Certificate #4312.01

TEST REPORT

Product Name:	High-Performance Outdoor AX6000 Wi-Fi 6 Access Point
Trade Mark:	GRANDSTREAM
Model No.:	GWN7664ELR
Report Number:	24031510115RFC-2
Test Standards:	FCC 47 CFR Part 15 Subpart E
FCC ID:	YZZGWN7664ELR
Test Result:	PASS
Date of Issue:	June 28, 2024

Prepared for:

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

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
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Prepared by:	David Chen Senior Project Engineer	Reviewed by:	Kevin Liang Assistant Manager
Approved by:	Robben Chen Assistant Manager	Date:	June 28, 2024

Version

Version No.	Date	Description
V1.0	June 28, 2024	Original

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

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

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	High-Performance Outdoor AX6000 Wi-Fi 6 Access Point		
Model No.:	GWN7664ELR		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n/ax	
	U-NII 5 GHz Bands:	5 150 MHz to 5 250 MHz	IEEE 802.11a/n/ac/ax
		5 250 MHz to 5 350 MHz	IEEE 802.11a/n/ac/ax
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac/ax
		5 725 MHz to 5 850 MHz	IEEE 802.11a/n/ac/ax
Software Version:	0.3.12.1(Provided by the customer)		
Hardware Version:	V1.1 (Provided by the customer)		
Sample Received Date:	March 14, 2024		
Sample Tested Date:	March 14, 2024 to May 31, 2024		

1.2.2 Description of Accessories

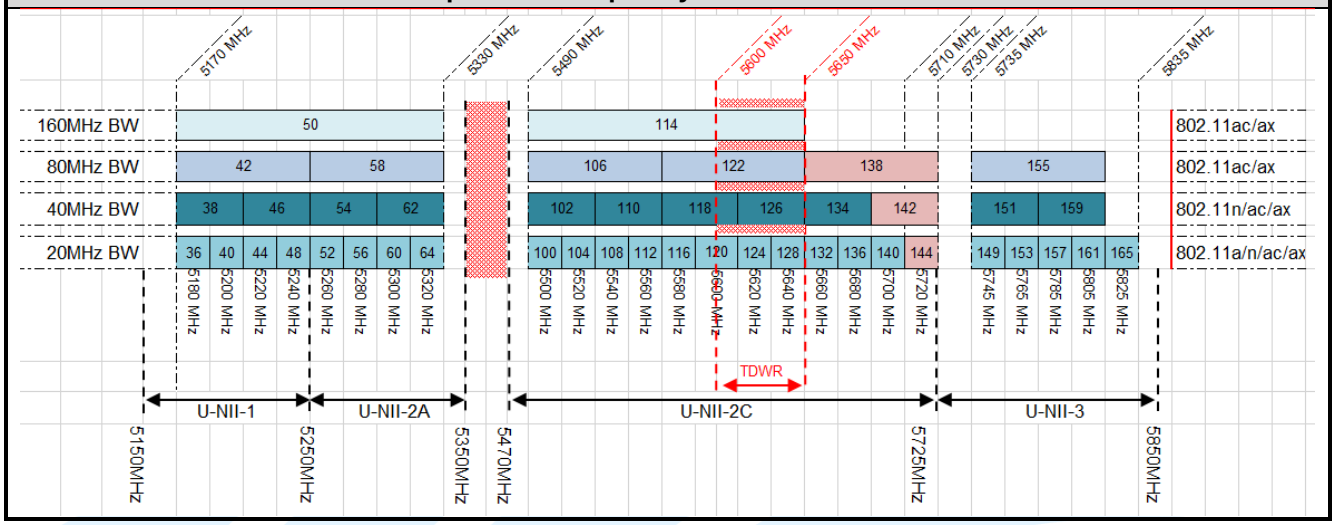
Others
1x Mounting Bracket, 1x Base Bracket

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 5720 MHz				
	5745 MHz to 5825 MHz				
Support Standards:	IEEE 802.11a/n/ac/ax				
TPC Function:	Support				
DFS Operational mode:	Master				
Type of Modulation:	IEEE 802.11a/n: OFDM(64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ac: OFDM (256QAM, 64QAM, 16QAM, QPSK, BPSK)				
	IEEE 802.11ax: OFDM /OFDMA Note 1 (1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK)				
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20: 20 MHz				
	IEEE 802.11n-HT40/ac-VHT40/ax-HE40: 40 MHz				
	IEEE 802.11ac-VHT80/ax-HE80: 80 MHz				
	IEEE 802.11ac-VHT160/ax-HE160: 160 MHz				
Data Rate:	IEEE 802.11a: Up to 54 Mbps				
	IEEE 802.11n: Up to MCS31				
	IEEE 802.11ac-VHT20: Up to MCS8				
	IEEE 802.11ac-VHT40/VHT80/VHT160: Up to MCS9				
	IEEE 802.11ax-HE20/HE40/HE80/HE160: Up to MCS11				
Number of Channels:	5150 MHz to 5350 MHz: 8 for 802.11a/n-HT20/ac-VHT20/ax-HE20 4 for 802.11n-HT40)/ac-VHT40/ax-HE40 2 for 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
	5470 MHz to 5725 MHz: 12 for 802.11a/n-HT20/ac-VHT20/ax-HE20 6 for 802.11n-HT40)/ac-VHT40/ax-HE40 3 for 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
	5725 MHz to 5850 MHz: 8 for IEEE 802.11a/n-HT20/ac-VHT20/ax-HE20 4 for IEEE 802.11n-HT40/ac-VHT40/ax-HE40 2 for IEEE 802.11ac-VHT80/ax-HE80 1 for 802.11ac-VHT160/ax-HE160				
Antenna Type: (Provided by the customer)	Antenna 0	PCB Antenna			
	Antenna 1	PCB Antenna			
	Antenna 2	PCB Antenna			
	Antenna 3	PCB Antenna			
Antenna Gain (dBi): (Provided by the customer)	**Antenna**	**NII-1**	**NII-2A**	**NII-2C**	**NII-3**
	Antenna 0	6.79	6.79	6.79	6.79
	Antenna 1	6.98	6.98	6.98	6.98
	Antenna 2	7.09	7.09	7.09	7.09
	Antenna 3	7.01	7.01	7.01	7.01
Normal Test Voltage:	48 Vdc				
Note 1: For IEEE 802.11ax, the customer declaration the product supports only the SU mode.					

1.4 OTHER INFORMATION

Operation Frequency Each of 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
POE	CISCO	MA-INJ-4	QS-6593-01N A02	UnionTrust
Key-Press Attenuator	Huaxin	KT2.5-90/1S-2S	UTTL-EN023	UnionTrust
4 Way Divider	WOKEN	0120A040560002D	UTTL-EN028	UnionTrust
Wireless Router	SAGEMCOM	RAC2V1S	253703944	UnionTrust
Notebook	DELL	Latitude 3400	16238087894	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust
Enterprise Full Touch Handheld Computer	Bluebird Inc.	EF551	S2022120907-ZJC12/12	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length(Meter)	Supplied by
1	Ethernet Cable*2	RJ45	1.5 Unshielded without ferrite	UnionTrust
2	Antenna Cable*4	SMA	0.3	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

Tests were sub-contracted. (Radiated Emissions and Band Edge Measurement)
Dongguan DN Testing Co., Ltd.

Address: No. 1, West 4th Street, Xingfa South Road, Wusha Community, Chang'an Town, Dongguan, People's Republic of China
Telephone: +86-769-88087383
Email: joise.yang@dn-testing.com

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 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 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

Dongguan DN Testing Co., Ltd.

A2LA-Lab Certificate No.: 7050.01

CAB identifier: CN0149

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	± 0.68 dB
10	Occupied Bandwidth	± 1.86 %
11	Radio Frequency	5.6 GHz: ± 6.4 x 10^{-8}
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)	N/A	PASS
26 dB emission bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)	KDB 789033 D02 v02r01 Section C.1	PASS
6 dB bandwidth	FCC 47 CFR Part 15 Subpart E Section 15.407 (e)	KDB 789033 D02 v02r01 Section C.2	PASS
99% Occupied Bandwidth	N/A	KDB 789033 D02 v02r01 Section D	N/A Note 3
Maximum conducted output power	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
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(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
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h)	KDB 905462 D02 UNII DFS Compliance Procedures New Rules v02	PASS Note 2
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013, Section 6.2.	PASS

Note:

1) N/A: In this whole report not applicable.
2) Please refer to Report No.: 24031510115RFC-3 for DFS Test report.
3) No test requirement, for reporting purposes only.

Disclaimer and Explanations:

The declared of product specification and data (e.g., antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification.

3. EQUIPMENT LIST

Dongguan DN Testing Co., Ltd.

Test Equipment for Radiated Emission(30MHz-1000MHz)						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☒	Receiver	R&S	ESR7	102497	2023-10-24	2024-10-23
☒	Test Software	Tonscend	JS32-RE V5.0.0	NA	NA	NA
☒	RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	DNT-001	2023-10-24	2024-10-23
☒	Log periodic antenna	ETS-LINDGREN	VULB 9168	01475	2023-10-24	2024-10-23
☒	Pre-amplifier	Schwarzbeck	BBV9743B	00423	2023-10-24	2024-10-23

Test Equipment for Radiated Emission(Above 1000MHz)						
☒	Frequency analyser	Keysight	N9010A	MY52221458	2023-10-24	2024-10-23
☒	RF Cable	ETS-LINDGREN	RFC-NMS-100-NMS-350-IN	DNT-002	2023-10-24	2024-10-23
☒	Horn Antenna	ETS-LINDGREN	3117	00252567	2023-10-24	2024-10-23
☒	Double ridged waveguide antenna	ETS-LINDGREN	3116C	00251780	2023-10-24	2024-10-23
☒	Test Software	Tonscend	JS32-RE V5.0.0	NA	NA	NA
☒	Pre-amplifier	ETS-LINDGREN	3117-PA	252567	2023-10-24	2024-10-23
☒	Pre-amplifier	ETS-LINDGREN	3116C-PA	251780	2023-10-24	2024-10-23

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Conducted Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☑	Receiver	R&S	ESR7	101181	27-Oct-2023	26-Oct-2024
☑	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	27-Oct-2023	26-Oct-2024
☑	LISN	R&S	ESH2-Z5	860014/024	27-Oct-2023	26-Oct-2024
☐	LISN	ETS-Lindgren	3816/2SH	00201088	27-Oct-2023	26-Oct-2024
☑	Test Software	EZ-EMC	EZ-CON	Software Version: EMC-CON 3A1.1		

Conducted RF test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date**	**Cal. Due date**
☑	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	14-Apr-2023	13-Apr-2024
					29-Mar-2024	28-Mar-2025
☑	EXA Spectrum Analyzer	KEYSIGHT	N9020A	MY51286807	27-Oct-2023	26-Oct-2024
☑	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	27-Oct-2023	26-Oct-2024
☐	EXG-B RF Analog Signal Generator	KEYSIGHT	N5171B	MY53051777	27-Oct-2023	26-Oct-2024
☑	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	27-Oct-2023	26-Oct-2024

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 (V)	Relative Humidity (%)
NT/NV	+15 to +35	48	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temp. (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
AC Power Line Conducted Emission	22.0	55..2	100.5	S202403142878-ZJA01/6	Linson Xie
26 dB emission bandwidth	23.4	51.2	100.2	S202403142878-ZJA02/6	Rain Wang
Maximum conducted output power					
Peak Power Spectral Density					
99% Occupied Bandwidth					
6 dB bandwidth					
Dynamic Frequency Selection					
Radiated Emissions and Band Edge Measurement	25	60	100.5	S202403142878-ZJA01/6	Wayne Lin

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 IEEE 802.11ax-HE20	5150 - 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 - 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 - 5725 MHz	Channel 100	Channel 120	Channel 140/ Channel 144
		5500 MHz	5600 MHz	5700 MHz/ 5720MHz
	5725 - 5850 MHz	Channel 144/ Channel 149	Channel 157	Channel 165
		5720MHz/ 5745 MHz	5785 MHz	5825 MHz
IEEE 802.11n-HT40 IEEE 802.11ac-VHT40 IEEE 802.11ax-HE4 0	5150 - 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5250 - 5350 MHz	Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
	5470 - 5725 MHz	Channel 102	Channel 118	Channel 134/ Channel 142
		5510 MHz	5590 MHz	5670 MHz/ 5710MHz
	5725 - 5850 MHz	Channel 142/ Channel 151	--	Channel 159
		5710MHz/ 5755 MHz	--	5795 MHz
IEEE 802.11ac-VHT80 IEEE 802.11ax-HE80	5150 - 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 - 5350 MHz	--	Channel 58	--
		--	5290 MHz	--
	5470 - 5725 MHz	Channel 106	--	Channel 138
		5530 MHz	--	5610 MHz/ 5569 MHz
	5725 - 5850 MHz	Channel 138	Channel 155	--
		5610 MHz/	5775 MHz	--
IEEE 802.11ac-VHT160 IEEE 802.11ax-HE160	5150 - 5350 MHz	Channel 50		
		5250 MHz		
	5470 - 5725 MHz	Channel 114		
		5570 MHz		

4.3 EUT TEST STATUS

Mode	Tx/Rx Function	Description
IEEE 802.11a	1Tx/1Rx	1. Keep the EUT in continuously transmitting or receiving with modulation and data rates test single. 2. Keep the equipment in normal operation and achieve a certain throughput.
IEEE 802.11n IEEE 802.11ac IEEE 802.11ax	4Tx/4Rx	

Mode	Power Setting (Provided by the customer)															
	U-NII-1 Ant. 0~3				U-NII-2A Ant. 0~3				U-NII-2C Ant. 0~3				U-NII-3 Ant. 0~3			
IEEE 802.11a	12	12	12	11	14.5	13.5	13.5	13	17	18	18	18	21.5	21.5	21.5	21.5
IEEE 802.11n-HT20	4	4	4	4	4.5	4.5	4.5	4.5	3	3	3	3	14.5	14.5	14.5	14.5
IEEE 802.11n-HT40	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	14.5	14.5	14.5	14.5
IEEE 802.11ac-VHT20	4	4	4	4	4.5	4.5	4.5	4.5	3	3	3	3	14.5	14.5	14.5	14.5
IEEE 802.11ac-VHT40	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	14.5	14.5	14.5	14.5
IEEE 802.11ac-VHT80	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	15	15	15	15
IEEE 802.11ac-VHT160	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	-	-	-	-
IEEE 802.11ax-HE20 (SU)	4	4	4	4	4.5	4.5	4.5	4.5	3	3	3	3	14.5	14.5	14.5	14.5
IEEE 802.11ax-HE40 (SU)	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	14.5	14.5	14.5	14.5
IEEE 802.11ax-HE80 (SU)	4	4	4	4	4.5	4.5	4.5	4.5	7	7	7	7	15	15	15	15
IEEE 802.11ax-HE160 (SU)	4	4	4	4	4.5	4.5	4.5	4.5	9	9	9	9	-	-	-	-

Test Software (Provided by the customer)
Test software name: MT7986_000F QA 0.0.2.78

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	MCS24
IEEE 802.11n-HT40	MCS24
IEEE 802.11ac-VHT20	MCS0
IEEE 802.11ac-VHT40	MCS0
IEEE 802.11ac-VHT80	MCS0
IEEE 802.11ac-VHT160	MCS0
IEEE 802.11ax-HE20	MCS0
IEEE 802.11ax-HE40	MCS0
IEEE 802.11ax-HE80	MCS0
IEEE 802.11ax-HE160	MCS0

