

# TEST REPORT

**Product Name:** IP Phone  
**Trade Mark:** GRANDSTREAM  
**Model No. / HVIN:** GRP2615  
**Add. Model No. / HVIN:** N/A  
**Report Number:** 190515026RFC-4  
**Test Standards:** FCC 47 CFR Part 15 Subpart E  
RSS-247 Issue 2  
RSS-Gen Issue 5  
**FCC ID:** YZZGRP2615  
**IC:** 11964A-GRP2615  
**Test Result:** PASS  
**Date of Issue:** July 20, 2019

Prepared for:

**Grandstream Networks, Inc.**  
**126 Brookline Ave., 3rd Floor, Boston, MA 02215, USA**

Prepared by:

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**Version**

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## 1. GENERAL INFORMATION

### 1.1 CLIENT INFORMATION

<b>Applicant:</b>	Grandstream Networks, Inc.
<b>Address of Applicant:</b>	126 Brookline Ave., 3rd Floor, Boston, MA 02215, USA
<b>Manufacturer:</b>	Grandstream Networks, Inc.
<b>Address of Manufacturer:</b>	126 Brookline Ave., 3rd Floor, Boston, MA 02215, USA

### 1.2 EUT INFORMATION

#### 1.2.1 General Description of EUT

<b>Product Name:</b>	IP Phone		
<b>Model No. / HVIN:</b>	GRP2615		
<b>Add. Model No. / HVIN:</b>	N/A		
<b>Trade Mark:</b>	GRANDSTREAM		
<b>DUT Stage:</b>	Identical Prototype		
<b>EUT Supports Function:</b>	2.4 GHz ISM Band:	IEEE 802.11b/g/n Bluetooth V4.2	
	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
<b>Software Version:</b>	0.4.24.21		
<b>Hardware Version:</b>	V1.1		
<b>Sample Received Date:</b>	June 6, 2019		
<b>Sample Tested Date:</b>	June 7, 2019 to June 25, 2019		

### 1.2.2 Description of Accessories

Adapter (1)	
Model No.:	PEA-120100VA
Input:	100-240 V~50/60 Hz 0.3 A
Output:	12.0 V == 1.0 A
AC Cable:	N/A
DC Cable:	2.5 Meter, Unshielded without ferrite

Adapter (2)	
Model No.:	F12L28-120100SPAU
Input:	100-240 V~50/60 Hz 0.3 A
Output:	12.0 V == 1.0 A
AC Cable:	N/A
DC Cable:	2.5 Meter, Unshielded without ferrite

Adapter (3)	
Model No.:	F12US1200100A
Input:	100-240 V~50/60 Hz 0.5 A
Output:	12.0 V == 1.0 A
AC Cable:	N/A
DC Cable:	2.5 Meter, Unshielded without ferrite

Cable (1)	
Description:	Ethernet Cable (RJ45)
Cable Type:	Unshielded without ferrite
Length:	1.5 Meter

Cable (2)	
Description:	Phone Cord (RJ9)
Cable Type:	Unshielded without ferrite
Length:	3.5 Meter

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

<b>Frequency Bands:</b>	5150 MHz to 5250 MHz (U-NII-1) 5250 MHz to 5350 MHz (U-NII-2A) 5470 MHz to 5725 MHz (U-NII-2C) 5 725 MHz to 5 850 MHz (U-NII-3)								
<b>Frequency Ranges:</b>	5180 MHz to 5240 MHz 5260 MHz to 5320 MHz 5500 MHz to 5700 MHz 5 745 MHz to 5 825 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: 3.5 dBi 5250 MHz to 5350 MHz: 3.5 dBi 5470 MHz to 5725 MHz: 3.5 dBi 5725 MHz to 5850 MHz: 3.5 dBi								
<b>Maximum EIRP (dBm):</b>	<table border="1"> <thead> <tr> <th><b>Chain 0</b></th> <th><b>U-NII-1</b></th> </tr> </thead> <tbody> <tr> <td>IEEE 802.11a:</td> <td>19.54</td> </tr> <tr> <td>IEEE 802.11n-HT20:</td> <td>19.03</td> </tr> <tr> <td>IEEE 802.11n-HT40:</td> <td>17.16</td> </tr> </tbody> </table>	<b>Chain 0</b>	<b>U-NII-1</b>	IEEE 802.11a:	19.54	IEEE 802.11n-HT20:	19.03	IEEE 802.11n-HT40:	17.16
<b>Chain 0</b>	<b>U-NII-1</b>								
IEEE 802.11a:	19.54								
IEEE 802.11n-HT20:	19.03								
IEEE 802.11n-HT40:	17.16								

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	IEEE 802.11ac-VHT20:	18.89			
	IEEE 802.11ac-VHT40:	17.07			
	IEEE 802.11ac-VHT80:	12.78			
<b>Maximum conducted output power (dBm):</b>		<b>U-NII-1</b>	<b>U-NII-2A</b>	<b>U-NII-2C</b>	<b>U-NII-3</b>
	IEEE 802.11a:	16.04	16.11	14.93	14.15
	IEEE 802.11n-HT20:	15.53	15.79	14.66	14.57
	IEEE 802.11n-HT40:	13.66	14.09	12.92	12.72
	IEEE 802.11ac-VHT20	15.39	15.80	14.52	14.45
	IEEE 802.11ac-VHT40	13.57	13.89	12.85	12.73
	IEEE 802.11ac-VHT80:	9.28	11.26	10.11	13.87
	<b>Normal Test Voltage:</b>	AC 120V/60Hz			

## 1.4 OTHER INFORMATION

Operation Frequency Each of Channel				
	<b>U-NII-1</b>	<b>U-NII-2A</b>	<b>U-NII-2C</b>	<b>U-NII-3</b>
<b>IEEE 802.11a, IEEE 802.11n-HT20, IEEE 802.11ac-VHT20</b>	<b>f = 5000 + 5k, k = 32 + 4n</b>			<b>f = 5000 + 5k, k = 145 + 4n</b>
	<b>n = 1,..., 4</b>	<b>n = 5,..., 8</b>	<b>n = 17,..., 27</b>	<b>n = 1,..., 5</b>
<b>IEEE 802.11n-HT40, IEEE 802.11ac-VHT40</b>	<b>f = 5000 + 5k, k = 30 + 8n</b>			<b>f = 5000 + 5k, k = 143 + 8n</b>
	<b>n = 1, 2</b>	<b>n = 1,..., 5</b>	<b>n = 9,..., 13</b>	<b>n = 1, 2</b>
<b>IEEE 802.11ac-VHT80</b>	<b>f = 5000 + 5k, k = 26 + 16n</b>			<b>f = 5000 + 5k, k = 155</b>
	<b>n = 1</b>	<b>n = 1, 2</b>	<b>n = 5, 6</b>	
Note: <b>f</b> is the operating frequency (MHz); <b>k</b> 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	B40-80	MP12NEQ6	UnionTrust
Mobile Phone	Apple	A1688	N/A	UnionTrust
USB disk	Kingston	DTSE9	N/A	UnionTrust
mouse	DELL	MS111	CN-011D3V-738	UnionTrust
Headset	YEY	VE120-MV	N/A	UnionTrust
Standard POE Power supply	TP-LINK	TL-POE160S	N/A	UnionTrust
IP Phone	GRANDSTREAM	GRP2612W	N/A	Applicant

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

### 2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Ethernet Cable	RJ45	1.0 Unshielded without ferrite	UnionTrust
2	Ethernet Cable	RJ45	5.0 Unshielded without ferrite	UnionTrust
3	Ethernet Cable	RJ45	2.0 Unshielded without ferrite	UnionTrust

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4	Antenna Cable	SMA	0.15 Meter	UnionTrust
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## 1.6 TEST LOCATION

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Telephone: +86 (0) 755 2823 0888

Fax: +86 (0) 755 2823 0886

## 1.7 TEST FACILITY

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

### CNAS-Lab Code: L9069

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

### A2LA-Lab Certificate No.: 4312.01

Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

### ISED Wireless Device Testing Laboratories

CAB identifier: CN0032

### FCC Accredited Lab.

Designation Number: CN1194

Test Firm Registration Number: 259480

## 1.8 DEVIATION FROM STANDARDS

None.

## 1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

## 1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

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## 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 E Section 15.407(a)(1) (2) RSS-Gen Issue 5, Section 6.8	N/A	PASS
<b>26 dB emission bandwidth</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 2 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
<b>6 dB bandwidth</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 2 Section 6.2.4.1	KDB 789033 D02 v02r01 Section C.2	PASS
<b>Occupied Bandwidth</b>	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, section 6.7	PASS
<b>Maximum conducted output power</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a (Method PM)	PASS
<b>Peak Power Spectral Density</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
<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 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
<b>Dynamic Frequency Selection</b>	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 2 Section 6.3	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
<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 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS

**Note:**

- 1) N/A: In this whole report not applicable.

