FCC REPORT

Applicant:	FN-LINK TECHNOLOGY LIMITED
Address of Applicant:	No. 8, Litong Road, Liuyang Economic Development Zone, Liuyang, China
Manufacturer/ Factory:	FN-LINK TECHNOLOGY LIMITED
Address of Manufacturer/ Factory:	No. 8, Litong Road, Liuyang Economic Development Zone, Liuyang, China

Equipment Under Test (EUT)

Product Name:	Wi-Fi Dual-band 2X2 11ac +Bluetooth V4.2 Module
Model No.:	6222D-UUB
Trade Mark:	FN-LINK
FCC ID:	2AATL-6222D-UUB
Applicable standards:	FCC CFR Title 47 Part 15 Subpart E Section 15.407
Date of sample receipt:	June 19, 2018
Date of Test:	June 19, 2018~ July 11, 2018
Date of report issue:	July 12, 2018
Test Result :	PASS *

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Robinson Lo
Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	*July 12, 2018*	*Original*

Prepared By: ***Date:*** *July 12, 2018*

Project Engineer

Check By: ***Date:*** *July 12, 2018*

Reviewer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	Subpart C 15.203	PASS
AC Power Line Conducted Emission	Subpart C 15.207 & Subpart E 15.407 b(6)	PASS
Maximum Conducted Output Power	Subpart E 15.407(a)	PASS
99% Bandwidth	Subpart E 15.407	PASS
26dB Emission bandwidth	Subpart E 15.407(a)	PASS
Power Spectral Density	Subpart E 15.407(a)	PASS
Undesirable Emission	Subpart E 15.407(b)(6), Subpart C 15.205/15.209	PASS
Radiated Emission	Subpart C 15.209 & Subpart E15.407(b)	PASS
Band Edge	Subpart C 15.205 & Subpart E 15.407(b)	PASS
Frequency Stability	Subpart E 15.407(g)	PASS

Remark: Test according to ANSI C63.10:2013.

Pass: The EUT complies with the essential requirements in the standard.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	± 4.34dB	(1)
Radiated Emission	30MHz ~ 1000MHz	± 4.24dB	(1)
Radiated Emission	1GHz ~ 40GHz	± 4.68dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	± 3.45dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Name:	Wi-Fi Dual-band 2X2 11ac +Bluetooth V4.2 Module
Model No.:	6222D-UUB
Serial No.:	FN6222DUUB00001
Test sample(s) ID:	GTS201806000179-1
Sample(s) Status:	Engineer sample
Hardware version:	1.0
Software version:	1.0
Operation Frequency:	

Band	Mode	Frequency Range(MHz)	Number of channels
U-NII Band I	IEEE 802.11a	5180-5240	4
	IEEE 802.11n/ac 20MHz	5180-5240	4
	IEEE 802.11n/ac 40MHz	5190-5230	2
	IEEE 802.11ac 80MHz	5210	1
U-NII Band II-A	IEEE 802.11a	5260-5320	4
	IEEE 802.11n/ac 20MHz	5260-5320	4
	IEEE 802.11n/ac 40MHz	5270-5310	2
	IEEE 802.11ac 80MHz	5290	1
U-NII Band II-C	IEEE 802.11a	5500-5700	11
	IEEE 802.11n/ac 20MHz	5500-5700	11
	IEEE 802.11n/ac 40MHz	5510-5670	5
	IEEE 802.11ac 80MHz	5530-5610	2

Modulation technology:	IEEE 802.11a: OFDM(BPSK/QPSK/16QAM/64QAM) IEEE 802.11n: OFDM(BPSK/QPSK/16QAM/64QAM) IEEE 802.11ac: OFDM (BPSK/QPSK/16QAM/64QAM/256QAM)	
Antenna Type:	Chain A	PIFA Antenna
	Chain B	PIFA Antenna
Antenna gain:	Chain A	5150 MHz to 5250 MHz: 3.79dBi
		5250 MHz to 5350 MHz: 3.83dBi
		5470 MHz to 5725 MHz: 4.14dBi
	Chain B	5150 MHz to 5250 MHz: 3.79dBi
		5250 MHz to 5350 MHz: 3.83dBi
		5470 MHz to 5725 MHz: 4.14dBi
Directional gain	5150 MHz to 5250 MHz:	6.80dBi
	5250 MHz to 5350 MHz:	6.84dBi
	5470 MHz to 5725 MHz:	7.15dBi
Normal Test Voltage:	DC 3.3V	
Extreme Test Voltage	Min.: DC 3.15V,Max.: 3.45V	
Extreme Test Temperature	-10℃~70℃	

Channel list for 802.11a/n(HT20)/ac(HT20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180MHz	40	5200MHz	44	5220MHz	48	5240MHz
52	5260MHz	56	5280MHz	60	5300MHz	64	5320MHz
100	5500MHz	104	5520MHz	108	5540MHz	112	5560MHz
116	5580MHz	120	5600MHz	124	5620MHz	128	5640MHz
132	5660MHz	136	5680MHz	140	5700MHz		

Channel list for 802.11n(HT40)/ac(HT40)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
38	5190MHz	46	5230MHz	54	5270MHz	62	5310MHz
102	5510MHz	110	5550MHz	118	5590MHz	126	5630MHz
134	5670MHz						

Channel list for 802.11ac(HT80)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
42	5210MHz	58	5290MHz	106	5530MHz	122	5610MHz

Selected Test Channel for 802.11a/n(HT20)/ac(HT20)		
Band	Channel	Frequency
U-NII Band I	The lowest channel (CH36)	5180MHz
	The middle channel (CH40)	5200MHz
	The highest channel (CH48)	5240MHz
U-NII Band II-A	The lowest channel (CH52)	5260MHz
	The middle channel (CH60)	5300MHz
	The highest channel (CH64)	5320MHz
U-NII Band II-C	The lowest channel (CH100)	5500MHz
	The middle channel (CH116)	5580MHz
	The highest channel (CH140)	5700MHz

Selected Test Channel for 802.11n(HT40)/ac(HT40)		
Band	Channel	Frequency
U-NII Band I	The lowest channel (CH38)	5190MHz
	The highest channel (CH46)	5230MHz
U-NII Band II-A	The lowest channel (CH54)	5270MHz
	The highest channel (CH62)	5310MHz
U-NII Band II-C	The lowest channel (CH102)	5510MHz
	The middle channel (CH110)	5550MHz
	The highest channel (CH134)	5670MHz

Selected Test Channel for 802.11ac(HT80)		
Band	Channel	Frequency
U-NII Band I	One channel (CH42)	5210MHz
U-NII Band II-A	One channel(CH58)	5290MHz
U-NII Band II-C	The lowest channel (CH106)	5530MHz
	The highest channel (CH122)	5610MHz

5.2 Test mode

Transmitting mode	Keep the EUT in transmitting with modulation. EUT was test with 99% duty cycle at its maximum power control level.
Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Pre-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

Mode	Data rate
802.11a	6 Mbps
802.11n(HT20)	6.5 Mbps
802.11n(HT40)	13.5 Mbps
802.11ac(VHT20)	6.5 Mbps
802.11ac(VHT40)	13.5 Mbps
802.11ac(VHT80)	29.3 Mbps

Keep the EUT in continuously transmitting or receiving with modulation test single.

Mode	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (VHT20)	802.11ac (VHT40)	802.11ac (VHT80)
TX/RX Function	2TX/2RX	2TX/2RX	2TX/2RX	2TX/2RX	2TX/2RX	2TX/2RX

5.3 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383, January 08, 2018.

● **Industry Canada (IC) —Registration No.: 9079A-2**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. Has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2, August 15, 2016.

5.4 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, sBaoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

5.5 Description of Support Units

Manufacturer	Description	Model	Serial Number
IBM Thinkpad	Notebook PC	2374	L3-G0686
Fn-link	Auxiliary PCB	N/A	N/A

5.6 Deviation from Standards

None.

5.7 Abnormalities from Standard Conditions

None.

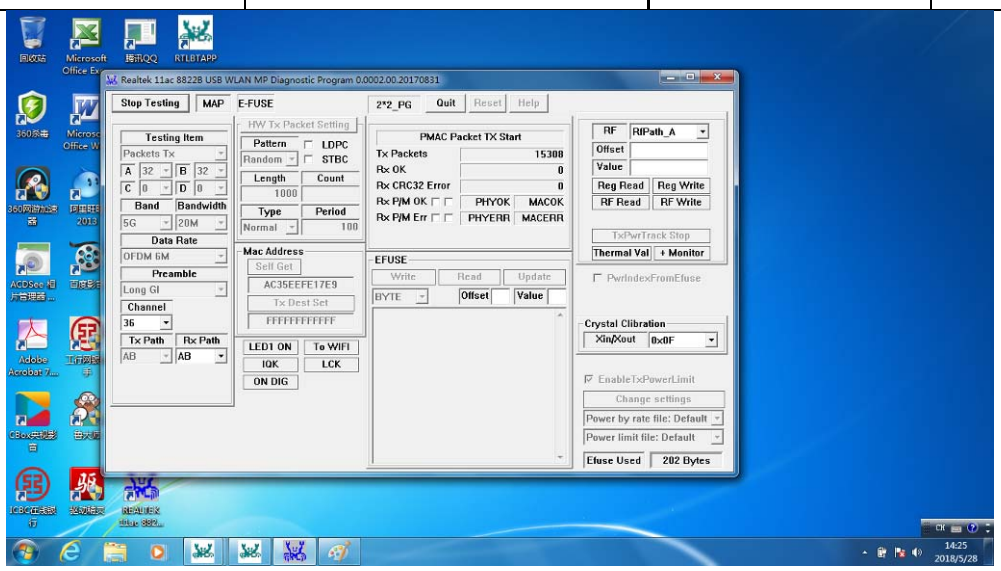
5.8 Other Information Requested by the Customer

None.

