

# FCC TEST REPORT

**Product Name:** MI BOX  
**Trade Mark:** MI  
**Model No.:** MDZ-22-AB  
**Report Number:** 180320001RFC-4  
**Test Standards:** FCC 47 CFR Part 15 Subpart E  
**FCC ID:** 2AIMRMITVMDZ22AB  
**Test Result:** PASS  
**Date of Issue:** June 22, 2018

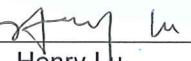
Prepared for:

**Beijing Xiaomi Electronics Co.,Ltd**  
Room 707,7F,Building 5,No 58,JinghaiWulu Road Beijing economic  
& Technological Development Zone, Beijing, China

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**  
16/F, Block A, Building 6, Baoneng Science and Technology Park,  
Qingxiang Road No.1, Longhua New District, Shenzhen, China  
**TEL:** +86-755-2823 0888  
**FAX:** +86-755-2823 0886

Tested by: \_\_\_\_\_

  
Henry Lu  
Project Engineer

Reviewed by: \_\_\_\_\_

  
Kevin Liang  
Assistant Manager

Approved by: \_\_\_\_\_

  
Billy Li  
Technical Director

Date: \_\_\_\_\_

June 22, 2018

  
\* Certified \*

**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  
Tel: +86-755-28230888 Fax: +86-755-28230886 E-mail: info@uttlab.com [Http://www.uttlab.com](http://www.uttlab.com)

**Version**

Version No.	Date	Description
V1.0	June 22, 2018	Original



## CONTENTS

<b>1. GENERAL INFORMATION .....</b>	<b>4</b>
1.1 CLIENT INFORMATION .....	4
1.2 EUT INFORMATION .....	4
1.2.1 GENERAL DESCRIPTION OF EUT .....	4
1.2.2 DESCRIPTION OF ACCESSORIES.....	4
1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD.....	5
1.4 OTHER INFORMATION.....	6
1.5 DESCRIPTION OF SUPPORT UNITS .....	6
1.6 TEST LOCATION.....	6
1.7 TEST FACILITY.....	6
1.8 DEVIATION FROM STANDARDS .....	7
1.9 ABNORMALITIES FROM STANDARD CONDITIONS.....	7
1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER .....	7
1.11 MEASUREMENT UNCERTAINTY .....	7
<b>2. TEST SUMMARY .....</b>	<b>8</b>
<b>3. EQUIPMENT LIST .....</b>	<b>9</b>
<b>4. TEST CONFIGURATION .....</b>	<b>10</b>
4.1 ENVIRONMENTAL CONDITIONS FOR TESTING .....	10
4.1.1 NORMAL OR EXTREME TEST CONDITIONS .....	10
4.2 TEST CHANNELS .....	10
4.3 EUT TEST STATUS .....	11
4.4 PRE-SCAN.....	11
4.5 TEST SETUP .....	11
4.5.1 FOR RADIATED EMISSIONS TEST SETUP .....	11
4.5.2 FOR CONDUCTED EMISSIONS TEST SETUP .....	13
4.5.3 FOR CONDUCTED RF TEST SETUP .....	13
4.6 SYSTEM TEST CONFIGURATION .....	14
4.7 DUTY CYCLE .....	15
<b>5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION .....</b>	<b>18</b>
5.1 REFERENCE DOCUMENTS FOR TESTING .....	18
5.2 ANTENNA REQUIREMENT .....	18
5.3 26 dB BANDWIDTH.....	19
5.4 6 dB BANDWIDTH.....	26
5.5 MAXIMUM CONDUCTED OUTPUT POWER .....	29
5.6 PEAK POWER SPECTRAL DENSITY .....	33
5.7 FREQUENCY STABILITY .....	45
5.8 RADIATED EMISSIONS AND BAND EDGE MEASUREMENT.....	48
5.9 DYNAMIC FREQUENCY SELECTION .....	89
5.10 AC POWER LINE CONDUCTED EMISSION .....	99
<b>APPENDIX 1 PHOTOS OF TEST SETUP .....</b>	<b>102</b>
<b>APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS.....</b>	<b>102</b>

## 1. GENERAL INFORMATION

### 1.1 CLIENT INFORMATION

<b>Applicant:</b>	Beijing Xiaomi Electronics Co.,Ltd
<b>Address of Applicant:</b>	Room 707,7F,Building 5,No 58,JinghaiWulu Road Beijing economic & Technological Development Zone, Beijing, China
<b>Manufacturer:</b>	Beijing Xiaomi Electronics Co.,Ltd
<b>Address of Manufacturer:</b>	Room 707,7F,Building 5,No 58,JinghaiWulu Road Beijing economic & Technological Development Zone, Beijing, China

### 1.2 EUT INFORMATION

#### 1.2.1 General Description of EUT

<b>Product Name:</b>	MI BOX		
<b>Model No.:</b>	MDZ-22-AB		
<b>Add. Model No.:</b>	MDZ-22-AC, MDZ-22-AD, MDZ-22-AE, MDZ-22-AF (See Note 1)		
<b>Trade Mark:</b>	MI		
<b>DUT Stage:</b>	Identical Prototype		
<b>EUT Supports Function:</b>	2.4 GHz ISM Band:	IEEE 802.11b/g/n Bluetooth: V4.0	
	5 GHz U-NII Bands:	IEEE 802.11a/n/ac	5 180 MHz to 5 240 MHz
		IEEE 802.11a/n/ac	5 260 MHz to 5 320 MHz
		IEEE 802.11a/n/ac	5 500 MHz to 5 700 MHz
		IEEE 802.11a/n/ac	5 745 MHz to 5 825 MHz
<b>Sample Received Date:</b>	May 9, 2018		
<b>Sample Tested Date:</b>	May 18, 2018 to May 30, 2018		
<b>Note 1:</b> The additional model MDZ-22-AC, MDZ-22-AD, MDZ-22-AE, MDZ-22-AF is identical with the test model MDZ-22-AB except the model number for marketing purpose.			

#### 1.2.2 Description of Accessories

Adapter	
<b>Trade Mark:</b>	MI
<b>Model No.:</b>	AY11BA-AF0522102
<b>Input:</b>	100-240 V~50/60 Hz 0.5 A
<b>Output:</b>	5.2 V = 2.1 A
<b>AC Cable:</b>	N/A
<b>DC Cable:</b>	1.05 Meter

HDMI Cable	
<b>Description:</b>	HDMI Cable
<b>Cable Type:</b>	Shielded without ferrite
<b>Length:</b>	1.05 Meter

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

<b>Operational Frequency Band:</b>	5150 MHz to 5250 MHz				
	5250 MHz to 5350 MHz				
	5470 MHz to 5725 MHz				
	5725 MHz to 5850 MHz				
<b>Support Standards:</b>	IEEE 802.11a/n/ac				
<b>TPC Function:</b>	Not Support				
<b>DFS Operational mode:</b>	Slave without radar Interference detection function				
<b>Type of Modulation:</b>	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)				
<b>Channel Spacing:</b>	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz				
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz				
	IEEE 802.11ac-VHT80: 80 MHz				
<b>Data Rate:</b>	IEEE 802.11a: Up to 54 Mbps				
	IEEE 802.11n-HT20: Up to MCS7				
	IEEE 802.11n-HT40: Up to MCS7				
	IEEE 802.11ac-VHT20: Up to MCS8				
	IEEE 802.11ac-VHT40: Up to MCS9				
	IEEE 802.11ac-VHT80: Up to MCS9				
<b>Number of Channels:</b>	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				
<b>Antenna Type:</b>	PCB Antenna				
<b>Antenna Gain:</b>	5150 MHz to 5250 MHz   1.9 dBi				
	5250 MHz to 5350 MHz   1.9 dBi				
	5470 MHz to 5725 MHz   1.9 dBi				
	5725 MHz to 5850 MHz   1.9 dBi				
<b>Maximum EIRP (dBm):</b>	Mode	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a	12.64	13.21	11.74	11.64
	IEEE 802.11n-HT20	11.75	11.75	11.67	10.78
	IEEE 802.11n-HT40	7.98	7.95	7.69	7.79
	IEEE 802.11ac-VHT80	8.38	8.62	8.59	8.47
<b>Normal Test Voltage:</b>	120V~60Hz				
<b>Extreme Test Voltage:</b>	102 to 138 Vac				

Extreme Test Temperature:	-10 °C to +45 °C
---------------------------	------------------

## 1.4 OTHER INFORMATION

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

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

## 1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

### 1) Support Equipment

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

### 2) Support Cable

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

## 1.6 TEST LOCATION

### Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

Telephone: +86 (0) 755 2823 0888

Fax: +86 (0) 755 2823 0886

## 1.7 TEST FACILITY

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

### CNAS-Lab Code: L9069

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

### 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.:

### 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  
Tel: +86-755-28230888

Fax: +86-755-28230886

E-mail: info@uttlab.com

[Http://www.uttlab.com](http://www.uttlab.com)

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
<b>Antenna Requirement</b>	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
<b>26 dB emission bandwidth</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)	KDB 789033 D02 v02r01 Section C.1	PASS
<b>6 dB bandwidth</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (e)	KDB 789033 D02 v02r01 Section C.2	PASS
<b>Maximum conducted output power</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)	KDB 789033 D02 v02r01 Section E.3.a(Method PM)	PASS
<b>Peak Power Spectral Density</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)	KDB 789033 D02 v02r01 Section F	PASS
<b>Frequency stability</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (g)	ANSI C63.10-2013	PASS
<b>Radiated Emissions and Band Edge Measurement</b>	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 v02r01 Section G.3, G.4, G.5, and G.6	PASS
<b>Dynamic Frequency Selection</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (h)	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
<b>AC Power Line Conducted Emission</b>	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

