Nemko Korea Co., Ltd.

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FCC EVALUATION REPORT FOR CERTIFICATION

Applicant :
Anam Electronics Co., Ltd.
27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea.
Attn. : Byeong-Seob, Lee

Dates of Issue : July 25, 2019
Test Report No. : NK-19-R-052
Test Site : Nemko Korea Co., Ltd.

FCC ID	**MBBVOP13082E**
Brand Name	**ANAM**
Contact Person	**Anam Electronics Co., Ltd.** **27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375,** **Republic of Korea.** **Byeong-Seob, Lee** **Telephone No. : +82-2-6424-4881**

Applied Standard:	FCC 47 CFR Part 15.407
Classification:	Unlicensed National Information Infrastructure (NII)
EUT Type:	DMA WiFi/BT Platform Module

The device bearing the brand name and model specified above has been shown to comply 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. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and 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.

Jul. 25. 2019

Tested By : Wonjae Song
Engineer

July. 25. 2019

Reviewed By : Seungyong Shin
Technical Manager

TABLE OF CONTENTS

1. SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.

Responsible Party :	Anam Electronics Co., Ltd. 27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea
Contact Person :	Byeong Seob, Lee
Manufacturer :	Anam Electronics Co., Ltd. 27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea

- FCC ID: MBBVOP13082E
- Model: VOP13082E
- Variant Model: VOP13082B, VOP13802C, VOP13082D
- Brand Name: ANAM
- EUT Type: DMA WiFi/BT Platform Module
- Classification: Unlicensed National Information Infrastructure (NII)
- Applied Standard: FCC 47 CFR Part 15.407
- Test Procedure(s): 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E”.
- Dates of Test: May 30, 2019 ~ July 25, 2019
- Place of Tests: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **Anam Electronics Co., Ltd. FCC ID : MBB VOP13082E** and **IC : 11657A- VOP13082E.**

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon- Eup, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.

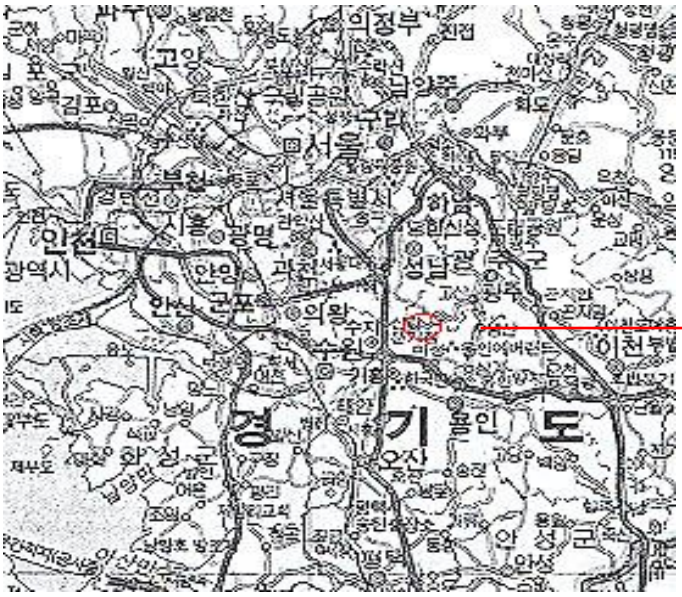

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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
Industry Canada	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the SISO, CDD, MIMO transceiver which is module supporting the 802.11a/b/g/n/ac mode (802.11a/b/g/n(20,40MHz)/ac(20,40,80MHz) : 1TX/1RX, 4TX/4RX).
The Laptop was used to control the EUT to transmit the wanted TX channel continuously (duty cycle< 98%) by the testing program (TeraTerm) supported by manufacturer.
The operating voltage of EUT was 5.0 Vdc supplied from jig board connected to USB port on Laptop PC.
The EUT was tested at the lowest, middle and the highest channels with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

3.1.1 Table of test power setting

Frequency	Mode	Power setting Level (1TX)	Power setting Level (2TX)
5180 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5220 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5240 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5190 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5230 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5210 MHz	802.11ac (80 MHz)	12	9
5260 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5300 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8

Frequency	Mode	Power setting Level (1TX)	Power setting Level (2TX)
5320 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5270 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5310 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5290 MHz	802.11ac (80 MHz)	12	9
5500 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5600 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5700 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5510 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5590 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5670 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5530 MHz	802.11ac (80 MHz)	12	9
5610 MHz	802.11ac (80 MHz)	12	9
5720 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5710 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5690 MHz	802.11ac (80 MHz)	12	9

Frequency	Mode	Power setting Level (1TX)	Power setting Level (2TX)
5745 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5785 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5825 MHz	802.11a	11	-
	802.11n (20 MHz)	12	8
	802.11ac (20 MHz)	12	8
5755 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5795 MHz	802.11n (40 MHz)	12	9
	802.11ac (40 MHz)	12	9
5775 MHz	802.11ac (80 MHz)	12	9

3.1.2 Table of test channels

Frequency band	Mode	Test Channel (CH)	Frequency (MHz)
U-NII-1	802.11a,n,ac (20MHz)	36	5180
		44	5220
		48	5240
	802.11n,ac (40MHz)	38	5190
		46	5230
	802.11ac (80MHz)	42	5210
U-NII-2A	802.11a,n,ac (20MHz)	52	5260
		60	5300
		64	5320
	802.11n,ac (40MHz)	54	5270
		62	5310
	802.11ac (80MHz)	58	5290

Frequency band	Mode	Test Channel (CH)	Frequency (MHz)
U-NII-2C	802.11a,n,ac (20MHz)	100	5500
		120	5600
		140	5700
	802.11n,ac (40MHz)	102	5510
		118	5590
		134	5670
	802.11ac (80MHz)	106	5530
		122	5610
Straddle	802.11a,n,ac (20MHz)	144	5720
	802.11n,ac (40MHz)	142	5710
	802.11ac (80MHz)	138	5690
U-NII-3	802.11a,n,ac (20MHz)	149	5745
		157	5785
		165	5825
	802.11n,ac (40MHz)	151	5755
		159	5795
	802.11ac (80MHz)	155	5775

3.1.3 Antenna information:

Frequency band	Mode	Data rate	Antenna TX mode	Support CDD	Support MIMO
5 GHz	802.11a	All	■ 1TX, □ 2TX	□ Yes, ■ No	□ Yes, ■ No
	802.11n (20 MHz)	MCS 0~7	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS 8~15	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No
	802.11n (40 MHz)	MCS 0~7	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS 8~15	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No
5 GHz	802.11ac (20 MHz)	MCS0NSS1~ MCS8NSS1	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS0NSS2~ MCS8NSS2	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No

5 GHz	802.11ac (40 MHz)	MCS0NSS1~ MCS9NSS1	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS0NSS2~ MCS9NSS2	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No
	802.11ac (80 MHz)	MCS0NSS1~ MCS9NSS1	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS0NSS2~ MCS9NSS2	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No

Note :

1. CDD mode is Cyclic Delay Diversity mode.
2. For 802.11n(20 MHz),EUT support CDD mode for MCS0~7 and MIMO mode for MCS8~15.
3. For 802.11n(40 MHz),EUT support CDD mode for MCS0~7 and MIMO mode for MCS8~15.
4. For 802.11ac(20 MHz),EUT support CDD mode for MCS0NSS1~MCS8NSS1 and MIMO mode for MCS0NSS2~MCS8NSS2.
5. For 802.11ac(40 MHz),EUT support CDD mode for MCS0NSS1~MCS9NSS1 and MIMO mode for MCS0NSS2~MCS9NSS2.
6. For 802.11ac(80 MHz),EUT support CDD mode for MCS0NSS1~MCS9NSS1 and MIMO mode for MCS0NSS2~MCS9NSS2.
7. CDD mode, N_{SS}=1, MIMO mode, N_{SS}= 2, where N_{SS} = number of spatial streams.
8. MIMO mode means SM-MIMO transmission.

3.1.4 Additional Information Related to Testing

The cable and attenuator loss from 30MHz to 26.5GHz was reflected in spectrum analyzer with correction factor for all conducted testing.

3.1.5 Table of test modes

Test Items	Mode	*Data rate (Mbps)	Test Channel (CH)	Antenna
Conducted Emissions	802.11ac (20 MHz)	N/A	N/A	N/A
Radiated Emissions	802.11ac (20 MHz)	MCS0NSS1	36/52/100/149	Ant 1
26 dB Bandwidth	802.11a	6	36/44/48 52/60/64 100/120/140 144/149/157/165	Ant 1
	802.11n (20 MHz)	MCS0		Ant 1
	802.11ac (20 MHz)	MCS0NSS1		Ant 1

26 dB Bandwidth	802.11n (40 MHz)	MCS0	38/46 54/62 102/118/134 142/151/159	Ant 1
	802.11ac (40 MHz)	MCS0NSS1		Ant 1
	802.11ac (80 MHz)	MCS0NSS1	42/58/106 122/138/155	Ant 1
6 dB Bandwidth	802.11a	6	144/149 157/165	Ant 1
	802.11n (20 MHz)	MCS0		Ant 1
	802.11ac (20 MHz)	MCS0NSS1		Ant 1
	802.11n (40 MHz)	MCS0	142/151/159	Ant 1
	802.11ac (40 MHz)	MCS0NSS1		Ant 1
	802.11ac (80 MHz)	MCS0NSS1	138/155	Ant 1
Maximum conducted Output Power	802.11a	6	36/44/48 52/60/64 100/120/140 144/149/157/165	Ant 0, Ant 1
	802.11n (20 MHz)	MCS0		Ant 0, Ant 1
	802.11ac (20 MHz)	MCS0NSS1		Ant 0, Ant 1
	802.11n (40 MHz)	MCS0	38/46 54/62 102/118/134 142/151/159	Ant 0, Ant 1
	802.11ac (40 MHz)	MCS0NSS1		Ant 0, Ant 1
	802.11ac (80 MHz)	MCS0NSS1	42/58/106 122/138/155	Ant 0, Ant 1
Power Spectral Density	802.11a	6	36/44/48 52/60/64 100/120/140 144/149/157/165	Ant 1
	802.11n (20 MHz)	MCS0		Ant 1
	802.11ac (20 MHz)	MCS0NSS1		Ant 1
	802.11n (40 MHz)	MCS0	38/46 54/62 102/118/134 142/151/159	Ant 1
	802.11ac (40 MHz)	MCS0NSS1		Ant 1
	802.11ac (80 MHz)	MCS0NSS1	42/58/106 122/138/155	Ant 1

Radiated Spurious Emission	802.11ac (20 MHz)	MCS0NSS1	36/44/48 52/60/64 100/120/140 144/149/157/165	Ant 1
Radiated Band edge Emission	802.11ac (20 MHz)	MCS0NSS1	36/48 52/64 100/140 144/149/165	Ant 1
	802.11ac (40 MHz)	MCS0NSS1	38/46 54/62 102/134 142/151/159	Ant 1
	802.11ac (80 MHz)	MCS0NSS1	42/58/106 122/138/155	Ant 1

Note :

*1. *The worst data rate was determined by the conducted output power that generates the highest emission performing pre-scan testing in all data rates of each mode.*

3.1.6 Table of actual operating channels

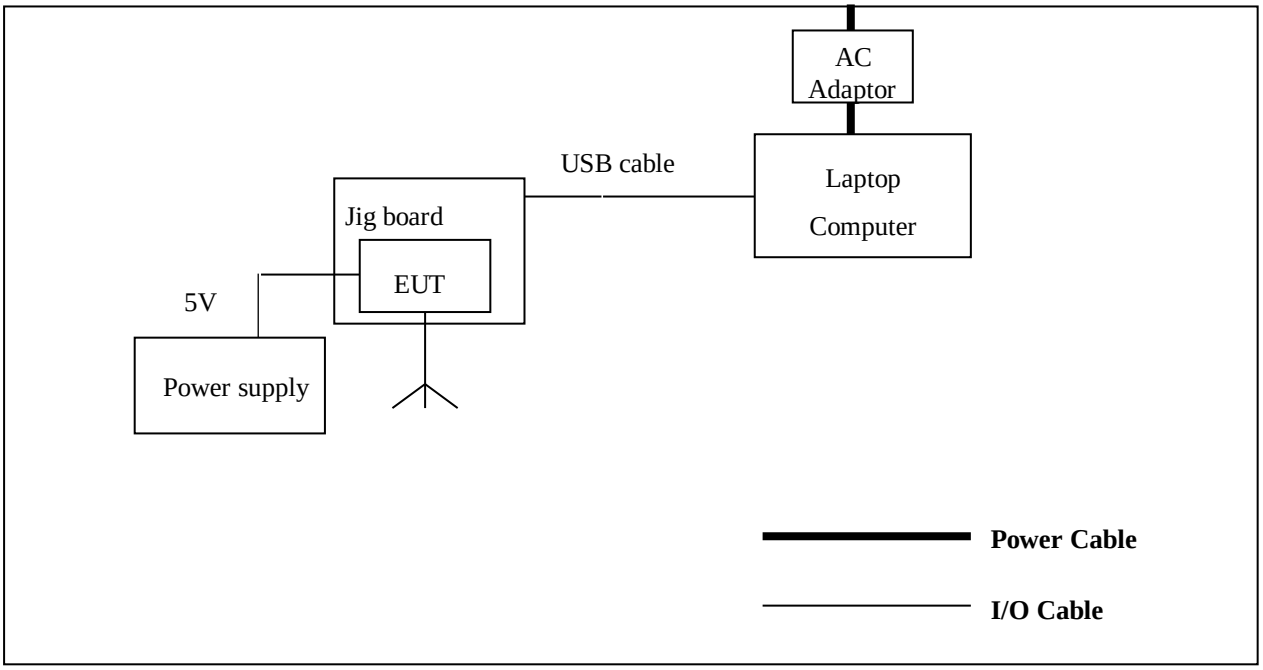
Frequency band	Bandwidth	channel	Frequency (MHz)
UNII-1	20MHz	36	5180
		40	5200
		44	5220
		48	5240
	40MHz	38	5190
		46	5230
	80MHz	42	5210
U-NII-2A	20MHz	52	5260
		56	5280
		60	5300
		64	5320
	40MHz	54	5270
		62	5310
	80MHz	58	5290

U-NII-2C	20MHz	100	5500
		104	5520
		108	5540
		112	5560
		116	5580
		120	5600
		124	5620
		128	5640
		132	5660
		136	5680
		140	5700
	40MHz	102	5510
		110	5550
		118	5590
		126	5630
		134	5670
	80MHz	106	5530
		122	5610
Straddle	20MHz	144	5720
	40MHz	142	5710
	80MHz	138	5690
UNII-3	20MHz	149	5745
		153	5765
		157	5785
		161	5805
		165	5825
	40MHz	151	5755
		159	5795
	80MHz	155	5775

3.2 Support Equipment

EUT	Anam Electronics Co., Ltd. Model : VOP13082E	S/N: N/A
Laptop Computer	HP Model : G62-355TU	FCC DOC S/N : CNF0489WDT
AC/DC Adapter	HP Model : PPP009D 1.5 m unshielded power cable	FCC DOC S/N : WBGSV0ACXZH162

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Anam Electronics Co., Ltd. DMA WiFi/BT Platform Module FCC ID: MBB VOP13082E, IC: 11657A- VOP13082E.**

Specifications:

EUT Type	DMA WiFi/BT Platform Module
Model Name	VOP13082E
Variant Model Name	VOP13082B, VOP13802C, VOP13082D
Brand Name	ANAM
Frequency of Operation	For U-NII-1 Band 802.11a,n,ac(20 MHz): 5180 MHz ~ 5240 MHz 802.11n,ac(40 MHz): 5190 MHz ~ 5230 MHz 802.11ac(80 MHz): 5210 MHz For U-NII-2A Band 802.11a,n,ac(20 MHz): 5260 MHz ~ 5320 MHz 802.11n,ac(40 MHz): 5270 MHz ~ 5310 MHz 802.11ac(80 MHz): 5290 MHz For U-NII-2C Band 802.11a,n,ac(20 MHz): 5500 MHz ~ 5720 MHz 802.11n,ac(40 MHz): 5510 MHz ~ 5710 MHz 802.11ac(80 MHz): 5530 MHz ~ 5690 MHz For U-NII-3 Band 802.11a,n,ac(20 MHz): 5745 MHz ~ 5825 MHz 802.11n,ac(40 MHz): 5755 MHz ~ 5795 MHz 802.11ac(80 MHz): 5775 MHz
Maximum Conducted Output Power	For U-NII-1 Band 802.11a : 13.75 dBm 802.11n(20 MHz) : 13.82 dBm 802.11n(40 MHz) : 14.74 dBm 802.11ac(20 MHz) : 13.71 dBm 802.11ac(40 MHz) : 13.76 dBm 802.11ac(80 MHz) : 12.35 dBm For U-NII-2A Band 802.11a : 13.57 dBm 802.11n(20 MHz) : 13.59 dBm 802.11n(40 MHz) : 13.77 dBm 802.11ac(20 MHz) : 16.43 dBm 802.11ac(40 MHz) : 13.54 dBm 802.11ac(80 MHz) : 12.53 dBm For U-NII-2C Band 802.11a : 14.49 dBm 802.11n(20 MHz) : 14.35 dBm 802.11n(40 MHz) : 13.98 dBm 802.11ac(20 MHz) : 14.25 dBm 802.11ac(40 MHz) : 13.57 dBm 802.11ac(80 MHz) : 12.90 dBm

	For U-NII-3 Band 802.11a : 14.54 dBm 802.11n(20 MHz) : 14.36 dBm 802.11n(40 MHz) : 13.80 dBm 802.11ac(20 MHz) : 14.32 dBm 802.11ac(40 MHz) : 13.57 dBm 802.11ac(80 MHz) : 11.29 dBm
FCC Classification	Unlicensed National Information Infrastructure (NII)
Number of Channels	For U-NII-1 Band 802.11a,n,ac(20 MHz): 4ch 802.11n,ac(40 MHz): 2ch 802.11ac(80 MHz): 1ch For U-NII-2A Band 802.11a,n,ac(20 MHz): 4ch 802.11n,ac(40 MHz): 2ch 802.11ac(80 MHz): 1ch For U-NII-2C Band 802.11a,n,ac(20 MHz): 12ch 802.11n,ac(40 MHz): 6ch 802.11ac(80 MHz): 3ch For U-NII-3 Band 802.11a,n,ac(20 MHz): 5ch 802.11n,ac(40 MHz): 2ch 802.11ac(80 MHz): 1ch
Modulations	OFDM(BPSK,QPSK,16QAM,64QAM, 256QAM) for 802.11a,n,ac
Antenna Gain (peak)	Ant : 2.8 dBi
Antenna Setup	802.11a/n(20,40MHz)/ac(20,40,80MHz) : 1TX / 1RX, 2TX / 2RX
Voltage	5 Vdc
Temperature Range	-10 ℃ ~ +70 ℃
Size (W x H x D)	About 74 mm x 87 mm x 16.4 mm
Weight	About 44 g
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	Result	Remark
Conducted Emission	15.207	NA	
Radiated Emission	15.209	Complies	
26 dB Spectrum Bandwidth and 99% Occupied bandwidth	15.407(a)	Complies	
6 dB Bandwidth	15.407(e)	Complies	
Maximum Conducted Output Power	15.407(a)	Complies	
Power Spectral Density	15.407(a)	Complies	
Radiated Spurious Emission	15.407(b)	Complies	
DFS	15.407(h)	Complies	
Maximum Permissible Exposure	1.1307(b)	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Anam Electronics Co., Ltd. DMA WiFi/BT Platform Module FCC ID: MBB VOP13082E, IC: 11657A- VOP13082E** is in compliance with Part 15.247 of the FCC Rule and RSS-247 Issue 2 of the IC Specification.

6. ANTENNA REQUIREMENTS

§15.203 of the FCC Rules part 15 Subpart C
: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 antenna of the **Anam Electronics Co., Ltd. DMA WiFi/BT Platform Module FCC ID: MBB VOP13082E, IC: 11657A- VOP13082E** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

Directional gain was be calculated according to "**662911 D01 Multiple Transmitter Output v02r01**" and would be found at end of average output power and PSD results in this report.

Used Anetnna				
Model name	Max. gain (dBi)		Type	External or Internal
	2.4GHz	5GHz		
N2420DG3-T2L-PK1-G520U	3.1	2.8	PIFA	Internal
503021-0113-0BC[1)]	2.0	2.0	Dipole	External
120300055600J	2.0	2.0	Dipole	External
120700034000J	2.0	2.0	Dipole	External
120300055601J	2.0	2.0	Dipole	External
KH-WFDI-AN001[2)]	4.0	2.8	PIFA	Internal
KH-WFDI-AN002	4.0	2.8	PIFA	Internal
KH-WFDI-AN003	3.6	2.1	PIFA	Internal
KH-WFDI-AN004	3.6	2.1	PIFA	Internal
KH-WFDI-AN005	3.5	2.1	PIFA	Internal
KH-WFDI-AN006	3.5	2.1	PIFA	Internal

Note:
1. Pre-radiated testing was performed to determine worst antenna type of two antenna type (Dipole and PIFA).
2. Pre-radiated testing was performed to determine worst antenna type of two antenna type (Dipole and PIFA). As a result, this antenna was determined as worst antenna type for final radiated testing.

7. DESCRIPTION OF TESTS

7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room. Rohde & Schwarz (ESH3-Z5) and (ESH2-Z5) of the 50 ohm/50 µH Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ESH3-Z5) and the support equipment is powered from the Rohde & Schwarz LISN (ESH2-Z5). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ". If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentinefashion) to a 1 meter length. Sufficient time for 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 to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time. The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCS30). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.
Each EME reported was calibrated using the R&S signal generator.

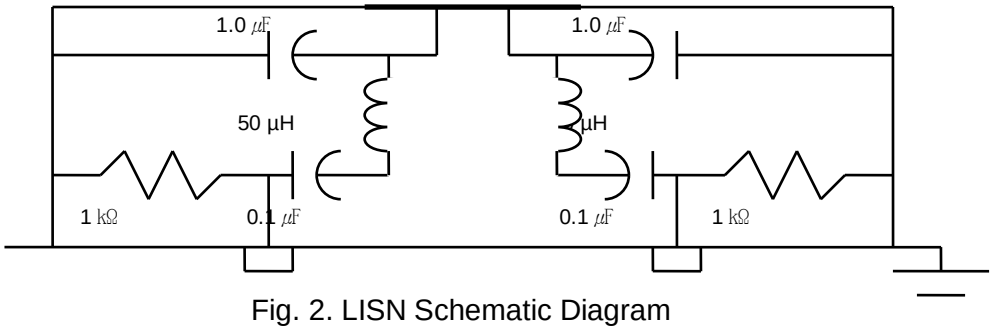


Fig. 2. LISN Schematic Diagram

7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.10-2013.
The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz, Q-par Angus QSH22K20 : 26.5 to 40 GHz) was used.
For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. 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 EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0˚ to 360˚ and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

Unwanted emissions in the restricted bands

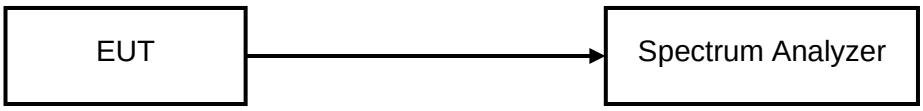
At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.
At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “789033 D02 General UNII Test Procedures New Rules v02r01”in section G)5) and G)6). Peak emission levels was measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels was measured using the “Method VB” by setting the analyzer RBW = 1 MHz, VBW = 10 kHz (VBW ≤ RBW/100), Detector = Peak , if the EUT is configured to transmit with duty cycle ≥ 98 percent. When the duty cycle ≤ 98 percent, VBW ≥ 1/T(T = minimum transmission duration over which the transmitter is on) was used, and allow max hold to run for at least 50 times (1/duty cycle) traces.

Unwanted emissions outside of the restricted bands

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection.
At frequencies above 1000 MHz, measurements performed using the peak measurement procedures described in KDB “789033 D02 General UNII Test Procedures New Rules v02r01” in section G)5). Peak emission levels was measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. If the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

7.3 26 dB Bandwidth and 99% Occupied bandwidth

Test Setup

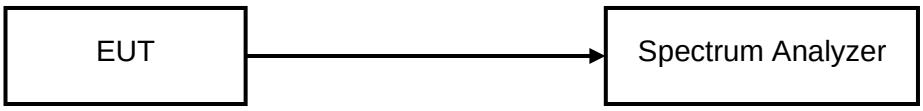


Test Procedure

EUTs 26 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
RBW = approximately 1 % of the emission bandwidth
VBW ≥ 3 x RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
The bandwidth measurement function on the spectrum analyzer is used to measure the 26 dB bandwidth and 99% occupied bandwidth.

7.4 6 dB Bandwidth

Test Setup

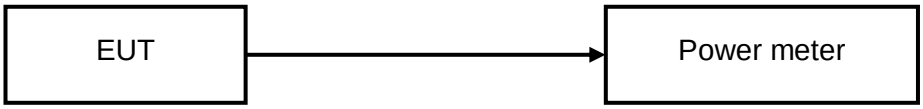


Test Procedure

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
The spectrum analyzer setting is as follows.
RBW = 100 kHz
VBW > 3 x RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

7.5 Maximum Conducted Output Power (average)

Test Setup

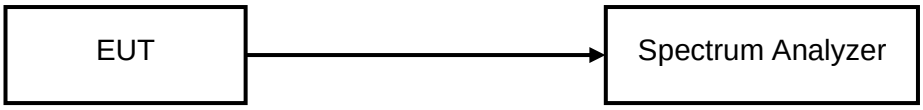


Test Procedure

EUTs Maximum Conducted Output Power (average) is measured at low, middle, high channels with a Power meter connected to the antenna terminal while the EUTs operating at its maximum power control level.
Add 10 log (1/x), where x is the duty cycle

7.6 Maximum Power Spectral Density (average)

Test Setup

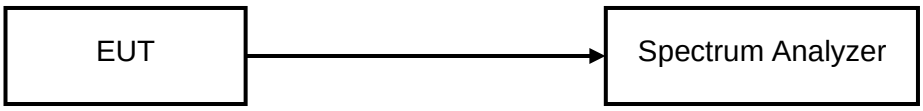


Test Procedure

EUTs Maximum Power Spectral Density (average) is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.
Measure the duty cycle, x, of the transmitter output signal
The spectrum analyzer setting is as follows.
Span = encompass the EBW of the signal.
RBW = 1 MHz for UNII-1, 2A, 2C band or 500kHz for UNII-3 band
VBW ≥ 3 RBW
Number of points in sweep ≥ 2 Span / RBW
Sweep time = auto
Detector = RMS
Trace average at least 100 traces in power averaging mode
Use the peak search function on the instrument to find the peak of the spectrum.

7.7 Duty Cycle

Test Setup



Test Procedure

EUTs duty cycle are measured at middle channel with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

Center frequency = Center frequency of the transmission
Span = zero
RBW = 8 MHz
VBW = 8 MHz
Detector = peak
Sweep time = at least 3 ms
Sweep mode = Single
The marker function on the spectrum analyzer is used to determine the duty cycle

The results of the duty cycle measurement according to the above test procedure

	Data rate	On time (ms)	On + Off time (ms)	Duty Cycle (%)	Duty Factor (dB)
a mode	6Mbps	1.392	1.455	95.7	0.19
n(20MHz) mode	MCS0	1.300	1.362	95.4	0.20
n(40MHz) mode	MCS0	0.647	0.711	91.0	0.41
ac(20MHz) mode	MCS0	1.312	1.376	95.3	0.21
ac(40MHz) mode	MCS0	0.652	0.714	91.3	0.40
ac(80MHz) mode	MCS0	0.323	0.387	83.5	0.79

8. TEST DATA

8.1 Radiated Emissions

FCC §15.209

Frequency (MHz)	Reading (dBµV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
32.10	41.40	V	100	296	-25.4	16.0	40.0	24.0
180.62	63.59	V	100	75	-26.5	37.1	43.5	6.4
225.78	66.01	V	100	144	-24.1	41.9	46.0	4.1
839.90	32.15	V	100	253	-11.9	20.3	46.0	25.8

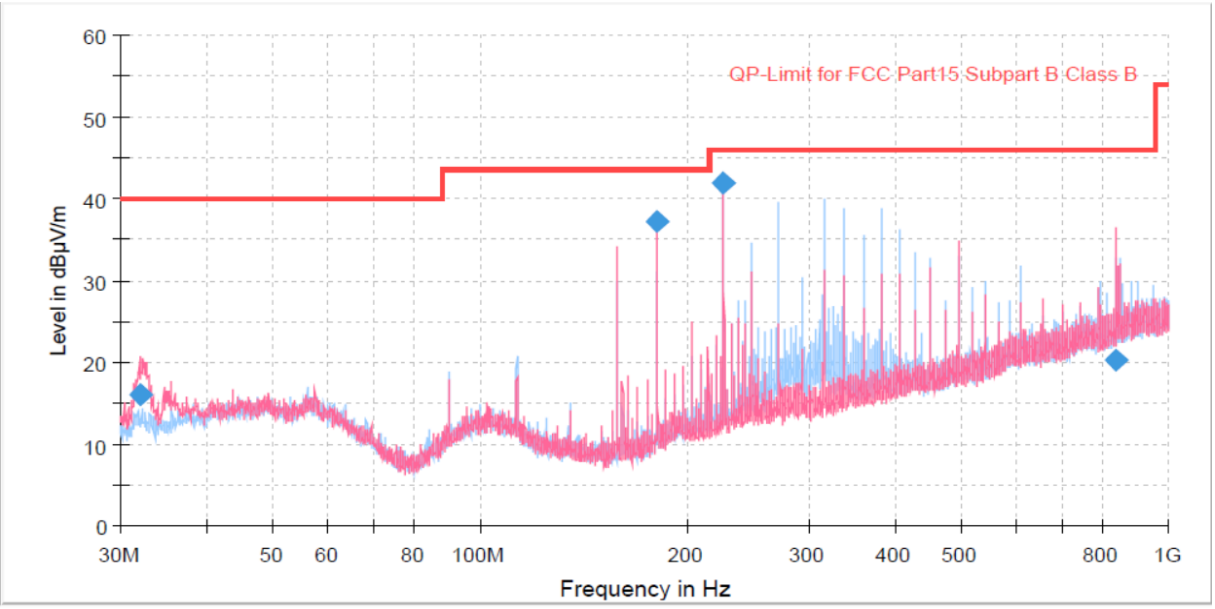
Radiated Measurements at 3meters

Notes:

1. *All modes were measured and the worst-case emission was reported.*
2. *The radiated limits are shown on Figure 3. Above 1 GHz the limit is 500 µV/m.*
3. **Pol. H = Horizontal, V = Vertical*
4. ***AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*
5. *Measurements using CISPR quasi-peak mode below 1 GHz.*
6. *The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded.*
7. *Middle channel (5785MHz) in ac (20MHz) mode is the worst case.*
8. *No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).*
9. *The limit is on the FCC §15.209.*

PLOTS OF EMISSIONS

Radiated emission below 1GHz_ ac (20MHz) mode_ 5260 MHz



8.2 26 dB Bandwidth and 99 % Occupied bandwidth

8.2.1 26 dB Bandwidth and 99 % Occupied bandwidth – U-NII-1 band

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11a mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5180	20.23	16.53
Middle	5220	19.78	16.52
Highest	5240	20.02	16.53

802.11n (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5180	20.23	17.60
Middle	5220	20.09	17.61
Highest	5240	20.15	17.60

802.11n (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5190	40.61	36.17
Highest	5230	40.88	36.22

TEST DATA

802.11ac (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5180	20.23	17.59
Middle	5220	20.19	17.59
Highest	5240	20.15	17.61

802.11ac (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5190	40.15	36.13
Highest	5230	40.20	36.18

802.11ac (80 MHz) mode

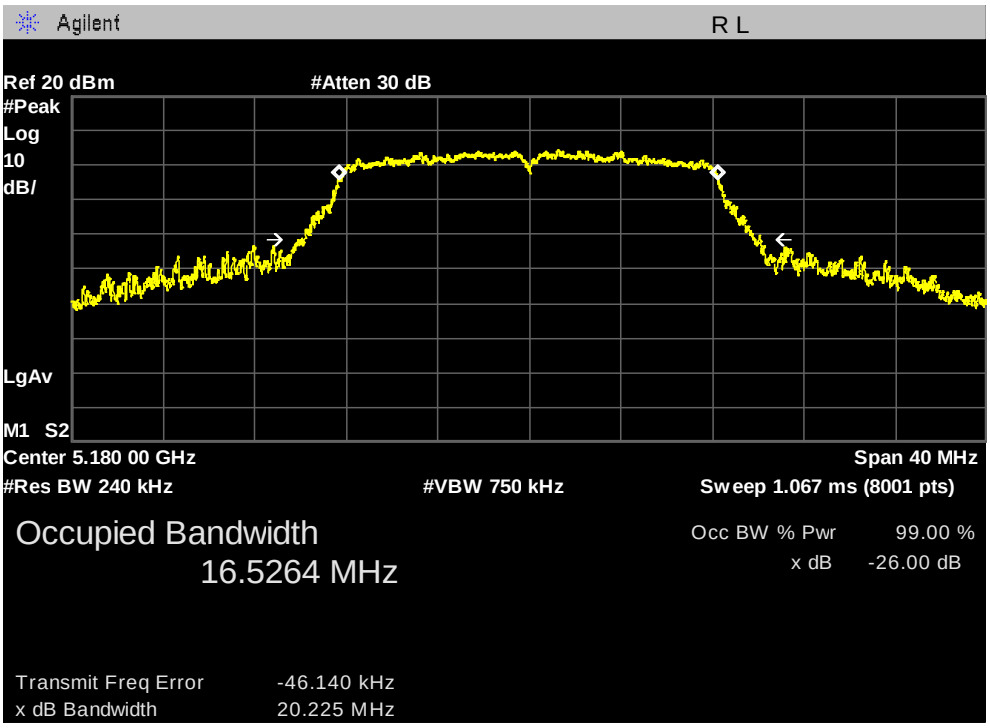
Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Middle	5210	81.37	75.82

Note:
The worst ant port was determined by the conducted output power that generates the highest emission performing pre-scan testing in all ant port of each mode.