5.9 Additional Instructions

EUT Software Settings:

Mode	Special software is used. The software provided by client to enable the EUT under transmission condition continuously at specific channel frequencies individually.		
Test Software Name	Realtek 11ac 8822B USB WLAN MP Diagnostic Program 0.0002.00.20170831		
Mode	Channel	Frequency (MHz)	Soft Set
OFDM	CH36	5180	TX level : default
	CH38	5190	
	CH40	5200	
	CH42	5210	
	CH46	5230	
	CH48	5240	
	CH52	5260	
	CH54	5270	
	CH58	5290	
	CH60	5300	
	CH62	5310	
	CH64	5320	
	CH100	5500	
	CH102	5510	
	CH106	5530	
	CH110	5550	
	CH116	5580	
	CH122	5610	
	CH134	5670	
	CH140	5700	



6 Test Instruments list

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 27 2018	June. 26 2019
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 27 2018	June. 26 2019
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 27 2018	June. 26 2019
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 27 2018	June. 26 2019
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 27 2018	June. 26 2019
9	Coaxial Cable	GTS	N/A	GTS211	June. 27 2018	June. 26 2019
10	Coaxial cable	GTS	N/A	GTS210	June. 27 2018	June. 26 2019
11	Coaxial Cable	GTS	N/A	GTS212	June. 27 2018	June. 26 2019
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 27 2018	June. 26 2019
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 27 2018	June. 26 2019
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 27 2018	June. 26 2019
15	Band filter	Amindeon	82346	GTS219	June. 27 2018	June. 26 2019
16	Power Meter	Anritsu	ML2495A	GTS540	June. 27 2018	June. 26 2019
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 27 2018	June. 26 2019
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 27 2018	June. 26 2019
19	Splitter	Agilent	11636B	GTS237	June. 27 2018	June. 26 2019
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 27 2018	June. 26 2019

Conducted Emission						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.16 2014	May.15 2019
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 27 2018	June. 26 2019
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 27 2018	June. 26 2019
4	Artificial Mains Network	SCHWARZBECK MESS	NSLK8127	GTS226	June. 27 2018	June. 26 2019
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 27 2018	June. 26 2019
8	Absorbing clamp	Elektronik-Feinmechanik	MDS21	GTS229	June. 27 2018	June. 26 2019

General used equipment:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 27 2018	June. 26 2019
2	Barometer	ChangChun	DYM3	GTS255	June. 27 2018	June. 26 2019

7 Test results and Measurement Data

7.1 Antenna requirement:

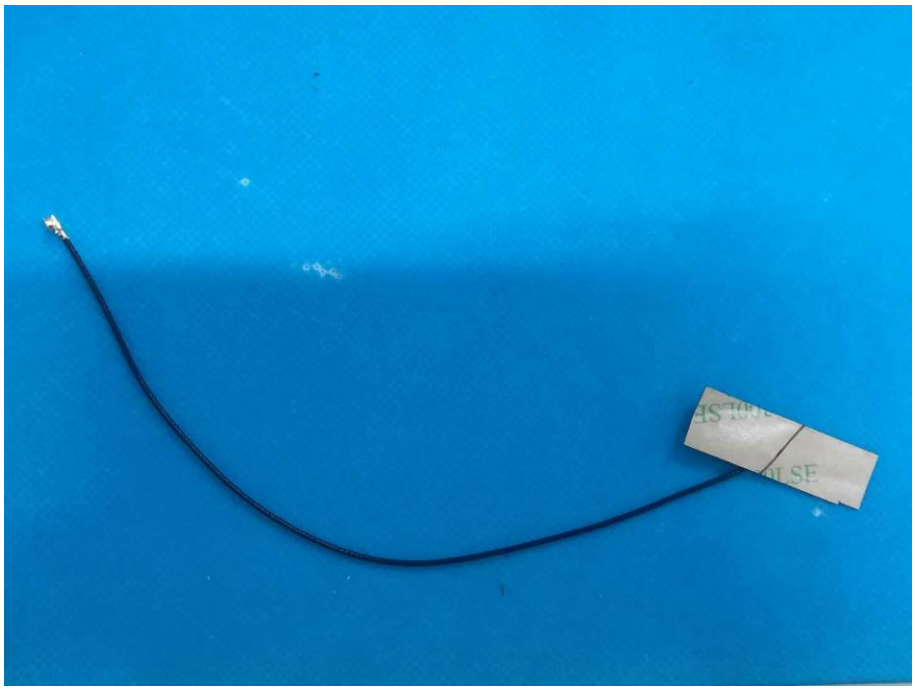
Standard requirement:	47 CFR Part 15, Subpart C 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
E.U.T Antenna:	

Frequency range and Max Gain:

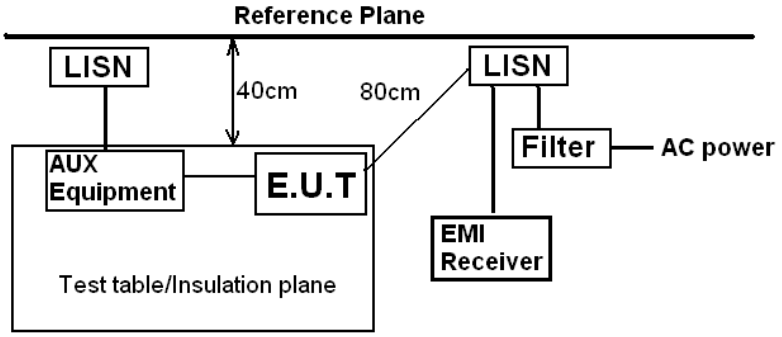
5150MHz~5250MHz: 3.79dBi, Directional gain: 6.80dBi.

5250MHz~5350MHz: 3.83dBi, Directional gain: 6.84dBi.

5470MHz~5725MHz: 4.14dBi, Directional gain: 7.15dBi.



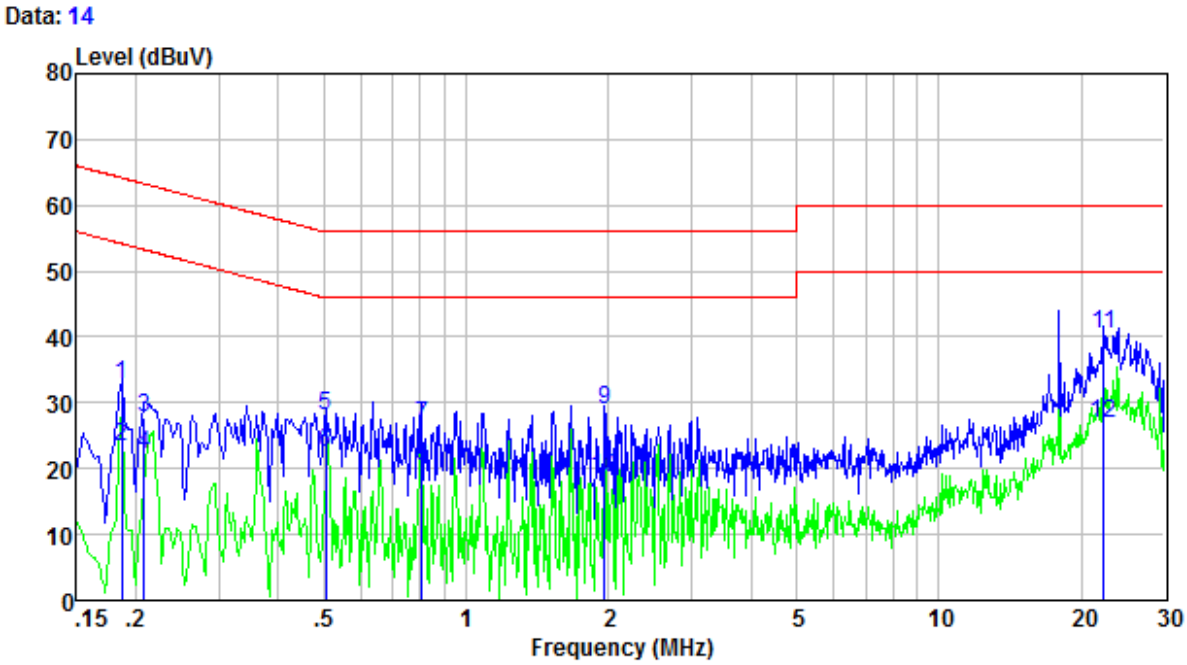
7.2 Conducted Emissions

Test Requirement:	47 CFR Part 15, Subpart C 15.207 & Subpart E 15.407 b(6)
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Class / Severity:	Class B
Receiver setup:	RBW=9KHz, VBW=30KHz
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 * Decreases with the logarithm of the frequency.
Test procedure	The E.U.T and simulators are connected to the main power through a line impedance stabilization network(L.I.S.N.). The provide a 50ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs). Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.
Test setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

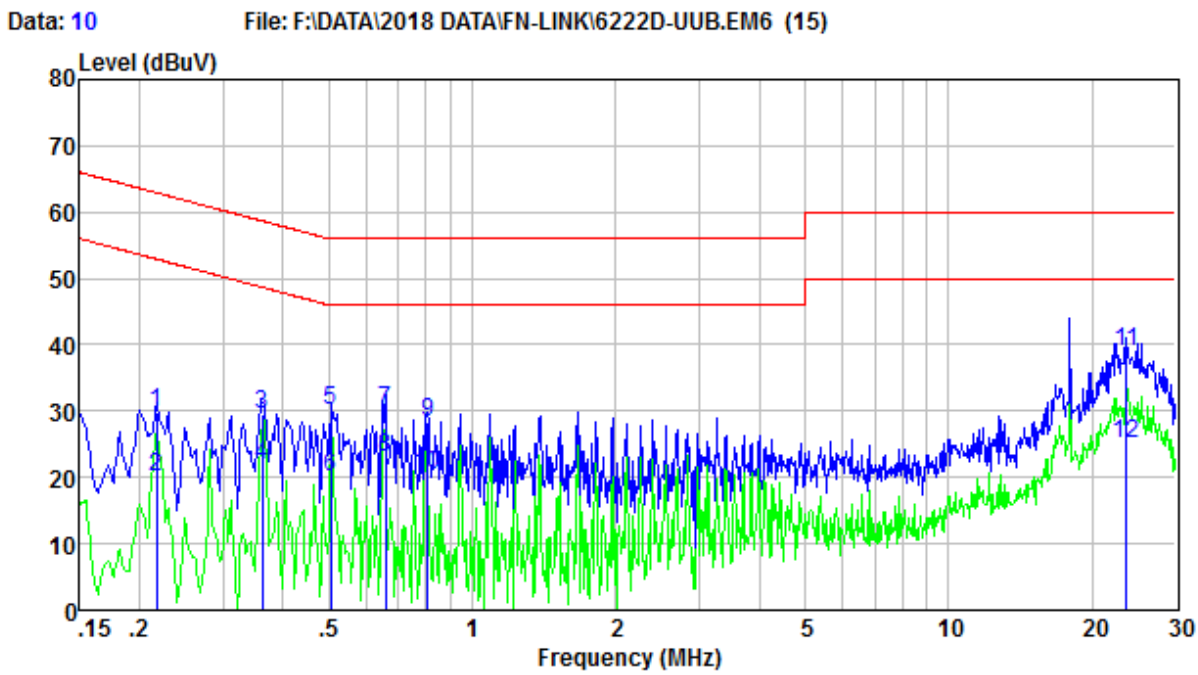
An initial pre-scan was performed on the line and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Line:



Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.186	23.10	9.56	0.02	32.68	64.20	-31.52	QP
0.186	13.70	9.56	0.02	23.28	54.20	-30.92	Average
0.208	18.20	9.56	0.01	27.77	63.27	-35.50	QP
0.208	12.70	9.56	0.01	22.27	53.27	-31.00	Average
0.505	18.30	9.58	0.02	27.90	56.00	-28.10	QP
0.505	12.70	9.58	0.02	22.30	46.00	-23.70	Average
0.804	16.90	9.59	0.03	26.52	56.00	-29.48	QP
0.804	10.60	9.59	0.03	20.22	46.00	-25.78	Average
1.959	19.30	9.59	0.03	28.92	56.00	-27.08	QP
1.959	9.10	9.59	0.03	18.72	46.00	-27.28	Average
22.298	30.40	9.86	0.05	40.31	60.00	-19.69	QP
22.298	17.10	9.86	0.05	27.01	50.00	-22.99	Average

Neutral:

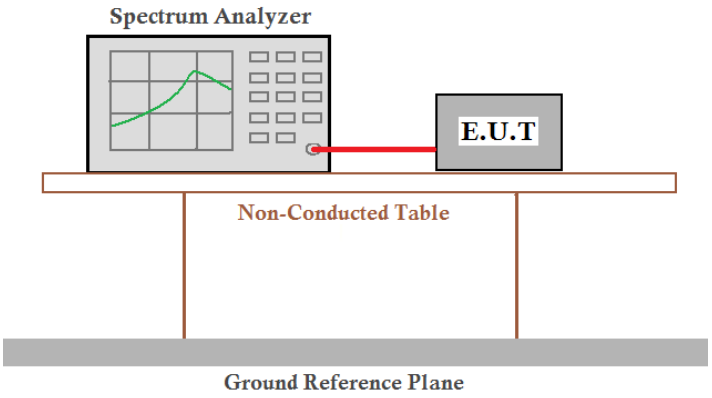


Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.217	20.10	9.58	0.01	29.69	62.92	-33.23	QP
0.217	10.60	9.58	0.01	20.19	52.92	-32.73	Average
0.361	19.79	9.62	0.02	29.43	58.69	-29.26	QP
0.361	12.29	9.62	0.02	21.93	48.69	-26.76	Average
0.505	20.50	9.63	0.02	30.15	56.00	-25.85	QP
0.505	10.40	9.63	0.02	20.05	46.00	-25.95	Average
0.658	20.39	9.64	0.03	30.06	56.00	-25.94	QP
0.658	13.39	9.64	0.03	23.06	46.00	-22.94	Average
0.804	18.81	9.64	0.03	28.48	56.00	-27.52	QP
0.804	10.71	9.64	0.03	20.38	46.00	-25.62	Average
23.636	29.10	9.93	0.04	39.07	60.00	-20.93	QP
23.636	15.10	9.93	0.04	25.07	50.00	-24.93	Average

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level =Receiver Read level + LISN Factor + Cable Loss

7.3 Emission Bandwidth and 99% Occupied Bandwidth

Test Requirement:	47 CFR Part 15, Subpart E 15.407
Test Method:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	N/A
Test setup:	
Test procedure:	According to KDB 789033 D02 General U-NII Test Procedures New Rules v02r01.
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data:

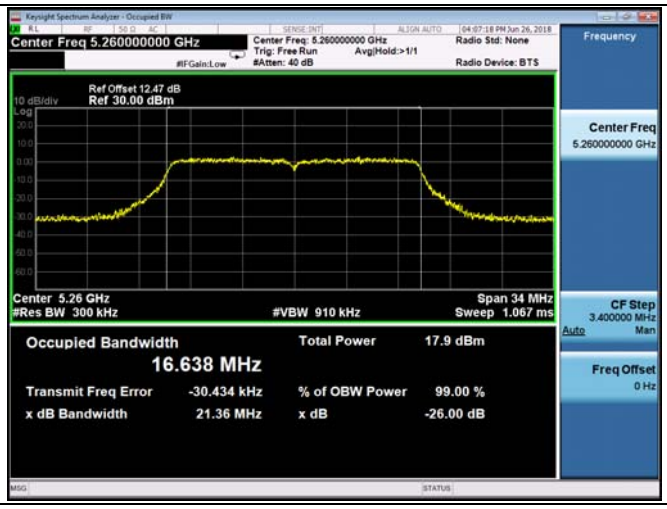
U-NII Band I_MIMO							
The worst case test data: Chain A							
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11a	**802.11n(HT 20)**	**802.11ac(VHT20)**	**802.11a**	**802.11n(HT 20)**	**802.11ac(VHT20)**
36	5180.00	16.650	17.630	17.686	21.11	21.19	21.39
40	5200.00	16.641	17.651	17.669	20.96	21.16	21.12
48	5240.00	16.644	17.659	17.673	20.95	21.71	21.53
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11n(HT40)	**802.11ac(VHT40)**		**802.11n(HT40)**	**802.11ac(VHT40)**	
38	5190.00	36.533	36.421		43.16	46.03	
46	5230.00	36.496	36.497		44.21	43.74	
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11ac(VHT80)			**802.11ac(VHT80)**		
42	5210.00	75.597			115.5		

U-NII Band II-A_MIMO							
The worst case test data: Chain A							
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11a	**802.11n(HT 20)**	**802.11ac(VHT20)**	**802.11a**	**802.11n(HT 20)**	**802.11ac(VHT20)**
52	5260.00	16.638	17.648	17.692	21.36	21.34	21.61
60	5300.00	16.666	17.671	17.714	20.83	22.21	21.26
64	5320.00	16.682	17.655	17.716	21.60	21.33	21.20
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11n(HT40)	**802.11ac(VHT40)**		**802.11n(HT40)**	**802.11ac(VHT40)**	
54	5270.00	36.447	36.544		45.72	48.28	
62	5310.00	36.553	36.552		51.06	48.39	
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11ac(VHT80)			**802.11ac(VHT80)**		
58	5290.00	75.860			128.30		

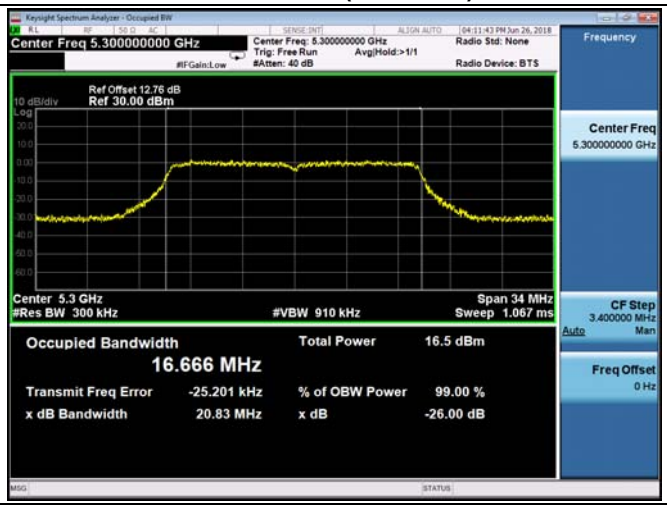
U-NII Band II-C_MIMO							
The worst case test data: Chain 1							
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11a	**802.11n(HT 20)**	**802.11ac(VHT20)**	**802.11a**	**802.11n(HT 20)**	**802.11ac(VHT20)**
100	5500.00	16.713	17.671	17.711	20.93	21.65	21.78
116	5580.00	16.690	17.695	17.720	20.88	22.18	22.99
140	5700.00	16.678	17.661	17.731	21.97	21.56	23.84
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11n(HT40)	**802.11ac(VHT40)**		**802.11n(HT40)**	**802.11ac(VHT40)**	
102	5510.00	36.538	36.582		51.43	54.10	
110	5550.00	36.593	36.635		52.16	59.87	
134	5670.00	36.651	36.653		59.20	56.46	
CH. No.	**Frequency (MHz)**	**99% Occupied Bandwidth (MHz)**			**26dB Occupied Bandwidth (MHz)**		
		802.11ac(VHT80)			**802.11ac(VHT80)**		
106	5530.00	76.035			129.7		
122	5610.00	76.021			129.9		

Test plots as followed:

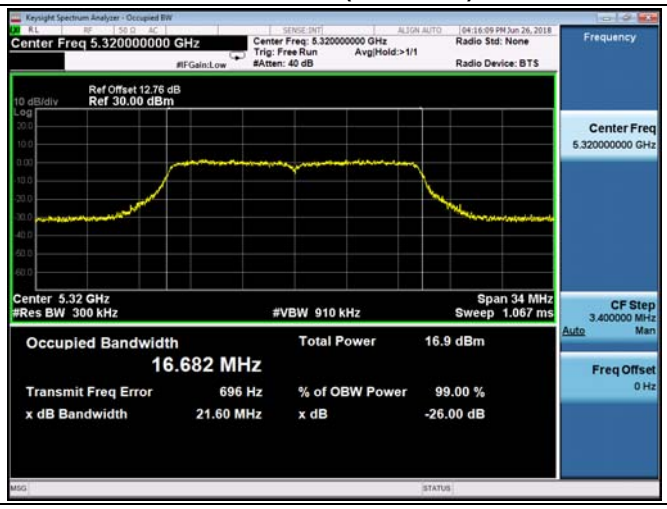
802.11a mode
Channel 36 (5180MHz)
Channel 40 (5200MHz)
Channel 48 (5240MHz)



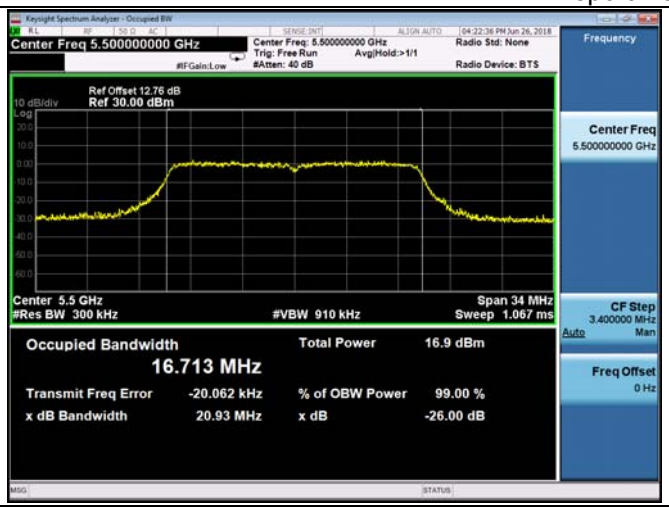
Channel 52 (5260MHz)



Channel 60 (5300MHz)



Channel 64 (5320MHz)

