



CERTIFICATION TEST REPORT

Report Number. : 12875712-E1V2

Applicant : DISH TECHNOLOGIES LLC
9601 MERIDIAN BLVD
ENGLEWOOD, CO 80112

Model : AIRTV 3

FCC ID : DKN-ATV3

EUT Description : OVER THE AIR TV STREAMING DEVICE

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

Date Of Issue:
August 27, 2019

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	8/23/2019	Initial Issue	
V2	8/27/2019	Updated KDB info, OFS statement, and antenna info	Tri Pham

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: DISH TECHNOLOGIES LLC
9601 MERIDIAN BLVD
ENGLEWOOD, CO 80112

EUT DESCRIPTION: OVER THE AIR TV STREAMING DEVICE

MODEL: AIRTV 3

SERIAL NUMBER: Conducted: P2-B127
Radiated: P2-B136

DATE TESTED: AUGUST 5, 2019 – AUGUST 19, 2019

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	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.

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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, ANSI C63.10-2013, KDB 558074 D01 v05r02.

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
<input checked="" type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D	<input checked="" type="checkbox"/> Chamber I
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E	<input type="checkbox"/> Chamber J
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F	<input type="checkbox"/> Chamber K
	<input type="checkbox"/> Chamber G	<input type="checkbox"/> Chamber L
	<input type="checkbox"/> Chamber H	<input type="checkbox"/> Chamber M

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: 2324A.

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

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)

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

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.

$$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$$

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%.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is an over the air tv streaming device.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

2.4GHz BAND

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
1Tx			
2412 - 2462	802.11b	8.93	7.82
2412 - 2462	802.11n HT20	20.2	104.71

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2Tx			
2412 - 2462	802.11n HT20 CDD	22.24	167.49

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an embedded antenna, with a maximum gain of 4.5 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was WCA.3.0.

The test utility software used during testing was the Marvel Labtool.

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was tested at normal operation on the Y-axis position.

For 11n HT20 modes, radiated harmonics spurious were performed with the EUT set at the 2TX CDD mode with power setting equal or higher than SISO modes as the worst-case scenario. 11g mode covered by HT20 mode since it has the same power as 11n HT20.

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

802.11b mode: 1 Mbps
802.11g mode : 6 Mbps
802.11n HT20 1Tx mode: MCS0
802.11n HT20 2Tx mode: MCS8

5.6. DESCRIPTION OF TEST SETUP

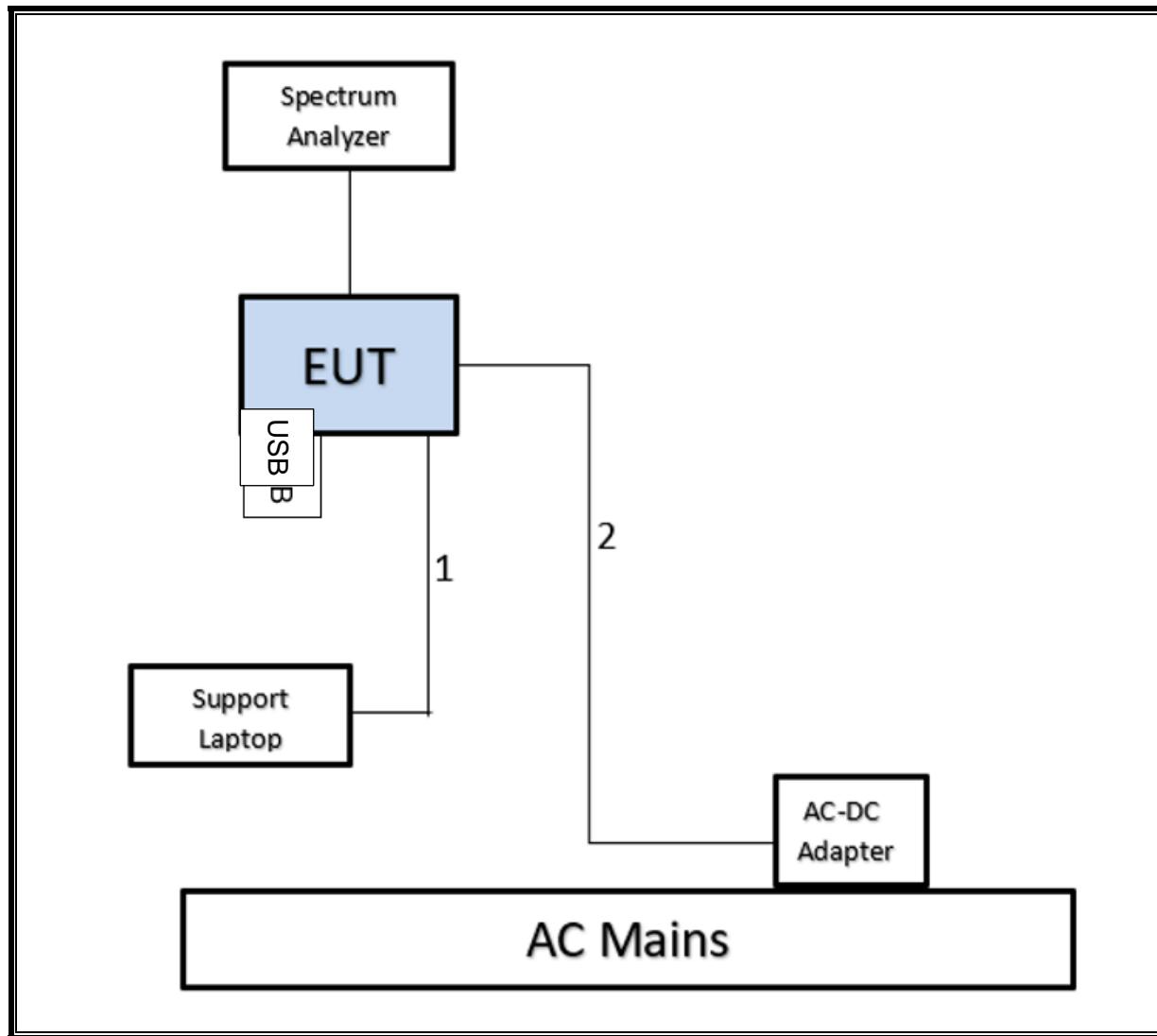
SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Hewlett-Packard	EliteBook 8470P	CNU342CL9Z	n/a
Laptop AC-DC power supply	Hewlett-Packard	PA-1650-32HJ	ETC1806006544	n/a
AC-DC Power supply	LITE-ON	PB-1300-1ES1	ETC1806006544	n/a

