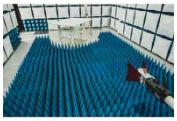
PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
Tel. 410.290.6652 / Fax 410.290.6654
http://www.pctest.com



MEASUREMENT REPORT
FCC Part 15.407 802.11a/ax WIFI 6E

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

Date of Testing:
9/9 – 11/18/2021
Test Report Issue Date:
12/22/2021
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2109220110-11-R1.A3L

FCC ID:	**A3LSMS908E**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-S908E/DS
Additional Model(s):	SM-S908E
EUT Type:	Portable Handset
Frequency Range:	5935 – 7115MHz
Modulation Type:	OFDM
FCC Classification:	15E 6GHz Low Power Indoor Client (6XD)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 648474 D03 v01r04, KDB 662911 D01 v02r01, KDB 987594 D02 v01r01

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 789033 D02 v02r01. Test results reported herein relate only to the item(s) tested.

Note: This revised Test Report (S/N: 1M2109220110-11-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.

Randy Ortanez
President

ACCREDITED
TESTING CERT#2041.01

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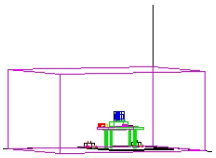
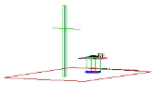


MEASUREMENT REPORT



Channel Bandwidth [MHz]	UNII Band	Tx Frequency [MHz]	MIMO	
			Max. Power [mW]	Max. Power [dBm]
20	5	5935 - 6415	18.836	12.75
	6	6435 - 6515	30.620	14.86
	7	6535 - 6875	31.550	14.99
	8	6895 - 7115	31.477	14.98
40	5	5965 - 6405	36.392	15.61
	6	6445 - 6525	37.497	15.74
	7	6565 - 6845	39.537	15.97
	8	6885 - 7085	35.481	15.50
80	5	5985 - 6385	39.719	15.99
	6	6465	34.198	15.34
	7	6545 - 6865	38.905	15.90
	8	6945 - 7025	36.141	15.58
160	5	6025 - 6345	35.075	15.45
	6	6505	35.237	15.47
	7	6665 - 6825	35.075	15.45
	8	6985	32.885	15.17

EUT Overview

1.0 INTRODUCTION

1.1 Scope

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

1.2 PCTEST Test Location

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

1.3 Test Facility / Accreditations

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

- PCTEST is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.

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

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

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMS908E**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter while operating in the 6GHz band.

Test Device Serial No.: *0501M, 0579M, 3922M, 0299M, 0545M*

2.2 Device Capabilities

This device contains the following capabilities:

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

Band 5		Band 6		Band 7		Band 8	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
2	5935	97	6435	117	6535	189	6895
:	:	:	:	:	:	:	:
45	6175	105	6475	149	6695	209	6995
:	:	:	:	:	:	:	:
93	6415	113	6515	185	6875	233	7115

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

Band 5		Band 6		Band 7		Band 8	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
3	5965	99	6445	123	6565	187	6885
:	:	:	:	:	:	:	:
43	6165	107	6485	155	6725	211	7005
:	:	:	:	:	:	:	:
91	6405	115	6525	179	6845	227	7085

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

Band 5		Band 6		Band 7		Band 8	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
7	5985	103	6465	119	6545	199	6945
:	:			:	:	:	:
39	6145			151	6705	215	7025
:	:			:	:		
87	6385			183	6865		

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

Band 5		Band 6		Band 7		Band 8	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
15	6025	111	6505	143	6665	207	6985
:	:			:	:		
47	6185			175	6825		
:	:						
79	6345						

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

Notes:

1. 6GHz NII operation is possible in 20MHz, and 40MHz, and 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 and KDB 789033 D02 v02r01. 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		MIMO Duty Cycle [%]
6GHz	a	98.6
	ax (HT20)	96.8
	ax (HT40)	94.4
	ax (HT80)	90.6
	ax (HT160)	90.4

Table 2-5. Measured Duty Cycles

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

WiFi Configurations		SISO		CDD		SDM	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
6GHz	11a	×	×	✓	✓	×	×
	11ax (20MHz)	×	×	✓	✓	✓	✓
	11ax (40MHz)	×	×	✓	✓	✓	✓
	11ax (80MHz)	×	×	✓	✓	✓	✓
	11ax (160MHz)	×	×	✓	✓	✓	✓

Table 2-6. Frequency / Channel Operations

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

2.3 Antenna Description

Following antenna was used for the testing.

Frequency Band	Antenna-1 Gain [dBi]	Antenna-2 Gain [dBi]	Directional Gain [dBi]
Band 5	-6.31	-5.56	-2.92
Band 6	-11.39	-6.32	-5.48
Band 7	-7.00	-7.37	-4.17
Band 8	-7.00	-10.56	-5.59

Table 2-7. Antenna Peak Gain

2.4 Test Configuration

The EUT was tested per the guidance of KDB 987594 D02 and KDB 789033 D02 v02r01. 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, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5 and 7.6 for antenna port conducted emissions test setups.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) EP-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

2.5 Software and Firmware

The test was conducted with firmware version S908USQU0AUJV installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

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

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 789033 D02 v02r01 were used in the measurement of the EUT**.**

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

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 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 7.9. 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 474788 D01.

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
-	WL25-1	Conducted Cable Set (25GHz)	9/7/2021	Annual	9/7/2022	WL25-1
-	WL25-2	Conducted Cable Set (25GHz)	9/7/2021	Annual	9/7/2022	WL25-2
-	WL25-3	Conducted Cable Set (25GHz)	9/7/2021	Annual	9/7/2022	WL25-3
-	WL40-1	Conducted Cable Set (40GHz)	9/10/2021	Annual	9/10/2022	WL40-1
Agilent	N9038A	MXE EMI Receiver	8/11/2020	Annual	12/1/2021	MY51210133
Agilent	N9030A	PXA Signal Analyzer (44GHz)	7/21/2021	Annual	7/21/2022	MY49430494
Anritsu	ML2495A	Power Meter	1/18/2021	Annual	1/18/2022	941001
Anritsu	MA2411B	Pulse Power Sensor	3/8/2021	Annual	3/8/2022	1339007
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
Emco	3116C	Horn Antenna (18 - 40GHz)	5/112021	Biennial	5/11/2023	218893
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	7/9/2020	Biennial	7/9/2022	114451
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	8/17/2020	Annual	12/17/2021	MY52350166
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	9/10/2021	Annual	9/10/2022	NMLC-2
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	7/21/2021	Annual	7/12/2022	MY49430494
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/3/2021	Annual	8/3/2022	100342
Rohde & Schwarz	ESW44	EMI Test Receiver 2Hz to 44GHz	1/21/2021	Annual	1/21/2022	101716
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	8/25/2021	Annual	8/25/2022	103200
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	9/3/2021	Annual	9/3/2022	102138
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	9/21/2021	Biennial	9/21/2023	310233
Schwarzbeck	VULB9162	Bilog Antenna	4/17/2020	Biennial	4/17/2022	00301

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: A3LSMS908E
FCC Classification: 15E 6GHz Low Power Indoor Client (6XD)

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1046, 15.407(a)(11)	Maximum Conducted Output Power	N/A	CONDUCTED	PASS	Section 7.3
2.1049, 15.407(a)(10)	Occupied Bandwidth/ 26dB Bandwidth	99% of the occupied bandwidth of any channel must be contained within each of its respective U-NII sub bands The maximum transmitter channel bandwidth for U-NII devices in the 5.925-7.125 GHz band is 320 megahertz.		PASS	Section 7.2
15.407(a)(8)	Maximum Power Spectral Density	< -1dBm/MHz e.i.r.p.		PASS	Section 7.4
15.407(a)(8)	Maximum Radiated Output Power	< 24dBm over the frequency band of operation		PASS	Section 7.3
15.407(b)(6)	In-Band Emissions	EUT must meet the limits detailed in 15.407(b)(6)		PASS	Section 7.5
15.407(d)(6)	Contention Based Protocol	EUT must detect AWGN signal with 90% (or better) certainty		PASS	Section 7.6
15.407(b)(5)	Undesirable Emissions	< -27dBm/MHz e.i.r.p. outside of the 5.925 – 7.125GHz band	RADIATED	PASS	Section 7.7
15.205, 15.209	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 7.7, 7.8
15.407(b)(8)	AC Conducted Emissions (150kHz – 30MHz)	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 7.9

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 PCTEST "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 PCTEST "Chamber Automation," Version 1.3.1.

7.2 26dB Bandwidth Measurement – 802.11a/ax

2.1049, 15.407(a)(10)

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 KDB 789033 D02 v02r01, 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
KDB 789033 D02 v02r01 – Section C
KDB 987594 D02

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 ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold

Test Setup

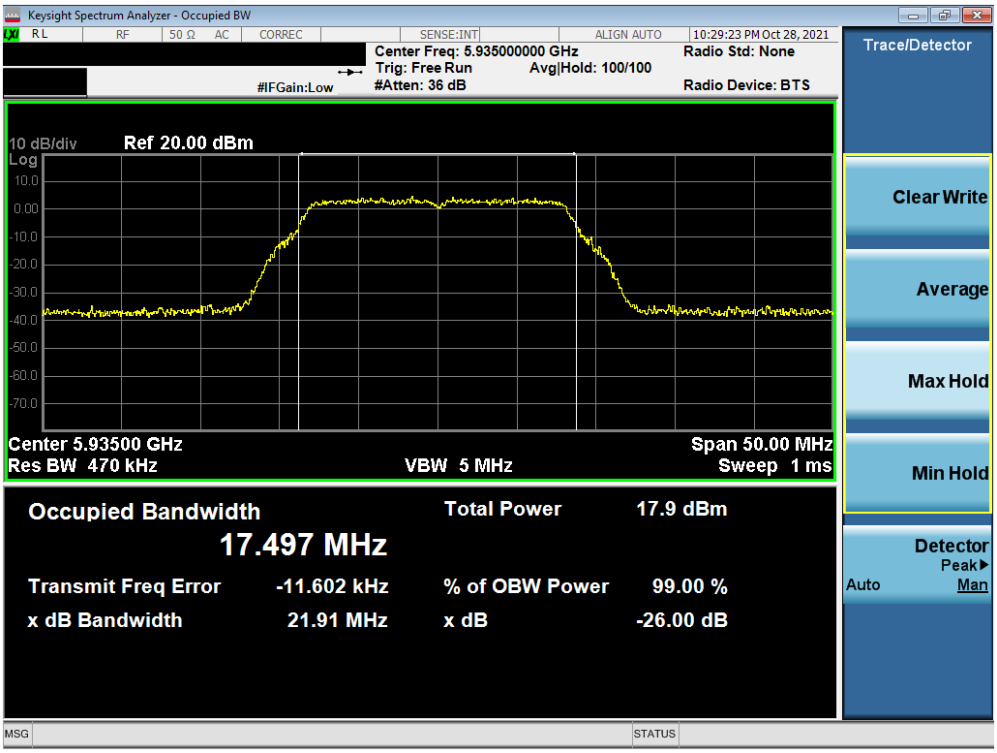
The EUT and measurement equipment were set up as shown in the diagram below.

Figure 7-1. Test Instrument & Measurement Setup

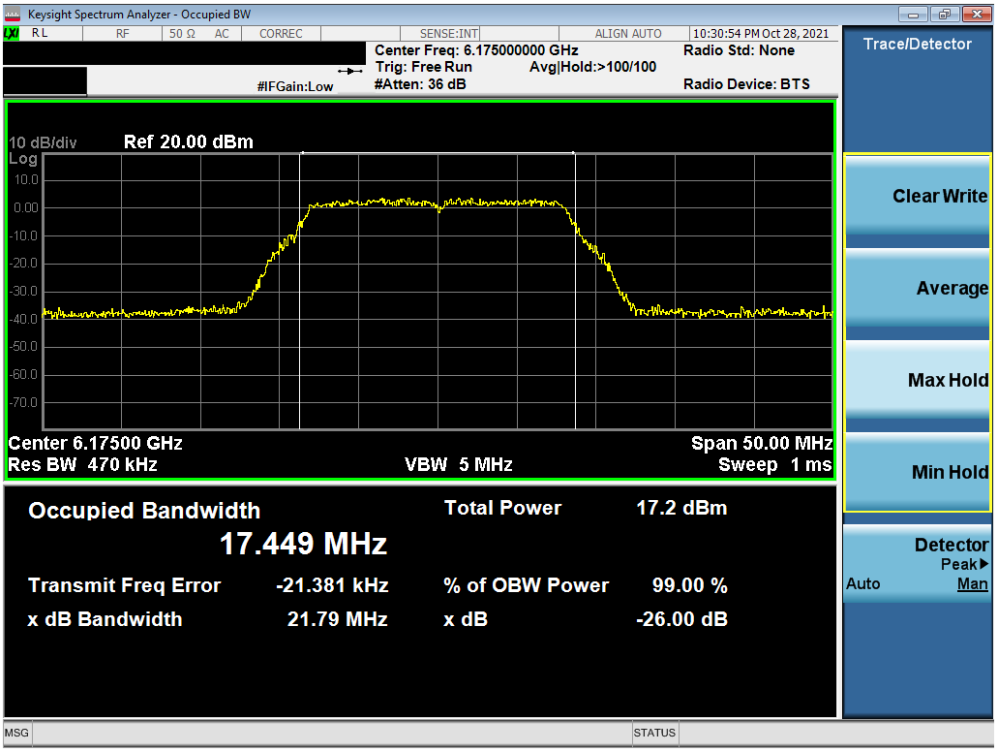
Test Notes

None.

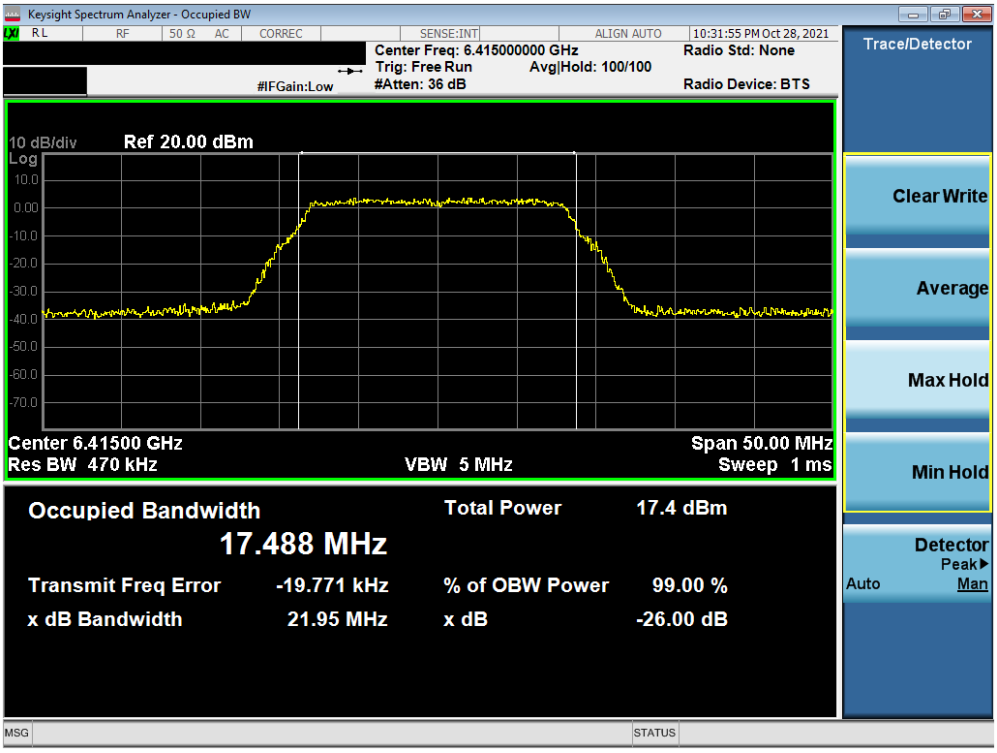
MIMO Antenna-1 26 dB Bandwidth Measurements - (UNII Band 5)



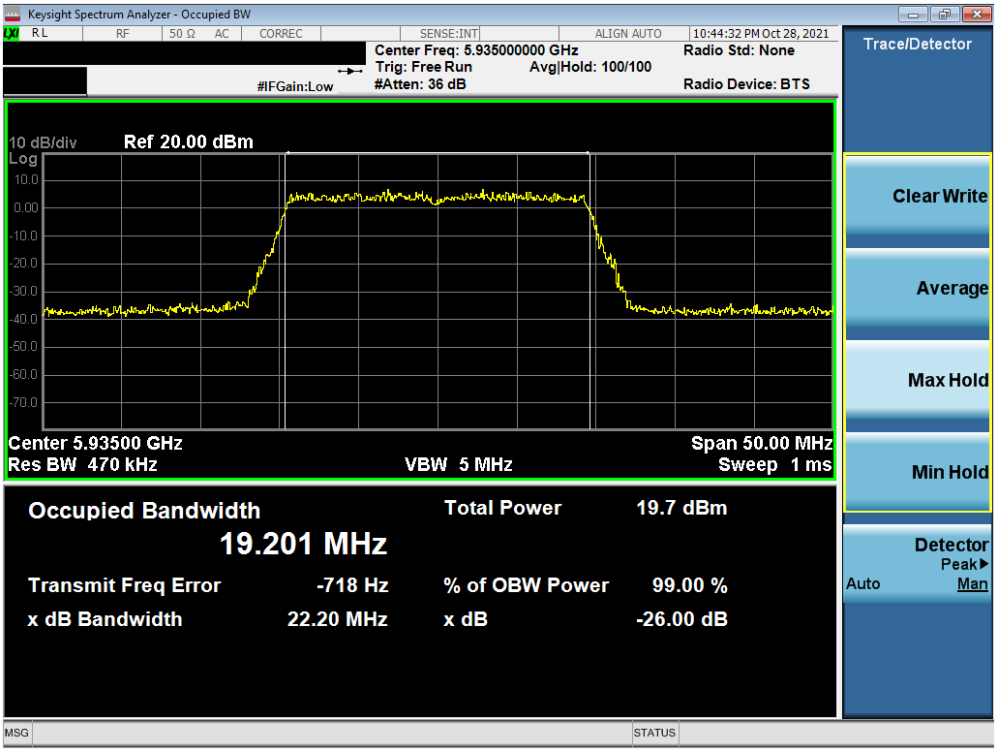
Plot 7-1. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 2)



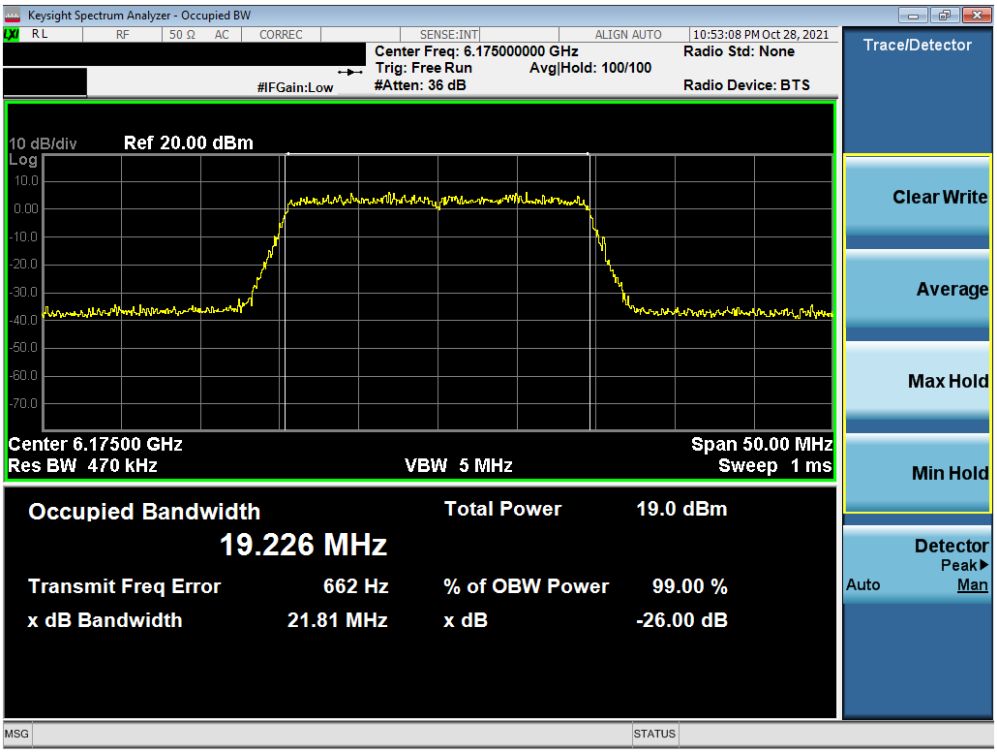
Plot 7-2. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 45)



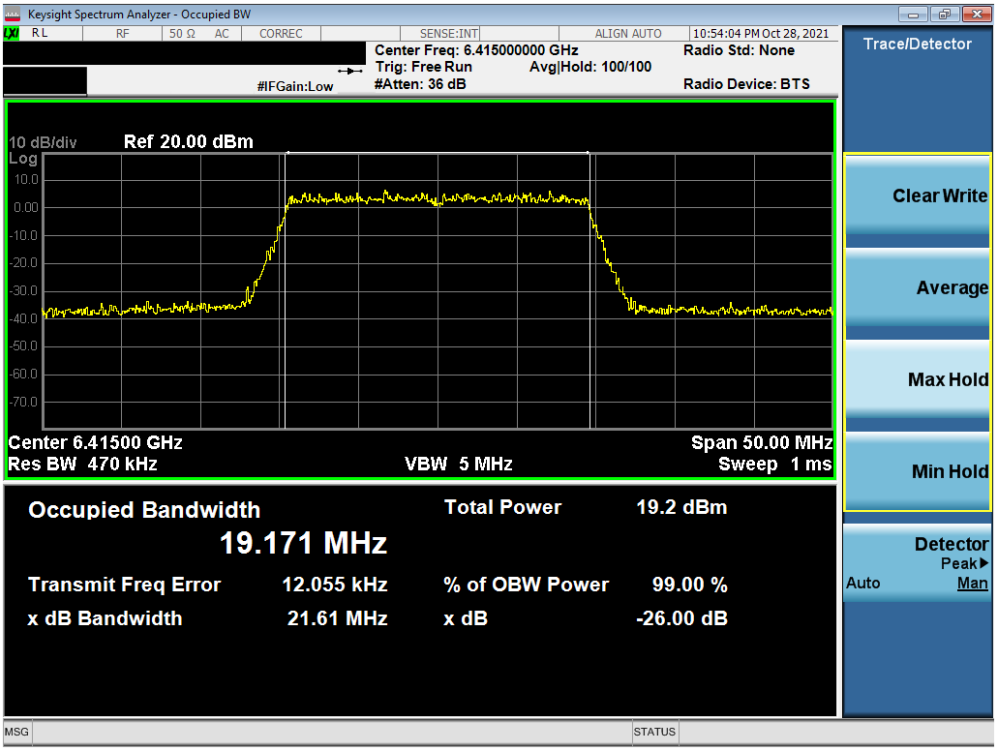
Plot 7-3. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 93



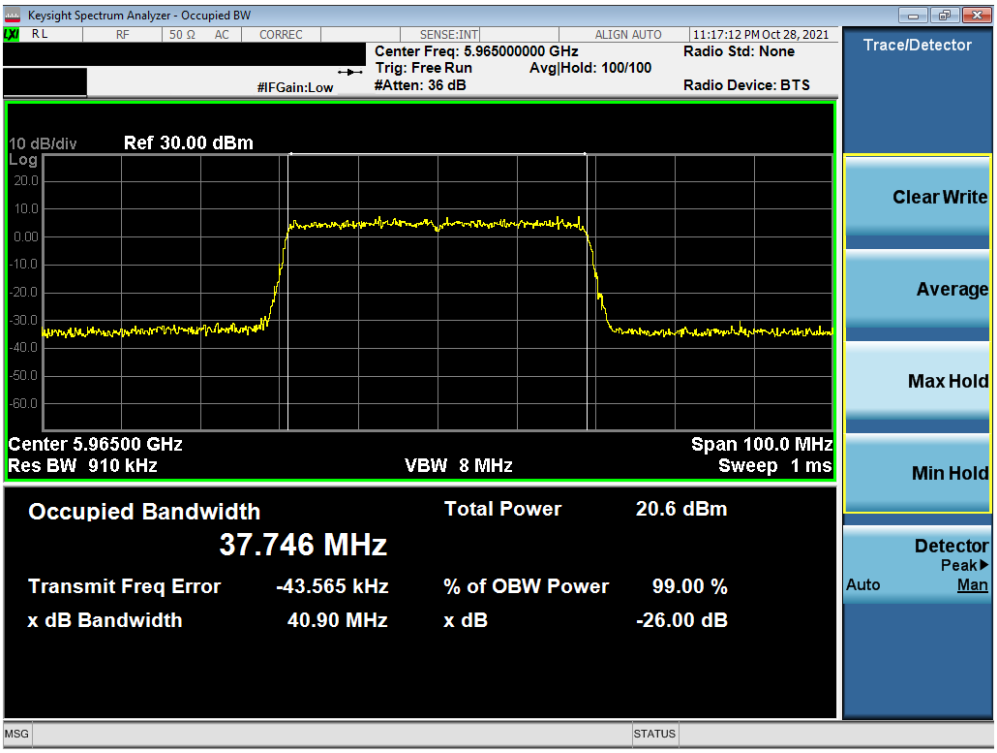
Plot 7-4. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 2)



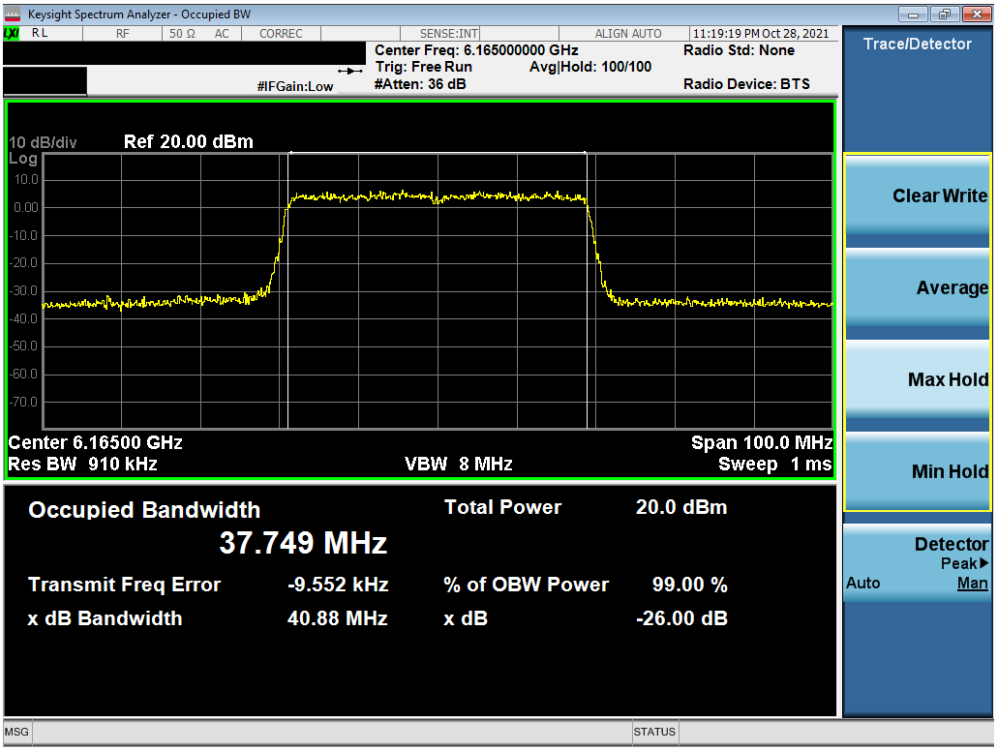
Plot 7-5. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 45)



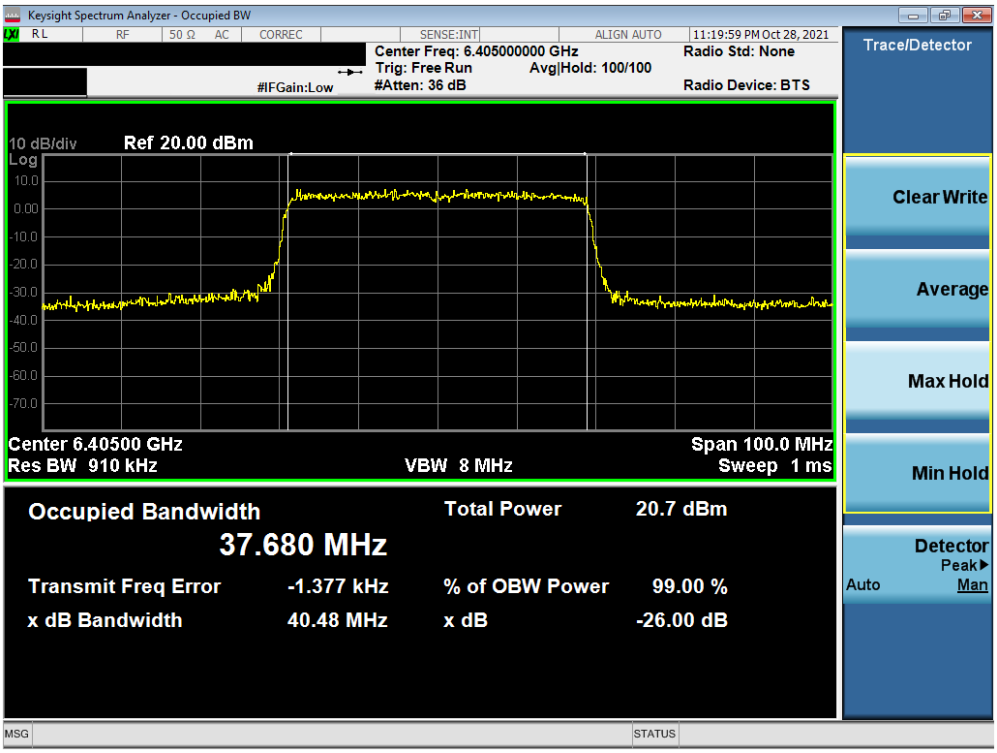
Plot 7-6. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 93



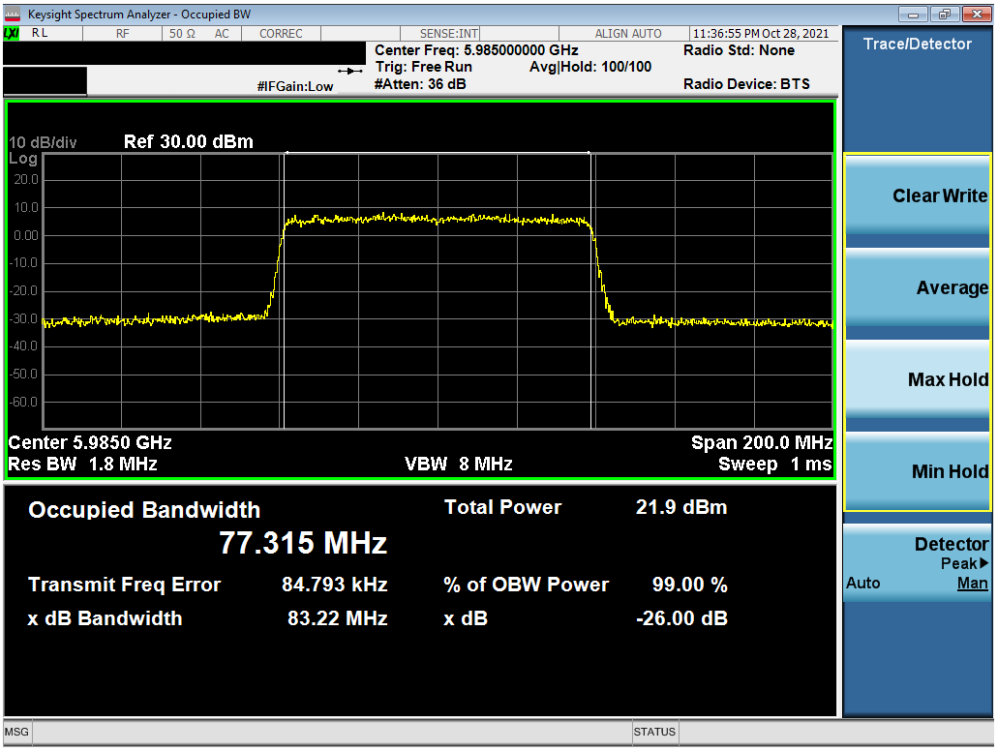
Plot 7-7. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 3)



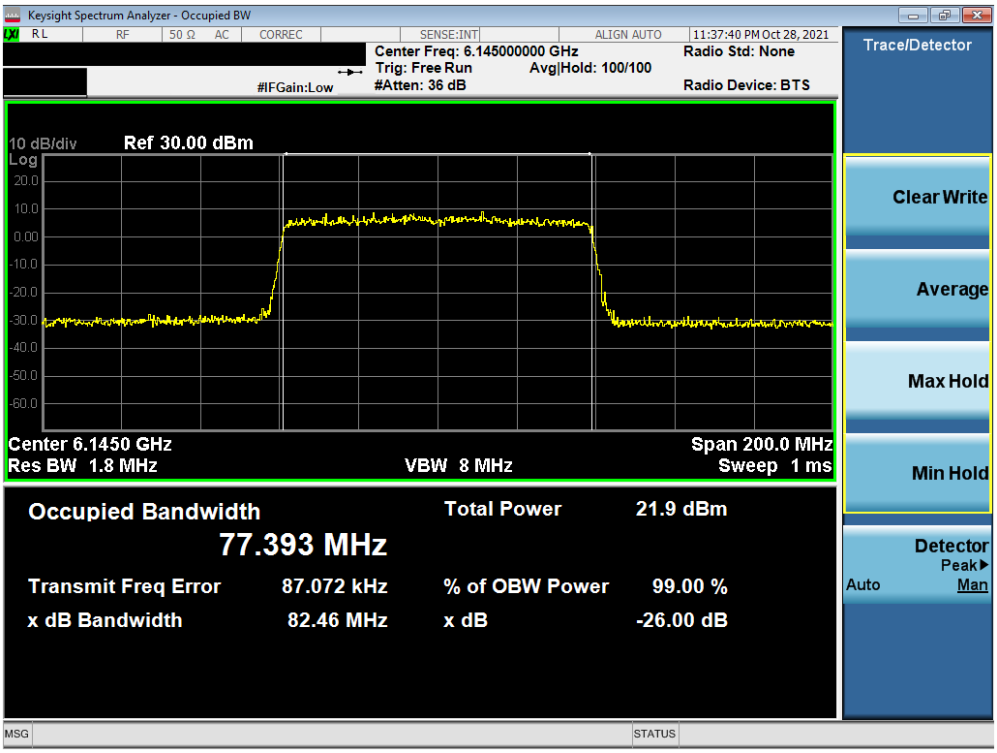
Plot 7-8. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 43)



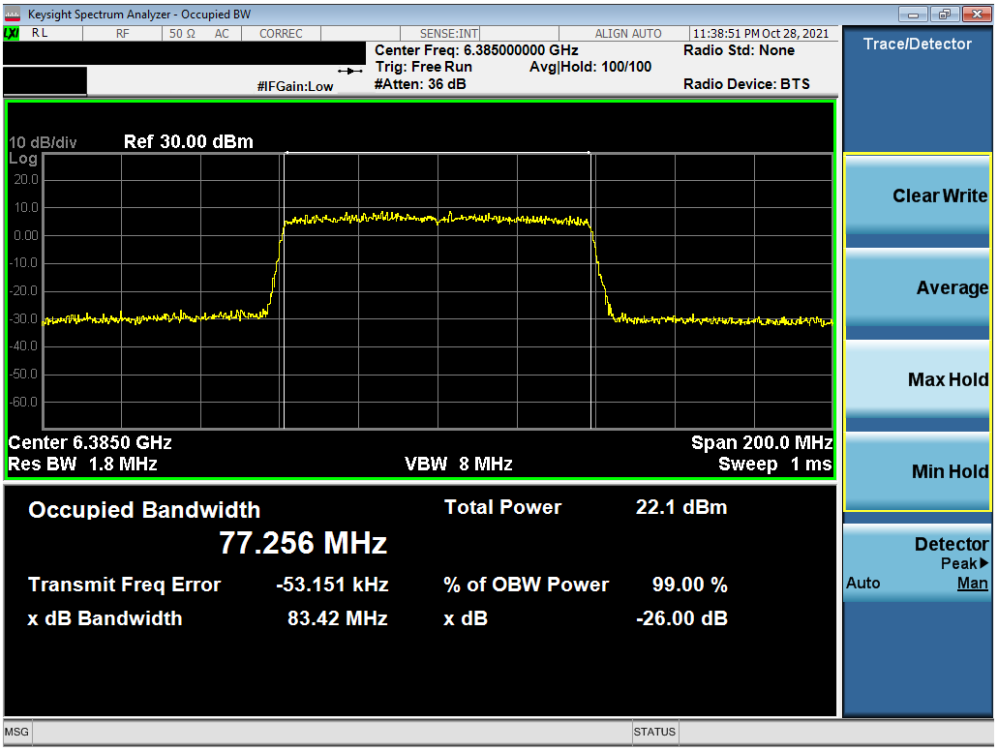
Plot 7-9. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



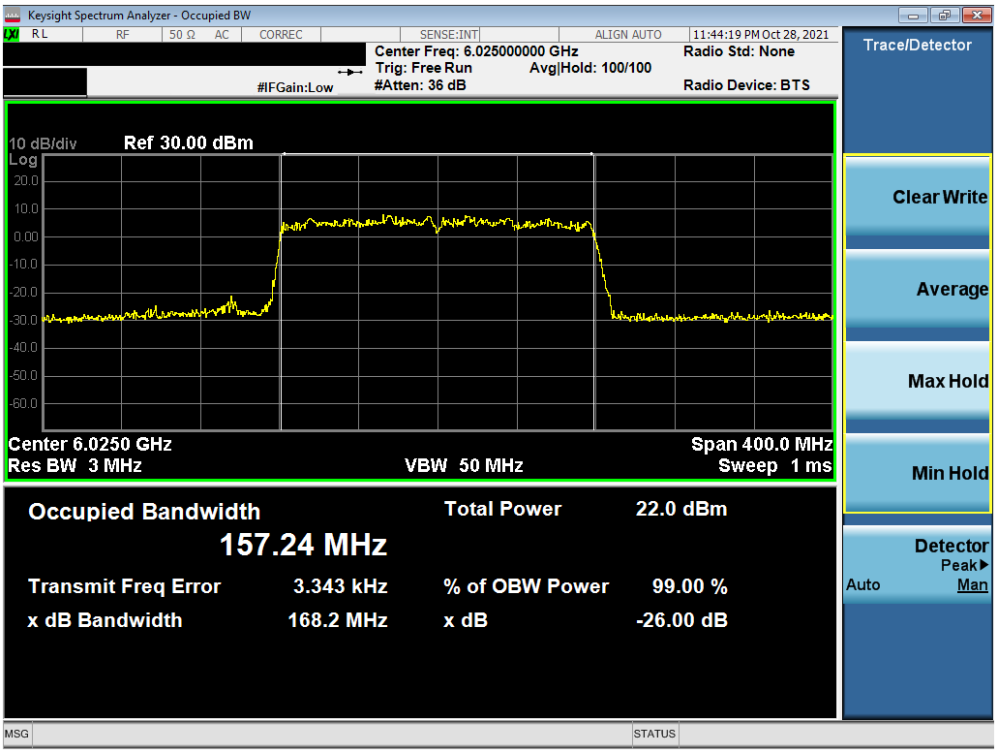
Plot 7-10. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 7)