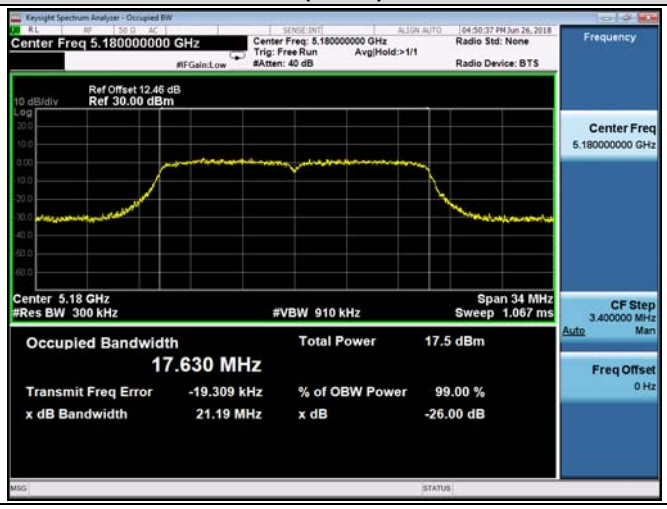


Channel 100 (5500MHz)

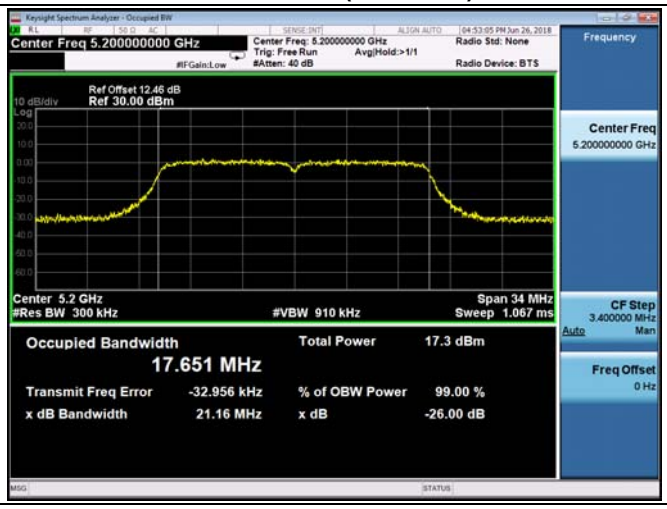
Channel 116 (5580MHz)

Channel 140 (5700MHz)

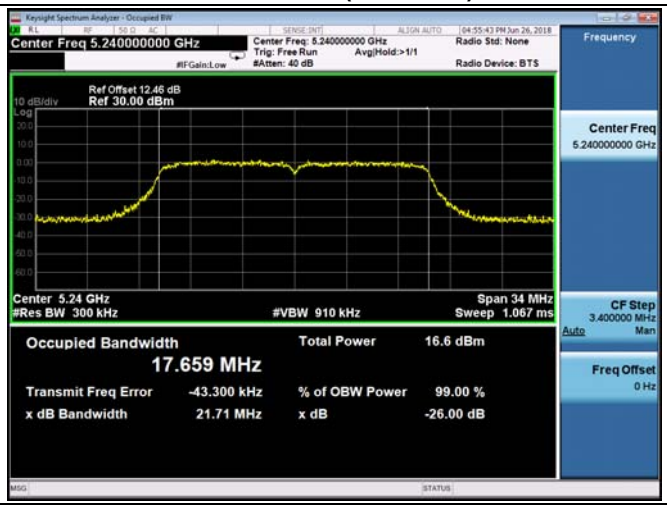
802.11n(HT20) mode



Channel 36 (5180MHz)



Channel 40 (5200MHz)

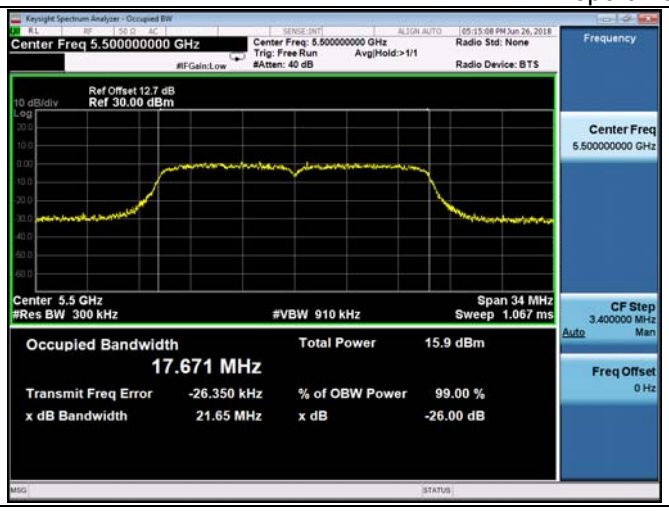


Channel 48 (5240MHz)

Channel 52 (5260MHz)

Channel 60 (5300MHz)

Channel 64 (5320MHz)

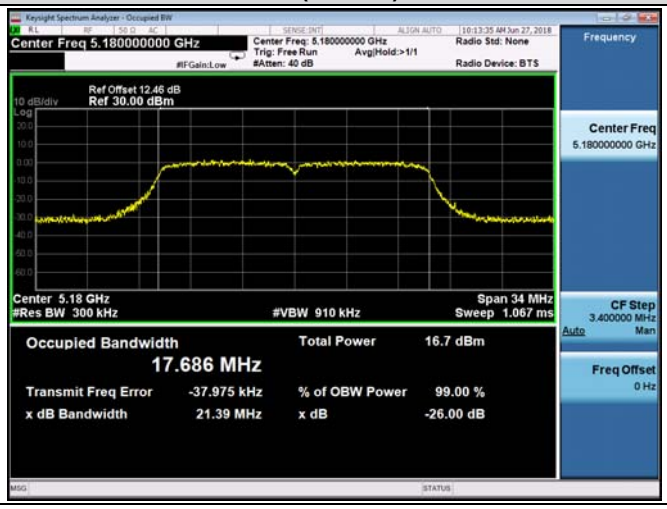


Channel 100 (5500MHz)

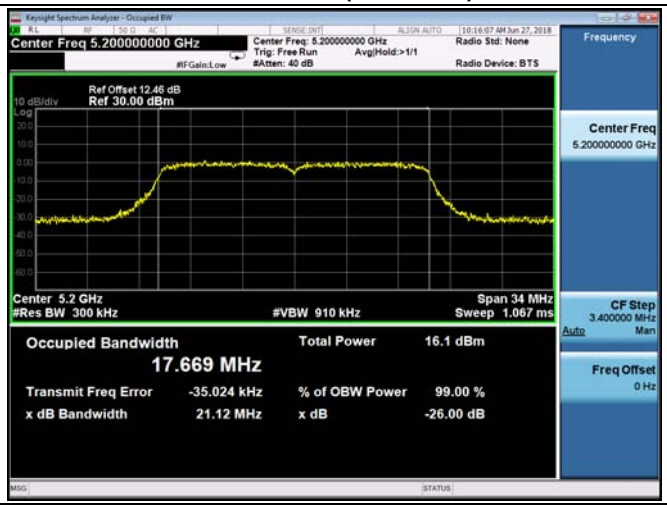
Channel 116 (5580MHz)

Channel 140 (5700MHz)

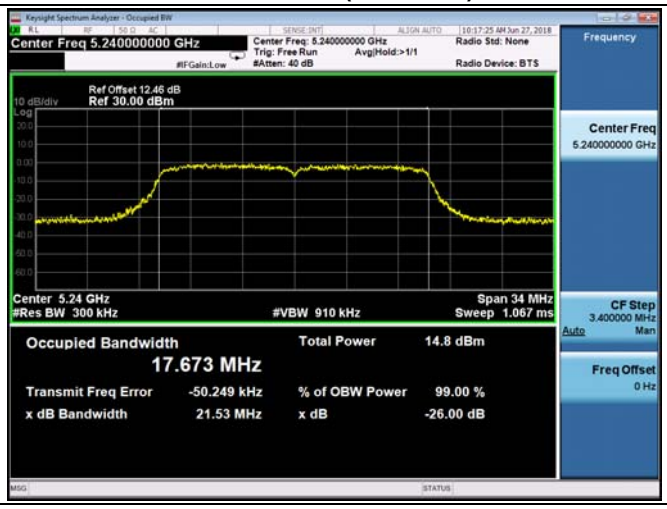
802.11ac(VHT20) mode



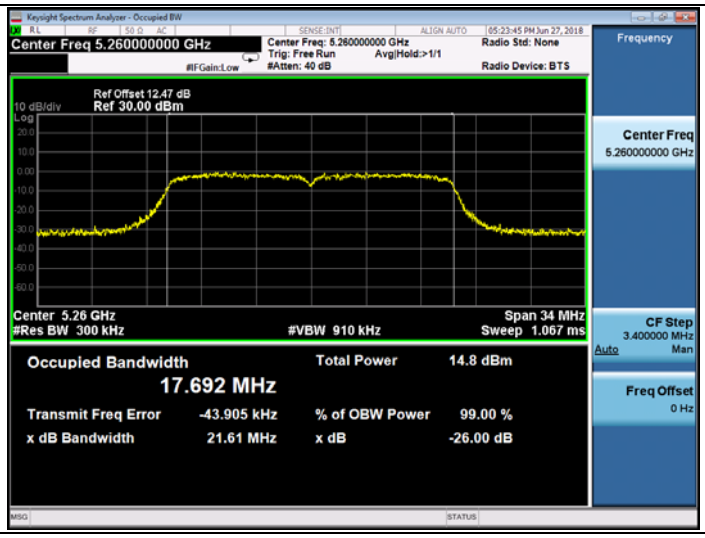
Channel 36 (5180MHz)



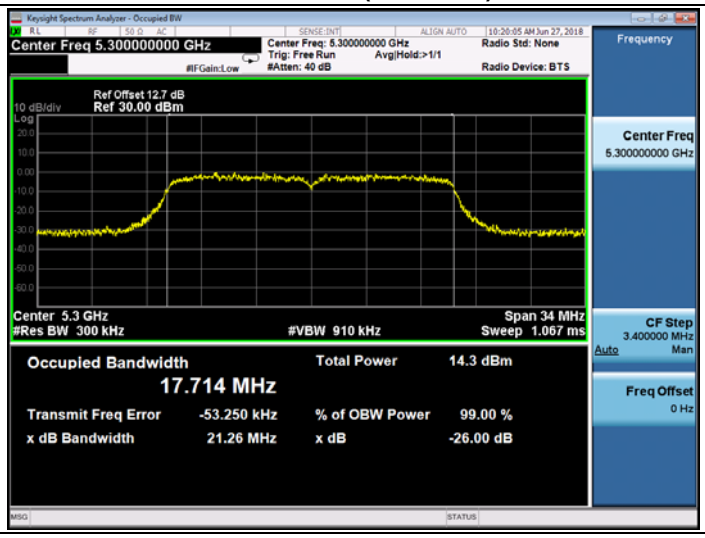
Channel 40 (5200MHz)