I/O CABLES (CONDUCTED, RADIATED AND CONDUCTED EMISSIONS)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Ethernet	1	Ethernet	Un-shielded	2	Laptop to EUT
2	AC	1	AC	Un-shielded	1.5	
3	Coaxial	1	Coaxial	shielded	2	EUT to 50 Ohm load

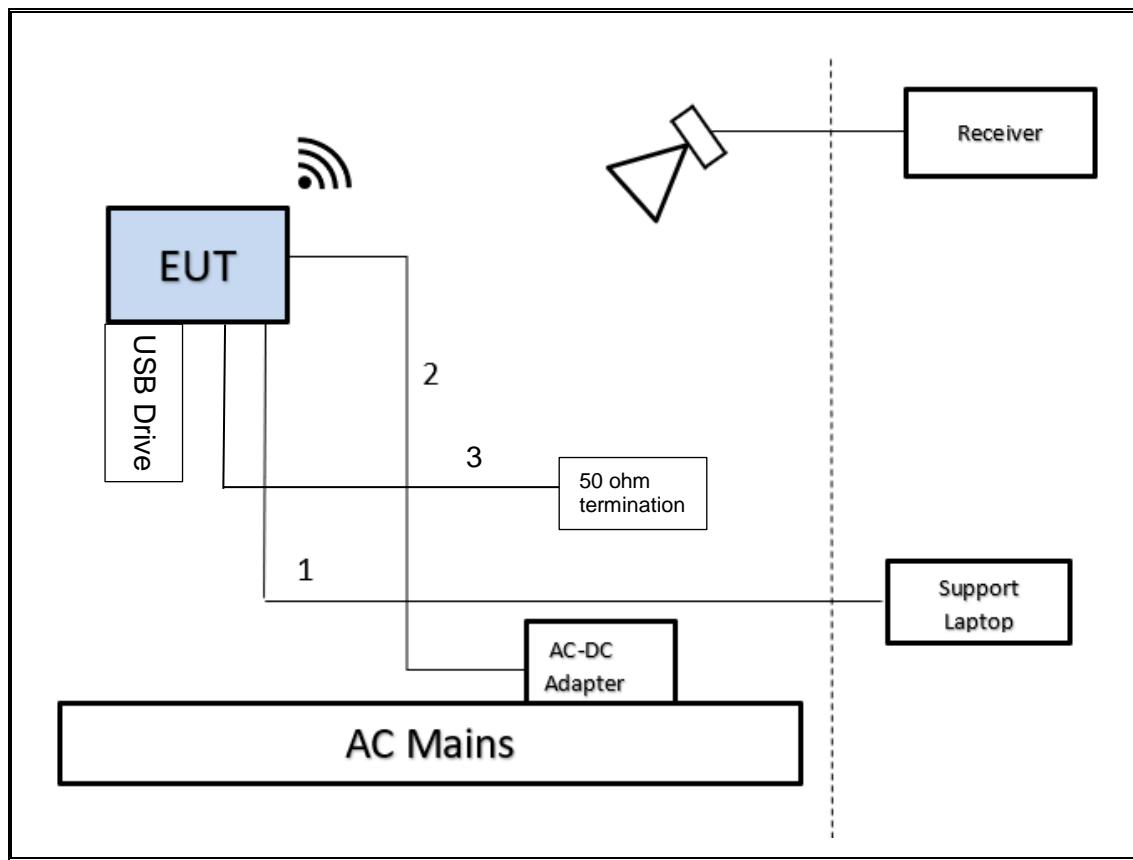
CONDCTED TEST SETUP DIAGRAM



TEST SETUP

For conducted tests, the EUT was connected to a laptop. The test software exercises the radio.

RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT is connected to a laptop. The test software exercises the radio.

6. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Section 11.6

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

6 dB BW: ANSI C63.10 Section 11.8.1

Output Power: ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Section 11.10.3 Method AVGPSD-1

Band-edge: ANSI C63.10 Section 11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction factor

Radiated emissions non-restricted frequency bands: ANSI C63.10 Section 11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Section 11.12.1

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

Conducted emissions in restricted frequency bands: ANSI C63.10 Section 11.12.

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

7. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
3 Port rf switch	DOW-KEY MICROWAVE	401-2308	172937	09/15/2019	09/15/2018
6 Port rf switch	NARDA	SEM163	172935	09/15/2019	09/15/2018
6 Port rf switch	Pasternack	PE7165	172936	09/17/2019	09/17/2018
Amplifier 1-8GHz 30dB gain	L3 Narda	AMF-4D-01000800-30-29P	167492	05/24/2020	06/24/2019
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	138301	09/15/2019	09/15/2018
Amplifier, 1 to 8GHz, 35dB	Miteq Inc.	AMF-4D-01000800-30-29P	T1573	12/01/2019	12/01/2018
Amplifier, 1 to 8GHz, 35dB	MITEQ	AMF-4D-01000800-30-29P	T1169	09/15/2019	09/15/2018
Amplifier, 100KHz to 1GHz, 32dB	Agilent (Keysight) Technologies	8447D	T15	10/20/2019	10/20/2018
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	T285	06/06/2020	07/06/2019
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180175	05/29/2020	06/29/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	T130	08/09/2020	08/09/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T119	03/22/2020	03/22/2019
Antenna, BroadBand Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0184971	11/13/2019	11/13/2018
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179376	02/14/2020	02/14/2019
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	T1165	05/24/2020	06/24/2019
RF Filter Box	UL (IN HOUSE)		172938	09/15/2019	09/15/2018
RF Filter Box, 1-18GHz	UL (IN HOUSE)		168534	05/24/2020	06/24/2019
RF SWITCH	Pasternack	PE7159	T1274	05/24/2020	06/24/2019
RF SWITCH	DOW-KEY MICROWAVE	401-2308	T729	05/24/2020	06/24/2019
Semi anechoic Chamber A	TDK RF SOLUTIONS INC.	N/A	T1199	01/18/2021	01/18/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T908	01/24/2020	01/24/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	01/23/2020	01/23/2019
Thermometer	Control Company	14-650-118, 15557603	T1820	02/26/2020	02/26/2019

