PCTEST
7185 Oakland Mills Road, Columbia, MD 21046 USA
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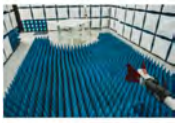

MEASUREMENT REPORT
FCC PART 15.407 UNII OFDMA

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

Date of Testing:
4/29 - 8/12/2020
Test Site/Location:
PCTEST Lab. Columbia, MD, USA
Test Report Serial No.:
1M2004140062-09.A3L

FCC ID:	**A3LSMH204V**
APPLICANT:	**Samsung Electronics Co., Ltd.**

Application Type:	Certification
Model:	SM-H204V
EUT Type:	Indoor Customer Premises Equipment (CPE)
Frequency Range:	5180 – 5825MHz
Modulation Type:	OFDMA
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15 Subpart E (15.407)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02 v02r01, KDB 662911 D01 v02r01

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

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

Randy Ortanez
President

ACCREDITED
CERT #2041.01

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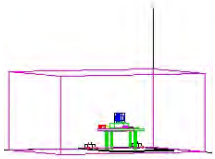
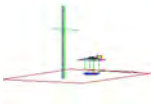


MEASUREMENT REPORT



UNII Band	Channel Bandwidth (MHz)	Tx Frequency (MHz)	MIMO	
			Max. Power (mW)	Max. Power (dBm)
1	20	5180 - 5240	769.130	28.86
2A		5260 - 5320	162.181	22.10
2C		5500 - 5720	110.408	20.43
3		5745 - 5825	669.885	28.26
1	40	5190 - 5230	707.946	28.50
2A		5270 - 5310	173.780	22.40
2C		5510 - 5710	144.212	21.59
3		5755 - 5795	619.441	27.92
1	80	5210	32.584	15.13
2A		5290	58.076	17.64
2C		5530 - 5690	151.008	21.79
3		5775	545.758	27.37
1	80+80	5210	16.558	12.19
2A		5290	16.866	12.27
2C		5530 - 5690	17.219	12.36
3		5775	19.231	12.84

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 17025-2005 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 Indoor Customer Premises Equipment (CPE) FCC ID: A3LSMH204V**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

Test Device Serial No.: 18425, 16452 ,17898, 23250

2.2 Device Capabilities

This device contains the following capabilities:

Multi-band LTE, 5G NR (n5, n66, n2, n261, n260), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII, Bluetooth (LE)

Band 1		Band 2A		Band 2C		Band 3	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
36	5180	52	5260	100	5500	149	5745
:	:	:	:	:	:	:	:
42	5210	56	5280	120	5600	157	5785
:	:	:	:	:	:	:	:
48	5240	64	5320	144	5720	165	5825

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

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

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

Band 1		Band 2A		Band 2C		Band 3	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	58	5290	106	5530	155	5775
				:	:		
				138	5690		

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

Band 1		Band 2A		Band 2C	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
42	5210	58	5290	106	5530
				138	5610

Table 2-4. 802.11ax (80+80MHz BW) Frequency / Channel Operations

Notes:

1. 5GHz NII operation is possible in 20MHz, and 40MHz, 80MHz and 80MHz+80MHz 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:

Table 2-5. Measured Duty Cycles

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

WiFi Configurations		MIMO
5GHz	11ax (20MHz)	✓
	11ax (40MHz)	✓
	11ax (80MHz)	✓
	11ax (80+80MHz)	✓

Table 2-6. Frequency / Channel Operations

✓= Support ; × = NOT Support
SISO = Single Input Single Output
SDM = Spatial Diversity Multiplexing – MIMO function

3. This device supports simultaneous transmission operation, which allows for two SISO channels to operate independent of one another in the 2.4GHz (WLAN & BTLE) and 5GHz bands simultaneously on each antenna. The following tables show the worst case configurations determined during testing. The data for these configurations is contained in this test report. The BTLE + 5GHz case is not considered as worst case since the BT power is lower than the 2.4GHz WLAN power.

Configuration 1: ANT1 and ANT2 transmitting in 2.4GHz mode and ANT3, ANT4, ANT5, ANT6 in 5GHz mode

Description	2.4 GHz Emission	5 GHz Emission
Antenna	1+2	3+4+5+6
Channel	6	100
Operating Frequency (MHz)	2437	5500
Data Rate (Mbps)	1Mbps	6Mbps
Mode	b	a

Table 2-7. Config-1 (ANT1+2 2.4GHz & ANT3+4+5+6 5GHz)

4. This device supports 80+80MHz channel bandwidth by concatenate two 80MHz channel bandwidths to achieve 160MHz bandwidth.

2.3 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	ANT3 Antenna Gain (dBi)	ANT4 Antenna Gain (dBi)	ANT5 Antenna Gain (dBi)	ANT6 Antenna Gain (dBi)	Directional Gain (dBi)
5.2	1.0	3.0	3.4	-0.7	4.7
5.3	2.1	3.2	2.6	-0.5	4.7
5.7	-2.7	1.5	3.5	3.1	5.4
5.8	-0.9	1.5	2.1	2.6	5.2

Table 2-8. Antenna Peak Gain

Per FCC 15.407(a)(ii), no reduction needed for both the maximum conducted output power and the maximum power spectral density when direction gain is less than 6 dBi.

2.4 Test Configuration

The EUT was tested per the guidance of KDB 789033 D02 v02r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing.

2.5 Software and Firmware

The test was conducted with firmware version H204VVRE0ATG6 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 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.

3.3 Environmental Conditions

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

4.0 ANTENNA REQUIREMENTS

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

- The antennas of the EUT are **permanently attached.**
- There are no provisions for 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
-	WL40-1	Conducted Cable Set (40GHz)	3/13/2020	Annual	3/13/2021	WL40-1
Anritsu	MA2411B	Pulse Power Sensor	12/4/2019	Annual	12/4/2020	846215
Anritsu	ML2495A	Power Meter	1/15/2020	Annual	1/15/2021	1328004
Anritsu	ML2496A	Power Meter	11/6/2019	Annual	11/6/2020	1405003
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	10/10/2019	Biennial	10/10/2021	121034
ETS Lindgren	3117	1-18 GHz DRG Horn (Medium)	2/14/2019	Biennial	2/14/2021	125518
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	1/9/2020	Annual	1/9/2021	NMLC-2
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/23/2019	Annual	9/23/2020	100348
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/10/2020	Annual	2/10/2021	102134
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	2/21/2020	Annual	2/21/2021	102133
Rohde & Schwarz	TS-PR26	18-26.5 GHz Pre-Amplifier	11/1/2019	Annual	11/1/2020	100040
Rohde & Schwarz	TS-PR40	26.5-40 GHz Pre-Amplifier	11/1/2019	Annual	11/1/2020	100037
Sunol	DRH-118	Horn Antenna (1-18GHz)	10/3/2019	Biennial	10/3/2021	A050307

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: A3LSMH204V
FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
N/A	RSS-Gen [6.7]	26dB Bandwidth	N/A	CONDUCTED	PASS	Section 7.2
15.407(e)	RSS-Gen [6.7]	6dB Bandwidth	>500kHz(5725-5850MHz)		PASS	Section 7.3
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Conducted Output Power	Maximum conducted powers must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.4
15.407 (a.1.iv), (a.2), (a.3)	RSS-247 [6.2]	Maximum Power Spectral Density	Maximum power spectral density must meet the limits detailed in 15.407 (a) (RSS-247 [6.2])		PASS	Section 7.5
15.407(h)	RSS-247 [6.3]	Dynamic Frequency Selection	See DFS Test Report		PASS	See DFS Test Report
15.407(b.1), (2), (3), (4)	RSS-247 [6.2]	Undesirable Emissions	Undesirable emissions must meet the limits detailed in 15.407(b) (RSS-247 [6.2])	RADIATED	PASS	Section 7.6
15.205, 15.407(b.1), (4), (5), (6)	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])		PASS	Section 7.6, 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 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.
6) 802.11ax OFDMA testing was performed for all signal tone configurations as specified by the 802.11ax standard. Worst case results are determined and reported per the guidance provided at the October 2018 TCB Workshop.
7) This device only supports full tone configuration

7.2 26dB Bandwidth Measurement – 802.11ax OFDMA

RSS-Gen [6.2]

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

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

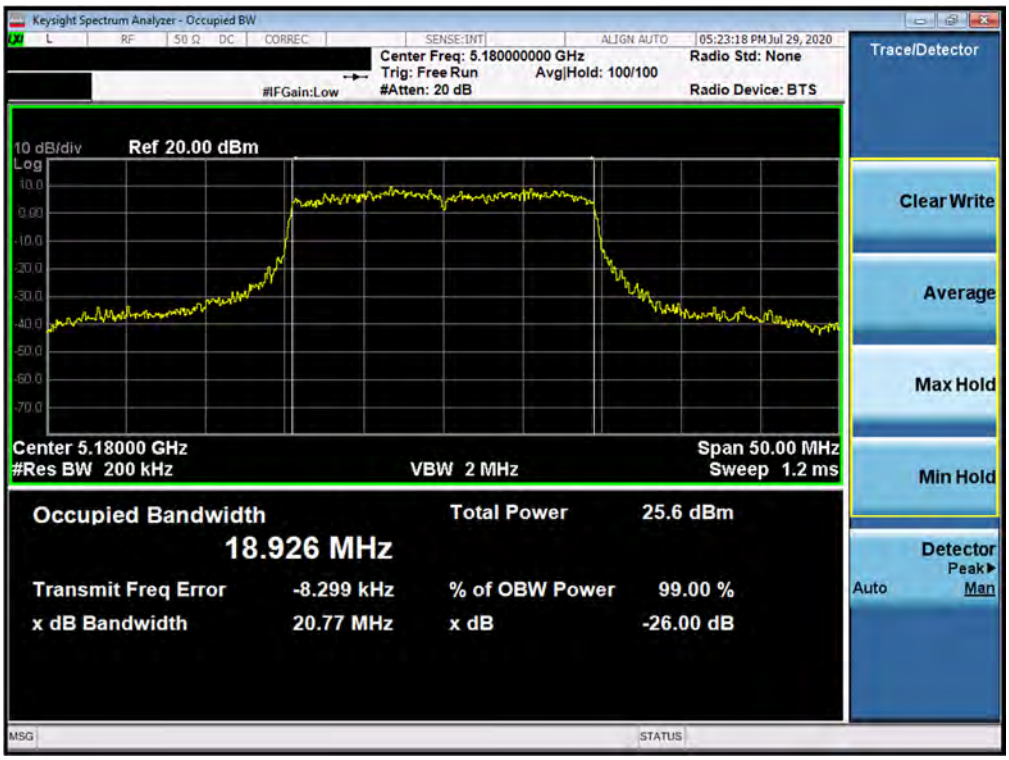
Test Notes

The 26dB Bandwidth measurement for each channel was measured with the RU index showing the highest conducted power.

SISO Antenna-3 26 dB Bandwidth Measurements (Full Tones)

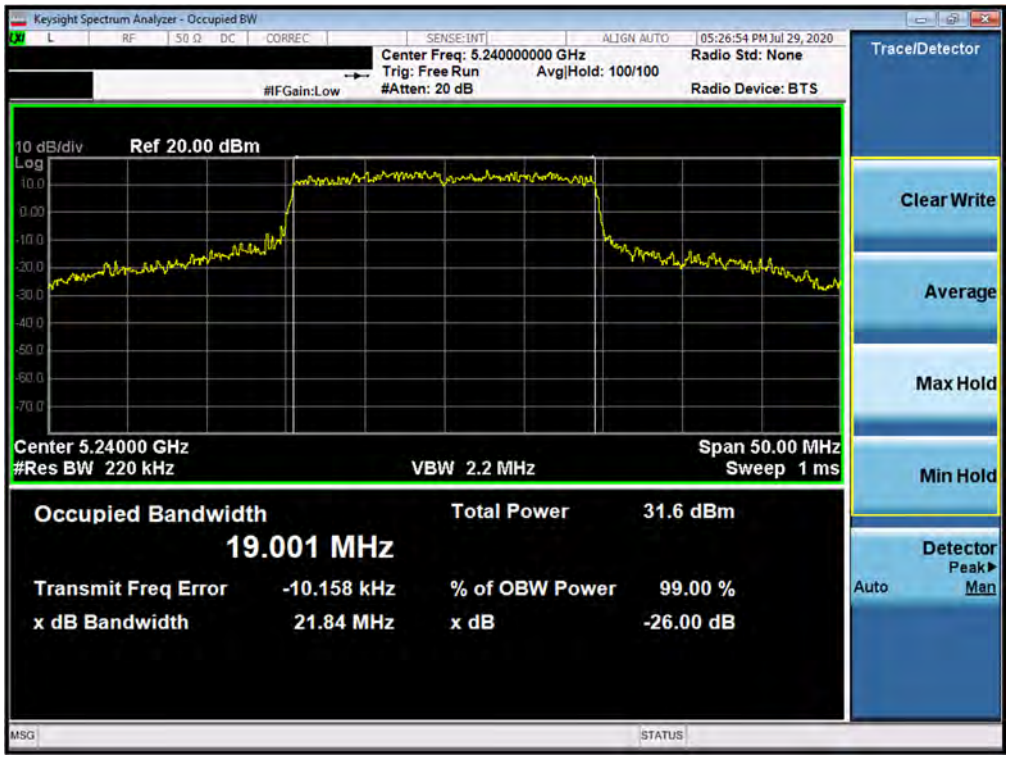
	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242T	MCS0	20.77
	5200	40	ax (20MHz)	242T	MCS0	21.23
	5240	48	ax (20MHz)	242T	MCS0	21.84
	5190	38	ax (40MHz)	484T	MCS0	40.09
	5230	46	ax (40MHz)	484T	MCS0	40.55
	5210	42	ax (80MHz)	996T	MCS0	82.35
Band 2A	5260	52	ax (20MHz)	242T	MCS0	20.73
	5280	56	ax (20MHz)	242T	MCS0	20.64
	5320	64	ax (20MHz)	242T	MCS0	21.07
	5270	54	ax (40MHz)	484T	MCS0	40.90
	5310	62	ax (40MHz)	484T	MCS0	40.12
	5290	58	ax (80MHz)	996T	MCS0	81.63
Band 2C	5500	100	ax (20MHz)	242T	MCS0	20.26
	5600	120	ax (20MHz)	242T	MCS0	20.31
	5720	144	ax (20MHz)	242T	MCS0	20.48
	5510	102	ax (40MHz)	484T	MCS0	40.33
	5590	118	ax (40MHz)	484T	MCS0	40.27
	5710	142	ax (40MHz)	484T	MCS0	40.02
	5530	106	ax (80MHz)	996T	MCS0	81.10
	5610	122	ax (80MHz)	996T	MCS0	80.98
	5690	138	ax (80MHz)	996T	MCS0	81.38

Table 7-2. Conducted Bandwidth Measurements (Full Tones)

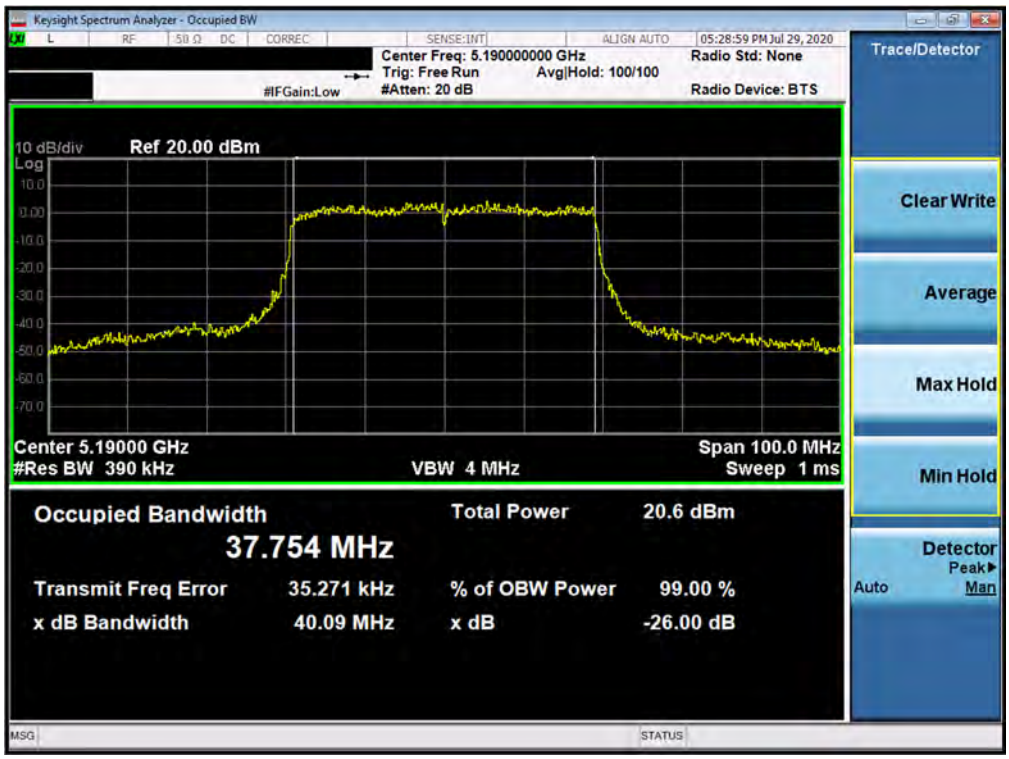


Plot 7-1. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 36)

Plot 7-2. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 40)

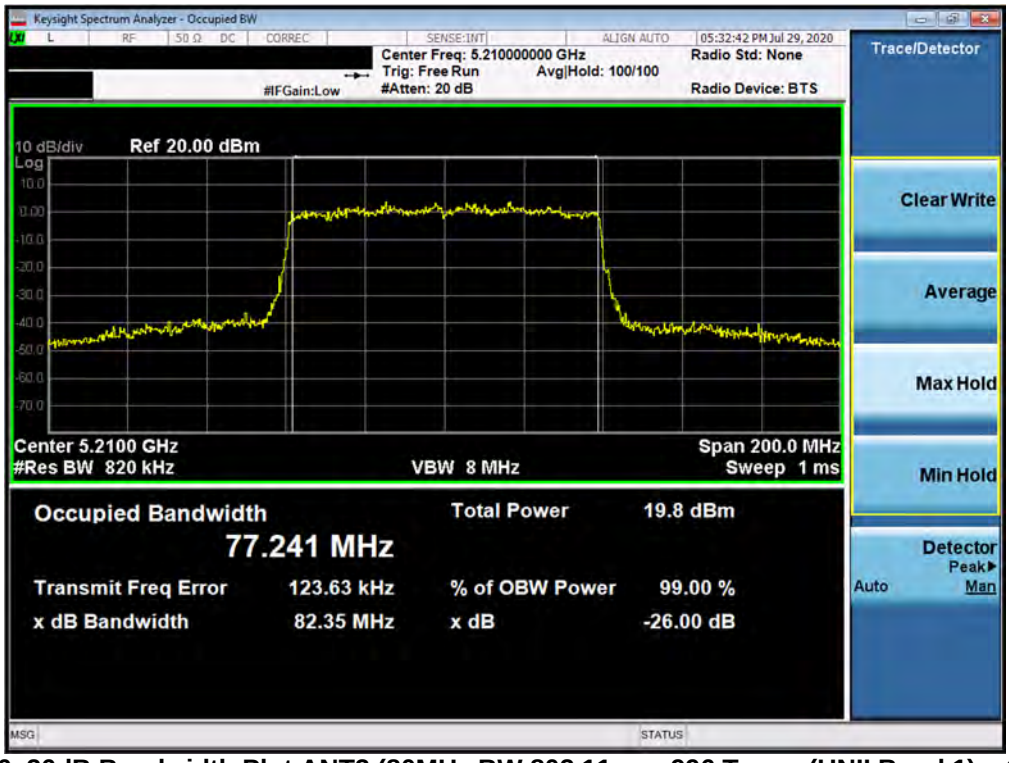


Plot 7-3. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 48)

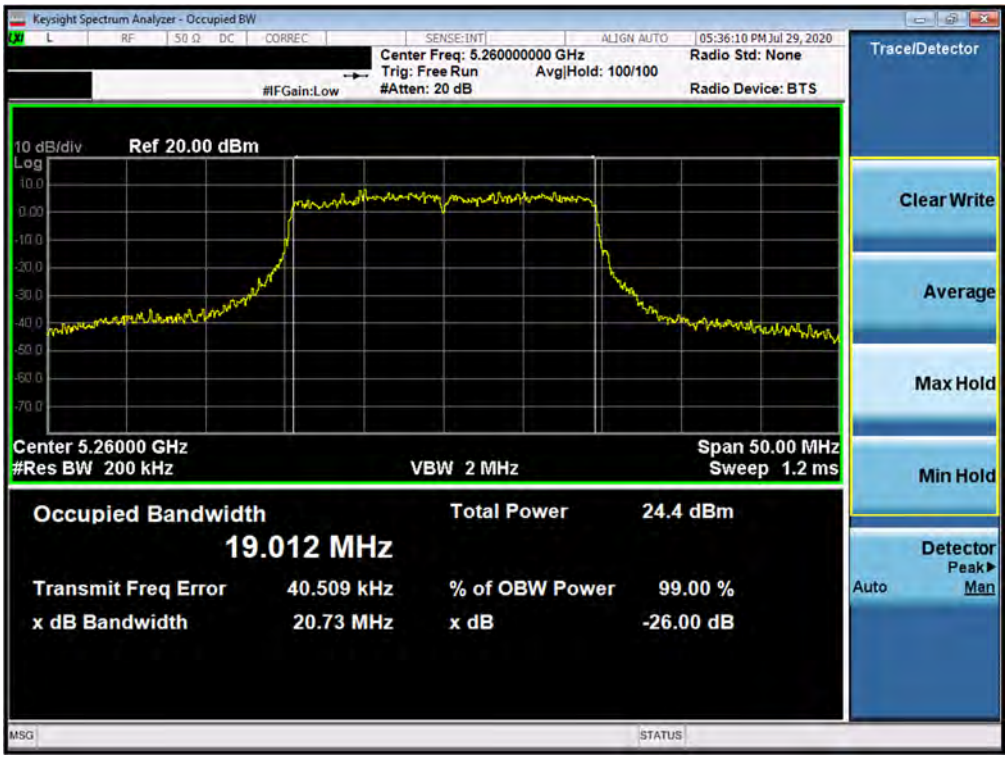


Plot 7-4. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 38)

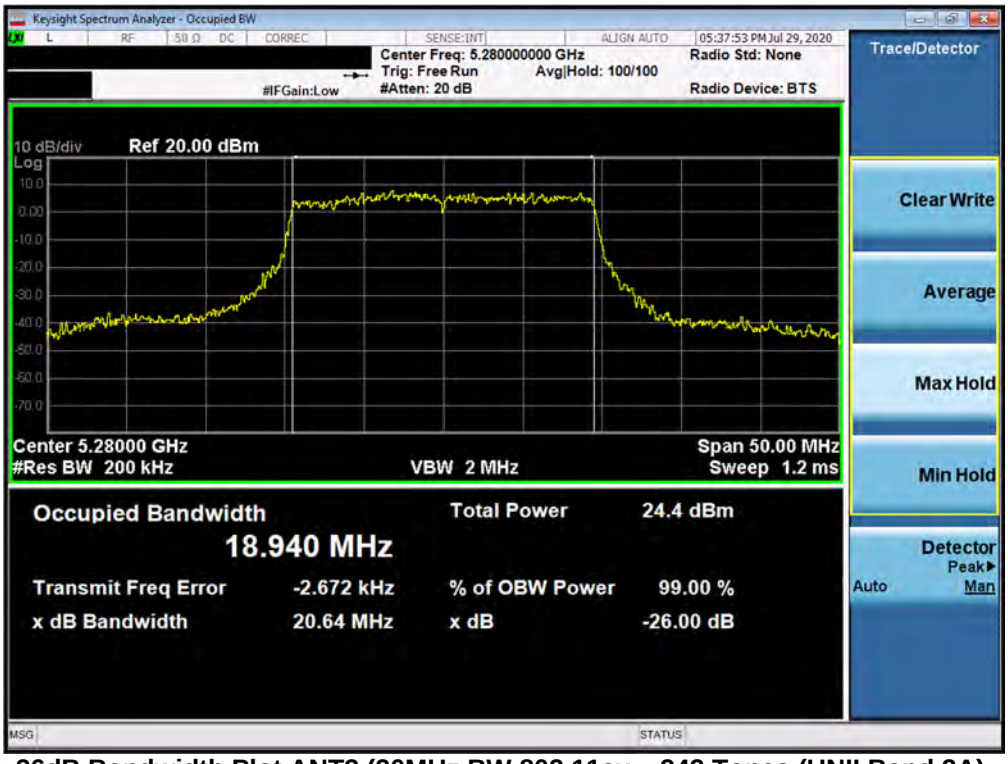
Plot 7-5. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 46)



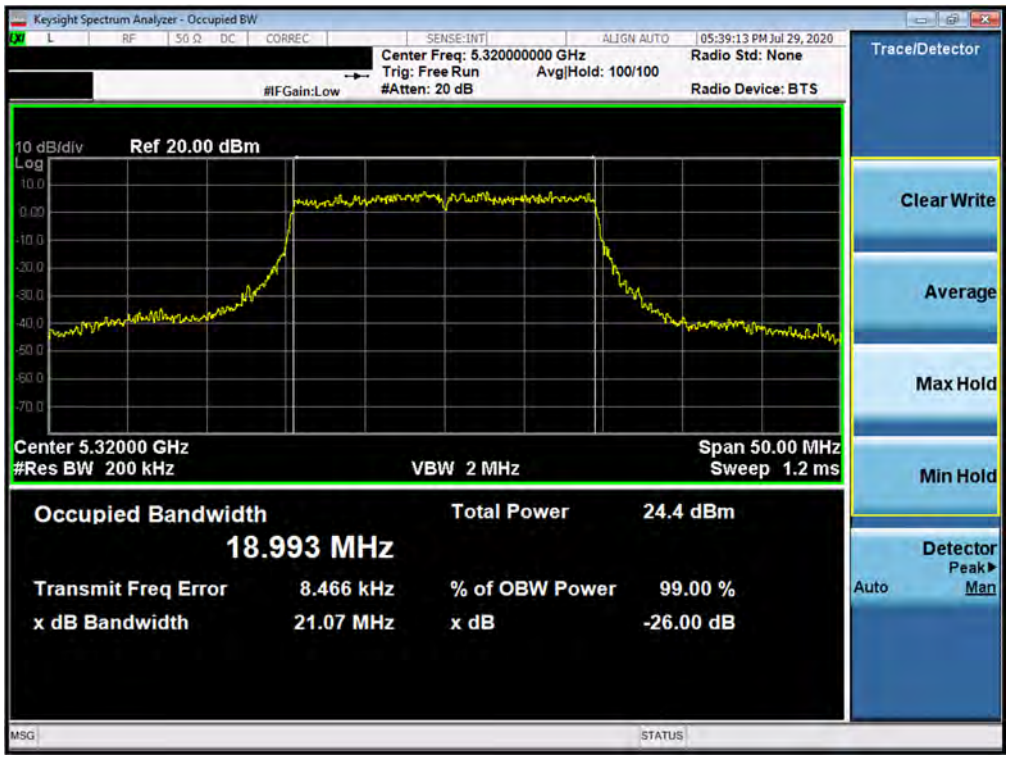
Plot 7-6. 26dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 1) – Ch. 42)



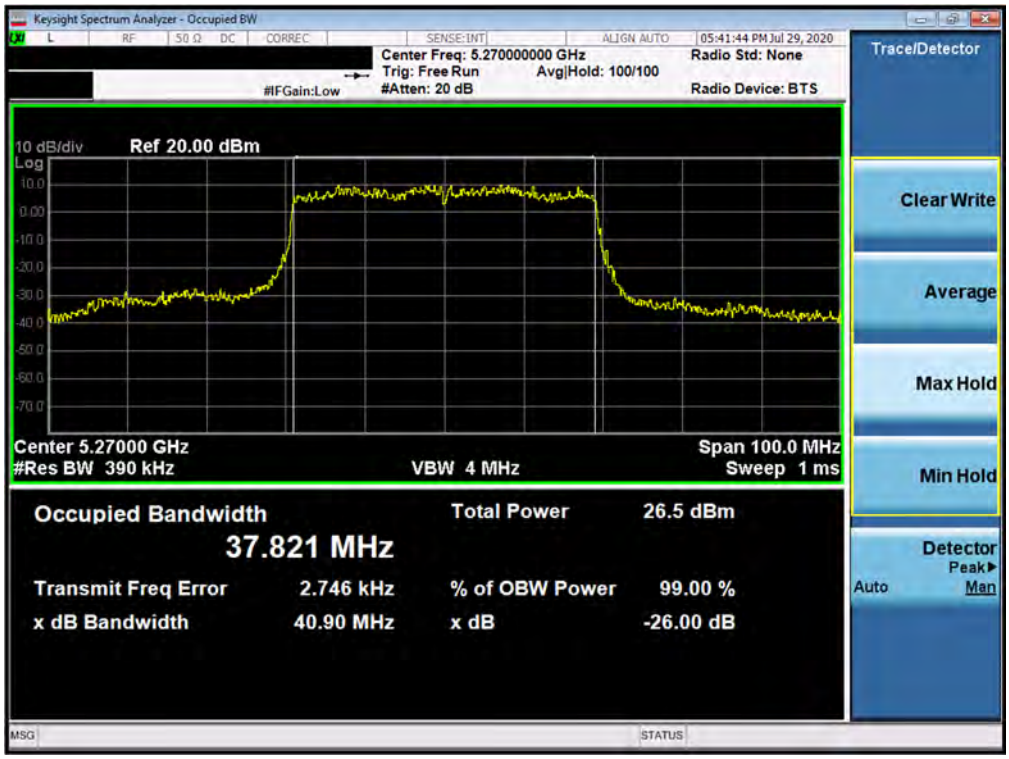
Plot 7-7. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 52)



Plot 7-8. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 56)

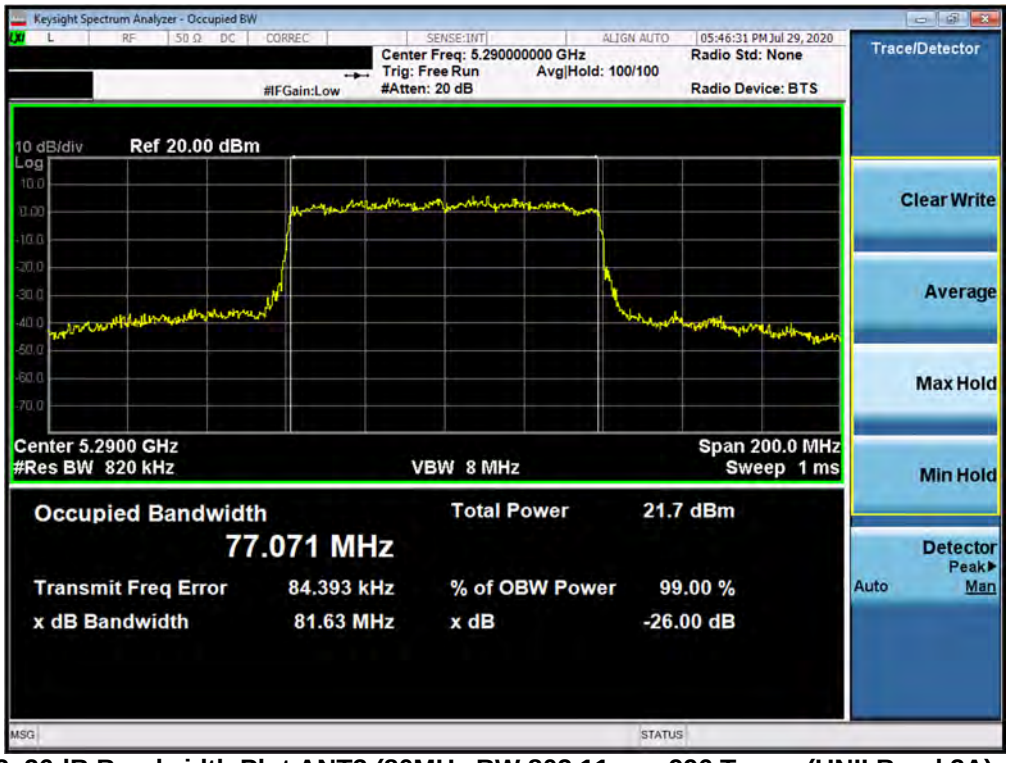


Plot 7-9. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 64)

