CERTIFICATION TEST REPORT

Report Number. : 12204447-E4V3

Applicant	:	APPLE, INC. 1 APPLE PARK WAY CUPERTINO, CA 95014, U.S.A.
Model	:	A2097
FCC ID	:	BCG-E3232A
EUT Description	:	SMARTPHONE
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART E

Date Of Issue:
August 10, 2018

Prepared by:
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NVLAP LAB CODE 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	7/13/2018	Initial Issue	Chin Pang
V2	7/16/2018	Address TCB's Questions	Chin Pang
V3	8/10/2018	Address TCB's Questions	Jingang Li

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: SMARTPHONE

MODEL: A2097

SERIAL NUMBER: C39WP04UK95F

DATE TESTED: JANUARY 27, 2018 – JUNE 26, 2018

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v02/D03 v01r02/D06 v02, FCC KDB 789033 D02 v02r01, ANSI C63.10-2013, FCC 06-96.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A (ISED:2324B-1)	☒ Chamber D (ISED:22541-1)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)
☒ Chamber C (ISED:2324B-3)	☒ Chamber F (ISED:22541-3)
	☒ Chamber G (ISED:22541-4)
	☒ Chamber H (ISED:22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through C are covered under ISED company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under ISED Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at NVLAP Lab Search.

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The Apple iPhone, is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, TD-SCDMA, CDMA, IEEE 802.11a/b/g/n/ac, Bluetooth, GPS and NFC. All models support at least one UICC based SIM. The second SIM is either UICC based, electronic SIM (e-SIM), or second SIM is not present. The device has a built-in inductive charging receiver which is not user accessible. The rechargeable battery is not user accessible.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

5.2 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz band, 1TX			
5180-5240	802.11a	Covered by 802.11n HT20 SISO	
5180-5240	802.11n HT20	20.84	121.34
5190-5230	802.11n HT40	21.84	152.76
5180-5240	802.11ac VHT20	Covered by 802.11n HT20 SISO	
5190-5230	802.11ac VHT40	Covered by 802.11n HT40 SISO	
5210	802.11ac VHT80	17.39	54.83
5.2 GHz band, 2TX			
5180-5240	802.11n HT20 CDD	20.90	123.03
5180-5240	802.11n HT20 SDM	Covered by 802.11n HT20 2TX CDD	
5180-5240	802.11n HT20 STBC		
5190-5230	802.11n HT40 CDD	22.83	191.87
5190-5230	802.11n HT40 SDM	Covered by 802.11n HT40 2TX CDD	
5190-5230	802.11n HT40 STBC		
5180-5240	802.11ac VHT20 CDD	Covered by 802.11n HT20 2TX CDD	
5180-5240	802.11ac VHT20 SDM		
5180-5240	802.11ac VHT20 STBC		
5190-5230	802.11ac VHT40 CDD	Covered by 802.11n HT40 2TX CDD	
5190-5230	802.11ac VHT40 SDM		
5190-5230	802.11ac VHT40 STBC		
5210	802.11ac VHT80 CDD	20.37	108.89
5210	802.11ac VHT80 SDM	Covered by 802.11ac VHT80 2TX CDD	
5210	802.11ac VHT80 STBC		

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5.3 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.3 GHz band, 1TX			
5260 - 5320	802.11a	Covered by 802.11n HT20 1TX	
5260 - 5320	802.11n HT20	20.91	123.31
5270 - 5310	802.11n HT40	21.82	152.05
5260 - 5320	802.11ac VHT20	Covered by 802.11n HT20 1TX	
5270 - 5310	802.11ac VHT40	Covered by 802.11n HT40 1TX	
5290	802.11ac VHT80	17.35	54.33
5.3 GHz band, 2TX			
5260 - 5320	802.11n HT20 CDD	20.92	123.59
5260 - 5320	802.11n HT20 SDM	Covered by 802.11n HT20 2TX CDD	
5260 - 5320	802.11n HT20 STBC		
5270 - 5310	802.11n HT40 CDD	22.87	193.64
5270 - 5310	802.11n HT40 SDM	Covered by 802.11n HT40 2TX CDD	
5270 - 5310	802.11n HT40 STBC		
5260 - 5320	802.11ac VHT20 CDD	Covered by 802.11n HT20 2TX CDD	
5260 - 5320	802.11ac VHT20 SDM		
5260 - 5320	802.11ac VHT20 STBC		
5270 - 5310	802.11ac VHT40 CDD	Covered by 802.11n HT40 2TX CDD	
5270 - 5310	802.11ac VHT40 SDM		
5270 - 5310	802.11ac VHT40 STBC		
5290	802.11ac VHT80 CDD	19.37	86.50
5290	802.11ac VHT80 SDM	Covered by 802.11n VHT80 2TX CDD	
5290	802.11ac VHT80 STBC		

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5.6 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.6 GHz band, 1TX			
5500-5720	802.11a	Covered by 802.11n HT20 1TX	
5500-5720	802.11n HT20	20.83	121.06
5510-5710	802.11n HT40	21.95	156.68
5500-5720	802.11ac VHT20	Covered by 802.11n HT20 1TX	
5510-5710	802.11ac VHT40	Covered by 802.11n HT40 1TX	
5530-5690	802.11ac VHT80	21.81	151.71
5.6 GHz band, 2TX			
5500-5720	802.11n HT20 CDD	20.84	121.34
5500-5720	802.11n HT20 SDM	Covered by 802.11n HT20 2TX CDD	
5500-5720	802.11n HT20 STBC		
5510-5710	802.11n HT40 CDD	22.71	186.64
5510-5710	802.11n HT40 SDM	Covered by 802.11n HT40 2TX CDD	
5510-5710	802.11n HT40 STBC		
5500-5720	802.11ac VHT20 CDD	Covered by 802.11n HT20 2TX CDD	
5500-5720	802.11ac VHT20 SDM		
5500-5720	802.11ac VHT20 STBC		
5510-5710	802.11ac VHT40 CDD	Covered by 802.11n HT40 2TX CDD	
5510-5710	802.11ac VHT40 SDM		
5510-5710	802.11ac VHT40 STBC		
5530-5690	802.11ac VHT80 CDD	22.66	184.50
5530-5690	802.11ac VHT80 SDM	Covered by 802.11ac VHT80 2TX CDD	
5530-5690	802.11ac VHT80 STBC		

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5.8 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.8 GHz band, 1TX			
5745-5825	802.11a	Covered by 802.11 HT20 1TX	
5745-5825	802.11n HT20	22.47	176.60
5755-5795	802.11n HT40	21.87	153.82
5745-5825	802.11ac VHT20	Covered by 802.11 HT20 1TX	
5755-5795	802.11ac VHT40	Covered by 802.11 HT40 1TX	
5775	802.11ac VHT80	21.74	149.28
5.8 GHz band, 2TX			
5745-5825	802.11n HT20 CDD	25.19	330.37
5745-5825	802.11n HT20 SDM	Covered by 802.11 HT20 2TX CDD	
5745-5825	802.11n HT20 STBC		
5755-5795	802.11n HT40 CDD	24.93	311.17
5755-5795	802.11n HT40 SDM	Covered by 802.11 HT40 2TX CDD	
5755-5795	802.11n HT40 STBC		
5745-5825	802.11ac VHT20 CDD	Covered by 802.11 HT20 2TX CDD	
5745-5825	802.11ac VHT20 SDM		
5745-5825	802.11ac VHT20 STBC		
5755-5795	802.11ac VHT40 CDD	Covered by 802.11 HT40 2TX CDD	
5755-5795	802.11ac VHT40 SDM		
5755-5795	802.11ac VHT40 STBC		
5775	802.11ac VHT80 CDD	24.83	304.09
5775	802.11ac VHT80 SDM	Covered by 802.11ac VHT80 CDD	
5775	802.11ac VHT80 STBC		

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5.3. MAXIMUM EIRP

Band (GHz)	Maximum Output Power (dBm)	Uncorrelated Chains Directional Gain (dBi)	Maximum EIRP (dBm)	Maximum EIRP (mW)
5.2	22.83	-5.65	17.18	53.24
5.3	22.87	-4.74	18.13	63.01
5.6	22.71	-3.11	19.60	91.20
5.8	25.19	-3.61	21.58	143.88

TPC is not required since the maximum EIRP is less than 500 mW (27 dBm).

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	Antenna 6 (dBi)	Antenna 5 (dBi)
5.2	-5.7	-5.6
5.3	-4.5	-5
5.6	-1.8	-5
5.8	-2.2	-5.7

5.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was v16.30.67.7

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5.6. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z on Ant 6 (Antenna 6) and Ant 5 (Antenna 5), it was determined that X (Flatbed) orientation was the worst-case for Ant 6 and Y (Landscape) orientation for Ant 5 and 2TX.

For radiated harmonics spurious below 1GHz, 1-18GHz L/M/H channels, 18-40GHz, and power line conducted emissions were performed with the EUT set at the 2TX CDD mode among the CDD/SDM modes with power setting equal or higher than SISO modes as worst-case scenario.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT was set to transmit at highest power on Low/Middle/High channels.

Below 1GHz tests were performed with EUT connected to AC power adapter as the worst case; and for above 1GHz, the worst-case configuration reported was tested with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop.

There were no emissions found below 30MHz within 20dB of the limit.

For simultaneous transmission with the Bluetooth was investigated, no noticeable emission was found.

Worst-case data rates as provided by the client were:

802.11n HT20mode: MCS0
802.11n HT40mode: MCS0
802.11ac VHT80 mode: MCS0

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

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5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	MacBook Pro	HRP007154	NA
AC/DC adapter	Delta Electronic	A1343	ADP-85EBT V85	NA
EUT AC Adapter	Apple	A1385	D293062F3WVDHLHCF	NA

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	2	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None Used						

I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	USB	Un-shielded	1	N/A

TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the EUT.

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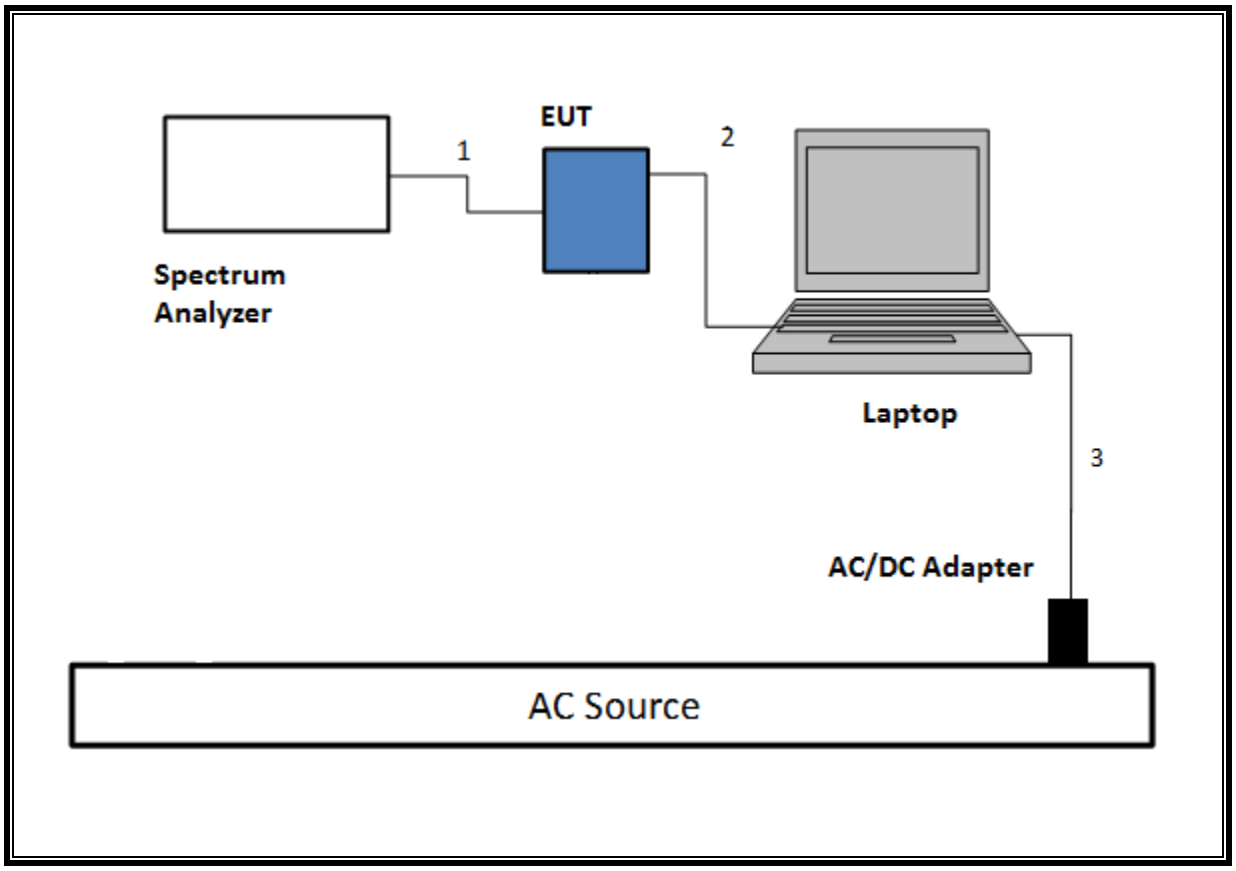
SETUP DIAGRAM FOR CONDUCTED TESTS



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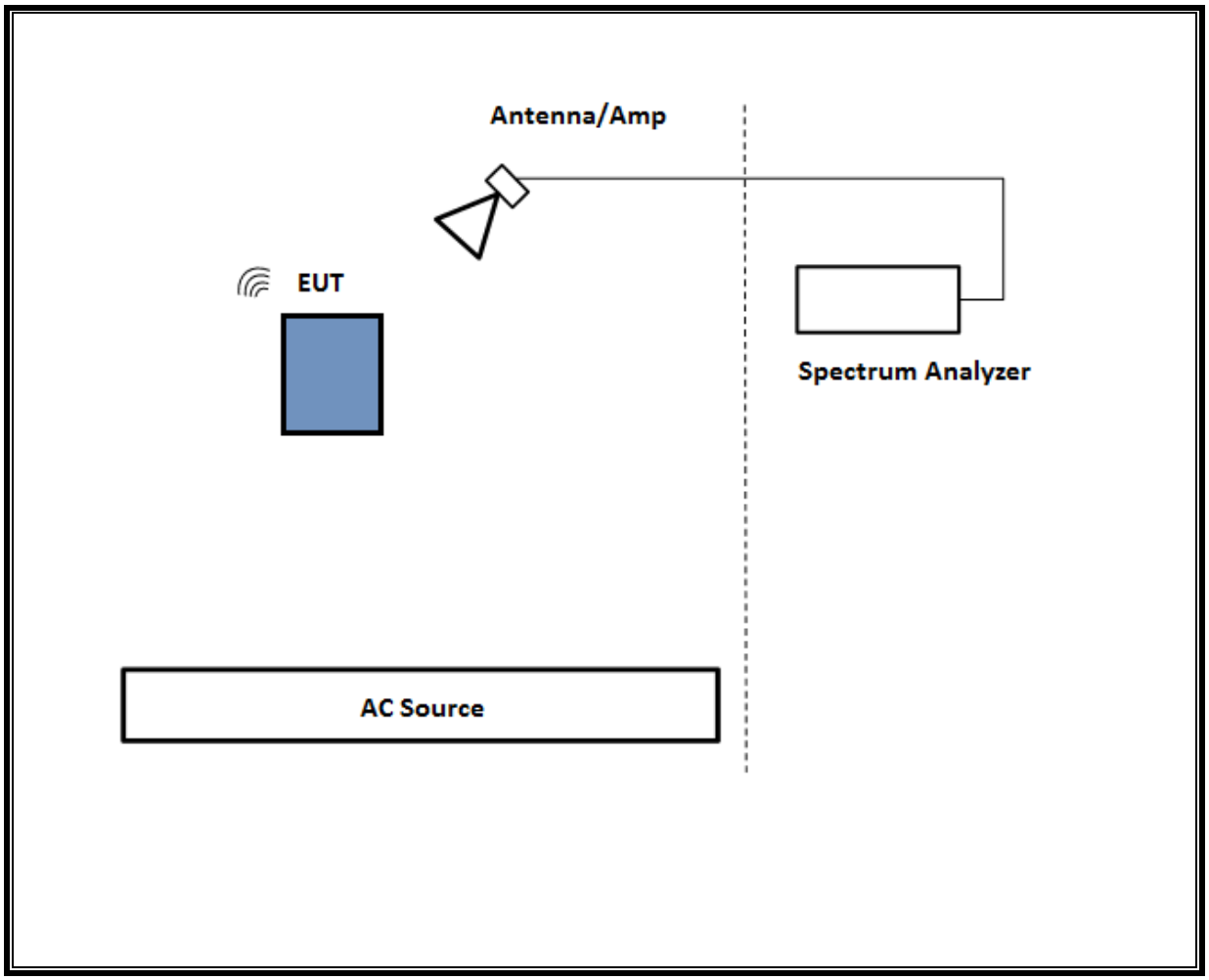
SETUP DIAGRAM FOR RADIATED TESTS Above 1GHz



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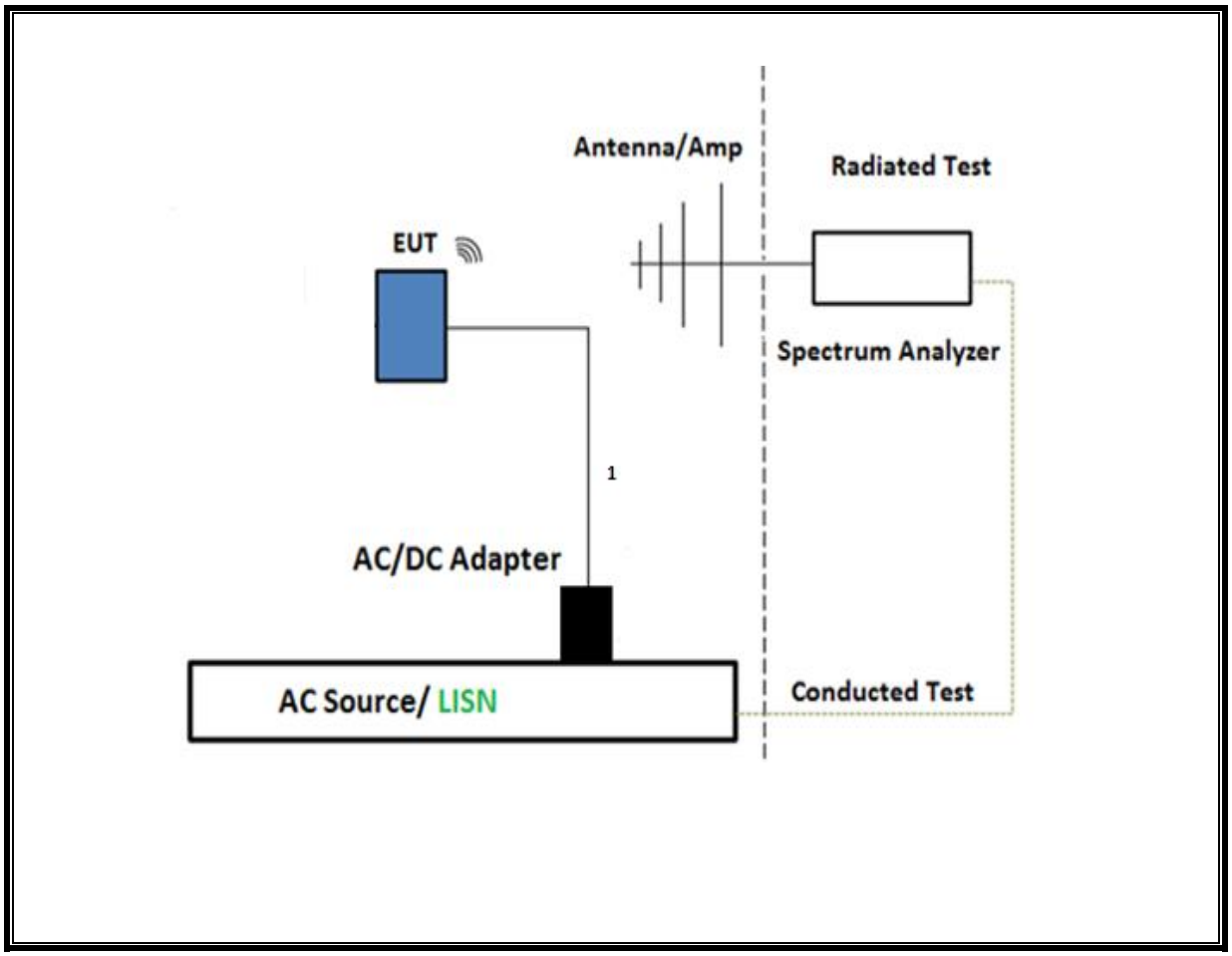
SETUP DIAGRAM FOR Below 1GHz and AC LINE CONDUCTED TEST



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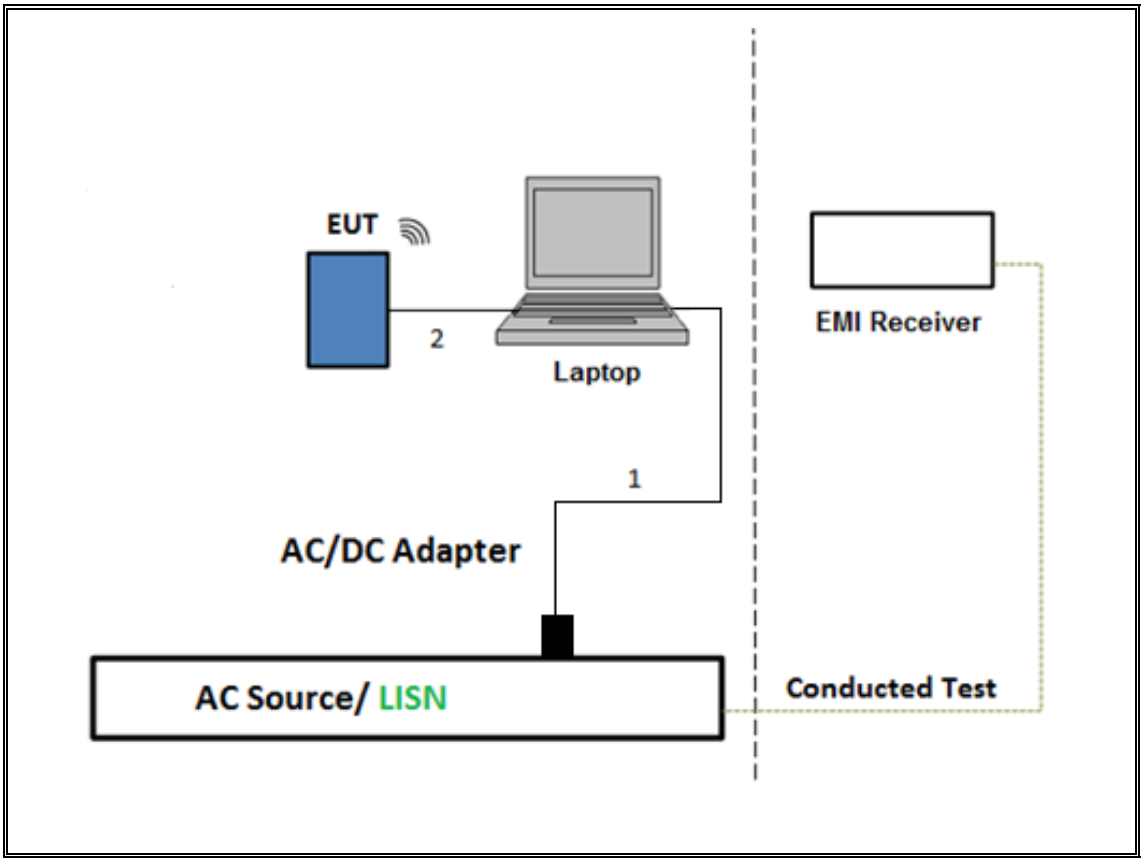
TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



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6. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 789033 D02 v02r01, Section B.

6 dB Emission BW: KDB 789033 D02 v02r01, Section C.2

26 dB Emission BW: KDB 789033 D02 v02r01, Section C.1

99% Occupied BW: KDB 789033 D02 v02r01, Section D.

Conducted Output Power: KDB 789033 D02 v02r01, Section E.3.b (Method PM-G) and Section E.2.b (Method SA-2)

Power Spectral Density: KDB 789033 D02 v02r01, Section F

Unwanted emissions in restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, and G.5.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Description	Manufacturer	Model	ID Num	Cal Due
*Antenna, Horn 1-18GHz	ETS Lindgren	3117	T136	06/26/2018
*Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T286	06/02/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	12/30/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T340	12/15/2018
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	04/03/2019
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T742	12/04/2018
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	04/12/2019
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T345	04/25/2019
*Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T407	04/14/2018
*Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T491	06/01/2018
*Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T834	06/01/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A-544	T341	11/12/2018
*Antenna, Horn 1-18GHz	ETS Lindgren	3117	T344	04/20/2018
*Amplifier, 1 to 18GHz, 35dB	Amplical	AMP1G18-35	T1569	05/31/2018
*Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	03/20/2018
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T757	9/14/2018
*Antenna, Horn 26.5GHz to 40GHz	ARA	MWH-2640/B	T446	06/12/2018
Amplifier, 26GHz to 40GHz	Miteq	TTA2640-35-HG	T1864	09/21/2018
*Antenna Horn 18 to 26.5GHz	ARA	MWH-1826/B	T449	06/12/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	01/08/2019
Power Meter, P-series single channel	Keysight	N1912A	T1273	07/17/2018
Power Sensor	Keysight	N1921A	T1226	08/30/2018
Antenna Horn 26-40GHz	ARA	MWH-2640	T90	08/25/2018
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	T1436	01/25/2019
*LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2018
*LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016	
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

Note: *Testing is completed before equipment expiration date.