### 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 applicable.

### 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. 03, 2018	Dec. 03, 2021
<input checked="" type="checkbox"/>	Receiver	R&S	ESIB26	100114	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Dec. 03, 2018	Dec. 03, 2019
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Dec. 08, 2018	Dec. 08, 2019
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	Dec. 08, 2018	Dec. 08, 2019
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May 18, 2019	May 18, 2020
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Jan. 05, 2019	Jan. 05, 2020
<input checked="" type="checkbox"/>	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160333		

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	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Nov. 24, 2018	Nov. 24, 2019
<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	Nov. 24, 2018	Nov. 24, 2019
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 24, 2018	Nov. 24, 2019

## 4. TEST CONFIGURATION

### 4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

#### 4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage	Relative Humidity (%)
NT/NV	+15 to +35	AC 120V/60Hz	20 to 75
<b>Remark:</b> 1) NV: Normal Voltage; NT: Normal Temperature			

#### 4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Tested by
26 dB emission bandwidth	24.7	53	100.01	Hank Wu
6 dB bandwidth				
Occupied Bandwidth				
Maximum conducted output power				
Peak Power Spectral Density				
Radiated Emissions and Band Edge Measurement	24.63	52	100.01	Andy Lin
Dynamic Frequency Selection	24.7	53	100.01	Hank Wu
AC Power Line Conducted Emission	25.3	44	99.8	Gemini Huang

## 4.2 TEST CHANNELS

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

## 4.3 EUT TEST STATUS

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

Power Setting				
	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
IEEE 802.11a	15	15	15	14
IEEE 802.11n-HT20	15	15	15	15
IEEE 802.11n-HT40	13	13	13	13
IEEE 802.11ac-VHT20	15	15	15	15
IEEE 802.11ac-VHT40	13	13	13	13
IEEE 802.11ac-VHT80	8	10	10	15

Power Setting: not applicable, test used software default power level.

Test Software
Test software name: putty.exe (Serial port tools);

#### 4.4 PRE-SCAN

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

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

## 4.5 TEST SETUP

### 4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

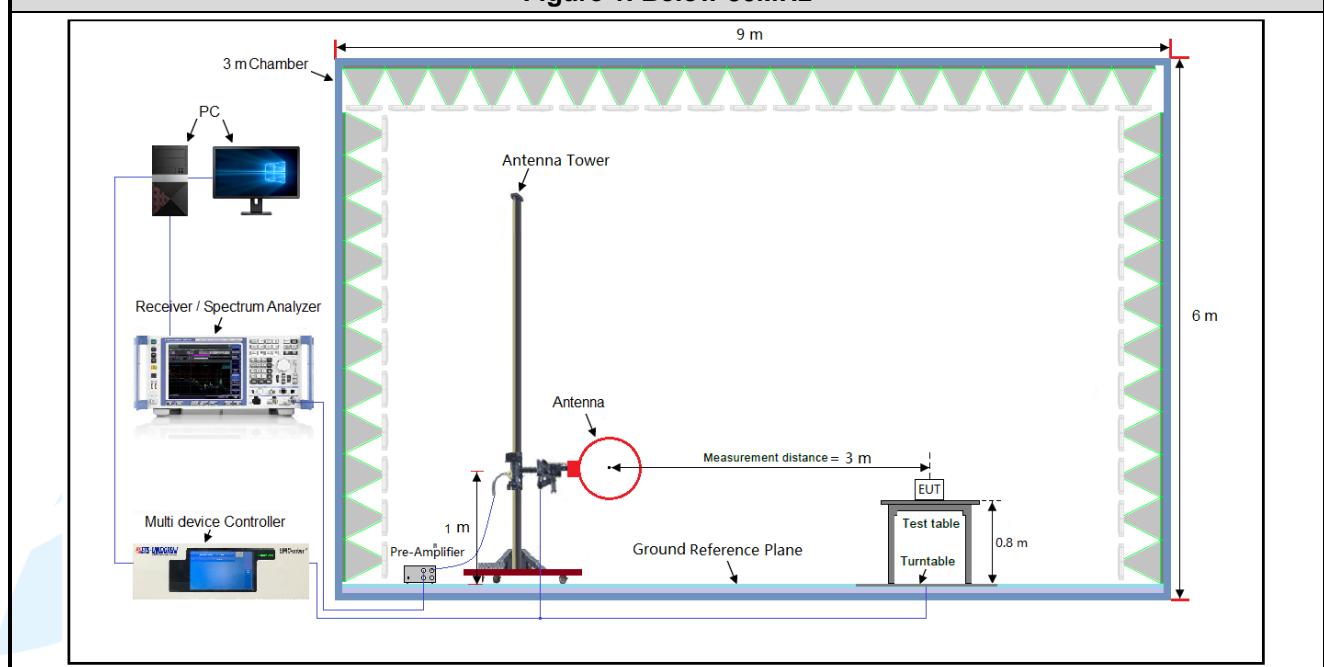
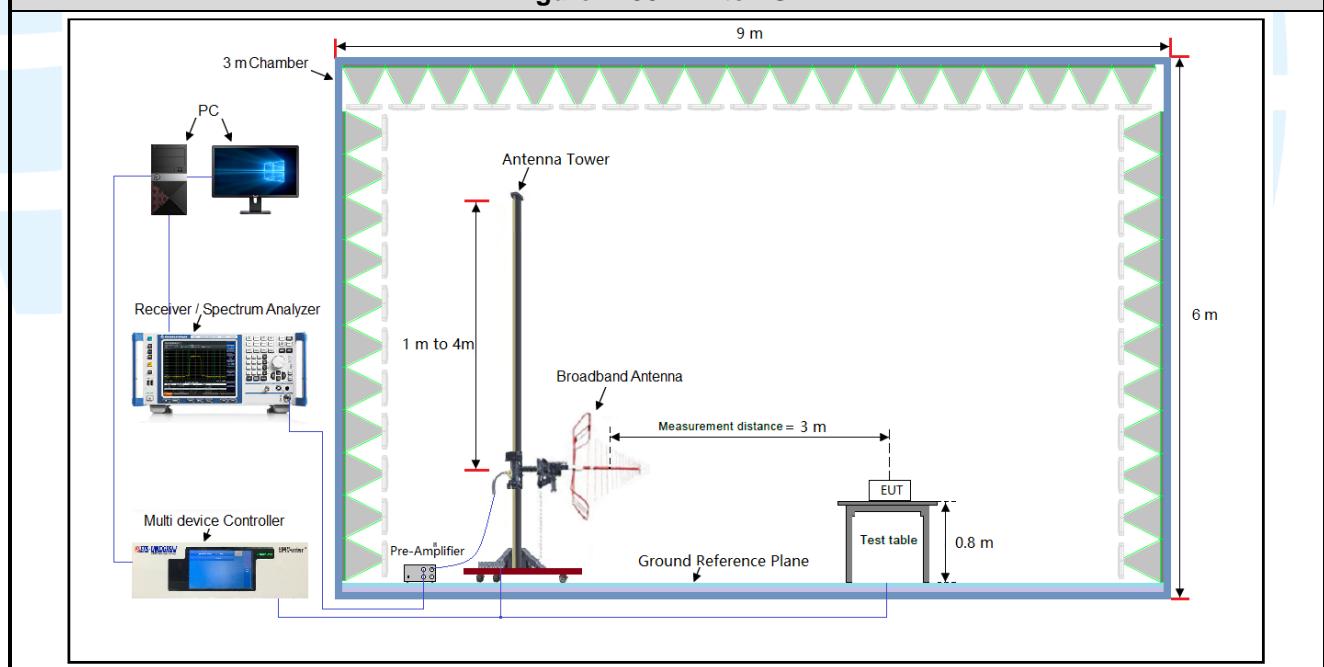
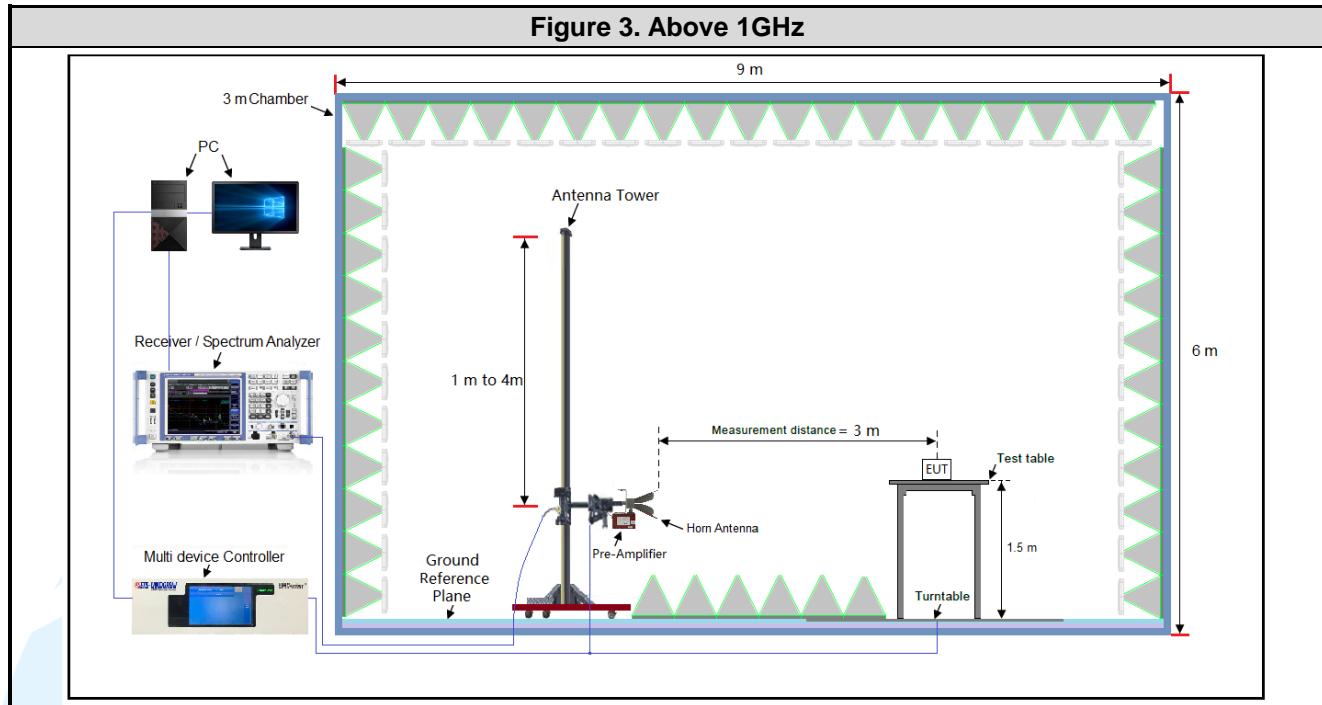


