FCC TEST REPORT

Product Name:	Smart Home Gateway
Trade Mark:	Sunniwell
Model No.:	S-GTAR100
Report Number:	181029005RFC-2
Test Standards:	FCC 47 CFR Part 15 Subpart E
FCC ID:	2AJJP-GTAR100A
Test Result:	PASS
Date of Issue:	December 25, 2018

Prepared for:

Sunniwell Co., Ltd.
1717 Haitai Building 229# Beisihuan Zhong Road, Bei jing 100083
P.R.China

Prepared by:

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Tested by: Henry Lu, Project Engineer

Reviewed by: Kevin Liang, Assistant Manager

Approved by: Billy Li, Technical Director

Date: December 25, 2018

Version

Version No.	Date	Description
V1.0	December 25, 2018	Original

CONTENTS

1. GENERAL INFORMATION

5.1 CLIENT INFORMATION

Applicant:	Sunniwell Co., Ltd.
Address of Applicant:	1717 Haitai Building 229# Beisihuan Zhong Road, Bei jing 100083 P.R.China
Manufacturer:	Sunniwell Co., Ltd.
Address of Manufacturer:	1717 Haitai Building 229# Beisihuan Zhong Road, Bei jing 100083 P.R.China

5.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Smart Home Gateway		
Model No.:	S-GTAR100		
Trade Mark:	Sunniwell		
DUT Stage:	Identical Prototype		
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
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac
Sample Received Date:	November 5, 2018		
Sample Tested Date:	November 5, 2018 to December 7, 2018		

1.2.2 Description of Accessories

Adapter	
Model No.:	F12L19-120100SPAU
Input:	100-240 V~50/60 Hz 0.3 A
Output:	12.0 V ⎓ 1 A
DC Cable:	1.40 Meter, Shielded without ferrite
Manufacturer:	SHENZHEN FRECOM ELECTRONICS Co .,LTD

5.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)
	5 725 MHz to 5 850 MHz (U-NII-3)
Frequency Ranges:	5180 MHz to 5240 MHz
	5 745 MHz to 5 825 MHz
Support Standards:	IEEE 802.11/n/ac
TPC Function:	Not Support
Type of Modulation:	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)
Channel Spacing:	n-HT20/ac-VHT20: 20 MHz
	IEEE 802.11n-HT40: 40 MHz
Data Rate:	IEEE 802.11n-HT20: Up to MCS15
	IEEE 802.11n-HT40: Up to MCS15
	IEEE 802.11ac-VHT20: Up to MCS8
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802. n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40
	5725 MHz to 5850 MHz: 5 for IEEE 802. n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40

Antenna Type:	Chain 0	External Antenna	
	Chain 1	External Antenna	
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 8 dBi	
		5725 MHz to 5850 MHz: 8 dBi	
	Chain 1	5150 MHz to 5250 MHz: 8 dBi	
		5725 MHz to 5850 MHz: 8 dBi	
Maximum Conducted Output Power: dBm	**MIMO_Chain 0+1**	**U-NII-1**	**U-NII-3**
	IEEE 802.11n-HT20:	15.11	15.19
	IEEE 802.11n-HT40:	14.59	15.06
	IEEE 802.11ac-VHT20:	14.78	15.43
Normal Test Voltage:	12 Vdc		

5.4 OTHER INFORMATION

Operation Frequency Each of Channel		
	U-NII-1	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 = 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, 2
IEEE 802.11ac-VHT80	f = 5000 + 5k, k = 26 + 16n	f = 5000 + 5k, k = 155
	n = 1	
Note: **f** is the operating frequency (MHz); **k** is the operating channel.		

5.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	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

5.6 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

5.7 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.

IC-Registration No.: 21600-1
The 3m Semi-anechoic chamber of Shenzhen UnionTrust Quality and Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 21600-1.

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.

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

5.8 DEVIATION FROM STANDARDS

None.

5.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

5.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

5.11 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 C Section 15.407(a)(1) (2)	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e)	KDB 789033 D02 v02r01 Section C.2	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(3)	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)(3)	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)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205	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)	KDB 905462 D03 Client Without DFS New Rules v01r02	N/A (Note 1, 2)
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	ANSI C63.10-2013, Section 6.2.	PASS
Note: 1) N/A: In this whole report not application. 2) This EUT does not support U-NII-2A and U-NII-2C frequency bands.			

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. 20, 2015	Dec. 19, 2018
☑	Receiver	R&S	ESIB26	100114	Dec. 10, 2017	Dec. 10, 2018
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec.10, 2017	Dec. 10, 2018
☑	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 22, 2017	Dec. 22, 2018
☑	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 17, 2017	Dec. 17, 2018
☑	Preamplifier	HP	8447F	2805A02960	Dec. 10, 2017	Dec. 10, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 22, 2018	May 22, 2019
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Dec. 17, 2017	Dec. 17, 2018
☑	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☑	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	June 06, 2018	June 06, 2019
☑	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	Dec. 10, 2017	Dec. 10, 2018
☑	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Dec. 10, 2017	Dec. 10, 2018
☑	LISN	R&S	ESH2-Z5	860014/024	Dec. 10, 2017	Dec. 10, 2018
☑	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	Dec.10, 2017	Dec. 10, 2018
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Dec. 10, 2017	Dec. 10, 2018
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Dec. 10, 2017	Dec. 10, 2018

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	12Vdc	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
AC Power Line Conducted Emission	26.1	50	99.8	Gemini Huang
26 dB emission bandwidth	23.2	50	99.8	Tony Kang
Maximum conducted output power	23.2	50	99.8	Tony Kang
Peak Power Spectral Density	23.2	50	99.8	Tony Kang
6 dB bandwidth	23.2	50	99.8	Tony Kang
Radiated Emissions and Band Edge Measurement	26.1	48	99.44	Fire Huo

4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
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
	5725 MHz to 5850 MHz	Channel 149	Channel 157	Channel 165
		5745 MHz	5785 MHz	5825 MHz
IEEE 802.11n-HT40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5725 MHz to 5850 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 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		
	U-NII-1	U-NII-3
IEEE 802.11n-HT20	34	46
IEEE 802.11n-HT40	32	46
IEEE 802.11ac-VHT20	33	47

Test Software
Test software name: RTL819x 3.5

4.4 PRE-SCAN

4.4.1 Pre-scan under all rates

Mode and Frequency	Maximum Conducted Average Power (dBm) for Data Rates (Mbps)							
IEEE 802.11n-HT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	10.47	10.44	1.42	10.40	10.39	10.37	10.36	10.26
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	10.21	10.18	10.15	10.11	9.97	9.93	9.88	9.79
IEEE 802.11n-HT40 5190 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	10.00	9.98	9.97	9.96	9.97	9.95	9.03	9.01
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	8.93	8.86	8.68	8.64	8.53	8.39	8.33	8.25
IEEE 802.11ac-VHT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	9.94	9.83	9.93	9.87	9.88	9.90	9.88	9.68
	MCS8							
	9.58							

4.4.2 Worst-case data rates

Mode	Worst-case data rates
IEEE 802.11n-HT20	MCS8
IEEE 802.11n-HT40	MCS0
IEEE 802.11ac-VHT20	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