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11n HT20 1TX/2TX	1.913	1.935	0.989	98.86%	0.00	0.010
802.11n HT40 1TX/2TX	0.944	0.964	0.979	97.90%	0.09	1.060
802.11ac VHT80 1TX/2TX	0.460	0.480	0.957	95.67%	0.19	2.176

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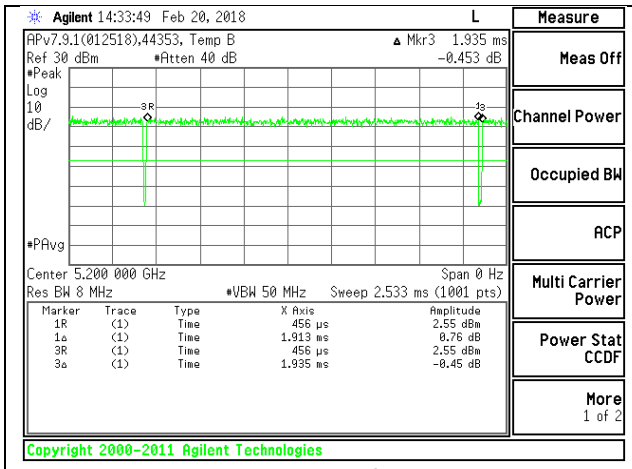
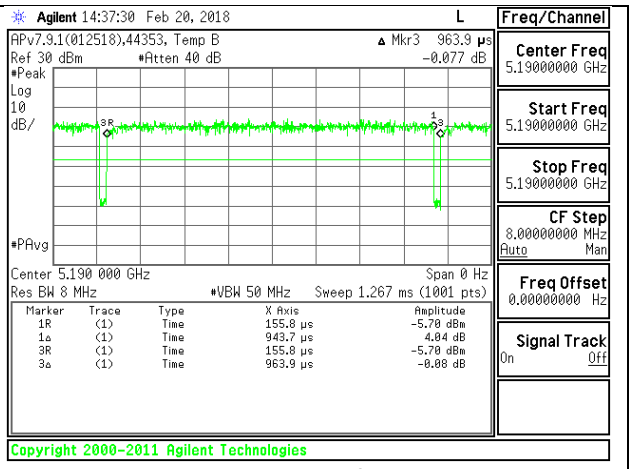
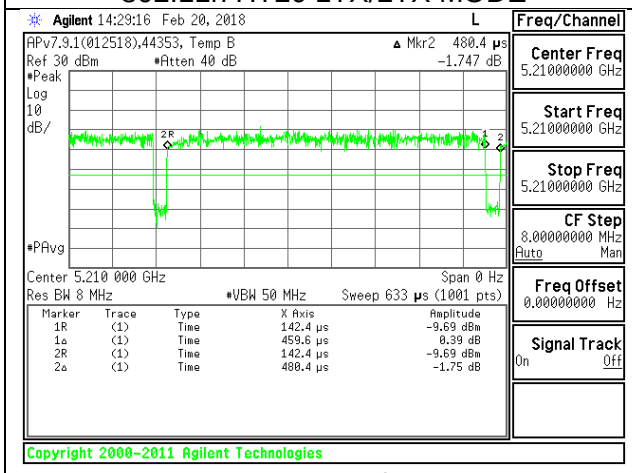
DUTY CYCLE PLOTS



802.11n HT20 1TX/2TX MODE



802.11n HT40 1TX/2TX MODE



802.11n VHT80 1TX/2TX MODE

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8.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

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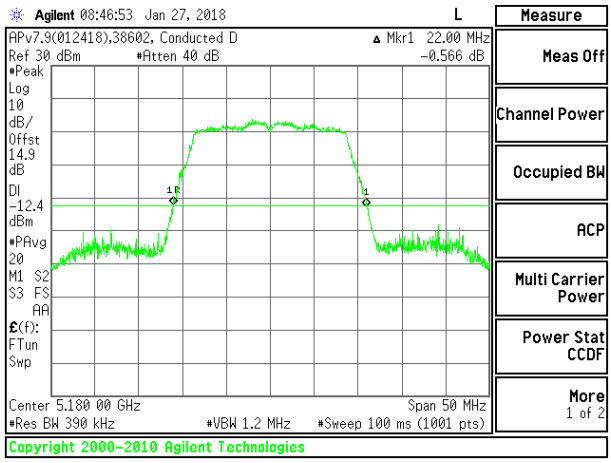
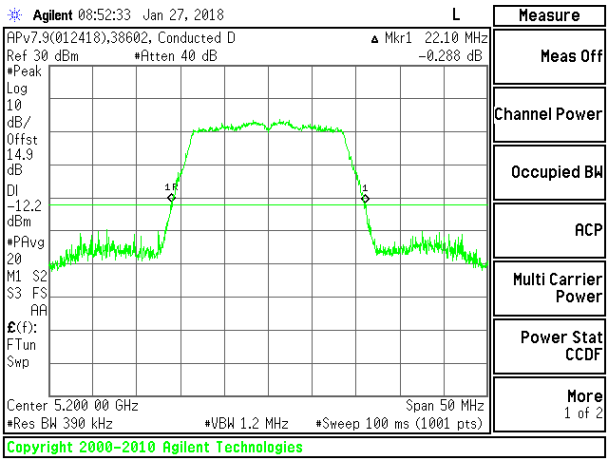
8.2.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

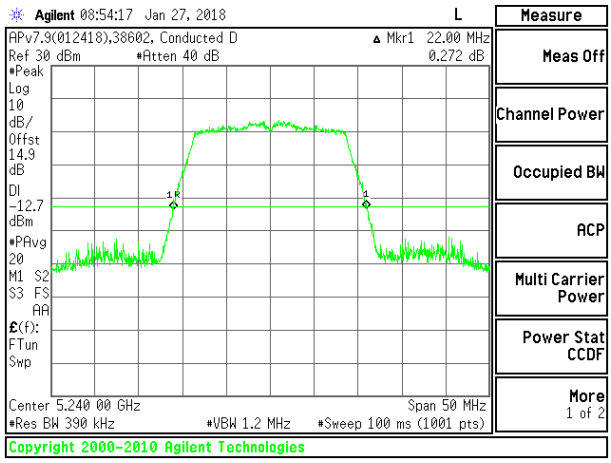
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.00
Mid	5200	22.10
High	5240	22.00



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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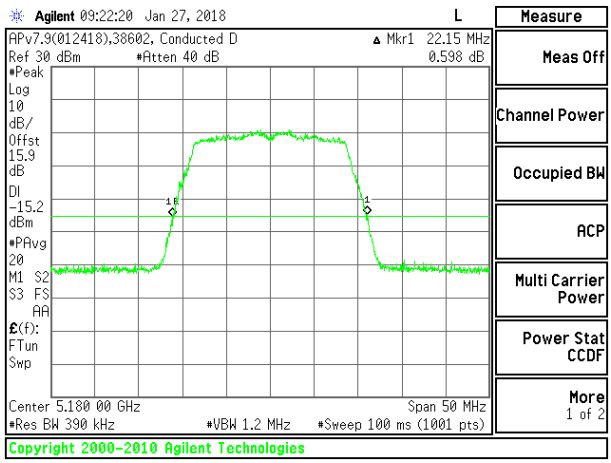
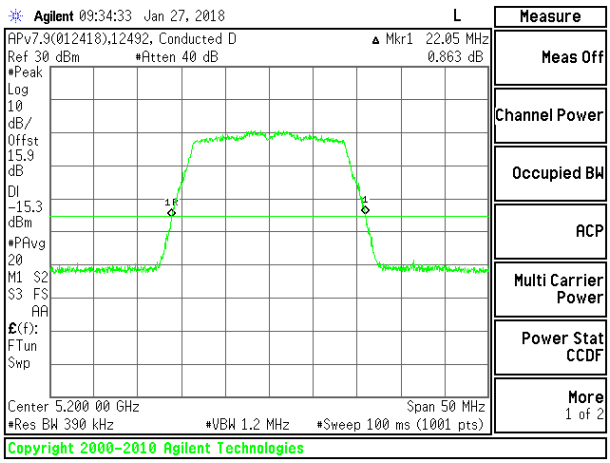
1TX Antenna 5 MODE

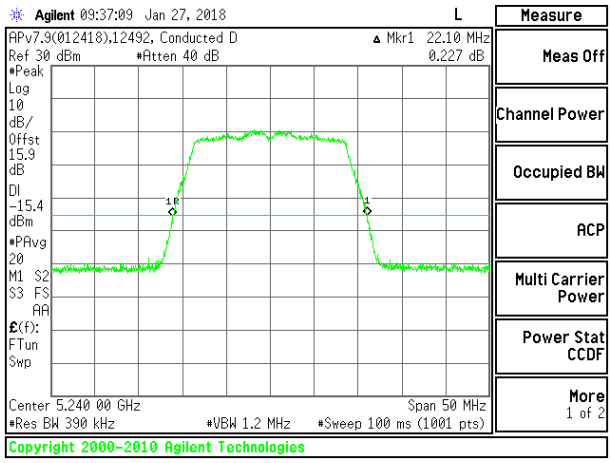
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.15
Mid	5200	22.05
High	5240	22.10



LOW CHANNEL



MID CHANNEL



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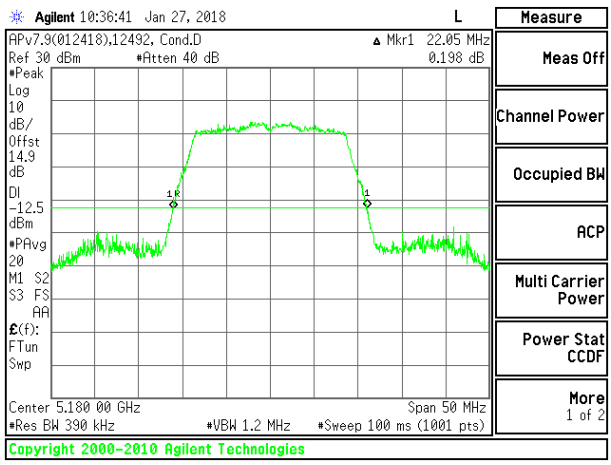
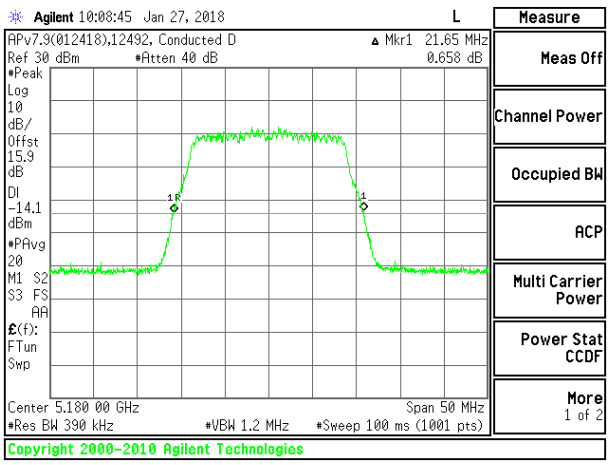
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5180	22.05	21.65
Mid	5200	21.95	21.10
High	5240	22.20	21.60

LOW CHANNEL

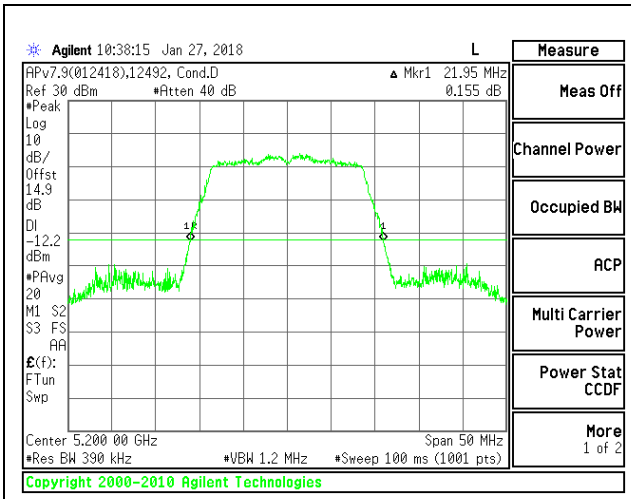


LOW CHANNEL ANTENNA 6

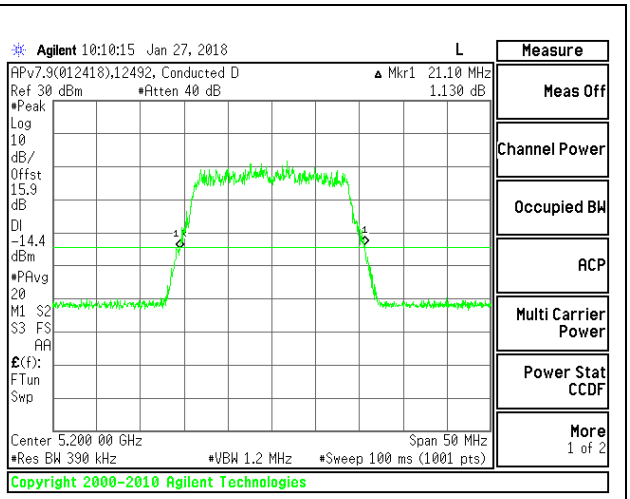


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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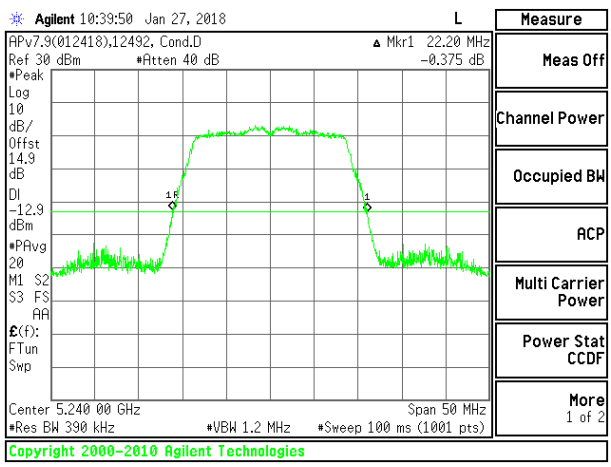
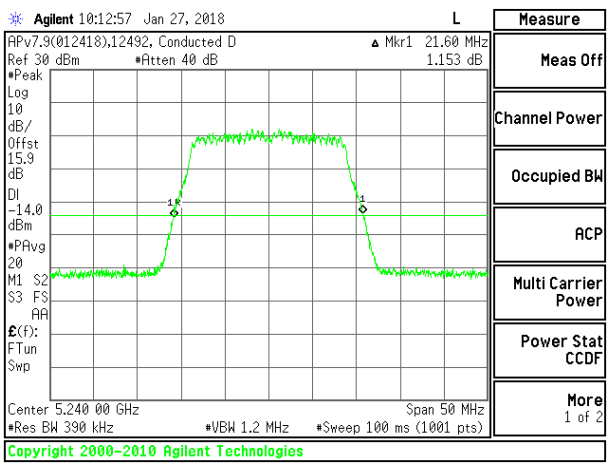
HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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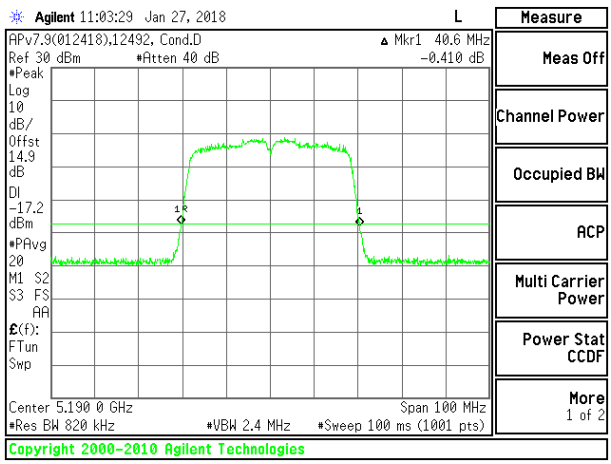
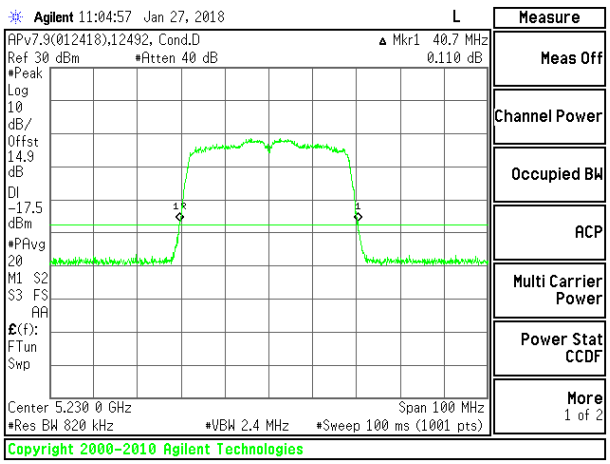
8.2.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5190	40.60
High	5230	40.70



LOW CHANNEL



HIGH CHANNEL

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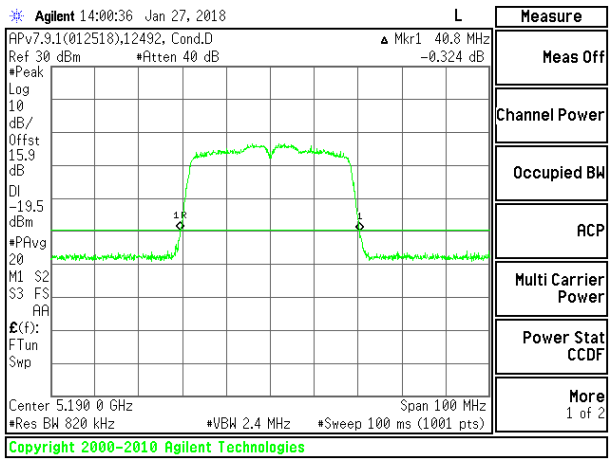
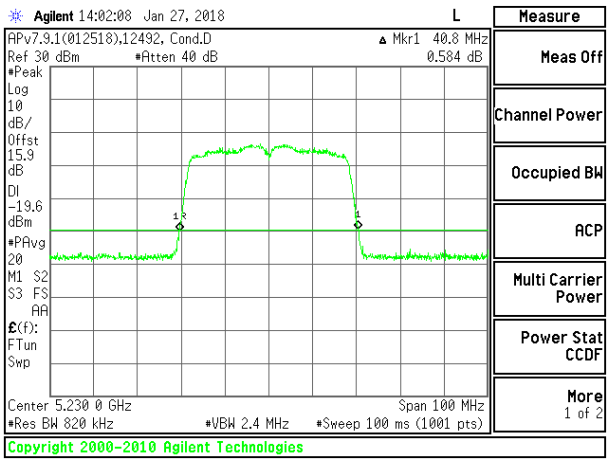
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5190	40.80
High	5230	40.80



LOW CHANNEL



HIGH CHANNEL

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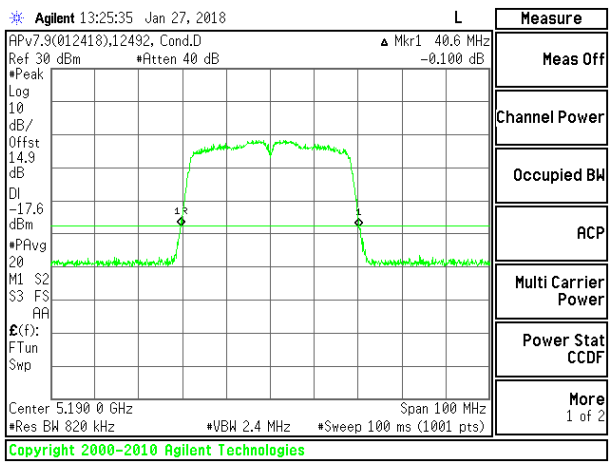
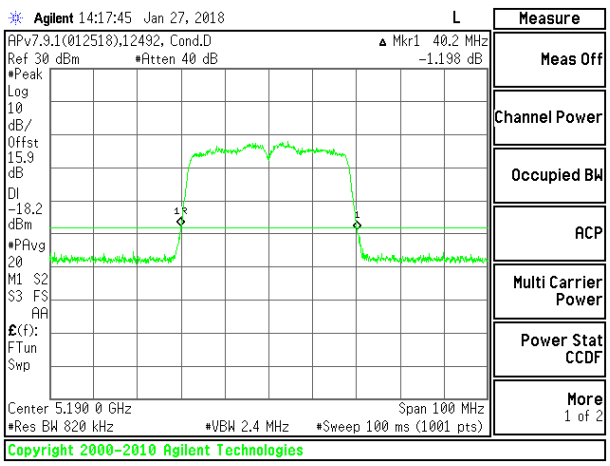
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5190	40.60	40.20
High	5230	40.70	40.30

LOW CHANNEL

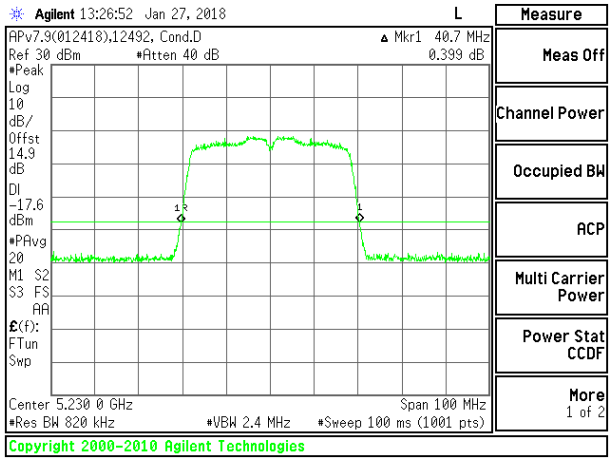


LOW CHANNEL ANTENNA 6

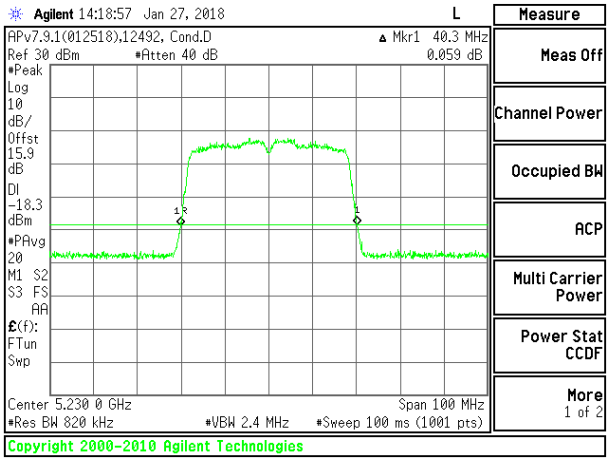


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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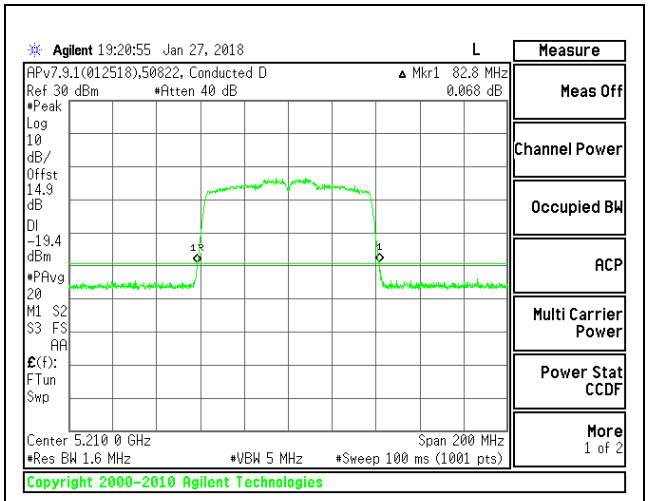
8.2.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5210	82.80



MID CHANNEL

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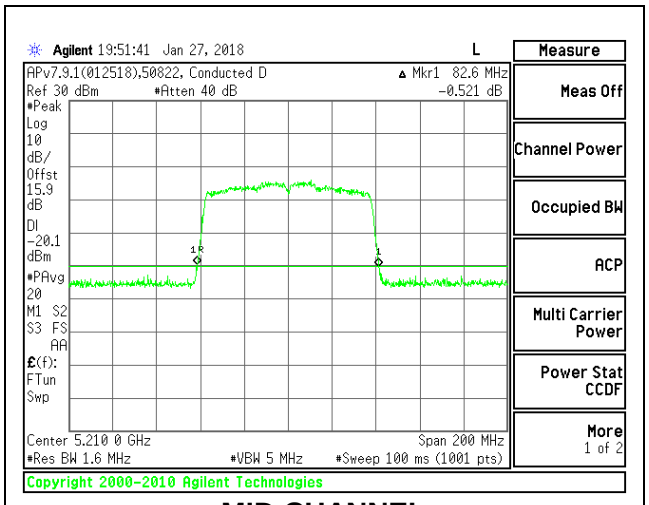
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5210	82.60



MID CHANNEL

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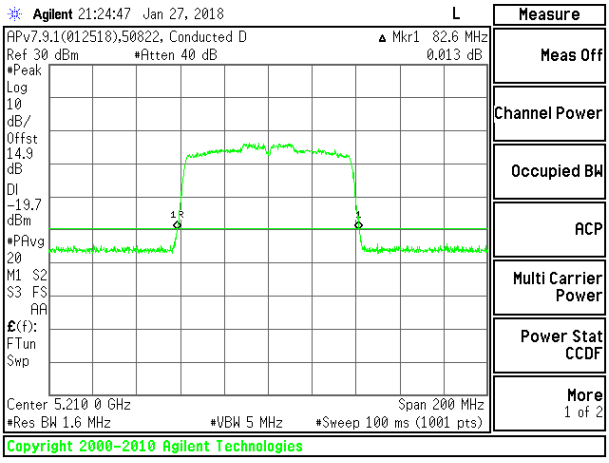
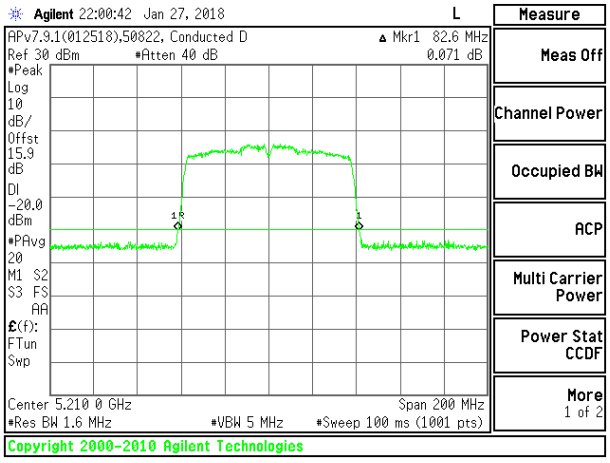
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Mid	5210	82.60	82.60

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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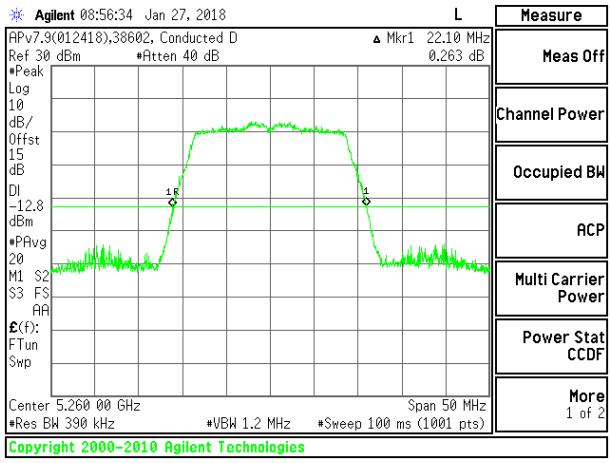
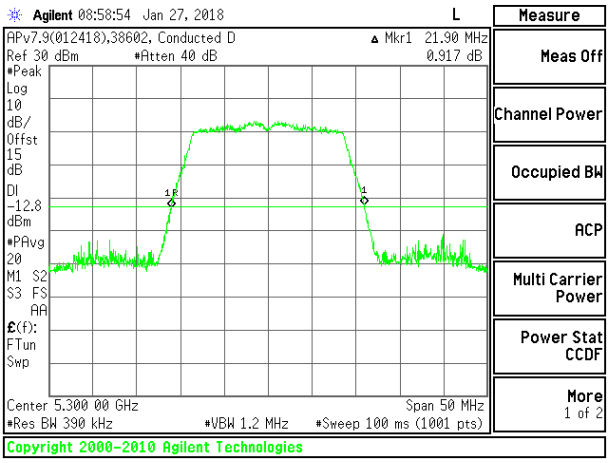
8.2.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

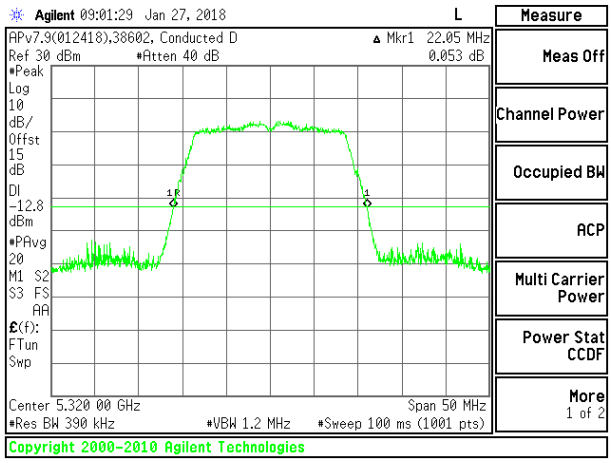
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	22.10
Mid	5300	21.90
High	5320	22.05



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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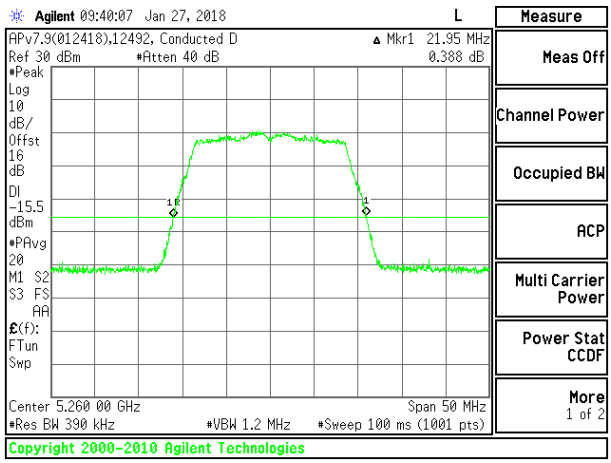
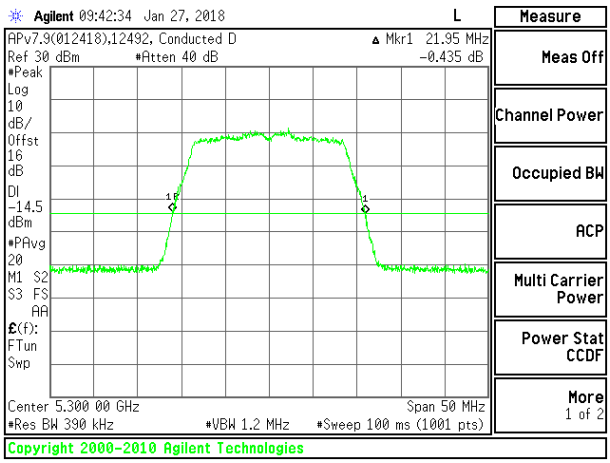
1TX Antenna 5 MODE

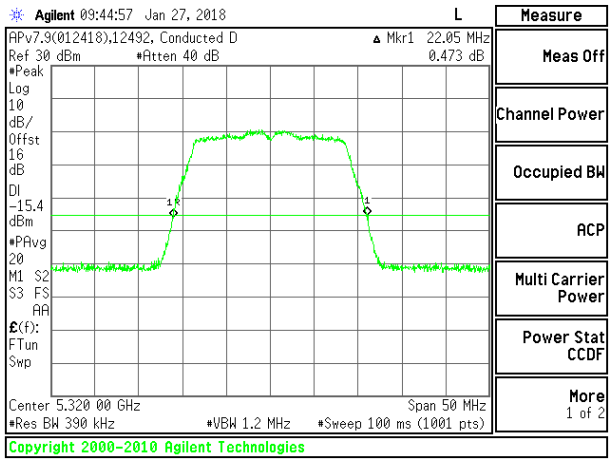
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	21.95
Mid	5300	21.95
High	5320	22.05



