MEASUREMENT REPORT

FCC PART 15.407 WLAN 802.11a/n/ac

FCC ID:	2ABLK-804MESH
APPLICANT:	Calix Inc.
Application Type:	Certification
Product:	804Mesh Dual Wi-Fi
Model No.:	804MESH
Brand Name:	Calix
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part15 Subpart E (Section 15.407)
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02v01r04, KDB 662911 D01v02r01
Test Date:	September 10 ~ 27, 2017

Reviewed By : Sunny Sun
(Sunny Sun)

Approved By : Marlinchen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

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 D02v01r04. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date	Note
1709RSU00402	Rev. 01	Initial Report	10-18-2017	Valid

CONTENTS

§2.1033General Information

Applicant:	Calix Inc.
Applicant Address:	1035 N. McDowell Blvd Petaluma, CA94954 U.S.A
Manufacturer:	Wuxi MitraStar Technology Co.Ltd
Manufacturer Address:	1-1# Minshan Road, Wuxi New Wu District, Jiangsu, P.R.C.
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
FCC Registration No.:	893164
FCC Rule Part(s):	Part15 Subpart E (Section 15.407)
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering

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. 893164) 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.**


Accredited Laboratory

A2LA has accredited

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Suzhou, Jiangsu, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 6th day of September 2016.

Senior Director of Quality and Communications for the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2018

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

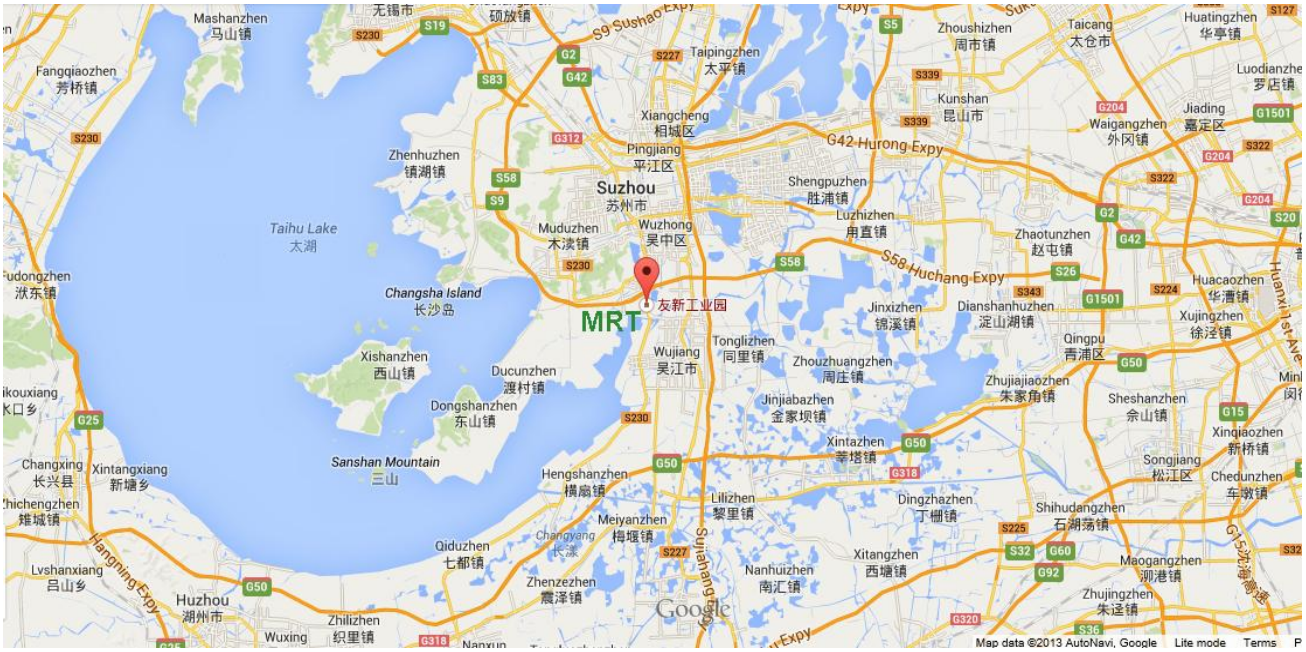
1. INTRODUCTION

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 FederalCommunications 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, 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	804Mesh Dual Wi-Fi
Model No.	804Mesh
Brand Name:	Calix
Wi-Fi Specification:	802.11a/b/g/n/ac
Frequency Range	**2.4GHz:** For 802.11b/g/n-HT20: 2412 ~ 2462 MHz For 802.11n-HT40: 2422 ~ 2452 MHz **5GHz:** For 802.11a/n-HT20/ac-VHT20:5180~5320MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40:5190~5310MHz, 5755~5795MHz For 802.11ac-VHT80:5210MHz, 5775MHz
Maximum Output Power	802.11a: 26.93dBm, 802.11n-HT20: 26.43dBm 802.11n-HT40: 26.90dBm, 802.11ac-VHT20: 26.93dBm, 802.11ac-VHT40: 26.92dBm, 802.11ac-VHT80: 25.62dBm
Type of Modulation	802.11b: DSSS 802.11a/g/n/ac: OFDM
Modulation Type	CCK, DQPSK, DBPSK for DSSS 16QAM, 64QAM, 256QAM, QPSK, BPSK for OFDM

2.2. Working Frequencies for this report

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	--	--

2.3. Description of Available Antennas

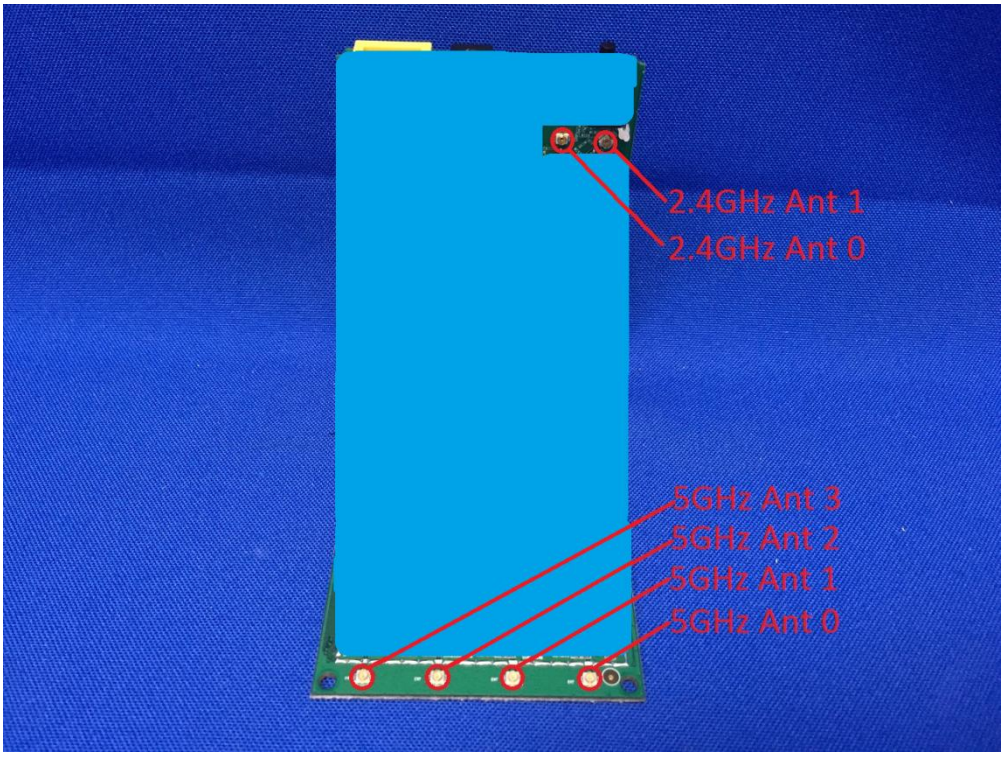
Antenna Type	Frequency Band (GHz)	T_X Paths	Directional Gain (dBi)	
			Non Beam Forming Mode	CDD & Beam-Forming Mode
PCB Antenna	2.4	2	1.40	--
	5.2	4	--	8.90
	5.8	4	--	9.00

Note:

1. Transmit at 2.4GHz support two antennas, and support four antennas at 5GHz transmit.
2. The EUT working on Beam Forming mode at 802.11n/ac, and working on CDD mode at 802.11a.
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, …, G_N dBi
   - transmit signals are correlated, then
   - Directional gain = 10 log[$(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2/N_{ANT}$] 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.]

2.4. Description of Antenna RF Port

Antenna RF Port						
--	2.4GHz RF Port		5GHz RF Port			
Software Control Port	Ant 0	Ant 1	Ant 0	Ant 1	Ant 2	Ant 3



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

2.6. Description of Test Software

The test utility software used during testing was “Telnet.exe”.

