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CNA S L9069



# TEST REPORT

Product Name: IP Phone  
 Trade Mark: GRANDSTREAM  
 Model No. / HVIN: GRP2624  
 Report Number: 200829033RFC-4  
 Test Standards: FCC 47 CFR Part 15 Subpart E  
 RSS-247 Issue 2  
 RSS-Gen Issue 5  
 FCC ID: YZZGRP2624  
 IC: 11964A-GRP2624  
 Test Result: PASS  
 Date of Issue: December 14, 2020

Prepared for:

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

Prepared by:

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December 14, 2020

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

**Version**

Version No.	Date	Description
V1.0	December 14, 2020	Original

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## CONTENTS

<b>1. GENERAL INFORMATION .....</b>	<b>4</b>
<b>1.1 CLIENT INFORMATION .....</b>	<b>4</b>
<b>1.2 EUT INFORMATION .....</b>	<b>4</b>
1.2.1 GENERAL DESCRIPTION OF EUT .....	4
1.2.2 DESCRIPTION OF ACCESSORIES.....	4
<b>1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD .....</b>	<b>5</b>
<b>1.4 OTHER INFORMATION.....</b>	<b>6</b>
<b>1.5 DESCRIPTION OF SUPPORT UNITS .....</b>	<b>7</b>
<b>1.6 TEST LOCATION.....</b>	<b>7</b>
<b>1.7 TEST FACILITY.....</b>	<b>7</b>
<b>1.8 DEVIATION FROM STANDARDS .....</b>	<b>8</b>
<b>1.9 ABNORMALITIES FROM STANDARD CONDITIONS.....</b>	<b>8</b>
<b>1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER .....</b>	<b>8</b>
<b>1.11 MEASUREMENT UNCERTAINTY .....</b>	<b>8</b>
<b>2. TEST SUMMARY .....</b>	<b>9</b>
<b>3. EQUIPMENT LIST .....</b>	<b>10</b>
<b>4. TEST CONFIGURATION .....</b>	<b>11</b>
<b>4.1 ENVIRONMENTAL CONDITIONS FOR TESTING.....</b>	<b>11</b>
4.1.1 NORMAL OR EXTREME TEST CONDITIONS .....	11
4.1.2 RECORD OF NORMAL ENVIRONMENT.....	11
<b>4.2 TEST CHANNELS .....</b>	<b>11</b>
<b>4.3 EUT TEST STATUS .....</b>	<b>12</b>
<b>4.4 PRE-SCAN.....</b>	<b>12</b>
<b>4.5 TEST SETUP .....</b>	<b>13</b>
4.5.1 FOR RADIATED EMISSIONS TEST SETUP .....	13
4.5.2 FOR CONDUCTED EMISSIONS TEST SETUP .....	14
4.5.3 FOR CONDUCTED RF TEST SETUP .....	15
<b>4.6 SYSTEM TEST CONFIGURATION .....</b>	<b>15</b>
<b>4.7 DUTY CYCLE .....</b>	<b>16</b>
<b>5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION .....</b>	<b>20</b>
<b>5.1 REFERENCE DOCUMENTS FOR TESTING .....</b>	<b>20</b>
<b>5.2 ANTENNA REQUIREMENT .....</b>	<b>20</b>
<b>5.3 26 DB BANDWIDTH &amp; OCCUPIED BANDWIDTH.....</b>	<b>21</b>
<b>5.4 6 DB BANDWIDTH &amp; OCCUPIED BANDWIDTH.....</b>	<b>32</b>
<b>5.5 MAXIMUM CONDUCTED OUTPUT POWER OR E.I.R.P .....</b>	<b>39</b>
<b>5.6 PEAK POWER SPECTRAL DENSITY .....</b>	<b>47</b>
<b>5.7 RADIATED EMISSIONS AND BAND EDGE MEASUREMENT.....</b>	<b>64</b>
<b>5.8 DYNAMIC FREQUENCY SELECTION .....</b>	<b>104</b>
<b>5.9 AC POWER LINE CONDUCTED EMISSION .....</b>	<b>114</b>
<b>APPENDIX 1 PHOTOS OF TEST SETUP.....</b>	<b>117</b>
<b>APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS.....</b>	<b>117</b>

# 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>	GRP2624		
<b>Trade Mark:</b>	GRANDSTREAM		
<b>DUT Stage:</b>	Production Unit		
<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>Sample Received Date:</b>	October 10, 2020		
<b>Sample Tested Date:</b>	October 10, 2020 to November 14, 2020		

### 1.2.2 Description of Accessories

Adapter(1)	
<b>Model No.:</b>	GQ12-120100-AU
<b>Input:</b>	100-240 V~50/60 Hz 0.4A Max
<b>Output:</b>	12.0 V = 1.0 A
<b>DC Cable:</b>	2.5 Meter, Unshielded without ferrite

Adapter(2)	
<b>Model No.:</b>	DSA-12PFU-12 FUS 120100
<b>Input:</b>	100-240 V~50/60 Hz 0.5A
<b>Output:</b>	12.0 V = 1.0 A
<b>DC Cable:</b>	2.5 Meter, Unshielded without ferrite

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

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

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

Others	
1x Handset, 1x Phone Stand	

### 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Bands:	5150 MHz to 5250 MHz (U-NII-1)
	5250 MHz to 5350 MHz (U-NII-2A)
	5470 MHz to 5725 MHz (U-NII-2C)
	5725 MHz to 5850 MHz (U-NII-3)
Frequency Ranges:	5180 MHz to 5240 MHz
	5260 MHz to 5320 MHz
	5500 MHz to 5700 MHz
	5745 MHz to 5825 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 MCS7
	IEEE 802.11n-HT40: Up to MCS7
	IEEE 802.11ac-VHT20: Up to MCS8
	IEEE 802.11ac-VHT40: 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

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	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>	Dipole Antenna				
<b>Antenna Gain:</b>	5150 MHz to 5250 MHz: 3.0 dBi				
	5250 MHz to 5350 MHz: 3.0 dBi				
	5470 MHz to 5725 MHz: 3.0 dBi				
	5725 MHz to 5850 MHz: 3.0 dBi				
<b>Maximum EIRP (dBm):</b>	<b>Chain 0</b>	<b>U-NII-1</b>			
	IEEE 802.11a:	18.56			
	IEEE 802.11n-HT20:	18.11			
	IEEE 802.11n-HT40:	17.22			
	IEEE 802.11ac-VHT20:	18.13			
	IEEE 802.11ac-VHT40:	17.08			
	IEEE 802.11ac-VHT80:	16.82			
<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:	15.56	15.61	15.71	16.36
	IEEE 802.11n-HT20:	15.11	15.13	14.96	15.97
	IEEE 802.11n-HT40:	14.22	14.23	14.01	15.90
	IEEE 802.11ac-VHT20:	15.13	15.23	14.98	15.93
	IEEE 802.11ac-VHT40:	14.08	14.07	13.93	15.80
	IEEE 802.11ac-VHT80:	13.82	13.99	13.77	18.48
<b>Normal Test Voltage:</b>	120V~60Hz				

### 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	$f = 5000 + 5k, k = 32 + 4n$			$f = 5000 + 5k,$ $k = 145 + 4n$
	$n = 1, \dots, 4$	$n = 5, \dots, 8$	$n = 17, \dots, 27$	$n = 1, \dots, 5$
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40	$f = 5000 + 5k, k = 30 + 8n$			$f = 5000 + 5k,$ $k = 143 + 8n$
	$n = 1, 2$	$n = 1, \dots, 5$	$n = 9, \dots, 13$	$n = 1, 2$
IEEE 802.11ac-VHT80	$f = 5000 + 5k, k = 26 + 16n$			$f = 5000 + 5k,$ $k = 155$
	$n = 1$	$n = 1, 2$	$n = 5, 6$	
Note: f is the operating frequency (MHz); k is the operating channel.				

## 1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

### 1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	FCC ID	Supplied by
Notebook	Lenovo	B40-80	MP12NEQ6	N/A	UnionTrust
USB disk	Kingston	DTSE9	N/A	N/A	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	N/A	UnionTrust
Headset	YEY	VE120-MV	N/A	N/A	UnionTrust
Wireless Home Router	SAGEMCOM	FAST5280	N/A	VW3FAST5280	UnionTrust
Key-Press Attenuator	Huaxin	KT2.5-90/1S-2S	N/A	N/A	UnionTrust
4 Way Divider	WOKEN	0120A040560002D	N/A	N/A	UnionTrust
IP Phone	GRANDSTREAM	GRP2634	N/A	YZZGRP2634	Applicant

### 2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Ethernet Cable	RJ45	1.5 Unshielded without ferrite	UnionTrust
2	Ethernet Cable	RJ45	2.0 Unshielded without ferrite	UnionTrust
3	Ethernet Cable	RJ45	5.0 Unshielded without ferrite	UnionTrust
4	Antenna Cable	SMA	0.3 Meter	UnionTrust

## 1.6 TEST LOCATION

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 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

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

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 UTR-RF-RSS247-V1.0

CAB identifier: CN0032

**FCC Accredited Lab.**

Designation Number: CN1194

Test Firm Registration Number: 259480

**1.8 DEVIATION FROM STANDARDS**

None.

**1.9 ABNORMALITIES FROM STANDARD CONDITIONS**

None.

**1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER**

None.