LOW CHANNEL



MID CHANNEL



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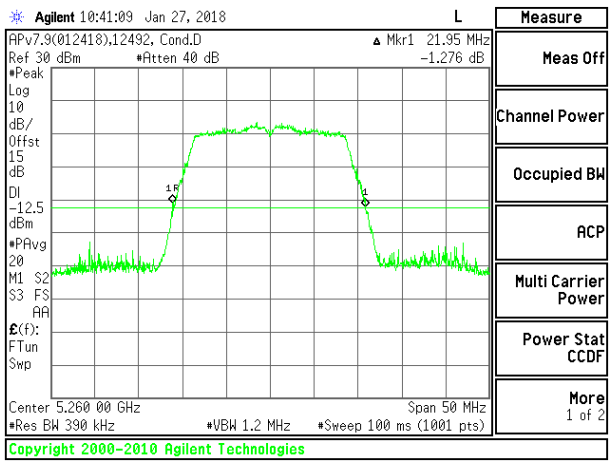
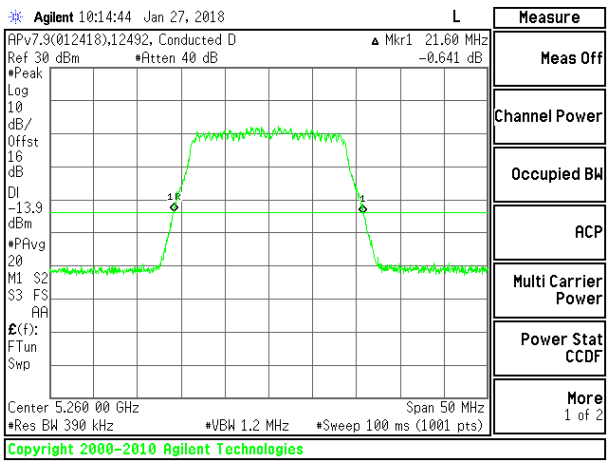
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5260	21.95	21.60
Mid	5300	22.05	21.70
High	5320	21.95	21.80

LOW CHANNEL

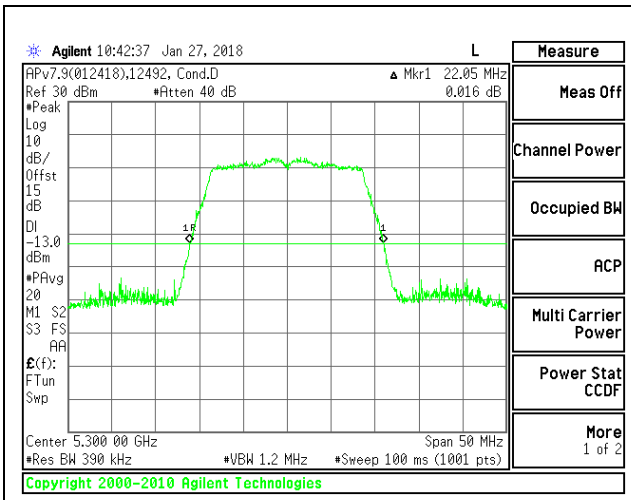


LOW CHANNEL ANTENNA 6

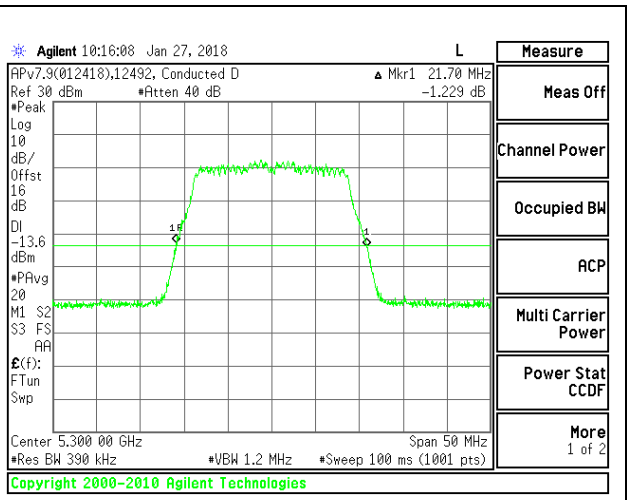


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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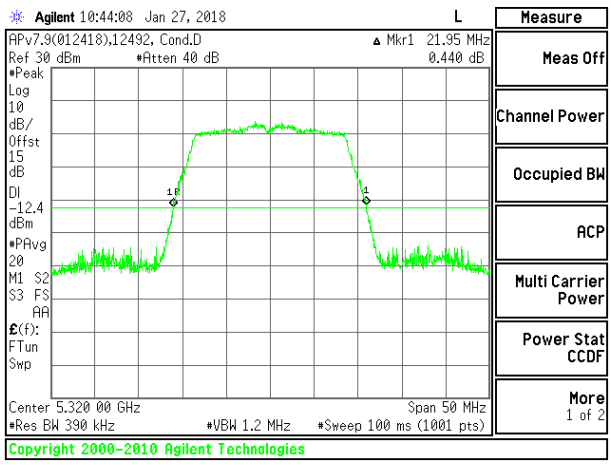
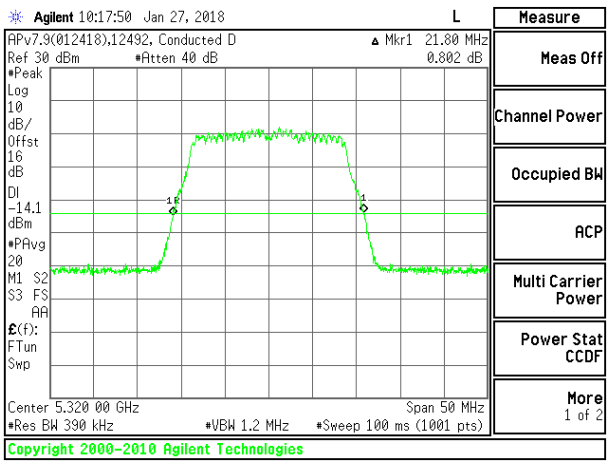
HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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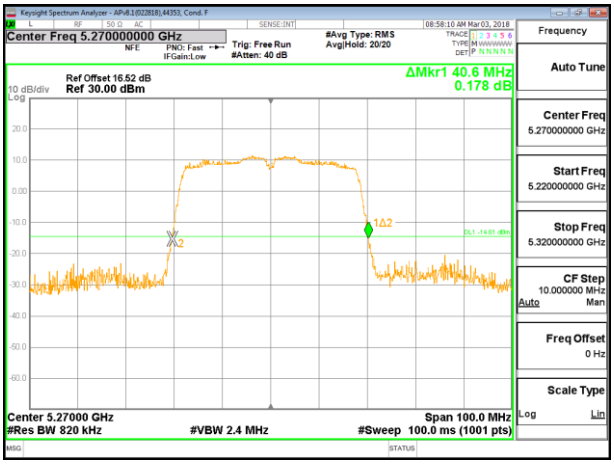
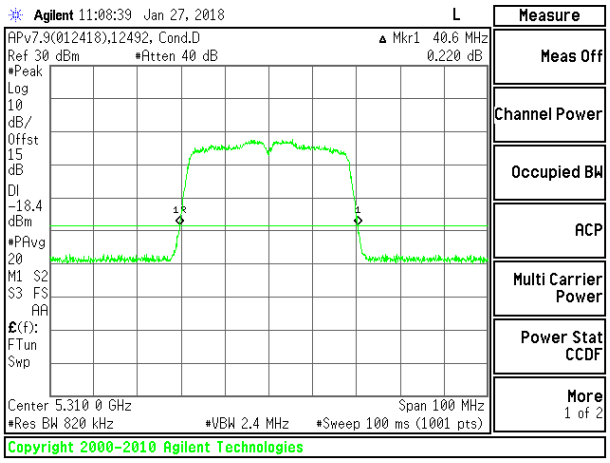
8.2.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5270	40.60
High	5310	40.60



LOW CHANNEL



HIGH CHANNEL

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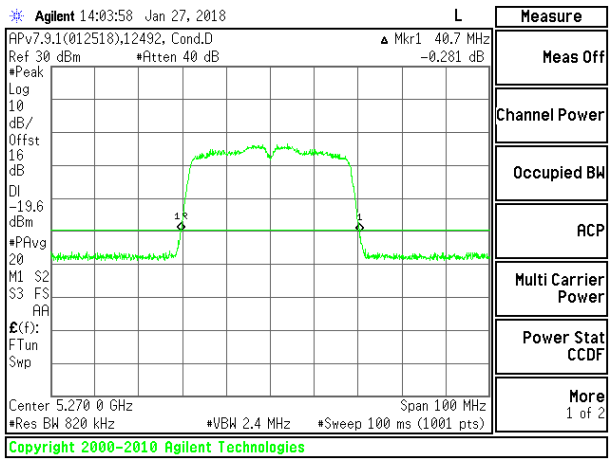
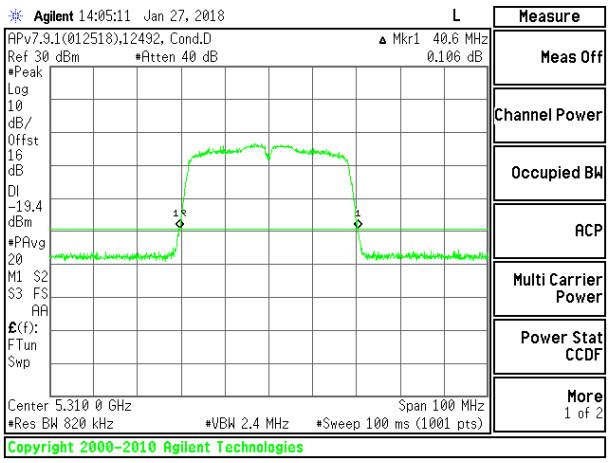
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5270	40.70
High	5310	40.60



LOW CHANNEL



HIGH CHANNEL

UL VERIFICATION SERVICES INC.
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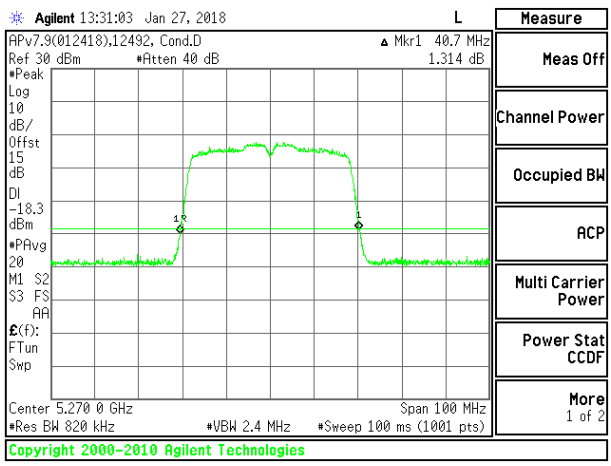
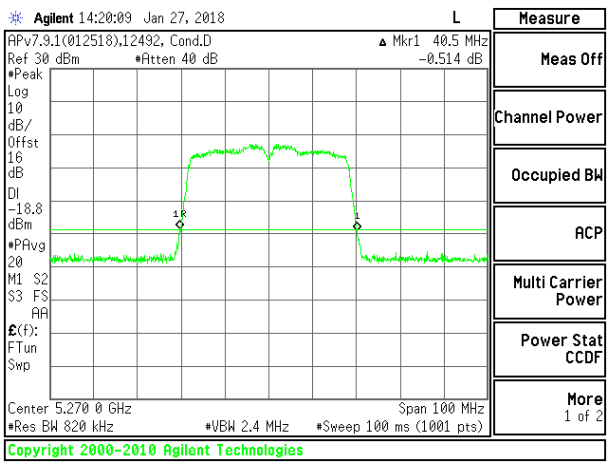
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5270	40.70	40.50
High	5310	40.60	40.20

LOW CHANNEL

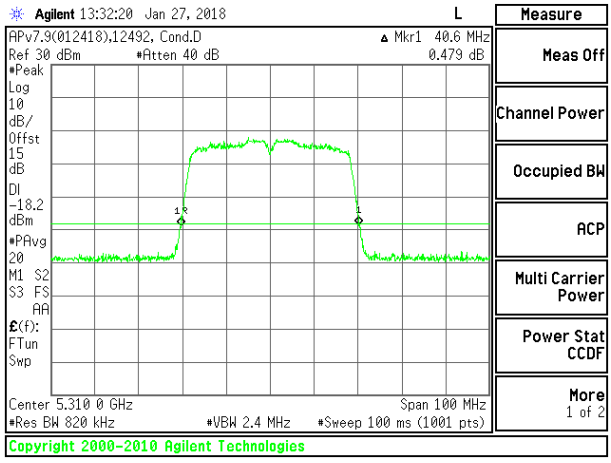


LOW CHANNEL ANTENNA 6

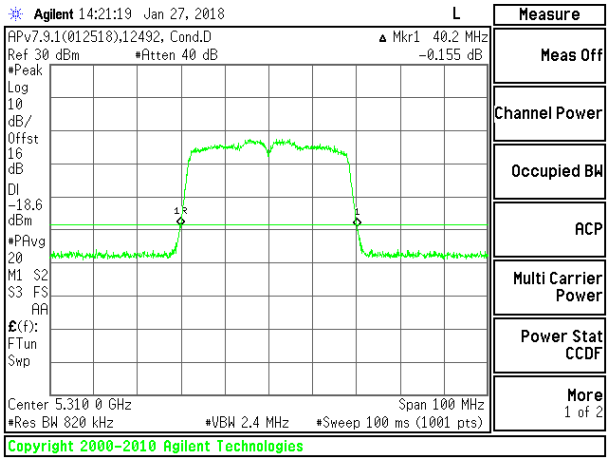


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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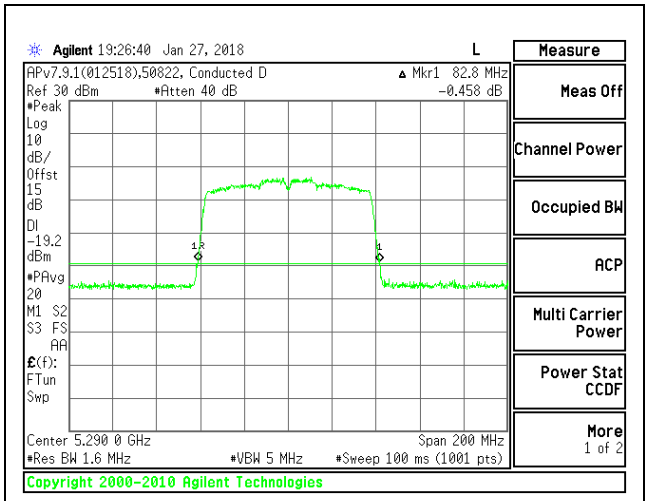
8.2.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5290	82.80



MID CHANNEL

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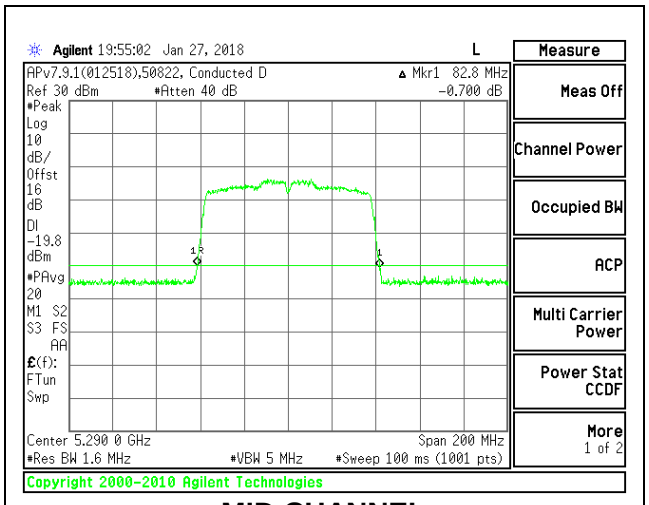
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5290	82.80



MID CHANNEL

UL VERIFICATION SERVICES INC.
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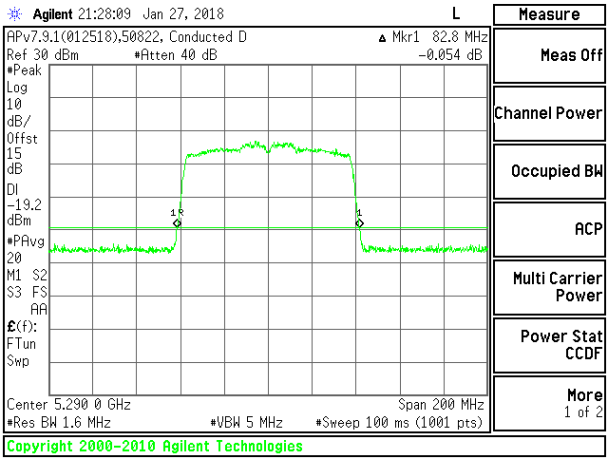
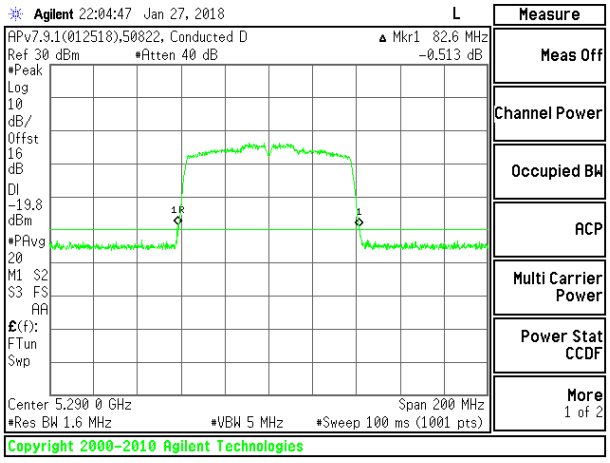
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Mid	5290	82.80	82.60

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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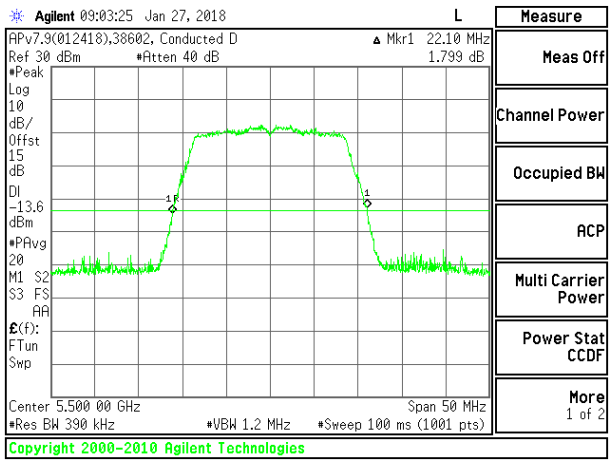
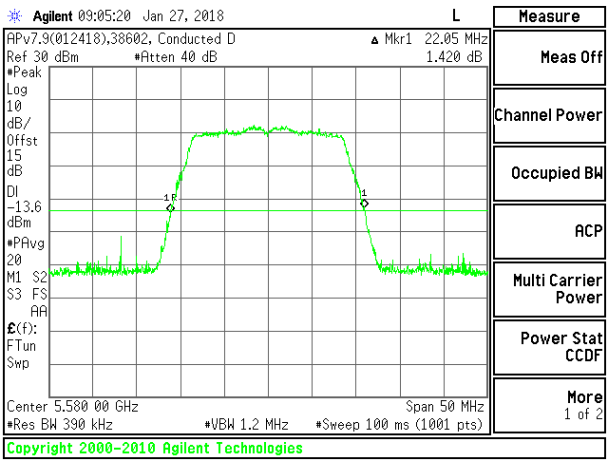
8.2.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

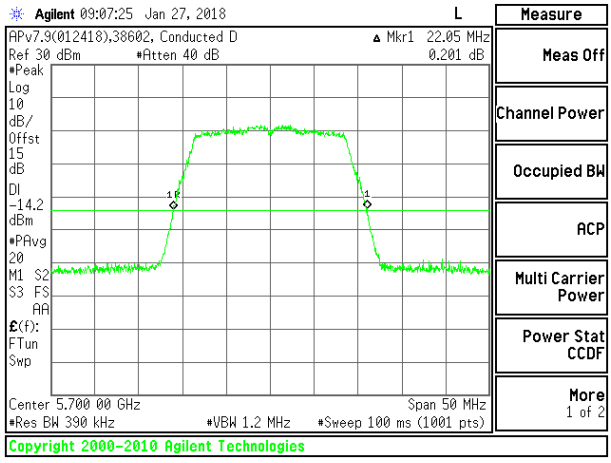
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	22.10
Mid	5580	22.05
High	5700	22.05
144	5720	21.95



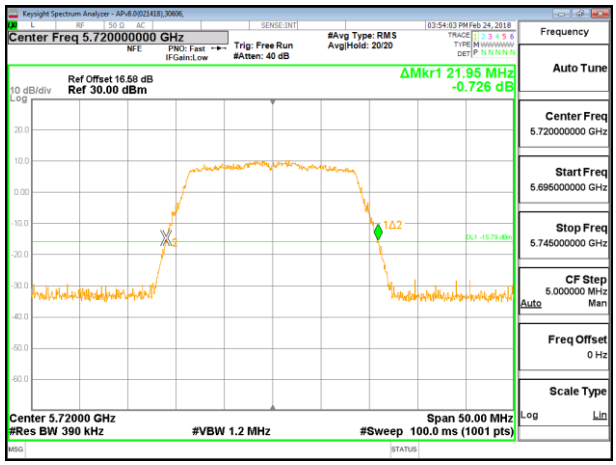
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



CHANNEL 144

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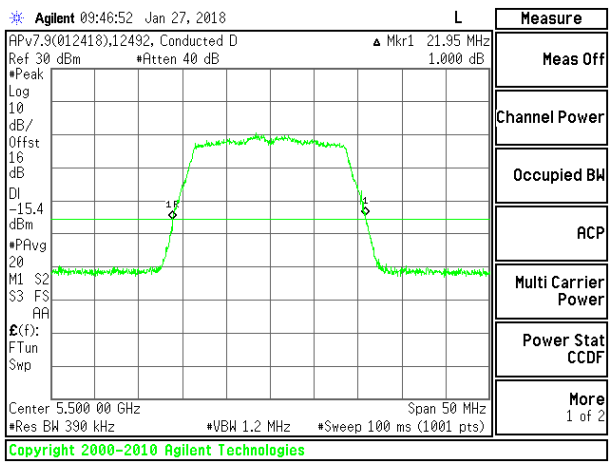
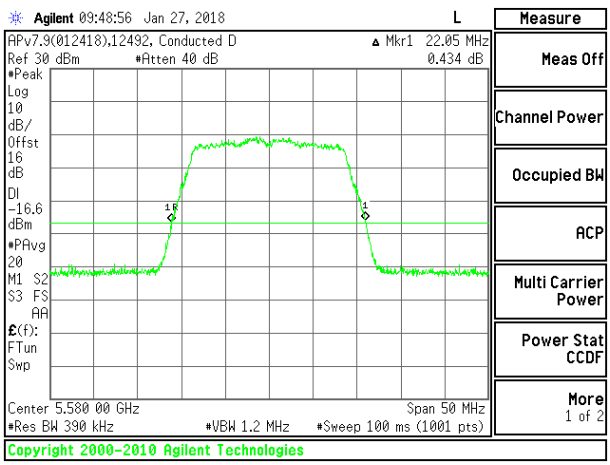
1TX Antenna 5 MODE

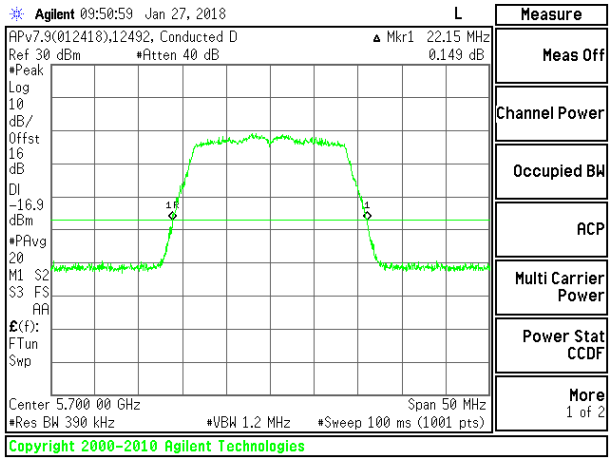
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	21.95
Mid	5580	22.05
High	5700	22.15
144	5720	21.90



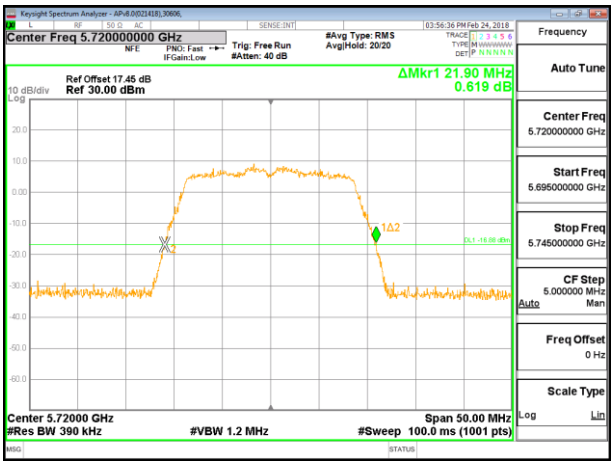
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



CHANNEL 144

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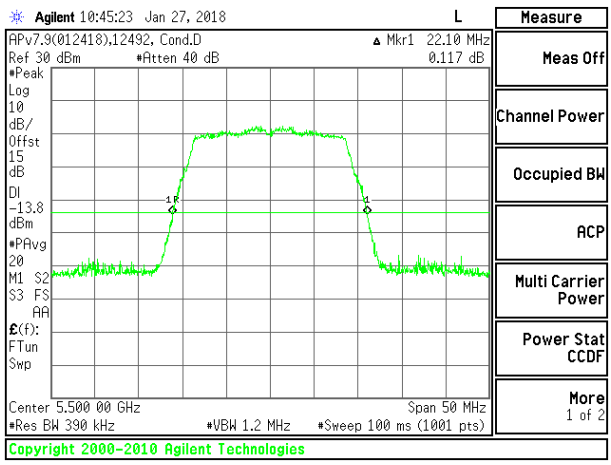
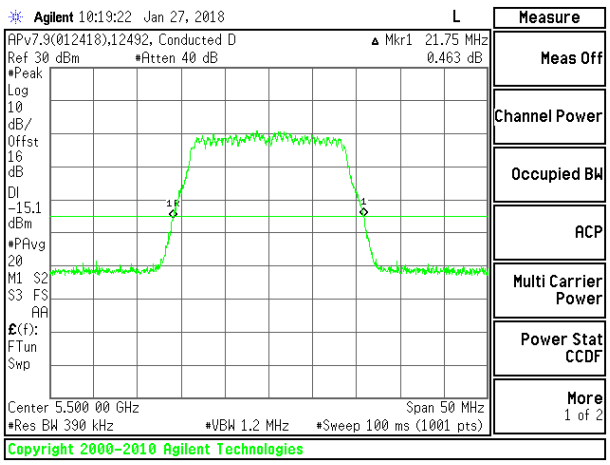
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5500	22.10	21.75
Mid	5580	22.05	21.60
High	5700	21.95	21.75
144	5720	22.15	21.70

LOW CHANNEL

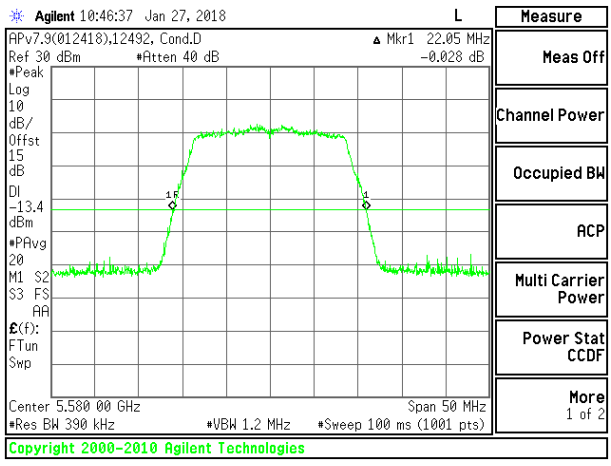


LOW CHANNEL ANTENNA 6

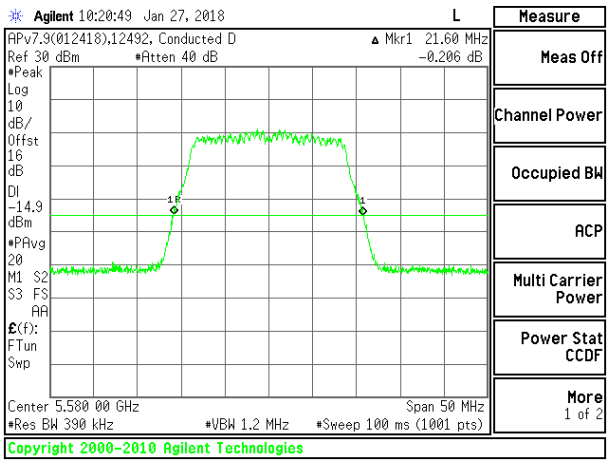


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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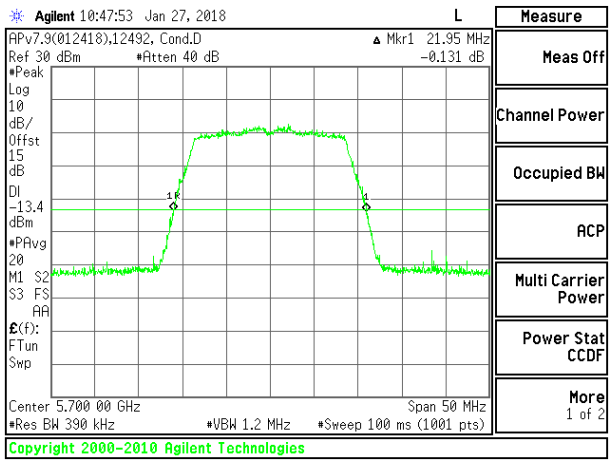
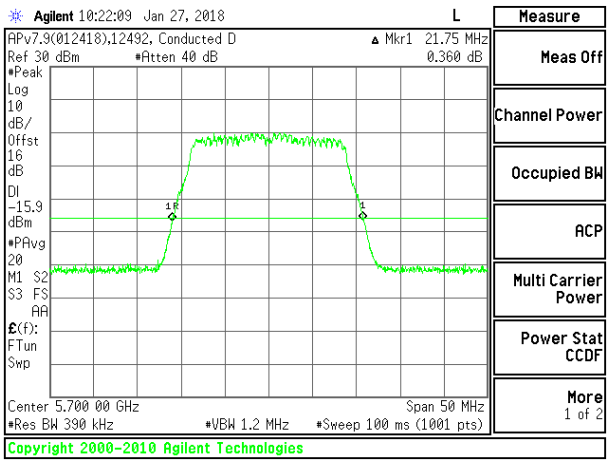
HIGH CHANNEL

