Certificate #4312.01

TEST REPORT

Product Name:	IP Phone
Trade Mark:	GRANDSTREAM
Model No.:	GRP2614
HVIN:	GRP2614V2CW
Report Number:	220105006RFC-4
Test Standards:	FCC 47 CFR Part 15 Subpart E RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	YZZGRP2614V2CW
IC:	11964A-GRP2614V2CW
Test Result:	PASS
Date of Issue:	April 7, 2022

Prepared for:

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

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
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Prepared by:	Gavin Xu Project Engineer	Reviewed by:	Henry Lu Team Leader
Approved by:	Kevin Liang Assistant Manager	Date:	April 7, 2022

Version

Version No.	Date	Description
V1.0	April 7, 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:	IP Phone		
Model No.:	GRP2614		
HVIN:	GRP2614V2CW		
Trade Mark:	GRANDSTREAM		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth 5.0	
	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
Sample Received Date:	January 6, 2022		
Sample Tested Date:	January 6, 2022 to February 25, 2022		

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

1.2.2 Description of Accessories

Adapter(1)	
Model No.:	GQ12-120100-AU
Input:	100-240 V~50/60 Hz 0.4A Max
Output:	12 V ⎓ 1.0 A
DC Cable:	2.5 Meter, Unshielded without ferrite

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

Adapter(3)	
Model No.:	F12US1200100A
Input:	100-240 V~50/60 Hz 0.5A max
Output:	12 V ⎓ 1.0 A
DC Cable:	2.5 Meter, Unshielded without ferrite

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

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

Others
1x Handset, 1x Phone Stand

Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.

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:	Slave without radar Interference detection function
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz
	IEEE 802.11ac-VHT80: 80 MHz
Data Rate:	IEEE 802.11a: Up to 54 Mbps
	IEEE 802.11n-HT20: Up to MCS7
	IEEE 802.11n-HT40: Up to MCS7
	IEEE 802.11ac-VHT20: Up to MCS8
	IEEE 802.11ac-VHT40: Up to MCS9
	IEEE 802.11ac-VHT80: Up to MCS9
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80

	5470 MHz to 5725 MHz: 11 for IEEE 802.11a/n-HT20/ac-VHT20 5 for IEEE 802.11n-HT40/ac-VHT40 2 for IEEE 802.11ac-VHT80				
	5725 MHz to 5850 MHz: 5 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80				
Antenna Type:	Dipole Antenna				
Antenna Gain: (Provided by the customer)	5150 MHz to 5250 MHz: 4.5 dBi				
	5250 MHz to 5350 MHz: 4.5 dBi				
	5470 MHz to 5725 MHz: 4.5 dBi				
	5725 MHz to 5850 MHz: 4.5 dBi				
Maximum EIRP (dBm):		**U-NII-1**			
	IEEE 802.11a:	19.09			
	IEEE 802.11n-HT20:	19.82			
	IEEE 802.11n-HT40:	19.94			
	IEEE 802.11ac-VHT20:	19.78			
	IEEE 802.11ac-VHT40:	19.79			
	IEEE 802.11ac-VHT80:	18.55			
Maximum conducted output power (dBm):		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	14.59	14.63	16.38	15.81
	IEEE 802.11n-HT20:	15.32	15.38	15.49	15.58
	IEEE 802.11n-HT40:	15.44	15.45	15.33	14.93
	IEEE 802.11ac-VHT20	15.28	15.34	15.5	15.55
	IEEE 802.11ac-VHT40	15.29	15.36	15.15	15.47
	IEEE 802.11ac-VHT80:	14.05	14.2	12.78	15.09
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
Notebook	DELL	Latitude 3400	16238087894	N/A	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	N/A	UnionTrust
Headset	YEY	VE120-MV	N/A	N/A	UnionTrust
IP Phone	GRANDSTREAM	GRP2615	N/A	N/A	Applicant
Wireless Router	SAGEMCOM	RAC2V1S	N/A	VW3FAST5280	UnionTrust
Key-Press Attenuator	Huaxin	KT2.5-90/1S-2S	N/A	N/A	UnionTrust
4 Way Divider	WOKEN	0120A040560002D	N/A	N/A	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Ethernet Cable	RJ45	1.5 Unshielded without ferrite	UnionTrust
2	Ethernet Cable	RJ45	2.0 Unshielded without ferrite	UnionTrust
3	Ethernet Cable	RJ45	5.0 Unshielded without ferrite	UnionTrust
4	Antenna Cable	SMA	0.5 Meter	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
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.2 (Method SA)	PASS
Peak Power Spectral Density	FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(1)(2)(3) RSS-247 Issue 2 Section 6.2.1.1/6.2.2.1/6.2.3.1/6.2.4.1	KDB 789033 D02 v02r01 Section F	PASS
Radiated Emissions and Band Edge Measurement	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(1)(2)(3)(4)(6) FCC 47 CFR Part 15 Subpart C Section 15.209/205 RSS-247 Issue 2 Section 6.2.1.2/6.2.2.2/6.2.3.2/6.2.4.2	KDB 789033 D02 v02r01 Section G.3, G.4, G.5, and G.6	PASS
Dynamic Frequency Selection	FCC 47 CFR Part 15 Subpart E Section 15.407 (h) RSS-247 Issue 2 Section 6.3	KDB 905462 D03 Client Without DFS New Rules v01r02	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart E Section 15.407 (b)(6) FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013, Section 6.2.	PASS
Note: 1) N/A: In this whole report not applicable.			
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.			

For Dynamic Frequency Selection

Test Case	Result
Channel Availability Check Time	N/A[1]
U-NII Detection Bandwidth	N/A[1]
Channel Closing Transmission Time	PASS
Channel Move Time	PASS
DFS Detection Threshold	N/A[1]
Non- Occupancy Period	N/A[1]
Note: 1) The EUT is slave, NA In this whole report not applicable.	

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	3m SAC	ETS-LINDGREN	3m	Euroshiedpn-CT001270-1317	Jan. 22, 2021	Jan. 21, 2024
☒	Receiver	R&S	ESIB26	100114	Nov. 05, 2021	Nov. 04, 2022
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Apr. 22, 2021	Apr. 21, 2022
☒	Loop Antenna	ETS-LINDGREN	6502	00202525	Nov. 11, 2021	Nov. 10, 2023
☒	Broadband Antenna	ETS-LINDGREN	3142E	00201566	Nov. 11, 2021	Nov. 10, 2023
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 11, 2021	Nov. 10, 2023
☒	Preamplifier	HP	8447F	2805A02960	Nov. 05, 2021	Nov. 04, 2022
☒	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3117-PA	00201541	Apr. 30, 2021	Apr. 29, 2023
☒	Pre-amplifier	ETS-Lindgren	00118385	00201874	Nov. 06, 2021	Nov. 05, 2022
☒	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-LINDGREN	3116C-PA	00202652	Nov. 14, 2020	Nov. 13, 2023
☒	Pre-amplifier	ETS-Lindgren	00118384	00202652	Nov. 17, 2020	Nov. 16, 2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☐	Band Rejection Filter (2400MHz~2500MHz)	Micro-Tronics	BRM50702	G248	Nov. 06, 2021	Nov. 05, 2022
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G186	Nov. 06, 2021	Nov. 05, 2022
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	Receiver	R&S	ESR7	1316.3003K07-101181-K3	Nov. 05, 2021	Nov. 04, 2022
☒	Pulse Limiter	R&S	ESH3-Z2	0357.8810.54	Nov. 05, 2021	Nov. 04, 2022
☒	LISN	R&S	ESH2-Z5	860014/024	Nov. 05, 2021	Nov. 04, 2022
☒	LISN	ETS-Lindgren	3816/2SH	00201088	Nov. 05, 2021	Nov. 04, 2022
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Apr. 22, 2021	Apr. 21, 2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 05, 2021	Nov. 04, 2022
☐	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 05, 2021	Nov. 04, 2022
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Nov. 05, 2021	Nov. 04, 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 (V)	Relative Humidity (%)
NV/NT	+15 to +35	120V~60Hz	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	25.5	49	100.55	220105006-A01/4	Hank Wu
6 dB bandwidth					
Occupied Bandwidth					
Maximum conducted output power					
Peak Power Spectral Density					
Dynamic Frequency Selection					
Radiated Emissions and Band Edge Measurement	24.6	51	100.14	220105006-A02/4	Asia Yan
AC Power Line Conducted Emission	25.6	50	100.55	220105006-A02/4	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	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting(Provided by the customer)				
	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
IEEE 802.11a	16	16	16	15
IEEE 802.11n-HT20	17	17	15	15
IEEE 802.11n-HT40	17	17	15	14
IEEE 802.11ac-VHT20	17	17	15	15
IEEE 802.11ac-VHT40	17	17	15	15
IEEE 802.11ac-VHT80	15	15	12	14

Test Software(Provided by the customer)
Test software name: QRCT4;

