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MEASUREMENT REPORT

FCC PART 15.407 WLAN 802.11a/n/ac

FCC ID: 2ABLK-844E-1

APPLICANT: Calix Inc.

Application Type: Certification

Product: WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway
with USB

Model No.: 844E-1

Trademark: Calix

FCC Classification: Unlicensed National Information Infrastructure (UNII)

FCC Rule Part(s): Part 15.407

Test Procedure(s): ANSI C63.10-2013, KDB 789033 D02v01,
KDB 662911 D01v02r01, KDB 644545 D03v01

Test Date: Jan. 13 ~ Mar. 08, 2015

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlin Chen
(Marlin Chen)



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 D02v01. 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 (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date
1501RSU00602	Rev. 01	Initial report	03-21-2015

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§2.1033 General Information

Applicant:	Calix Inc.
Applicant Address:	1035 N. McDowell Blvd Petaluma, CA94954 U.S.A
Manufacturer:	Wuxi Mitrastar Technology Co.,Ltd
Manufacturer Address:	60#-E, Minshan Road, New District Wuxi
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT FCC Registration No.:	809388
FCC Rule Part(s):	Part 15.407
Model No.:	844E-1
FCC ID:	2ABLK-844E-1
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 Tian'edang Rd., Suzhou, China.

- MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.
- MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.
- MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.
- MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, 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 Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB
Model No.	844E-1
Frequency Range	For 802.11a/n-HT20: 5180~5320MHz, 5500~5700MHz, 5745~5825MHz For 802.11ac-VHT20: 5180~5320MHz, 5500~5720MHz, 5745~5825MHz For 802.11n-HT40: 5190~5310MHz, 5510~5670MHz, 5755~5795MHz For 802.11ac-VHT40: 5190~5310MHz, 5510~5710MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5290MHz, 5530MHz, 5610MHz, 5690MHz, 5775MHz
Maximum Output Power	802.11a: 26.97dBm 802.11n-HT20: 26.83dBm 802.11n-HT40: 27.19dBm 802.11ac-VHT20: 27.20dBm 802.11ac-VHT40: 27.16dBm 802.11ac-VHT80: 24.87dBm
Type of Modulation	802.11a/n/ac: OFDM
Component	
Adapter #1	M/N: AMS49-1202500FU Input: 100-120V ~ 50/60Hz, 1.0A OUTPUT: 12Vdc, 2.5A
Adapter #2	M/N: MSP-C2000IC12.0-30B-US Input: 100-240V ~ 50/60Hz, 1.5A max OUTPUT: 12Vdc, 2.5A
UPS	M/N: DT30U12V-NA3-G Input: 100-240V ~ 50/60Hz, 1.0A OUTPUT: 12Vdc, 30W

2.2. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart E §15.407
- FCC KDB Publication No. 789033 D02 UNII Meas. Guidance v01
- ANSI C63.10-2013

Note:

1. All the test items were verified and recorded according to the standards and without any deviation during the test.
2. FCC permits the use of the 1.5 meter table as an alternative in ANSI C63.10-2013 through inquiry tracking number 198796
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B recorded in a separate report.

2.3. Working Frequencies

Channel List for 802.11a/n-HT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	52	5260 MHz	56	5280 MHz
60	5300 MHz	64	5320 MHz	100	5500 MHz
104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz
128	5640 MHz	132	5660 MHz	136	5680 MHz
140	5700 MHz	149	5745 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

Channel List for 802.11n-HT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz
62	5310 MHz	102	5510 MHz	110	5550 MHz
118	5590 MHz	126	5630 MHz	134	5670 MHz
151	5755 MHz	159	5795 MHz	--	--

Channel List for 802.11ac-VHT20

Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	52	5260 MHz	56	5280 MHz
60	5300 MHz	64	5320 MHz	100	5500 MHz
104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz
128	5640 MHz	132	5660 MHz	136	5680 MHz
140	5700 MHz	144	5720 MHz	149	5745 MHz
153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	--	--	--	--

Channel List for 802.11ac-VHT40

Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz	54	5270 MHz
62	5310 MHz	102	5510 MHz	110	5550 MHz
118	5590 MHz	126	5630 MHz	134	5670 MHz
142	5710 MHz	151	5755 MHz	159	5795 MHz

Channel List for 802.11ac-VHT80

Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210 MHz	58	5290 MHz	106	5530 MHz
122	5610 MHz	138	5690 MHz	155	5775 MHz

2.4. Description of Available Antennas

Antenna Type	Frequency Band (GHz)	Tx Paths	Directional Gain (dBi)		
			Non Beam Forming	Beam Forming	CDD
PCB Antenna	2.4	2	1.90	--	--
	5.2	4	2.17	8.04	8.04
	5.3	4	2.03	7.78	7.78
	5.6	4	2.55	8.38	8.38
	5.8	4	2.70	8.70	8.70

Note:

1. Transmit at 2.4GHz support two antennas, and support four antennas at 5GHz transmit.
2. The EUT working on Beam Forming mode, and the Beam Forming support 802.11n/ac, not include 802.11a, and 802.11a working on CDD mode.
3. 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).
4. 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 = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2/N_{ANT}]$ 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.]

2.5. Description of Antenna RF Port

RF Port				
Test Mode	Software Control Port			
2.4GHz Tx	Ant 0	Ant 1	--	--
Test Mode	Software Control Port			
5GHz Tx	Ant 0	Ant 1	Ant 2	Ant 3



2.6. 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

2.7. Test Software

The test utility software used during testing was "Hyperterminal".

Final Power Parameter Values of the test software.

Test Mode	Test Freq. (MHz)	Power Parameter Value	Test Mode	Test Freq. (MHz)	Power Parameter Value
802.11a	5180	16.0	802.11n-HT20	5180	16.0
	5220	18.0		5220	18.0
	5240	18.0		5240	18.0
	5260	15.0		5260	15.0
	5300	15.0		5300	15.0
	5320	15.0		5320	15.0
	5500	15.0		5500	15.0
	5600	15.0		5600	15.0
	5700	12.0		5700	12.0
	5745	21.0		5745	21.0
	5785	21.0		5785	21.0
	5825	21.0		5825	21.0
802.11n-HT40	5190	12.0	802.11ac-VHT20	5180	16.0
	5230	18.0		5220	18.0
	5270	15.0		5240	18.0
	5310	15.0		5260	15.0
	5510	15.0		5300	15.0
	5590	15.0		5320	15.0
	5670	15.0		5500	15.0
	5755	21.0		5600	15.0
	5795	21.0		5700	12.0
	5190	12.0		5720	15.0
802.11ac-VHT40	5230	18.0		5745	21.0
	5270	15.0		5785	21.0
	5310	15.0		5825	21.0
	5510	15.0	802.11ac-VHT80	5210	11.0
	5590	15.0		5290	13.0
	5670	15.0		5530	12.0
	5710	15.0		5610	15.0
	5755	21.0		5690	15.0
	5795	21.0		5775	19.0

