

MEASUREMENT REPORT

FCC PART 15 Subpart E WLAN 802.11a/n/ac

FCC ID: 2AD8UFZCWO4A1

APPLICANT: Nokia Solutions and Networks

Application Type: Certification

Product: Wi-Fi AP 4x4 OD small omni antenna US

Model No.: WO4C-AC400

Brand Name: Nokia

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Rule Part(s): Part 15 Subpart E (Section 15.407)

Test Procedure(s): ANSI C63.10-2013, KDB 789033 D02v01r03,
KDB 662911 D01v02r01, KDB 644545 D03v01

Test Date: July 28 , 2016 ~ July 06, 2017

Reviewed By : Paddy Chen
(Paddy Chen)

Approved By : Chenz Ker
(Chenz Ker)



The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02v01r03. Test results reported herein relate only to the item(s) tested.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Taiwan) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
1608TW0110-U11	Rev. 01	Draft report	07-06-2017	

Note: This report is prepared for FCC Class II permissive change and supplement to MRT Original "1608TW0110-U2" Report adding "Wi-Fi AP 4x4 OD small omni antenna US ant" and related data.

CONTENTS

Description	Page
§2.1033 General Information	6
1. INTRODUCTION	7
1.1. Scope	7
1.2. MRT Test Location	7
2. PRODUCT INFORMATION	8
2.1. Equipment Description.....	8
2.2. Operation Frequencies and Channel List.....	9
2.3. Description of Available Antennas.....	10
2.4. Description of Antenna RF Port	11
2.5. Test Mode	11
2.6. Test Software.....	11
2.7. Device Capabilities	12
2.8. Test Configuration	12
2.9. EMI Suppression Device(s)/Modifications.....	12
2.10. Labeling Requirements.....	12
3. DESCRIPTION OF TEST	13
3.1. Evaluation Procedure	13
3.2. AC Line Conducted Emissions	13
3.3. Radiated Emissions	14
4. ANTENNA REQUIREMENTS.....	15
5. TEST EQUIPMENT CALIBRATION DATE	16
6. MEASUREMENT UNCERTAINTY.....	17
7. TEST RESULT	18
7.1. Summary	18
7.2. 26dB Bandwidth Measurement.....	20
7.2.1. Test Limit	20
7.2.2. Test Procedure used.....	20
7.2.3. Test Setting.....	20
7.2.4. Test Setup	20
7.2.5. Test Result.....	21
7.3. 6dB Bandwidth Measurement.....	51
7.3.1. Test Limit	51
7.3.2. Test Procedure used.....	51

7.3.3. Test Setting.....	51
7.3.4. Test Setup	51
7.3.5. Test Result.....	52
7.4. Output Power Measurement.....	72
7.4.1. Test Limit	72
7.4.2. Test Procedure Used	72
7.4.3. Test Setting.....	72
7.4.4. Test Setup	73
7.4.5. Test Rate Assessment	74
7.4.6. Test Result.....	76
7.5. Transmit Power Control	83
7.5.1. Test Limit	83
7.5.2. Test Procedure Used	83
7.5.3. Test Setting.....	83
7.5.4. Test Setup	83
7.5.5. Test Result.....	83
7.6. Power Spectral Density Measurement	84
7.6.1. Test Limit	84
7.6.2. Test Procedure Used	84
7.6.3. Test Setting.....	84
7.6.4. Test Setup	85
7.6.5. Test Result.....	86
7.7. Frequency Stability Measurement.....	143
7.7.1. Test Limit	143
7.7.2. Test Procedure Used	143
7.7.3. Test Setup	143
7.7.4. Test Result.....	144
7.8. Radiated Spurious Emission Measurement	145
7.8.1. Test Limit	145
7.8.2. Test Procedure Used	145
7.8.3. Test Setting.....	145
7.8.4. Test Setup	147
7.8.5. Test Result.....	149
7.9. Radiated Restricted Band Edge Measurement	290
7.9.1. Test Limit	290
7.9.2. Test Result.....	292
7.10. AC Conducted Emissions Measurement.....	528
7.10.1. Test Limit	528
7.10.2. Test Procedure	528

7.10.3. Test Setup	529
7.10.4. Test Result.....	530
8. CONCLUSION.....	532

§2.1033 General Information

Applicant:	Nokia Solutions and Networks
Applicant Address:	Karaportti 3, FI-02610 Espoo, Finland
Manufacturer:	Nokia Solutions and Networks
Manufacturer Address:	Karaportti 3, FI-02610 Espoo, Finland
Test Site:	MRT Technology (Taiwan) Co., Ltd
Test Site Address:	No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C)
MRT FCC Registration No.:	153292
FCC Rule Part(s):	Part 15 Subpart E (Section 15.407)
Model No.:	WO4C-AC400
Test Device Serial No.:	N/A <input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
FCC Classification:	Unlicensed National Information Infrastructure (UNII)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan (R.O.C)

- MRT facility is a FCC registered (Reg. No. 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.
- MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Taiwan, EU and TELEC Rules.

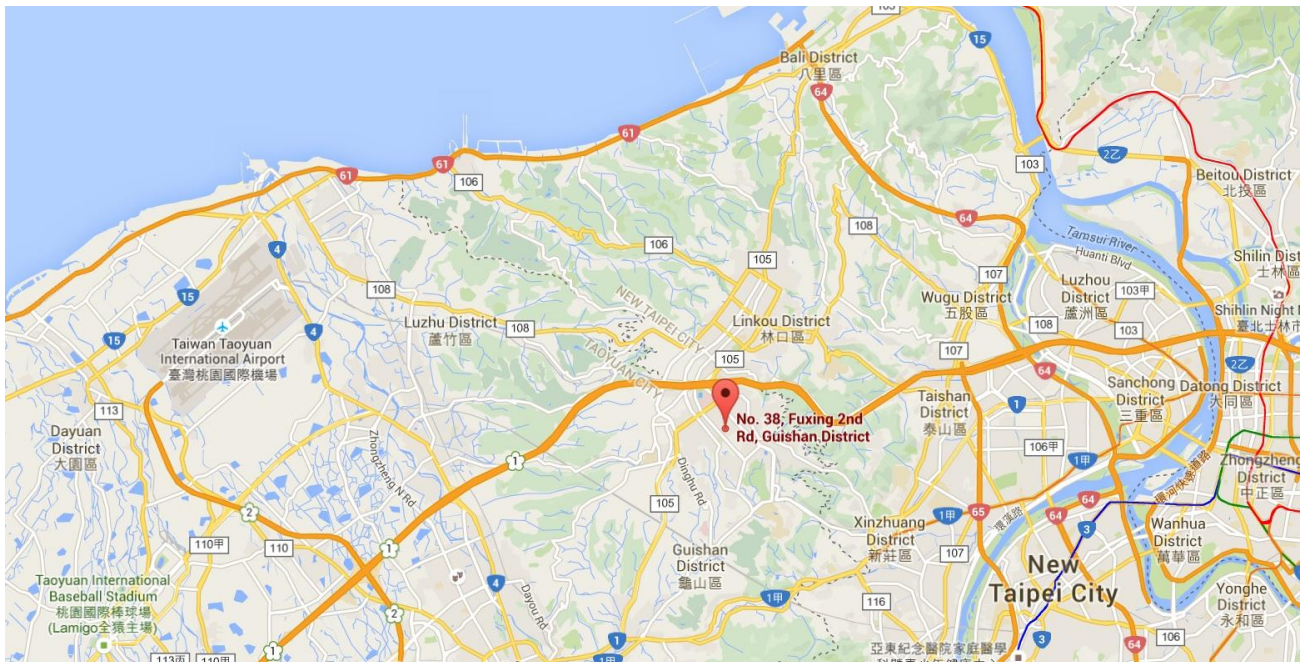
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Wi-Fi AP 4x4 OD small omni antenna US
Model No.	WO4C-AC400
Brand Name	Nokia
Hardware Version:	AM3
Frequency Range	<p><u>2.4GHz:</u> For 802.11b/g/n-HT20: 2412 ~ 2462 MHz For 802.11n-HT40: 2422 ~ 2452 MHz</p> <p><u>5GHz:</u> For 802.11a/n-HT20/ac-VHT20 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz For 802.11ac-VHT80+80: 5210 MHz + 5775 MHz</p>
Maximum Output Power	<p><u>CDD Mode:</u> 802.11a: 28.26dBm</p> <p><u>Beam-Forming Mode:</u> 802.11n-HT20: 26.09dBm, 802.11n-HT40: 25.98dBm, 802.11ac-VHT20: 26.18dBm, 802.11ac-VHT40: 26.00dBm, 802.11ac-VHT80: 21.15dBm 802.11ac-VHT80+80: 5210MHz - 22.00dBm, 5775MHz - 19.01dBm</p>
Modulation Type	16QAM, 64QAM, QPSK, BPSK for OFDM 802.11a/n/ac: OFDM

Note 1: We select the POE adapter (M/N: PoE35-54A) to perform all RF testing.