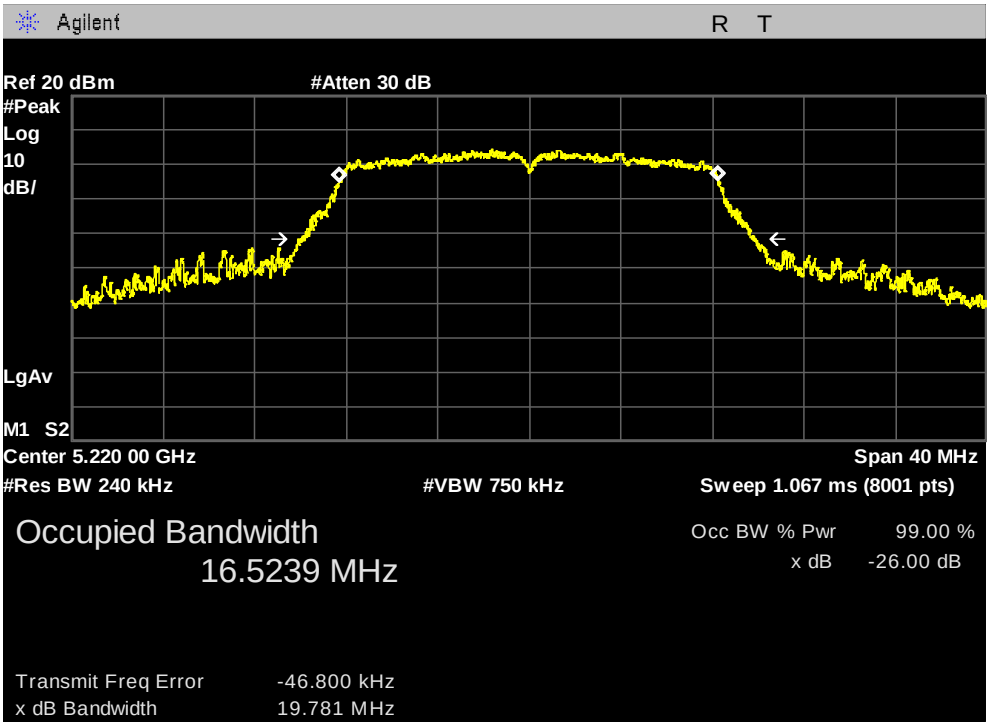
PLOTS OF EMISSIONS

802.11a mode

26 dB Bandwidth, Lowest Channel (5180 MHz)

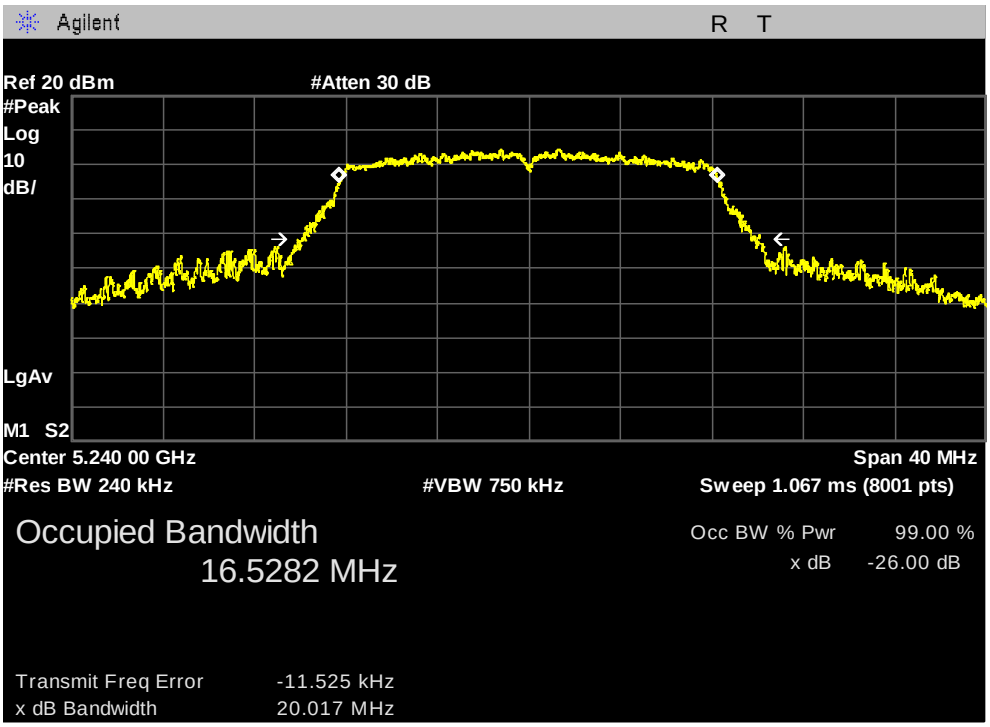


26 dB Bandwidth, Middle Channel (5220 MHz)



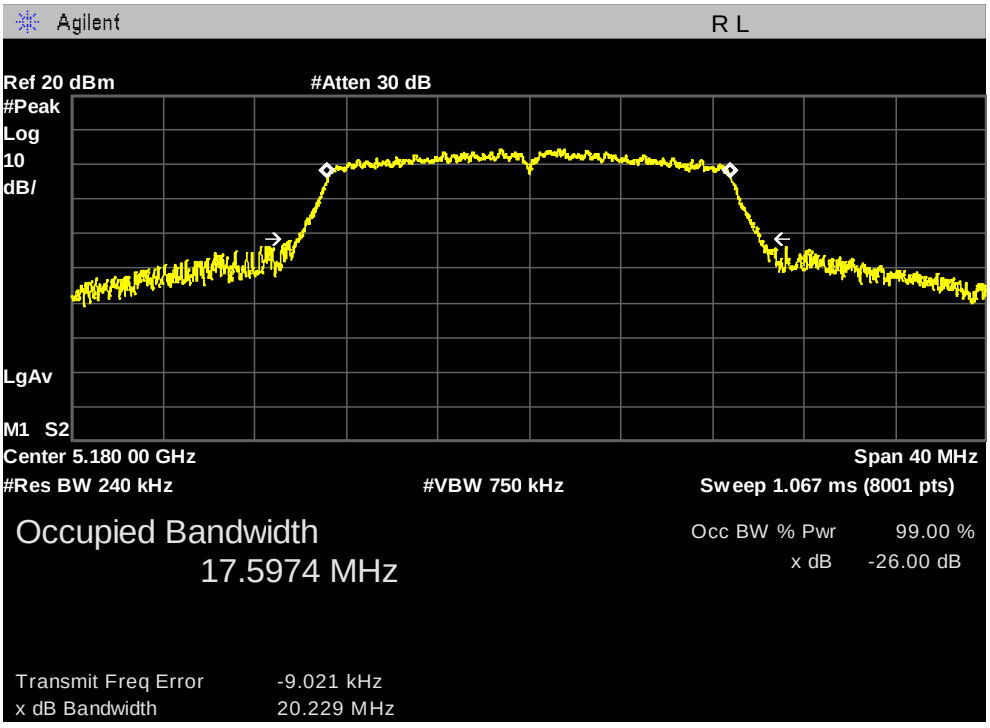
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5240 MHz)



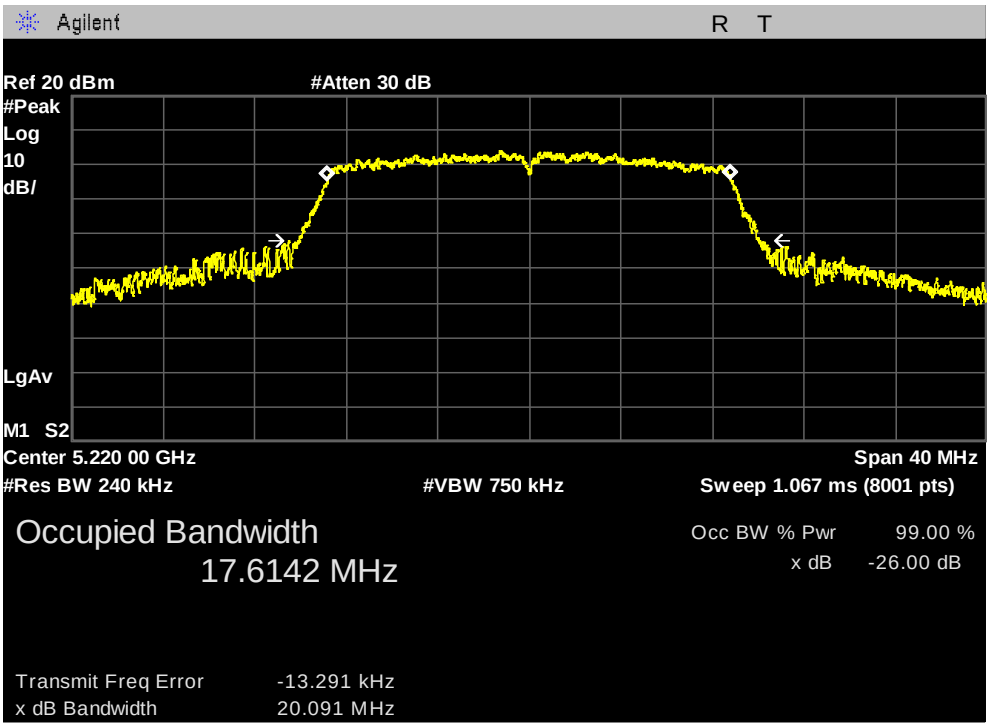
802.11n (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5180 MHz)

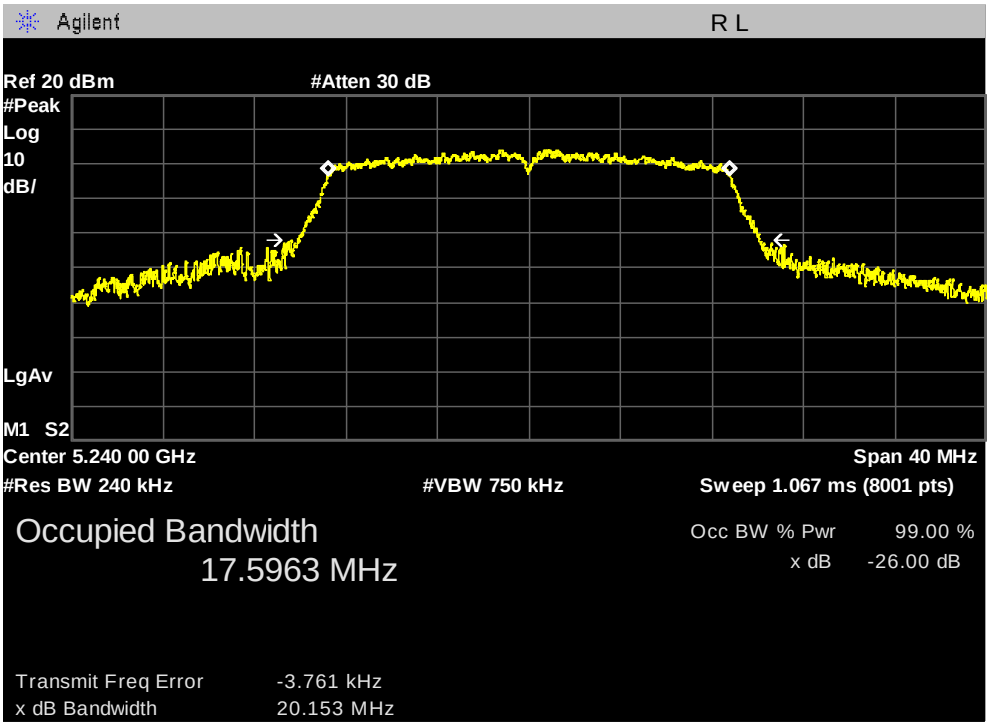


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5220 MHz)



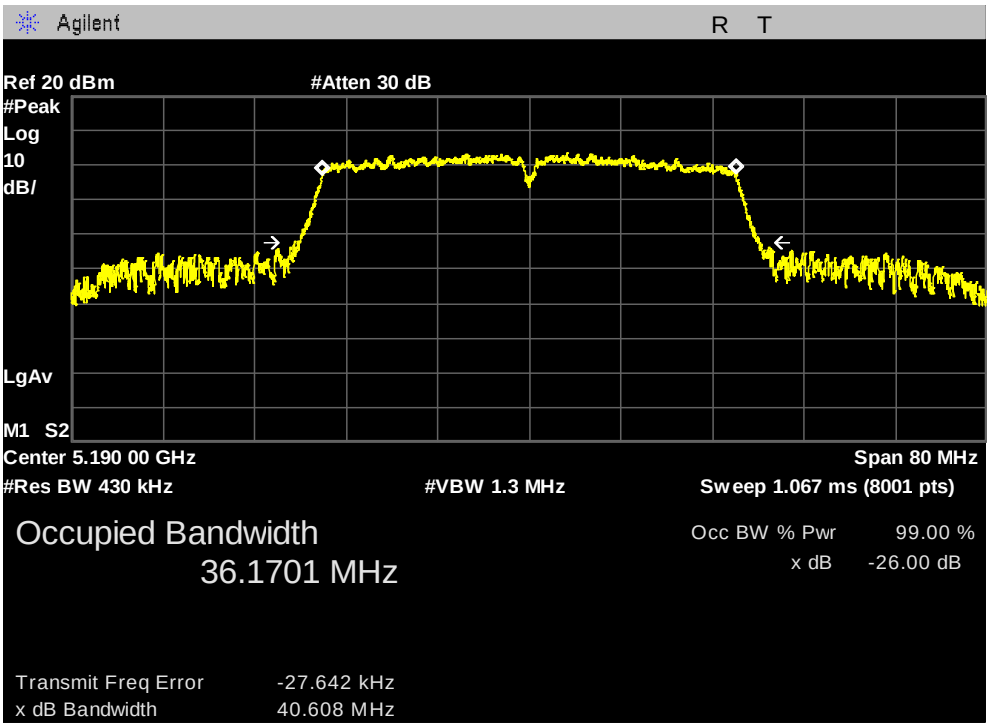
26 dB Bandwidth, Highest Channel (5240 MHz)



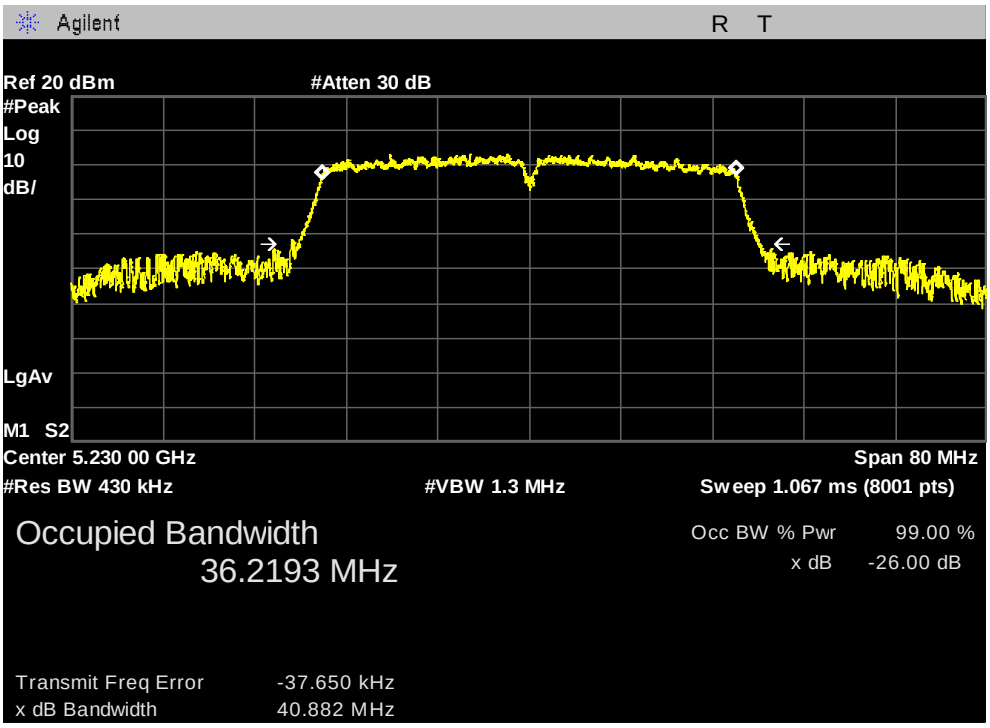
PLOTS OF EMISSIONS

802.11n (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5190 MHz)



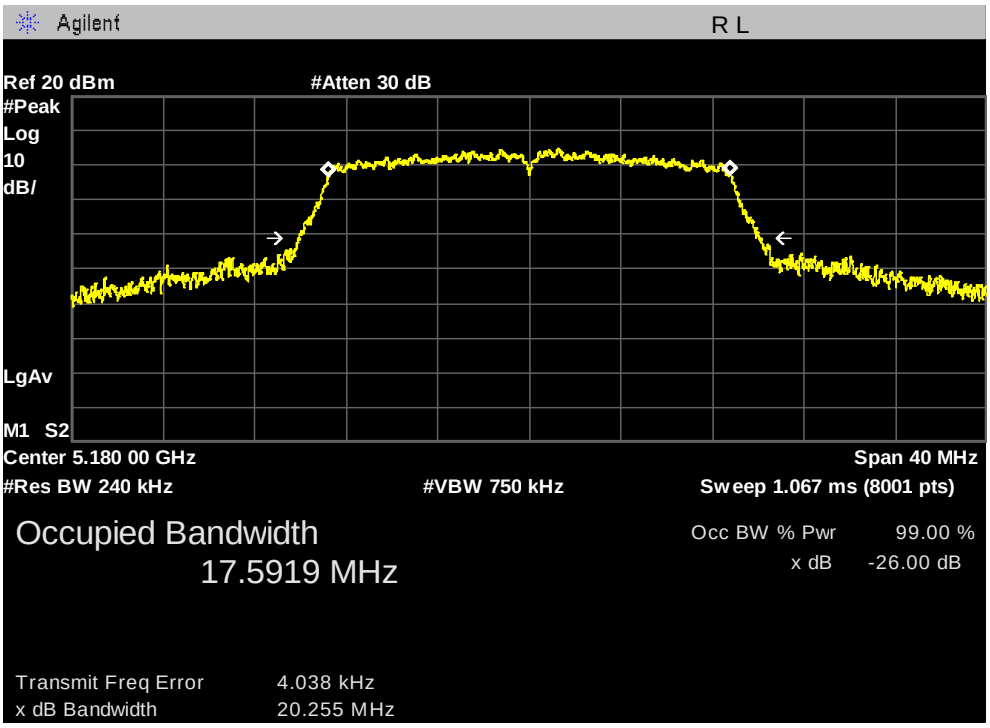
26 dB Bandwidth, Highest Channel (5230 MHz)



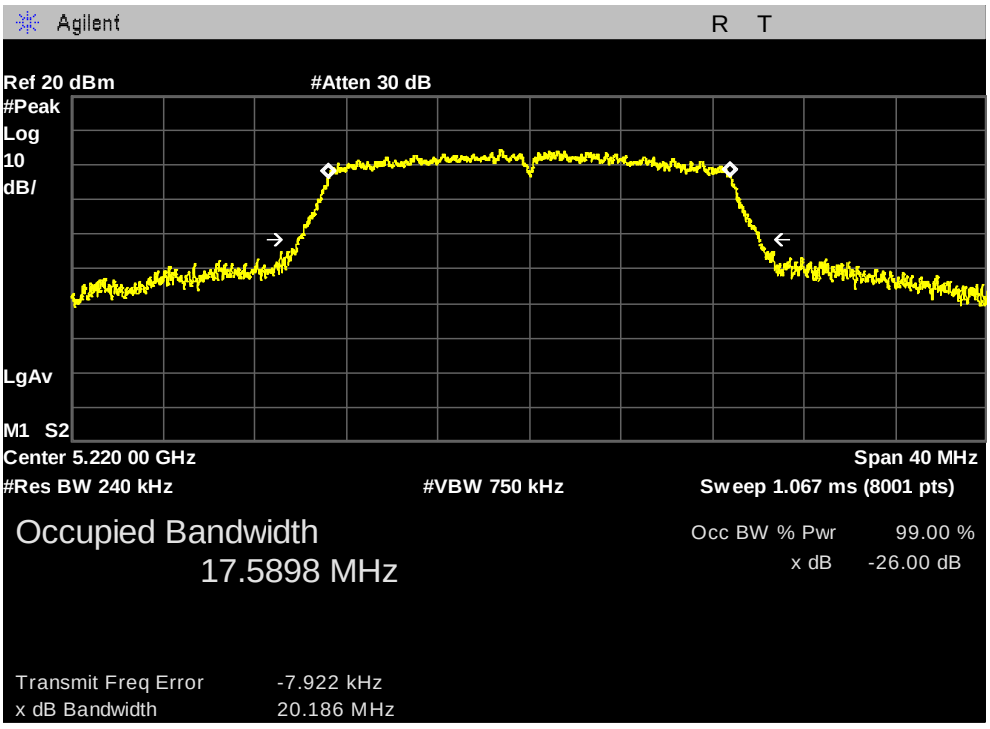
PLOTS OF EMISSIONS

802.11ac (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5180 MHz)

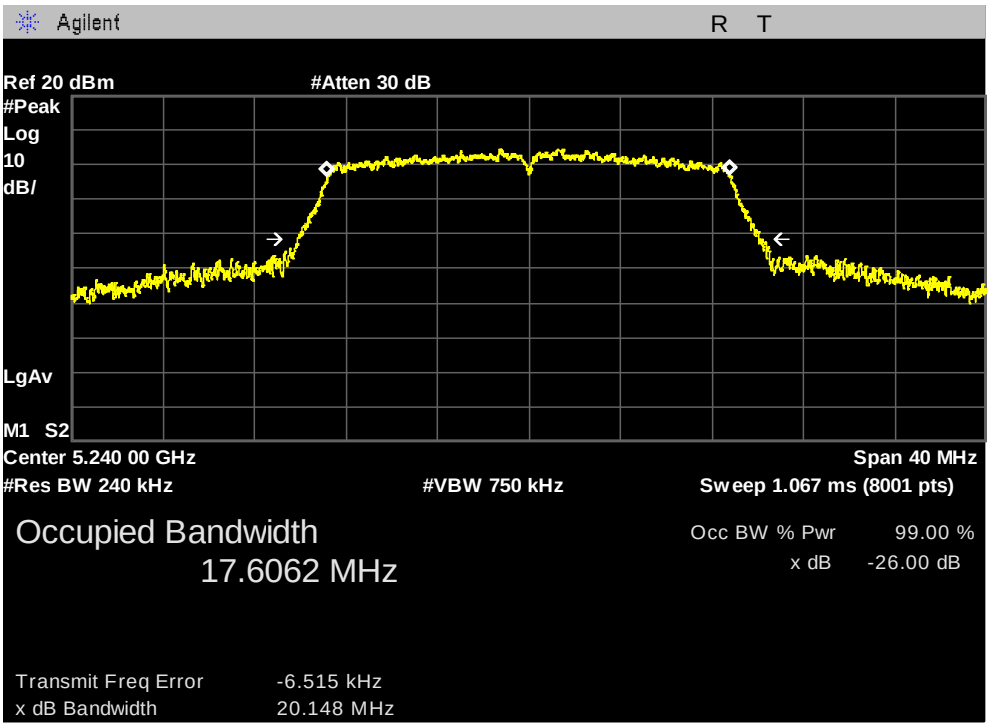


26 dB Bandwidth, Middle Channel (5220 MHz)



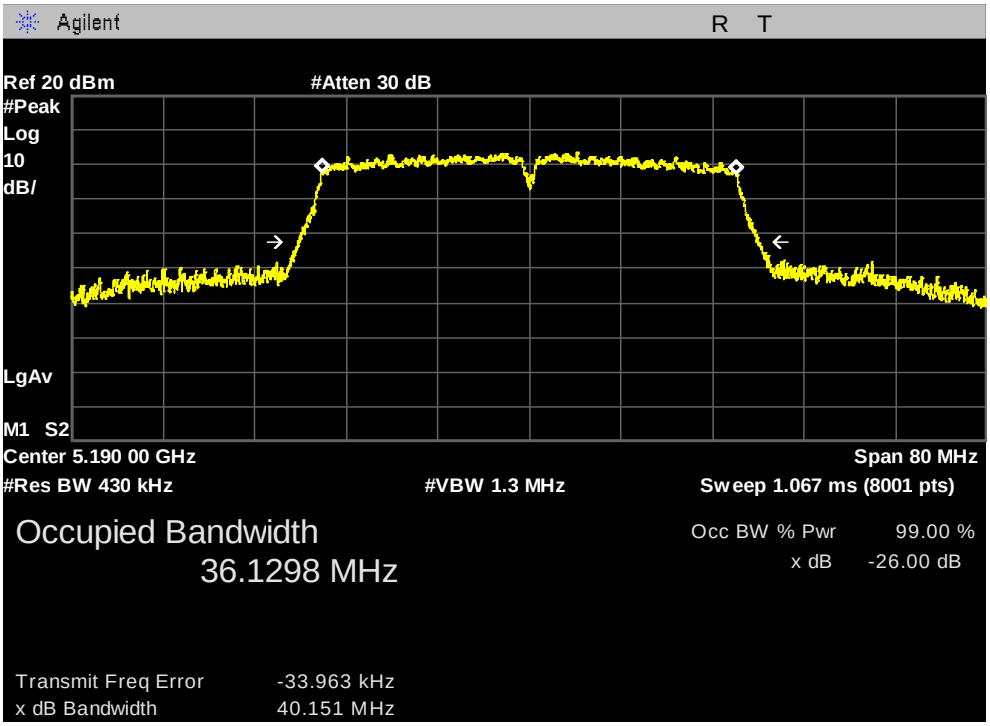
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5240 MHz)



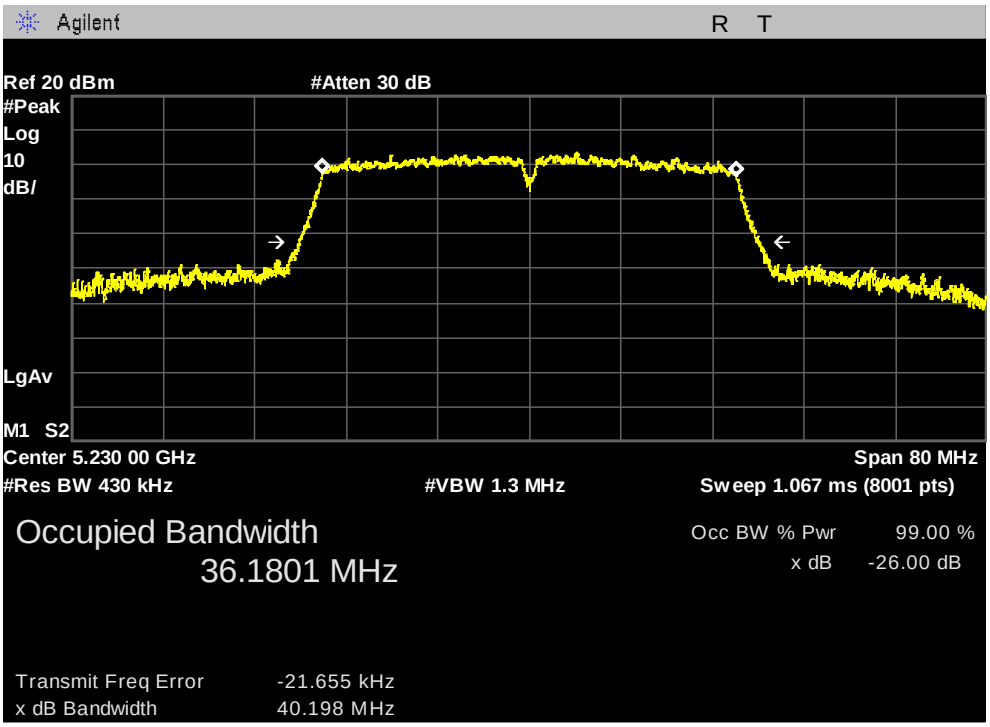
802.11ac (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5190 MHz)



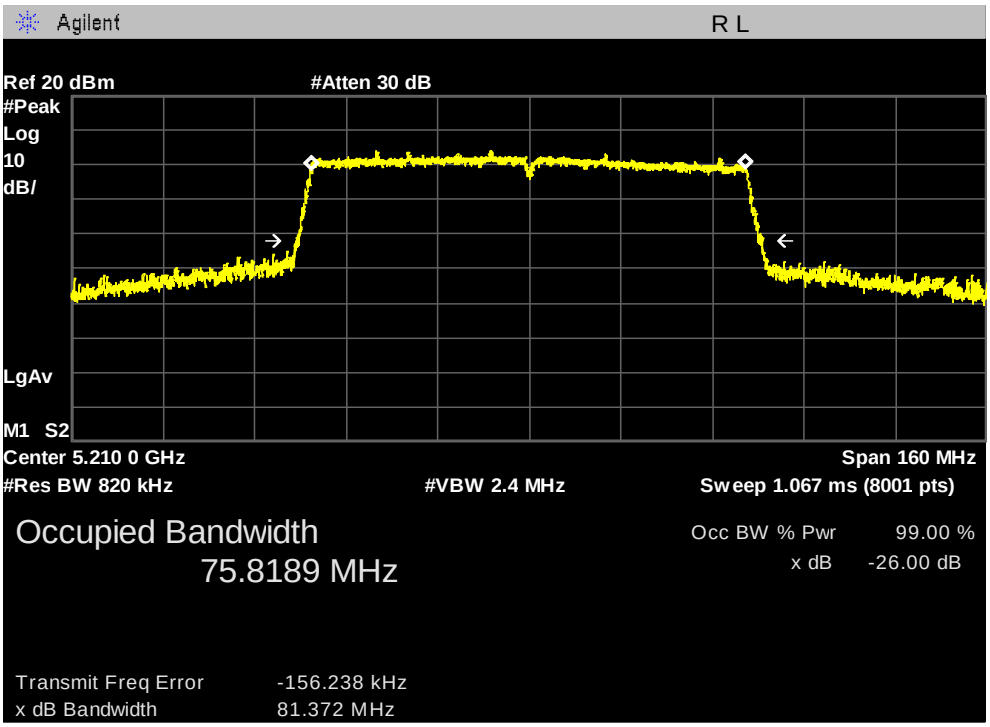
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5230 MHz)



802.11ac (80 MHz) mode

26 dB Bandwidth, Channel (5210 MHz)



8.2.2 26 dB Bandwidth and 99 % Occupied bandwidth – U-NII-2A band

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11a mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5260	19.83	16.56
Middle	5300	19.73	16.55
Highest	5320	20.02	16.57

802.11n (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5260	20.20	17.61
Middle	5300	20.22	17.61
Highest	5320	20.17	17.61

802.11n (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5190	40.74	36.20
Highest	5230	40.86	36.19

TEST DATA

802.11ac (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5260	20.17	17.59
Middle	5300	20.27	17.61
Highest	5320	20.12	17.61

802.11ac (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5190	40.03	36.12
Highest	5230	40.30	36.16

802.11ac (80 MHz) mode

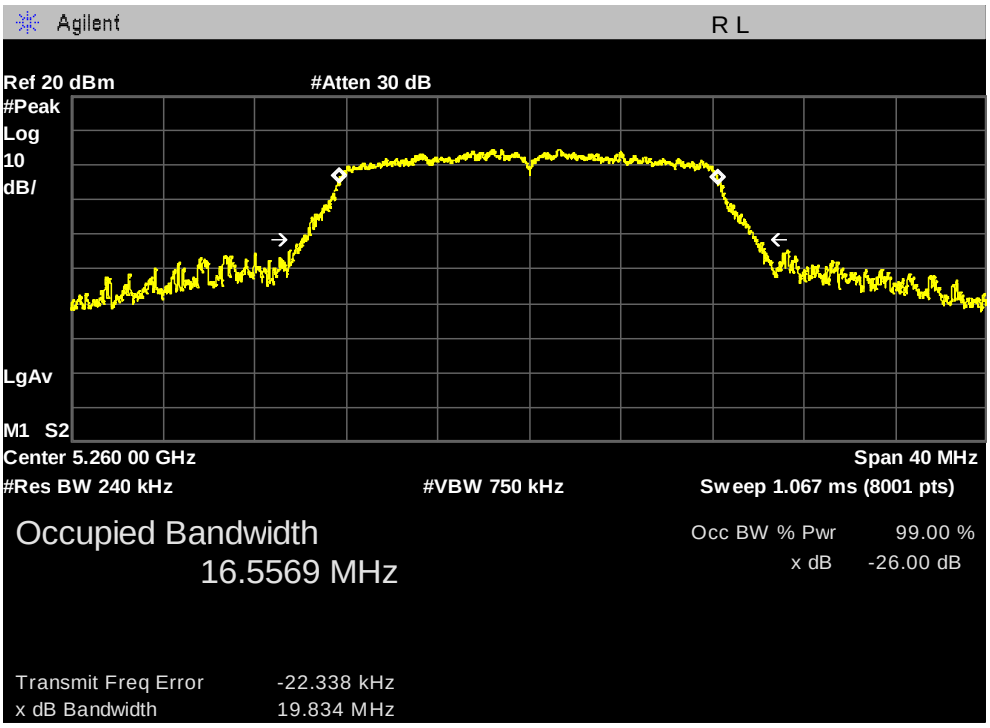
Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Middle	5290	81.30	75.75

Note:
The worst ant port was determined by the conducted output power that generates the highest emission performing pre-scan testing in all ant port of each mode.