### For Dynamic Frequency Selection

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

**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)
<input checked="" type="checkbox"/>	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	N/A	Dec. 20, 2015	Dec. 19, 2018
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec.10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 22, 2017	Dec. 22, 2018
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Dec. 10, 2017	Dec. 10, 2018
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3117	00164202	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	Dec. 17, 2017	Dec. 17, 2018
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3116C	00200180	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Dec. 17, 2017	Dec. 17, 2018
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input type="checkbox"/>	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Jun. 21, 2017	Jun. 21, 2018
<input checked="" type="checkbox"/>	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	Jun. 15, 2017	Jun. 15, 2018
<input checked="" type="checkbox"/>	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)
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Dec.10, 2017	Dec. 10, 2018
<input type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07 -101181-K3	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Dec. 10, 2017	Dec. 10, 2018
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Dec. 10, 2017	Dec. 10, 2018
<input type="checkbox"/>	EXG-B RF Analog Signal Generator	KEYSIGHT	N5171B	MY53051777	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Dec. 14, 2017	Dec. 14, 2018
<input checked="" type="checkbox"/>	DC Source	KIKUSUI	PWR400L	LK003024	Sep. 14, 2017	Sep. 13, 2018
<input type="checkbox"/>	Temp & Humidity chamber	Espec	GL(U)04KA(W)	16921H201P3	Sep. 14, 2017	Sep. 13, 2018
<input checked="" type="checkbox"/>	Temp & Humidity chamber	Votisch	VT4002	58566133290 020	Jun. 20, 2017	Jun. 20, 2018

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07 -101181-K3	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Dec. 10, 2017	Dec. 10, 2018
<input type="checkbox"/>	LISN	ETS-Lindgren	3816/2SH	00201088	Dec. 10, 2017	Dec. 10, 2018
<input checked="" type="checkbox"/>	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	Relative Humidity (%)	
TN/VN	+15 to +35	120V~60Hz	20 to 75	
TL/VL	-10	102	20 to 75	
TH/VL	+45	102	20 to 75	
TL/VH	-10	138	20 to 75	
TH/VH	+45	138	20 to 75	

**Remark:**

- 1) The EUT just work in such extreme temperature of -10 °C to +45 °C and the extreme voltage of 102 V to 138 V, so here the EUT is tested in the temperature of -10 °C to +45 °C and the voltage of 102 V to 138 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.

### 4.2 TEST CHANNELS

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20 IEEE 802.11ac-VHT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140
		5500 MHz	5580 MHz	5700 MHz
	5725 MHz to 5850 MHz	Channel 149	Channel 157	Channel 165
		5745 MHz	5785 MHz	5825 MHz
	IEEE 802.11n-HT40 IEEE 802.11ac-VHT40	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
		Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	Channel 102	Channel 110	Channel 134
		5510 MHz	5550 MHz	5670 MHz
	5250 MHz to 5350 MHz	Channel 151	--	Channel 159
		5755 MHz	--	5795 MHz
	5470 MHz to 5725 MHz	--	Channel 42	--
		--	5210 MHz	--
	5725 MHz to 5850 MHz	--	Channel 58	--
		--	5290 MHz	--
	5150 MHz to 5250 MHz	Channel 106	--	Channel 122
		5530 MHz	--	5610 MHz
	5250 MHz to 5350 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.

Mode	Power Setting
	Channel 1 -13
IEEE 802.11a	Test used power level: "50"
IEEE 802.11n-HT20	Test used power level: "40"
IEEE 802.11n-HT40	Test used power level: "40"
IEEE 802.11ac-VHT20	Test used power level: "40"
IEEE 802.11ac-VHT40	Test used power level: "40"
IEEE 802.11ac-VHT80	Test used power level: "40"

Test Software
Test software name: cmd.exe;

### 4.4 PRE-SCAN

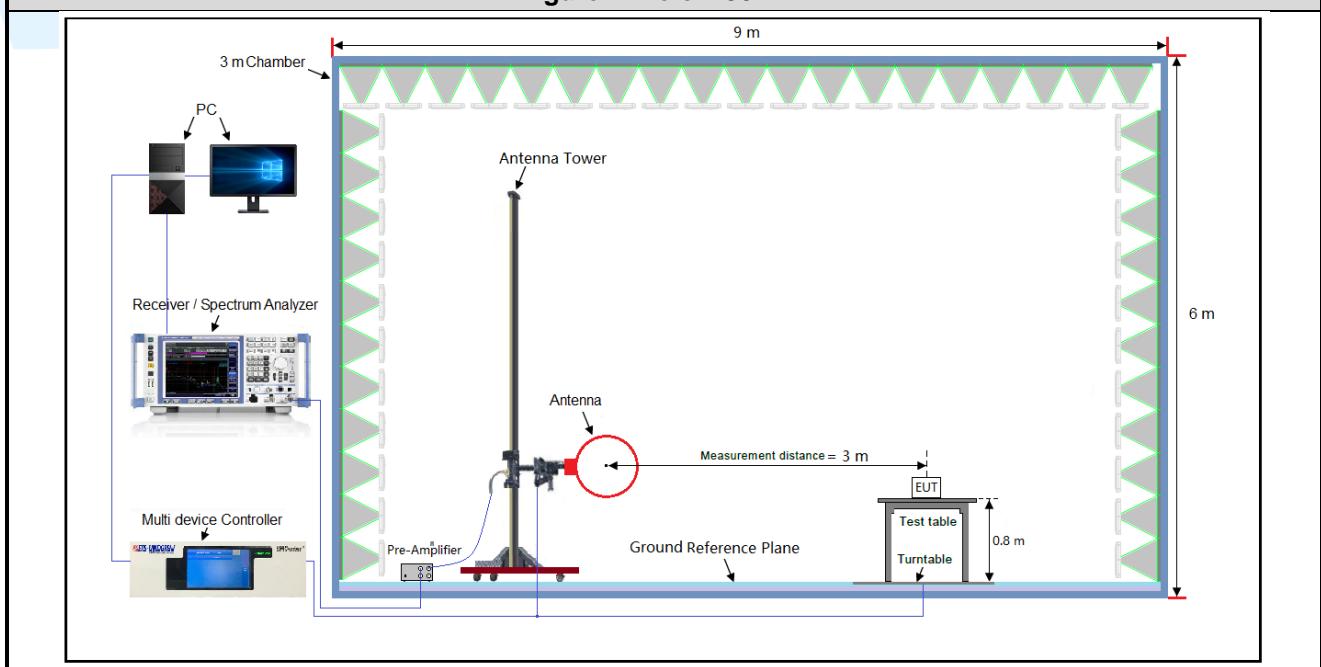
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rates. Following rate(s) was (were) selected for the final test as listed below.