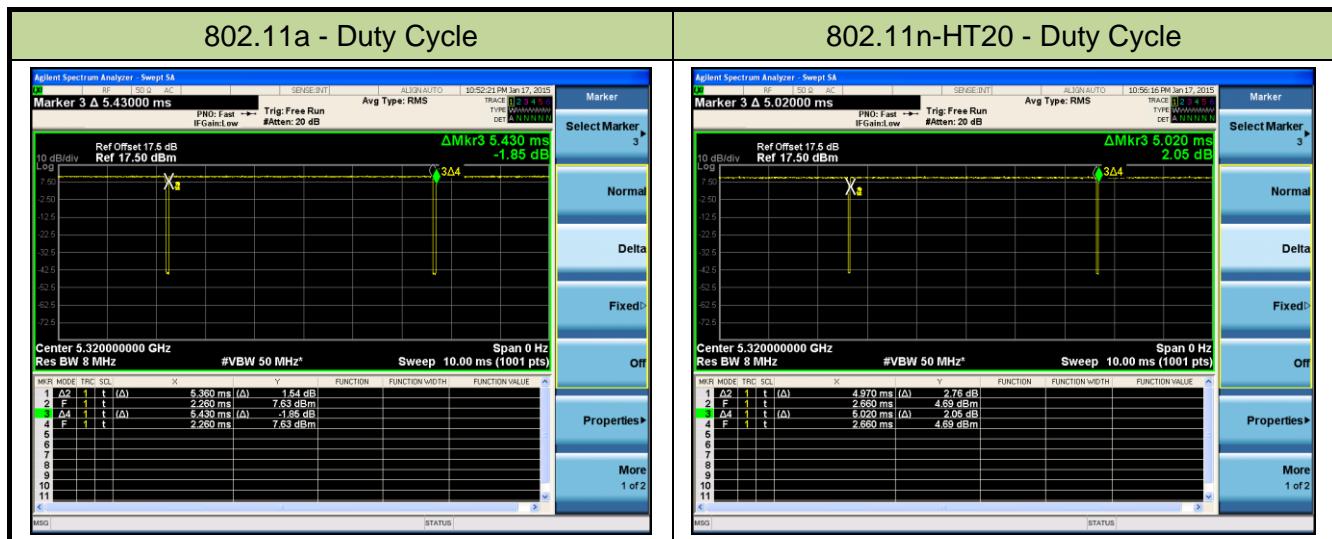
2.8. Device Capabilities

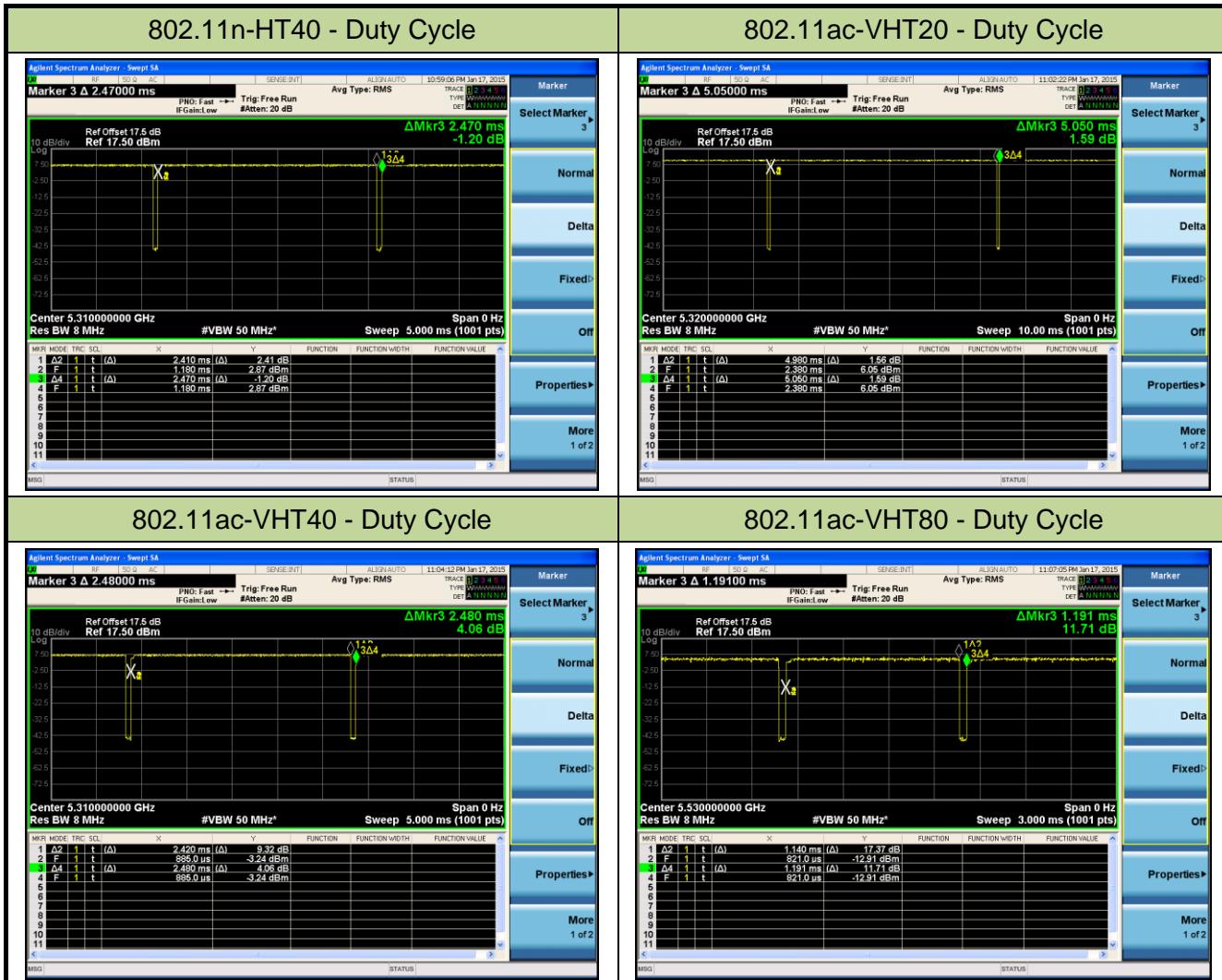
This device contains the following capabilities:

2.4GHz WLAN (DTS) & 5GHz WLAN (UNII).

Note: 5GHz (UNII) 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 = peak per the guidance of Section B)2)b) of KDB 789033 D02v01. 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	98.7%
802.11n-HT20	99.0%
802.11n-HT40	97.6%
802.11ac-VHT20	98.6%
802.11ac-VHT40	97.6%
802.11ac-VHT80	95.7%





2.9. Test Configuration

The WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB FCC ID: 2ABLK-844E-1 was tested per the guidance of KDB 789033 D02v01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.10. EMI Suppression Device(s)/Modifications

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

2.11. 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 trade name and 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 D02v01 were used in the measurement of the **WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB FCC ID: 2ABLK-844E-1**.

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 MF Model 210SS 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.”

- The antenna of the **WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB** is **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The **WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB** FCC ID: 2ABLK-844E-1 unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	101209	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	101683	1 year	2015/11/07
Two-Line V-Network	R&S	ENV216	101684	1 year	2015/11/07
Temperature/ Meter Humidity	Anymetre	TH101B	SR2-01	1 year	2015/11/14

Radiated Emission

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	E4447A	MY45300136	1 year	2015/10/09
EMI Test Receiver	R&S	ESR7	101209	1 year	2015/11/07
Preamplifier	MRT	AP01G18	S-001	1 year	2015/10/06
Preamplifier	MRT	AP18G40	S-001	1 year	2015/12/13
Loop Antenna	Schwarzbeck	FMZB1519	1519-041	1 year	2015/11/08
TRILOG Antenna	Schwarzbeck	VULB9162	9162-047	1 year	2015/11/08
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1167	1 year	2015/11/08
Broadband Horn Antenna	Schwarzbeck	BBHA9170	9170-549	1 year	2015/12/12
Temperature/Humidity Meter	Anymetre	TH101B	AC1-01	1 year	2015/11/14

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MY52090106	1 year	2015/04/23
USB Wideband Power Sensor	Boonton	55006	8911	1 year	2015/10/15
Temperature & Humidity Chamber	BAOYT	BYH-1500L	1309W043	1 year	2015/11/20
Temperature/Humidity Meter	Anymetre	TH101B	TR3-01	1 year	2015/11/14

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% ($U=2U_{c(y)}$): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% ($U=2U_{c(y)}$): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 40GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Product Name: WiFi Concurrent 4 Port GE LAN VoIP Ethernet Gateway with USB
FCC ID: 844E-1
FCC Classification: Unlicensed National Information Infrastructure (UNII)
Data Rate(s) Tested:
6Mbps ~ 54Mbps (a):
6.5/7.2Mbps ~ 260/288.8Mbps (n-HT20MHz BW);
13.5/15.0Mbps ~ 540/600Mbps (n-HT40MHz BW);
6.5/7.2Mbps ~ 312/346.7Mbps (ac-VHT20MHz BW);
13.5/15Mbps ~ 720/800Mbps (ac-VHT40MHz BW);
29.3/32.5Mbps ~ 1560/1733.3Mbps (ac-VHT80MHz BW)

FCC Part 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	$\geq 500\text{kHz}$		Pass	Section 7.3
15.407(a)(1)(ii), (2), (3)	Maximum Conducted Output Power	$< 27.96 \text{ dBm U-NII-1}$ $< 22.22 \text{ dBm U-NII-2a}$ $< 21.62 \text{ dBm U-NII-2b}$ $< 27.30 \text{ dBm U-NII-3}$		Pass	Section 7.4
15.407(h)(1)	Transmit Power Control	$< 24 \text{ dBm}$		Pass	Section 7.5
15.407(a)(1)(ii), (2), (3), (5)	Peak Power Spectral Density	$< 14.96 \text{ dBm/MHz U-NII-1}$ $< 9.22 \text{ dBm/MHz U-NII-2a}$ $< 8.62 \text{ dBm/MHz U-NII-2b}$ $< 27.30 \text{ dBm/500kHz U-NII-3}$		Pass	Section 7.6
15.407(g)	Frequency Stability	N/A		Pass	Section 7.7
15.407(b)(1), (2), (3), (4)	Undesirable Emissions	$< -27\text{dBm/MHz EIRP}$ $< -17\text{dBm/MHz EIRP}$	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	$< \text{FCC 15.207 limits}$	Line Conducted	Pass	Section 7.10

Notes:

- 1) All channels, modes, and modulations/data rates were investigated among all UNII bands. For radiated emission test, every axis (X, Y, Z) was also verified. 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) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 26dB Bandwidth Measurement