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

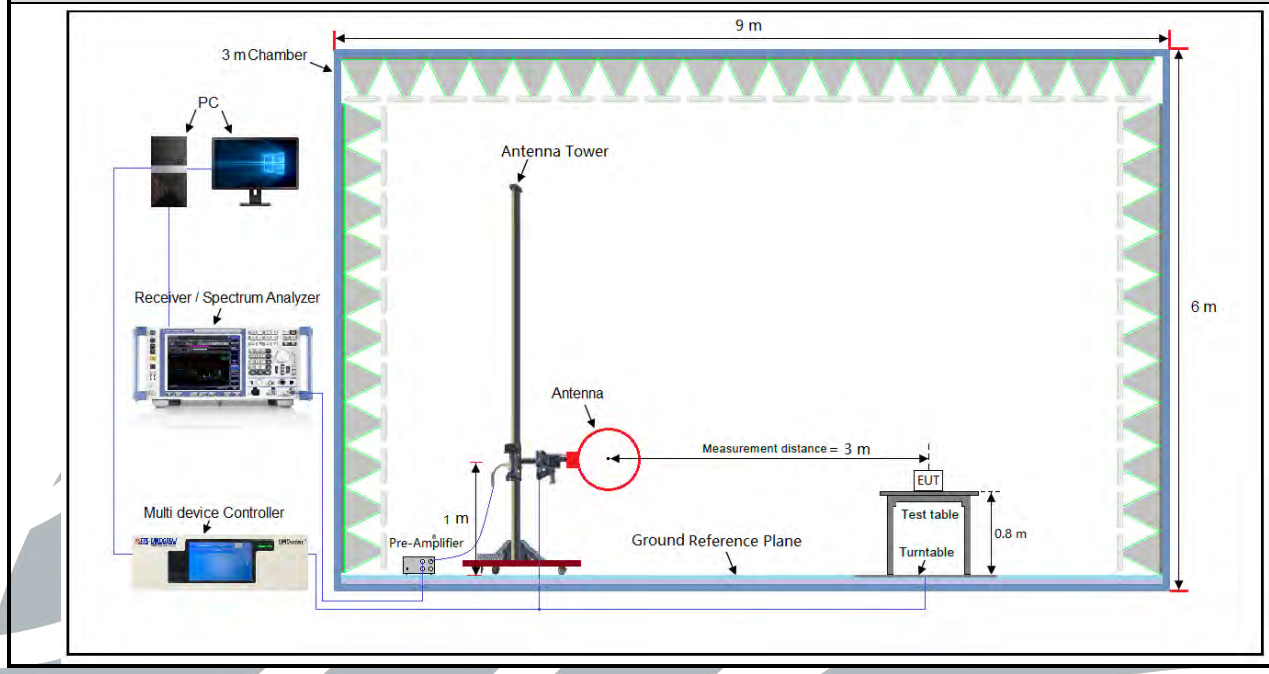


Figure 2. 30MHz to 1GHz

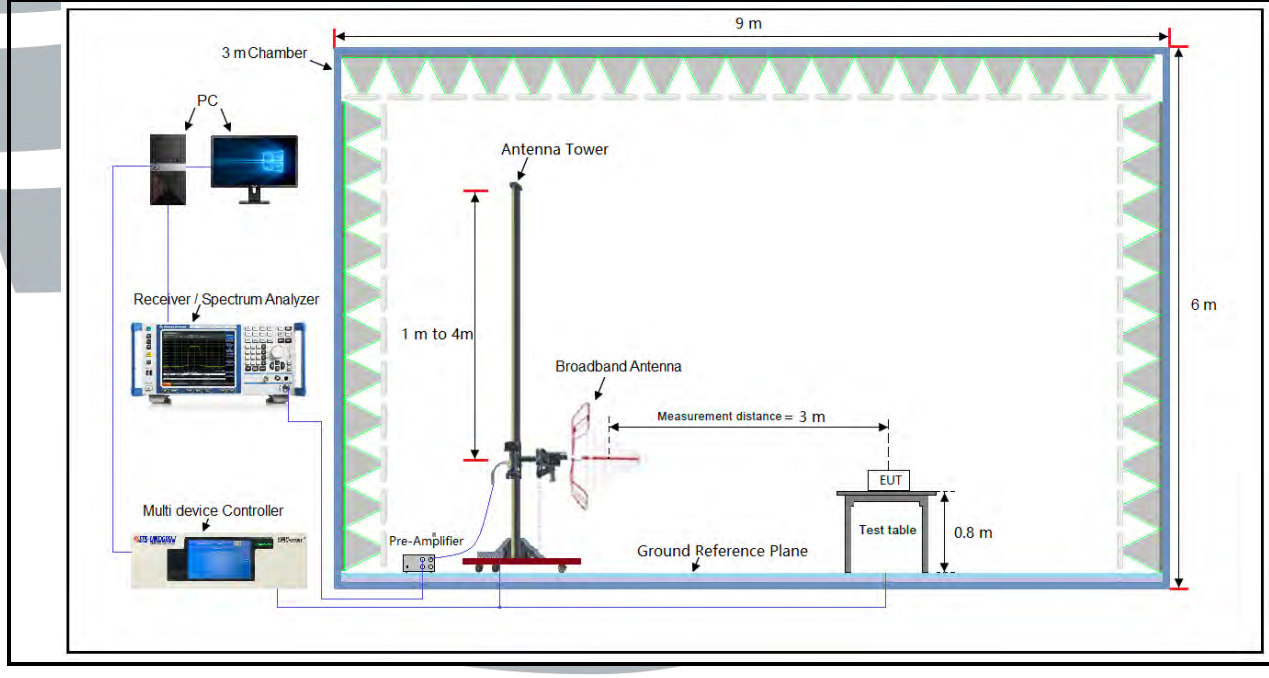
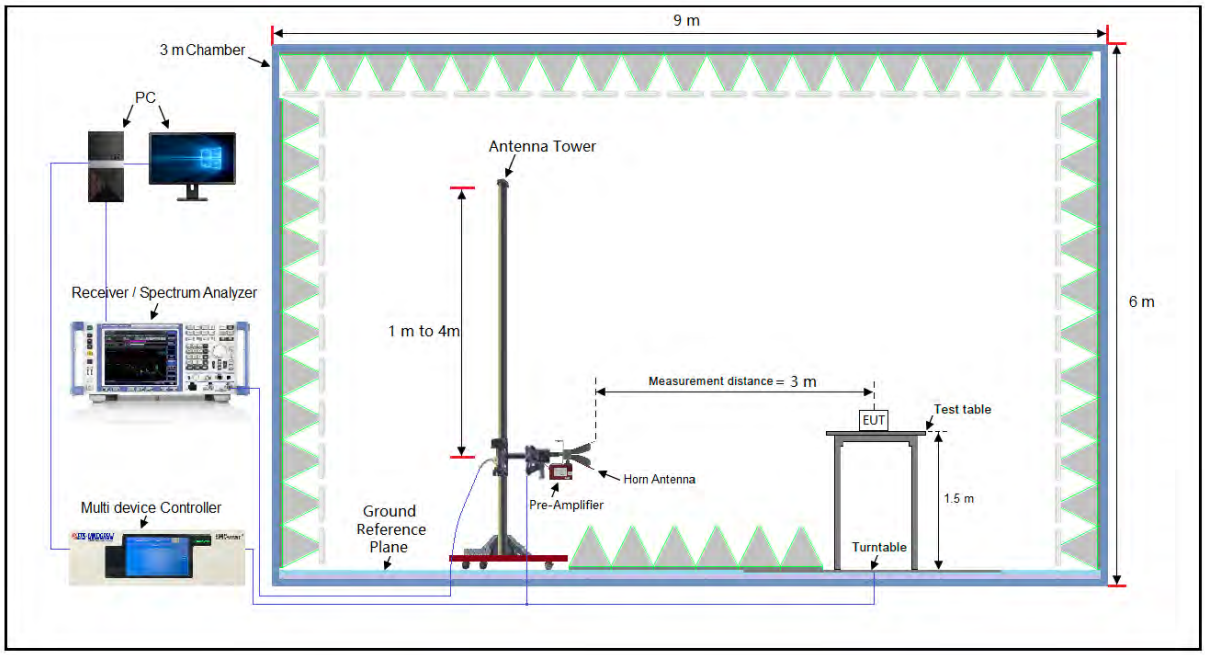
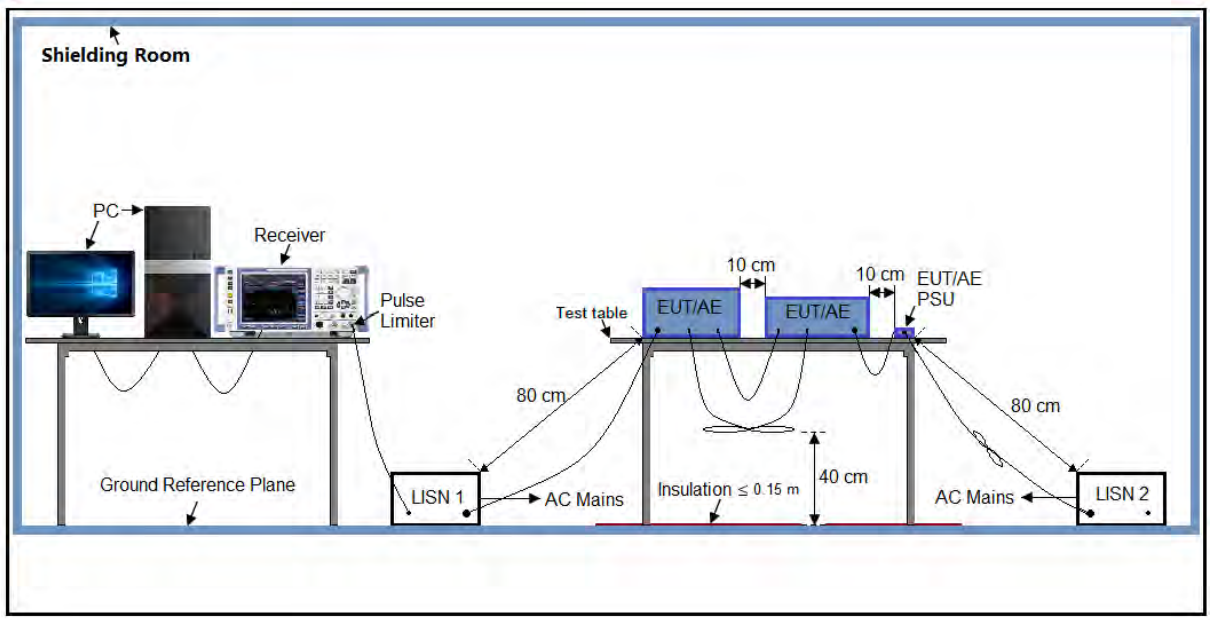


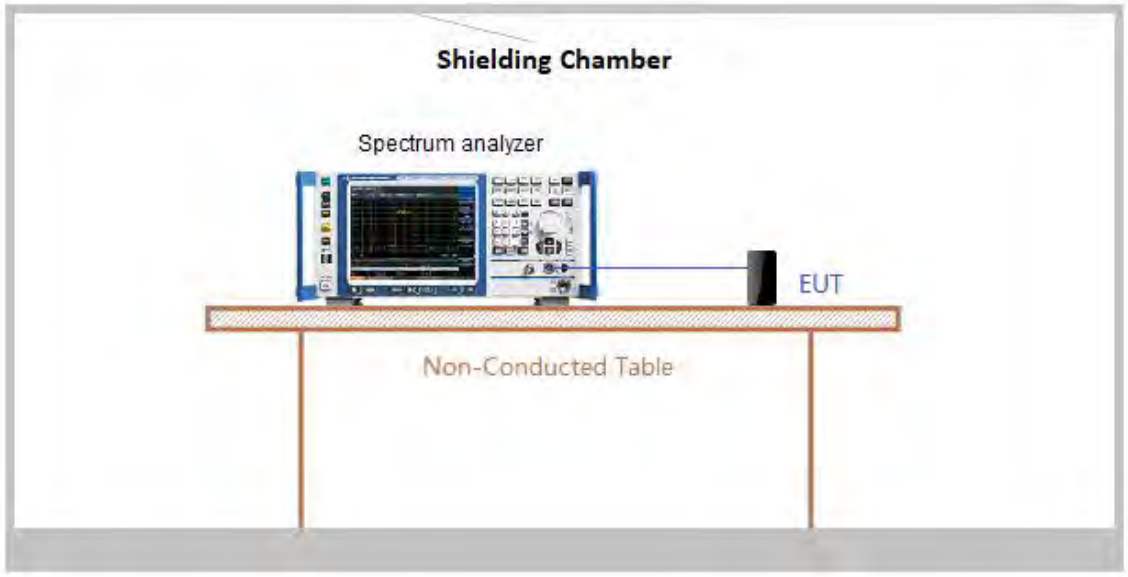
Figure 3. Above 1GHz



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.

