



# **CERTIFICATION TEST REPORT**

**Report Number. :** 11934192-E5V2

**Applicant :** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**Model :** A1862

**FCC ID :** BCGA1862

**EUT Description :** DESKTOP COMPUTER

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART E

**Date Of Issue:**  
December 08, 2017

**Prepared by:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888

## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	11/15/2017	Initial Issue	Francisco Guarnero
V2	12/08/2017	Addressed TCB questions	Jin Li

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** DESKTOP COMPUTER

**MODEL:** A1862

**SERIAL NUMBER:** C02TW087HR64 (CONDUCTED) C02VJ008GHVL (RADIATED)

**DATE TESTED:** AUGUST 17, 2017 – NOVEMBER 03, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

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 any government.

Approved & Released For  
UL Verification Services Inc. By:

Prepared By:



CHIN PANG  
CONSUMER TECHNOLOGY DIVISION  
SENIOR TEST ENGINEER  
UL Verification Services Inc.



FRANCISCO GUARNERO  
CONSUMER TECHNOLOGY DIVISION  
TEST ENGINEER  
UL Verification Services Inc.

## 2. SUMMARY OF TESTING

### 2.1. 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
<input type="checkbox"/> Chamber A (IC:2324B-1)	<input checked="" type="checkbox"/> Chamber D (IC:22541-1)
<input type="checkbox"/> Chamber B (IC:2324B-2)	<input checked="" type="checkbox"/> Chamber E (IC:22541-2)
<input type="checkbox"/> Chamber C (IC:2324B-3)	<input type="checkbox"/> Chamber F (IC:22541-3)
	<input type="checkbox"/> Chamber G (IC:22541-4)
	<input type="checkbox"/> Chamber H (IC:22541-5)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

### 2.2. SUMMARY TABLE

FCC Part Section	RSS Section	Test Description	Test Limit	Test Condition	Test Result
§15.407 (a)	RSS-247	Occupied Band width (26dB)	N/A	Conducted	Pass
§15.407	RSS-247 6.2.4	6dB Band width (5.8Ghz)	>500KHz		Pass
§15.407 (a)(1)	RSS-247 6.2	TX Cond. Power 5.15-5.25 GHz	<24dBm (FCC) / <23 dBm EIRP or <10+10Log(99% BW) EIRP (IC)		Pass
§15.407 (a)(2)	RSS-247 6.2	TX Cond. Power 5.25-5.35 & 5.47-5.725 GHz	<11+10log (OBW) (FCC) / <24 dBm or <11+10Log(99% BW) (IC)		Pass
§15.407 (a)(3)	RSS-247 6.2.4	TX Cond. Power 5.725-5.850 GHz	<30dBm		Pass
§15.407 (a)(1)	RSS-247 6.2	PSD (5.15-5.25 GHz)	<11dBm/MHz (FCC) <10 dBm/MHz EIRP (IC)		Pass
§15.407 (a)(2)	RSS-247 6.2	PSD (5.3,5.5GHz)	<11dBm/MHz		Pass
§15.407 (a)(3)	RSS-247 6.2.4	PSD (5.8GHz)	<30dBm per 500kHz		
§15.207 (a) §15.407(b) (6)	RSS-GEN 8.8	AC Power Line conducted emissions	Section 10		Pass
§15.407 (b) & 15.209	RSS-GEN 8.9/7	Radiated Spurious Emission	<54dBuV/m	Radiated	Pass

## 2.3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 789033 D02 v01r02, KDB 662911, ANSI C63.10-2013, RSS-GEN Issue 4, RSS-247 Issue 2.

## 2.4. CALIBRATION AND UNCERTAINTY

### 2.4.1. 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.

### 2.4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 2.4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Radiated Disturbance, 26000 to 40000 MHz	5.24 dB
Occupied Channel Bandwidth	±0.39 %
Time	±0.02 %

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

## **2.5. MEASUREMENT METHOD**

6 dB Emission BW: KDB 789033 D02 v01r04, Section C.

26 dB Emission BW: KDB 789033 D02 v01r04, Section C.

99% Occupied BW: KDB 789033 D02 v01r04, Section D.

Conducted Output Power: KDB 789033 D02 v01r04, Section E.3.b (Method PM-G).

Power Spectral Density: KDB 789033 D02 v01r04, Section F (Method SA-2).

Unwanted emissions in restricted bands: KDB 789033 D02 v01r04, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r04, Sections G.3, G.4, and G.5.

Conducted line emissions: C63.10, Clause 6.2



## 2.6. 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	Asset	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T711	1/30/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	11/29/17
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T340	12/14/2017
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T346	3/28/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T900	5/31/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T741	11/29/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T285	6/24/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T906	2/14/2018
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	3/28/2018
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T742	11/29/2017
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	03/20/2018
Power Meter, P-series single channel	Keysight	N1912A	T1244	6/15/2018
Power Sensor	Keysight	N1921A	T1224	1/31/2018
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	7/23/2018
Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T89	1/04/2018
Amplifier 26-40Ghz	Miteq	NSP 4000 SP2	T88	4/29/2018
Antenna Horn 26-40GHz	ARA	MWH-2640	T90	8/25/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T459	6/22/2018
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESC17	T1436	01/06/2018
Power Cable, Line Conducted Emissions	UL	PG1	T861	8/31/2018
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	

### 3. EQUIPMENT UNDER TEST

#### 3.1. DESCRIPTION OF EUT

The Apple iMac Pro is a desktop computer, with 27-inch Retina display, storage media, multimedia functions, IEEE 802.11a/b/g/n/ac radio and Bluetooth radio.

#### 3.2. 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)
<b>5.2 GHz band, 1TX</b>			
5180-5240	802.11a	Covered by 802.11n HT20 SISO	
5180-5240	802.11n HT20	19.84	96.38
5190-5230	802.11n HT40	18.83	76.38
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	10.34	10.81

##### 5.3 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
<b>5.3 GHz band, 1TX</b>			
5260 - 5320	802.11a	Covered by 802.11n HT20 SISO	
5260 - 5320	802.11n HT20	19.75	94.41
5270 - 5310	802.11n HT40	18.82	76.21
5260 - 5320	802.11ac VHT20	Covered by 802.11n HT20 SISO	
5270 - 5310	802.11ac VHT40	Covered by 802.11n HT40 SISO	
5290	802.11ac VHT80	11.43	13.90

##### 5.6 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
<b>5.6 GHz band, 1TX</b>			
5500-5720	802.11a	Covered by 802.11n HT20 SISO	
5500-5720	802.11n HT20	19.77	94.84
5510-5710	802.11n HT40	21.58	143.88
5500-5720	802.11ac VHT20	Covered by 802.11n HT20 SISO	
5510-5710	802.11ac VHT40	Covered by 802.11n HT40 SISO	
5530-5690	802.11ac VHT80	21.73	148.94

### 5.8 GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
<b>5.8 GHz band, 1TX</b>			
5745-5825	802.11a	Covered by 802.11n HT20 SISO	
5745-5825	802.11n HT20	21.80	151.36
5755-5795	802.11n HT40	18.82	76.21
5745-5825	802.11ac VHT20	Covered by 802.11n HT20 SISO	
5755-5795	802.11ac VHT40	Covered by 802.11n HT40 SISO	
5775	802.11ac VHT80	17.90	61.66

### 3.3. DESCRIPTION OF AVAILABLE ANTENNAS

Antenan Num	Peak Gain 5150-5250 MHz	Peak Gain 5250-5350 MHz	Peak Gain 5470-5725 MHz	Peak Gain 5725-5850 MHz
WF4	4.2	3.9	4.2	3.1

### 3.4. WORST-CASE CONFIGURATION AND MODE

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 highest SISO modes as worst-case scenario.

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

Radiated emissions below 30MHz, below 1GHz, above 18GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

All radiated testing was performed with the EUT in normal use orientation.

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

802.11a mode: 6 Mbps  
802.11n HT20 mode: MCS0  
802.11n HT40 mode: MCS0  
802.11ac VHT20 mode: MCS0  
802.11ac VHT40 mode: MCS0  
802.11ac VHT80 mode: MCS0

### 3.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 9.30.121.47

The test utility software used during testing (r711441 WLTEST) FWID 01-f52a9c20

### 3.6. DESCRIPTION OF TEST SETUP

#### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Keyboard	Apple	A1243	CC2420202BHDPQVAV	N/A
Mouse	Apple	A1152	CC23304069XDNYPAO	N/A

#### 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	4	SMA	Un-Shielded	0.2	N/A
2	AC	1	120Vac	Un-Shielded	3	N/A

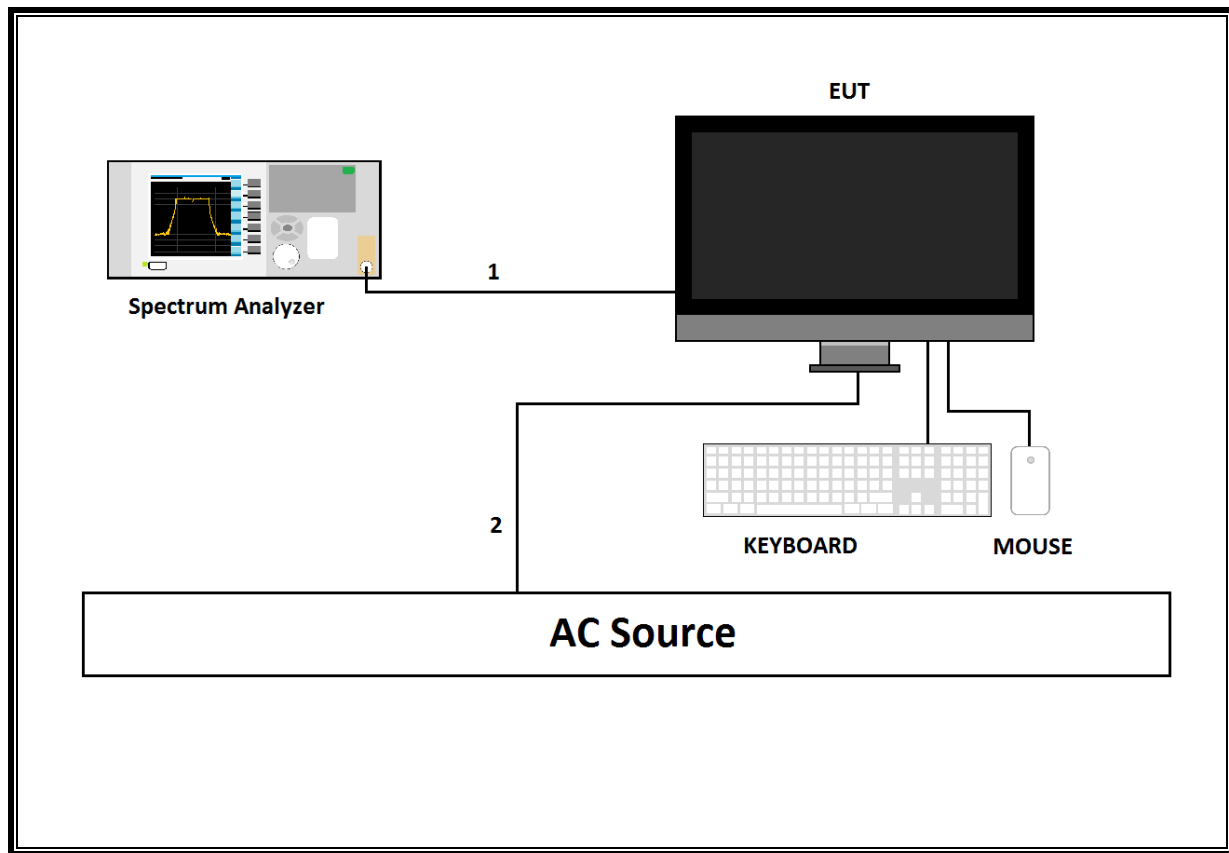
#### I/O CABLES (Radiated Test)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
2	AC	1	120Vac	Un-Shielded	3	N/A

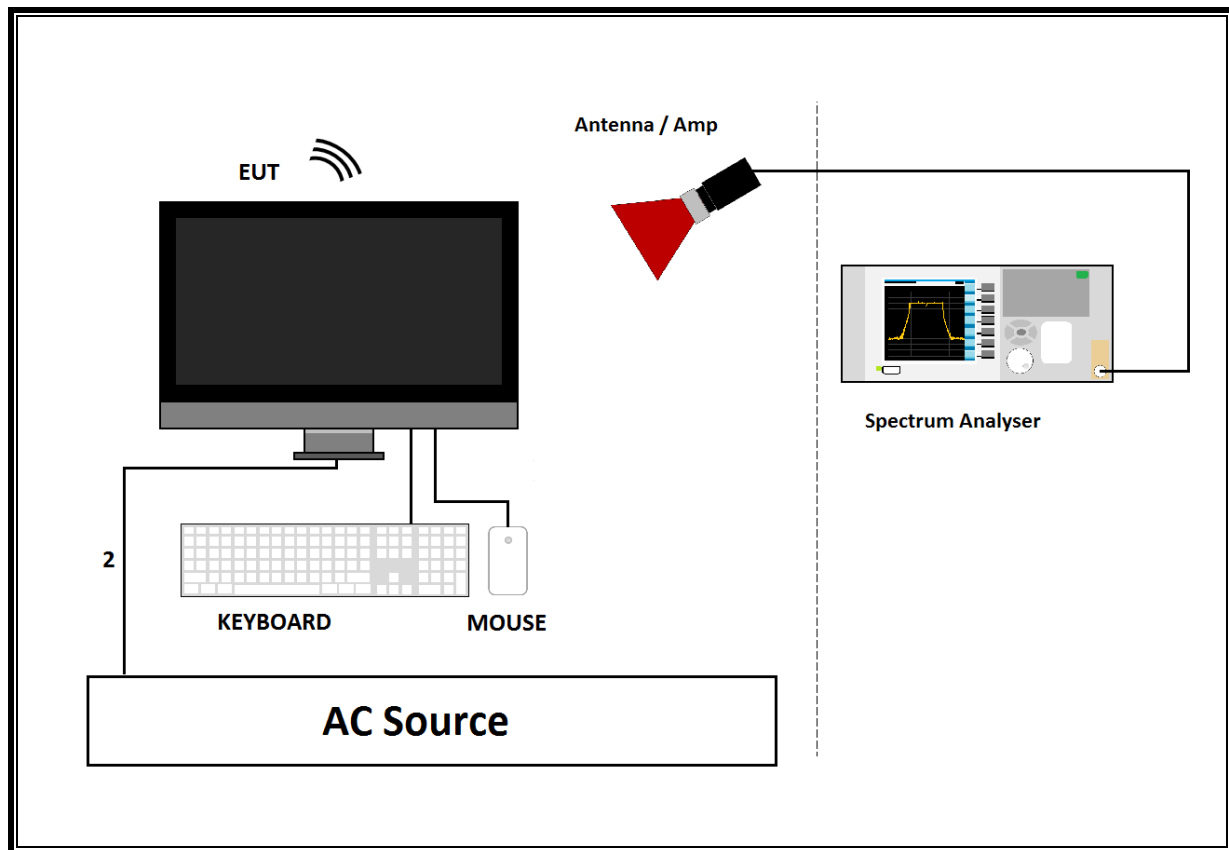
#### TEST SETUP

The EUT was power by AC Source. Test software exercised the EUT.