**1.11 MEASUREMENT UNCERTAINTY**

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.2 dB
2	Conducted emission 150KHz-30MHz	±2.7 dB
3	Radiated emission 9KHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.9 dB
5	Radiated emission 1GHz-18GHz	± 4.8 dB
6	Radiated emission 18GHz-26GHz	± 5.1 dB
7	Radiated emission 26GHz-40GHz	± 5.1 dB
8	Conducted spurious emissions	± 2.7 dB
9	RF Power, Conducted	± 0.9 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	2.4 GHz: ± 6.5 x 10 <sup>-8</sup>
12	Transmission Time	± 0.19 %



## 2. TEST SUMMARY

FCC 47 CFR Part 15 Subpart E Test Cases			
Test Item	Test Requirement	Test Method	Result
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203 FCC 47 CFR Part 15 Subpart E Section 15.407(a)(1) (2) RSS-Gen Issue 5, Section 6.8	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5) RSS-247 Issue 2 Section 6.2.1.2	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e) RSS-247 Issue 2 Section 6.2.4.1	KDB 789033 D02 v02r01 Section C.2	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, section 6.7	PASS
Maximum conducted output power	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section E.3.a (Method PM)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 2 Section 6.3	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS
<b>Note:</b> 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>
<b>Note:</b> 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, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Preamplifier	HP	8447F	2805A02960	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	Broadband Antenna (Pre-amplifier)	ETS-LINDGREN	3142E-PA	00201891	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	6dB Attenuator	Talent	RA6A5-N-18	18103002	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3117	00164202	Nov. 16, 2019	Nov. 15, 2020
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	May. 30, 2020	May. 29, 2021
<input type="checkbox"/>	Horn Antenna	ETS-LINDGREN	3116C	00200180	Jun. 19, 2020	Jun. 18, 2021
<input checked="" type="checkbox"/>	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Nov. 16, 2019	Nov. 15, 2020
<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	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G1868	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm dd, yyyy)	Cal. Due date (mm dd, yyyy)
<input checked="" type="checkbox"/>	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	LISN	R&S	ESH2-Z5	860014/024	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 24, 2019	Nov. 23, 2020
<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, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 24, 2019	Nov. 23, 2020
<input type="checkbox"/>	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 24, 2019	Nov. 23, 2020
<input checked="" type="checkbox"/>	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Nov. 24, 2019	Nov. 23, 2020

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## 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	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	51	99.80	Leo Li
6 dB bandwidth				
Occupied Bandwidth				
Maximum conducted output power				
Peak Power Spectral Density				
Radiated Emissions and Band Edge Measurement	25.6	57	100.62	Andy Lin
Dynamic Frequency Selection	24.7	51	99.80	Leo Li
AC Power Line Conducted Emission	24.6	56	99.75	Tripp Jiang

## 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	14	14	14	15
IEEE 802.11n-HT20	14	14	14	15
IEEE 802.11n-HT40	13	13	13	15
IEEE 802.11ac-VHT20	14	14	14	15
IEEE 802.11ac-VHT40	13	13	13	15
IEEE 802.11ac-VHT80	13	13	13	18

Test Software
Test software name: Putty commands;

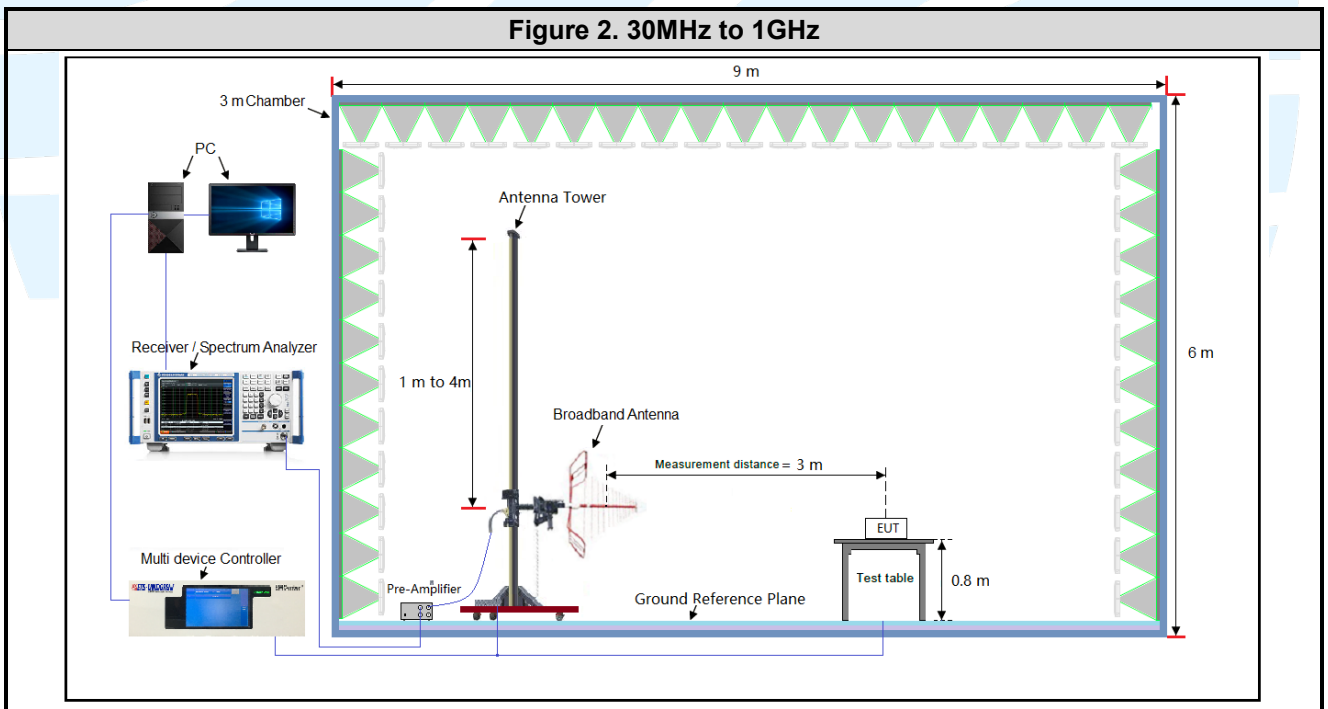
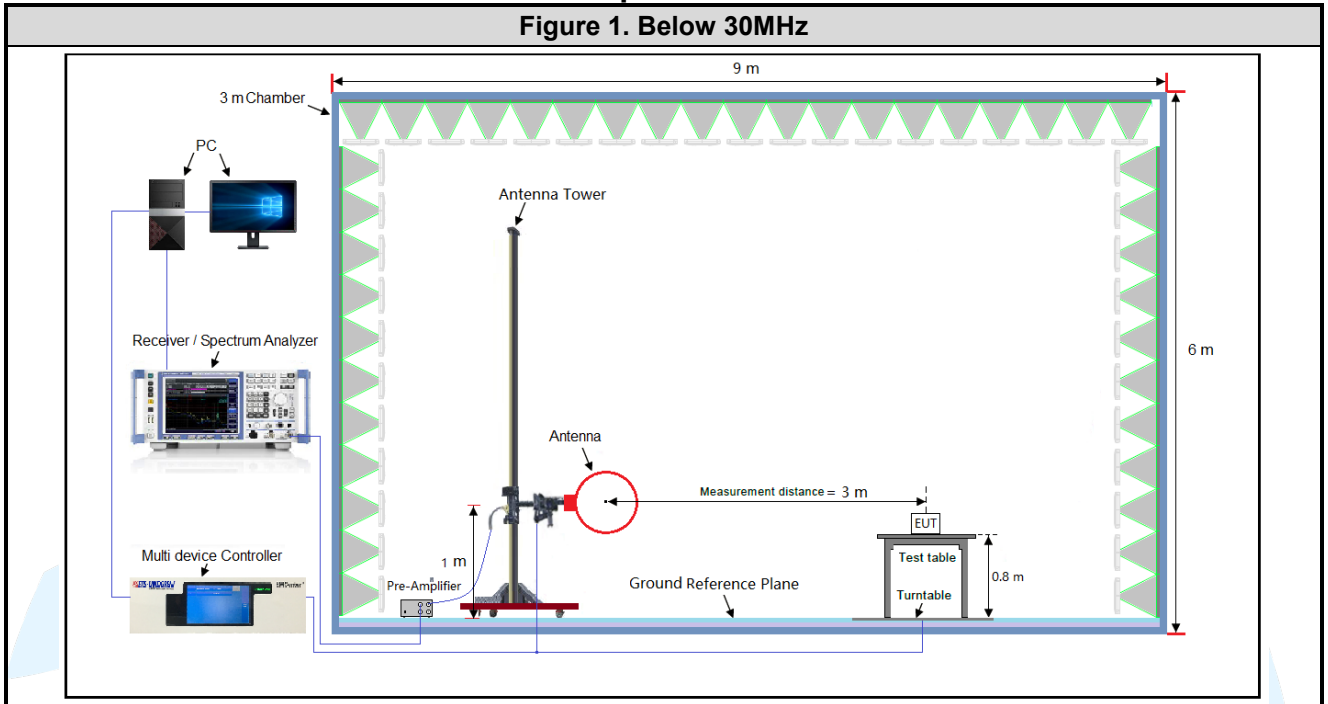
### 4.4 PRE-SCAN

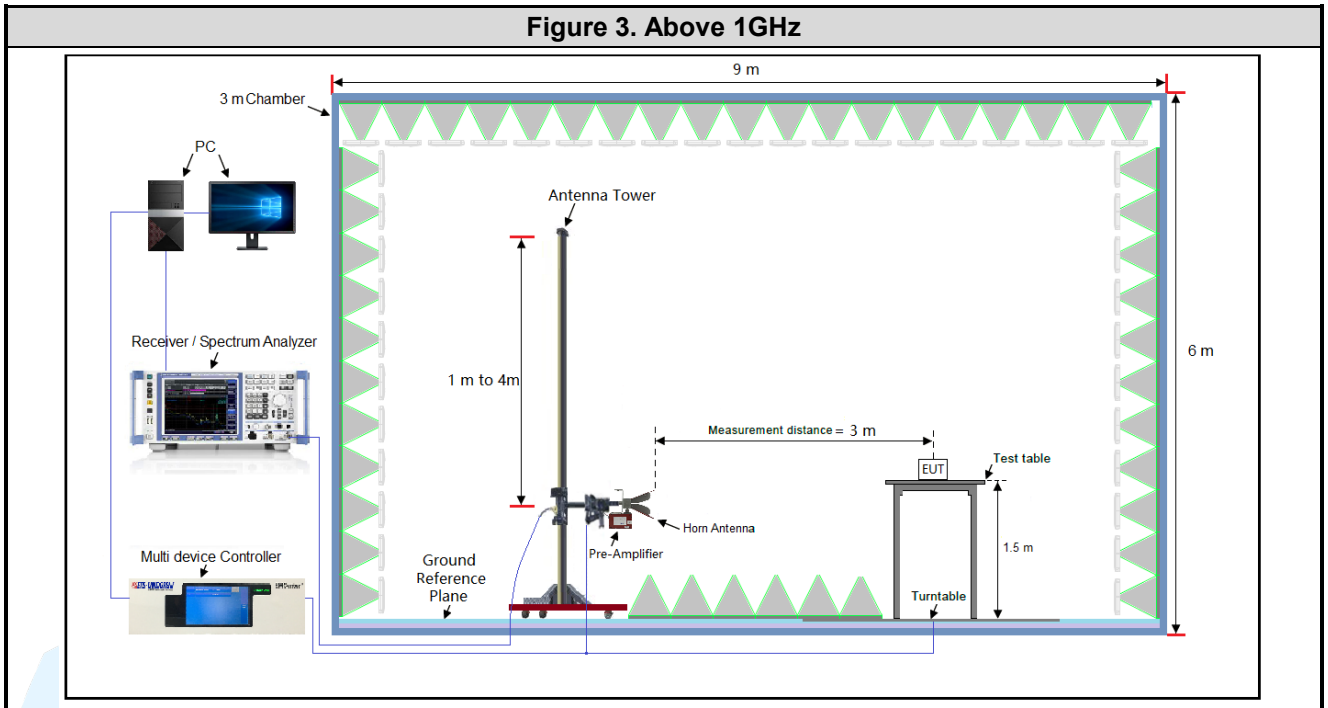
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. Following data rate was (were) selected for the final test as listed below

