CERTIFICATION TEST REPORT

Report Number. : 12646381-E4V3

Applicant	:	APPLE, INC. 1 APPLE PARK WAY CUPERTINO, CA 95014, U.S.A.
Model	:	A2178
FCC ID **IC ID:**	:	BCG-A2178 579C-A2178
EUT Description	:	iPod touch
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART E ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
May 01, 2019

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888

NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	4/15/2019	Initial Issue	Tony Li
V2	4/30/2019	Address TCB's Questions	Chin Pang
V3	5/1/2019	Address TCB's Question page 162 and 65	Chin Pang

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47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

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47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

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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: iPod touch

MODEL: A2178

SERIAL NUMBER: CCQXW00TLQJ9 (Conducted); CCQXW00LLQJ1 (Radiated)

DATE TESTED: FEBRUARY 13, 2019 – APRIL 30, 2019

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

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.

Approved & Released For
UL Verification Services Inc. By:

Chin pang
Senior Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:

Tony Li
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

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, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, 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	47658 Kato Rd
☒ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☐ Chamber I (ISED:2324A-5)
☒ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☐ Chamber J (ISED:2324A-6)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED:2324A-1)
	☒ Chamber G (ISED:22541-4)	☐ Chamber L (ISED:2324A-3)
	☐ Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

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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

RADIATED EMISSIONS

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an iPod touch with IEEE 802.11a/b/g/n/ac and Bluetooth Radio.

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			
5180-5240	802.11a	Covered By 802.11n HT20	
5180-5240	802.11n HT20	12.92	19.59
5180-5240	802.11ac VHT20	Covered By 802.11n HT20	
5190-5230	802.11n HT40	12.88	19.41
5190-5230	802.11ac VHT40	Covered By 802.11n HT40	
5210	802.11ac VHT80	10.91	12.33

5.3 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.3 GHz band			
5260 - 5320	802.11a	Covered by 802.11n HT20	
5260 - 5320	802.11n HT20	12.65	18.41
5260 - 5320	802.11ac VHT20	Covered by 802.11n HT20	
5270 - 5310	802.11n HT40	12.67	18.49
5270 - 5310	802.11ac VHT40	Covered by 802.11n HT40	
5290	802.11ac VHT80	11.97	15.74

5.6 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.6 GHz band			
5500-5720	802.11a	Covered by 802.11n HT20	
5500-5720	802.11n HT20	12.95	19.72
5500-5720	802.11ac VHT20	Covered by 802.11n HT20	
5510-5710	802.11n HT40	12.92	19.59
5510-5710	802.11ac VHT40	Covered by 802.11n HT40	
5530-5690	802.11ac VHT80	12.88	19.41

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5.8 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.8 GHz band			
5745-5825	802.11a	Covered by 802.11 HT20	
5745-5825	802.11n HT20	12.97	19.82
5745-5825	802.11ac VHT20	Covered by 802.11 HT20	
5755-5795	802.11n HT40	12.98	19.86
5755-5795	802.11ac VHT40	Covered by 802.11 HT40	
5775	802.11ac VHT80	12.85	19.28

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Range (GHz)	Antenna 6 (dBi)
5150-5250	3.1
5250-5350	2.6
5500-5700	2.8
5725-5825	2.4

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 7.64.132.

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in three orthogonal orientations X, Y and Z and it was determined that Z (Portrait) orientation was the worst-case orientation.

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.

Radiated emissions below 30MHz, below 1GHz, 18-40GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario. There were no emissions found below 30MHz within 20dB of the limit.

For below 1GHz tests EUT was 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.

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

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

802.11ac VHT20 and VHT40 mode are different from 802.11nHT20 and HT40 only in control messages and have the same power settings

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Apple	Macbook Pro	C02P41RZG086	FCC DoC
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
EUT AC Adapter	Apple	A1385	D292365CDYADHLH	NA

I/O CABLES

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

TEST SETUP

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

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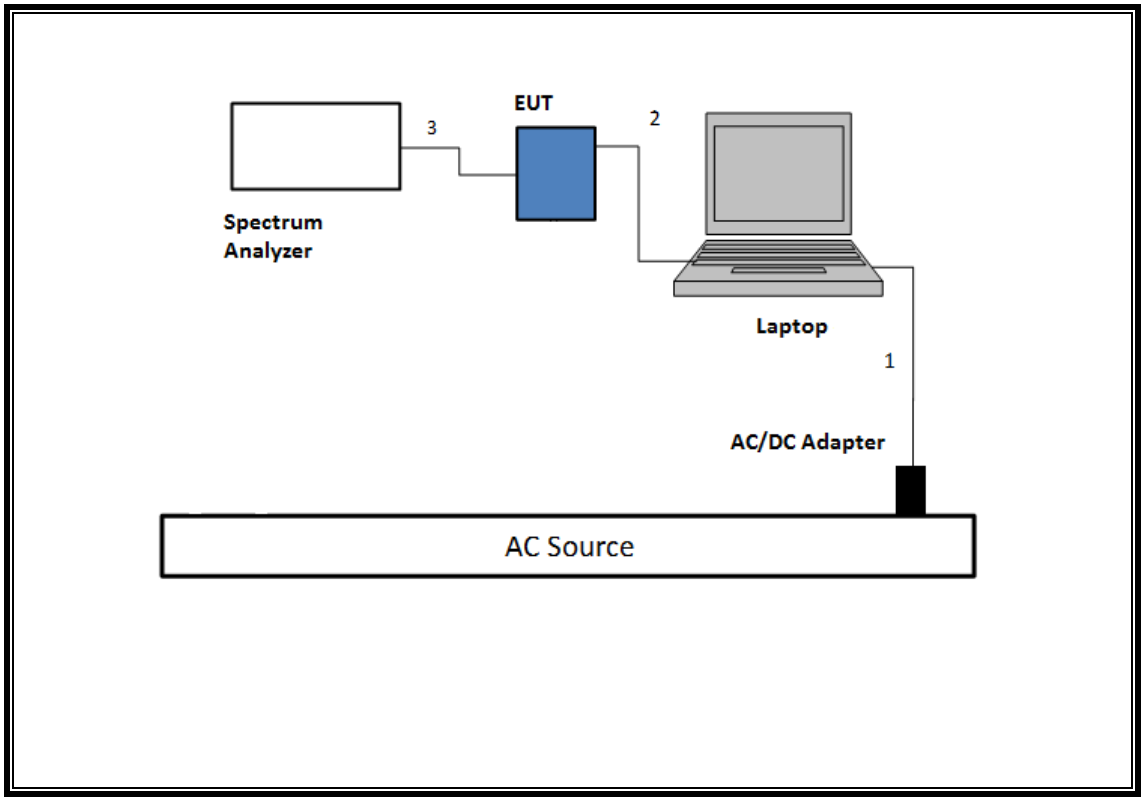
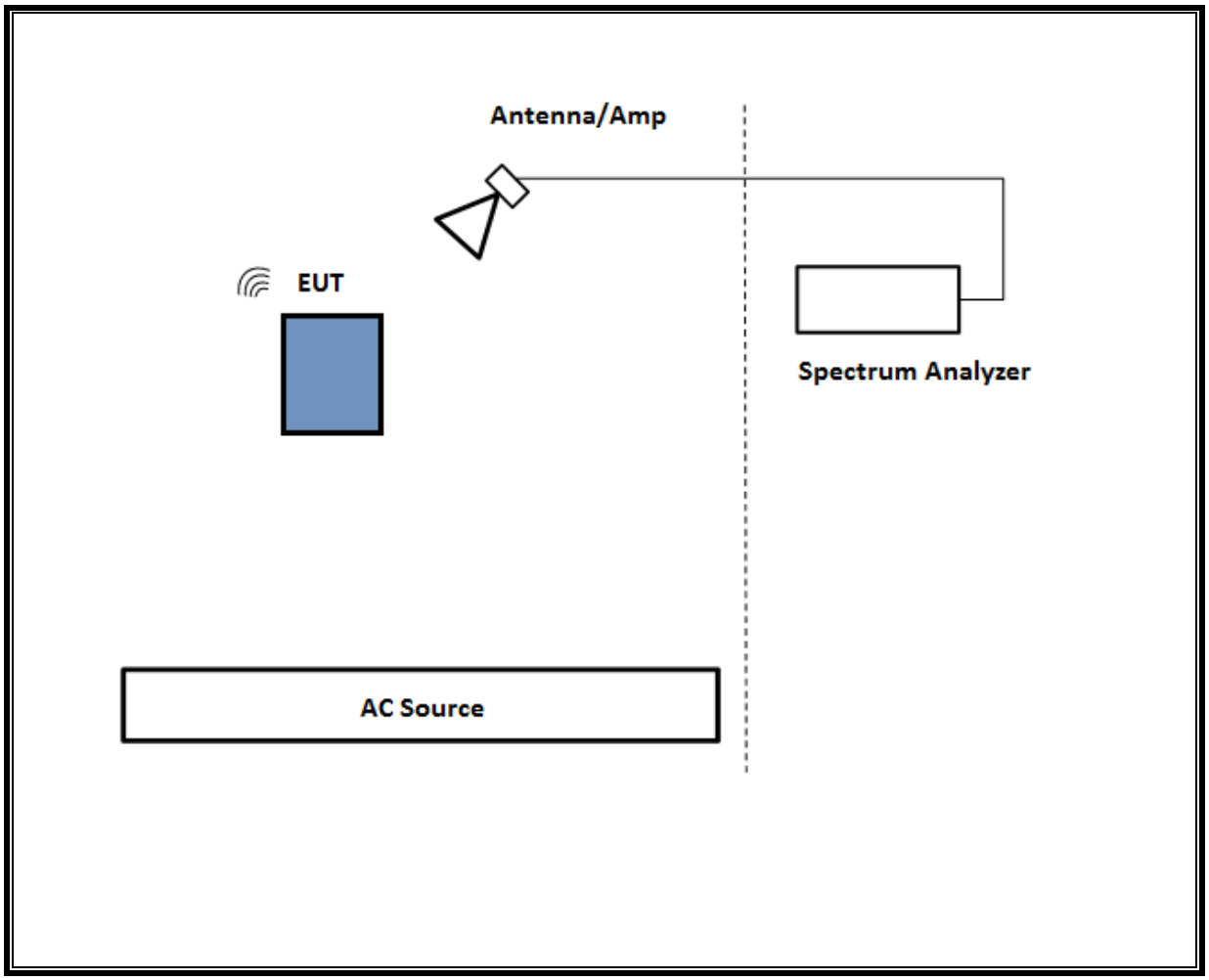
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS ABOVE 1GHz