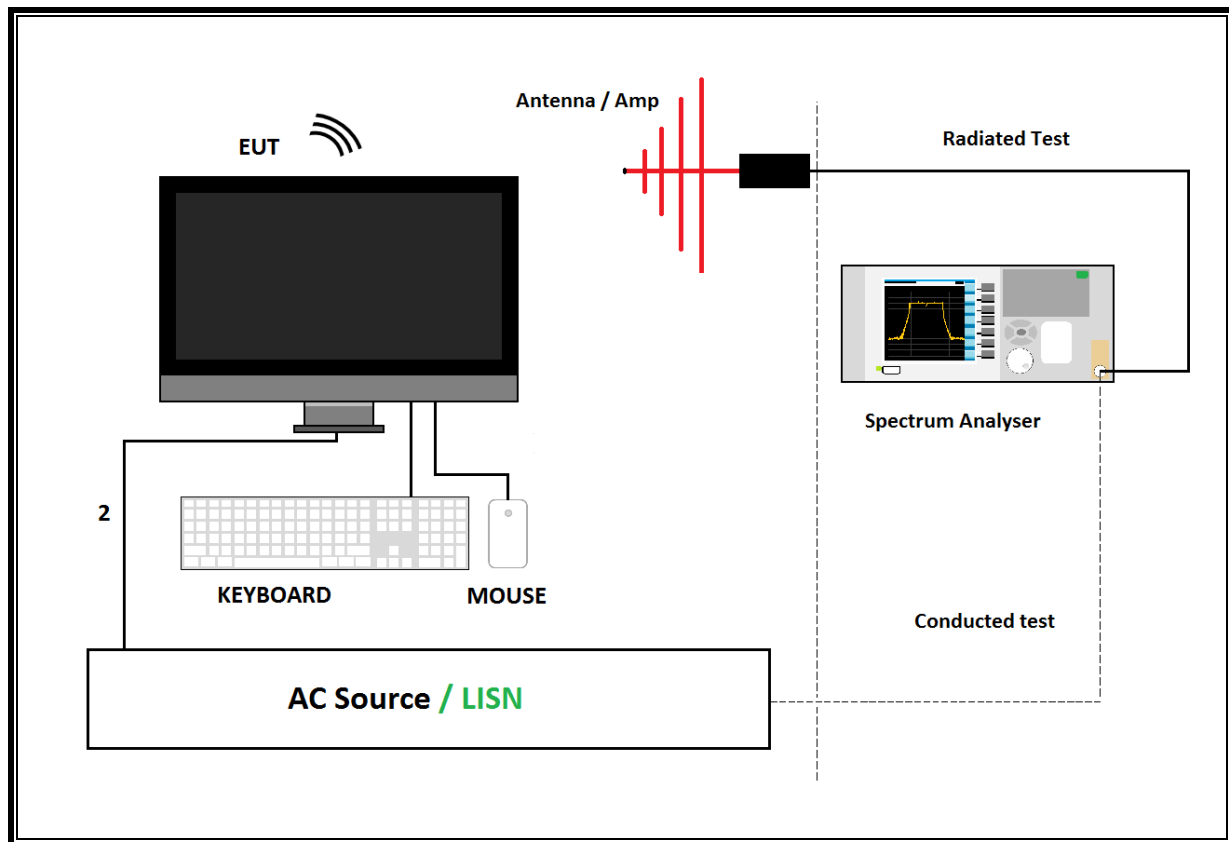
**SETUP DIAGRAM FOR CONDUCTED TESTS**



**SETUP DIAGRAM FOR RADIATED TESTS**



**SETUP DIAGRAM FOR BELOW 1GHz AND LINE CONDUCTED TEST**



## 4. ANTENNA PORT TEST RESULTS

### 4.1. ON TIME, DUTY CYCLE

#### ON TIME AND DUTY CYCLE

#### PROCEDURE

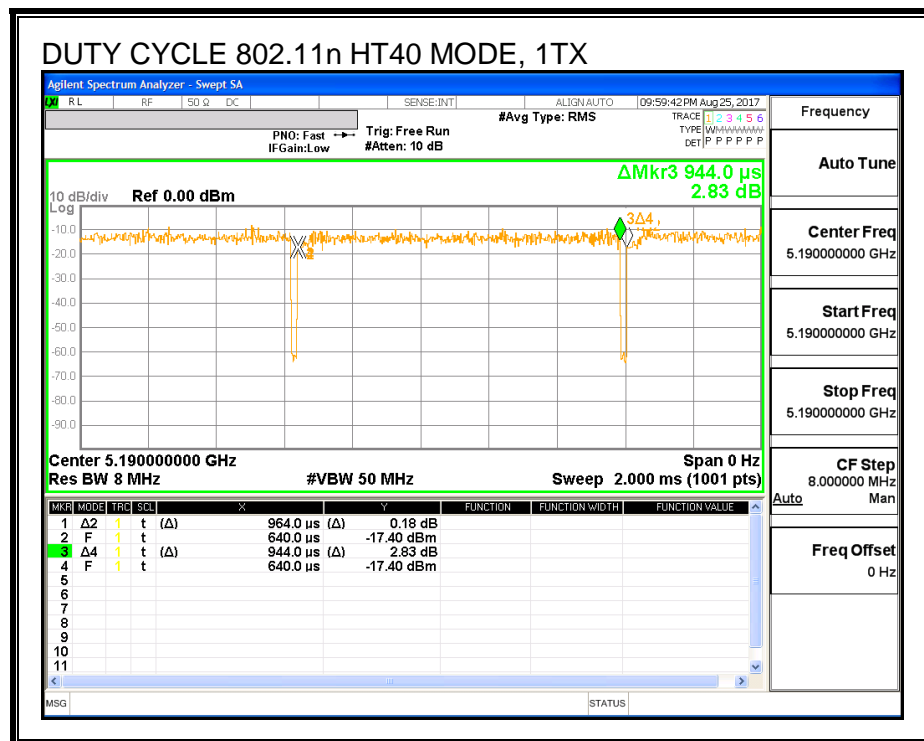
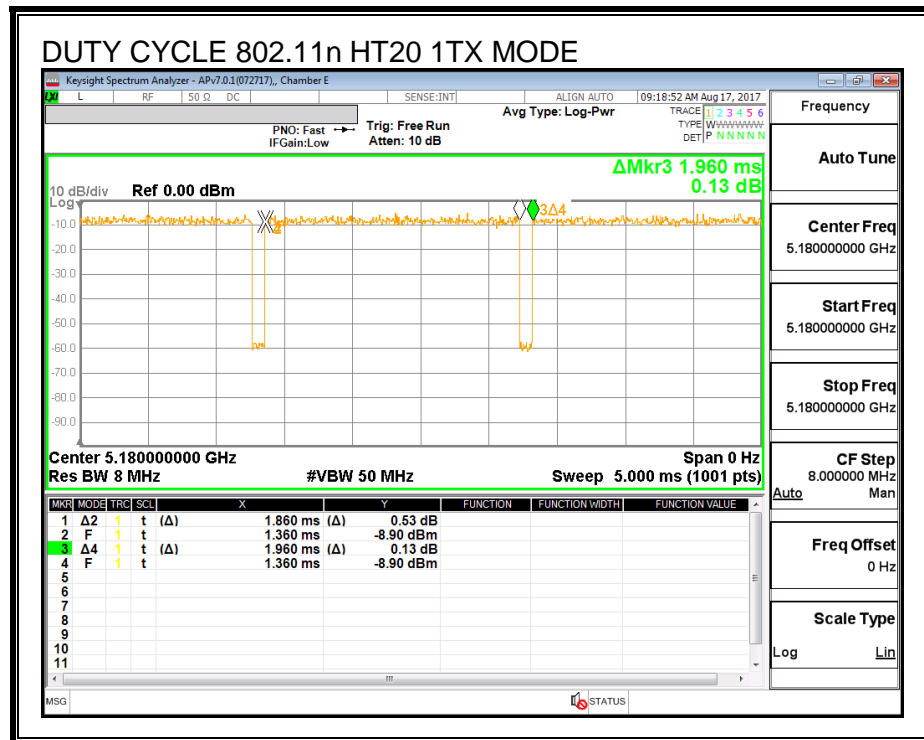
KDB 789033 Zero-Span Spectrum Analyzer Method.

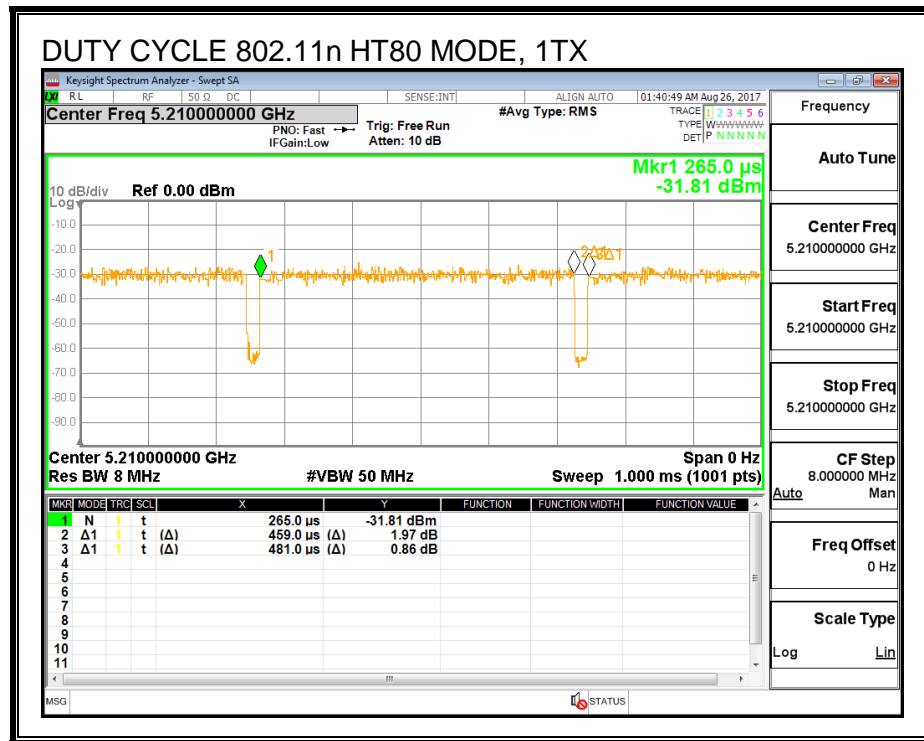
#### RESULTS

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	1.860	1.960	0.949	94.90%	0.23	0.538
802.11n HT40 1TX	0.944	0.964	0.979	97.93%	0.09	1.059
802.11ac VHT80 1TX	0.459	0.481	0.954	95.43%	0.20	2.179



