TEST REPORT

Product Name:	WIFI Module
Trade Mark:	N/A
Model No. / HVIN:	BL-R8812AF1-A
Add. Model No. / HVIN:	N/A
Report Number:	200111002RFC-2
Test Standards:	FCC 47 CFR Part 15 Subpart E RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	2AQ5RWBL-8812AF1-A
IC:	24301-BLR8812AF1A
Test Result:	PASS
Date of Issue:	April 19, 2020

Prepared for:

Shenzhen KTC Commercial Display Technology CO.,LTD.
No.4023,Northern Wuhe Road,Bantian Street,Longgang District,Shenzhen City,Guangdong Province,P.R.China

Prepared by:

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Date: April 19, 2020

Version

Version No.	Date	Description
V1.0	April 19, 2020	Original

CONTENTS

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Shenzhen KTC Commercial Display Technology CO.,LTD.
Address of Applicant:	No.4023,Northern Wuhe Road,Bantian Street,Longgang District,Shenzhen City,Guangdong Province,P.R.China
Manufacturer:	Shenzhen KTC Commercial Display Technology CO.,LTD.
Address of Manufacturer:	No.4023,Northern Wuhe Road,Bantian Street,Longgang District,Shenzhen City,Guangdong Province,P.R.China

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	WIFI Module		
Model No. / HVIN:	BL-R8812AF1-A		
Add. Model No. / HVIN:	N/A		
Trade Mark:	N/A		
DUT Stage:	Production Unit		
EUT Supports Function:	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	5 GHz U-NII Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Software Version:	V62.10		
Hardware Version:	V1		
Sample Received Date:	January 15, 2020		
Sample Tested Date:	January 15, 2020 to April 7, 2020		

1.2.2 Description of Accessories

None.

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)
	5250 MHz to 5350 MHz (U-NII-2A)
	5470 MHz to 5725 MHz (U-NII-2C)
	5 725 MHz to 5 850 MHz (U-NII-3)
Frequency Ranges:	5180 MHz to 5240 MHz
	5260 MHz to 5320 MHz
	5500 MHz to 5700 MHz
	5 745 MHz to 5 825 MHz
Support Standards:	IEEE 802.11a/n/ac
TPC Function:	Not Support
DFS Operational mode:	Slave with radar Interference detection function
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz
	IEEE 802.11ac-VHT80: 80 MHz

Data Rate:	IEEE 802.11a: Up to 54 Mbps					
	IEEE 802.11n-HT20: Up to MCS15					
	IEEE 802.11n-HT40: Up to MCS15					
	IEEE 802.11ac-VHT20: Up to MCS8					
	IEEE 802.11ac-VHT40: Up to MCS9					
	IEEE 802.11ac-VHT80: Up to MCS9					
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80					
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80					
	5470 MHz to 5725 MHz: 11 for IEEE 802.11a/n-HT20/ac-VHT20 5 for IEEE 802.11n-HT40/ac-VHT40 2 for IEEE 802.11ac-VHT80					
	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80					
Antenna Type:	Chain 0	PCB Antenna				
	Chain 1	PCB Antenna				
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 5.0 dBi				
		5250 MHz to 5350 MHz: 5.0 dBi				
		5470 MHz to 5725 MHz: 5.0 dBi				
		5725 MHz to 5850 MHz: 5.0 dBi				
	Chain 1	5150 MHz to 5250 MHz: 5.0 dBi				
		5250 MHz to 5350 MHz: 5.0 dBi				
		5470 MHz to 5725 MHz: 5.0 dBi				
		5725 MHz to 5850 MHz: 5.0 dBi				
Maximum EIRP (dBm):	**SISO_Chain 0**	**U-NII-1**				
	IEEE 802.11a:	17.15				
	SISO_Chain 1	**U-NII-1**				
	IEEE 802.11a:	16.93				
	MIMO_Chain 0+1	**U-NII-1**				
	IEEE 802.11n-HT20:	20.64				
	IEEE 802.11n-HT40:	18.73				
	IEEE 802.11ac-VHT20:	20.42				
	IEEE 802.11ac-VHT40:	18.96				
	IEEE 802.11ac-VHT80:	17.40				
Maximum conducted output power (dBm):	**SISO_Chain 0**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**	
	IEEE 802.11a:	12.15	12.15	14.14	6.82	
	SISO_Chain 1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**	
	IEEE 802.11a:	11.93	13.80	15.19	6.99	
	MIMO_Chain 0+1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**	
	IEEE 802.11n-HT20:	15.64	17.30	17.18	9.39	

	IEEE 802.11n-HT40:	13.73	13.98	15.41	7.59
	IEEE 802.11ac-VHT20:	15.42	17.33	17.14	9.91
	IEEE 802.11ac-VHT40:	13.96	13.95	15.32	7.78
	IEEE 802.11ac-VHT80:	12.40	12.28	10.58	7.00
Normal Test Voltage:	3.3 Vdc				

1.4 OTHER INFORMATION

Operation Frequency Each of Channel				
	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20	f = 5000 + 5k, k = 32 + 4n			f = 5000 + 5k, k = 145 + 4n
	n = 1,..., 4	n = 5,..., 8	n = 17,..., 27	n = 1,..., 5
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40	f = 5000 + 5k, k = 30 + 8n			f = 5000 + 5k, k = 143 + 8n
	n = 1, 2	n = 1,..., 5	n = 9,..., 13	n = 1, 2
IEEE 802.11ac-VHT80	f = 5000 + 5k, k = 26 + 16n			f = 5000 + 5k, k = 155
	n = 1	n = 1, 2	n = 5, 6	

Note:
f is the operating frequency (MHz);
k is the operating channel.

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	FCC ID	Supplied by
Notebook	Lenovo	E450	SL10G10780		UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

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

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories
CAB identifier: CN0032

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product 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.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.8 dB
2	Conducted emission 150KHz-30MHz	±3.4 dB
3	Radiated emission 9KHz-30MHz	±4.9 dB
4	Radiated emission 30MHz-1GHz	±4.7 dB
5	Radiated emission 1GHz-18GHz	±5.1 dB
6	Radiated emission 18GHz-26GHz	±5.2 dB
7	Radiated emission 26GHz-40GHz	±5.2 dB

2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart E Test Cases			
Test Item	**Test Requirement**	**Test Method**	**Result**
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203 FCC 47 CFR Part 15 Subpart E Section 15.407(a)(1) (2) RSS-Gen Issue 5, Section 6.8	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 2 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 2 Section 6.2.4.1	KDB 789033 D02 v02r01 Section C.2	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, section 6.7	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a (Method PM)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 2 Section 6.3	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS

For Dynamic Frequency Selection

Test Case	Result
Channel Availability Check Time	N/A[1]
U-NII Detection Bandwidth	N/A[1]
Channel Closing Transmission Time	PASS
Channel Move Time	PASS
DFS Detection Threshold	N/A[1]
Non- Occupancy Period	N/A[1]

Note:

1) The EUT is slave, NA In this whole report not application.

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 03, 2018	Dec. 03, 2021
☒	Receiver	R&S	ESIB26	100114	Nov. 24, 2019	Nov. 23, 2020
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 24, 2019	Nov. 23, 2020
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 16, 2019	Nov. 15, 2020
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 16, 2019	Nov. 15, 2020
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 16, 2019	Nov. 15, 2020
☒	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2019	Nov. 23, 2020
☐	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	Nov. 24, 2019	Nov. 23, 2020
☐	6dB Attenuator	Talent	RA6A5-N-18	18103002	Nov. 24, 2019	Nov. 23, 2020
☐	Horn Antenna	ETS-LINDGREN	3117	00164202	Nov. 16, 2019	Nov. 15, 2020
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 18, 2019	May 18, 2020
☐	Horn Antenna	ETS-LINDGREN	3116C	00200180	Jun. 23, 2019	Jun. 23, 2020
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Nov. 16, 2019	Nov. 15, 2020
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☐	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Nov. 24, 2019	Nov. 23, 2020
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	Nov. 24, 2019	Nov. 23, 2020
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	Receiver	R&S	ESR7	1316.3003K07 -101181-K3	Nov. 24, 2019	Nov. 23, 2020
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 24, 2019	Nov. 23, 2020
☒	LISN	R&S	ESH2-Z5	860014/024	Nov. 24, 2019	Nov. 23, 2020
☐	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 24, 2019	Nov. 23, 2020
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 24, 2019	Nov. 23, 2020
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 24, 2019	Nov. 23, 2020
☐	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 24, 2019	Nov. 23, 2020
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Nov. 24, 2019	Nov. 23, 2020

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage	Relative Humidity (%)
NT/NV	+15 to +35	3.3Vdc	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Tested by
26 dB emission bandwidth	22.0	51.0	99.0	Hank Wu
6 dB bandwidth				
Occupied Bandwidth				
Maximum conducted output power				
Peak Power Spectral Density				
Radiated Emissions and Band Edge Measurement	26.8	55.0	100.4	Andy Lin
Dynamic Frequency Selection	22.5	55.0	100.4	Hank Wu
AC Power Line Conducted Emission	23.6	49.0	100.42	Bert Xiong

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140
		5500 MHz	5580 MHz	5700 MHz
	5725 MHz to 5850 MHz	Channel 149	Channel 157	Channel 165
		5745 MHz	5785 MHz	5825 MHz
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5250 MHz to 5350 MHz	Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
	5470 MHz to 5725 MHz	Channel 102	Channel 110	Channel 134
		5510 MHz	5550 MHz	5670 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 MHz to 5350 MHz	--	Channel 58	--
		--	5290 MHz	--
	5470 MHz to 5725 MHz	Channel 106	--	--
		5530 MHz	--	--
	5725 MHz to 5850 MHz	--	Channel 155	--
		--	5775 MHz	--

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11a/n/ac	1Tx/1Rx or 2Tx/2Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting								
Mode	U-NII-1		U-NII-2A		U-NII-2C		U-NII-3	
	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	36	35	36	35	42	36	27	22
IEEE 802.11n-HT20	43	43	43	43	43	43	27	27
IEEE 802.11n-HT40	45	45	43	43	45	45	29	29
IEEE 802.11ac-VHT20	43	43	43	43	43	43	27	27
IEEE 802.11ac-VHT40	45	45	43	43	45	45	29	29
IEEE 802.11ac-VHT80	43	43	40	40	40	40	30	30

Test Software
Test software name: REALTEK 11ac 8812 AU USB WLAN NIC Mass production kit

4.4 PRE-SCAN

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

Mode	Worst-case data rates
IEEE 802.11a	6 Mbps
IEEE 802.11n-HT20	MCS0
IEEE 802.11n-HT40	MCS0
IEEE 802.11ac-VHT20	MCS0
IEEE 802.11ac-VHT40	MCS0
IEEE 802.11ac-VHT80	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