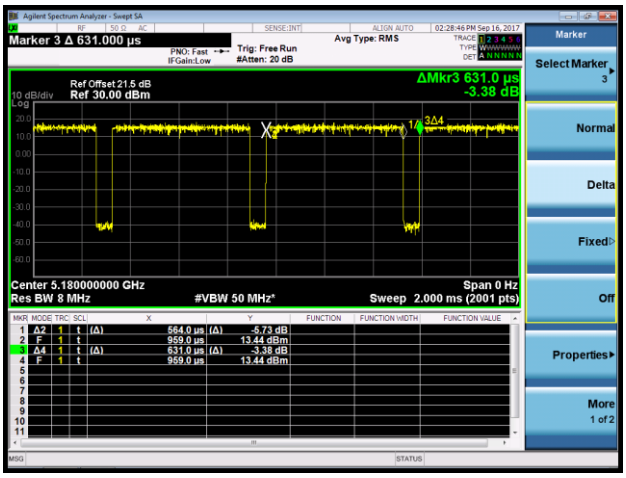
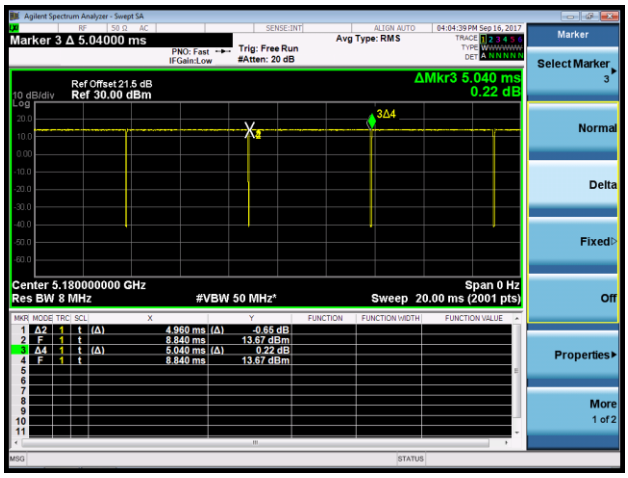
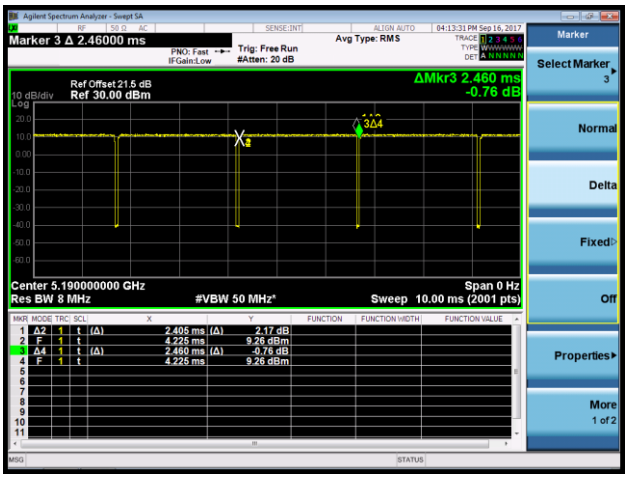
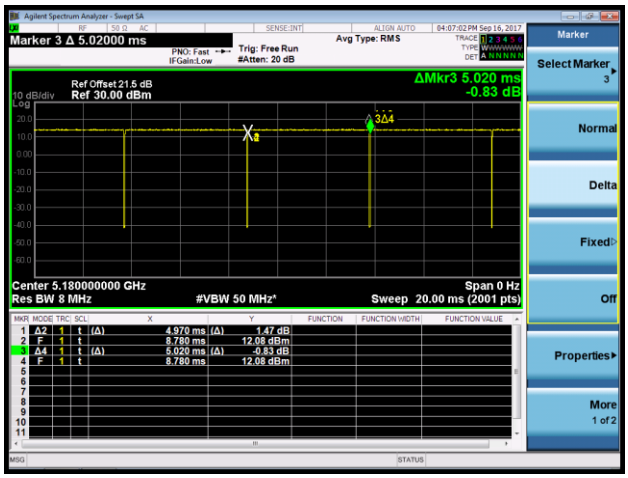
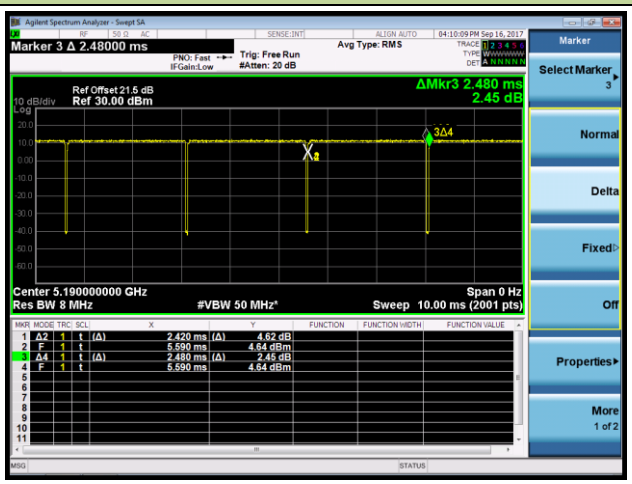
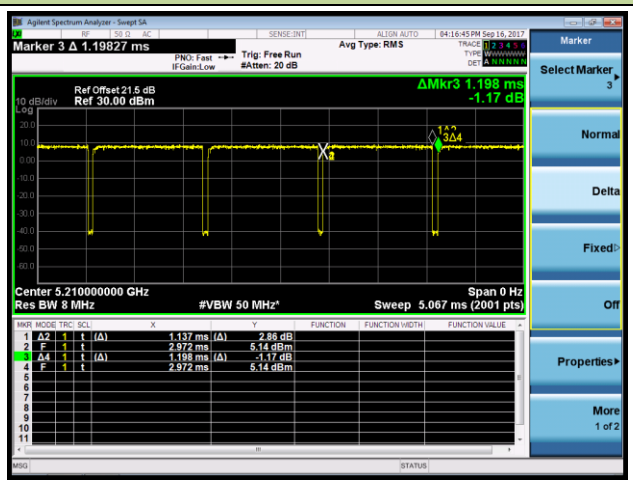
2.7. Device Capabilities

This device contains the following capabilities:

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

Note: 5GHz (NII) operation is possible in 20MHz, 40MHzand 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 D02v01r04. 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	89.38%
802.11n-HT20	98.41%
802.11n-HT40	97.76%
802.11ac-VHT20	99.00%
802.11ac-VHT40	97.58%
802.11ac-VHT80	94.91%

802.11a	802.11n-HT20
	
802.11n-HT40	802.11ac-VHT20
	
802.11ac-VHT40	802.11ac-VHT80
	

2.8. Test Configuration

The **804Mesh Dual Wi-Fi** was tested per the guidance of KDB 789033 D02v01r04. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testingand 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 pamphletsupplied to the user and be readily visible to the purchaser at the time of purchase. However, when the deviceis 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 andlabel location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed WirelessDevices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v01r04 were used in themeasurement of the **804Mesh Dual Wi-Fi.**

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an8'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.

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, remotecontrolled, 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. An80cm 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 tomaximize 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 theresponsible party can be used with the device. The use of a permanently attached antenna or of an antennathat uses a unique coupling to the intentional radiator shall be considered sufficient to comply with theprovisions of this section.”

- The antenna of the **804Mesh Dual Wi-Fi** is **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The **804Mesh Dual Wi-Fi** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2018/04/24
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2018/06/20
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2018/06/20
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06181	1 year	2017/12/20
Shielding Anechoic Chamber	Mikebang	Chamber-SR2	MRTSUE06214	1 year	2018/05/10

Radiated Disturbance - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	Agilent	N9038A	MRTSUE06125	1 year	2018/08/03
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2018/03/28
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2017/11/21
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2017/11/19
Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2017/10/22
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2018/01/04
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06183	1 year	2017/12/20
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2018/05/10

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	Agilent	N9038A	MRTSUE06125	1 year	2018/08/03
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2017/12/06
Signal Analyzer	R&S	FSV40	MRTSUE06218	1 year	2018/03/27
Temperature/Humidity Meter	Yuhuaze	HTC-2	MRTSUE06180	1 year	2017/12/22

Software	Version	Function
e3	V8.3.5	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 - SR2
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: ± 3.46dB
Radiated Emission Measurement - AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: ± 4.18dB 1GHz ~ 25GHz: ± 4.76dB

7. TEST RESULT

7.1. Summary

Product Name: **804Mesh Dual Wi-Fi**

FCC ID: **2ABLK-804MESH**

FCC Classification: **Unlicensed National Information Infrastructure (UNII)**

Data Rate / MCS Tested: **6Mbps ~ 54Mbps (a); MCS0 for 802.11n-HT20MHz; MCS0 for 802.11n-HT40MHz; MCS0 for 802.11ac-VHT20MHz; MCS0 for 802.11ac-VHT40MHz; MCS0 for 802.11ac-VHT80MHz**

FCC Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section7.2
15.407(e)	6dB Bandwidth	≥ 500kHz		Pass	Section 7.3
15.407(a)(1)(ii), (2), (3)	Maximum Conducted Output Power	Refer to Section 7.5		Pass	Section 7.5
15.407(h)(1)	Transmit Power Control	≤ 24 dBm		N/A	Section 7.6
15.407(a)(1)(ii), (2), (3), (5)	Peak Power Spectral Density	Refer to Section 7.7		Pass	Section 7.7
15.407(g)	Frequency Stability	N/A		Pass	Section 7.8
15.407(b)(1), (2), (3), (4)	Undesirable Emissions	≤ -27dBm/MHz EIRP ≤ -17dBm/MHz EIRP	Radiated	Pass	Section 7.9 & 7.10
15.205, 15.209 15.407(b)(5), (6), (7)	General Field Strength Limits(Restricted Bands andRadiated Emission Limits)	Emissions in restrictedbands must meet theradiated limits detailed in15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.11

Notes:

1) 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 ofthe system to connect the EUT to the analyzer at all frequencies of interest.
2) Test Items “26dB Bandwidth”, “99% Bandwidth”, “6dB Bandwidth” & “Operation Frequency Rage of 26dB BW” have been assessed single and MIMO transmission, and showed the worst test data in this report.

7.2. 26dB Bandwidth Measurement

7.2.1.Test Limit

N/A

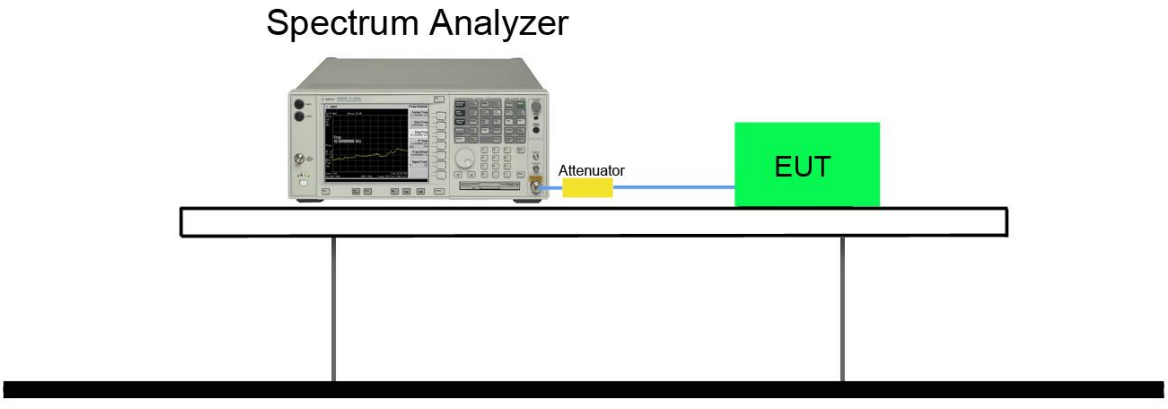
7.2.2.Test Procedure used

KDB 789033 D02v01r04 - 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 ≥ 3×RBW.
4. Detector = Peak.
5. Trace mode = max hold.

7.2.4.Test Setup



7.2.5.Test Result

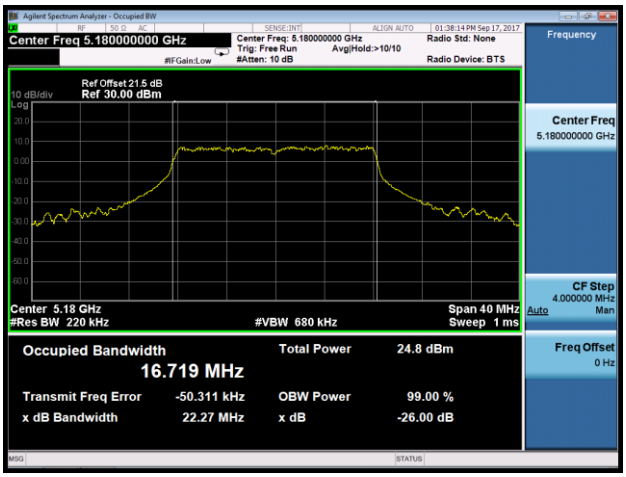
Product	804Mesh Dual Wi-Fi	Temperature	24°C
Test Engineer	Vince Yu	Relative Humidity	59%
Test Site	TR3	Test Date	2017/09/17

Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0 / Ant 0 + 1 + 2 + 3					
802.11a	6Mbps	36	5180	22.27	16.72
802.11a	6Mbps	44	5220	22.08	16.69
802.11a	6Mbps	48	5240	22.13	16.70
802.11a	6Mbps	149	5745	37.95	20.89
802.11a	6Mbps	157	5785	38.85	22.56
802.11a	6Mbps	165	5825	38.87	22.93
802.11n-HT20	MCS0	36	5180	23.99	18.09
802.11n-HT20	MCS0	44	5220	23.90	18.15
802.11n-HT20	MCS0	48	5240	23.98	18.08
802.11n-HT20	MCS0	149	5745	35.98	19.74
802.11n-HT20	MCS0	157	5785	36.21	19.95
802.11n-HT20	MCS0	165	5825	36.92	20.19
802.11n-HT40	MCS0	38	5190	42.43	36.49
802.11n-HT40	MCS0	46	5230	55.13	36.99
802.11n-HT40	MCS0	151	5755	76.62	40.90
802.11n-HT40	MCS0	159	5795	74.97	39.18
802.11ac-VHT20	MCS0	36	5180	23.79	18.10
802.11ac-VHT20	MCS0	44	5220	24.34	18.15
802.11ac-VHT20	MCS0	48	5240	24.20	18.14
802.11ac-VHT20	MCS0	149	5745	39.01	19.61
802.11ac-VHT20	MCS0	157	5785	36.25	19.34
802.11ac-VHT20	MCS0	165	5825	37.13	19.53

