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MEASUREMENT REPORT
FCC PART 15.407 802.11a/n/ac/ax (OFDM)

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

Date of Testing:
3/4 - 5/30/2023
Test Report Issue Date:
5/31/2023
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2303170032-11.A3L

FCC ID:	**A3LSMF731B**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-F731B
EUT Type:	Portable Handset
Frequency Range:	5180 – 5925MHz
Modulation Type:	OFDM
FCC Equipment Class:	Unlicensed National Information Infrastructure TX (NII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 291074 D02 v01, KDB 648474 D03 v01r04, 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. Test results reported herein relate only to the item(s) tested.

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

RJ Ortanez
Executive Vice President

ACCREDITED
CERT #2041.01

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UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	MIMO	
			Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	78.343	18.94
2A		5260 - 5320	76.913	18.86
2C		5500 - 5720	79.433	19.00
3		5745 - 5825	76.913	18.86
4		5845 - 5885	35.318	15.48
1	40	5190 - 5230	62.661	17.97
2A		5270 - 5310	62.661	17.97
2C		5510 - 5710	62.951	17.99
3		5755 - 5795	62.373	17.95
4		5835 - 5875	28.774	14.59
1	80	5210	47.534	16.77
2A		5290	46.881	16.71
2C		5530 - 5690	48.641	16.87
3		5775	48.641	16.87
4		5855	21.330	13.29
1	160	5250	38.459	15.85
2C		5570	38.459	15.85
4		5815	16.749	12.24

EUT Overview

Note: The UNII Band 4 max power values shown in the above table are e.i.r.p values.

1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Test Location

These measurement tests were conducted at the Element laboratory 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 Element lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC 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.

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

- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.

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

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF731B**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

Test Device Serial No.: 0084M, 0097M, 0091M, 0032M, 0096M, 0432M, 0164M, 0227M

2.2 Device Capabilities

This device contains the following capabilities:

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

Band 1		Band 2A		Band 2C		Band 3		Band 3/4	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
36	5180	52	5260	100	5500	149	5745	169	5845
:	:	:	:	:	:	:	:	:	:
40	5200	56	5280	120	5600	157	5785	173	5865
:	:	:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825	177	5885

Table 2-1. 802.11ax (20MHz) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3		Band 3/4	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
38	5190	54	5270	102	5510	151	5755	167	5835
:	:	:	:	:	:	:	:	:	:
46	5230	62	5310	118	5590	159	5795	175	5875
				:	:				
				142	5710				

Table 2-2. 802.11ax (40MHz BW) Frequency / Channel Operations

Band 1		Band 2A		Band 2C		Band 3		Band 3/4	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	58	5290	106	5530	155	5775	171	5855
				:	:				
				122	5610				
				:	:				
				138	5690				

Table 2-3. 802.11ax (80MHz BW) Frequency / Channel Operations

Band 1/2A		Band 2C		Band 3/4	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
50	5250	114	5570	163	5815

Table 2-4. 802.11ax (160MHz BW) Frequency / Channel Operations

Notes:

1. 5GHz NII operation is possible in 20MHz, 40MHz, 80MHz, and 160MHz channel bandwidths. 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 B)2)b) of 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:

Maximum Achievable Duty Cycles			
802.11 Mode/Band		MIMO	
		Duty Cycle [%]	DCCF [dB]
5GHz	a	96.68	0.15
	n (HT20)	98.11	N/A
	ac (HT20)	98.16	N/A
	ax (HE20)	99.74	N/A
	n (HT40)	98.09	N/A
	ac (HT40)	96.21	0.17
	ax (HE40)	99.78	N/A
	ac (HT80)	92.59	0.33
	ax (HE80)	99.78	N/A
	ac (HT160)	92.61	0.33
	ax (HE160)	99.78	N/A

Table 2-5. Measured Duty Cycles

A duty cycle correction factor was applied to RMS measurements for transmission modes with <98% duty cycle.

Example DCCF Calculation:
DCCF = 10log(1/DC) = 10log(1/0.9668) = 0.1464

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

WiFi Configurations		SISO		SDM		CDD	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
5GHz	11a	×	×	×	×	✓	✓
	11n	×	×	✓	✓	✓	✓
	11ac	×	×	✓	✓	✓	✓
	11ax	×	×	✓	✓	✓	✓

Table 2-6. Antenna / Technology Configuration

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

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

802.11a	MCS Index			Spatial Stream	OFDM (802.11n/802.11ac)				OFDM (802.11ac)				OFDM (802.11ax)											
20MHz					20MHz		40MHz		80MHz		160MHz		20MHz			40MHz			80MHz			160MHz		
	HT	VHT	HE		0.8µs GI	0.4µs GI	0.8µs GI	0.4µs GI	0.8µs GI	0.4µs GI	0.8µs GI	0.4µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI
6	0	0	0	1	6.5	7.2	13.5	15	29.3	32.5	58.5	65	8.6	8.1	7.3	17.2	16.3	14.6	36	34	30.6	72.1	68.1	61.3
9	1	1	1	1	13	14.4	27	30	58.5	65	117	130	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5
12	2	2	2	1	19.5	21.7	40.5	45	87.8	97.5	175.5	195	25.8	24.4	21.9	51.6	48.8	43.9	108.1	102.1	91.9	216.2	204.2	183.8
18	3	3	3	1	26	28.9	54	60	117	130	234	260	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245
24	4	4	4	1	39	43.3	81	90	175.5	195	351	390	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5
36	5	5	5	1	52	57.8	108	120	234	260	468	520	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490
48	6	6	6	1	58.5	65	121.5	135	263.3	292.5	526.5	585	77.4	73.1	65.8	154.9	146.3	131.6	324.3	306.3	275.6	648.5	612.5	551.3
54	7	7	7	1	65	72.2	135	150	292.5	325	585	650	86	81.3	73.1	172.1	162.5	146.3	360.3	340.3	306.3	720.6	680.6	612.5
		8	8	1	78	86.7	162	180	351	390	702	780	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735
	`	9	9	1	N/A	N/A	180	200	390	433.3	780	866.7	114.7	108.3	97.5	229.4	216.7	195	480.4	453.7	408.3	960.8	907.4	816.7
			10	1									129	121.9	109.7	258.1	243.8	219.4	540.4	510.4	459.4	1080.9	1020.8	918.8
			11	1									143.4	135.4	121.9	286.8	270.8	243.8	600.5	567.1	510.4	1201	1134.3	1020.8
6	8	0	0	2	13	14.4	27	30	58.5	65	117	130	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5
9	9	1	1	2	26	28.9	54	60	117	130	234	260	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245
12	10	2	2	2	39	43.3	81	90	175.5	195	351	390	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5
18	11	3	3	2	52	57.8	108	120	234	260	468	520	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490
24	12	4	4	2	78	86.7	162	180	351	390	702	780	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735
36	13	5	5	2	104	115.6	216	240	468	520	936	1040	137.6	130	117	275.3	260	234	576.5	544.4	490	1152.9	1088.9	980
48	14	6	6	2	117	130	243	270	526.5	585	1053	1170	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225	1102.5
54	15	7	7	2	130	144.4	270	300	585	650	1170	1300	172.1	162.5	146.3	344.1	325	292.5	720.6	680.6	612.5	1441.2	1361.1	1225
		8	8	2	156	173.3	324	360	702	780	1404	1560	206.5	195	175.5	412.9	390	351	864.7	816.7	735	1729.4	1633.3	1470
		9	9	2	N/A	N/A	360	400	780	866.7	1560	1733.3	229.4	216.7	195	458.8	433.3	390	960.8	907.4	816.7	1921.6	1814.8	1633.3
			10	2									258.1	243.8	219.4	516.2	487.5	438.8	1080.9	1020.8	918.8	2161.8	2041.7	1837.5
			11	2									286.8	270.8	243.8	573.5	541.7	487.5	1201	1134.3	1020.8	2402	2268.5	2041.7

Table 2-7. Supported Data Rates

2.3 Antenna Description

The following antenna gains were used for the testing.

Frequency [GHz]	Antenna 1 Gain (dBi)	Antenna 2 Gain (dBi)	Directional Gain (dBi)
5.20	-4.49	-6.34	-2.36
5.30	-4.51	-5.72	-2.08
5.50	-5.66	-6.74	-3.17
5.80	-5.92	-7.38	-3.61
5.85	-5.78	-6.96	-3.34

Table 2-8. Antenna Peak Gain

2.4 Test Configuration

ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 7.6 for radiated emissions test setups, and 7.2, 7.3, 7.4 and 7.5 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 worst case radiated emissions data is shown in this report.

This device supports three configurations: one is with screen open; one is where the screen is half open (90 degrees), and one is with the screen closed. All configurations are tested, and the worst case radiated emissions data is shown in this report.

2.5 Software and Firmware

The test was conducted with software/firmware version F731BXXU0AWD7 installed on the EUT.

2.6 EMI Suppression Device(s) / Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

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

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

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

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

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

Line conducted emissions test results are shown in Section 7.7. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

3.3 Radiated Emissions

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

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

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

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

3.4 Environmental Conditions

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

4.0 ANTENNA REQUIREMENTS

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

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

Conclusion:

The EUT 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
-	AP2-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-001
-	AP2-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-002
-	ETS-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	ETS-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-002
-	NMLC-2	Line Conducted Emissions Cable (NM)	1/11/2023	Annual	1/11/2024	NMLC-2
EMCO	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9203-2178
EMCO	3116	Horn Antenna (18-40GHz)	7/20/2021	Biennial	7/20/2023	9704-5182
Keysight Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	8/18/2022	Annual	8/18/2023	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer	9/6/2022	Annual	9/6/2023	MY55410501
Keysight Technologies	N9038A	MXE EMI Receiver	1/21/2022	Annual	6/21/2023	MY51210133
Sunol Sciences	DRH-118	Horn (Small)	2/14/2022	Biennial	2/14/2024	A102416-2
Sunol Sciences	JB5	Bi-Log Antenna (30M-5GHz)	8/30/2022	Biennial	8/30/2024	A102416-1
Sunol Sciences	DRH-118	Horn Antenna (1-18GHz)	7/14/2021	Biennial	7/14/2023	A051107
Rohde & Schwarz	ESW26	ESW26 EMI Test Receiver	5/19/2022	Annual	5/19/2023	161675
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	9/21/2021	Annual	9/21/2023	310233

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: A3LSMF731B
FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
N/A	RSS-Gen [6.6]	26dB Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
15.407(e)	RSS-Gen [6.6]	6dB Bandwidth	>500kHz(5725-5850MHz and 5850 – 5895MHz)		PASS	Section 7.3
15.407 (a)(1)(iv), (a)(2), (a)(3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a)(1)(iv), (a)(2), (a)(3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See DFS Test Report		PASS	See DFS Test Report
15.407(b)(1), (b)(2), (b)(3), (b)(4)	RSS-247 [6.2]	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])	RADIATED	PASS	Section 7.6
15.205, 15.407(b)(1), (b)(4), (b)(5), (b)(6)	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])		PASS	Section 7.6
15.407	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 (RSS-Gen [8.8]) limits	LINE CONDUCTED	PASS	Section 7.7

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst-case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "UNII Automation," Version 4.7.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 1.5.0.

7.2 26dB Bandwidth Measurement

Test Overview and Limit

The bandwidth at 26dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26dB bandwidth.

The 26dB bandwidth is used to determine the conducted power limits.

Test Procedure Used

ANSI C63.10-2013 – Section 12.4

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth
3. VBW $\geq$ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

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

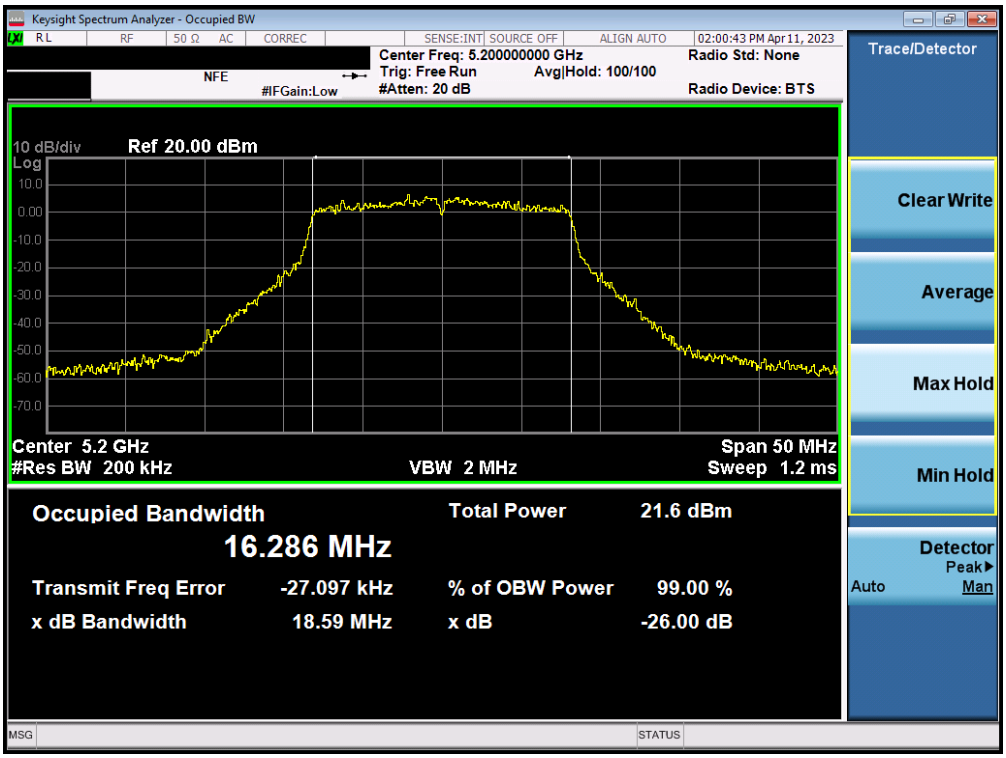
None.

MIMO 26dB Bandwidth Measurements

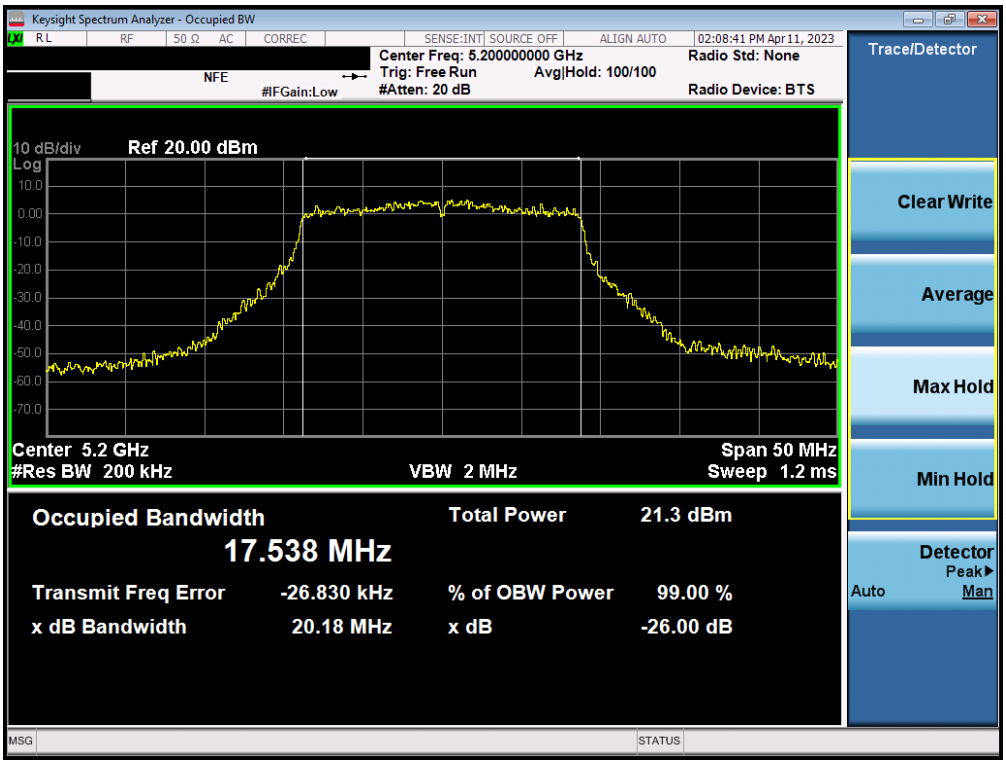
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 26dB Bandwidth [MHz]	Antenna-2 26dB Bandwidth [MHz]
Band 1	5180	36	a	6	18.79	19.18
	5200	40	a	6	18.59	18.57
	5240	48	a	6	19.67	18.87
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	19.89	20.08
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	20.18	19.64
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	20.25	19.94
	5180	36	ax (20MHz)	6.5/7.2 (MCS0)	20.54	20.64
	5200	40	ax (20MHz)	6.5/7.2 (MCS0)	20.29	20.30
	5240	48	ax (20MHz)	6.5/7.2 (MCS0)	20.99	20.26
	5190	38	n (40MHz)	13.5/15 (MCS0)	39.53	39.27
	5230	46	n (40MHz)	13.5/15 (MCS0)	40.33	39.34
	5190	38	ax (40MHz)	13.5/15 (MCS0)	39.81	39.61
	5230	46	ax (40MHz)	13.5/15 (MCS0)	39.97	39.76
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	80.89	80.64
	5210	42	ax (80MHz)	29.3/32.5 (MCS0)	80.25	80.46
Band 1/2A	5250	50	ac (160MHz)	58.5/65 (MCS0)	163.50	162.40
	5250	50	ax (160MHz)	58.5/65 (MCS0)	163.60	162.40
Band 2A	5260	52	a	6	18.34	18.84
	5280	56	a	6	18.45	19.16
	5320	64	a	6	19.43	18.73
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	20.14	19.18
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	20.04	19.93
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	20.21	19.72
	5260	52	ax (20MHz)	6.5/7.2 (MCS0)	20.56	20.20
	5280	56	ax (20MHz)	6.5/7.2 (MCS0)	20.38	20.72
	5320	64	ax (20MHz)	6.5/7.2 (MCS0)	20.65	20.29
	5270	54	n (40MHz)	13.5/15 (MCS0)	39.39	39.40
	5310	62	n (40MHz)	13.5/15 (MCS0)	39.94	39.46
	5270	54	ax (40MHz)	13.5/15 (MCS0)	39.95	40.00
	5310	62	ax (40MHz)	13.5/15 (MCS0)	39.87	39.47
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	80.50	80.90
	5290	58	ax (80MHz)	29.3/32.5 (MCS0)	80.70	80.99
Band 2C	5500	100	a	6	18.64	18.64
	5600	120	a	6	18.82	18.94
	5720	144	a	6	18.37	18.76
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	19.53	19.87
	5600	120	n (20MHz)	6.5/7.2 (MCS0)	20.14	19.60
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	19.94	19.90
	5500	100	ax (20MHz)	6.5/7.2 (MCS0)	20.37	20.47
	5600	120	ax (20MHz)	6.5/7.2 (MCS0)	20.52	20.66
	5720	144	ax (20MHz)	6.5/7.2 (MCS0)	20.40	20.53
	5510	102	n (40MHz)	13.5/15 (MCS0)	39.35	38.93
	5590	118	n (40MHz)	13.5/15 (MCS0)	39.56	39.22
	5710	142	n (40MHz)	13.5/15 (MCS0)	39.66	39.16
	5510	102	ax (40MHz)	13.5/15 (MCS0)	39.74	39.86
	5590	118	ax (40MHz)	13.5/15 (MCS0)	40.18	39.73
	5710	142	ax (40MHz)	13.5/15 (MCS0)	39.72	39.76
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	81.43	80.61
	5610	122	ac (80MHz)	29.3/32.5 (MCS0)	80.93	80.76
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	81.04	80.62
	5530	106	ax (80MHz)	29.3/32.5 (MCS0)	80.80	80.83
	5610	122	ax (80MHz)	29.3/32.5 (MCS0)	81.55	81.19
	5690	138	ax (80MHz)	29.3/32.5 (MCS0)	81.29	81.15
	5570	114	ax (160MHz)	29.3/32.5 (MCS0)	163.30	162.70
	5570	114	ax (160MHz)	29.3/32.5 (MCS0)	163.30	162.80

Table 7-2. Bands 1, 2A, 2C Conducted 26dB Bandwidth Measurements MIMO

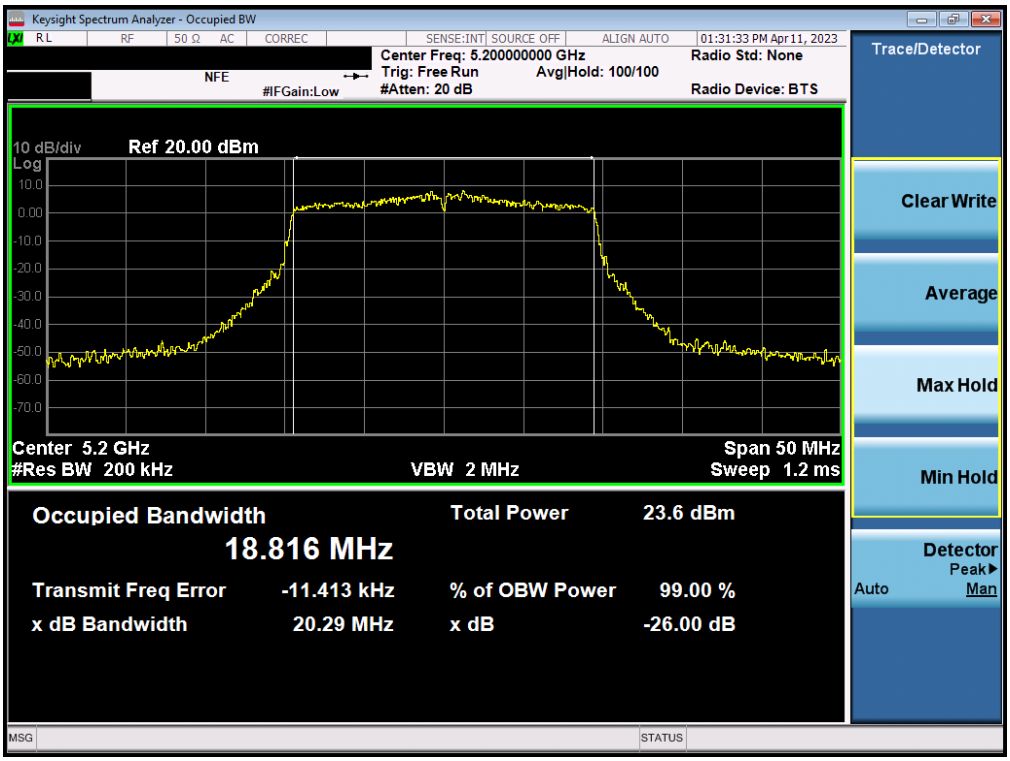
7.2.1 MIMO Antenna-1 26dB Bandwidth Measurements



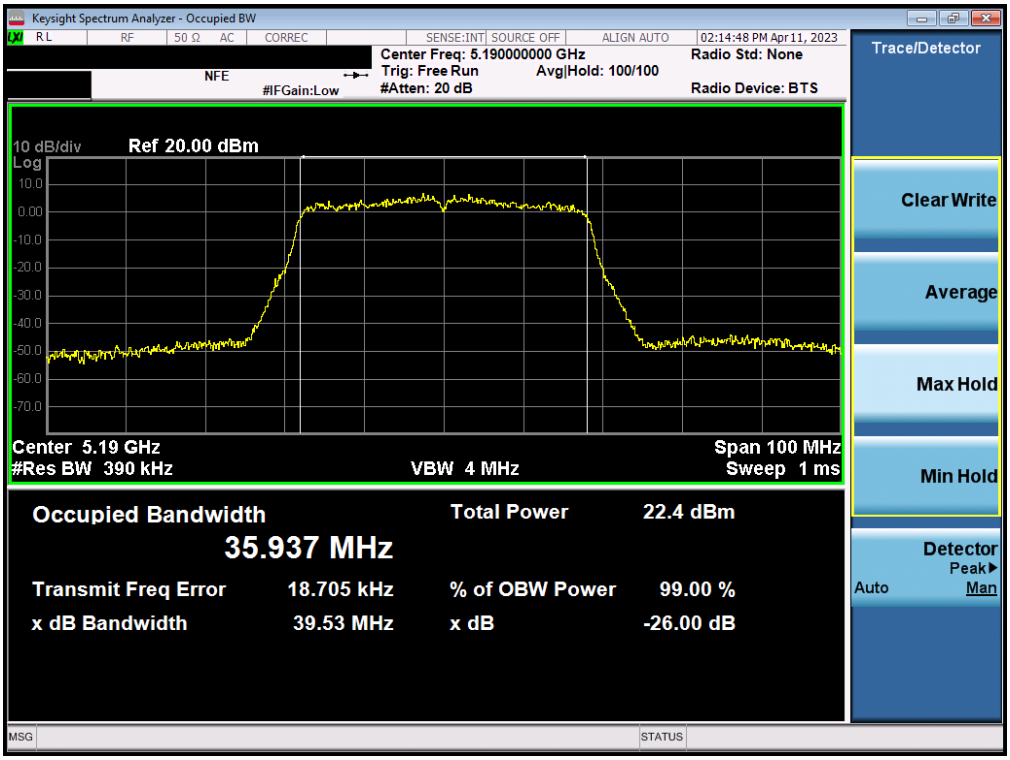
Plot 7-1. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 1) – Ch. 40)



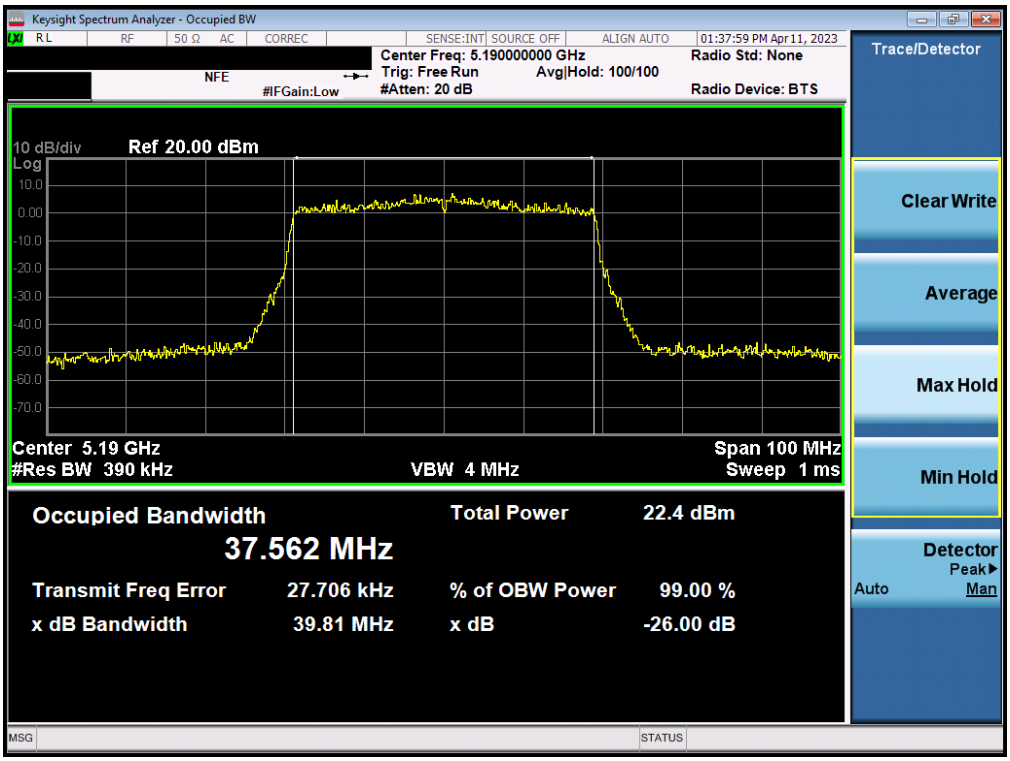
Plot 7-2. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



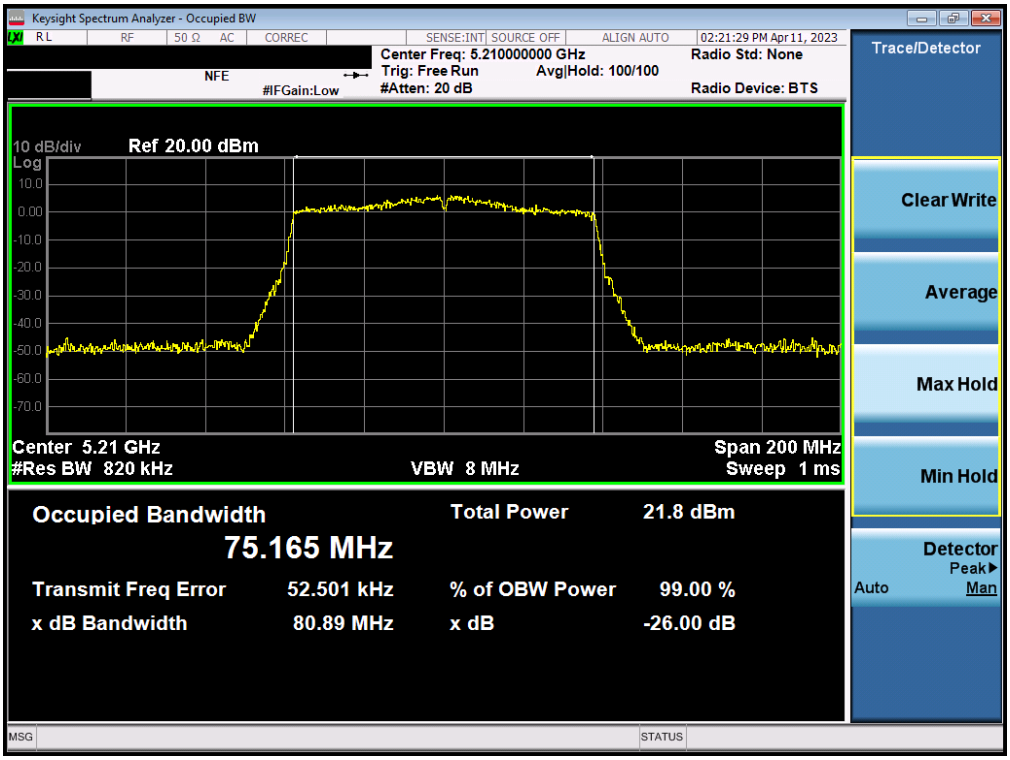
Plot 7-3. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



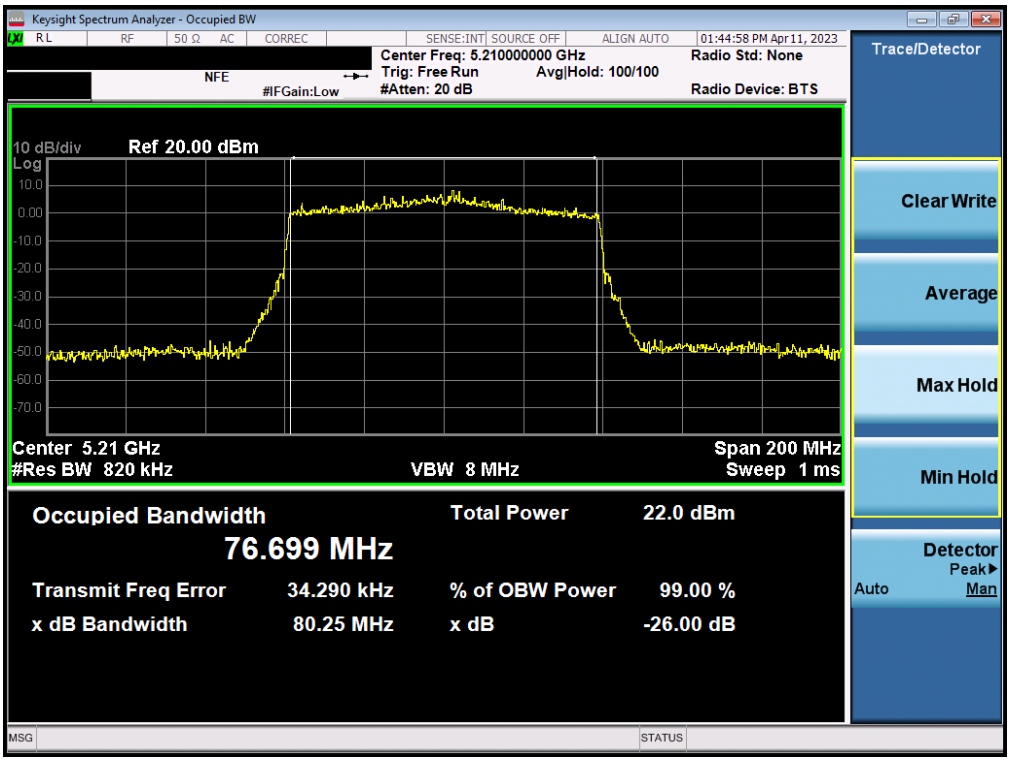
Plot 7-4. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



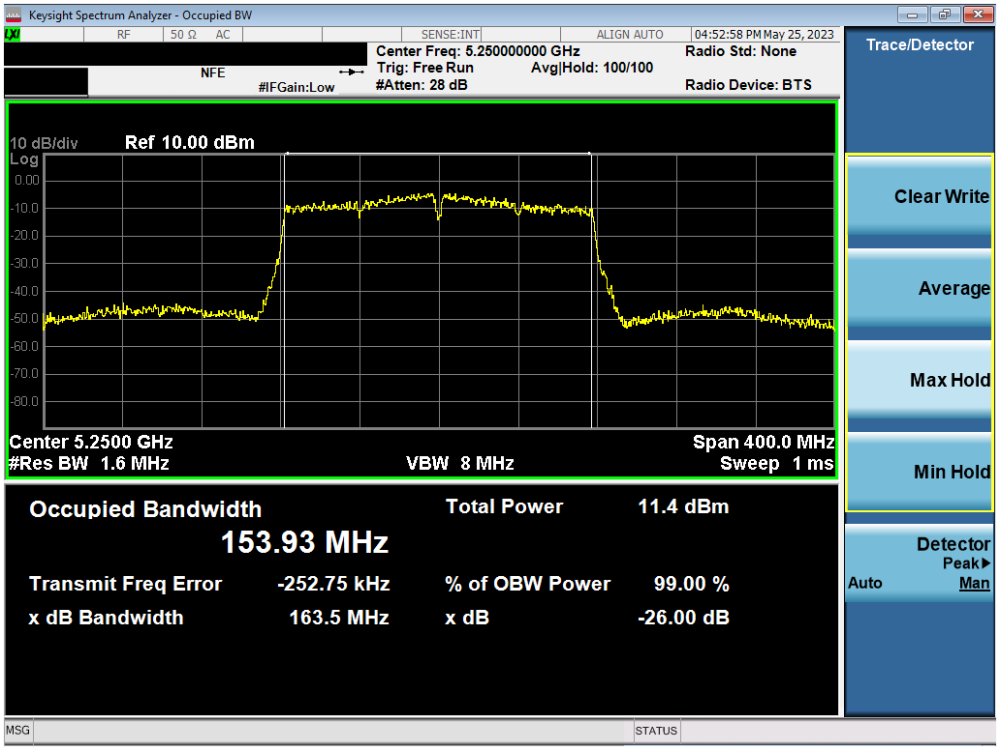
Plot 7-5. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



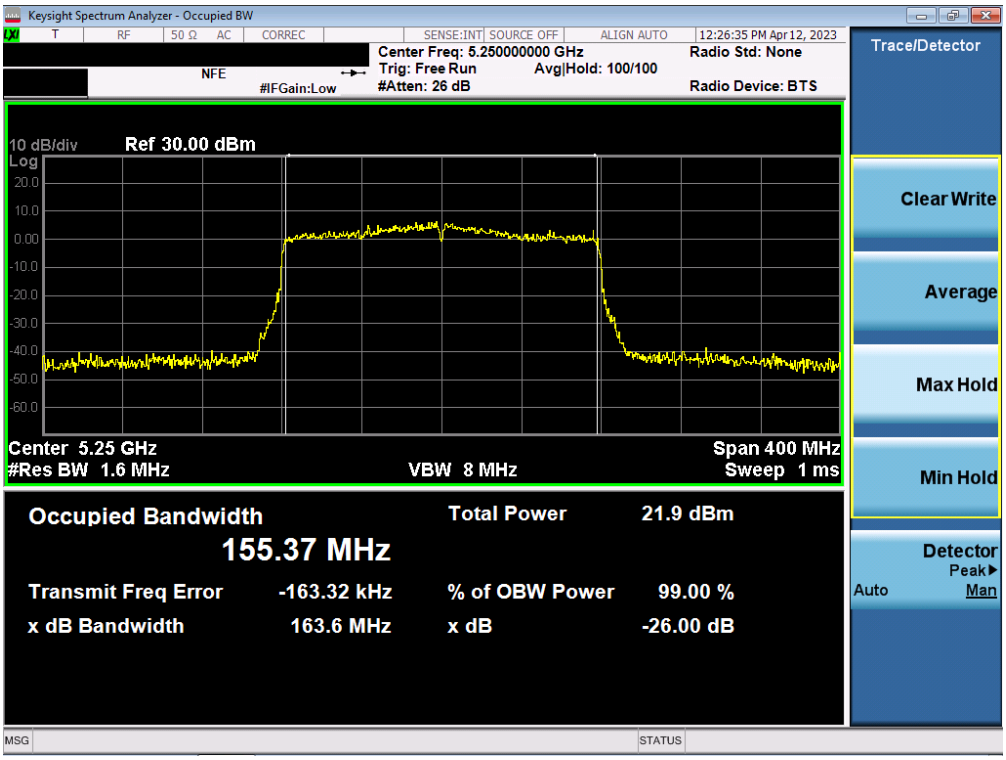
Plot 7-6. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