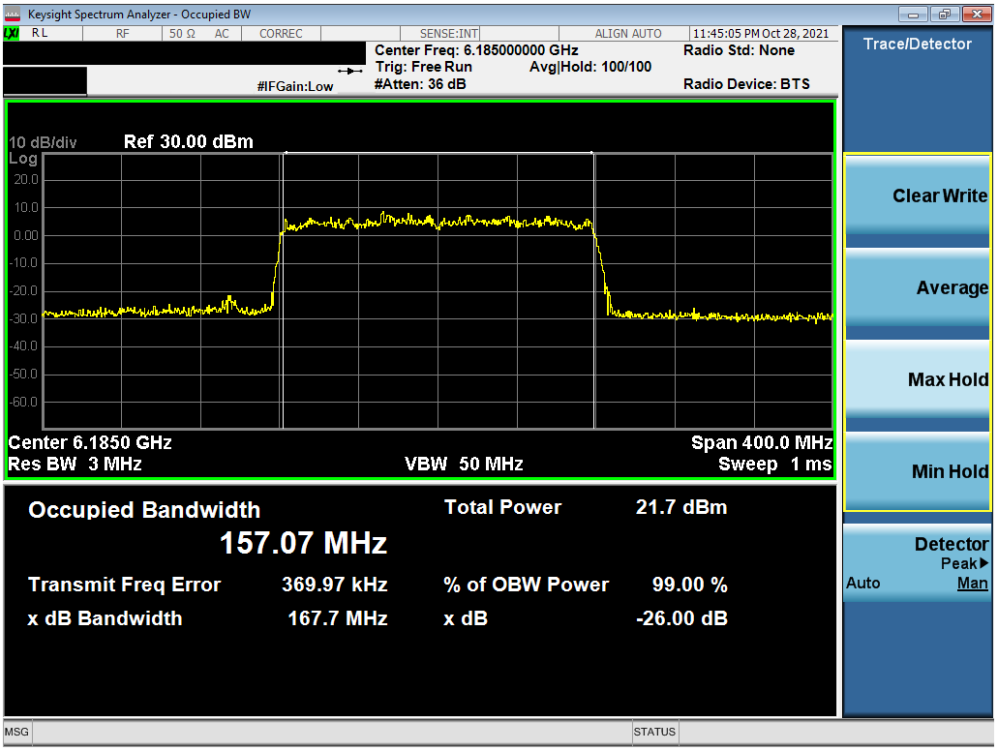
Plot 7-11. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



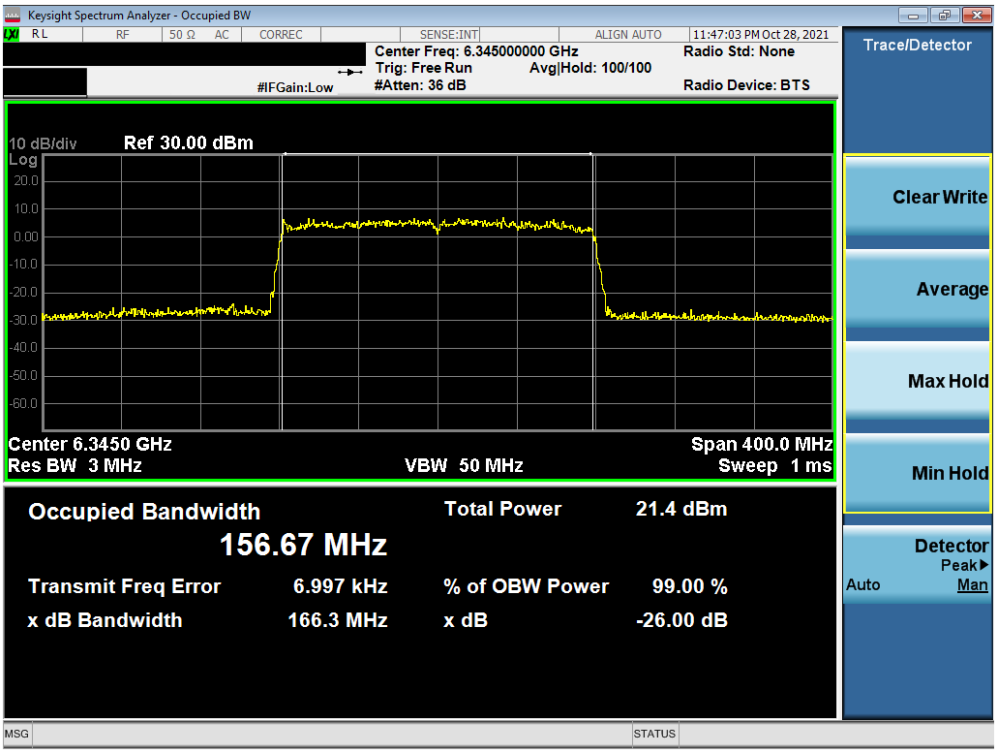
Plot 7-12. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-13. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 15)

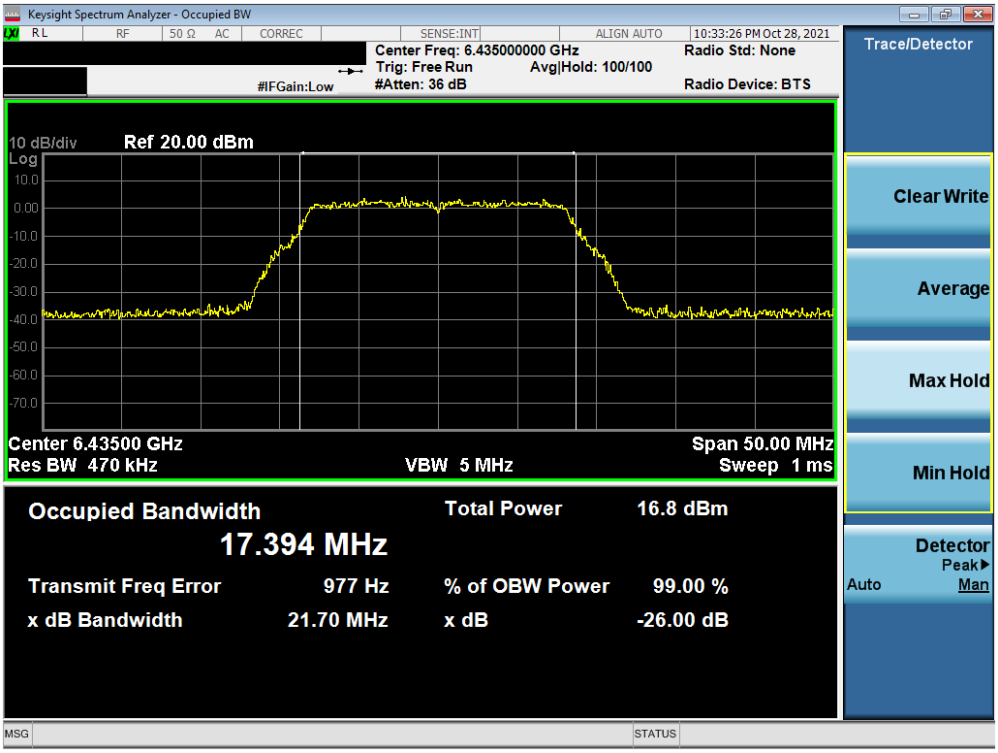


Plot 7-14. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

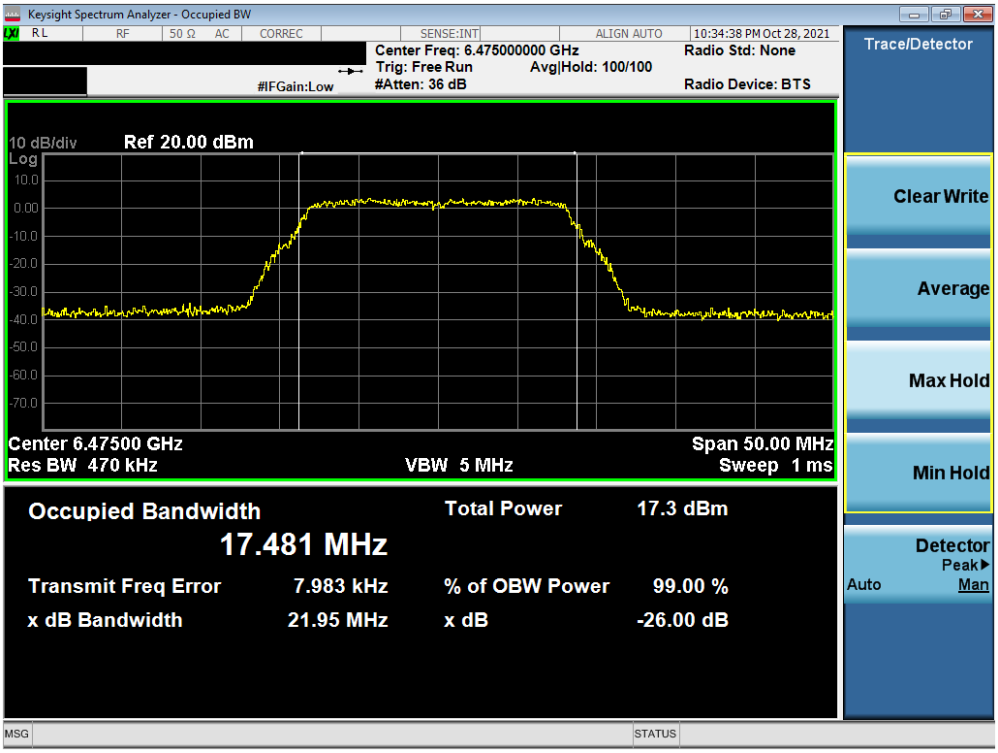


Plot 7-15. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

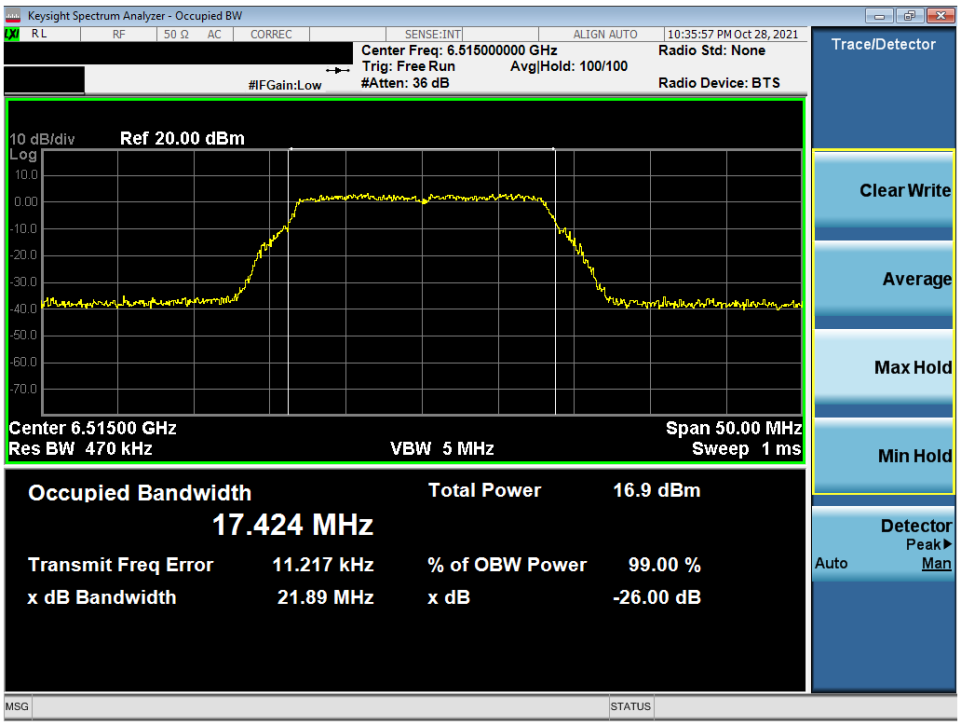
MIMO Antenna-1 26 dB Bandwidth Measurements - (UNII Band 6)



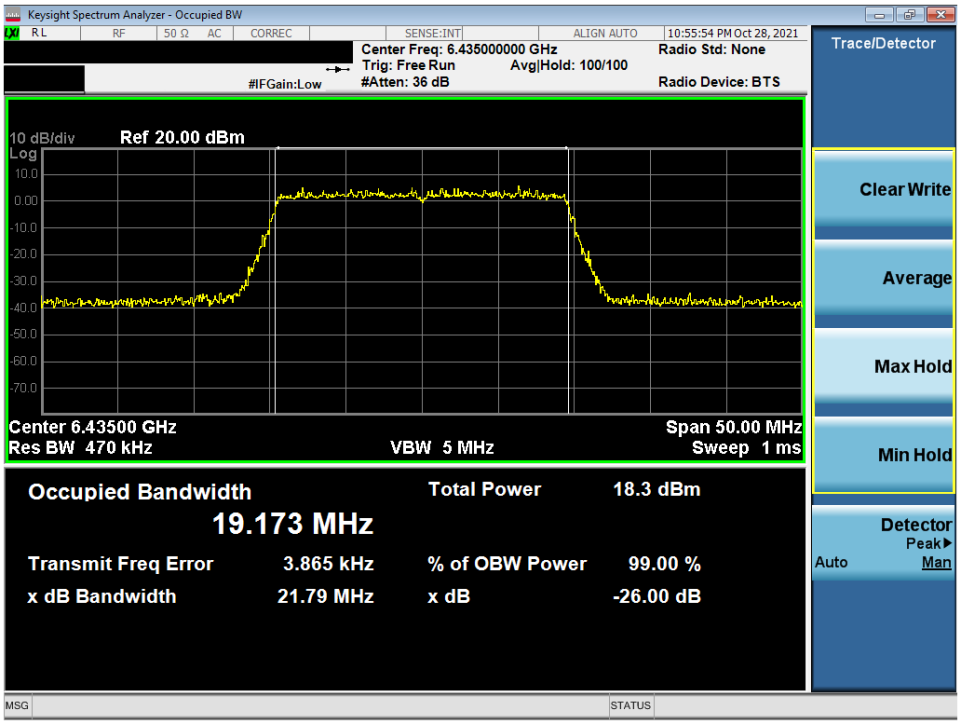
Plot 7-16. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 97)



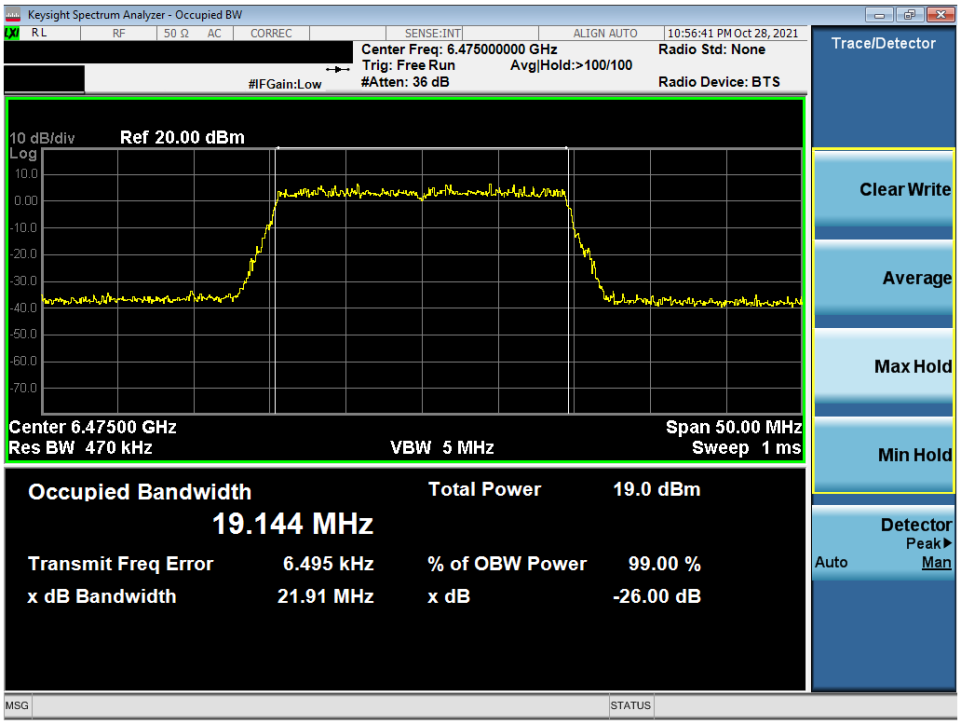
Plot 7-17. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 105)



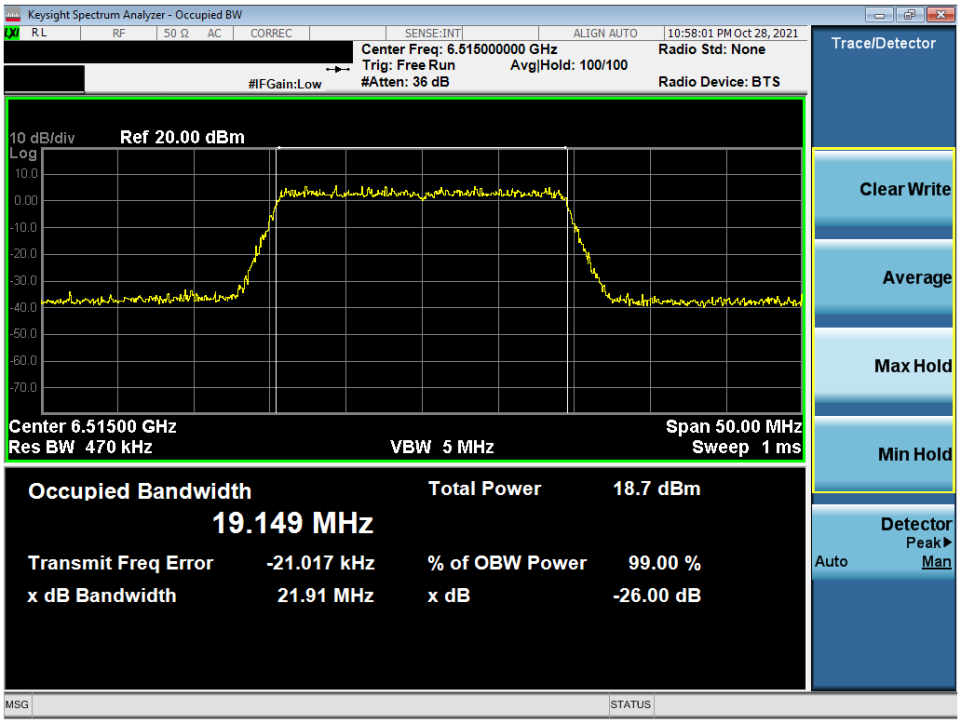
Plot 7-18. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 113)



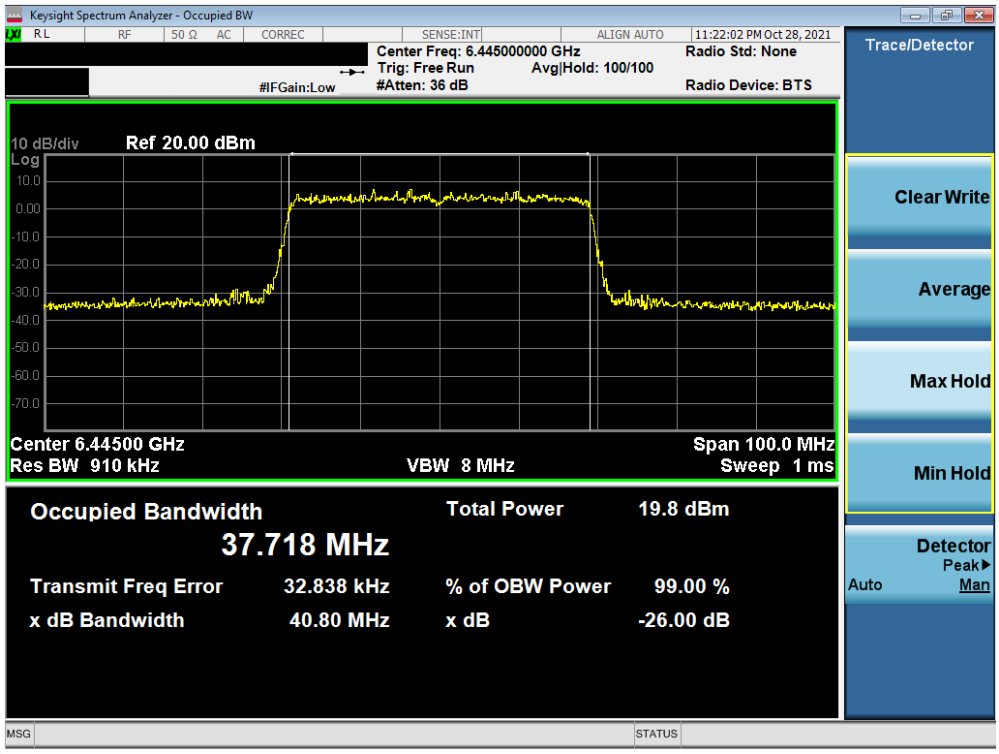
Plot 7-19. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



Plot 7-20. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



Plot 7-21. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 113)



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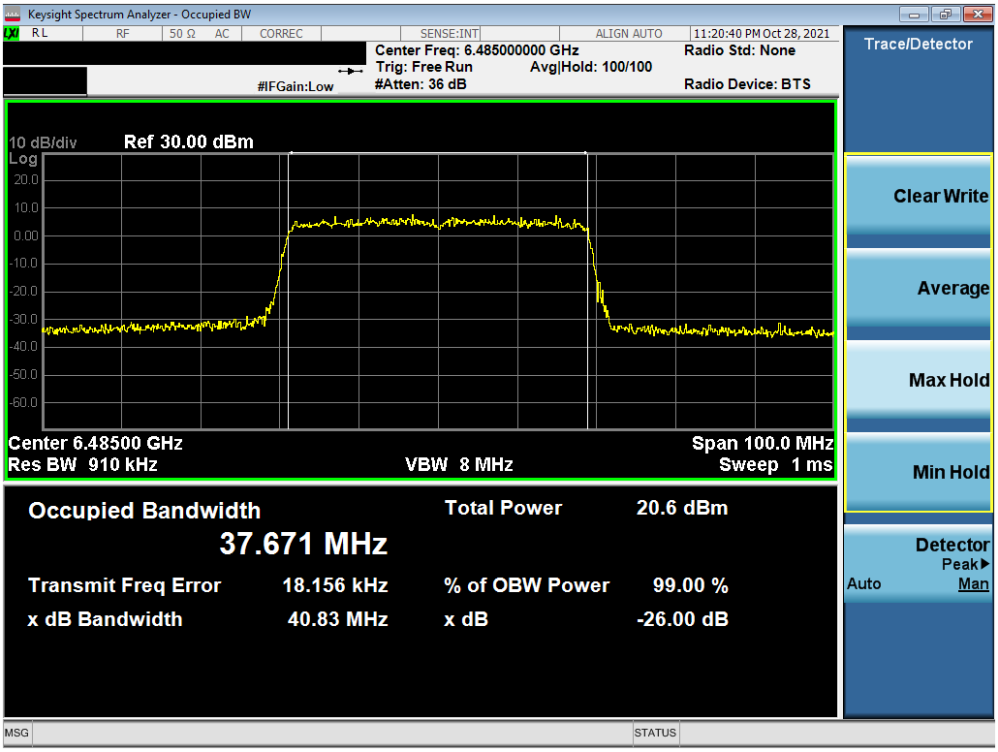
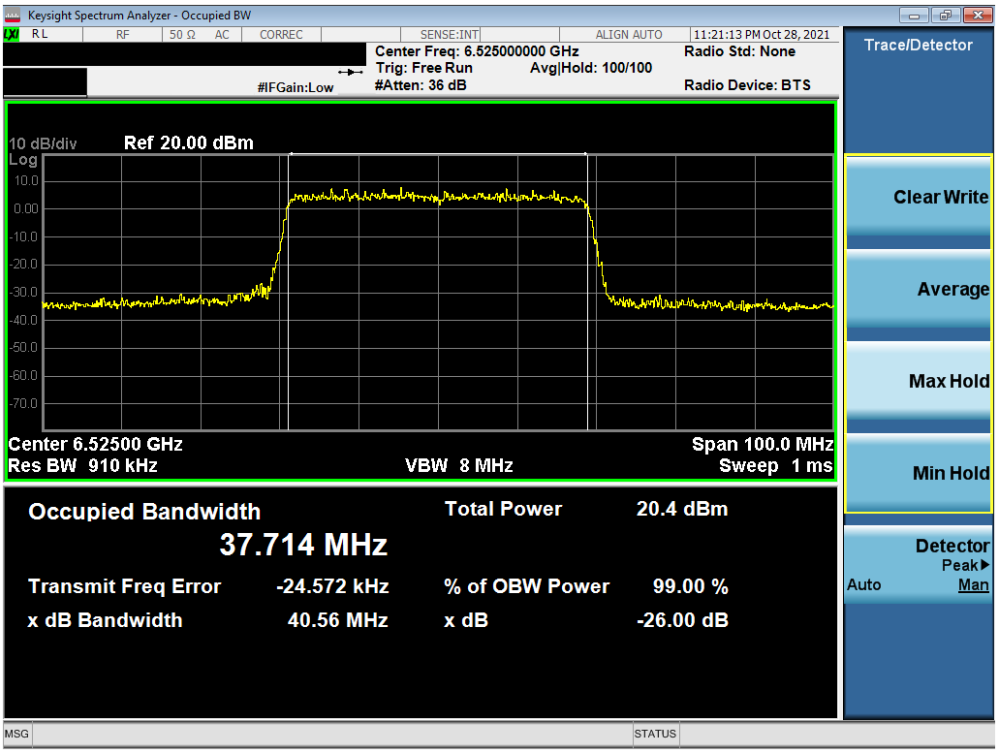
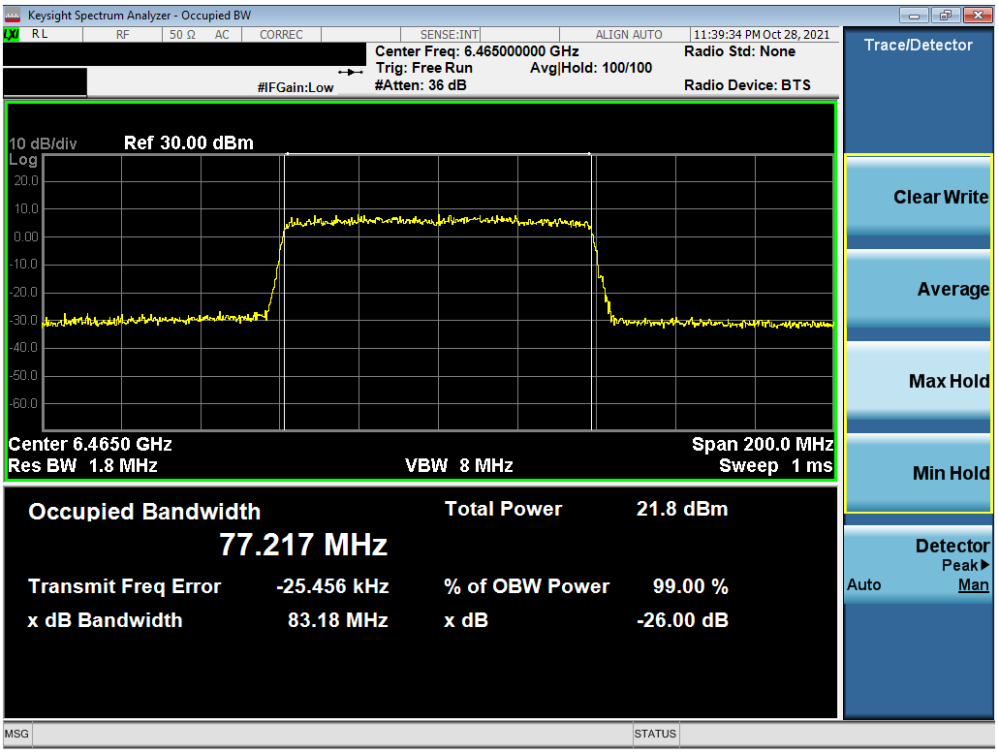
Plot 7-22. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 99)



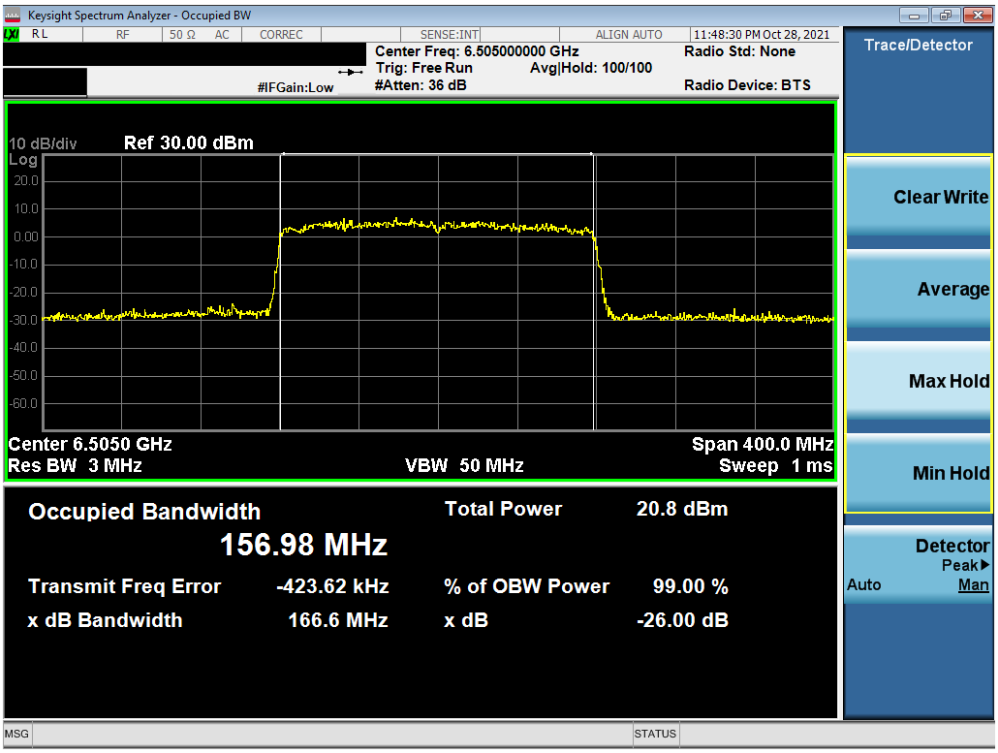
Plot 7-23. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 107)



Plot 7-24. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 6) – Ch. 115)

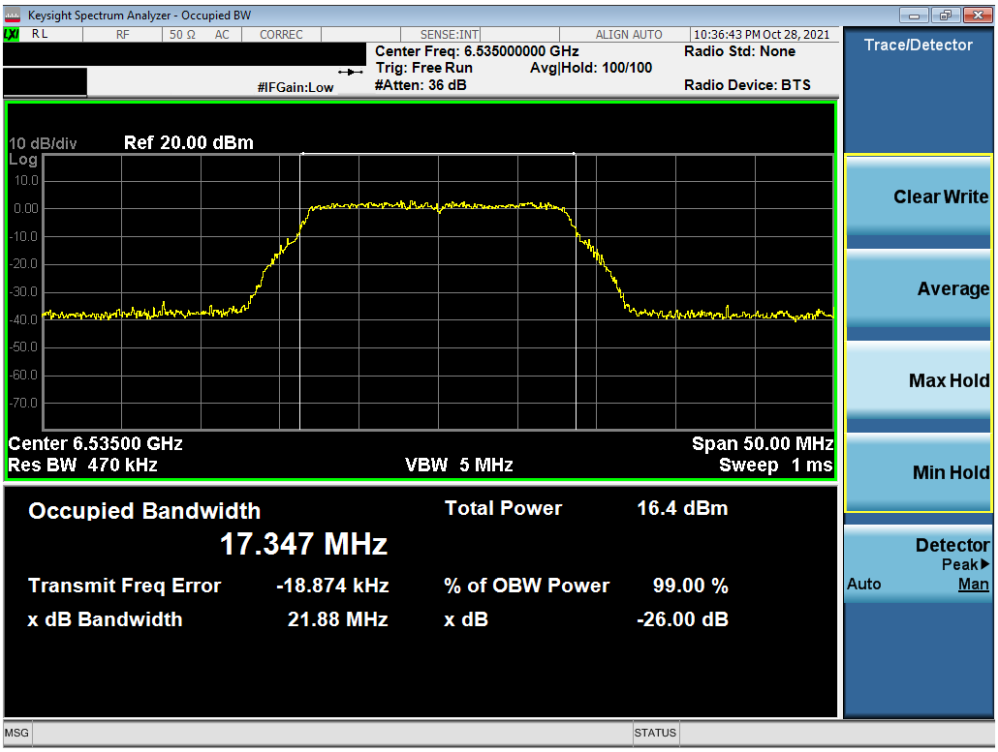


Plot 7-25. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 6) – Ch. 103)

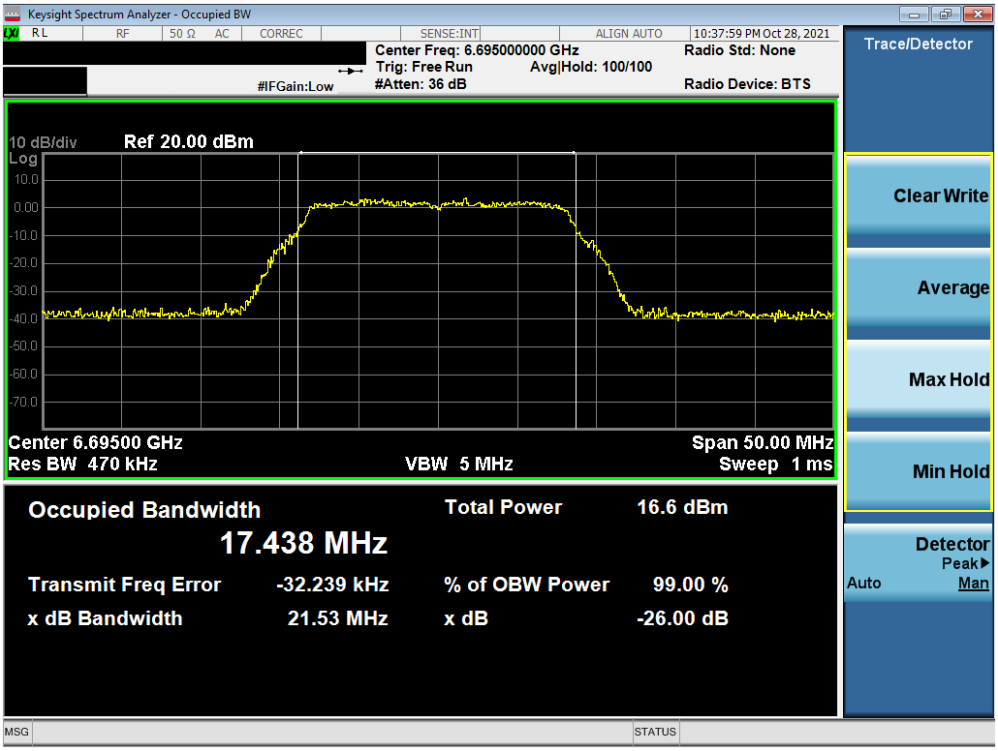


Plot 7-26. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 6) – Ch. 111)

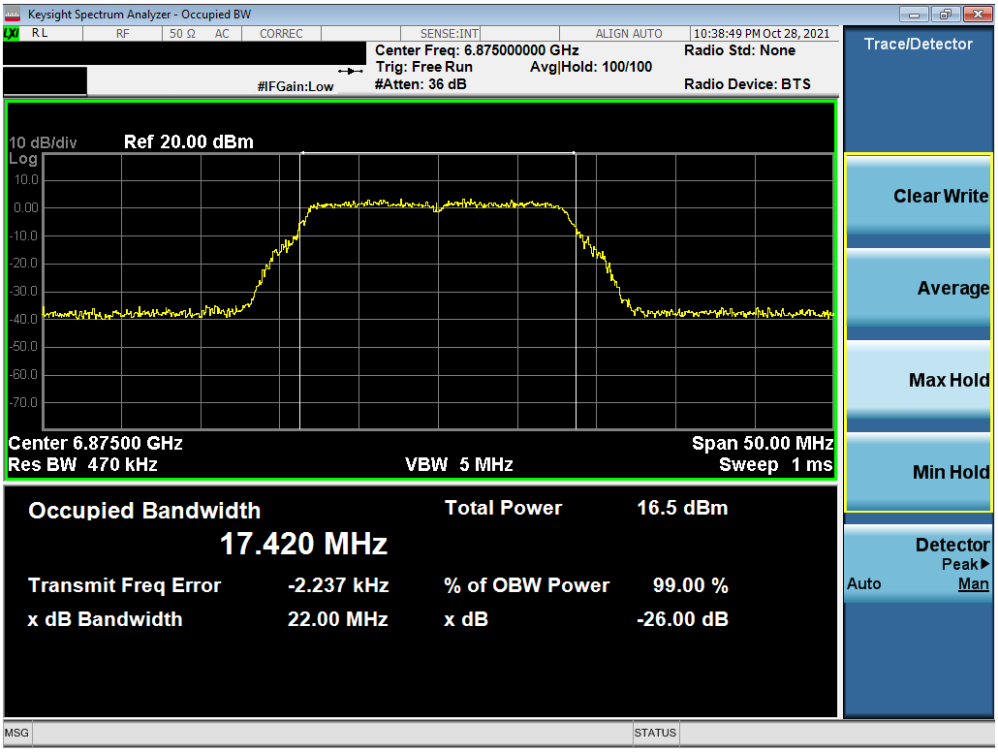
MIMO Antenna-1 26 dB Bandwidth Measurements - (UNII Band 7)



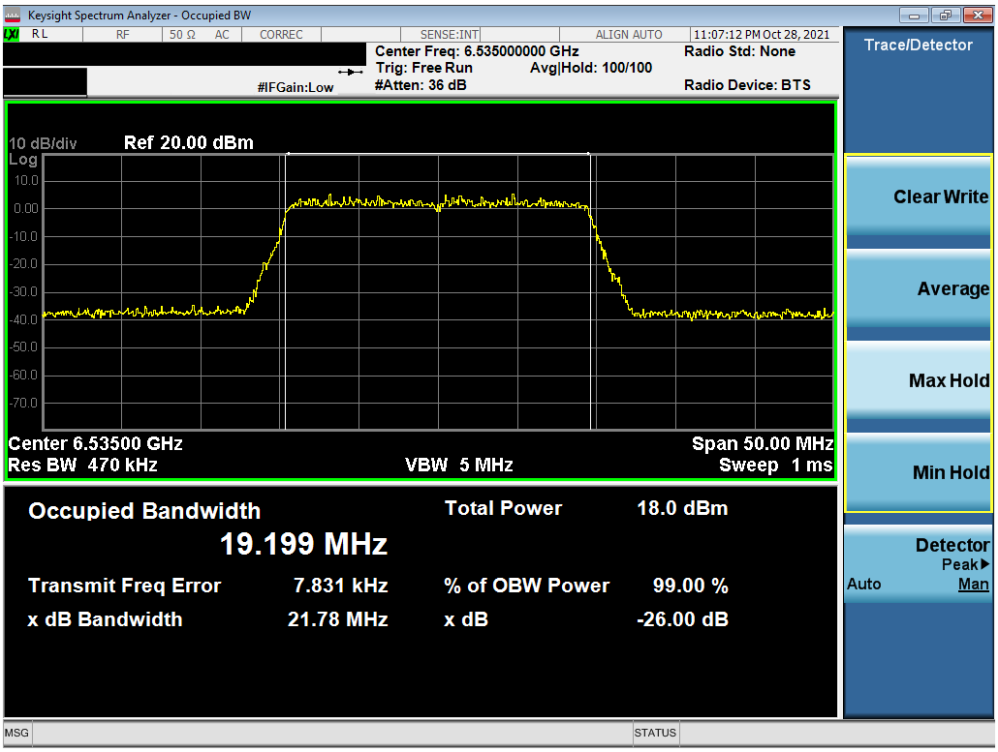
Plot 7-27. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 117)



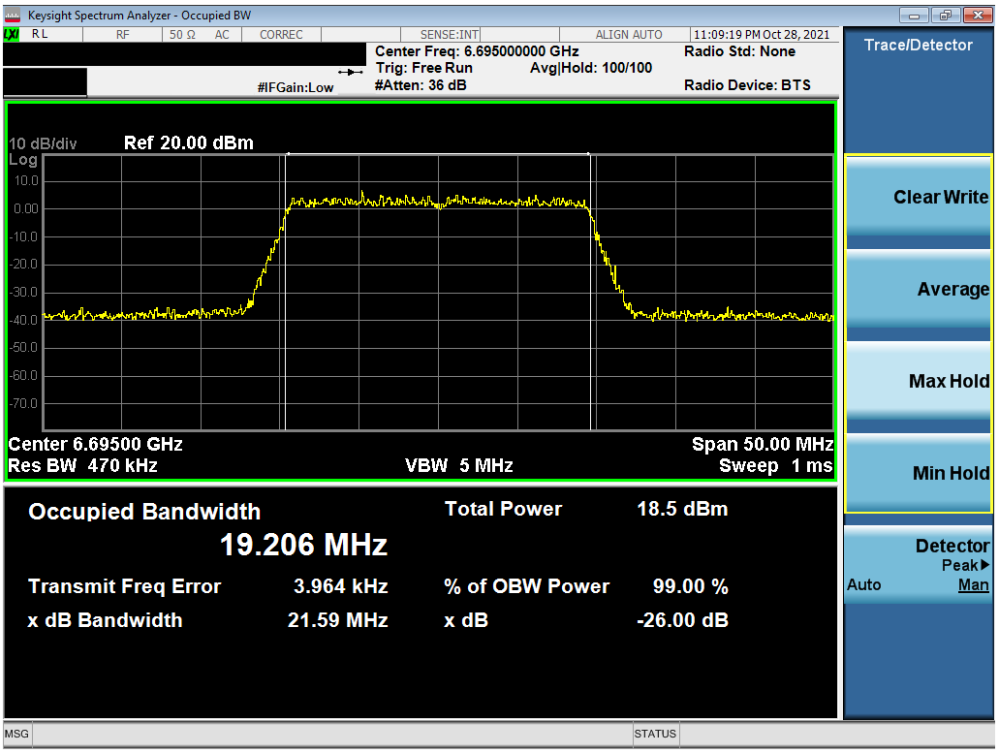
Plot 7-28. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 149)