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 3.9.1, Dec 28, 2015

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

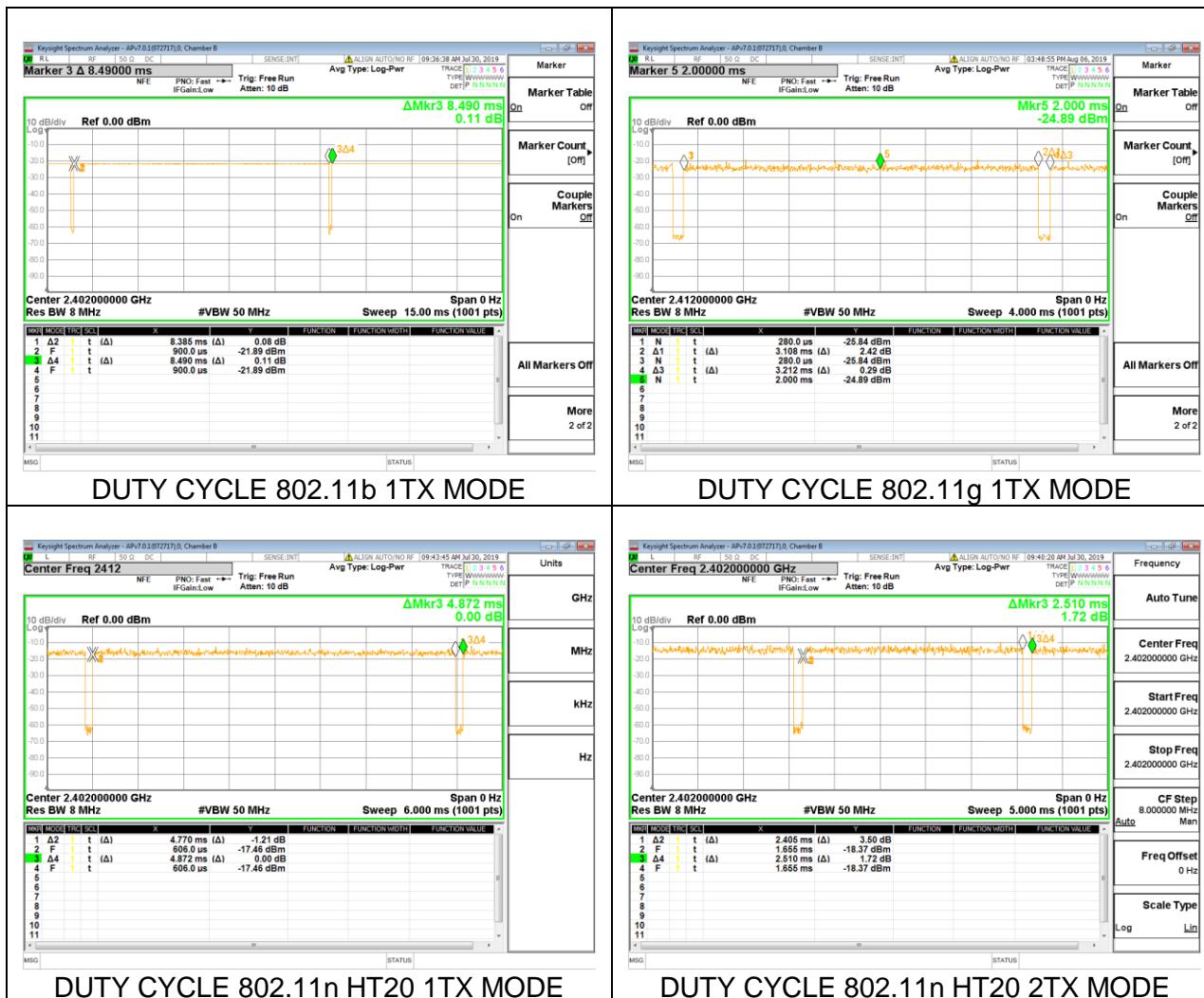
PROCEDURE

KDB 558074 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)
2.4GHz Band						
802.11b 1TX	8.385	8.490	0.988	98.76%	0.00	0.010
802.11g 1TX	3.108	3.212	0.968	96.76%	0.14	0.322
802.11n HT20 1TX	4.770	4.872	0.979	97.91%	0.09	0.210
802.11n HT20 2TX	2.405	2.510	0.958	95.82%	0.19	0.416

DUTY CYCLE PLOTS



8.2. 99% BANDWIDTH

LIMITS

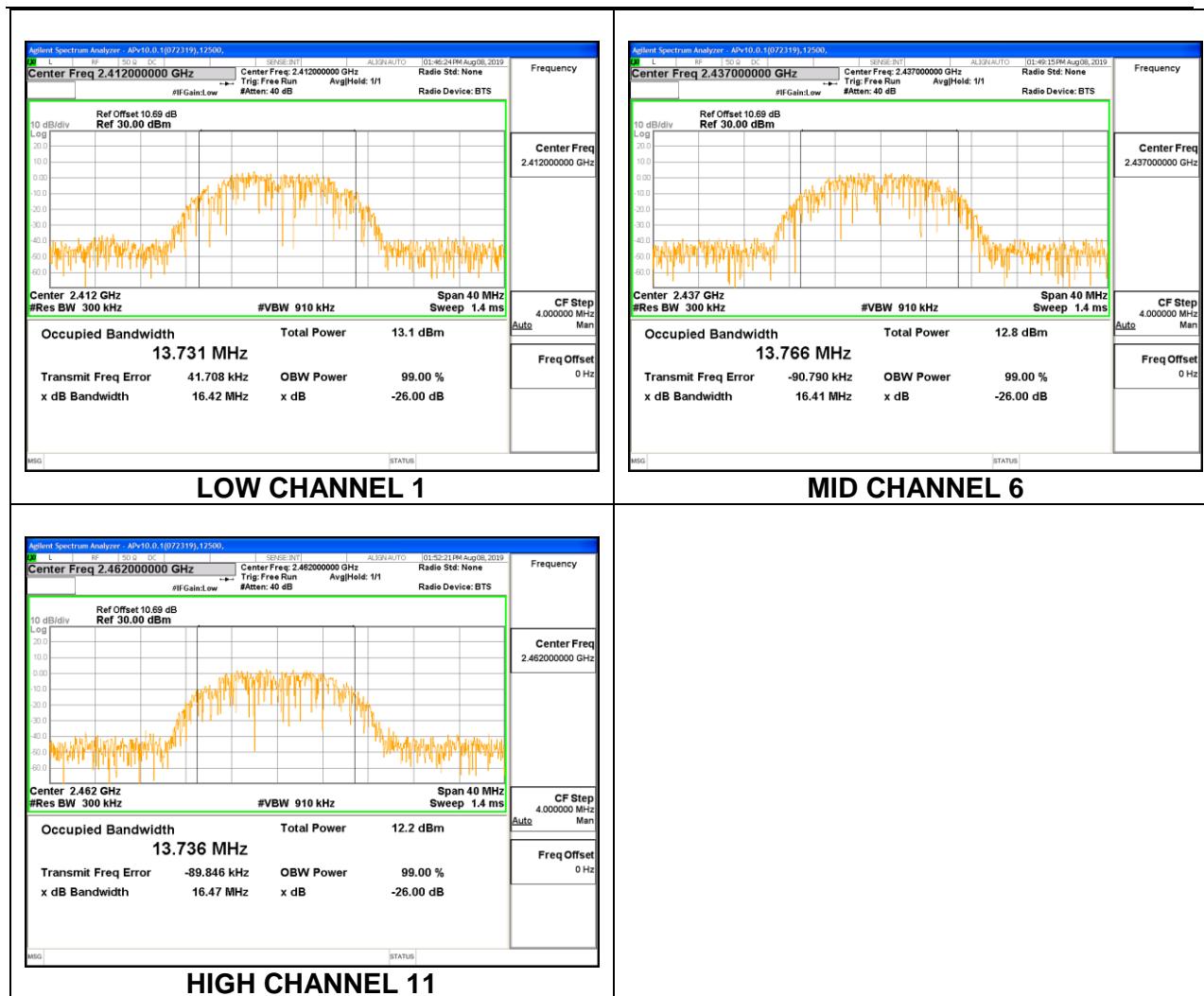
None; for reporting purposes only.