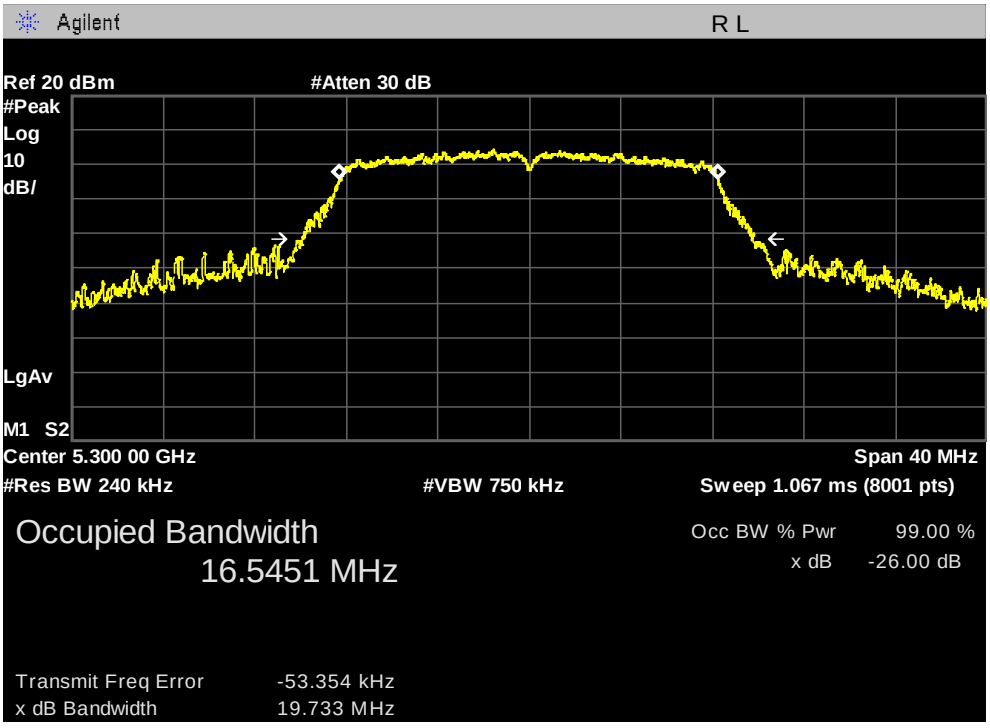
PLOTS OF EMISSIONS

802.11a mode

26 dB Bandwidth, Lowest Channel (5260 MHz)

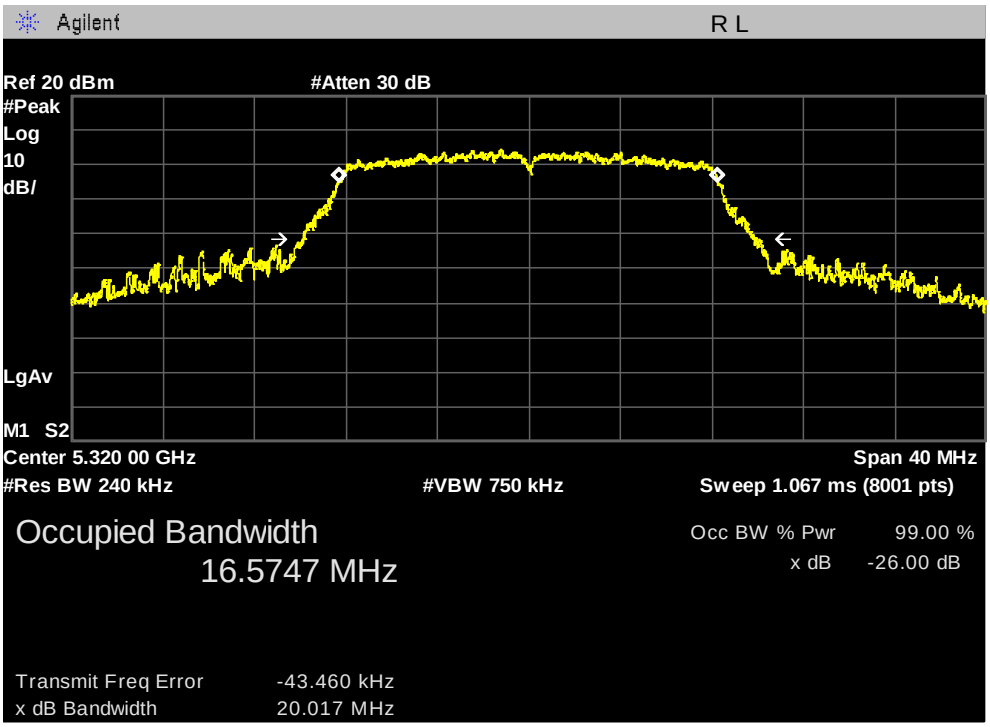


26 dB Bandwidth, Middle Channel (5300 MHz)



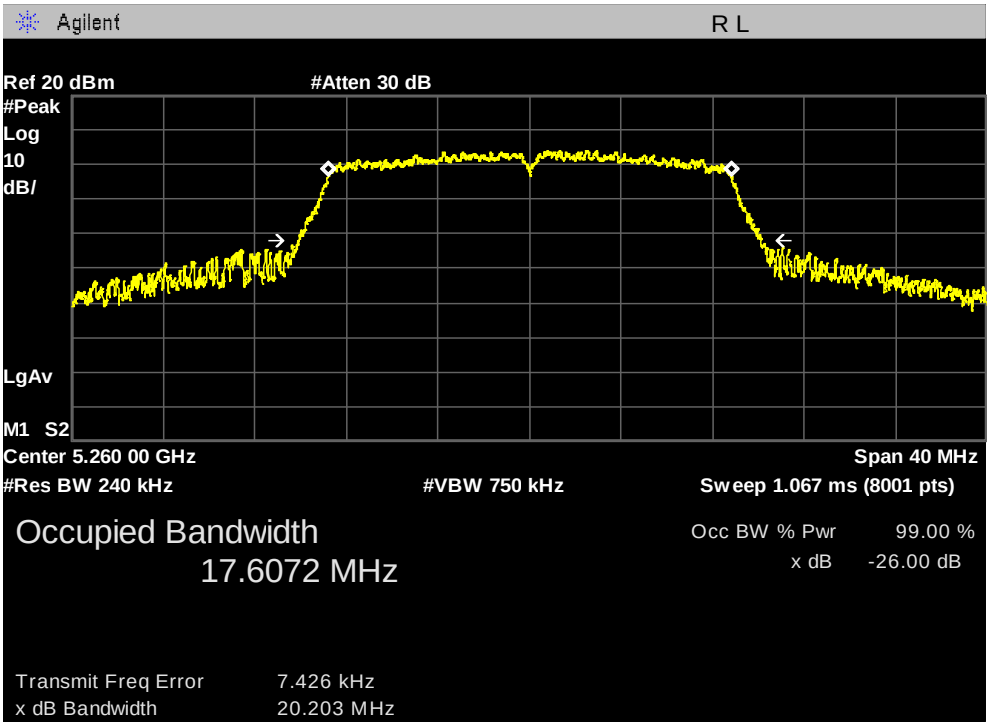
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5320 MHz)



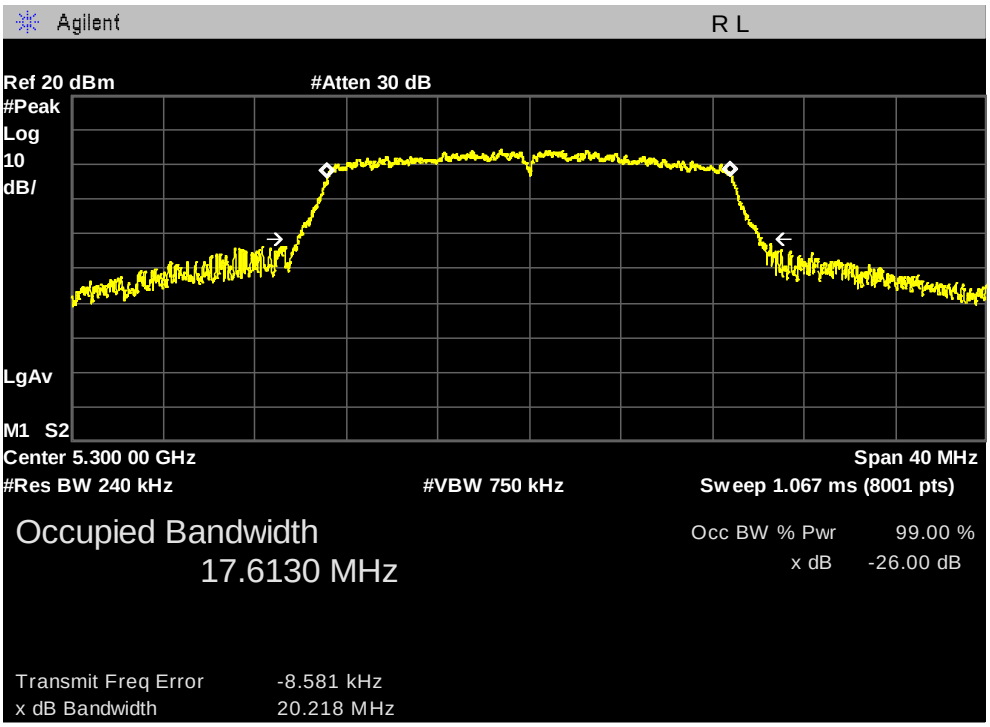
802.11n (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5260 MHz)

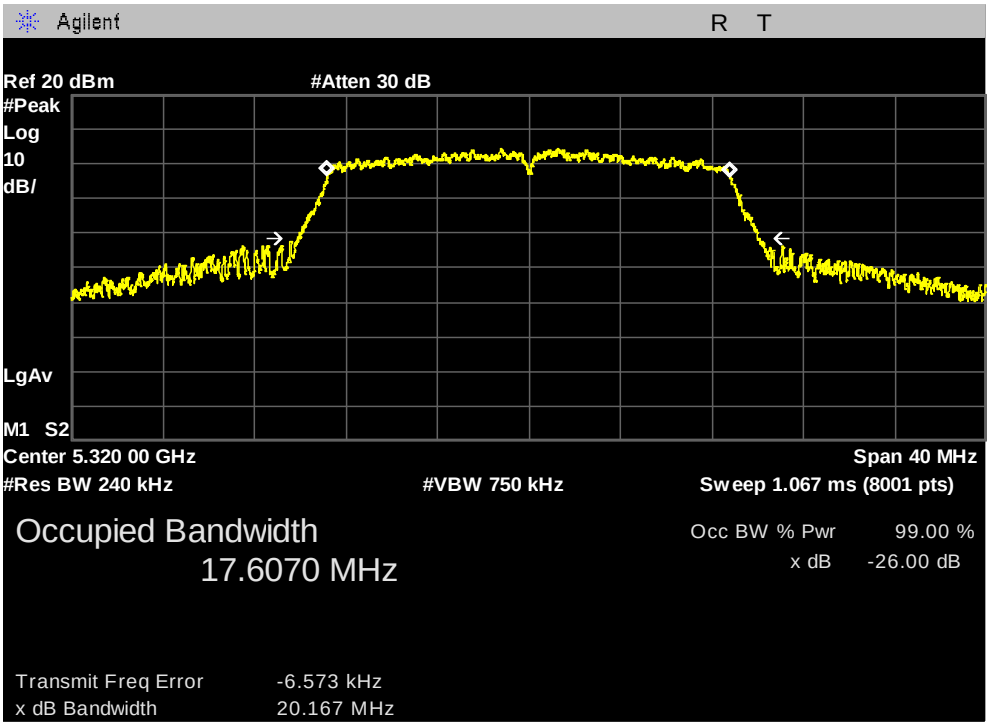


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5300 MHz)



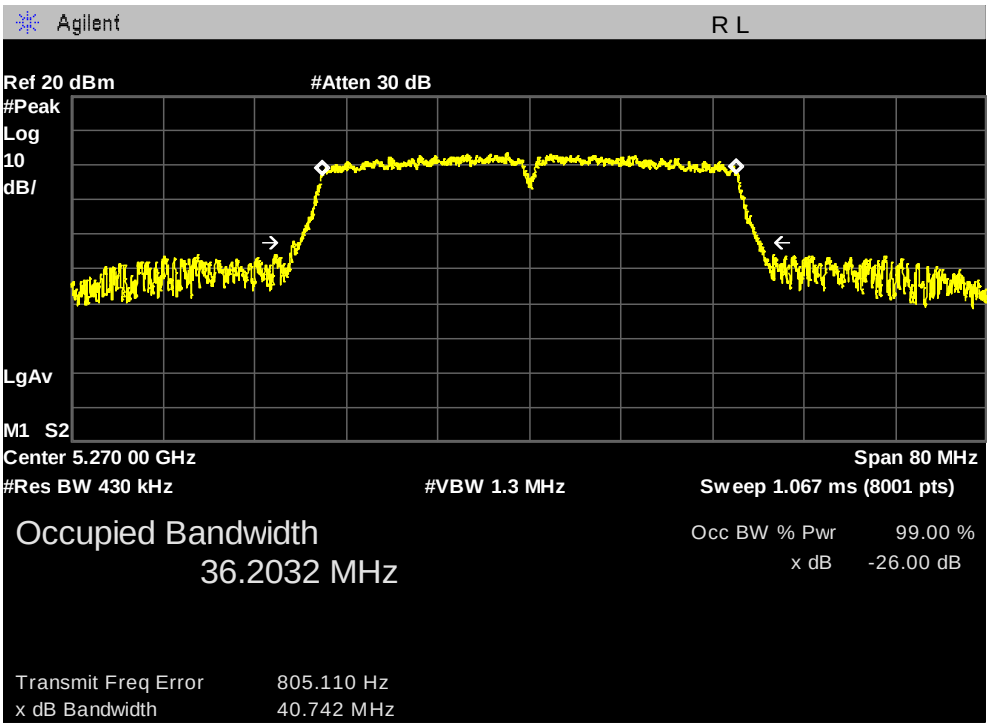
26 dB Bandwidth, Highest Channel (5320 MHz)



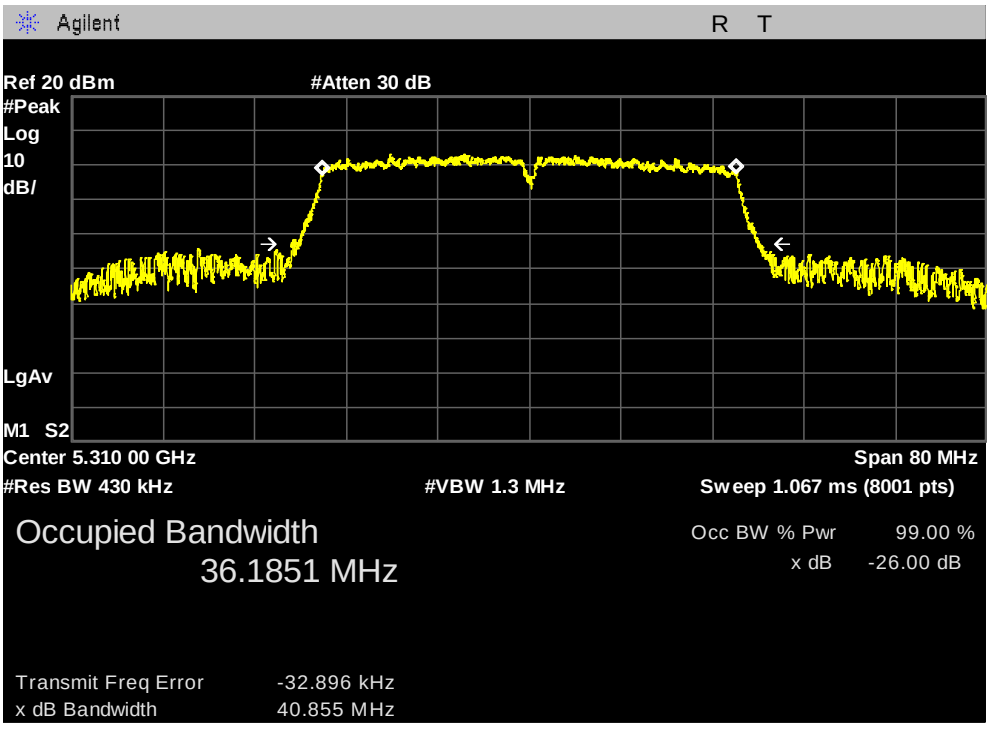
PLOTS OF EMISSIONS

802.11n (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5270 MHz)



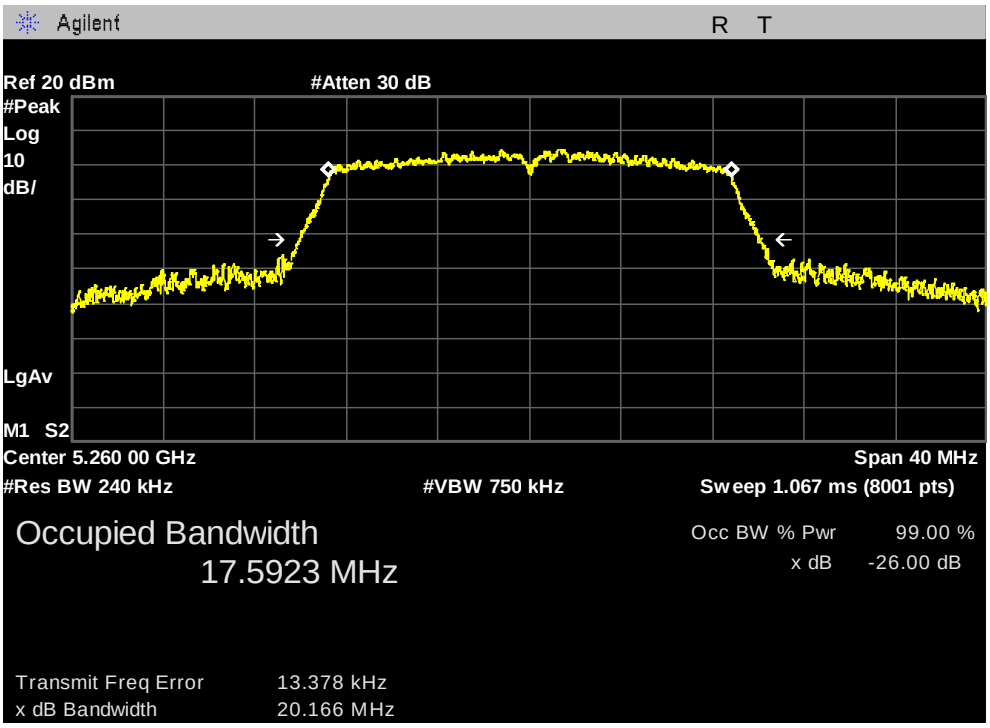
26 dB Bandwidth, Highest Channel (5310 MHz)



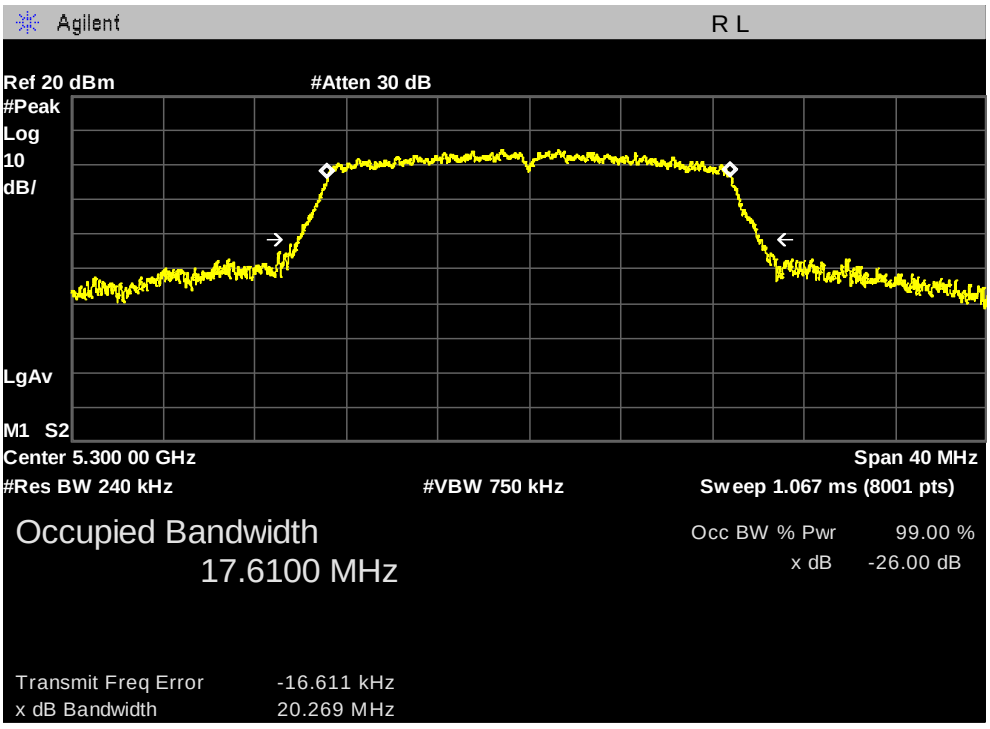
PLOTS OF EMISSIONS

802.11ac (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5260 MHz)

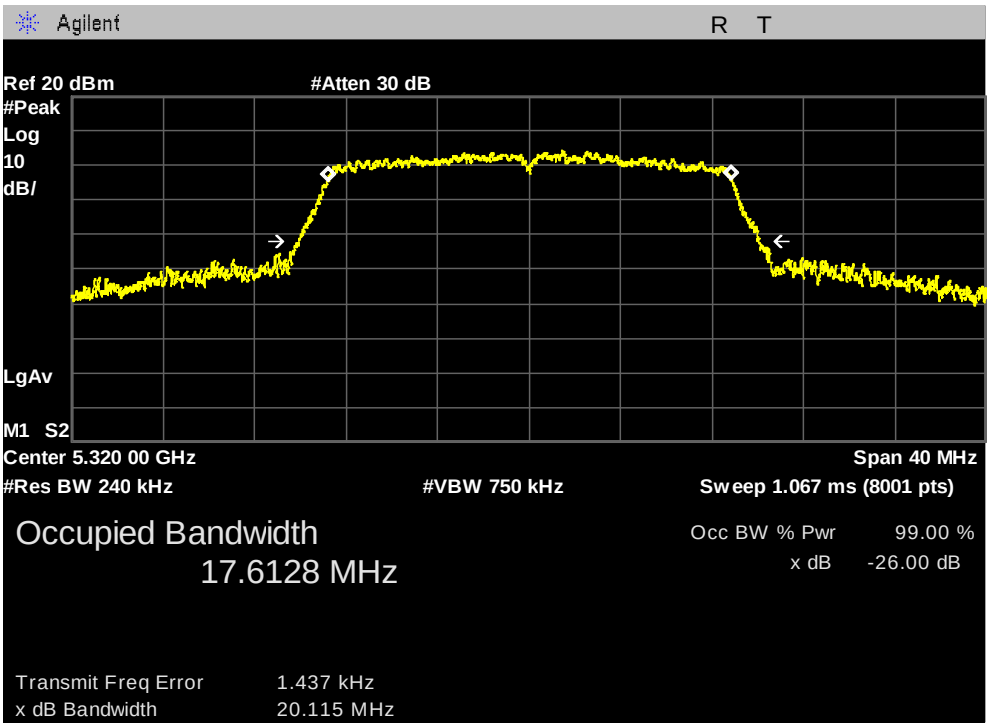


26 dB Bandwidth, Middle Channel (5300 MHz)



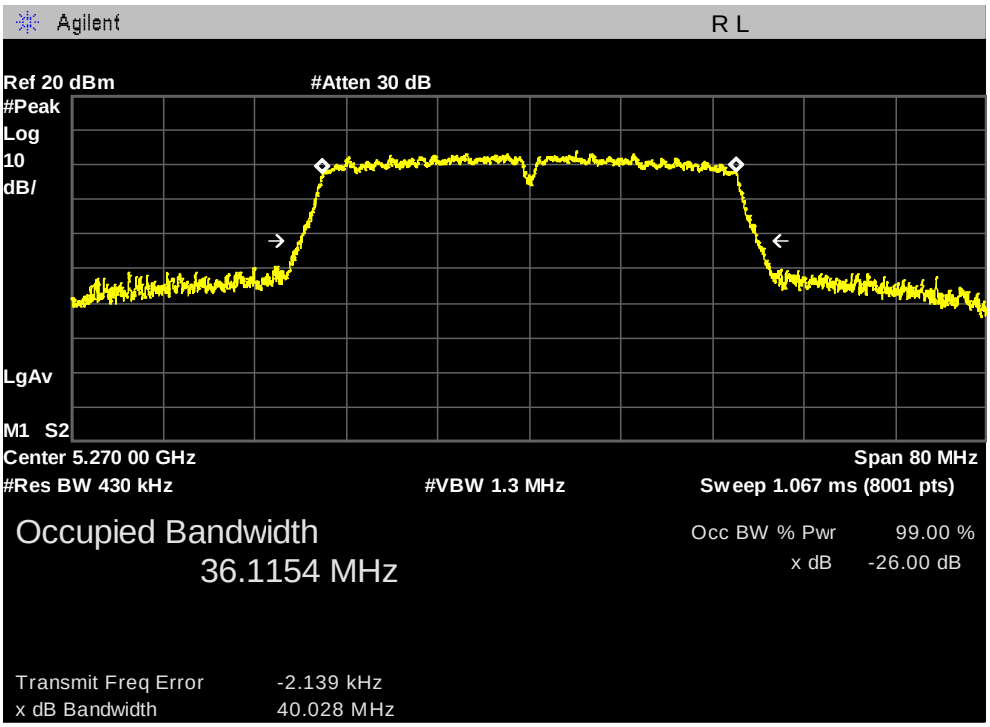
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5320 MHz)



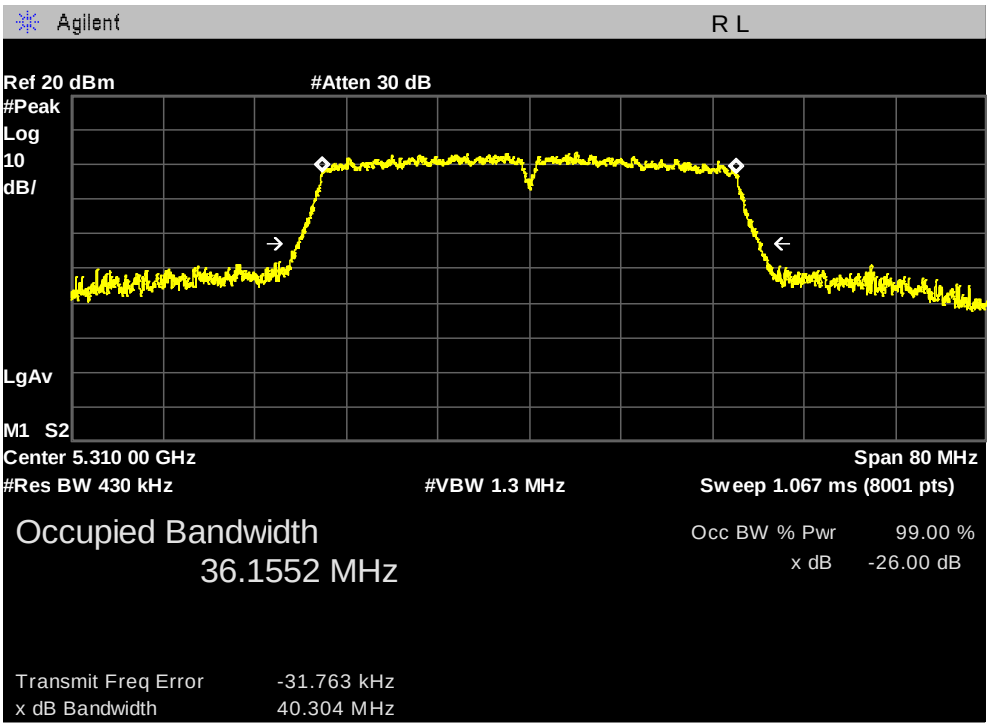
802.11ac (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5270 MHz)



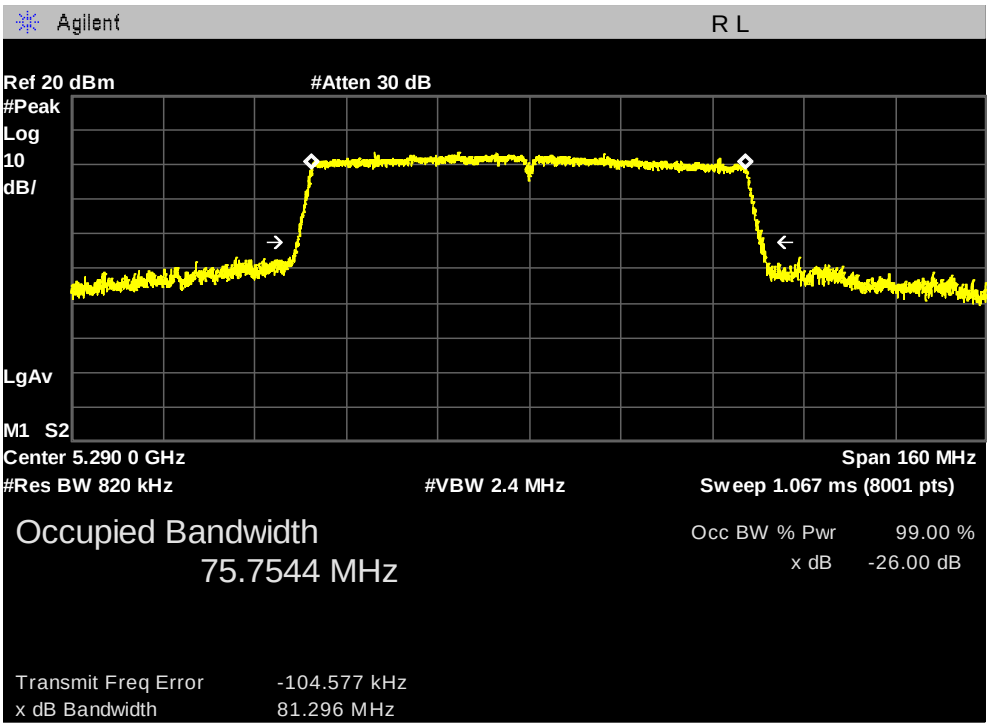
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5310 MHz)



802.11ac (80 MHz) mode

26 dB Bandwidth, Channel (5290 MHz)



8.2.3 26 dB Bandwidth and 99 % Occupied bandwidth – U-NII-2C band

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel, Straddle channel

802.11a mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5500	19.94	16.56
Middle	5600	20.31	16.59
Highest	5700	23.36	16.64
Straddle	5720	16.24	13.48

802.11n (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5500	20.16	17.62
Middle	5600	20.59	17.62
Highest	5700	21.40	17.65
Straddle	5720	16.77	13.99

802.11n (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5510	40.77	36.23
Middle	5590	40.90	36.25
Highest	5670	50.08	36.29
Straddle	5710	35.27	33.11

TEST DATA

802.11ac (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5500	20.13	17.62
Middle	5600	20.26	17.61
Highest	5700	20.81	17.65
Straddle	5720	16.16	13.90

802.11ac (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5510	40.17	36.15
Middle	5590	40.38	36.18
Highest	5670	40.36	36.27
Straddle	5710	35.18	33.02

802.11ac (80 MHz) mode

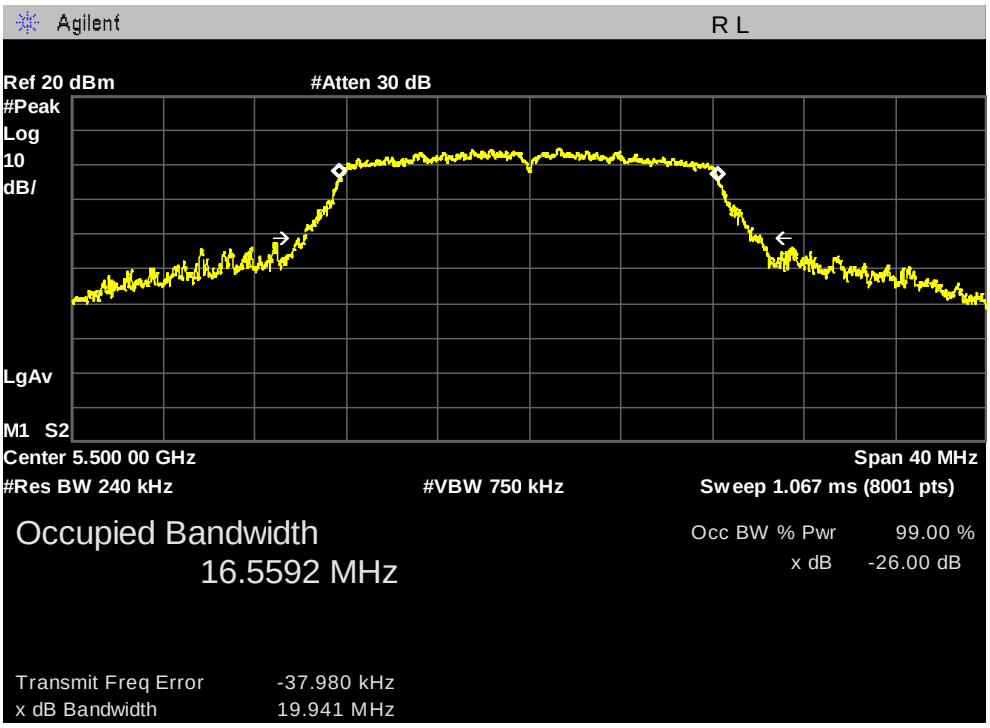
Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Lowest	5530	81.38	75.84
Highest	5610	81.31	75.84
Straddle	5690	75.90	73.10

Note:
The worst ant port was determined by the conducted output power that generates the highest emission performing pre-scan testing in all ant port of each mode.

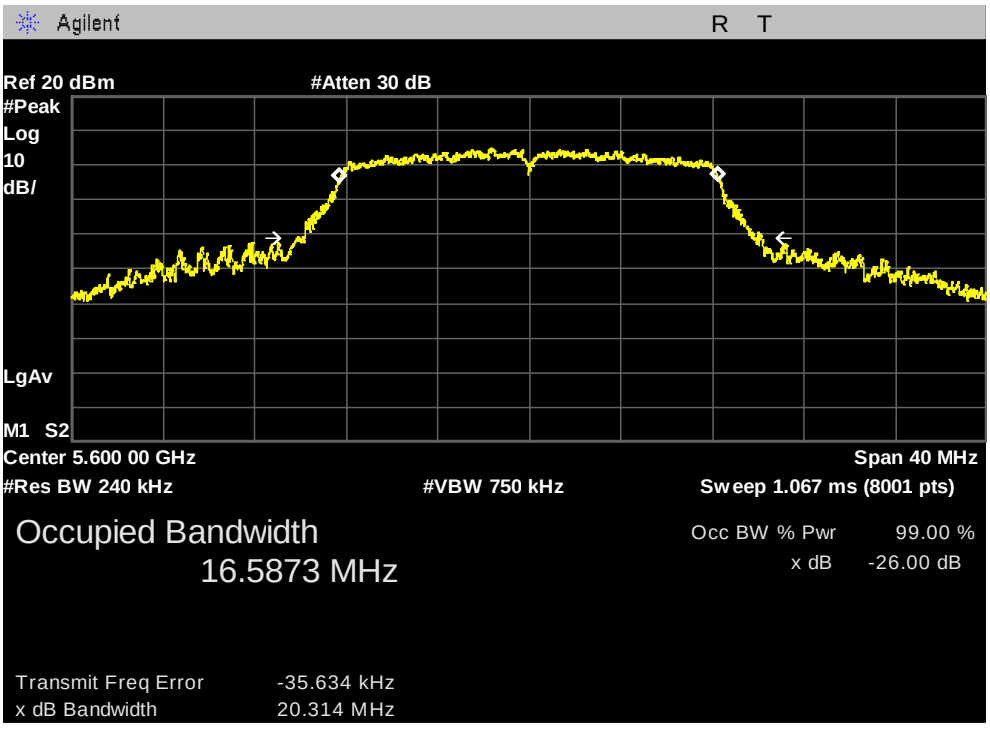
PLOTS OF EMISSIONS

802.11a mode

26 dB Bandwidth, Lowest Channel (5500 MHz)

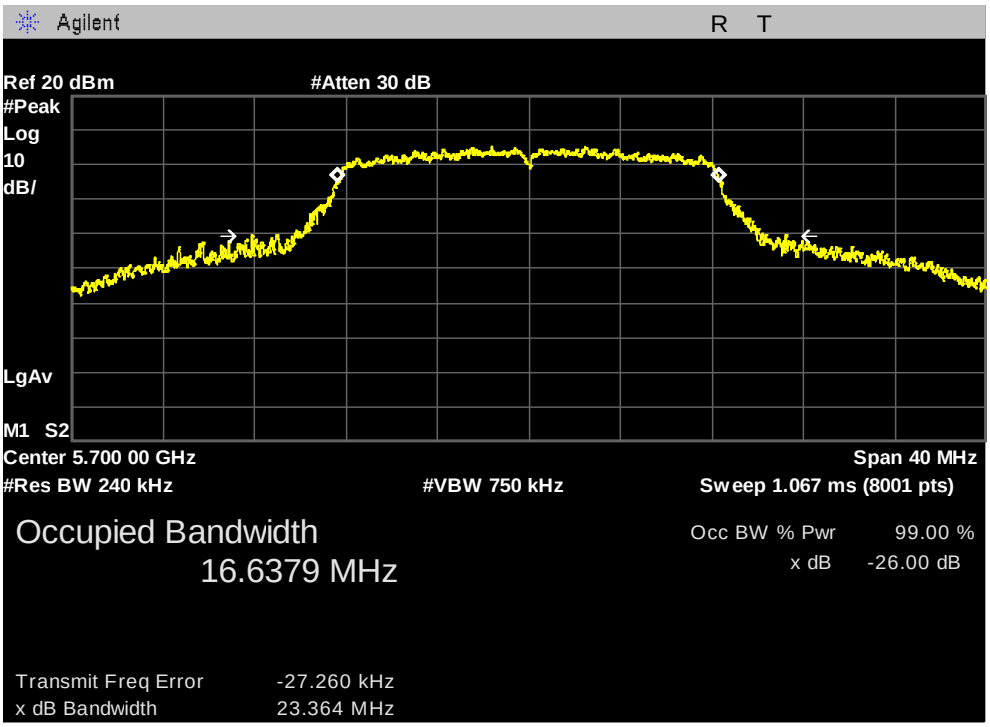


26 dB Bandwidth, Middle Channel (5600 MHz)