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

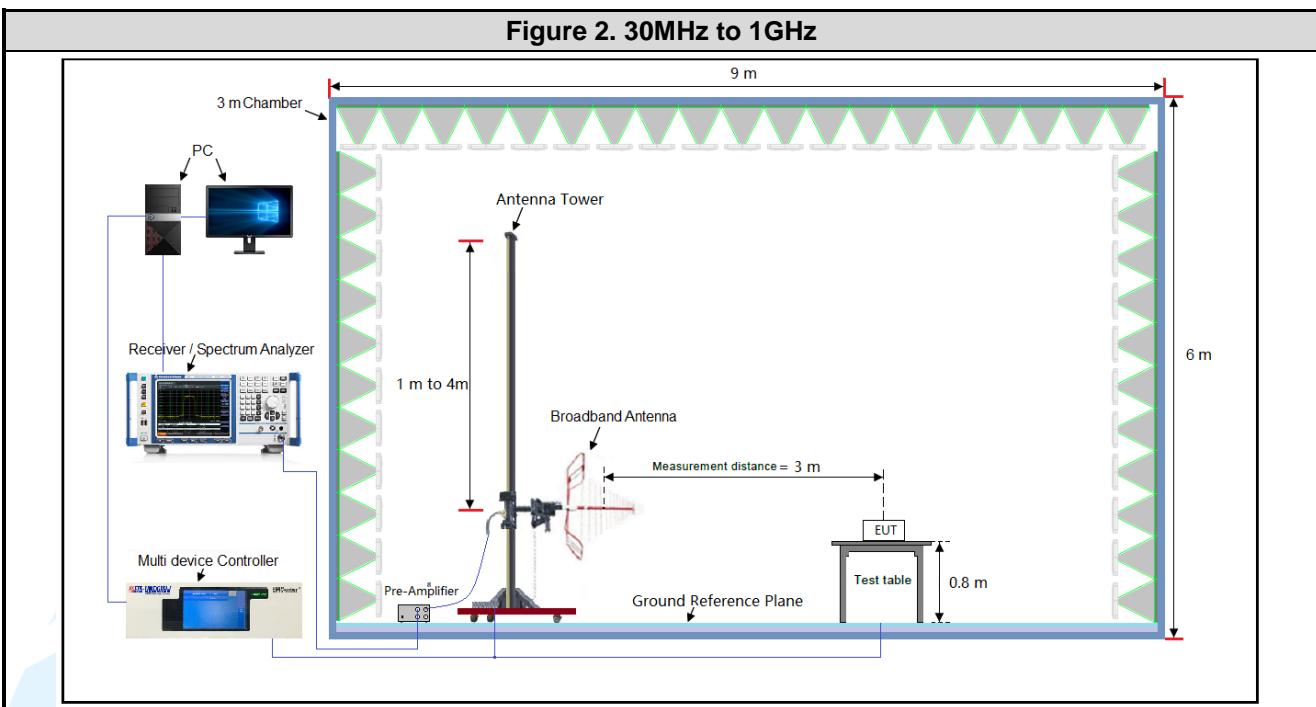
### 4.5 TEST SETUP

#### 4.5.1 For Radiated Emissions test setup

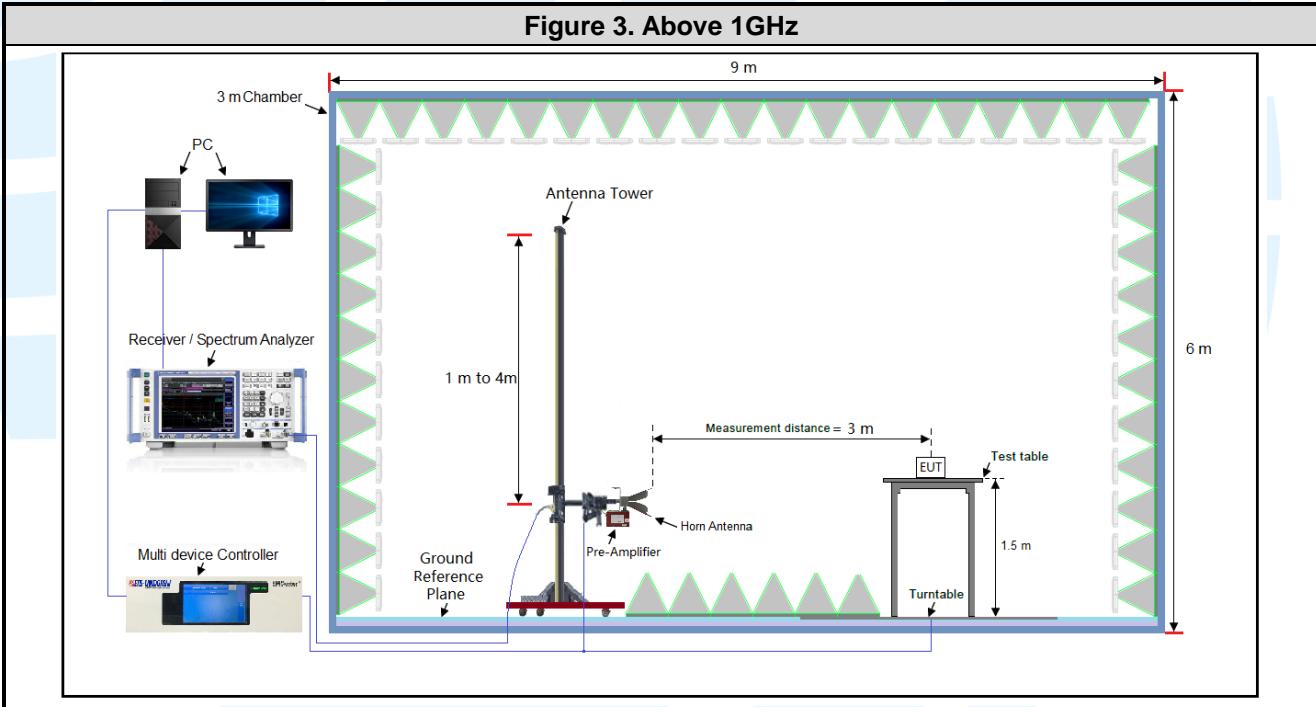
Figure 1. Below 30MHz



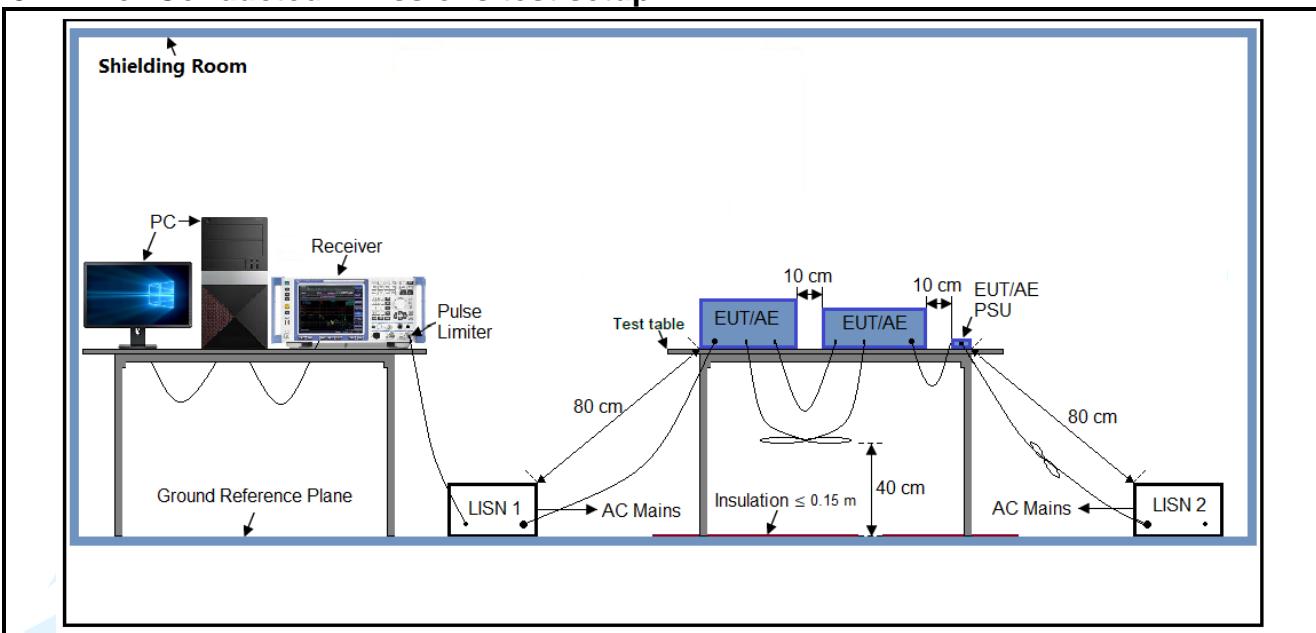
**Figure 2. 30MHz to 1GHz**



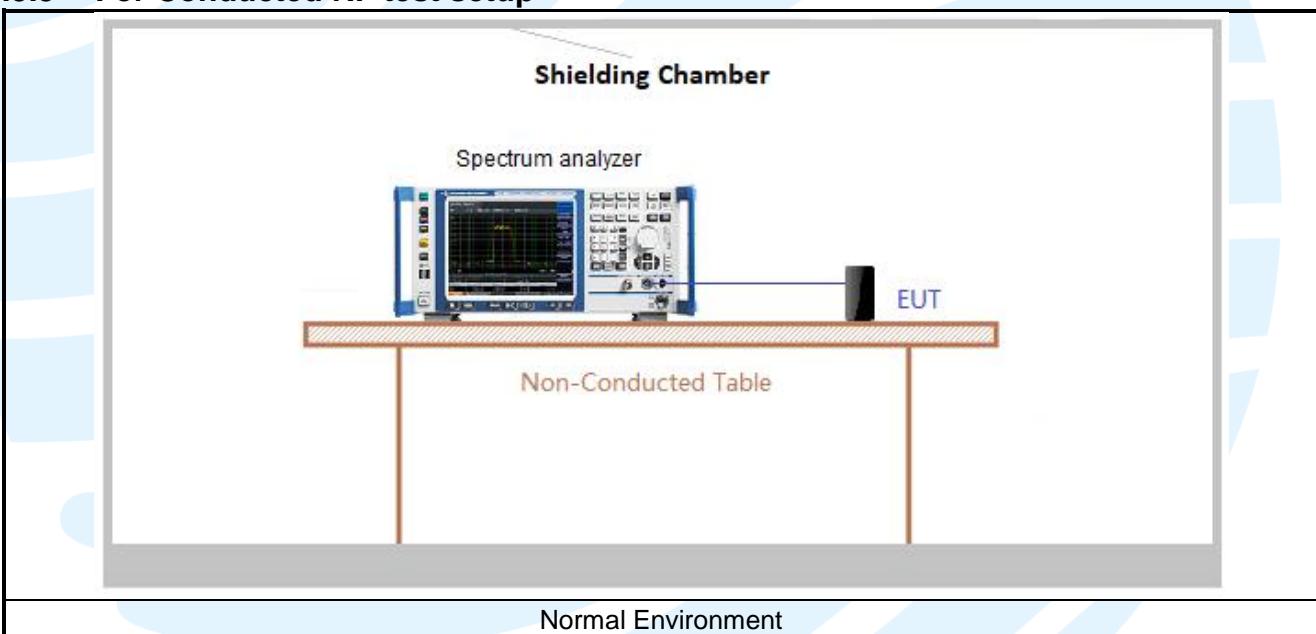
**Figure 3. Above 1GHz**

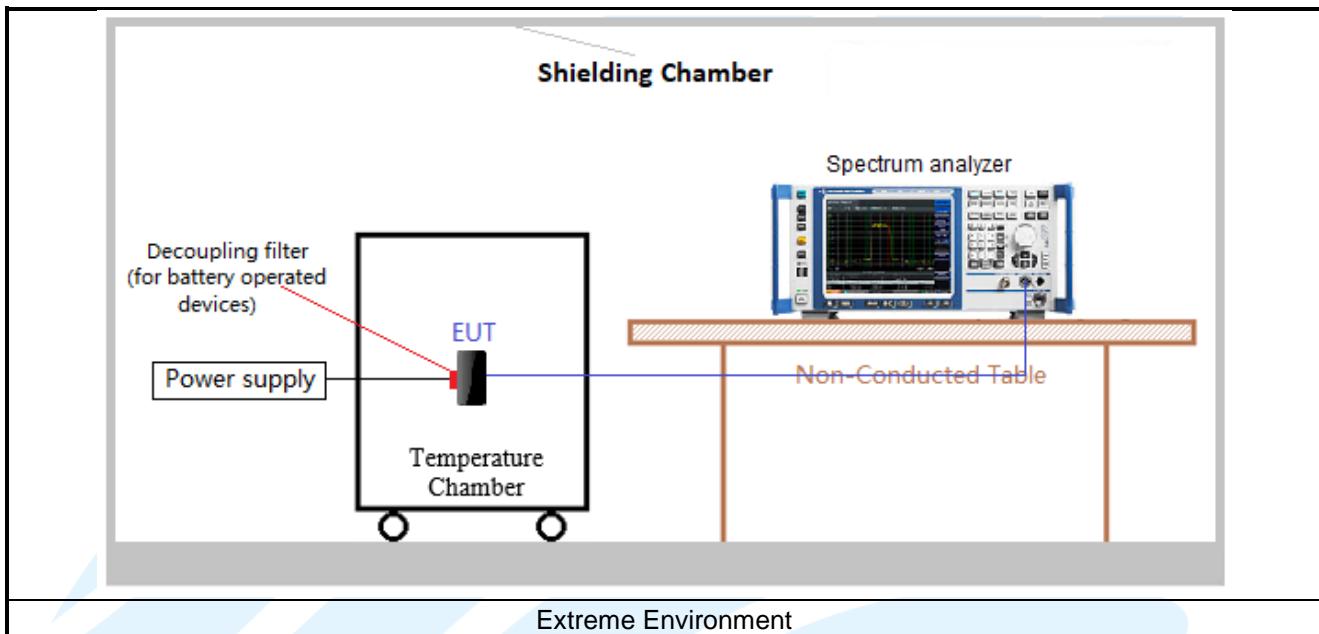


#### 4.5.2 For Conducted Emissions test setup



#### 4.5.3 For Conducted RF test setup





## 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 120~60Hz. 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

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.