RESULTS

8.2.1. 802.11b MODE

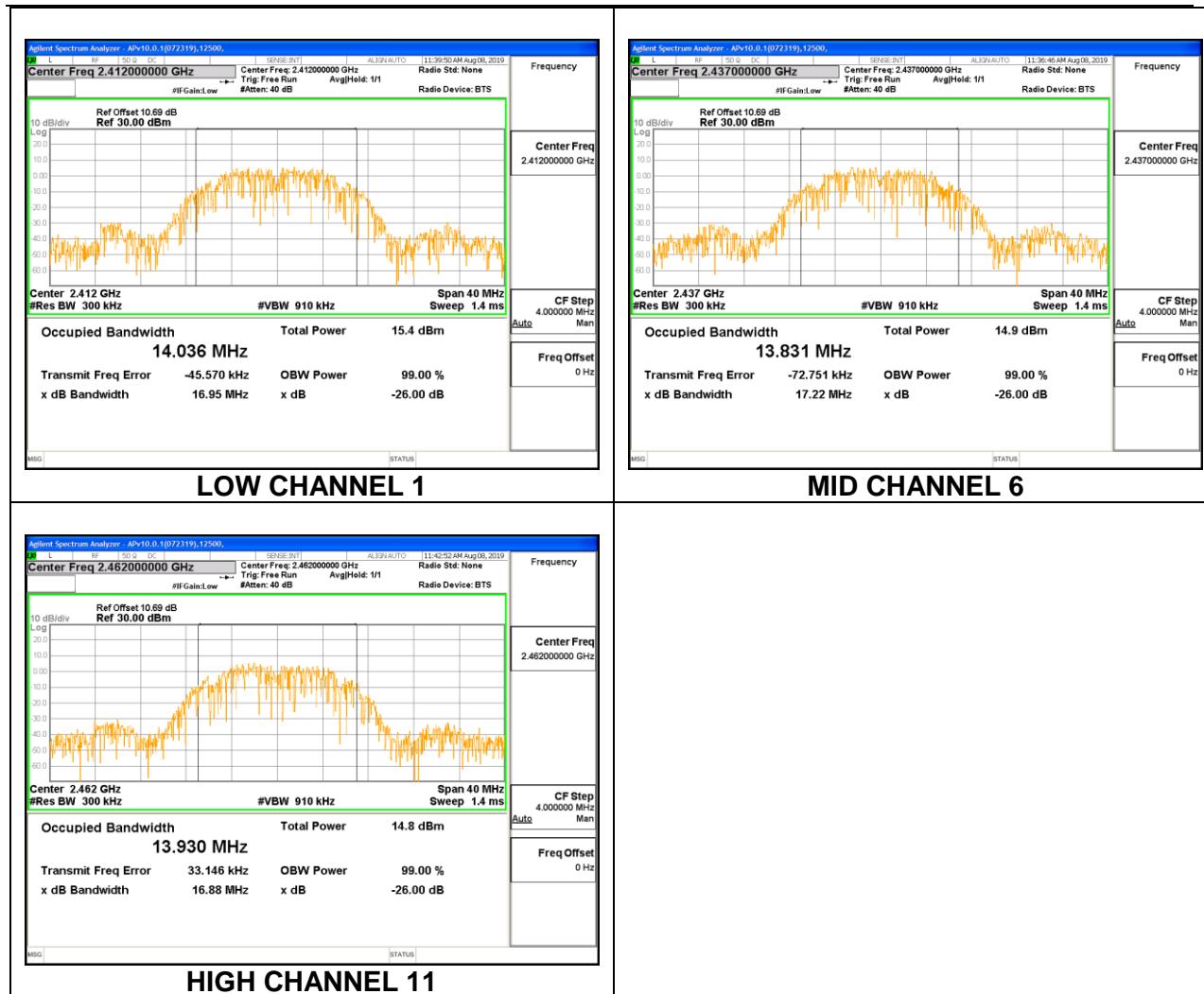
1TX Antenna 1 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	13.7300
Mid 6	2437	13.7660
High 11	2462	13.7360