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

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

4.7 DUTY CYCLE

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

Test Results

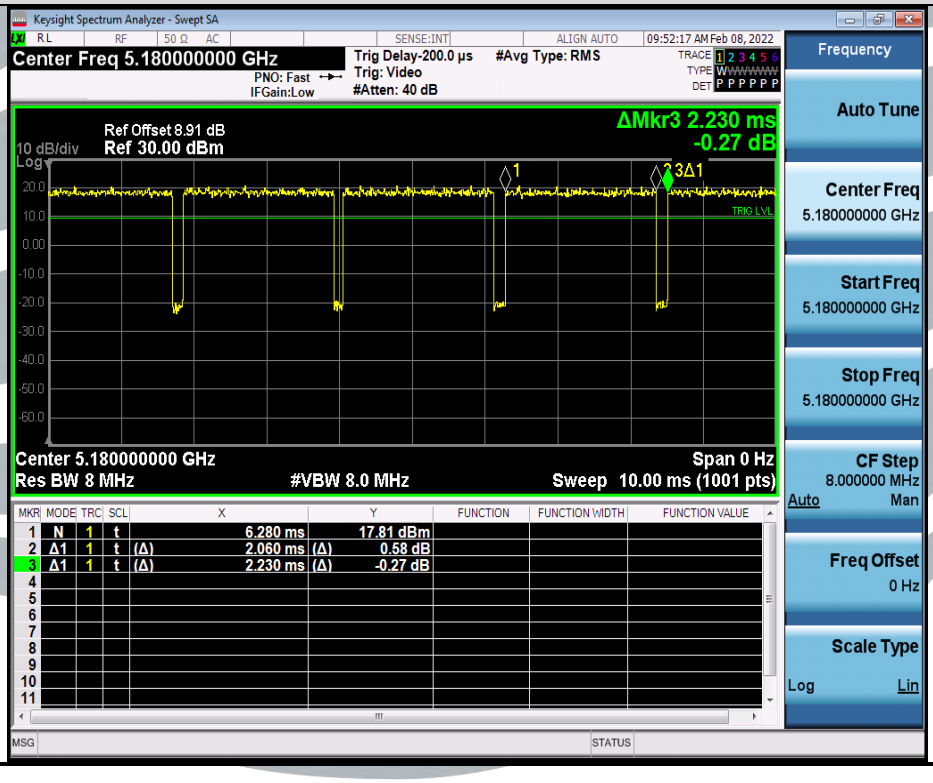
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
IEEE 802.11a	6	2.06	2.23	0.92	92.38	0.34	0.49	-0.69
IEEE 802.11n-HT20	MCS0	1.93	2.10	0.92	91.90	0.37	0.52	-0.73
IEEE 802.11n-HT40	MCS0	0.95	1.12	0.85	84.82	0.71	1.05	-1.43
IEEE 802.11ac-VHT20	MCS0	1.93	2.07	0.93	93.24	0.30	0.52	-0.61
IEEE 802.11ac-VHT40	MCS0	0.95	1.10	0.86	86.36	0.64	1.05	-1.27
IEEE 802.11ac-VHT80	MCS0	0.47	0.64	0.73	73.44	1.34	2.13	-2.68

Remark:

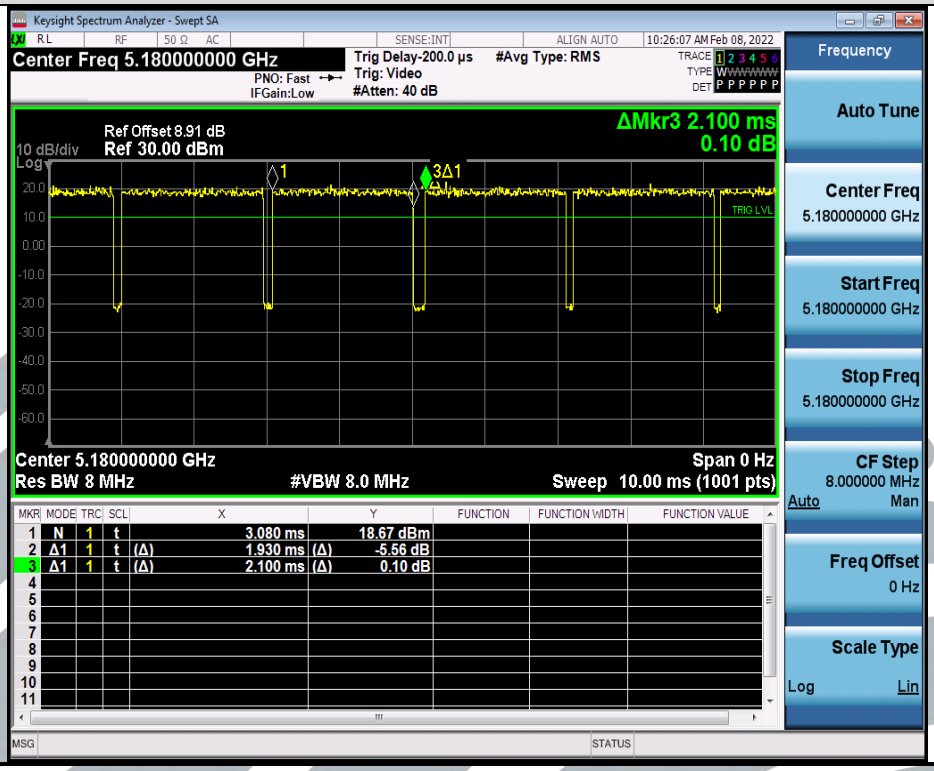
1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plots as follows