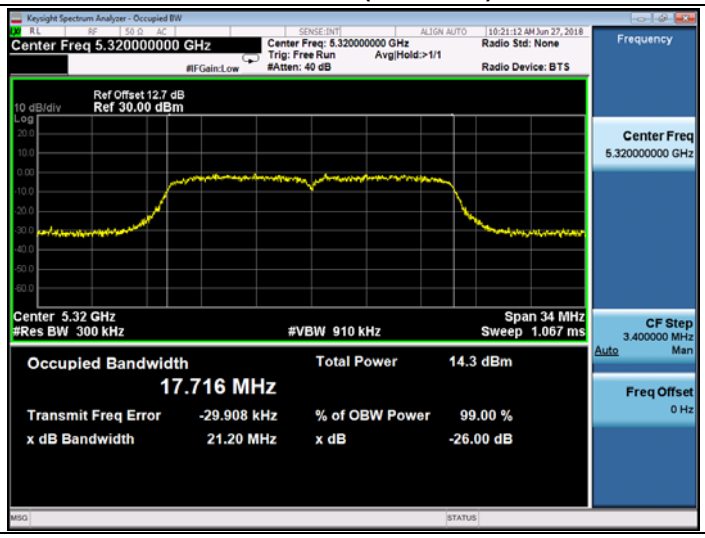
Channel 48 (5240MHz)



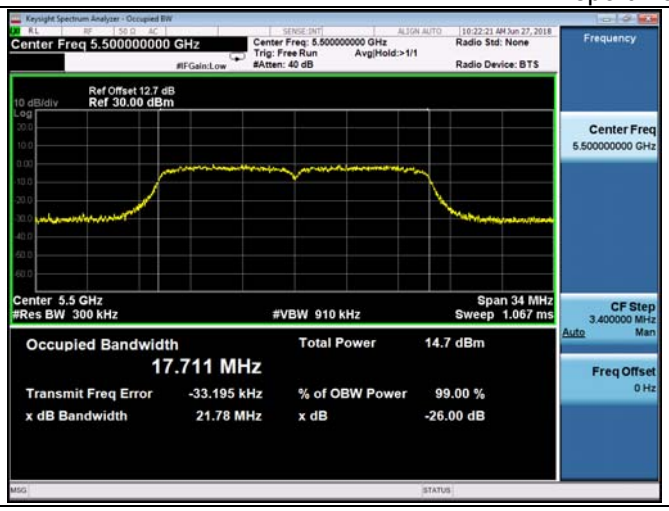
Channel 52 (5260MHz)



Channel 60 (5300MHz)



Channel 64 (5320MHz)



Channel 100 (5500MHz)

Channel 116 (5580MHz)

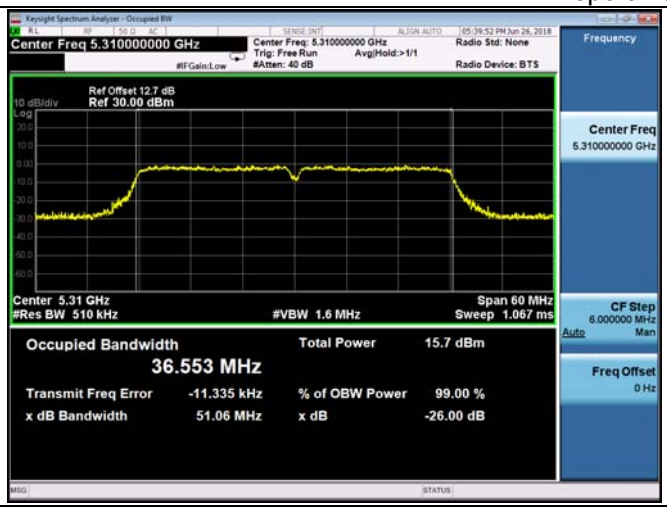
Channel 140 (5700MHz)

802.11n(HT40) mode

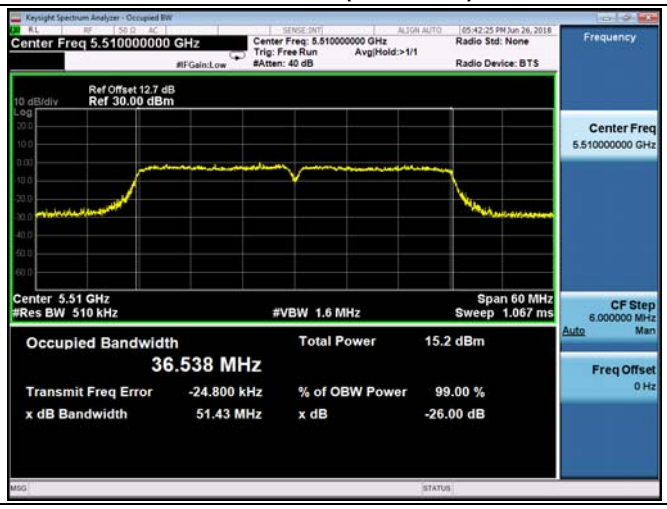
Channel 38 (5190MHz)

Channel 46 (5230MHz)

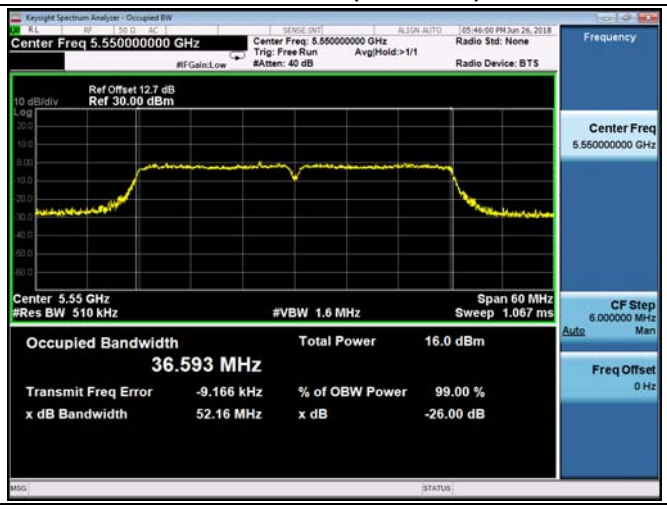
Channel 54 (5270MHz)



Channel 62 (5310MHz)



Channel 102 (5510MHz)



Channel 110 (5550MHz)

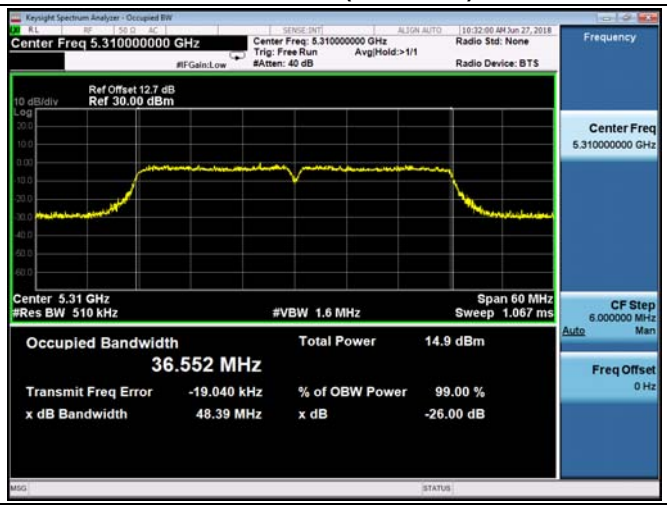
Channel 134 (5670MHz)

802.11ac(VHT40) mode

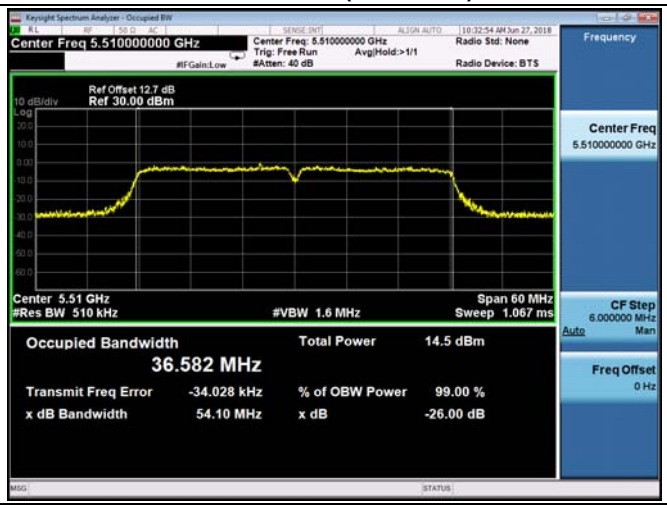
Channel 38 (5190MHz)

Channel 46 (5230MHz)

Channel 54 (5270MHz)



Channel 62 (5310MHz)

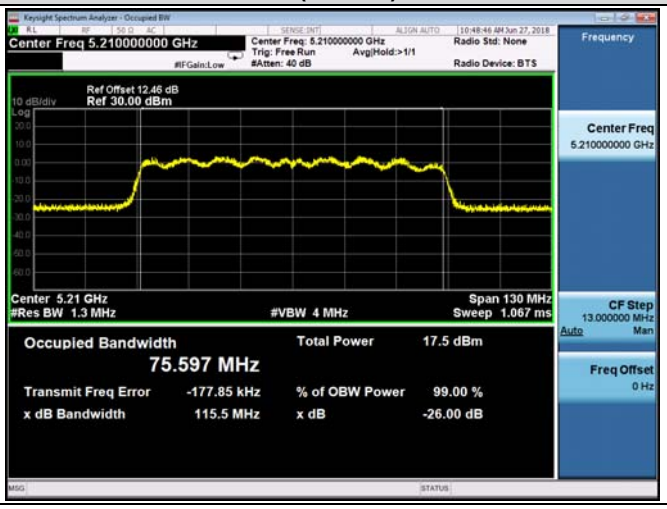


Channel 102 (5510MHz)

