Certificate #4312.01

TEST REPORT

Product Name:	In-Wall Wi-Fi Access Point
Trade Mark:	GRANDSTREAM
Model No. / HVIN:	GWN7624
Add. Model No. / HVIN:	N/A
Report Number:	220216022RFC-2
Test Standards:	FCC 47 CFR Part 15 Subpart E RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	YZZGWN7624
IC:	11964A-GWN7624
Test Result:	PASS
Date of Issue:	July 29, 2022

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:	Calvin Chen Senior Project Engineer	Reviewed by:	Eric Yu Project Supervisor
Approved by:	Kevin Liang Assistant Manager	Date:	July 29, 2022

Version

Version No.	Date	Description
V1.0	July 29, 2022	Original

CONTENTS

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:	In-Wall Wi-Fi Access Point		
Model No. / HVIN:	GWN7624		
Add. Model No. / HVIN:	N/A		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Production Unit		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	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
Software Version:	V1.0 (Provided by the customer)		
Hardware Version:	0.2.14.1 (Provided by the customer)		
Sample Received Date:	February 17, 2022		
Sample Tested Date:	February 21, 2022 to June 25, 2022		

1.2.2 Description of Accessories

None

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)
	5 725 MHz to 5 850 MHz (U-NII-3)
Frequency Ranges:	5180 MHz to 5240 MHz
	5260 MHz to 5320 MHz
	5500 MHz to 5700 MHz
	5 745 MHz to 5 825 MHz
Support Standards:	IEEE 802.11a/n/ac
TPC Function:	Not Support
DFS Operational mode:	Master
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

<table>
<tr><td></td><td colspan="6">IEEE 802.11n-HT20: Up to MCS31</td></tr>
<tr><td></td><td colspan="6">IEEE 802.11n-HT40: Up to MCS31</td></tr>
<tr><td></td><td colspan="6">IEEE 802.11ac-VHT20: Up to MCS9</td></tr>
<tr><td></td><td colspan="6">IEEE 802.11ac-VHT40: Up to MCS9</td></tr>
<tr><td></td><td colspan="6">IEEE 802.11ac-VHT80: Up to MCS9</td></tr>
<tr><td rowspan="4">Number of Channels:</td><td colspan="6">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</td></tr>
<tr><td colspan="6">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</td></tr>
<tr><td colspan="6">5470 MHz to 5725 MHz:
11 for IEEE 802.11a/n-HT20/ac-VHT20
5 for IEEE 802.11n-HT40/ac-VHT40
2 for IEEE 802.11ac-VHT80</td></tr>
<tr><td colspan="6">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</td></tr>
<tr><td rowspan="4">Antenna Type:</td><td>Chain 0</td><td colspan="5">Dipole Antenna</td></tr>
<tr><td>Chain 1</td><td colspan="5">Dipole Antenna</td></tr>
<tr><td>Chain 2</td><td colspan="5">Dipole Antenna</td></tr>
<tr><td>Chain 3</td><td colspan="5">Dipole Antenna</td></tr>
<tr><td rowspan="4">Antenna Gain:
(Provided by the customer)</td><td>Chain 0</td><td colspan="5">5150 MHz to 5850 MHz: 4.5 dBi</td></tr>
<tr><td>Chain 1</td><td colspan="5">5150 MHz to 5850 MHz: 5.0 dBi</td></tr>
<tr><td>Chain 2</td><td colspan="5">5150 MHz to 5850 MHz: 3.0 dBi</td></tr>
<tr><td>Chain 3</td><td colspan="5">5150 MHz to 5850 MHz: 3.5 dBi</td></tr>
<tr><td rowspan="11">Maximum EIRP (dBm):</td><td colspan="2">SISO Mode</td><td colspan="4">U-NII-1</td></tr>
<tr><td colspan="2" rowspan="4">IEEE 802.11a:</td><td>Chain 0</td><td colspan="3">14.83</td></tr>
<tr><td>Chain 1</td><td colspan="3">14.59</td></tr>
<tr><td>Chain 2</td><td colspan="3">14.02</td></tr>
<tr><td>Chain 3</td><td colspan="3">14.09</td></tr>
<tr><td colspan="2">MIMO Mode
(Chain 0+1+2+3)</td><td colspan="4">U-NII-1</td></tr>
<tr><td colspan="2">IEEE 802.11n-HT20:</td><td colspan="4">14.66</td></tr>
<tr><td colspan="2">IEEE 802.11n-HT40:</td><td colspan="4">16.28</td></tr>
<tr><td colspan="2">IEEE 802.11ac-VHT20:</td><td colspan="4">14.80</td></tr>
<tr><td colspan="2">IEEE 802.11ac-VHT40:</td><td colspan="4">16.82</td></tr>
<tr><td colspan="2">IEEE 802.11ac-VHT80:</td><td colspan="4">18.27</td></tr>
<tr><td rowspan="7">Maximum conducted output power (dBm):</td><td colspan="2">SISO Mode</td><td>U-NII-1</td><td>U-NII-2A</td><td>U-NII-2C</td><td>U-NII-3</td></tr>
<tr><td rowspan="4">IEEE 802.11a:</td><td>Chain 0</td><td>21.59</td><td>15.83</td><td>15.98</td><td>20.08</td></tr>
<tr><td>Chain 1</td><td>22.04</td><td>15.59</td><td>15.74</td><td>20.96</td></tr>
<tr><td>Chain 2</td><td>21.71</td><td>15.70</td><td>15.9</td><td>19.92</td></tr>
<tr><td>Chain 3</td><td>20.27</td><td>15.64</td><td>15.77</td><td>21.30</td></tr>
<tr><td colspan="2">MIMO Mode
(Chain 0+1+2+3)</td><td>U-NII-1</td><td>U-NII-2A</td><td>U-NII-2C</td><td>U-NII-3</td></tr>
<tr><td colspan="2">IEEE 802.11n-HT20:</td><td>21.64</td><td>16.17</td><td>15.97</td><td>25.62</td></tr>
</table>

	IEEE 802.11n-HT40:	23.71	18.36	18.37	25.10
	IEEE 802.11ac-VHT20:	21.69	15.97	16.08	25.53
	IEEE 802.11ac-VHT40:	19.76	18.69	18.79	25.15
	IEEE 802.11ac-VHT80:	16.78	16.43	17.40	25.84
Normal Test Voltage:	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,…, 4	n = 5,…, 8	n = 17,…, 27	n = 1,…, 5
IEEE 802.11n-HT40, IEEE 802.11ac-VHT40	f = 5000 + 5k, k = 30 + 8n			f = 5000 + 5k, k = 143 + 8n
	n = 1, 2	n = 1,…, 5	n = 9,…, 13	n = 1, 2
IEEE 802.11ac-VHT80	f = 5000 + 5k, k = 26 + 16n			f = 5000 + 5k, k = 155
	n = 1	n = 1, 2	n = 5, 6	
Note: **f** is the operating frequency (MHz); **k** is the operating channel.				

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	FCC ID	Supplied by
POE Adapter	GOSPELL	G0720-480-050	N/A	Applicant	POE Adapter
Notebook	DELL	Latitude 3400	16238087894	UnionTrust	Notebook

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.30 Meter	UnionTrust
2	Ethernet Cable	RJ45	1.50meter Unshielded without ferrite	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, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

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

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 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

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) 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 D02 UNII DFS Compliance Procedures New Rules v02	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
Note: 1) N/A: In this whole report not applicable.			

For Dynamic Frequency Selection

Test Case	Result
Channel Availability Check Time	PASS
U-NII Detection Bandwidth	PASS
Channel Closing Transmission Time	PASS
Channel Move Time	PASS
DFS Detection Threshold	PASS
Non- Occupancy Period	PASS

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	3M Chamber & Accessory Equipment	ETS-LINDGREN	3M	Euroshiedpn-CT001270-1317	22-Jan-2021	21-Jan-2024
☒	Receiver	R&S	ESIB26	100114	5-Nov-2021	4-Nov-2022
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	22-Apr-2021	21-Apr-2022
					15-Apr-2022	14-Apr-2023
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	11-Nov-2021	10-Nov-2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	11-Nov-2021	10-Nov-2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	11-Nov-2021	10-Nov-2023
☒	Preamplifier	HP	8447F	2805A02960	5-Nov-2021	4-Nov-2022
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201874	6-Nov-2021	5-Nov-2022
☒	Pre-amplifier	ETS-Lindgren	00118385	00201874	Nov. 06, 2021	Nov. 05, 2022
☒	Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	14-Nov-2020	13-Nov-2022
☒	Pre-amplifier	ETS-Lindgren	00118384	00202652	Nov. 17, 2020	Nov. 16, 2022
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G186	06-Nov-2021	05-Nov-2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	Receiver	R&S	ESR7	101181	5-Nov-2021	4-Nov-2022
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	5-Nov-2021	4-Nov-2022
☒	LISN	R&S	ESH2-Z5	860014/024	5-Nov-2021	4-Nov-2022
☒	Test Software	Audix	e3	Software Version: 9.160323		

RF Conducted Test Equipment List						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date	Cal. Due date
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	22-Apr-2021	21-Apr-2022
					15-Apr-2022	14-Apr-2023
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	5-Nov-2021	4-Nov-2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	5-Nov-2021	4-Nov-2022
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	5-Nov-2021	4-Nov-2022

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 / 240V~50Hz	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment and Test Sample

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
26 dB emission bandwidth	25.4	48	102.1	220216022-A01/2	Hank Wu
6 dB bandwidth					
Occupied Bandwidth					
Maximum conducted output power					
Peak Power Spectral Density					
Radiated Emissions and Band Edge Measurement	21.3	52	100.2	220216022-A02/2	Fire Huo
Dynamic Frequency Selection	24.7	53	100.5	220216022-B03/3	Hank Wu
AC Power Line Conducted Emission	24.1	46	101.1	220216022-B01/3	David Zhang

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 or 4Tx/4Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Remark: The device just supports 1TX and 4TX mode. Does not support 2TX,3TX mode.