Note 2: The product name difference as below:

- when the device has been connected the Galtronics Small Omni antenna, the product name is “Wi-Fi AP 4x4 OD small omni antenna WW”;

2.2. Operation Frequencies and Channel List

802.11a/n-HT20/ ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	149	5745 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

802.11n-HT40/ ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	151	5755 MHz
159	5795 MHz	--	--	--	--


802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	155	5775 MHz	--	--

802.11ac-VHT80+80

Channel	Frequency	Channel	Frequency
42 + 155	5210 MHz + 5775 MHz	--	--

2.3. Description of Available Antennas

Antenna	Manufacturer	Frequency Band (GHz)	Product Number	Tx Paths
	Galtronics	2.4	Galtronics Small Omni Antenna	2
		5		2

Product Number	Frequency Band (MHz)	Tx Paths	Per Chain Max Antenna Gain (dBi)				Beam Forming Directional Gain (dBi)	CDD Directional Gain (dBi)
			Ant 0	Ant 1	Ant 2	Ant 3		
Galtronics Small Omni Antenna	2412 ~2462	2	2.69	2.41	2.69	2.41	8.57	8.57
	5150 ~ 5250	2	3.27	3.85	3.27	3.85	9.59	9.59
	5150 ~ 5250 30°elevation angle	2	3.20	1.81	3.20	1.81	N/A	N/A
	5725 ~ 5850	2	4.35	4.30	4.35	4.30	10.35	10.35

Note

- The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11a/b/g mode, and CDD signals are correlated.
- The EUT supports Beam Forming technology for 802.11n/ac mode, and exclude 802.11b/g mode. Correlated signals include, but are not limited to, signals transmitted in any of the following modes:
 - Any transmit Beam Forming mode, whether fixed or adaptive (e.g., phased array modes, closed loop MIMO modes, Transmitter Adaptive Antenna modes, Maximum Ratio Transmission (MRT) modes, and Statistical Eigen Beam Forming (EBF) modes).
 - CDD signals are correlated and create unintended array gain that varies with signal bandwidth, antenna geometry, and cyclic delay values. Consequently, depending on system parameters, it may be appropriate to use different values of array gain for compliance with power limits versus compliance with powerspectral density limits.
- Unequal Antenna gains, with equal transmit powers. For Antenna gains given by G_1, G_2, \dots, G_N dBi transmit signals are correlated, then
 - Directional gain = $10 \cdot \log\left[\frac{(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2}{N_{ANT}}\right]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]
 - For example (Galtronics Small Omni Antenna): 5150 ~ 5250MHz Directional Gain = $10 \cdot \log\left[\frac{(10^{3.27/20} + 10^{3.85/20} + 10^{3.27/20} + 10^{3.85/20})^2}{4}\right] = 9.59$ dBi

2.4. Description of Antenna RF Port

Antenna RF Port								
---	2.4GHz RF Port				5GHz RF Port			
Software Control Port	Ant 0	Ant 1	Ant 2	Ant 3	Ant 0	Ant 1	Ant 2	Ant 3
<p>The image shows the back view of a blue antenna module. It features two LAN ports labeled LAN 1 POE and LAN 2. Each LAN port has four antenna connectors. The top two connectors are labeled 2.4G Ant 0 and 5G Ant 3, while the bottom two are labeled 2.4G Ant 1 and 5G Ant 2. On the right side, the top two connectors are labeled 2.4G Ant 3 and 5G Ant 0, and the bottom two are labeled 2.4G Ant 2 and 5G Ant 1. Red circles highlight each of the eight antenna connectors.</p>								

2.5. Test Mode

Test Mode	Mode 1: Transmit by 802.11a
	Mode 2: Transmit by 802.11n-HT20
	Mode 3: Transmit by 802.11n-HT40
	Mode 4: Transmit by 802.11ac-VHT20
	Mode 5: Transmit by 802.11ac-VHT40
	Mode 6: Transmit by 802.11ac-VHT80
	Mode 7: Transmit by 802.11ac-VHT80+80

2.6. Test Software

The test utility software used during testing was “QCARCT 3.0.174.0”.

2.7. Device Capabilities

This device contains the following capabilities:

2.4GHz WLAN (DTS) and 5GHz WLAN (NII).

Note: 5GHz (NII) operation is possible in 20MHz, 40MHz and 80MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = average per the guidance of Section B)2)b) of KDB 789033 D02v01r03. The RBW and VBW were both greater than $50/T$, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
802.11a	97.18 %
802.11n-HT20	98.81 %
802.11n-HT40	97.55 %
802.11ac-VHT20	98.82 %
802.11ac-VHT40	97.40 %
802.11ac-VHT80	94.30 %
802.11ac-VHT80+80	94.30 %

2.8. Test Configuration

The **FCC ID: 2AD8UFZCWO4A1** was tested per the guidance of KDB 789033 D02v01r03. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.9. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.10. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase.

However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v01r03 were used in the measurement of the **FCC ID: 2AD8UFZCWO4A1**.

Deviation from measurement procedure.....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.10.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- There are provisions for reverse connector to an external antenna.
- Galtronics Small Omni Antenna: reverse SMA connector.

Conclusion:

The **FCC ID: 2AD8UFZCWO4A1** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR3	MRTTWA00045	1 year	2018/03/17
Two-Line V-Network	R&S	ENV216	MRTTWA00019	1 year	2018/03/23
Two-Line V-Network	R&S	ENV216	MRTTWA00020	1 year	2018/03/23
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/09

Radiated Emissions

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Signal Analyzer	R&S	FSV40	MRTTWA00007	1 year	2018/03/02
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2018/03/16
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2018/04/06
Broadband Amplifier	SCHWARZBECK	BBV 9721	MRTTWA00006	1 year	2018/04/06
Active Loop Antenna	SCHWARZBECK	FMZB 1519B	MRTTWA00002	1 year	2018/04/06
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2018/04/06
Broadband Hornantenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2018/04/06
Breitband Hornantenna	SCHWARZBECK	BBHA 9170	MRTTWA00004	1 year	2018/04/06
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/09

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EXA Signal Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2017/07/11
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00014	1 year	2018/03/18
X-Series USB Peak and Average Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2018/03/18
Programmable Temperature & Humidity Chamber	TEN BILLION	TTH-B3UP	MRTTWA00036	1 year	2018/05/11
AC Power Source	T-power	TFC-1001	MRTTWA00030	N/A	N/A
Temperature/Humidity Meter	TFA	35.1078.10.IT	MRTTWA00033	1 year	2018/06/09

Software	Version	Function
EMI Software	V3	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 40GHz: 4.76dB
Frequency Stability - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.21%
Output Power - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.13dB
Power Spectrum Density - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 1.15dB
Occupied Bandwidth - TR3
Measuring Uncertainty for a Level of Confidence of 95% ($U=2Uc(y)$): 0.28%

7. TEST RESULT

7.1. Summary

Company Name: Nokia Solutions and Networks
FCC ID: 2AD8UFZCWO4A1
Model No.: WO4C-AC400
Data Rate(s) Tested: 6Mbps ~ 54Mbps (a);
6.5/7.2Mbps ~ 260/288.8Mbps (n-HT20);
13.5/15.0Mbps ~ 540/600Mbps (n-HT40);
6.5/7.2Mbps ~ 312/346.7Mbps (ac-VHT20MHz);
13.5/15.0Mbps ~ 720/800Mbps (ac-VHT40MHz);
29.3/32.5Mbps ~ 1560/1733.2Mbps (ac-VHT80MHz)
29.3/32.5Mbps ~ 780/866.6Mbps (ac-VHT80+80MHz BW)

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 7.2
15.407(e)	6dB Bandwidth	≥ 500kHz		Pass	Section 7.3
15.407(a)(1)(i), (3)	Maximum Conducted Output Power	Refer to Section 7.4		Pass	Section 7.4
15.407(h)(1)	Transmit Power Control	≤ 24 dBm		N/A	Section 7.5
15.407(a)(1)(i), (3), (5)	Power Spectral Density	Refer to Section 7.6		Pass	Section 7.6
15.407(g)	Frequency Stability	N/A		Pass	Section 7.7
15.407(b)(1), (4)	Undesirable Emissions	≤ -27dBm/MHz EIRP ≤ -17dBm/MHz EIRP	Radiated	Pass	Section 7.8 & 7.9
15.205, 15.209 15.407(b)(5), (6), (7)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.10

Notes:

- 1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 3) Test Items “26dB Bandwidth”, “6dB Bandwidth” have been assessed SISO and MIMO transmission, and showed the worst test data in this report.

7.2. 26dB Bandwidth Measurement

7.2.1. Test Limit

N/A

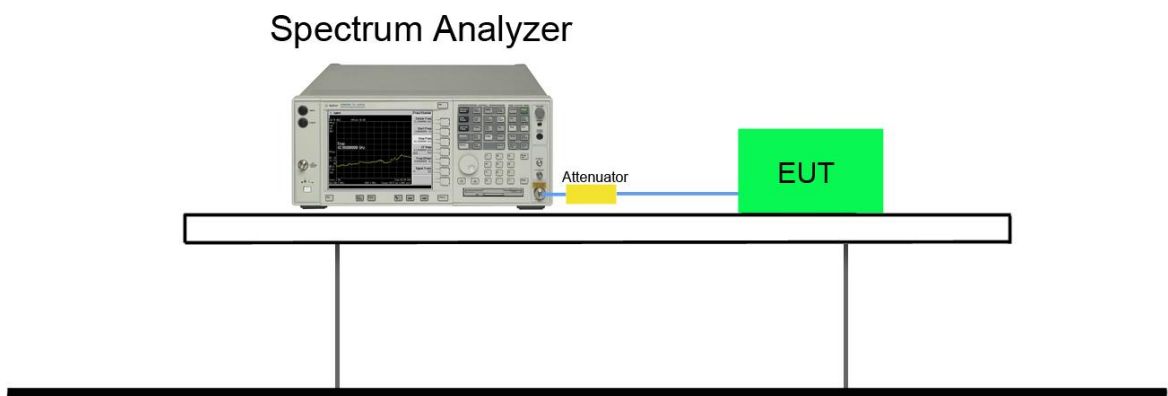
7.2.2. Test Procedure used

KDB 789033 D02v01r03 – Section C.1

7.2.3. Test Setting

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to $X = 26$. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth.
3. VBW $\geq 3 \times$ RBW.
4. Detector = Peak.
5. Trace mode = max hold.