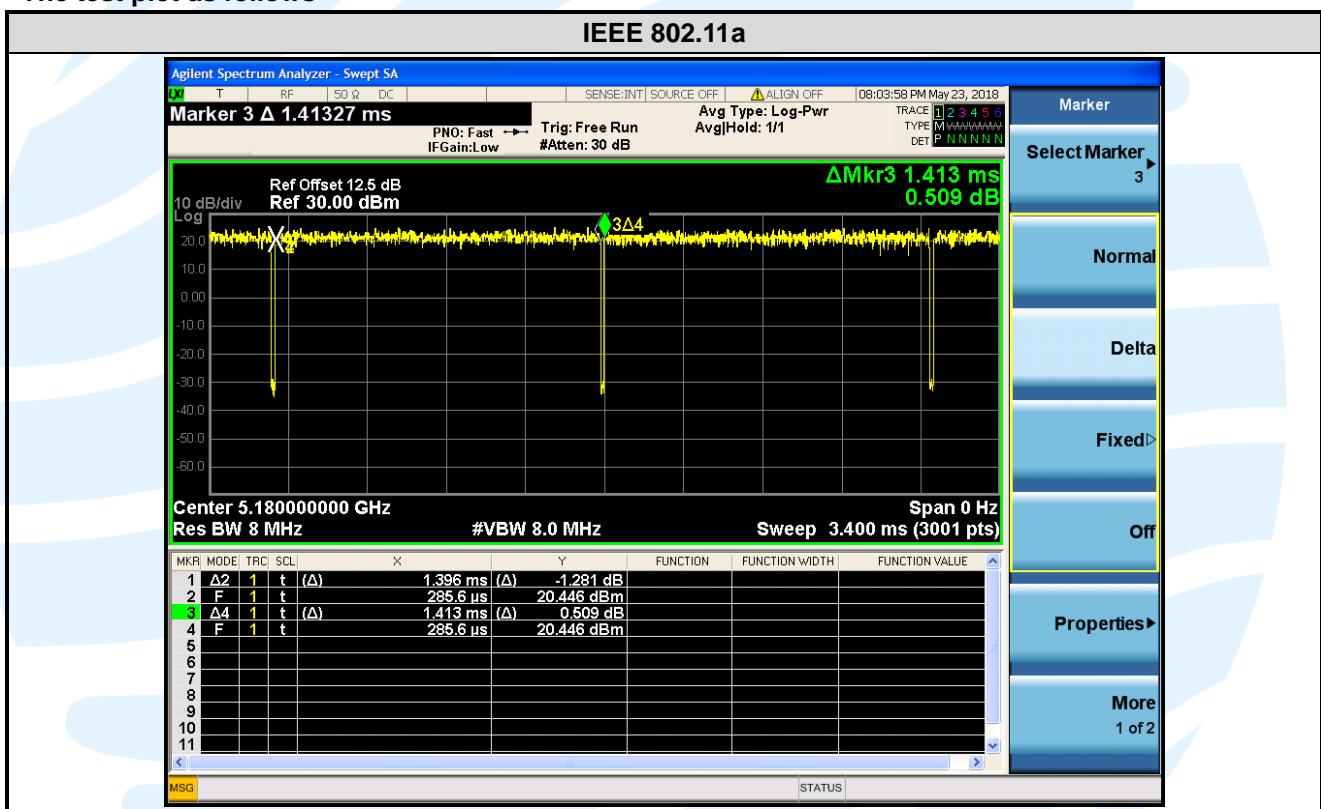
## 4.7 DUTY CYCLE

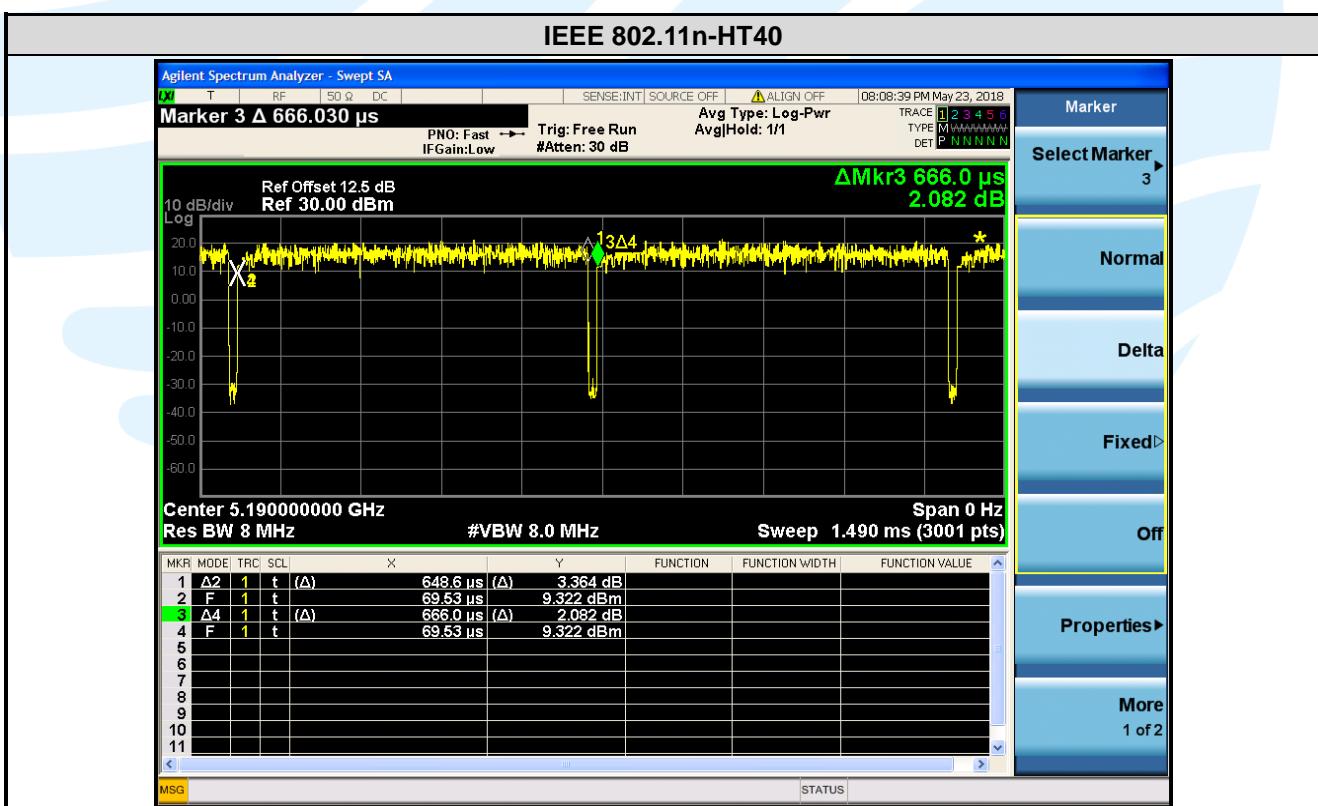
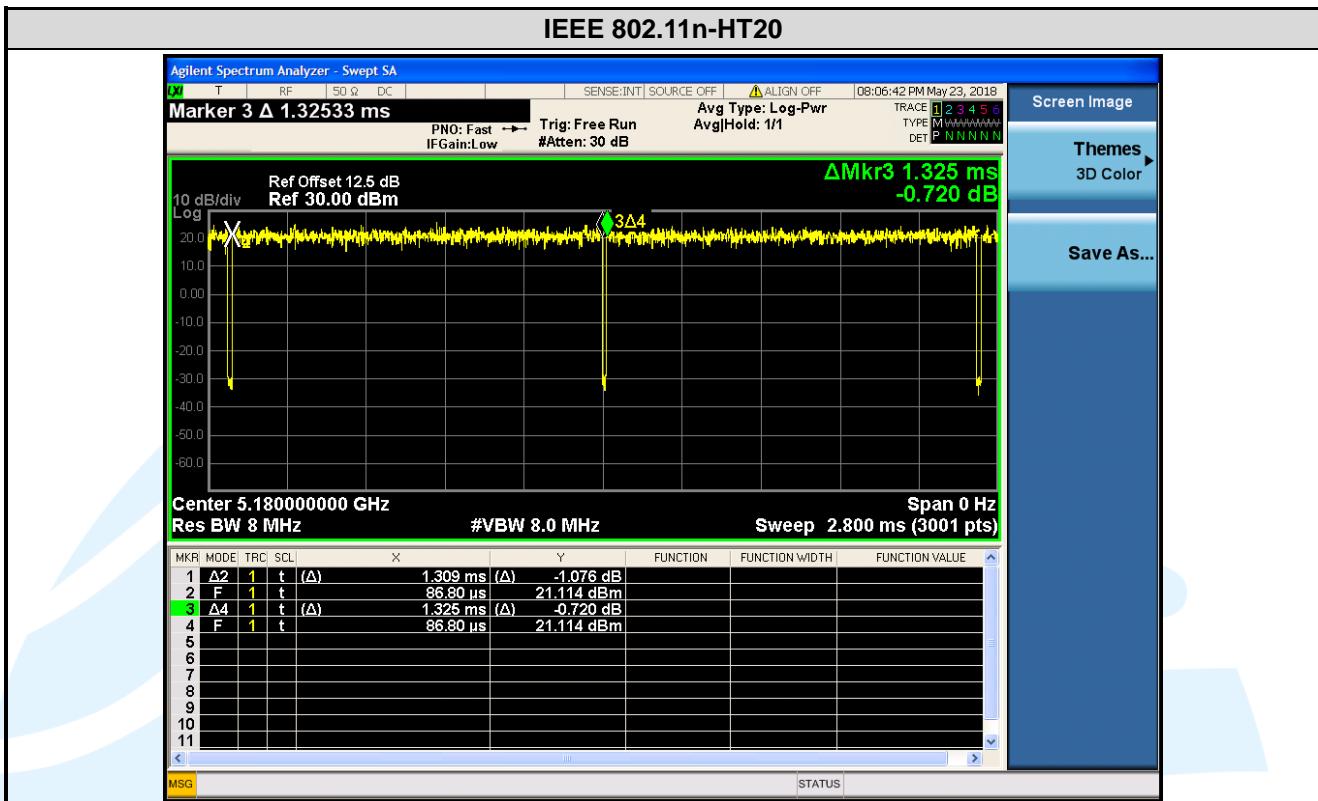
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	1.396	1.413	0.99	98.80	0.00	0.01	-0.11
IEEE 802.11n-HT20	MCS0	1.309	1.325	0.99	98.79	0.00	0.01	-0.11
IEEE 802.11n-HT40	MCS0	0.649	0.666	0.97	97.45	0.11	1.54	-0.22
IEEE 802.11ac-VHT80	MCS0	0.066	0.082	0.80	80.49	0.94	15.15	-1.89

