Tonal

REVISED TEST REPORT TO 110285-50

Apollo Board
Model: 500-0806

Trainer
Model: T2

Tested to The Following Standards:

FCC Part 15 Subpart E Section(s)

15.207 & 15.407
(NII 5470 – 5725 MHz)

Report No.: 110285-50A

Date of issue: December 20, 2024

Test Certificate # 803.01

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

TABLE OF CONTENTS

Administrative Information

Test Report Information

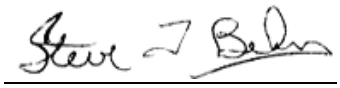
REPORT PREPARED FOR:	REPORT PREPARED BY:
Tonal 69 Converse, Suite 200 San Francisco, CA 94103	Lisa Bevington CKC Laboratories, Inc. 5046 Sierra Pines Drive Mariposa, CA 95338
Representative: Lars Gilstrom Customer Reference Number: PO3196	Project Number: 110285
DATE OF EQUIPMENT RECEIPT:	October 2, 2024
DATE(S) OF TESTING:	October 7, 8, 9, 17, 24, and 25, 2024 And November 1 and 6, 2024

Revision History

Original: Testing of Apollo Board, Model: 500-0806 & Trainer, Model: T2, to FCC Part 15 Subpart E Sections 15.207 & 15.407 (NII 5470 - 5725 MHz).
Revision A: 15.407(a), updated note on page 41.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable, and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.20

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Canada	Japan
Canyon Park, Bothell, WA	US0103	US1024	3082C	A-0136
Brea, CA	US0103	US1024	3082D	A-0136
Fremont, CA	US0103	US1024	3082B	A-0136
Mariposa, CA	US0103	US1024	3082A	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

Summary of Results

Standard / Specification: FCC Part 15 Subpart E - 15.407 (NII 5470 - 5725)

Test Procedure	Description	Modifications	Results
15.215	Occupied Bandwidth	NA	Pass
15.407(a)	Output Power	NA	Pass
15.407(a)	Power Spectral Density	NA	Pass
15.407(b)	Radiated Emissions & Band Edge	Mod. #1	Pass
15.407(g)	Frequency Stability	NA	NA1
15.207	AC Conducted Emissions	Mod. #1	Pass

NA = Not Applicable
NA1 = In accordance with KDB 789033, this test is not required.

ISO/IEC 17025 Decision Rule
The equipment sample utilized for testing is selected by the manufacturer. The declaration of pass or fail herein is a binary statement for simple acceptance rule (ILAC G8) based upon assessment to the specification(s) listed above, without consideration of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
Modification #1: Added a ferrite (Wurth: 742 712 21) on lower resistor wire. Green Resistor.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
Worst case tested: 802.11a 18Mbit/s 802.11n HT20 MSC2 802,11n HT40 MSC0 802.11ac VHT20 MSC2 802.11ac VHT40 MSC0 802.11ac VHT80 MSC1

Equipment Under Test (EUT)

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration A

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Apollo Board	Tonal	500-0806	080600030001263

Support Devices:

Device Name	Manufacturer	Model #	S/N
MCB Board	Tonal Systems	500-0131	500-0131_rev003_00001286_20240909_17
Laptop	Dell	XPS	22E00911
AC/DC Adapter for Laptop	Dell	DA130PM130	CN-06TTY6-48661-4CO-27M7-A00

Configuration 1

***Equipment Under Test* (* = EUT):**

Device Name	Manufacturer	Model #	S/N
Trainer	Tonal	T2	4000055

Support Devices:

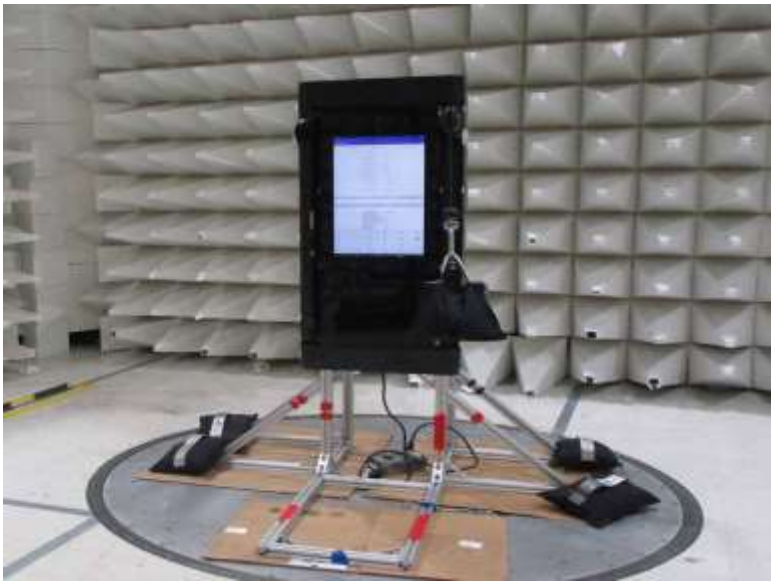
Device Name	Manufacturer	Model #	S/N
Laptop	Dell	XPS	22E00911
AC/DC Adapter for Laptop	Dell	DA130PM130	CN-06TTY6-48661-4CO-27M7-A00

General Product Information:

Description of EUT
Exercise Trainer

Product Information	Manufacturer-Provided Details
Operating Frequencies Tested:	5500MHz-5720MHz
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.11
Maximum Duty Cycle:	100%
Modulation Type(s):	802.11a (BPSK, QPSK, 16QAM, 64QAM) 802.11n HT20 (BPSK, QPSK, 16QAM, 64QAM) 802.11n HT40 (BPSK, QPSK, 16QAM, 64QAM) 802.11ac VHT20 (BPSK, QPSK, 16QAM,64QAM, 256QAM) 802.11ac VHT40 (BPSK, QPSK, 16QAM,64QAM, 256QAM) 802.11ac VHT80 (BPSK, QPSK, 16QAM,64QAM, 256QAM)
Number of TX Chains:	2 Note: The manufacturer declared MIMO is not enabled, completely uncorrelated transmission.
Beamforming Type:	NA
Antenna Type(s) and Gain:	External/4.66dBi
Antenna Connection Type:	External Connector
Nominal Input Voltage:	12VDC
Firmware / Software Version(s):	QRCT (Qualcomm Radio Control Toolkit) Version 4.1
Firmware / Software Description:	Using C-Prompt and QRCT application to control all modulation types and frequencies to continuously transmit or receive as intended
Firmware / Software Setting(s):	NA
Tune-up or Adjustment(s):	NA
Declared Operational Configuration:	☐ Indoor Access Point ☐ Outdoor Access Point ☒ Indoor Client ☐ Outdoor Client ☐ Outdoor Fixed Equipment
The validity of results is dependent on the stated product details, the accuracy of which the manufacturer assumes full responsibility.	

EUT and Accessory Photo(s)

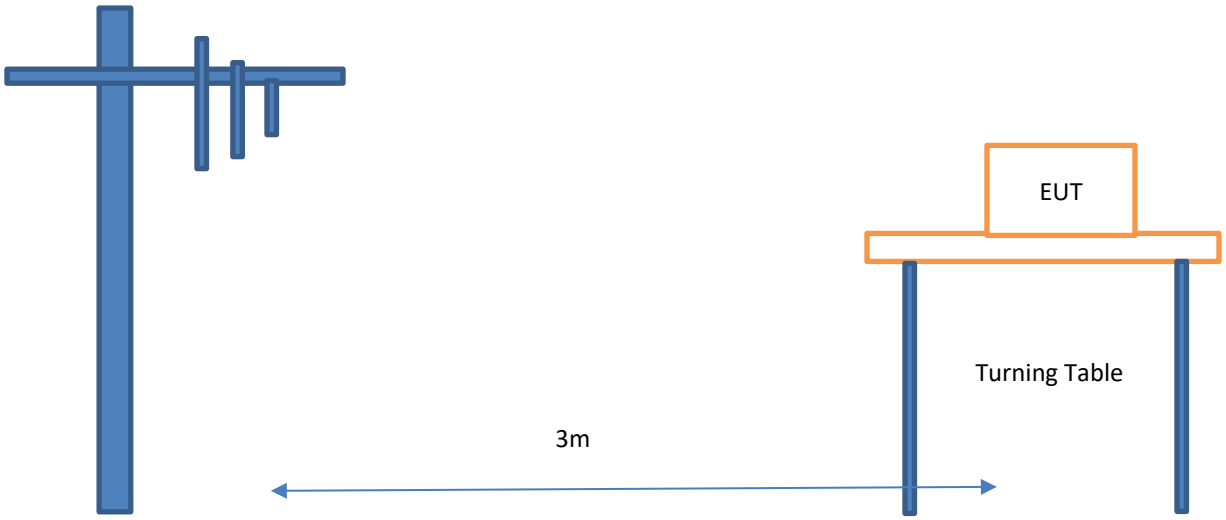


Support Equipment Photo(s)

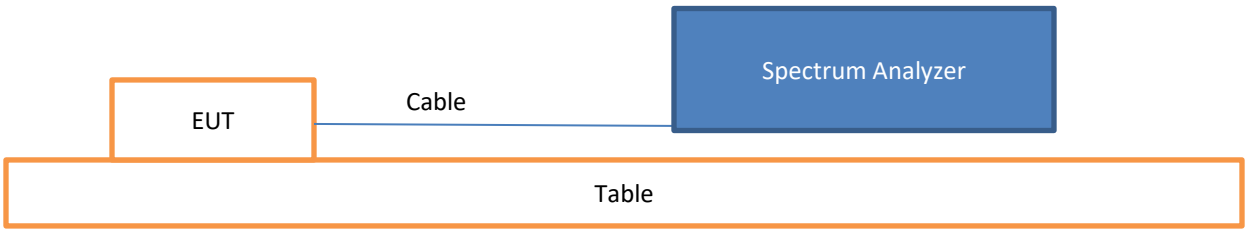
Block Diagram of Test Setup(s)

Config#	Setup Description of Block Diagram
1 & A	Radiated Measurement: The antenna is set up at 3meter distance from the EUT according to ANSI C63.10 2020. The EUT is set up and operated as intended. Conducted Measurement: The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.

Radiated Method Setup



Conducted Method Setup



FCC Part 15 Subpart E

15.215 Occupied Bandwidth

Test Setup/Conditions			
Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 789033	Test Date(s):	10/07-09/2024 and 11/08/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	21.2-23.7	Relative Humidity (%):	39-45

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

26dB Occupied Bandwidth

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5500	0	802.11a	20937	None	N/A
5580	0	802.11a	20798		
5720	0	802.11a	20979		
5500	0	802.11n HT20	21576		
5580	0	802.11n HT20	21614		
5720	0	802.11n HT20	21848		
5500	0	802.11ac 20MHz	21595		
5580	0	802.11ac 20MHz	21224		
5720	0	802.11ac 20MHz	21771		
5510	0	802.11n HT40	41573		
5550	0	802.11n HT40	41449		
5710	0	802.11n HT40	41589		
5510	0	802.11ac 40MHz	41617		
5550	0	802.11ac 40MHz	41482		
5710	0	802.11ac 40MHz	41829		
5530	0	802.11ac 80MHz	83983		
5610	0	802.11ac 80MHz	84206		
5690	0	802.11ac 80MHz	83824		

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5500	1	802.11a	20494	None	N/A
5580	1	802.11a	20289		
5720	1	802.11a	21162		
5500	1	802.11n HT20	21230		
5580	1	802.11n HT20	20916		
5720	1	802.11n HT20	22282		
5500	1	802.11ac 20MHz	21751		
5580	1	802.11ac 20MHz	20822		
5720	1	802.11ac 20MHz	21931		
5510	1	802.11n HT40	41277		
5550	1	802.11n HT40	41863		
5710	1	802.11n HT40	41914		
5510	1	802.11ac 40MHz	41500		
5550	1	802.11ac 40MHz	40802		
5710	1	802.11ac 40MHz	41838		
5530	1	802.11ac 80MHz	83788		
5610	1	802.11ac 80MHz	83000		
5690	1	802.11ac 80MHz	85319		

Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5720	0	802.11a	3200	≥500	Pass
5720	0	802.11n HT20	3819	≥500	Pass
5720	0	802.11ac 20MHz	3838	≥500	Pass
5710	0	802.11n HT40	3011	≥500	Pass
5710	0	802.11ac 40MHz	3011	≥500	Pass
5690	0	802.11ac 80MHz	3021	≥500	Pass

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5720	1	802.11a	3231	≥500	Pass
5720	1	802.11n HT20	3831	≥500	Pass
5720	1	802.11ac 20MHz	3850	≥500	Pass
5710	1	802.11n HT40	3021	≥500	Pass
5710	1	802.11ac 40MHz	3001	≥500	Pass
5690	1	802.11ac 80MHz	2820	≥500	Pass

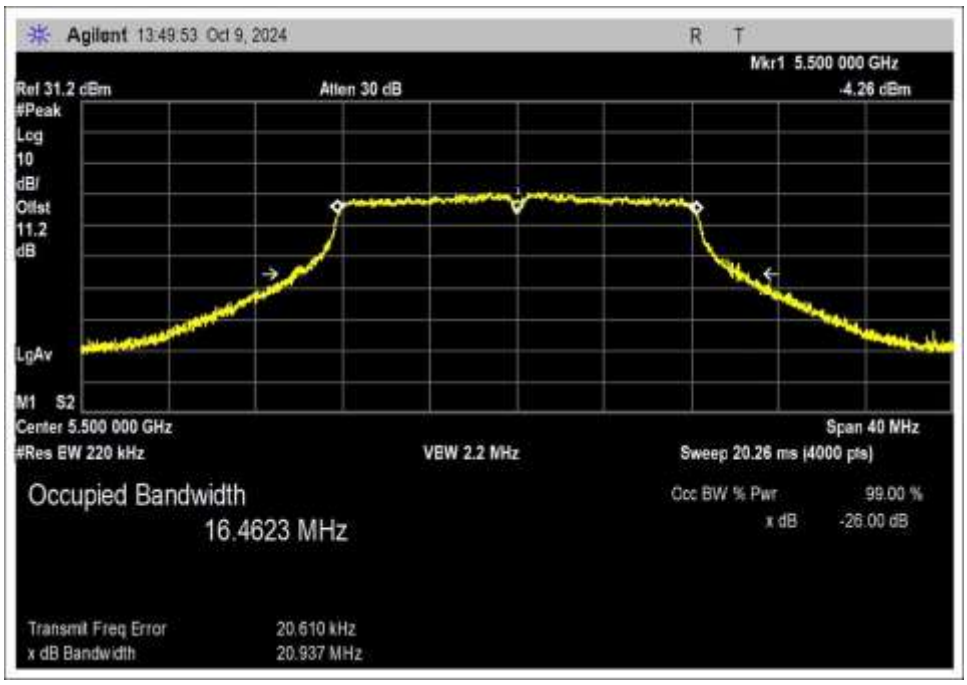
99% Occupied Bandwidth

Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5500	0	802.11a	16462.3	None	N/A
5580	0	802.11a	16455.5		
5720	0	802.11a	16455.6		
5500	0	802.11n HT20	17674.6		
5580	0	802.11n HT20	17686.7		
5720	0	802.11n HT20	17677.2		
5500	0	802.11ac 20MHz	17681.1		
5580	0	802.11ac 20MHz	17667.1		
5720	0	802.11ac 20MHz	17677.8		
5510	0	802.11n HT40	36187.9		
5550	0	802.11n HT40	36201.9		
5710	0	802.11n HT40	362437		
5510	0	802.11ac 40MHz	36205.7		
5550	0	802.11ac 40MHz	36180.7		
5710	0	802.11ac 40MHz	36246.1		
5530	0	802.11ac 80MHz	75630.7		
5610	0	802.11ac 80MHz	75606.2		
5690	0	802.11ac 80MHz	75639.6		

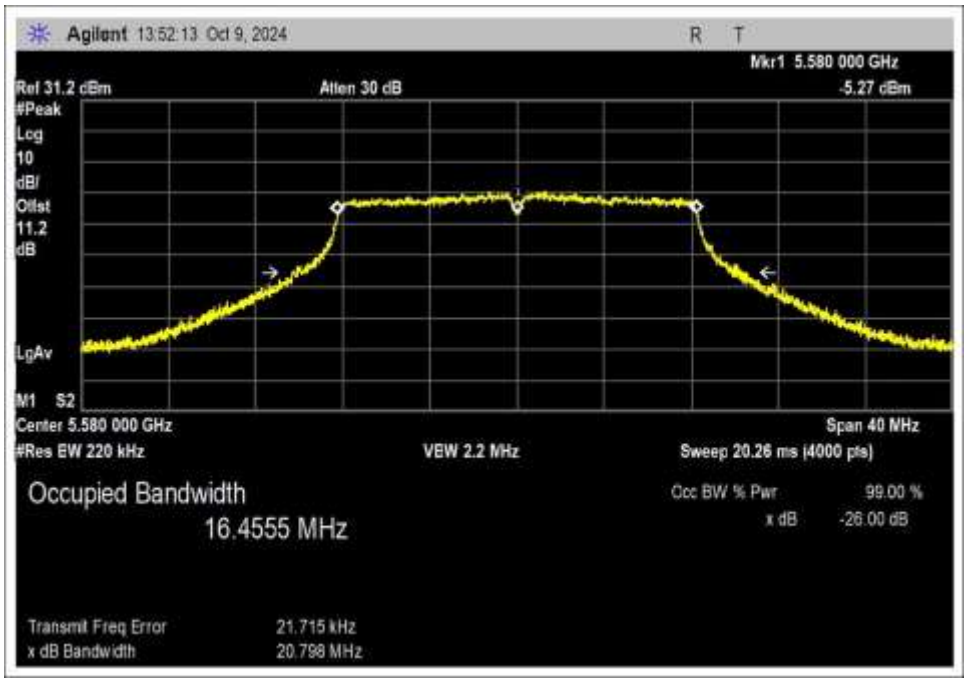
Test Data Summary					
Frequency (MHz)	**Antenna Port**	**Modulation**	**Measured (kHz)**	**Limit (kHz)**	**Results**
5500	1	802.11a	16447.8	None	N/A
5580	1	802.11a	16444.3		
5720	1	802.11a	16495.0		
5500	1	802.11n HT20	17676.2		
5580	1	802.11n HT20	17694.1		
5720	1	802.11n HT20	17688.9		
5500	1	802.11ac 20MHz	16678.4		
5580	1	802.11ac 20MHz	17667.5		
5720	1	802.11ac 20MHz	17687.2		
5510	1	802.11n HT40	36196.6		
5550	1	802.11n HT40	36207.0		
5710	1	802.11n HT40	36247.7		
5510	1	802.11ac 40MHz	36199.9		
5550	1	802.11ac 40MHz	36180.7		
5710	1	802.11ac 40MHz	36233.0		
5530	1	802.11ac 80MHz	75676.0		
5610	1	802.11ac 80MHz	75654.8		
5690	1	802.11ac 80MHz	75656.3		

Plot(s)

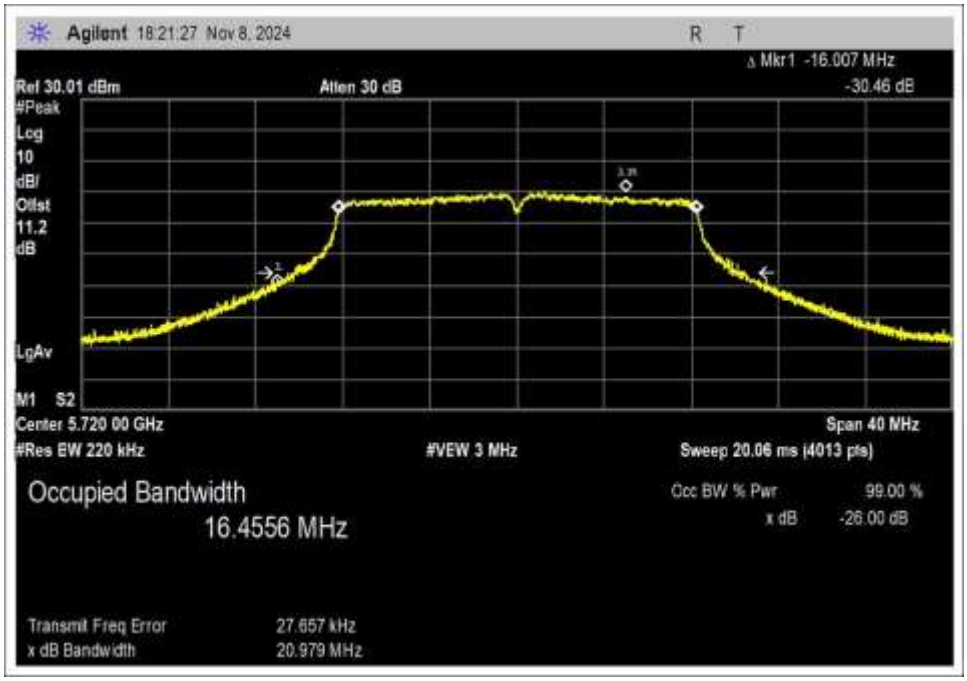
Chain 0
802.11a



Low Channel



Middle Channel



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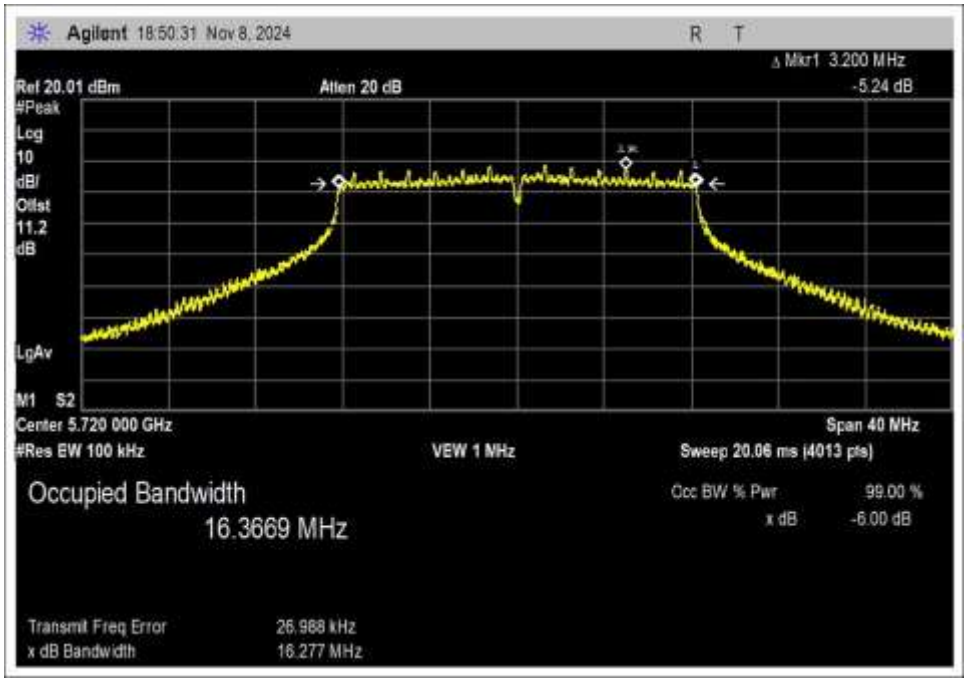
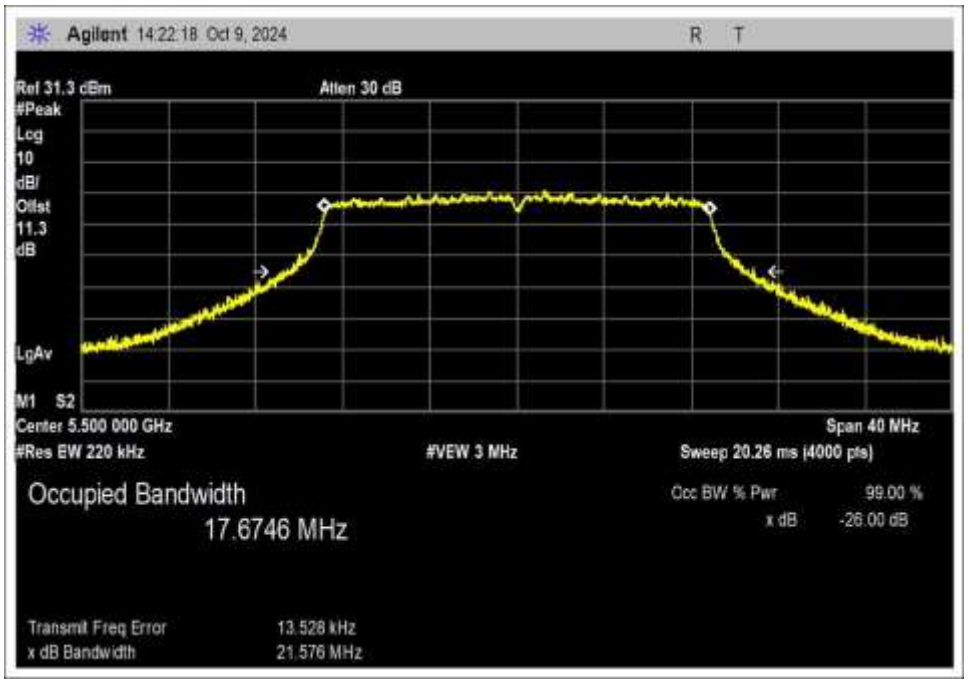


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

802.11n HT20



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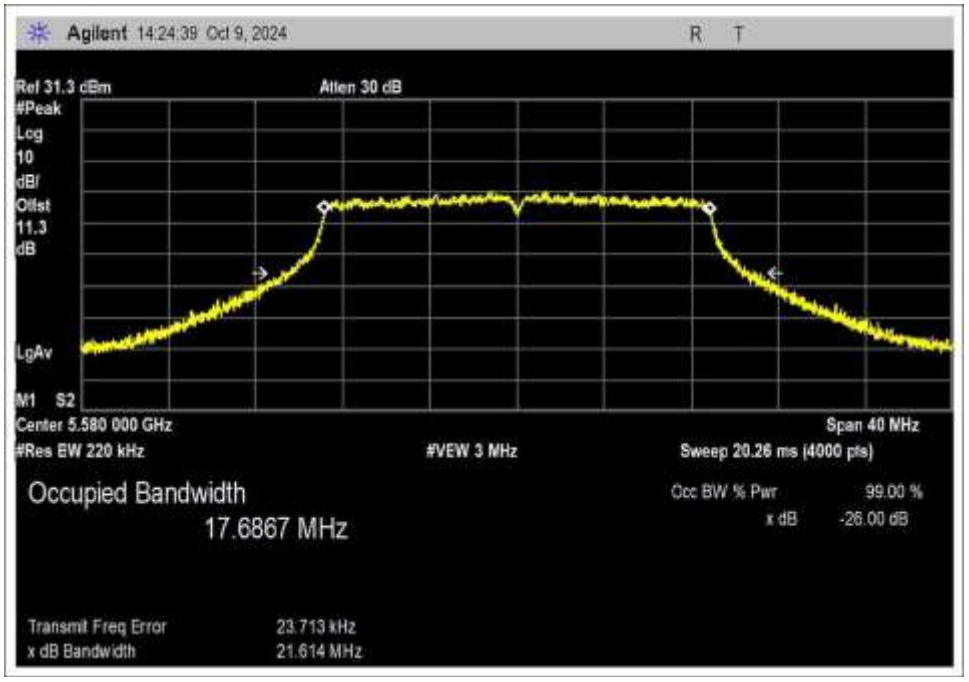

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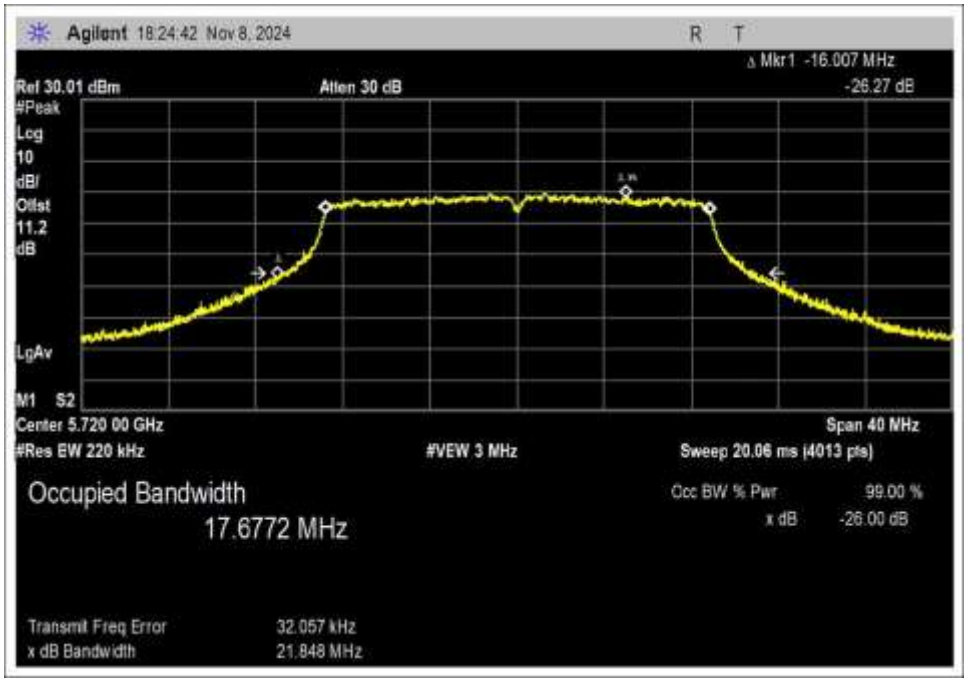

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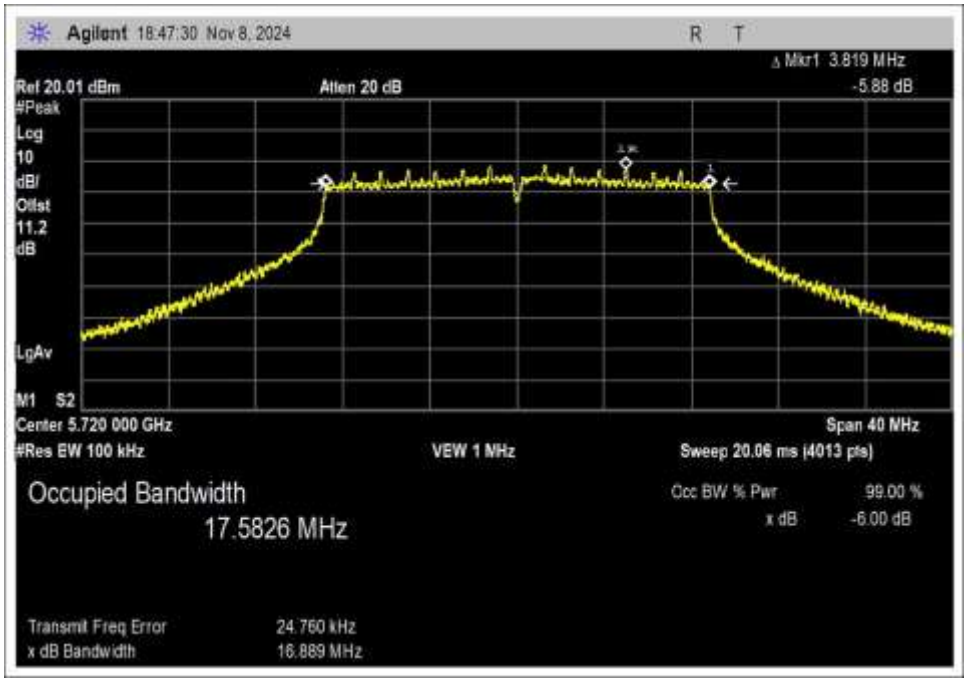
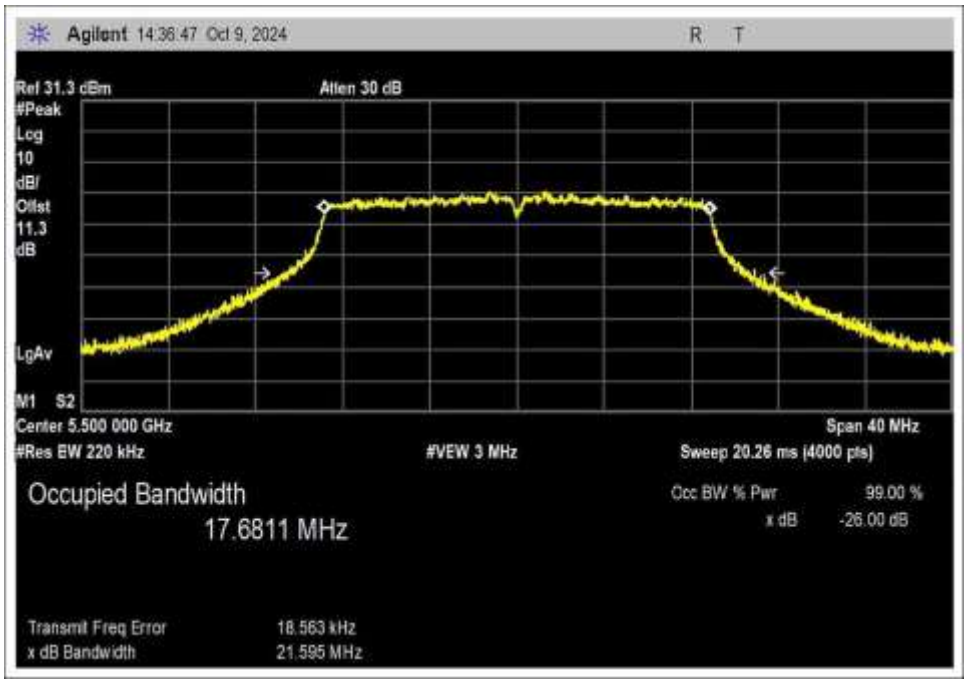