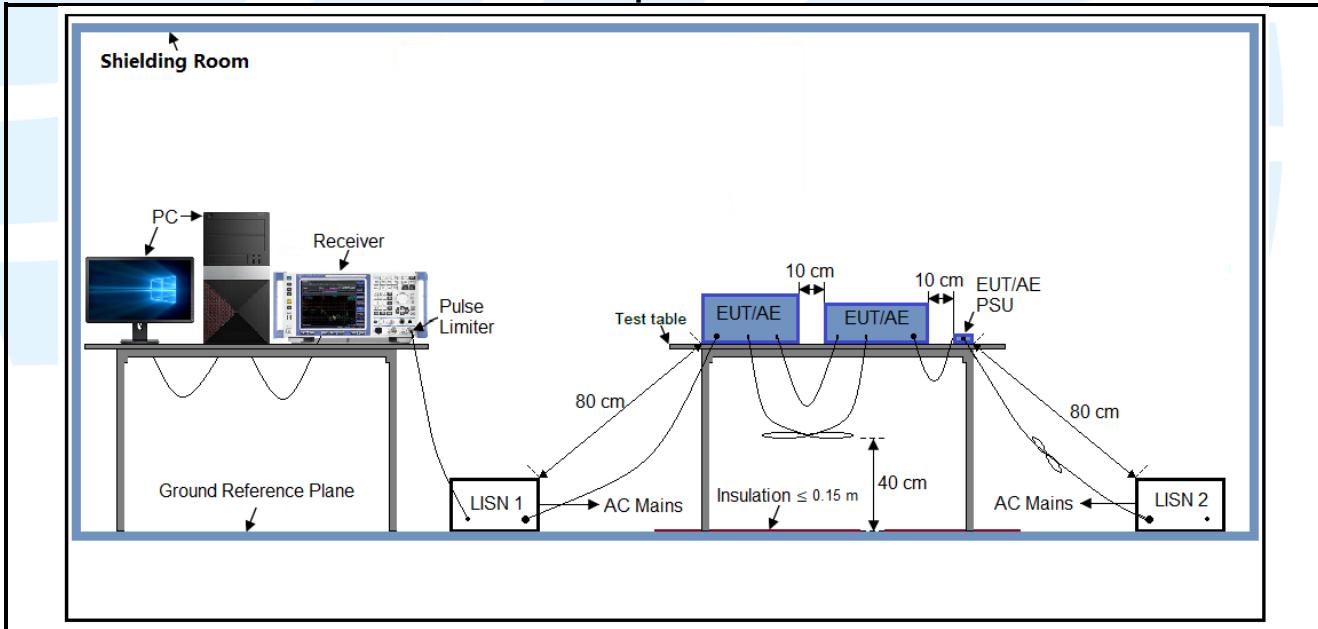
Figure 2. 30MHz to 1GHz



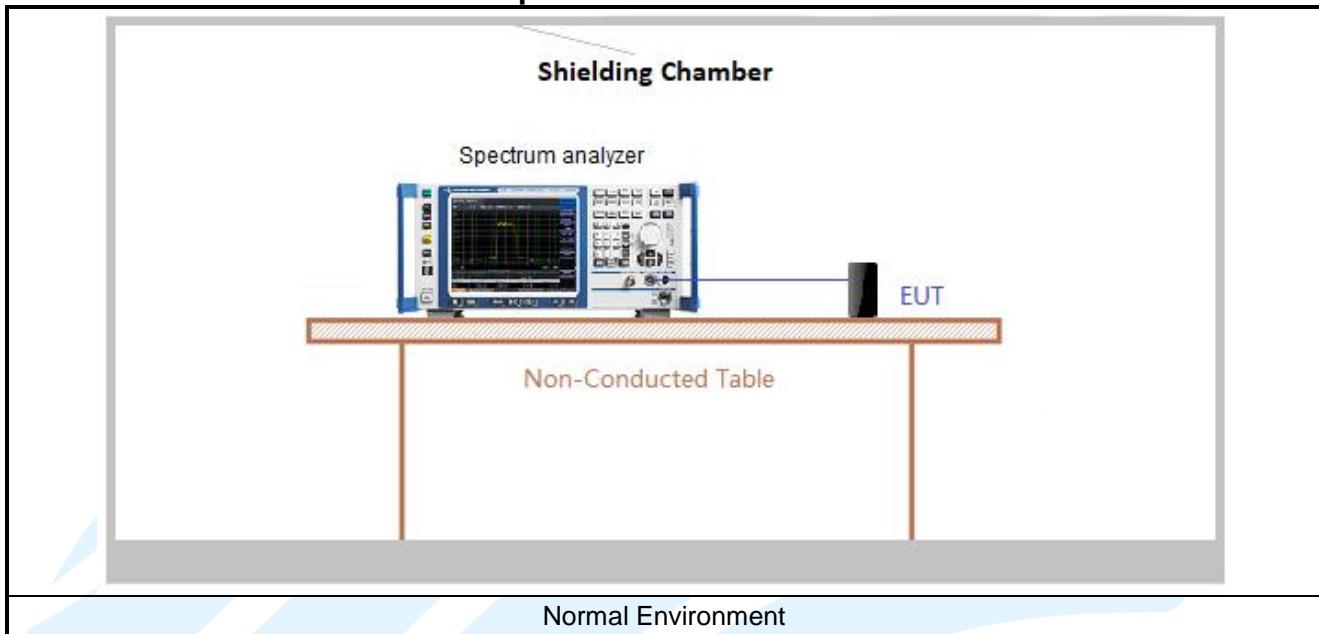
**Figure 3. Above 1GHz**



#### 4.5.2 For Conducted Emissions test setup



#### 4.5.3 For Conducted RF test setup



## 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 AC 120V/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.

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

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

## 4.7 DUTY CYCLE

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

