FCC TEST REPORT

Product Name:	Mobile Phone
Trade Mark:	MI
Model No.:	MDE5
Report Number:	170726002RFC-5
Test Standards:	FCC 47 CFR Part 15 Subpart E
FCC ID:	2AFZZ-XMSD5
Test Result:	PASS
Date of Issue:	September 4, 2017

Prepared for:

Xiaomi Communications Co., Ltd.
The Rainbow City of China Resources, NO.68,Qinghe Middle Street, Haidian District, Beijing, China

Prepared by:

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Approved by: Billy Li, Technical Director

Date: September 4, 2017

Version

Version No.	Date	Description
V1.0	September 4, 2017	Original

CONTENTS

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Xiaomi Communications Co., Ltd.
Address of Applicant:	The Rainbow City of China Resources, NO.68,Qinghe Middle Street, Haidian District, Beijing, China
Manufacturer:	Xiaomi Communications Co., Ltd.
Address of Manufacturer:	The Rainbow City of China Resources, NO.68,Qinghe Middle Street, Haidian District, Beijing, China

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Mobile Phone		
Model No.:	MDE5		
Add. Model No.:	N/A		
Trade Mark:	MI		
DUT Stage:	Identical Prototype		
EUT Supports Function:	GSM Bands:	GSM 850/ PCS 1900	
	UTRA Bands:	Band II/ Band IV/ Band V	
	CDMA Band:	BC0/ BC1/ BC10	
	E-UTRA Bands:	FDD Band 2/ Band 4/ Band 5/ Band 7/ Band 12/ Band 13/ Band 17/ Band 25/ Band 26/ Band 30	
		TDD Band 38/ Band 41	
	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth V3.0+EDR/ Bluetooth V4.1 LE/ Bluetooth V5.0 LE	
	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
	RNSS Bands:	1559 MHz to 1610 MHz	GPS/GLONASS/Galileo
	NFC:	13.553 MHz to 13.567 MHz	
Software Version:	MIUI 8		
Hardware Version:	P2.0		
IMEI Code:	865736030026044, 865736030026051		
Sample Received Date:	July 27, 2017		
Sample Tested Date:	July 27, 2017 to August 14, 2017		

1.2.2 Description of Accessories

Adapter	
Trade Mark:	XIAOMI
Model No.:	MDY-08-EY
Input:	100-240V~50/60 Hz 0.5A
Output:	5V ⎓ 3A/9V ⎓ 2A/12V ⎓ 1.5A
AC Cable:	N/A
DC Cable:	N/A

Battery	
Trade Mark:	MI
Model No.:	BM3B
Battery Type:	Lithium-ion Polymer Rechargeable Battery
Rated Voltage:	3.85 Vdc
Limited Charge Voltage:	4.4 Vdc
Rated Capacity:	3300 mAh

Cable(1)	
Trade Mark:	MI
Model No.:	L6BU2018-CS-H
Description:	USB Type-C Plug Cable
Cable Type:	Shielded without ferrite
Length:	1.0 Meter

Cable(2)	
Trade Mark:	MI
Model No.:	KLC-2588-1
Description:	USB Type-C Plug Cable
Cable Type:	Shielded without ferrite
Length:	1.0 Meter

Cable(3)	
Trade Mark:	MI
Model No.:	KLC-2469
Description:	USB Type-C to 3.5 mm Headphone Jack Adapter
Cable Type:	Unshielded without ferrite

Cable(4)	
Trade Mark:	MI
Model No.:	0QT000XI0007
Description:	USB Type-C to 3.5 mm Headphone Jack Adapter
Cable Type:	Unshielded without ferrite

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Range:	5150 MHz to 5250 MHz	
	5250 MHz to 5350 MHz	
	5470 MHz to 5725 MHz	
	5725 MHz to 5850 MHz	
Support Standards:	IEEE 802.11a/n/ac	
TPC Function:	Not Support	
DFS Operational mode:	Slave without 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	PIFA Antenna
	Chain 1	PIFA Antenna
Antenna Gain:	Chain 0	5150 MHz to 5250 MHz: 1.01 dBi
		5250 MHz to 5350 MHz:1.46 dBi
		5470 MHz to 5725 MHz: 0.11 dBi
		5725 MHz to 5850 MHz: -2.9 dBi
	Chain 1	5150 MHz to 5250 MHz: 1.00 dBi
		5250 MHz to 5350 MHz: 0.17 dBi
		5470 MHz to 5725 MHz:-3.26dBi
		5725 MHz to 5850 MHz: -3.79 dBi

Maximum Conducted Output Power (dBm):	**SISO_Chain 0**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	14.66	14.84	14.71	12.95
	IEEE 802.11n-HT20:	13.41	13.40	13.56	12.90
	IEEE 802.11n-HT40:	11.82	11.79	11.97	12.19
	IEEE 802.11ac-VHT20:	13.97	14.27	14.16	12.00
	IEEE 802.11ac-VHT40:	11.79	11.82	11.81	12.16
	IEEE 802.11ac-VHT80:	11.80	11.60	11.58	12.01
	SISO_Chain 1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	15.61	15.28	15.61	13.77
	IEEE 802.11n-HT20:	14.47	14.15	14.33	13.78
	IEEE 802.11n-HT40:	12.92	12.92	12.82	12.90
	IEEE 802.11ac-VHT20:	15.02	14.69	14.94	13.46
	IEEE 802.11ac-VHT40:	12.87	12.49	12.76	13.10
	IEEE 802.11ac-VHT80:	12.68	12.12	12.33	12.52
	CDD_Chain 0+1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	18.13	17.96	18.17	16.39
	MIMO_Chain 0+1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11n-HT20:	16.97	16.76	16.97	16.37
	IEEE 802.11n-HT40:	15.42	15.40	15.43	15.57
	IEEE 802.11ac-VHT20:	17.51	17.30	17.58	15.80
	IEEE 802.11ac-VHT40:	15.33	15.18	15.32	15.67
	IEEE 802.11ac-VHT80:	15.27	14.88	14.98	15.28
Normal Test Voltage:	3.85 Vdc				
Extreme Test Voltage:	3.7 to 4.4 Vdc				
Extreme Test Temperature:	-30 °C to +50 °C				

1.4 OTHER INFORMATION

Operation Frequency Each of Channel							
Channel	**Frequency**	**Channel**	**Frequency**	**Channel**	**Frequency**	**Channel**	**Frequency**
For IEEE 802.11a/n-HT20/ac-VHT20 operation in the 5150 MHz to 5350 MHz band							
36	5180 MHz	44	5220 MHz	52	5260 MHz	60	5300 MHz
40	5200 MHz	48	5240 MHz	56	5280 MHz	64	5320 MHz
For IEEE 802.11a/n-HT20/ac-VHT20 operation in the 5470 MHz to 5725 MHz band							
100	5500 MHz	112	5560 MHz	124	5620 MHz	136	5680 MHz
104	5520 MHz	116	5580 MHz	128	5640 MHz	140	5700 MHz
108	5540 MHz	120	5600 MHz	132	5660 MHz	--	--
For IEEE 802.11a/n-HT20/ac-VHT20 operation in the 5725 MHz to 5850 MHz band							
149	5745 MHz	153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	--	--	--	--	--	--
For IEEE 802.11n-HT40/ac-VHT40 operation in the 5150 MHz to 5350 MHz band							
38	5190 MHz	46	5230 MHz	54	5270 MHz	62	5310 MHz
For IEEE 802.11n-HT40/ac-VHT40 operation in the 5470 MHz to 5725 MHz band							
102	5510 MHz	110	5550 MHz	118	5590 MHz	126	5630 MHz
134	5670 MHz	--	--	--	--	--	--
For IEEE 802.11n-HT40/ac-VHT40 operation in the 5725 MHz to 5850 MHz band							
151	5755 MHz	159	5795 MHz	--	--	--	--

For IEEE 802.11ac-VHT80 operation in the 5150 MHz to 5350 MHz band							
42	5210 MHz	58	5290 MHz	--	--	--	--
For IEEE 802.11ac-VHT80 operation in the 5470 MHz to 5725 MHz band							
106	5530 MHz	122	5610 MHz	--	--	--	--
For IEEE 802.11ac-VHT80 operation in the 5725 MHz to 5850 MHz band							
155	5775 MHz	--	--	--	--	--	--

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	FCC ID	Supplied by
Notebook	Lenovo	E450	N/A	UnionTrust
Wireless AP	Alcatel-Lucent	G-240W-B	2ADZRG240WB	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust
2	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.

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

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 C Section 15.407(a)(1) (2)	ANSI C63.10-2013	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)	KDB 789033 D02 v01r04 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e)	KDB 789033 D02 v01r04 Section C.2	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)	KDB 789033 D02 v01r04 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)	KDB 789033 D02 v01r04 Section F	PASS
Frequency stability	FCC 47 CFR Part 15 Subpart E Section 15.407 (g)	ANSI C63.10-2013	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	KDB 789033 D02 v01r04 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	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	ANSI C63.10-2013	PASS
Note: 1) N/A: In this whole report not application.			

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. 20, 2015	Dec. 19, 2018
☑	Receiver	R&S	ESIB26	100114	Dec. 22, 2016	Dec. 22, 2017
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec. 22, 2016	Dec. 22, 2017
☑	Loop Antenna	ETS-LINDGREN	6502	00202525	Jun. 24, 2015	Jun. 23, 2018
☑	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Jul. 24, 2015	Jul. 23, 2018
☑	Preamplifier	HP	8447F	2805A02960	Dec. 22, 2016	Dec. 22, 2017
☐	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	Dec. 30, 2016	Dec. 30, 2017
☐	Horn Antenna	ETS-LINDGREN	3117	00164202	Jul. 24, 2015	Jul. 23, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Dec. 30, 2016	Dec. 30, 2017
☐	Horn Antenna	ETS-LINDGREN	3116C	00200180	Jul. 28, 2015	Jul. 27, 2018
☑	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Jul. 29, 2015	Jul. 28, 2018
☑	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☐	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Jun. 21, 2017	Jun. 20, 2018
☑	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	Jun. 15, 2017	Jun. 14, 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. 22, 2016	Dec. 22, 2017
☐	Receiver	R&S	ESR7	1316.3003K07 -101181-K3	Dec. 22, 2016	Dec. 22, 2017
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Dec. 22, 2016	Dec. 22, 2017
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Dec. 22, 2016	Dec. 22, 2017
☐	EXG-B RF Analog Signal Generator	KEYSIGHT	N5171B	MY53051777	Jan. 09, 2016	Jan. 08, 2018
☑	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Jan. 08, 2016	Jan. 07, 2018
☑	DC Source	KIKUSUI	PWR400L	LK003024	Sep. 21, 2016	Sep. 20, 2017
☑	Temp & Humidity chamber	Votisch	VT4002	58566133290 020	Jun. 19, 2017	Jun. 18, 2018