7.2.1. Test Limit

N/A

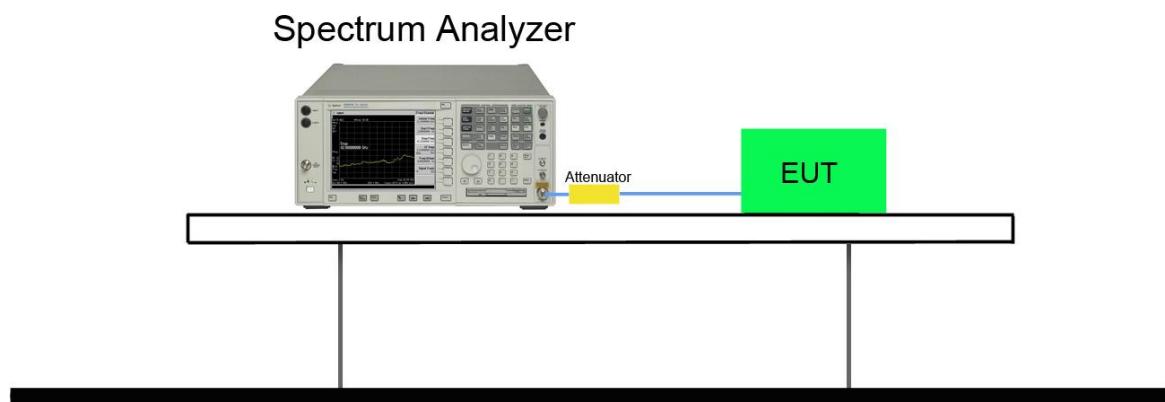
7.2.2. Test Procedure used

KDB 789033 D02v01 - 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

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
Ant 0 / Ant 0 + 1 + 2 + 3						
802.11a	6	36	5180	22.27	16.76	Pass
802.11a	6	44	5220	22.54	16.80	Pass
802.11a	6	48	5240	22.38	16.79	Pass
802.11a	6	52	5260	22.51	16.79	Pass
802.11a	6	60	5300	22.45	16.79	Pass
802.11a	6	64	5320	22.65	16.82	Pass
802.11a	6	100	5500	22.52	16.81	Pass
802.11a	6	120	5600	22.30	16.77	Pass
802.11a	6	140	5700	22.51	16.80	Pass
802.11a	6	149	5745	22.63	16.78	Pass
802.11a	6	157	5785	22.67	16.80	Pass
802.11a	6	165	5825	22.91	16.84	Pass
802.11n-HT20	6.5	36	5180	24.41	18.09	Pass
802.11n-HT20	6.5	44	5220	24.02	18.08	Pass
802.11n-HT20	6.5	48	5240	24.31	18.08	Pass
802.11n-HT20	6.5	52	5260	24.37	18.08	Pass
802.11n-HT20	6.5	60	5300	24.37	18.10	Pass
802.11n-HT20	6.5	64	5320	24.33	18.09	Pass
802.11n-HT20	6.5	100	5500	24.24	18.08	Pass
802.11n-HT20	6.5	120	5600	23.91	18.07	Pass
802.11n-HT20	6.5	140	5700	24.15	18.09	Pass
802.11n-HT20	6.5	149	5745	23.91	18.10	Pass
802.11n-HT20	6.5	157	5785	24.07	18.09	Pass
802.11n-HT20	6.5	165	5825	24.13	18.10	Pass
802.11n-HT40	13.5	38	5190	42.61	36.43	Pass
802.11n-HT40	13.5	46	5230	42.77	36.45	Pass
802.11n-HT40	13.5	54	5270	42.78	36.46	Pass
802.11n-HT40	13.5	62	5310	42.95	36.48	Pass
802.11n-HT40	13.5	102	5510	42.99	36.44	Pass
802.11n-HT40	13.5	118	5590	42.69	36.44	Pass
802.11n-HT40	13.5	134	5670	42.82	36.45	Pass
802.11n-HT40	13.5	151	5755	42.77	36.49	Pass

802.11n-HT40	13.5	159	5795	42.41	36.41	Pass
802.11ac-VHT20	6.5	36	5180	24.35	18.07	Pass
802.11ac-VHT20	6.5	44	5220	24.25	18.10	Pass
802.11ac-VHT20	6.5	48	5240	24.27	18.09	Pass
802.11ac-VHT20	6.5	52	5260	24.27	18.09	Pass
802.11ac-VHT20	6.5	60	5300	24.21	18.08	Pass
802.11ac-VHT20	6.5	64	5320	24.24	18.08	Pass
802.11ac-VHT20	6.5	100	5500	24.33	18.09	Pass
802.11ac-VHT20	6.5	120	5600	24.29	18.06	Pass
802.11ac-VHT20	6.5	140	5700	24.70	18.09	Pass
802.11ac-VHT20	6.5	144	5720	24.42	18.10	Pass
802.11ac-VHT20	6.5	149	5745	24.53	18.11	Pass
802.11ac-VHT20	6.5	157	5785	24.65	18.08	Pass
802.11ac-VHT20	6.5	165	5825	24.78	18.10	Pass
802.11ac-VHT40	13.5	38	5190	42.77	36.48	Pass
802.11ac-VHT40	13.5	46	5230	42.87	36.51	Pass
802.11ac-VHT40	13.5	54	5270	42.48	36.49	Pass
802.11ac-VHT40	13.5	62	5310	42.54	36.46	Pass
802.11ac-VHT40	13.5	102	5510	42.69	36.53	Pass
802.11ac-VHT40	13.5	118	5590	42.80	36.49	Pass
802.11ac-VHT40	13.5	134	5670	42.90	36.46	Pass
802.11ac-VHT40	13.5	142	5710	42.67	36.42	Pass
802.11ac-VHT40	13.5	151	5755	42.56	36.45	Pass
802.11ac-VHT40	13.5	159	5795	42.76	36.51	Pass
802.11ac-VHT80	29.3	42	5210	84.41	75.54	Pass
802.11ac-VHT80	29.3	58	5290	83.84	75.46	Pass
802.11ac-VHT80	29.3	106	5530	83.89	75.41	Pass
802.11ac-VHT80	29.3	122	5610	84.00	75.48	Pass
802.11ac-VHT80	29.3	138	5690	83.38	75.35	Pass
802.11ac-VHT80	29.3	155	5775	83.44	75.40	Pass

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
Ant 1 / Ant 0 + 1 + 2 + 3						
802.11a	6	36	5180	23.22	16.84	Pass
802.11a	6	44	5220	23.19	16.84	Pass
802.11a	6	48	5240	23.31	16.86	Pass
802.11a	6	52	5260	23.21	16.83	Pass
802.11a	6	60	5300	23.26	16.85	Pass
802.11a	6	64	5320	23.27	16.85	Pass
802.11a	6	100	5500	23.14	16.82	Pass
802.11a	6	120	5600	22.91	16.85	Pass
802.11a	6	140	5700	22.98	16.83	Pass
802.11a	6	149	5745	23.96	16.88	Pass
802.11a	6	157	5785	24.08	16.92	Pass
802.11a	6	165	5825	25.02	16.96	Pass
802.11n-HT20	6.5	36	5180	24.53	18.12	Pass
802.11n-HT20	6.5	44	5220	24.77	18.08	Pass
802.11n-HT20	6.5	48	5240	24.77	18.10	Pass
802.11n-HT20	6.5	52	5260	24.41	18.09	Pass
802.11n-HT20	6.5	60	5300	24.72	18.07	Pass
802.11n-HT20	6.5	64	5320	24.28	18.07	Pass
802.11n-HT20	6.5	100	5500	24.59	18.12	Pass
802.11n-HT20	6.5	120	5600	24.24	18.08	Pass
802.11n-HT20	6.5	140	5700	24.51	18.06	Pass
802.11n-HT20	6.5	149	5745	25.25	18.07	Pass
802.11n-HT20	6.5	157	5785	25.49	18.07	Pass
802.11n-HT20	6.5	165	5825	25.65	18.12	Pass
802.11n-HT40	13.5	38	5190	41.82	36.36	Pass
802.11n-HT40	13.5	46	5230	42.36	36.39	Pass
802.11n-HT40	13.5	54	5270	42.08	36.36	Pass
802.11n-HT40	13.5	62	5310	41.94	36.39	Pass
802.11n-HT40	13.5	102	5510	41.87	36.37	Pass
802.11n-HT40	13.5	118	5590	41.78	36.34	Pass
802.11n-HT40	13.5	134	5670	41.67	36.34	Pass
802.11n-HT40	13.5	151	5755	44.34	36.45	Pass
802.11n-HT40	13.5	159	5795	42.48	36.41	Pass

