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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:
6/5/2024 – 7/10/2024
Test Report Issue Date:
7/29/2024
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2405140040-04-R1.A3L

FCC ID:	**A3LSMX820**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-X820
EUT Type:	Portable Tablet
Frequency Range:	5180 – 5885MHz
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 662911 D01 v02r01, KDB 648474 D03 v01r04, KDB 484596 D01 v02r03

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

Note: This revised Test Report (S/N: 1M2405140040-04-R1.A3L) supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

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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Channel Bandwidth [MHz]	UNII Band	Tx Frequency [MHz]	Ant1		Ant2		MIMO	
			Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]
20	1	5180 - 5240	49.77	16.97	49.55	16.95	95.50	19.80
	2A	5260 - 5320	45.50	16.58	47.32	16.75	97.72	19.90
	2C	5500 - 5720	49.66	16.96	50.00	16.99	99.32	19.97
	3	5745 - 5825	50.00	16.99	47.86	16.80	96.09	19.83
	4	5845 - 5885	12.02	10.80	7.16	8.55	41.30	16.16
40	1	5190 - 5230	48.08	16.82	46.03	16.63	94.41	19.75
	2A	5270 - 5310	44.16	16.45	45.29	16.56	95.06	19.78
	2C	5510 - 5710	48.75	16.88	48.31	16.84	95.94	19.82
	3	5755 - 5795	45.50	16.58	47.86	16.80	93.54	19.71
	4	5835 - 5875	13.03	11.15	7.55	8.78	41.71	16.20
80	1	5210	35.89	15.55	31.62	15.00	73.28	18.65
	2A	5290	35.32	15.48	34.67	15.40	72.61	18.61
	2C	5530 - 5690	36.14	15.58	34.86	15.42	73.45	18.66
	3	5775	38.82	15.89	38.90	15.90	76.21	18.82
	4	5855	9.46	9.76	5.36	7.29	32.36	15.10
160	1/2A	5250	30.90	14.90	26.24	14.19	55.98	17.48
	2C	5570	26.30	14.20	25.64	14.09	54.58	17.37
	3/4	5815	7.41	8.70	4.26	6.29	24.32	13.86

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 Tablet FCC ID: A3LSMX820**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

Test Device Serial No.: 17720, 17670, 18108, 25483, 17936

2.2 Device Capabilities

This device contains the following capabilities:

802.11b/g/n/ac/ax WLAN, 802.11a/n/ac/ax UNII (5GHz and 6GHz), Bluetooth (1x, EDR, LE), 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. 802.11a/n/ac/ax (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. 802.11/n/ac/ax (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	167	5835
				:	:				
				122	5610				
				:	:				
				138	5690				

Table 2-3. 802.11ac/ax (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. 802.11/ac/ax (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:

802.11 Mode/Band		ANT1		ANT2		MIMO (1+2)	
		Duty Cycle [%]	Radiated DCCF [dB]	Duty Cycle [%]	Radiated DCCF [dB]	Duty Cycle [%]	Radiated DCCF [dB]
5GHz	a	97.41	0.11	97.62	0.10	97.55	0.11
	n (HT20)	94.94	0.23	95.21	0.21	95.08	0.22
	ac (VHT20)	97.32	0.12	97.26	0.12	95.10	0.22
	ax (HE20)	96.48	0.16	96.93	0.14	94.25	0.26
	n (HT40)	91.34	0.39	94.68	0.24	90.86	0.42
	ac (VHT40)	95.04	0.22	95.46	0.20	90.96	0.41
	ax (HE40)	94.34	0.25	94.18	0.26	90.22	0.45
	ac (VHT80)	94.43	0.25	94.75	0.23	90.46	0.44
	ax (HE80)	93.68	0.28	94.23	0.26	90.00	0.46
	ac (HT160)	94.27	0.26	94.72	0.24	91.13	0.40
	ax (HE160)	94.19	0.26	94.20	0.26	93.08	0.31

Table 2-5. Measured Duty Cycles

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

WiFi Configurations		SISO		SDM		CDD	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
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 [MHz]	Antenna 1 Gain (dBi)	Antenna 2 Gain (dBi)	Directional Gain (dBi)
5150	-4.9	-7.2	-2.96
5350	-5.0	-7.7	-3.24
5500	-4.9	-8.0	-3.30
5700	-5.2	-8.2	-3.56
5795	-5.3	-8.1	-3.58
5815	-5.5	-7.8	-3.56
5825	-5.5	-8.2	-3.74
5850	-5.6	-8.1	-3.75
5885	-5.7	-7.9	-3.72

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.

2.5 Software and Firmware

The test was conducted with software/firmware version X820XXU0AXFC 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 15°C to 35°C. 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
-	WL25-1	Conducted Cable Set (25GHz)	4/2/2024	Annual	4/2/2025	WL25-1
-	WL25-2	Conducted Cable Set (25GHz)	4/2/2024	Annual	4/2/2025	WL25-2
-	WL40-1	Conducted Cable Set (40GHz)	4/2/2024	Annual	4/2/2025	WL40-1
	AP1-002	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	AP1-002
-	ETS-001	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	ETS-001
-	ETS-002	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	ETS-002
	MD 1M 18-40	EMC Cable and Switch System	4/2/2024	Annual	4/2/2025	MD 1M 18-40
Anritsu	MA24406A	Microwave Peak Power Sensor	9/7/2023	Annual	9/7/2024	11240
Emco	3116	Horn Antenna (18 - 40GHz)	8/8/2022	Biennial	8/8/2024	9203-2178
Rohde & Schwarz	TC-TA18	Vivaldi Antenna	2/23/2023	Biennial	2/23/2025	26040036
Rohde & Schwarz	FSW26	Signal and spectrum analyzer	3/8/2024	Annual	3/8/2025	103187
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	4/2/2024	Annual	4/2/2025	NMLC-2
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	8/11/2022	Biennial	8/11/2024	114451
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	4/9/2024	Annual	4/9/2025	MY52350166
Keysight Technologies	N9020A	MXA Signal Analyzer	4/11/2024	Annual	4/11/2025	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer	2/29/2024	Annual	3/1/2025	MY55410501
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	9/7/2023	Annual	9/7/2024	MY57141001
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	9/25/2023	Annual	9/25/2024	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/11/2023	Annual	9/11/2024	100348
Rohde & Schwarz	ESW44	EMI Test Receiver 2Hz to 44 GHz	4/5/2024	Annual	4/5/2025	101716
Rohde & Schwarz	FSW26	Signal and spectrum analyze (26.5GHz)	3/8/2024	Annual	3/8/2025	103187
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	2/15/2024	Annual	2/15/2025	103200
Sunol	JB6	JB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816
Sunol	JB5	Bi-Log Antenna (30M-5GHz)	8/30/2022	Biennial	8/30/2024	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.
FCC ID: A3LSMX820
FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
N/A	26dB Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
15.407(e)	6dB Bandwidth	>500kHz(5725-5850MHz and 5850 – 5895MHz)		PASS	Section 7.3
15.407 (a)(1)(iv), (a)(2), (a)(3)	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a)		PASS	Section 7.4
15.407 (a)(1)(iv), (a)(2), (a)(3)	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a)		PASS	Section 7.5
15.407(h)	Dynamic Frequency Selection	See DFS Test Report		PASS	See DFS Test Report
15.407(b)(1), (b)(2), (b)(3), (b)(4)	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b)	RADIATED	PASS	Section 7.6
15.205, 15.407(b)(1), (b)(4), (b)(5), (b)(6)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS	Section 7.6
15.407	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 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 "EMC Software Tool," Version 2.3.0.
5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element "Chamber Automation," Version 1.5.0.
6) Data was leveraged from model SM-X828U for the certification of SM-X820. See Table 7-2 for spot-check results.

FCC Rules	Test Item	Test Case	Units	Limit	Reference Model: SM-X828U	Variant Model: SM-X820	Deviation (dB)	Max Deviation (dB)	Pass/Fail
2.1046, 15.407(a)(8)	Conducted Output Power	20MHz, Ch.40, 802.11a, MIMO	dBm	N/A	19.68	19.52	-0.16	3	PASS
15.209, 15.407(b)(1), 15.407(b)(2), 15.407(b)(3), 15.407(b)(4)	Radiated Spurious Emissions	20MHz, Ch.120, 802.11a, MIMO	dBm	53.98	44.01	43.61	-0.40	3	PASS
15.209	Radiated Band Edge Emissions	80MHz, Ch.42, 802.11ac, MIMO	dBm	53.98	51.84	52.03	0.19	3	PASS

Table 7-2. Summary of Spot-checks

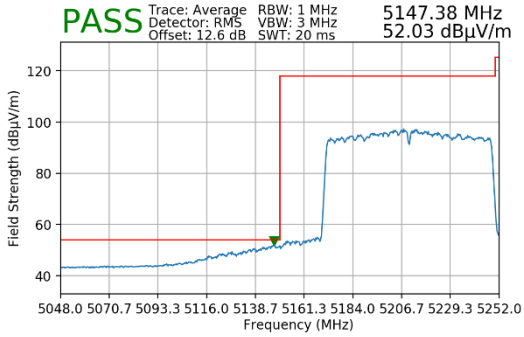
5GHz WIFI (20MHz 802.11a MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5200	40	16.26	16.74	19.52	23.98	-4.46	-2.96	16.56	30.00	-13.44

Table 7-3. Conducted Output Power Measurements (Spot-check)

Mode	Antenna	UNII Band	Channel	Test Channel Freq. [MHz]	Restricted	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
802.11a	MIMO	2C	120	5600	*	11200.00	Average	V	133	148	-81.00	17.61	0.00	43.61	53.98	-10.37

Table 7-4. Radiated Measurements MIMO (Spot-check)

Worst Case Mode:	802.11ac
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	42



Plot 7-1. Radiated Lower Band Edge Plot MIMO (Average – UNII Band 1)

1) Each spot check test on the EUT was performed using the same procedure and setting that were used to perform the test on the corresponding reference device.
2) All test cases were performed to verify the variant EUT is still in compliance with the spot checked results to the reference device and was performed using the guidance of ANSI C63.10-2013.

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

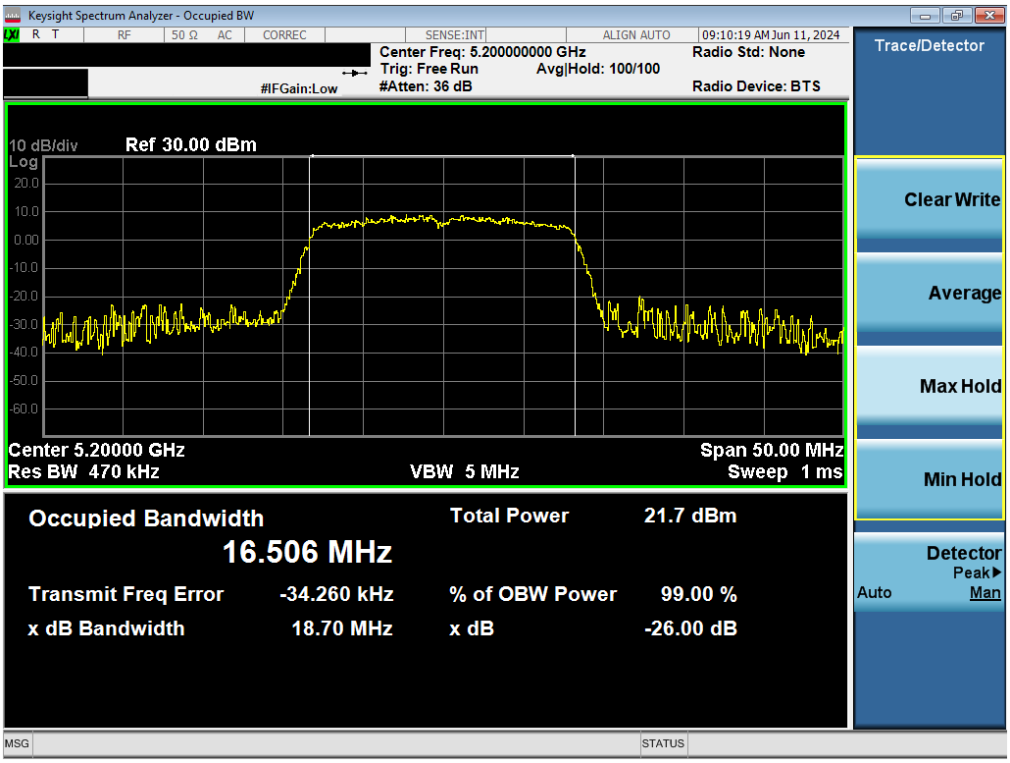
None.

MIMO 26dB Bandwidth Measurements

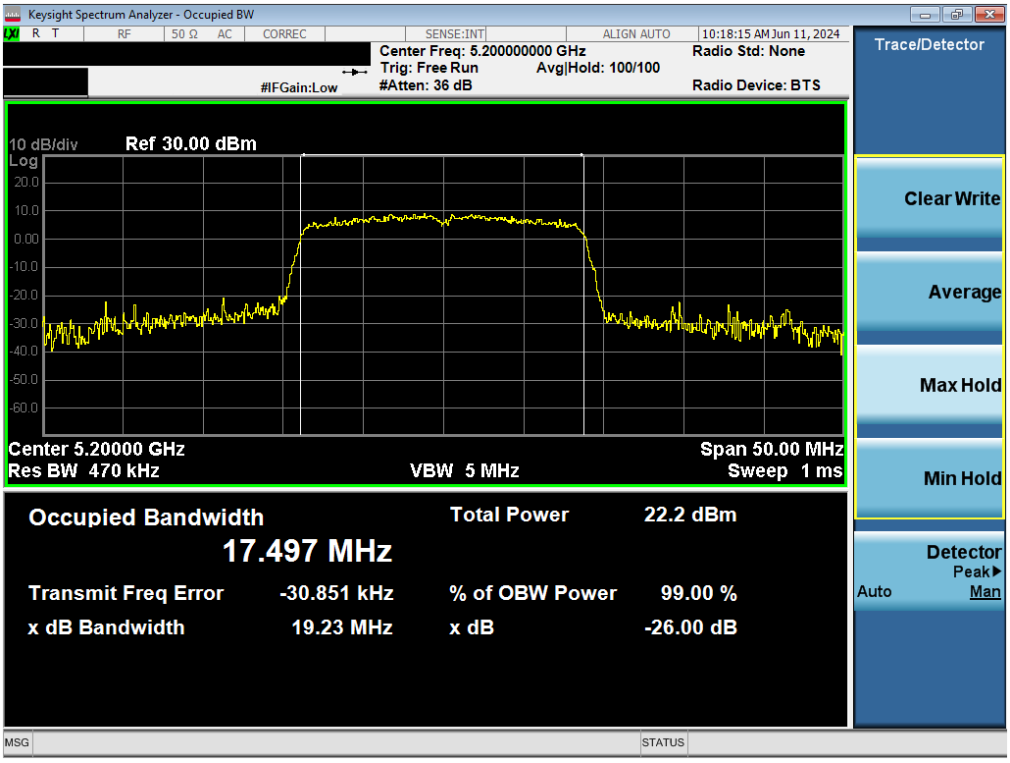
	Frequency [MHz]	Channel	802.11 MODE	Antenna-1 26dB Bandwidth [MHz]	Antenna-2 26dB Bandwidth [MHz]
Band 1	5180	36	a	18.80	18.57
	5200	40	a	18.70	18.43
	5240	48	a	18.85	18.43
	5180	36	n	19.29	19.05
	5200	40	n	19.23	19.06
	5240	48	n	19.25	19.19
	5180	36	ax SU	20.02	20.15
	5200	40	ax SU	20.06	20.03
	5240	48	ax SU	20.01	20.15
	5190	38	n	39.12	38.88
	5230	46	n	39.07	38.80
	5190	38	ax SU	41.19	43.88
	5230	46	ax SU	42.90	47.86
	5210	42	ac	80.00	80.10
	5210	42	ax SU	81.58	81.46
Band 1/2A	5250	50	ac	162.76	162.23
	5250	50	ax SU	168.73	163.82
Band 2A	5260	52	a	18.75	18.46
	5280	56	a	18.77	18.46
	5320	64	a	18.62	18.52
	5260	52	n	19.25	19.12
	5280	56	n	19.25	19.07
	5320	64	n	19.27	19.14
	5260	52	ax SU	20.10	20.18
	5280	56	ax SU	20.08	20.12
	5320	64	ax SU	20.10	20.11
	5270	54	n	39.09	38.85
	5310	62	n	39.00	38.82
	5270	54	ax SU	44.52	44.89
	5310	62	ax SU	45.36	44.09
	5290	58	ac	80.27	80.19
	5290	58	ax SU	81.69	81.46
Band 2C	5500	100	a	18.69	18.49
	5600	120	a	18.87	18.45
	5720	144	a	18.85	18.41
	5500	100	n	19.38	19.15
	5600	120	n	19.20	19.18
	5720	144	n	19.20	19.10
	5500	100	ax SU	20.08	20.15
	5600	120	ax SU	20.09	20.10
	5720	144	ax SU	20.09	20.06
	5510	102	n	39.08	38.71
	5590	118	n	39.28	38.73
	5710	142	n	38.82	38.73
	5510	102	ax SU	42.63	45.06
	5590	118	ax SU	42.94	44.03
	5710	142	ax SU	42.45	43.68
	5530	106	ac	80.22	80.24
	5610	122	ac	80.26	80.07
	5690	138	ac	80.32	80.18
	5530	106	ax SU	81.59	81.71
	5610	122	ax SU	81.60	81.59
	5690	138	ax SU	81.59	81.59
	5570	114	ac	162.31	162.43
	5570	114	ax SU	168.95	163.92

Table 7-5. Bands 1, 2A, 2C Conducted 26dB Bandwidth Measurements MIMO

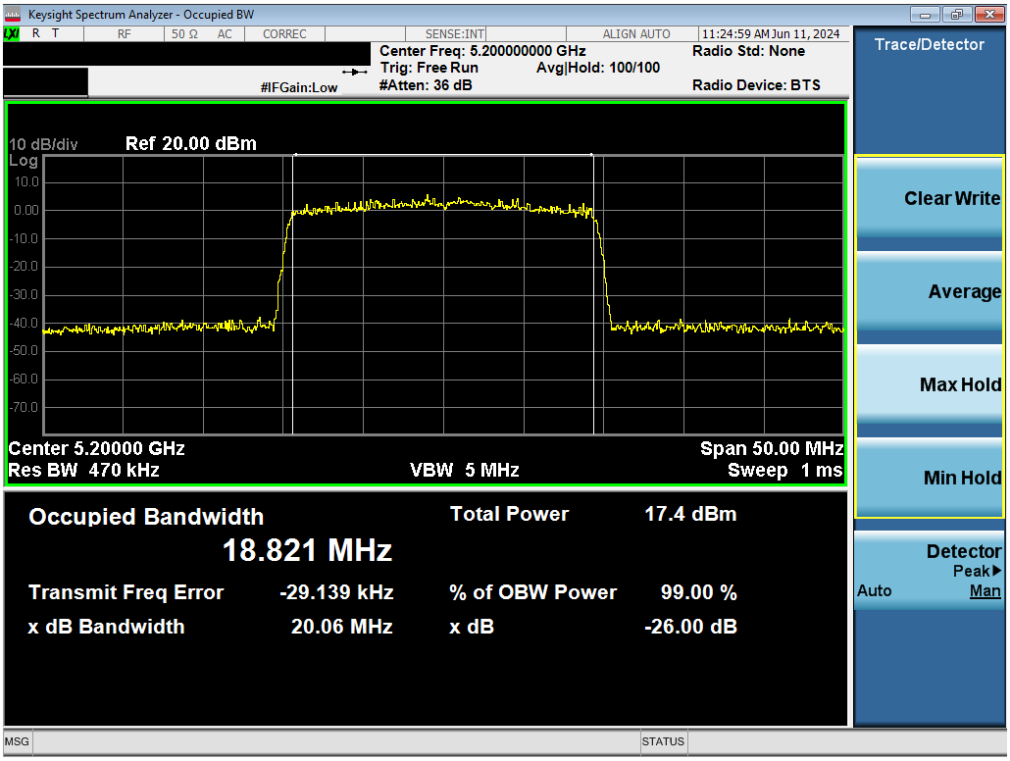
7.2.1 MIMO Antenna-1 26dB Bandwidth Measurements



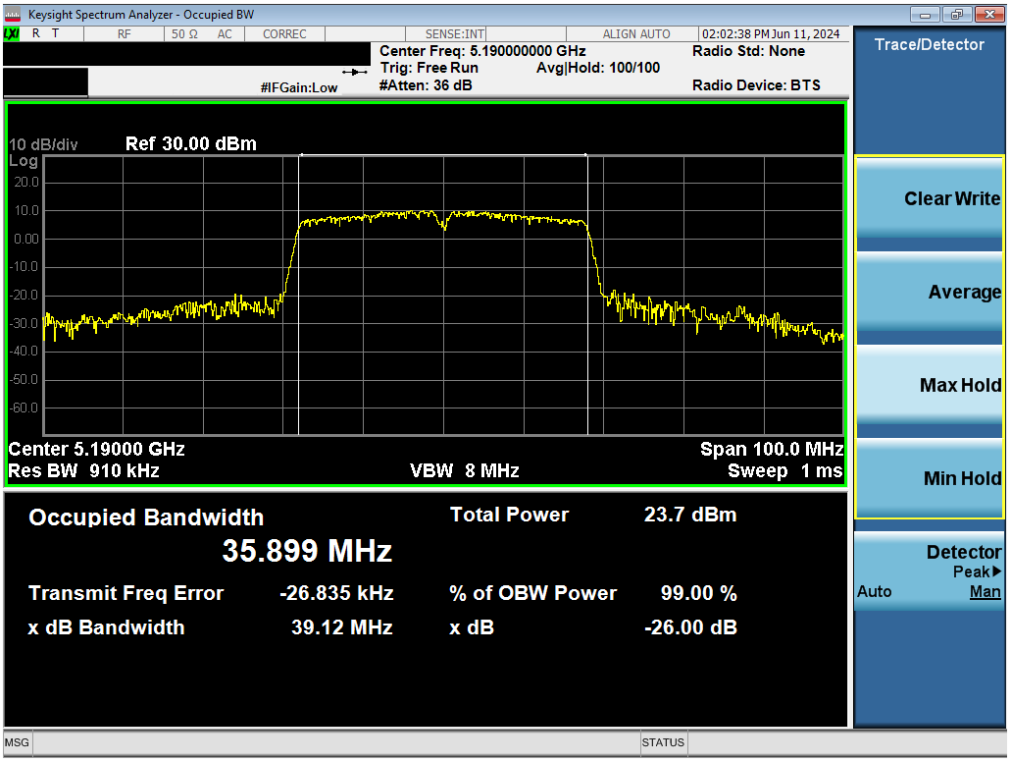
Plot 7-2. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 1) – Ch. 40)



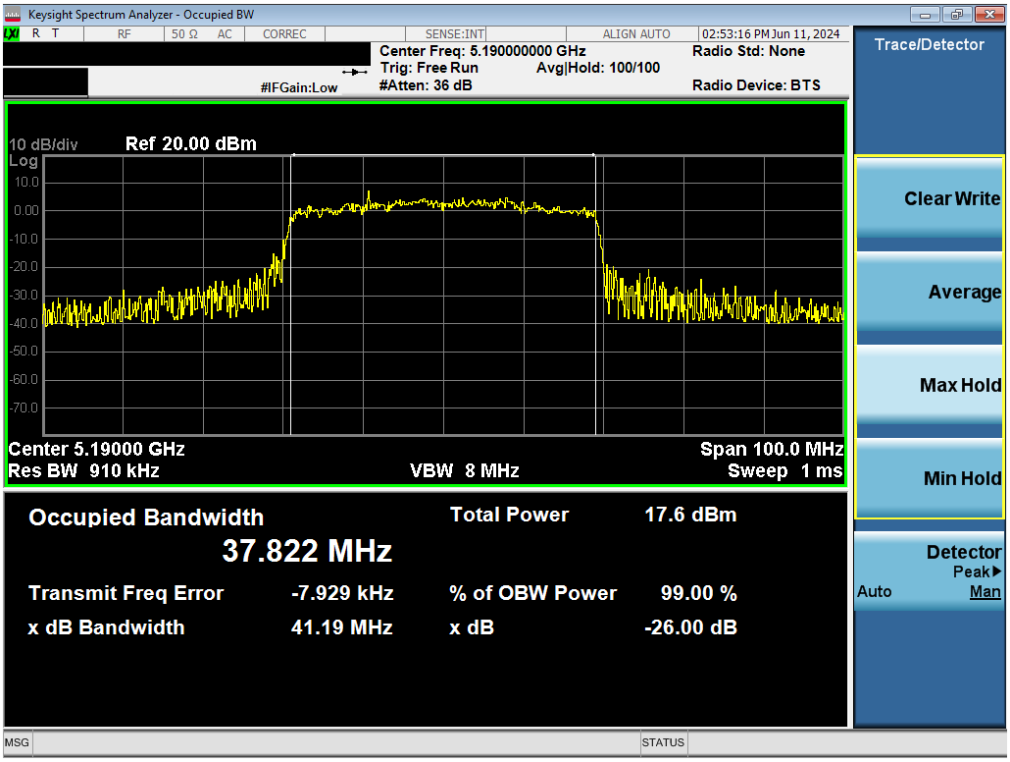
Plot 7-3. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



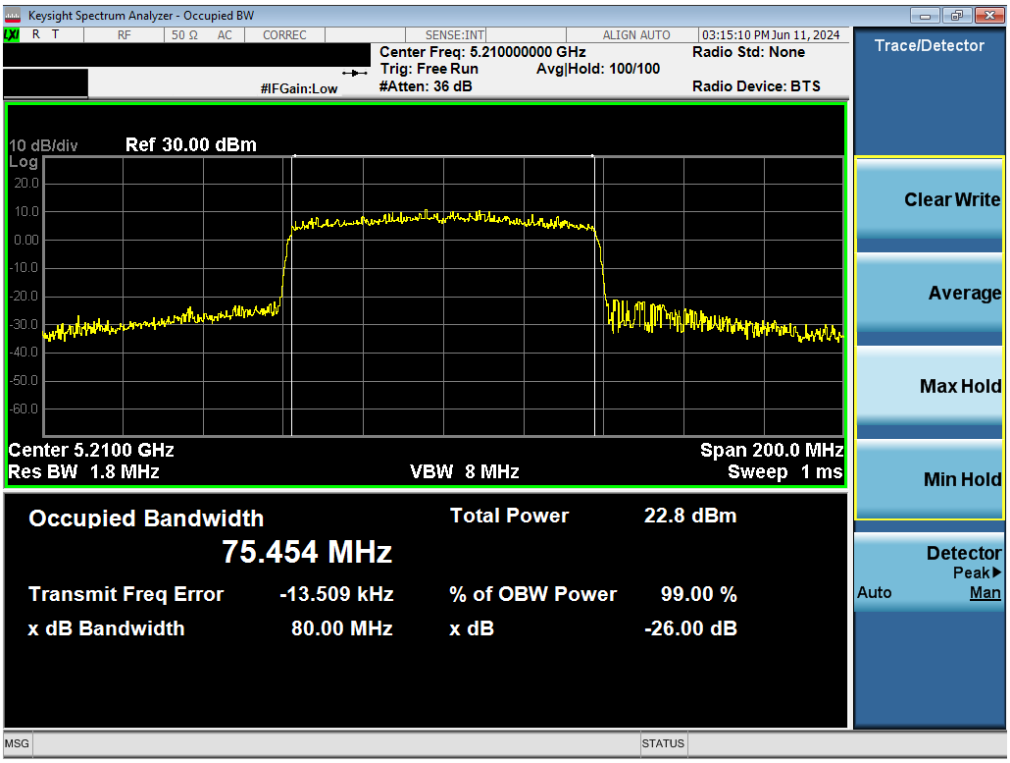
Plot 7-4. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



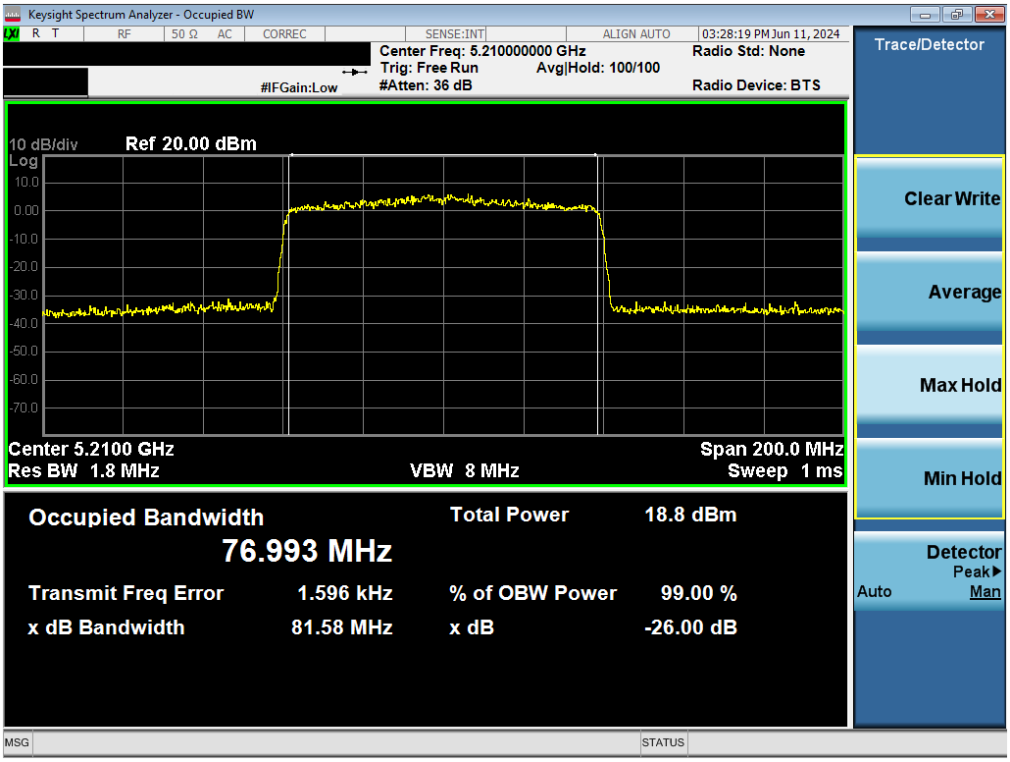
Plot 7-5. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



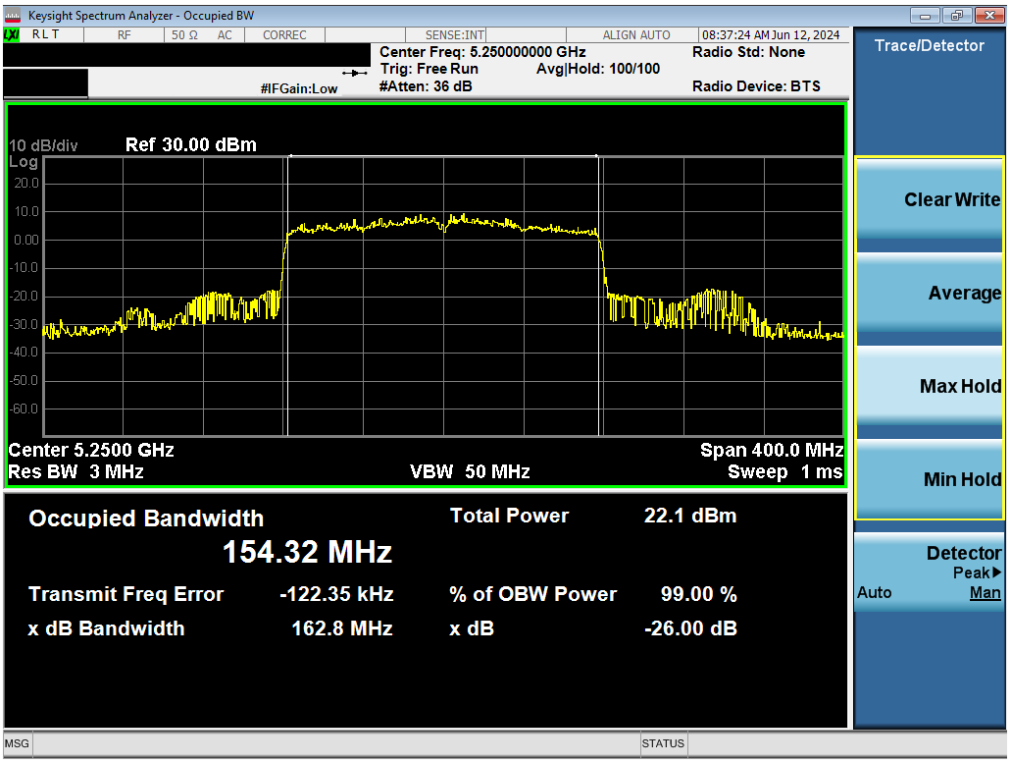
Plot 7-6. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



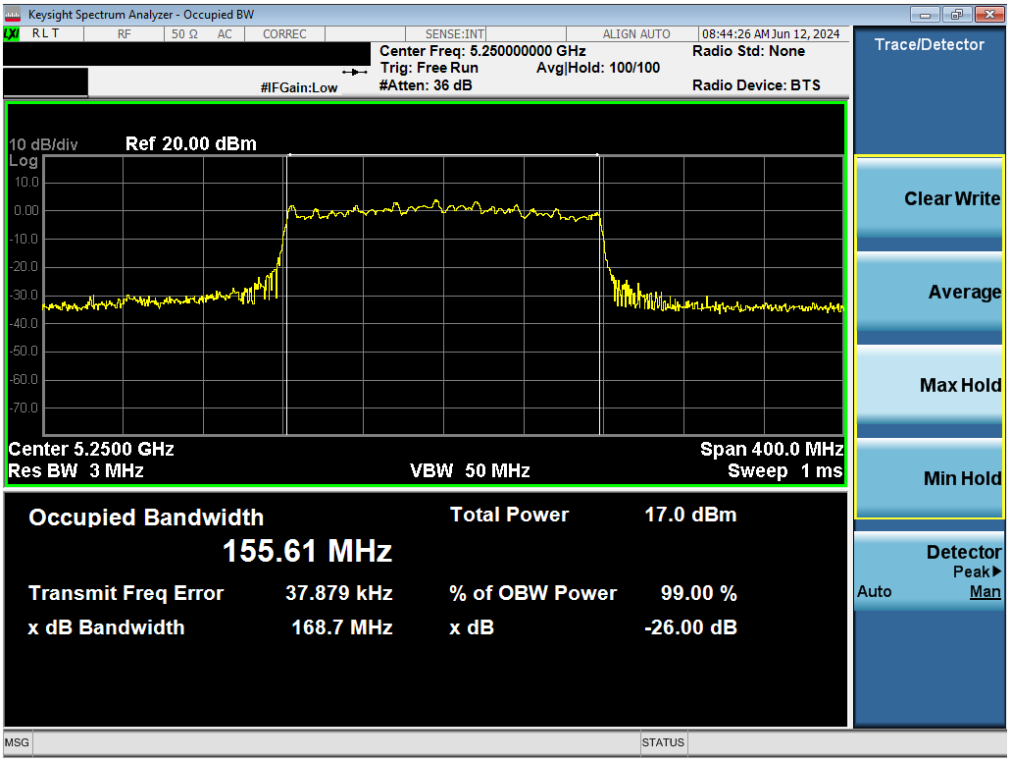
Plot 7-7. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