Test Software (Provided by the customer)
Test software name: QRCT 4

Power Setting for U-NII-1 RSS-247 (Provided by the customer):

Chains	802.11a			802.11n-ht20/ac-vht20 MIMO			802.11n-HT40 MIMO		802.11ac-VHT40 MIMO		802.11ac-VHT80 MIMO
	36	44	48	36	44	48	38	46	38	46	42
	5180	5220	5240	5180	5220	5240	5190	5230	5190	5230	5210
Chain 0	1D	1D	1D	07(ht20) 0A(ac20)	07(ht20) 0A(ac20)	08(ht20) 0A(ac20)	09	0A	0A	0A	0B
Chain 1	1C	1C	1C								
Chain 2	1E	1E	1E								
Chain 3	1E	1E	1E								

Power Setting (Provided by the customer):

Antenna	802.11a											
	36	44	48	52	60	64	100	116	140	149	157	165
	5180	5220	5240	5260	5300	5320	5500	5580	5700	5745	5785	5825
ANT 0	2E	38	38	28	28	28	28	28	28	35	38	35
ANT 1	2E	38	38	28	28	28	28	28	28	35	38	35
ANT 2	2E	38	38	28	28	28	28	28	28	35	38	35
ANT 3	2E	38	38	28	29	29	2A	29	2A	35	38	35

Antenna	802.11n HT20 MIMO											
	36	44	48	52	60	64	100	116	140	149	157	165
	5180	5220	5240	5260	5300	5320	5500	5580	5700	5745	5785	5825
ANT 0	28	28	28	1E	1D	1D	1D	1D	1D	35	38	35
ANT 1												
ANT 2												
ANT 3												

Antenna	802.11n HT40 MIMO								
	38	46	54	62	102	110	134	151	159
	5190	5230	5270	5310	5510	5550	5670	5755	5795
ANT 0	24	2D	22	23	22	22	23	30	30
ANT 1									
ANT 2									
ANT 3									

Antenna	802.11ac VHT20 MIMO											
	36	44	48	52	60	64	100	116	140	149	157	165
	5180	5220	5240	5260	5300	5320	5500	5580	5700	5745	5785	5825
ANT 0	27	27	28	1D	1D	1D	1D	1D	1D	35	38	35
ANT 1												
ANT 2												
ANT 3												

Antenna	802.11ac VHT40 MIMO								
	38	46	54	62	102	110	134	151	159
	5190	5230	5270	5310	5510	5550	5670	5755	5795
ANT 0	24	1D	22	22	22	22	22	30	30
ANT 1									
ANT 2									
ANT 3									

Antenna	802.11ac VHT80 MIMO				
	42	58	106	122	155
	5210	5290	5530	5610	5775
ANT 0	1E	1E	20	20	30
ANT 1					
ANT 2					
ANT 3					