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

802.11ac 20MHz



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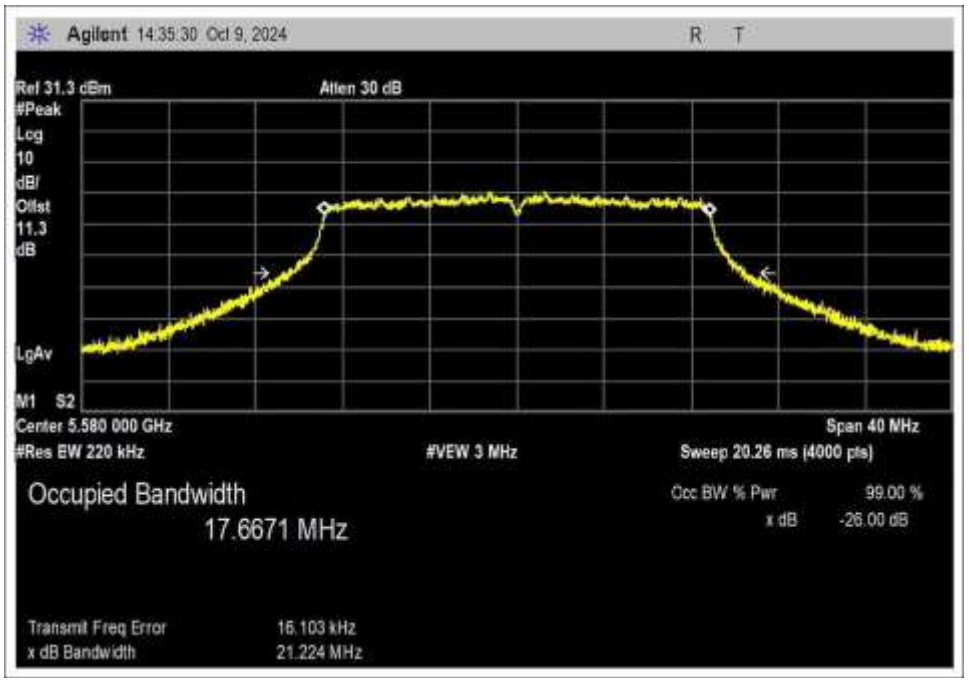

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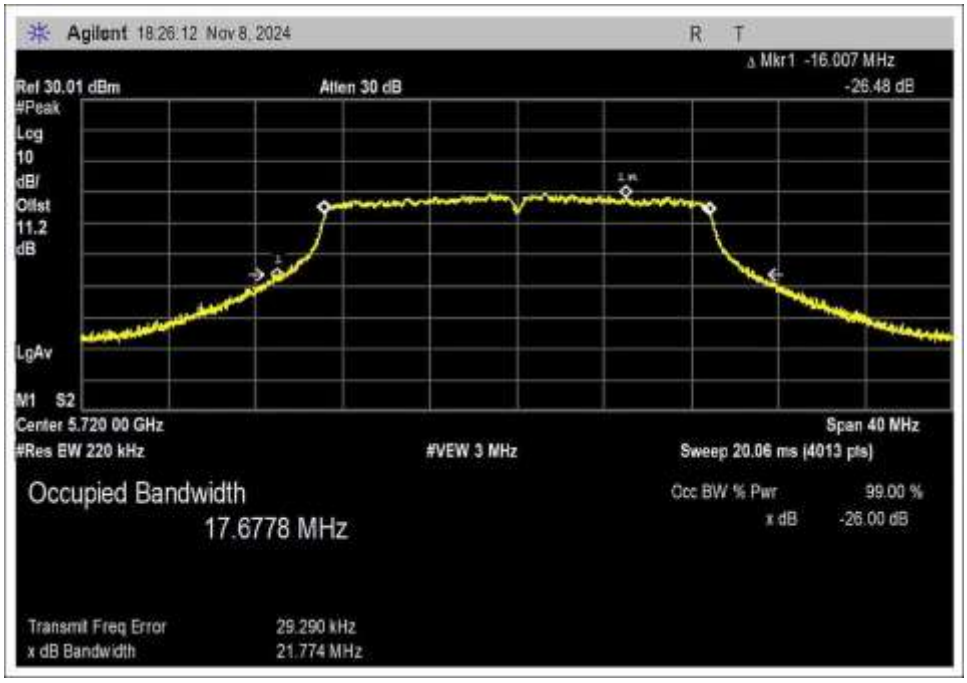

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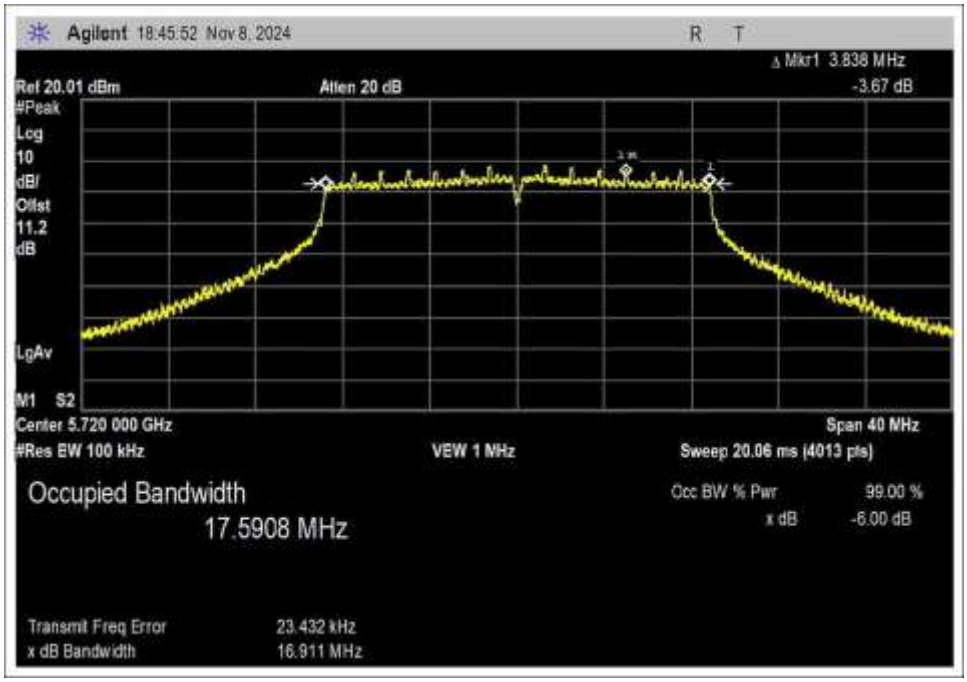
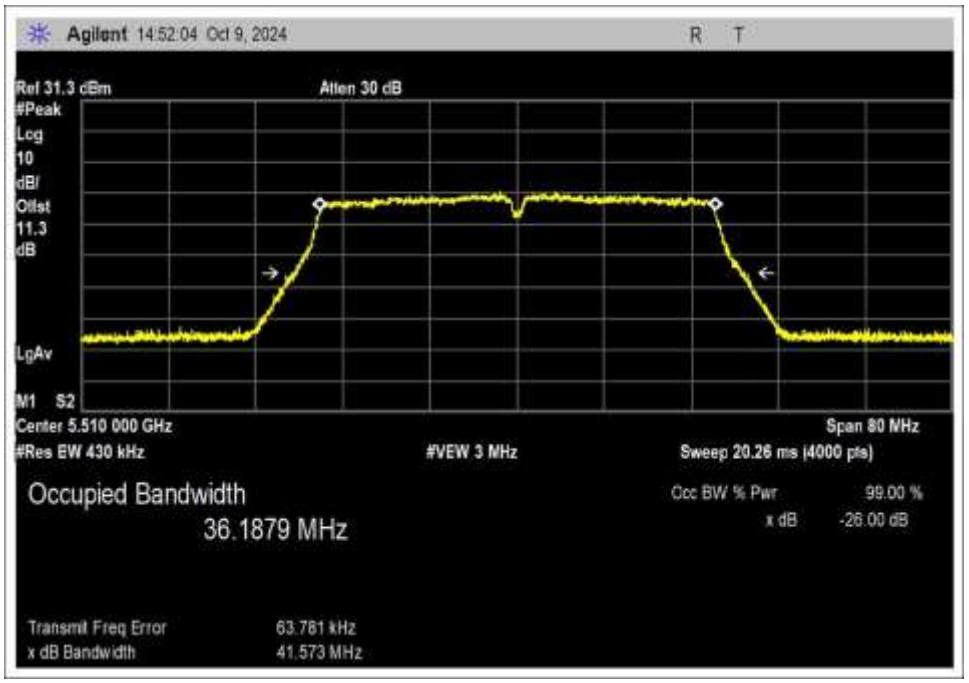


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

802.11 n HT40



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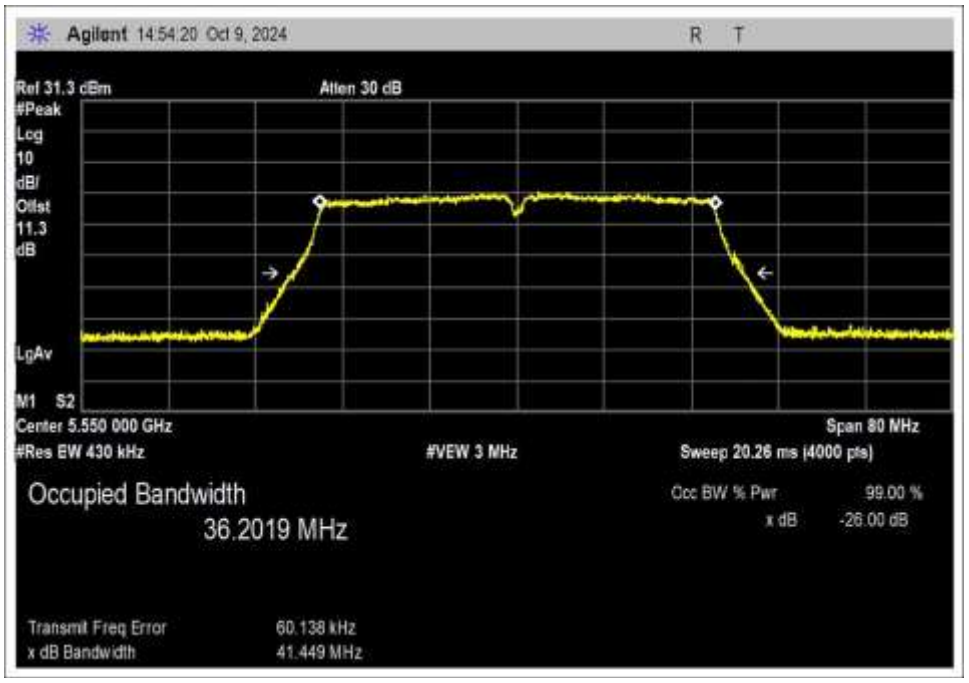

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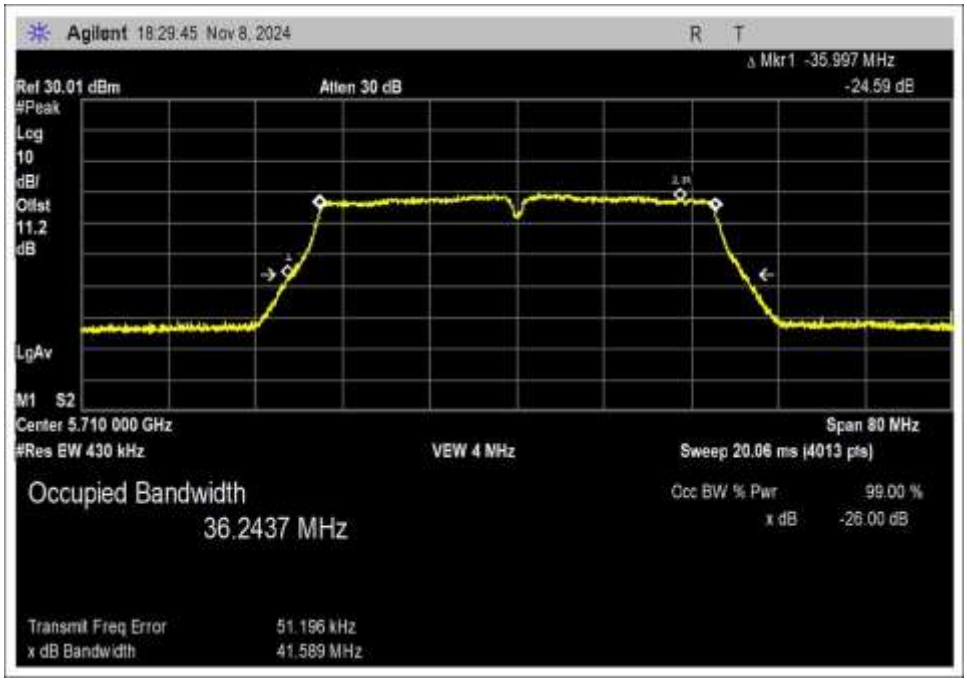

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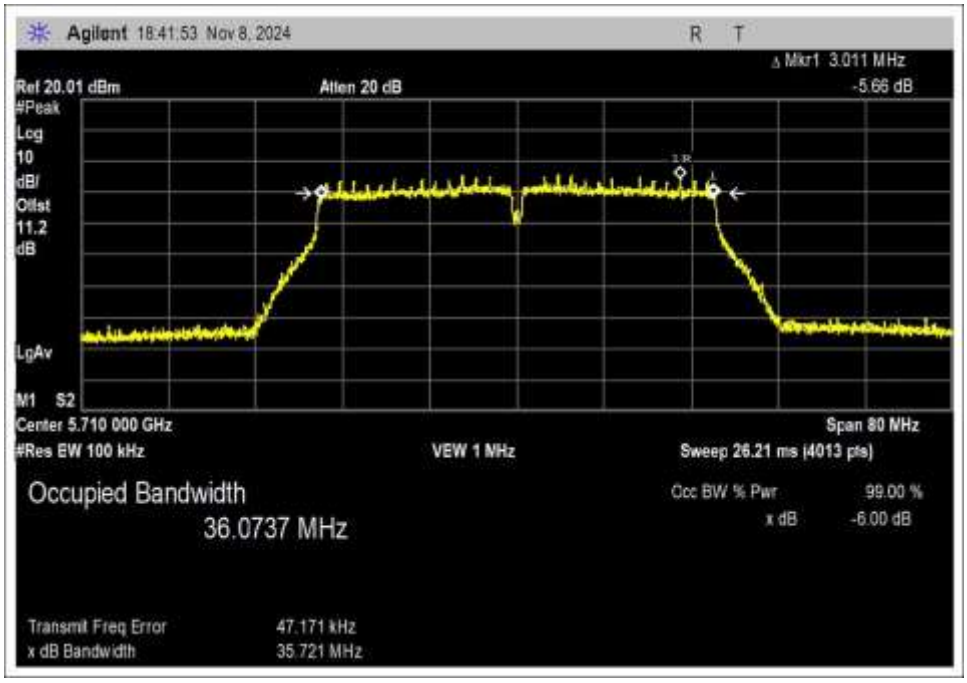
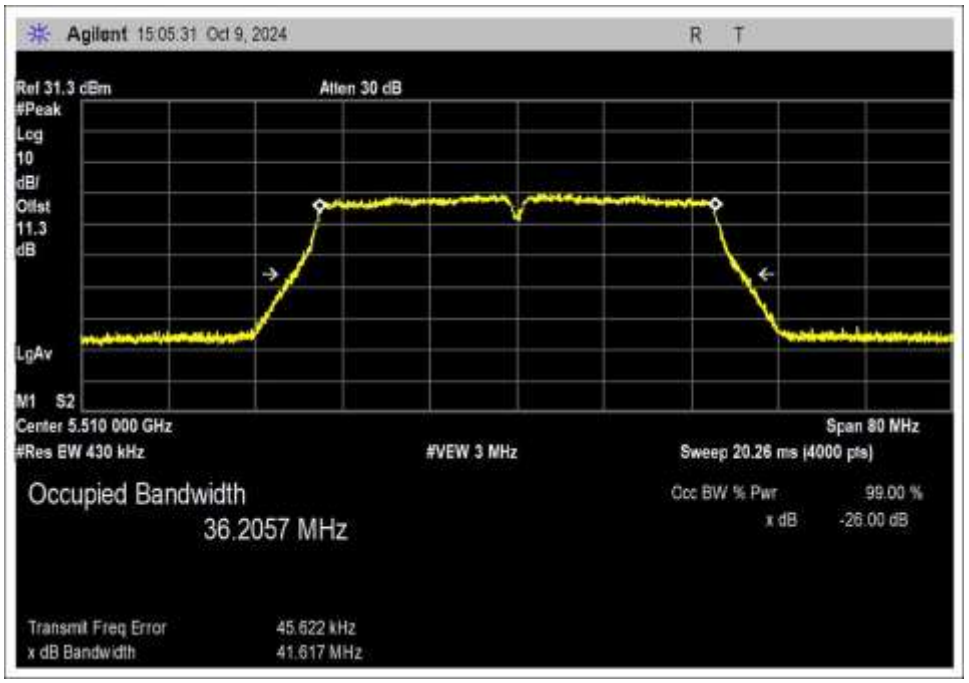
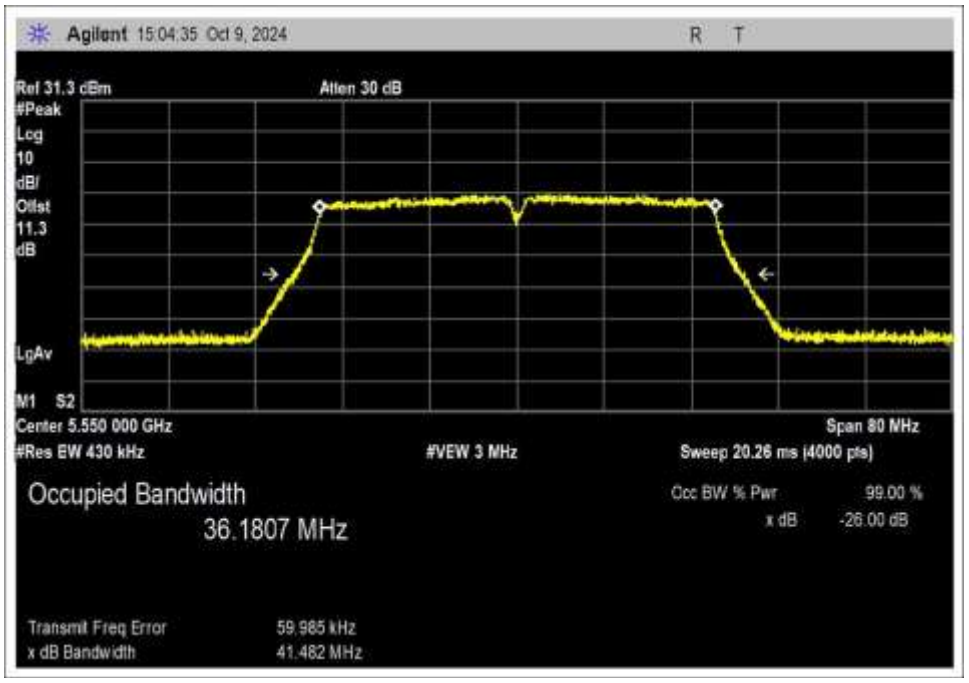


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

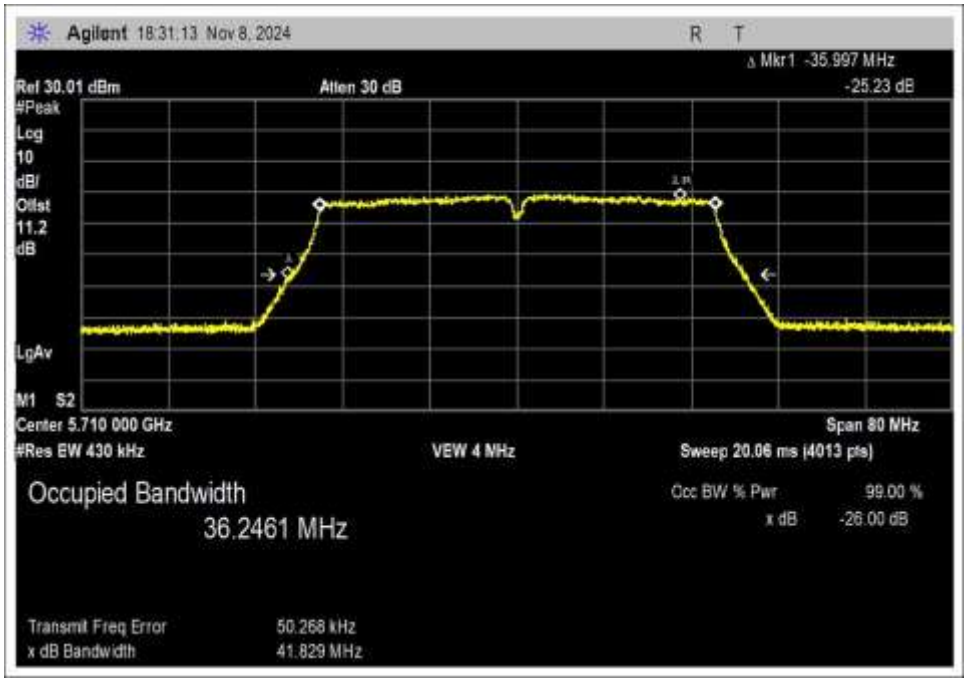
802.11ac 40MHz



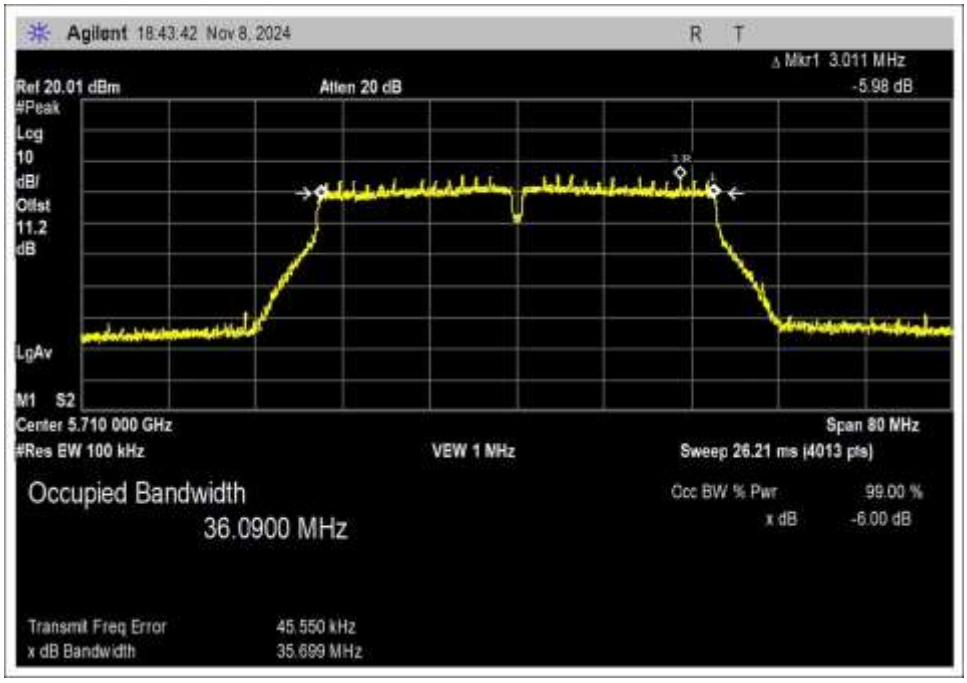
Low Channel



Middle Channel

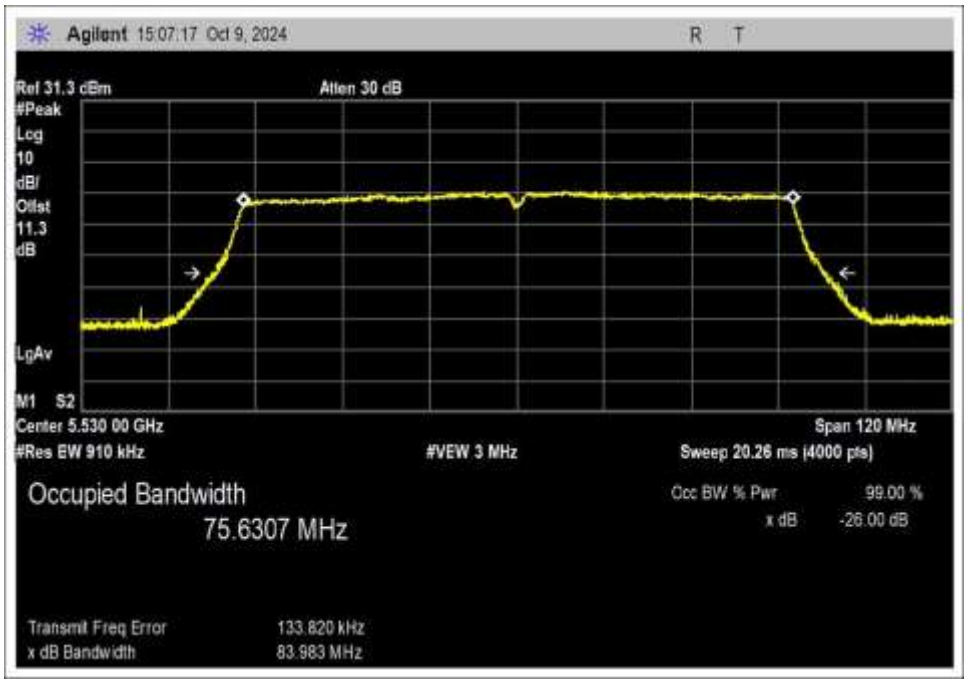


High Channel



Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

802.11ac 80MHz



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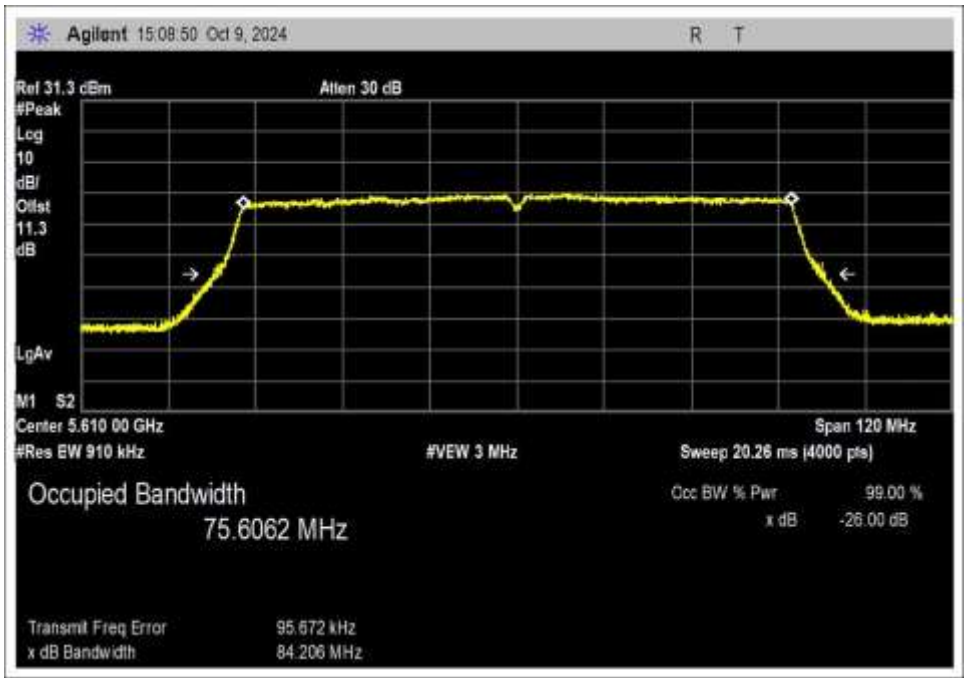
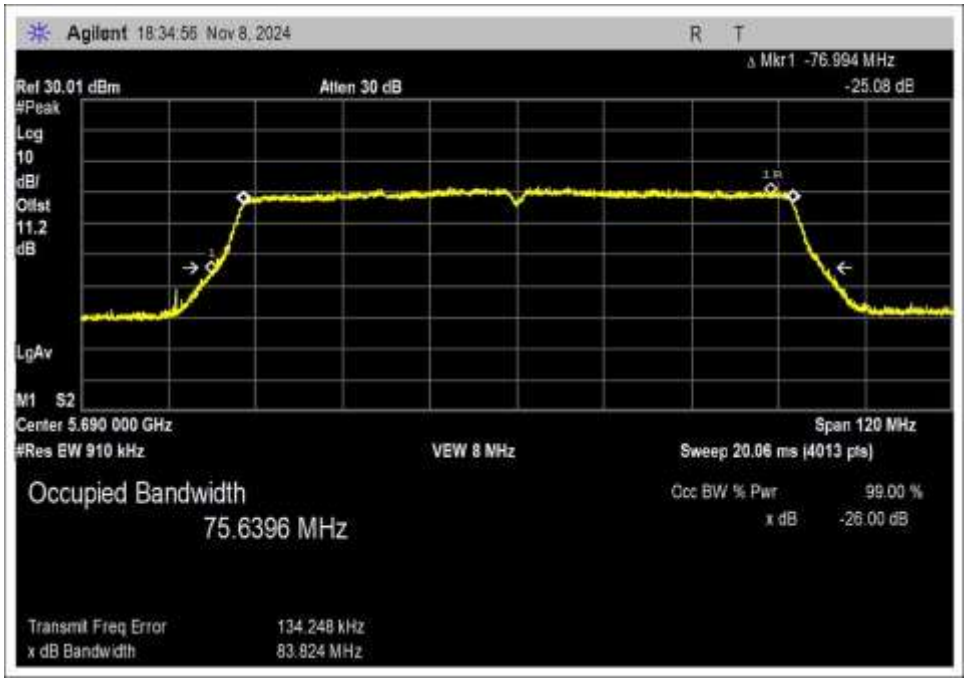
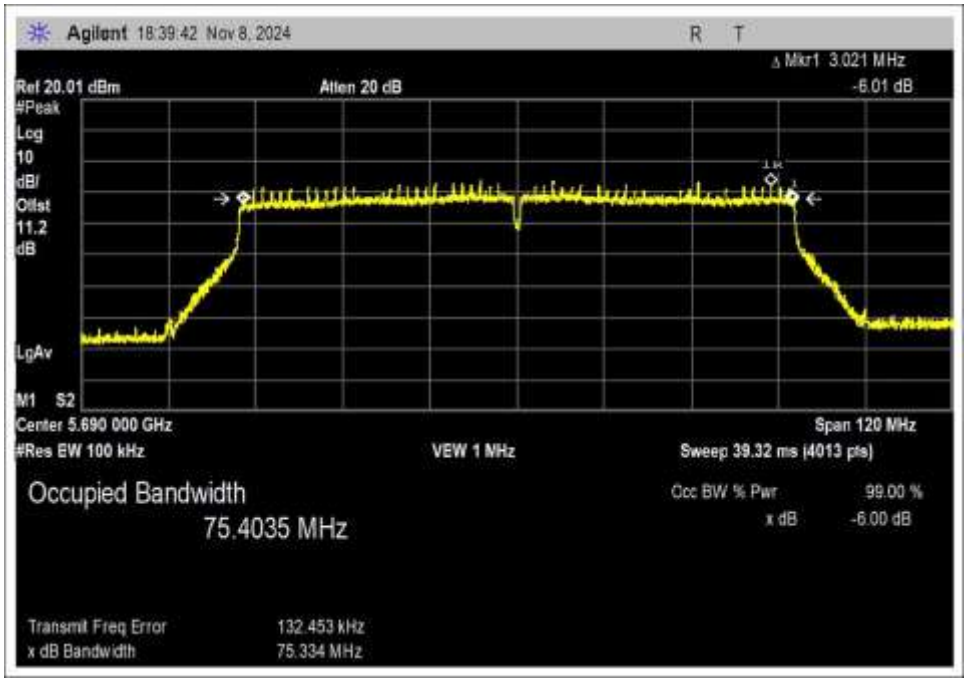