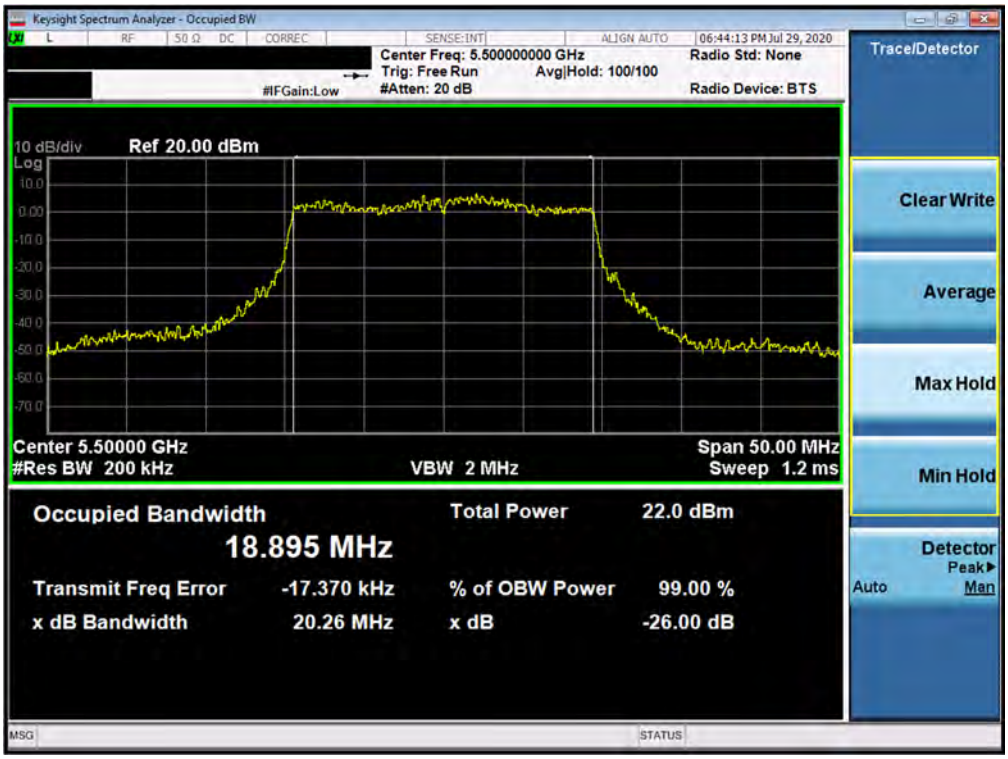


Plot 7-10. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 54)

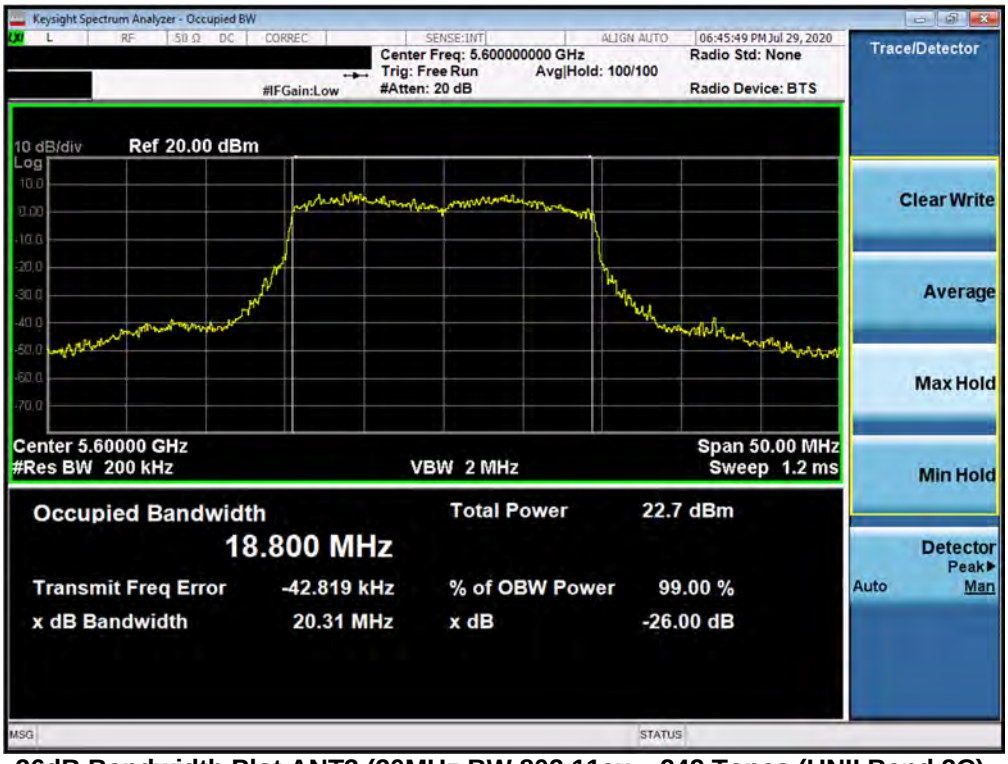
Plot 7-11. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 62)



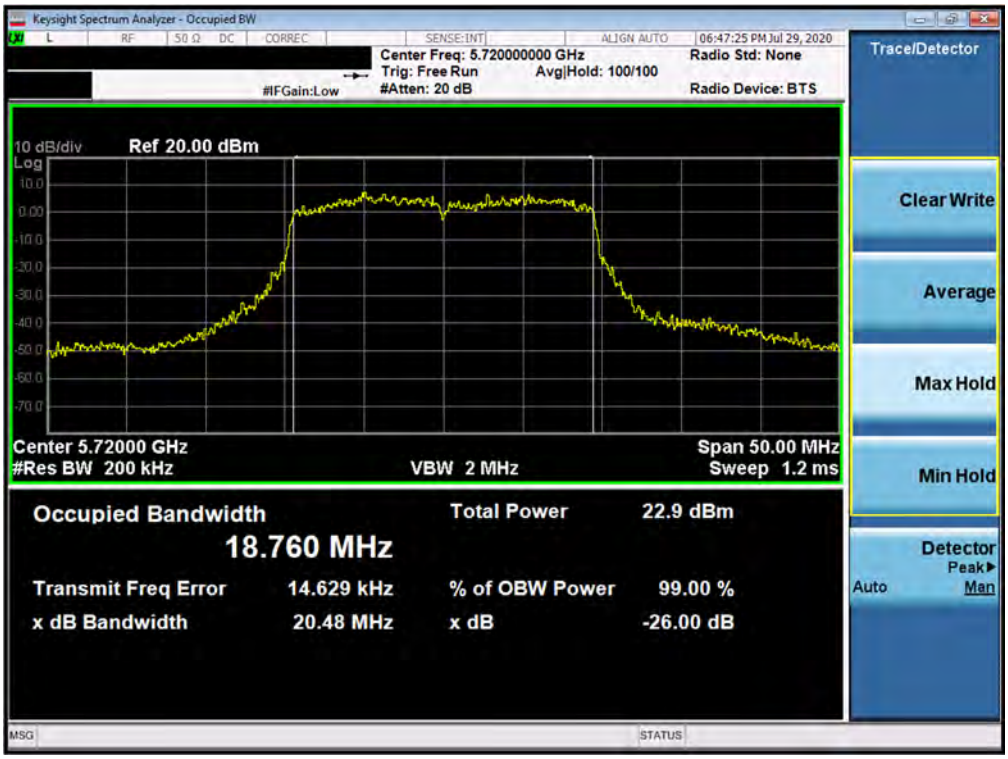
Plot 7-12. 26dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 2A) – Ch. 58)



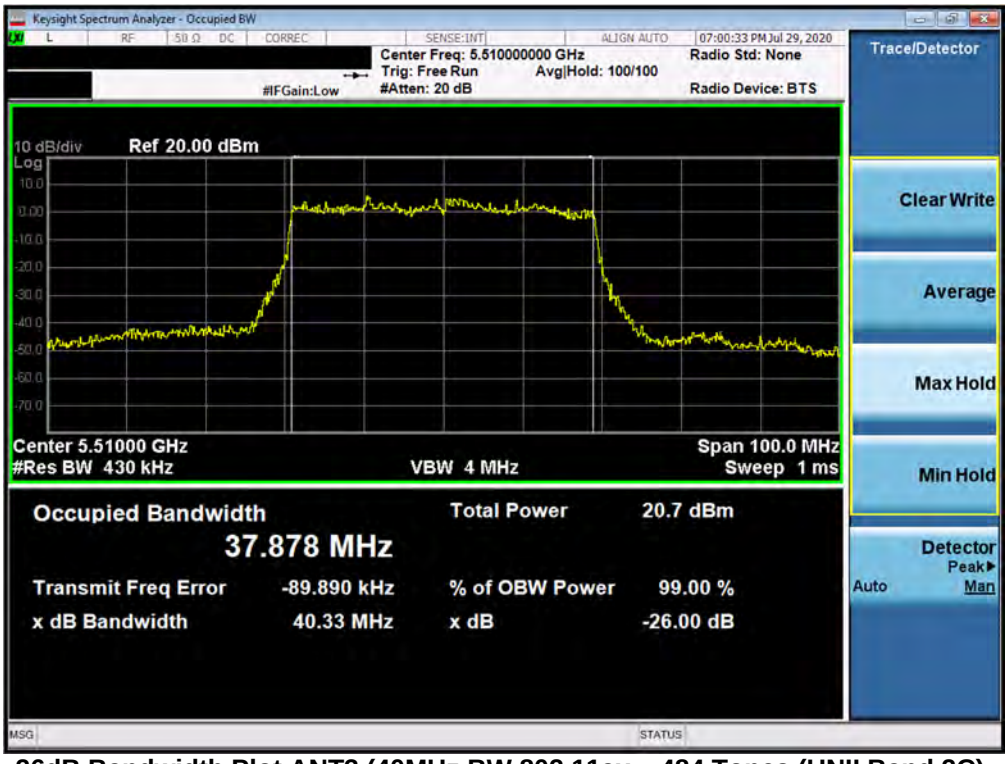
Plot 7-13. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 100)



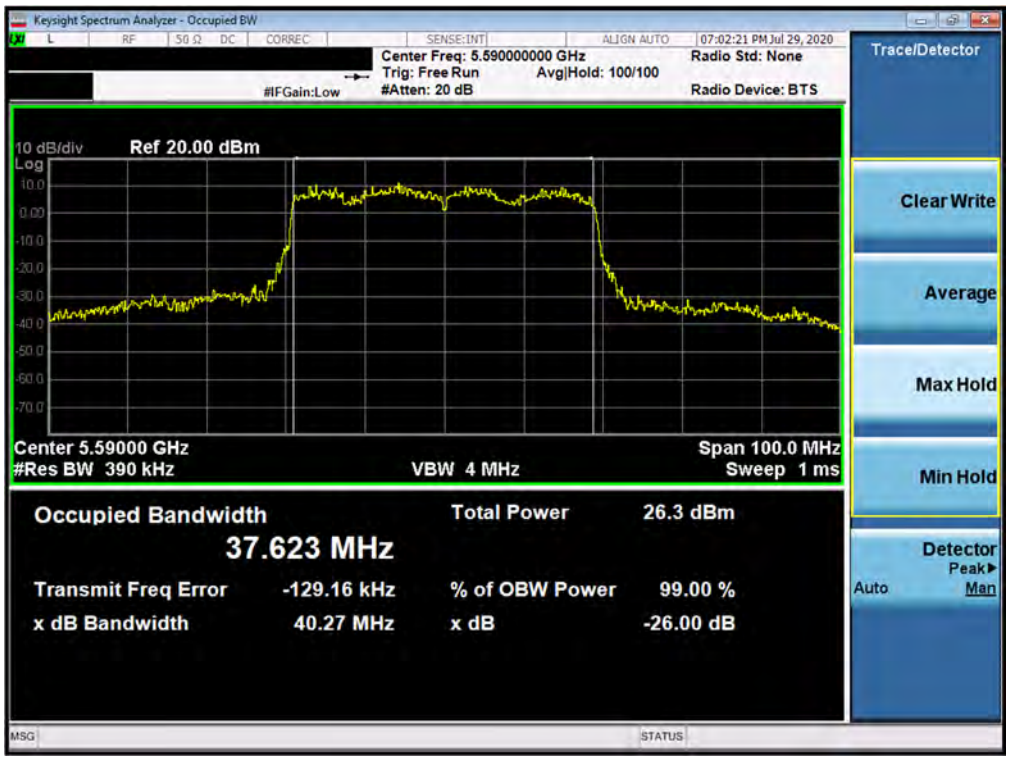
Plot 7-14. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 120)



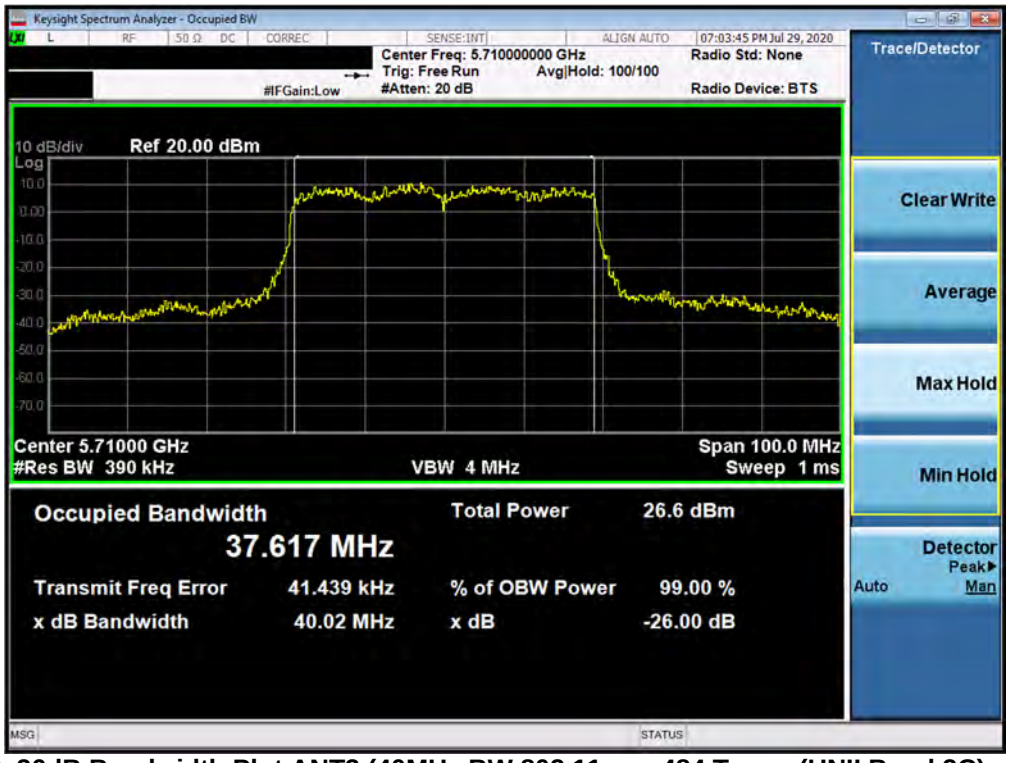
Plot 7-15. 26dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 144)



Plot 7-16. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 102)

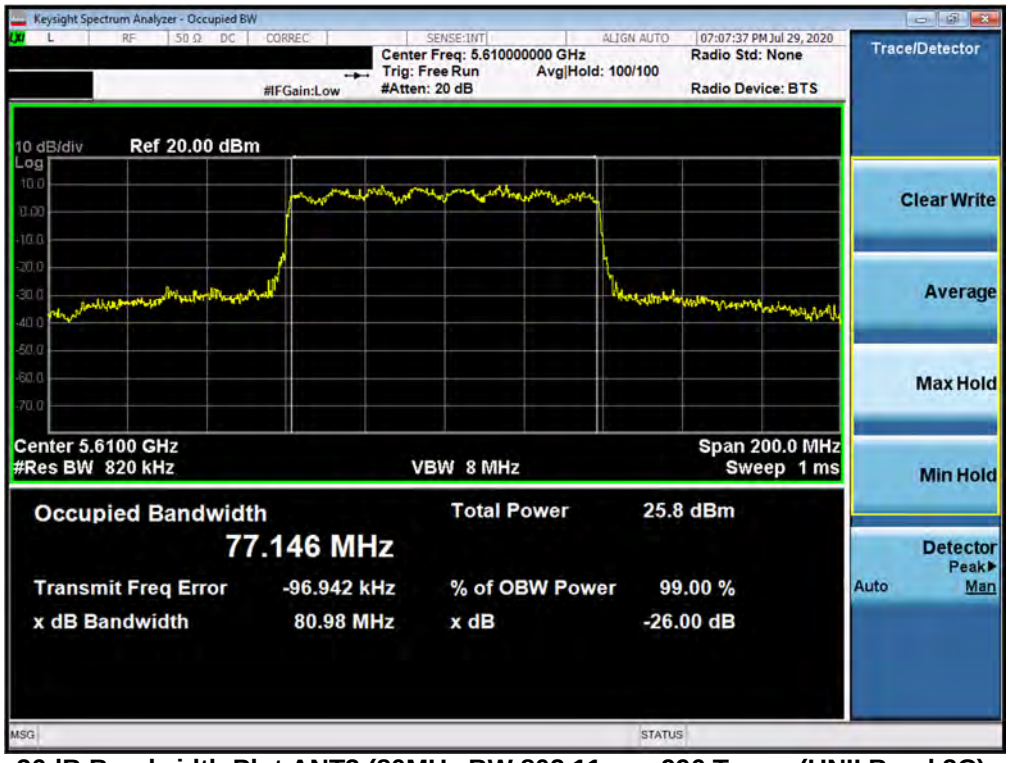


Plot 7-17. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 118)

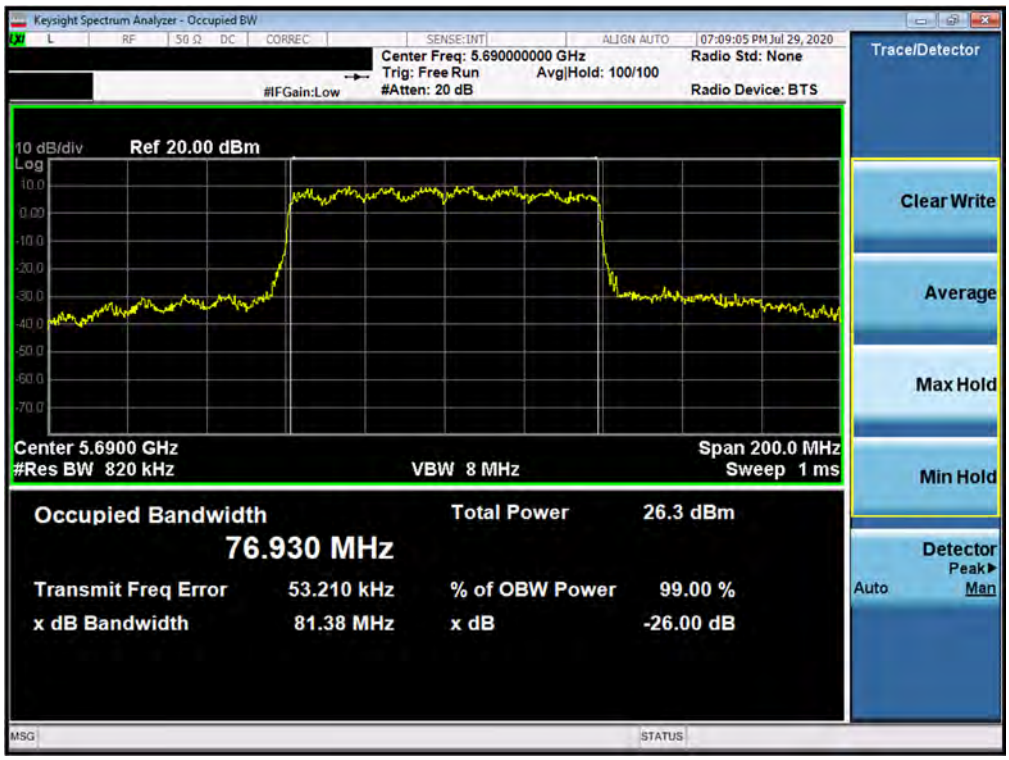


Plot 7-18. 26dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 142)

Plot 7-19. 26dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 106)



Plot 7-20. 26dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 122)

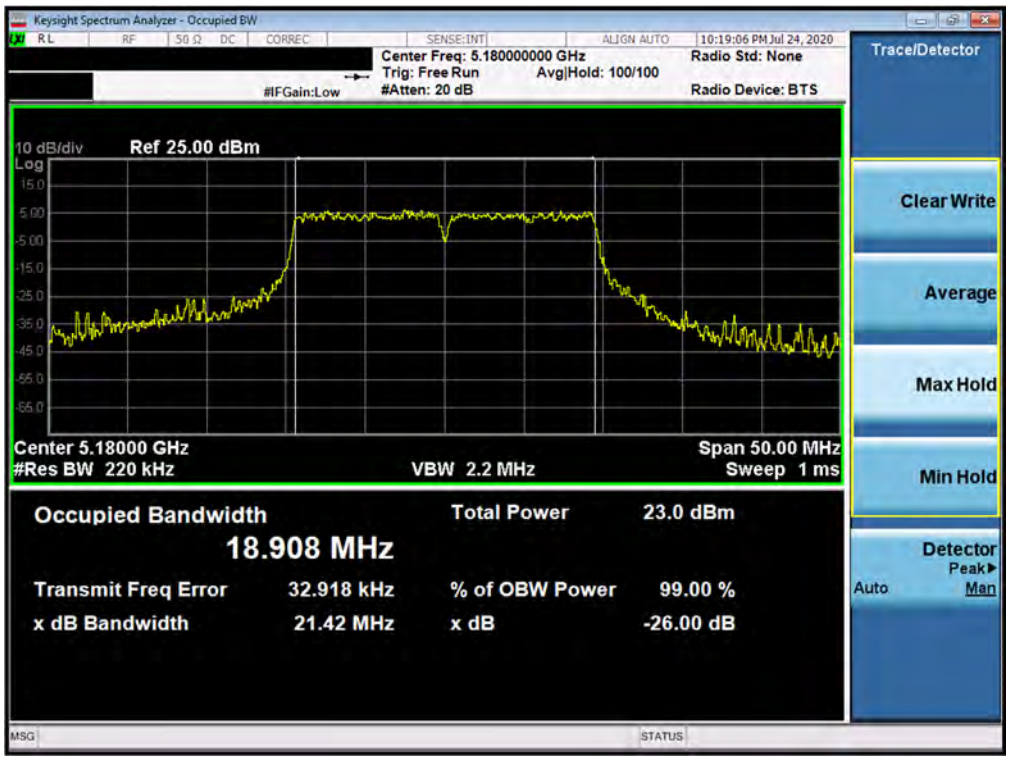


Plot 7-21. 26dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 138)

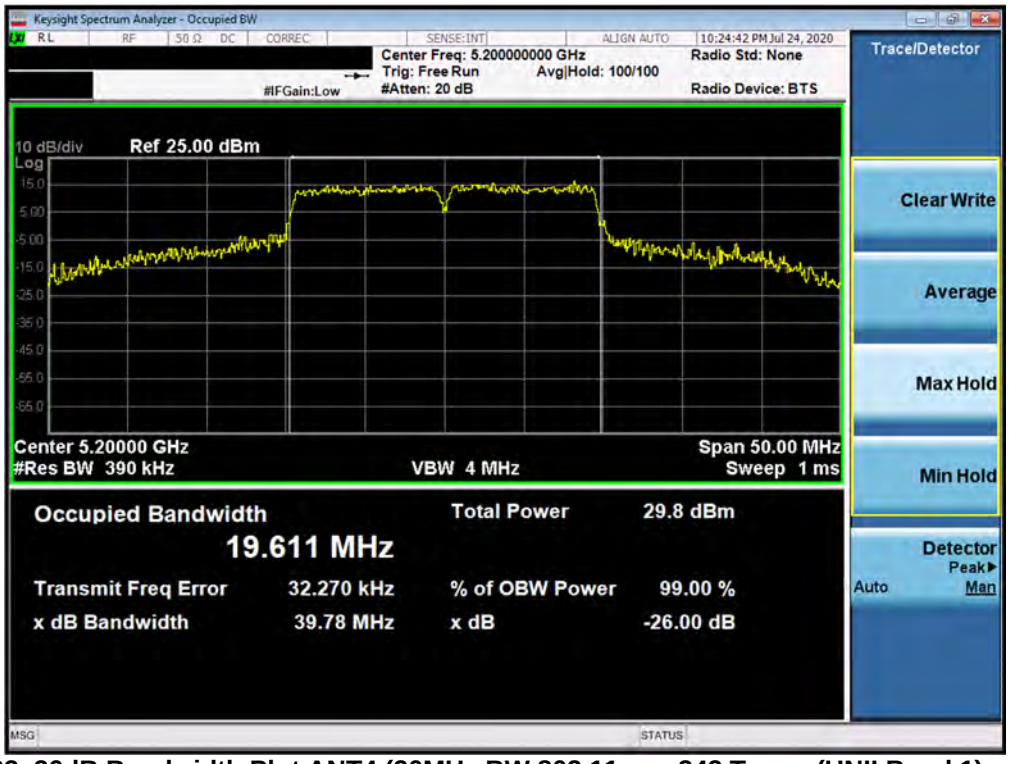
Antenna-4 26dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242T	MCS0	21.42
	5200	40	ax (20MHz)	242T	MCS0	39.78
	5240	48	ax (20MHz)	242T	MCS0	38.41
	5190	38	ax (40MHz)	484T	MCS0	43.27
	5230	46	ax (40MHz)	484T	MCS0	85.64
	5210	42	ax (80MHz)	996T	MCS0	81.54
Band 2A	5260	52	ax (20MHz)	242T	MCS0	21.96
	5280	56	ax (20MHz)	242T	MCS0	21.63
	5320	64	ax (20MHz)	242T	MCS0	21.28
	5270	54	ax (40MHz)	484T	MCS0	43.48
	5310	62	ax (40MHz)	484T	MCS0	43.41
	5290	58	ax (80MHz)	996T	MCS0	81.14
Band 2C	5500	100	ax (20MHz)	242T	MCS0	21.41
	5600	120	ax (20MHz)	242T	MCS0	21.59
	5720	144	ax (20MHz)	242T	MCS0	21.27
	5510	102	ax (40MHz)	484T	MCS0	42.44
	5590	118	ax (40MHz)	484T	MCS0	42.13
	5710	142	ax (40MHz)	484T	MCS0	43.85
	5530	106	ax (80MHz)	996T	MCS0	81.49
	5610	122	ax (80MHz)	996T	MCS0	81.35
	5690	138	ax (80MHz)	996T	MCS0	81.26

Table 7-3. Conducted Bandwidth Measurements (Full Tones)

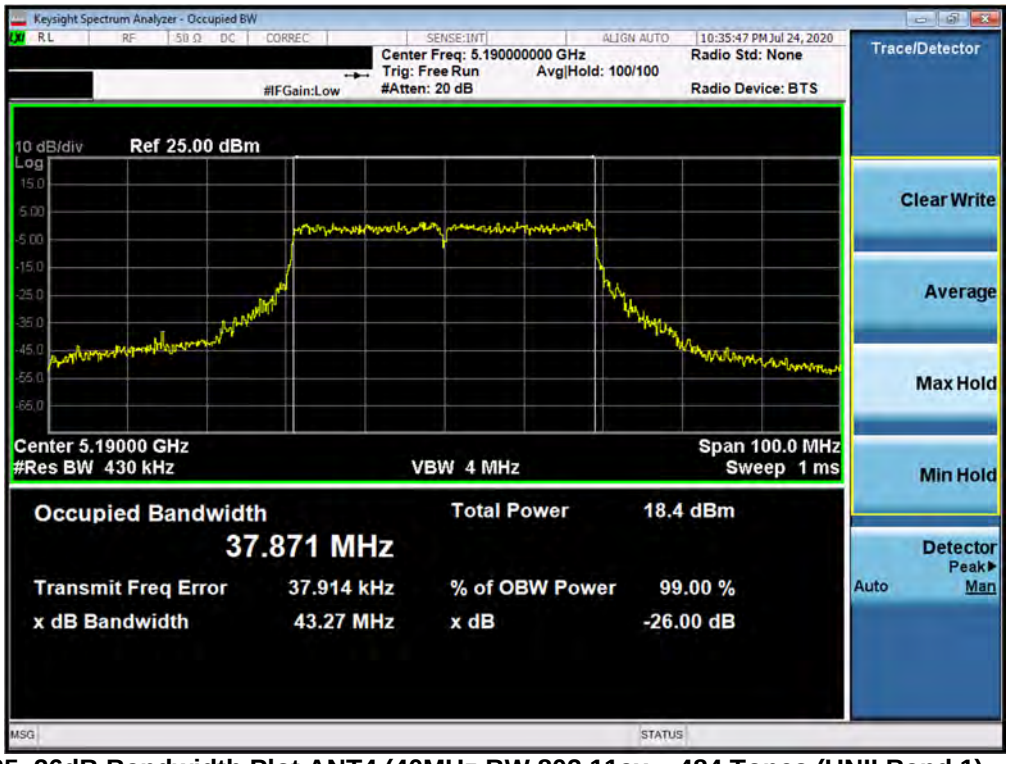


Plot 7-22. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 36)



Plot 7-23. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 40)

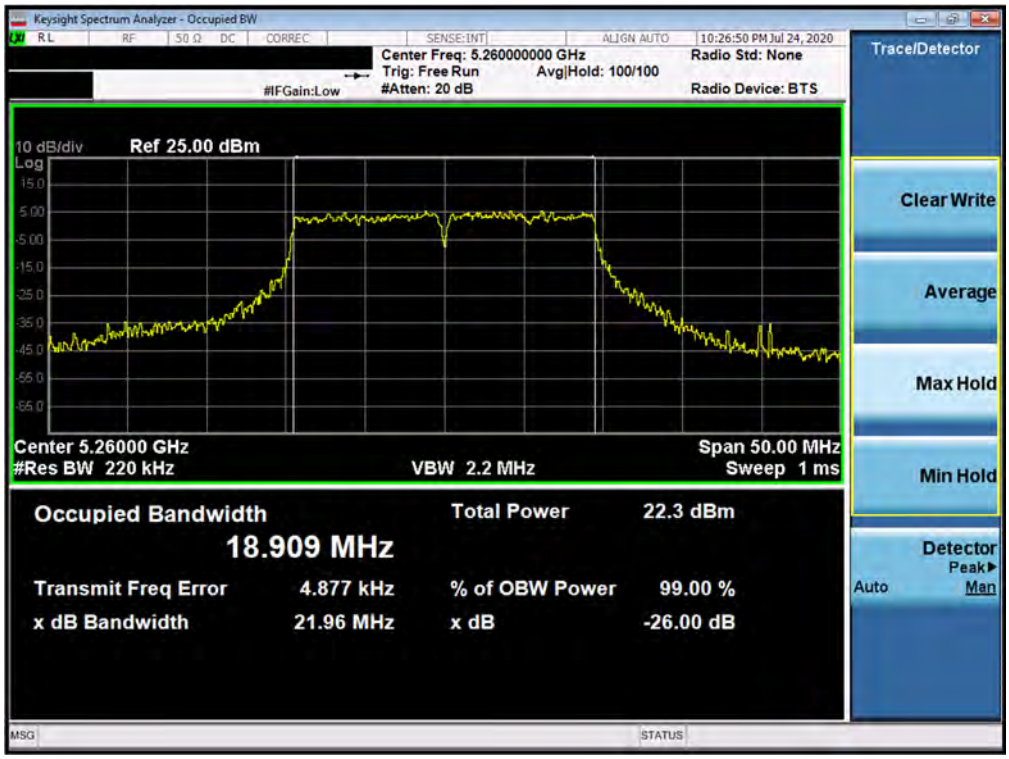
Plot 7-24. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 48)



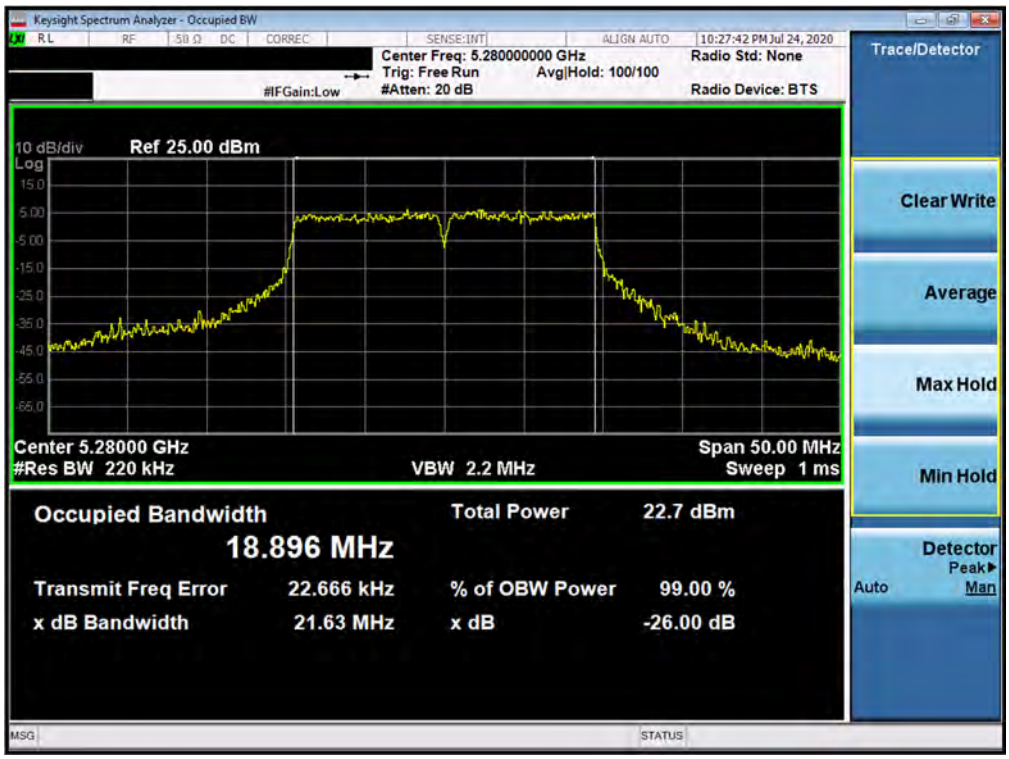
Plot 7-25. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 38)

Plot 7-26. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 46)