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. 22, 2016	Dec. 22, 2017
☑	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Dec. 22, 2016	Dec. 22, 2017
☑	LISN	R&S	ESH2-Z5	860014/024	Dec. 22, 2016	Dec. 22, 2017
☑	Test Software	Audix	e3	Software Version: 9.160323		

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Test Environment	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
TN/VN	+15 to +35	3.85	20 to 75
TL/VL	-30	3.7	20 to 75
TH/VL	+50	3.7	20 to 75
TL/VH	-30	4.4	20 to 75
TH/VH	+50	4.4	20 to 75

Remark:

1) The EUT just work in such extreme temperature of -30 °C to +50 °C and the extreme voltage of 3.7 V to 4.4 V, so here the EUT is tested in the temperature of -30 °C to +50 °C and the voltage of 3.7 V to 4.4 V.
2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (Kpa)	Tested by
AC Power Line Conducted Emission	26.2	49	100.0	Bessy Xu
26 dB emission bandwidth	25.3	48	99.90	Tiny You
Maximum conducted output power	25.3	48	99.90	Tiny You
Peak Power Spectral Density	25.3	48	99.90	Tiny You
6 dB bandwidth	25.3	48	99.90	Tiny You
Frequency stability	25.3	48	99.90	Tiny You
Dynamic Frequency Selection	25.3	48	99.90	Tiny You
Radiated Emissions and Band Edge Measurement	25.6	45	99.05	Terence Chen

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 120	Channel 140
		5500 MHz	5600 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 118	Channel 134
		5510 MHz	5590 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	--	Channel 122
		5530 MHz	--	5610 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.

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 802.11a 5180 MHz	6	9	12	18	24	36	48	54
	18.13	17.99	17.85	18.02	18.01	18.02	17.16	17.02
IEEE 802.11n-HT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	16.94	16.31	15.78	15.35	14.93	14.71	14.47	14.41
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	16.97	16.35	15.81	15.48	15.04	14.77	14.51	14.40
IEEE 802.11n-HT40 5190 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	15.33	14.68	14.17	13.84	13.40	13.13	12.87	12.76
	MCS8	MCS9	MCS10	MCS11	MCS12	MCS13	MCS14	MCS15
	15.38	14.71	14.14	13.70	13.22	12.89	12.68	12.52
IEEE 802.11ac-VHT20 5180 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	17.51	16.88	16.34	15.01	15.56	15.31	15.07	14.94
	MCS8							
	14.53							
IEEE 802.11ac-VHT40 5190 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	15.32	14.70	14.27	13.74	13.31	13.08	12.86	12.54
	MCS8	MCS9						
	12.23	11.89						
IEEE 802.11ac-VHT80 5210 MHz	MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
	15.27	14.63	14.08	13.73	13.34	13.01	12.76	12.40
	MCS8	MCS9						
	12.14	11.56						

4.4.2 Worst-case data rates

Mode	Worst-case data rates
IEEE 802.11a	6 Mbps
IEEE 802.11n-HT20	MCS8
IEEE 802.11n-HT40	MCS8
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

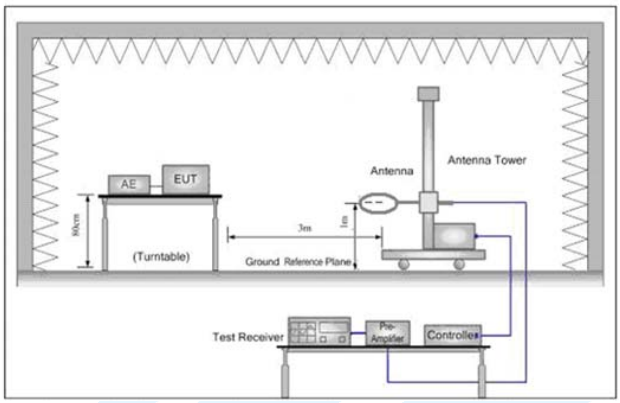


Figure 1. Below 30MHz

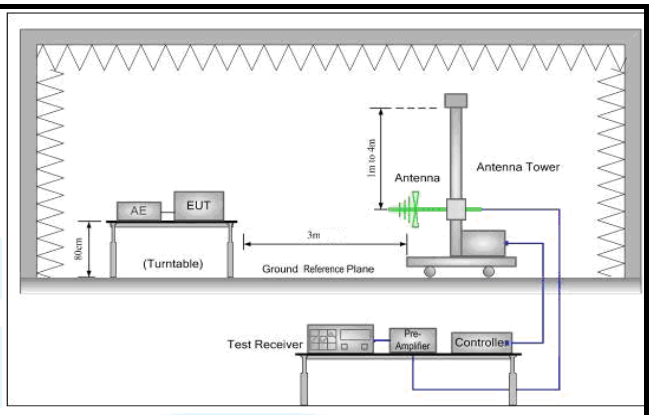


Figure 2. 30MHz to 1GHz

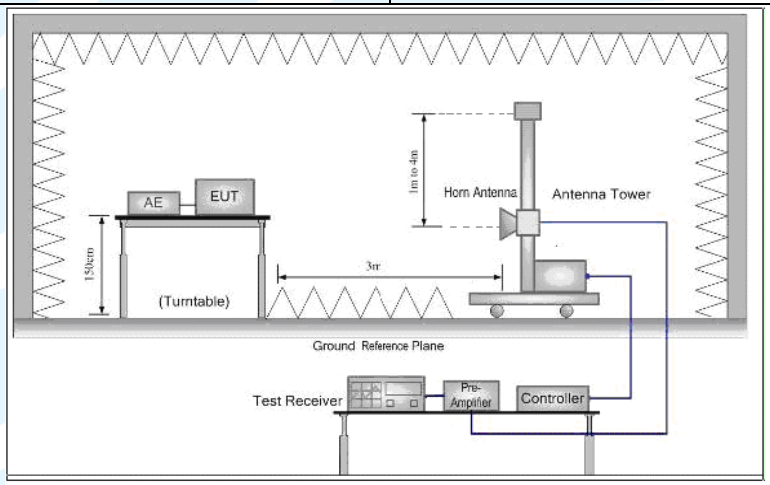
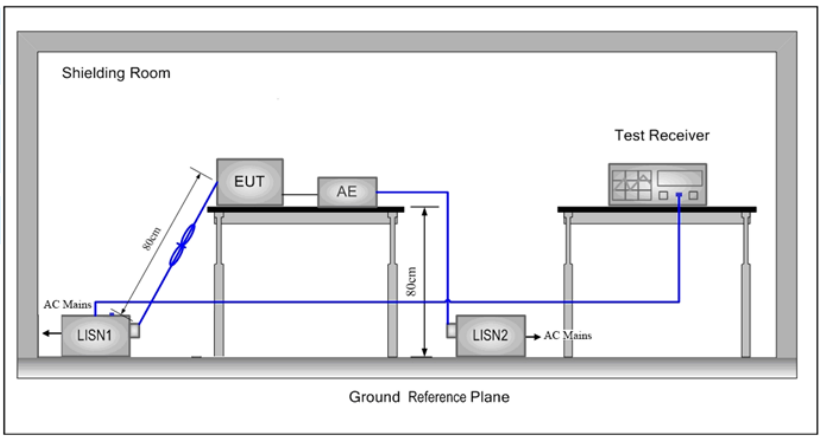


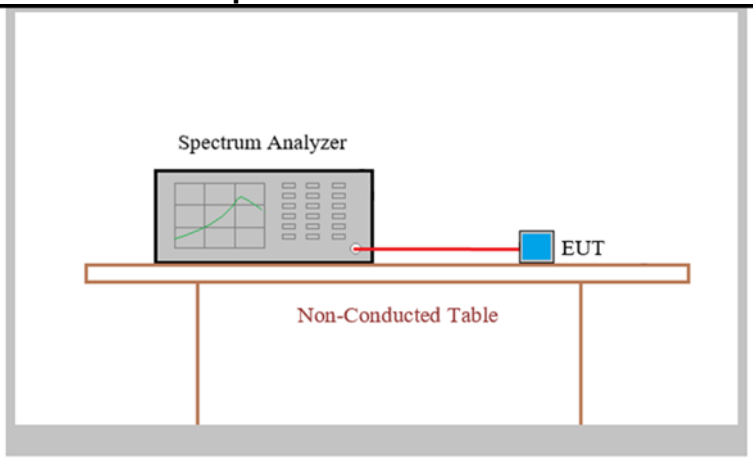
Figure 3. Above 1GHz

4.5.2 For Conducted Emissions test setup

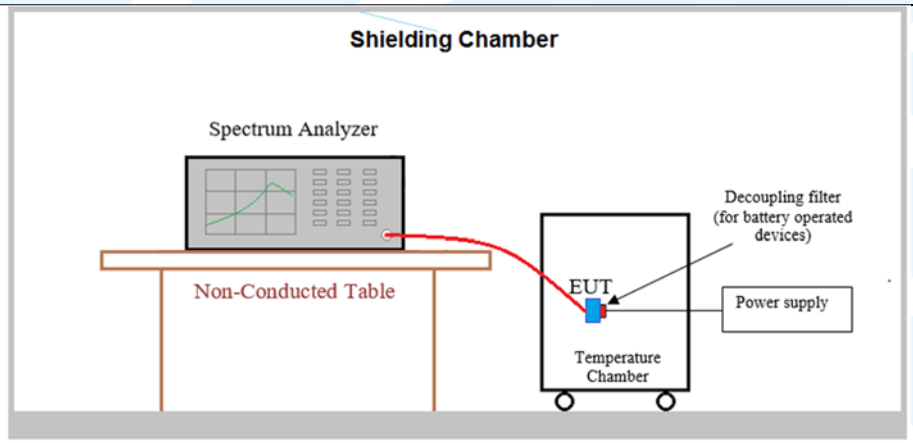
Figure 3. Conducted Emissions setup



4.5.3 For Conducted RF test setup



Normal Environment



Extreme 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 3.85Vdc rechargeable Li-on battery. 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	Y axis
	1TX	Chain 1	Y axis
	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.