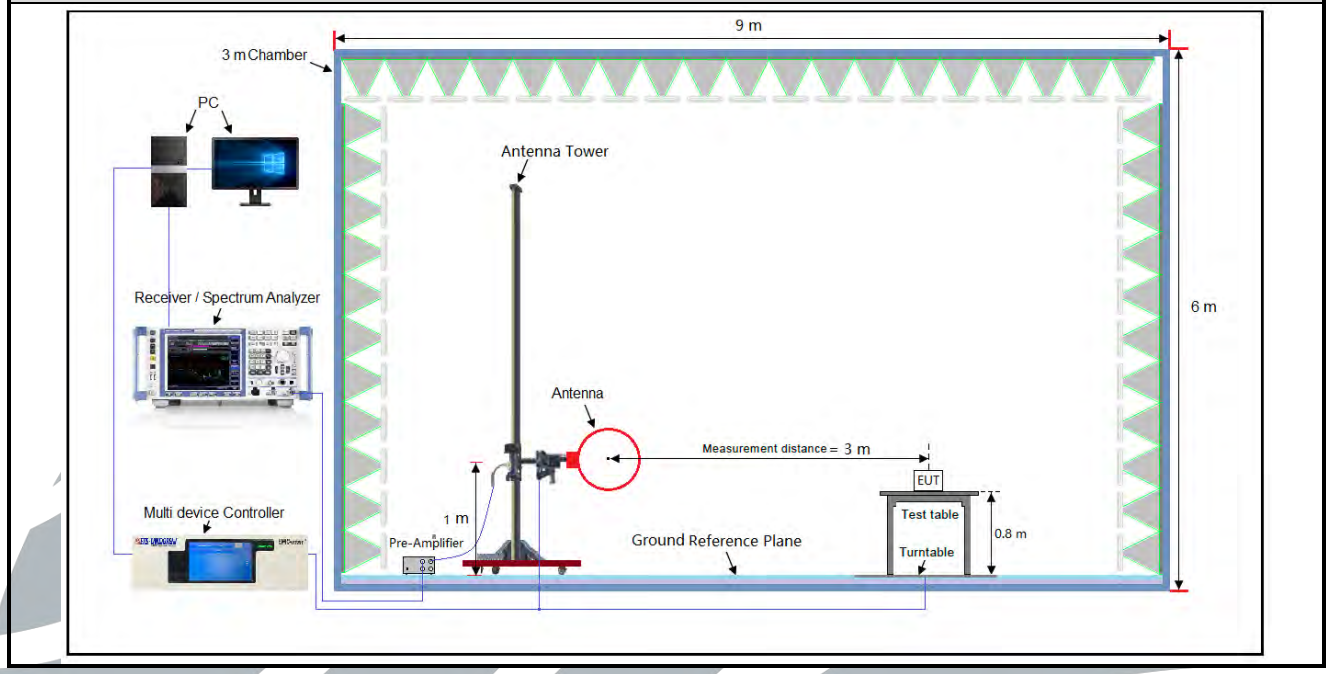


Figure 2. 30MHz to 1GHz

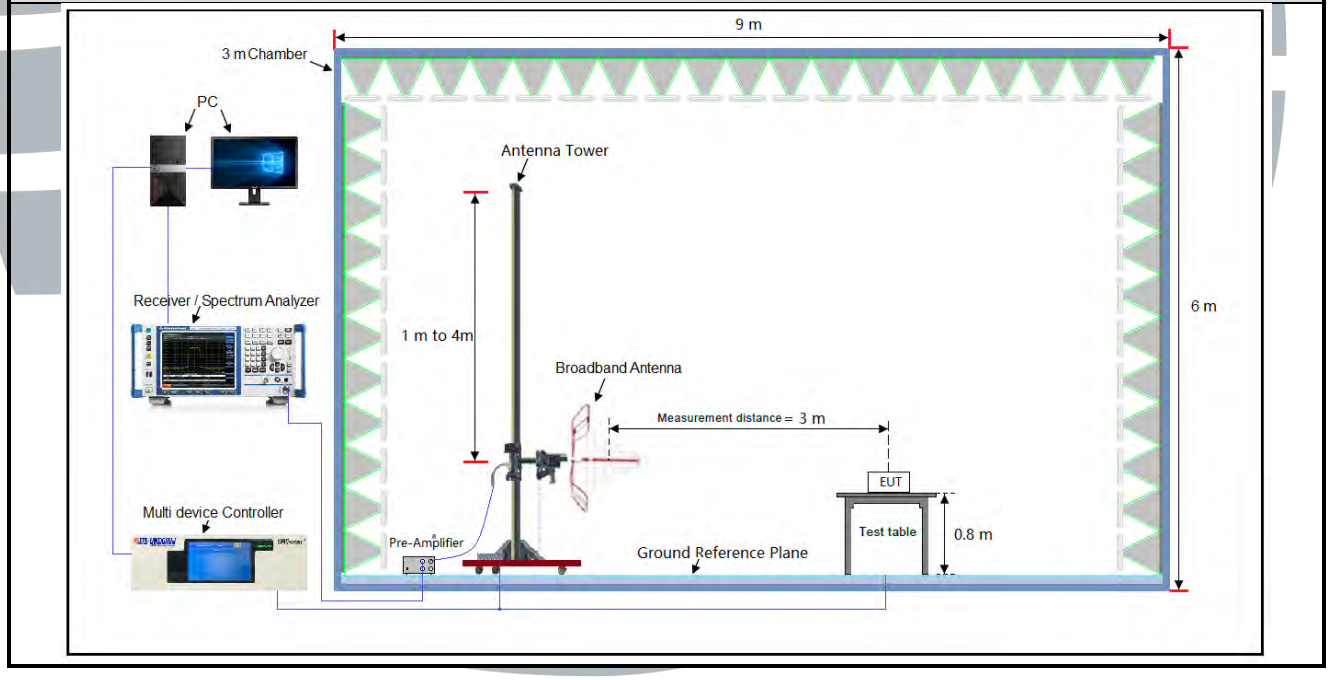
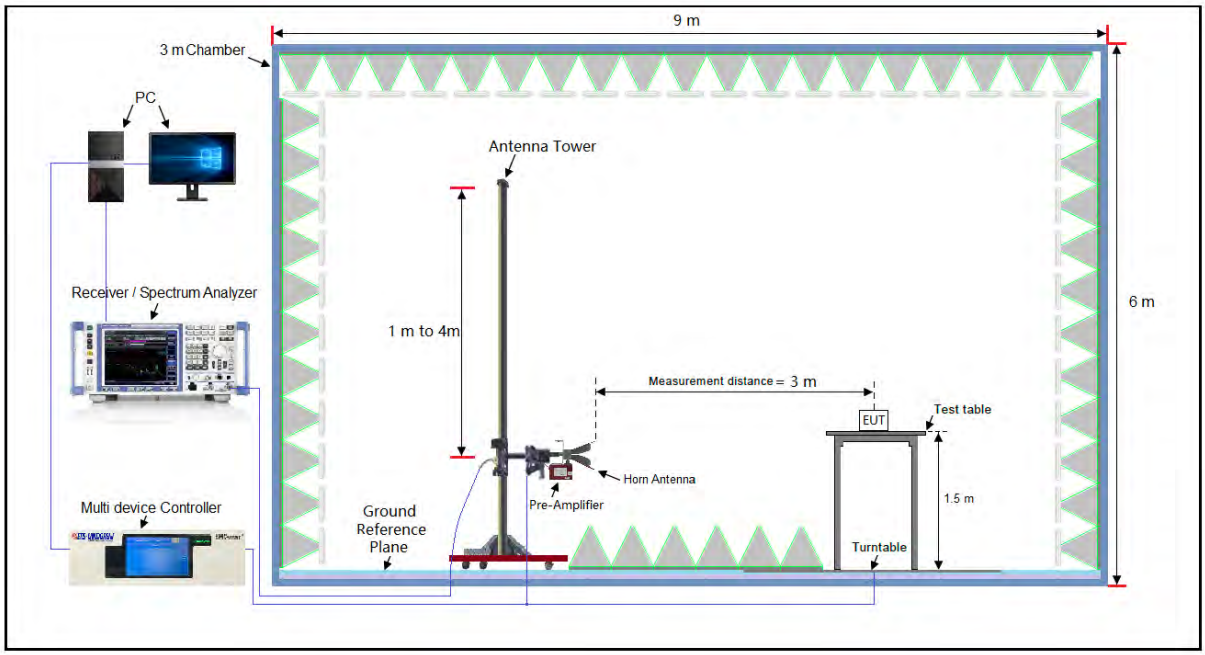
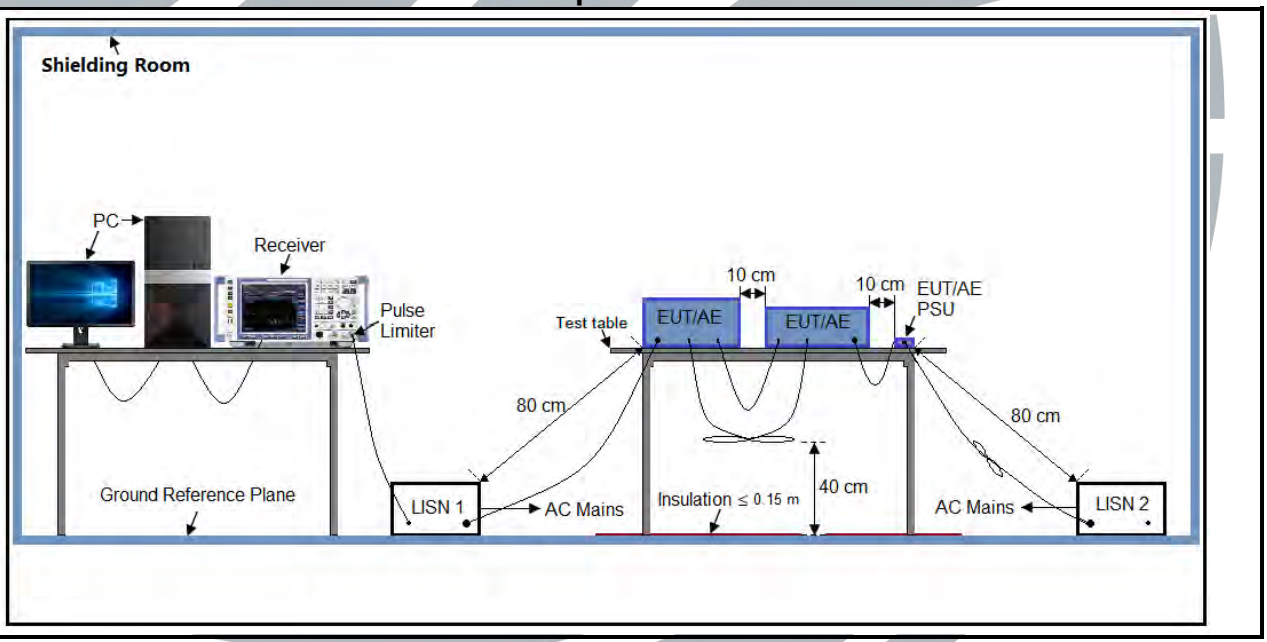


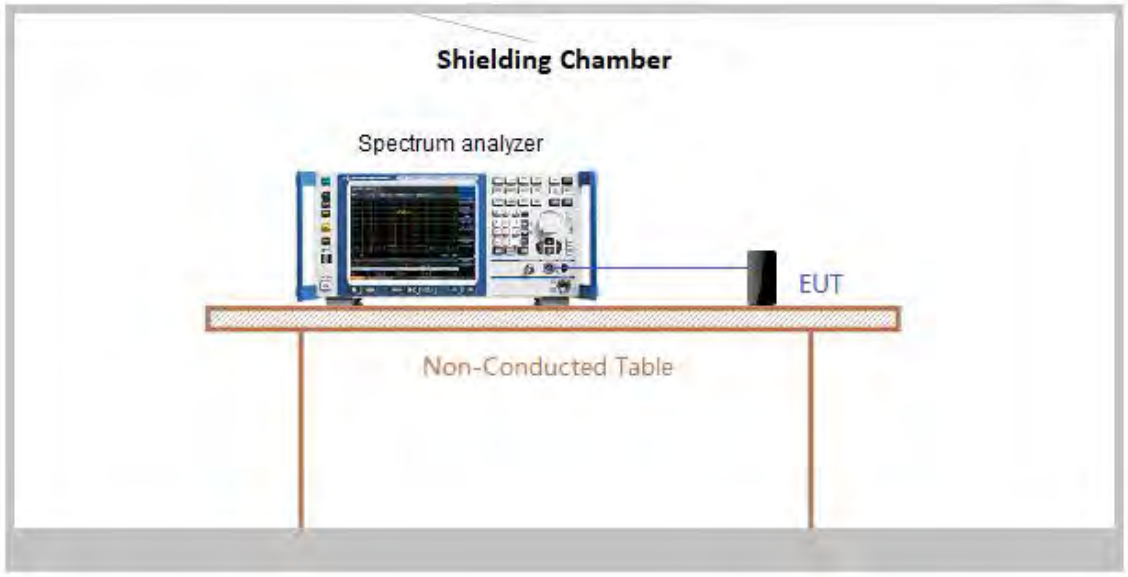
Figure 3. Above 1GHz



4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



Normal Environment

4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Z axis
	1TX	Chain 1	Z axis
	2TX	Chain 0+1	Z axis

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 12.2.

Test Results

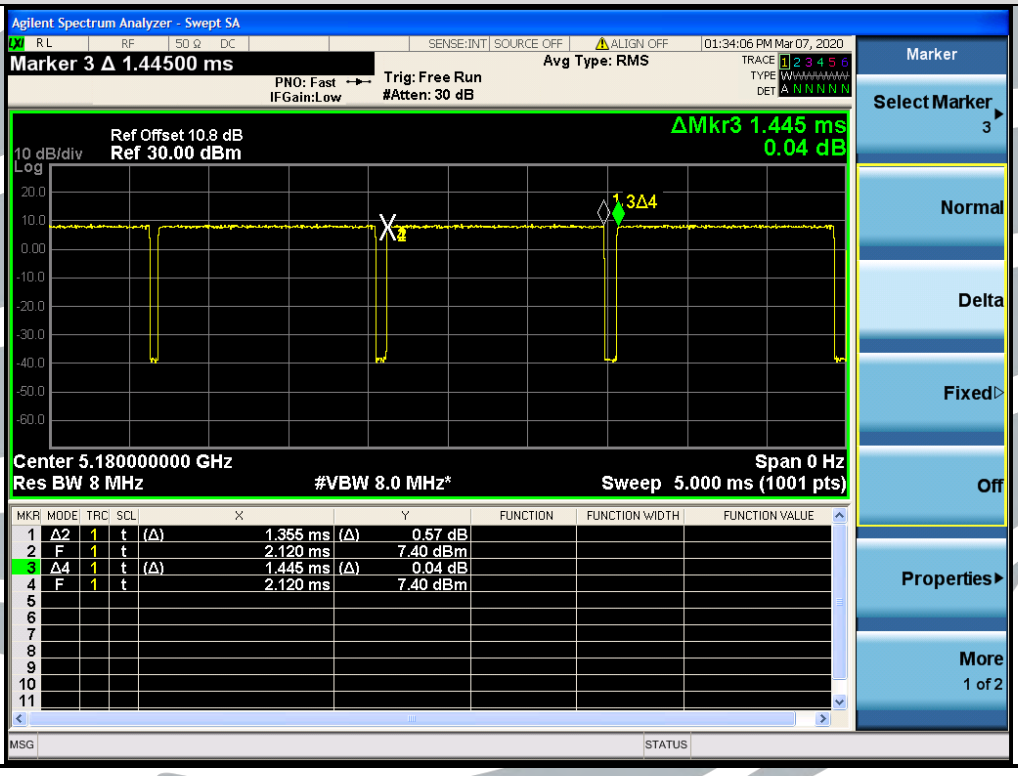
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	1.355	1.445	0.94	93.77	0.28	0.74	-0.56
IEEE 802.11n-HT20	MCS0	1.250	1.425	0.88	87.72	0.57	0.80	-1.14
IEEE 802.11n-HT40	MCS0	0.624	0.729	0.86	85.60	0.68	1.60	-1.35
IEEE 802.11ac-VHT20	MCS0	1.275	1.450	0.88	87.93	0.56	0.78	-1.12
IEEE 802.11ac-VHT40	MCS0	0.639	0.744	0.86	85.89	0.66	1.56	-1.32
IEEE 802.11ac-VHT80	MCS0	0.314	0.444	0.71	70.72	1.50	3.18	-3.01

Remark:

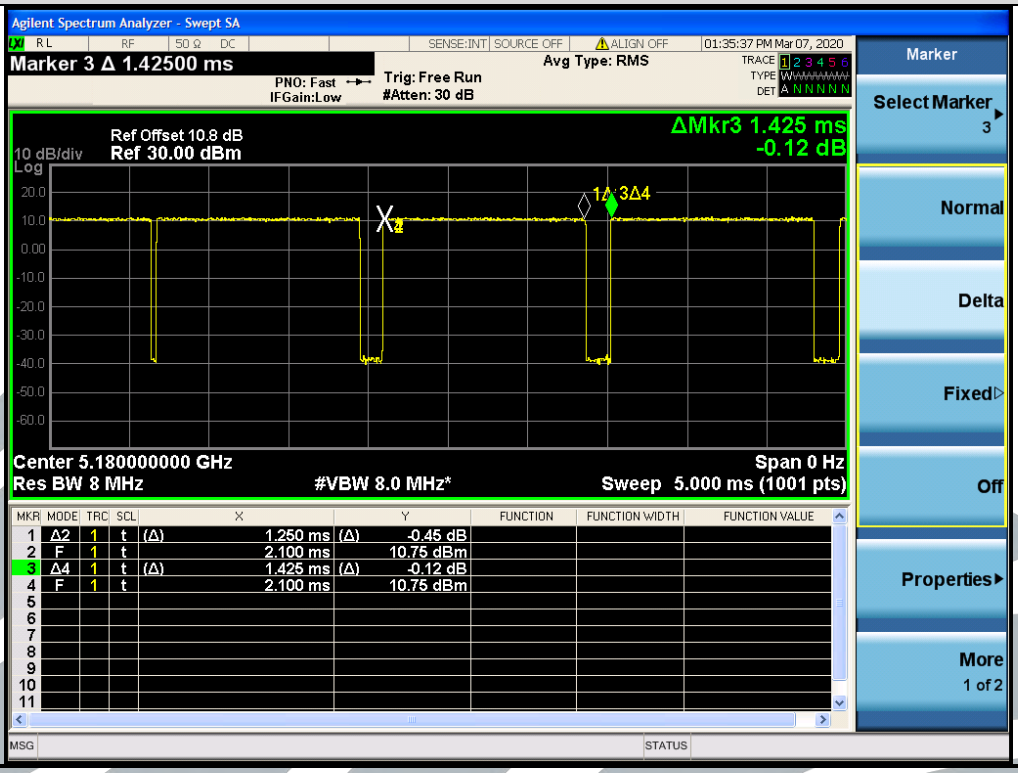
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plots as follows