# DUTY CYCLE PLOTS





## 4.2. 26 dB BANDWIDTH

### LIMITS

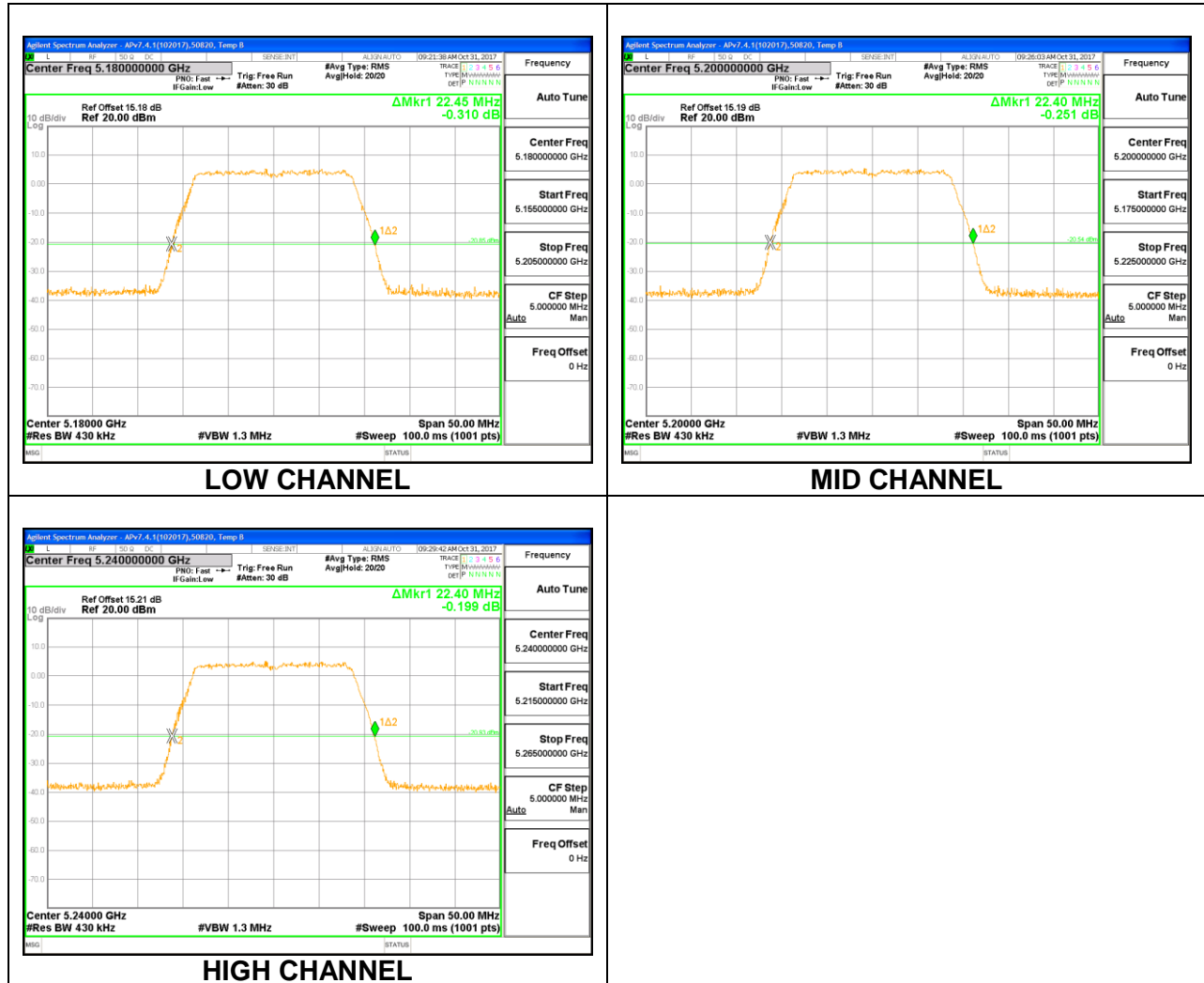
None; for reporting purposes only.

### RESULTS

#### 4.2.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

##### 1TX Antenna WF4

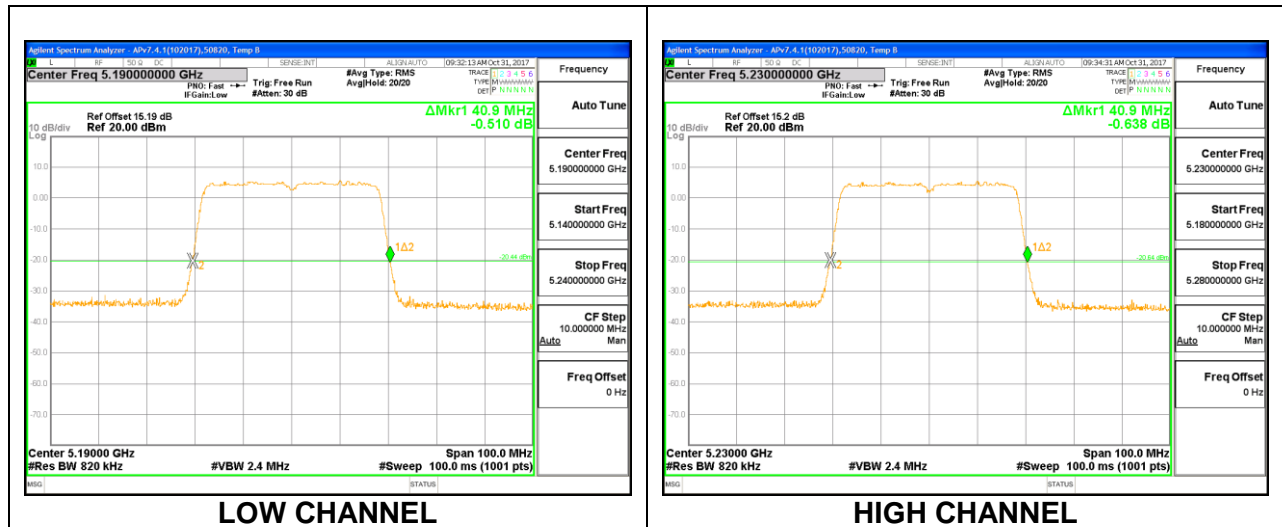
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	22.45
Mid	5200	22.40
High	5240	22.40



## 4.2.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

### 1TX Antenna WF4

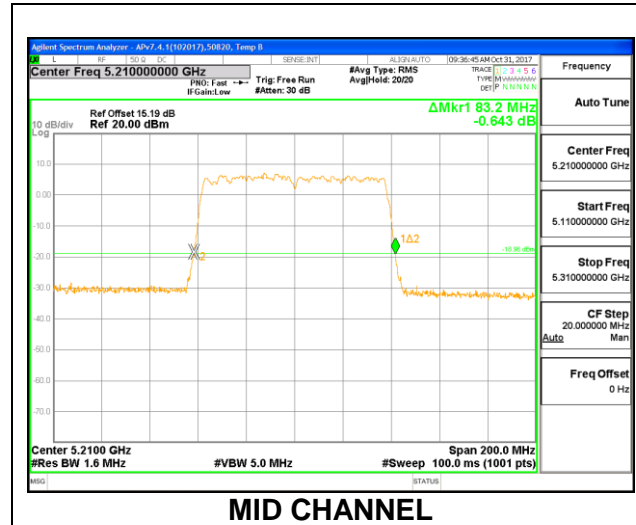
Channel	Frequency	26dB Bandwidth
	(MHz)	(MHz)
Low	5190	40.90
High	5230	40.90



### 4.2.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

#### 1TX Antenna WF4

Channel	Frequency	26 dB Bandwidth
	(MHz)	(MHz)
Mid	5210	83.20



## 4.2.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

### 1TX Antenna WF4

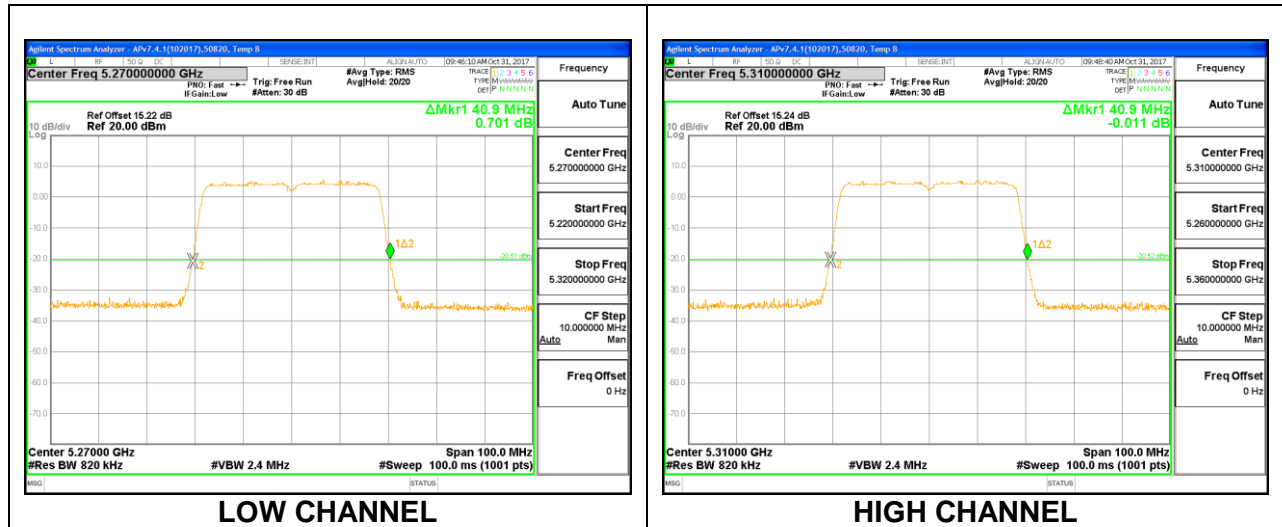
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	22.40
Mid	5300	22.35
High	5320	22.45



## 4.2.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

### 1TX Antenna WF4

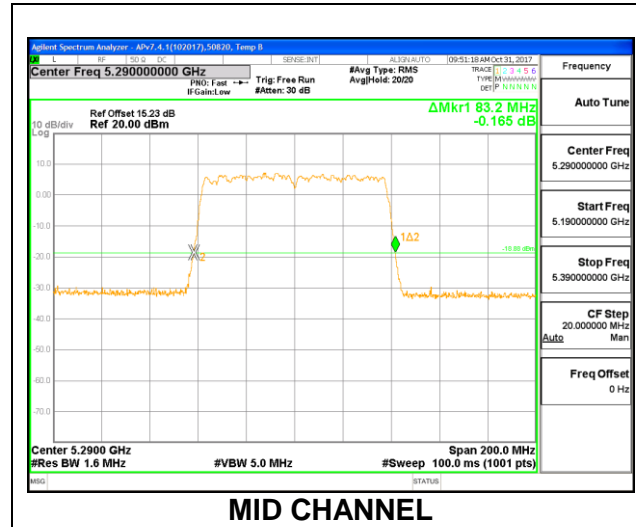
Channel	Frequency	26dB Bandwidth
	(MHz)	(MHz)
Low	5270	40.90
High	5310	40.90