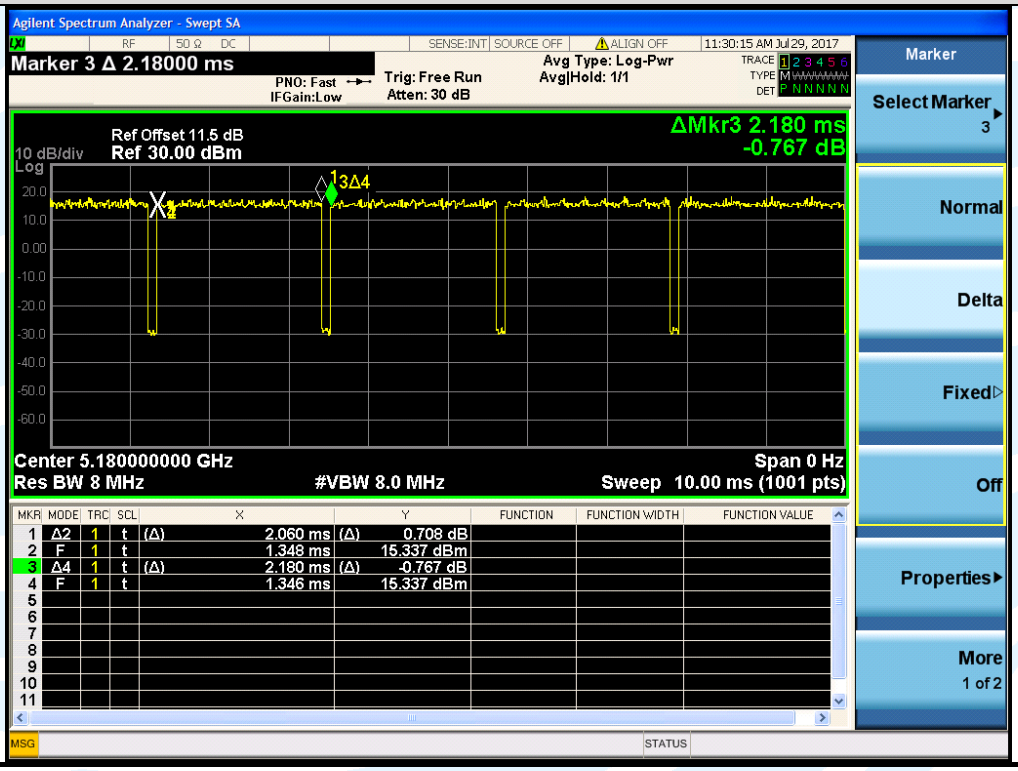
4.7 DUTY CYCLE

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	2.060	2.180	0.94	94.50	0.25	0.49	-0.49
IEEE 802.11n-HT20	MCS8	0.985	1.100	0.90	89.55	0.48	1.02	-0.96
IEEE 802.11n-HT40	MCS8	0.495	0.615	0.80	80.49	0.94	2.02	-1.89
IEEE 802.11ac-VHT20	MCS0	0.995	1.110	0.90	89.64	0.47	1.01	-0.95
IEEE 802.11ac-VHT40	MCS0	0.498	0.618	0.81	80.58	0.94	2.01	-1.88
IEEE 802.11ac-VHT80	MCS0	0.464	0.568	0.82	81.69	0.88	2.16	-1.76

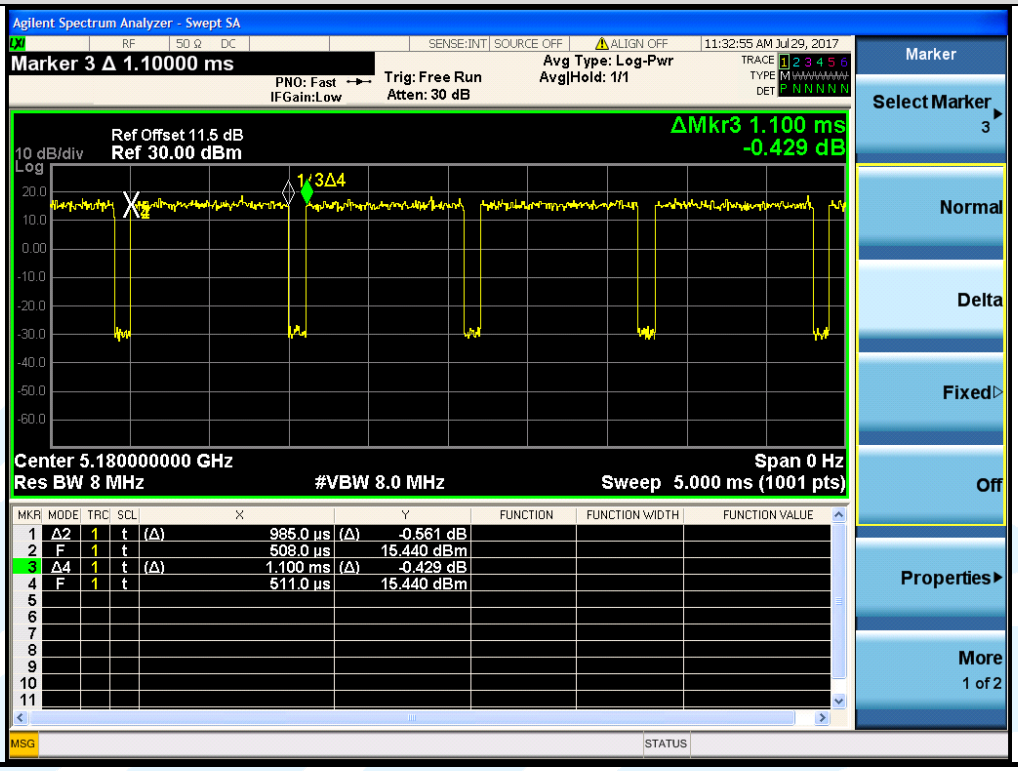
Remark:
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plot as follows

