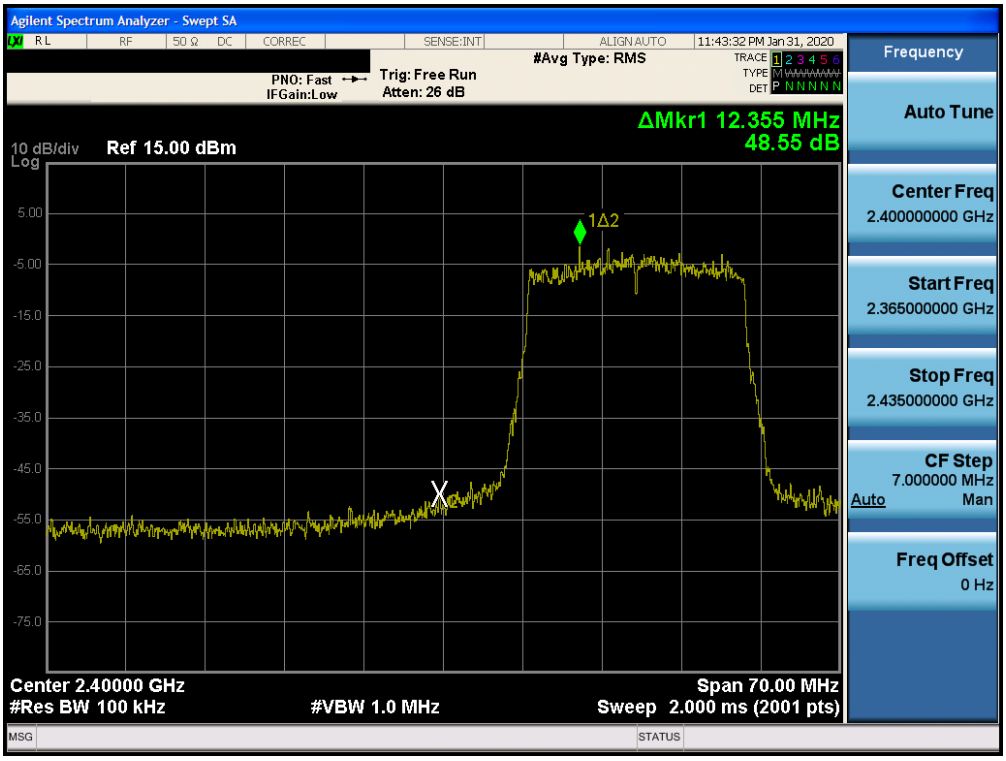


Plot 7-79. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 1)



Plot 7-80. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 2)