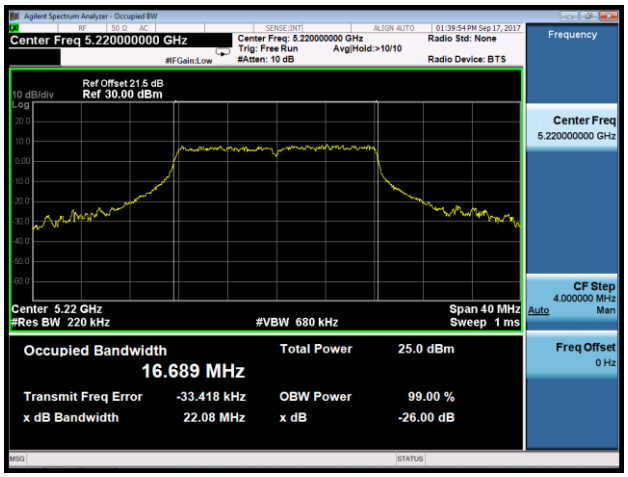
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)
Ant 0 / Ant 0 + 1 + 2 + 3					
802.11ac-VHT40	MCS0	38	5190	42.57	36.48
802.11ac-VHT40	MCS0	46	5230	58.75	37.21
802.11ac-VHT40	MCS0	151	5755	75.04	39.91
802.11ac-VHT40	MCS0	159	5795	74.52	38.75
802.11ac-VHT80	MCS0	42	5210	83.95	75.61
802.11ac-VHT80	MCS0	155	5775	141.1	77.19

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

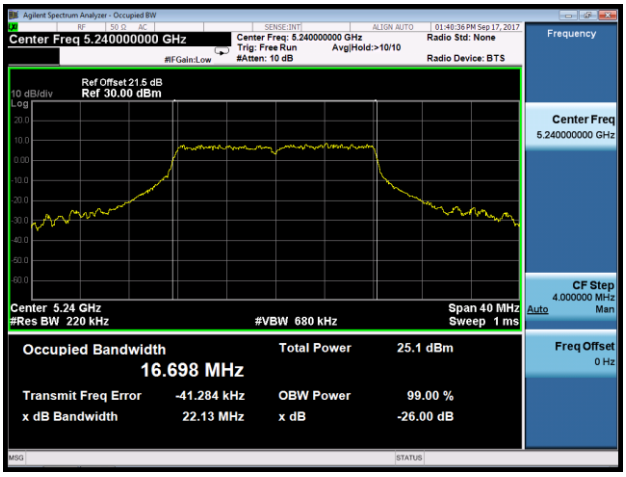
Channel36 (5180MHz)



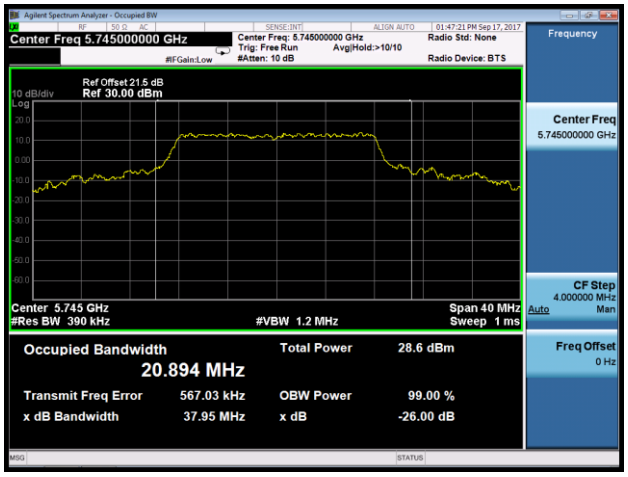
Channel 44 (5220MHz)



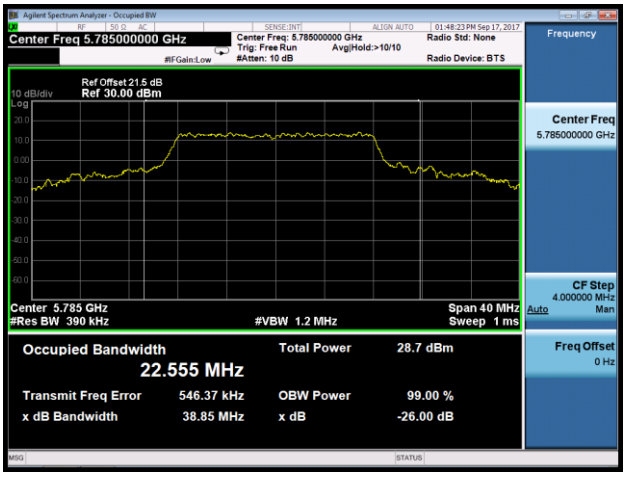
Channel48 (5240MHz)



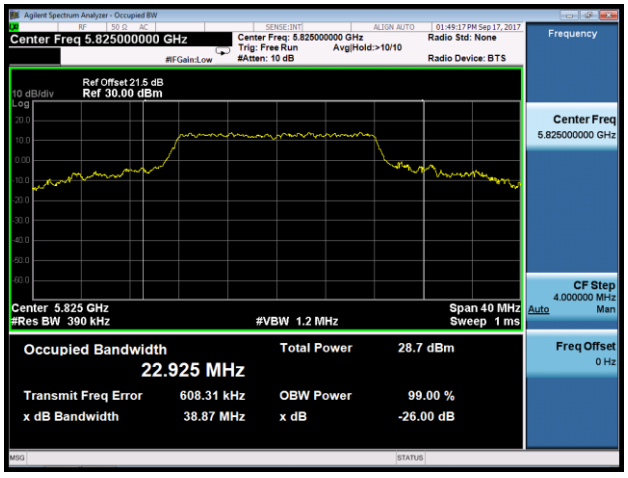
Channel149 (5745MHz)



Channel157 (5785MHz)

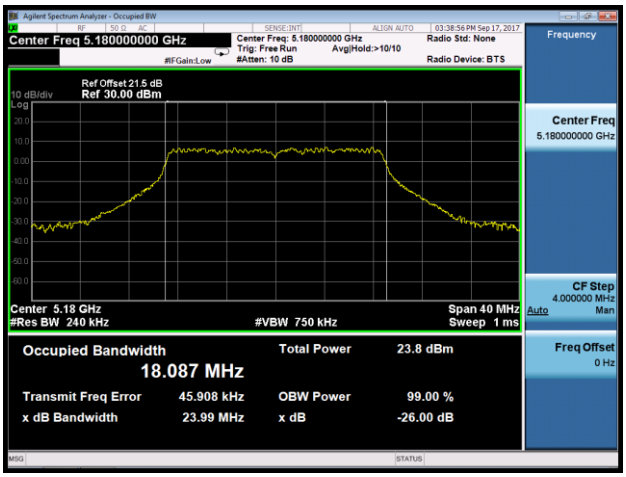


Channel165 (5825MHz)

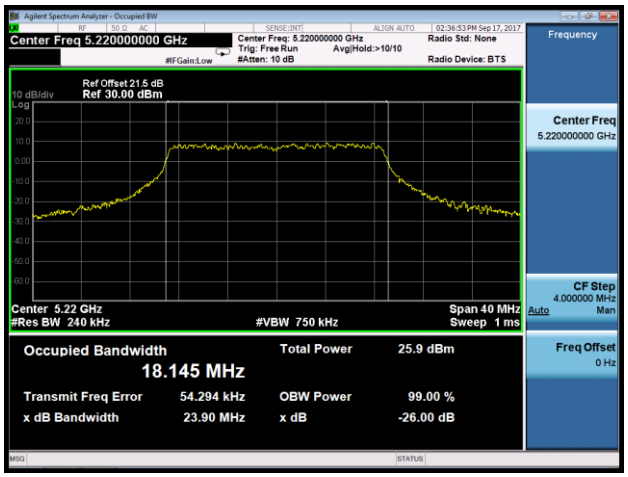


802.11n-HT20 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3

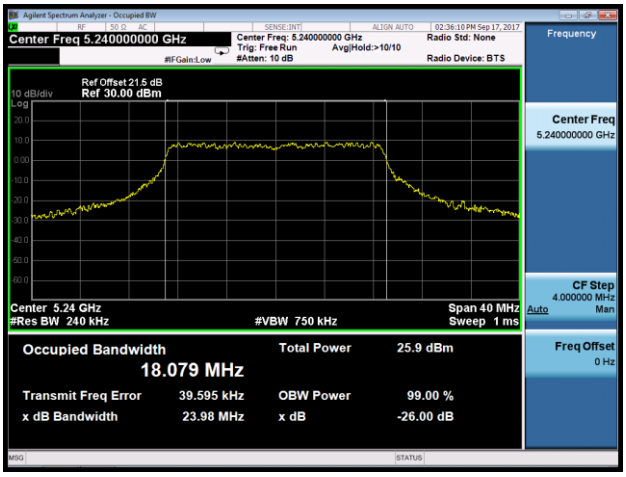
Channel36 (5180MHz)



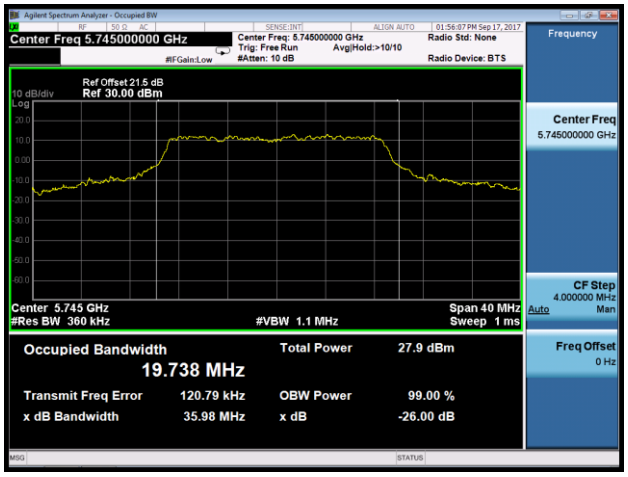
Channel 44 (5220MHz)



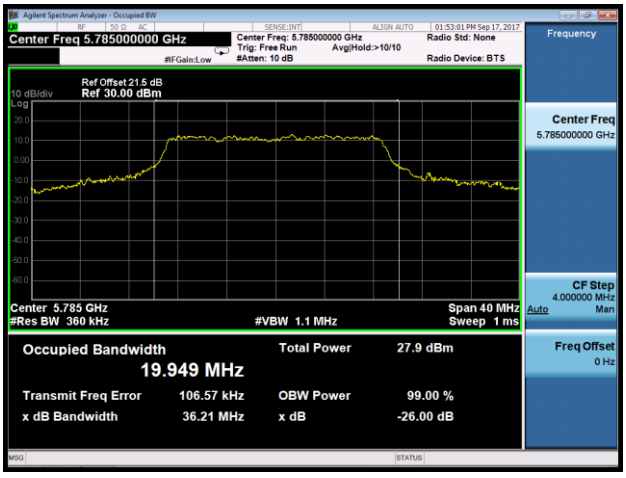
Channel48 (5240MHz)