Middle Channel

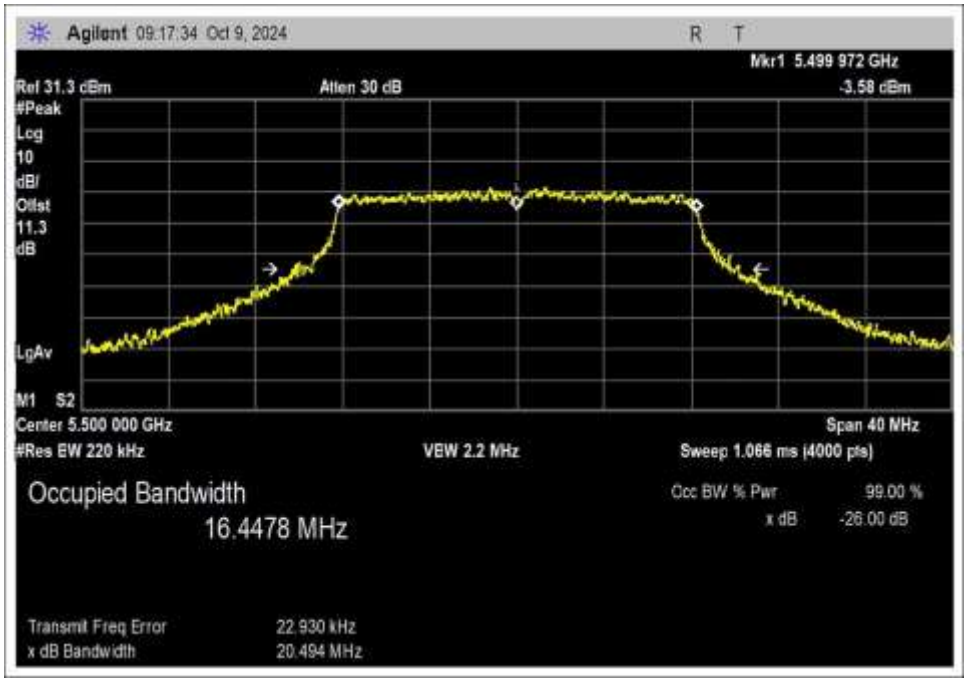


High Channel

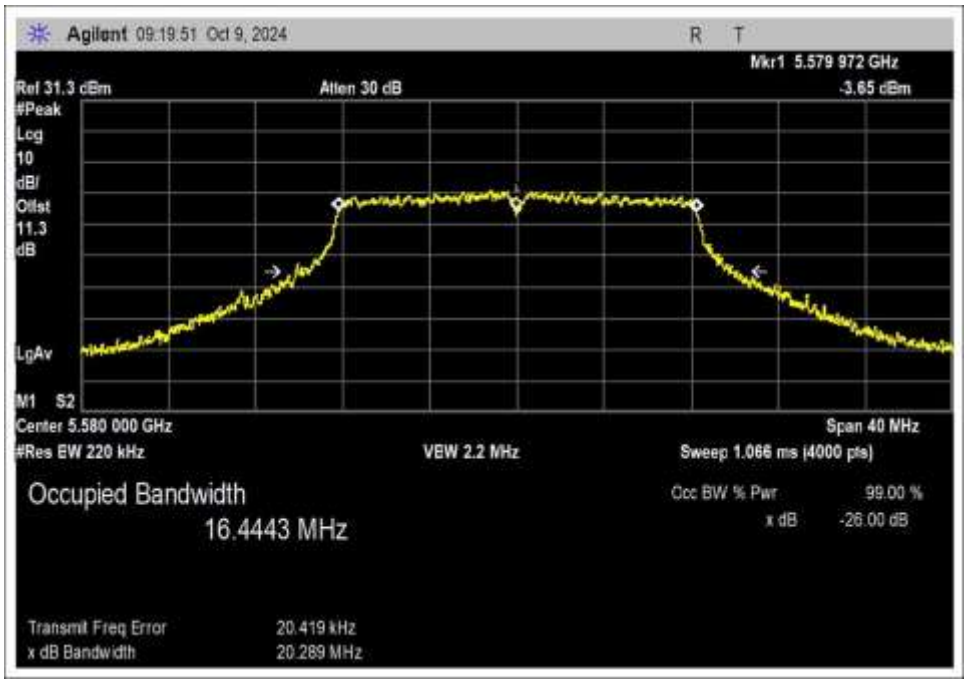


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

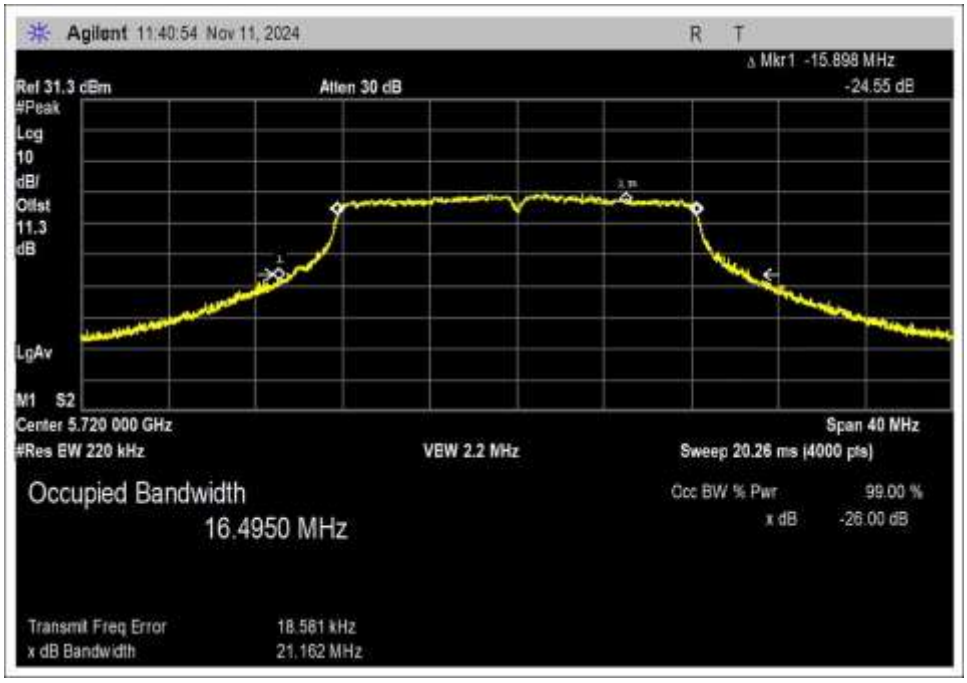
Chain 1
802.11a



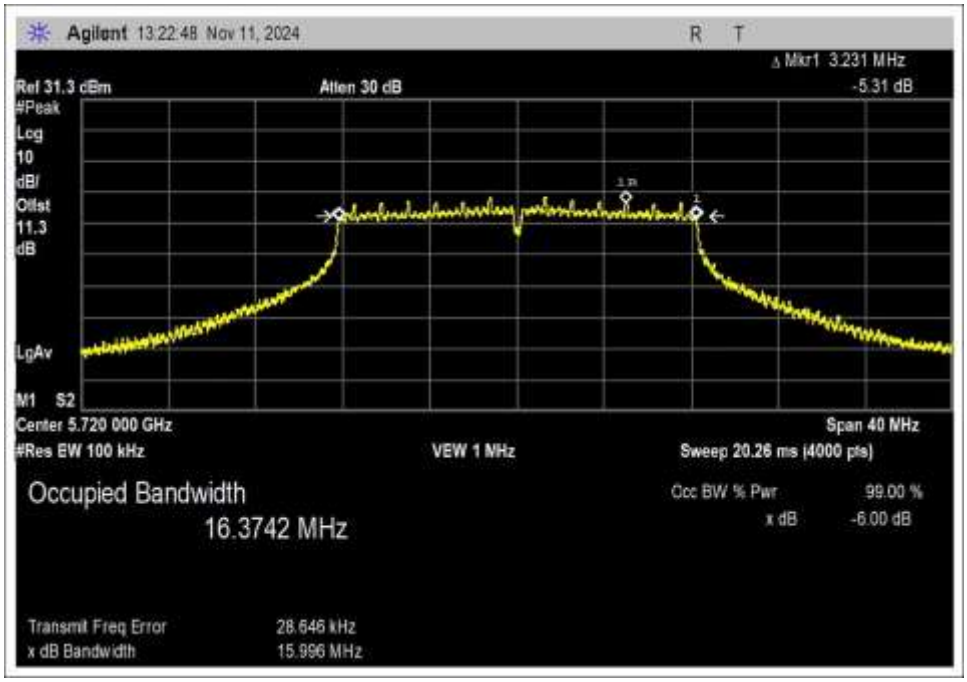
Low Channel



Middle Channel

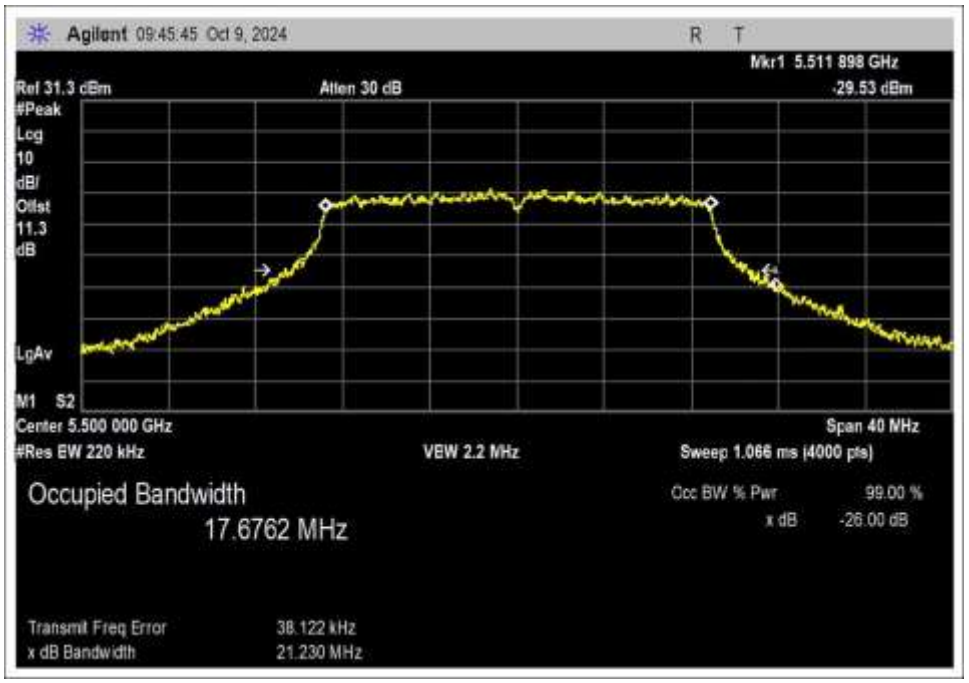


High Channel

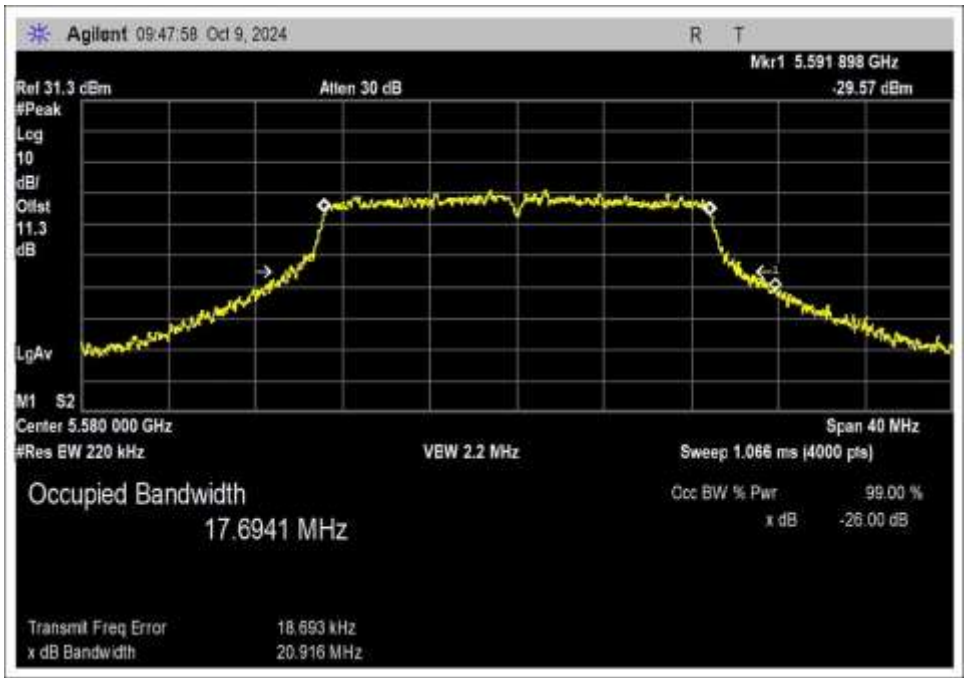


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

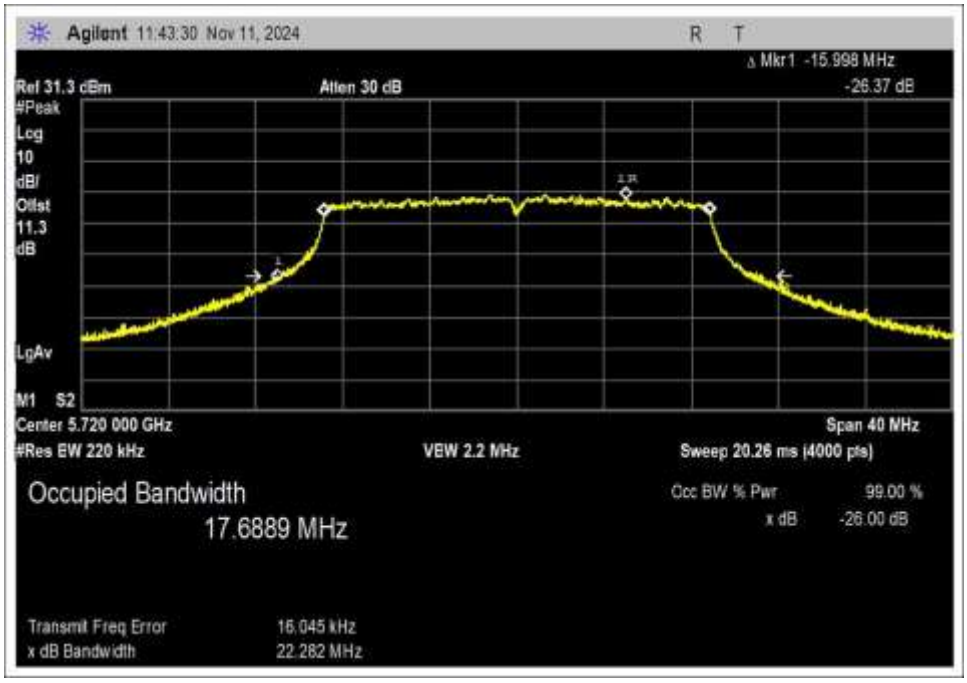
802.11n HT20



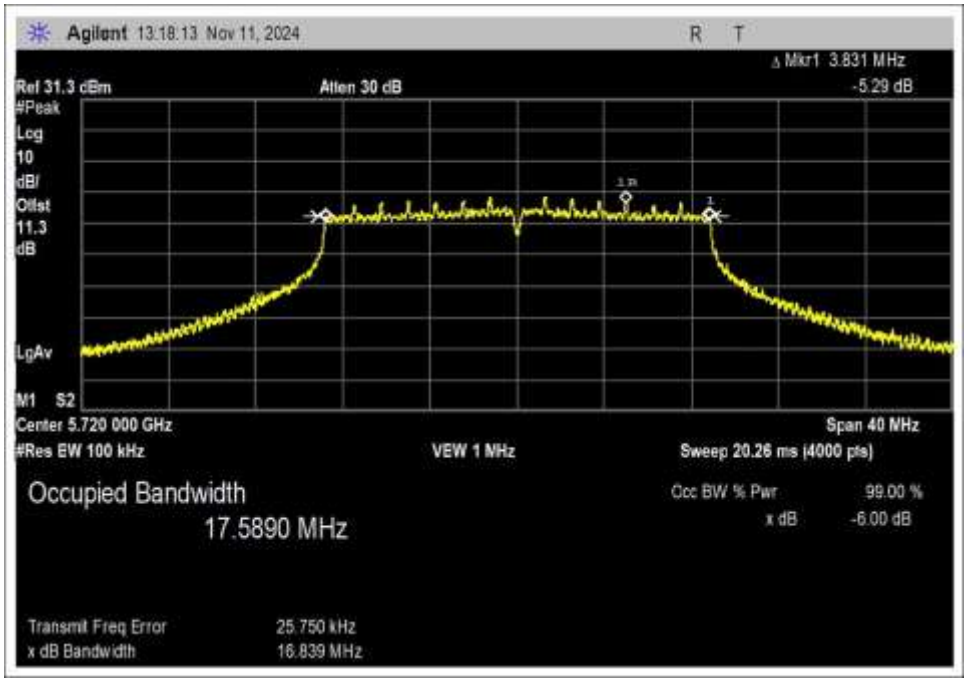
Low Channel



Middle Channel

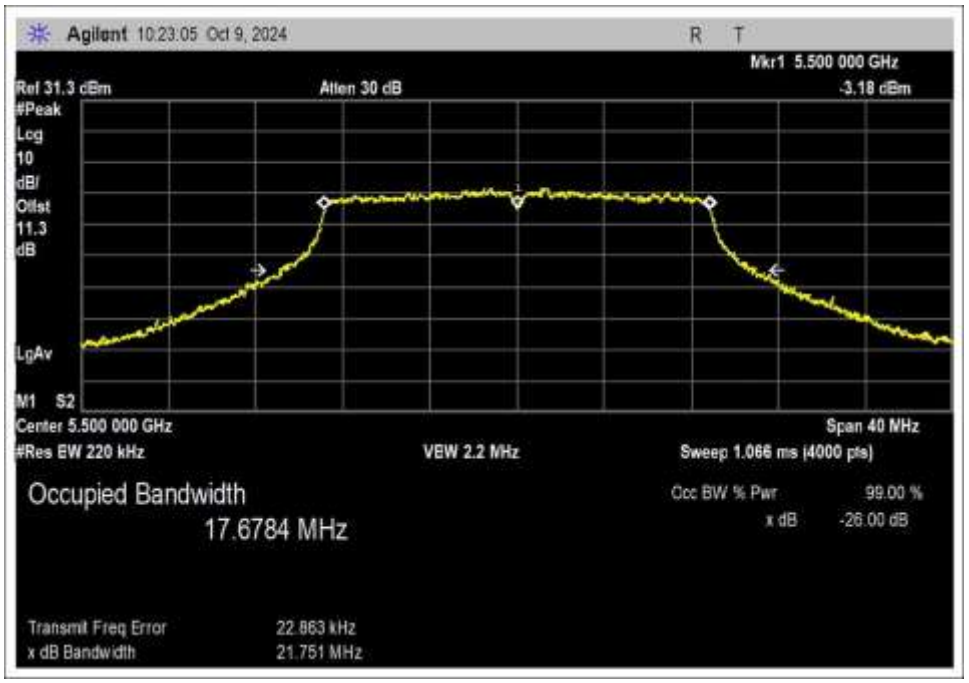


High Channel

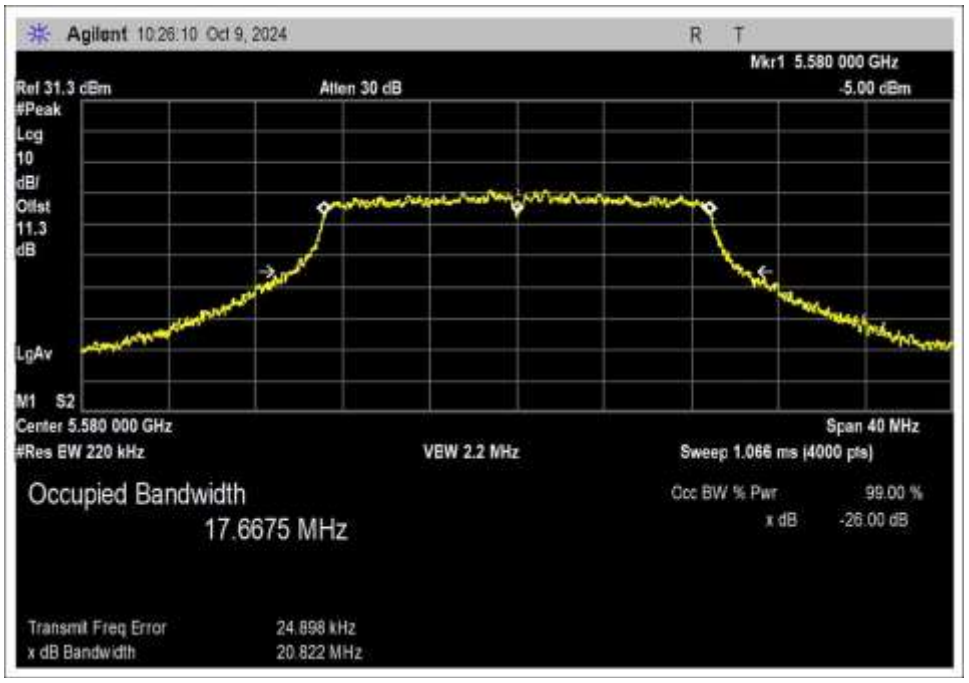


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

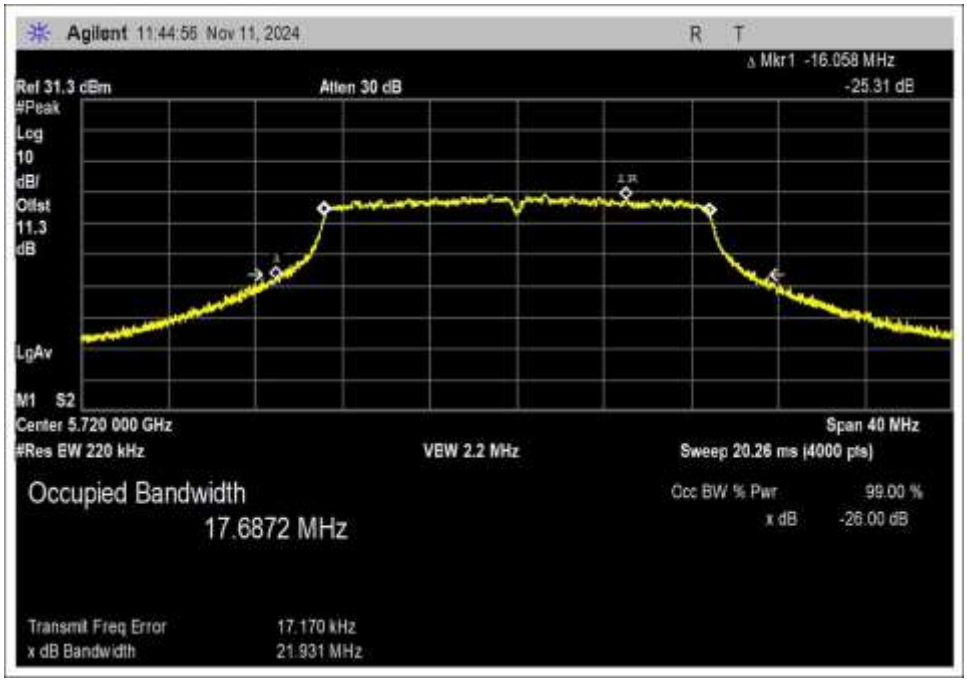
802.11ac 20MHz



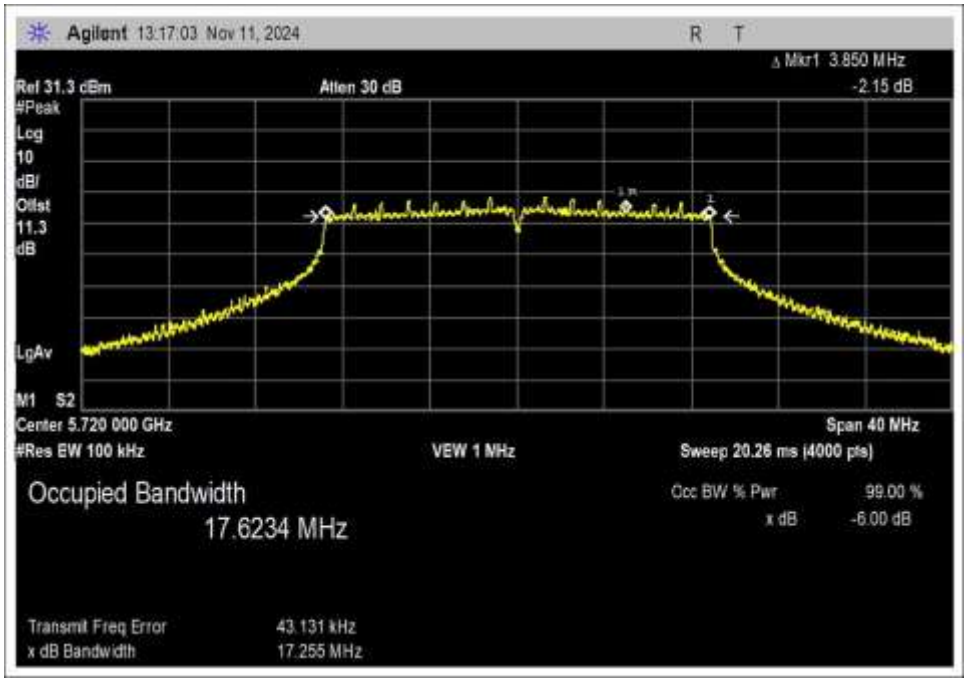
Low Channel



Middle Channel

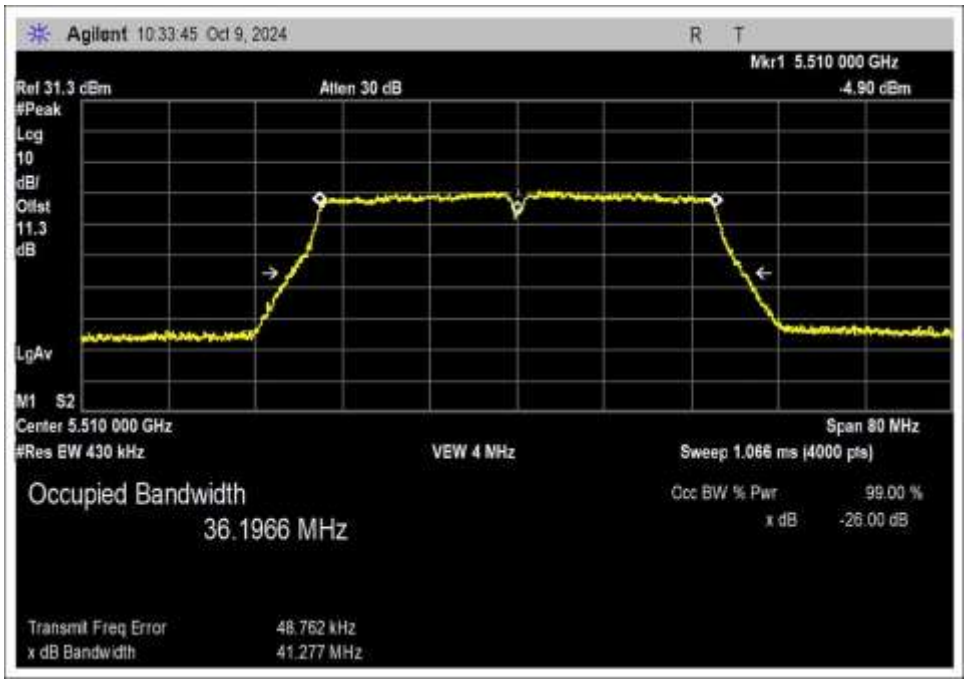


High Channel

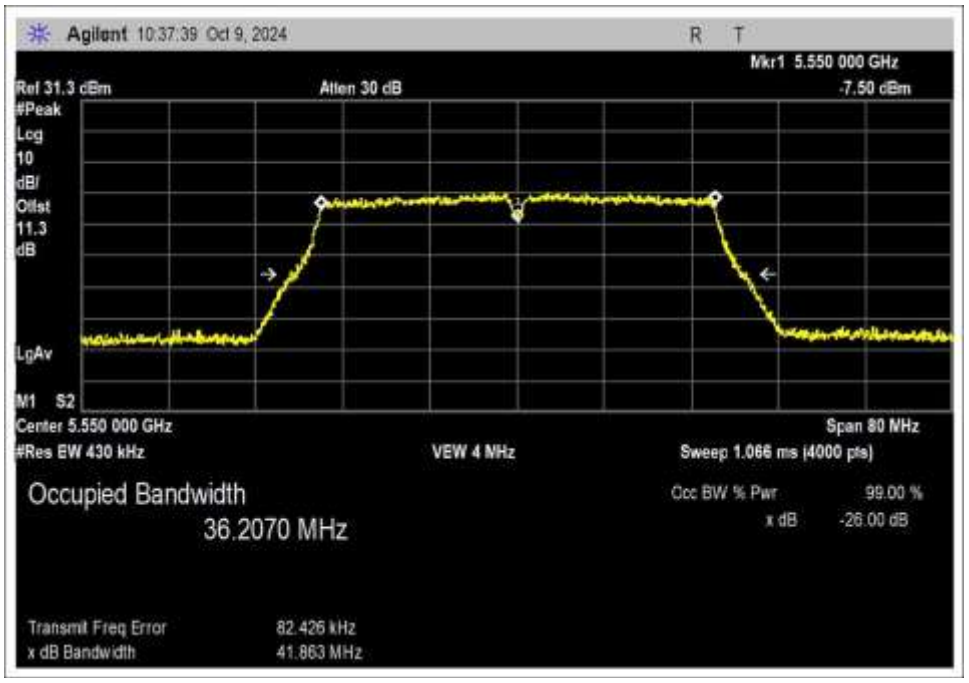


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3l

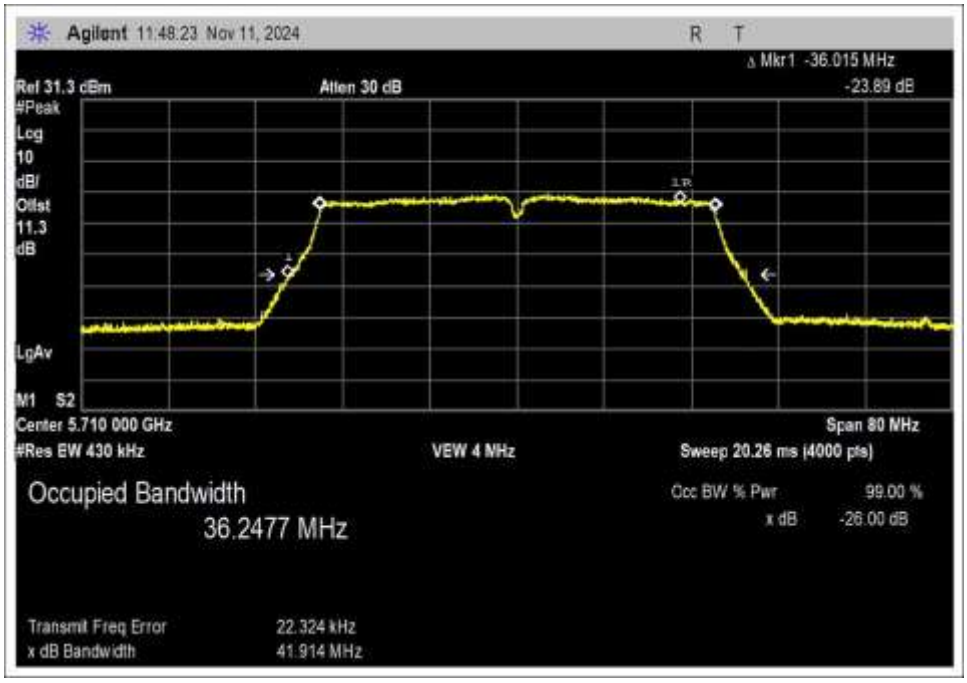
802.11 n HT40



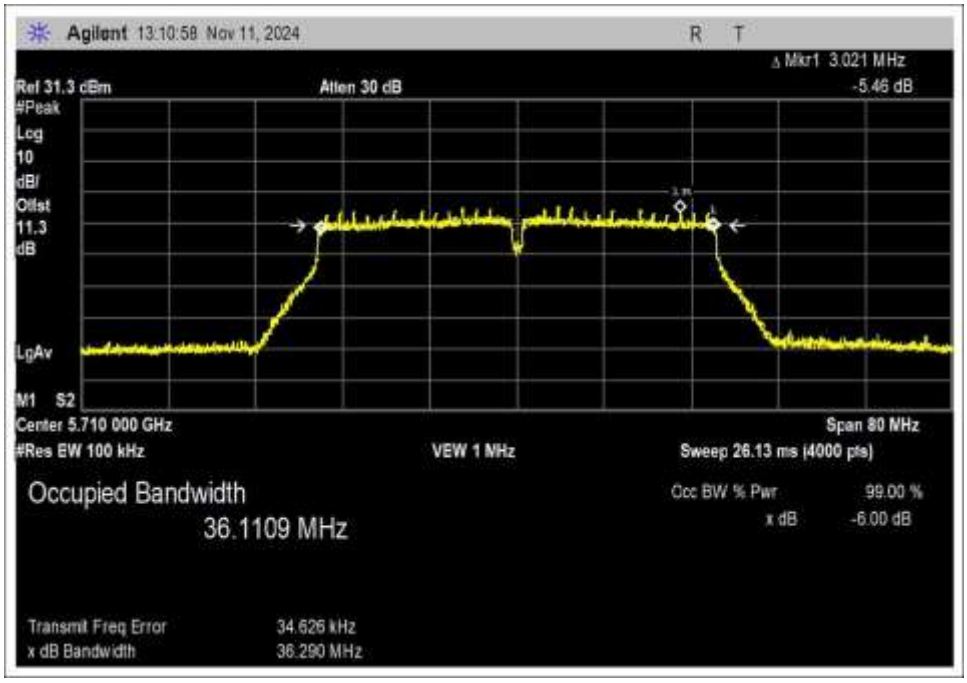
Low Channel



Middle Channel

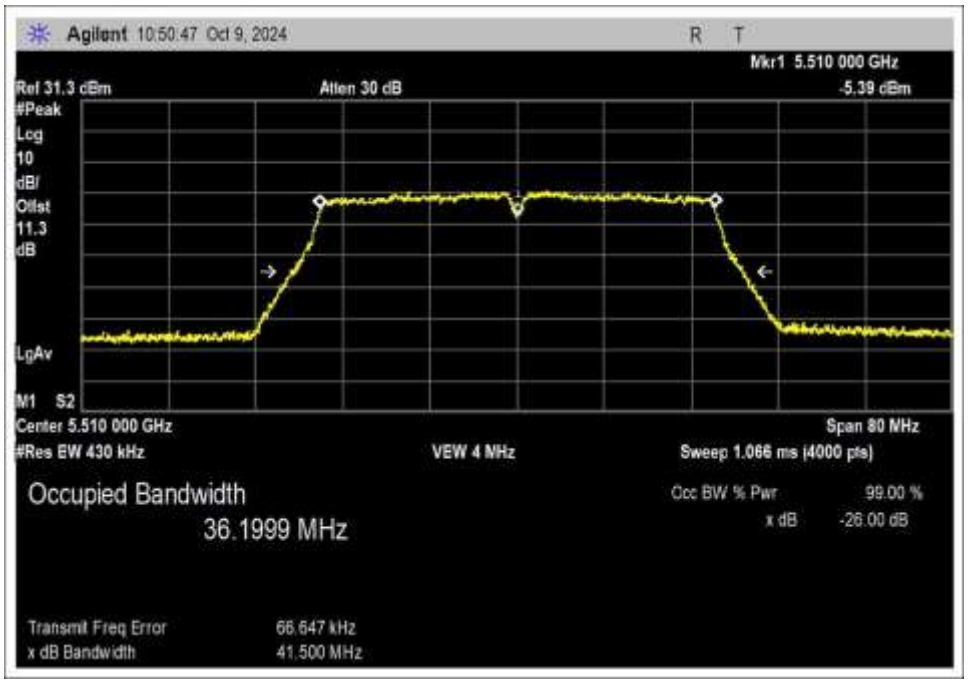


High Channel

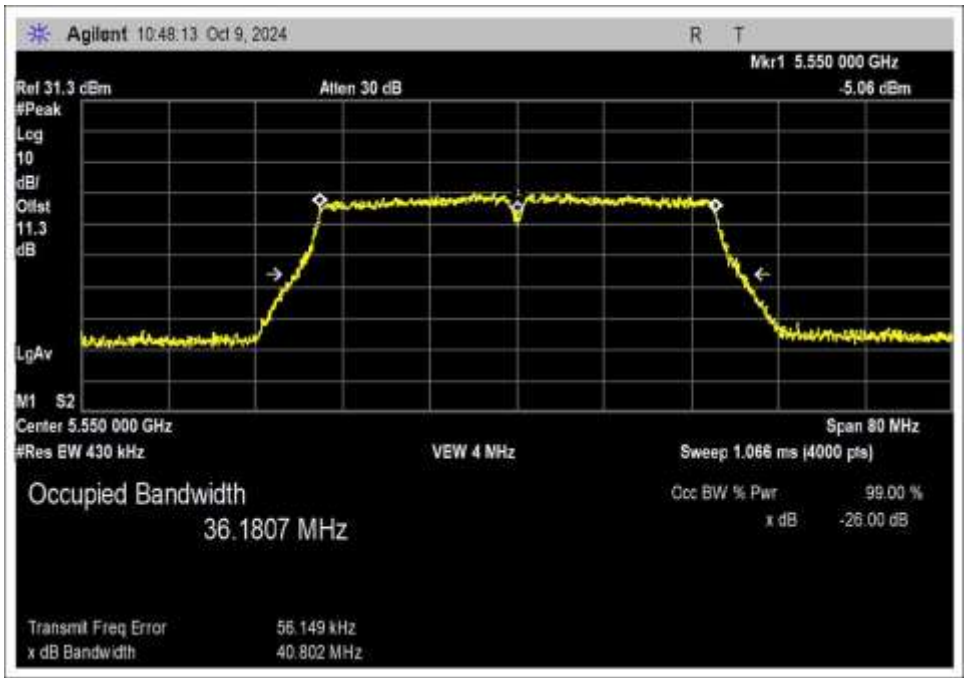


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

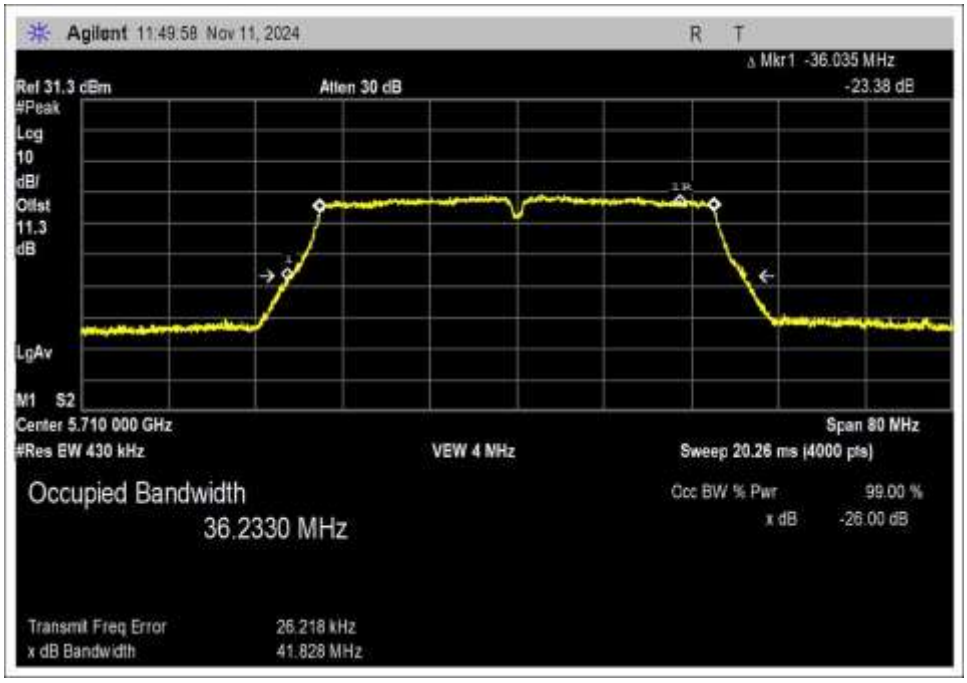
802.11ac 40MHz



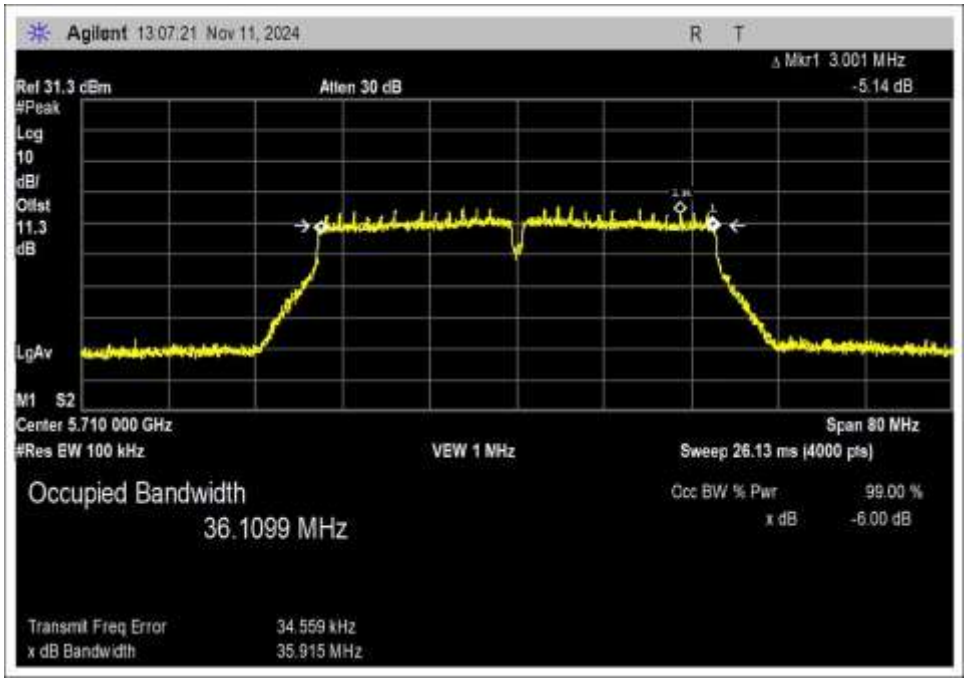
Low Channel



Middle Channel

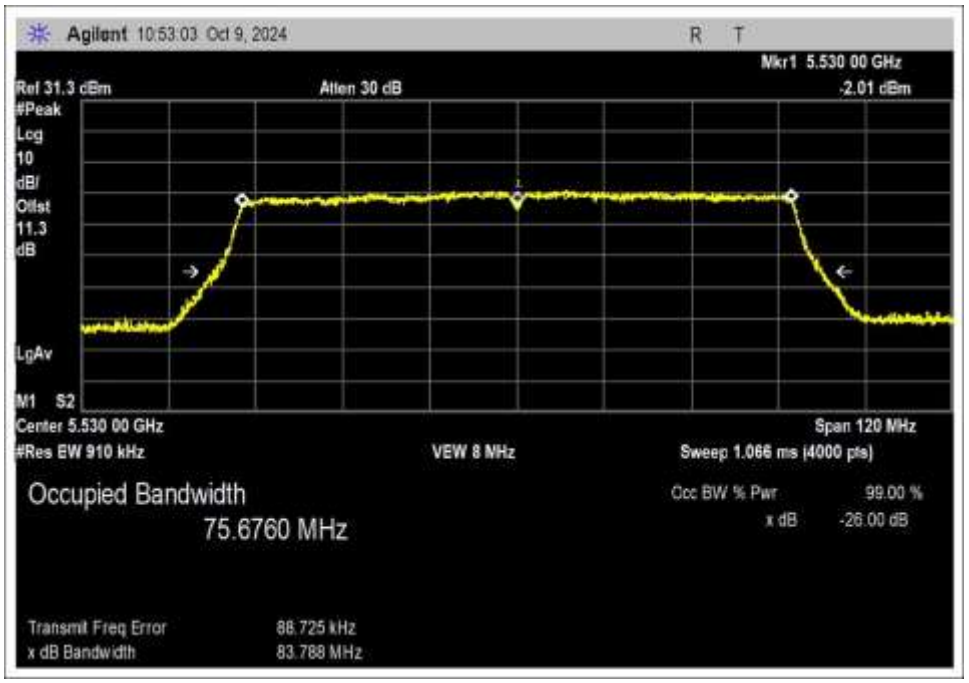


High Channel

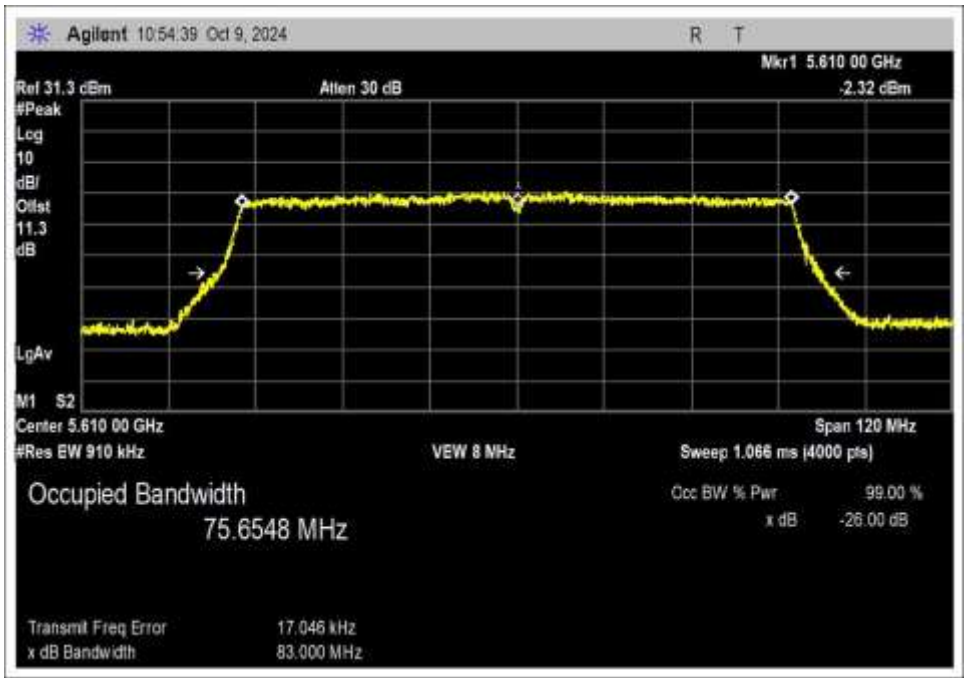


Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

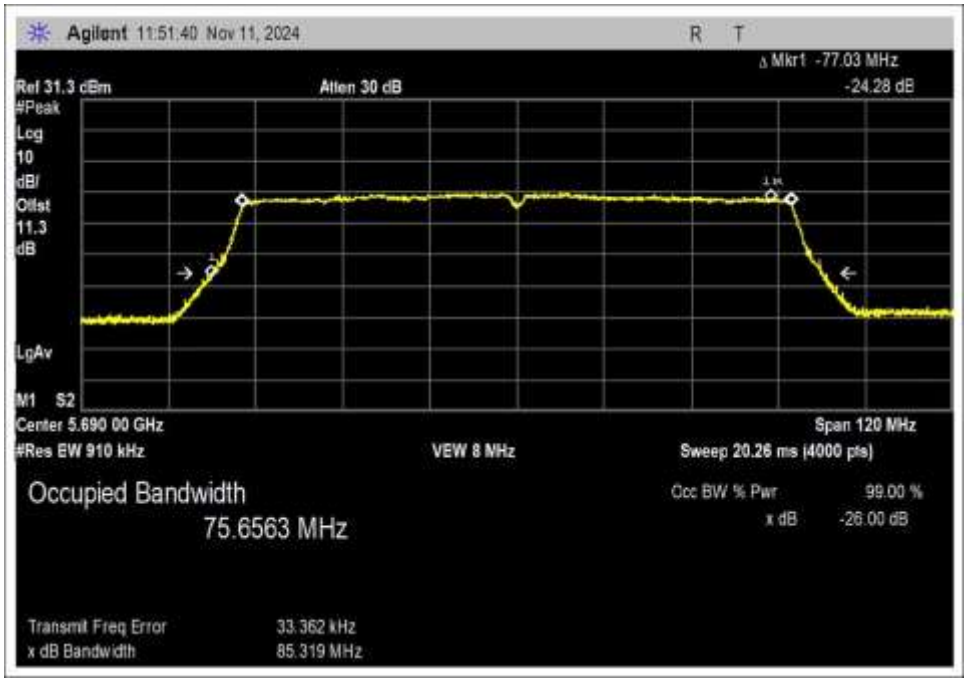
802.11ac 80MHz



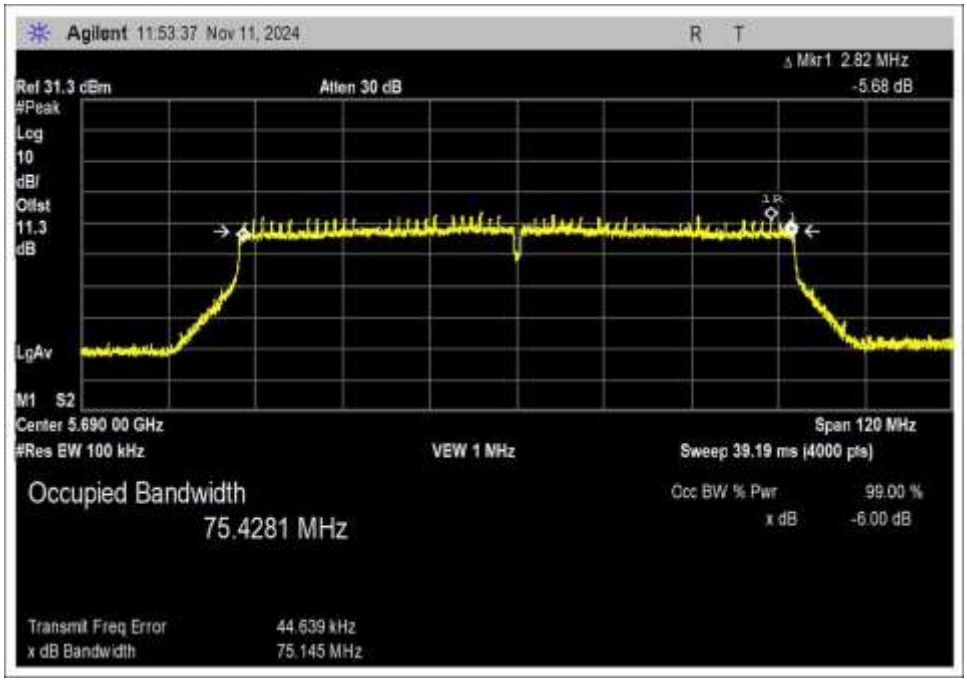
Low Channel



Middle Channel



High Channel



Addition 6dB Occupied Bandwidth on High Channel overlapping UNII 3

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.407(a) Output Power

Test Setup/Conditions			
Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 789033	Test Date(s):	10/07-09/2024 and 11/08/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	21.2-23.7	Relative Humidity (%):	39-45

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

Test Data Summary - Voltage Variations					
Frequency (MHz)	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
5500	802.11a/1	12.02	12.0	12.01	0.02
5580	802.11a/1	11.87	11.9	11.93	0.03
5720	802.11a/1	8.98	9.00	9.00	0.02

Test performed using operational mode with the highest output power, representing worst case.

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	12VDC
$V_{Minimum}$:	10.2VDC
$V_{Maximum}$:	13.8VDC

Test Data Summary - RF Conducted Measurement- Chain 0							
Measurement Option: AVGSA-1							
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	RF Conducted (dBm)		EIRP (dBm)		Results
			Measured	Limit	Calculated	Limit	
5500	802.11a	External/4.66	11.18	≤24	15.84	≤30	Pass
5580	802.11a	External/4.66	10.94	≤24	15.6	≤30	Pass
5720	802.11a	External/4.66	8.1	≤24	12.76	≤30	Pass
5500	802.11n HT20	External/4.66	11.05	≤24	15.71	≤30	Pass
5580	802.11n HT20	External/4.66	10.81	≤24	15.47	≤30	Pass
5720	802.11n HT20	External/4.66	7.85	≤24	12.51	≤30	Pass
5500	802.11ac 20MHz	External/4.66	11.03	≤24	15.69	≤30	Pass
5580	802.11ac 20MHz	External/4.66	10.8	≤24	15.46	≤30	Pass
5720	802.11ac 20MHz	External/4.66	7.88	≤24	12.54	≤30	Pass