4.4 PRE-SCAN

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

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

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

Figure 1. Below 30MHz

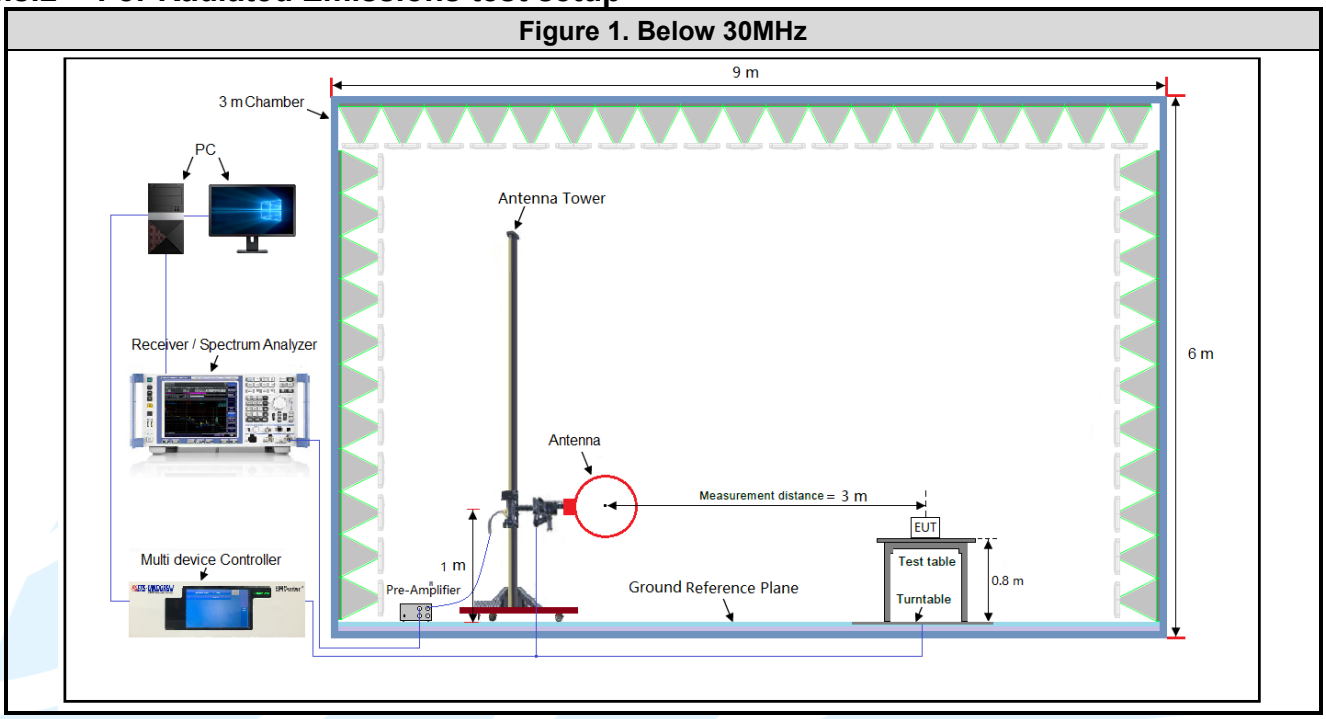


Figure 2. 30MHz to 1GHz

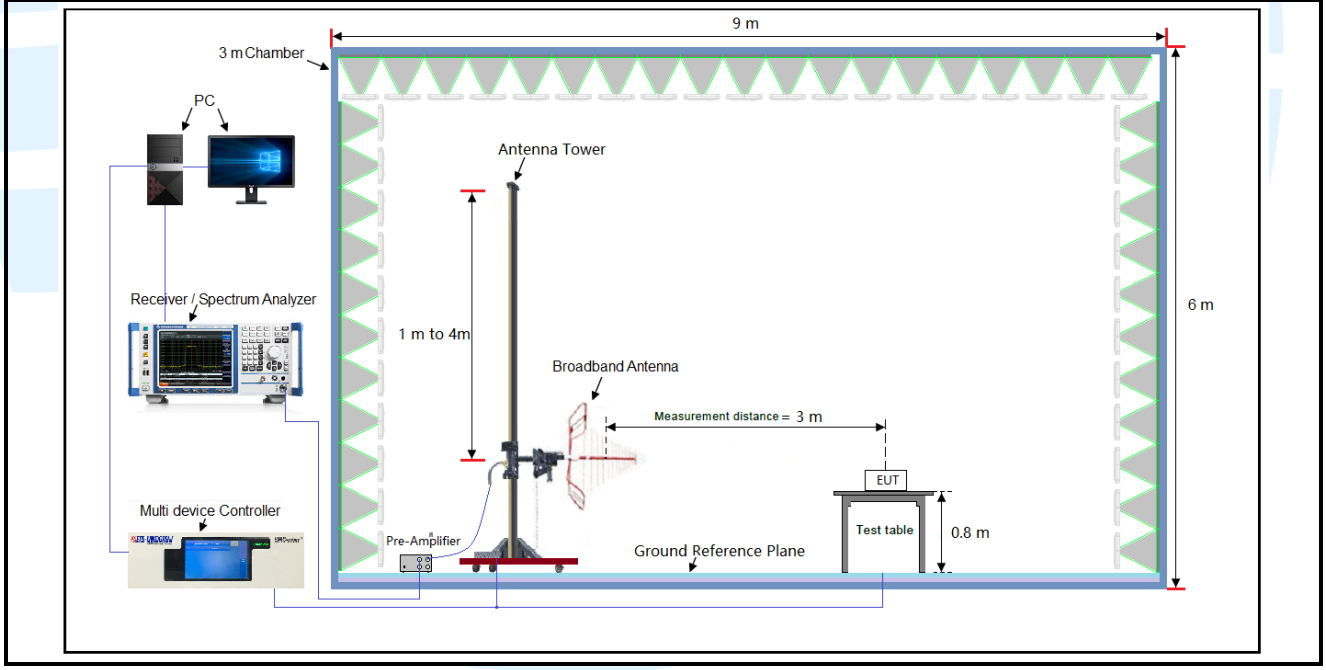
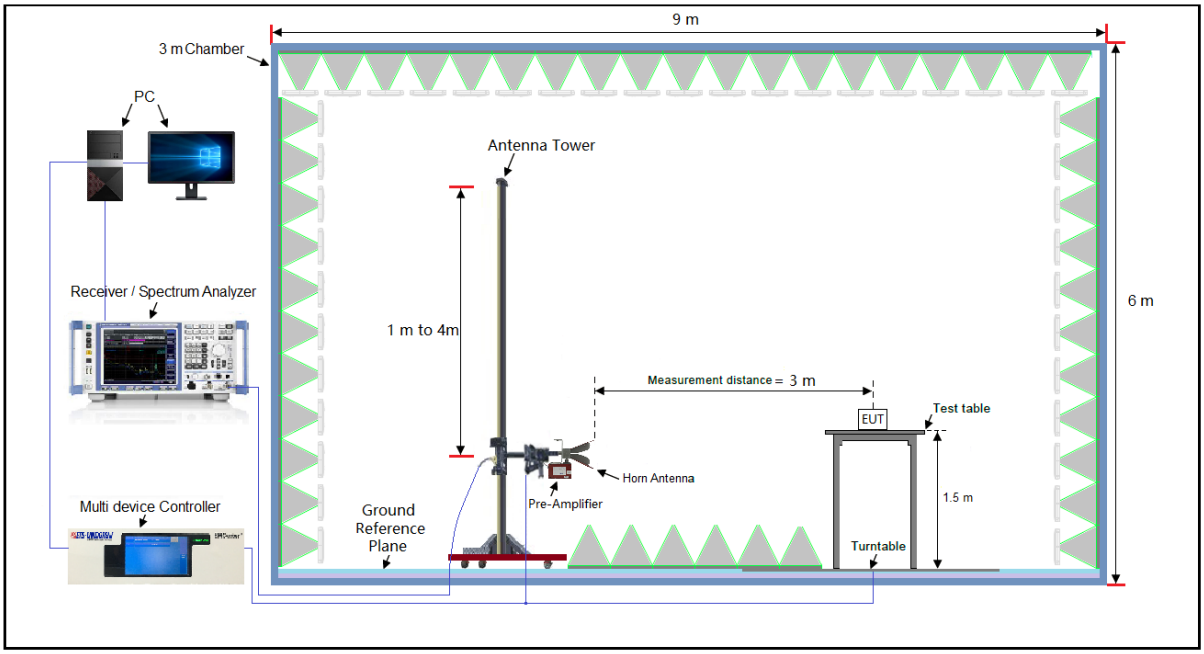
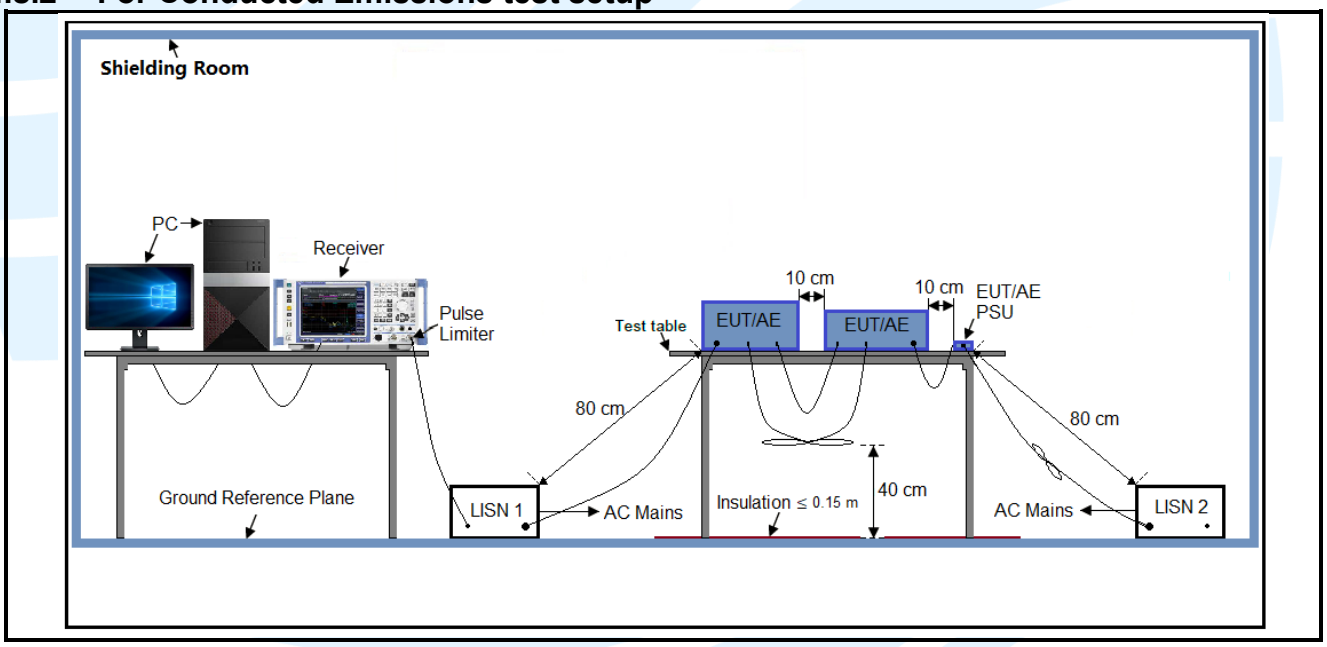


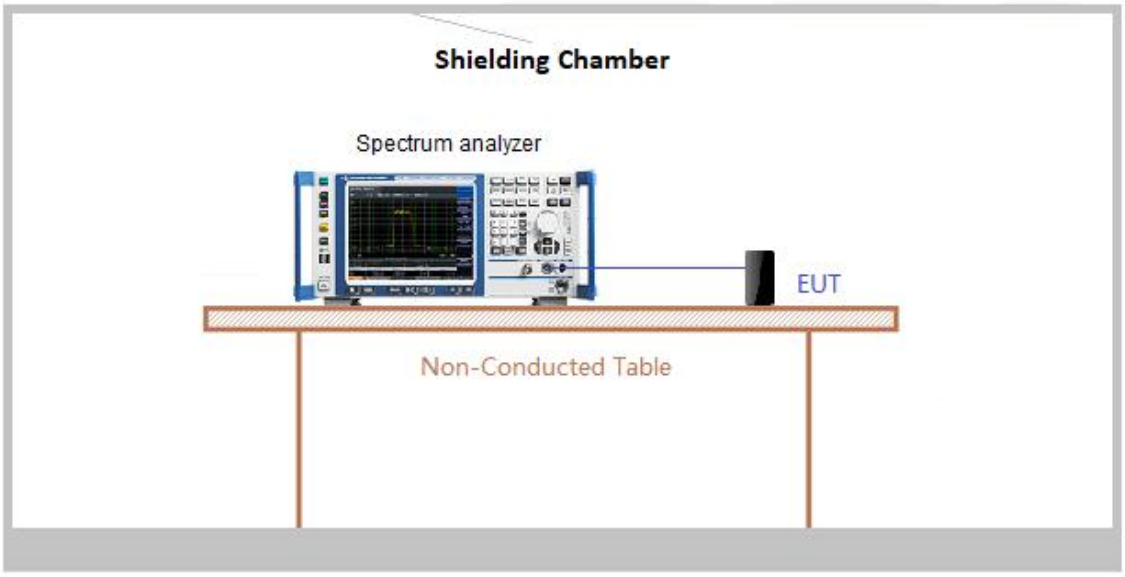
Figure 3. Above 1GHz



4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



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 (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis
	1TX	Chain 1	Y axis
	1TX	Chain 2	Y axis
	1TX	Chain 3	Y axis
	4TX	Chain 0+1+2+3	Y axis