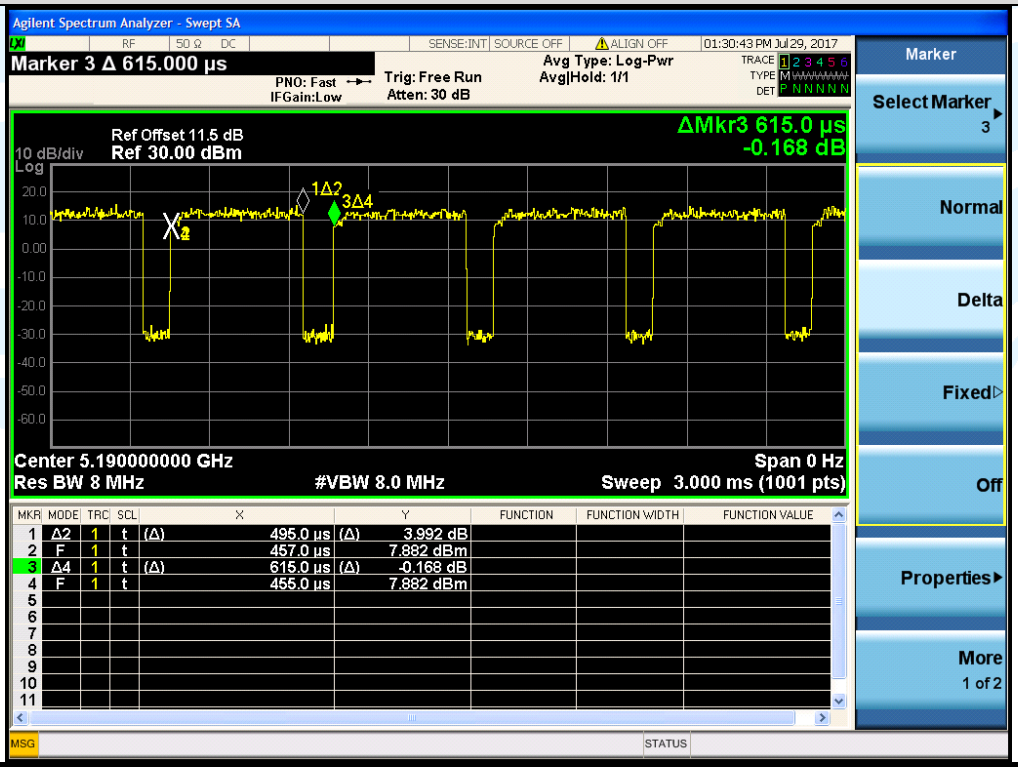
IEEE 802.11a



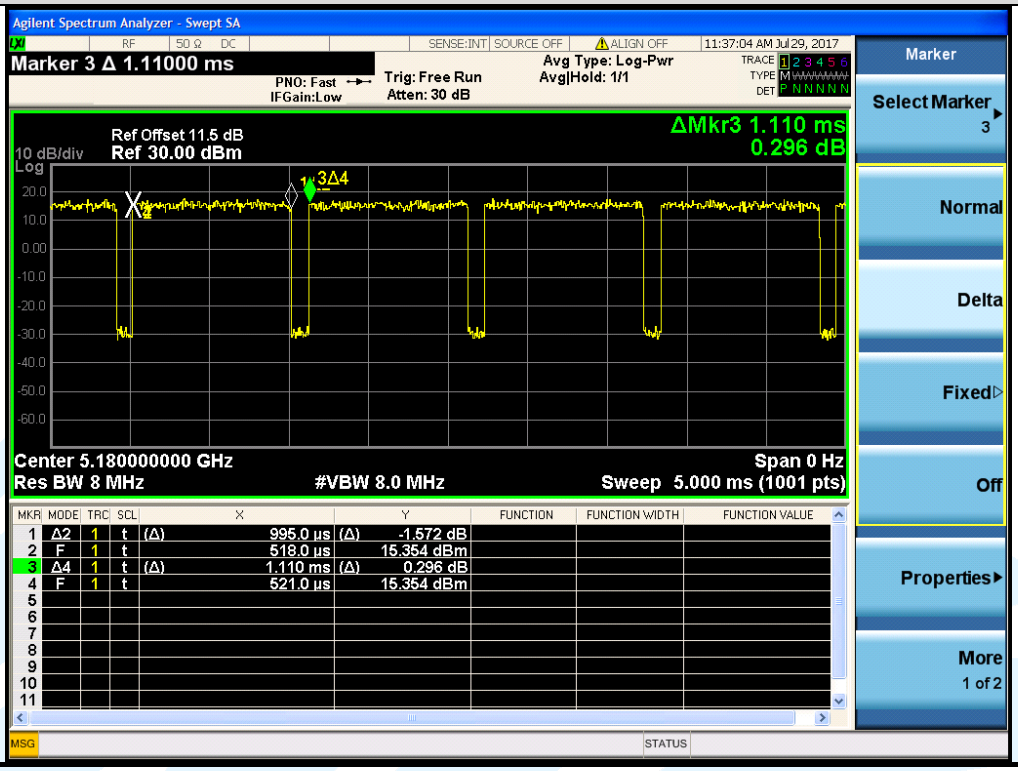
IEEE 802.11n-HT20



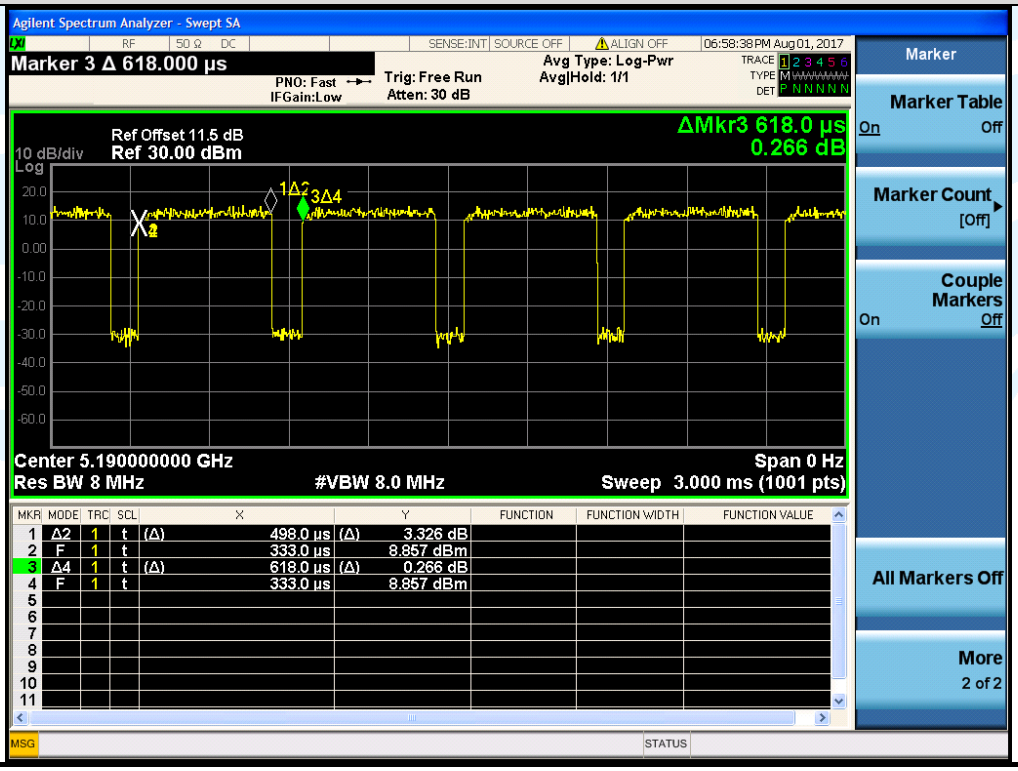
IEEE 802.11n-HT40



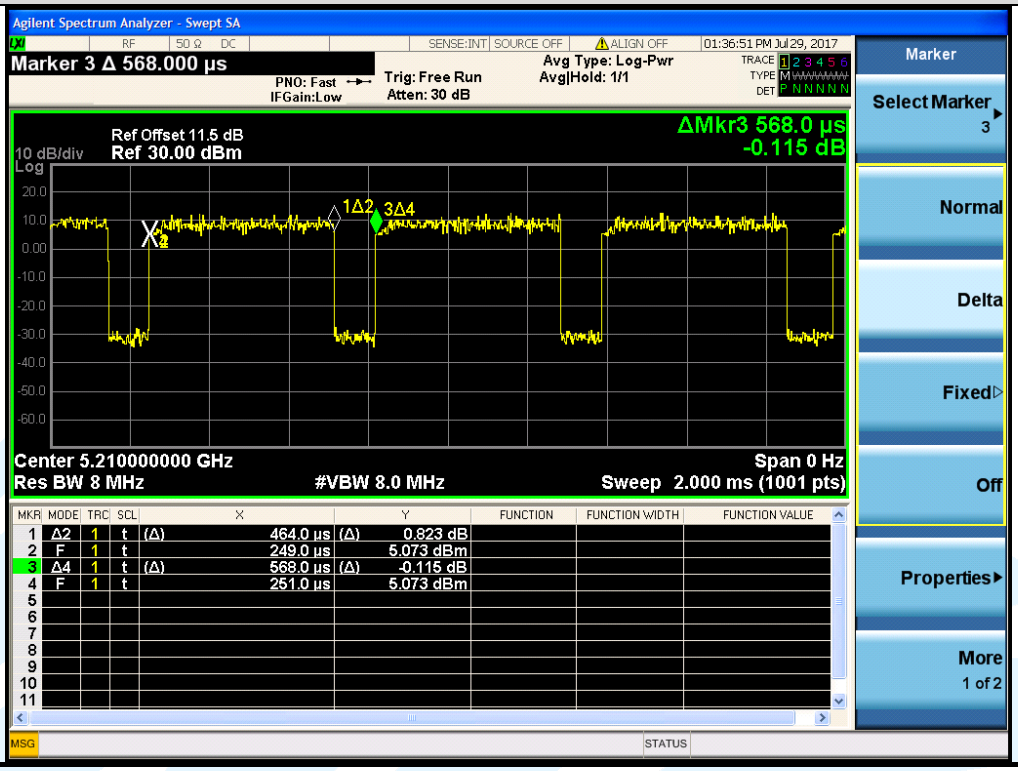
IEEE 802.11ac-VHT20



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	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
4	KDB 789033 D02 General UNII Test Procedures New Rules v01r04	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15 subpart E
5	905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
6	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
7	KDB 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
8	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.
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 not the same, the best case directional gain of the antenna is 4.02 dBi (See section 5.5).

5.3 26 DB BANDWIDTH

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

Test Method: KDB 789033 D02 v01r04 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.

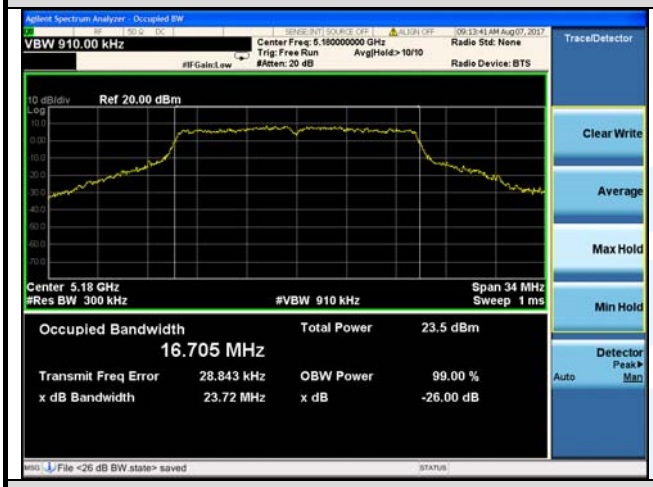
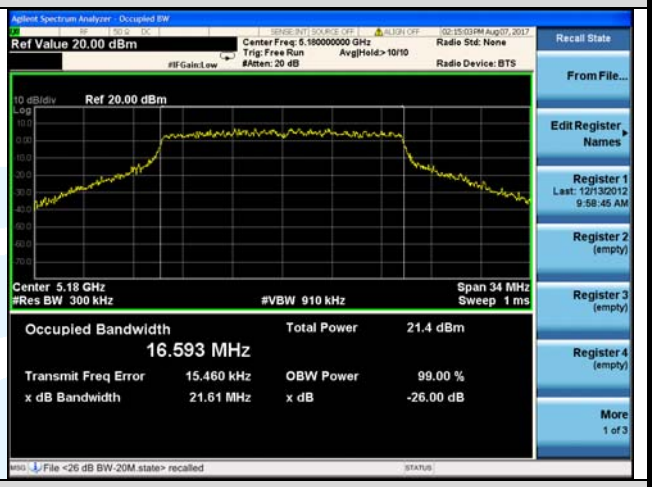
Instruments Used: Refer to section 3 for details