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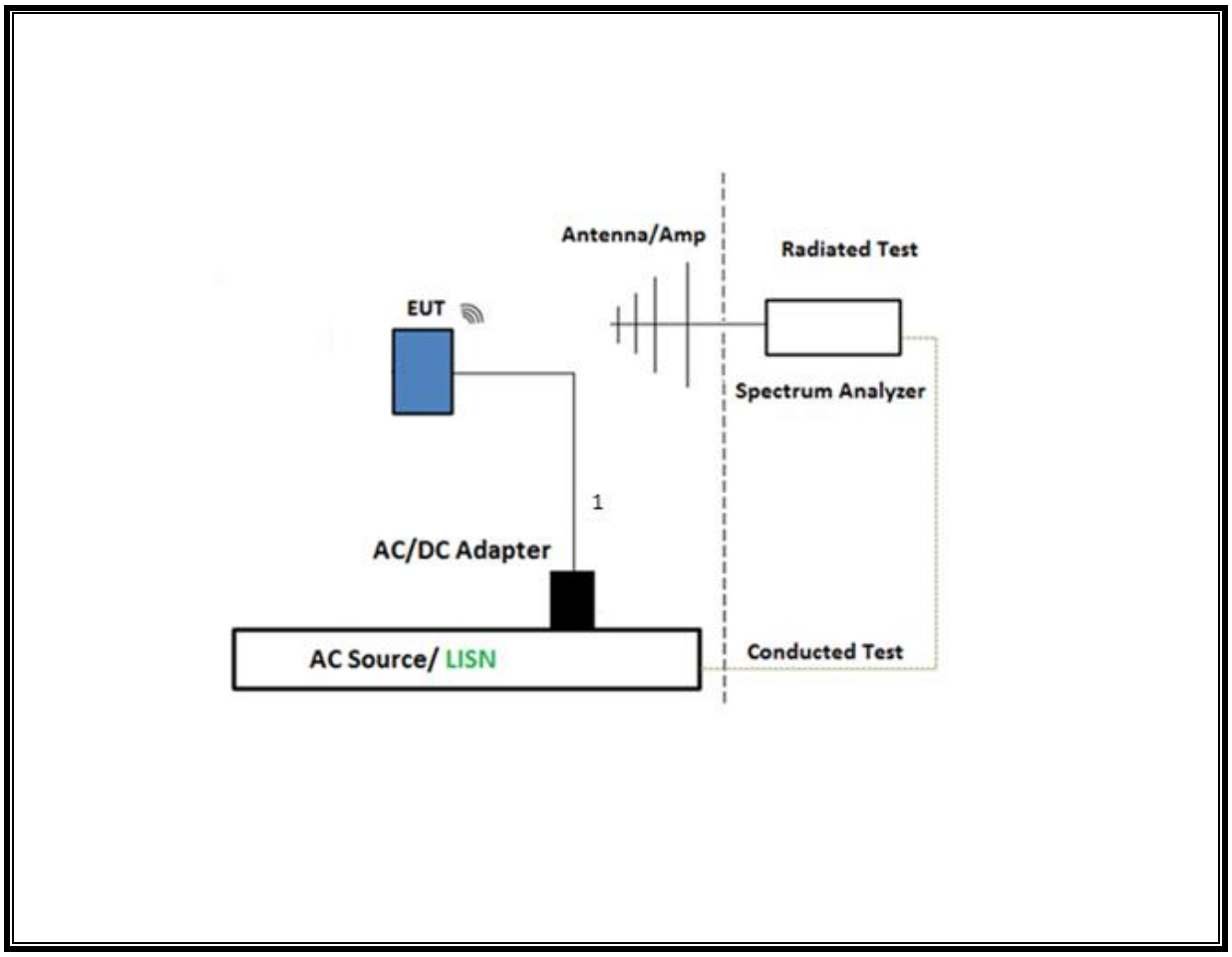
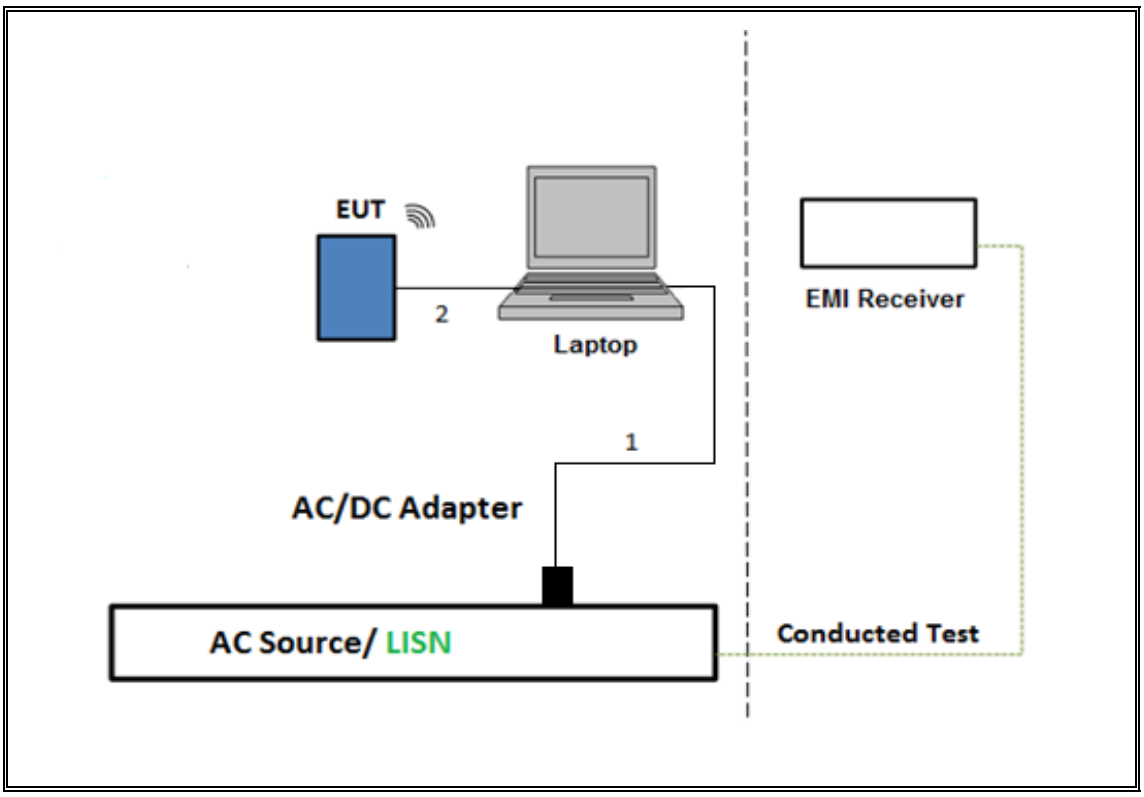
SETUP DIAGRAM FOR BELOW 1GHz AND AC LINE CONDUCTED TEST



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 KDB 789033 D02 v02r01, Section E.2.b (Method SA-1)

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.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

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7. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
*Spectrum Analyzer, PXA, 3Hz to 50GHz w/Ext. Mixer	Agilent (Keysight) Technologies	N9030A	T342	02/22/2019	02/22/2018
Thermometer	Control Company	14-650-118, 15557603	T1817	05/01/2019	05/01/2018
Horn Antenna 1-18GHz	ETS-Lindgren	3117	T345	04/25/2019	04/25/2018
Horn Antenna 1-18GHz	ETS-Lindgren	3117	T120	07/02/2019	07/02/2018
Amplifier, 10KHz to 1GHz, 32dB	Sonoma Instrument Co.	310N	T286	06/04/2019	06/04/2018
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1616	10/18/2019	10/18/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	T185	04/19/2019	04/19/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T407	05/10/2019	05/10/2018
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	06/16/2019	06/16/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	06/21/2019	06/21/2018
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25	T491	05/19/2019	05/19/2018
*RF Amplifier	MITEQ	AFS42-00101800-25-S-42	T739	03/09/2019	03/09/2018
*Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	03/09/2019	03/09/2018
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T227	10/29/2019	10/29/2018
Power Sensor	Power Sensor	Keysight	T1226	02/06/2020	02/06/2019
Antenna Horn 26-40GHz	ARA	MWH-2640	T90	09/11/2019	09/11/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T340	01/22/2020	01/22/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	01/08/2019	01/08/2018
AC Line Conducted					
*EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	T1436	02/23/2019	
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2019	
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/19/2019	
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		

*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	1.918	1.943	0.987	98.71%	0.00	0.010
802.11n HT40	0.940	0.960	0.979	97.92%	0.09	1.064
802.11ac VHT80	0.460	0.483	0.952	95.22%	0.21	2.174

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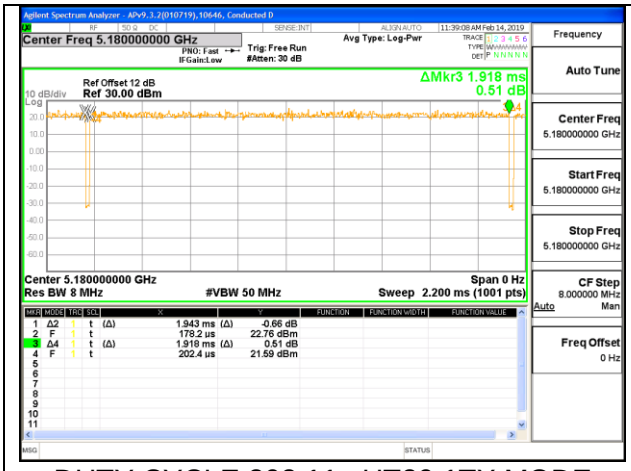
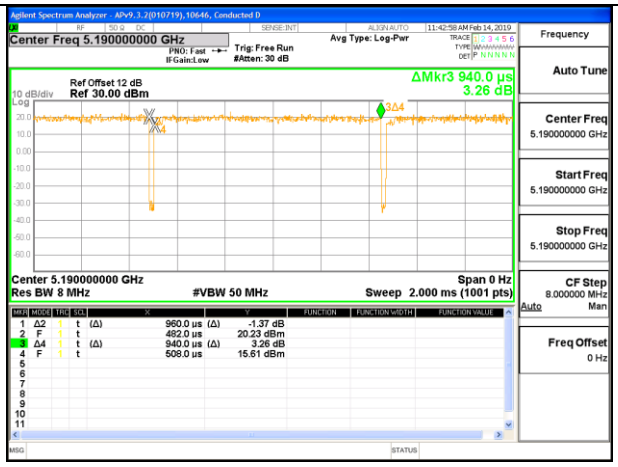
DUTY CYCLE PLOTS



DUTY CYCLE 802.11n HT20 1TX MODE



DUTY CYCLE 802.11n HT40 1TX MODE

DUTY CYCLE 802.11ac VHT80 1TX MODE

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8.2. 26 dB BANDWIDTH

LIMITS

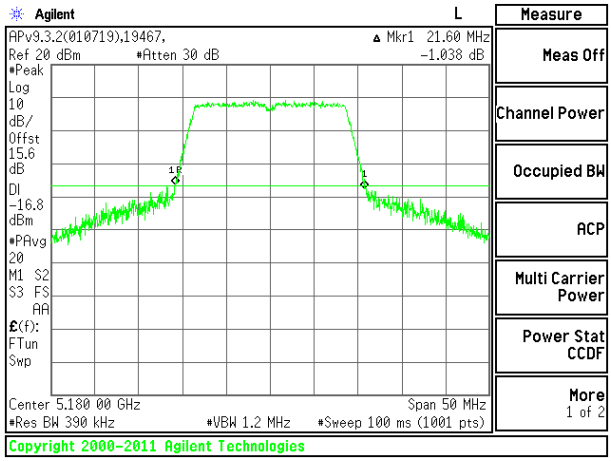
None; for reporting purposes only.

RESULTS

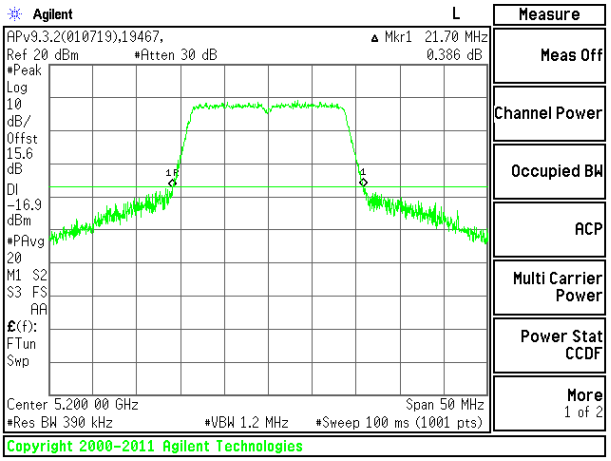
8.2.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

ID:	19467	Date:	02/07/2019

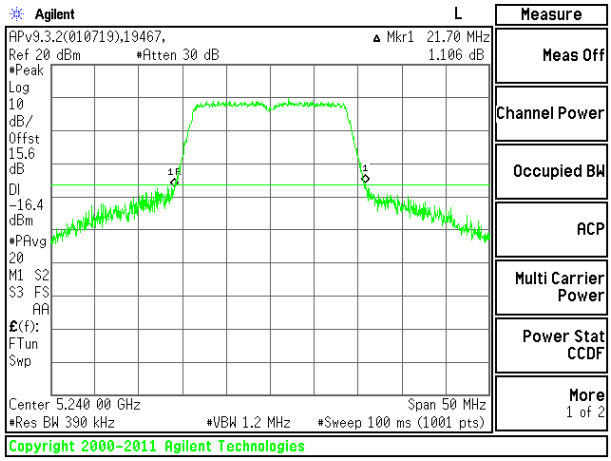
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	21.60
Mid	5200	21.70
High	5240	21.70



LOW CHANNEL



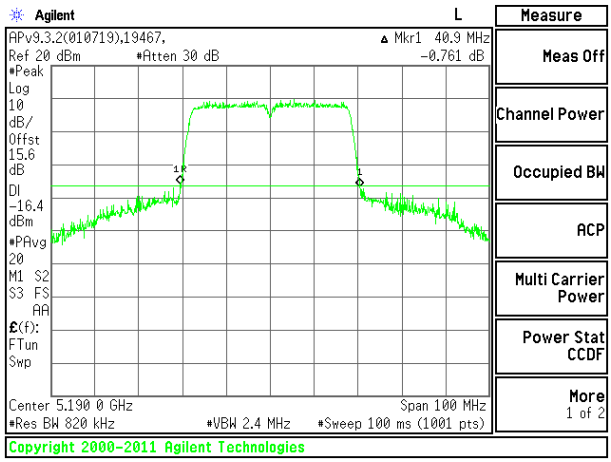
MID CHANNEL



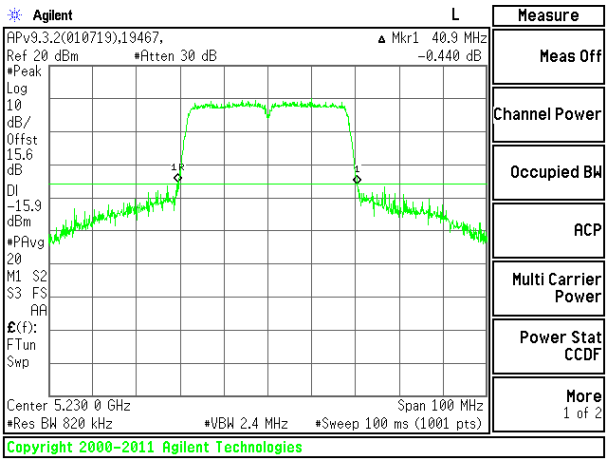
HIGH CHANNEL

8.2.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5190	40.90
High	5230	40.90