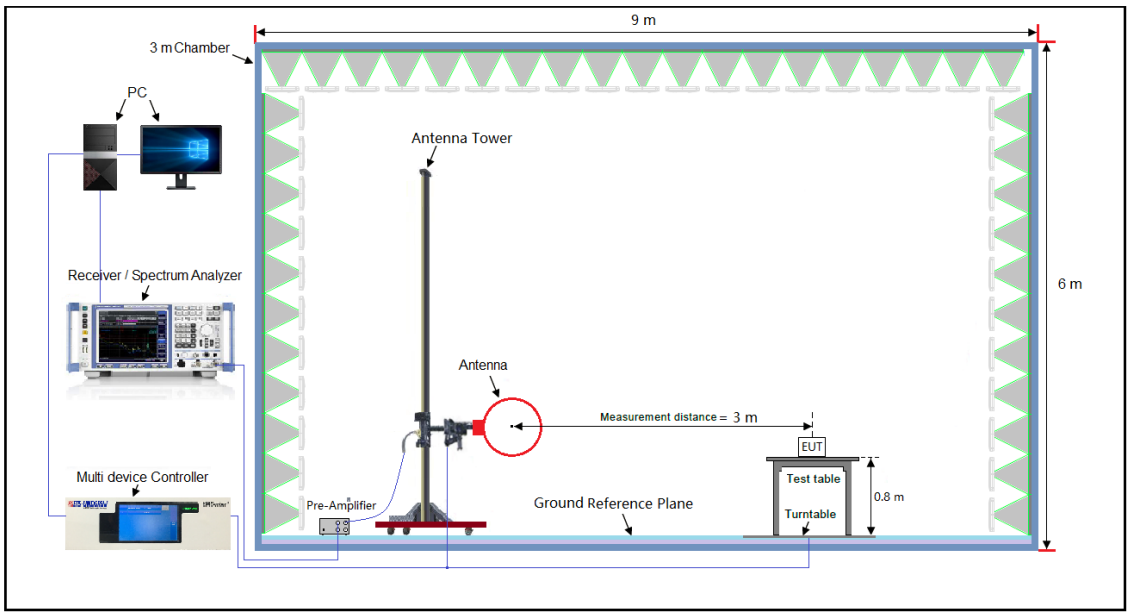


Figure 1. Below 30MHz

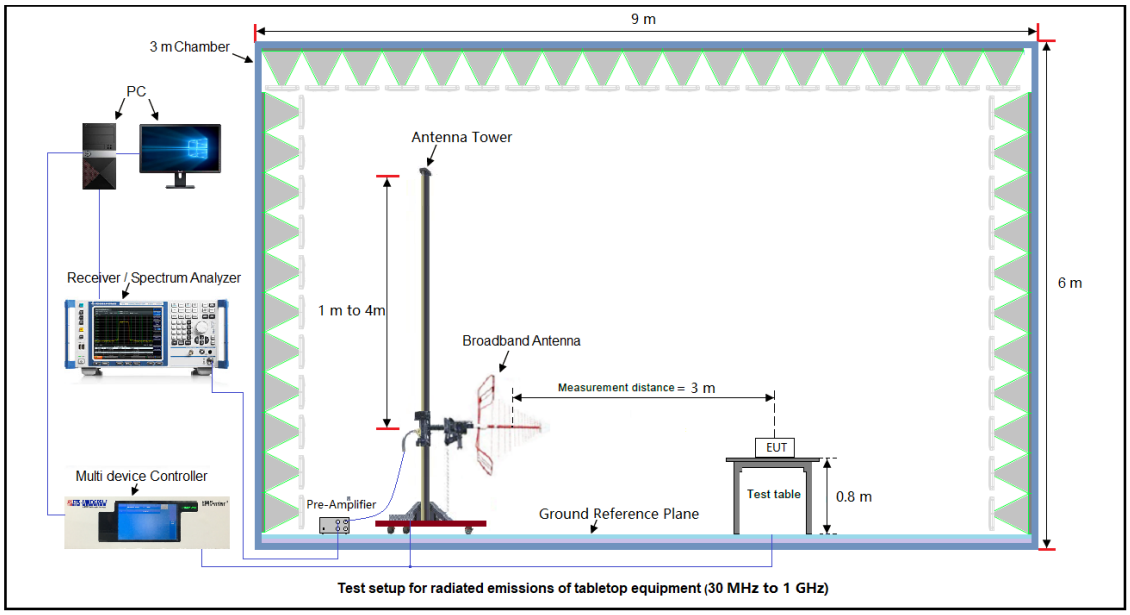


Figure 2. 30MHz to 1GHz

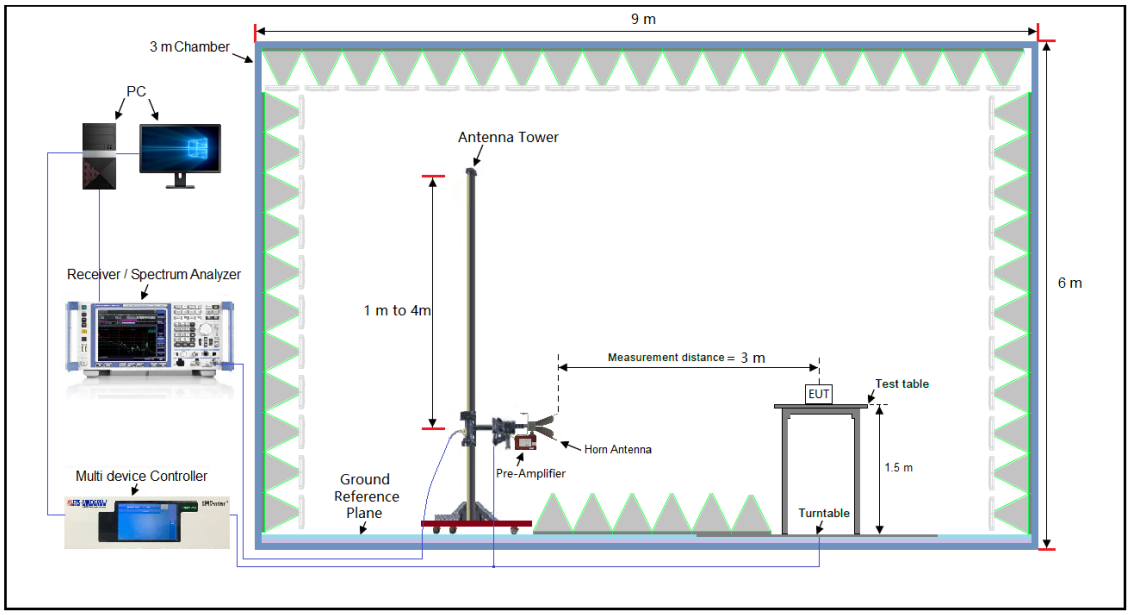
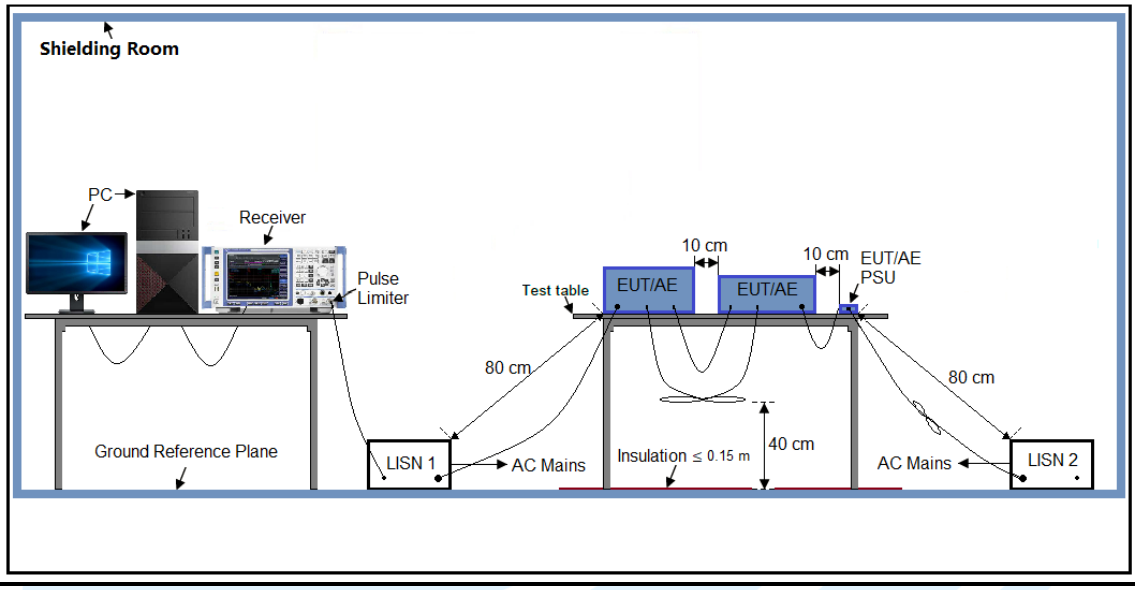
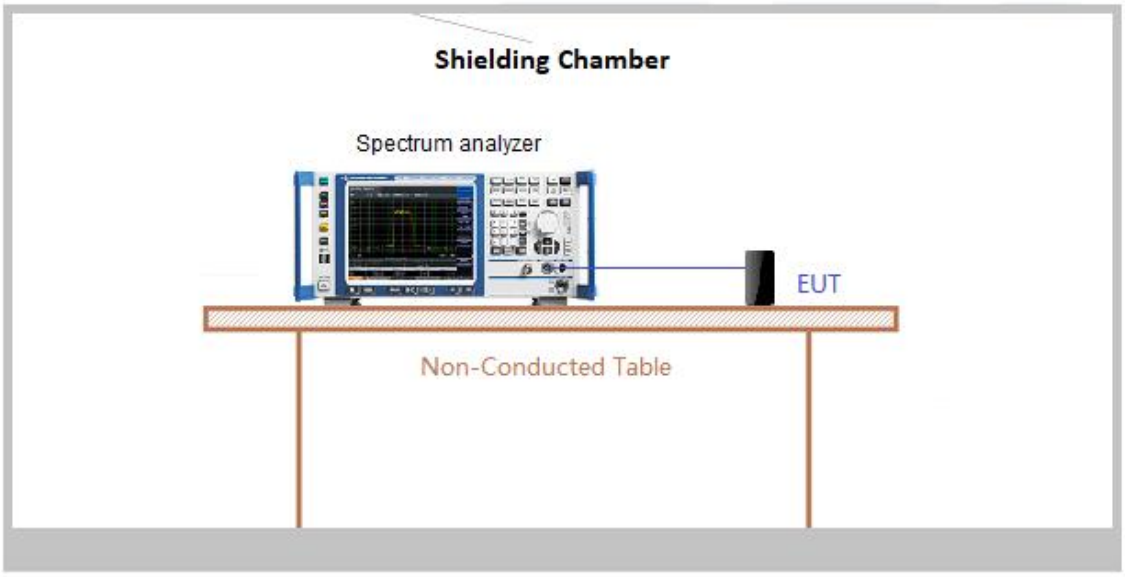