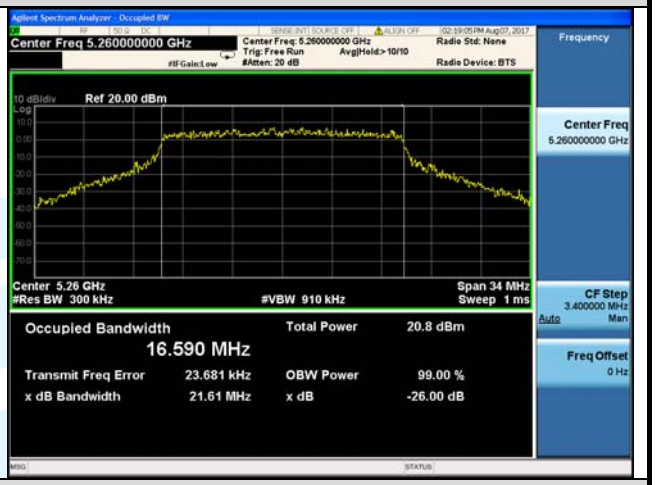
Test Mode: Transmitter mode

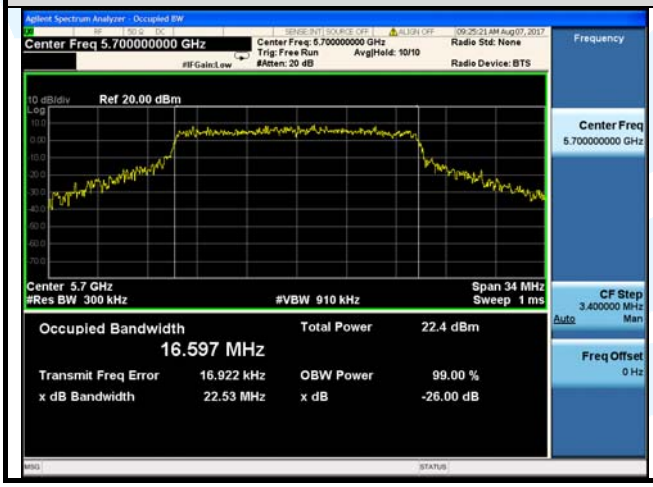
Test Results: Pass

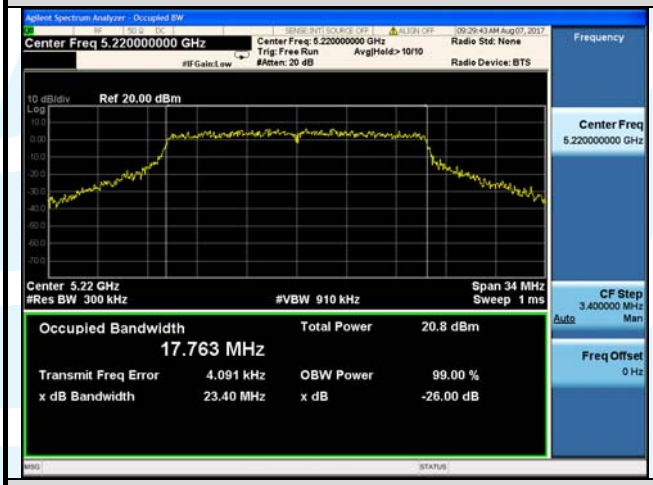
Mode	Channel	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	36 (5180)	23.72	21.61	16.705	16.593
	44 (5220)	23.46	20.54	16.666	16.522
	48 (5240)	22.99	21.36	16.664	16.566
	52 (5260)	24.65	21.61	16.634	16.590
	60 (5300)	23.00	21.88	16.690	16.596
	64 (5320)	22.05	22.13	16.643	16.586
	100 (5500)	22.23	22.00	16.612	16.618
	120 (5600)	22.88	21.99	16.686	16.584
	140 (5700)	22.53	22.23	16.597	16.575
IEEE 802.11n-HT20	36 (5180)	23.79	23.28	17.860	17.768
	44 (5220)	23.40	22.81	17.763	17.769
	48 (5240)	23.42	22.47	17.840	17.740
	52 (5260)	22.63	22.72	17.761	17.768
	60 (5300)	23.70	22.42	17.821	17.735
	64 (5320)	23.26	23.33	17.791	17.788
	100 (5500)	23.59	23.03	17.788	17.724
	120 (5600)	21.79	23.10	17.796	17.790
	140 (5700)	24.02	22.76	17.785	17.824
IEEE 802.11n-HT40	38 (5190)	40.91	39.60	36.156	36.099
	46 (5230)	41.23	40.93	36.174	36.158
	54 (5270)	40.62	40.82	36.201	36.250
	62 (5310)	40.66	41.49	36.143	36.234
	102 (5510)	40.42	40.68	36.155	36.174
	118 (5590)	40.70	40.82	36.121	36.146
	134 (5670)	40.88	41.08	36.173	36.121
IEEE 802.11ac-VHT80	42 (5210)	91.90	82.12	76.477	75.832
	58 (5290)	90.55	82.85	76.421	75.805
	106 (5530)	83.71	82.05	76.263	75.745
	122 (5610)	93.51	82.14	76.667	75.600

The test plot 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 120	
	
Channel 140	
	

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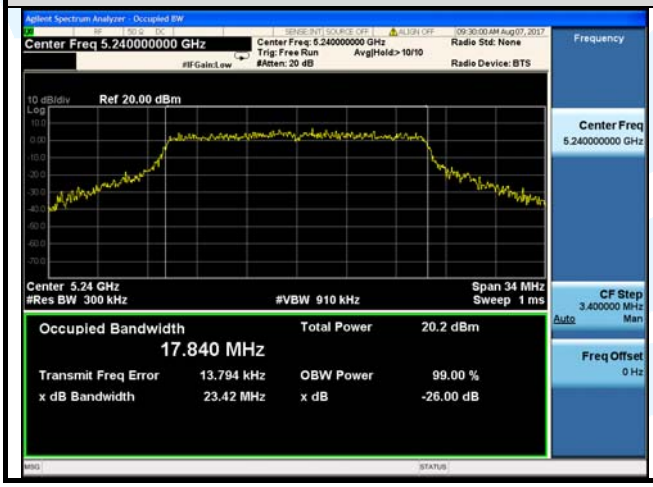
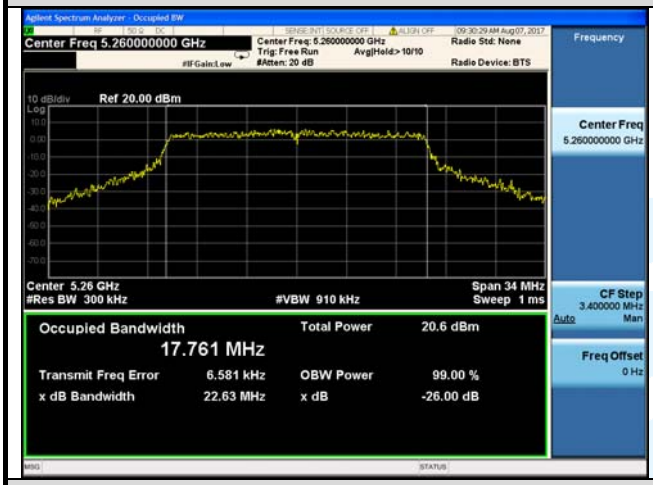
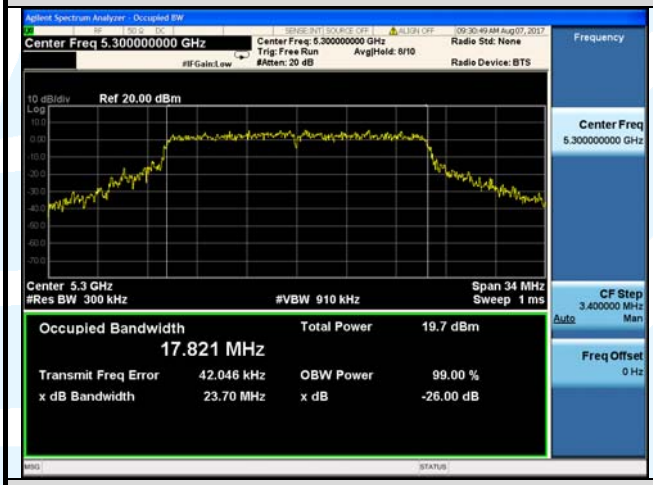
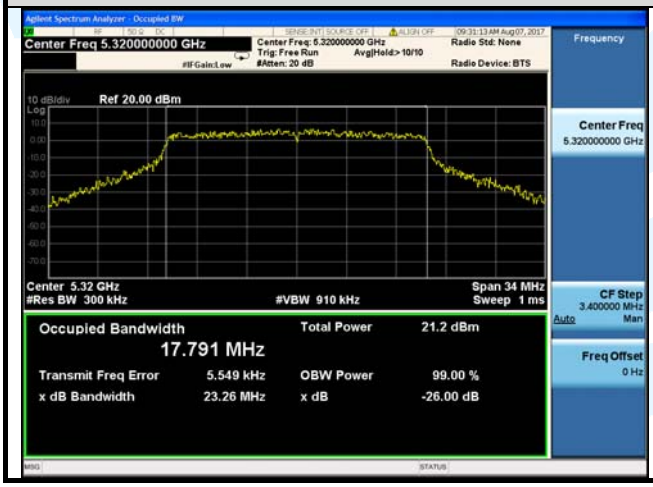
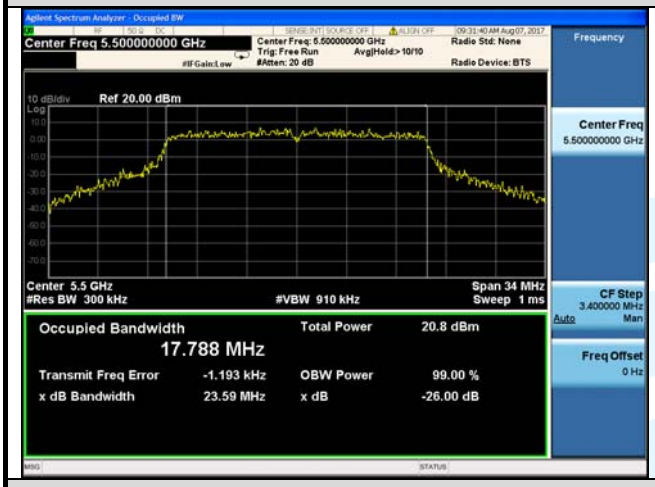
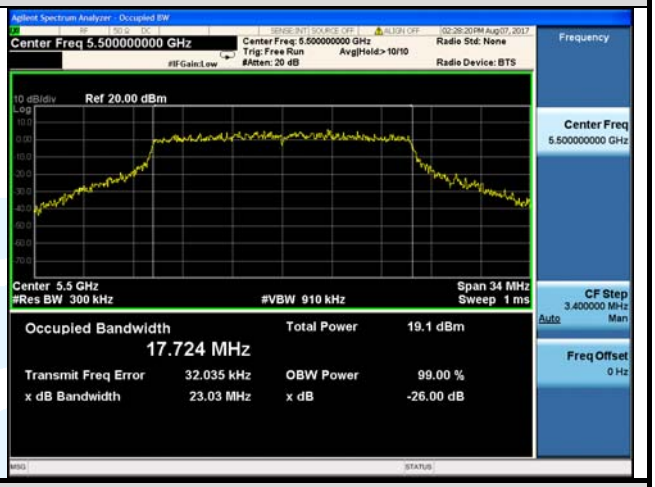
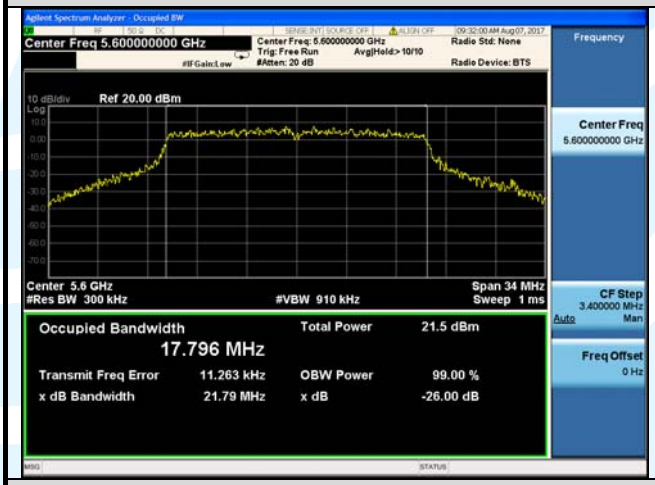
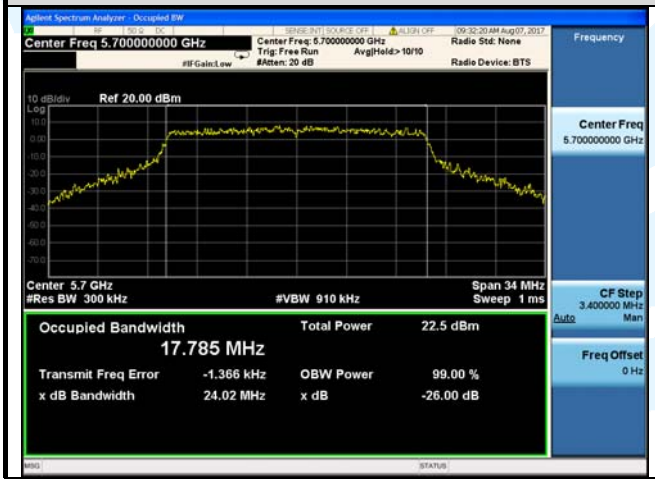
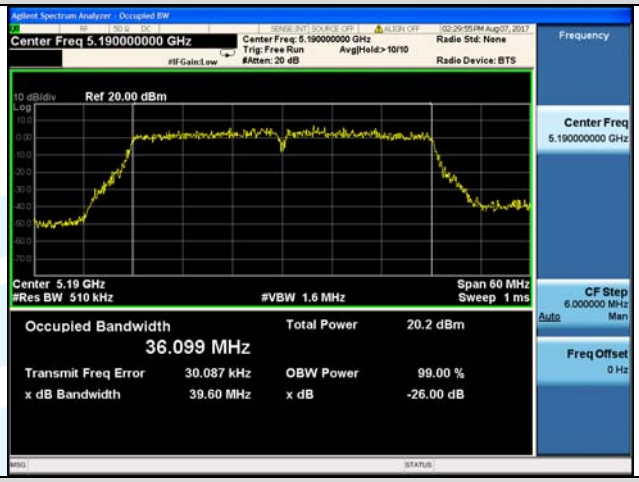
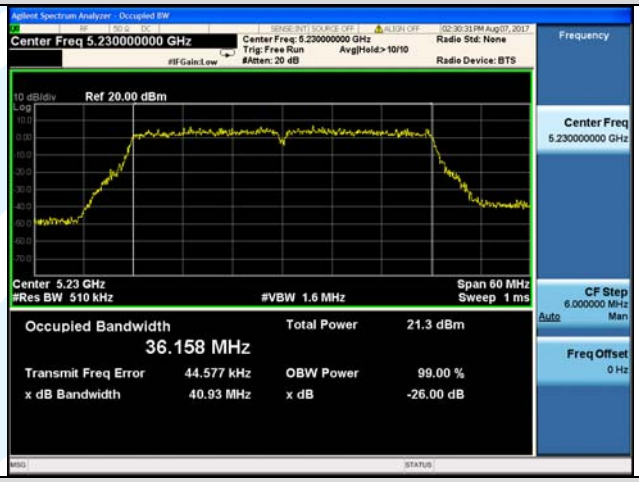
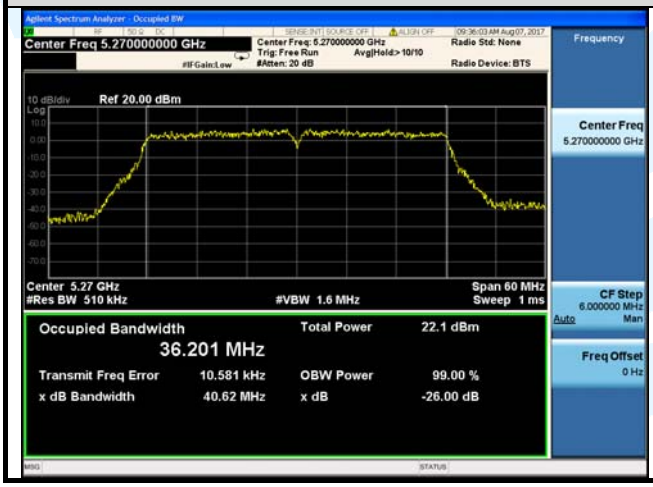
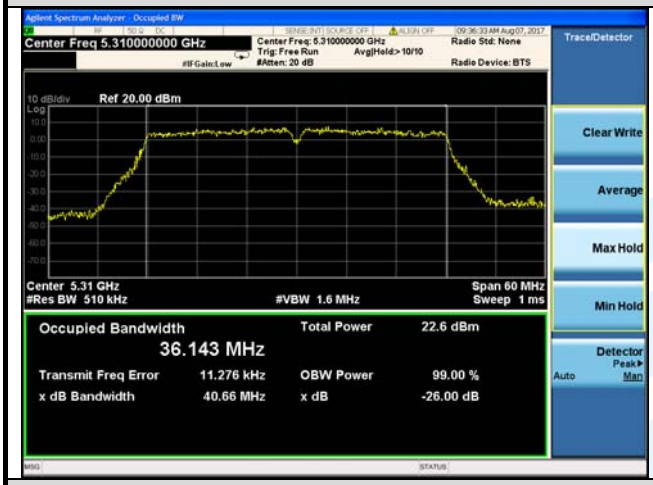
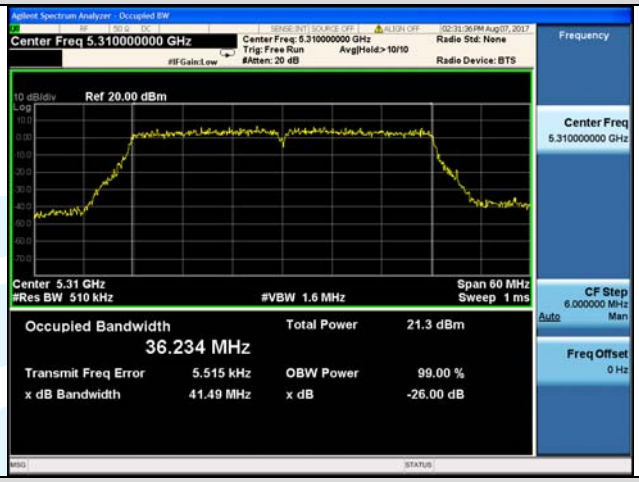
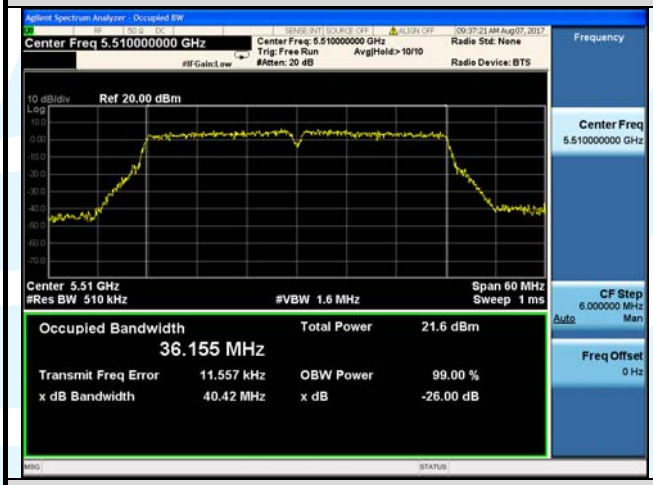
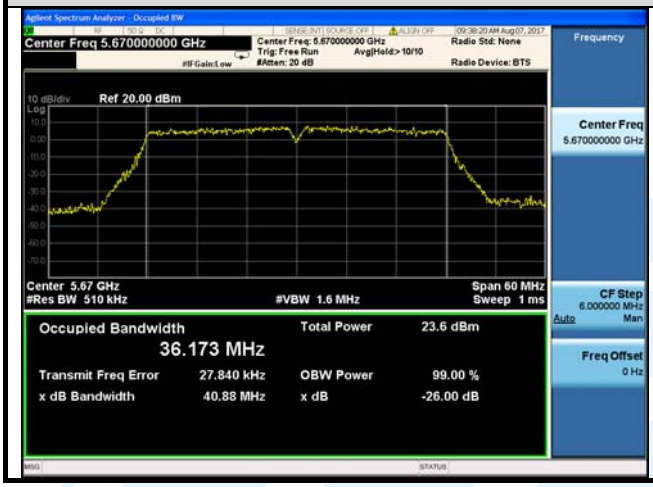
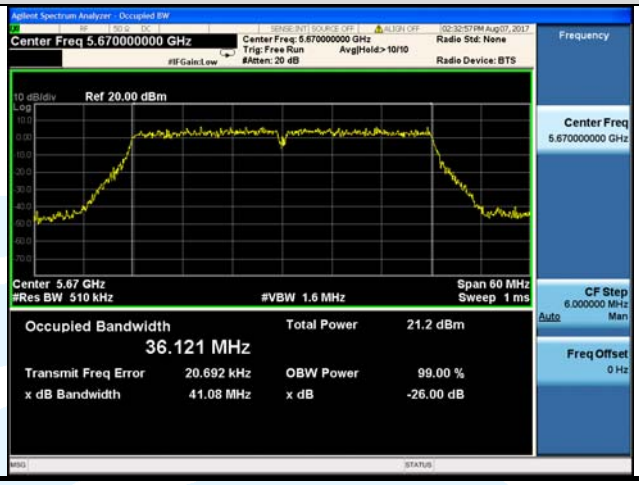
	