7.2.4. Test Setup



7.2.5. Test Result

Product	Wi-Fi AP 4x4 OD ext. antenna US	Temperature	25°C
Test Engineer	Johnson Liao	Relative Humidity	50 ~ 58%
Test Site	SR2	Test Date	2016/09/14
Test Item	26dB Bandwidth		

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0					
802.11a	6	36	5180	20.09	16.43
802.11a	6	44	5220	20.20	16.43
802.11a	6	48	5240	20.15	16.44
802.11a	6	149	5745	21.83	16.56
802.11a	6	157	5785	22.49	16.61
802.11a	6	165	5825	23.70	16.69
802.11n-HT20	6.5	36	5180	20.09	17.61
802.11n-HT20	6.5	44	5220	20.28	17.62
802.11n-HT20	6.5	48	5240	21.01	17.63
802.11n-HT20	6.5	149	5745	21.79	17.67
802.11n-HT20	6.5	157	5785	21.59	17.68
802.11n-HT20	6.5	165	5825	22.40	17.72
802.11n-HT40	13.5	38	5190	40.04	35.95
802.11n-HT40	13.5	46	5230	39.97	35.96
802.11n-HT40	13.5	151	5755	41.42	36.10
802.11n-HT40	13.5	159	5795	59.93	36.29
802.11ac-VHT20	6.5	36	5180	20.24	17.61
802.11ac-VHT20	6.5	44	5220	20.65	17.62
802.11ac-VHT20	6.5	48	5240	21.10	17.63
802.11ac-VHT20	6.5	149	5745	21.62	17.68
802.11ac-VHT20	6.5	157	5785	21.92	17.70
802.11ac-VHT20	6.5	165	5825	22.96	17.74
802.11ac-VHT40	13.5	38	5190	39.87	35.94
802.11ac-VHT40	13.5	46	5230	39.98	35.94
802.11ac-VHT40	13.5	151	5755	40.75	36.11
802.11ac-VHT40	13.5	159	5795	52.68	36.22



Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0					
802.11ac-VHT80	29.3	42	5210	84.66	75.92
802.11ac-VHT80	29.3	155	5775	85.19	75.88



Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 1					
802.11a	6	36	5180	20.37	16.46
802.11a	6	44	5220	20.26	16.47
802.11a	6	48	5240	20.34	16.46
802.11a	6	149	5745	22.77	16.59
802.11a	6	157	5785	22.15	16.53
802.11a	6	165	5825	21.58	16.53
802.11n-HT20	6.5	36	5180	20.91	17.62
802.11n-HT20	6.5	44	5220	20.82	17.63
802.11n-HT20	6.5	48	5240	20.32	17.64
802.11n-HT20	6.5	149	5745	21.09	17.68
802.11n-HT20	6.5	157	5785	21.66	17.67
802.11n-HT20	6.5	165	5825	21.07	17.68
802.11n-HT40	13.5	38	5190	39.87	35.95
802.11n-HT40	13.5	46	5230	39.62	35.96
802.11n-HT40	13.5	151	5755	40.10	36.08
802.11n-HT40	13.5	159	5795	40.38	36.05
802.11ac-VHT20	6.5	36	5180	20.91	17.65
802.11ac-VHT20	6.5	44	5220	20.86	17.65
802.11ac-VHT20	6.5	48	5240	21.08	17.64
802.11ac-VHT20	6.5	149	5745	21.72	17.70
802.11ac-VHT20	6.5	157	5785	21.61	17.68
802.11ac-VHT20	6.5	165	5825	20.96	17.67
802.11ac-VHT40	13.5	38	5190	40.01	35.97
802.11ac-VHT40	13.5	46	5230	40.08	35.97
802.11ac-VHT40	13.5	151	5755	40.56	36.09
802.11ac-VHT40	13.5	159	5795	40.59	36.09
802.11ac-VHT80	29.3	42	5210	84.88	75.91
802.11ac-VHT80	29.3	155	5775	84.10	75.82



Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 2					
802.11a	6	36	5180	20.33	16.46
802.11a	6	44	5220	20.27	16.48
802.11a	6	48	5240	20.40	16.49
802.11a	6	149	5745	21.98	16.55
802.11a	6	157	5785	21.92	16.66
802.11a	6	165	5825	22.08	16.53
802.11n-HT20	6.5	36	5180	20.90	17.61
802.11n-HT20	6.5	44	5220	20.99	17.63
802.11n-HT20	6.5	48	5240	20.82	17.64
802.11n-HT20	6.5	149	5745	21.97	17.69
802.11n-HT20	6.5	157	5785	21.67	17.67
802.11n-HT20	6.5	165	5825	21.73	17.68
802.11n-HT40	13.5	38	5190	40.16	35.93
802.11n-HT40	13.5	46	5230	39.95	35.97
802.11n-HT40	13.5	151	5755	46.64	36.12
802.11n-HT40	13.5	159	5795	46.46	36.14
802.11ac-VHT20	6.5	36	5180	21.00	17.60
802.11ac-VHT20	6.5	44	5220	20.66	17.63
802.11ac-VHT20	6.5	48	5240	20.94	17.63
802.11ac-VHT20	6.5	149	5745	22.03	17.68
802.11ac-VHT20	6.5	157	5785	21.46	17.70
802.11ac-VHT20	6.5	165	5825	21.98	17.67
802.11ac-VHT40	13.5	38	5190	40.03	35.98
802.11ac-VHT40	13.5	46	5230	39.93	35.96
802.11ac-VHT40	13.5	151	5755	44.02	36.06
802.11ac-VHT40	13.5	159	5795	44.14	36.14
802.11ac-VHT80	29.3	42	5210	83.98	75.89
802.11ac-VHT80	29.3	155	5775	83.52	75.97



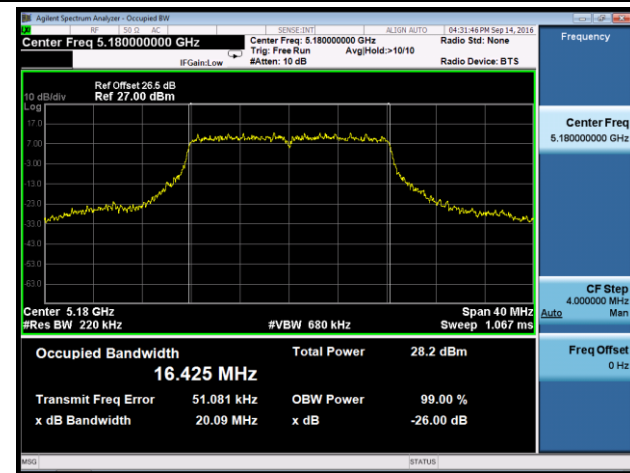
Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 3					
802.11a	6	36	5180	20.13	16.44
802.11a	6	44	5220	20.12	16.46
802.11a	6	48	5240	20.24	16.49
802.11a	6	149	5745	20.23	16.50
802.11a	6	157	5785	20.31	16.46
802.11a	6	165	5825	20.19	16.48
802.11n-HT20	6.5	36	5180	20.28	17.61
802.11n-HT20	6.5	44	5220	20.80	17.62
802.11n-HT20	6.5	48	5240	20.25	17.64
802.11n-HT20	6.5	149	5745	20.78	17.64
802.11n-HT20	6.5	157	5785	20.79	17.64
802.11n-HT20	6.5	165	5825	20.81	17.64
802.11n-HT40	13.5	38	5190	40.03	35.96
802.11n-HT40	13.5	46	5230	39.88	35.95
802.11n-HT40	13.5	151	5755	40.06	36.03
802.11n-HT40	13.5	159	5795	40.06	35.97
802.11ac-VHT20	6.5	36	5180	20.35	17.62
802.11ac-VHT20	6.5	44	5220	20.18	17.62
802.11ac-VHT20	6.5	48	5240	20.65	17.62
802.11ac-VHT20	6.5	149	5745	21.01	17.63
802.11ac-VHT20	6.5	157	5785	21.00	17.64
802.11ac-VHT20	6.5	165	5825	20.51	17.63
802.11ac-VHT40	13.5	38	5190	40.07	35.98
802.11ac-VHT40	13.5	46	5230	39.47	35.98
802.11ac-VHT40	13.5	151	5755	40.22	35.97
802.11ac-VHT40	13.5	159	5795	40.22	35.99
802.11ac-VHT80	29.3	42	5210	84.61	75.84
802.11ac-VHT80	29.3	155	5775	84.42	75.86



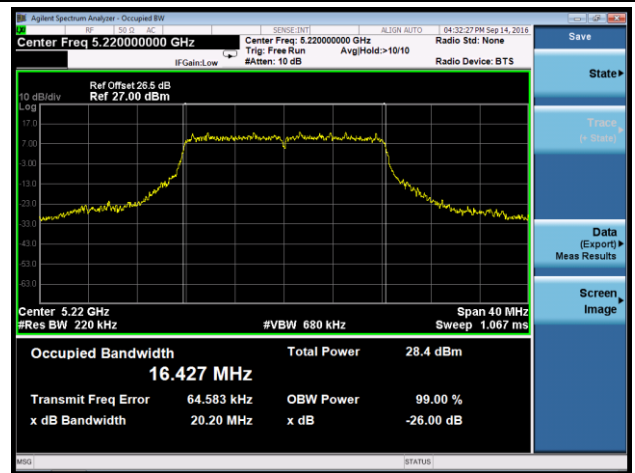
Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0+1+2+3					
802.11ac-VHT 80+80	117.2	42	5210	86.24	76.08
		155	5775	87.86	79.21

802.11a 26dB Bandwidth & 99% Bandwidth - Ant 0

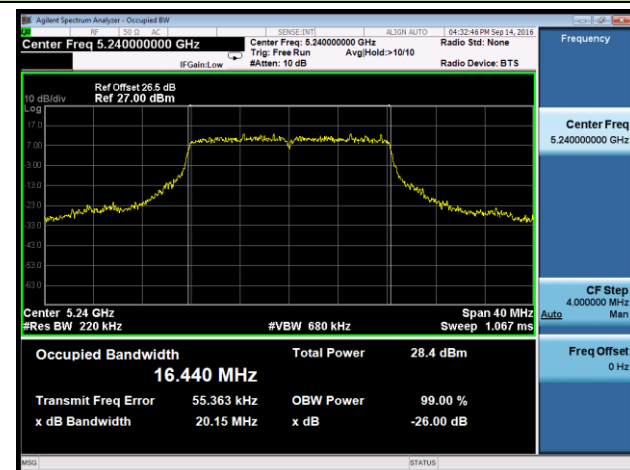
Channel 36 (5180MHz)