Figure 3. Above 1GHz

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. It was powered by a 12Vdc adapter. 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	2TX	Chain 0+1	Y 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

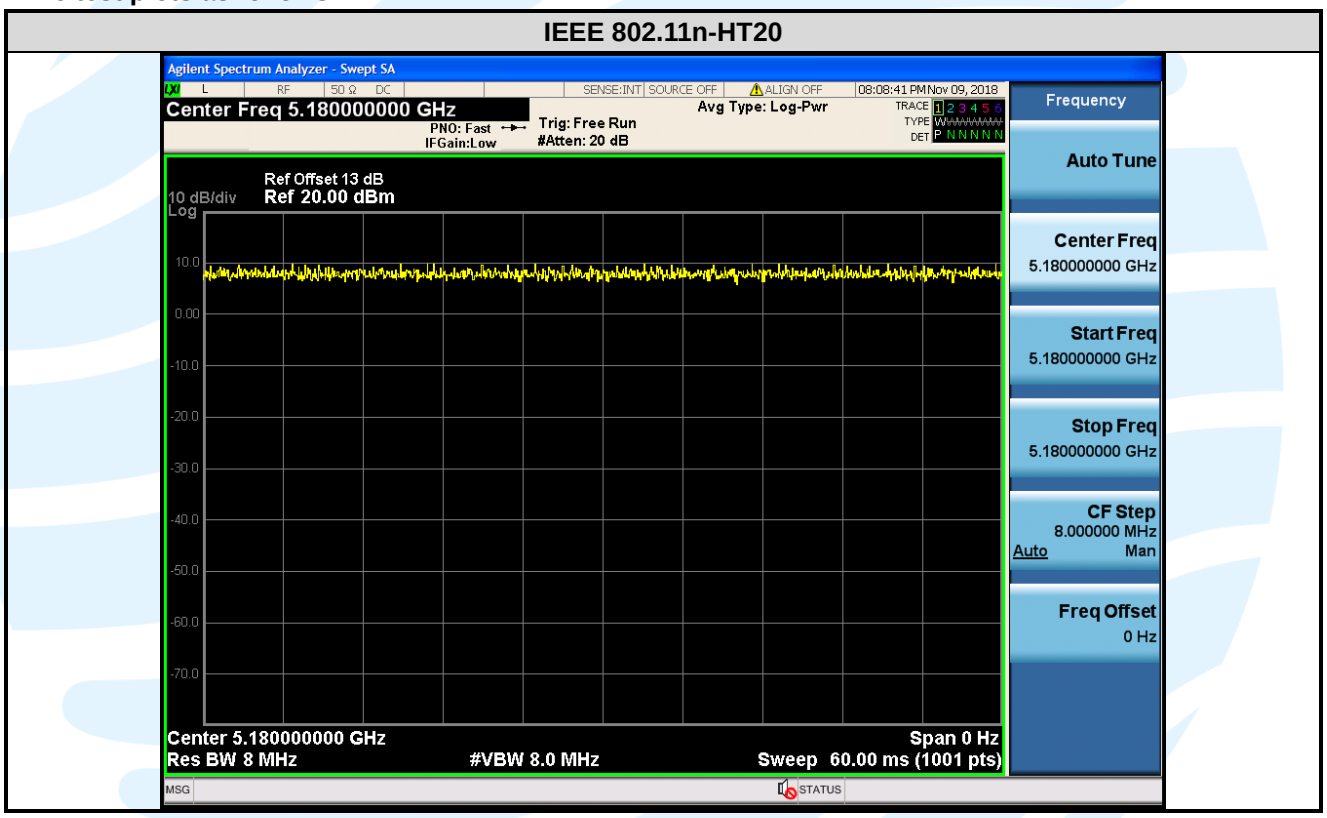
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11n-HT20	MCS0	1	1	1.00	100.00	0.00	0.01	0.00
IEEE 802.11n-HT40	MCS0	1	1	1.00	100.00	0.00	0.01	0.00
IEEE 802.11ac-VHT20	MCS0	1	1	1.00	100.00	0.00	0.01	0.00

Remark:

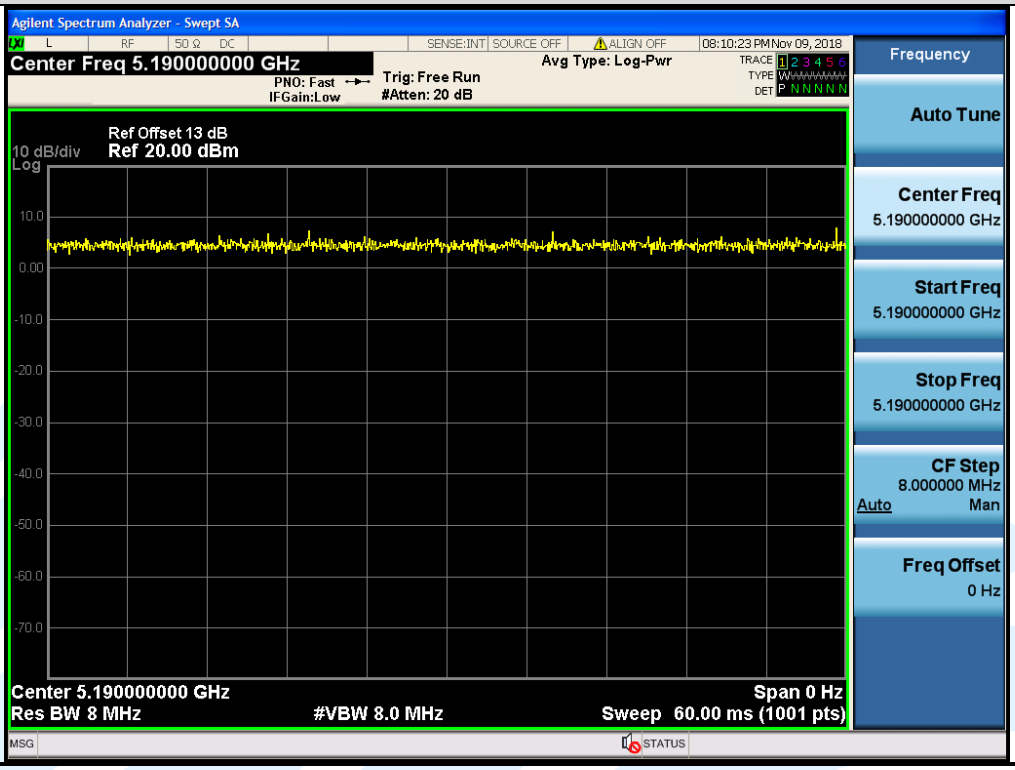
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plots as follows