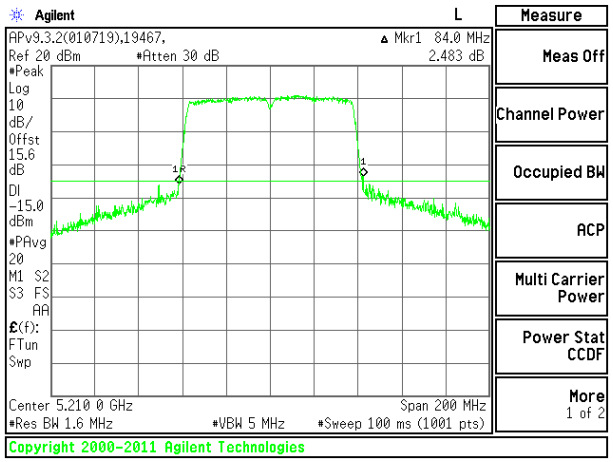
LOW CHANNEL



HIGH CHANNEL

8.2.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

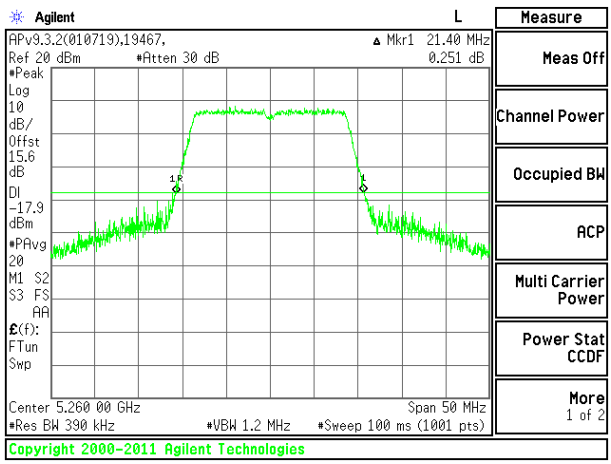
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5210	84.00



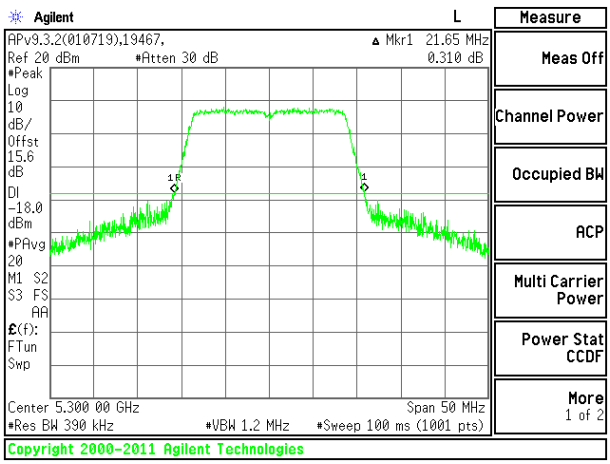
MID CHANNEL

8.2.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

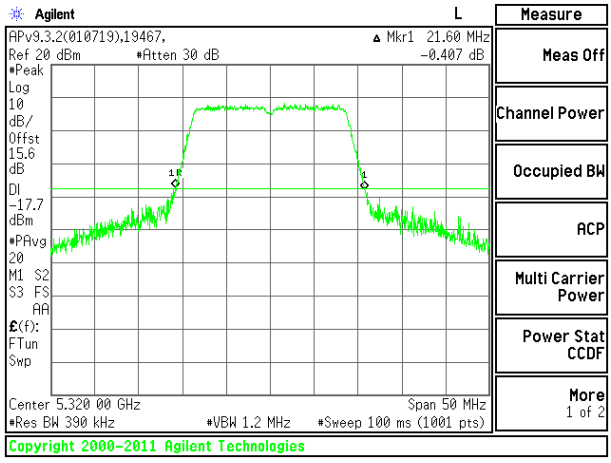
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	21.40
Mid	5300	21.65
High	5320	21.60



LOW CHANNEL



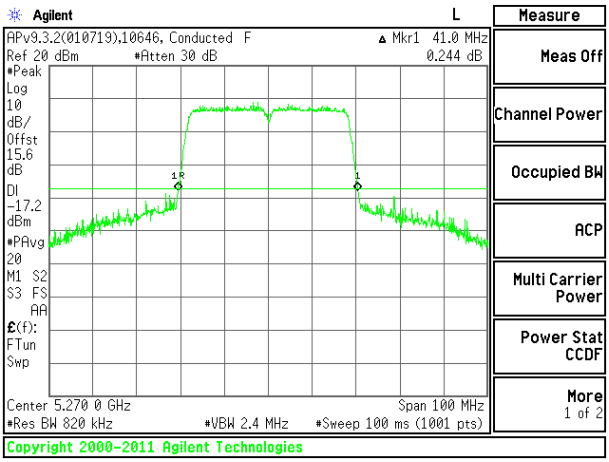
MID CHANNEL



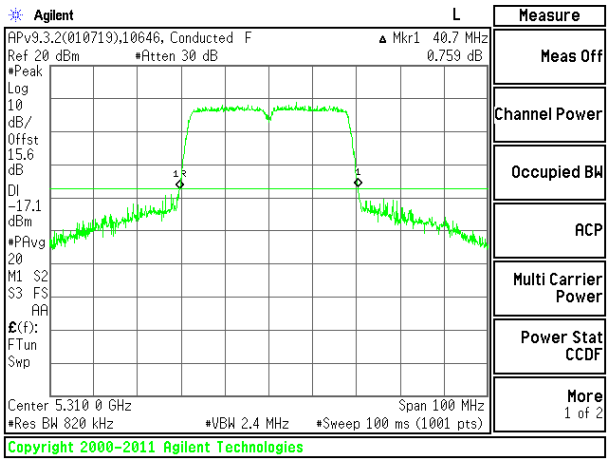
HIGH CHANNEL

8.2.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5270	41.00
High	5310	40.70



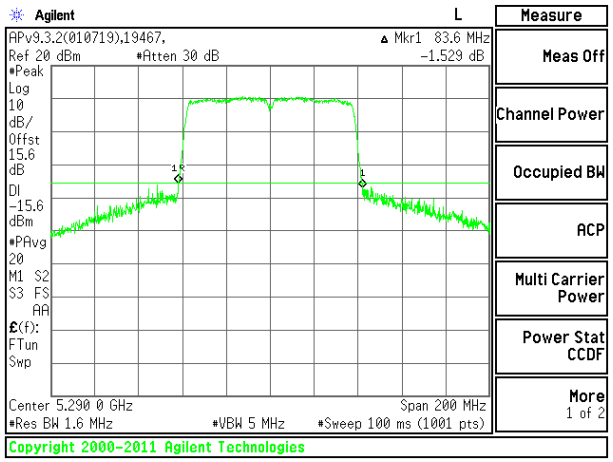
LOW CHANNEL



HIGH CHANNEL

8.2.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

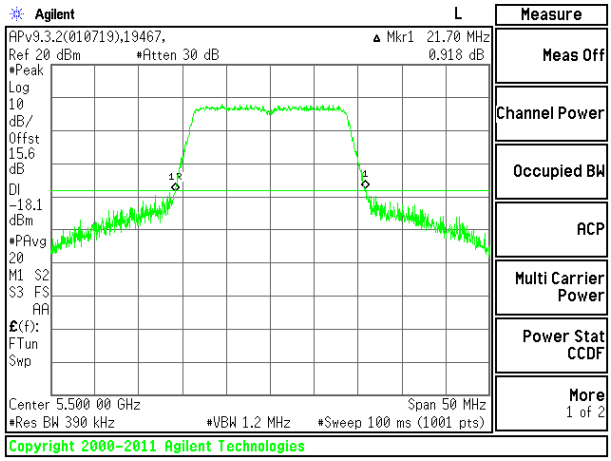
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5290	83.60



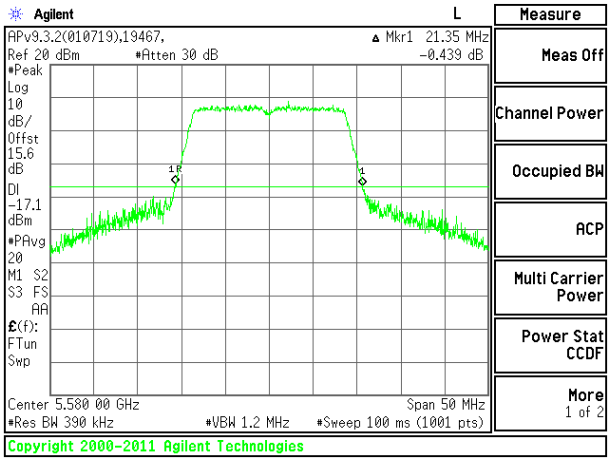
MID CHANNEL

8.2.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

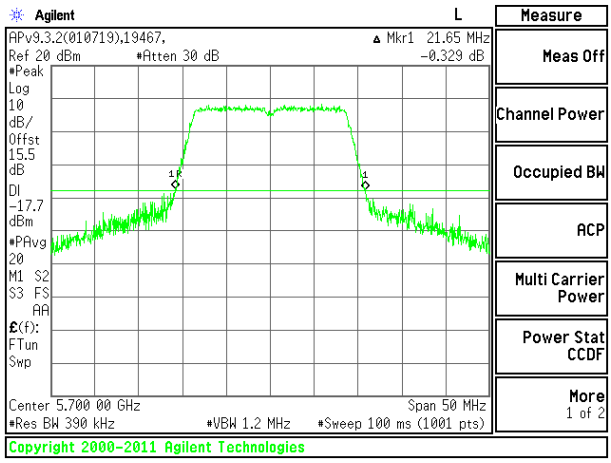
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	21.70
Mid	5580	21.35
High	5700	21.65
144	5720	21.65