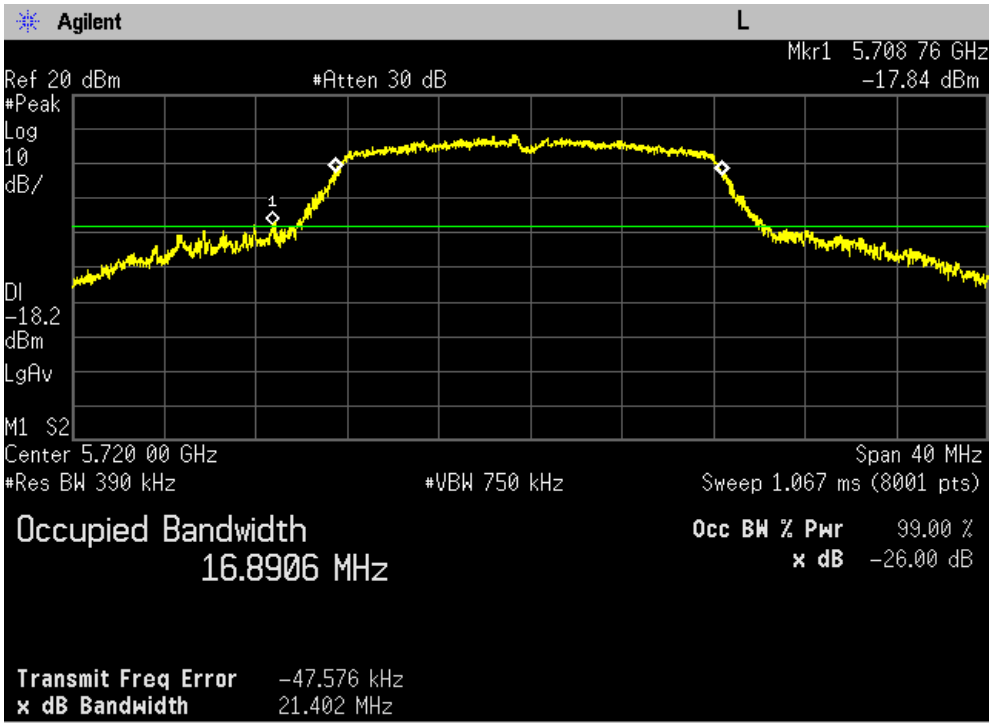


PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5700 MHz)

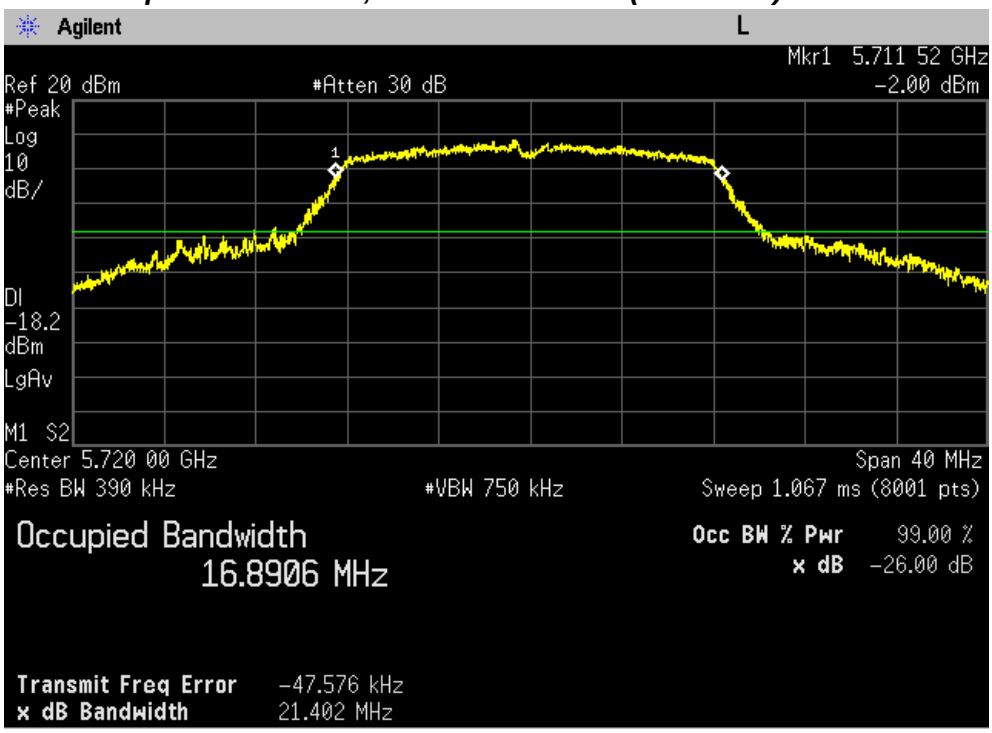


26 dB Bandwidth, Straddle Channel (5720 MHz)



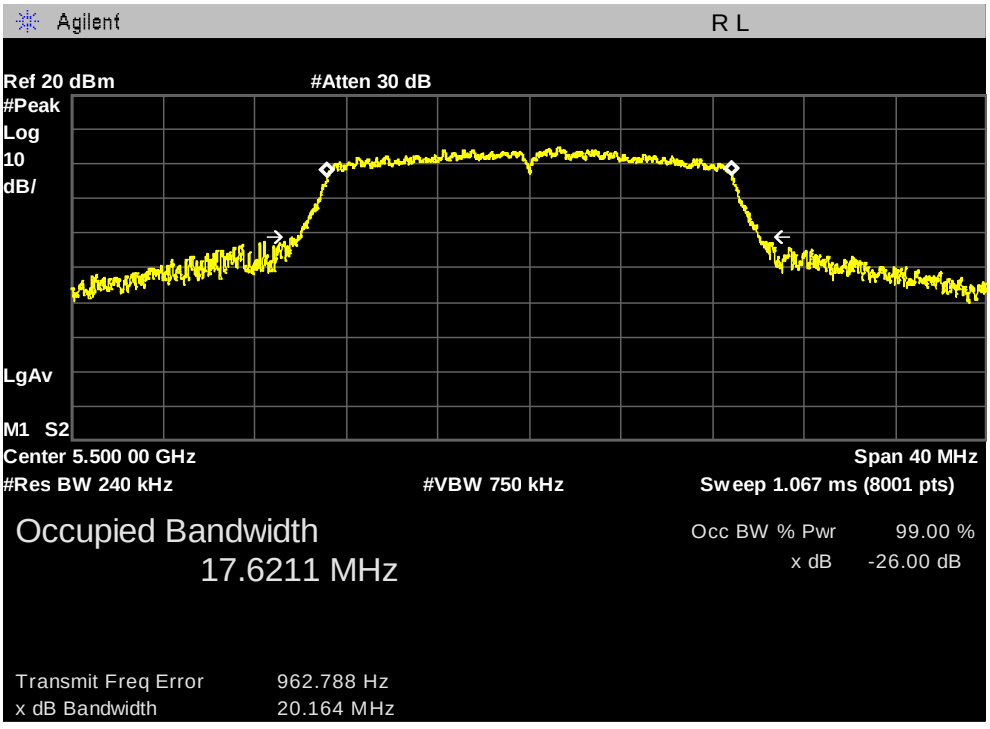
PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5720 MHz)



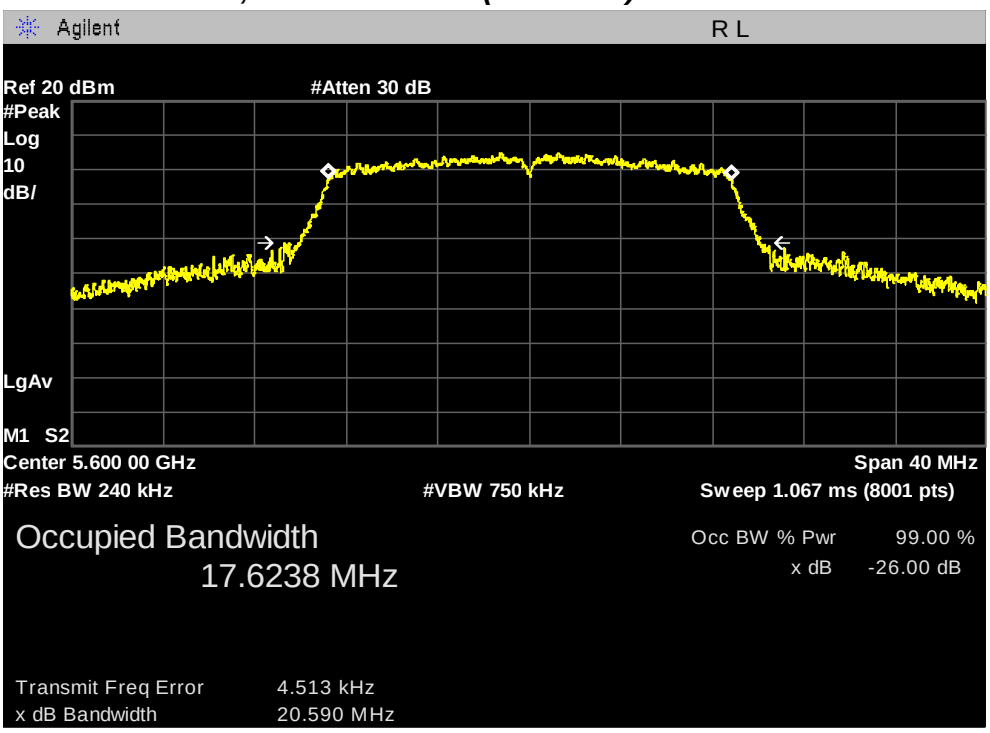
802.11n (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5500 MHz)

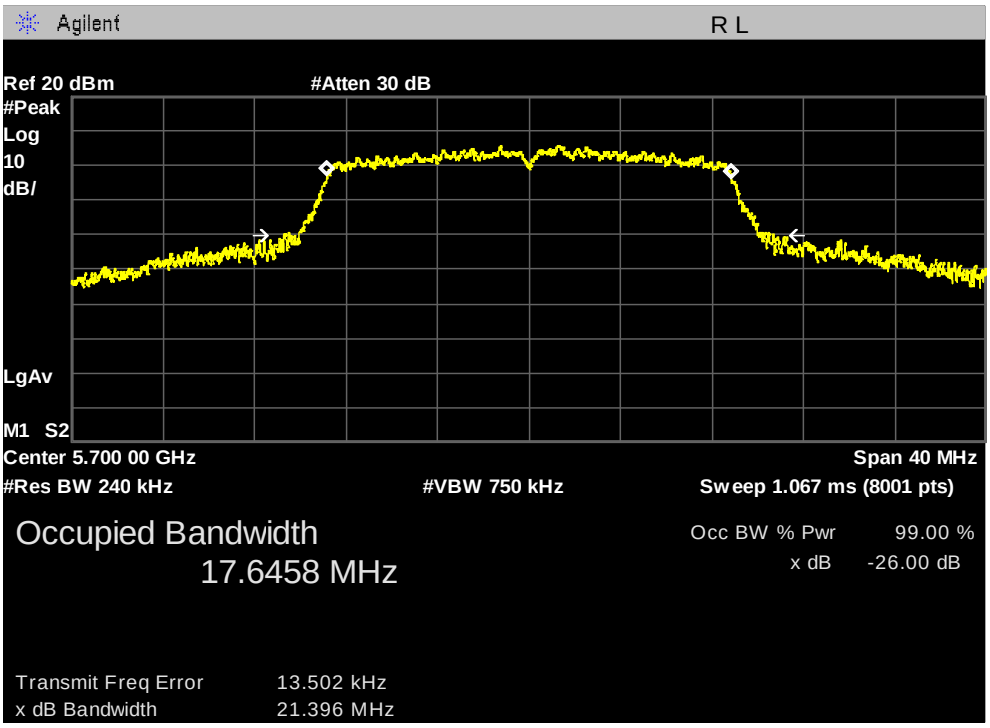


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5600 MHz)

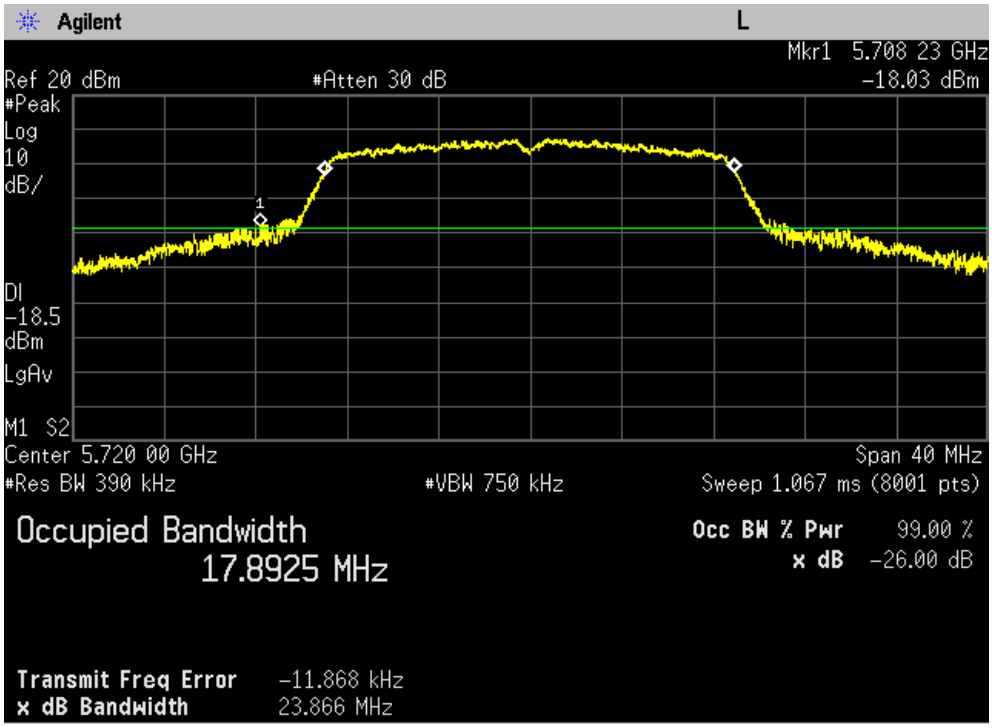


26 dB Bandwidth, Highest Channel (5700 MHz)

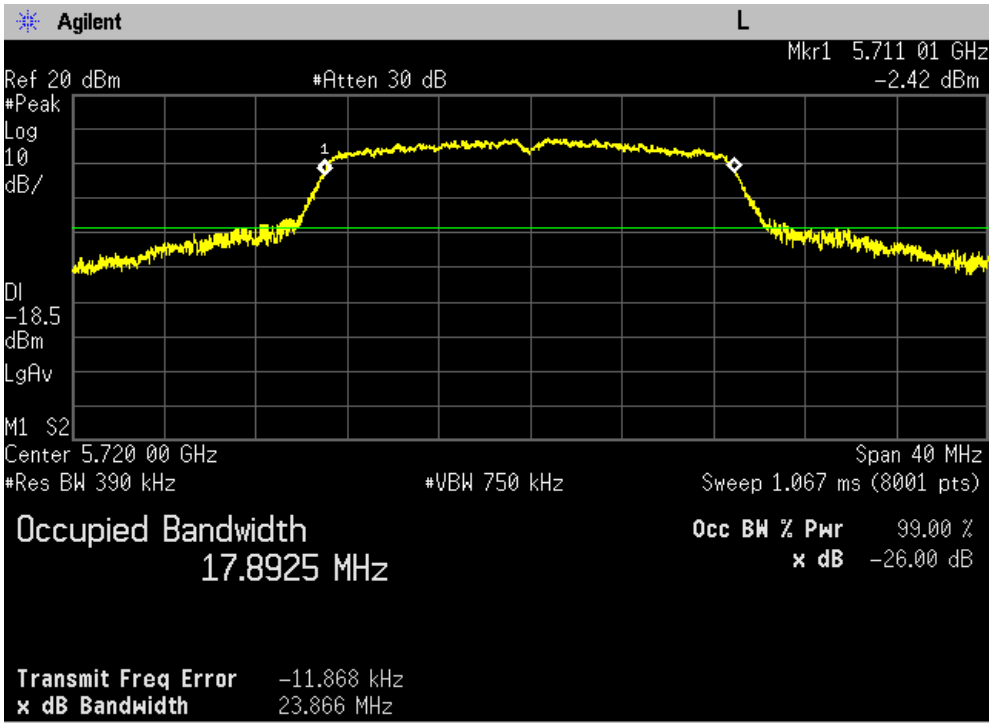


PLOTS OF EMISSIONS

26 dB Bandwidth, Straddle Channel (5720 MHz)



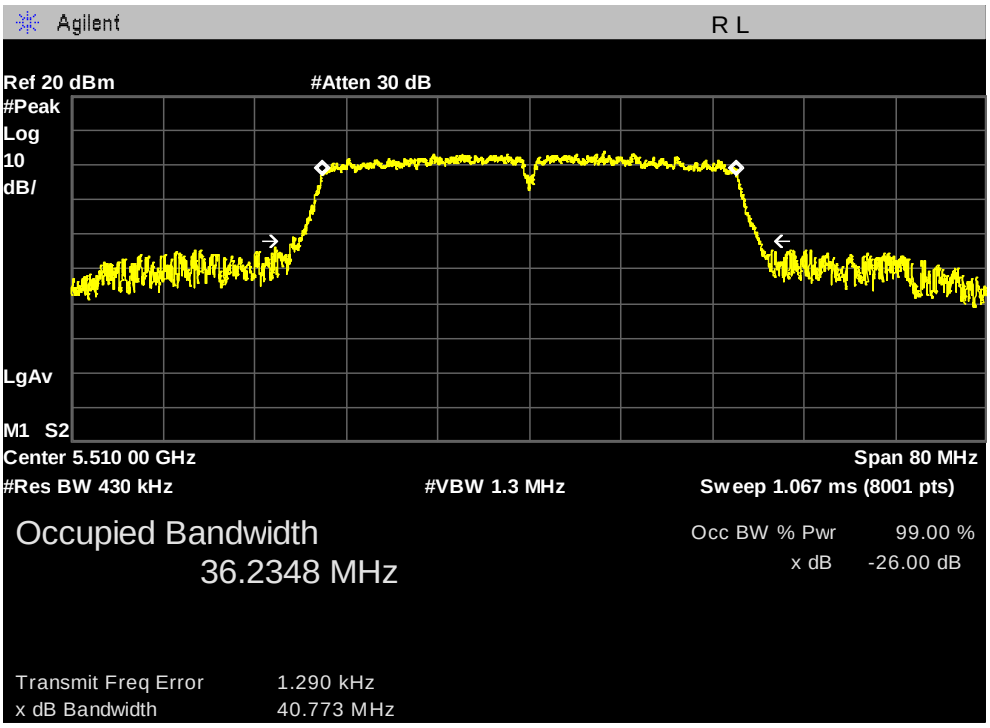
99% Occupied Bandwidth, Straddle Channel (5720 MHz)



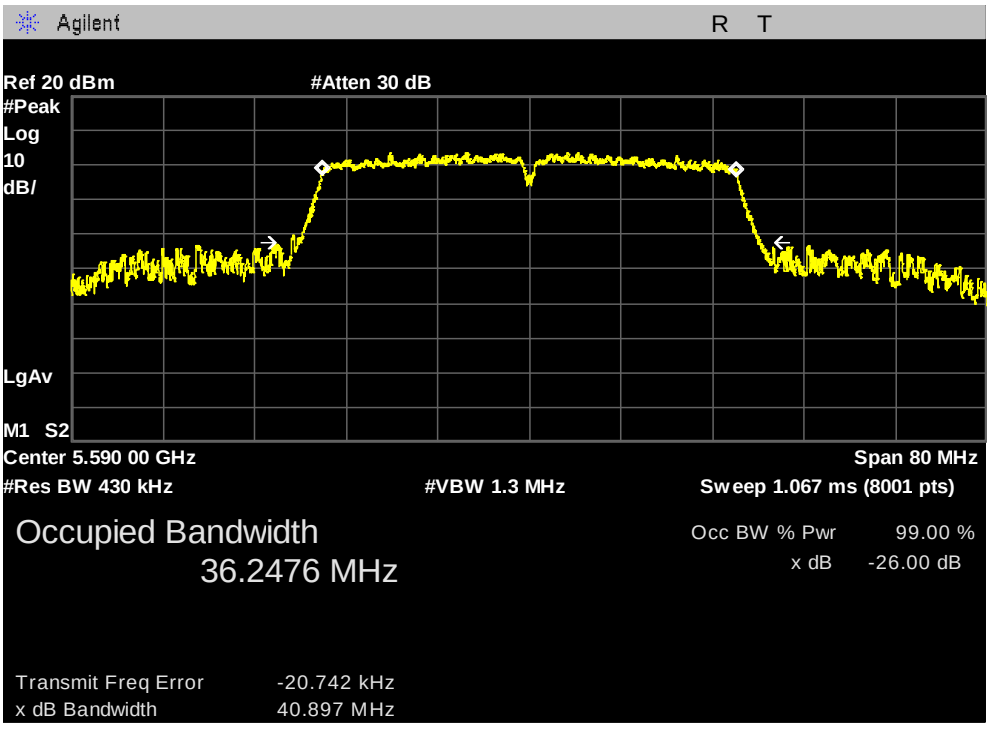
PLOTS OF EMISSIONS

802.11n (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5510 MHz)

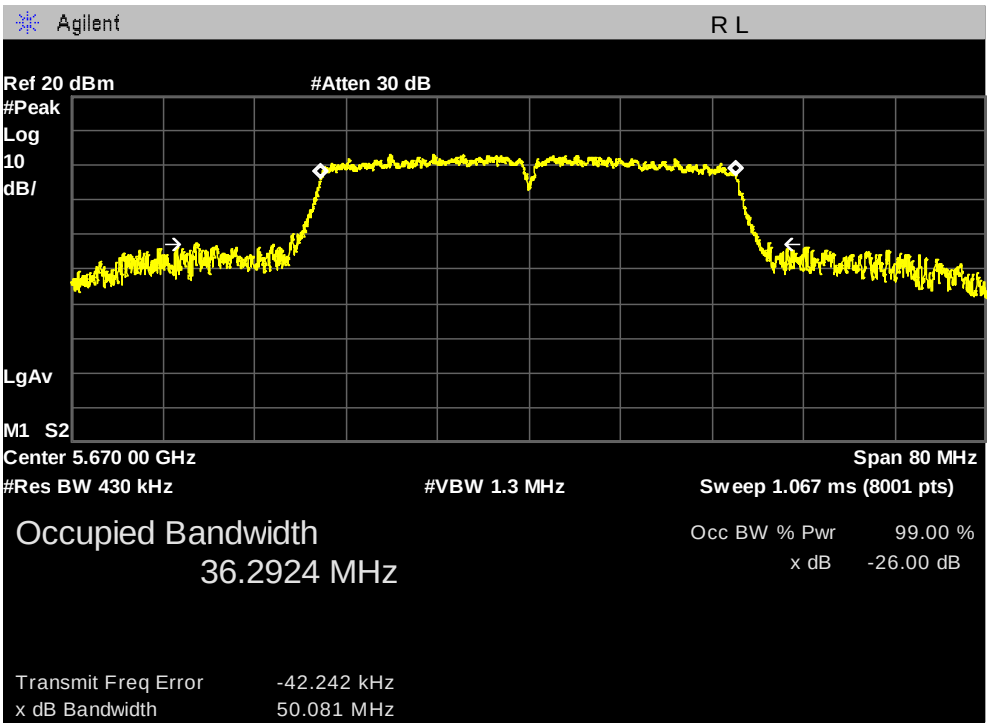


26 dB Bandwidth, Middle Channel (5590 MHz)

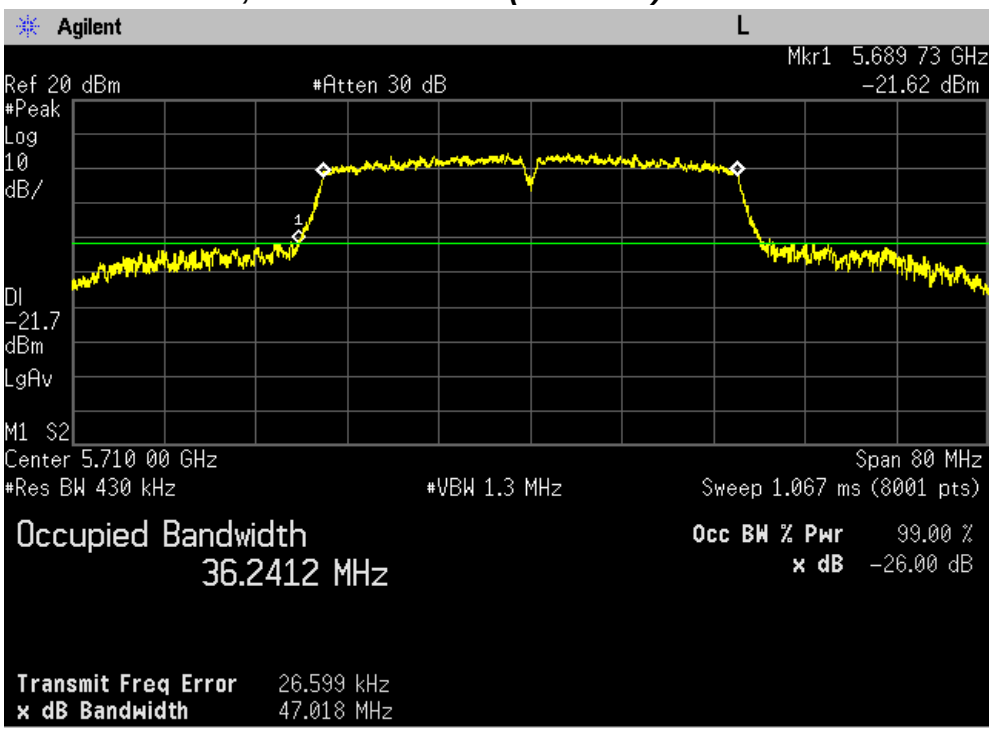


PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5670 MHz)

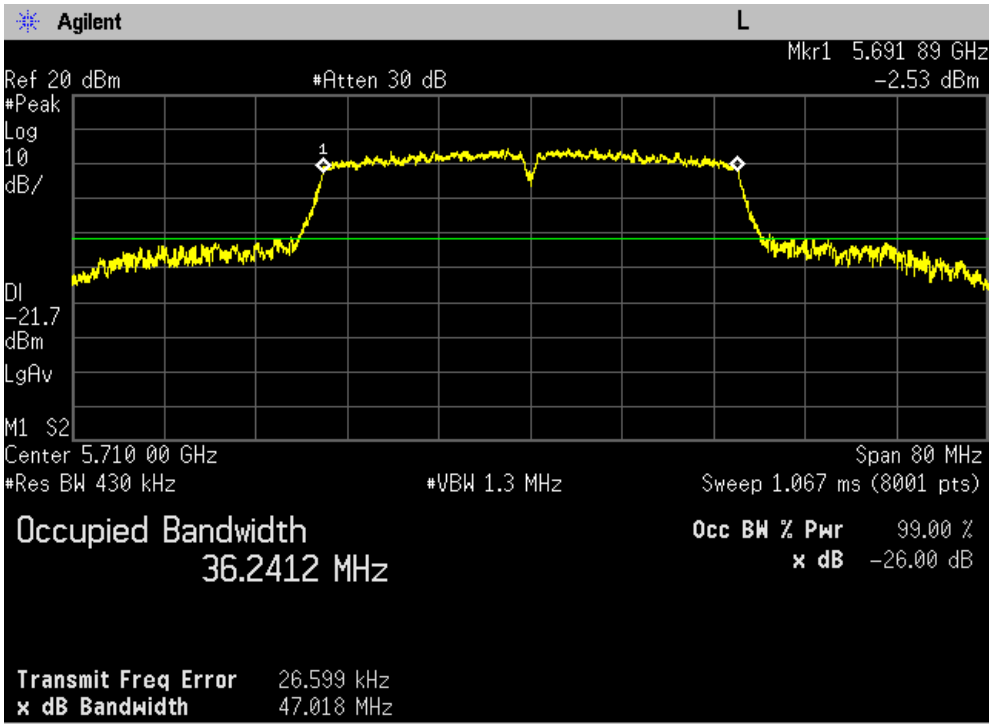


26 dB Bandwidth, Straddle Channel (5710 MHz)



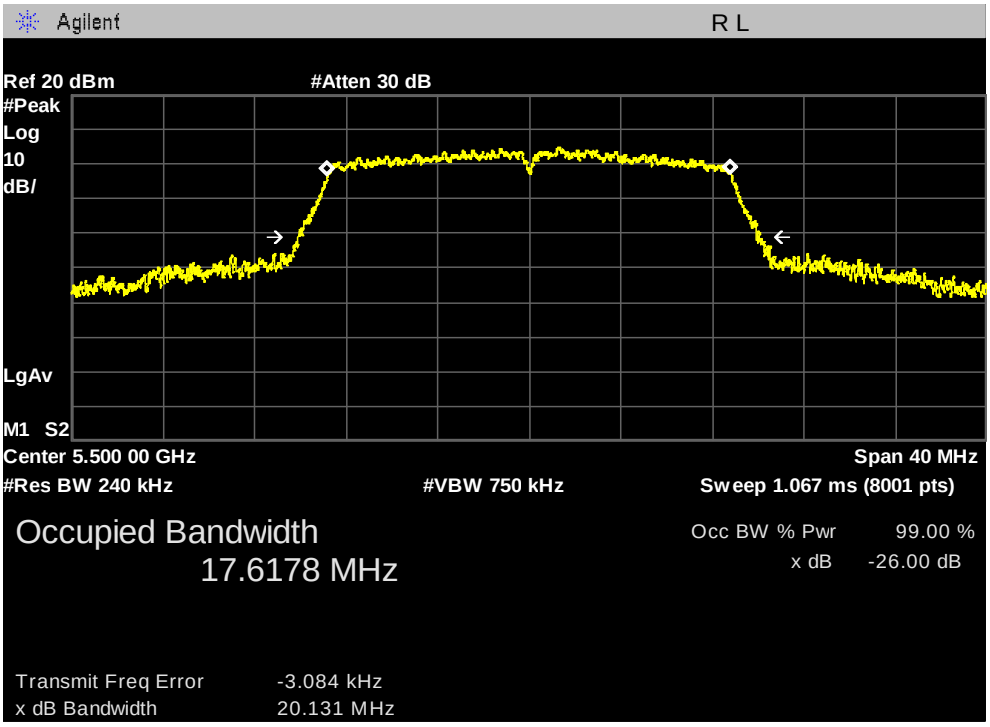
PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5710 MHz)



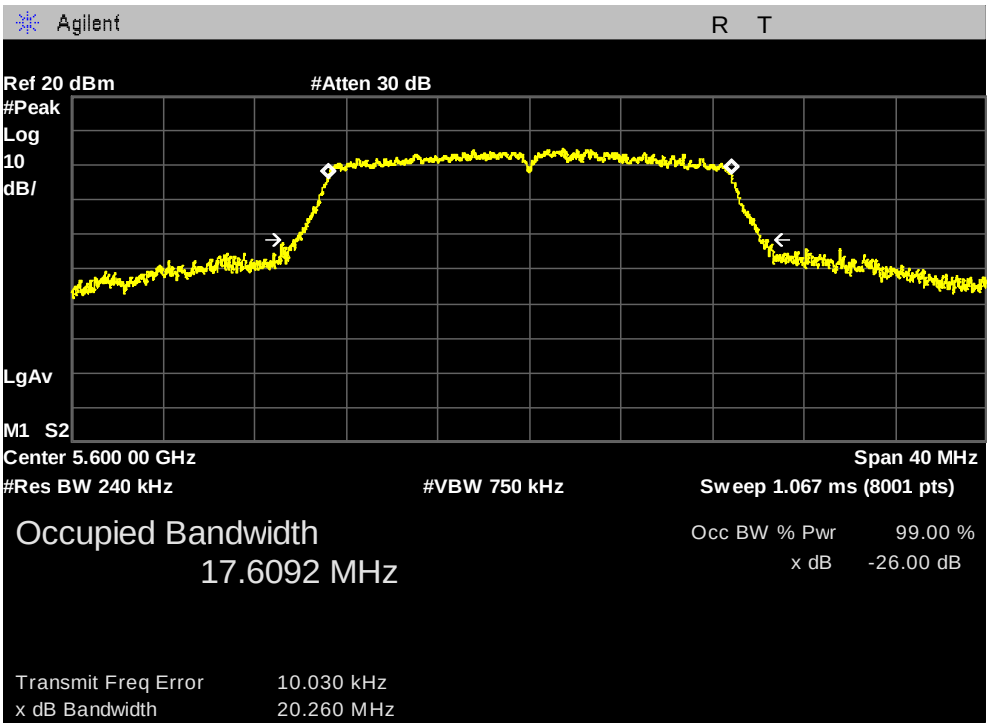
802.11ac (20 MHz) mode

26 dB Bandwidth, Lowest Channel (5500 MHz)

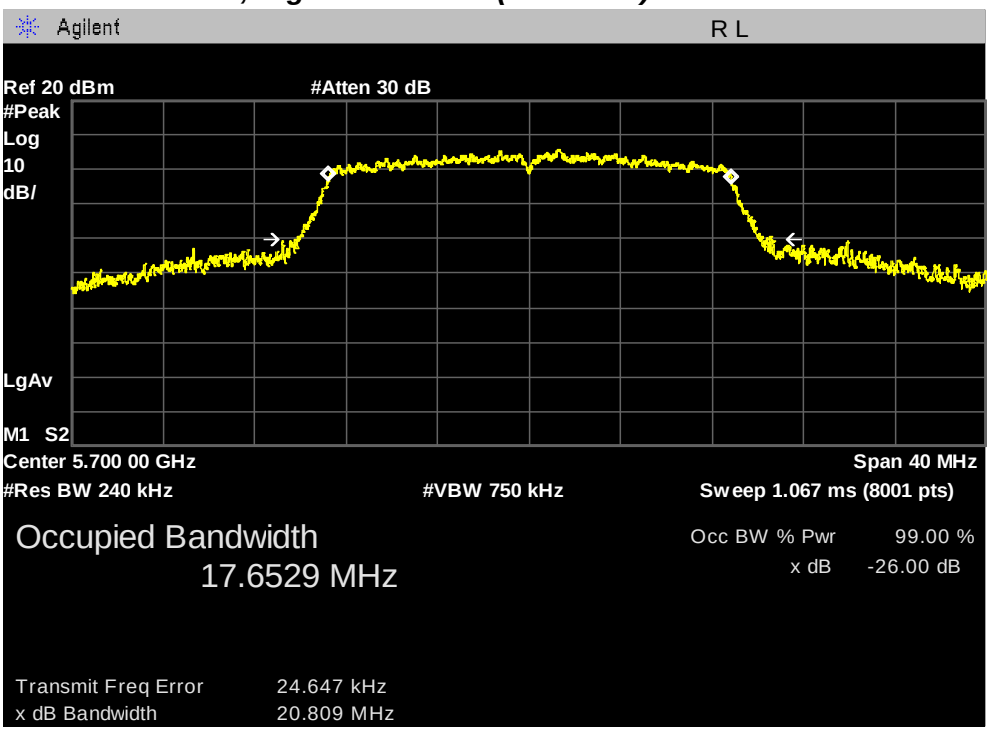


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5600 MHz)