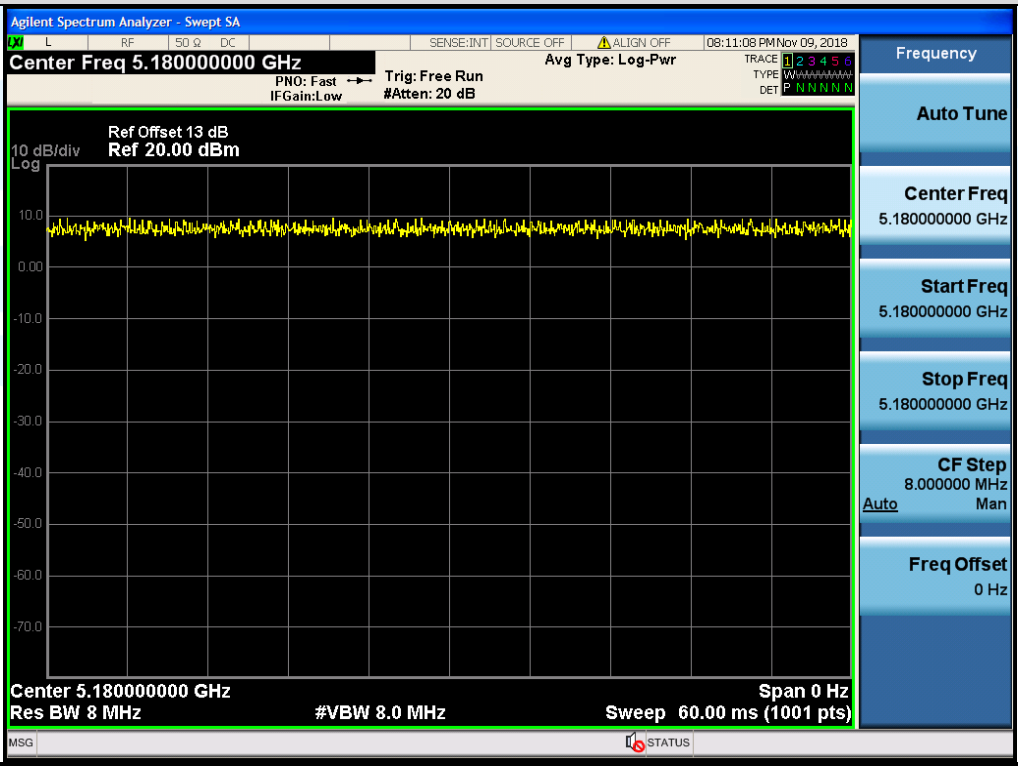
IEEE 802.11n-HT20



IEEE 802.11n-HT40



IEEE 802.11ac-VHT20



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.12 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	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
4	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
5	KDB 905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
6	KDB 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
7	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.13 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.
EUT Antenna:
Both antenna in the external 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 11.01 dBi (See section 5.5).

5.14 26 DB BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a) (2)(5)

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.

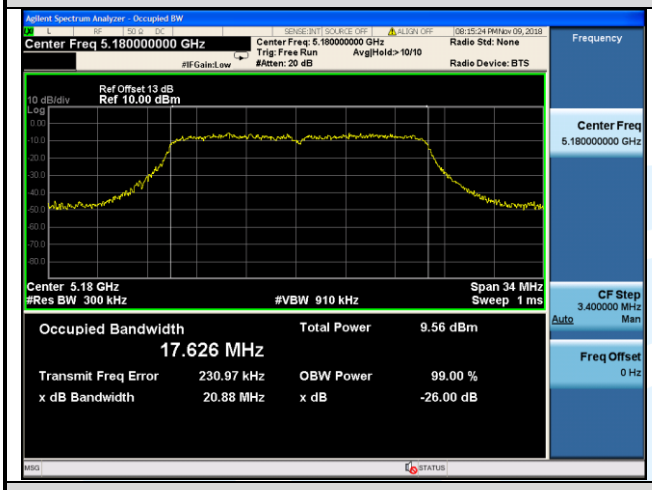
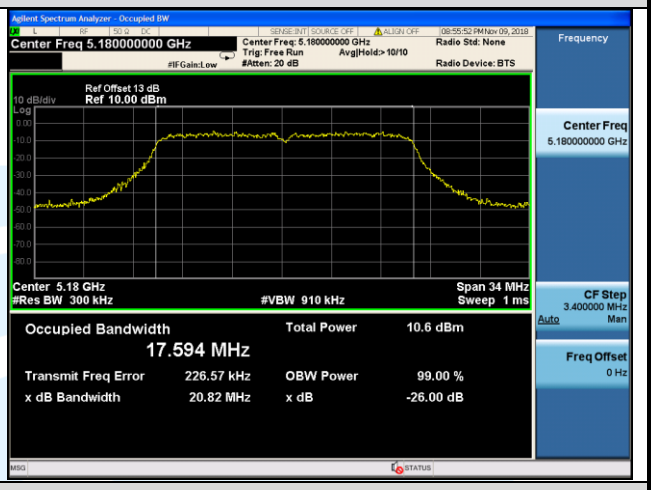
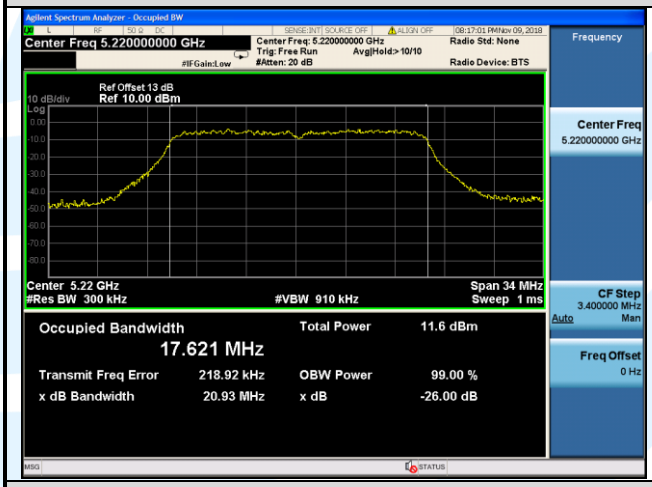
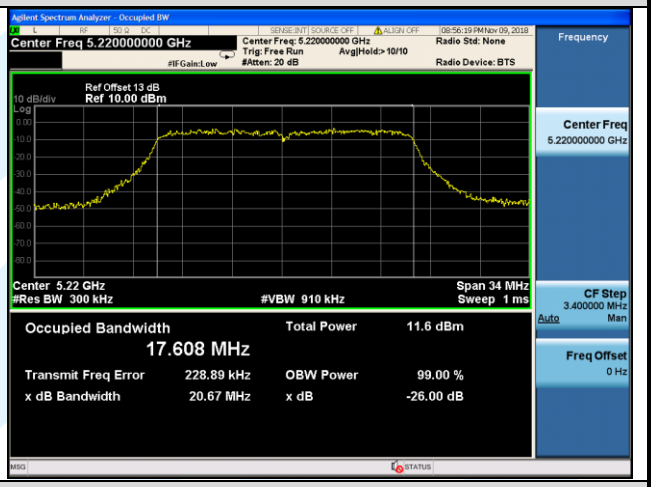
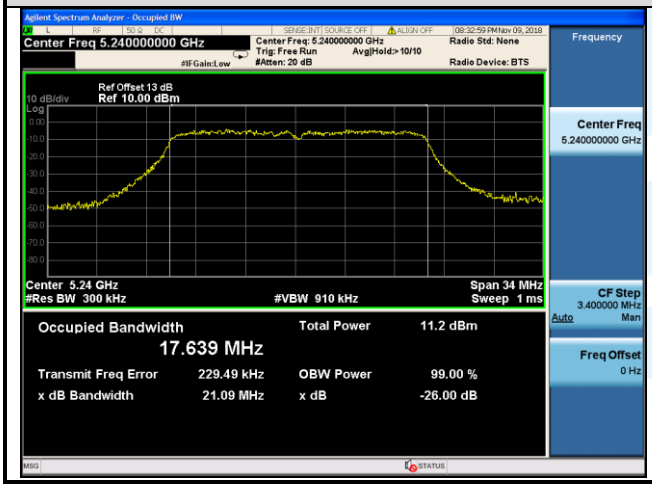
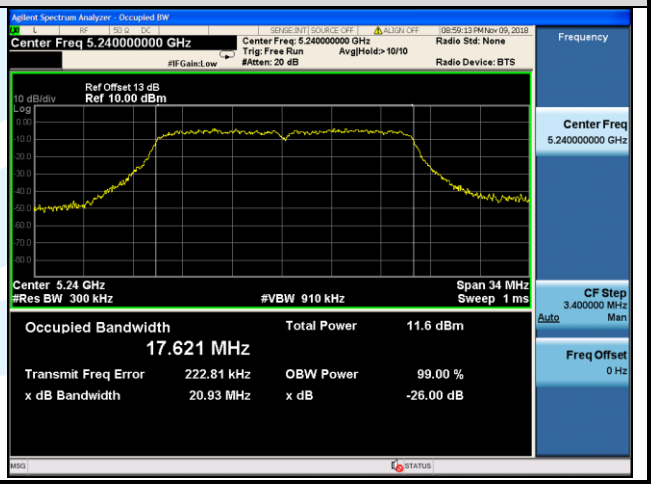
Instruments Used: Refer to section 3 for details