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

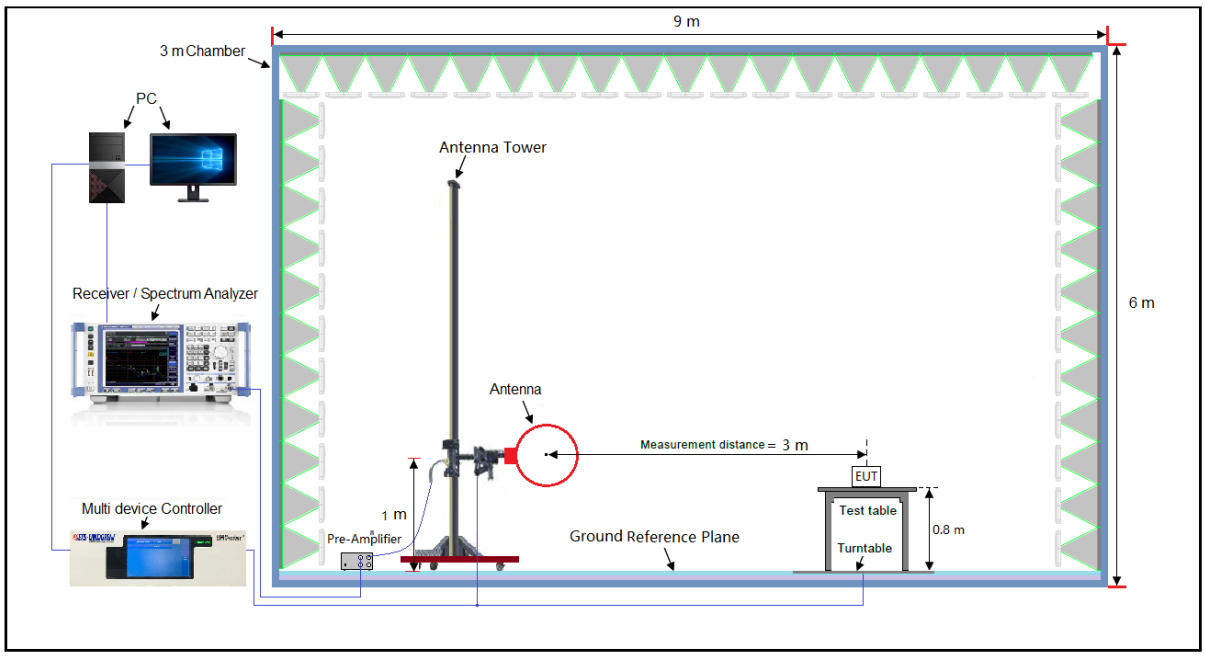


Figure 2. 30MHz to 1GHz

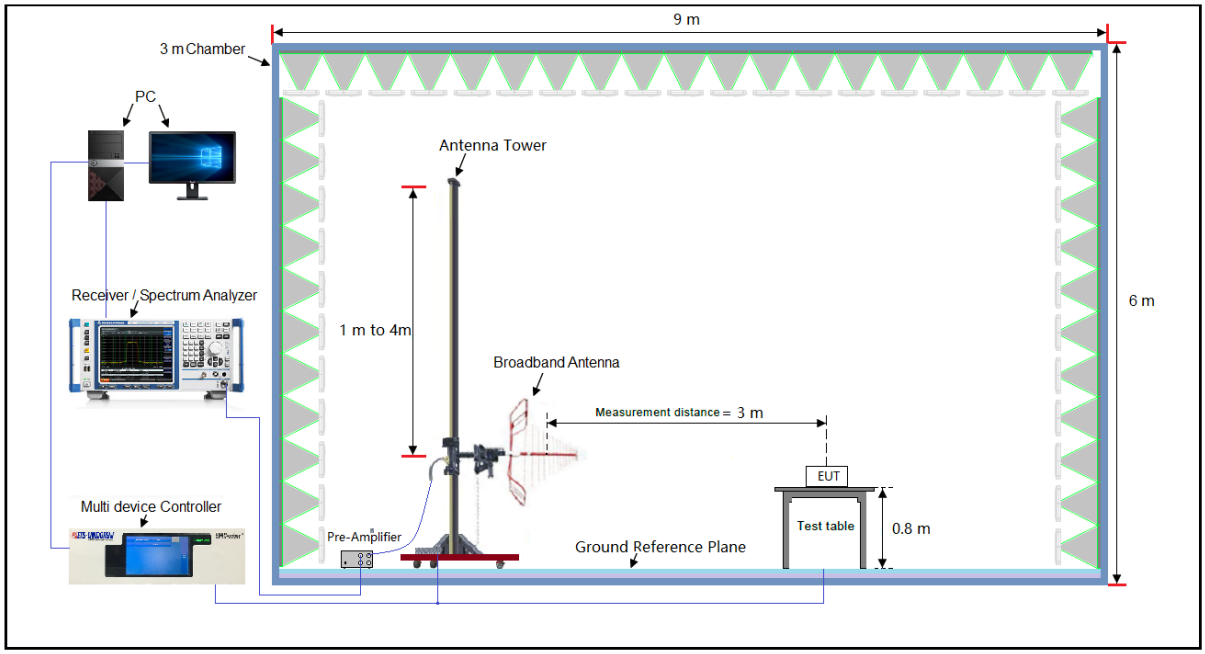
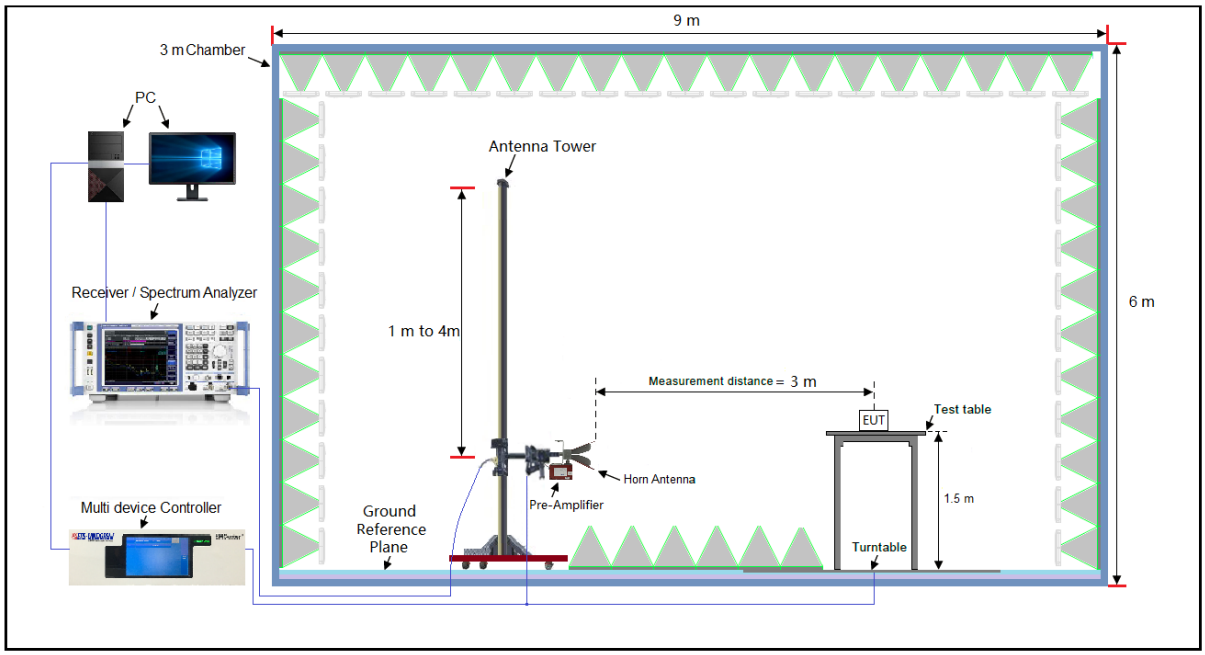
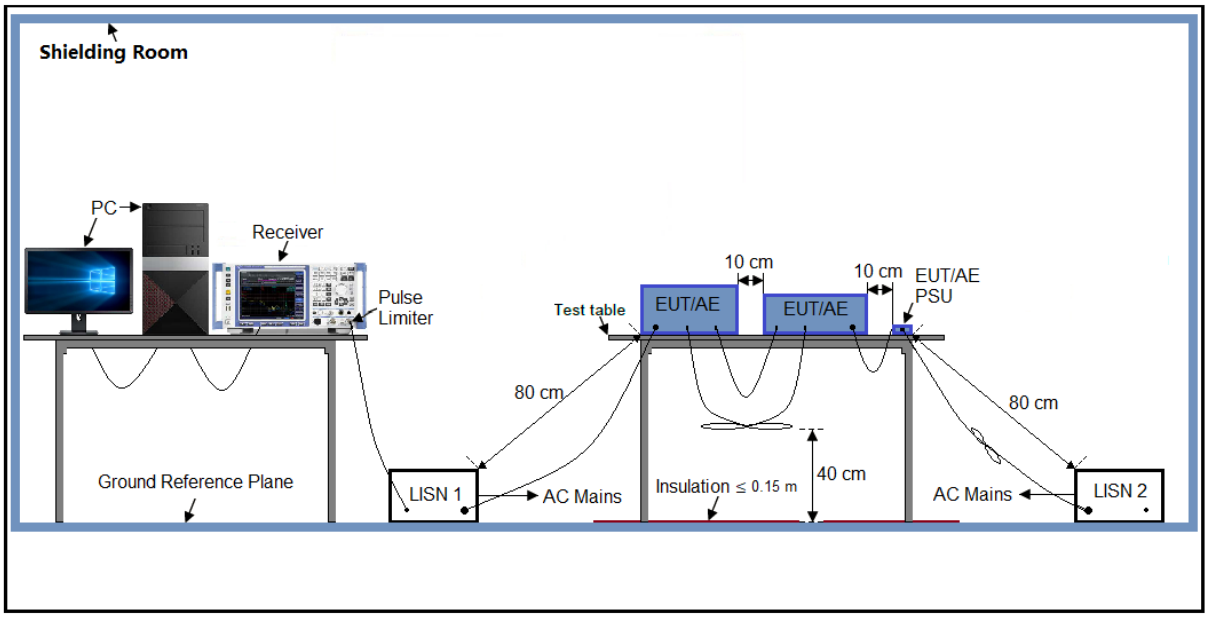


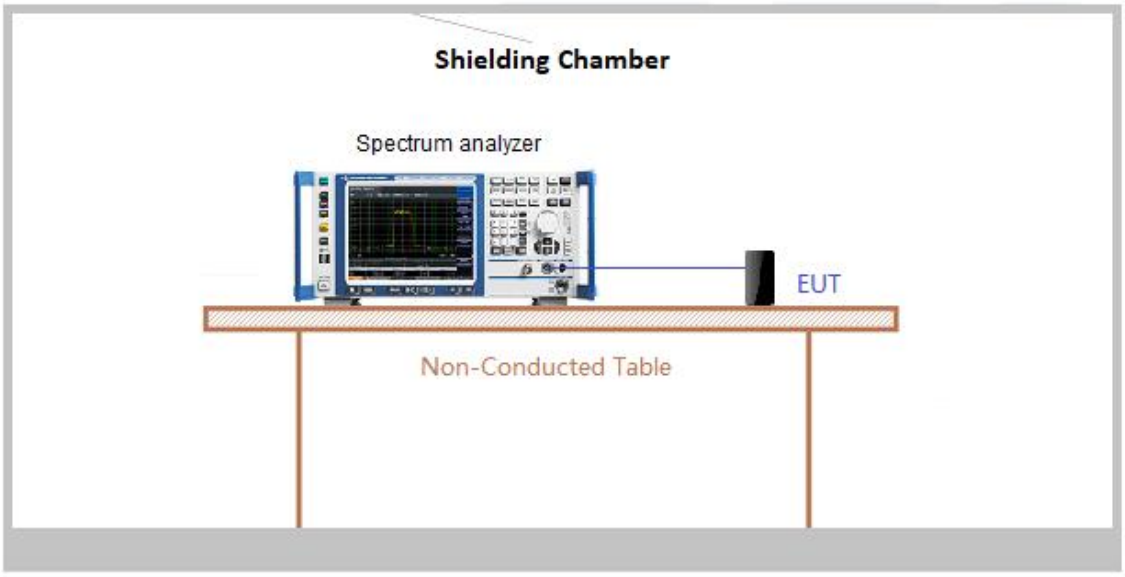
Figure 3. Above 1GHz



4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



Normal Environment

4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. 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 orientation.

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.

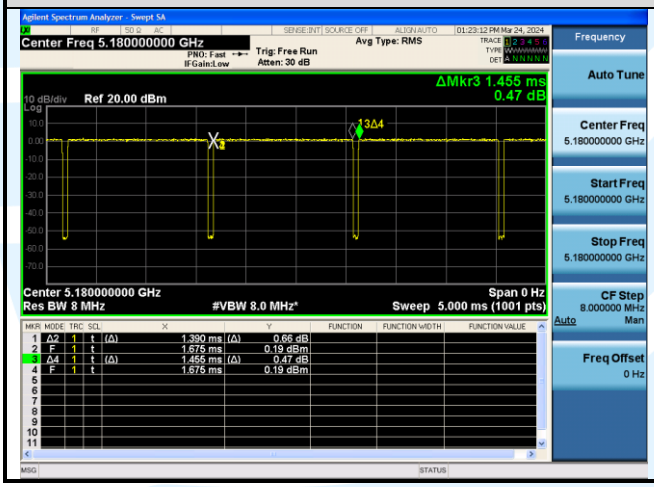
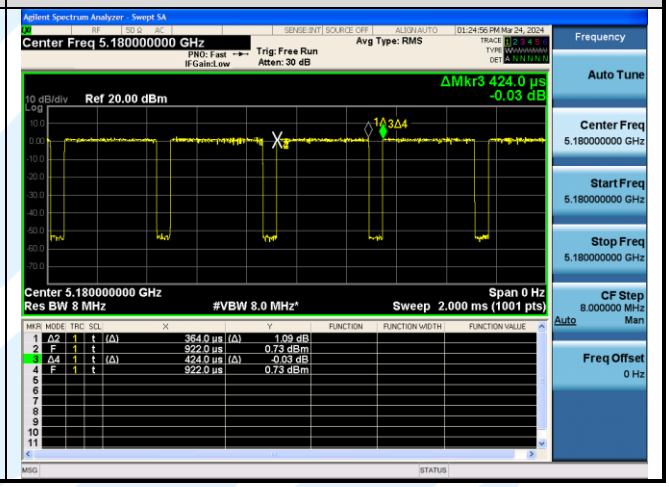
Test Results

Mode	RU	Data Rates	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/T Minimum VBW (kHz)
IEEE 802.11a	N/A	6 Mbps	1.390	1.455	0.96	95.53	0.20	0.72
IEEE 802.11n-HT20	N/A	MCS 24	0.364	0.424	0.86	85.85	0.66	2.75
IEEE 802.11n-HT40	N/A	MCS 24	0.202	0.262	0.77	77.10	1.13	4.95
IEEE 802.11ac-VHT20	N/A	MCS 0	0.368	0.428	0.86	85.98	0.66	2.72
IEEE 802.11ac-VHT40	N/A	MCS 0	0.206	0.265	0.78	77.74	1.09	4.85
IEEE 802.11ac-VHT80	N/A	MCS 0	0.122	0.180	0.68	67.78	1.69	8.20
IEEE 802.11ac-VHT160	N/A	MCS 0	0.087	0.144	0.60	60.42	2.19	11.49
IEEE 802.11ax-HE20	SU	MCS 0	0.344	0.404	0.85	85.15	0.70	2.91
IEEE 802.11ax-HE40	SU	MCS 0	0.344	0.404	0.85	85.15	0.70	2.91
IEEE 802.11ax-HE80	SU	MCS 0	0.336	0.396	0.85	84.85	0.71	2.98
IEEE 802.11ax-HE160	SU	MCS 0	0.332	0.390	0.85	85.13	0.70	3.01

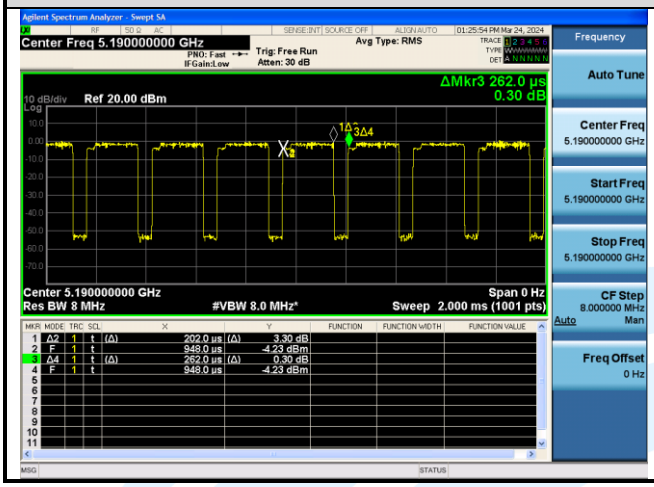
Remark:

1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle)

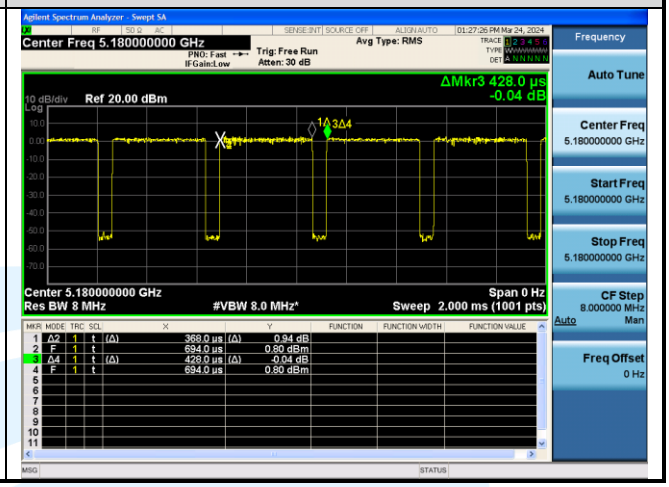
The test plots as follows

IEEE 802.11a	IEEE 802.11n-HT20
	

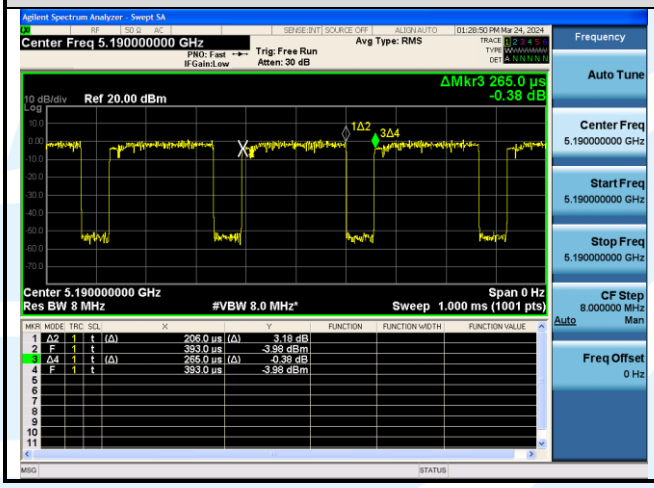
IEEE 802.11n-HT40



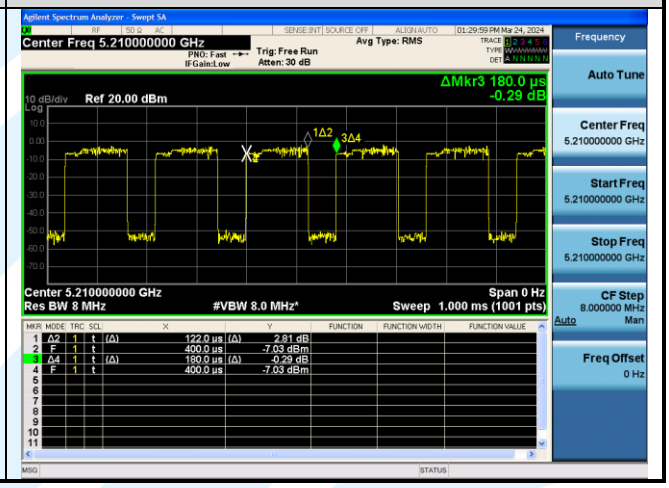
IEEE 802.11ac-VHT20



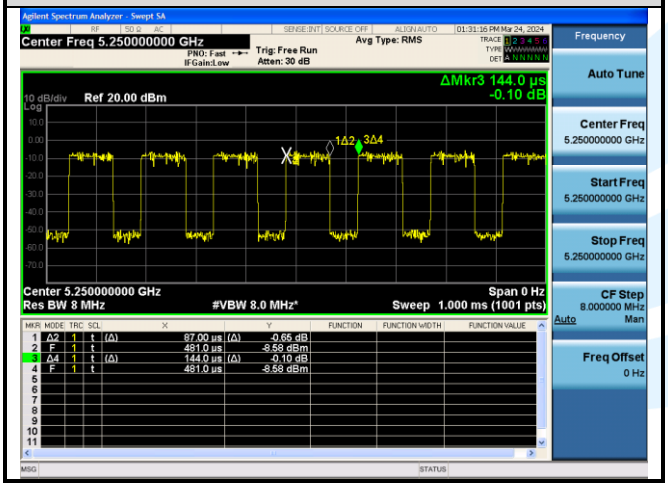
IEEE 802.11ac-VHT40

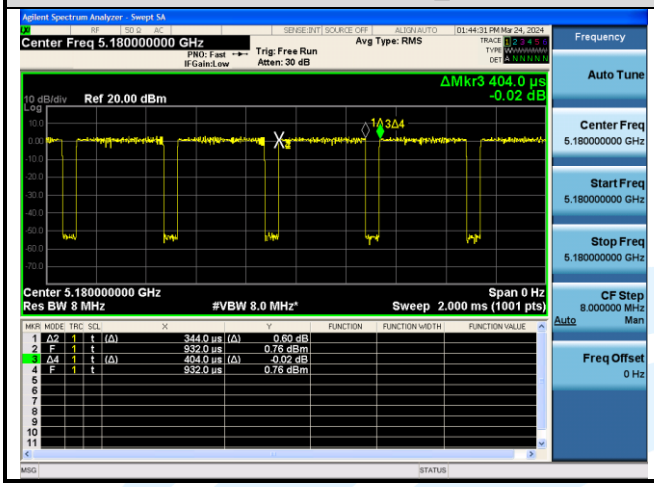
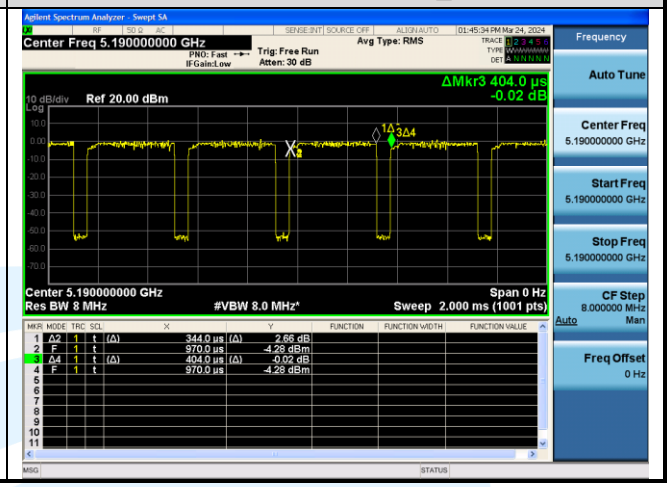


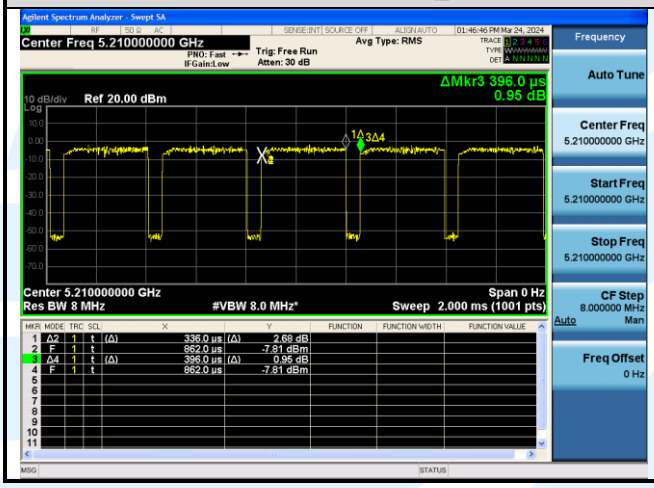
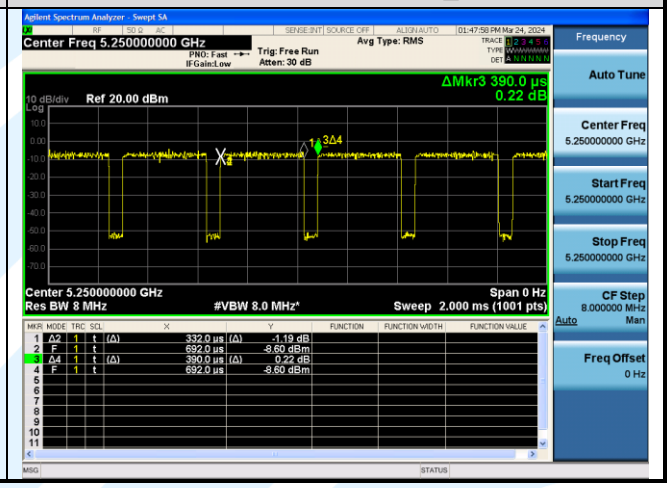
IEEE 802.11ac-VHT80



IEEE 802.11ac-VHT160



IEEE 802.11ax-HE20_SU	IEEE 802.11ax-HE40_SU
	

IEEE 802.11ax-HE80_SU	IEEE 802.11ax-HE160_SU
	

5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
4	KDB 789033 D02 General UNII Test Procedures New Rules 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 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. **15.407(a)(1) (2) requirement:** The conducted output power limit specified in paragraph (a) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (a) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power and the peak power spectral density shall be reduced by the by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
EUT Antenna:
All antennas (4 Antennas) in the interior of the equipment and no consideration of replacement. The transmit signals are correlated with each other, the best case directional gain of the antenna is 12.99 dBi. (See section 5.5).

5.3 26 DB BANDWIDTH & 99% OCCUPIED 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.

26 dB Bandwidth

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 %.

Occupied Bandwidth

a) Set center frequency to the nominal EUT channel center frequency.
b) Set span = 1.5 times to 5.0 times the OBW.
c) Set RBW = 1% to 5% of the OBW
d) Set VBW ≥ 3 x RBW
e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
f) Use the 99% power bandwidth function of the instrument (if available).
g) If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

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

Test Results: **Please refer to Appendix A**

5.46 DB BANDWIDTH & 99% OCCUPIED 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.

6dB Bandwidth

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.

Occupied Bandwidth

h) Set center frequency to the nominal EUT channel center frequency.
i) Set span = 1.5 times to 5.0 times the OBW.
j) Set RBW = 1% to 5% of the OBW
k) Set VBW ≥ 3 x RBW
l) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
m) Use the 99% power bandwidth function of the instrument (if available).
n) If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

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 Results: **Please refer to Appendix A**

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 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.

4. For an indoor access point operating in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. Indoor access points operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

Test Procedure:

1. Connected the EUT's antenna port to measure device by 10dB attenuator.
2. Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of Tx on burst.

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

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Directional gain and the maximum output power limit.

Frequency (MHz)	Antenna Gain (dBi)				Directional gain (dBi)		FCC Limit	
	Ant .0	Ant .1	Ant .2	Ant .3	Power	PSD	Power (dBm)	PSD (dBm/MHz or dBm/500kHz)
U-NII-1	6.79	6.98	7.09	7.01	12.99	12.99	23.01	10.01
U-NII-2A	6.79	6.98	7.09	7.01	12.99	12.99	17.01	4.01
U-NII-2C	6.79	6.98	7.09	7.01	12.99	12.99	17.01	4.01
U-NII-3	6.79	6.98	7.09	7.01	12.99	12.99	23.01	23.01
Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows: If transmit signals are correlated, then Directional gain = 10*log[(10^G1/20 + 10^G2/20 + … + 10^GN /20)^2 /NANT]dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]								

For U-NII-2A:

IEEE 802.11a/n/ac/ax: the minimum 26 dB emission bandwidth is 20.07*MHz*

11 dBm + $10\log_{10}$ (20.07) = 24.03 dBm

24.03 dBm > 17.01

So the 17.01 dBm limit applicable

For U-NII-2C Band:

IEEE 802.11a: the minimum 26 dB emission bandwidth is 19.84 MHz

11 dBm + 10log10 (19.84) = 23.98 dBm

23.98 dBm > 17.01 dBm

So the 17.01 dBm limit applicable

Maximum output power(TPC Highest Power)

Mode	Band	Freq. (MHz)	CONDUCTED AVG POWER										
			Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
			Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
IEEE 802.11a	U-NII-1	5180	13.18	13.35	13.06	13.20	13.38	13.55	13.26	13.40	N/A	28.91	Pass
		5220	13.33	13.77	13.48	13.60	13.53	13.97	13.68	13.80	N/A	28.91	Pass
		5240	13.24	13.55	13.30	13.52	13.44	13.75	13.50	13.72	N/A	28.91	Pass
	U-NII-2A	5260	15.43	15.26	15.22	15.66	15.63	15.46	15.42	15.86	N/A	22.91	Pass
		5300	14.88	14.62	14.73	15.22	15.08	14.82	14.93	15.42	N/A	22.91	Pass
		5320	14.75	14.39	14.64	15.12	14.95	14.59	14.84	15.32	N/A	22.91	Pass
	U-NII-2C	5500	18.44	18.42	17.38	19.19	18.64	18.62	17.58	19.39	N/A	22.91	Pass
		5580	18.95	18.59	18.23	19.35	19.15	18.79	18.43	19.55	N/A	22.91	Pass
		5700	17.66	17.10	17.89	16.30	17.86	17.30	18.09	16.50	N/A	22.91	Pass
		5720	18.71	18.23	19.34	18.03	18.91	18.43	19.54	18.23	N/A	22.91	Pass
	U-NII-3	5745	21.50	20.41	21.48	20.05	21.70	20.61	21.68	20.25	N/A	28.91	Pass
		5785	21.77	20.88	21.36	20.45	21.97	21.08	21.56	20.65	N/A	28.91	Pass
		5825	22.05	20.81	20.68	20.62	22.25	21.01	20.88	20.82	N/A	28.91	Pass
IEEE 802.11n-HT20	U-NII-1	5180	2.35	0.53	3.79	3.11	3.01	1.19	4.45	3.77	9.29	23.01	Pass
		5220	2.49	0.30	3.43	3.00	3.15	0.96	4.09	3.66	9.14	23.01	Pass
		5240	2.44	0.33	3.35	2.92	3.10	0.99	4.01	3.58	9.09	23.01	Pass
	U-NII-2A	5260	2.66	0.35	4.21	3.26	3.32	1.01	4.87	3.92	9.52	17.01	Pass
		5300	2.08	-0.41	3.27	2.57	2.74	0.25	3.93	3.23	8.76	17.01	Pass
		5320	2.02	-0.44	2.89	2.61	2.68	0.22	3.55	3.27	8.63	17.01	Pass
	U-NII-2C	5500	5.45	5.67	5.61	7.65	6.11	6.33	6.27	8.31	12.88	17.01	Pass
		5580	6.10	6.32	5.70	8.21	6.76	6.98	6.36	8.87	13.38	17.01	Pass
		5700	5.00	5.63	6.78	6.26	5.66	6.29	7.44	6.92	12.65	17.01	Pass
		5720	5.15	5.93	7.26	6.32	5.81	6.59	7.92	6.98	12.92	17.01	Pass
	U-NII-3	5745	14.68	15.13	16.93	14.72	15.34	15.79	17.59	15.38	22.15	23.01	Pass
		5785	14.86	15.75	16.76	15.12	15.52	16.41	17.42	15.78	22.37	23.01	Pass
		5825	15.02	15.71	15.82	15.03	15.68	16.37	16.48	15.69	22.09	23.01	Pass
IEEE 802.11n-HT40	U-NII-1	5190	2.52	0.20	3.78	2.84	3.65	1.33	4.91	3.97	9.67	23.01	Pass
		5230	2.65	0.50	3.58	3.36	3.78	1.63	4.71	4.49	9.83	23.01	Pass
	U-NII-2A	5270	2.04	0.26	3.58	3.05	3.17	1.39	4.71	4.18	9.56	17.01	Pass
		5310	1.94	-0.55	2.76	2.56	3.07	0.58	3.89	3.69	9.01	17.01	Pass
	U-NII-2C	5510	8.73	8.08	8.03	9.73	9.86	9.21	9.16	10.86	15.85	17.01	Pass
		5550	8.68	7.79	8.05	10.08	9.81	8.92	9.18	11.21	15.89	17.01	Pass
		5670	8.54	7.95	8.32	8.39	9.67	9.08	9.45	9.52	15.46	17.01	Pass
		5710	8.49	8.33	9.56	8.46	9.62	9.46	10.69	9.59	15.89	17.01	Pass
	U-NII-3	5755	14.16	14.86	16.57	14.23	15.29	15.99	17.70	15.36	22.22	23.01	Pass
		5795	14.35	15.35	16.30	14.60	15.48	16.48	17.43	15.73	22.37	23.01	Pass
IEEE 802.11ac-VHT20	U-NII-1	5180	2.33	0.49	3.75	3.06	2.99	1.15	4.41	3.72	9.24	23.01	Pass
		5220	2.45	0.28	3.39	2.96	3.11	0.94	4.05	3.62	9.10	23.01	Pass
		5240	2.39	0.31	3.36	2.88	3.05	0.97	4.02	3.54	9.05	23.01	Pass
	U-NII-2A	5260	2.64	0.36	4.19	3.24	3.30	1.02	4.85	3.90	9.50	17.01	Pass
		5300	2.05	-0.43	3.25	2.53	2.71	0.23	3.91	3.19	8.73	17.01	Pass
		5320	1.99	-0.46	2.87	2.58	2.65	0.20	3.53	3.24	8.60	17.01	Pass
	U-NII-2C	5500	5.45	5.70	5.62	7.66	6.11	6.36	6.28	8.32	12.88	17.01	Pass