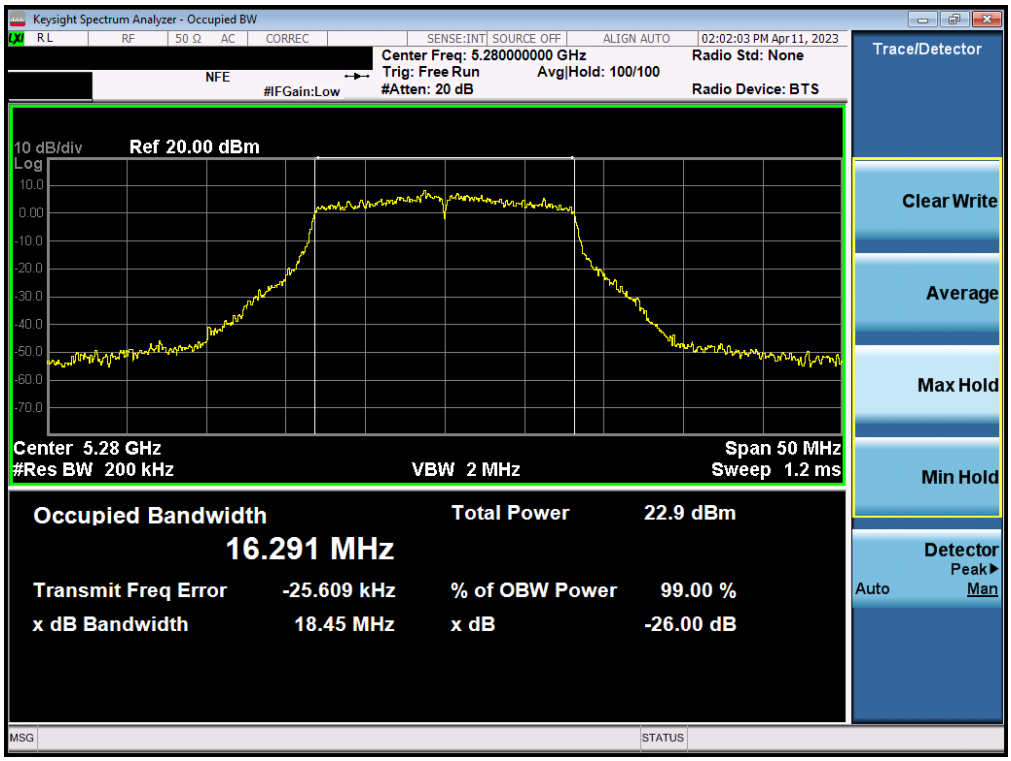
Plot 7-7. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



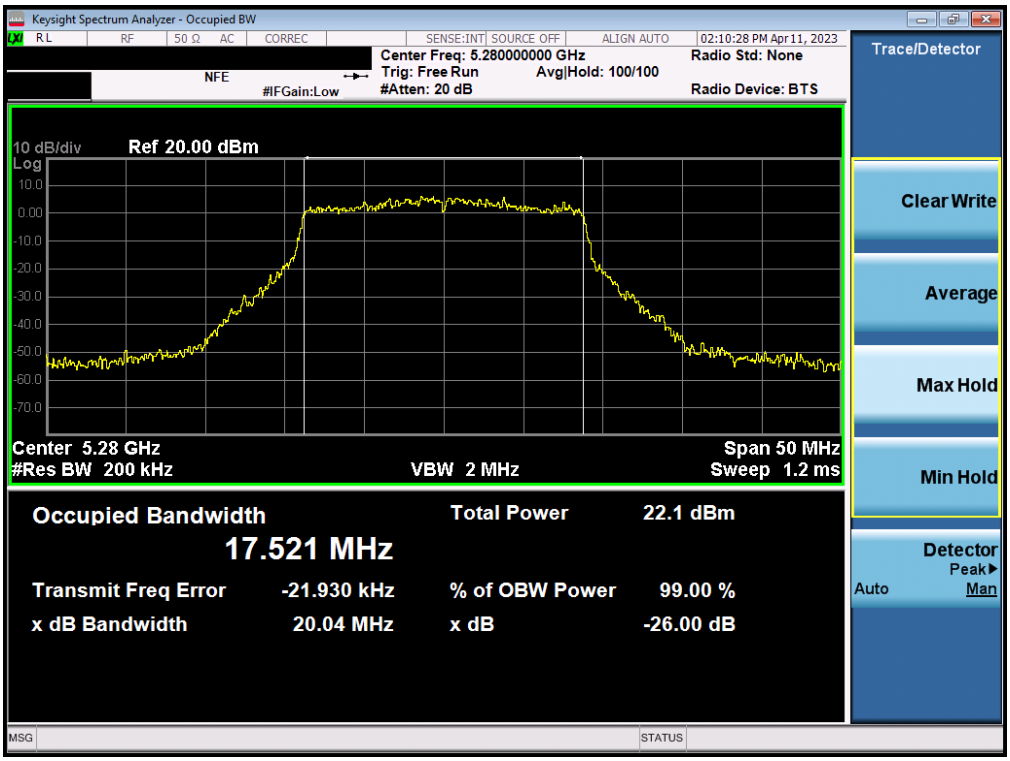
Plot 7-8. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



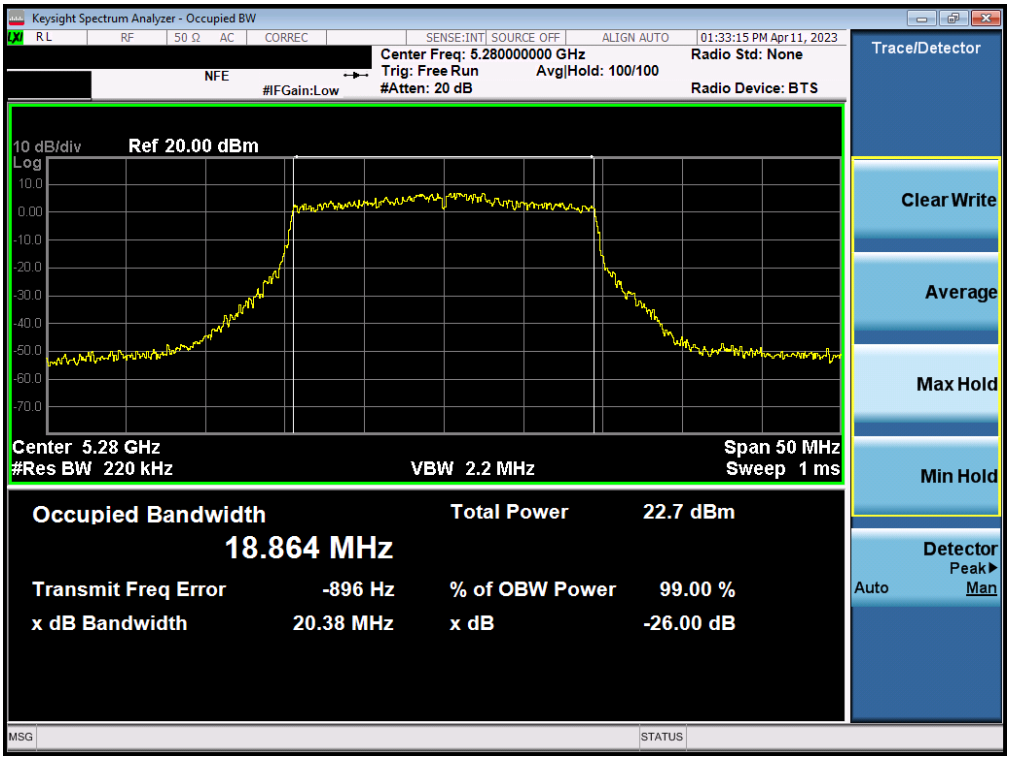
Plot 7-9. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



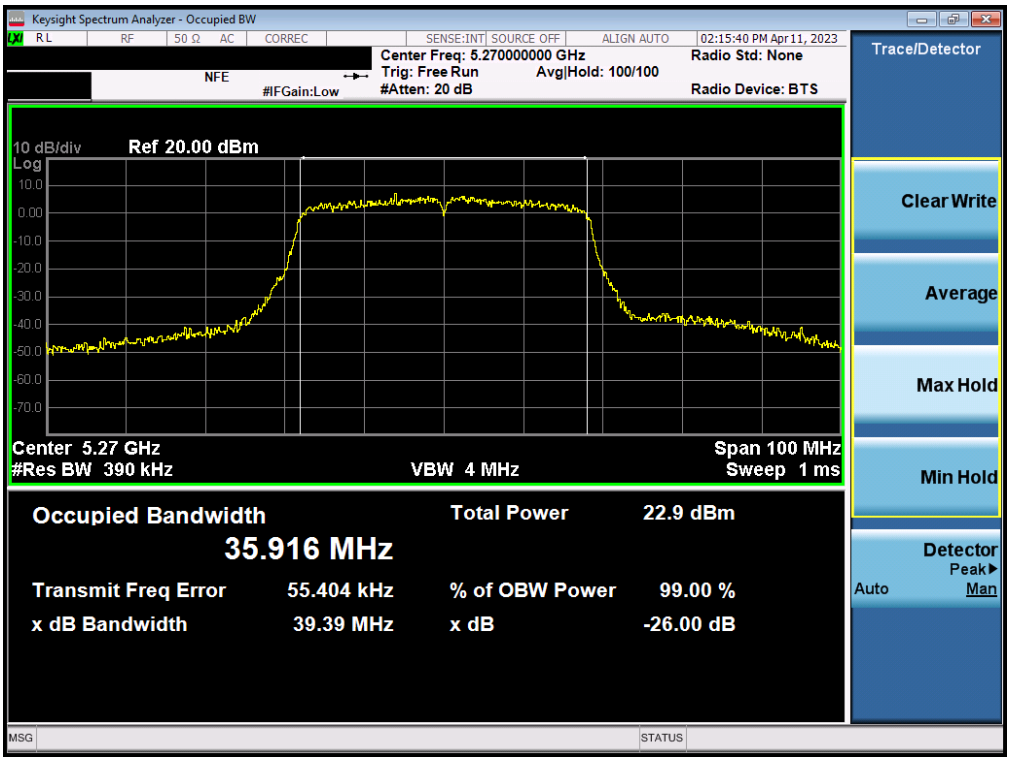
Plot 7-10. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 2A) – Ch. 56)



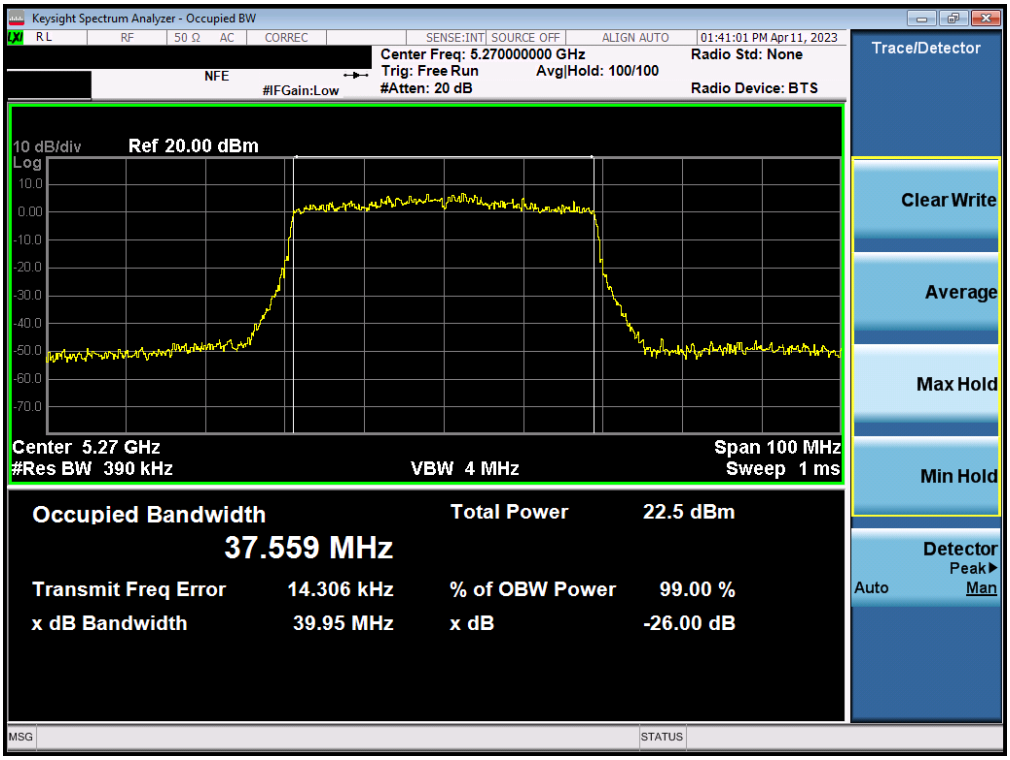
Plot 7-11. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



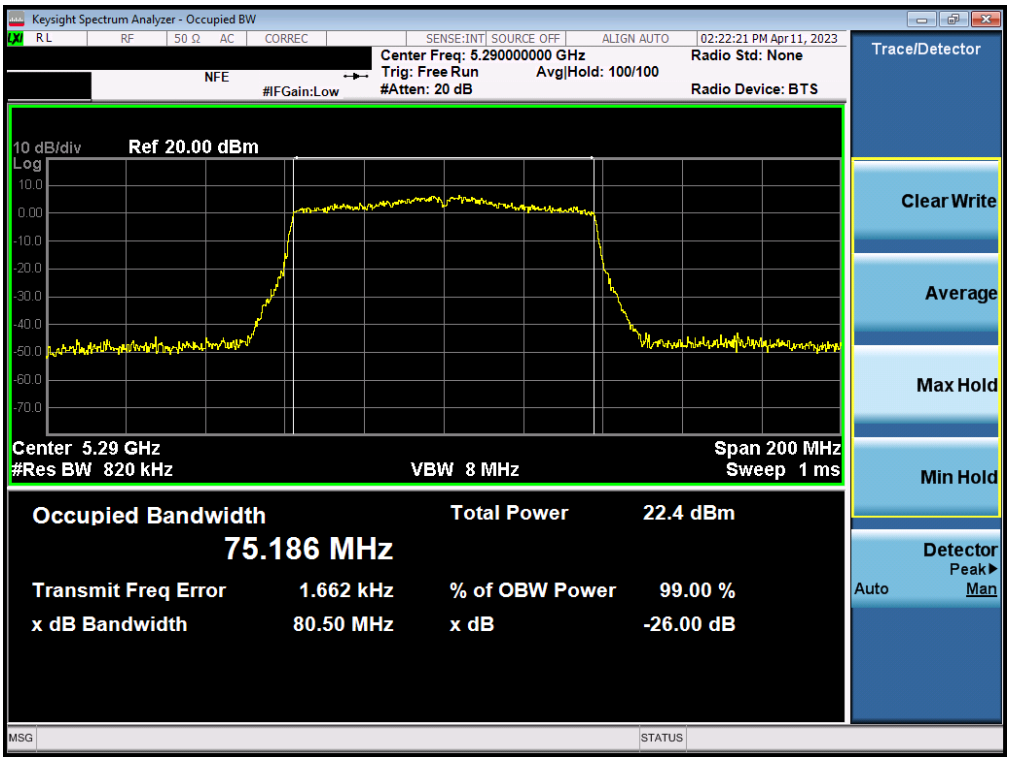
Plot 7-12. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



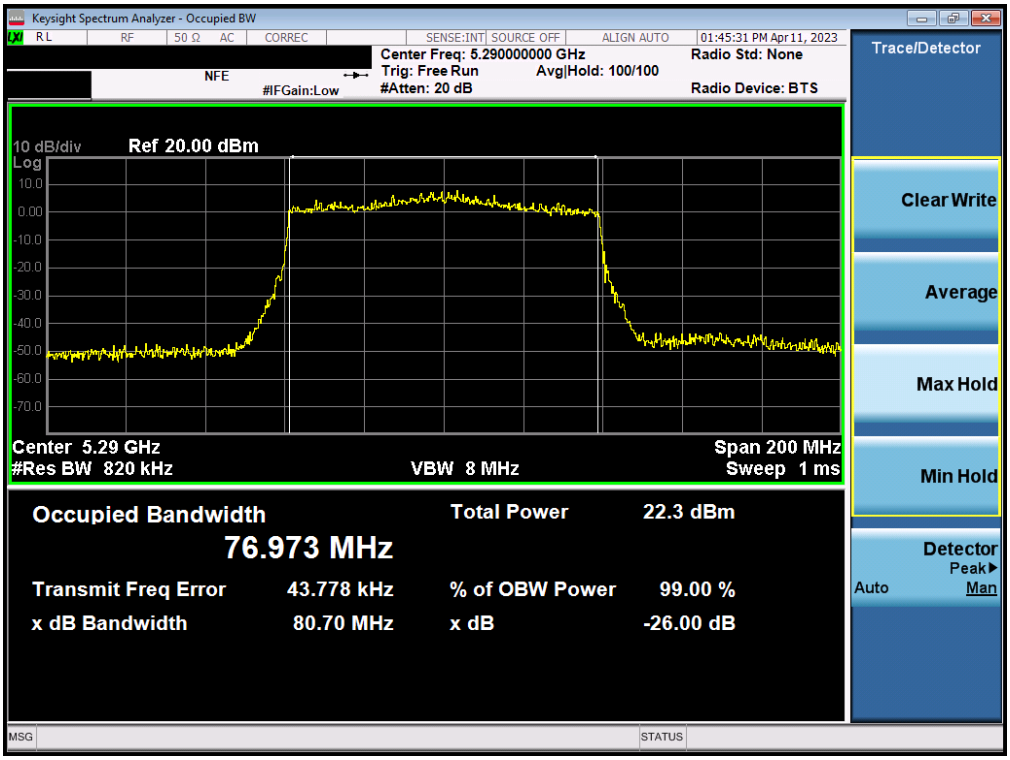
Plot 7-13. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



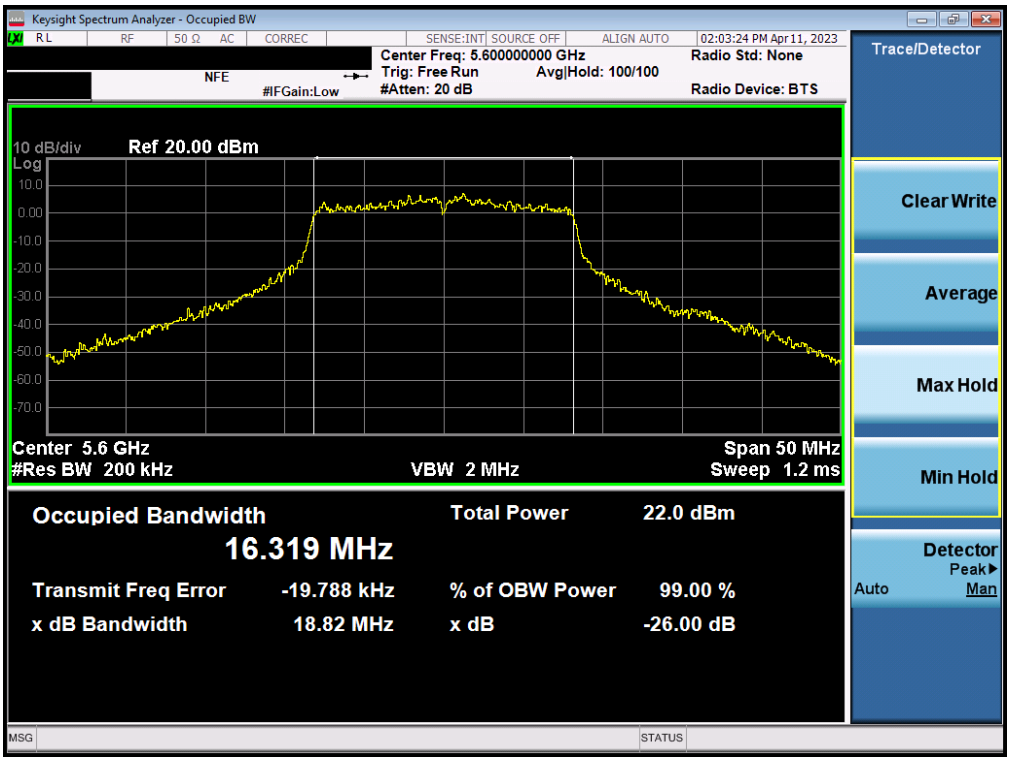
Plot 7-14. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)



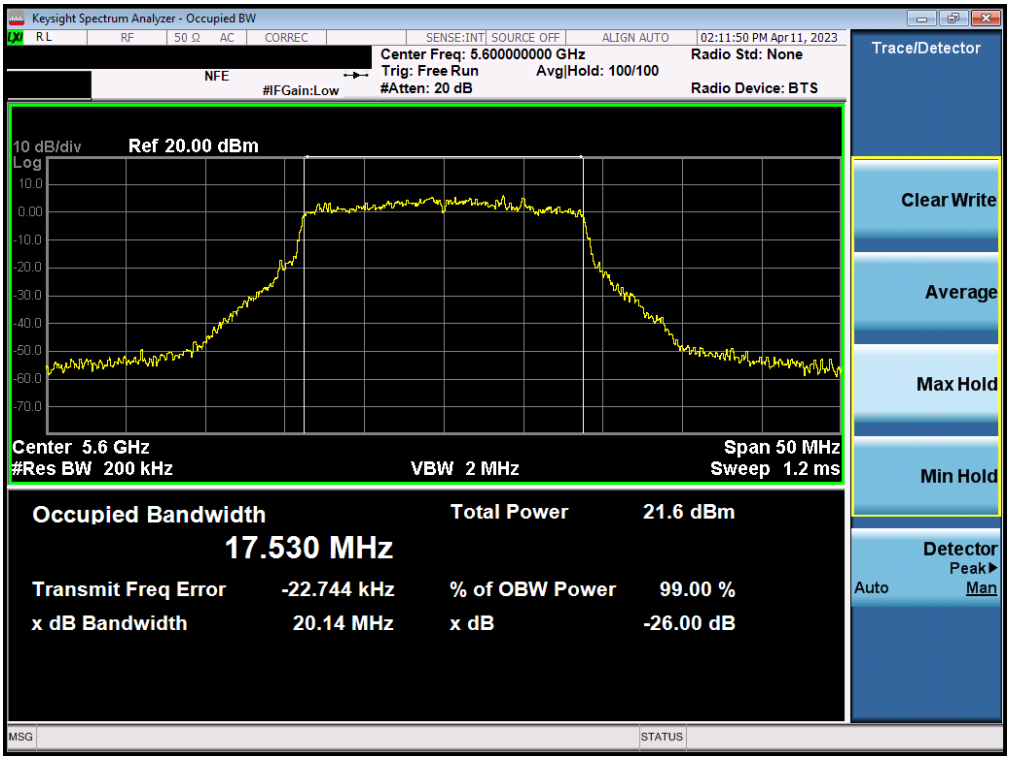
Plot 7-15. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



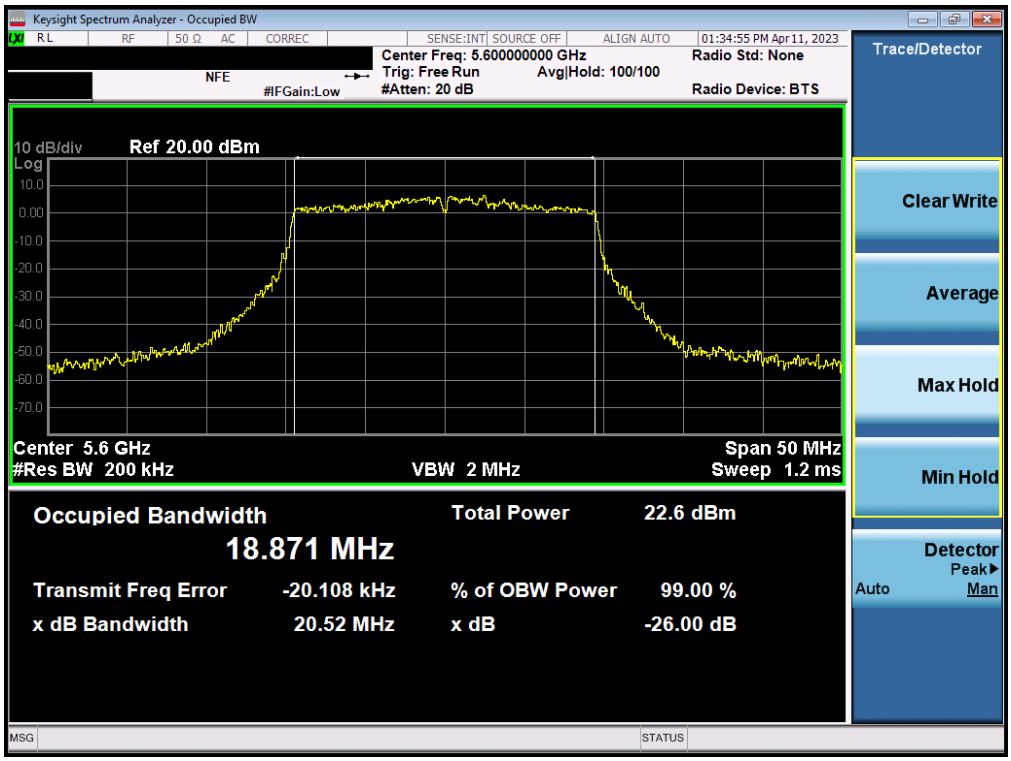
Plot 7-16. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 2A) – Ch. 58)



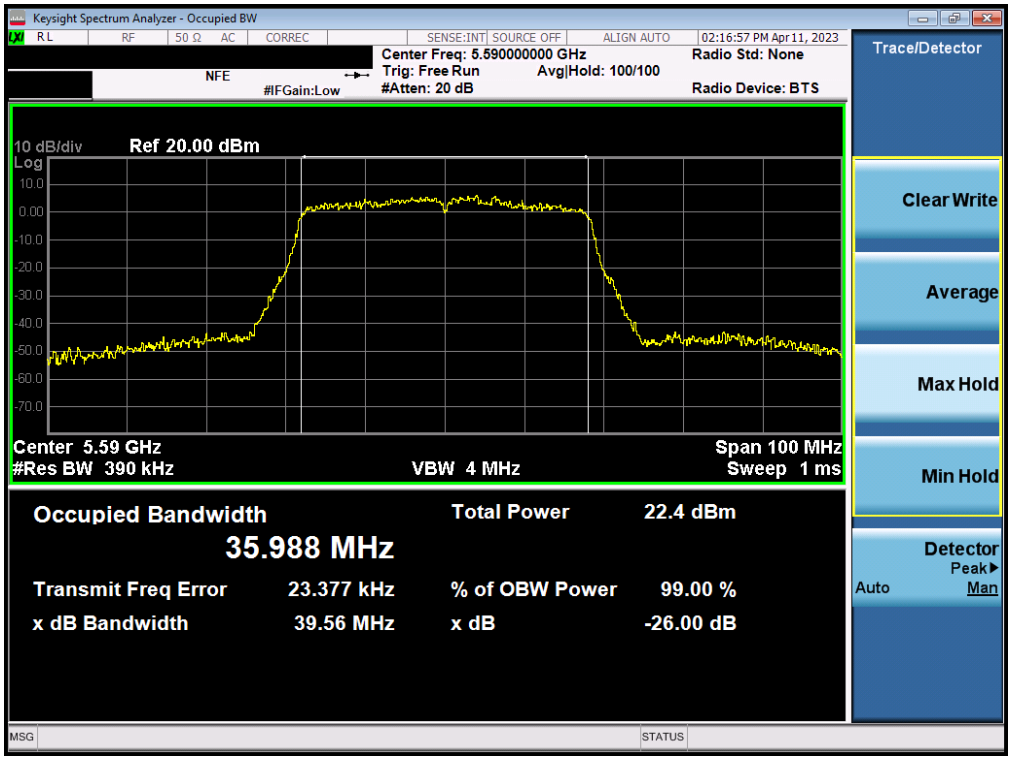
Plot 7-17. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 2C) – Ch. 120)



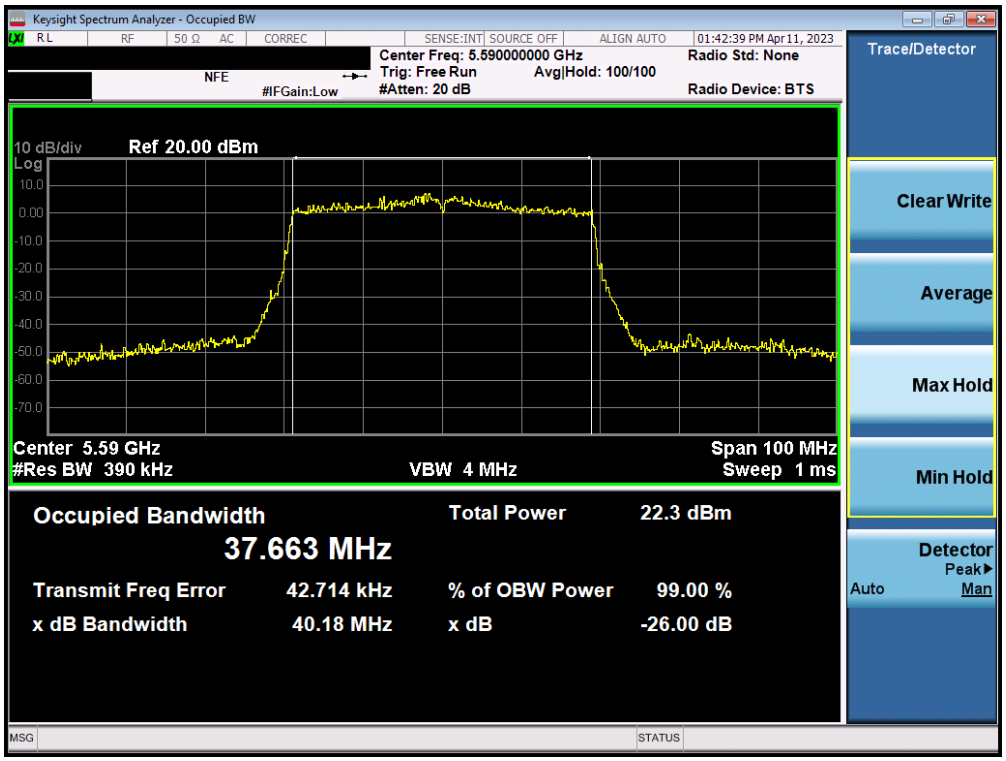
Plot 7-18. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 120



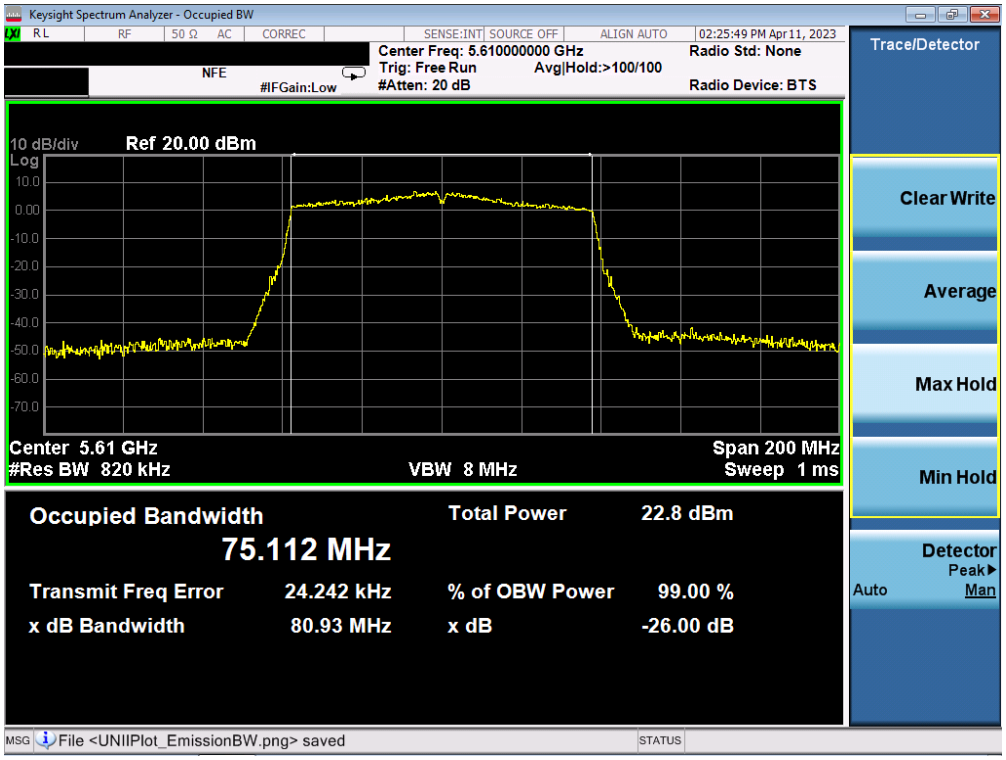
Plot 7-19. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2C) – Ch. 120)



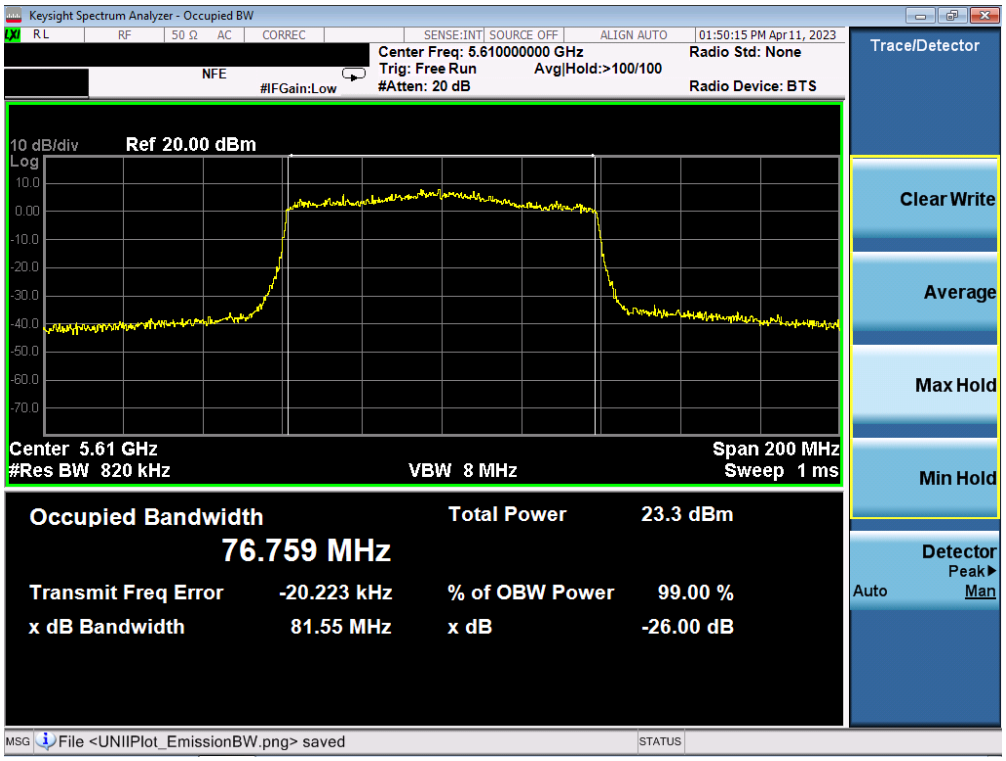
Plot 7-20. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)



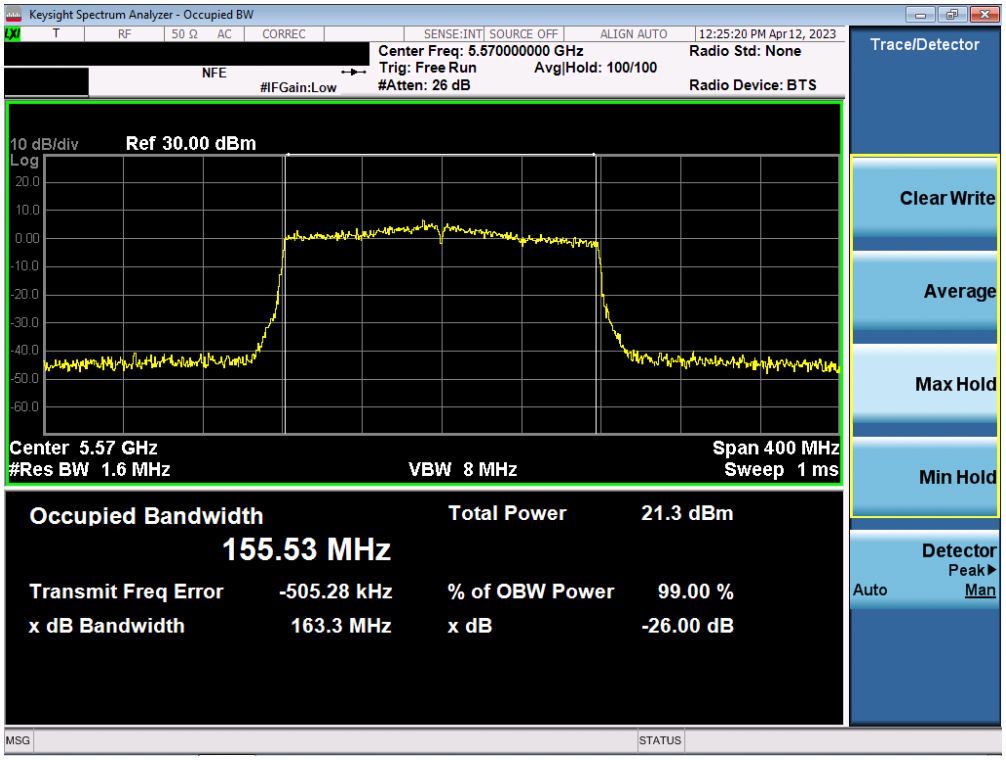
Plot 7-21. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2C) – Ch. 118)