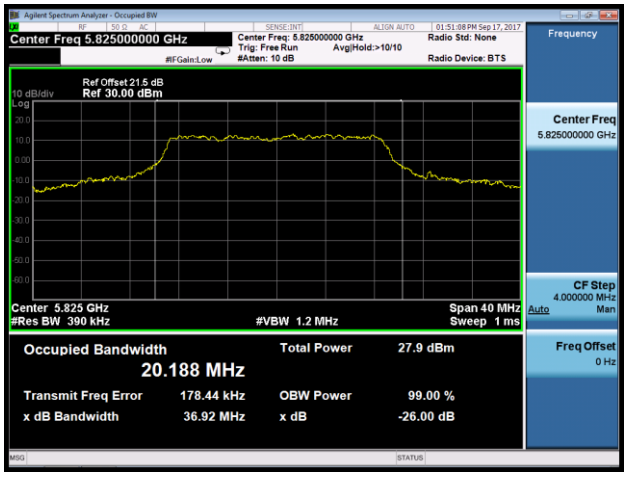
Channel149 (5745MHz)

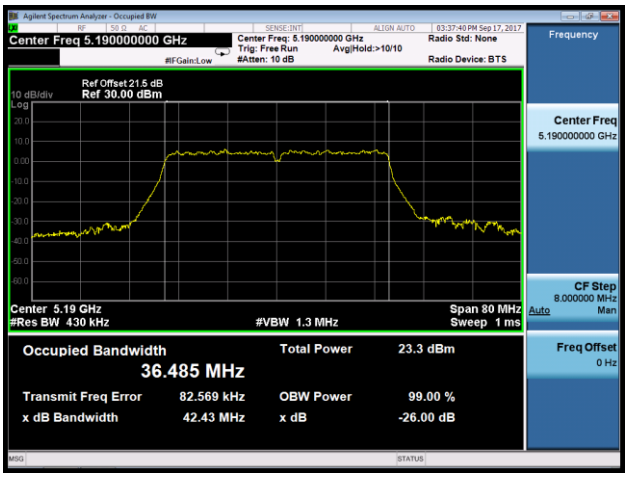
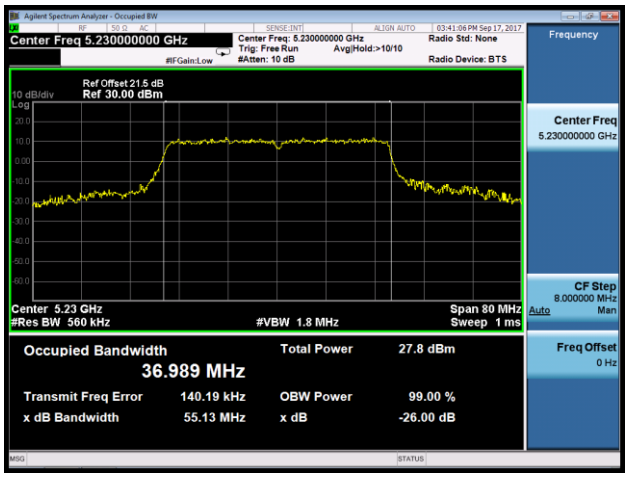
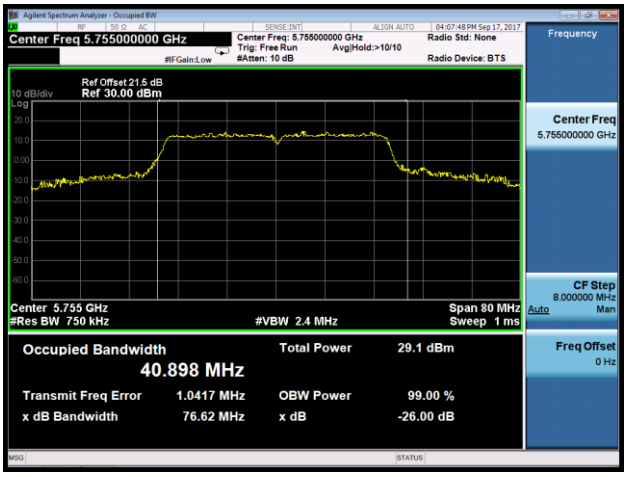
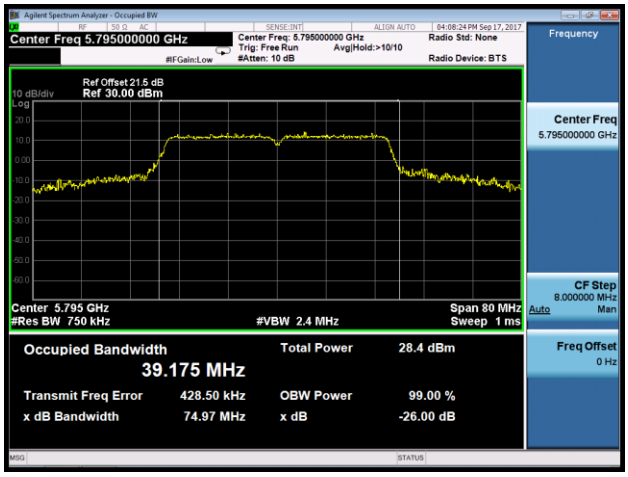


Channel157 (5785MHz)



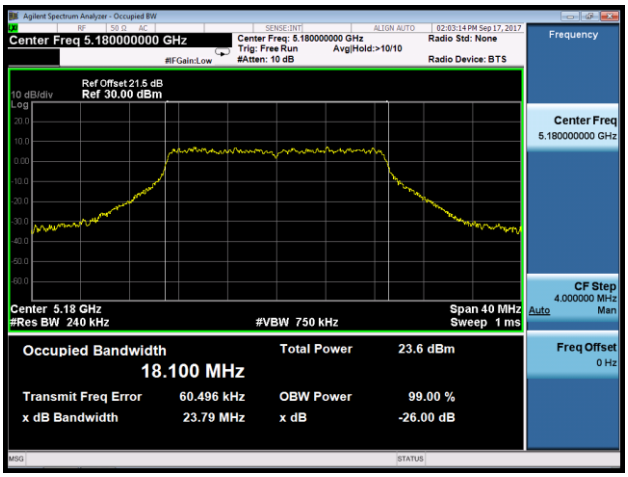
Channel165 (5825MHz)



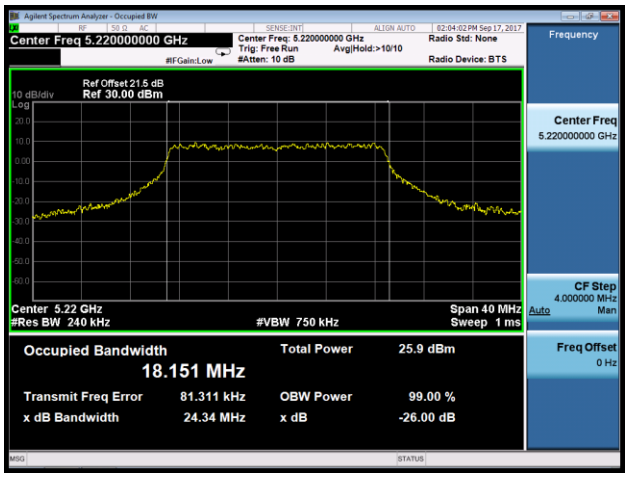
802.11n-HT40 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel38 (5190MHz)	**Channel46 (5230MHz)**
	
Channel151 (5755MHz)	**Channel159 (5795MHz)**
	

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

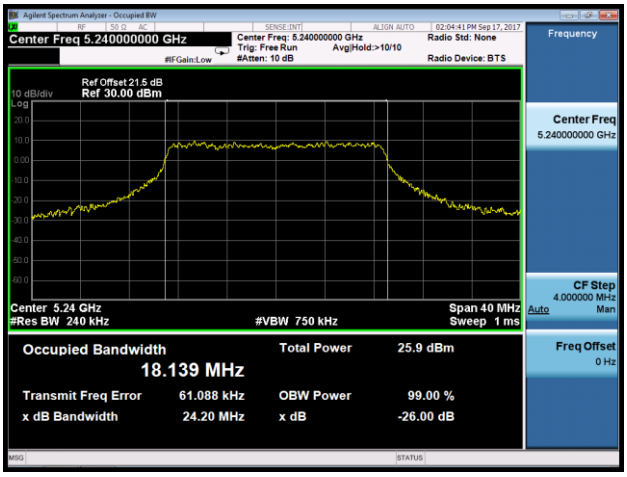
Channel36 (5180MHz)



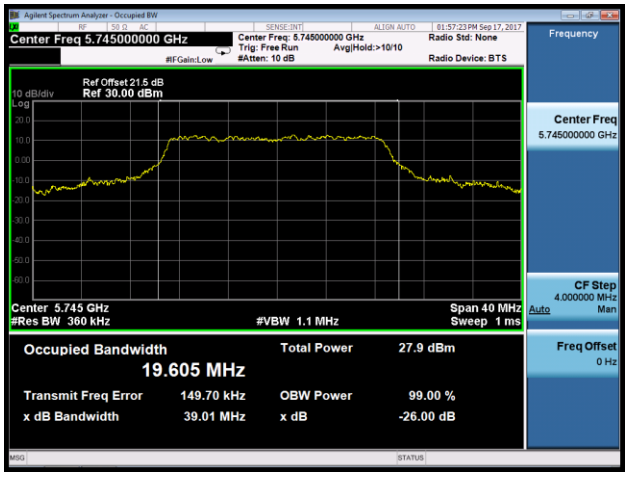
Channel 44 (5220MHz)



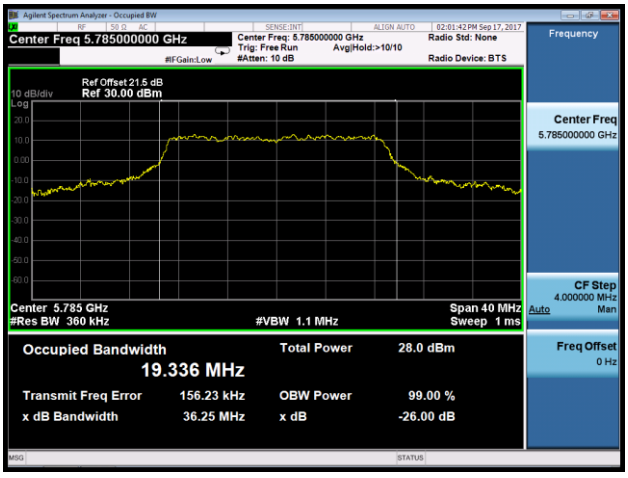
Channel48 (5240MHz)



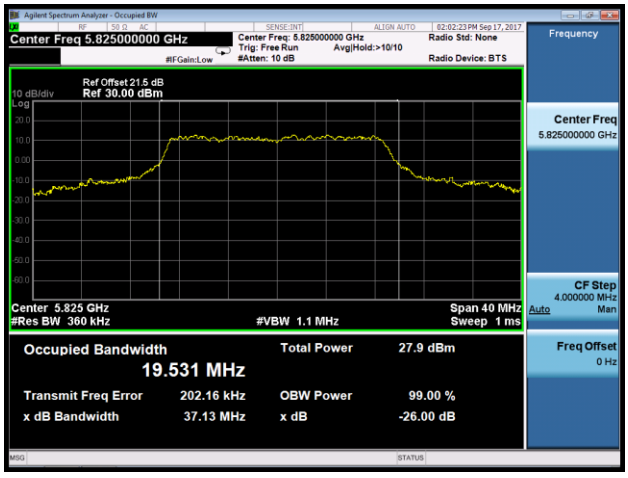
Channel149 (5745MHz)