Mode	Band	Freq. (MHz)	CONDUCTED AVG POWER										
			Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
			Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
		5580	6.08	6.42	5.80	8.33	6.74	7.08	6.46	8.99	13.45	17.01	Pass
		5700	5.06	5.71	6.72	6.33	5.72	6.37	7.38	6.99	12.68	17.01	Pass
		5720	5.16	5.94	7.14	6.43	5.82	6.60	7.80	7.09	12.90	17.01	Pass
	U-NII-3	5745	14.61	15.18	16.89	14.73	15.27	15.84	17.55	15.39	22.13	23.01	Pass
		5785	14.85	15.70	16.78	15.13	15.51	16.36	17.44	15.79	22.36	23.01	Pass
		5825	15.03	15.68	15.81	15.04	15.69	16.34	16.47	15.70	22.08	23.01	Pass
IEEE 802.11ac-VHT40	U-NII-1	5190	2.48	0.16	3.74	2.86	3.57	1.25	4.83	3.95	9.61	23.01	Pass
		5230	2.66	0.45	3.56	3.33	3.75	1.54	4.65	4.42	9.77	23.01	Pass
	U-NII-2A	5270	2.01	0.24	3.55	3.03	3.10	1.33	4.64	4.12	9.49	17.01	Pass
		5310	1.92	-0.58	2.73	2.57	3.01	0.51	3.82	3.66	8.96	17.01	Pass
	U-NII-2C	5510	8.71	8.00	8.61	9.81	9.80	9.09	9.70	10.90	15.95	17.01	Pass
		5550	8.68	7.91	8.84	10.00	9.77	9.00	9.93	11.09	16.04	17.01	Pass
		5670	8.49	7.85	8.31	8.35	9.58	8.94	9.40	9.44	15.37	17.01	Pass
		5710	8.52	8.33	9.58	8.50	9.61	9.42	10.67	9.59	15.88	17.01	Pass
	U-NII-3	5755	14.12	14.84	16.53	14.19	15.21	15.93	17.62	15.28	22.15	23.01	Pass
		5795	14.33	15.35	16.29	14.52	15.42	16.44	17.38	15.61	22.31	23.01	Pass
IEEE 802.11ac-VHT80	U-NII-1	5210	1.56	-0.03	2.67	2.76	3.25	1.66	4.36	4.45	9.59	23.01	Pass
	U-NII-2A	5290	0.96	-0.46	2.39	2.27	2.65	1.23	4.08	3.96	9.15	17.01	Pass
	U-NII-2C	5530	7.62	7.46	7.49	9.48	9.31	9.15	9.18	11.17	15.81	17.01	Pass
		5690	7.50	7.73	8.15	8.08	9.19	9.42	9.84	9.77	15.58	17.01	Pass
	U-NII-3	5775	15.04	14.78	15.83	14.16	16.73	16.47	17.52	15.85	22.70	23.01	Pass
IEEE 802.11ac-VHT160	U-NII-2A	5250	1.45	-0.35	3.23	2.10	3.64	1.84	5.42	4.29	10.00	17.01	Pass
	U-NII-2C	5570	7.47	6.34	6.63	8.38	9.66	8.53	8.82	10.57	15.49	17.01	Pass

IEEE 802.11ax

Mode	Band	Freq. (MHz)	RU & Index	CONDUCTED AVG POWER										
				Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
				Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
IEEE 802.11ax-HE20	U-NII-1	5180	SU	2.36	0.75	3.23	3.16	3.06	1.45	3.93	3.86	9.20	23.01	Pass
		5220	SU	2.50	0.33	3.85	3.15	3.20	1.03	4.55	3.85	9.36	23.01	Pass
		5240	SU	2.52	0.03	3.59	2.73	3.22	0.73	4.29	3.43	9.12	23.01	Pass
	U-NII-2A	5260	SU	2.79	0.25	4.00	3.19	3.49	0.95	4.70	3.89	9.48	17.01	Pass
		5300	SU	2.59	0.06	3.41	2.99	3.29	0.76	4.11	3.69	9.16	17.01	Pass
		5320	SU	2.57	0.24	2.97	2.77	3.27	0.94	3.67	3.47	8.98	17.01	Pass
	U-NII-2C	5500	SU	5.51	5.73	5.67	7.86	6.21	6.43	6.37	8.56	13.03	17.01	Pass
		5580	SU	6.21	6.40	6.19	8.22	6.91	7.10	6.89	8.92	13.56	17.01	Pass
		5700	SU	5.02	5.66	6.75	6.38	5.72	6.36	7.45	7.08	12.72	17.01	Pass
		5720	SU	5.15	5.90	7.30	6.43	5.85	6.60	8.00	7.13	12.98	17.01	Pass
	U-NII-3	5745	SU	14.72	15.28	16.99	14.78	15.42	15.98	17.69	15.48	22.26	23.01	Pass
		5785	SU	14.92	15.81	16.89	15.29	15.62	16.51	17.59	15.99	22.51	23.01	Pass
		5825	SU	15.15	15.78	15.86	15.09	15.85	16.48	16.56	15.79	22.20	23.01	Pass
IEEE 802.11ax-HE40	U-NII-1	5190	SU	2.39	0.30	3.38	2.96	3.09	1.00	4.08	3.66	9.12	23.01	Pass
		5230	SU	2.90	0.33	4.05	3.09	3.60	1.03	4.75	3.79	9.51	23.01	Pass

Mode	Band	Freq. (MHz)	RU & Index	CONDUCTED AVG POWER										
				Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
				Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
	U-NII-2A	5270	SU	2.18	-0.07	3.41	2.91	2.88	0.63	4.11	3.61	9.01	17.01	Pass
		5310	SU	1.96	-0.11	2.79	2.51	2.66	0.59	3.49	3.21	8.64	17.01	Pass
	U-NII-2C	5510	SU	8.86	8.41	8.88	10.15	9.56	9.11	9.58	10.85	15.84	17.01	Pass
		5550	SU	8.86	8.21	9.07	10.40	9.56	8.91	9.77	11.10	15.93	17.01	Pass
		5670	SU	8.58	8.17	8.83	8.69	9.28	8.87	9.53	9.39	15.29	17.01	Pass
		5710	SU	8.59	8.59	10.48	8.81	9.29	9.29	11.18	9.51	15.91	17.01	Pass
	U-NII-3	5755	SU	14.70	15.38	17.09	14.79	15.40	16.08	17.79	15.49	22.32	23.01	Pass
		5795	SU	14.96	15.95	16.89	15.24	15.66	16.65	17.59	15.94	22.54	23.01	Pass
IEEE 802.11ax-HE80	U-NII-1	5210	SU	2.19	0.70	3.61	3.37	2.90	1.41	4.32	4.08	9.35	23.01	Pass
	U-NII-2A	5290	SU	3.08	0.86	3.89	3.63	3.79	1.57	4.60	4.34	9.75	17.01	Pass
	U-NII-2C	5530	SU	8.76	8.03	8.19	9.99	9.47	8.74	8.90	10.70	15.55	17.01	Pass
		5690	SU	8.88	8.29	9.27	8.71	9.59	9.00	9.98	9.42	15.54	17.01	Pass
	U-NII-3	5775	SU	14.89	15.59	16.75	14.85	15.60	16.30	17.46	15.56	22.32	23.01	Pass
IEEE 802.11ax-HE160	U-NII-2A	5250	SU	3.47	0.83	3.37	3.69	4.17	1.53	4.07	4.39	9.70	17.01	Pass
	U-NII-2C	5570	SU	10.00	8.69	8.63	10.65	10.70	9.39	9.33	11.35	16.30	17.01	Pass

Maximum output power (TPC Lowest Power)

Mode	Band	Freq. (MHz)	CONDUCTED AVG POWER										
			Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
			Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
IEEE 802.11a	U-NII-2A	5260	9.13	9.00	8.68	9.63	9.33	9.20	8.88	9.83	N/A	22.91	Pass
		5300	8.61	8.30	8.10	9.21	8.81	8.50	8.30	9.41	N/A	22.91	Pass
		5320	8.43	8.05	8.26	9.10	8.63	8.25	8.46	9.30	N/A	22.91	Pass
	U-NII-2C	5500	12.25	12.21	11.43	12.50	12.45	12.41	11.63	12.70	N/A	22.91	Pass
		5580	12.89	12.54	12.16	13.30	13.09	12.74	12.36	13.50	N/A	22.91	Pass
		5700	11.60	11.61	11.75	10.09	11.80	11.81	11.95	10.29	N/A	22.91	Pass
		5720	12.37	11.91	12.95	11.66	12.57	12.11	13.15	11.86	N/A	22.91	Pass
IEEE 802.11n-HT20	U-NII-2A	5260	-3.80	-6.00	-2.29	-2.94	-3.14	-5.34	-1.63	-2.28	3.13	17.01	Pass
		5300	-4.02	-6.44	-2.73	-3.50	-3.36	-5.78	-2.07	-2.84	2.71	17.01	Pass
		5320	-4.28	-6.69	-3.41	-3.46	-3.62	-6.03	-2.75	-2.80	2.41	17.01	Pass
	U-NII-2C	5500	-0.60	-0.30	-0.28	1.46	0.06	0.36	0.38	2.12	6.83	17.01	Pass
		5580	0.03	0.29	-0.42	1.80	0.69	0.95	0.24	2.46	7.19	17.01	Pass
		5700	-1.58	-0.87	0.33	0.13	-0.92	-0.21	0.99	0.79	6.25	17.01	Pass
		5720	-0.99	-0.23	1.12	0.18	-0.33	0.43	1.78	0.84	6.77	17.01	Pass
IEEE 802.11n-HT40	U-NII-2A	5270	-4.30	-5.99	-2.72	-3.26	-3.17	-4.86	-1.59	-2.13	3.25	17.01	Pass
		5310	-4.72	-6.95	-3.84	-4.04	-3.59	-5.82	-2.71	-2.91	2.42	17.01	Pass
	U-NII-2C	5510	2.63	1.98	1.93	3.63	3.76	3.11	3.06	4.76	9.75	17.01	Pass
		5550	2.23	1.34	1.63	3.63	3.36	2.47	2.76	4.76	9.45	17.01	Pass
		5670	1.50	0.85	1.29	1.39	2.63	1.98	2.42	2.52	8.41	17.01	Pass
		5710	1.44	1.29	2.63	1.43	2.57	2.42	3.76	2.56	8.88	17.01	Pass
IEEE 802.11ac-VHT20	U-NII-2A	5260	-3.83	-6.06	-2.33	-3.02	-3.17	-5.40	-1.67	-2.36	3.07	17.01	Pass
		5300	-4.06	-6.46	-2.76	-3.56	-3.40	-5.80	-2.10	-2.90	2.67	17.01	Pass
		5320	-4.31	-6.71	-3.45	-3.51	-3.65	-6.05	-2.79	-2.85	2.36	17.01	Pass
	U-NII-2C	5500	-0.64	-0.28	-0.32	1.49	0.02	0.38	0.34	2.15	6.82	17.01	Pass
		5580	0.01	0.36	-0.45	1.83	0.67	1.02	0.21	2.49	7.20	17.01	Pass
		5700	-1.65	-0.88	0.35	0.16	-0.99	-0.22	1.01	0.82	6.25	17.01	Pass
		5720	-1.06	-0.25	1.12	0.21	-0.40	0.41	1.78	0.87	6.75	17.01	Pass
IEEE 802.11ac-VHT40	U-NII-2A	5270	-4.37	-6.03	-2.75	-3.31	-3.28	-4.94	-1.66	-2.22	3.17	17.01	Pass
		5310	-4.75	-7.00	-3.86	-4.10	-3.66	-5.91	-2.77	-3.01	2.35	17.01	Pass
	U-NII-2C	5510	2.59	1.93	1.96	3.66	3.68	3.02	3.05	4.75	9.71	17.01	Pass
		5550	2.19	1.29	1.65	3.68	3.28	2.38	2.74	4.77	9.42	17.01	Pass
		5670	1.53	0.79	1.27	1.42	2.62	1.88	2.36	2.51	8.38	17.01	Pass
		5710	1.49	1.26	2.61	1.39	2.58	2.35	3.70	2.48	8.84	17.01	Pass
IEEE 802.11ac-VHT80	U-NII-2A	5290	-5.41	-6.66	-4.07	-4.19	-3.72	-4.97	-2.38	-2.50	2.75	17.01	Pass
	U-NII-2C	5530	1.18	1.10	1.08	3.11	2.87	2.79	2.77	4.80	9.42	17.01	Pass
		5690	0.75	0.68	1.59	1.46	2.44	2.37	3.28	3.15	8.85	17.01	Pass
IEEE 802.11ac-VHT160	U-NII-2A	5250	-4.72	-6.53	-3.07	-4.03	-2.53	-4.34	-0.88	-1.84	3.80	17.01	Pass
	U-NII-2C	5570	1.07	-0.15	0.23	2.06	3.26	2.04	2.42	4.25	9.10	17.01	Pass

IEEE 802.11ax

Mode	Band	Freq. (MHz)	RU & Index	CONDUCTED AVG POWER										
				Meas Value (dBm)				Corr'd Value (dBm)					Limit (dBm)	Result
				Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
IEEE 802.11ax-HE20	U-NII-2A	5260	SU	-3.94	-6.11	-2.35	-3.21	-3.24	-5.41	-1.65	-2.51	3.02	17.01	Pass
		5300	SU	-4.13	-6.51	-2.79	-3.58	-3.43	-5.81	-2.09	-2.88	2.67	17.01	Pass
		5320	SU	-4.32	-6.71	-3.53	-3.53	-3.62	-6.01	-2.83	-2.83	2.37	17.01	Pass
	U-NII-2C	5500	SU	-0.69	-0.22	-0.31	1.55	0.01	0.48	0.39	2.25	6.89	17.01	Pass
		5580	SU	0.12	0.31	-0.46	1.97	0.82	1.01	0.24	2.67	7.30	17.01	Pass
		5700	SU	-1.66	-0.93	0.39	0.26	-0.96	-0.23	1.09	0.96	6.32	17.01	Pass
		5720	SU	-1.21	-0.33	1.18	0.32	-0.51	0.37	1.88	1.02	6.80	17.01	Pass
IEEE 802.11ax-HE40	U-NII-2A	5270	SU	-4.36	-6.03	-2.76	-3.31	-3.66	-5.33	-2.06	-2.61	2.77	17.01	Pass
		5310	SU	-4.75	-7.07	-3.85	-4.14	-4.05	-6.37	-3.15	-3.44	1.93	17.01	Pass
	U-NII-2C	5510	SU	2.55	1.81	1.91	3.59	3.25	2.51	2.61	4.29	9.24	17.01	Pass
		5550	SU	2.19	1.33	1.54	3.57	2.89	2.03	2.24	4.27	8.97	17.01	Pass
		5670	SU	1.47	0.79	1.25	1.34	2.17	1.49	1.95	2.04	7.94	17.01	Pass
		5710	SU	1.41	1.26	2.58	1.39	2.11	1.96	3.28	2.09	8.41	17.01	Pass
IEEE 802.11ax-HE80	U-NII-2A	5290	SU	-5.52	-6.75	-4.19	-4.26	-4.81	-6.04	-3.48	-3.55	1.68	17.01	Pass
	U-NII-2C	5530	SU	1.09	1.02	1.03	3.01	1.80	1.73	1.74	3.72	8.36	17.01	Pass
		5690	SU	0.73	0.62	1.52	1.41	1.44	1.33	2.23	2.12	7.82	17.01	Pass
IEEE 802.11ax-HE160	U-NII-2A	5250	SU	-4.78	-6.65	-3.23	-4.15	-4.08	-5.95	-2.53	-3.45	2.19	17.01	Pass
	U-NII-2C	5570	SU	3.93	2.66	2.59	4.55	4.63	3.36	3.29	5.25	10.23	17.01	Pass