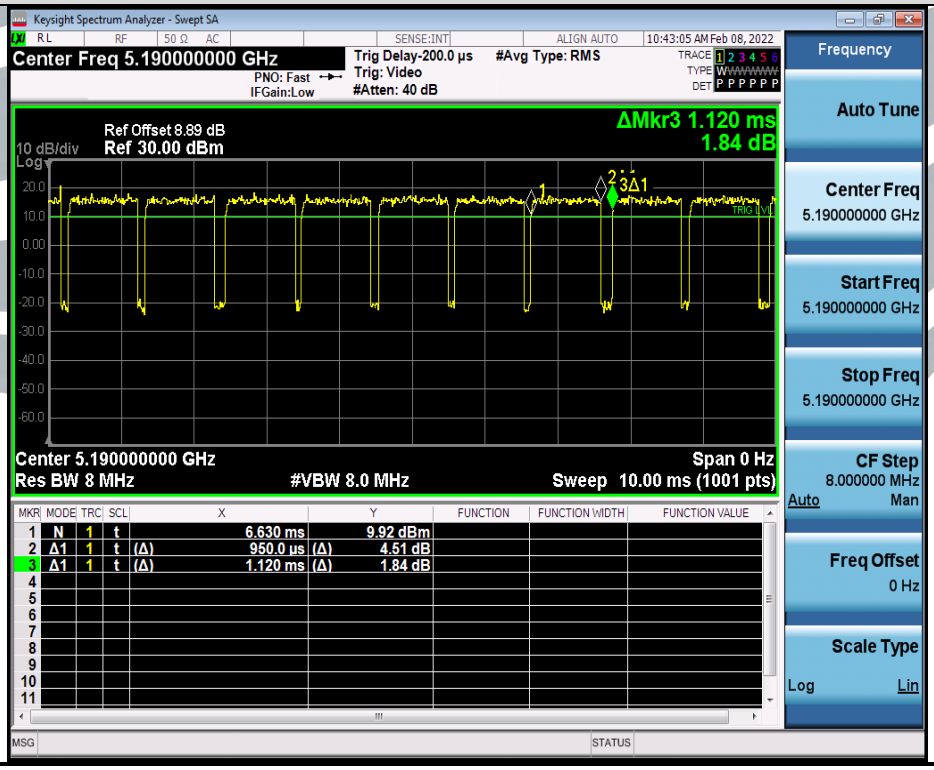
IEEE 802.11a



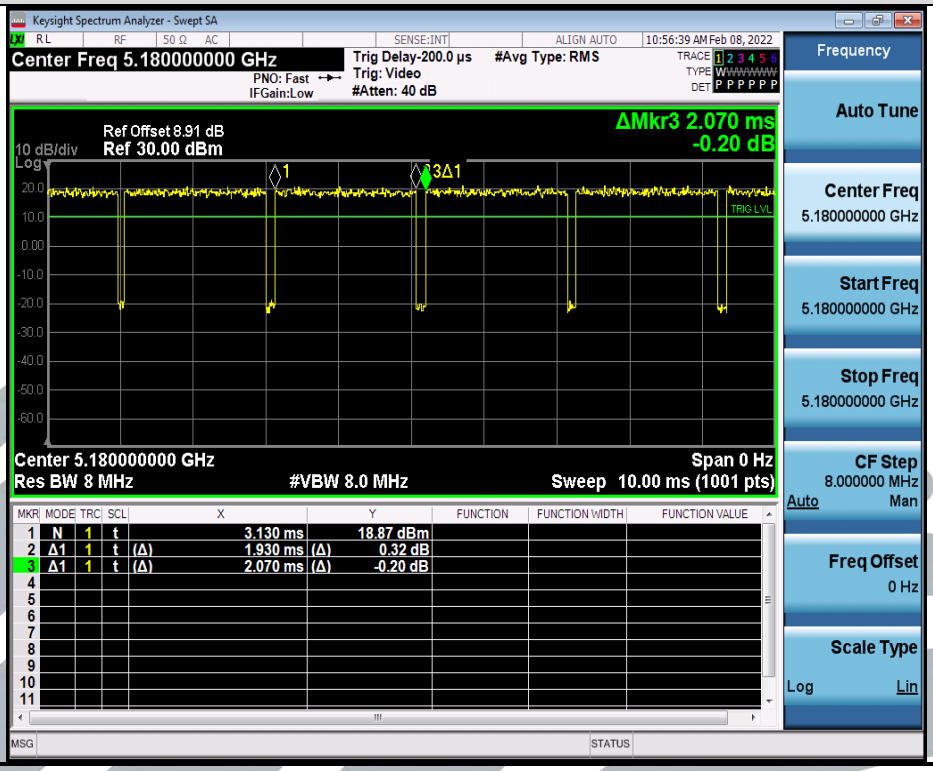
IEEE 802.11n-HT20



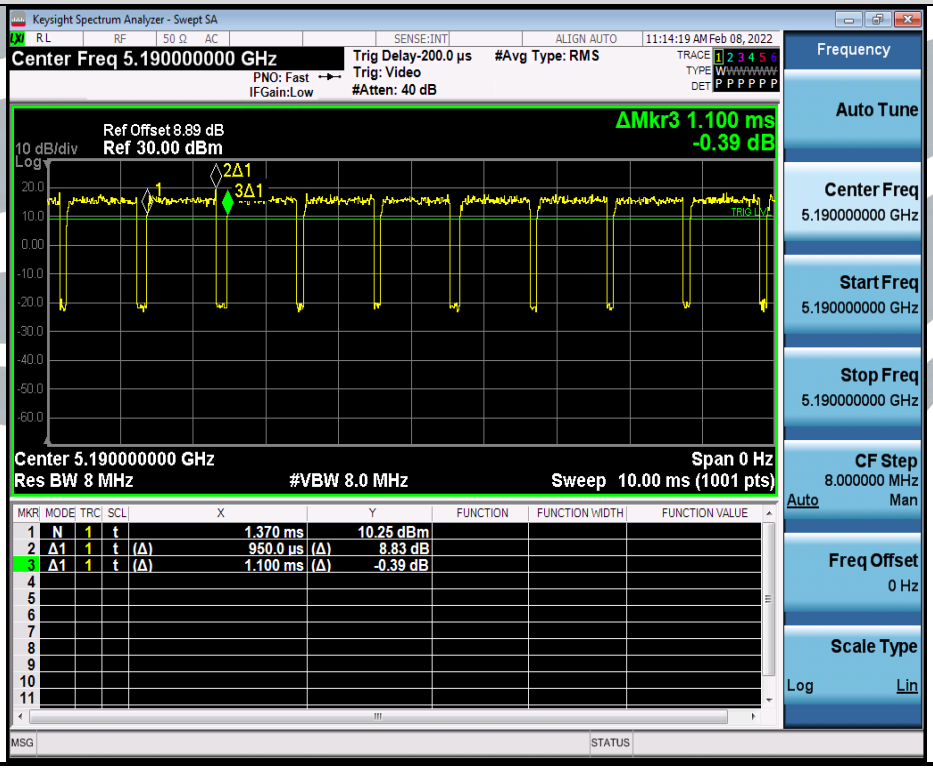
IEEE 802.11n-HT40

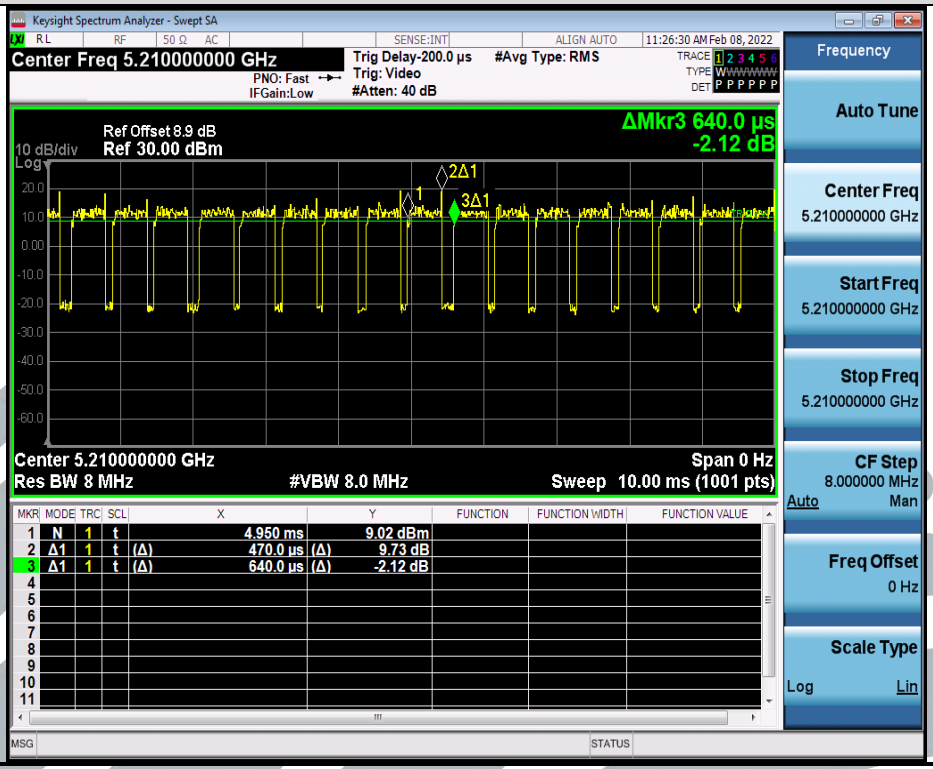


IEEE 802.11ac-VHT20



IEEE 802.11ac-VHT40



IEEE 802.11ac-VHT80


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 905462 D03 Client Without DFS New Rules v01r02	U-NII client devices without radar detection capability
10	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.2 ANTENNA REQUIREMENT

Standard Requirement
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:
Antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is 4.5 dBi.

5.3 26 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart E Section 15.407 (a)(2)(5)
RSS-247 Issue 2 Section 6.2.1.2

Test Method: KDB 789033 D02 v02r01 Section C.1

Limit: None; for reporting purposes only.

Test Procedure:

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

Spectrum analyzer according to the following Settings:
a) Set RBW = approximately 1 % of the emission bandwidth.
b) Set the VBW > RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

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

Test Setup: Refer to section 4.5.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Test Mode	Antenna	Channel	26db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	21.000	5169.720	5190.720	---	PASS
		5220	21.080	5209.640	5230.720	---	PASS
		5240	20.880	5229.720	5250.600	---	PASS
		5260	20.320	5249.840	5270.160	---	PASS
		5300	20.320	5289.800	5310.120	---	PASS
		5320	20.360	5309.840	5330.200	---	PASS
		5500	23.440	5490.000	5513.440	---	PASS
		5580	22.720	5569.680	5592.400	---	PASS
		5700	24.160	5689.360	5713.520	---	PASS
		5745	22.760	5734.600	5757.360	---	PASS
		5785	21.280	5774.680	5795.960	---	PASS
		5825	20.920	5814.760	5835.680	---	PASS
11N20SISO	Ant1	5180	23.520	5167.800	5191.320	---	PASS
		5220	21.920	5209.040	5230.960	---	PASS
		5240	21.360	5229.400	5250.760	---	PASS
		5260	22.320	5248.960	5271.280	---	PASS
		5300	22.400	5288.880	5311.280	---	PASS
		5320	22.080	5308.880	5330.960	---	PASS
		5500	20.360	5489.840	5510.200	---	PASS
		5580	20.680	5569.600	5590.280	---	PASS
		5700	20.760	5689.640	5710.400	---	PASS
		5745	21.880	5734.760	5756.640	---	PASS
		5785	20.760	5774.600	5795.360	---	PASS
		5825	21.120	5814.640	5835.760	---	PASS
11N40SISO	Ant1	5190	52.560	5161.120	5213.680	---	PASS
		5230	55.440	5198.160	5253.600	---	PASS
		5270	53.920	5246.000	5299.920	---	PASS
		5310	53.760	5279.840	5333.600	---	PASS
		5510	41.520	5489.040	5530.560	---	PASS
		5550	40.640	5529.680	5570.320	---	PASS
		5670	43.840	5649.360	5693.200	---	PASS
		5755	41.040	5734.440	5775.480	---	PASS
		5795	43.360	5774.600	5817.960	---	PASS
11AC20SISO	Ant1	5180	27.080	5167.800	5194.880	---	PASS

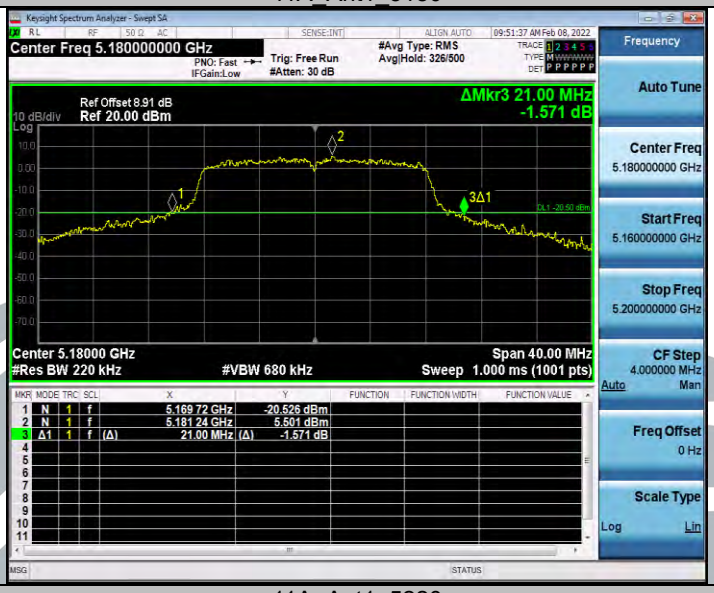
		5220	21.880	5208.920	5230.800	---	PASS
		5240	24.200	5227.120	5251.320	---	PASS
		5260	21.960	5249.200	5271.160	---	PASS
		5300	28.840	5284.320	5313.160	---	PASS
		5320	22.600	5308.880	5331.480	---	PASS
		5500	20.640	5489.480	5510.120	---	PASS
		5580	20.560	5569.520	5590.080	---	PASS
		5700	20.680	5689.520	5710.200	---	PASS
		5745	21.320	5734.760	5756.080	---	PASS
		5785	21.080	5774.720	5795.800	---	PASS
		5825	20.640	5814.720	5835.360	---	PASS
11AC40SISO	Ant1	5190	56.480	5163.280	5219.760	---	PASS
		5230	54.400	5199.200	5253.600	---	PASS
		5270	57.920	5240.560	5298.480	---	PASS
		5310	58.160	5275.600	5333.760	---	PASS
		5510	41.680	5489.840	5531.520	---	PASS
		5550	42.000	5528.160	5570.160	---	PASS
		5670	44.160	5648.080	5692.240	---	PASS
		5755	51.120	5733.000	5784.120	---	PASS
		5795	42.000	5774.440	5816.440	---	PASS
11AC80SISO	Ant1	5210	85.600	5166.000	5251.600	---	PASS
		5290	83.360	5247.760	5331.120	---	PASS
		5530	82.880	5488.400	5571.280	---	PASS
		5775	85.760	5732.760	5818.520	---	PASS

Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	16.499	5171.742	5188.241	---	PASS
		5220	16.485	5211.751	5228.236	---	PASS
		5240	16.479	5231.738	5248.217	---	PASS
		5260	16.456	5251.771	5268.227	---	PASS
		5300	16.498	5291.729	5308.227	---	PASS
		5320	16.485	5311.732	5328.217	---	PASS
		5500	16.543	5491.751	5508.294	---	PASS
		5580	16.567	5571.728	5588.295	---	PASS
		5700	16.706	5691.707	5708.413	---	PASS
		5745	16.558	5736.748	5753.306	---	PASS
		5785	16.485	5776.751	5793.236	---	PASS
		5825	16.496	5816.739	5833.235	---	PASS
11N20SISO	Ant1	5180	17.662	5171.160	5188.822	---	PASS
		5220	17.625	5211.176	5228.801	---	PASS
		5240	17.630	5231.168	5248.798	---	PASS
		5260	17.649	5251.161	5268.810	---	PASS
		5300	17.664	5291.141	5308.805	---	PASS
		5320	17.638	5311.161	5328.799	---	PASS
		5500	17.531	5491.228	5508.759	---	PASS
		5580	17.527	5571.223	5588.750	---	PASS
		5700	17.570	5691.213	5708.783	---	PASS
		5745	17.632	5736.197	5753.829	---	PASS
		5785	17.550	5776.216	5793.766	---	PASS
		5825	17.543	5816.220	5833.763	---	PASS
11N40SISO	Ant1	5190	36.348	5171.839	5208.187	---	PASS
		5230	36.404	5211.760	5248.164	---	PASS
		5270	36.322	5251.843	5288.165	---	PASS
		5310	36.363	5291.800	5328.163	---	PASS
		5510	36.091	5491.968	5528.059	---	PASS
		5550	36.116	5531.956	5568.072	---	PASS
		5670	36.147	5651.971	5688.118	---	PASS
		5755	36.096	5736.978	5773.074	---	PASS
		5795	36.038	5776.986	5813.024	---	PASS
11AC20SISO	Ant1	5180	17.718	5171.126	5188.844	---	PASS
		5220	17.661	5211.160	5228.821	---	PASS
		5240	17.710	5231.120	5248.830	---	PASS
		5260	17.603	5251.187	5268.790	---	PASS