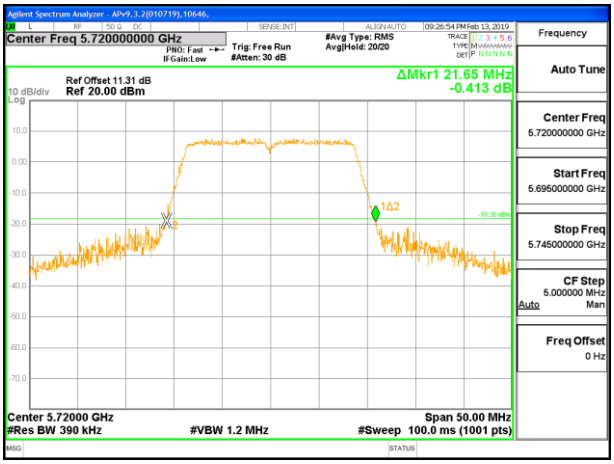
LOW CHANNEL



MID CHANNEL



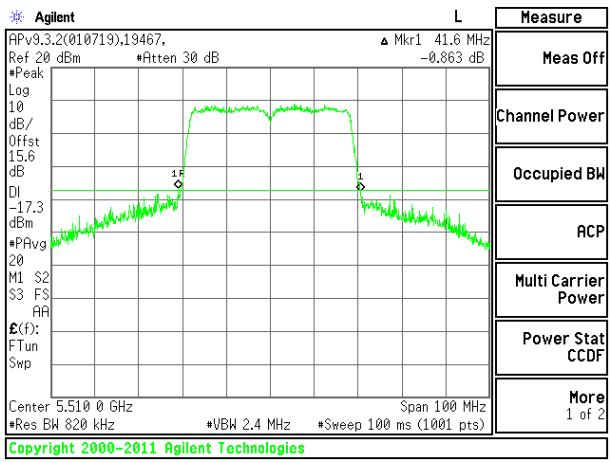
HIGH CHANNEL



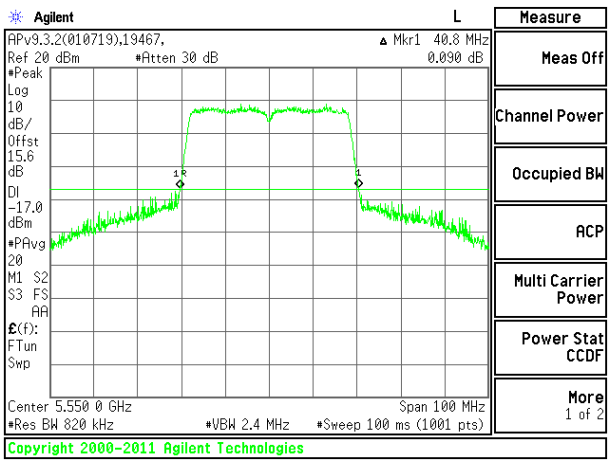
CHANNEL 144

8.2.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

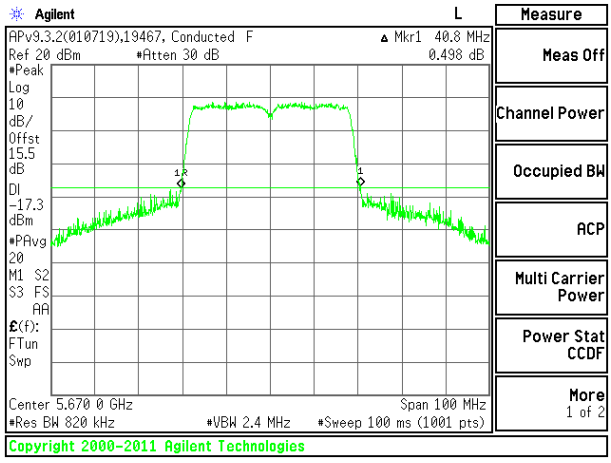
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	41.60
Mid	5550	40.80
High	5670	40.80
142	5710	40.50



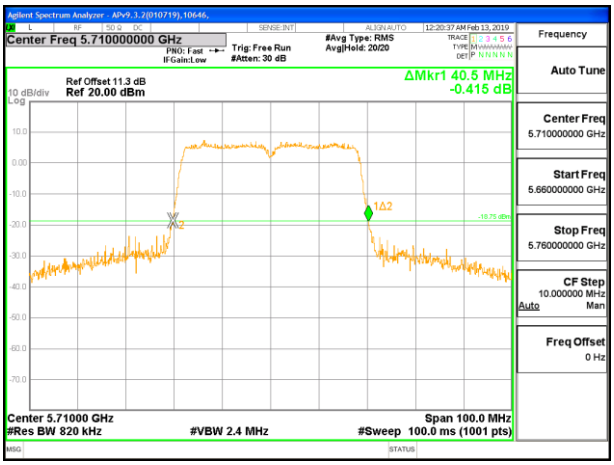
LOW CHANNEL



MID CHANNEL



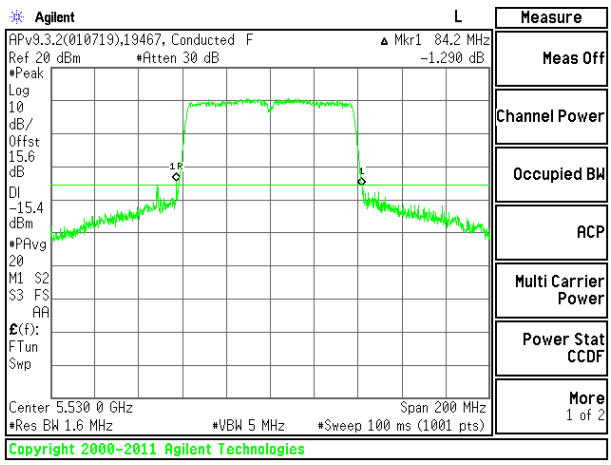
HIGH CHANNEL



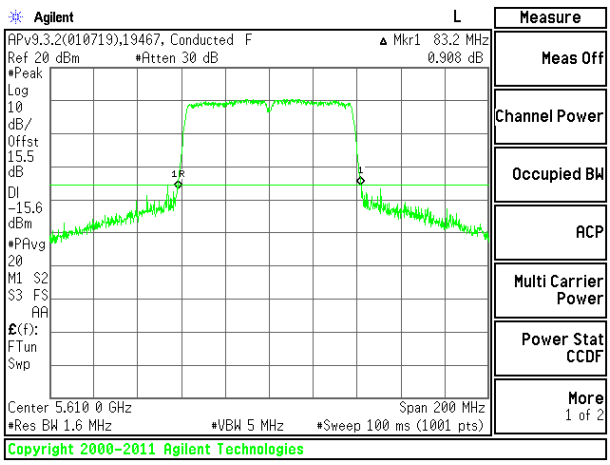
CHANNEL 142

8.2.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

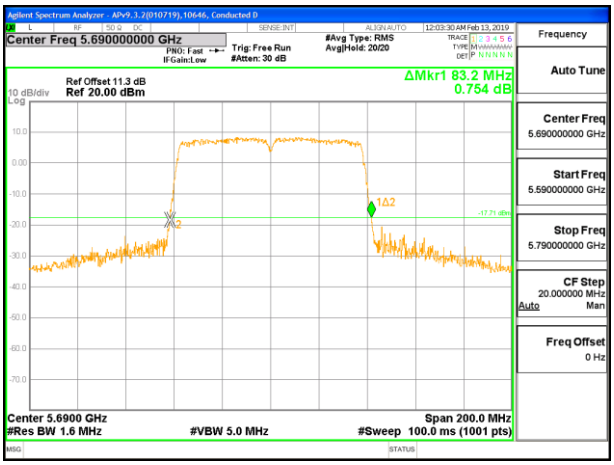
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5530	84.20
High	5610	83.20
138	5690	83.20



LOW CHANNEL



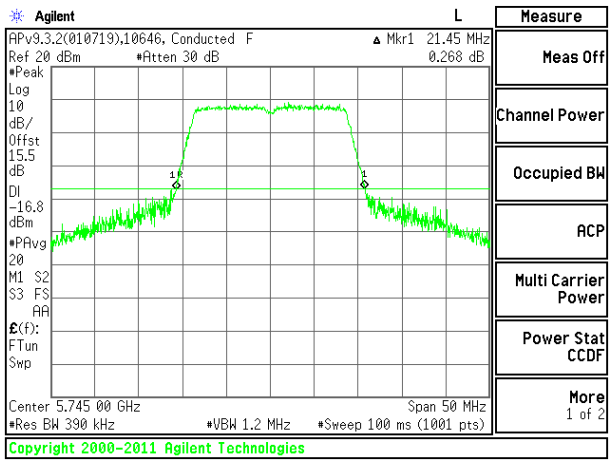
HIGH CHANNEL



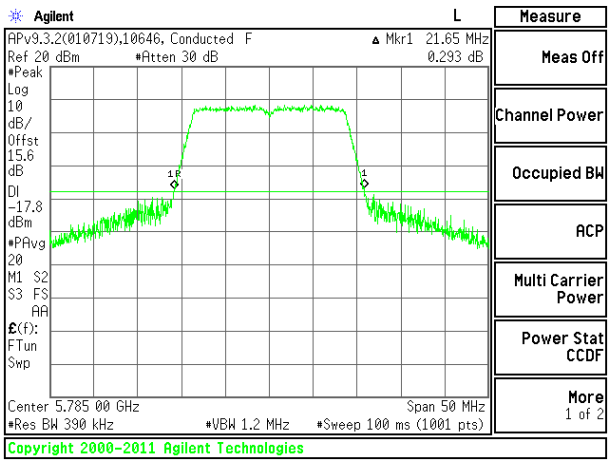
CHANNEL 138

8.2.10. 802.11n HT20 MODE IN THE 5.8 GHz BAND

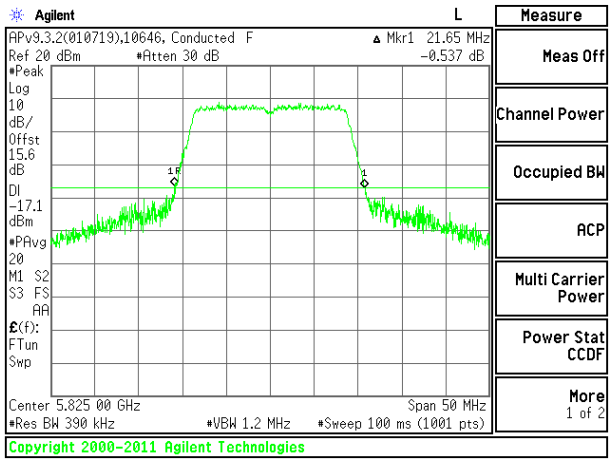
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5745	21.45
Mid	5785	21.65
High	5825	21.65



LOW CHANNEL



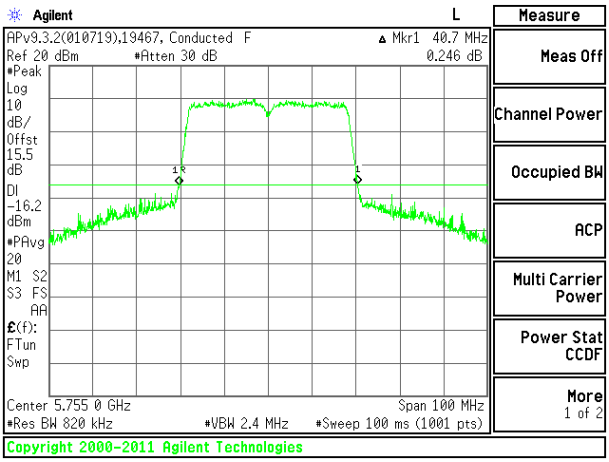
MID CHANNEL



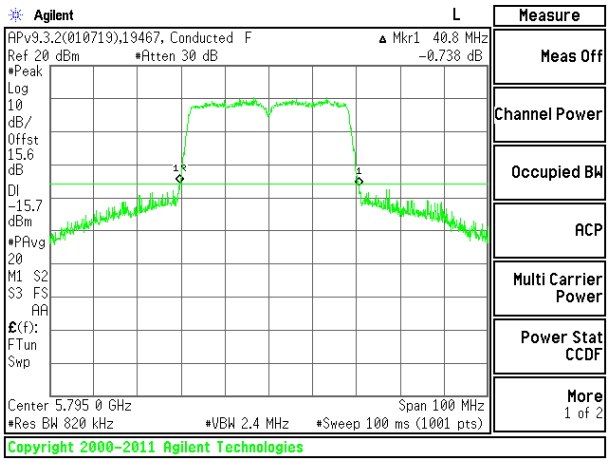
HIGH CHANNEL

8.2.11. 802.11n HT40 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	26dB Bandwidth (MHz)
Low	5755	40.70
High	5795	40.80



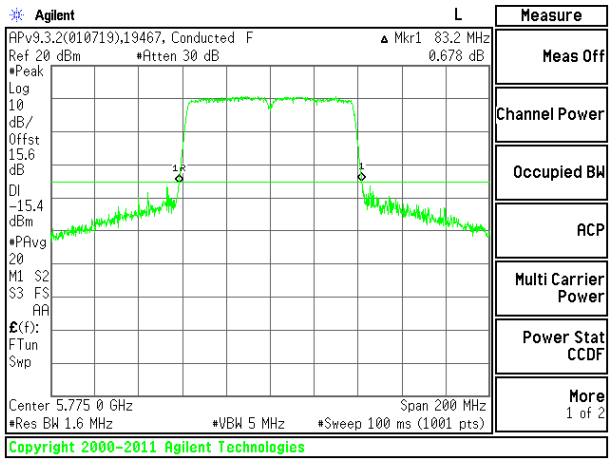
LOW CHANNEL



HIGH CHANNEL

8.2.12. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Mid	5775	83.20



MID CHANNEL

8.3. 99% BANDWIDTH

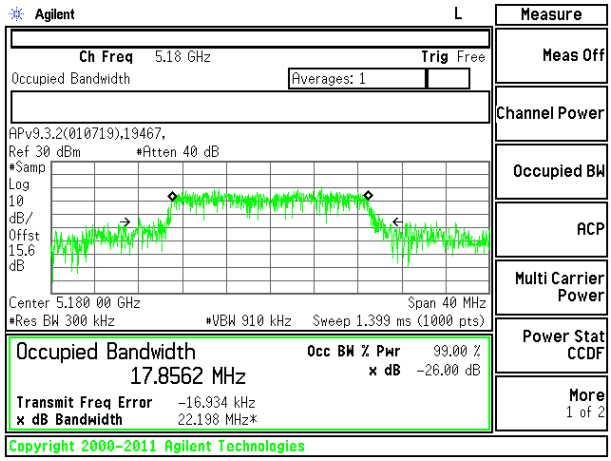
LIMITS

None; for reporting purposes only.