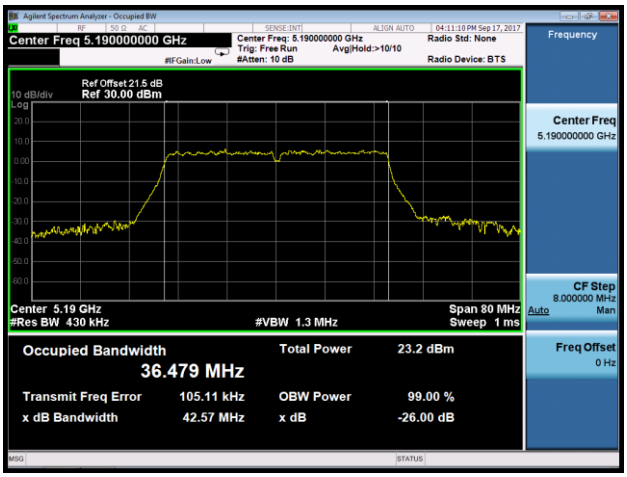
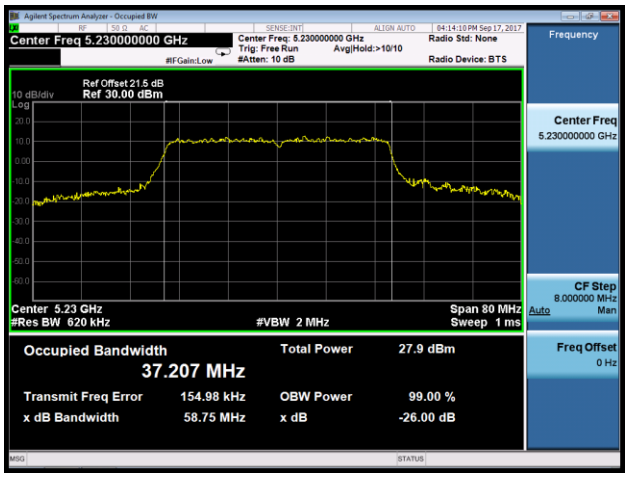
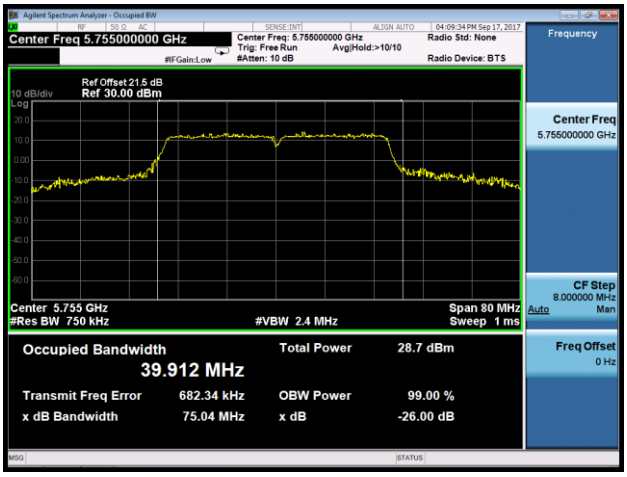
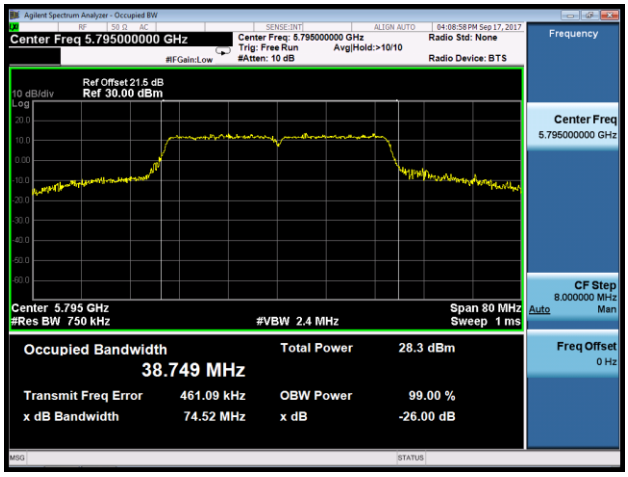
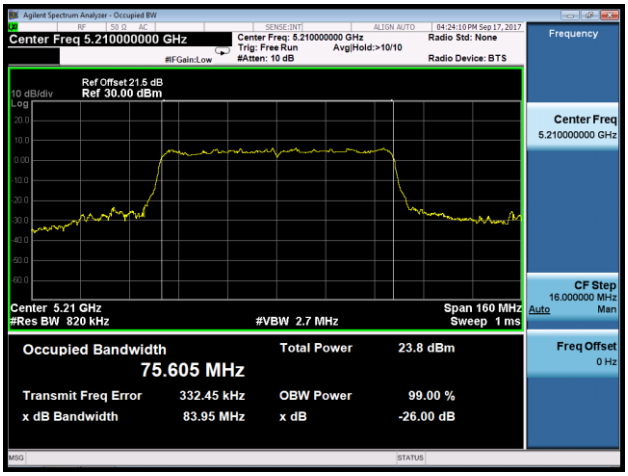
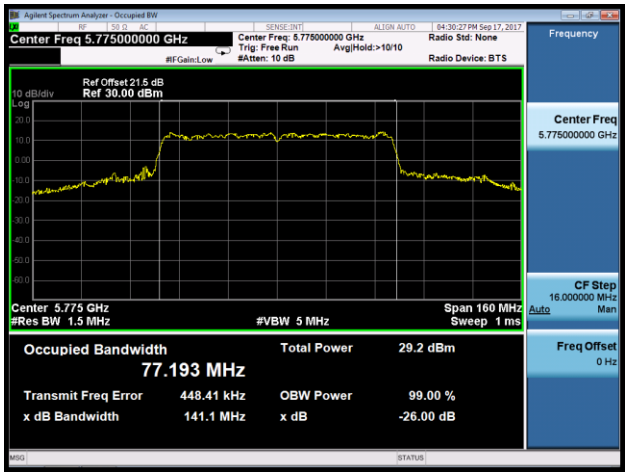


Channel157 (5785MHz)



Channel165 (5825MHz)



802.11ac-VHT40 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel38 (5190MHz)	Channel46 (5230MHz)
	
Channel151 (5755MHz)	Channel159 (5795MHz)
	
802.11ac-VHT80 26dB Bandwidth & 99% Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel42 (5210MHz)	Channel155 (5775MHz)
	

7.3. 6dB Bandwidth Measurement

7.3.1.Test Limit

The minimum 6dBbandwidth shall be at least 500 kHz.

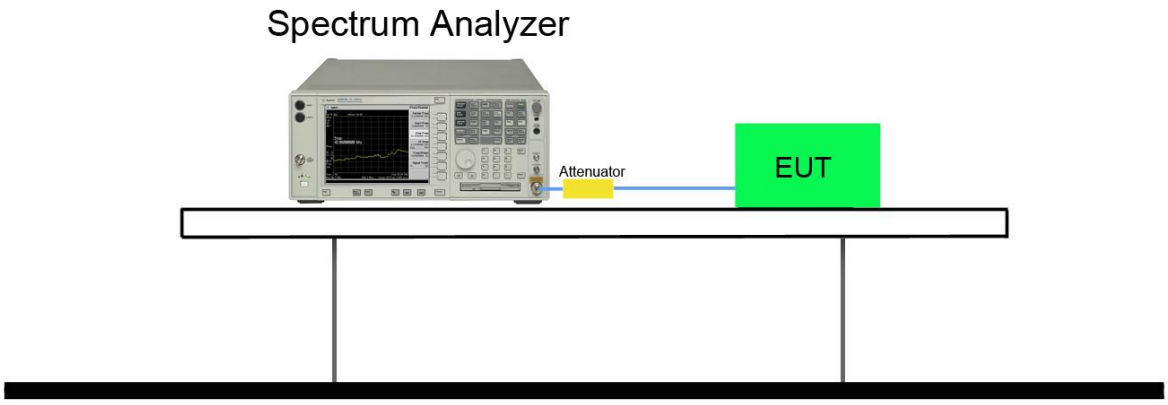
7.3.2.Test Procedure used

KDB 789033 D02v01r04 - Section C.2

7.3.3.Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW≧ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

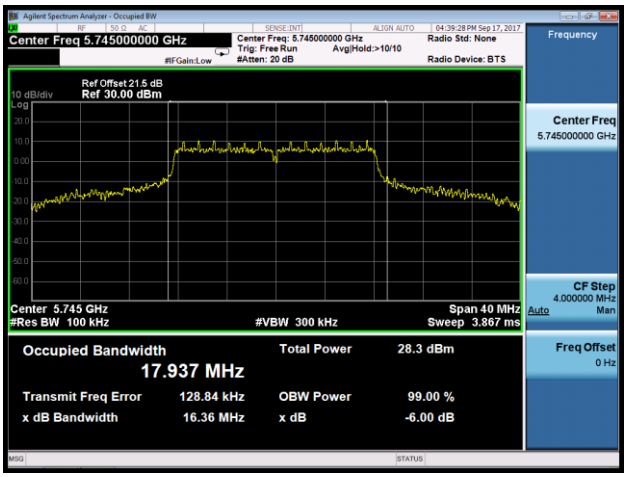
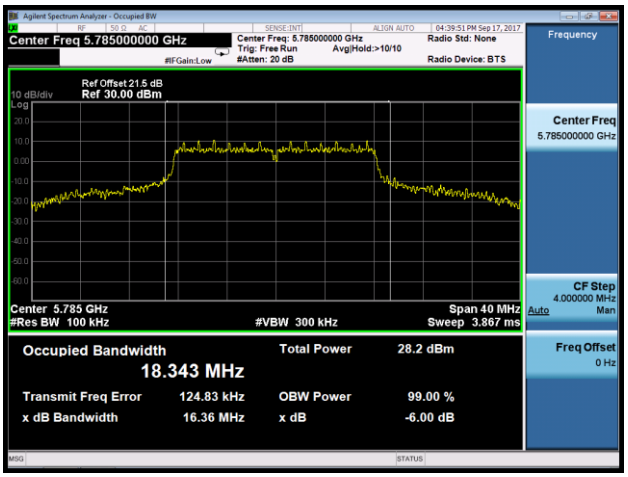
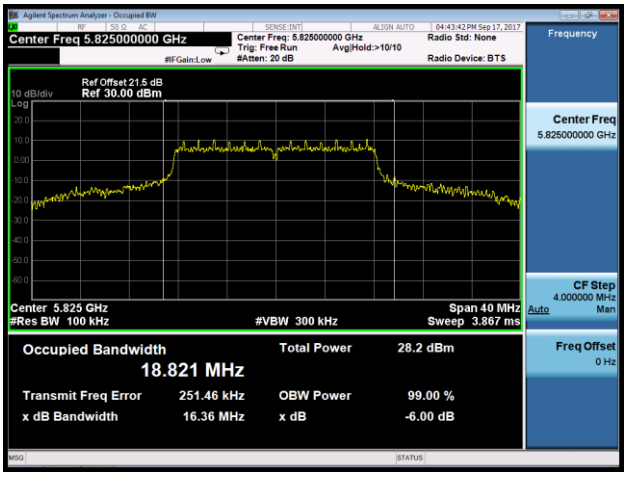
7.3.4.Test Setup