		5300	17.967	5290.928	5308.895	---	PASS
		5320	17.609	5311.185	5328.794	---	PASS
		5500	17.521	5491.225	5508.746	---	PASS
		5580	17.524	5571.223	5588.747	---	PASS
		5700	17.552	5691.209	5708.761	---	PASS
		5745	17.605	5736.204	5753.809	---	PASS
		5785	17.557	5776.216	5793.773	---	PASS
		5825	17.529	5816.228	5833.757	---	PASS
11AC40SISO	Ant1	5190	36.377	5171.843	5208.220	---	PASS
		5230	36.397	5211.711	5248.108	---	PASS
		5270	36.284	5251.890	5288.174	---	PASS
		5310	36.426	5291.680	5328.106	---	PASS
		5510	35.989	5491.971	5527.960	---	PASS
		5550	36.011	5531.989	5568.000	---	PASS
		5670	36.110	5651.947	5688.057	---	PASS
		5755	36.210	5736.952	5773.162	---	PASS
		5795	36.028	5776.984	5813.012	---	PASS
11AC80SISO	Ant1	5210	75.171	5172.348	5247.519	---	PASS
		5290	75.283	5252.263	5327.546	---	PASS
		5530	74.944	5492.411	5567.355	---	PASS
		5775	75.165	5737.324	5812.489	---	PASS

Note: The maximum EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

Test Graphs:

11A_Ant1_5180

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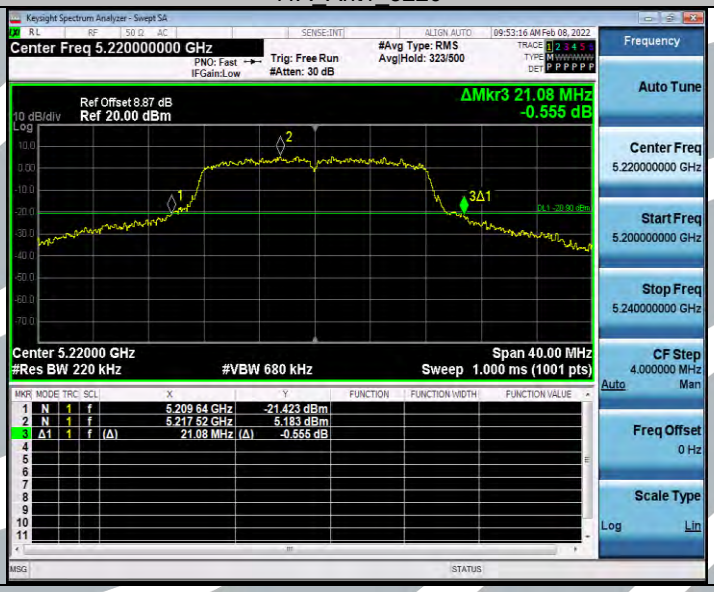

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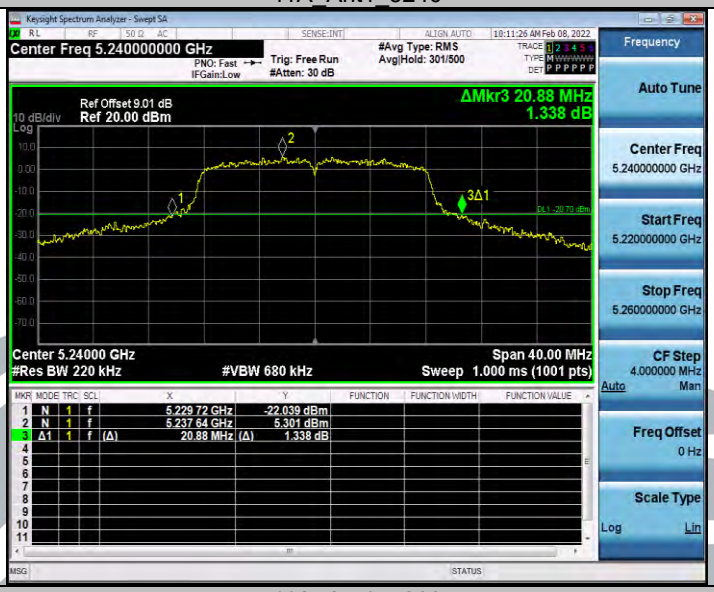

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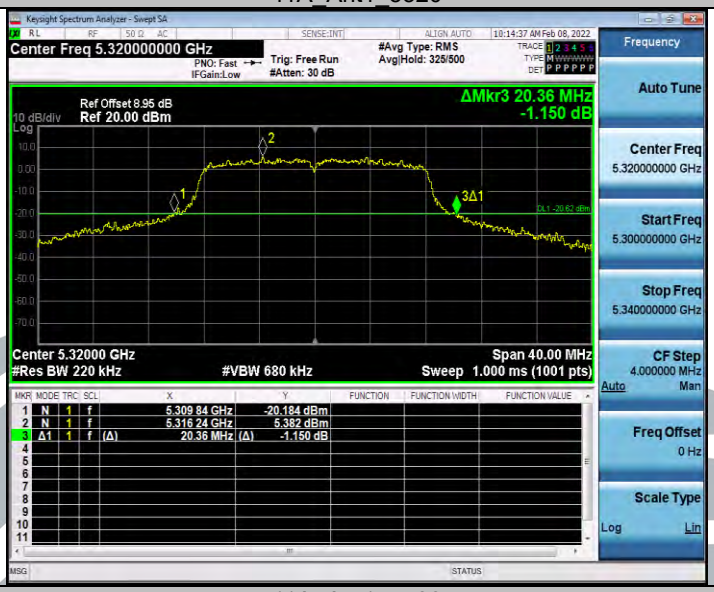
11A_Ant1_5300

11A_Ant1_5320



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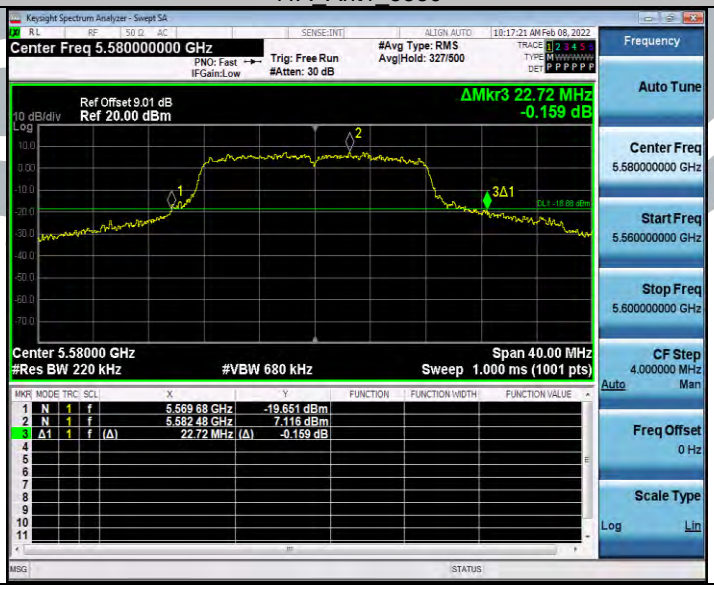

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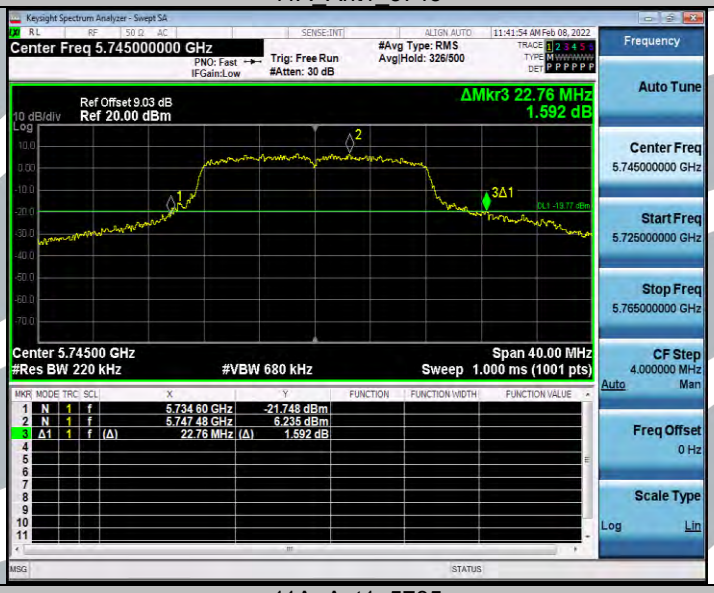

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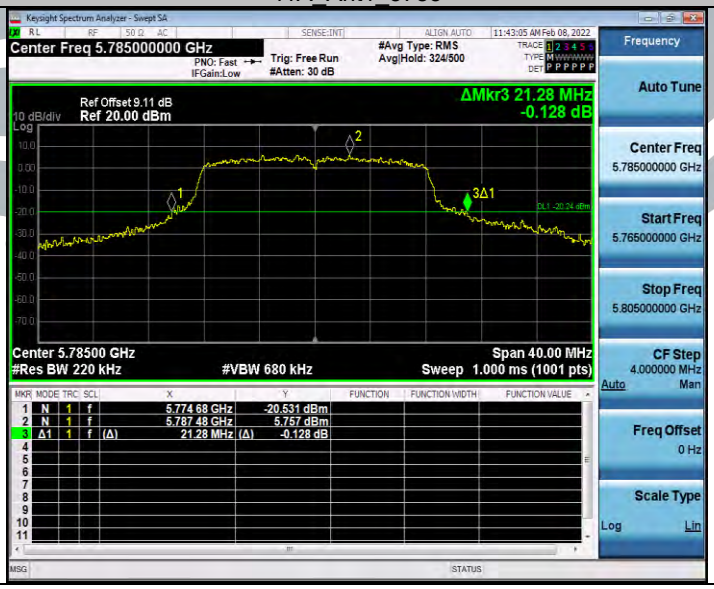

11A_Ant1_5825


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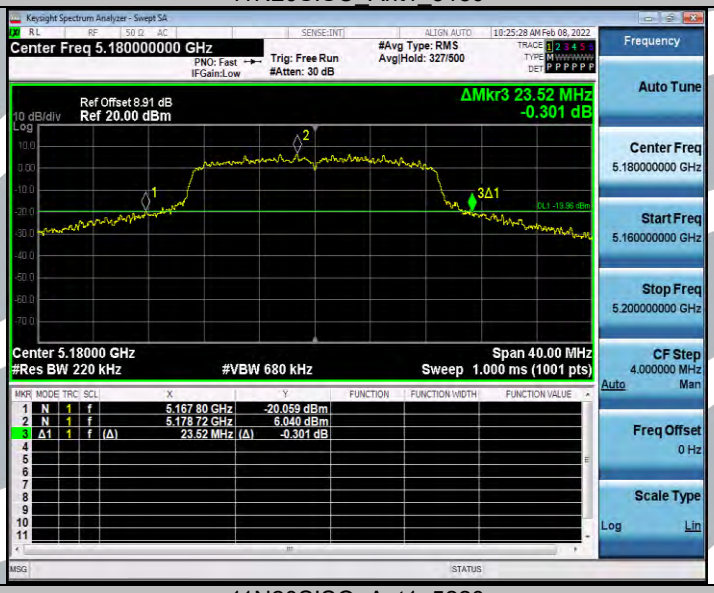