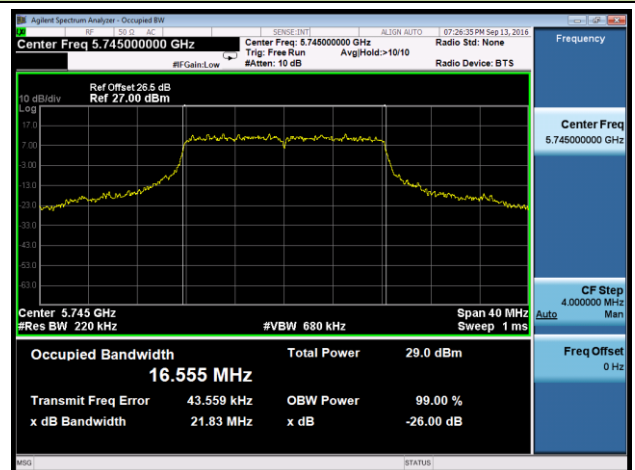
Channel 44 (5220MHz)



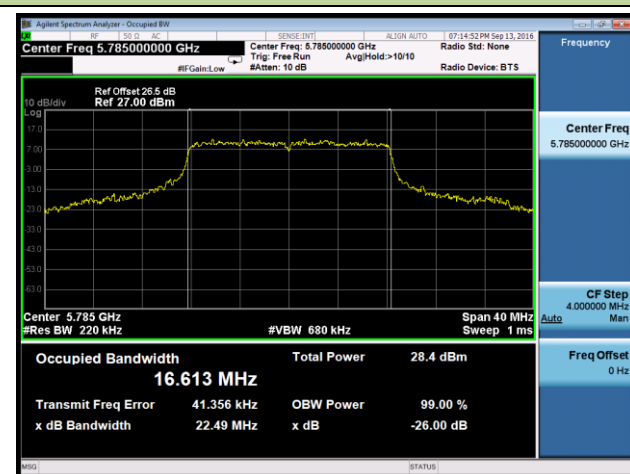
Channel 48 (5240MHz)



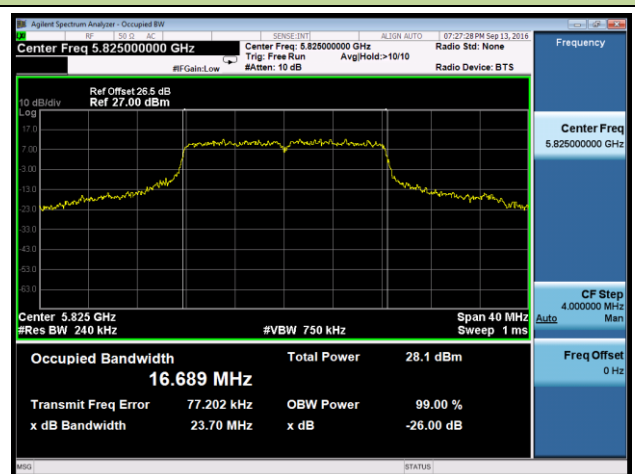
Channel 149 (5745MHz)



Channel 157 (5785MHz)

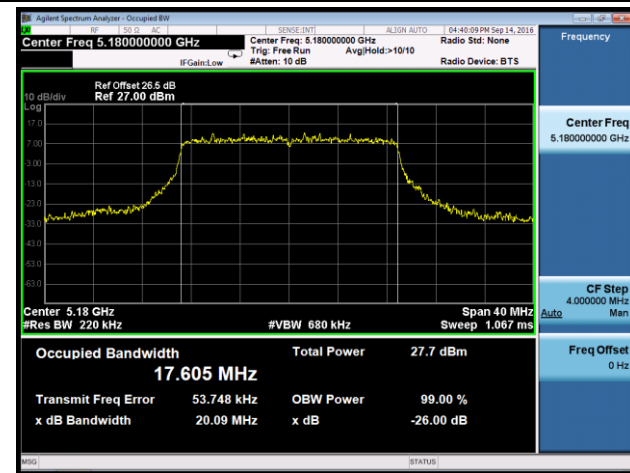


Channel 165 (5825MHz)

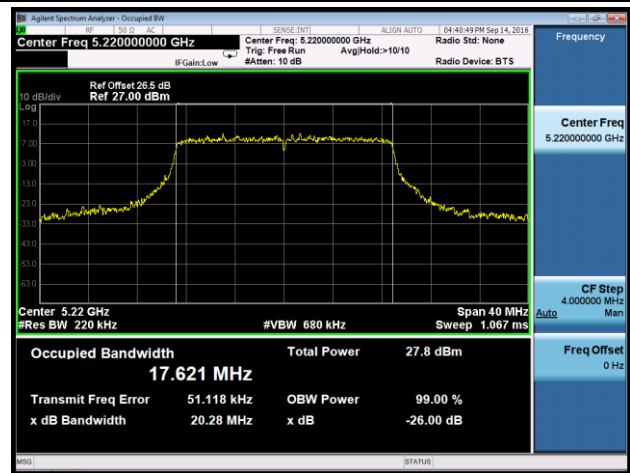


802.11n-HT20 26dB Bandwidth & 99% Bandwidth - Ant 0

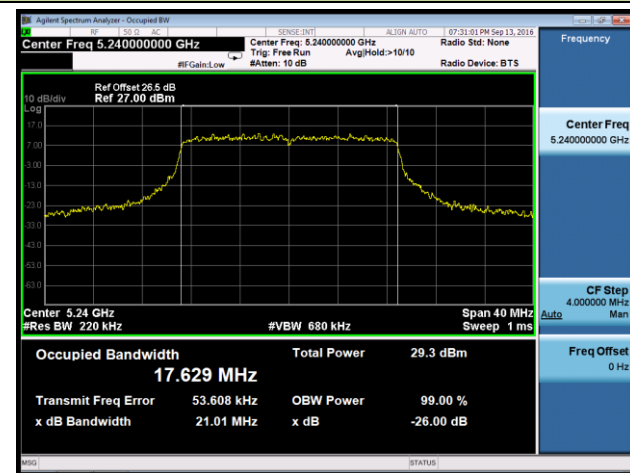
Channel 36 (5180MHz)



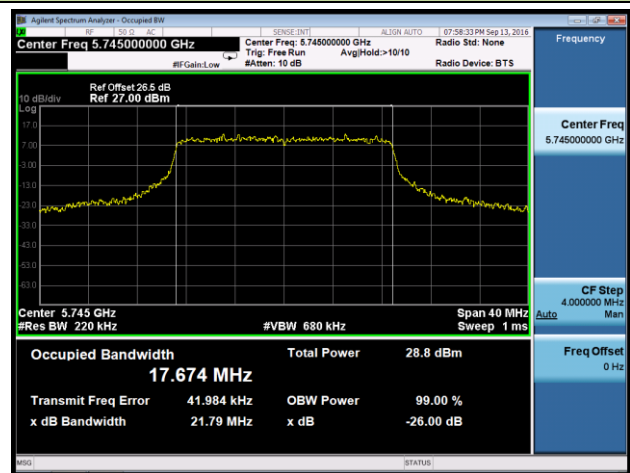
Channel 44 (5220MHz)



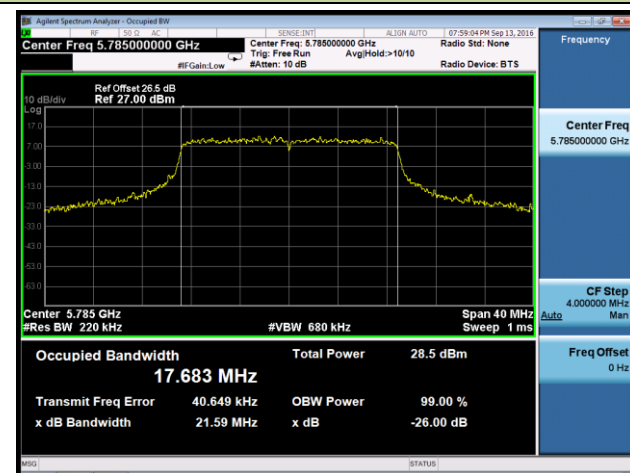
Channel 48 (5240MHz)



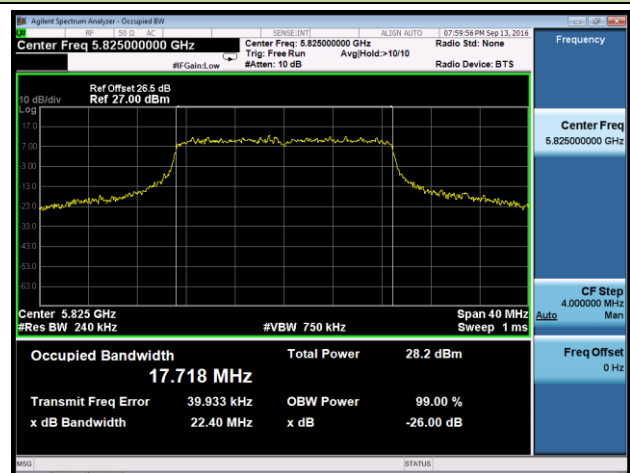
Channel 149 (5745MHz)