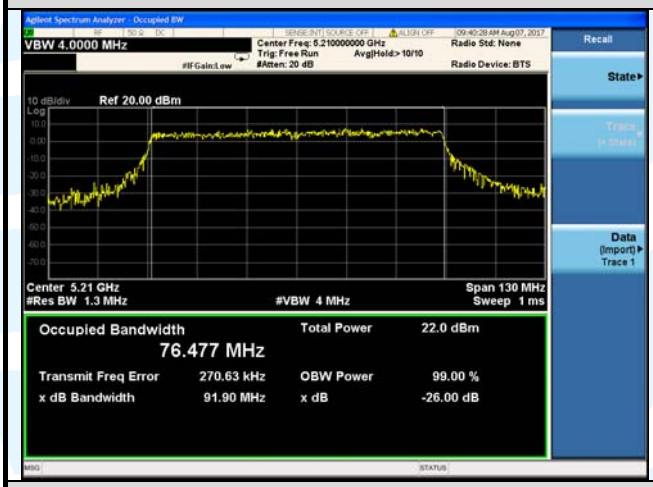
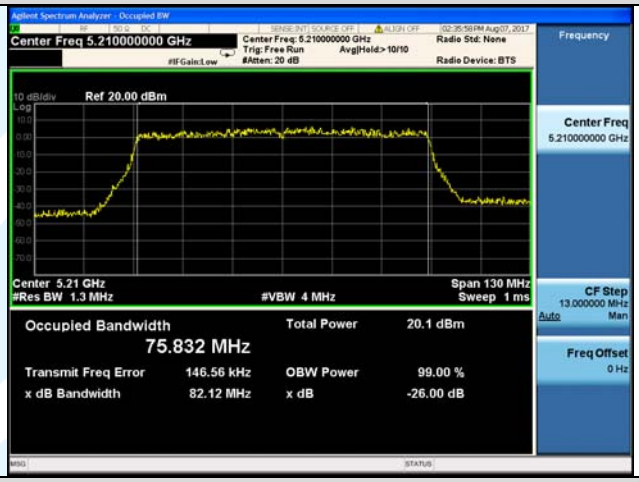
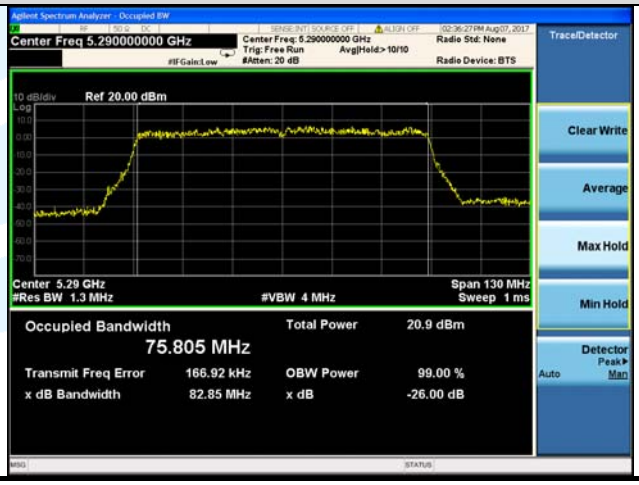
IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 52	
	