5510	802.11n HT40	External/4.66	10.94	≤24	15.6	≤30	Pass
5550	802.11n HT40	External/4.66	11.04	≤24	15.7	≤30	Pass
5710	802.11n HT40	External/4.66	8.54	≤24	13.2	≤30	Pass
5510	802.11ac 40MHz	External/4.66	10.89	≤24	15.55	≤30	Pass
5550	802.11ac 40MHz	External/4.66	11.03	≤24	15.69	≤30	Pass
5710	802.11ac 40MHz	External/4.66	8.56	≤24	13.22	≤30	Pass
5530	802.11ac 80MHz	External/4.66	11.53	≤24	16.19	≤30	Pass
5610	802.11ac 80MHz	External/4.66	10.03	≤24	14.69	≤30	Pass
5690	802.11ac 80MHz	External/4.66	8.69	≤24	13.35	≤30	Pass

Test Data Summary - RF Conducted Measurement- Chain 1							
Measurement Option: AVGSA-1							
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	RF Conducted (dBm)		EIRP (dBm)		Results
			Measured	Limit	Calculated	Limit	
5500	802.11a	External/4.66	11.99	≤24	16.65	≤30	Pass
5580	802.11a	External/4.66	11.86	≤24	16.52	≤30	Pass
5720	802.11a	External/4.66	8.96	≤24	13.62	≤30	Pass
5500	802.11n HT20	External/4.66	11.88	≤24	16.54	≤30	Pass
5580	802.11n HT20	External/4.66	11.76	≤24	16.42	≤30	Pass
5720	802.11n HT20	External/4.66	8.79	≤24	13.45	≤30	Pass
5500	802.11ac 20MHz	External/4.66	11.89	≤24	16.55	≤30	Pass
5580	802.11ac 20MHz	External/4.66	11.77	≤24	16.43	≤30	Pass
5720	802.11ac 20MHz	External/4.66	8.77	≤24	13.43	≤30	Pass
5510	802.11n HT40	External/4.66	11.83	≤24	16.49	≤30	Pass
5550	802.11n HT40	External/4.66	11.67	≤24	16.33	≤30	Pass
5710	802.11n HT40	External/4.66	9.31	≤24	13.97	≤30	Pass
5510	802.11ac 40MHz	External/4.66	11.83	≤24	16.49	≤30	Pass
5550	802.11ac 40MHz	External/4.66	11.61	≤24	16.27	≤30	Pass
5710	802.11ac 40MHz	External/4.66	9.38	≤24	14.04	≤30	Pass
5530	802.11ac 80MHz	External/4.66	11.33	≤24	15.99	≤30	Pass
5610	802.11ac 80MHz	External/4.66	10.86	≤24	15.52	≤30	Pass
5690	802.11ac 80MHz	External/4.66	9.73	≤24	14.39	≤30	Pass

EIRP is calculated as RF conducted power (dBm) + antenna gain (dBi)

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The limit is calculated in accordance with 15.407(a)(2):

$$Limit = The\ lesser\ of \begin{cases} 24\ dBm - (G-6) \\ 11dBm + 10LOG(B) - (G-6) \end{cases}$$

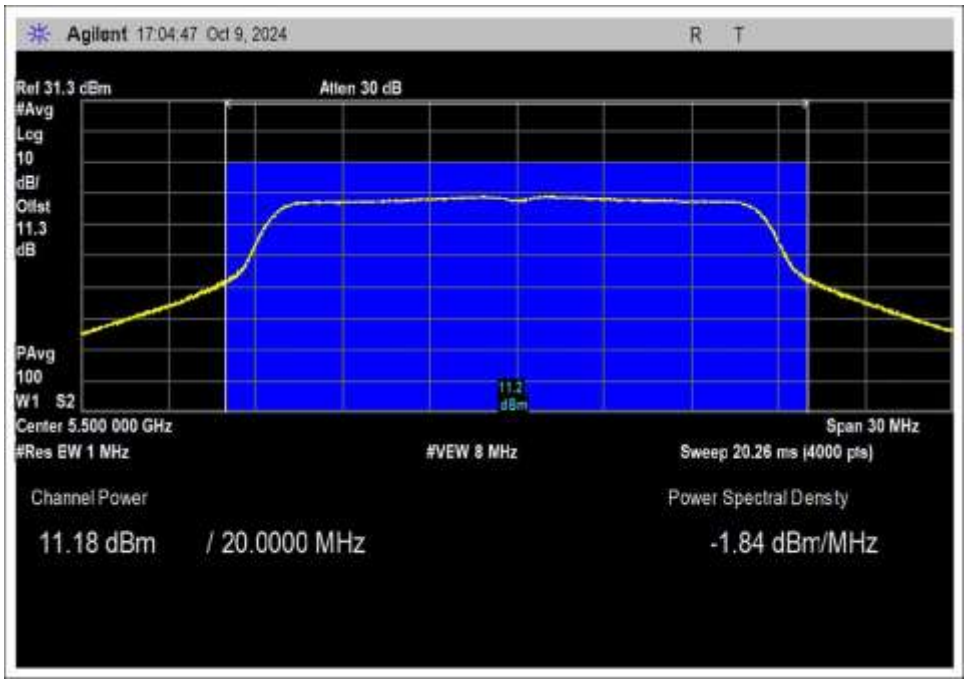
Addition RF out power on High Channel overlapping UNII 3

Test Data Summary - RF Conducted Measurement- Chain 0							
Measurement Option: AVGSA-1							
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**RF Conducted (dBm)**		**EIRP (dBm)**		**Results**
			Measured	**Limit**	**Calculated**	**Limit**	
5720	802.11a	External/4.66	1.57	≤30	6.23	≤36	Pass
5720	802.11n HT20	External/4.66	1.8	≤30	6.46	≤36	Pass
5720	802.11ac 20MHz	External/4.66	1.77	≤30	6.43	≤36	Pass
5710	802.11n HT40	External/4.66	-2.28	≤30	2.38	≤36	Pass
5710	802.11ac 40MHz	External/4.66	-2.32	≤30	2.34	≤36	Pass
5690	802.11ac 80MHz	External/4.66	-5.14	≤30	-0.48	≤36	Pass

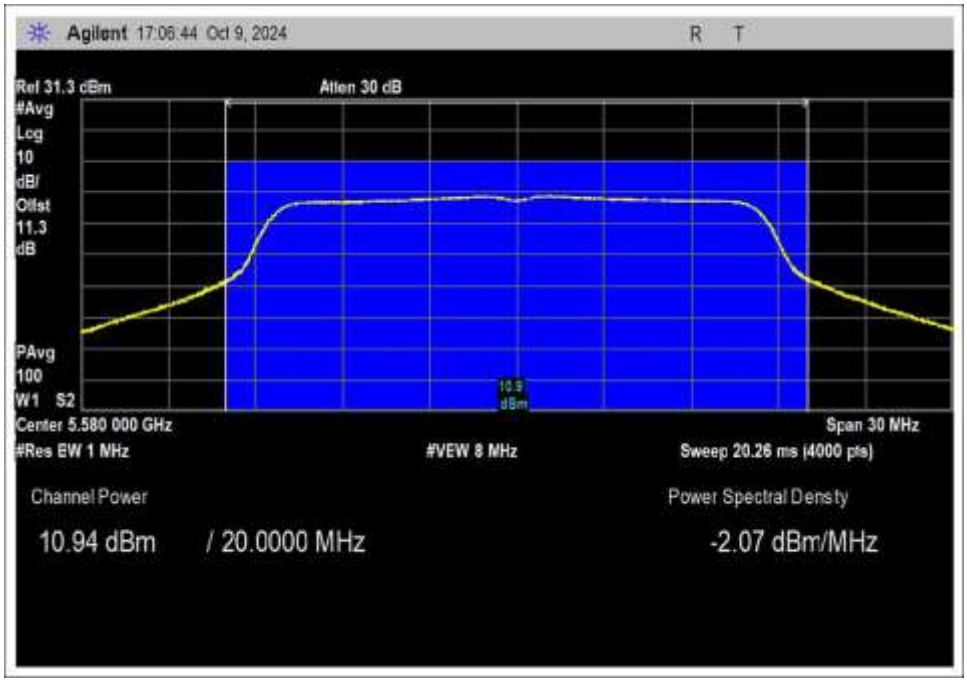
Test Data Summary - RF Conducted Measurement- Chain 1							
Measurement Option: AVGSA-1							
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**RF Conducted (dBm)**		**EIRP (dBm)**		**Results**
			Measured	**Limit**	**Calculated**	**Limit**	
5720	802.11a	External/4.66	2.58	≤30	7.24	≤36	Pass
5720	802.11n HT20	External/4.66	2.63	≤30	7.29	≤36	Pass
5720	802.11ac 20MHz	External/4.66	2.59	≤30	7.25	≤36	Pass
5710	802.11n HT40	External/4.66	-1.42	≤30	3.24	≤36	Pass
5710	802.11ac 40MHz	External/4.66	-1.5	≤30	3.16	≤36	Pass
5690	802.11ac 80MHz	External/4.66	-4.47	≤30	0.19	≤36	Pass

Plot(s)