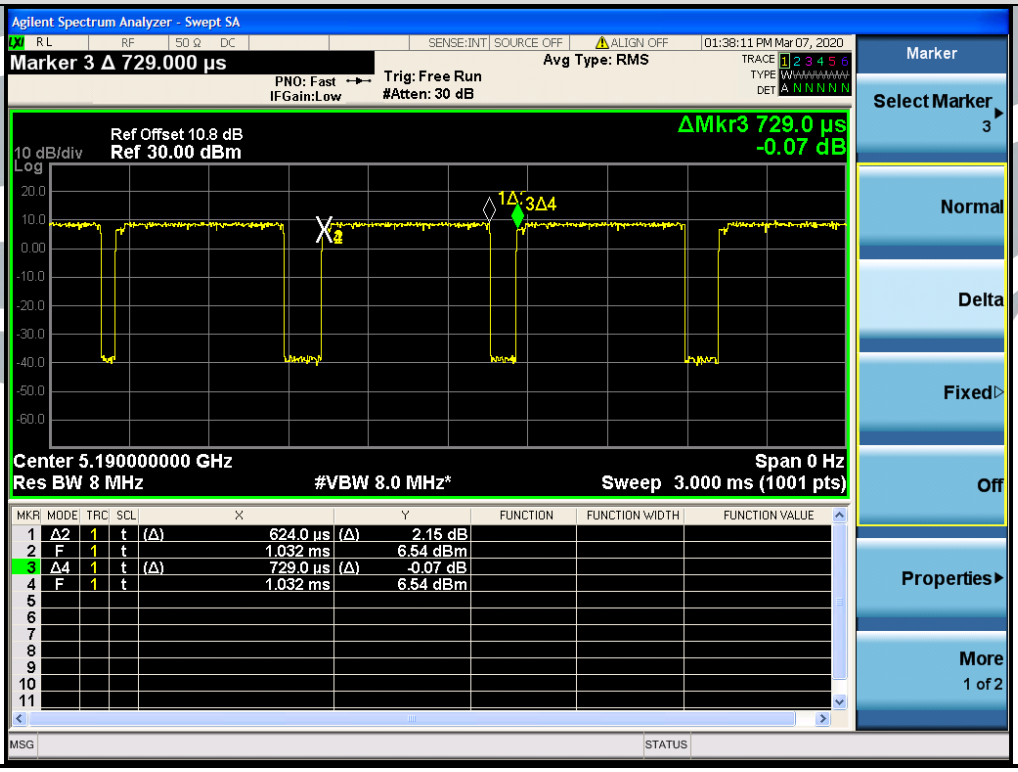
IEEE 802.11a



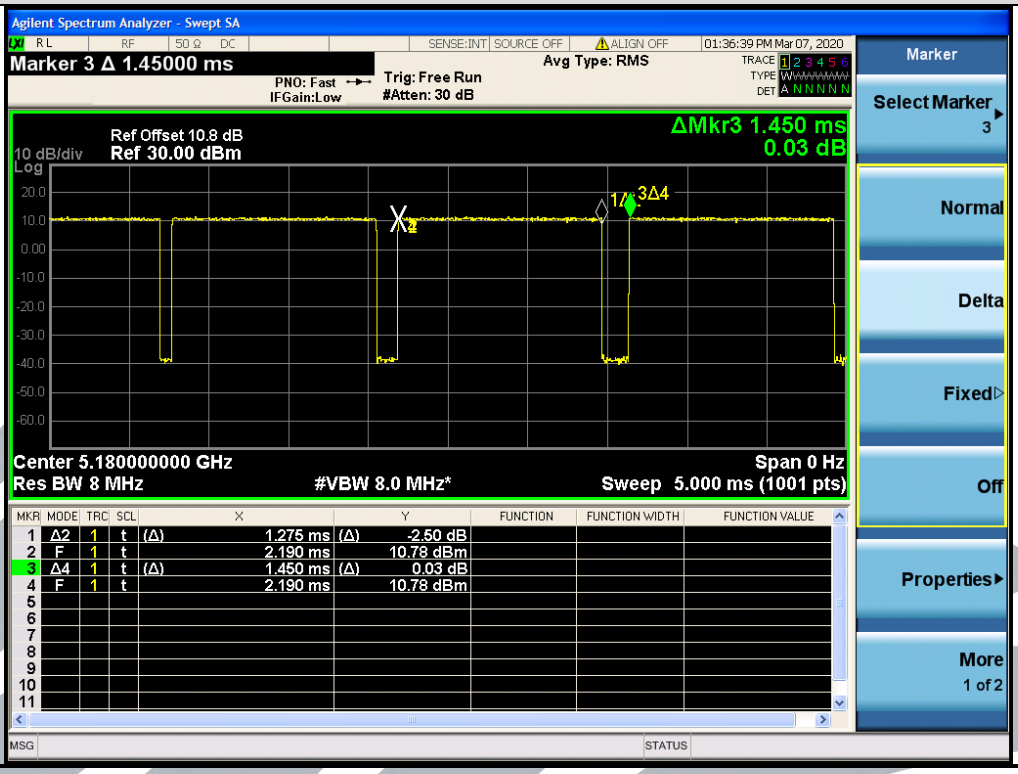
IEEE 802.11n-HT20



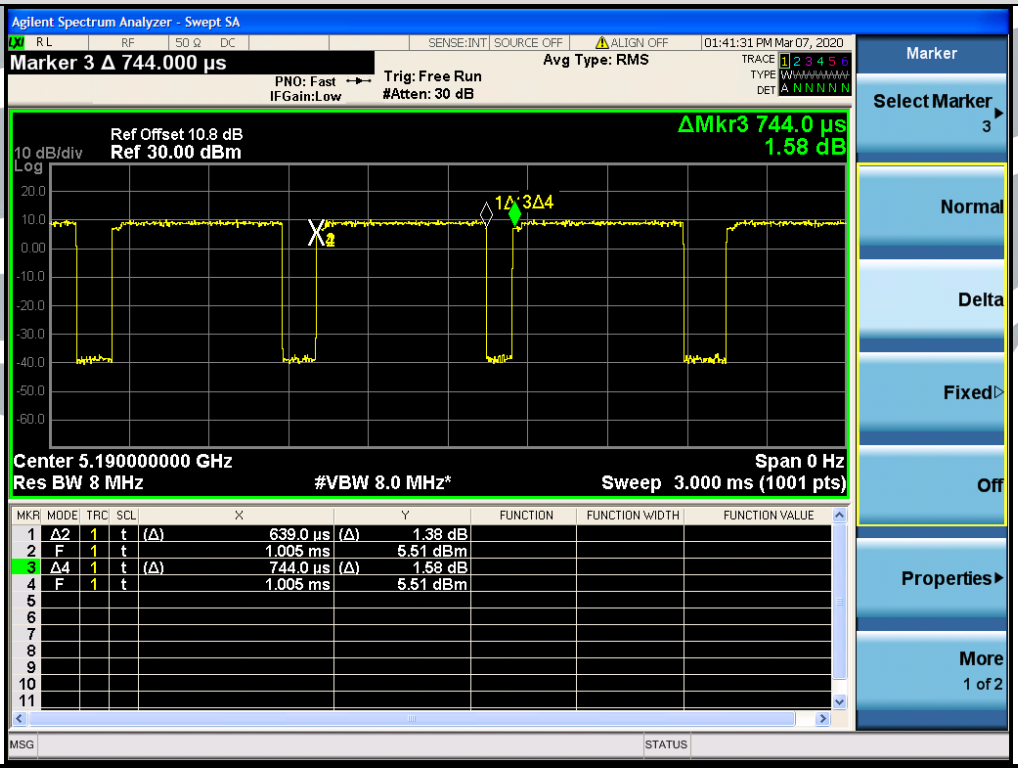
IEEE 802.11n-HT40



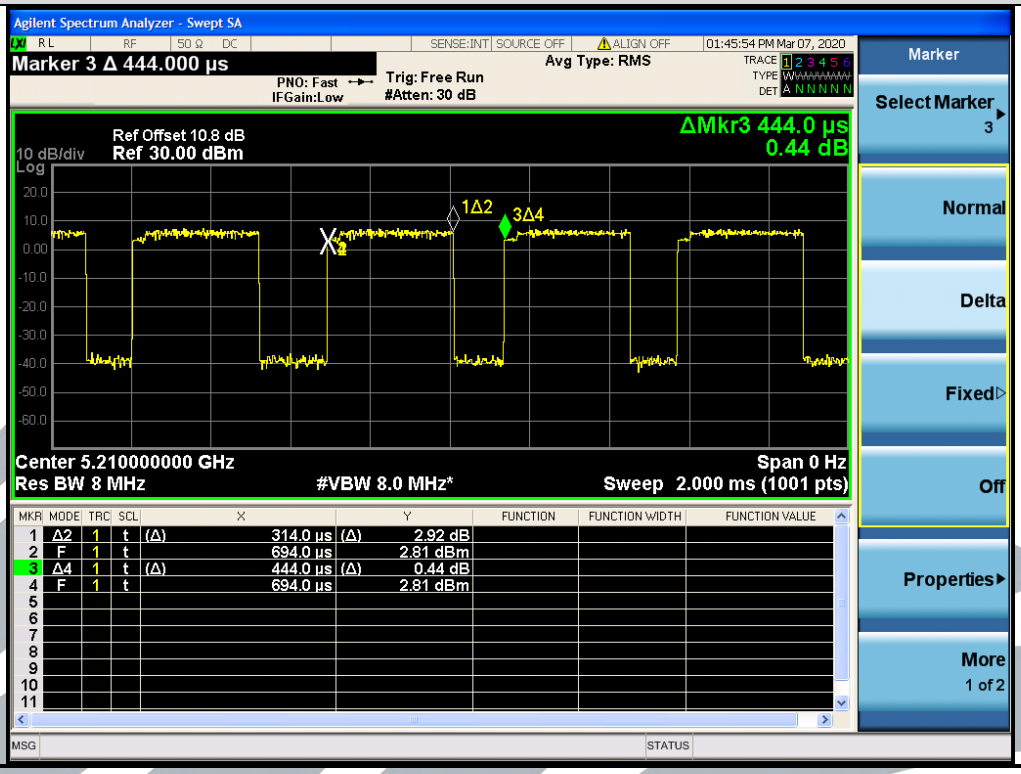
IEEE 802.11ac-VHT20



IEEE 802.11ac-VHT40



IEEE 802.11ac-VHT80



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
6	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E
7	KDB 905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
8	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection
9	KDB 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
10	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
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. **15.407(a)(1) (2) requirement:** The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **RSS-Gen Issue 5, Section 6.8 requirement:** According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns.
EUT Antenna:
Both antenna in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other and the antenna gain of both chains is completely consistent, the best case directional gain of the antenna is 8.01 dBi (See section 5.5).

5.3 26 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)
RSS-247 Issue 2 Section 6.2.1.2

Test Method: KDB 789033 D02 v02r01 Section C.1

Limit: None; for reporting purposes only.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum analyzer.

Spectrum analyzer according to the following Settings:
a) Set RBW = approximately 1 % of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

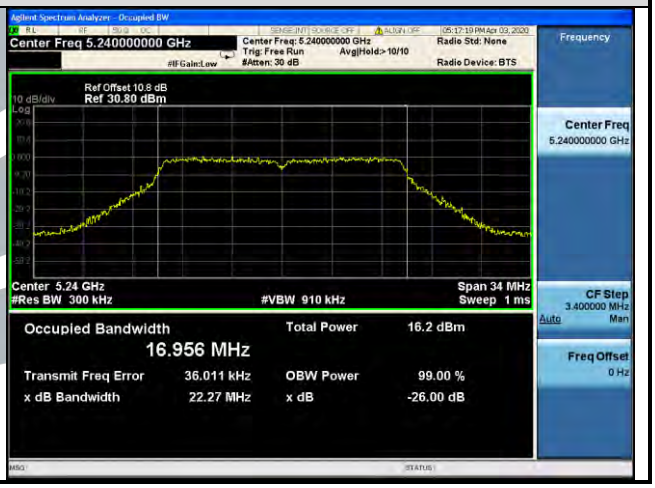
Instruments Used: Refer to section 3 for details

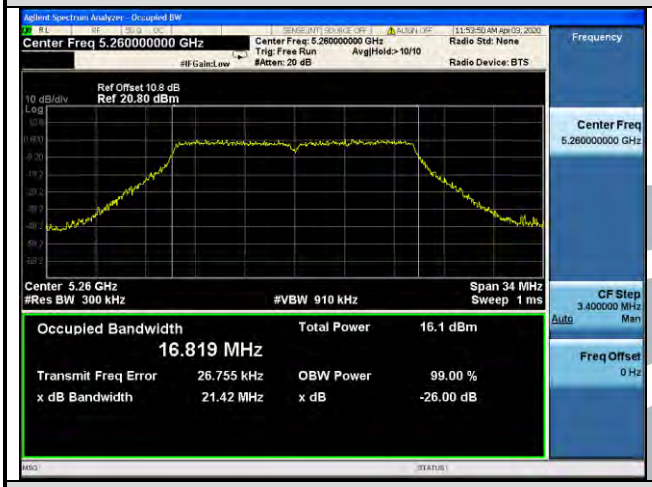
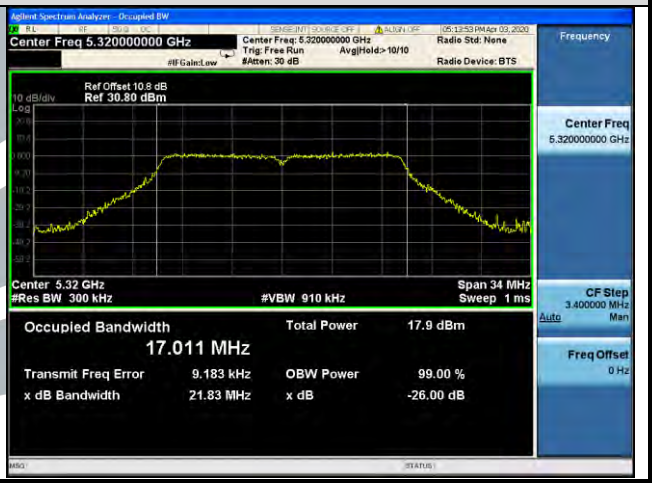
Test Results: Pass

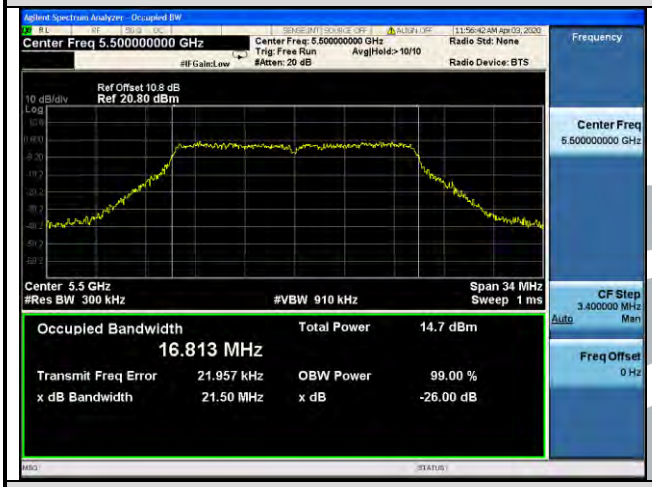
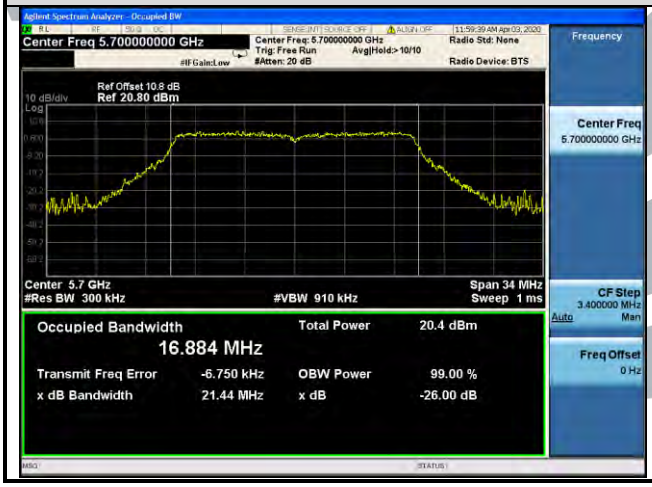
Mode	Channel	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	36 (5180)	21.85	22.32	16.905	17.044
	44 (5220)	21.31	22.17	16.847	16.985
	48 (5240)	21.58	22.27	16.851	16.956
	52 (5260)	21.42	22.30	16.819	16.966
	60 (5300)	21.60	22.39	16.831	17.047
	64 (5320)	21.45	21.83	16.806	17.011
	100 (5500)	21.50	22.58	16.813	17.056
	116 (5580)	21.12	22.40	16.816	16.996
	140 (5700)	21.44	22.23	16.884	16.968
IEEE 802.11n-HT20	36 (5180)	21.90	22.01	17.835	17.856
	44 (5220)	21.86	22.32	17.866	17.902
	48 (5240)	22.25	21.75	17.867	17.899
	52 (5260)	22.45	21.85	17.897	17.902
	60 (5300)	21.86	21.89	17.888	17.908
	64 (5320)	22.11	21.93	17.949	17.832
	100 (5500)	22.04	22.40	17.894	17.907
	116 (5580)	21.98	22.03	17.848	17.837
	140 (5700)	21.75	21.73	17.818	17.834
IEEE 802.11n-HT40	38 (5190)	43.44	43.56	36.486	36.388
	46 (5230)	42.94	42.87	36.493	36.340
	54 (5270)	43.71	42.86	36.547	36.409
	62 (5310)	43.75	43.05	36.403	36.466
	102 (5510)	42.87	42.66	36.421	36.376
	110 (5550)	43.24	43.78	36.423	36.554
	134 (5670)	43.85	42.52	36.454	36.363