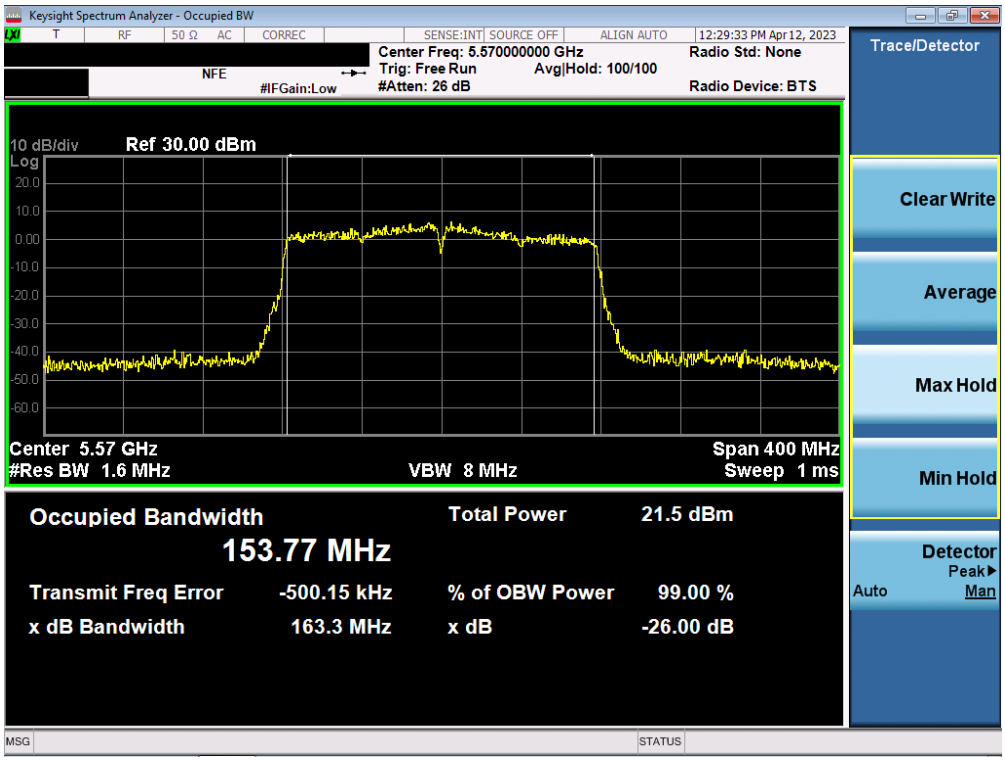
Plot 7-22. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-23. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 2C) – Ch. 122)

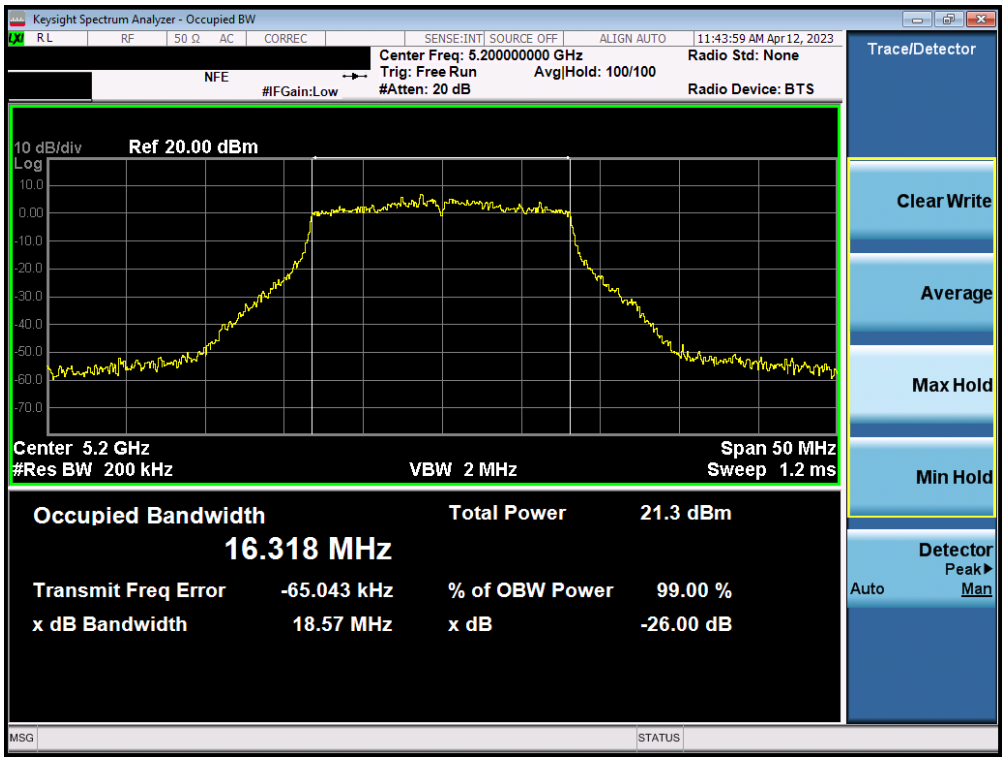


Plot 7-24. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 2C) – Ch. 114)

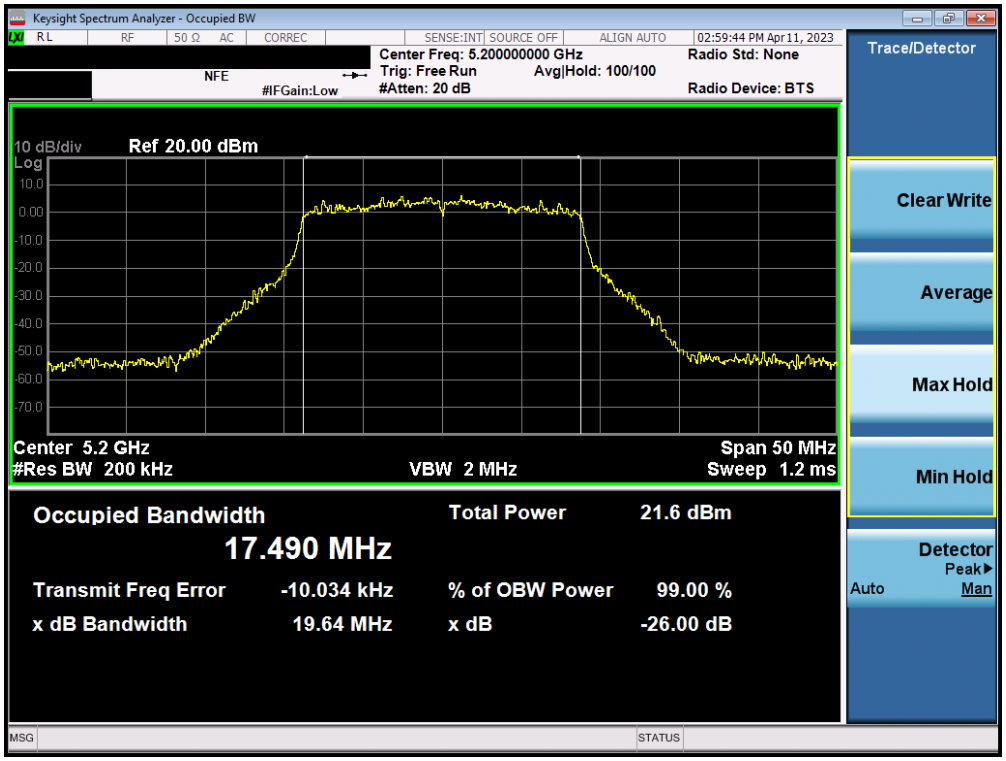


Plot 7-25. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 2C) – Ch. 114)

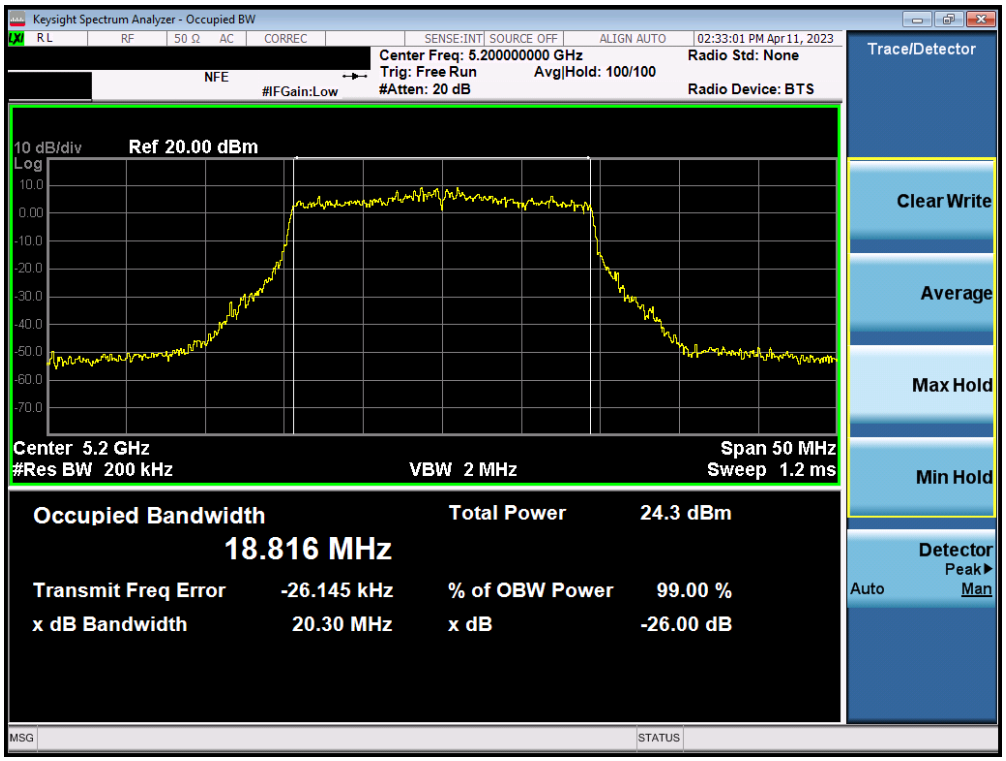
7.2.2 MIMO Antenna-2 26dB Bandwidth Measurements



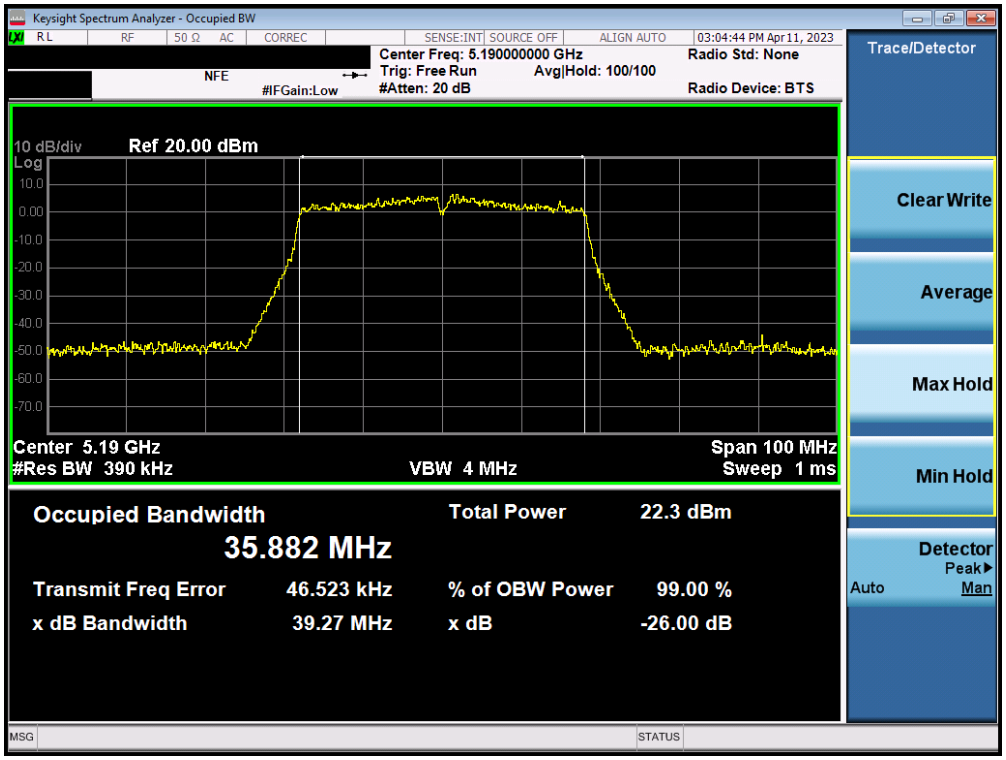
Plot 7-26. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 1) – Ch. 40)



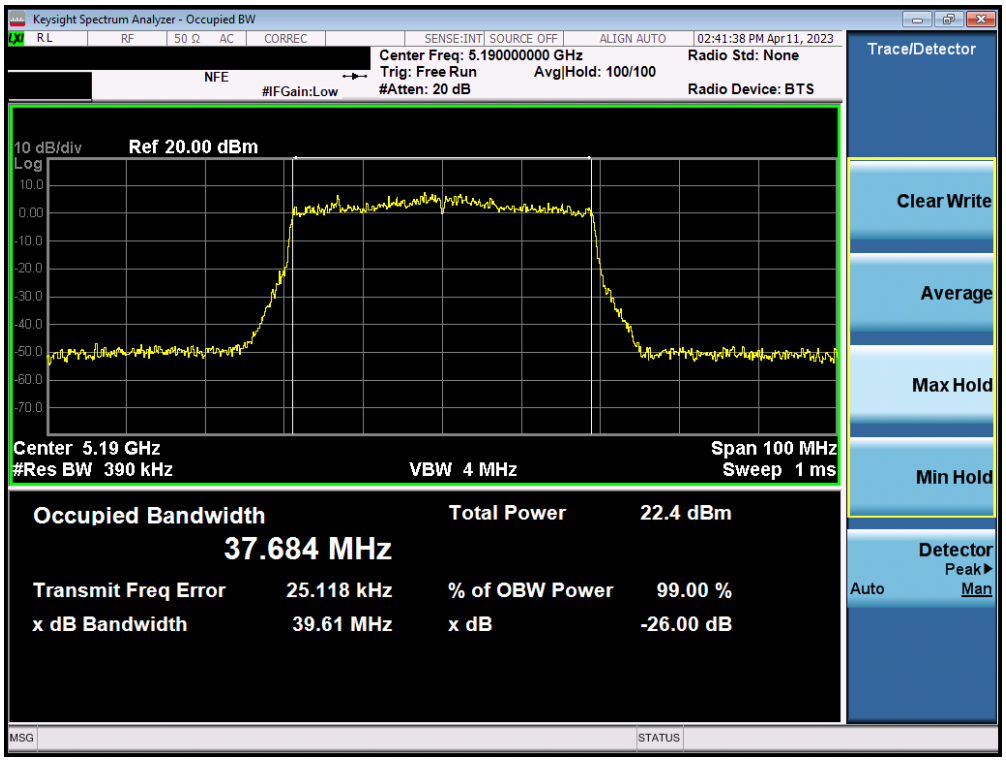
Plot 7-27. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



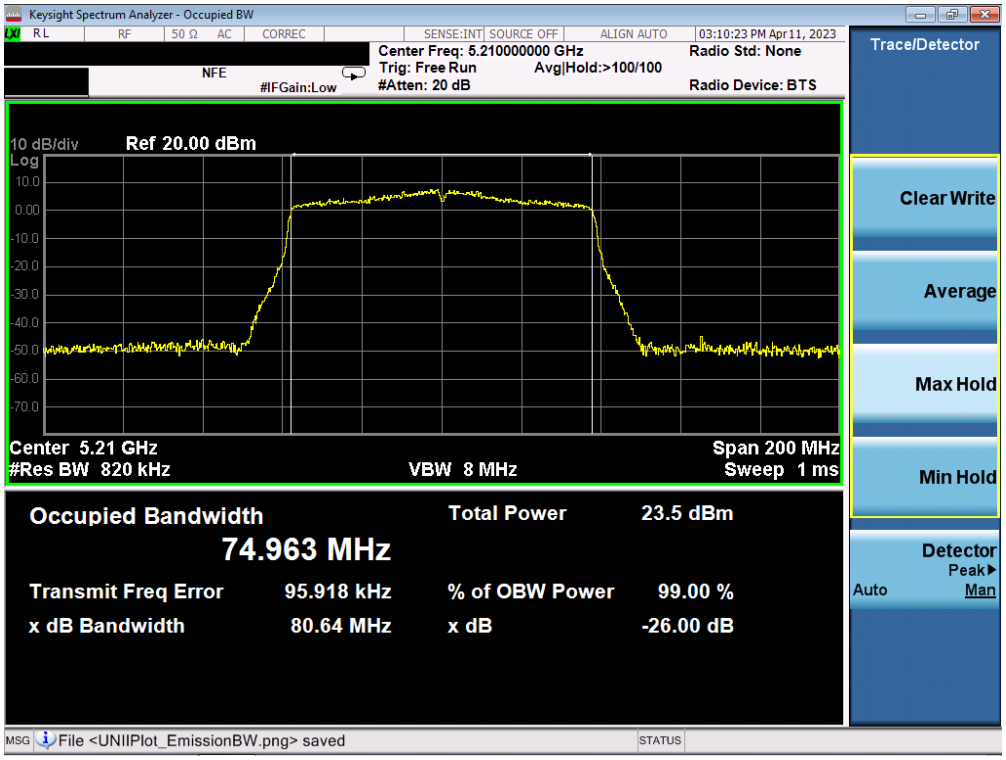
Plot 7-28. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



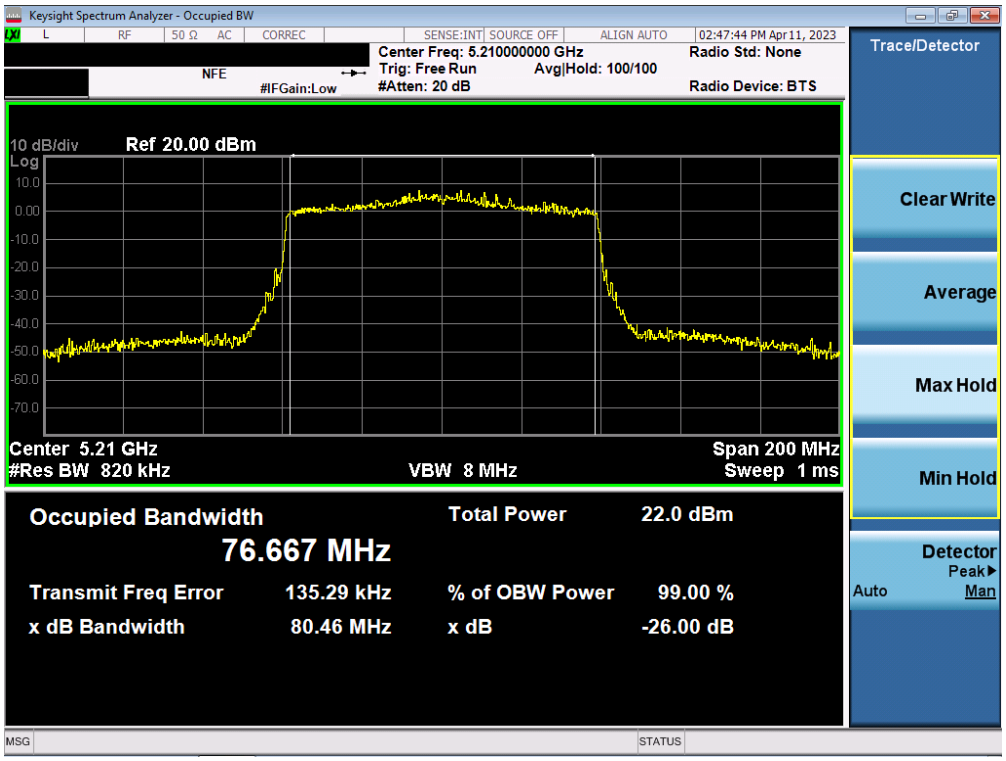
Plot 7-29. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



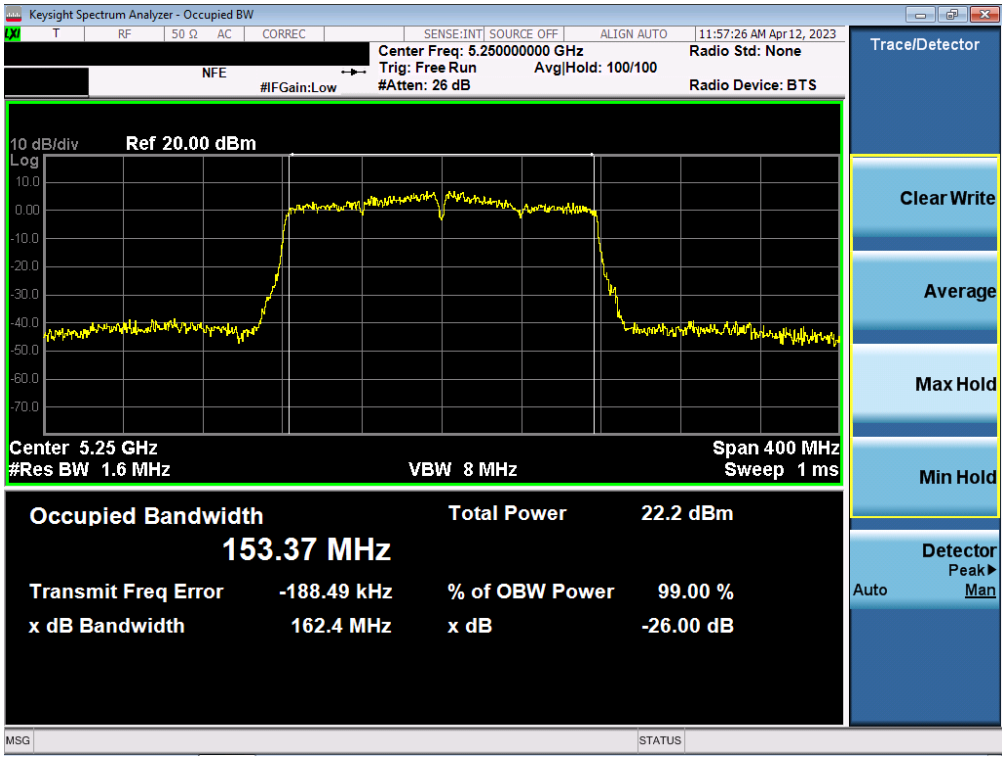
Plot 7-30. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



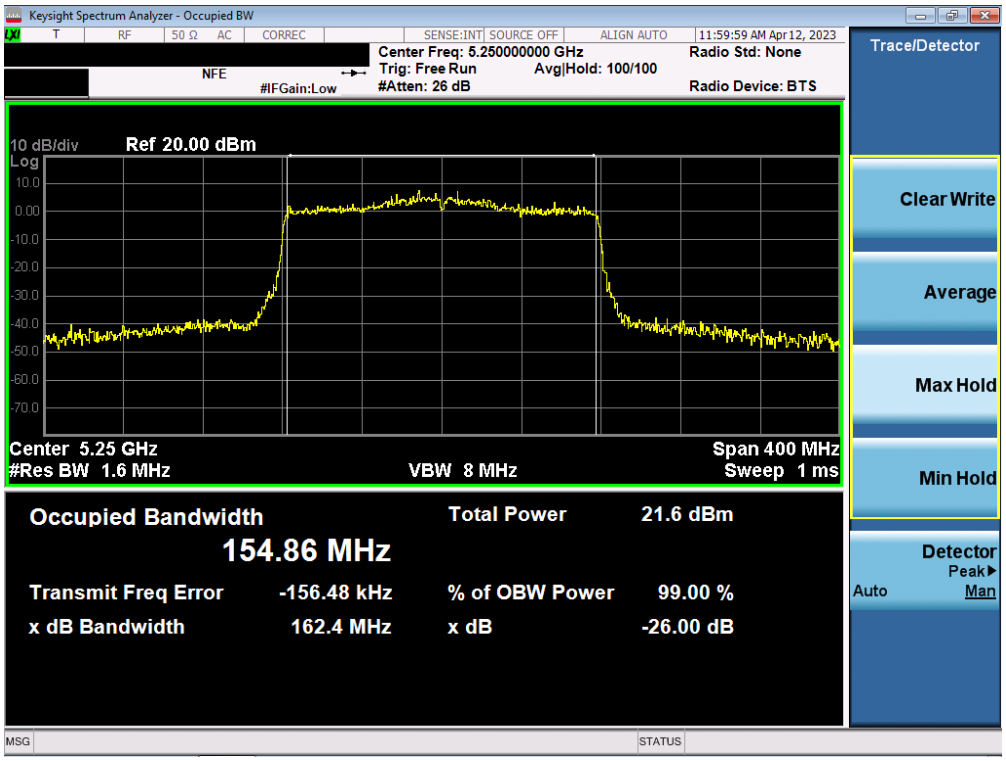
Plot 7-31. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



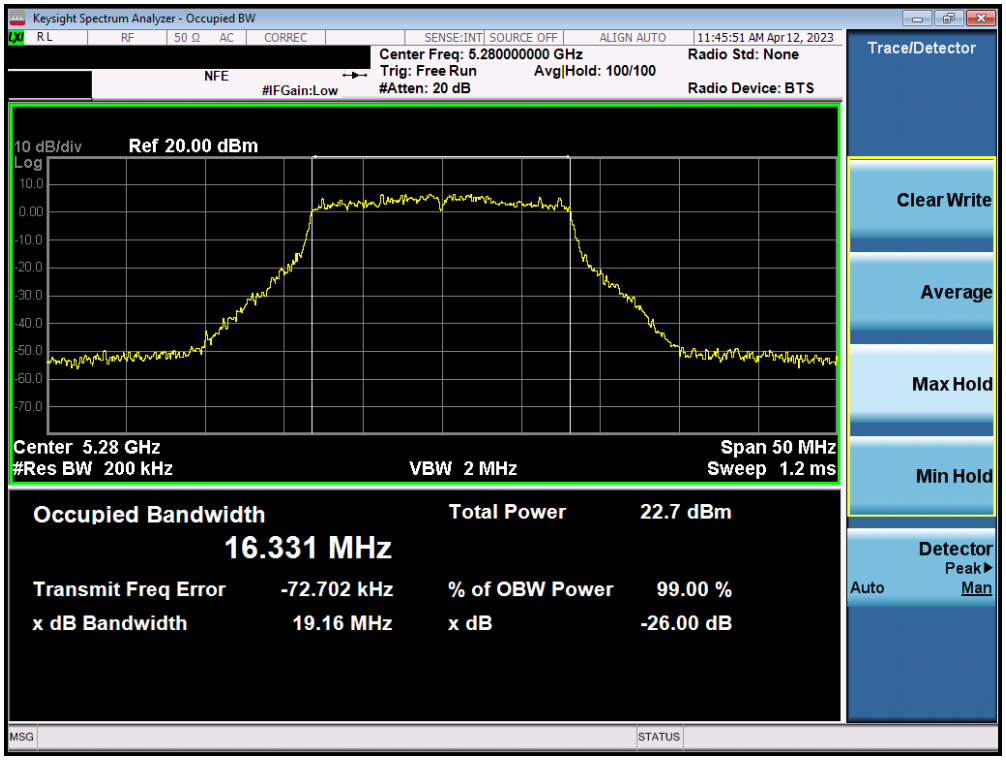
Plot 7-32. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



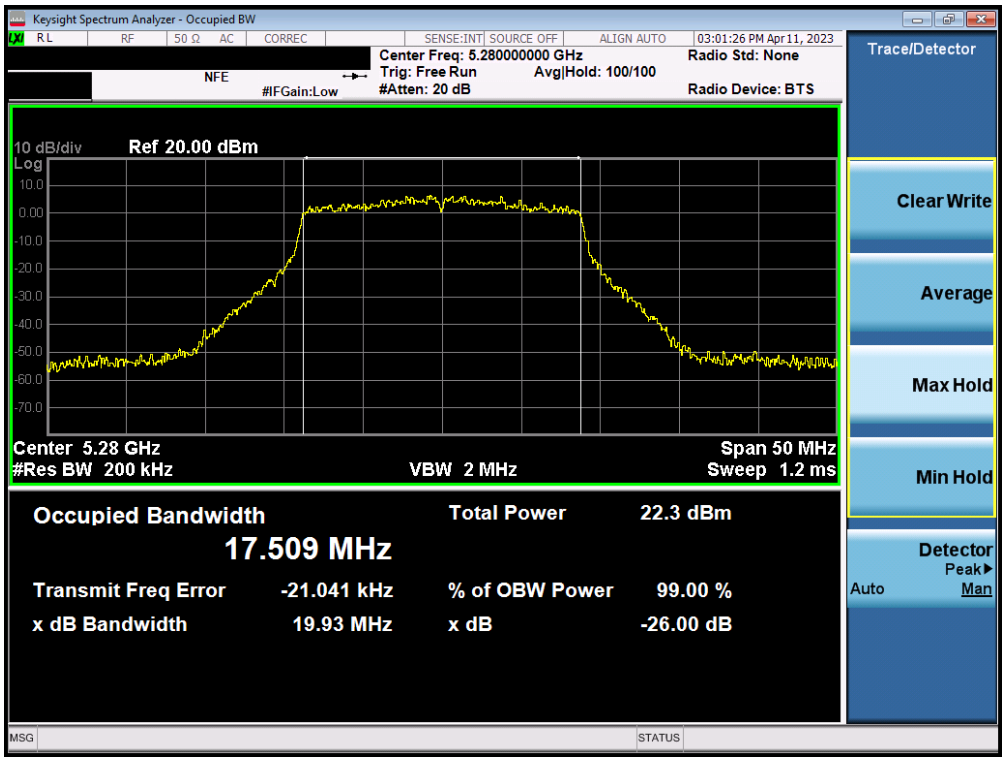
Plot 7-33. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



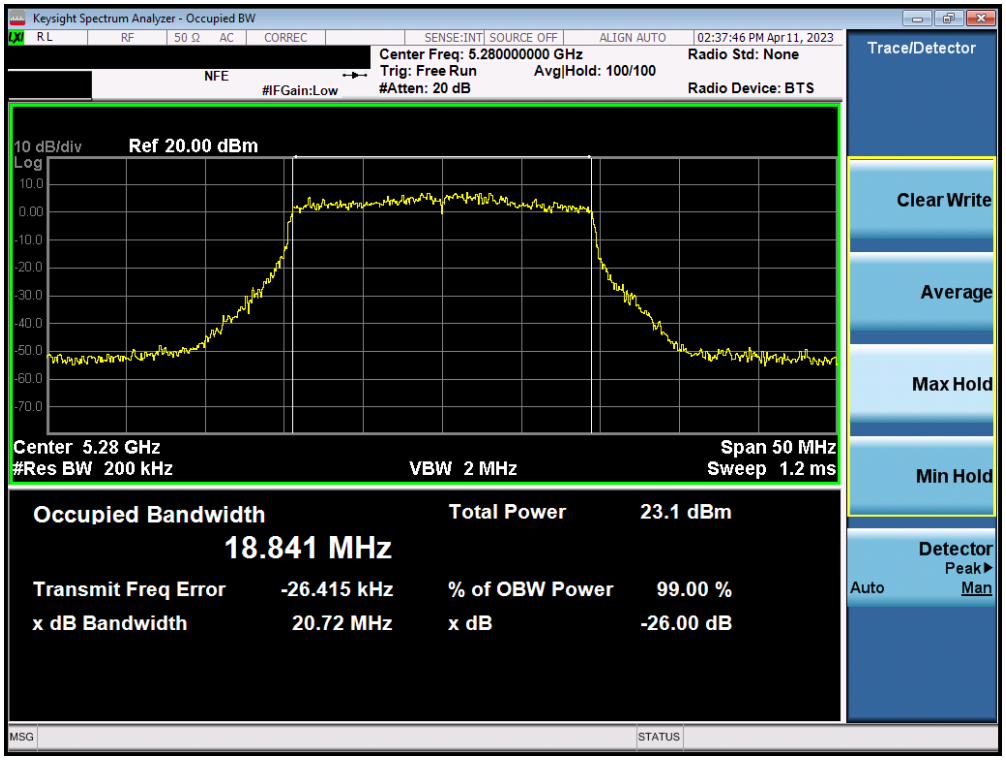
Plot 7-34. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



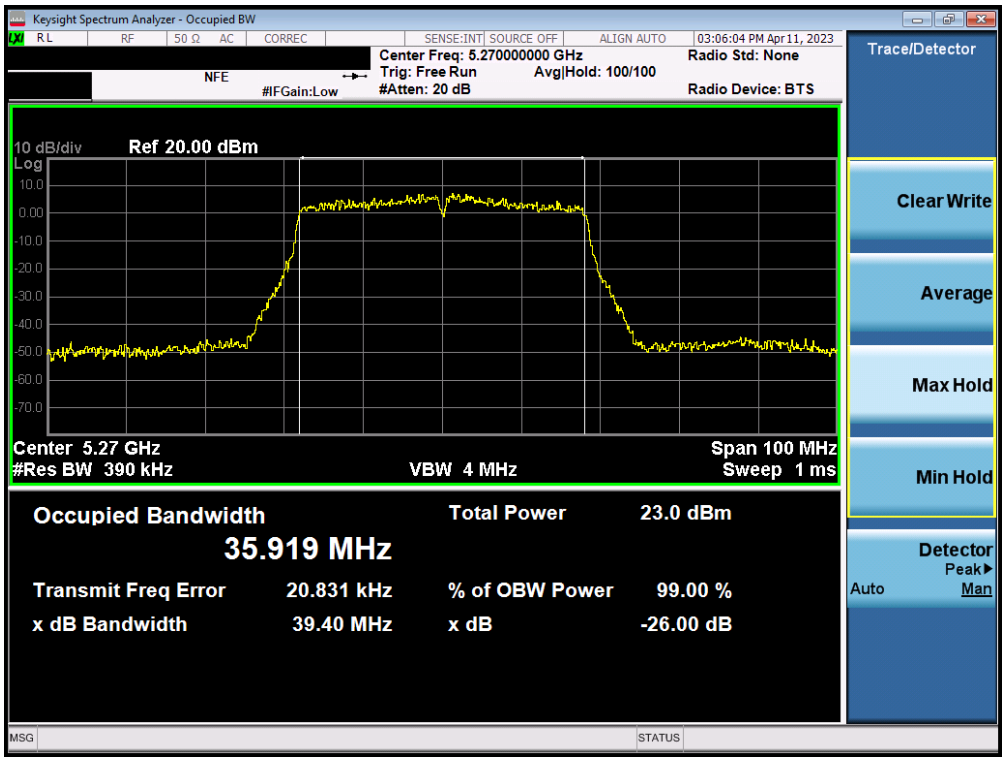
Plot 7-35. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 2A) – Ch. 56)



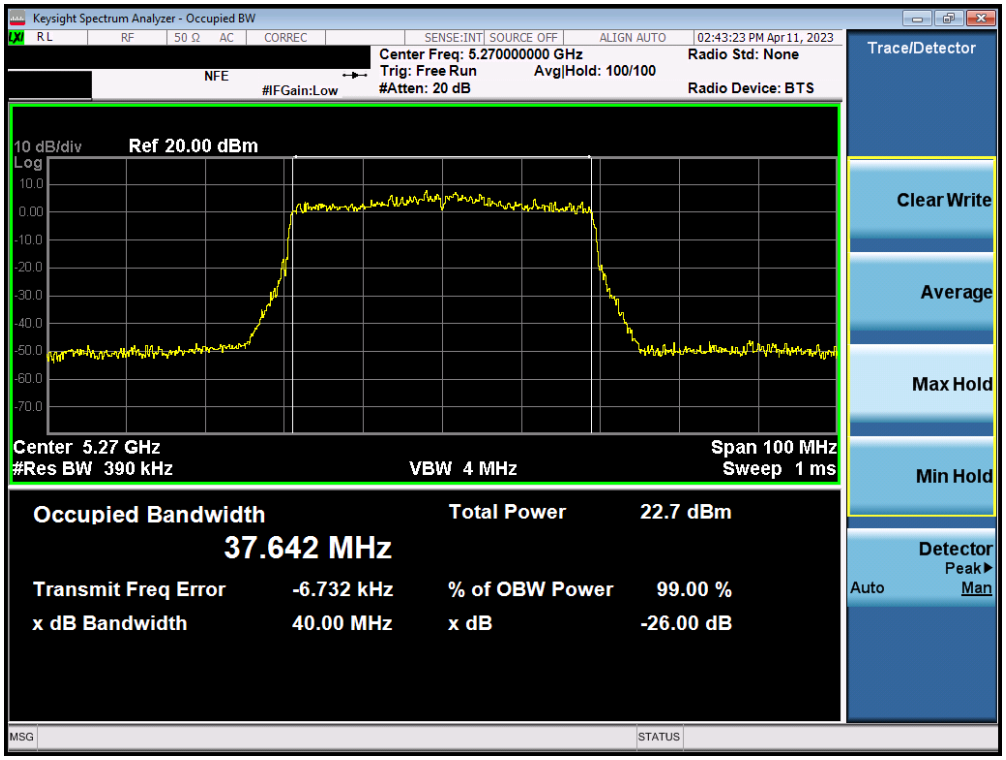
Plot 7-36. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



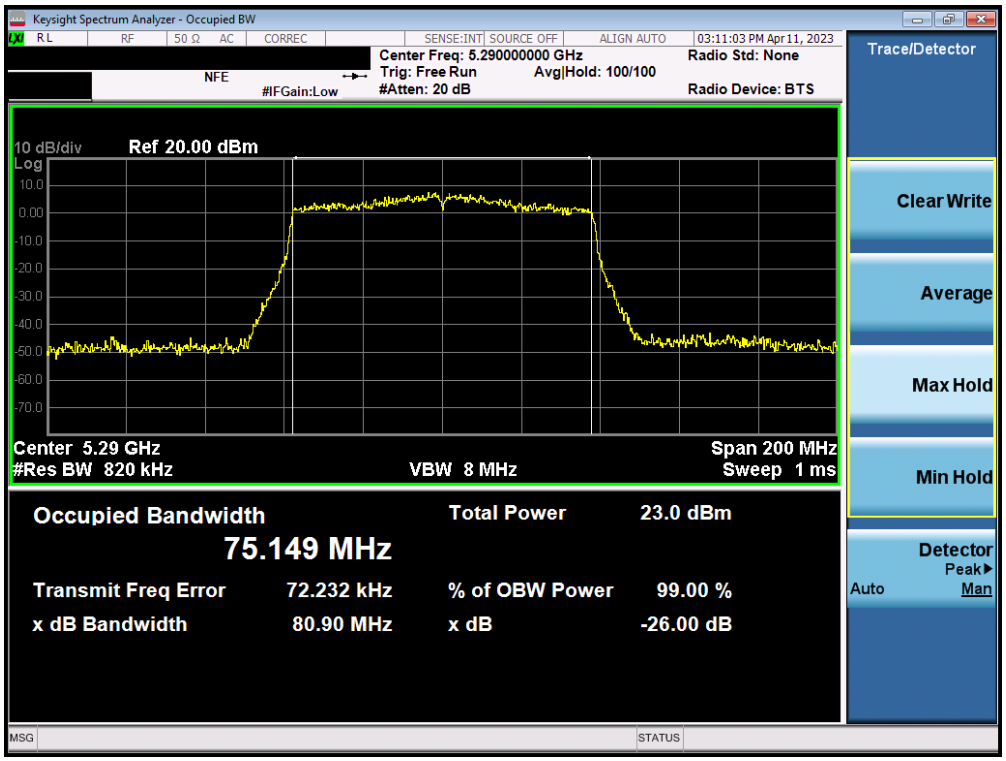
Plot 7-37. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