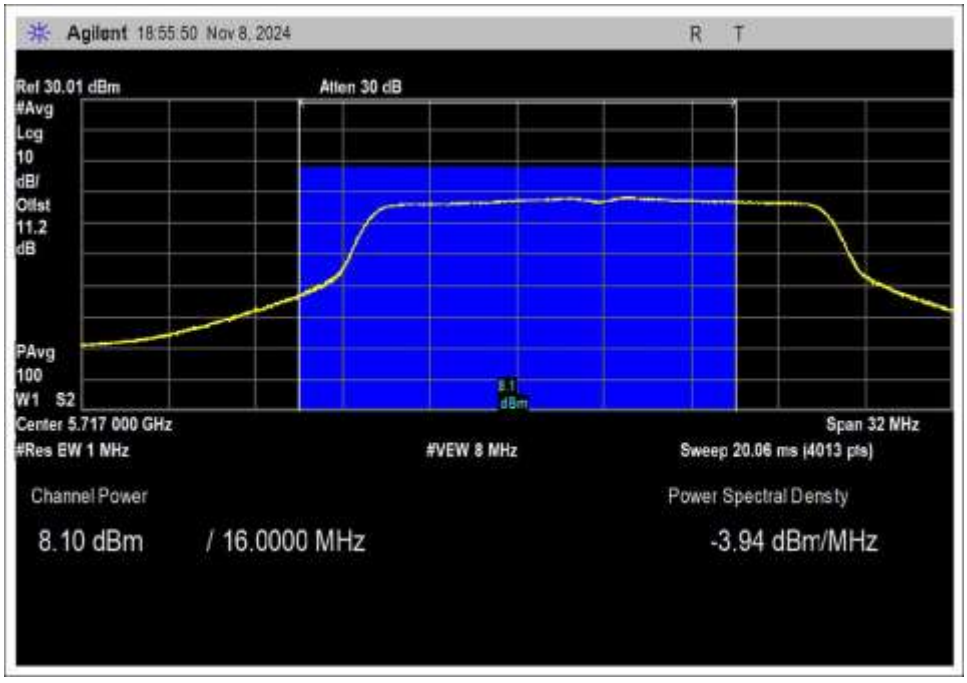
Chain 0
802.11a



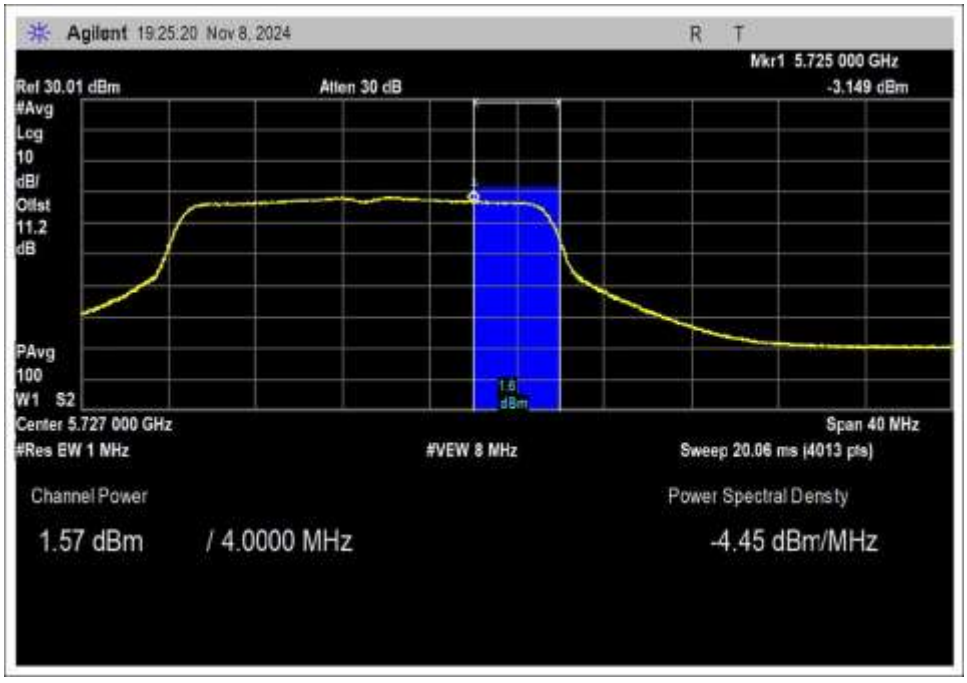
Low Channel



Middle Channel

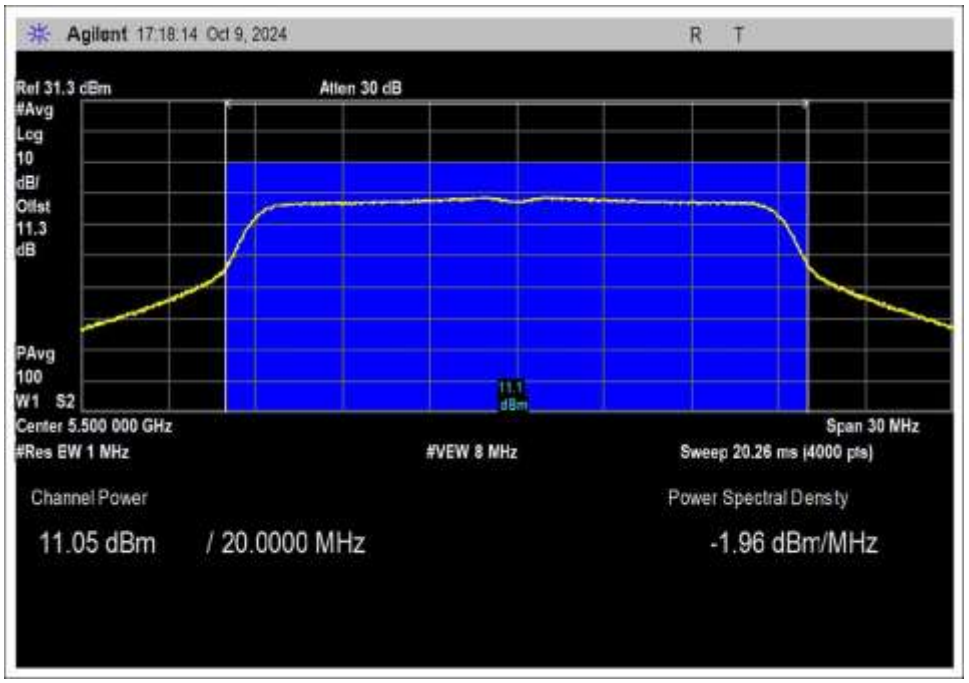


High Channel

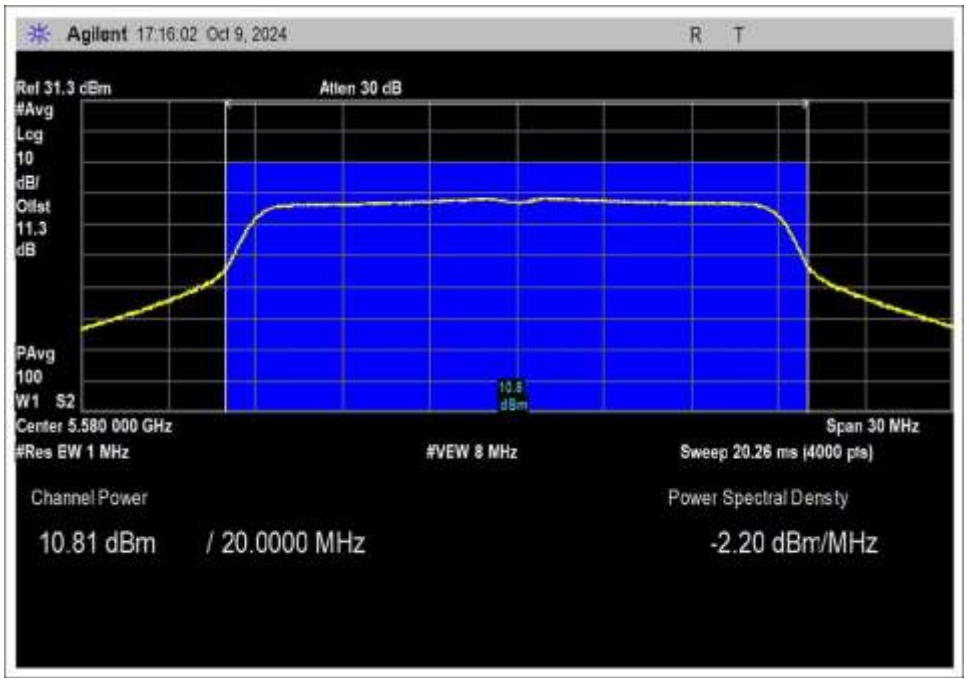


Addition RF out power on High Channel overlapping UNII 3

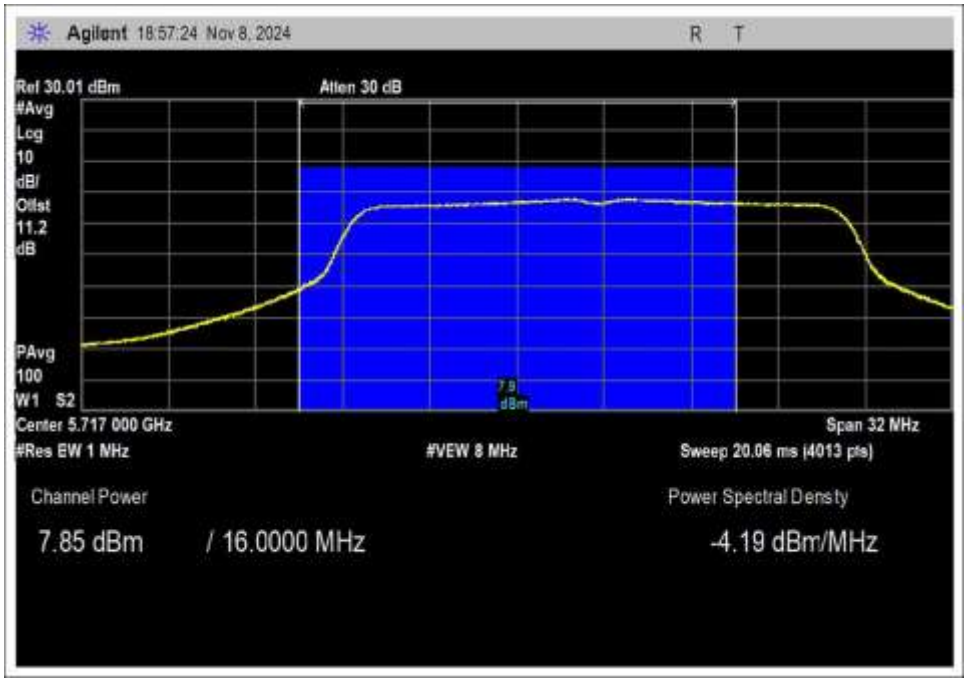
802.11n HT20



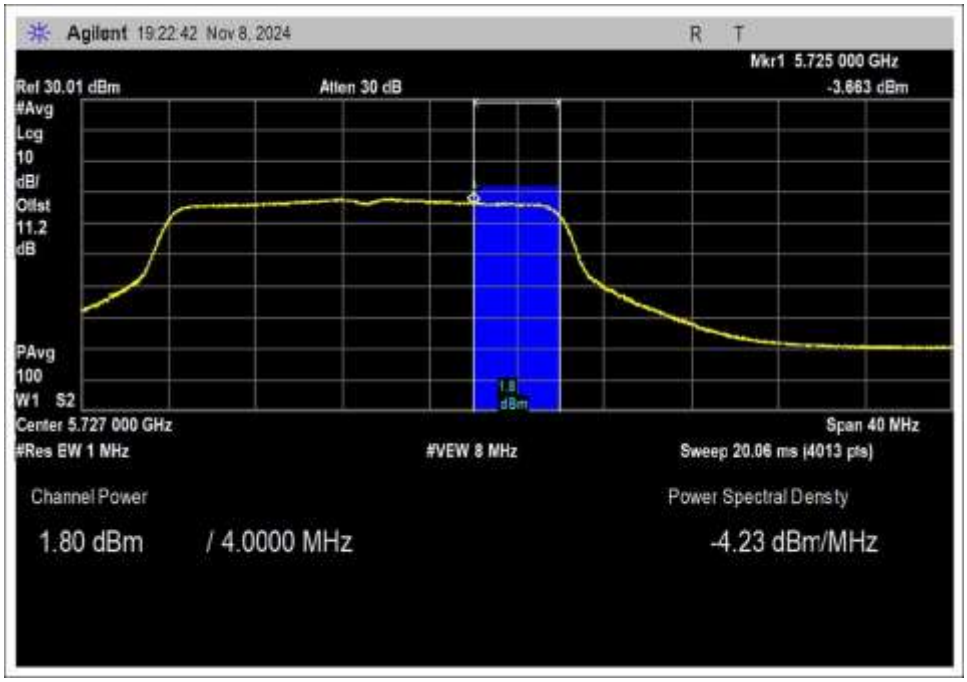
Low Channel



Middle Channel

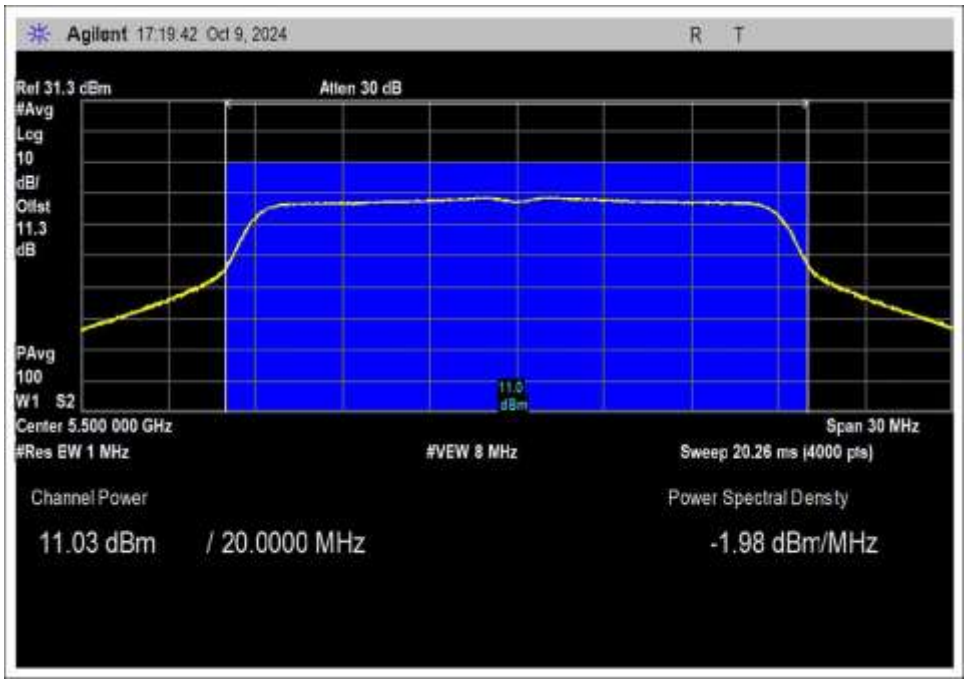


High Channel

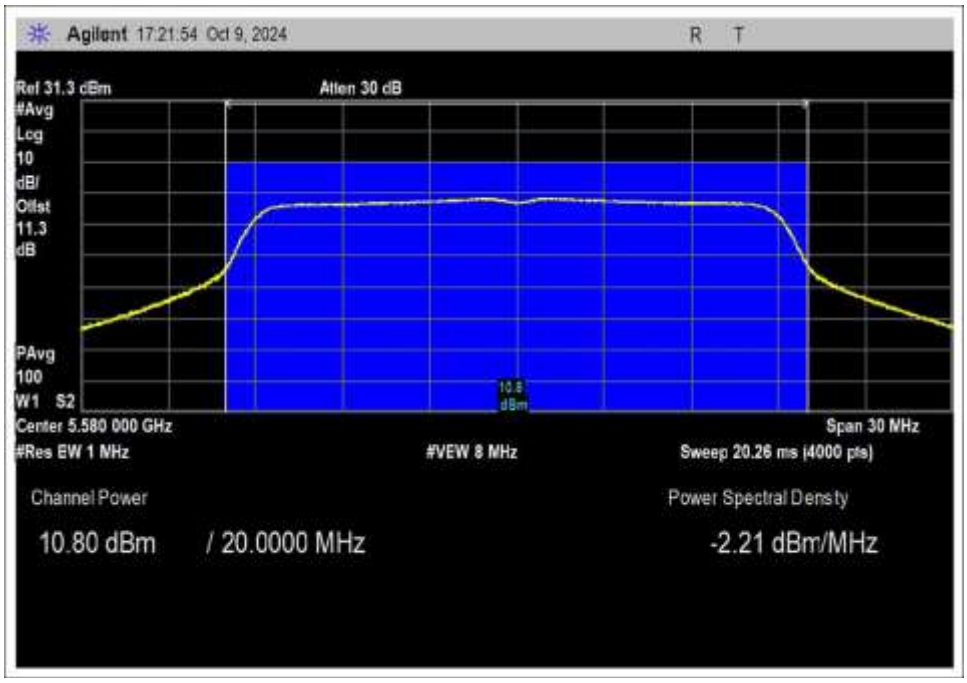


Addition RF out power on High Channel overlapping UNII 3

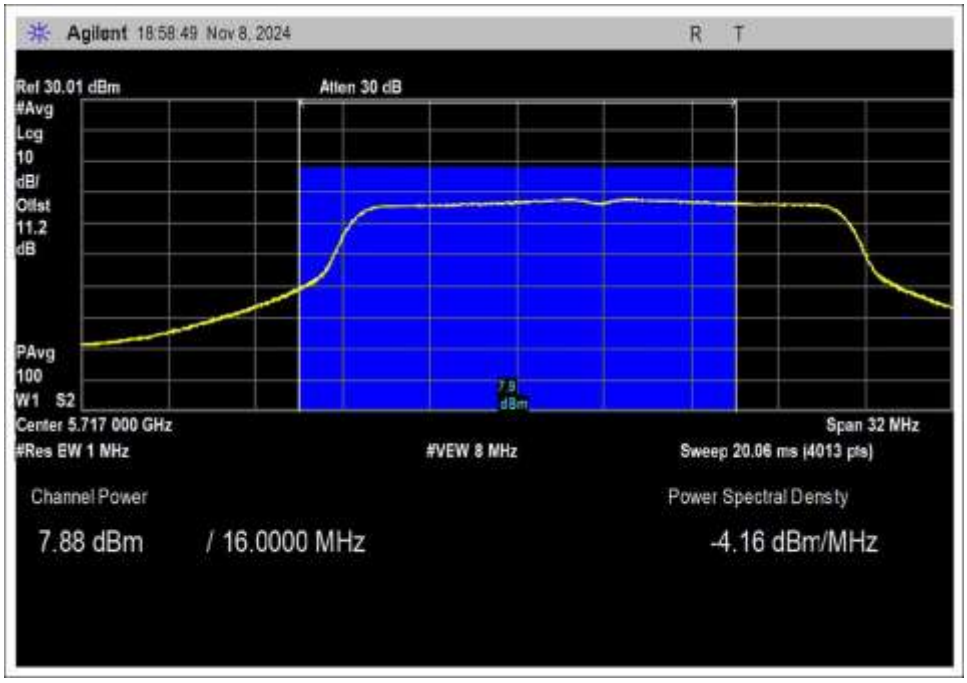
802.11ac 20MHz



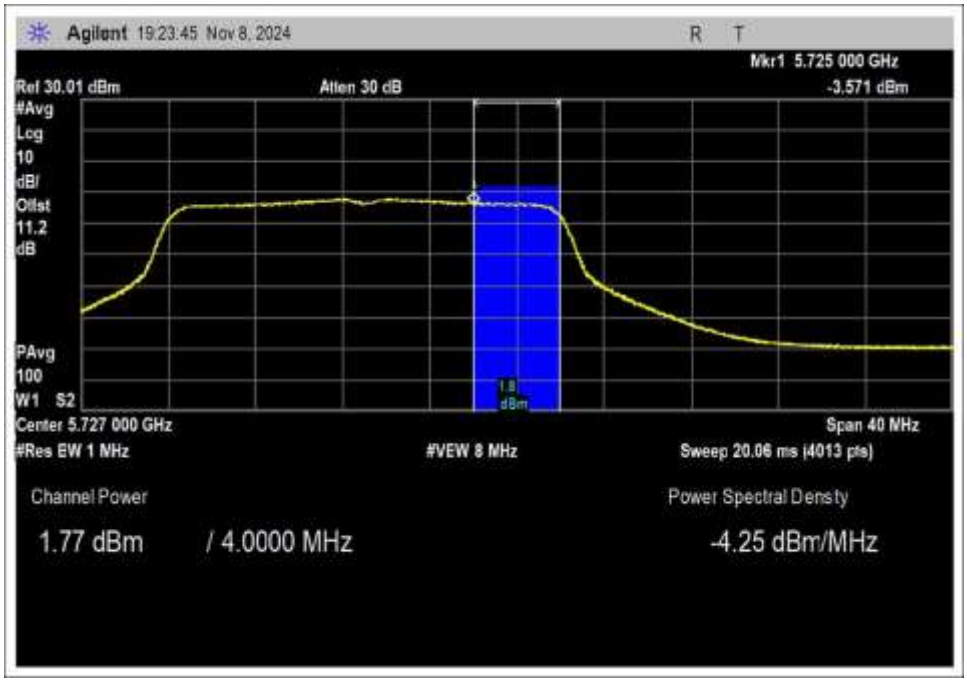
Low Channel



Middle Channel

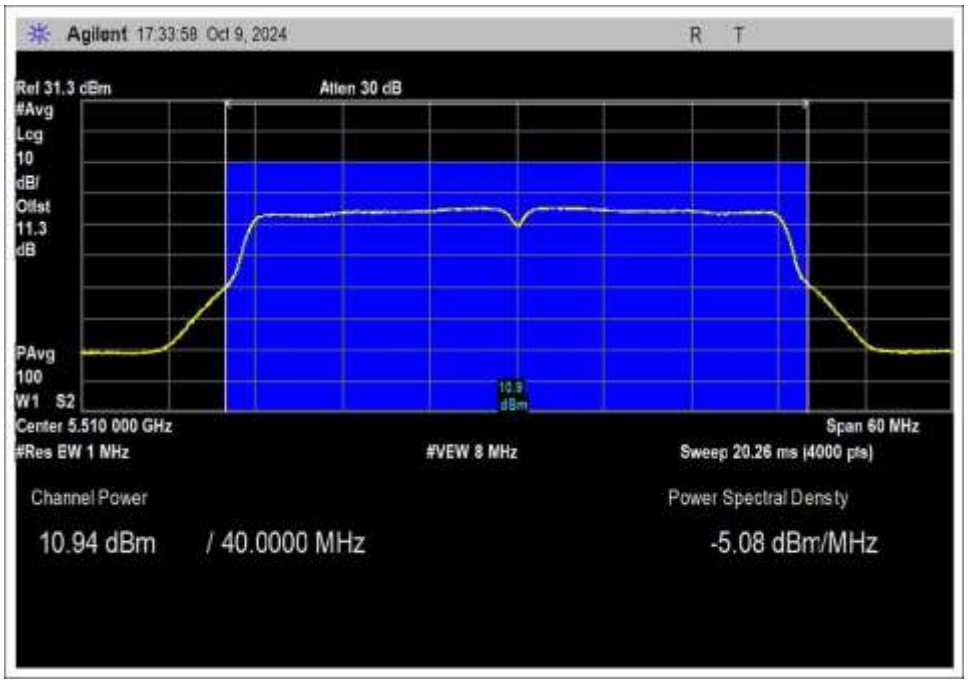


High Channel

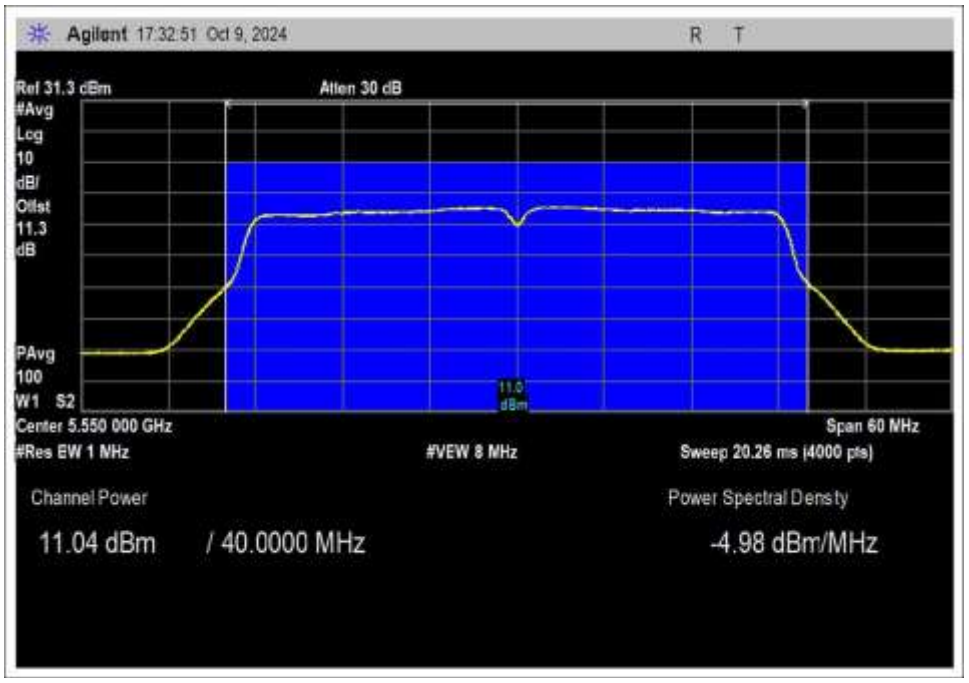


Addition RF out power on High Channel overlapping UNII 3

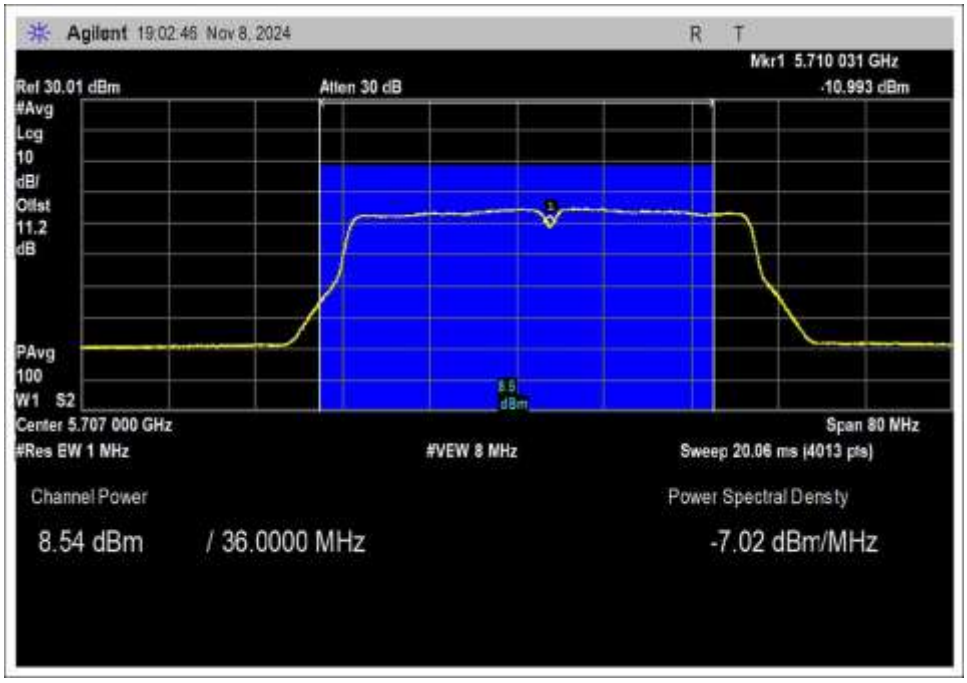
802.11 n HT40



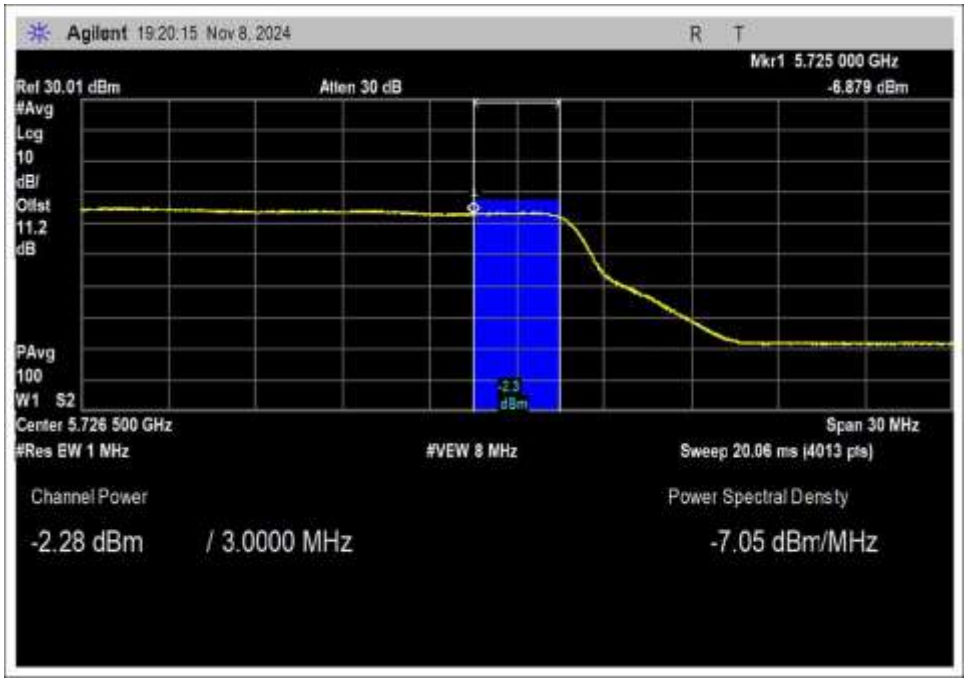
Low Channel



Middle Channel

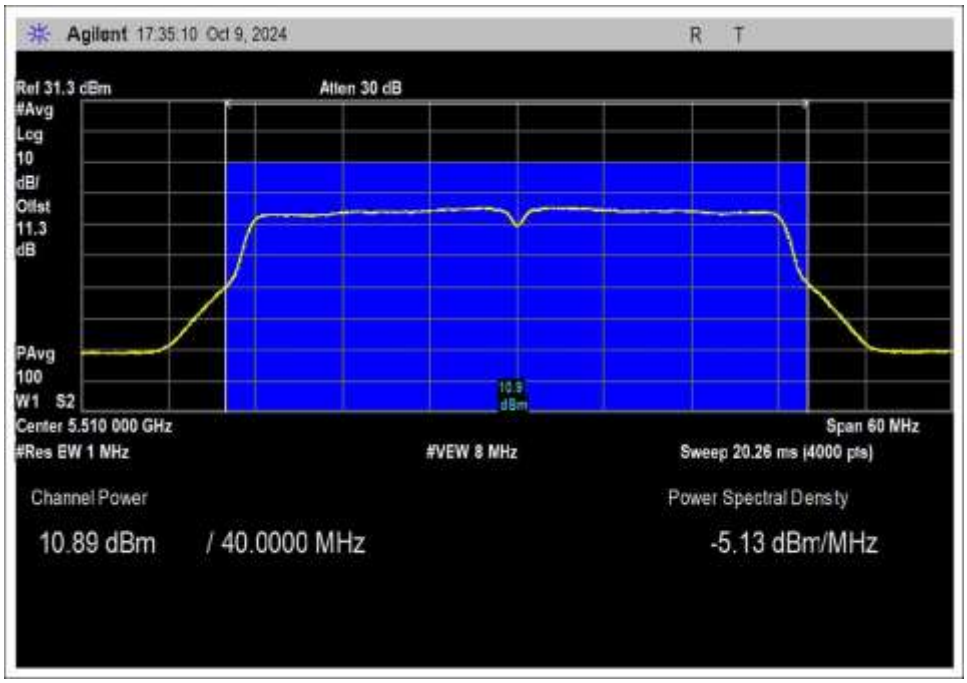


High Channel

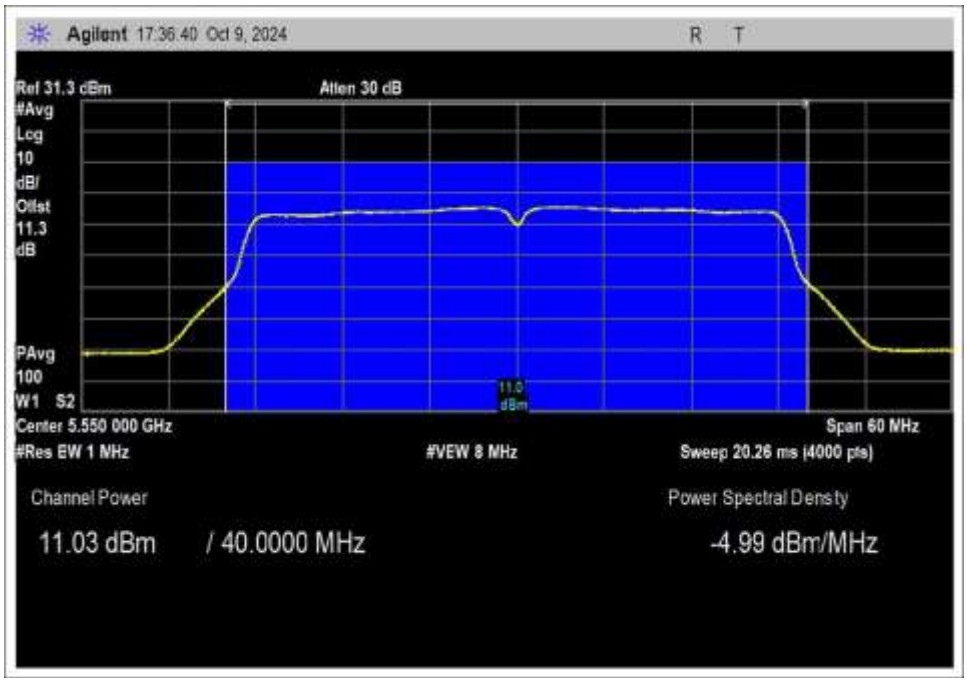


Addition RF out power on High Channel overlapping UNII 3

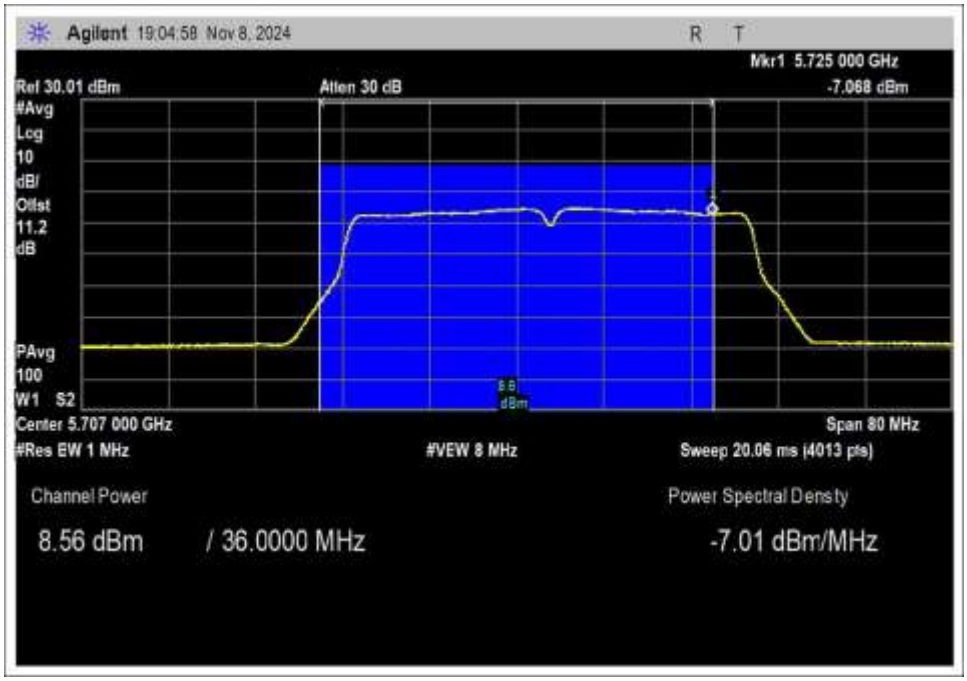
802.11ac 40MHz



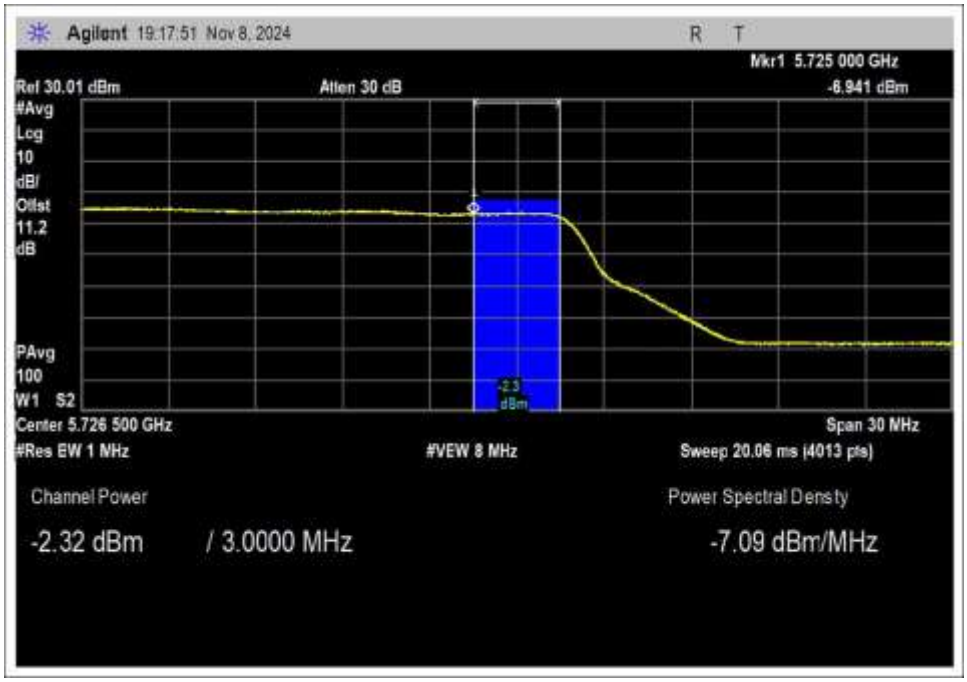
Low Channel



Middle Channel

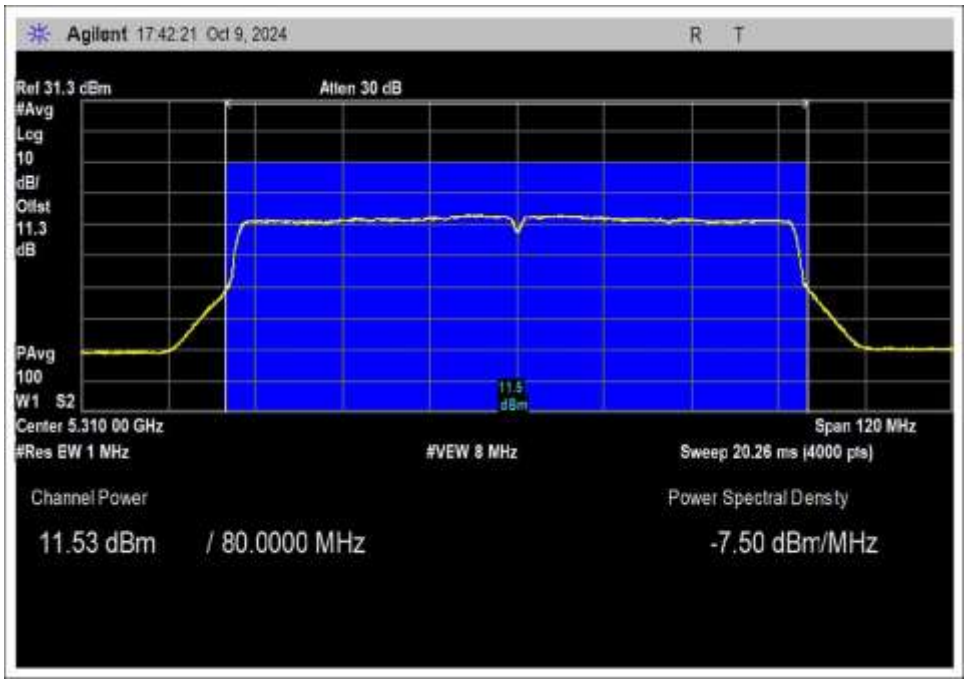


High Channel

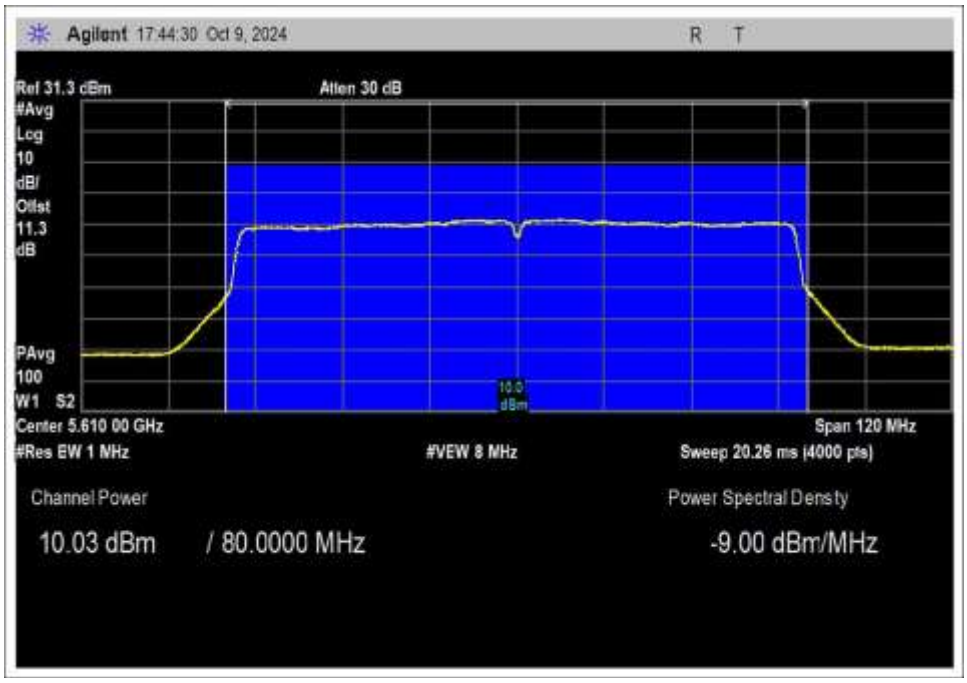


Addition RF out power on High Channel overlapping UNII 3

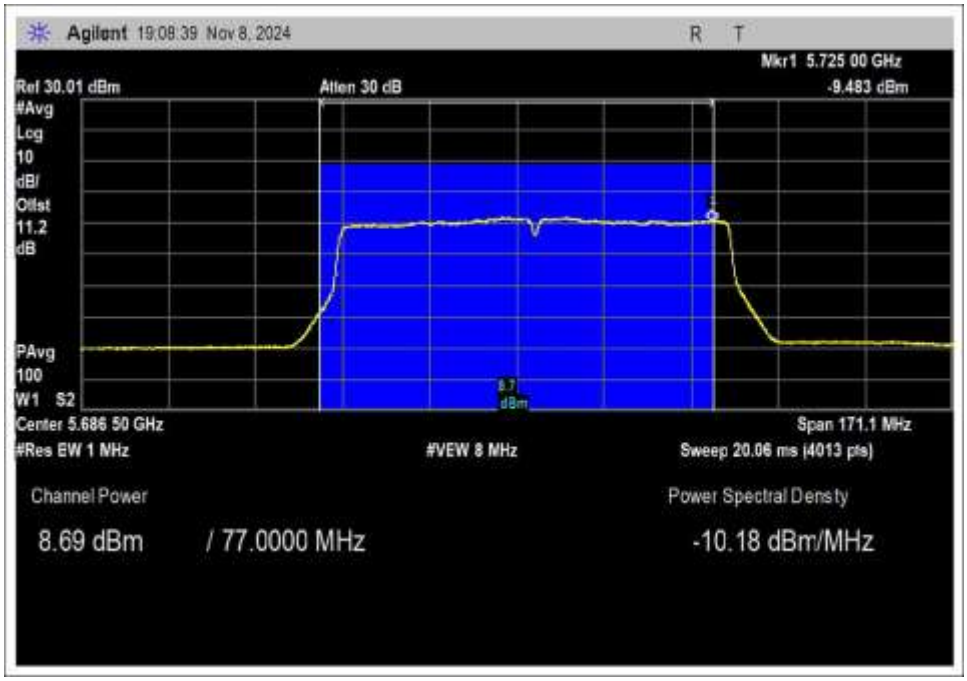
802.11ac 80MHz



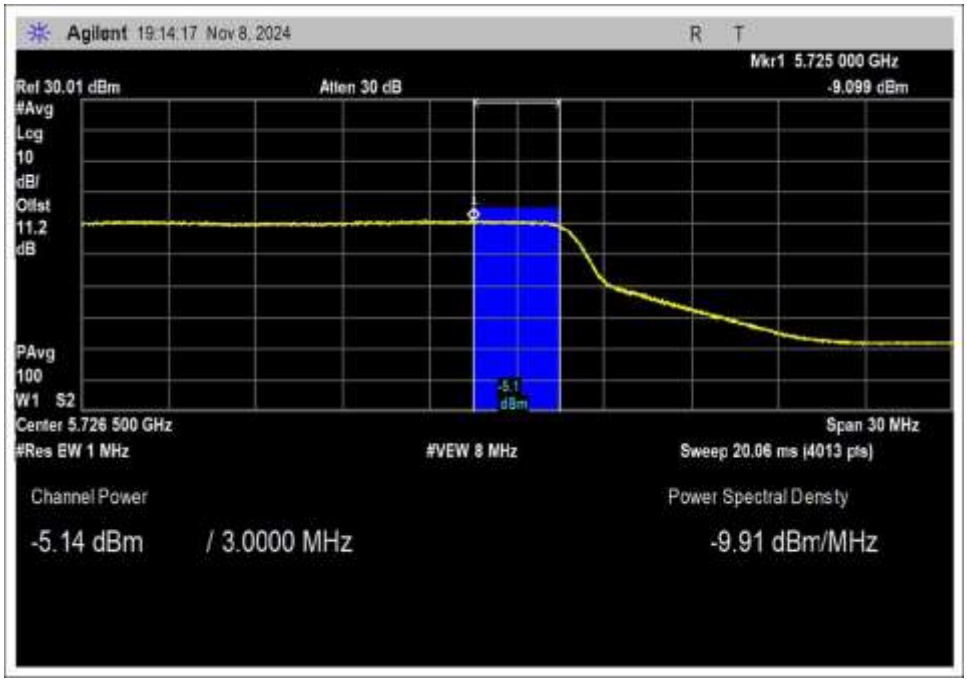
Low Channel



Middle Channel

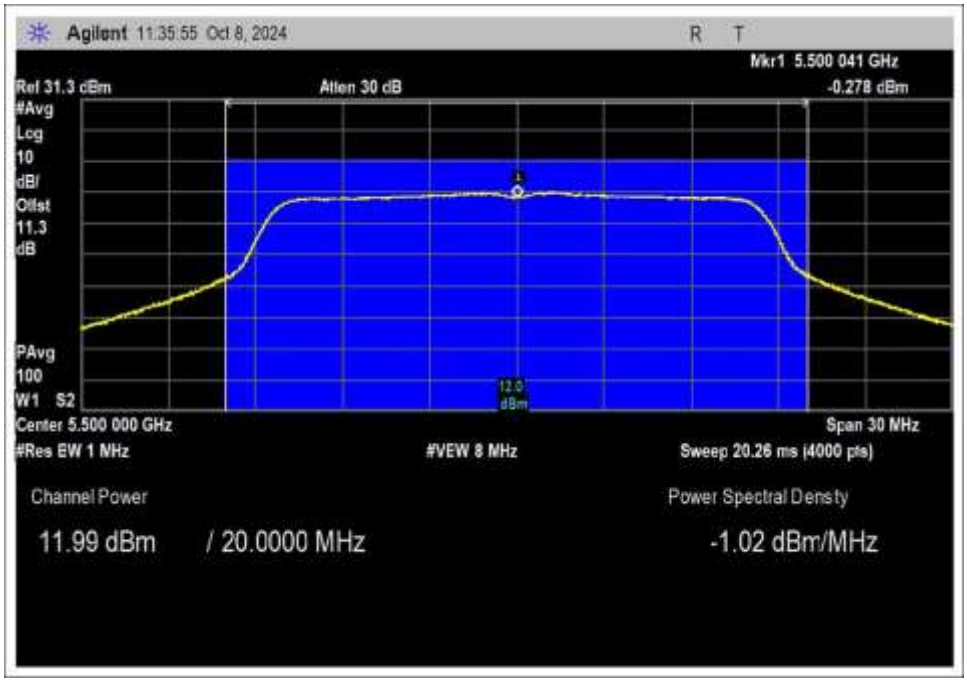


High Channel

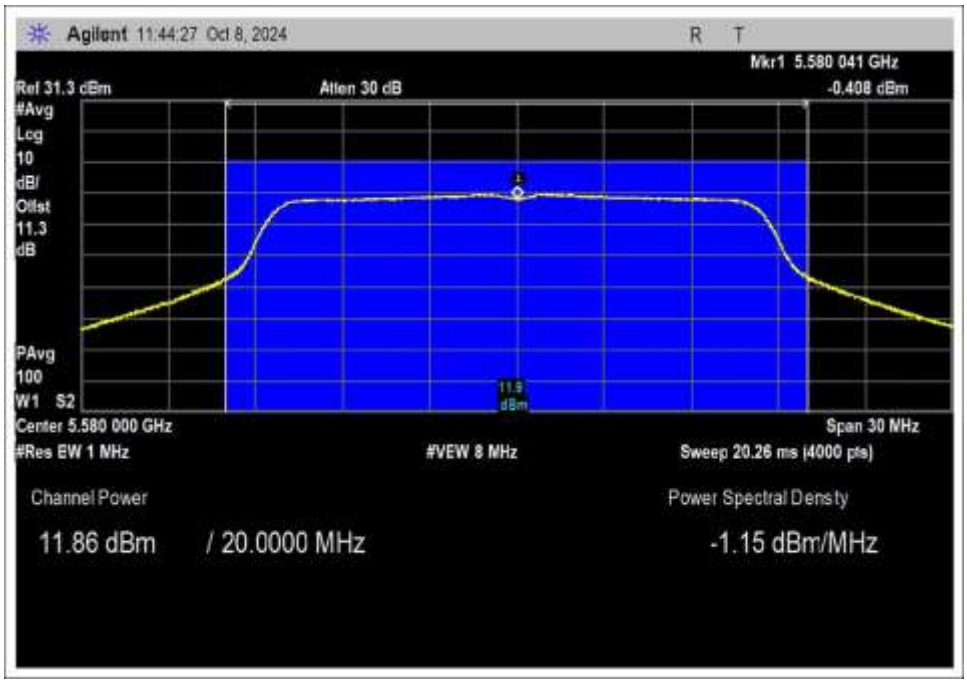


Addition RF out power on High Channel overlapping UNII 3

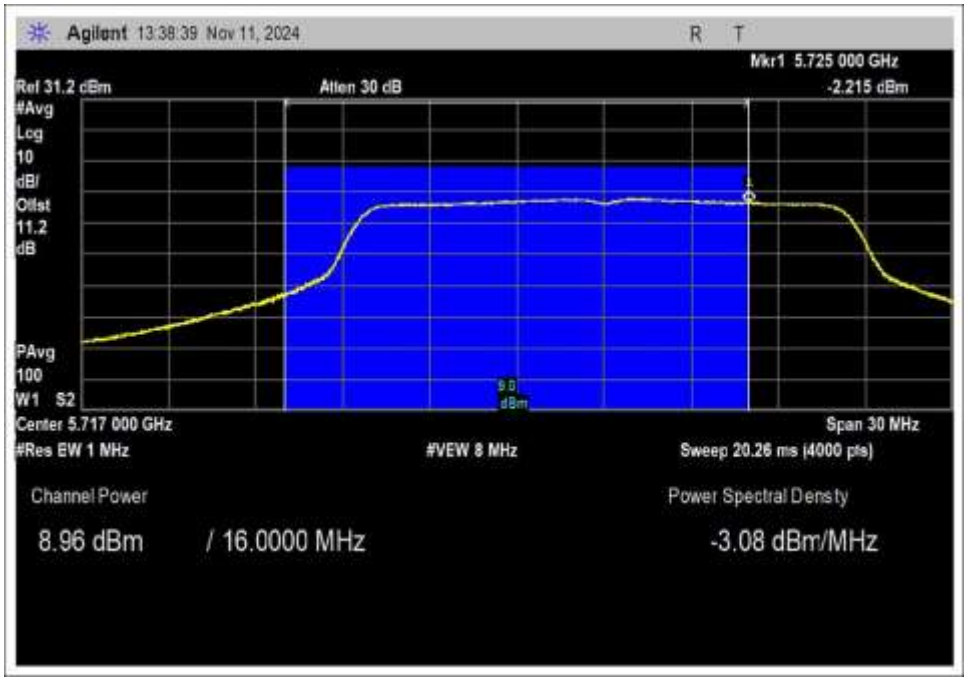
Chain 1
802.11a



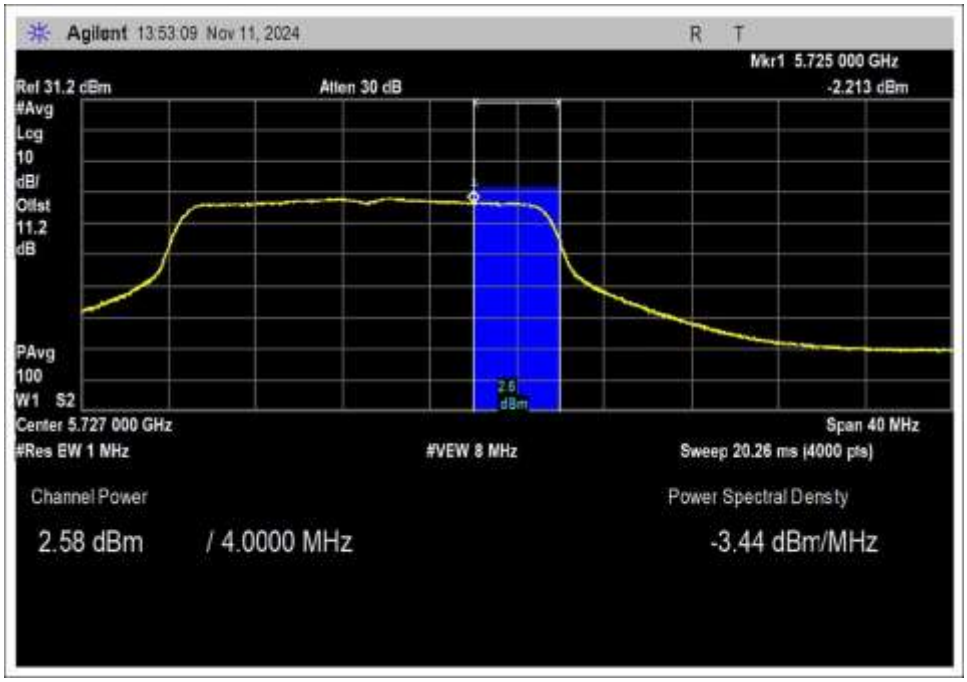
Low Channel



Middle Channel

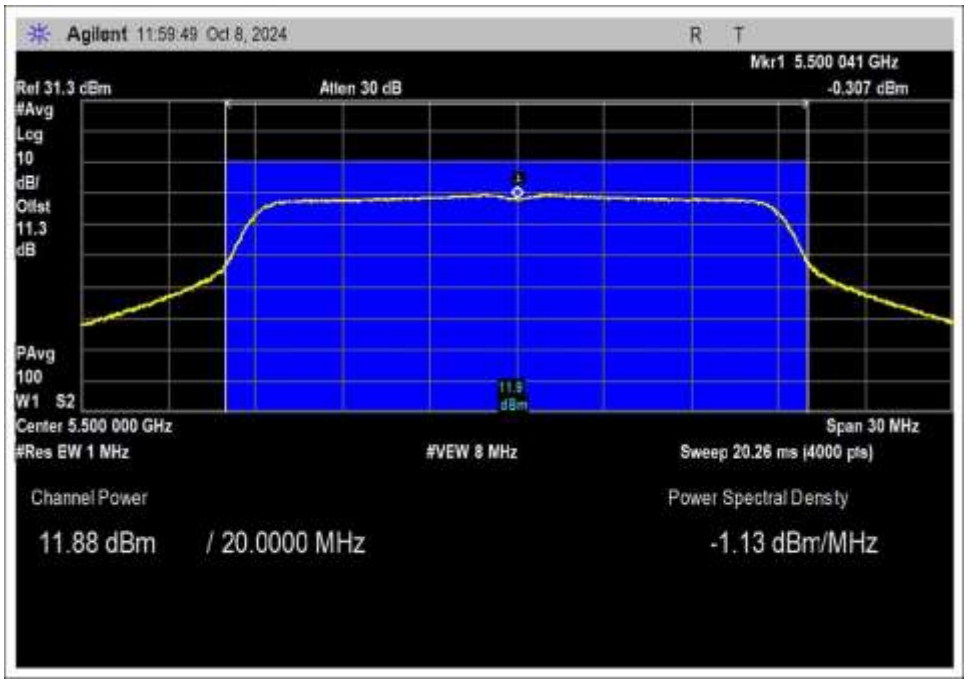


High Channel

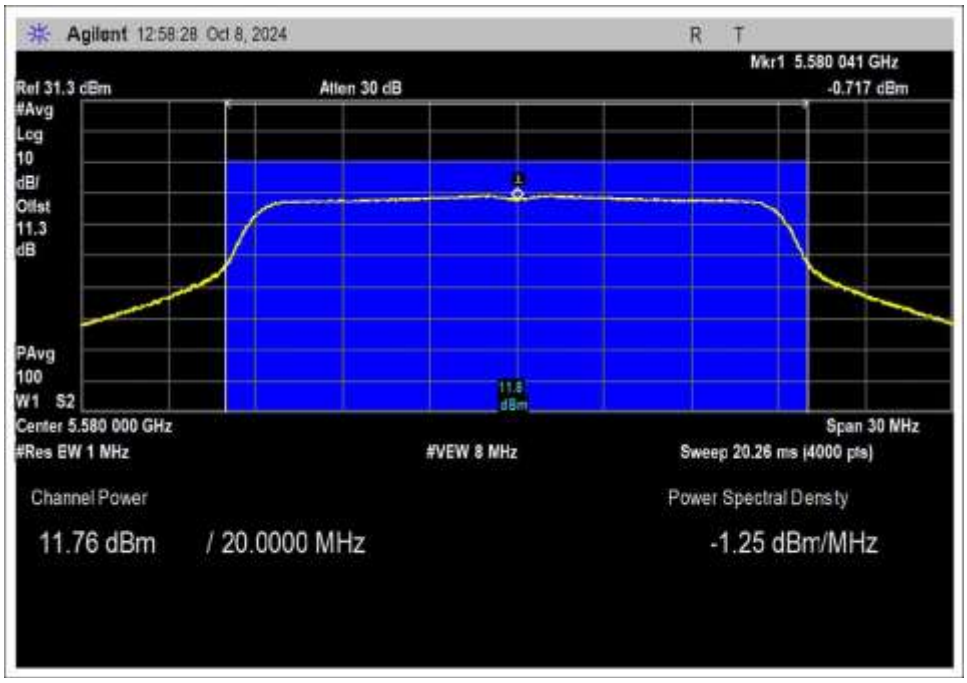


Addition RF out power on High Channel overlapping UNII 3

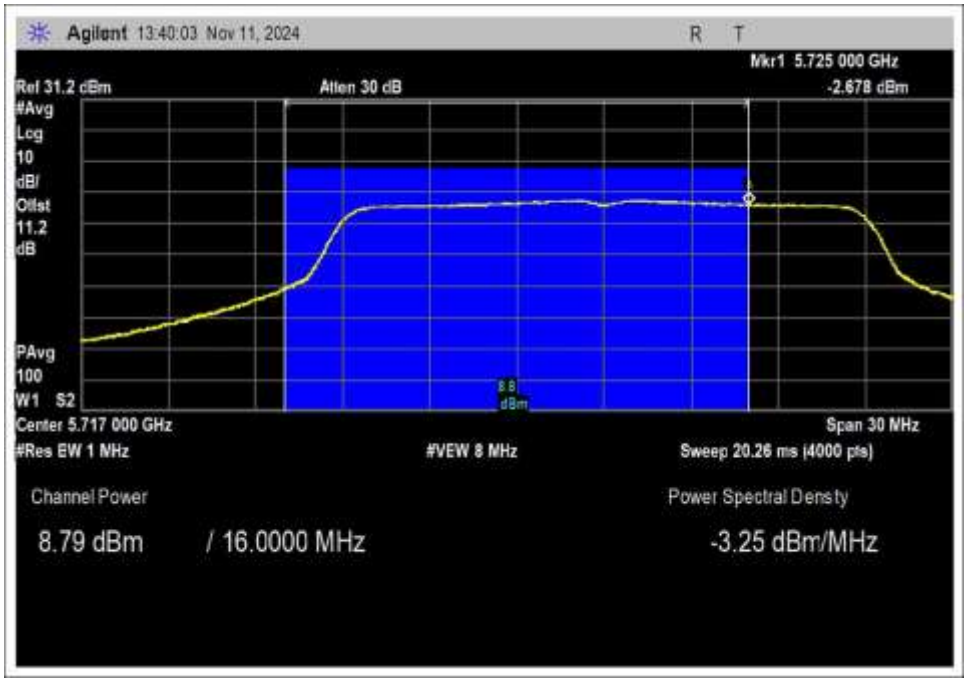
802.11n HT20



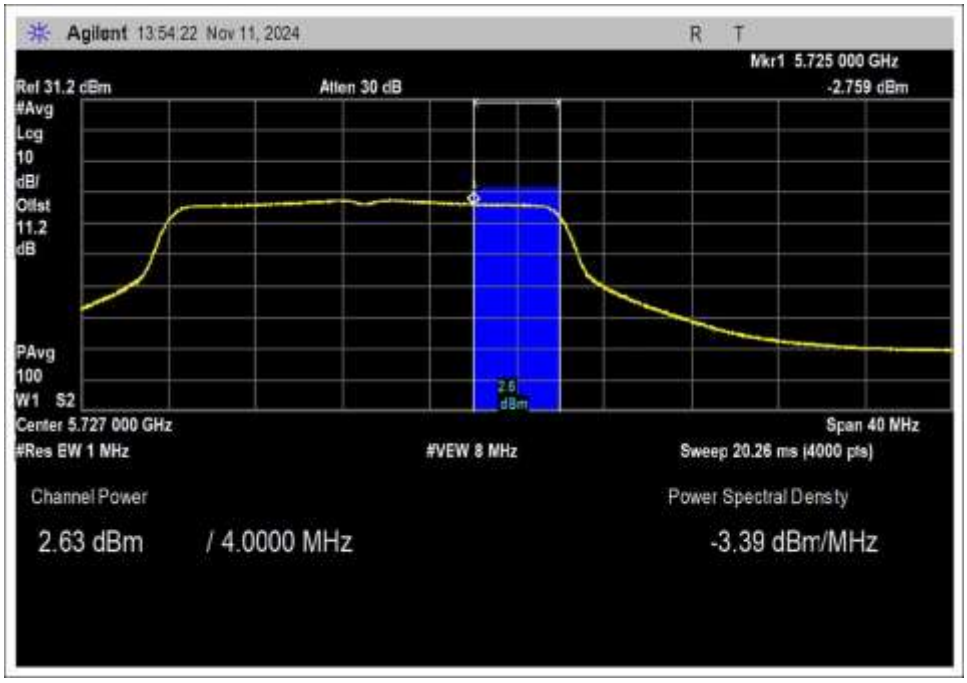
Low Channel



Middle Channel

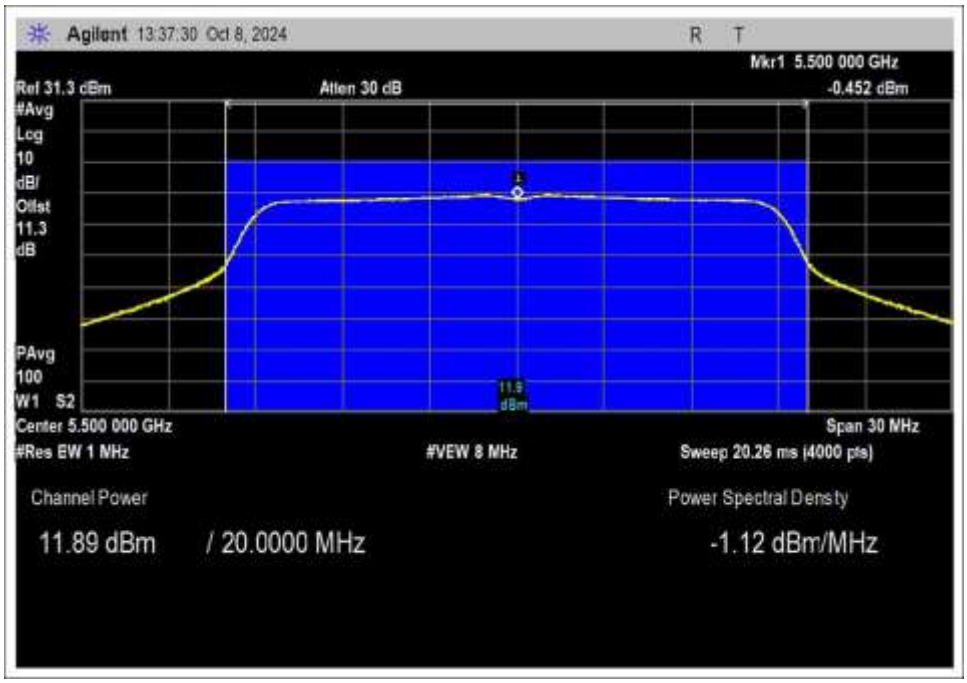


High Channel

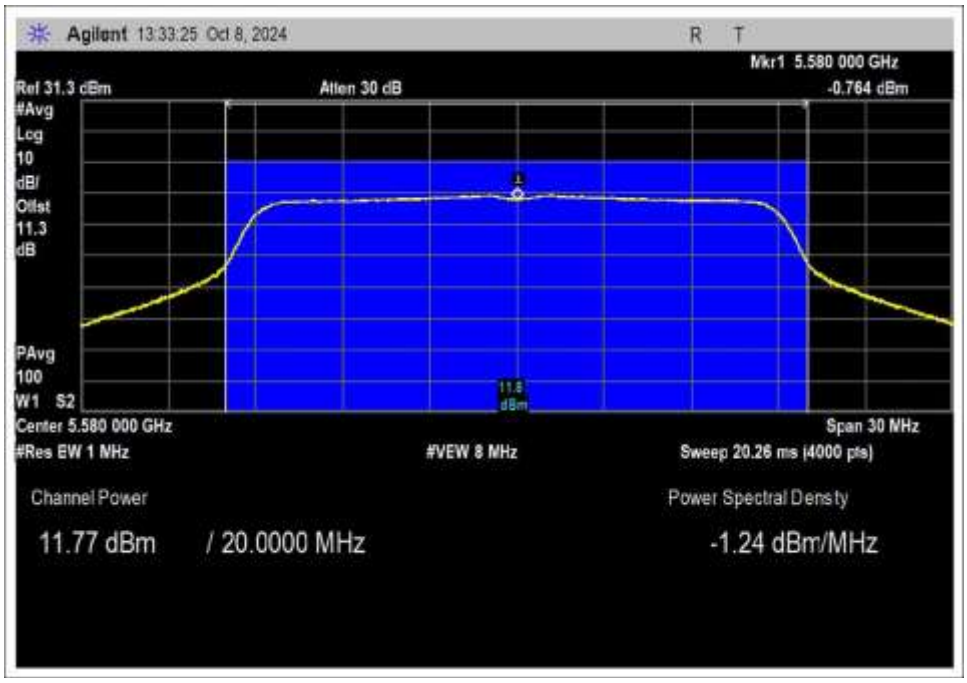


Addition RF out power on High Channel overlapping UNII 3

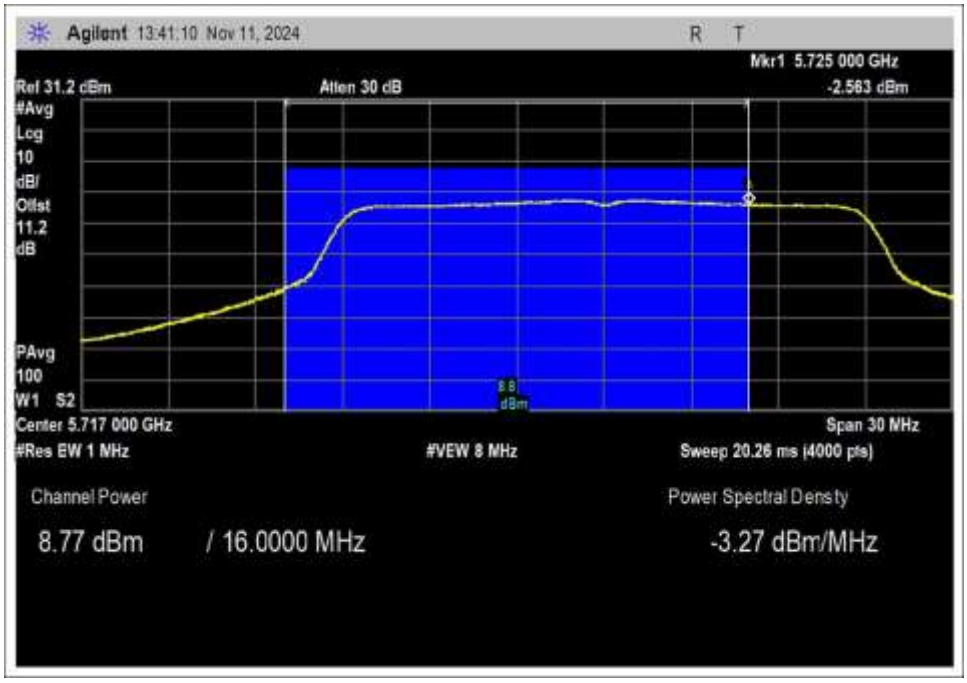
802.11ac 20MHz



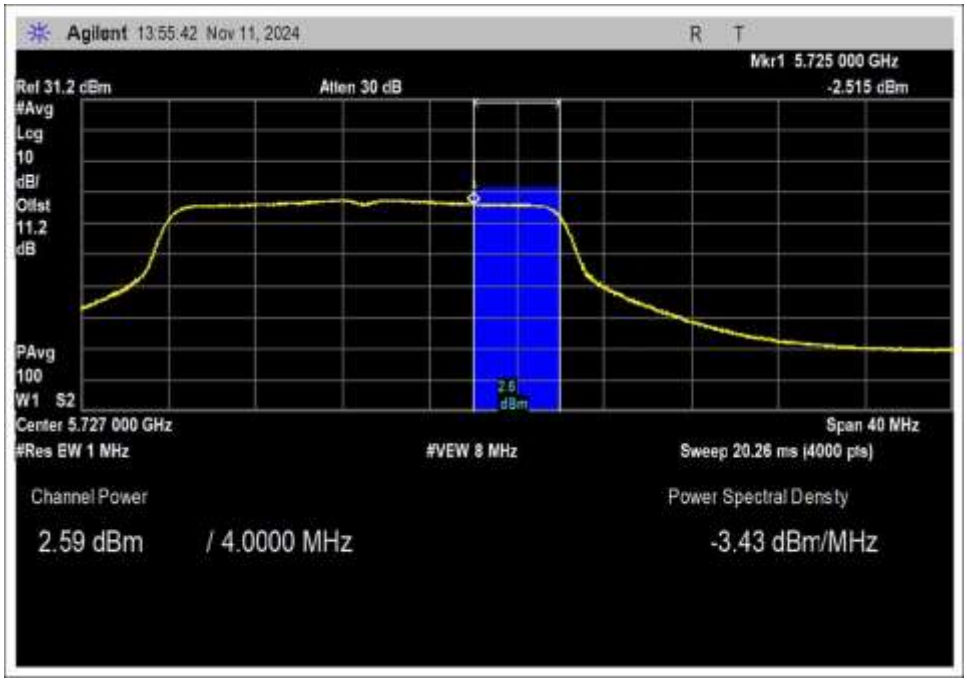
Low Channel



Middle Channel