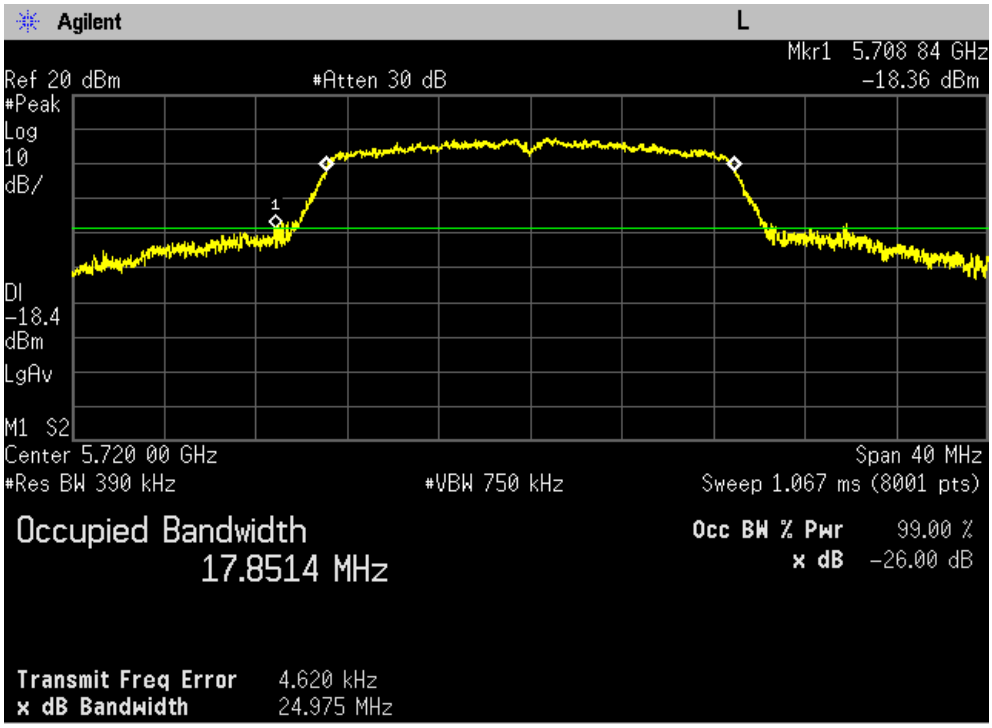


26 dB Bandwidth, Highest Channel (5700 MHz)

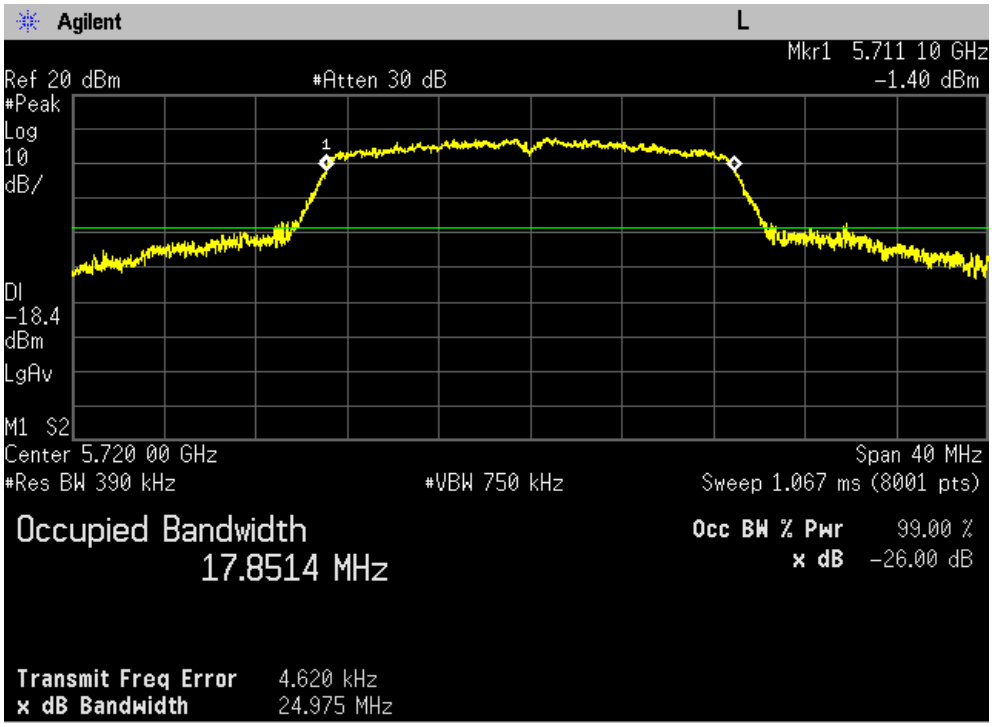


PLOTS OF EMISSIONS

26 dB Bandwidth, Straddle Channel (5720 MHz)



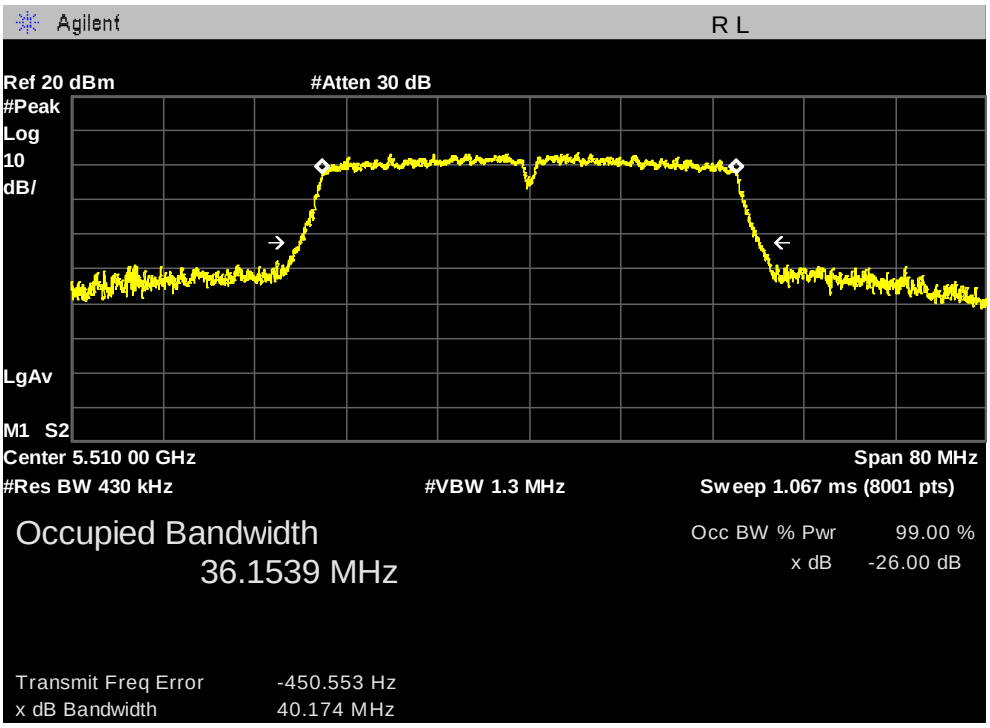
99% Occupied Bandwidth, Straddle Channel (5720 MHz)



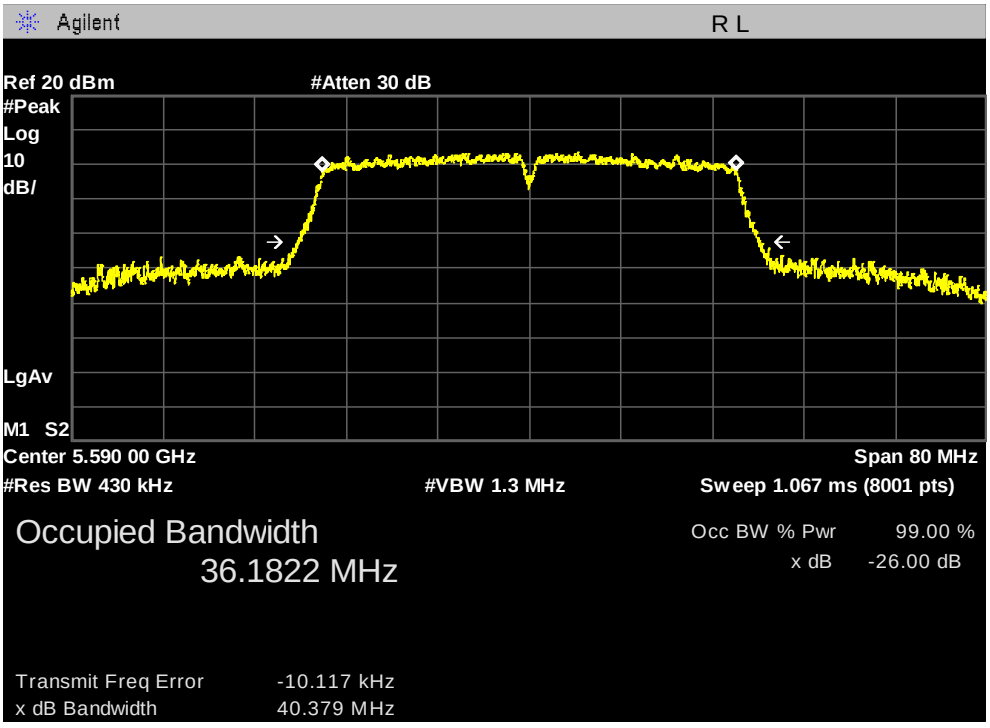
PLOTS OF EMISSIONS

802.11ac (40 MHz) mode

26 dB Bandwidth, Lowest Channel (5510 MHz)

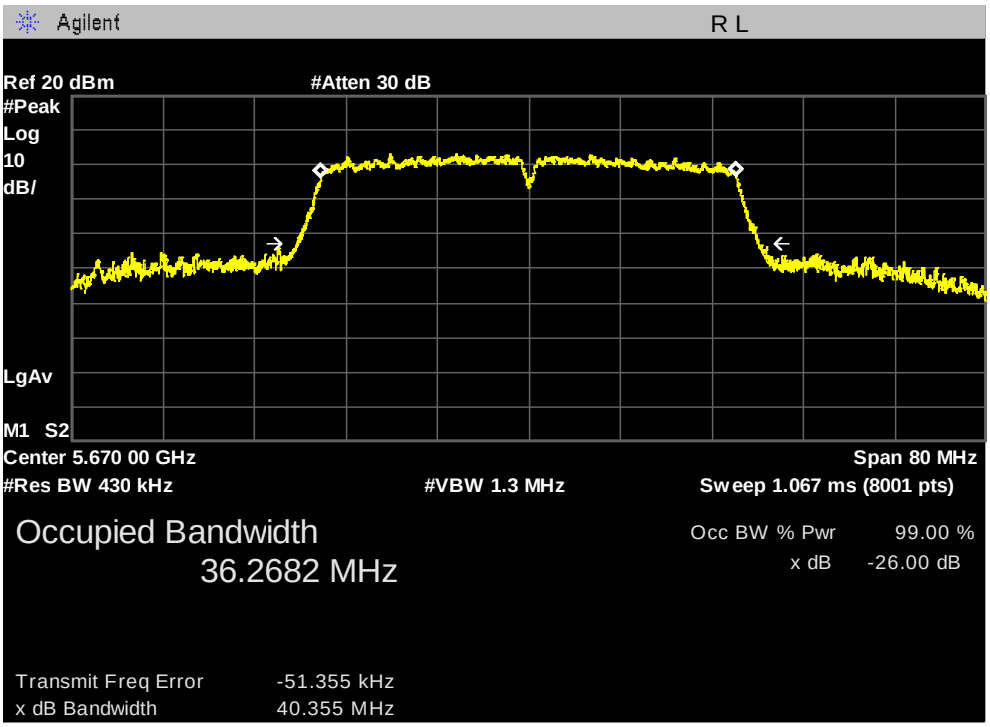


26 dB Bandwidth, Middle Channel (5590 MHz)

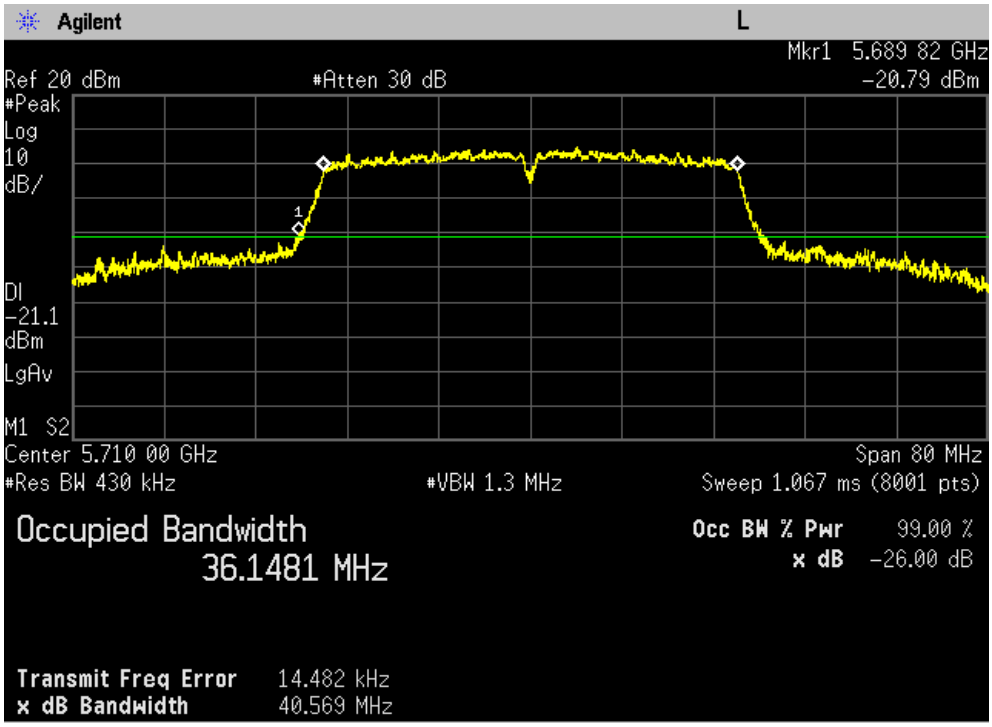


PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5670 MHz)

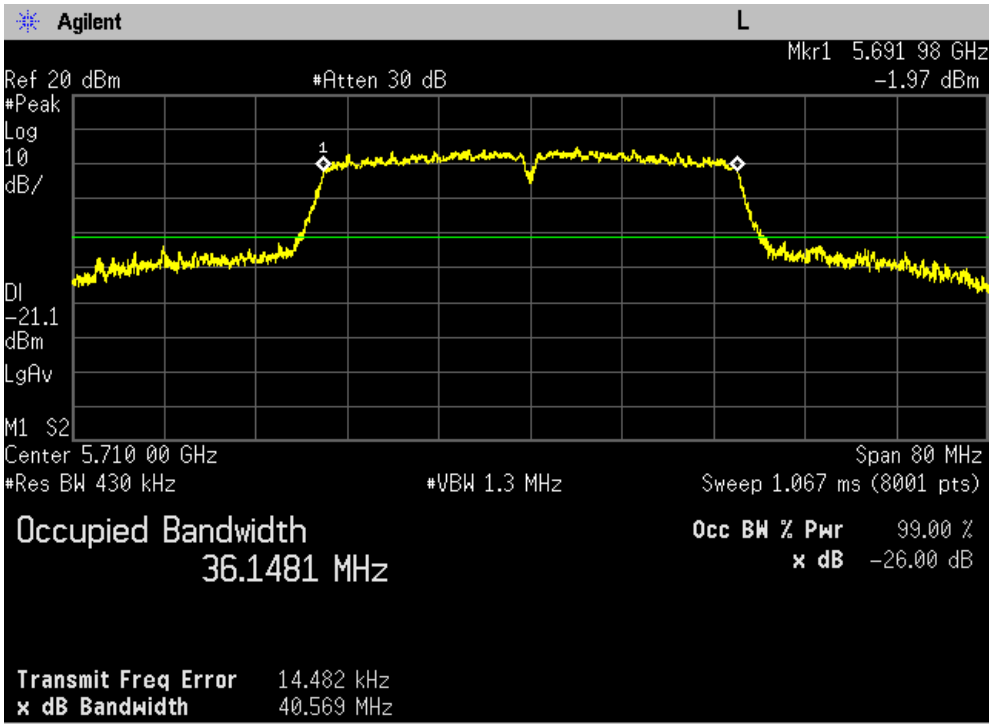


26 dB Bandwidth, Straddle Channel (5710 MHz)



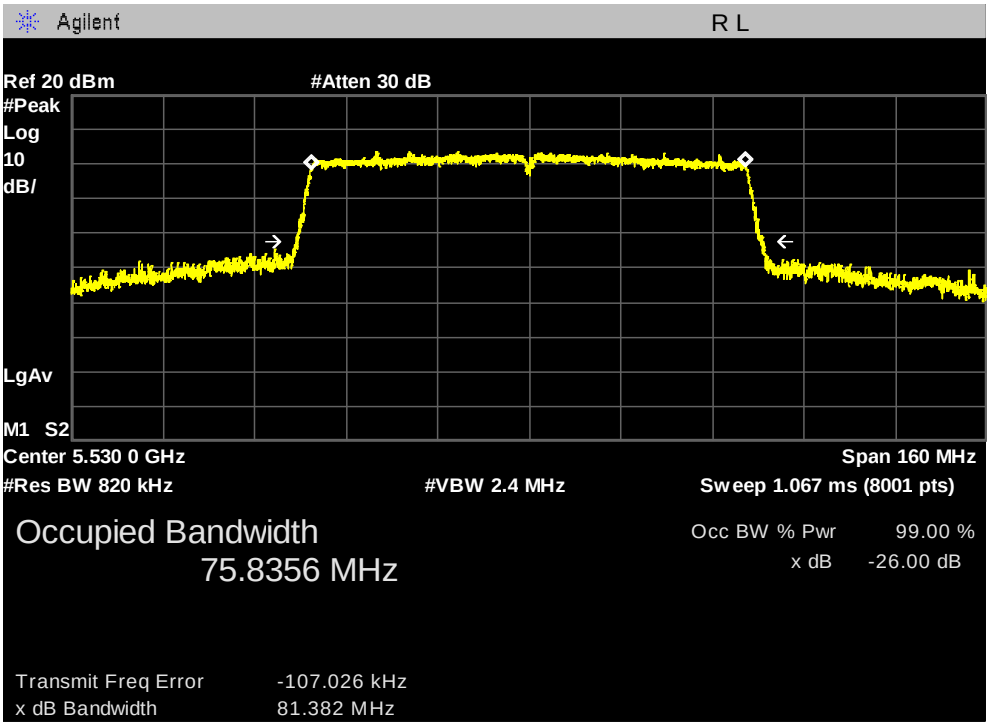
PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5710 MHz)



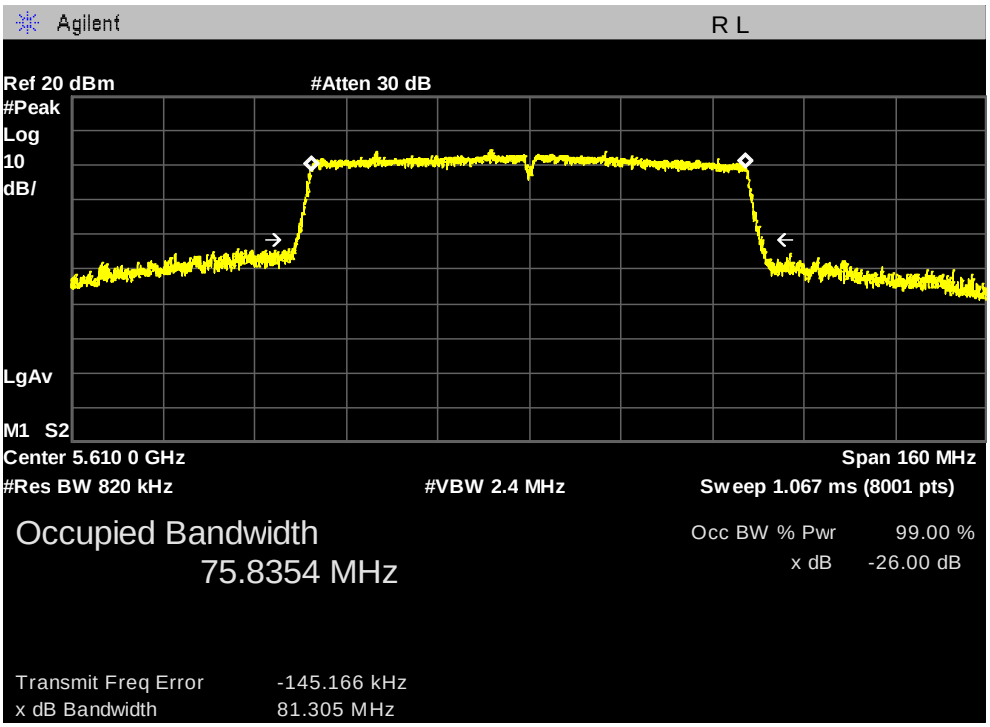
802.11ac (80 MHz) mode

26 dB Bandwidth, Lowest Channel (5530 MHz)

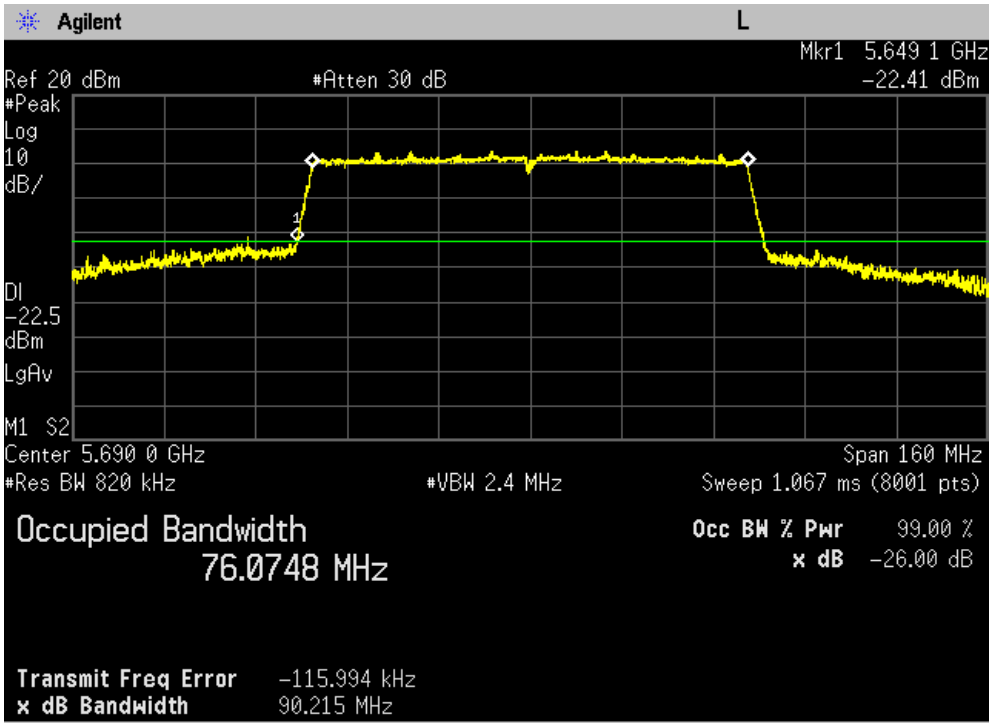


PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5610 MHz)

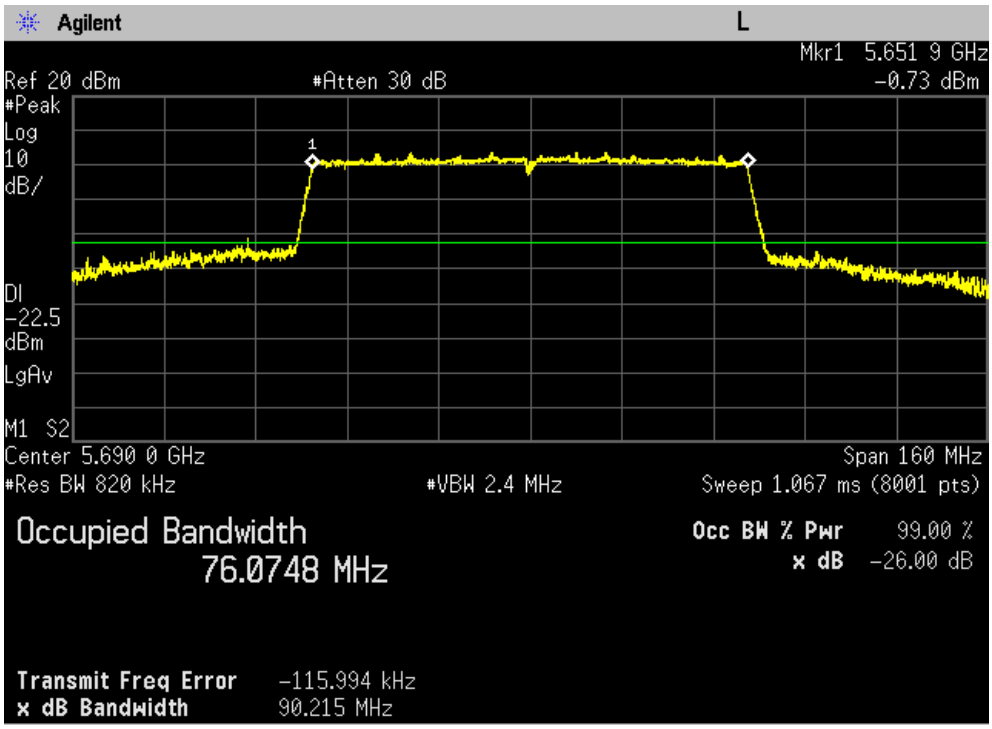


26 dB Bandwidth, Straddle Channel (5690 MHz)



PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5690 MHz)



8.2.4 26 dB Bandwidth and 99 % Occupied bandwidth – U-NII-3 band

FCC §15.407(a)

Test Mode : Set to Straddle channel, Lowest channel, Middle channel and Highest channel

802.11a mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5720	5.16	3.41
Lowest	5745	21.22	16.55
Middle	5785	23.54	16.64
Highest	5825	20.67	16.60

802.11n (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5720	7.10	3.90
Lowest	5745	20.75	17.63
Middle	5785	25.52	17.67
Highest	5825	21.38	17.64

802.11n (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5710	11.75	3.11
Lowest	5755	49.34	36.28
Highest	5795	47.28	36.30

TEST DATA

802.11ac (20 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5720	8.82	3.95
Lowest	5745	21.06	17.63
Middle	5785	21.40	17.69
Highest	5825	20.51	17.65

802.11ac (40 MHz) mode

Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5710	5.40	3.13
Lowest	5755	40.48	36.19
Highest	5795	40.68	36.28

802.11ac (80 MHz) mode

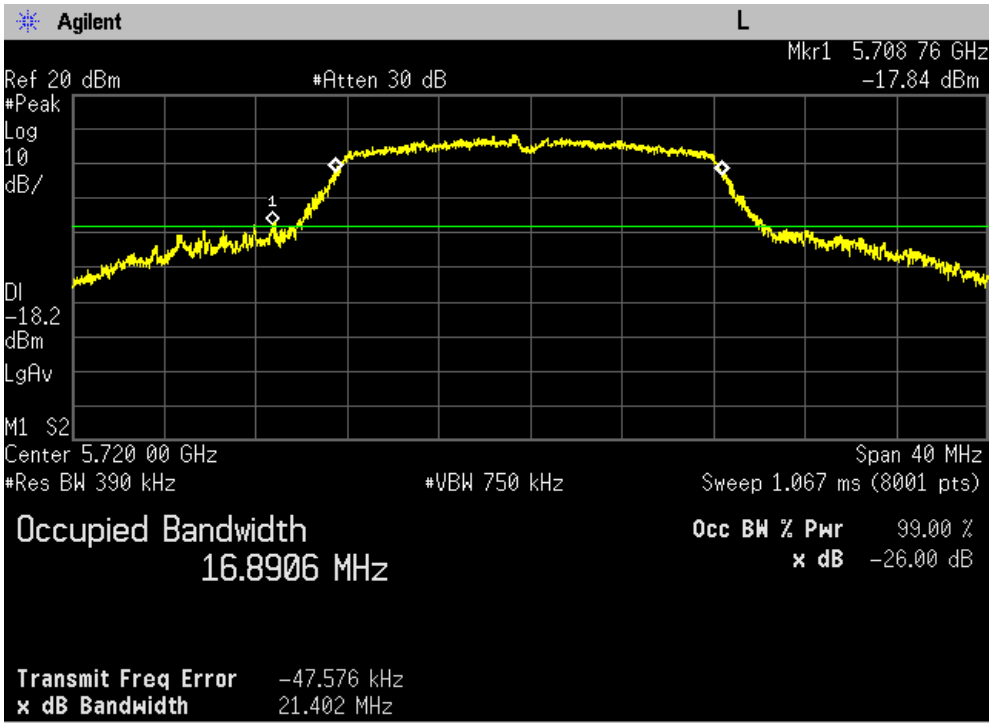
Channel	Frequency (MHz)	26 dB Bandiwidth (MHz)	99% Occupied Bandwidth (MHz)
Straddle	5690	14.32	2.97
Middle	5775	80.34	75.82

Note:
The worst ant port was determined by the conducted output power that generates the highest emission performing pre-scan testing in all ant port of each mode.

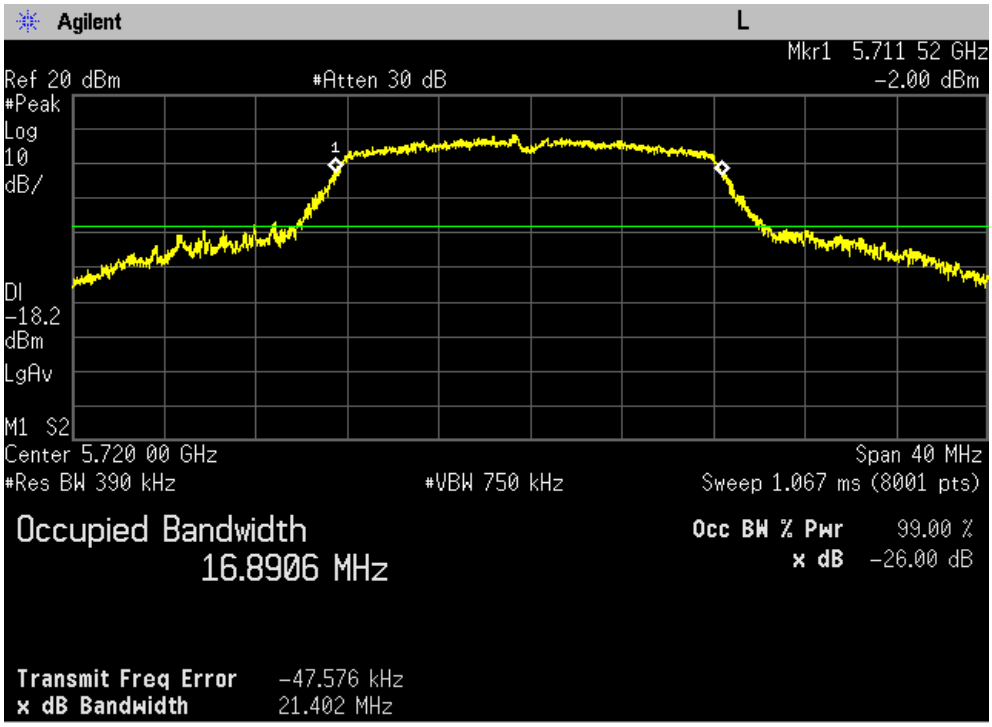
PLOTS OF EMISSIONS

802.11a mode

26 dB Bandwidth, Straddle Channel (5720 MHz)

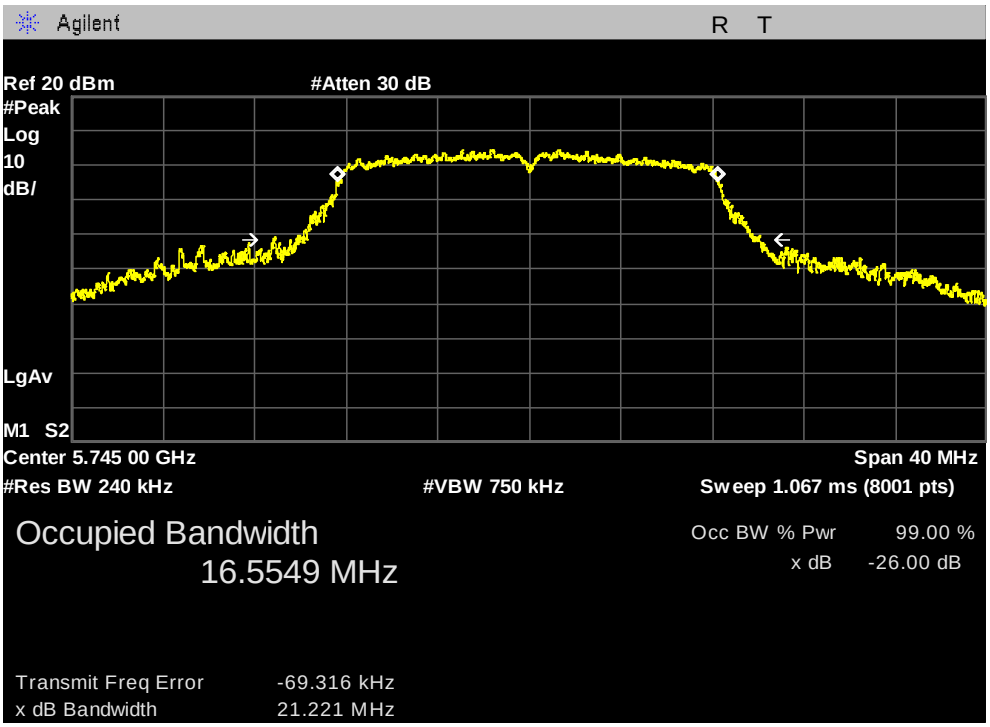


99% Occupied Bandwidth, Straddle Channel (5720 MHz)

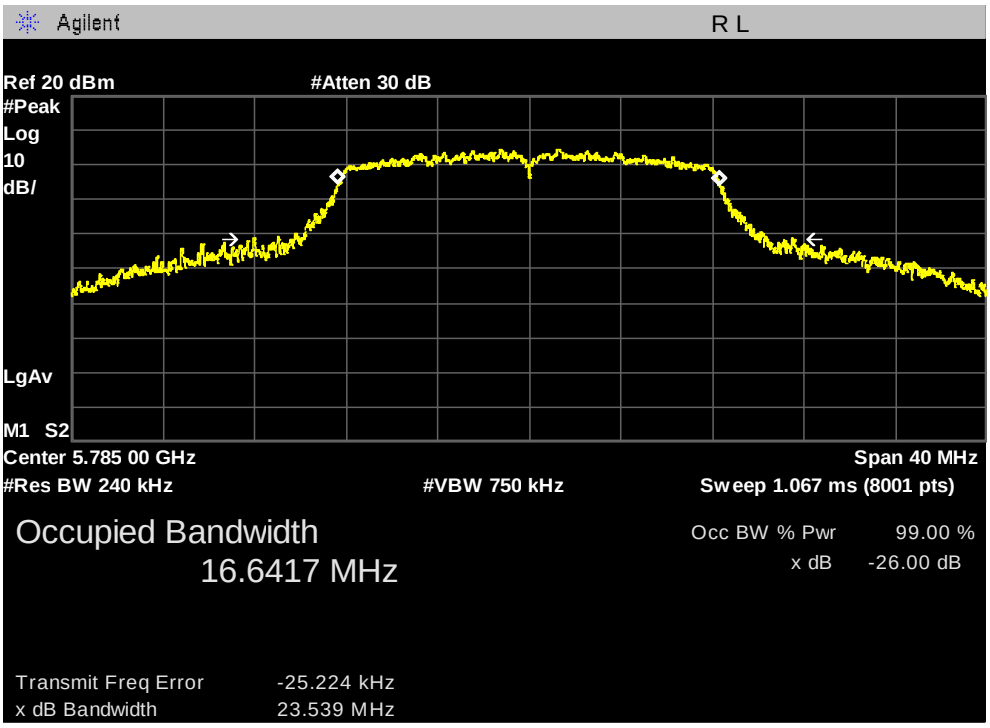


PLOTS OF EMISSIONS

26 dB Bandwidth, Lowest Channel (5745 MHz)