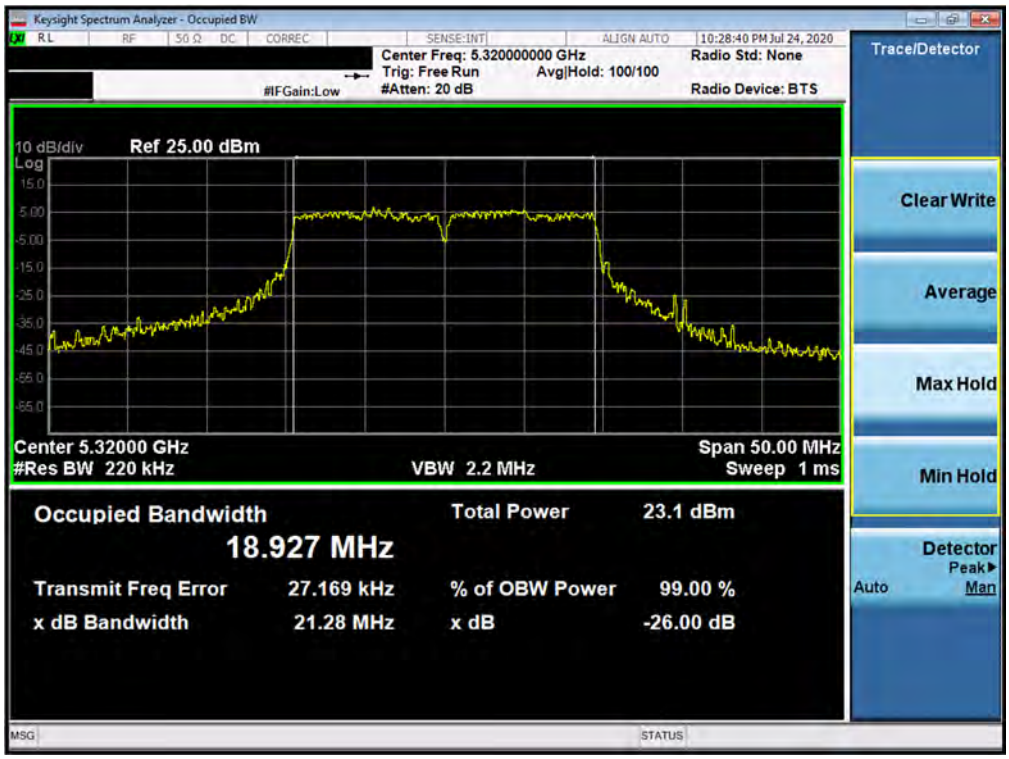
Plot 7-27. 26dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 1) – Ch. 42)



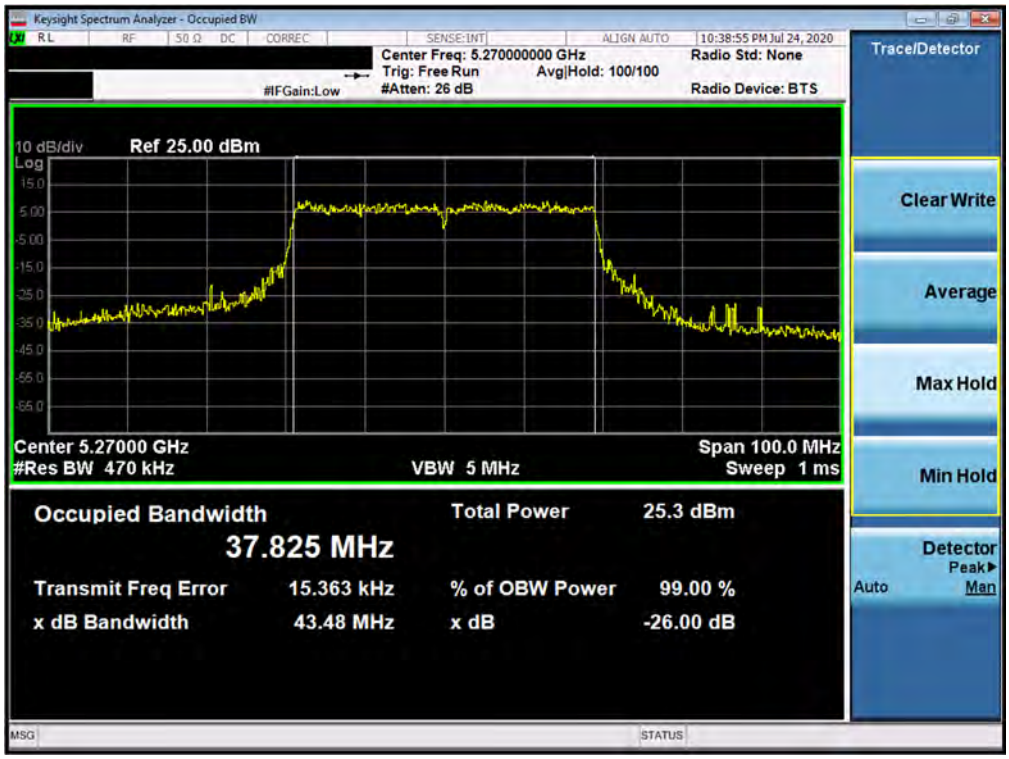
Plot 7-28. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 52)



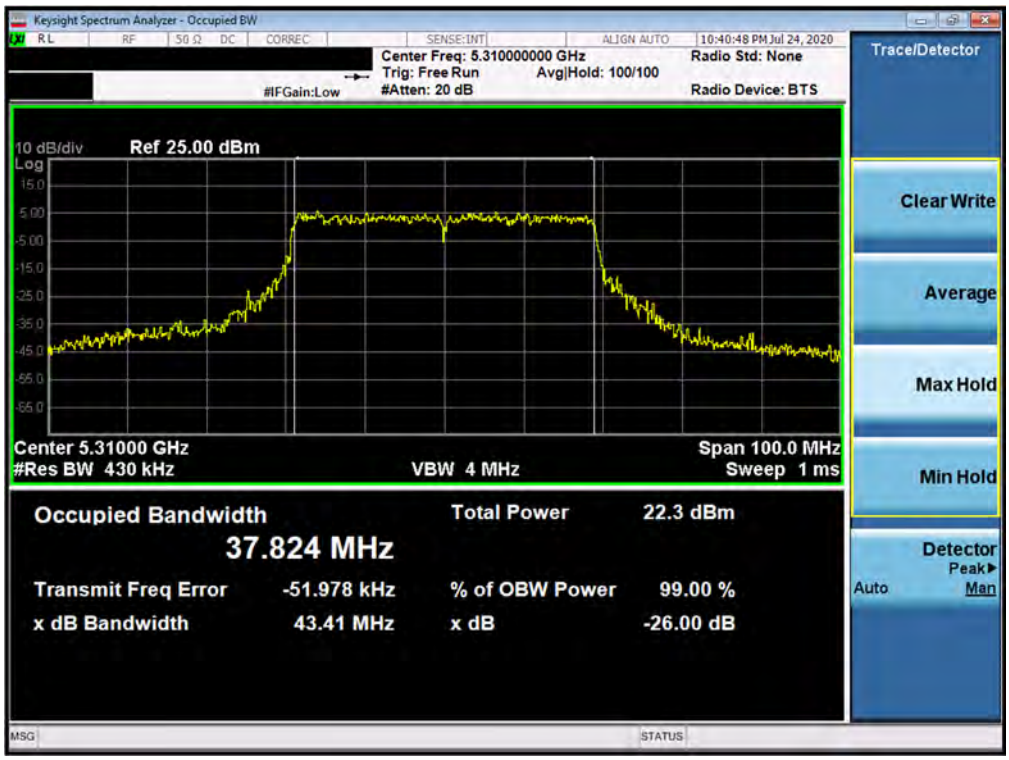
Plot 7-29. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 56)



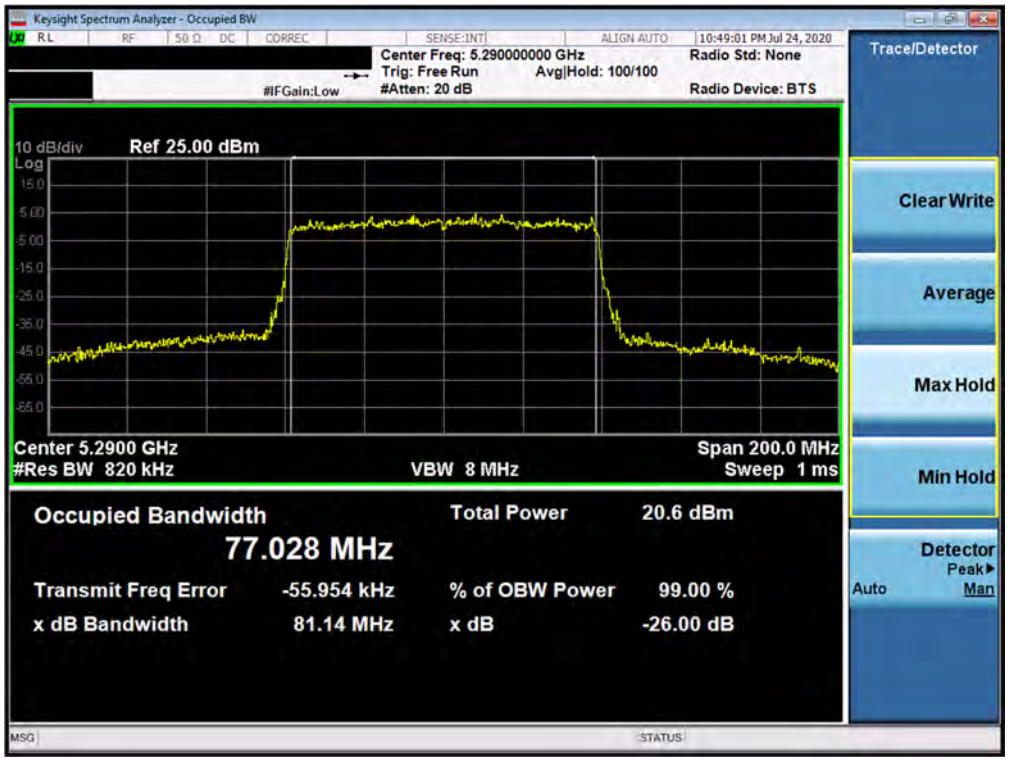
Plot 7-30. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 64)



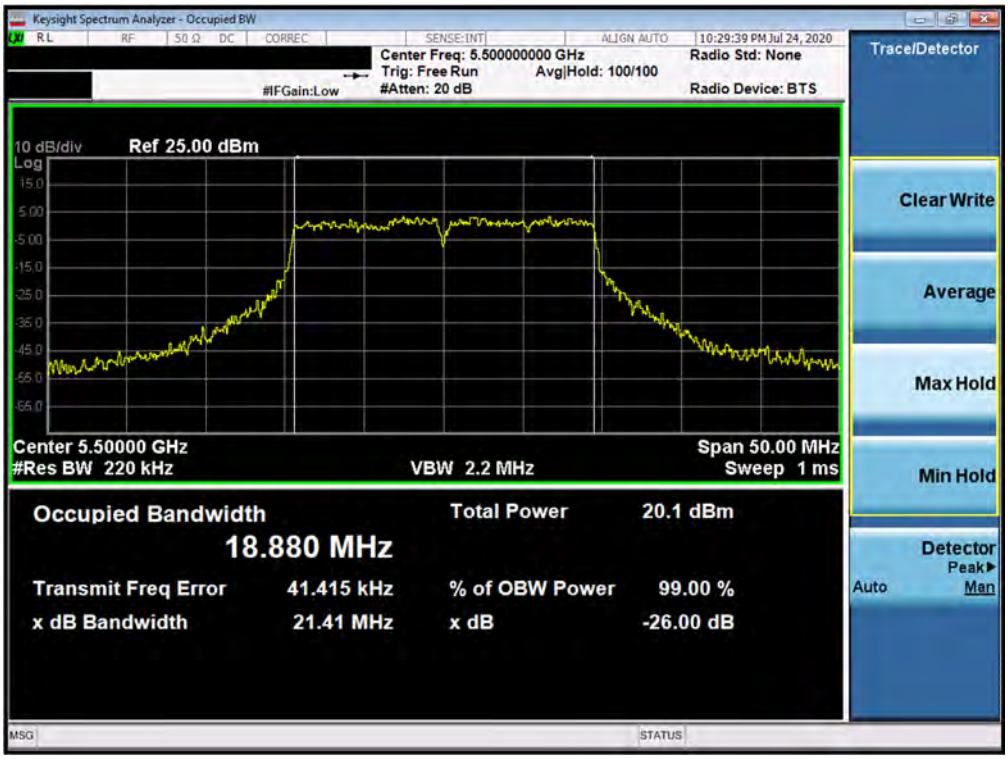
Plot 7-31. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 54)



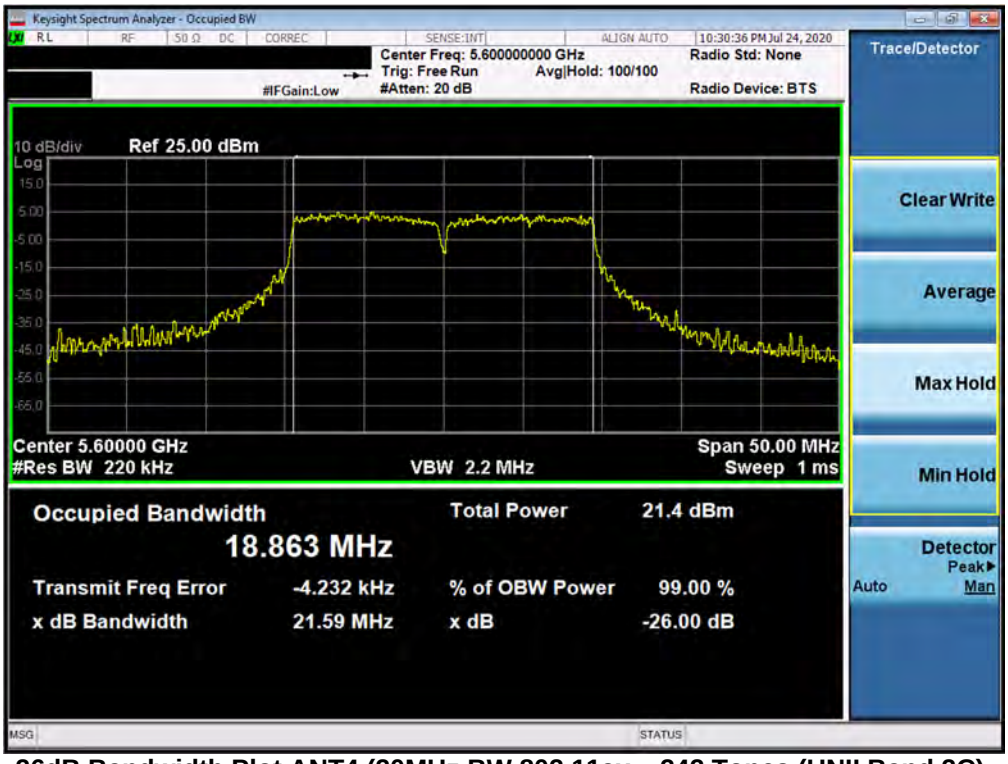
Plot 7-32. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 62)



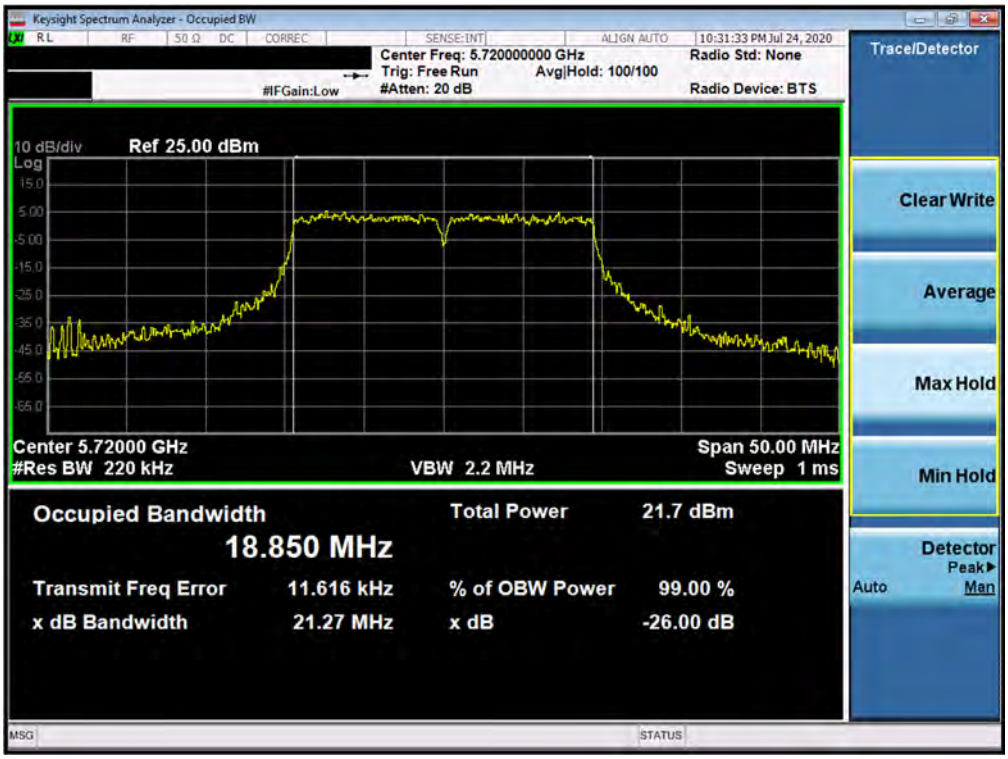
Plot 7-33. 26dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 2A) – Ch. 58)



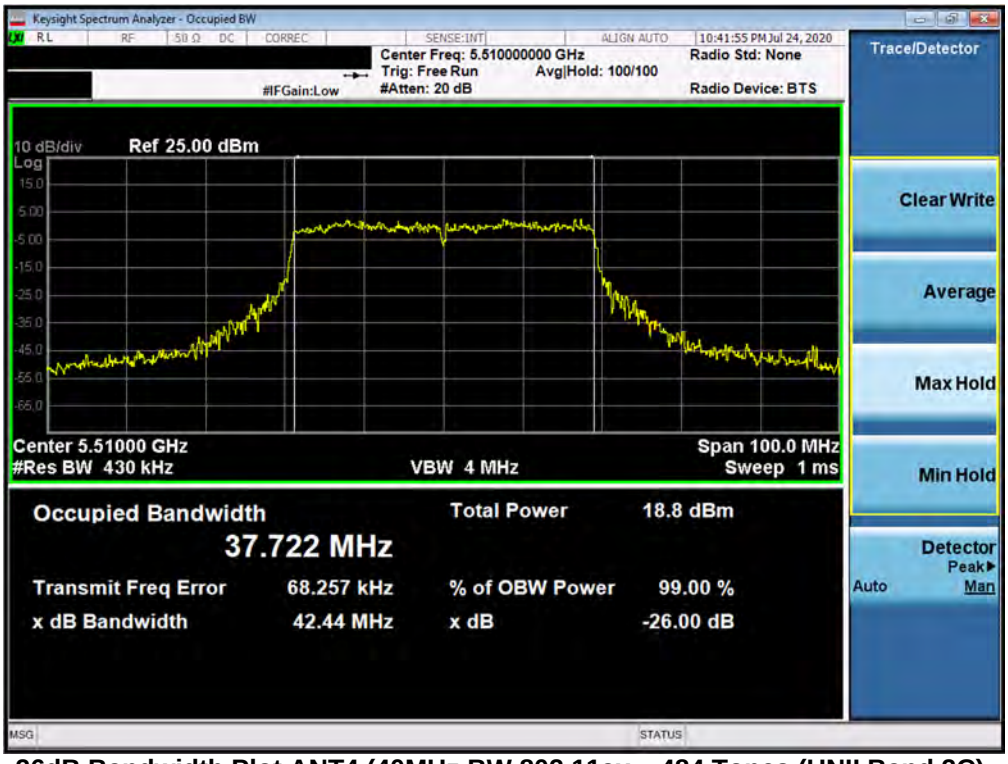
Plot 7-34. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 100)



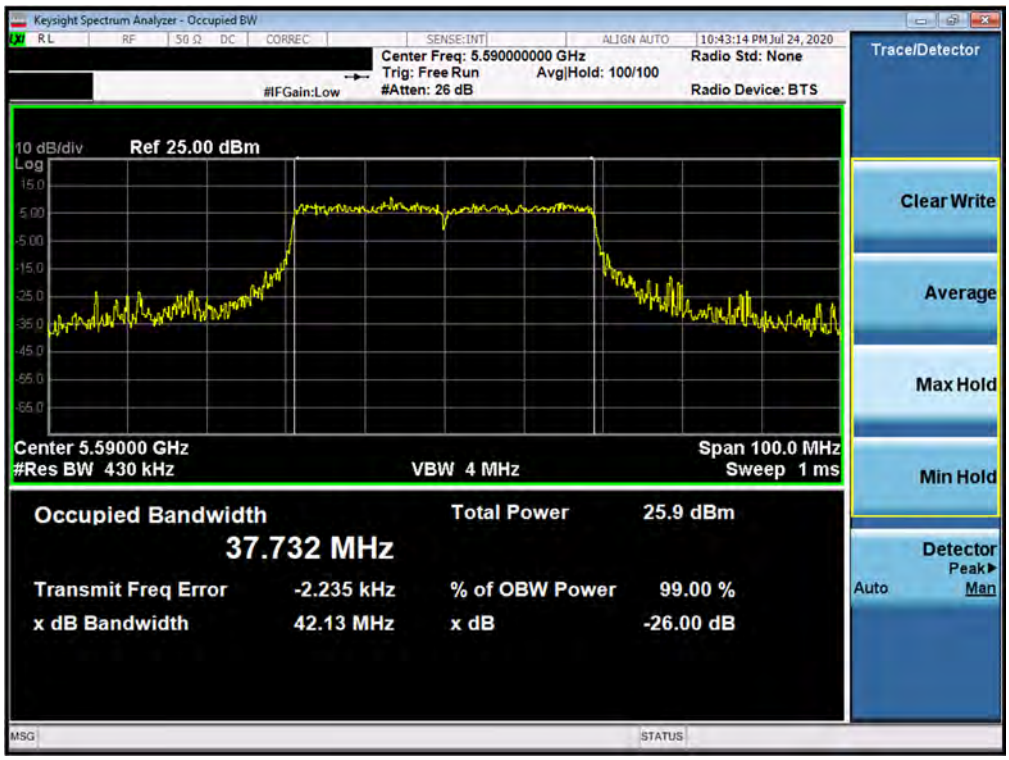
Plot 7-35. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 120)



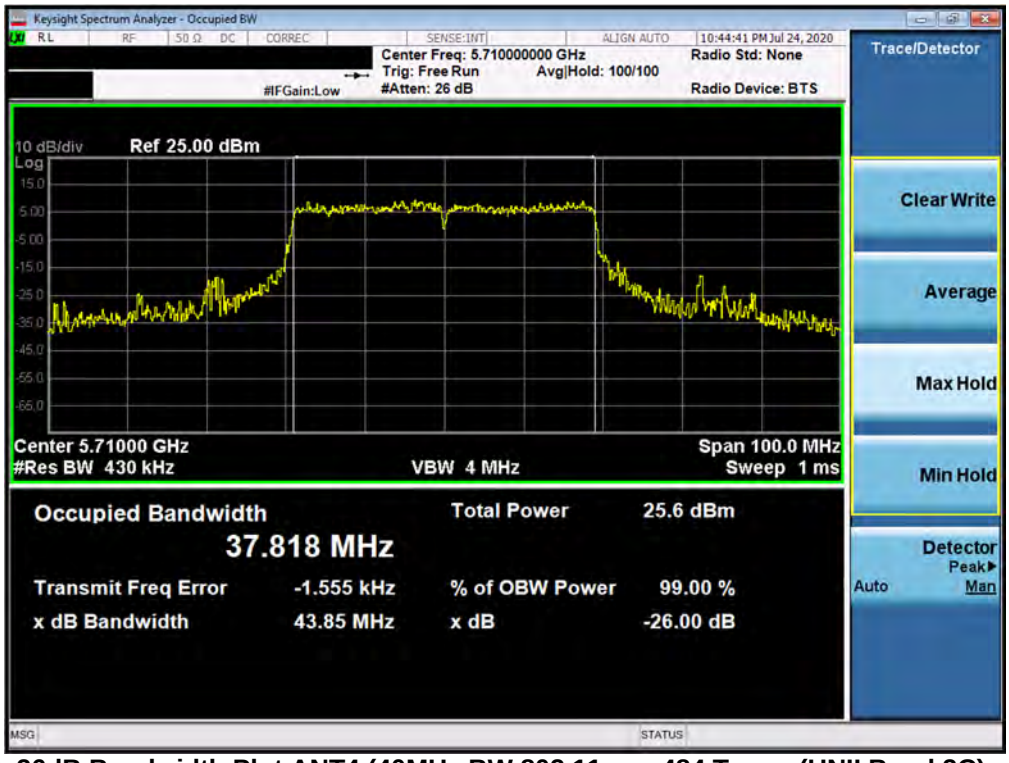
Plot 7-36. 26dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 144)



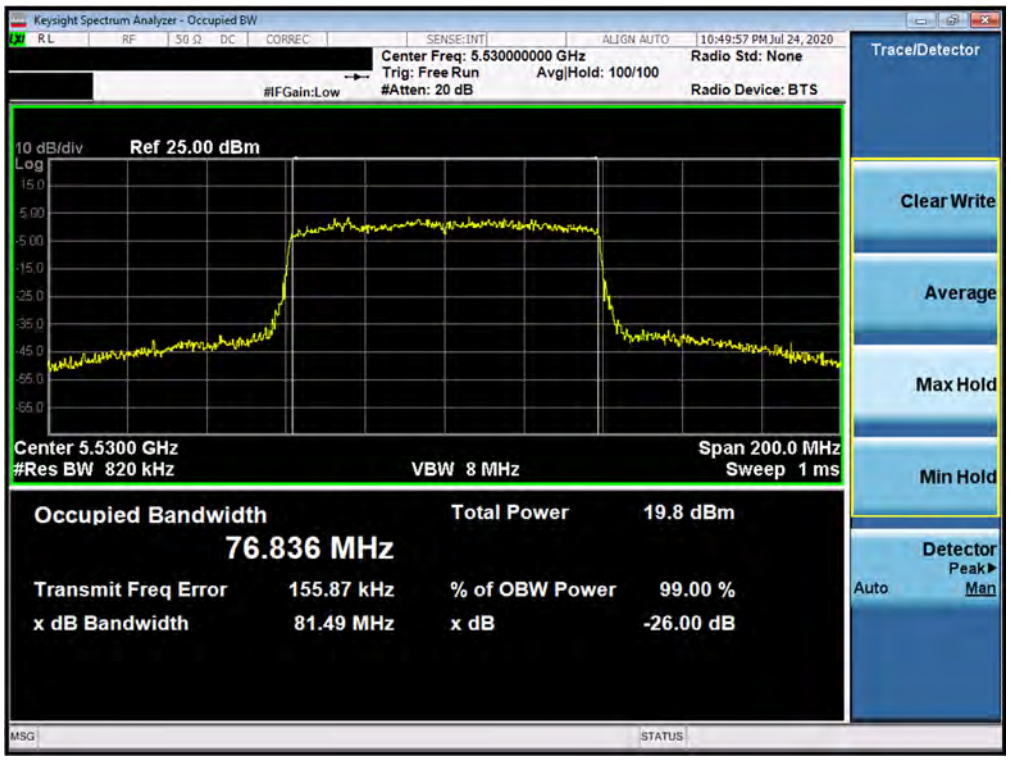
Plot 7-37. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 102)



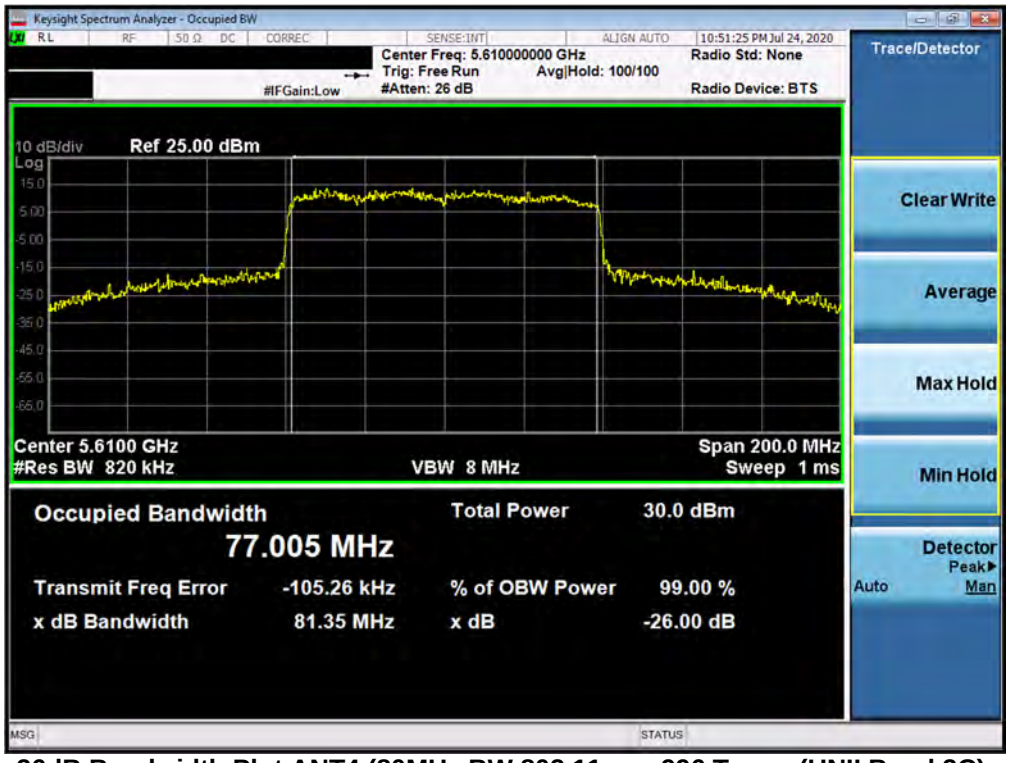
Plot 7-38. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 118)



Plot 7-39. 26dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 142)



Plot 7-40. 26dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 106)



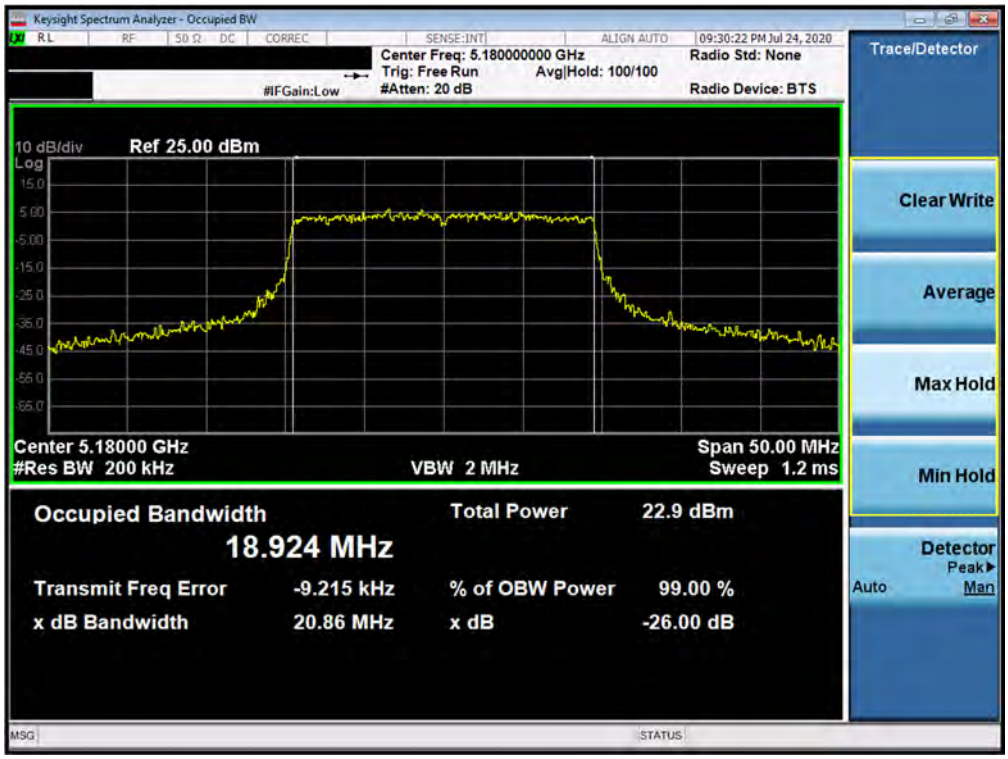
Plot 7-41. 26dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 122)

Plot 7-42. 26dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 138)