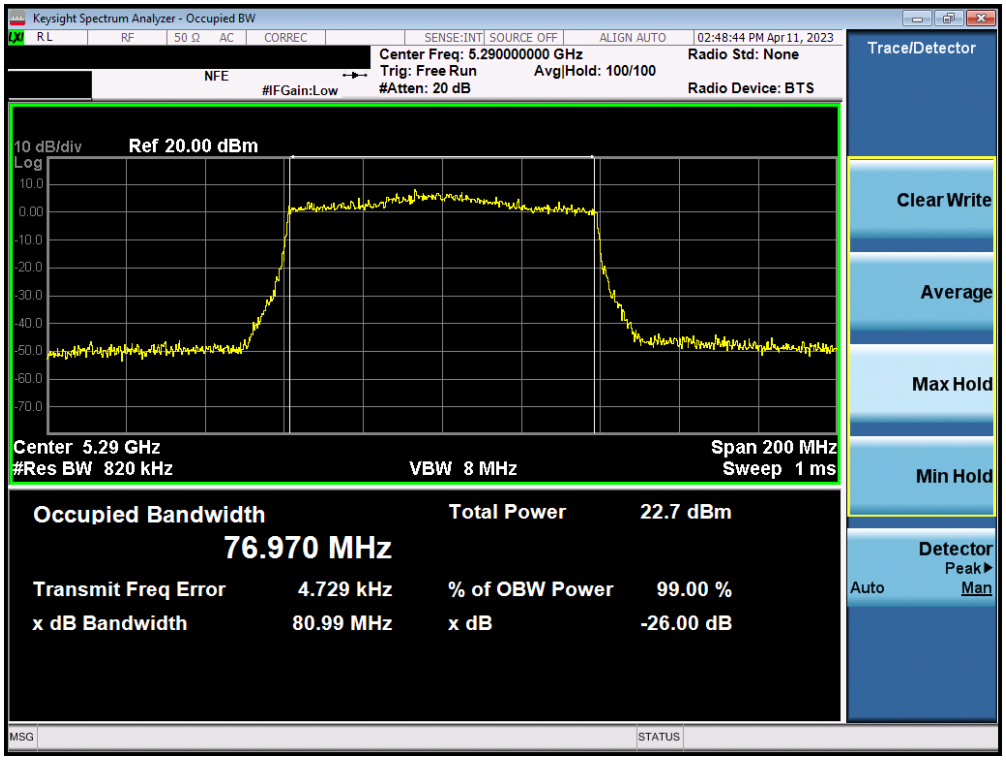
Plot 7-38. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



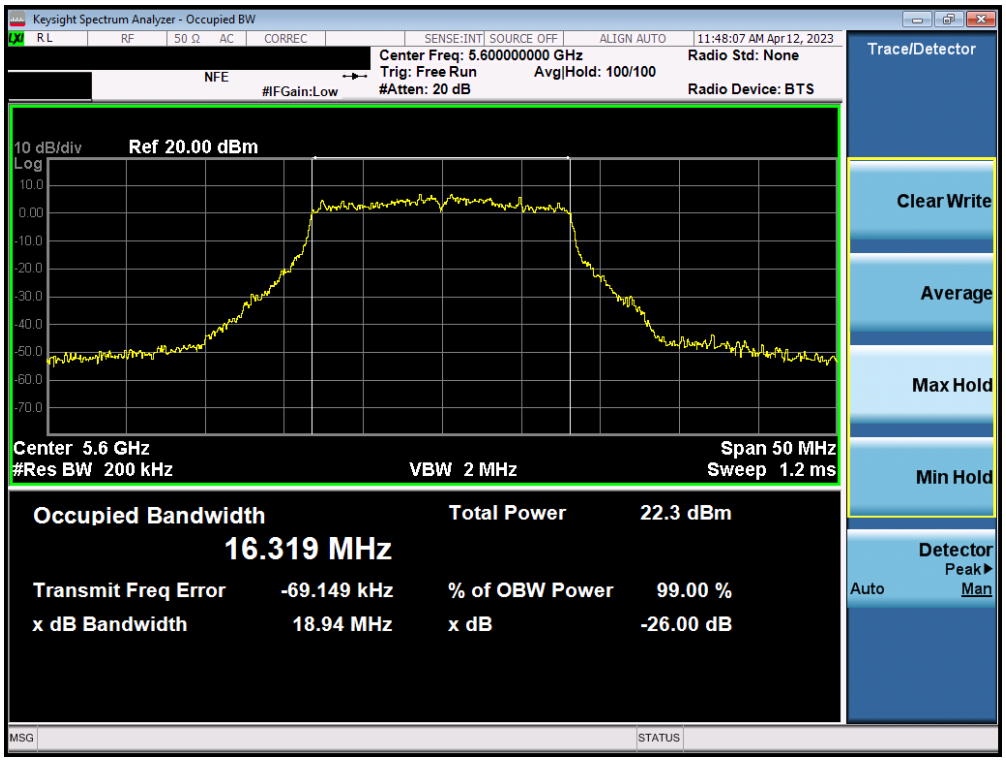
Plot 7-39. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)



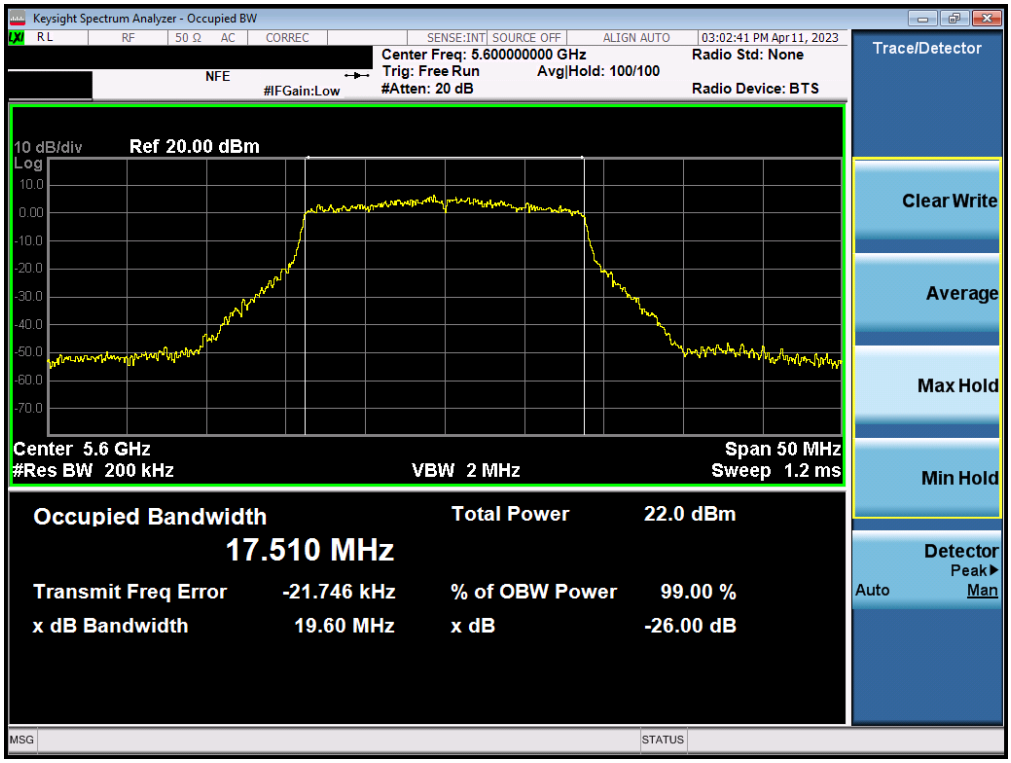
Plot 7-40. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



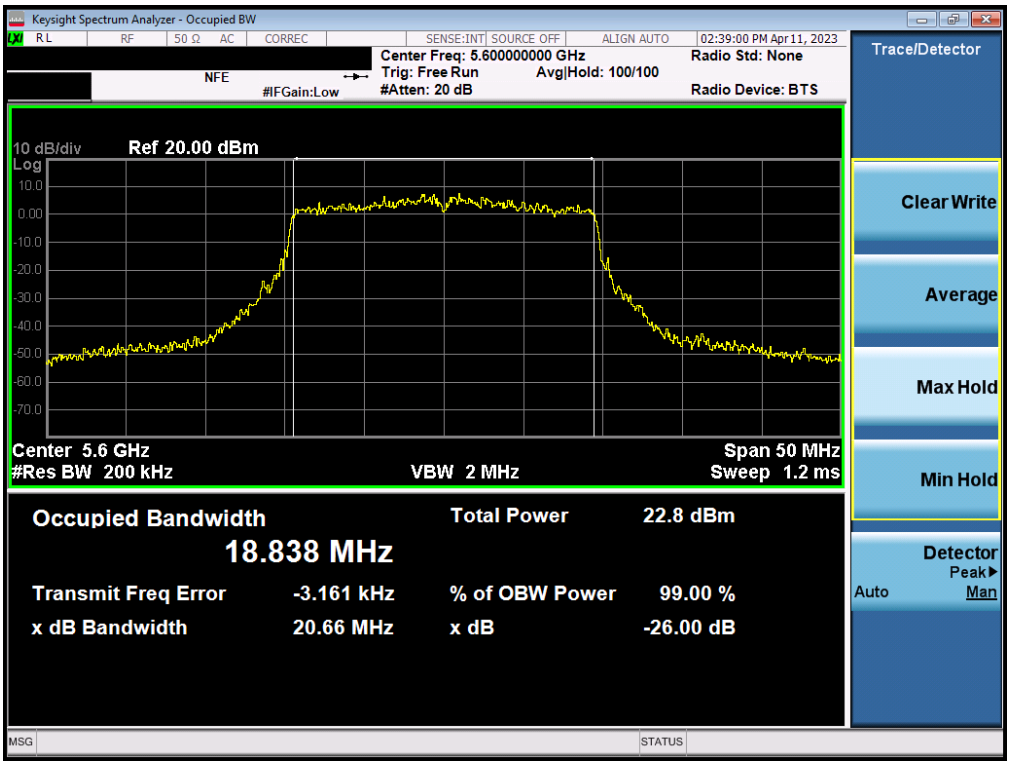
Plot 7-41. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 2A) – Ch. 58)



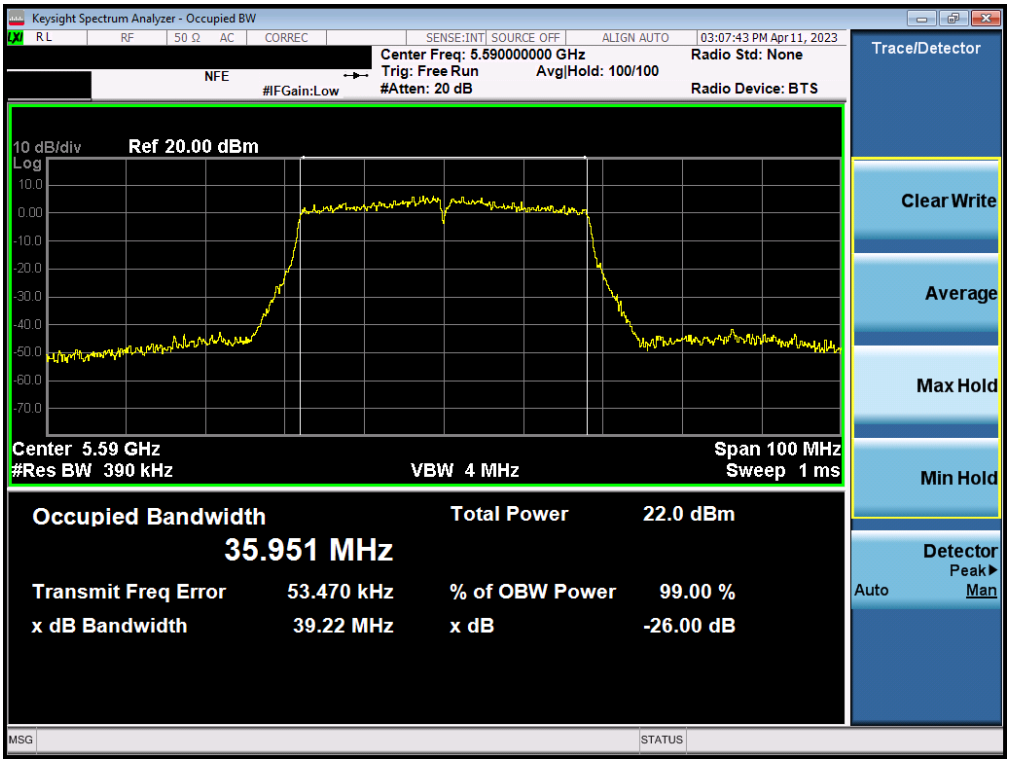
Plot 7-42. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 2C) – Ch. 120)



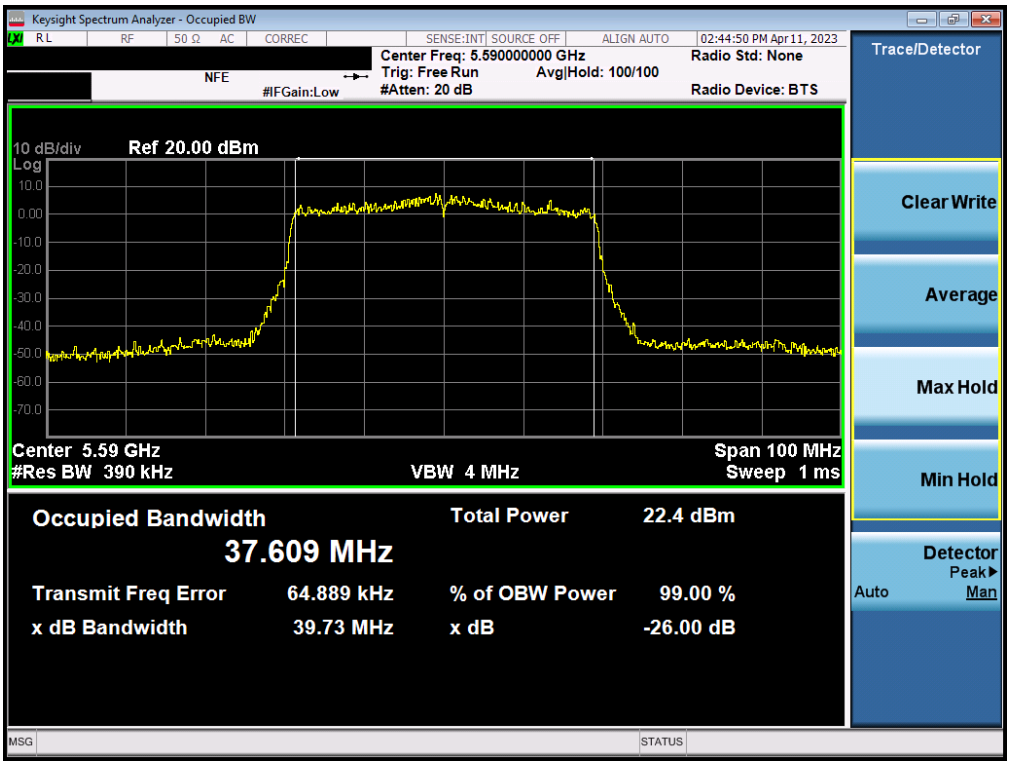
Plot 7-43. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)



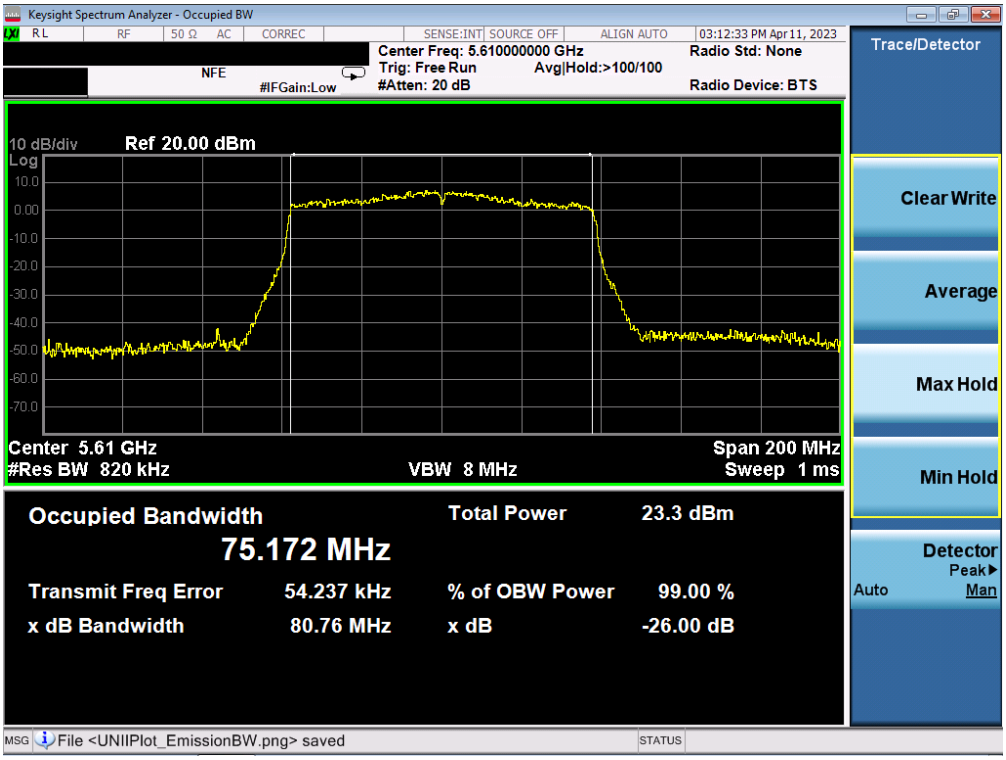
Plot 7-44. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 2C) – Ch. 120)



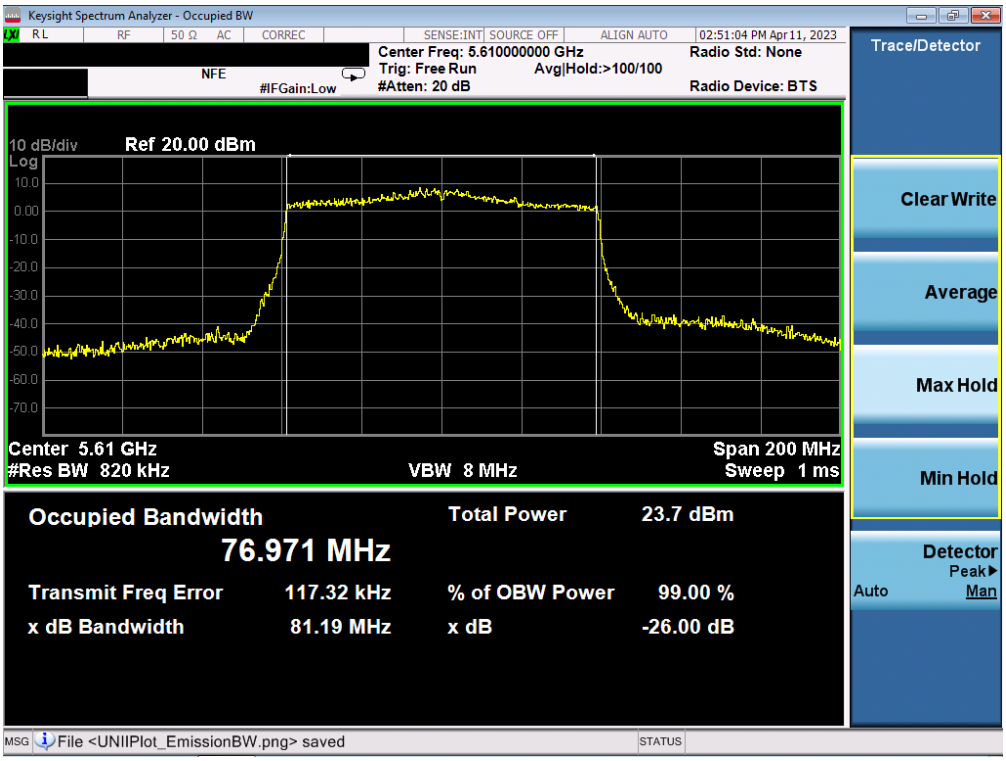
Plot 7-45. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)



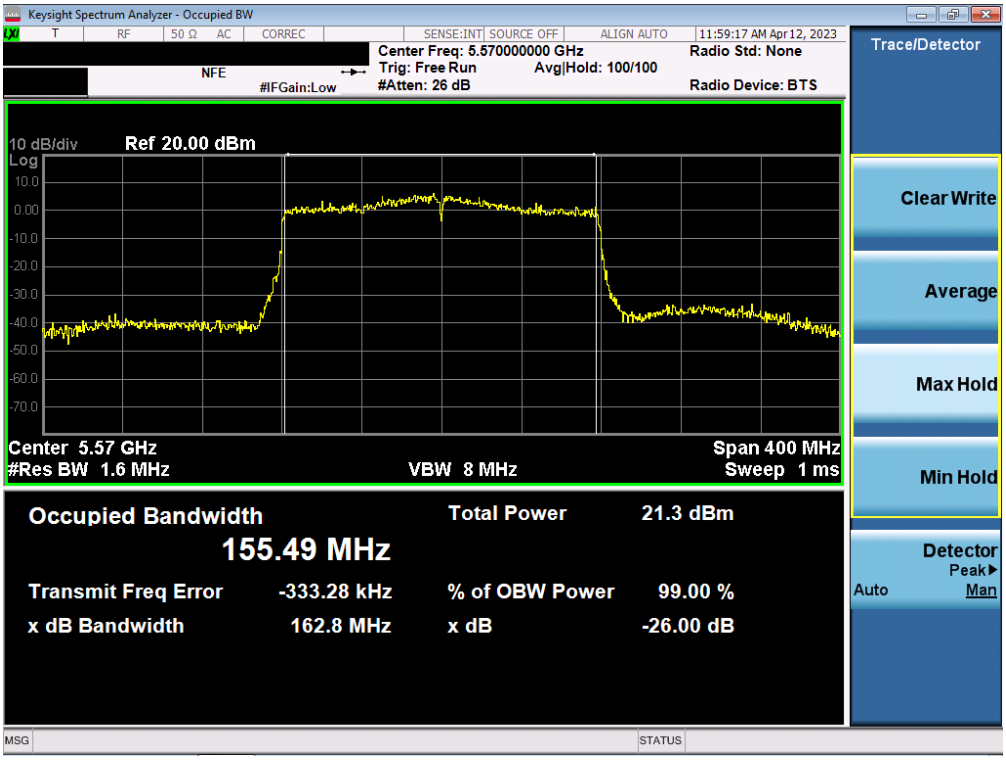
Plot 7-46. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 2C) – Ch. 118)



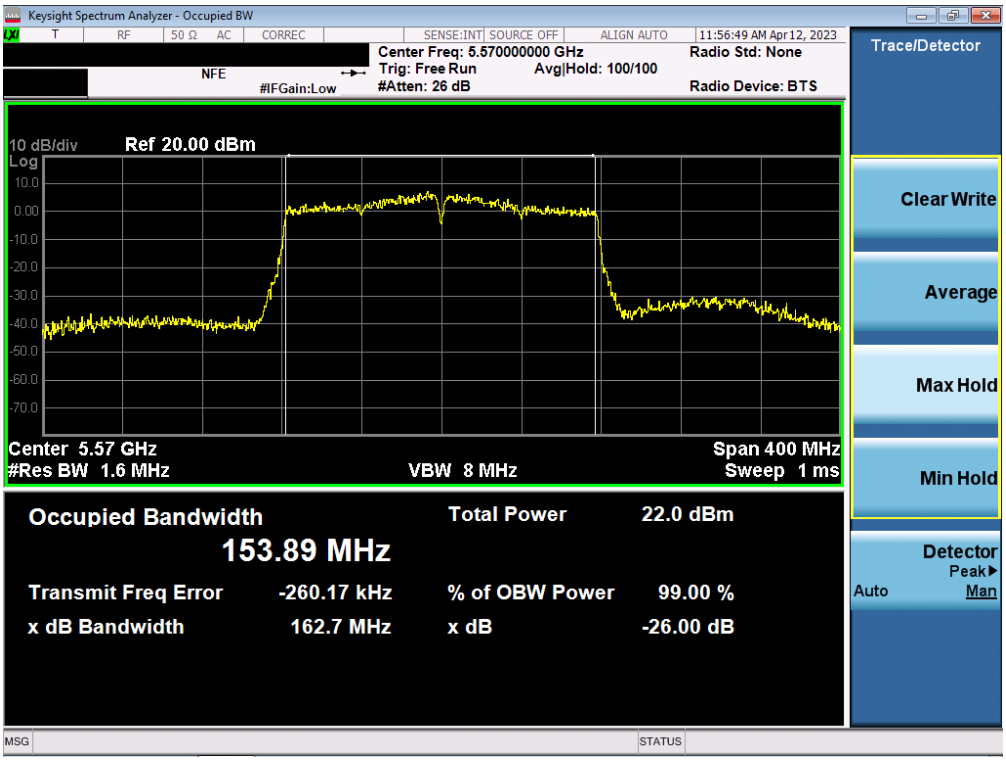
Plot 7-47. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-48. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 2C) – Ch. 122)



Plot 7-49. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ac (UNII Band 2C) – Ch. 114)



Plot 7-50. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ax (UNII Band 2C) – Ch. 114)

7.3 6dB Bandwidth Measurement

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013, and at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 6dB bandwidth.

In the 5.725 – 5.850GHz band and 5.850 – 5.895GHz band, the 6dB bandwidth must be ≥ 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100 kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

Test Setup

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

Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None.

MIMO 6dB Bandwidth Measurements

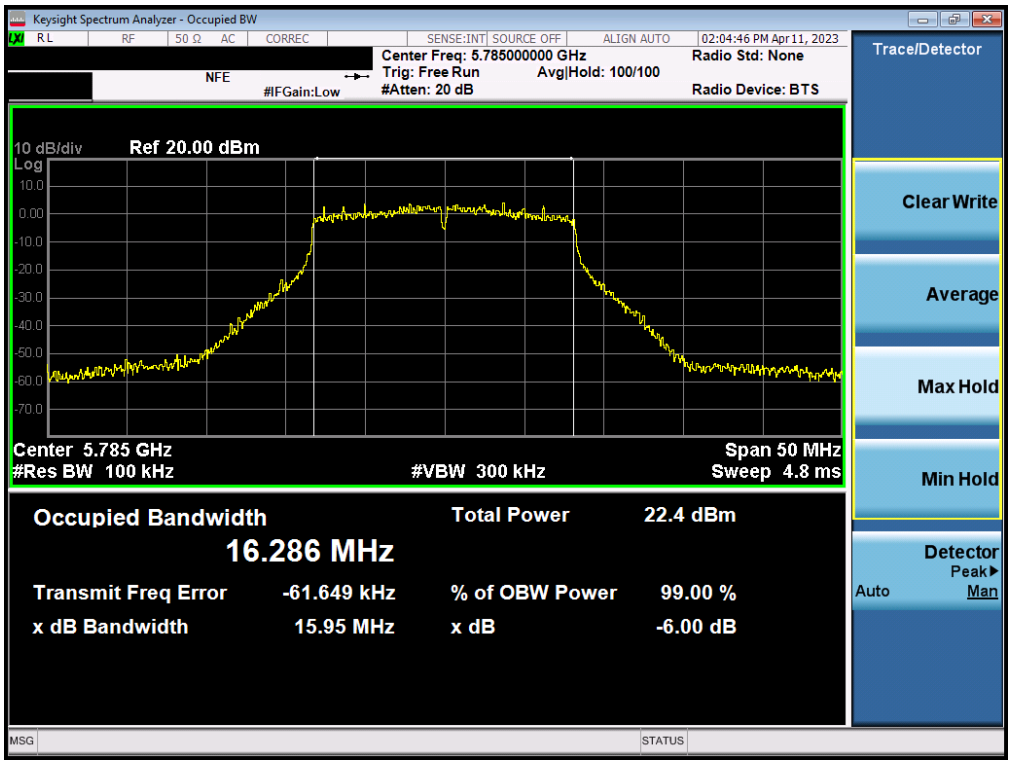
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 6dB Bandwidth [MHz]	Antenna-2 6dB Bandwidth [MHz]
Band 3	5745	149	a	6	10.22	14.45
	5785	157	a	6	15.95	13.87
	5825	165	a	6	13.88	14.45
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	13.00	15.91
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	14.46	15.10
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	11.38	11.32
	5745	149	ax (20MHz)	6.5/7.2 (MCS0)	18.25	18.16
	5785	157	ax (20MHz)	6.5/7.2 (MCS0)	14.53	18.32
	5825	165	ax (20MHz)	6.5/7.2 (MCS0)	18.72	18.48
	5755	151	n (40MHz)	13.5/15 (MCS0)	34.56	24.12
	5775	155	n (40MHz)	13.5/15 (MCS0)	34.66	35.09
	5755	151	ax (40MHz)	13.5/15 (MCS0)	37.31	37.44
	5775	155	ax (40MHz)	13.5/15 (MCS0)	35.12	31.35
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	75.16	74.02
	5775	155	ax (80MHz)	29.3/32.5 (MCS0)	50.53	71.47

Table 7-3. Band 3 Conducted 6dB Bandwidth Measurements MIMO

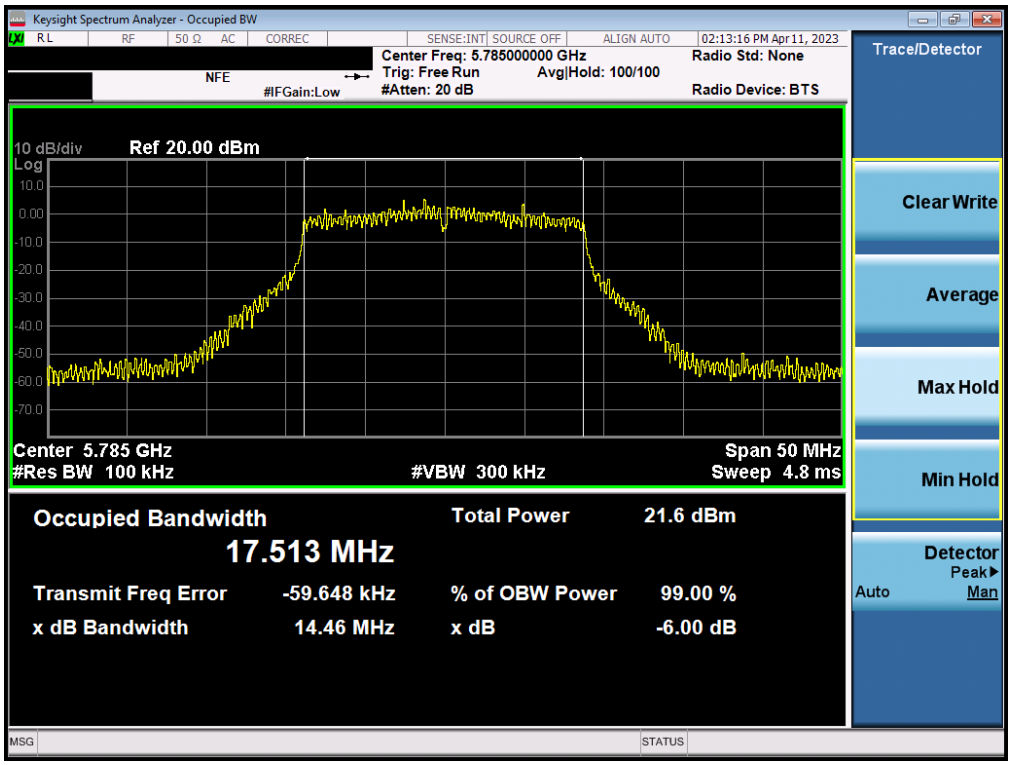
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 6dB Bandwidth [MHz]	Antenna-2 6dB Bandwidth [MHz]
Band 3/4	5845	169	a	6	15.56	16.36
Band 4	5865	173	a	6	16.36	16.29
	5885	177	a	6	12.20	15.08
Band 3/4	5845	169	n (20MHz)	6.5/7.2 (MCS0)	14.75	11.70
Band 4	5865	173	n (20MHz)	6.5/7.2 (MCS0)	13.87	15.13
	5885	177	n (20MHz)	6.5/7.2 (MCS0)	13.92	8.54
Band 3/4	5845	169	ax (20MHz)	6.5/7.2 (MCS0)	17.96	18.52
Band 4	5865	173	ax (20MHz)	6.5/7.2 (MCS0)	18.72	17.83
	5885	177	ax (20MHz)	6.5/7.2 (MCS0)	15.42	18.76
Band 3/4	5835	167	n (40MHz)	13.5/15 (MCS0)	35.22	35.06
Band 4	5875	175	n (40MHz)	13.5/15 (MCS0)	33.82	35.24
Band 3/4	5835	167	ax (40MHz)	13.5/15 (MCS0)	31.49	33.90
Band 4	5875	175	ax (40MHz)	13.5/15 (MCS0)	35.14	36.59
Band 3/4	5855	171	ac (80MHz)	29.3/32.5 (MCS0)	51.58	72.68
	5855	171	ax (80MHz)	29.3/32.5 (MCS0)	71.56	75.18
	5815	163	ac (160MHz)	58.5/65 (MCS0)	150.20	150.30
	5815	163	ax (160MHz)	58.5/65 (MCS0)	124.70	154.10

Table 7-4. Bands 3/4 Conducted 6dB Bandwidth Measurements MIMO ANT1

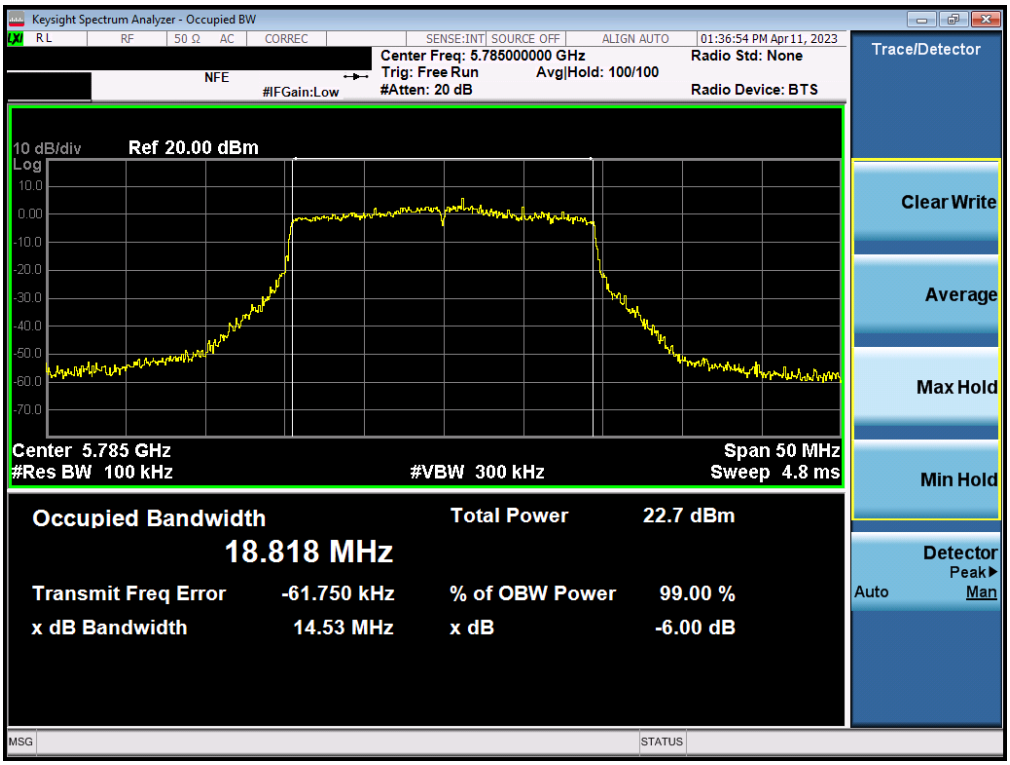
7.3.1 MIMO Antenna-1 6dB Bandwidth Measurements



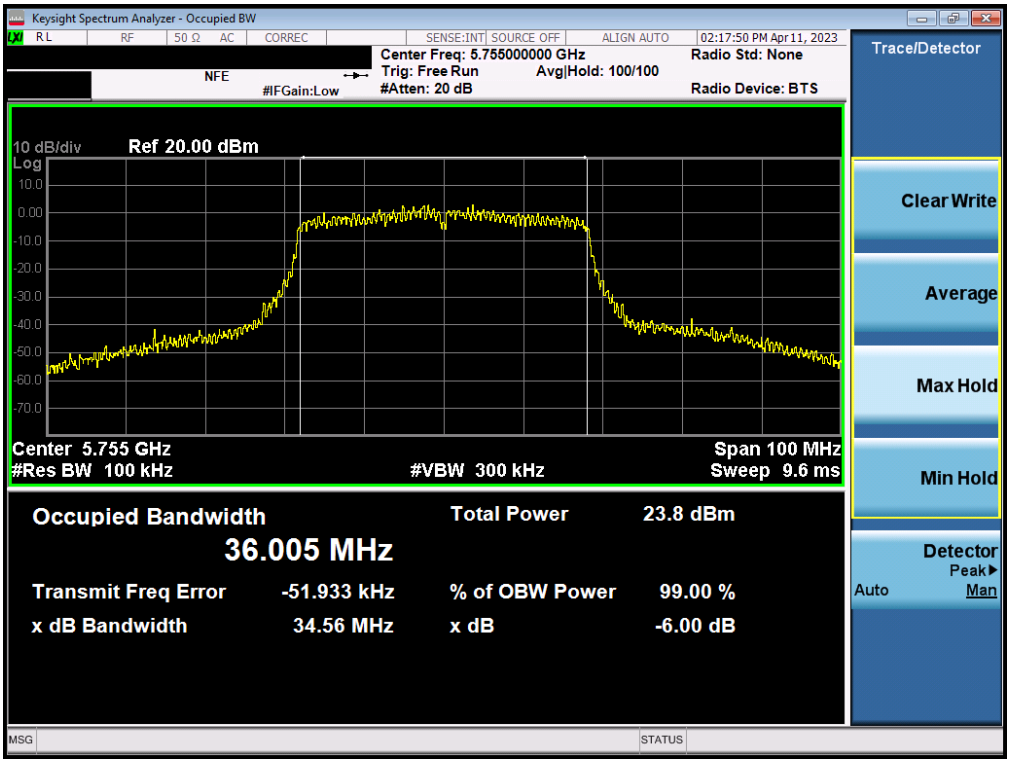
Plot 7-51. 6dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 3) – Ch. 157)