1TX Antenna 2 MODE

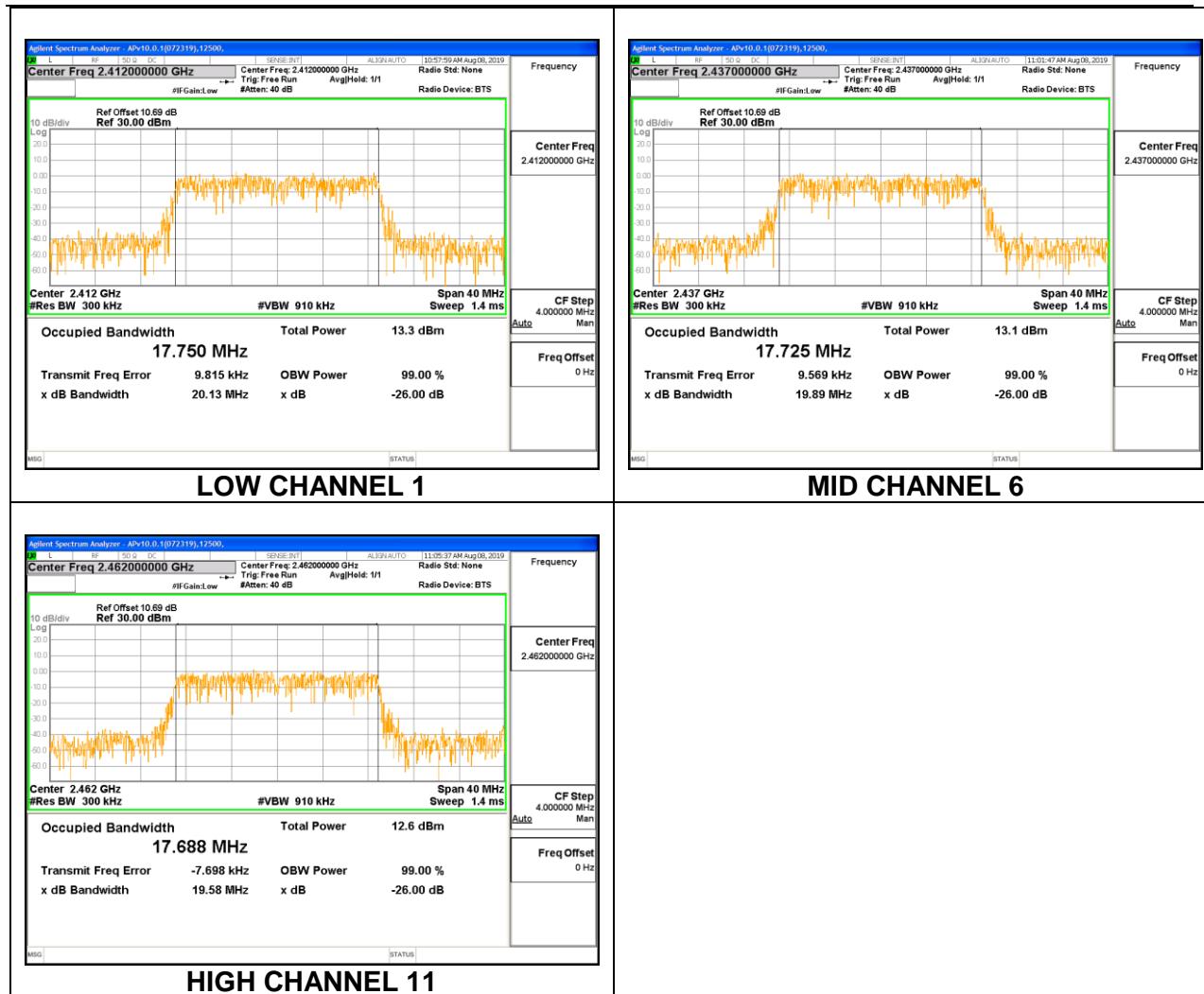
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	14.0360
Mid 6	2437	13.8310
High 11	2462	13.9300



8.2.2. 802.11n HT20 MODE

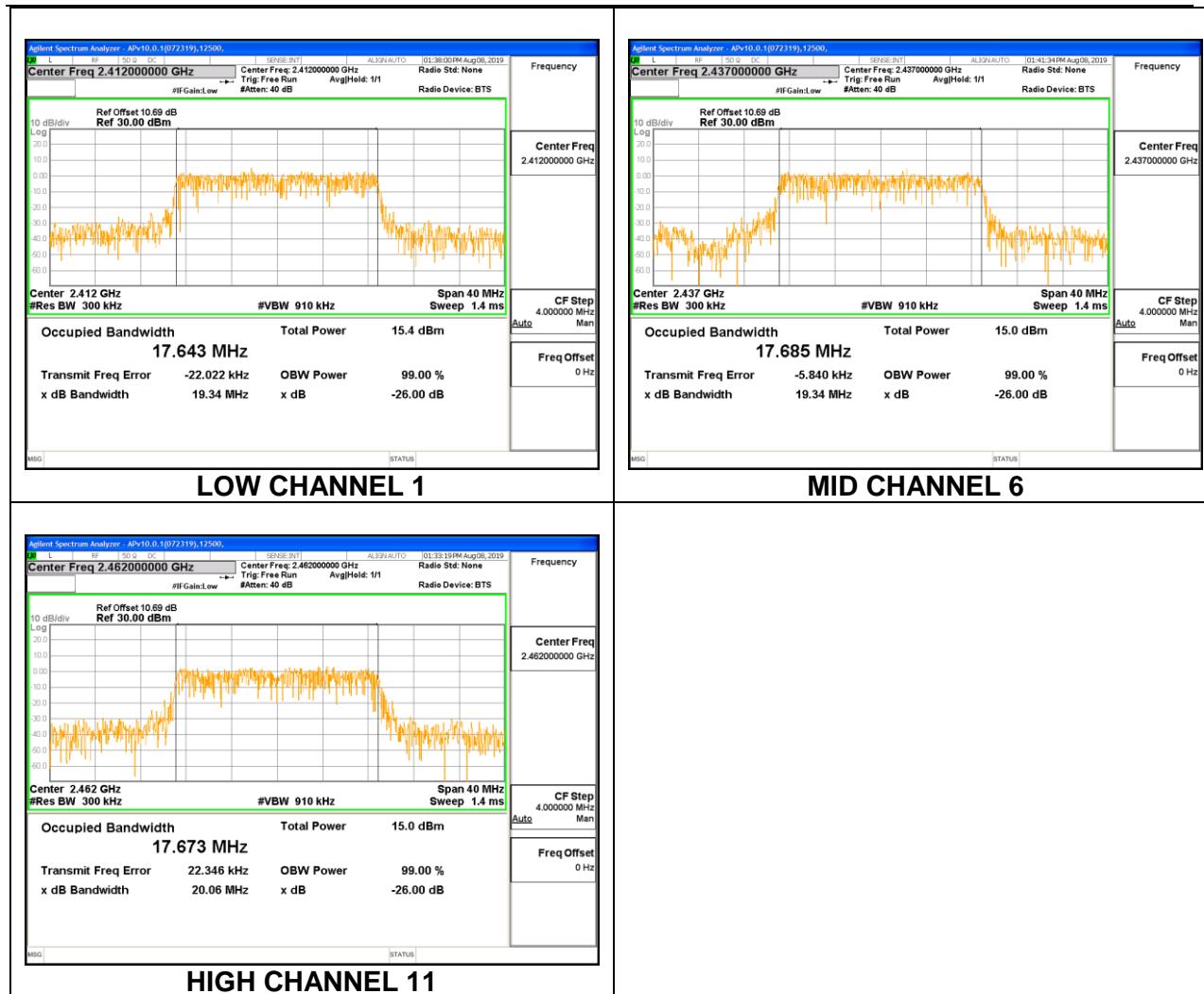
1TX Antenna 1 MODE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	17.7500
Mid 6	2437	17.7240
High 11	2462	17.6880