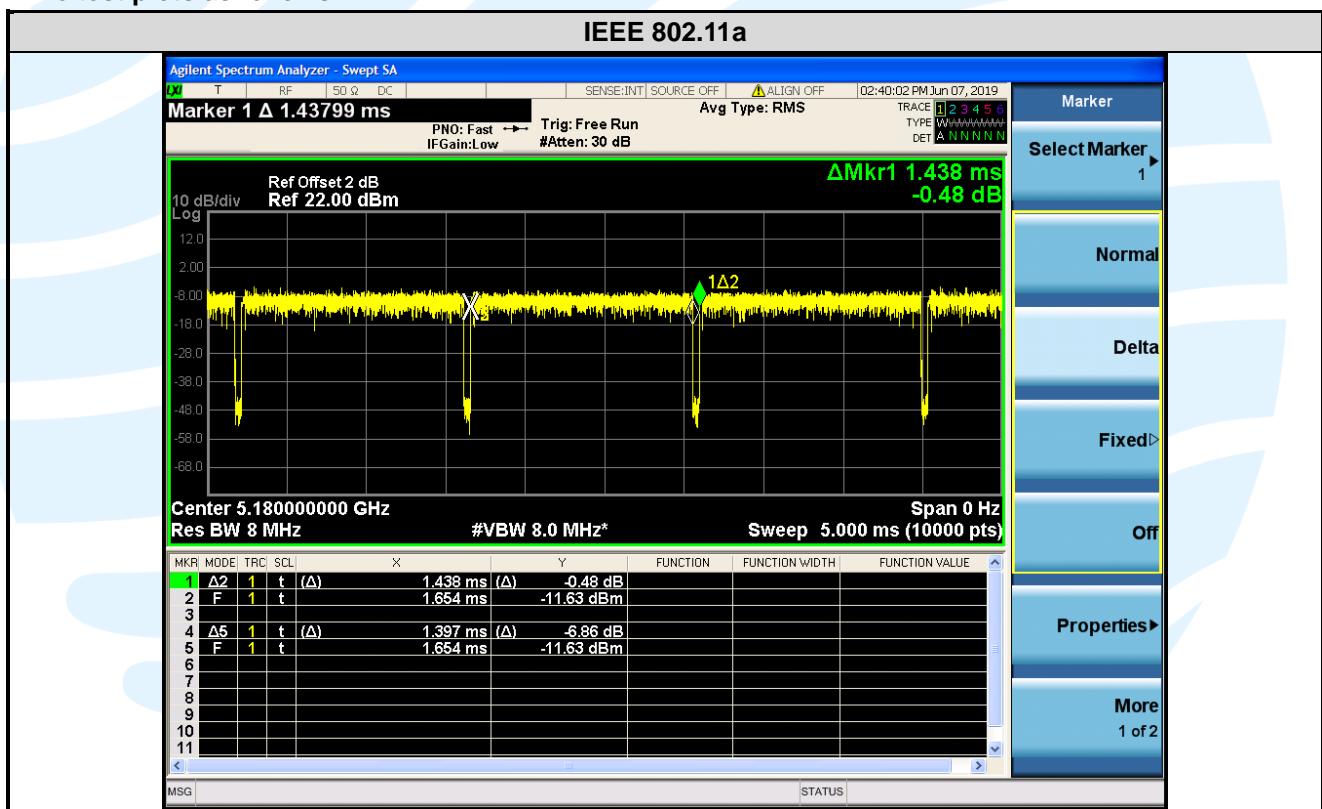
### Test Results

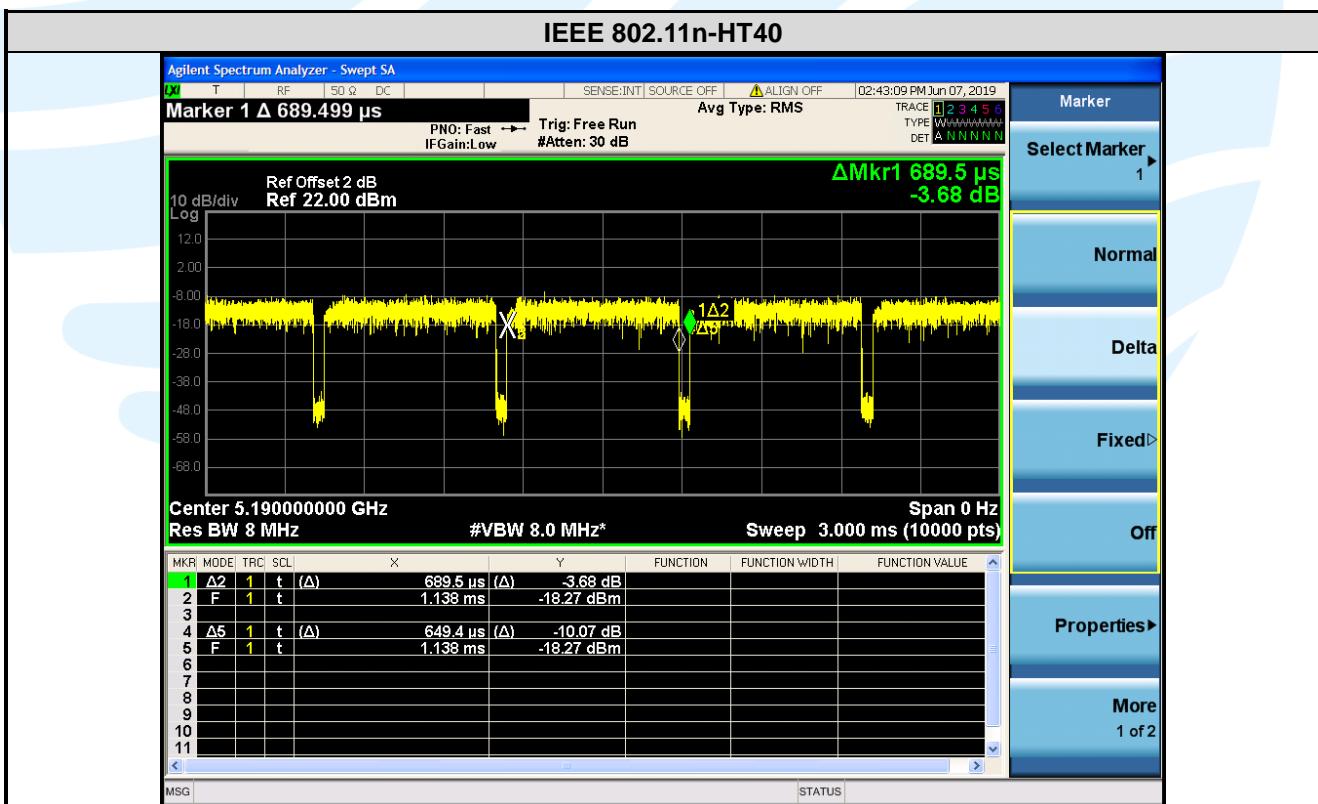
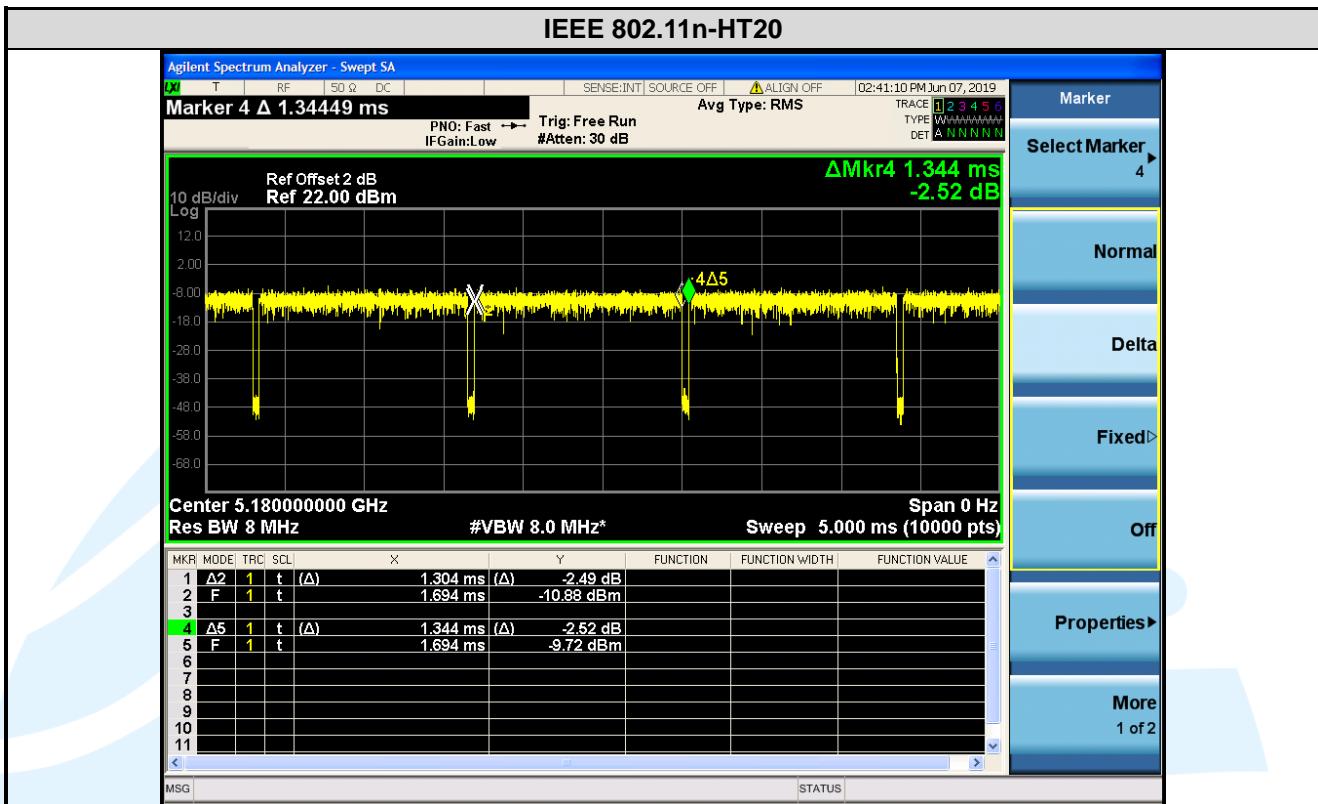
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	54	1.397	1.438	0.97	97.15	0.13	0.72	-0.25
IEEE 802.11n-HT20	MCS7	1.304	1.344	0.97	97.02	0.13	0.77	-0.26
IEEE 802.11n-HT40	MCS7	0.649	0.690	0.94	94.18	0.26	1.54	-0.52
IEEE 802.11ac-VHT20	MCS8	1.316	1.358	0.97	96.91	0.14	0.76	-0.27
IEEE 802.11ac-VHT40	MCS9	0.656	0.698	0.94	93.97	0.27	1.53	-0.54
IEEE 802.11ac-VHT80	MCS9	0.324	0.366	0.89	88.57	0.53	3.09	-1.05