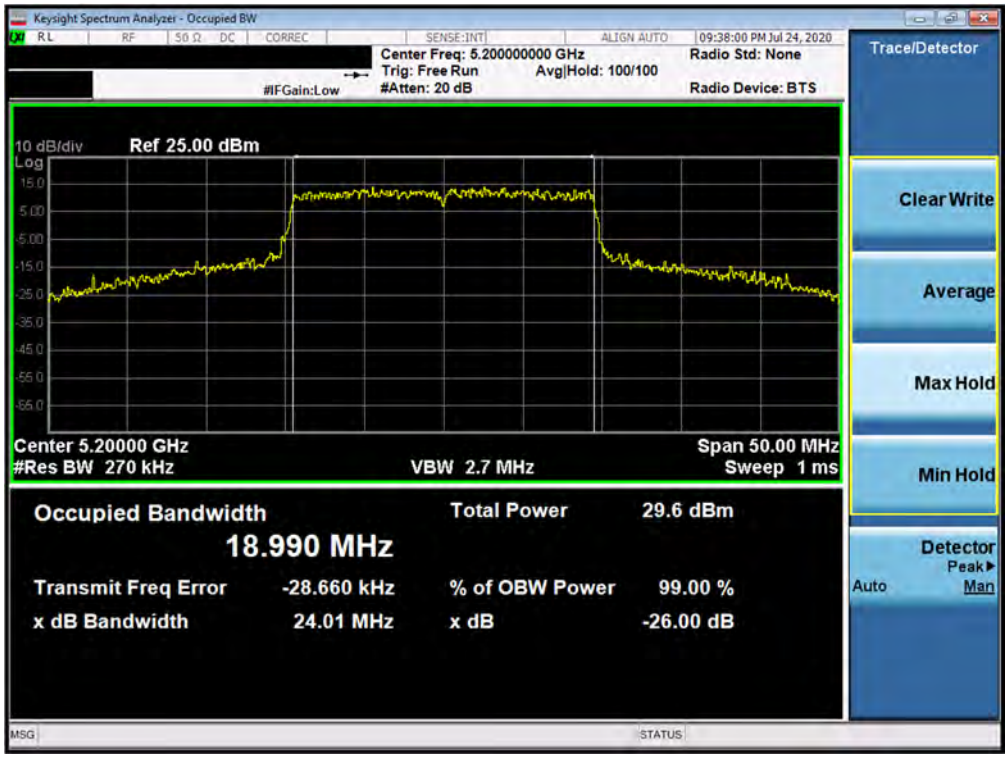
Antenna-5 26 dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242T	MCS0	20.86
	5200	40	ax (20MHz)	242T	MCS0	24.01
	5240	48	ax (20MHz)	242T	MCS0	21.06
	5190	38	ax (40MHz)	484T	MCS0	42.79
	5230	46	ax (40MHz)	484T	MCS0	77.36
	5210	42	ax (80MHz)	996T	MCS0	82.04
Band 2A	5260	52	ax (20MHz)	242T	MCS0	20.87
	5280	56	ax (20MHz)	242T	MCS0	20.76
	5320	64	ax (20MHz)	242T	MCS0	20.60
	5270	54	ax (40MHz)	484T	MCS0	43.39
	5310	62	ax (40MHz)	484T	MCS0	42.62
	5290	58	ax (80MHz)	996T	MCS0	81.67
Band 2C	5500	100	ax (20MHz)	242T	MCS0	20.64
	5600	120	ax (20MHz)	242T	MCS0	20.75
	5720	144	ax (20MHz)	242T	MCS0	20.67
	5510	102	ax (40MHz)	484T	MCS0	41.72
	5590	118	ax (40MHz)	484T	MCS0	41.97
	5710	142	ax (40MHz)	484T	MCS0	45.60
	5530	106	ax (80MHz)	996T	MCS0	81.02
	5610	122	ax (80MHz)	996T	MCS0	81.00
	5690	138	ax (80MHz)	996T	MCS0	81.51

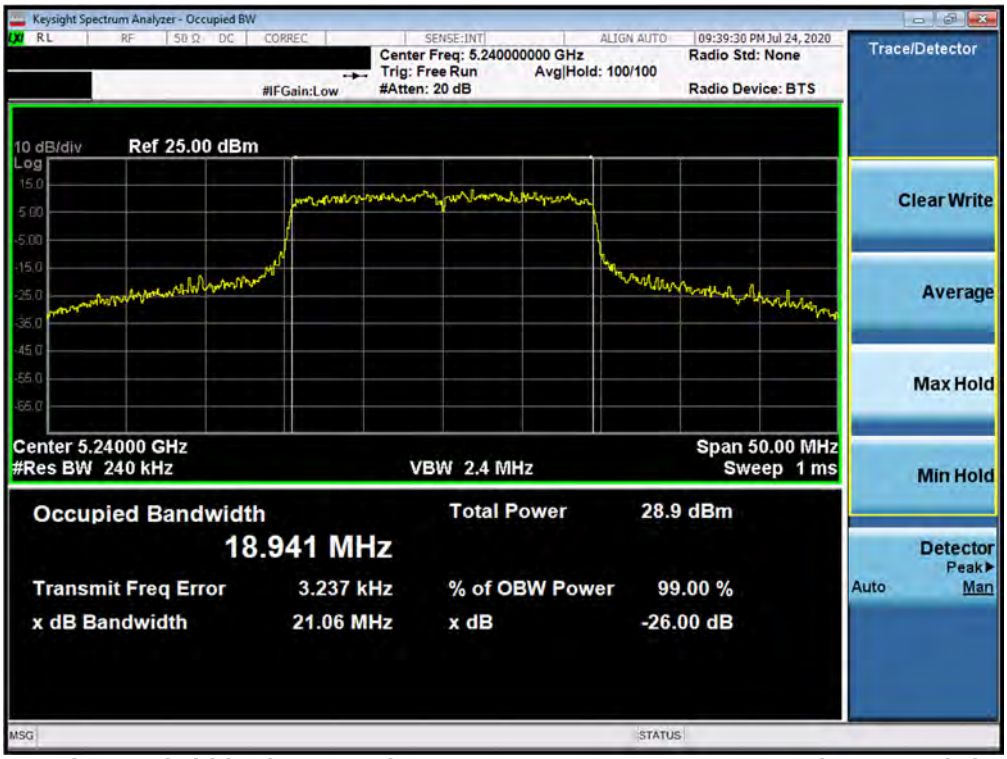
Table 7-4. Conducted Bandwidth Measurements (Full Tones)



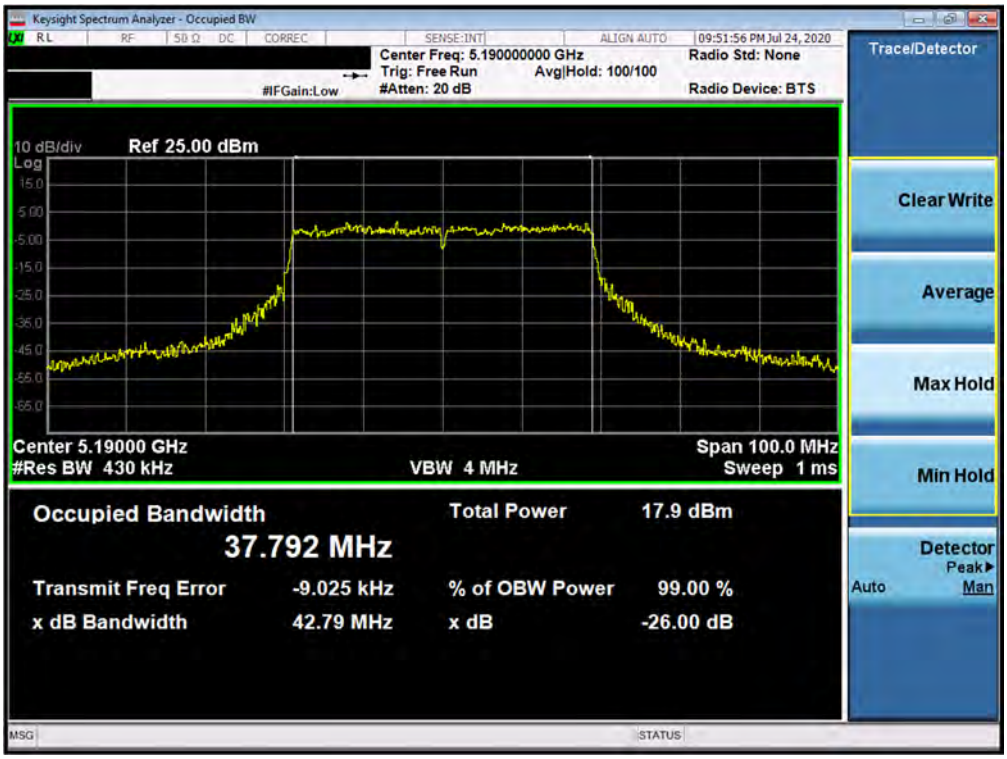
Plot 7-43. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 36)



Plot 7-44. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 40)

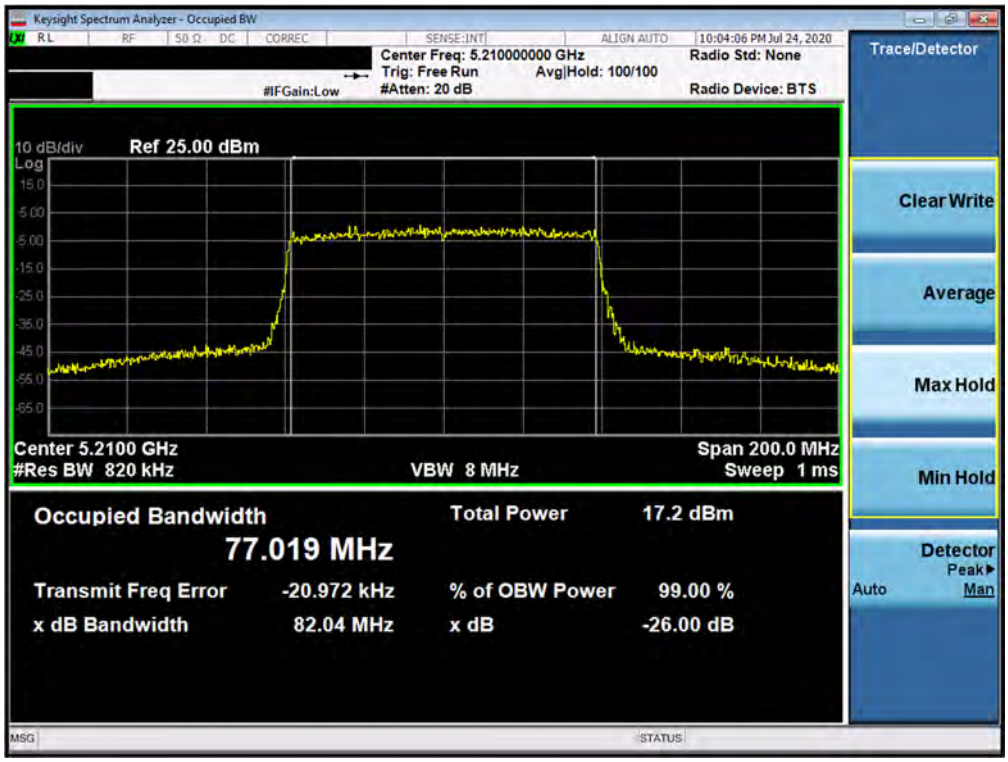


Plot 7-45. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 48)

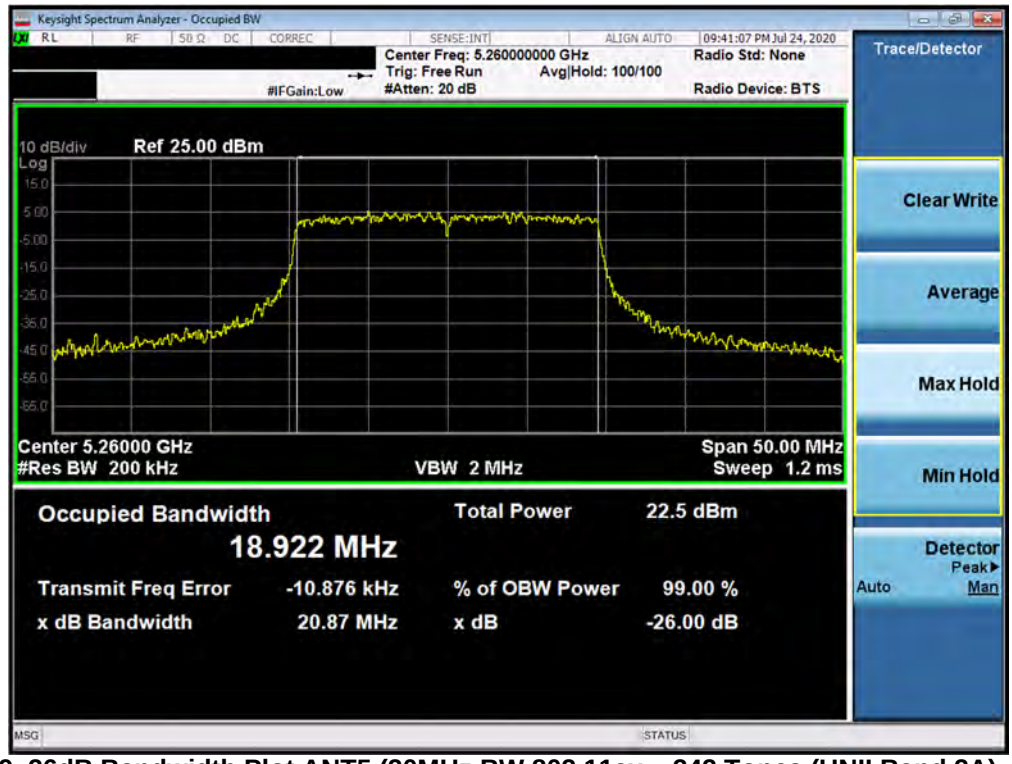


Plot 7-46. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 38)

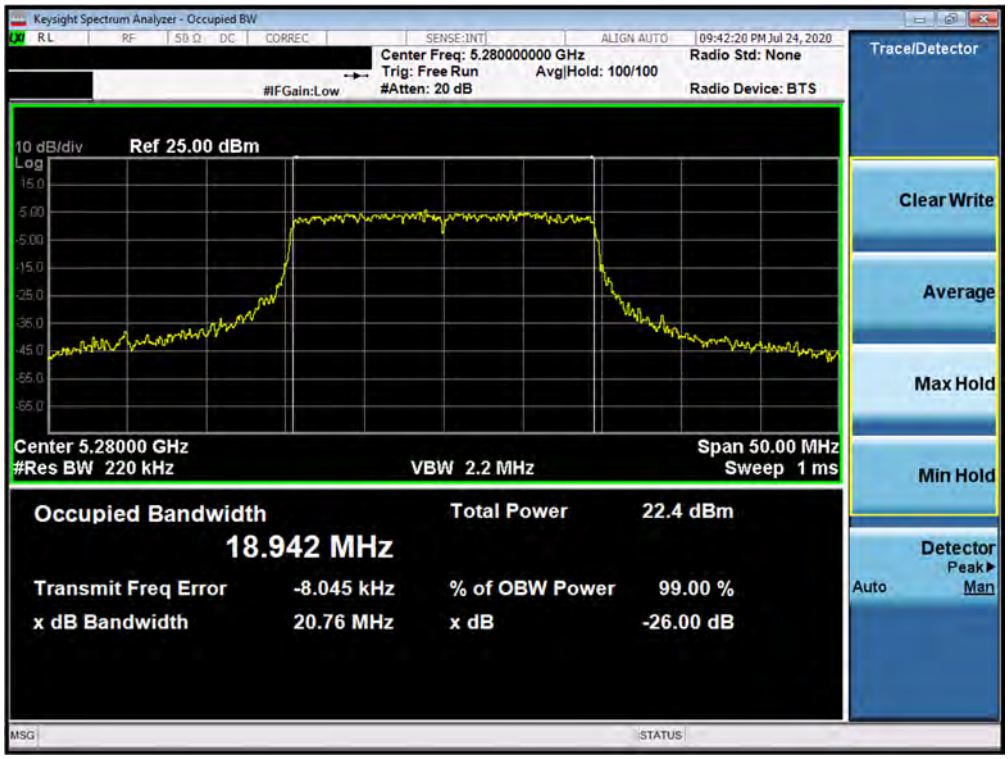
Plot 7-47. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 46)



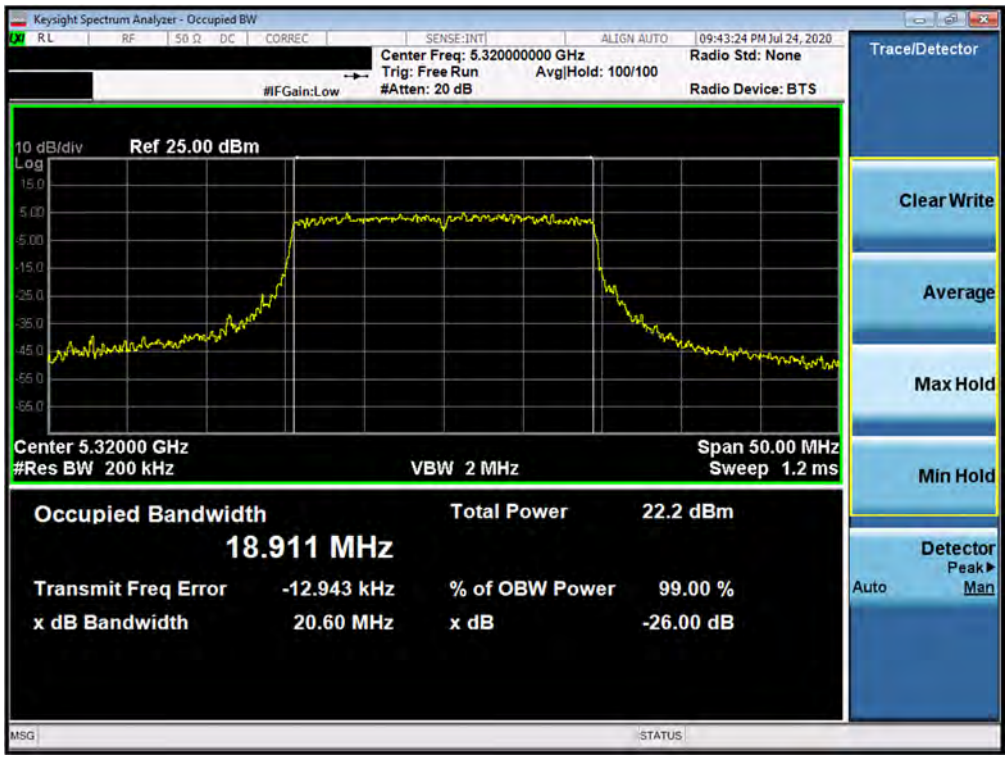
Plot 7-48. 26dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 1) – Ch. 42)



Plot 7-49. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 52)

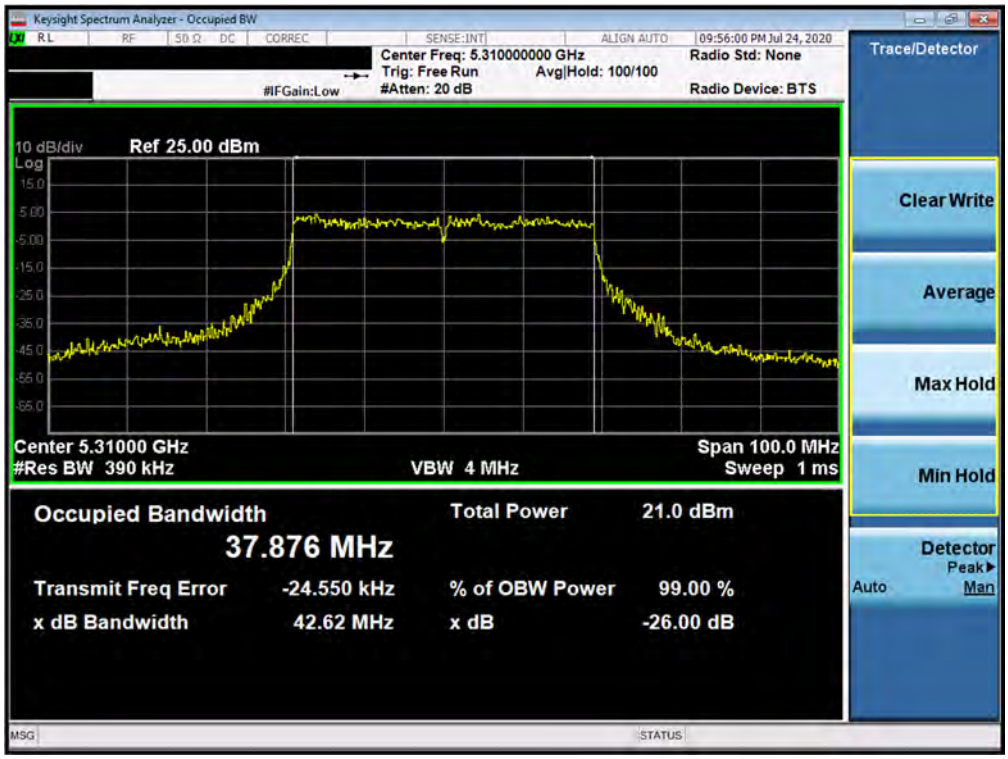


Plot 7-50. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 56)

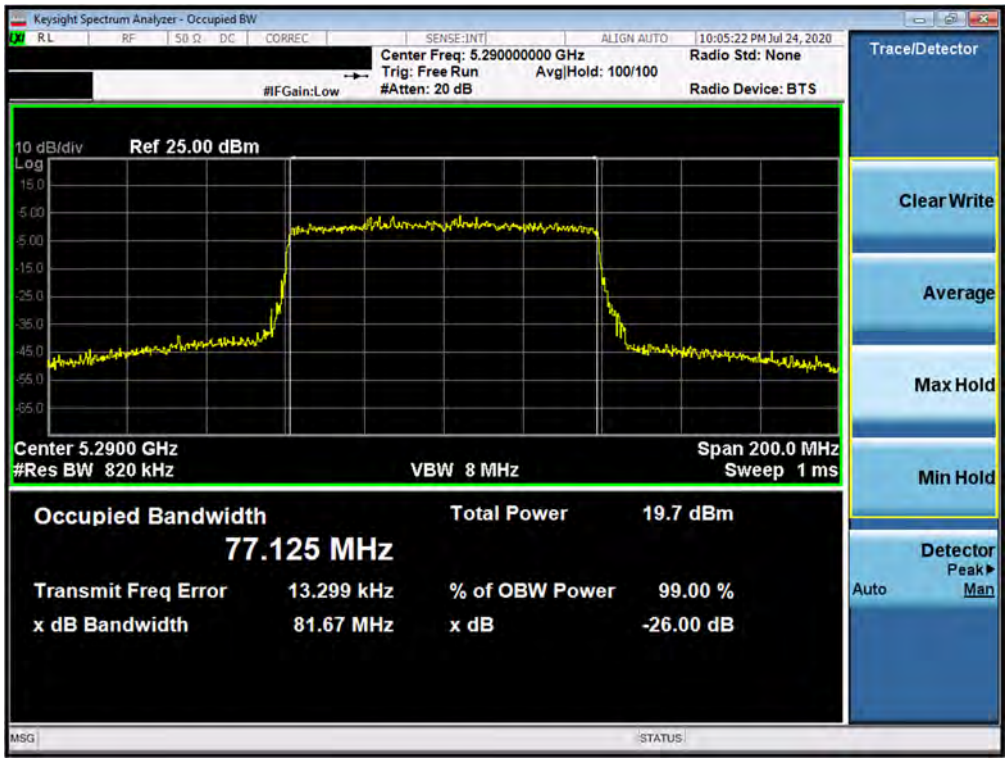


Plot 7-51. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 64)

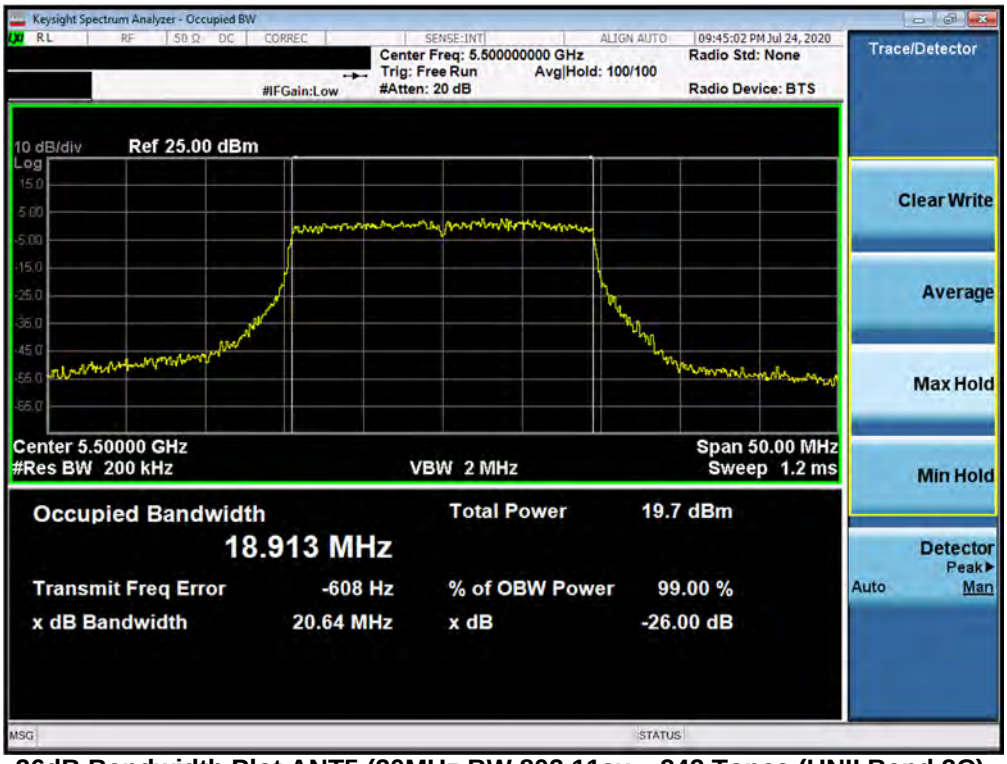
Plot 7-52. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 54)



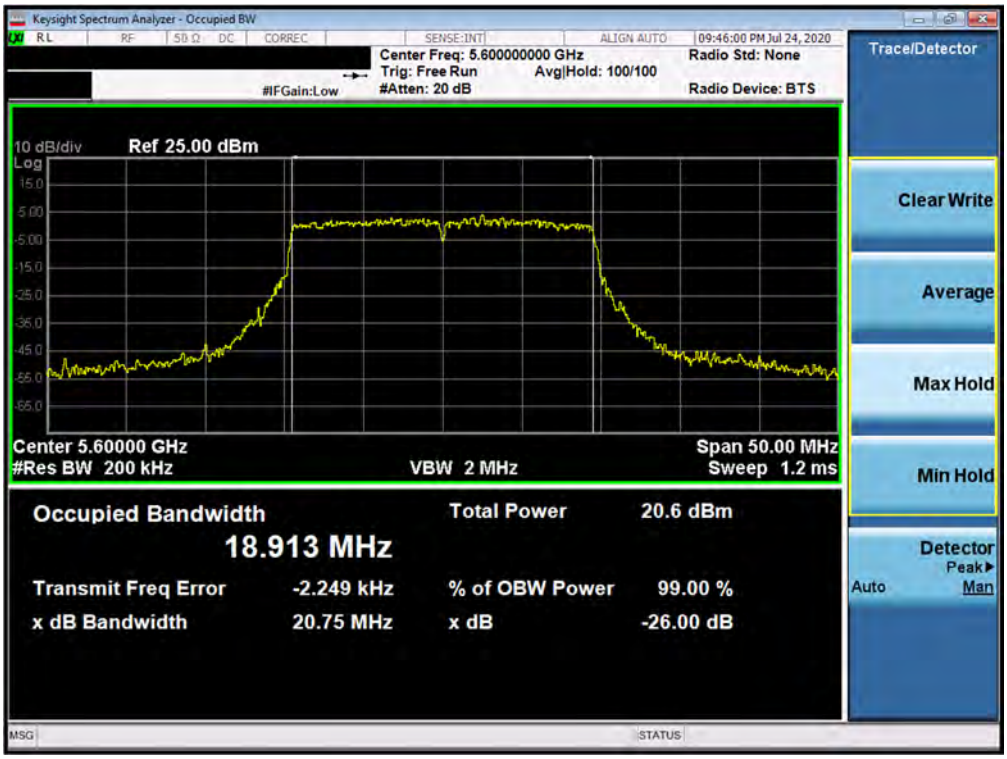
Plot 7-53. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 62)



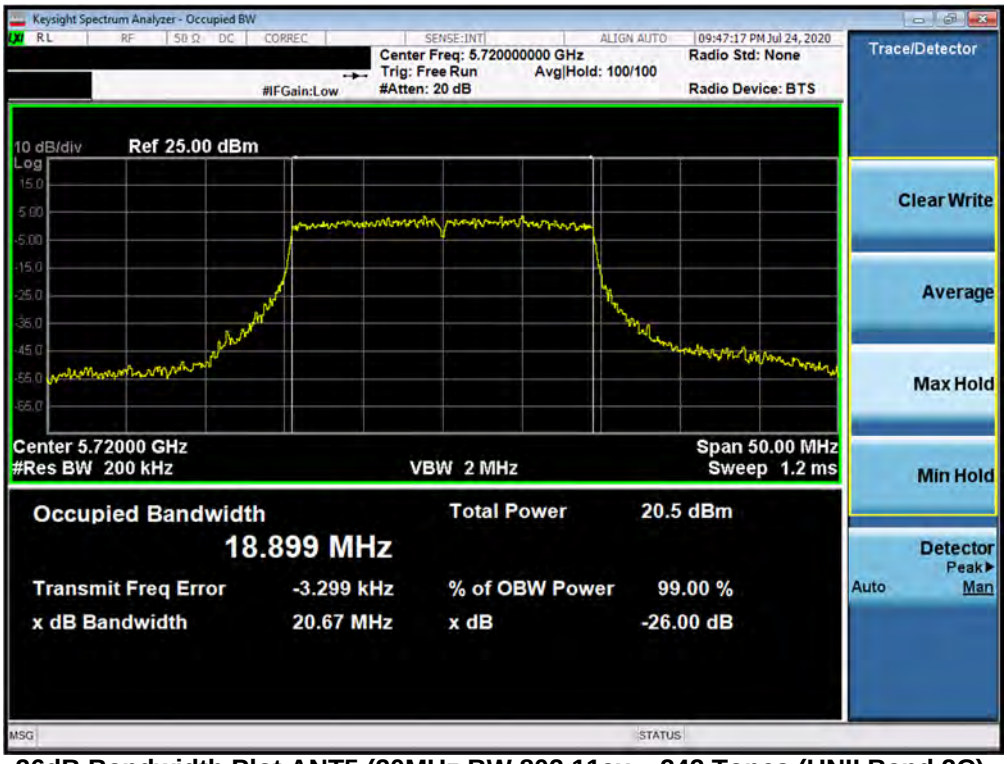
Plot 7-54. 26dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 2A) – Ch. 58)



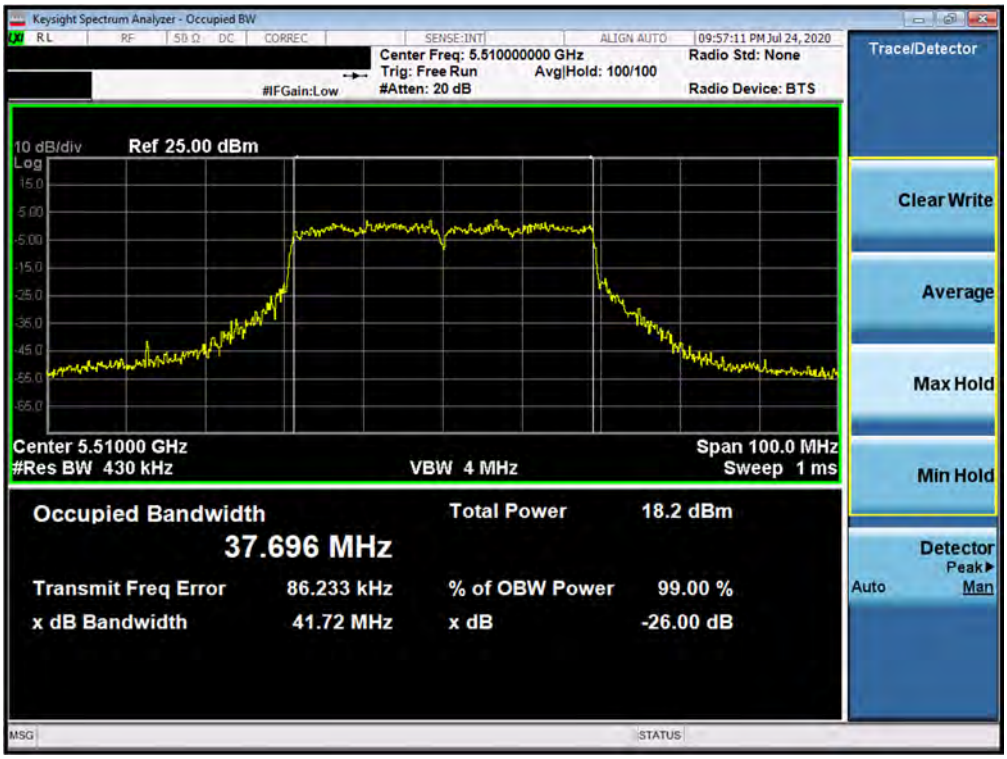
Plot 7-55. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 100)