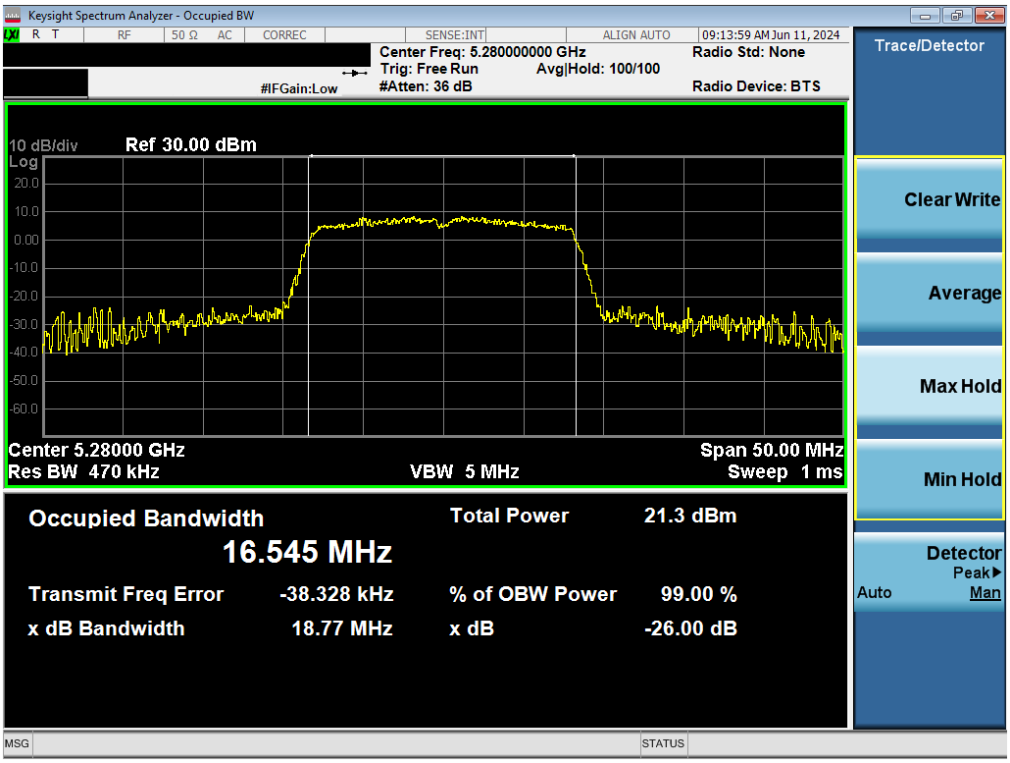
Plot 7-8. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



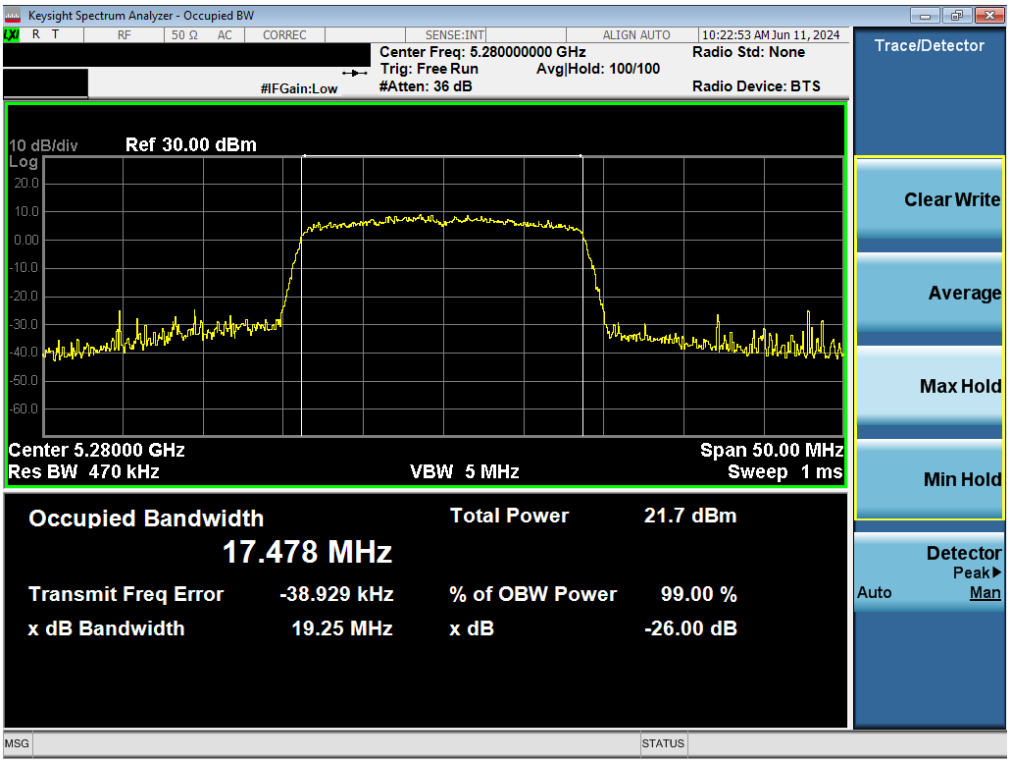
Plot 7-9. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



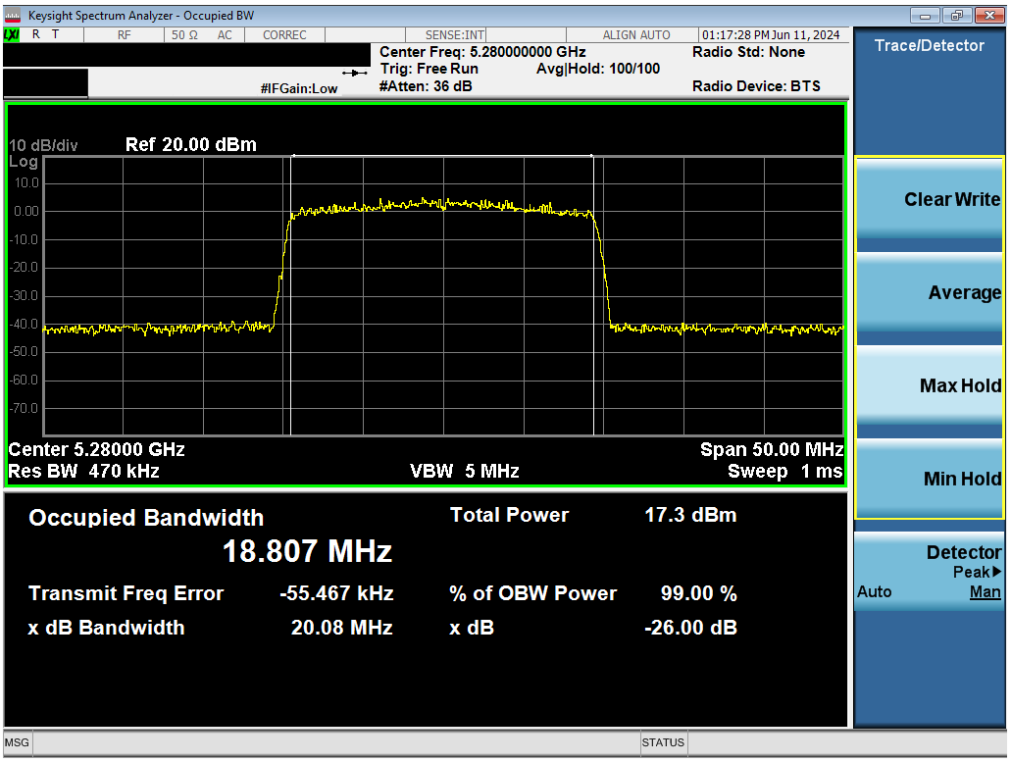
Plot 7-10. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



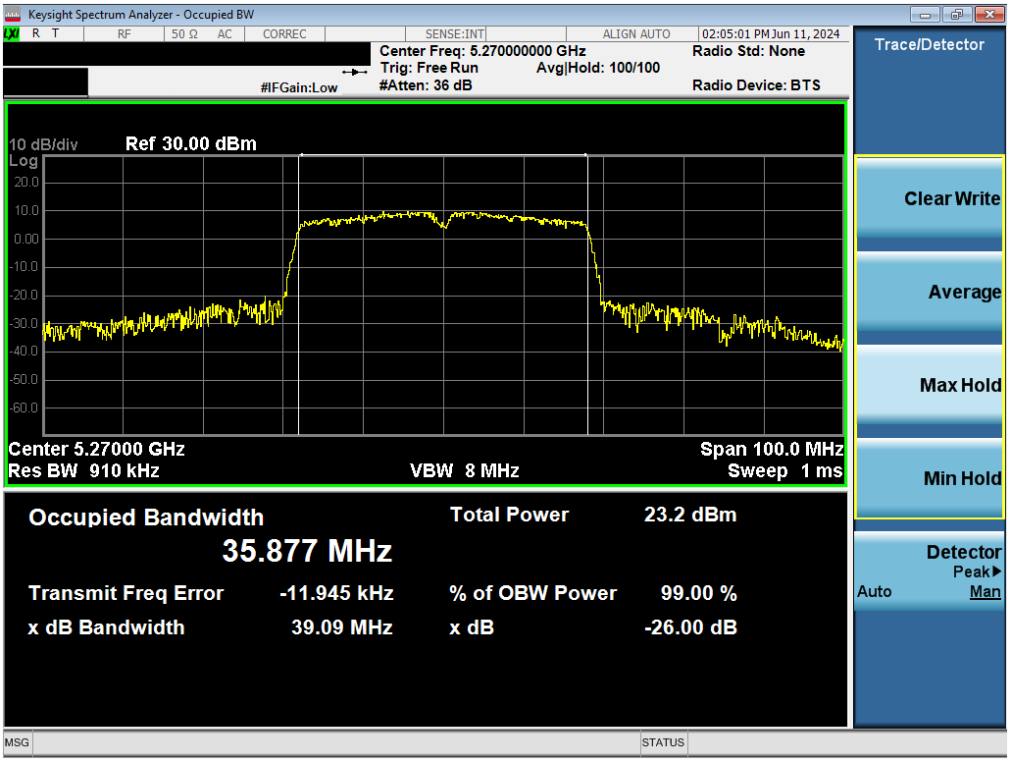
Plot 7-11. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 2A) – Ch. 56)



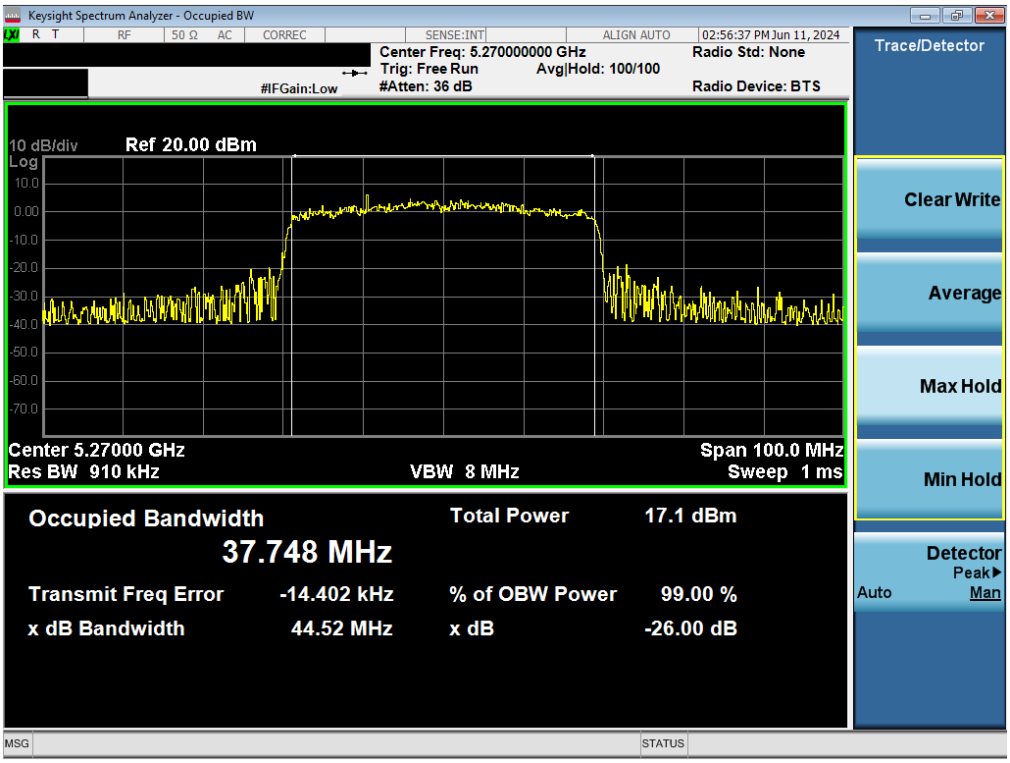
Plot 7-12. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



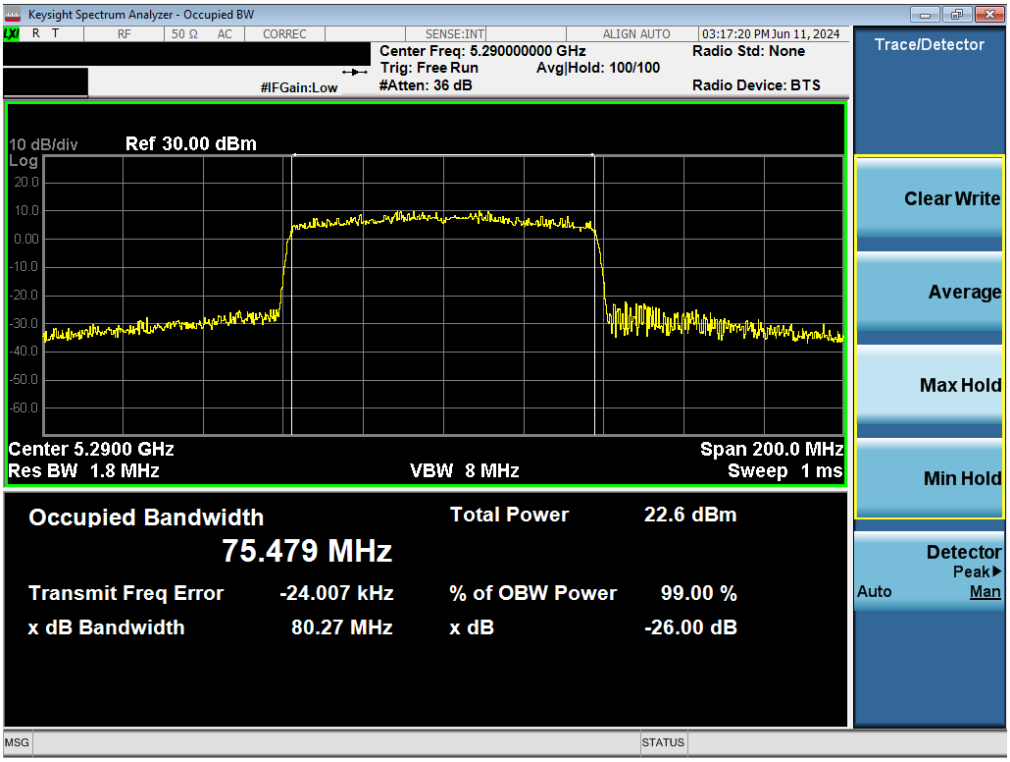
Plot 7-13. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



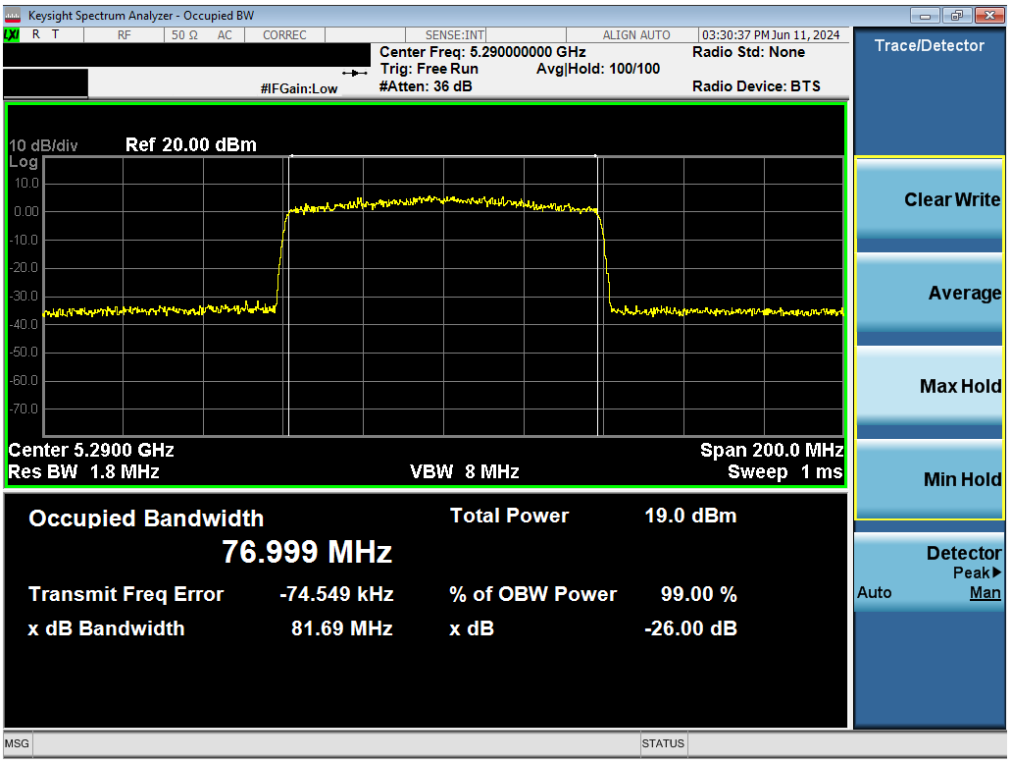
Plot 7-14. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



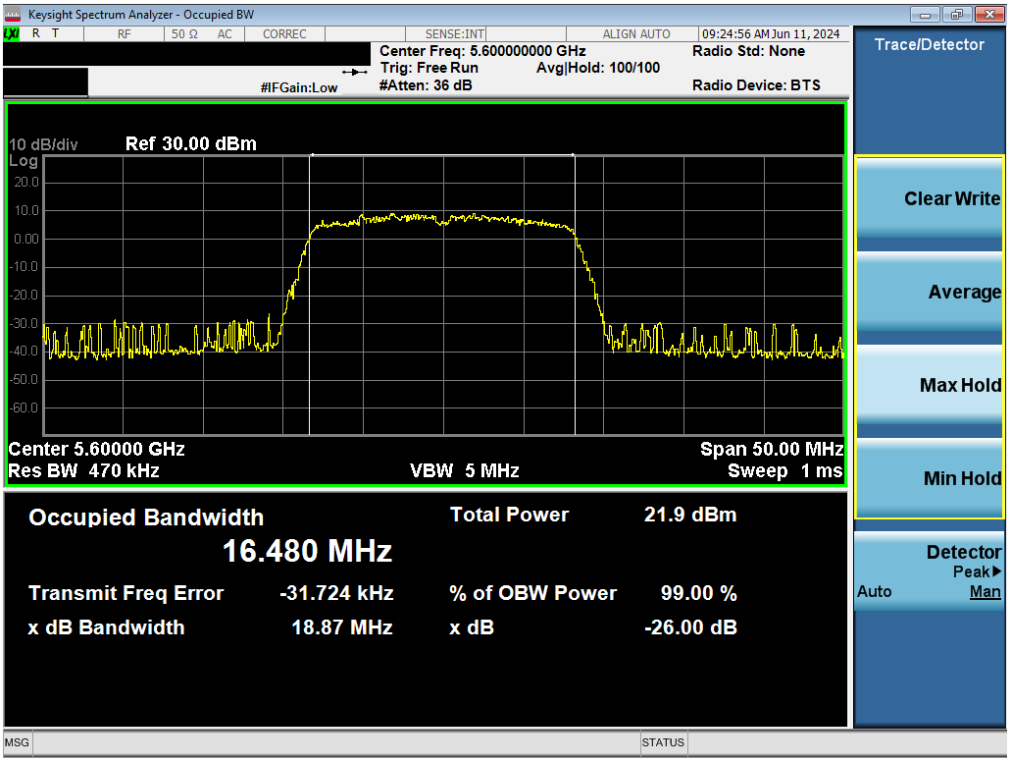
Plot 7-15. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)



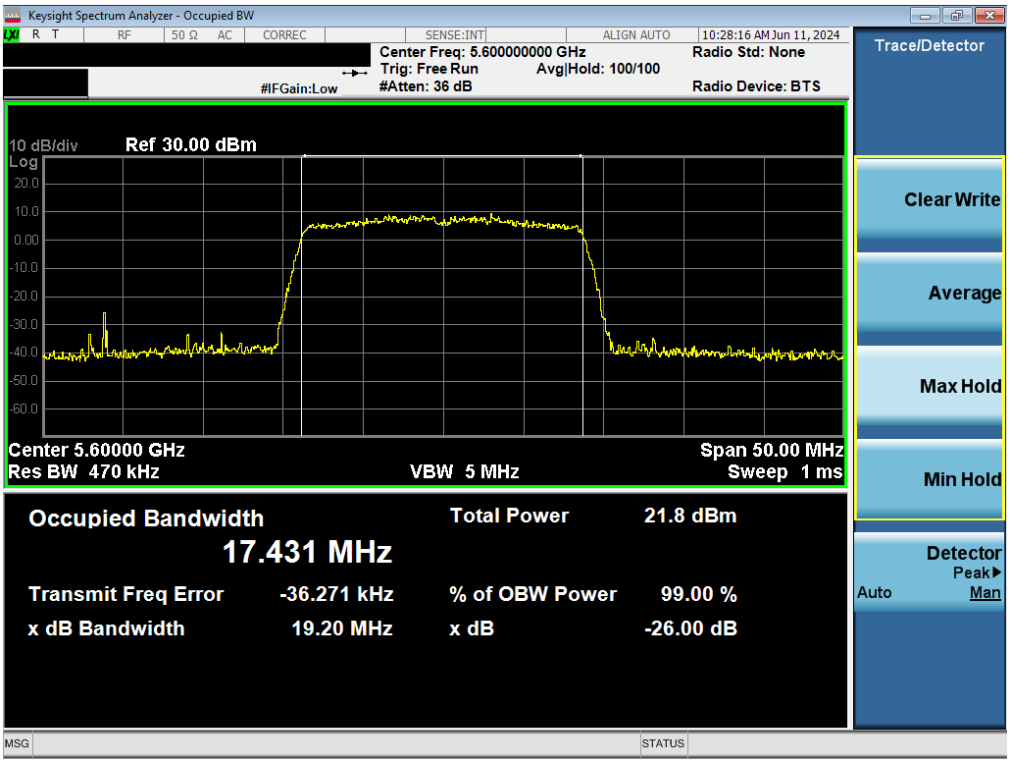
Plot 7-16. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



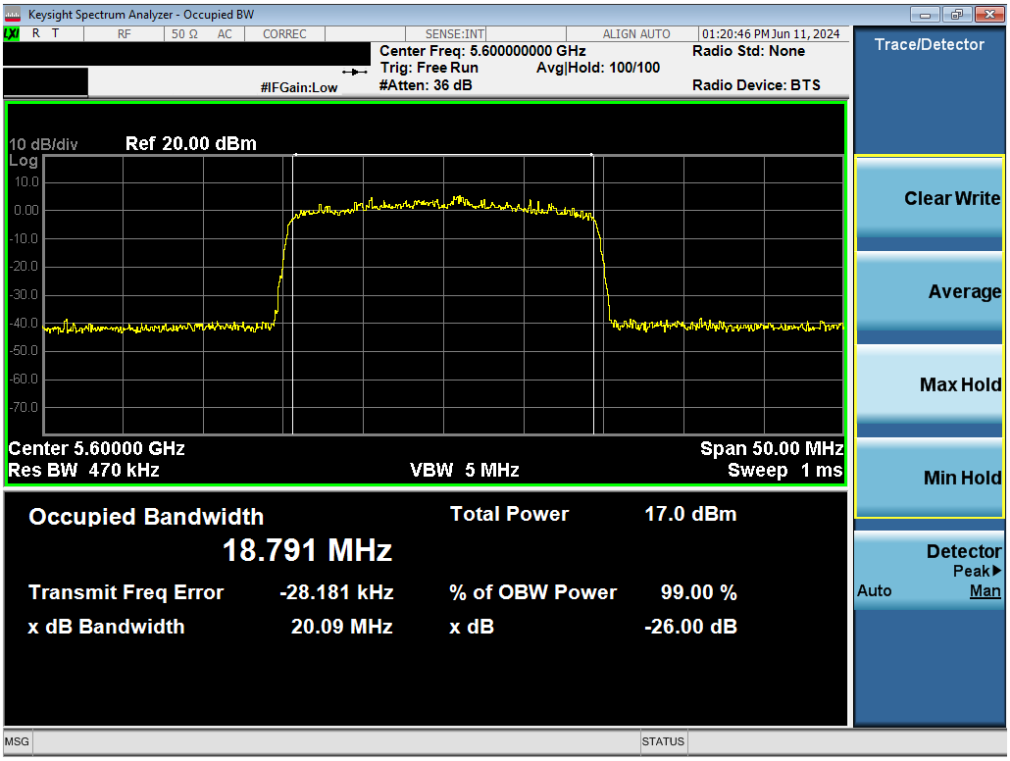
Plot 7-17. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 2A) – Ch. 58)



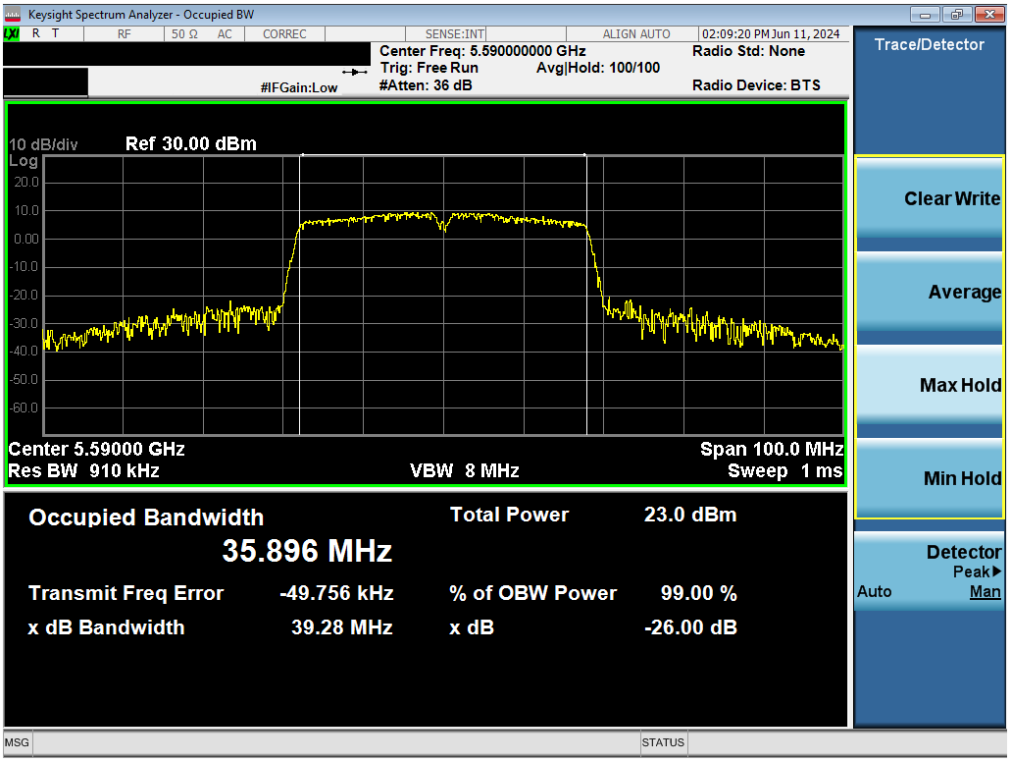
Plot 7-18. 26dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 2C) – Ch. 120)



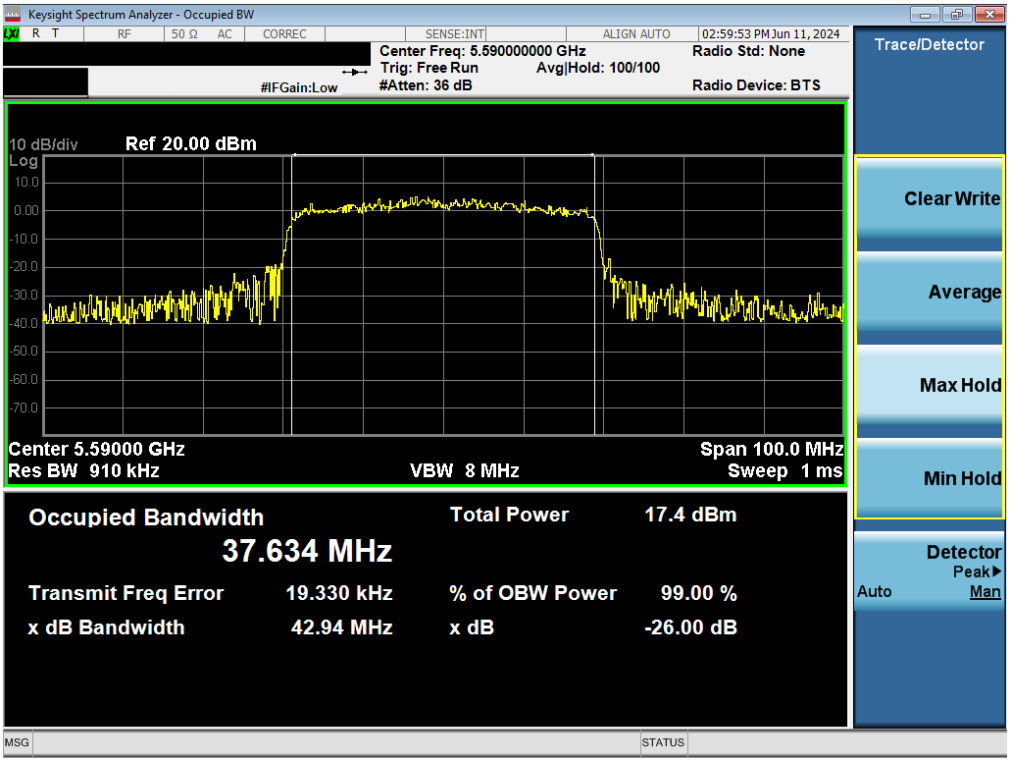
Plot 7-19. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)



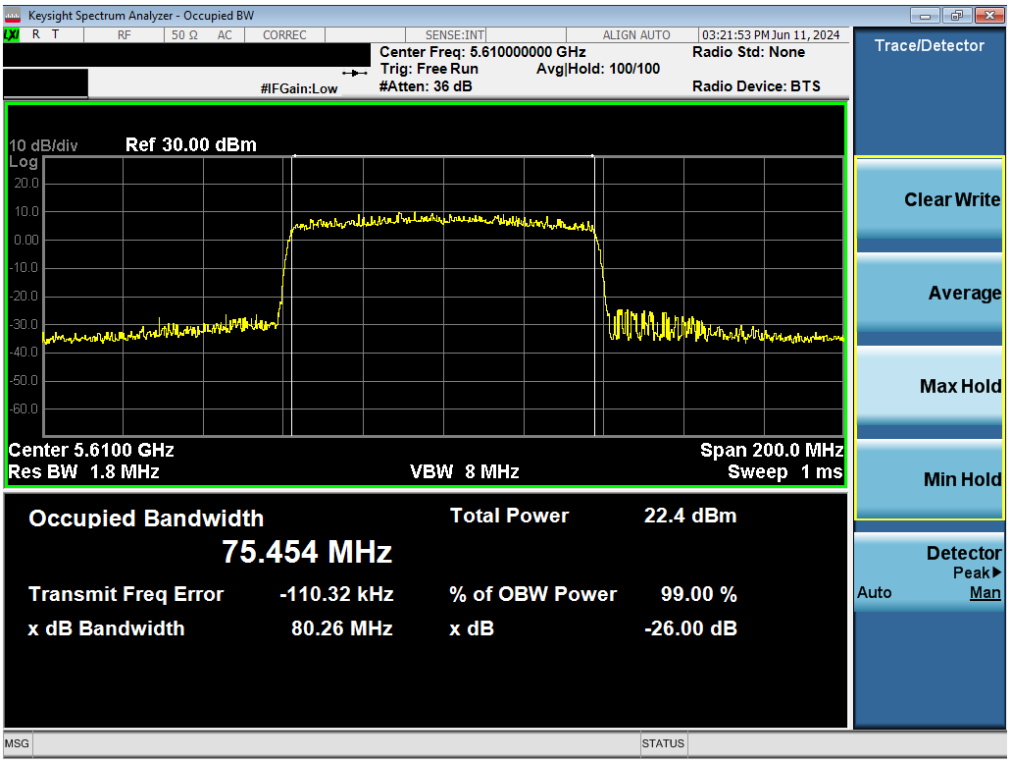
Plot 7-20. 26dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2C) – Ch. 120)



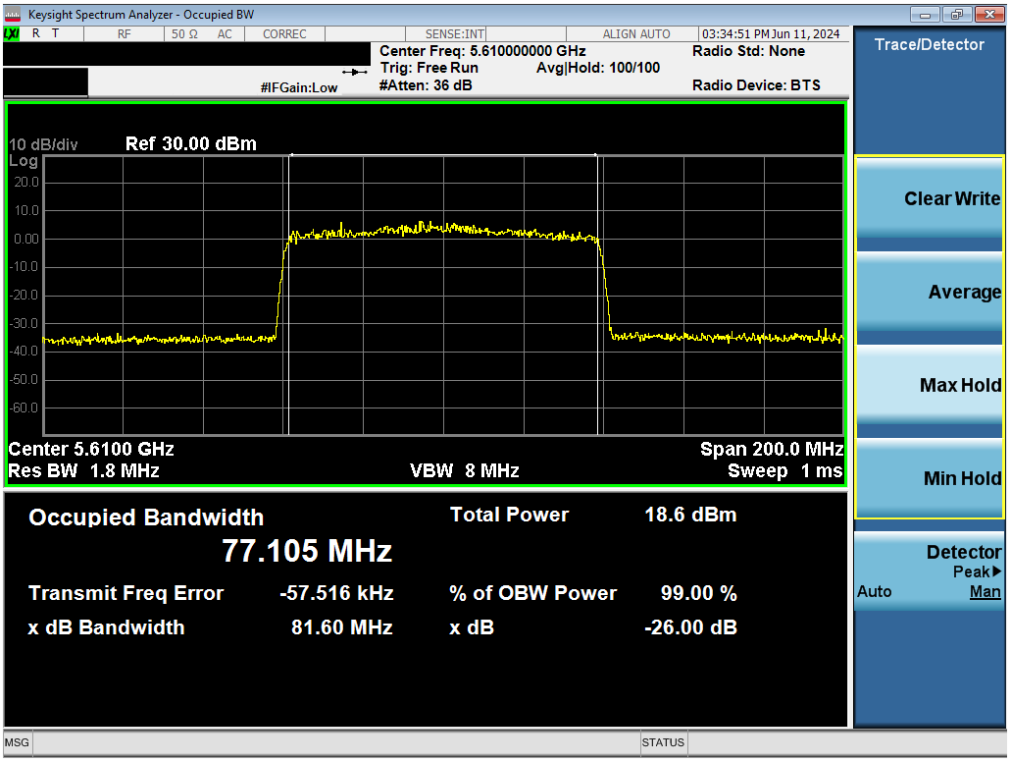
Plot 7-21. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)