1TX Antenna 2 MODE

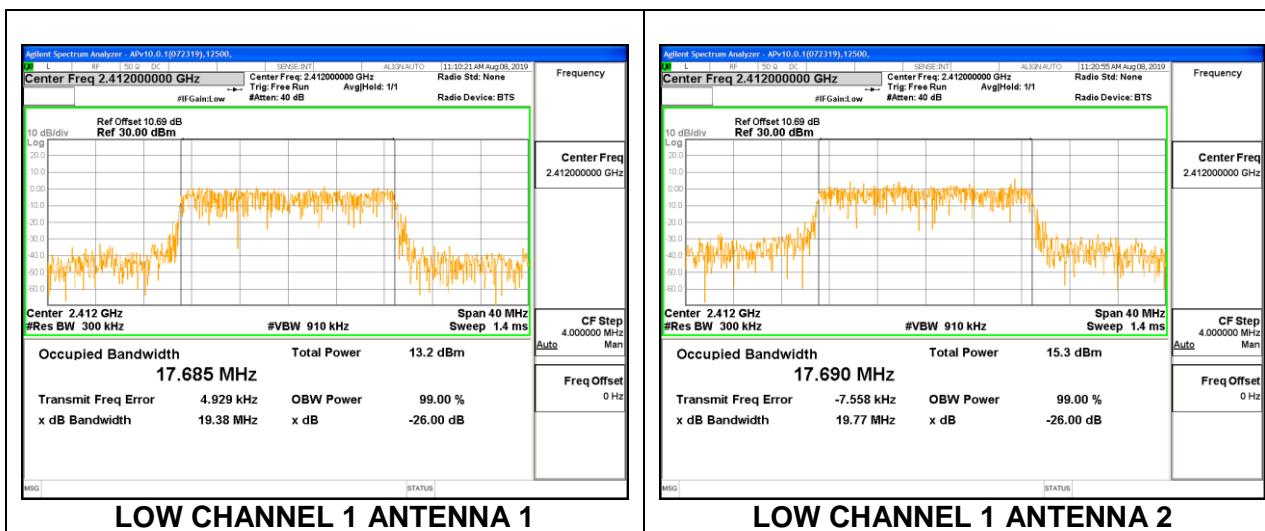
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low 1	2412	17.6420
Mid 6	2437	17.6850
High 11	2462	17.6720



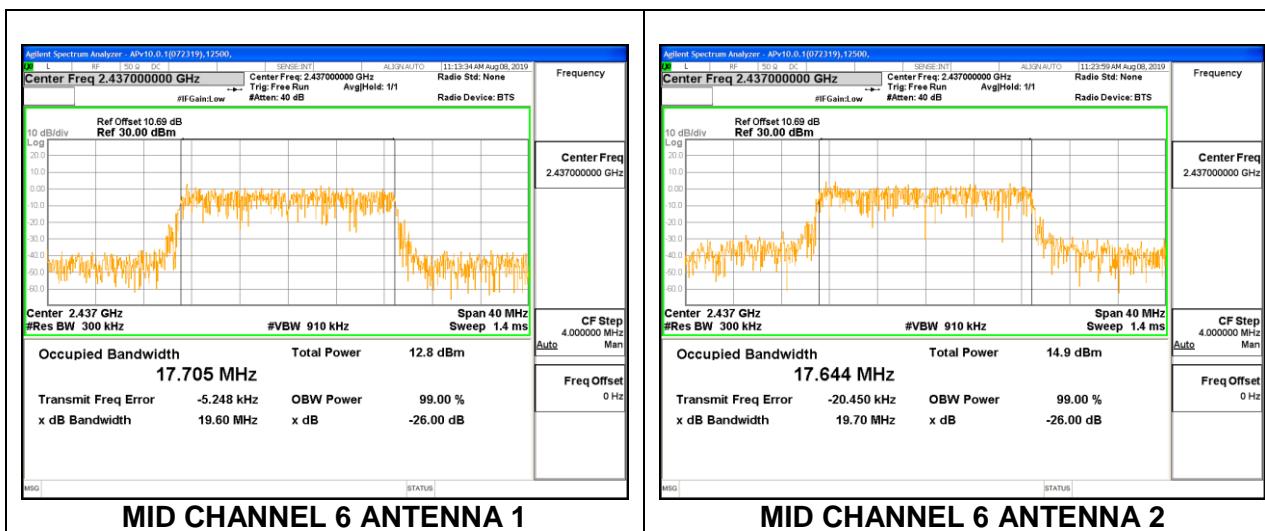
2TX Antenna 1 + Antenna 2 CDD MODE

Channel	Frequency (MHz)	99% Bandwidth Antenna 1 (MHz)	99% Bandwidth Antenna 2 (MHz)
Low 1	2412	17.6850	17.6910
Mid 6	2437	17.7050	17.6440
High 11	2462	17.6480	17.6590