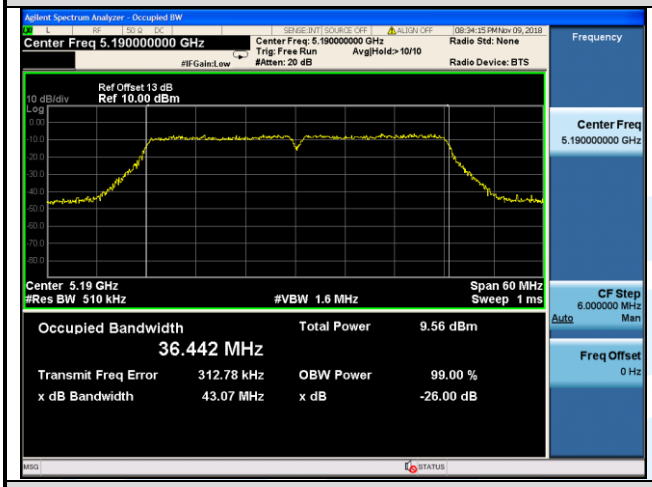
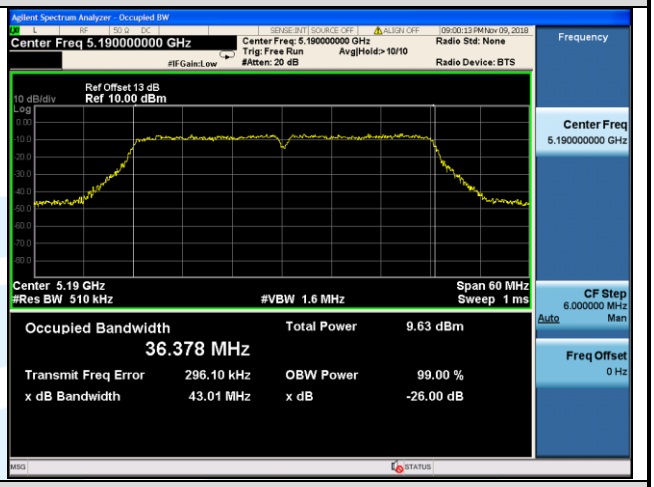
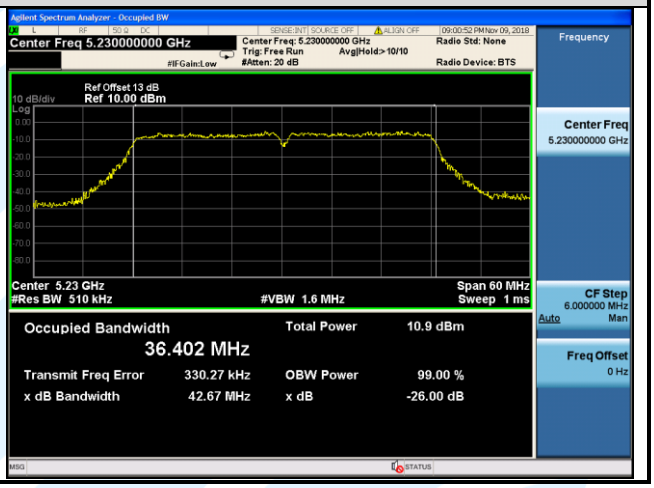
Test Mode: Transmitter mode

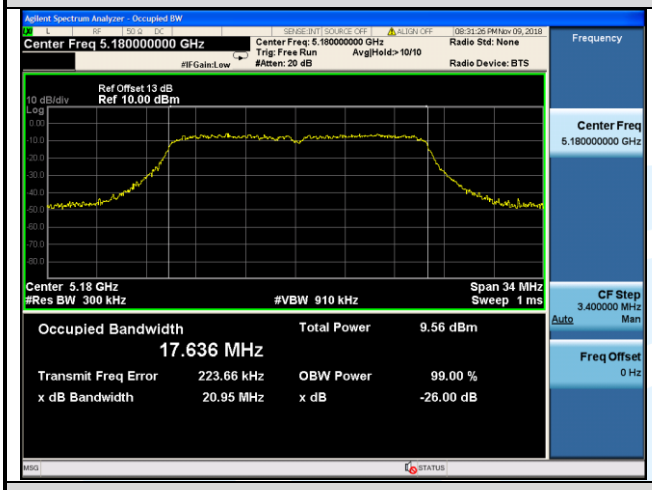
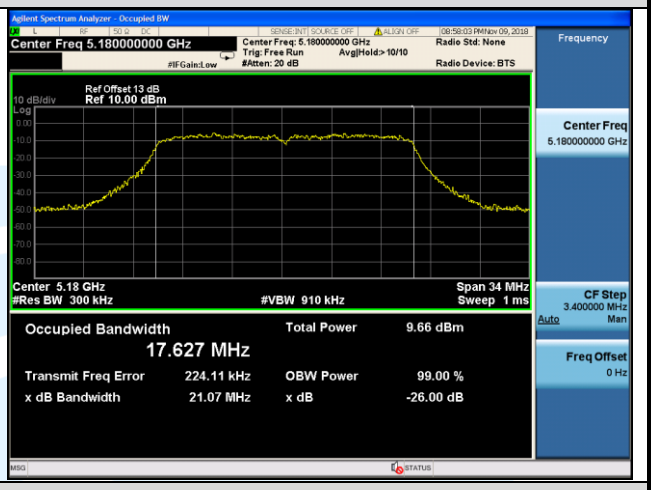
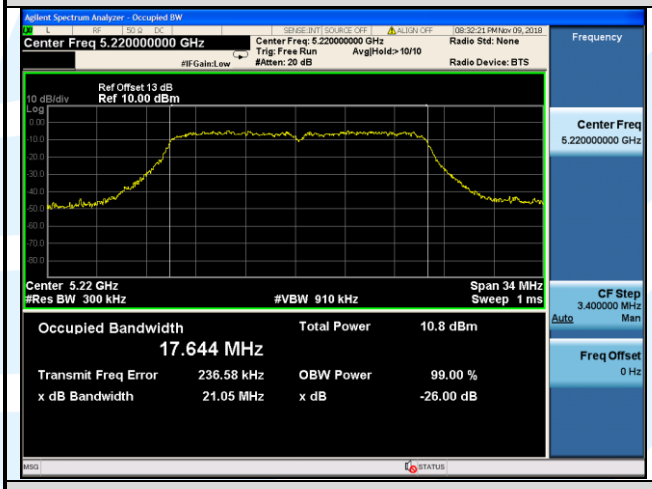
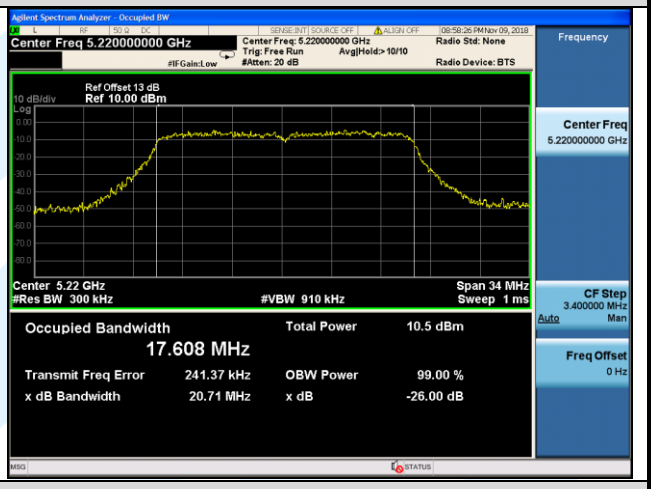
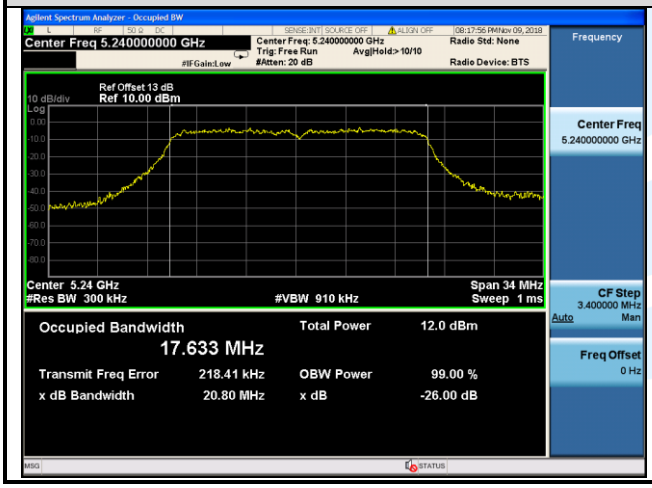
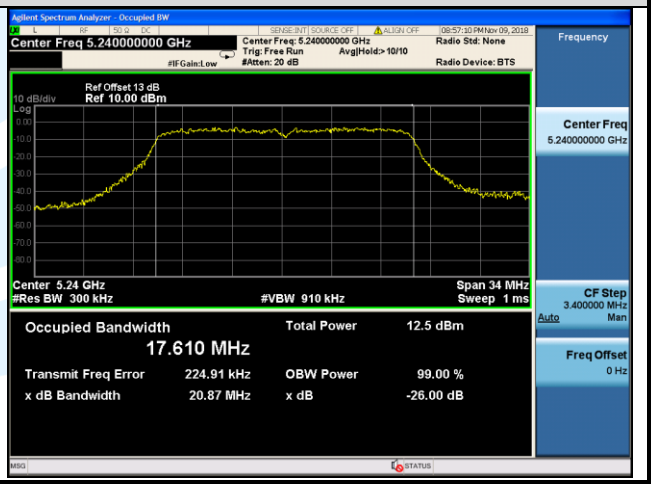
Test Results: Pass