## 4.2.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

### 1TX Antenna WF4

Channel	Frequency	26 dB Bandwidth
	(MHz)	(MHz)
Mid	5290	83.20

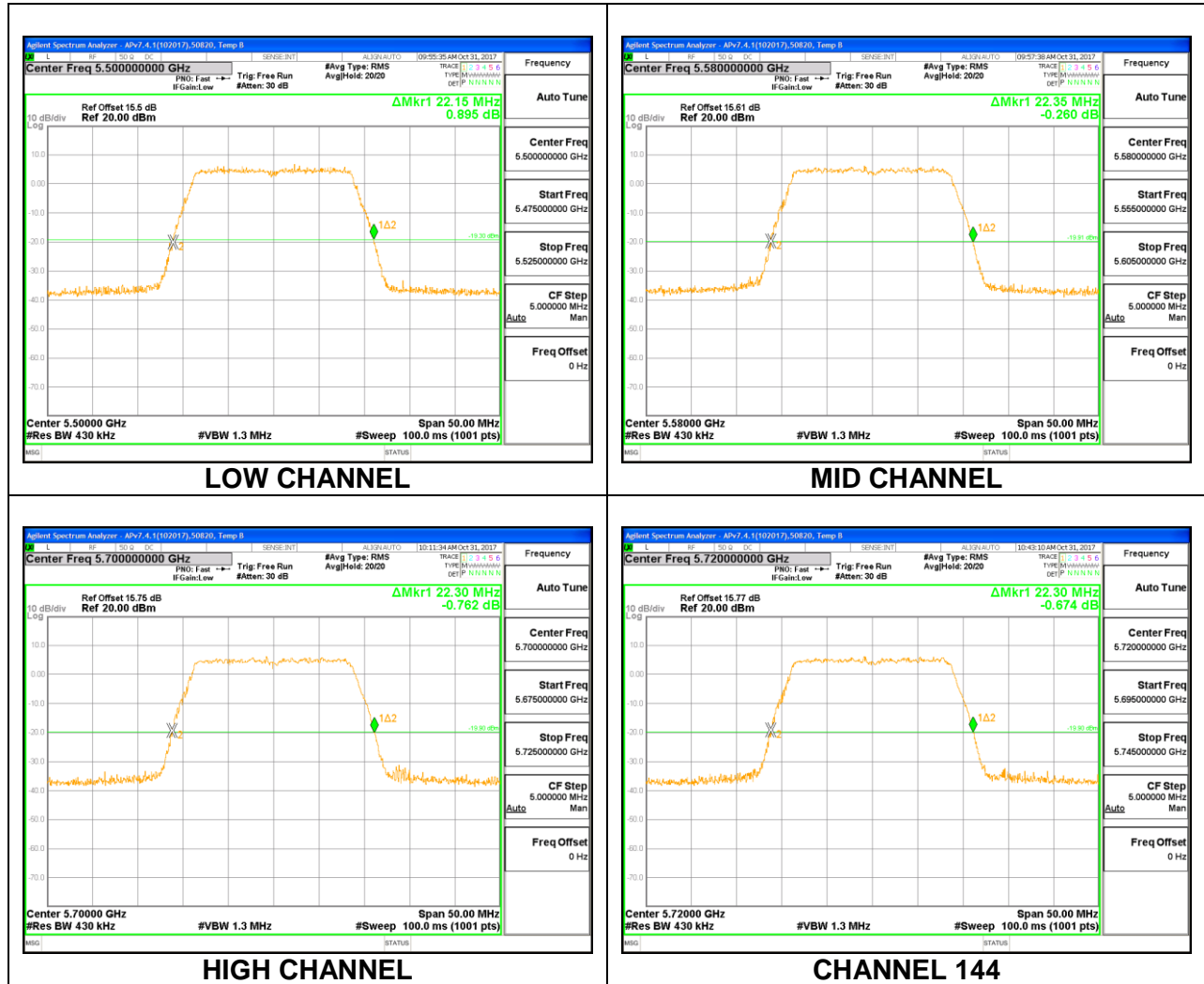




## 4.2.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

### 1TX Antenna WF4

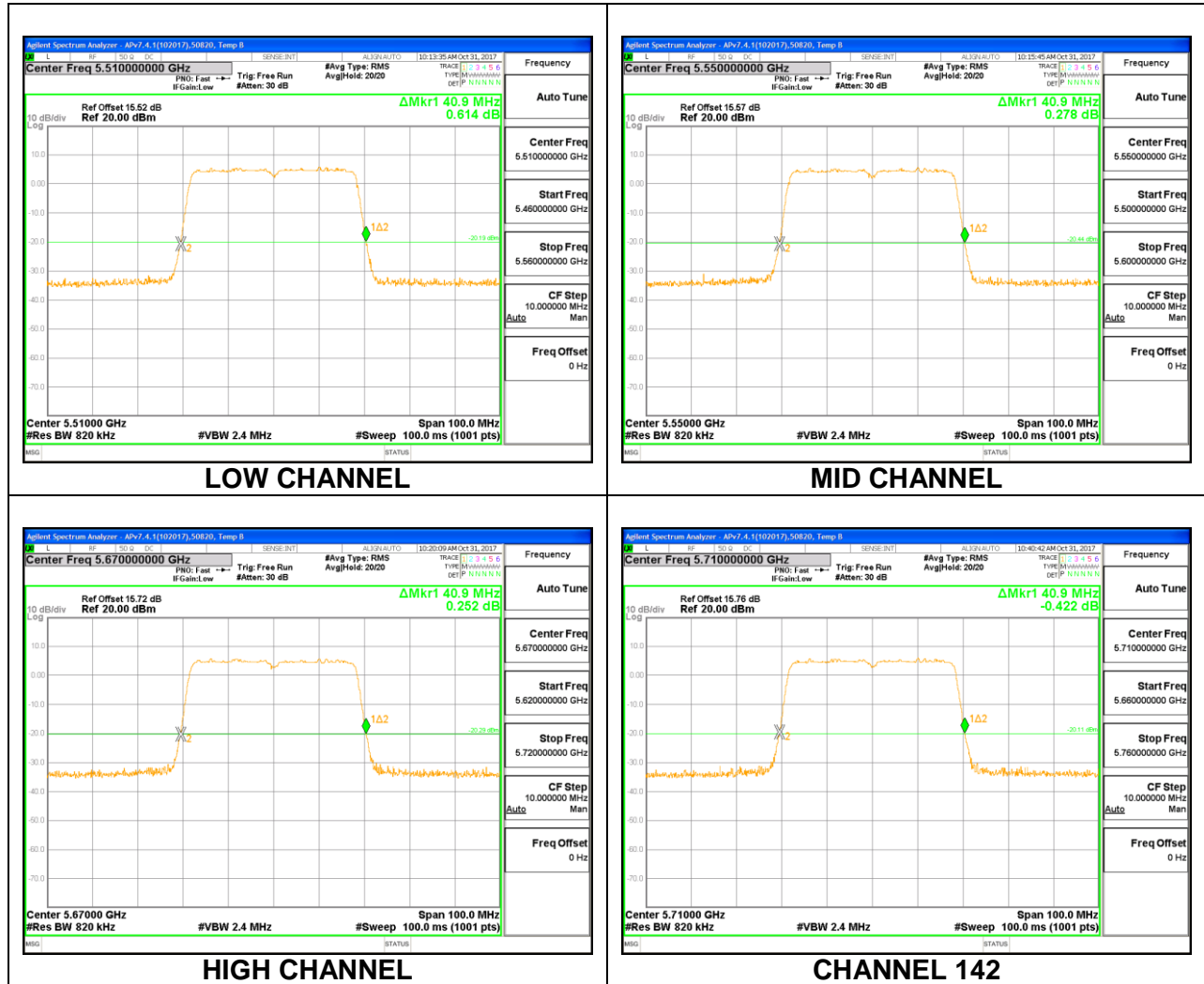
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	22.15
Mid	5580	22.35
High	5700	22.30
144	5720	22.30



## 4.2.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

### 1TX Antenna WF4

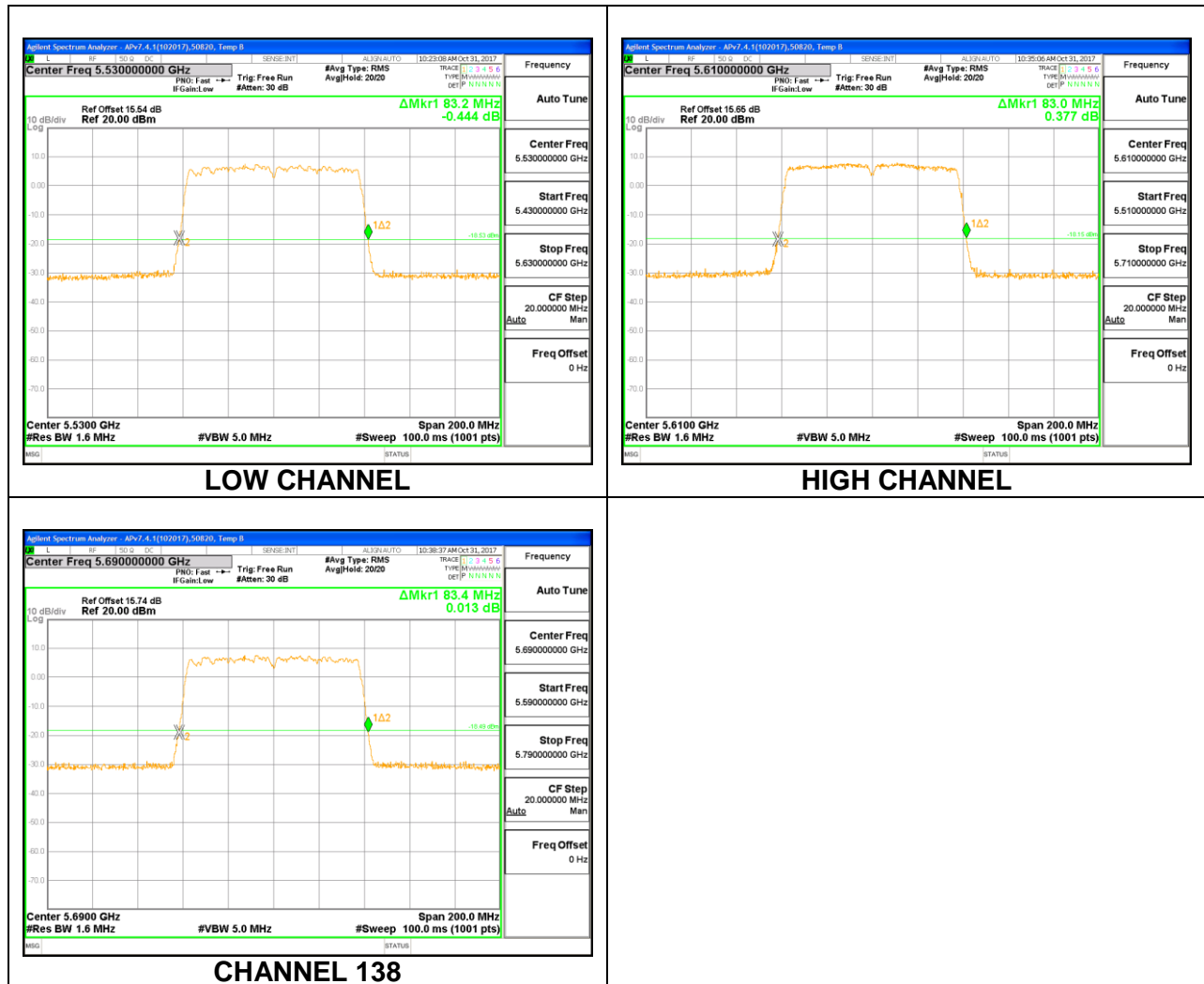
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	40.90
Mid	5550	40.90
High	5670	40.90
142	5710	40.90



## 4.2.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

### 1TX Antenna WF4

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5530	83.20
High	5610	83.00
138	5690	83.40



## 4.2.10. 802.11n HT20 MODE IN THE 5.8 GHz BAND

### 1TX Antenna WF4

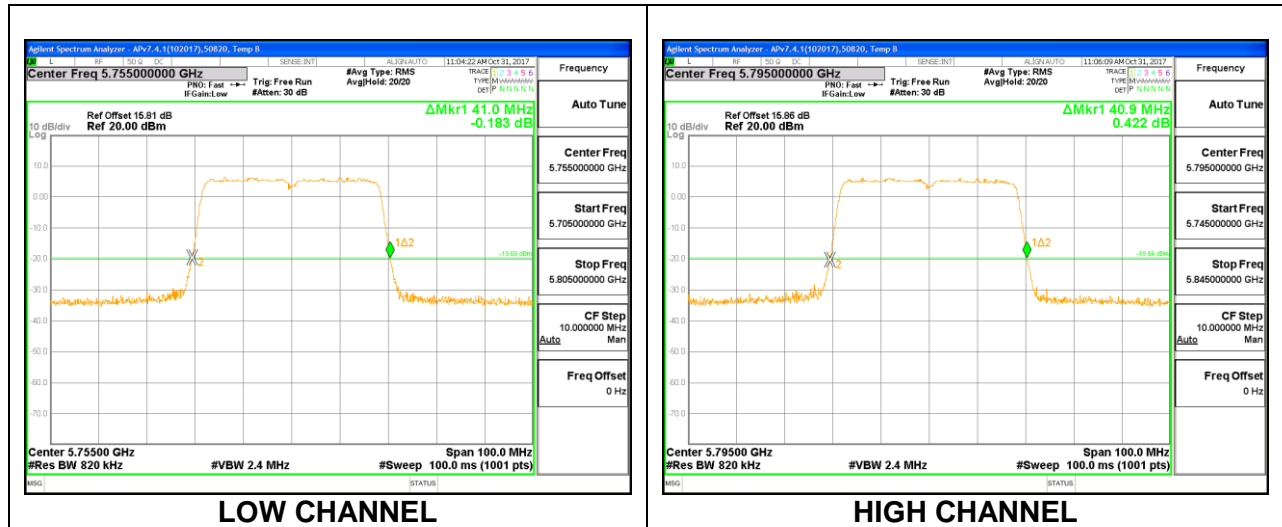
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5745	22.15
Mid	5785	22.40
High	5825	22.35



## 4.2.11. 802.11n HT40 MODE IN THE 5.8 GHz BAND

### 1TX Antenna WF4

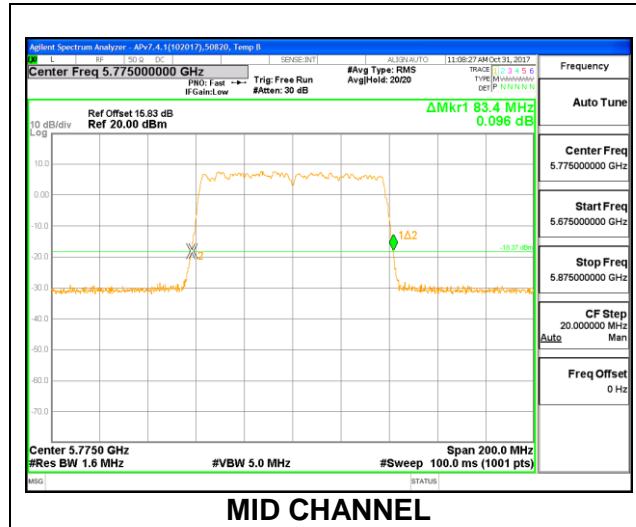
Channel	Frequency	26dB Bandwidth
	(MHz)	(MHz)
Low	5755	41.00
High	5795	40.90