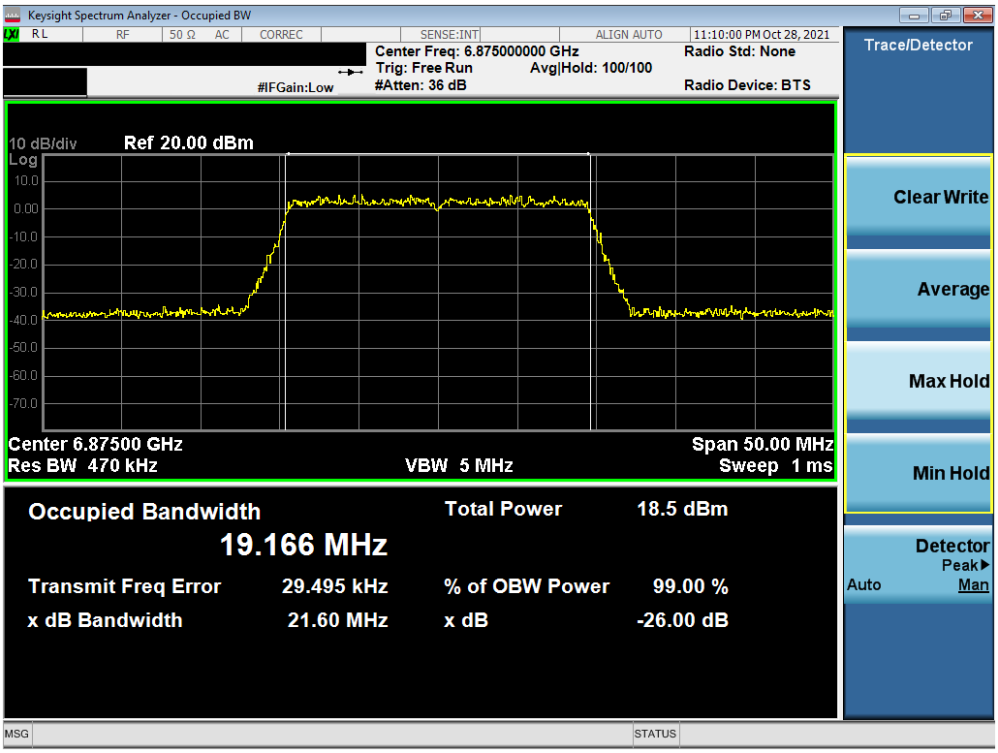
Plot 7-29. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 7) – Ch. 185)



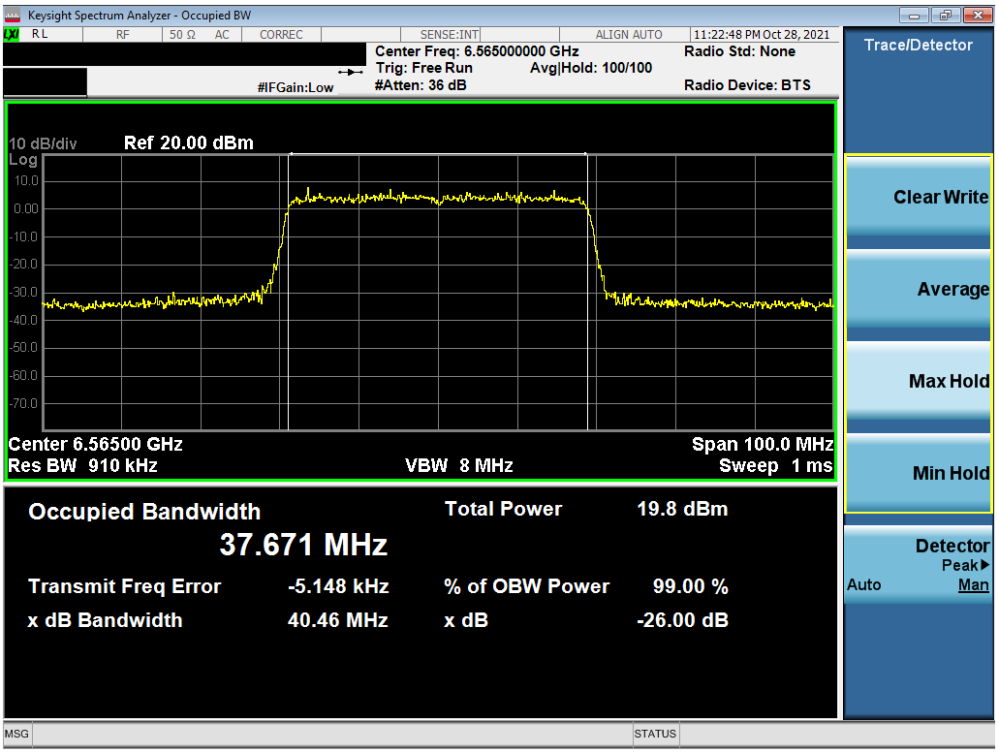
Plot 7-30. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 117)



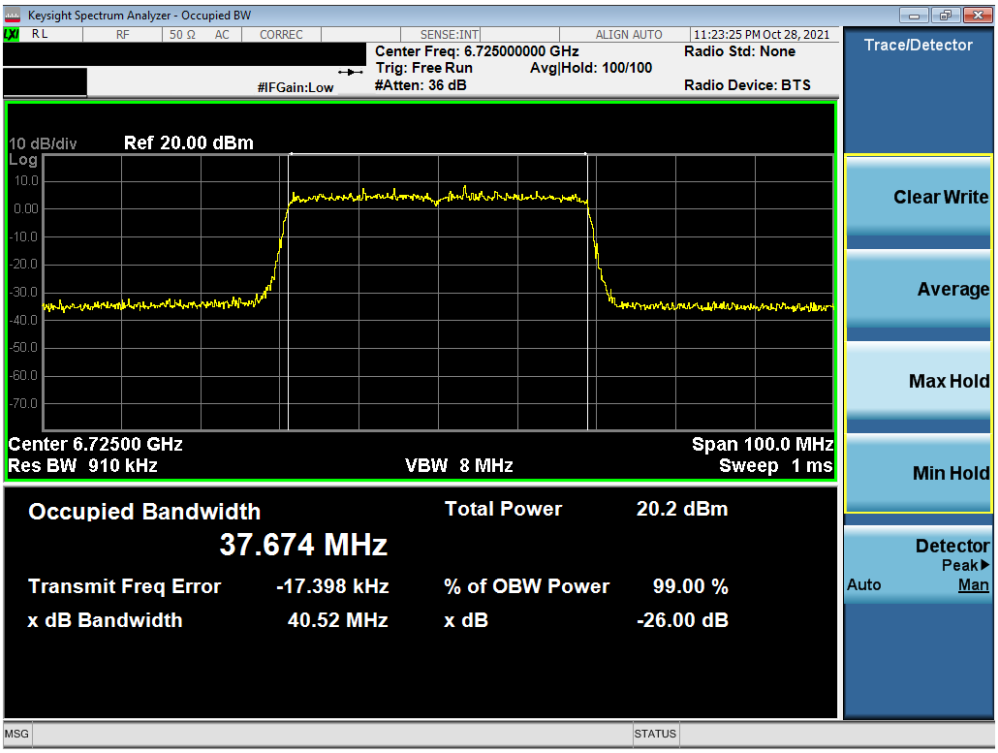
Plot 7-31. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



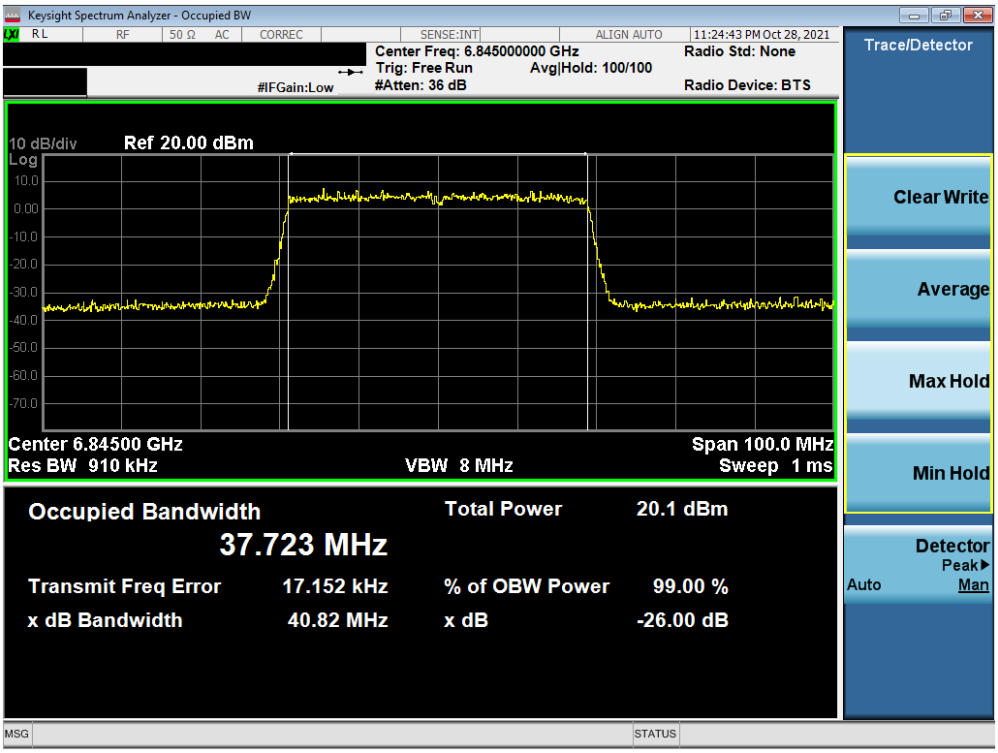
Plot 7-32. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 7) – Ch. 185)



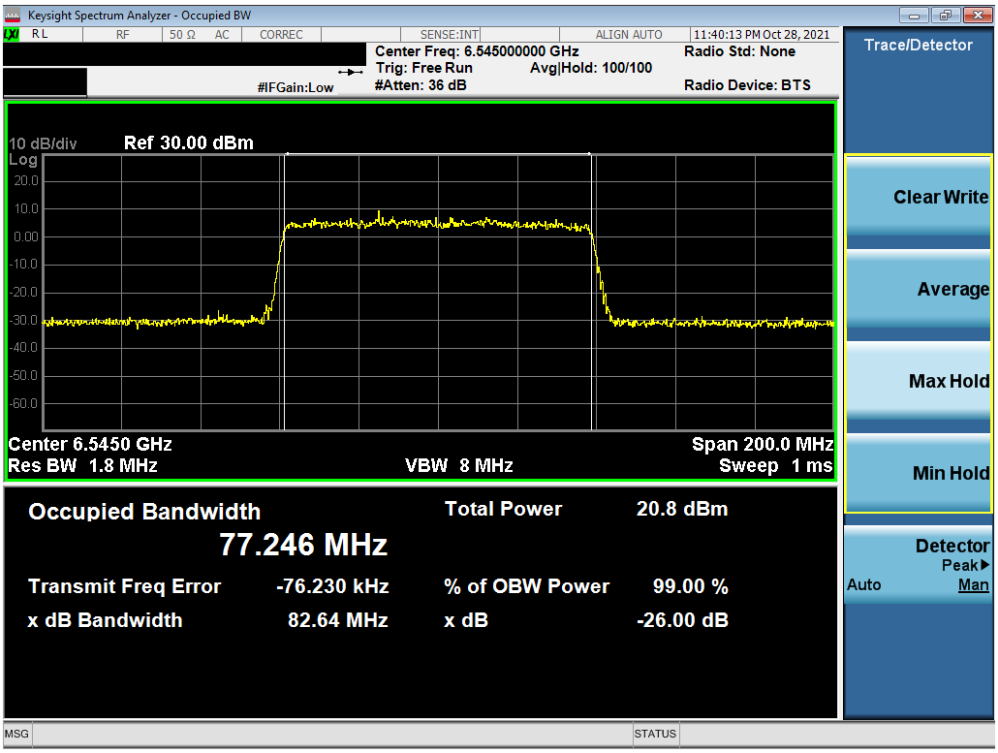
Plot 7-33. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 123)



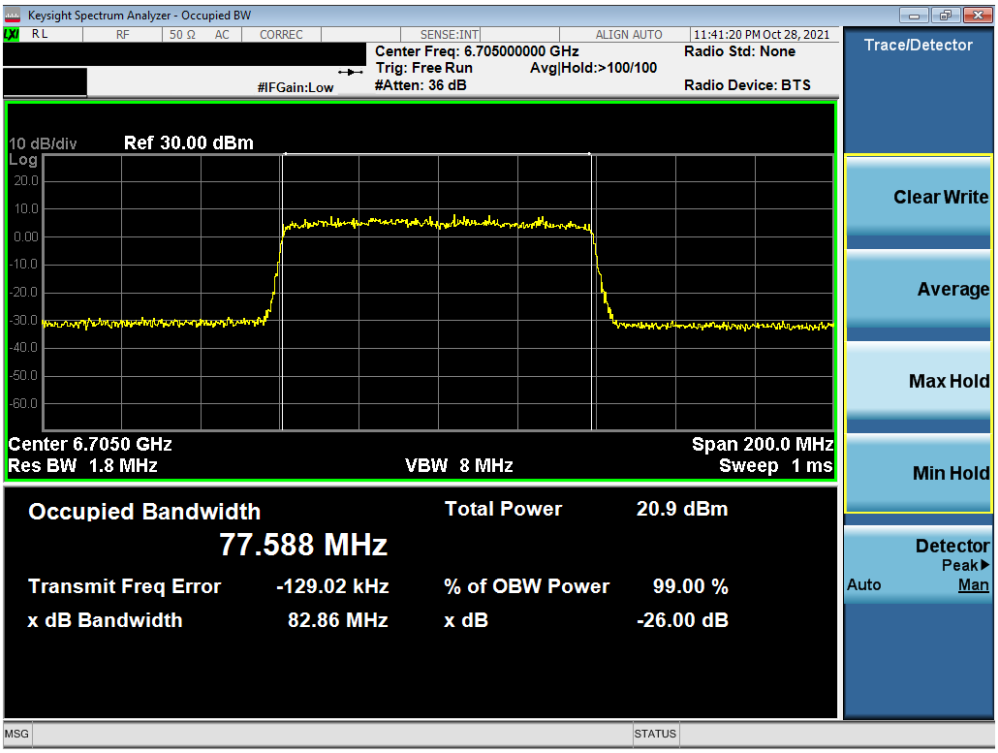
Plot 7-34. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



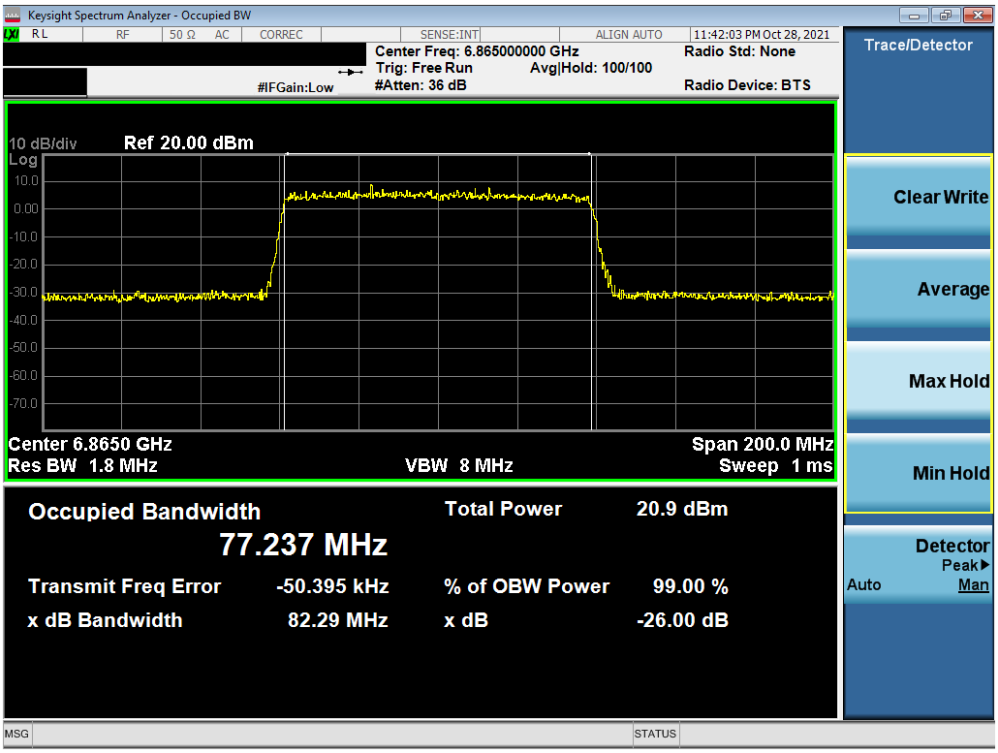
Plot 7-35. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



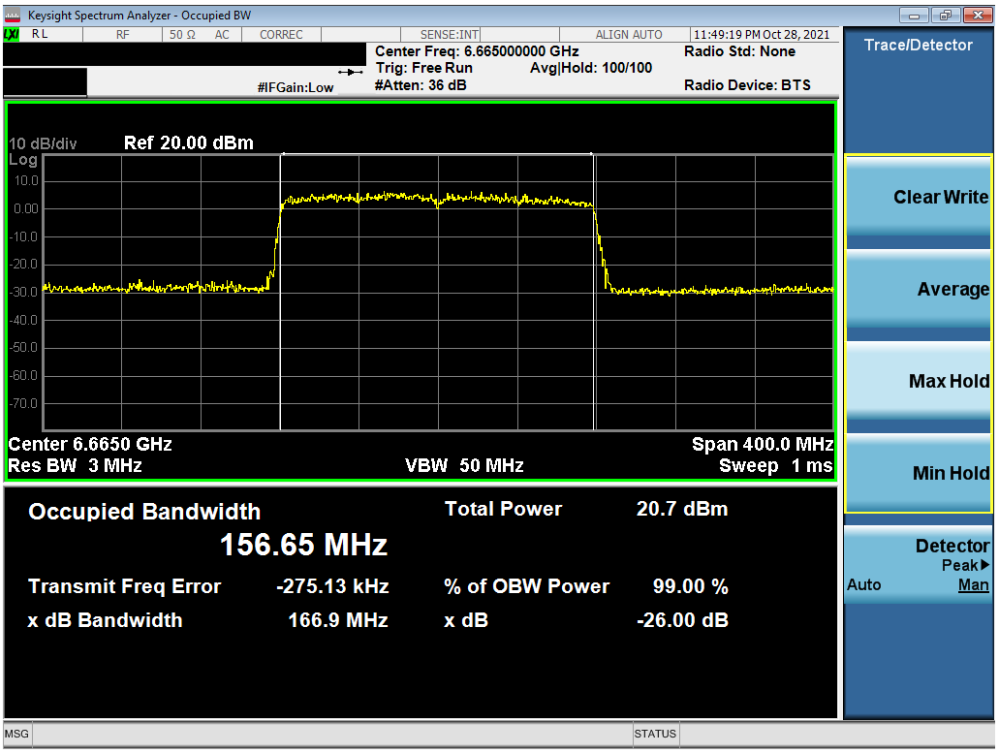
Plot 7-36. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 119)



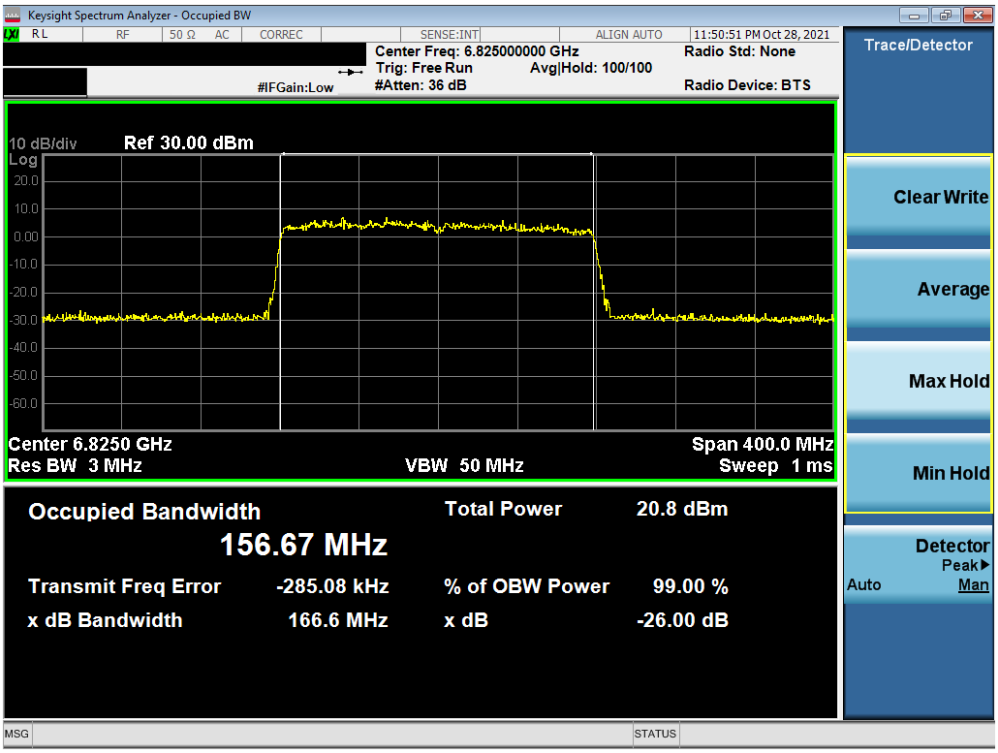
Plot 7-37. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-38. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 7) – Ch. 183)

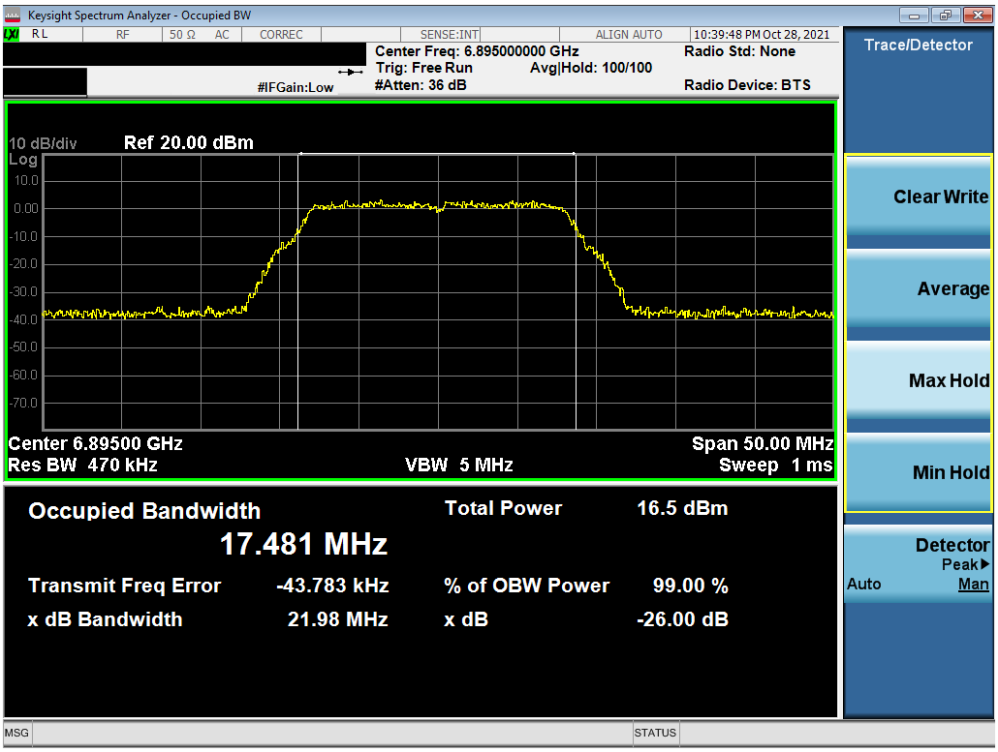


Plot 7-39. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

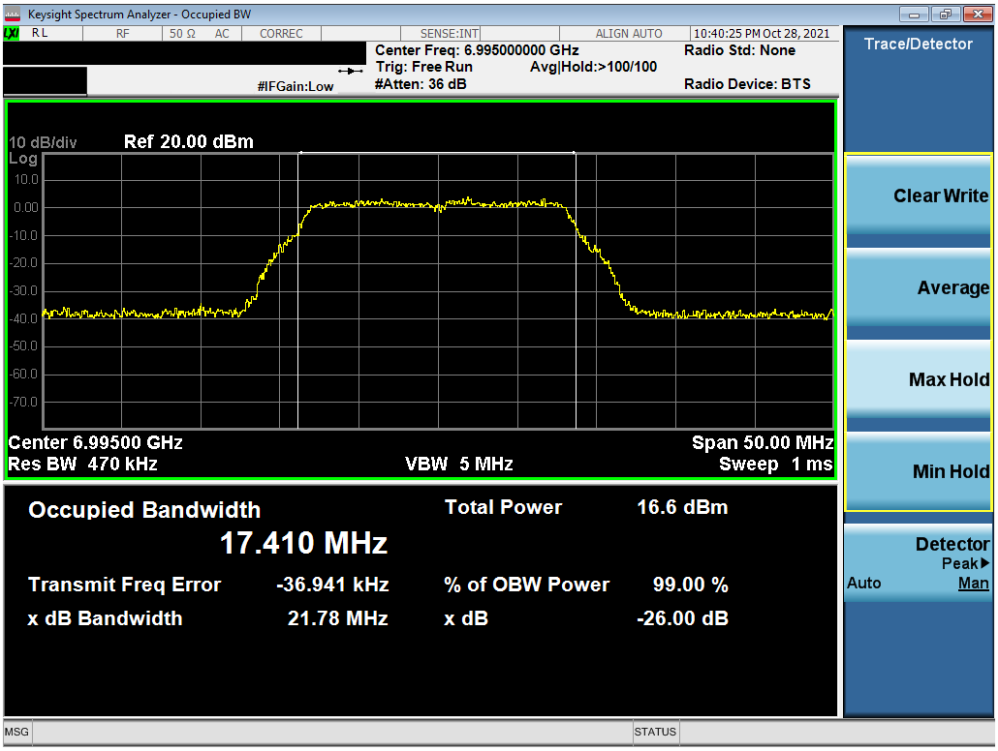


Plot 7-40. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 7) – Ch. 175)

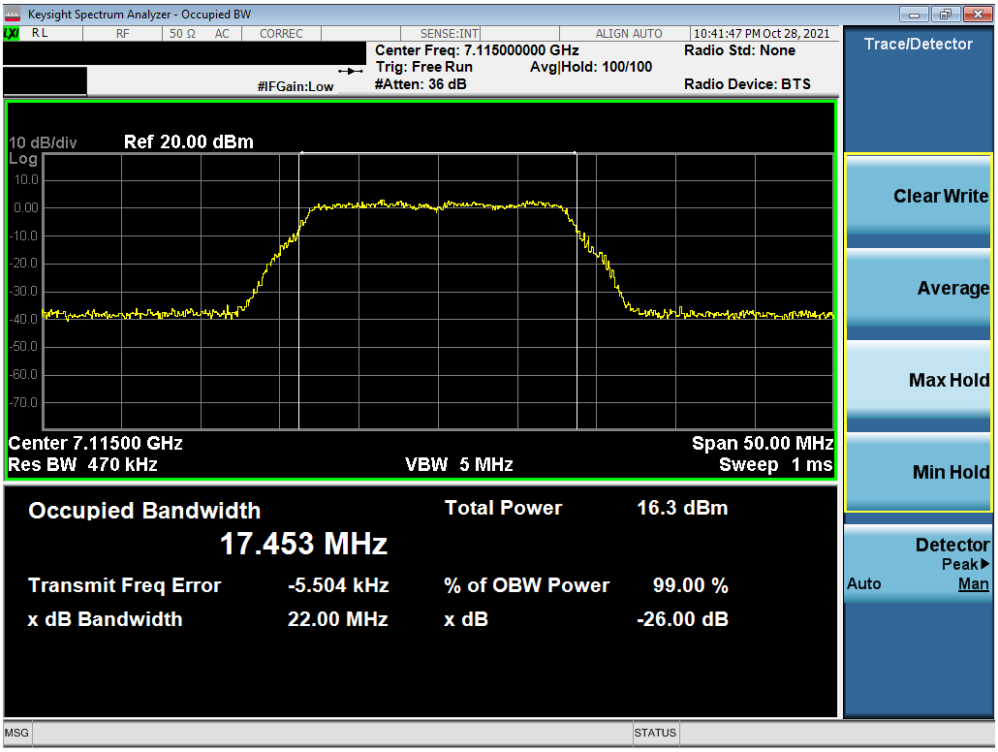
MIMO Antenna-1 26 dB Bandwidth Measurements - (UNII Band 8)



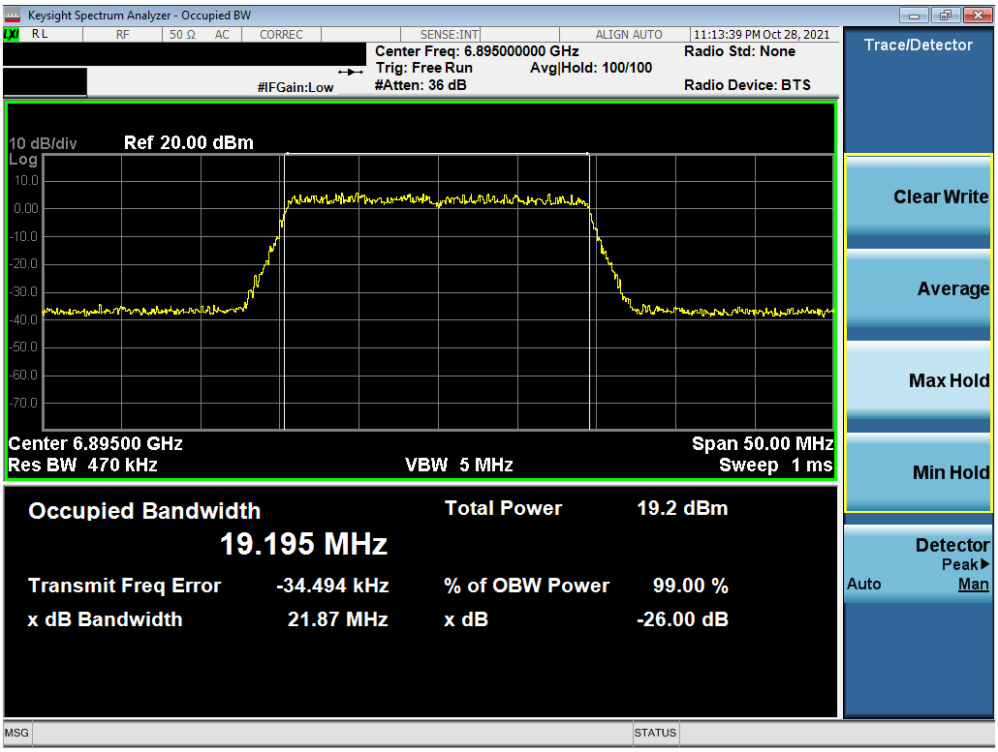
Plot 7-41. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 189)



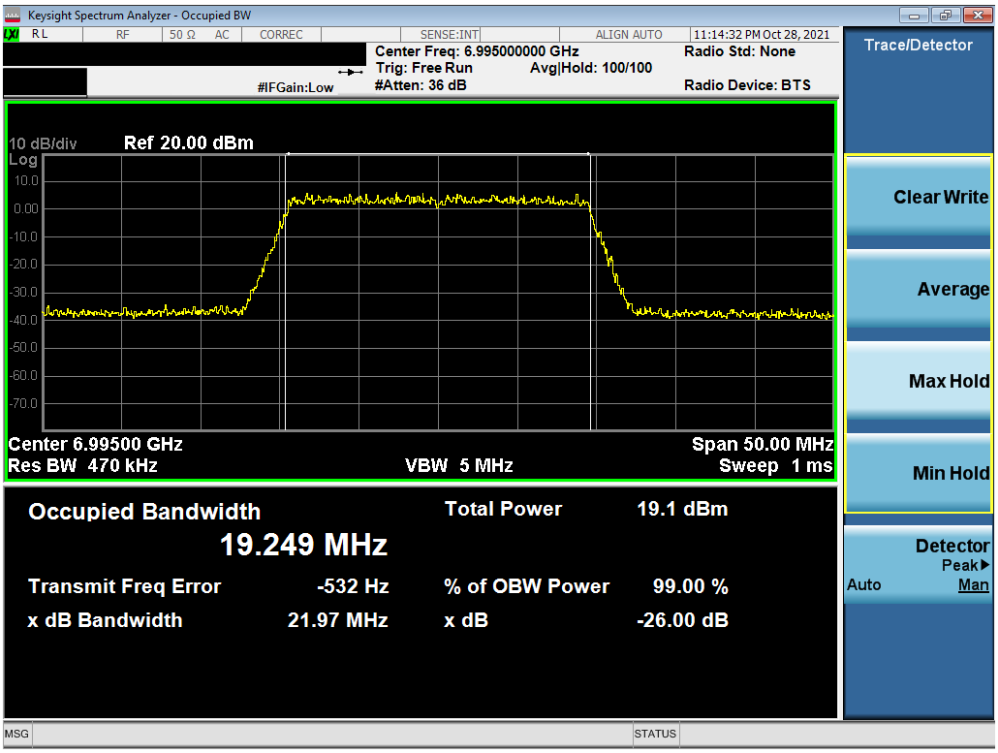
Plot 7-42. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 209)



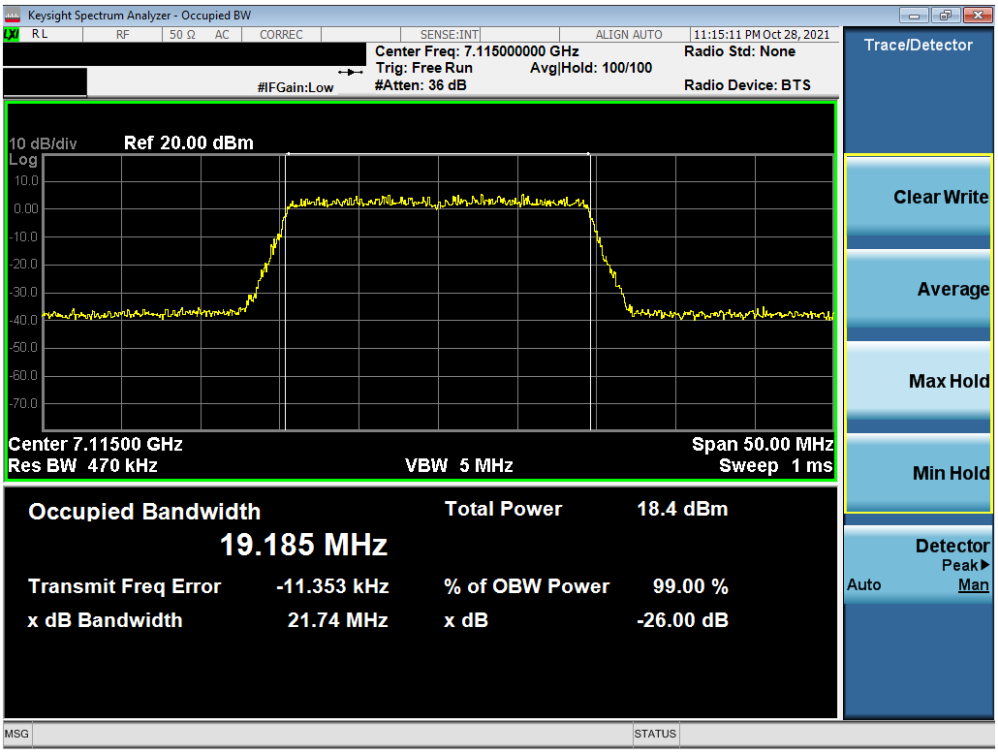
Plot 7-43. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11a (UNII Band 8) – Ch. 233)



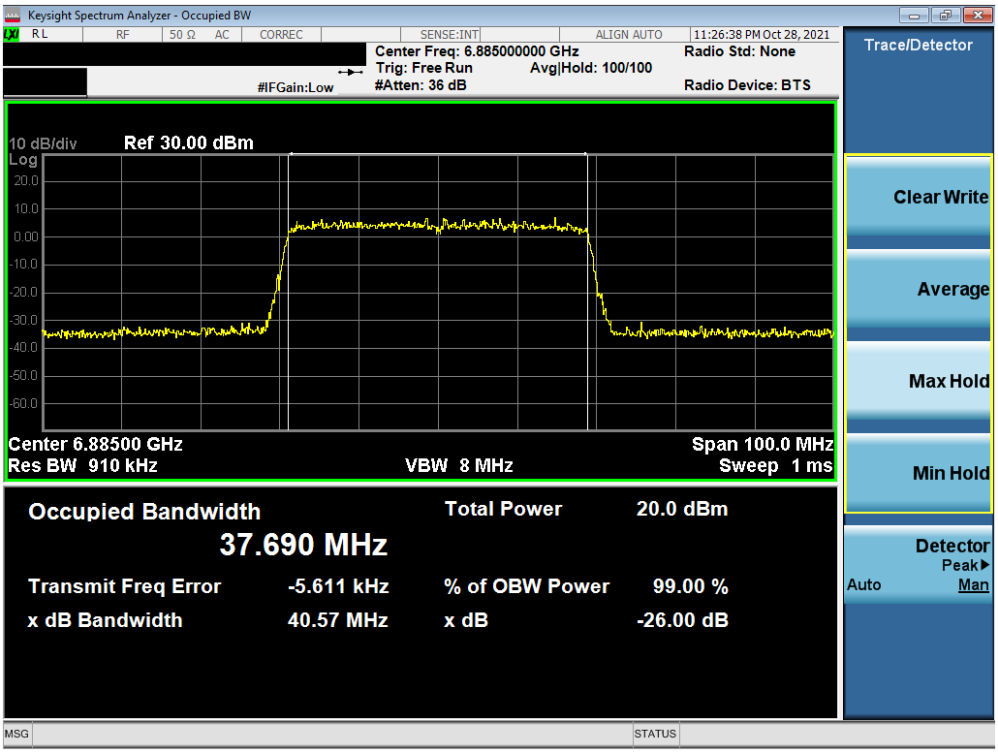
Plot 7-44. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 189)