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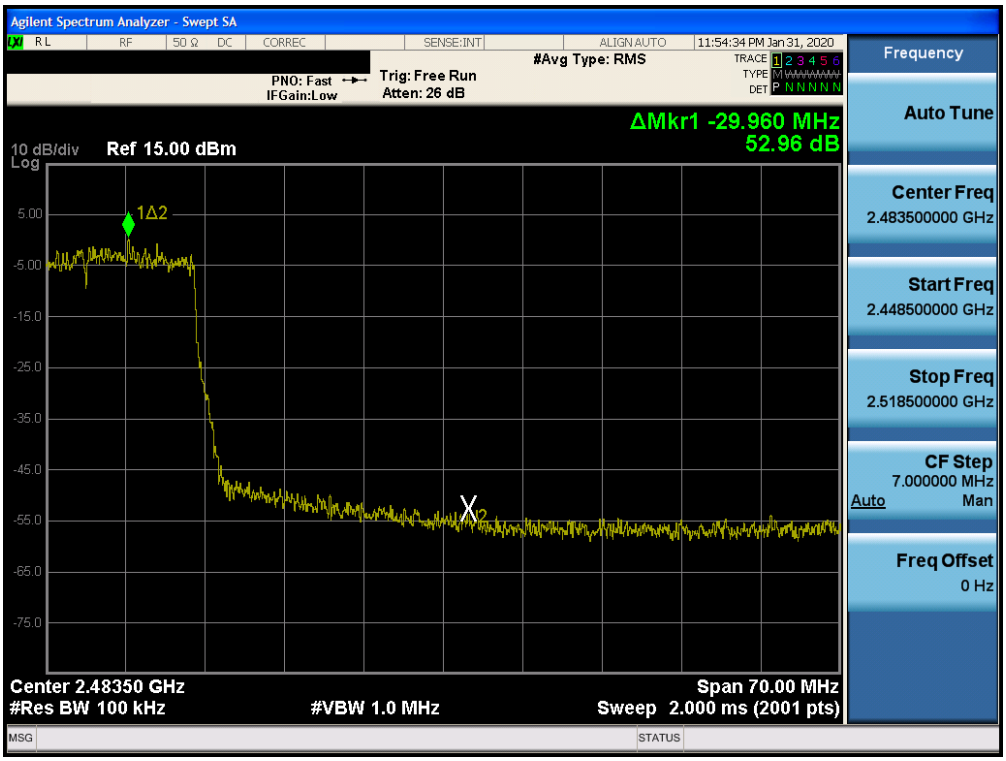
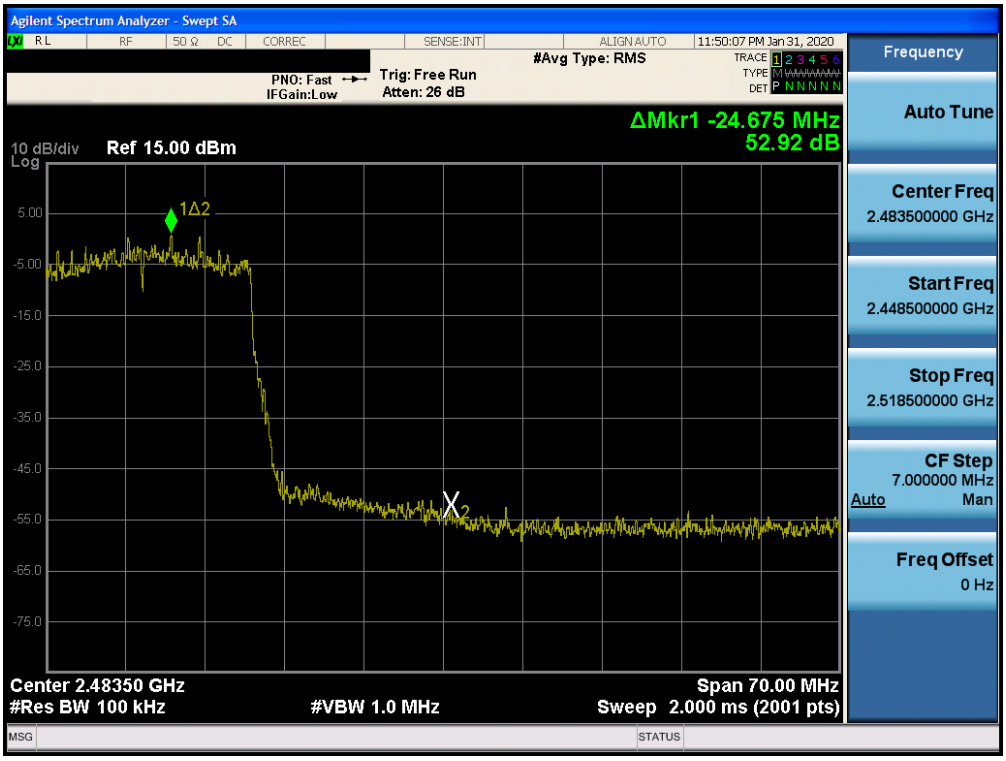


Plot 7-81. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 9)



Plot 7-82. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 10)