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

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

4.7 DUTY CYCLE

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

Test Results

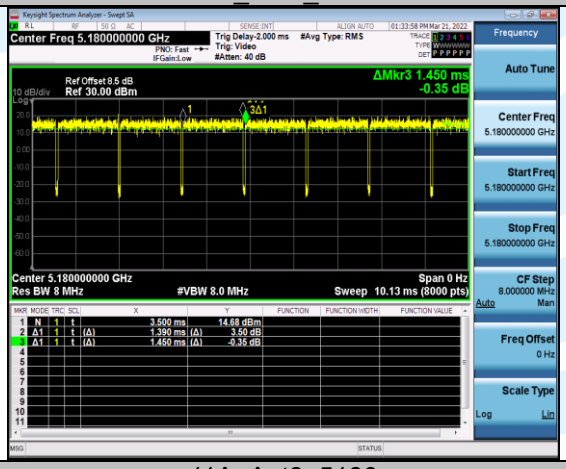
Test Mode	Antenna	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]	Limit	Verdict
11A	Ant1	5180	1.39	1.45	95.86	---	PASS
	Ant2	5180	1.39	1.45	95.86	---	PASS
	Ant3	5180	1.40	1.45	96.55	---	PASS
	Ant4	5180	1.40	1.45	96.55	---	PASS
11N20MIMO	Ant1	5180	0.36	0.42	85.71	---	PASS
	Ant2	5180	0.37	0.42	88.10	---	PASS
	Ant3	5180	0.37	0.42	88.10	---	PASS
	Ant4	5180	0.37	0.42	88.10	---	PASS
11N40MIMO	Ant1	5190	0.20	0.55	36.36	---	PASS
	Ant2	5190	0.20	0.55	36.36	---	PASS
	Ant3	5190	0.20	0.55	36.36	---	PASS
	Ant4	5190	0.20	0.55	36.36	---	PASS
11AC20MIMO	Ant1	5180	0.37	0.43	86.05	---	PASS
	Ant2	5180	0.37	0.43	86.05	---	PASS
	Ant3	5180	0.37	0.43	86.05	---	PASS
	Ant4	5180	0.37	0.42	88.10	---	PASS
11AC40MIMO	Ant1	5190	0.20	0.26	76.92	---	PASS
	Ant2	5190	0.20	0.25	80.00	---	PASS
	Ant3	5190	0.21	0.26	80.77	---	PASS
	Ant4	5190	0.21	0.26	80.77	---	PASS
11AC80MIMO	Ant1	5210	0.12	0.45	26.67	---	PASS
	Ant2	5210	0.12	0.45	26.67	---	PASS
	Ant3	5210	0.12	0.47	25.53	---	PASS
	Ant4	5210	0.12	0.45	26.67	---	PASS

Remark:

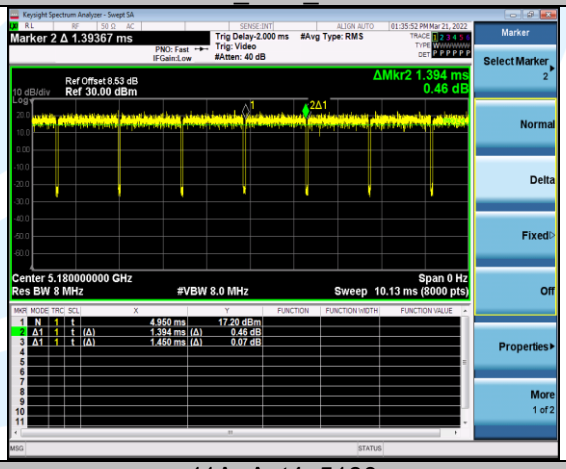
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log (1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

Test Graphs as follows:

11A_Ant1_5180

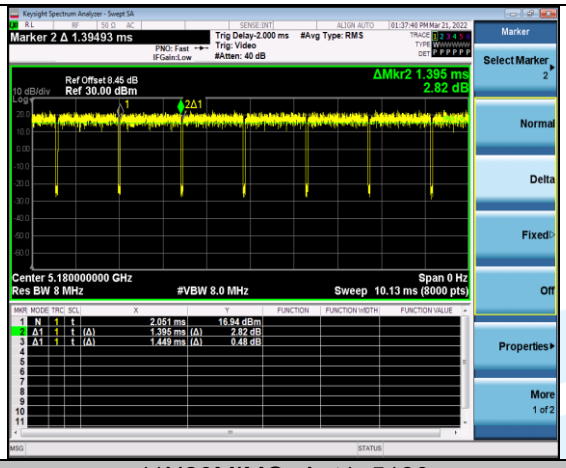


11A_Ant2_5180

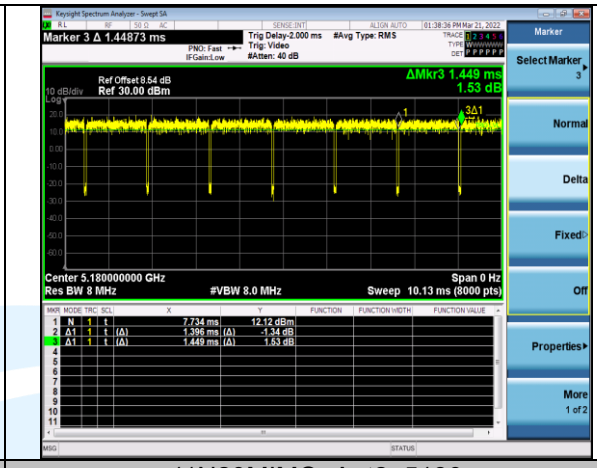


11A_Ant3_5180

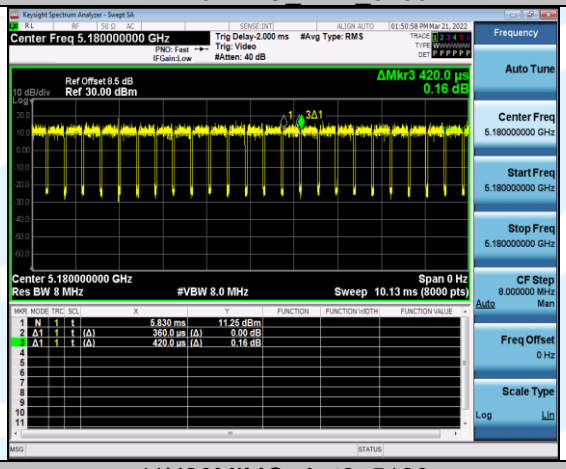
11A_Ant4_5180



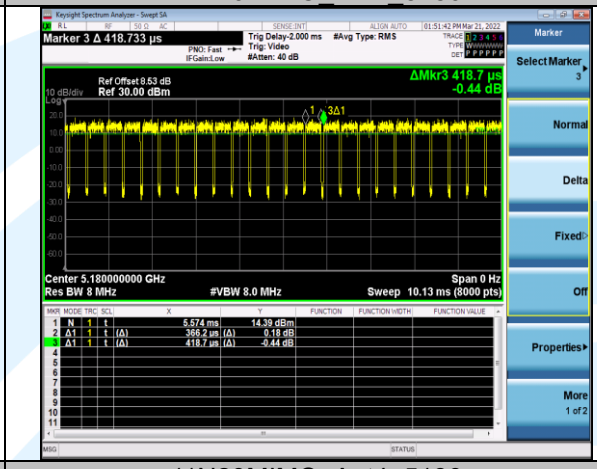
11N20MIMO_Ant1_5180



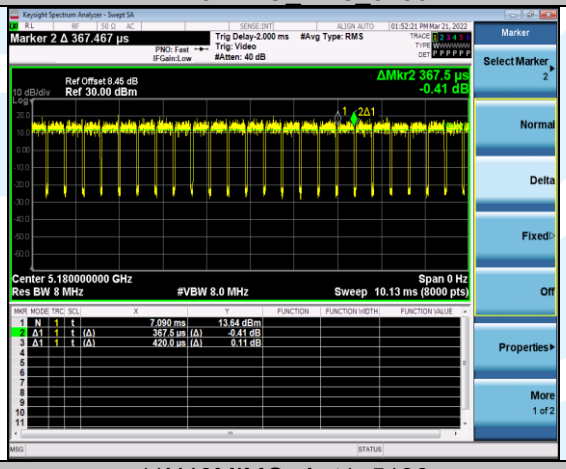
11N20MIMO_Ant2_5180



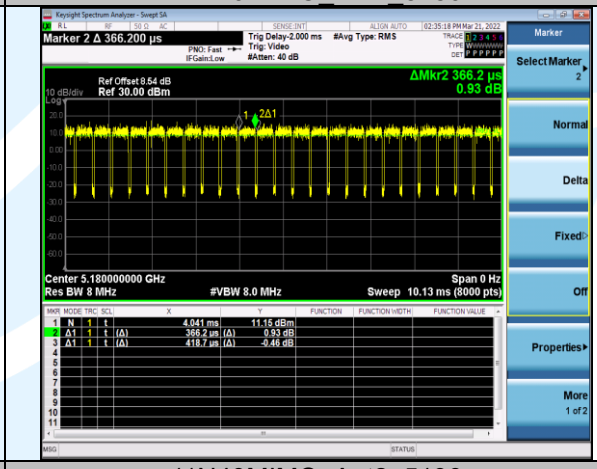
11N20MIMO_Ant3_5180



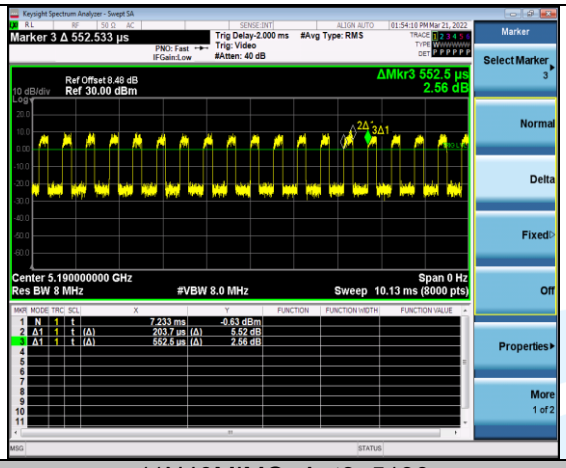
11N20MIMO_Ant4_5180



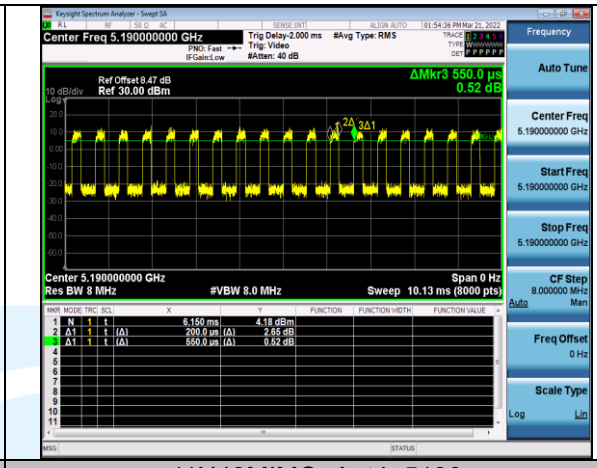
11N40MIMO_Ant1_5190



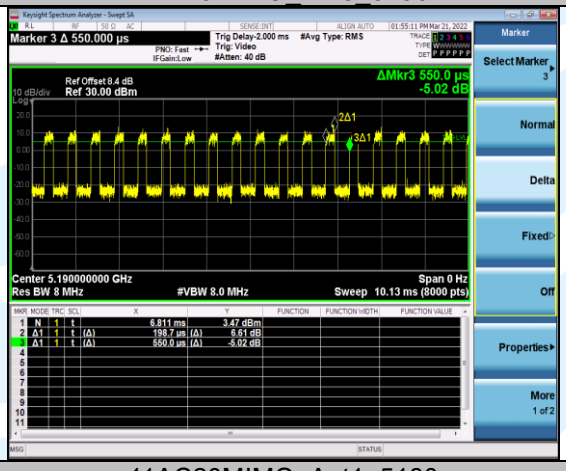
11N40MIMO_Ant2_5190



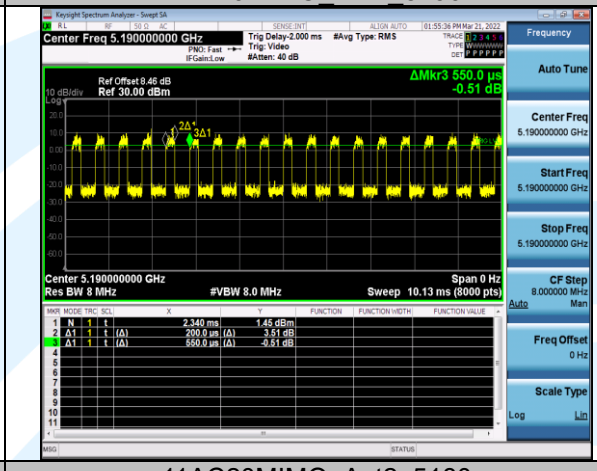
11N40MIMO_Ant3_5190



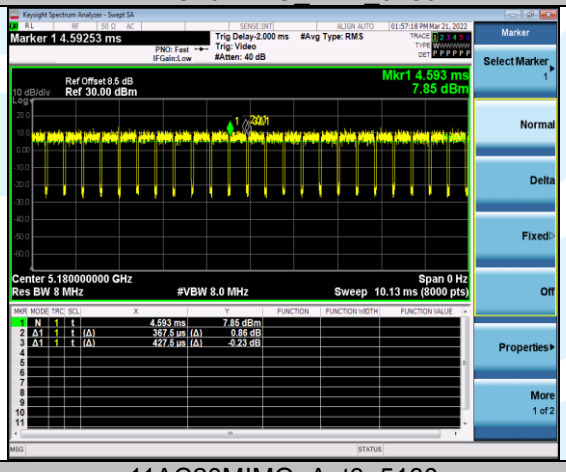
11N40MIMO_Ant4_5190



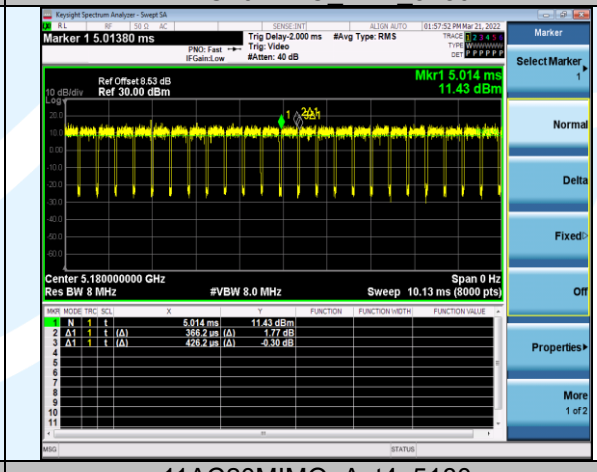
11AC20MIMO_Ant1_5180



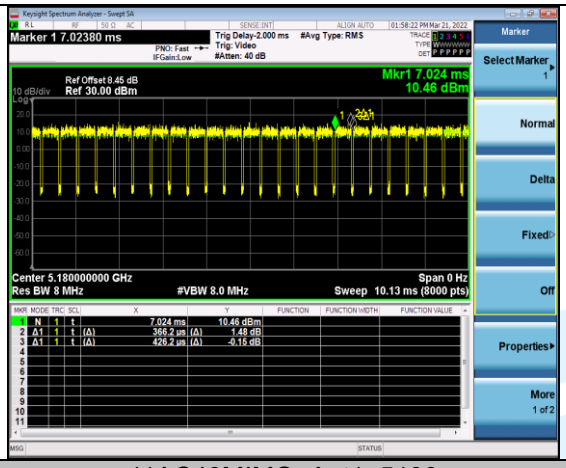
11AC20MIMO_Ant2_5180



11AC20MIMO_Ant3_5180



11AC20MIMO_Ant4_5180



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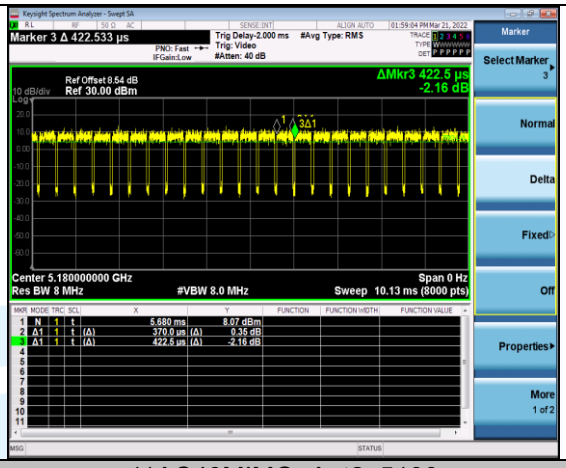