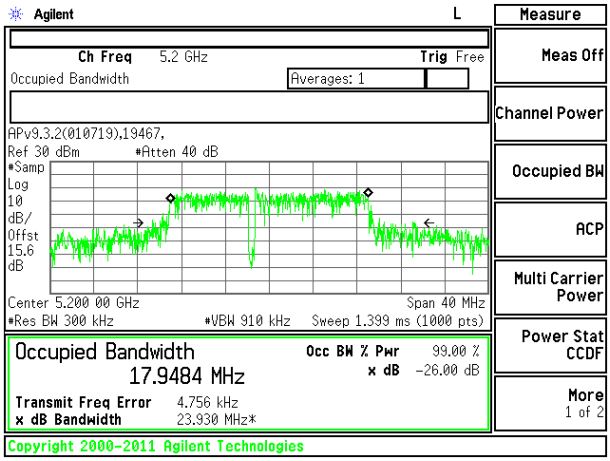
RESULTS

8.3.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

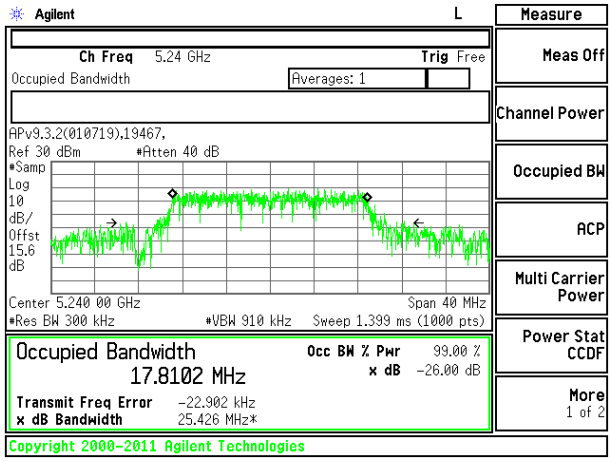
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.8562
Mid	5200	17.9484
High	5240	17.8102



LOW CHANNEL



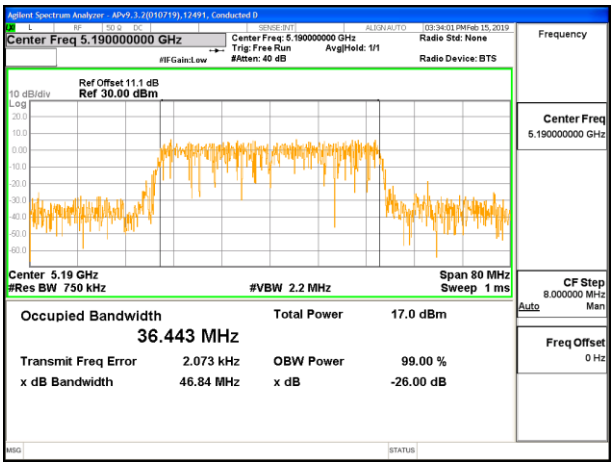
MID CHANNEL



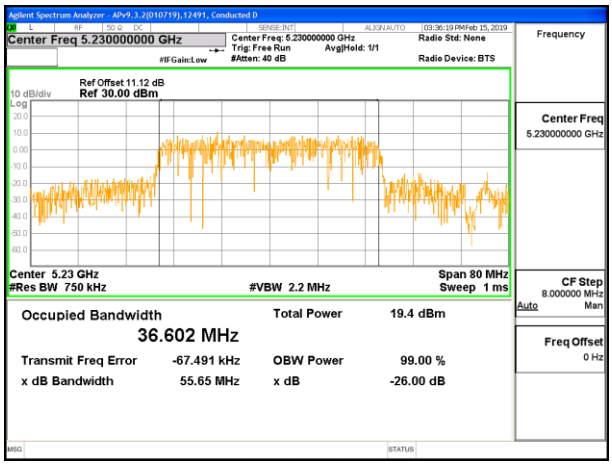
HIGH CHANNEL

8.3.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	36.4430
High	5230	36.6020



LOW CHANNEL



HIGH CHANNEL

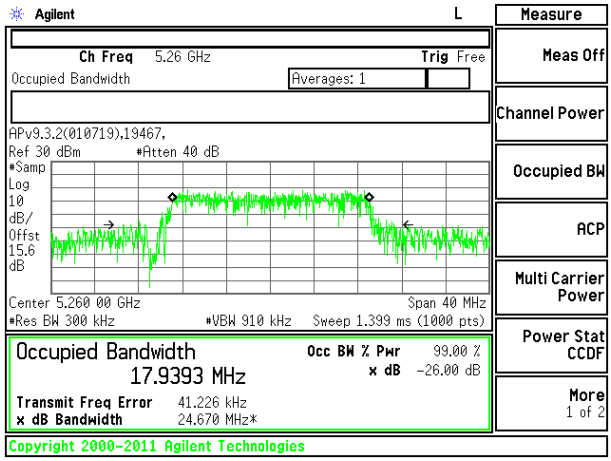
8.3.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5210	75.6110

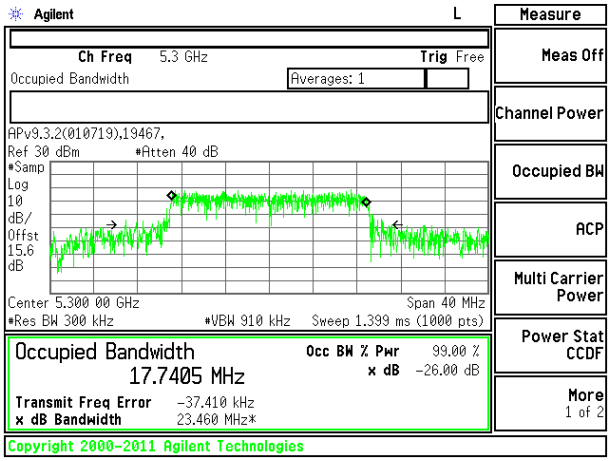
MID CHANNEL

8.3.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

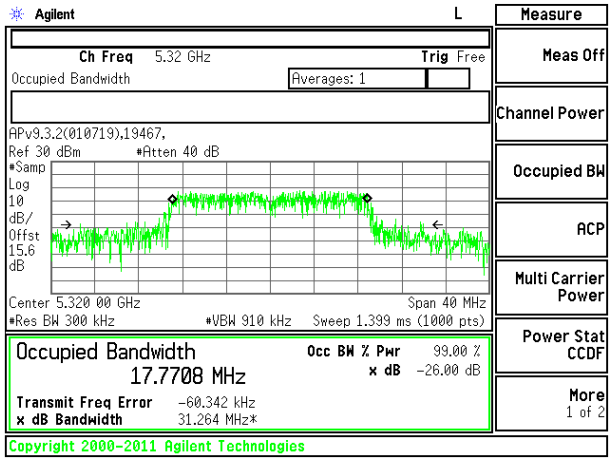
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.9393
Mid	5300	17.7405
High	5320	17.7708



LOW CHANNEL



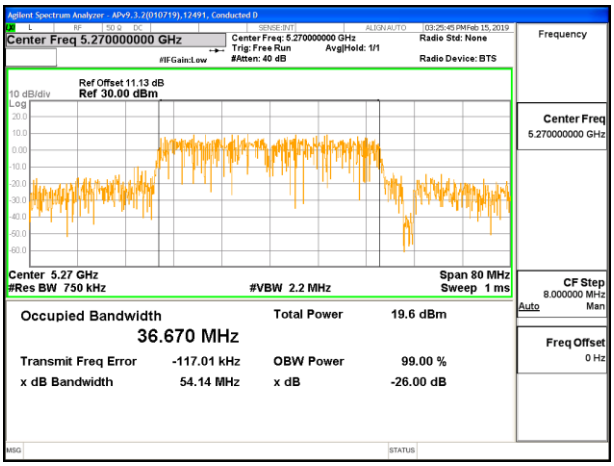
MID CHANNEL



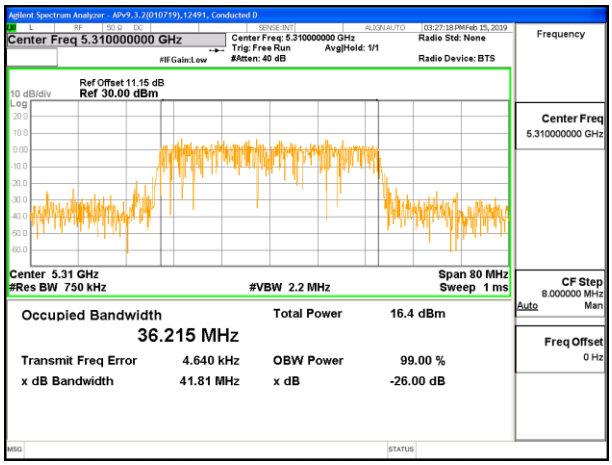
HIGH CHANNEL

8.3.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5270	36.6700
High	5310	36.2150



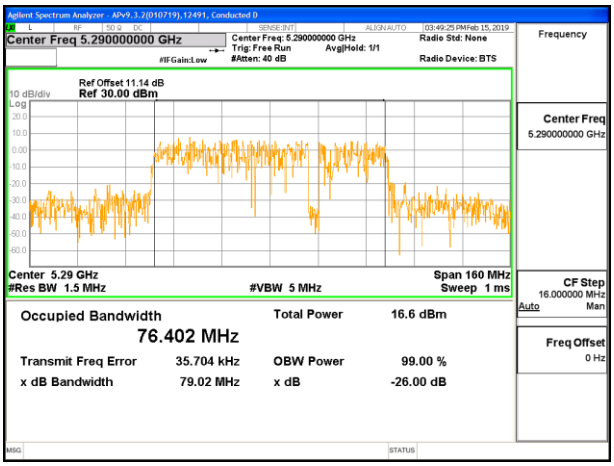
LOW CHANNEL



HIGH CHANNEL

8.3.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

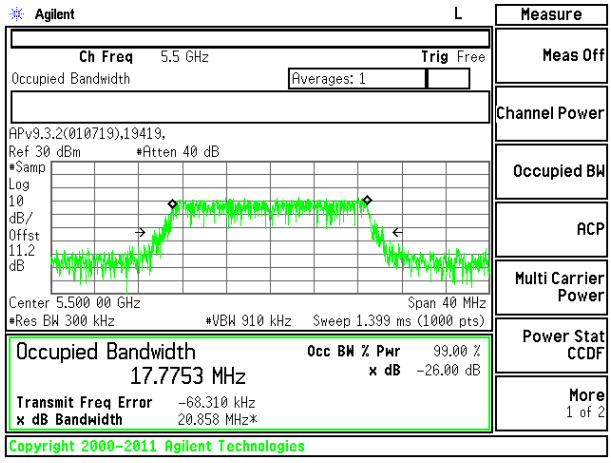
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5290	76.4020



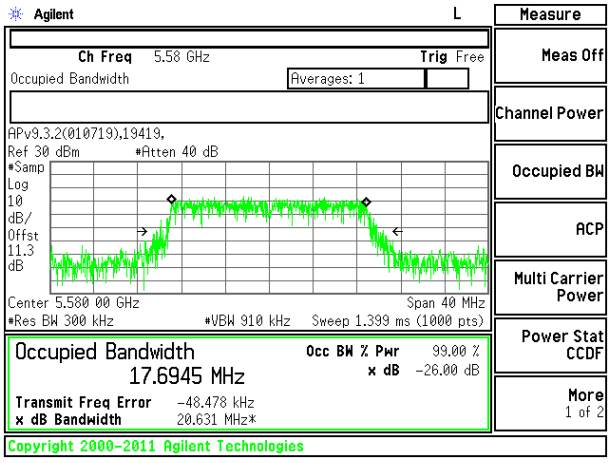
MID CHANNEL

8.3.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

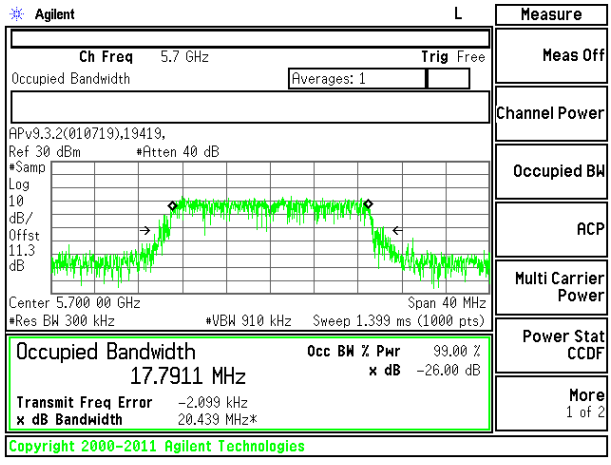
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.7753
Mid	5580	17.6945
High	5700	17.7911
144	5720	17.7490