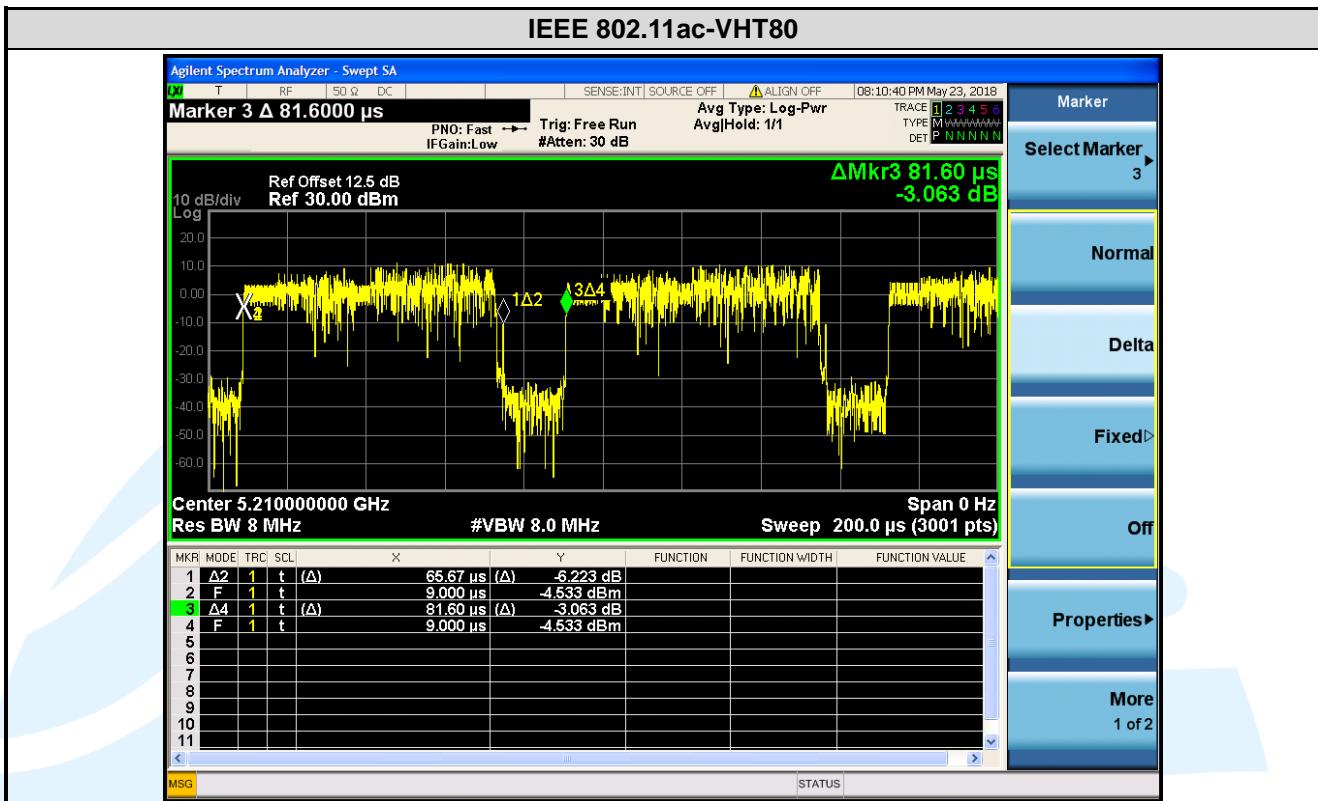
**Remark:**

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

The test plot as follows







## 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 Unlicensed Wireless Devices
4	KDB 789033 D02 General U-NII 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 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

### 5.2 ANTENNA REQUIREMENT

Standard Requirement
<b>15.203 requirement:</b> 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.
<b>15.407(a)(1) (2) requirement:</b> 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 amount in dB that the directional gain of the antenna exceeds 6 dBi.
<b>EUT Antenna:</b> Both antenna in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other and the antenna gain of both chains is completely consistent, the best case directional gain of the antenna is 1.9 dBi.