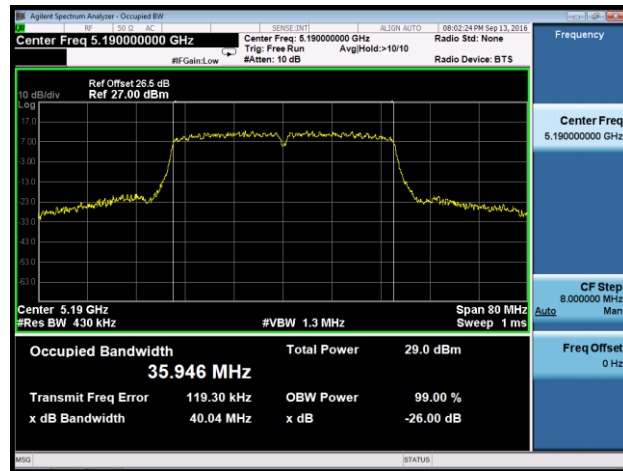
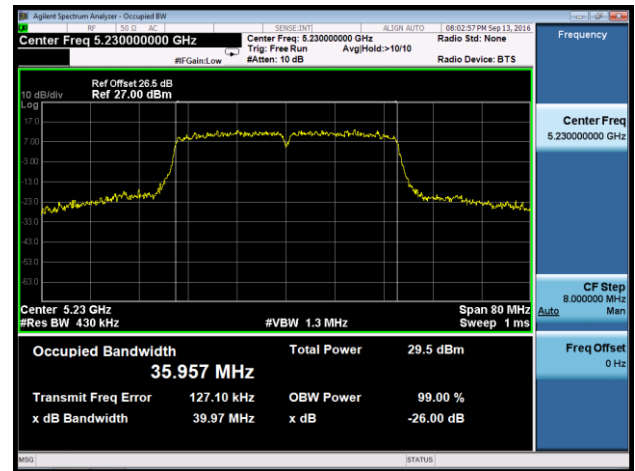
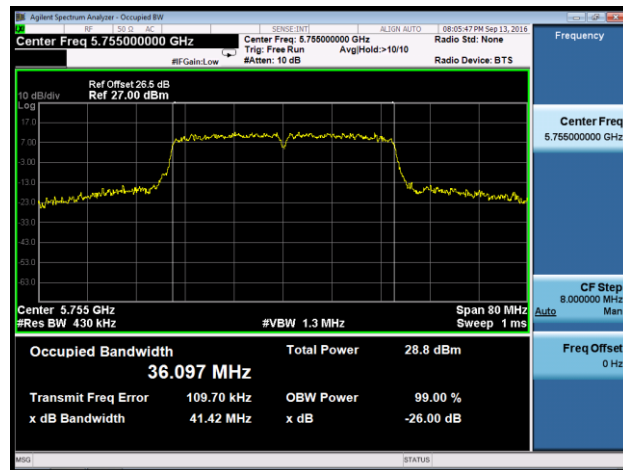
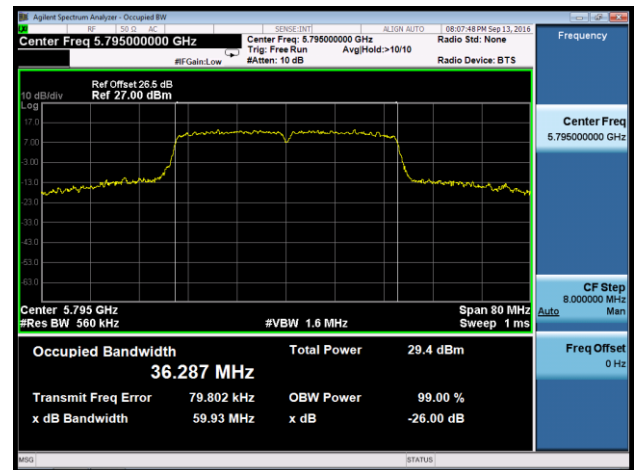


Channel 157 (5785MHz)



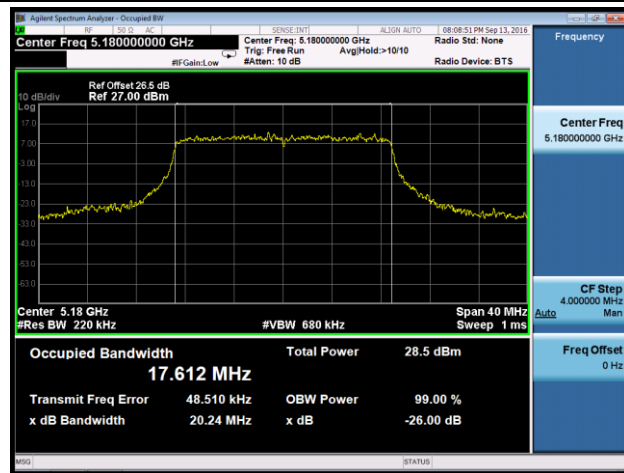
Channel 165 (5825MHz)



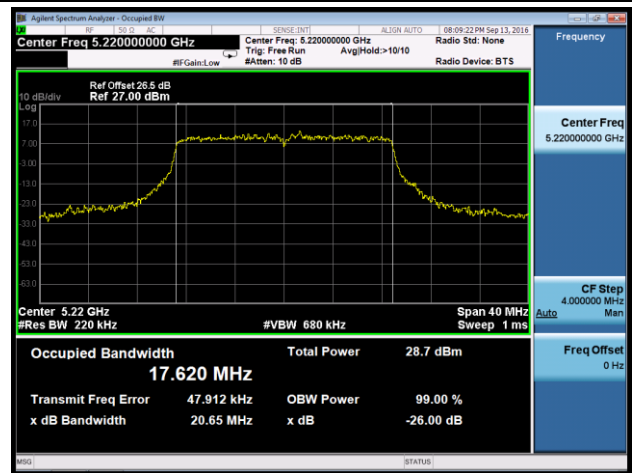
802.11n-HT40 26dB Bandwidth & 99% Bandwidth - Ant 0
Channel 38 (5190MHz)

Channel 46 (5230MHz)

Channel 151 (5755MHz)

Channel 159 (5795MHz)


802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth - Ant 0

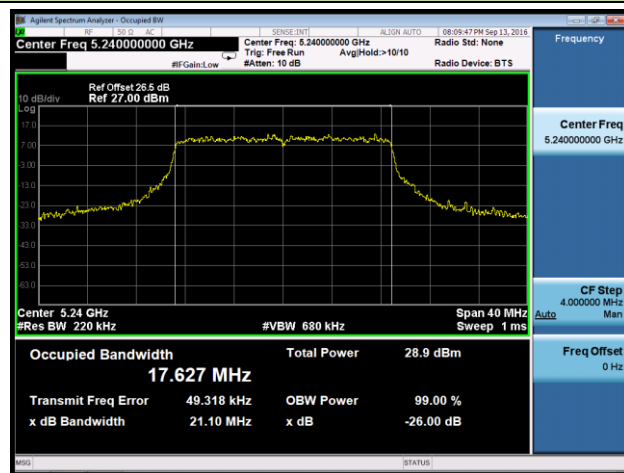
Channel 36 (5180MHz)



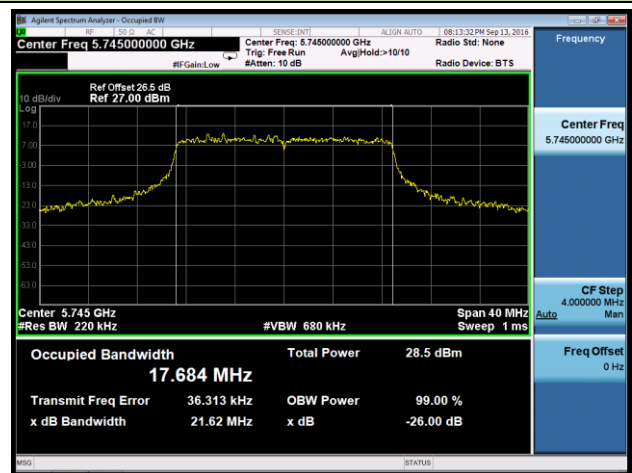
Channel 44 (5220MHz)



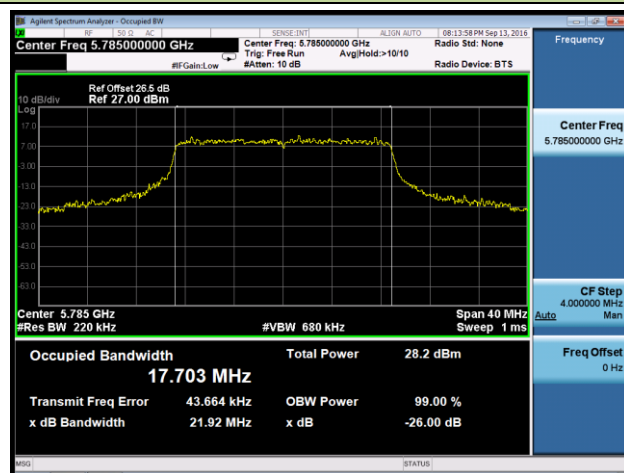
Channel 48 (5240MHz)



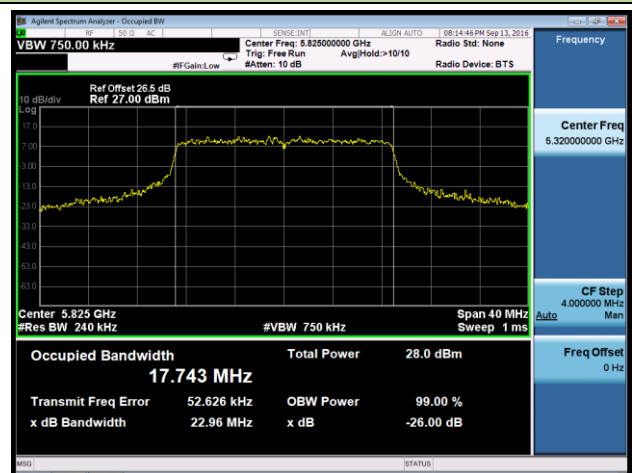
Channel 149 (5745MHz)