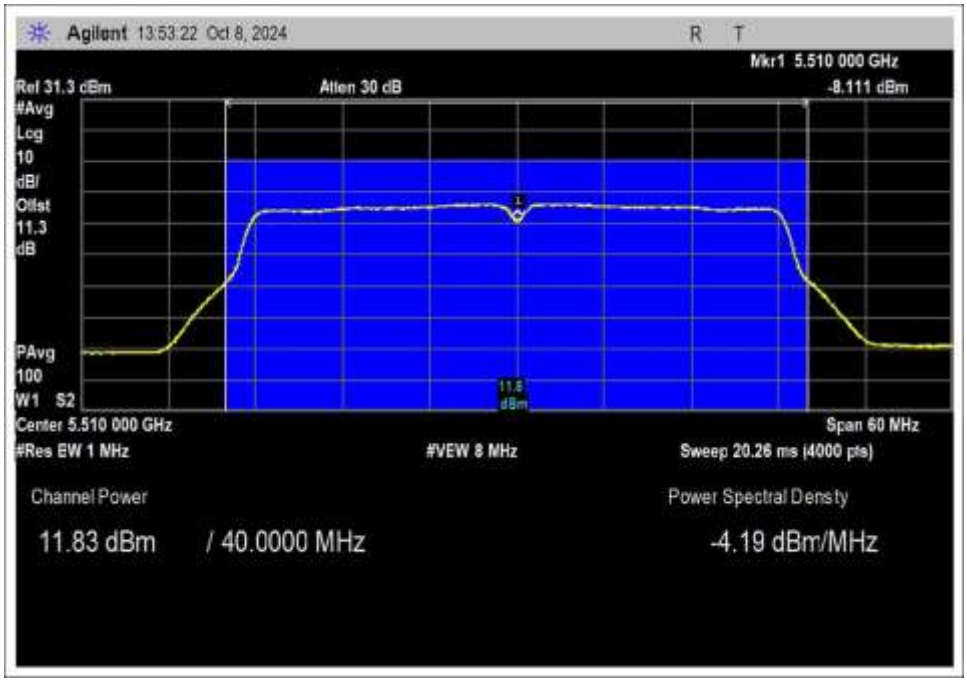


High Channel

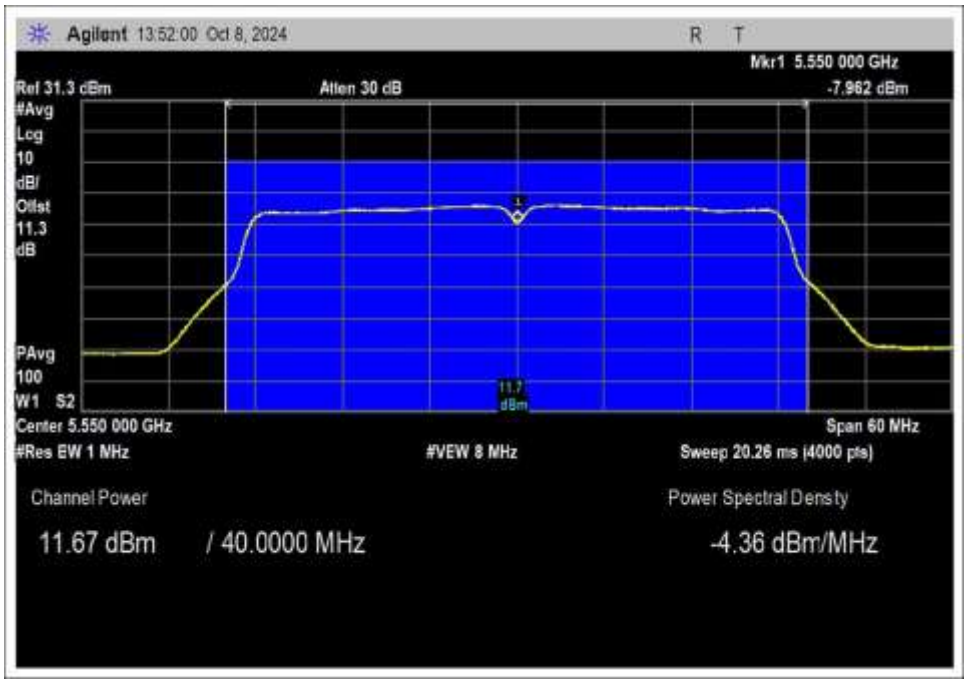


Addition RF out power on High Channel overlapping UNII 3

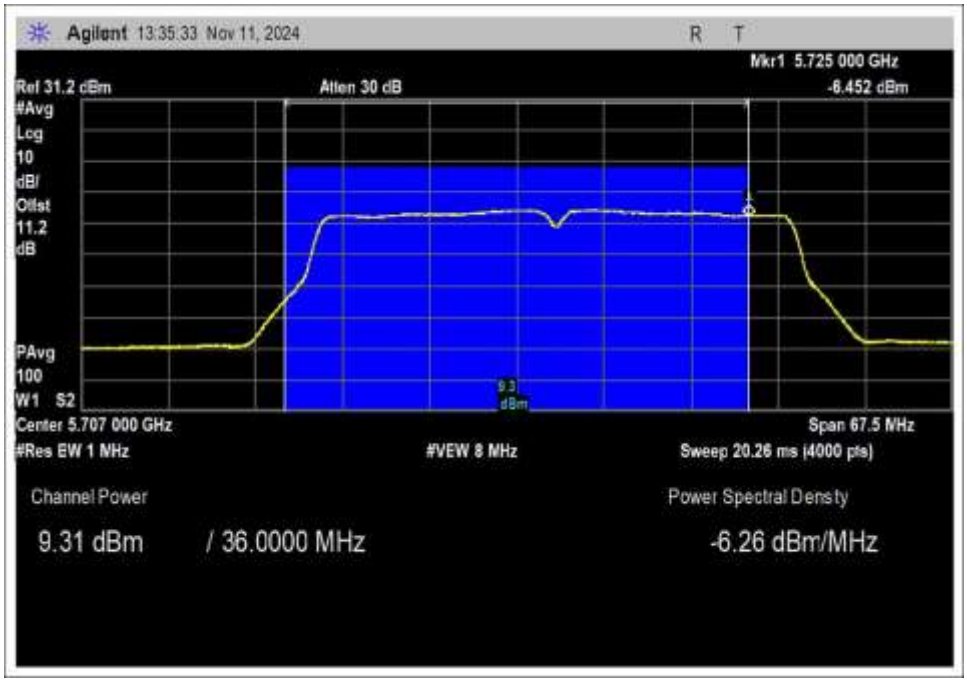
802.11 n HT40



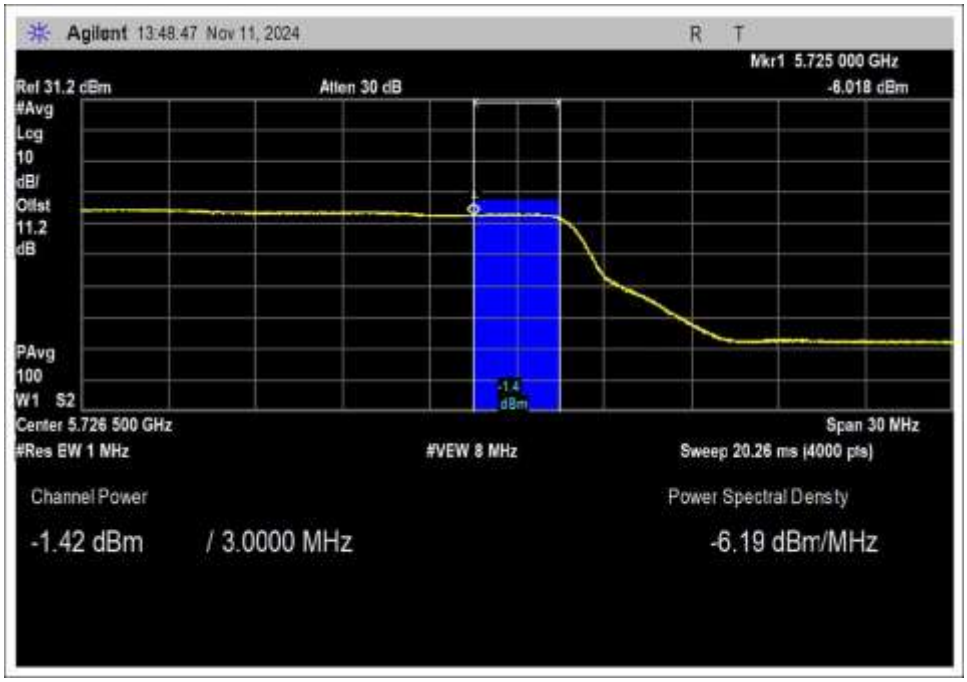
Low Channel



Middle Channel

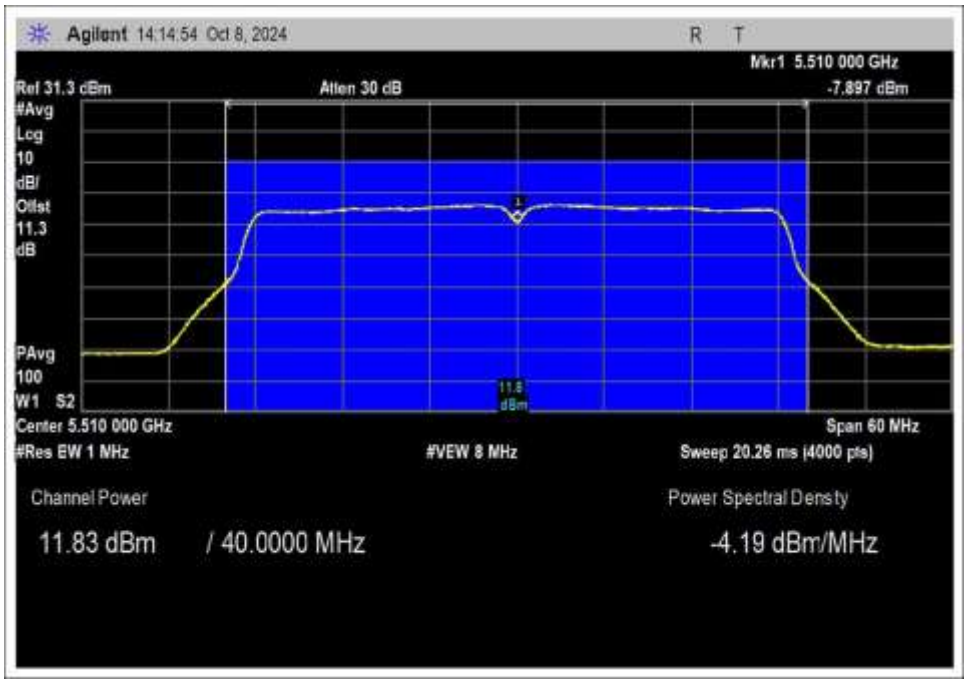


High Channel

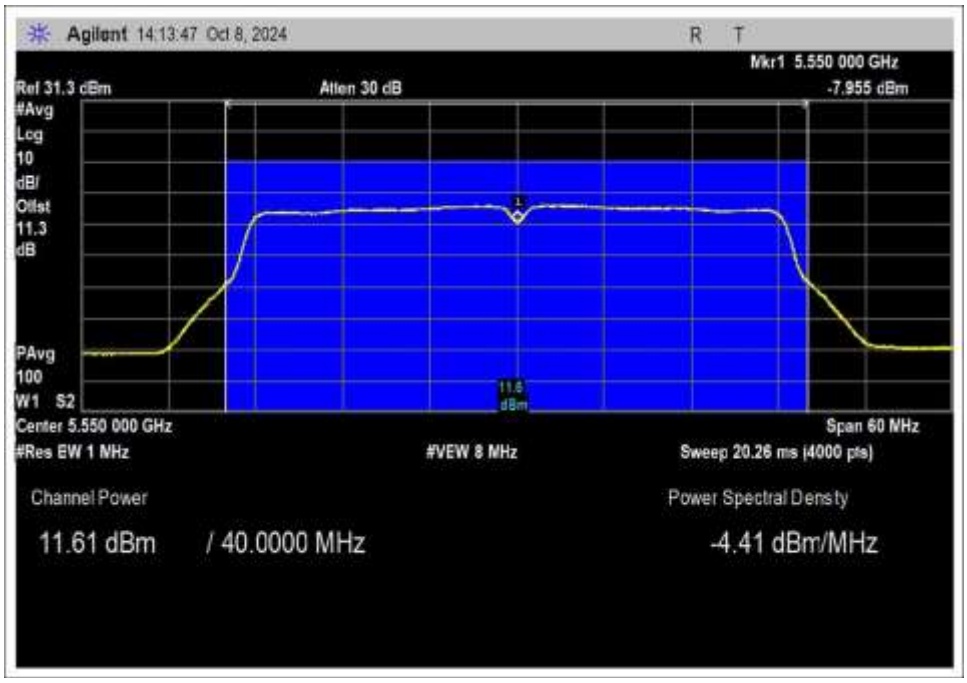


Addition RF out power on High Channel overlapping UNII 3

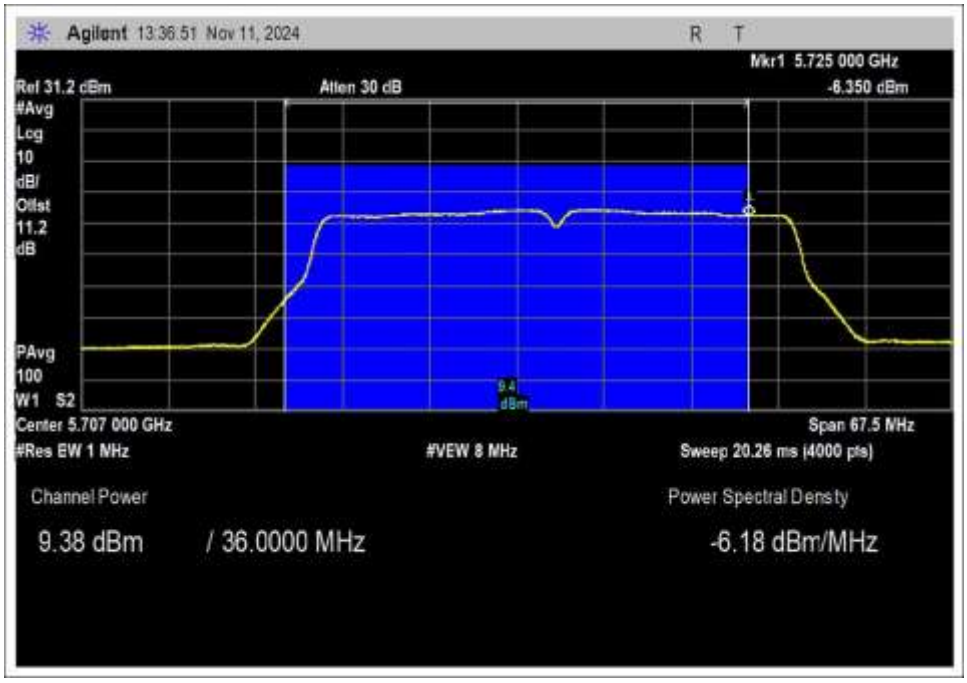
802.11ac 40MHz



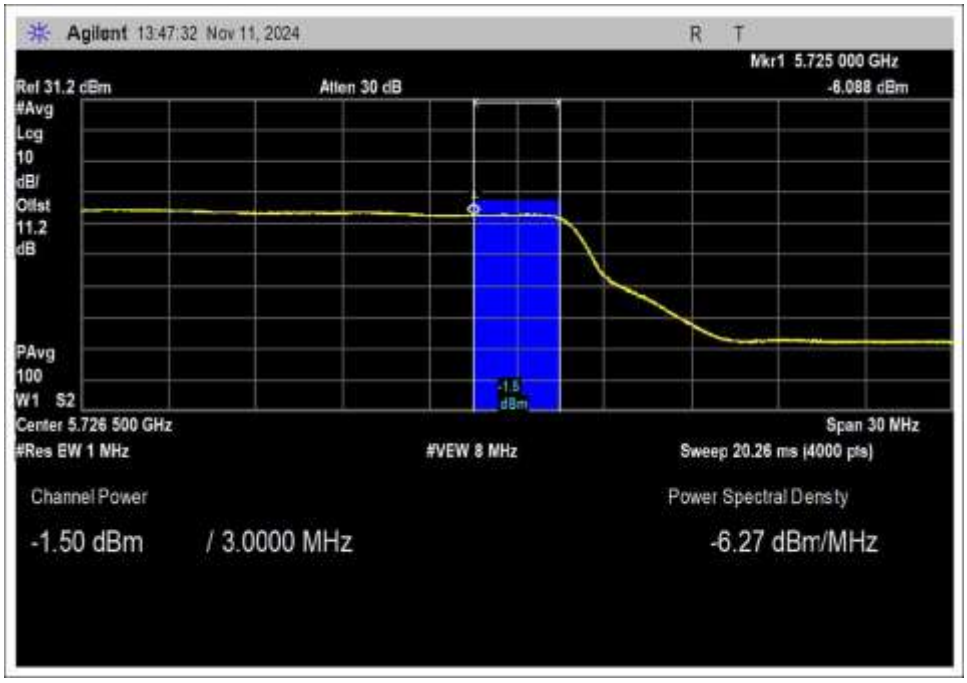
Low Channel



Middle Channel

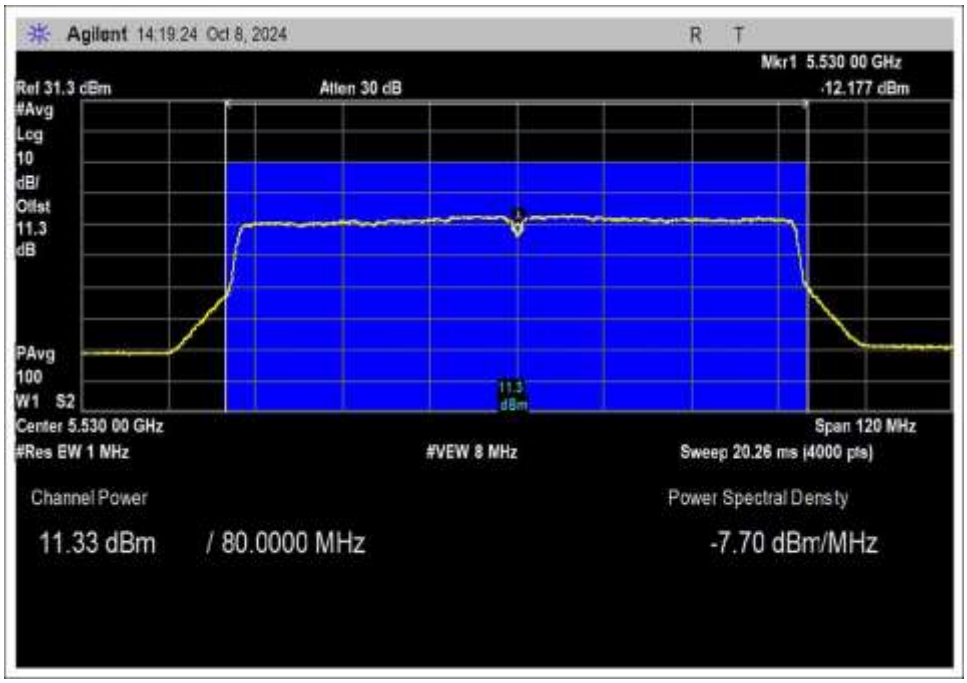


High Channel

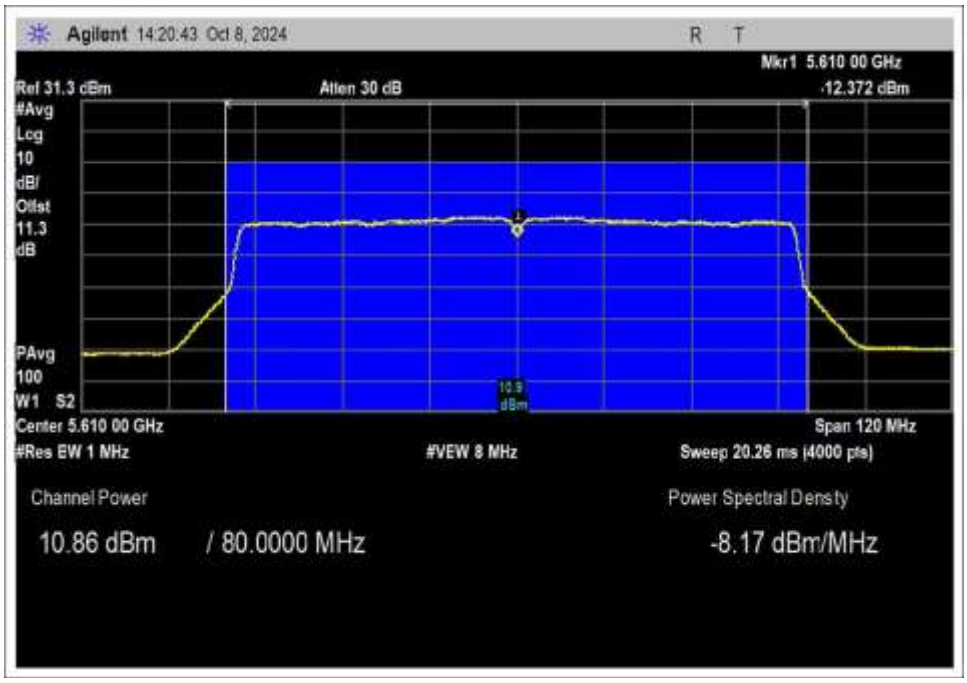


Addition RF out power on High Channel overlapping UNII 3

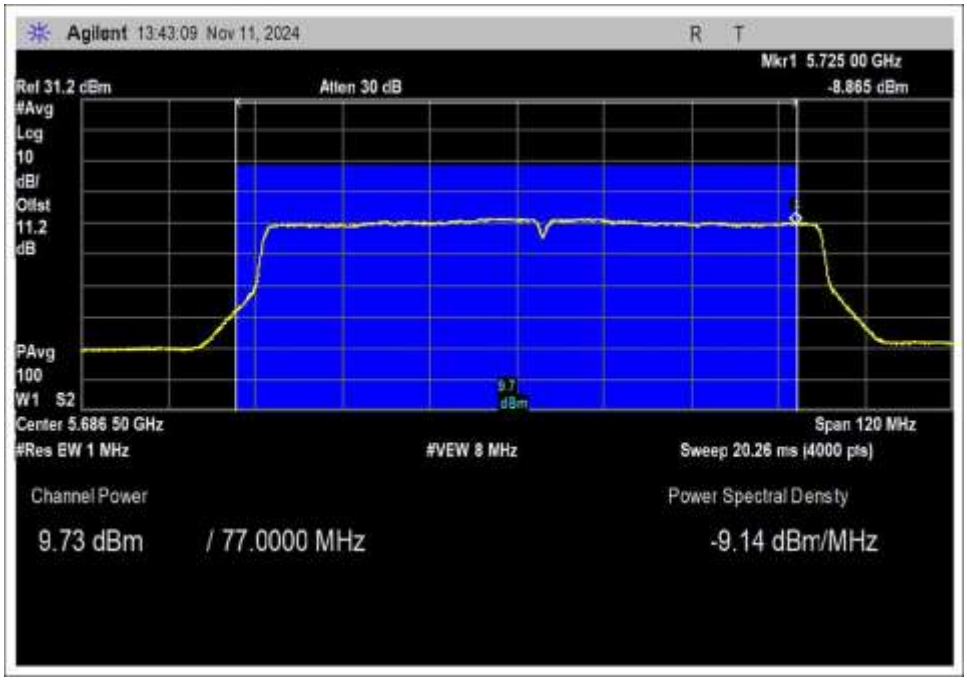
802.11ac 80MHz



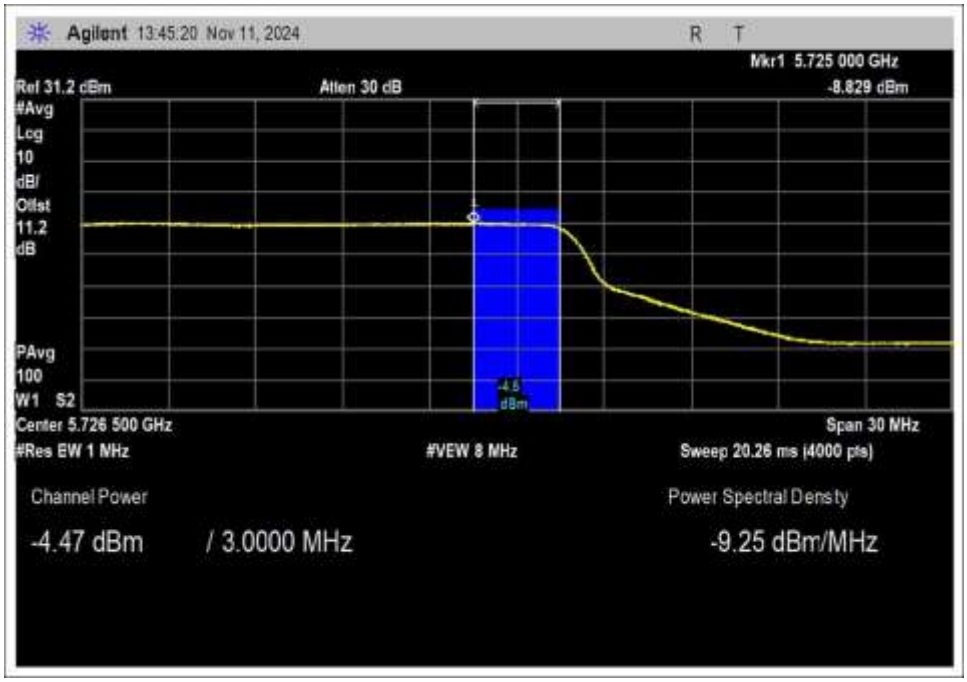
Low Channel



Middle Channel



High Channel



Addition RF out power on High Channel overlapping UNII 3

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.407(a) Power Spectral Density

Test Setup/Conditions			
Test Location:	Fremont Lab Bench	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 789033	Test Date(s):	10/07-09/2024 and 11/08/2024
Configuration:	A		
Test Setup:	The EUT is placed non-conducted table. It is operated as intended. It is connected straight to a Spectrum Analyzer.		

Environmental Conditions			
Temperature (ºC)	21.2-23.7	Relative Humidity (%):	39-45

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03013	Cable	Astrolab	32022-2-2909K-36TC	1/9/2024	1/9/2026
P07365	Attenuator	Weinschel	54A-10	5/26/2023	5/26/2025
03471	Spectrum Analyzer	Agilent	E4440A	2/23/2024	2/23/2026

Test Data Summary - RF Conducted Measurement -Chain 0					
Measurement Option: AVGSA-1					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm/MHz)**	**Limit (dBm/MHz)**	**Results**
5500	802.11a	External/4.66	-1.84	≤11	Pass
5580	802.11a	External/4.66	-2.07	≤11	Pass
5720	802.11a	External/4.66	-3.94	≤11	Pass
5500	802.11n HT20	External/4.66	-1.96	≤11	Pass
5580	802.11n HT20	External/4.66	-2.2	≤11	Pass
5720	802.11n HT20	External/4.66	-4.19	≤11	Pass
5500	802.11ac 20MHz	External/4.66	-1.98	≤11	Pass
5580	802.11ac 20MHz	External/4.66	-2.21	≤11	Pass
5720	802.11ac 20MHz	External/4.66	-4.16	≤11	Pass
5510	802.11n HT40	External/4.66	-5.08	≤11	Pass
5550	802.11n HT40	External/4.66	-4.98	≤11	Pass
5710	802.11n HT40	External/4.66	-7.02	≤11	Pass
5510	802.11ac 40MHz	External/4.66	-5.13	≤11	Pass
5550	802.11ac 40MHz	External/4.66	-4.99	≤11	Pass