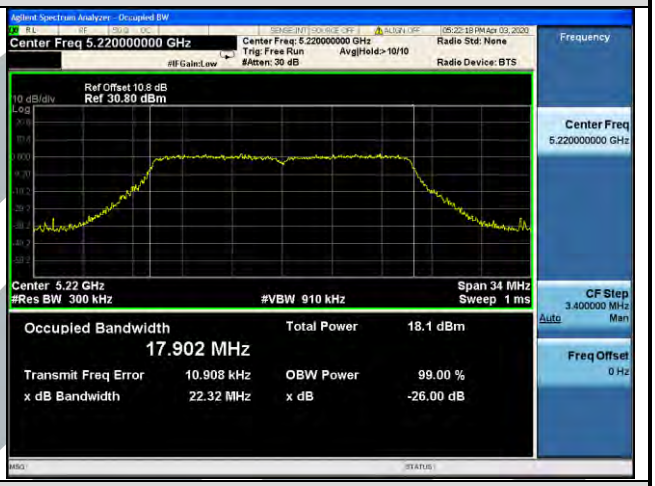
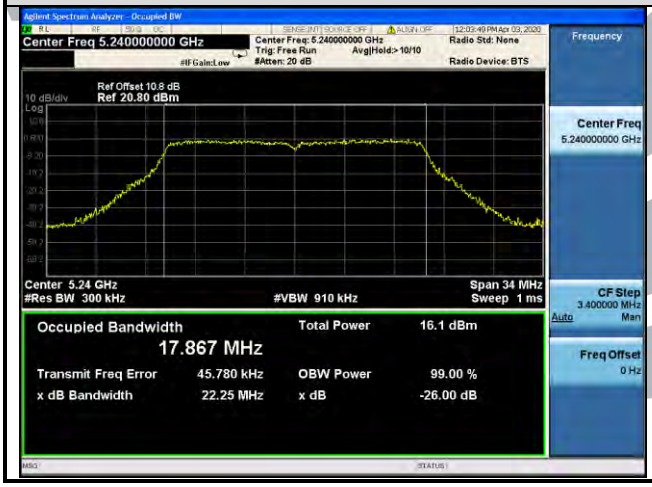
IEEE 802.11ac-VHT20	36 (5180)	21.83	21.36	17.879	17.767
	44 (5220)	21.90	21.99	17.925	17.817
	48 (5240)	22.05	21.66	17.866	17.845
	52 (5260)	21.79	22.10	17.878	17.902
	60 (5300)	21.83	21.65	17.872	17.859
	64 (5320)	21.63	21.98	17.898	17.913
	100 (5500)	22.02	22.21	17.851	17.888
	116 (5580)	21.74	22.41	17.859	17.921
	140 (5700)	21.63	21.82	17.893	17.893
IEEE 802.11ac-VHT40	38 (5190)	42.18	43.13	36.380	36.378
	46 (5230)	42.97	42.75	36.453	36.551
	54 (5270)	42.85	43.25	36.377	36.457
	62 (5310)	43.84	42.77	36.423	36.348
	102 (5510)	43.04	43.93	36.399	36.565
	110 (5550)	43.89	43.17	36.351	36.360
	134 (5670)	43.15	43.25	36.385	36.491
IEEE 802.11ac-VHT80	42 (5230)	81.21	81.65	75.209	75.133
	58 (5290)	81.86	81.20	74.997	75.132
	106 (5530)	82.09	81.38	75.124	75.189

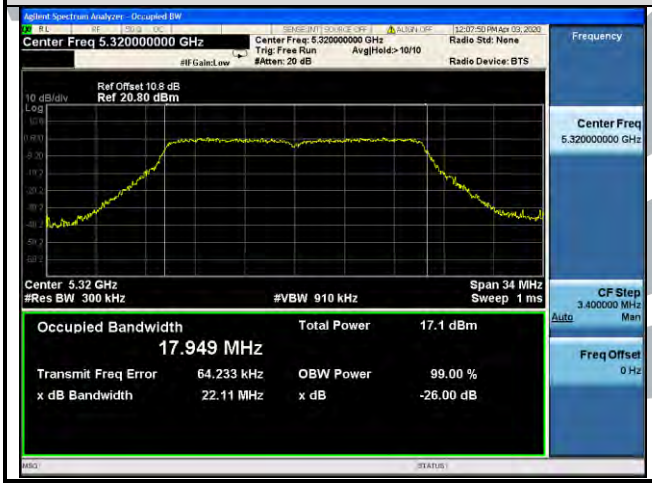
The test plots as follows:

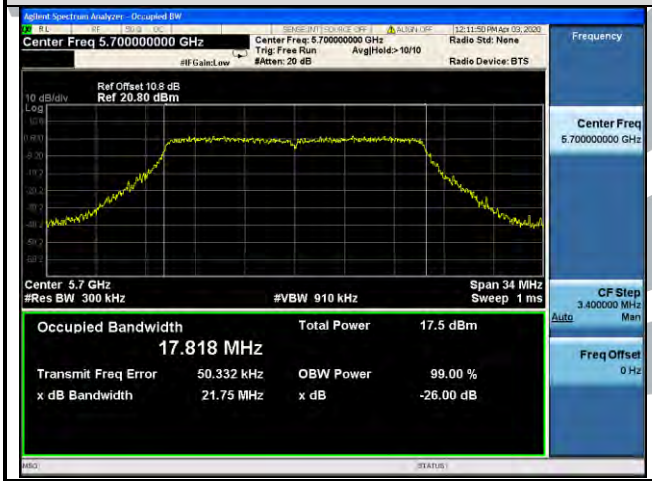
IEEE 802.11a	
Chain 0	**Chain 1**
Channel 36	
	
Channel 44	
	
Channel 48	
	

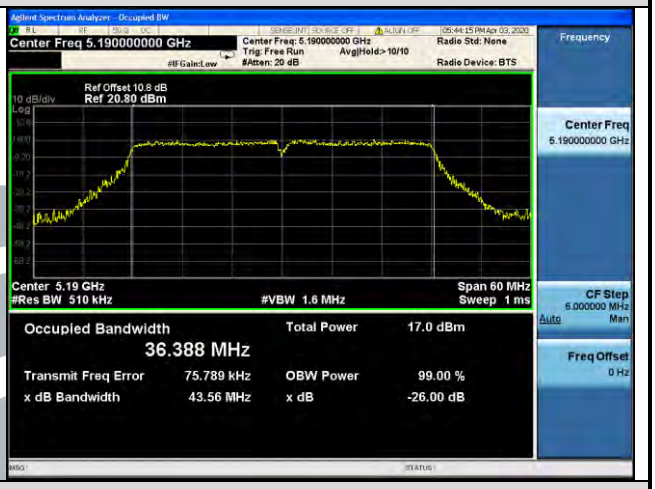
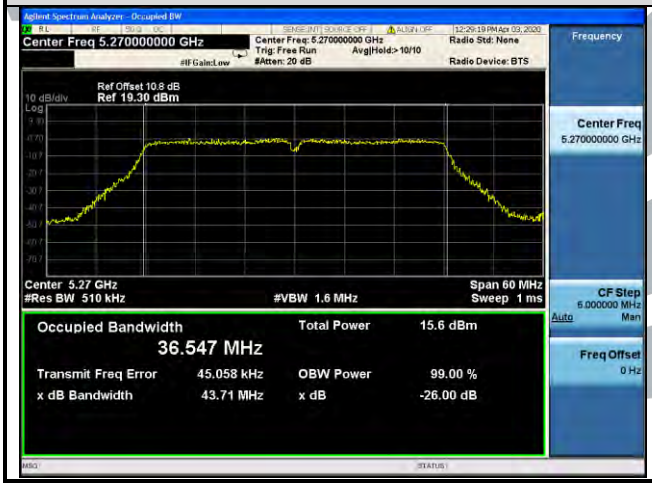
IEEE 802.11a	
Chain 0	Chain 1
Channel 52	
	
Channel 60	
	
Channel 64	
	

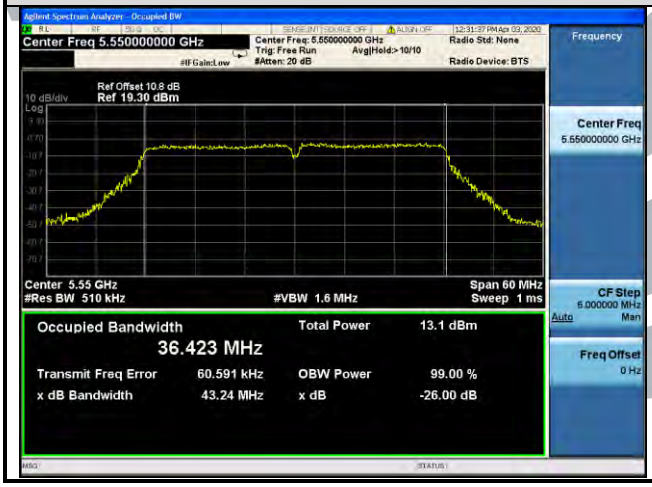
IEEE 802.11a	
Chain 0	Chain 1
Channel 100	
	
Channel 116	
	
Channel 140	
	

IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 36	
	
Channel 44	
	
Channel 48	
	

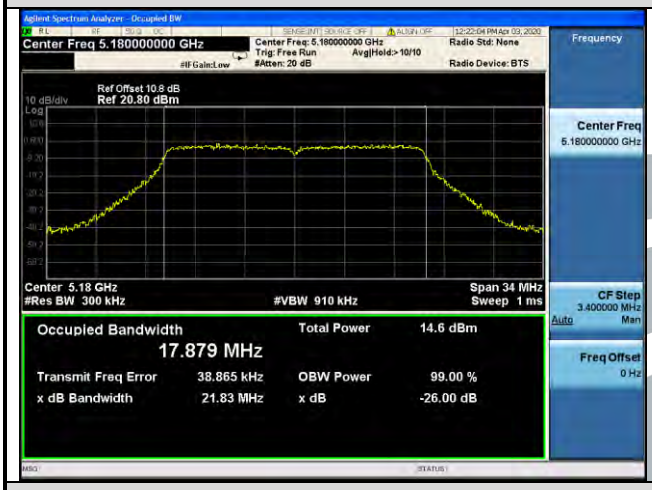
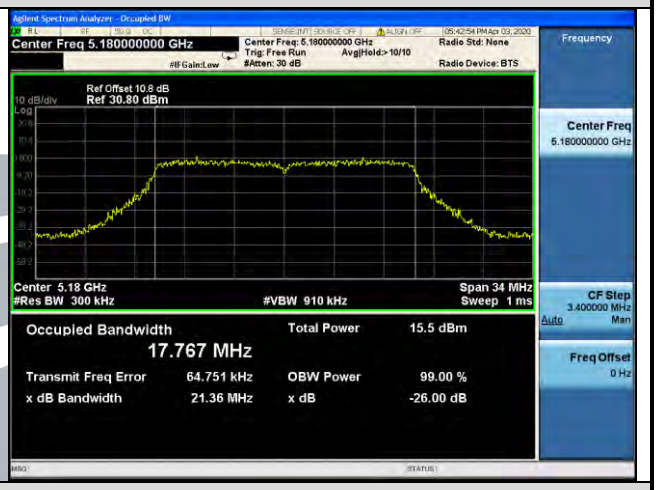
IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 52	
	
Channel 60	
	
Channel 64	
	

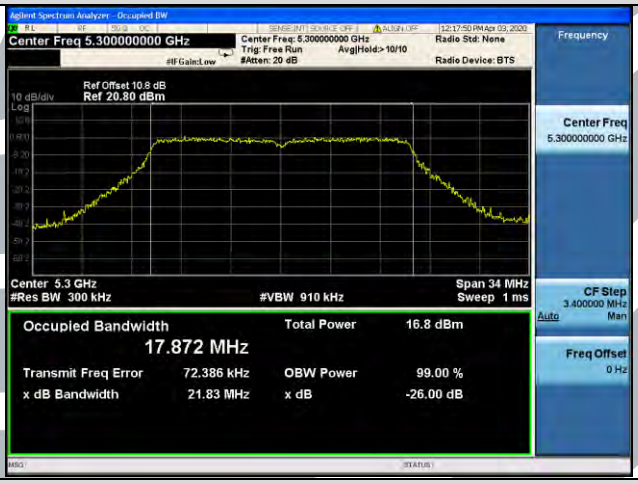
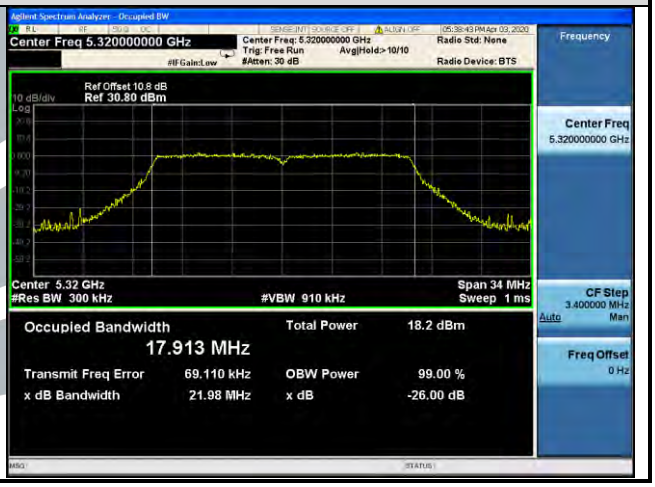
IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 100	
	
Channel 116	
	
Channel 140	
	

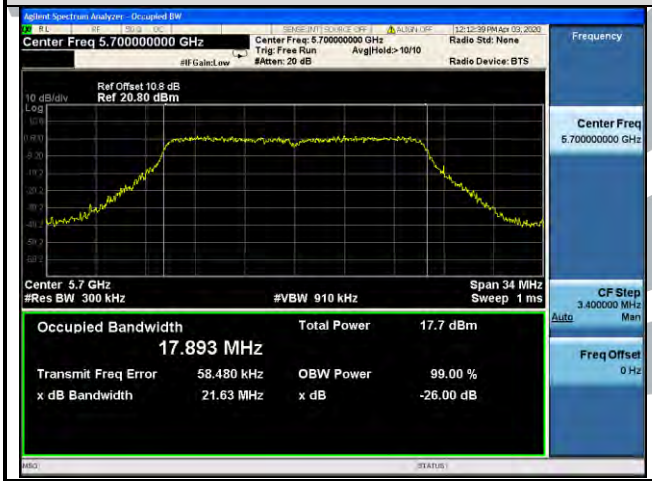
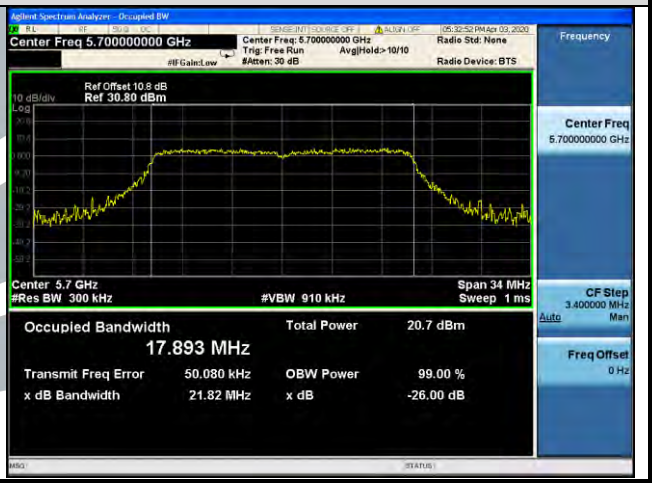
IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 38	
	
Channel 46	
	
Channel 54	
	

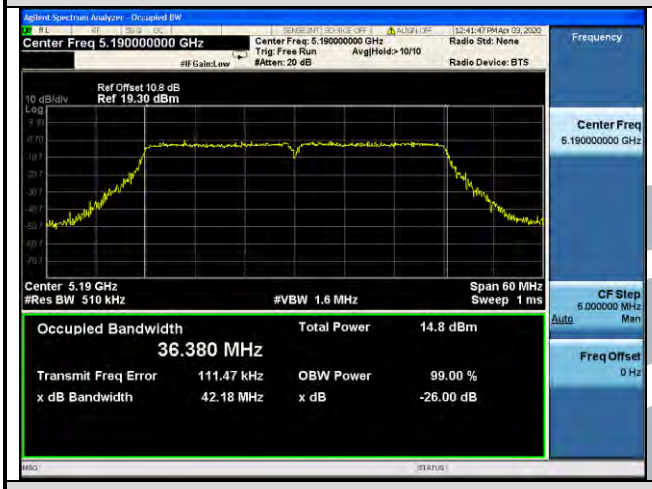
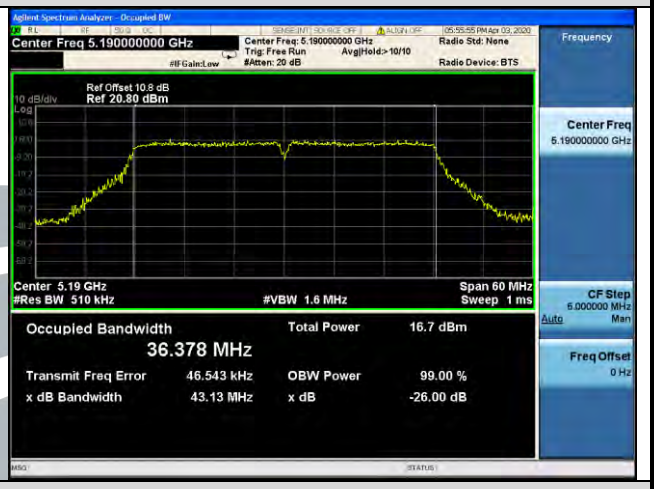
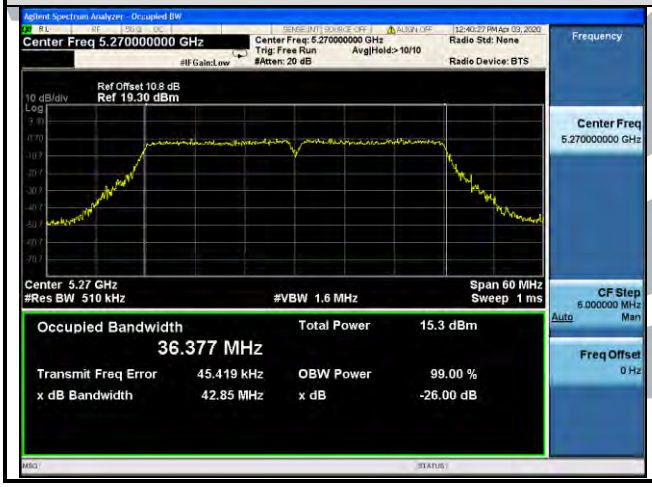
IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 62	
	