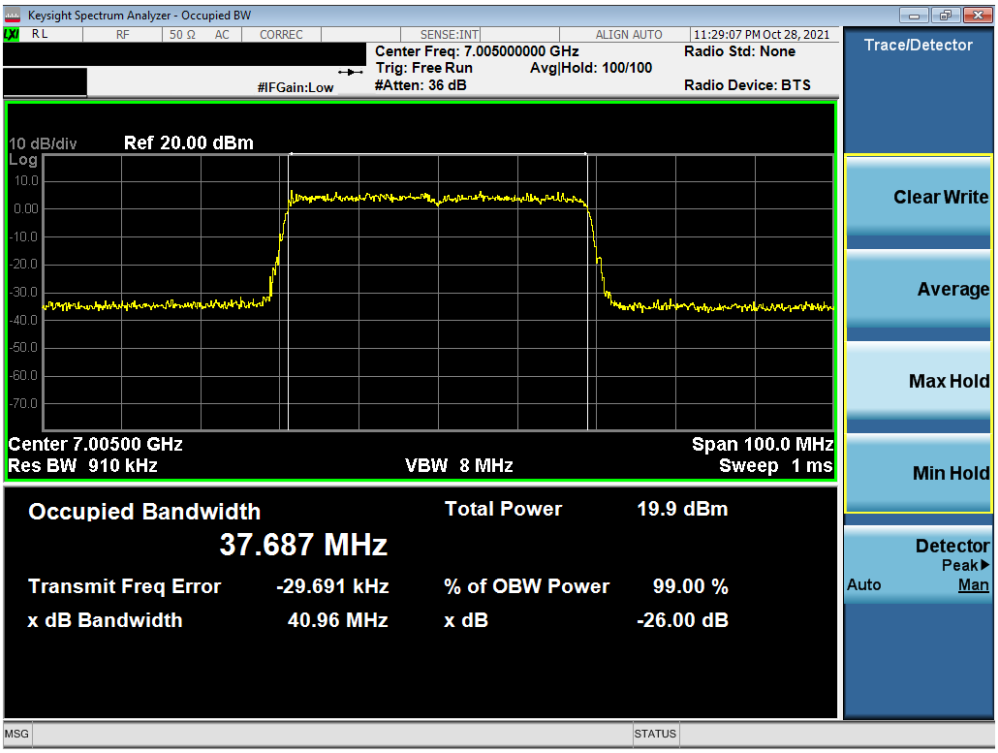
Plot 7-45. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 209)



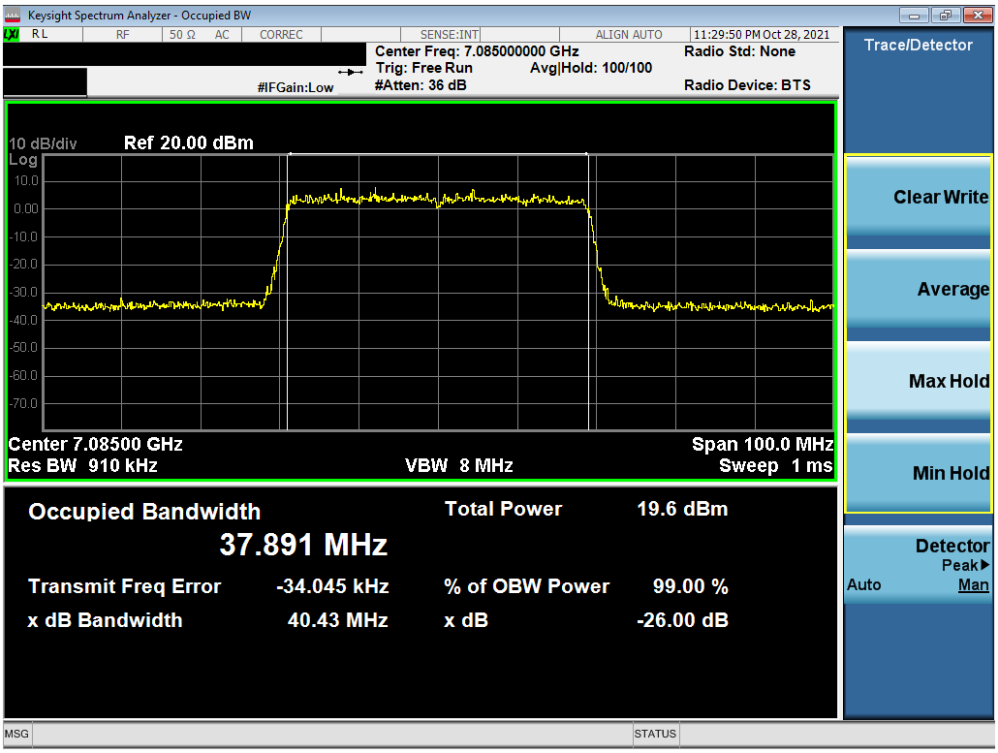
Plot 7-46. 26dB Bandwidth Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 8) – Ch. 233)



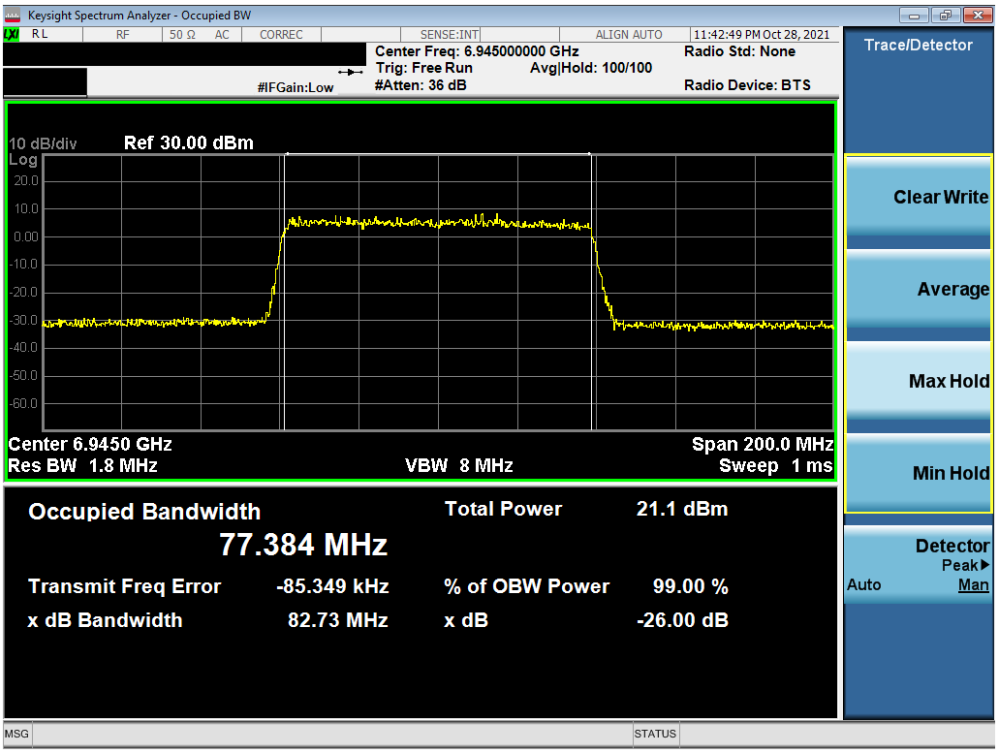
Plot 7-47. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 187)



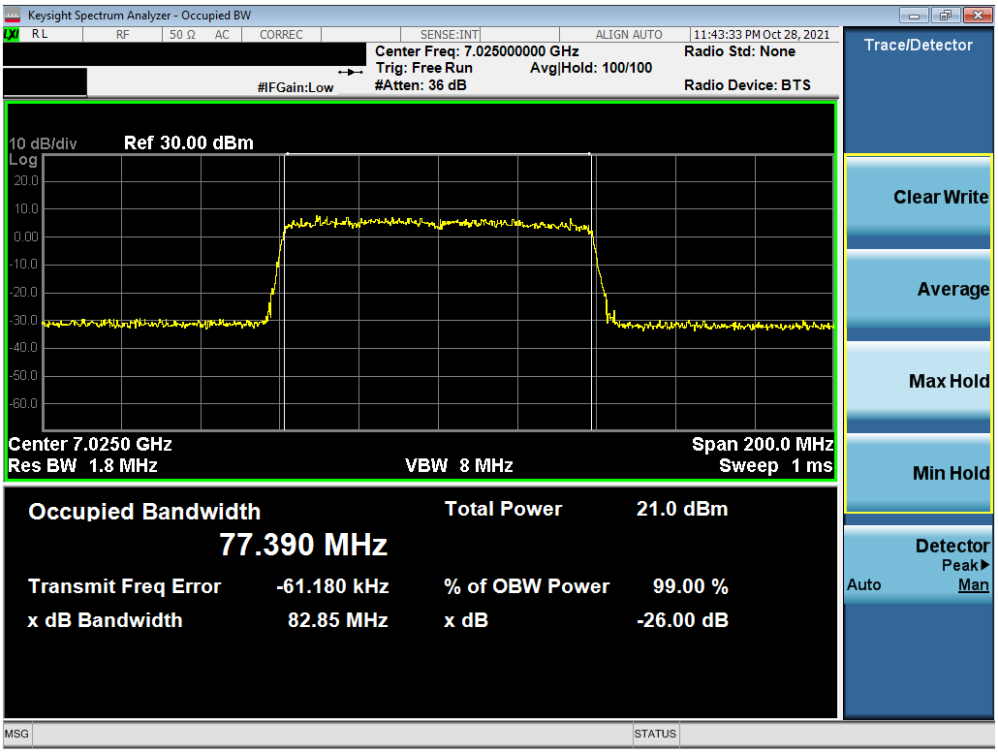
Plot 7-48. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 211)



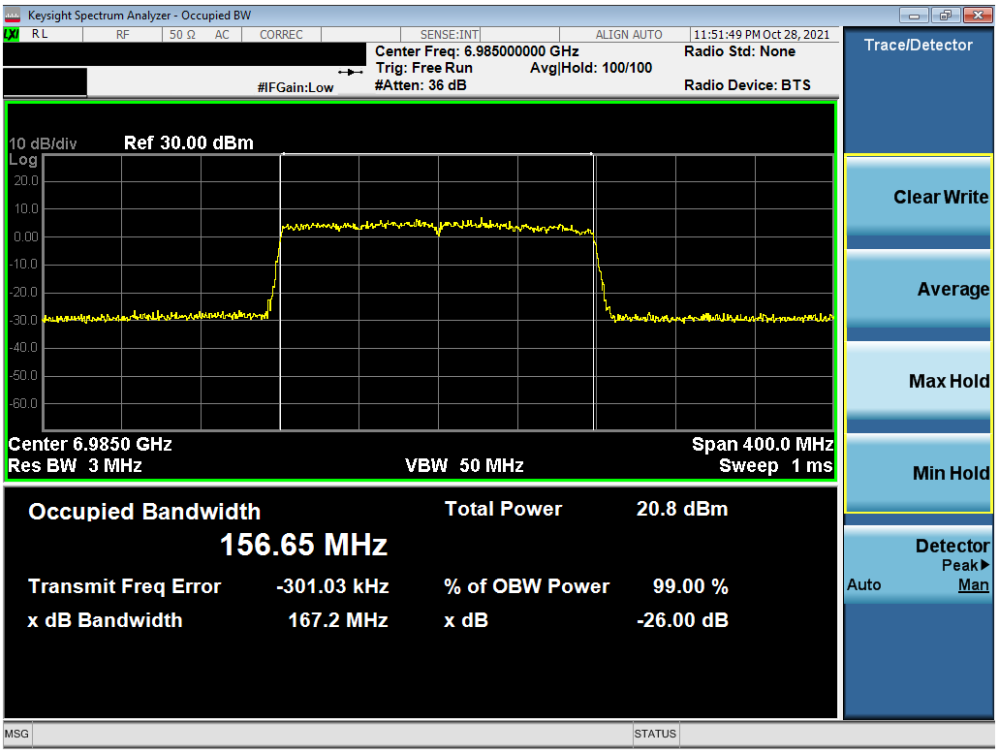
Plot 7-49. 26dB Bandwidth Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 8) – Ch. 227)



Plot 7-50. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 8) – Ch. 199)

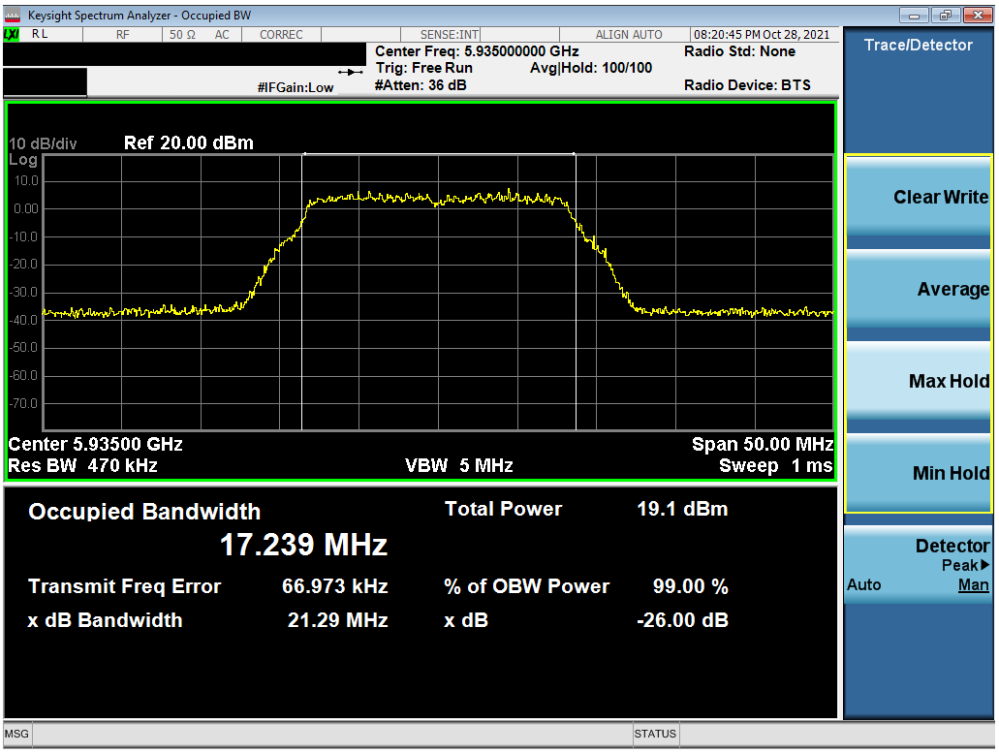


Plot 7-51. 26dB Bandwidth Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 8) – Ch. 215)

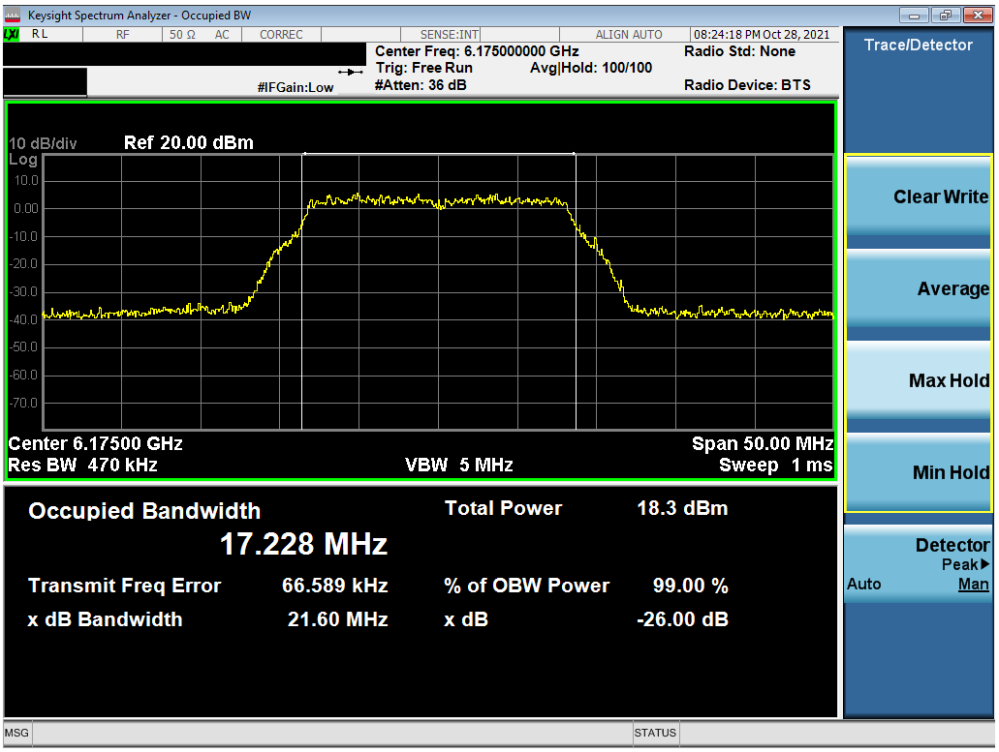


Plot 7-52. 26dB Bandwidth Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 8) – Ch. 207)

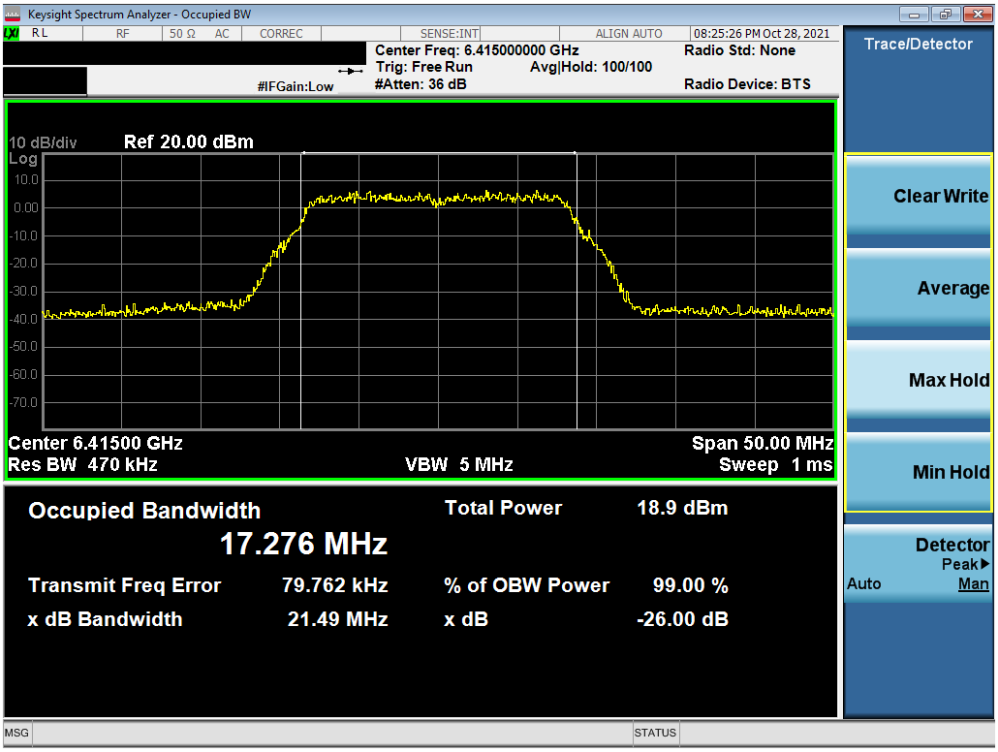
MIMO Antenna-2 26 dB Bandwidth Measurements - (UNII Band 5)



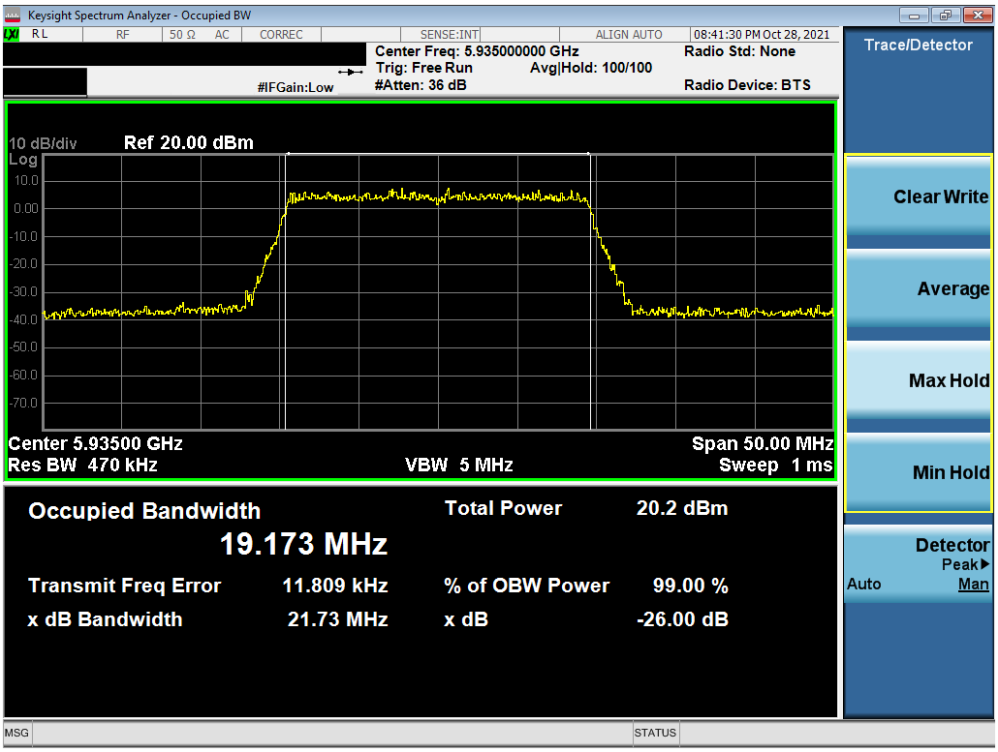
Plot 7-53. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 2)



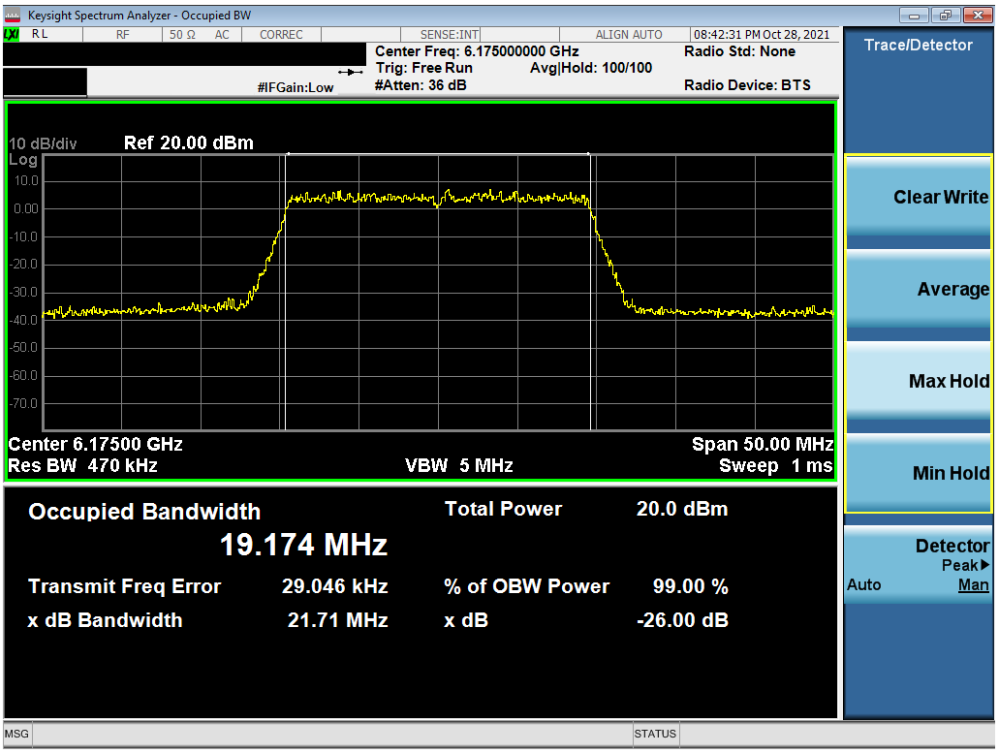
Plot 7-54. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 45)



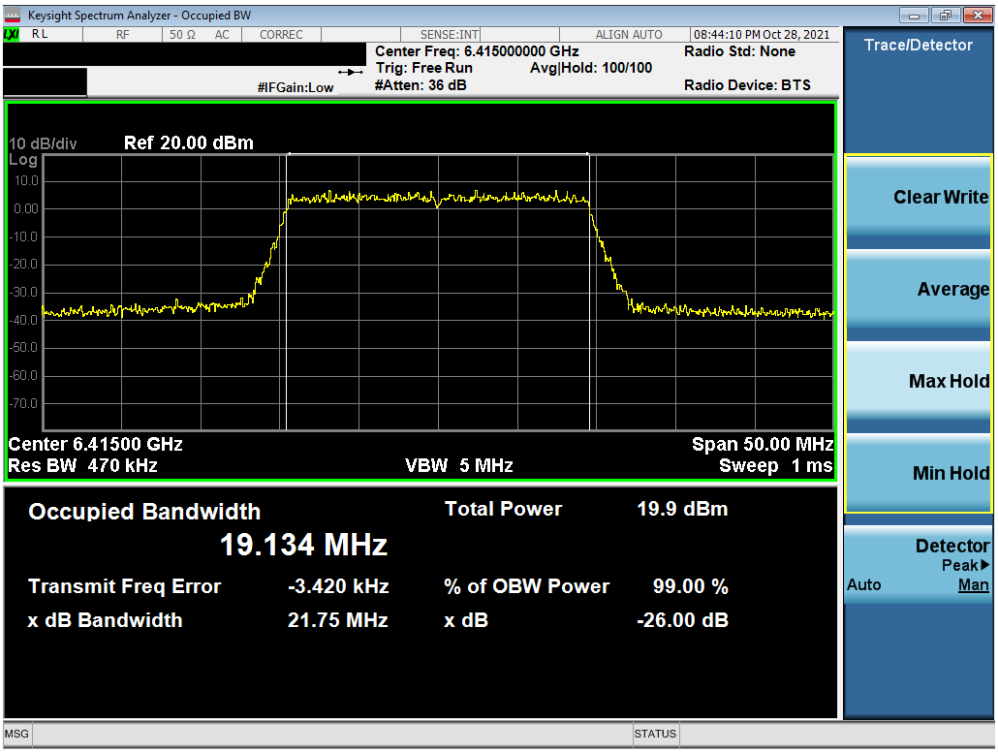
Plot 7-55. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 5) – Ch. 93



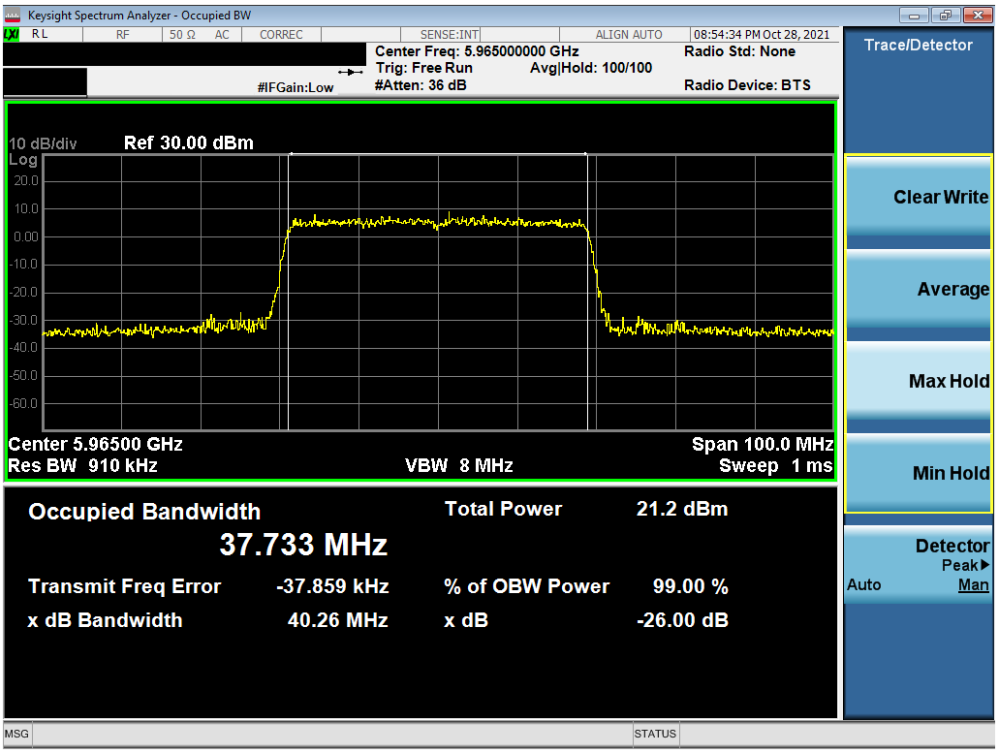
Plot 7-56. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 2)



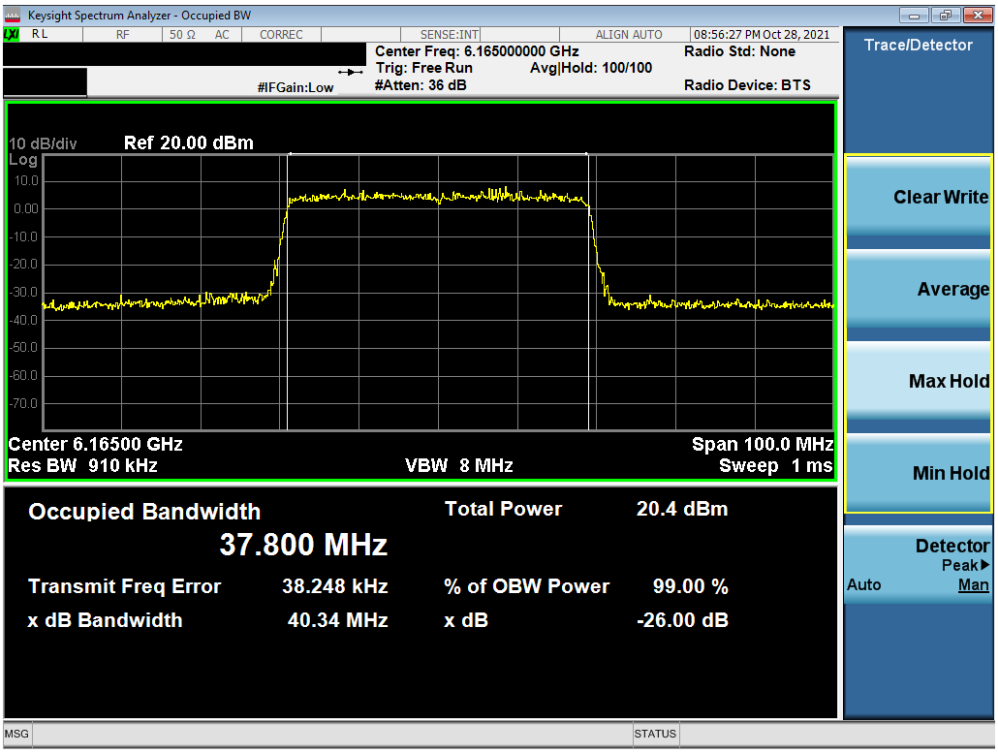
Plot 7-57. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 45)



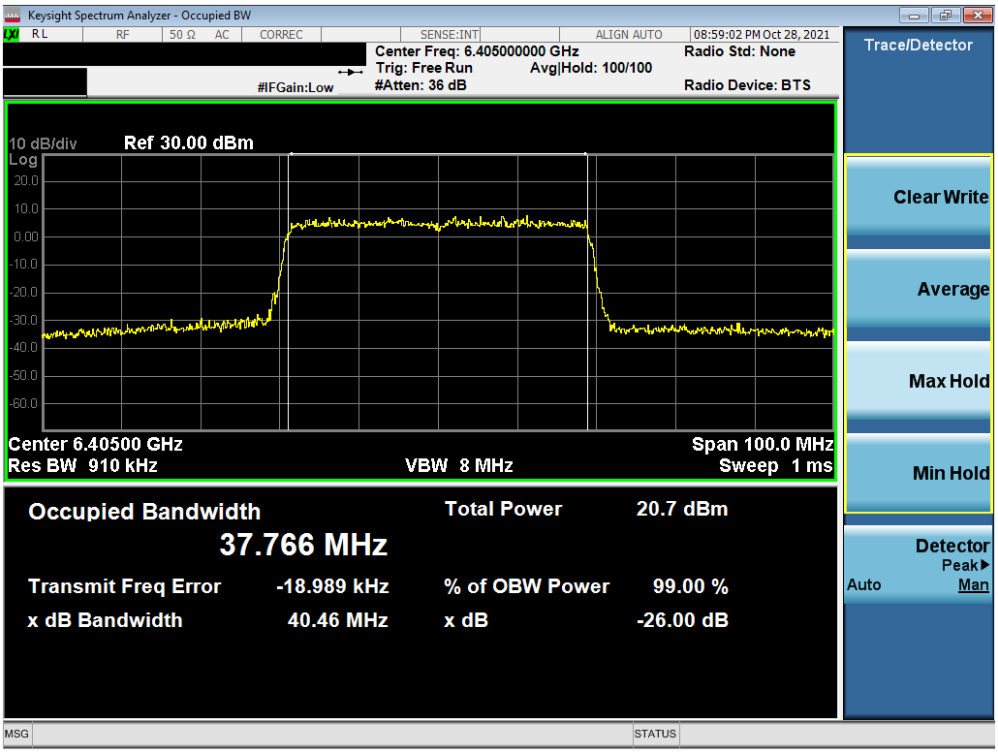
Plot 7-58. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 5) – Ch. 93



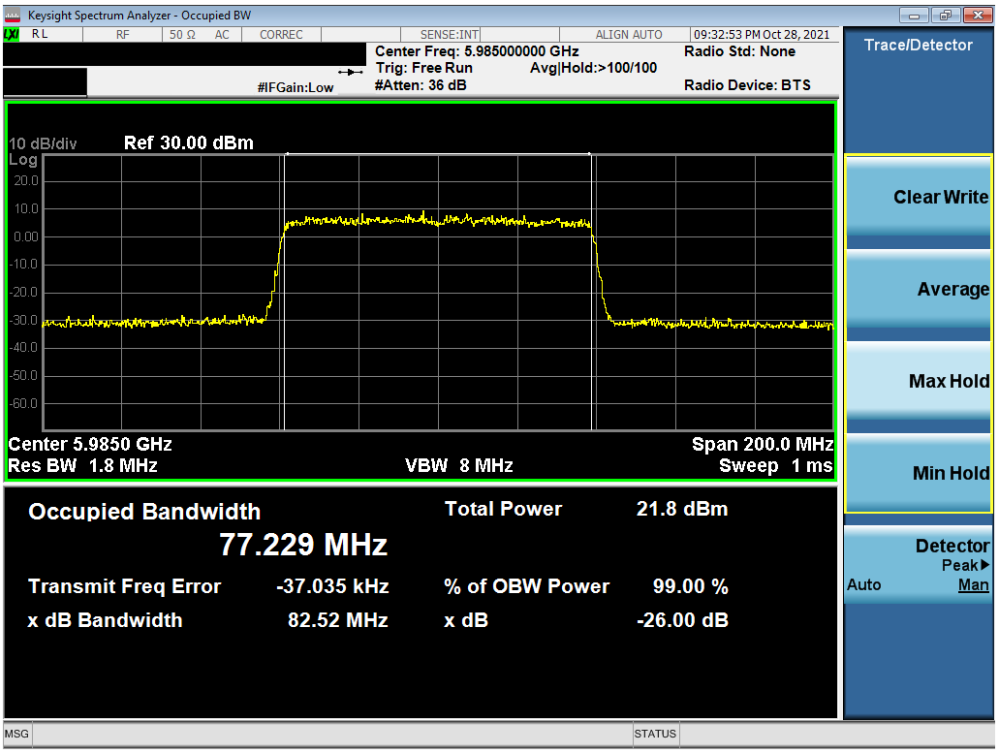
Plot 7-59. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 3)



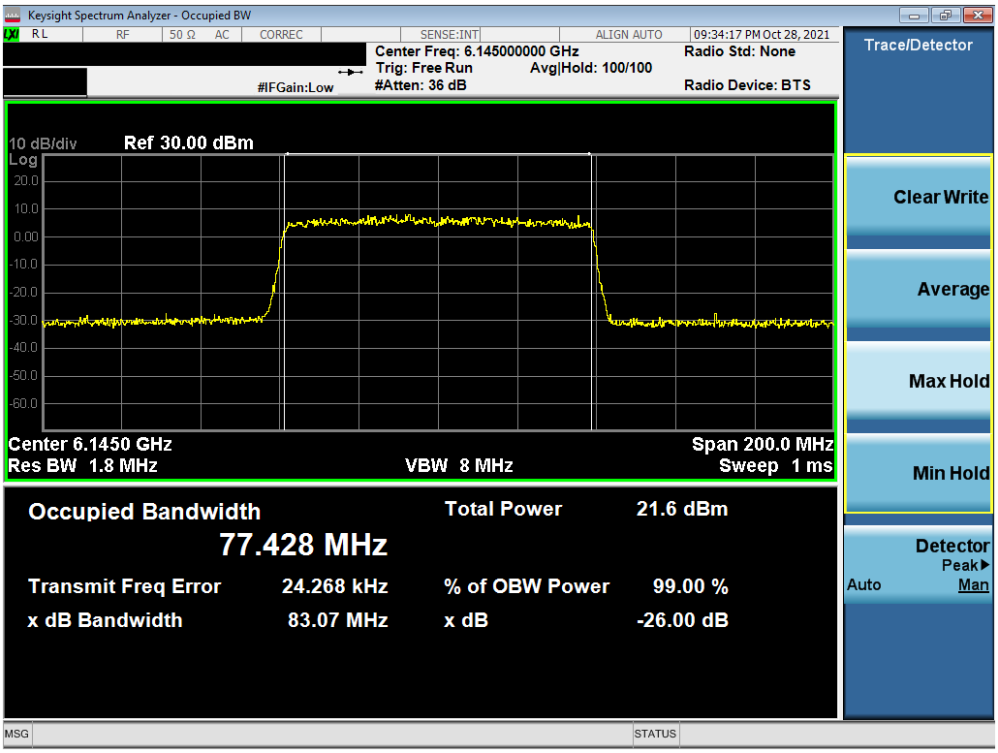
Plot 7-60. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 43)



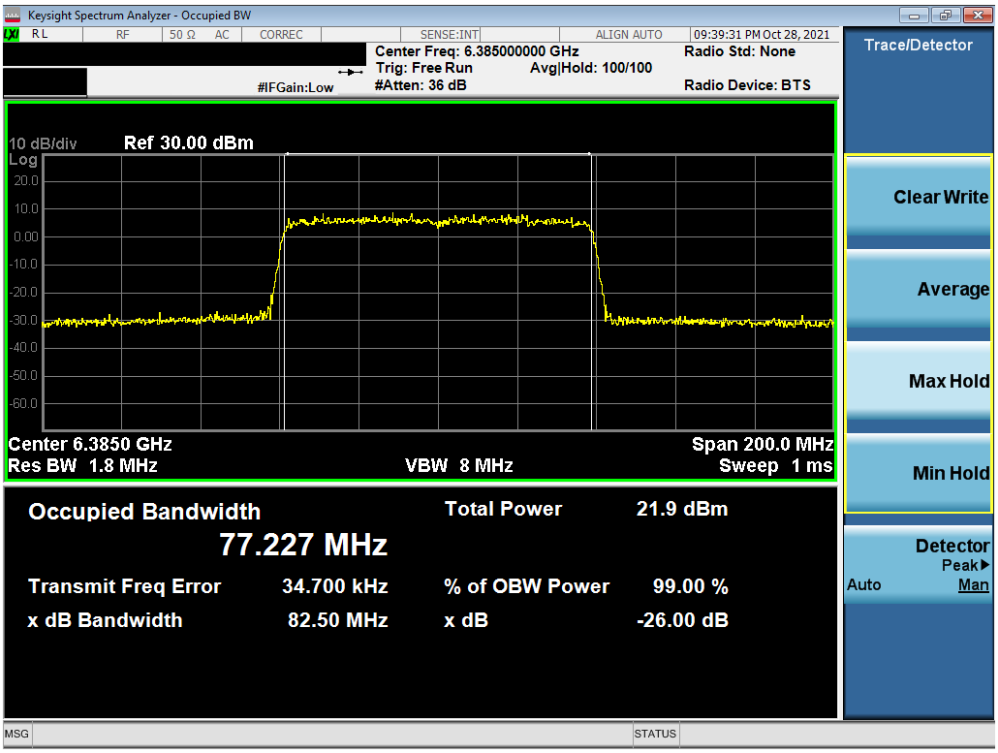
Plot 7-61. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