EIRP

Mode	Band	Freq. (MHz)	CONDUCTED AVG POWER																				
			Meas Value (dBm)				Corr'd Value (dBm)					Elevation angle above 30 degrees Gain(dBi)					EIRP(dBm)					Limit (dBm)	Result
			Ant. 0	Ant. 1	Ant. 2	Ant. 3	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Sum	Ant. 0	Ant. 1	Ant. 2	Ant. 3	Total		
IEEE 802.11a	U-NII-1	5180	13.18	13.35	13.06	13.20	13.38	13.55	13.26	13.40	N/A	5.3	4.1	5.9	4.15	10.92	18.68	17.65	19.16	17.55	N/A	21	Pass
		5220	13.33	13.77	13.48	13.60	13.53	13.97	13.68	13.80	N/A	5.3	4.1	5.9	4.15	10.92	18.83	18.07	19.58	17.95	N/A	21	Pass
		5240	13.24	13.55	13.30	13.52	13.44	13.75	13.50	13.72	N/A	5.3	4.1	5.9	4.15	10.92	18.74	17.85	19.40	17.87	N/A	21	Pass
IEEE 802.11n-HT20	U-NII-1	5180	2.35	0.53	3.79	3.11	3.01	1.19	4.45	3.77	9.29	5.3	4.1	5.9	4.15	10.92	8.31	5.29	10.35	7.92	20.21	21	Pass
		5220	2.49	0.30	3.43	3.00	3.15	0.96	4.09	3.66	9.14	5.3	4.1	5.9	4.15	10.92	8.45	5.06	9.99	7.81	20.06	21	Pass
		5240	2.44	0.33	3.35	2.92	3.10	0.99	4.01	3.58	9.09	5.3	4.1	5.9	4.15	10.92	8.40	5.09	9.91	7.73	20.01	21	Pass
IEEE 802.11n-HT40	U-NII-1	5190	2.52	0.20	3.78	2.84	3.65	1.33	4.91	3.97	9.67	5.3	4.1	5.9	4.15	10.92	8.95	5.43	10.81	8.12	20.59	21	Pass
		5230	2.65	0.50	3.58	3.36	3.78	1.63	4.71	4.49	9.83	5.3	4.1	5.9	4.15	10.92	9.08	5.73	10.61	8.64	20.75	21	Pass
IEEE 802.11ac-VHT20	U-NII-1	5180	2.33	0.49	3.75	3.06	2.99	1.15	4.41	3.72	9.24	5.3	4.1	5.9	4.15	10.92	8.29	5.25	10.31	7.87	20.16	21	Pass
		5220	2.45	0.28	3.39	2.96	3.11	0.94	4.05	3.62	9.10	5.3	4.1	5.9	4.15	10.92	8.41	5.04	9.95	7.77	20.02	21	Pass
		5240	2.39	0.31	3.36	2.88	3.05	0.97	4.02	3.54	9.05	5.3	4.1	5.9	4.15	10.92	8.35	5.07	9.92	7.69	19.97	21	Pass
IEEE 802.11ac-VHT40	U-NII-1	5190	2.48	0.16	3.74	2.86	3.57	1.25	4.83	3.95	9.61	5.3	4.1	5.9	4.15	10.92	8.87	5.35	10.73	8.10	20.53	21	Pass
		5230	2.66	0.45	3.56	3.33	3.75	1.54	4.65	4.42	9.77	5.3	4.1	5.9	4.15	10.92	9.05	5.64	10.55	8.57	20.69	21	Pass
IEEE 802.11ac-VHT80	U-NII-1	5210	1.56	-0.03	2.67	2.76	3.25	1.66	4.36	4.45	9.59	5.3	4.1	5.9	4.15	10.92	8.55	5.76	10.26	8.60	20.51	21	Pass
IEEE 802.11ac-VHT160	U-NII-1	5250	1.45	-0.35	3.23	2.10	3.64	1.84	5.42	4.29	10.00	5.3	4.1	5.9	4.15	10.92	8.94	5.94	11.32	8.44	20.92	21	Pass
IEEE 802.11ax-HE20	U-NII-1	5180	2.36	0.75	3.23	3.16	3.06	1.45	3.93	3.86	9.20	5.3	4.1	5.9	4.15	10.92	8.36	5.55	9.83	8.01	20.12	21	Pass
		5220	2.50	0.33	3.85	3.15	3.20	1.03	4.55	3.85	9.36	5.3	4.1	5.9	4.15	10.92	8.50	5.13	10.45	8.00	20.28	21	Pass
		5240	2.52	0.03	3.59	2.73	3.22	0.73	4.29	3.43	9.12	5.3	4.1	5.9	4.15	10.92	8.52	4.83	10.19	7.58	20.04	21	Pass
IEEE 802.11ax-HE40	U-NII-1	5190	2.39	0.30	3.38	2.96	3.09	1.00	4.08	3.66	9.12	5.3	4.1	5.9	4.15	10.92	8.39	5.10	9.98	7.81	20.04	21	Pass
		5230	2.90	0.33	4.05	3.09	3.60	1.03	4.75	3.79	9.51	5.3	4.1	5.9	4.15	10.92	8.90	5.13	10.65	7.94	20.43	21	Pass
IEEE 802.11ax-HE80	U-NII-1	5210	2.19	0.70	3.61	3.37	2.90	1.41	4.32	4.08	9.35	5.3	4.1	5.9	4.15	10.92	8.20	5.51	10.22	8.23	20.27	21	Pass
IEEE 802.11ax-HE160	U-NII-1	5250	3.47	0.83	3.37	3.69	4.17	1.53	4.07	4.39	9.70	5.3	4.1	5.9	4.15	10.92	9.47	5.63	9.97	8.54	20.62	21	Pass

5.6 PEAK POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3)
Test Method: KDB 789033 D02 v02r01 Section F
Limits:

1. For the band 5.15-5.25 GHz.
   (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

   (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

   (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

   (iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

2. For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
3. For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.
4. For an indoor access point operating in the 5.850-5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the

frequency band of operation must not exceed 36 dBm. Indoor access points operating on a channel that spans the 5.725-5.850 GHz and 5.850-5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

Test Procedure:

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

Spectrum analyzer according to the following Settings:

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

Using method SA-2

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 1 MHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Sweep time = auto, trigger set to “free run”.
d) Trace average at least 100 traces in power averaging mode.
e) Record the max value and add 10 log (1/duty cycle)

2. For U-NII-3 band:

a) Set span to encompass the entire emission bandwidth (EBW) of the signal.
b) Set RBW = 500 kHz, Set VBW ≥ 3 RBW, Detector = RMS
c) Use the peak marker function to determine the maximum power level in any 500 kHz band segment within the fundamental EBW.
d) Sweep time = auto, trigger set to “free run”.
e) Trace average at least 100 traces in power averaging mode.
f) Record the max value and add 10 log (1/duty cycle)

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

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: **Please refer to Appendix A**

Directional gain and the maximum power spectral density limit.

Frequency (MHz)	Antenna Gain (dBi)				Directional gain (dBi)		FCC Limit	
	Ant .0	Ant .1	Ant .2	Ant .3	Power	PSD	Power (dBm)	PSD (dBm/MHz or dBm/500kHz)
U-NII-1	6.79	6.98	7.09	7.01	12.99	12.99	23.01	10.01
U-NII-2A	6.79	6.98	7.09	7.01	12.99	12.99	17.01	4.01
U-NII-2C	6.79	6.98	7.09	7.01	12.99	12.99	17.01	4.01
U-NII-3	6.79	6.98	7.09	7.01	12.99	12.99	23.01	23.01

Unequal antenna gains, with equal transmit powers. Directional gain is to be computed as follows:
If transmit signals are correlated, then

Directional gain = 10*log[(10^G1/20 + 10^G2/20 + … + 10^GN /20)^2 /NANT]dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

5.7 RADIATED EMISSIONS AND BAND EDGE MEASUREMENT

Test Requirement: 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

Test Method: KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6

Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

Limits:

1. Limits of Radiated Emission and Band edge Measurement

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in 15.209(a) as below table. Other emissions shall be at least 20 dB below the highest level of the desired power.

Frequency	Field strength (microvolt/meter)	Limit (dBμV/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	2400/F(kHz)	--	--	300
0.490 MHz-1.705 MHz	24000/F(kHz)	--	--	30
1.705 MHz-30 MHz	30	--	--	30
30 MHz-88 MHz	100	40.0	Quasi-peak	3
88 MHz-216 MHz	150	43.5	Quasi-peak	3
216 MHz-960 MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1 GHz	500	54.0	Average	3

Remark:

a. The lower limit shall apply at the transition frequencies.
b. Emission level (dBuV/m) = 20 log Emission level (uV/m).
c. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

2. Limits of Unwanted Emission Out of the Restricted Bands

Applicable To	Limit	
789033 D02 General U-NII Test Procedures New Rules v01r04	**Field Strength at 3 m**	
	PK: 74 (dBμV/m)	**AV: 54 (dBμV/m)**
Applicable To	EIRP Limit	Equivalent Field Strength at 3 m
FCC Part 15.407 (b)(1)	PK: -27 (dBm/MHz)	PK: 74 (dBμV/m)
FCC Part 15.407 (b)(2)	PK: -27 (dBm/MHz)	PK: 74 (dBμV/m)
FCC Part 15.407 (b)(3)	PK: -27 (dBm/MHz)	PK: 68.2 (dBμV/m)
FCC Part 15.407 (b)(4)	27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;	PK: 68.2 (dBμV/m)
	15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;	
	10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges;	
	-27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.	

Test Setup: Refer to section 4.5.1 for details.

Test Procedures:

1. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
6. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Remark:

a) The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
b) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
c) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for RMS Average (Duty cycle < 98 %) for Average detection (AV) at frequency above 1 GHz, then the measurement results was added to a correction factor (10 log(1/duty cycle)).
d) The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) or ≥ 1/T(duty cycle is < 98%) for Average detection (AV) at frequency above 1 GHz.
e) All modes of operation were investigated and the worst-case emissions are reported.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

Please refer to Appendix A

5.8 AC POWER LINE CONDUCTED EMISSION

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.207

Test Method: ANSI C63.10-2013 Section 6.2

Limits:

Frequency range (MHz)	Limits (dB(μV)	
	Quasi-peak	Average
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50

Remark:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 to 0.50 MHz.

Test Setup: Refer to section 4.4.2 for details.

Test Procedures:

Test frequency range :150KHz-30MHz

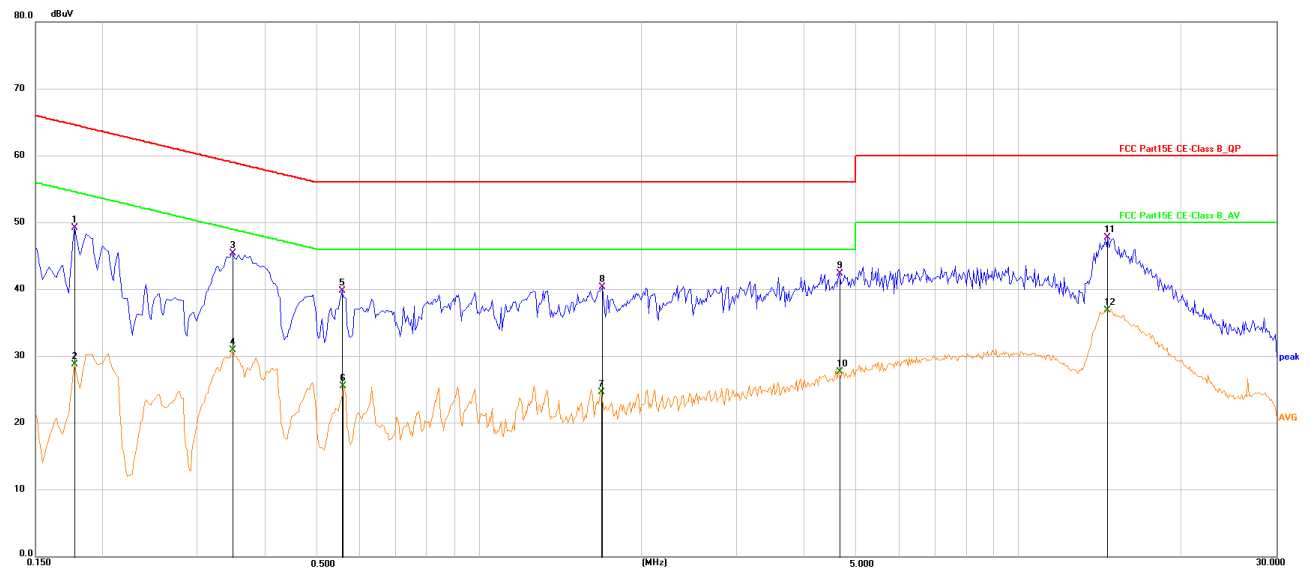
1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

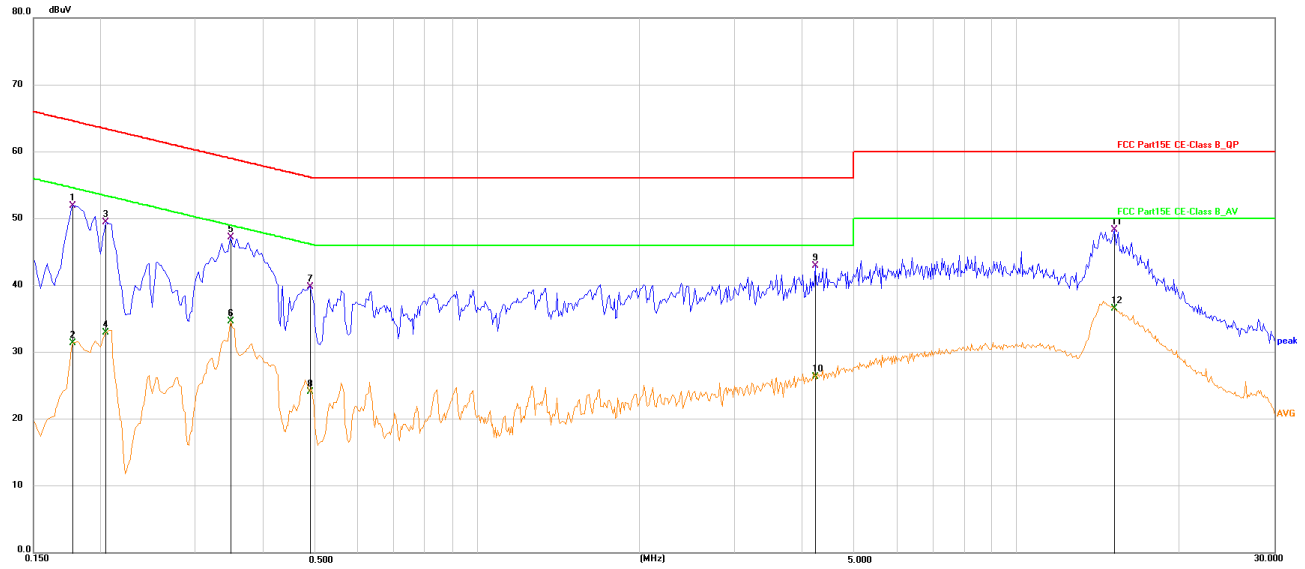
The worst measurement data as follows:
Quasi Peak and Average:
Mode: WIFI Link