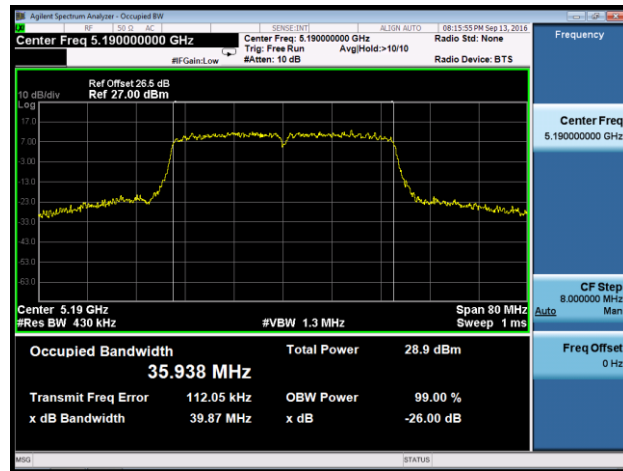
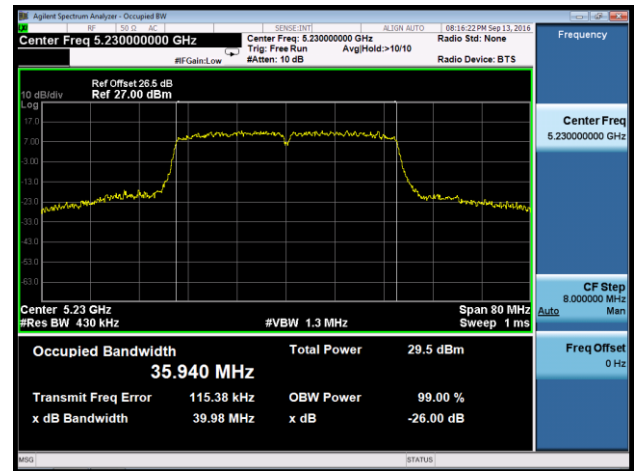
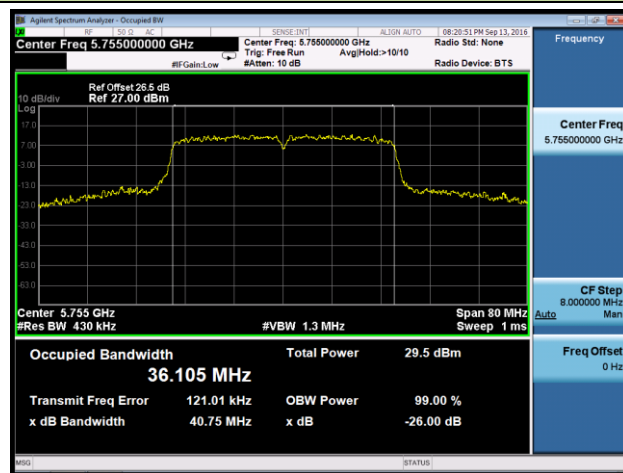
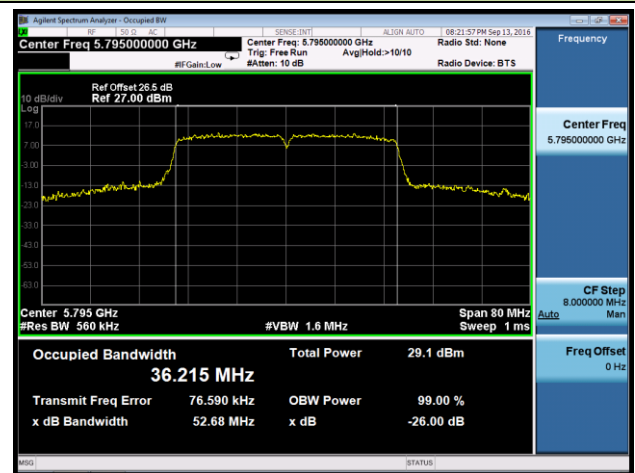


Channel 157 (5785MHz)



Channel 165 (5825MHz)

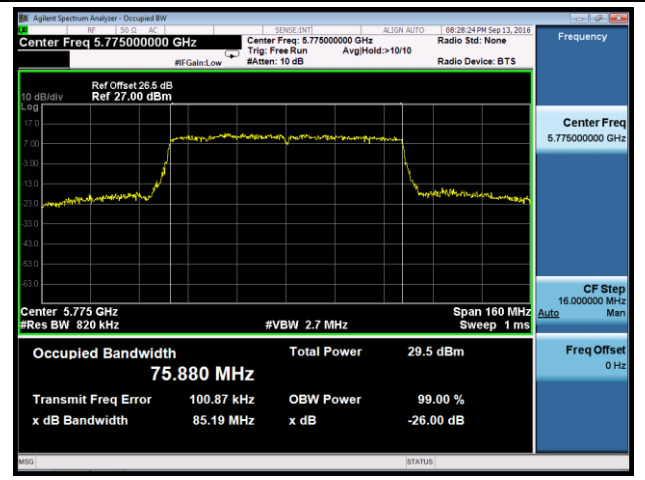
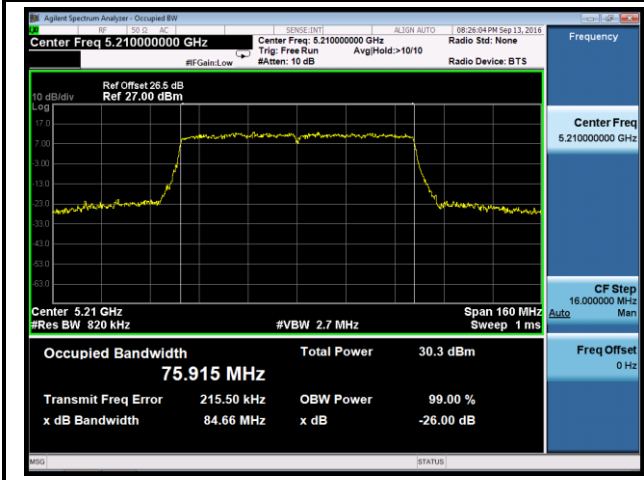


802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth - Ant 0
Channel 38 (5190MHz)

Channel 46 (5230MHz)

Channel 151 (5755MHz)

Channel 159 (5795MHz)


802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth - Ant 0

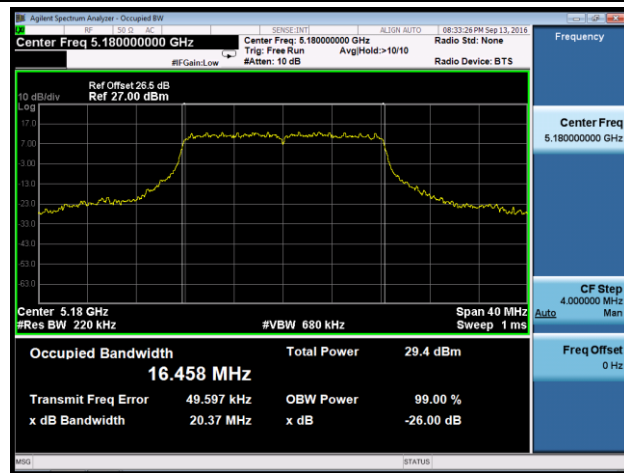
Channel 42 (5210MHz)

Channel 155 (5755MHz)

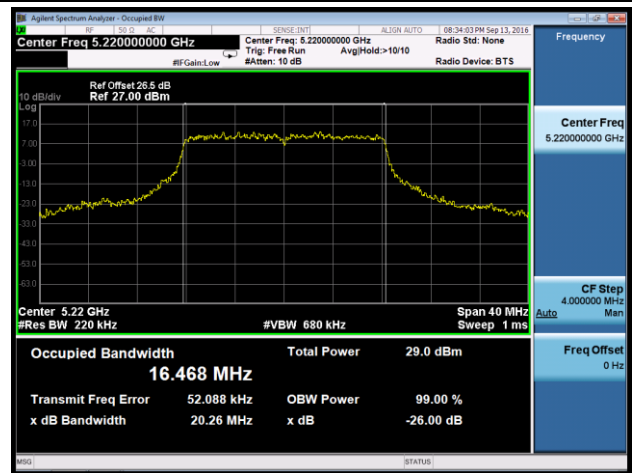


802.11a 26dB Bandwidth & 99% Bandwidth - Ant 1

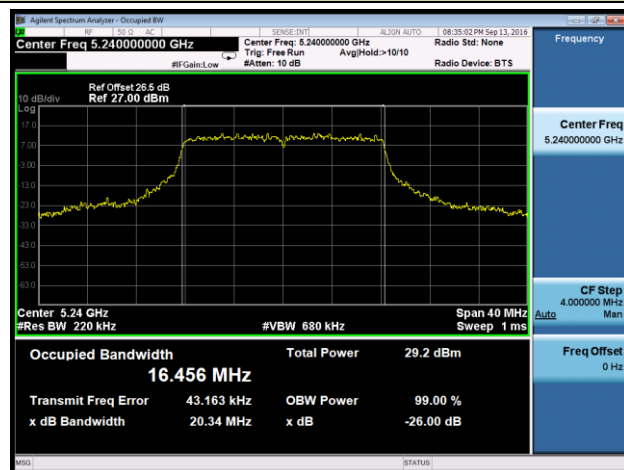
Channel 36 (5180MHz)



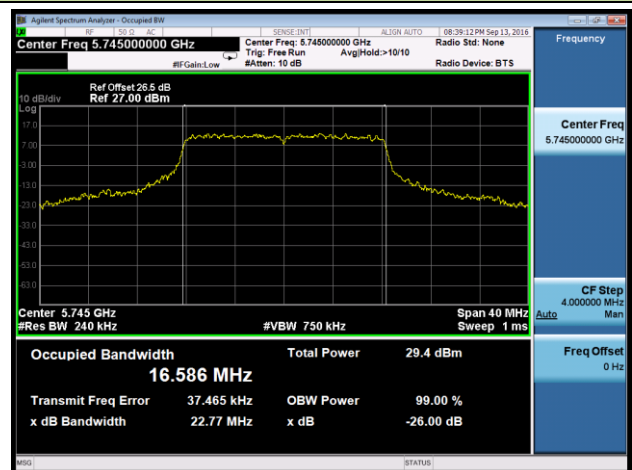
Channel 44 (5220MHz)