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

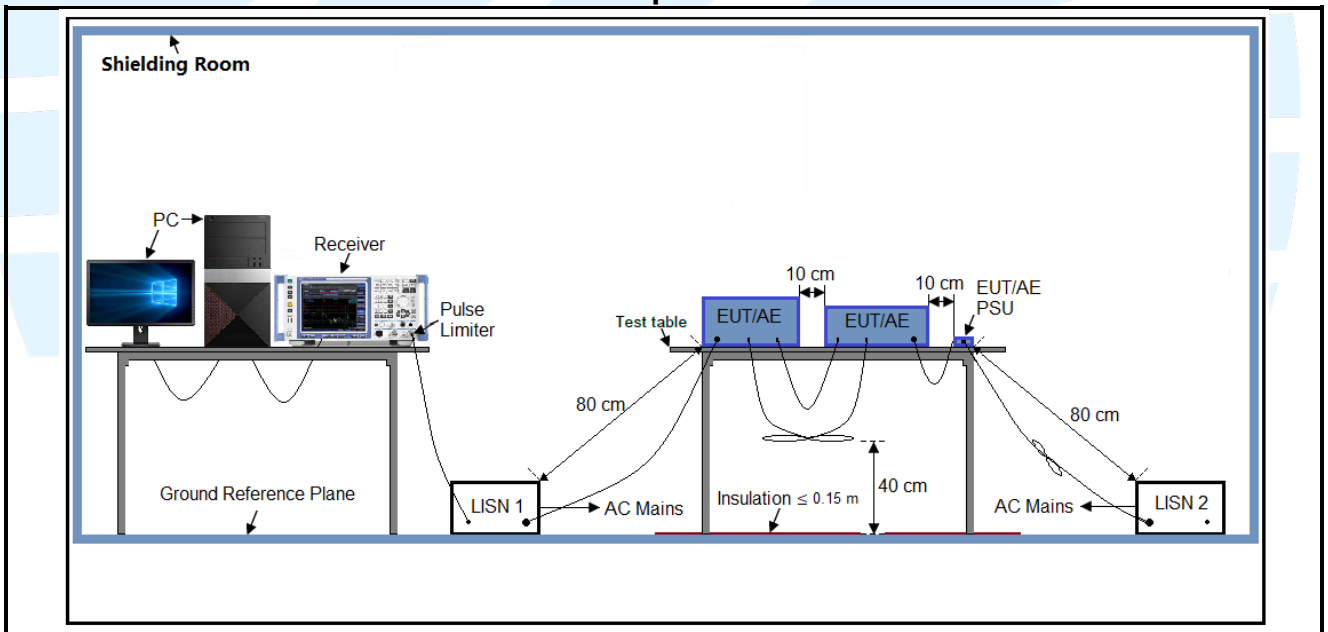
### 4.5 TEST SETUP

#### 4.5.1 For Radiated Emissions test setup

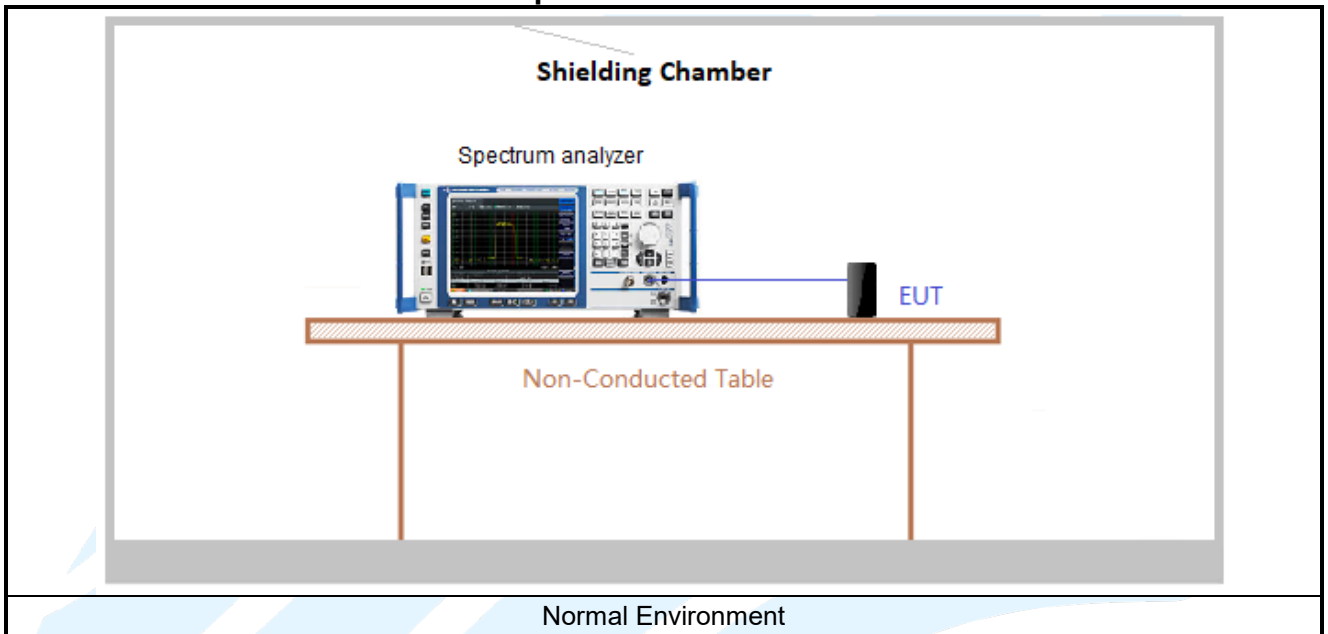




**4.5.2 For Conducted Emissions test setup**



**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 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.

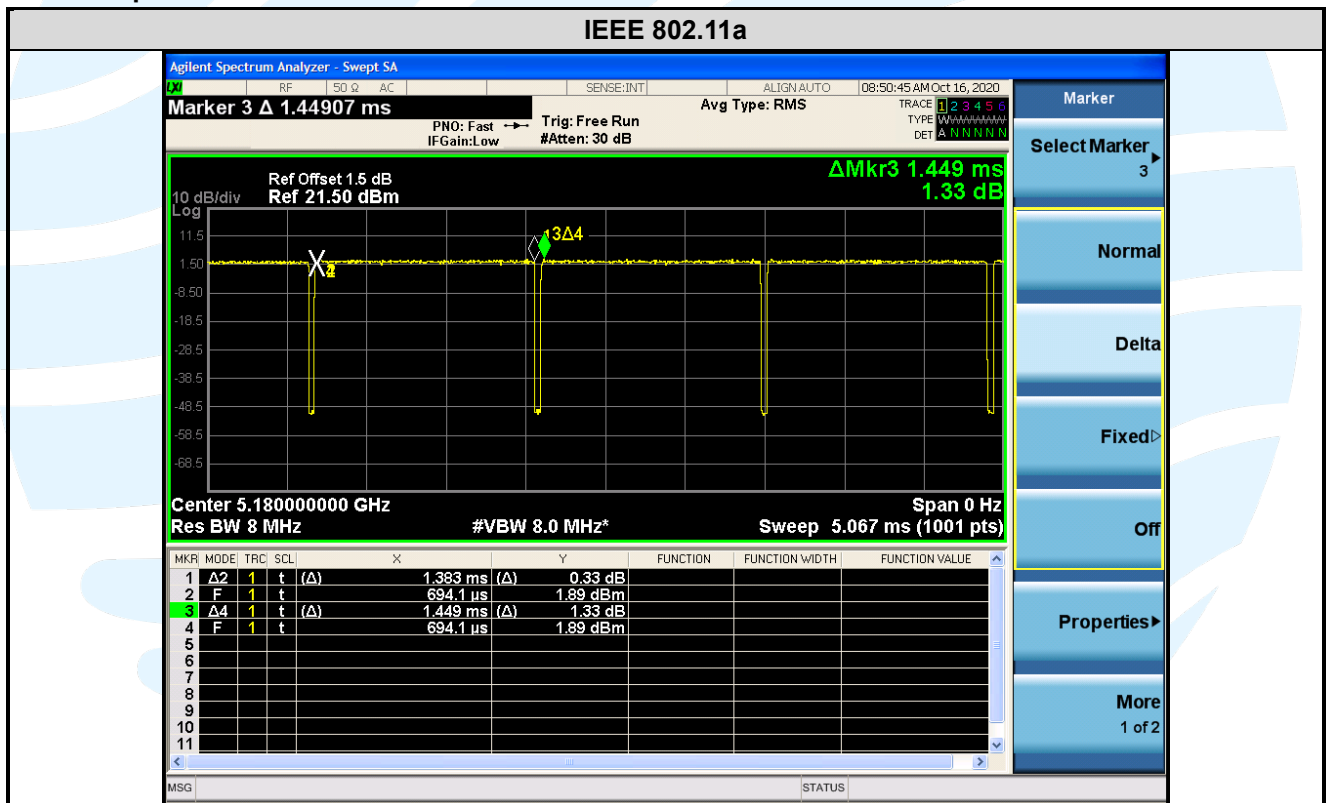
**Test Results**

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	6	1.3830	1.4490	0.95	95.45	0.20	0.72	-0.40
IEEE 802.11n-HT20	MCS0	1.2970	1.3530	0.96	95.86	0.18	0.77	-0.37
IEEE 802.11n-HT40	MCS0	0.6420	0.6900	0.93	93.04	0.31	1.56	-0.63
IEEE 802.11ac-VHT20	MCS0	1.2900	1.3600	0.95	94.85	0.23	0.78	-0.46
IEEE 802.11ac-VHT40	MCS0	0.6510	0.6960	0.94	93.53	0.29	1.54	-0.58
IEEE 802.11ac-VHT80	MCS0	0.0620	0.1060	0.58	58.49	2.33	16.13	-4.66