## 5.326 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

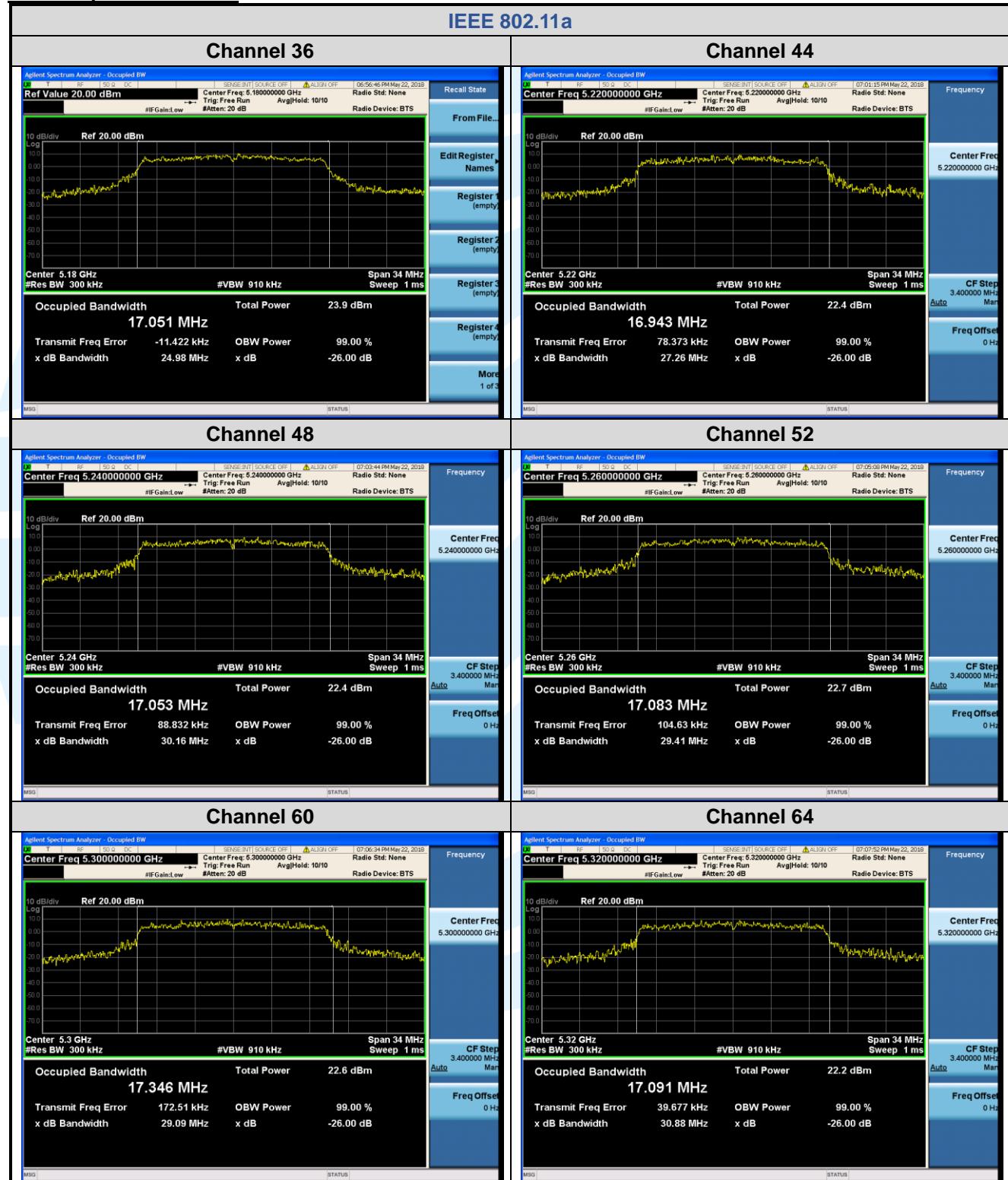
**Test Results:** Pass

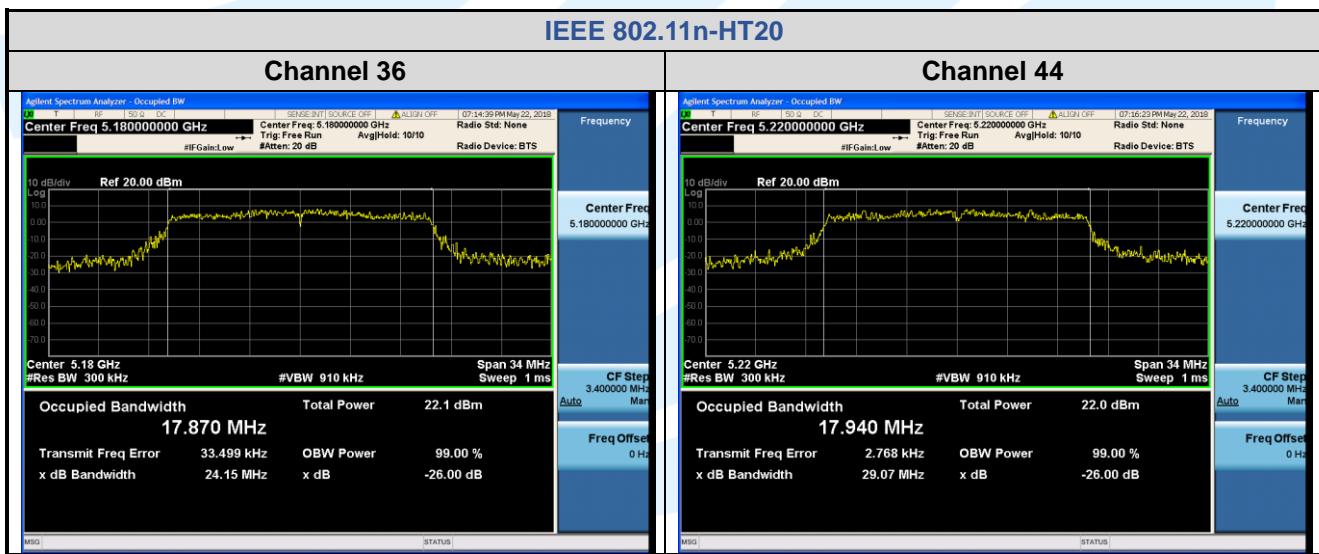
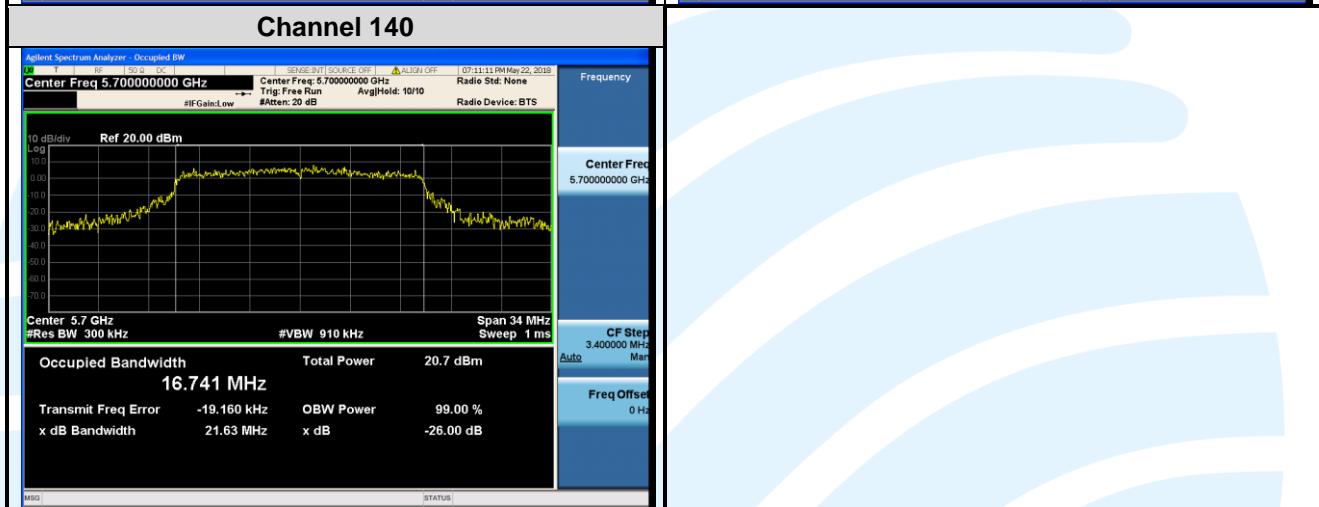
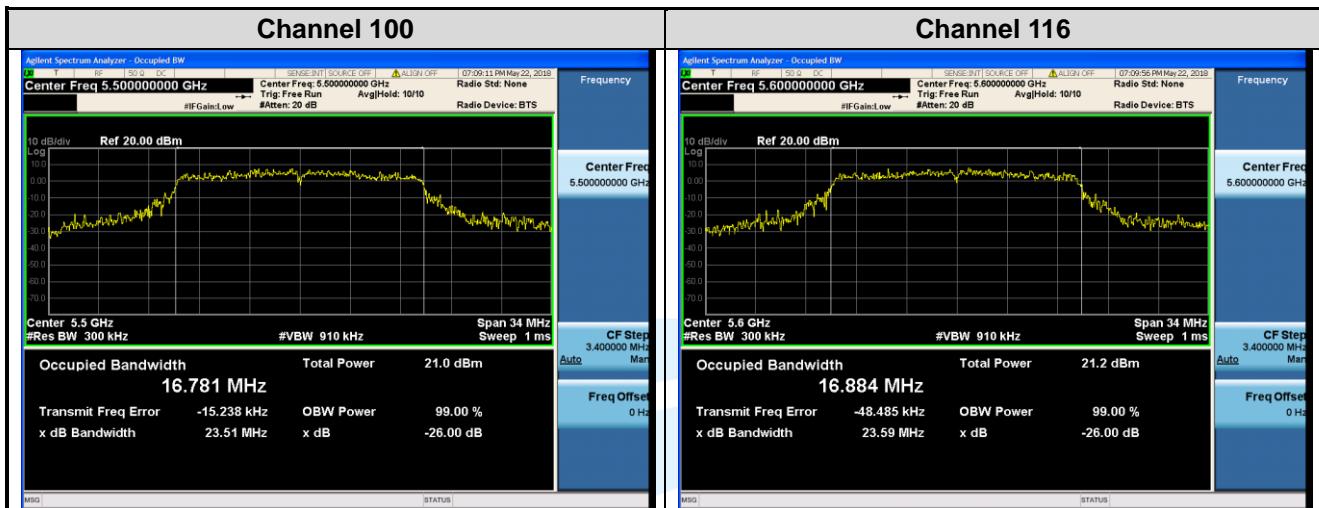
**Test Data:**

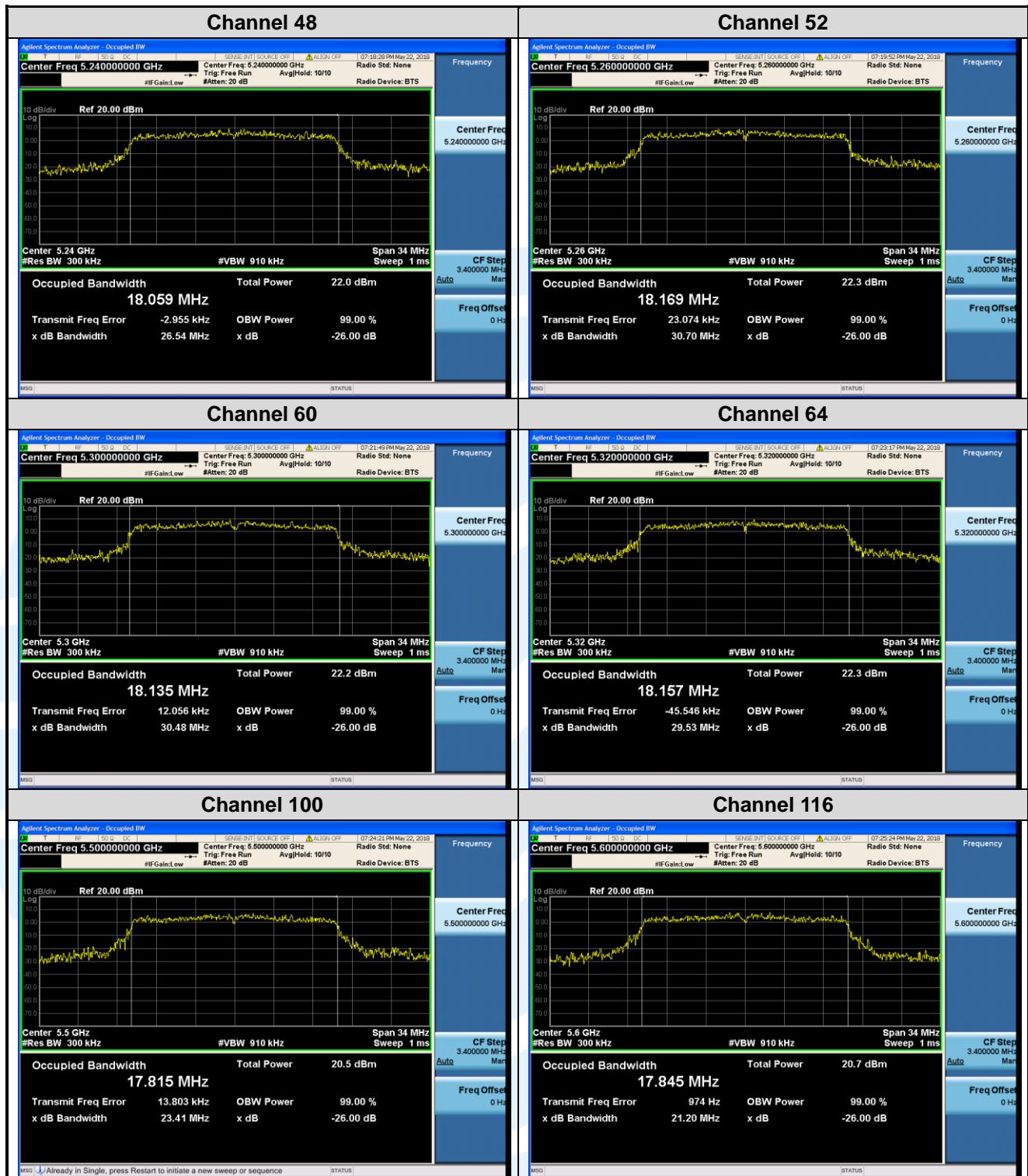
Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
IEEE 802.11a	36 (5180)	24.98	17.051
	44 (5220)	27.26	16.943
	48 (5240)	30.16	17.053
	52 (5260)	29.41	17.083
	60 (5300)	29.09	17.346
	64 (5320)	30.88	17.091
	100 (5500)	23.51	16.781
	116 (5580)	23.59	16.884
	140 (5700)	21.63	16.741
IEEE 802.11n-HT20	36 (5180)	24.15	17.870
	44 (5220)	29.07	17.940
	48 (5240)	26.54	18.059
	52 (5260)	30.70	18.169
	60 (5300)	30.48	18.135
	64 (5320)	29.53	18.157
	100 (5500)	23.41	17.815
	116 (5580)	21.20	17.845
	140 (5700)	22.33	17.863
IEEE 802.11n-HT40	38 (5190)	43.70	36.459
	46 (5230)	49.57	36.186
	54 (5270)	53.15	36.329
	62 (5310)	53.26	36.190
	102 (5510)	44.39	36.175
	110 (5550)	40.49	36.186
	134 (5670)	43.05	36.269

