TEST REPORT

Product Name:	Wifi Module
Trade Mark:	N/A
Model No.:	MWH516B.01
HVIN:	MWH516B.01
Report Number:	211230011RFC-4
Test Standards:	FCC 47 CFR Part 15 Subpart E RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	BBP-WLPIN01
IC:	144D-WLPIN01
Test Result:	PASS
Date of Issue:	March 31, 2022

Prepared for:

Ricoh Company Ltd
2-7-1 Izumi, Ebina, Kanagawa 243-0460, Japan

Prepared by:

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Date: March 31, 2022

Version

Version No.	Date	Description
V1.0	March 31, 2022	Original

CONTENTS

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Ricoh Company Ltd
Address of Applicant:	2-7-1 Izumi, Ebina, Kanagawa 243-0460, Japan
Manufacturer:	Ricoh Company Ltd
Address of Manufacturer:	2-7-1 Izumi, Ebina, Kanagawa 243-0460, Japan

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	Wifi Module		
Model No.:	MWH516B.01		
HVIN:	MWH516B.01		
Trade Mark:	N/A		
DUT Stage:	Identical Prototype		
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth 5.1	
	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:	December 31, 2021		
Sample Tested Date:	February 17, 2022 to March 12, 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

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:	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 MCS15	
	IEEE 802.11n-HT40: Up to MCS15	
	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:	Chain 0	PCB Antenna
	Chain 1	PCB Antenna
Antenna Gain: (Provided by the customer)	Chain 0	5150 MHz to 5250 MHz: 0.50 dBi
		5250 MHz to 5350 MHz: 0.50 dBi
		5470 MHz to 5725 MHz: 0.38 dBi
		5725 MHz to 5850 MHz: 0.44 dBi
	Chain 1	5150 MHz to 5250 MHz: 0.45 dBi
		5250 MHz to 5350 MHz: 0.45 dBi

		5470 MHz to 5725 MHz: 0.32 dBi			
		5725 MHz to 5850 MHz: 0.30 dBi			
Maximum EIRP (dBm):	**SISO_Chain 0**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	16.27	16.99	16.12	15.78
	SISO_Chain 1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	16.16	16.05	15.95	15.49
	MIMO_Chain 0+1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11n-HT20:	18.61	18.61	17.58	18.20
	IEEE 802.11n-HT40:	15.53	18.72	17.52	17.86
	IEEE 802.11ac-VHT20:	18.67	18.66	17.58	18.16
	IEEE 802.11ac-VHT40:	15.56	18.72	17.58	17.79
	IEEE 802.11ac-VHT80:	14.00	12.29	19.71	19.56
Maximum conducted output power (dBm):	**SISO_Chain 0**	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	15.77	16.49	15.74	15.34
	SISO_Chain 1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11a:	15.71	15.60	15.63	15.19
	MIMO_Chain 0+1	**U-NII-1**	**U-NII-2A**	**U-NII-2C**	**U-NII-3**
	IEEE 802.11n-HT20:	18.11	18.11	17.20	17.76
	IEEE 802.11n-HT40:	15.03	18.22	17.14	17.42
	IEEE 802.11ac-VHT20:	18.17	18.16	17.20	17.72
	IEEE 802.11ac-VHT40:	15.06	18.22	17.20	17.35
	IEEE 802.11ac-VHT80:	13.50	11.79	19.33	19.12
Normal Test Voltage:	5Vdc				

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	LENOVO	E450	PF-0EQBE3 15/11	UnionTrust	Notebook
Notebook Adapter	LENOVO	ADLX65NLC3A	5A10J75114	UnionTrust	Notebook Adapter
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust	Mouse
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	Antenna Cable	SMA	0.15 Meter	UnionTrust
2	USB extension cable	USB	1 Meter	UnionTrust
3	USB extension cable	USB	1 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	18103002	Nov. 11, 2021	Nov. 10, 2023
☒	Preamplifier	HP	8447F	2805A02960	Nov. 05, 2021	Nov. 04, 2022
☒	Band Rejection Filter (5150MHz~5880MHz)	Micro-Tronics	BRM50716	G186	Nov. 06, 2021	Nov. 05, 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
☒	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: 9.20151119i		

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	Relative Humidity (%)
NV/NT	+15 to +35	5Vdc	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	25.2	49	100.03	211230013–A02/11	Hank Wu
6 dB bandwidth					
Occupied Bandwidth					
Maximum conducted output power					
Peak Power Spectral Density					
Dynamic Frequency Selection					
Radiated Emissions and Band Edge Measurement	24.2	49	100.02	211230013–A01/11	Asia Yan
AC Power Line Conducted Emission	25.3	45	101.10	211230013–A01/11	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	1Tx/1Rx	1. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.
IEEE 802.11n/ac	2Tx/2Rx	2. Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

Power Setting								
Mode	U-NII-1		U-NII-2A		U-NII-2C		U-NII-3	
	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1	Chain 0	Chain 1
IEEE 802.11a	1D	1D	1D	1D	1D	1D	18	18
IEEE 802.11n-HT20	1B	1B	1B	1B	18	18	11	11
IEEE 802.11n-HT40	15	15	15	15	0A	0A	11	11
IEEE 802.11ac-VHT20	1B	1B	1B	1B	18	18	11	11
IEEE 802.11ac-VHT40	15	15	15	15	0A	0A	11	11
IEEE 802.11ac-VHT80	12	12	12	12	1D	1D	11	11

Test Software
Test software name: QATool_Dbg;

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	MCS8
IEEE 802.11n-HT40	MCS8
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