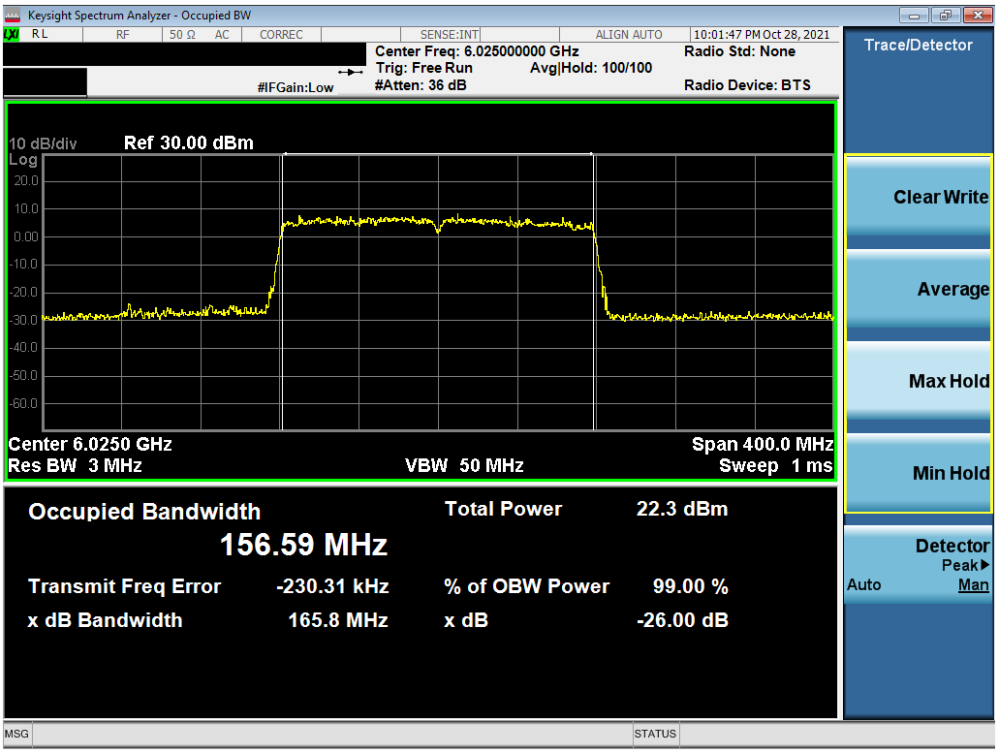
Plot 7-62. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 7)



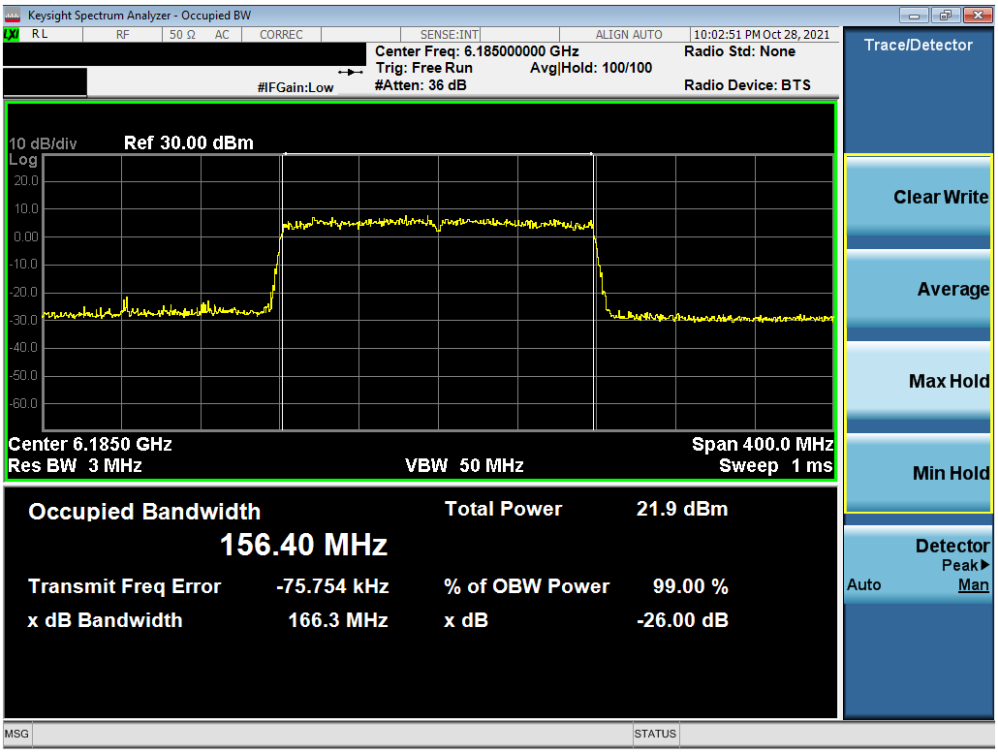
Plot 7-63. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



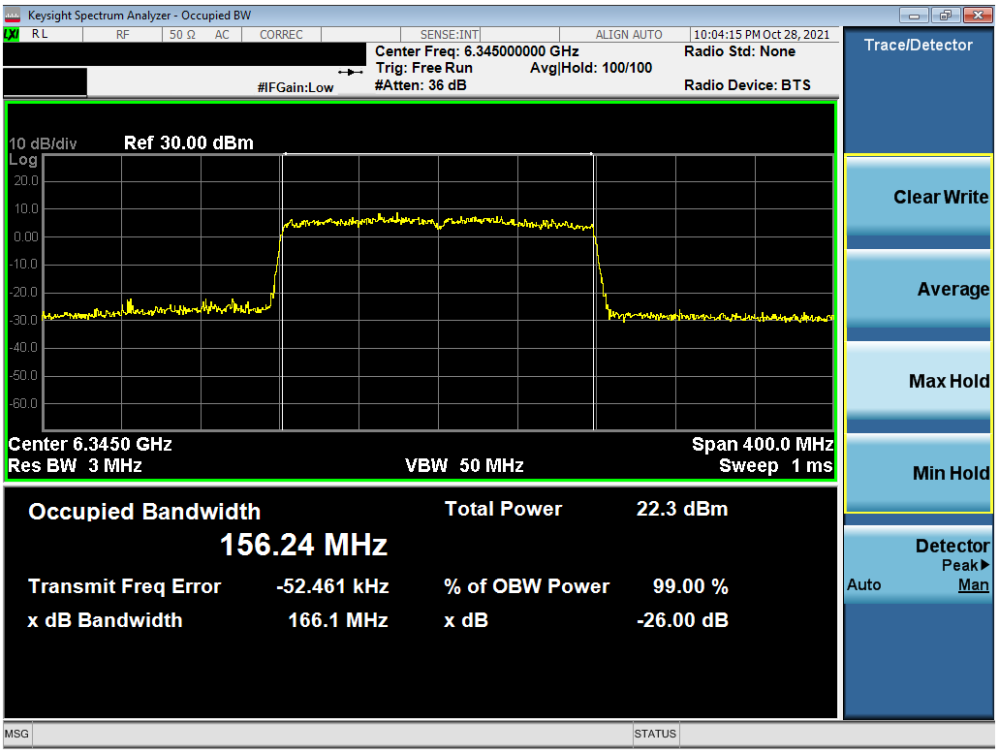
Plot 7-64. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-65. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 15)

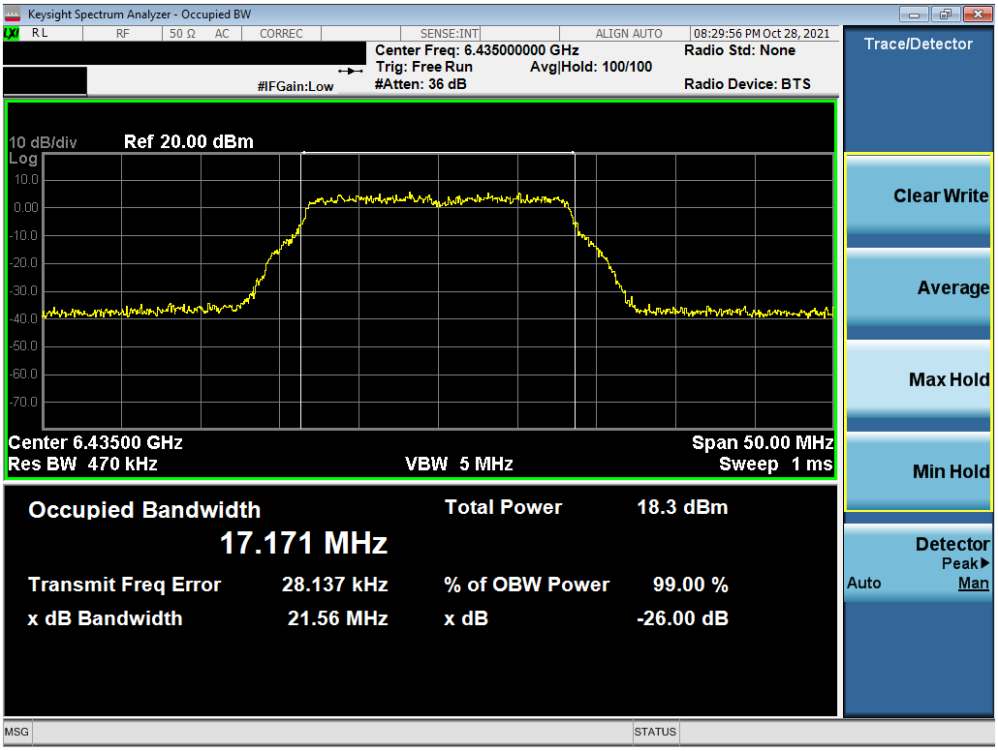


Plot 7-66. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

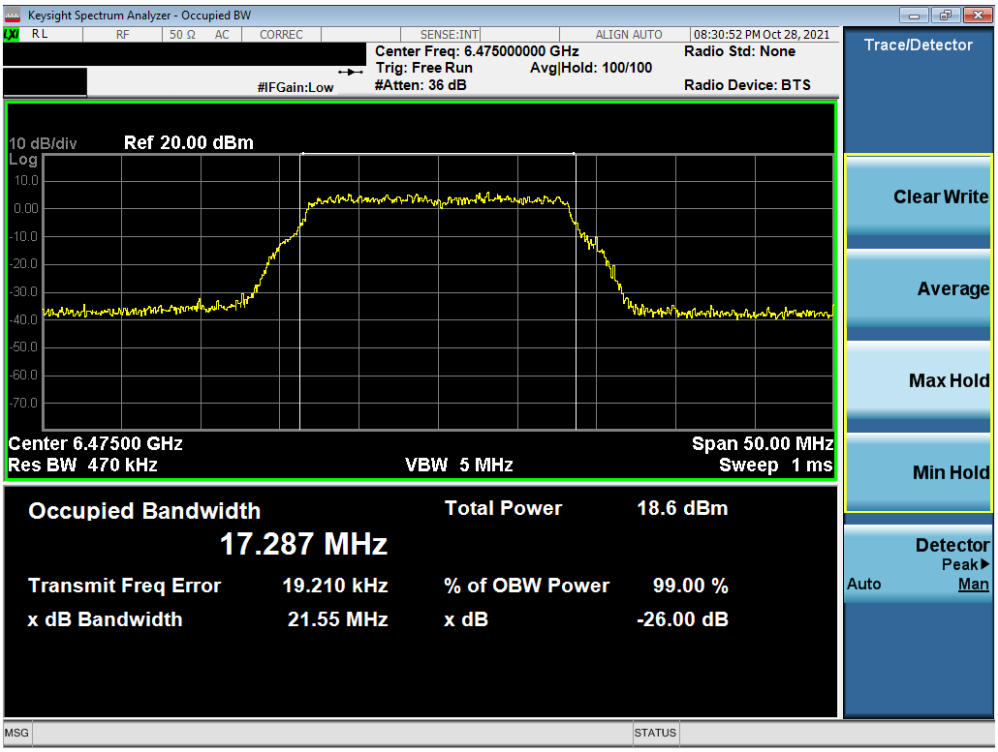


Plot 7-67. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

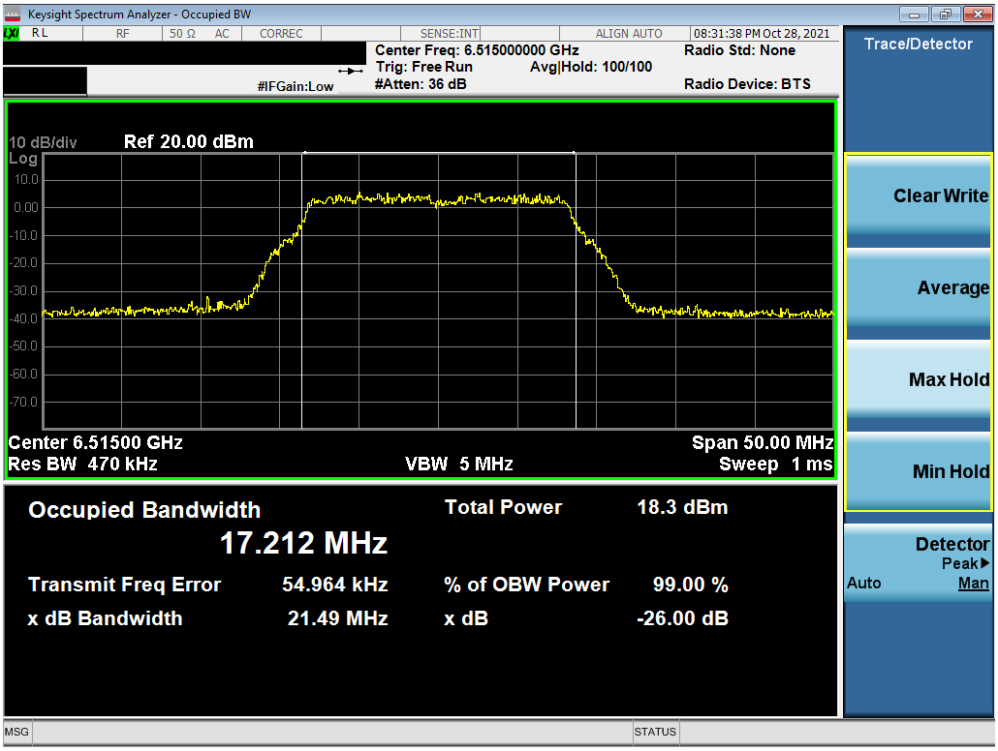
MIMO Antenna-2 26 dB Bandwidth Measurements - (UNII Band 6)



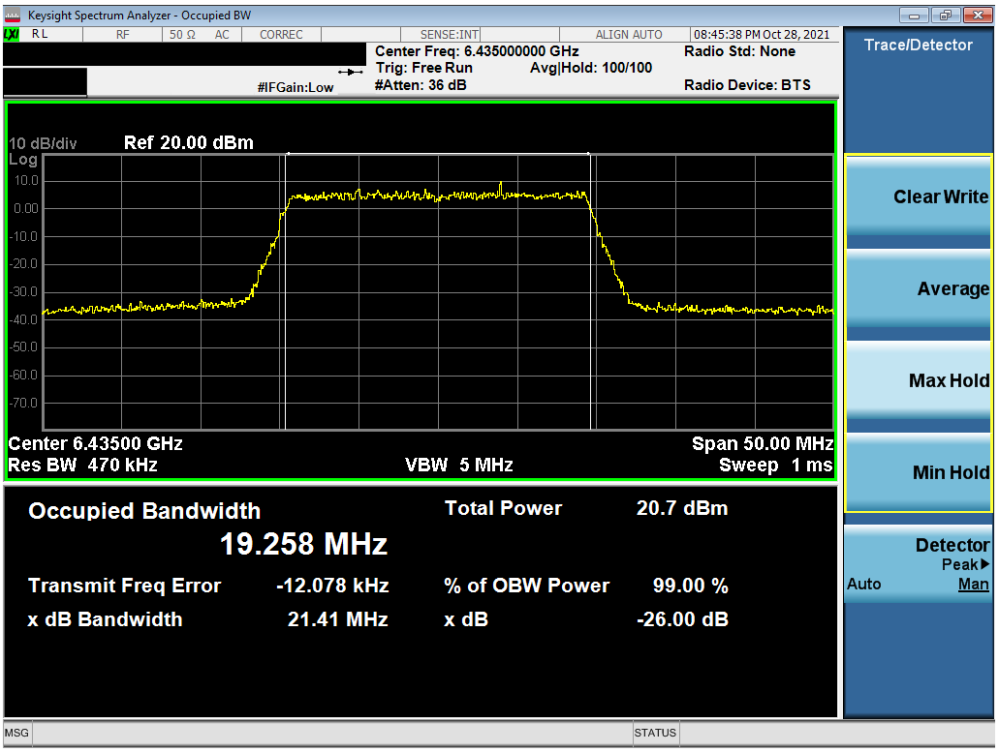
Plot 7-68. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 97)



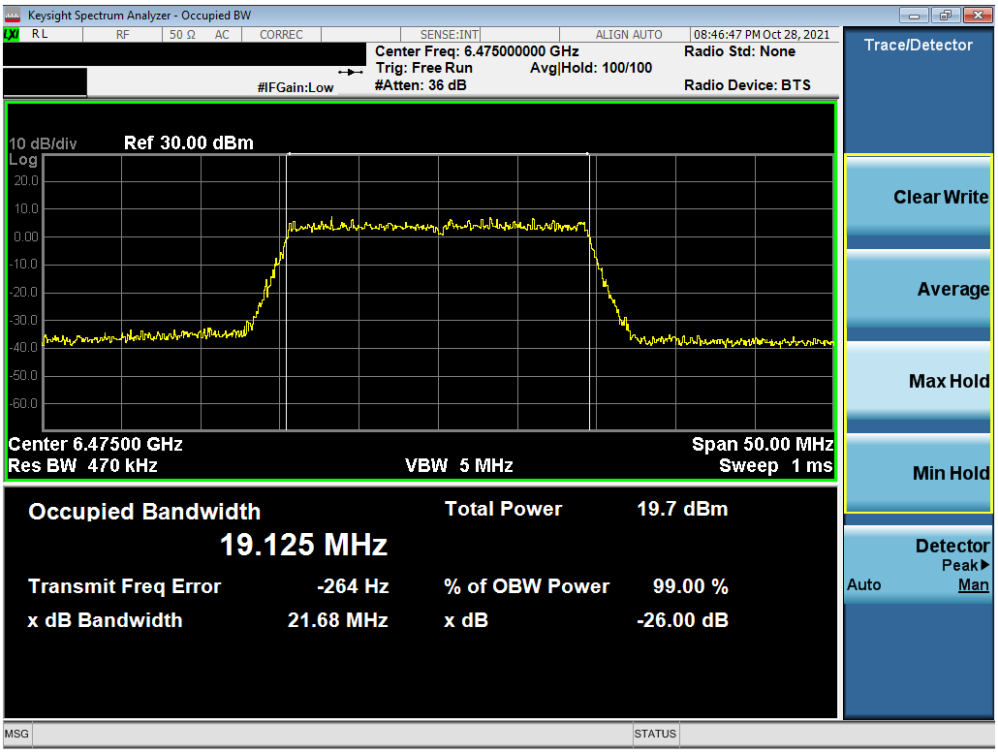
Plot 7-69. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 105)



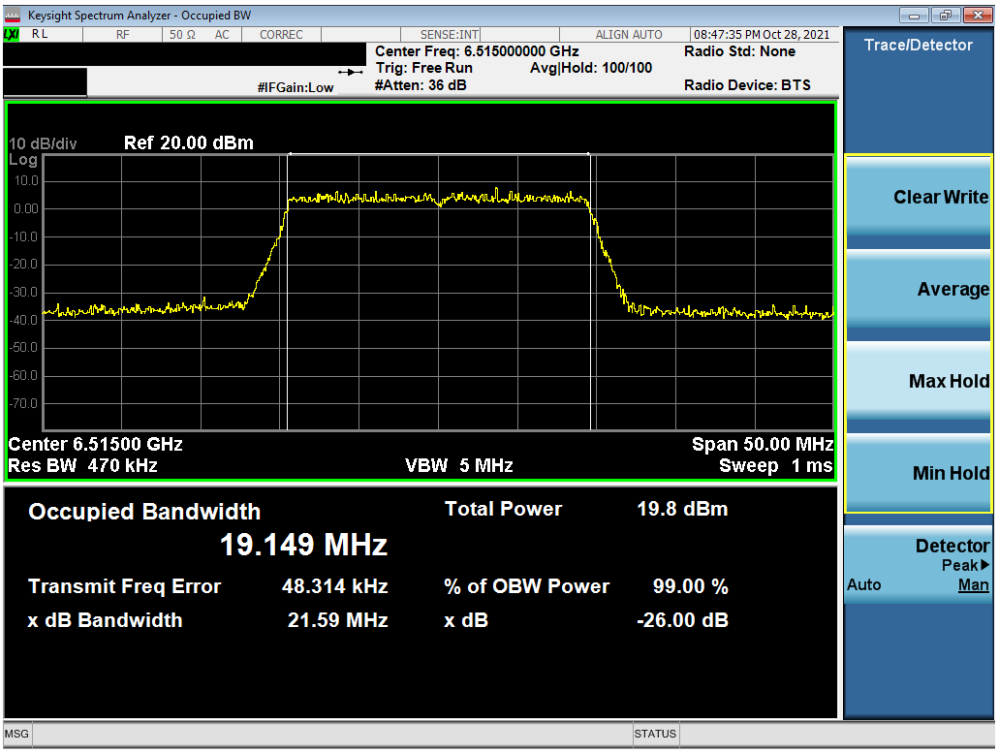
Plot 7-70. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 6) – Ch. 113)



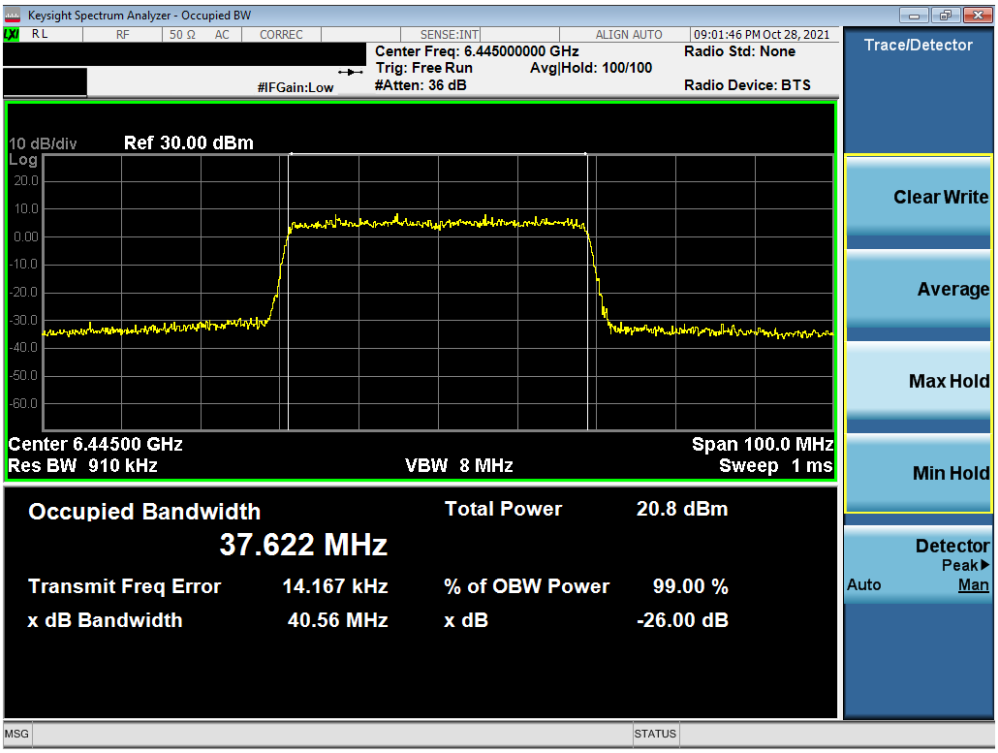
Plot 7-71. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



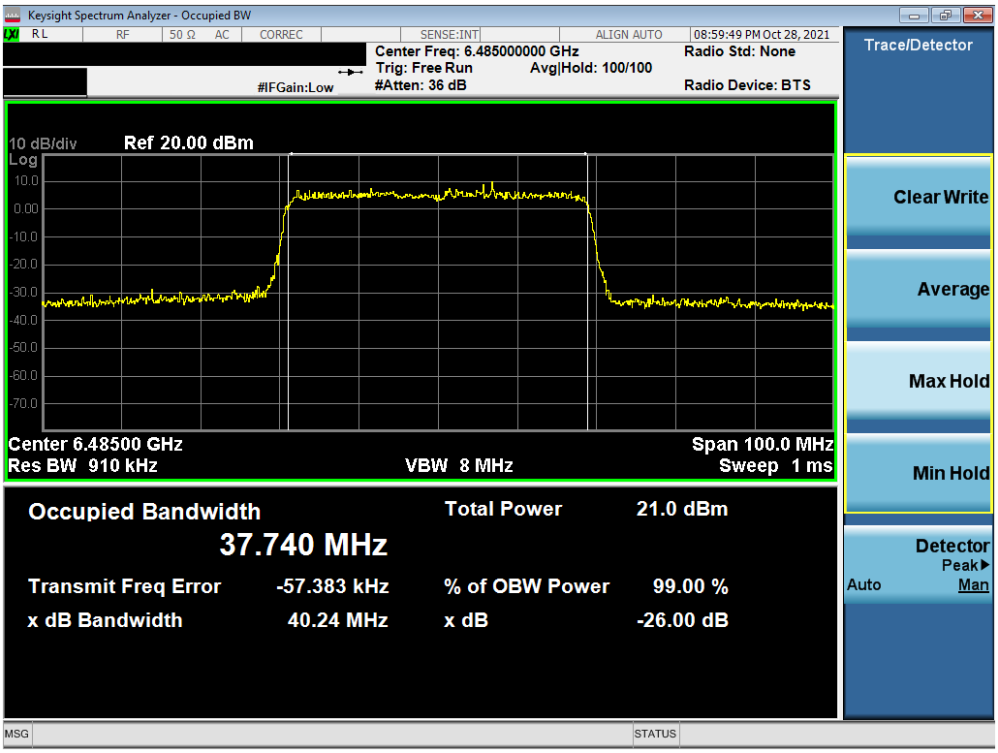
Plot 7-72. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



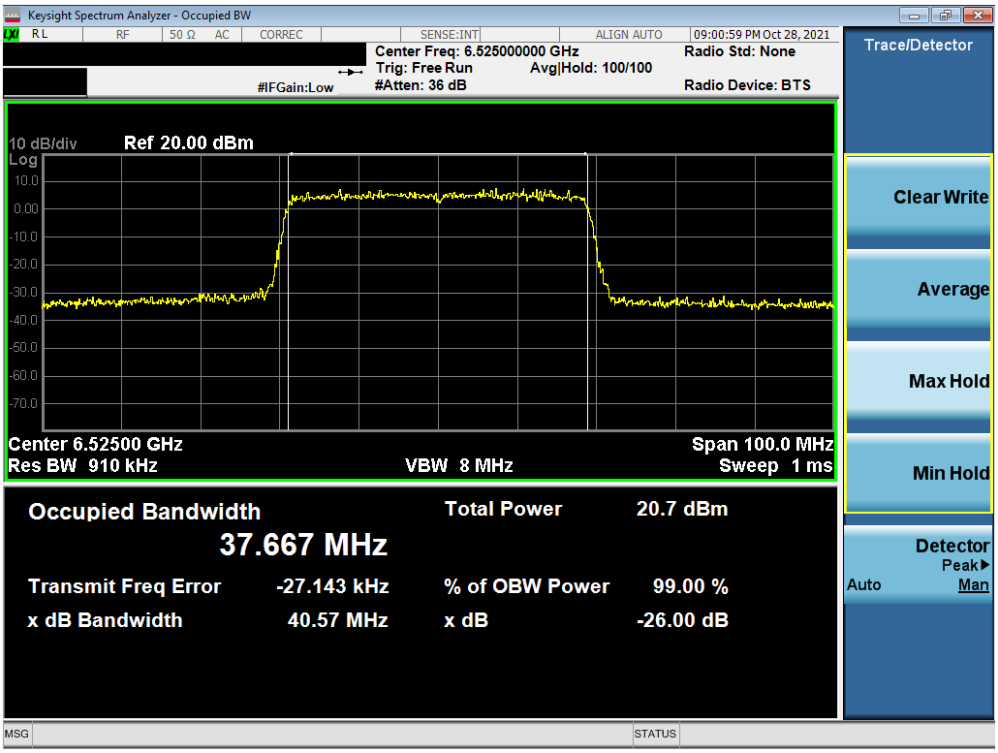
Plot 7-73. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 6) – Ch. 113)



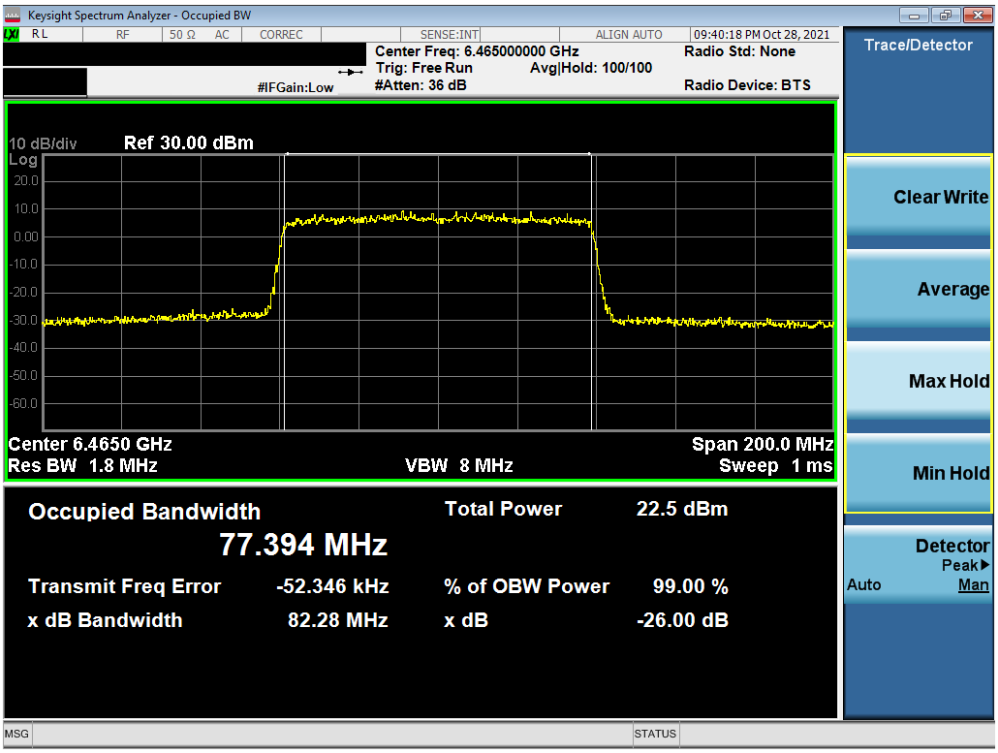
Plot 7-74. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 99)



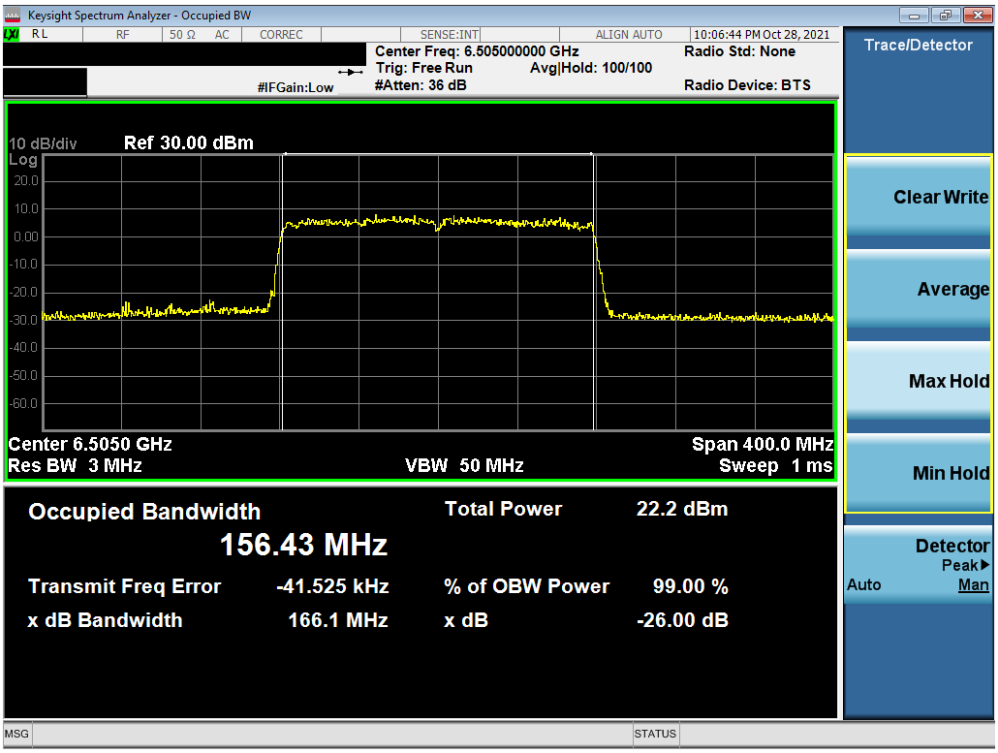
Plot 7-75. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 107)



Plot 7-76. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 6) – Ch. 115)

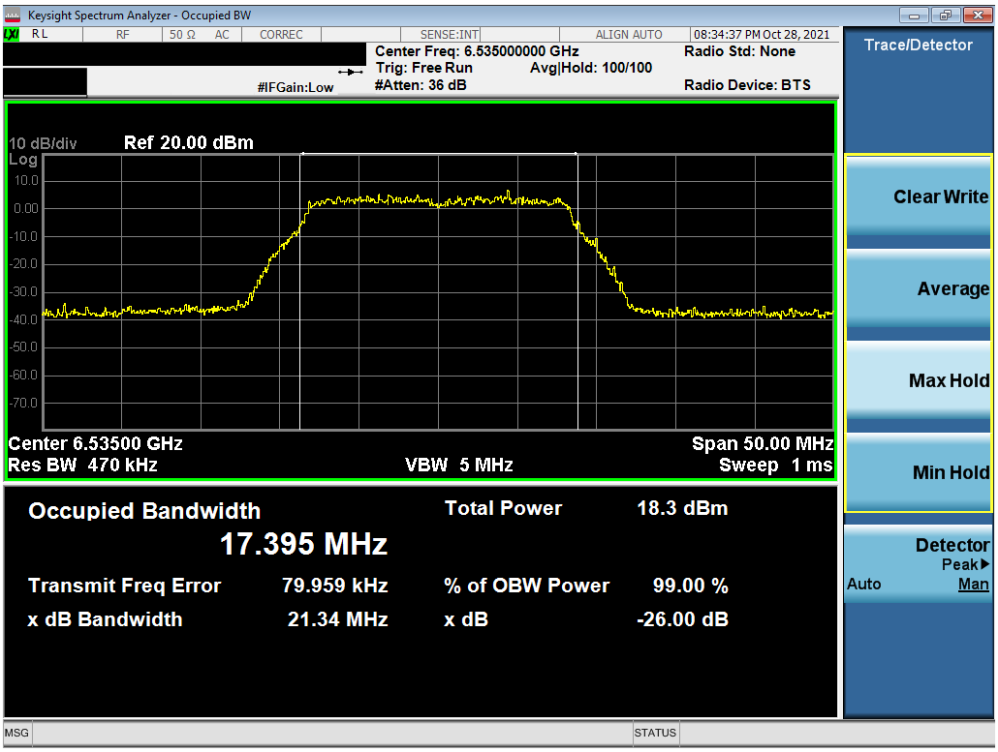


Plot 7-77. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 6) – Ch. 103)

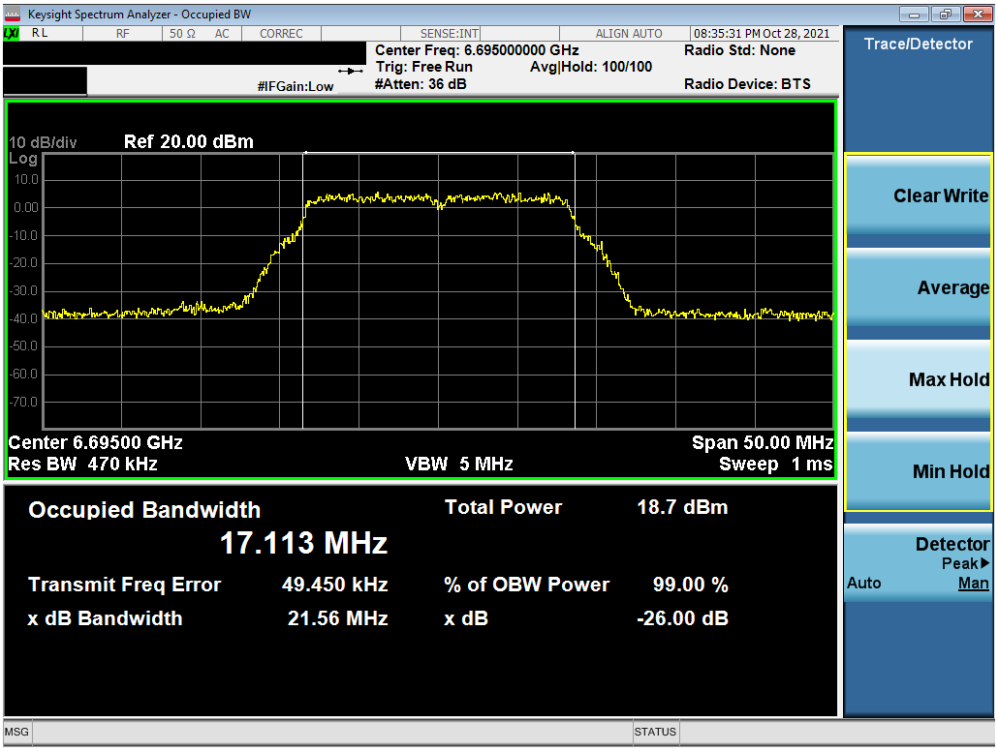


Plot 7-78. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 6) – Ch. 111)

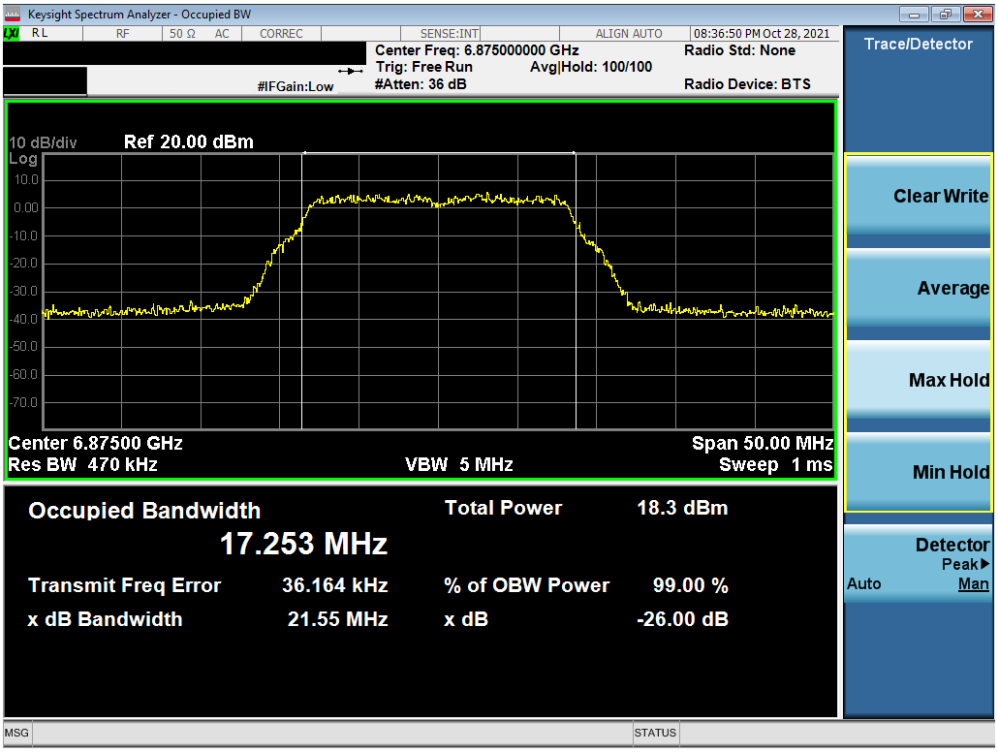
MIMO Antenna-2 26 dB Bandwidth Measurements - (UNII Band 7)