## 4.2.12. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

### 1TX Antenna WF4

Channel	Frequency	26 dB Bandwidth
	(MHz)	(MHz)
Mid	5775	83.40



### **4.3. 99% BANDWIDTH**

#### **LIMITS**

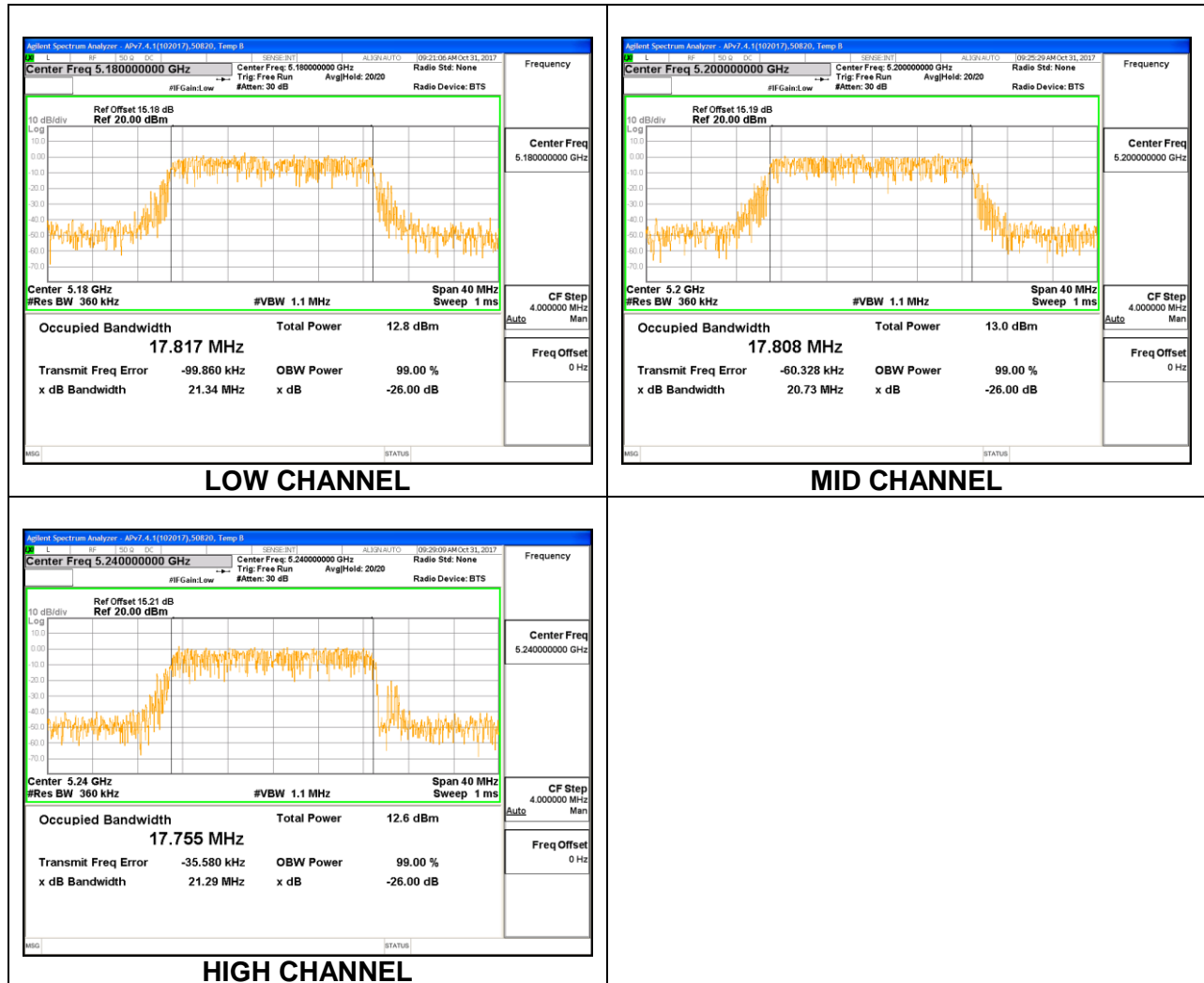
None; for reporting purposes only.

#### **RESULTS**

### 4.3.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND

#### 1TX Antenna WF4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.817
Mid	5200	17.808
High	5240	17.755

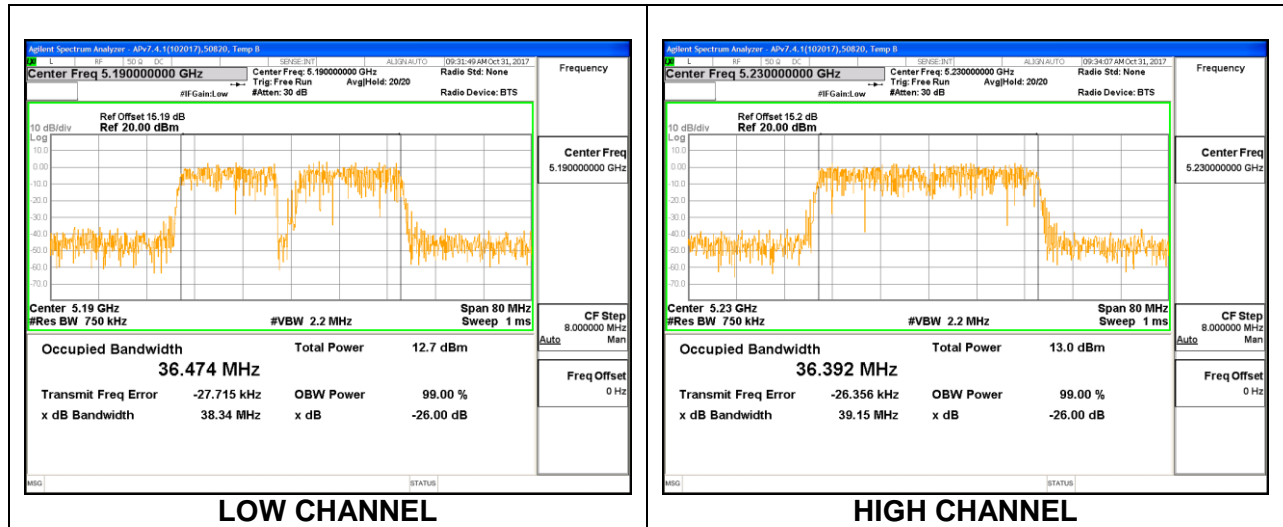




### 4.3.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

#### 1TX Antenna WF4

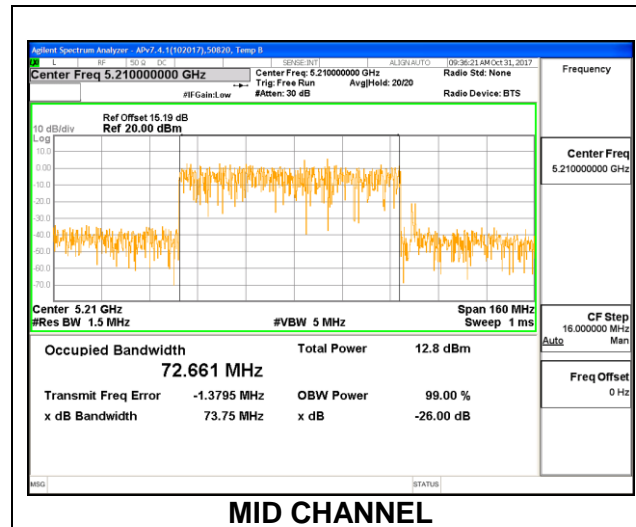
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	5190	36.474
High	5230	36.392



### 4.3.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

#### 1TX Antenna WF4

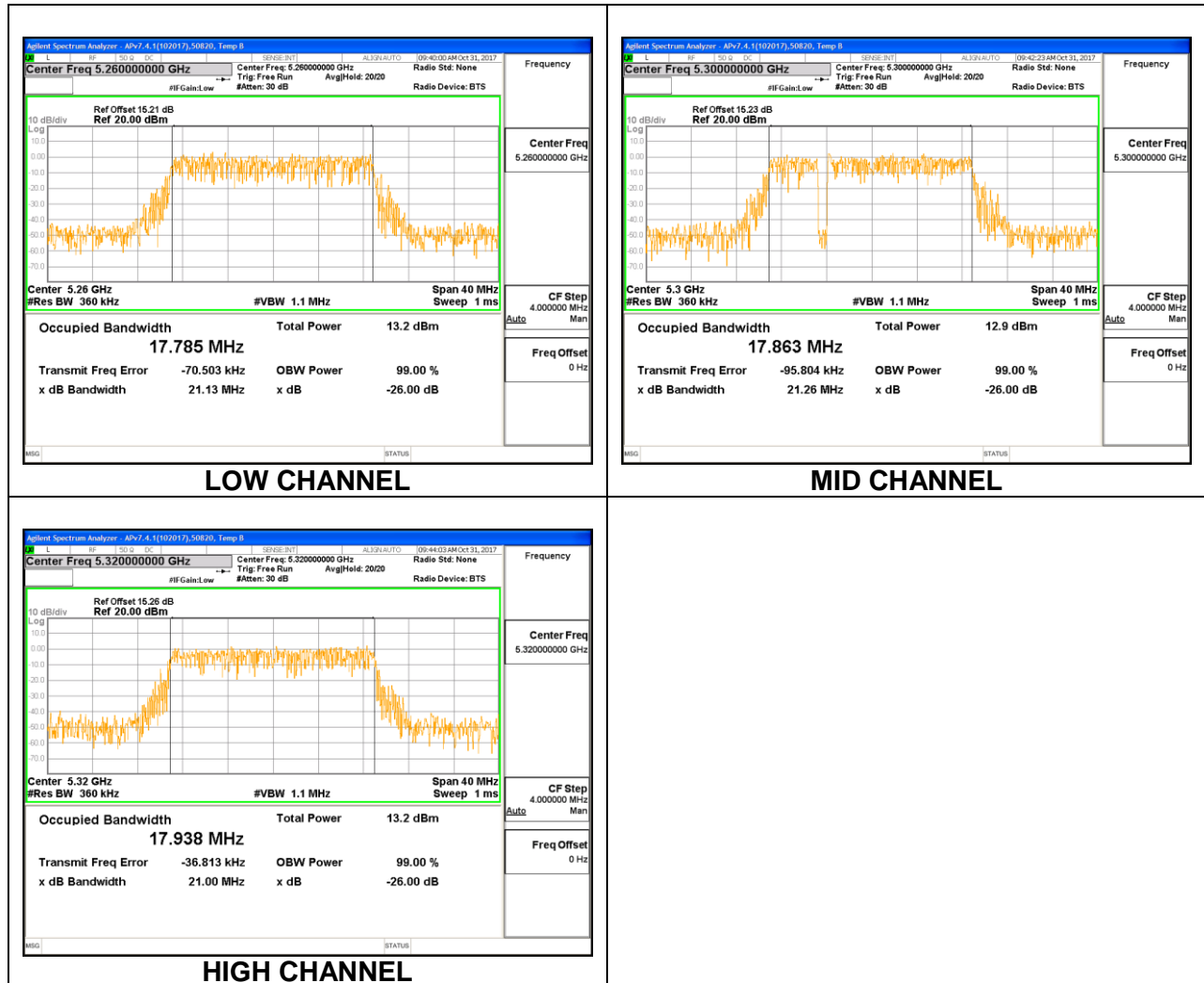
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Mid	5210	72.661



### 4.3.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

#### 1TX Antenna WF4

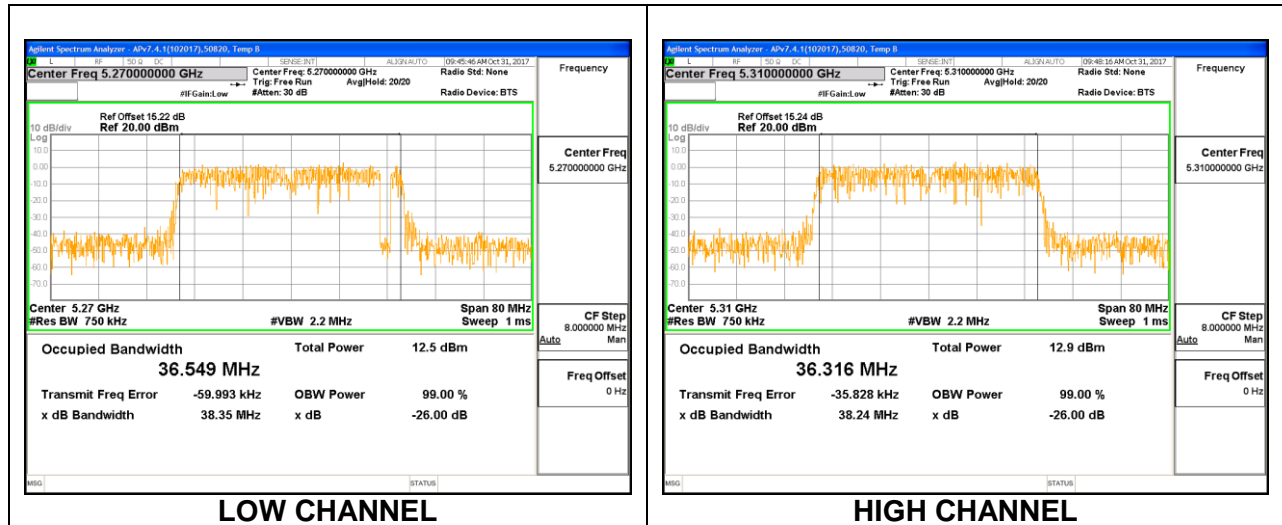
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.785
Mid	5300	17.863
High	5320	17.938



### 4.3.5. 802.11n HT40 MODE IN THE 5.3 GHz BAND

#### 1TX Antenna WF4

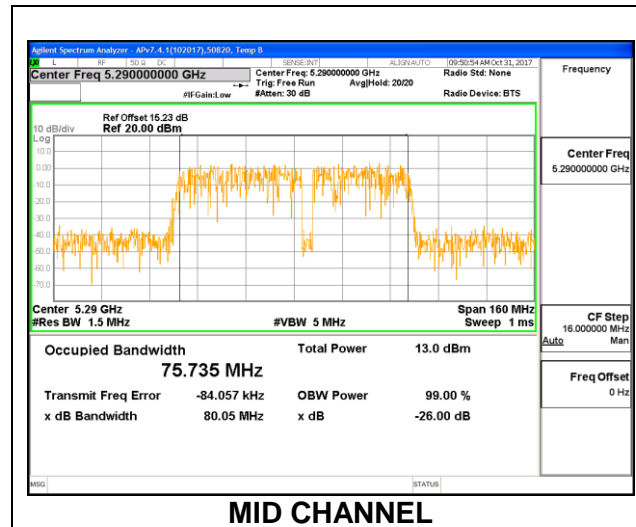
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	5270	36.549
High	5310	36.316