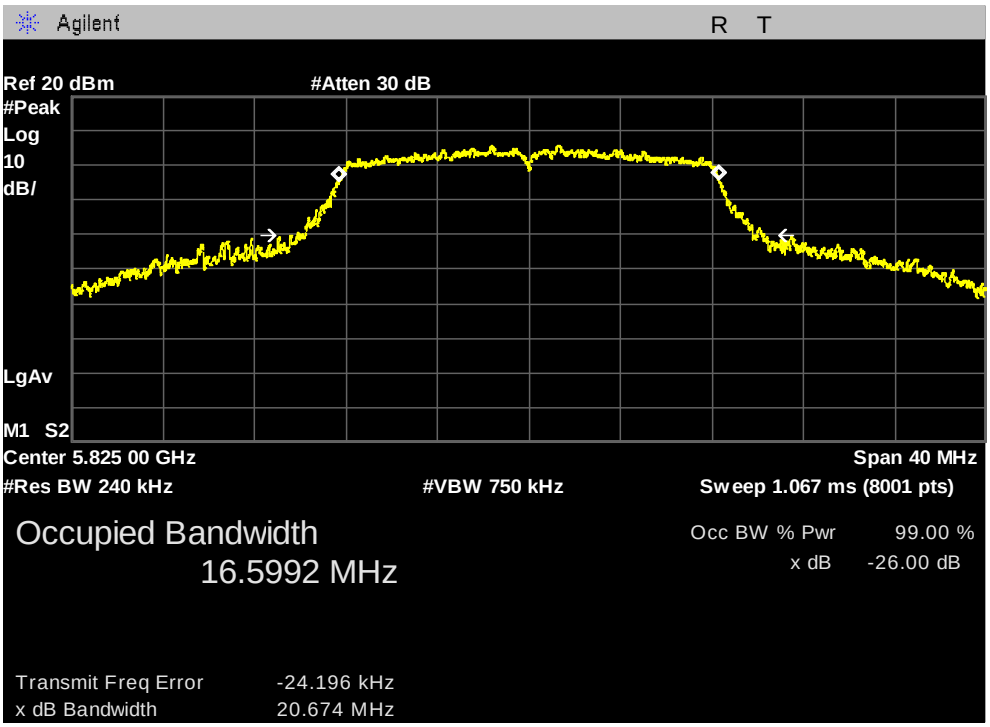


26 dB Bandwidth, Middle Channel (5785 MHz)



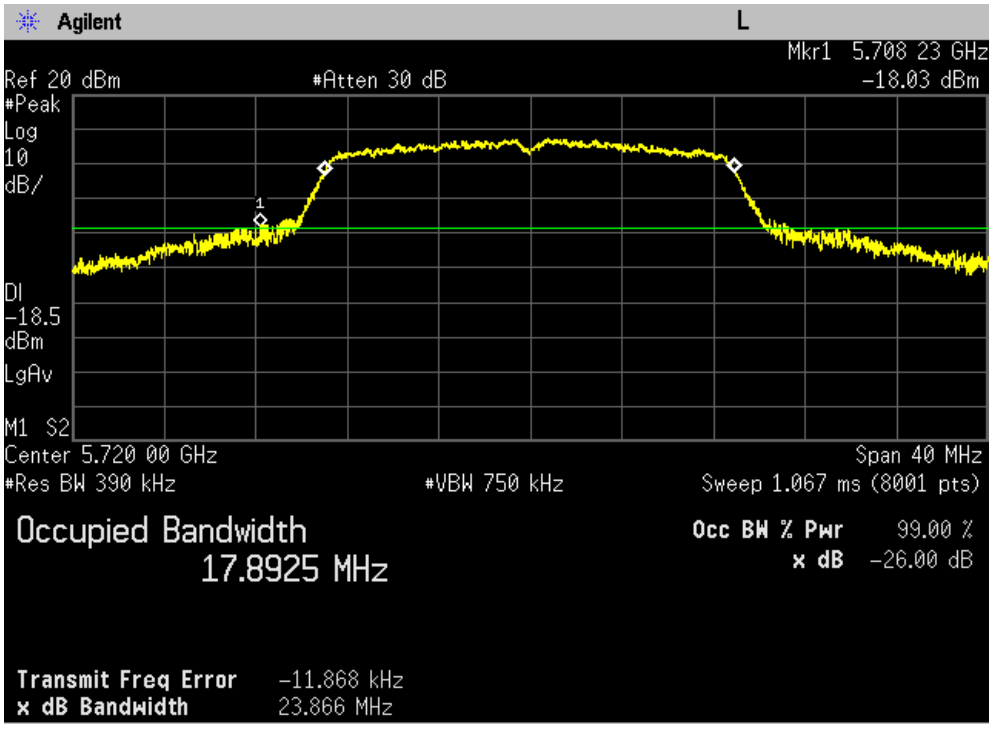
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5825 MHz)



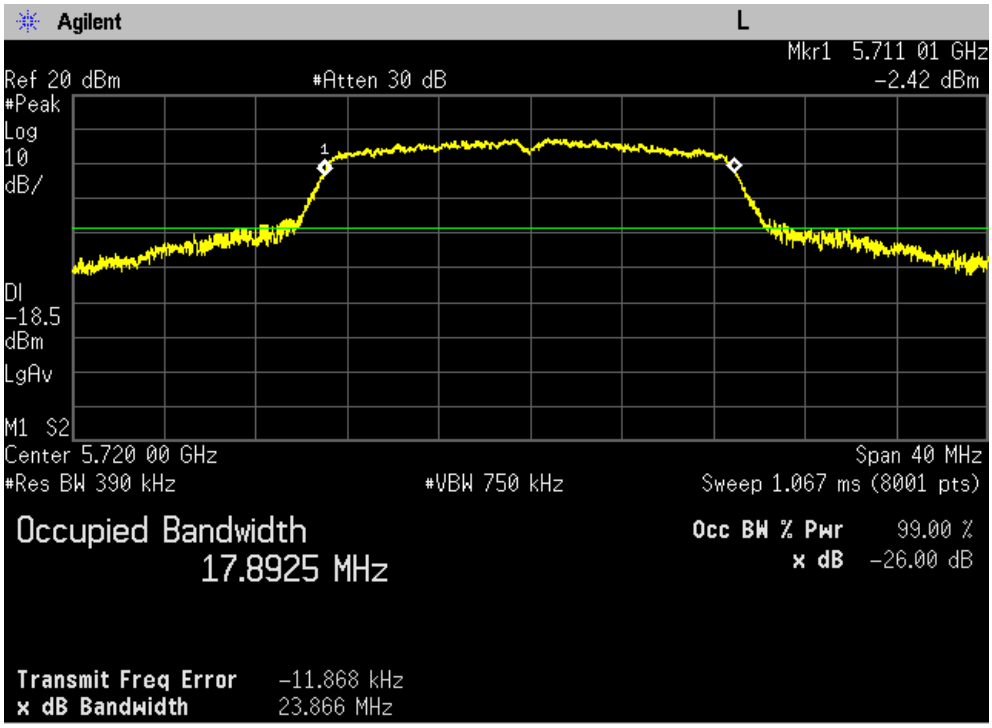
802.11n (20 MHz) mode

26 dB Bandwidth, Straddle Channel (5720 MHz)

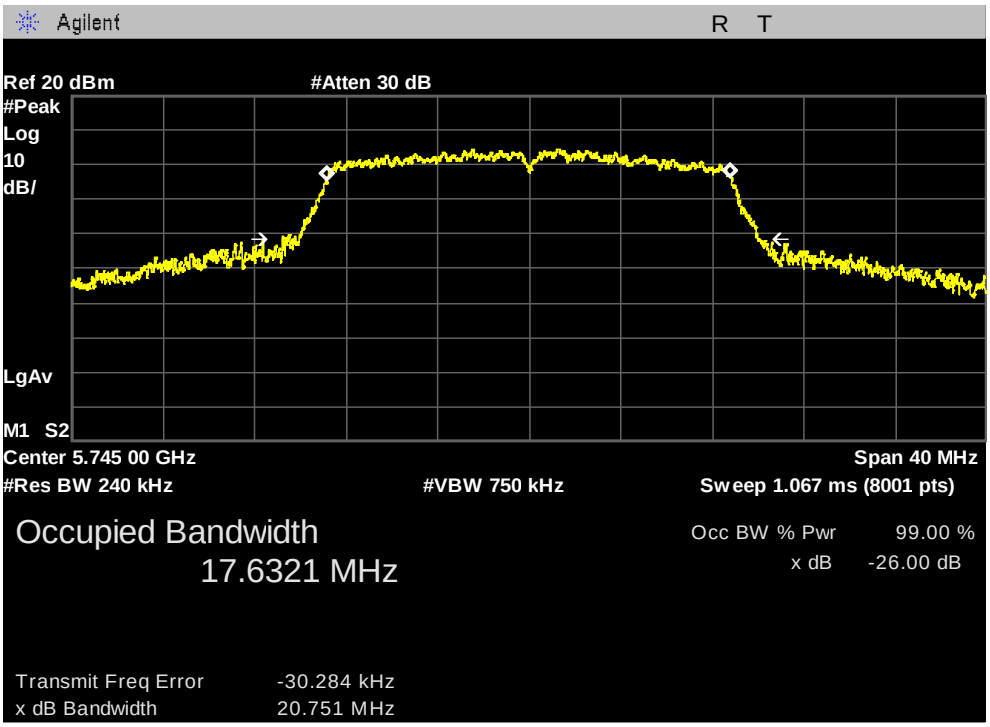


PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5720 MHz)

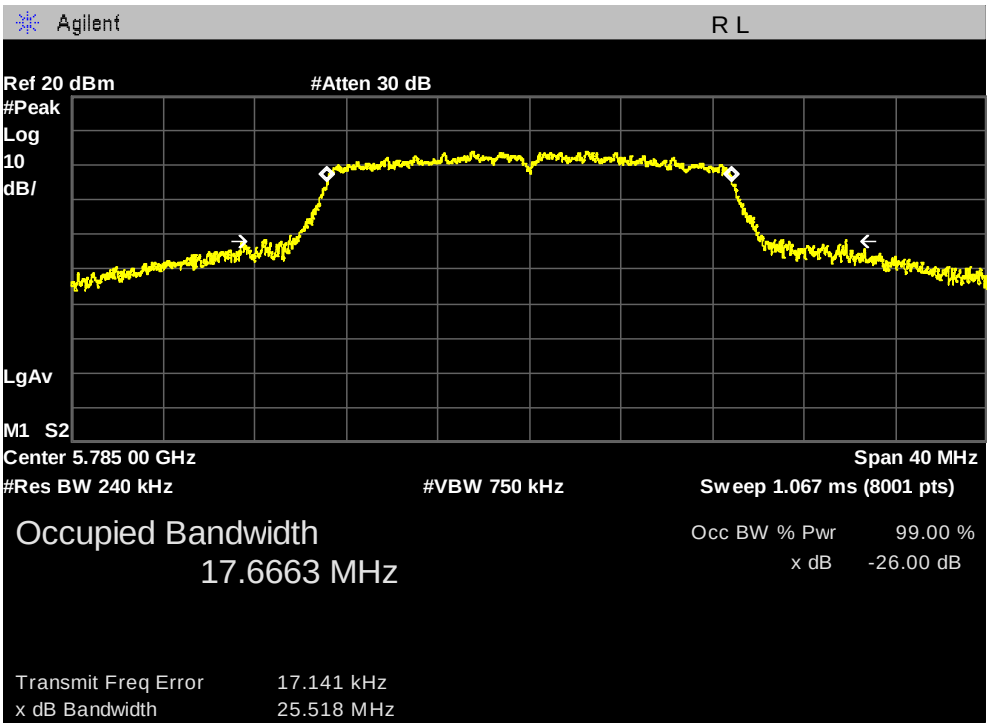


26 dB Bandwidth, Lowest Channel (5745 MHz)

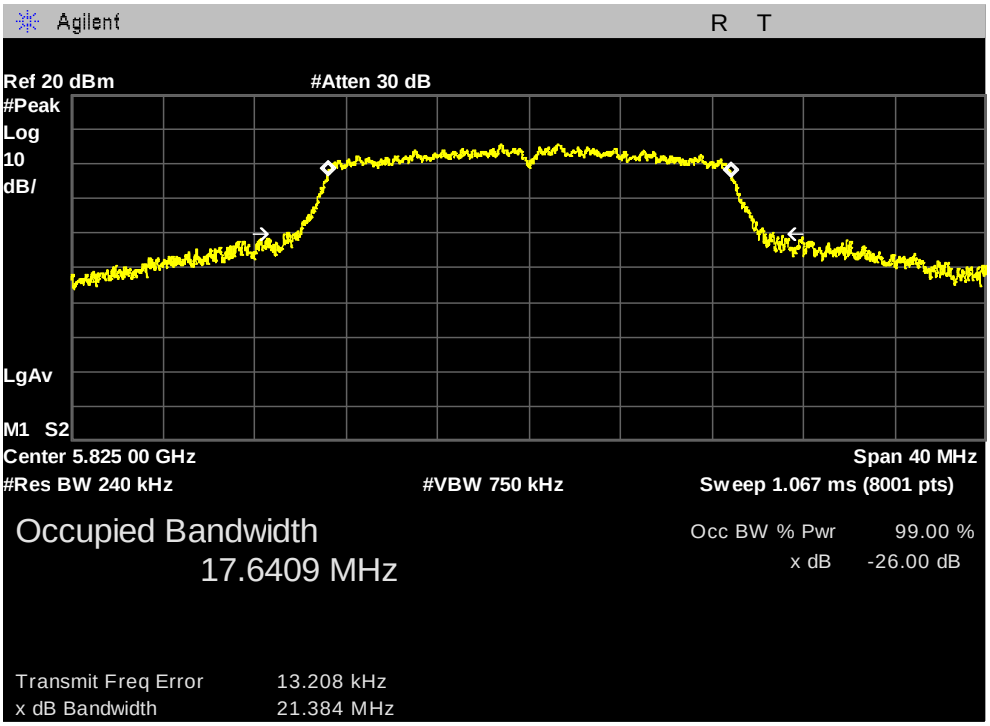


PLOTS OF EMISSIONS

26 dB Bandwidth, Middle Channel (5785 MHz)



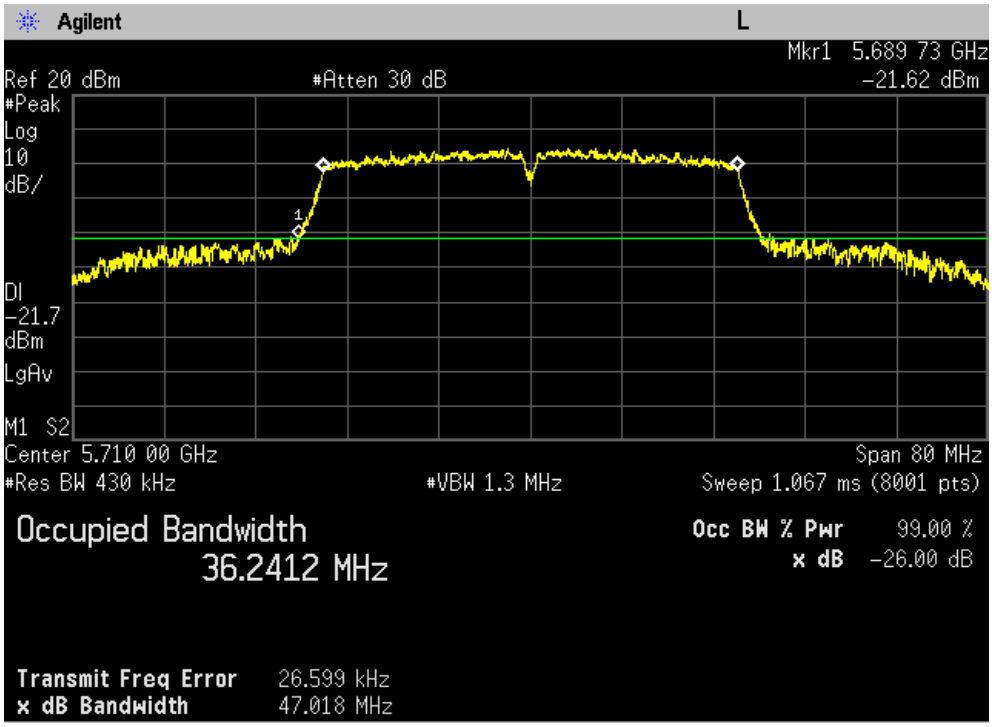
26 dB Bandwidth, Highest Channel (5825 MHz)



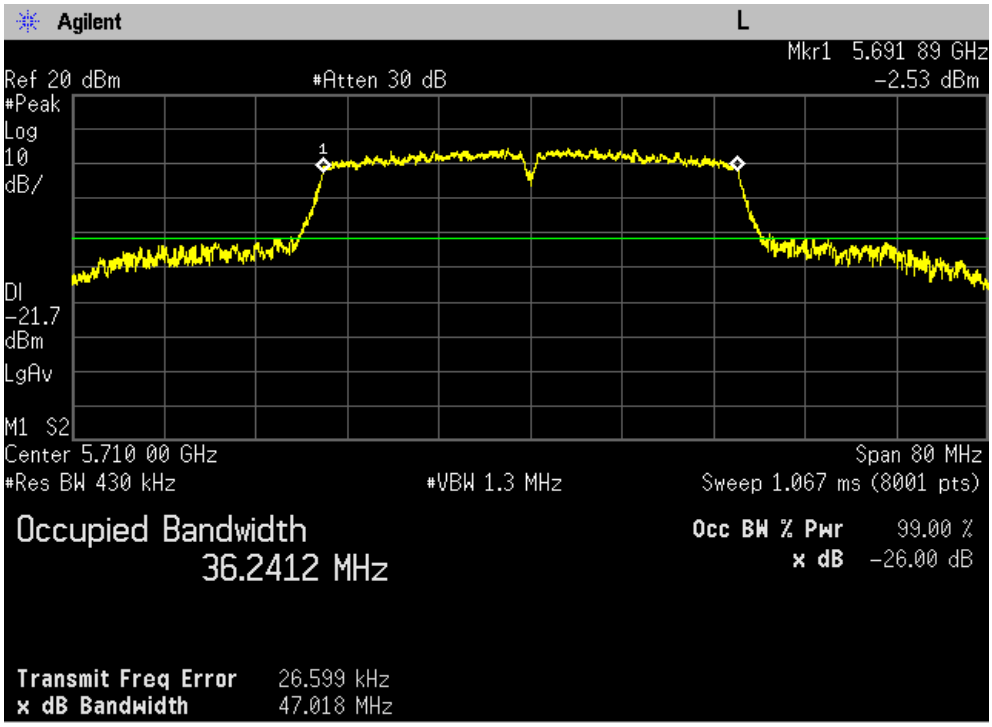
PLOTS OF EMISSIONS

802.11n (40 MHz) mode

26 dB Bandwidth, Straddle Channel (5710 MHz)

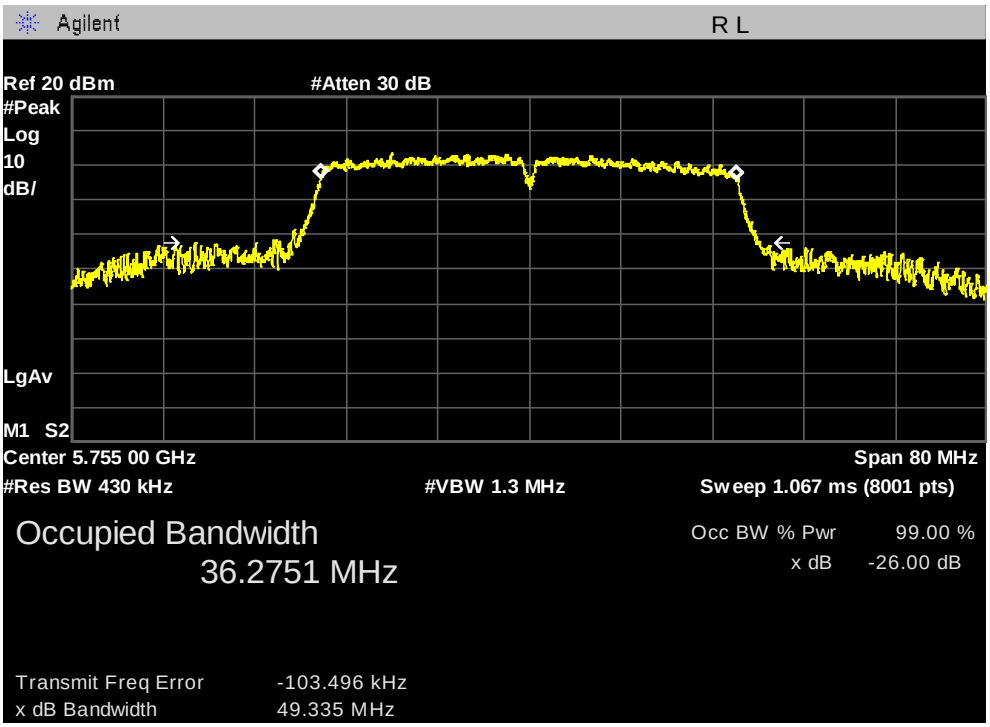


99% Occupied Bandwidth, Straddle Channel (5710 MHz)

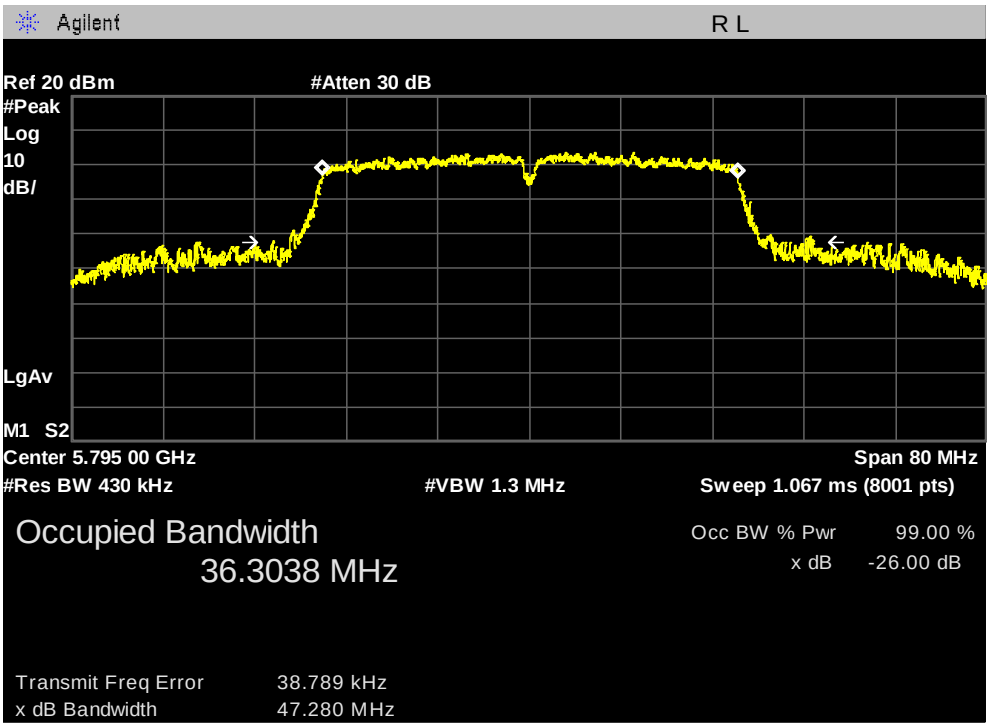


PLOTS OF EMISSIONS

26 dB Bandwidth, Lowest Channel (5755 MHz)



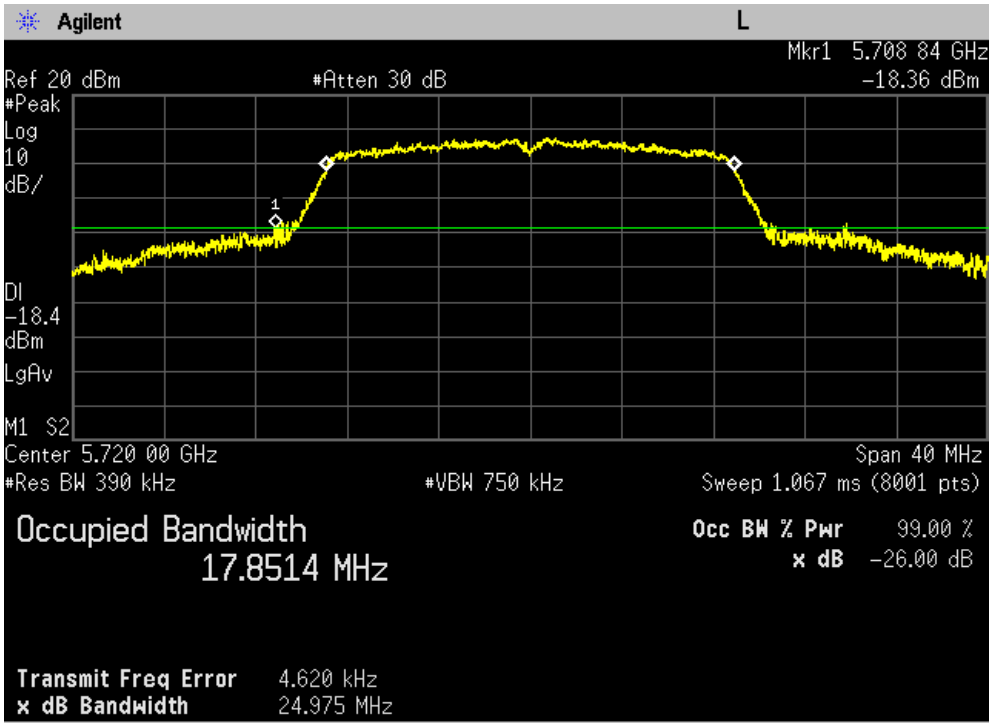
26 dB Bandwidth, Highest Channel (5795 MHz)



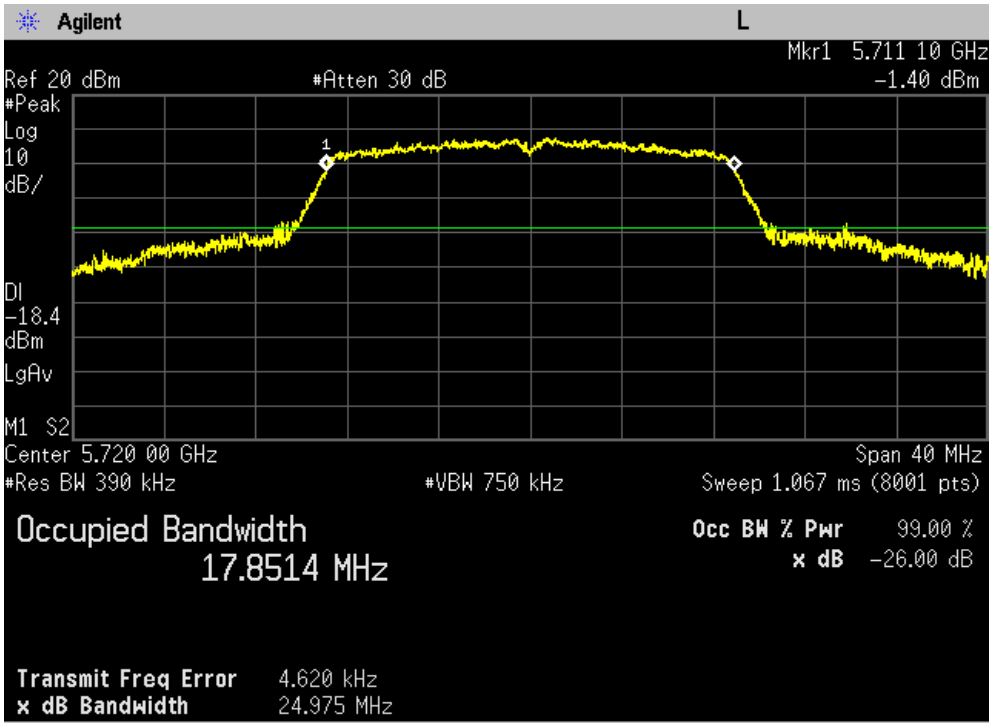
PLOTS OF EMISSIONS

802.11ac (20 MHz) mode

26 dB Bandwidth, Straddle Channel (5720 MHz)

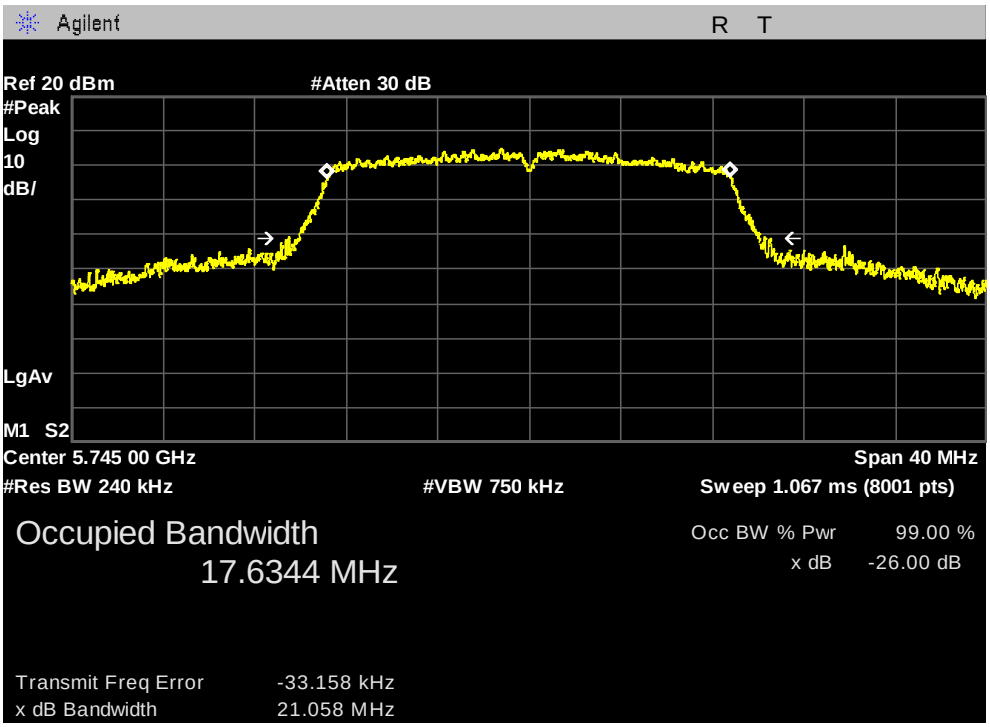


99% Occupied Bandwidth, Straddle Channel (5720 MHz)

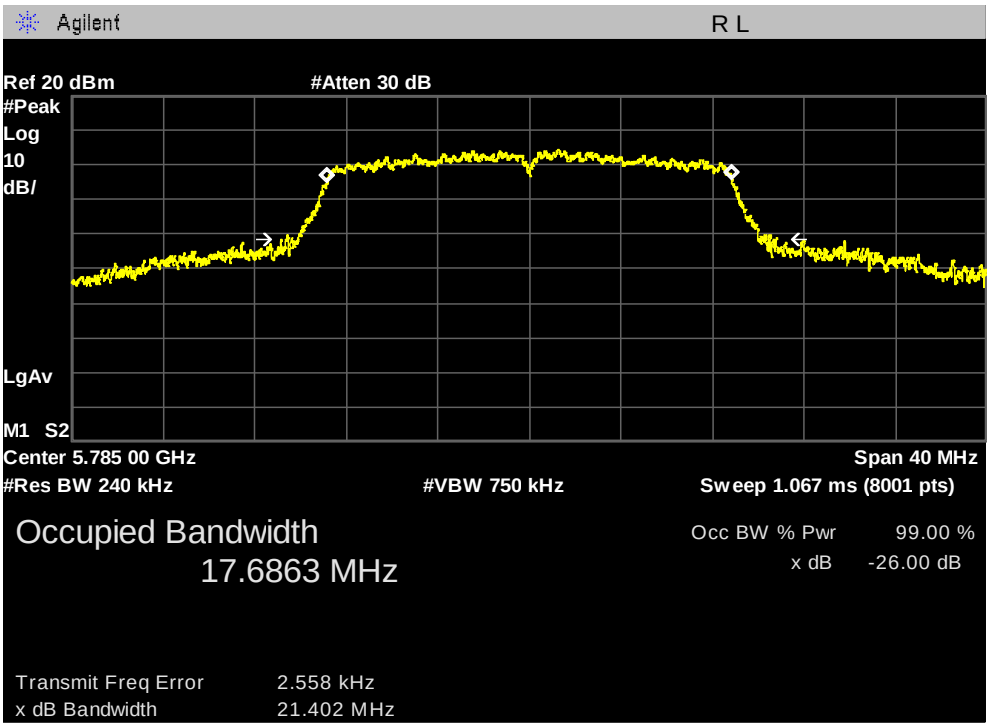


PLOTS OF EMISSIONS

26 dB Bandwidth, Lowest Channel (5745 MHz)

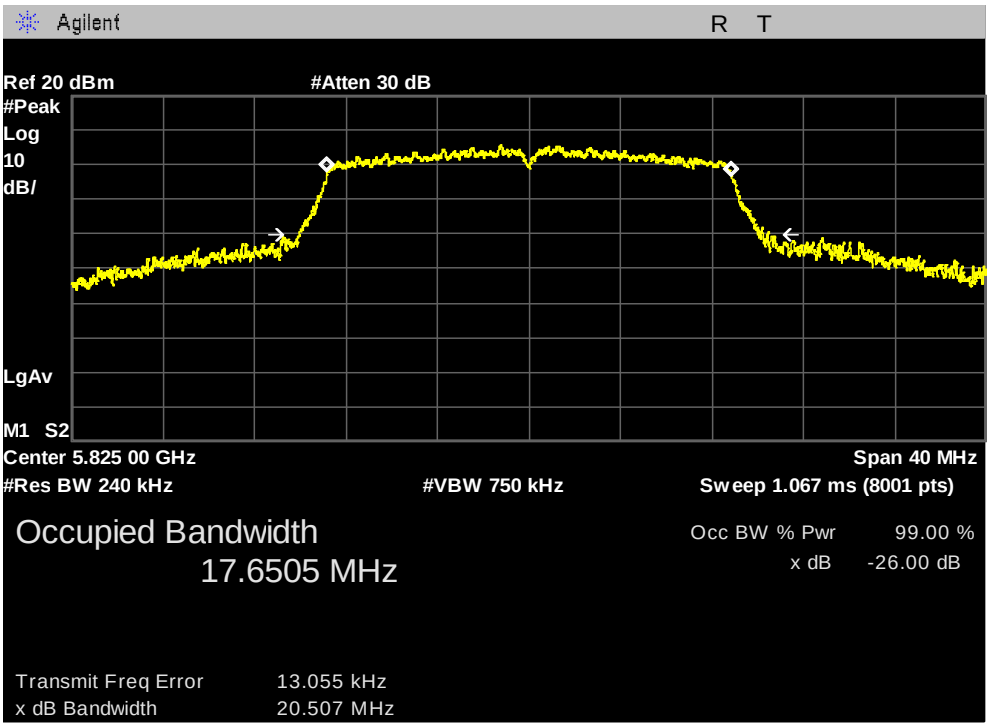


26 dB Bandwidth, Middle Channel (5785 MHz)