Mode	Channel	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11n-HT20	36 (5180)	20.88	20.82	17.63	17.59
	44 (5220)	20.93	20.67	17.62	17.61
	48 (5240)	21.09	20.93	17.64	17.62
IEEE 802.11n-HT40	38 (5190)	43.07	43.01	36.44	36.38
	46 (5230)	42.99	42.67	36.39	36.40
IEEE 802.11ac-VHT20	36 (5180)	20.95	21.07	17.64	1763
	44 (5220)	21.05	20.71	17.64	17.61
	48 (5240)	20.80	20.87	17.63	17.61

The test plots as follows:

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

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

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

5.15 6 DB BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.407 (e)

Test Method: KDB 789033 D02 v02r01Section 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:
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.

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

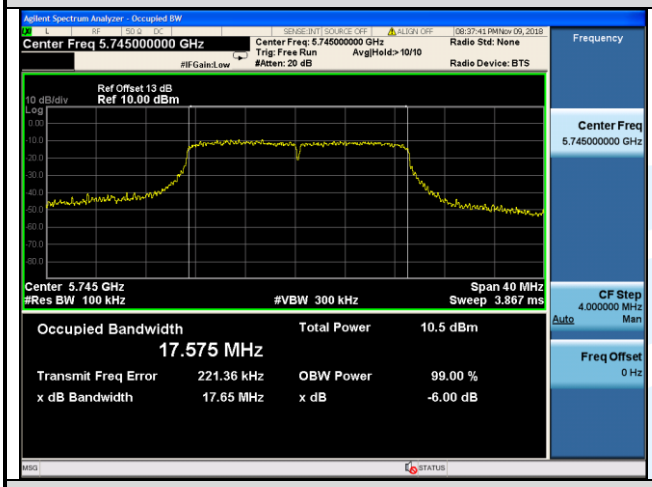
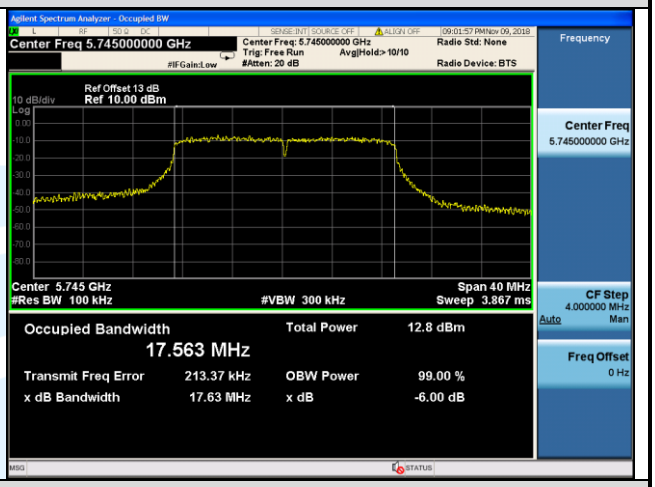
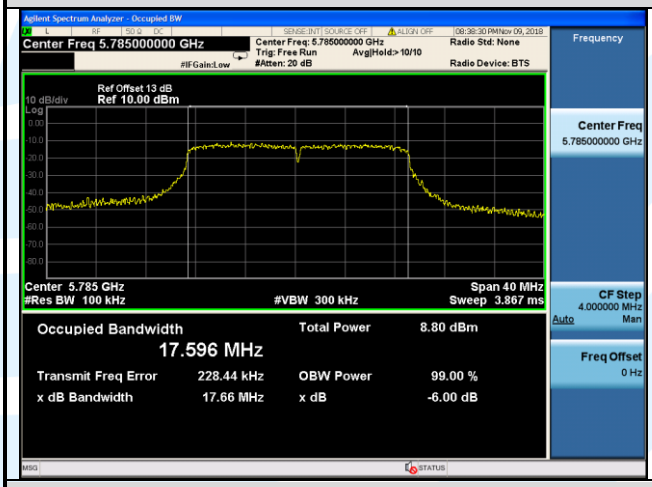
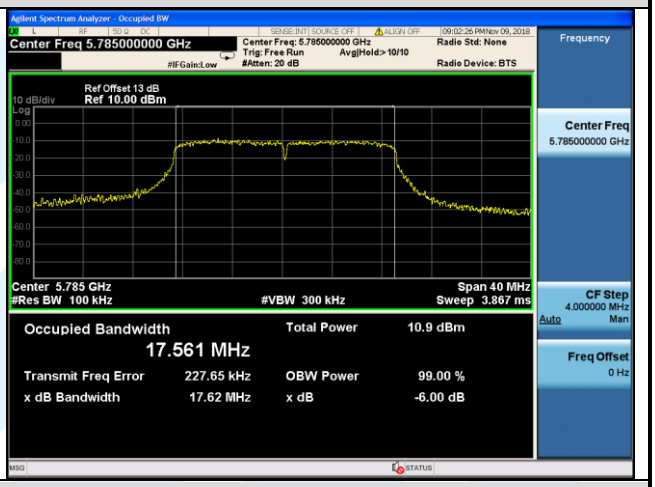
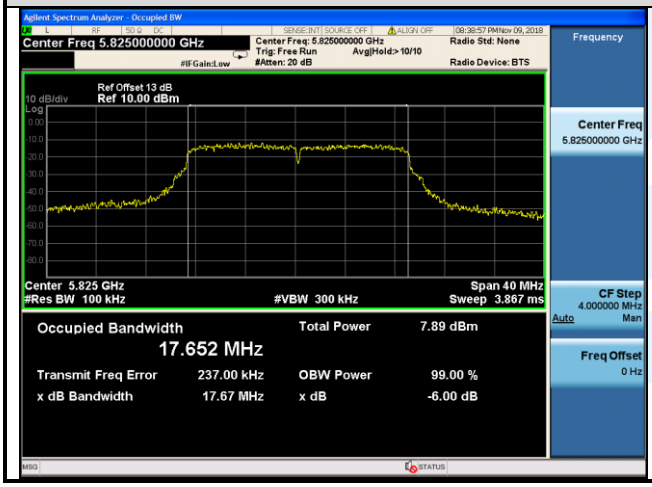
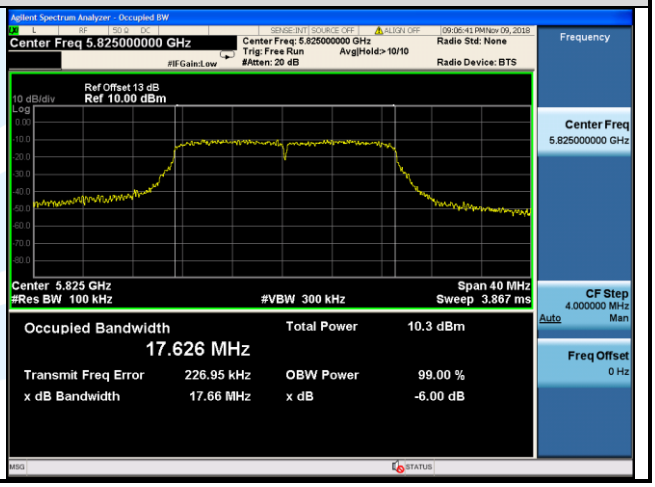
Test Mode: Transmitter mode