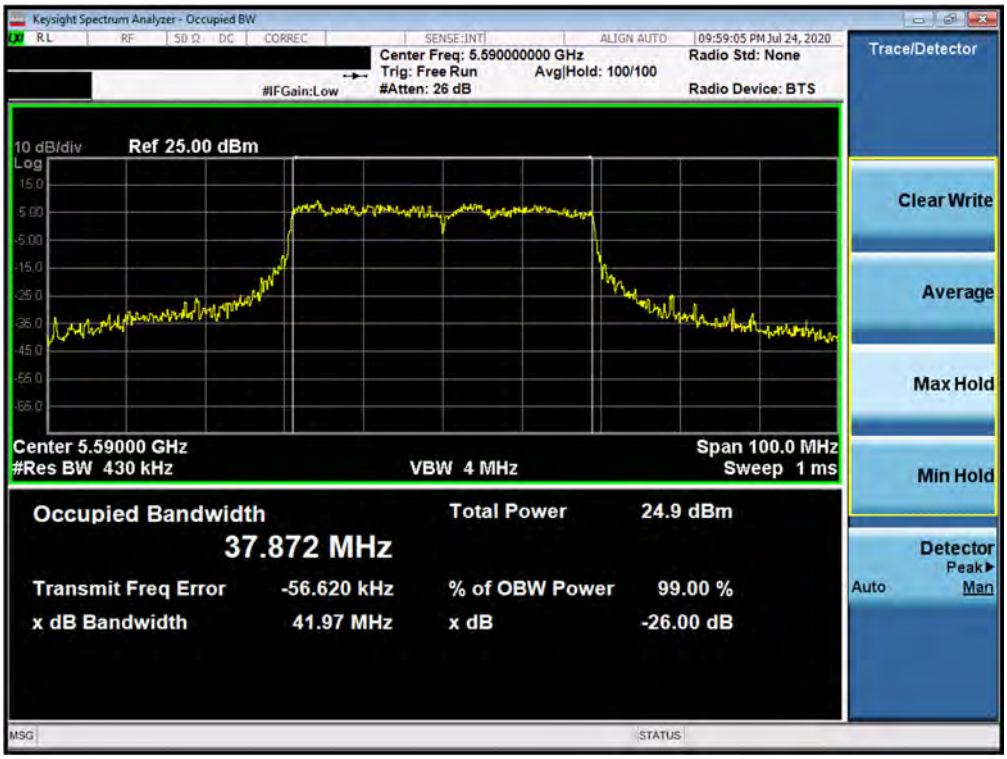
Plot 7-56. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 120)



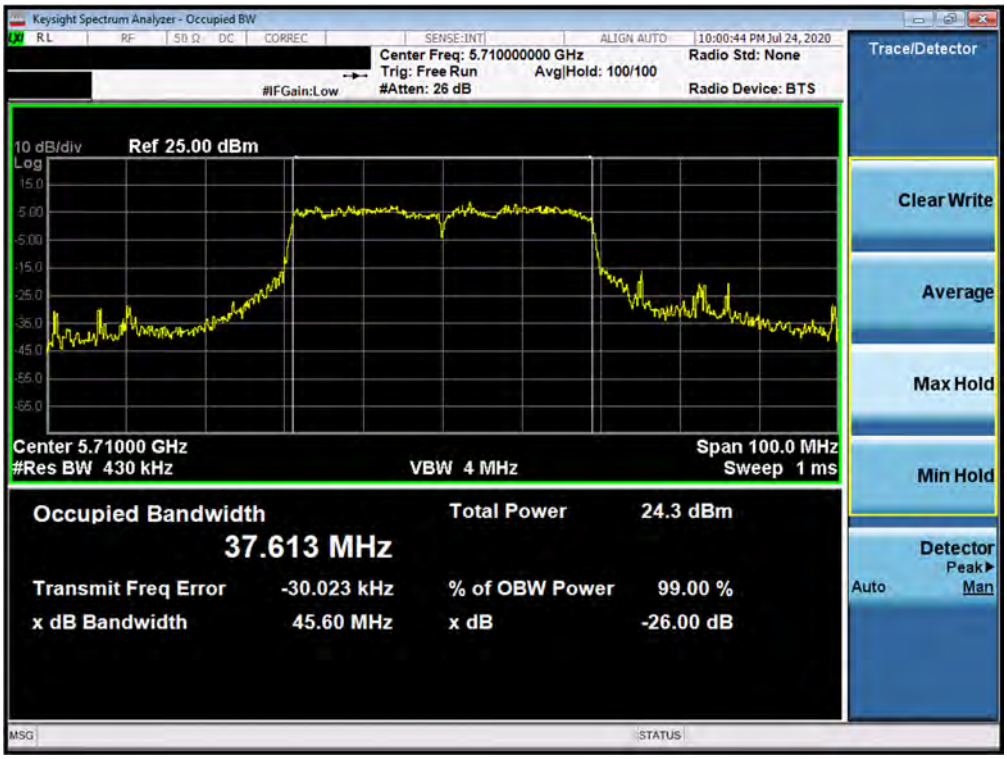
Plot 7-57. 26dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 144)



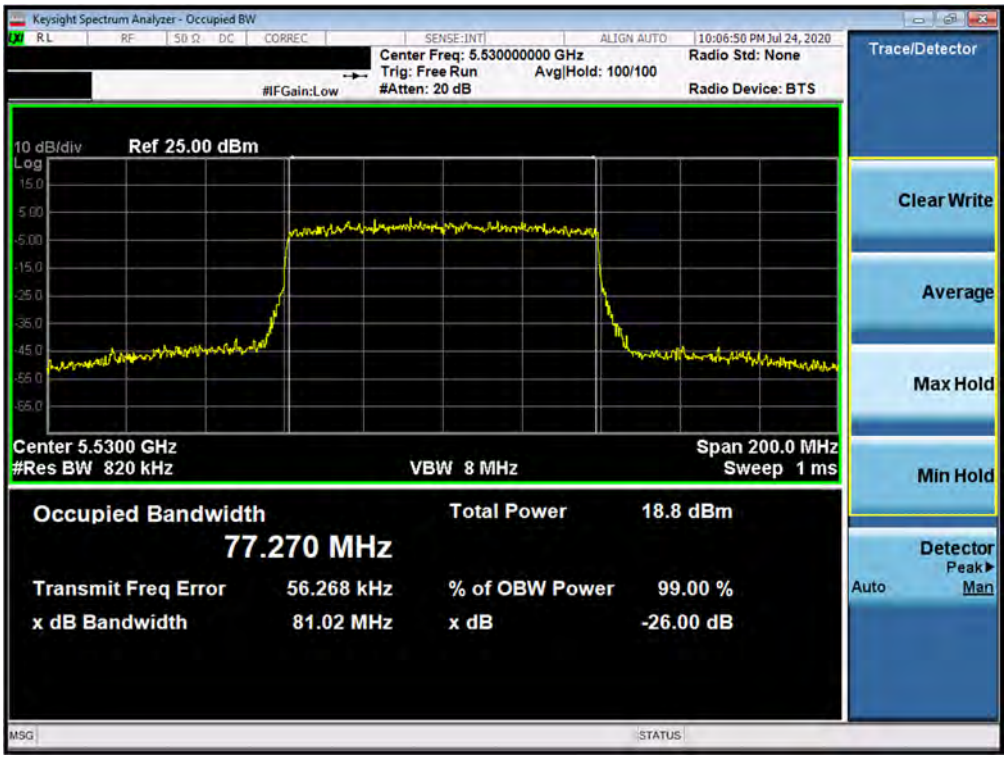
Plot 7-58. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 102)



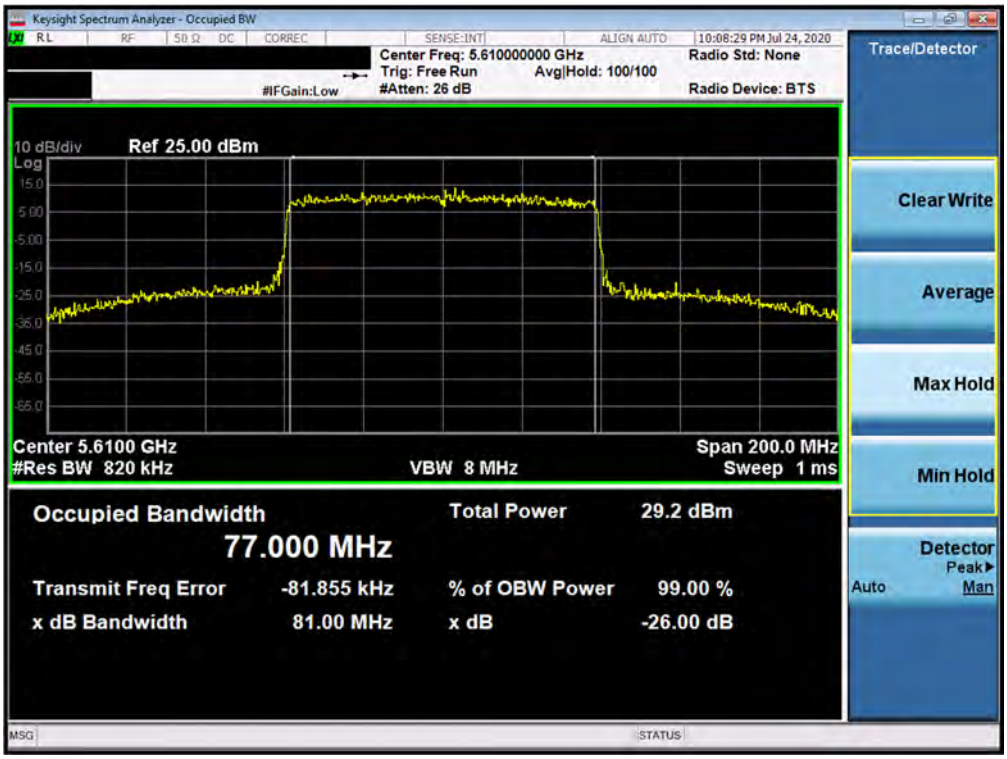
Plot 7-59. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 118)



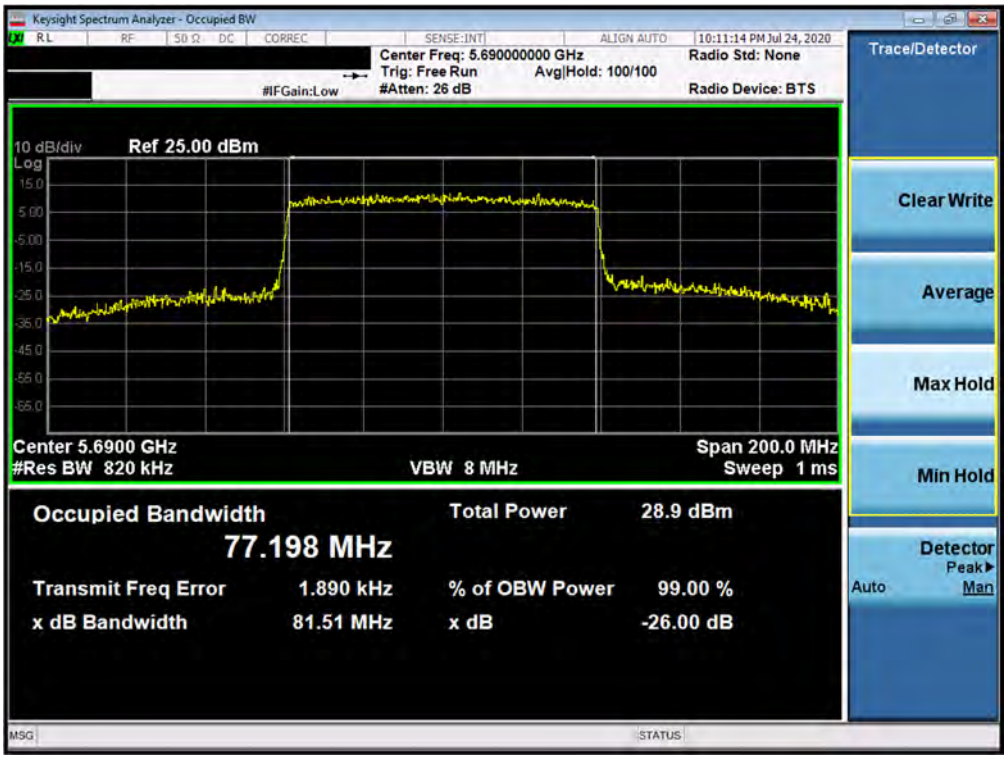
Plot 7-60. 26dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 142)



Plot 7-61. 26dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 106)



Plot 7-62. 26dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 122)

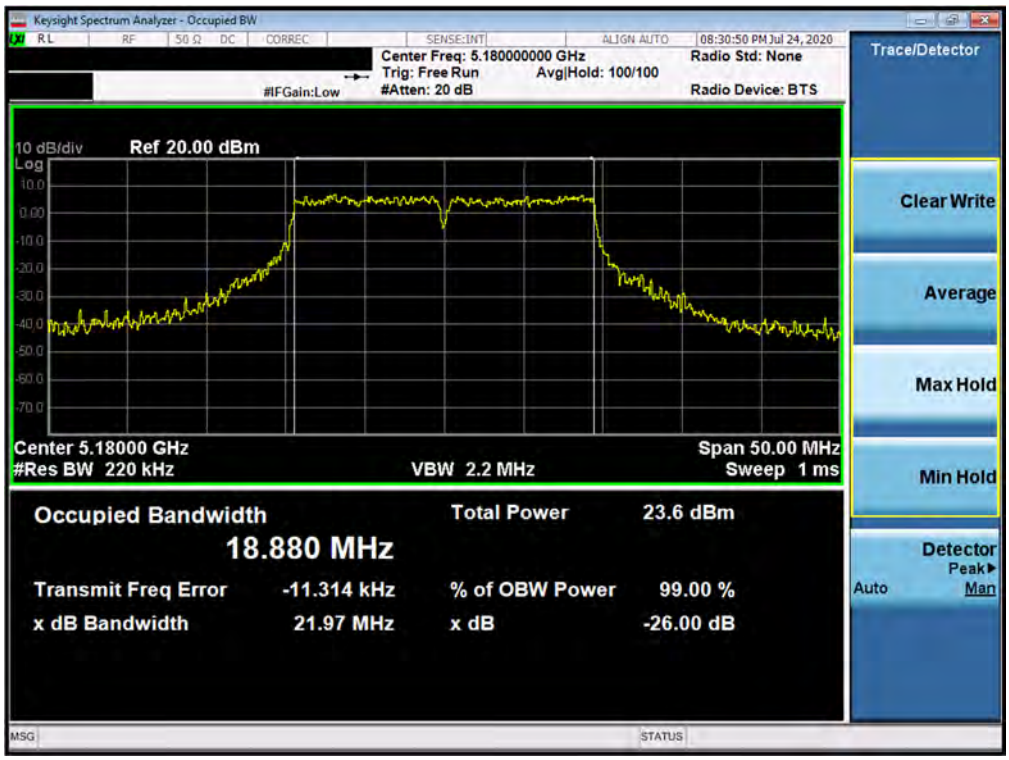


Plot 7-63. 26dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 138)

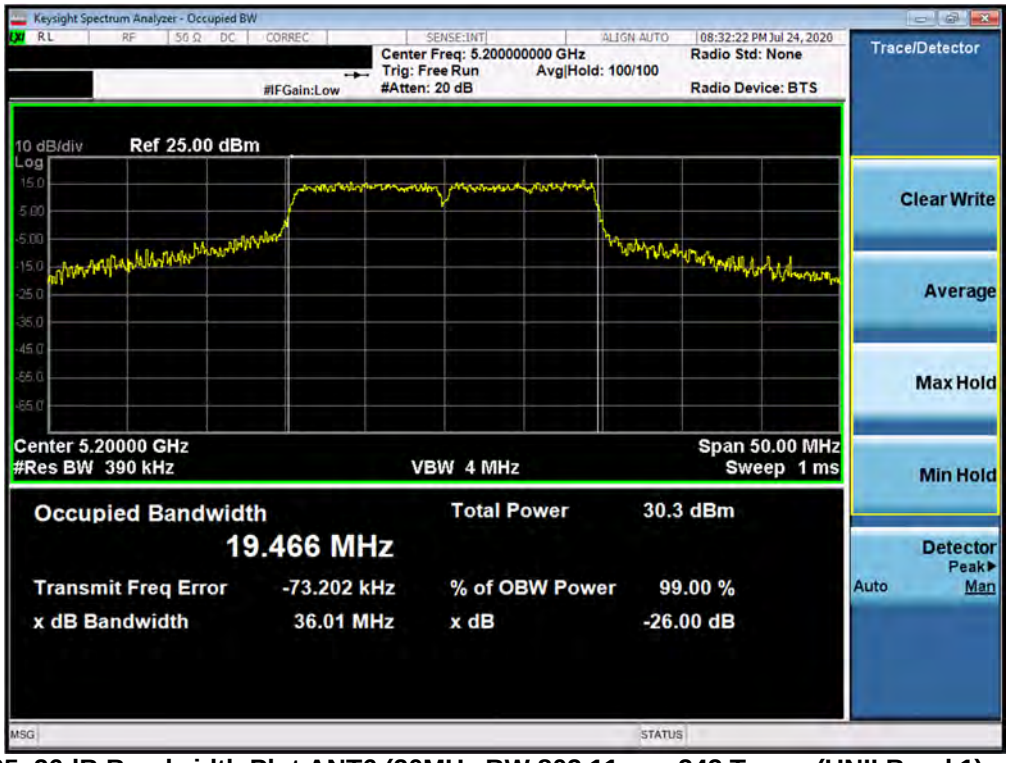
Antenna-6 26dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5180	36	ax (20MHz)	242T	MCS0	21.97
	5200	40	ax (20MHz)	242T	MCS0	36.01
	5240	48	ax (20MHz)	242T	MCS0	31.71
	5190	38	ax (40MHz)	484T	MCS0	43.30
	5230	46	ax (40MHz)	484T	MCS0	79.45
	5210	42	ax (80MHz)	996T	MCS0	81.24
Band 2A	5260	52	ax (20MHz)	242T	MCS0	21.62
	5280	56	ax (20MHz)	242T	MCS0	22.20
	5320	64	ax (20MHz)	242T	MCS0	21.95
	5270	54	ax (40MHz)	484T	MCS0	43.81
	5310	62	ax (40MHz)	484T	MCS0	43.85
	5290	58	ax (80MHz)	996T	MCS0	81.07
Band 2C	5500	100	ax (20MHz)	242T	MCS0	22.40
	5600	120	ax (20MHz)	242T	MCS0	21.85
	5720	144	ax (20MHz)	242T	MCS0	21.81
	5510	102	ax (40MHz)	484T	MCS0	42.35
	5590	118	ax (40MHz)	484T	MCS0	43.61
	5710	142	ax (40MHz)	484T	MCS0	42.25
	5530	106	ax (80MHz)	996T	MCS0	80.90
	5610	122	ax (80MHz)	996T	MCS0	80.94
	5690	138	ax (80MHz)	996T	MCS0	81.10

Table 7-5. Conducted Bandwidth Measurements (Full Tones)

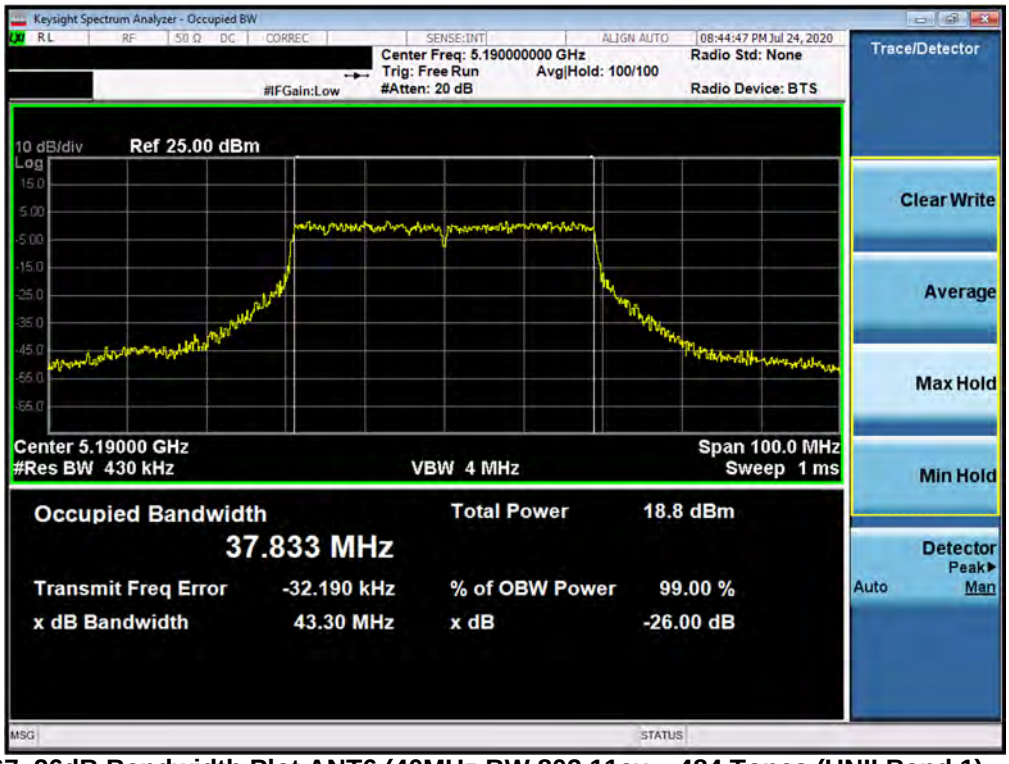


Plot 7-64. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 36)



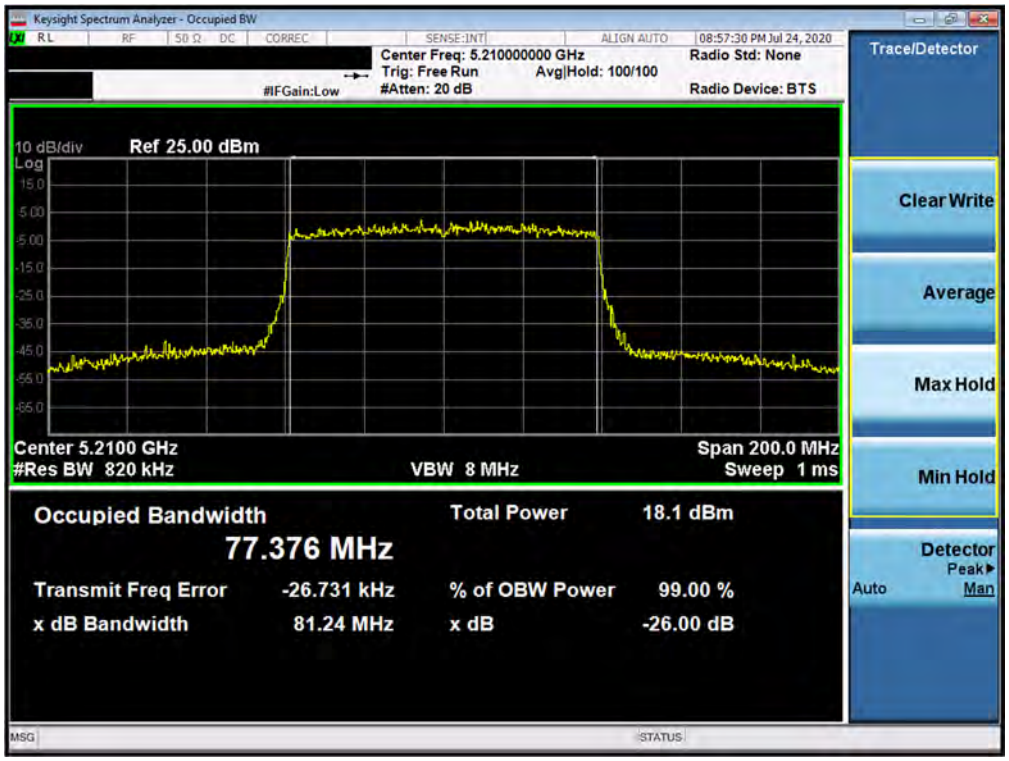
Plot 7-65. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 40)

Plot 7-66. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 1) – Ch. 48)

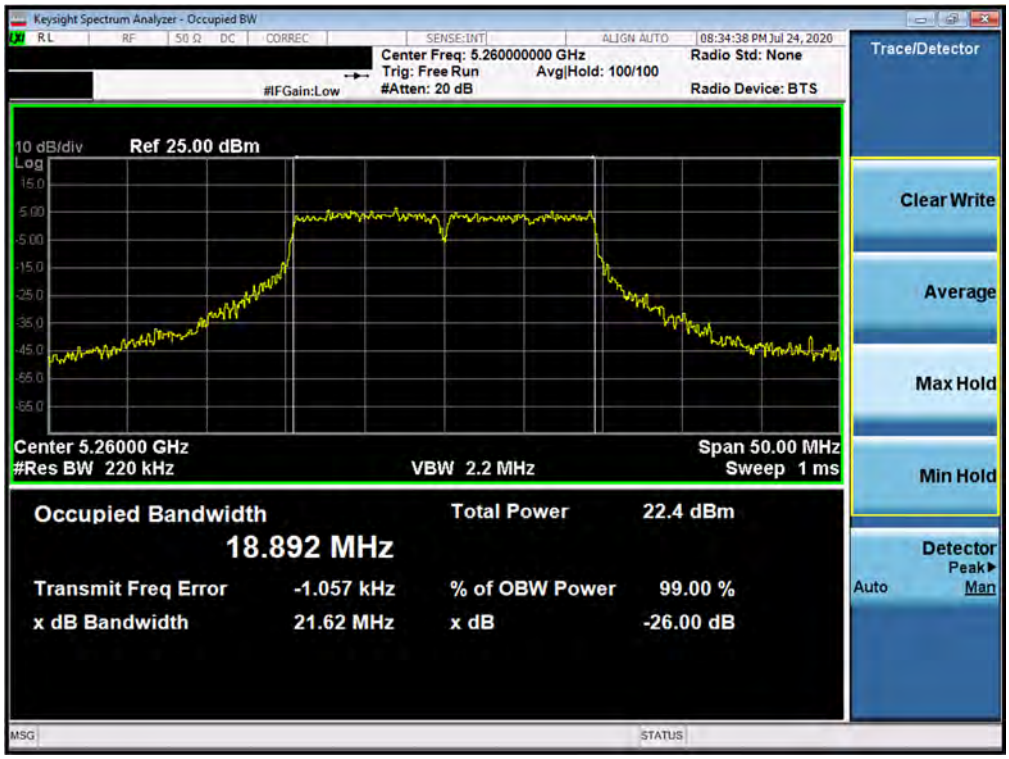


Plot 7-67. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 38)

Plot 7-68. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 1) – Ch. 46)

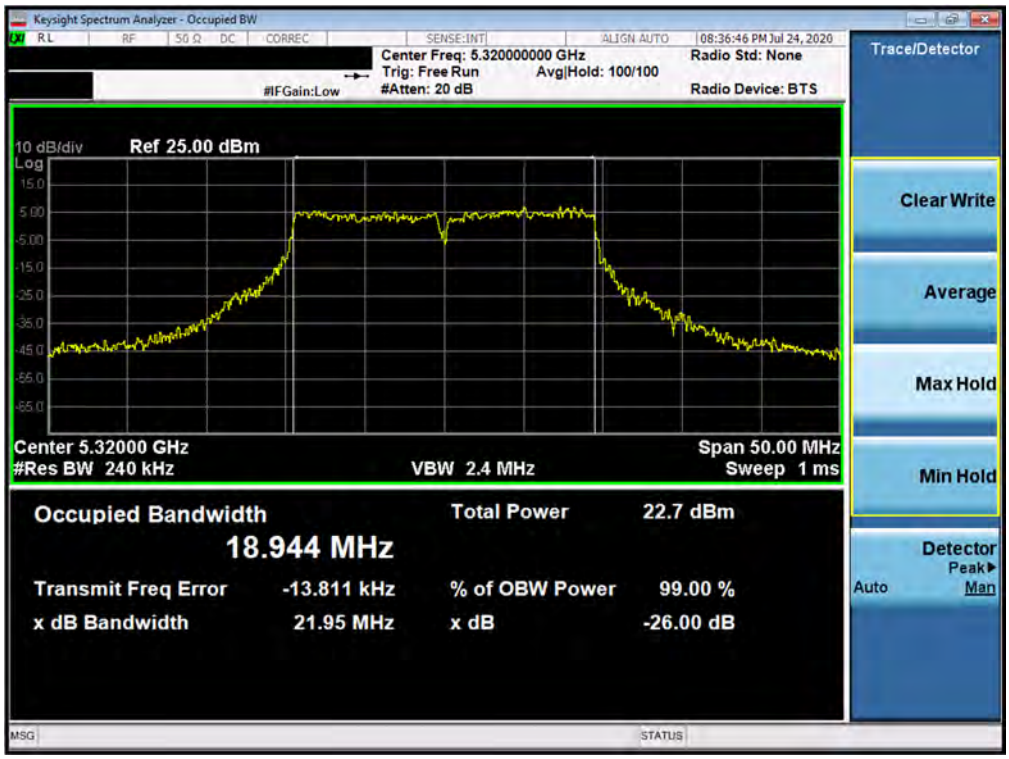


Plot 7-69. 26dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 1) – Ch. 42)



Plot 7-70. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 52)

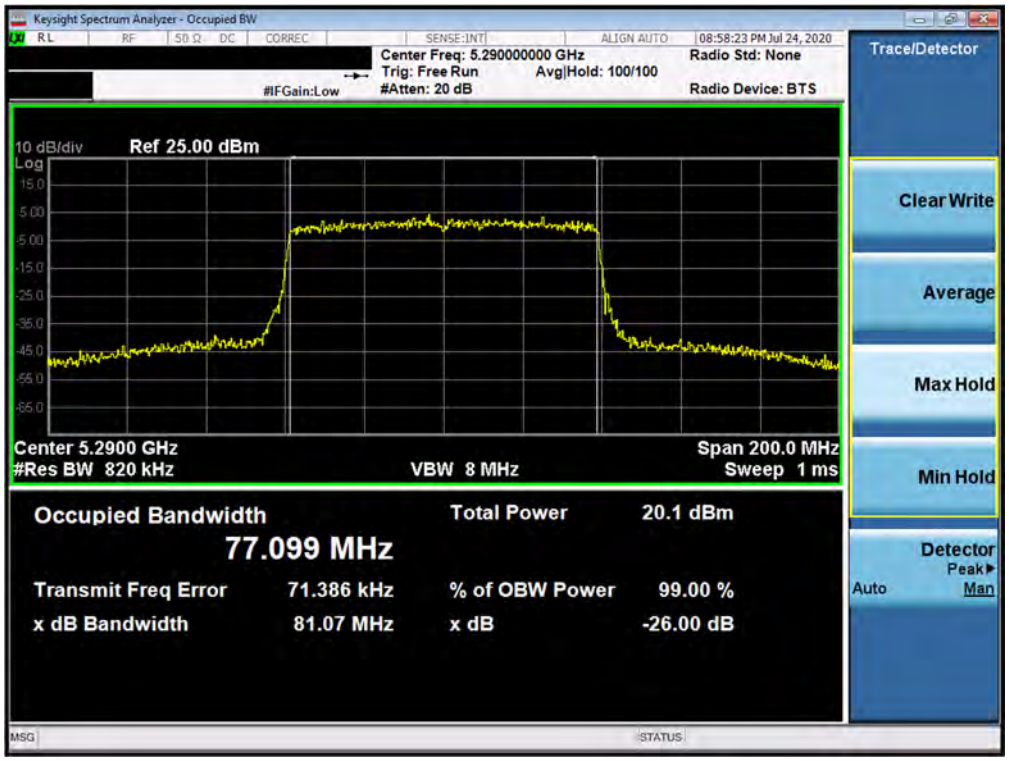
Plot 7-71. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 56)



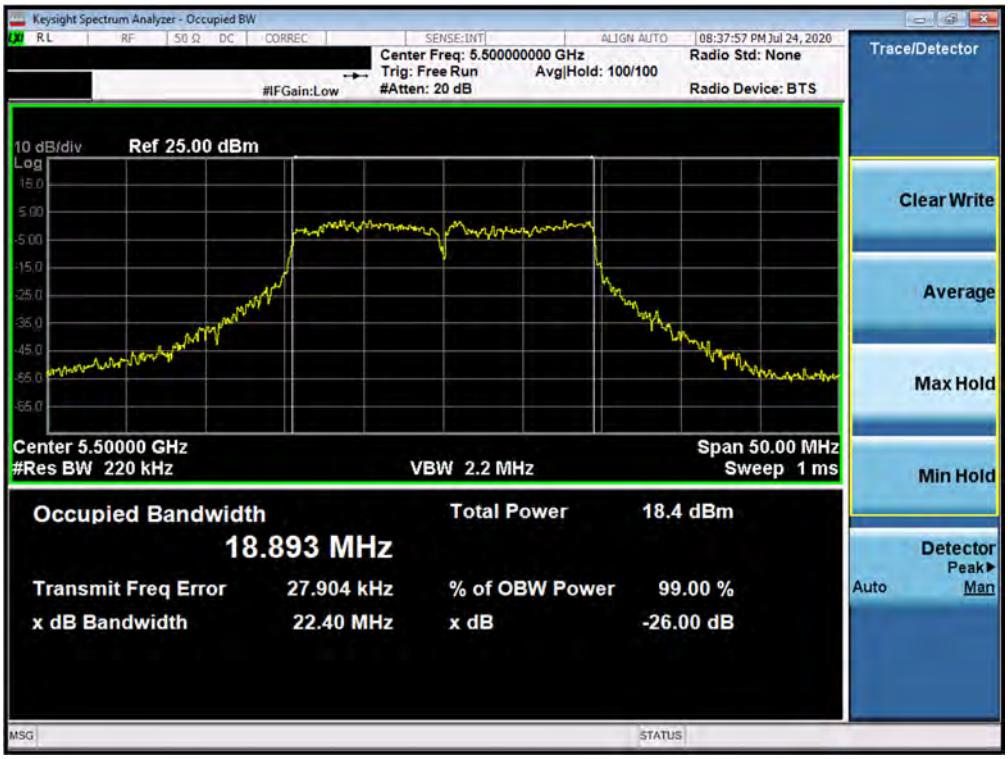
Plot 7-72. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2A) – Ch. 64)