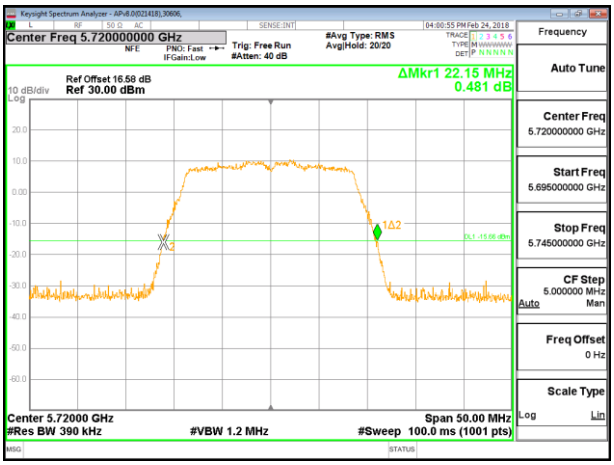


HIGH CHANNEL ANTENNA 6

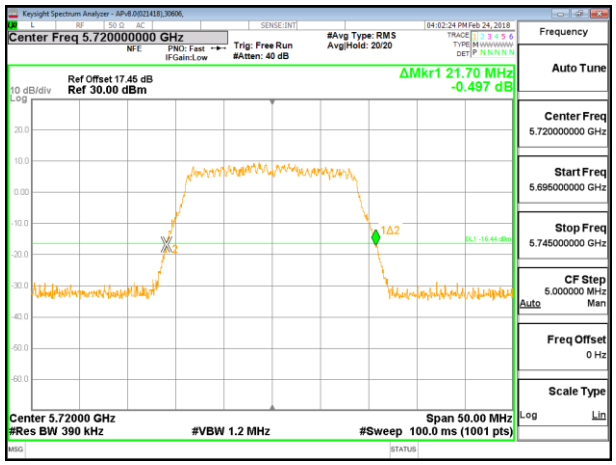


HIGH CHANNEL ANTENNA 5

CHANNEL 144



CHANNEL 144 ANTENNA 6



CHANNEL 144 ANTENNA 5

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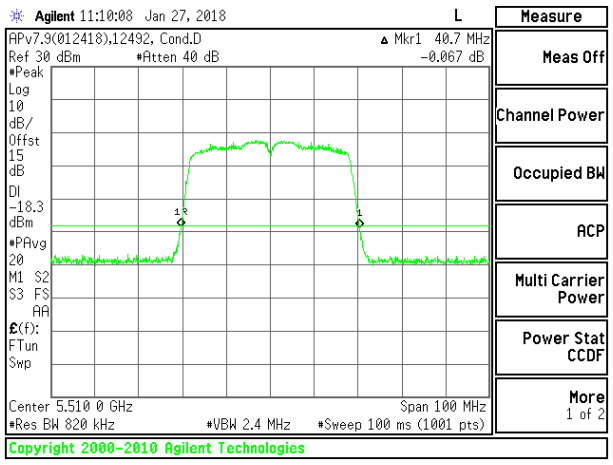
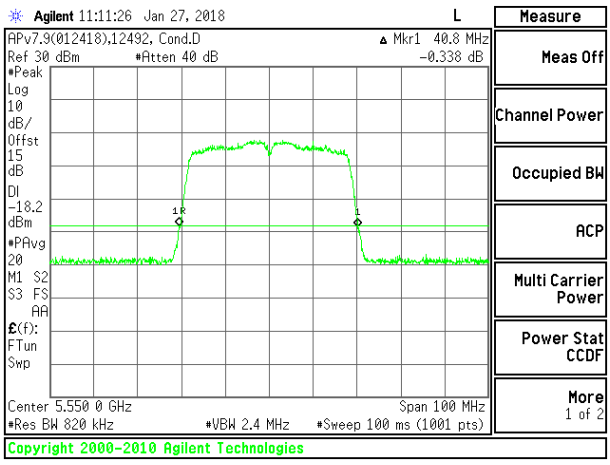
8.2.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

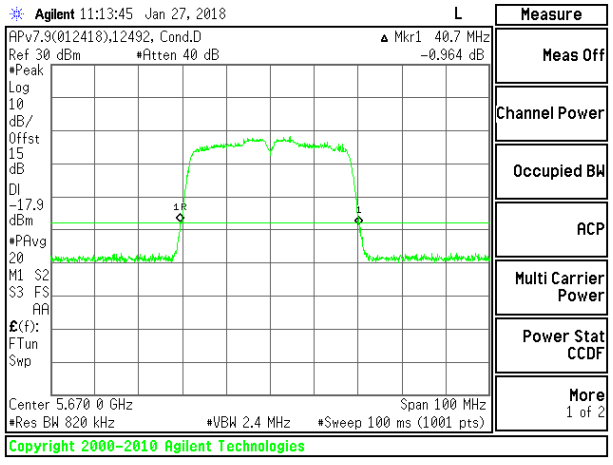
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	40.70
Mid	5550	40.80
High	5670	40.70
142	5710	40.90



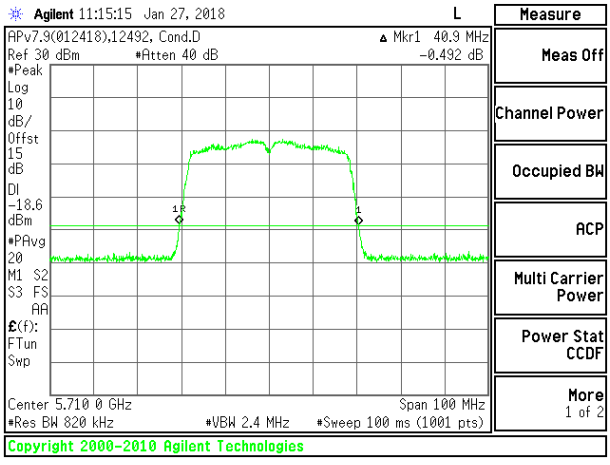
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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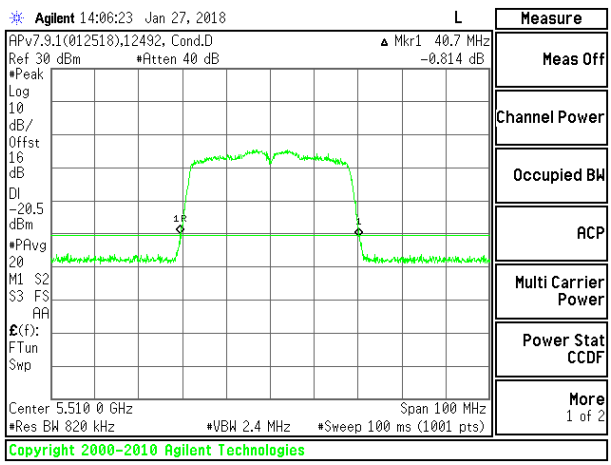
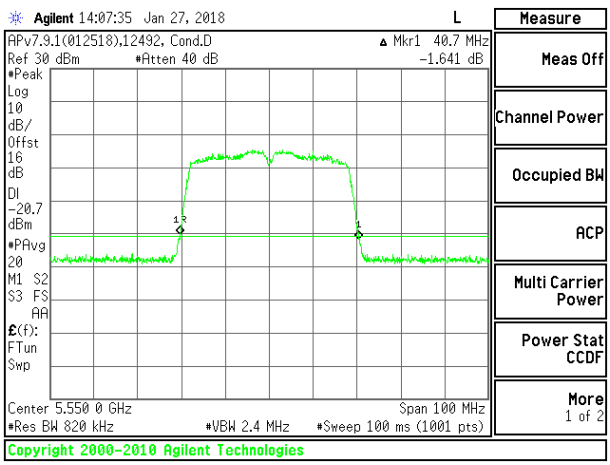
1TX Antenna 5 MODE

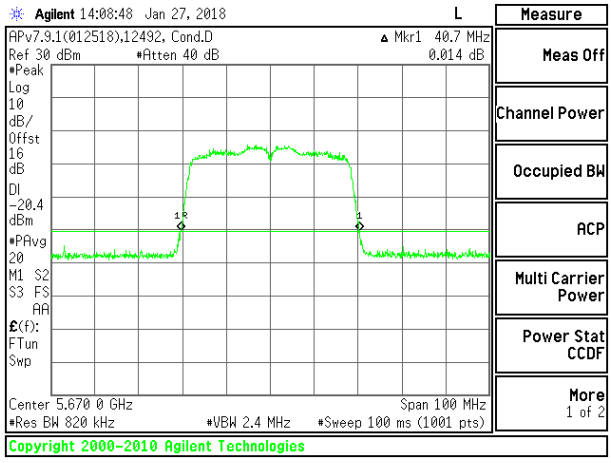
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	40.70
Mid	5550	40.70
High	5670	40.70
142	5710	40.60



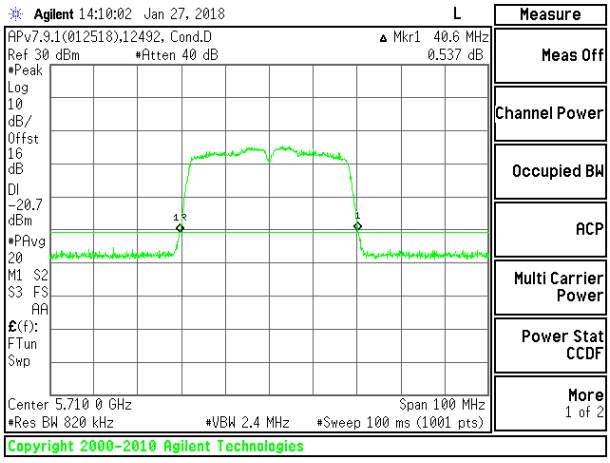
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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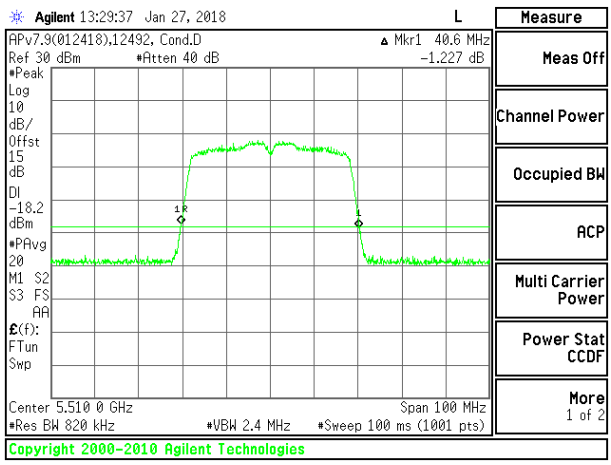
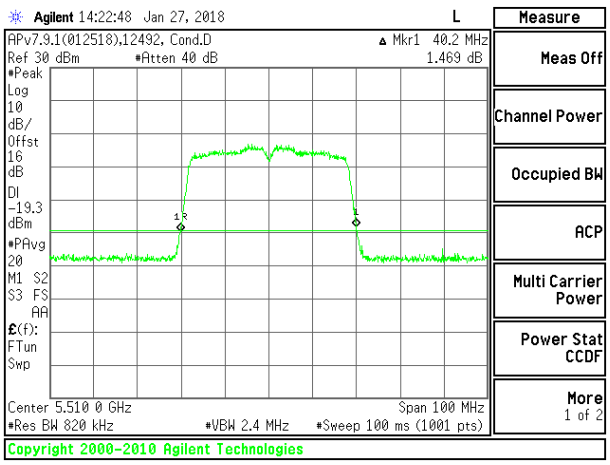
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5510	40.60	40.20
Mid	5550	40.70	40.10
High	5670	40.40	40.10
142	5710	40.70	40.20

LOW CHANNEL

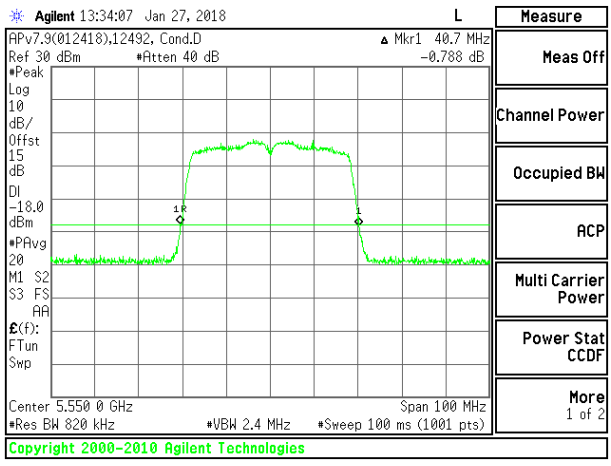


LOW CHANNEL ANTENNA 6

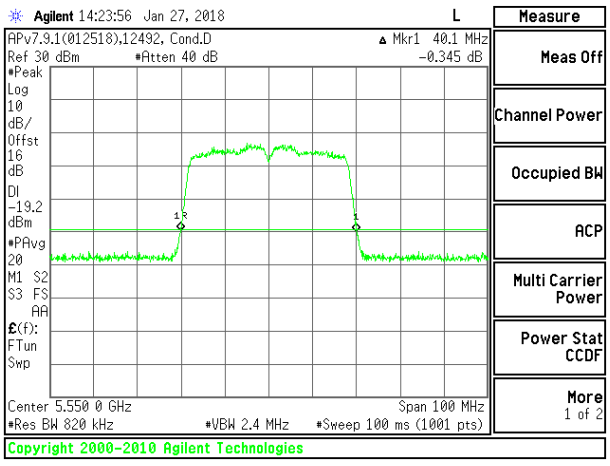


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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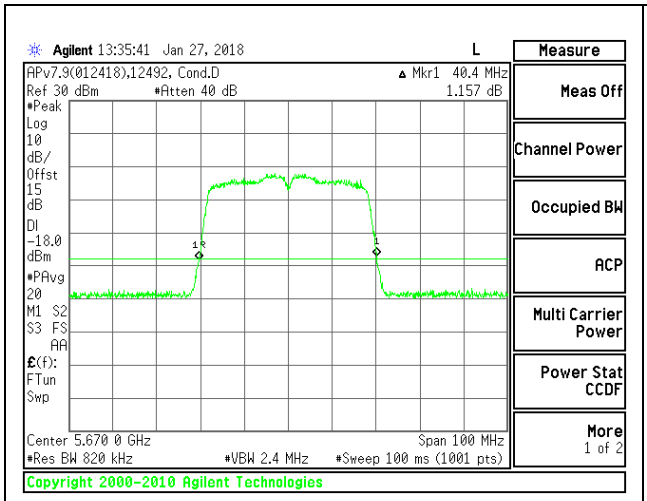
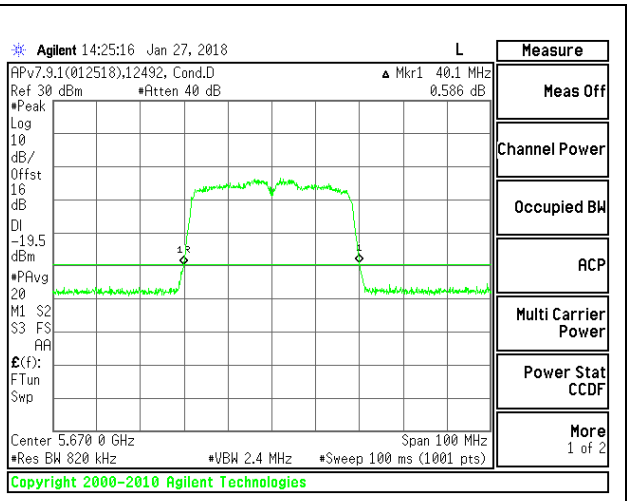
HIGH CHANNEL

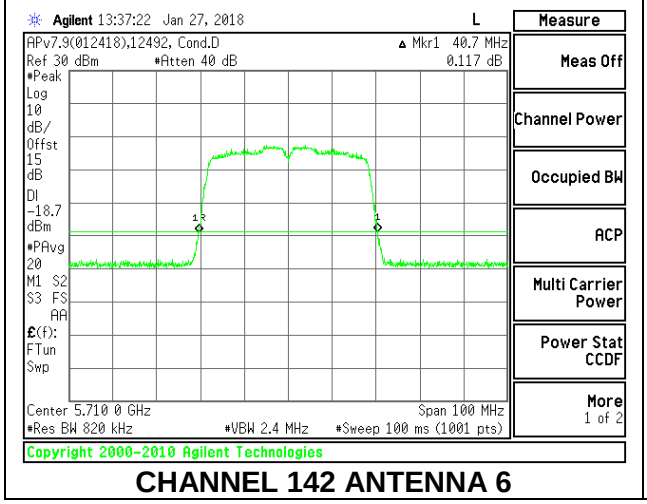


HIGH CHANNEL ANTENNA 6

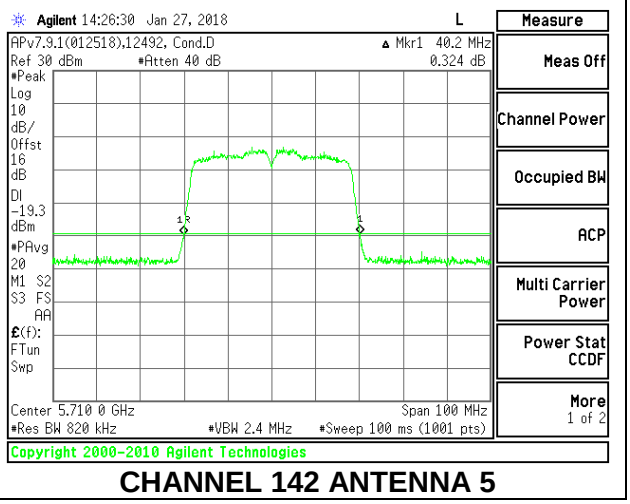


HIGH CHANNEL ANTENNA 5

CHANNEL 142



CHANNEL 142 ANTENNA 6



CHANNEL 142 ANTENNA 5

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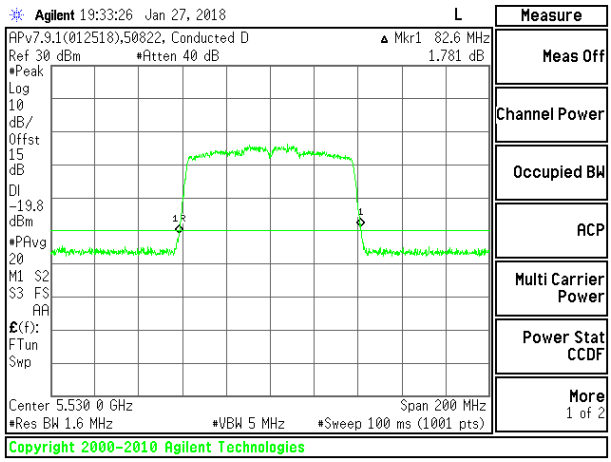
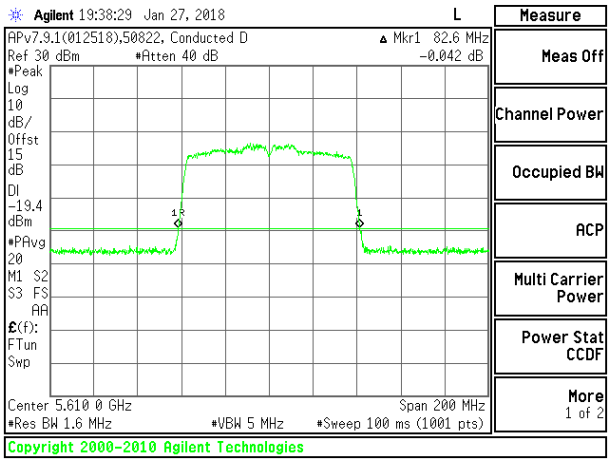
8.2.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

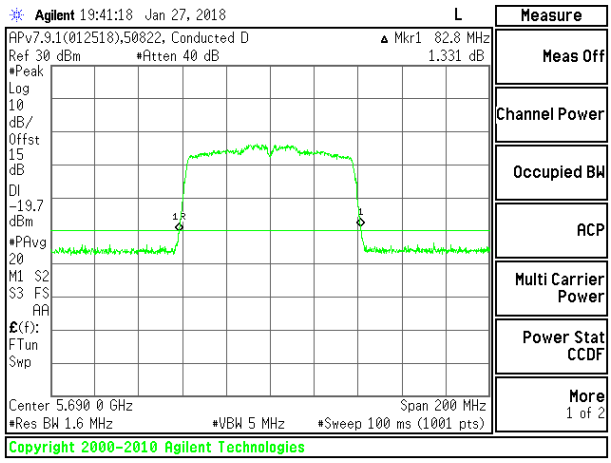
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5530	82.60
High	5610	82.60
138	5690	82.80



LOW CHANNEL



HIGH CHANNEL



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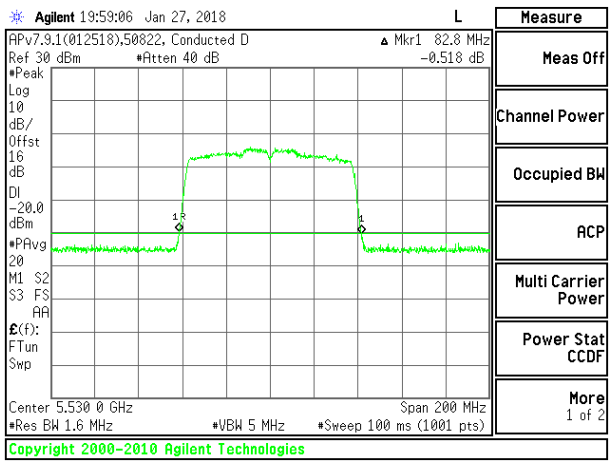
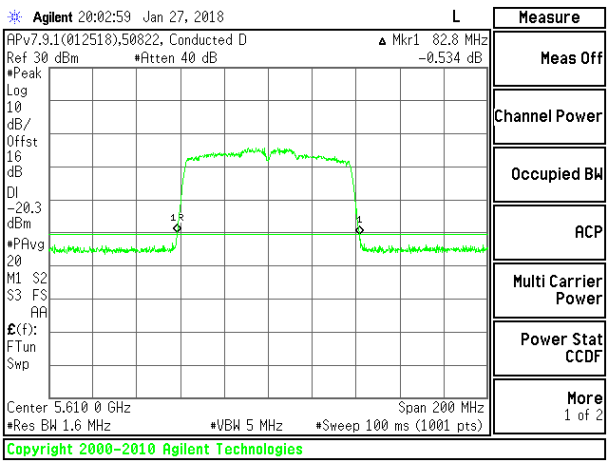
1TX Antenna 5 MODE

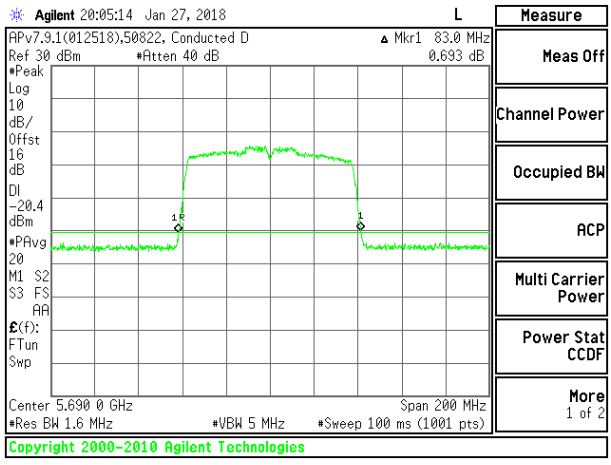
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5530	82.80
High	5610	82.80
138	5690	83.00



LOW CHANNEL



HIGH CHANNEL



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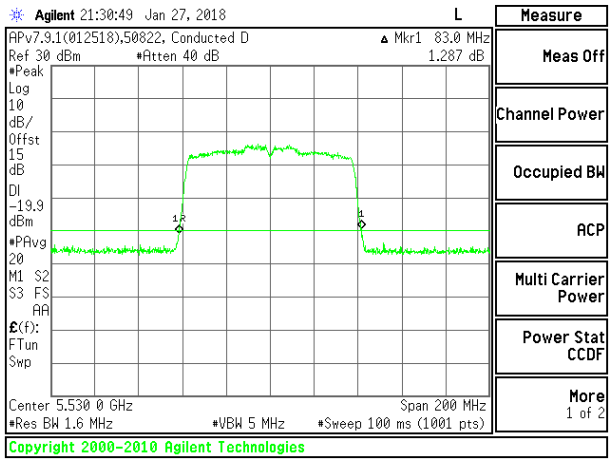
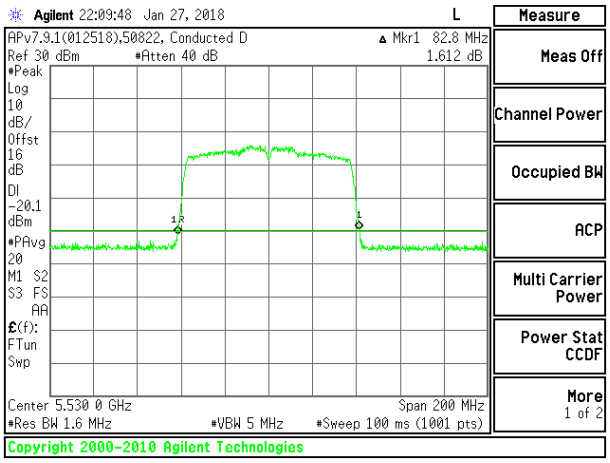
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5530	83.00	82.80
High	5610	83.20	82.60
138	5690	83.20	82.00

LOW CHANNEL

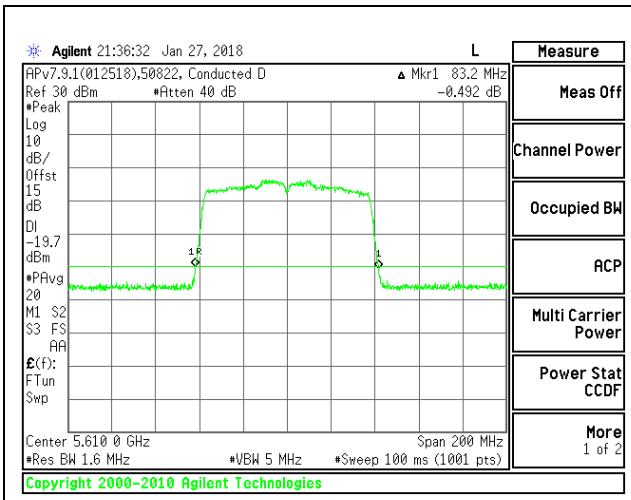


LOW CHANNEL ANTENNA 6

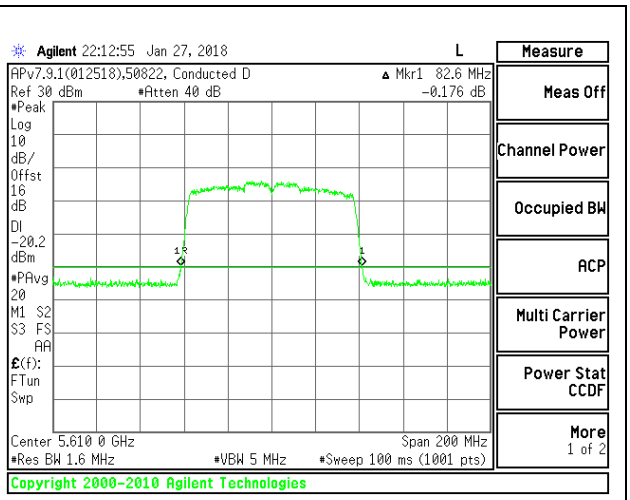


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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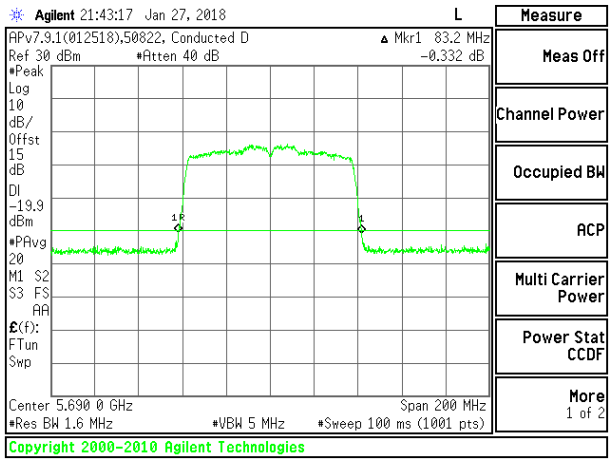
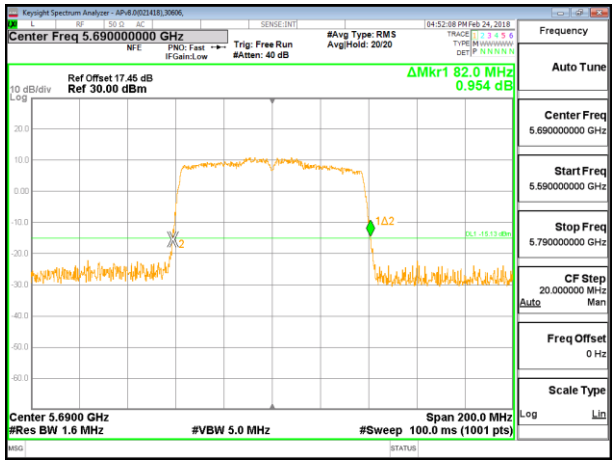