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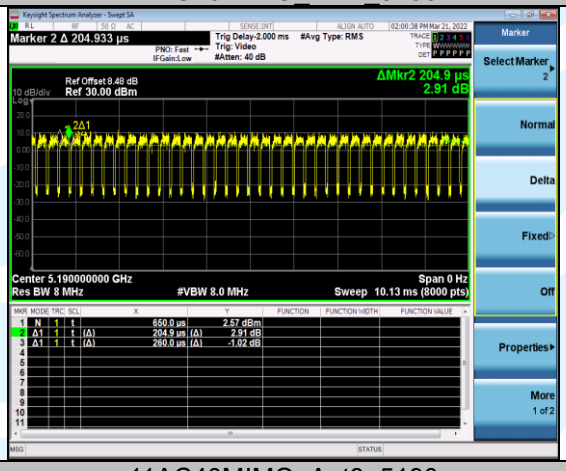
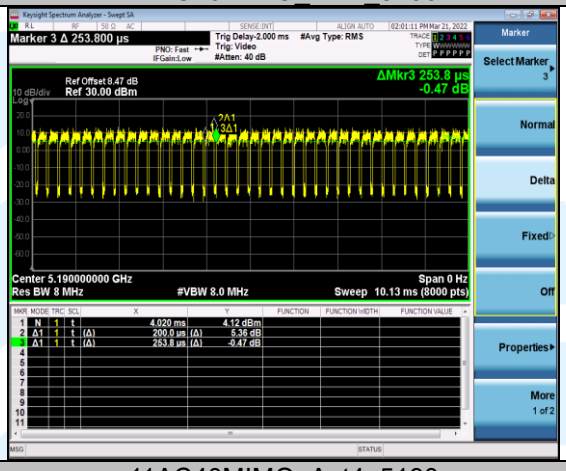
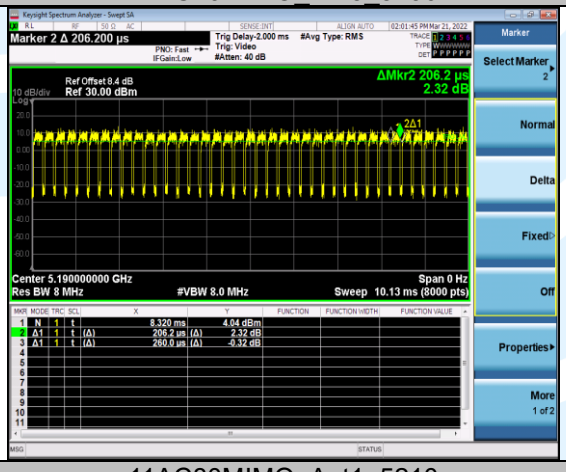


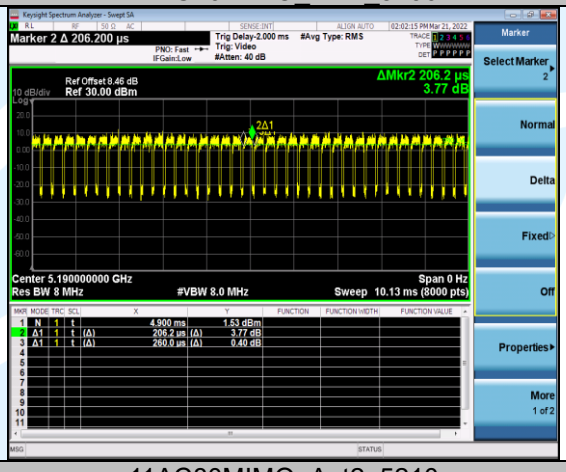
11AC40MIMO_Ant3_5190



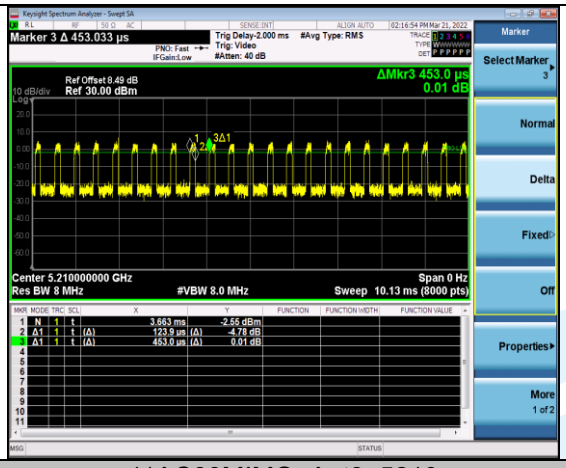
11AC40MIMO_Ant4_5190

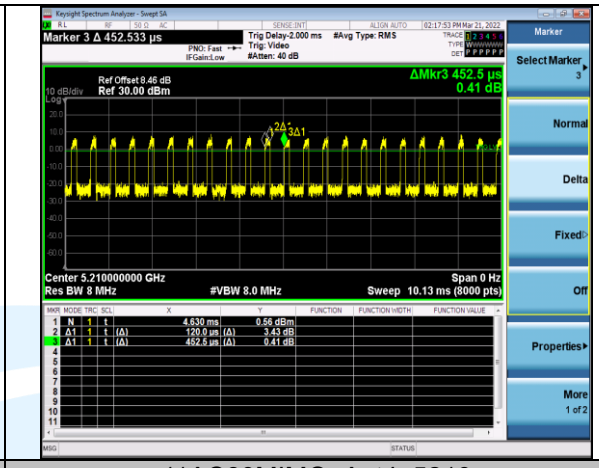


11AC80MIMO_Ant1_5210



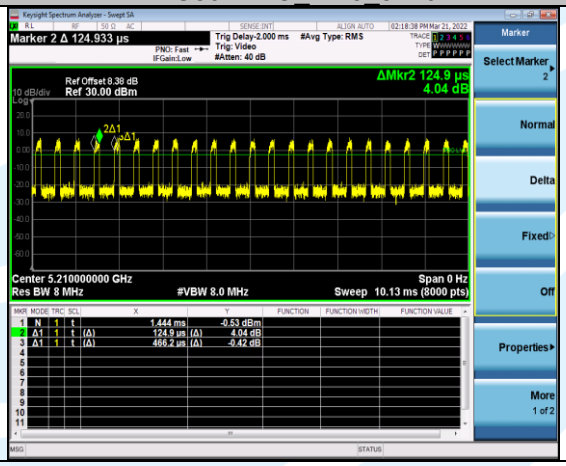
11AC80MIMO_Ant2_5210

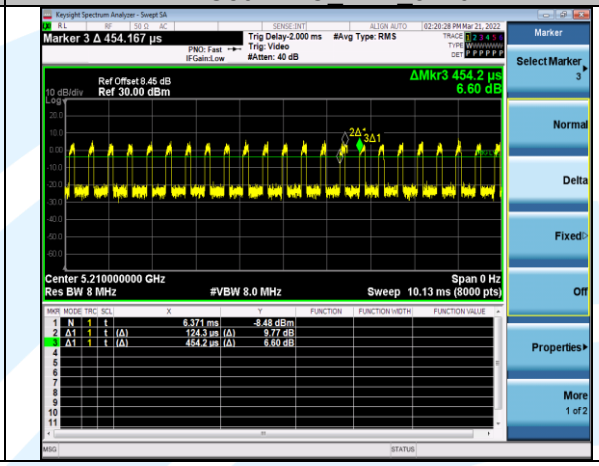




11AC80MIMO_Ant3_5210

11AC80MIMO_Ant4_5210





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 Unlicesed 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 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. **RSS-Gen Issue 5, Section 6.8 requirement:** 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.
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 11.02 dBi (See section 5.5).

5.3 26 DB BANDWIDTH

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

Test Mode	Antenna	Channel	26db EBW [MHz]	FL[MHz]	FH[MHz]	Limit [MHz]	Verdict
11A	Ant1	5180	30.520	5164.040	5194.560	---	---
	Ant2	5180	26.760	5165.640	5192.400	---	---
	Ant3	5180	26.760	5165.640	5192.400	---	---
	Ant4	5180	30.000	5165.720	5195.720	---	---
	Ant1	5220	39.360	5200.040	5239.400	---	---
	Ant2	5220	37.560	5200.880	5238.440	---	---
	Ant3	5220	37.280	5201.040	5238.320	---	---
	Ant4	5220	32.600	5204.360	5236.960	---	---
	Ant1	5240	39.200	5220.000	5259.200	---	---
	Ant2	5240	37.040	5221.080	5258.120	---	---
	Ant3	5240	37.520	5220.840	5258.360	---	---
	Ant4	5240	33.120	5224.520	5257.640	---	---
	Ant1	5260	19.560	5250.280	5269.840	---	---
	Ant2	5260	19.760	5250.160	5269.920	---	---
	Ant3	5260	19.800	5250.200	5270.000	---	---
	Ant4	5260	19.600	5250.280	5269.880	---	---
	Ant1	5300	19.720	5290.120	5309.840	---	---
	Ant2	5300	19.760	5290.160	5309.920	---	---
	Ant3	5300	19.840	5290.120	5309.960	---	---
	Ant4	5300	19.760	5290.320	5310.080	---	---
	Ant1	5320	19.640	5310.120	5329.760	---	---
	Ant2	5320	19.800	5310.160	5329.960	---	---
	Ant3	5320	19.840	5310.080	5329.920	---	---
	Ant4	5320	19.800	5310.360	5330.160	---	---
	Ant1	5500	19.720	5490.120	5509.840	---	---
	Ant2	5500	20.080	5490.080	5510.160	---	---
	Ant3	5500	19.800	5490.160	5509.960	---	---
	Ant4	5500	24.400	5487.880	5512.280	---	---
	Ant1	5580	19.640	5570.120	5589.760	---	---
	Ant2	5580	21.280	5568.920	5590.200	---	---
	Ant3	5580	20.040	5569.960	5590.000	---	---
	Ant4	5580	19.960	5570.240	5590.200	---	---
	Ant1	5700	24.400	5687.880	5712.280	---	---
	Ant2	5700	24.880	5687.640	5712.520	---	---
	Ant3	5700	22.240	5687.960	5710.200	---	---