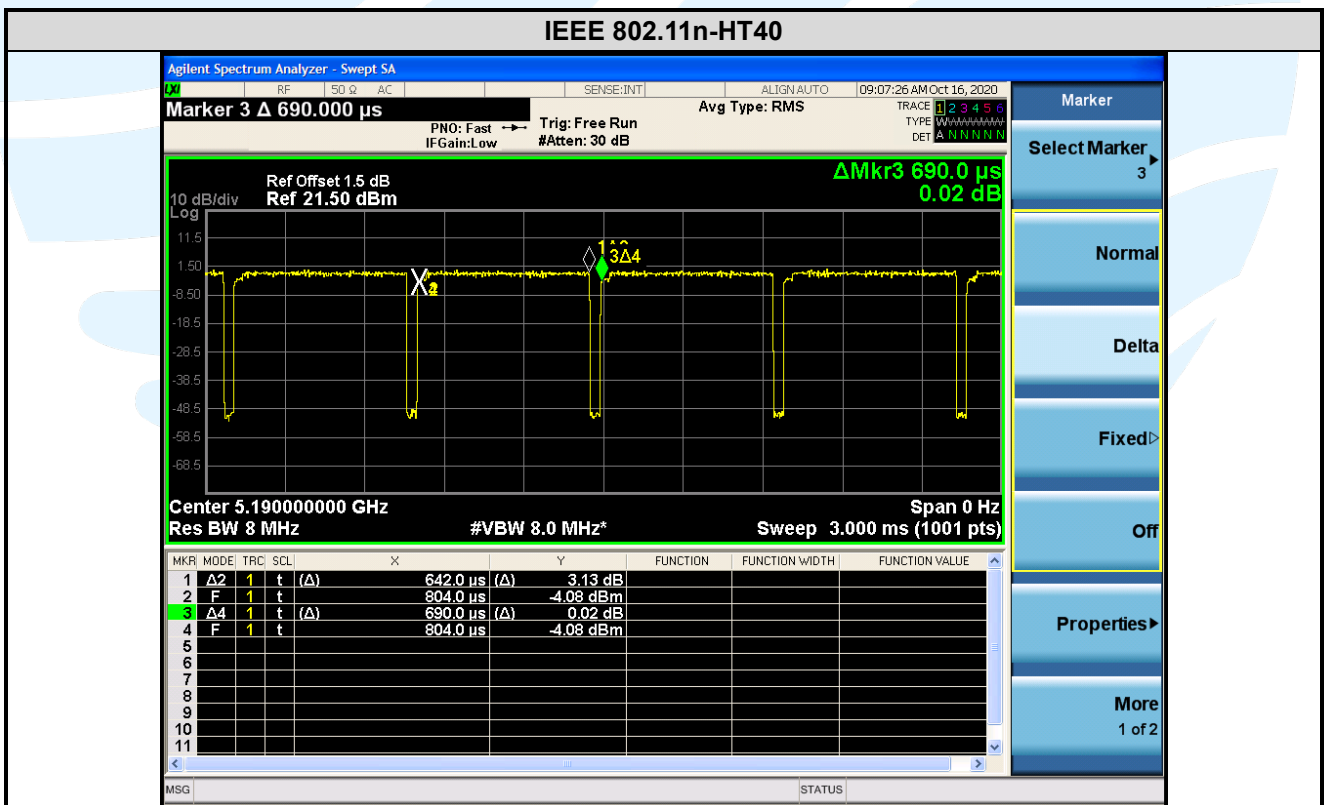
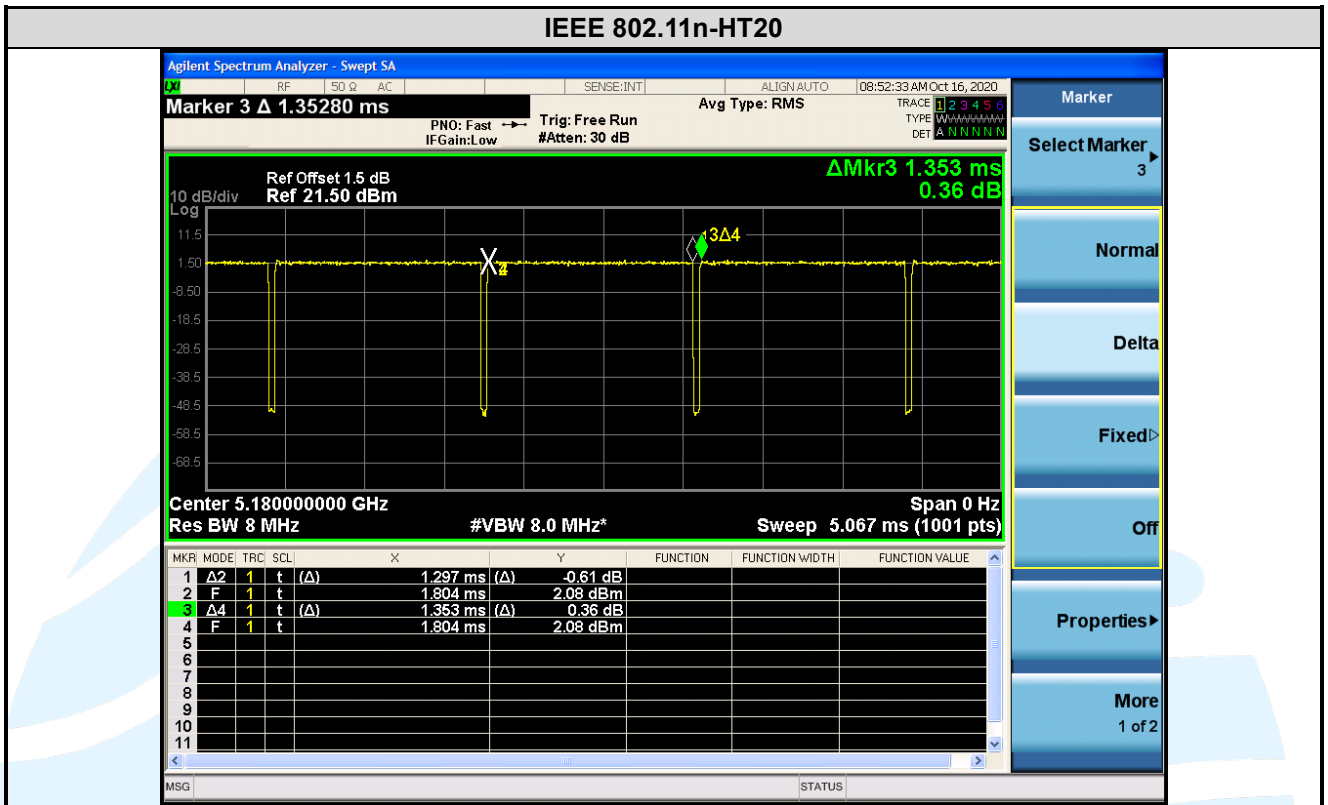
**Remark:**

- 1) Duty cycle= On Time/ Period;
- 2) Duty Cycle factor = 10 \* log(1/ Duty cycle);
- 3) Average factor = 20 log<sub>10</sub> Duty Cycle.