802.11ac-VHT20	6.5	36	5180	24.90	18.08	Pass
802.11ac-VHT20	6.5	44	5220	24.73	18.09	Pass
802.11ac-VHT20	6.5	48	5240	24.73	18.12	Pass
802.11ac-VHT20	6.5	52	5260	24.59	18.07	Pass
802.11ac-VHT20	6.5	60	5300	24.73	18.08	Pass
802.11ac-VHT20	6.5	64	5320	24.46	18.09	Pass
802.11ac-VHT20	6.5	100	5500	24.46	18.08	Pass
802.11ac-VHT20	6.5	120	5600	24.55	18.08	Pass
802.11ac-VHT20	6.5	140	5700	24.46	18.07	Pass
802.11ac-VHT20	6.5	144	5720	24.70	18.08	Pass
802.11ac-VHT20	6.5	149	5745	24.80	18.10	Pass
802.11ac-VHT20	6.5	157	5785	24.90	18.12	Pass
802.11ac-VHT20	6.5	165	5825	25.41	18.14	Pass
802.11ac-VHT40	13.5	38	5190	42.33	36.42	Pass
802.11ac-VHT40	13.5	46	5230	42.87	36.43	Pass
802.11ac-VHT40	13.5	54	5270	42.51	36.39	Pass
802.11ac-VHT40	13.5	62	5310	42.19	36.36	Pass
802.11ac-VHT40	13.5	102	5510	41.88	36.43	Pass
802.11ac-VHT40	13.5	118	5590	41.86	36.37	Pass
802.11ac-VHT40	13.5	134	5670	42.41	36.38	Pass
802.11ac-VHT40	13.5	142	5710	41.56	36.36	Pass
802.11ac-VHT40	13.5	151	5755	42.05	36.40	Pass
802.11ac-VHT40	13.5	159	5795	41.87	36.44	Pass
802.11ac-VHT80	29.3	42	5210	80.04	75.19	Pass
802.11ac-VHT80	29.3	58	5290	79.61	75.23	Pass
802.11ac-VHT80	29.3	106	5530	79.73	75.19	Pass
802.11ac-VHT80	29.3	122	5610	81.74	75.05	Pass
802.11ac-VHT80	29.3	138	5690	79.53	75.14	Pass
802.11ac-VHT80	29.3	155	5775	81.89	75.23	Pass

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
Ant 2 / Ant 0 + 1 + 2 + 3						
802.11a	6	36	5180	22.85	16.76	Pass
802.11a	6	44	5220	22.70	16.78	Pass
802.11a	6	48	5240	22.89	16.77	Pass
802.11a	6	52	5260	22.83	16.77	Pass
802.11a	6	60	5300	23.01	16.78	Pass
802.11a	6	64	5320	22.83	16.78	Pass
802.11a	6	100	5500	22.76	16.78	Pass
802.11a	6	120	5600	22.72	16.79	Pass
802.11a	6	140	5700	22.53	16.79	Pass
802.11a	6	149	5745	22.54	16.85	Pass
802.11a	6	157	5785	22.32	16.85	Pass
802.11a	6	165	5825	23.39	16.85	Pass
802.11n-HT20	6.5	36	5180	23.79	17.95	Pass
802.11n-HT20	6.5	44	5220	23.76	17.97	Pass
802.11n-HT20	6.5	48	5240	23.14	17.98	Pass
802.11n-HT20	6.5	52	5260	23.80	17.95	Pass
802.11n-HT20	6.5	60	5300	23.58	17.96	Pass
802.11n-HT20	6.5	64	5320	24.24	17.96	Pass
802.11n-HT20	6.5	100	5500	23.97	17.92	Pass
802.11n-HT20	6.5	120	5600	23.59	17.97	Pass
802.11n-HT20	6.5	140	5700	24.06	17.97	Pass
802.11n-HT20	6.5	149	5745	23.93	18.00	Pass
802.11n-HT20	6.5	157	5785	23.99	18.01	Pass
802.11n-HT20	6.5	165	5825	23.92	17.99	Pass
802.11n-HT40	13.5	38	5190	42.53	36.43	Pass
802.11n-HT40	13.5	46	5230	42.35	36.43	Pass
802.11n-HT40	13.5	54	5270	42.04	36.40	Pass
802.11n-HT40	13.5	62	5310	42.33	36.41	Pass
802.11n-HT40	13.5	102	5510	42.40	36.36	Pass
802.11n-HT40	13.5	118	5590	42.23	36.37	Pass
802.11n-HT40	13.5	134	5670	42.12	36.37	Pass
802.11n-HT40	13.5	151	5755	42.62	36.48	Pass
802.11n-HT40	13.5	159	5795	42.27	36.45	Pass

802.11ac-VHT20	6.5	36	5180	23.81	18.00	Pass
802.11ac-VHT20	6.5	44	5220	23.66	17.99	Pass
802.11ac-VHT20	6.5	48	5240	24.00	18.01	Pass
802.11ac-VHT20	6.5	52	5260	24.03	18.00	Pass
802.11ac-VHT20	6.5	60	5300	23.87	17.99	Pass
802.11ac-VHT20	6.5	64	5320	24.07	18.01	Pass
802.11ac-VHT20	6.5	100	5500	24.12	18.01	Pass
802.11ac-VHT20	6.5	120	5600	24.09	17.99	Pass
802.11ac-VHT20	6.5	140	5700	23.89	18.00	Pass
802.11ac-VHT20	6.5	144	5720	24.18	18.04	Pass
802.11ac-VHT20	6.5	149	5745	24.16	18.01	Pass
802.11ac-VHT20	6.5	157	5785	24.22	18.02	Pass
802.11ac-VHT20	6.5	165	5825	24.44	18.04	Pass
802.11ac-VHT40	13.5	38	5190	42.69	36.44	Pass
802.11ac-VHT40	13.5	46	5230	42.03	36.39	Pass
802.11ac-VHT40	13.5	54	5270	42.15	36.40	Pass
802.11ac-VHT40	13.5	62	5310	42.47	36.42	Pass
802.11ac-VHT40	13.5	102	5510	42.27	36.39	Pass
802.11ac-VHT40	13.5	118	5590	41.82	36.33	Pass
802.11ac-VHT40	13.5	134	5670	42.60	36.38	Pass
802.11ac-VHT40	13.5	142	5710	42.44	36.35	Pass
802.11ac-VHT40	13.5	151	5755	42.35	36.41	Pass
802.11ac-VHT40	13.5	159	5795	42.40	36.40	Pass
802.11ac-VHT80	29.3	42	5210	82.75	75.51	Pass
802.11ac-VHT80	29.3	58	5290	82.93	75.45	Pass
802.11ac-VHT80	29.3	106	5530	83.21	75.42	Pass
802.11ac-VHT80	29.3	122	5610	82.98	75.34	Pass
802.11ac-VHT80	29.3	138	5690	82.64	75.23	Pass
802.11ac-VHT80	29.3	155	5775	83.18	75.37	Pass

Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
Ant 3 / Ant 0 + 1 + 2 + 3						
802.11a	6	36	5180	23.08	16.80	Pass
802.11a	6	44	5220	23.42	16.81	Pass
802.11a	6	48	5240	23.47	16.79	Pass
802.11a	6	52	5260	23.23	16.79	Pass
802.11a	6	60	5300	23.16	16.77	Pass
802.11a	6	64	5320	23.21	16.78	Pass
802.11a	6	100	5500	23.38	16.81	Pass
802.11a	6	120	5600	23.24	16.78	Pass
802.11a	6	140	5700	23.07	16.81	Pass
802.11a	6	149	5745	23.23	16.82	Pass
802.11a	6	157	5785	23.36	16.82	Pass
802.11a	6	165	5825	23.37	16.80	Pass
802.11n-HT20	6.5	36	5180	23.76	17.93	Pass
802.11n-HT20	6.5	44	5220	23.93	17.92	Pass
802.11n-HT20	6.5	48	5240	23.51	17.91	Pass
802.11n-HT20	6.5	52	5260	23.73	17.90	Pass
802.11n-HT20	6.5	60	5300	23.60	17.89	Pass
802.11n-HT20	6.5	64	5320	23.67	17.89	Pass
802.11n-HT20	6.5	100	5500	23.55	17.92	Pass
802.11n-HT20	6.5	120	5600	23.77	17.90	Pass
802.11n-HT20	6.5	140	5700	23.44	17.92	Pass
802.11n-HT20	6.5	149	5745	23.62	17.93	Pass
802.11n-HT20	6.5	157	5785	23.61	17.93	Pass
802.11n-HT20	6.5	165	5825	23.20	17.90	Pass
802.11n-HT40	13.5	38	5190	41.74	36.32	Pass
802.11n-HT40	13.5	46	5230	42.06	36.33	Pass
802.11n-HT40	13.5	54	5270	42.06	36.31	Pass
802.11n-HT40	13.5	62	5310	41.83	36.32	Pass
802.11n-HT40	13.5	102	5510	41.77	36.34	Pass
802.11n-HT40	13.5	118	5590	41.37	36.34	Pass
802.11n-HT40	13.5	134	5670	41.51	36.31	Pass
802.11n-HT40	13.5	151	5755	41.91	36.35	Pass
802.11n-HT40	13.5	159	5795	42.57	36.35	Pass