CHANNEL 138 ANTENNA 6



CHANNEL 138 ANTENNA 5

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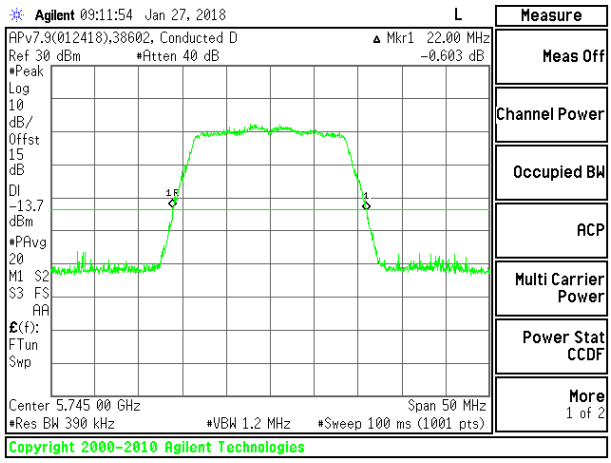
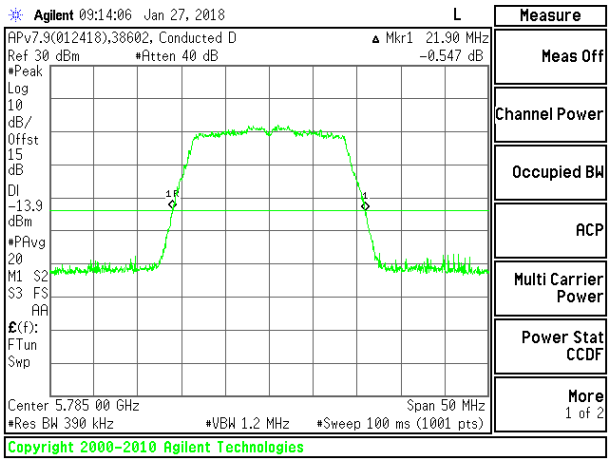
8.2.10. 802.11n HT20 MODE IN THE 5.8 GHz BAND

1TX Antenna 6 MODE

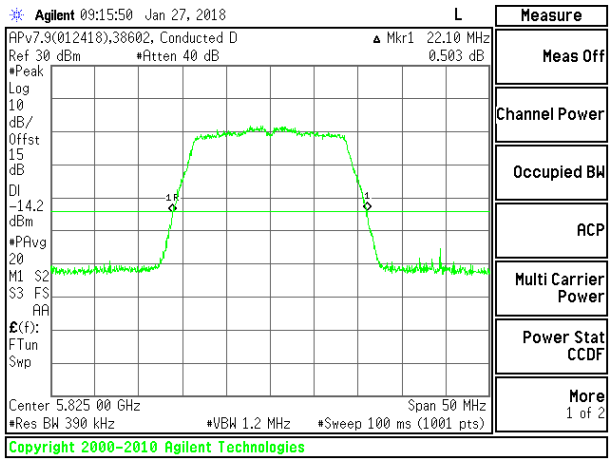
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5745	22.00
Mid	5785	21.90
High	5825	22.10



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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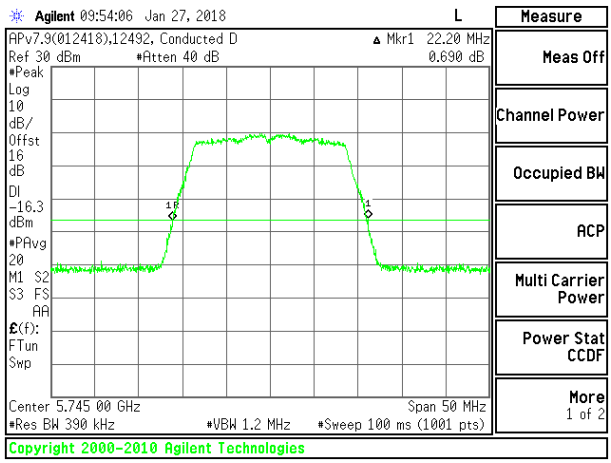
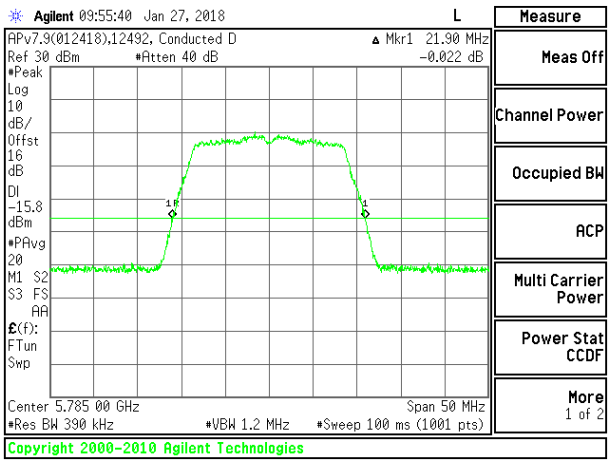
1TX Antenna 5 MODE

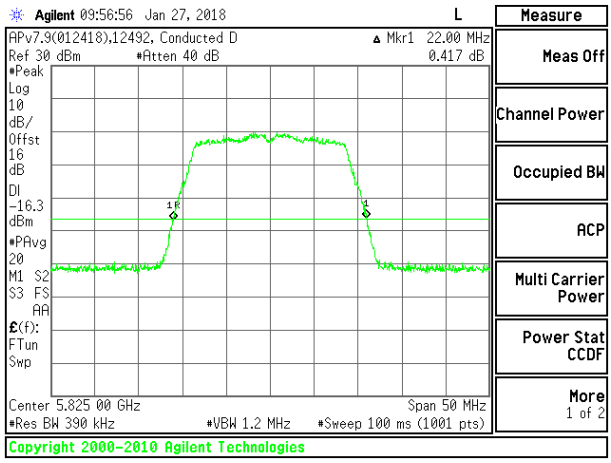
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5745	22.20
Mid	5785	21.90
High	5825	22.00



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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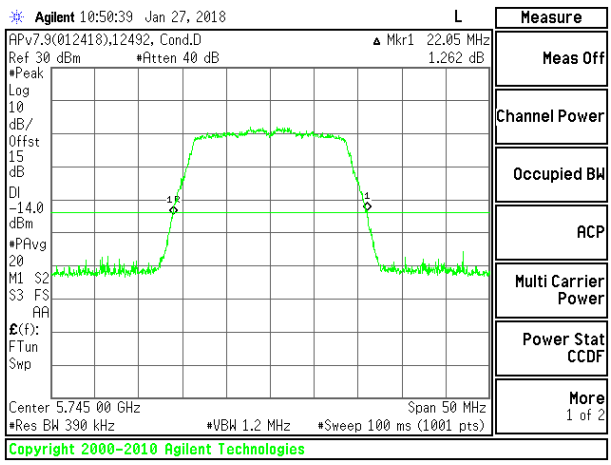
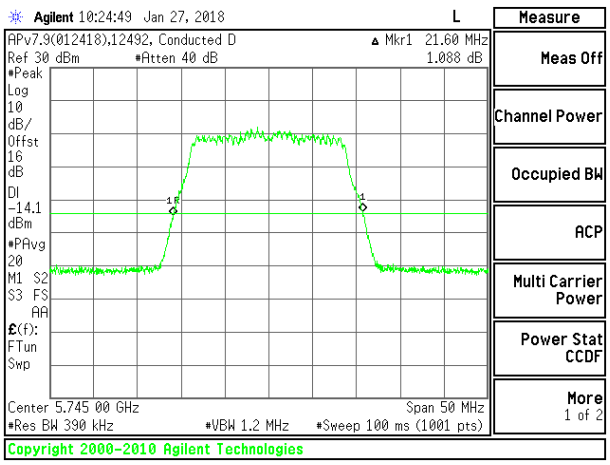
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5745	22.05	21.60
Mid	5785	22.00	21.70
High	5825	21.90	21.55

LOW CHANNEL

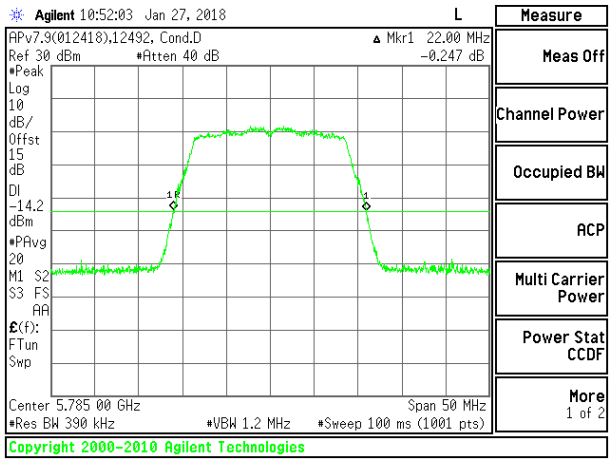


LOW CHANNEL ANTENNA 6

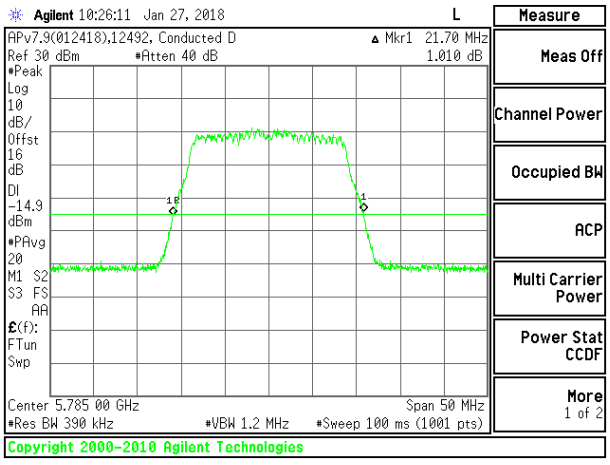


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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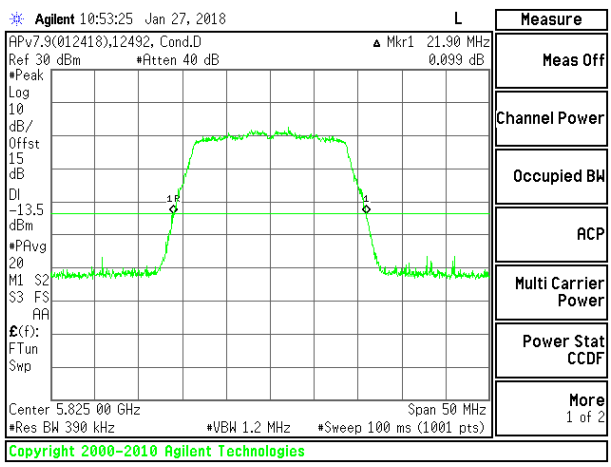
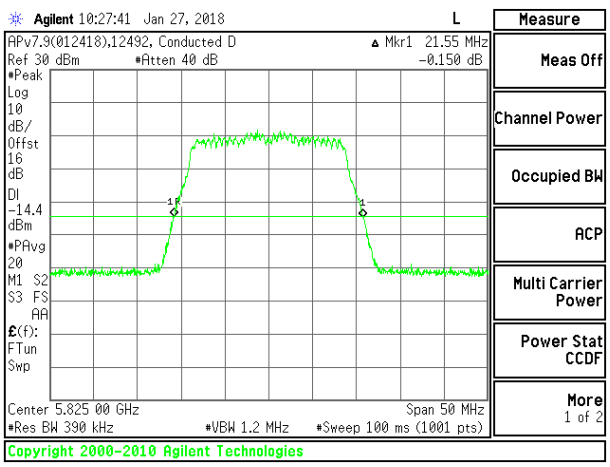
HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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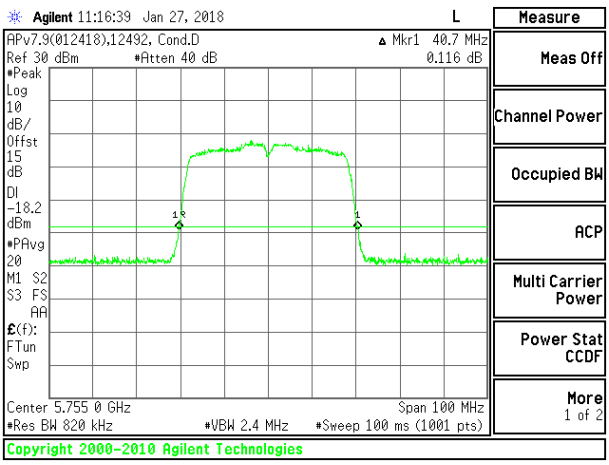
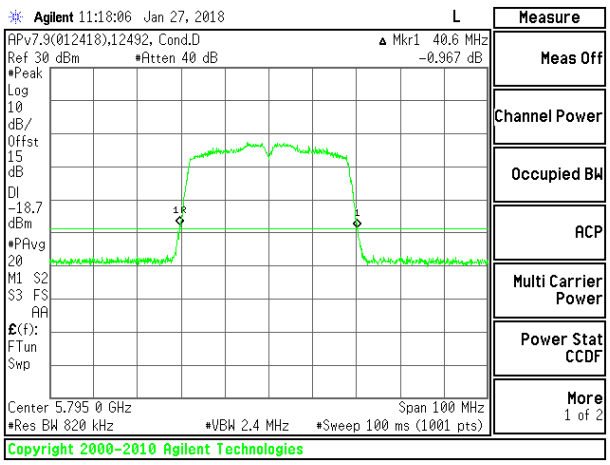
8.2.11. 802.11n HT40 MODE IN THE 5.8 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5755	40.70
High	5795	40.60



LOW CHANNEL



HIGH CHANNEL

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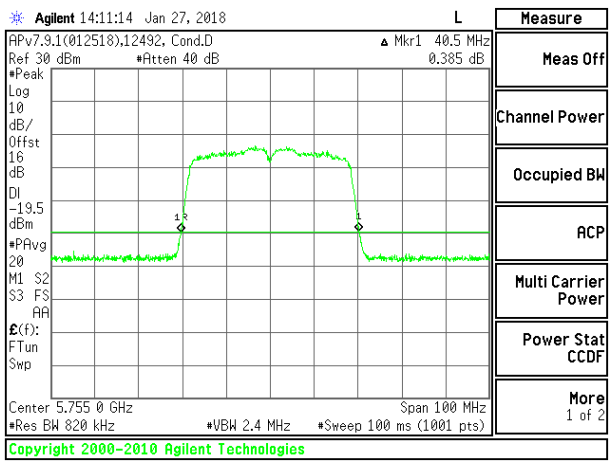
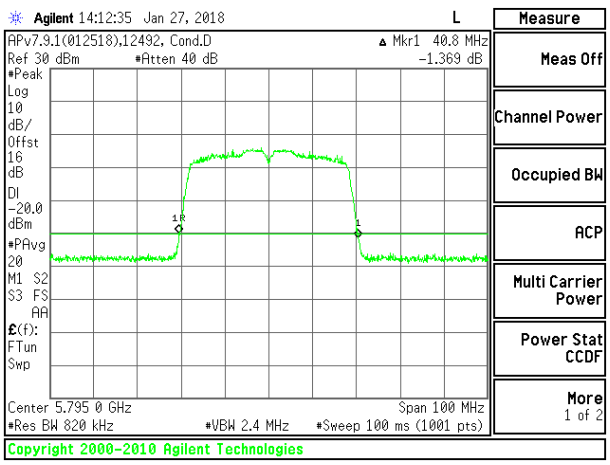
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5755	40.50
High	5795	40.80



LOW CHANNEL



HIGH CHANNEL

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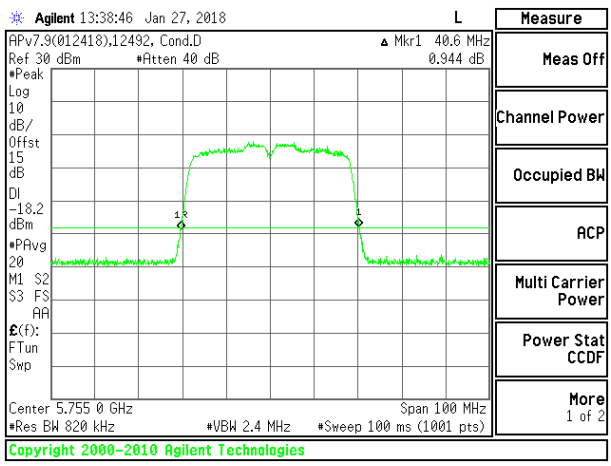
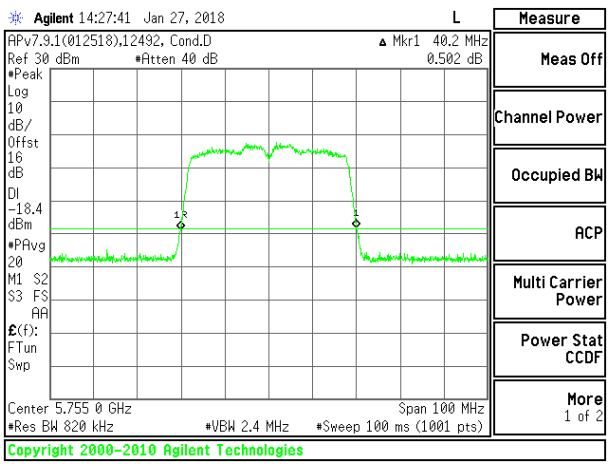
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Low	5755	40.60	40.20
High	5795	40.50	40.20

LOW CHANNEL

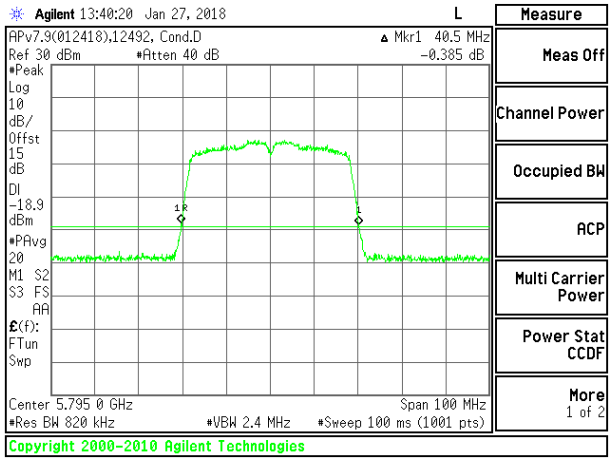


LOW CHANNEL ANTENNA 6

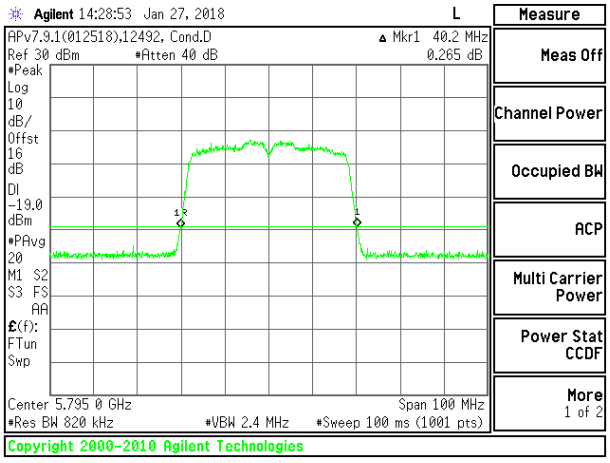


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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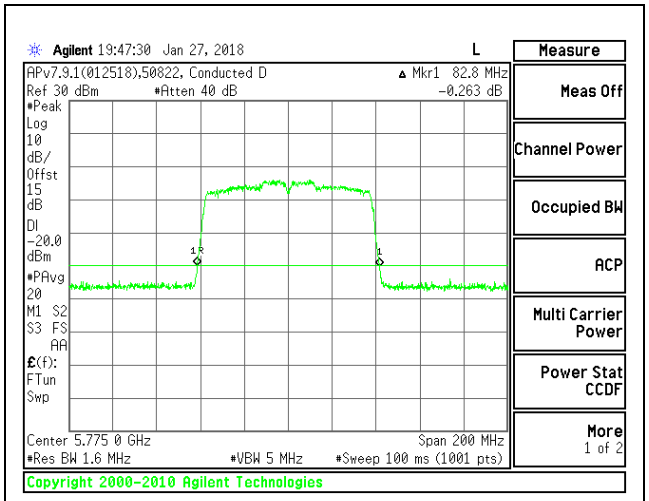
8.2.12. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5775	82.80



MID CHANNEL

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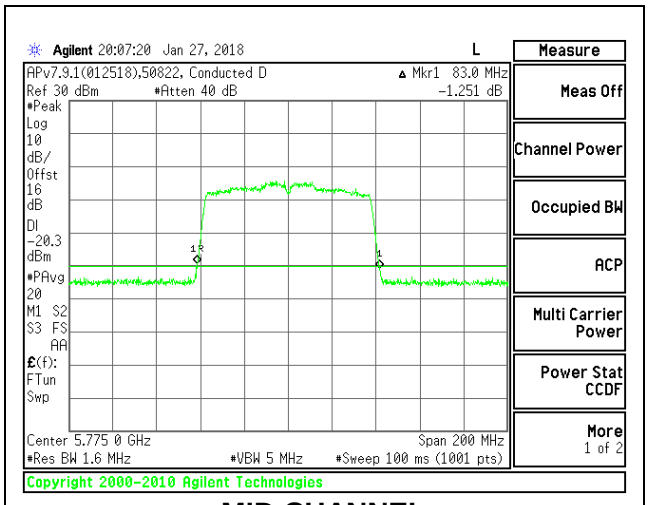
1TX Antenna 5 MODE

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5775	83.00



MID CHANNEL

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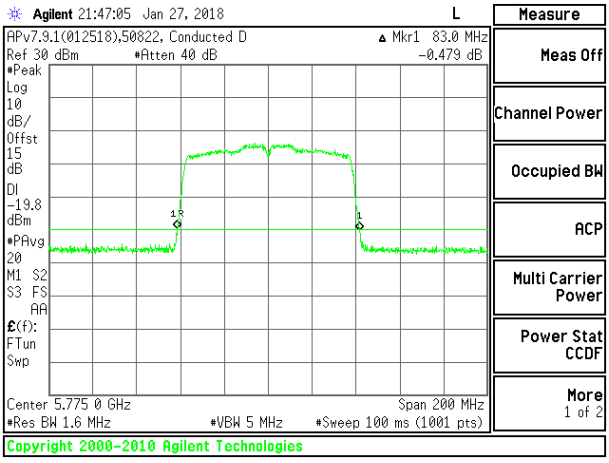
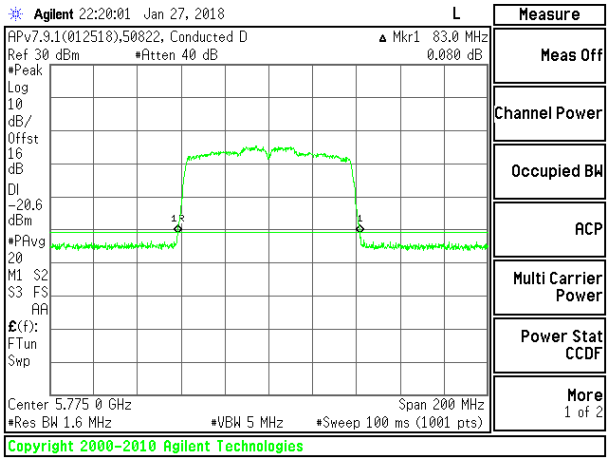
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 6 (MHz)	26 dB Bandwidth Antenna 5 (MHz)
Mid	5775	83.00	83.00

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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8.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

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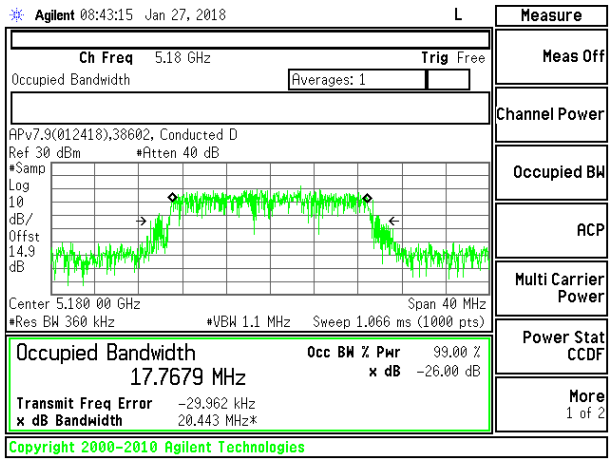
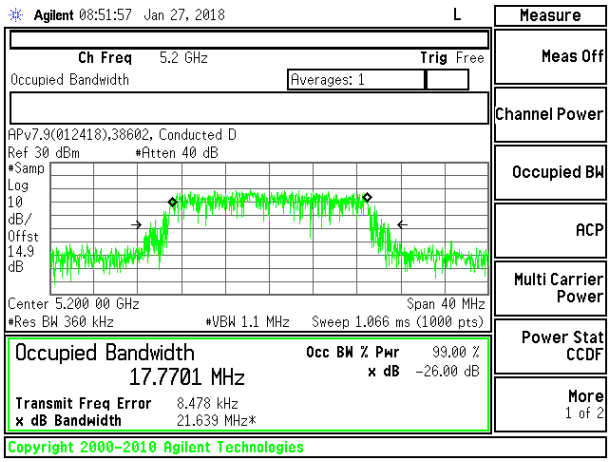
8.3.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

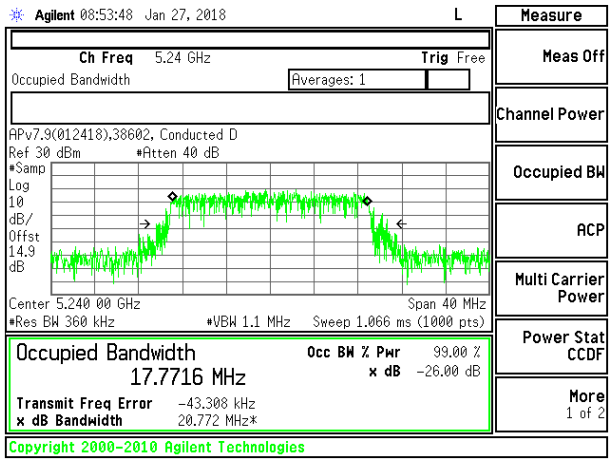
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.7680
Mid	5200	17.7700
High	5240	17.7720



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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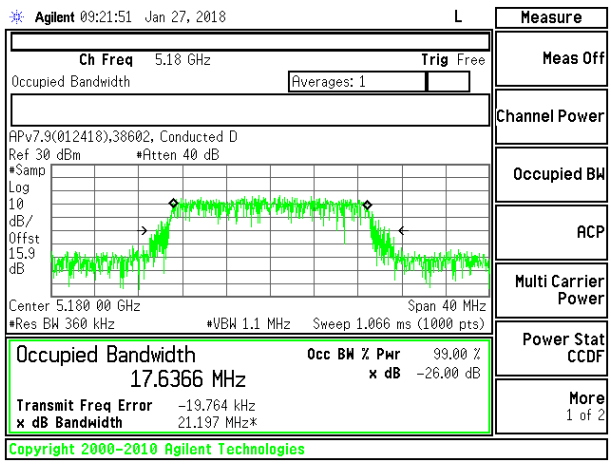
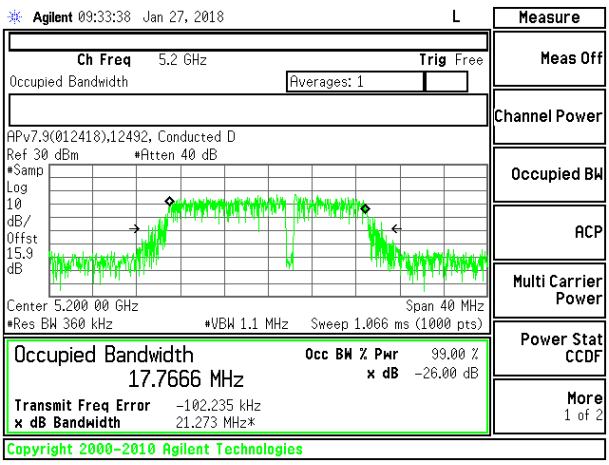
1TX Antenna 5 MODE