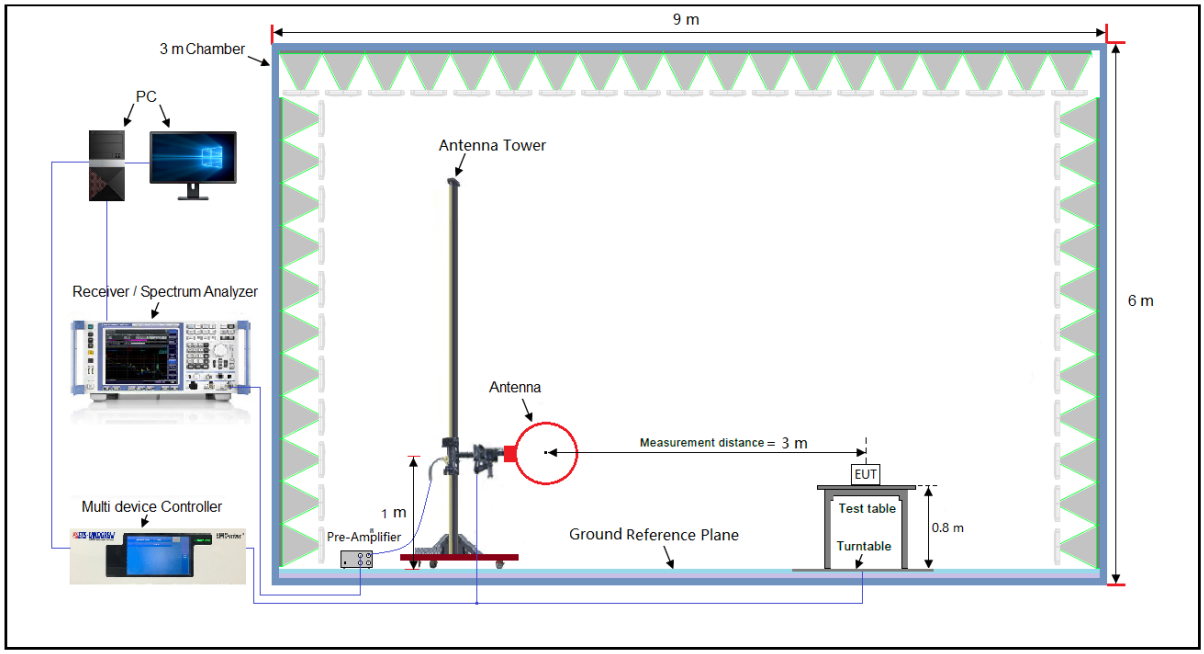


Figure 2. 30MHz to 1GHz

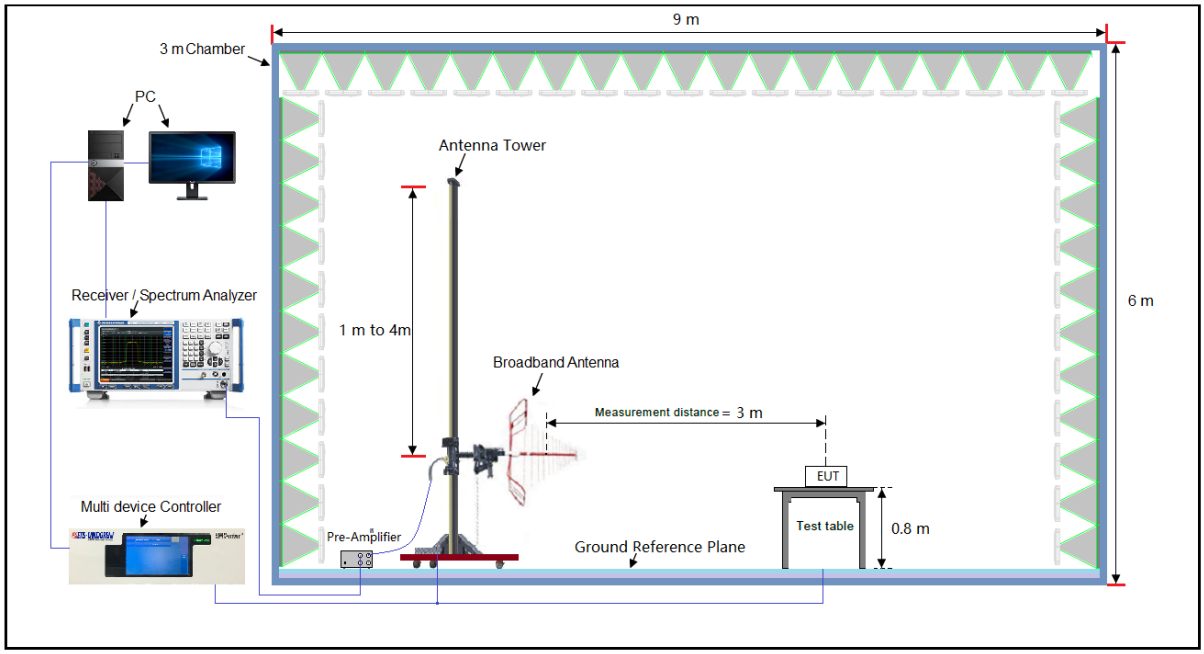
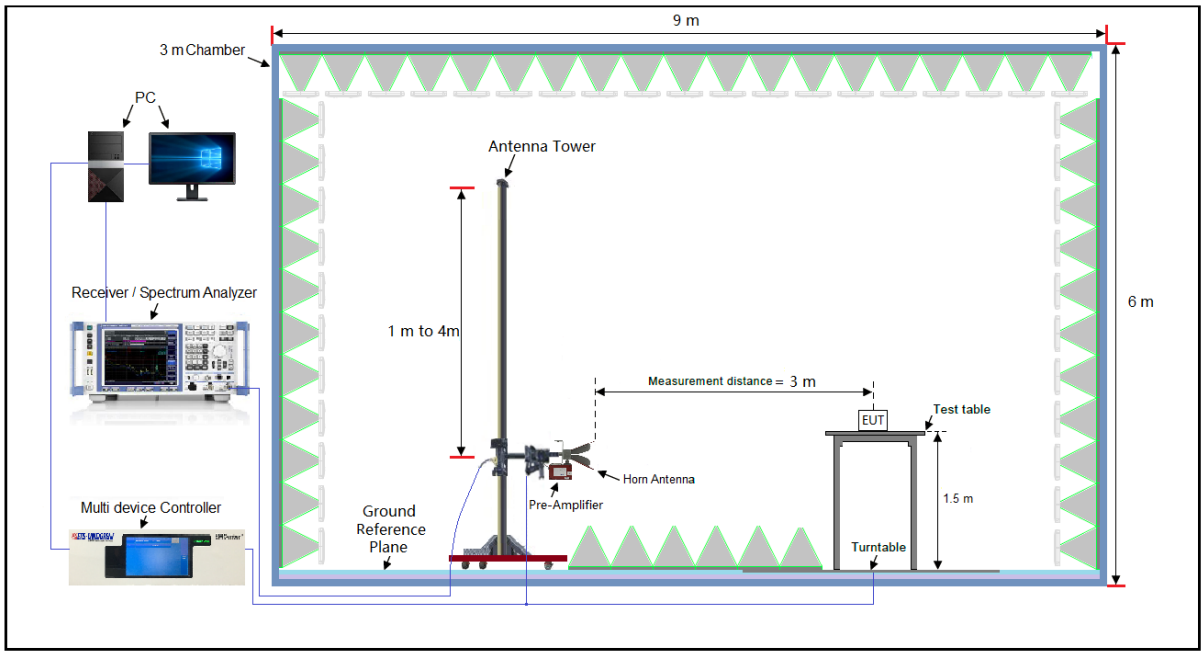
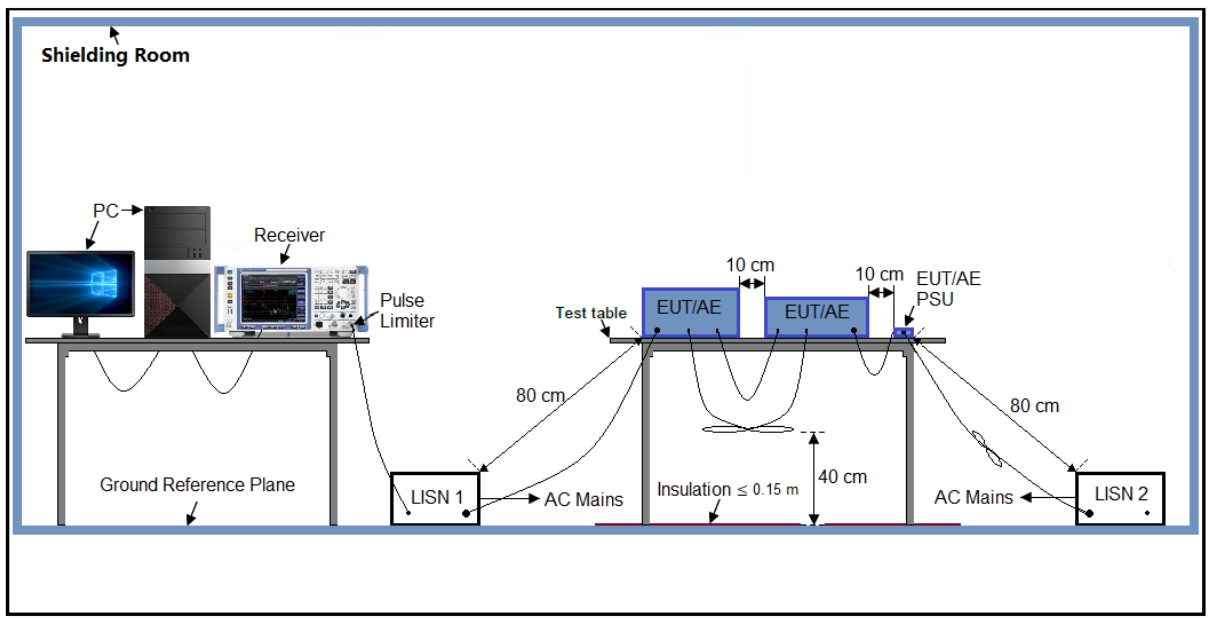