The test plots as follows







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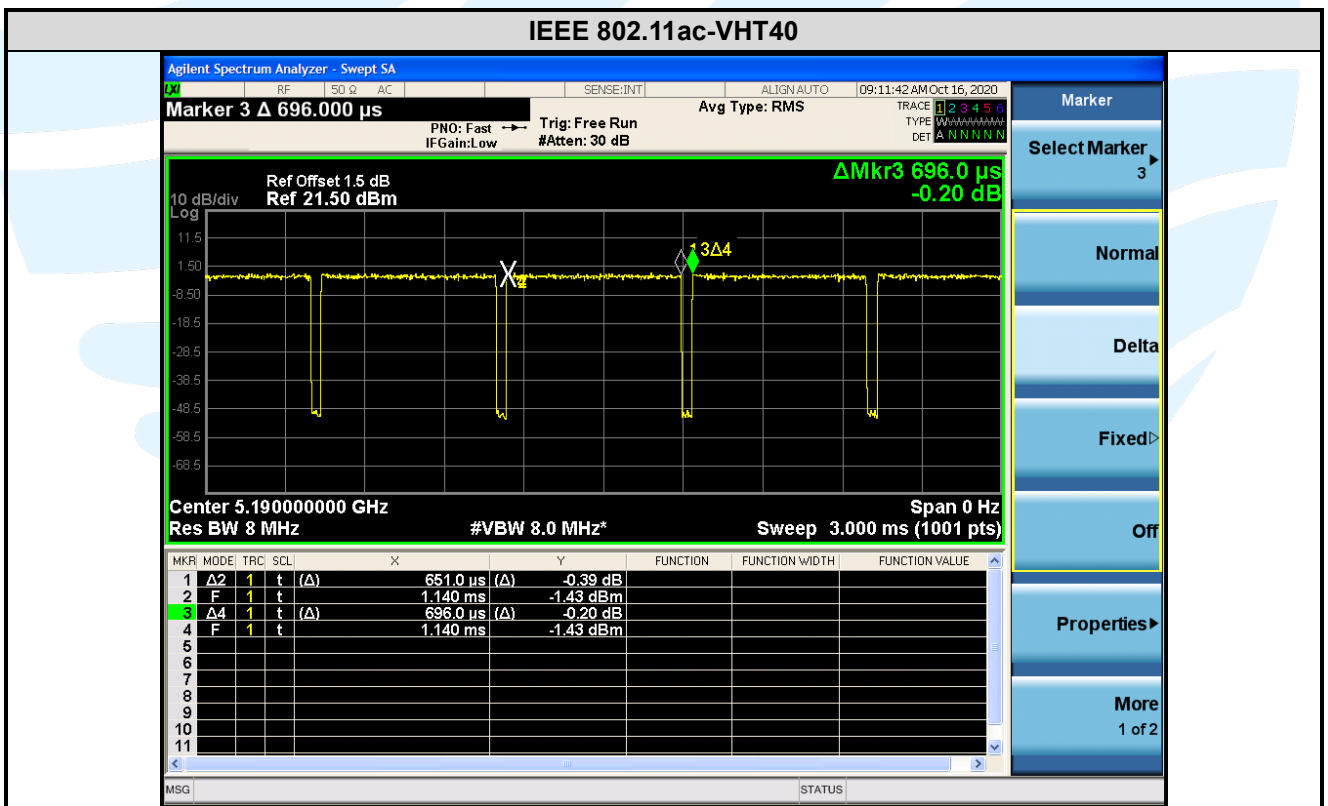
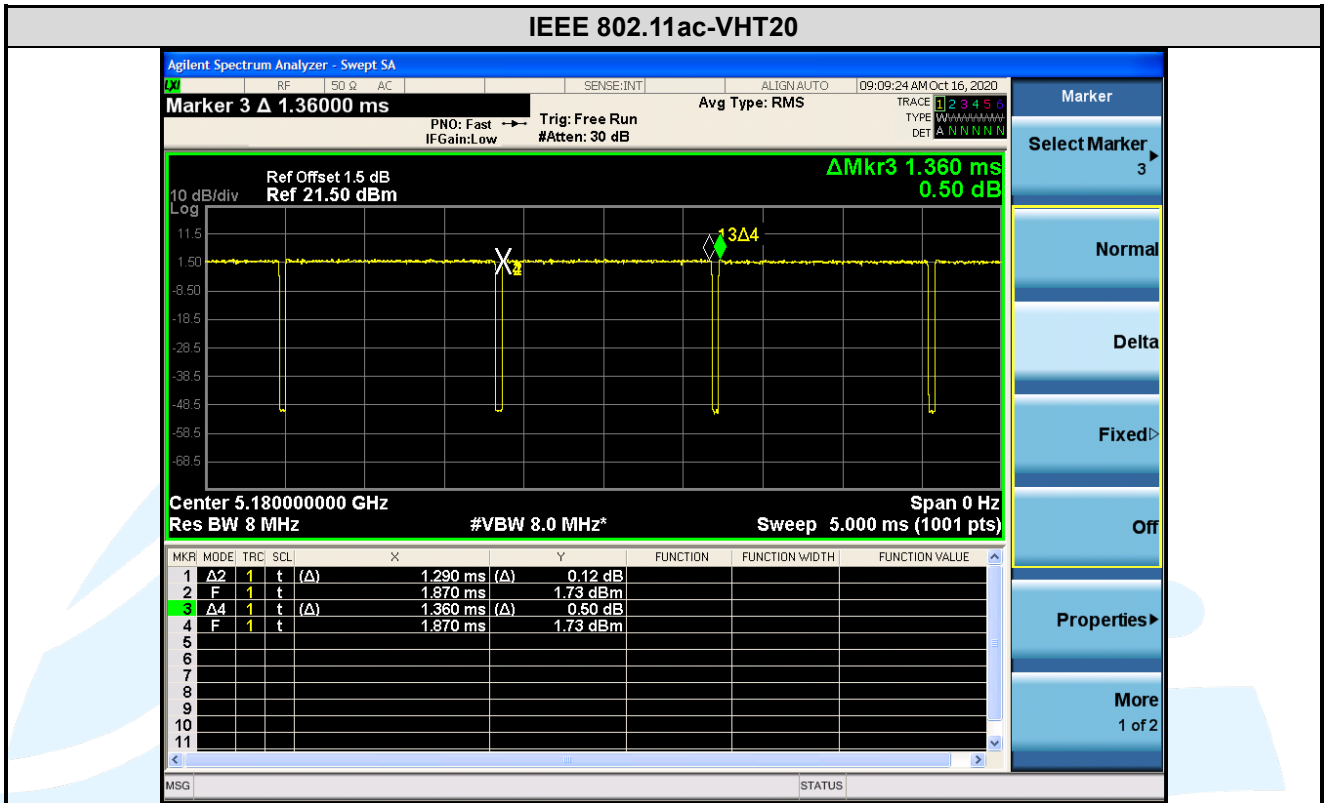
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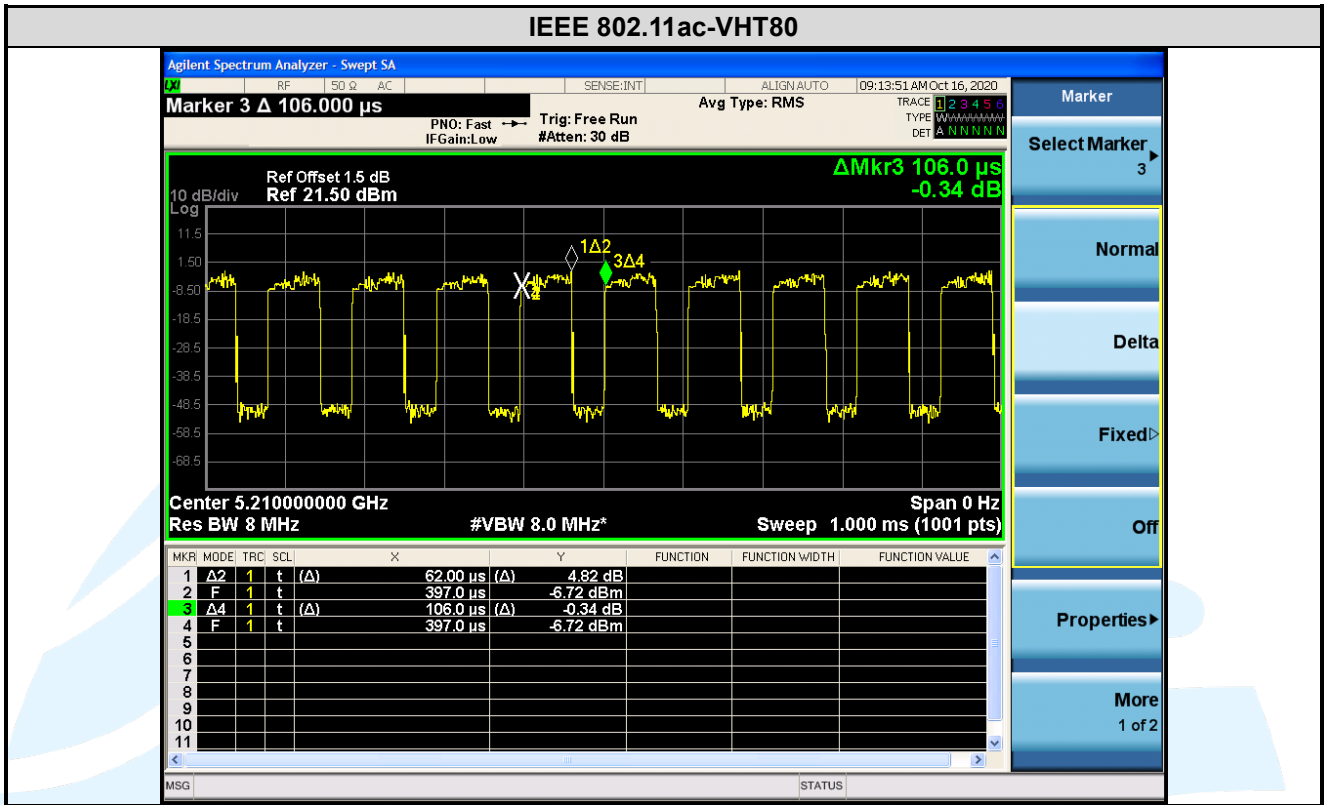
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## 5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

### 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

### 5.2 ANTENNA REQUIREMENT

Standard Requirement
<p><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.</p> <p><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 by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p> <p><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.</p> <p><b>EUT Antenna:</b> Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 3.0 dBi.</p>

### 5.326 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 %.

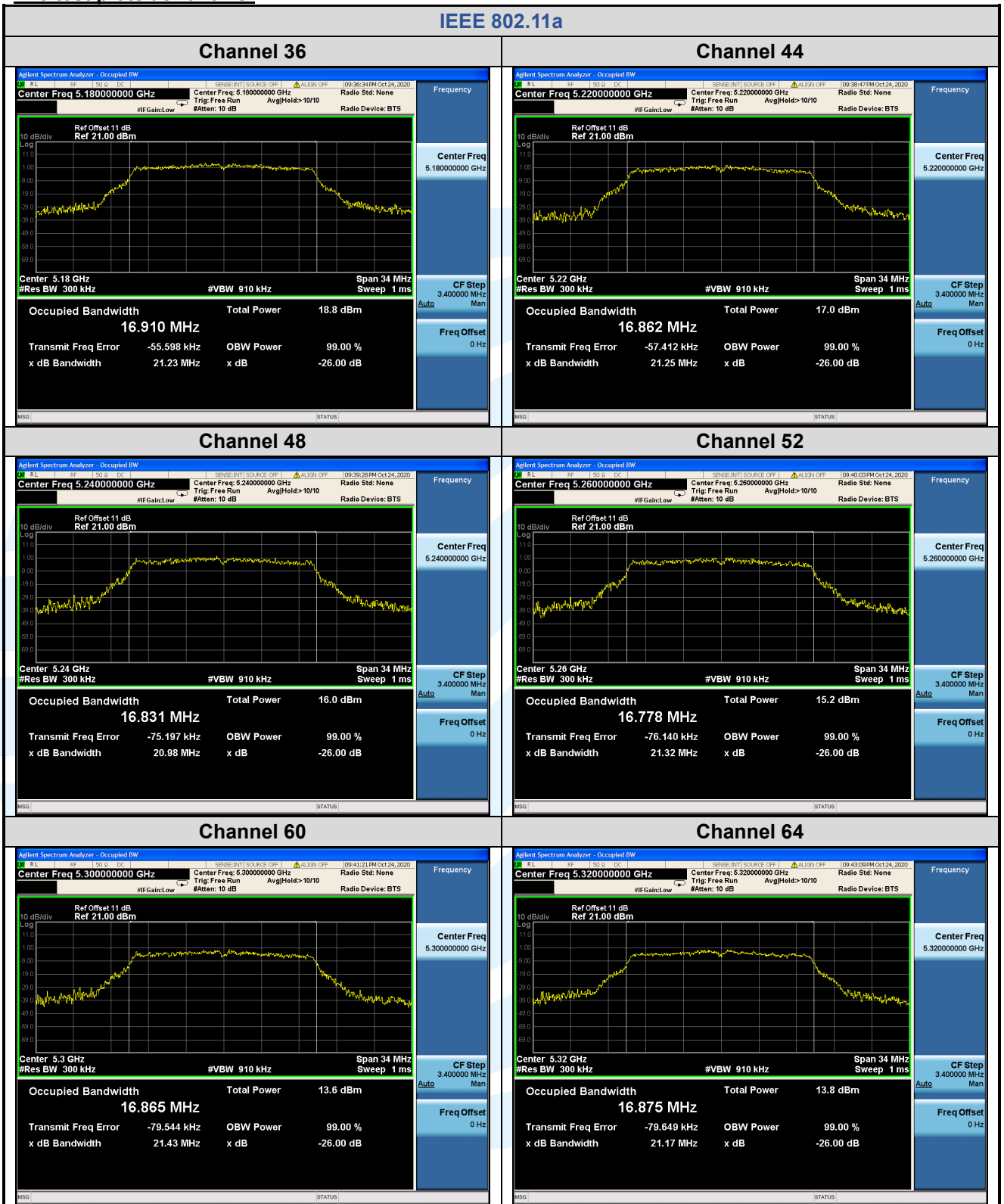
Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