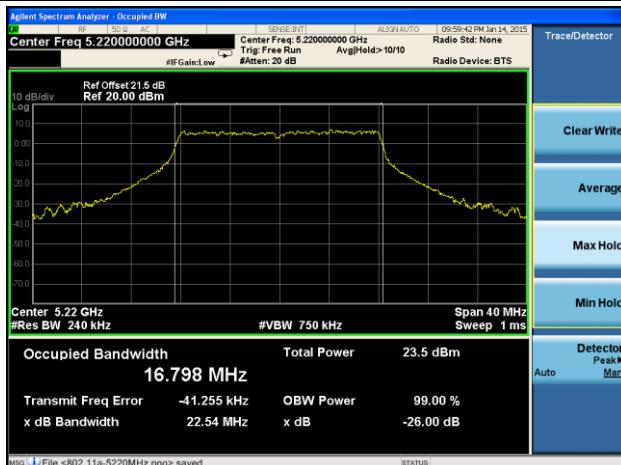
802.11ac-VHT20	6.5	36	5180	23.89	17.92	Pass
802.11ac-VHT20	6.5	44	5220	23.59	17.91	Pass
802.11ac-VHT20	6.5	48	5240	23.47	17.90	Pass
802.11ac-VHT20	6.5	52	5260	23.47	17.90	Pass
802.11ac-VHT20	6.5	60	5300	23.90	17.89	Pass
802.11ac-VHT20	6.5	64	5320	23.52	17.88	Pass
802.11ac-VHT20	6.5	100	5500	23.56	17.90	Pass
802.11ac-VHT20	6.5	120	5600	23.52	17.89	Pass
802.11ac-VHT20	6.5	140	5700	23.44	17.92	Pass
802.11ac-VHT20	6.5	144	5720	23.63	17.92	Pass
802.11ac-VHT20	6.5	149	5745	23.78	17.92	Pass
802.11ac-VHT20	6.5	157	5785	23.64	17.92	Pass
802.11ac-VHT20	6.5	165	5825	23.69	17.91	Pass
802.11ac-VHT40	13.5	38	5190	41.89	36.31	Pass
802.11ac-VHT40	13.5	46	5230	41.78	36.32	Pass
802.11ac-VHT40	13.5	54	5270	41.80	36.31	Pass
802.11ac-VHT40	13.5	62	5310	41.55	36.32	Pass
802.11ac-VHT40	13.5	102	5510	41.47	36.29	Pass
802.11ac-VHT40	13.5	118	5590	41.71	36.32	Pass
802.11ac-VHT40	13.5	134	5670	41.51	36.30	Pass
802.11ac-VHT40	13.5	142	5710	41.89	36.28	Pass
802.11ac-VHT40	13.5	151	5755	41.74	36.28	Pass
802.11ac-VHT40	13.5	159	5795	41.59	36.35	Pass
802.11ac-VHT80	29.3	42	5210	81.57	75.47	Pass
802.11ac-VHT80	29.3	58	5290	82.19	75.55	Pass
802.11ac-VHT80	29.3	106	5530	82.60	75.36	Pass
802.11ac-VHT80	29.3	122	5610	82.63	75.44	Pass
802.11ac-VHT80	29.3	138	5690	81.95	75.45	Pass
802.11ac-VHT80	29.3	155	5775	82.80	75.46	Pass

802.11a 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3

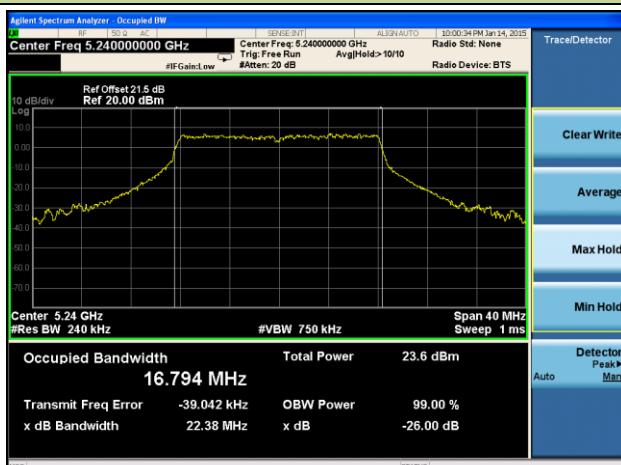
Channel 36 (5180MHz)



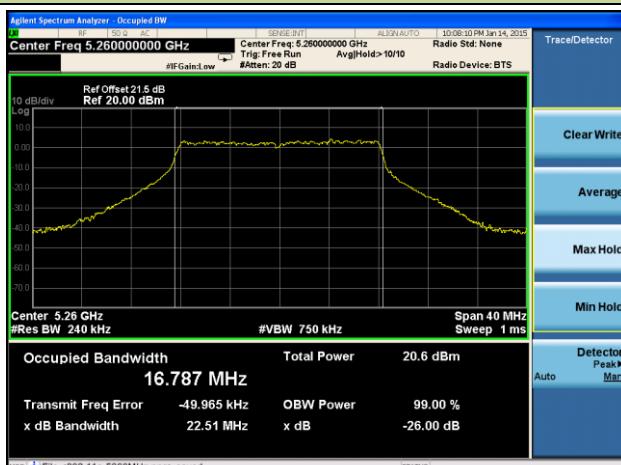
Channel 44 (5220MHz)



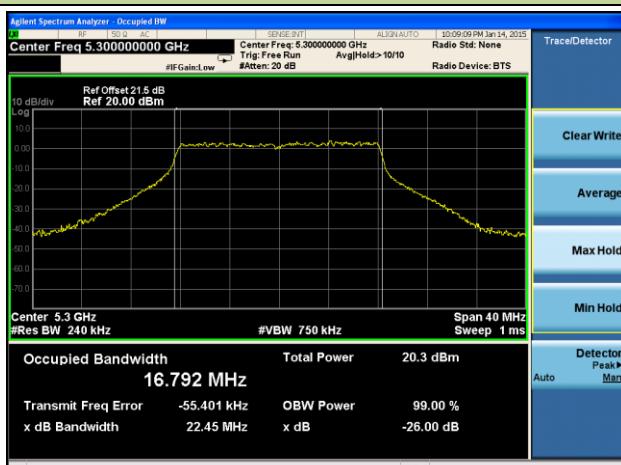
Channel 48 (5240MHz)



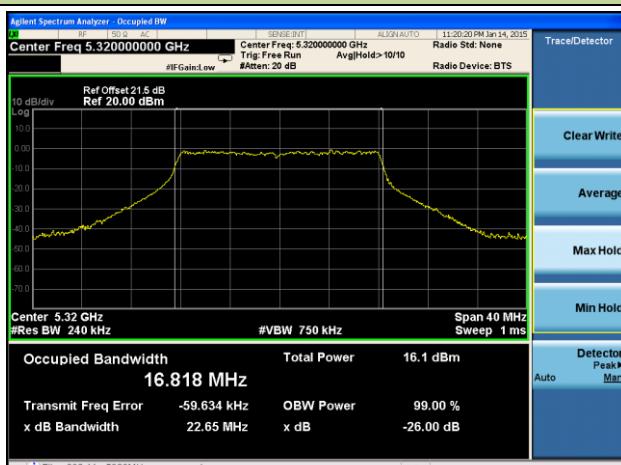
Channel 52 (5260MHz)