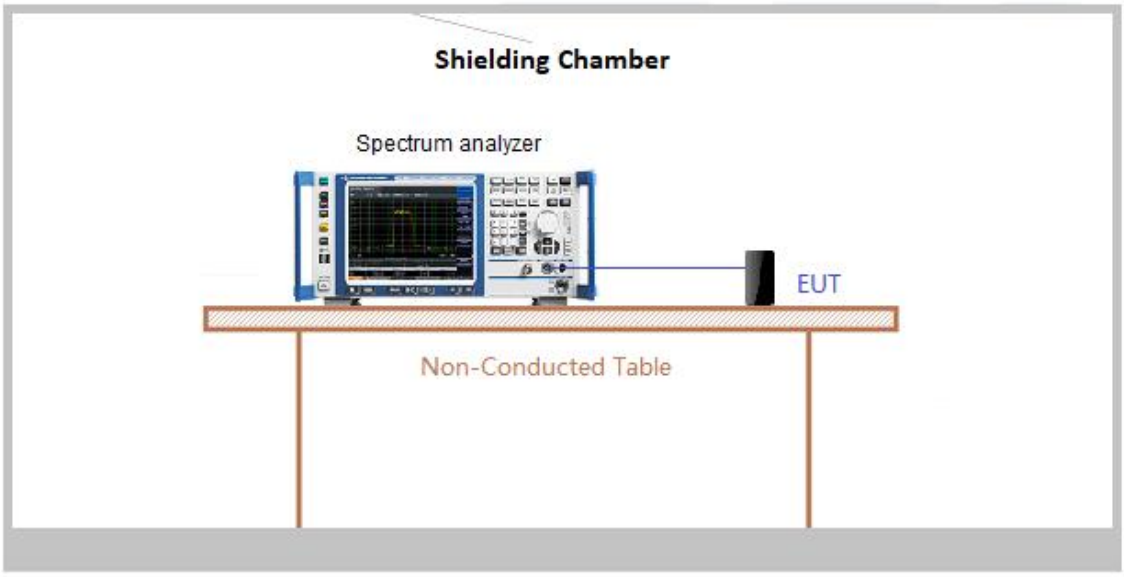
Figure 3. Above 1GHz



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

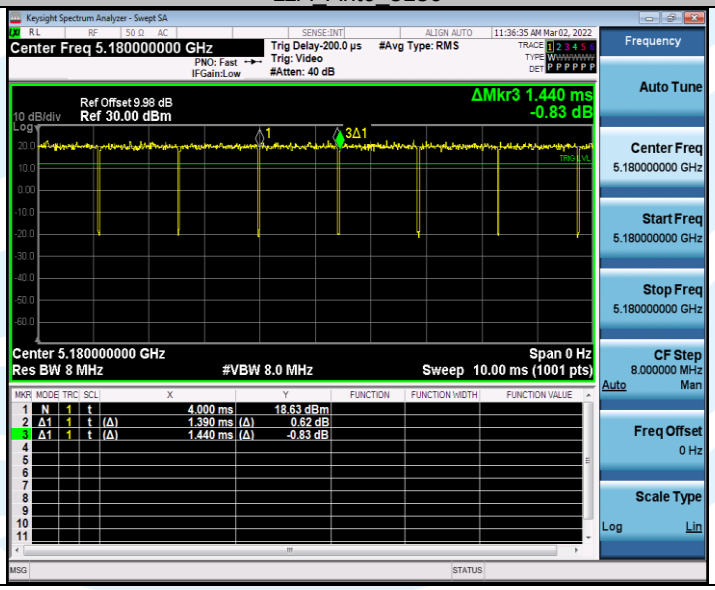
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)
Ant 0							
IEEE 802.11a	6	1.39	1.44	0.97	96.53	0.15	0.72
IEEE 802.11n-HT20	MCS0	1.30	1.35	0.96	96.30	0.16	0.77
IEEE 802.11n-HT40	MCS0	0.64	0.69	0.93	92.75	0.33	1.56
IEEE 802.11ac-VHT20	MCS0	1.31	1.36	0.96	96.32	0.16	0.76
IEEE 802.11ac-VHT40	MCS0	0.65	0.70	0.93	92.86	0.32	1.54
IEEE 802.11ac-VHT80	MCS0	0.32	0.37	0.86	86.49	0.63	3.13
Ant 1							
IEEE 802.11a	6	1.39	1.44	0.97	96.53	0.15	0.72
IEEE 802.11n-HT20	MCS0	1.30	1.35	0.96	96.30	0.16	0.77
IEEE 802.11n-HT40	MCS0	0.64	0.69	0.93	92.75	0.33	1.56
IEEE 802.11ac-VHT20	MCS0	1.31	1.36	0.96	96.32	0.16	0.76
IEEE 802.11ac-VHT40	MCS0	0.65	0.70	0.93	92.86	0.32	1.54
IEEE 802.11ac-VHT80	MCS0	0.32	0.37	0.86	86.49	0.63	3.13

Remark:

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

The test plots as follows

11A_Ant0_5180



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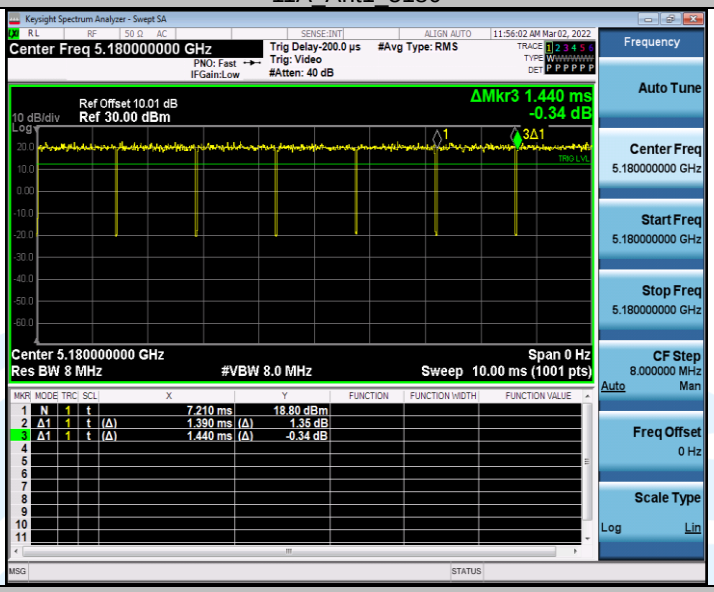