### 4.3.6. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

#### 1TX Antenna WF4

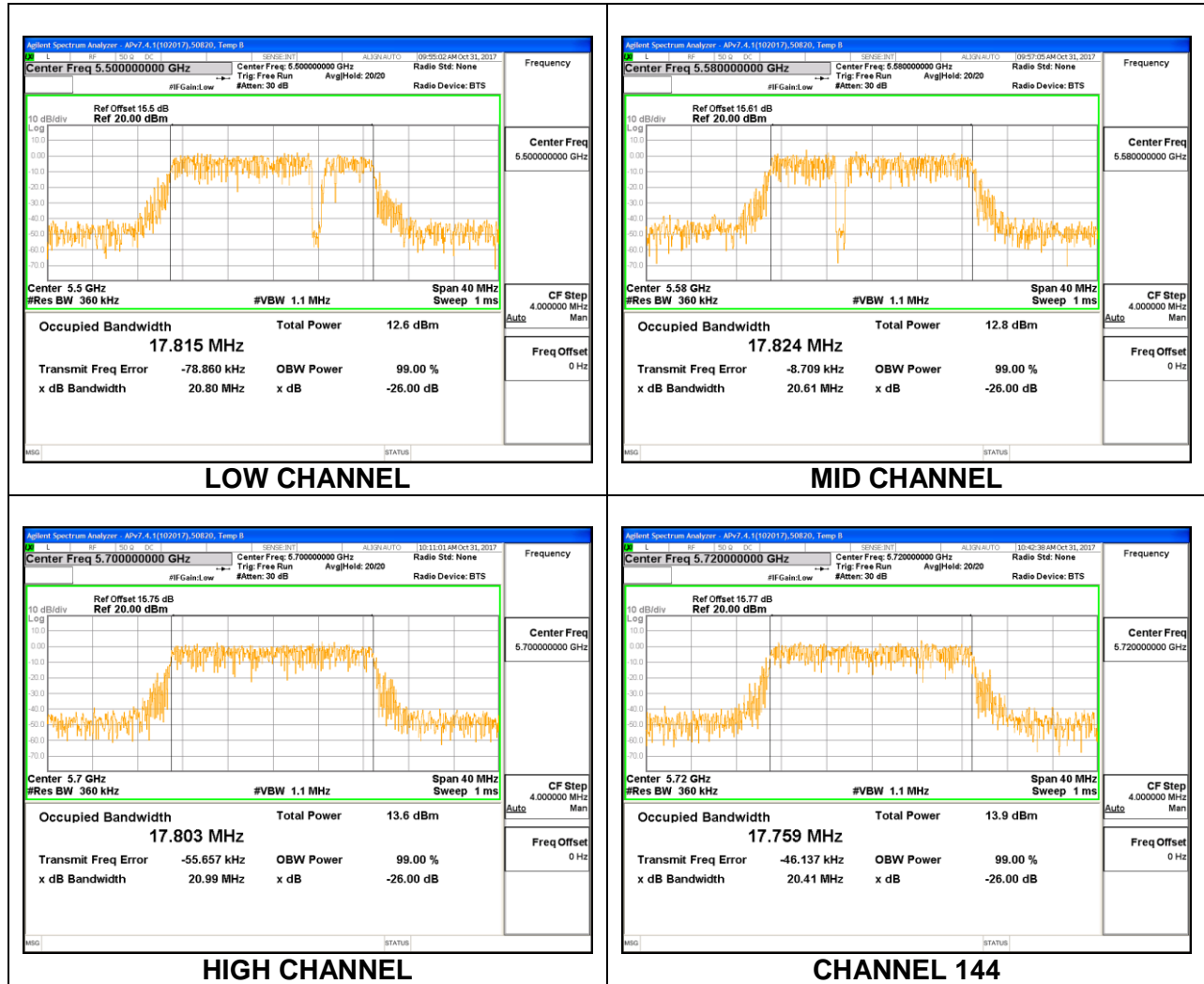
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Mid	5290	75.735



### 4.3.7. 802.11n HT20 MODE IN THE 5.6 GHz BAND

#### 1TX Antenna WF4

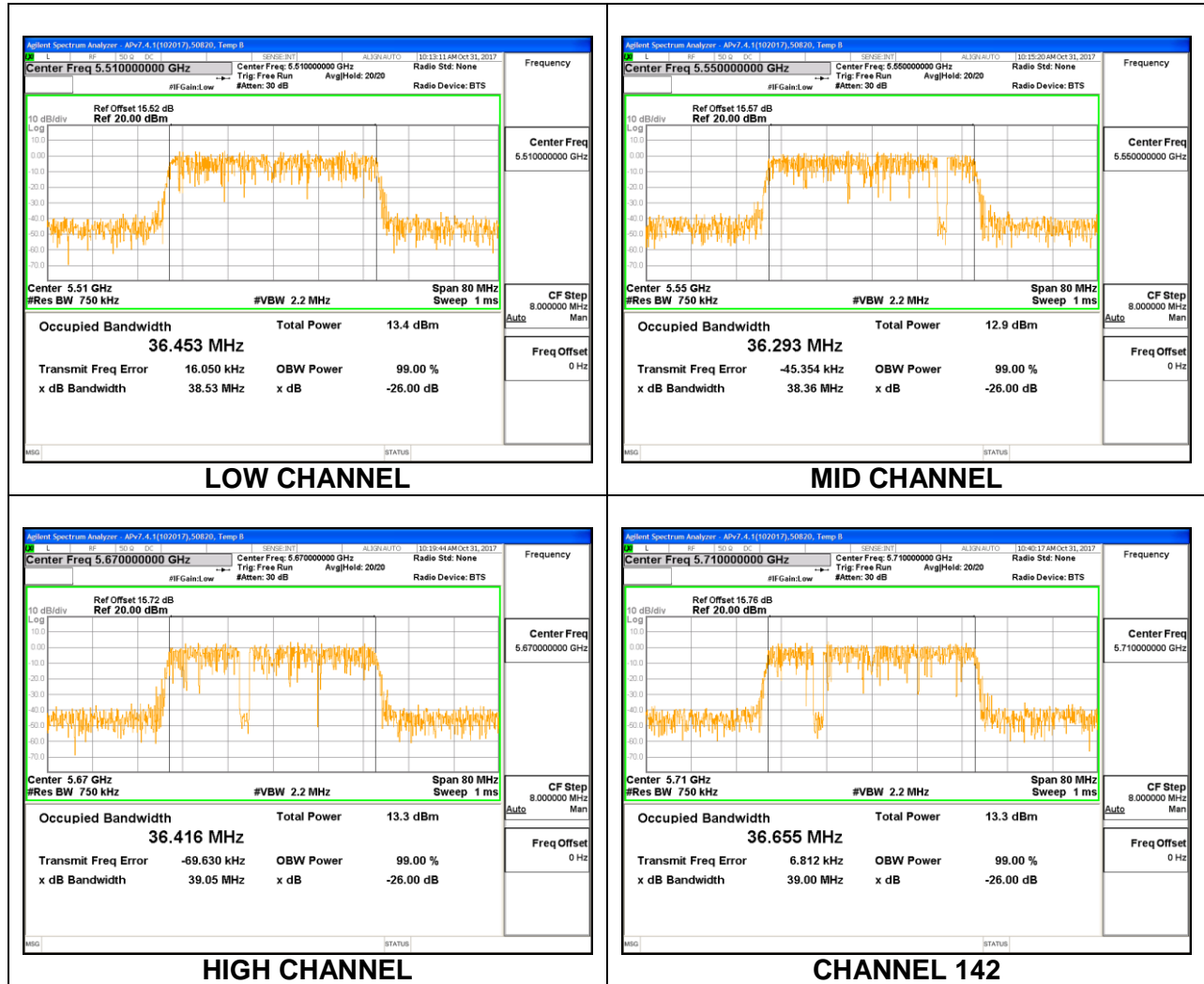
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.815
Mid	5580	17.824
High	5700	17.803
144	5720	17.759



### 4.3.8. 802.11n HT40 MODE IN THE 5.6 GHz BAND

#### 1TX Antenna WF4

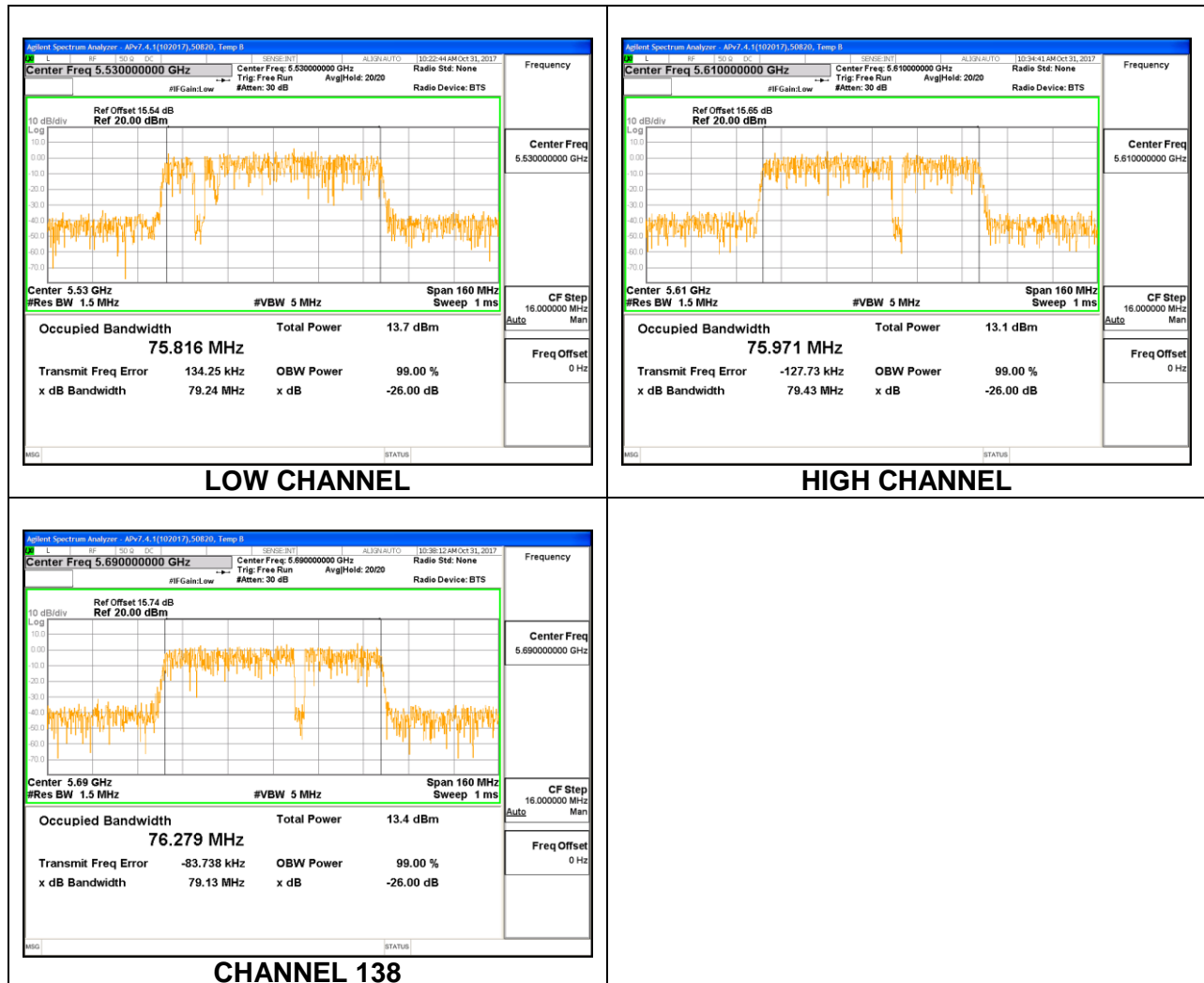
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	36.453
Mid	5550	36.293
High	5670	36.416
142	5710	36.655



### 4.3.9. 802.11ac VHT80 MODE IN THE 5.6 GHz BAND

#### 1TX Antenna WF4

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5530	75.816
High	5610	75.971
138	5690	76.279