Plot 7-52. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)

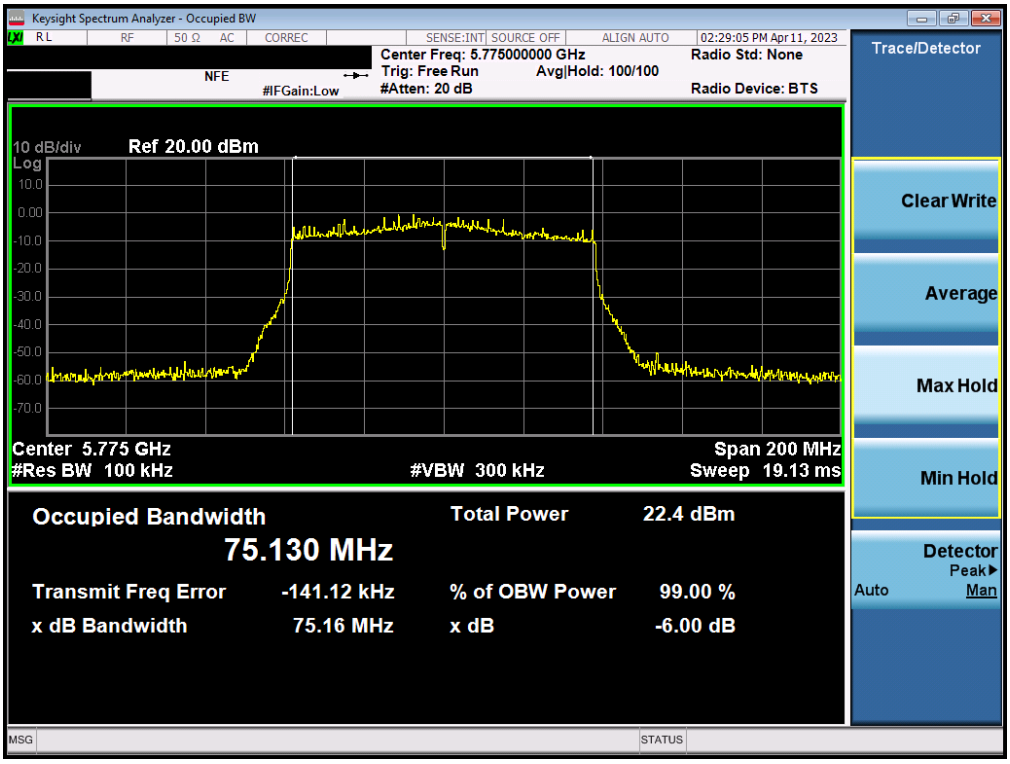


Plot 7-53. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 3) – Ch. 157)

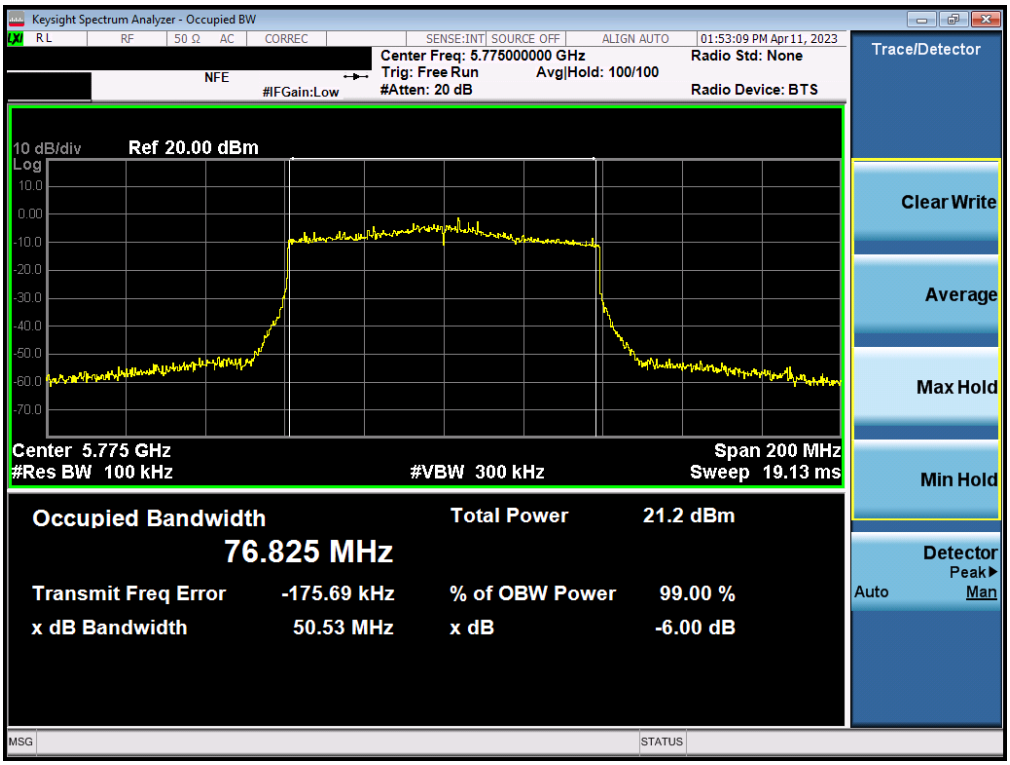


Plot 7-54. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)

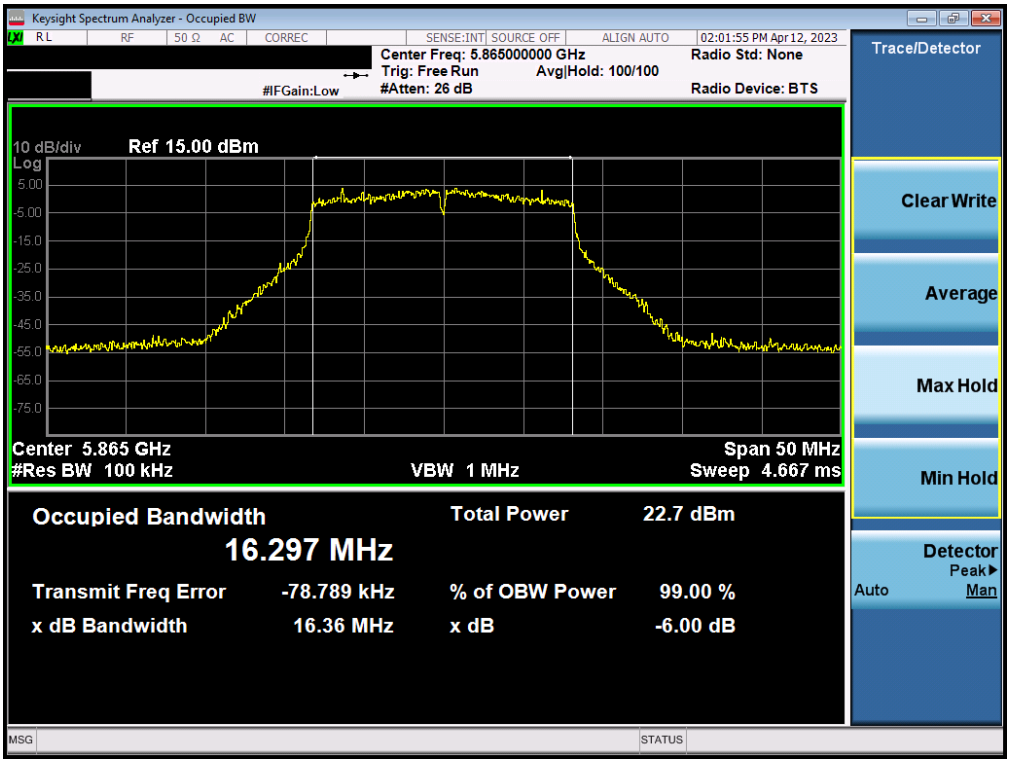
Plot 7-55. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 3) – Ch. 151)



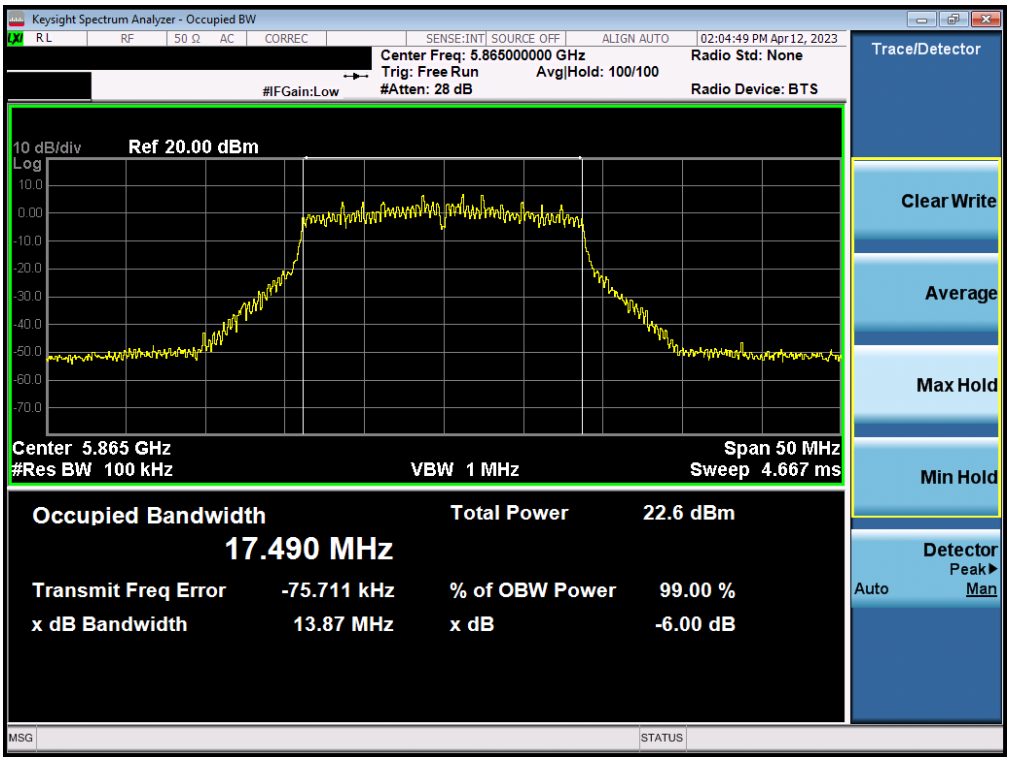
Plot 7-56. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)



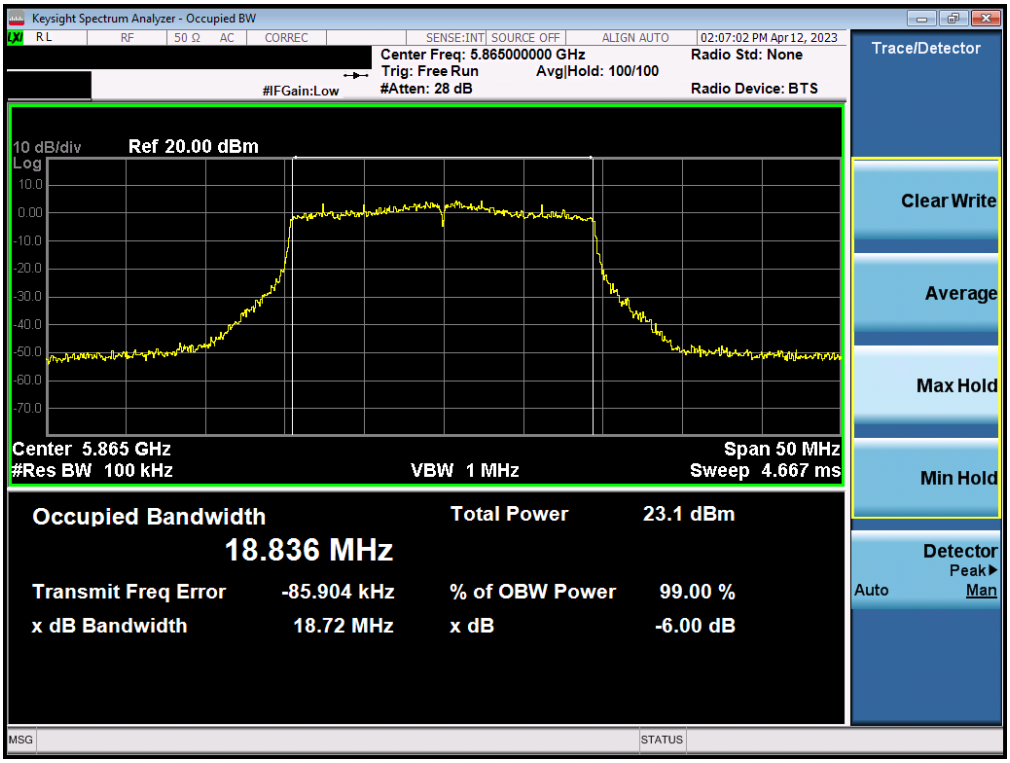
Plot 7-57. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 3) – Ch. 155)



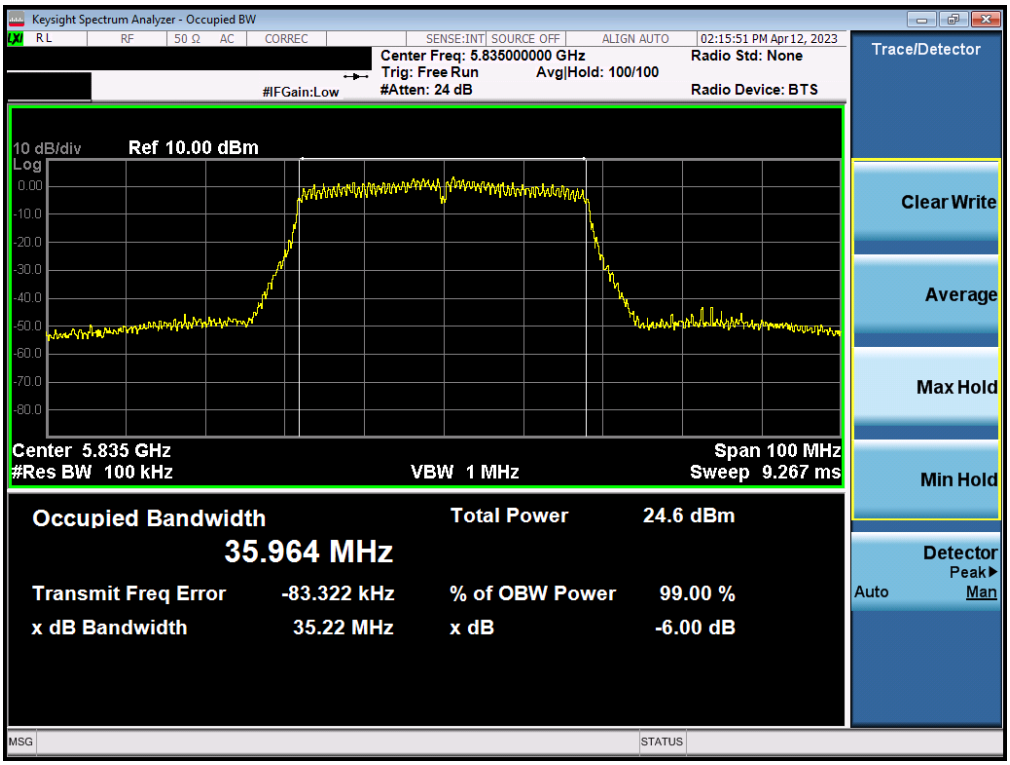
Plot 7-58. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11a (UNII Band 4) – Ch. 173)



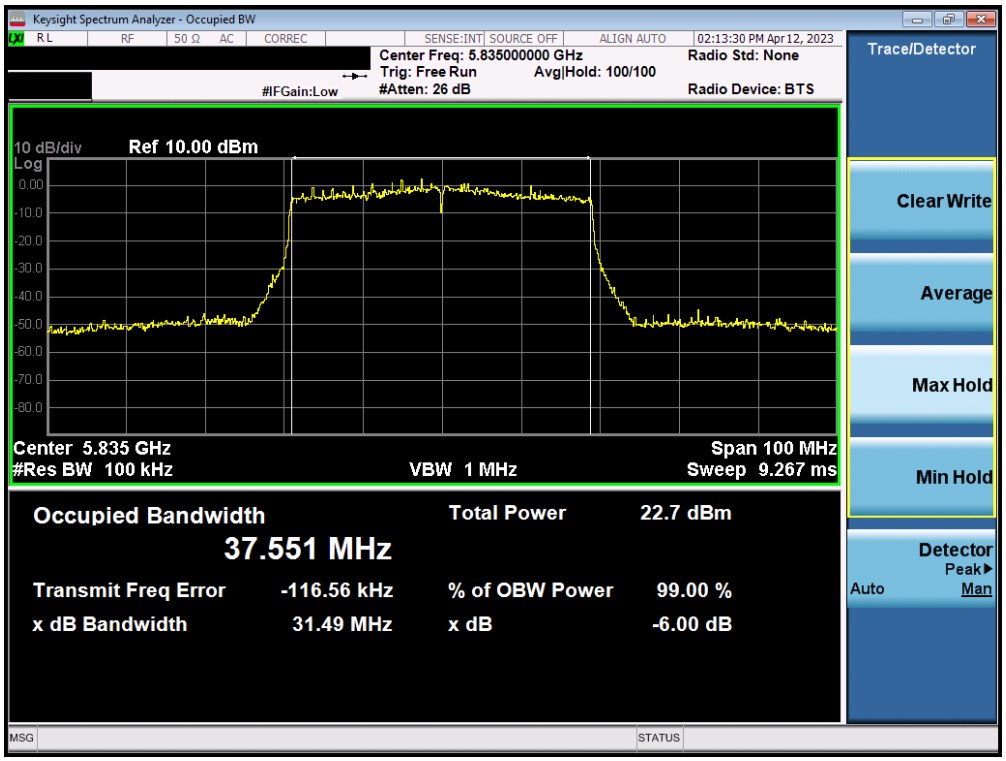
Plot 7-59. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 4) – Ch. 173)



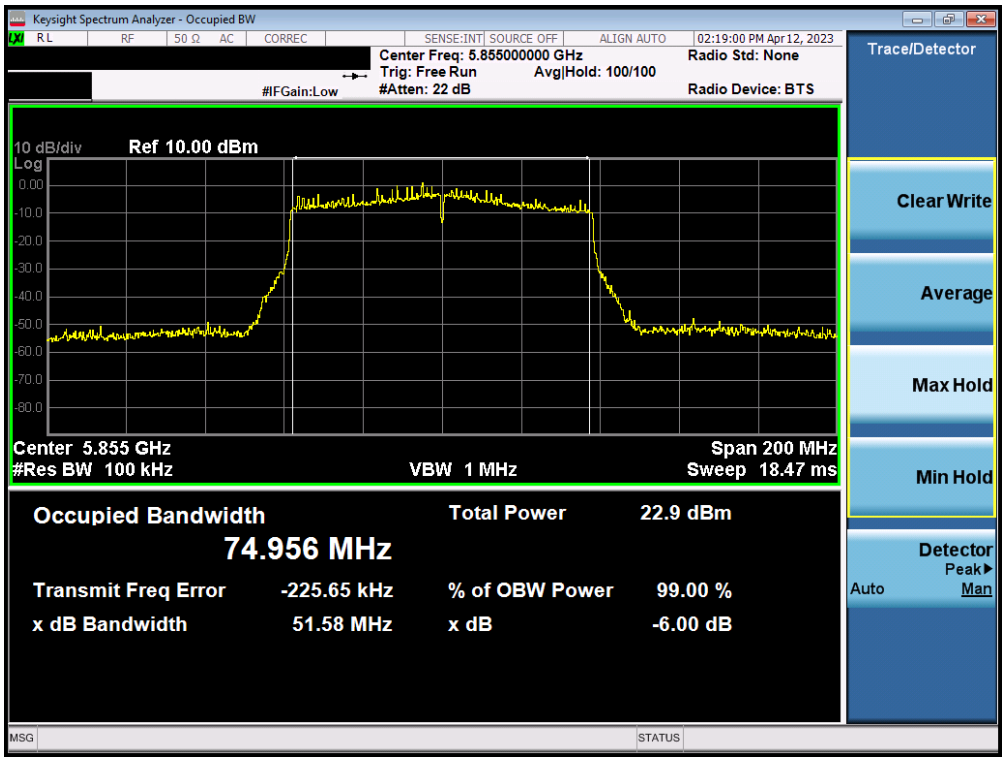
Plot 7-60. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 4) – Ch. 173)



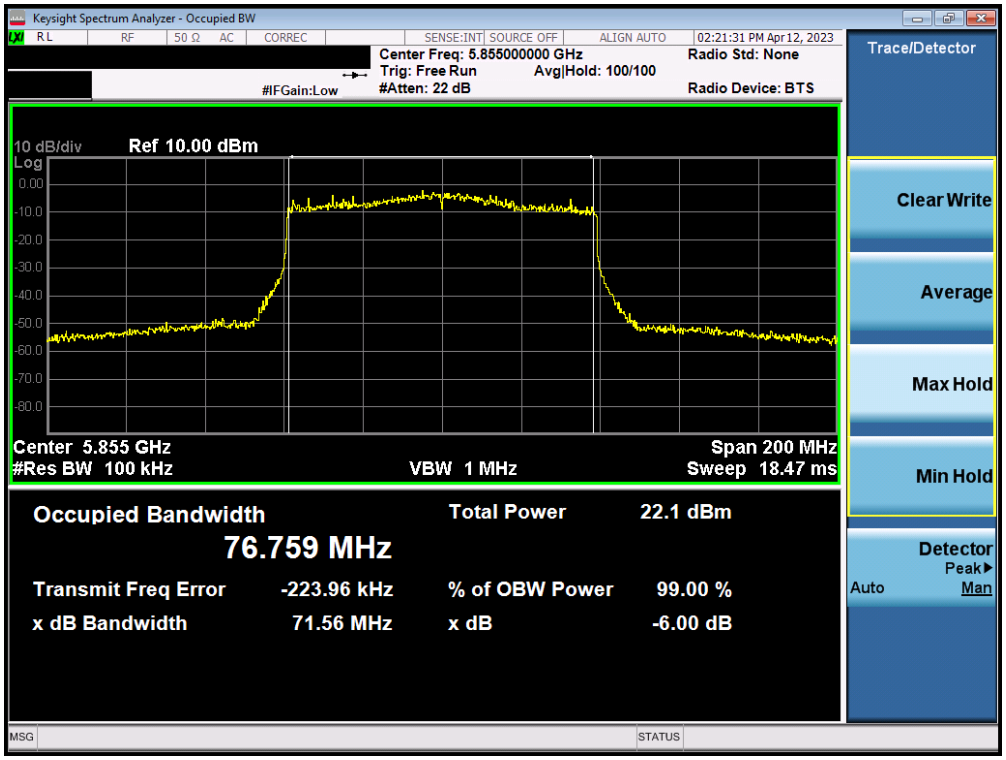
Plot 7-61. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 3/4) – Ch. 167)



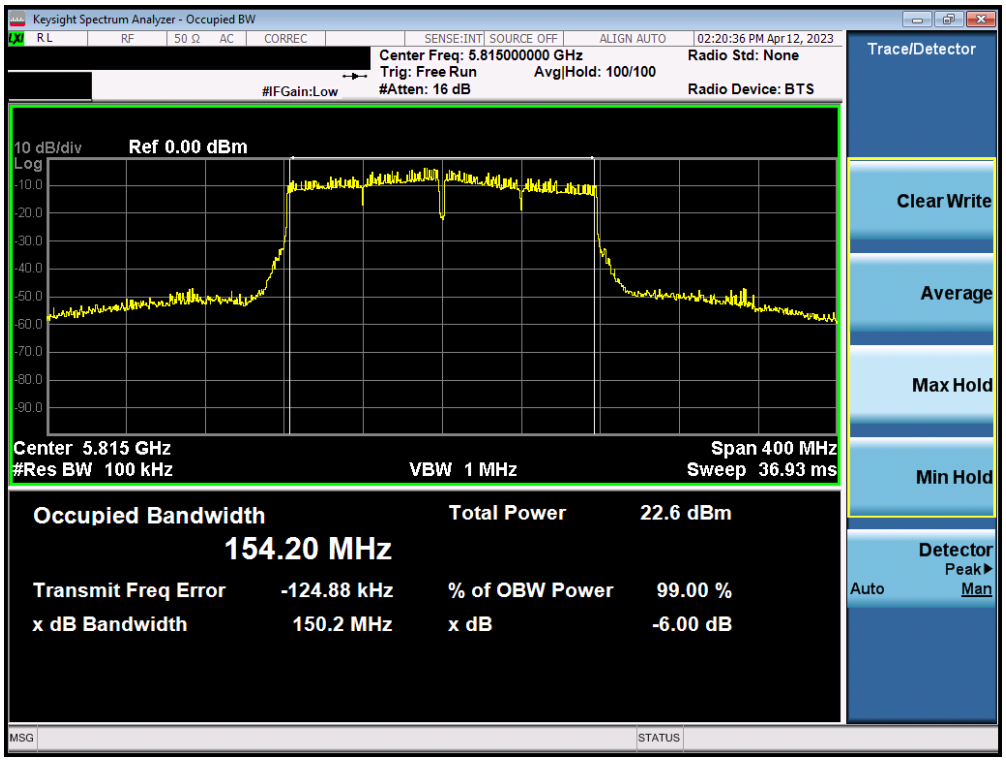
Plot 7-62. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 3/4) – Ch. 167)



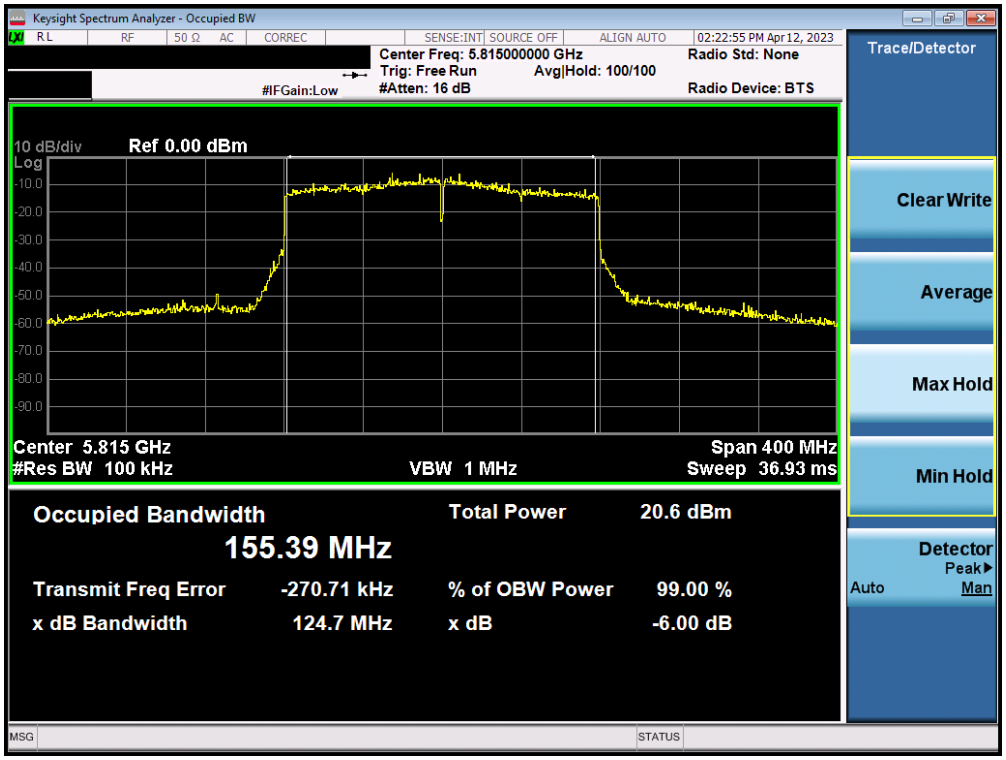
Plot 7-63. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 3/4) – Ch. 171)



Plot 7-64. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 3/4) – Ch. 171)

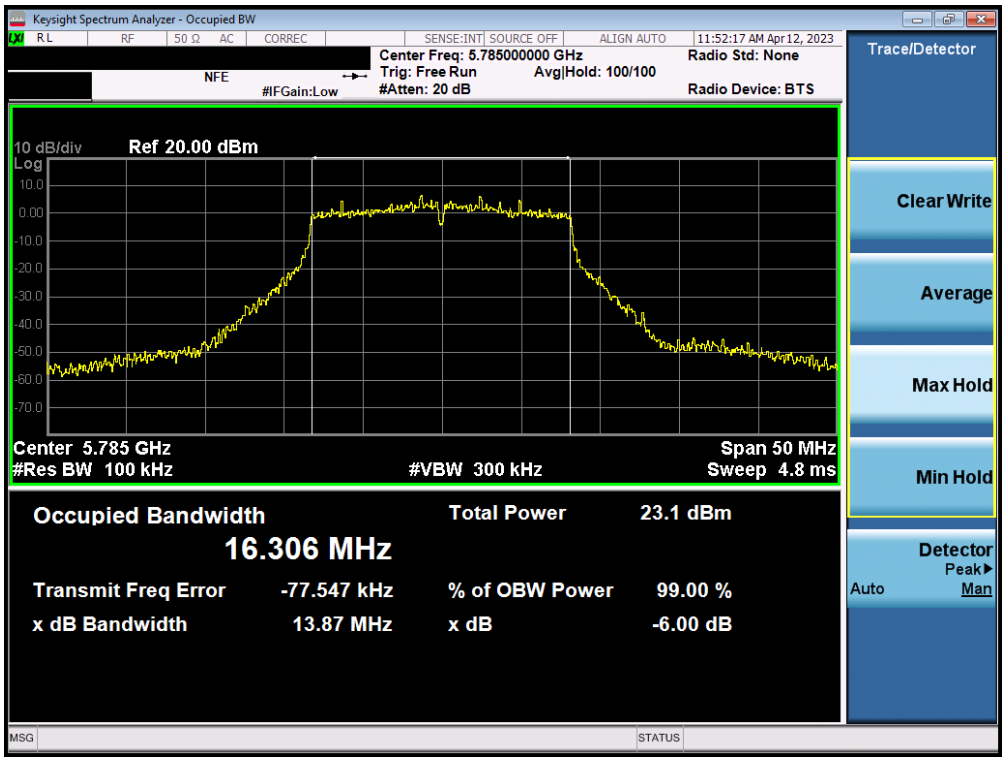


Plot 7-65. 6dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 3/4) – Ch. 163)

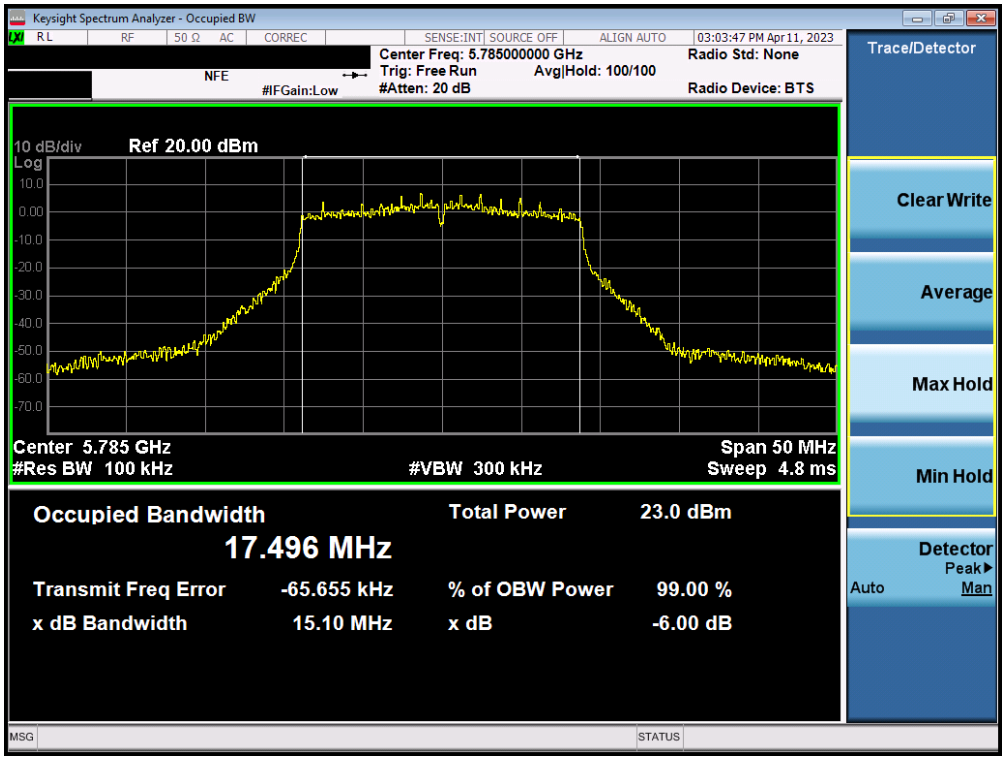


Plot 7-66. 6dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 3/4) – Ch. 163)

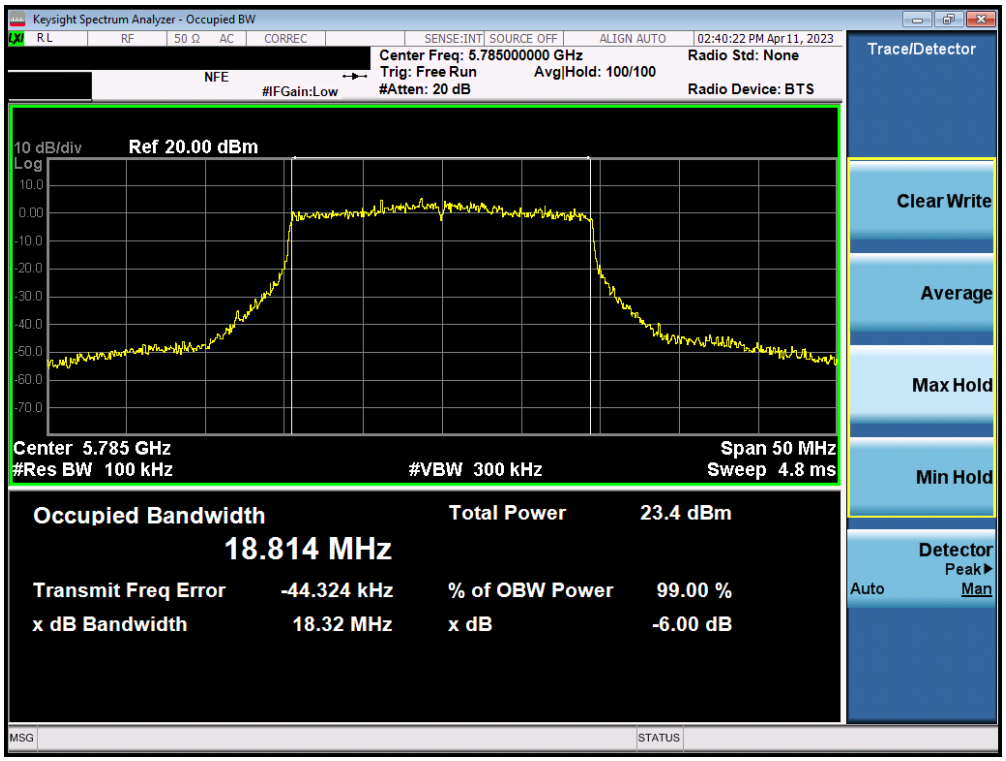
7.3.2 MIMO Antenna-2 6dB Bandwidth Measurements



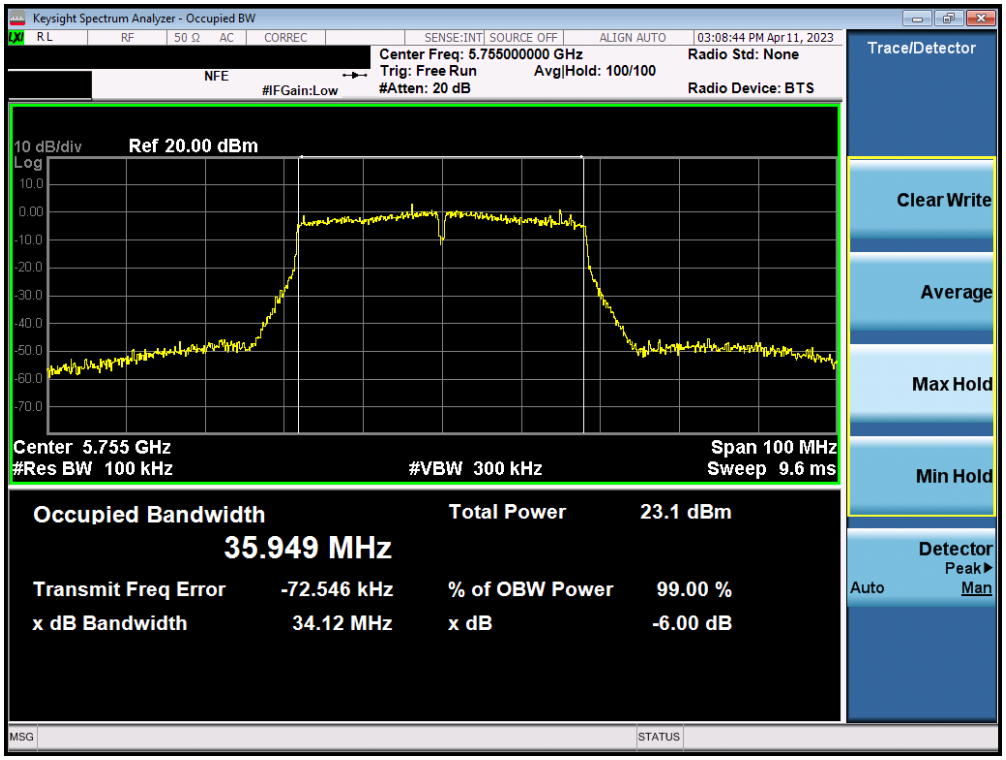
Plot 7-67. 6dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 3) – Ch. 157)