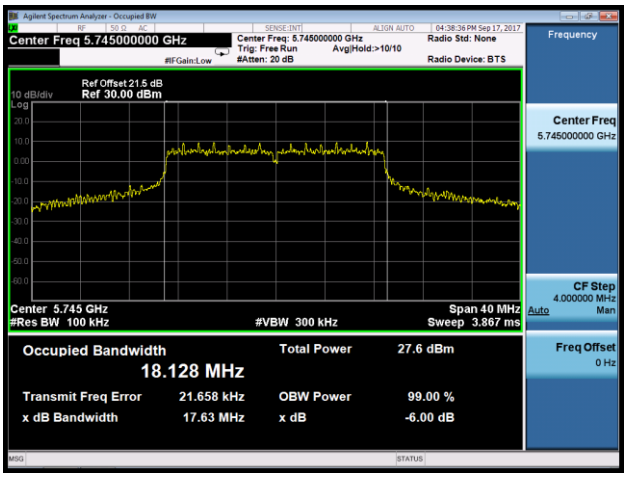
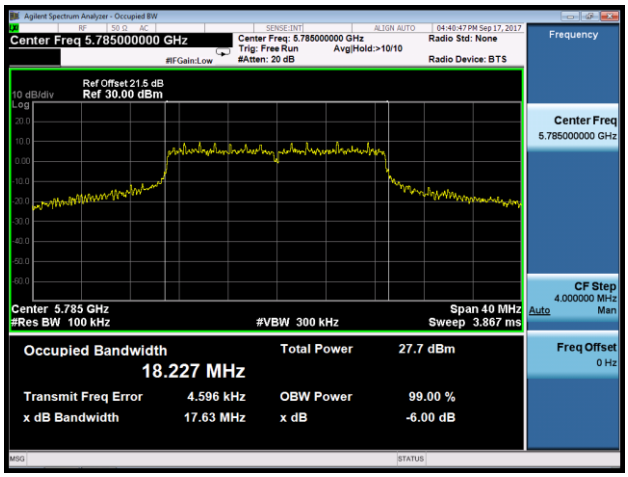
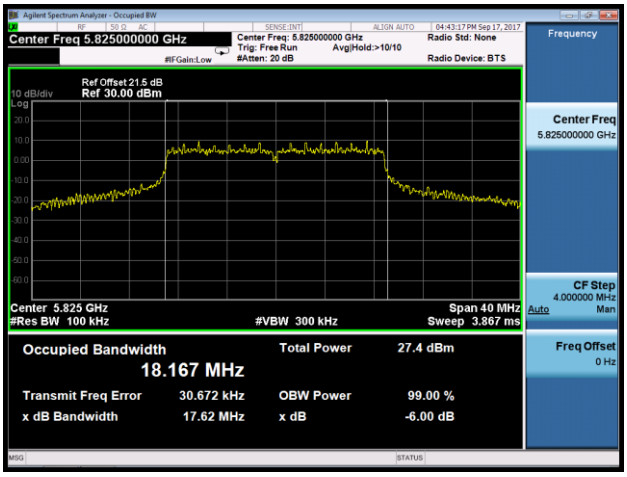
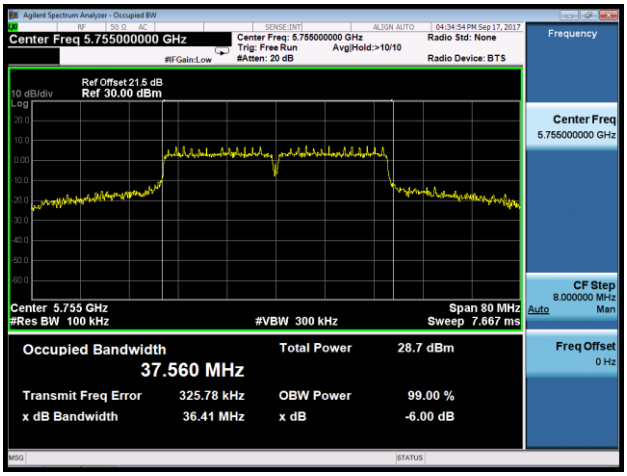
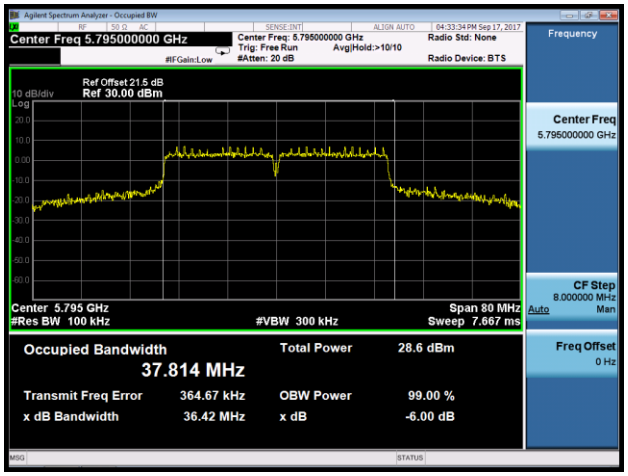


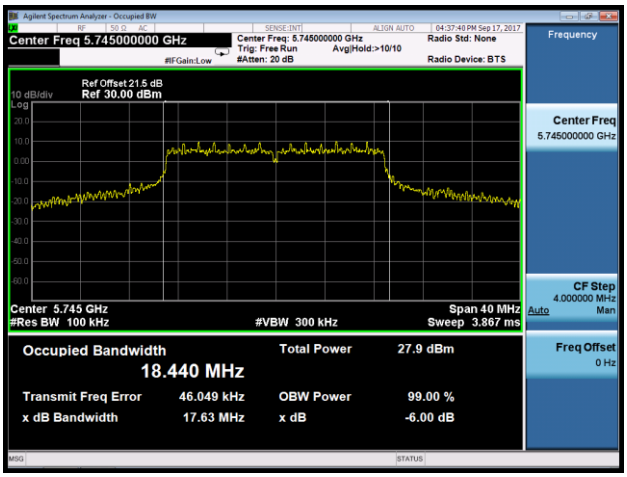
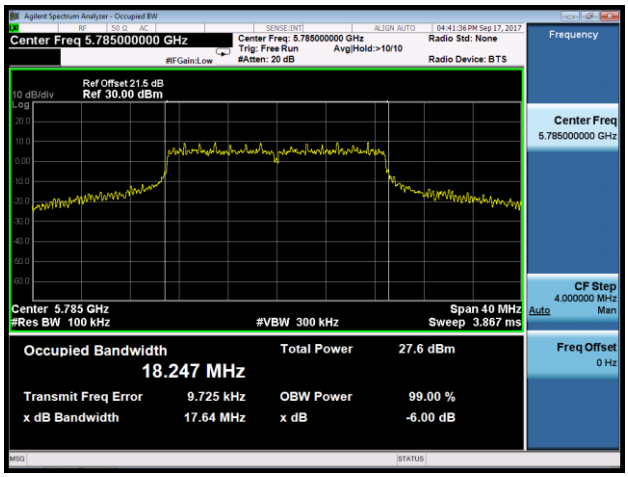
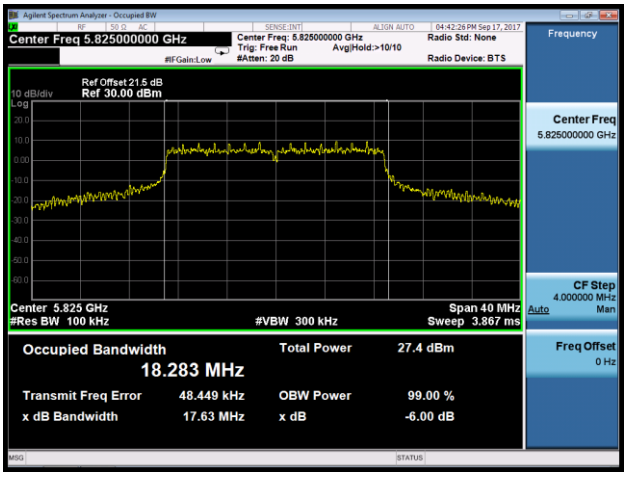
7.3.5.Test Result

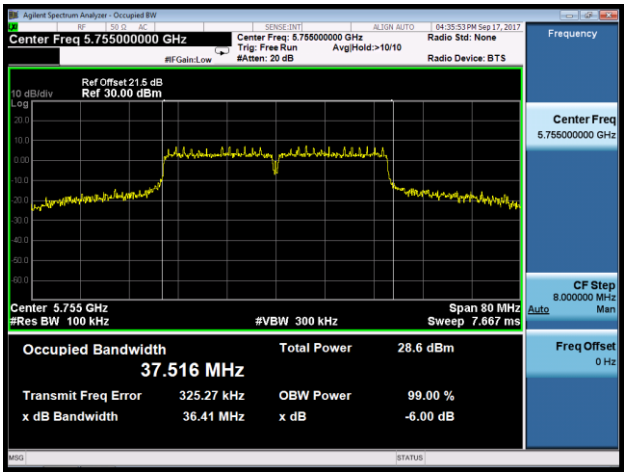
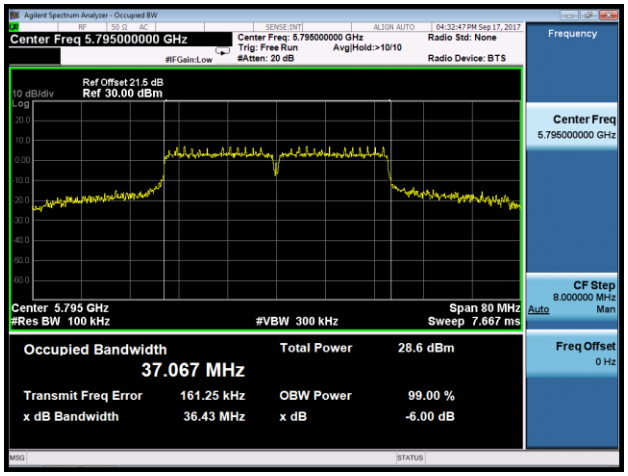
Product	804Mesh Dual Wi-Fi	Temperature	24°C
Test Engineer	Roy Cheng	Relative Humidity	59%
Test Site	TR3	Test Date	2017/09/17

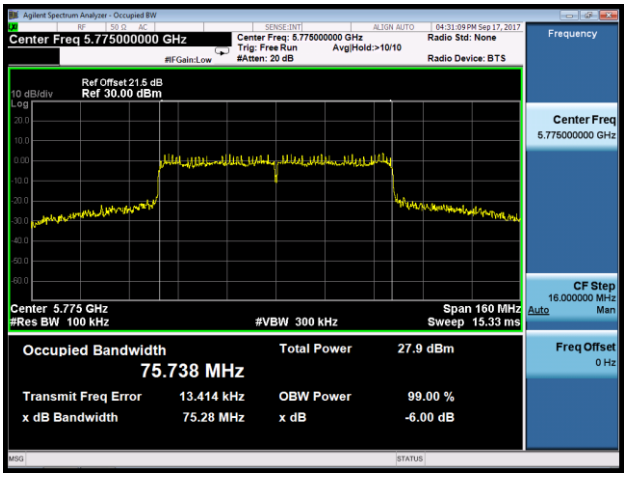
Test Mode	Data Rate/ MCS	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant 0 / Ant 0 + 1 + 2 + 3						
802.11a	6Mbps	149	5745	16.36	≥ 0.5	Pass
802.11a	6Mbps	157	5785	16.36	≥ 0.5	Pass
802.11a	6Mbps	165	5825	16.36	≥ 0.5	Pass
802.11n-HT20	MCS0	149	5745	17.63	≥ 0.5	Pass
802.11n-HT20	MCS0	157	5785	17.63	≥ 0.5	Pass
802.11n-HT20	MCS0	165	5825	17.62	≥ 0.5	Pass
802.11n-HT40	MCS0	151	5755	36.41	≥ 0.5	Pass
802.11n-HT40	MCS0	159	5795	36.42	≥ 0.5	Pass
802.11ac-VHT20	MCS0	149	5745	17.63	≥ 0.5	Pass
802.11ac-VHT20	MCS0	157	5785	17.64	≥ 0.5	Pass
802.11ac-VHT20	MCS0	165	5825	17.63	≥ 0.5	Pass
802.11ac-VHT40	MCS0	151	5755	36.41	≥ 0.5	Pass
802.11ac-VHT40	MCS0	159	5795	36.43	≥ 0.5	Pass
802.11ac-VHT80	MCS0	155	5775	75.28	≥ 0.5	Pass