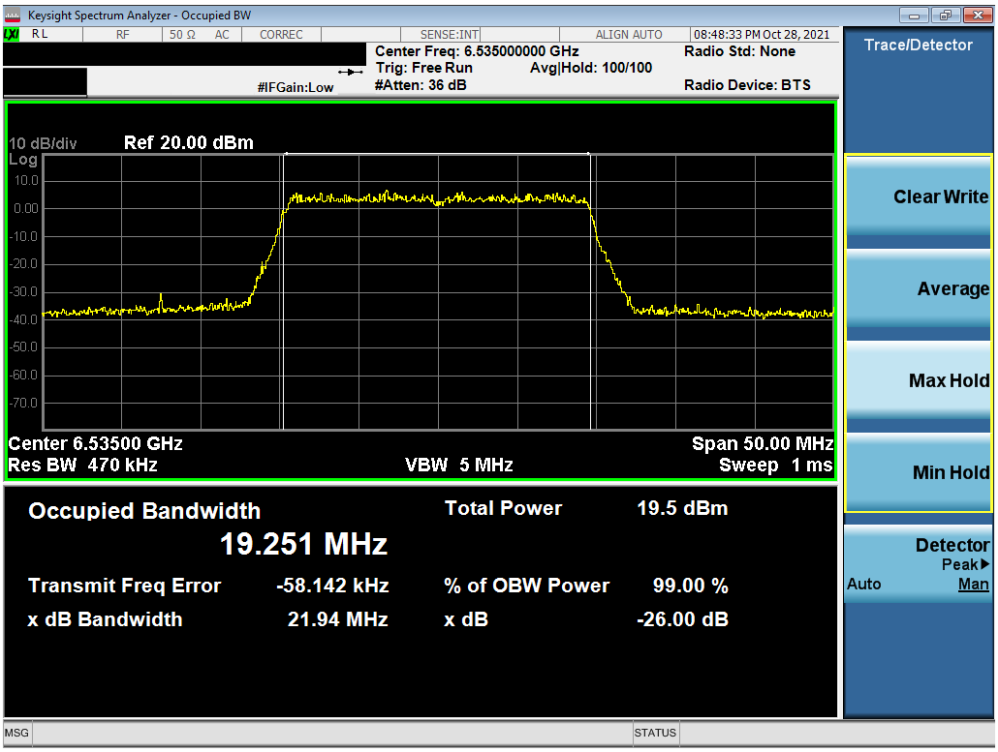
Plot 7-79. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 117)



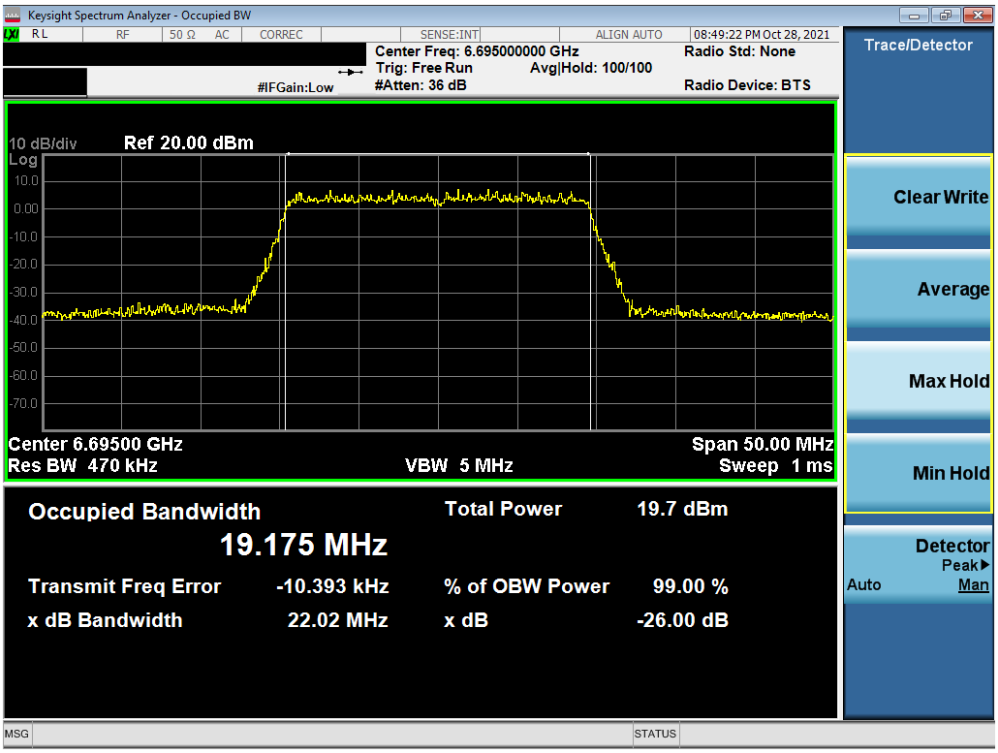
Plot 7-80. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 149)



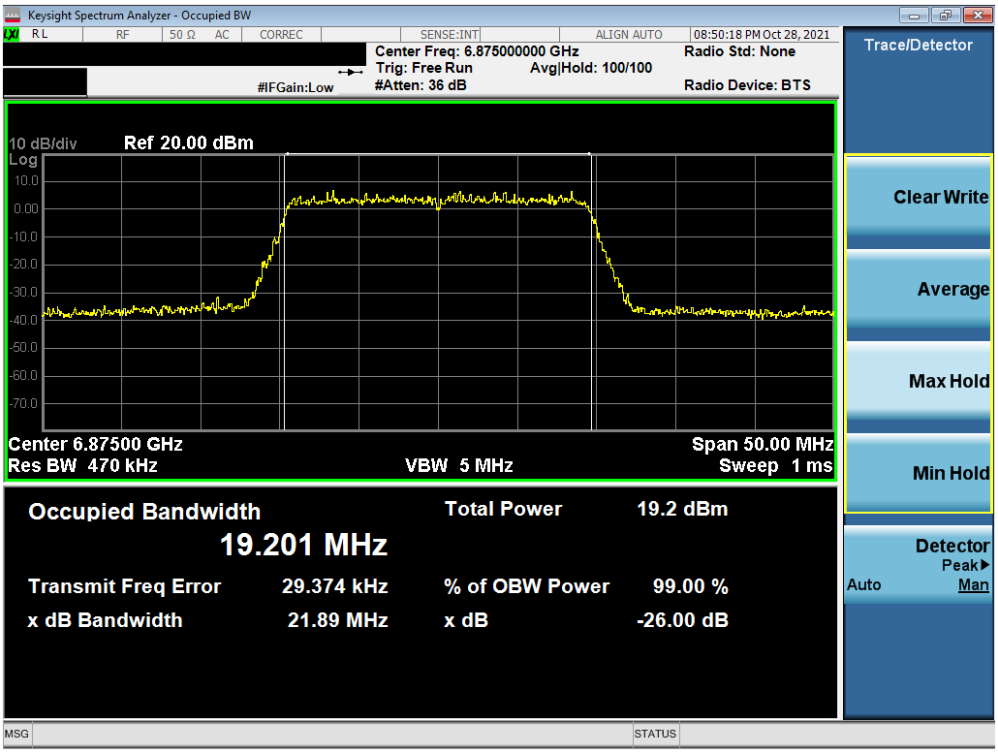
Plot 7-81. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 7) – Ch. 185)



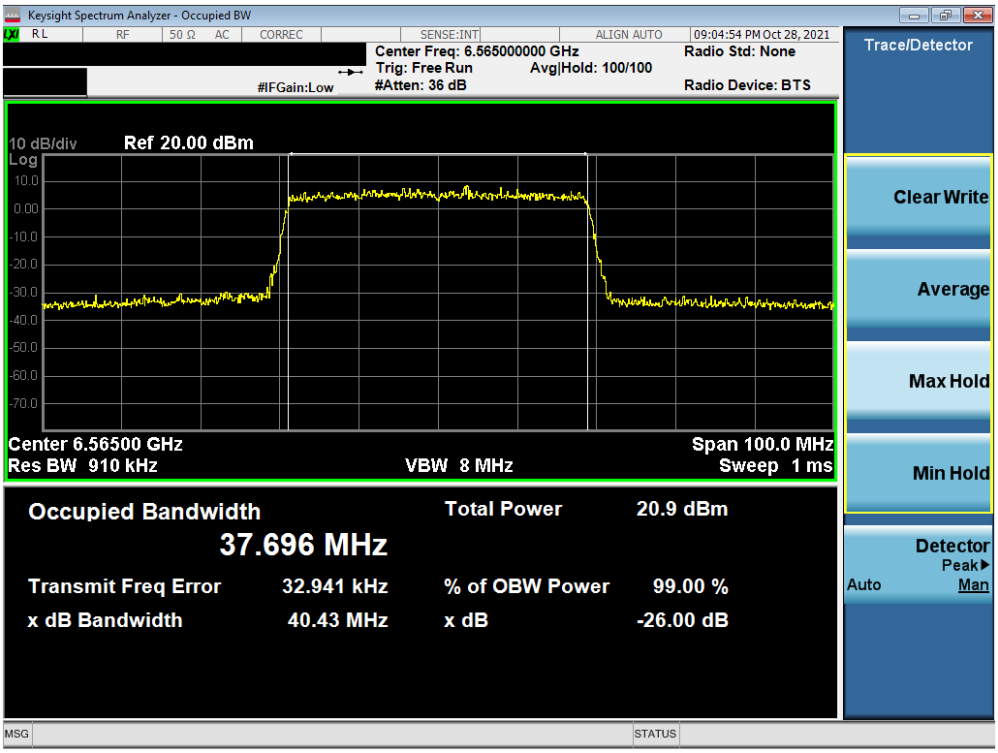
Plot 7-82. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 117)



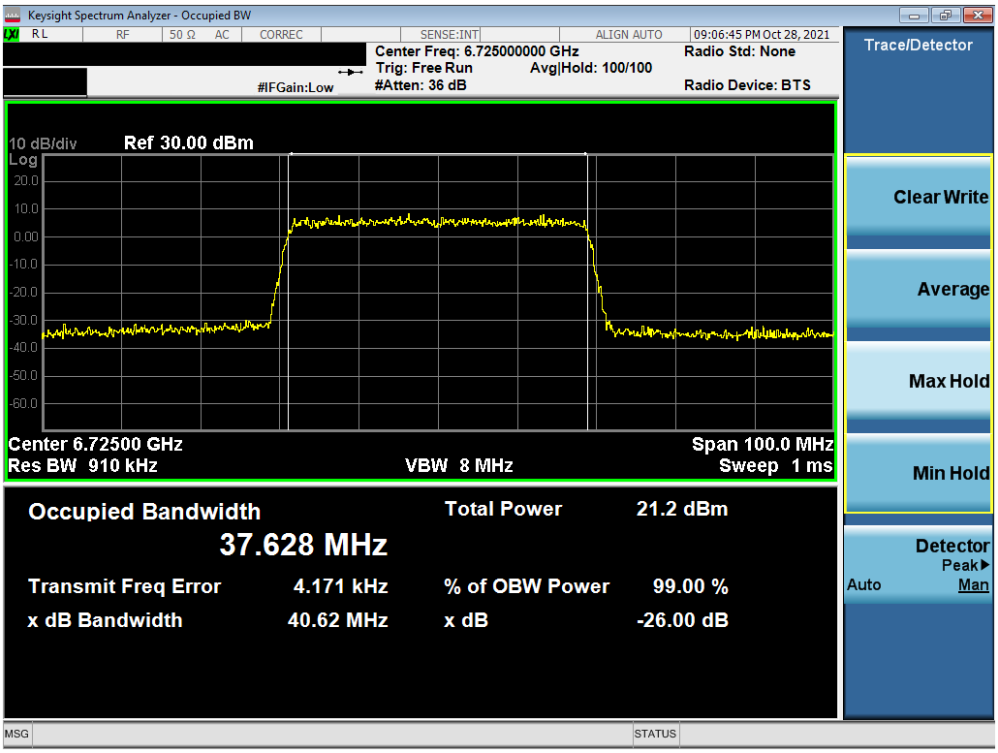
Plot 7-83. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 149)



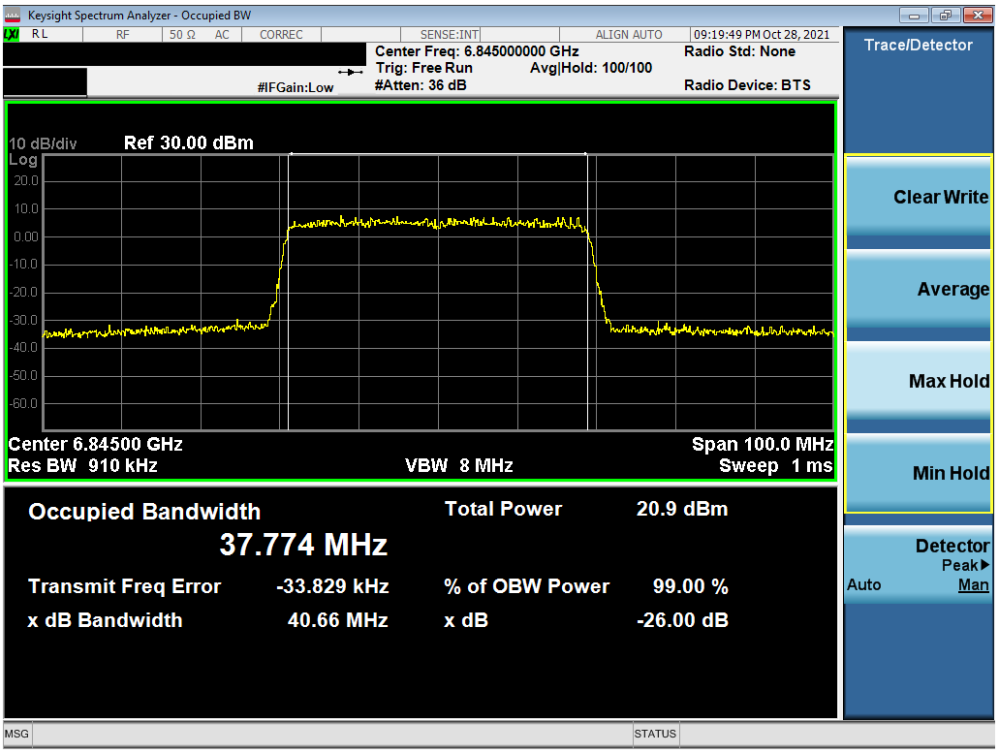
Plot 7-84. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 7) – Ch. 185)



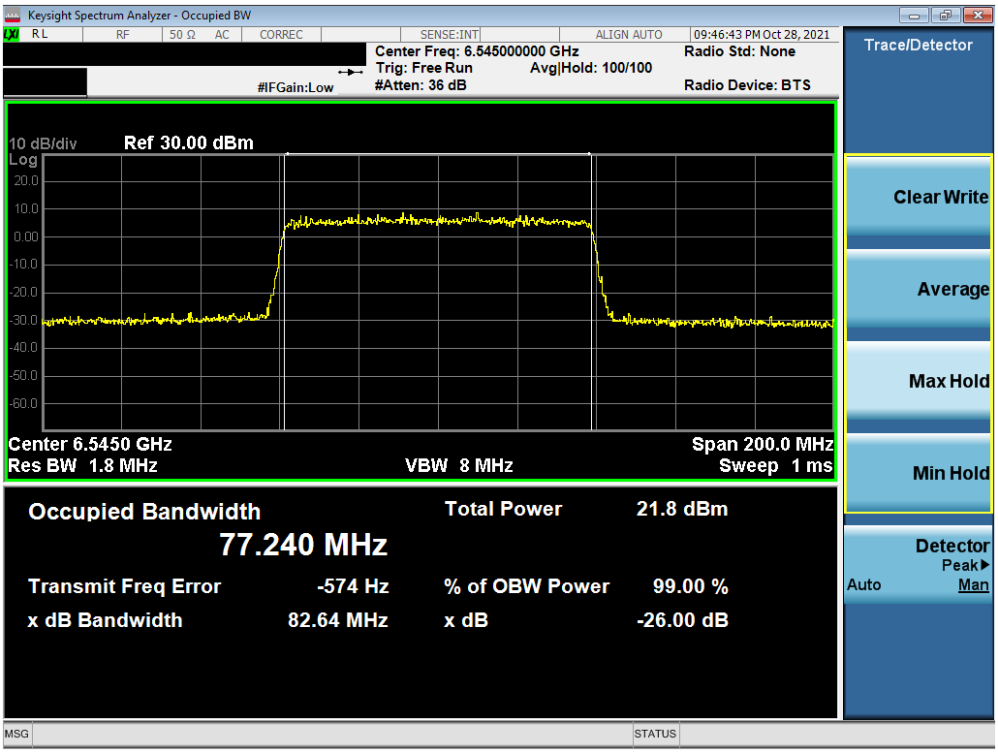
Plot 7-85. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 123)



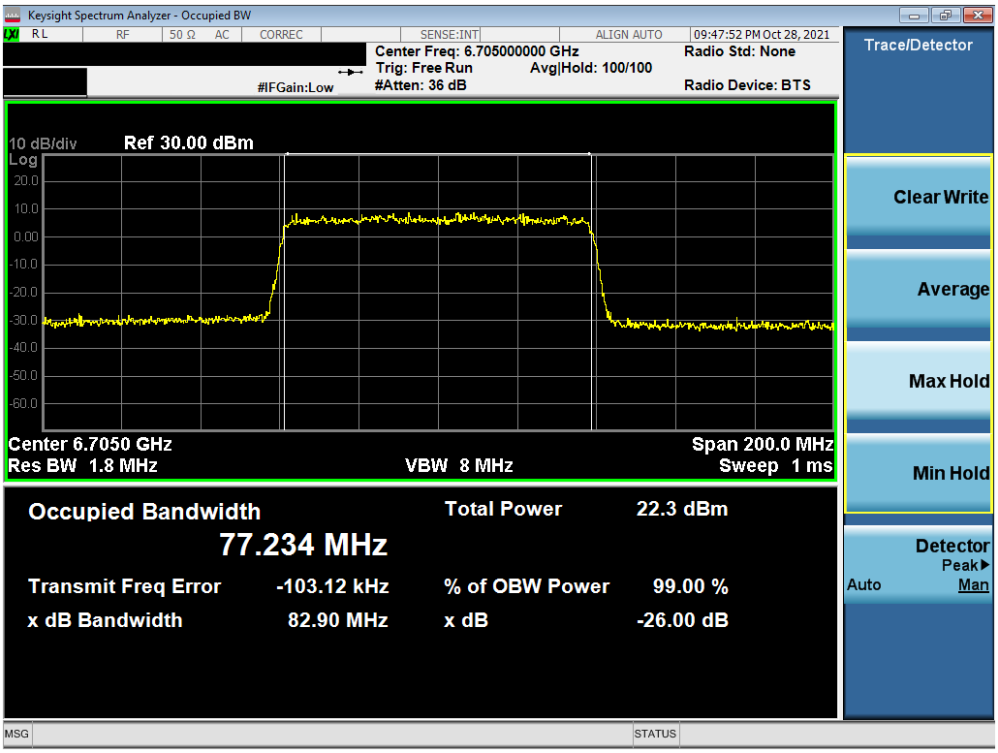
Plot 7-86. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 155)



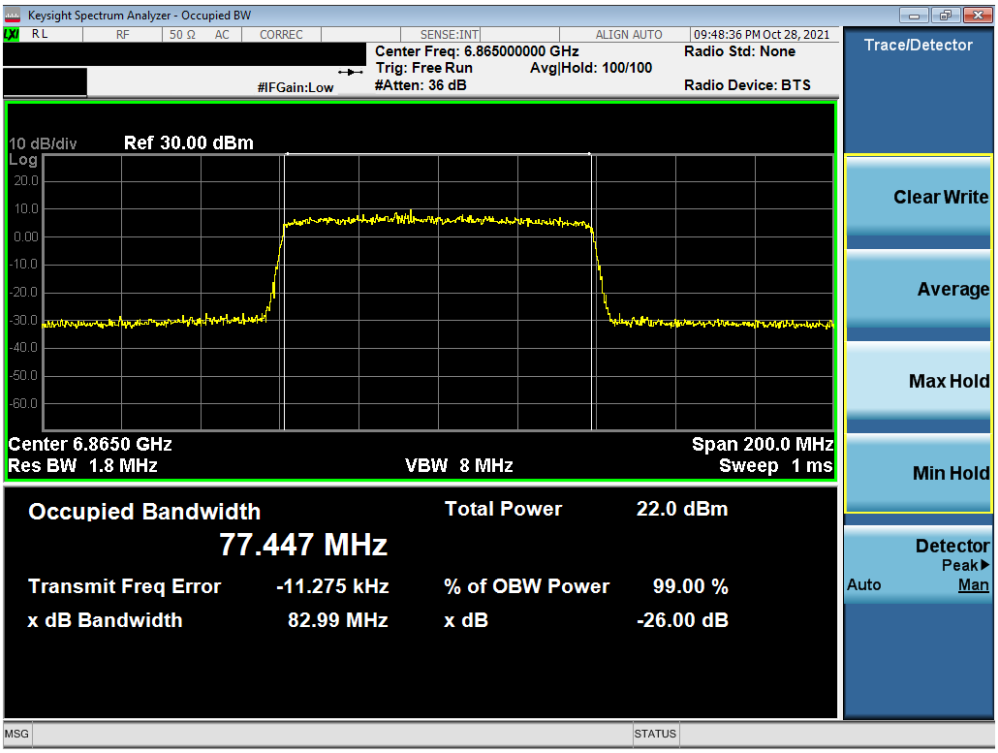
Plot 7-87. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 7) – Ch. 179)



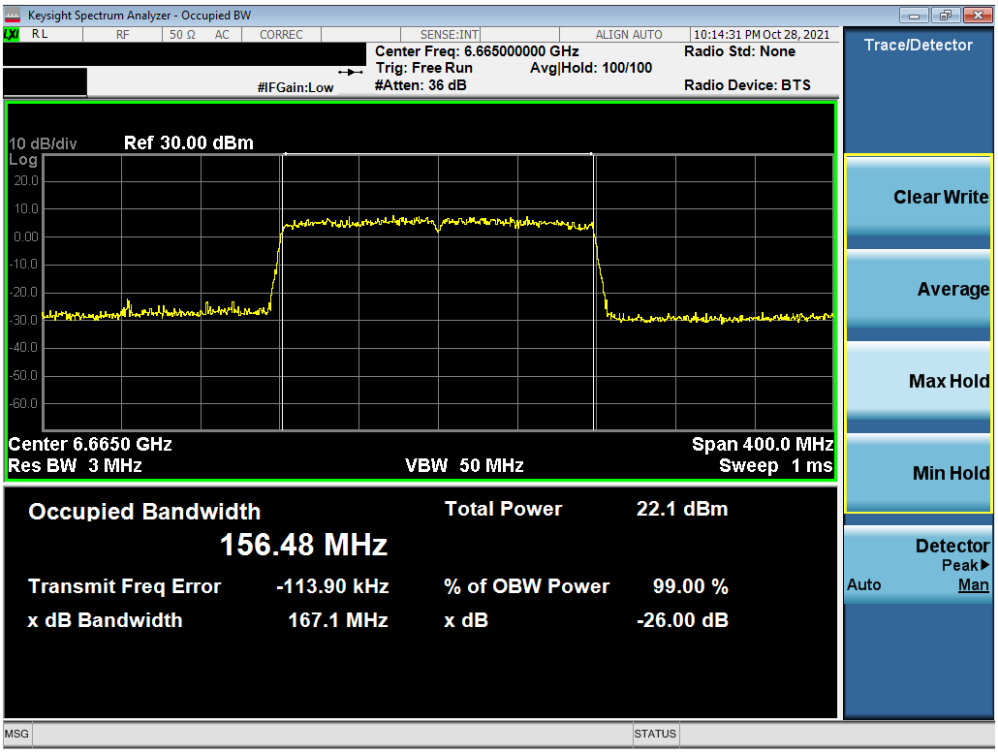
Plot 7-88. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 119)



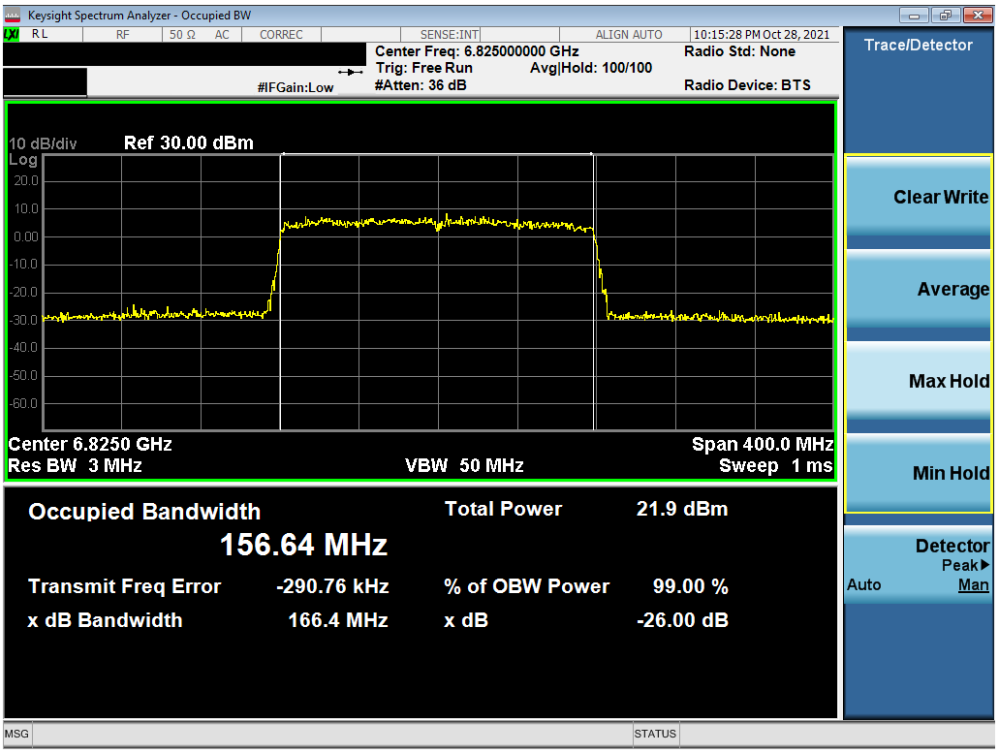
Plot 7-89. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 151)



Plot 7-90. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 7) – Ch. 183)

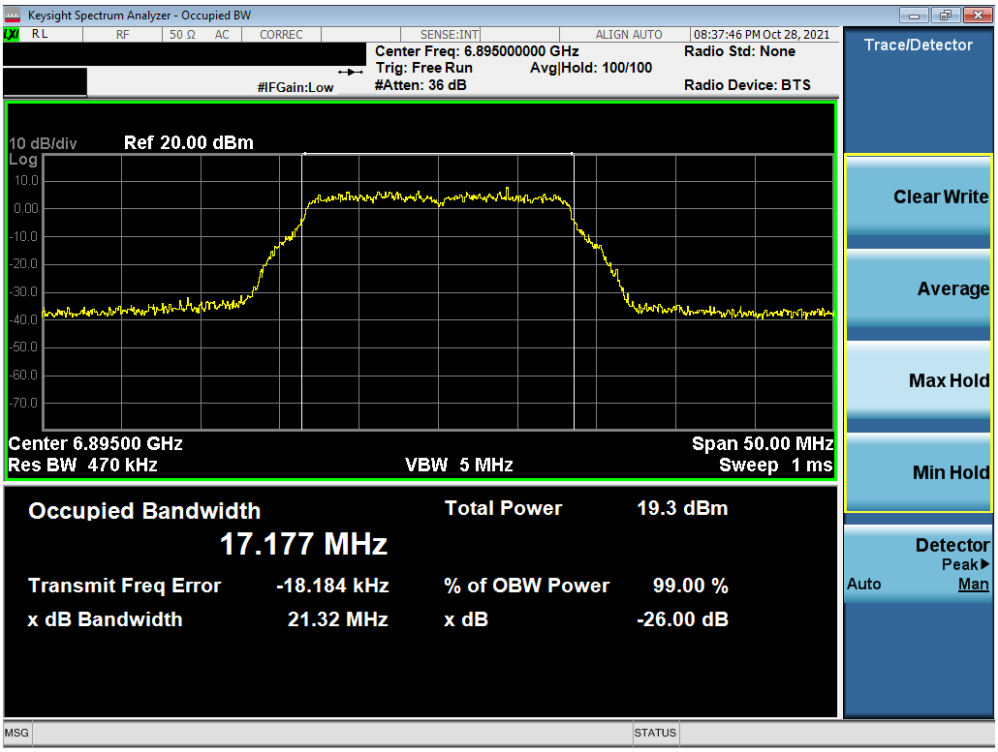


Plot 7-91. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 143)

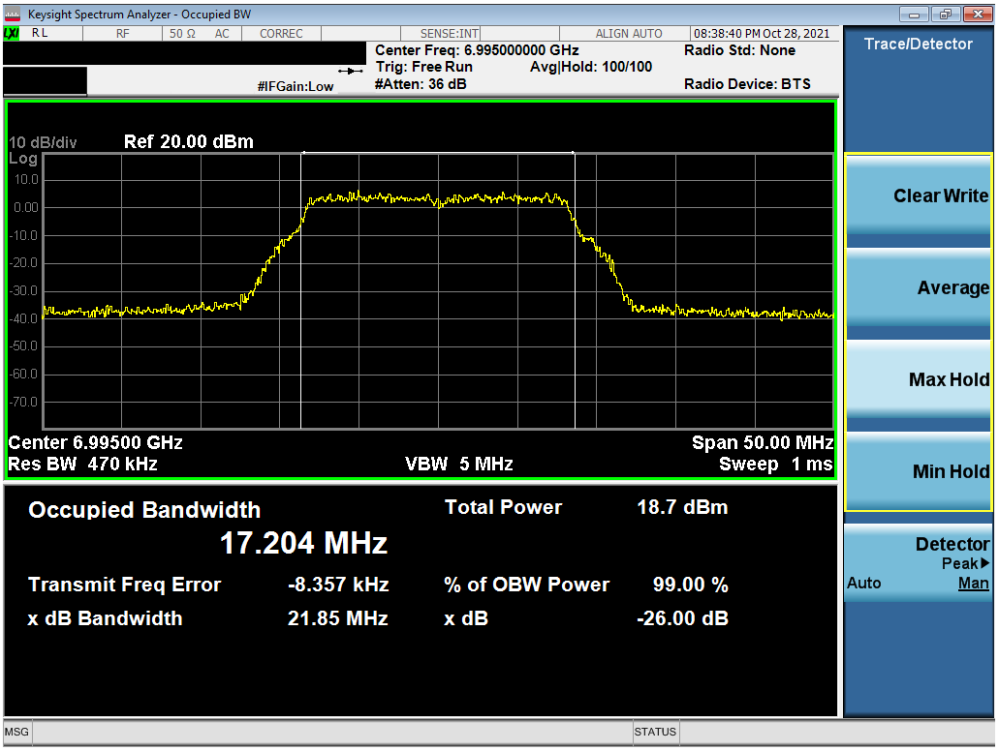


Plot 7-92. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 7) – Ch. 175)

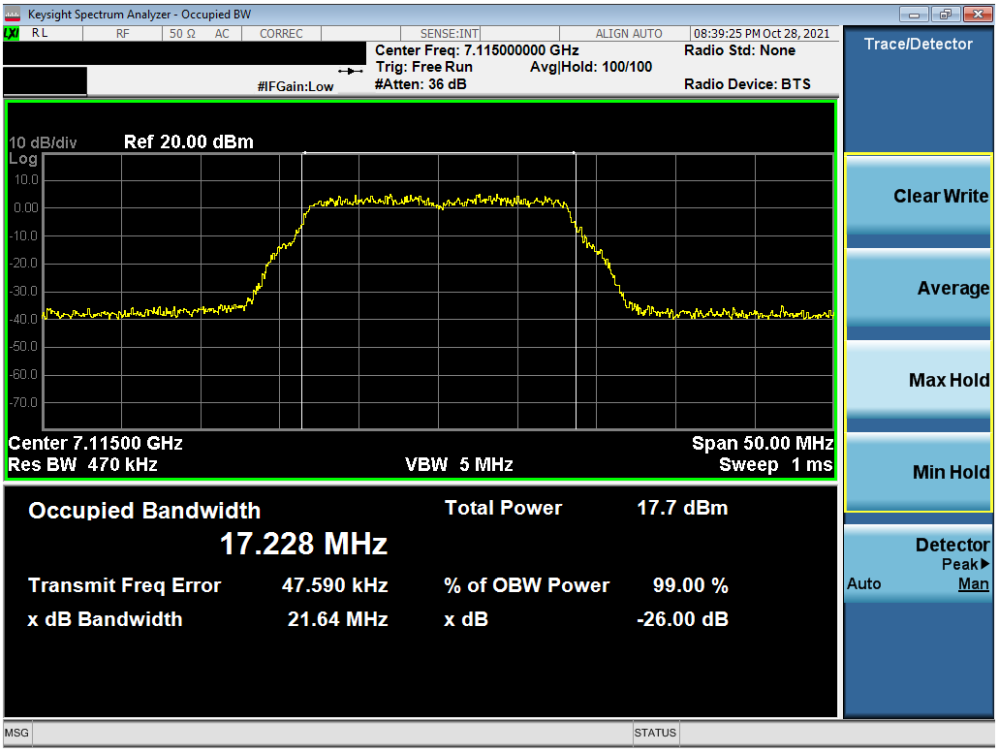
MIMO Antenna-2 26 dB Bandwidth Measurements - (UNII Band 8)



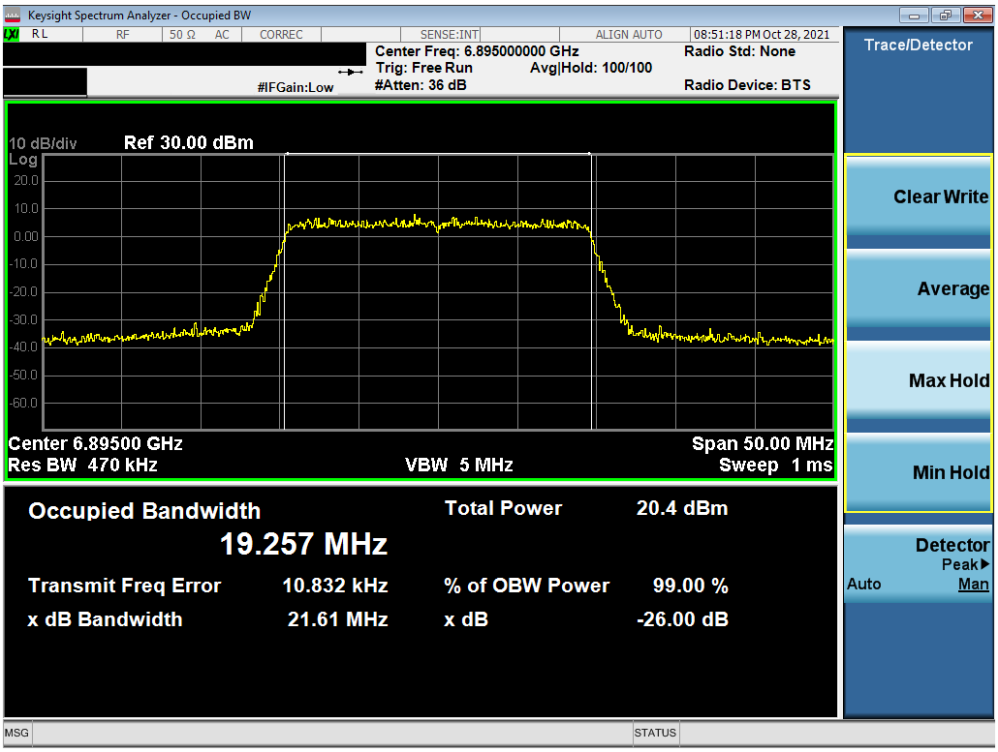
Plot 7-93. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 189)



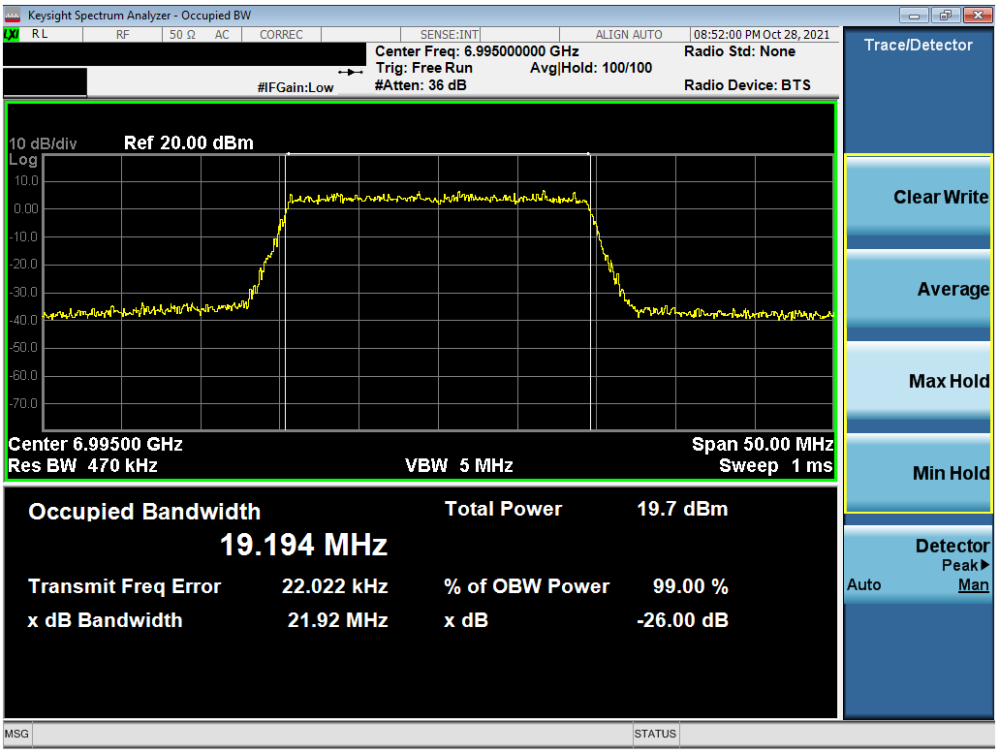
Plot 7-94. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 209)



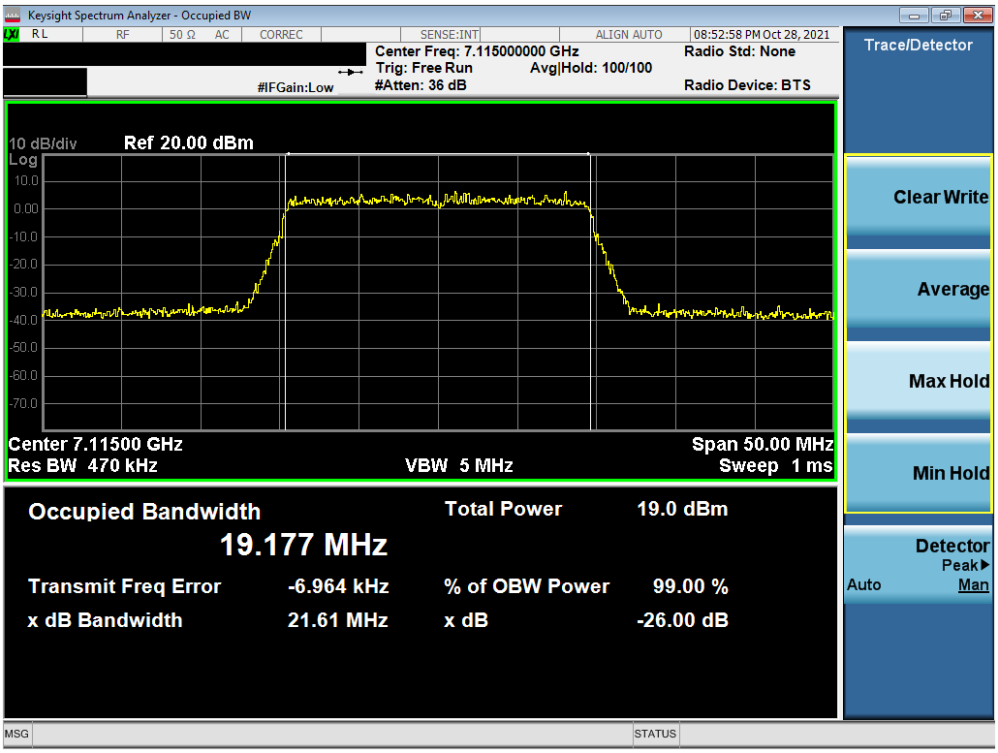
Plot 7-95. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11a (UNII Band 8) – Ch. 233)