	Ant4	5700	19.520	5690.280	5709.800	---	---
11N20MIMO	Ant1	5180	20.160	5170.120	5190.280	---	---
	Ant2	5180	20.120	5170.000	5190.120	---	---
	Ant3	5180	20.200	5169.960	5190.160	---	---
	Ant4	5180	20.440	5169.800	5190.240	---	---
	Ant1	5220	20.040	5210.080	5230.120	---	---
	Ant2	5220	20.120	5210.000	5230.120	---	---
	Ant3	5220	20.280	5209.880	5230.160	---	---
	Ant4	5220	20.320	5209.920	5230.240	---	---
	Ant1	5240	19.960	5230.000	5249.960	---	---
	Ant2	5240	20.120	5230.040	5250.160	---	---
	Ant3	5240	20.280	5229.960	5250.240	---	---
	Ant4	5240	19.960	5230.160	5250.120	---	---
	Ant1	5260	20.000	5250.080	5270.080	---	---
	Ant2	5260	20.080	5250.040	5270.120	---	---
	Ant3	5260	20.240	5250.000	5270.240	---	---
	Ant4	5260	20.240	5250.040	5270.280	---	---
	Ant1	5300	20.000	5290.120	5310.120	---	---
	Ant2	5300	20.160	5290.000	5310.160	---	---
	Ant3	5300	20.280	5289.840	5310.120	---	---
	Ant4	5300	20.280	5289.880	5310.160	---	---
	Ant1	5320	20.040	5310.000	5330.040	---	---
	Ant2	5320	20.080	5310.040	5330.120	---	---
	Ant3	5320	20.200	5310.080	5330.280	---	---
	Ant4	5320	20.280	5309.960	5330.240	---	---
	Ant1	5500	20.040	5490.040	5510.080	---	---
	Ant2	5500	20.160	5490.000	5510.160	---	---
	Ant3	5500	20.320	5489.920	5510.240	---	---
	Ant4	5500	20.280	5489.840	5510.120	---	---
	Ant1	5580	20.120	5570.000	5590.120	---	---
	Ant2	5580	20.120	5570.000	5590.120	---	---
	Ant3	5580	20.440	5569.800	5590.240	---	---
	Ant4	5580	20.200	5569.960	5590.160	---	---
	Ant1	5700	20.120	5690.000	5710.120	---	---
	Ant2	5700	20.080	5690.000	5710.080	---	---
	Ant3	5700	20.360	5689.920	5710.280	---	---
	Ant4	5700	20.200	5689.960	5710.160	---	---
11N40MIMO	Ant1	5190	40.400	5170.160	5210.560	---	---
	Ant2	5190	39.920	5170.160	5210.080	---	---
	Ant3	5190	39.680	5170.160	5209.840	---	---
	Ant4	5190	39.600	5170.160	5209.760	---	---
	Ant1	5230	42.720	5209.280	5252.000	---	---
	Ant2	5230	39.840	5210.240	5250.080	---	---
	Ant3	5230	40.240	5209.760	5250.000	---	---
	Ant4	5230	40.480	5209.600	5250.080	---	---
	Ant1	5270	40.480	5250.000	5290.480	---	---
	Ant2	5270	39.520	5250.320	5289.840	---	---
	Ant3	5270	39.280	5250.480	5289.760	---	---
	Ant4	5270	39.680	5250.320	5290.000	---	---
	Ant1	5310	40.480	5289.680	5330.160	---	---
	Ant2	5310	39.920	5290.080	5330.000	---	---
	Ant3	5310	39.920	5290.160	5330.080	---	---
	Ant4	5310	39.920	5290.080	5330.000	---	---
	Ant1	5510	40.720	5489.680	5530.400	---	---
	Ant2	5510	39.760	5490.080	5529.840	---	---
	Ant3	5510	39.520	5490.320	5529.840	---	---
	Ant4	5510	39.600	5490.240	5529.840	---	---
	Ant1	5550	40.080	5530.000	5570.080	---	---
	Ant2	5550	39.920	5530.000	5569.920	---	---
	Ant3	5550	39.680	5530.080	5569.760	---	---
	Ant4	5550	39.840	5530.160	5570.000	---	---
	Ant1	5670	40.400	5649.600	5690.000	---	---
	Ant2	5670	40.160	5650.000	5690.160	---	---

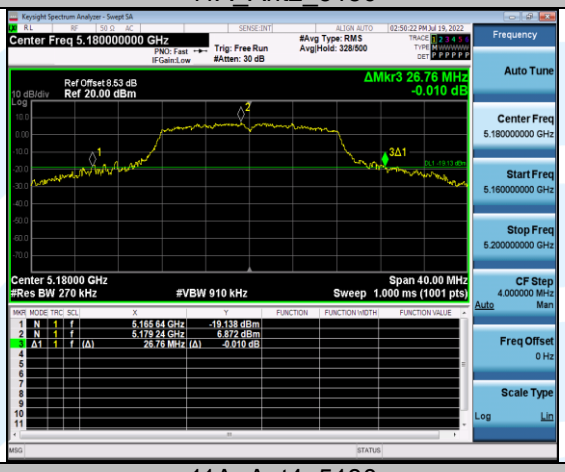
	Ant3	5670	39.200	5650.400	5689.600	---	---
	Ant4	5670	40.400	5650.000	5690.400	---	---
11AC20MIMO	Ant1	5180	20.080	5170.040	5190.120	---	---
	Ant2	5180	20.120	5170.000	5190.120	---	---
	Ant3	5180	20.120	5170.120	5190.240	---	---
	Ant4	5180	20.320	5169.880	5190.200	---	---
	Ant1	5220	20.160	5210.040	5230.200	---	---
	Ant2	5220	20.040	5210.080	5230.120	---	---
	Ant3	5220	20.360	5209.880	5230.240	---	---
	Ant4	5220	19.880	5210.080	5229.960	---	---
	Ant1	5240	20.240	5230.000	5250.240	---	---
	Ant2	5240	19.960	5230.120	5250.080	---	---
	Ant3	5240	20.200	5230.080	5250.280	---	---
	Ant4	5240	20.240	5229.960	5250.200	---	---
	Ant1	5260	20.040	5250.080	5270.120	---	---
	Ant2	5260	20.120	5250.040	5270.160	---	---
	Ant3	5260	20.080	5250.040	5270.120	---	---
	Ant4	5260	20.240	5250.000	5270.240	---	---
	Ant1	5300	20.160	5290.000	5310.160	---	---
	Ant2	5300	20.120	5290.040	5310.160	---	---
	Ant3	5300	20.320	5289.920	5310.240	---	---
	Ant4	5300	20.280	5289.960	5310.240	---	---
	Ant1	5320	20.120	5310.040	5330.160	---	---
	Ant2	5320	20.120	5310.000	5330.120	---	---
	Ant3	5320	20.320	5309.920	5330.240	---	---
	Ant4	5320	20.280	5309.960	5330.240	---	---
	Ant1	5500	20.040	5490.080	5510.120	---	---
	Ant2	5500	20.080	5490.040	5510.120	---	---
	Ant3	5500	20.360	5489.880	5510.240	---	---
	Ant4	5500	20.080	5490.000	5510.080	---	---
	Ant1	5580	20.200	5569.960	5590.160	---	---
	Ant2	5580	20.120	5570.000	5590.120	---	---
	Ant3	5580	20.040	5570.000	5590.040	---	---
	Ant4	5580	20.240	5569.960	5590.200	---	---
	Ant1	5700	20.080	5690.000	5710.080	---	---
	Ant2	5700	20.040	5690.040	5710.080	---	---
	Ant3	5700	20.240	5689.960	5710.200	---	---
	Ant4	5700	20.240	5689.960	5710.200	---	---
11AC40MIMO	Ant1	5190	40.160	5170.080	5210.240	---	---
	Ant2	5190	39.920	5170.080	5210.000	---	---
	Ant3	5190	39.520	5170.400	5209.920	---	---
	Ant4	5190	39.680	5170.240	5209.920	---	---
	Ant1	5230	40.320	5210.160	5250.480	---	---
	Ant2	5230	39.920	5210.160	5250.080	---	---
	Ant3	5230	39.440	5210.400	5249.840	---	---
	Ant4	5230	39.840	5210.320	5250.160	---	---
	Ant1	5270	40.640	5249.840	5290.480	---	---
	Ant2	5270	40.000	5250.080	5290.080	---	---
	Ant3	5270	39.360	5250.480	5289.840	---	---
	Ant4	5270	39.680	5250.400	5290.080	---	---
	Ant1	5310	40.880	5289.680	5330.560	---	---
	Ant2	5310	39.920	5290.080	5330.000	---	---
	Ant3	5310	39.600	5290.160	5329.760	---	---
	Ant4	5310	39.520	5290.320	5329.840	---	---
	Ant1	5510	40.160	5490.080	5530.240	---	---
	Ant2	5510	40.080	5490.080	5530.160	---	---
	Ant3	5510	39.680	5490.240	5529.920	---	---
	Ant4	5510	39.600	5490.240	5529.840	---	---
	Ant1	5550	40.240	5529.920	5570.160	---	---
	Ant2	5550	39.680	5530.240	5569.920	---	---
	Ant3	5550	39.440	5530.400	5569.840	---	---
	Ant4	5550	39.760	5530.240	5570.000	---	---
	Ant1	5670	40.160	5650.000	5690.160	---	---