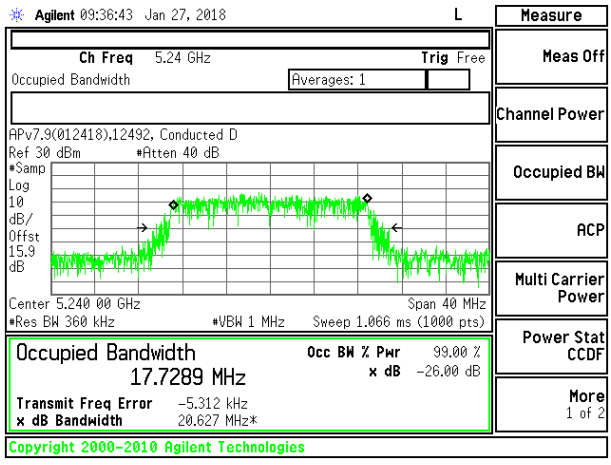
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.6370
Mid	5200	17.7670
High	5240	17.7290



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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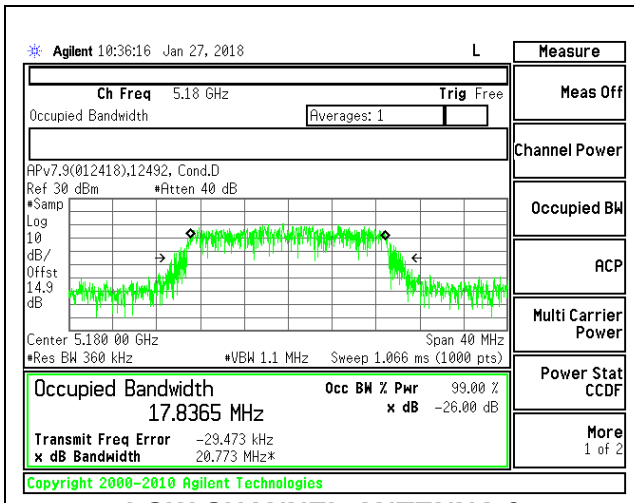
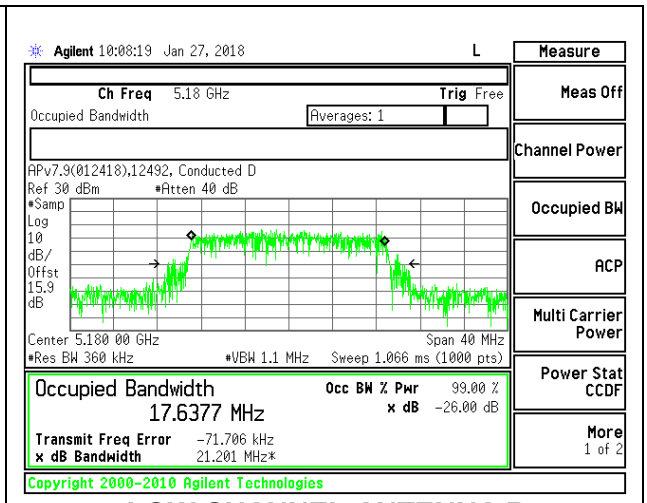
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5180	17.8370	17.6380
Mid	5200	17.6570	17.7100
High	5240	17.6860	17.6720

LOW CHANNEL

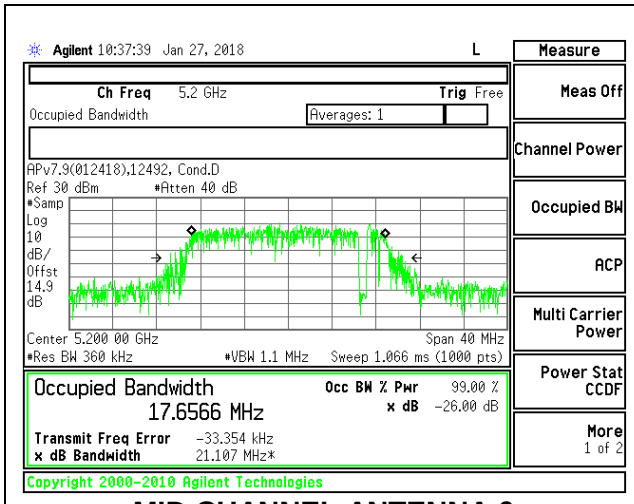


LOW CHANNEL ANTENNA 6

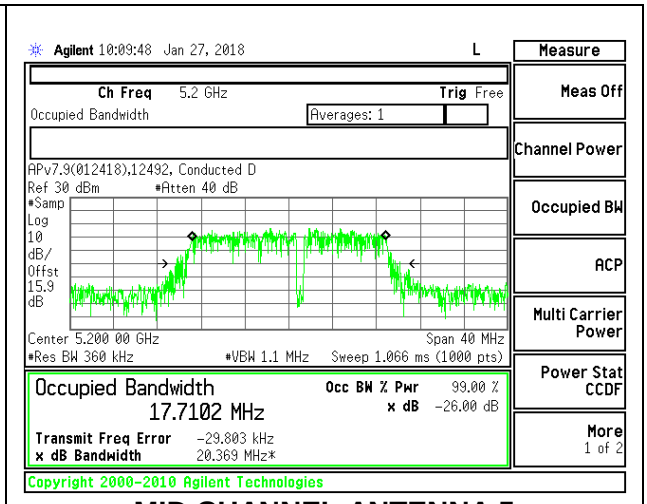


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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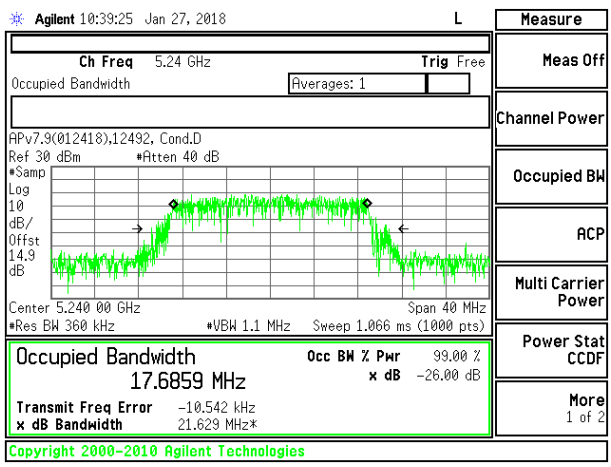
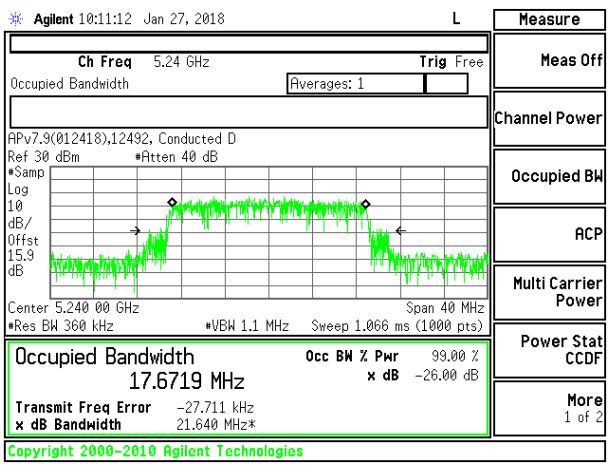
HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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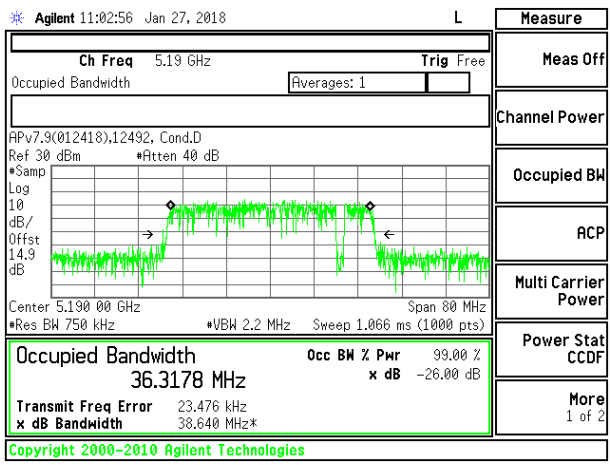
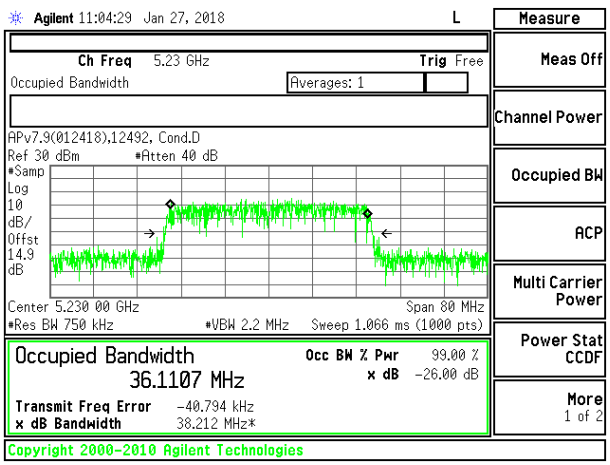
8.3.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	36.318
High	5230	36.111



LOW CHANNEL



HIGH CHANNEL

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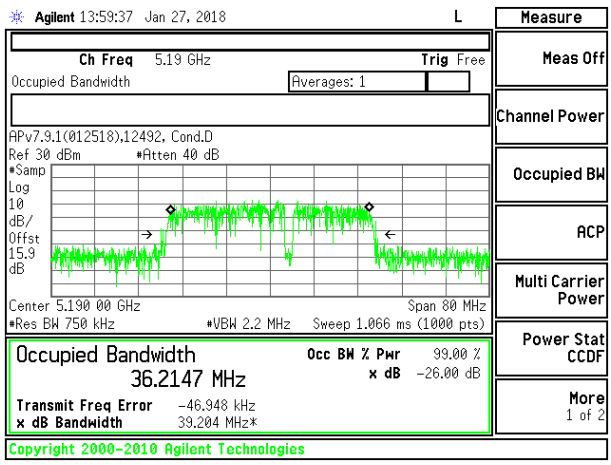
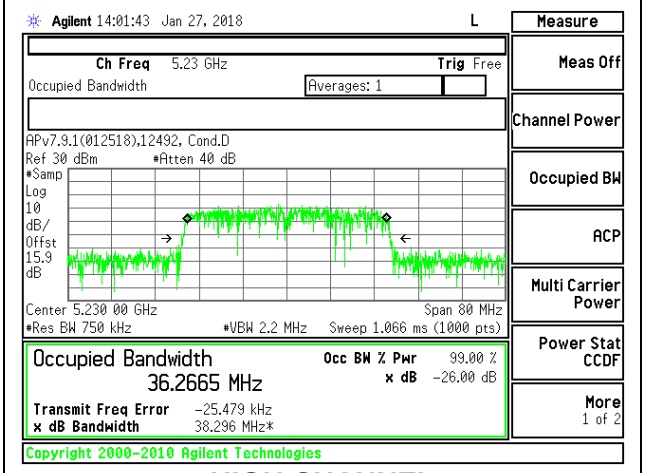
1TX Antenna 5 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	36.215
High	5230	36.266



LOW CHANNEL



HIGH CHANNEL

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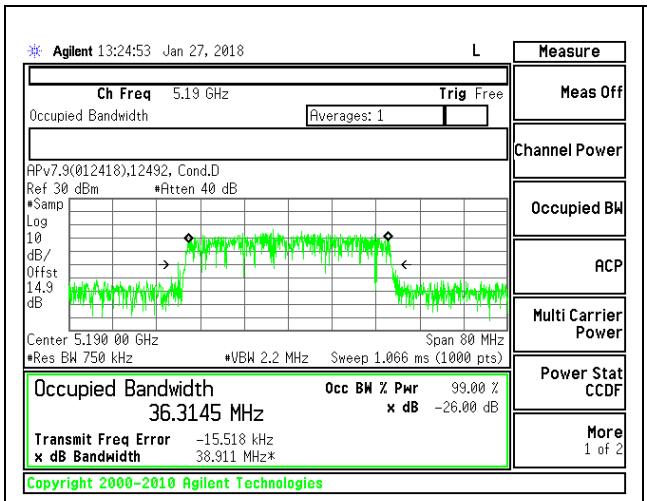
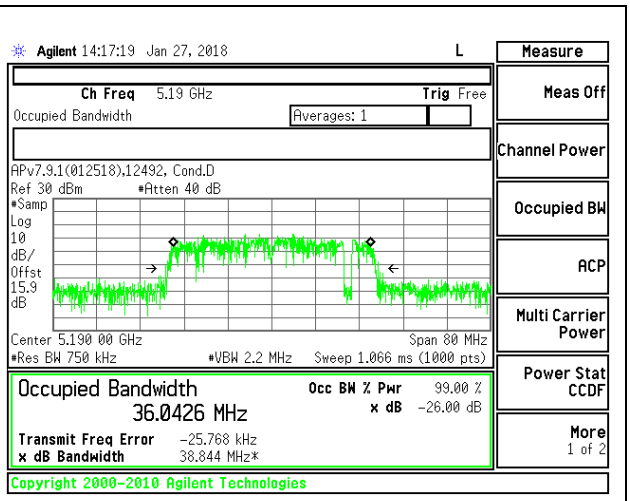
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5190	36.315	36.043
High	5230	36.269	36.021

LOW CHANNEL

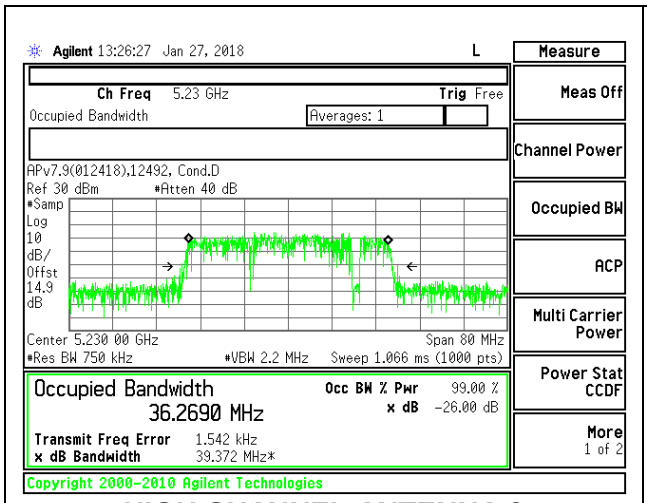


LOW CHANNEL ANTENNA 6

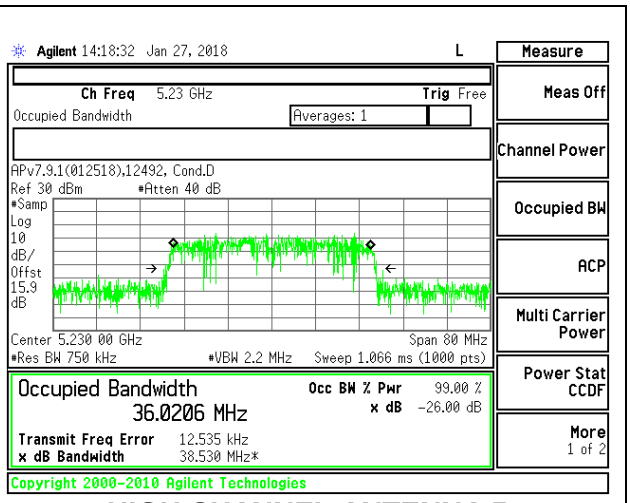


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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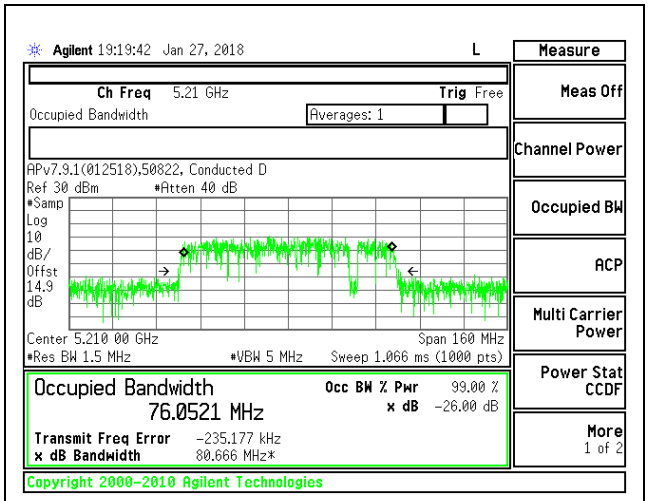
8.3.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5210	76.052



MID CHANNEL

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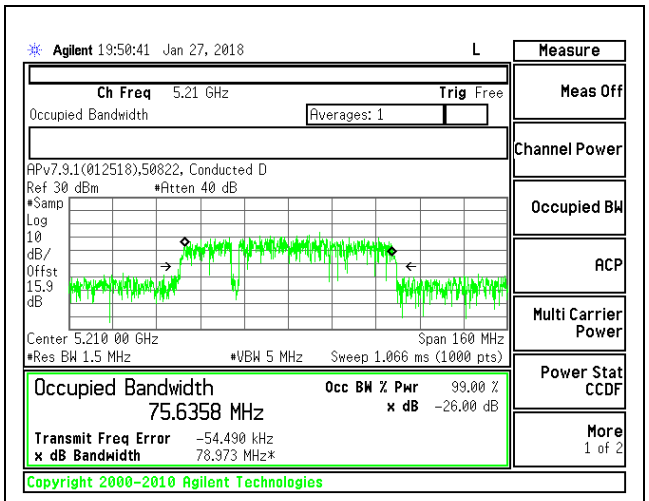
1TX Antenna 5 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5210	75.636



MID CHANNEL

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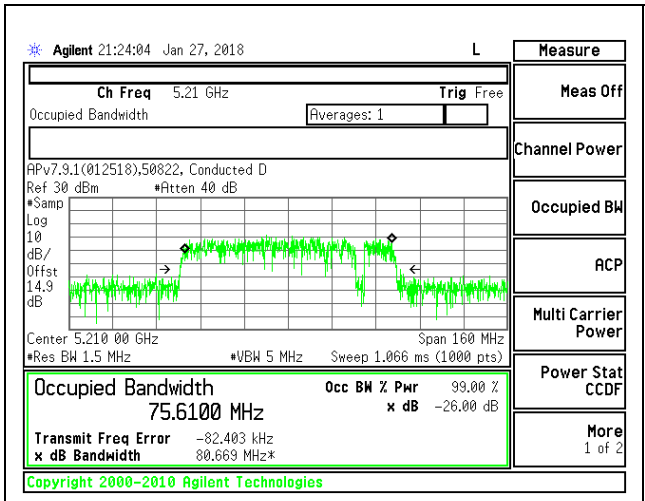
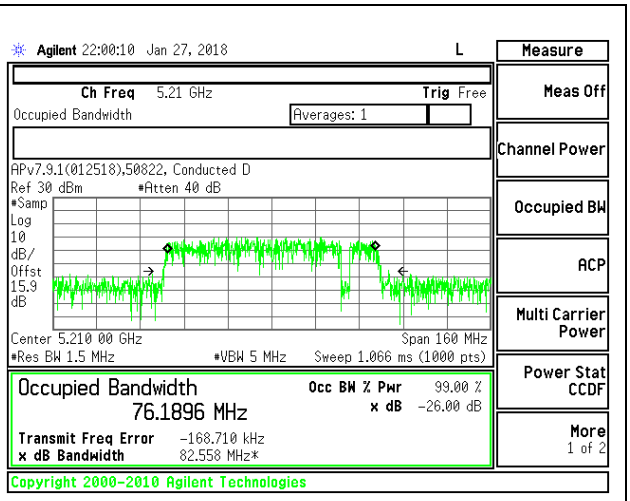
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Mid	5210	75.610	76.190

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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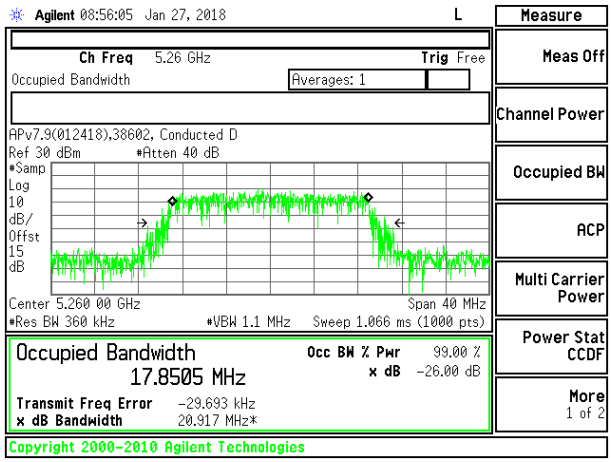
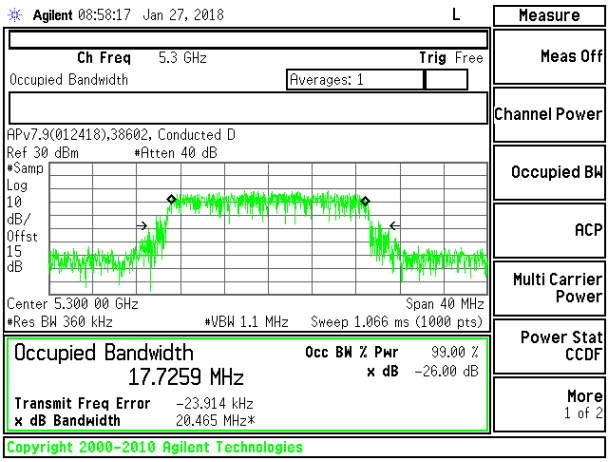
8.3.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

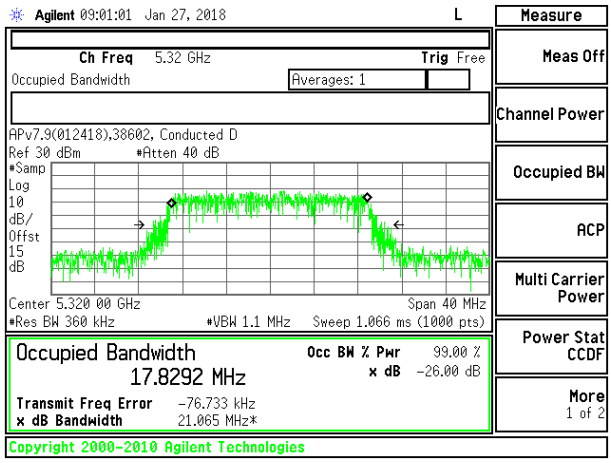
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.851
Mid	5300	17.726
High	5320	17.829



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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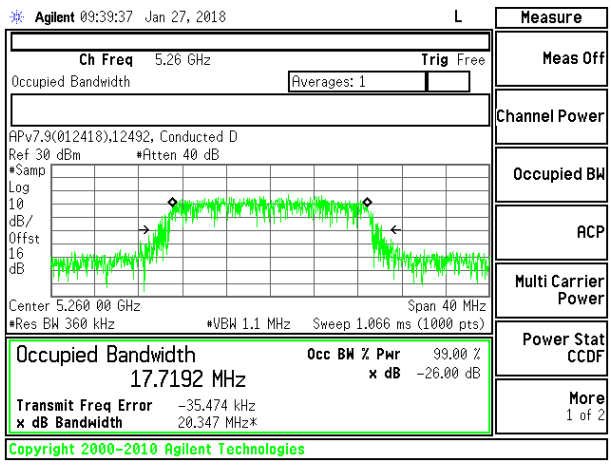
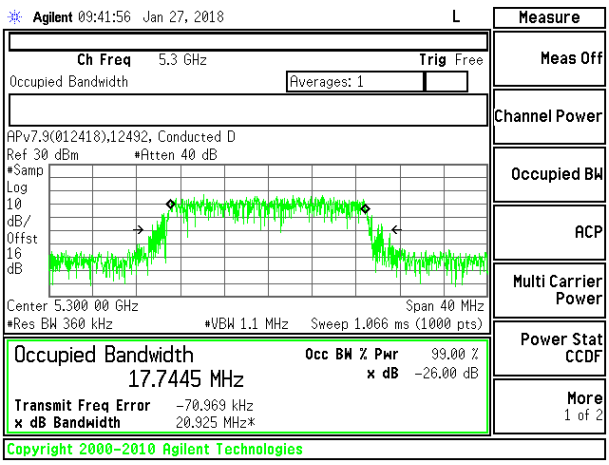
1TX Antenna 5 MODE

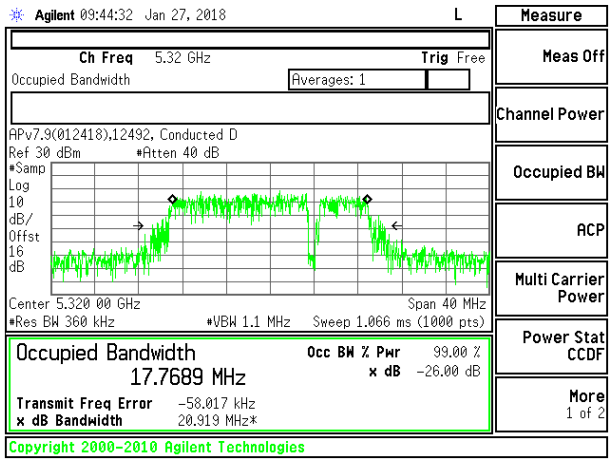
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.719
Mid	5300	17.745
High	5320	17.769



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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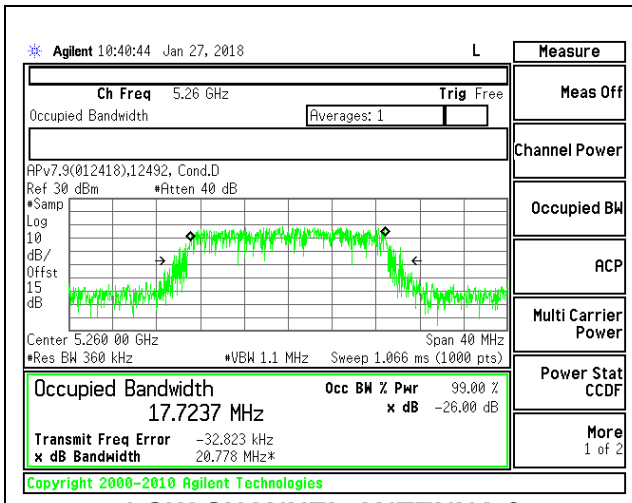
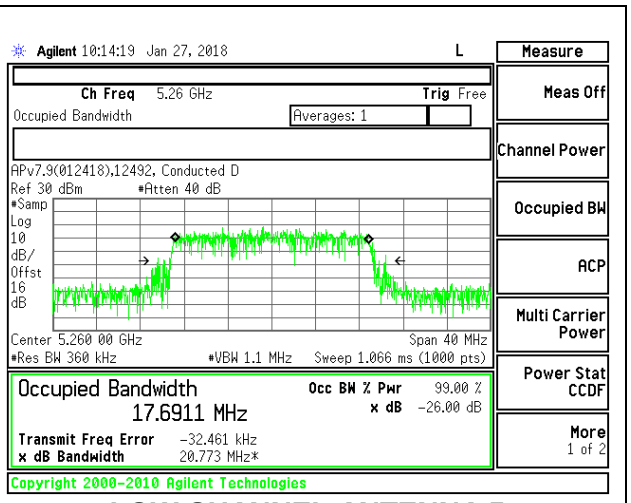
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5260	17.724	17.691
Mid	5300	17.755	17.808
High	5320	17.877	17.861