802.11a 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 149 (5745MHz)	**Channel 157 (5785MHz)**
	
Channel 165 (5825MHz)	
	

802.11n-HT20 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 149 (5745MHz)	**Channel 157 (5785MHz)**
	
Channel 165 (5825MHz)	
	
802.11n-HT40 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 151 (5755MHz)	**Channel 159 (5795MHz)**
	

802.11ac-VHT20 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 149 (5745MHz)	**Channel 157 (5785MHz)**
	
Channel 165 (5825MHz)	
	

802.11ac-VHT40 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 151 (5755MHz)	**Channel 159 (5795MHz)**
	

802.11ac-VHT80 6dB Bandwidth - Ant 0 / Ant 0 + 1 + 2 + 3	
Channel 155 (5775MHz)	
	

7.4. Output Power Measurement

7.4.1.Test Limit

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

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (23.98dBm) or 11dBm +10 log (26dB BW).

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm).

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

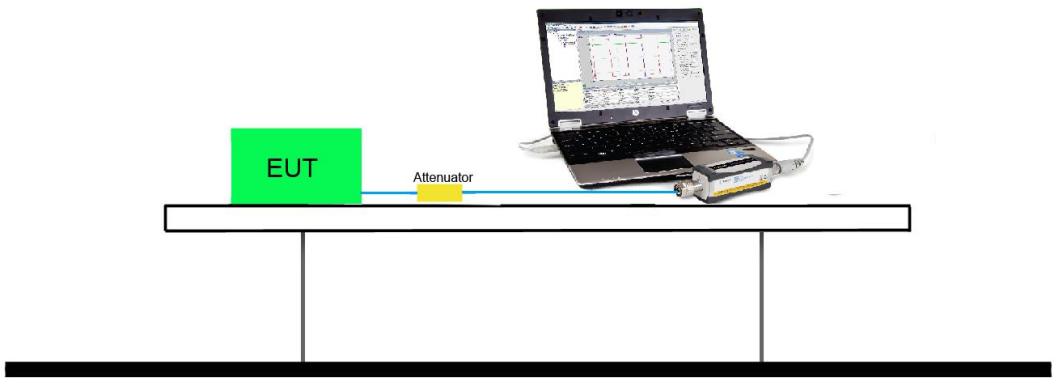
7.4.2.Test Procedure Used

KDB 789033D02v01r04- Section E)3)b) Method PM-G

7.4.3.Test Setting

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.4.4.Test Setup



7.4.5.Test Result

Power output test was verified over all data rates of each mode shown as below table, and then choose the maximum power output (gray marker) for final test of each channel.

Test Mode	Bandwidth	Channel	Frequency (MHz)	Data Rate/ MCS	Average Power (dBm)
Ant 0 / Ant 0 + 1 + 2 + 3					
802.11a	20	36	5180	6Mbps	18.34
				24Mbps	18.12
				54Mbps	17.95
802.11n	20	36	5180	MCS0	17.66
				MCS3	17.53
				MCS7	17.38
802.11n	40	38	5190	MCS0	16.06
				MCS3	15.87
				MCS7	15.64
802.11ac	20	36	5180	MCS0	17.62
				MCS4	17.53
				MCS8	17.32
802.11ac	40	38	5190	MCS0	15.96
				MCS4	15.83
				MCS9	15.68
802.11ac	80	42	5210	MCS0	15.84
				MCS4	15.65
				MCS9	15.41

Product	804Mesh Dual Wi-Fi	Temperature	25°C
Test Engineer	Roy Cheng	Relative Humidity	49%
Test Site	TR3	Test Date	2017/09/17

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Ant 2 Average Power (dBm)	Ant 3 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
11a	6	36	5180	18.34	18.28	18.44	18.22	24.34	≤ 27.10	Pass
11a	6	44	5220	20.24	20.53	20.22	20.17	26.31	≤ 27.10	Pass
11a	6	48	5240	20.41	20.52	20.11	20.31	26.36	≤ 27.10	Pass
11a	6	149	5745	21.19	20.62	20.46	21.01	26.85	≤ 27.00	Pass
11a	6	157	5785	21.38	20.72	20.42	20.89	26.89	≤ 27.00	Pass
11a	6	165	5825	21.08	20.58	20.24	20.86	26.72	≤ 27.00	Pass
11n-HT20	MCS0	36	5180	17.66	17.42	17.03	17.42	23.41	≤ 27.10	Pass
11n-HT20	MCS0	44	5220	20.15	20.08	19.74	20.11	26.04	≤ 27.10	Pass
11n-HT20	MCS0	48	5240	20.33	20.18	20.05	19.85	26.13	≤ 27.10	Pass
11n-HT20	MCS0	149	5745	20.99	20.21	19.93	20.25	26.38	≤ 27.00	Pass
11n-HT20	MCS0	157	5785	20.92	20.42	20.07	20.18	26.43	≤ 27.00	Pass
11n-HT20	MCS0	165	5825	20.94	20.08	20.13	19.92	26.31	≤ 27.00	Pass
11n-HT40	MCS0	38	5190	16.06	15.91	15.75	15.62	21.86	≤ 27.10	Pass
11n-HT40	MCS0	46	5230	20.52	20.53	20.21	20.28	26.41	≤ 27.10	Pass
11n-HT40	MCS0	151	5755	21.21	20.68	20.56	21.02	26.90	≤ 27.00	Pass
11n-HT40	MCS0	159	5795	21.36	20.86	20.56	20.58	26.87	≤ 27.00	Pass
11ac-VHT20	MCS0	36	5180	17.62	17.48	17.18	17.81	23.55	≤ 27.10	Pass
11ac-VHT20	MCS0	44	5220	21.00	21.10	20.80	20.71	26.93	≤ 27.10	Pass
11ac-VHT20	MCS0	48	5240	21.20	20.75	20.65	20.89	26.90	≤ 27.10	Pass
11ac-VHT20	MCS0	149	5745	20.83	20.18	20.06	20.35	26.39	≤ 27.00	Pass
11ac-VHT20	MCS0	157	5785	21.08	20.41	20.25	20.41	26.57	≤ 27.00	Pass
11ac-VHT20	MCS0	165	5825	20.68	20.28	20.02	20.22	26.33	≤ 27.00	Pass
11ac-VHT40	MCS0	38	5190	15.96	15.58	15.43	15.38	21.61	≤ 27.10	Pass
11ac-VHT40	MCS0	46	5230	20.54	20.52	20.16	20.12	26.36	≤ 27.10	Pass
11ac-VHT40	MCS0	151	5755	21.48	20.65	20.56	20.82	26.91	≤ 27.00	Pass
11ac-VHT40	MCS0	159	5795	21.36	20.77	20.68	20.76	26.92	≤ 27.00	Pass

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Ant 2 Average Power (dBm)	Ant 3 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
11ac-VHT80	MCS0	42	5210	15.84	15.36	15.04	15.41	21.44	≤ 27.10	Pass
11ac-VHT80	MCS0	155	5775	20.08	19.36	19.26	19.65	25.62	≤ 27.00	Pass

Note: The Total Average Power (dBm) = $10*\log\{10^{(\text{Ant 0 Average Power }/10)}+10^{(\text{Ant 1 Average Power }/10)}+10^{(\text{Ant 2 Average Power }/10)}+10^{(\text{Ant 3 Average Power }/10)}\}$.

7.5. Transmit Power Control

7.5.1.Test Limit

The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm.

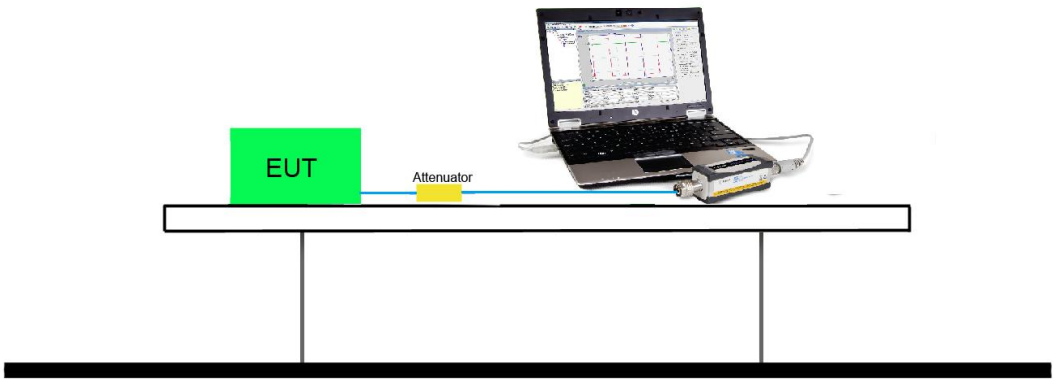
7.5.2.Test Procedure Used

KDB 789033 D02v01- Section E)3)b) Method PM-G

7.5.3.Test Setting

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.5.4.Test Setup



7.5.5.Test Result

Not Applicant.

7.6. Power Spectral Density Measurement

7.6.1.Test Limit

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If transmitting antennas of directional gain greater than 6dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

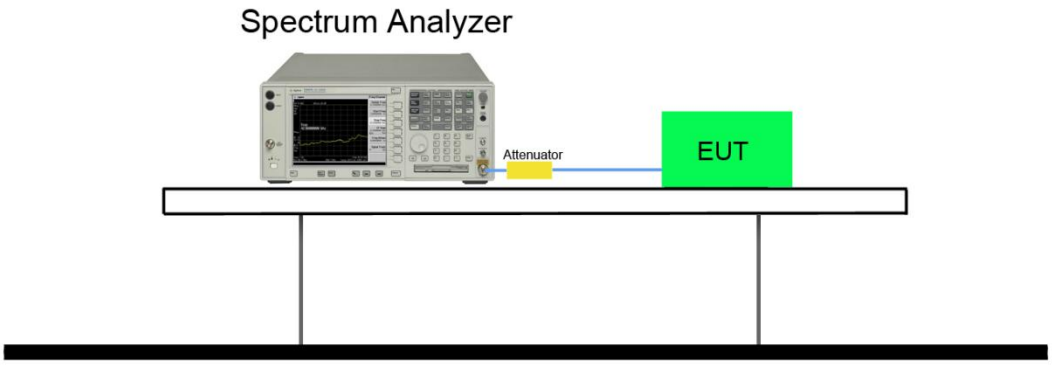
7.6.2.Test Procedure Used

KDB 789033 D02v01r04-SectionF

7.6.3.Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz, RBW = 100 kHz
4. VBW = 3MHz
5. Number of sweep points ≥ 2 × (span / RBW)
6. Detector = power averaging (Average)
7. Sweep time = auto
8. Trigger = free run
9. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
10. Add 10*log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10*log(1/0.25) = 6 dB if the duty cycle is 25 percent.
11. When the measurement bandwidth of Maximum PSD is specified in 500 kHz, add a constant factor 10*log(500kHz/100kHz) = 6.99 dB to the measured result.