Live Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1770	39.04	10.18	49.22	64.63	-15.41	QP
2	0.1770	18.55	10.18	28.73	54.63	-25.90	AVG
3	0.3480	35.20	10.17	45.37	59.01	-13.64	QP
4	0.3480	20.78	10.17	30.95	49.01	-18.06	AVG
5	0.5550	29.57	10.20	39.77	56.00	-16.23	QP
6	0.5595	15.36	10.20	25.56	46.00	-20.44	AVG
7	1.6845	14.36	10.26	24.62	46.00	-21.38	AVG
8	1.6935	30.06	10.26	40.32	56.00	-15.68	QP
9	4.6545	32.16	10.23	42.39	56.00	-13.61	QP
10	4.6545	17.42	10.23	27.65	46.00	-18.35	AVG
11	14.6625	37.21	10.50	47.71	60.00	-12.29	QP
12	14.6625	26.32	10.50	36.82	50.00	-13.18	AVG

Neutral Line



No.	Frequency (MHz)	Reading (dBuV)	Correction factor (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1770	41.82	10.12	51.94	64.63	-12.69	QP
2	0.1770	21.23	10.12	31.35	54.63	-23.28	AVG
3	0.2040	39.35	10.05	49.40	63.45	-14.05	QP
4	0.2040	22.92	10.05	32.97	53.45	-20.48	AVG
5	0.3480	37.03	10.14	47.17	59.01	-11.84	QP
6	0.3480	24.45	10.14	34.59	49.01	-14.42	AVG
7	0.4874	29.51	10.27	39.78	56.21	-16.43	QP
8	0.4874	13.76	10.27	24.03	46.21	-22.18	AVG
9	4.2404	32.61	10.27	42.88	56.00	-13.12	QP
10	4.2404	16.01	10.27	26.28	46.00	-19.72	AVG
11	15.1575	37.67	10.64	48.31	60.00	-11.69	QP
12	15.1575	25.87	10.64	36.51	50.00	-13.49	AVG

Remark:

1. Correct Factor = LISN Factor + Cable Loss + Pulse Limiter Factor, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result - Limit
4. An initial pre-scan was performed on the Phase and neutral lines with peak detector. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

APPENDIX A RF TEST DATA

A.1 99% BANDWIDTH

For U-NII-1, U-NII-2A and U-NII-2C Band:

Mode	Channel	RU & Index	Ant.	99% BW (MHz)
IEEE 802.11a	36	N/A	0	16.710
			1	16.622
			2	16.620
			3	16.682
	44		0	16.615
			1	16.571
			2	16.606
			3	16.580
	48		0	16.620
			1	16.607
			2	16.667
			3	16.659
	52		0	16.565
			1	16.549
			2	16.539
			3	16.541
	60		0	16.643
			1	16.609
			2	16.579
			3	16.605
	64		0	16.658
			1	16.590
			2	16.597
			3	16.570
	100		0	16.626
			1	16.564
			2	16.611
			3	16.585
	116		0	16.529
			1	16.557
			2	16.571
			3	16.521
	140		0	16.574
			1	16.529
			2	16.570
			3	16.553
IEEE 802.11n_20	36		0	17.626
			1	17.630
			2	17.636
			3	17.640
	44		0	17.582
			1	17.614
			2	17.588
			3	17.619
	48		0	17.620
			1	17.677
			2	17.641
			3	17.647
	52		0	17.600
			1	17.613
			2	17.631
			3	17.620
	60		0	17.621
			1	17.635
			2	17.657
			3	17.633
	64		0	17.643

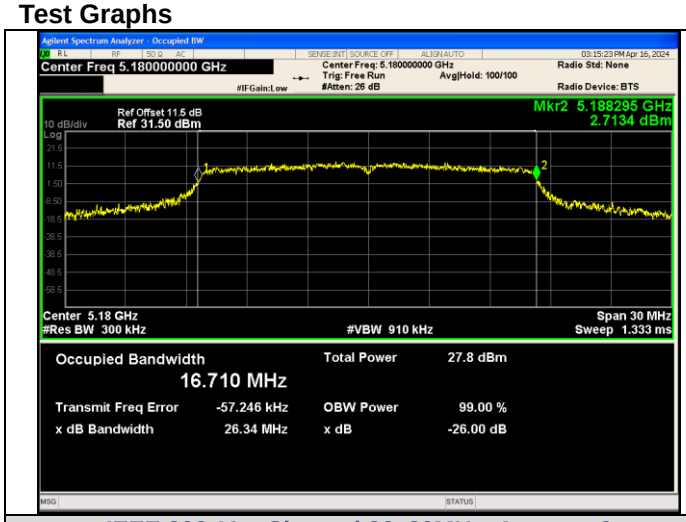
			1	17.644
			2	17.653
			3	17.635
	100		0	17.620
			1	17.656
			2	17.625
			3	17.652
	116		0	17.585
			1	17.614
			2	17.595
			3	17.613
	140		0	17.638
			1	17.693
			2	17.614
			3	17.646
IEEE 802.11n_40	38		0	35.910
			1	36.023
			2	35.965
			3	35.941
	46		0	35.884
			1	35.927
			2	35.880
			3	35.865
	54		0	35.871
			1	35.970
			2	35.831
			3	35.846
	62		0	35.823
			1	35.989
			2	35.919
			3	35.881
	102		0	35.841
			1	36.026
			2	35.921
			3	35.904
	110		0	35.822
			1	35.988
			2	35.892
			3	35.813
	134		0	35.859
			1	35.995
			2	35.891
			3	35.849
IEEE 802.11ac_20	36		0	17.645
			1	17.651
			2	17.624
			3	17.625
	44		0	17.626
			1	17.614
			2	17.569
			3	17.604
	48		0	17.662
			1	17.647
			2	17.644
			3	17.635
	52		0	17.616
			1	17.633
			2	17.624
			3	17.611
	60		0	17.629
			1	17.670
			2	17.646
			3	17.623

	64		0	17.620
			1	17.701
			2	17.629
			3	17.622
	100		0	17.624
			1	17.665
			2	17.658
			3	17.642
	116		0	17.608
			1	17.651
			2	17.612
			3	17.600
	140		0	17.659
			1	17.683
			2	17.637
			3	17.615
IEEE 802.11ac_40	38		0	35.919
			1	36.000
			2	35.977
			3	35.938
	46		0	35.798
			1	35.965
			2	35.919
			3	35.795
	54		0	35.816
			1	35.944
			2	35.913
			3	35.823
	62		0	35.950
			1	36.005
			2	35.942
			3	35.859
	102		0	35.857
			1	36.059
			2	35.952
			3	35.869
	110		0	35.861
			1	35.962
			2	35.896
			3	35.811
	134		0	35.964
			1	36.180
			2	35.991
			3	35.906
IEEE 802.11ac_80	42		0	74.960
			1	75.201
			2	75.273
			3	75.060
	58		0	74.995
			1	75.065
			2	74.925
			3	74.995
	106		0	74.973
			1	75.189
			2	75.136
			3	74.946
IEEE 802.11ac_160	50		0	153.513
			1	153.661
			2	153.133
			3	153.408
	114		0	153.486
			1	153.630
			2	153.645

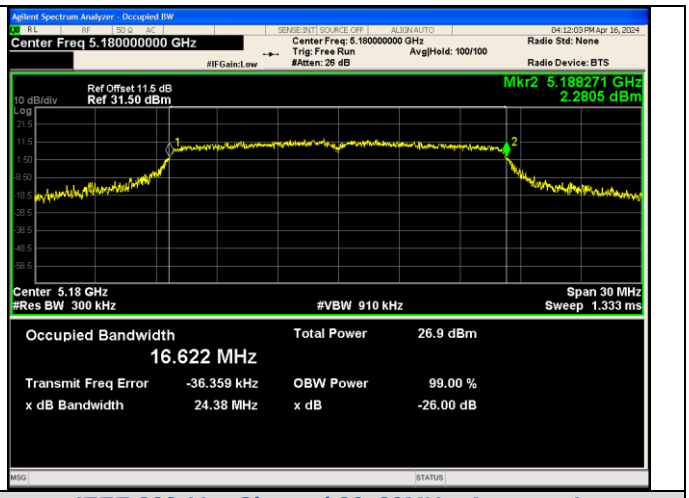
			3	153.181
IEEE 802.11ax_20	36	SU	0	18.889
			1	18.872
			2	18.886
			3	18.917
	44		0	18.864
			1	18.871
			2	18.871
			3	18.881
	48		0	18.828
			1	18.821
			2	18.770
			3	18.802
	52		0	18.864
			1	18.895
			2	18.810
			3	18.851
	60		0	18.867
			1	18.881
			2	18.857
			3	18.907
	64		0	18.849
			1	18.865
			2	18.876
			3	18.925
	100		0	18.876
			1	18.921
			2	18.848
			3	18.830
	116		0	18.853
			1	18.878
			2	18.849
			3	18.815
	140		0	18.882
			1	18.901
			2	18.869
			3	18.889
IEEE 802.11ax_40	38		0	37.440
			1	37.399
			2	37.386
			3	37.361
	46		0	37.352
			1	37.305
			2	37.334
			3	37.320
	54		0	37.302
			1	37.317
			2	37.311
			3	37.299
	62		0	37.460
			1	37.330
			2	37.378
			3	37.447
	102		0	37.356
			1	37.411
			2	37.441
			3	37.400
	110		0	37.311
			1	37.332
			2	37.346
			3	37.275
	134		0	37.376
			1	37.458

			2	37.479
			3	37.391
IEEE 802.11ax_80	42		0	76.461
			1	76.753
			2	76.691
			3	76.605
	58		0	76.474
			1	76.618
			2	76.415
			3	76.660
	106		0	76.498
			1	76.591
			2	76.792
			3	76.578
IEEE 802.11ax_160	50		0	154.924
			1	154.926
			2	154.577
			3	154.826
	114		0	154.997
			1	155.180
			2	155.035
			3	154.488