LOW CHANNEL

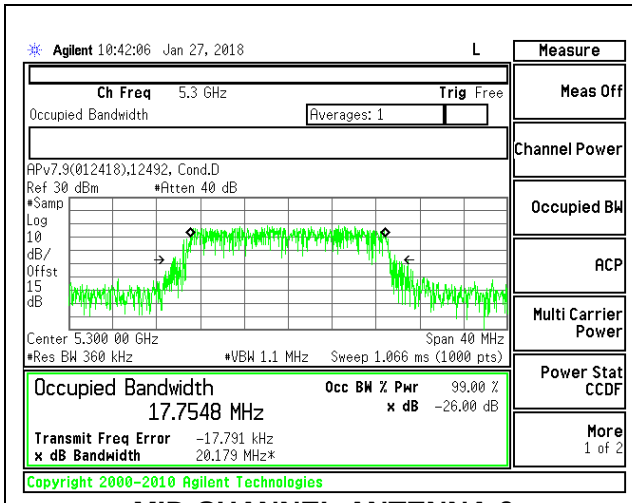


LOW CHANNEL ANTENNA 6

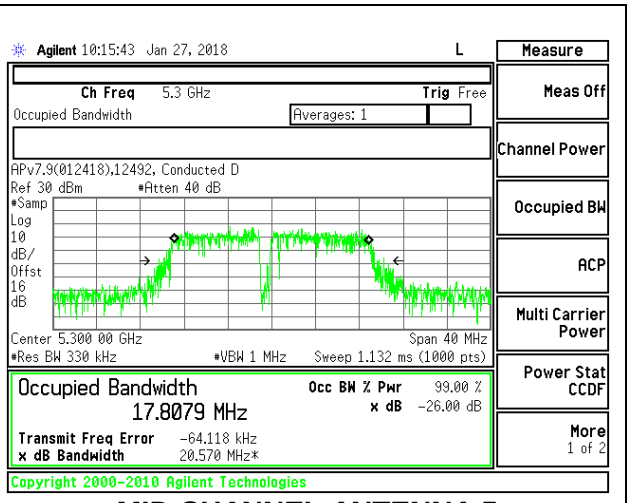


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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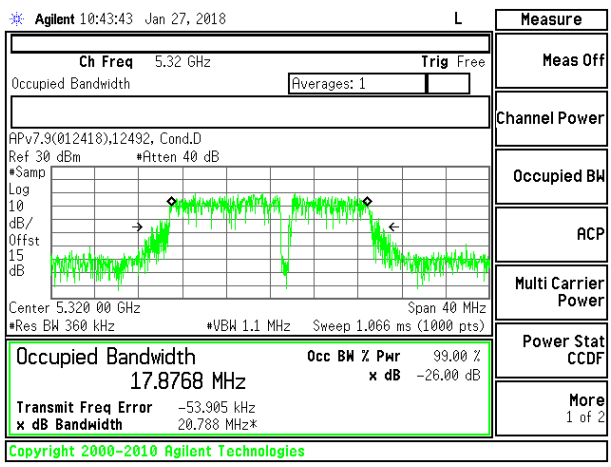
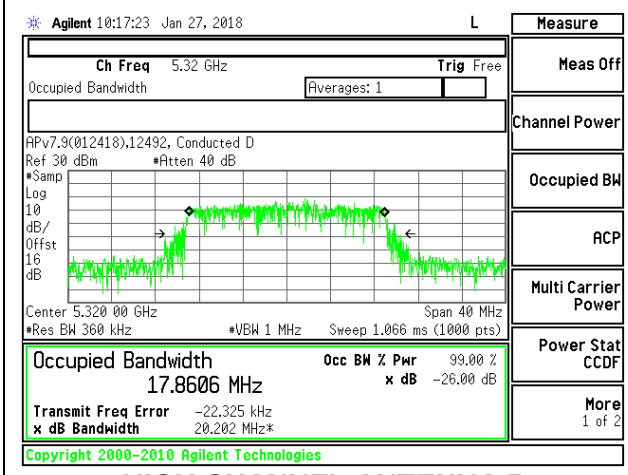
HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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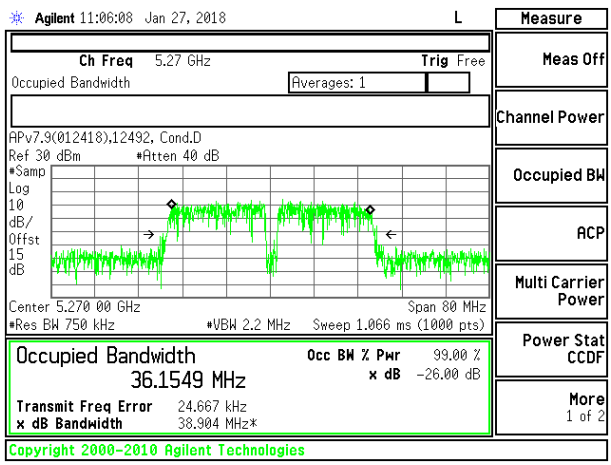
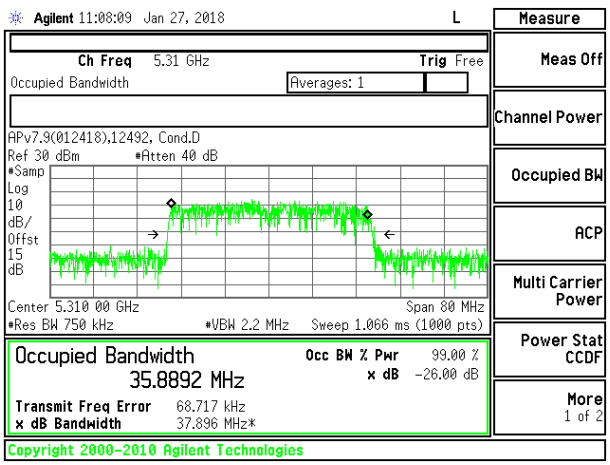
8.3.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5270	36.155
High	5310	35.889



LOW CHANNEL



HIGH CHANNEL

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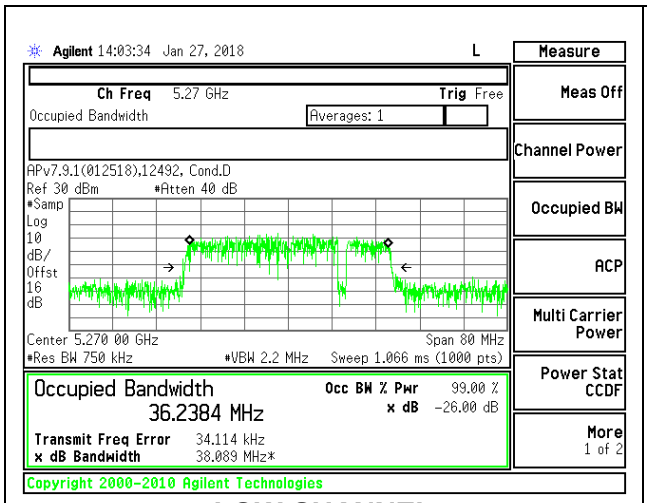
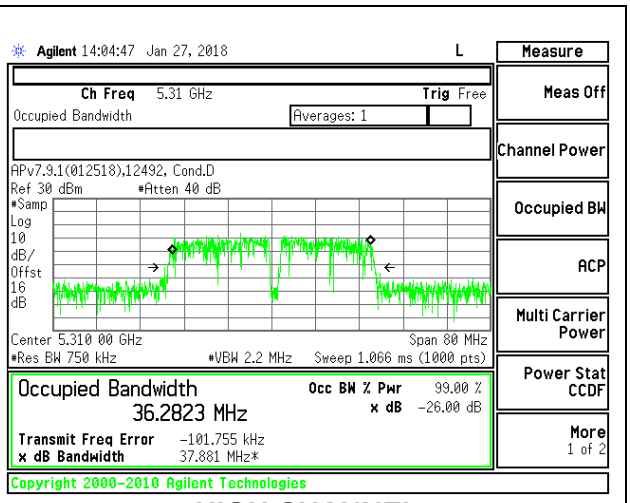
1TX Antenna 5 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5270	36.238
High	5310	36.282



LOW CHANNEL



HIGH CHANNEL

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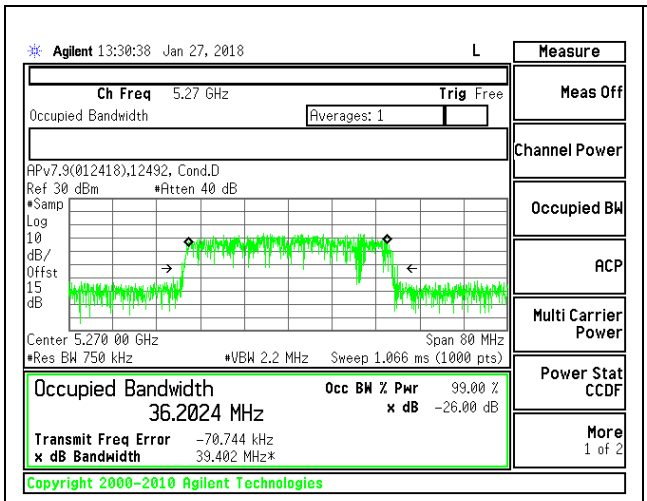
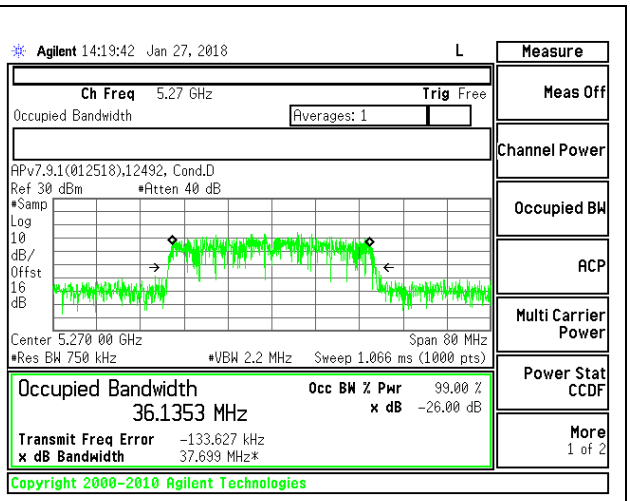
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5270	36.202	36.135
High	5310	36.300	36.136

LOW CHANNEL

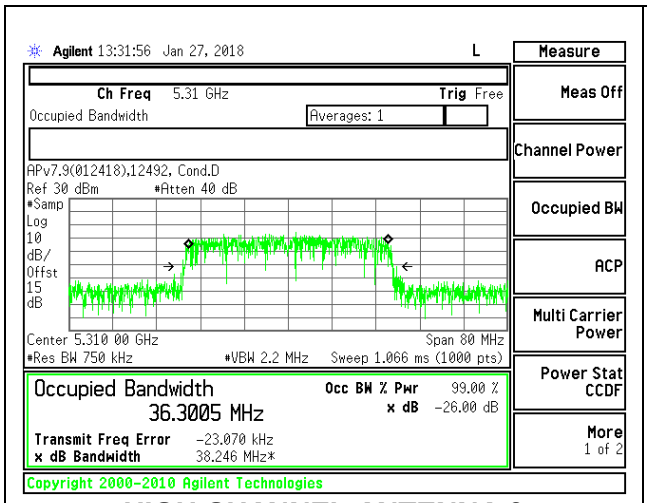


LOW CHANNEL ANTENNA 6

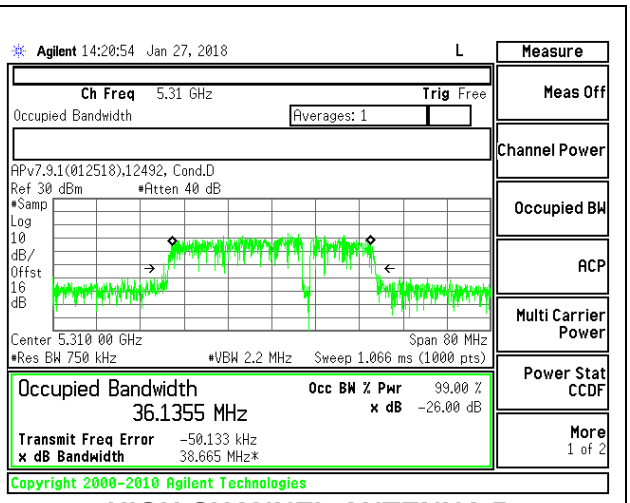


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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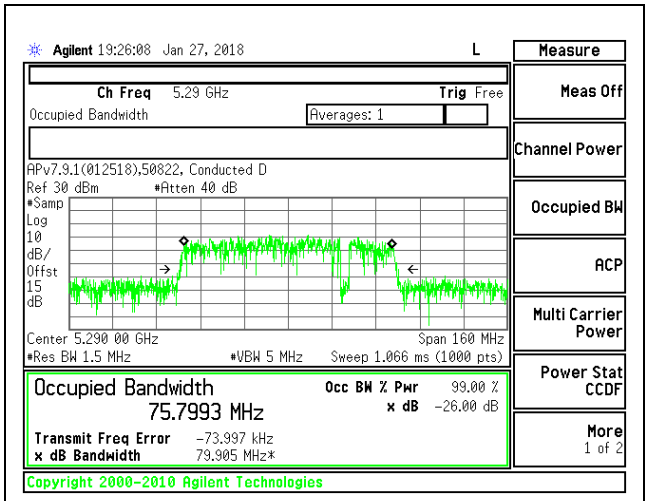
8.3.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

1TX Antenna 6 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5290	75.799



MID CHANNEL

UL VERIFICATION SERVICES INC.
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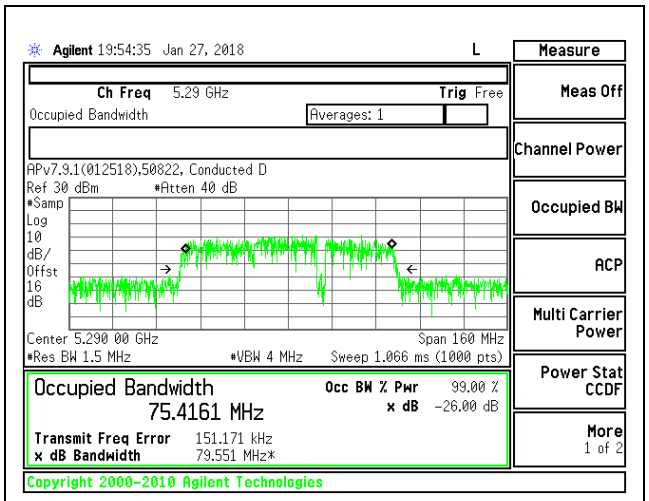
1TX Antenna 5 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5290	75.416



MID CHANNEL

UL VERIFICATION SERVICES INC.
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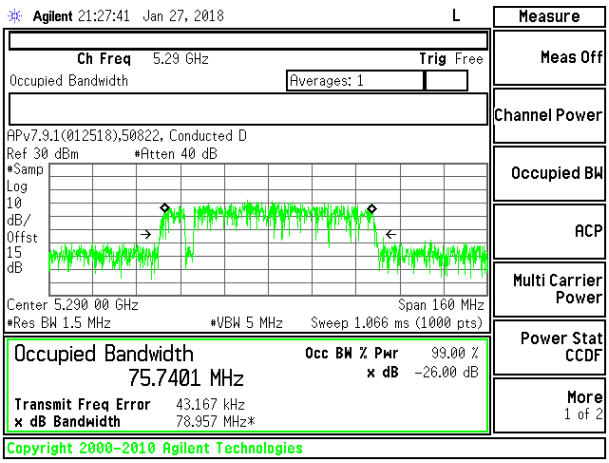
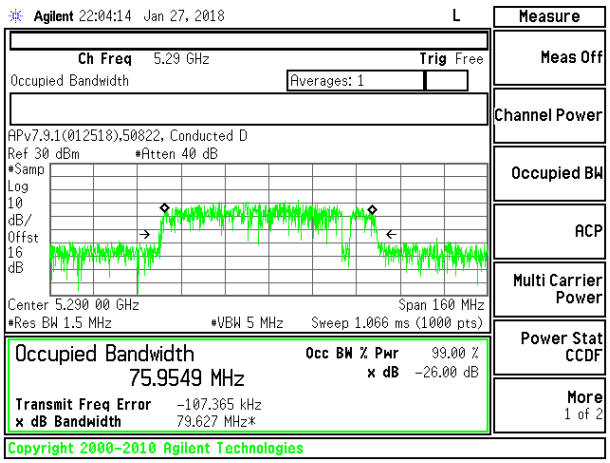
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Mid	5290	75.740	75.955

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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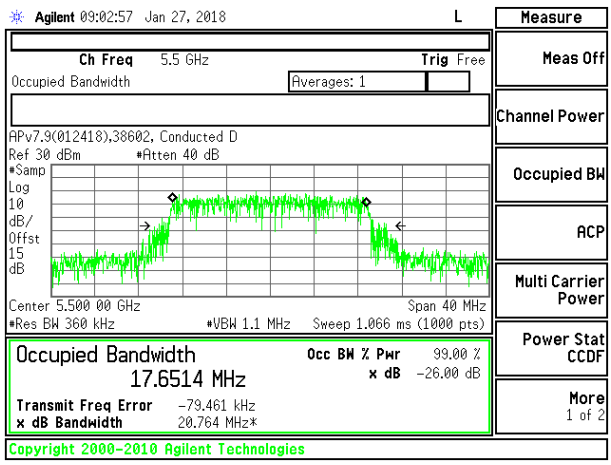
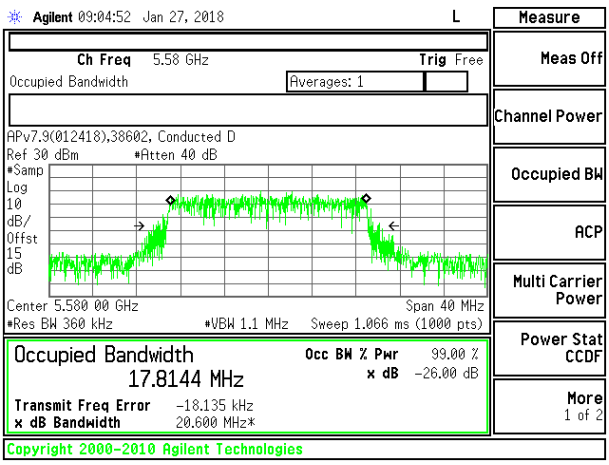
8.3.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

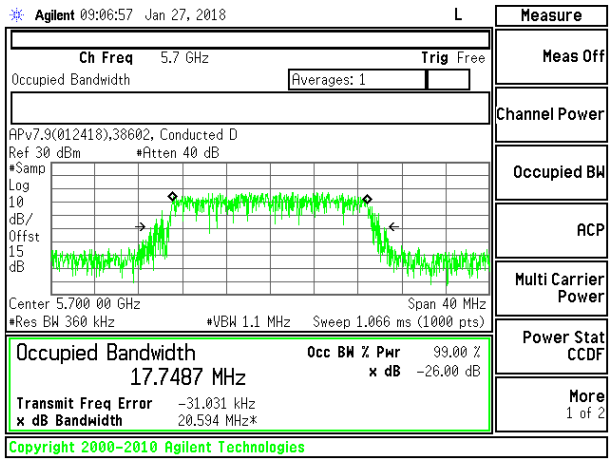
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.651
Mid	5580	17.814
High	5700	17.749
144	5720	17.778



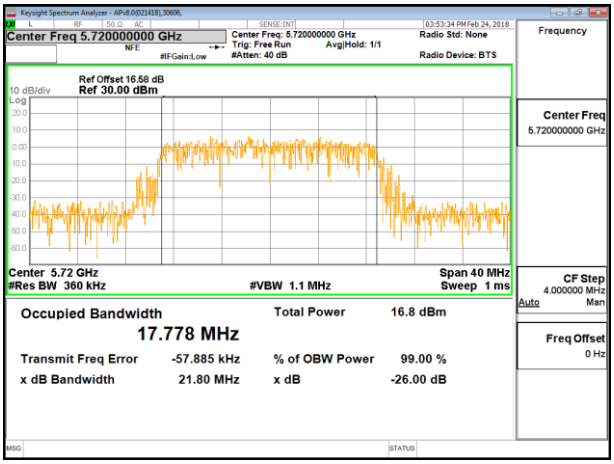
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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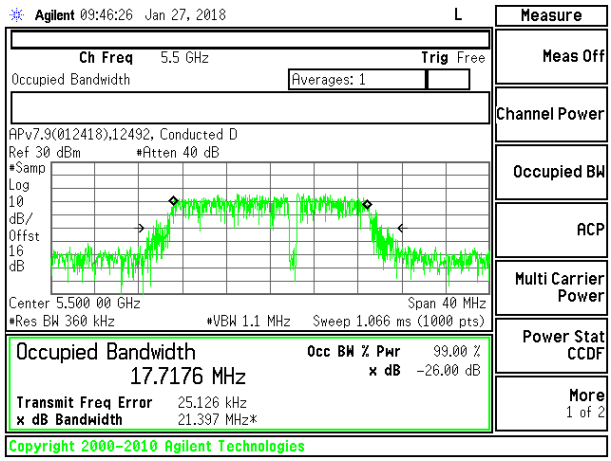
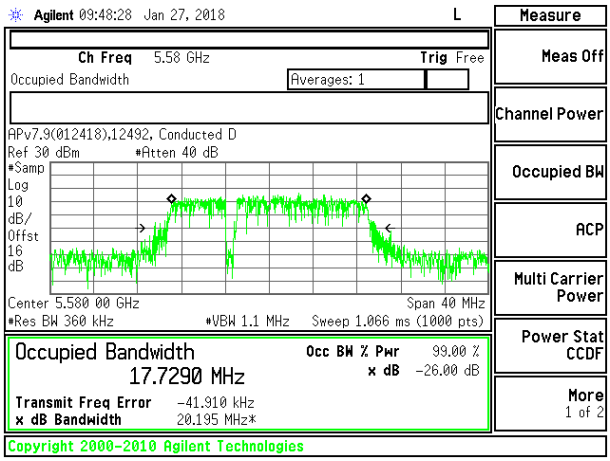
1TX Antenna 5 MODE

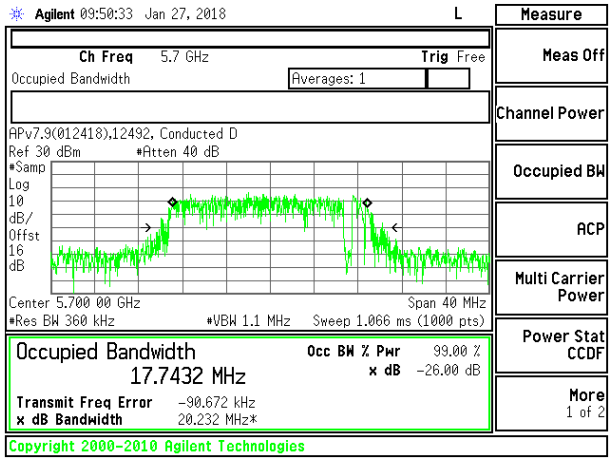
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.718
Mid	5580	17.729
High	5700	17.743
144	5720	17.807



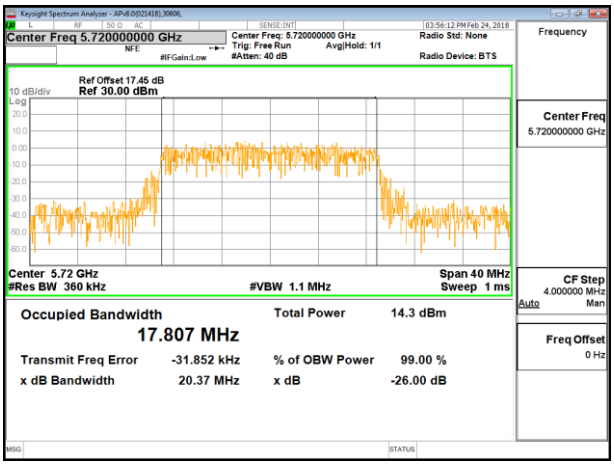
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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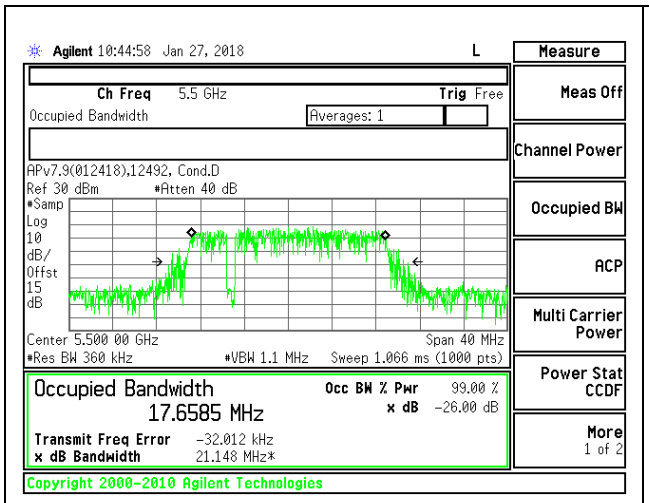
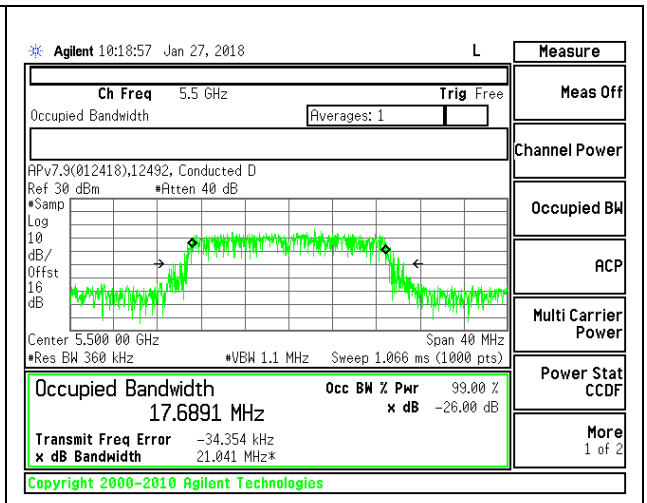
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5500	17.659	17.689
Mid	5580	17.767	17.791
High	5700	17.687	17.717
144	5720	17.733	17.794

LOW CHANNEL

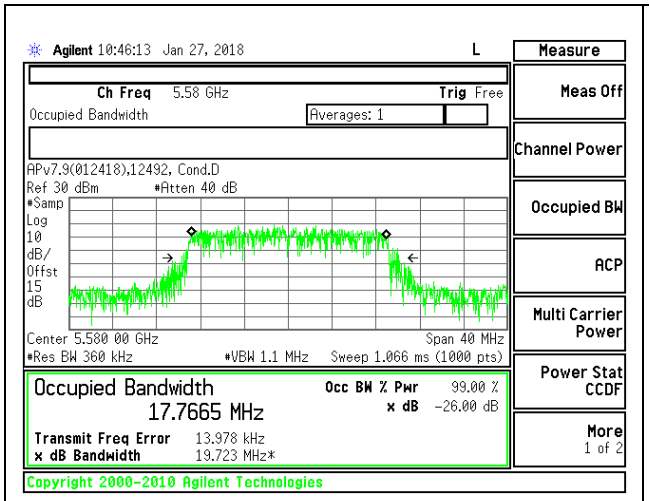


LOW CHANNEL ANTENNA 6

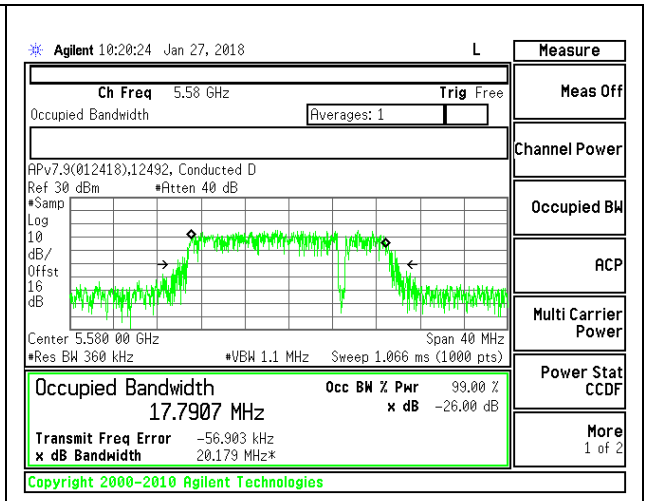


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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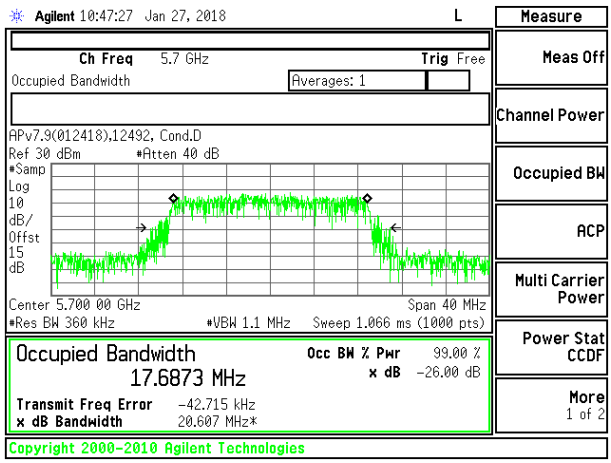
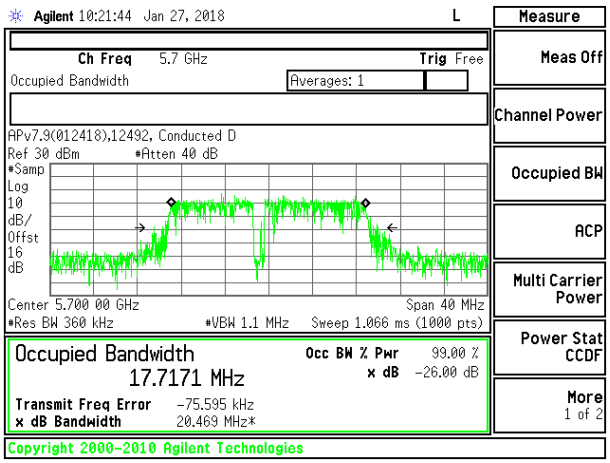
HIGH CHANNEL