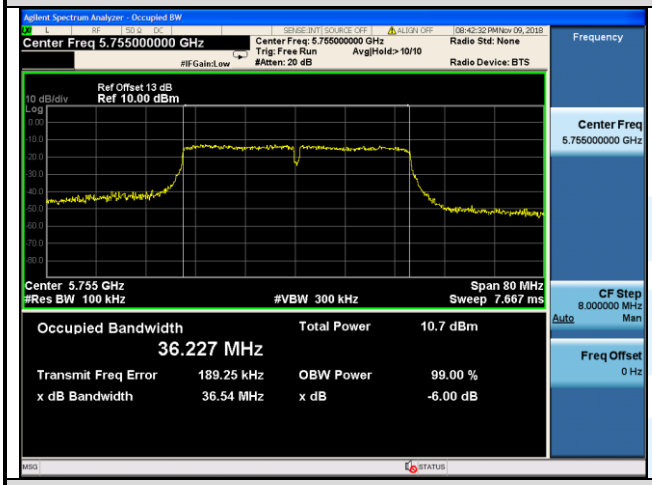
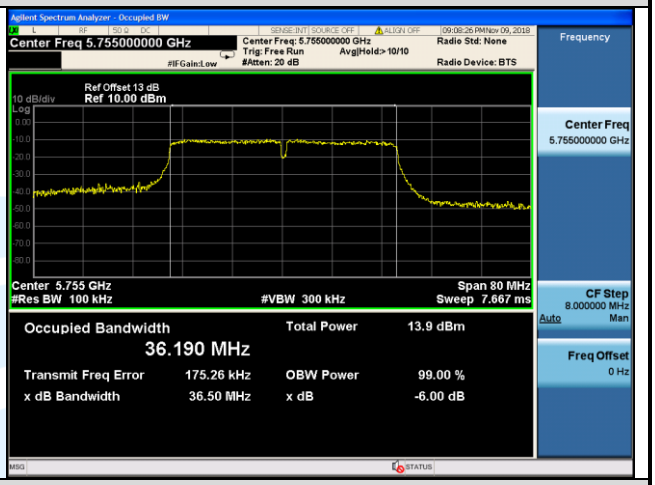
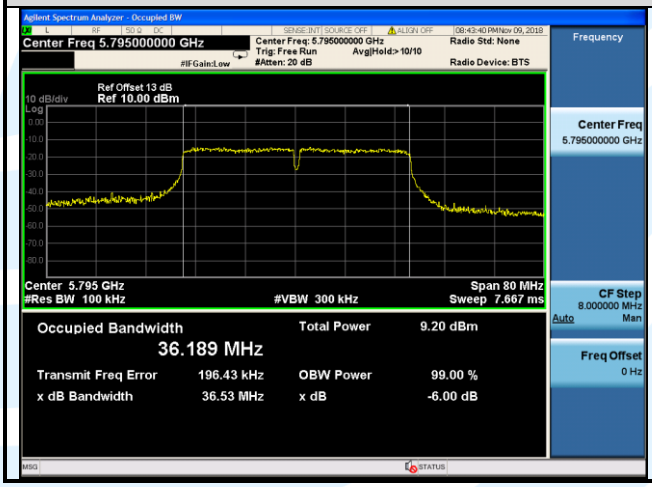
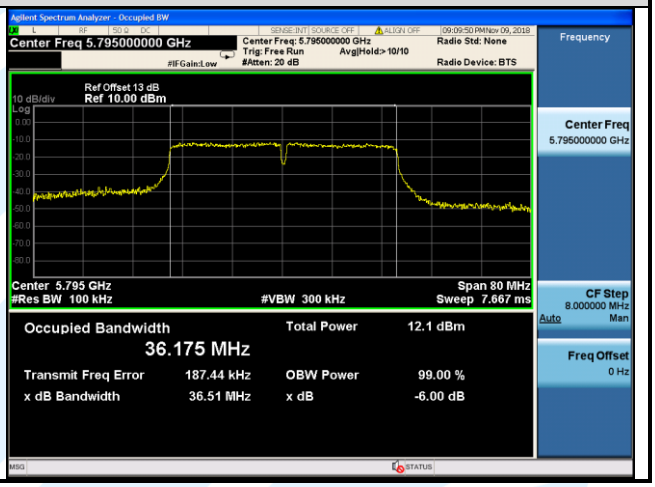
Test Results: Pass