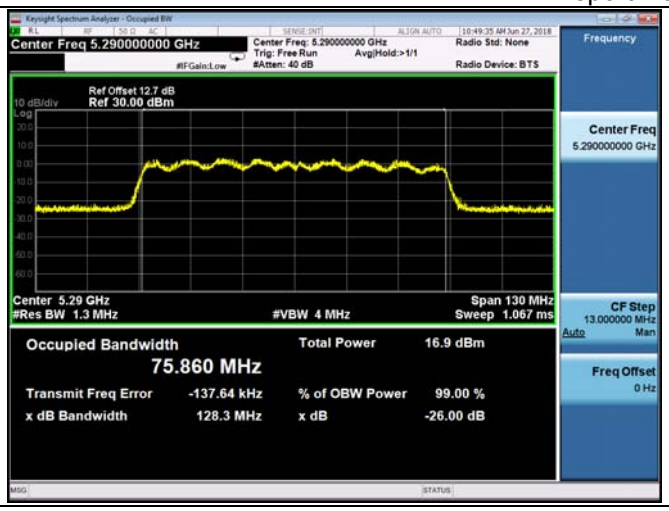
Channel 110 (5550MHz)

Channel 134 (5670MHz)

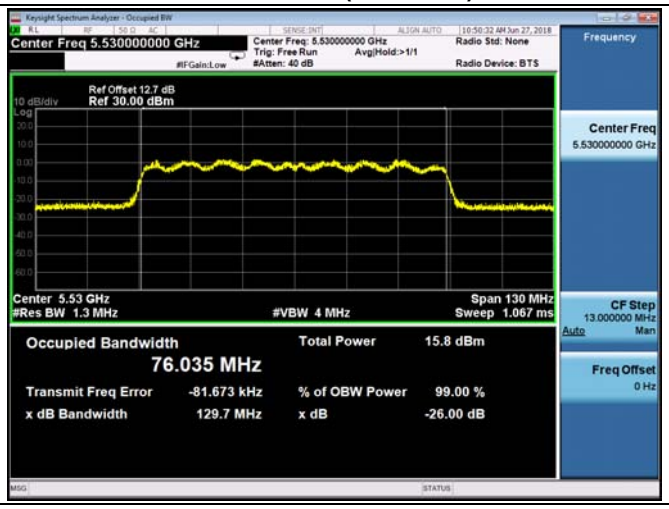
802.11ac(VHT80) mode



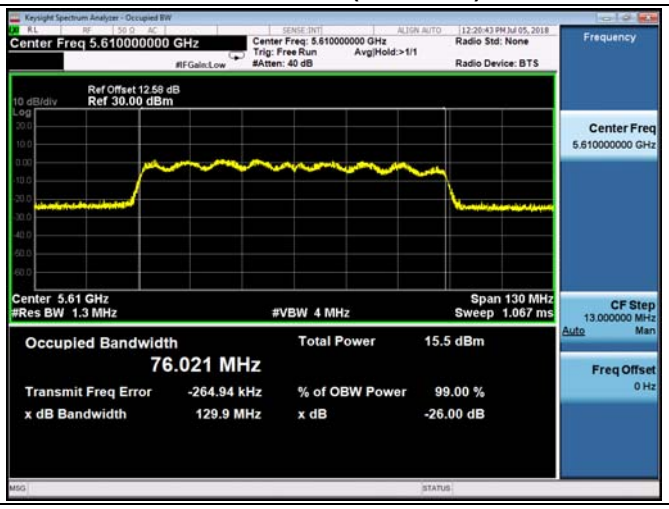
Channel 42 (5210MHz)



Channel 58 (5290MHz)



Channel 106 (5530MHz)



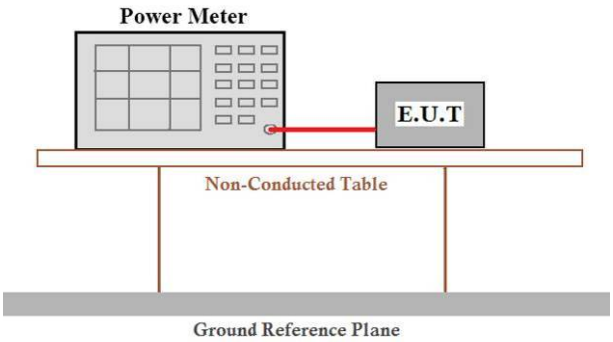
Channel 122 (5610MHz)

7.4 Output Power

Test Requirement:	47 CFR Part 15, Subpart E 15.407 (a)
Test Method:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	

Frequency band (MHz)	Limit
5150-5250	≤1W(30dBm) for master device
	≤250mW(23.98dBm) for client device
5250-5350	≤250mW(23.98dBm) for client device or 11dBm+10logB
5470-5725	≤250mW(23.98dBm) for client dev ce or 11dBm+10lo B*
Remark: *Where B is the 26dB emission bandwidth in MHz. The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.	

Test setup:



Test procedure:

Measurement using an RF average power meter

(i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied

a) The EUT is configured to transmit continuously or to transmit with a constant duty cycle.

b) At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.

c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section B).

(iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(iv) Adjust the measurement in dBm by adding 10 log(1/x) where x is the duty cycle (e.g., 10log(1/0.25) if the duty cycle is 25 percent).

Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Directional gain and the maximum output power limit

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain A Antenna Gain (dBi)	Chain B Antenna Gain (dBi)	Correlated Chains directional gain	Max Conducted Power Limits(dBm)
U-NII-1	3.79	3.79	6.80	23.20
U-NII-2A	3.83	3.83	6.84	23.16
U-NII-2C	4.14	4.14	7.15	22.85
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N ANT transmitter outputs of equal power. Directional gain is to be computed as follows: If any transmit signals are correlated with each other, Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi				

Measurement Data

U-NII Band I

802.11a MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
36	5180.00	11.61	9.73	0.18	13.96	23.20	Pass
40	5200.00	11.12	9.58	0.18	13.61	23.20	Pass
48	5240.00	11.24	11.24	0.18	14.43	23.20	Pass

802.11n(HT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
36	5180.00	10.57	8.68	0.18	12.92	23.20	Pass
40	5200.00	10.55	8.98	0.18	13.03	23.20	Pass
48	5240.00	9.75	9.71	0.18	12.92	23.20	Pass

802.11ac(VHT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
36	5180.00	10.02	8.22	0.18	12.40	23.20	Pass
40	5200.00	9.63	8.05	0.18	12.10	23.20	Pass
48	5240.00	8.61	8.61	0.18	11.80	23.20	Pass

802.11n(HT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
38	5190.00	10.79	9.13	0.28	13.33	23.20	Pass
46	5230.00	9.94	9.43	0.28	12.98	23.20	Pass

802.11 ac(VHT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
38	5190.00	9.85	8.23	0.35	12.48	23.20	Pass
46	5230.00	9.26	8.83	0.35	12.41	23.20	Pass

802.11 ac(VHT80) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
42	5210.00	9.30	8.02	0.60	12.32	23.20	Pass

Note: Output Power = Measured Power + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

Total (Chain A+B) = $10*\log[(10^{\text{Chain A}/10})+(10^{\text{Chain B}/10})]$

U-NII Band II-A

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 20.83 MHz

11 dBm + $10\log_{10}$ (20.83) = 24.19 dBm > 23.16 dBm

So the 23.16 dB limit applicable

802.11a MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
52	5260.00	10.83	11.47	0.18	14.35	23.16	Pass
60	5300.00	10.22	11.60	0.18	14.15	23.16	Pass
64	5320.00	9.60	11.60	0.18	13.90	23.16	Pass

802.11n(HT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
52	5260.00	9.82	10.34	0.18	13.28	23.16	Pass
60	5300.00	9.20	10.58	0.18	13.13	23.16	Pass
64	5320.00	9.23	10.77	0.18	13.26	23.16	Pass

802.11ac(VHT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
52	5260.00	8.32	8.95	0.18	11.84	23.16	Pass
60	5300.00	8.05	9.49	0.18	12.02	23.16	Pass
64	5320.00	8.13	9.74	0.18	12.20	23.16	Pass

802.11n(HT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
54	5270.00	9.22	10.14	0.28	12.99	23.16	Pass
62	5310.00	9.56	10.73	0.28	13.47	23.16	Pass

802.11 ac(VHT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
54	5270.00	8.17	9.10	0.35	12.02	23.16	Pass
62	5310.00	8.17	9.65	0.35	12.33	23.16	Pass

802.11 ac(VHT80) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
58	5290.00	8.50	9.24	0.60	12.50	23.16	Pass

Note: Output Power = Measured Power + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

Total (Chain A+B) = $10*\log[(10^{\text{Chain A}/10})+(10^{\text{Chain B}/10})]$

U-NII Band II-C

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 20.88 MHz

11 dBm + $10\log_{10}$ (20.88) = 24.20 dBm > 22.85 dBm

So the 22.85 dB limit applicable

802.11a MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
100	5500.00	9.63	12.30	0.18	14.36	22.85	Pass
116	5580.00	8.64	12.14	0.18	13.92	22.85	Pass
140	5700.00	8.67	10.10	0.18	12.63	22.85	Pass
802.11n(HT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
100	5500.00	8.75	11.45	0.18	13.50	22.85	Pass
116	5580.00	7.87	11.56	0.18	13.29	22.85	Pass
140	5700.00	6.75	8.55	0.18	10.93	22.85	Pass
802.11ac(VHT20) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
100	5500.00	7.74	10.46	0.18	12.50	22.85	Pass
116	5580.00	6.82	10.55	0.18	12.26	22.85	Pass
140	5700.00	6.37	8.39	0.18	10.69	22.85	Pass
802.11n(HT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
102	5510.00	6.87	9.76	0.28	11.84	22.85	Pass
110	5550.00	8.07	11.51	0.28	13.41	22.85	Pass
134	5670.00	8.33	10.51	0.28	12.85	22.85	Pass
802.11 ac(VHT40) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
102	5510.00	6.35	9.69	0.35	11.69	22.85	Pass
110	5550.00	6.75	10.13	0.35	12.12	22.85	Pass
134	5670.00	7.46	9.65	0.35	12.05	22.85	Pass
802.11 ac(VHT80) MIMO mode							
CH No.	Frequency (MHz)	Measured Power (dBm)		Duty Factor	Total Output Power Chain A+B (dBm)	Limit (dBm)	Result
		Chain A	Chain B				
106	5530.00	5.90	8.89	0.60	11.26	22.85	Pass
122	5610.00	6.12	9.25	0.60	11.57	22.85	Pass

Note: Output Power = Measured Power + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

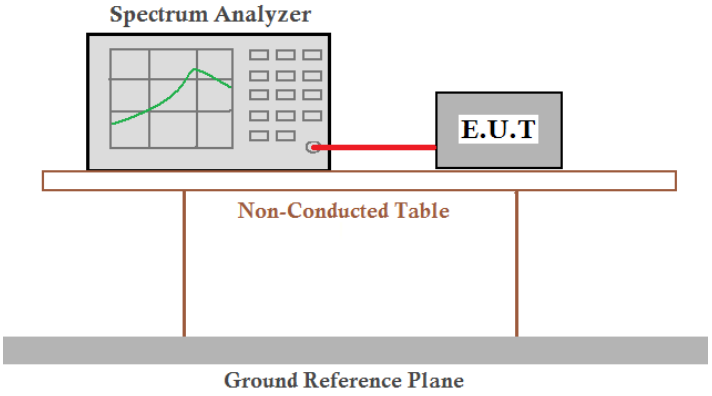
Total (Chain A+B) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

7.5 Power Spectral Density

Test Requirement:	47 CFR Part 15, Subpart E 15.407 (a)
Test Method:	KDB 789033 D02 General U-NII Test Procedures New Rules v02r01
Limit:	

Frequency band (MHz)	Limit
5150-5250	≤17dBm in 1MHz for master device
	≤11dBm in 1MHz for client device
5250-5350	≤11dBm in1MHz for client device
5470-5725	≤11dBm in 1MHz for client device
Remark: The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test.	