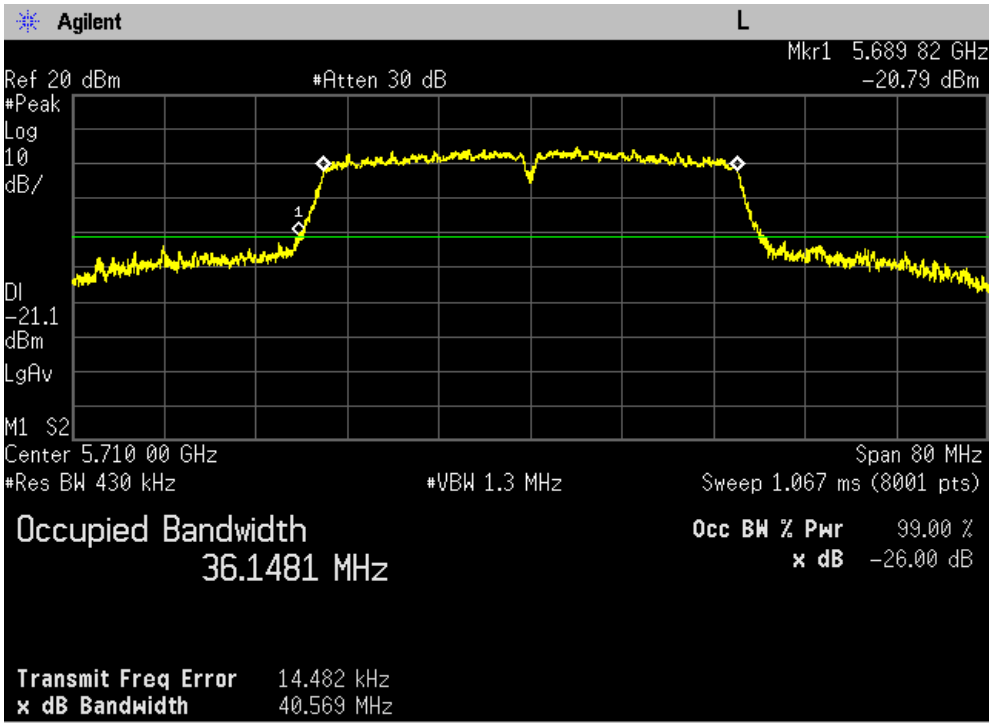
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5825 MHz)



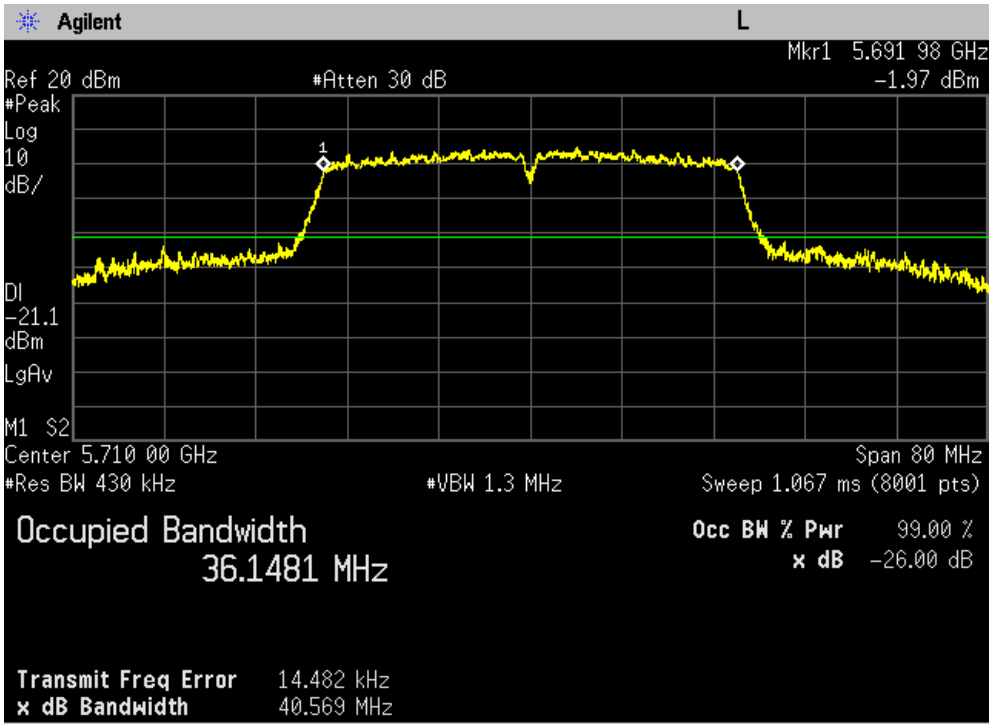
802.11ac (40 MHz) mode

26 dB Bandwidth, Straddle Channel (5710 MHz)

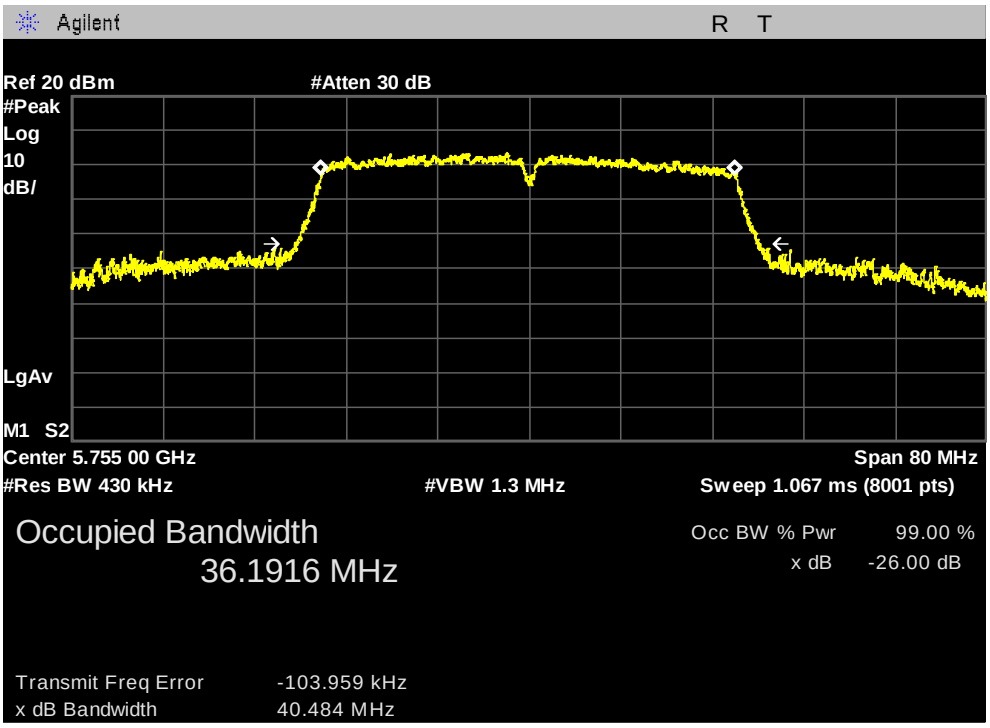


PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5710 MHz)

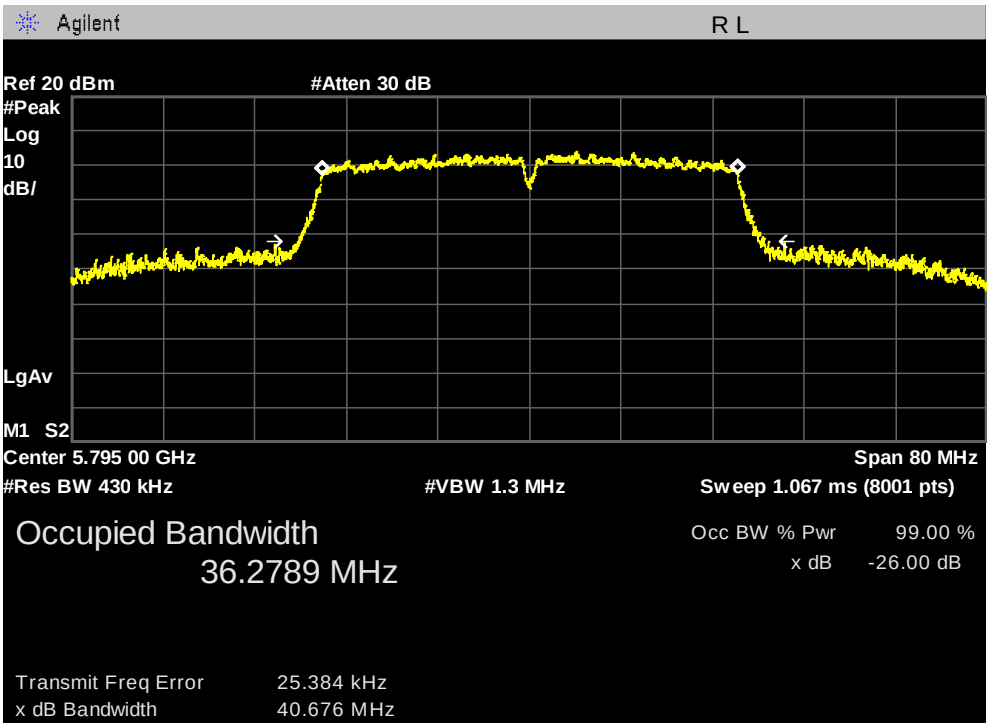


26 dB Bandwidth, Lowest Channel (5755 MHz)



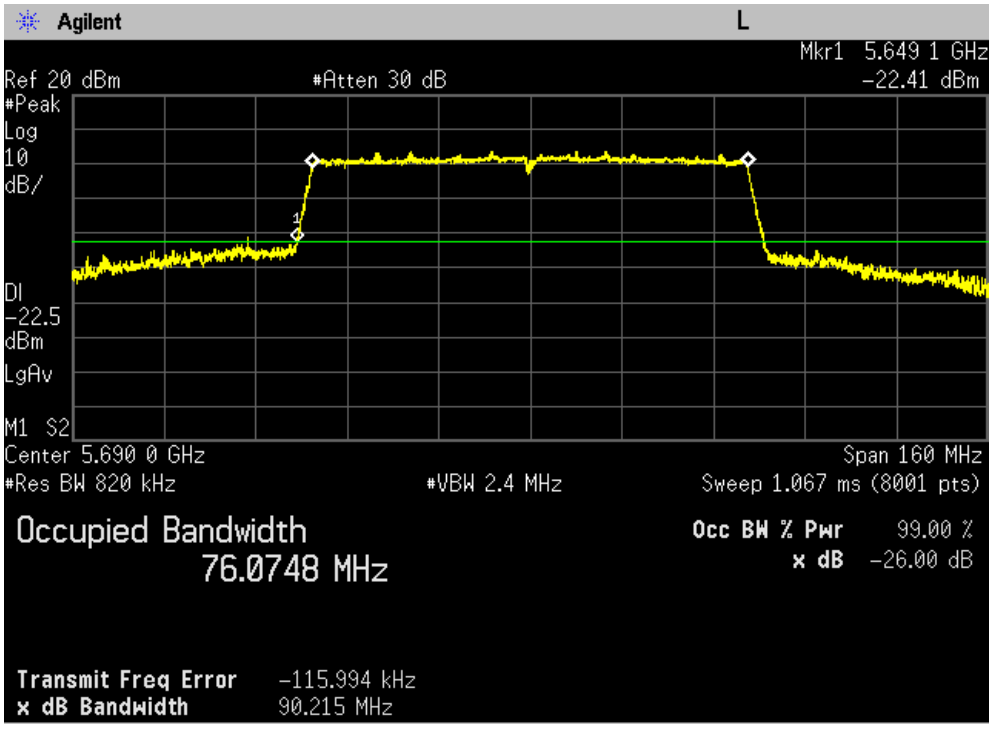
PLOTS OF EMISSIONS

26 dB Bandwidth, Highest Channel (5795 MHz)



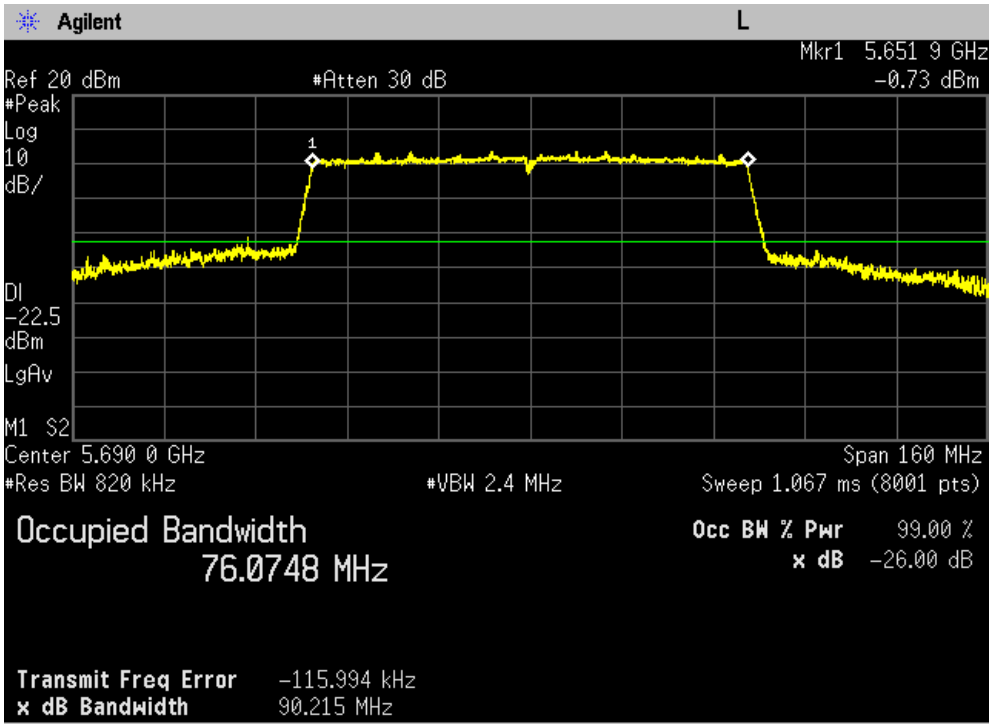
802.11ac (80 MHz) mode

26 dB Bandwidth, Straddle Channel (5690 MHz)

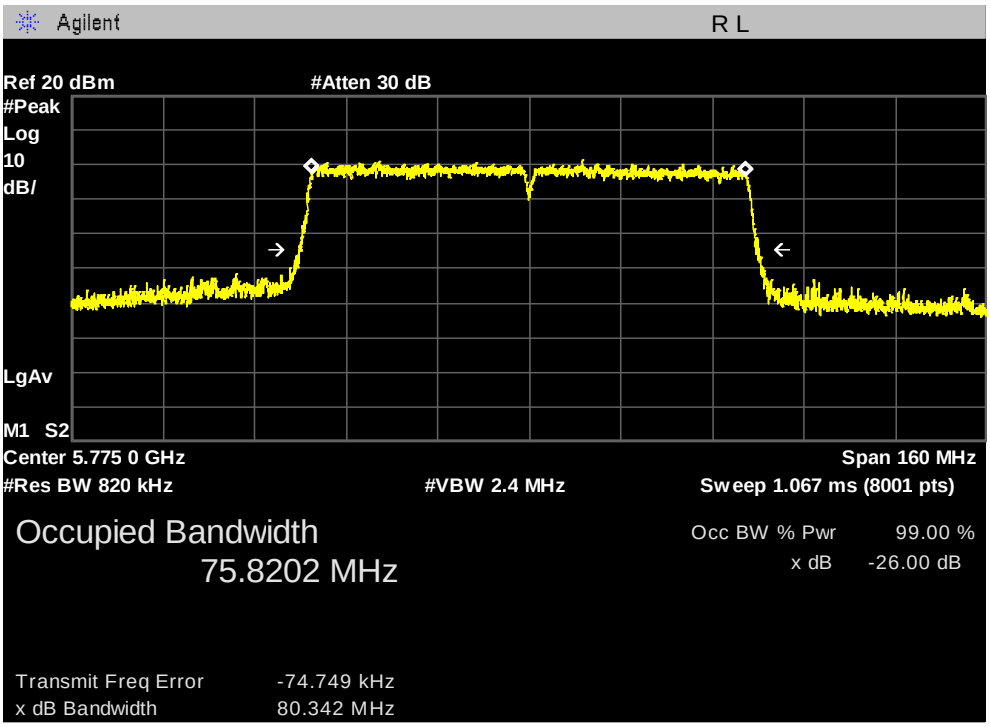


PLOTS OF EMISSIONS

99% Occupied Bandwidth, Straddle Channel (5690 MHz)



26 dB Bandwidth, Lowest Channel (5775 MHz)



8.3 6 dB Bandwidth – UNII-3 band

FCC §15.407(e)

Test Mode : Set to Straddle channel, Lowest channel, Middle channel and Highest channel

802.11a mode

Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5720	2.54	500.0
Lowest	5745	15.12	
Middle	5785	15.11	
Highest	5825	15.11	

802.11n (20 MHz) mode

Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5720	2.55	500.0
Lowest	5745	15.12	
Middle	5785	15.14	
Highest	5825	15.03	

802.11n (40 MHz) mode

Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5710	2.56	500.0
Lowest	5755	35.32	
Highest	5795	35.15	

TEST DATA

802.11ac (20 MHz) mode

Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5720	2.56	500.0
Lowest	5745	15.08	
Middle	5785	15.11	
Highest	5825	15.11	

802.11ac (40 MHz) mode

Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5710	2.56	500.0
Lowest	5755	35.44	
Highest	5795	35.14	

802.11ac (80 MHz) mode

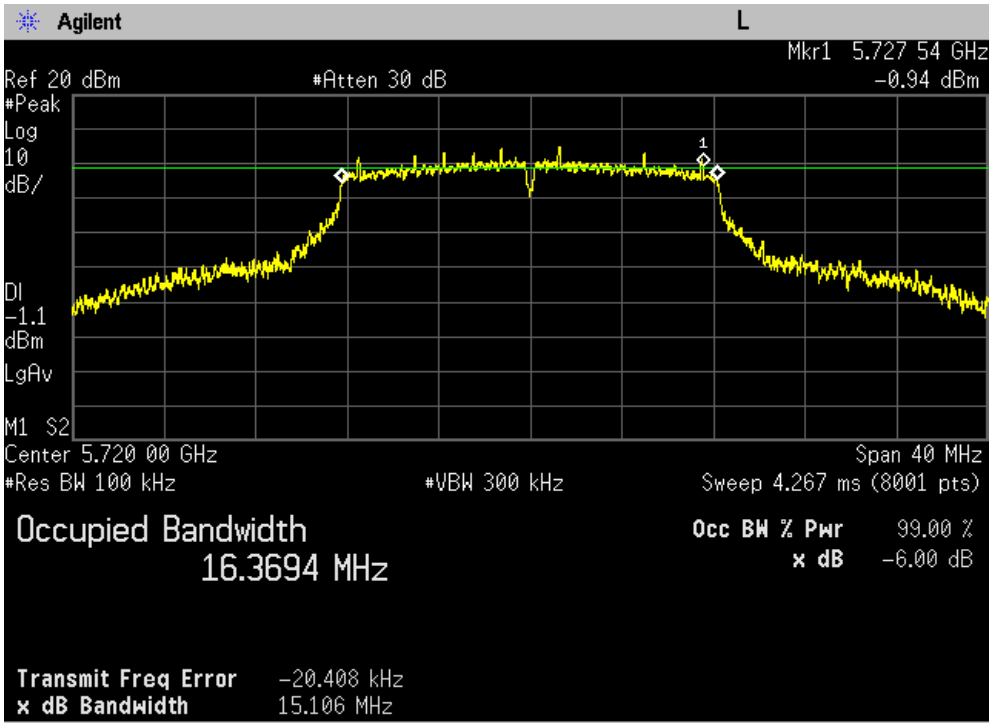
Channel	Frequency (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)
Straddle	5690	2.60	500.0
Middle	5775	76.33	

Note:
The worst ant port was determined by the conducted output power that generates the highest emission performing pre-scan testing in all ant port of each mode.

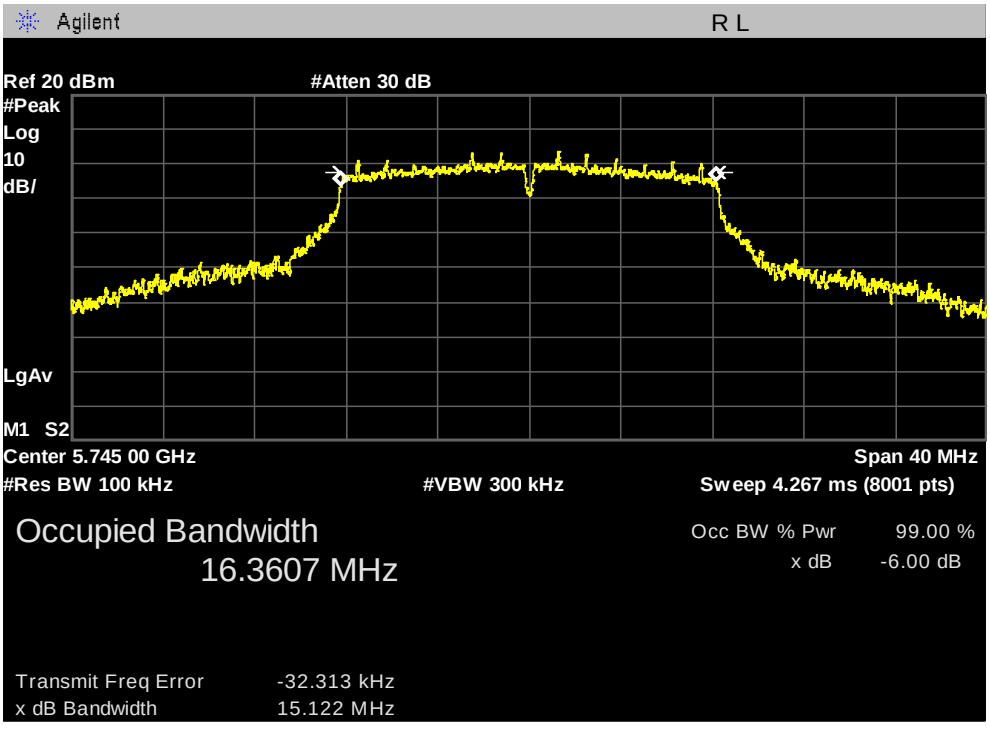
PLOTS OF EMISSIONS

802.11a mode

6 dB Bandwidth, Straddle Channel (5720 MHz)

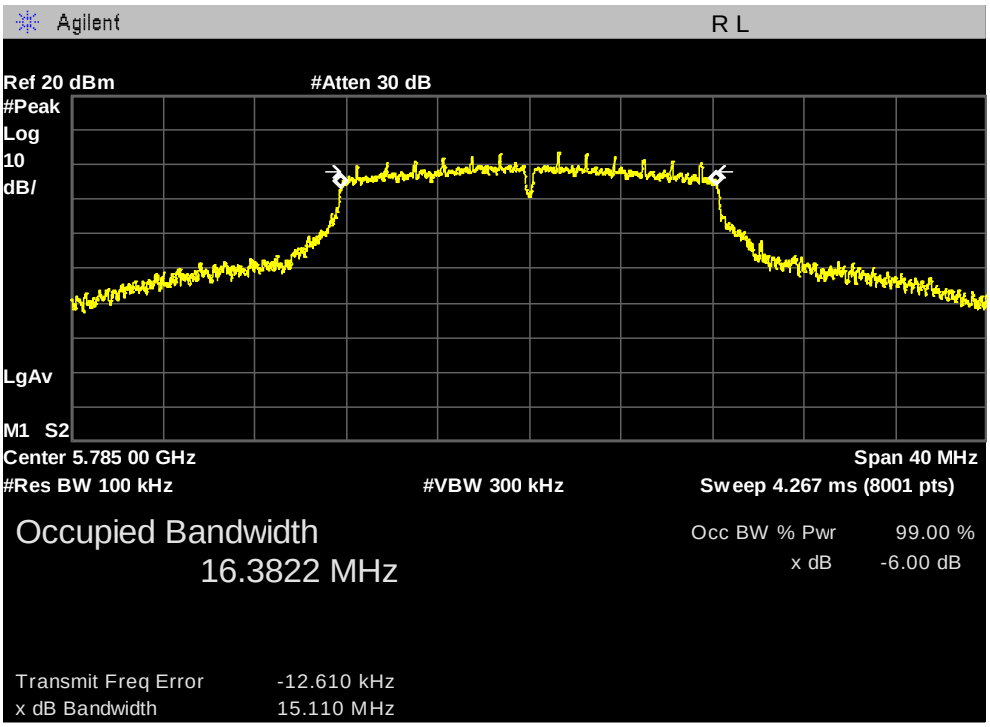


6 dB Bandwidth, Lowest Channel (5745 MHz)

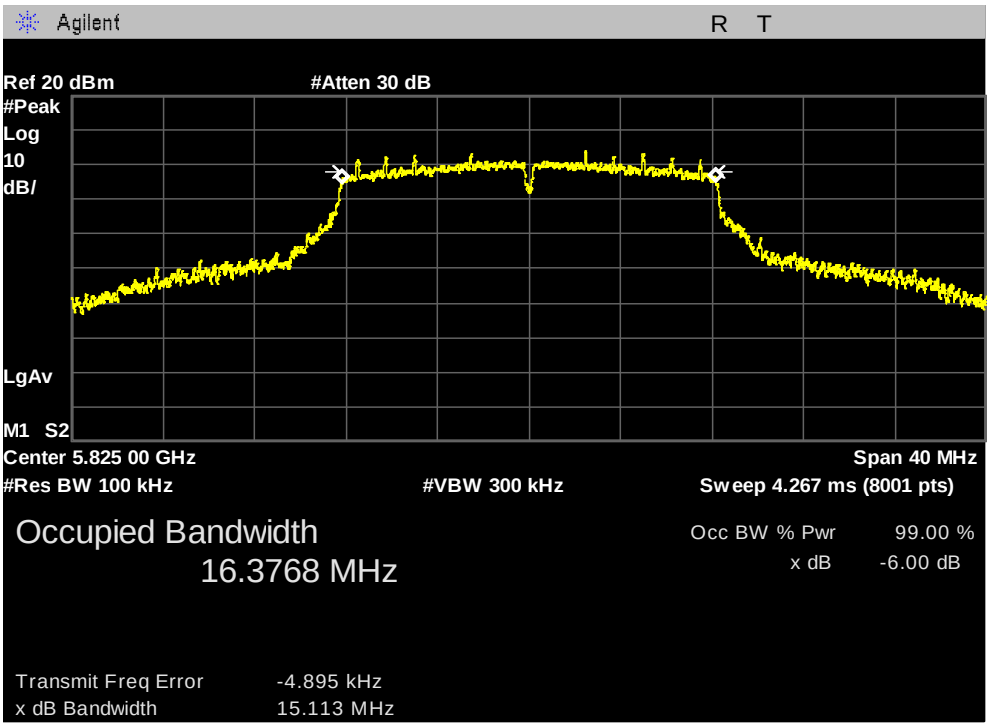


PLOTS OF EMISSIONS

6 dB Bandwidth, Middle Channel (5785 MHz)



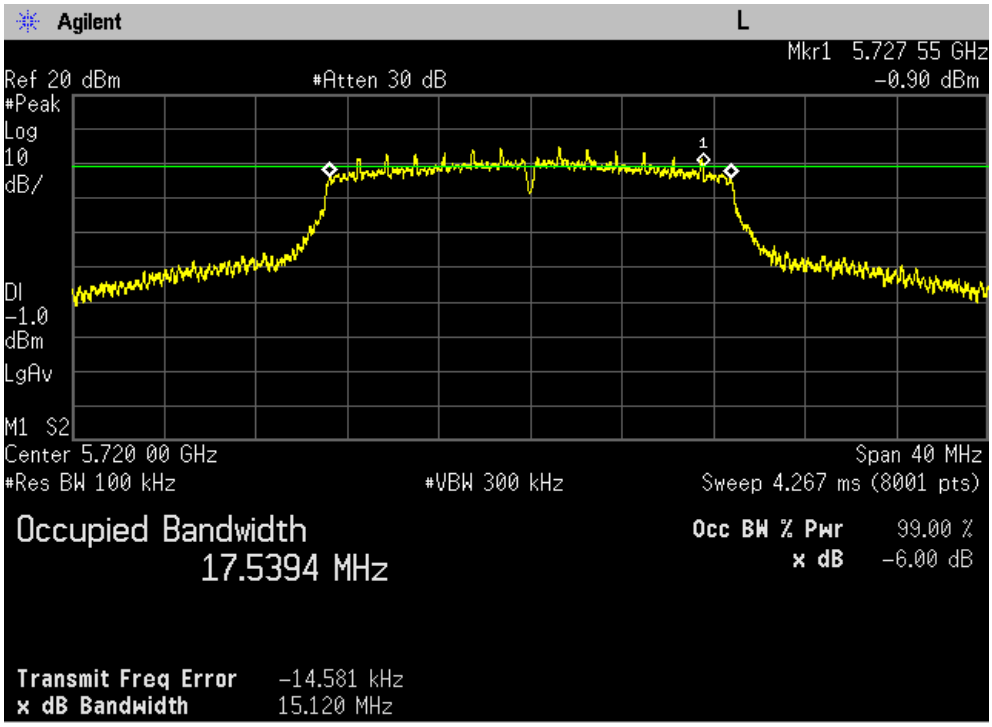
6 dB Bandwidth, Highest Channel (5825 MHz)



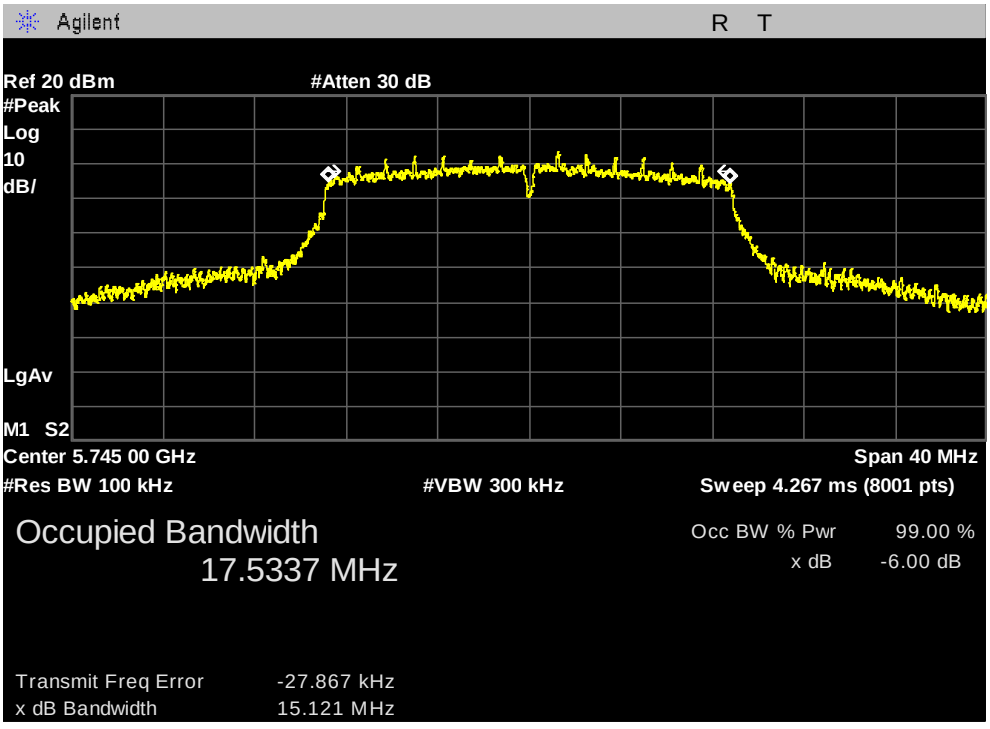
PLOTS OF EMISSIONS

802.11n (20 MHz) mode

6 dB Bandwidth, Lowest Channel (5720 MHz)

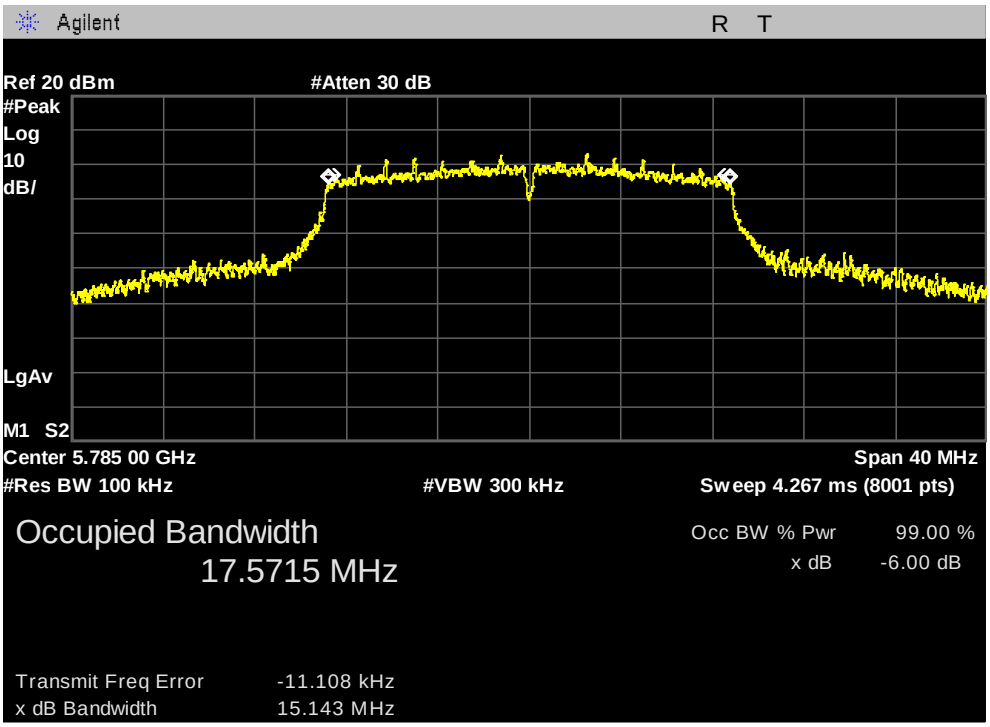


6 dB Bandwidth, Lowest Channel (5745 MHz)

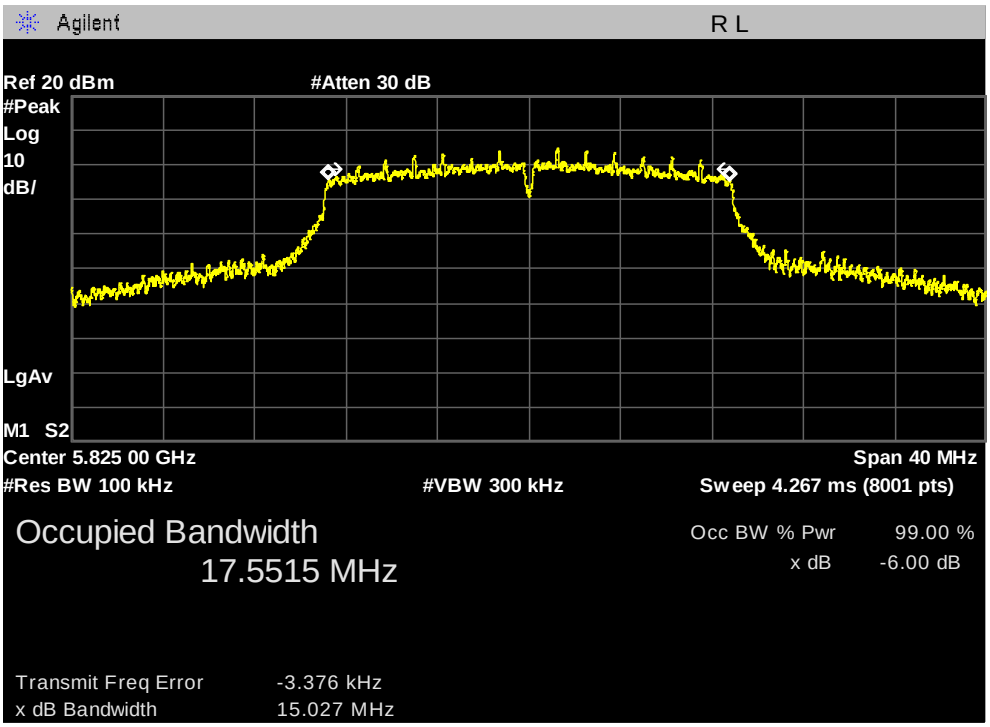


PLOTS OF EMISSIONS

6 dB Bandwidth, Middle Channel (5785 MHz)