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11N20SISO_Ant1_5240

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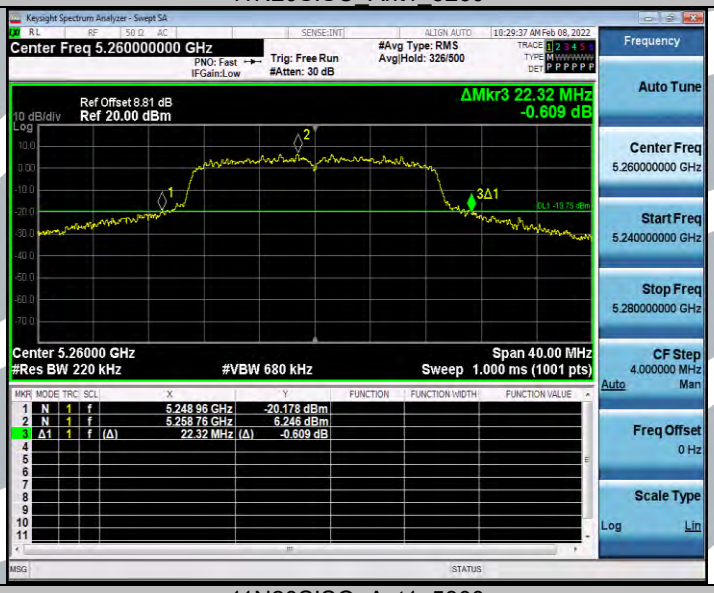

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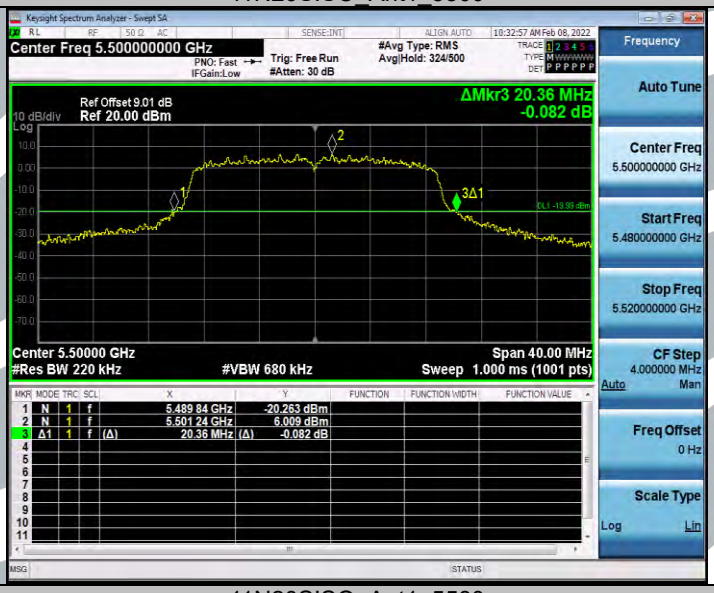

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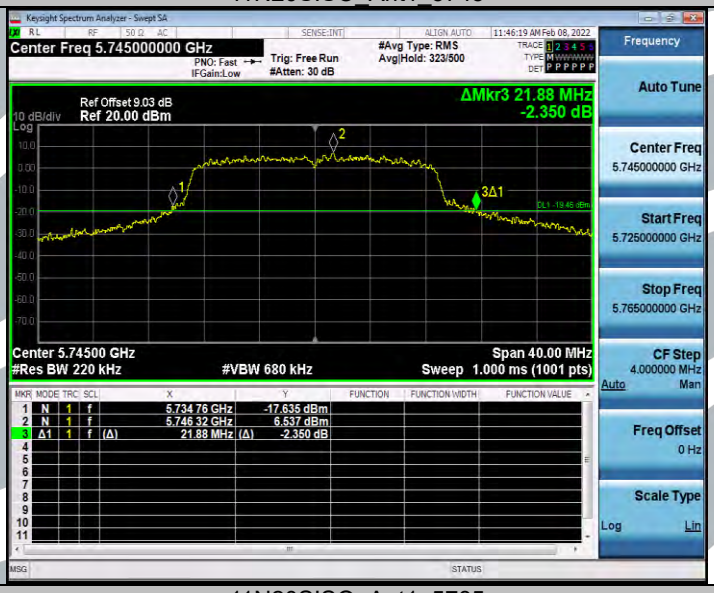

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11N20SISO_Ant1_5825

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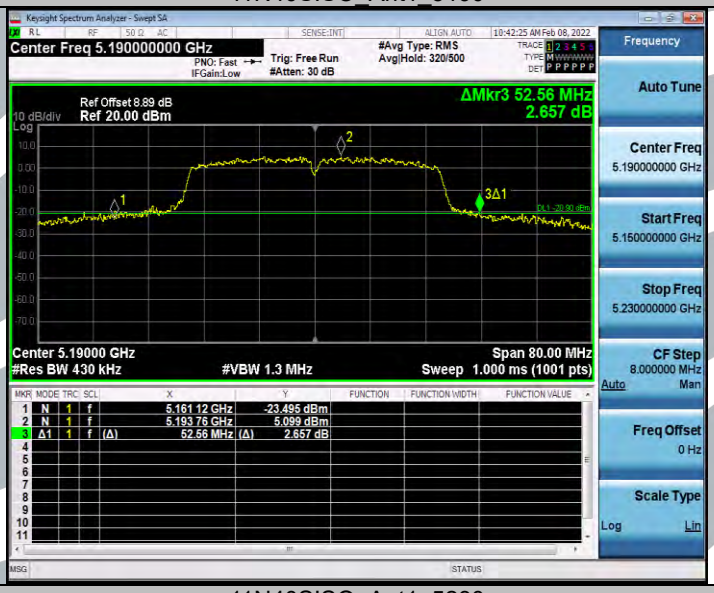

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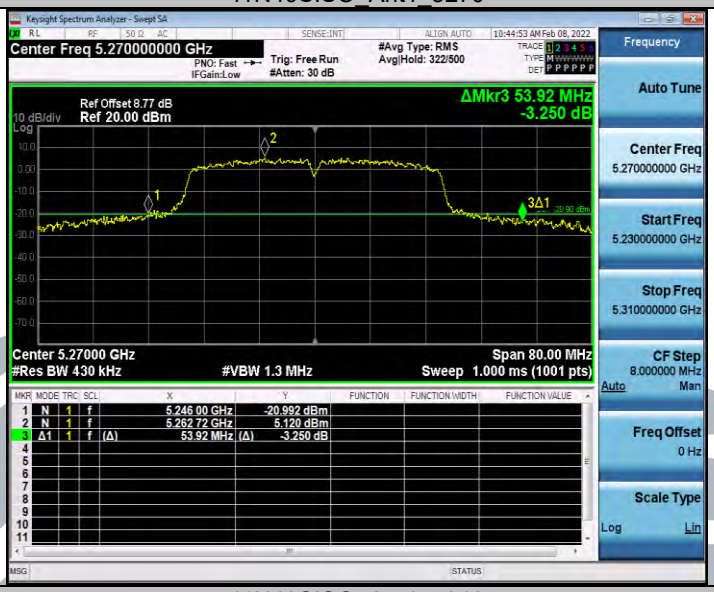

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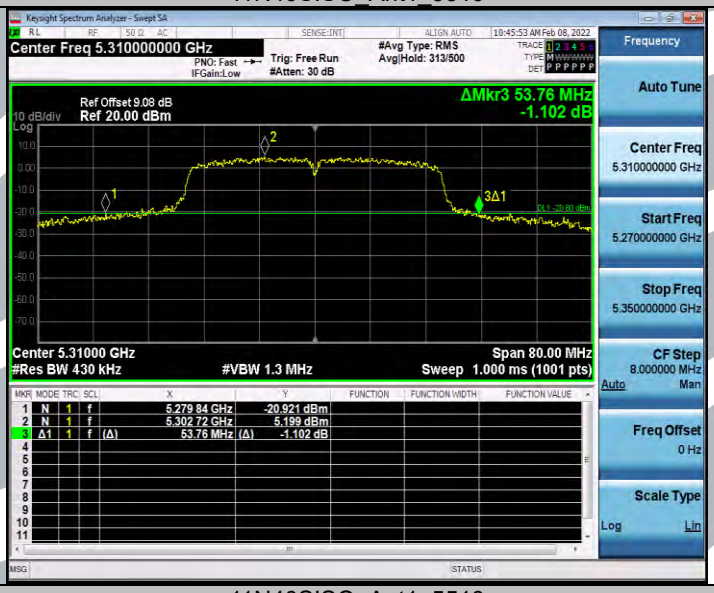

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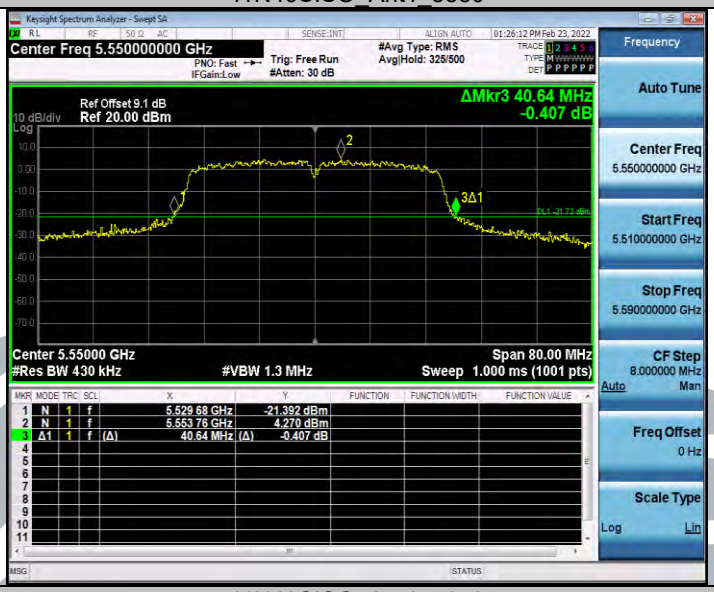
11N40SISO_Ant1_5550



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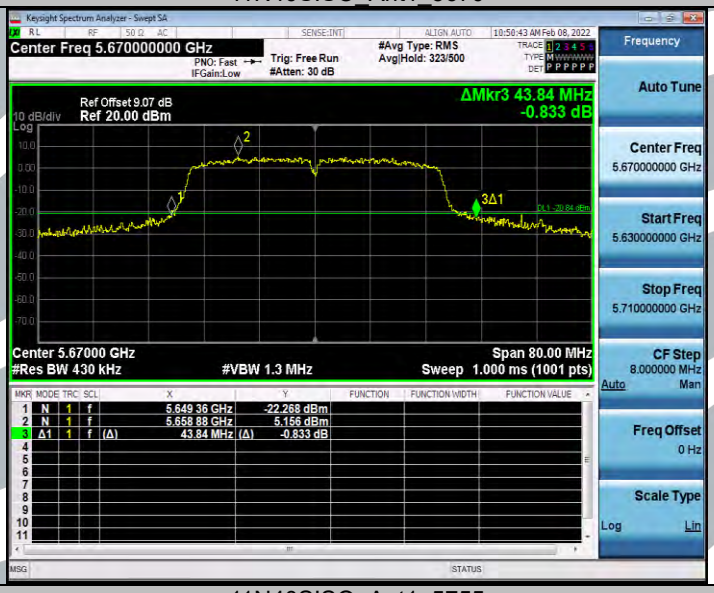