Test setup:



Test procedure:

1) Create an average power spectrum for the EUT operating mode being tested by following the instructions in section E)2) for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power…”.
2) Use the peak search function on the instrument to find the peak of the spectrum.
3) Make the following adjustments to the peak value of the spectrum, if applicable:
   a) If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.
   b) If Method SA-3 Alternative was used and the linear mode was used in step E)2)g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
4) The result is the PSD.

Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Directional gain and the maximum output power limit

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains directional gain	PSD Limits (dBm/MHz)
U-NII-1	3.79	3.79	6.80	10.20
U-NII-2A	3.83	3.83	6.84	10.16
U-NII-2C	4.14	4.14	7.15	9.85
Basic methodology with N_{ANT} transmit antennas, each with the same directional gain G_{ANT} dBi, being driven by N ANT transmitter outputs of equal power. Directional gain is to be computed as follows: If any transmit signals are correlated with each other, Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi				

Measurement Data

U-NII Band I

802.11a MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
36	5180.00	1.766	-0.439	0.18	3.99	10.20	Pass
40	5200.00	1.676	0.134	0.18	4.16	10.20	Pass
48	5240.00	1.543	1.664	0.18	4.79	10.20	Pass

802.11n(HT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
36	5180.00	0.691	-1.435	0.18	2.95	10.20	Pass
40	5200.00	0.788	-0.470	0.18	3.39	10.20	Pass
48	5240.00	0.201	0.031	0.18	3.31	10.20	Pass

802.11ac(VHT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
36	5180.00	0.306	-1.729	0.18	2.60	10.20	Pass
40	5200.00	-0.297	-1.602	0.18	2.29	10.20	Pass
48	5240.00	-0.644	-0.865	0.18	2.44	10.20	Pass

802.11n(HT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
38	5190.00	-1.775	-3.536	0.28	0.72	10.20	Pass
46	5230.00	-2.103	-2.867	0.28	0.82	10.20	Pass

802.11ac(VHT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
38	5190.00	-3.014	-4.871	0.35	-0.48	10.20	Pass
46	5230.00	-3.272	-4.061	0.35	-0.29	10.20	Pass

802.11ac(VHT80) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
38	5210.00	-5.593	-6.089	0.60	-2.22	10.20	Pass

Note: Total PSD = Measured PSD + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

Total (Chain A+B) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

U-NII Band II-A

802.11a MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
52	5260.00	1.242	1.892	0.18	4.77	10.16	Pass
60	5300.00	0.128	2.026	0.18	4.37	10.16	Pass
64	5320.00	0.122	1.966	0.18	4.33	10.16	Pass
802.11n(HT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
52	5260.00	-0.124	0.412	0.18	3.34	10.16	Pass
60	5300.00	-1.053	0.941	0.18	3.25	10.16	Pass
64	5320.00	-0.808	1.144	0.18	3.47	10.16	Pass
802.11ac(VHT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
52	5260.00	-1.277	-0.842	0.18	2.14	10.16	Pass
60	5300.00	-1.831	-0.065	0.18	2.33	10.16	Pass
64	5320.00	-1.629	0.149	0.18	2.54	10.16	Pass
802.11n(HT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
54	5270.00	-3.491	-2.590	0.28	0.27	10.16	Pass
62	5310.00	-3.987	-2.149	0.28	0.32	10.16	Pass
802.11ac(VHT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
54	5270.00	-4.733	-3.673	0.35	-0.81	10.16	Pass
62	5310.00	-5.161	-3.267	0.35	-0.75	10.16	Pass
802.11ac(VHT80) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
58	5290.00	-6.041	-4.692	0.60	-1.70	10.16	Pass

Note: Total PSD = Measured PSD + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

Total (Chain A+B) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

U-NII Band II-C

802.11a MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
100	5500.00	0.157	3.133	0.18	5.09	9.85	Pass
116	5580.00	-0.174	2.776	0.18	4.74	9.85	Pass
140	5700.00	-0.439	2.221	0.18	4.28	9.85	Pass

802.11n(HT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
100	5500.00	-0.673	2.329	0.18	4.27	9.85	Pass
116	5580.00	-1.012	1.895	0.18	3.87	9.85	Pass
140	5700.00	-1.256	1.213	0.18	3.34	9.85	Pass

802.11ac(VHT20) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
100	5500.00	-1.619	1.273	0.18	3.25	9.85	Pass
116	5580.00	-2.402	0.375	0.18	2.40	9.85	Pass
140	5700.00	-2.342	0.592	0.18	2.56	9.85	Pass

802.11n(HT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
102	5510.00	-4.627	-1.660	0.28	0.40	9.85	Pass
110	5550.00	-4.407	-1.013	0.28	0.90	9.85	Pass
134	5670.00	-5.666	-2.450	0.28	-0.48	9.85	Pass

802.11ac(VHT40) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
102	5510.00	-5.116	-1.845	0.35	0.18	9.85	Pass
110	5550.00	-5.414	-5.624	0.35	-2.16	9.85	Pass
134	5670.00	-5.802	-2.723	0.35	-0.63	9.85	Pass

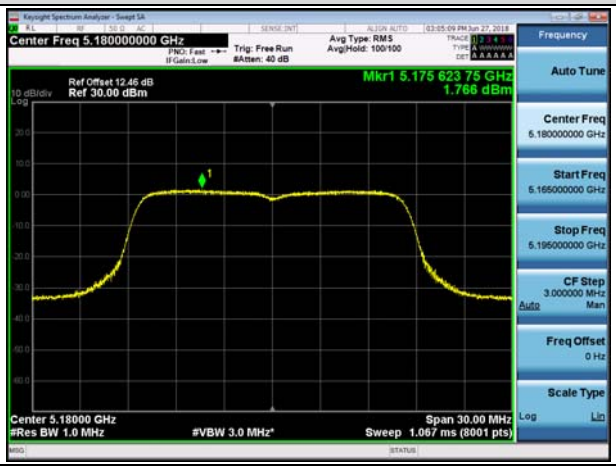
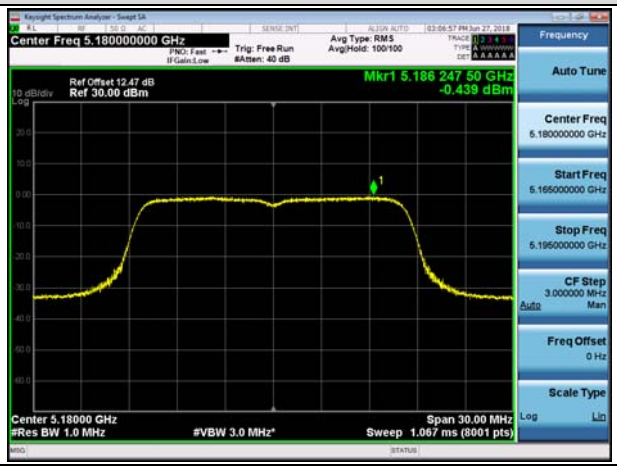
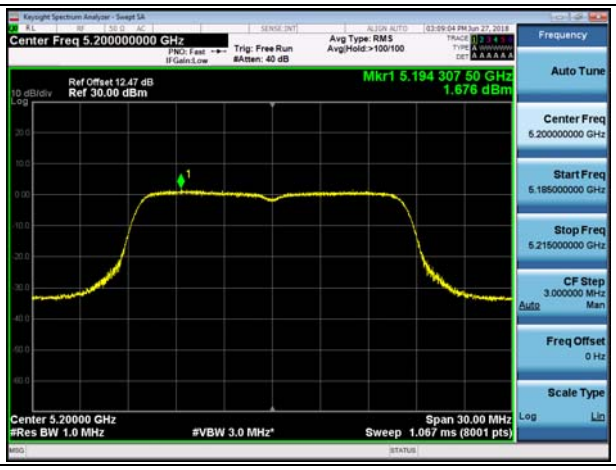
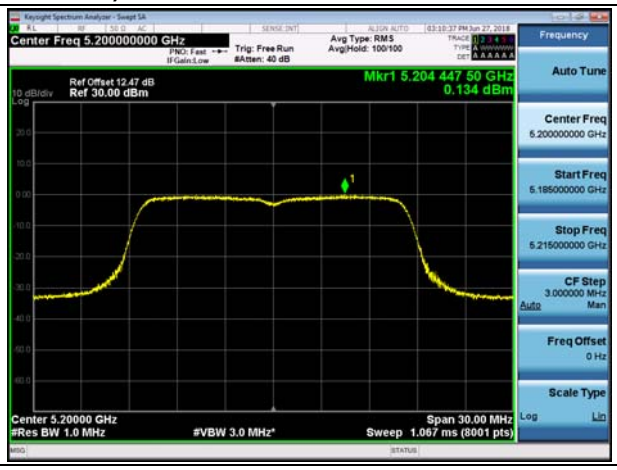
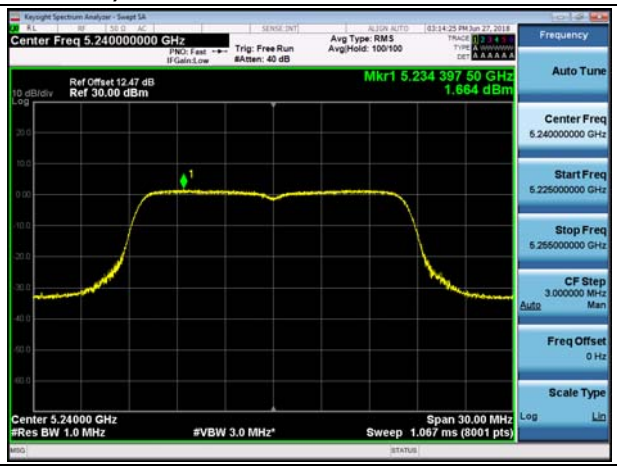
802.11ac(VHT80) MIMO mode							
Channel No.	Frequency (MHz)	Measured PSD (dBm/MHz)		Duty Factor	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Result
		Chain A	Chain B				
106	5530.00	-7.178	-4.011	0.60	-1.70	9.85	Pass
122	5610.00	-7.737	-5.038	0.60	-2.57	9.85	Pass