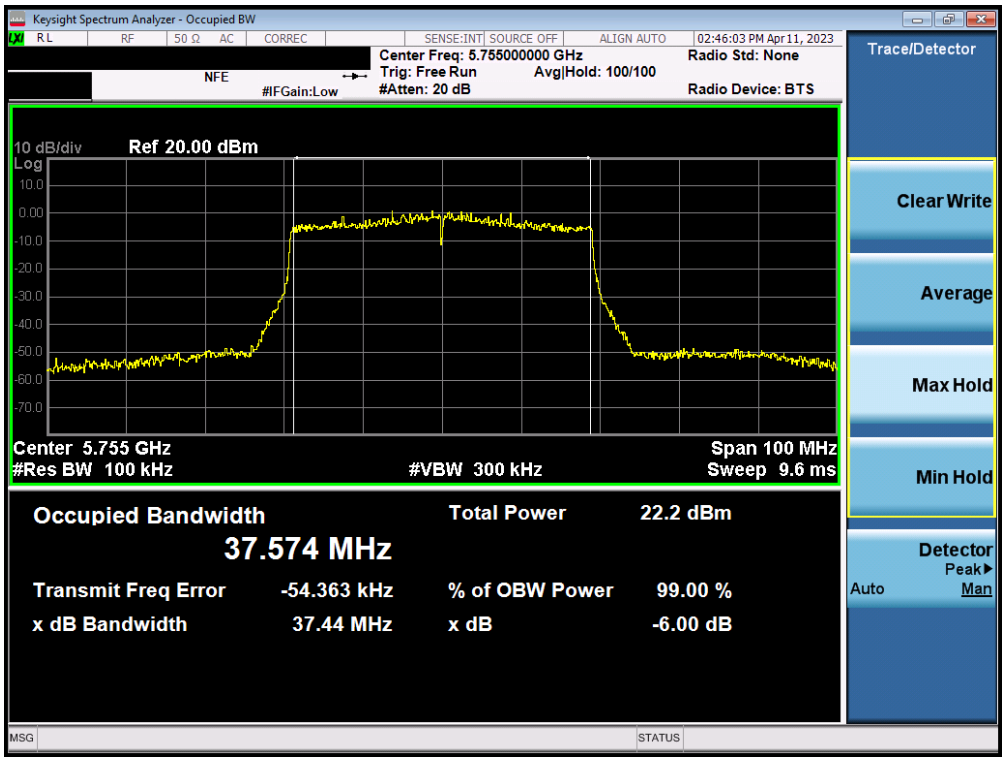
Plot 7-68. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)



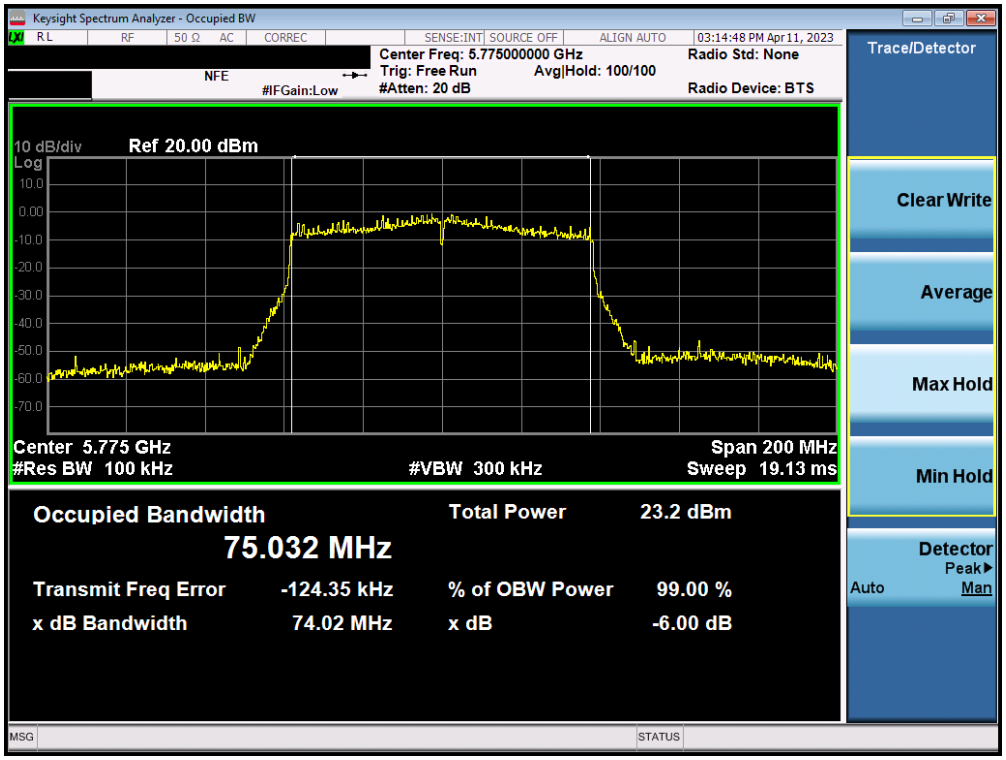
Plot 7-69. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 3) – Ch. 157)



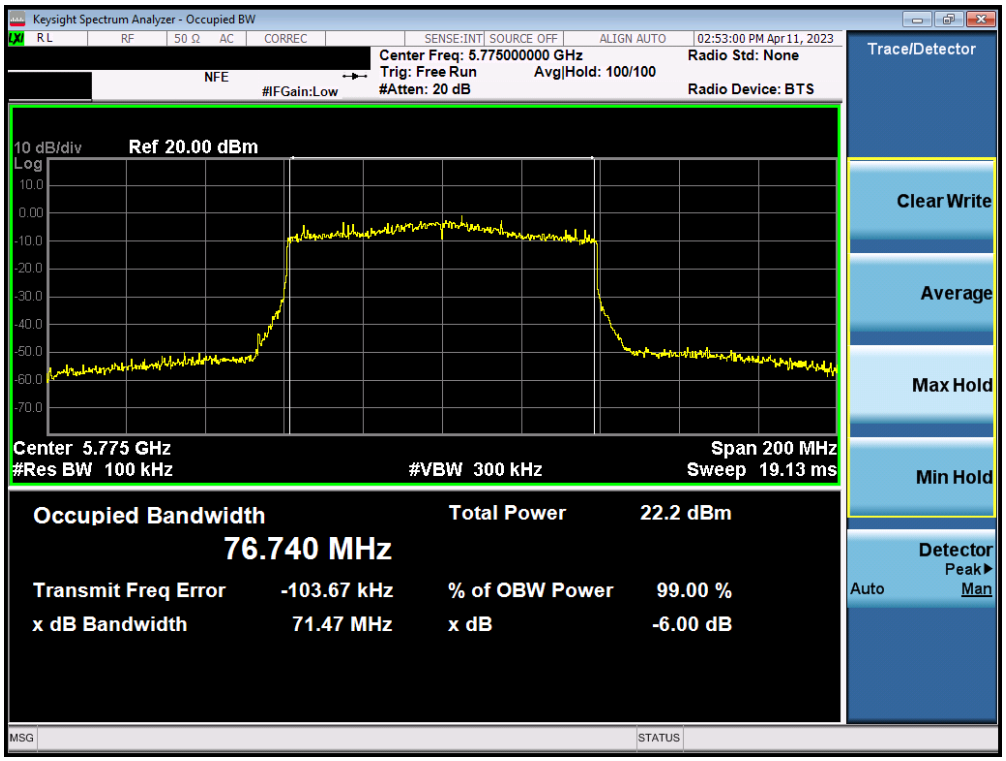
Plot 7-70. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)



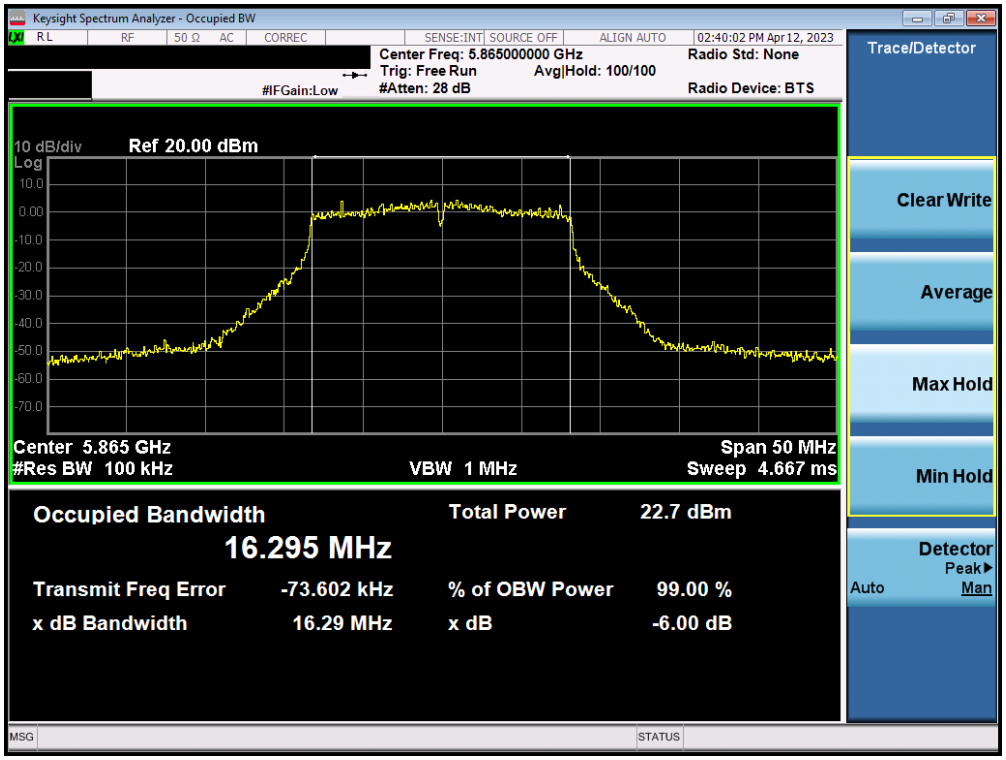
Plot 7-71. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3) – Ch. 151)



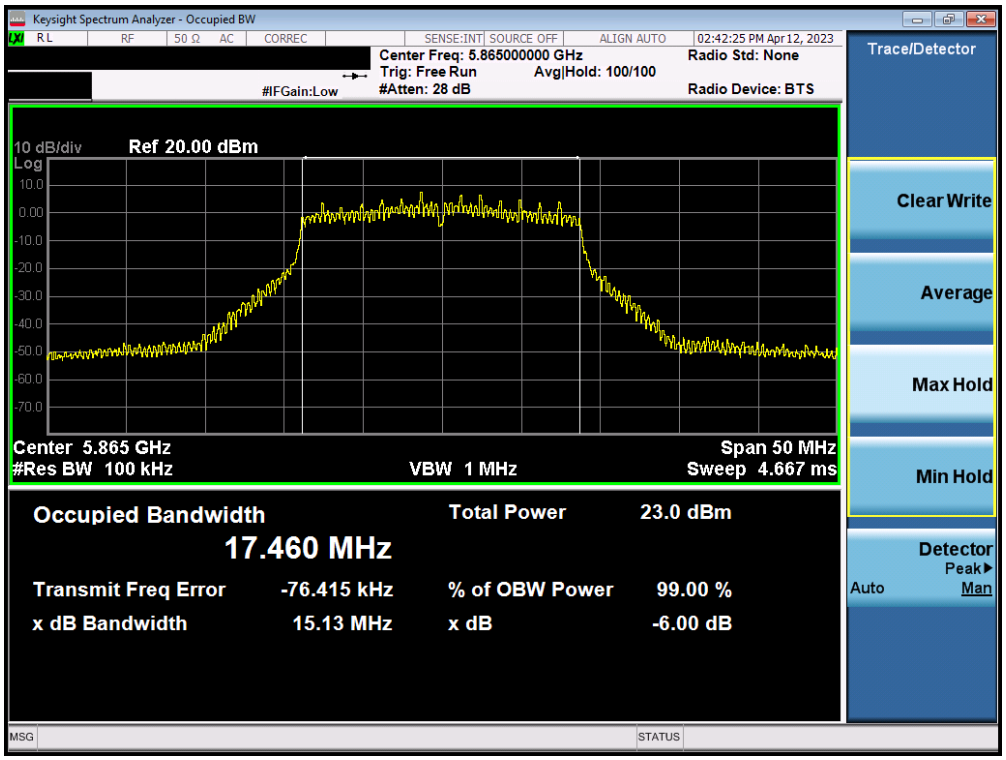
Plot 7-72. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)



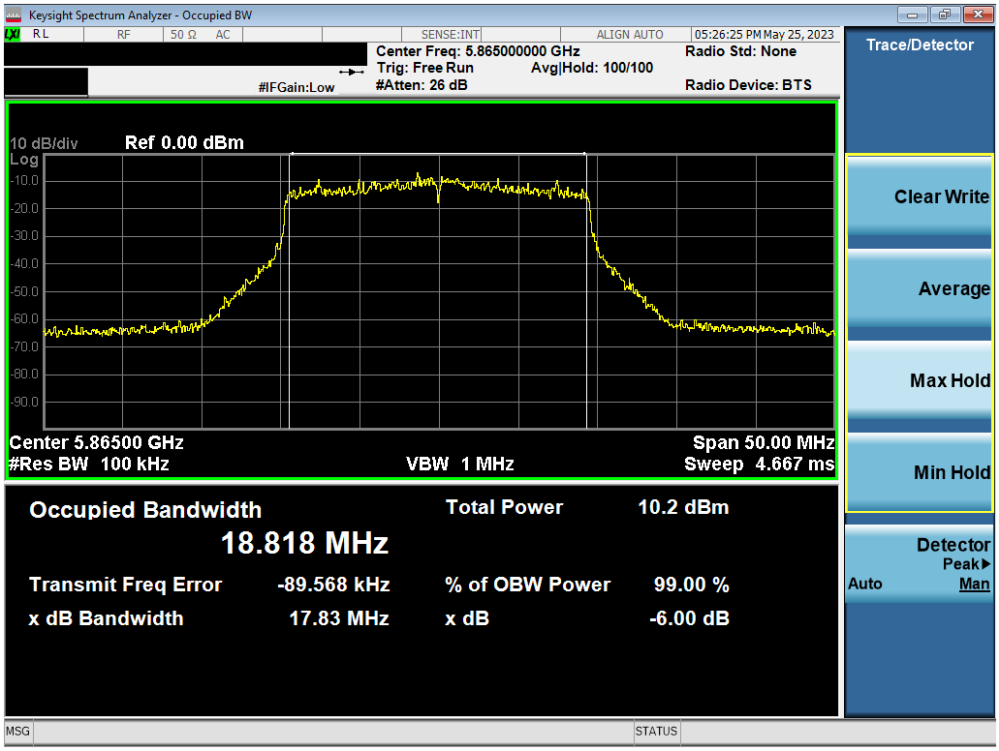
Plot 7-73. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3) – Ch. 155)



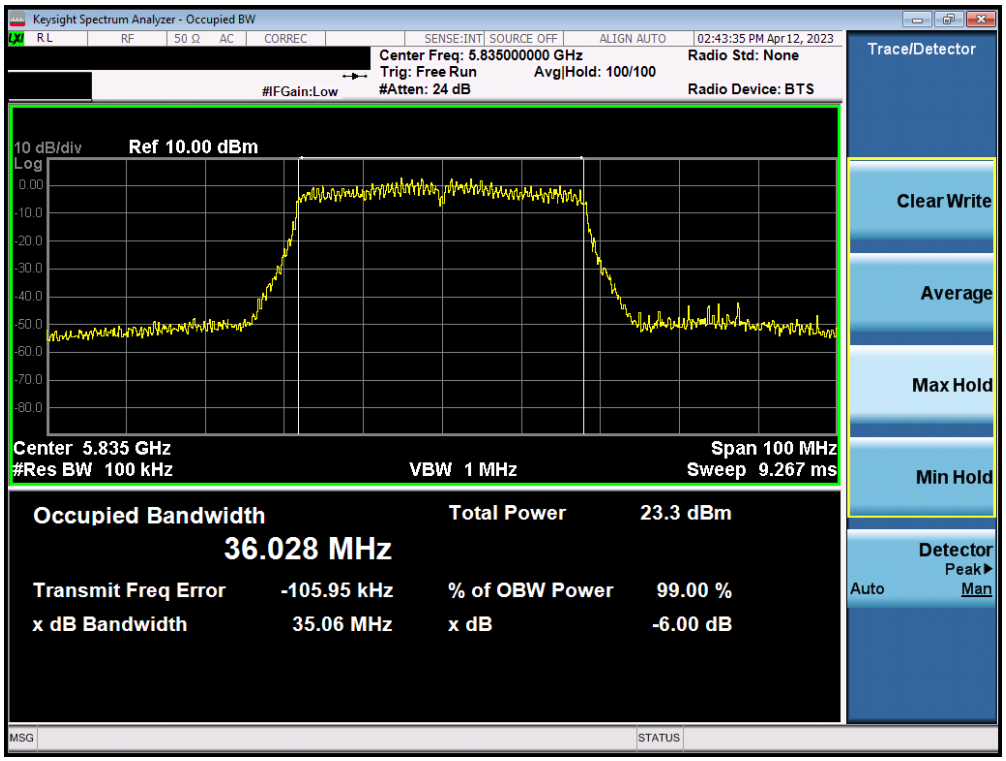
Plot 7-74. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11a (UNII Band 4) – Ch. 173)



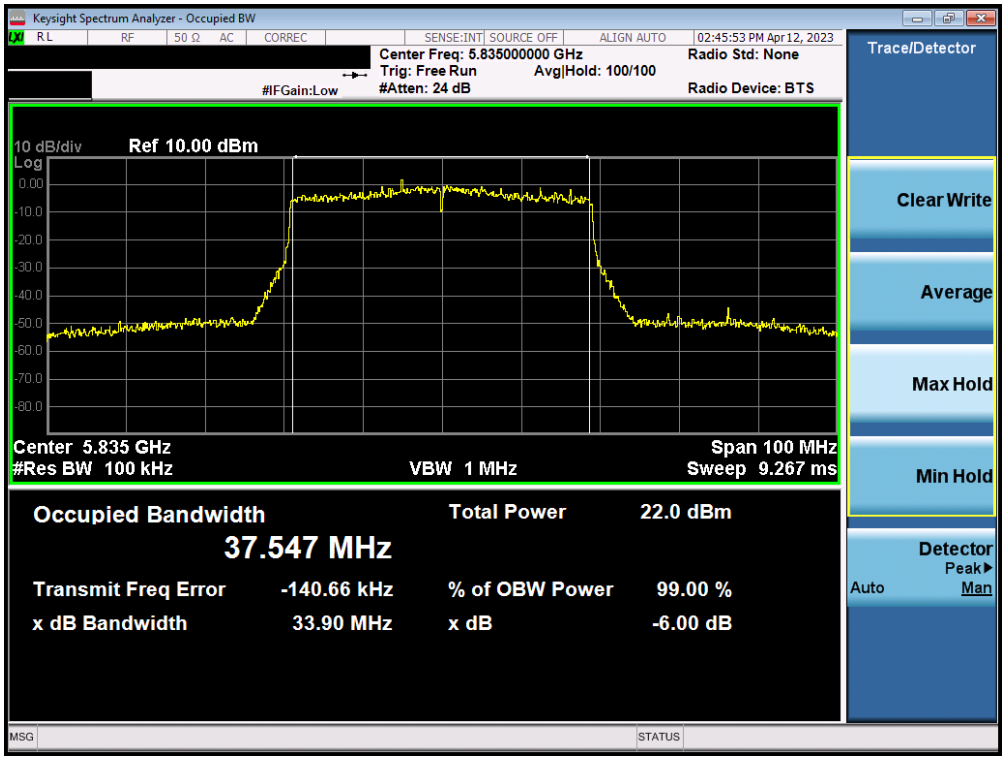
Plot 7-75. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 4) – Ch. 173)



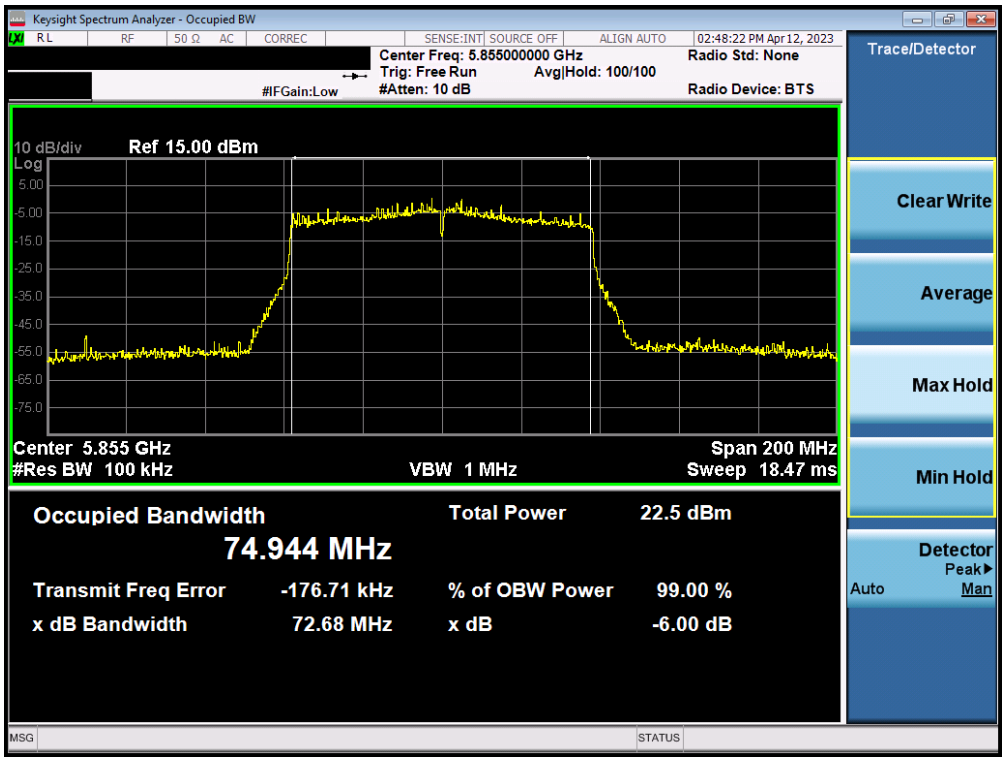
Plot 7-76. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 4) – Ch. 173)



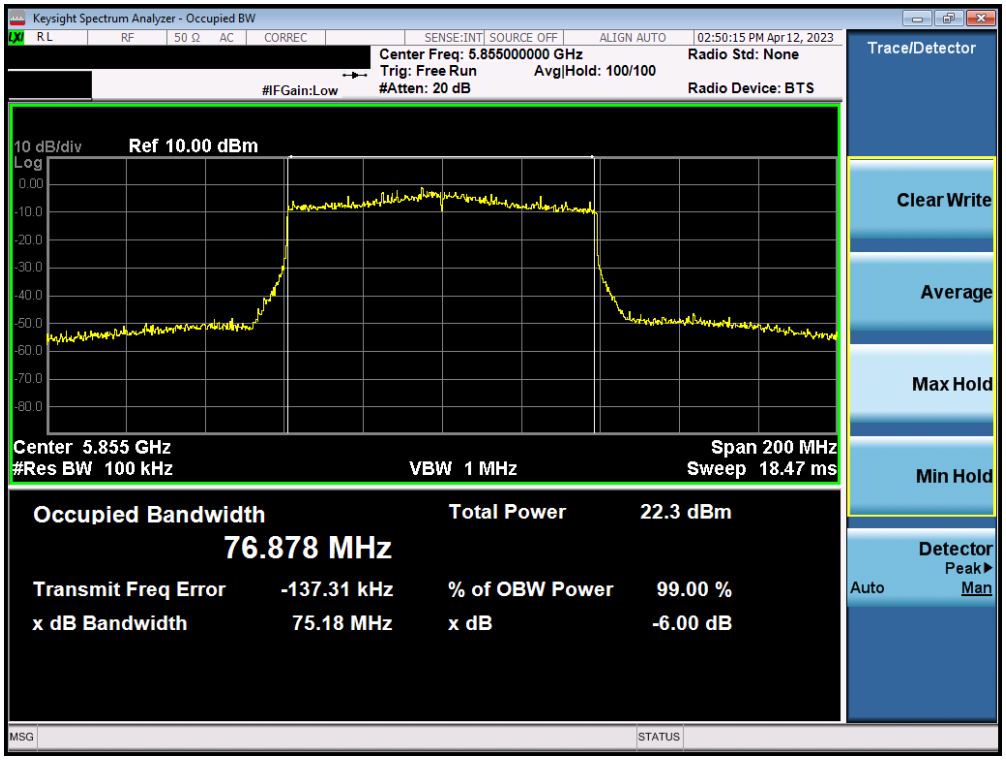
Plot 7-77. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 3/4) – Ch. 167)



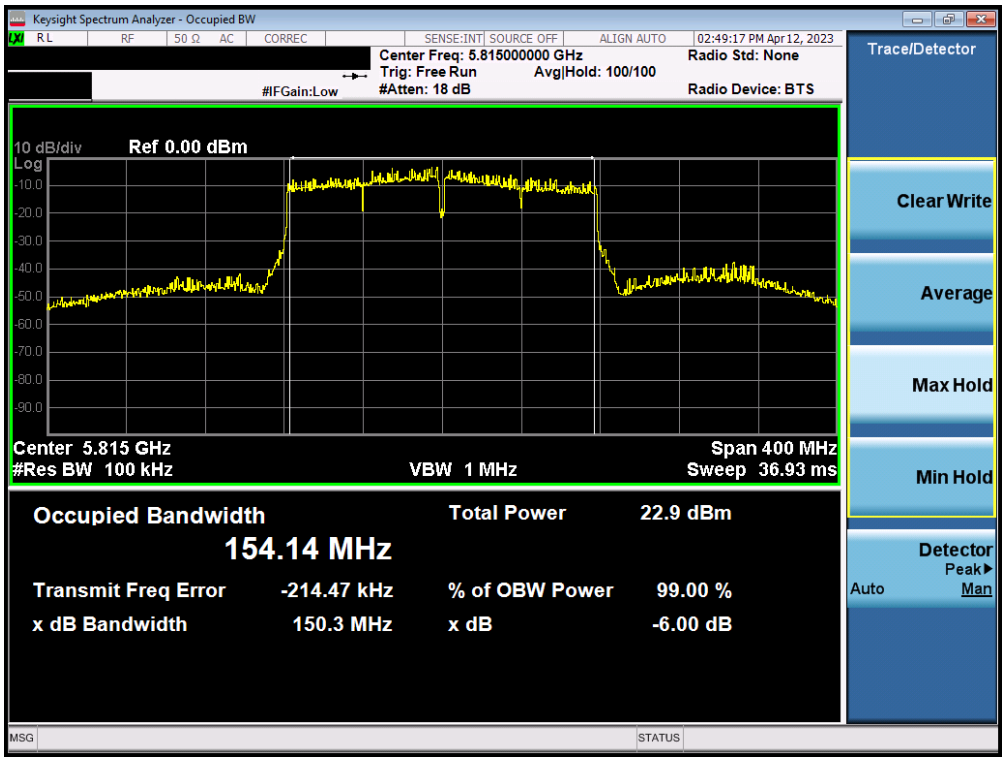
Plot 7-78. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3/4) – Ch. 167)



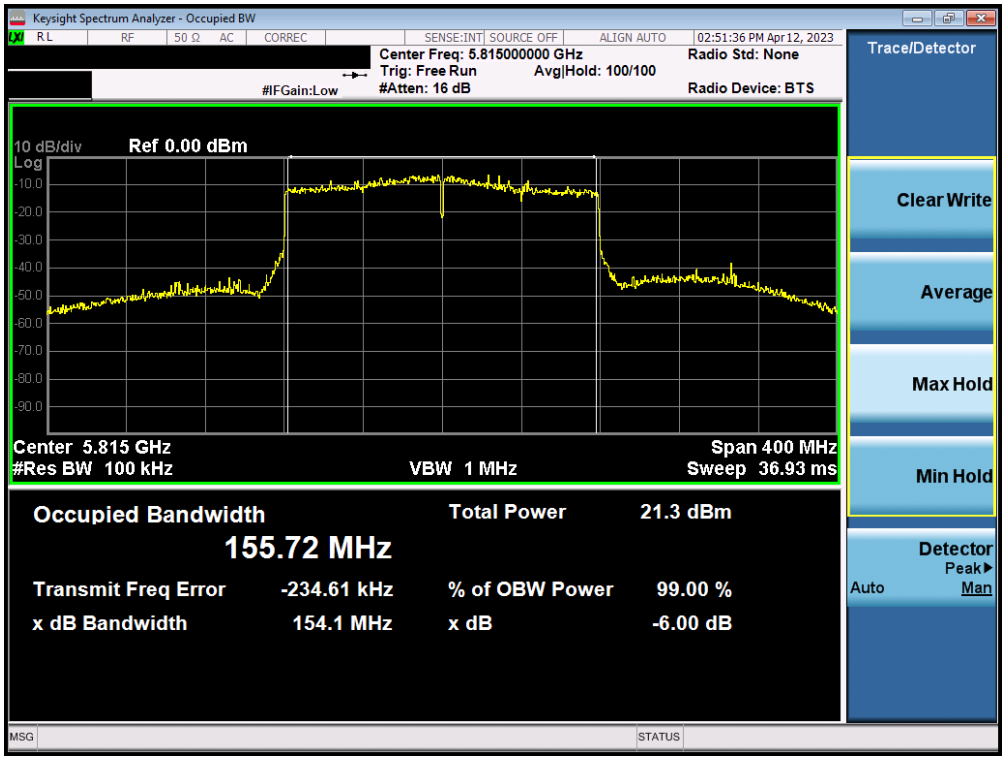
Plot 7-79. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3/4) – Ch. 171)



Plot 7-80. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3/4) – Ch. 171)



Plot 7-81. 6dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ac (UNII Band 3/4) – Ch. 163)



Plot 7-82. 6dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ax (UNII Band 3/4) – Ch. 163)

7.4 UNII Output Power Measurement

Test Overview and Limits

A transmitter antenna terminal of the EUT is connected to the input of an RF pulse power sensor. Measurement is made using a broadband average power meter while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013, and at the appropriate frequencies.

The output power limits are as specified in the tables below.

UNII Band	Frequency Range	Maximum Conducted Power Limit		Maximum e.i.r.p	
		FCC	ISED	FCC	ISED
UNII 1	5.15 – 5.25GHz	23.98dBm (250mW)	N/A	N/A	The lesser of 23.01dBm (200mW) **or** 10dBm + 10log$_{10}$B
UNII 2A	5.25 – 5.35GHz	The lesser of 23.98dBm (250mW) **or** 11dBm + 10log$_{10}$BW		N/A	The lesser of 30dBm (1W) **or** 17dBm + 10log$_{10}$BW
UNII 2C	5.47 – 5.725GHz				
UNII 3	5.725 – 5.850GHz	30dBm (1W)		N/A	N/A
UNII 4	5.850 – 5.895GHz	N/A		30dBm (1W)	N/A

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.3.2 Method PM-G
ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique

Test Settings

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 diagram below.

Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None.

MIMO Maximum Conducted Output Power Measurements

	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
5GHz (20MHz Bandwidth)	5180	36	AVG	15.72	15.46	18.60	23.98	-5.38	-2.36	16.24	30.00	-13.76
	5200	40	AVG	15.32	15.40	18.37	23.98	-5.61	-2.36	16.01	30.00	-13.99
	5220	44	AVG	15.46	15.44	18.46	23.98	-5.52	-2.36	16.10	30.00	-13.90
	5240	48	AVG	15.54	15.24	18.40	23.98	-5.58	-2.36	16.04	30.00	-13.96
	5260	52	AVG	15.43	15.32	18.39	23.63	-5.24	-2.08	16.31	29.63	-13.32
	5280	56	AVG	15.68	15.90	18.80	23.63	-4.83	-2.08	16.72	29.63	-12.91
	5300	60	AVG	15.79	15.57	18.69	23.63	-4.94	-2.08	16.61	29.63	-13.02
	5320	64	AVG	15.84	15.70	18.78	23.63	-4.85	-2.08	16.70	29.63	-12.93
	5500	100	AVG	15.90	15.52	18.72	23.64	-4.92	-3.17	15.55	29.64	-14.09
	5600	120	AVG	15.52	15.58	18.56	23.64	-5.08	-3.17	15.39	29.64	-14.25
	5620	124	AVG	15.30	15.40	18.36	23.64	-5.28	-3.17	15.19	29.64	-14.45
	5720	144	AVG	15.56	15.89	18.74	23.64	-4.90	-3.17	15.57	29.64	-14.07
	5745	149	AVG	15.88	15.59	18.75	30.00	-11.25	-3.61	15.14	36.00	-20.86
	5785	157	AVG	15.90	15.29	18.62	30.00	-11.38	-3.61	15.01	36.00	-20.99
	5825	165	AVG	15.72	15.87	18.81	30.00	-11.19	-3.61	15.20	36.00	-20.80
	5845	169	AVG	15.78	15.67	18.74			-3.34	15.40	30.00	-14.60
	5865	173	AVG	15.69	15.53	18.62			-3.34	15.28	30.00	-14.72
	5885	177	AVG	15.69	15.68	18.70			-3.34	15.36	30.00	-14.64

Table 7-5. MIMO 20MHz BW 802.11a (UNII) Maximum Conducted Output Power

	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
5GHz (20MHz Bandwidth)	5180	36	AVG	15.67	15.46	18.58	23.98	-5.40	-2.36	16.22	30.00	-13.78
	5200	40	AVG	15.61	15.52	18.58	23.98	-5.40	-2.36	16.22	30.00	-13.78
	5220	44	AVG	15.99	15.86	18.94	23.98	-5.04	-2.36	16.58	30.00	-13.42
	5240	48	AVG	15.98	15.78	18.89	23.98	-5.09	-2.36	16.53	30.00	-13.47
	5260	52	AVG	15.73	15.97	18.86	23.98	-5.12	-2.08	16.78	30.00	-13.22
	5280	56	AVG	15.69	15.87	18.79	23.98	-5.19	-2.08	16.71	30.00	-13.29
	5300	60	AVG	15.77	15.72	18.76	23.98	-5.22	-2.08	16.68	30.00	-13.32
	5320	64	AVG	15.84	15.67	18.77	23.98	-5.21	-2.08	16.69	30.00	-13.31
	5500	100	AVG	15.99	15.50	18.76	23.98	-5.22	-3.17	15.59	30.00	-14.41
	5600	120	AVG	15.96	15.94	18.96	23.98	-5.02	-3.17	15.79	30.00	-14.21
	5620	124	AVG	16.02	15.96	19.00	23.98	-4.98	-3.17	15.83	30.00	-14.17
	5720	144	AVG	15.76	15.94	18.86	23.98	-5.12	-3.17	15.69	30.00	-14.31
	5745	149	AVG	15.98	15.57	18.79	30.00	-11.21	-3.61	15.18	36.00	-20.82
	5785	157	AVG	15.93	15.28	18.63	30.00	-11.37	-3.61	15.02	36.00	-20.98
	5825	165	AVG	15.95	15.78	18.88	30.00	-11.12	-3.61	15.27	36.00	-20.73
	5845	169	AVG	15.87	15.63	18.76			-3.34	15.42	30.00	-14.58
	5865	173	AVG	15.83	15.49	18.67			-3.34	15.33	30.00	-14.67
	5885	177	AVG	15.82	15.66	18.75			-3.34	15.41	30.00	-14.59

Table 7-6. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
5GHz (20MHz Bandwidth)	5180	36	AVG	15.89	15.78	18.85	23.98	-5.13	-2.36	16.49	30.00	-13.51
	5200	40	AVG	15.78	15.64	18.72	23.98	-5.26	-2.36	16.36	30.00	-13.64
	5220	44	AVG	15.71	15.57	18.65	23.98	-5.33	-2.36	16.29	30.00	-13.71
	5240	48	AVG	15.69	15.45	18.58	23.98	-5.40	-2.36	16.22	30.00	-13.78
	5260	52	AVG	15.44	15.63	18.55	23.63	-5.08	-2.08	16.47	29.63	-13.16
	5280	56	AVG	15.39	15.54	18.48	23.63	-5.15	-2.08	16.40	29.63	-13.23
	5300	60	AVG	15.44	15.45	18.46	23.63	-5.17	-2.08	16.38	29.63	-13.25
	5320	64	AVG	15.50	15.38	18.45	23.63	-5.18	-2.08	16.37	29.63	-13.26
	5500	100	AVG	15.87	15.17	18.54	23.64	-5.10	-3.17	15.37	29.64	-14.27
	5600	120	AVG	15.82	15.66	18.75	23.64	-4.89	-3.17	15.58	29.64	-14.06
	5620	124	AVG	15.42	15.57	18.51	23.64	-5.13	-3.17	15.34	29.64	-14.30
	5720	144	AVG	15.38	15.65	18.53	23.64	-5.11	-3.17	15.36	29.64	-14.28
	5745	149	AVG	15.65	15.26	18.47	30.00	-11.53	-3.61	14.86	36.00	-21.14
	5785	157	AVG	15.81	14.97	18.42	30.00	-11.58	-3.61	14.81	36.00	-21.19
	5825	165	AVG	15.59	15.47	18.54	30.00	-11.46	-3.61	14.93	36.00	-21.07
	5845	169	AVG	15.57	15.33	18.46			-3.34	15.12	30.00	-14.88
	5865	173	AVG	15.89	15.72	18.82			-3.34	15.48	30.00	-14.52
	5885	177	AVG	15.86	15.86	18.87			-3.34	15.53	30.00	-14.47