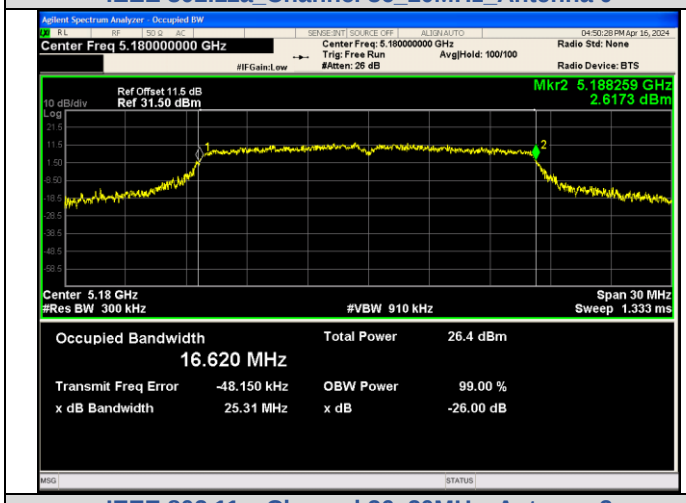
Test Graphs



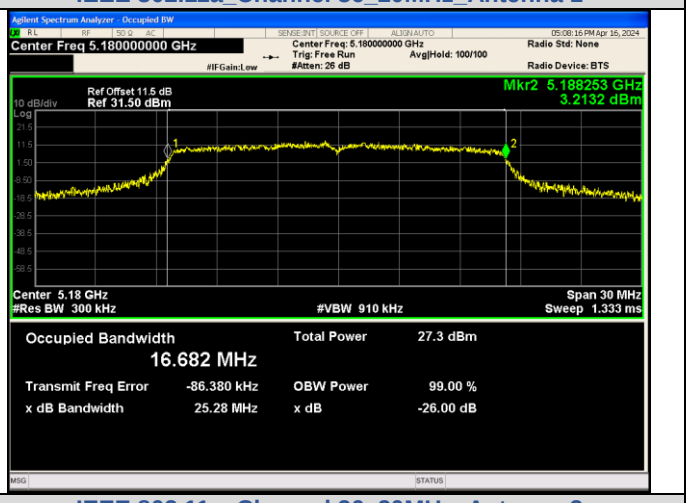
IEEE 802.11a_Channel 36_20MHz_Antenna 0



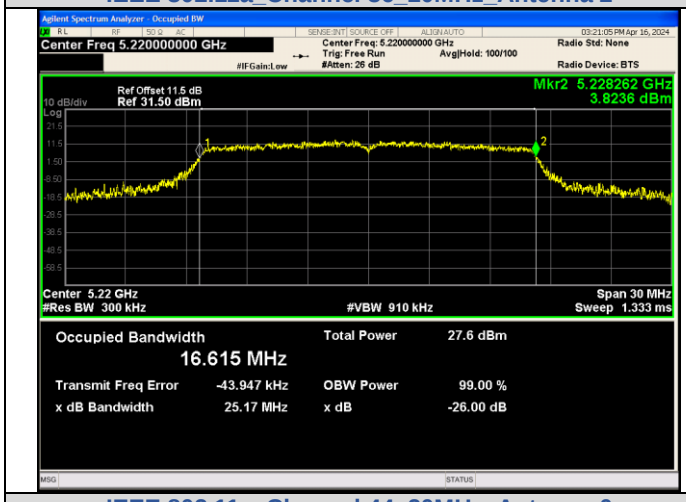
IEEE 802.11a_Channel 36_20MHz_Antenna 1



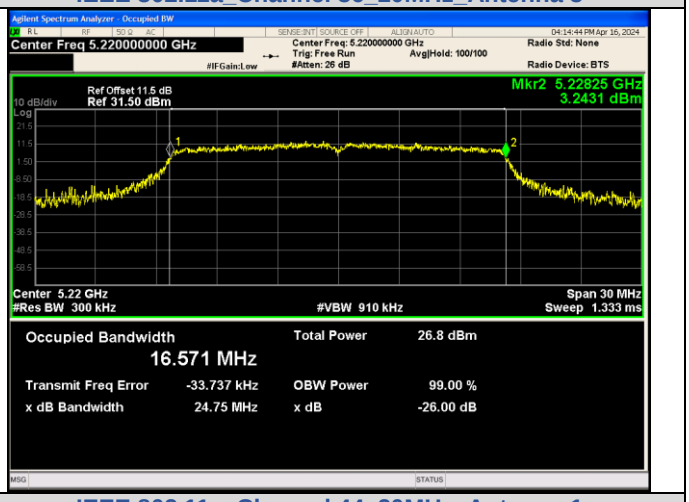
IEEE 802.11a_Channel 36_20MHz_Antenna 2



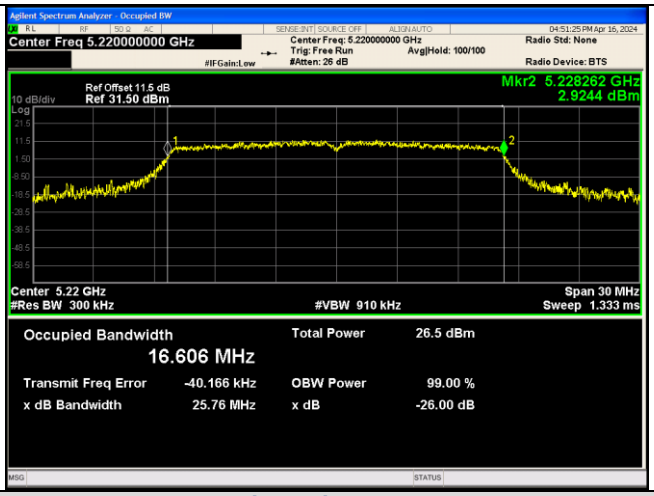
IEEE 802.11a_Channel 36_20MHz_Antenna 3



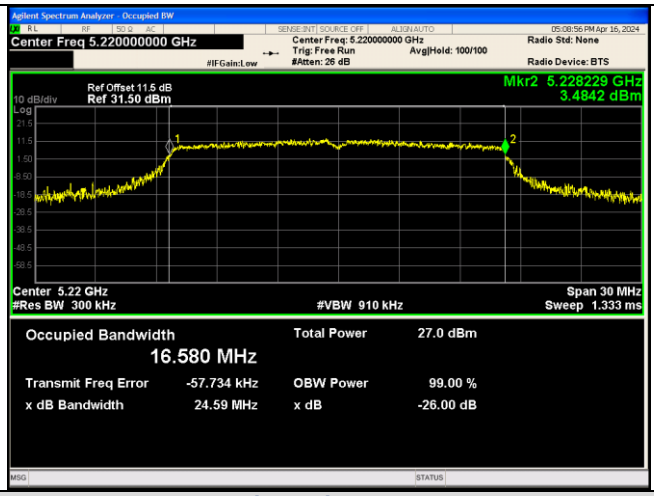
IEEE 802.11a_Channel 44_20MHz_Antenna 0



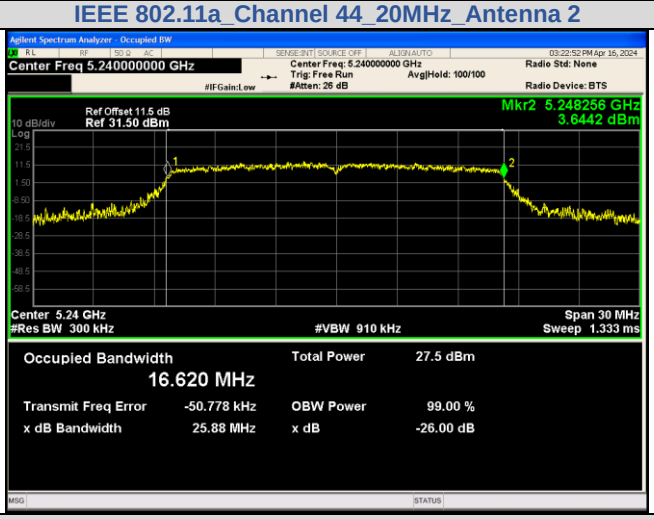
IEEE 802.11a_Channel 44_20MHz_Antenna 1



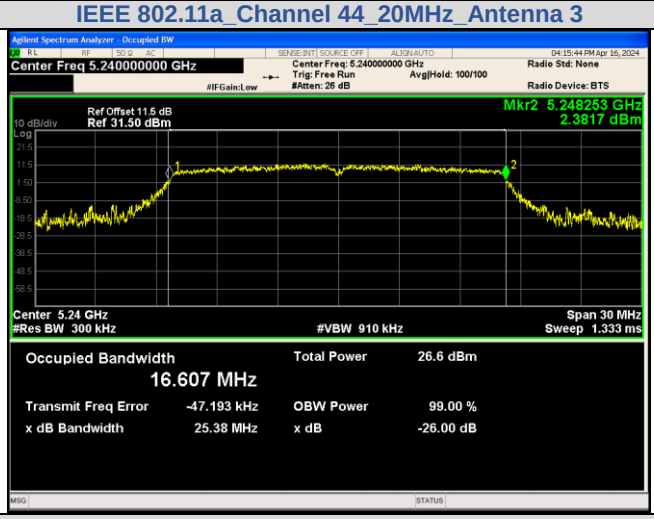
IEEE 802.11a_Channel 44_20MHz_Antenna 2



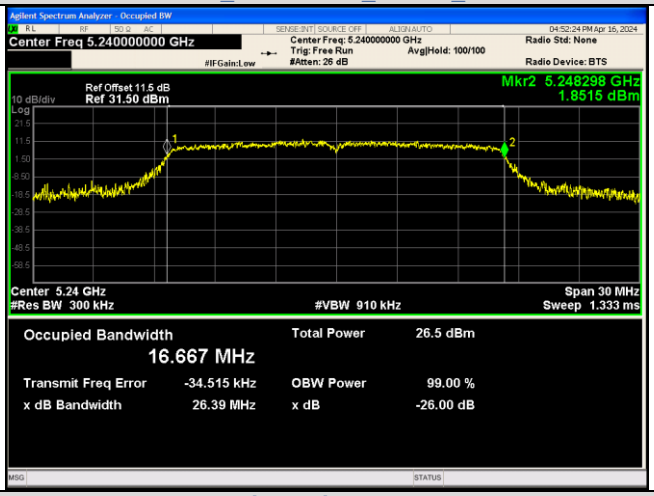
IEEE 802.11a_Channel 44_20MHz_Antenna 3



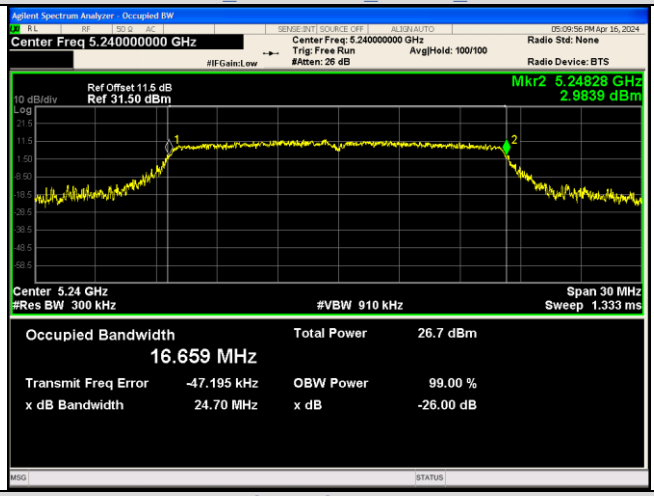
IEEE 802.11a_Channel 48_20MHz_Antenna 0



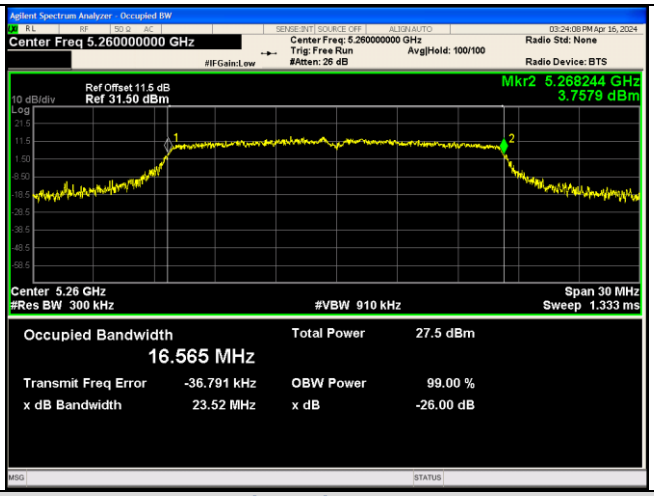
IEEE 802.11a_Channel 48_20MHz_Antenna 1



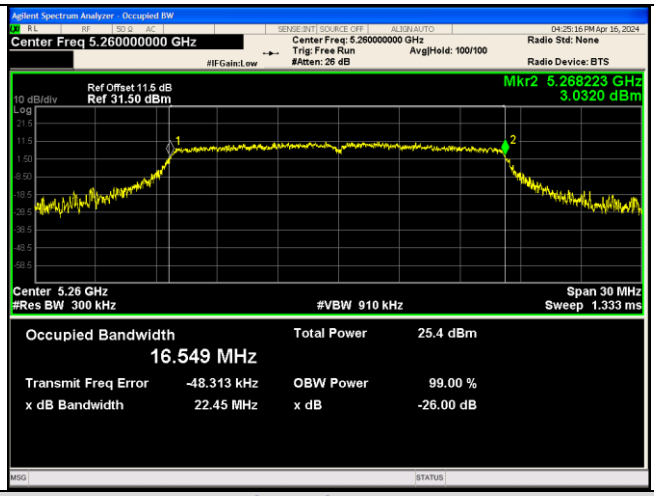
IEEE 802.11a_Channel 48_20MHz_Antenna 2



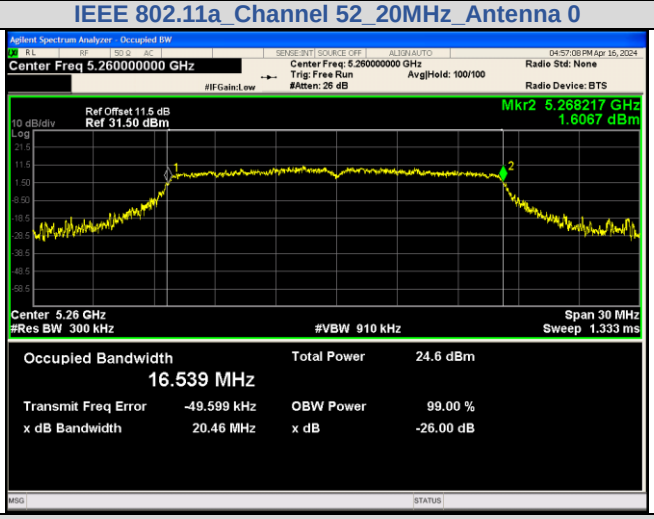
IEEE 802.11a_Channel 48_20MHz_Antenna 3



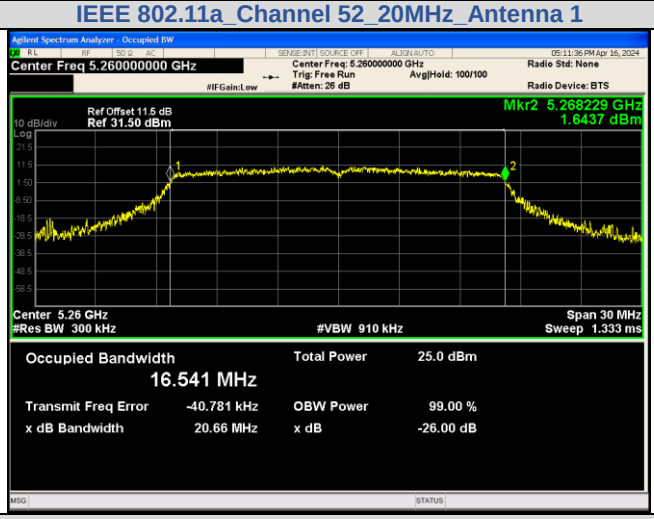
IEEE 802.11a_Channel 52_20MHz_Antenna 0



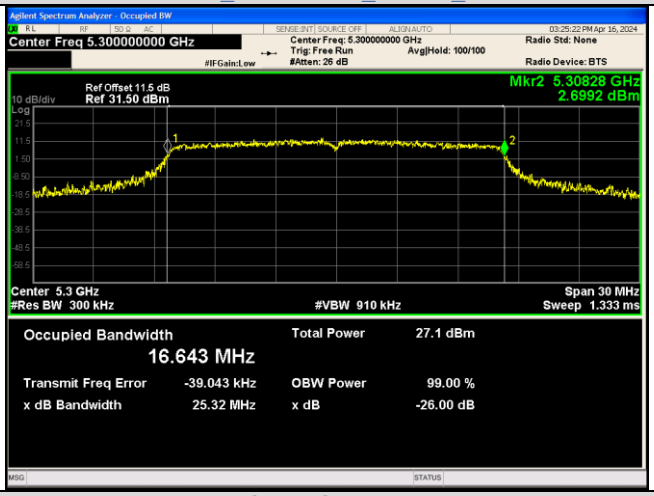
IEEE 802.11a_Channel 52_20MHz_Antenna 1



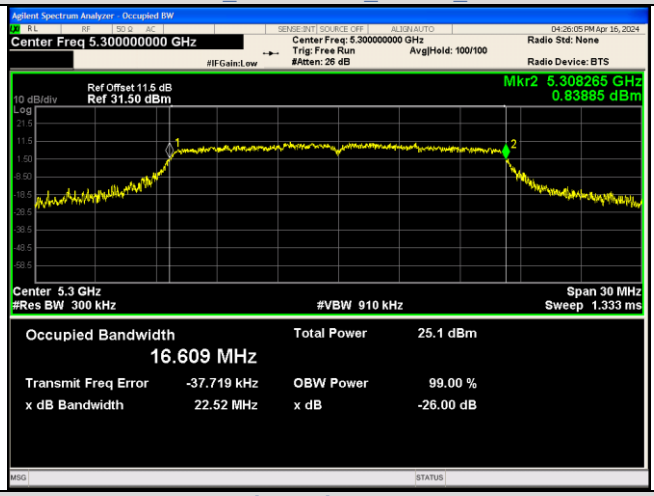
IEEE 802.11a_Channel 52_20MHz_Antenna 2



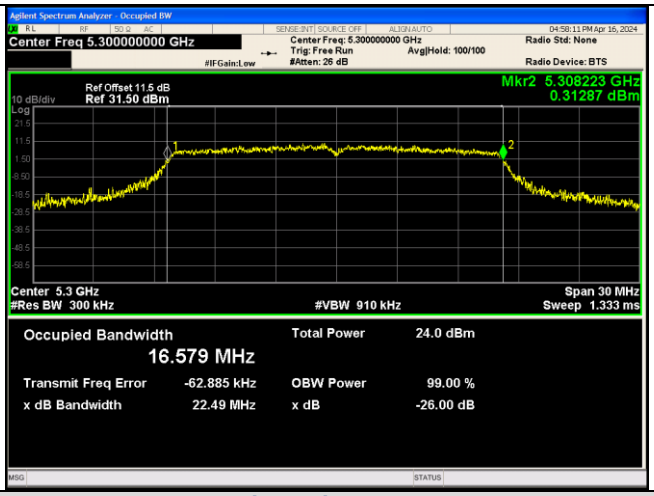
IEEE 802.11a_Channel 52_20MHz_Antenna 3



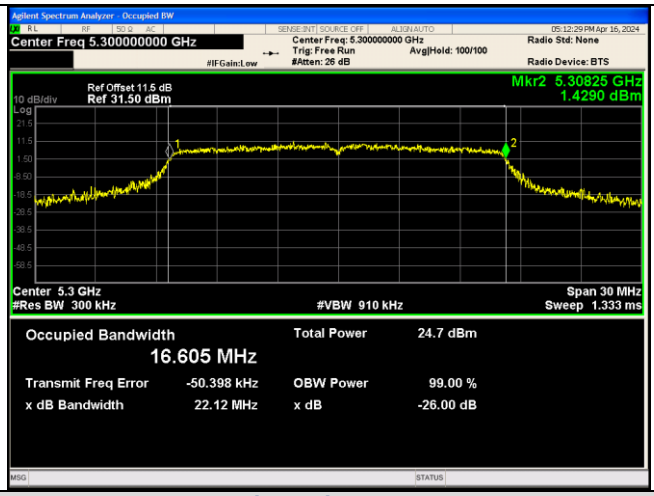
IEEE 802.11a_Channel 60_20MHz_Antenna 0