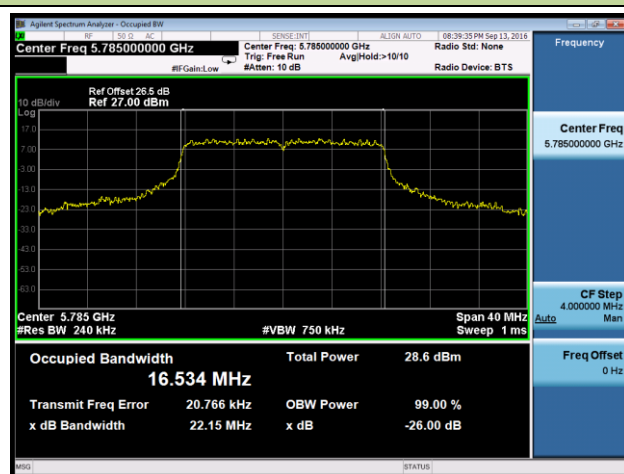
Channel 48 (5240MHz)



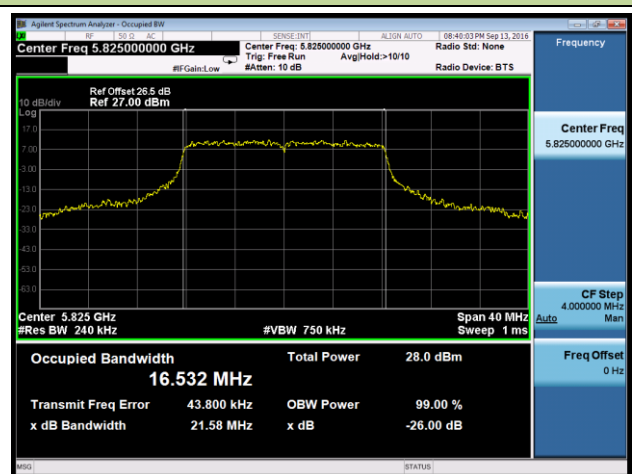
Channel 149 (5745MHz)



Channel 157 (5785MHz)

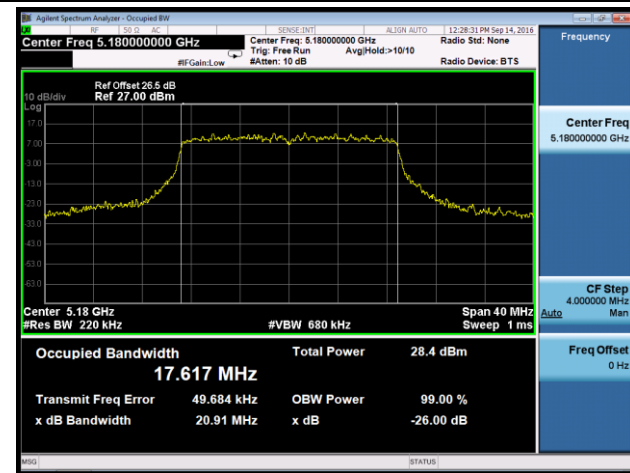


Channel 165 (5825MHz)

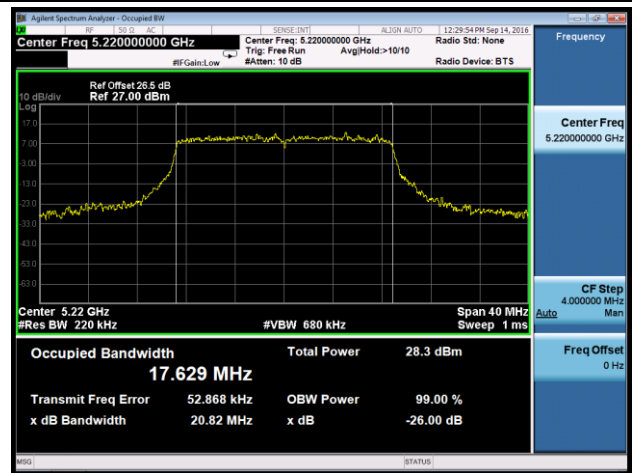


802.11n-HT20 26dB Bandwidth & 99% Bandwidth - Ant 1

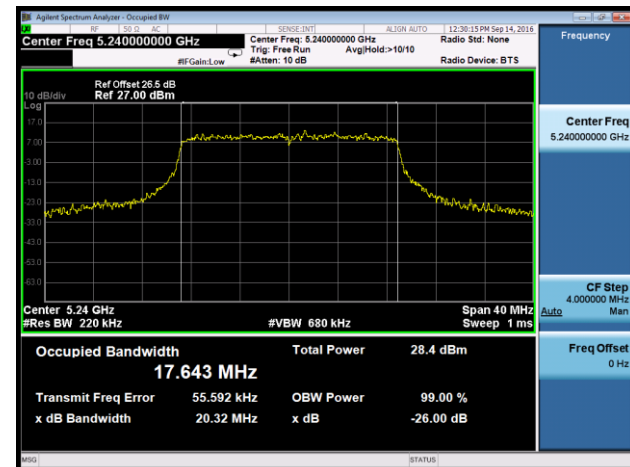
Channel 36 (5180MHz)



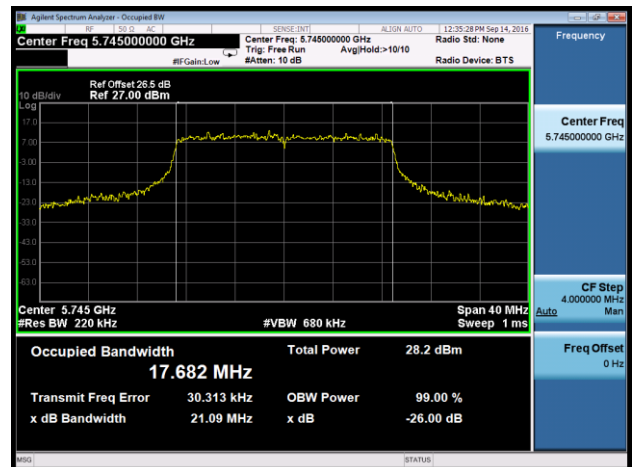
Channel 44 (5220MHz)



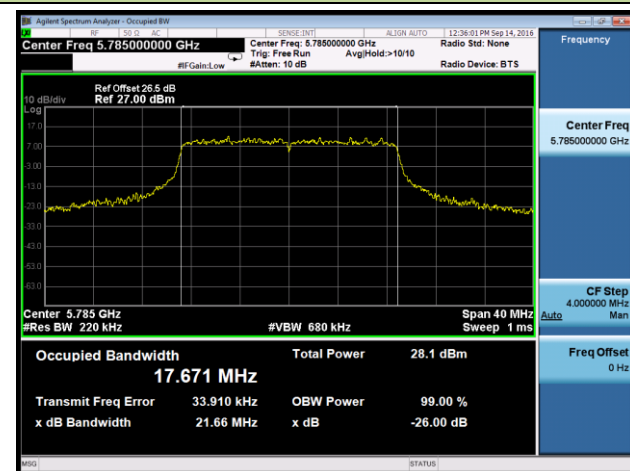
Channel 48 (5240MHz)



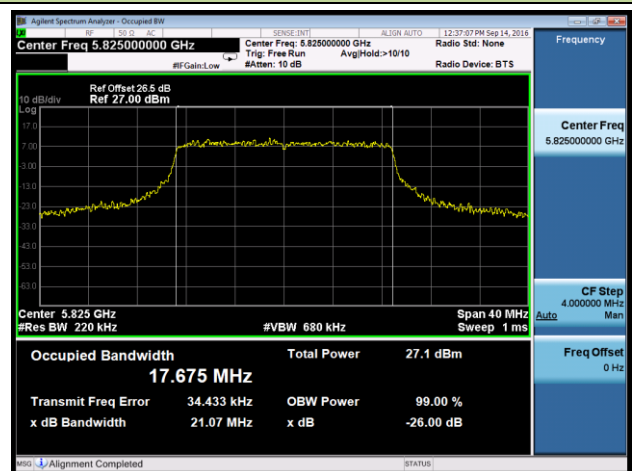
Channel 149 (5745MHz)



Channel 157 (5785MHz)

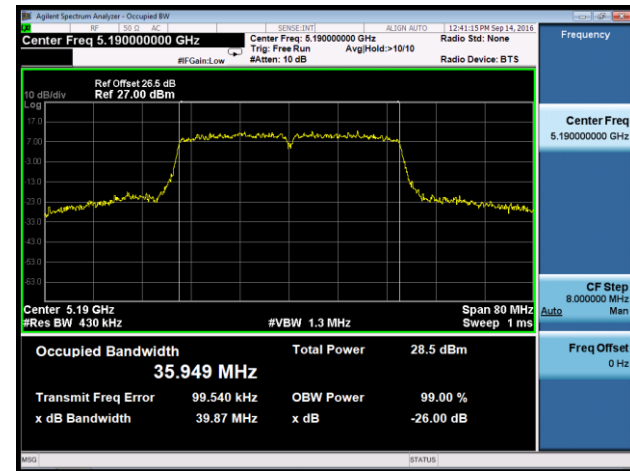


Channel 165 (5825MHz)

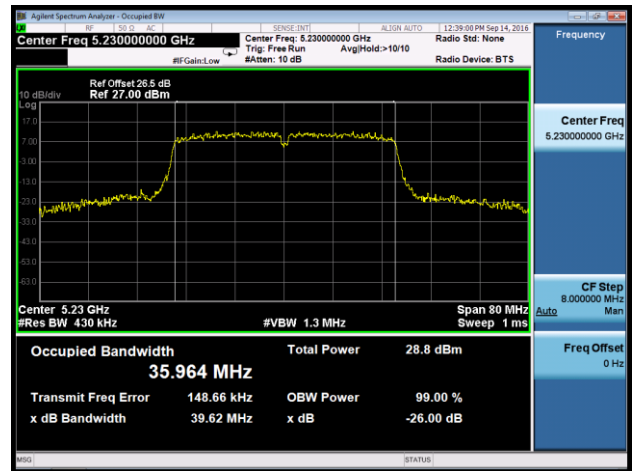


802.11n-HT40 26dB Bandwidth & 99% Bandwidth - Ant 1

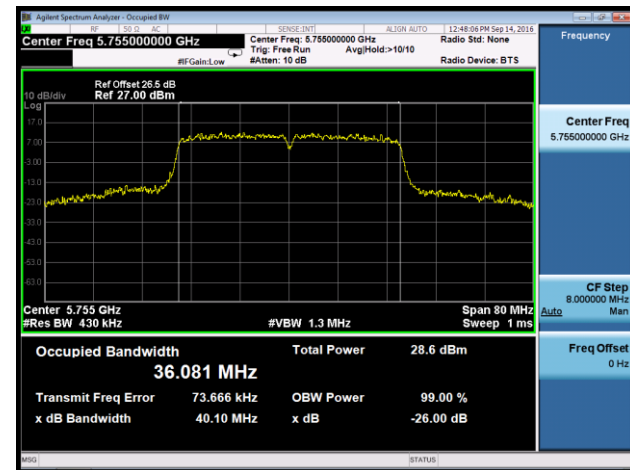
Channel 38 (5190MHz)