Channel 102	
	
Channel 110	
	

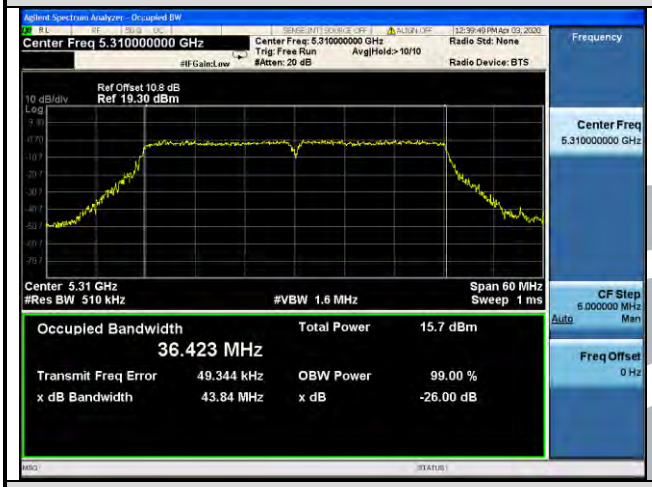
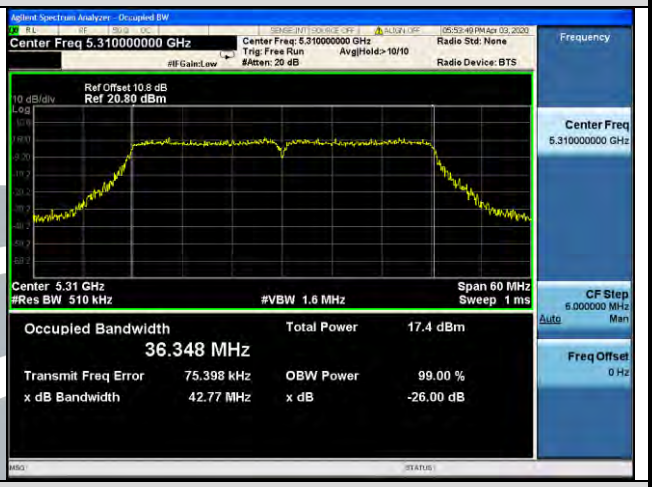
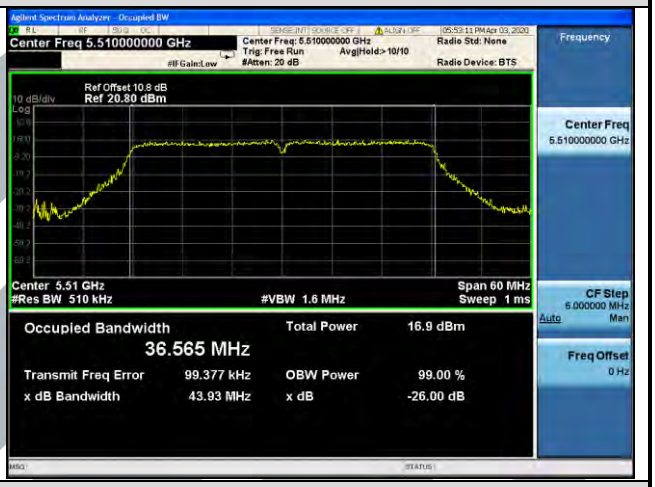
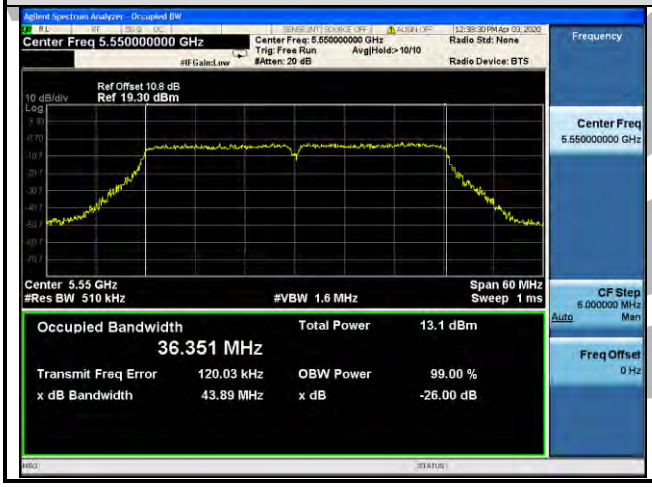
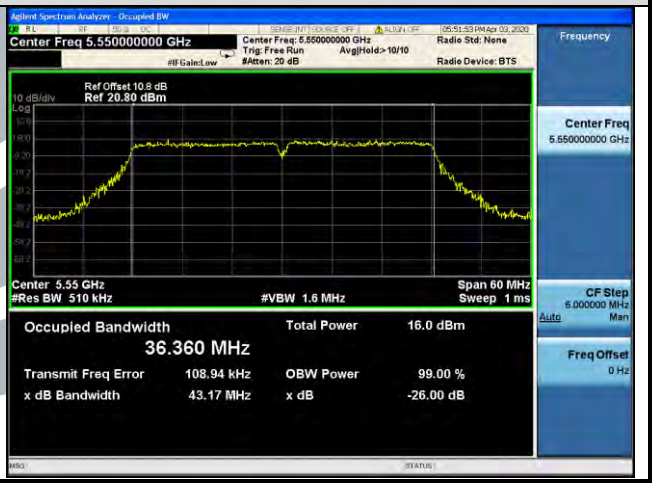
IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 134	

IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 36	
	
Channel 44	
	
Channel 48	
	

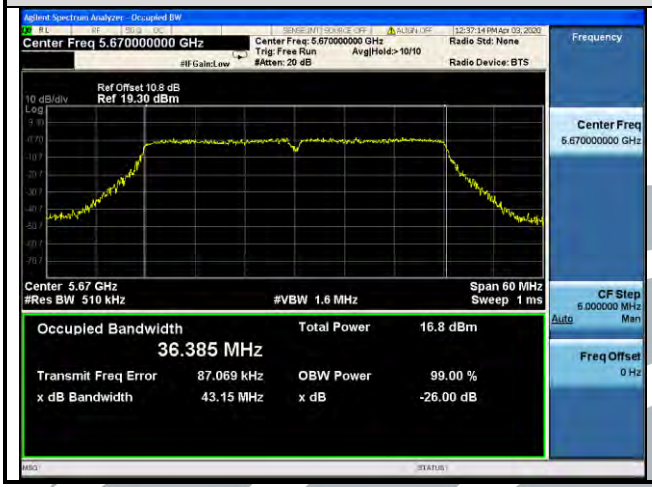
IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 52	
	
Channel 60	
	
Channel 64	
	

IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 100	
	
Channel 116	
	
Channel 140	
	

IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 38	
	
Channel 46	
	
Channel 54	
	

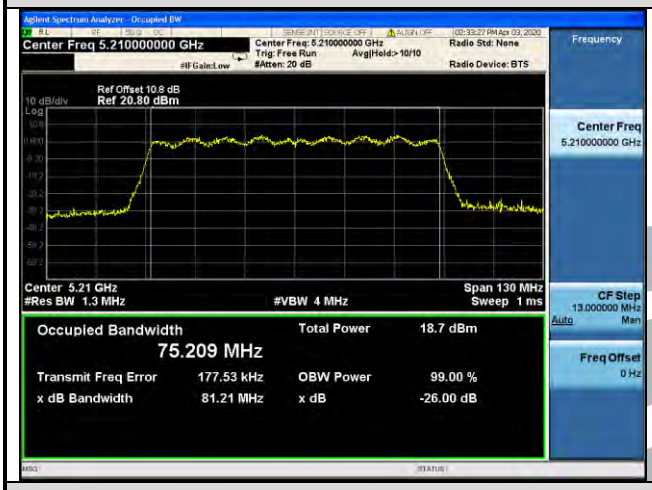
IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 62	
	
Channel 102	
	
Channel 110	
	

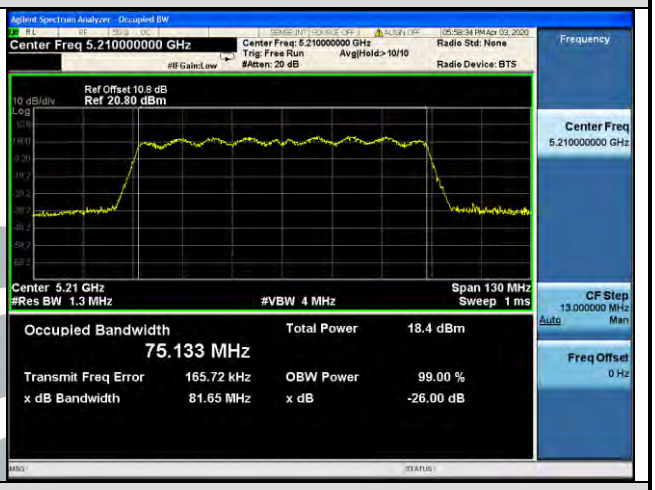
IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 134	



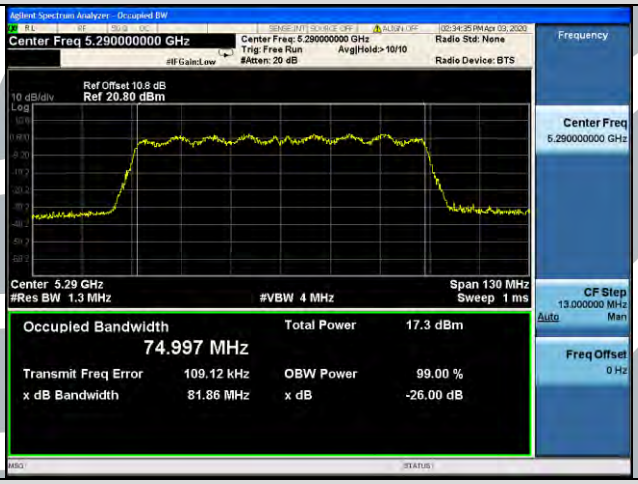
IEEE 802.11ac-VHT80

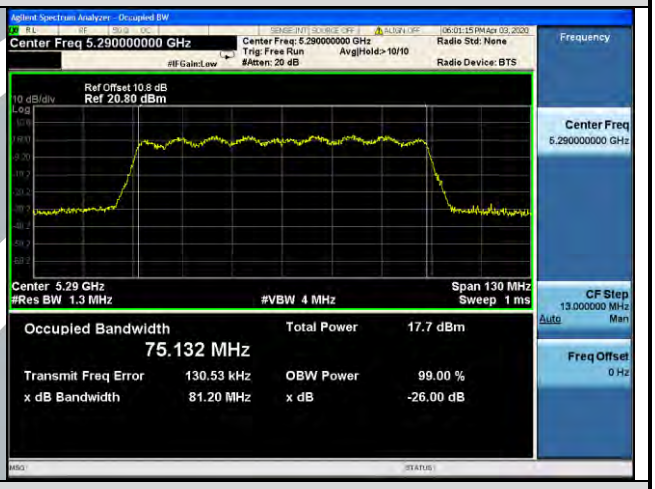
Channel 42



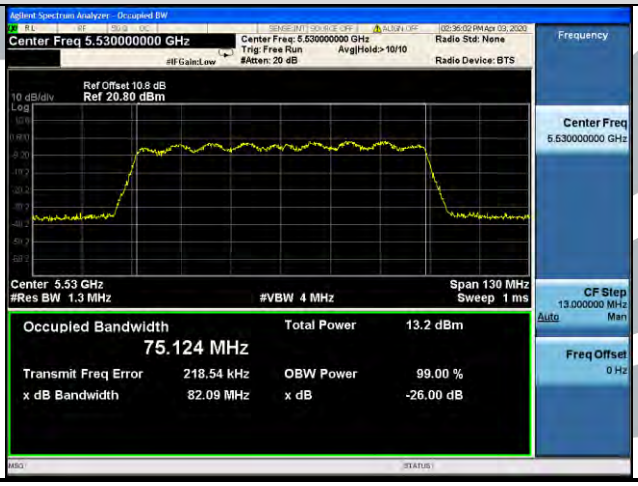


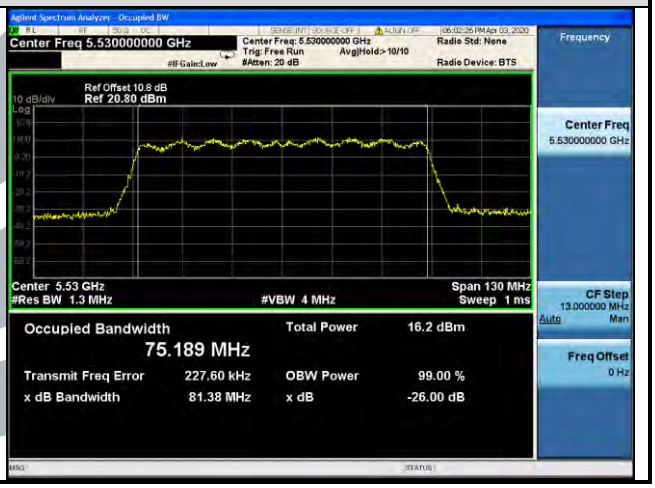
Channel 58





Channel 106





5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement:	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 2 Section 6.2.4.1
Test Method:	KDB 789033 D02 v02r01 Section C.2
Limit:	Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

6dB Bandwidth

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 * RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) 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.

Occupied Bandwidth

a) Set RBW = 1% to 5% of the occupied bandwidth
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.