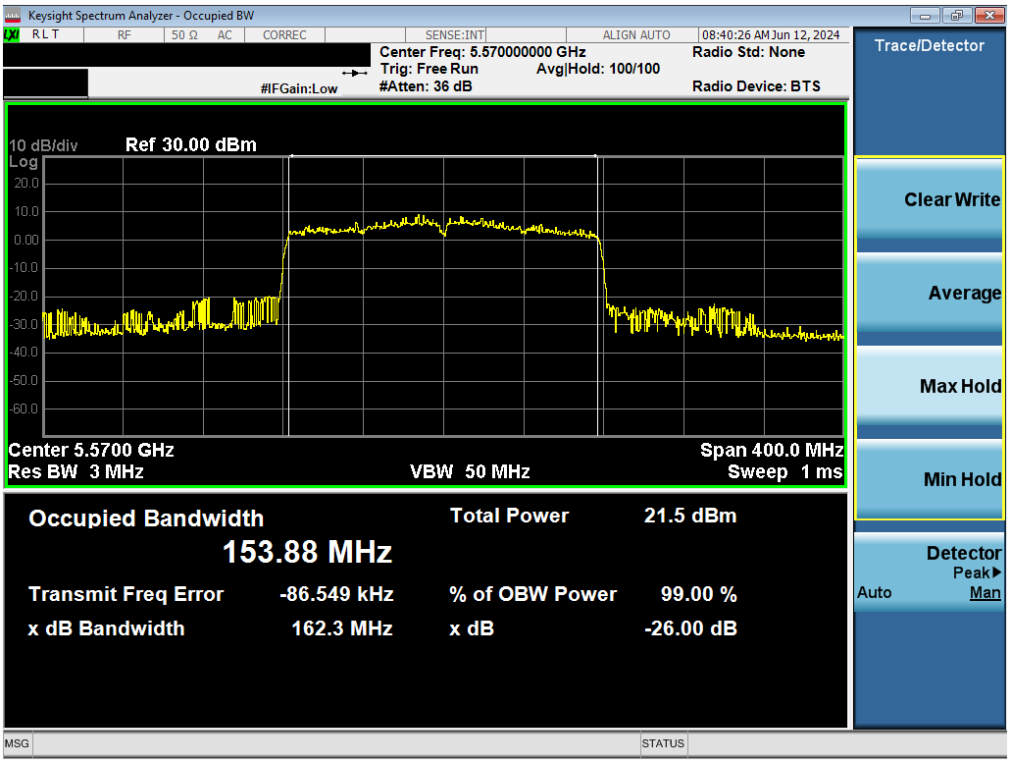
Plot 7-22. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2C) – Ch. 118)



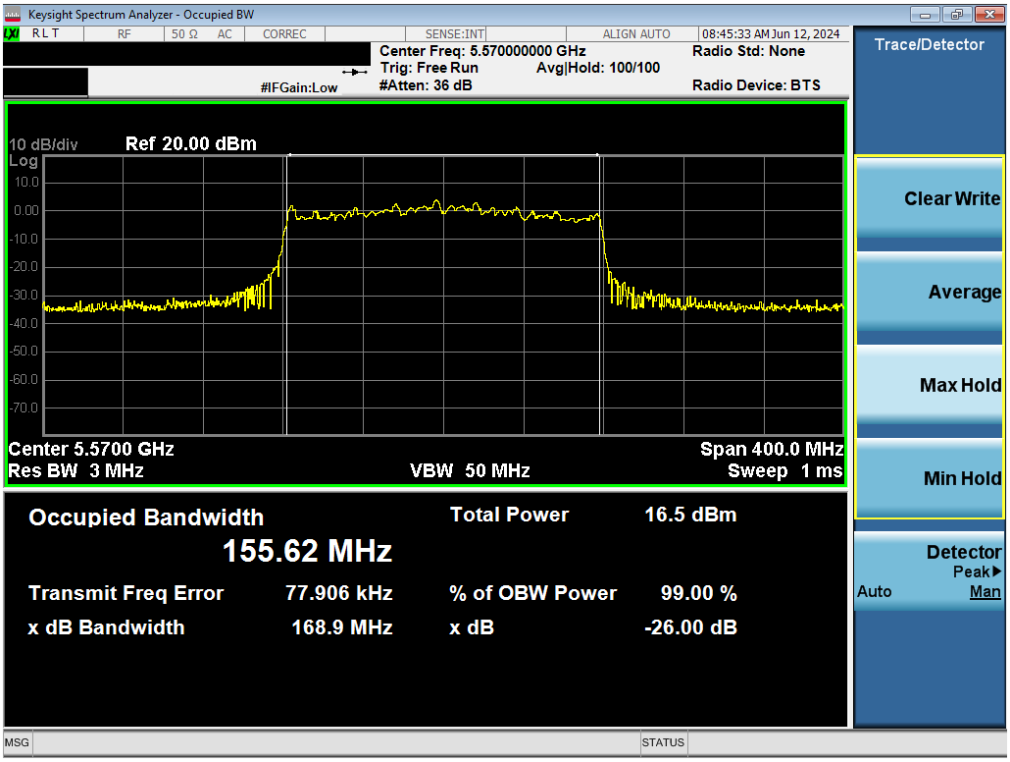
Plot 7-23. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-24. 26dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 2C) – Ch. 122)

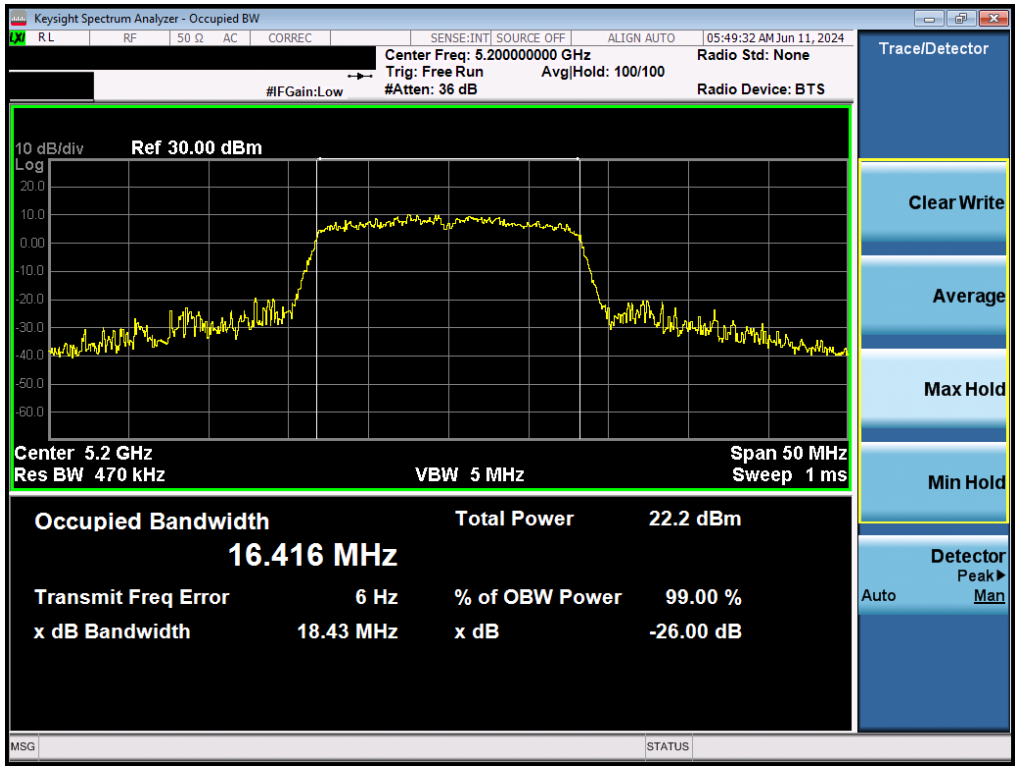


Plot 7-25. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 2C) – Ch. 114)

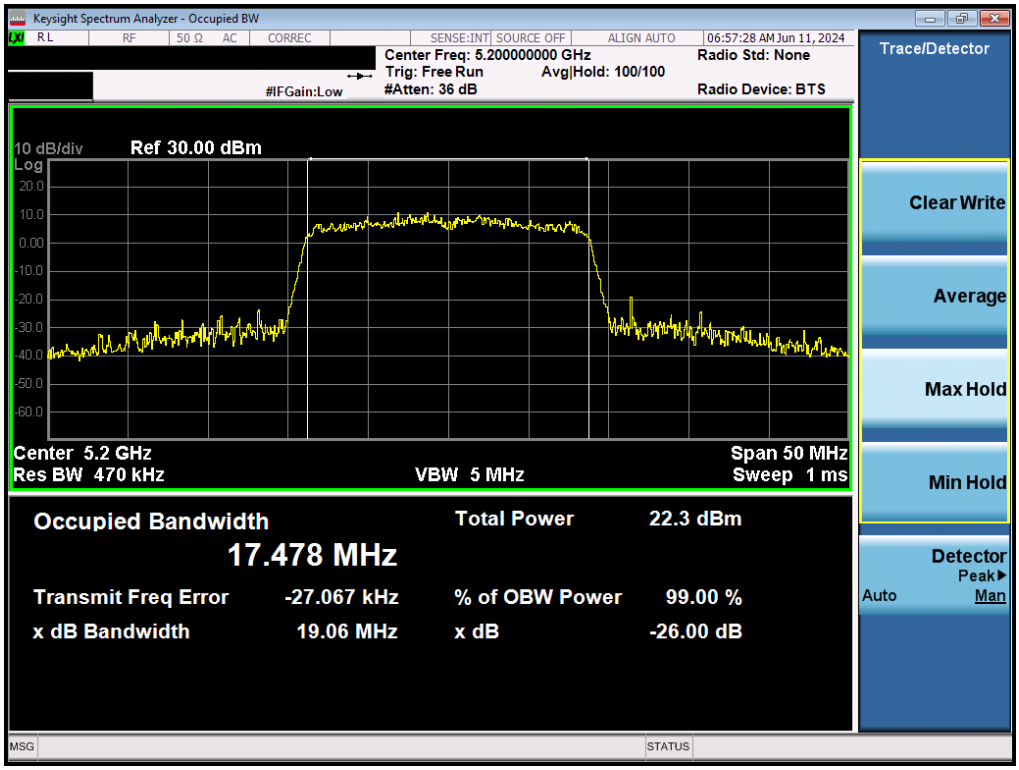


Plot 7-26. 26dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 2C) – Ch. 114)

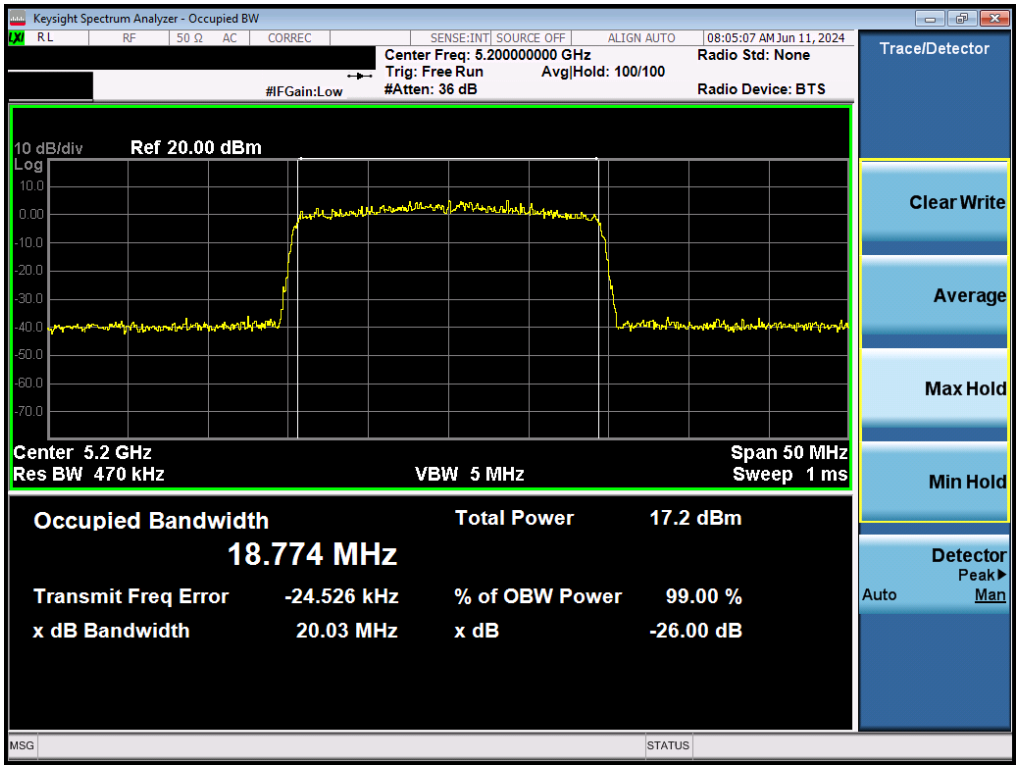
7.2.2 MIMO Antenna-2 26dB Bandwidth Measurements



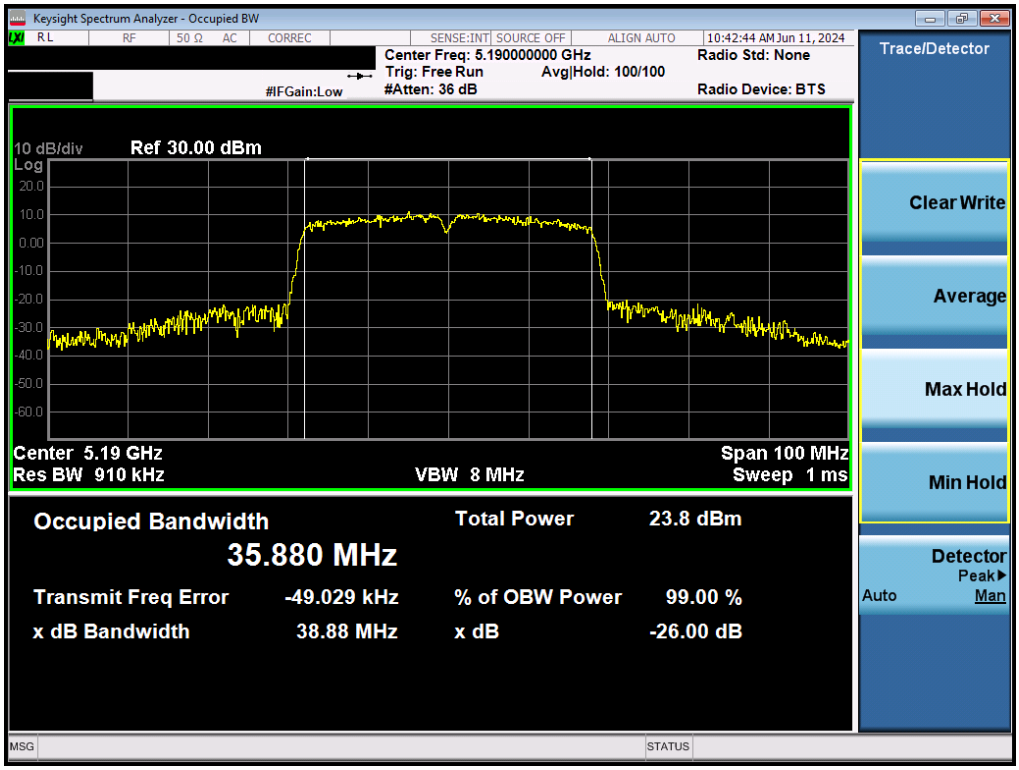
Plot 7-27. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 1) – Ch. 40)



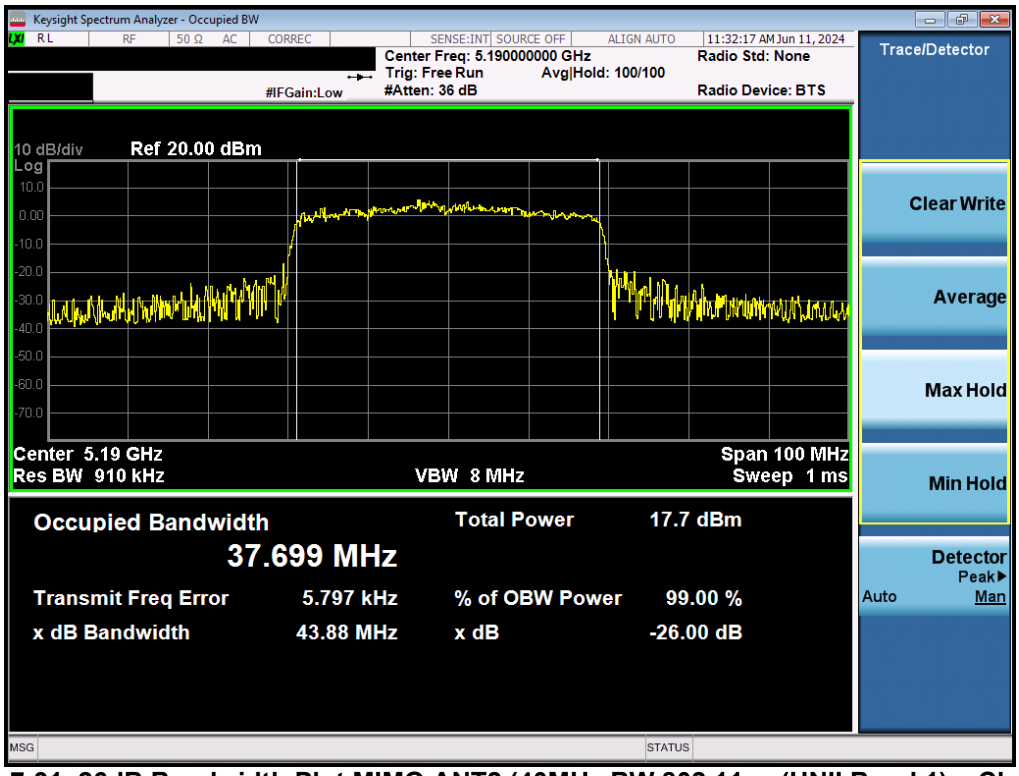
Plot 7-28. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



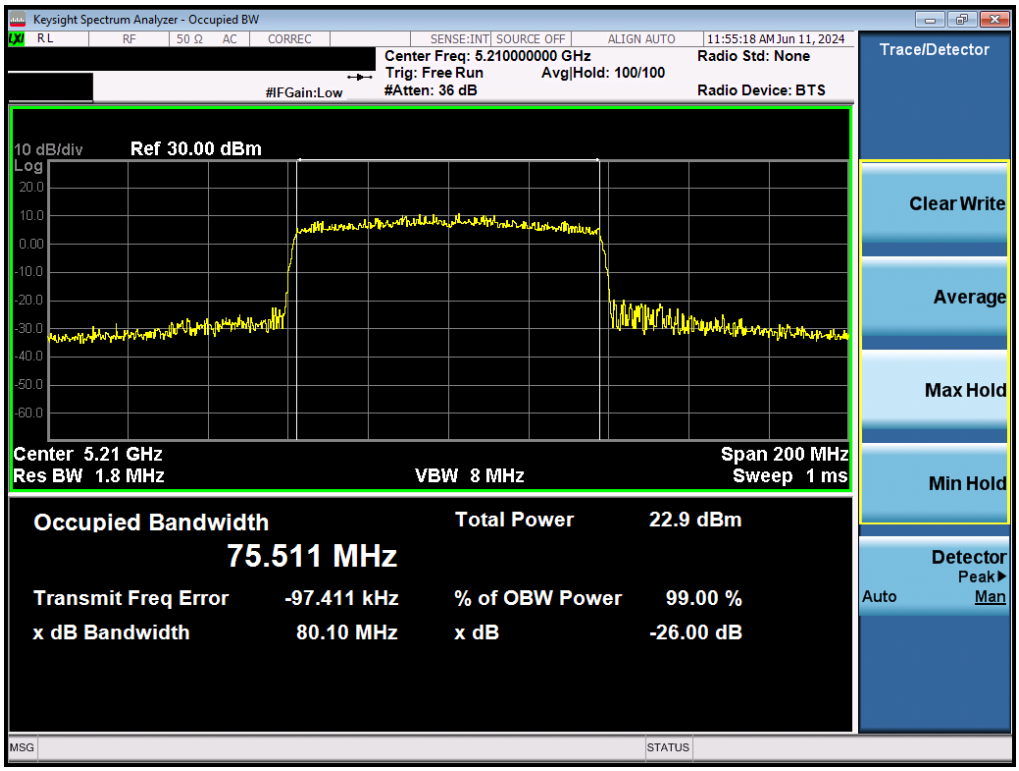
Plot 7-29. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



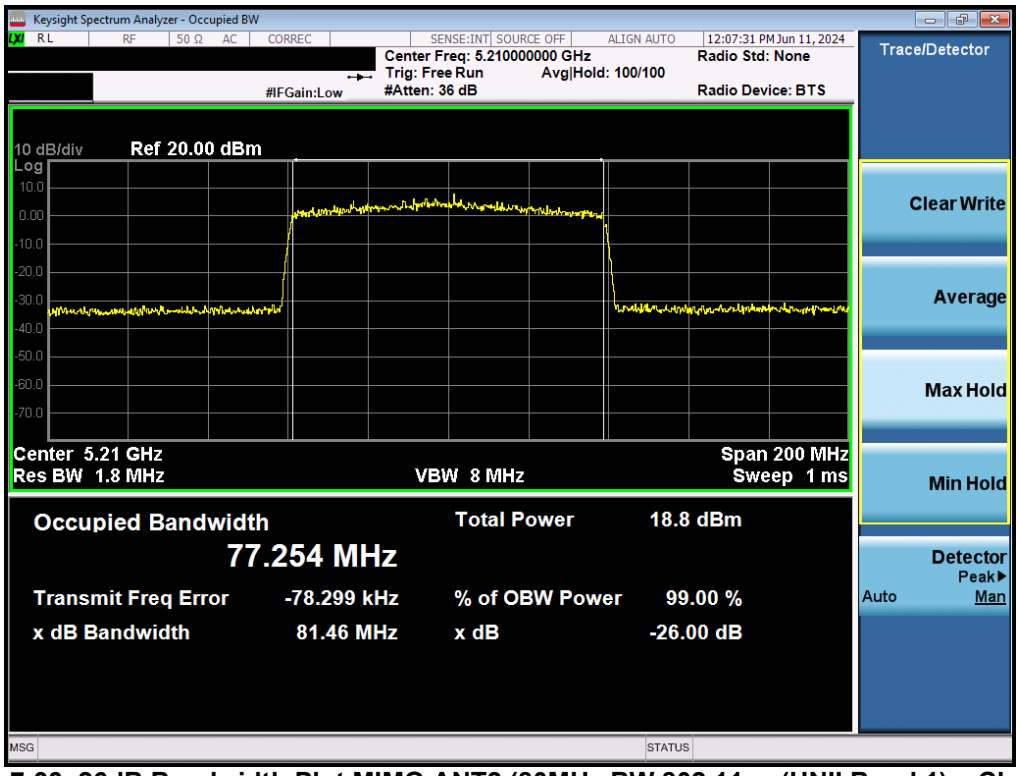
Plot 7-30. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



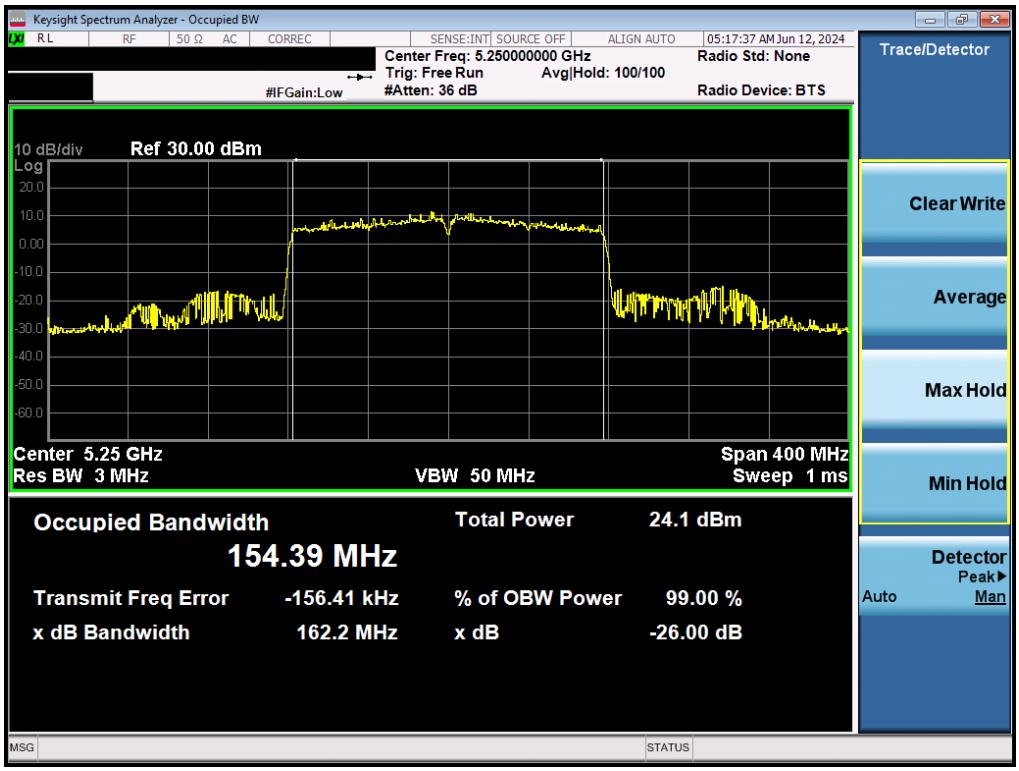
Plot 7-31. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



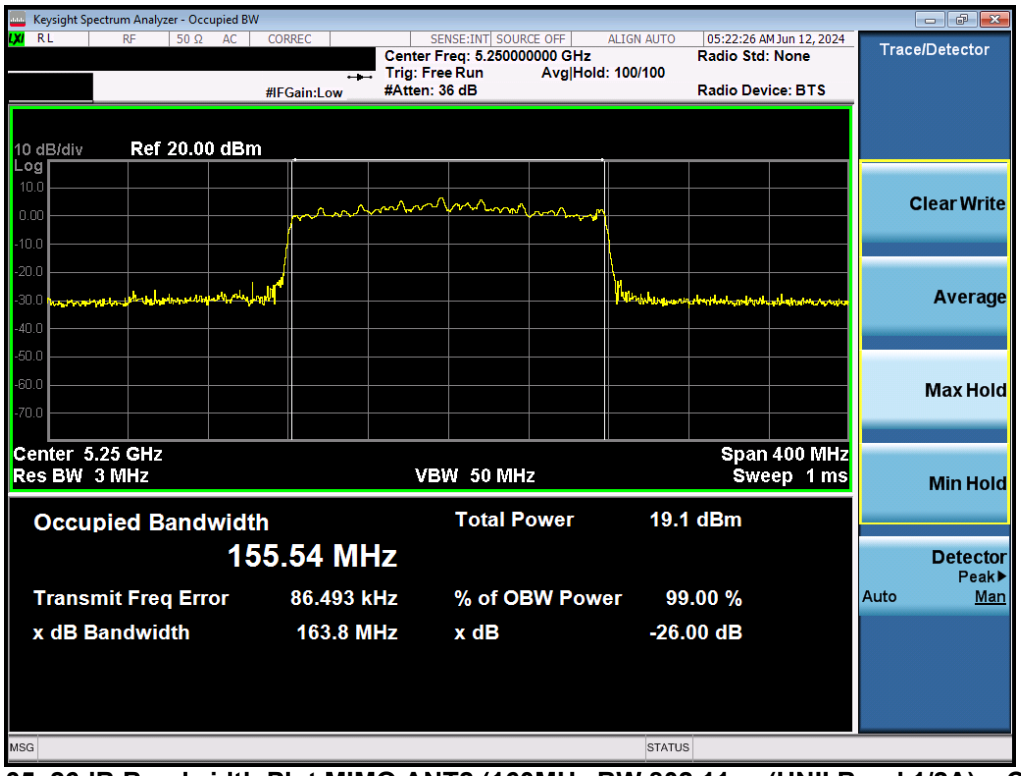
Plot 7-32. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



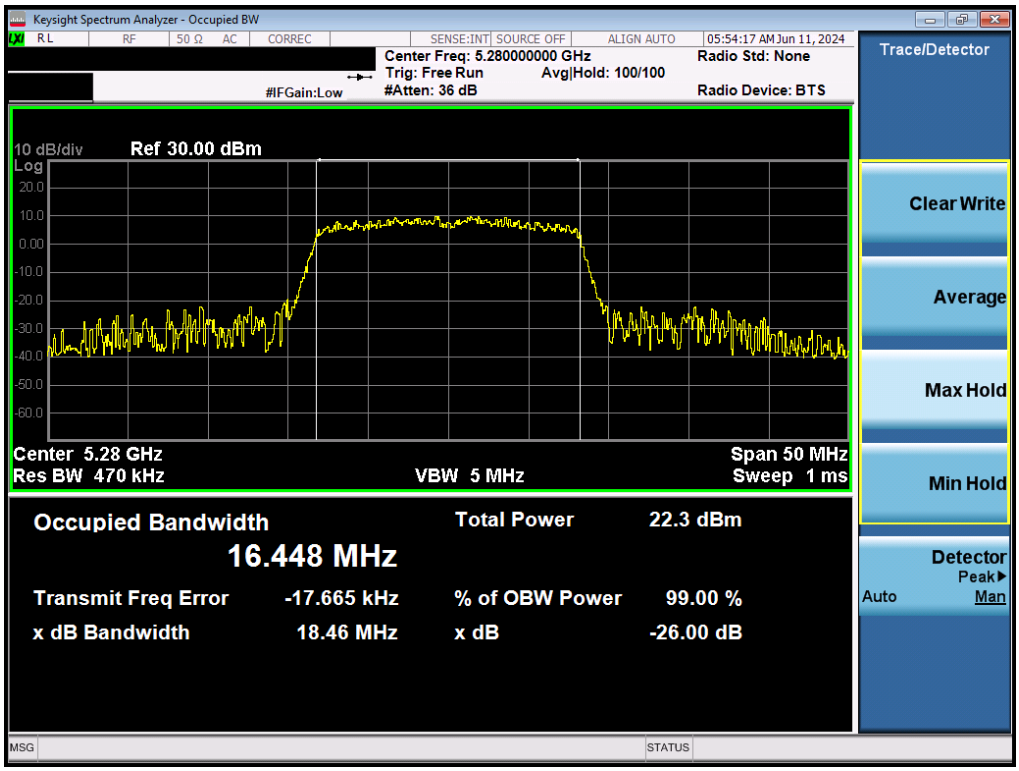
Plot 7-33. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



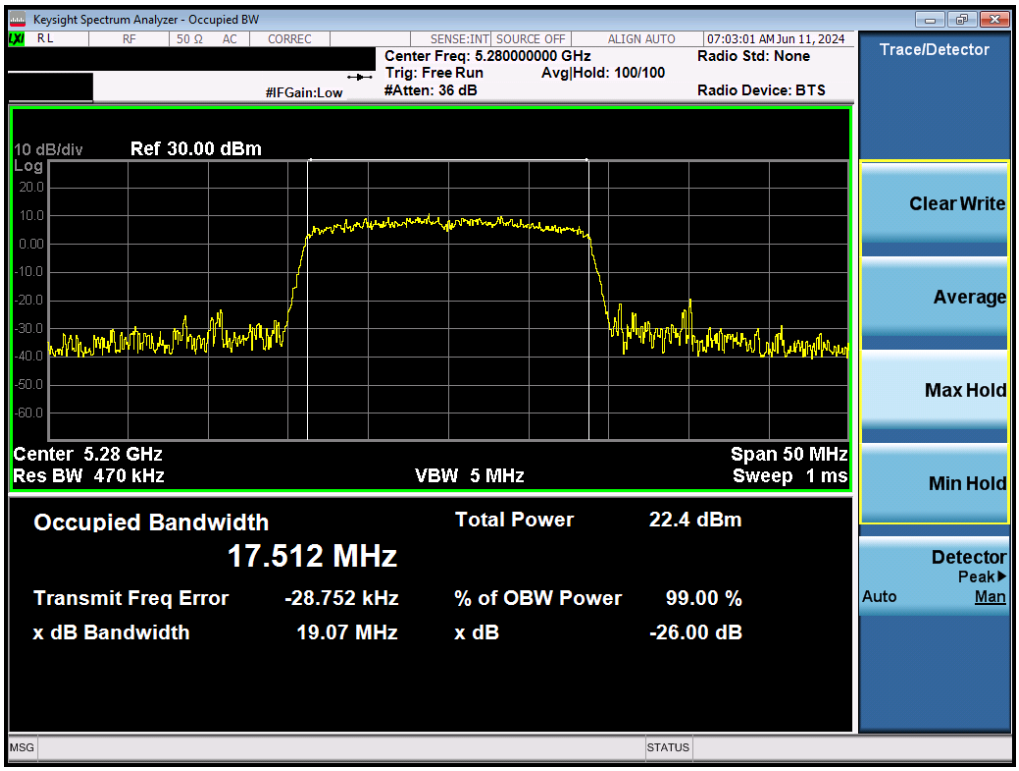
Plot 7-34. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



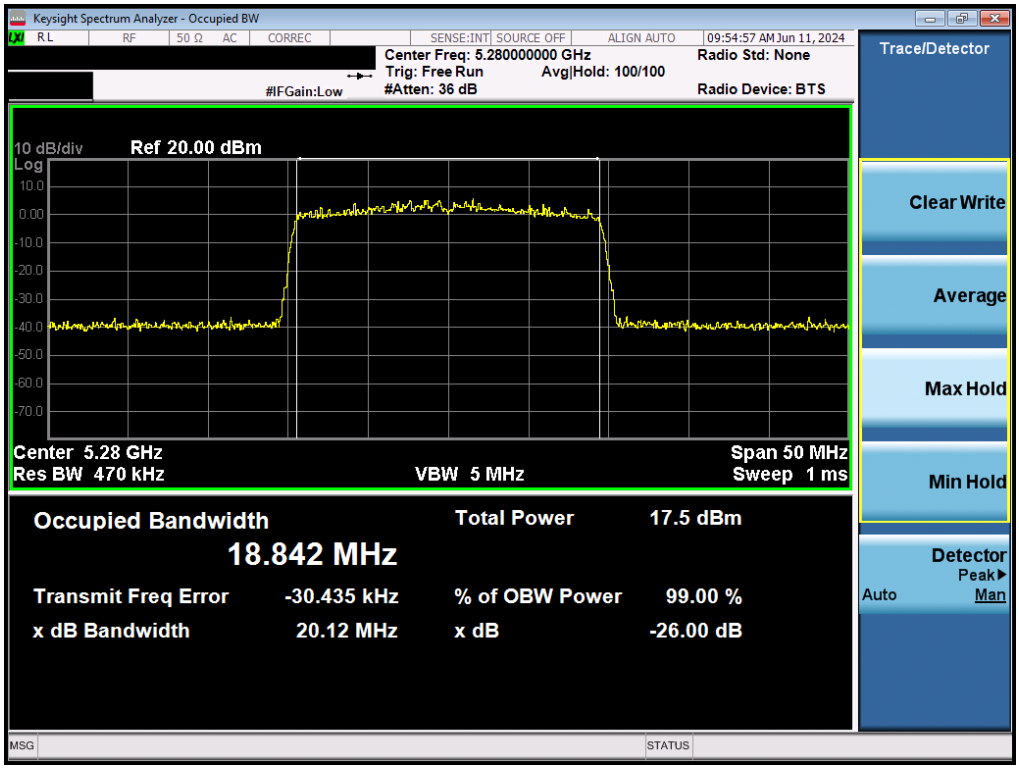
Plot 7-35. 26dB Bandwidth Plot MIMO ANT2 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



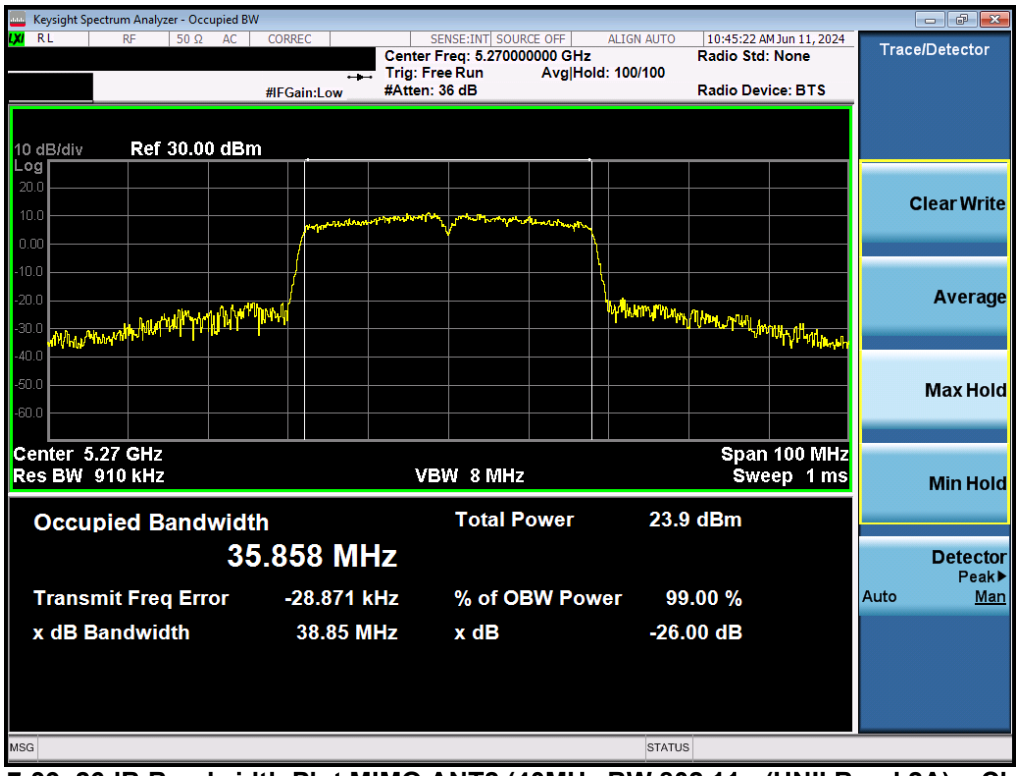
Plot 7-36. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 2A) – Ch. 56)