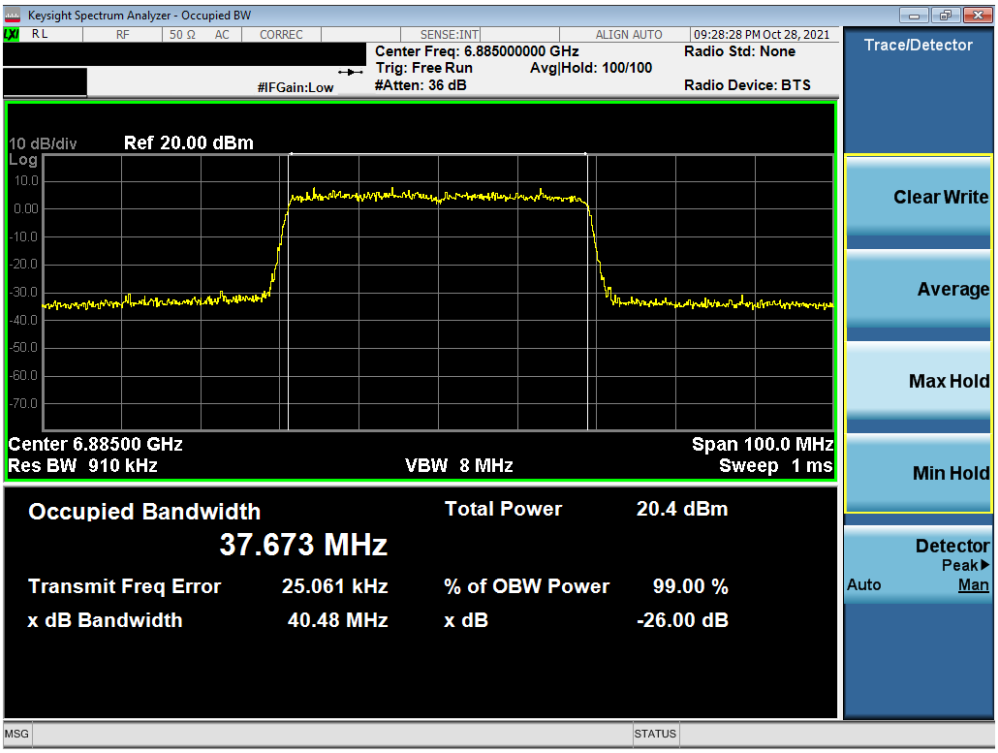
Plot 7-96. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 189)



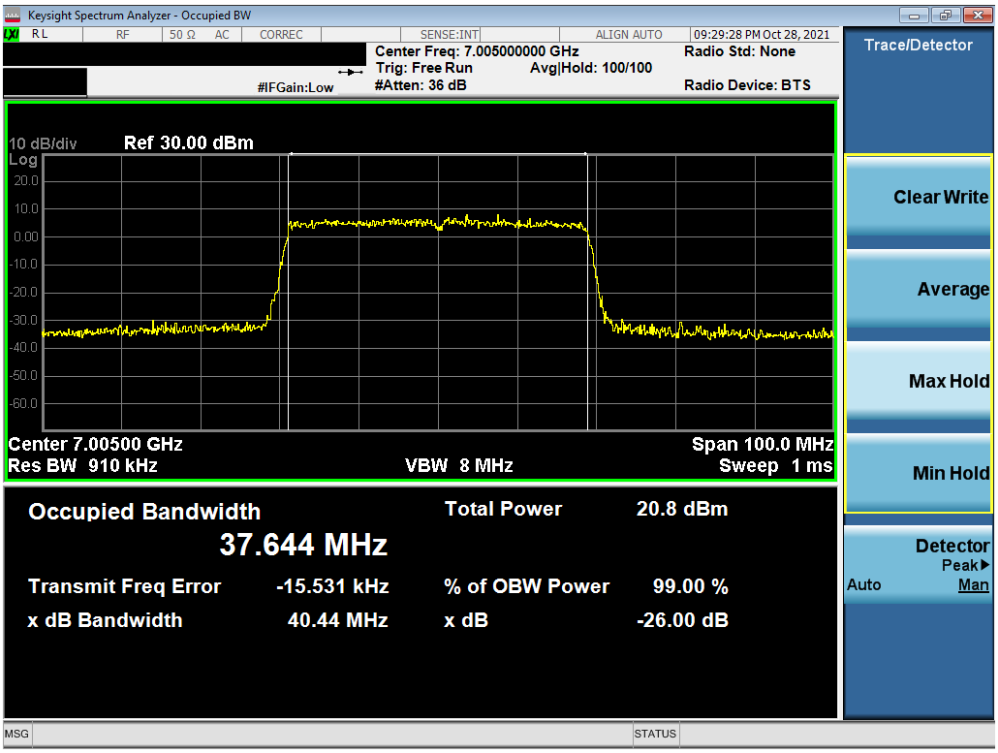
Plot 7-97. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 209)



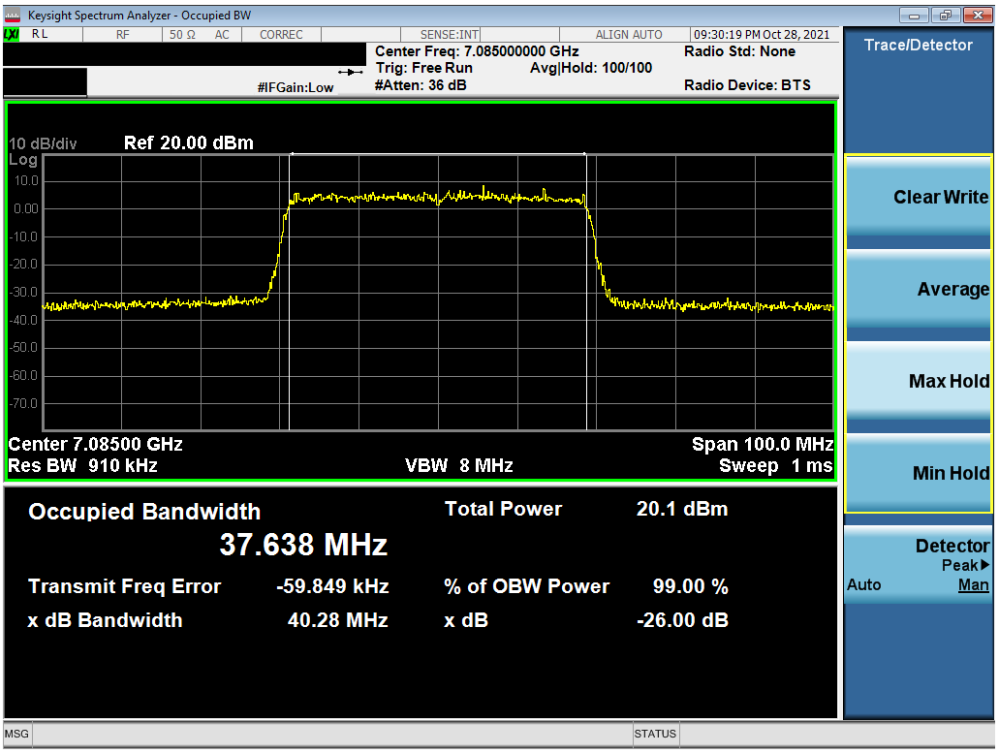
Plot 7-98. 26dB Bandwidth Plot MIMO ANT2 (20MHz 802.11ax (UNII Band 8) – Ch. 233)



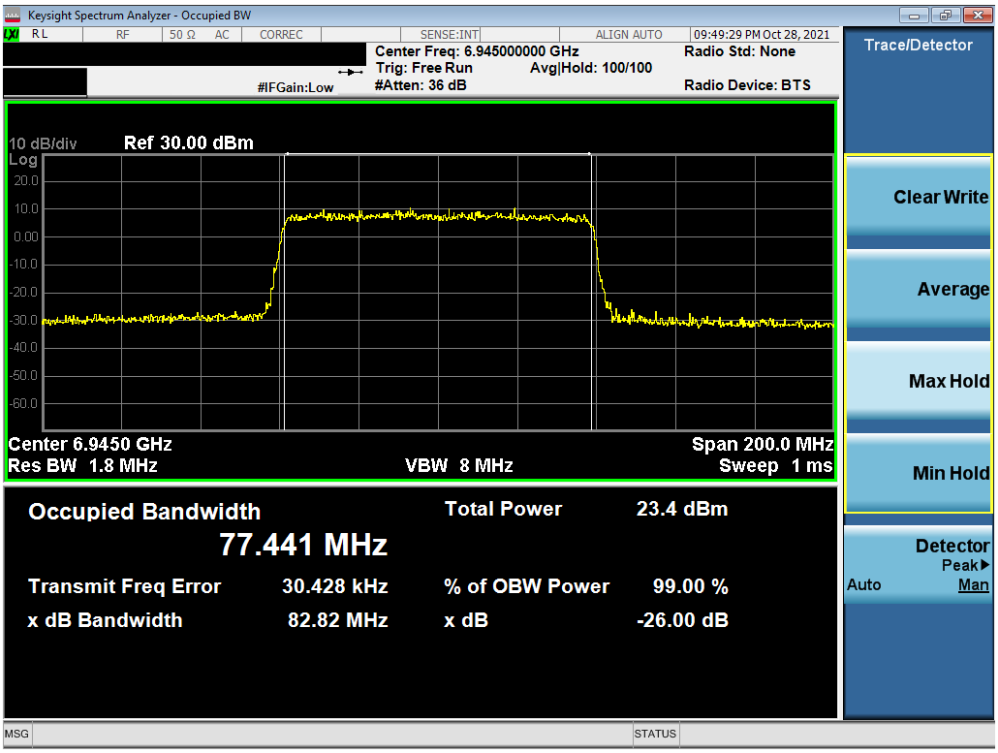
Plot 7-99. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 187)



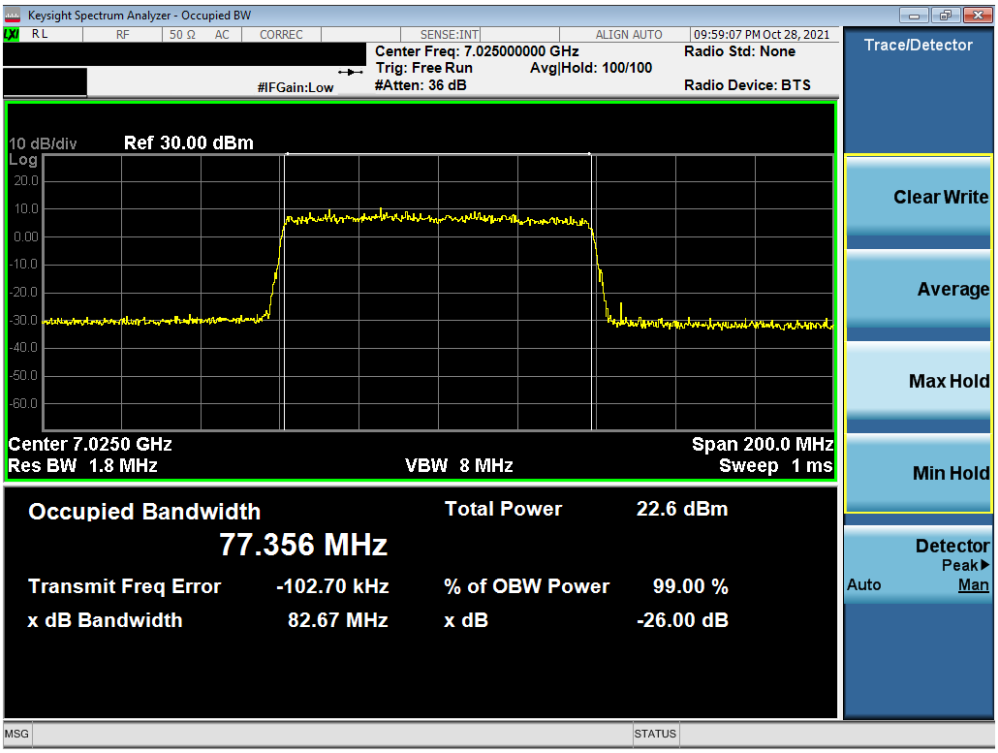
Plot 7-100. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 211)



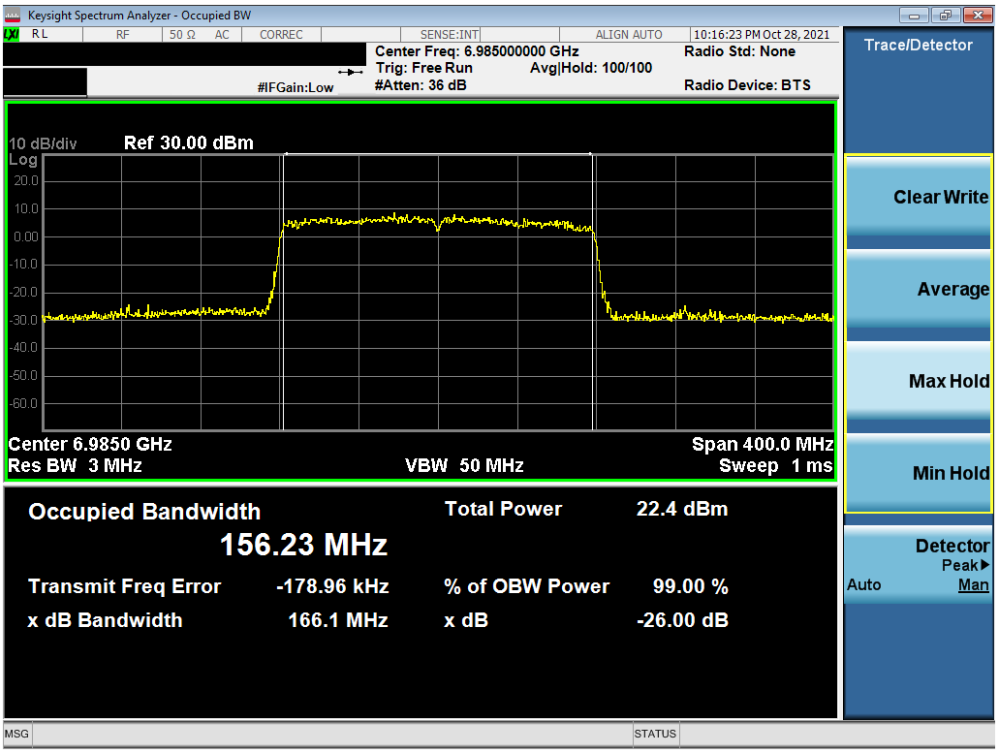
Plot 7-101. 26dB Bandwidth Plot MIMO ANT2 (40MHz 802.11ax (UNII Band 8) – Ch. 227)



Plot 7-102. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 8) – Ch. 199)



Plot 7-103. 26dB Bandwidth Plot MIMO ANT2 (80MHz 802.11ax (UNII Band 8) – Ch. 215)



Plot 7-104. 26dB Bandwidth Plot MIMO ANT2 (160MHz 802.11ax (UNII Band 8) – Ch. 207)

7.3 UNII Output Power Measurement – 802.11a/ax

§ 2.1046, §15.407(a)(11), §15.407(a)(8)

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 KDB 789033 D02 v02r01, and at the appropriate frequencies.

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.3.2 Method PM-G
KDB 789033 D02 v02r01 – Section E)3)b) Method PM-G
ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique
KDB 662911 v02r01 – Section E)1) 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 7-2. Test Instrument & Measurement Setup

Test Notes

None.

MIMO Maximum Conducted Output Power Measurements

6GHz (20MHz Bandwidth)									
	6GHz (20MHz) 802.11a Conducted Power [dBm]								
	Freq [MHz]	Channel	ANT1	ANT2	MIMO	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	5935	2	9.35	9.43	12.40	-2.92	9.48	24.0	-14.52
	6075	25	9.34	9.22	12.29	-2.92	9.37	24.0	-14.63
	6175	45	9.20	9.01	12.12	-2.92	9.20	24.0	-14.80
	6275	65	9.36	9.30	12.34	-2.92	9.42	24.0	-14.58
	6415	93	9.49	9.40	12.46	-2.92	9.54	24.0	-14.46
	6435	97	12.02	11.47	14.76	-5.48	9.28	24.0	-14.72
	6475	105	12.05	11.35	14.73	-5.48	9.25	24.0	-14.75
	6515	113	12.13	11.55	14.86	-5.48	9.38	24.0	-14.62
	6535	117	11.72	11.33	14.54	-4.17	10.37	24.0	-13.63
	6675	145	12.09	11.57	14.85	-4.17	10.68	24.0	-13.32
	6695	149	12.19	11.50	14.87	-4.17	10.70	24.0	-13.30
	6875	185	11.26	11.80	14.55	-4.17	10.38	24.0	-13.62
	6895	189	10.98	12.78	14.98	-5.59	9.39	24.0	-14.61
	6995	209	11.09	12.14	14.66	-5.59	9.07	24.0	-14.93
	7115	233	11.20	11.26	14.24	-5.59	8.65	24.0	-15.35

Table 7-2. MIMO 20MHz BW 802.11a (UNII) Maximum Conducted Output Power

6GHz (20MHz Bandwidth)									
	6GHz (20MHz) 802.11ax Conducted Power [dBm]								
	Freq [MHz]	Channel	ANT1	ANT2	MIMO	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	5935	2	9.64	9.83	12.75	-2.92	9.83	24.0	-14.17
	6075	25	9.29	9.36	12.34	-2.92	9.42	24.0	-14.58
	6175	45	9.41	9.22	12.33	-2.92	9.41	24.0	-14.59
	6275	65	9.72	9.50	12.62	-2.92	9.70	24.0	-14.30
	6415	93	9.41	9.42	12.43	-2.92	9.51	24.0	-14.49
	6435	97	12.14	11.35	14.77	-5.48	9.29	24.0	-14.71
	6475	105	12.14	11.47	14.83	-5.48	9.35	24.0	-14.65
	6515	113	12.16	11.50	14.86	-5.48	9.38	24.0	-14.62
	6535	117	12.04	11.46	14.77	-4.17	10.60	24.0	-13.40
	6675	145	12.30	11.46	14.91	-4.17	10.74	24.0	-13.26
	6695	149	12.26	11.67	14.99	-4.17	10.82	24.0	-13.18
	6875	185	11.50	11.81	14.67	-4.17	10.50	24.0	-13.50
	6895	189	11.15	12.49	14.88	-5.59	9.29	24.0	-14.71
	6995	209	11.22	12.33	14.82	-5.59	9.23	24.0	-14.77
	7115	233	11.24	11.35	14.31	-5.59	8.72	24.0	-15.28

Table 7-3. MIMO 20MHz BW 802.11ax (UNII) Maximum Conducted Output Power

6GHz (40MHz Bandwidth)									
	6GHz (40MHz) 802.11ax Conducted Power [dBm]								
	Freq [MHz]	Channel	ANT1	ANT2	MIMO	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	5965	3	12.41	12.56	15.50	-2.92	12.58	24.0	-11.42
	6085	27	12.30	12.33	15.33	-2.92	12.41	24.0	-11.59
	6165	43	12.40	12.28	15.35	-2.92	12.43	24.0	-11.57
	6285	67	12.62	12.57	15.61	-2.92	12.69	24.0	-11.31
	6405	91	12.56	12.62	15.60	-2.92	12.68	24.0	-11.32
	6445	99	13.15	12.16	15.69	-5.48	10.21	24.0	-13.79
	6485	107	13.21	12.19	15.74	-5.48	10.26	24.0	-13.74
	6525	115	13.28	12.09	15.74	-5.48	10.26	24.0	-13.74
	6565	123	13.19	12.21	15.74	-4.17	11.57	24.0	-12.43
	6685	147	13.10	12.55	15.84	-4.17	11.67	24.0	-12.33
	6725	155	13.35	12.52	15.97	-4.17	11.80	24.0	-12.20
	6845	179	12.47	12.42	15.46	-4.17	11.29	24.0	-12.71
	6885	187	12.62	12.32	15.48	-5.59	9.89	24.0	-14.11
	7005	211	12.01	12.92	15.50	-5.59	9.91	24.0	-14.09
	7085	227	12.28	12.32	15.31	-5.59	9.72	24.0	-14.28

Table 7-4. MIMO 40MHz BW 802.11ax (UNII) Maximum Conducted Output Power

6GHz (80MHz Bandwidth)	6GHz (80MHz) 802.11ax Conducted Power [dBm]								
	Freq [MHz]	Channel	ANT1	ANT2	MIMO	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	5985	7	13.20	12.72	15.98	-2.92	13.06	24.0	-10.94
	6065	23	12.42	11.79	15.13	-2.92	12.21	24.0	-11.79
	6145	39	13.16	12.80	15.99	-2.92	13.07	24.0	-10.93
	6305	71	13.12	12.70	15.93	-2.92	13.01	24.0	-10.99
	6385	87	12.94	12.76	15.86	-2.92	12.94	24.0	-11.06
	6465	103	12.63	12.02	15.34	-5.48	9.86	24.0	-14.14
	6545	119	12.57	11.84	15.23	-4.17	11.06	24.0	-12.94
	6705	151	12.71	11.89	15.33	-4.17	11.16	24.0	-12.84
	6785	167	12.50	13.24	15.90	-4.17	11.73	24.0	-12.27
	6865	183	12.65	12.60	15.63	-4.17	11.46	24.0	-12.54
	6945	199	11.58	13.38	15.58	-5.59	9.99	24.0	-14.01
	7025	215	11.51	12.51	15.05	-5.59	9.46	24.0	-14.54

Table 7-5. MIMO 80MHz BW 802.11ax (UNII) Maximum Conducted Output Power

6GHz (160MHz Bandwidth)	6GHz (160MHz) 802.11ax Conducted Power [dBm]								
	Freq [MHz]	Channel	ANT1	ANT2	MIMO	Ant. Gain [dBi]	Max e.i.r.p. [dBm]	Max e.i.r.p. Limit [dBm]	e.i.r.p. Margin [dB]
	6025	15	12.29	12.58	15.45	-2.92	12.53	24.0	-11.47
	6185	47	12.37	12.28	15.33	-2.92	12.41	24.0	-11.59
	6345	79	12.17	12.61	15.41	-2.92	12.49	24.0	-11.51
	6505	111	12.74	12.16	15.47	-5.48	9.99	24.0	-14.01
	6665	143	12.75	12.09	15.45	-4.17	11.28	24.0	-12.72
	6825	175	12.14	12.65	15.41	-4.17	11.24	24.0	-12.76
	6985	207	11.59	12.66	15.17	-5.59	9.58	24.0	-14.42

Table 7-6. MIMO 160MHz BW 802.11ax (UNII) Maximum Conducted Output Power

Note:

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

Per ANSI C63.10-2013 Section 14.4.3, the directional gain is calculated using the following formula, where GN is the gain of the nth antenna and NANT, the total number of antennas used.

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}] \text{ dBi}$$
$$= 10 \log[(10^{-6.31/20} + 10^{-5.56/20})^2 / 2] \text{ dBi}$$
$$= -2.92 \text{ dBi}$$

Sample MIMO Calculation:

At 5935MHz in 802.11ax (20MHz BW) mode, the average conducted output power was measured to be 9.64 dBm for Antenna-1 and 9.83 dBm for Antenna-2.

Antenna 1 + Antenna 2 = MIMO

(9.64 dBm + 9.83 dBm) = (9.204 mW + 9.616mW) =18.820 mW = 12.75 dBm

Sample e.i.r.p. Calculation:

At 5935MHz in 802.11ax (20MHz BW) mode, the average MIMO conducted power was calculated to be 12.75 dBm with directional gain of -2.92 dBi.

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

12.75 dBm + -2.92 dBi = 9.83 dBm

7.4 Maximum Power Spectral Density – 802.11a/ax

§15.407(a)(8)

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 KDB 789033 D02 v02r01, and at the appropriate frequencies. Method SA-1, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, was used to measure the power spectral density for 802.11ax. Method SA-2, as defined in ANSI C63.10-2013 and KDB 789033 D02 v02r01, was used to measure the power spectral density for 802.11a/802.11ax.

In the 5.925-7.125 GHz bands, the maximum power spectral density must not exceed −1 dBm e.i.r.p. in any 1-megahertz band

Test Procedure Used

ANSI C63.10-2013 – Section 12.3.2.2
KDB 789033 D02 v02r01 – Section F
ANSI C63.10-2013 – Section 14.3.2.2 Measure-and-Sum Technique
KDB 662911 v02r01 – Section E)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 7-3. Test Instrument & Measurement Setup

Test Notes

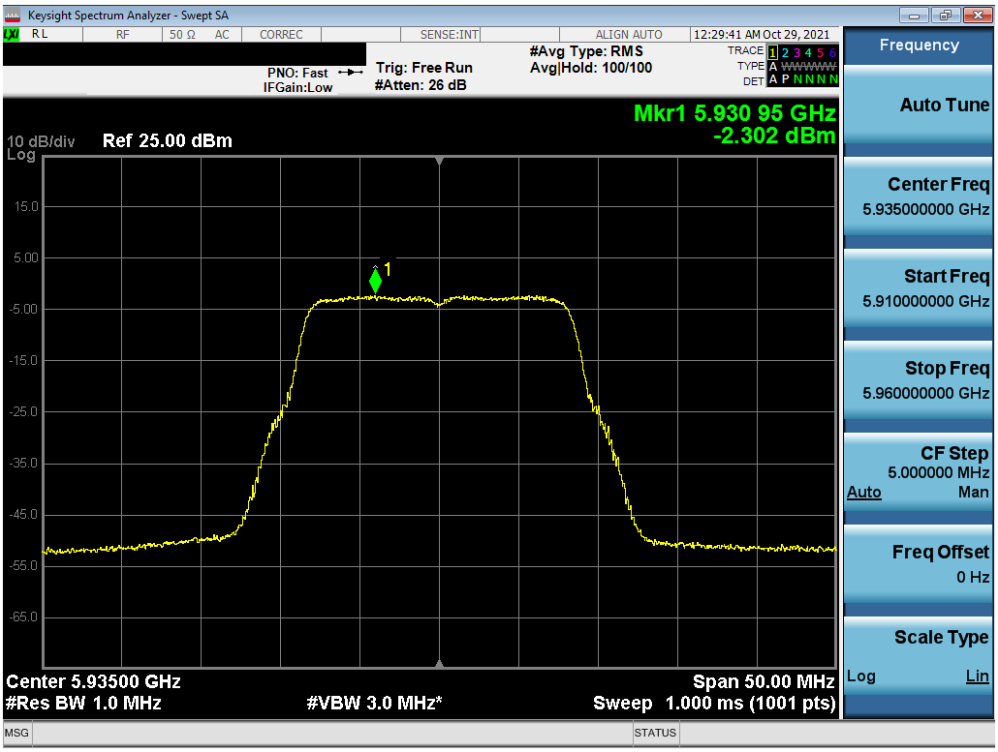
None.

MIMO Power Spectral Density Measurements

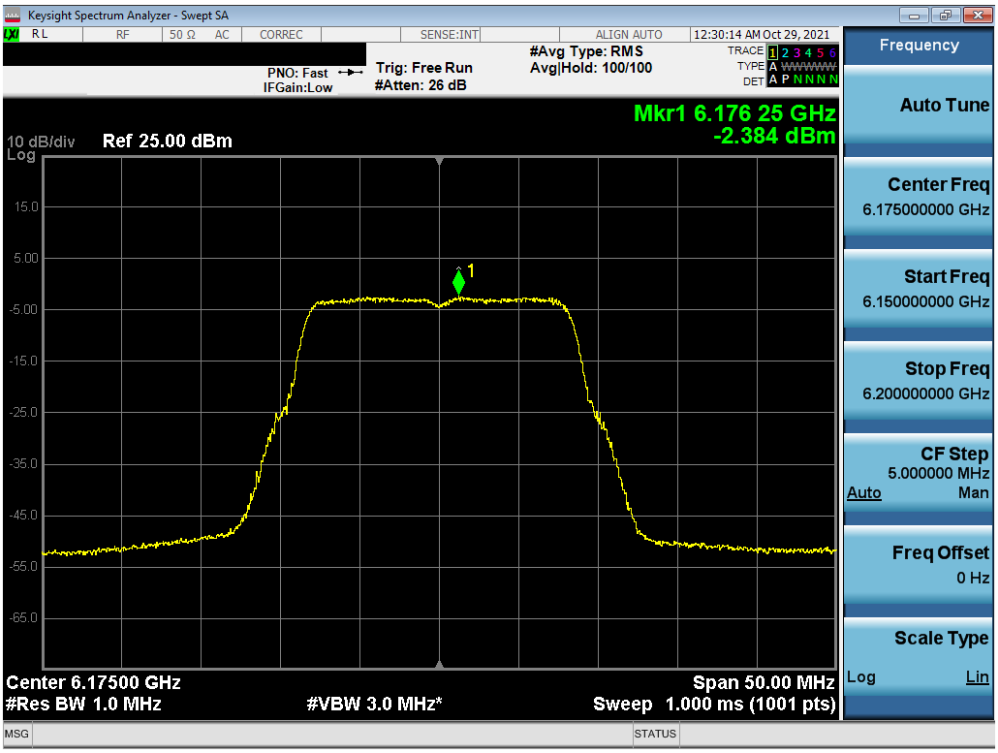
	Frequency [MHz]	Channel	802.11 MODE	Antenna-1 Power Density [dBm]	Antenna-2 Power Density [dBm]	Summed MIMO Power Density [dBm/MHz]	Directional Gain [dBi]	e.i.r.p Density [dBm/MHz]	Max EIRP Density [dBm/MHz]	Margin [dB]
Band 5	5935	2	a	-2.30	-1.45	1.15	-2.92	-1.76	-1	-0.76
	6175	45	a	-2.38	-2.60	0.52	-2.92	-2.40	-1	-1.40
	6415	93	a	-1.77	-1.66	1.30	-2.92	-1.62	-1	-0.62
	5935	2	ax (20MHz)	-2.10	-1.85	1.03	-2.92	-1.88	-1	-0.88
	6175	45	ax (20MHz)	-2.50	-2.60	0.46	-2.92	-2.46	-1	-1.46
	6415	93	ax (20MHz)	-2.55	-2.00	0.74	-2.92	-2.17	-1	-1.17
	5965	3	ax (40MHz)	-2.00	-1.27	1.39	-2.92	-1.52	-1	-0.52
	6165	43	ax (40MHz)	-2.80	-2.26	0.49	-2.92	-2.43	-1	-1.43
	6405	91	ax (40MHz)	-2.05	-1.94	1.02	-2.92	-1.90	-1	-0.90
	5985	7	ax (80MHz)	-4.28	-4.31	-1.29	-2.92	-4.20	-1	-3.20
	6145	39	ax (80MHz)	-4.14	-4.66	-1.38	-2.92	-4.29	-1	-3.29
	6385	87	ax (80MHz)	-4.10	-4.31	-1.19	-2.92	-4.11	-1	-3.11
	6025	15	ax (160MHz)	-7.64	-7.05	-4.33	-2.92	-7.24	-1	-6.24
	6185	47	ax (160MHz)	-8.02	-7.59	-4.79	-2.92	-7.71	-1	-6.71
	6345	79	ax (160MHz)	-7.27	-6.88	-4.06	-2.92	-6.98	-1	-5.98
Band 6	6435	97	a	-0.66	0.29	2.85	-5.48	-2.63	-1	-1.63
	6475	105	a	-0.27	0.53	3.16	-5.48	-2.32	-1	-1.32
	6515	113	a	-0.47	0.33	2.96	-5.48	-2.52	-1	-1.52
	6435	97	ax (20MHz)	-0.88	0.08	2.64	-5.48	-2.84	-1	-1.84
	6475	105	ax (20MHz)	-0.28	0.33	3.04	-5.48	-2.44	-1	-1.44
	6515	113	ax (20MHz)	-0.69	-0.07	2.64	-5.48	-2.84	-1	-1.84
	6445	99	ax (40MHz)	-2.95	-1.72	0.72	-5.48	-4.76	-1	-3.76
	6485	107	ax (40MHz)	-2.14	-1.83	1.03	-5.48	-4.45	-1	-3.45
	6525	115	ax (40MHz)	-2.46	-2.21	0.68	-5.48	-4.80	-1	-3.80
	6465	103	ax (80MHz)	-4.59	-3.96	-1.25	-5.48	-6.73	-1	-5.73
	6505	111	ax (160MHz)	-7.98	-7.02	-4.46	-5.48	-9.94	-1	-8.94
Band 7	6535	117	a	-1.25	0.20	2.55	-4.17	-1.63	-1	-0.63
	6695	149	a	-0.83	0.75	3.04	-4.17	-1.13	-1	-0.13
	6875	185	a	-0.47	0.19	2.88	-4.17	-1.29	-1	-0.29
	6535	117	ax (20MHz)	-1.32	0.05	2.43	-4.17	-1.75	-1	-0.75
	6695	149	ax (20MHz)	-0.71	0.21	2.79	-4.17	-1.39	-1	-0.39
	6875	185	ax (20MHz)	-0.85	-0.06	2.57	-4.17	-1.60	-1	-0.60
	6565	123	ax (40MHz)	-3.15	-1.96	0.50	-4.17	-3.68	-1	-2.68
	6725	155	ax (40MHz)	-2.43	-1.23	1.22	-4.17	-2.95	-1	-1.95
	6885	179	ax (40MHz)	-2.75	-2.17	0.56	-4.17	-3.61	-1	-2.61
	6545	119	ax (80MHz)	-5.46	-4.47	-1.93	-4.17	-6.10	-1	-5.10
	6705	151	ax (80MHz)	-5.23	-4.06	-1.60	-4.17	-5.77	-1	-4.77
	6865	183	ax (80MHz)	-5.14	-4.12	-1.59	-4.17	-5.77	-1	-4.77
	6665	143	ax (160MHz)	-8.58	-7.28	-4.87	-4.17	-9.05	-1	-8.05
	6825	175	ax (160MHz)	-8.40	-7.41	-4.87	-4.17	-9.04	-1	-8.04
Band 8	6895	189	a	-0.42	1.27	3.52	-5.59	-2.07	-1	-1.07
	6995	209	a	-0.54	0.87	3.23	-5.59	-2.36	-1	-1.36
	7115	233	a	-0.98	-0.11	2.49	-5.59	-3.10	-1	-2.10
	6895	189	ax (20MHz)	-0.98	0.79	3.01	-5.59	-2.58	-1	-1.58
	6995	209	ax (20MHz)	-0.71	0.38	2.88	-5.59	-2.71	-1	-1.71
	7115	233	ax (20MHz)	-1.18	-0.48	2.19	-5.59	-3.40	-1	-2.40
	6885	187	ax (40MHz)	-2.55	-2.07	0.71	-5.59	-4.88	-1	-3.88
	7005	211	ax (40MHz)	-3.01	-1.86	0.61	-5.59	-4.97	-1	-3.97
	7085	227	ax (40MHz)	-3.20	-2.55	0.15	-5.59	-5.44	-1	-4.44
	6945	199	ax (80MHz)	-5.24	-2.96	-0.94	-5.59	-6.53	-1	-5.53
	7025	215	ax (80MHz)	-5.21	-3.48	-1.25	-5.59	-6.84	-1	-5.84
	6985	207	ax (160MHz)	-8.21	-6.74	-4.40	-5.59	-9.99	-1	-8.99

Table 7-7. MIMO e.i.r.p. Conducted Power Spectral Density Measurements

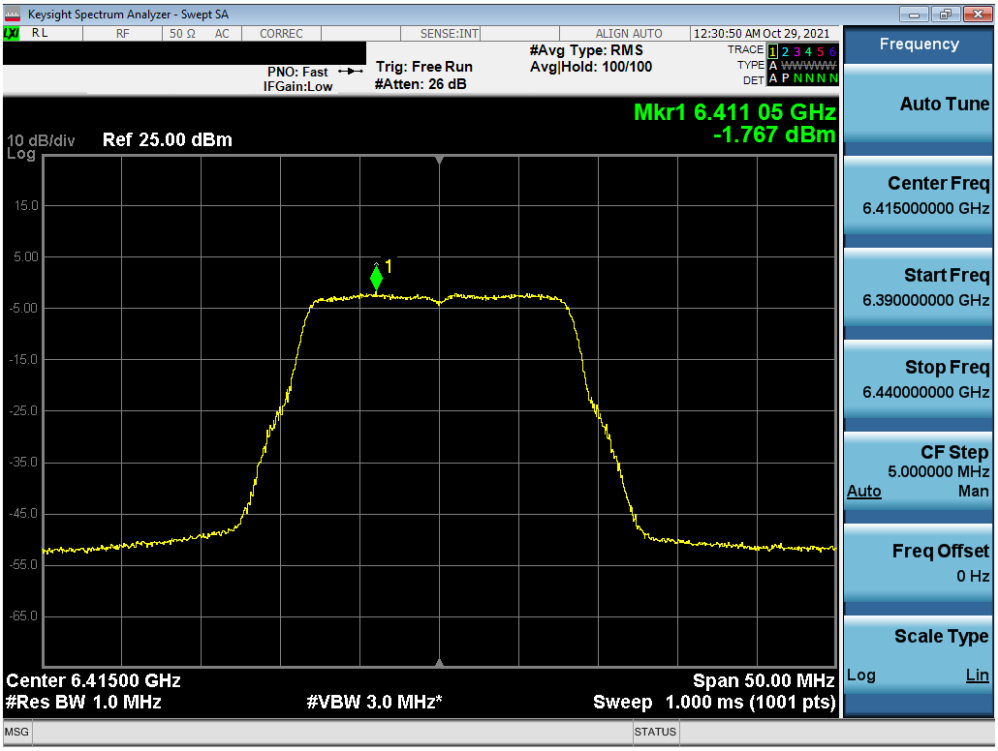
MIMO Antenna-1 Power Spectral Density Measurements - (UNII Band 5)



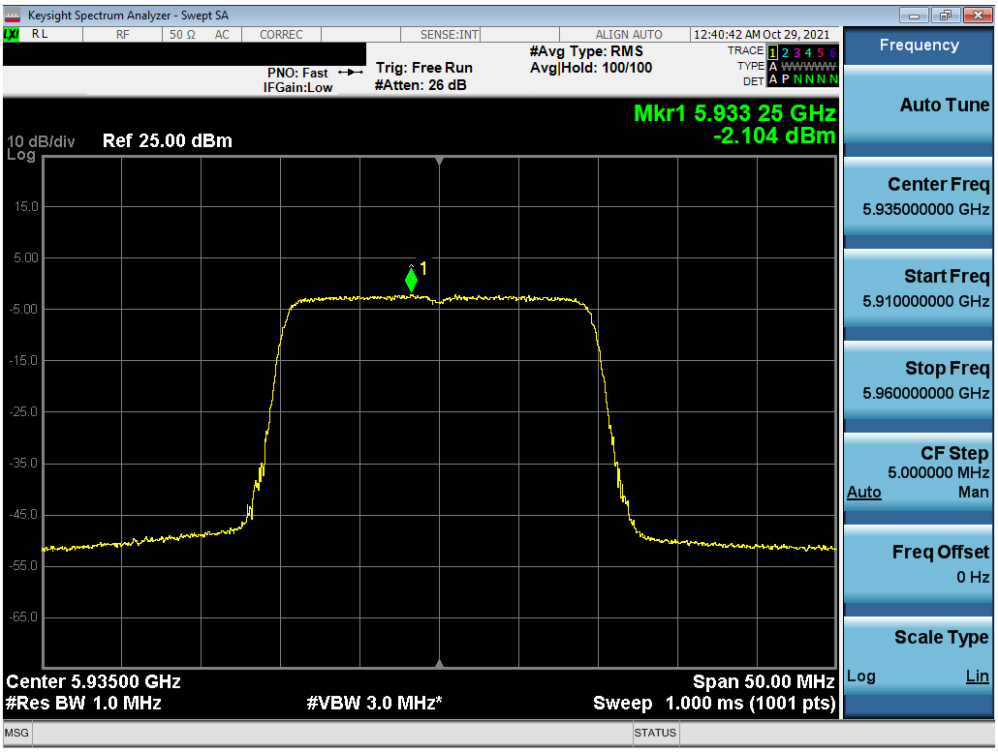
Plot 7-105. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 2)