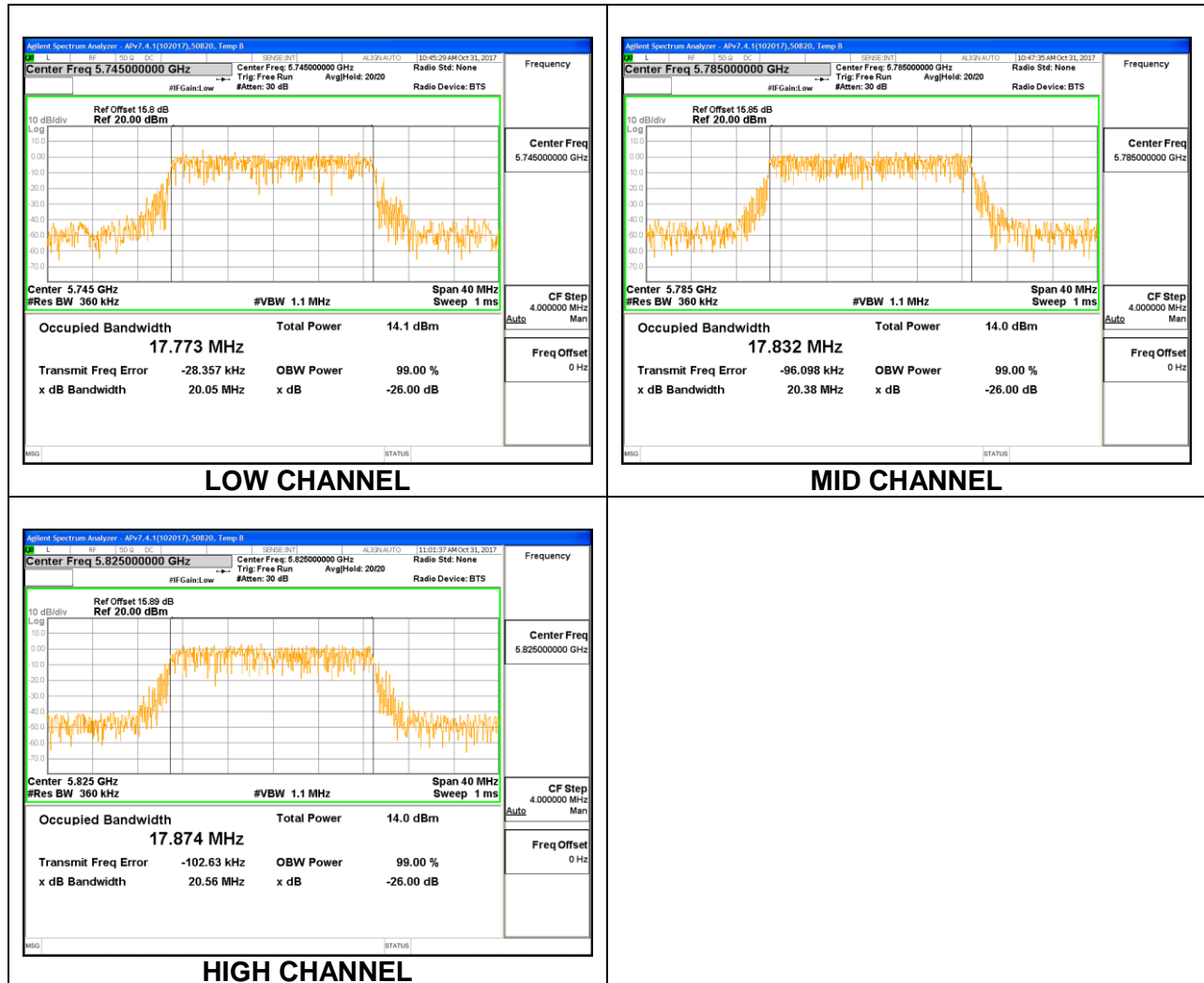




### 4.3.10. 802.11n HT20 MODE IN THE 5.8 GHz BAND

#### 1TX Antenna WF4

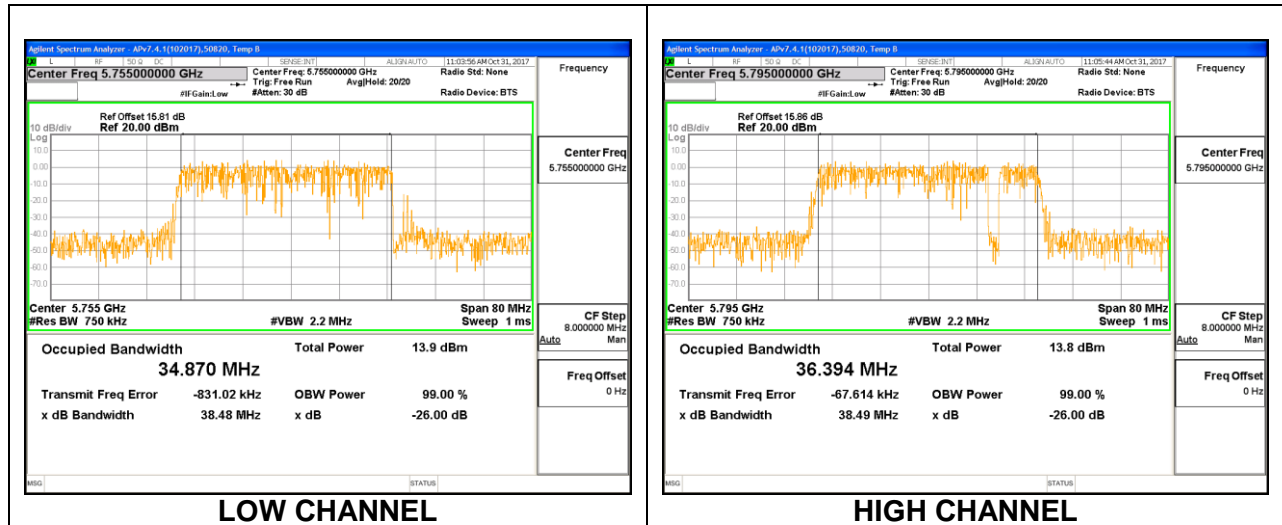
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	17.773
Mid	5785	17.832
High	5825	17.874



### 4.3.11. 802.11n HT40 MODE IN THE 5.8 GHz BAND

#### 1TX Antenna WF4

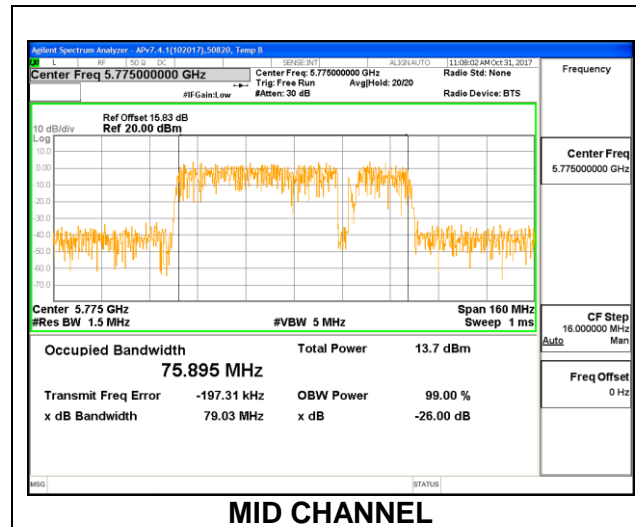
Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Low	5755	34.870
High	5795	36.394



### 4.3.12. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

#### 1TX Antenna WF4

Channel	Frequency	99% Bandwidth
	(MHz)	(MHz)
Mid	5775	75.895



#### **4.4. 6 dB BANDWIDTH**

##### **LIMITS**

FCC §15.407

IC RSS-247 (6.2.4)

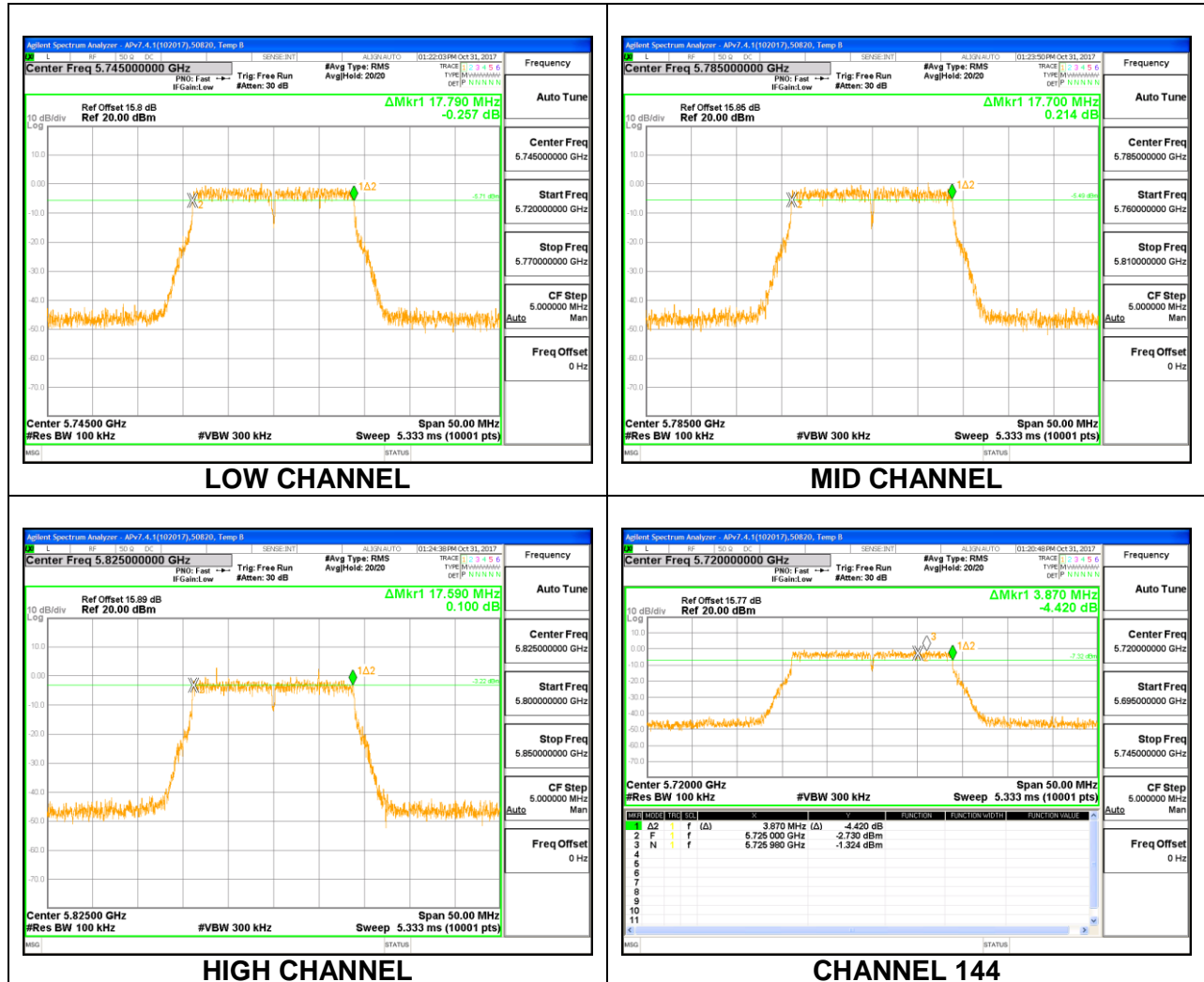
The minimum 6 dB bandwidth shall be at least 500 kHz.

##### **RESULTS**

# 4.4.1. 802.11n HT20 MODE IN THE 5.8 GHz BAND

## 1TX Antenna WF4

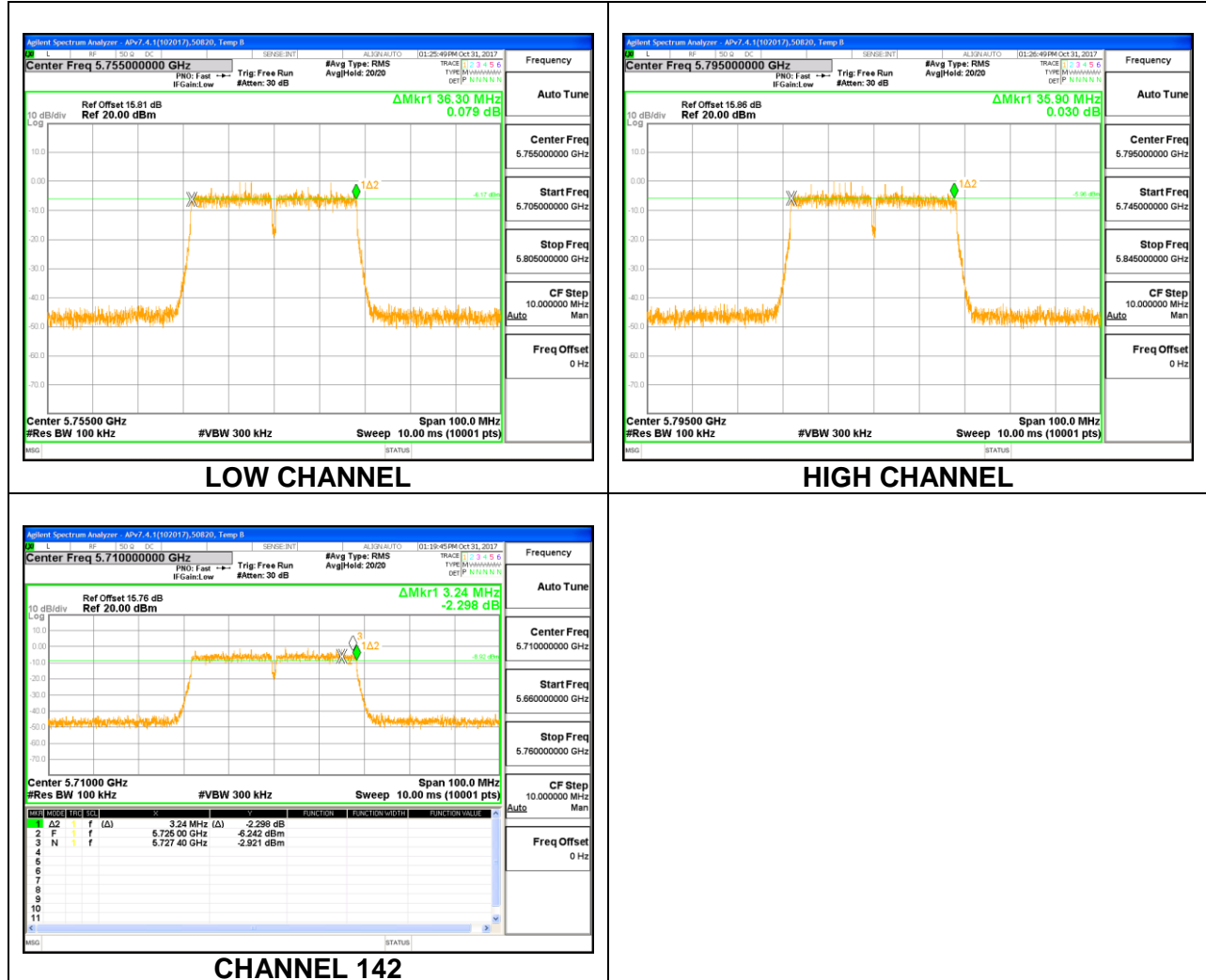
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	17.79	0.5
Mid	5785	17.70	0.5
High	5825	17.59	0.5
144	5720	3.87	0.5