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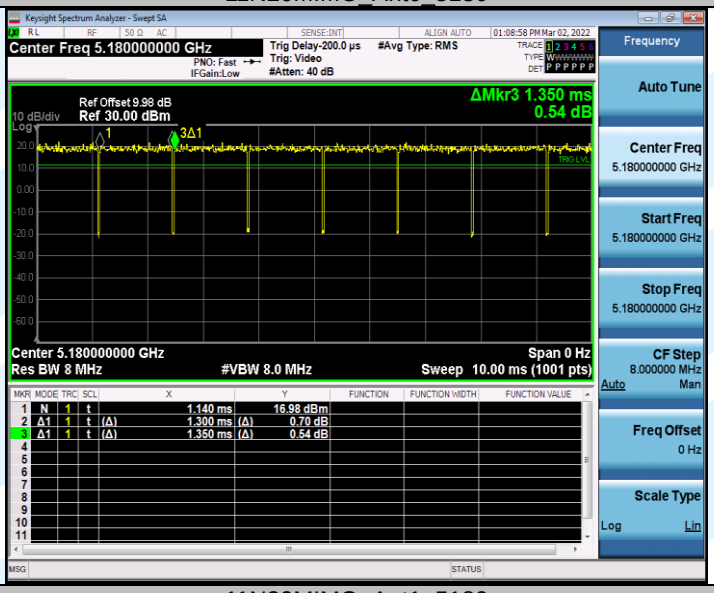

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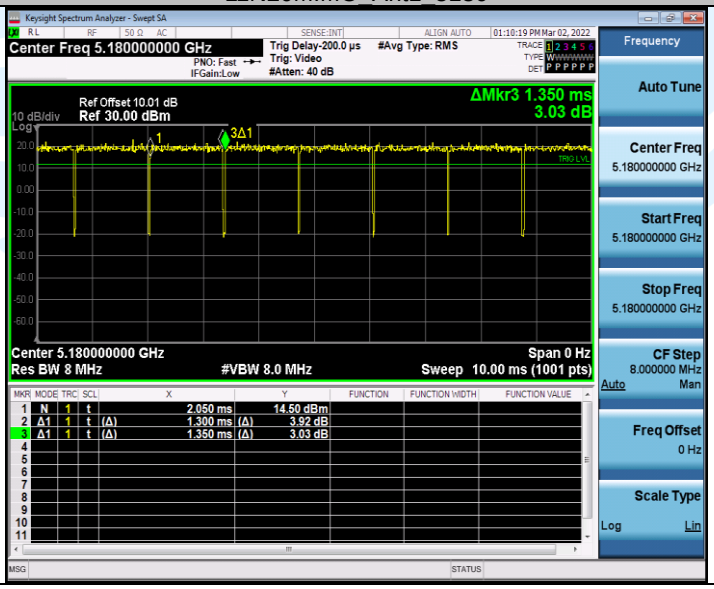

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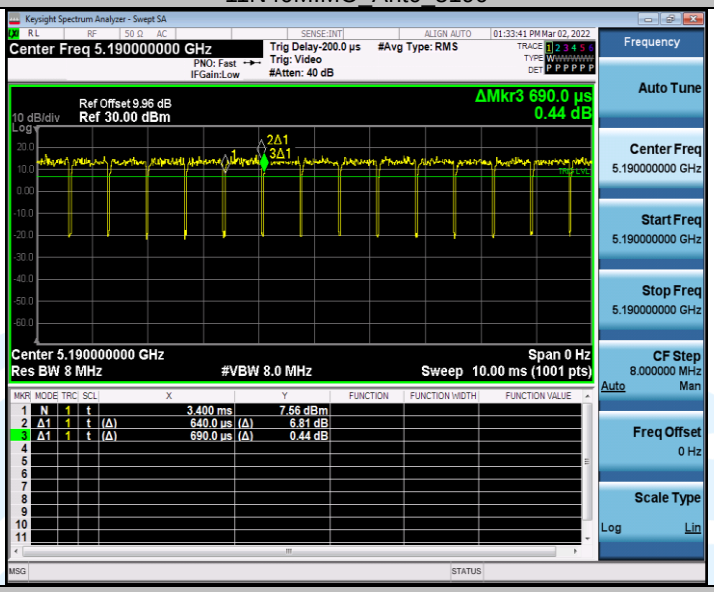
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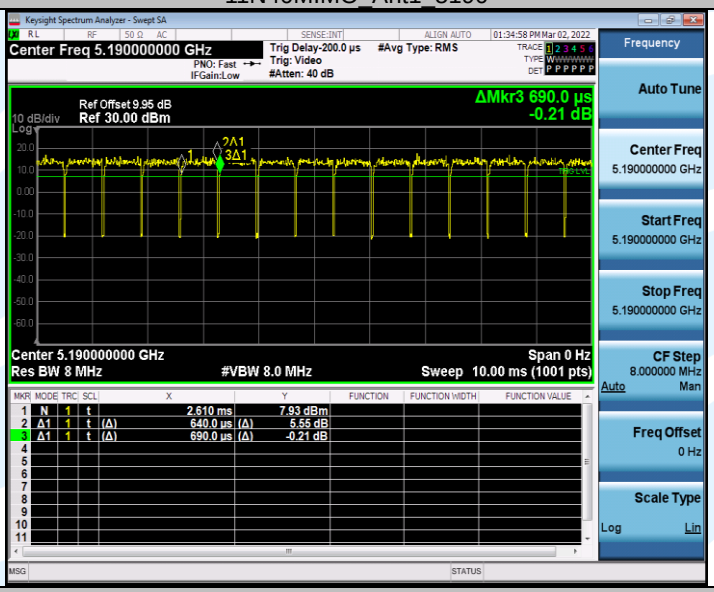
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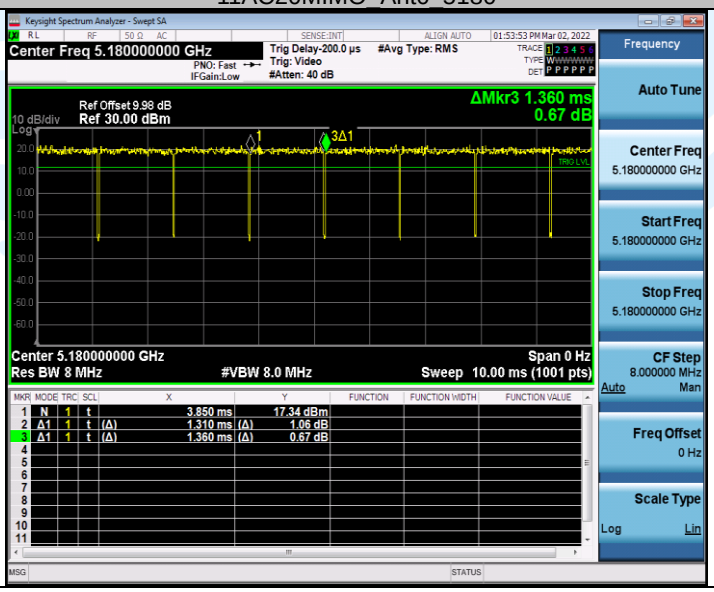