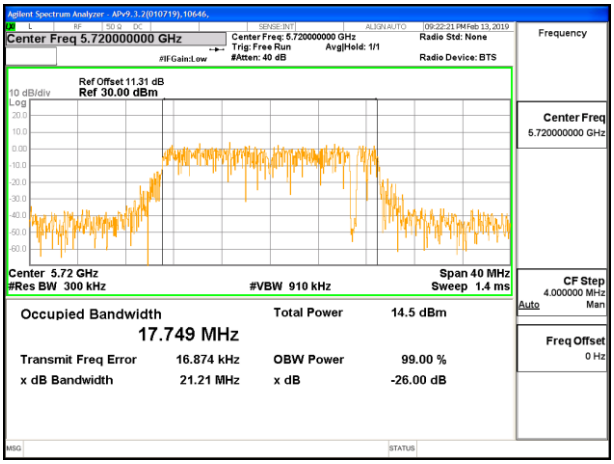
LOW CHANNEL



MID CHANNEL



HIGH CHANNEL



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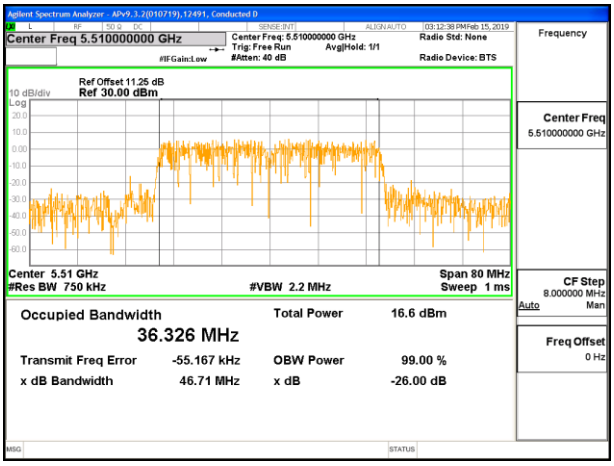
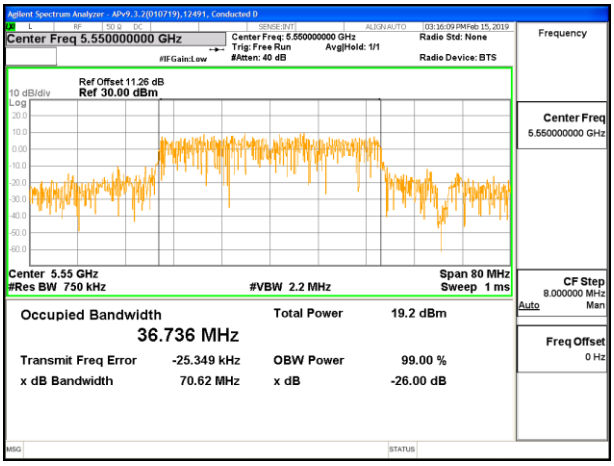
8.3.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

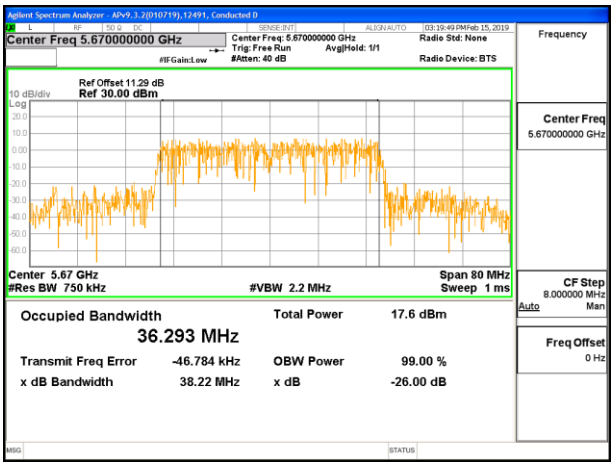
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	36.3260
Mid	5550	36.7360
High	5670	36.2930
142	5710	37.0950



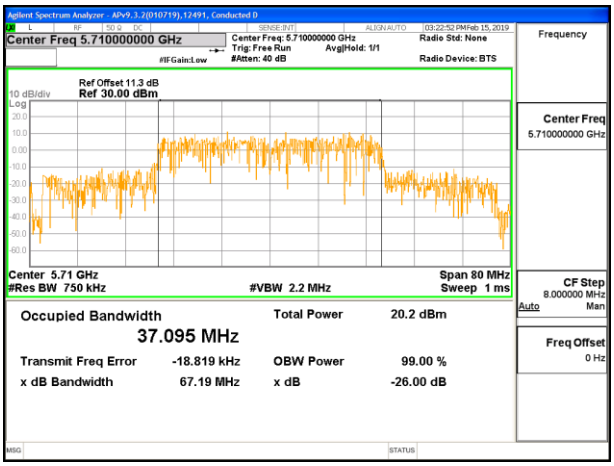
LOW CHANNEL



MID CHANNEL



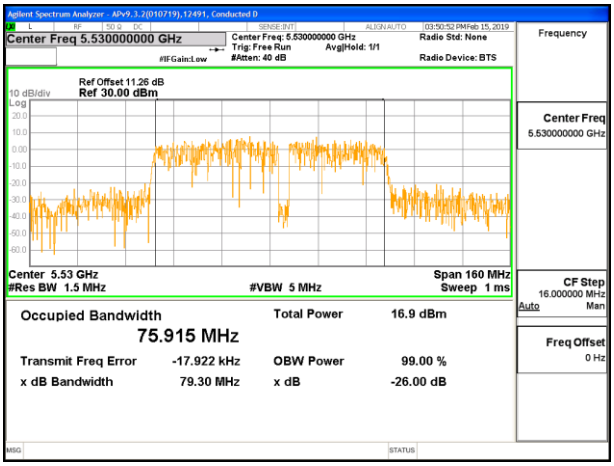
HIGH CHANNEL



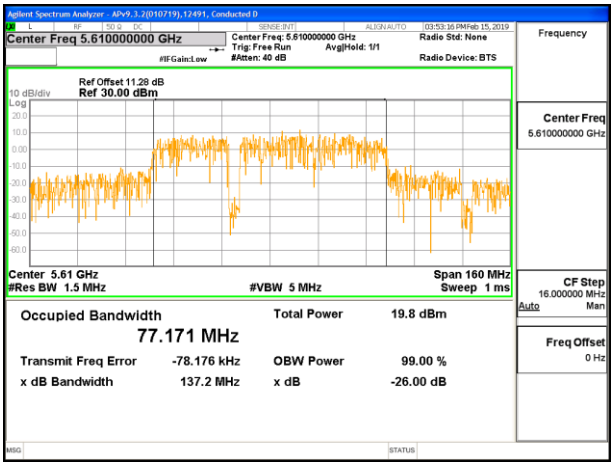
CHANNEL 142

8.3.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5530	75.9150
High	5610	77.1710
138	5690	76.8920



LOW CHANNEL

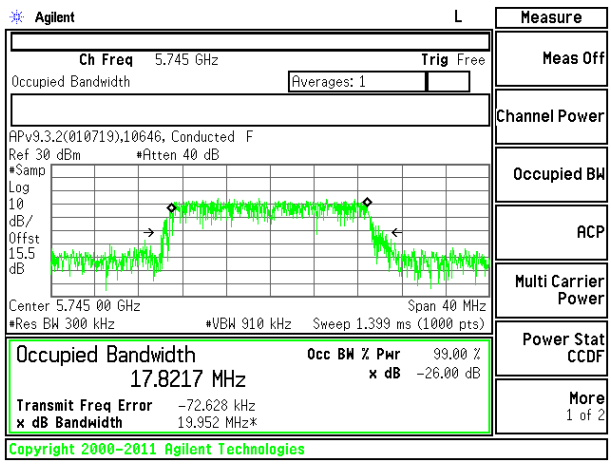


HIGH CHANNEL

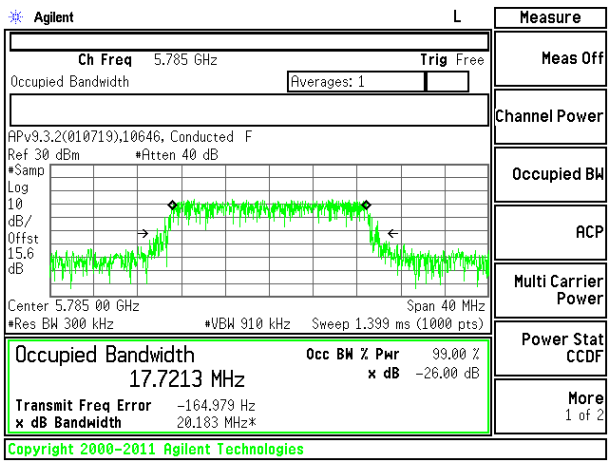
CHANNEL 138

8.3.10. 802.11n HT20 MODE IN THE 5.8 GHz BAND

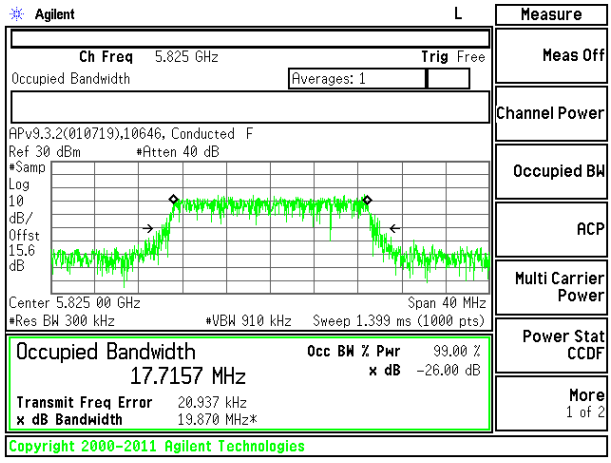
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	17.8217
Mid	5785	17.7213
High	5825	17.7157



LOW CHANNEL



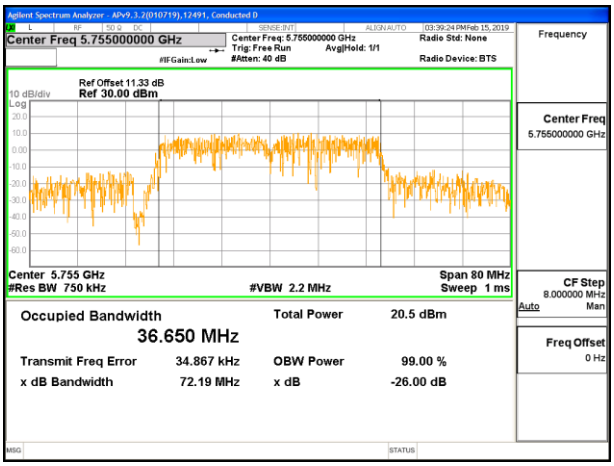
MID CHANNEL



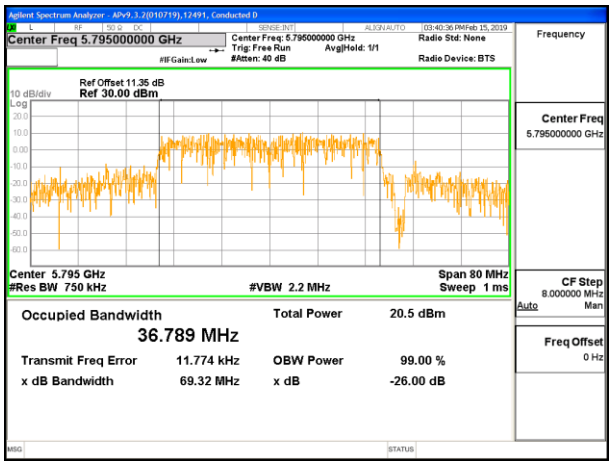
HIGH CHANNEL

8.3.11. 802.11n HT40 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5755	36.6500
High	5795	36.7890