Plot 7-73. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 54)

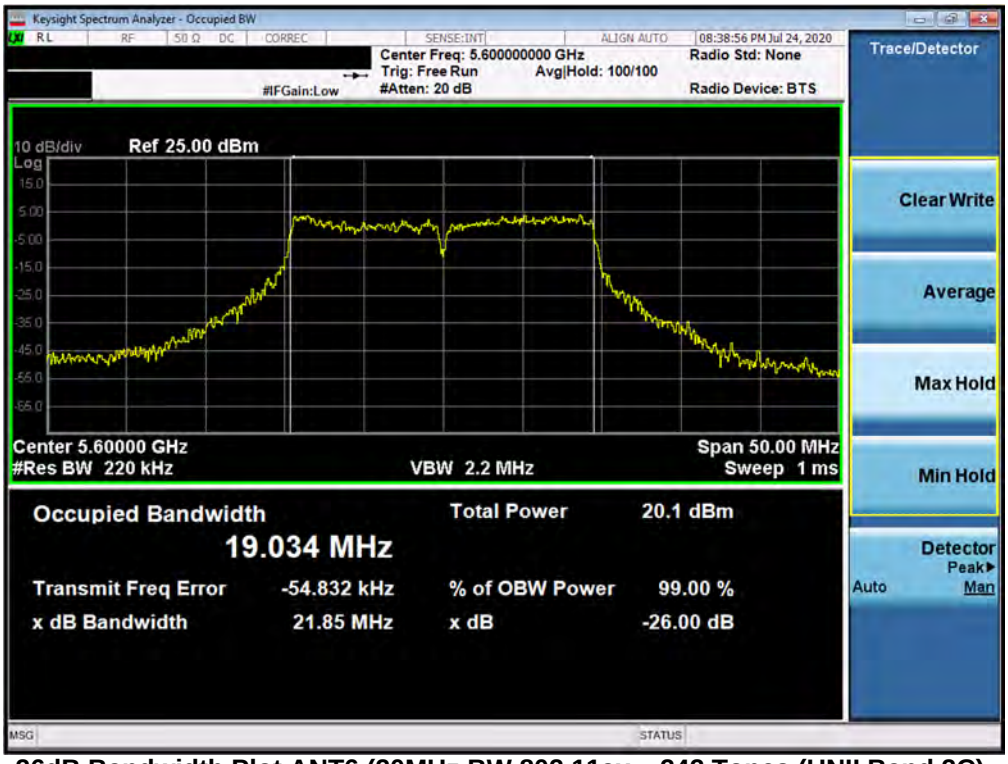
Plot 7-74. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 2A) – Ch. 62)



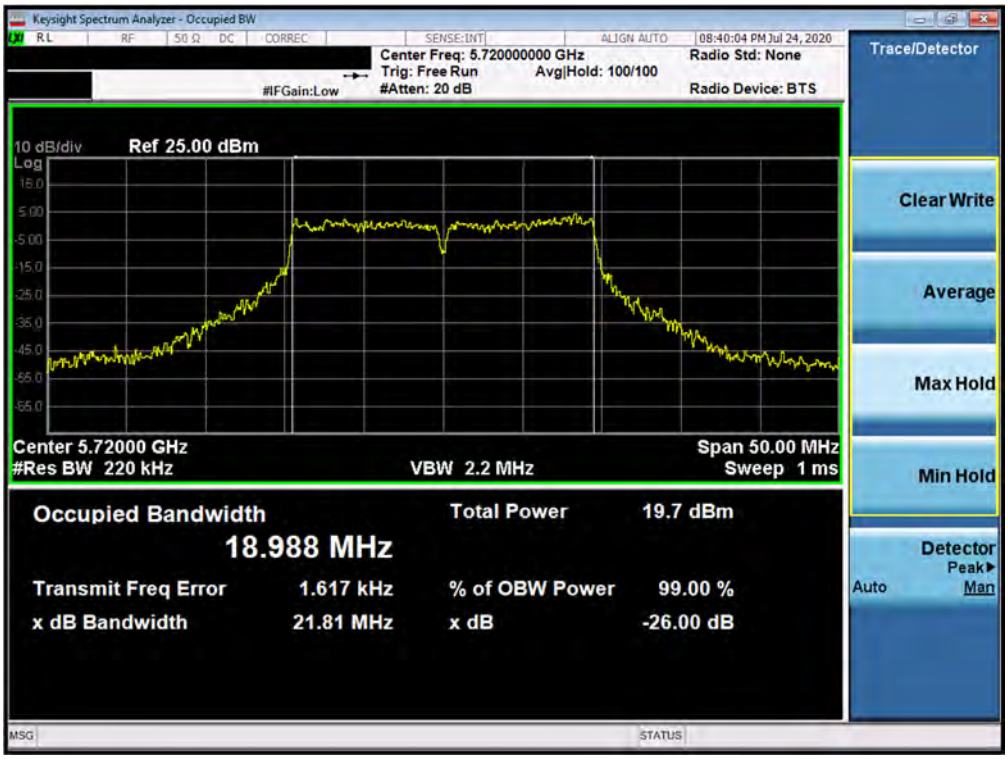
Plot 7-75. 26dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 2A) – Ch. 58)



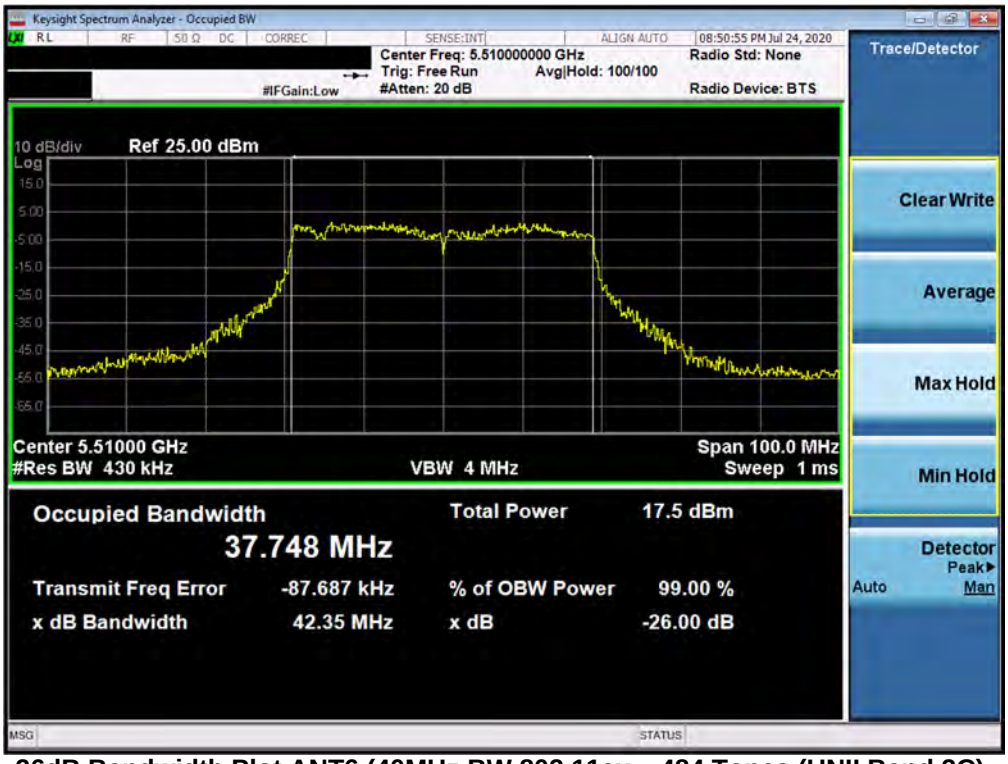
Plot 7-76. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 100)



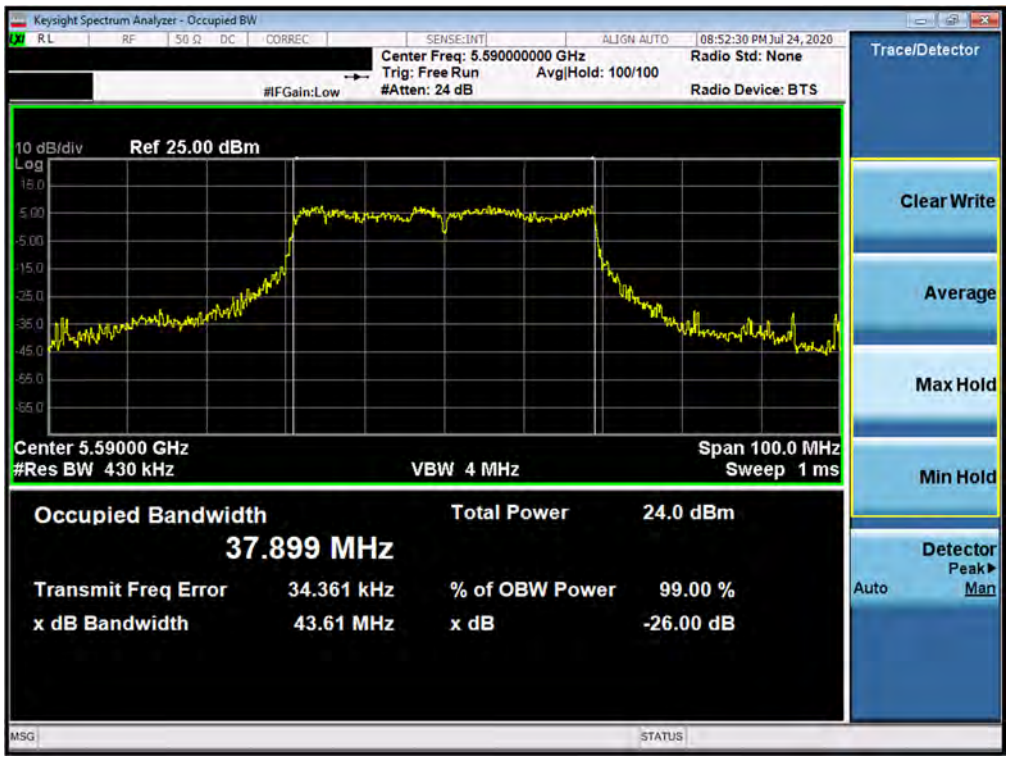
Plot 7-77. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 120)



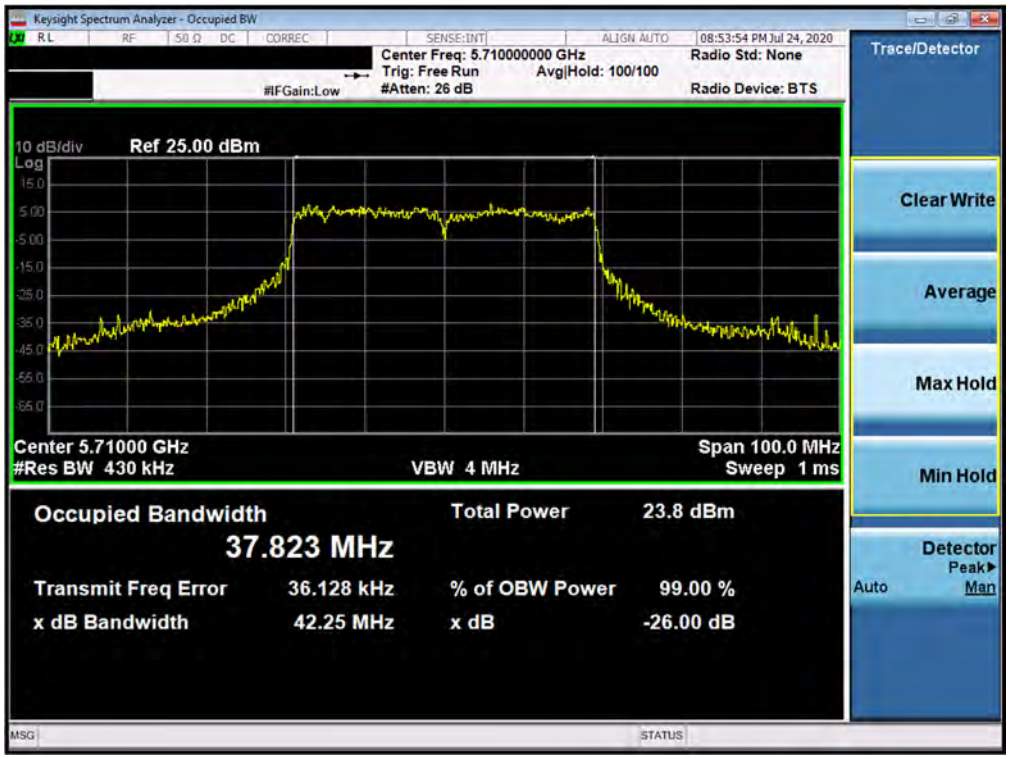
Plot 7-78. 26dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 2C) – Ch. 144)



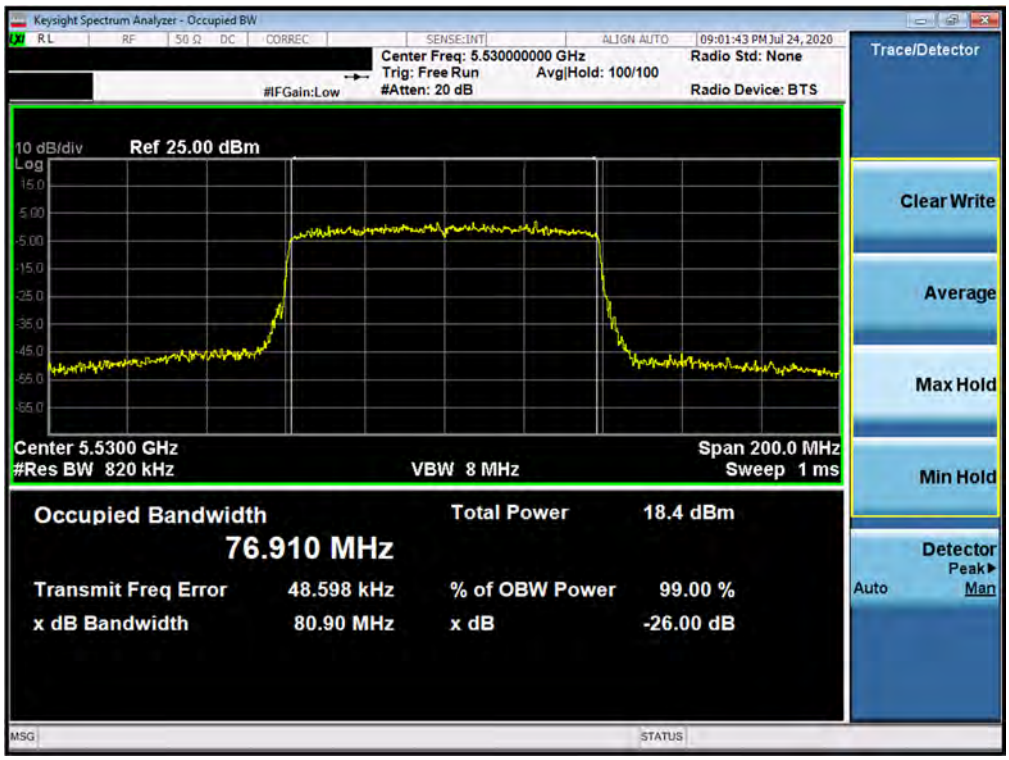
Plot 7-79. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 102)



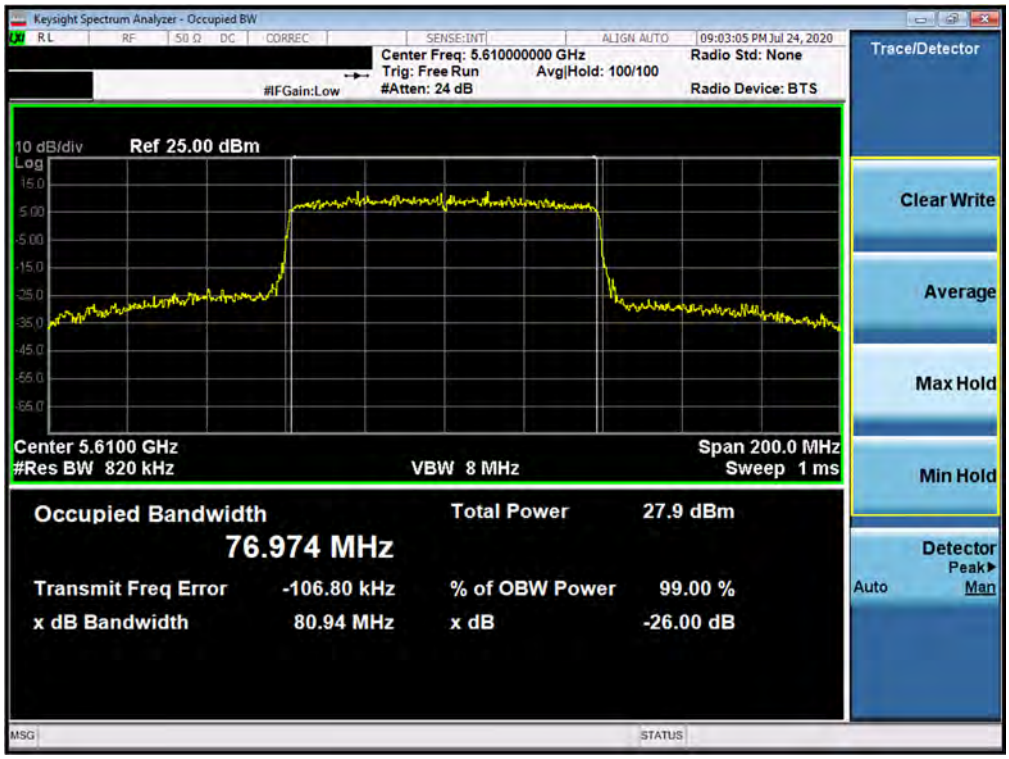
Plot 7-80. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 118)



Plot 7-81. 26dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 2C) – Ch. 142)



Plot 7-82. 26dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 106)



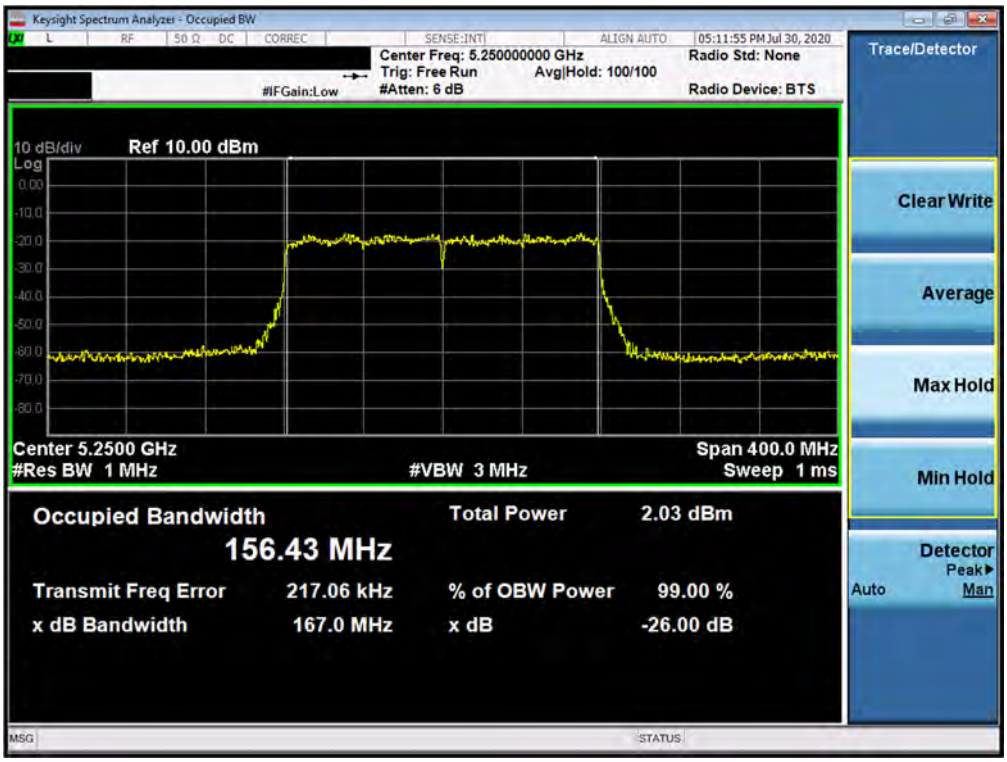
Plot 7-83. 26dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 122)

Plot 7-84. 26dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 138)

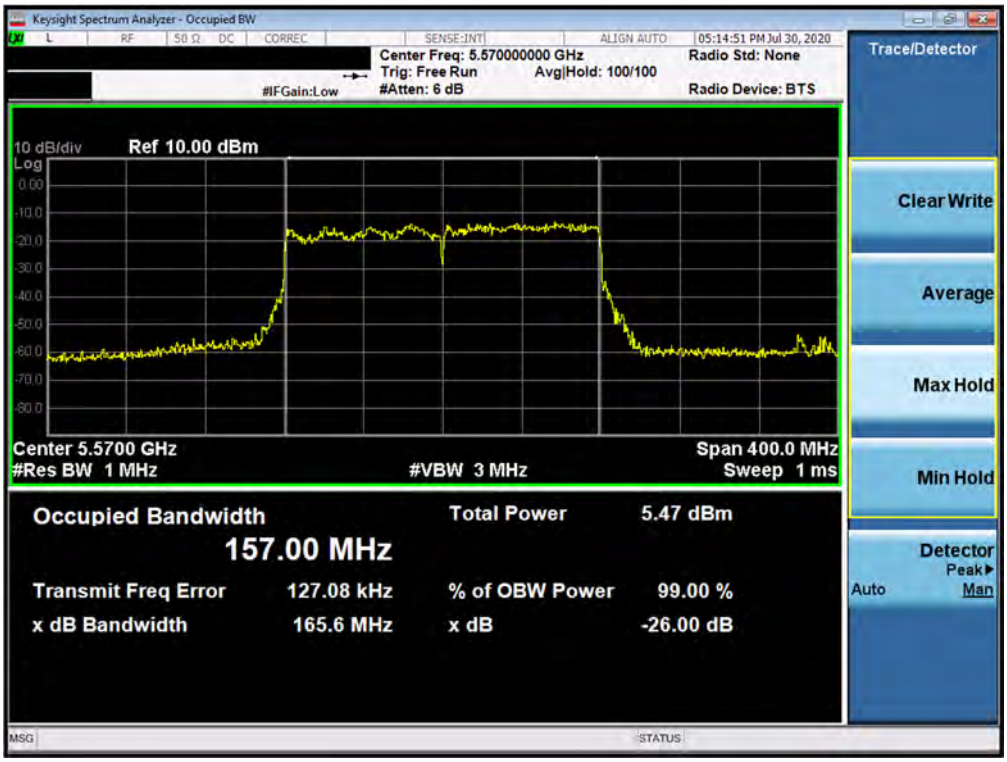
MIMO 26dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 26dB Bandwidth [MHz]
Band 1	5210	42	ax (80MHz)	996T	MCS0	167.00
Band 2A	5290	58	ax (80MHz)	996T	MCS0	
Band 2C	5530	106	ax (80MHz)	996T	MCS0	165.60
	5610	122	ax (80MHz)	996T	MCS0	

Table 7-6. MIMO Bandwidth Measurements (Full Tones)



Plot 7-85. 26dB Bandwidth Plot (80+80MHz BW 802.11ax – 996 Tones (UNII Band 1 and 2A) – Ch. 142 and Ch. 58)



Plot 7-86. 26dB Bandwidth Plot (80+800MHz BW 802.11ax – 996 Tones (UNII Band 2C) – Ch. 106 and Ch. 122)

7.3 6dB Bandwidth Measurement – 802.11ax OFDMA

§15.407 (e); RSS-Gen [6.7]

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 KDB 789033 D02 v02r01, 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, the 6dB bandwidth must be ≥ 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 6.9.2
KDB 789033 D02 v02r01 – Section C

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

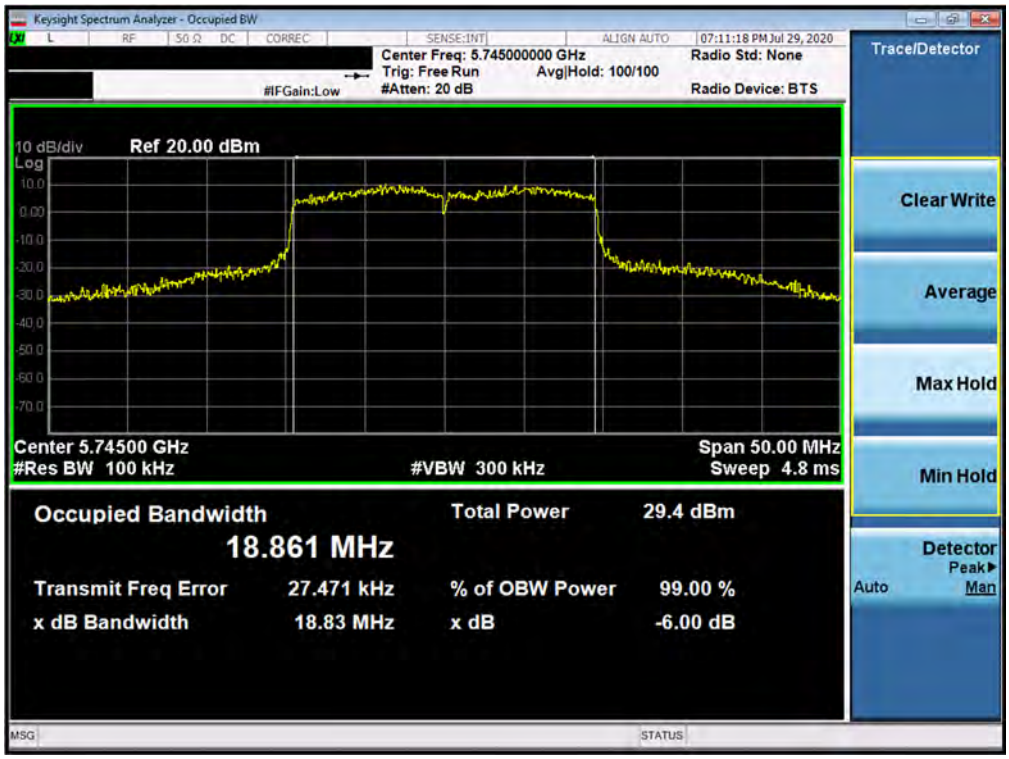
Test Notes

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

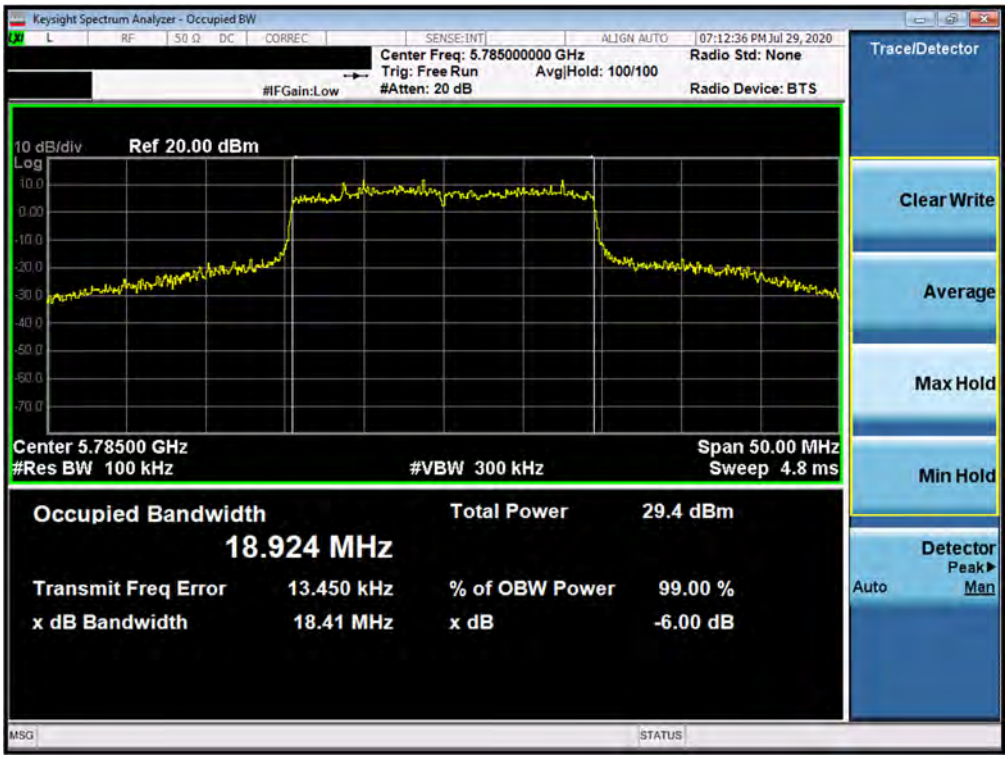
Antenna-3 6 dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	ax (20MHz)	242T	MCS0	18.83
	5785	157	ax (20MHz)	242T	MCS0	18.42
	5825	165	ax (20MHz)	242T	MCS0	18.98
	5755	151	ax (40MHz)	484T	MCS0	36.72
	5795	159	ax (40MHz)	484T	MCS0	37.17
	5775	155	ax (80MHz)	996T	MCS0	76.34

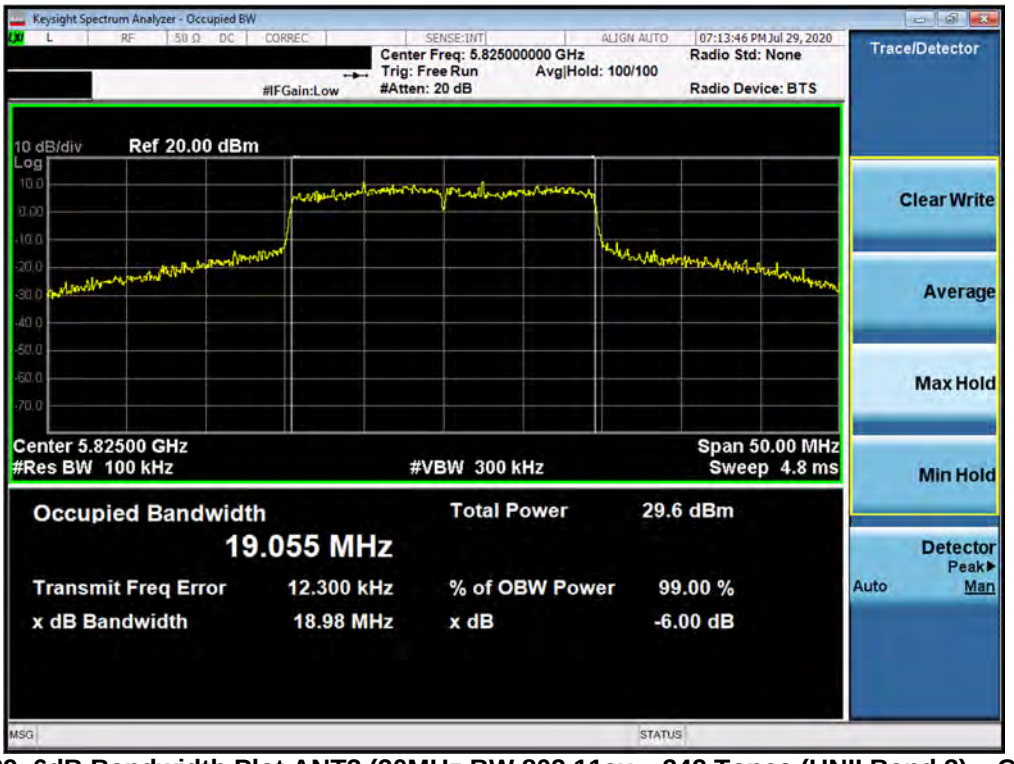
Table 7-7. Conducted Bandwidth Measurements ANT3 (Full Tones)



Plot 7-87. 6dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 149)

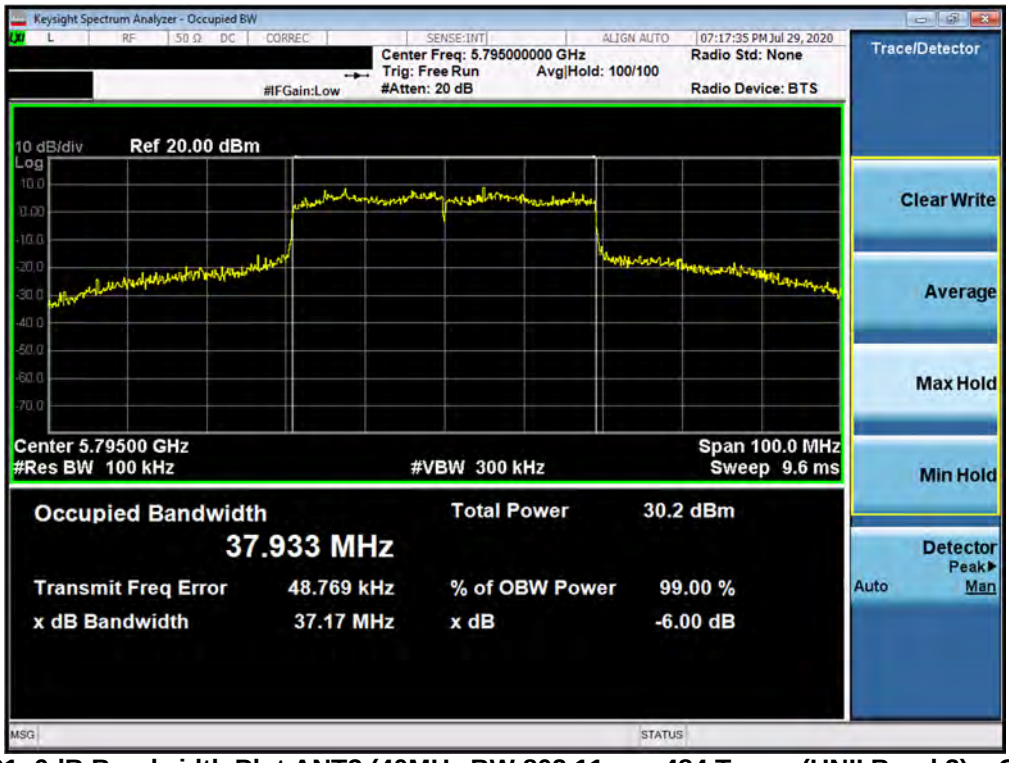


Plot 7-88. 6dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 157)