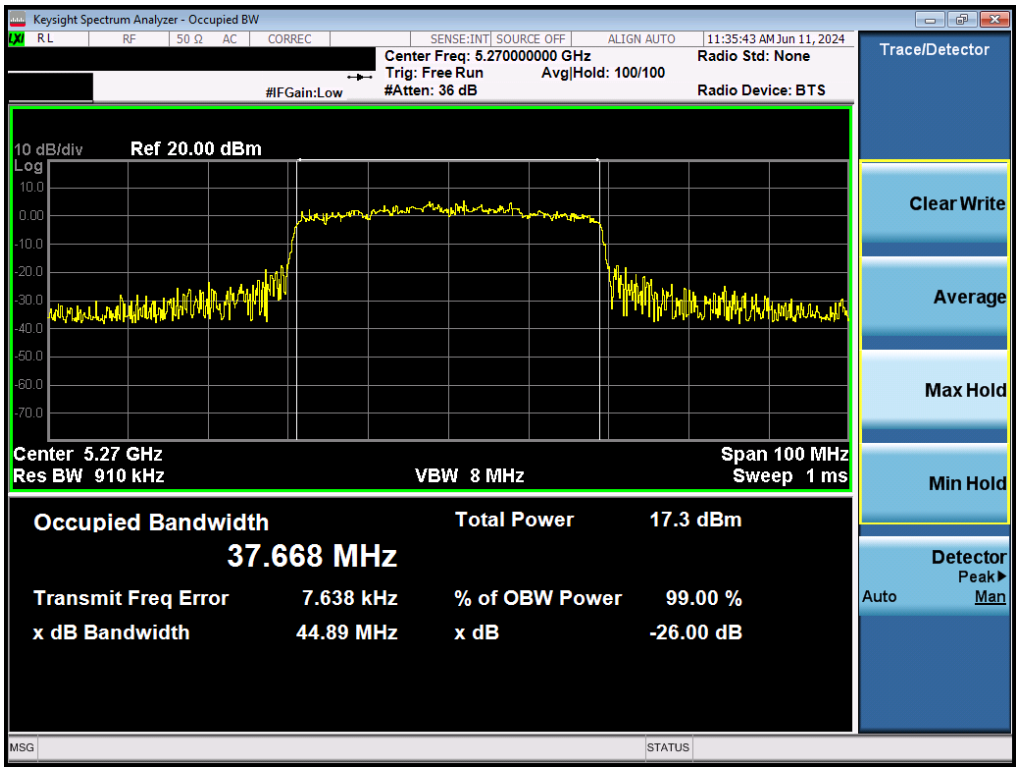
Plot 7-37. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



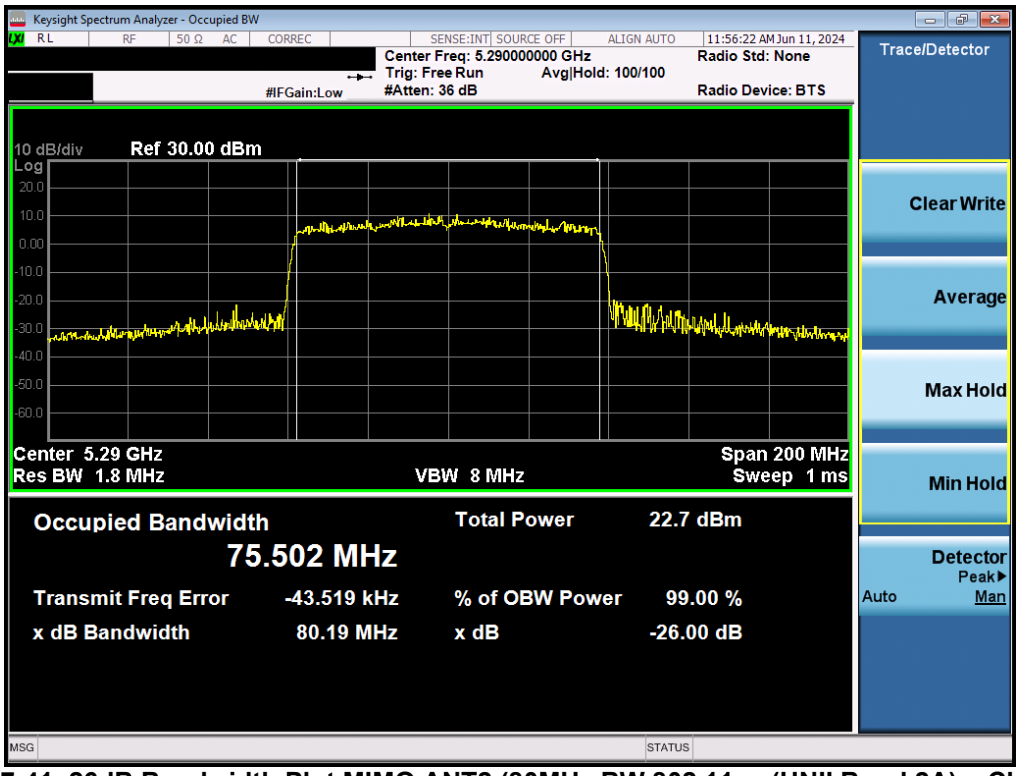
Plot 7-38. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



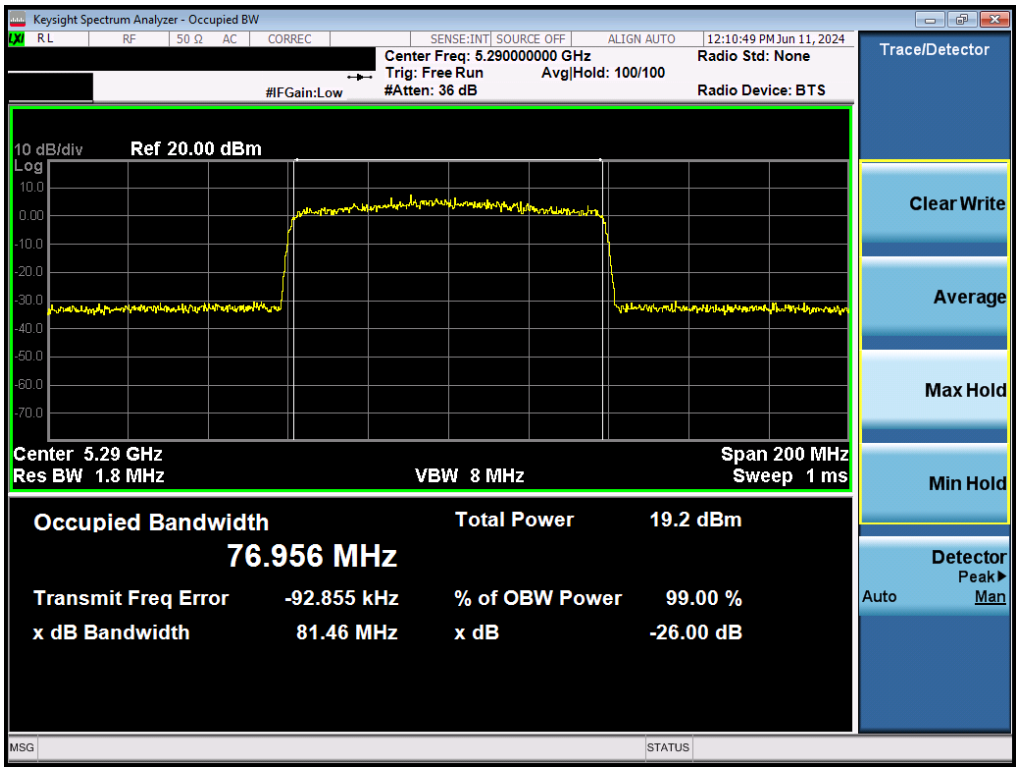
Plot 7-39. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 2A) – Ch. 54)



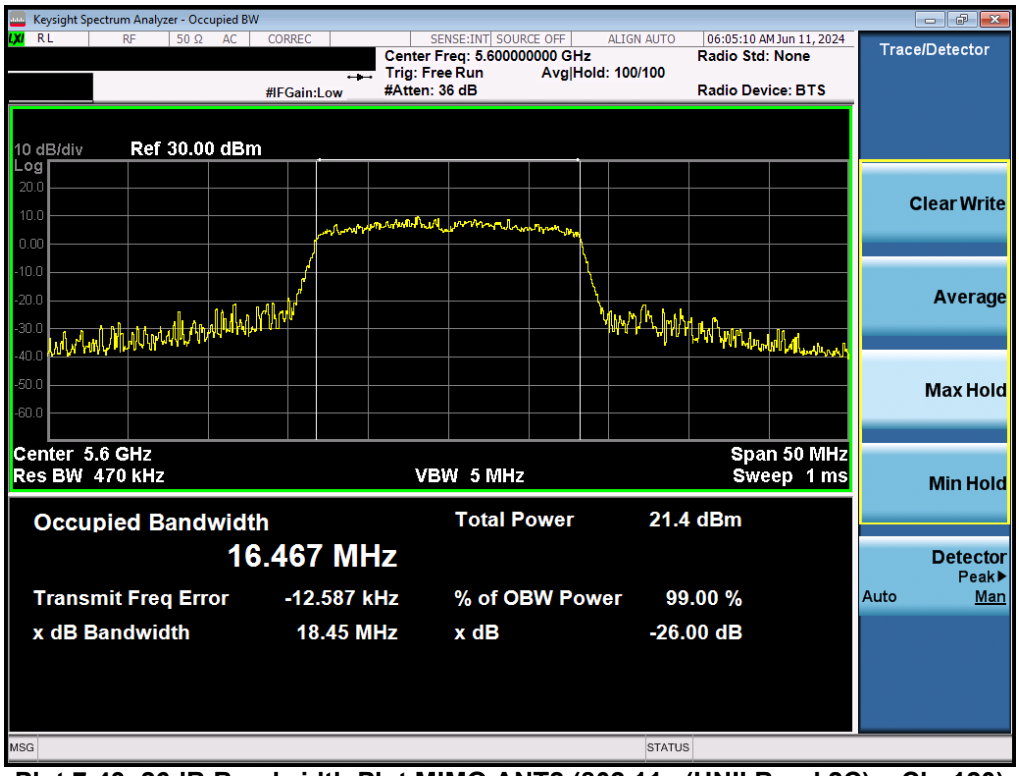
Plot 7-40. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)



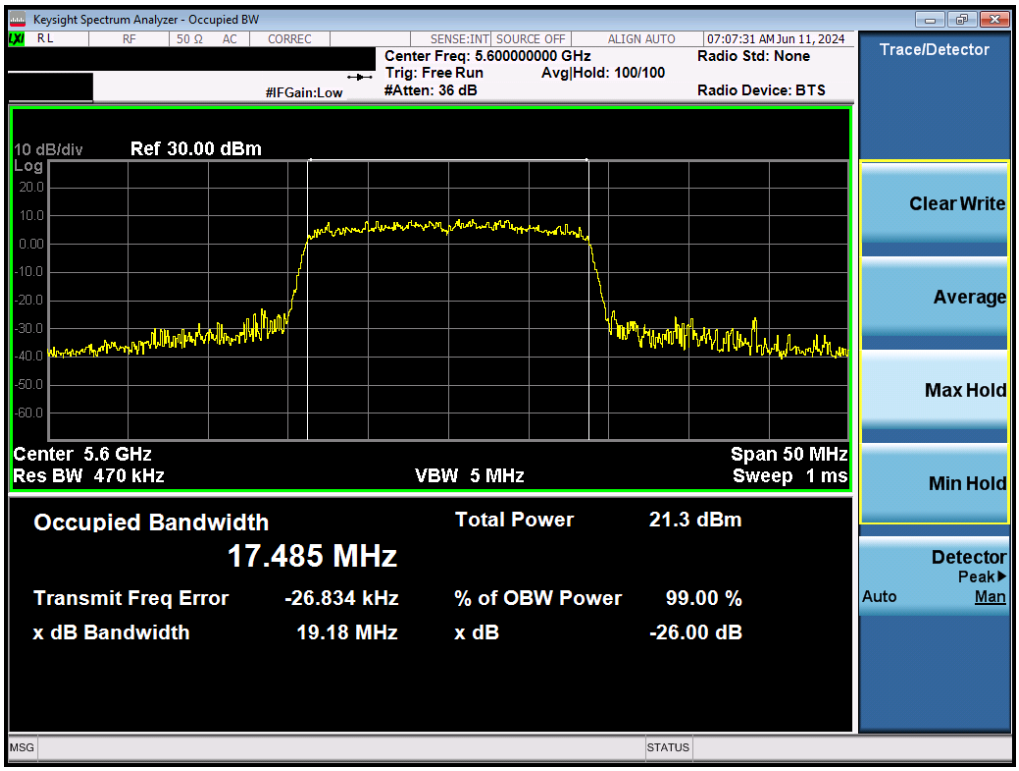
Plot 7-41. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 2A) – Ch. 58)



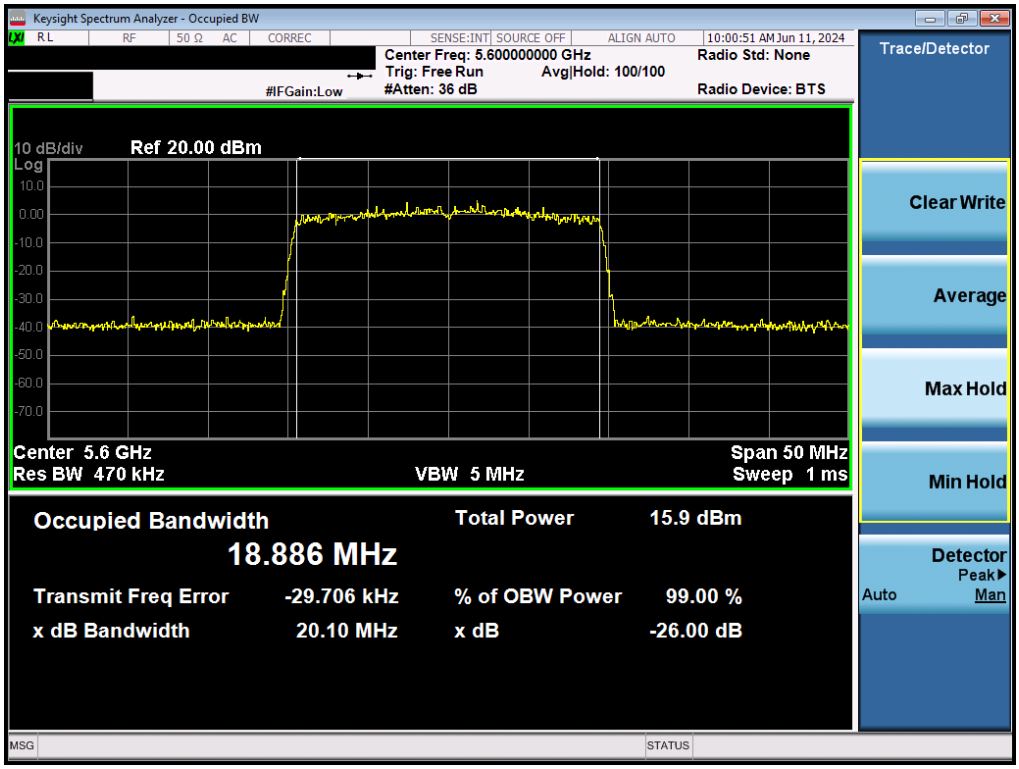
Plot 7-42. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 2A) – Ch. 58)



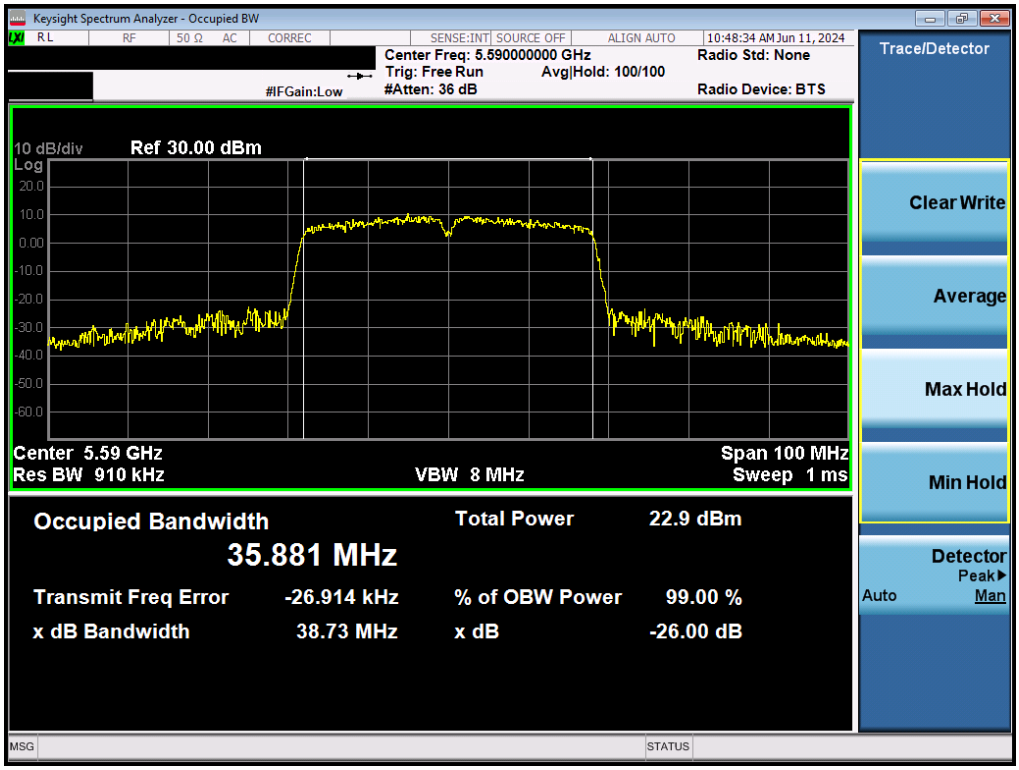
Plot 7-43. 26dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 2C) – Ch. 120)



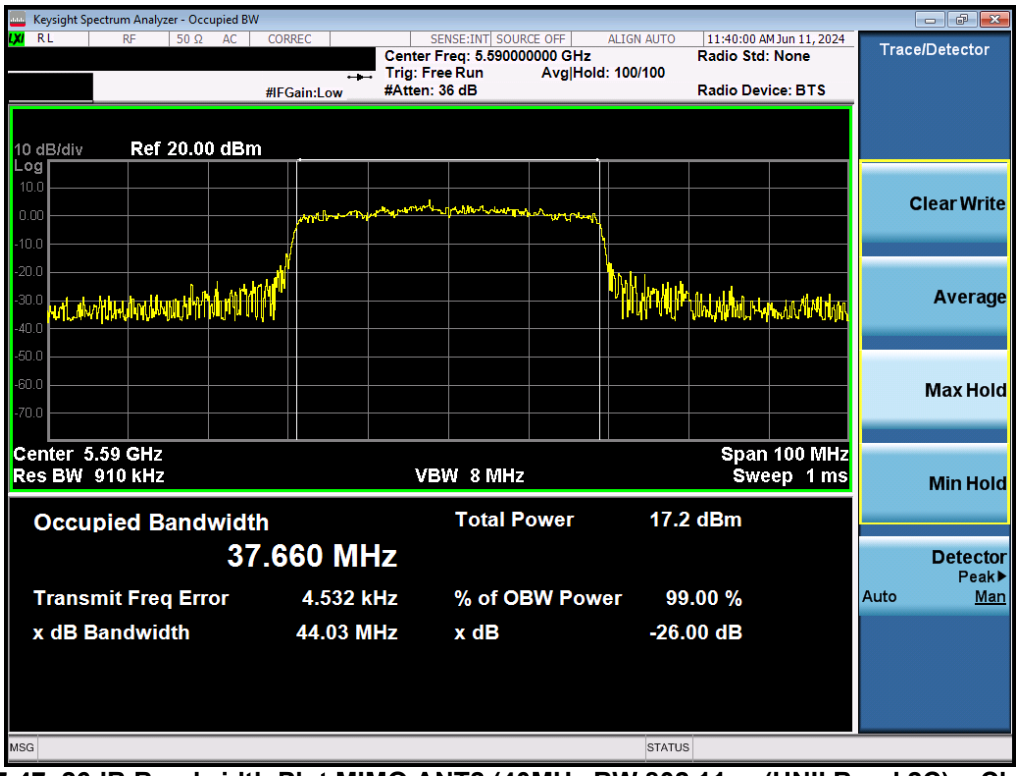
Plot 7-44. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 2C) – Ch. 120)



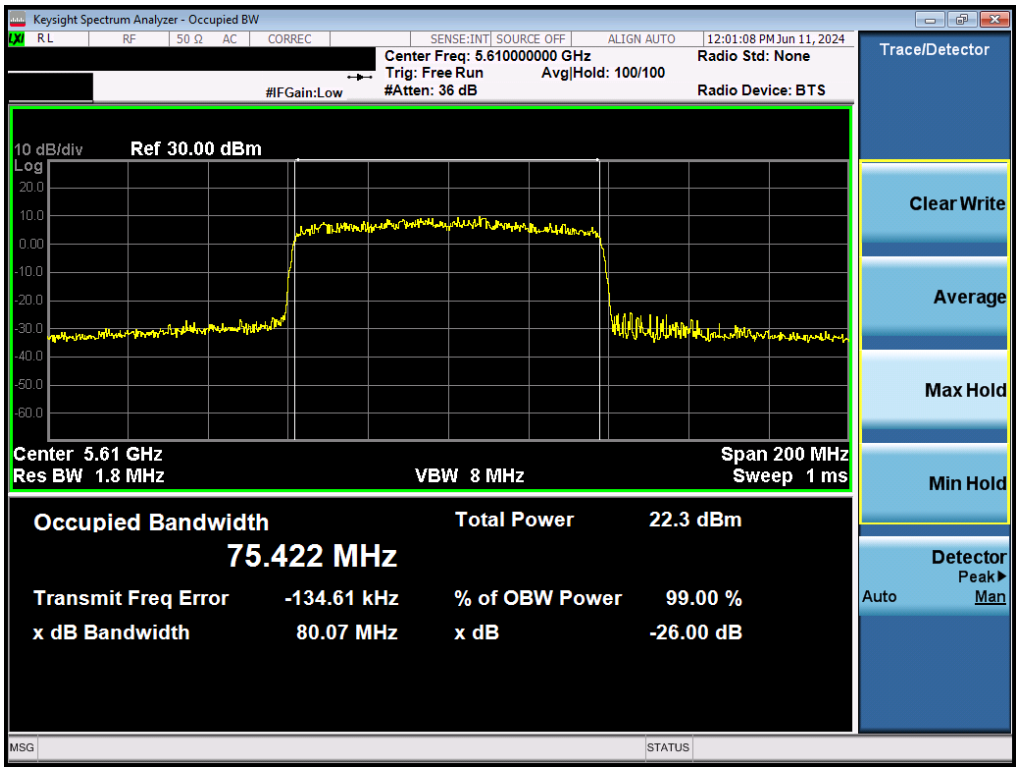
Plot 7-45. 26dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 2C) – Ch. 120)



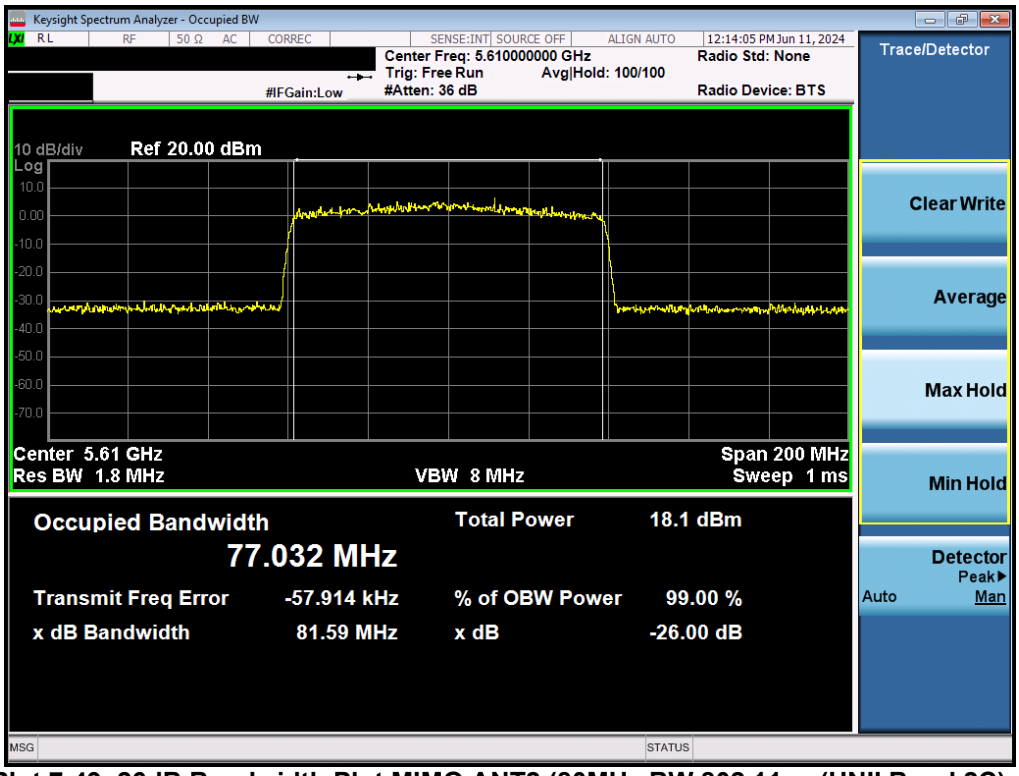
Plot 7-46. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 2C) – Ch. 118)



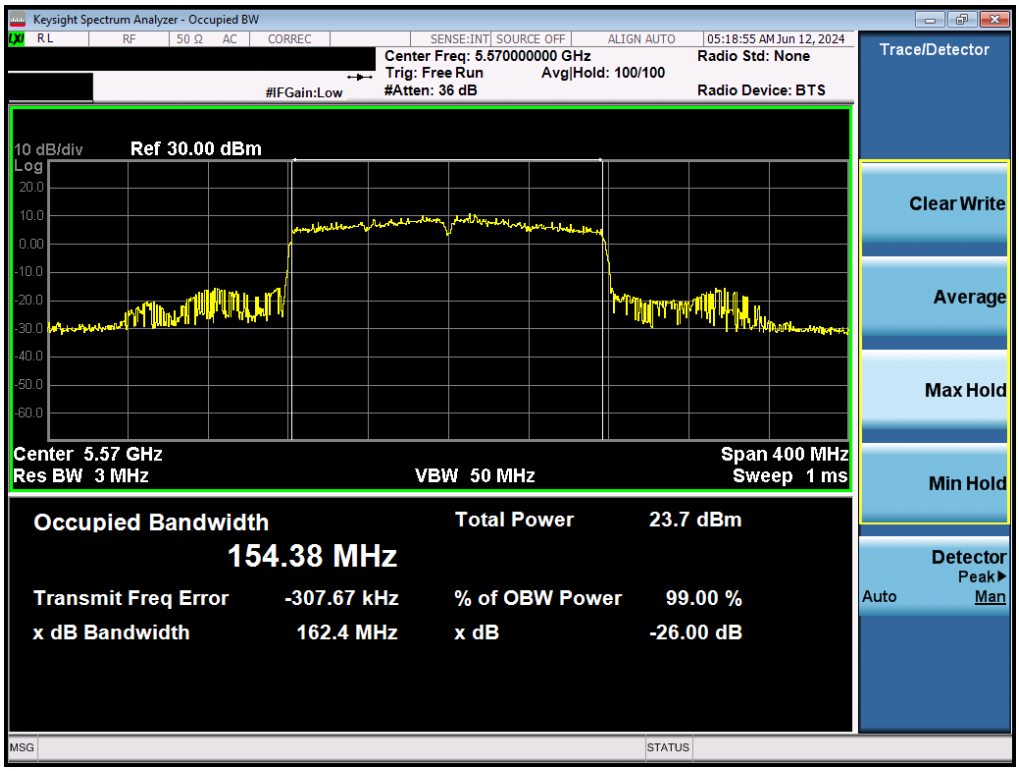
Plot 7-47. 26dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 2C) – Ch. 118)



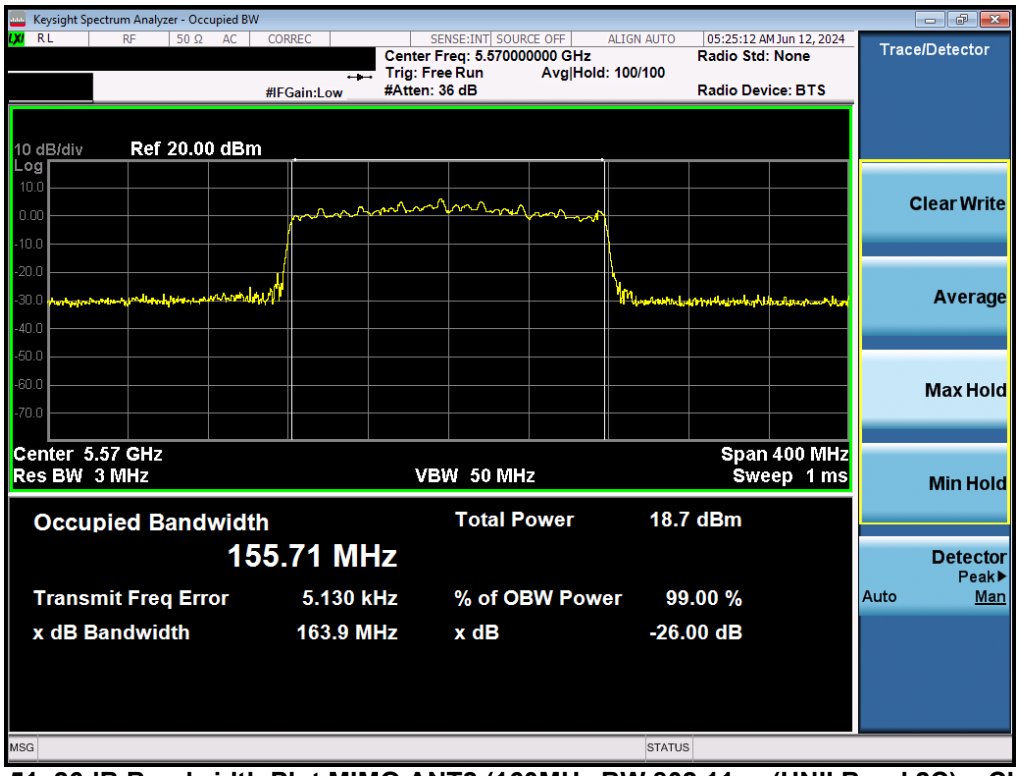
Plot 7-48. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 2C) – Ch. 122)



Plot 7-49. 26dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 2C) –



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



Plot 7-51. 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

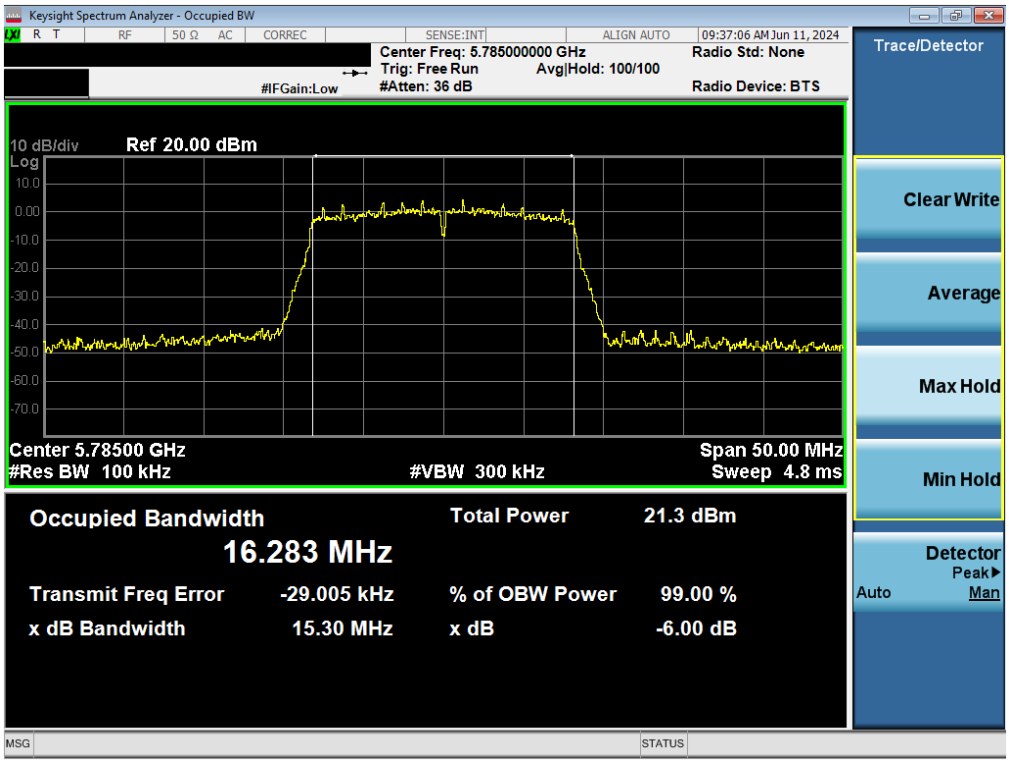
	Frequency [MHz]	Channel	802.11 MODE	Antenna-1 6dB Bandwidth [MHz]	Antenna-2 6dB Bandwidth [MHz]
Band 3	5745	149	a	15.34	15.31
	5785	157	a	15.30	15.33
	5825	165	a	15.06	15.38
	5745	149	n	15.48	15.95
	5785	157	n	16.15	16.29
	5825	165	n	15.12	16.80
	5745	149	ax SU	18.33	16.57
	5785	157	ax SU	16.56	17.94
	5825	165	ax SU	18.17	18.27
	5755	151	n	35.21	35.19
	5795	159	n	35.21	35.17
	5755	151	ax SU	35.20	35.18
	5795	159	ax SU	35.21	35.18
	5775	155	ac	75.29	75.36
	5775	155	ax SU	75.38	75.40