Channel 46 (5230MHz)



Channel 151 (5755 MHz)

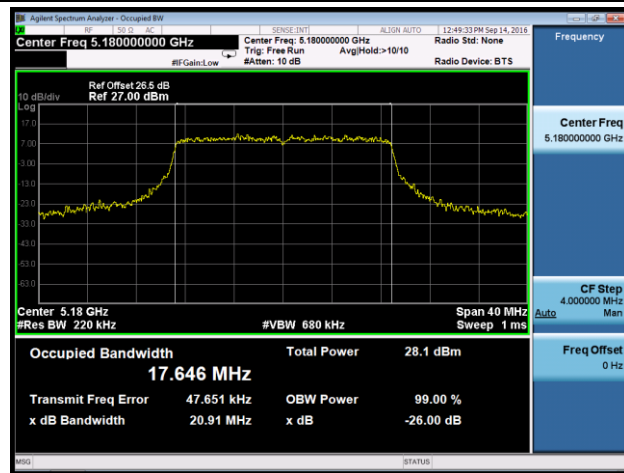


Channel 159 (5795 MHz)

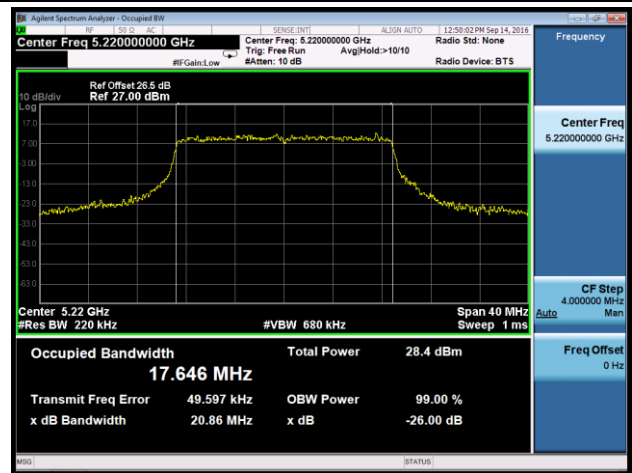


802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth - Ant 1

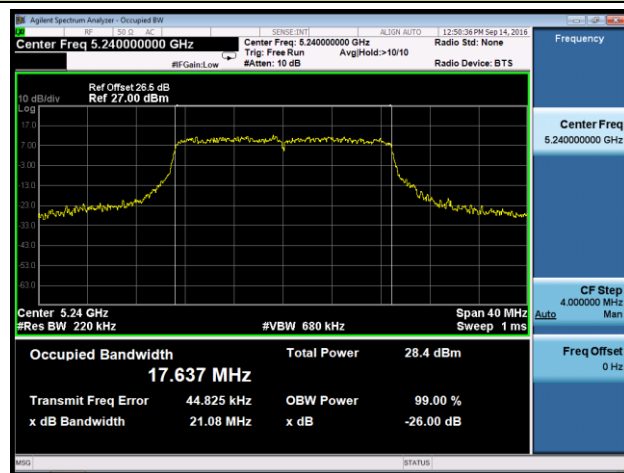
Channel 36 (5180MHz)



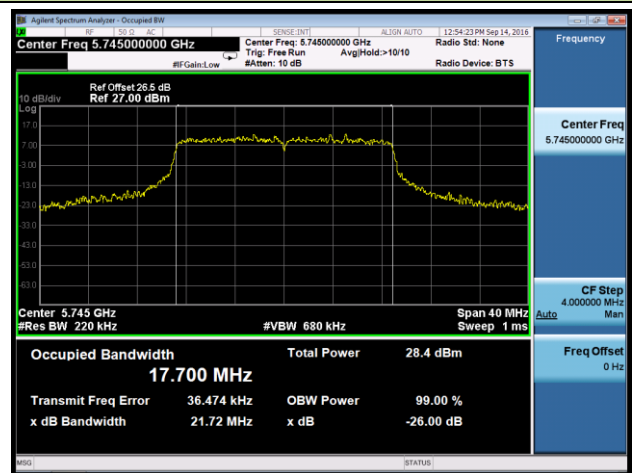
Channel 44 (5220MHz)



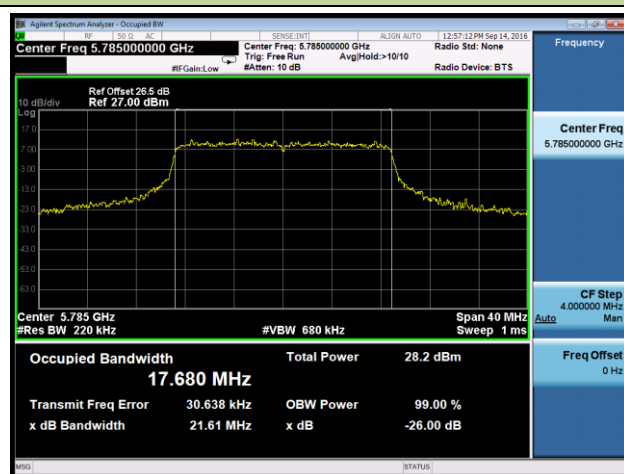
Channel 48 (5240MHz)



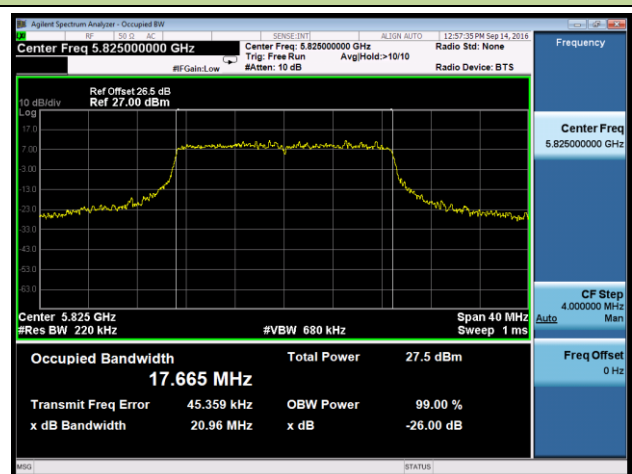
Channel 149 (5745MHz)



Channel 157 (5785MHz)

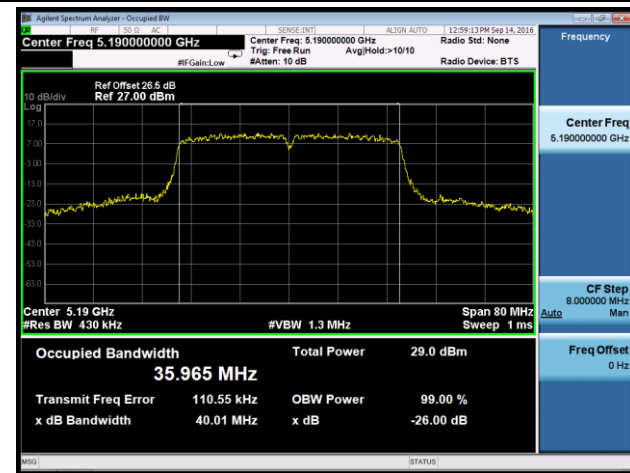


Channel 165 (5825MHz)

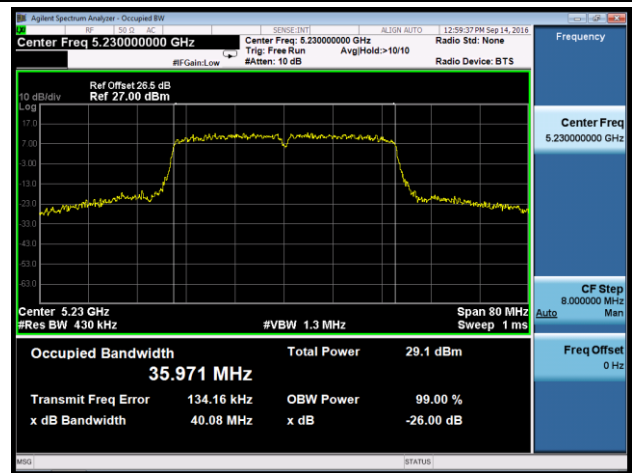


802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth - Ant 1

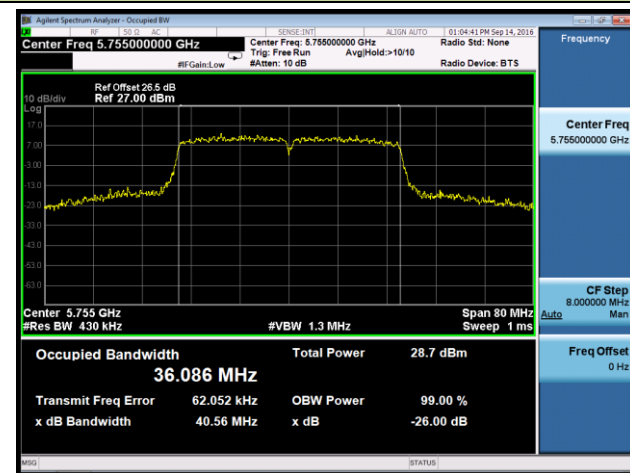
Channel 38 (5190MHz)



Channel 46 (5230MHz)



Channel 151 (5755MHz)



Channel 159 (5795MHz)