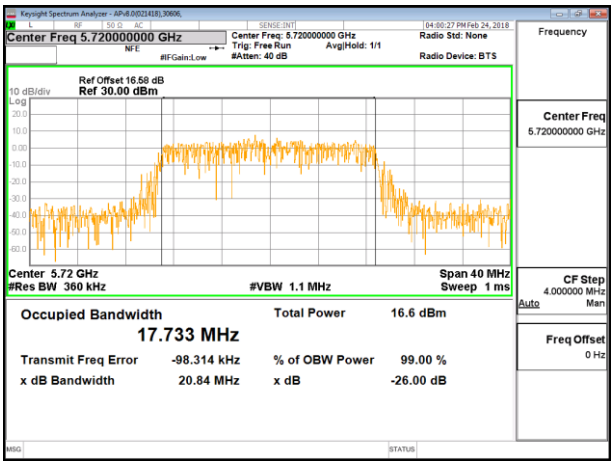


HIGH CHANNEL ANTENNA 6

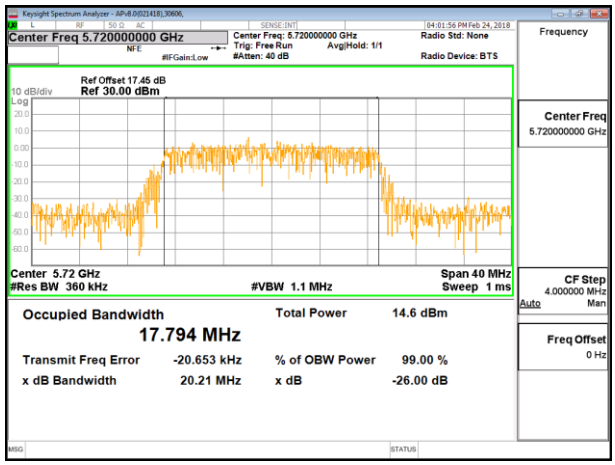


HIGH CHANNEL ANTENNA 5

CHANNEL 144



CHANNEL 144 ANTENNA 6



CHANNEL 144 ANTENNA 5

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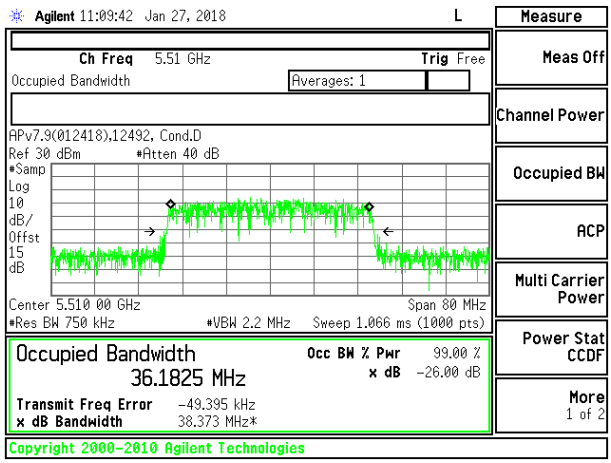
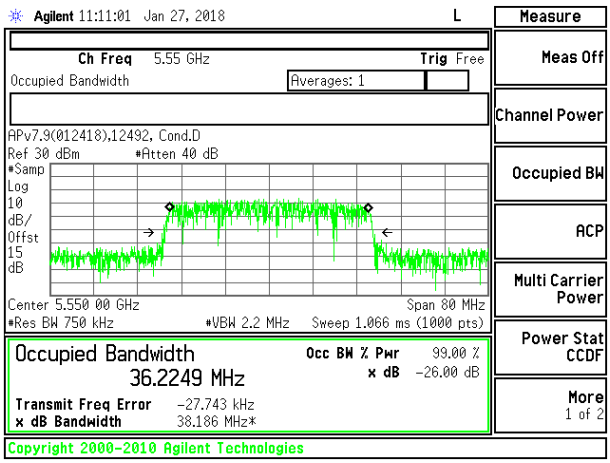
8.3.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

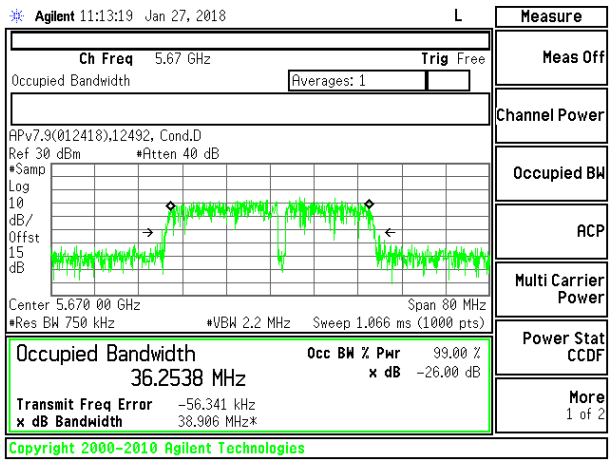
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	36.183
Mid	5550	36.225
High	5670	36.254
142	5710	36.024



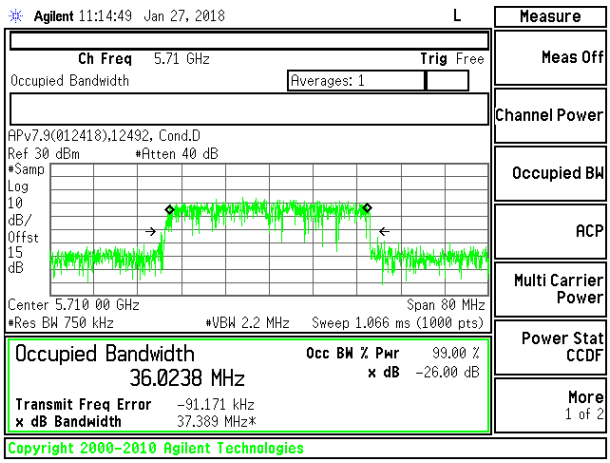
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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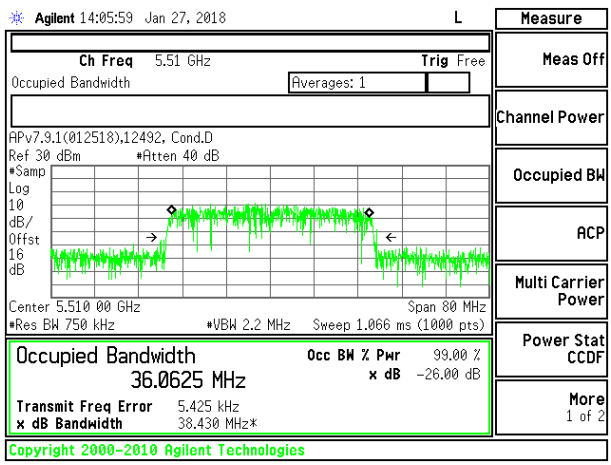
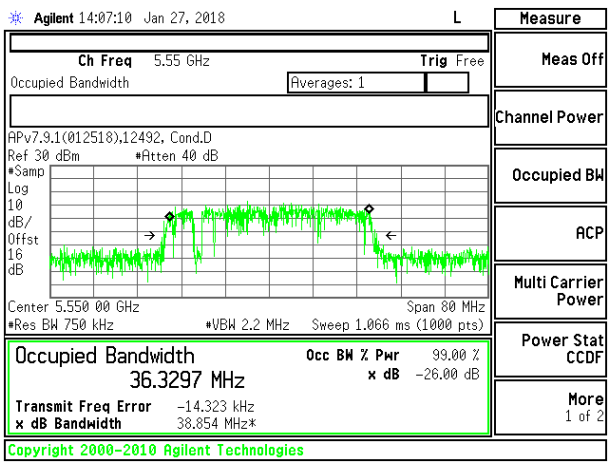
1TX Antenna 5 MODE

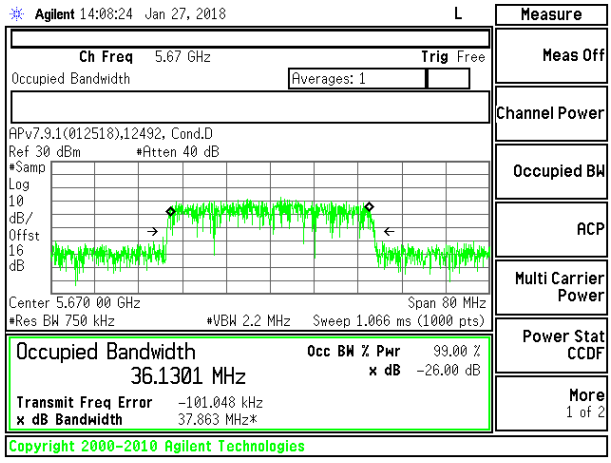
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	36.063
Mid	5550	36.330
High	5670	36.130
142	5710	36.301



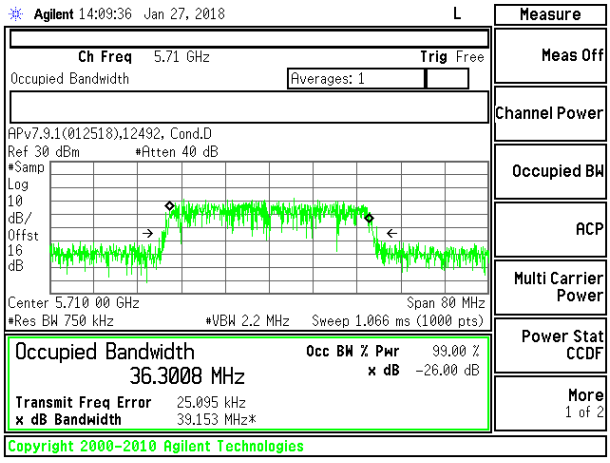
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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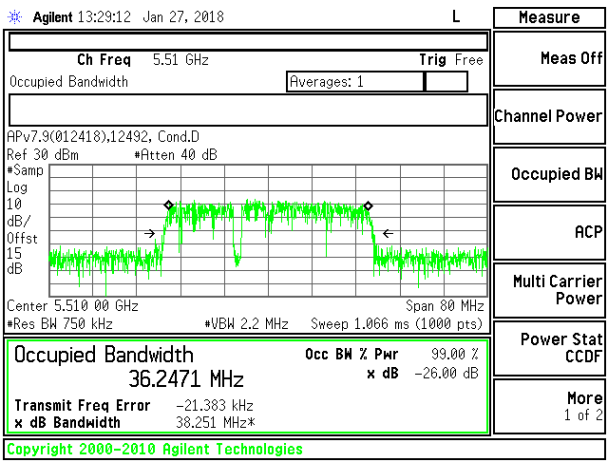
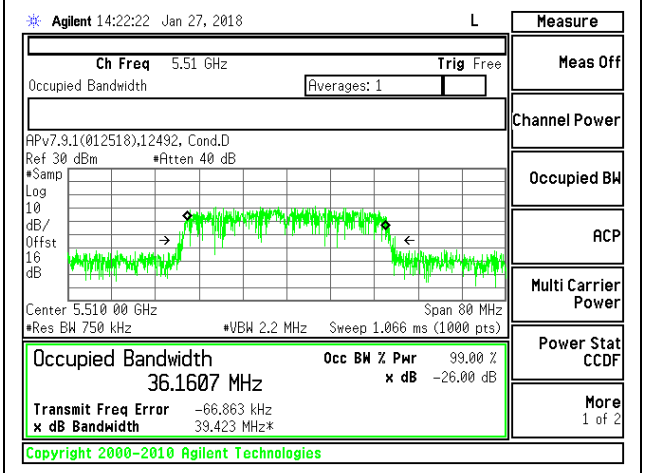
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5510	36.247	36.161
Mid	5550	36.373	36.261
High	5670	36.216	36.372
142	5710	36.271	36.218

LOW CHANNEL

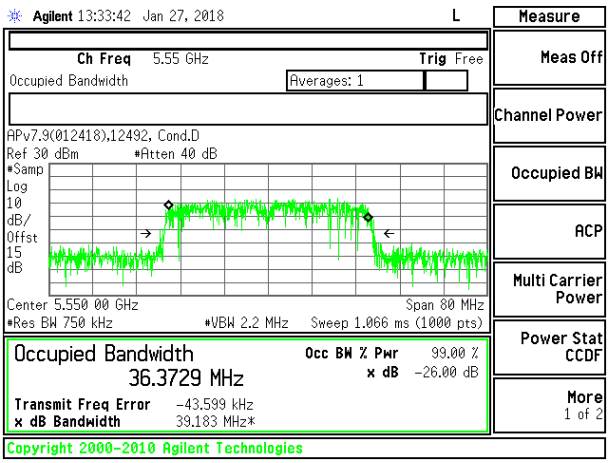


LOW CHANNEL ANTENNA 6

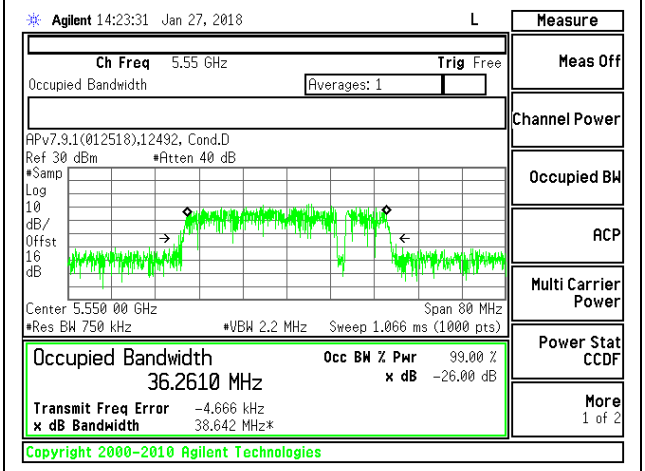


LOW CHANNEL ANTENNA 5

MID CHANNEL



MID CHANNEL ANTENNA 6



MID CHANNEL ANTENNA 5

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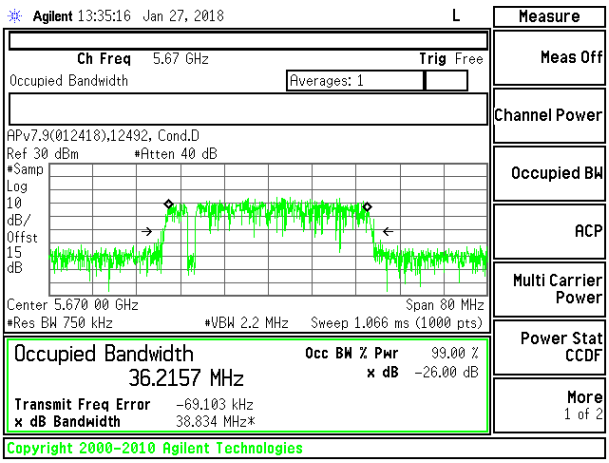
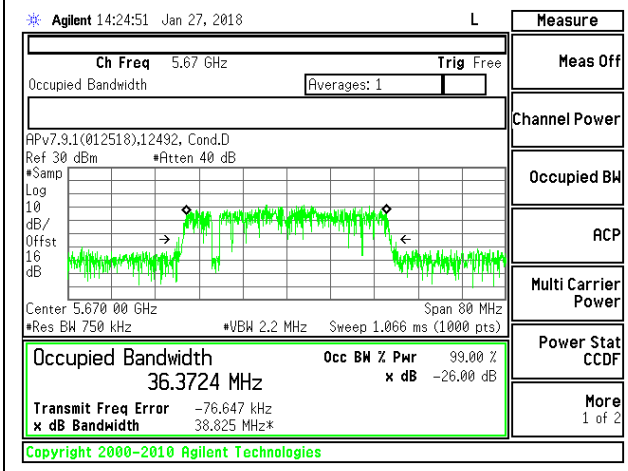
HIGH CHANNEL

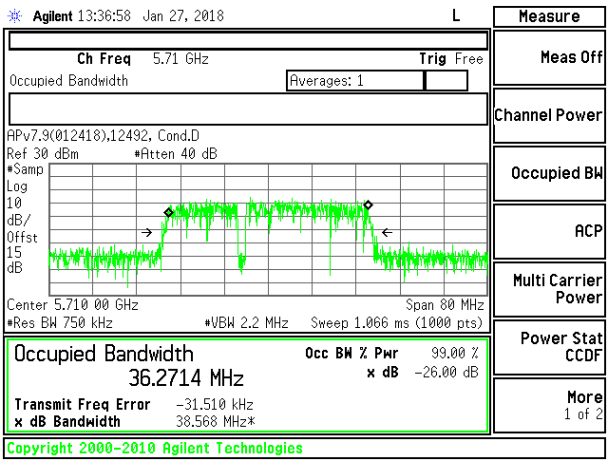


HIGH CHANNEL ANTENNA 6

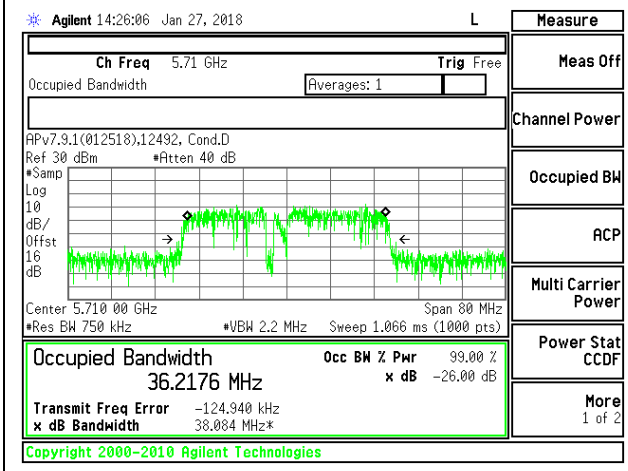


HIGH CHANNEL ANTENNA 5

CHANNEL 142



CHANNEL 142 ANTENNA 6



CHANNEL 142 ANTENNA 5

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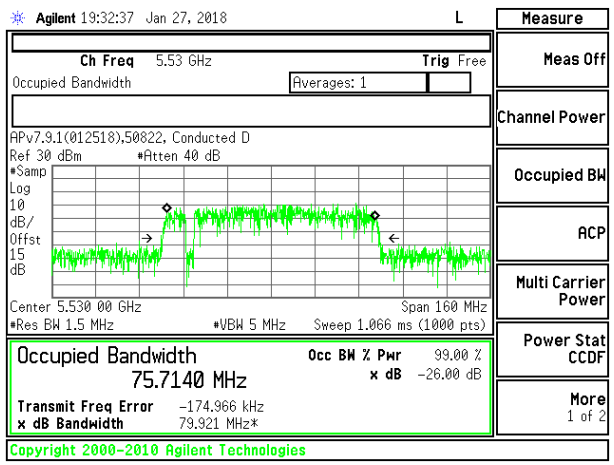
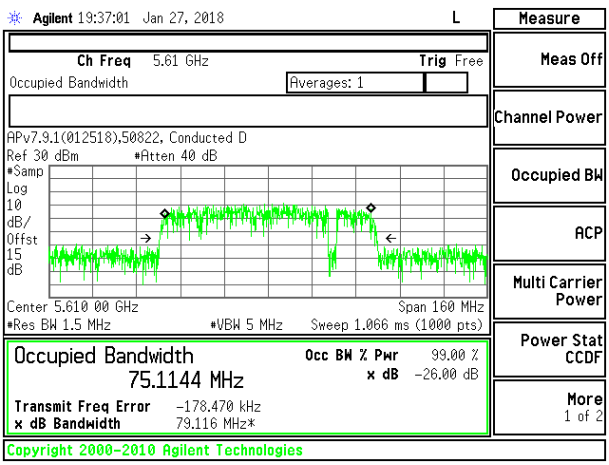
8.3.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

1TX Antenna 6 MODE

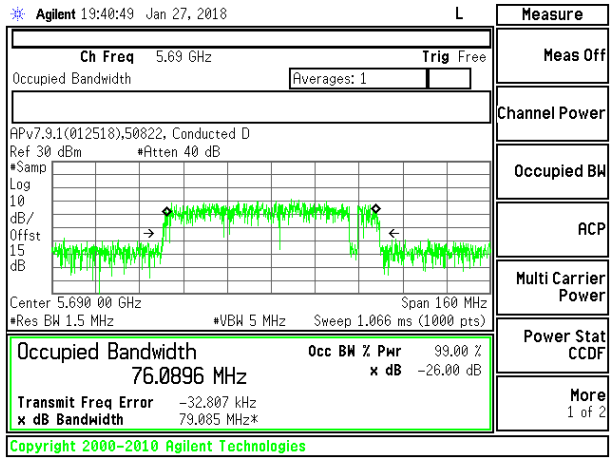
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5530	75.714
High	5610	75.114
138	5690	76.090



LOW CHANNEL



HIGH CHANNEL



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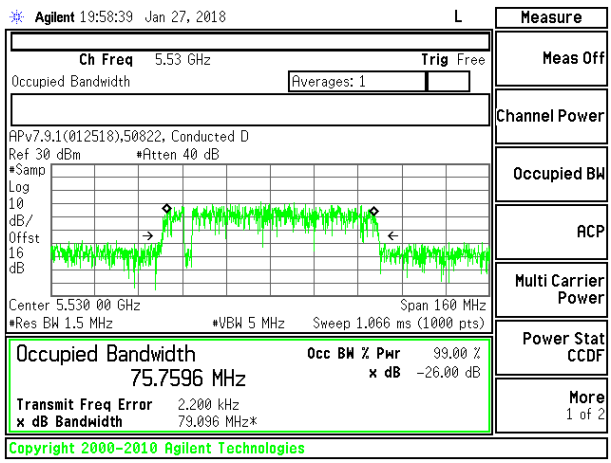
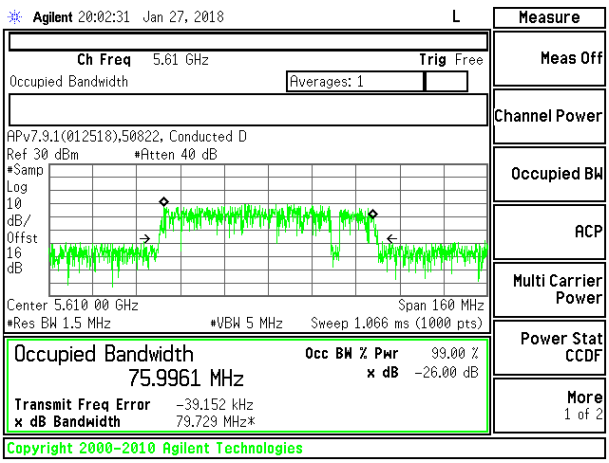
1TX Antenna 5 MODE

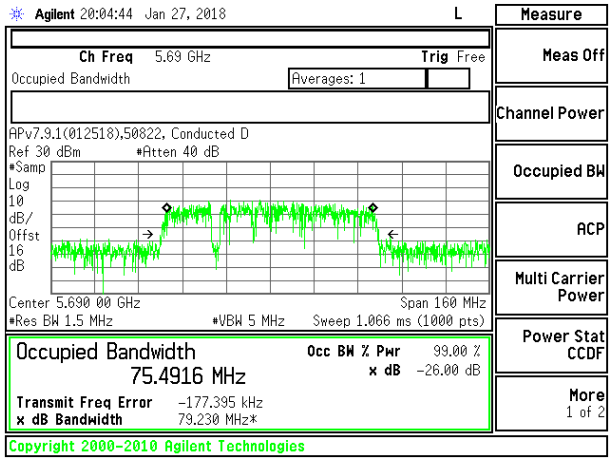
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5530	75.760
High	5610	75.996
138	5690	75.492



LOW CHANNEL



HIGH CHANNEL



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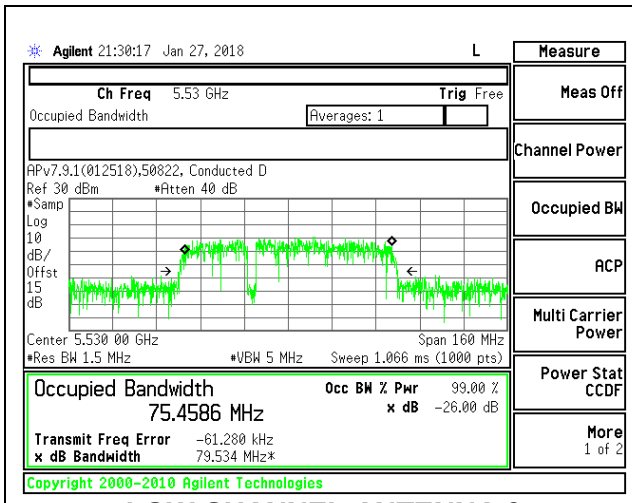
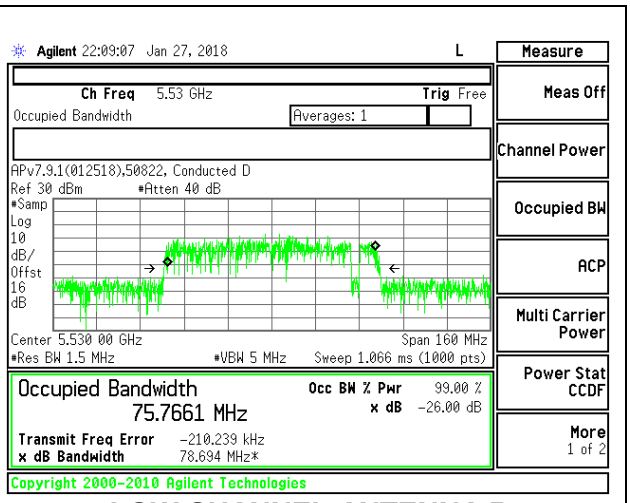
2TX Antenna 6 + Antenna 5 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 6 (MHz)	99% Bandwidth Antenna 5 (MHz)
Low	5530	75.459	75.766
High	5610	75.839	75.633
138	5690	75.391	76.007

LOW CHANNEL

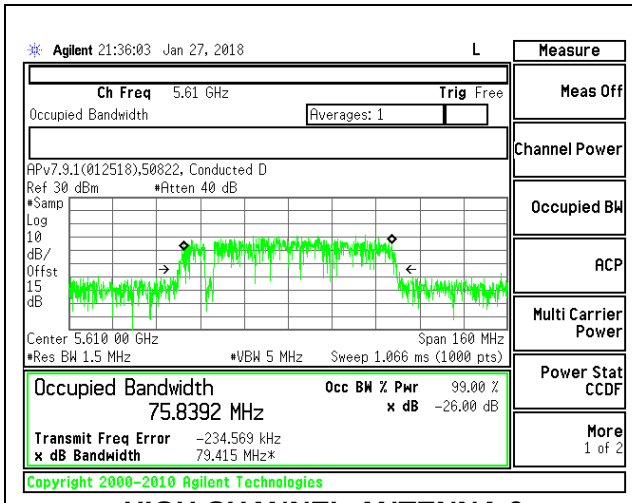


LOW CHANNEL ANTENNA 6

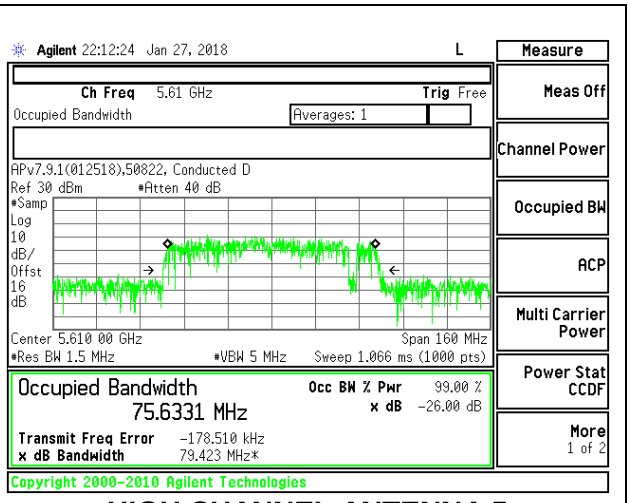


LOW CHANNEL ANTENNA 5

HIGH CHANNEL



HIGH CHANNEL ANTENNA 6



HIGH CHANNEL ANTENNA 5

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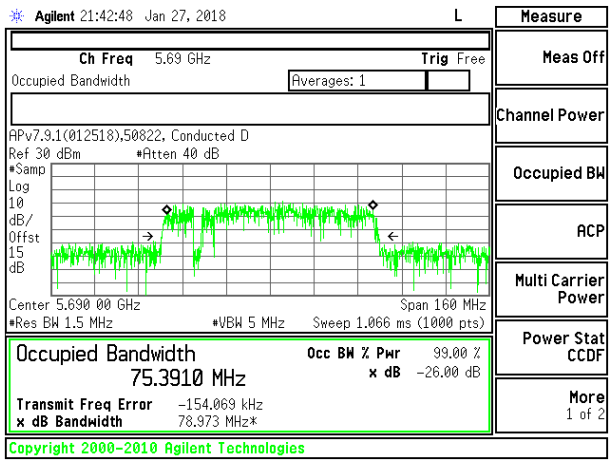
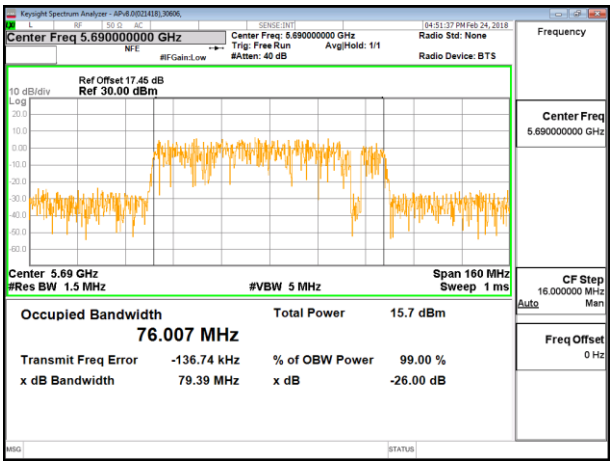
CHANNEL 138



CHANNEL 138 ANTENNA 6



CHANNEL 138 ANTENNA 5

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