7.6.4.Test Setup



7.6.5.Test Result

Product	804Mesh Dual Wi-Fi	Temperature	24°C
Test Engineer	Roy Cheng	Relative Humidity	59%
Test Site	TR3	Test Date	2017/09/20
Test Item	Power Spectral Density (UNII-Band 1)		

Test Mode	Data Rate / MCS	Channel No.	Freq. (MHz)	Ant 0 PSD (dBm/ MHz)	Ant 1 PSD (dBm/ MHz)	Ant 2 PSD (dBm/ MHz)	Ant 3 PSD (dBm/ MHz)	Duty Cycle (%)	Total PSD (dBm/ MHz)	Limit (dBm/MHz)	Result
11a	6Mbps	36	5180	5.06	4.77	4.87	4.40	89.38	11.29	≤ 14.10	Pass
11a	6Mbps	44	5220	6.91	7.04	7.72	7.64	89.38	13.85	≤ 14.10	Pass
11a	6Mbps	48	5240	6.61	6.67	7.60	7.66	89.38	13.67	≤ 14.10	Pass
11n-HT20	MCS0	36	5180	5.56	5.30	5.12	5.30	98.41	11.34	≤ 14.10	Pass
11n-HT20	MCS0	44	5220	7.51	7.49	7.37	7.21	98.41	13.42	≤ 14.10	Pass
11n-HT20	MCS0	48	5240	7.75	7.61	7.53	7.39	98.41	13.59	≤ 14.10	Pass
11n-HT40	MCS0	38	5190	1.64	1.28	0.80	1.05	97.76	7.32	≤ 14.10	Pass
11n-HT40	MCS0	46	5230	6.48	6.02	6.40	6.12	97.76	12.38	≤ 14.10	Pass
11ac-VHT20	MCS0	36	5180	5.90	5.48	5.54	5.47	99.00	11.62	≤ 14.10	Pass
11ac-VHT20	MCS0	44	5220	8.23	7.91	7.92	7.83	99.00	14.00	≤ 14.10	Pass
11ac-VHT20	MCS0	48	5240	8.01	8.24	7.83	7.68	99.00	13.97	≤ 14.10	Pass
11ac-VHT40	MCS0	38	5190	1.64	0.77	0.90	1.06	97.58	7.23	≤ 14.10	Pass
11ac-VHT40	MCS0	46	5230	6.09	6.17	6.03	6.13	97.58	12.23	≤ 14.10	Pass
11ac-VHT80	MCS0	42	5210	-0.62	-1.49	-1.22	-1.38	94.91	5.08	≤ 14.10	Pass

Note 1: When EUT duty cycle < 98%, the total PSD = $10*\log\{10^{(\text{Ant 0 PSD}/10)}+10^{(\text{Ant 1 PSD}/10)}+10^{(\text{Ant 2 PSD}/10)}+10^{(\text{Ant 3 PSD}/10)}\} + 10*\log(1/\text{duty cycle})$

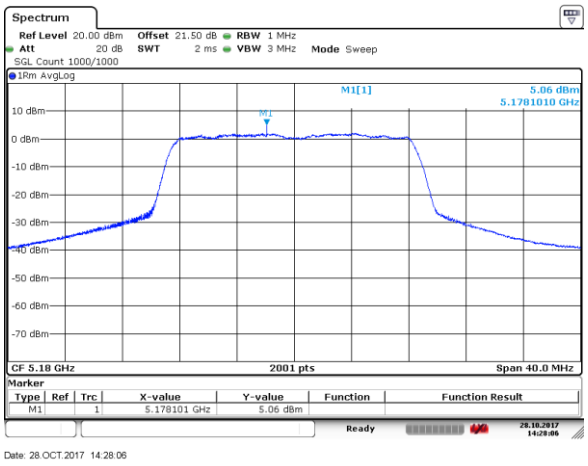
Note 2: When EUT duty cycle > 98%, the total PSD = $10*\log\{10^{(\text{Ant 0 PSD}/10)}+10^{(\text{Ant 1 PSD}/10)}+10^{(\text{Ant 2 PSD}/10)}+10^{(\text{Ant 3 PSD}/10)}\} + 10*\log(1/\text{duty cycle})$

Test Mode	Data Rate / MCS	Freq. (MHz)	Ant 0 PSD (dBm/ 100kHz)	Ant 1 PSD (dBm/ 100kHz)	Ant 2 PSD (dBm/ 100kHz)	Ant 3 PSD (dBm/ 100kHz)	Duty Cycle (%)	Constant Factor	Total PSD (dBm/ 500kHz)	Limit (dBm/ 500kHz)	Result
11a	6Mbps	5745	1.67	0.63	1.73	0.59	89.38	6.99	14.69	≤ 27.00	Pass
11a	6Mbps	5785	1.55	1.05	0.45	1.08	89.38	6.99	14.55	≤ 27.00	Pass
11a	6Mbps	5825	1.53	0.78	0.85	0.69	89.38	6.99	14.47	≤ 27.00	Pass
11n-HT20	MCS0	5745	0.35	-0.03	-0.38	0.17	98.41	6.99	13.05	≤ 27.00	Pass
11n-HT20	MCS0	5785	0.73	0.09	-0.14	-0.09	98.41	6.99	13.17	≤ 27.00	Pass
11n-HT20	MCS0	5825	0.45	0.35	0.14	-0.15	98.41	6.99	13.21	≤ 27.00	Pass
11n-HT40	MCS0	5755	-1.87	-2.43	-2.39	-2.45	97.76	6.99	10.83	≤ 27.00	Pass
11n-HT40	MCS0	5795	-1.90	-2.75	-2.45	-2.92	97.76	6.99	10.62	≤ 27.00	Pass
11ac-VHT20	MCS0	5745	0.63	-0.13	-0.10	-0.04	99.00	6.99	13.11	≤ 27.00	Pass
11ac-VHT20	MCS0	5785	0.79	-0.06	0.09	0.15	99.00	6.99	13.27	≤ 27.00	Pass
11ac-VHT20	MCS0	5825	0.26	0.43	-0.23	0.18	99.00	6.99	13.18	≤ 27.00	Pass
11ac-VHT40	MCS0	5755	-1.92	-2.86	-2.34	-2.45	97.58	6.99	10.74	≤ 27.00	Pass
11ac-VHT40	MCS0	5795	-2.15	-2.60	-2.59	-2.83	97.58	6.99	10.58	≤ 27.00	Pass
11ac-VHT80	MCS0	5775	-6.42	-5.94	-6.82	-6.60	94.91	6.99	6.80	≤ 27.00	Pass

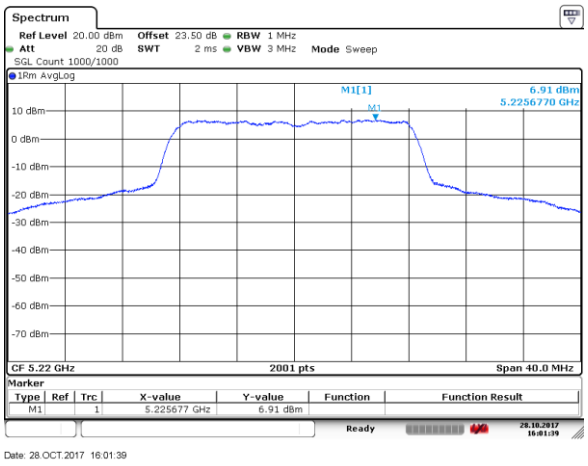
Note: When EUT duty cycle < 98%, the total PSD = $10*\log\{10^{(\text{Ant 0 PSD}/10)}+10^{(\text{Ant 1 PSD}/10)}+10^{(\text{Ant 2 PSD}/10)}+10^{(\text{Ant 3 PSD}/10)}\}$ + 10*log(1/duty cycle) + Constant Factor.

802.11a Power Spectral Density - Ant 0 / Ant 0 + 1 + 2 + 3

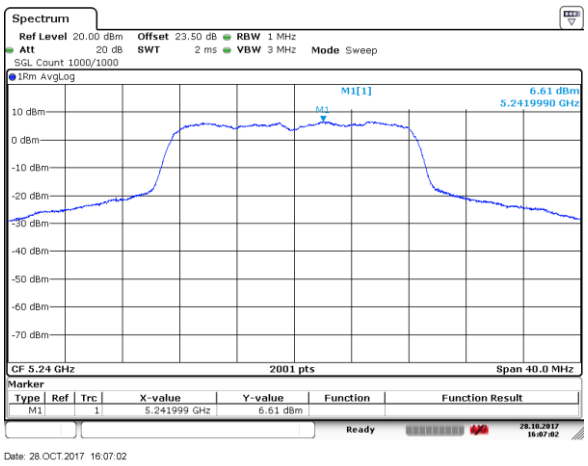
Channel 36 (5180MHz)



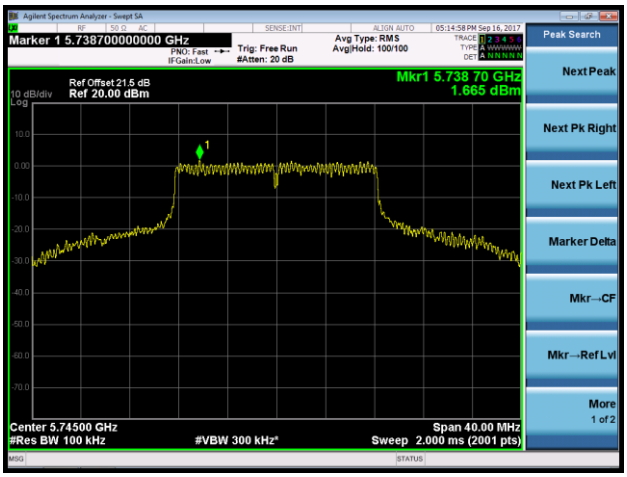
Channel 44 (5220MHz)



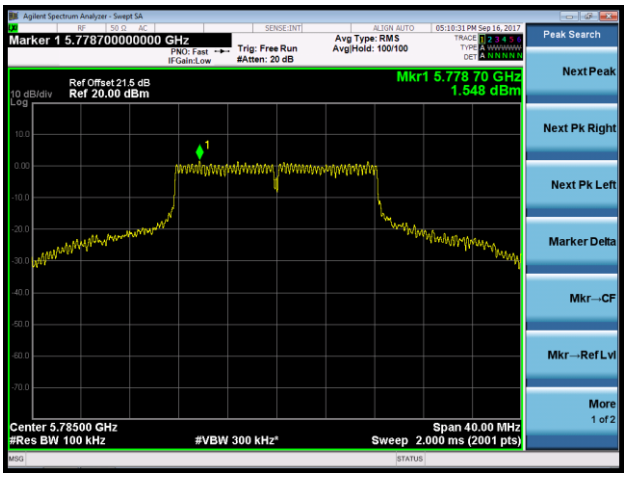
Channel 48 (5240MHz)



Channel 149 (5745MHz)



Channel 157 (5785MHz)



Channel 165 (5825MHz)