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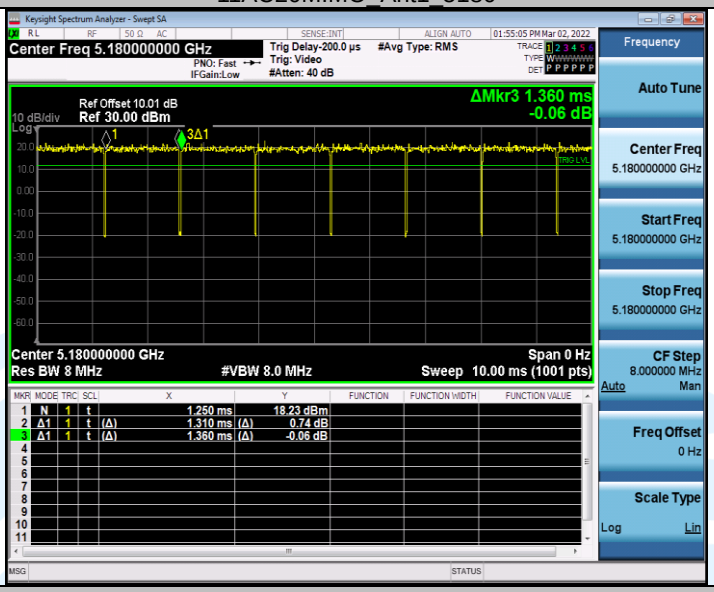

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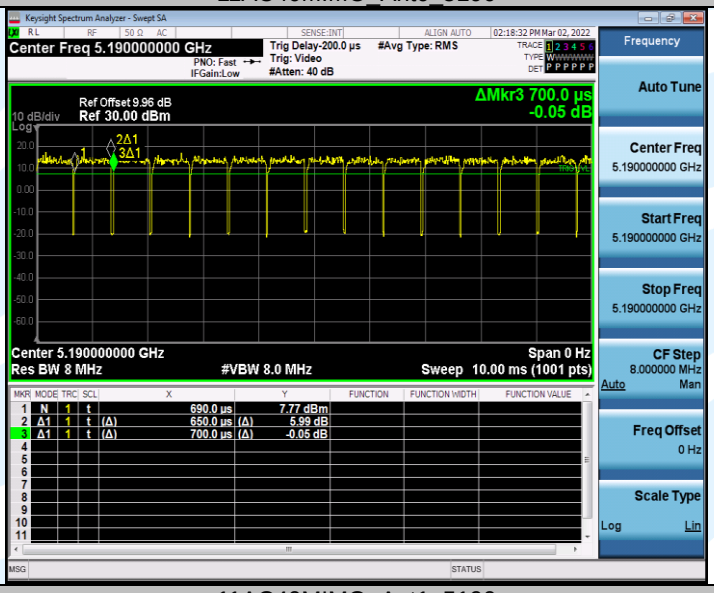

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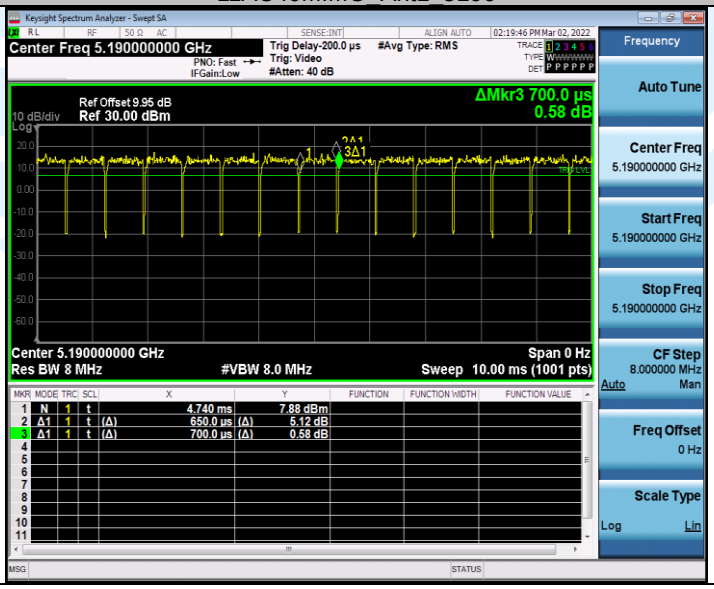

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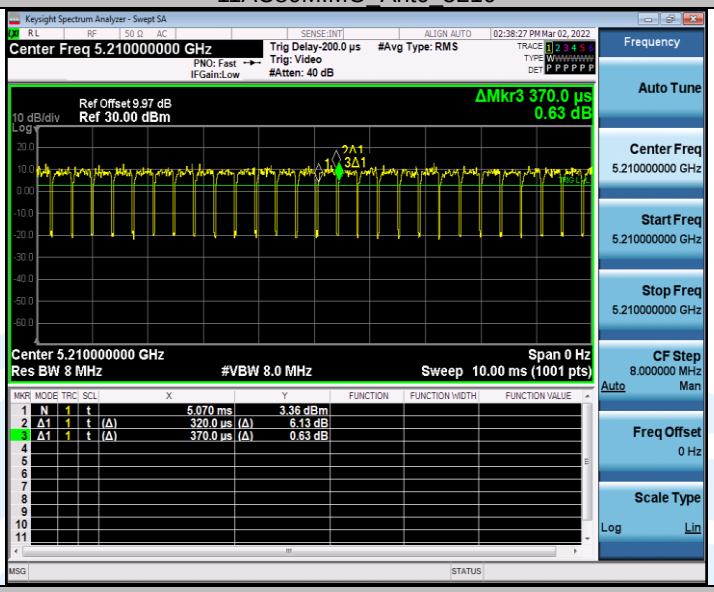
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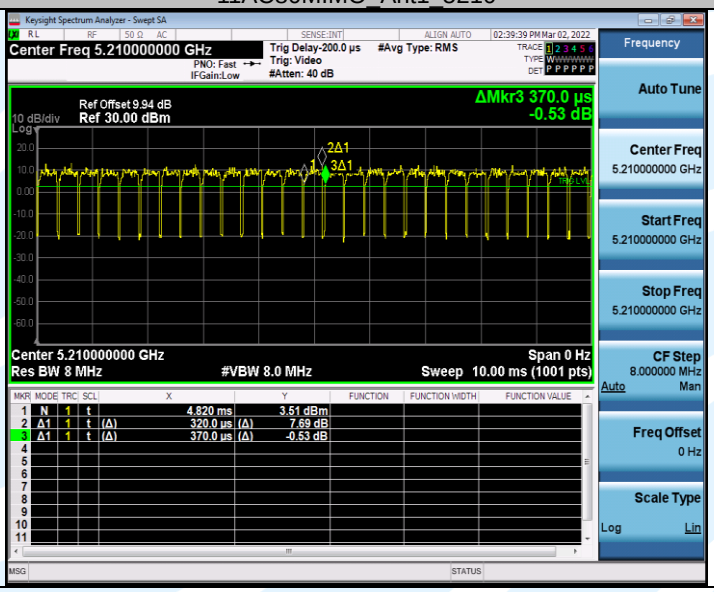


5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing 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 3.49 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	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
IEEE 802.11a	Ant0	5180	19.960	16.906
	Ant1	5180	19.880	16.888
	Ant0	5220	20.080	16.969
	Ant1	5220	19.960	16.914
	Ant0	5240	19.960	16.926
	Ant1	5240	20.160	16.975
	Ant0	5260	20.160	16.958
	Ant1	5260	20.120	16.903
	Ant0	5300	20.120	16.977
	Ant1	5300	20.280	16.923
	Ant0	5320	20.120	16.872
	Ant1	5320	20.080	16.916
	Ant0	5500	19.960	16.930
	Ant1	5500	20.000	16.871
	Ant0	5580	20.080	16.980
	Ant1	5580	20.200	16.994
	Ant0	5700	20.440	17.006
	Ant1	5700	20.200	16.930