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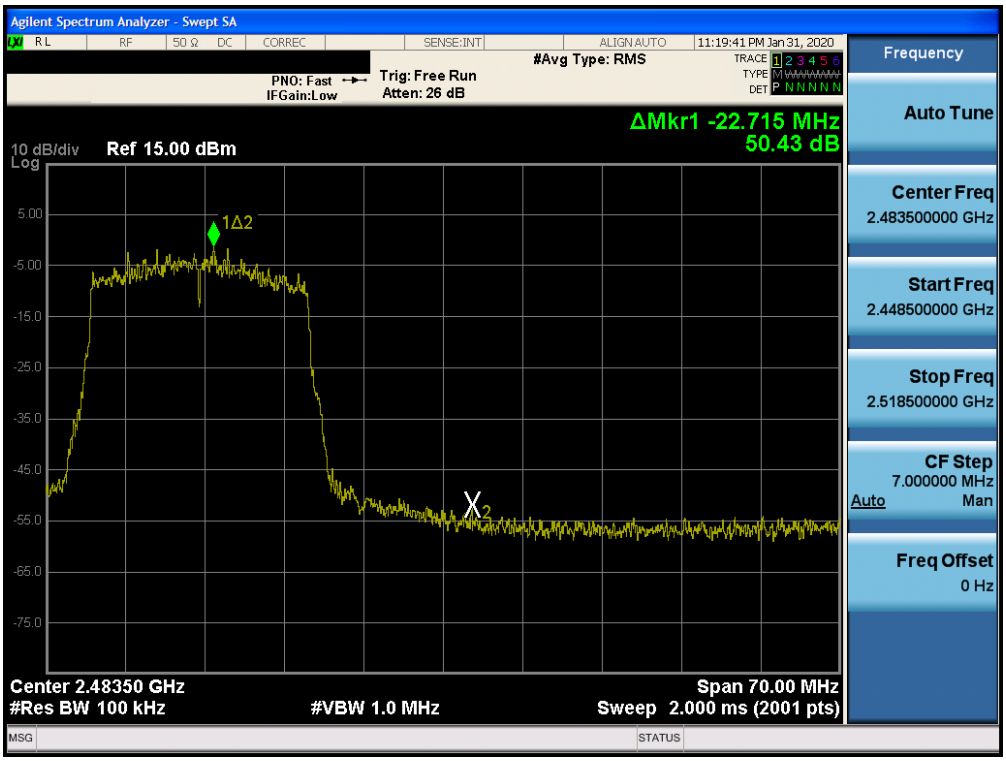
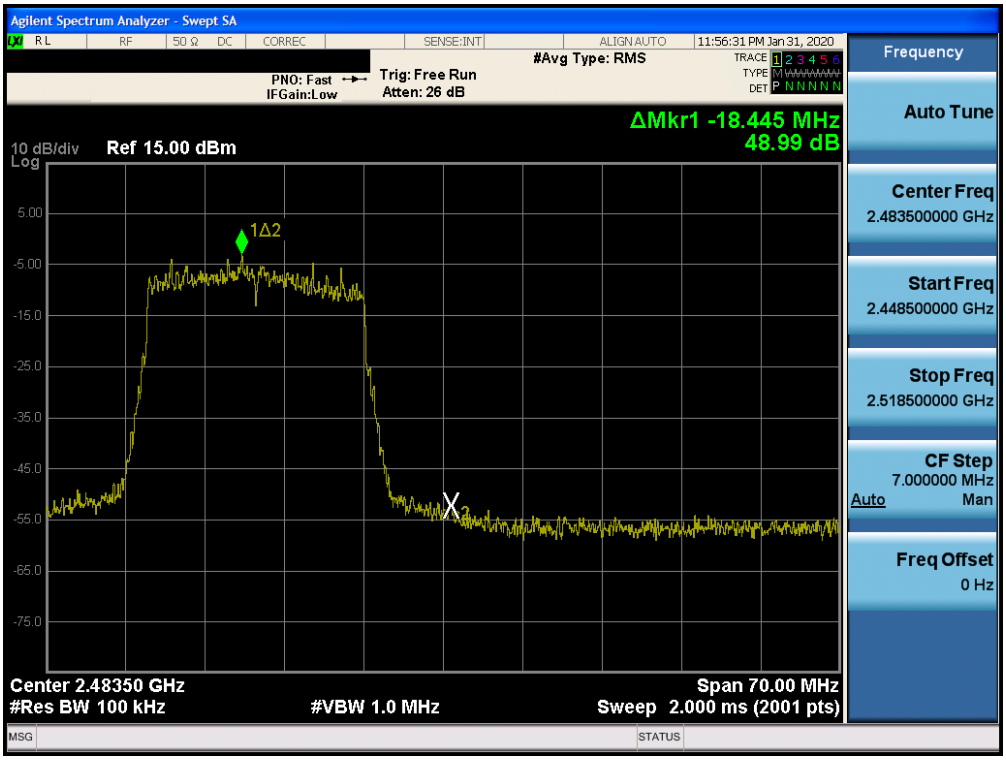


Plot 7-83. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 11)



Plot 7-84. Band Edge SISO CORE 0 (802.11ax OFDMA – RU242 – Ch. 12)

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