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

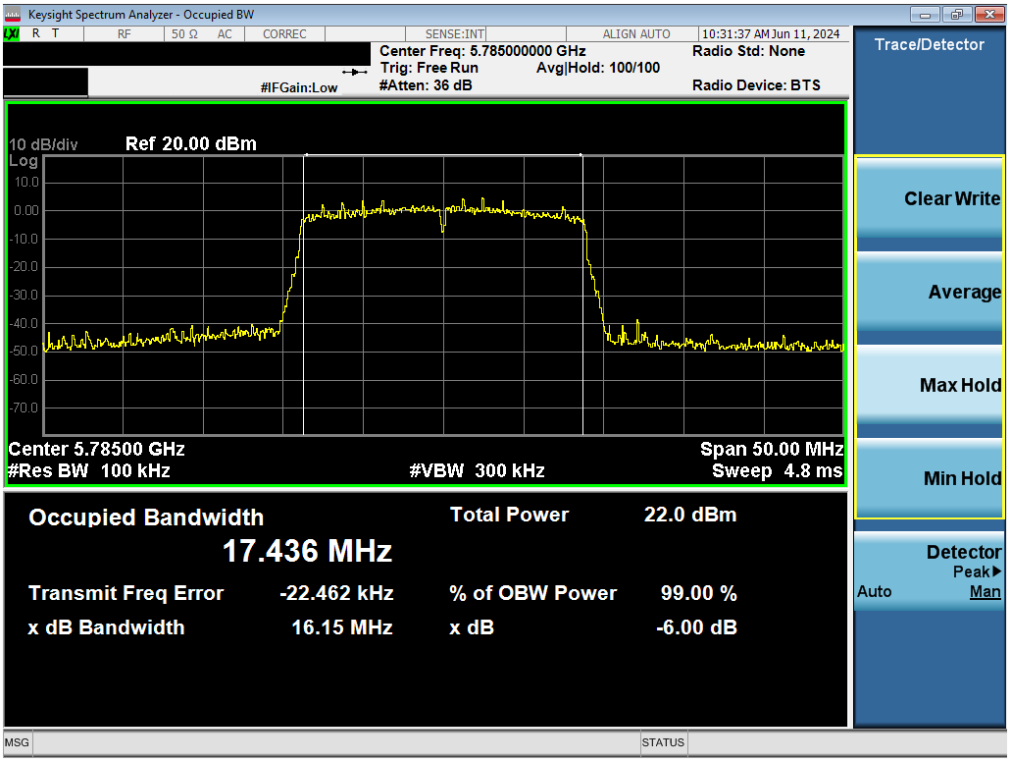
	Frequency [MHz]	Channel	802.11 MODE	Antenna-1 6dB Bandwidth [MHz]	Antenna-2 6dB Bandwidth [MHz]
Band 3/4	5845	169	a	15.06	15.76
Band 4	5865	173	a	16.29	15.97
	5885	177	a	15.83	15.96
Band 3/4	5845	169	n	15.74	16.54
Band 4	5865	173	n	15.74	15.74
	5885	177	n	15.16	15.73
Band 3/4	5845	169	ax SU	16.58	16.98
Band 4	5865	173	ax SU	17.73	16.64
	5885	177	ax SU	17.31	18.45
Band 3/4	5835	167	n	35.19	35.19
Band 4	5875	175	n	35.19	35.19
Band 3/4	5835	167	ax SU	35.18	35.18
Band 4	5875	175	ax SU	35.20	35.17
Band 3/4	5855	171	ac	75.45	75.25
	5855	171	ax SU	75.60	76.28
	5815	163	ac	151.54	155.38
	5815	163	ax SU	155.49	155.34

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

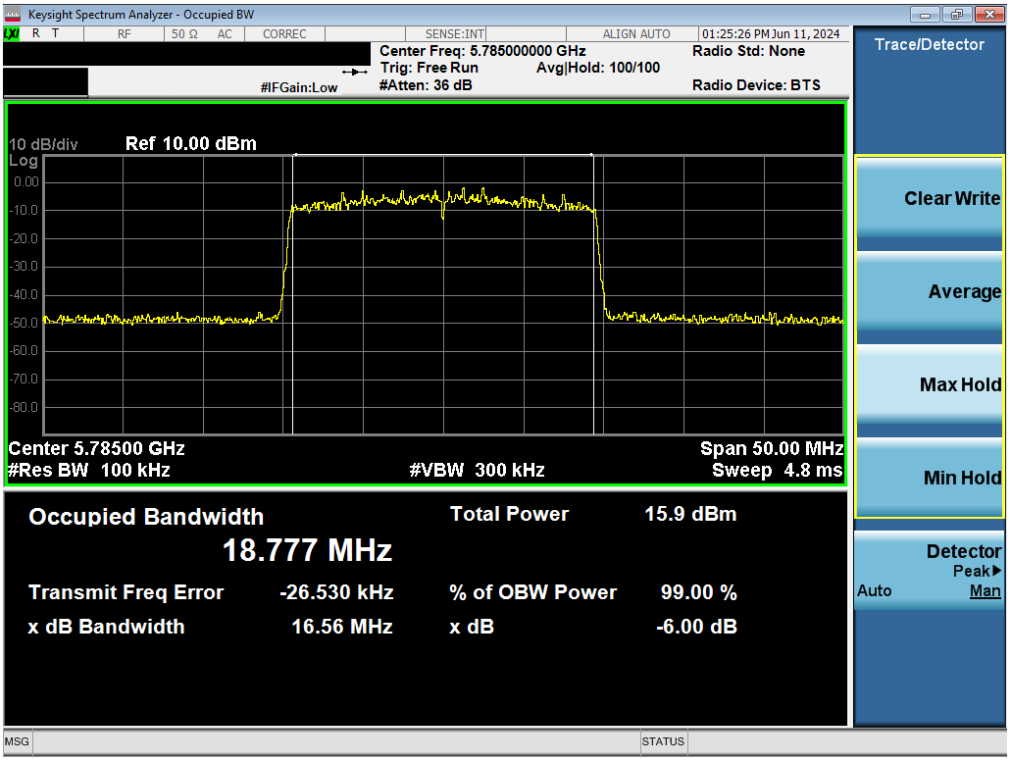
7.3.1 MIMO Antenna-1 6dB Bandwidth Measurements



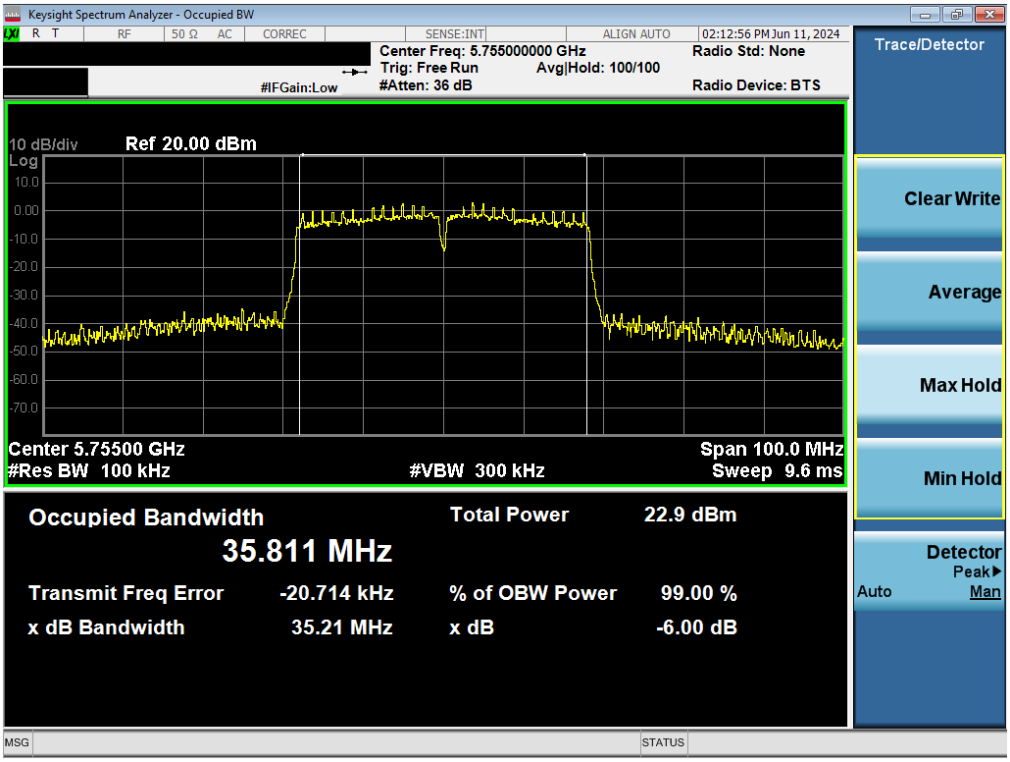
Plot 7-52. 6dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 3) – Ch. 157)



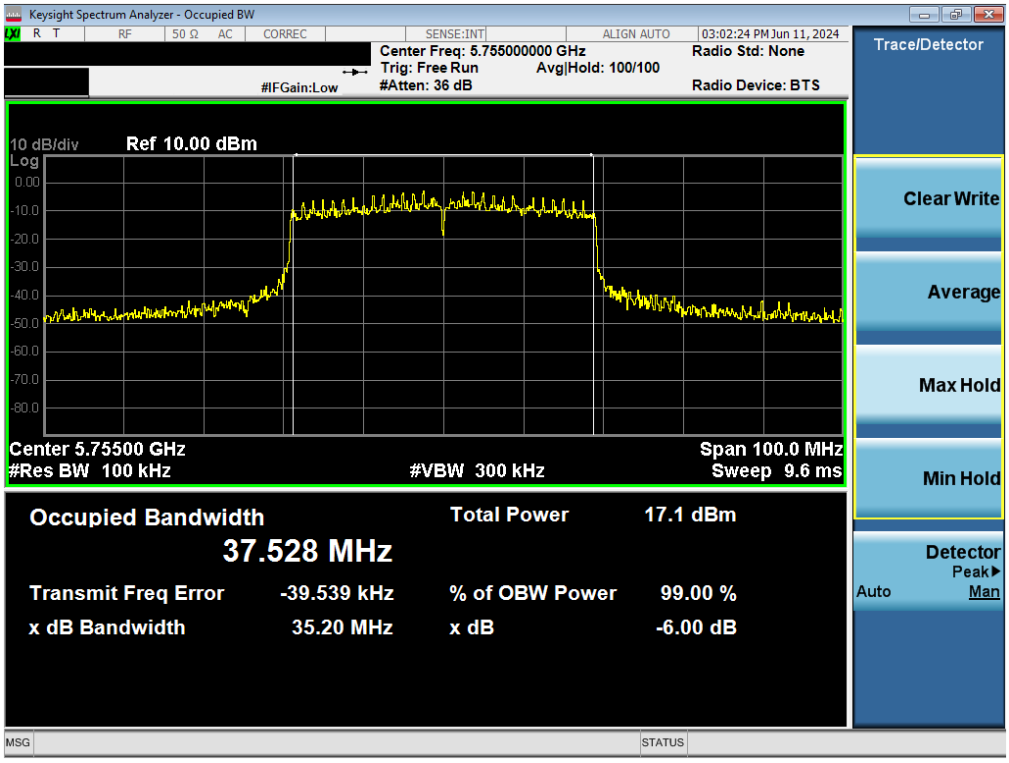
Plot 7-53. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)



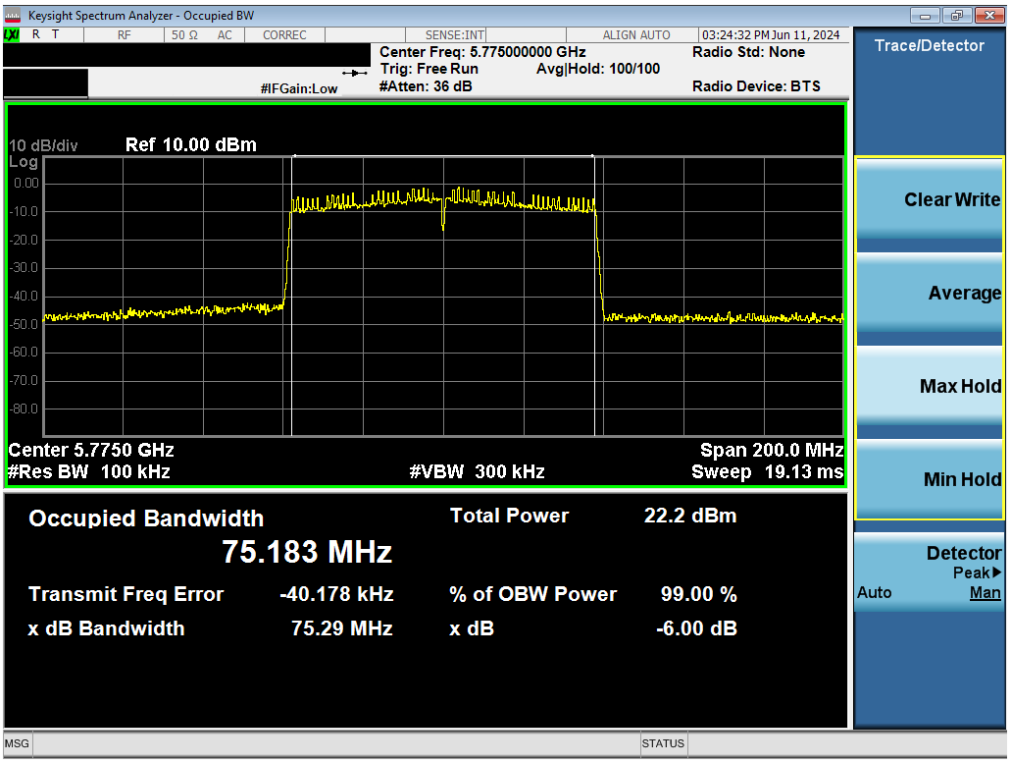
Plot 7-54. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 3) – Ch. 157)



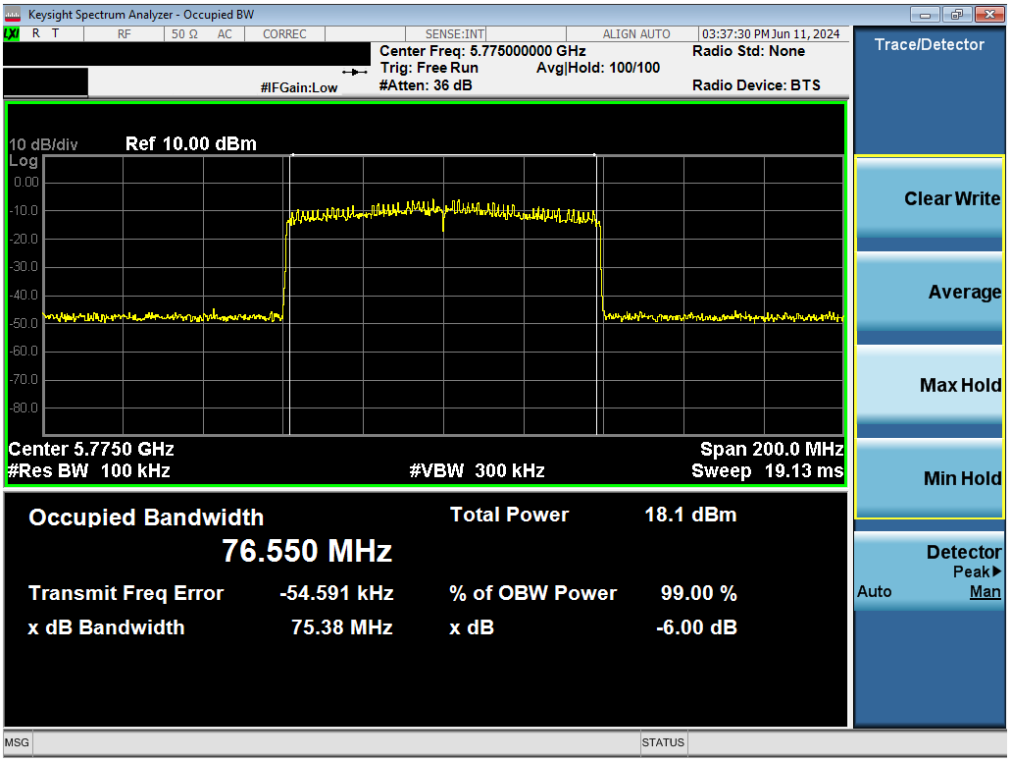
Plot 7-55. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)



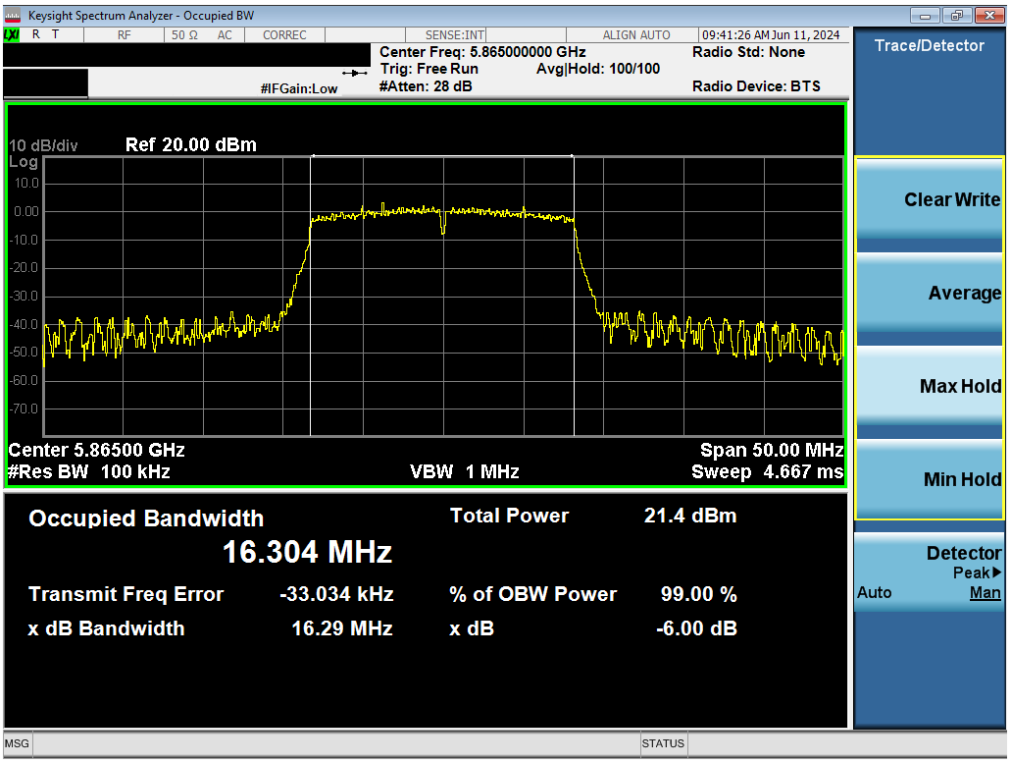
Plot 7-56. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 3) – Ch. 151)



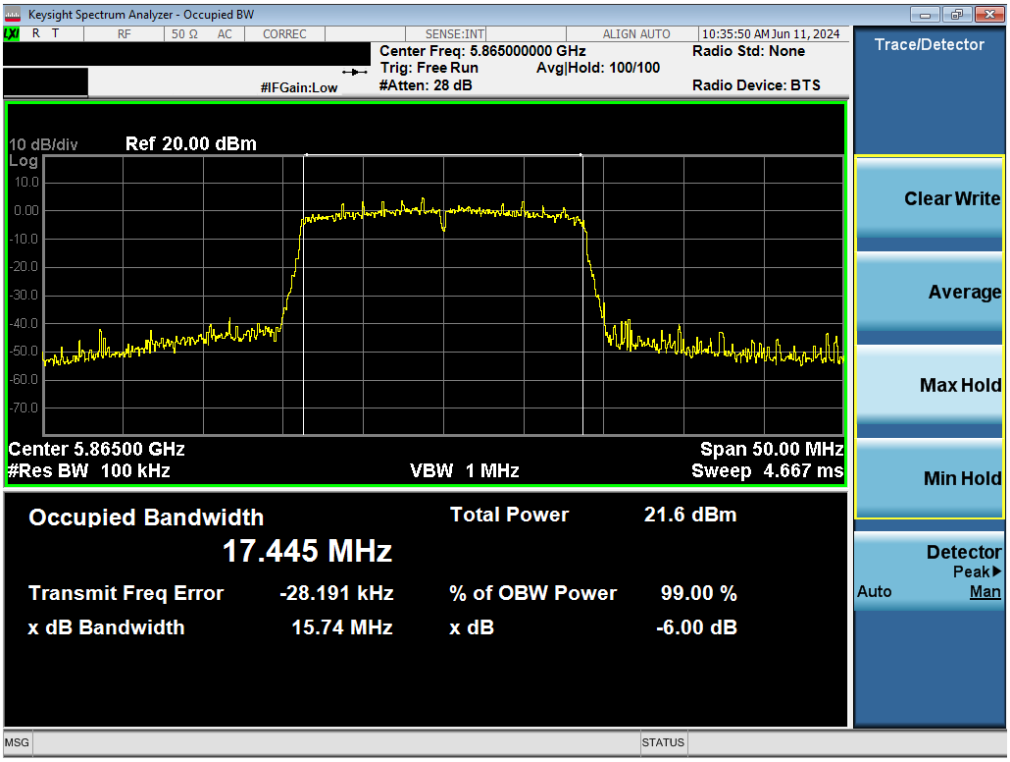
Plot 7-57. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)



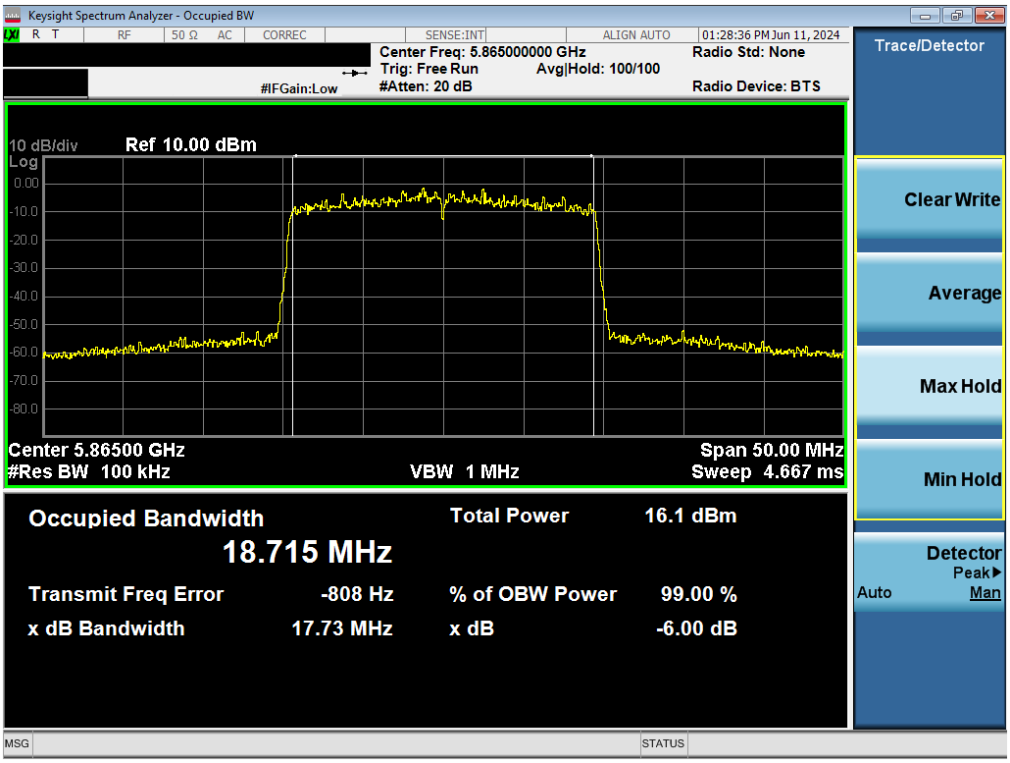
Plot 7-58. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 3) – Ch. 155)



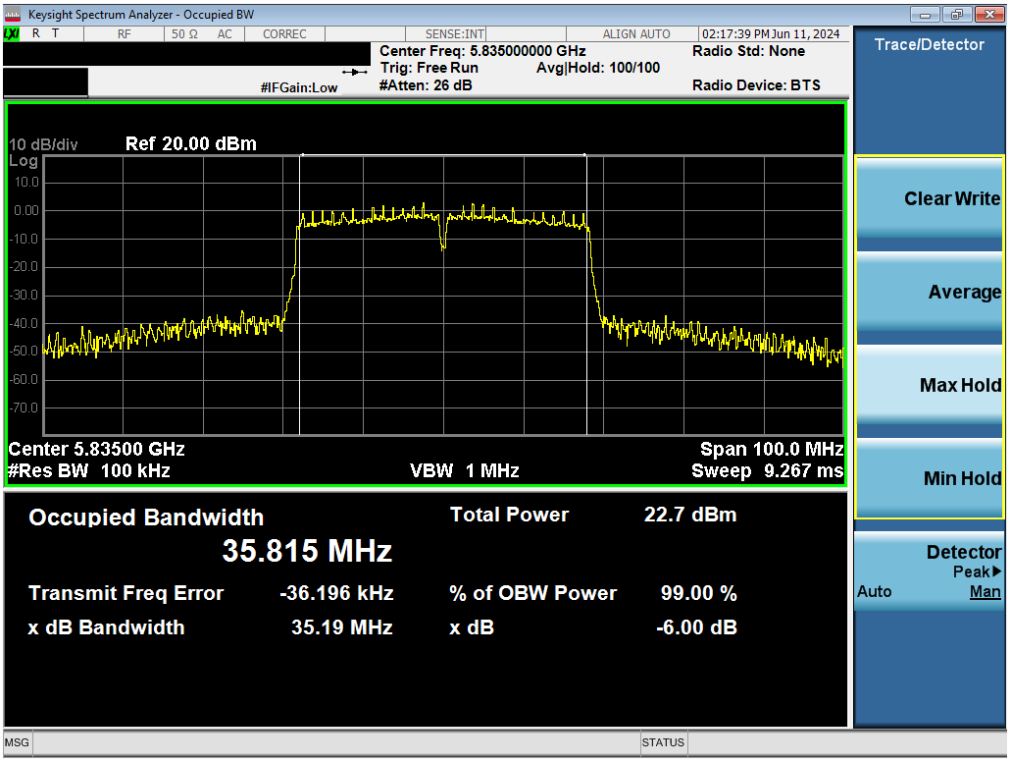
Plot 7-59. 6dB Bandwidth Plot MIMO ANT1 (802.11a (UNII Band 4) – Ch. 173)



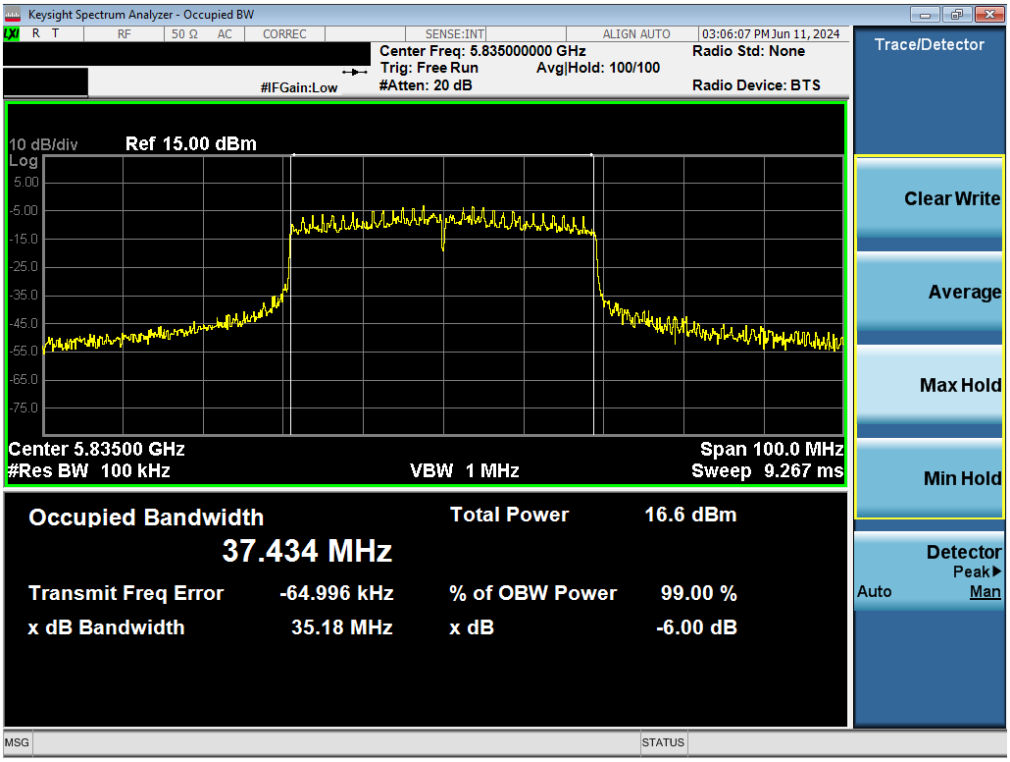
Plot 7-60. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 4) – Ch. 173)



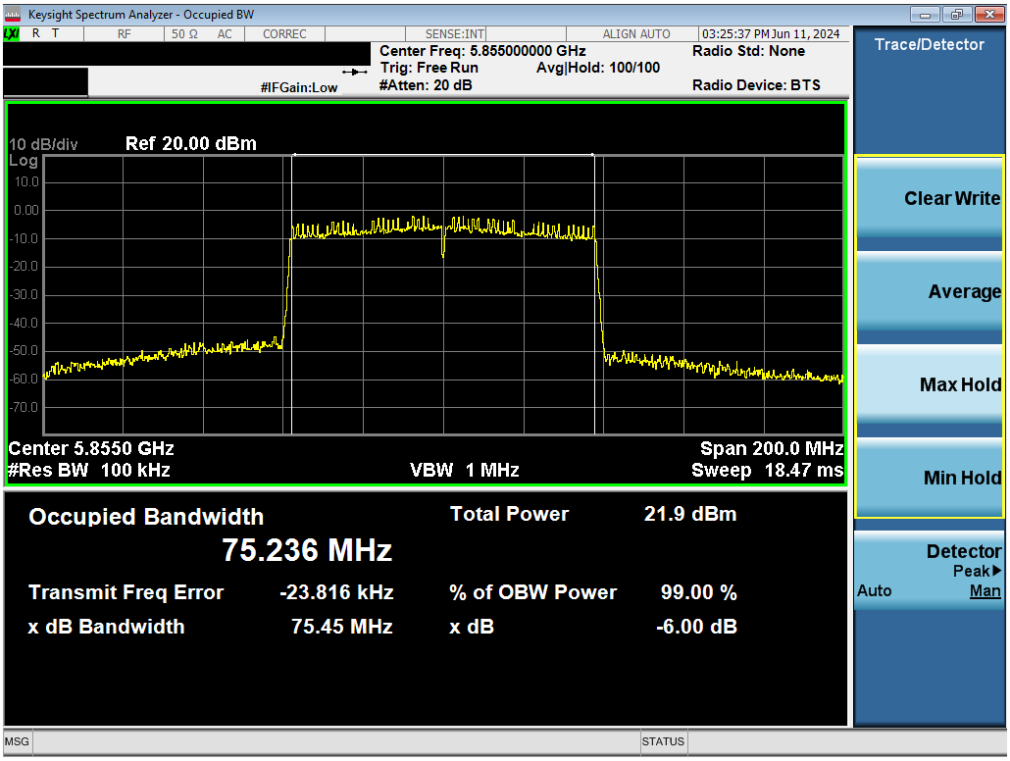
Plot 7-61. 6dB Bandwidth Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 4) – Ch. 173)



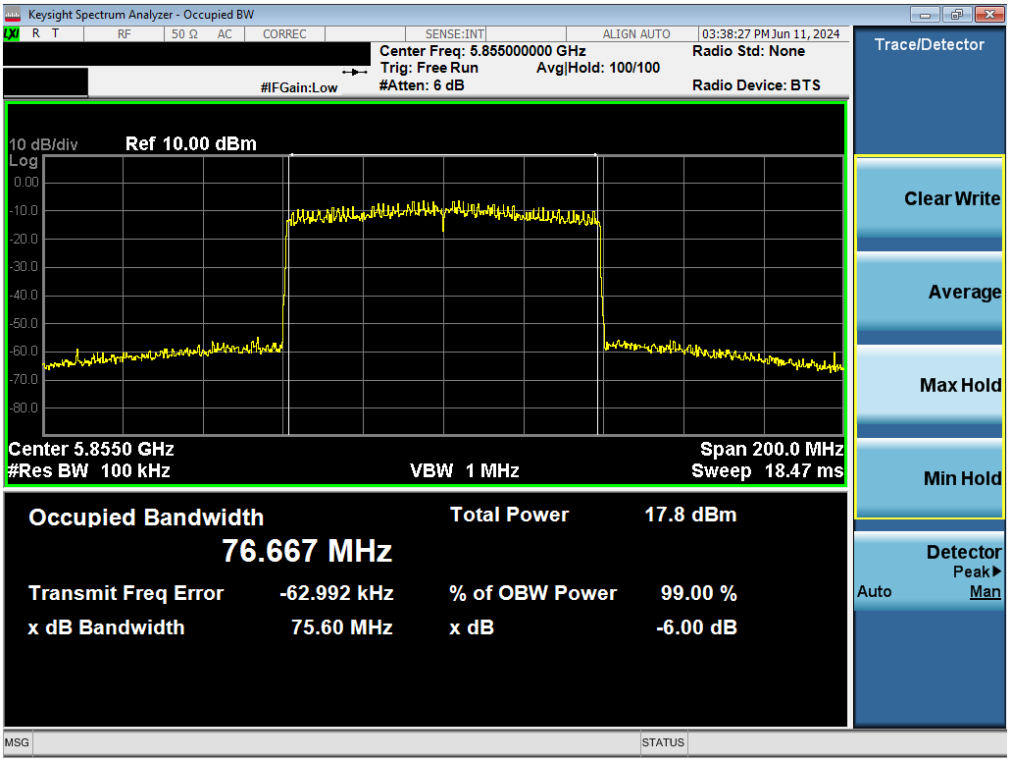
Plot 7-62. 6dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 3/4) – Ch. 167)



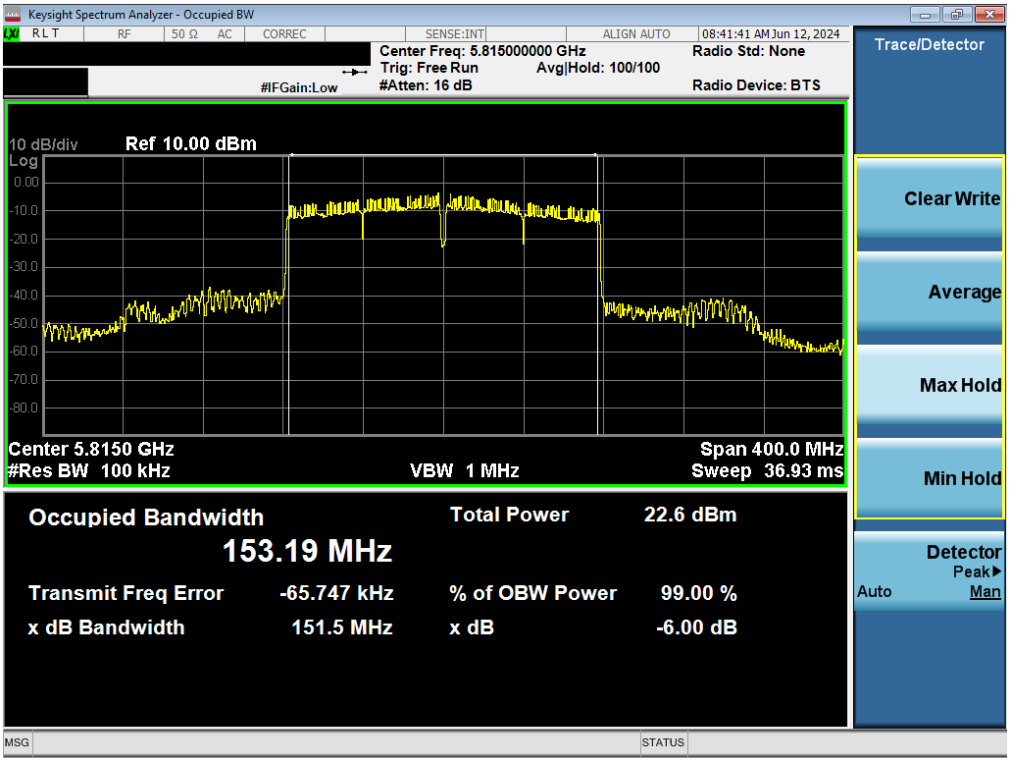
Plot 7-63. 26dB Bandwidth Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 3/4) – Ch. 167)