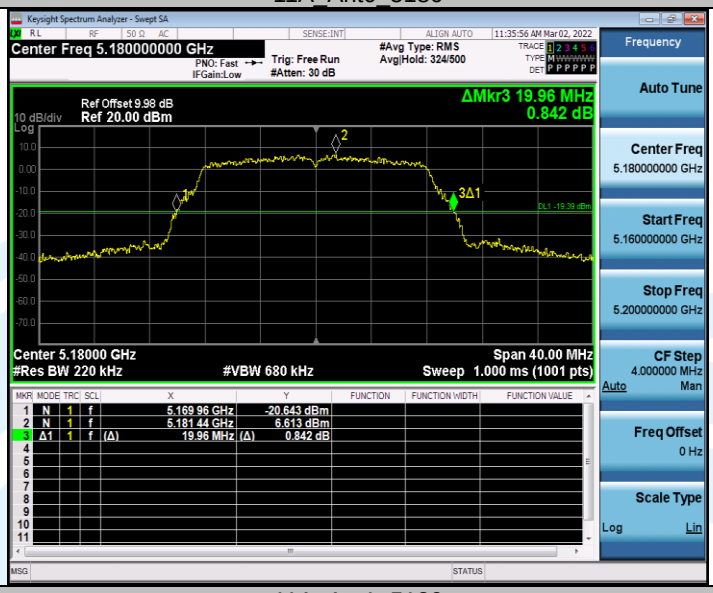
Test Mode	Antenna	Channel	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
IEEE 802.11n20 MIMO	Ant0	5180	20.280	17.854
	Ant1	5180	20.280	17.714
	Ant0	5220	20.480	17.876
	Ant1	5220	20.240	17.751
	Ant0	5240	20.320	17.881
	Ant1	5240	20.360	17.740
	Ant0	5260	20.240	17.913
	Ant1	5260	20.480	17.744
	Ant0	5300	20.400	17.849
	Ant1	5300	20.400	17.695
	Ant0	5320	20.240	17.881
	Ant1	5320	20.200	17.691
	Ant0	5500	20.400	17.886
	Ant1	5500	20.280	17.702
	Ant0	5580	20.240	17.870
	Ant1	5580	20.160	17.732
	Ant0	5700	20.280	17.909
	Ant1	5700	20.240	17.724
IEEE 802.11n40 MIMO	Ant0	5190	40.880	36.265
	Ant1	5190	40.400	36.197
	Ant0	5230	40.720	36.321
	Ant1	5230	40.560	36.177
	Ant0	5270	40.720	36.320
	Ant1	5270	39.840	36.176
	Ant0	5310	40.320	36.390
	Ant1	5310	40.080	36.201
	Ant0	5510	40.480	36.383
	Ant1	5510	39.920	36.136
	Ant0	5550	40.800	36.295
	Ant1	5550	40.000	36.220
	Ant0	5670	40.720	36.355
	Ant1	5670	40.960	36.350
IEEE 802.11ac20 MIMO	Ant0	5180	20.280	17.855
	Ant1	5180	20.240	17.723
	Ant0	5220	20.400	17.869
	Ant1	5220	20.360	17.724
	Ant0	5240	20.440	17.876
	Ant1	5240	20.480	17.751
	Ant0	5260	20.240	17.888
	Ant1	5260	20.520	17.740
	Ant0	5300	20.480	17.910
	Ant1	5300	20.360	17.735
	Ant0	5320	20.280	17.835
	Ant1	5320	20.200	17.694
	Ant0	5500	20.360	17.829
	Ant1	5500	20.240	17.695
	Ant0	5580	20.360	17.870
	Ant1	5580	20.440	17.708
	Ant0	5700	20.200	17.859
	Ant1	5700	20.160	17.729

Test Mode	Antenna	Channel	26 dB Bandwidth [MHz]	99% Occupied Bandwidth [MHz]
IEEE 802.11ac40 MIMO	Ant0	5190	40.560	36.257
	Ant1	5190	40.320	36.135
	Ant0	5230	40.560	36.188
	Ant1	5230	40.080	36.207
	Ant0	5270	40.720	36.275
	Ant1	5270	40.480	36.151
	Ant0	5310	40.400	36.396
	Ant1	5310	40.000	36.166
	Ant0	5510	40.480	36.249
	Ant1	5510	40.000	36.123
	Ant0	5550	40.160	36.336
	Ant1	5550	40.000	36.240
	Ant0	5670	41.280	36.380
	Ant1	5670	40.080	36.285
IEEE 802.11ac80 MIMO	Ant0	5210	81.280	75.353
	Ant1	5210	80.160	75.270
	Ant0	5290	80.640	75.348
	Ant1	5290	80.480	75.285
	Ant0	5530	81.120	75.341
	Ant1	5530	80.640	75.351

The test plots as follows

26 dB Bandwidth:

11A_Ant0_5180



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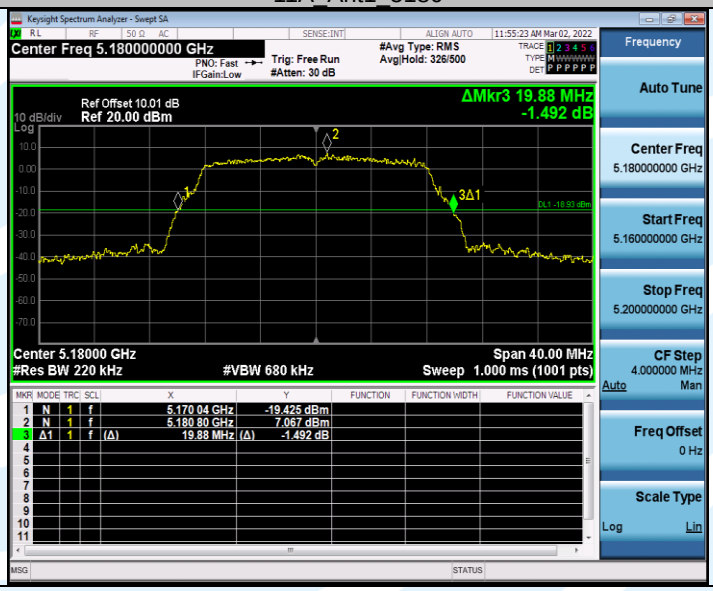

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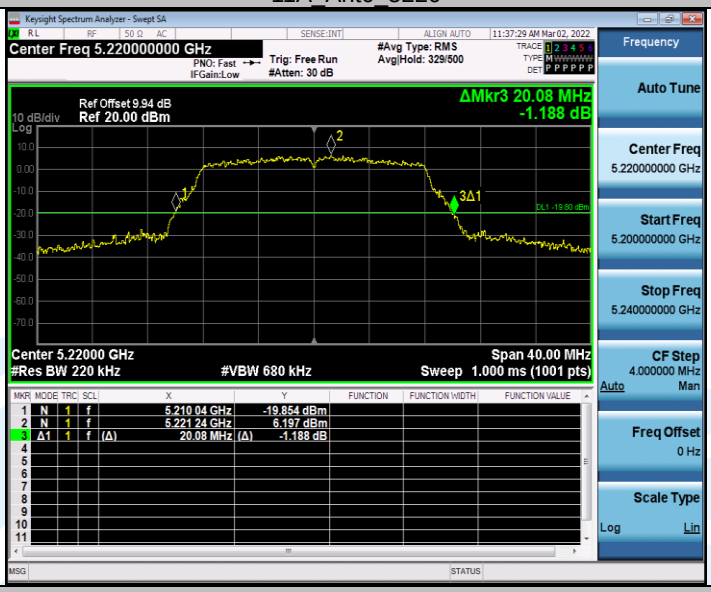