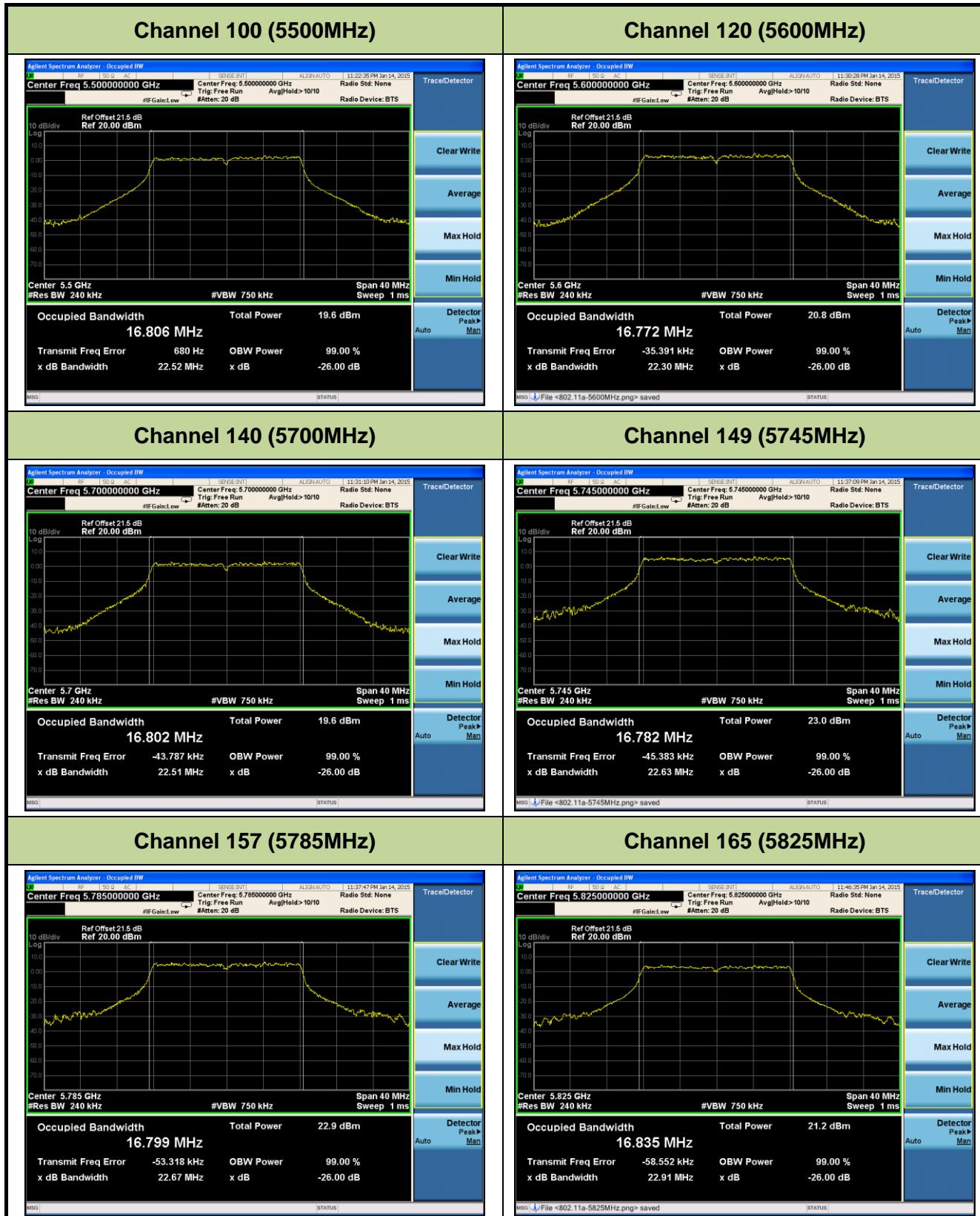


Channel 60 (5300MHz)



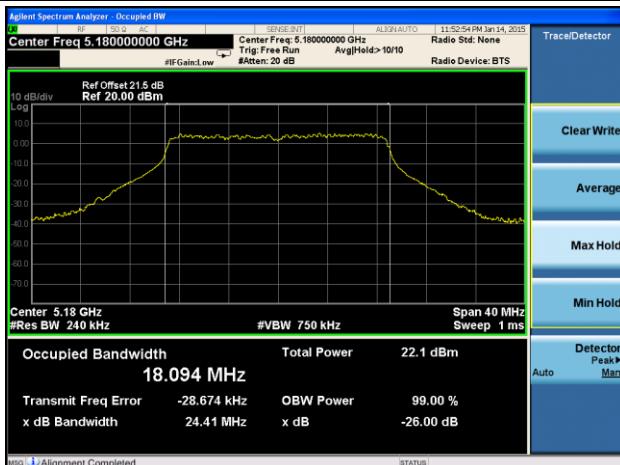
Channel 64 (5320MHz)



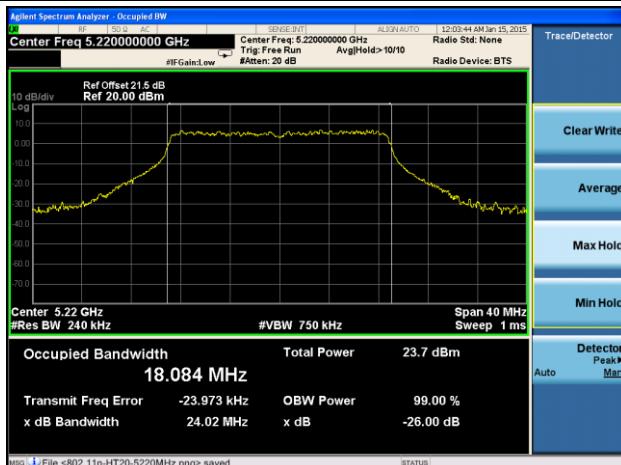


802.11n-HT20 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3

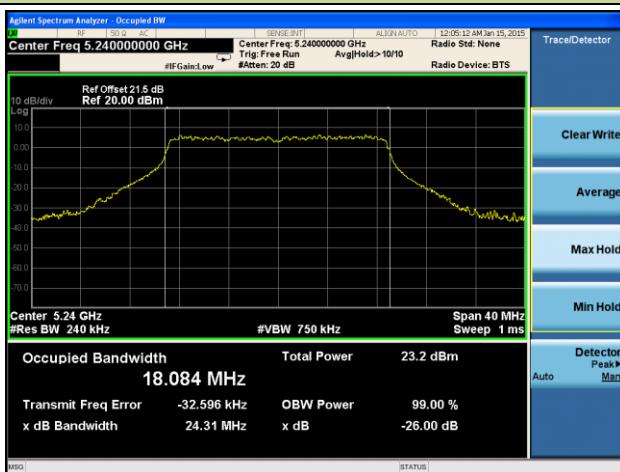
Channel 36 (5180MHz)



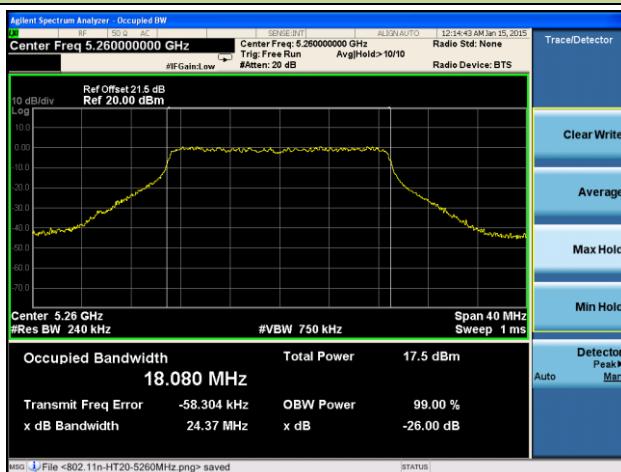
Channel 44 (5220MHz)



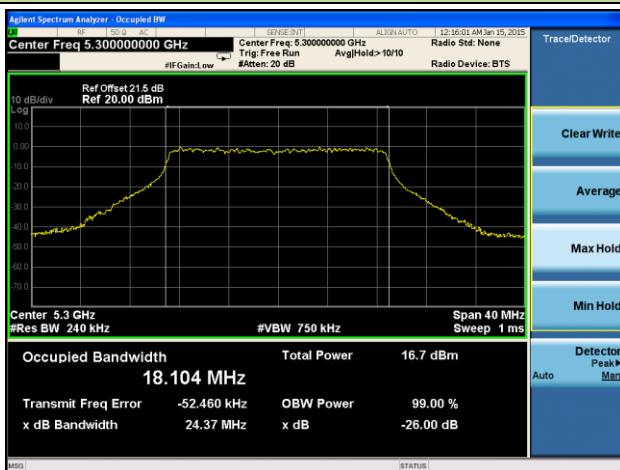
Channel 48 (5240MHz)



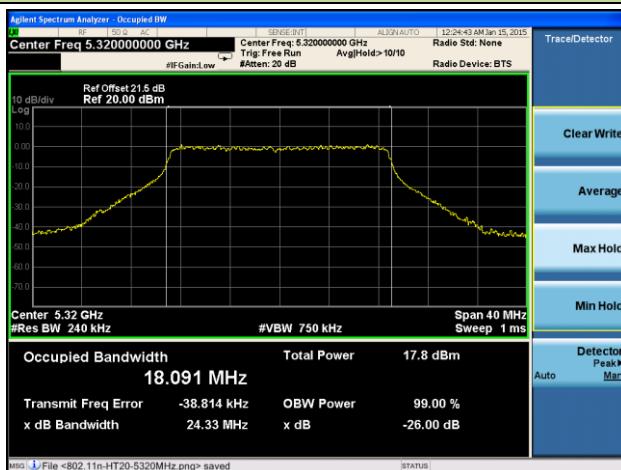
Channel 52 (5260MHz)