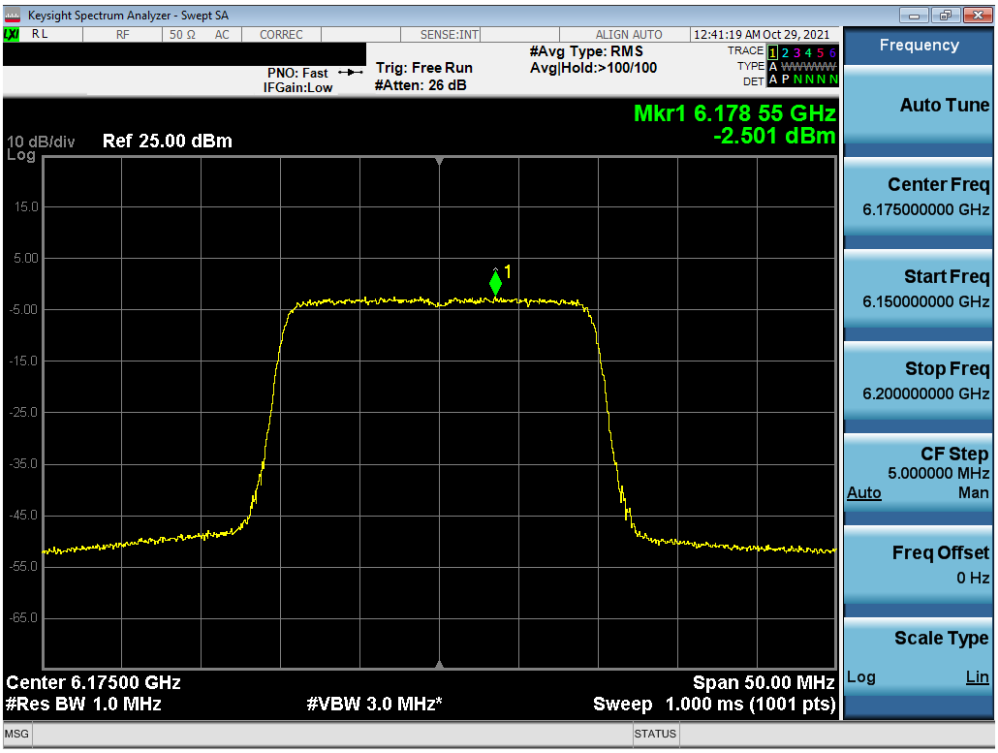
Plot 7-106. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 45)



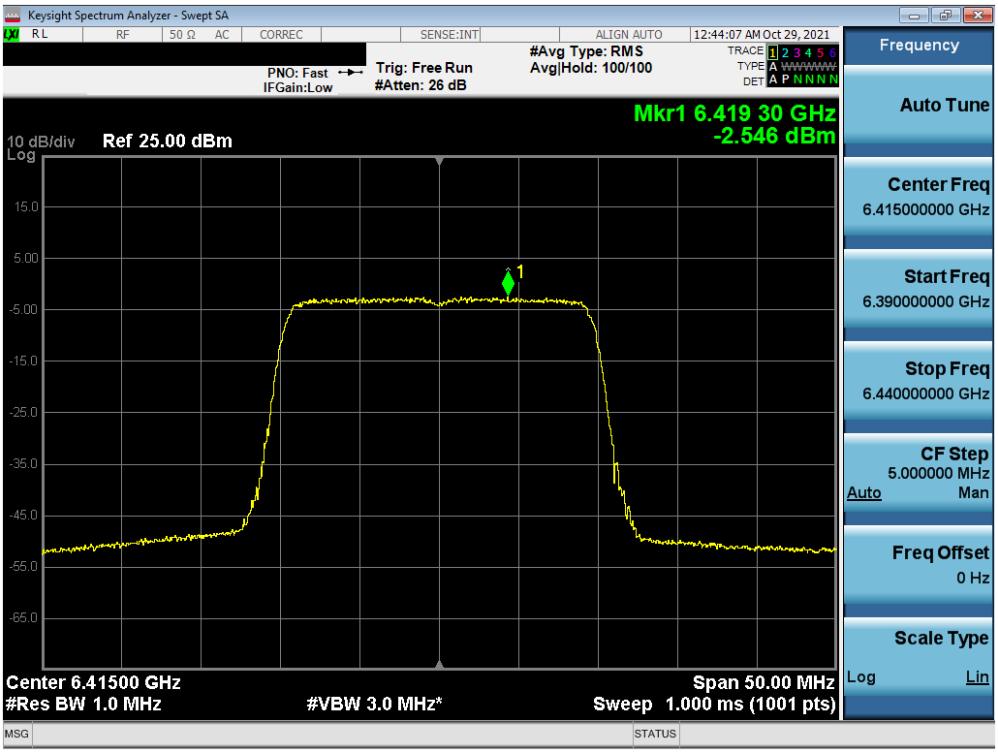
Plot 7-107. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 5) – Ch. 93



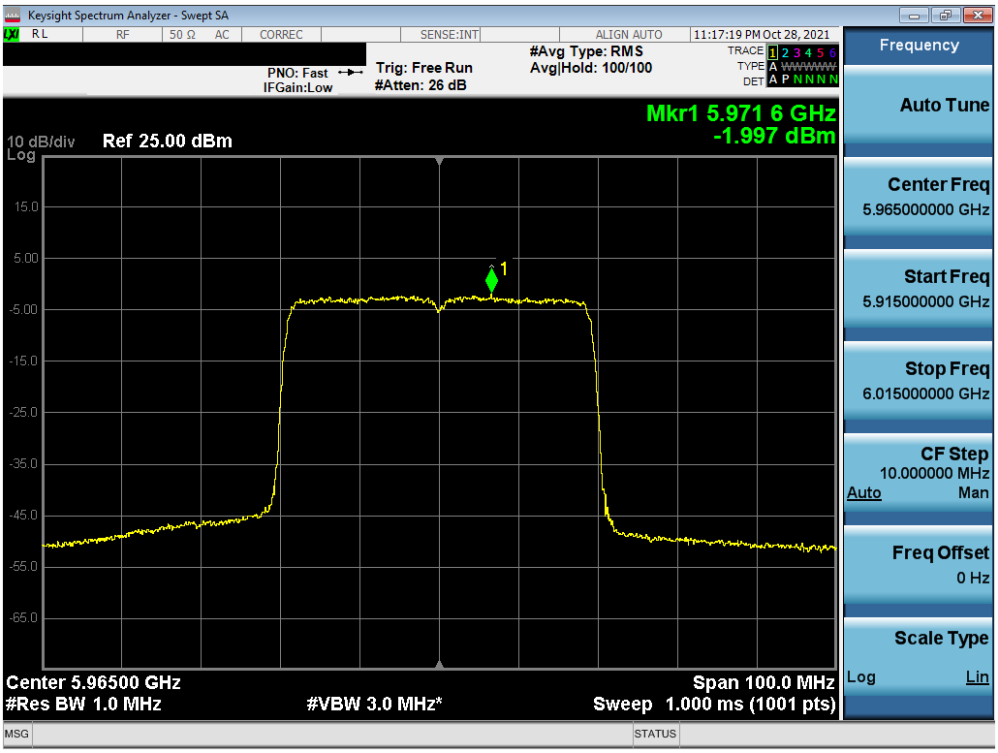
Plot 7-108. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 2)



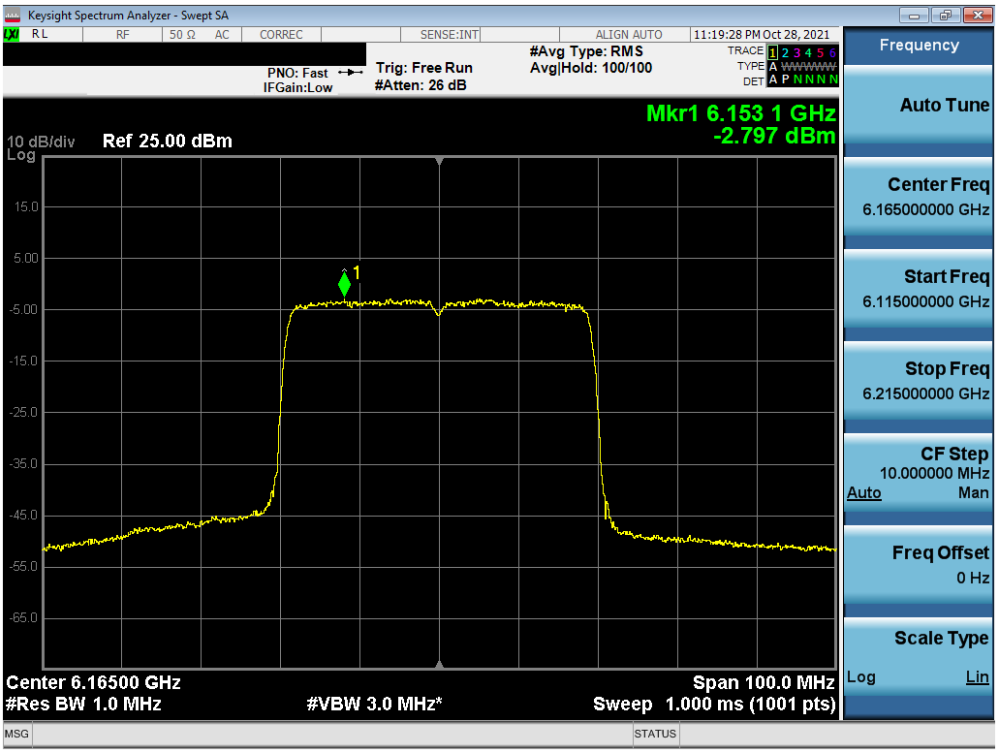
Plot 7-109. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 45)



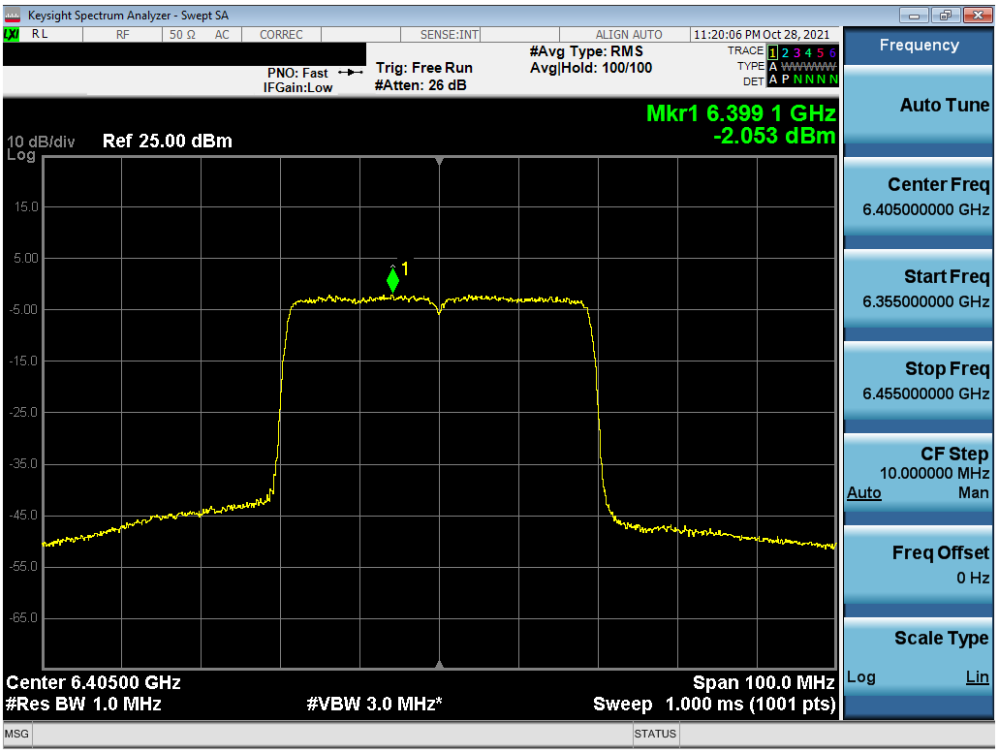
Plot 7-110. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 5) – Ch. 93



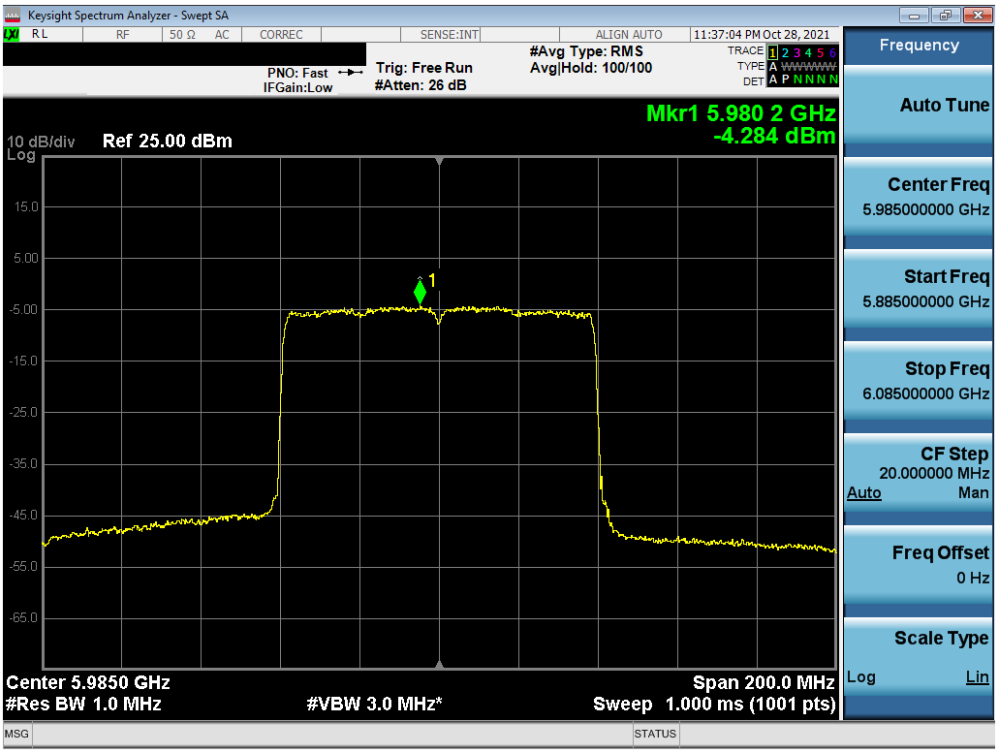
Plot 7-111. Power Spectral Density Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 3)



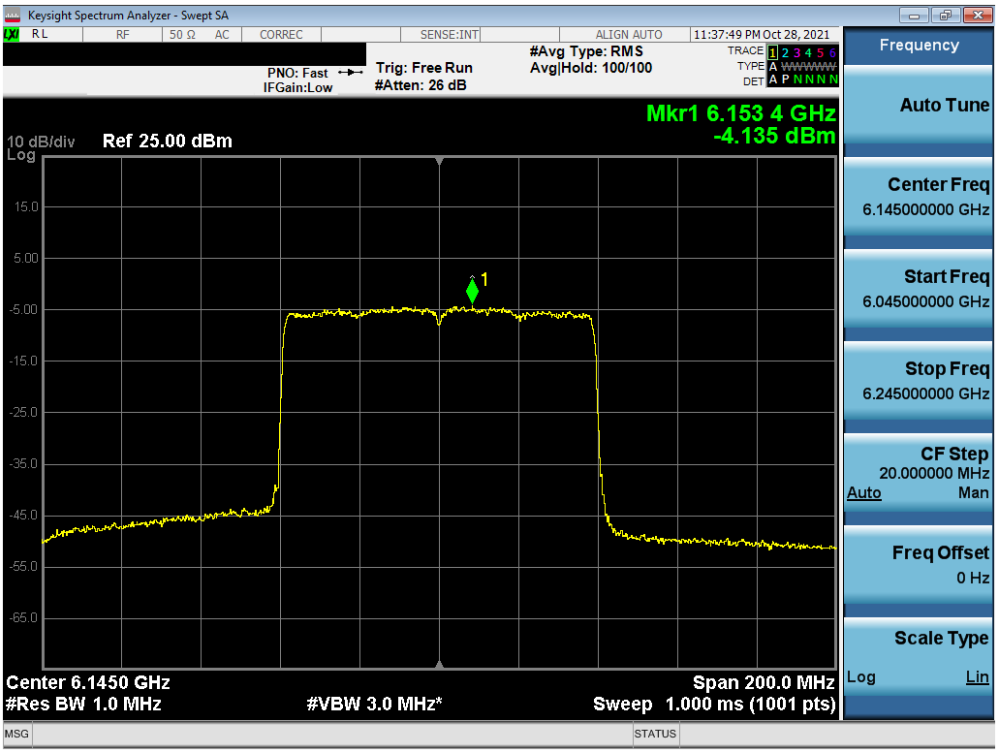
Plot 7-112. Power Spectral Density Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 43)



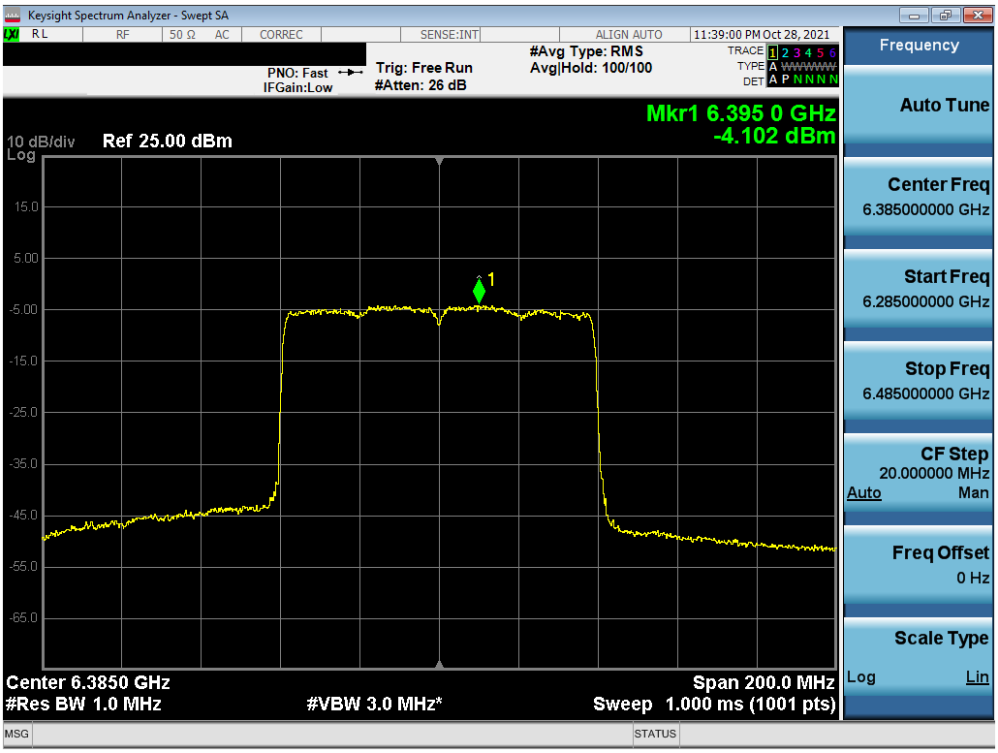
Plot 7-113. Power Spectral Density Measurement Plot MIMO ANT1 (40MHz 802.11ax (UNII Band 5) – Ch. 91)



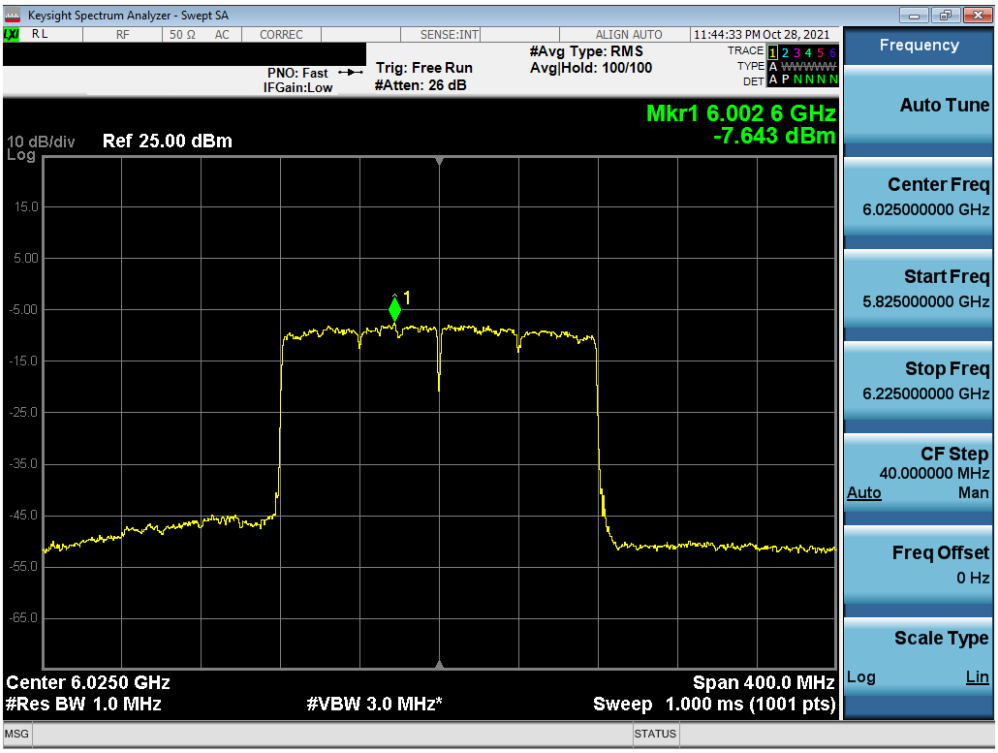
Plot 7-114. Power Spectral Density Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 7)



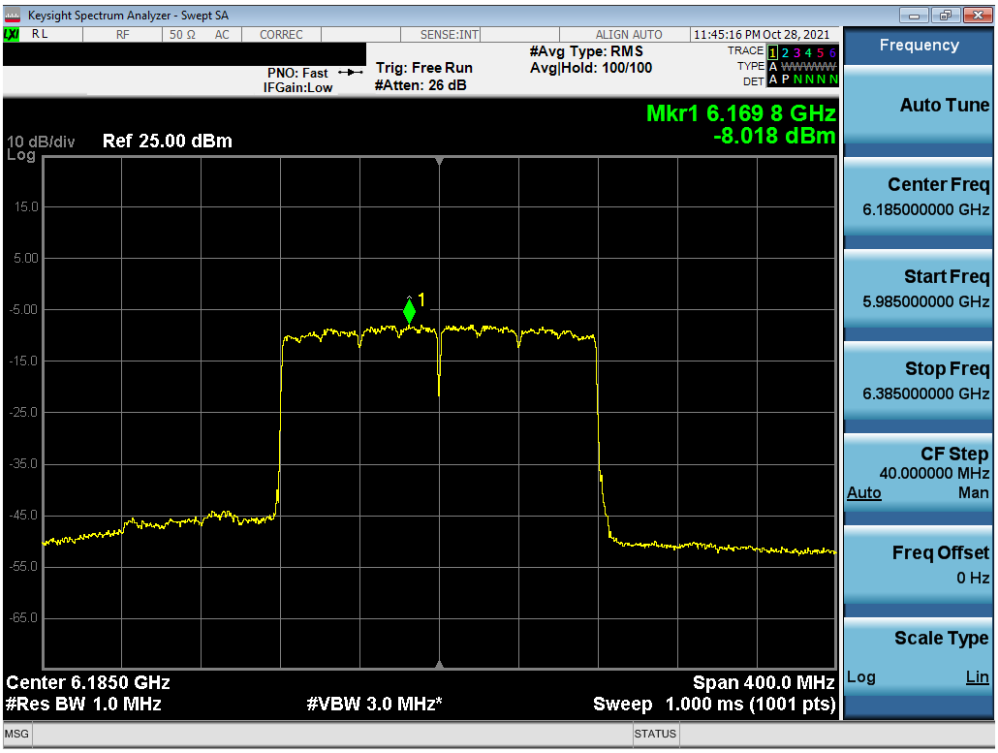
Plot 7-115. Power Spectral Density Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 39)



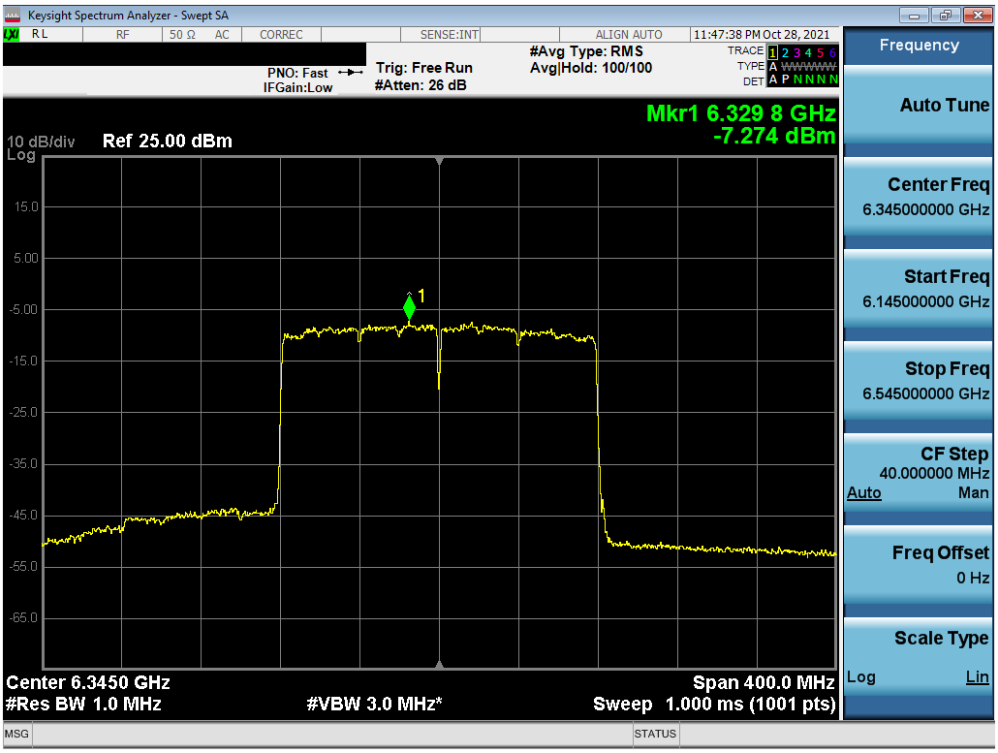
Plot 7-116. Power Spectral Density Measurement Plot MIMO ANT1 (80MHz 802.11ax (UNII Band 5) – Ch. 87)



Plot 7-117. Power Spectral Density Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 15)

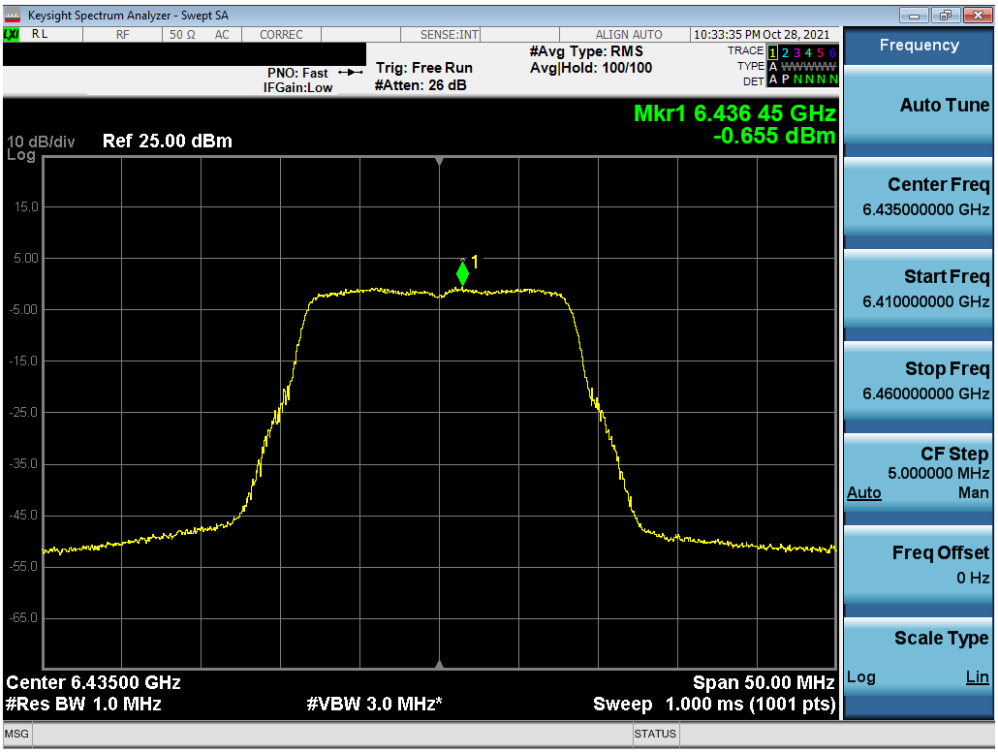


Plot 7-118. Power Spectral Density Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 47)

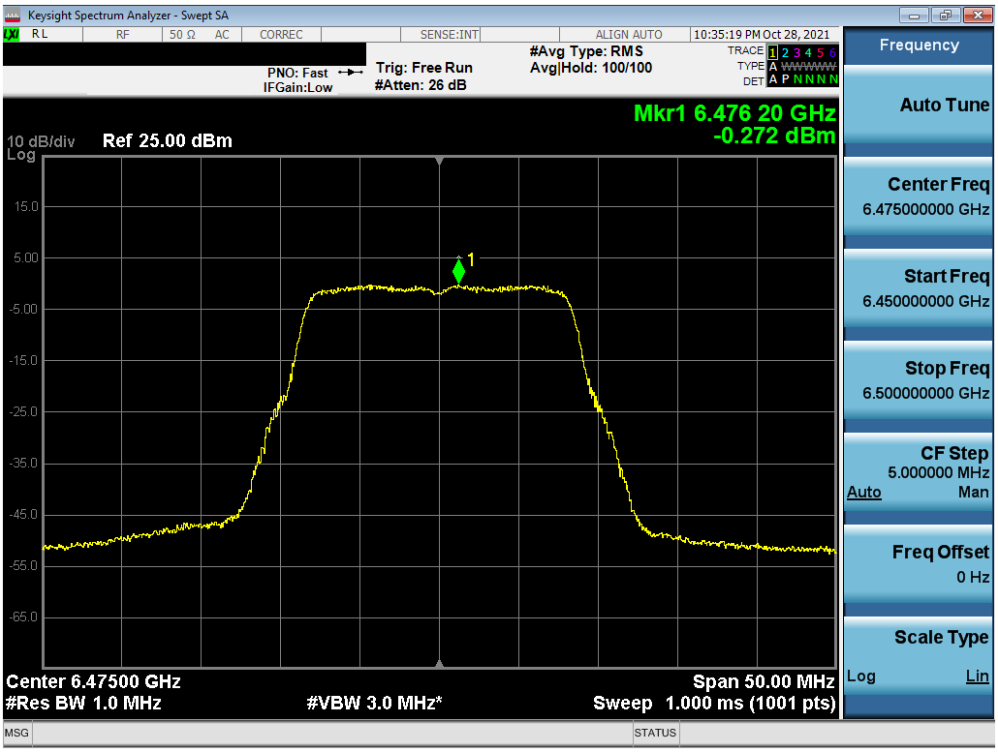


Plot 7-119. Power Spectral Density Measurement Plot MIMO ANT1 (160MHz 802.11ax (UNII Band 5) – Ch. 79)

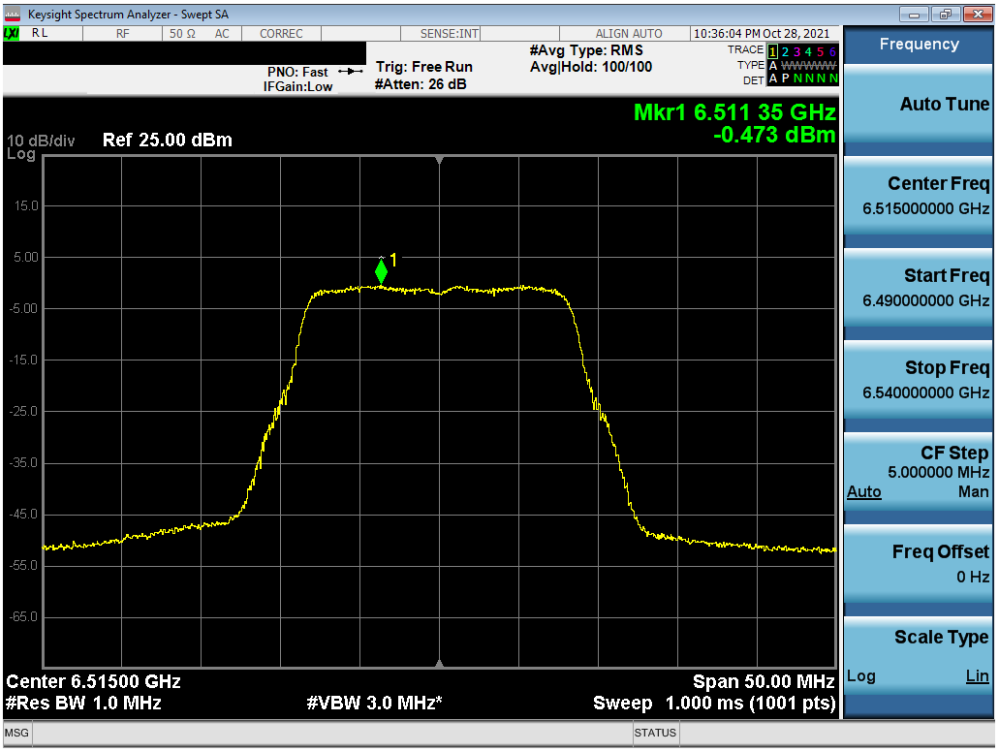
MIMO Antenna-1 Power Spectral Density Measurements - (UNII Band 6)



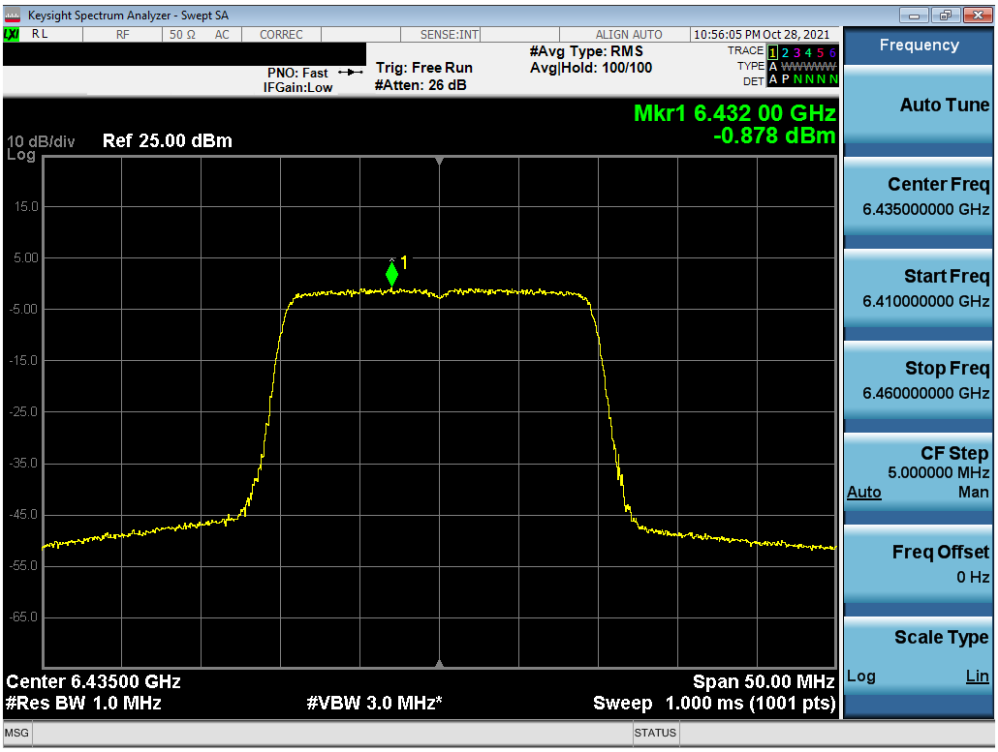
Plot 7-120. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 97)



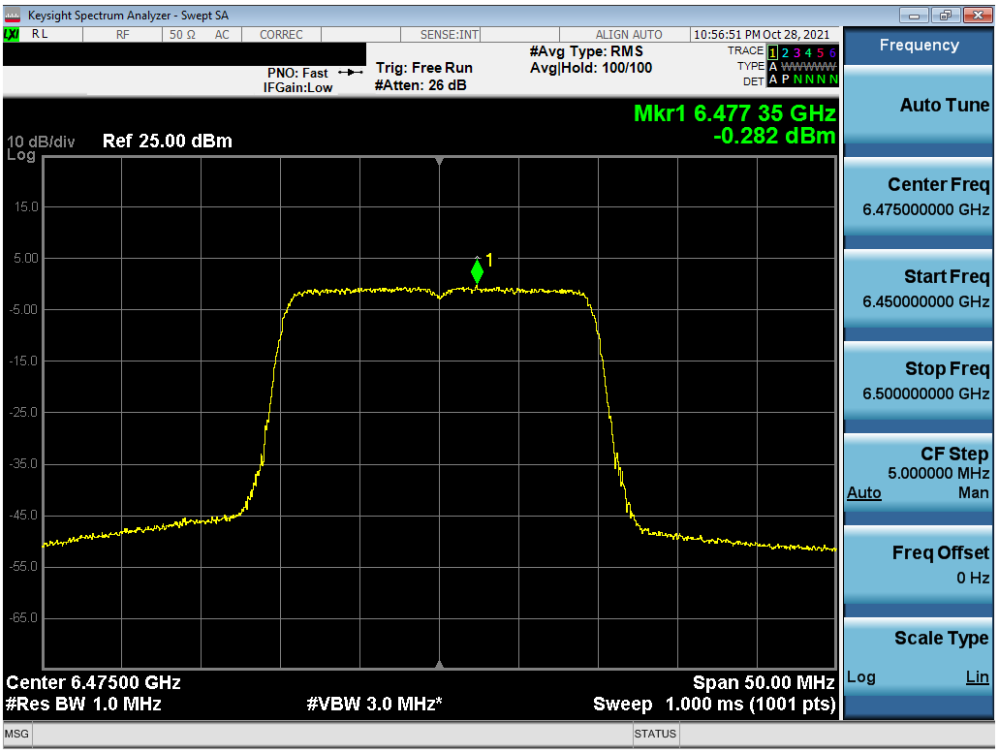
Plot 7-121. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 105)



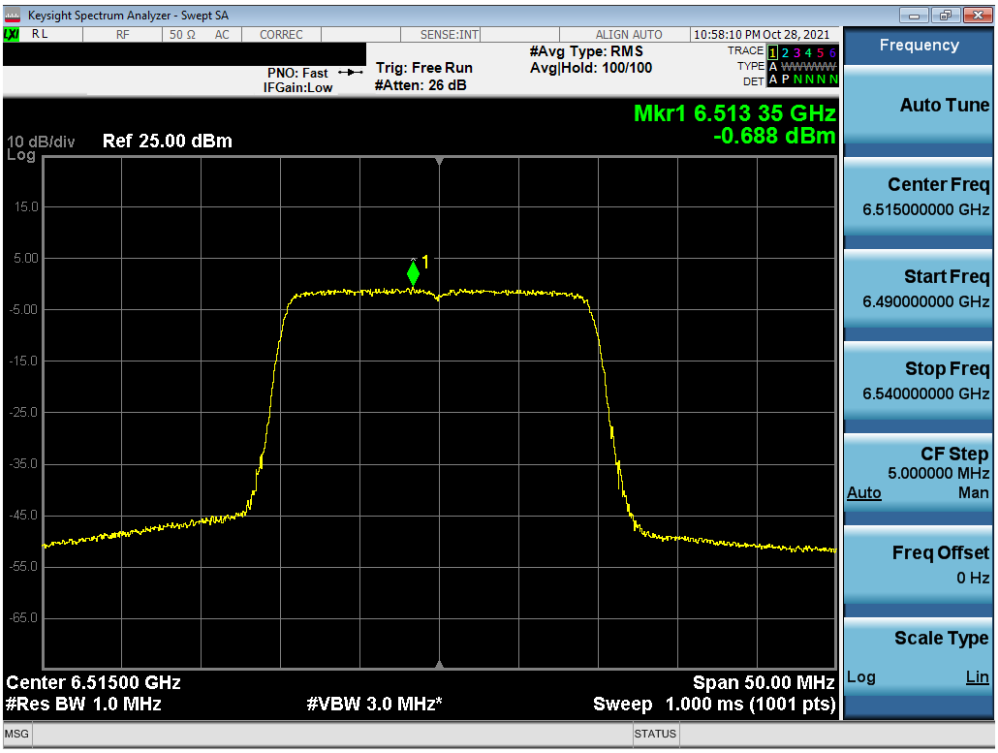
Plot 7-122. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11a (UNII Band 6) – Ch. 113)



Plot 7-123. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 97)



Plot 7-124. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 105)



Plot 7-125. Power Spectral Density Measurement Plot MIMO ANT1 (20MHz 802.11ax (UNII Band 6) – Ch. 113)