Channel 60	
	
Channel 64	
	

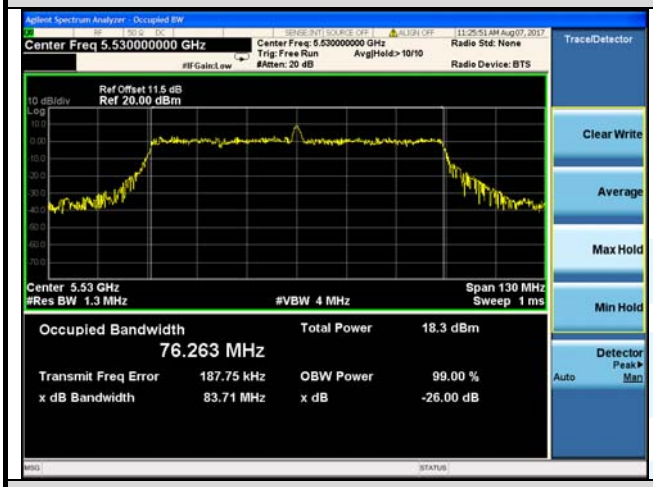
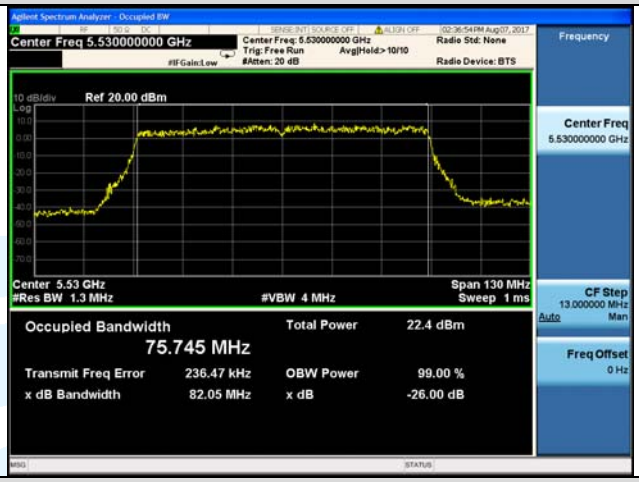
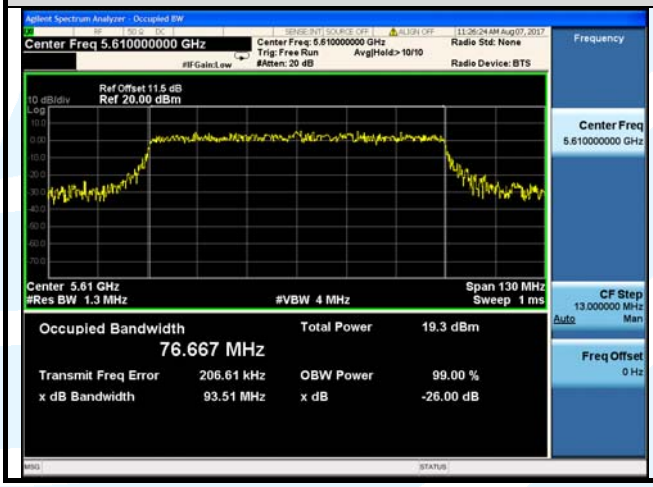
IEEE 802.11n-HT20	
Chain 0	Chain 1
Channel 100	
	
Channel 120	
	
Channel 140	
	

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 118	
	

IEEE 802.11n-HT40	
Chain 0	Chain 1
Channel 134	
	

IEEE 802.11ac-VHT80	
Channel 42	
	
Channel 58	
	

IEEE 802.11ac-VHT80	
Channel 106	
	
Channel 122	
	

5.46 DB BANDWIDTH

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

Test Method: KDB 789033 D02 v01r04Section 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

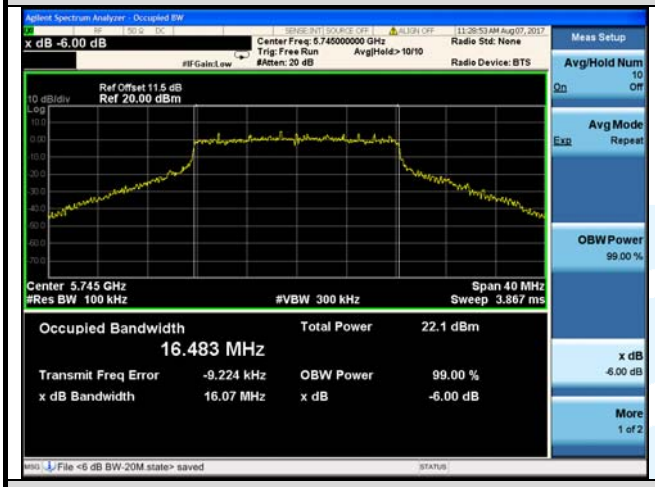
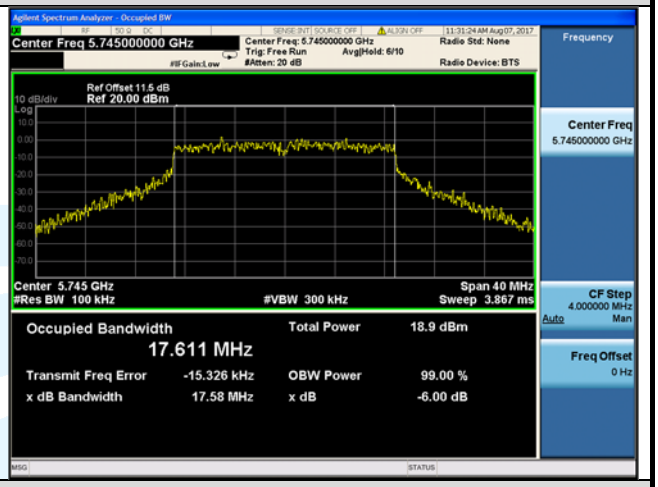
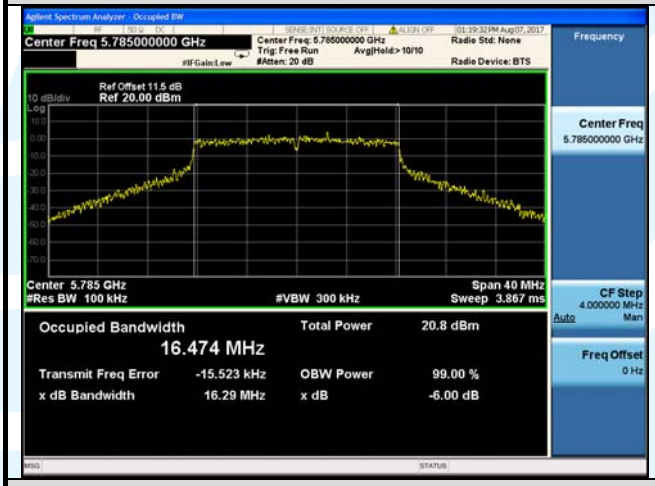
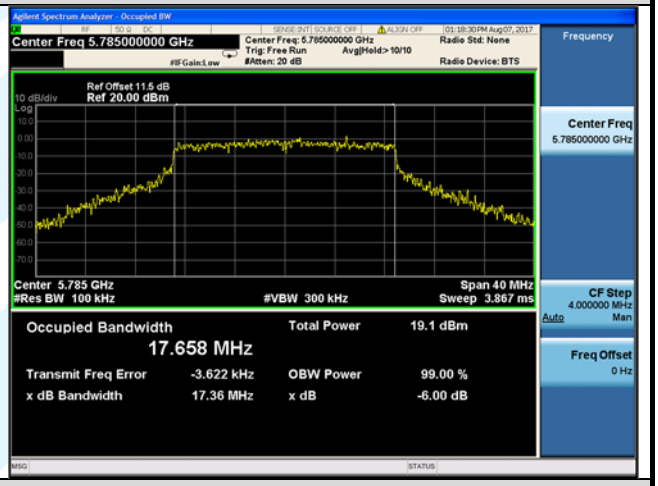
Test Mode: Transmitter mode

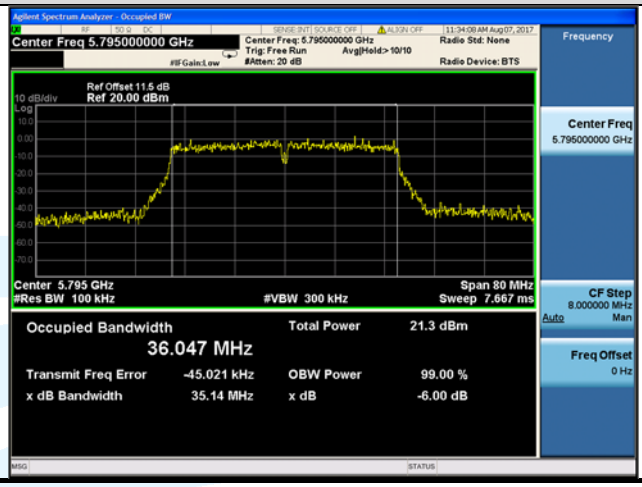
Test Results: Pass

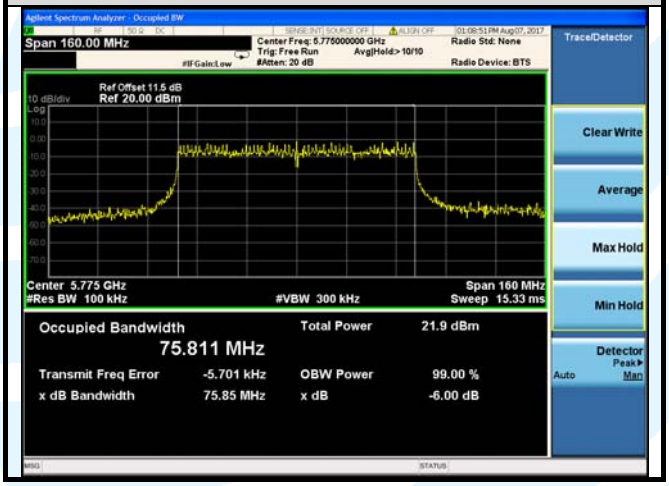
Test Data:

Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Pass / Fail
The worst case test data: Chain 1					
IEEE 802.11a	149 (5745)	16.07	16.483	> 500 kHz	Pass
	157 (5785)	16.29	16.474	> 500 kHz	Pass
	165 (5825)	16.02	16.436	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	17.58	17.611	> 500 kHz	Pass
	157 (5785)	17.36	17.658	> 500 kHz	Pass
	165 (5825)	16.05	17.659	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	35.13	36.121	> 500 kHz	Pass
	159 (5795)	35.14	36.047	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	75.85	75.811	> 500 kHz	Pass

The test plot as follows:

IEEE 802.11a	IEEE 802.11n-HT20
Channel 149	
	
Channel 157	
	
Channel 165	
	

IEEE 802.11n-HT40	
Channel 151	Channel 159
	

IEEE 802.11ac-VHT80
Channel 151


5.5 MAXIMUM CONDUCTED OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
Test Method: KDB 789033 D02 v01r04 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 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.