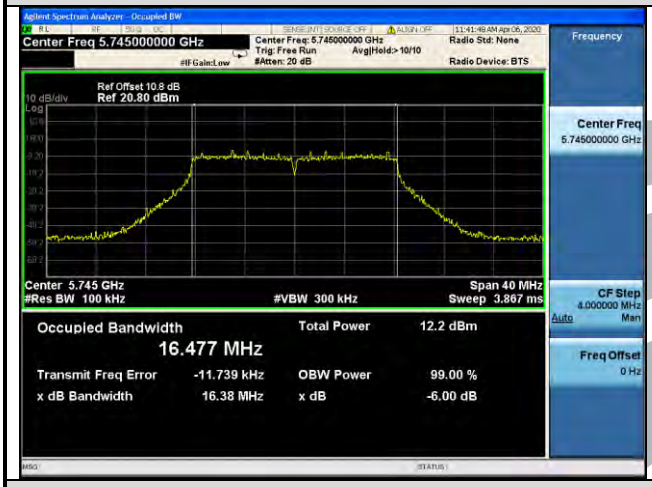
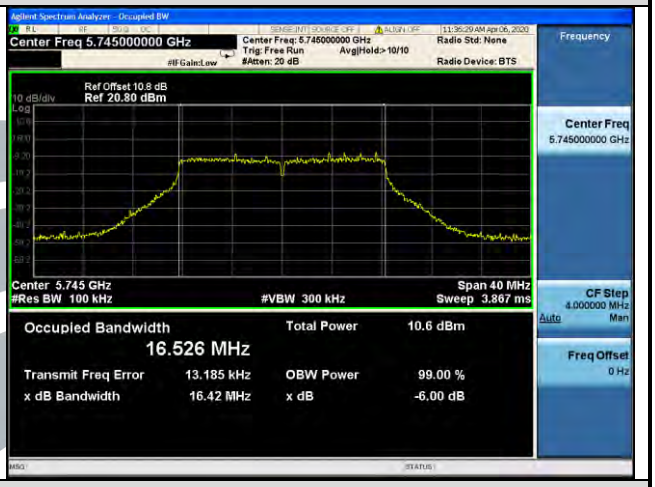
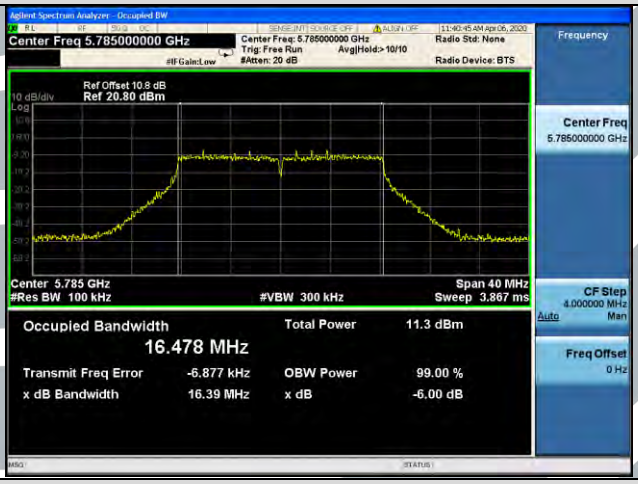
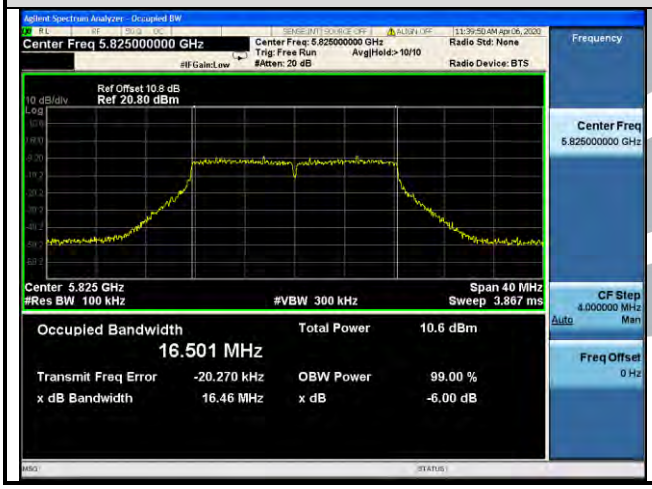
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

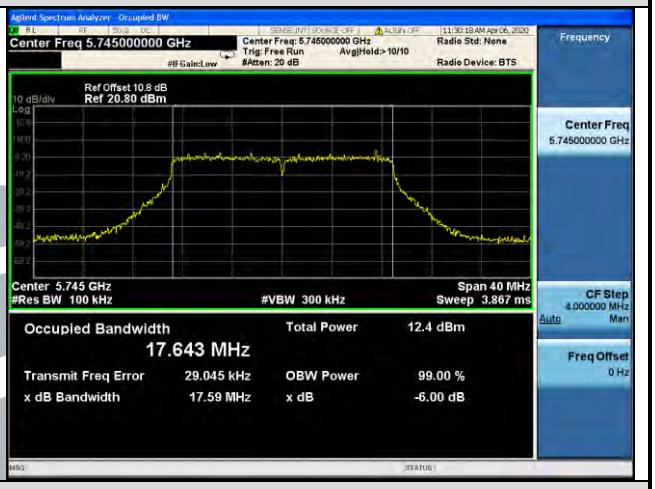
Test Setup:	Refer to section 4.5.3 for details.
Instruments Used:	Refer to section 3 for details
Test Mode:	Transmitter mode
Test Results:	Pass

Test Data:

Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)		99% Bandwidth (MHz)		6 dB Bandwidth Limit	Pass / Fail
		Chain 0	Chain 1	Chain 0	Chain 1		
IEEE 802.11a	149 (5745)	16.38	16.42	16.477	16.526	> 500 kHz	Pass
	157 (5785)	16.39	16.39	16.478	16.498	> 500 kHz	Pass
	165 (5825)	16.46	16.40	16.501	16.539	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	17.59	17.59	17.628	17.643	> 500 kHz	Pass
	157 (5785)	17.39	17.58	17.633	17.634	> 500 kHz	Pass
	165 (5825)	17.60	17.36	17.640	17.635	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	36.06	36.11	36.161	36.169	> 500 kHz	Pass
	159 (5795)	35.90	35.87	36.109	36.114	> 500 kHz	Pass
IEEE 802.11ac-VHT20	149 (5745)	17.60	17.57	17.638	17.628	> 500 kHz	Pass
	157 (5785)	17.57	17.55	17.637	17.624	> 500 kHz	Pass
	165 (5825)	17.59	17.54	17.627	17.625	> 500 kHz	Pass
IEEE 802.11ac-VHT40	151 (5755)	36.32	36.34	36.113	36.137	> 500 kHz	Pass
	159 (5795)	36.06	35.66	36.118	36.140	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	73.96	75.27	74.946	75.112	> 500 kHz	Pass

The test plots as follows:
6 dB Bandwidth

IEEE 802.11a	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 149	
	
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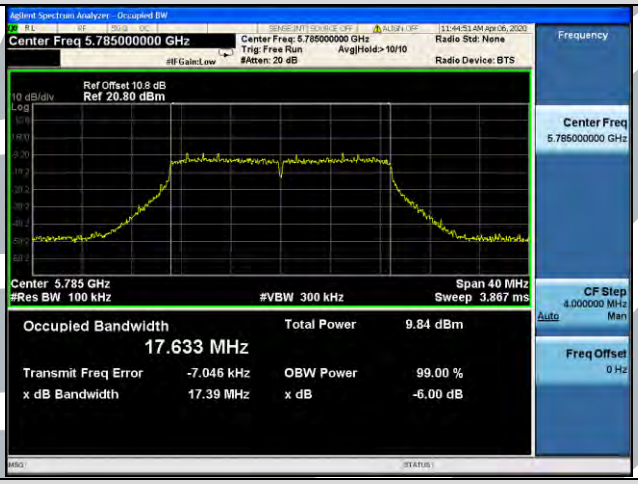
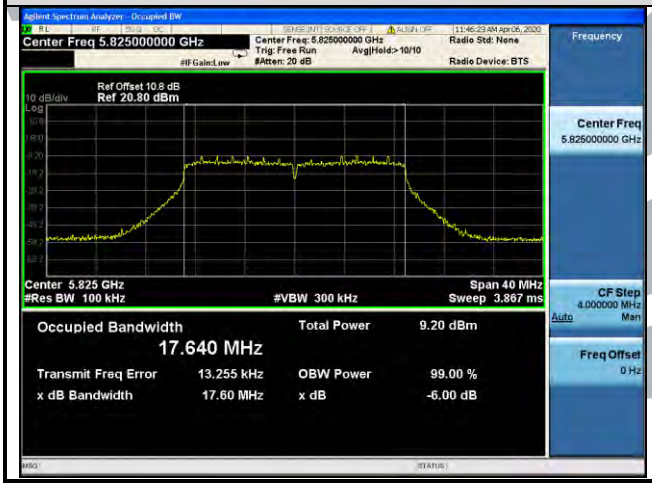
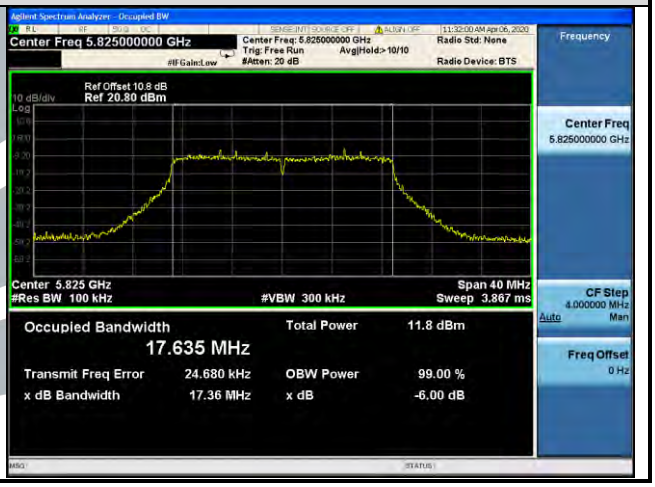
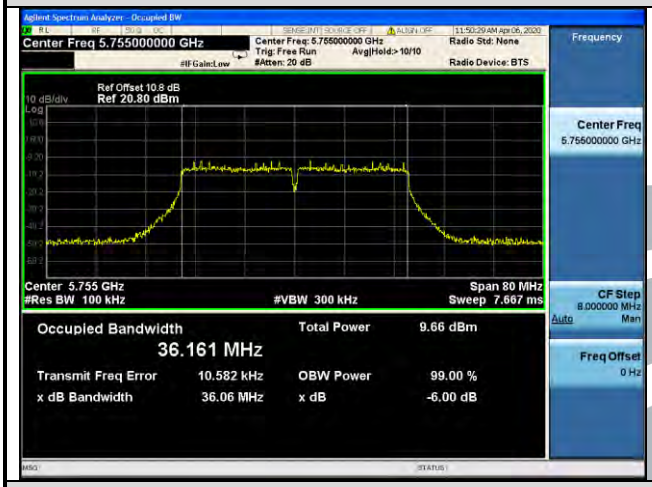
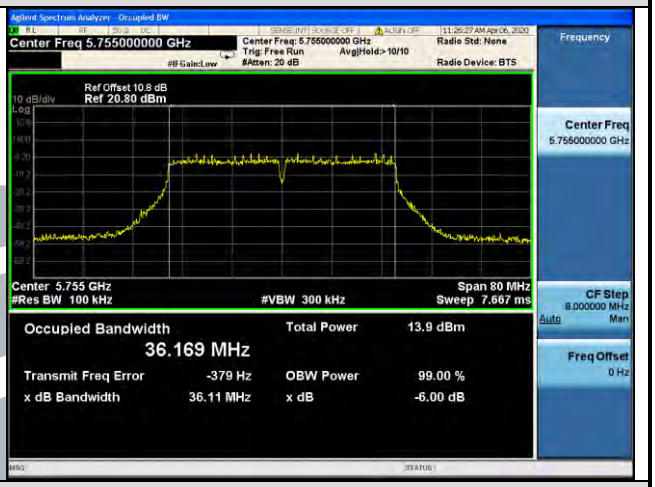
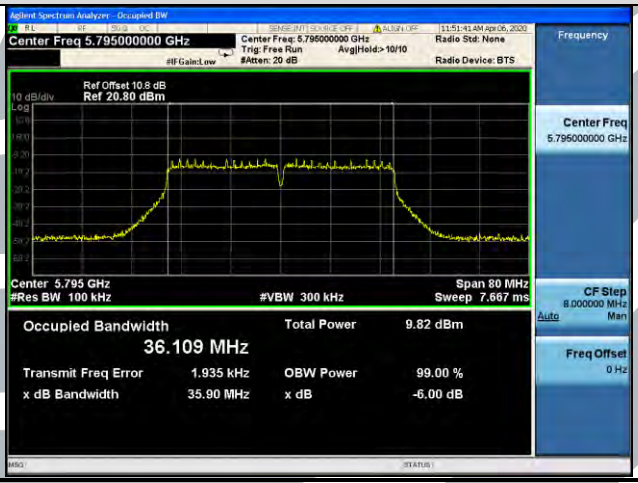
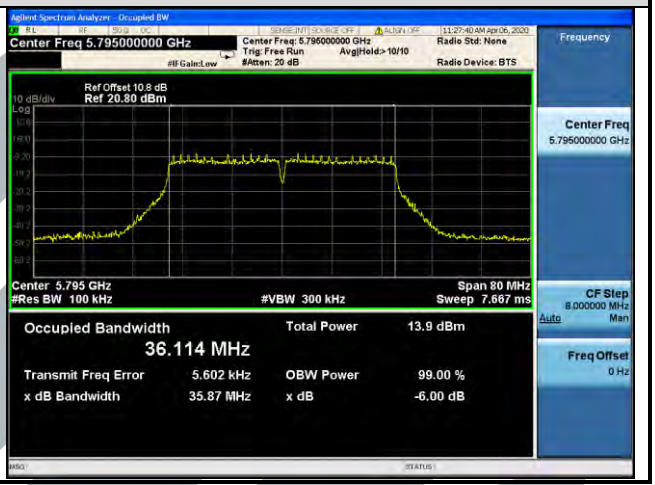
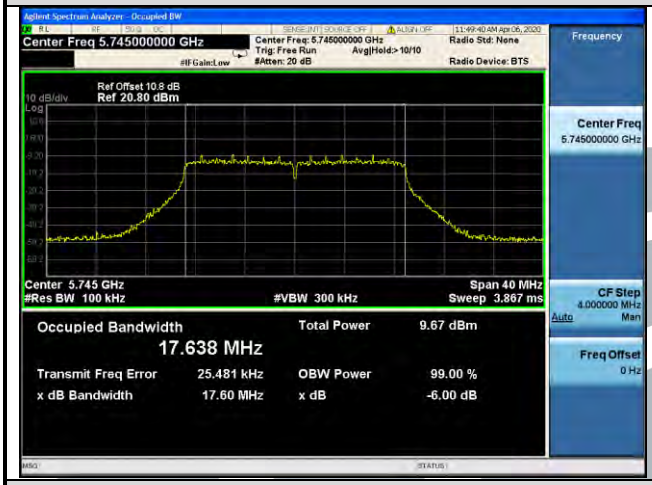
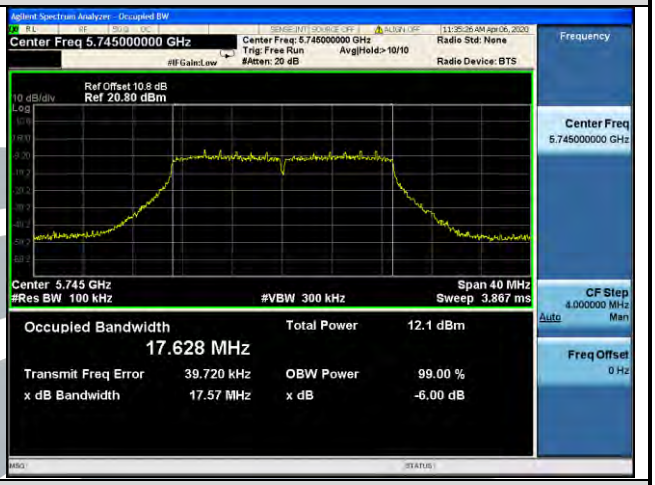
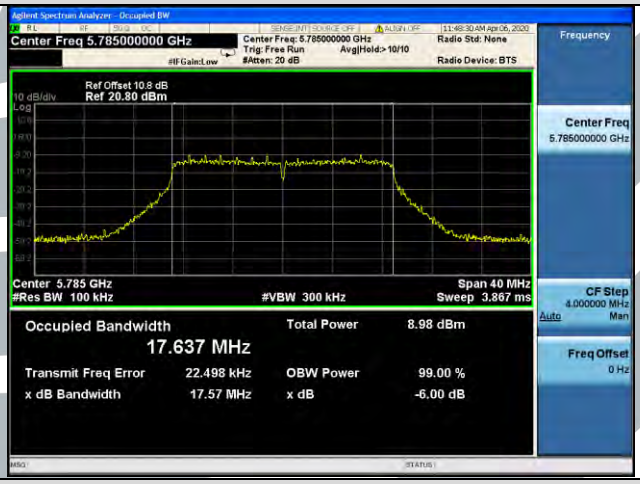
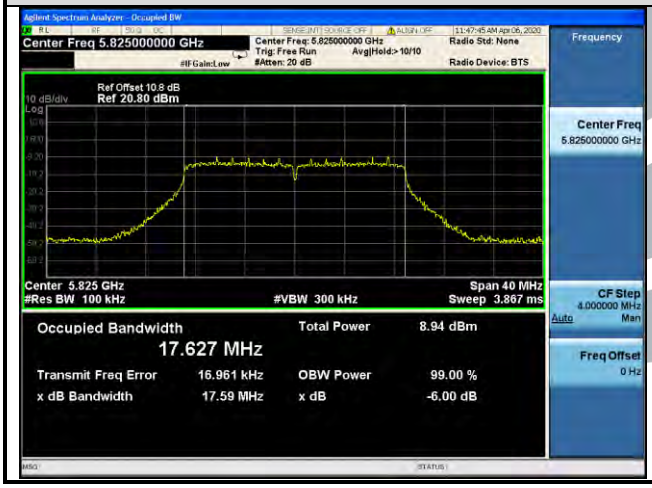
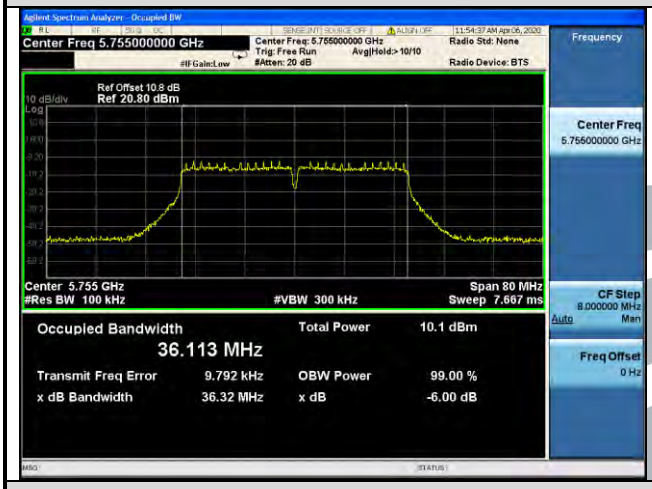
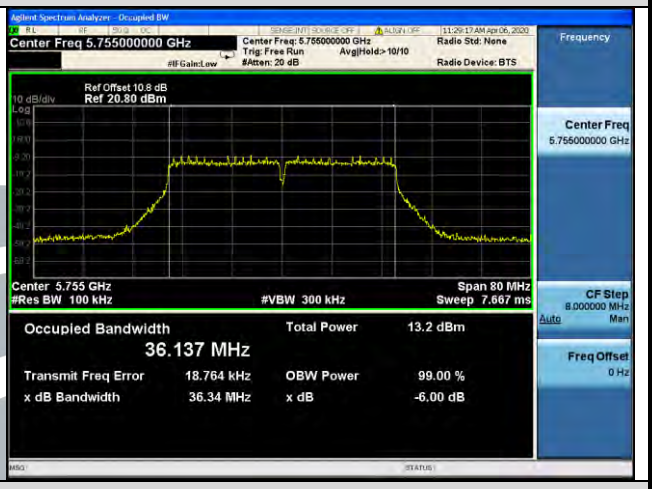
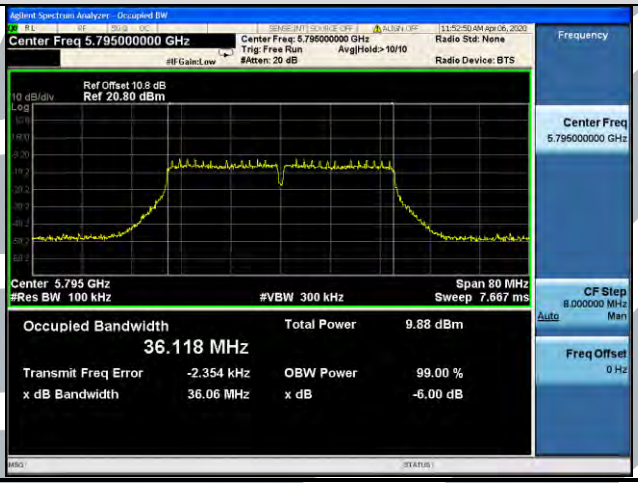
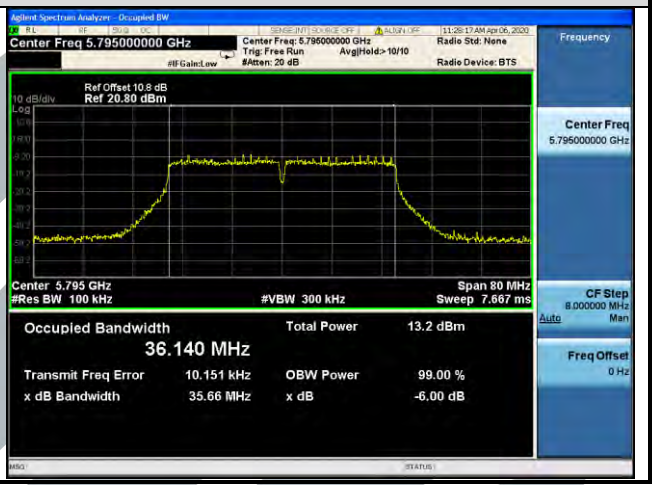
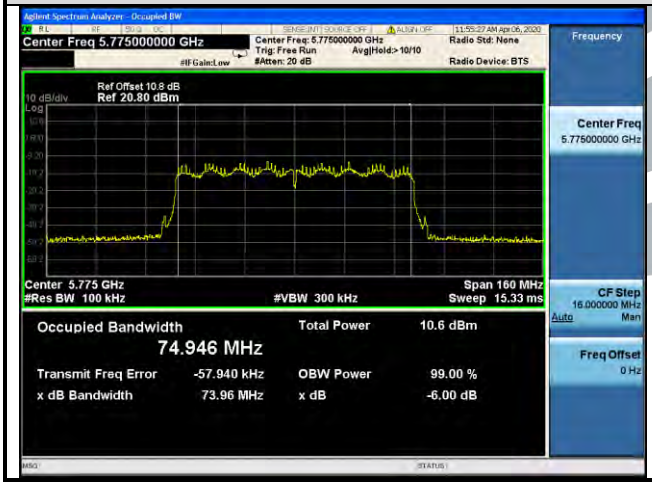
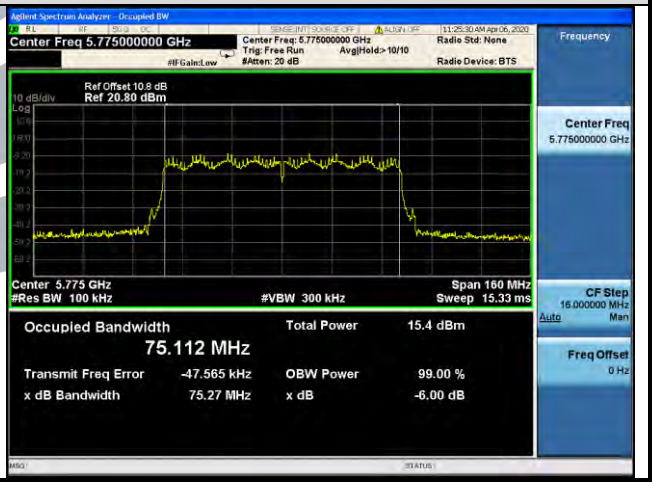
	