	Ant2	5670	40.080	5649.840	5689.920	---	---
	Ant3	5670	39.440	5650.160	5689.600	---	---
	Ant4	5670	39.840	5650.240	5690.080	---	---
11AC80MIMO	Ant1	5210	80.640	5169.840	5250.480	---	---
	Ant2	5210	79.840	5170.000	5249.840	---	---
	Ant3	5210	79.840	5170.000	5249.840	---	---
	Ant4	5210	80.320	5169.840	5250.160	---	---
	Ant1	5290	80.320	5250.160	5330.480	---	---
	Ant2	5290	79.680	5250.320	5330.000	---	---
	Ant3	5290	79.840	5250.320	5330.160	---	---
	Ant4	5290	80.320	5249.840	5330.160	---	---
	Ant1	5530	80.640	5489.680	5570.320	---	---
	Ant2	5530	79.680	5490.320	5570.000	---	---
	Ant3	5530	79.360	5490.480	5569.840	---	---
	Ant4	5530	80.640	5489.520	5570.160	---	---
	Ant1	5610	80.480	5569.680	5650.160	---	---
	Ant2	5610	79.360	5570.480	5649.840	---	---
	Ant3	5610	79.520	5570.160	5649.680	---	---
	Ant4	5610	80.480	5569.840	5650.320	---	---

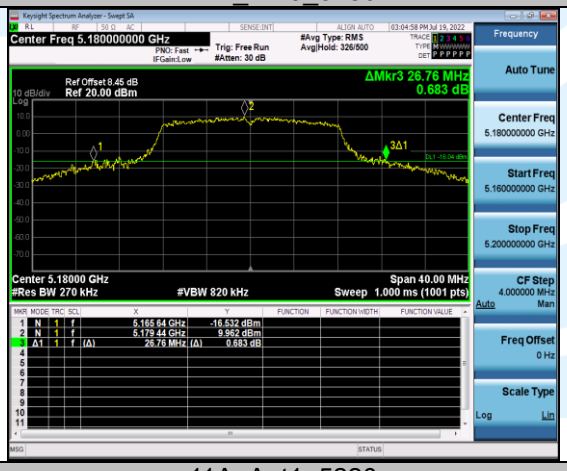
The test plots as follows:

11A_Ant1_5180

11A_Ant2_5180



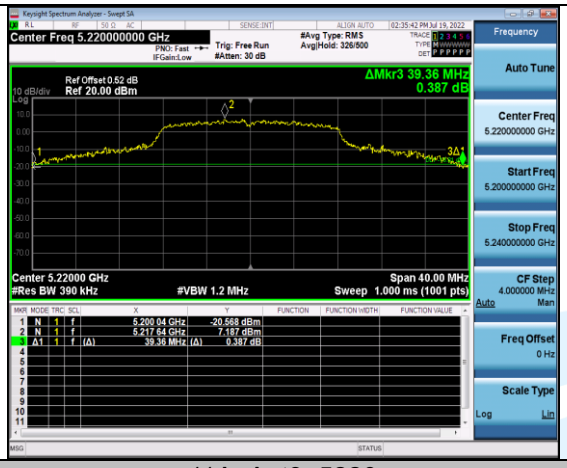
11A_Ant3_5180



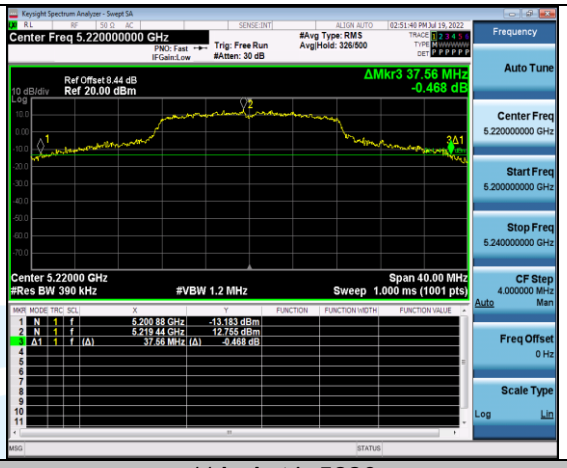
11A_Ant4_5180

11A_Ant1_5220

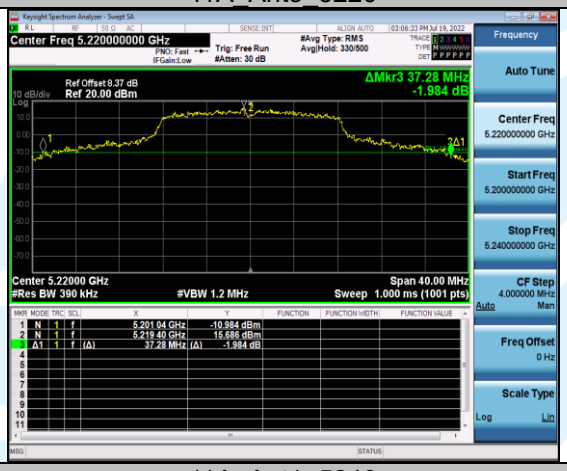
11A_Ant2_5220



11A_Ant3_5220

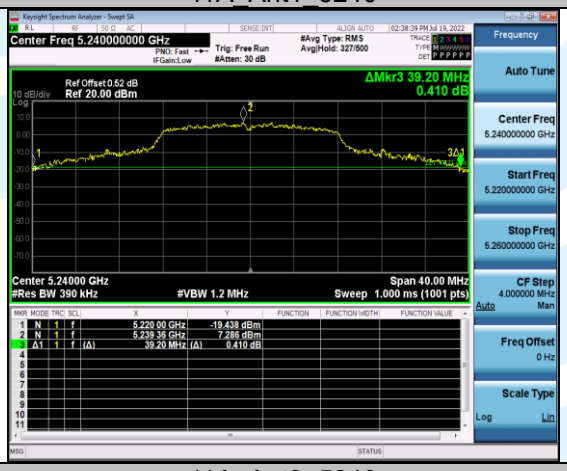


11A_Ant4_5220

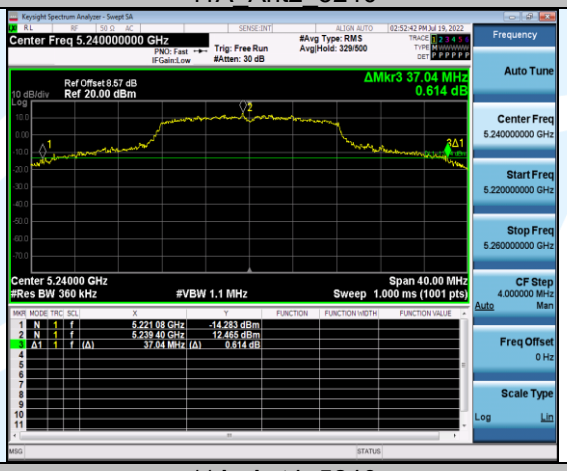


11A_Ant1_5240

11A_Ant2_5240



11A_Ant3_5240



11A_Ant4_5240