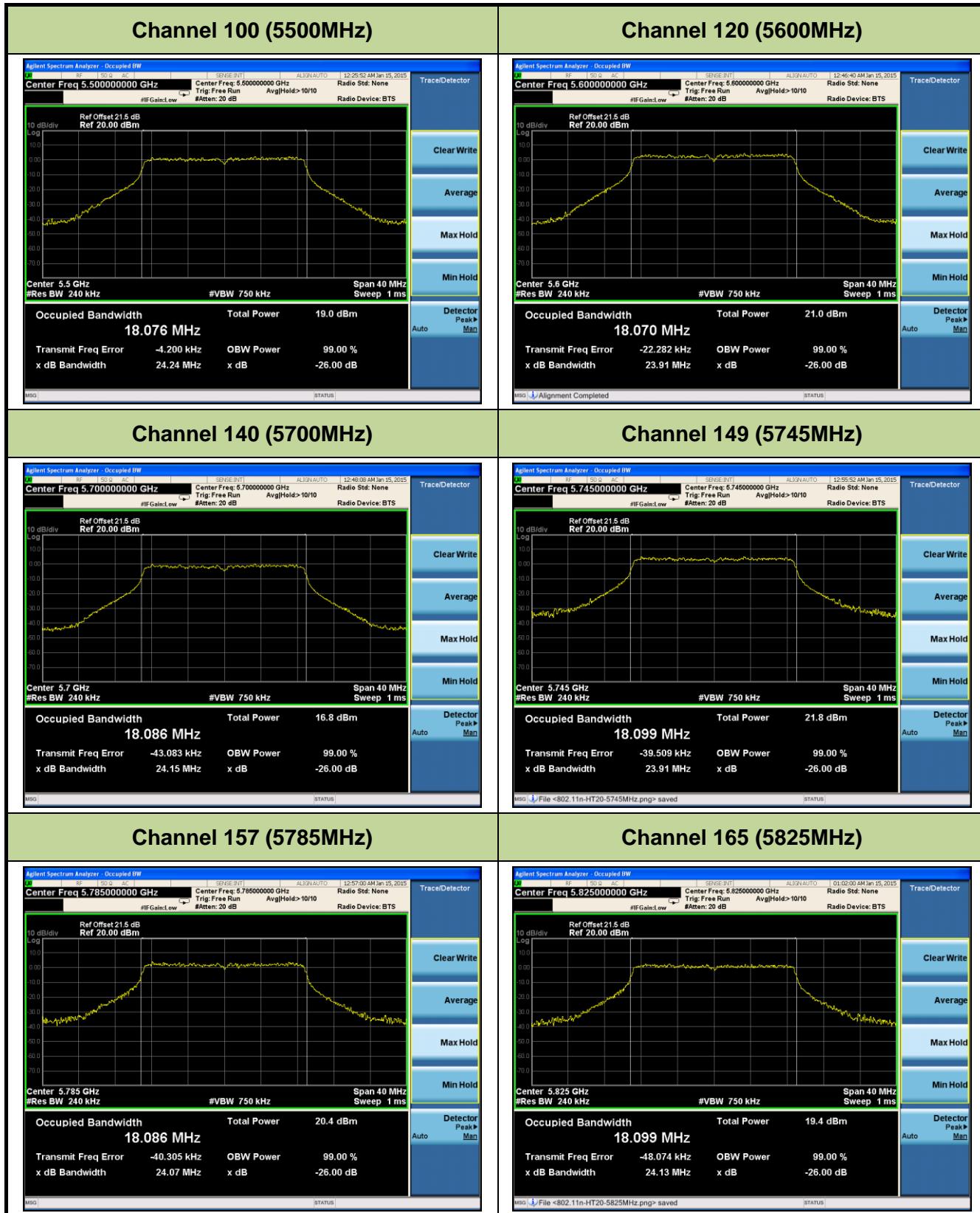


Channel 60 (5300MHz)



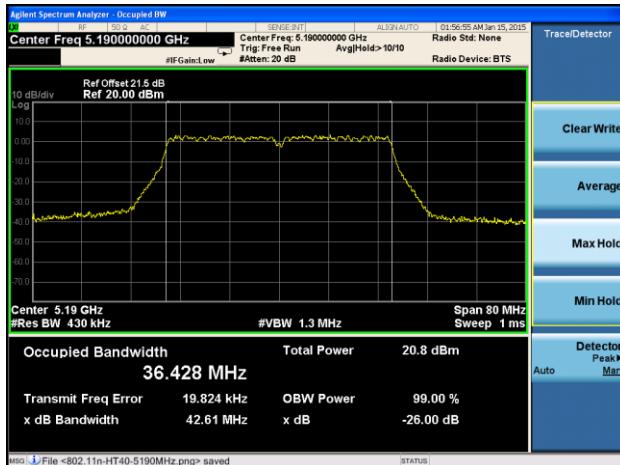
Channel 64 (5320MHz)



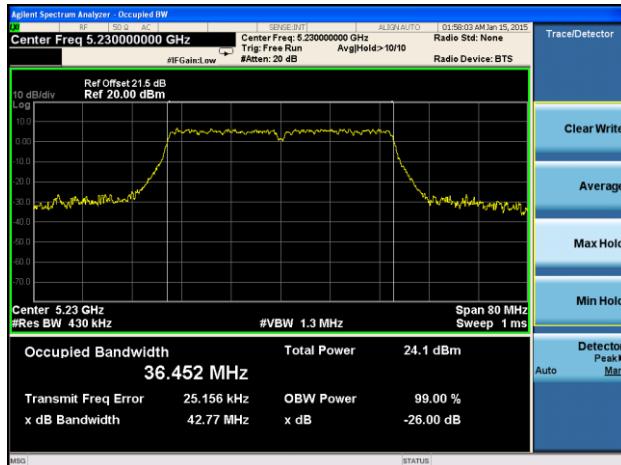


802.11n-HT40 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3

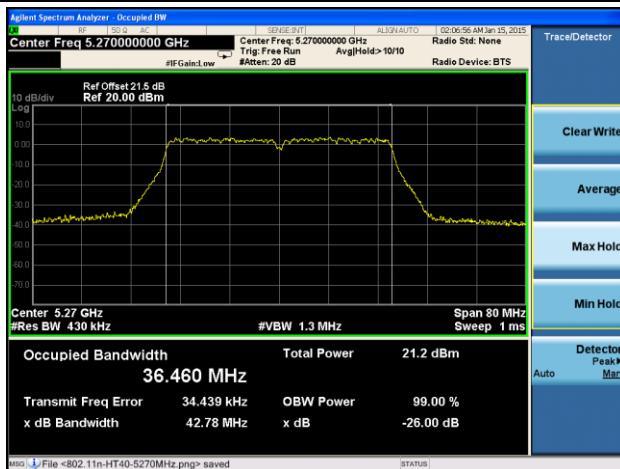
Channel 38 (5190MHz)



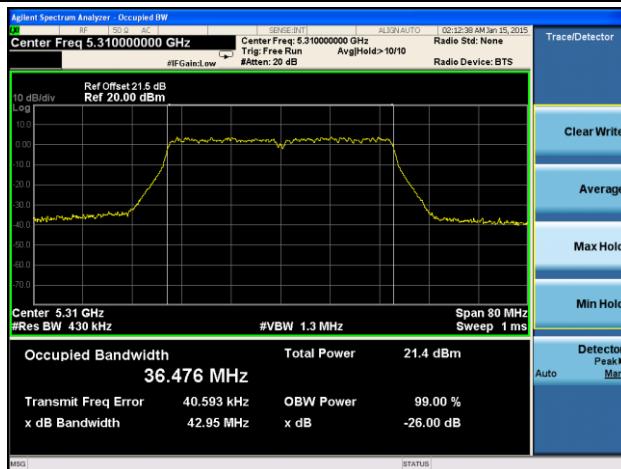
Channel 46 (5230MHz)



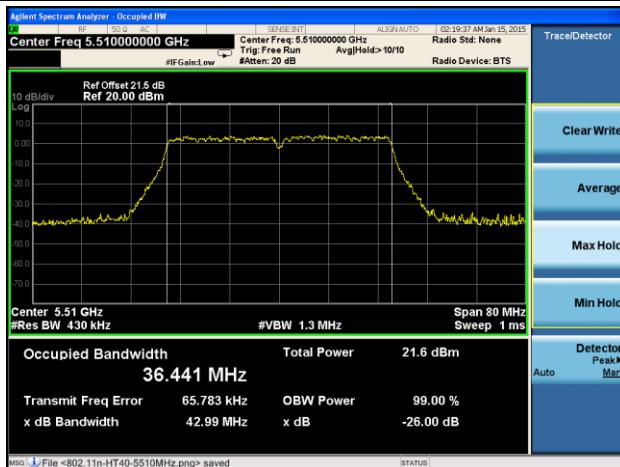
Channel 54 (5270MHz)