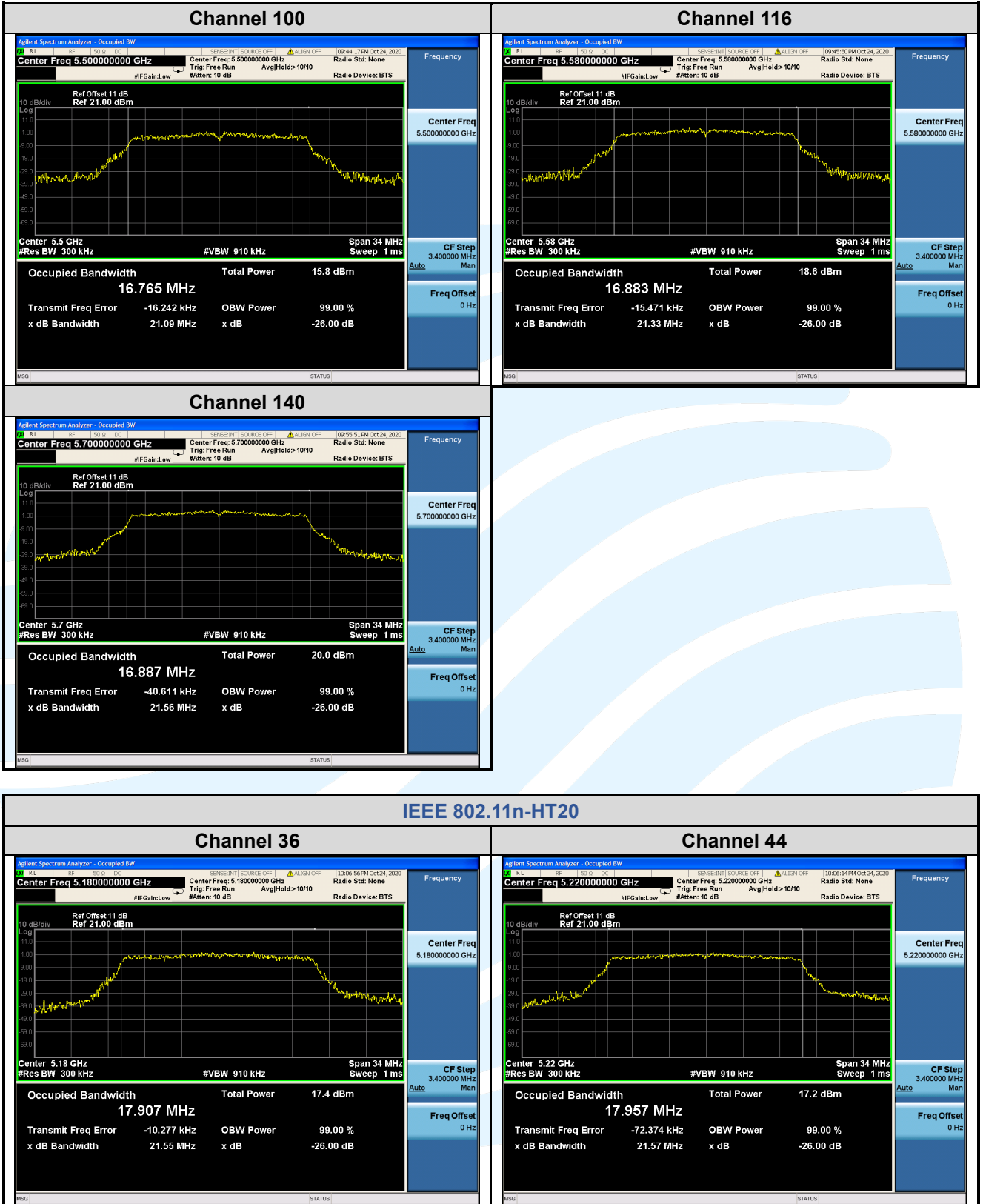
**Test Setup:** Refer to section 4.5.3 for details.  
**Instruments Used:** Refer to section 3 for details  
**Test Results:** Pass

Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
IEEE 802.11a	36 (5180)	21.23	16.910
	44 (5220)	21.25	16.862
	48 (5240)	20.98	16.831
	52 (5260)	21.32	16.778
	60 (5300)	21.43	16.865
	64 (5320)	21.17	16.875
	100 (5500)	21.09	16.765
	116 (5580)	21.33	16.883
	140 (5700)	21.56	16.887
IEEE 802.11n-HT20	36 (5180)	21.55	17.907
	44 (5220)	21.57	17.957
	48 (5240)	21.46	17.879
	52 (5260)	21.63	17.955
	60 (5300)	21.63	17.927
	64 (5320)	21.70	17.936
	100 (5500)	21.72	17.954
	116 (5580)	21.59	17.967
	140 (5700)	21.46	17.974
IEEE 802.11n-HT40	38 (5190)	39.81	36.219
	46 (5230)	39.84	36.211
	54 (5270)	39.64	36.180
	62 (5310)	43.78	36.276
	102 (5510)	39.64	36.316
	110 (5550)	40.45	36.275
	134 (5670)	39.96	36.243

Mode	Channel	26 dB Bandwidth (MHz)	99% Bandwidth (MHz)
IEEE 802.11ac-VHT20	36 (5180)	21.24	17.956
	44 (5220)	21.66	17.945
	48 (5240)	21.80	18.061
	52 (5260)	21.78	17.916
	60 (5300)	22.19	18.081
	64 (5320)	21.80	17.928
	100 (5500)	21.65	17.919
	116 (5580)	21.51	17.997
	140 (5700)	21.66	17.932
IEEE 802.11ac-VHT40	38 (5190)	39.99	36.320
	46 (5230)	39.80	36.224
	54 (5270)	39.82	36.294
	62 (5310)	40.23	36.288
	102 (5510)	40.18	36.266
	110 (5550)	39.96	36.247
	134 (5670)	39.60	36.163
IEEE 802.11ac-VHT80	42 (5210)	80.70	75.350
	58 (5290)	81.03	75.370
	106 (5530)	81.02	75.302

The test plots as follows:





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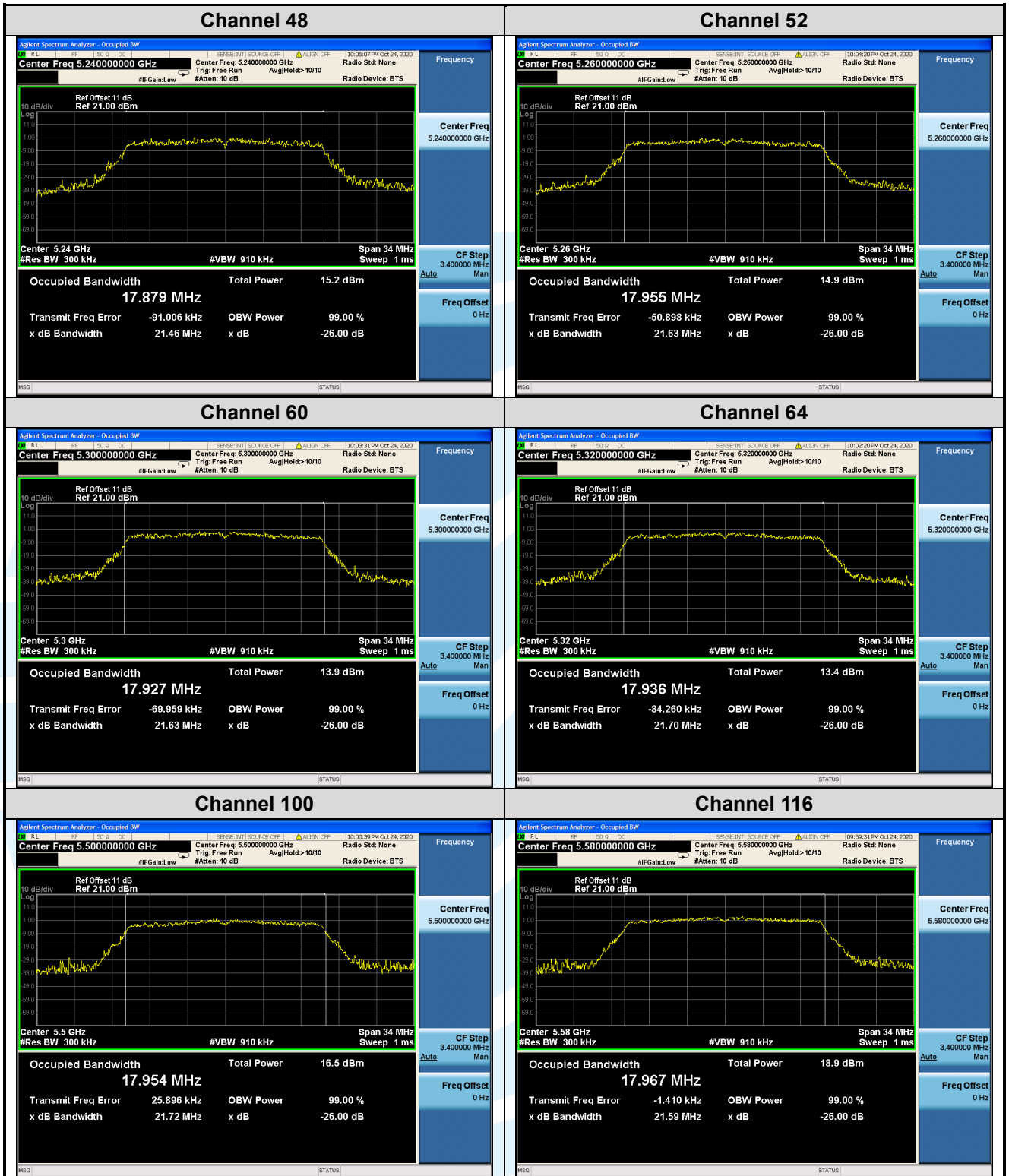
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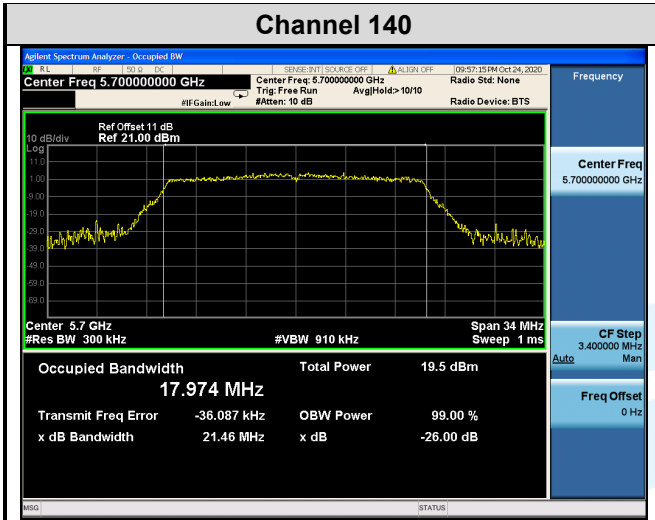
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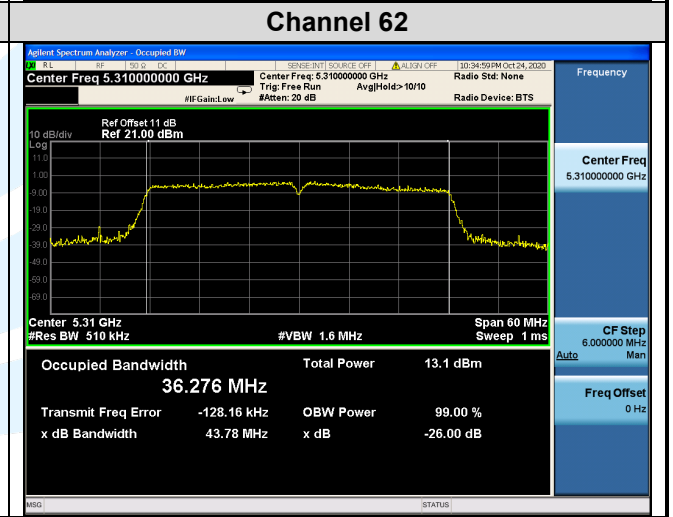
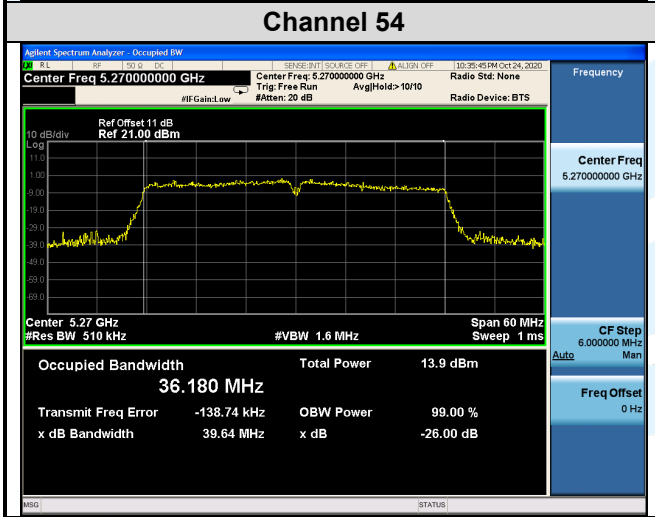
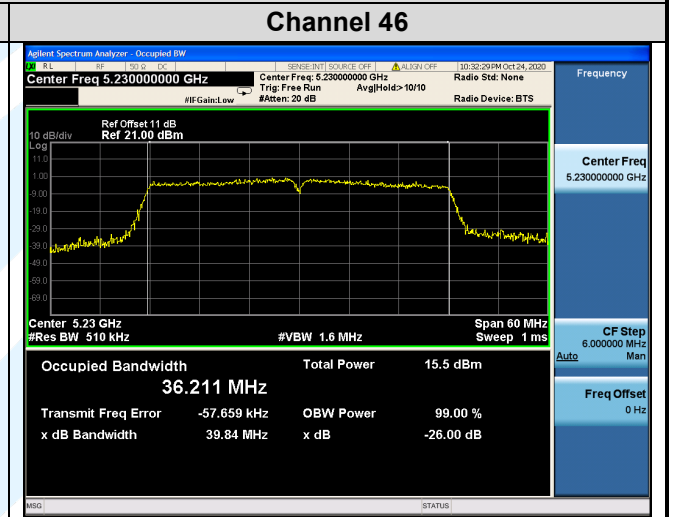
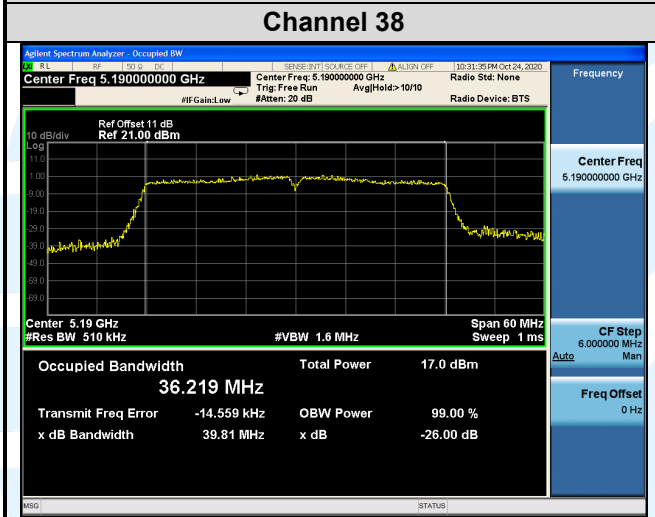
E-mail: info@uttlab.com