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:

For U-NII-2A, U-NII-2C Band:

For IEEE 802.11 a/n/ac, the minimum 26 dB emission bandwidth is 21.79 MHz

11 dBm + $10\log_{10}$ (21.79) = 24.38 dBm > 24 dBm (200mW)

So the 24 dB limit applicable

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	1.01	1.00	4.02	24.00
U-NII-2A	1.46	0.17	3.85	24.00
U-NII-2C	0.11	-3.26	1.60	24.00
U-NII-3	-2.90	-3.79	-0.32	30.00
Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows:				
If transmit signals are correlated, then				
Directional gain = 10 log[(10^G1 /20 + 10^G2 /20 + … + 10^GN /20)^2 /NANT] dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]				

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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 802.11a	36 (5180)	14.31	14.56	15.36	15.61	18.13	24	Pass
	44 (5220)	14.37	14.62	15.25	15.50	18.09	24	Pass
	48 (5240)	14.41	14.66	15.25	15.50	18.11	24	Pass
	52 (5260)	14.34	14.59	15.03	15.28	17.96	24	Pass
	60 (5300)	14.59	14.84	14.69	14.94	17.90	24	Pass
	64 (5320)	14.52	14.77	14.56	14.81	17.80	24	Pass
	100 (5500)	14.40	14.65	15.36	15.61	18.17	24	Pass
	120 (5600)	14.09	14.34	13.95	14.20	17.28	24	Pass
	140 (5700)	14.46	14.71	14.27	14.52	17.63	24	Pass
	149 (5745)	12.64	12.89	13.12	13.37	16.15	30	Pass
	157 (5785)	12.70	12.95	13.52	13.77	16.39	30	Pass
	165 (5825)	12.26	12.51	12.48	12.73	15.63	30	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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)	12.89	13.37	13.99	14.47	16.97	24	Pass
	44 (5220)	12.93	13.41	13.89	14.37	16.93	24	Pass
	48 (5240)	12.91	13.39	13.90	14.38	16.92	24	Pass
	52 (5260)	12.83	13.31	13.67	14.15	16.76	24	Pass
	60 (5300)	12.90	13.38	13.34	13.82	16.62	24	Pass
	64 (5320)	12.92	13.40	13.20	13.68	16.55	24	Pass
	100 (5500)	13.08	13.56	13.85	14.33	16.97	24	Pass
	120 (5600)	12.63	13.11	12.77	13.25	16.19	24	Pass
	140 (5700)	12.99	13.47	12.84	13.32	16.41	24	Pass
	149 (5745)	12.36	12.84	13.21	13.69	16.30	30	Pass
	157 (5785)	12.42	12.90	13.30	13.78	16.37	30	Pass
	165 (5825)	12.17	12.65	12.93	13.41	16.06	30	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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)	10.79	11.74	11.97	12.92	15.38	24	Pass
	46 (5230)	10.87	11.82	11.97	12.92	15.42	24	Pass
	54 (5270)	10.84	11.79	11.97	12.92	15.40	24	Pass
	62 (5310)	10.84	11.79	11.26	12.21	15.02	24	Pass
	102 (5510)	11.02	11.97	11.87	12.82	15.43	24	Pass
	118 (5590)	10.47	11.42	10.75	11.7	14.57	24	Pass
	134 (5670)	10.81	11.76	10.93	11.88	14.83	24	Pass
	151 (5755)	11.07	12.02	11.44	12.39	15.22	30	Pass
	159 (5795)	11.24	12.19	11.95	12.9	15.57	30	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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)	13.43	13.90	14.55	15.02	17.51	24	Pass
	44 (5220)	13.50	13.97	14.48	14.95	17.50	24	Pass
	48 (5240)	13.44	13.91	14.45	14.92	17.45	24	Pass
	52 (5260)	13.37	13.84	14.22	14.69	17.30	24	Pass
	60 (5300)	13.55	14.02	14.02	14.49	17.27	24	Pass
	64 (5320)	13.80	14.27	13.53	14.00	17.15	24	Pass
	100 (5500)	13.69	14.16	14.47	14.94	17.58	24	Pass
	120 (5600)	13.17	13.64	13.36	13.83	16.75	24	Pass
	140 (5700)	13.58	14.05	13.40	13.87	16.97	24	Pass
	149 (5745)	11.20	11.67	11.87	12.34	15.03	30.00	Pass
	157 (5785)	11.53	12.00	12.99	13.46	15.80	30.00	Pass
	165 (5825)	11.06	11.53	12.00	12.47	15.04	30.00	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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-VHT40	38 (5190)	10.73	11.67	11.93	12.87	15.32	24.00	Pass
	46 (5230)	10.85	11.79	11.86	12.80	15.33	24.00	Pass
	54 (5270)	10.88	11.82	11.55	12.49	15.18	24.00	Pass
	62 (5310)	10.85	11.79	11.28	12.22	15.02	24.00	Pass
	102 (5510)	10.87	11.81	11.82	12.76	15.32	24.00	Pass
	118 (5590)	10.53	11.47	10.61	11.55	14.52	24.00	Pass
	134 (5670)	10.85	11.79	10.47	11.41	14.61	24.00	Pass
	151 (5755)	11.18	12.12	11.67	12.61	15.38	30.00	Pass
	159 (5795)	11.22	12.16	12.16	13.10	15.67	30.00	Pass

Mode	Channel/ Frequency (MHz)	Maximum Conducted Output Power (dBm)						
		SISO				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-VHT80	42 (5230)	10.92	11.80	11.80	12.68	15.27	24	Pass
	58 (5290)	10.72	11.60	11.24	12.12	14.88	24	Pass
	106 (5530)	10.70	11.58	11.45	12.33	14.98	24	Pass
	122 (5610)	10.49	11.37	10.28	11.16	14.28	24	Pass
	155 (5775)	11.13	12.01	11.64	12.52	15.28	30	Pass

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

5.6 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)

Test Method: KDB 789033 D02 v01r04 Section F

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 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.

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.

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	1.01	1.00	4.02	11.00
U-NII-2A	1.46	0.17	3.85	11.00
U-NII-2C	0.11	-3.26	1.60	11.00
U-NII-3	-2.90	-3.79	-0.32	30.00
Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows:				
If transmit signals are correlated, then				
Directional gain = 10 log[(10^G1 /20 + 10^G2 /20 + … + 10^GN /20)^2 /NANT] dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]				

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

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/MHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limits	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11a	36 (5180)	5.504	5.754	5.808	6.058	8.92	11	Pass
	44 (5220)	5.610	5.860	5.976	6.226	9.06	11	Pass
	48 (5240)	4.764	5.014	5.664	5.914	8.50	11	Pass
	52 (5260)	5.120	5.370	6.120	6.370	8.91	11	Pass
	60 (5300)	5.727	5.977	6.395	6.645	9.33	11	Pass
	64 (5320)	5.225	5.475	6.511	6.761	9.18	11	Pass
	100 (5500)	6.407	6.657	5.670	5.920	9.31	11	Pass
	120 (5600)	6.477	6.727	5.333	5.583	9.20	11	Pass
	140 (5700)	7.228	7.478	5.683	5.933	9.78	11	Pass

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/MHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limits	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11n-HT20	36 (5180)	3.780	4.260	2.160	2.640	6.54	11	Pass
	44 (5220)	4.106	4.586	2.330	2.810	6.80	11	Pass
	48 (5240)	3.585	4.065	4.592	5.072	7.61	11	Pass
	52 (5260)	3.862	4.342	4.785	5.265	7.84	11	Pass
	60 (5300)	4.208	4.688	3.783	4.263	7.49	11	Pass
	64 (5320)	4.659	5.139	4.232	4.712	7.94	11	Pass
	100 (5500)	4.866	5.346	3.790	4.270	7.85	11	Pass
	120 (5600)	4.202	4.682	4.279	4.759	7.73	11	Pass
	140 (5700)	4.765	5.245	4.476	4.956	8.11	11	Pass

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/MHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limits	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11n-HT40	38 (5190)	2.242	3.192	2.161	3.111	6.16	11	Pass
	46 (5230)	2.490	3.440	2.372	3.322	6.39	11	Pass
	54 (5270)	2.122	3.072	2.980	3.930	6.53	11	Pass
	62 (5310)	2.239	3.189	2.076	3.026	6.12	11	Pass
	102 (5510)	1.622	2.572	1.044	1.994	5.30	11	Pass
	118 (5590)	2.050	3.000	2.422	3.372	6.20	11	Pass
	134 (5670)	3.136	4.086	2.549	3.499	6.81	11	Pass

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/MHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limits	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11ac-VHT80	42 (5230)	-2.961	-2.081	-2.542	-1.662	1.14	11	Pass
	58 (5290)	-2.746	-1.866	-2.820	-1.940	1.11	11	Pass
	106 (5530)	-3.351	-2.471	-3.866	-2.986	0.29	11	Pass
	122 (5610)	-3.028	-2.148	-3.078	-2.198	0.84	11	Pass

For U-NII-3 band

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/500kHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limit	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11a	149 (5745)	4.562	4.812	3.934	4.184	7.52	30	Pass
	157 (5785)	4.585	4.835	2.810	3.060	7.05	30	Pass
	165 (5825)	3.778	4.028	2.614	2.864	6.50	30	Pass

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/500kHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limit	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11n-HT20	149 (5745)	2.771	3.251	1.621	2.101	5.72	30	Pass
	157 (5785)	2.431	2.911	0.857	1.337	5.21	30	Pass
	165 (5825)	2.148	2.628	1.103	1.583	5.15	30	Pass
IEEE 802.11n-HT40	151 (5755)	1.164	2.114	0.148	1.098	4.65	30	Pass
	159 (5795)	1.091	2.041	0.401	1.351	4.72	30	Pass

Mode	Channel/ Frequency (MHz)	Maximum Power Spectral Density (dBm/500kHz)						
		SISO				Total PSD MIMO_ Chain 0+1	Limit	Pass / Fail
		Chain 0		Chain 1				
		Meas PSD	Corr'd PSD	Meas PSD	Corr'd PSD			
IEEE 802.11ac-VHT80	155 (5775)	-4.219	-3.339	-4.836	-3.956	-0.63	30	Pass

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