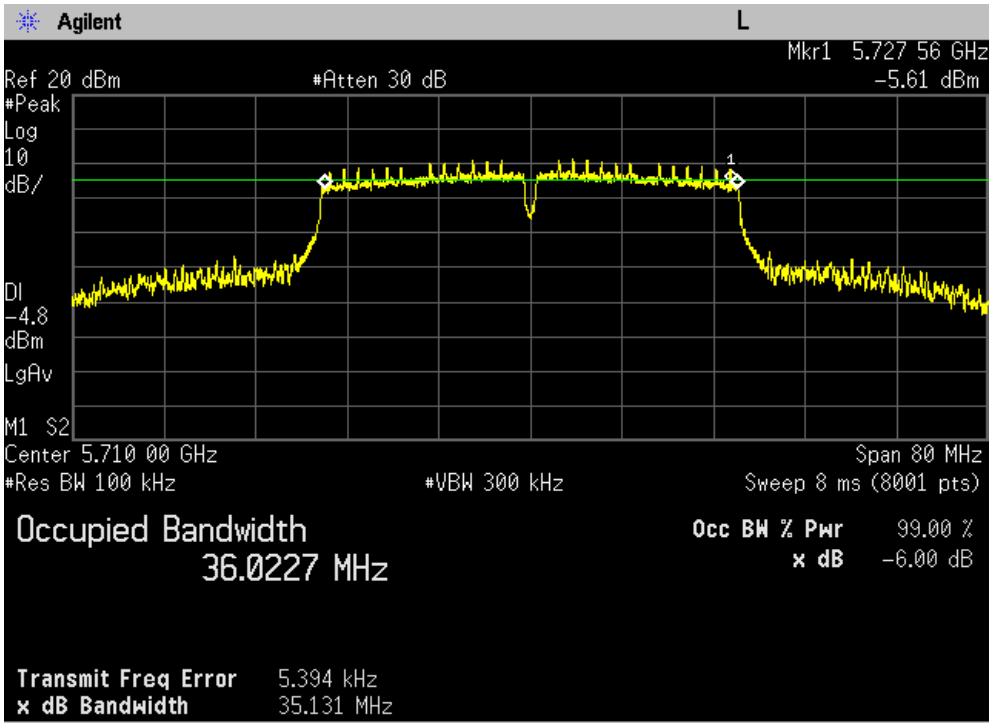
6 dB Bandwidth, Highest Channel (5825 MHz)



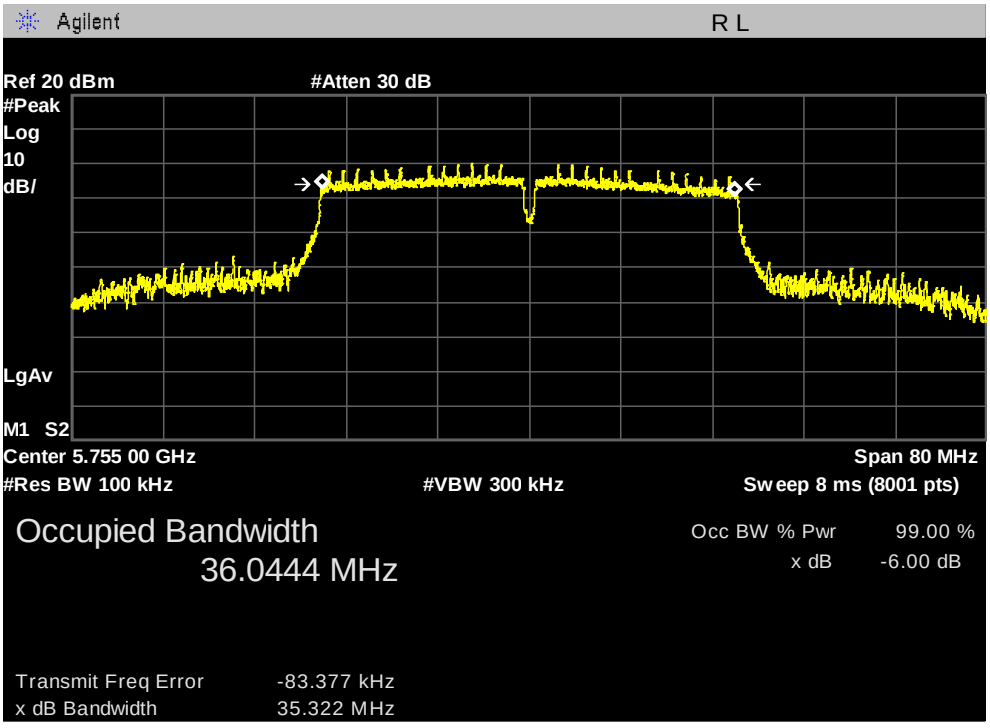
PLOTS OF EMISSIONS

802.11n (40 MHz) mode

6 dB Bandwidth, Straddle Channel (5710 MHz)

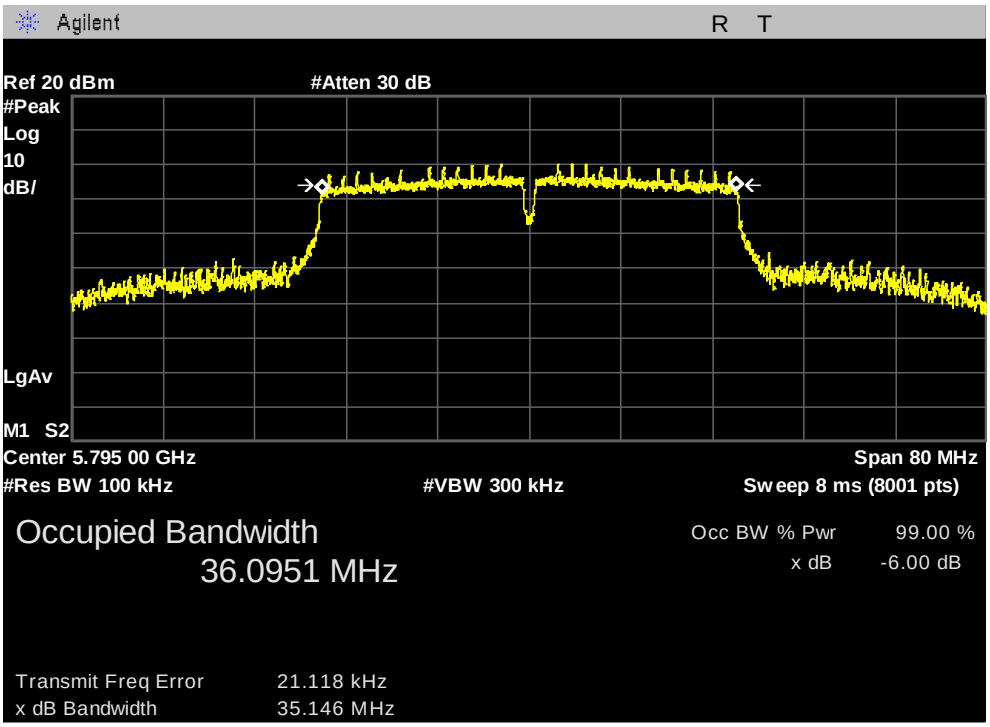


6 dB Bandwidth, Lowest Channel (5755 MHz)



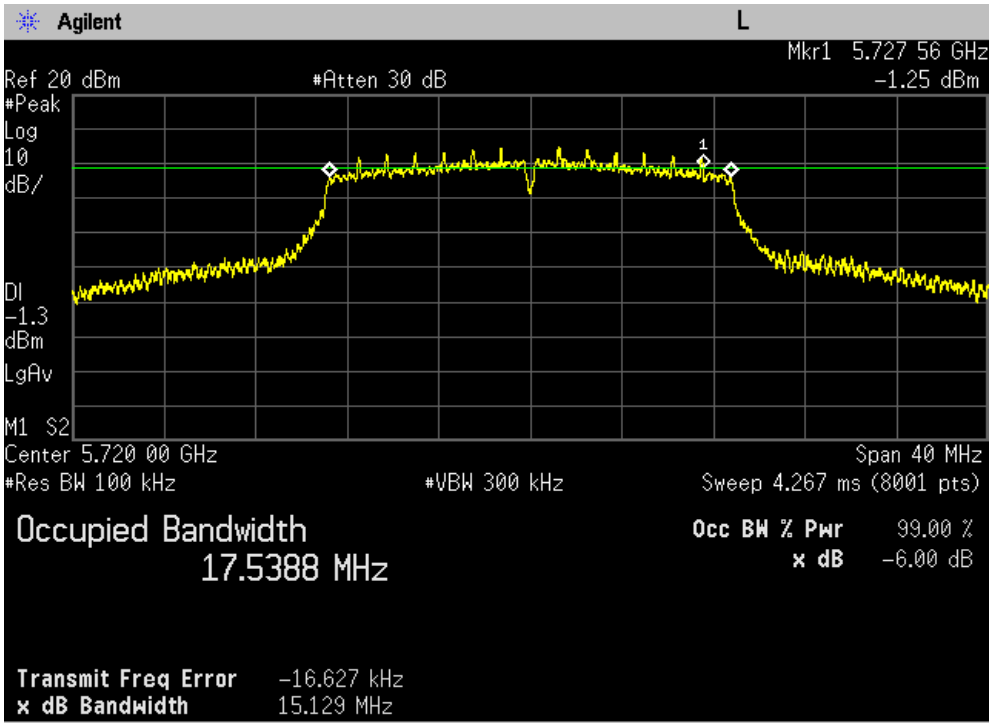
PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (5795 MHz)



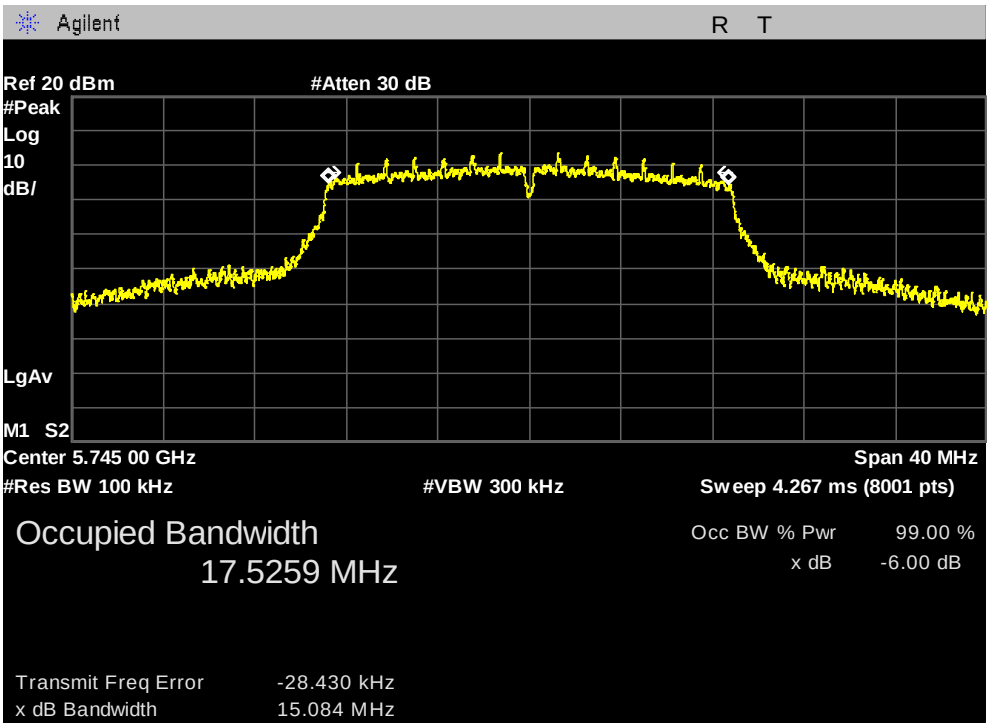
802.11ac (20 MHz) mode

6 dB Bandwidth, Straddle Channel (5720 MHz)

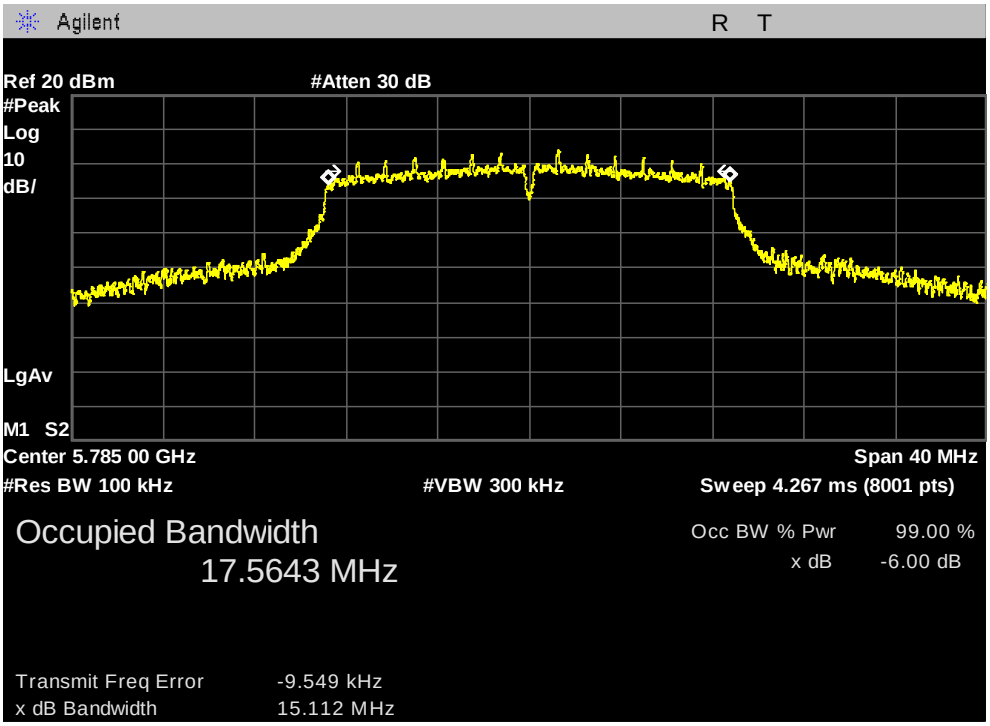


PLOTS OF EMISSIONS

6 dB Bandwidth, Lowest Channel (5745 MHz)

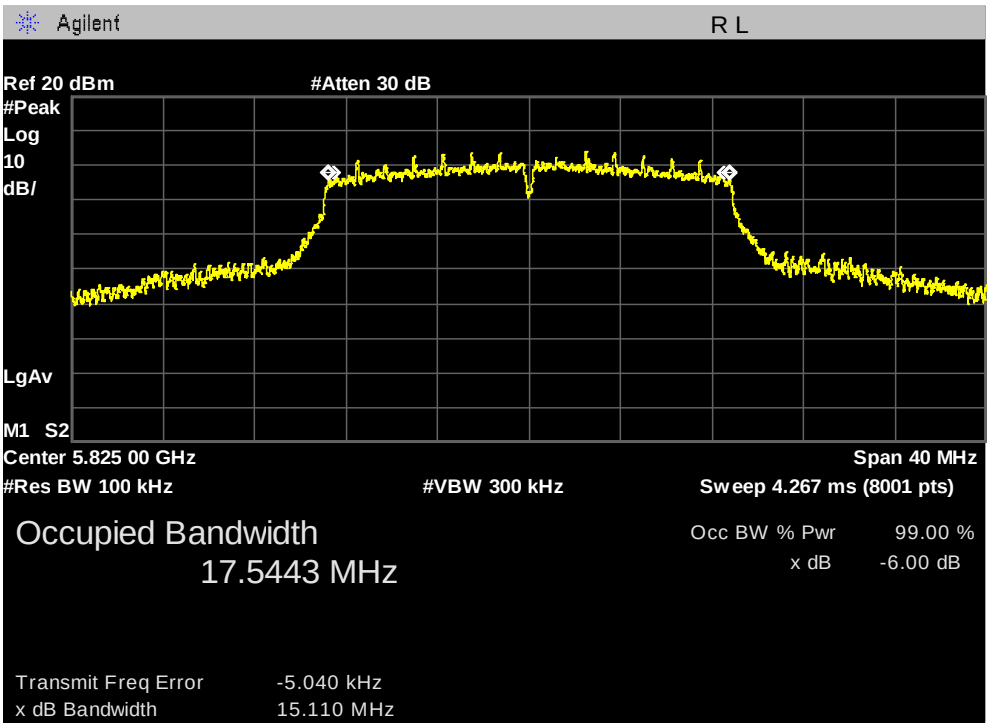


6 dB Bandwidth, Middle Channel (5785 MHz)



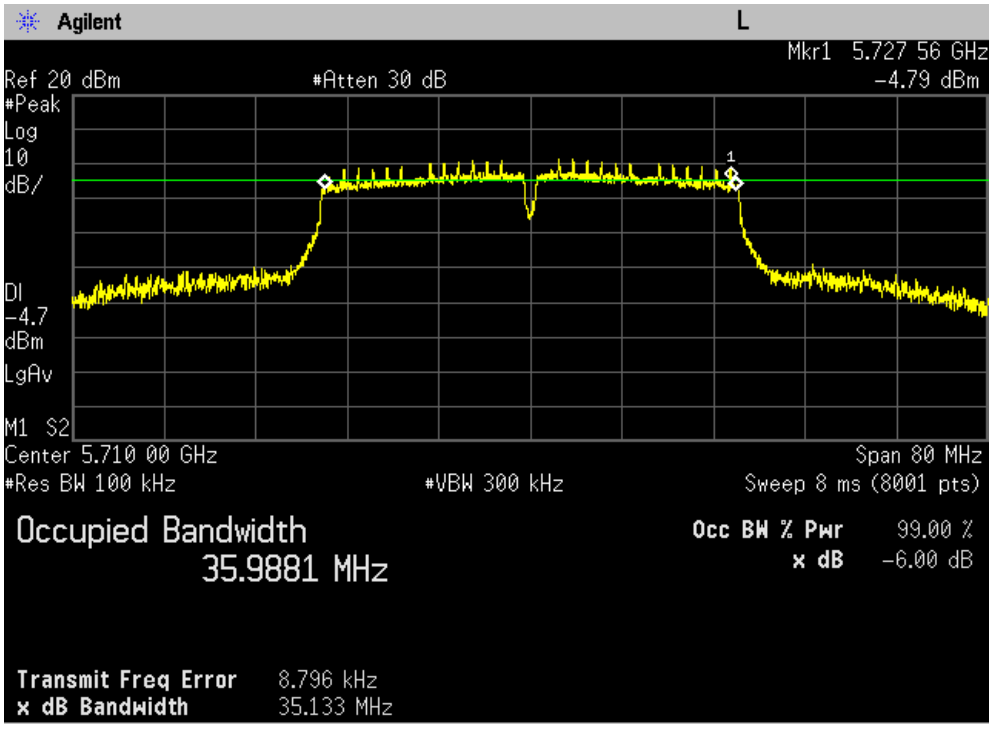
PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (5825 MHz)



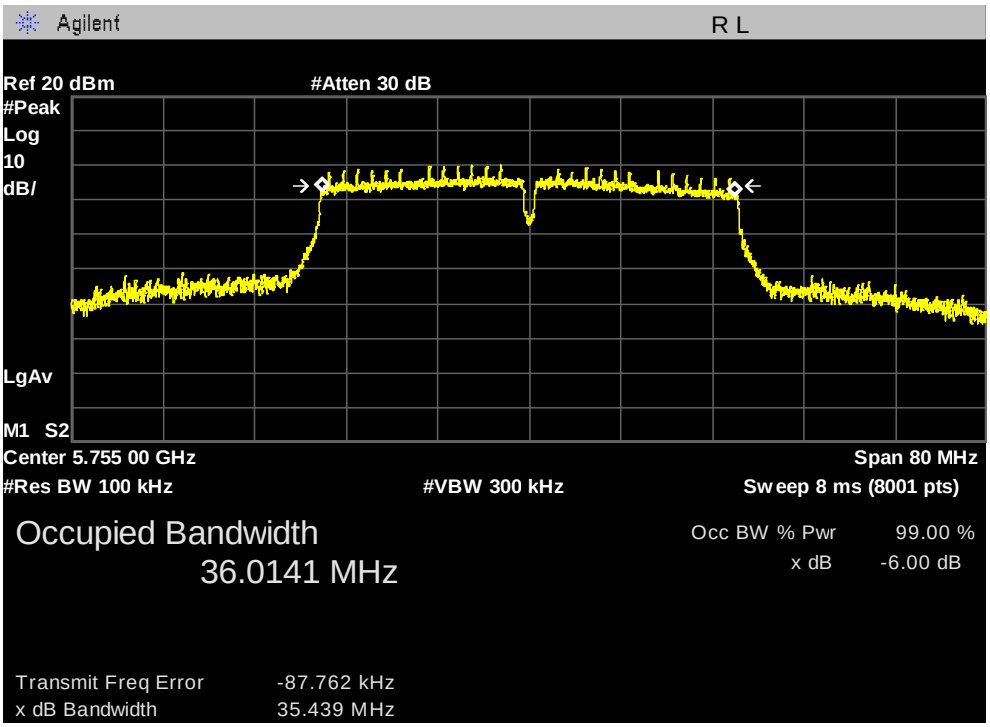
802.11ac (40 MHz) mode

6 dB Bandwidth, Straddle Channel (5710 MHz)

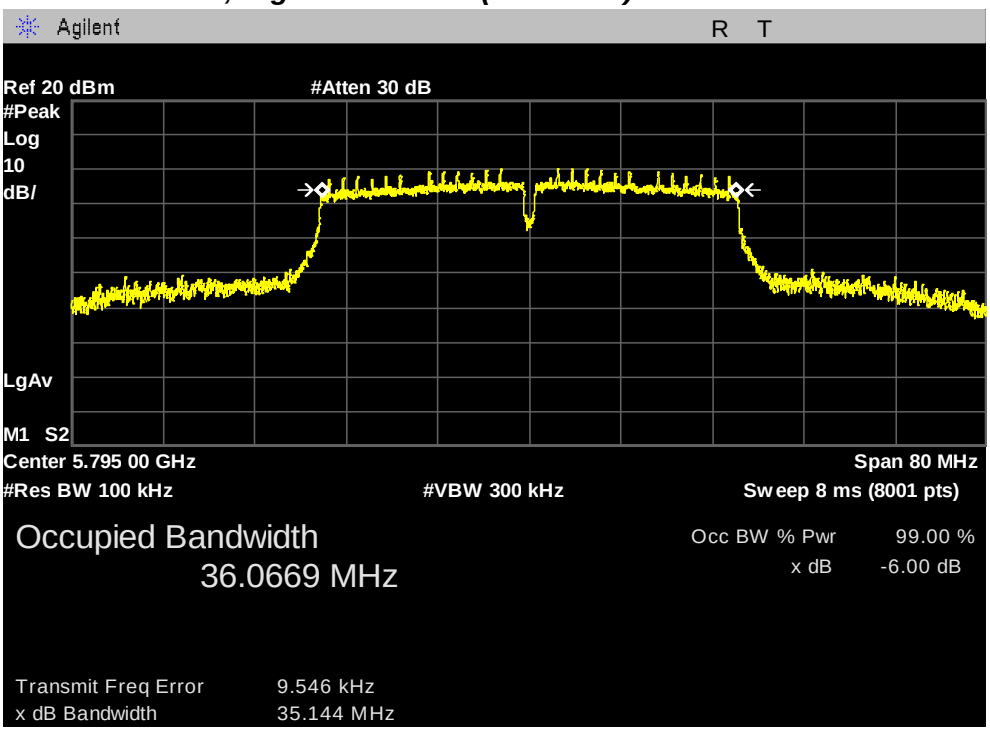


PLOTS OF EMISSIONS

6 dB Bandwidth, Lowest Channel (5755 MHz)



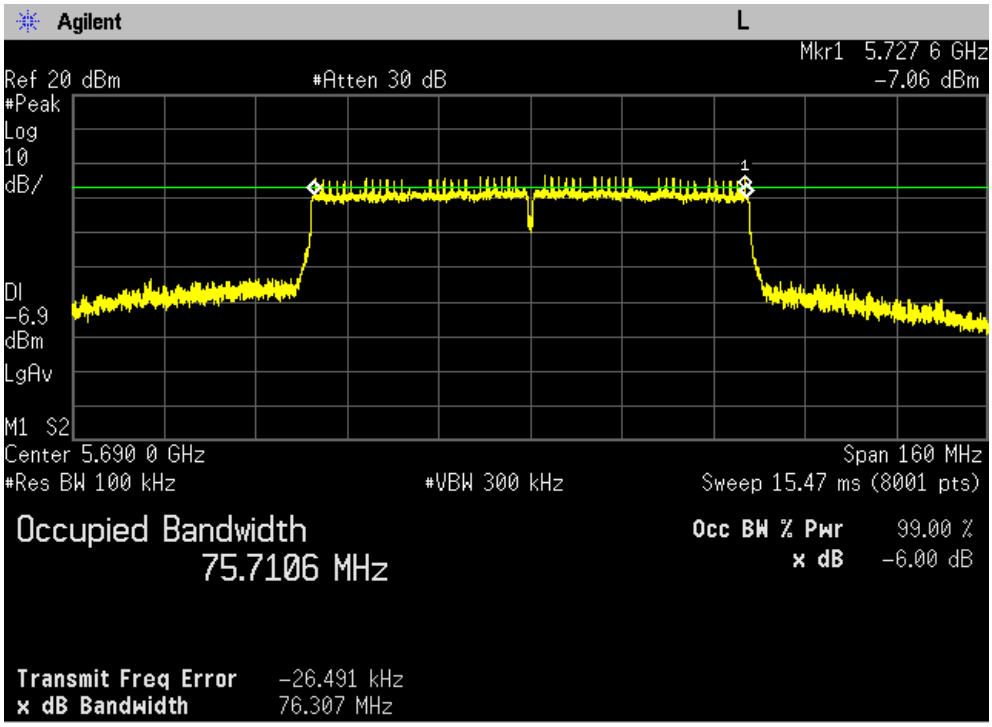
6 dB Bandwidth, Highest Channel (5795 MHz)



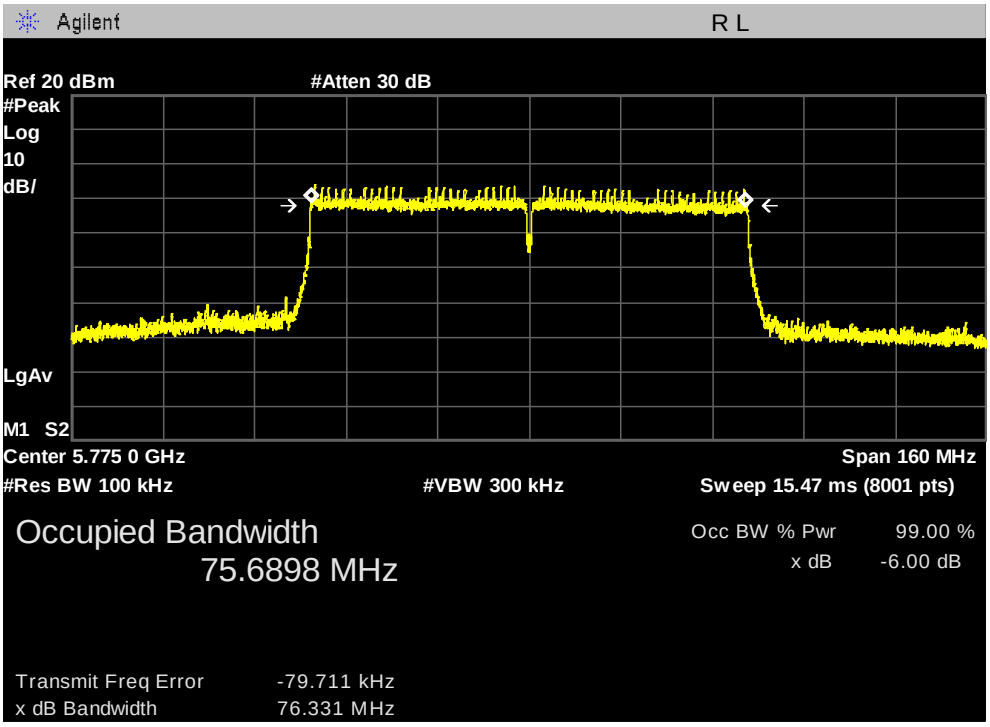
PLOTS OF EMISSIONS

802.11ac (80 MHz) mode

6 dB Bandwidth, Straddle Channel (5690 MHz)



6 dB Bandwidth, Lowest Channel (5775 MHz)



8.4 Maximum Conducted Output Power (average)

8.4.1 Maximum Conducted Output Power – U-NII-1 band

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11a mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5180	13.56	0.19	13.75	23.98
Middle	5220	13.21	0.19	13.40	23.98
Highest	5240	13.35	0.19	13.54	23.98

802.11n (20MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5180	13.18	0.20	13.38	23.98
Middle	5220	12.98	0.20	13.18	23.98
Highest	5240	13.15	0.20	13.35	23.98

TEST DATA

802.11n (20MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5180	9.78	11.31	0.20	13.82	23.98
Middle	5220	9.59	11.07	0.20	13.60	23.98
Highest	5240	9.76	11.05	0.20	13.66	23.98

802.11n (40MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5190	13.14	0.41	13.55	23.98
Highest	5230	12.82	0.41	13.23	23.98

802.11n (40MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5190	10.36	12.10	0.41	14.74	23.98
Highest	5230	10.08	11.70	0.41	14.39	23.98

TEST DATA

802.11ac (20MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5180	13.31	0.21	13.52	23.98
Middle	5220	13.03	0.21	13.24	23.98
Highest	5240	13.24	0.21	13.45	23.98

802.11ac (20MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5180	9.55	11.26	0.21	13.71	23.98
Middle	5220	9.42	10.93	0.21	13.46	23.98
Highest	5240	9.44	11.06	0.21	13.55	23.98

802.11ac (40MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5190	13.17	0.40	13.57	23.98
Highest	5230	12.76	0.40	13.16	23.98

TEST DATA

802.11ac (40MHz) mode _2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5190	9.42	11.13	0.40	13.77	23.98
Highest	5230	9.02	10.62	0.40	13.30	23.98

802.11ac (80MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Middle	5210	11.56	0.79	12.35	23.98

802.11ac (80MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Middle	5210	7.40	7.51	0.79	11.26	23.98

TEST DATA

Note:

1. *Maximum Conducted (average) Power = Measured conducted power + Duty Factor*
2. *Total output power = 10 log [10^{(Chain 0 Power + duty factor)/10} + 10^{(Chain 1 Power + duty factor)/10} + 10^{(Chain 2 Power + duty factor)/10}+ 10^{(Chain 3 Power + duty factor)/10}]*
3. *For CDD transmission, directional gain is.* ***2.8 dBi.***
   For MIMO transmission, directional gain is ***2.8 dBi.***
   Directional gain was calculated according to KDB662911 D01 Multiple Transmitter Output v02r01.
   For power measurements on IEEE 802.11 devices employing CDD, directional gain is as follows,
   Directional gain = G_{ANT} + Array Gain = 2.8 dBi + 0 dB = 2.8 dBi.
   Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
   Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
   Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.
   For power measurements on all devices employing MIMO, directional gain is as follows,
   ***Directional gain = G_{ANT} + 10 log(N_{ANT}/N_{SS}) dBi = 2.8 dBi + 10 log(2/2) dB = 2.8 dBi**.*
   where N_{SS} = the number of independent spatial streams of data and G_{ANT} is the antenna gain in dBi
   For this device, MIMO mode means SM-MIMO(Spatial Multiplexing) transmission and N_{SS}=2.
4. *The following equation was used for spectrum offset:*
   Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

8.4.2 Maximum Conducted Output Power – U-NII-2A band

FCC §15.407(a)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

802.11a mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5260	13.38	0.19	13.57	23.97
Middle	5300	13.51	0.19	13.70	23.95
Highest	5320	13.25	0.19	13.44	23.98

802.11n (20MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5260	13.24	0.21	13.45	23.98
Middle	5300	13.38	0.21	13.59	23.98
Highest	5320	13.14	0.21	13.35	23.98

TEST DATA

802.11n (20MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5260	9.82	9.94	0.21	13.10	23.43
Middle	5300	9.95	10.02	0.21	13.21	23.43
Highest	5320	9.75	9.86	0.21	13.03	23.43

802.11n (40MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5270	13.09	0.42	13.51	23.98
Highest	5310	13.03	0.42	13.45	23.98

802.11n (40MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5270	10.22	10.46	0.42	13.77	23.98
Highest	5310	10.06	10.25	0.42	13.59	23.98

TEST DATA

802.11ac (20MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5260	13.27	0.21	13.48	23.98
Middle	5300	13.4	0.21	13.61	23.98
Highest	5320	13.26	0.21	13.47	23.98

802.11ac (20MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5260	13.05	13.29	0.21	16.39	23.98
Middle	5300	13.14	13.28	0.21	16.43	23.98
Highest	5320	13.08	13.19	0.21	16.36	23.98

802.11ac (40MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Lowest	5270	13.13	0.41	13.54	23.98
Highest	5310	13.03	0.41	13.44	23.98

TEST DATA

802.11ac (40MHz) mode _2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Lowest	5270	8.06	8.18	0.41	11.54	23.98
Highest	5310	8.19	8.36	0.41	11.70	23.98

802.11ac (80MHz) mode_1TX

Channel	Frequency (MHz)	Measured conducted power (dBm)	Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
Middle	5290	11.76	0.77	12.53	23.98

802.11ac (80MHz) mode_2TX

Channel	Frequency (MHz)	Measured conducted power (dBm)		Duty Factor (dB)	Maximum Conducted Power (dBm)	FCC Limit (dBm)
		Ant 0	Ant 1		Total output power	
Middle	5290	6.87	7.07	0.77	10.75	23.98

TEST DATA

Note:

1. *Maximum Conducted (average) Power = Measured conducted power + Duty Factor*
2. *Total output power = 10 log [10^{(Chain 0 Power + duty factor)/10} + 10^{(Chain 1 Power + duty factor)/10} + 10^{(Chain 2 Power + duty factor)/10}+ 10^{(Chain 3 Power + duty factor)/10}]*
3. *For CDD transmission, directional gain is.* ***2.8 dBi.***
   For MIMO transmission, directional gain is ***2.8 dBi.***
   Directional gain was calculated according to KDB662911 D01 Multiple Transmitter Output v02r01.
   For power measurements on IEEE 802.11 devices employing CDD, directional gain is as follows,
   Directional gain = G_{ANT} + Array Gain = 2.8 dBi + 0 dB = 2.8 dBi.
   Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;
   Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};
   Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.
   For power measurements on all devices employing MIMO, directional gain is as follows,
   ***Directional gain = G_{ANT} + 10 log(N_{ANT}/N_{SS}) dBi = 2.8 dBi + 10 log(2/2) dB = 2.8 dBi**.*
   where N_{SS} = the number of independent spatial streams of data and G_{ANT} is the antenna gain in dBi
   For this device, MIMO mode means SM-MIMO(Spatial Multiplexing) transmission and N_{SS}=2.
4. *FCC conducted output power limit = 250 mW or 11 dBm + 10 log B, whichever power is less.*
   B is the 26 dB emission bandwidth in megahertz.
5. *The following equation was used for spectrum offset:*
   Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)
6. *A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW (26.99dBm) for FCC.*