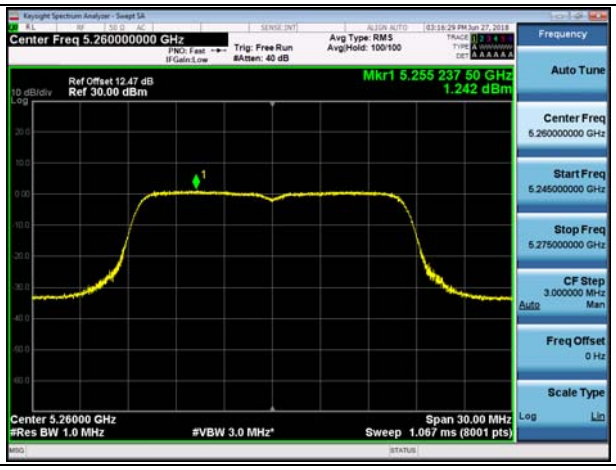
Note: Total PSD = Measured PSD + Duty Factor

Duty Factor = 10 log (1/Duty Cycle)

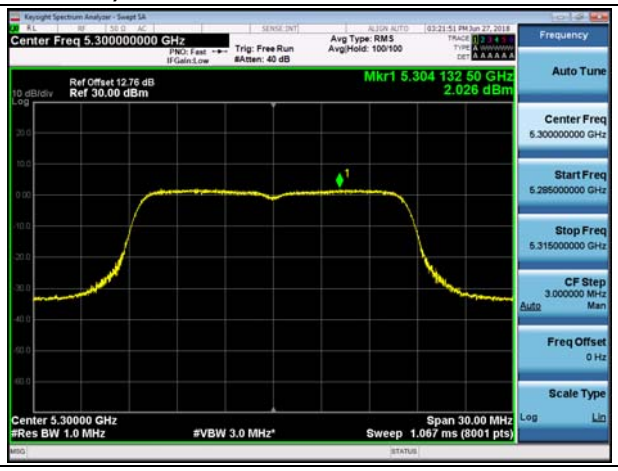
Total (Chain A+B) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Test plots as followed:

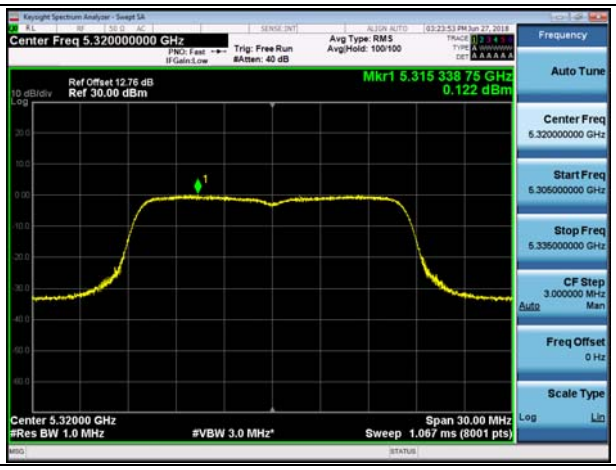
802.11a MIMO mode	
Chain A	**Chain B**
	
Channel 36 (5180MHz)	
	
Channel 40 (5200MHz)	
	
Channel 48 (5240MHz)	

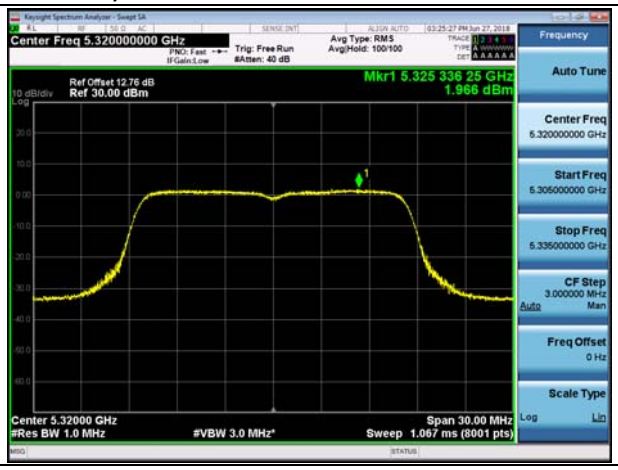


Channel 52 (5260MHz)



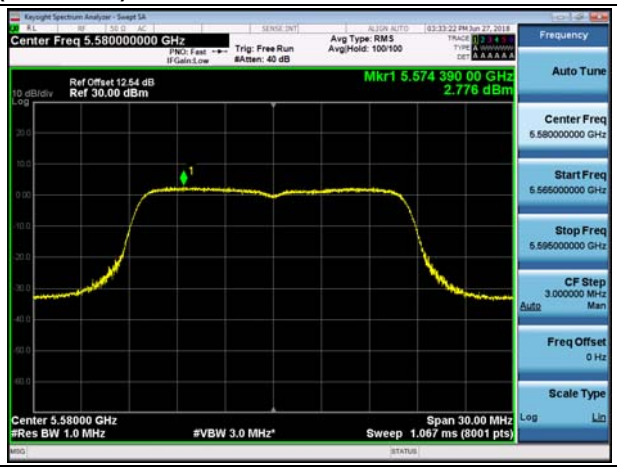
Channel 60 (5300MHz)



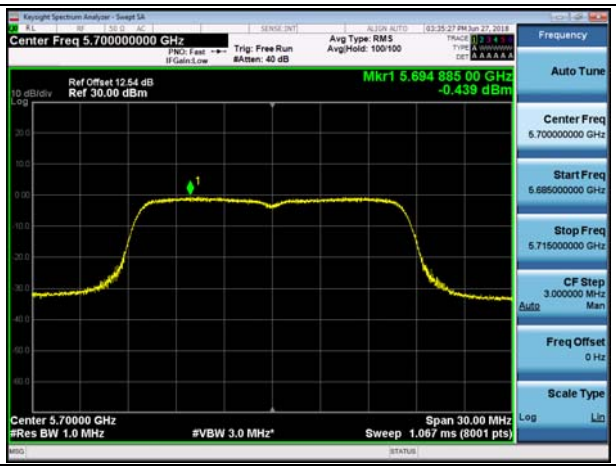


Channel 64 (5320MHz)

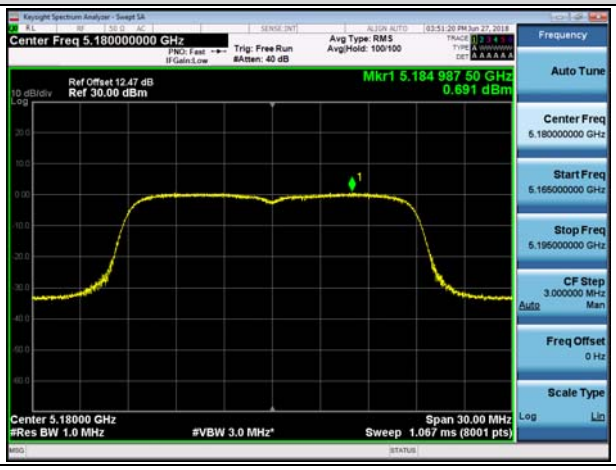
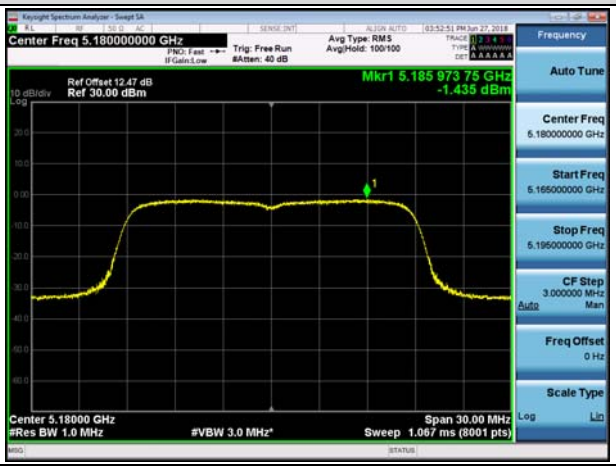
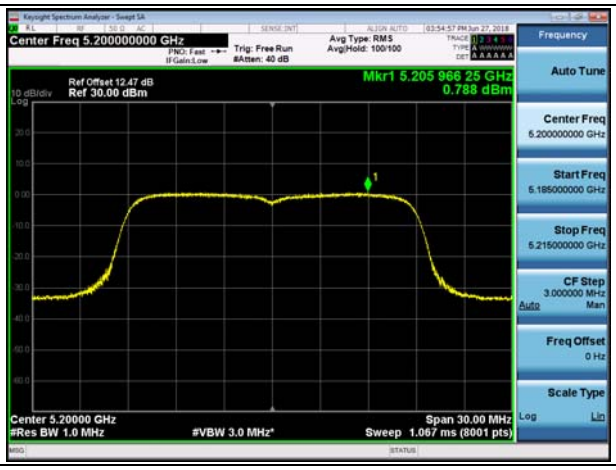
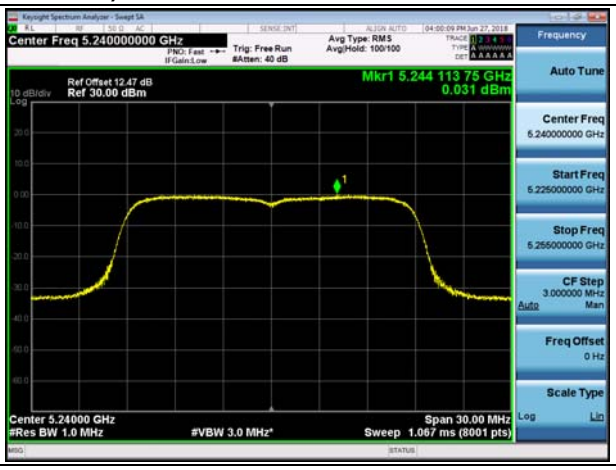
Channel 100 (5500MHz)



Channel 116 (5580MHz)



Channel 140 (5700MHz)

802.11n(HT20) MIMO mode	
Chain A	**Chain B**
	
Channel 36 (5180MHz)	
	
Channel 40 (5200MHz)	
	
Channel 48 (5240MHz)	