Plot 7-89. 6dB Bandwidth Plot ANT3 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 165)

Plot 7-90. 6dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 151)



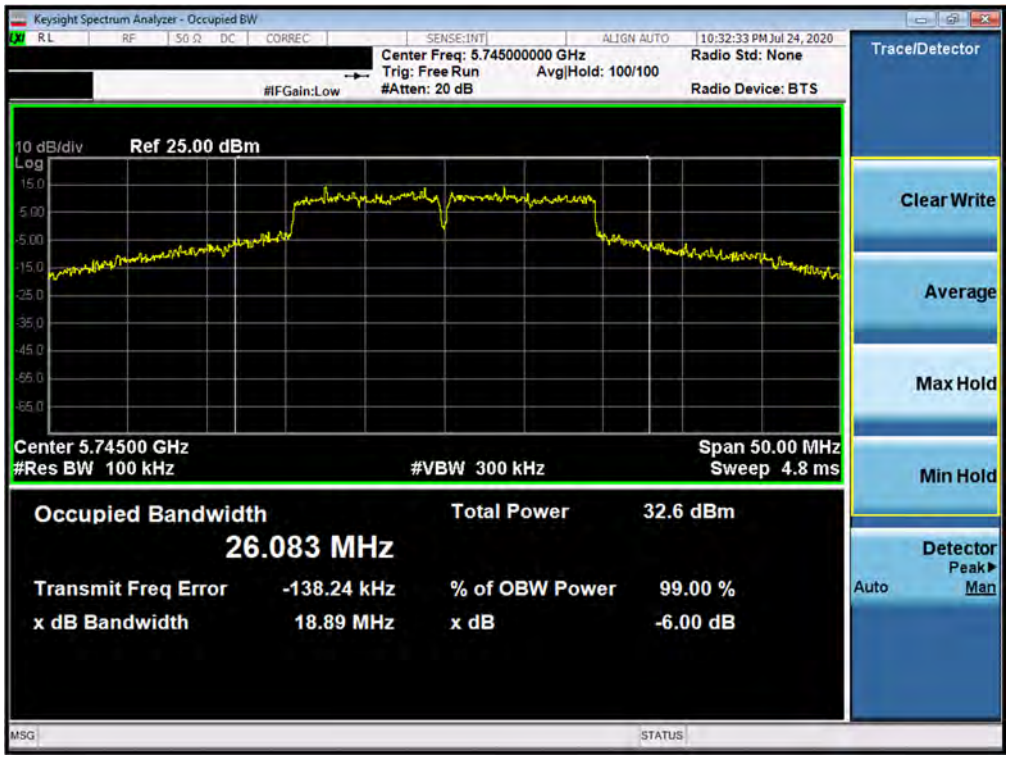
Plot 7-91. 6dB Bandwidth Plot ANT3 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 159)

Plot 7-92. 6dB Bandwidth Plot ANT3 (80MHz BW 802.11ax – 996 Tones (UNII Band 3) – Ch. 155)

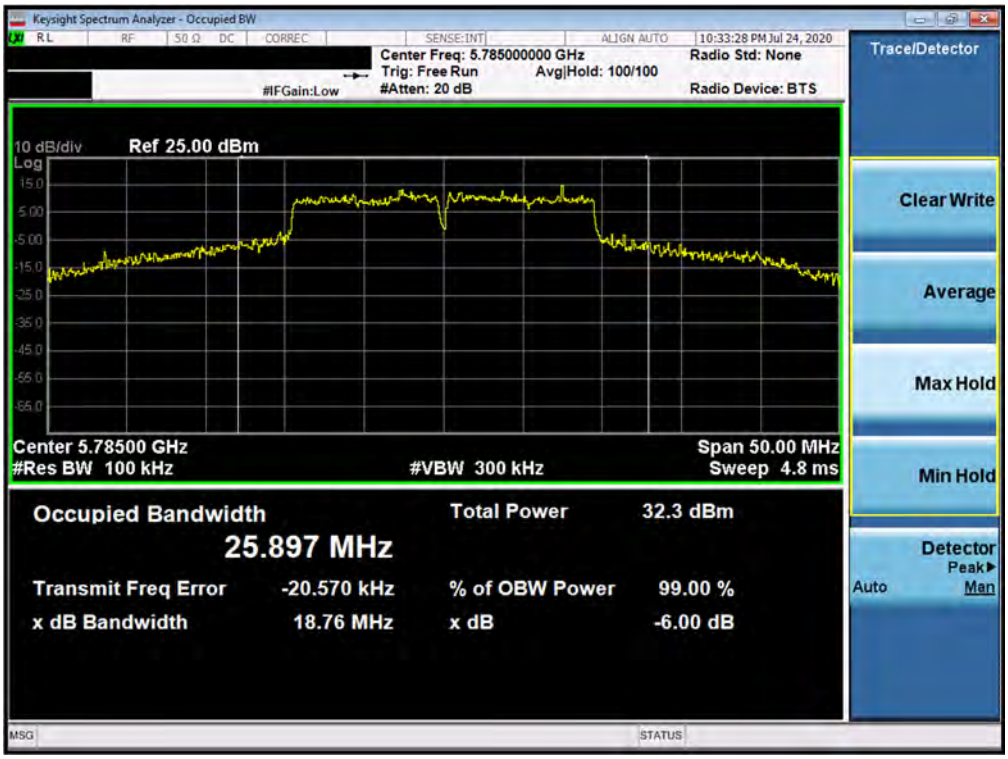
Antenna-4 6dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	ax (20MHz)	242T	MCS0	18.89
	5785	157	ax (20MHz)	242T	MCS0	18.76
	5825	165	ax (20MHz)	242T	MCS0	18.94
	5755	151	ax (40MHz)	484T	MCS0	38.10
	5795	159	ax (40MHz)	484T	MCS0	38.07
	5775	155	ax (80MHz)	996T	MCS0	77.61

Table 7-8. Conducted Bandwidth Measurements ANT4 (Full Tones)



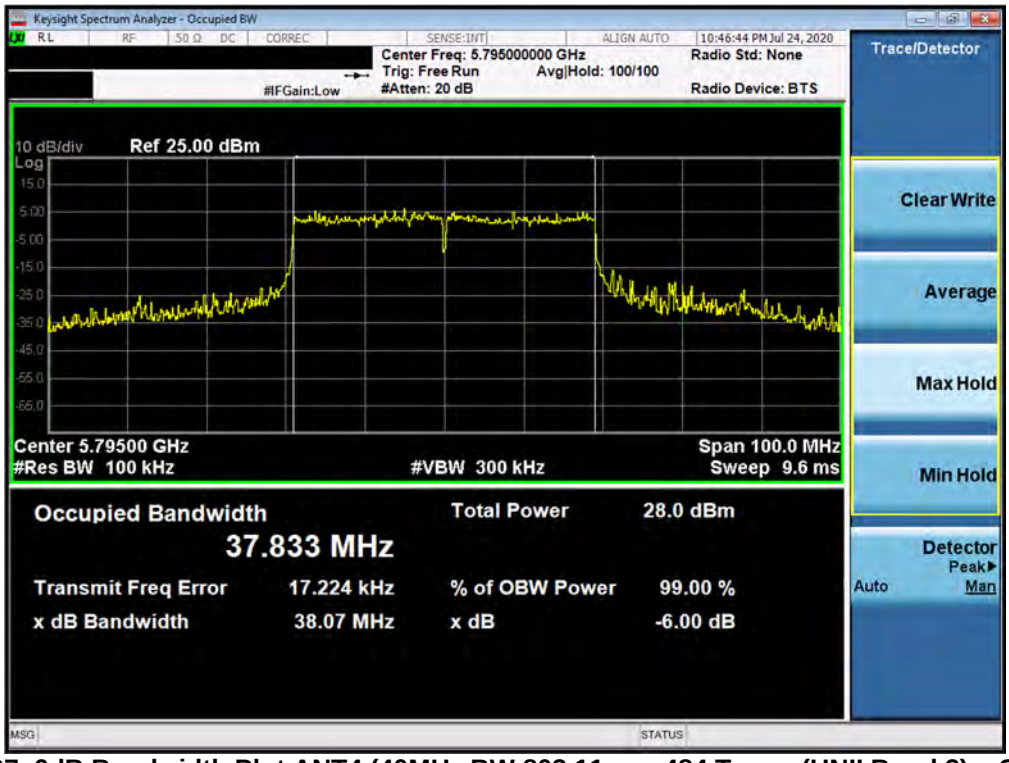
Plot 7-93. 6dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 149)



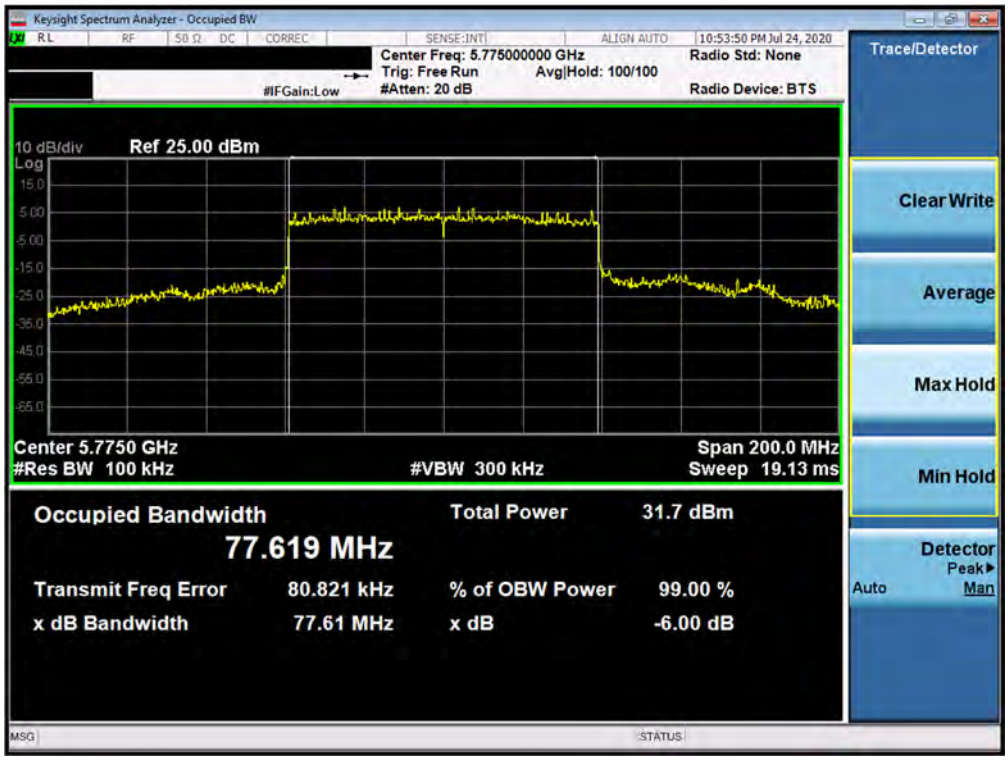
Plot 7-94. 6dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 157)

Plot 7-95. 6dB Bandwidth Plot ANT4 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 165)

Plot 7-96. 6dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 151)



Plot 7-97. 6dB Bandwidth Plot ANT4 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 159)

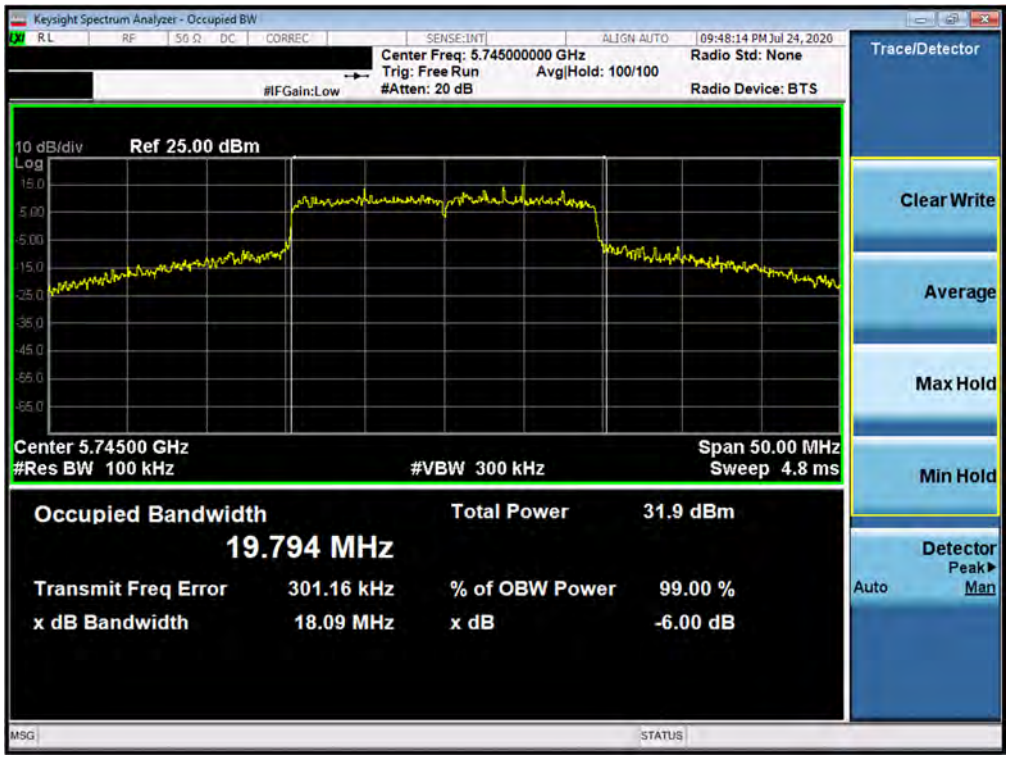


Plot 7-98. 6dB Bandwidth Plot ANT4 (80MHz BW 802.11ax – 996 Tones (UNII Band 3) – Ch. 155)

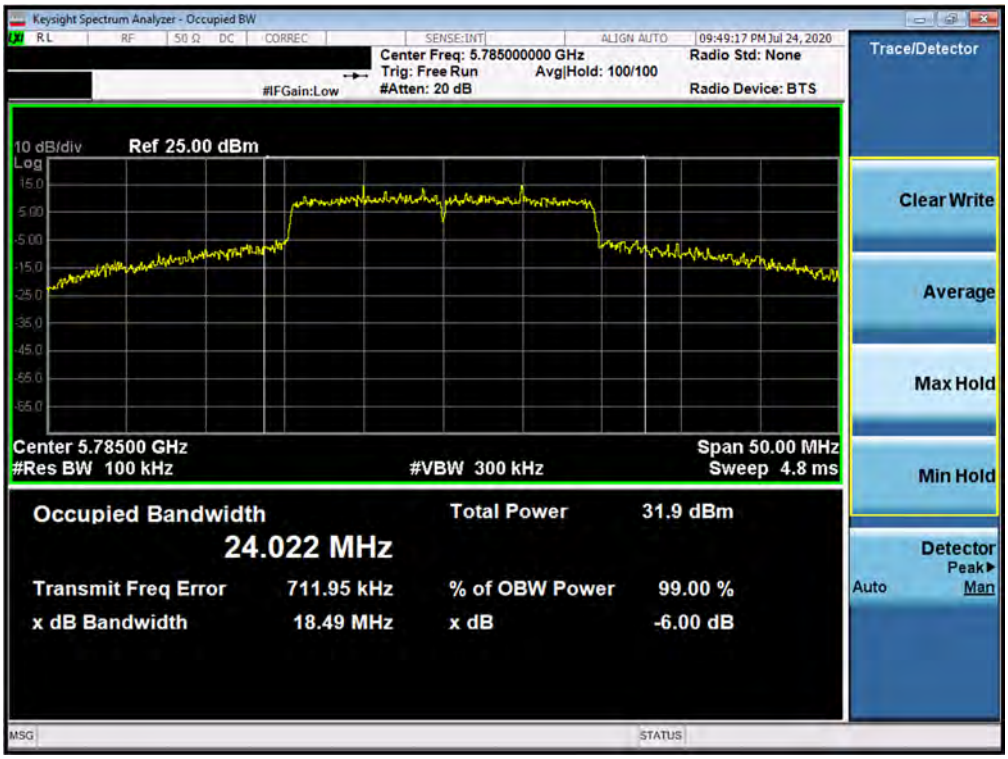
Antenna-5 6 dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	ax (20MHz)	242T	MCS0	18.09
	5785	157	ax (20MHz)	242T	MCS0	18.49
	5825	165	ax (20MHz)	242T	MCS0	18.68
	5755	151	ax (40MHz)	484T	MCS0	37.80
	5795	159	ax (40MHz)	484T	MCS0	37.93
	5775	155	ax (80MHz)	996T	MCS0	76.21

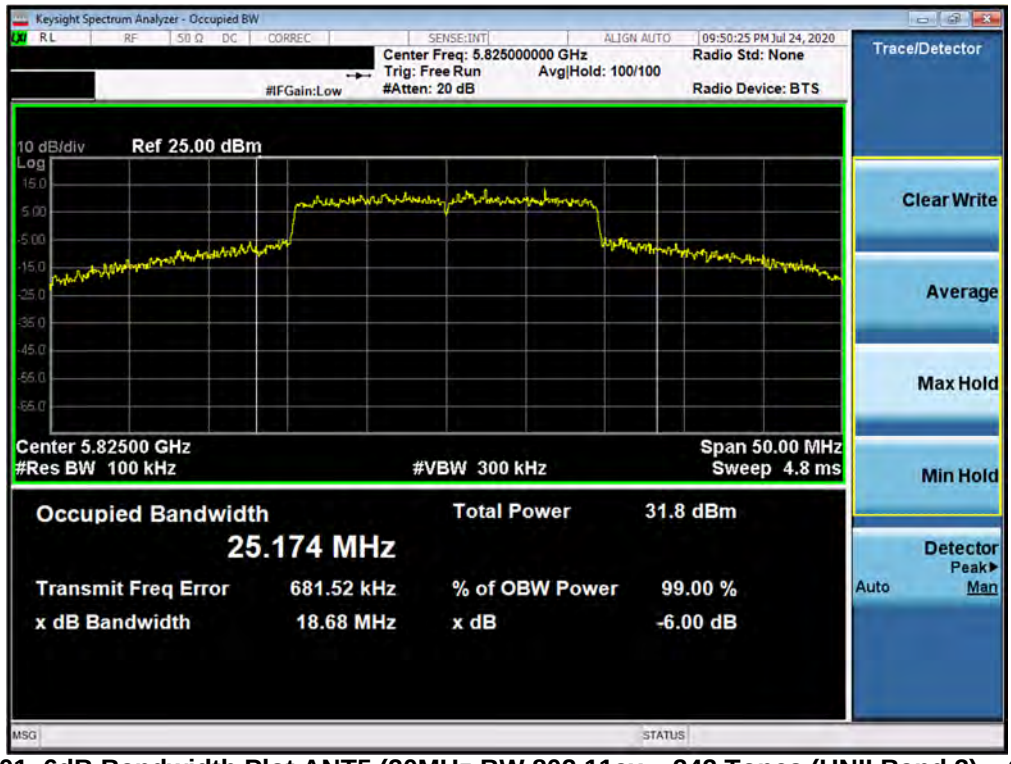
Table 7-9. Conducted Bandwidth Measurements ANT5 (Full Tones)



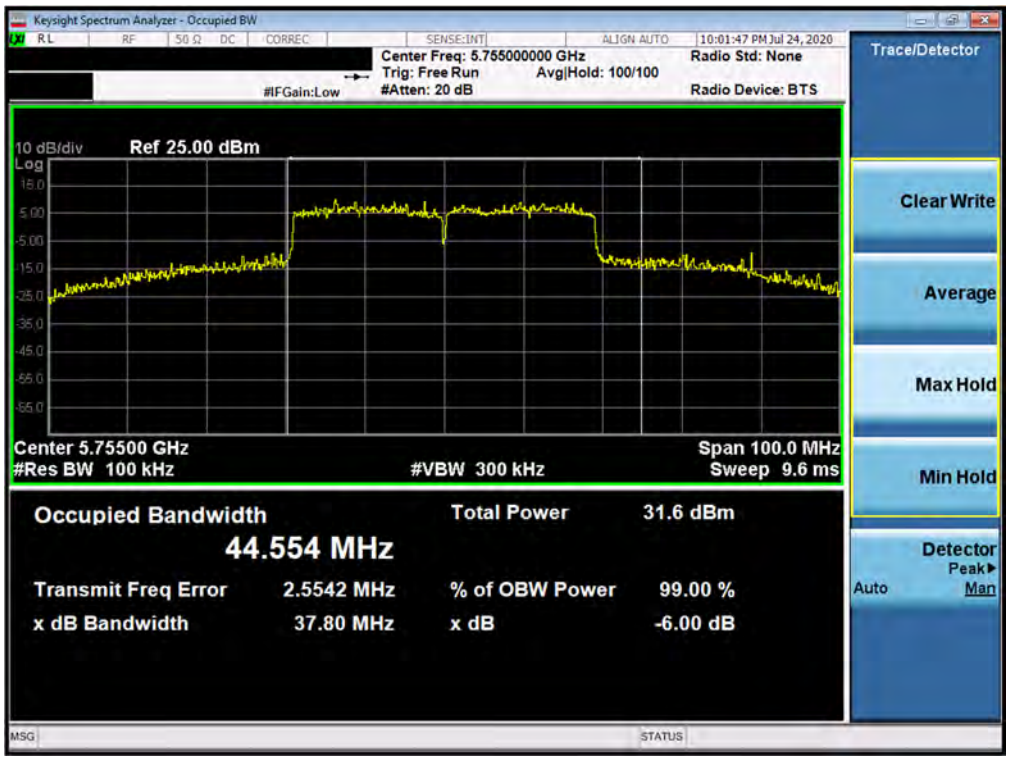
Plot 7-99. 6dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 149)



Plot 7-100. 6dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 157)

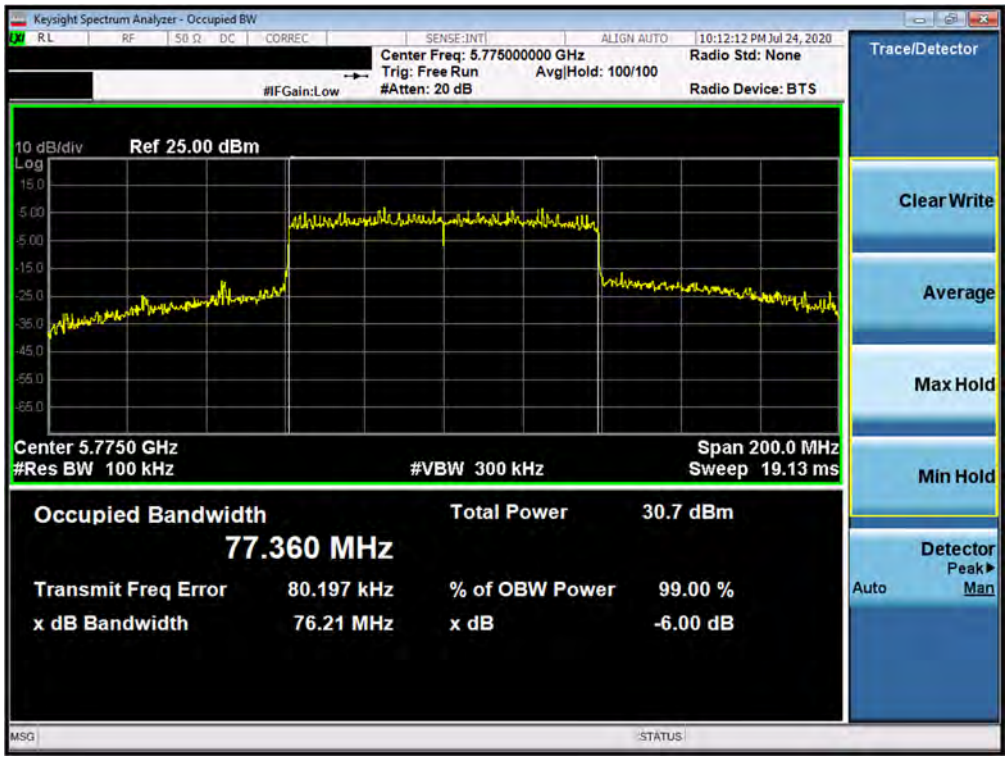


Plot 7-101. 6dB Bandwidth Plot ANT5 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 165)



Plot 7-102. 6dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 151)

Plot 7-103. 6dB Bandwidth Plot ANT5 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 159)

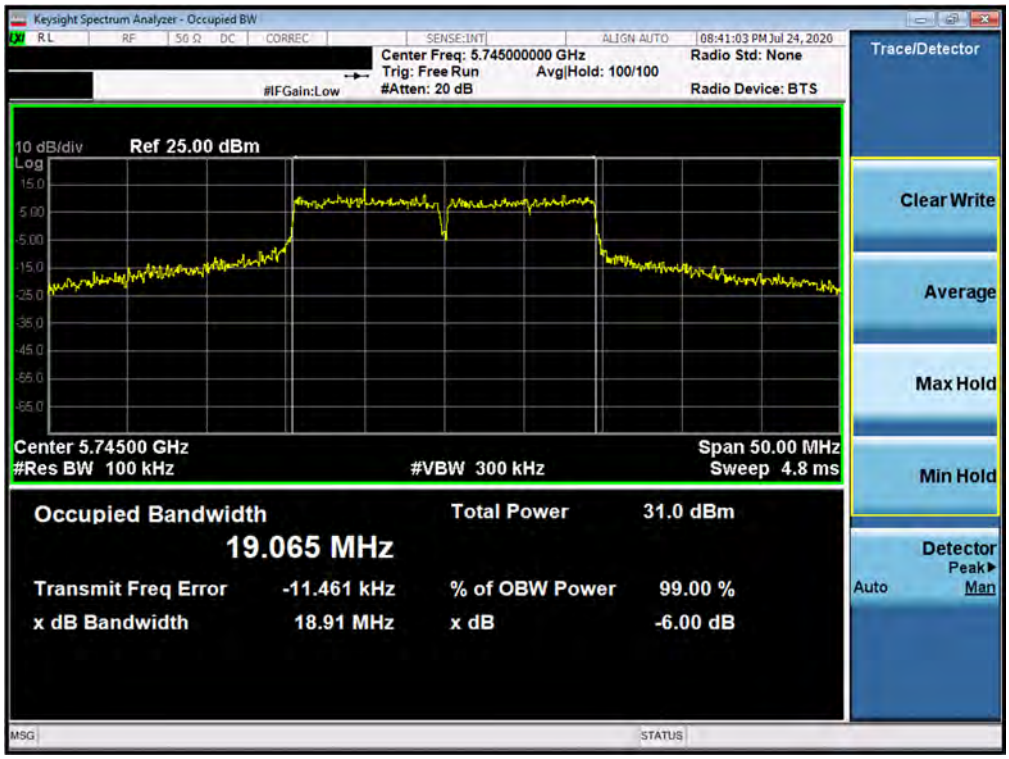


Plot 7-104. 6dB Bandwidth Plot ANT5 (80MHz BW 802.11ax – 996 Tones (UNII Band 3) – Ch. 155)

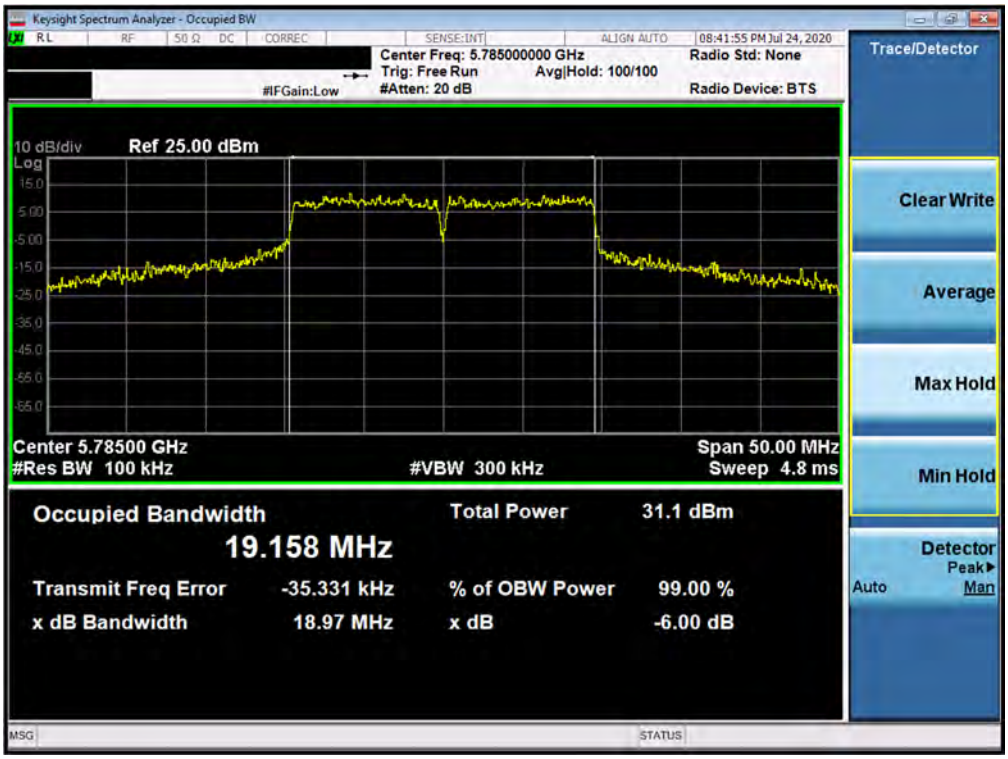
Antenna-6 6dB Bandwidth Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Measured 6dB Bandwidth [MHz]
Band 3	5745	149	ax (20MHz)	242T	MCS0	18.91
	5785	157	ax (20MHz)	242T	MCS0	18.97
	5825	165	ax (20MHz)	242T	MCS0	18.89
	5755	151	ax (40MHz)	484T	MCS0	38.01
	5795	159	ax (40MHz)	484T	MCS0	38.04
	5775	155	ax (80MHz)	996T	MCS0	75.39

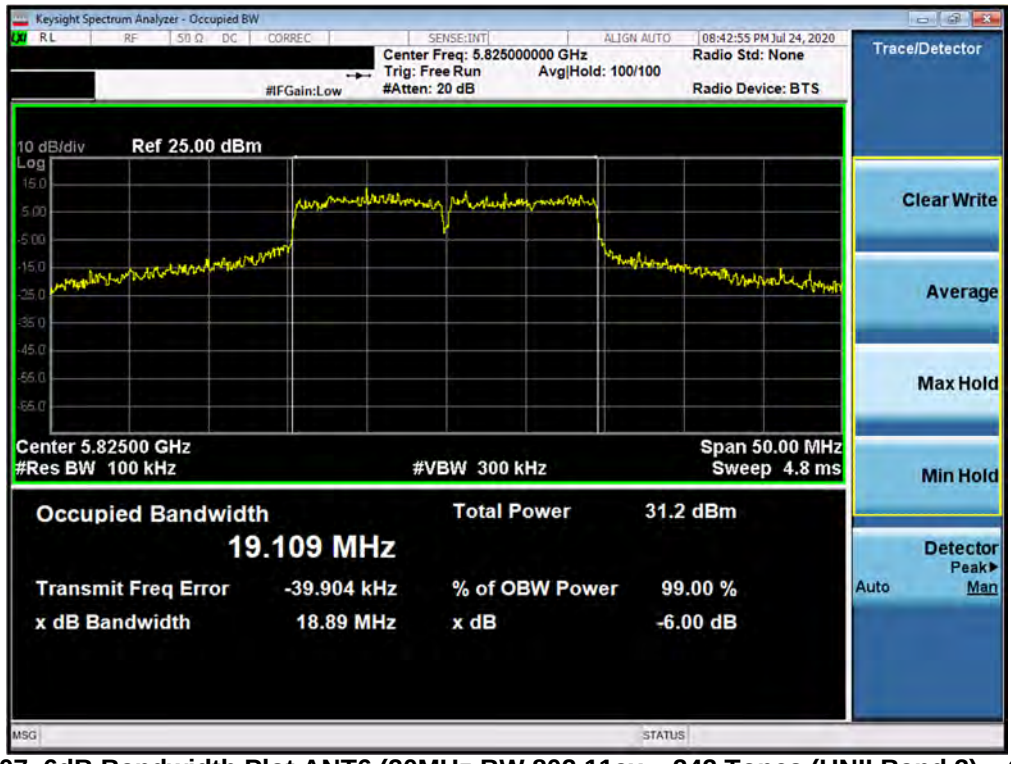
Table 7-10. Conducted Bandwidth Measurements ANT6 (Full Tones)



Plot 7-105. 6dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 149)