5710	802.11ac 40MHz	External/4.66	-7.01	≤11	Pass
5530	802.11ac 80MHz	External/4.66	-7.5	≤11	Pass
5610	802.11ac 80MHz	External/4.66	-9	≤11	Pass
5690	802.11ac 80MHz	External/4.66	-10.18	≤11	Pass

Test Data Summary - RF Conducted Measurement -Chain 1					
Measurement Option: AVGSA-1					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm/MHz)**	**Limit (dBm/MHz)**	**Results**
5500	802.11a	External/4.66	-1.02	≤11	Pass
5580	802.11a	External/4.66	-1.15	≤11	Pass
5720	802.11a	External/4.66	-3.08	≤11	Pass
5500	802.11n HT20	External/4.66	-1.13	≤11	Pass
5580	802.11n HT20	External/4.66	-1.25	≤11	Pass
5720	802.11n HT20	External/4.66	-3.25	≤11	Pass
5500	802.11ac 20MHz	External/4.66	-1.12	≤11	Pass
5580	802.11ac 20MHz	External/4.66	-1.24	≤11	Pass
5720	802.11ac 20MHz	External/4.66	-3.27	≤11	Pass
5510	802.11n HT40	External/4.66	-4.19	≤11	Pass
5550	802.11n HT40	External/4.66	-4.36	≤11	Pass
5710	802.11n HT40	External/4.66	-6.26	≤11	Pass
5510	802.11ac 40MHz	External/4.66	-4.19	≤11	Pass
5550	802.11ac 40MHz	External/4.66	-4.41	≤11	Pass
5710	802.11ac 40MHz	External/4.66	-6.18	≤11	Pass
5530	802.11ac 80MHz	External/4.66	-7.7	≤11	Pass
5610	802.11ac 80MHz	External/4.66	-8.17	≤11	Pass
5690	802.11ac 80MHz	External/4.66	-9.14	≤11	Pass

The limit is calculated in accordance with 15.407(a)(2):

$Limit = 11 - Roundup(G - 6)$

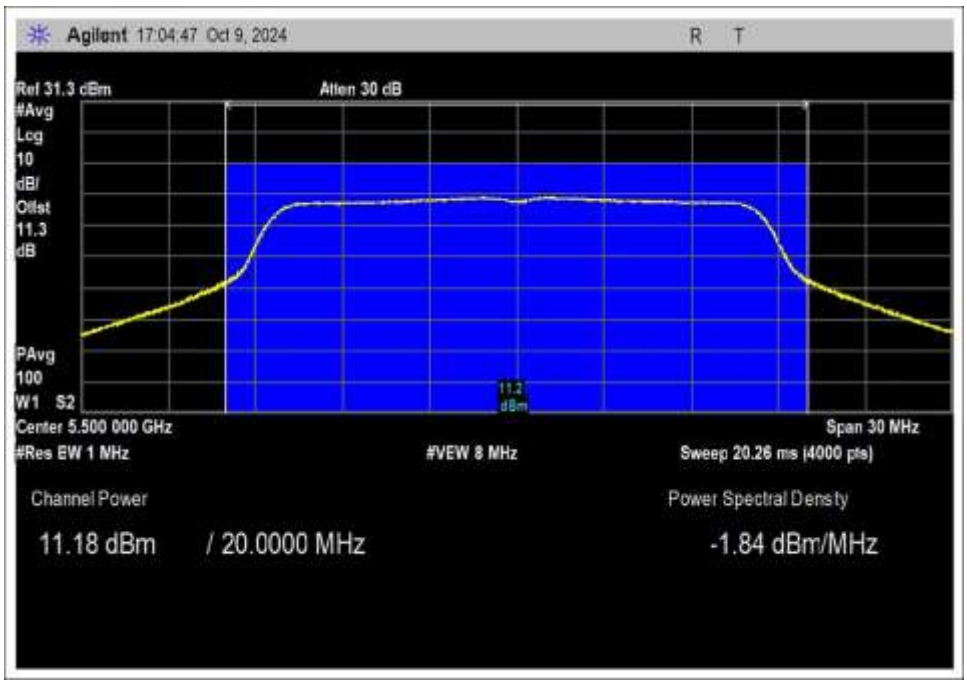
Addition Power Spectral Density on High Channel overlapping UNII 3

Test Data Summary - RF Conducted Measurement -Chain 0					
Measurement Option: AVGSA-1					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm/500kHz)**	**Limit (dBm/500kHz)**	**Results**
5720	802.11a	External/4.66	-5.536	≤30	Pass
5720	802.11n HT20	External/4.66	-6.203	≤30	Pass
5720	802.11ac 20MHz	External/4.66	-6.235	≤30	Pass
5710	802.11n HT40	External/4.66	-9.171	≤30	Pass
5710	802.11ac 40MHz	External/4.66	-9.415	≤30	Pass
5690	802.11ac 80MHz	External/4.66	-11.980	≤30	Pass

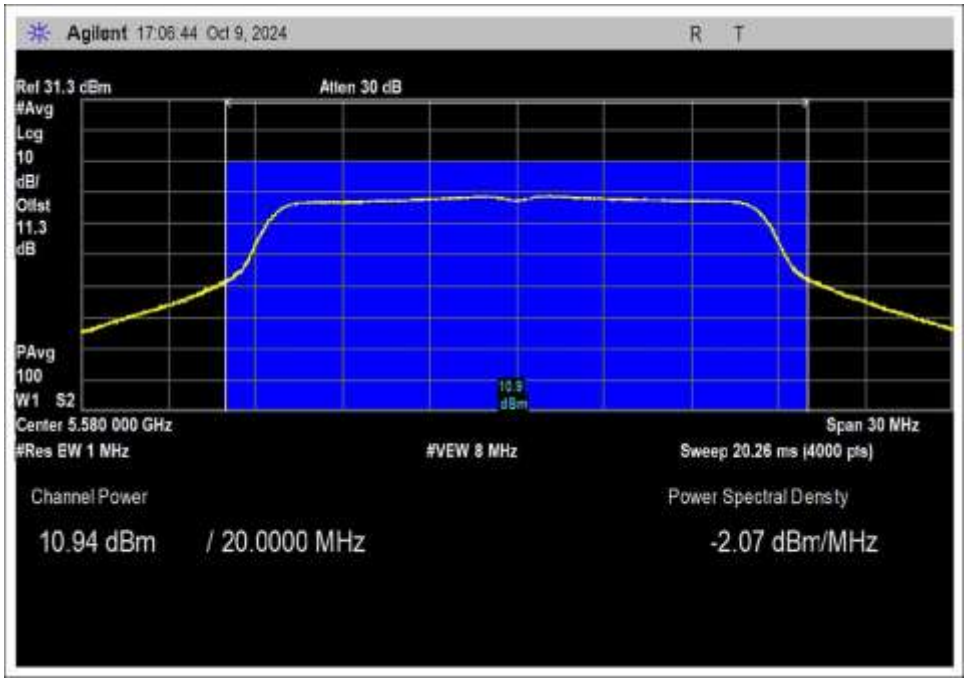
Test Data Summary - RF Conducted Measurement -Chain 1					
Measurement Option: AVGSA-1					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm/500kHz)**	**Limit (dBm/500kHz)**	**Results**
5720	802.11a	External/4.66	-4.680	≤30	Pass
5720	802.11n HT20	External/4.66	-5.259	≤30	Pass
5720	802.11ac 20MHz	External/4.66	-4.964	≤30	Pass
5710	802.11n HT40	External/4.66	-8.205	≤30	Pass
5710	802.11ac 40MHz	External/4.66	-8.250	≤30	Pass
5690	802.11ac 80MHz	External/4.66	-11.019	≤30	Pass

Plot(s)