Channel 165	
	

IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

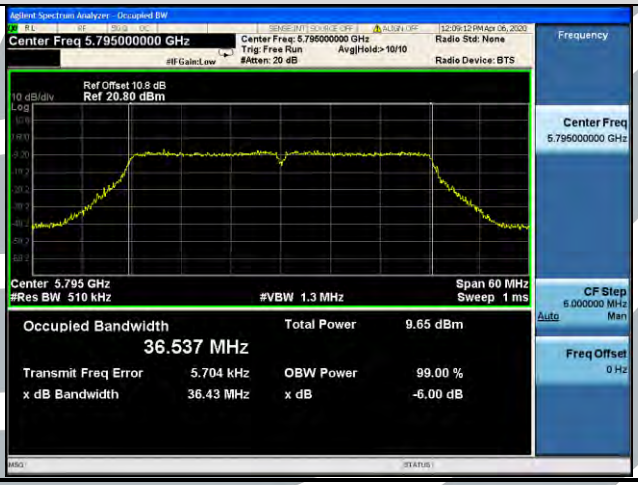
IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

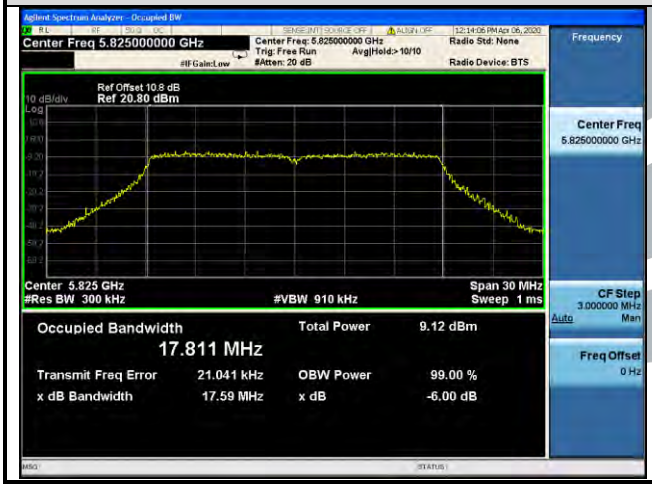
IEEE 802.11ac-VHT80	
Chain 0	Chain 1
Channel 155	
	

Occupied Bandwidth

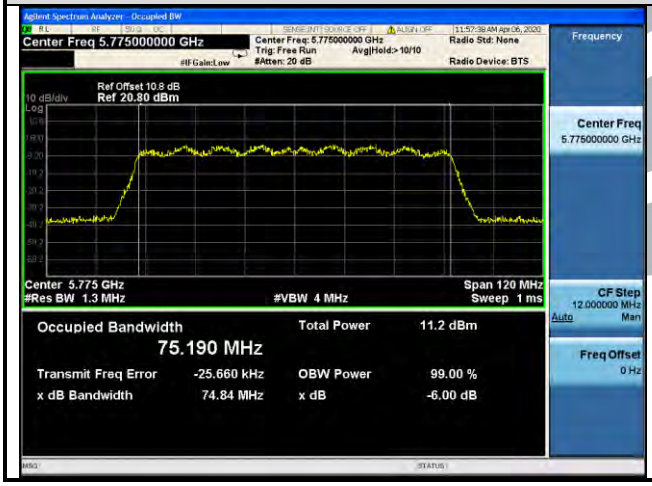
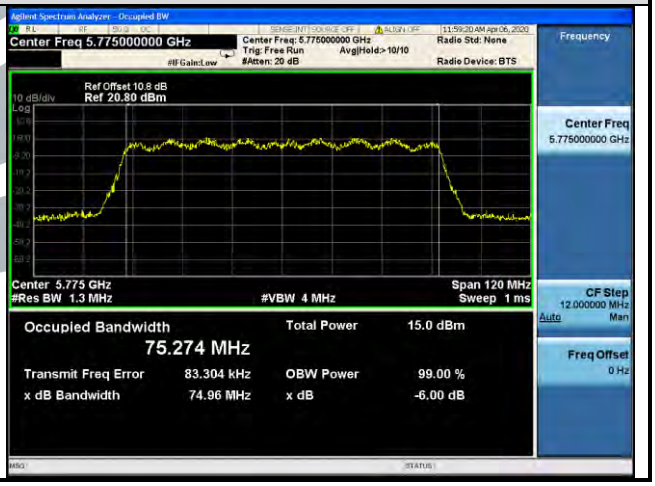
IEEE 802.11a	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

IEEE 802.11ac-VHT20	
Chain 0	Chain 1
Channel 149	
	
Channel 157	
	
Channel 165	
	

IEEE 802.11ac-VHT40	
Chain 0	Chain 1
Channel 151	
	
Channel 159	
	

IEEE 802.11ac-VHT80	
Chain 0	Chain 1
Channel 155	
	

5.5 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section E.3.a (Method PM)

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. 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 or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Limits: RSS-247 Issue 2

1. **Frequency band 5150-5250 MHz**
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. **Frequency band 5250-5350 MHz**
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

a) The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;

b) The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW/MHz for $0^o \le \theta < 8^o$

ii. -13 − 0.716 (θ-8) dBW/MHz for $8^o \le \theta < 40^o$

iii. -35.9 − 1.22 (θ-40) dBW/MHz for $40^o \le \theta \le 45^o$

iv. -42 dBW/MHz for $\theta > 45^o$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:

i. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or

ii. devices shall implement a method to permanently reduce their e.i.r.p. via a firmwarefeature in the event that the Department requires it. The test report must demonstratehow the device's power table can be updated to meet this firmware requirement. Themanufacturer shall provide this firmware to update all systems automatically incompliance with the directions received from the Department.

3. **Frequency bands 5470-5600 MHz and 5650-5725 MHz**
The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. **Frequency band 5725-5850 MHz**

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices

operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint[3] systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Directional gain and the maximum output power limit.

RSS-247 Issue 2

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	5.00	5.00	8.01	23.00
U-NII-2A	5.00	5.00	8.01	21.99
U-NII-2C	5.00	5.00	8.01	21.99
U-NII-3	5.00	5.00	8.01	27.99
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				

FCC 47 CFR Part 15 Subpart E

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	5.00	5.00	8.01	24.00
U-NII-2A	5.00	5.00	8.01	21.99
U-NII-2C	5.00	5.00	8.01	21.99
U-NII-3	5.00	5.00	8.01	27.99
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				

Frequency band 5150-5250 MHz
RSS-247 Issue 2:
For IEEE 802.11 a, the minimum 99% emission bandwidth is 16.847 MHz
10 dBm + $10\log_{10}$ (16.847) = 22.27 dBm < 23 dBm
So the 22.27 dB limit applicable

For IEEE 802.11 n-HT20/ ac-VHT20, the minimum 99% emission bandwidth is 17.817 MHz
10 dBm + $10\log_{10}$ (17.817) = 22.51 dBm < 23 dBm
So the 22.51 dB limit applicable

For IEEE 802.11 n-HT40/ ac-VHT40/ ac-VHT80, the minimum 99% emission bandwidth is 36.340 MHz
10 dBm + $10\log_{10}$ (36.340) = 25.60 dBm > 23 dBm
So the 23 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum e.i.r.p (dBm)		Total e.i.r.p MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	16.95	16.45	N/A	22.27	Pass
	44 (5220)	17.15	16.57	N/A	22.27	Pass
	48 (5240)	17.14	16.93	N/A	22.27	Pass
IEEE 802.11n-HT20	36 (5180)	15.88	18.49	20.39	22.51	Pass
	44 (5220)	16.11	18.43	20.43	22.51	Pass
	48 (5240)	16.44	18.56	20.64	22.51	Pass
IEEE 802.11n-HT40	38 (5190)	14.50	14.85	17.68	23	Pass
	46 (5230)	14.71	16.55	18.73	23	Pass
IEEE 802.11ac-VHT20	36 (5180)	15.79	18.43	20.32	22.51	Pass
	44 (5220)	15.87	18.44	20.35	22.51	Pass
	48 (5240)	16.10	18.42	20.42	22.51	Pass
IEEE 802.11ac-VHT40	38 (5190)	14.31	14.98	17.67	23	Pass
	46 (5230)	15.31	16.51	18.96	23	Pass
IEEE 802.11ac-VHT80	42 (5210)	15.51	12.86	17.40	23	Pass

Remark:
1. Maximum e.i.r.p = Maximum conducted output power + Antenna Gain
2. Total e.i.r.p (Chain 0+1) = 10*log[($10^{\text{Chain 0/10}}$)+($10^{\text{Chain 1/10}}$)] + Directional gain

FCC 47 CFR Part 15 Subpart E:

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	11.95	11.45	N/A	24	Pass
	44 (5220)	12.15	11.57	N/A	24	Pass
	48 (5240)	12.14	11.93	N/A	24	Pass
IEEE 802.11n-HT20	36 (5180)	10.88	13.49	15.39	24	Pass
	44 (5220)	11.11	13.43	15.43	24	Pass
	48 (5240)	11.44	13.56	15.64	24	Pass
IEEE 802.11n-HT40	38 (5190)	9.50	9.85	12.68	24	Pass
	46 (5230)	9.71	11.55	13.73	24	Pass
IEEE 802.11ac-VHT20	36 (5180)	10.79	13.43	15.32	24	Pass
	44 (5220)	10.87	13.44	15.35	24	Pass
	48 (5240)	11.10	13.42	15.42	24	Pass
IEEE 802.11ac-VHT40	38 (5190)	9.31	9.98	12.67	24	Pass
	46 (5230)	10.31	11.51	13.96	24	Pass
IEEE 802.11ac-VHT80	42 (5210)	10.51	7.86	12.40	24	Pass