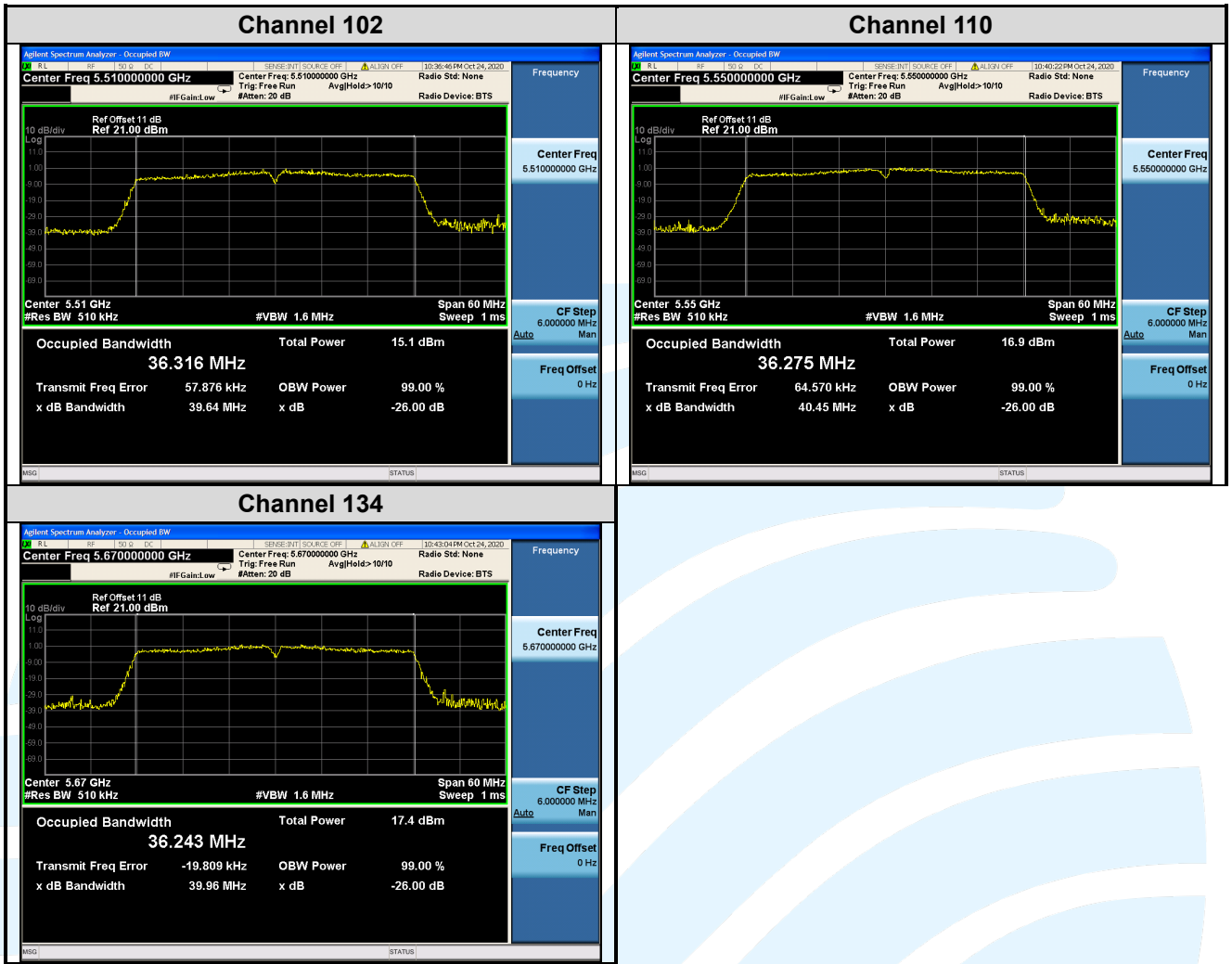
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## IEEE 802.11n-HT40