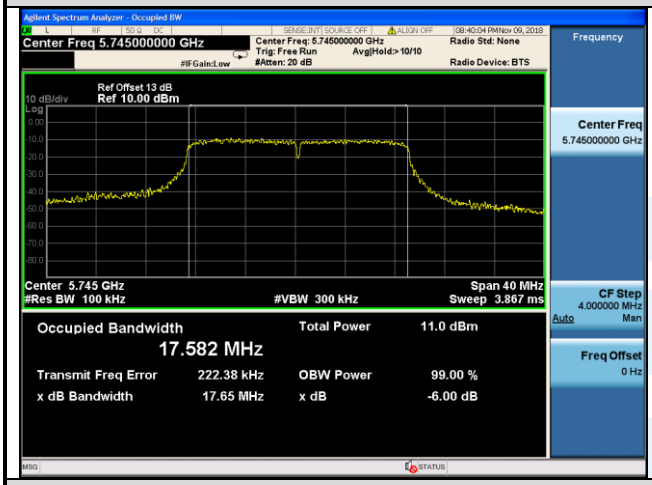
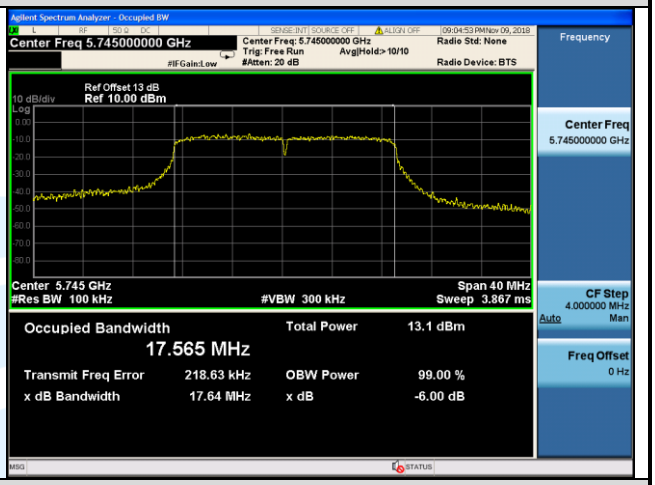
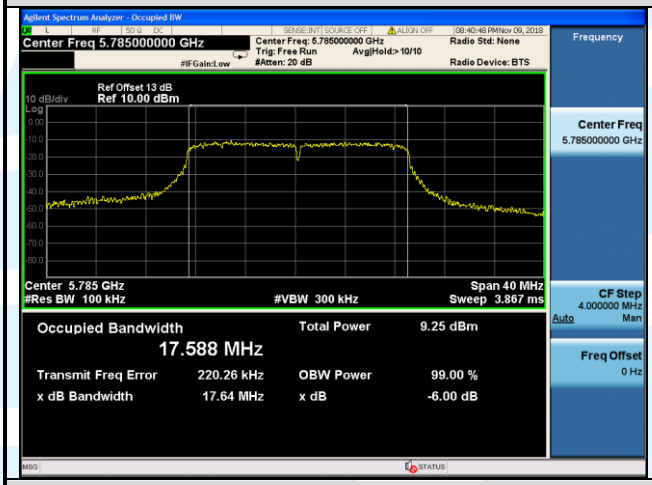
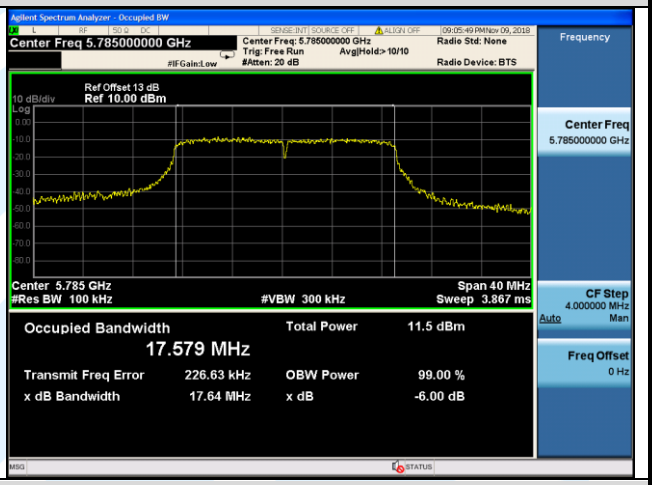
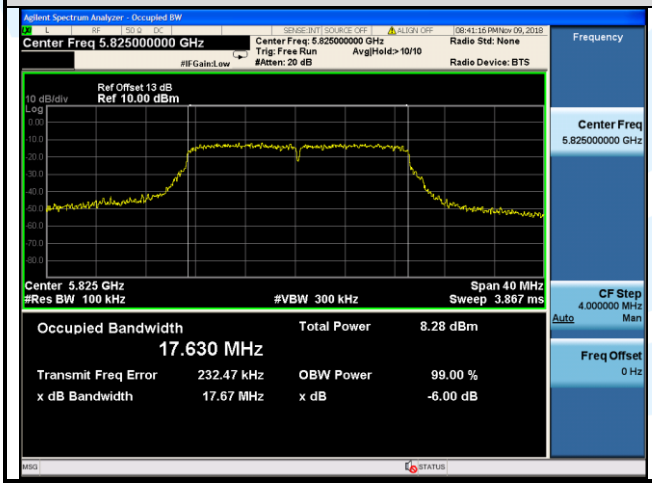
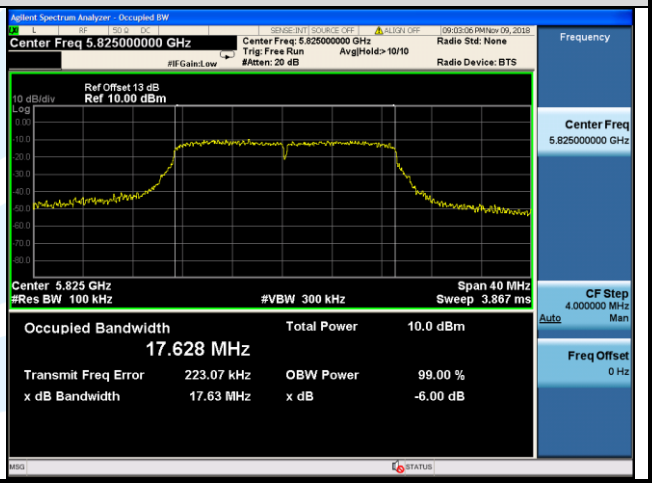
Test Data:

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 802.11n-HT20	149 (5745)	17.65	17.63	17.575	17.563	> 500 kHz	Pass
	157 (5785)	17.66	17.62	17.596	17.561	> 500 kHz	Pass
	165 (5825)	17.67	17.66	17.652	17.626	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	36.54	36.50	36.227	36.190	> 500 kHz	Pass
	159 (5795)	36.53	36.51	36.189	36.175	> 500 kHz	Pass
IEEE 802.11ac-VHT20	149 (5745)	17.65	17.64	17.582	17.565	> 500 kHz	Pass
	157 (5785)	17.64	17.64	17.588	17.579	> 500 kHz	Pass
	165 (5825)	17.67	17.63	17.630	17.628	> 500 kHz	Pass

The test plots as follows:

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	
	

5.16 MAXIMUM CONDUCTED OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(3)

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

Limits:

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 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.

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.

Frequency Band	Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated chains directional gain (dBi)	Peak Power Limits (dBm)
U-NII-1	8.00	8.00	11.01	18.99
U-NII-3	8.00	8.00	11.01	24.99
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				

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		MIMO				Total Power MIMO_ Chain 0+1	Limits (dBm)	Pass / Fail
		Chain 0		Chain 1				
		Meas Power	Corr'd Power	Meas Power	Corr'd Power			
IEEE 802.11n-HT20	36 (5180)	10.47	10.47	9.86	9.86	13.19	18.99	Pass
	44 (5220)	11.60	11.60	10.82	10.82	14.24	18.99	Pass
	48 (5240)	12.15	12.15	12.04	12.04	15.11	18.99	Pass
	149 (5745)	11.59	11.59	12.70	12.70	15.19	24.99	Pass
	157 (5785)	10.84	10.84	11.51	11.51	14.20	24.99	Pass
	165 (5825)	10.64	10.64	11.17	11.17	13.92	24.99	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		MIMO				Total Power MIMO_ Chain 0+1	Limits (dBm)	Pass / Fail
		Chain 0		Chain 1				
		Meas Power	Corr'd Power	Meas Power	Corr'd Power			
IEEE 802.11n-HT40	38 (5190)	10.00	10.00	10.15	10.15	13.09	18.99	Pass
	46 (5230)	11.76	11.76	11.40	11.40	14.59	18.99	Pass
	151 (5755)	11.73	11.73	12.35	12.35	15.06	24.99	Pass
	159 (5795)	10.78	10.78	11.52	11.52	14.18	24.99	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		MIMO				Total Power MIMO_ Chain 0+1	Limits (dBm)	Pass / Fail
		Chain 0		Chain 1				
		Meas Power	Corr'd Power	Meas Power	Corr'd Power			
IEEE 802.11ac-VHT20	36 (5180)	9.94	9.94	8.91	8.91	12.47	18.99	Pass
	44 (5220)	11.66	11.66	10.39	10.39	14.08	18.99	Pass
	48 (5240)	12.00	12.00	11.52	11.52	14.78	18.99	Pass
	149 (5745)	11.94	11.94	12.85	12.85	15.43	24.99	Pass
	157 (5785)	11.25	11.25	11.71	11.71	14.50	24.99	Pass
	165 (5825)	11.00	11.00	11.40	11.40	14.21	24.99	Pass

Remark:
1. Corr'd Power = Meas Power + Duty Cycle Factor
2. Total (Chain 0+1) = $10*\log[(10^{\text{Chain 0/10}})+(10^{\text{Chain 1/10}})]$