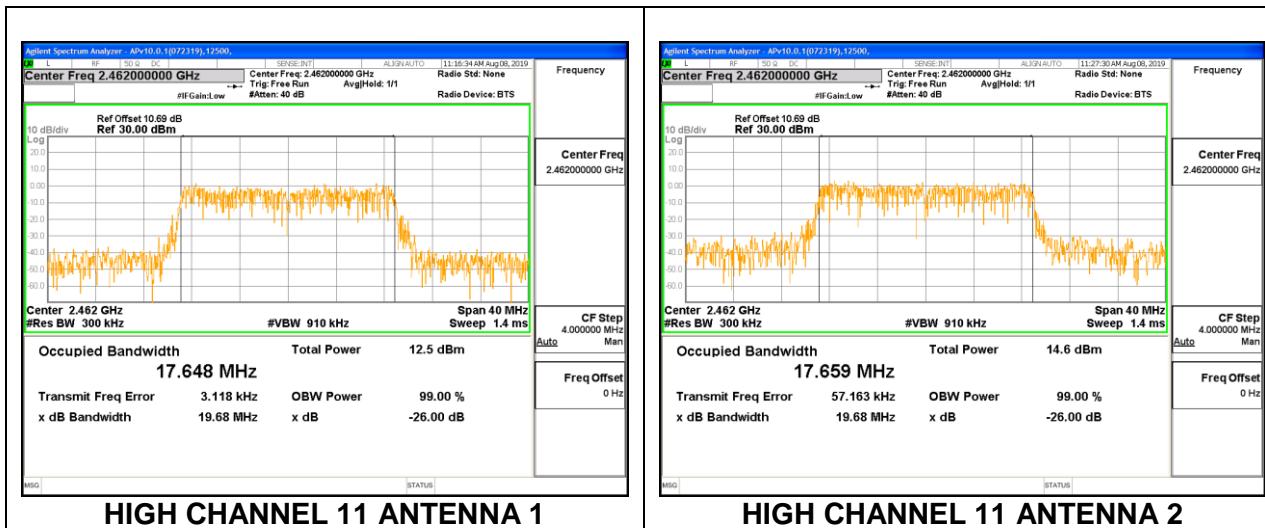
LOW CHANNEL 1



MID CHANNEL 6



HIGH CHANNEL 11



8.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

RESULTS

8.3.1. 802.11b MODE

1TX Antenna 1 MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	10.0000	0.5
Mid 6	2437	9.9600	0.5
High 11	2462	10.0000	0.5



1TX Antenna 2 MODE

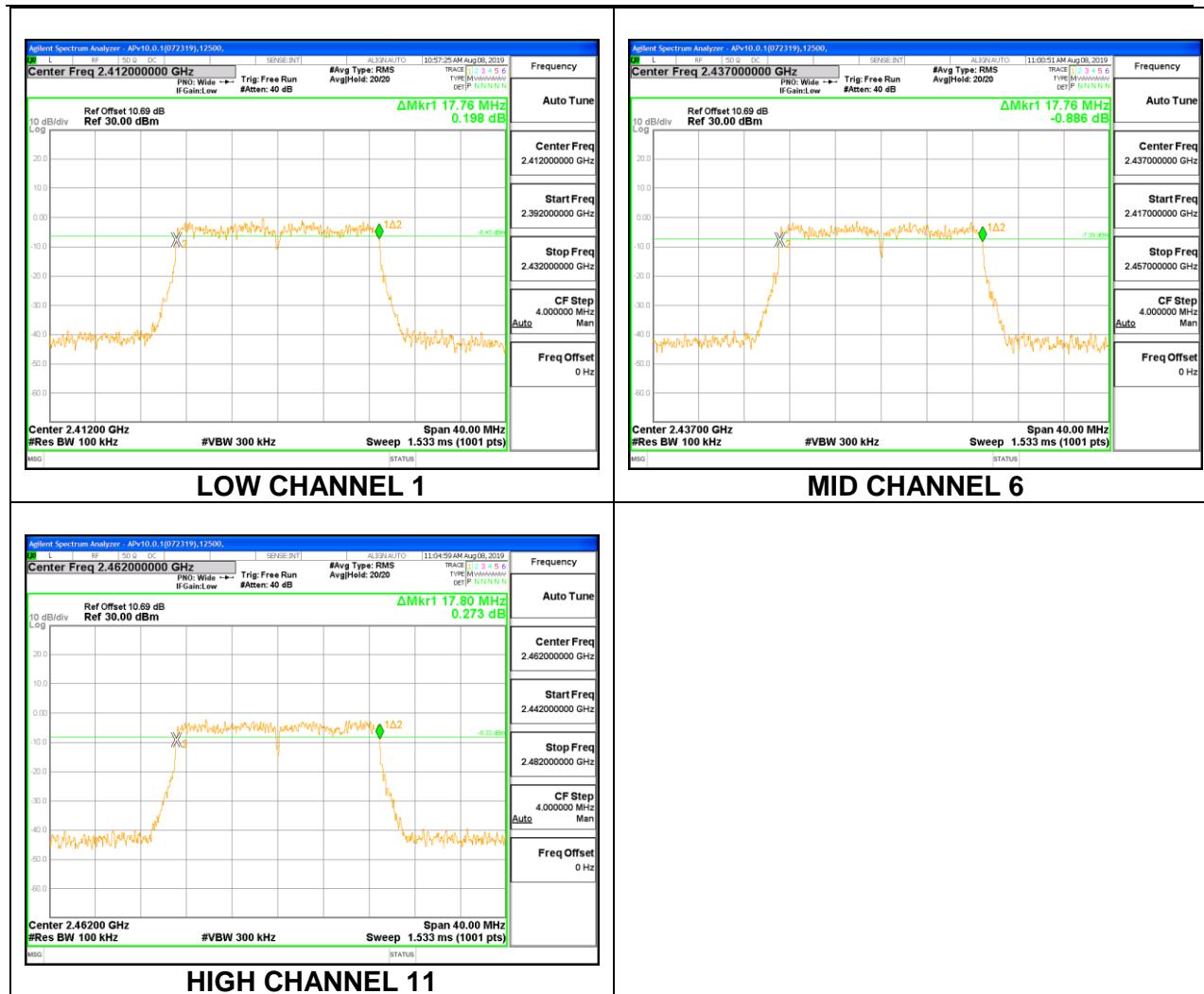
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	10.0400	0.5
Mid 6	2437	9.8000	0.5
High 11	2462	9.9200	0.5