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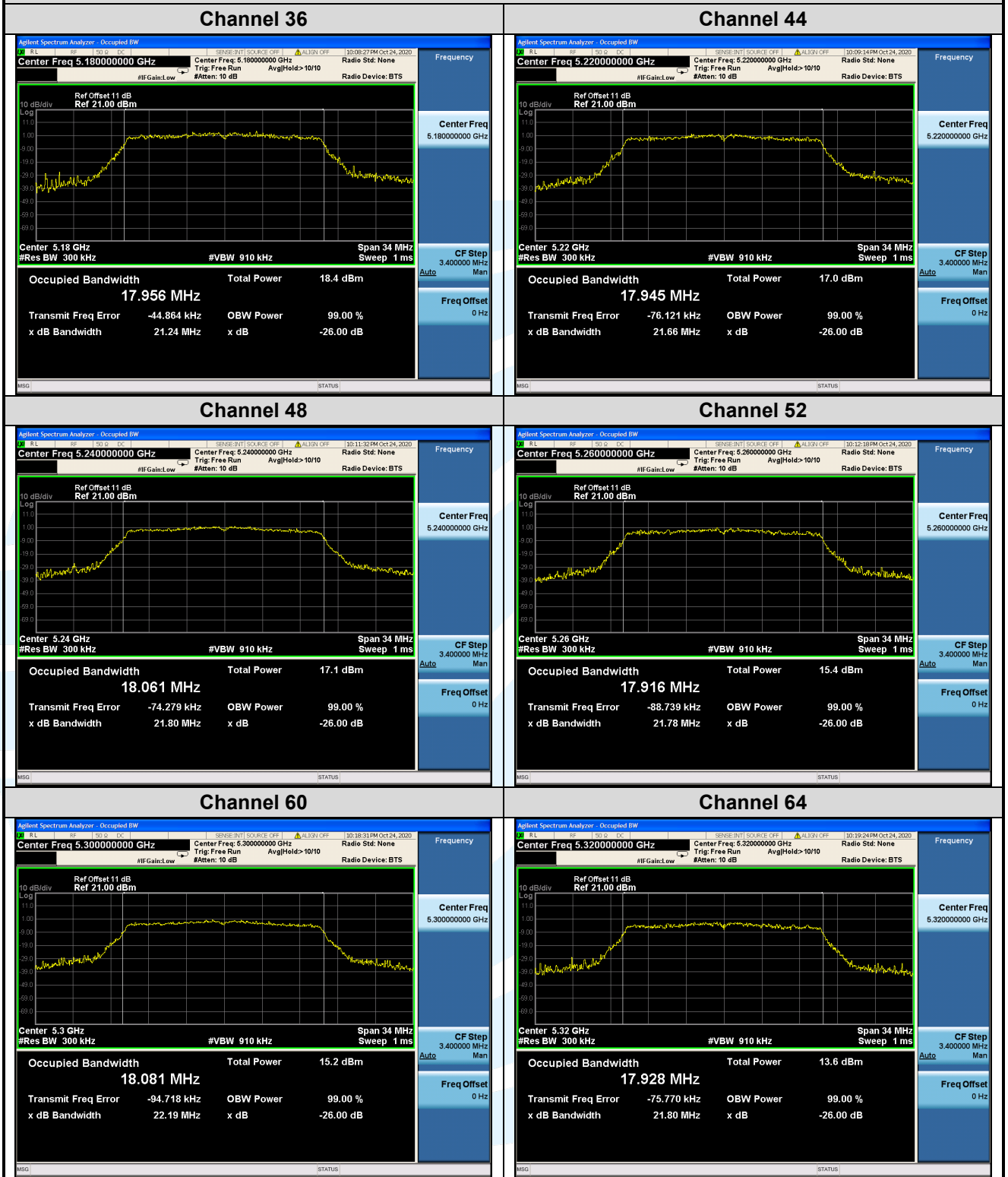
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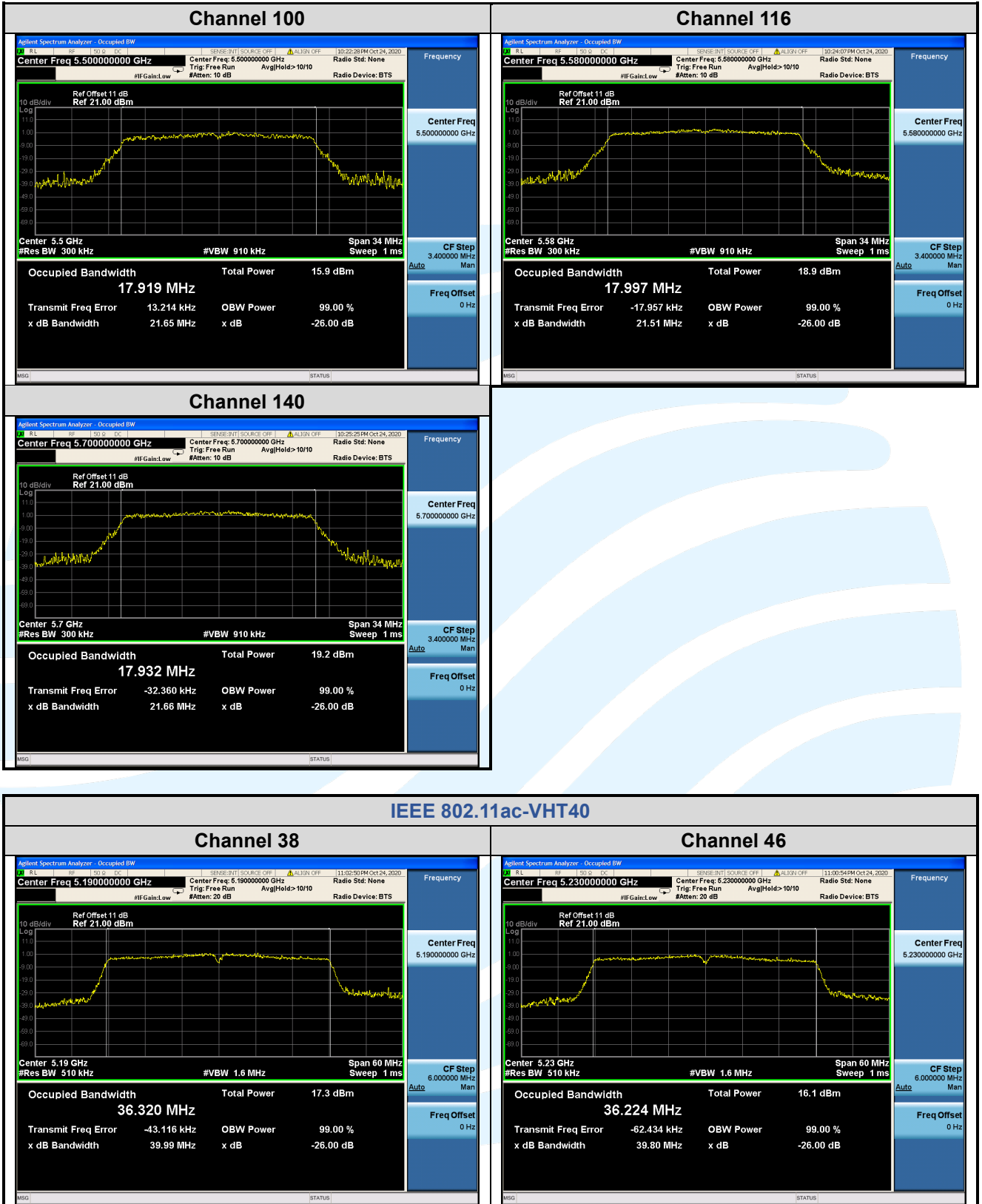
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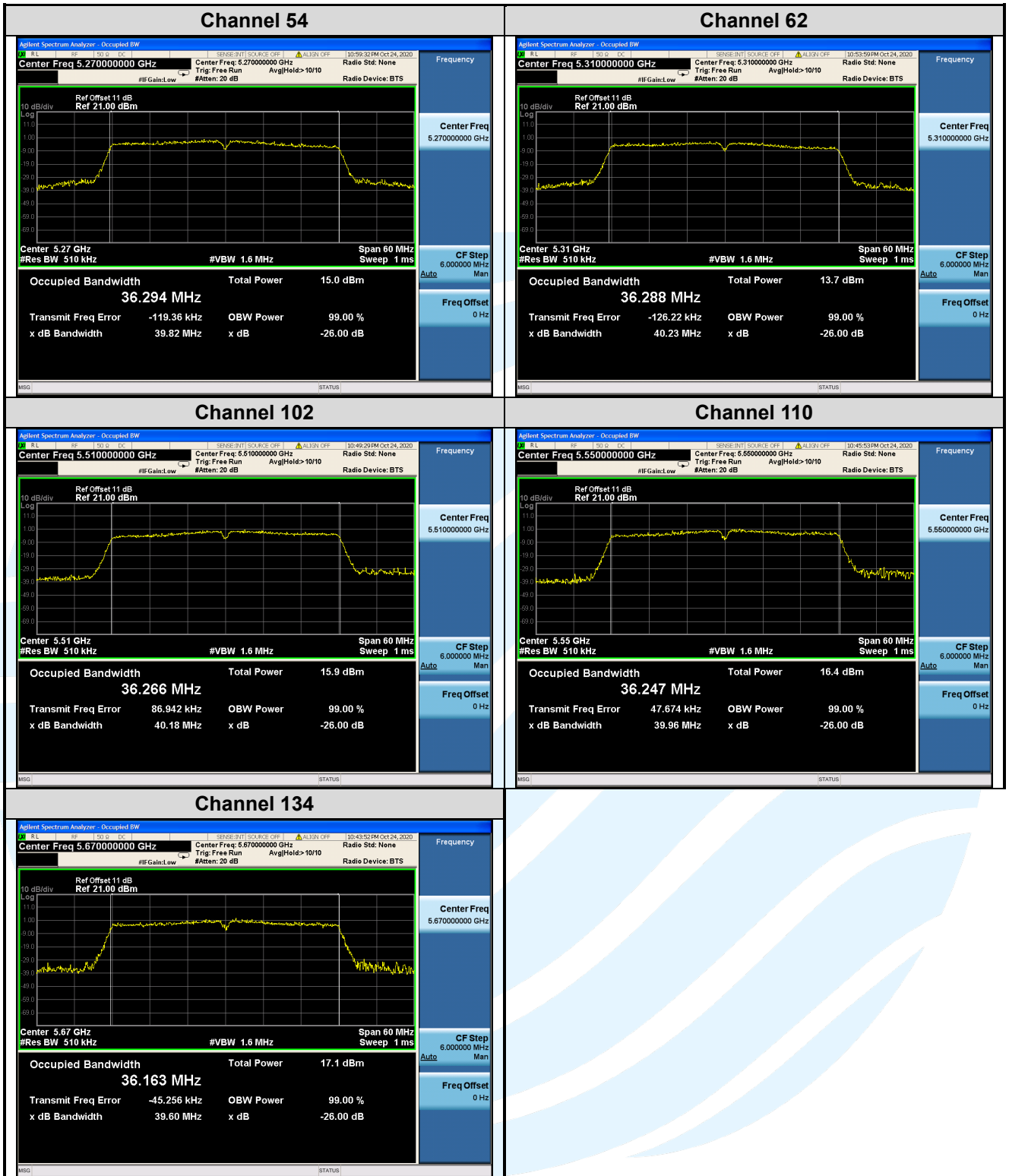
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IEEE 802.11ac-VHT20







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### 5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 15 Subpart E Section 15.407 (e)  
 RSS-247 Issue 2 Section 6.2.4.1

**Test Method:** KDB 789033 D02 v02r01 Section C.2

**Limit:** Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

**Test Procedure:**

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

Spectrum analyzer according to the following Settings:

- 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
IEEE 802.11a	149 (5745)	16.31	17.030	> 500 kHz	Pass
	157 (5785)	16.34	16.988	> 500 kHz	Pass
	165 (5825)	16.34	16.960	> 500 kHz	Pass
IEEE 802.11n-HT20	149 (5745)	17.55	18.026	> 500 kHz	Pass
	157 (5785)	17.56	18.002	> 500 kHz	Pass
	165 (5825)	17.26	17.939	> 500 kHz	Pass
IEEE 802.11n-HT40	151 (5755)	36.34	36.321	> 500 kHz	Pass
	159 (5795)	35.71	36.273	> 500 kHz	Pass
IEEE 802.11ac-VHT20	149 (5745)	17.55	18.018	> 500 kHz	Pass
	157 (5785)	17.27	18.008	> 500 kHz	Pass
	165 (5825)	17.28	17.990	> 500 kHz	Pass
IEEE 802.11ac-VHT40	151 (5755)	36.26	36.267	> 500 kHz	Pass
	159 (5795)	36.33	36.354	> 500 kHz	Pass
IEEE 802.11ac-VHT80	155 (5775)	76.13	76.081	> 500 kHz	Pass



The test plots as follows:  
6 dB Bandwidth