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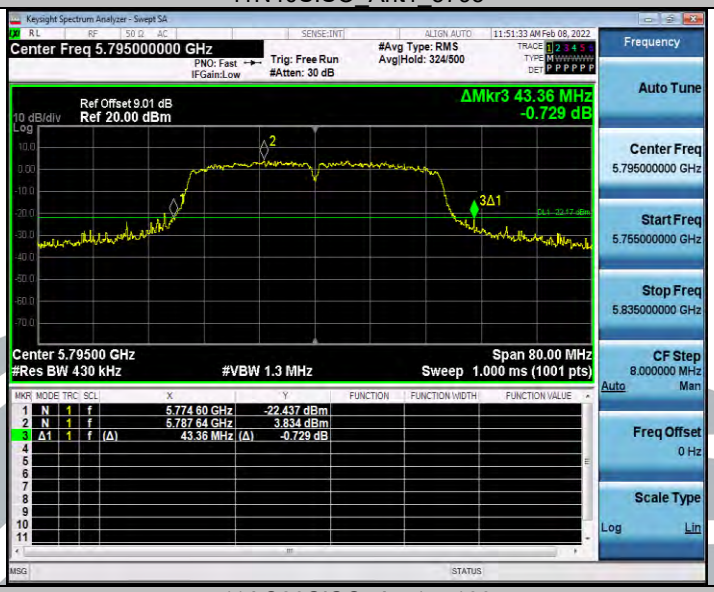
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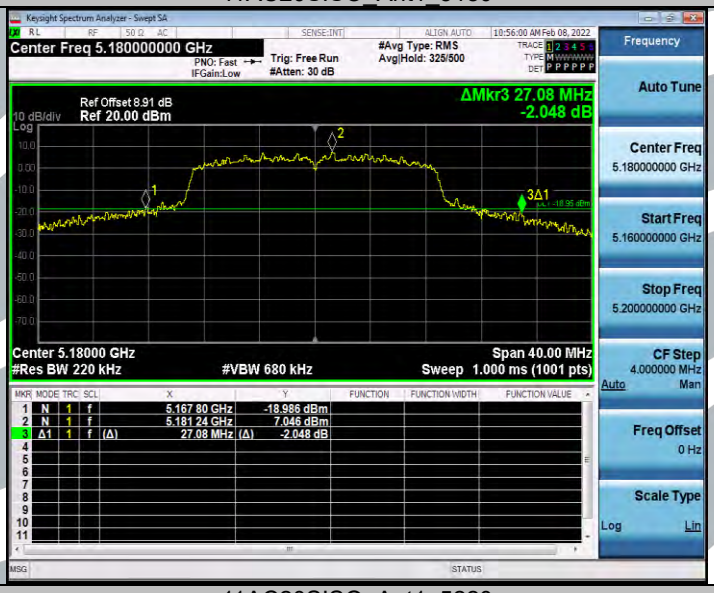
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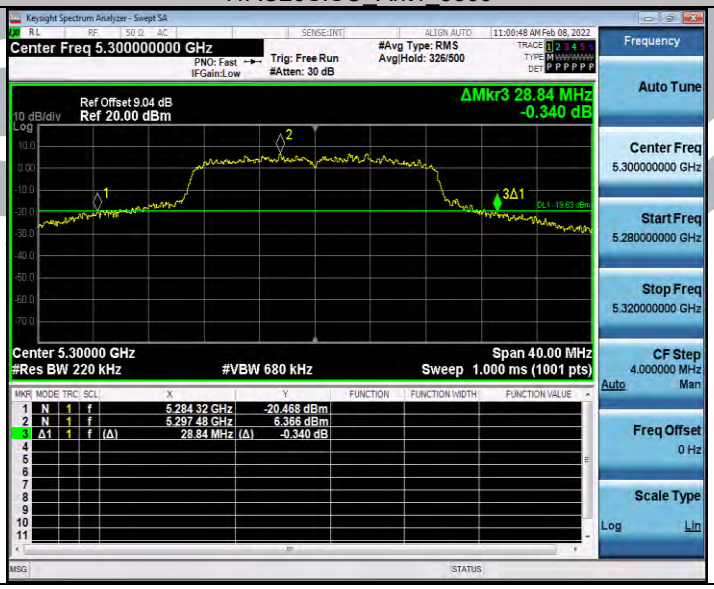

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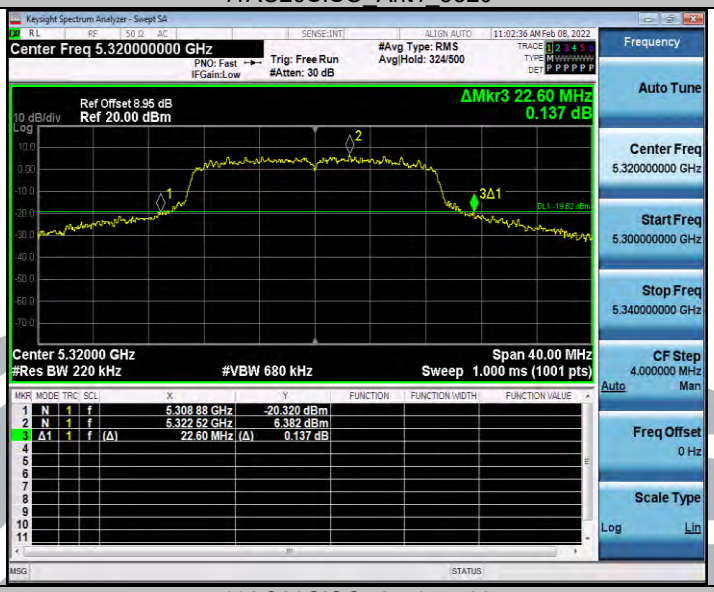

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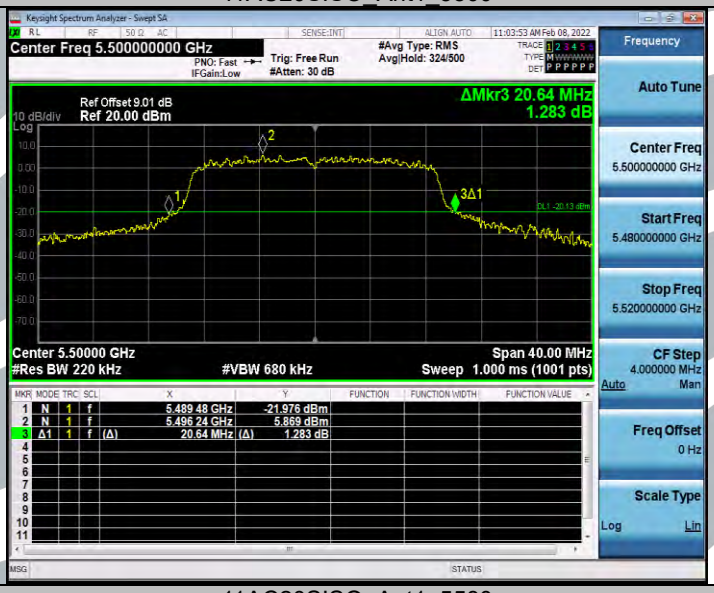

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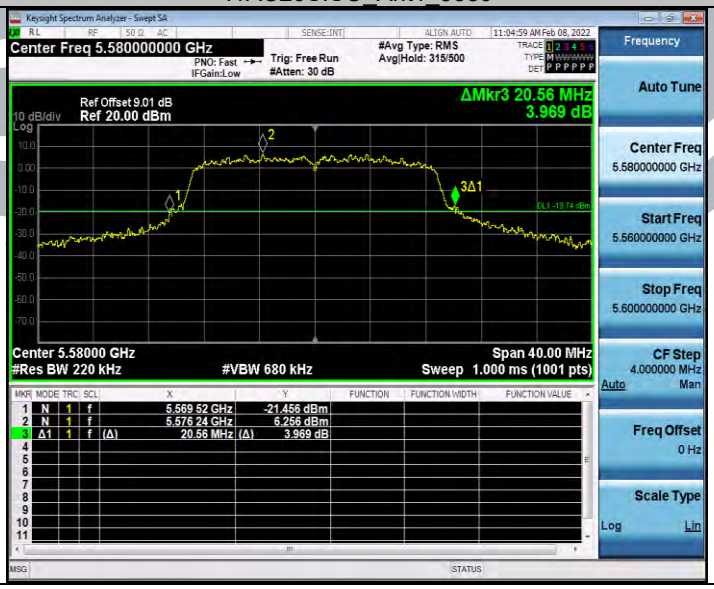
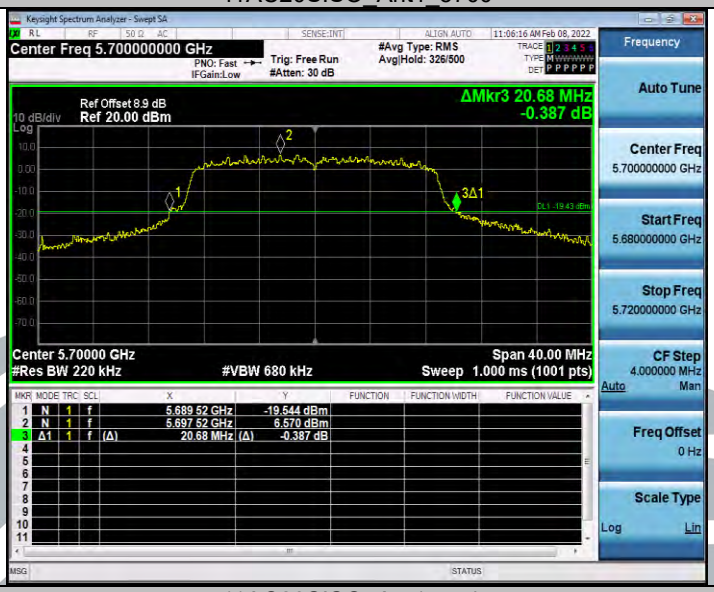


11AC20SISO_Ant1_5700



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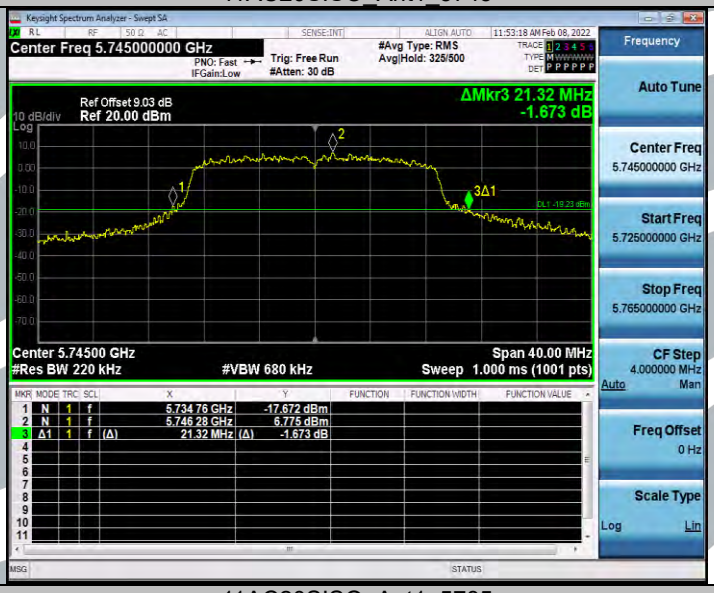