Remark:

1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency band 5250-5350 MHz
RSS-247 Issue 2:
For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.806 MHz
11 dBm + $10\log_{10}$ (16.806) = 23.25 dBm > 21.99 dBm
So the 21.99 dB limit applicable

For IEEE 802.11 n-HT40//ac-VHT 40/ac-VHT80, the minimum 99% emission bandwidth is 36.403 MHz
11 dBm + $10\log_{10}$ (36.403) = 26.61 dBm > 21.99 dBm (200mW)
So the 21.99 dB limit applicable

FCC 47 CFR Part 15 Subpart E:
For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 21.42 MHz
11 dBm + $10\log_{10}$ (21.42) = 24.31 dBm > 21.99 dBm (200mW)
So the 21.99 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)		Pass / Fail
		SISO					
		Chain 0	Chain 1		FCC Part 15E	RSS-247	
IEEE 802.11a	52 (5260)	11.84	12.93	N/A	21.99	21.99	Pass
	60 (5300)	12.15	13.17	N/A	21.99	21.99	Pass
	64 (5320)	12.08	13.80	N/A	21.99	21.99	Pass
IEEE 802.11n-HT20	52 (5260)	10.44	13.80	15.45	21.99	21.99	Pass
	60 (5300)	13.23	13.92	16.60	21.99	21.99	Pass
	64 (5320)	13.32	15.08	17.30	21.99	21.99	Pass
IEEE 802.11n-HT40	54 (5270)	10.54	11.36	13.98	21.99	21.99	Pass
	62 (5310)	10.29	10.66	13.48	21.99	21.99	Pass
IEEE 802.11ac-VHT20	52 (5260)	11.91	13.91	16.03	21.99	21.99	Pass
	60 (5300)	12.79	14.43	16.70	21.99	21.99	Pass
	64 (5320)	13.21	15.21	17.33	21.99	21.99	Pass
IEEE 802.11ac-VHT40	54 (5270)	10.53	11.31	13.95	21.99	21.99	Pass
	62 (5310)	10.54	10.68	13.62	21.99	21.99	Pass
IEEE 802.11ac-VHT80	58 (5290)	10.28	7.93	12.28	21.99	21.99	Pass

Remark:
1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency bands 5470-5725 MHz (RSS-247 Issue 2 Not including 5600-5650 MHz)
RSS-247 Issue 2:
For IEEE 802.11 a/n-HT20/ac-VHT20, the minimum 99% emission bandwidth is 16.813 MHz
11 dBm + $10\log_{10}$ (16.813) = 23.26 dBm > 21.99 dBm
So the 21.99 dB limit applicable

For IEEE 802.11 n-HT40//ac-VHT40/ac-VHT80, the minimum 99% emission bandwidth is 36.351 MHz
11 dBm + $10\log_{10}$ (36.054) = 26.61 dBm > 21.99 dBm
So the 21.99 dB limit applicable

FCC 47 CFR Part 15 Subpart E:
For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 21.12 MHz
11 dBm + $10\log_{10}$ (21.12) = 24.25 dBm > 21.99 dBm
So the 21.99 dB limit applicable

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)		Pass / Fail
		SISO					
		Chain 0	Chain 1		FCC Part 15E	RSS-247	
IEEE 802.11a	100 (5500)	9.95	11.81	N/A	21.99	21.99	Pass
	116 (5580)	11.15	13.06	N/A	21.99	21.99	Pass
	140 (5700)	14.14	15.19	N/A	21.99	21.99	Pass
IEEE 802.11n-HT20	100 (5500)	8.96	10.98	13.10	21.99	21.99	Pass
	116 (5580)	11.89	12.92	15.44	21.99	21.99	Pass
	140 (5700)	12.99	15.10	17.18	21.99	21.99	Pass
IEEE 802.11n-HT40	102 (5510)	8.17	9.37	11.82	21.99	21.99	Pass
	110 (5550)	8.66	9.66	12.19	21.99	21.99	Pass
	134 (5670)	12.14	12.65	15.41	21.99	21.99	Pass
IEEE 802.11ac-VHT20	100 (5500)	9.01	12.21	13.91	21.99	21.99	Pass
	116 (5580)	10.55	13.34	15.17	21.99	21.99	Pass
	140 (5700)	13.21	14.89	17.14	21.99	21.99	Pass
IEEE 802.11ac-VHT40	102 (5510)	8.68	9.61	12.18	21.99	21.99	Pass
	110 (5550)	9.34	9.78	12.58	21.99	21.99	Pass
	134 (5670)	12.31	12.31	15.32	21.99	21.99	Pass
IEEE 802.11ac-VHT80	106 (5530)	7.04	8.04	10.58	21.99	21.99	Pass

Remark:
1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency band 5725-5850 MHz

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Total Power MIMO_ Chain 0+1 (dBm)	Limit (dBm)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	149 (5745)	6.82	6.99	N/A	27.99	Pass
	157 (5785)	6.73	6.93	N/A	27.99	Pass
	165 (5825)	5.84	6.49	N/A	27.99	Pass
IEEE 802.11n-HT20	149 (5745)	5.19	7.32	9.39	27.99	Pass
	157 (5785)	4.80	6.69	8.86	27.99	Pass
	165 (5825)	4.29	6.11	8.30	27.99	Pass
IEEE 802.11n-HT40	151 (5755)	4.38	4.78	7.59	27.99	Pass
	159 (5795)	3.41	3.89	6.66	27.99	Pass
IEEE 802.11ac-VHT20	149 (5745)	5.43	7.68	9.71	27.99	Pass
	157 (5785)	4.68	7.58	9.38	27.99	Pass
	165 (5825)	4.22	6.21	8.34	27.99	Pass
IEEE 802.11ac-VHT40	151 (5755)	4.54	4.98	7.78	27.99	Pass
	159 (5795)	3.64	4.32	7.00	27.99	Pass
IEEE 802.11ac-VHT80	155 (5775)	3.86	4.11	7.00	27.99	Pass

Remark:

1. Maximum conducted output power = Conducted output power + Duty Cycle Factor
2. Total Power(Chain 0+1) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})]$

5.6 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1

Test Method: KDB 789033 D02 v02r01 Section F

Limits: FCC 47 CFR Part 15 Subpart E

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. 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 or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Limits: RSS-247 Issue 2

1. **Frequency band 5150-5250 MHz**
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

2. **Frequency band 5250-5350 MHz**
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 $\log_{10}$B, dBm, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

Devices, other than devices installed in vehicles, shall comply with the following:

a) The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band;

b) The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

Additional requirements

In addition to the above requirements, devices shall comply with the following, where applicable:

a) Outdoor fixed devices with a maximum e.i.r.p. greater than 200 mW shall comply with the following e.i.r.p. at different elevations, where θ is the angle above the local horizontal plane (of the Earth) as shown below:

i. -13 dBW/MHz for $0^o \le \theta < 8^o$

ii. -13 − 0.716 (θ-8) dBW/MHz for $8^o \le \theta < 40^o$

iii. -35.9 − 1.22 (θ-40) dBW/MHz for $40^o \le \theta \le 45^o$

iv. -42 dBW/MHz for $\theta > 45^o$

The measurement procedure defined in Annex A of this document shall be used to verify the compliance to the e.i.r.p. at different elevations.

b) Devices, other than outdoor fixed devices, having an e.i.r.p. greater than 200 mW shall comply with either i. or ii. below:

iii. devices shall comply with the e.i.r.p. elevation mask in 6.2.2.3(a); or

iv. devices shall implement a method to permanently reduce their e.i.r.p. via a firmwarefeature in the event that the Department requires it. The test report must demonstratehow the device's power table can be updated to meet this firmware requirement. Themanufacturer shall provide this firmware to update all systems automatically incompliance with the directions received from the Department.

3. **Frequency bands 5470-5600 MHz and 5650-5725 MHz**
The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

4. **Frequency band 5725-5850 MHz**

The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices

operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint[3] systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

Test Procedure:

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer.

Spectrum analyzer according to the following Settings:

1. For U-NII-1, U-NII-2A, U-NII-2C band:

Using method SA-2

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Sweep time = auto, trigger set to “free run”.
d) Trace average at least 100 traces in power averaging mode.
e) Record the max value and add 10 log (1/duty cycle)

2. For U-NII-3 band:

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 500 kHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
d) Sweep time = auto, trigger set to “free run”.
e) Trace average at least 100 traces in power averaging mode.
f) Record the max value and add 10 log (1/duty cycle)

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Directional gain and the maximum output power limit.

RSS-247 Issue 2:

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	5.00	5.00	8.01	7.99
U-NII-2A	5.00	5.00	8.01	8.99
U-NII-2C	5.00	5.00	8.01	8.99
U-NII-3	5.00	5.00	8.01	27.99
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				

FCC 47 CFR Part 15 Subpart E:

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	PSD Limits (dBm/MHz or dBm/500kHz)
U-NII-1	5.00	5.00	8.01	8.99
U-NII-2A	5.00	5.00	8.01	8.99
U-NII-2C	5.00	5.00	8.01	8.99
U-NII-3	5.00	5.00	8.01	27.99
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				

Frequency band 5150-5250 MHz
RSS-247 Issue 2

Mode	Channel/ Frequency (MHz)	e.i.r.p. spectral density (dBm/MHz)		Total e.i.r.p. spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	1.61	1.29	N/A	10	Pass
	44 (5220)	2.26	3.72	N/A	10	Pass
	48 (5240)	2.53	3.51	N/A	10	Pass
IEEE 802.11n-HT20	36 (5180)	3.48	4.37	6.96	10	Pass
	44 (5220)	2.72	5.62	7.42	10	Pass
	48 (5240)	2.81	5.69	7.49	10	Pass
IEEE 802.11n-HT40	38 (5190)	-0.65	2.55	4.25	10	Pass
	46 (5230)	0.25	2.94	4.81	10	Pass
IEEE 802.11ac-VHT20	36 (5180)	1.73	3.34	5.62	10	Pass
	44 (5220)	2.31	4.08	6.29	10	Pass
	48 (5240)	2.73	4.41	6.66	10	Pass
IEEE 802.11ac-VHT40	38 (5190)	-0.47	1.83	3.84	10	Pass
	46 (5230)	0.14	2.86	4.72	10	Pass
IEEE 802.11ac-VHT80	42 (5210)	-2.93	1.25	2.65	10	Pass

Remark:

1. e.i.r.p. spectral density = Power spectral density + Duty Cycle Factor + Antenna Gain
2. Total e.i.r.p. spectral density (Chain 0+1) = $10*\log[(10^{\text{Chain 0}/10})+(10^{\text{Chain 1}/10})]$ + Directional gain

FCC 47 CFR Part 15 Subpart E

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	36 (5180)	-3.39	-3.71	N/A	11	Pass
	44 (5220)	-2.74	-1.28	N/A	11	Pass
	48 (5240)	-2.47	-1.49	N/A	11	Pass
IEEE 802.11n-HT20	36 (5180)	-1.52	-0.63	1.96	11	Pass
	44 (5220)	-2.28	0.62	2.42	11	Pass
	48 (5240)	-2.19	0.69	2.49	11	Pass
IEEE 802.11n-HT40	38 (5190)	-5.65	-2.45	-0.75	11	Pass
	46 (5230)	-4.75	-2.06	-0.19	11	Pass
IEEE 802.11ac-VHT20	36 (5180)	-3.27	-1.66	0.62	11	Pass
	44 (5220)	-2.69	-0.92	1.29	11	Pass
	48 (5240)	-2.27	-0.59	1.66	11	Pass
IEEE 802.11ac-VHT40	38 (5190)	-5.47	-3.17	-1.16	11	Pass
	46 (5230)	-4.86	-2.14	-0.28	11	Pass
IEEE 802.11ac-VHT80	42 (5210)	-7.93	-3.75	-2.35	11	Pass

Remark:

1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency band 5250-5350 MHz

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	52 (5260)	-2.06	-0.74	N/A	11	Pass
	60 (5300)	-0.72	-0.06	N/A	11	Pass
	64 (5320)	-0.53	0.32	N/A	11	Pass
IEEE 802.11n-HT20	52 (5260)	-2.74	0.96	2.50	11	Pass
	60 (5300)	-1.18	0.10	2.52	11	Pass
	64 (5320)	-0.17	0.57	3.23	11	Pass
IEEE 802.11n-HT40	54 (5270)	-5.15	-2.46	-0.59	11	Pass
	62 (5310)	-4.77	-2.16	-0.26	11	Pass
IEEE 802.11ac-VHT20	52 (5260)	-1.83	-1.00	1.62	11	Pass
	60 (5300)	-0.85	-0.29	2.45	11	Pass
	64 (5320)	-0.68	0.84	3.15	11	Pass
IEEE 802.11ac-VHT40	54 (5270)	-5.26	-3.34	-1.19	11	Pass
	62 (5310)	-5.48	-3.27	-1.22	11	Pass
IEEE 802.11ac-VHT80	58 (5290)	-8.01	-4.44	-2.86	11	Pass

Remark:

1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency bands 5470-5725 MHz (RSS-247 Issue 2 Not including 5600-5650 MHz)

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/MHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	100 (5500)	-2.36	-0.99	N/A	11	Pass
	116 (5580)	-0.37	0.60	N/A	11	Pass
	140 (5700)	2.26	3.43	N/A	11	Pass
IEEE 802.11n-HT20	100 (5500)	-5.16	-0.70	0.63	11	Pass
	116 (5580)	-2.58	0.59	2.30	11	Pass
	140 (5700)	0.18	3.68	5.28	11	Pass
IEEE 802.11n-HT40	102 (5510)	-8.33	-3.33	-2.14	11	Pass
	110 (5550)	-6.55	-2.74	-1.23	11	Pass
	134 (5670)	-3.84	-0.24	1.33	11	Pass
IEEE 802.11ac-VHT20	100 (5500)	-4.68	-1.48	0.22	11	Pass
	116 (5580)	-2.63	0.45	2.19	11	Pass
	140 (5700)	0.14	3.70	5.28	11	Pass
IEEE 802.11ac-VHT40	102 (5510)	-8.05	-3.54	-2.23	11	Pass
	110 (5550)	-7.60	-3.58	-2.13	11	Pass
	134 (5670)	-3.54	-0.04	1.57	11	Pass
IEEE 802.11ac-VHT80	106 (5530)	-11.48	-6.57	-5.36	11	Pass

Remark:

1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

Frequency band 5725-5850 MHz

Mode	Channel/ Frequency (MHz)	Power spectral density (dBm/MHz)		Total power spectral density MIMO_ Chain 0+1 (dBm/MHz)	Limit (dBm/500KHz)	Pass / Fail
		SISO				
		Chain 0	Chain 1			
IEEE 802.11a	149 (5745)	-12.27	-8.71	N/A	30	Pass
	157 (5785)	-11.83	-8.54	N/A	30	Pass
	165 (5825)	-11.95	-8.91	N/A	30	Pass
IEEE 802.11n-HT20	149 (5745)	-11.43	-8.38	-6.63	30	Pass
	157 (5785)	-11.92	-7.89	-6.44	30	Pass
	165 (5825)	-12.36	-7.03	-5.91	30	Pass
IEEE 802.11n-HT40	151 (5755)	-10.55	-10.95	-7.74	30	Pass
	159 (5795)	-11.26	-10.82	-8.02	30	Pass
IEEE 802.11ac-VHT20	149 (5745)	-11.42	-8.39	-6.63	30	Pass
	157 (5785)	-12.02	-8.72	-7.05	30	Pass
	165 (5825)	-13.55	-9.19	-7.83	30	Pass
IEEE 802.11ac-VHT40	151 (5755)	-11.02	12.74	12.76	30	Pass
	159 (5795)	-11.13	-10.99	-8.05	30	Pass
IEEE 802.11ac-VHT80	155 (5775)	-11.61	-11.99	-8.79	30	Pass

Remark:

1. Power spectral density = Conducted power spectral density + Duty Cycle Factor
2. Total Power (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$

The test plots as follows:

IEEE 802.11a	
Chain 0	**Chain 1**
Channel 36	
	
Channel 44	
	
Channel 48