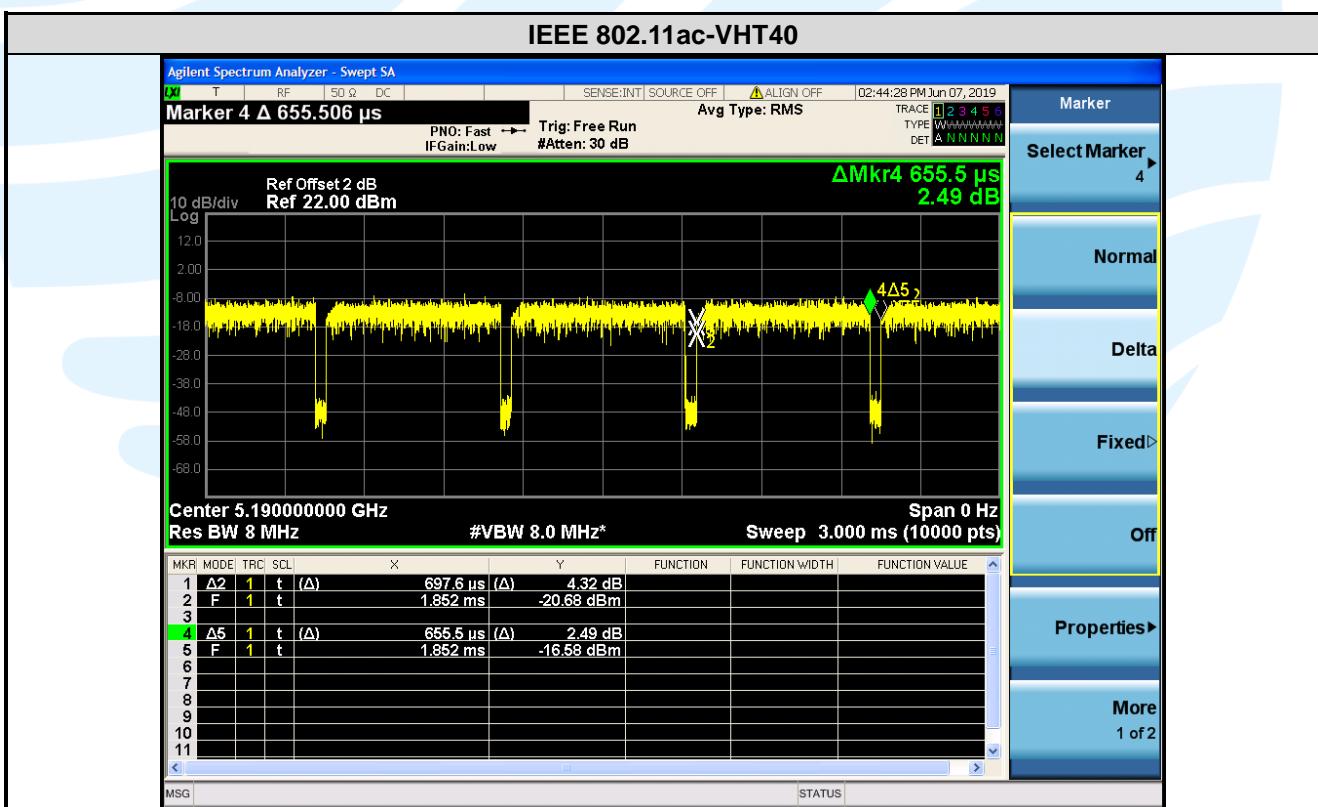
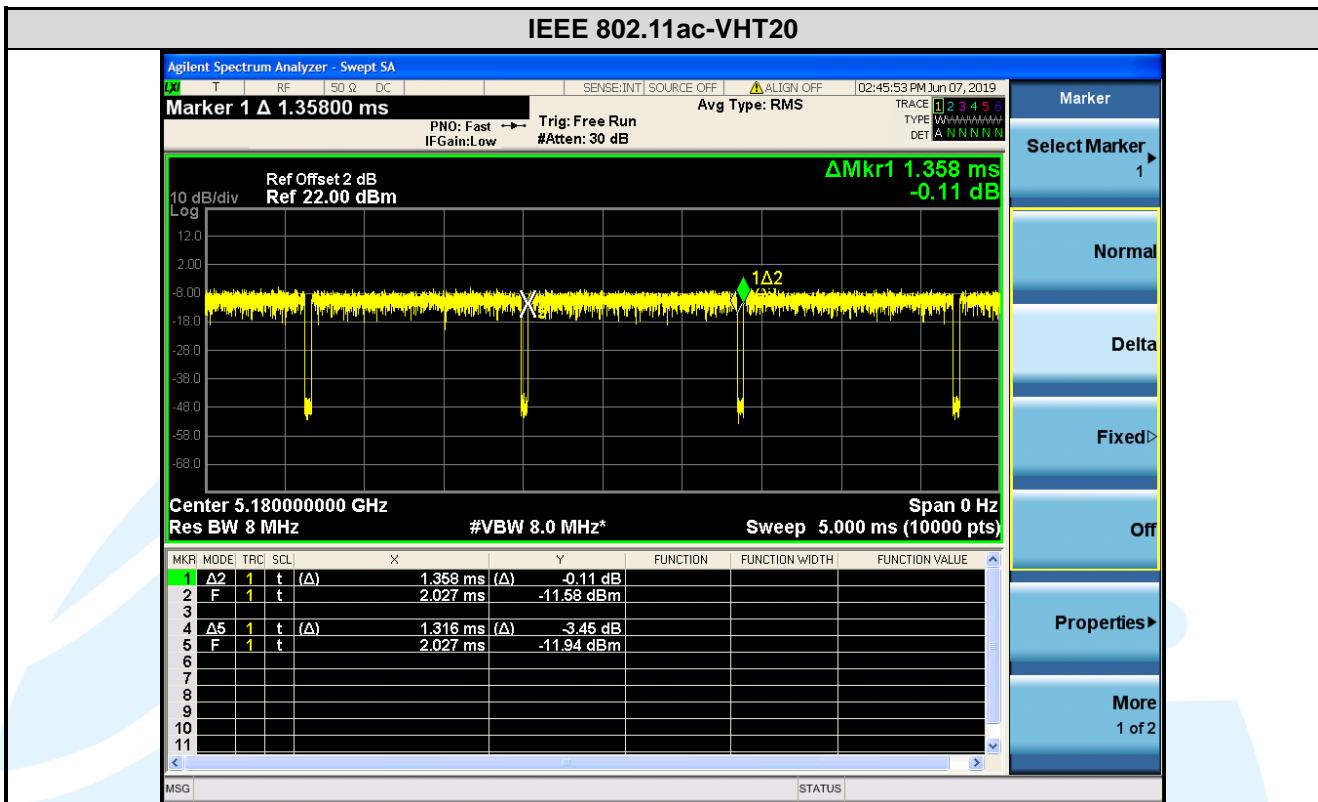
### Remark:

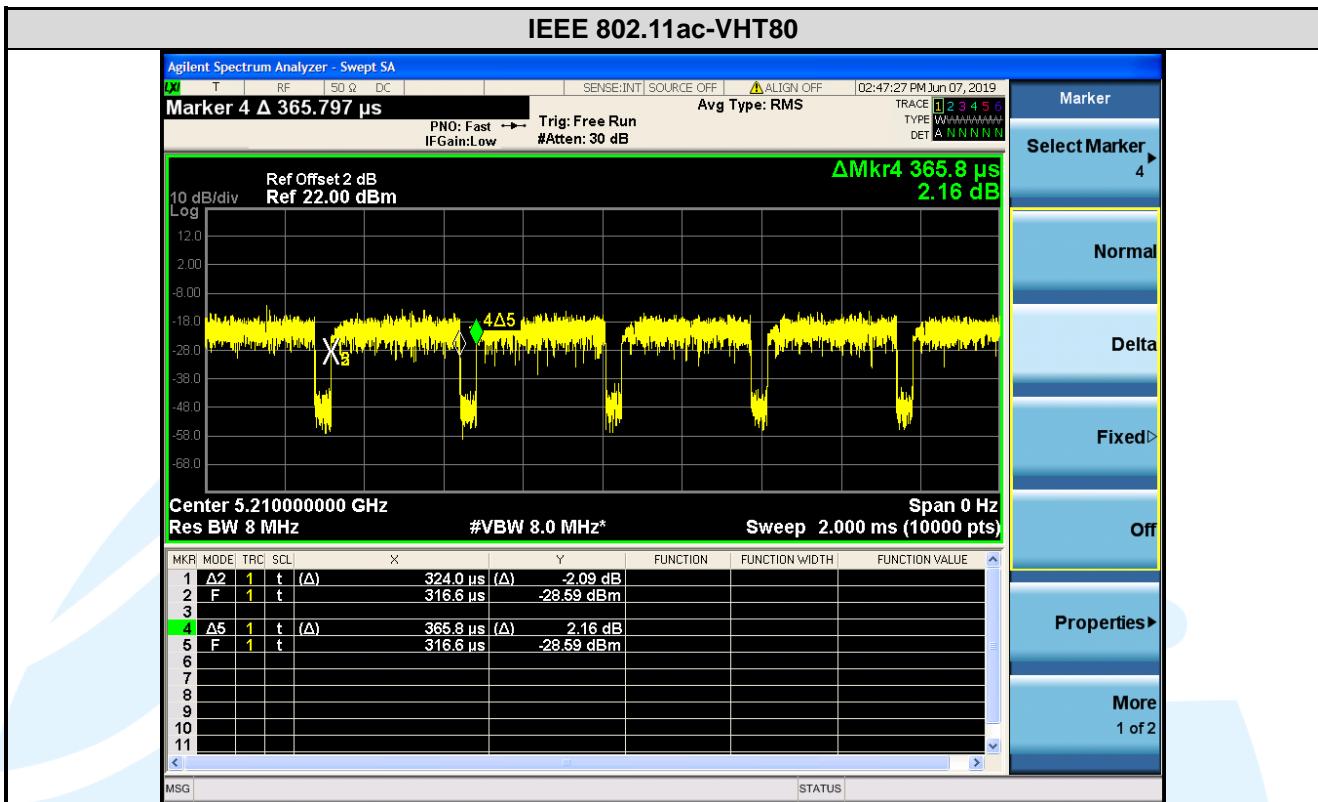
- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor =  $10 * \log(1/\text{Duty cycle})$ ;
- 3) Average factor =  $20 \log_{10} \text{Duty Cycle}$ .

### The test plots 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	RSS-247 Issue 2	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
6	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) device part 15, subpart E
7	KDB 905462 D06 802.11 Channel Plans New Rules v02	Operation in U-NII bands -802.11 channel PLAN(§15.407)
8	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	Compliance measurement procedures for Unlicensed –National Information Infrastructure devices operates in the frequency bands 5250 MHz to 5350 MHz and 5470 MHz to 5725 MHz bands incorporating dynamic frequency selection
9	KDB 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
10	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

### 5.2 ANTENNA REQUIREMENT

Standard Requirement
<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>RSS-Gen Issue 5, Section 6.8 requirement:</b> According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns.
<b>EUT Antenna:</b> Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 3.5 dBi.

## 5.3.26 DB BANDWIDTH & OCCUPIED BANDWIDTH

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

RSS-247 Issue 2 Section 6.2.1.2

**Test Method:** KDB 789033 D02 v02r01 Section C.1

**Limit:** None; for reporting purposes only.

**Test Procedure:**

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

Spectrum analyzer according to the following Settings:

a) Set RBW = approximately 1 % of the emission bandwidth.

b) Set the VBW > RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

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

**Test Setup:** Refer to section 4.5.3 for details.

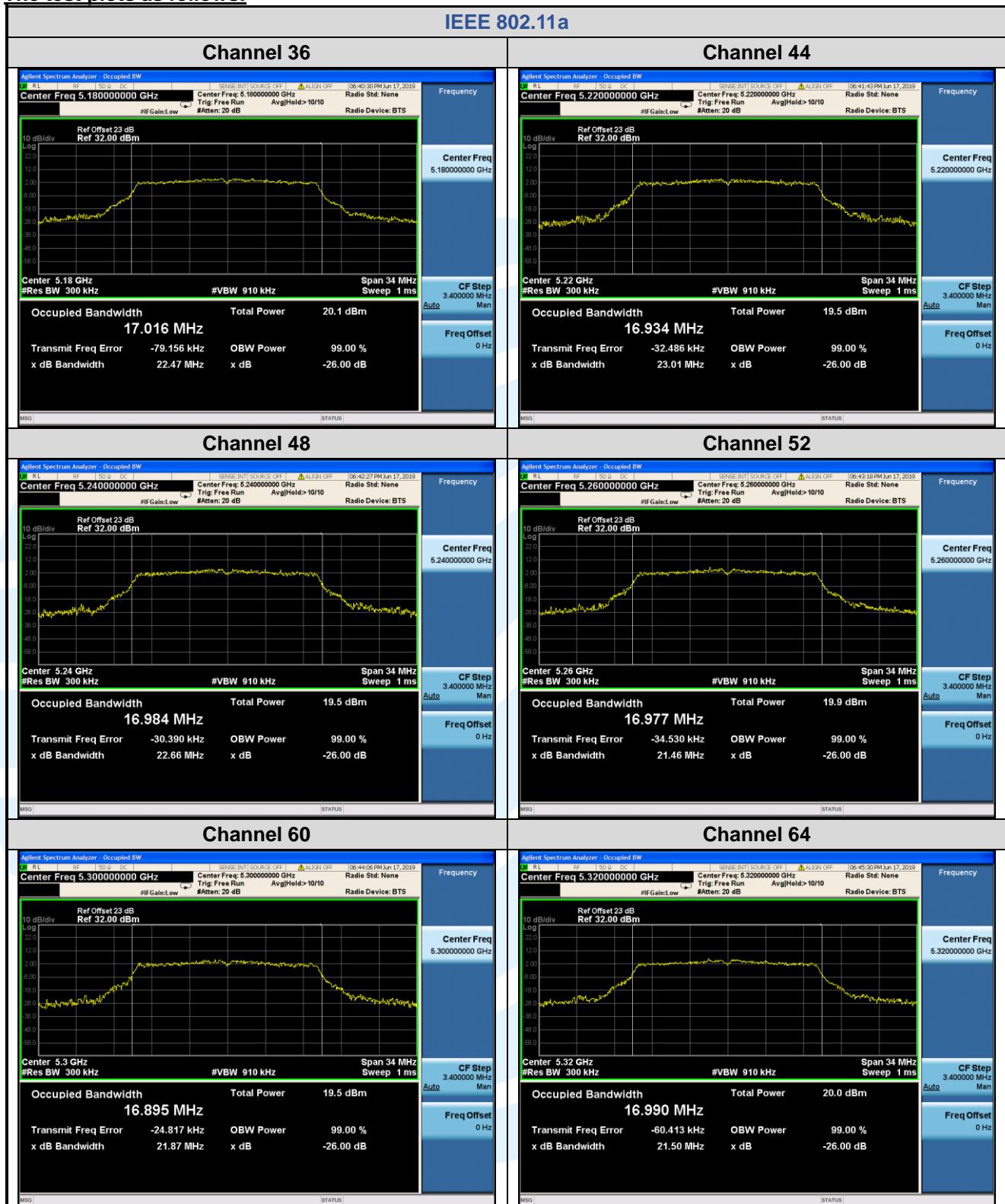
**Instruments Used:** Refer to section 3 for details