Table 7-7. MIMO 20MHz BW 802.11ac (UNII) Maximum Conducted Output Power

	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
5GHz (20MHz Bandwidth)	5180	36	AVG	15.57	14.98	18.30	23.98	-5.68	-2.36	15.94	30.00	-14.06
	5200	40	AVG	15.04	15.16	18.11	23.98	-5.87	-2.36	15.75	30.00	-14.25
	5220	44	AVG	15.86	15.23	18.57	23.98	-5.41	-2.36	16.21	30.00	-13.79
	5240	48	AVG	15.31	15.23	18.28	23.98	-5.70	-2.36	15.92	30.00	-14.08
	5260	52	AVG	15.38	15.29	18.35	23.63	-5.28	-2.08	16.27	29.63	-13.36
	5280	56	AVG	15.32	15.30	18.32	23.63	-5.31	-2.08	16.24	29.63	-13.39
	5300	60	AVG	15.20	15.55	18.39	23.63	-5.24	-2.08	16.31	29.63	-13.32
	5320	64	AVG	15.21	15.60	18.42	23.63	-5.21	-2.08	16.34	29.63	-13.29
	5500	100	AVG	15.67	15.56	18.63	23.64	-5.01	-3.17	15.46	29.64	-14.18
	5600	120	AVG	15.64	15.43	18.55	23.64	-5.09	-3.17	15.38	29.64	-14.26
	5620	124	AVG	15.44	15.35	18.41	23.64	-5.23	-3.17	15.24	29.64	-14.40
	5720	144	AVG	15.53	15.23	18.39	23.64	-5.25	-3.17	15.22	29.64	-14.42
	5745	149	AVG	15.68	15.86	18.78	30.00	-11.22	-3.61	15.17	36.00	-20.83
	5785	157	AVG	15.41	15.64	18.54	30.00	-11.46	-3.61	14.93	36.00	-21.07
	5825	165	AVG	15.55	15.28	18.43	30.00	-11.57	-3.61	14.82	36.00	-21.18
	5845	169	AVG	15.34	15.20	18.28			-3.34	14.94	30.00	-15.06
	5865	173	AVG	15.68	15.56	18.63			-3.34	15.29	30.00	-14.71
	5885	177	AVG	15.64	15.03	18.36			-3.34	15.02	30.00	-14.98

Table 7-8. MIMO 20MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz (40MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5190	38	AVG	14.59	14.50	17.56	23.98	-6.42	-2.36	15.20	30.00	-14.80
	5230	46	AVG	14.89	14.83	17.87	23.98	-6.11	-2.36	15.51	30.00	-14.49
	5270	54	AVG	14.81	14.82	17.83	23.63	-5.80	-2.08	15.75	29.63	-13.88
	5310	62	AVG	14.65	14.73	17.70	23.63	-5.93	-2.08	15.62	29.63	-14.01
	5510	102	AVG	14.68	14.90	17.80	23.64	-5.84	-3.17	14.63	29.64	-15.01
	5590	118	AVG	14.86	14.76	17.82	23.64	-5.82	-3.17	14.65	29.64	-14.99
	5710	142	AVG	14.70	14.66	17.69	23.64	-5.95	-3.17	14.52	29.64	-15.12
	5755	151	AVG	14.59	14.99	17.80	30.00	-12.20	-3.61	14.19	36.00	-21.81
	5795	159	AVG	14.35	14.92	17.65	30.00	-12.35	-3.61	14.04	36.00	-21.96
	5670	134	AVG	14.58	14.59	17.60			-3.34	14.26	30.00	-15.74
	5710	142	AVG	14.73	14.96	17.86			-3.34	14.52	30.00	-15.48

Table 7-9. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

5GHz (40MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5190	38	AVG	14.65	14.84	17.76	23.98	-6.22	-2.36	15.40	30.00	-14.60
	5230	46	AVG	14.94	14.98	17.97	23.98	-6.01	-2.36	15.61	30.00	-14.39
	5270	54	AVG	14.98	14.94	17.97	23.63	-5.66	-2.08	15.89	29.63	-13.74
	5310	62	AVG	14.94	14.74	17.85	23.63	-5.78	-2.08	15.77	29.63	-13.86
	5510	102	AVG	14.75	14.97	17.87	23.64	-5.77	-3.17	14.70	29.64	-14.94
	5590	118	AVG	14.72	14.75	17.75	23.64	-5.89	-3.17	14.58	29.64	-15.06
	5710	142	AVG	14.71	14.77	17.75	23.64	-5.89	-3.17	14.58	29.64	-15.06
	5755	151	AVG	14.51	14.98	17.76	30.00	-12.24	-3.61	14.15	36.00	-21.85
	5795	159	AVG	14.37	14.99	17.70	30.00	-12.30	-3.61	14.09	36.00	-21.91
	5670	134	AVG	14.58	14.60	17.60			-3.34	14.26	30.00	-15.74
	5710	142	AVG	14.88	14.96	17.93			-3.34	14.59	30.00	-15.41

Table 7-10. MIMO 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz (40MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5190	38	AVG	14.80	14.98	17.90	23.98	-6.08	-2.36	15.54	30.00	-14.46
	5230	46	AVG	14.63	14.78	17.72	23.98	-6.26	-2.36	15.36	30.00	-14.64
	5270	54	AVG	14.69	14.75	17.73	23.63	-5.90	-2.08	15.65	29.63	-13.98
	5310	62	AVG	14.66	14.55	17.62	23.63	-6.01	-2.08	15.54	29.63	-14.09
	5510	102	AVG	14.36	14.86	17.63	23.64	-6.01	-3.17	14.46	29.64	-15.18
	5590	118	AVG	14.96	14.99	17.99	23.64	-5.65	-3.17	14.82	29.64	-14.82
	5710	142	AVG	14.91	14.97	17.95	23.64	-5.69	-3.17	14.78	29.64	-14.86
	5755	151	AVG	14.18	14.99	17.61	30.00	-12.39	-3.61	14.00	36.00	-22.00
	5795	159	AVG	14.57	14.98	17.79	30.00	-12.21	-3.61	14.18	36.00	-21.82
	5835	167	AVG	14.88	14.90	17.90			-3.34	14.56	30.00	-15.44
	5875	175	AVG	14.81	14.91	17.87			-3.34	14.53	30.00	-15.47

Table 7-11. MIMO 40MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz (80MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5210	42	AVG	13.26	13.73	16.51	23.98	-7.47	-2.36	14.15	30.00	-15.85
	5290	58	AVG	13.42	13.70	16.57	23.63	-7.06	-2.08	14.49	29.63	-15.14
	5530	106	AVG	13.27	13.92	16.62	23.64	-7.02	-3.17	13.45	29.64	-16.19
	5610	122	AVG	13.66	13.93	16.81	23.64	-6.83	-3.17	13.64	29.64	-16.00
	5690	138	AVG	13.78	13.93	16.87	23.64	-6.77	-3.17	13.70	29.64	-15.94
	5775	155	AVG	13.48	13.92	16.72	30.00	-13.28	-3.61	13.11	36.00	-22.89
	5855	171	AVG	13.50	13.73	16.63			-3.34	13.29	30.00	-16.71

Table 7-12. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz (80MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5210	42	AVG	13.68	13.84	16.77	23.98	-7.21	-2.36	14.41	30.00	-15.59
	5290	58	AVG	13.52	13.88	16.71	23.63	-6.92	-2.08	14.63	29.63	-15.00
	5530	106	AVG	13.41	13.87	16.66	23.64	-6.98	-3.17	13.49	29.64	-16.15
	5610	122	AVG	13.67	13.88	16.79	23.64	-6.85	-3.17	13.62	29.64	-16.02
	5690	138	AVG	13.43	13.73	16.59	23.64	-7.05	-3.17	13.42	29.64	-16.22
	5775	155	AVG	13.22	13.88	16.57	30.00	-13.43	-3.61	12.96	36.00	-23.04
	5855	171	AVG	13.43	13.73	16.59			-3.34	13.25	30.00	-16.75

Table 7-13. MIMO 80MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz (160MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5250	50	AVG	12.51	12.93	15.74	23.98	-8.24	-2.36	13.38	30.00	-16.62
	5570	114	AVG	12.27	12.92	15.62	23.64	-8.02	-3.17	12.45	29.64	-17.19
	5815	163	AVG	12.18	12.93	15.58			-3.34	12.24	30.00	-17.76

Table 7-14. MIMO 160MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz (160MHz Bandwidth)	Freq [MHz]	Channel	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]
				ANT1	ANT2	MIMO						
	5250	50	AVG	12.80	12.88	15.85	23.98	-8.13	-2.36	13.49	30.00	-16.51
	5570	114	AVG	11.91	12.86	15.42	23.64	-8.22	-3.17	12.25	29.64	-17.39
	5815	163	AVG	12.02	12.83	15.45			-3.34	12.11	30.00	-17.89

Table 7-15. MIMO 160MHz BW 802.11ax (UNII) Maximum Conducted Output Power

Note:

Per ANSI C63.10-2013 and KDB 662911 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.

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

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

Sample MIMO Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average conducted output power was measured to be 15.67 dBm for Antenna 1 and 15.46 dBm for Antenna 2.

Antenna 1 + Antenna 2 = MIMO

(15.67 dBm + 15.46 dBm) = (36.90 mW + 35.16 mW) = 72.05 mW = 18.58 dBm

Sample e.i.r.p Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average MIMO conducted power was calculated to be 18.58 dBm with directional gain of -2.36 dBi.

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

18.58dBm + -2.36 dBi = 16.22 dBm

7.5 Maximum Power Spectral Density

Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal while the EUT was operating at its maximum duty cycle, at its maximum power control level, as defined in ANSI C63.10-2013, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013, was used to measure the power spectral density.

The output power density limits are as specified in the tables below.

UNII Band	Frequency Range	Maximum Power Spectral Density	
		FCC	ISED
UNII 1	5.15 – 5.25GHz	11dBm/MHz	10dBm/MHz e.i.r.p
UNII 2A	5.25 – 5.35GHz	11dBm/MHz	
UNII 2C	5.47 – 5.725GHz		
UNII 3	5.725 – 5.850GHz	30dBm/500kHz	
UNII 4	5.850 – 5.895GHz	14dBm/MHz e.i.r.p	N/A

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2 (Method SA-1)
ANSI C63.10-2013 – Section 14.3.2.2 Measure-and-Sum Technique

Test Settings

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
3. RBW = 1MHz
4. VBW = 3MHz
5. Number of sweep points $\geq$ 2 x (span/RBW)
6. Sweep time = auto
7. Detector = power averaging (RMS)
8. Trigger was set to free run for all modes
9. Trace was averaged over 100 sweeps
10. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

Test Setup

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

Figure 7-4. Test Instrument & Measurement Setup

Summed MIMO Power Spectral Density Measurements

	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 Power Density [dBm]	Antenna-2 Power Density [dBm]	Summed MIMO Power Density [dBm]	DCCF [dB]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	a	6	6.15	5.56	8.88	0.15	11.0	-1.97
	5200	40	a	6	5.68	5.45	8.58	0.15	11.0	-2.27
	5240	48	a	6	5.70	5.65	8.69	0.15	11.0	-2.16
	5180	36	n (20MHz)	6.5/7.2 (MCS0)	5.59	5.19	8.40	0.00	11.0	-2.60
	5200	40	n (20MHz)	6.5/7.2 (MCS0)	5.77	5.22	8.51	0.00	11.0	-2.49
	5240	48	n (20MHz)	6.5/7.2 (MCS0)	5.63	5.81	8.73	0.00	11.0	-2.27
	5180	36	ax (20MHz)	6.5/7.2 (MCS0)	5.91	5.56	8.75	0.00	11.0	-2.25
	5200	40	ax (20MHz)	6.5/7.2 (MCS0)	6.35	6.08	9.23	0.00	11.0	-1.77
	5240	48	ax (20MHz)	6.5/7.2 (MCS0)	5.74	6.20	8.99	0.00	11.0	-2.01
	5190	38	n (40MHz)	13.5/15 (MCS0)	2.87	2.84	5.87	0.00	11.0	-5.13
	5230	46	n (40MHz)	13.5/15 (MCS0)	2.70	3.25	5.99	0.00	11.0	-5.01
	5190	38	ax (40MHz)	13.5/15 (MCS0)	2.01	1.86	4.95	0.00	11.0	-6.05
	5230	46	ax (40MHz)	13.5/15 (MCS0)	1.50	1.40	4.46	0.00	11.0	-6.54
	5210	42	ac (80MHz)	29.3/32.5 (MCS0)	-1.52	-0.84	1.84	0.33	11.0	-8.83
	5210	42	ax (80MHz)	29.3/32.5 (MCS0)	-1.74	-1.66	1.31	0.00	11.0	-9.69
1/2A	5250	50	ac (160MHz)	58.5/65 (MCS0)	-4.93	-4.80	-1.85	0.33	11.0	-12.52
	5250	50	ax (160MHz)	58.5/65 (MCS0)	-5.02	-4.25	-1.61	0.00	11.0	-12.61
Band 2A	5260	52	a	6	6.17	6.20	9.20	0.15	11.0	-1.65
	5280	56	a	6	7.10	6.69	9.91	0.15	11.0	-0.94
	5320	64	a	6	6.30	6.85	9.59	0.15	11.0	-1.26
	5260	52	n (20MHz)	6.5/7.2 (MCS0)	5.69	6.33	9.03	0.00	11.0	-1.97
	5280	56	n (20MHz)	6.5/7.2 (MCS0)	6.54	6.12	9.35	0.00	11.0	-1.65
	5320	64	n (20MHz)	6.5/7.2 (MCS0)	5.79	6.36	9.09	0.00	11.0	-1.91
	5260	52	ax (20MHz)	6.5/7.2 (MCS0)	5.83	5.92	8.89	0.00	11.0	-2.11
	5280	56	ax (20MHz)	6.5/7.2 (MCS0)	5.70	5.91	8.82	0.00	11.0	-2.18
	5320	64	ax (20MHz)	6.5/7.2 (MCS0)	5.75	6.51	9.16	0.00	11.0	-1.84
	5270	54	n (40MHz)	13.5/15 (MCS0)	3.26	3.42	6.35	0.00	11.0	-4.65
	5310	62	n (40MHz)	13.5/15 (MCS0)	2.96	3.33	6.16	0.00	11.0	-4.84
	5270	54	ax (40MHz)	13.5/15 (MCS0)	2.23	2.34	5.30	0.00	11.0	-5.70
	5310	62	ax (40MHz)	13.5/15 (MCS0)	2.12	2.04	5.09	0.00	11.0	-5.91
	5290	58	ac (80MHz)	29.3/32.5 (MCS0)	-0.96	-0.69	2.19	0.33	11.0	-8.48
	5290	58	ax (80MHz)	29.3/32.5 (MCS0)	-1.10	-0.70	2.11	0.00	11.0	-8.89
Band 2C	5500	100	a	6	6.59	6.25	9.43	0.15	11.0	-1.42
	5600	120	a	6	5.87	6.35	9.13	0.15	11.0	-1.72
	5720	144	a	6	6.86	6.72	9.80	0.15	11.0	-1.05
	5500	100	n (20MHz)	6.5/7.2 (MCS0)	5.93	6.08	9.01	0.00	11.0	-1.99
	5600	120	n (20MHz)	6.5/7.2 (MCS0)	5.54	5.82	8.69	0.00	11.0	-2.31
	5720	144	n (20MHz)	6.5/7.2 (MCS0)	6.07	5.92	9.01	0.00	11.0	-1.99
	5500	100	ax (20MHz)	6.5/7.2 (MCS0)	6.09	6.14	9.13	0.00	11.0	-1.87
	5600	120	ax (20MHz)	6.5/7.2 (MCS0)	5.56	5.62	8.60	0.00	11.0	-2.40
	5720	144	ax (20MHz)	6.5/7.2 (MCS0)	5.88	5.70	8.80	0.00	11.0	-2.20
	5510	102	n (40MHz)	13.5/15 (MCS0)	2.78	2.79	5.79	0.00	11.0	-5.21
	5590	118	n (40MHz)	13.5/15 (MCS0)	2.71	2.57	5.65	0.00	11.0	-5.35
	5710	142	n (40MHz)	13.5/15 (MCS0)	2.78	2.81	5.81	0.00	11.0	-5.19
	5510	102	ax (40MHz)	13.5/15 (MCS0)	1.84	2.10	4.98	0.00	11.0	-6.02
	5590	118	ax (40MHz)	13.5/15 (MCS0)	2.09	2.12	5.12	0.00	11.0	-5.88
	5710	142	ax (40MHz)	13.5/15 (MCS0)	2.11	2.02	5.08	0.00	11.0	-5.92
	5530	106	ac (80MHz)	29.3/32.5 (MCS0)	-1.51	-0.81	1.86	0.33	11.0	-8.81
	5610	122	ac (80MHz)	29.3/32.5 (MCS0)	-0.90	-1.25	1.94	0.33	11.0	-8.73
	5690	138	ac (80MHz)	29.3/32.5 (MCS0)	-0.74	-0.46	2.41	0.33	11.0	-8.26
	5530	106	ax (80MHz)	29.3/32.5 (MCS0)	-1.63	-1.23	1.58	0.00	11.0	-9.42
	5610	122	ax (80MHz)	29.3/32.5 (MCS0)	-1.42	-1.22	1.69	0.00	11.0	-9.31
	5690	138	ax (80MHz)	29.3/32.5 (MCS0)	-1.59	-1.40	1.52	0.00	11.0	-9.48
	5570	114	ac (160MHz)	29.3/32.5 (MCS0)	-5.18	-4.80	-1.97	0.33	11.0	-12.64
	5570	114	ax (160MHz)	29.3/32.5 (MCS0)	-5.20	-4.17	-1.65	0.00	11.0	-12.65

Table 7-16. Bands 1, 2A, 2C MIMO Conducted Power Spectral Density Measurements

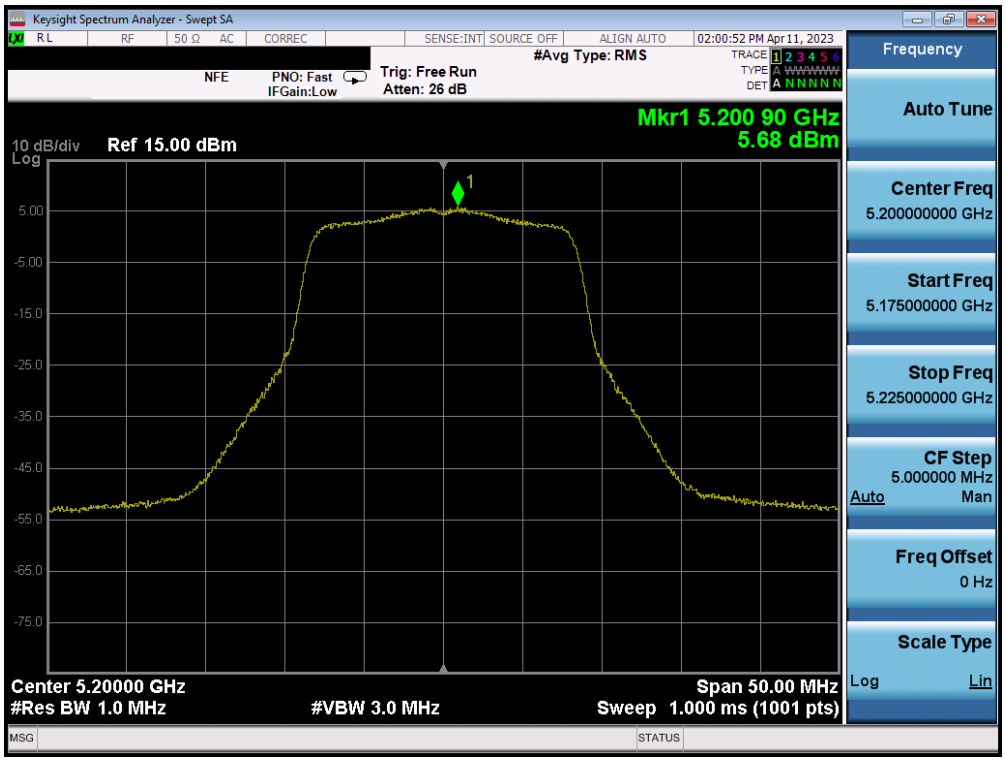
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenn-1 Power Density [dBm]	Antenn-2 Power Density [dBm]	Summed MIMO Power Density [dBm]	DCCF [dB]	Max Permissible Power Density [dBm/500kHz]	Margin [dB]
Band 3	5745	149	a	6	4.15	4.29	7.23	0.15	30.0	-22.62
	5785	157	a	6	3.54	4.19	6.89	0.15	30.0	-22.96
	5825	165	a	6	4.01	3.88	6.95	0.15	30.0	-22.90
	5745	149	n (20MHz)	6.5/7.2 (MCS0)	3.25	3.66	6.47	0.00	30.0	-23.53
	5785	157	n (20MHz)	6.5/7.2 (MCS0)	3.02	3.69	6.38	0.00	30.0	-23.62
	5825	165	n (20MHz)	6.5/7.2 (MCS0)	3.79	3.30	6.56	0.00	30.0	-23.44
	5745	149	ax (20MHz)	6.5/7.2 (MCS0)	3.53	3.99	6.78	0.00	30.0	-23.22
	5785	157	ax (20MHz)	6.5/7.2 (MCS0)	3.18	3.83	6.53	0.00	30.0	-23.47
	5825	165	ax (20MHz)	6.5/7.2 (MCS0)	3.02	3.32	6.18	0.00	30.0	-23.82
	5755	151	n (40MHz)	13.5/15 (MCS0)	0.44	0.53	3.50	0.00	30.0	-26.50
	5775	155	n (40MHz)	13.5/15 (MCS0)	-0.20	0.81	3.34	0.00	30.0	-26.66
	5755	151	ax (40MHz)	13.5/15 (MCS0)	-0.98	-0.52	2.27	0.00	30.0	-27.73
	5775	155	ax (40MHz)	13.5/15 (MCS0)	-0.78	-0.47	2.39	0.00	30.0	-27.61
	5775	155	ac (80MHz)	29.3/32.5 (MCS0)	-3.46	-3.17	-0.30	0.33	30.0	-29.97
	5775	155	ax (80MHz)	29.3/32.5 (MCS0)	-4.36	-3.58	-0.94	0.00	30.0	-30.94

Table 7-17. Band 3 MIMO Conducted Power Spectral Density Measurements

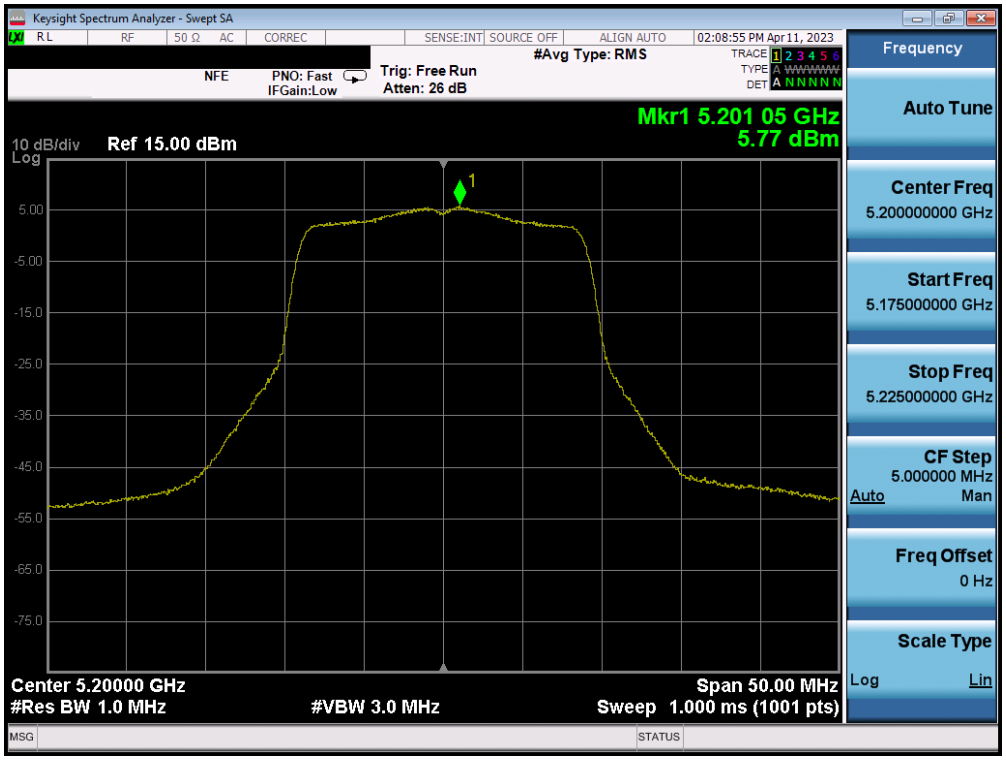
	Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 Power Density [dBm/MHz]	Antenna-2 Power Density [dBm/MHz]	MIMO Summed Power Density [dBm/MHz]	Directional Antenna Gain [dBi]	DCCF [dB]	EIRP Power Density [dBm/MHz]	Max EIRP Power Density [dBm/MHz]	Margin [dB]
Band 3/4	5845	169	a	6	7.07	6.55	9.83	-3.34	0.15	6.64	14.00	-7.36
Band 4	5865	173	a	6	6.84	6.41	9.64	-3.34	0.15	6.45	14.00	-7.55
	5885	177	a	6	6.26	5.61	8.96	-3.34	0.15	5.77	14.00	-8.23
Band 3/4	5845	169	n (20MHz)	6.5/7.2 (MCS0)	6.35	6.10	9.24	-3.34	0.00	5.90	14.00	-8.10
Band 4	5865	173	n (20MHz)	6.5/7.2 (MCS0)	6.32	6.11	9.23	-3.34	0.00	5.89	14.00	-8.11
	5885	177	n (20MHz)	6.5/7.2 (MCS0)	5.78	5.31	8.56	-3.34	0.00	5.22	14.00	-8.78
Band 3/4	5845	169	ax (20MHz)	6.5/7.2 (MCS0)	6.34	4.85	8.67	-3.34	0.00	5.33	14.00	-8.67
Band 4	5865	173	ax (20MHz)	6.5/7.2 (MCS0)	6.33	5.09	8.76	-3.34	0.00	5.42	14.00	-8.58
	5885	177	ax (20MHz)	6.5/7.2 (MCS0)	6.43	4.60	8.62	-3.34	0.00	5.28	14.00	-8.72
Band 3/4	5835	167	n (40MHz)	13.5/15 (MCS0)	3.22	1.85	5.60	-3.34	0.00	2.26	14.00	-11.74
Band 4	5875	175	n (40MHz)	13.5/15 (MCS0)	2.53	2.13	5.34	-3.34	0.00	2.00	14.00	-12.00
Band 3/4	5835	167	ax (40MHz)	13.5/15 (MCS0)	2.61	1.76	5.21	-3.34	0.00	1.87	14.00	-12.13
Band 4	5875	175	ax (40MHz)	13.5/15 (MCS0)	2.81	2.22	5.54	-3.34	0.00	2.20	14.00	-11.80
Band 3/4	5855	171	ac (80MHz)	29.3/32.5 (MCS0)	-0.26	-0.81	2.48	-3.34	0.33	-0.53	14.00	-14.53
	5855	171	ax (80MHz)	29.3/32.5 (MCS0)	-0.50	-1.18	2.18	-3.34	0.00	-1.16	14.00	-15.16
	5815	163	ac (160MHz)	58.5/65 (MCS0)	-5.10	-4.69	-1.88	-3.34	0.33	-4.89	14.00	-18.89
	5815	163	ax (160MHz)	58.5/65 (MCS0)	-5.66	-4.93	-2.27	-3.34	0.00	-5.61	14.00	-19.61

Table 7-18. Bands 3/4 MIMO Conducted Power Spectral Density Measurements

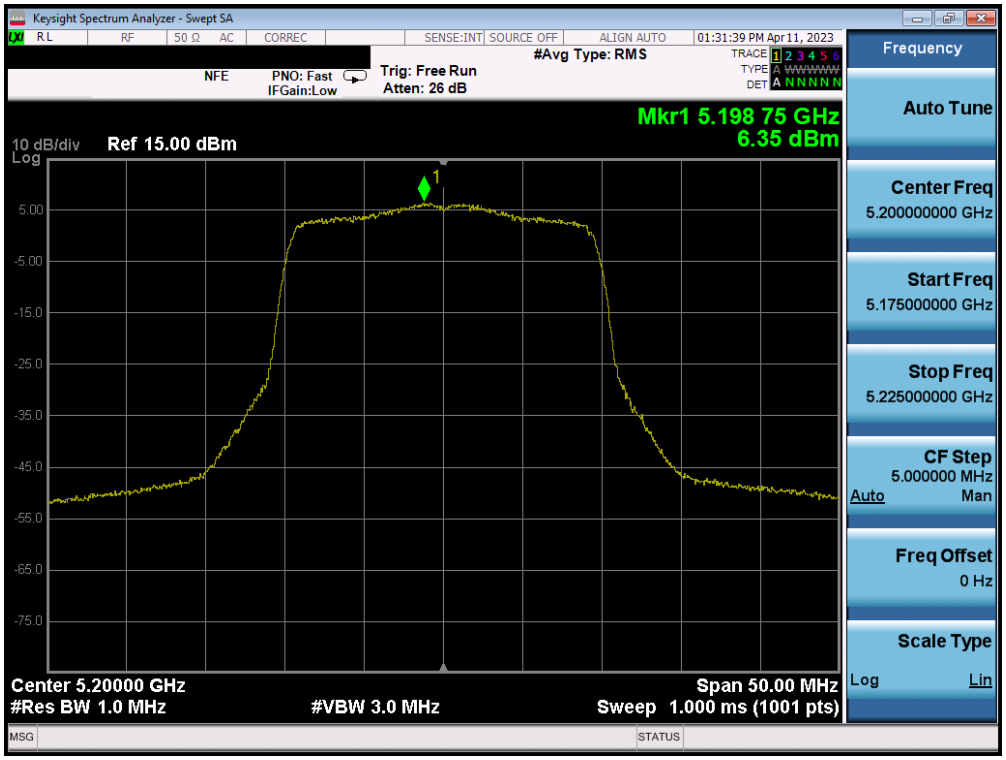
7.5.1 MIMO Antenna-1 Power Spectral Density Measurements



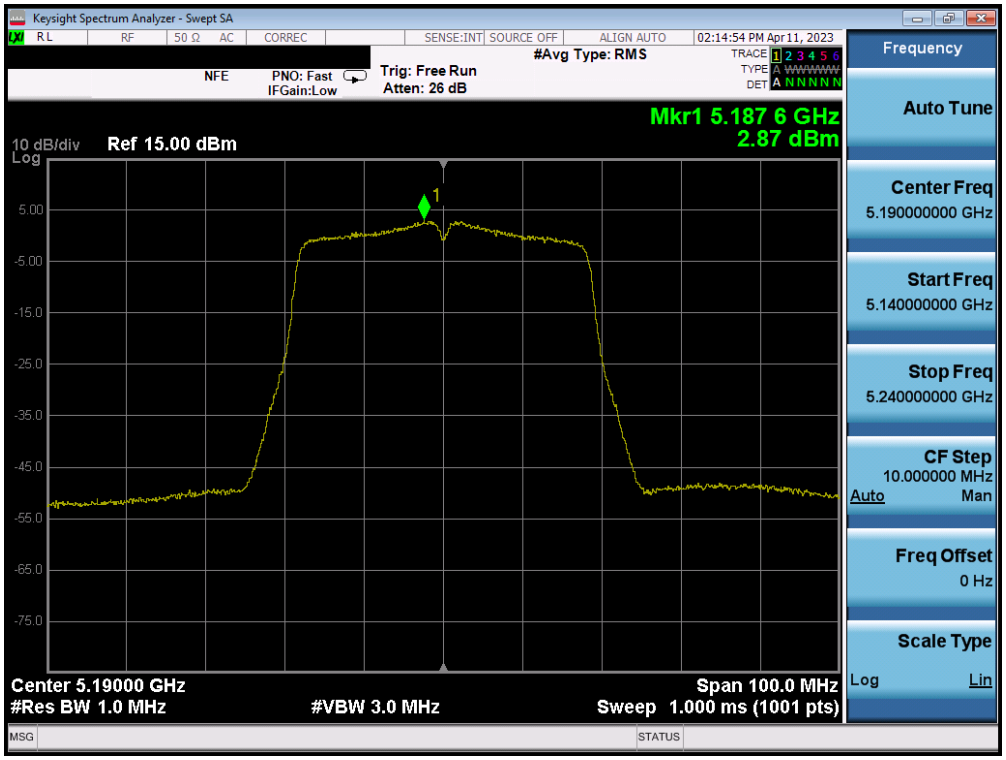
Plot 7-83. Power Spectral Density Plot MIMO ANT1 (802.11a (UNII Band 1) – Ch. 40)



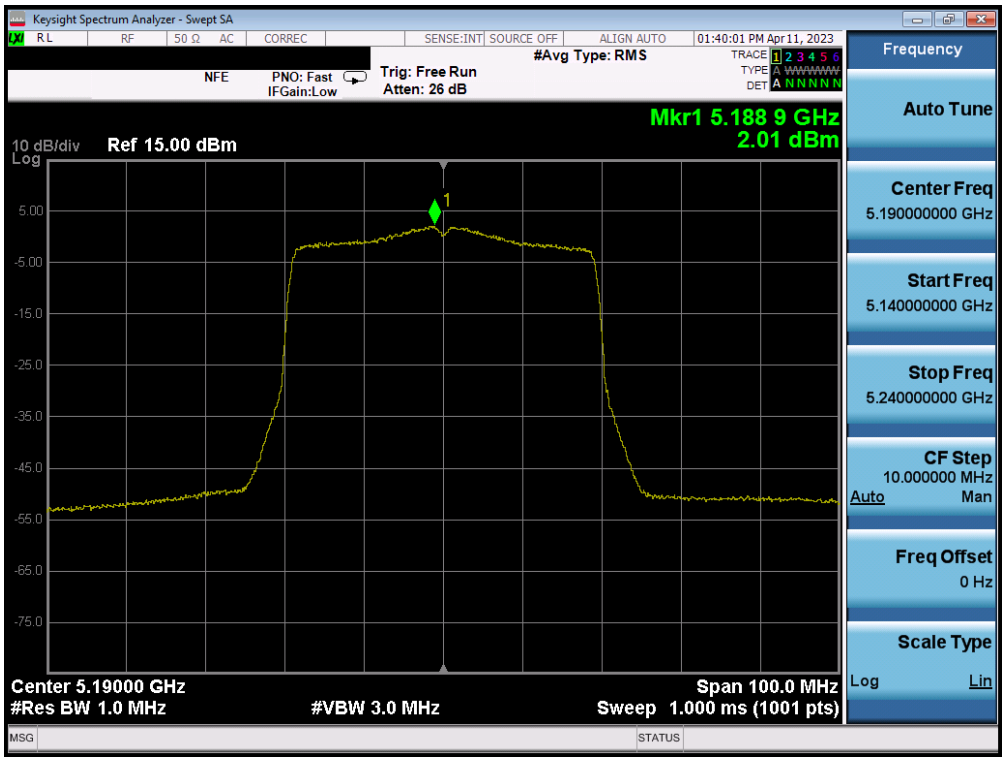
Plot 7-84. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



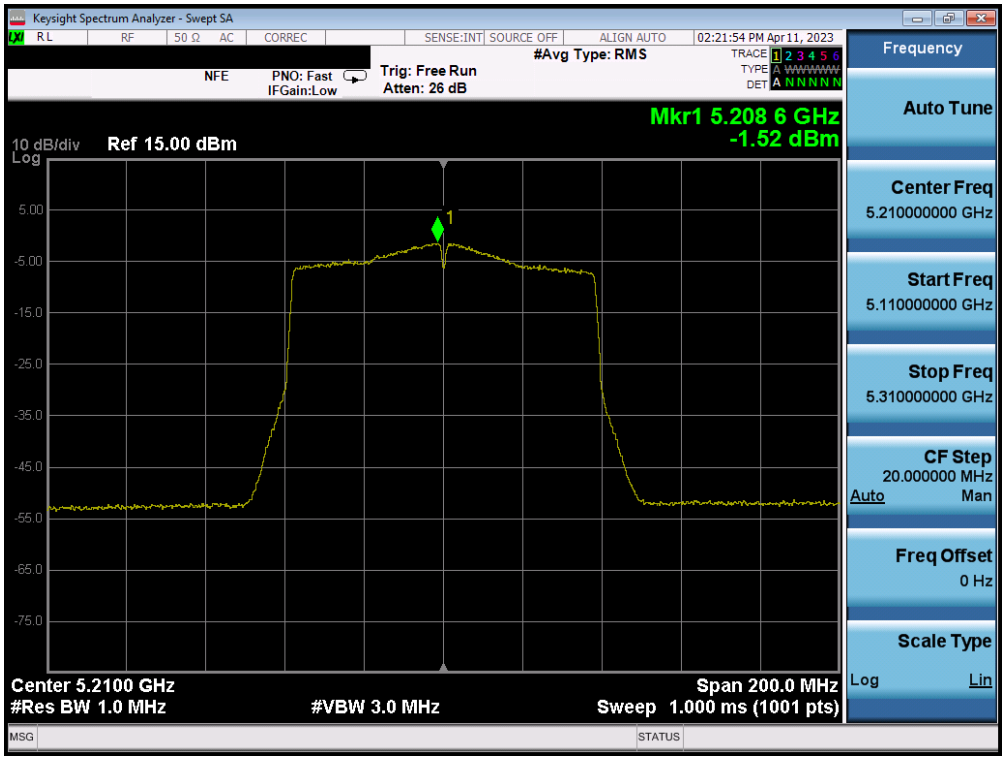
Plot 7-85. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



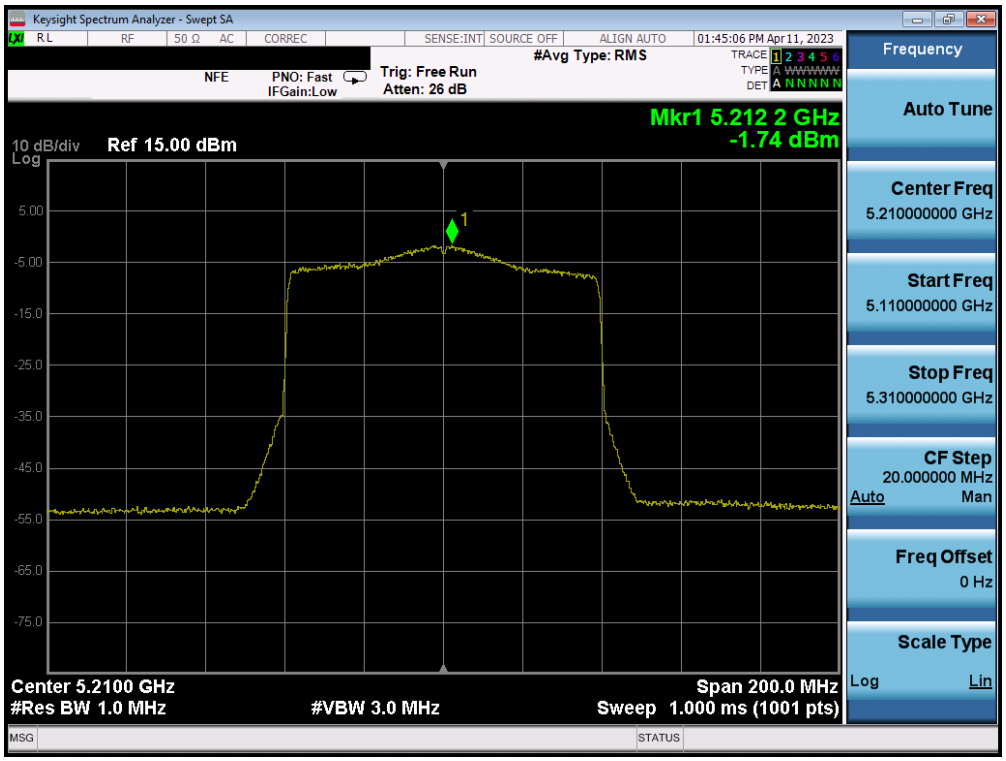
Plot 7-86. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