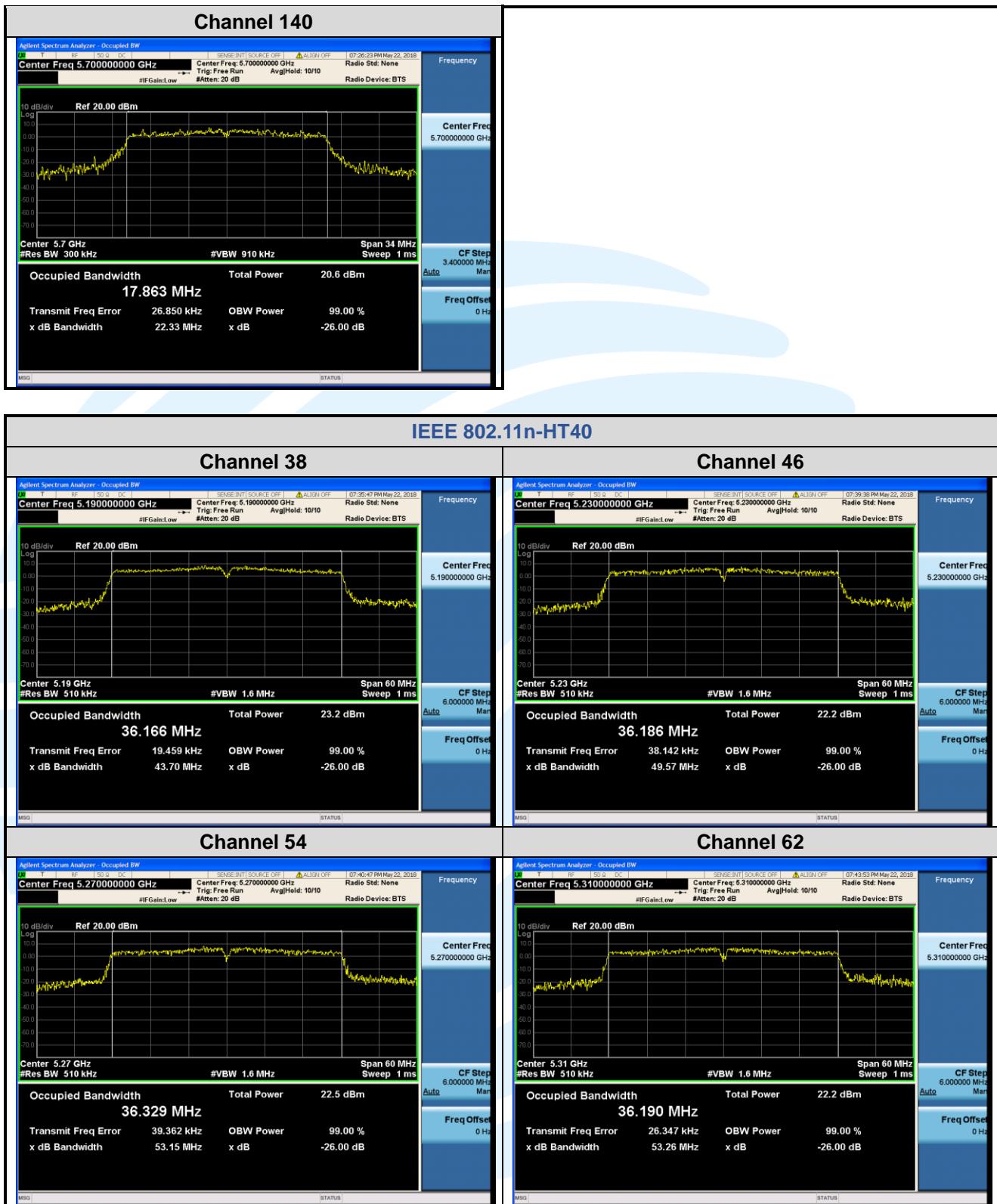
IEEE 802.11ac-VHT80	42 (5230)	81.25	75.711
	58 (5290)	97.06	75.943
	106 (5530)	81.11	75.622
	122 (5610)	81.23	75.684

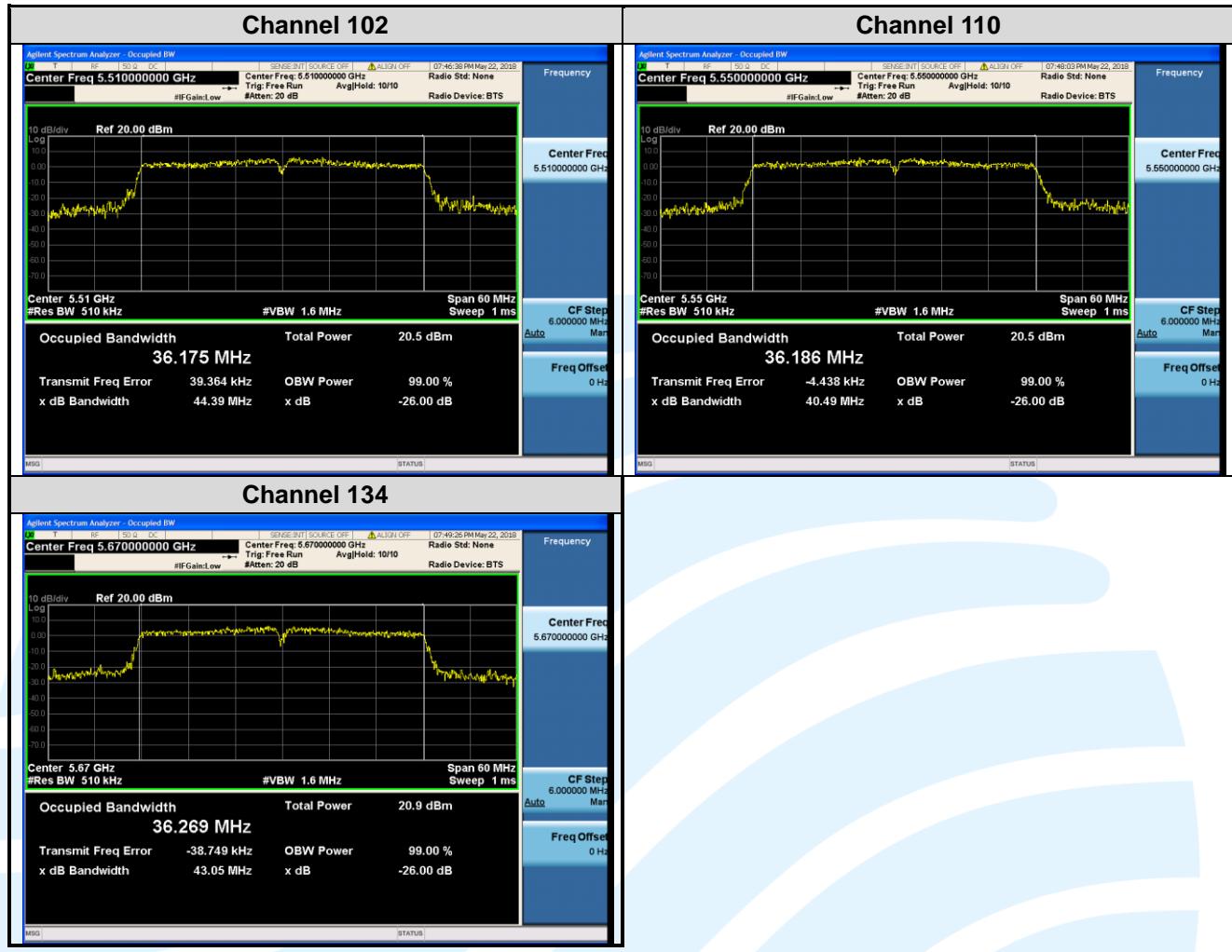
The test plot as follows:













## 5.4.6 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)  $\geq 3 * \text{RBW}$ .
- 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

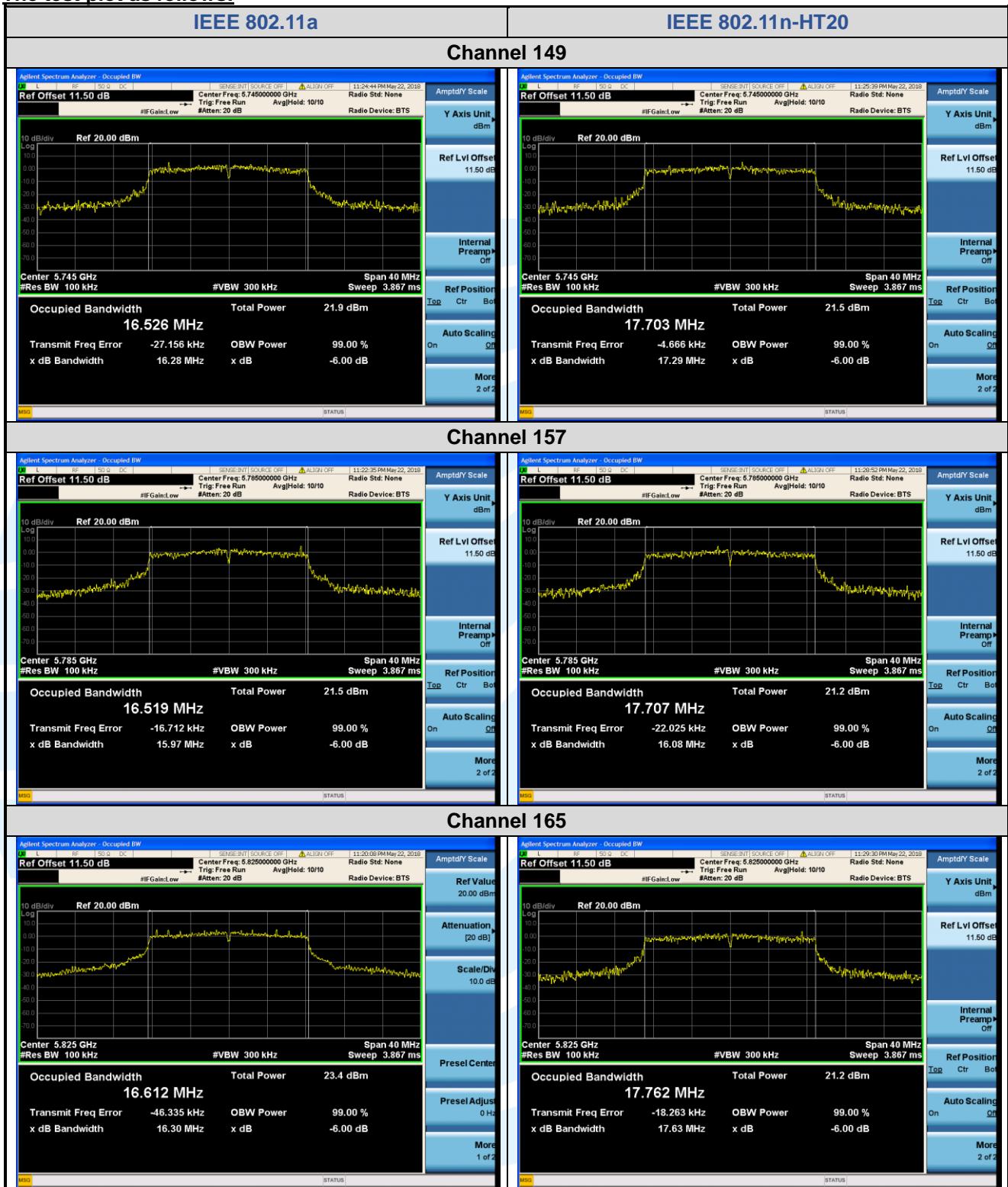
**Test Mode:** Transmitter mode

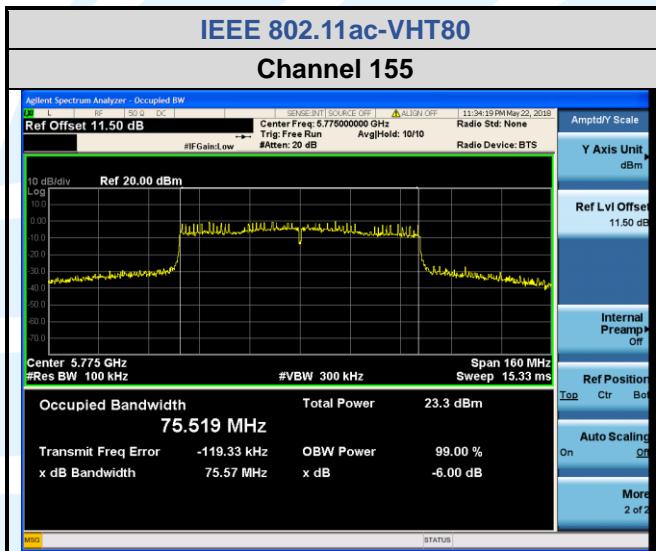
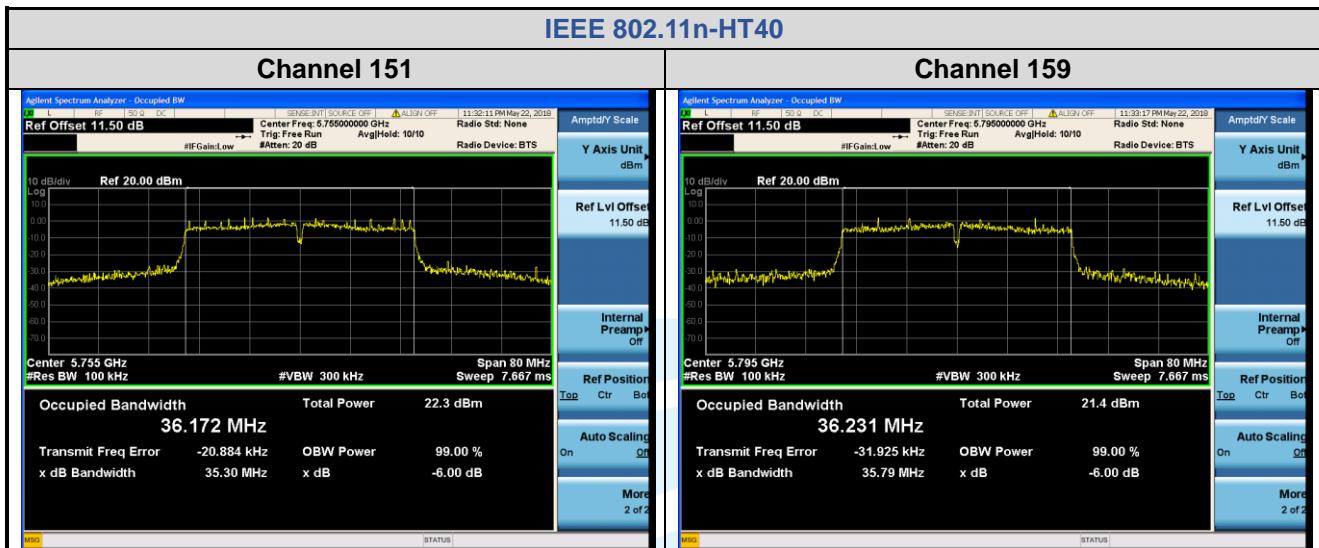
**Test Results:** Pass

**Test Data:**

Mode	Channel/ Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Pass / Fail
IEEE 802.11a	149 (5745)	16.28	16.526	> 500 kHz	Pass
	157 (5785)	15.97	16.519	> 500 kHz	Pass
	165 (5825)	16.30	16.612	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	17.29	17.703	> 500 kHz	Pass
	157 (5785)	16.08	17.707	> 500 kHz	Pass
	165 (5825)	17.63	17.762	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	35.30	36.172	> 500 kHz	Pass
	159 (5795)	35.79	36.231	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	75.57	75.519	> 500 kHz	Pass

The test plot as follows:





## 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 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 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  $11 \text{ dBm} + 10 \log B$ , 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:**

**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  
Tel: +86-755-28230888 Fax: +86-755-28230886 E-mail: info@uttlab.com

[Http://www.uttlab.com](http://www.uttlab.com)

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:**

#### Antenna gain and the maximum output power limit.

Frequency Band	Antenna Gain (dBi))	Peak Power Limits (dBm)
U-NII-1	1.9	24.00
U-NII-2A	1.9	24.00
U-NII-2C	1.9	24.00
U-NII-3	1.9	30.00

#### For U-NII-1 Band:

Mode	Channel/ Frequency (MHz)	Maximum conducted output power (dBm)		Limit (dBm)	Pass / Fail
		Meas Power	Corr'd Power		
IEEE 802.11a	36 (5180)	12.62	12.62	24	Pass
	44 (5220)	12.41	12.41	24	Pass
	48 (5240)	<b>12.64</b>	12.64	24	Pass
IEEE 802.11n-HT20	36 (5180)	11.68	11.68	24	Pass
	44 (5220)	11.65	11.65	24	Pass
	48 (5240)	<b>11.75</b>	11.75	24	Pass
IEEE 802.11n-HT40	38 (5190)	<b>7.87</b>	7.98	24	Pass
	46 (5230)	7.68	7.79	24	Pass
IEEE 802.11ac- VHT80	42 (5210)	<b>7.44</b>	8.38	24	Pass

#### Remark:

1. Corr'd Power = Meas Power + Duty Cycle Factor