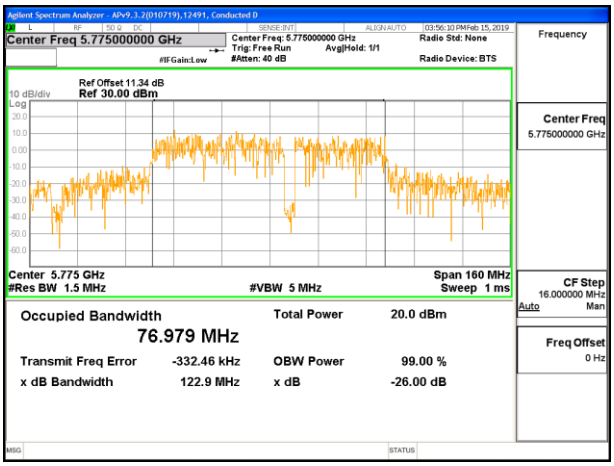
LOW CHANNEL



HIGH CHANNEL

8.3.12. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Mid	5775	76.9790



MID CHANNEL

8.4. 6 dB BANDWIDTH

LIMITS

FCC §15.407 (e)

RSS-247 6.2.4.1

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

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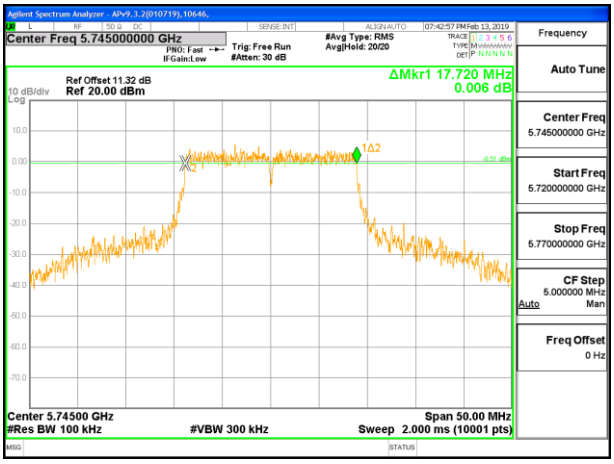
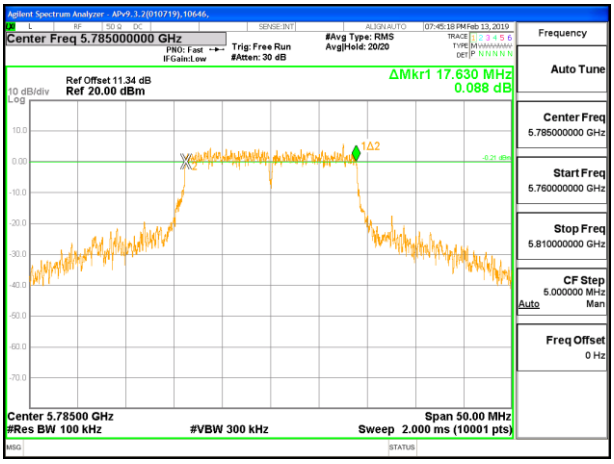
8.4.1. 802.11n HT20 MODE IN THE 5.8 GHz BAND

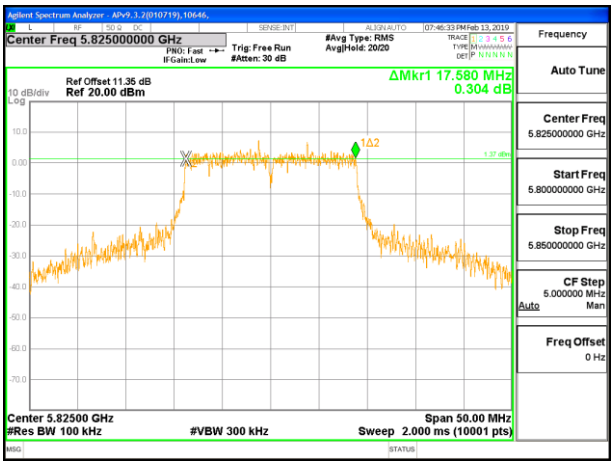
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	17.720	0.5
Mid	5785	17.630	0.5
High	5825	17.580	0.5
144	5720	3.910	0.5



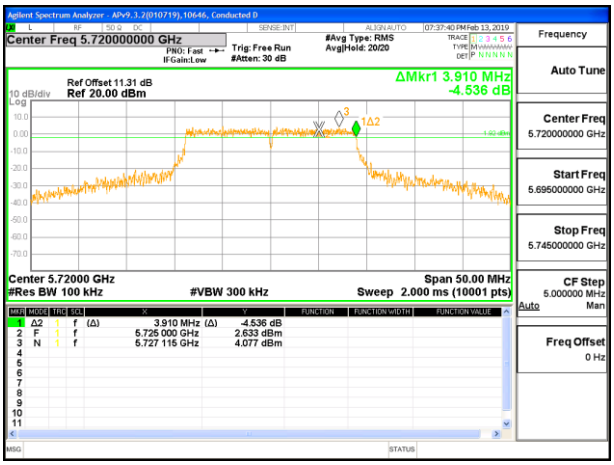
LOW CHANNEL



MID CHANNEL



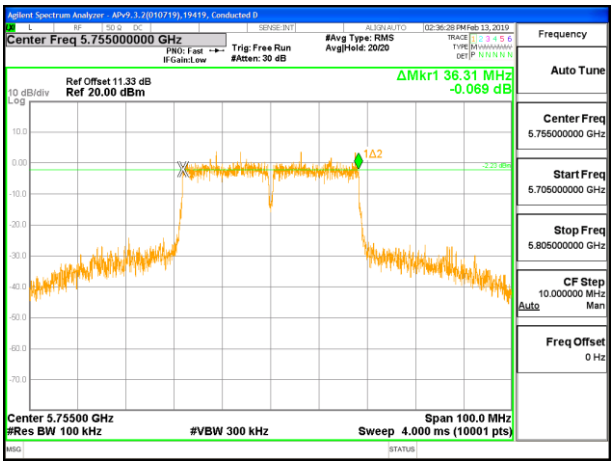
HIGH CHANNEL



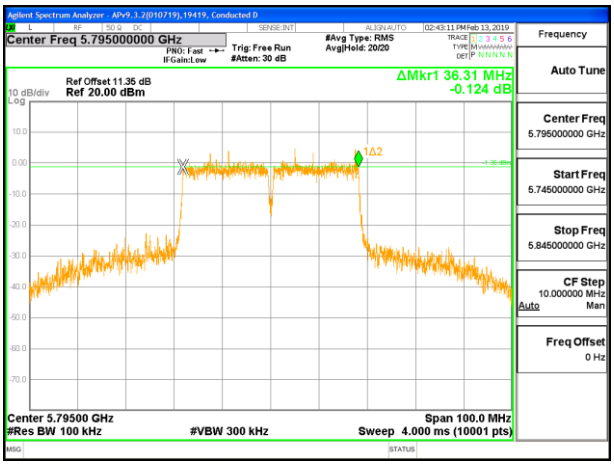
CHANNEL 144

8.4.2. 802.11n HT40 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5755	36.310	0.5
High	5795	36.310	0.5
142	5710	3.200	0.5



LOW CHANNEL



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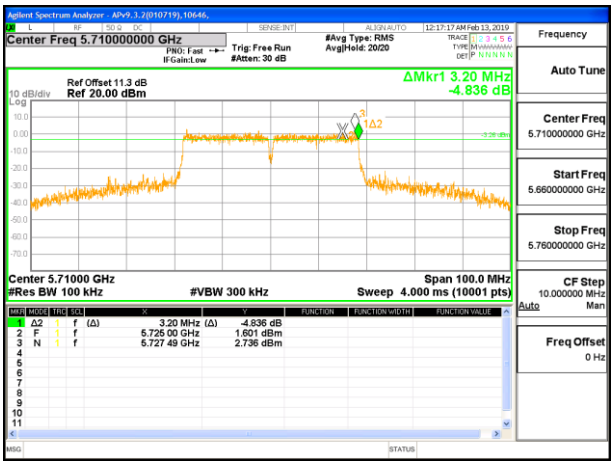
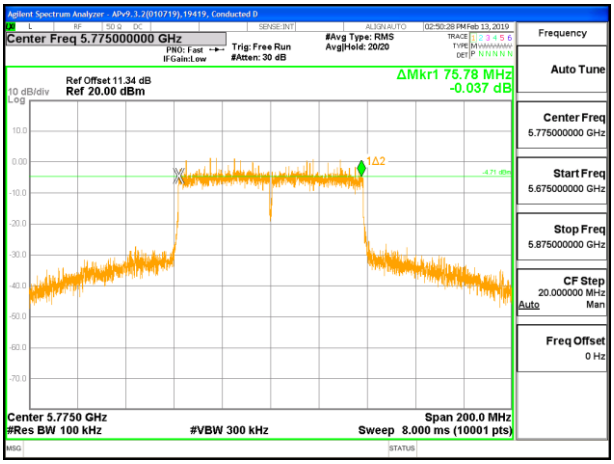


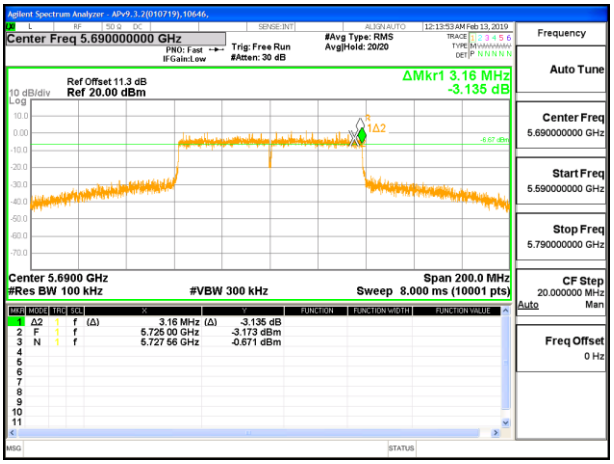
CHANNEL 142

8.4.3. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Mid	5775	75.780	0.5
138	5690	3.160	0.5



MID CHANNEL



CHANNEL 138

8.5. OUTPUT POWER AND PSD

LIMITS

FCC §15.407

Band 5.15–5.25 GHz
(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Bands 5.25-5.35 GHz and 5.47-5.725 GHz
The maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Band 5.725-5.85 GHz
The maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

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RSS-247

Band 5.15-5.25 GHz
The maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

Band 5.25-5.35 GHz
The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Bands 5.47-5.6 GHz and 5.65-5.725 GHz
The maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Band 5.725-5.85 GHz
The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

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TEST PROCEDURE

The measurement method used for output power is KDB 789033 D02 v02r01, Section E.3.b (Method PM-G) and for straddles channels KDB 789033 D02 v02r01, Section E.2.b (Method SA-1) was used.

The measurement method used for power spectral density is KDB 789033 D02 v02r01, Section F

DIRECTIONAL ANTENNA GAIN

For 1 TX:
There is only one transmitter output therefore the directional gain is equal to the antenna gain.

ID:	44366	**Date:**	4/08/2019

RESULTS:

8.5.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5180	21.60	17.86	3.10
Mid	5200	21.70	17.95	3.10
High	5240	21.70	17.81	3.10

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	Max ISED Power Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm/1MHz)	ISED PSD Limit (dBm/1MHz)	Max ISED PSD Limit (dBm/1MHz
Low	5180	24.00	22.52	19.42	19.42	11.00	10.00	6.90
Mid	5200	24.00	22.54	19.44	19.44	11.00	10.00	6.90
High	5240	24.00	22.51	19.41	19.41	11.00	10.00	6.90

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD

Output Power Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	FCC Power Limit (dBm)	FCC Power Margin (dB)	ISED Power Limit (dBm)	ISED Power Margin (dB)
Low	5180	12.92	12.92	24.00	-11.08	19.42	-6.50
Mid	5200	12.89	12.89	24.00	-11.11	19.44	-6.55
High	5240	12.86	12.86	24.00	-11.14	19.41	-6.55

PSD Results

Channel	Frequency (MHz)	Meas PSD (dBm/ 1MHz)	Total Corr'd PSD (dBm/ 1MHz)	ISED PSD Limit (dBm/ 1MHz)	ISED PSD Margin (dB)	FCC PSD Limit (dBm/ 1MHz)	FCC PSD Margin (dB)
Low	5180	1.177	1.177	6.90	-5.72	11.00	-9.82
Mid	5200	1.177	1.177	6.90	-5.72	11.00	-9.82
High	5240	1.273	1.273	6.90	-5.63	11.00	-9.73