## 4.4.2. 802.11n HT40 MODE IN THE 5.8 GHz BAND

### 1TX Antenna WF4

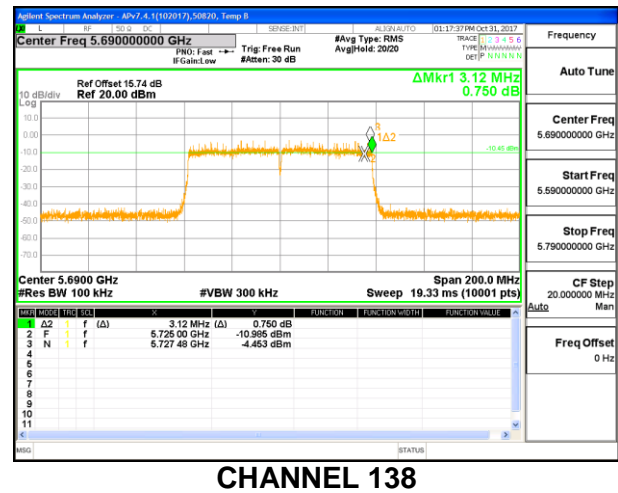
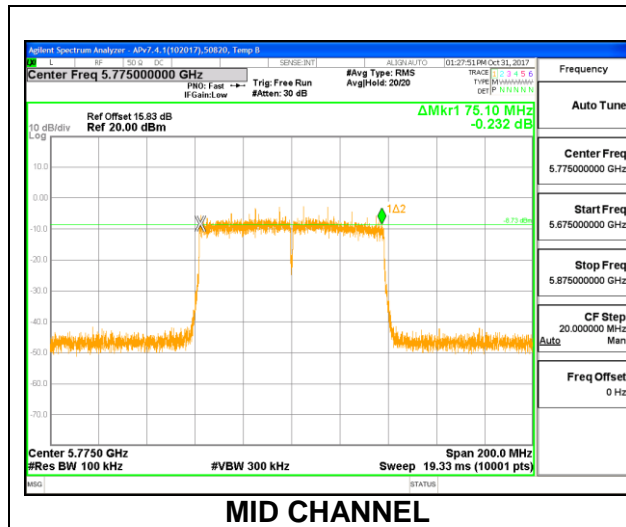
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5755	36.30	0.5
High	5795	35.90	0.5
142	5710	3.24	0.5



### 4.4.3. 802.11ac VHT80 MODE IN THE 5.8 GHz BAND

#### 1TX Antenna WF4

Channel	Frequency	6 dB Bandwidth	Minimum Limit
	(MHz)	(MHz)	(MHz)
Mid	5775	75.10	0.5
138	5690	3.12	0.5



## 4.5. OUTPUT POWER AND PSD

### LIMITS

#### FCC §15.407 (a) (1)

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(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.



FCC §15.407 (a) (2)

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

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

FCC §15.407 (a) (3)

For the 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.

**TEST PROCEDURE**

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

# **DIRECTIONAL ANTENNA GAIN**

For 1 TX:

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

## **RESULTS**

<b>ID:</b>	30554	<b>Date:</b>	10/31/2017
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### **4.5.1. 802.11n HT20 MODE IN THE 5.2 GHz BAND**

#### **1TX Antenna WF4 (FCC) MOBILE**

##### **Antenna Gain and Limits**

Channel	Frequency (MHz)	Directional Gain (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	4.20	24.00	11.00
Mid	5200	4.20	24.00	11.00
High	5240	4.20	24.00	11.00

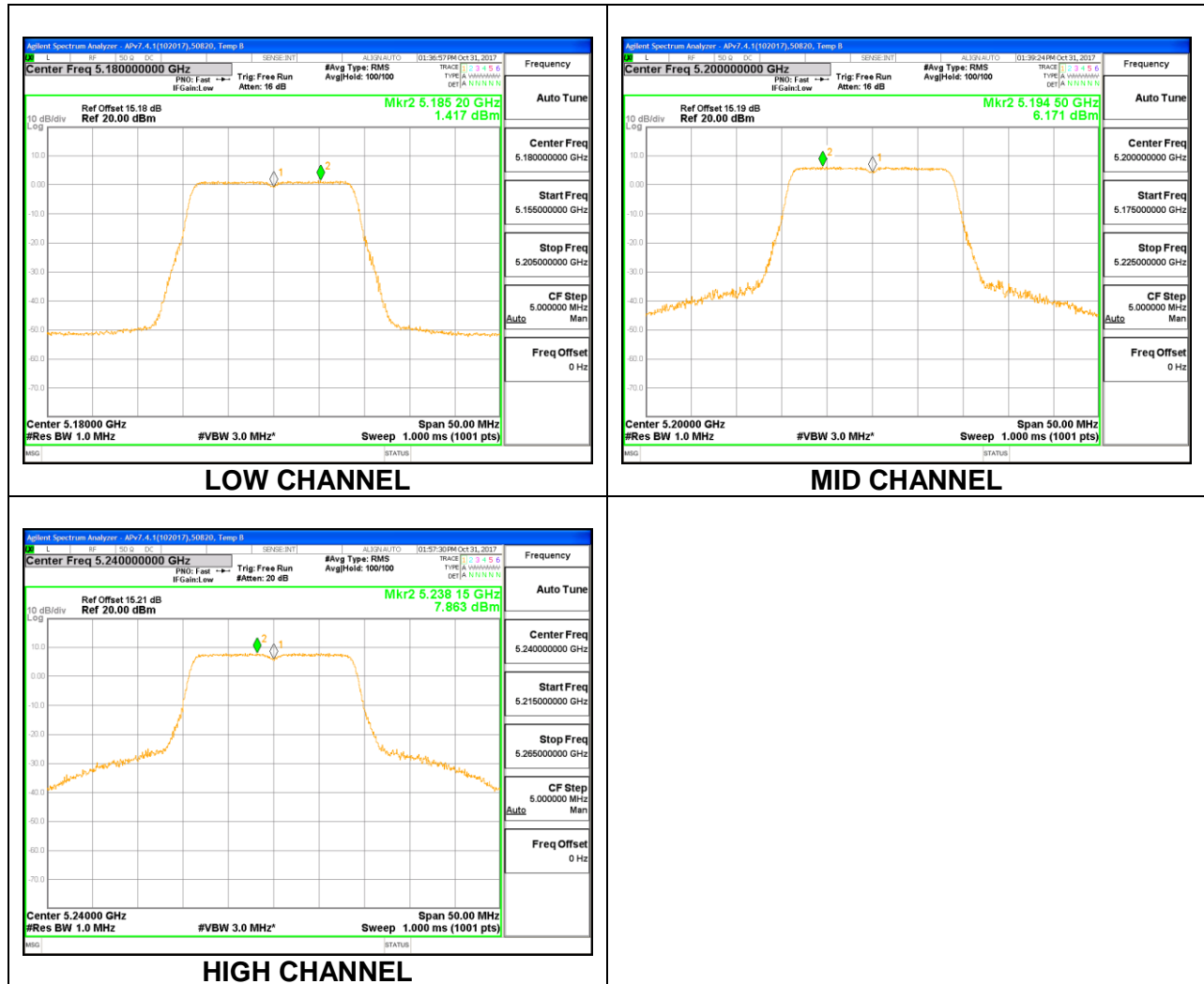
<b>Duty Cycle CF (dB)</b>	0.23	<b>Included in Calculations of Corr'd Power &amp; PSD</b>
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##### **Output Power Results**

Channel	Frequency (MHz)	WF4 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	12.81	12.81	24.00	-11.19
Mid	5200	17.94	17.94	24.00	-6.06
High	5240	19.84	19.84	24.00	-4.16

##### **PSD Results**

Channel	Frequency (MHz)	WF4 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	1.417	1.647	11.00	-9.35
Mid	5200	6.171	6.401	11.00	-4.60
High	5240	7.863	8.093	11.00	-2.91



## 4.5.2. 802.11n HT40 MODE IN THE 5.2 GHz BAND

### 1TX Antenna WF4 (FCC) MOBILE

#### Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5190	4.20	24.00	11.00
High	5230	4.20	24.00	11.00

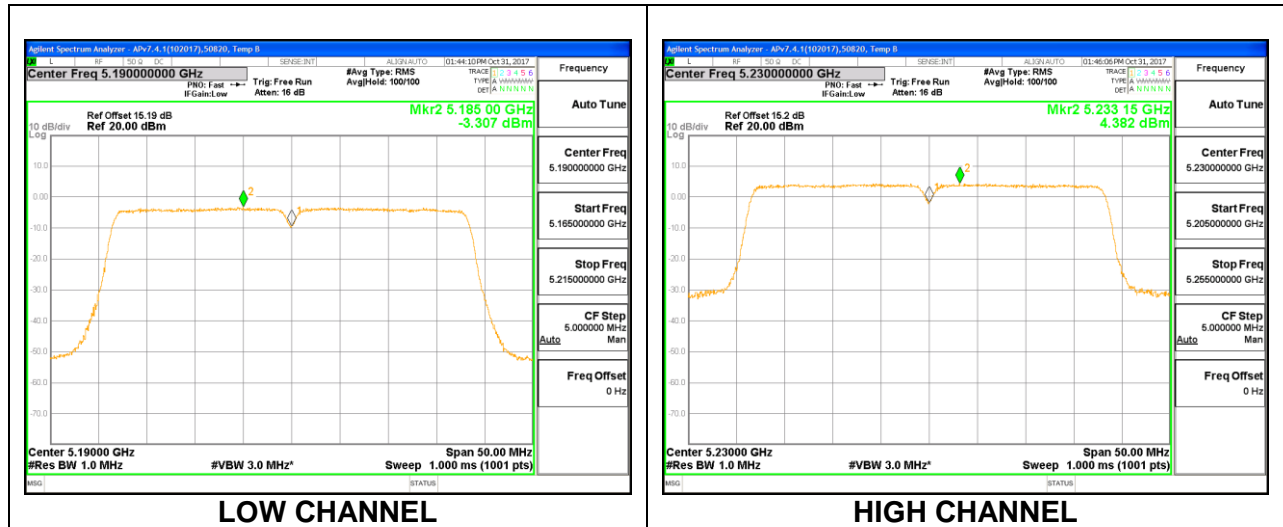
Duty Cycle CF (dB)	0.09	Included in Calculations of Corr'd Power & PSD
--------------------	------	--

#### Output Power Results

Channel	Frequency (MHz)	WF4 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	10.99	10.99	24.00	-13.01
High	5230	18.83	18.83	24.00	-5.17

#### PSD Results

Channel	Frequency (MHz)	WF4 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5190	-3.307	-3.217	11.00	-14.22
High	5230	4.382	4.472	11.00	-6.53



### 4.5.3. 802.11ac VHT80 MODE IN THE 5.2 GHz BAND

#### 1TX Antenna WF4 (FCC) MOBILE

##### Antenna Gain and Limits

Channel	Frequency	Directional Gain	Power Limit	PSD Limit
	(MHz)	(dBi)	(dBm)	(dBm)
Mid	5210	4.20	24.00	11.00

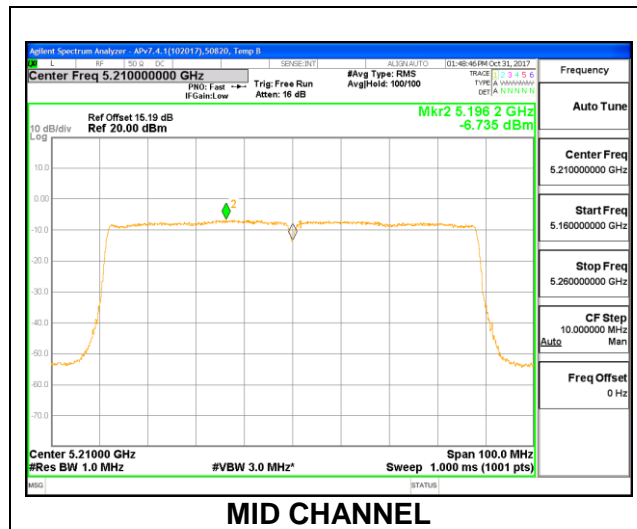
Duty Cycle CF (dB)	0.20	Included in Calculations of Corr'd Power & PSD
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##### Output Power Results

Channel	Frequency	WF4 Meas Power	Total Corr'd Power	Power Limit	Power Margin
	(MHz)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5210	10.34	10.34	24.00	-13.66

##### PSD Results

Channel	Frequency	WF4 Meas PSD	Total Corr'd PSD	PSD Limit	PSD Margin
	(MHz)	(dBm)	(dBm)	(dBm)	(dB)
Mid	5210	-6.735	-6.535	11.00	-17.54



#### 4.5.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

##### 1TX Antenna WF4 (FCC)

###### Bandwidth and Antenna Gain

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Min 99% BW (MHz)	Directional Gain (dBi)
Low	5260	22.40	17.79	3.90
Mid	5300	22.35	17.86	3.90
High	5320	22.45	17.94	3.90

###### Limits

Channel	Frequency (MHz)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Power Limit (dBm)	FCC PSD Limit (dBm)	IC PSD Limit (dBm)	PSD Limit (dBm)
Low	5260	24.00	23.50	29.50	23.50	11.00	11.00	11.00
Mid	5300	24.00	23.52	29.52	23.52	11.00	11.00	11.00
High	5320	24.00	23.54	29.54	23.54	11.00	11.00	11.00

Duty Cycle CF (dB)	0.23	Included in Calculations of Corr'd Power & PSD
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###### Output Power Results

Channel	Frequency (MHz)	WF4 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	19.75	19.75	23.50	-3.75
Mid	5300	17.92	17.92	23.52	-5.60
High	5320	14.84	14.84	23.54	-8.70

###### PSD Results

Channel	Frequency (MHz)	WF4 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5260	8.091	8.321	11.00	-2.68
Mid	5300	5.920	6.150	11.00	-4.85
High	5320	3.060	3.290	11.00	-7.71