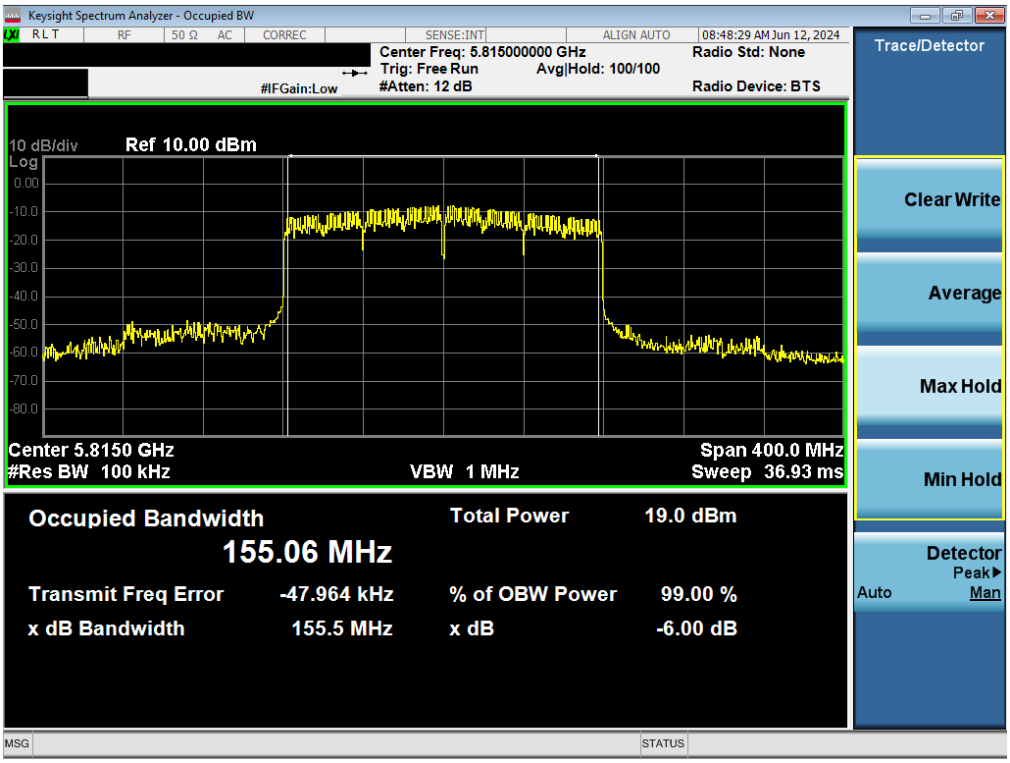
Plot 7-64. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 3/4) – Ch. 171)



Plot 7-65. 6dB Bandwidth Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 3/4) – Ch. 171)

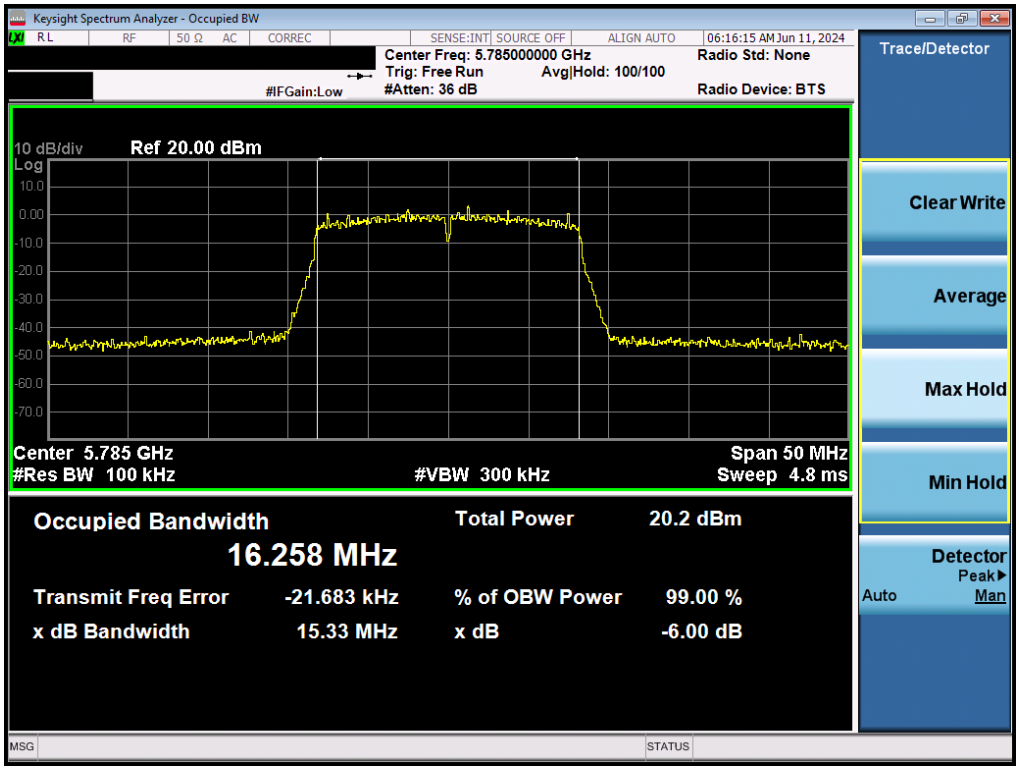


Plot 7-66. 6dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 3/4) – Ch. 163)

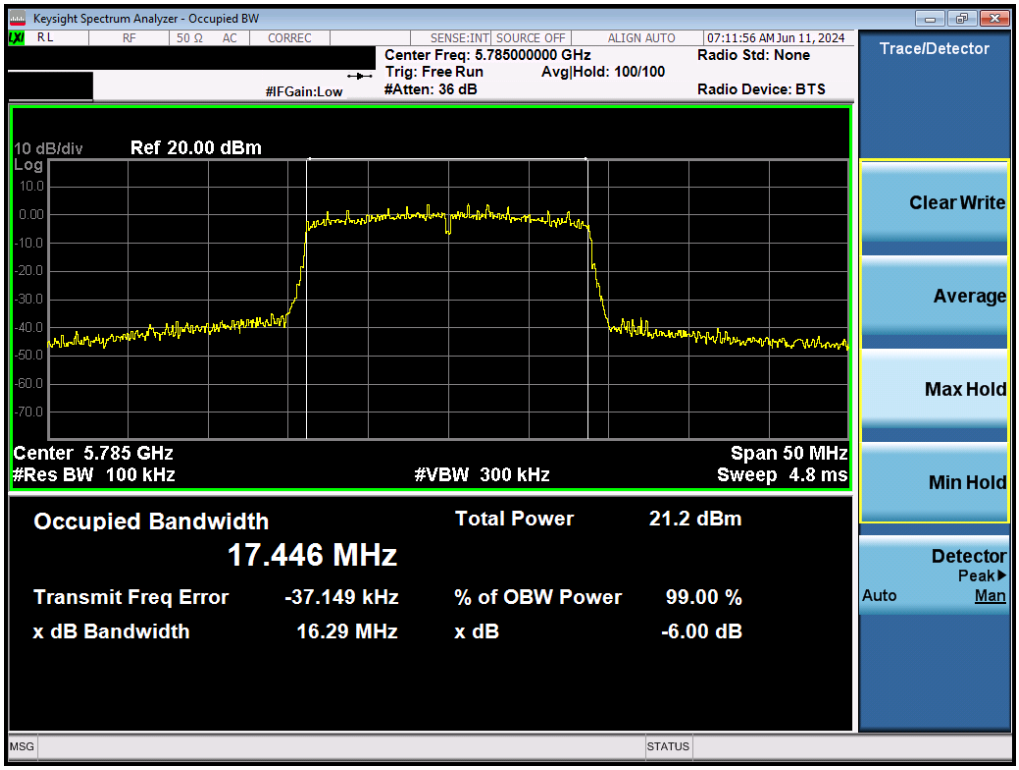


Plot 7-67. 6dB Bandwidth Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 3/4) – Ch. 163)

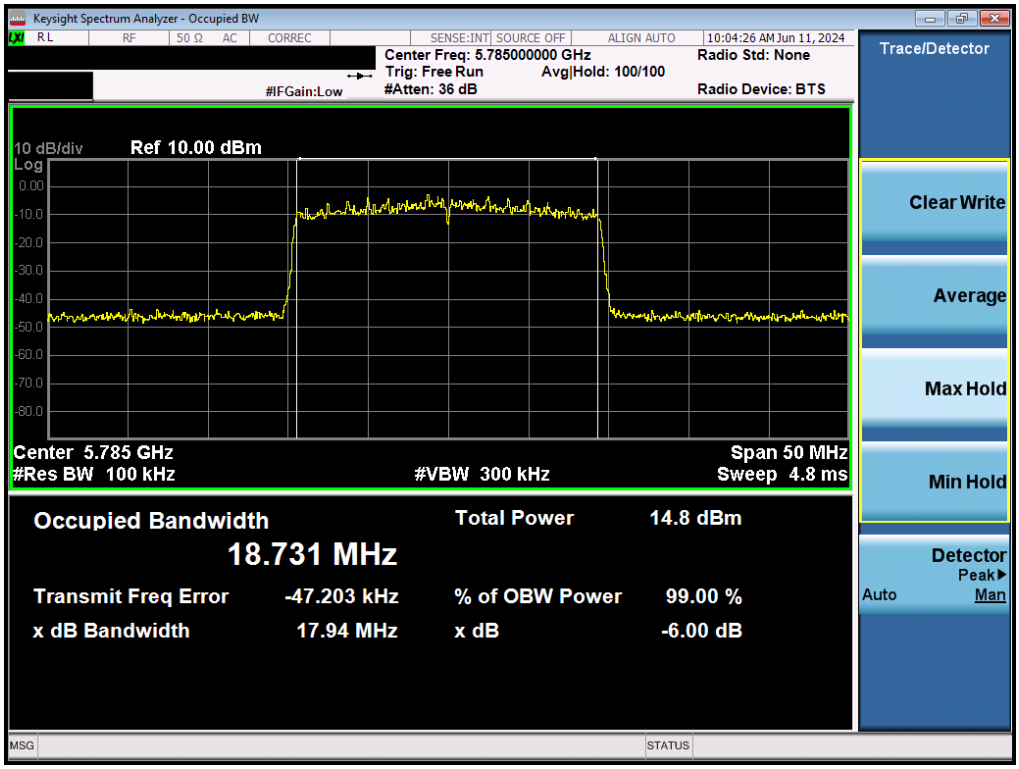
7.3.2 MIMO Antenna-2 6dB Bandwidth Measurements



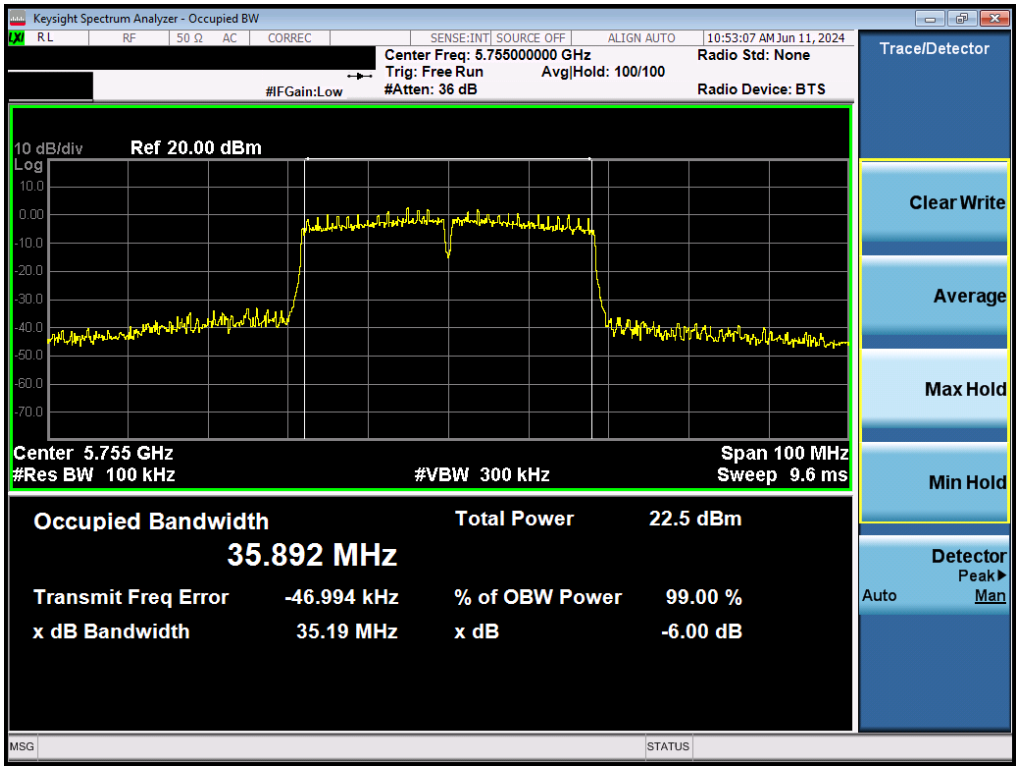
Plot 7-68. 6dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 3) – Ch. 157)



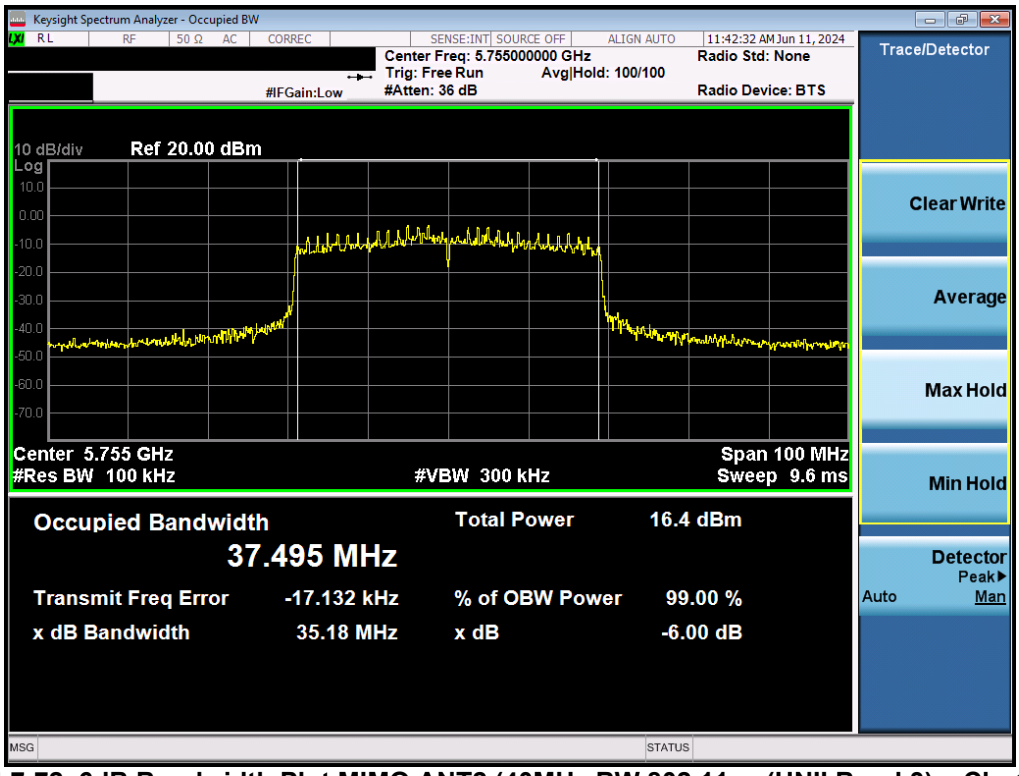
Plot 7-69. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 3) – Ch. 157)



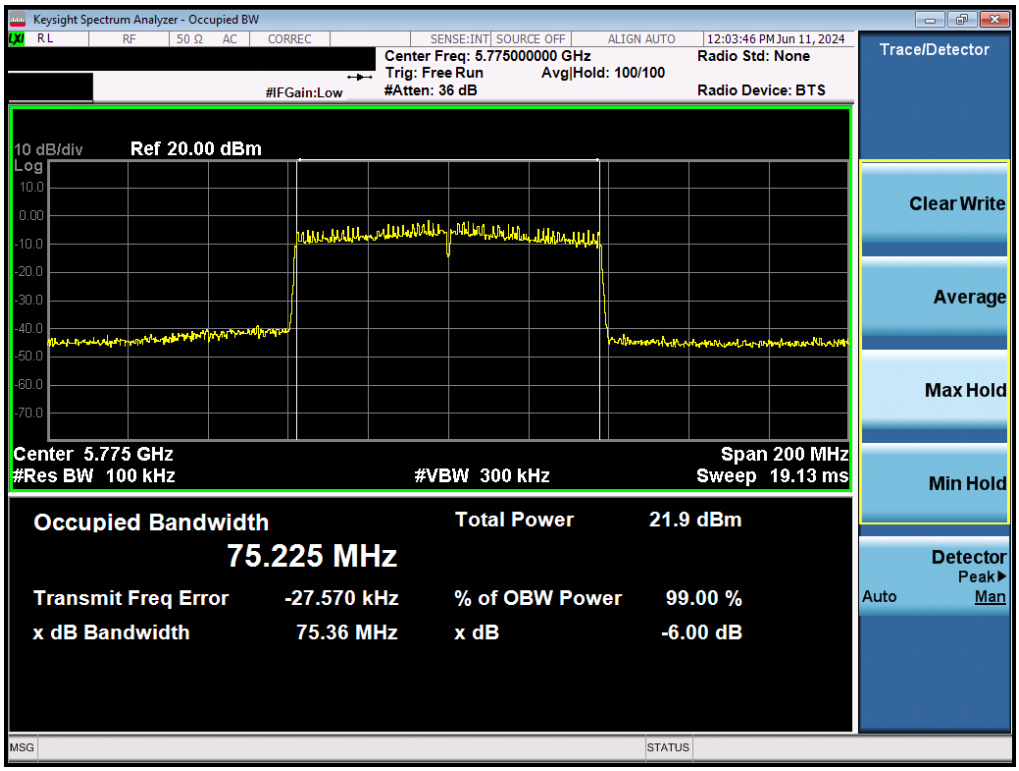
Plot 7-70. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 3) – Ch. 157)



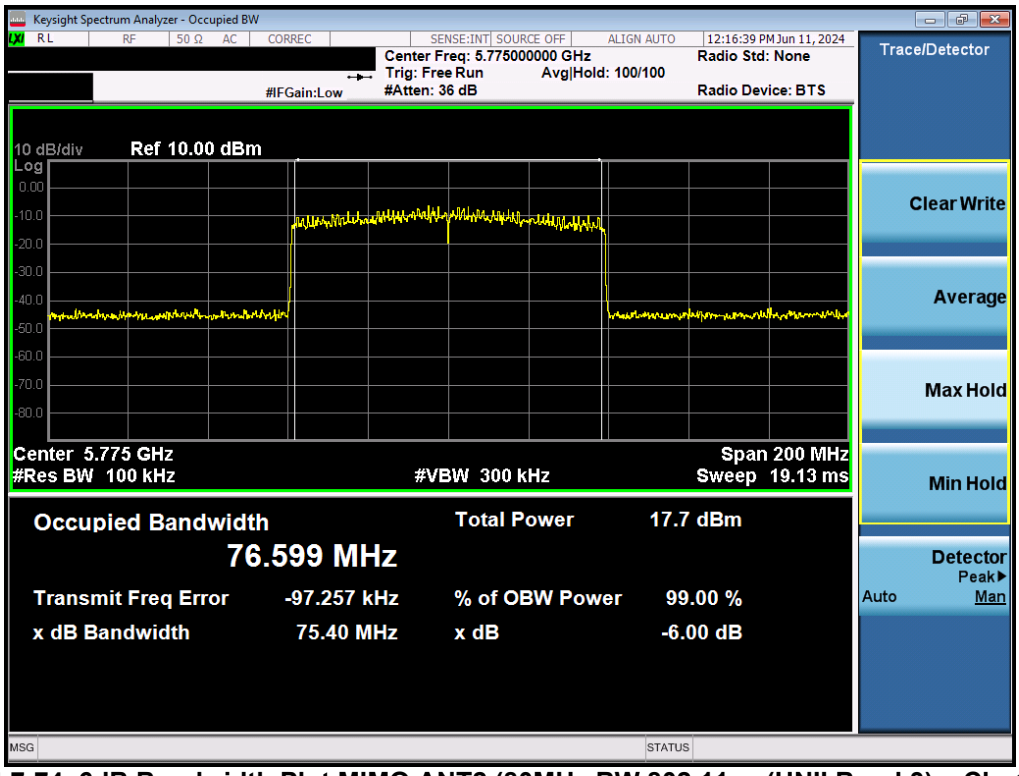
Plot 7-71. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 3) – Ch. 151)



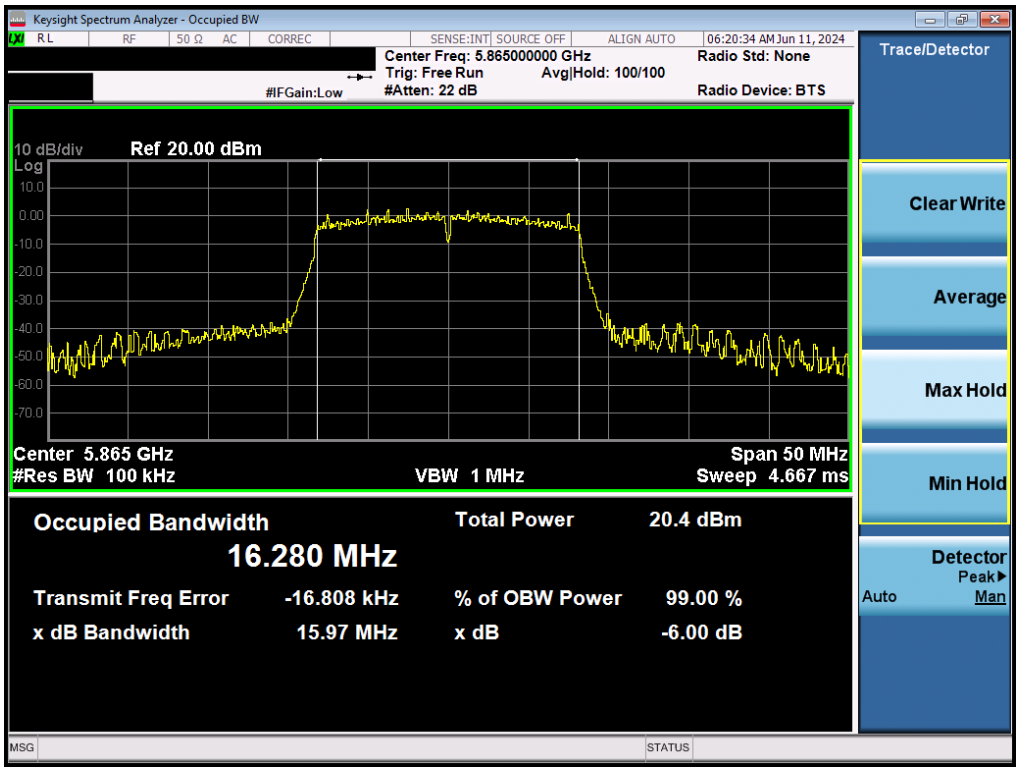
Plot 7-72. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3) – Ch. 151)



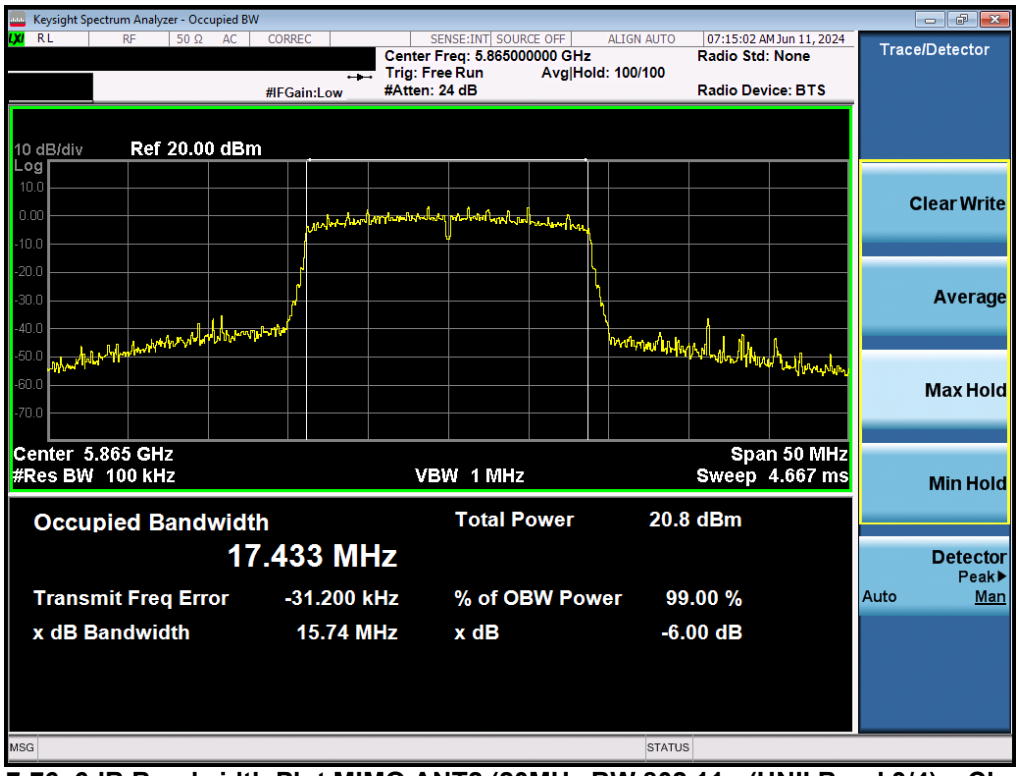
Plot 7-73. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3) – Ch. 155)



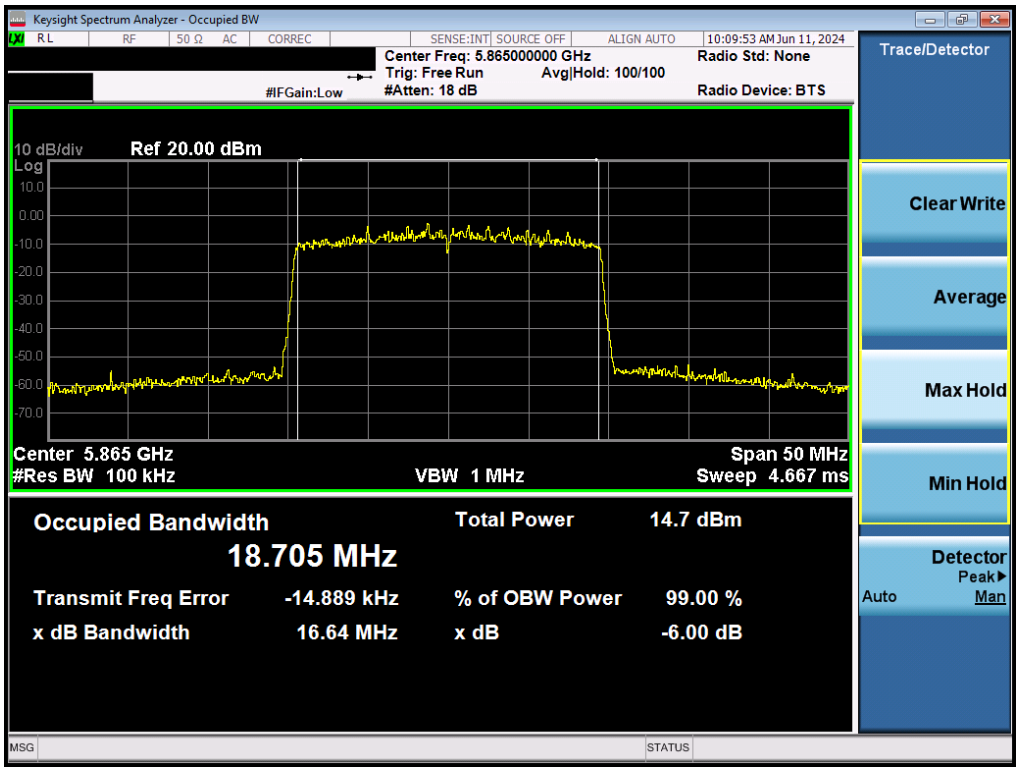
Plot 7-74. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3) – Ch. 155)



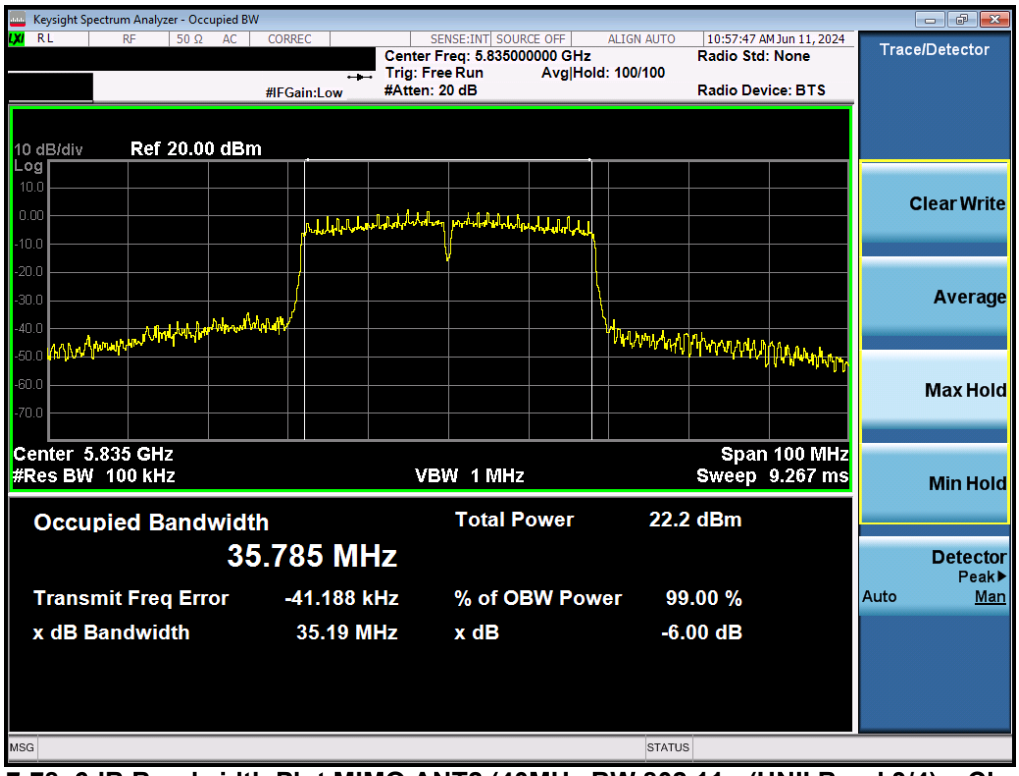
Plot 7-75. 6dB Bandwidth Plot MIMO ANT2 (802.11a (UNII Band 4) – Ch. 173)



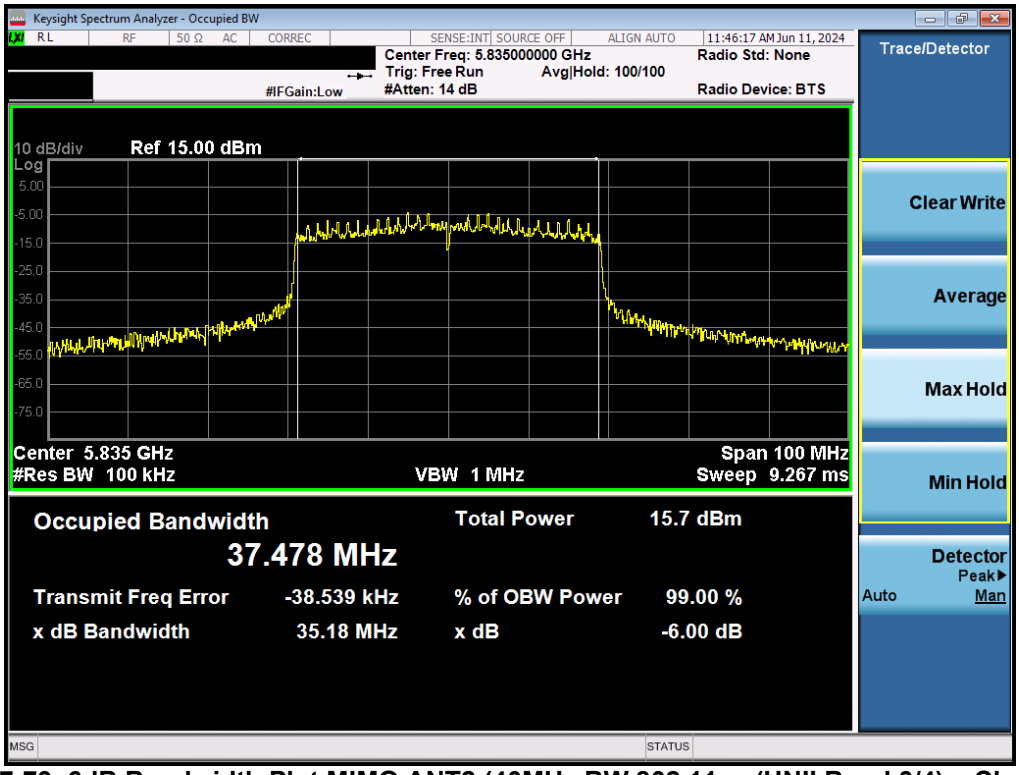
Plot 7-76. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11n (UNII Band 3/4) – Ch. 173)



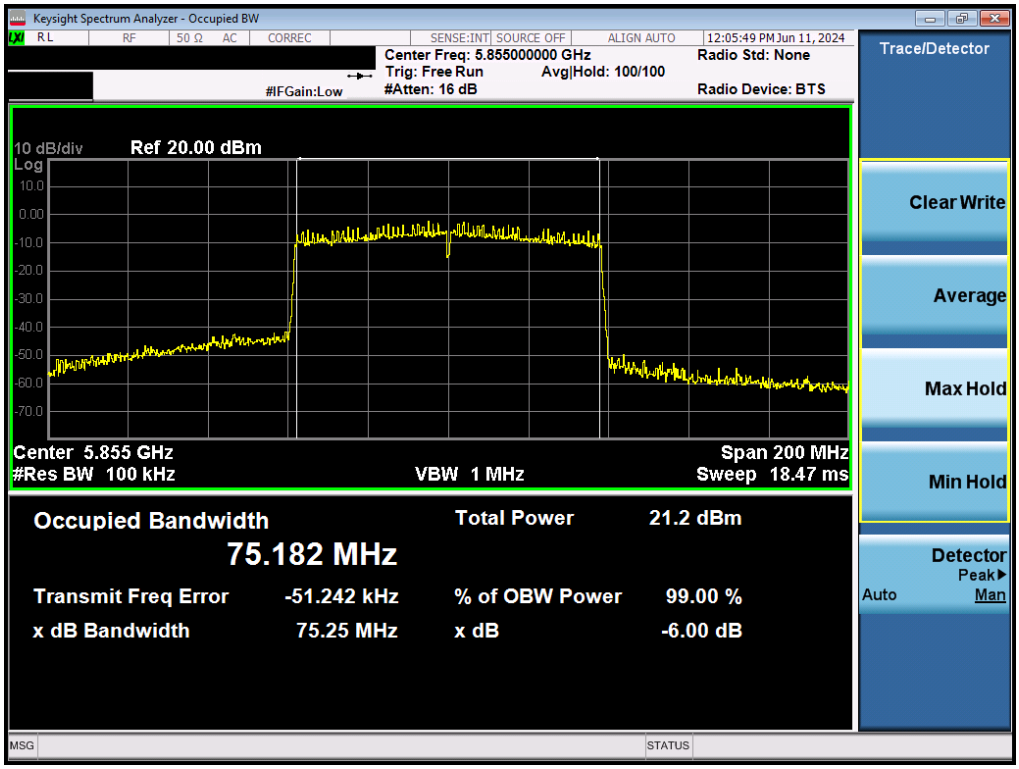
Plot 7-77. 6dB Bandwidth Plot MIMO ANT2 (20MHz BW 802.11ax (UNII Band 3/4) – Ch. 173)