8.3.2. 802.11n HT20 MODE

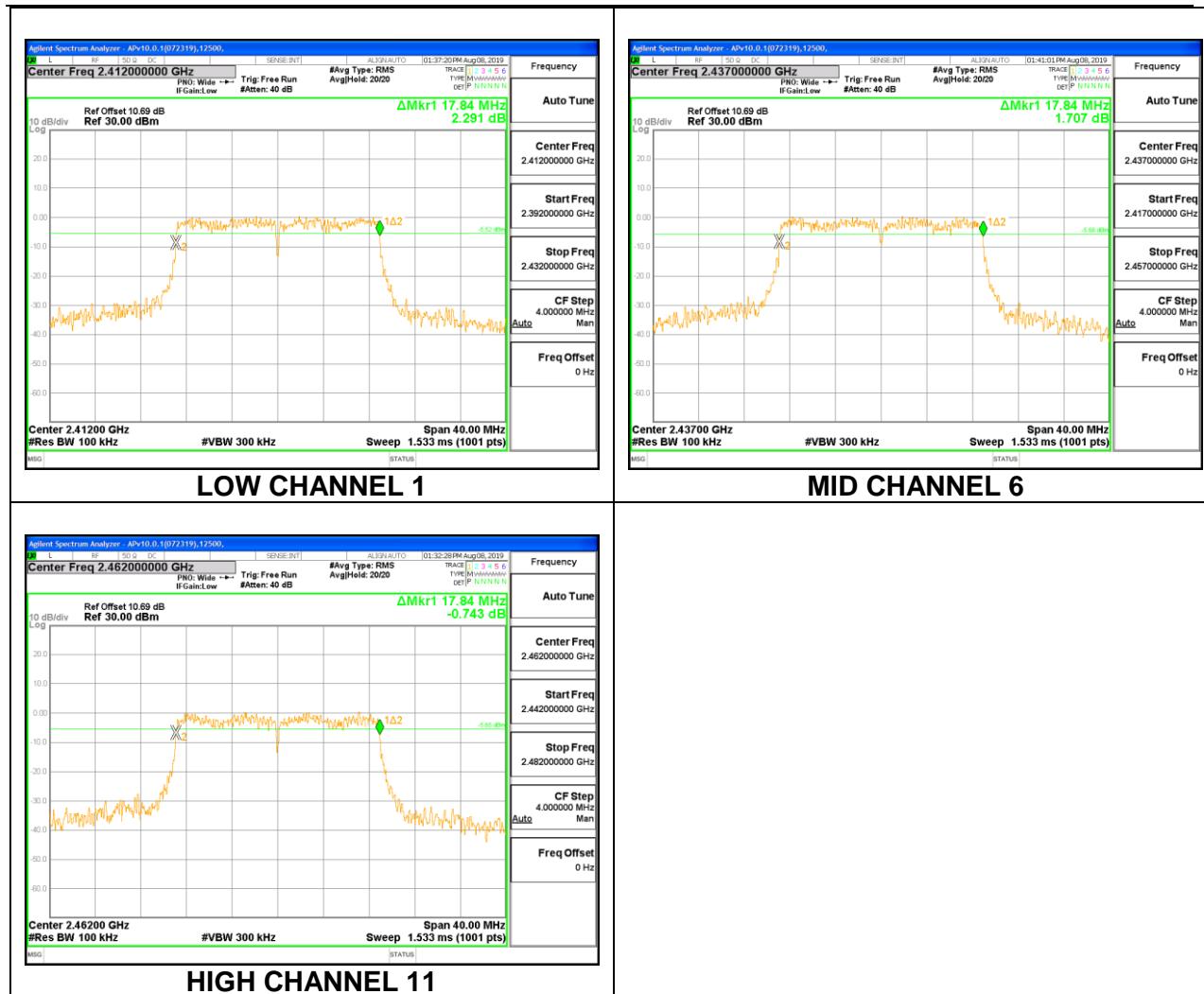
1TX Antenna 1 MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	17.7600	0.5
Mid 6	2437	17.7600	0.5
High 11	2462	17.8000	0.5



1TX Antenna 2 MODE

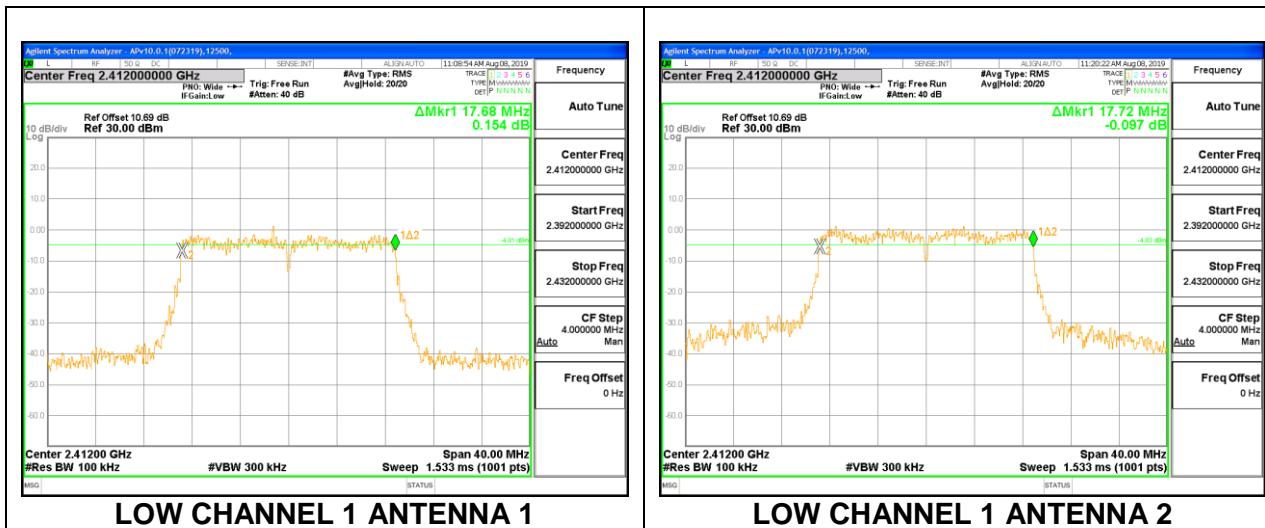
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low 1	2412	17.8400	0.5
Mid 6	2437	17.8400	0.5
High 11	2462	17.8400	0.5



2TX Antenna 1 + Antenna 2 CDD MODE

Channel	Frequency (MHz)	6 dB BW Antenna 1 (MHz)	6 dB BW Antenna 2 (MHz)	Minimum Limit (MHz)
Low 1	2412	17.6800	17.7200	0.5
Mid 6	2437	17.7600	17.8000	0.5
High 11	2462	17.8400	17.8000	0.5

LOW CHANNEL 1



MID CHANNEL 6