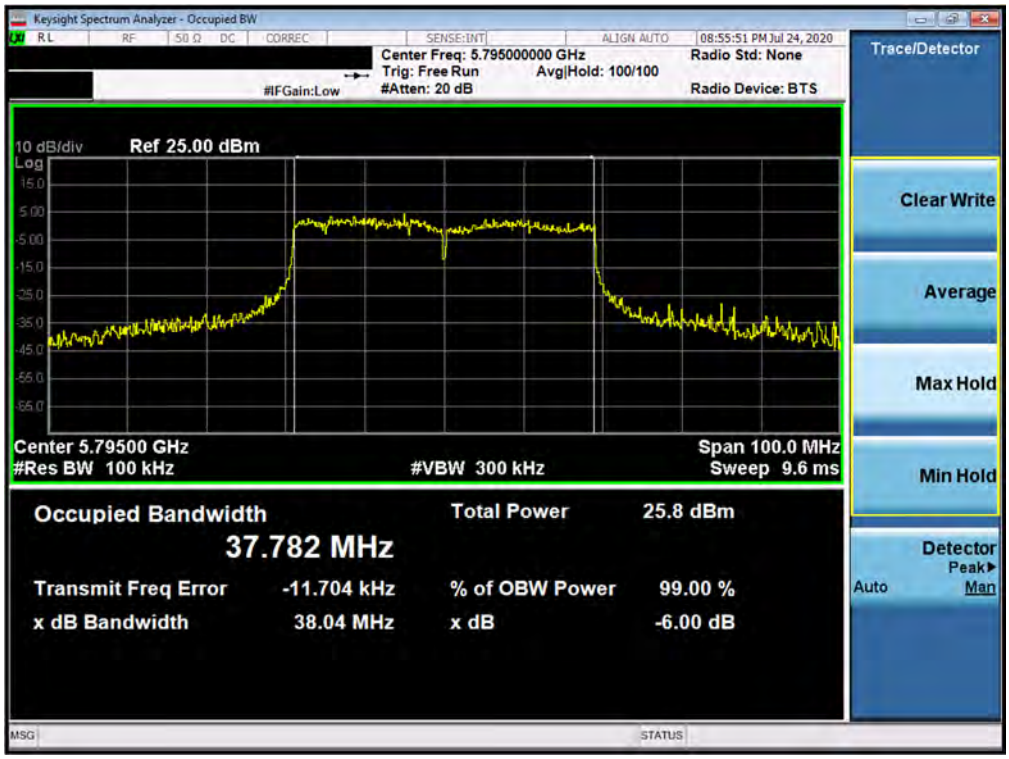


Plot 7-106. 6dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 157)

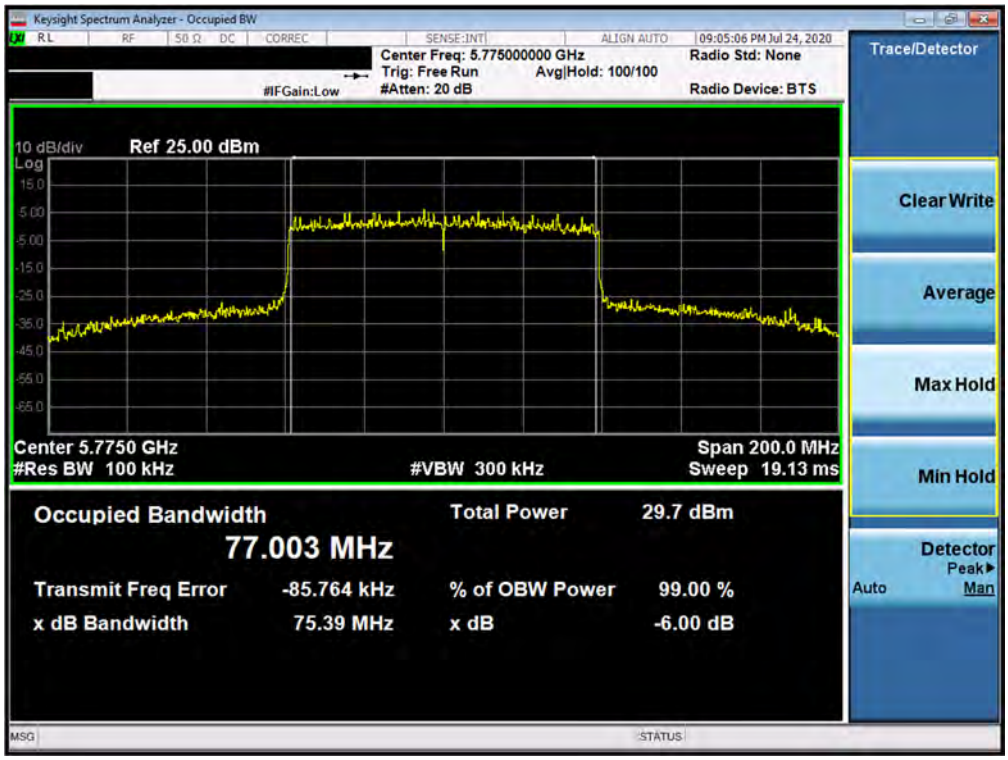


Plot 7-107. 6dB Bandwidth Plot ANT6 (20MHz BW 802.11ax – 242 Tones (UNII Band 3) – Ch. 165)

Plot 7-108. 6dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 151)



Plot 7-109. 6dB Bandwidth Plot ANT6 (40MHz BW 802.11ax – 484 Tones (UNII Band 3) – Ch. 159)



Plot 7-110. 6dB Bandwidth Plot ANT6 (80MHz BW 802.11ax – 996 Tones (UNII Band 3) – Ch. 155)

7.4 UNII Output Power Measurement – 802.11ax OFDMA

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

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.

In the 5.15 – 5.25GHz band, the maximum permissible conducted output power is 250mW (23.98dBm). The maximum e.i.r.p. shall not exceed the lesser of 200 mW or 10 + 10 log10B, dBm.

In the 5.25 – 5.35GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(19.76) = 23.96dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 log10B, dBm.

In the 5.47 – 5.725GHz band, the maximum permissible conducted output power is the lesser of 250mW (23.98dBm) or 11 dBm + 10log$_{10}$(26dB BW) = 11 dBm + 10log$_{10}$(36.55) = 26.63dBm. The maximum e.i.r.p. shall not exceed the lesser of 1.0 W or 17 + 10 log10B, dBm.

In the 5.725 – 5.850GHz band, the maximum permissible conducted output power is 1W (30dBm). The maximum e.i.r.p. is 36 dBm.

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 7-3. Test Instrument & Measurement Setup

MIMO Conducted Output Power Measurements (242 Tones)

	Band	Freq [MHz]	Channel	Tones	Average Conducted Power (dBm)				
					RU Index: 61				
					ANT3	ANT4	ANT5	ANT6	MIMO
20MHz BW	1	5180	36	242T	16.93	17.27	17.13	17.12	23.13
		5200	40	242T	22.64	22.72	22.15	22.19	28.45
		5240	48	242T	22.80	22.95	22.61	22.98	28.86
	2A	5260	52	242T	16.18	16.19	15.81	15.90	22.04
		5280	56	242T	16.30	16.26	15.83	15.90	22.10
		5320	64	242T	15.46	15.75	15.99	15.85	21.79
	2C	5500	100	242T	12.87	13.33	13.47	13.36	19.28
		5600	120	242T	14.89	14.87	14.19	13.54	20.43
		5720	144	242T	14.69	14.89	14.49	13.41	20.43
	3	5745	149	242T	22.38	22.95	21.70	20.51	28.00
		5785	157	242T	22.08	22.86	21.67	20.49	27.88
		5825	165	242T	22.44	22.49	22.42	21.53	28.26

Table 7-11. MIMO 20MHz BW (UNII) Maximum Conducted Output Power (242 Tones)

	Band	Freq [MHz]	Channel	Tones	Average Conducted Power (dBm)				
					RU Index: 65				
					ANT3	ANT4	ATN3	ANT6	MIMO
40MHz BW	1	5190	38	484T	11.26	11.47	10.67	11.20	17.18
		5230	46	484T	22.89	22.31	22.56	22.12	28.50
	2A	5270	54	484T	16.82	16.45	16.43	15.77	22.40
		5310	62	484T	13.84	13.98	14.41	14.40	20.19
	2C	5510	102	484T	9.86	10.35	10.92	10.89	16.55
		5590	118	484T	16.01	16.16	15.55	14.35	21.59
		5710	142	484T	15.47	16.45	15.56	14.30	21.53
	3	5755	151	484T	21.99	22.10	21.28	20.12	27.46
		5795	159	484T	22.36	22.32	22.13	20.52	27.92

Table 7-12. MIMO 40MHz BW (UNII) Maximum Conducted Output Power (484 Tones)

80MHz BW	Band	Freq [MHz]	Channel	Tones	Average Conducted Power (dBm) RU Index: 67				
					ANT3	ANT4	ATN3	ANT6	MIMO
	1	5210	42	996T	9.33	9.29	8.95	8.86	15.13
	2A	5290	58	996T	11.64	11.57	11.83	11.43	17.64
	2C	5530	106	996T	10.50	8.98	9.39	9.79	15.72
		5610	122	996T	16.28	15.94	15.13	13.78	21.40
		5690	138	996T	16.49	16.48	15.63	14.05	21.79
	3	5775	155	996T	21.83	21.96	21.38	19.96	27.37

Table 7-13. MIMO 80MHz BW (UNII) Maximum Conducted Output Power (996 Tones)

80+80MHz BW	Band	Freq [MHz]	Channel	Tones	Average Conducted Power (dBm) RU Index: 67				
					ANT3	ANT4	ANT5	ANT6	MIMO
	1	5210	42	996T	9.49	8.84			12.19
	2A	5290	58	996T			9.50	9.01	12.27
	2C	5530	106	996T	8.93	9.73			12.36
	2C	5610	122	996T			9.77	9.89	12.84

Table 7-14. MIMO 80+80MHz BW (UNII) Maximum Conducted Output Power (996+996 Tones)

Note:

Per ANSI C63.10-2013 and KDB 662911 v02r01 Section E)1), the conducted powers at Antenna 3, Antenna 4, Antenna 5 and Antenna 6 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.

$$\text{Directional gain} = 10 \log[(10^{G_1/20} + 10^{G_2/20} + \ldots + 10^{G_N/20})^2 / N_{ANT}] \text{ dBi}$$

Sample MIMO Calculation:

At 5240MHz in 802.11ax (20MHz BW) mode, the average conducted output power was measured to be 22.80 dBm for Antenna-3, 22.95 dBm for Antenna-4, 22.61 dBm for Antenna-5 and 22.98 dBm for Antenna-6.

Antenna 3 + Antenna 4 + Antenna 5 + Antenna 6 = MIMO

(23.80 dBm + 22.95 dBm + 22.61 dBm + 22.98 dBm) = (190.55 mW + 197.24 mW + 182.39 mW + 198.30 mW) = 768.79 mW = 28.86 dBm

At 5530MHz in 802.11ax (80+80MHz BW) mode, the average conducted output power was measured to be 9.93 dBm for Antenna-3 and 10.73 dBm for Antenna-4.

Antenna 3 + Antenna 4 = MIMO

(8.93 dBm + 10.73 dBm) = (7.816 mW + 11.830 mW) = 19.647 mW = 12.93 dBm

Sample e.i.r.p. Calculation:

At 5180MHz in 802.11n (20MHz BW) mode, the average MIMO conducted power was calculated to be 28.86 dBm with directional gain of 4.28 dBi.

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

28.86 dBm + 4.28 dBi = 33.14 dBm

7.5 Maximum Power Spectral Density – 802.11ax OFDMA

§15.407(a.1.iv) §15.407(a.2) §15.407(a.3); RSS-247 [6.2]

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.

In the 5.15 – 5.25GHz bands, the maximum permissible power spectral density is 17dBm/MHz.

In the 5.25 – 5.35GHz and 5.47 – 5.725GHz bands, the maximum permissible power spectral density is 11dBm/MHz.

In the 5.725 – 5.850GHz band, the maximum permissible power spectral density is 30dBm/500kHz.

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 7-4. Test Instrument & Measurement Setup

Test Notes

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

Summed MIMO Power Spectral Density Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Antenna-3 Power Density [dBm]	Antenna-4 Power Density [dBm]	Antenna-5 Power Density [dBm]	Antenna-6 Power Density [dBm]	Summed MIMO Power Density [dBm]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5180	36	ax (20MHz)	242T	MCS0	5.10	5.02	4.87	4.63	10.93	17.00	-6.07
	5200	40	ax (20MHz)	242T	MCS0	10.57	11.00	11.11	11.02	16.95	17.00	-0.05
	5240	48	ax (20MHz)	242T	MCS0	10.39	11.01	10.70	11.10	16.83	17.00	-0.17
	5190	38	ax (40MHz)	484T	MCS0	-2.37	-1.82	-2.17	-2.25	3.87	17.00	-13.13
	5230	46	ax (40MHz)	484T	MCS0	10.63	10.13	10.05	9.97	16.22	17.00	-0.78
	5210	42	ax (80MHz)	996T	MCS0	-6.58	-6.59	-6.01	-5.91	-0.24	17.00	-17.24
Band 2A	5260	52	ax (20MHz)	242T	MCS0	4.53	4.71	4.15	4.02	10.38	11.00	-0.62
	5280	56	ax (20MHz)	242T	MCS0	4.26	4.67	4.76	4.16	10.49	11.00	-0.51
	5320	64	ax (20MHz)	242T	MCS0	4.86	5.16	4.52	4.13	10.71	11.00	-0.29
	5270	54	ax (40MHz)	484T	MCS0	4.67	4.54	4.26	3.68	10.32	11.00	-0.68
	5310	62	ax (40MHz)	484T	MCS0	0.83	1.26	0.05	-0.11	6.56	11.00	-4.44
	5290	58	ax (80MHz)	996T	MCS0	-4.18	-4.76	-4.19	-4.69	1.57	11.00	-9.43
Band 2C	5500	100	ax (20MHz)	242T	MCS0	4.19	3.31	2.94	2.55	9.31	11.00	-1.69
	5600	120	ax (20MHz)	242T	MCS0	4.61	4.55	4.01	3.26	10.16	11.00	-0.84
	5720	144	ax (20MHz)	242T	MCS0	5.47	5.52	4.76	3.38	10.88	11.00	-0.12
	5510	102	ax (40MHz)	484T	MCS0	-1.51	-1.94	-2.29	-2.38	4.00	11.00	-7.00
	5590	118	ax (40MHz)	484T	MCS0	5.54	5.15	4.84	3.53	10.85	11.00	-0.15
	5710	142	ax (40MHz)	484T	MCS0	5.13	5.76	4.28	3.88	10.85	11.00	-0.15
	5530	106	ax (80MHz)	996T	MCS0	-4.55	-3.81	-6.47	-6.45	0.86	11.00	-10.14
	5610	122	ax (80MHz)	996T	MCS0	4.90	5.54	4.41	2.59	10.51	11.00	-0.49
	5690	138	ax (80MHz)	996T	MCS0	5.27	6.14	4.23	3.43	10.91	11.00	-0.09

Table 7-15. Bands 1, 2A, 2C MIMO Conducted Power Spectral Density Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Antenna-3 Power Density [dBm]	Antenna-4 Power Density [dBm]	Antenna-5 Power Density [dBm]	Antenna-6 Power Density [dBm]	Summed MIMO Power Density [dBm]	Max Permissible Power Density	Margin [dB]
Band 3	5745	149	ax (20MHz)	242T	MCS0	13.49	14.16	13.99	13.04	19.71	30.00	-10.29
	5785	157	ax (20MHz)	242T	MCS0	12.90	13.52	13.47	12.66	19.17	30.00	-10.83
	5825	165	ax (20MHz)	242T	MCS0	12.33	12.79	12.13	12.17	18.38	30.00	-11.62
	5755	151	ax (40MHz)	484T	MCS0	10.64	12.06	11.12	9.97	17.04	30.00	-12.96
	5795	159	ax (40MHz)	484T	MCS0	10.11	10.87	9.05	9.29	15.91	30.00	-14.09
	5775	155	ax (80MHz)	996T	MCS0	7.28	7.35	6.40	5.81	12.78	30.00	-17.22

Table 7-16. Band 3 MIMO Conducted Power Spectral Density Measurements (Full Tones)

	Frequency [MHz]	Channel No.	802.11 Mode	Tones	Data Rate [Mbps]	Antenna-3 Power Density [dBm]	Antenna-4 Power Density [dBm]	Antenna-5 Power Density [dBm]	Antenna-6 Power Density [dBm]	Summed MIMO Power Density [dBm]	Max Power Density [dBm/MHz]	Margin [dB]
Band 1	5210	42	ax (80MHz)	996T	MCS0	-5.42	-6.46			-2.90	17.00	-19.90
Band 2A	5290	58	ax (80MHz)	996T	MCS0			-6.64	-4.69	-2.55	11.00	-13.55
Band 2C	5530	106	ax (80MHz)	996T	MCS0	-4.18	-2.81			-0.43	11.00	-11.43
	5610	122	ax (80MHz)	996T	MCS0			-6.19	-5.88	-3.02	11.00	-14.02

Table 7-17. Bands 1, 2A, 2C MIMO 80+80MHz Conducted Power Spectral Density Measurements (Full Tones)

Note:

Per ANSI C63.10-2013 Section 14.3.2.2 and KDB 662911 v02r01 Section E)2), the power spectral density at Antenna 3, Antenna 4, Antenna 5 and Antenna 6 were first measured separately with reduced Antenna 3, Antenna 4 powers, Antenna 5 powers and Antenna 6 powers per manufacture's tune-up document. The measured values were then summed in linear power units then converted back to dBm.

Sample MIMO Calculation:

Assuming the average conducted power spectral density was measured to be 22.80 dBm for Antenna-3, 22.95 dBm for Antenna-4, 22.61 dBm for Antenna-5 and 22.98 dBm for Antenna-6.

Antenna 3 + Antenna 4 + Antenna 5 + Antenna 6 = MIMO

(10.57 dBm + 11.00 dBm + 11.11 dBm + 11.02 dBm) = (11.402 mW + 12.589 mW + 12.912 mW + 12.647 mW) = 49.551 mW = 16.95 dBm

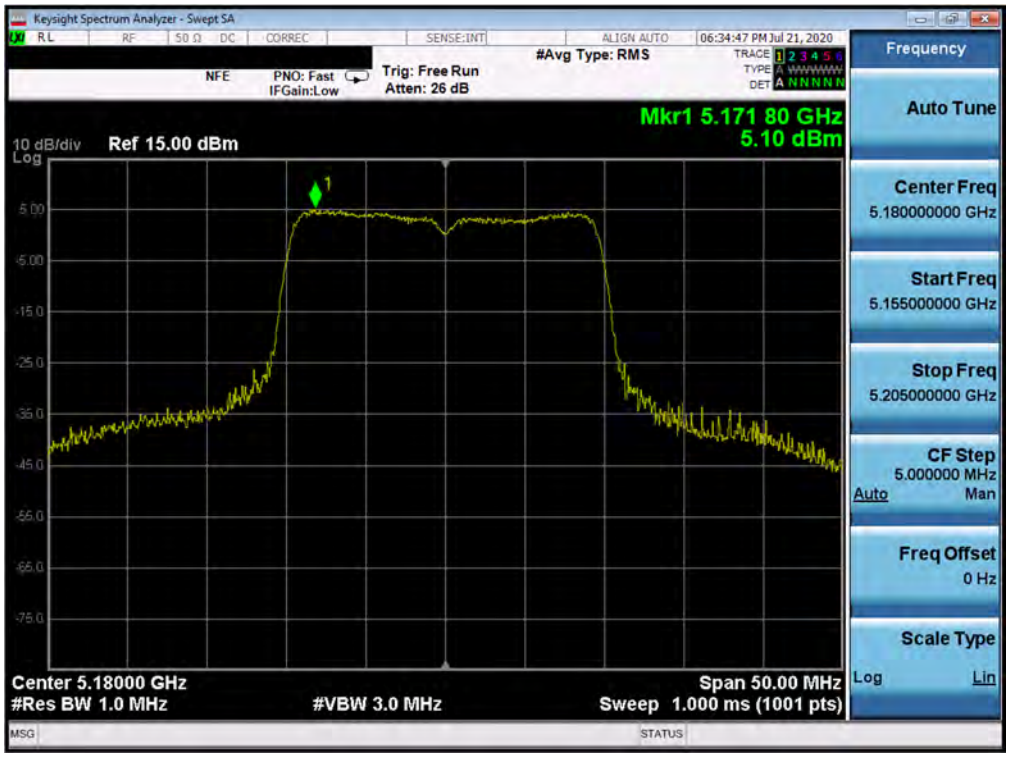
Sample e.i.r.p Power Spectral Density Calculation:

Assuming the average MIMO power density was calculated to be 16.95 dBm with directional gain of 4.7 dBi.

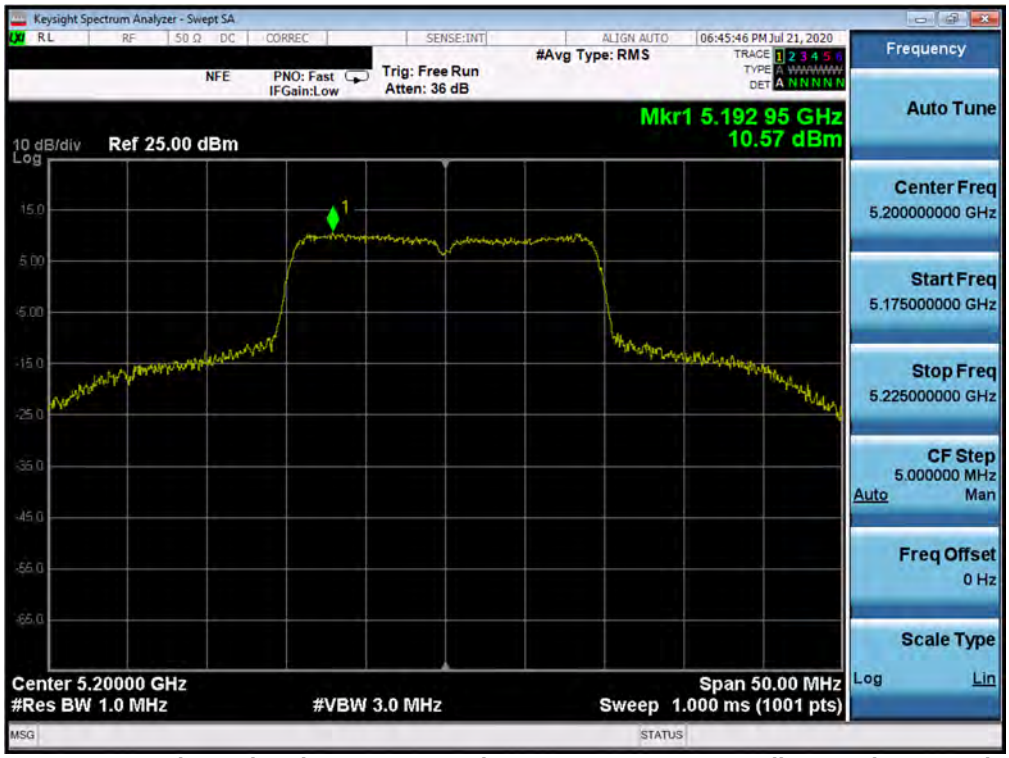
e.i.r.p. Power Spectral Density(dBm) = Power Spectral Density (dBm) + directional gain (dBi)

16.95 dBm + 4.7 dBi = 21.65 dBm

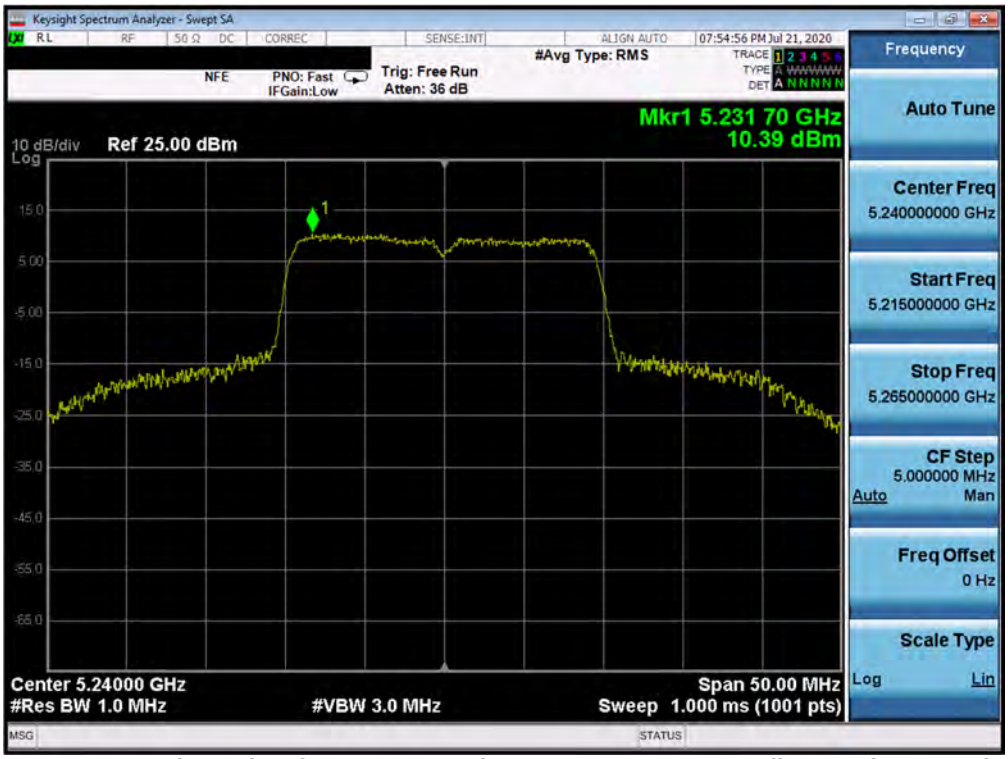
MIMO Antenna-3 Power Spectral Density Measurements (Full Tones)



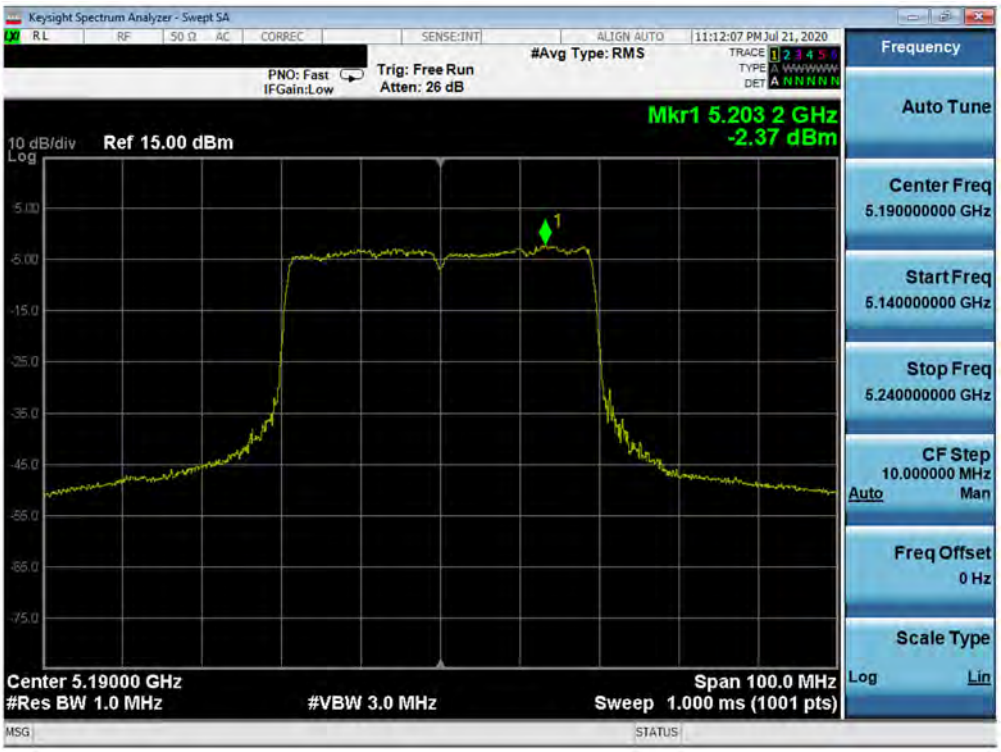
Plot 7-111. Power Spectral Density Plot MIMO ANT3 (20MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 36)



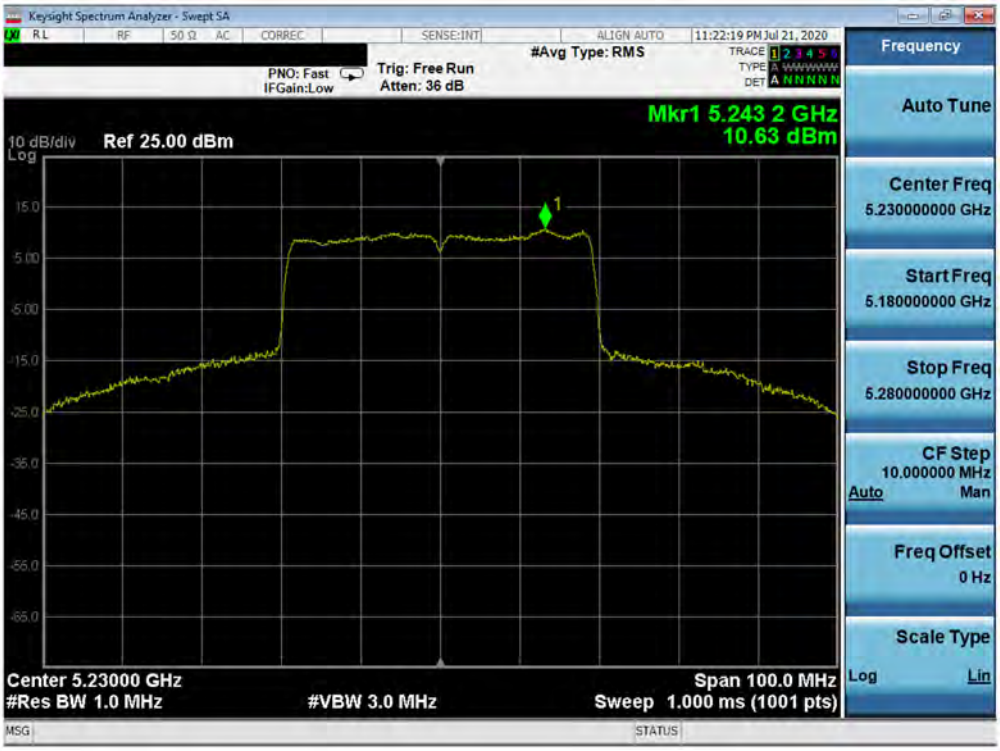
Plot 7-112. Power Spectral Density Plot MIMO ANT3 (20MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 40)



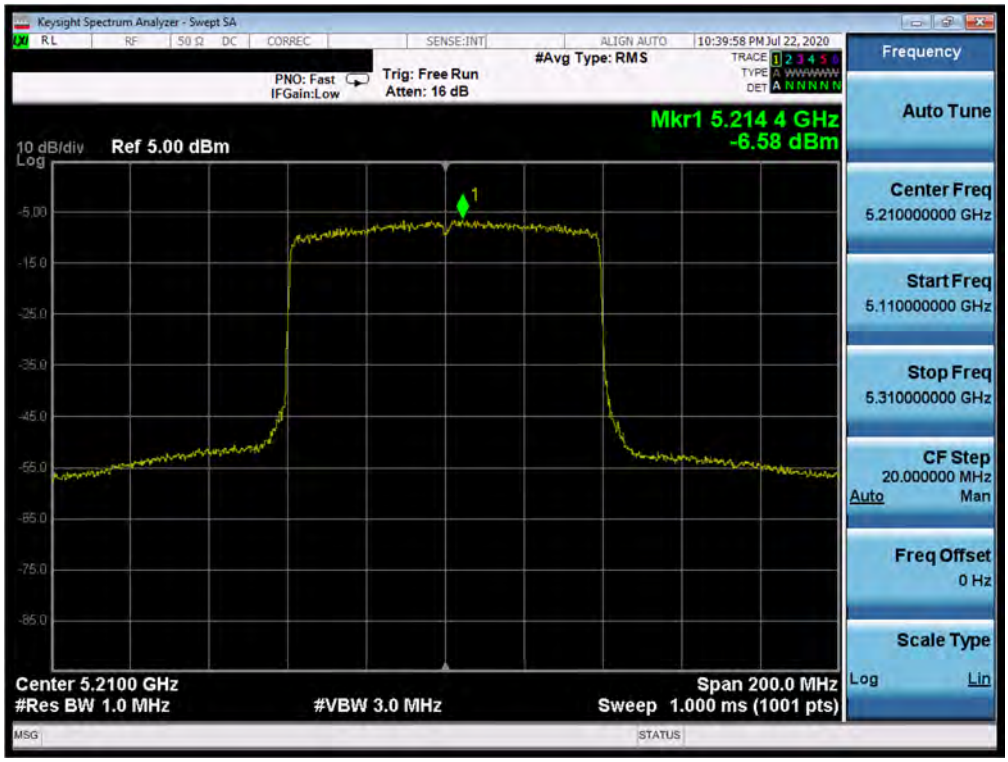
Plot 7-113. Power Spectral Density Plot MIMO ANT3 (20MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 48)



Plot 7-114. Power Spectral Density Plot MIMO ANT3 (40MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 38)



Plot 7-115. Power Spectral Density Plot MIMO ANT3 (40MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 46)



Plot 7-116. Power Spectral Density Plot MIMO ANT3 (80MHz BW 802.11ax – Full Tones (UNII Band 1) – Ch. 42)