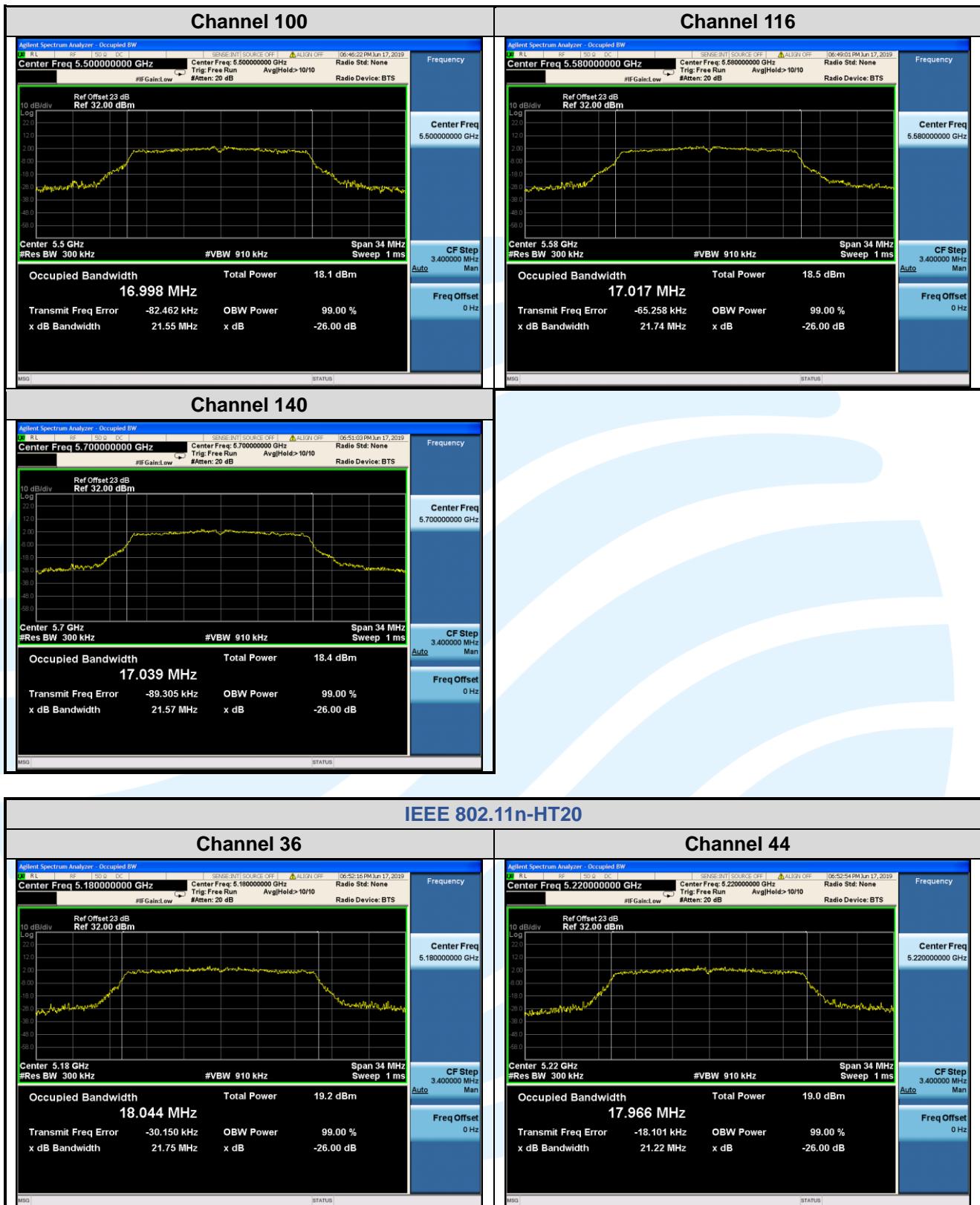
**Test Results:** Pass

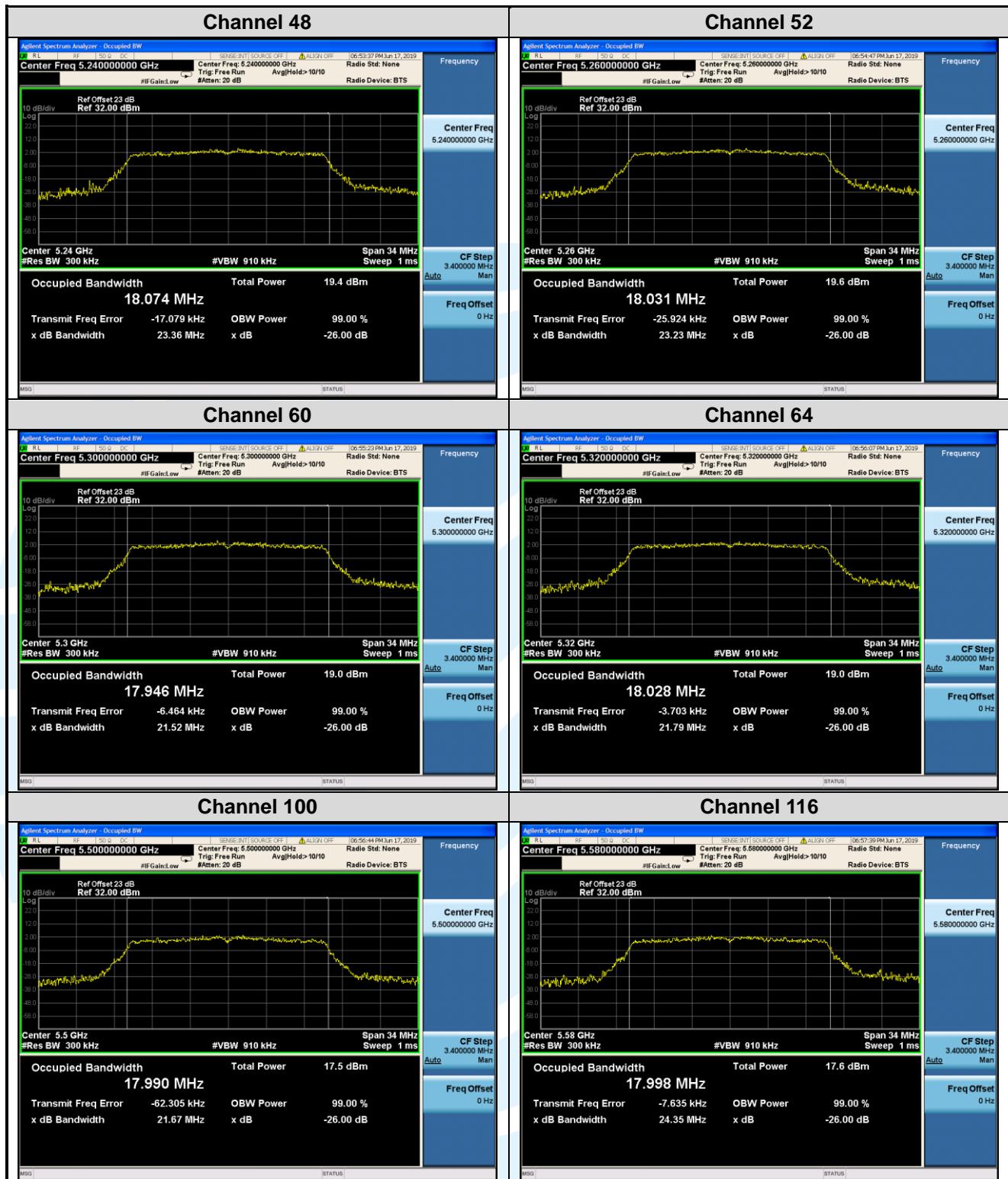
Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
IEEE 802.11a	36 (5180)	22.47	17.016
	44 (5220)	23.01	16.934
	48 (5240)	22.66	16.984
	52 (5260)	21.46	16.977
	60 (5300)	21.87	16.895
	64 (5320)	21.50	16.990
	100 (5500)	21.55	16.998
	116 (5580)	21.74	17.017
	140 (5700)	21.57	17.039
IEEE 802.11n-HT20	36 (5180)	21.75	18.044
	44 (5220)	21.22	17.966
	48 (5240)	23.36	18.074
	52 (5260)	23.23	18.031
	60 (5300)	21.52	17.946
	64 (5320)	21.79	18.028
	100 (5500)	21.67	17.990
	116 (5580)	24.35	17.998
	140 (5700)	21.53	18.064
IEEE 802.11n-HT40	38 (5190)	39.62	36.262
	46 (5230)	48.50	36.310
	54 (5270)	39.84	36.217
	62 (5310)	40.12	36.206
	102 (5510)	39.89	36.368
	110 (5550)	39.66	36.296
	134 (5670)	48.86	36.311