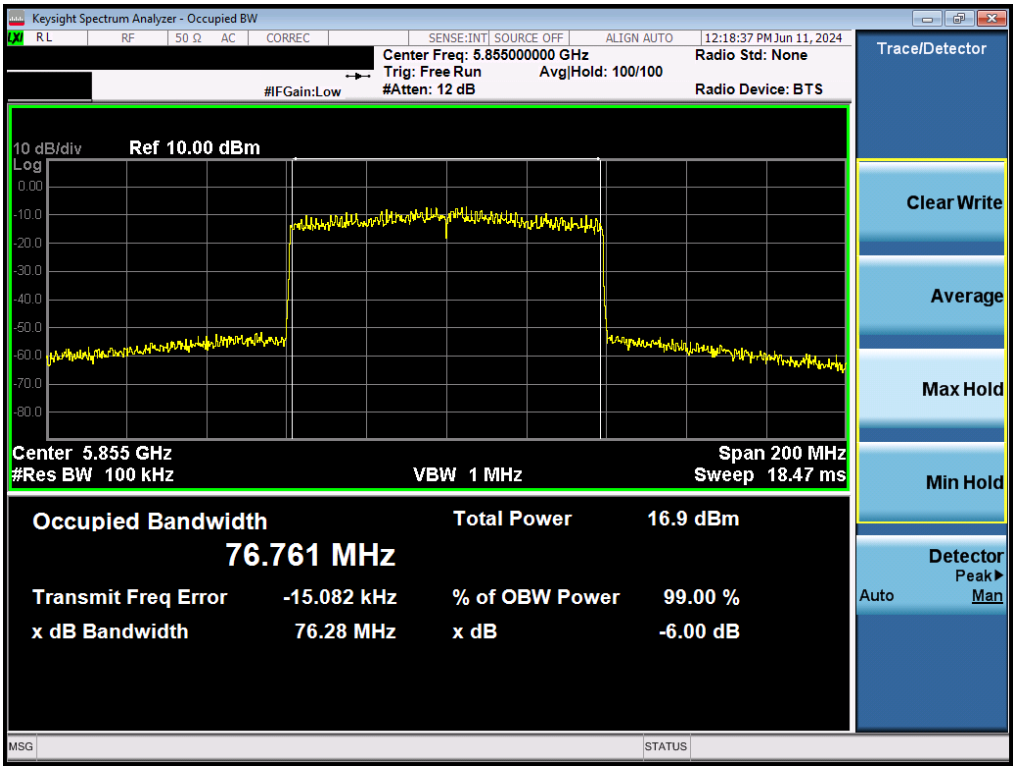
Plot 7-78. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11n (UNII Band 3/4) – Ch. 167)



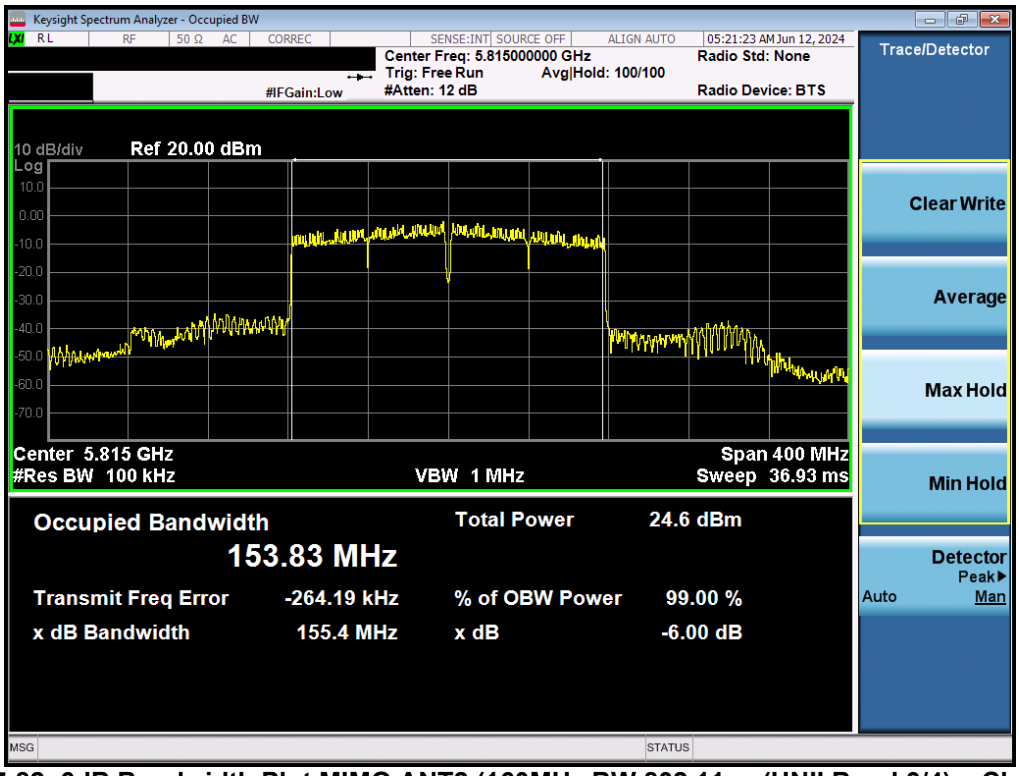
Plot 7-79. 6dB Bandwidth Plot MIMO ANT2 (40MHz BW 802.11ax (UNII Band 3/4) – Ch. 167)



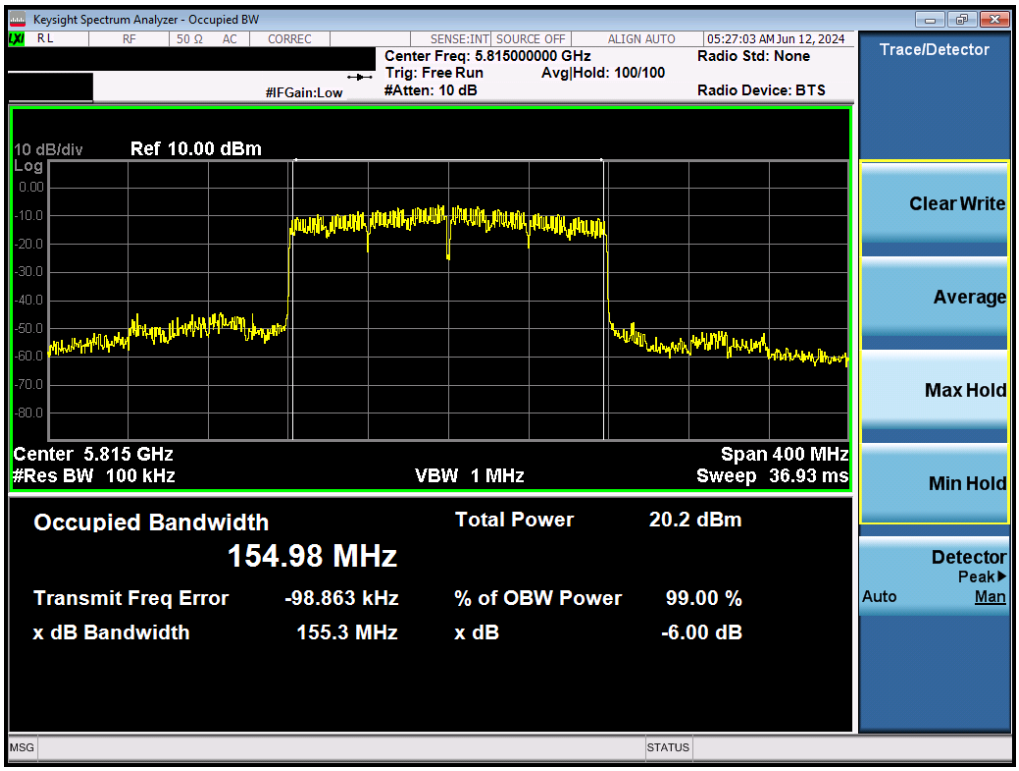
Plot 7-80. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ac (UNII Band 3/4) – Ch. 171)



Plot 7-81. 6dB Bandwidth Plot MIMO ANT2 (80MHz BW 802.11ax (UNII Band 3/4) – Ch. 171)



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



Plot 7-83. 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	FCC
UNII 1	5.15 – 5.25GHz	23.98dBm (250mW)	N/A
UNII 2A	5.25 – 5.35GHz	The lesser of 23.98dBm (250mW) **or** 11dBm + 10log$_{10}$B	N/A
UNII 2C	5.47 – 5.725GHz		
UNII 3	5.725 – 5.850GHz	30dBm (1W)	N/A
UNII 4	5.850 – 5.895GHz	N/A	30dBm (1W)

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

5GHz WIFI (20MHz 802.11a MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	0	36	16.36	16.95	19.68	23.98	-4.30	-2.96	16.72	30.00	-13.28
	0	40	16.35	16.97	19.68	23.98	-4.30	-2.96	16.72	30.00	-13.28
	0	44	16.33	16.92	19.65	23.98	-4.33	-2.96	16.69	30.00	-13.31
	0	48	16.67	16.90	19.80	23.98	-4.18	-2.96	16.84	30.00	-13.16
UNII-2A	0	52	16.75	16.87	19.82	23.98	-4.16	-3.24	16.58	30.00	-13.42
	0	56	16.72	16.86	19.80	23.98	-4.18	-3.24	16.56	30.00	-13.44
	0	60	16.46	16.35	19.42	23.98	-4.56	-3.24	16.18	30.00	-13.82
	0	64	16.88	16.90	19.90	23.98	-4.08	-3.24	16.66	30.00	-13.34
UNII-2C	0	100	16.40	16.68	19.55	23.98	-4.43	-3.30	16.25	30.00	-13.75
	0	120	16.70	16.92	19.82	23.98	-4.16	-3.30	16.52	30.00	-13.48
	0	124	16.78	16.91	19.86	23.98	-4.12	-3.30	16.55	30.00	-13.45
	0	144	16.76	16.64	19.71	23.98	-4.27	-3.30	16.41	30.00	-13.59
UNII-3	5	149	16.42	16.70	19.57	30.00	-10.43	-3.45	16.12	36.00	-19.88
	5	157	16.07	16.51	19.31	30.00	-10.69	-3.45	15.86	36.00	-20.14
	5	165	16.38	16.60	19.50	30.00	-10.50	-3.45	16.05	36.00	-19.95
UNII-4	5	169	16.64	16.98	19.82	-	-	-3.66	16.16	30.00	-13.84
	5	173	16.55	16.89	19.73	-	-	-3.66	16.07	30.00	-13.93
	5	177	16.69	16.80	19.76	-	-	-3.66	16.09	30.00	-13.91

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

5GHz WIFI (20MHz 802.11n MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	0	36	16.27	16.56	19.43	23.98	-4.55	-2.96	16.47	30.00	-13.53
	0	40	16.38	16.62	19.51	23.98	-4.47	-2.96	16.55	30.00	-13.45
	0	44	16.28	16.91	19.62	23.98	-4.36	-2.96	16.66	30.00	-13.34
	0	48	16.35	16.90	19.64	23.98	-4.34	-2.96	16.68	30.00	-13.32
UNII-2A	0	52	15.95	16.46	19.22	23.98	-4.76	-3.24	15.98	30.00	-14.02
	0	56	16.37	16.27	19.33	23.98	-4.65	-3.24	16.09	30.00	-13.91
	0	60	16.84	16.72	19.79	23.98	-4.19	-3.24	16.55	30.00	-13.45
	0	64	16.62	16.79	19.72	23.98	-4.26	-3.24	16.48	30.00	-13.52
UNII-2C	0	100	16.25	16.76	19.52	23.98	-4.46	-3.30	16.22	30.00	-13.78
	0	124	16.51	16.70	19.62	23.98	-4.36	-3.30	16.31	30.00	-13.69
	0	144	16.94	16.98	19.97	23.98	-4.01	-3.30	16.67	30.00	-13.33
UNII-3	5	149	16.20	16.56	19.39	30.00	-10.61	-3.45	15.94	36.00	-20.06
	5	157	16.61	16.92	19.78	30.00	-10.22	-3.45	16.33	36.00	-19.67
	5	165	16.69	16.88	19.80	30.00	-10.20	-3.45	16.35	36.00	-19.65
UNII-4	5	169	16.42	16.77	19.61	-	-	-3.66	15.95	30.00	-14.05
	5	173	16.63	16.75	19.70	-	-	-3.66	16.04	30.00	-13.96
	5	177	16.53	16.66	19.61	-	-	-3.66	15.94	30.00	-14.06

Table 7-9. MIMO 20MHz BW 802.11n (UNII) Maximum Conducted Output Power

5GHz WIFI (20MHz 802.11ac MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	0	36	16.85	16.73	19.80	23.98	-4.18	-2.96	16.84	30.00	-13.16
	0	40	16.49	16.70	19.61	23.98	-4.37	-2.96	16.65	30.00	-13.35
	0	44	16.38	16.58	19.49	23.98	-4.49	-2.96	16.53	30.00	-13.47
	0	48	16.42	16.81	19.63	23.98	-4.35	-2.96	16.67	30.00	-13.33
UNII-2A	0	52	16.56	16.73	19.66	23.98	-4.32	-3.24	16.42	30.00	-13.58
	0	56	16.65	16.75	19.71	23.98	-4.27	-3.24	16.47	30.00	-13.53
	0	60	16.67	16.76	19.73	23.98	-4.25	-3.24	16.49	30.00	-13.51
	0	64	16.76	16.85	19.82	23.98	-4.16	-3.24	16.58	30.00	-13.42
UNII-2C	0	100	16.27	16.80	19.55	23.98	-4.43	-3.30	16.25	30.00	-13.75
	0	120	16.50	16.77	19.65	23.98	-4.33	-3.30	16.35	30.00	-13.65
	0	124	16.36	16.58	19.48	23.98	-4.50	-3.30	16.18	30.00	-13.82
	0	144	16.52	16.66	19.60	23.98	-4.38	-3.30	16.30	30.00	-13.70
UNII-3	5	149	16.26	16.61	19.45	30.00	-10.55	-3.45	16.00	36.00	-20.00
	5	157	16.24	16.51	19.39	30.00	-10.61	-3.45	15.94	36.00	-20.06
	5	165	16.70	16.93	19.83	30.00	-10.17	-3.45	16.38	36.00	-19.62
UNII-4	5	169	16.67	16.90	19.80	-	-	-3.66	16.13	30.00	-13.87
	5	173	16.63	16.50	19.58	-	-	-3.66	15.91	30.00	-14.09
	5	177	16.59	16.74	19.68	-	-	-3.66	16.01	30.00	-13.99

Table 7-10. MIMO 20MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz WIFI (20MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	0	36	10.78	10.39	13.60	23.98	-10.38	-2.96	10.64	30.00	-19.36
	0	40	10.46	10.74	13.61	23.98	-10.37	-2.96	10.65	30.00	-19.35
	0	44	10.11	10.80	13.48	23.98	-10.50	-2.96	10.52	30.00	-19.48
	0	48	10.17	10.86	13.54	23.98	-10.44	-2.96	10.58	30.00	-19.42
UNII-2A	0	52	10.48	10.86	13.68	23.98	-10.30	-3.24	10.44	30.00	-19.56
	0	56	10.80	10.84	13.83	23.98	-10.15	-3.24	10.59	30.00	-19.41
	0	60	10.63	10.92	13.79	23.98	-10.19	-3.24	10.55	30.00	-19.45
	0	64	10.96	10.97	13.98	23.98	-10.00	-3.24	10.74	30.00	-19.26
UNII-2C	0	100	10.26	10.67	13.48	23.98	-10.50	-3.30	10.18	30.00	-19.82
	0	120	10.45	10.59	13.53	23.98	-10.45	-3.30	10.23	30.00	-19.77
	0	124	10.19	10.51	13.36	23.98	-10.62	-3.30	10.06	30.00	-19.94
	0	144	10.64	10.32	13.49	23.98	-10.49	-3.30	10.19	30.00	-19.81
UNII-3	5	149	10.33	10.48	13.42	30.00	-16.58	-3.45	9.97	36.00	-26.03
	5	157	10.35	10.48	13.43	30.00	-16.57	-3.45	9.98	36.00	-26.02
	5	165	10.47	10.89	13.70	30.00	-16.30	-3.45	10.25	36.00	-25.75
UNII-4	5	169	10.49	10.73	13.62	-	-	-3.66	9.96	30.00	-20.04
	5	173	10.40	10.65	13.54	-	-	-3.66	9.87	30.00	-20.13
	5	177	10.33	10.56	13.46	-	-	-3.66	9.79	30.00	-20.21

Table 7-11. MIMO 20MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz WIFI (40MHz 802.11n MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5190	38	16.77	16.70	19.75	23.98	-4.23	-2.96	16.79	30.00	-13.21
	5230	46	16.37	16.75	19.57	23.98	-4.41	-2.96	16.61	30.00	-13.39
UNII-2A	5270	54	16.79	16.75	19.78	23.98	-4.20	-3.24	16.54	30.00	-13.46
	5310	62	16.82	16.66	19.75	23.98	-4.23	-3.24	16.51	30.00	-13.49
UNII-2C	5510	102	16.15	16.61	19.40	23.98	-4.58	-3.30	16.10	30.00	-13.90
	5590	118	16.53	16.76	19.66	23.98	-4.32	-3.30	16.36	30.00	-13.64
	5630	126	16.38	16.47	19.44	23.98	-4.54	-3.30	16.14	30.00	-13.86
	5710	142	16.82	16.62	19.73	23.98	-4.25	-3.30	16.43	30.00	-13.57
UNII-3	5755	151	16.49	16.77	19.64	30.00	-10.36	-3.45	16.19	36.00	-19.81
	5795	159	16.38	16.61	19.51	30.00	-10.49	-3.45	16.06	36.00	-19.94
UNII-4	5835	167	16.45	16.62	19.55	-	-	-3.45	16.10	30.00	-13.90
	5875	175	16.78	16.93	19.87	-	-	-3.66	16.20	30.00	-13.80

Table 7-12. MIMO 40MHz BW 802.11n (UNII) Maximum Conducted Output Power

5GHz WIFI (40MHz 802.11ac MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5190	38	16.67	16.71	19.70	23.98	-4.28	-2.96	16.74	30.00	-13.26
	5230	46	16.22	16.85	19.56	23.98	-4.42	-2.96	16.60	30.00	-13.40
UNII-2A	5270	54	16.61	16.83	19.73	23.98	-4.25	-3.24	16.49	30.00	-13.51
	5310	62	16.60	16.91	19.77	23.98	-4.21	-3.24	16.53	30.00	-13.47
UNII-2C	5510	102	16.08	16.60	19.36	23.98	-4.62	-3.30	16.06	30.00	-13.94
	5590	118	16.75	16.80	19.79	23.98	-4.19	-3.30	16.49	30.00	-13.51
	5630	126	16.54	16.59	19.58	23.98	-4.40	-3.30	16.28	30.00	-13.72
	5710	142	16.98	16.63	19.82	23.98	-4.16	-3.30	16.52	30.00	-13.48
UNII-3	5755	151	16.54	16.85	19.71	30.00	-10.29	-3.45	16.26	36.00	-19.74
	5795	159	16.45	16.65	19.56	30.00	-10.44	-3.45	16.11	36.00	-19.89
UNII-4	5835	167	16.37	16.55	19.47	-	-	-3.45	16.02	30.00	-13.98
	5875	175	16.75	16.91	19.84	-	-	-3.66	16.18	30.00	-13.82

Table 7-13. MIMO 40MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz WIFI (40MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5190	38	10.55	10.87	13.72	23.98	-10.26	-2.96	10.76	30.00	-19.24
	5230	46	10.07	10.70	13.41	23.98	-10.57	-2.96	10.45	30.00	-19.55
UNII-2A	5270	54	10.37	10.51	13.45	23.98	-10.53	-3.24	10.21	30.00	-19.79
	5310	62	10.63	10.85	13.75	23.98	-10.23	-3.24	10.51	30.00	-19.49
UNII-2C	5510	102	10.24	10.41	13.34	23.98	-10.64	-3.30	10.04	30.00	-19.96
	5590	118	10.76	10.81	13.80	23.98	-10.18	-3.30	10.50	30.00	-19.50
	5630	126	10.41	10.66	13.55	23.98	-10.43	-3.30	10.25	30.00	-19.75
	5710	142	10.98	10.73	13.87	23.98	-10.11	-3.30	10.57	30.00	-19.43
UNII-3	5755	151	10.45	10.84	13.66	30.00	-16.34	-3.45	10.21	36.00	-25.79
	5795	159	10.31	10.70	13.52	30.00	-16.48	-3.45	10.07	36.00	-25.93
UNII-4	5835	167	10.34	10.65	13.51	-	-	-3.45	10.06	30.00	-19.94
	5875	175	10.22	10.53	13.39	-	-	-3.66	9.72	30.00	-20.28

Table 7-14. MIMO 40MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz WIFI (80MHz 802.11ac MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5210	42	15.39	15.87	18.65	23.98	-5.33	-2.96	15.69	30.00	-14.31
UNII-2A	5290	58	15.49	15.70	18.61	23.98	-5.37	-3.24	15.37	30.00	-14.63
UNII-2C	5530	106	15.07	15.57	18.34	23.98	-5.64	-3.30	15.04	30.00	-14.96
	5610	122	15.49	15.80	18.66	23.98	-5.32	-3.30	15.36	30.00	-14.64
	5690	138	15.47	15.30	18.40	23.98	-5.58	-3.30	15.10	30.00	-14.90
UNII-3	5775	155	15.68	15.94	18.82	30.00	-11.18	-3.45	15.37	36.00	-20.63
UNII-4	5885	171	15.44	15.64	18.55	-	-	-3.45	15.10	30.00	-14.90

Table 7-15. MIMO 80MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz WIFI (80MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
UNII-1	5210	42	10.41	10.59	13.51	23.98	-10.47	-2.96	10.55	30.00	-19.45
UNII-2A	5290	58	10.46	10.78	13.63	23.98	-10.35	-3.24	10.39	30.00	-19.61
UNII-2C	5530	106	10.25	10.56	13.42	23.98	-10.56	-3.30	10.12	30.00	-19.88
	5610	122	10.41	10.20	13.32	23.98	-10.66	-3.30	10.02	30.00	-19.98
	5690	138	10.61	10.45	13.54	23.98	-10.44	-3.30	10.24	30.00	-19.76
UNII-3	5775	155	10.78	10.96	13.88	30.00	-16.12	-3.45	10.43	36.00	-25.57
UNII-4	5885	171	10.31	10.40	13.37	-	-	-3.45	9.92	30.00	-20.08

Table 7-16. MIMO 80MHz BW 802.11ax (UNII) Maximum Conducted Output Power

5GHz WIFI (160MHz 802.11ac MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
	5250	50	14.89	14.01	17.48	23.98	-6.50	-2.96	14.52	30.00	-15.48
	5570	114	14.62	14.08	17.37	23.98	-6.61	-3.30	14.07	30.00	-15.93
	5815	163	14.85	13.67	17.31	30.00	-12.69	-3.45	13.86	30.00	-16.14

Table 7-17. MIMO 160MHz BW 802.11ac (UNII) Maximum Conducted Output Power

5GHz WIFI (160MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Band	Freq [MHz]	Channel	Avg. Conducted Powers [dBm]								
			ANT1	ANT2	MIMO						
	5250	50	10.98	10.08	13.56	23.98	-10.42	-2.96	10.60	30.00	-19.40
	5570	114	10.99	10.40	13.72	23.98	-10.26	-3.30	10.42	30.00	-19.58
	5815	163	10.99	10.01	13.54	30.00	-16.46	-3.45	10.09	30.00	-19.91

Table 7-18. 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 16.27 dBm for Antenna 1 and 16.56 dBm for Antenna 2.

Antenna 1 + Antenna 2 = MIMO

(16.27dBm + 16.56 dBm) = (42.36 mW + 45.29 mW) = 87.65 mW = 19.43 dBm

Sample e.i.r.p Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average MIMO conducted power was calculated to be 19.43 dBm with directional gain of -2.96 dBi.

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

19.43 dBm + -2.96 dBi = 16.47 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-2, 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 Conducted Power Limit
		FCC
UNII 1	5.15 – 5.25GHz	11dBm/MHz
UNII 2A	5.25 – 5.35GHz	
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

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.3 (Method SA-2)
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 ≥ 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	802.11 MODE	Antenna 1 PSD [dBm]	Antenna 2 PSD [dBm]	DCCF [dB]	MIMO Summed PSD [dBm]	Max PSD [dBm]	Margin [dB]
Band 1	5180	36	a	6.21	5.42	0.11	8.95	11.00	-2.05
	5200	40	a	5.56	5.43	0.11	8.62	11.00	-2.38
	5240	48	a	5.11	5.39	0.11	8.37	11.00	-2.63
	5180	36	n	5.64	5.00	0.22	8.56	11.00	-2.44
	5200	40	n	5.40	5.18	0.22	8.52	11.00	-2.48
	5240	48	n	5.11	5.40	0.22	8.49	11.00	-2.51
	5180	36	ac	5.98	5.66	0.22	9.05	11.00	-1.95
	5200	40	ac	5.77	5.62	0.22	8.93	11.00	-2.07
	5240	48	ac	5.31	5.36	0.22	8.56	11.00	-2.44
	5180	36	ax SU	0.20	-1.16	0.26	2.84	11.00	-8.16
	5200	40	ax SU	-0.78	-0.77	0.26	2.50	11.00	-8.50
	5240	48	ax SU	-1.27	-0.55	0.26	2.38	11.00	-8.62
	5190	38	n	2.38	2.17	0.42	5.70	11.00	-5.30
	5230	46	n	1.34	2.01	0.42	5.12	11.00	-5.88
	5190	38	ac	2.35	2.41	0.41	5.80	11.00	-5.20
	5230	46	ac	1.42	2.34	0.41	5.33	11.00	-5.67
	5190	38	ax SU	-4.15	-4.08	0.45	-0.65	11.00	-11.65
	5230	46	ax SU	-4.78	-3.93	0.45	-0.87	11.00	-11.87
	5210	42	ac	-2.57	-2.69	0.44	0.82	11.00	-10.18
	5210	42	ax SU	-6.33	-7.13	0.46	-3.24	11.00	-14.24
Band 1/2A	5250	50	ac	-5.58	-3.76	0.40	-1.16	11.00	-12.16
	5250	50	ax SU	-10.43	-8.00	0.31	-5.73	11.00	-16.73
Band 2A	5260	52	a	5.23	5.51	0.11	8.49	11.00	-2.51
	5280	56	a	5.36	5.38	0.11	8.49	11.00	-2.51
	5320	64	a	5.40	5.62	0.11	8.63	11.00	-2.37
	5260	52	n	5.01	5.02	0.22	8.25	11.00	-2.75
	5280	56	n	4.81	5.26	0.22	8.27	11.00	-2.73
	5320	64	n	5.57	5.85	0.22	8.94	11.00	-2.06
	5260	52	ac	5.78	5.69	0.22	8.96	11.00	-2.04
	5280	56	ac	5.46	5.57	0.22	8.75	11.00	-2.25
	5320	64	ac	5.42	5.90	0.22	8.89	11.00	-2.11
	5260	52	ax SU	-0.95	-0.84	0.26	2.38	11.00	-8.62
	5280	56	ax SU	-1.02	-0.95	0.26	2.29	11.00	-8.71
	5320	64	ax SU	-0.97	-0.76	0.26	2.41	11.00	-8.59
	5270	54	n	1.82	1.96	0.42	5.32	11.00	-5.68
	5310	62	n	1.67	2.55	0.42	5.56	11.00	-5.44
	5270	54	ac	2.02	2.50	0.41	5.69	11.00	-5.31
	5310	62	ac	1.70	2.49	0.41	5.53	11.00	-5.47
	5270	54	ax SU	-4.79	-4.16	0.45	-1.00	11.00	-12.00
	5310	62	ax SU	-4.03	-3.64	0.45	-0.37	11.00	-11.37
	5290	58	ac	-2.50	-2.79	0.44	0.80	11.00	-10.20
	5290	58	ax SU	-6.83	-6.93	0.46	-3.41	11.00	-14.41
Band 2C	5500	100	a	4.80	5.37	0.11	8.21	11.00	-2.79
	5600	120	a	5.46	4.61	0.11	8.18	11.00	-2.82
	5720	144	a	5.16	4.25	0.11	7.85	11.00	-3.15
	5500	100	n	4.92	5.29	0.22	8.34	11.00	-2.66
	5600	120	n	5.03	4.13	0.22	7.83	11.00	-3.17
	5720	144	n	5.31	4.08	0.22	7.97	11.00	-3.03
	5500	100	ac	5.14	5.74	0.22	8.68	11.00	-2.32
	5600	120	ac	4.99	4.30	0.22	7.89	11.00	-3.11
	5720	144	ac	4.80	3.60	0.22	7.47	11.00	-3.53
	5500	100	ax SU	-1.12	-1.36	0.26	2.03	11.00	-8.97
	5600	120	ax SU	-1.07	-2.48	0.26	1.55	11.00	-9.45
	5720	144	ax SU	-1.42	-3.06	0.26	1.11	11.00	-9.89
	5510	102	n	1.34	2.27	0.42	5.26	11.00	-5.74
	5590	118	n	1.93	1.31	0.42	5.06	11.00	-5.94
	5710	142	n	2.33	1.39	0.42	5.32	11.00	-5.68
	5510	102	ac	1.16	1.95	0.41	4.99	11.00	-6.01
	5590	118	ac	2.49	1.49	0.41	5.44	11.00	-5.56
	5710	142	ac	2.36	1.53	0.41	5.38	11.00	-5.62
	5510	102	ax SU	-4.02	-3.46	0.45	-0.27	11.00	-11.27
	5590	118	ax SU	-4.34	-3.92	0.45	-0.66	11.00	-11.66
	5710	142	ax SU	-3.61	-4.15	0.45	-0.41	11.00	-11.41
	5530	106	ac	-3.33	-3.40	0.44	0.09	11.00	-10.91
	5610	122	ac	-3.14	-3.55	0.44	0.11	11.00	-10.89
	5690	138	ac	-2.61	-4.19	0.44	0.12	11.00	-10.88
	5530	106	ax SU	-7.58	-6.99	0.46	-3.81	11.00	-14.81
	5610	122	ax SU	-7.34	-7.81	0.46	-4.10	11.00	-15.10
	5690	138	ax SU	-6.78	-8.67	0.46	-4.15	11.00	-15.15
	5570	114	ac	-5.80	-3.93	0.40	-1.36	11.00	-12.36
	5570	114	ax SU	-10.88	-8.16	0.31	-5.99	11.00	-16.99

Table 7-19. Bands 1, 2A, 2C MIMO Conducted Power Spectral Density Measurements

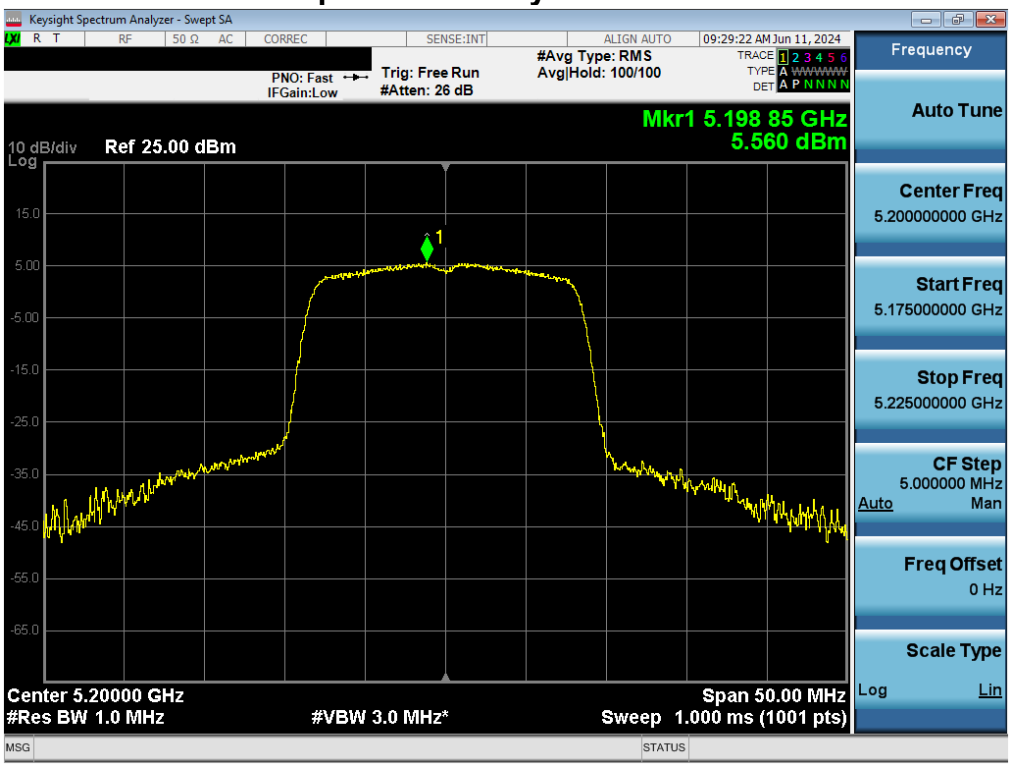
	Frequency [MHz]	Channel	802.11 MODE	Antenna 1 PSD [dBm]	Antenna 2 PSD [dBm]	DCCF [dB]	MIMO Summed PSD [dBm]	Max PSD [dBm]	Margin [dB]
Band 3	5745	149	a	1.85	1.36	0.11	4.73	28.28	-23.55
	5785	157	a	2.18	1.21	0.11	4.84	28.28	-23.44
	5825	165	a	2.04	1.16	0.11	4.74	28.28	-23.54
	5745	149	n	1.39	0.82	0.22	4.34	28.28	-23.94
	5785	157	n	2.35	1.20	0.22	5.04	28.28	-23.24
	5825	165	n	1.82	0.73	0.22	4.54	28.28	-23.74
	5745	149	ac	1.57	1.27	0.22	4.66	28.28	-23.62
	5785	157	ac	1.48	0.75	0.22	4.36	28.28	-23.92
	5825	165	ac	2.12	1.18	0.22	4.91	28.28	-23.37
	5745	149	ax SU	-4.32	-5.42	0.26	-1.56	28.28	-29.84
	5785	157	ax SU	-4.44	-5.36	0.26	-1.61	28.28	-29.89
	5825	165	ax SU	-3.86	-5.18	0.26	-1.20	28.28	-29.48
	5755	151	n	-1.17	-1.40	0.42	2.15	28.28	-26.13
	5795	159	n	-0.80	-1.82	0.42	2.15	28.28	-26.13
	5755	151	ac	-0.69	-1.32	0.41	2.43	28.28	-25.85
	5795	159	ac	-0.95	-1.63	0.41	2.14	28.28	-26.14
	5755	151	ax SU	-6.64	-6.51	0.45	-3.11	28.28	-31.39
	5795	159	ax SU	-6.05	-6.78	0.45	-2.94	28.28	-31.22
	5775	155	ac	-5.41	-6.53	0.44	-2.48	28.28	-30.76
	5775	155	ax SU	-10.57	-10.93	0.46	-7.28	28.28	-35.56