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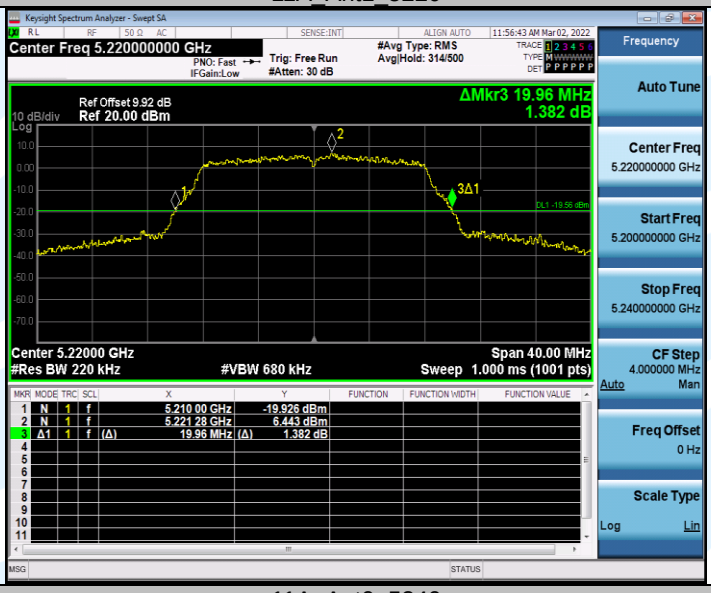

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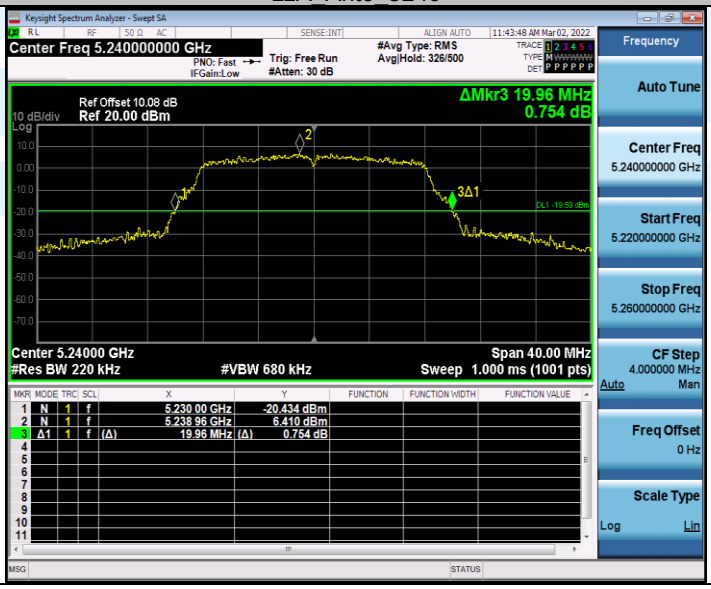

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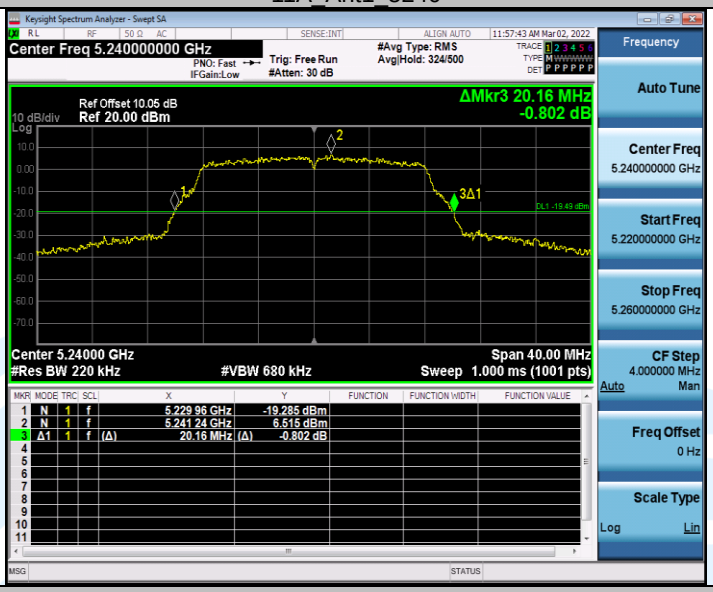
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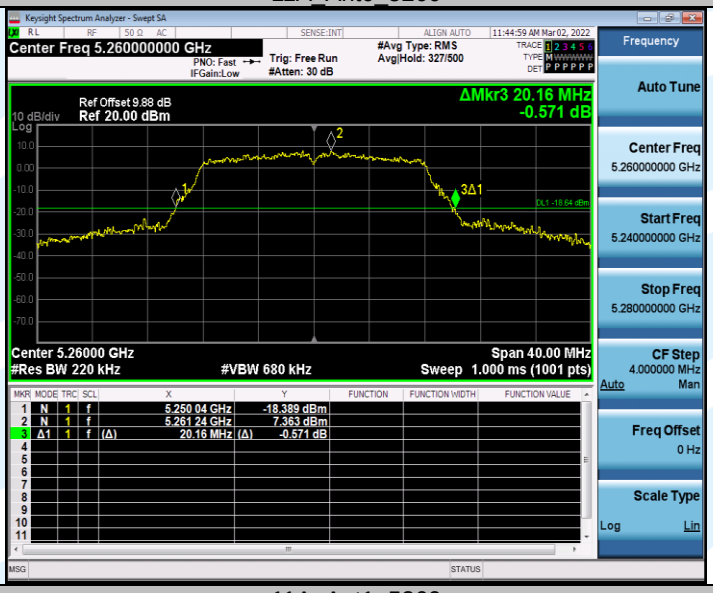
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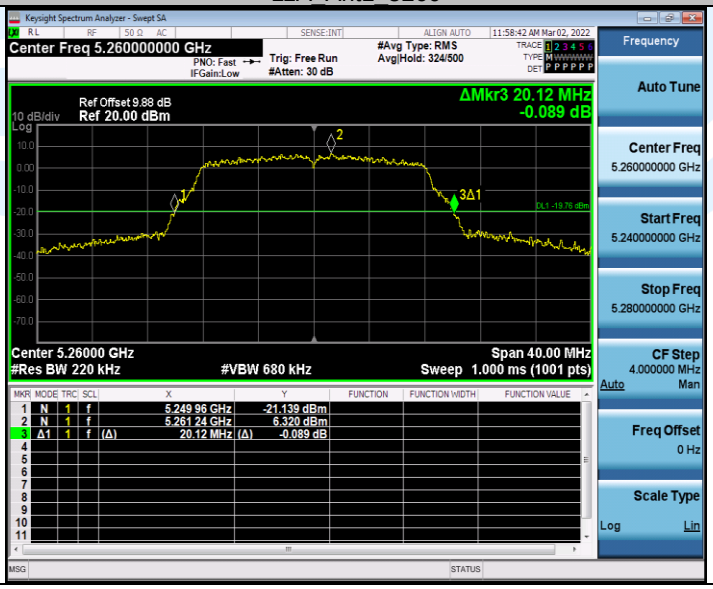