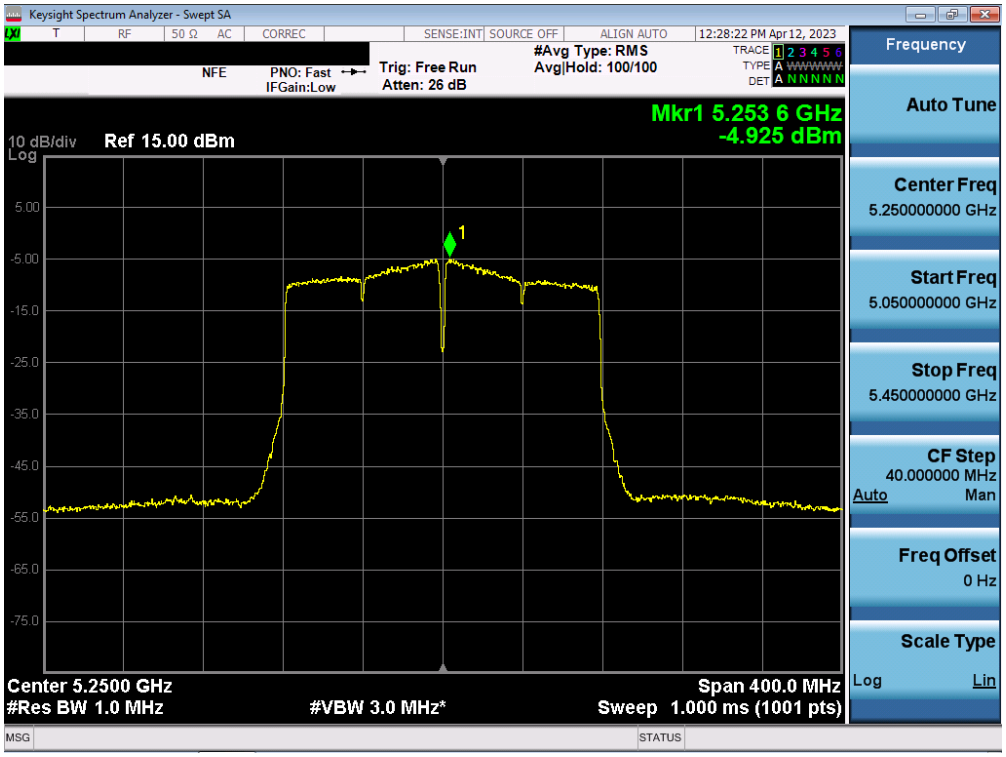
Plot 7-87. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



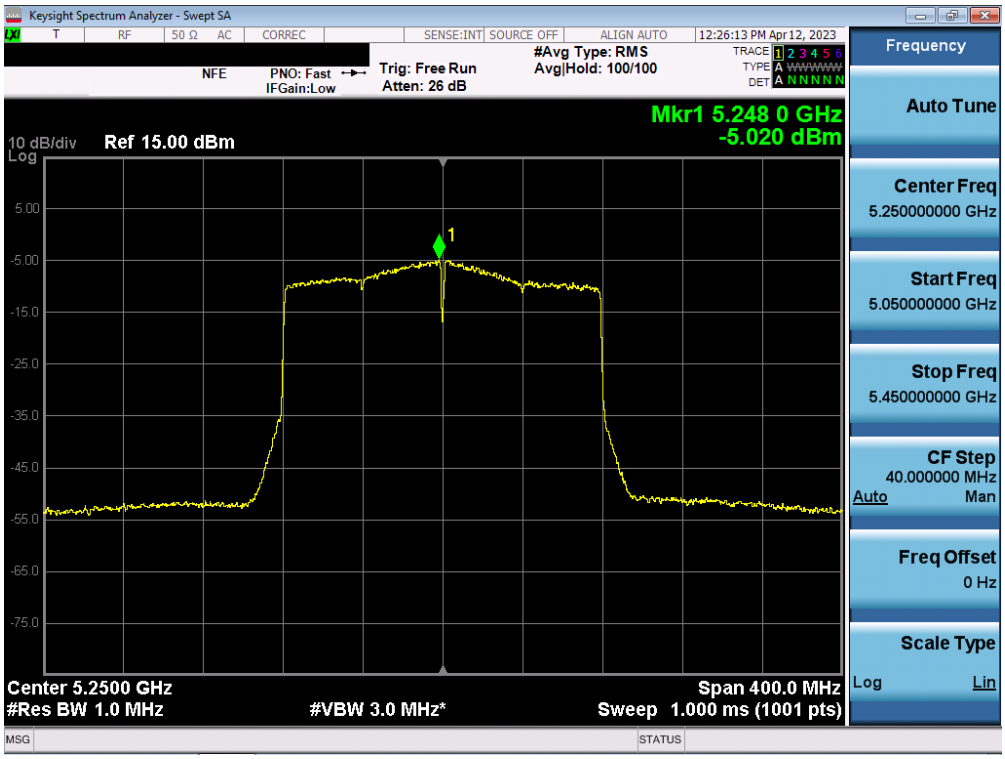
Plot 7-88. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



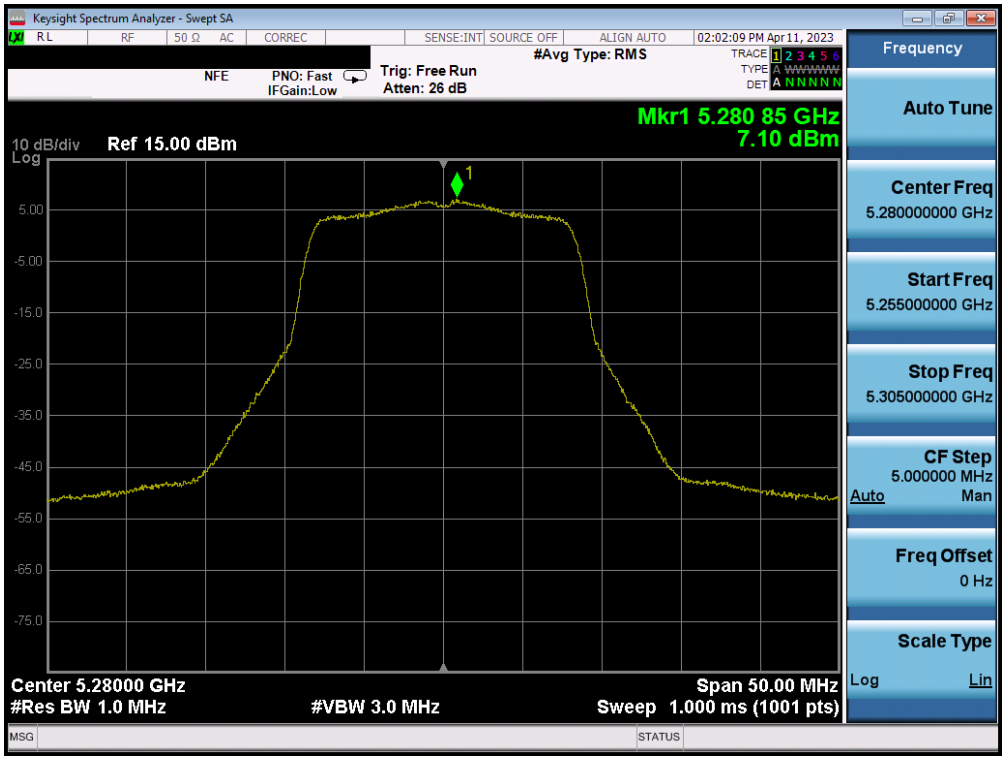
Plot 7-89. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



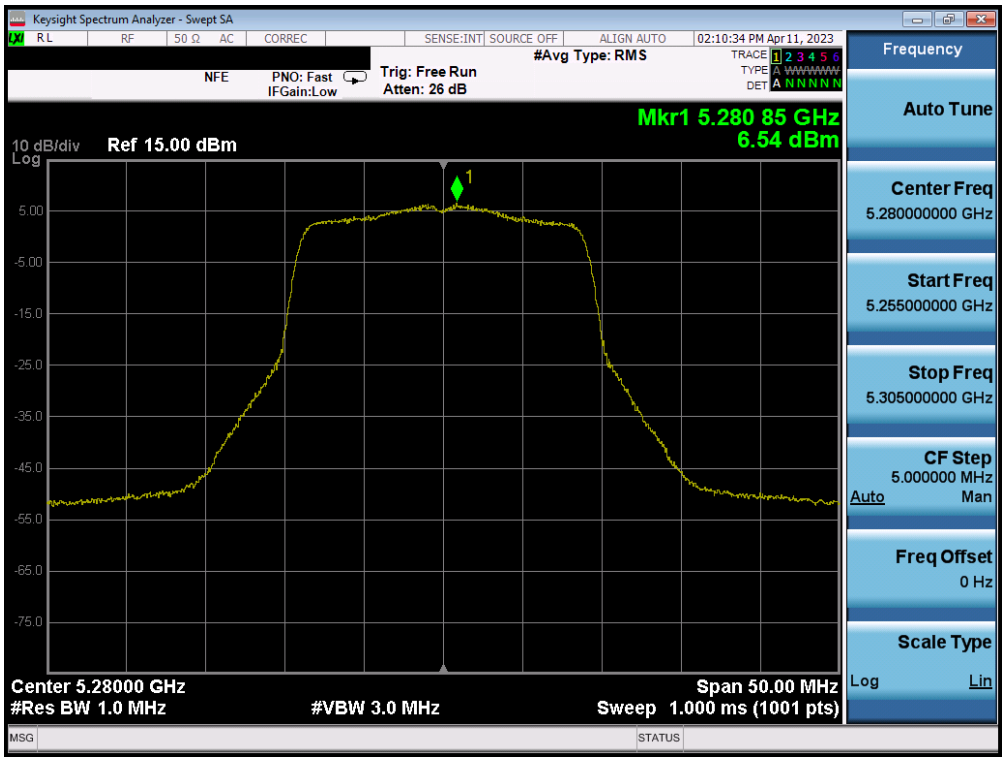
Plot 7-90. Power Spectral Density Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



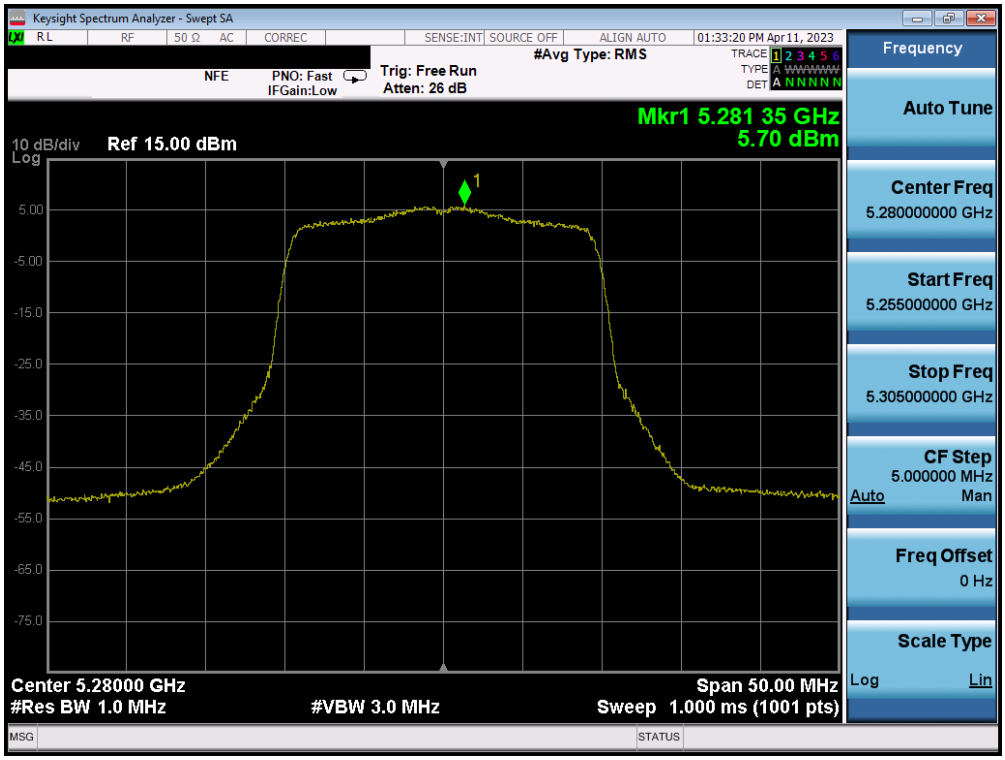
Plot 7-91. Power Spectral Density Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



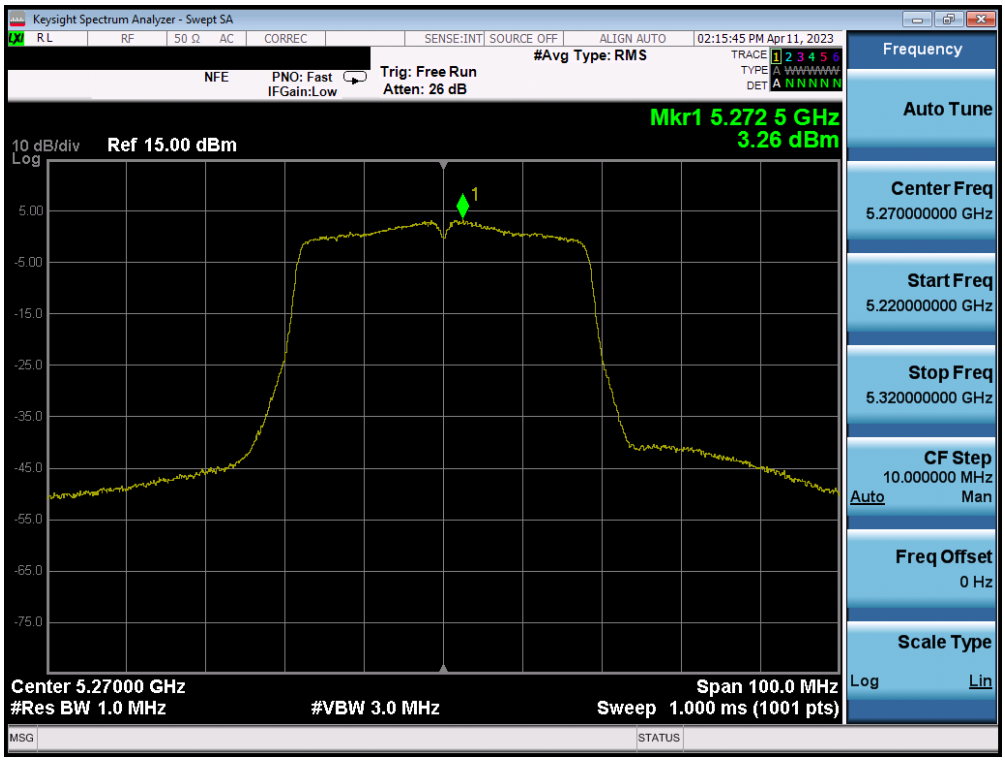
Plot 7-92. Power Spectral Density Plot MIMO ANT1 (802.11a (UNII Band 2A) – Ch. 56)



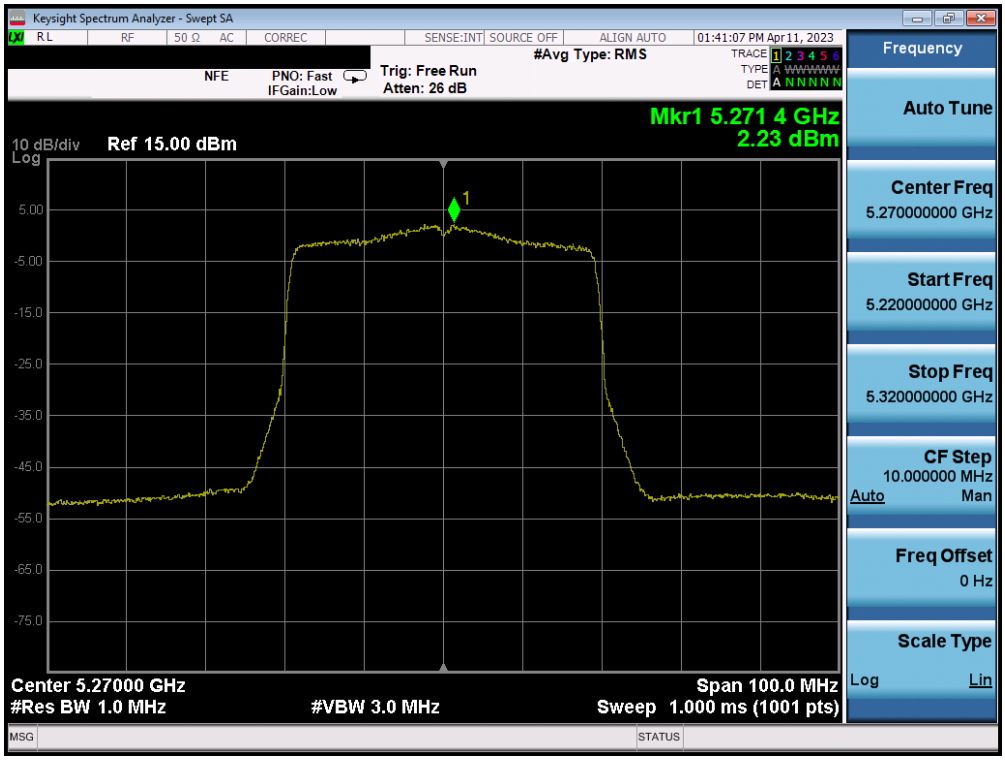
Plot 7-93. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



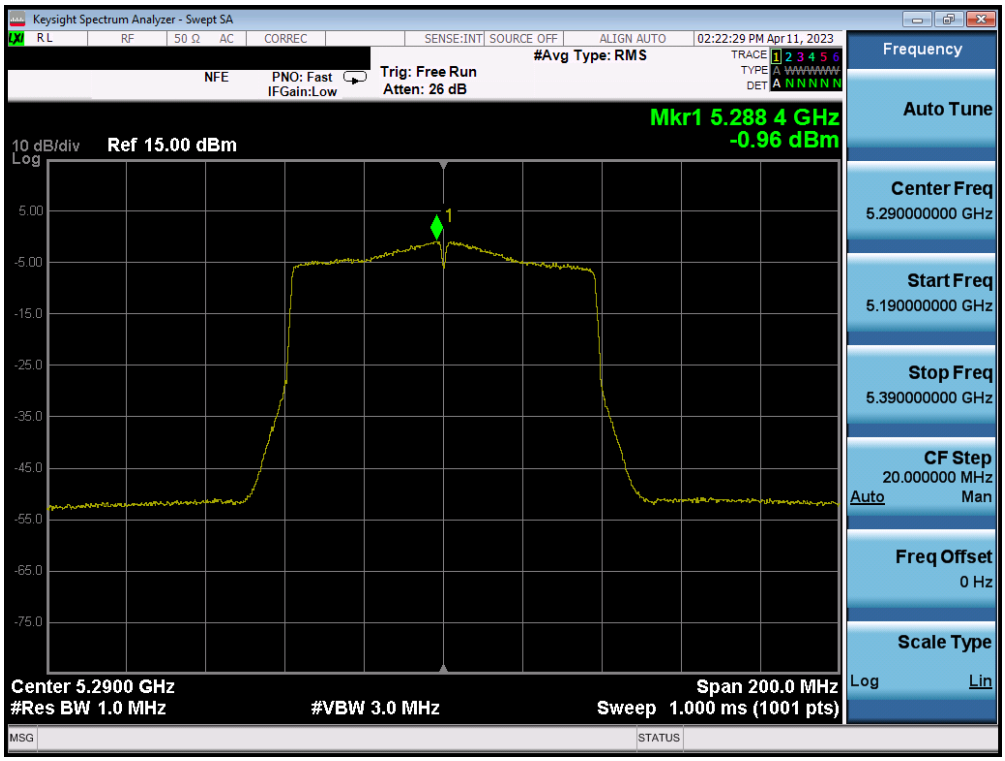
Plot 7-94. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



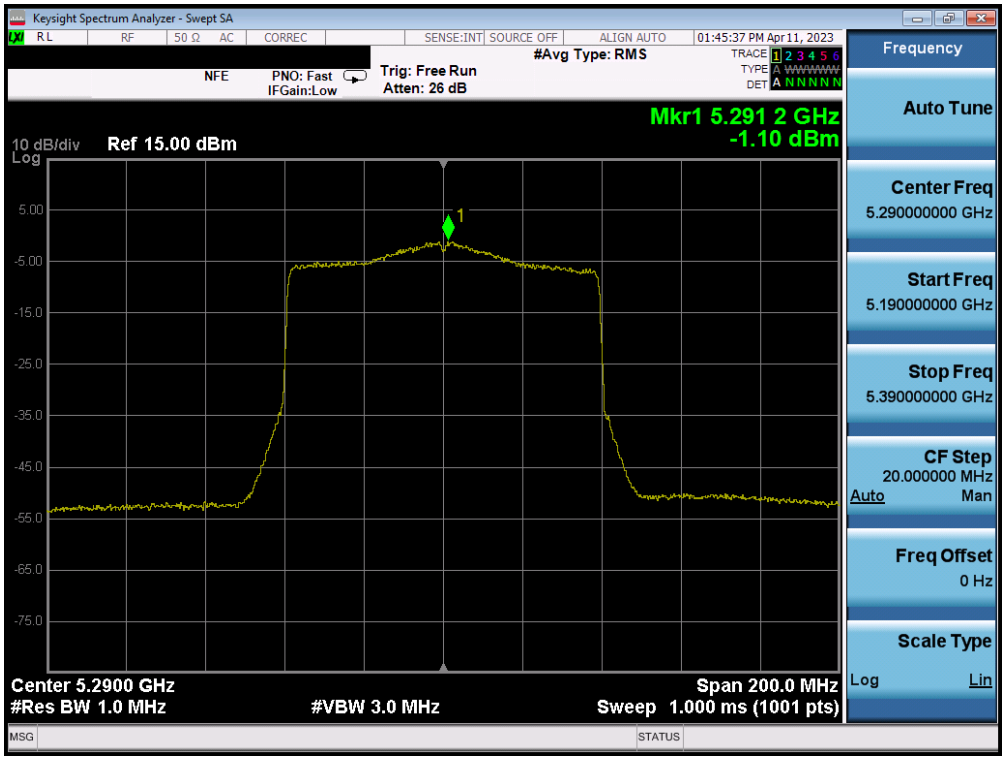
Plot 7-95. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



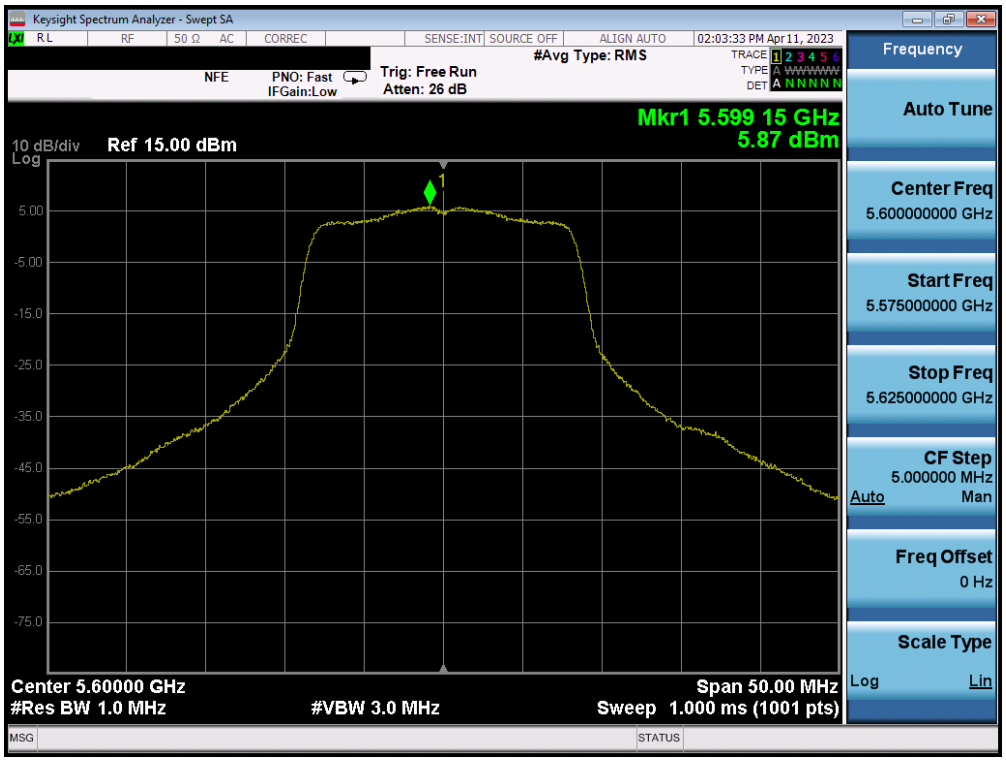
Plot 7-96. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)



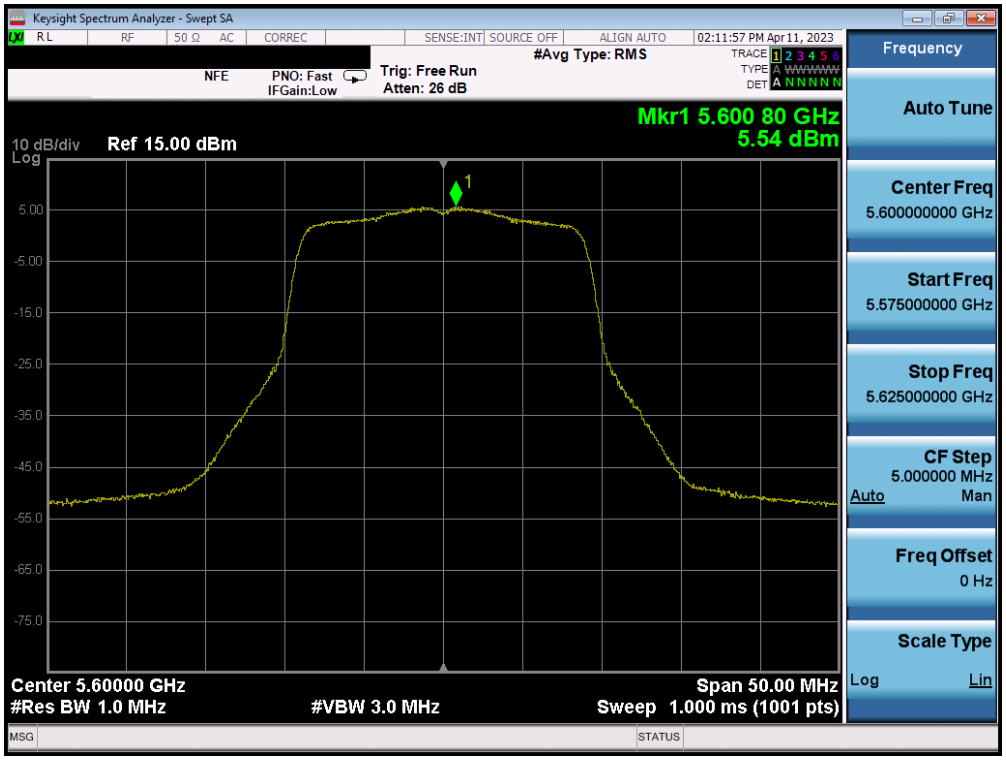
Plot 7-97. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



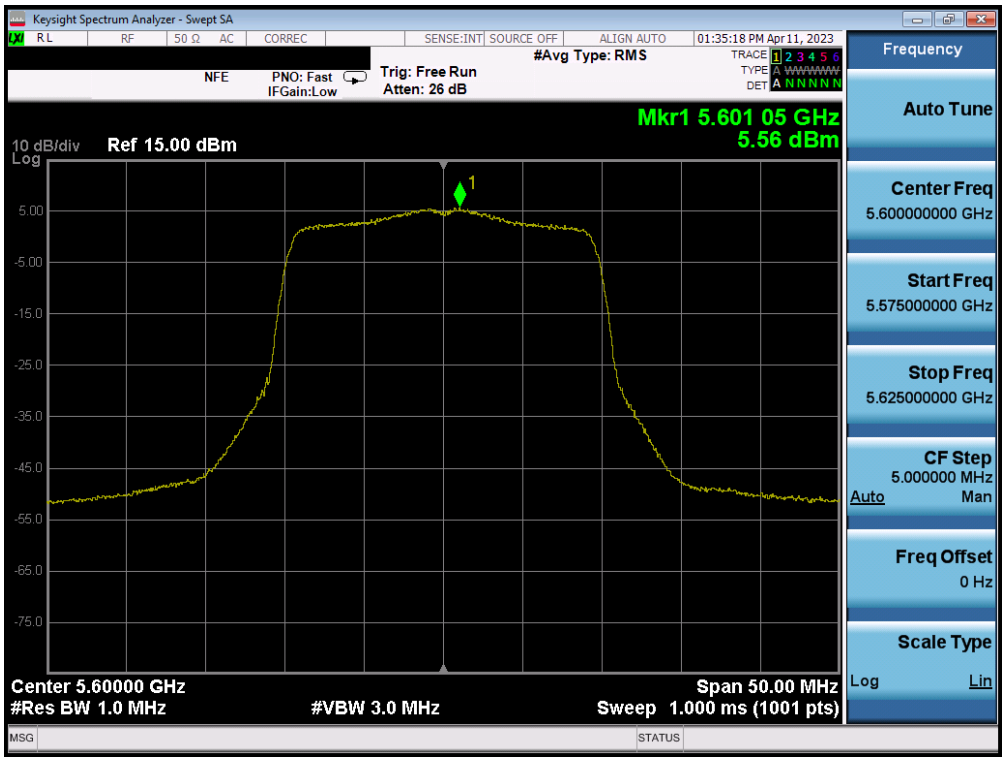
Plot 7-98. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 2A) – Ch. 58)



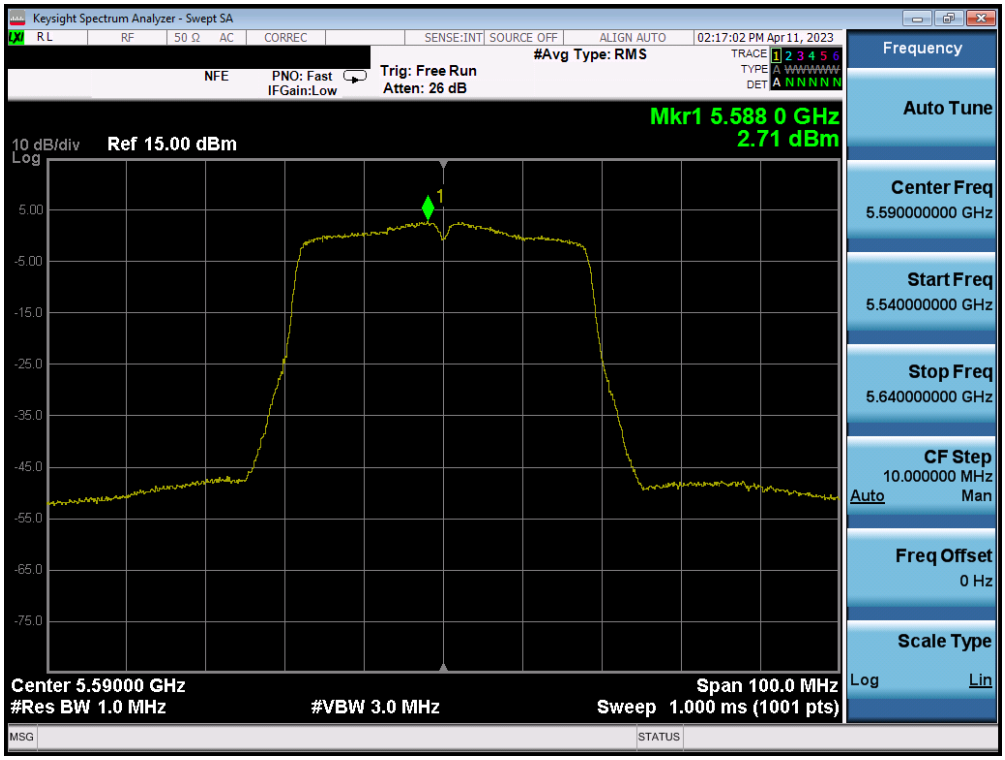
Plot 7-99. Power Spectral Density Plot MIMO ANT1 (802.11a (UNII Band 2C) – Ch. 120)



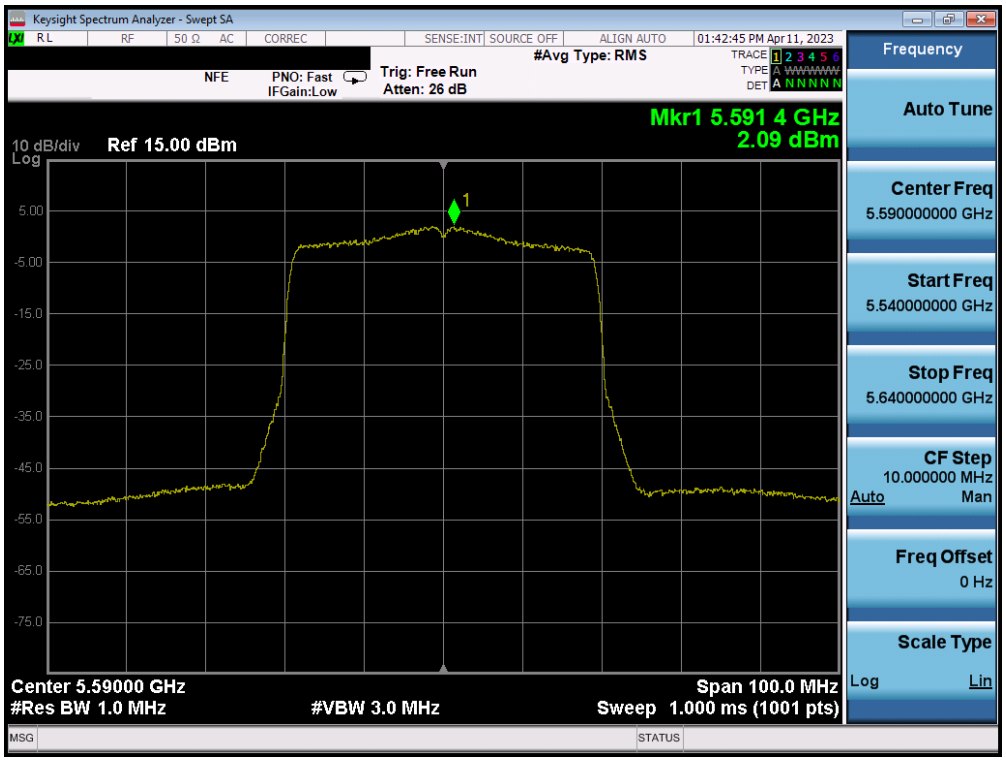
Plot 7-100. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)



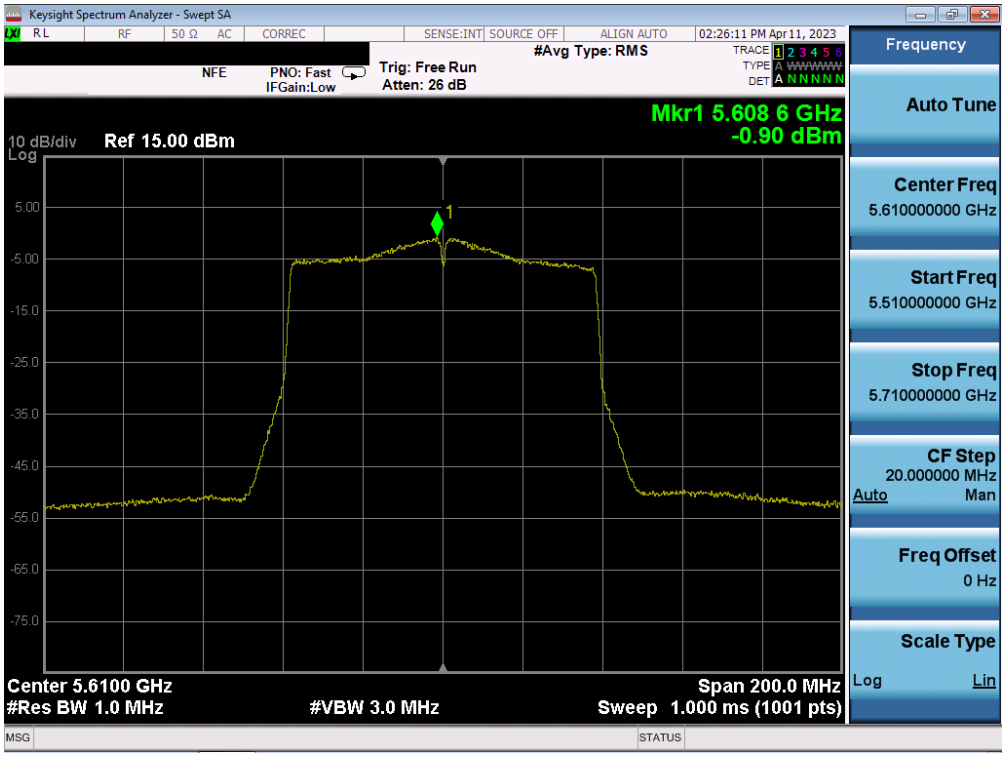
Plot 7-101. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2C) – Ch. 120)



Plot 7-102. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)



Plot 7-103. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2C) – Ch. 118)



Plot 7-104. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)