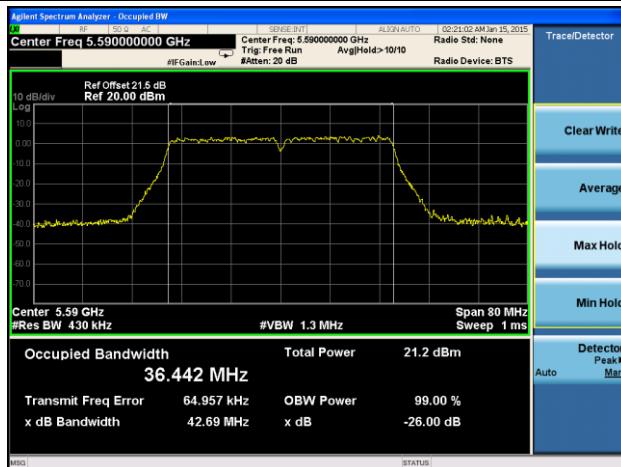
Channel 62 (5310MHz)

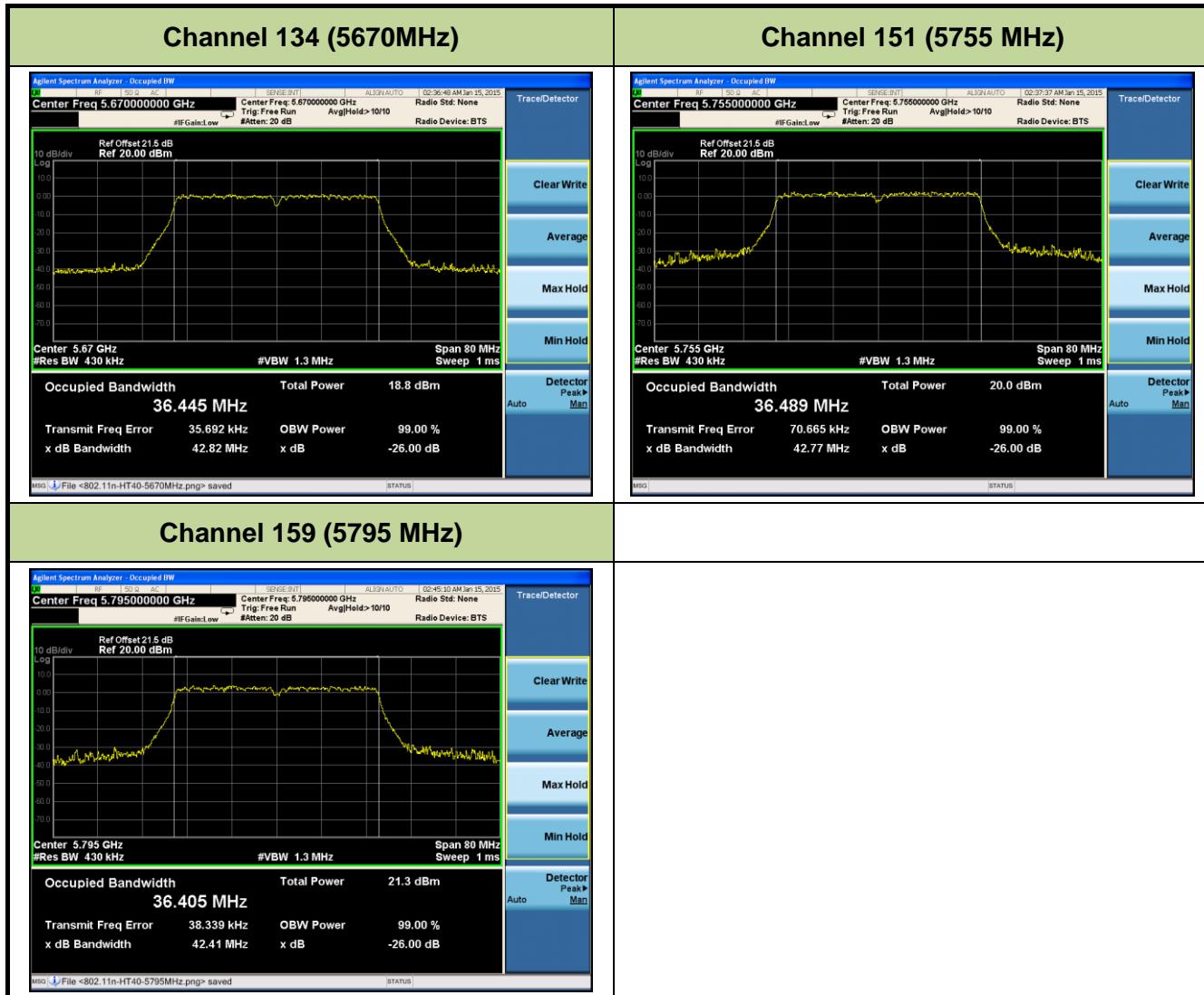


Channel 102 (5510MHz)



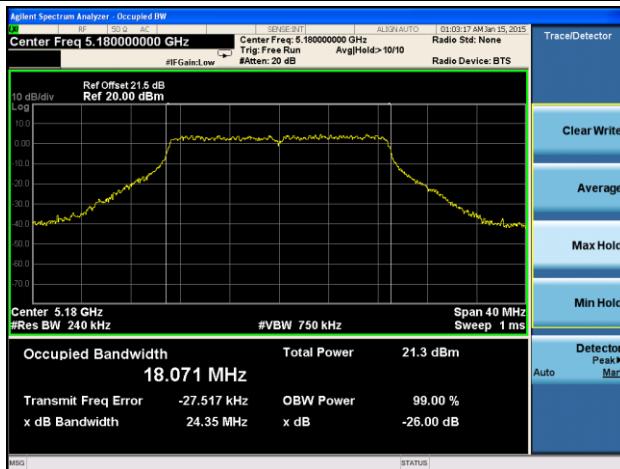
Channel 118 (5590MHz)





802.11ac-VHT20 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3

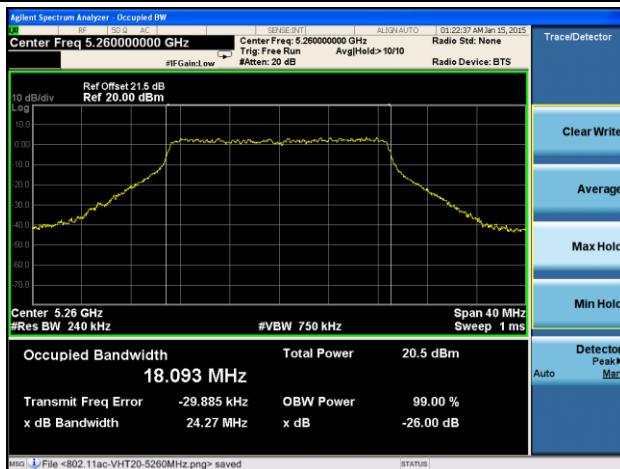
Channel 36 (5180MHz)



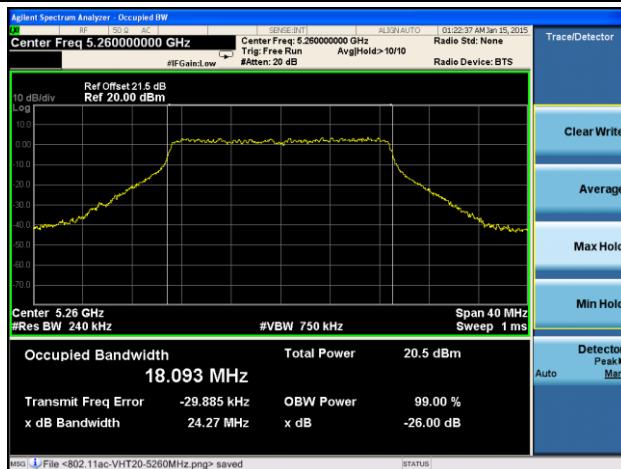
Channel 44 (5220MHz)



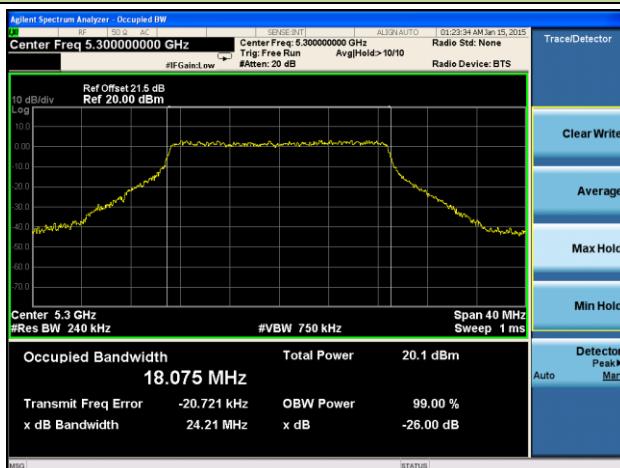
Channel 48 (5240MHz)



Channel 52 (5260MHz)



Channel 60 (5300MHz)



Channel 64 (5320MHz)