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11AC20SISO_Ant1_5825

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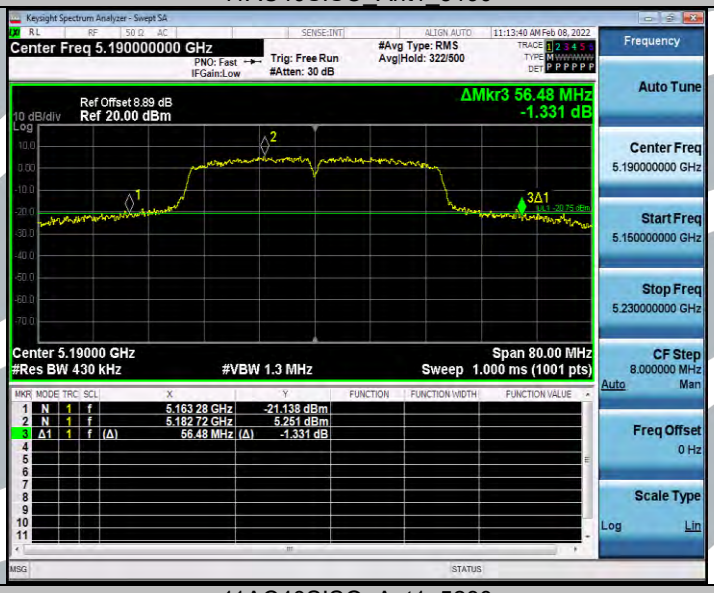

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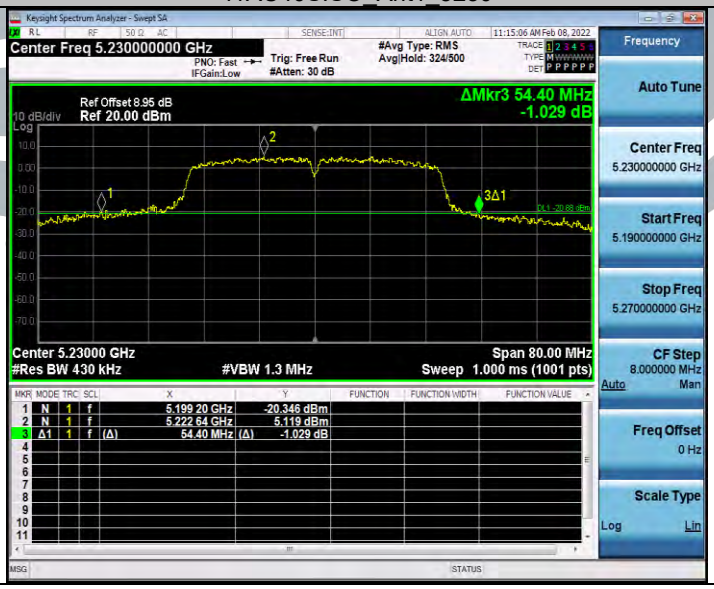

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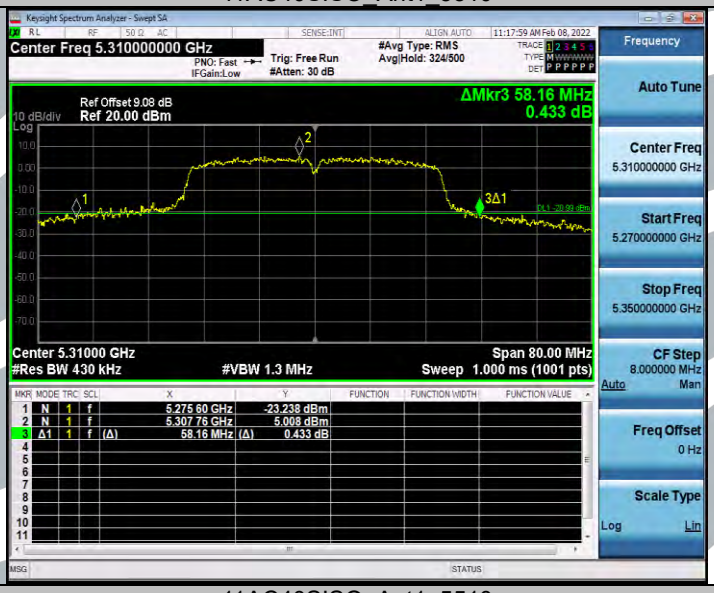
11AC40SISO_Ant1_5310



11AC40SISO_Ant1_5510

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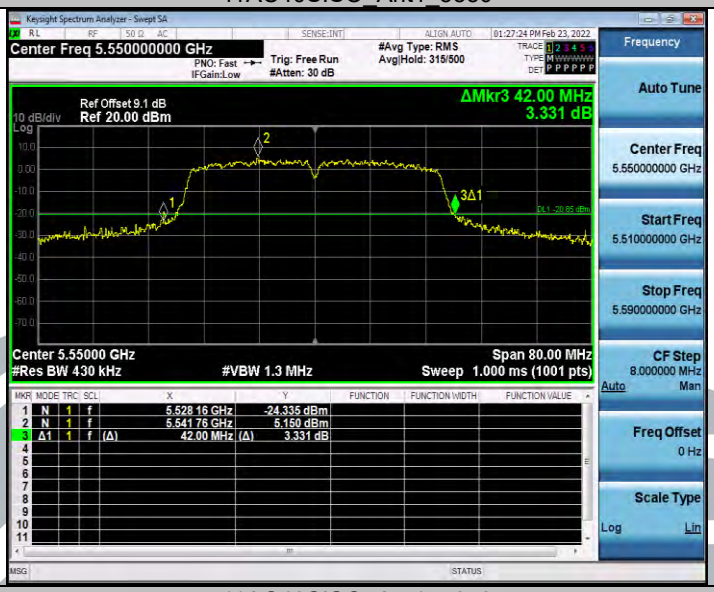

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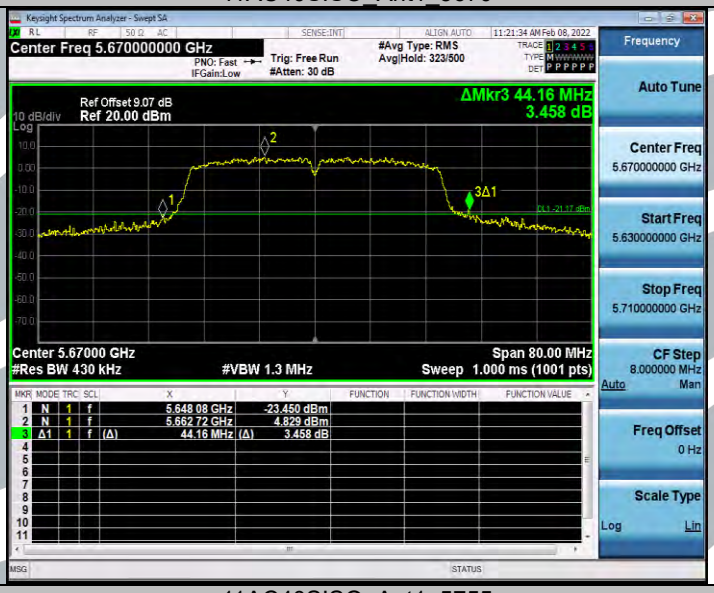

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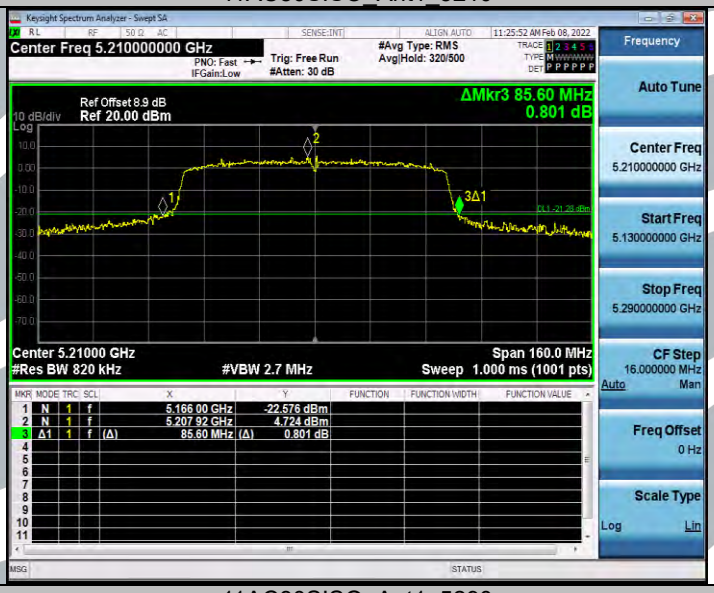

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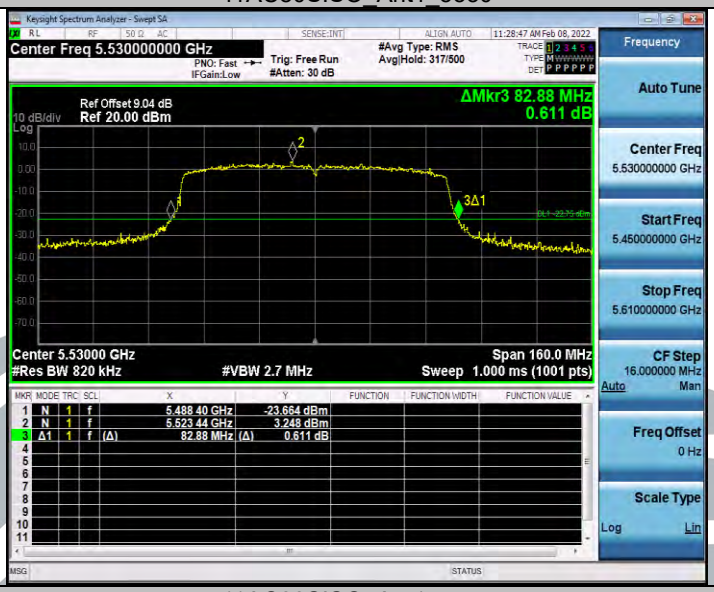
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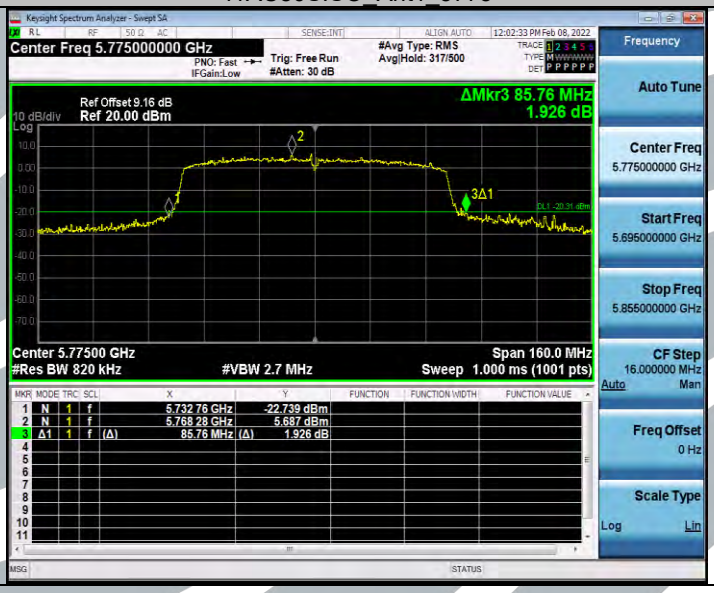

11A_Ant1_5180

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