Table 7-20. Band 3 MIMO Conducted Power Spectral Density Measurements

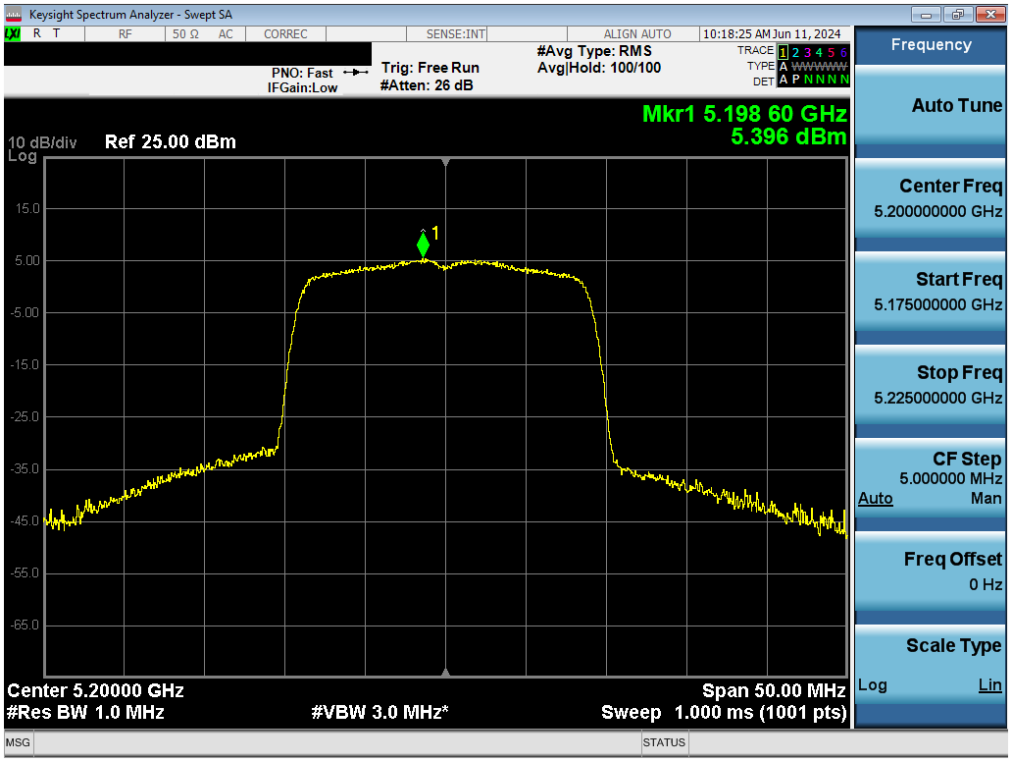
	Frequency [MHz]	Channel	802.11 MODE	Antenna 1 PSD [dBm]	Antenna 2 PSD [dBm]	MIMO Summed PSD [dBm]	Directional Antenna Gain [dBi]	DCCF [dB]	EIRP PSD [dBm]	Max EIRP PSD [dBm]	Margin [dB]
and 3/4	5845	169	a	4.72	4.13	7.45	-3.75	0.11	3.81	14.00	-10.19
Band 4	5865	173	a	5.06	4.07	7.60	-3.75	0.11	3.96	14.00	-10.04
	5885	177	a	5.21	3.61	7.50	-3.75	0.11	3.86	14.00	-10.14
and 3/4	5845	169	n	4.59	3.75	7.20	-3.75	0.22	3.67	14.00	-10.33
Band 4	5865	173	n	4.84	3.56	7.26	-3.75	0.22	3.73	14.00	-10.27
	5885	177	n	4.93	3.24	7.18	-3.75	0.22	3.65	14.00	-10.35
and 3/4	5845	169	ac	4.58	3.65	7.15	-3.75	0.22	3.62	14.00	-10.38
Band 4	5865	173	ac	4.79	3.65	7.27	-3.75	0.22	3.74	14.00	-10.26
	5885	177	ac	4.81	3.64	7.27	-3.75	0.22	3.74	14.00	-10.26
and 3/4	5845	169	ax SU	-1.75	-2.93	0.71	-3.75	0.26	-2.78	14.00	-16.78
Band 4	5865	173	ax SU	-1.44	-2.62	1.02	-3.75	0.26	-2.47	14.00	-16.47
	5885	177	ax SU	-1.63	-2.77	0.85	-3.75	0.26	-2.64	14.00	-16.64
and 3/4	5835	167	n	1.54	0.66	4.13	-3.75	0.42	0.80	14.00	-13.20
Band 4	5875	175	n	2.20	0.86	4.59	-3.75	0.42	1.26	14.00	-12.74
and 3/4	5835	167	ac	1.39	1.09	4.25	-3.75	0.41	0.91	14.00	-13.09
Band 4	5875	175	ac	2.16	1.41	4.81	-3.75	0.41	1.47	14.00	-12.53
and 3/4	5835	167	ax SU	-4.52	-5.25	-1.86	-3.75	0.45	-5.16	14.00	-19.16
Band 4	5875	175	ax SU	-4.11	-5.59	-1.77	-3.75	0.45	-5.08	14.00	-19.08
Band 3/4	5855	171	ac	-3.81	-4.35	-1.07	-3.75	0.44	-4.38	14.00	-18.38
	5855	171	ax SU	-7.47	-9.14	-5.22	-3.75	0.46	-8.51	14.00	-22.51
	5815	163	ac	-6.16	-4.24	-2.09	-3.75	0.44	-5.40	14.00	-19.40
	5815	163	ax SU	-10.15	-7.06	-5.33	-3.75	0.46	-8.62	14.00	-22.62

Table 7-21. Bands 3/4 MIMO Conducted Power Spectral Density Measurements

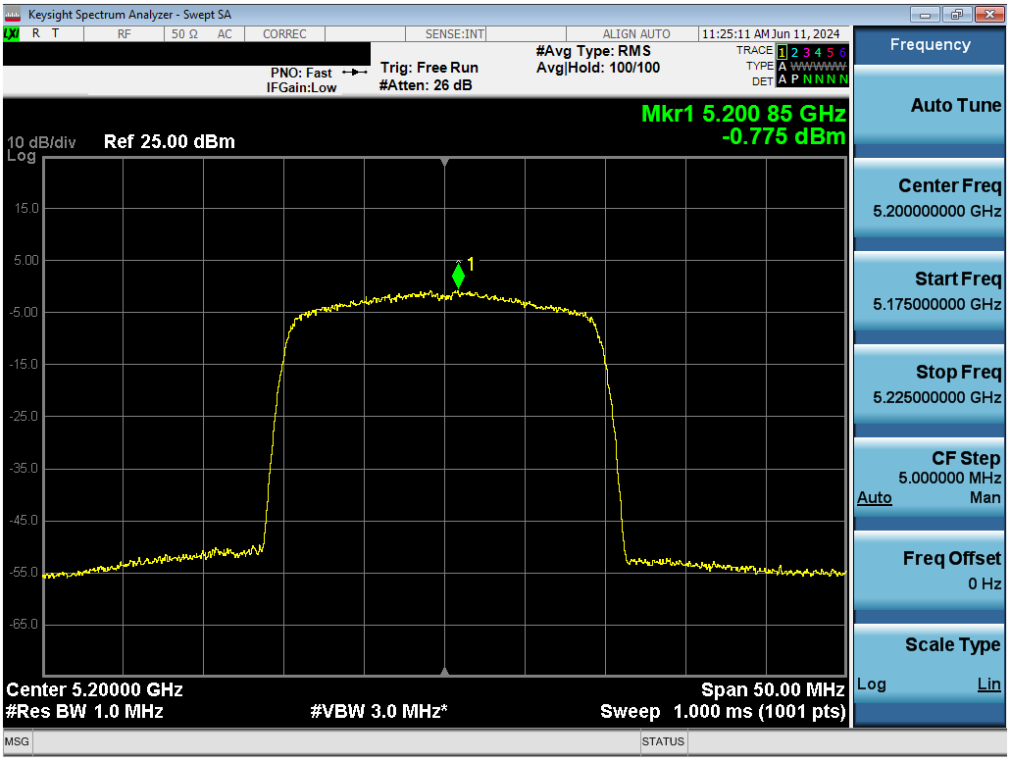
7.5.1 MIMO Antenna-1 Power Spectral Density Measurements



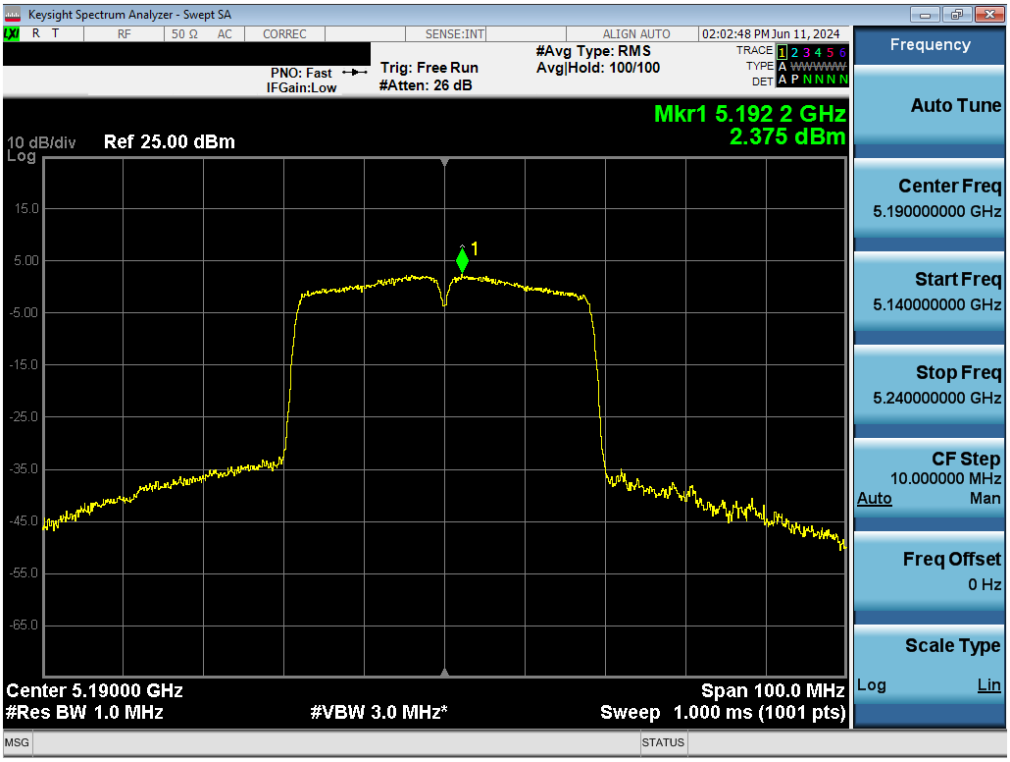
Plot 7-84. Power Spectral Density Plot MIMO ANT1 (802.11a (UNII Band 1) – Ch. 40)



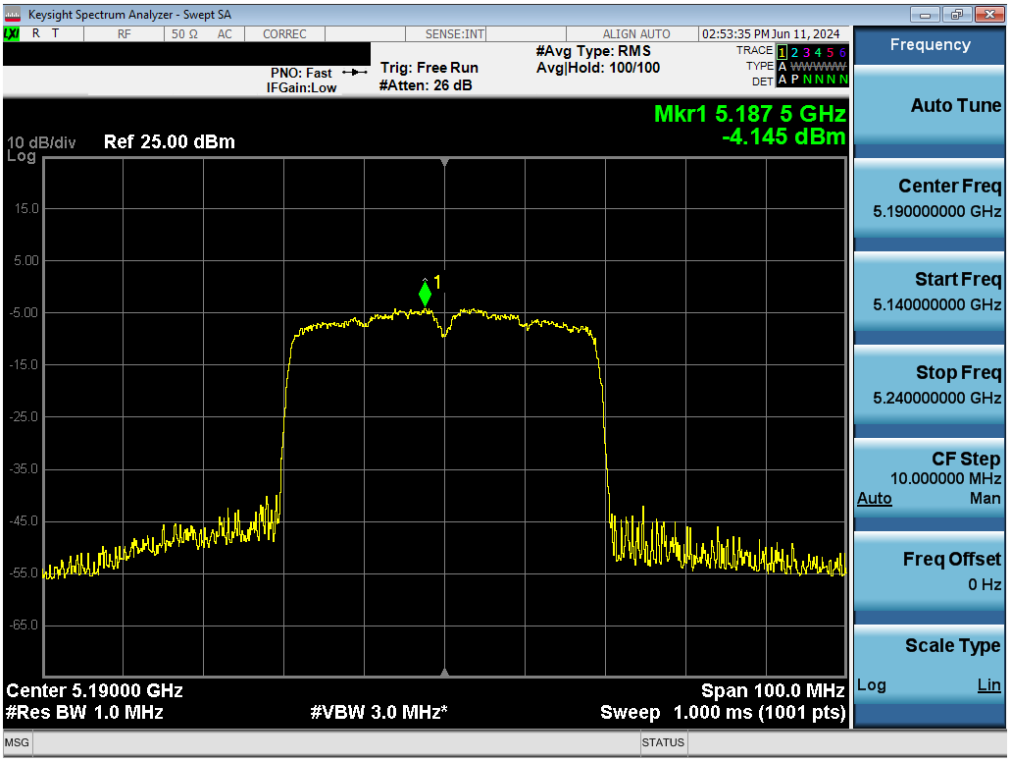
Plot 7-85. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 1) – Ch. 40)



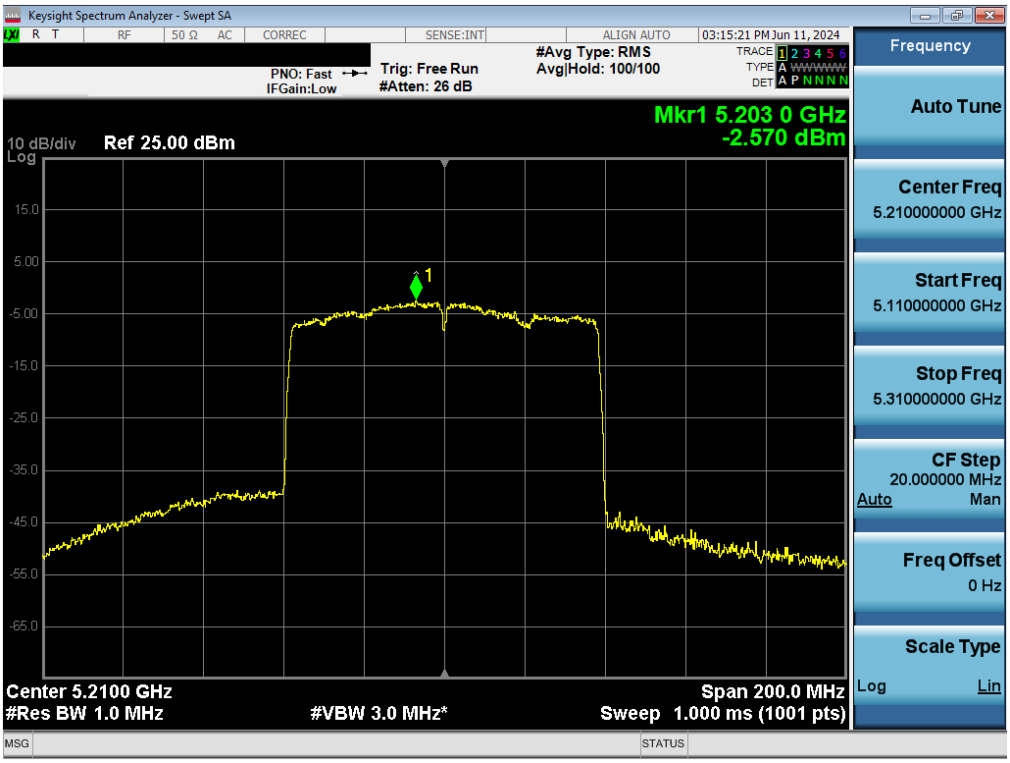
Plot 7-86. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 1) – Ch. 40)



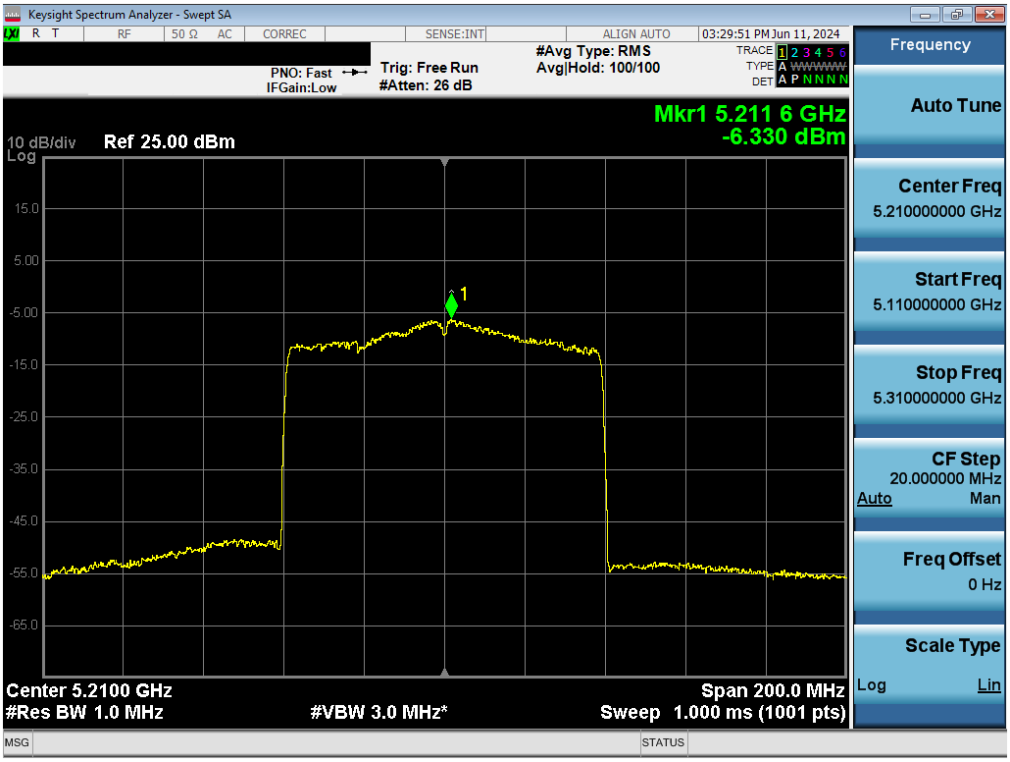
Plot 7-87. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11n (UNII Band 1) – Ch. 38)



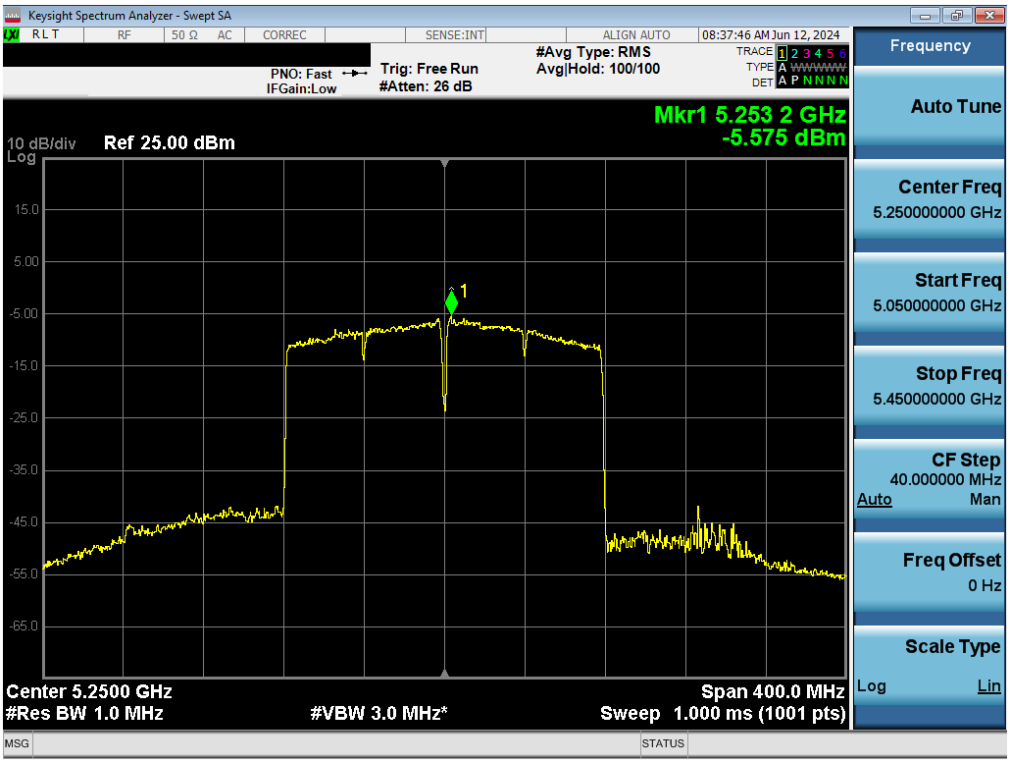
Plot 7-88. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 1) – Ch. 38)



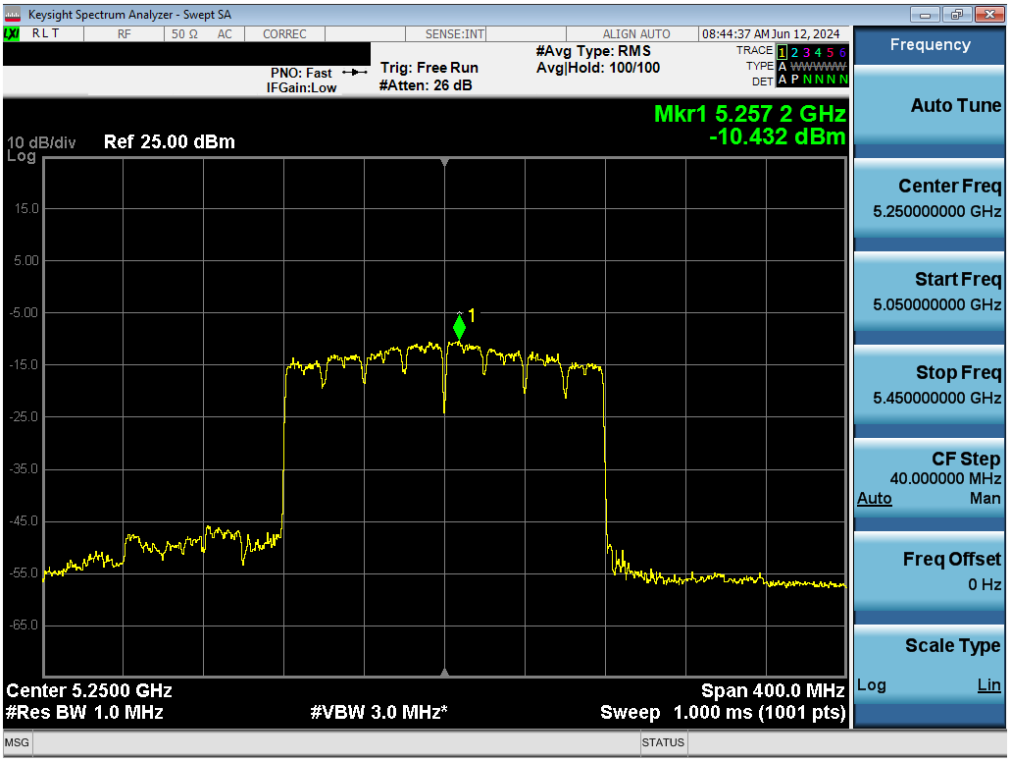
Plot 7-89. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ac (UNII Band 1) – Ch. 42)



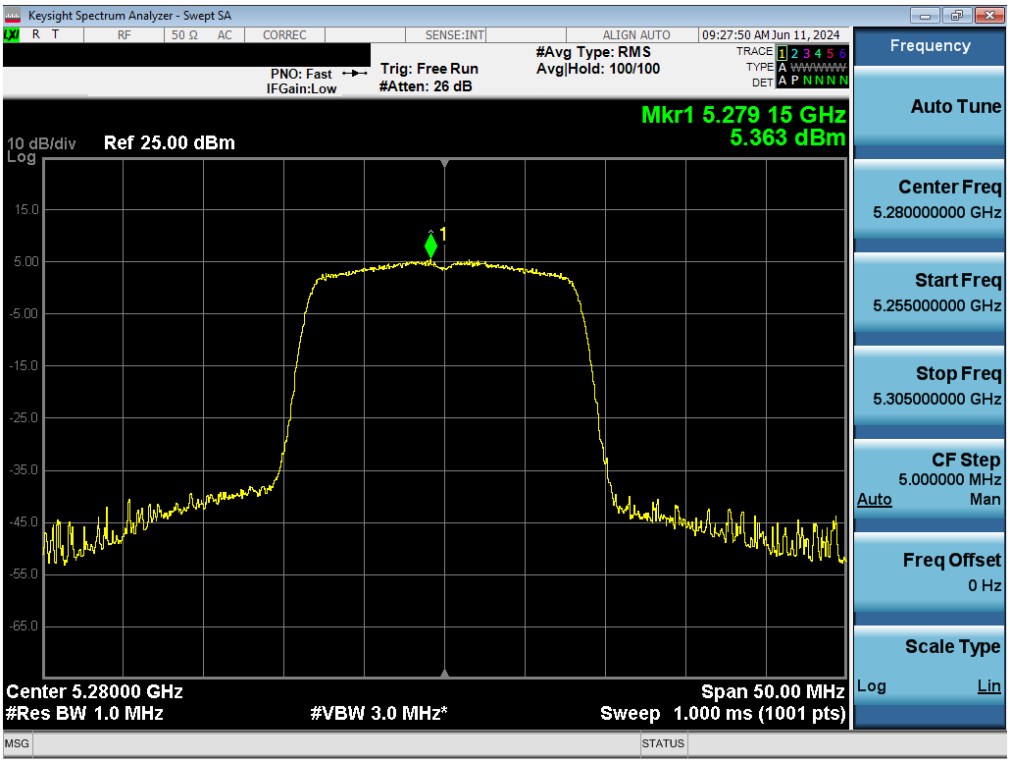
Plot 7-90. Power Spectral Density Plot MIMO ANT1 (80MHz BW 802.11ax (UNII Band 1) – Ch. 42)



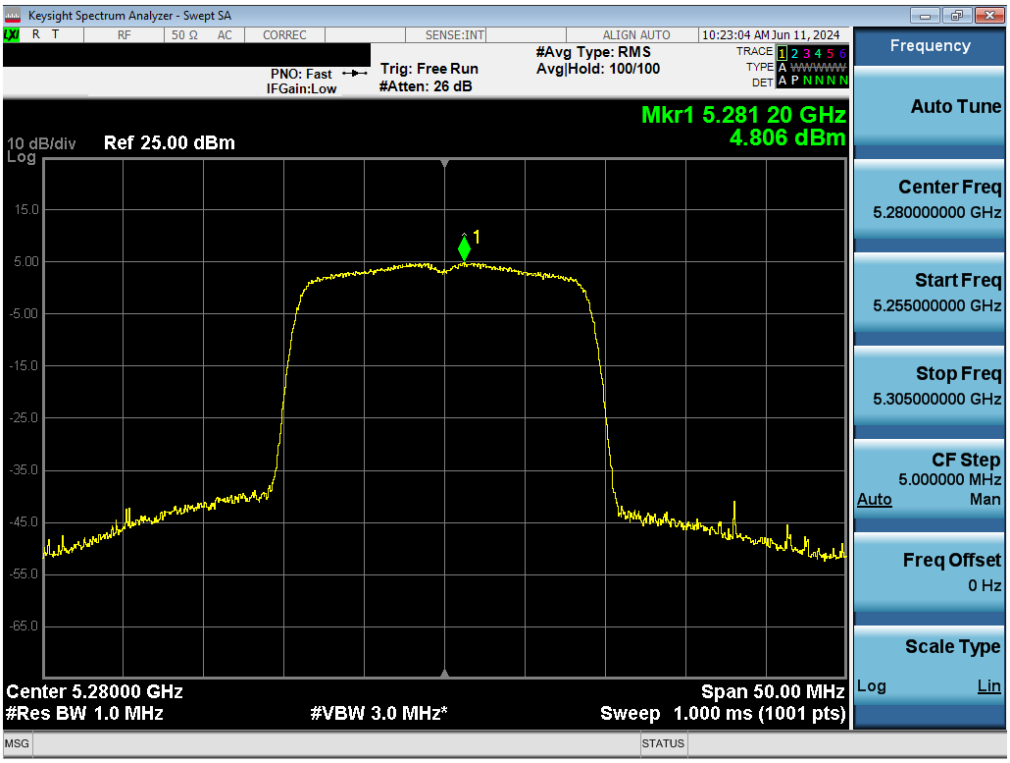
Plot 7-91. Power Spectral Density Plot MIMO ANT1 (160MHz BW 802.11ac (UNII Band 1/2A) – Ch. 50)



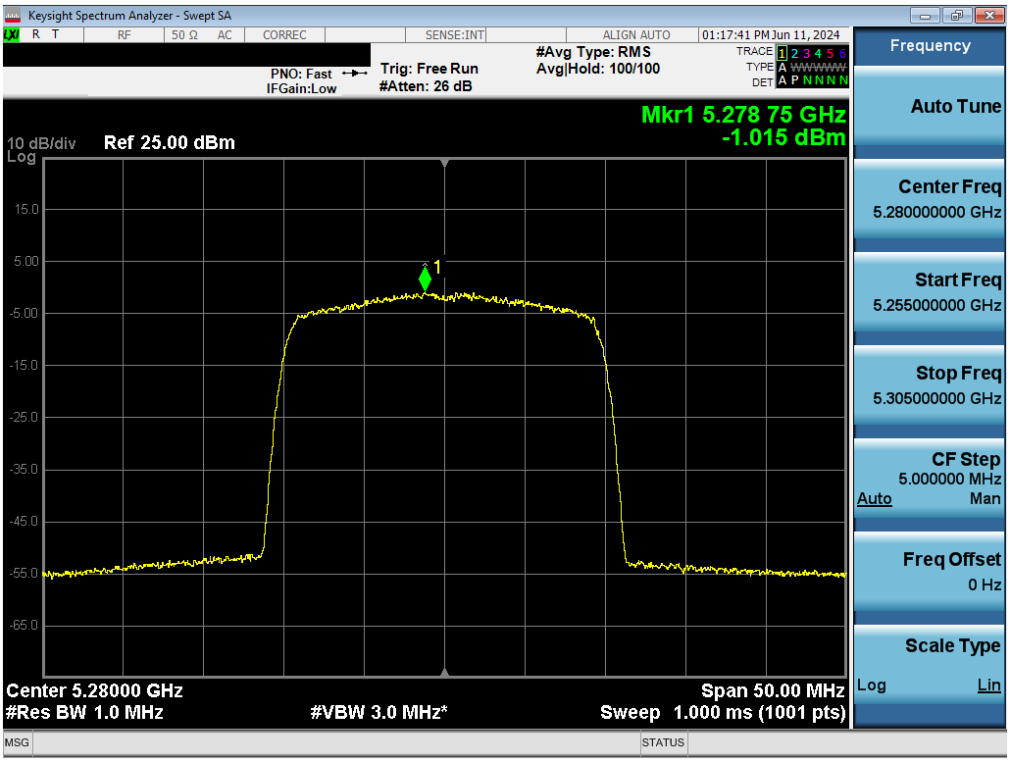
Plot 7-92. Power Spectral Density Plot MIMO ANT1 (160MHz BW 802.11ax (UNII Band 1/2A) – Ch. 50)



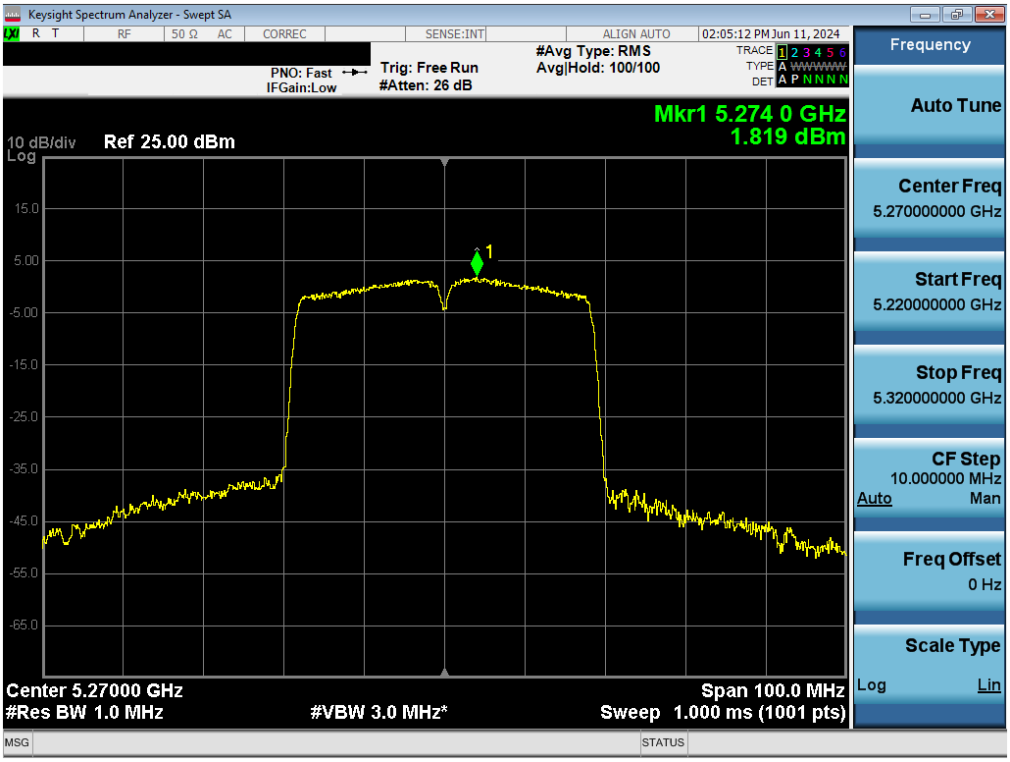
Plot 7-93. Power Spectral Density Plot MIMO ANT1 (802.11a (UNII Band 2A) – Ch. 56)



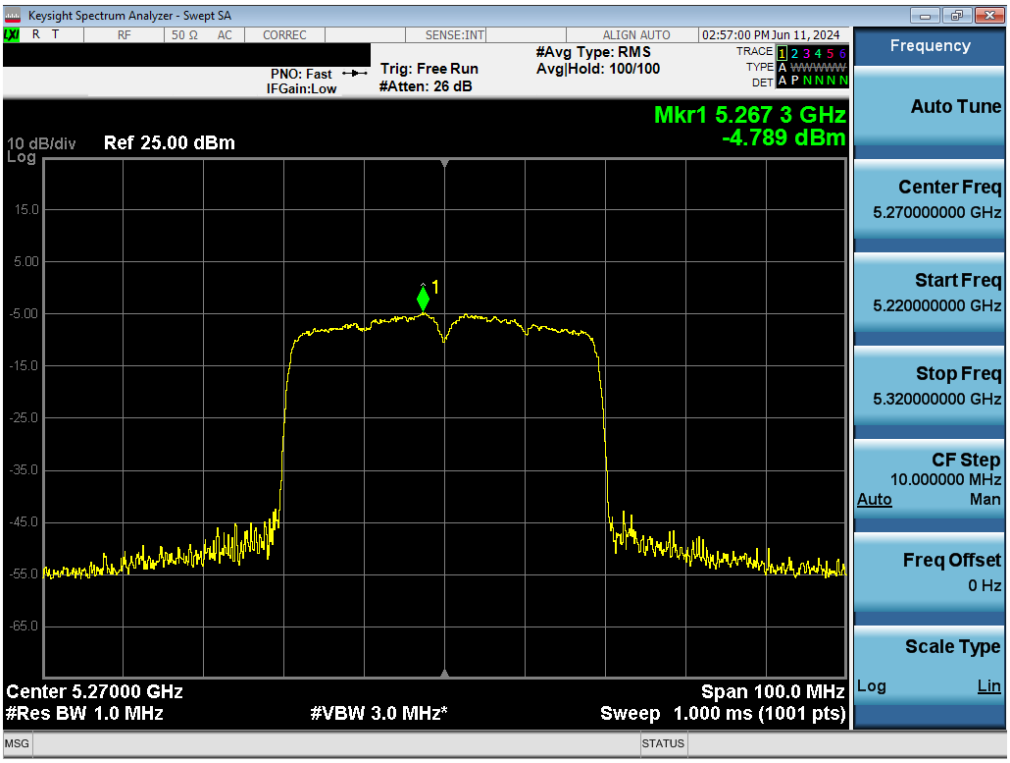
Plot 7-94. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11n (UNII Band 2A) – Ch. 56)



Plot 7-95. Power Spectral Density Plot MIMO ANT1 (20MHz BW 802.11ax (UNII Band 2A) – Ch. 56)



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



Plot 7-97. Power Spectral Density Plot MIMO ANT1 (40MHz BW 802.11ax (UNII Band 2A) – Ch. 54)