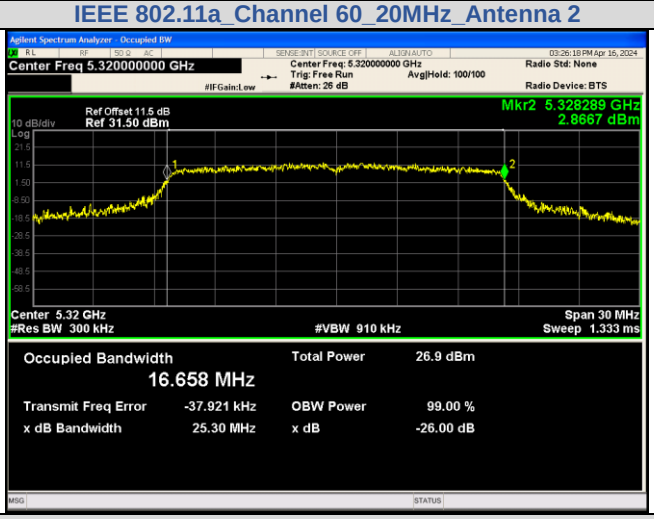
IEEE 802.11a_Channel 60_20MHz_Antenna 1



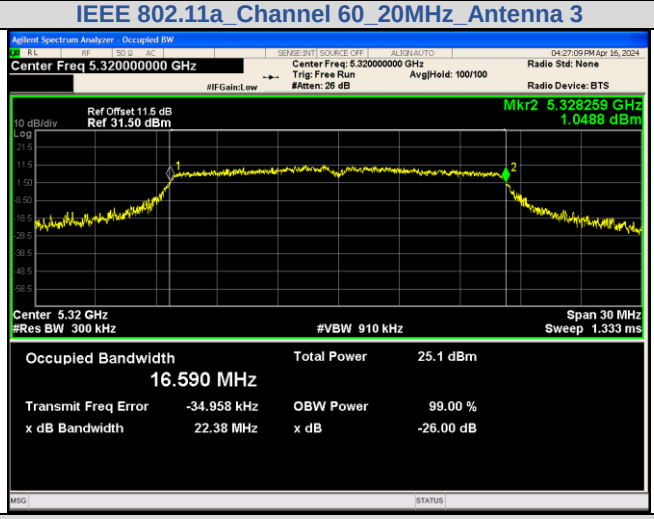
IEEE 802.11a_Channel 60_20MHz_Antenna 2



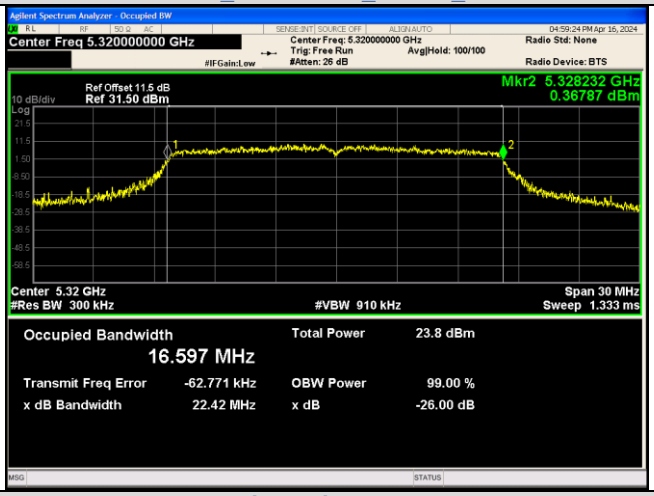
IEEE 802.11a_Channel 60_20MHz_Antenna 3



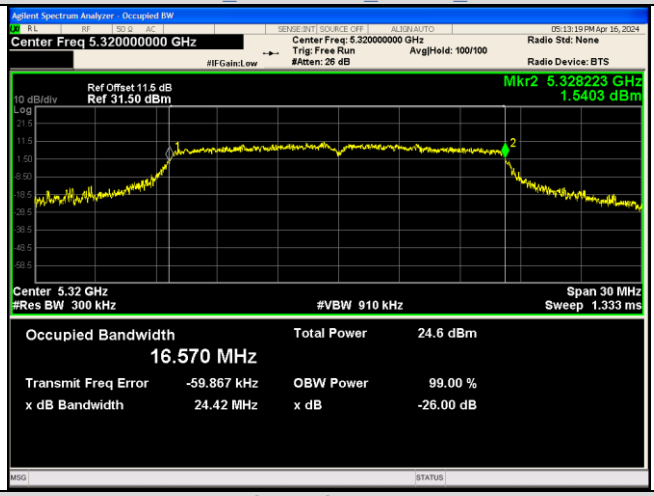
IEEE 802.11a_Channel 64_20MHz_Antenna 0



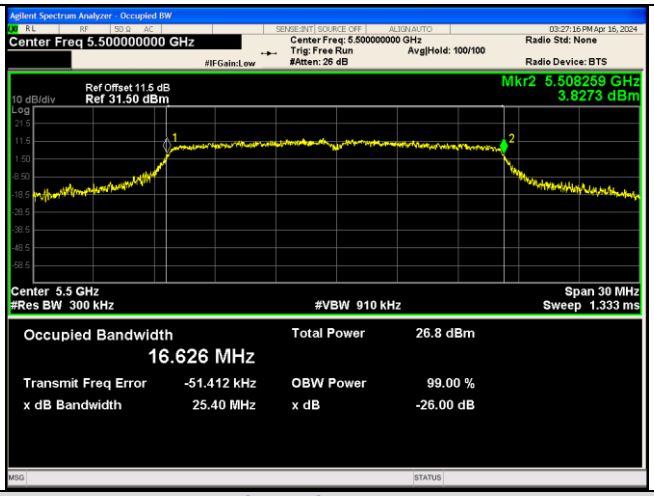
IEEE 802.11a_Channel 64_20MHz_Antenna 1



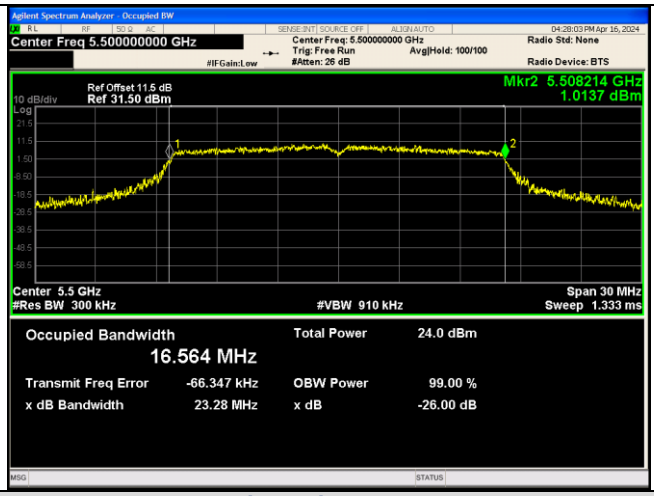
IEEE 802.11a_Channel 64_20MHz_Antenna 2



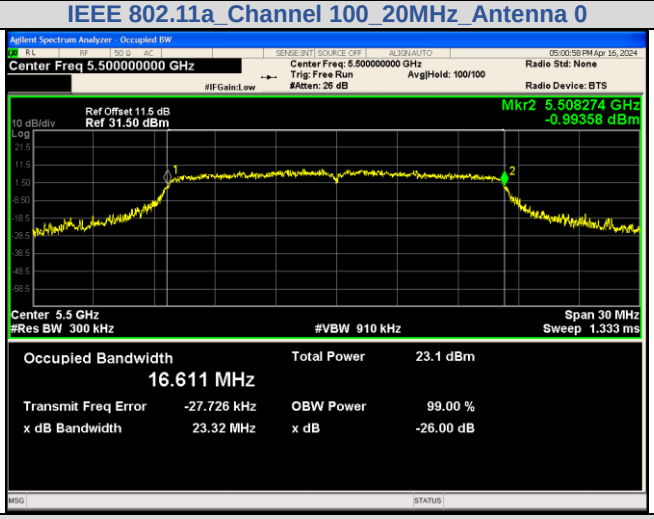
IEEE 802.11a_Channel 64_20MHz_Antenna 3



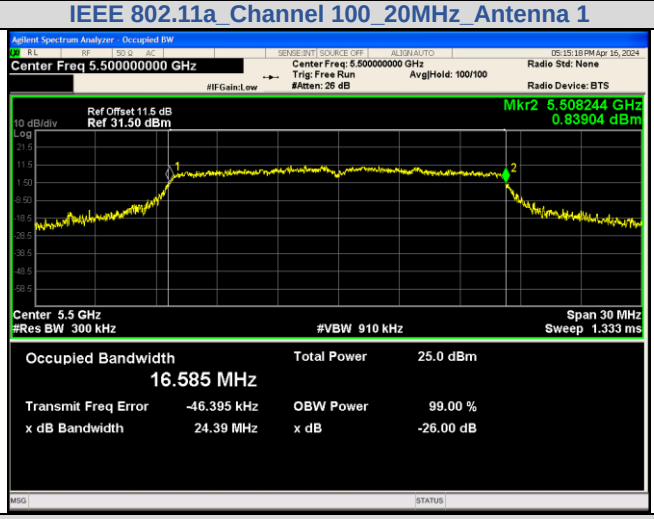
IEEE 802.11a_Channel 100_20MHz_Antenna 0



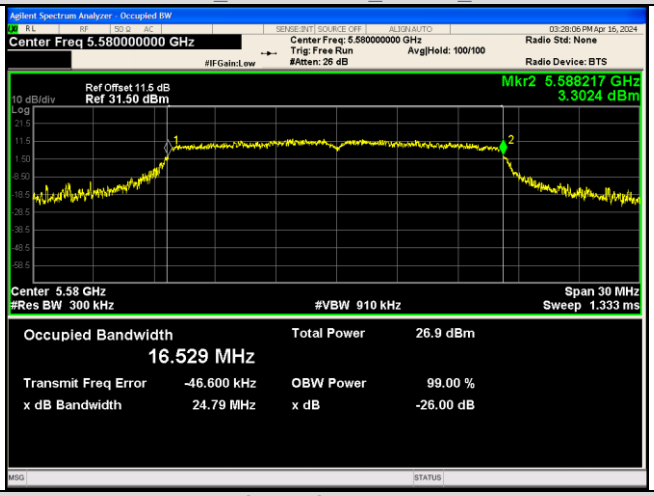
IEEE 802.11a_Channel 100_20MHz_Antenna 1



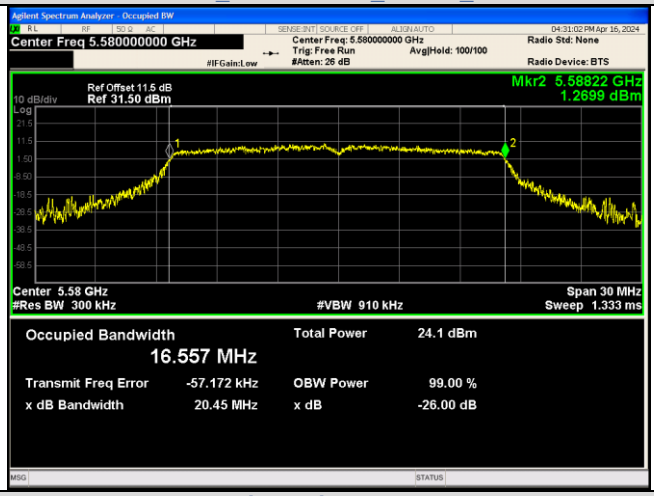
IEEE 802.11a_Channel 100_20MHz_Antenna 2



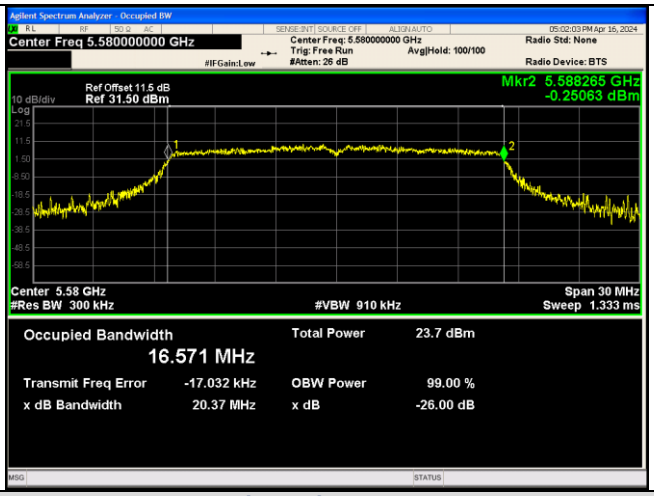
IEEE 802.11a_Channel 100_20MHz_Antenna 3



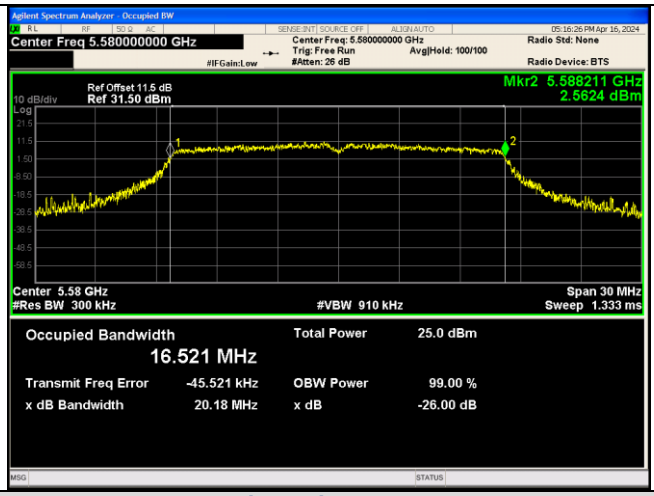
IEEE 802.11a_Channel 116_20MHz_Antenna 0



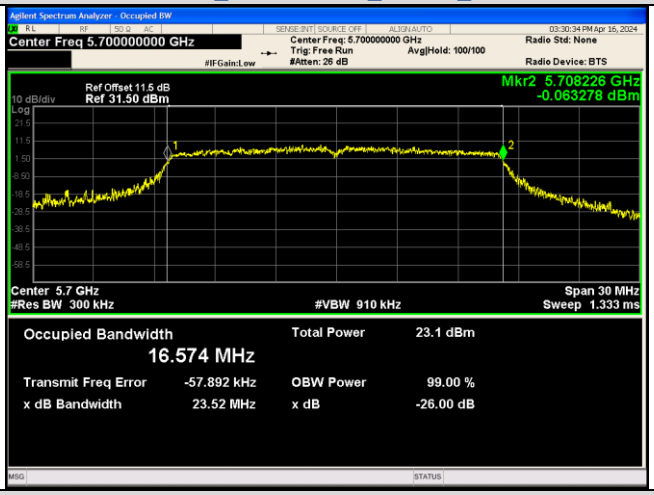
IEEE 802.11a_Channel 116_20MHz_Antenna 1



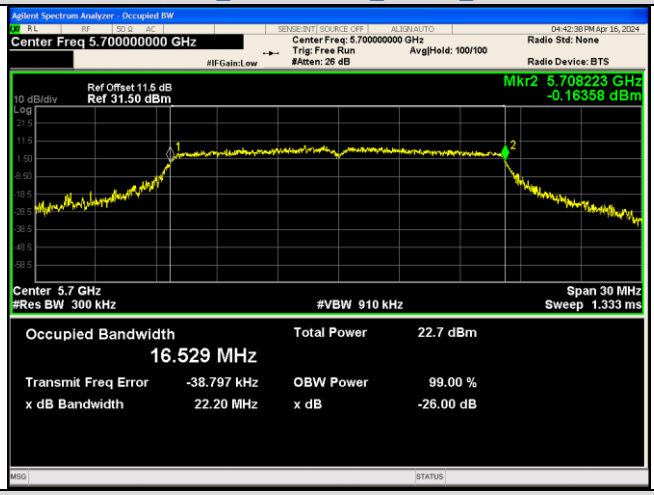
IEEE 802.11a_Channel 116_20MHz_Antenna 2



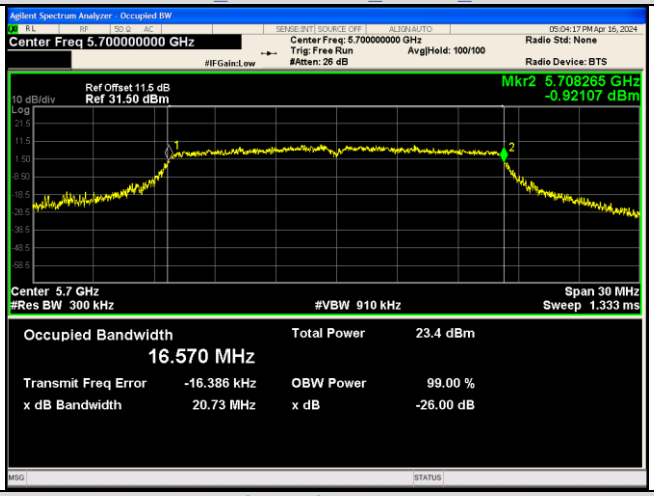
IEEE 802.11a_Channel 116_20MHz_Antenna 3



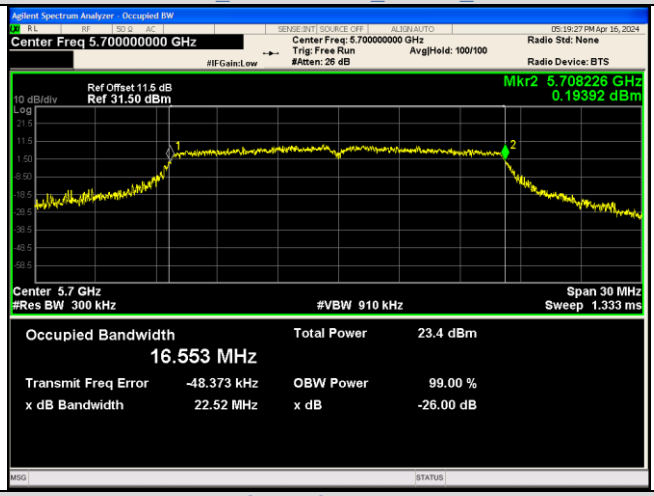
IEEE 802.11a_Channel 140_20MHz_Antenna 0



IEEE 802.11a_Channel 140_20MHz_Antenna 1



IEEE 802.11a_Channel 140_20MHz_Antenna 2



IEEE 802.11a_Channel 140_20MHz_Antenna 3