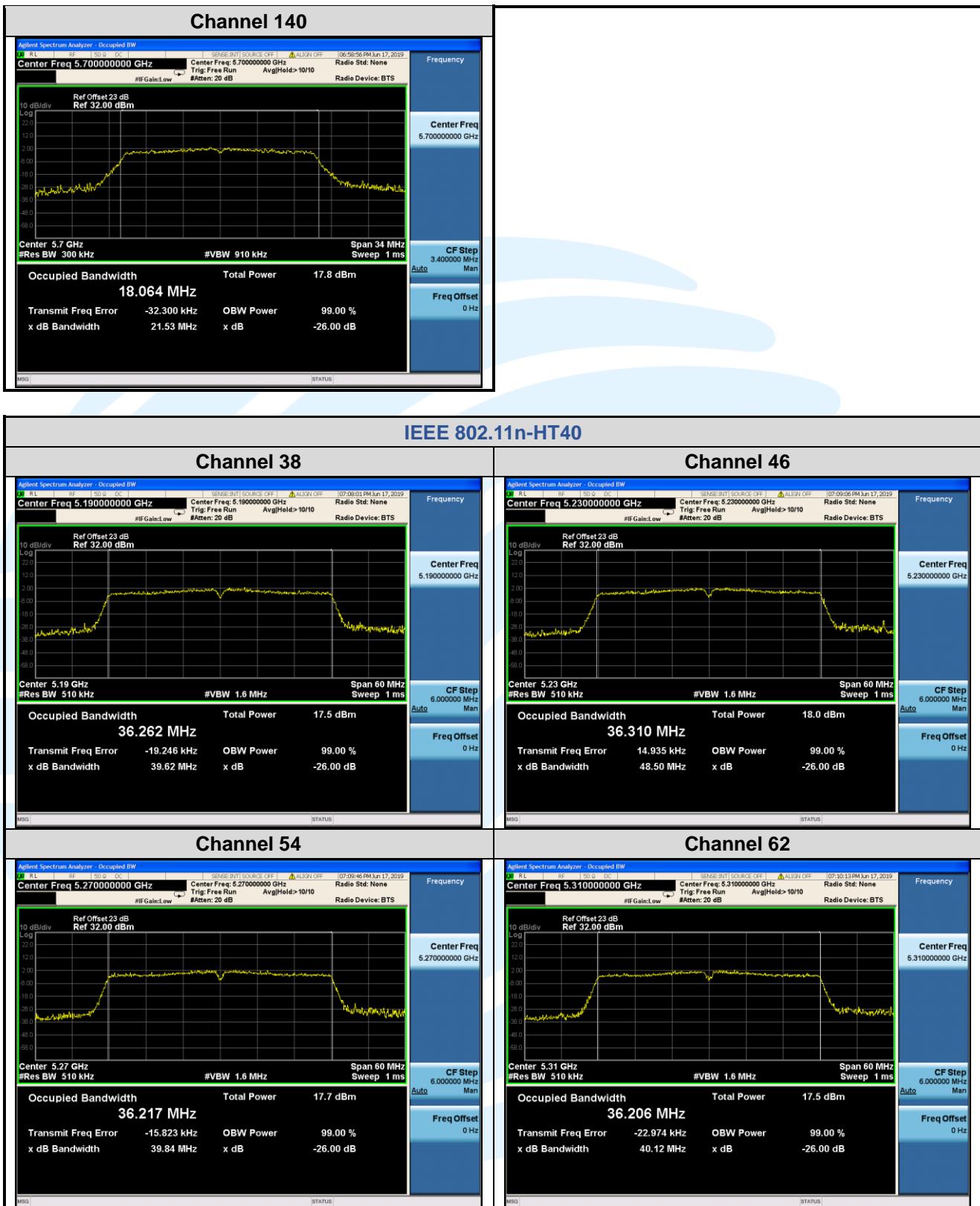
Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
IEEE 802.11ac-VHT20	36 (5180)	22.29	18.083
	44 (5220)	25.16	18.012
	48 (5240)	23.44	18.054
	52 (5260)	22.79	18.060
	60 (5300)	21.42	18.002
	64 (5320)	21.55	17.934
	100 (5500)	23.77	18.040
	116 (5580)	22.35	18.027
	140 (5700)	21.52	17.985
IEEE 802.11ac-VHT40	38 (5190)	39.88	36.327
	46 (5230)	44.89	36.303
	54 (5270)	42.04	36.247
	62 (5310)	39.89	36.299
	102 (5510)	40.01	36.334
	110 (5550)	39.81	36.286
	134 (5670)	46.53	36.262
IEEE 802.11ac-VHT80	42 (5230)	82.22	75.570
	58 (5290)	81.23	75.497
	106 (5530)	81.42	75.599

The test plots as follows:

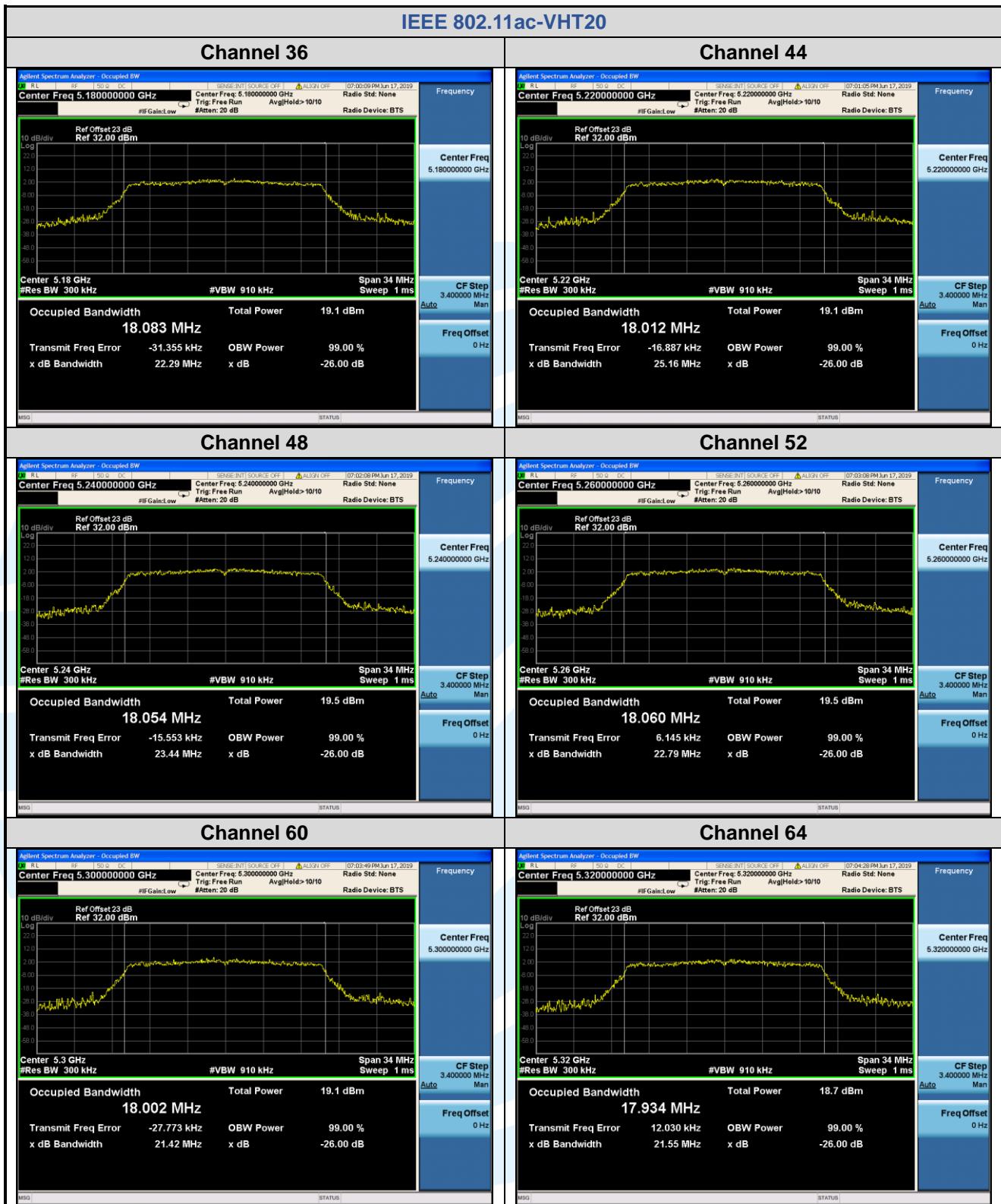


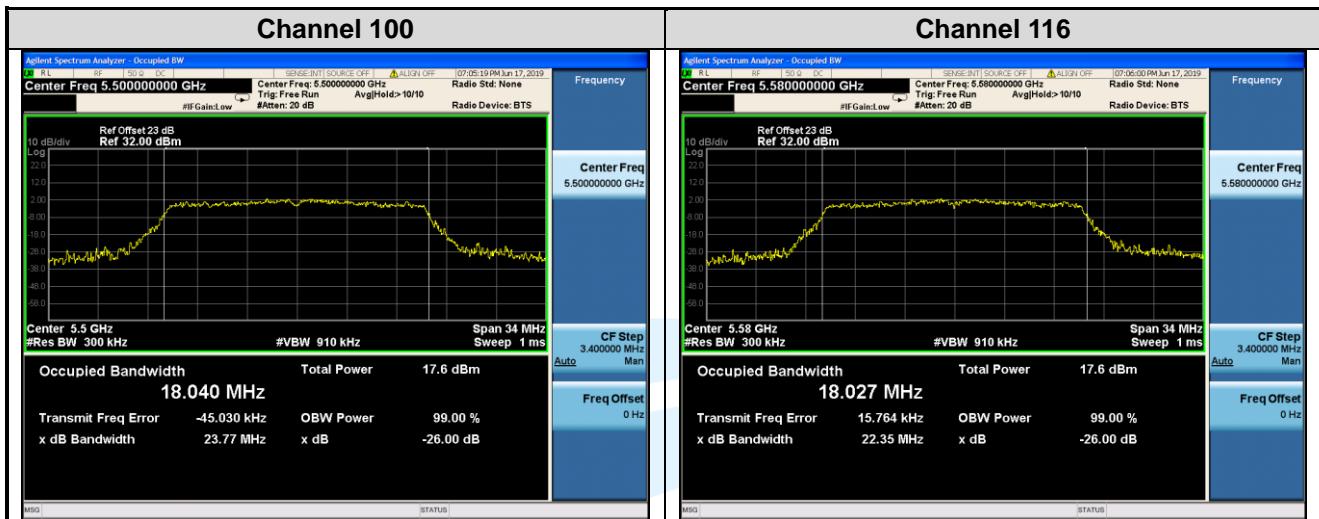












### Channel 140



### IEEE 802.11ac-VHT40