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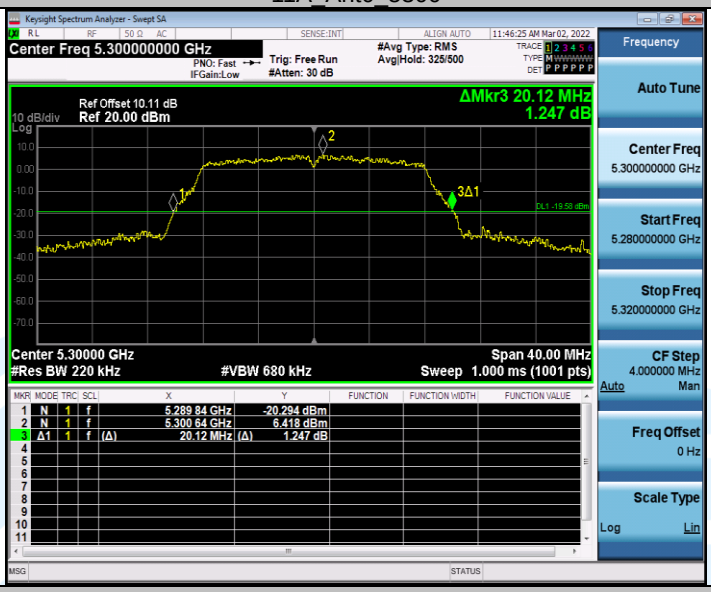
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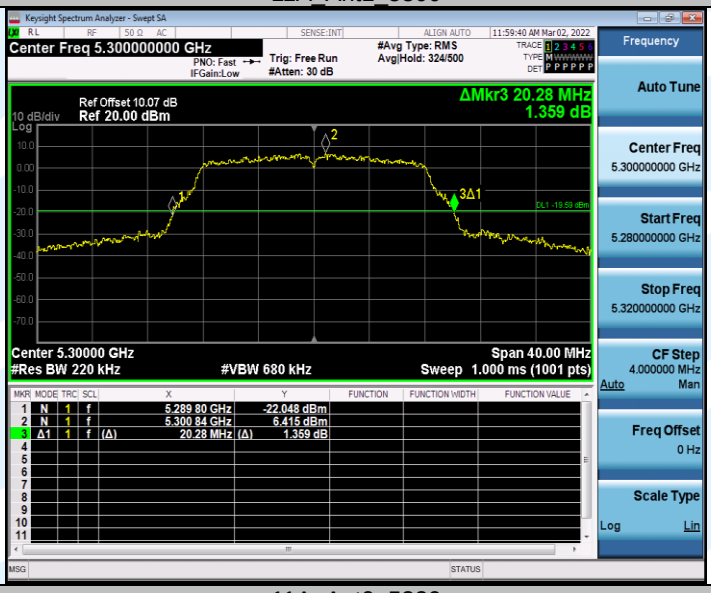
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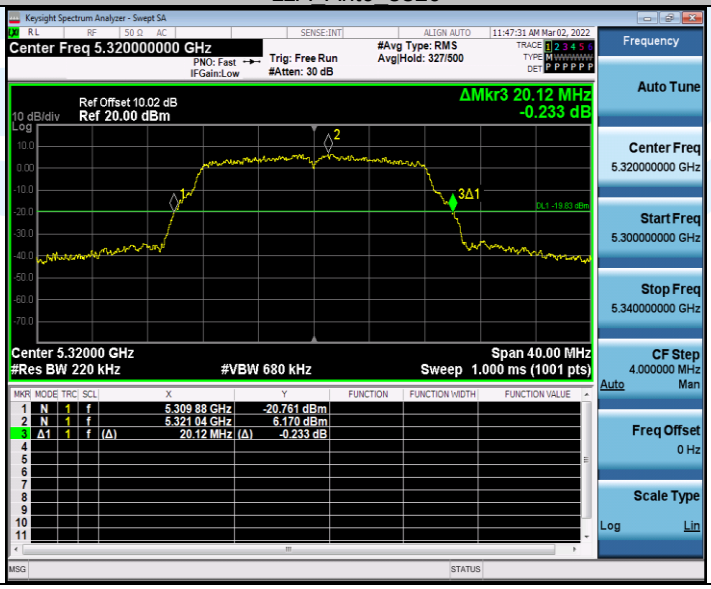

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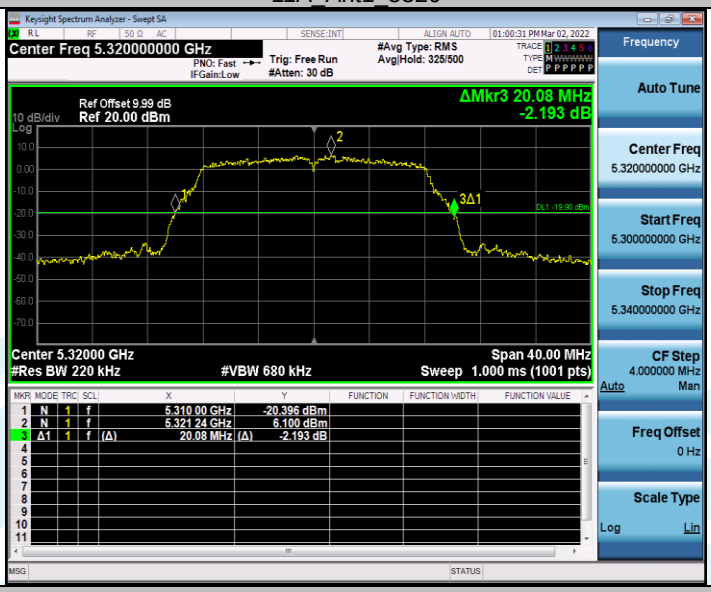
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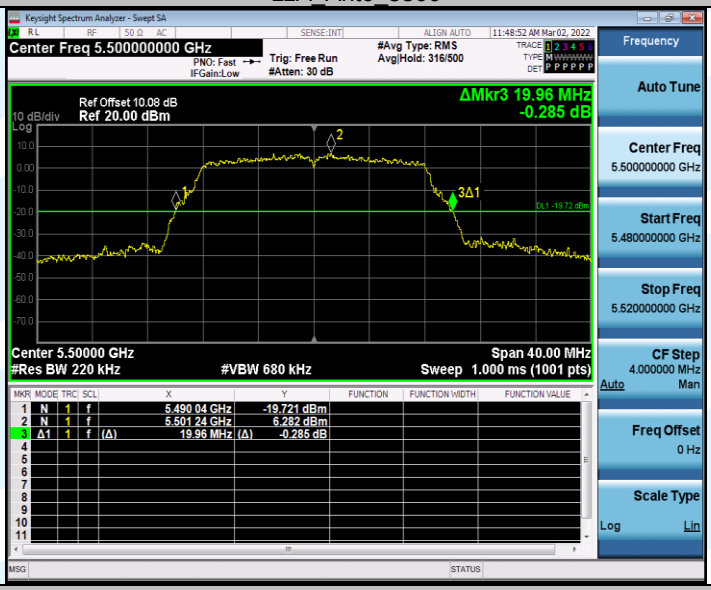
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