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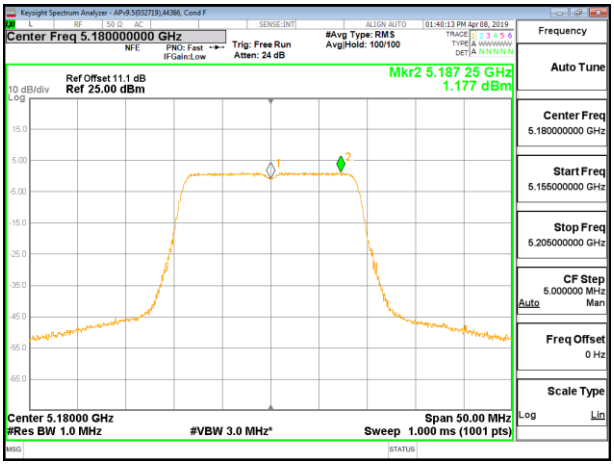
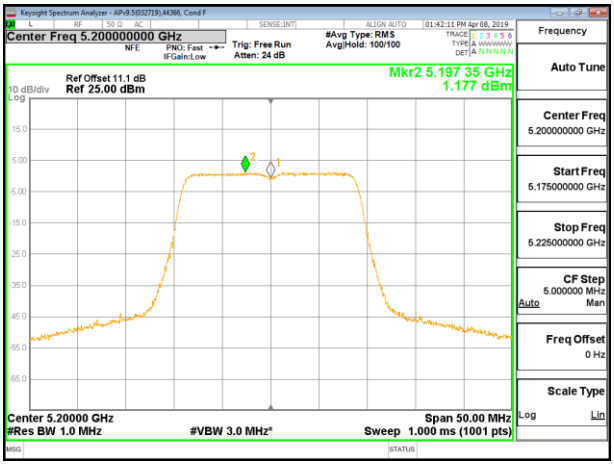
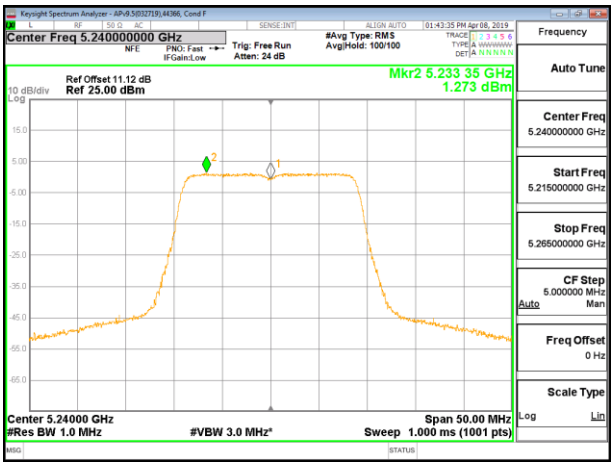


LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.5.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5190	40.90	36.44	3.10
High	5230	40.90	36.60	3.10

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	Max ISED Power Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm/1MHz)	ISED PSD Limit (dBm/1MHz)	Max ISED PSD Limit (dBm/1MHz
Low	5190	24.00	23.00	19.90	19.90	11.00	10.00	6.90
High	5230	24.00	23.00	19.90	19.90	11.00	10.00	6.90

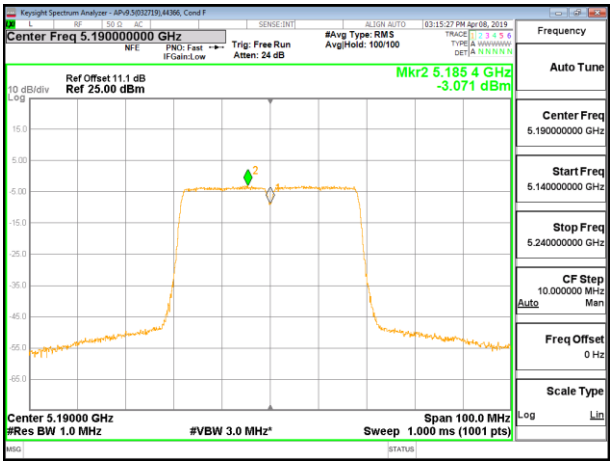
Duty Cycle CF (dB)	0.09	Included in Calculations of Corr'd Power & PSD

Output Power Results

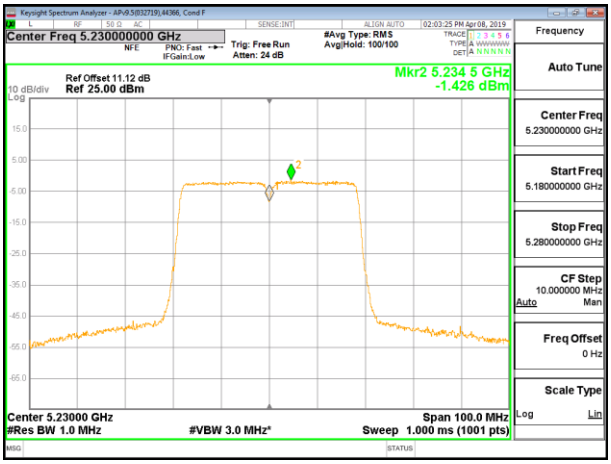
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	FCC Power Limit (dBm)	FCC Power Margin (dB)	ISED Power Limit (dBm)	ISED Power Margin (dB)
Low	5190	11.41	11.41	24.00	-12.59	19.90	-8.49
High	5230	12.88	12.88	24.00	-11.12	19.90	-7.02

PSD Results

Channel	Frequency (MHz)	Meas PSD (dBm/ 1MHz)	Total Corr'd PSD (dBm/ 1MHz)	ISED PSD Limit (dBm/ 1MHz)	ISED PSD Margin (dB)	FCC PSD Limit (dBm/ 1MHz)	FCC PSD Margin (dB)
Low	5190	-3.07	-2.98	6.90	-9.88	11.00	-13.98
High	5230	-1.43	-1.34	6.90	-8.24	11.00	-12.34



LOW CHANNEL



HIGH CHANNEL

8.5.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Mid	5210	84.00	75.61	3.10

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	Max ISED Power Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm/1MHz)	ISED PSD Limit (dBm/1MHz)	Max ISED PSD Limit (dBm/1MHz
Mid	5210	24.00	23.00	19.90	19.90	11.00	10.00	6.90

Duty Cycle CF (dB)	0.21	Included in Calculations of Corr'd Power & PSD

Output Power Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	FCC Power Limit (dBm)	FCC Power Margin (dB)	ISED Power Limit (dBm)	ISED Power Margin (dB)
Mid	5210	10.91	10.91	24.00	-13.09	19.90	-8.99

PSD Results

Channel	Frequency (MHz)	Meas PSD (dBm/ 1MHz)	Total Corr'd PSD (dBm/ 1MHz)	ISED PSD Limit (dBm/ 1MHz)	ISED PSD Margin (dB)	FCC PSD Limit (dBm/ 1MHz)	FCC PSD Margin (dB)
Mid	5210	-6.12	-5.91	6.90	-12.81	11.00	-16.91

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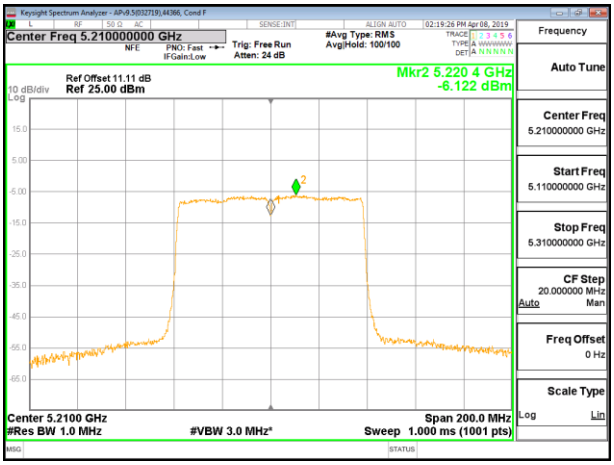


MID CHANNEL

8.5.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5260	21.40	17.939	2.60
Mid	5300	21.65	17.741	2.60
High	5320	21.60	17.771	2.60

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm/1MHz)	ISED PSD Limit (dBm/1MHz)	PSD Limit (dBm/1MHz)
Low	5260	24.00	23.54	29.54	23.54	11.00	11.00	11.00
Mid	5300	24.00	23.49	29.49	23.49	11.00	11.00	11.00
High	5320	24.00	23.50	29.50	23.50	11.00	11.00	11.00

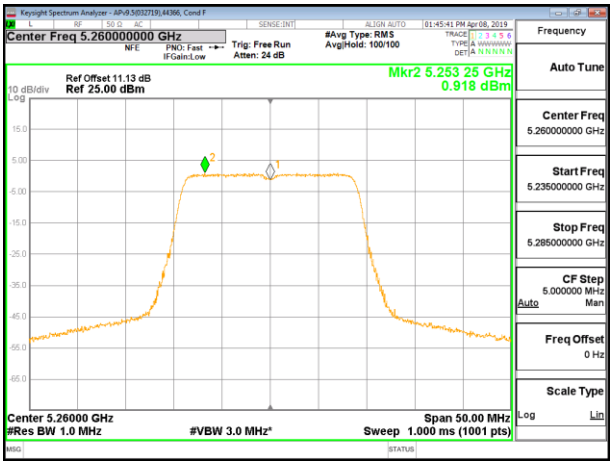
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD

Output Power Results

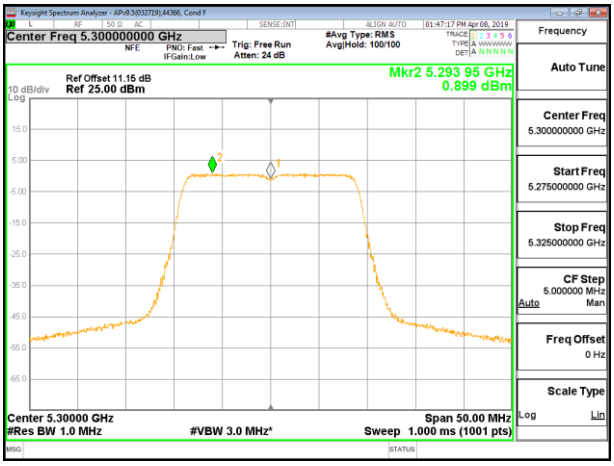
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	FCC Power Limit (dBm)	FCC Power Margin (dB)	ISED Power Limit (dBm)	ISED Power Margin (dB)
Low	5260	12.65	12.65	24.00	-11.35	23.54	-10.89
Mid	5300	12.64	12.64	24.00	-11.36	23.49	-10.85
High	5320	12.60	12.60	24.00	-11.40	23.50	-10.90

PSD Results

Channel	Frequency (MHz)	Meas PSD (dBm/ 1MHz)	Total Corr'd PSD (dBm/ 1MHz)	PSD Limit (dBm/ 1MHz)	PSD Margin (dB)
Low	5260	0.918	0.918	11.00	-10.08
Mid	5300	0.899	0.899	11.00	-10.10
High	5320	0.831	0.831	11.00	-10.17



LOW CHANNEL



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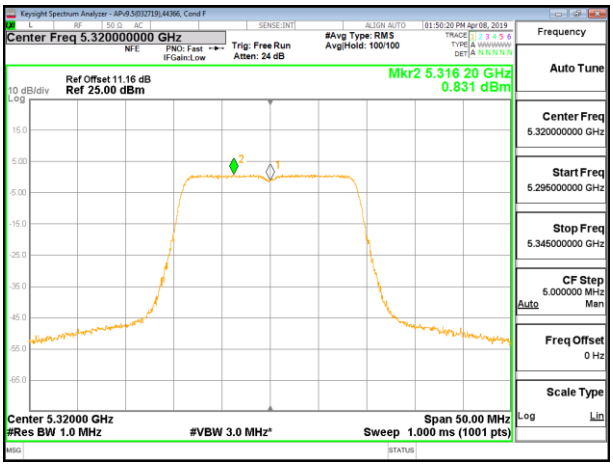

HIGH CHANNEL

8.5.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5270	41.00	36.67	2.60
High	5310	40.70	36.22	2.60

Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	ISED Power Limit (dBm)	ISED EIRP Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm/1MHz	ISED PSD Limit (dBm/1MHz)	PSD Limit (dBm/1MHz)
Low	5270	24.00	24.00	30.00	24.00	11.00	11.00	11.00
High	5310	24.00	24.00	30.00	24.00	11.00	11.00	11.00

Duty Cycle CF (dB)	0.09	Included in Calculations of Corr'd Power & PSD

Output Power Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	FCC/ISED Power Limit (dBm)	FCC/ISED Power Margin (dB)
Low	5270	12.64	12.64	24.00	-11.36
High	5310	12.67	12.67	24.00	-11.33

PSD Results

Channel	Frequency (MHz)	Meas PSD (dBm/ 1MHz)	Total Corr'd PSD (dBm/ 1MHz)	PSD Limit (dBm/ 1MHz)	PSD Margin (dB)
Low	5270	-1.763	-1.673	11.00	-12.67
High	5310	-1.854	-1.764	11.00	-12.76

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