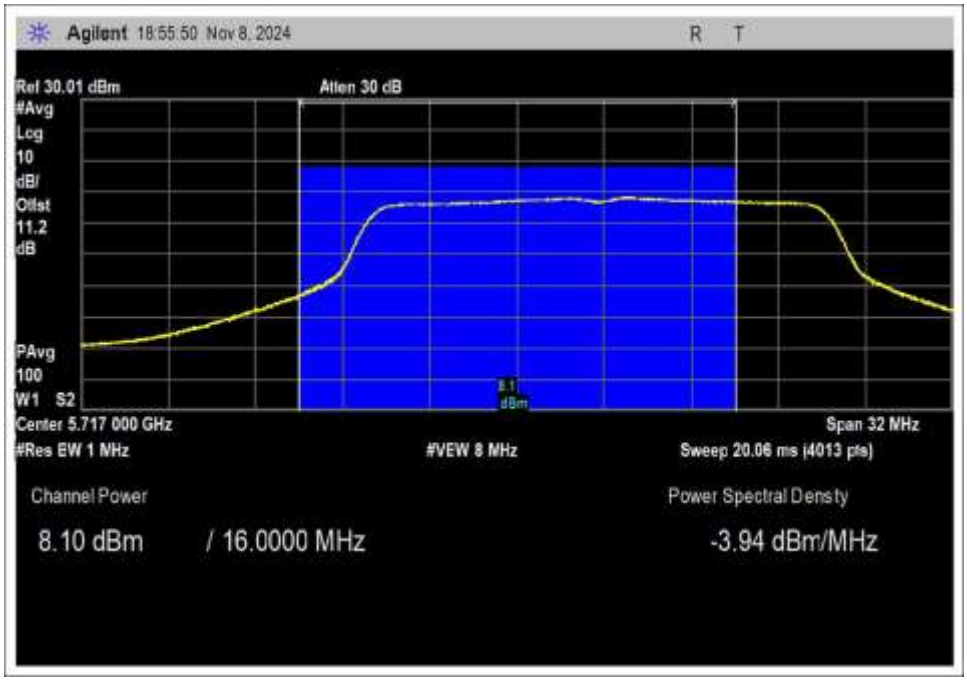
Chain 0
802.11a



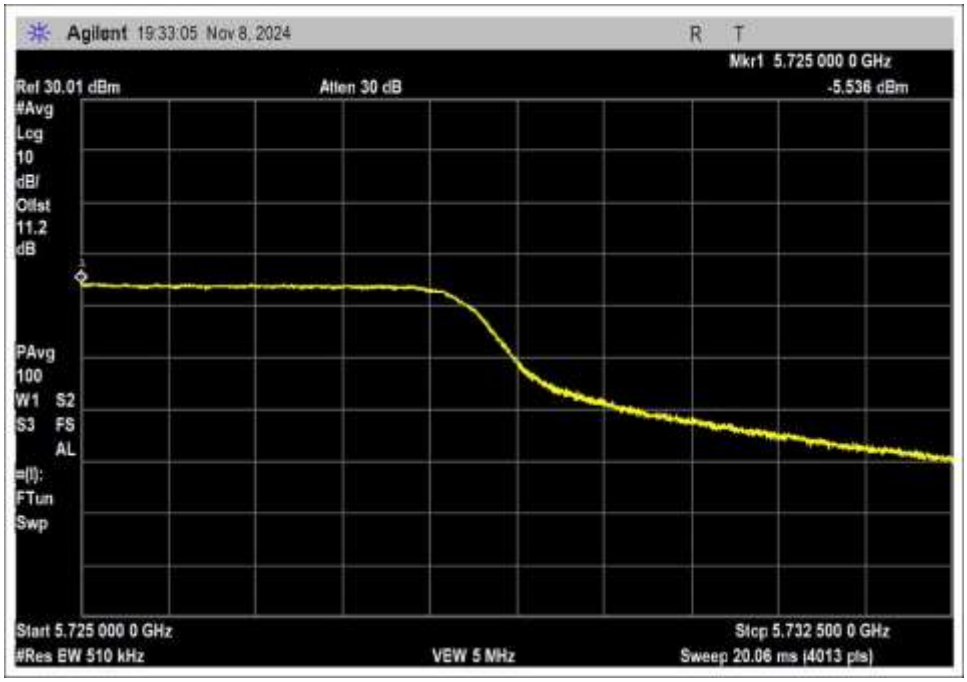
Low Channel



Middle Channel

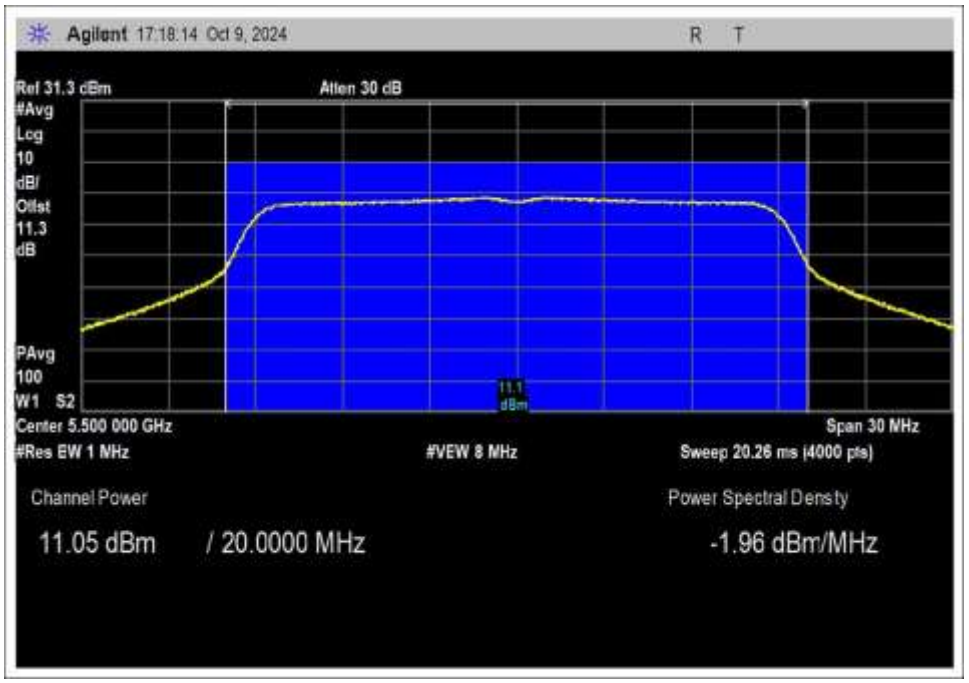


High Channel

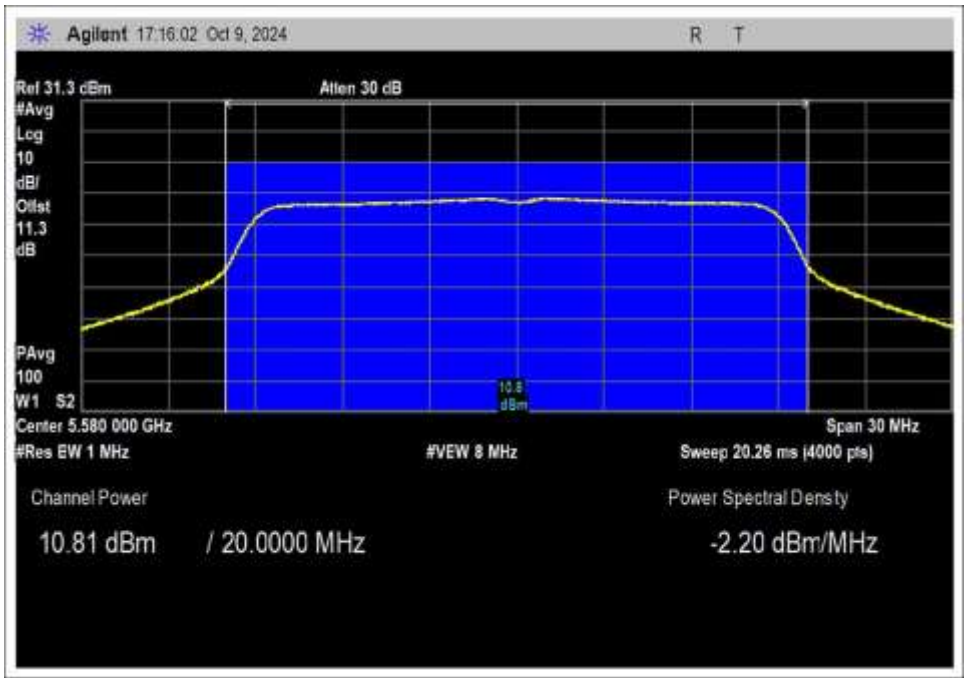


Addition Power Spectral Density on High Channel overlapping UNII 3

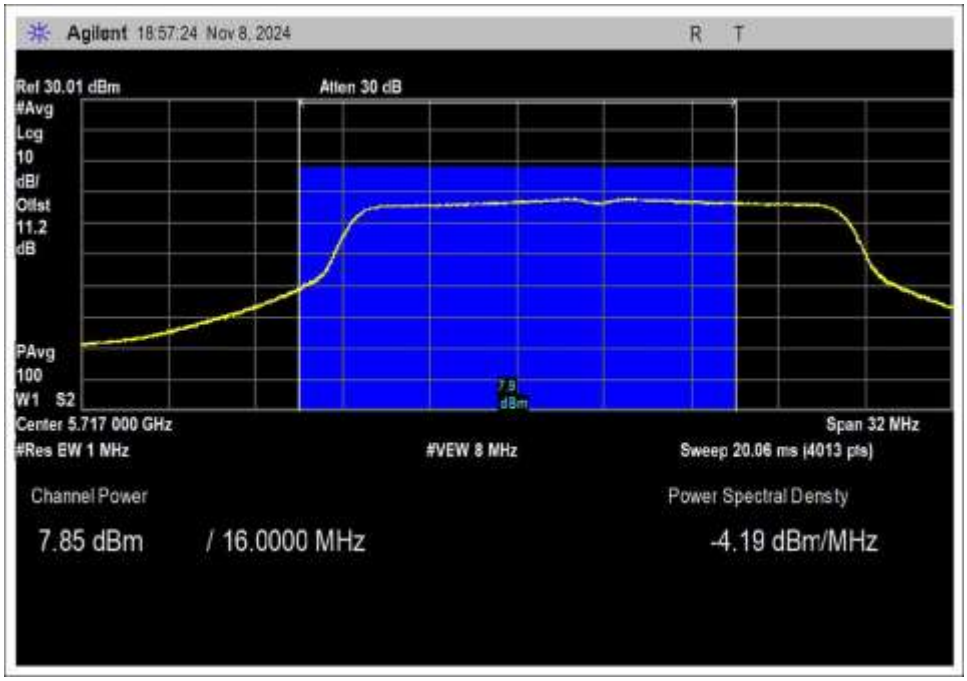
802.11n HT20



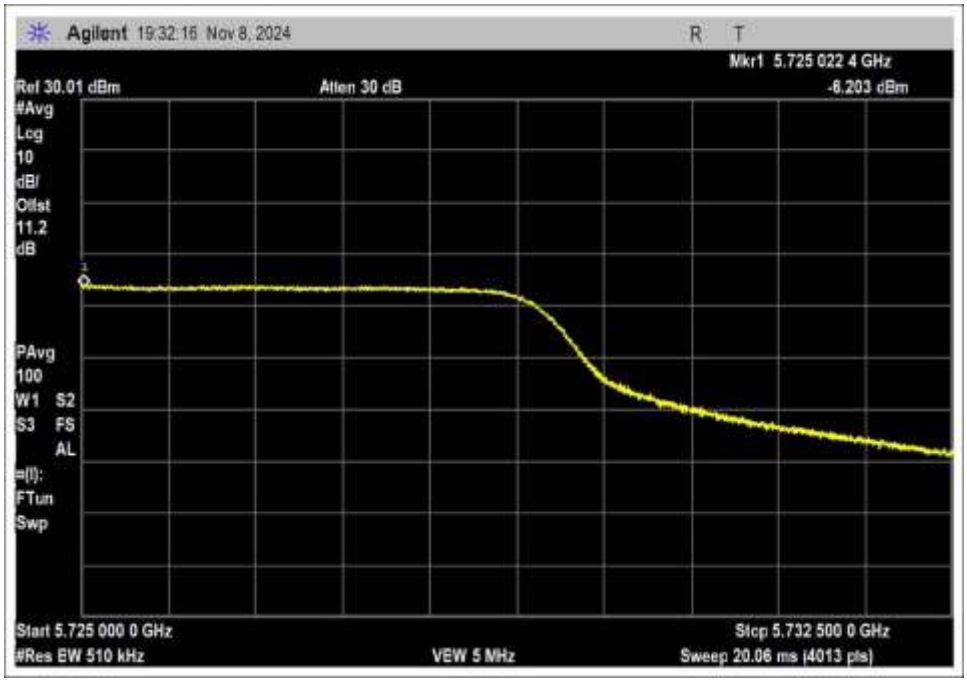
Low Channel



Middle Channel

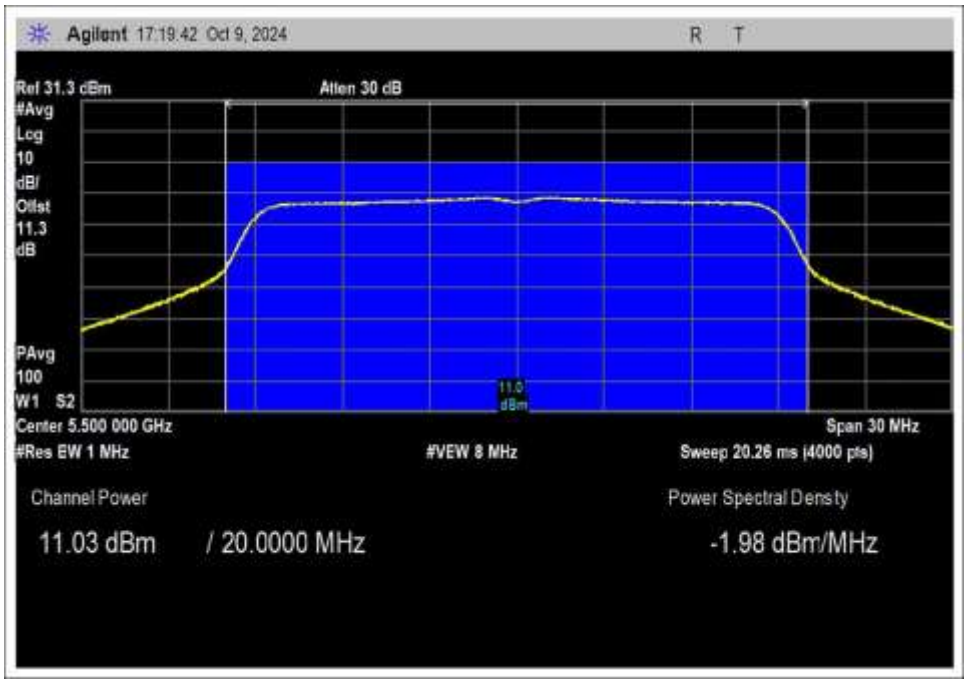


High Channel

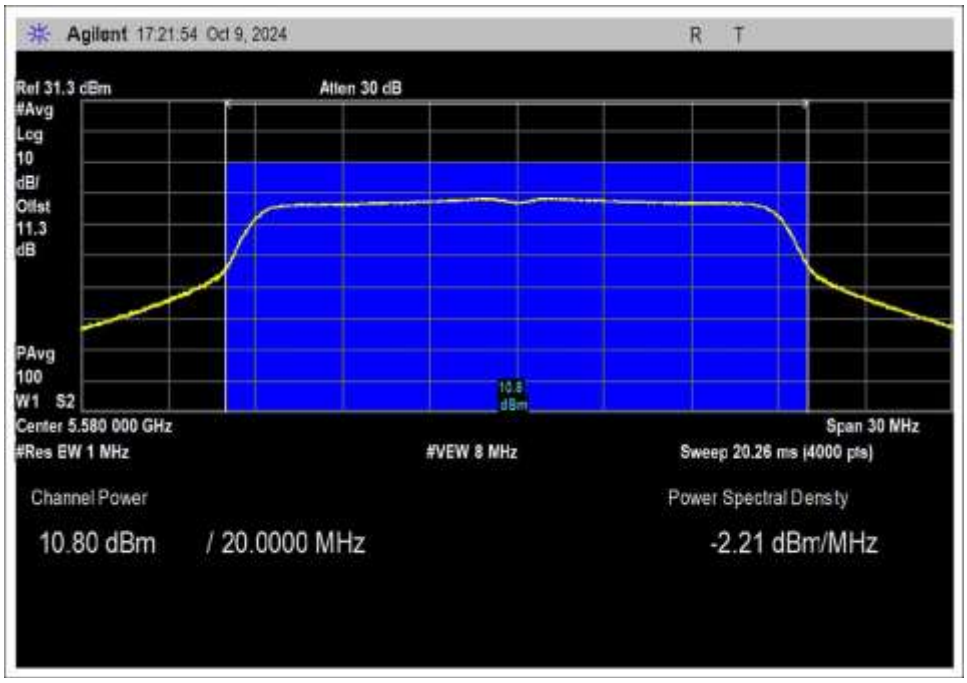


Addition Power Spectral Density on High Channel overlapping UNII 3

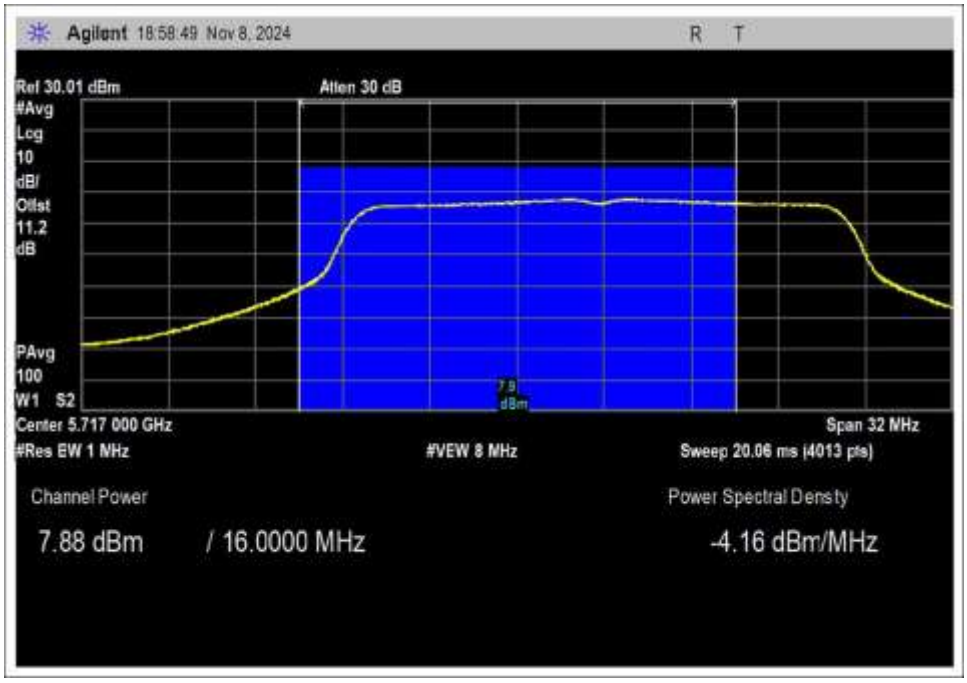
802.11ac 20MHz



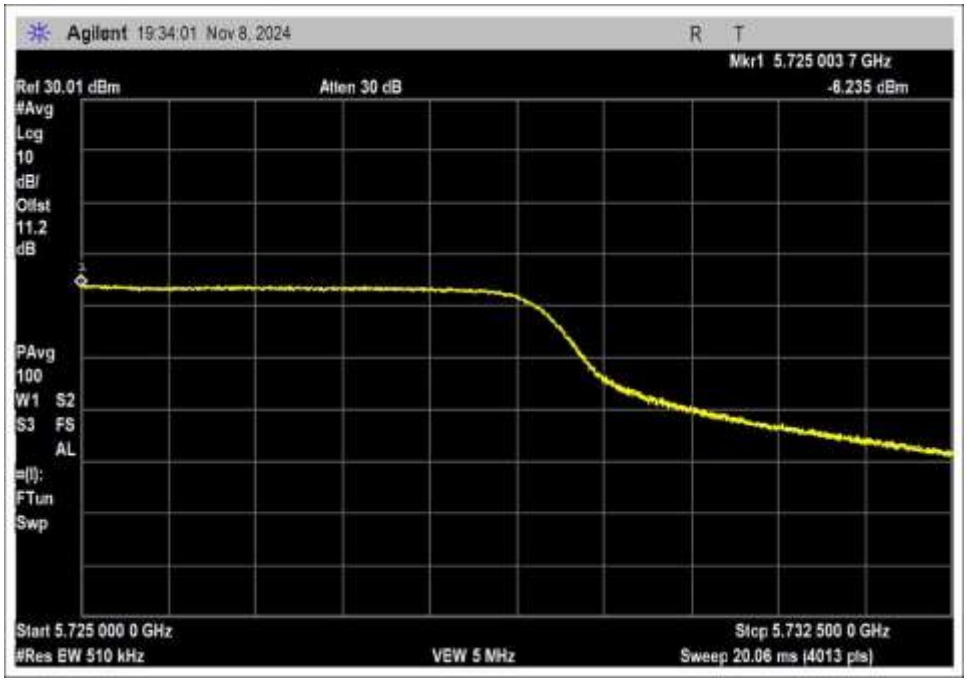
Low Channel



Middle Channel

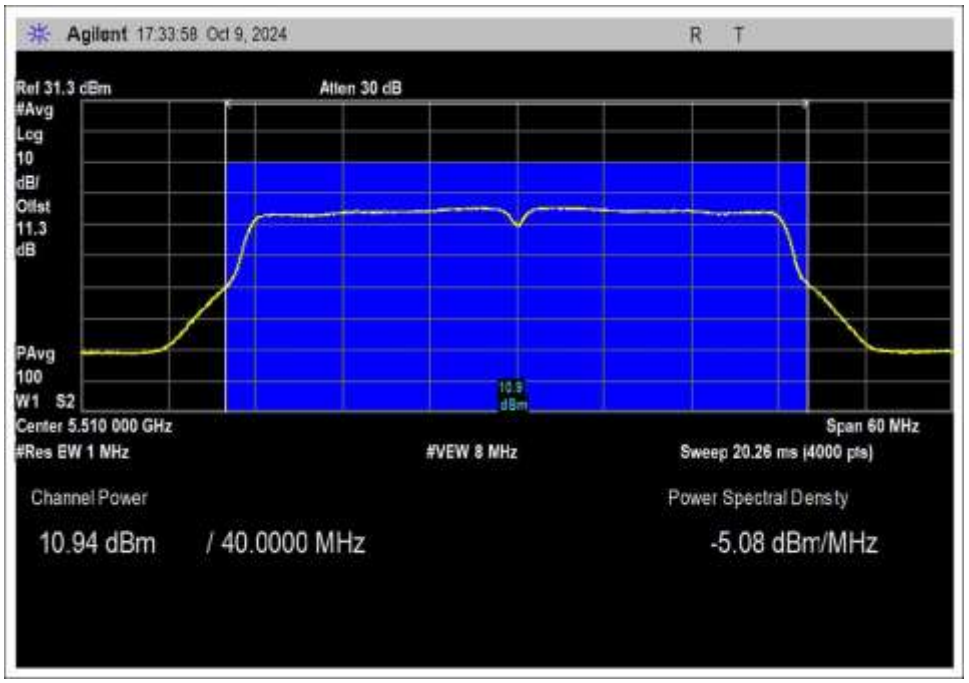


High Channel

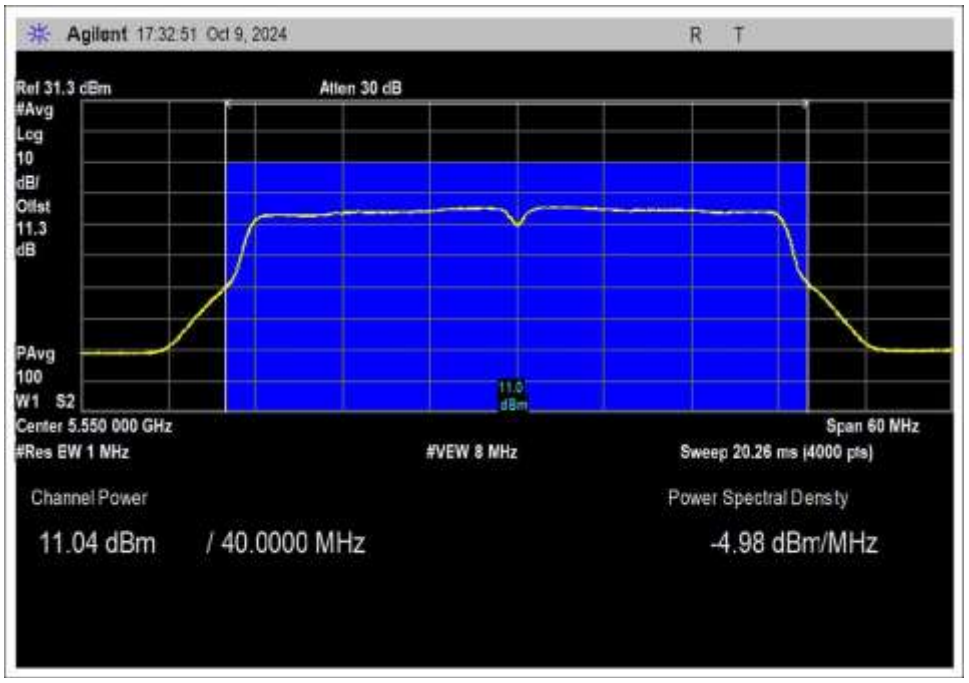


Addition Power Spectral Density on High Channel overlapping UNII 3

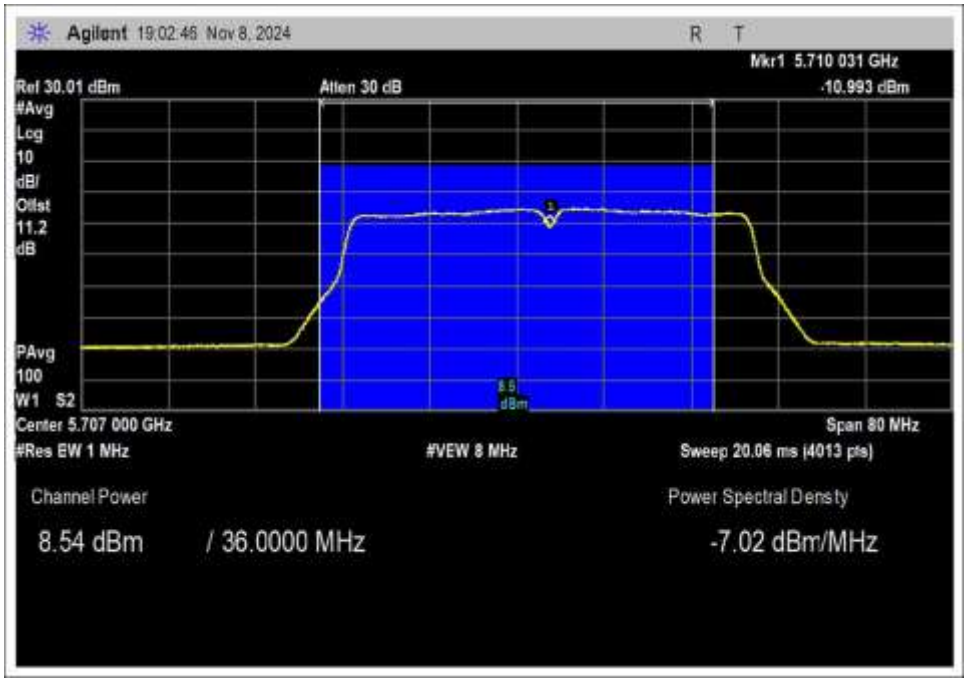
802.11 n HT40



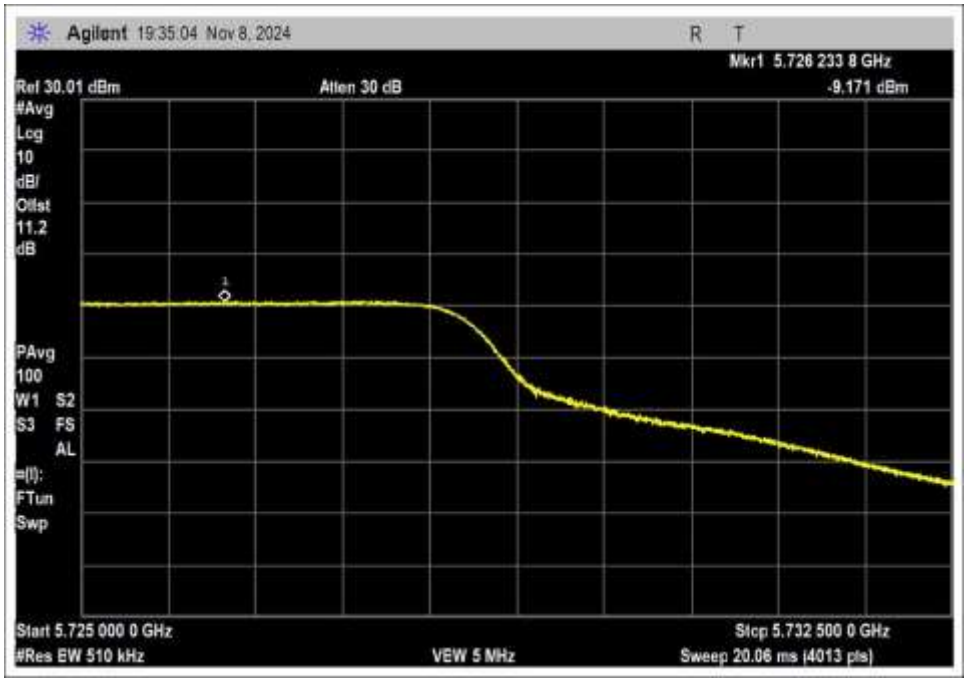
Low Channel



Middle Channel

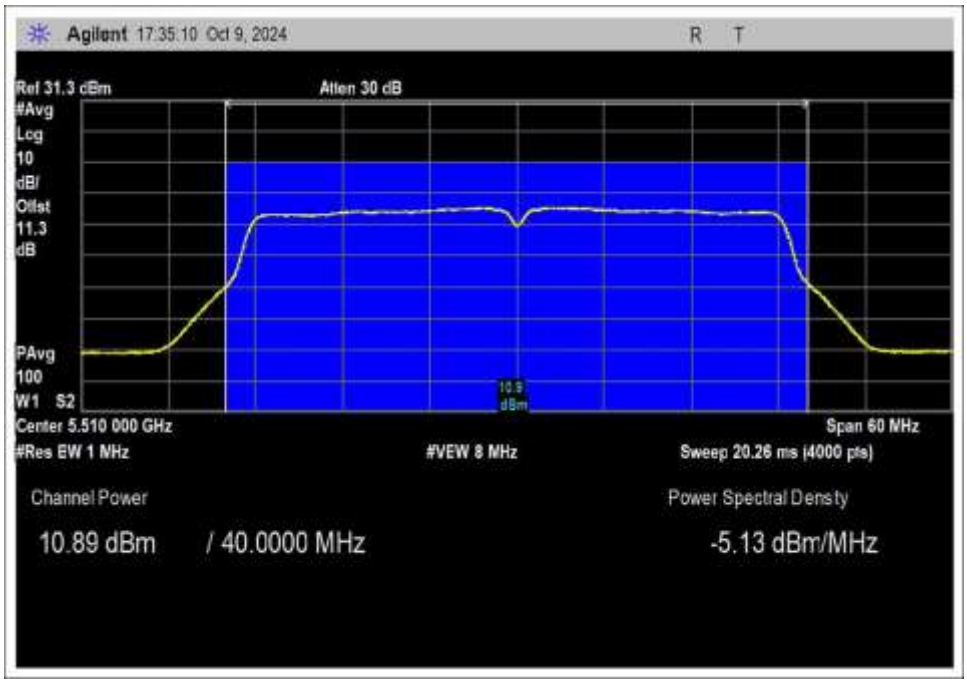


High Channel

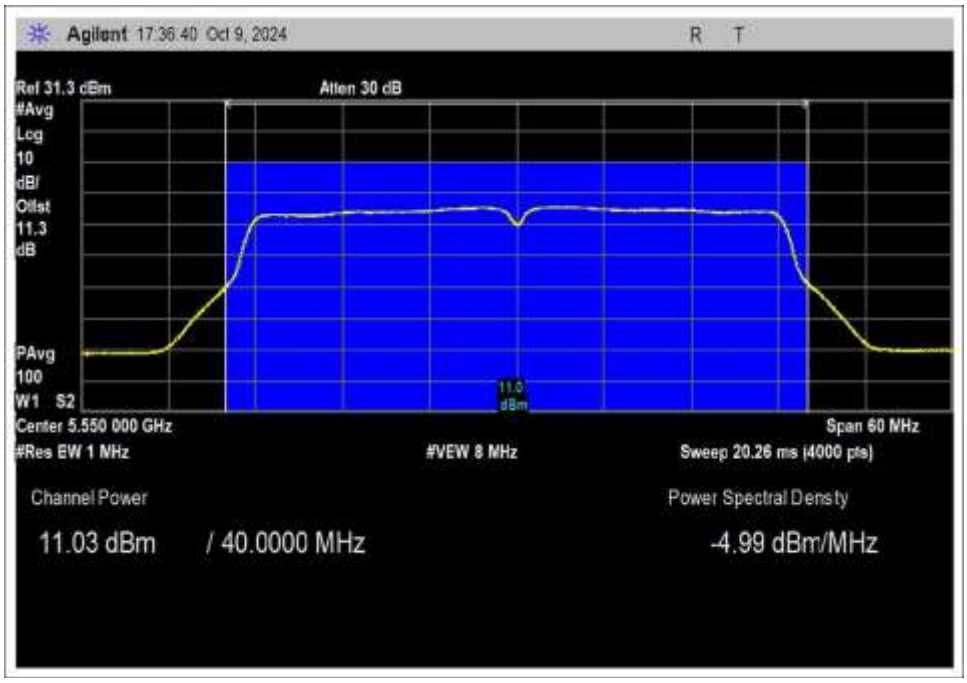


Addition Power Spectral Density on High Channel overlapping UNII 3

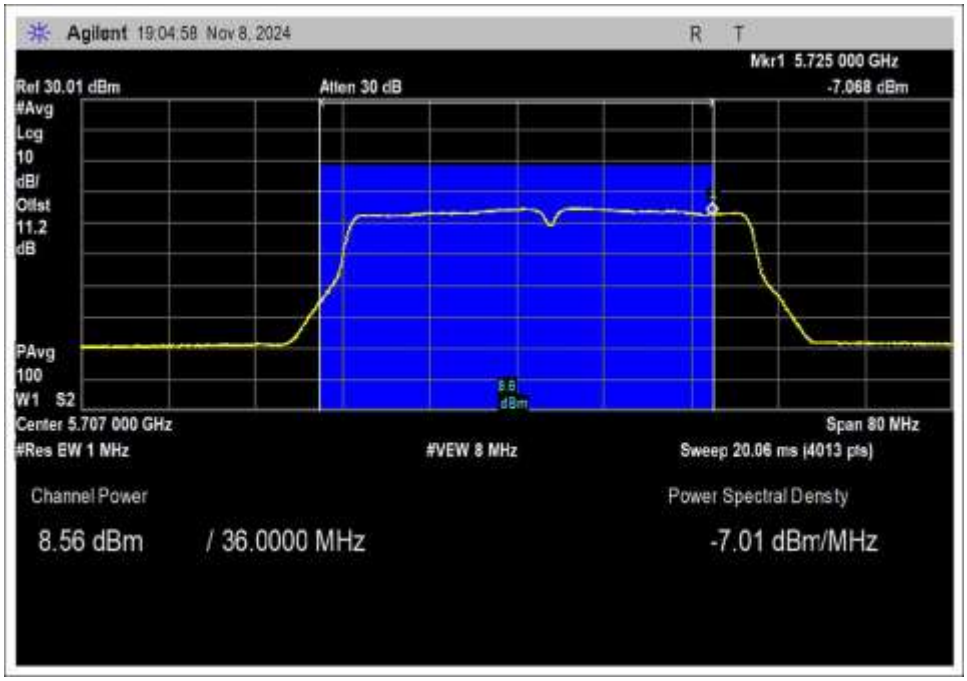
802.11ac 40MHz



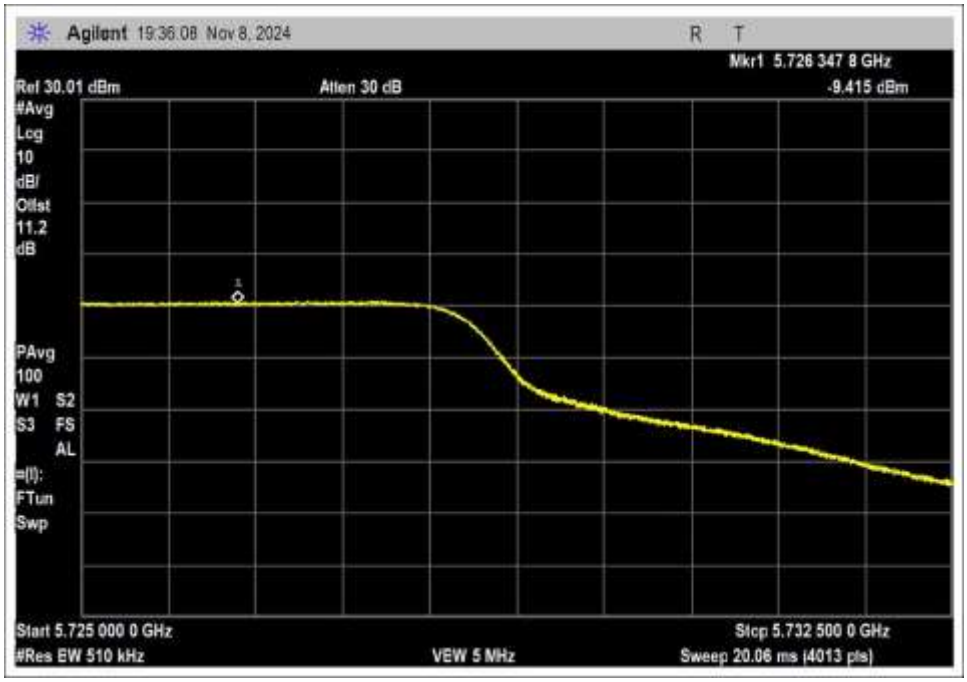
Low Channel



Middle Channel

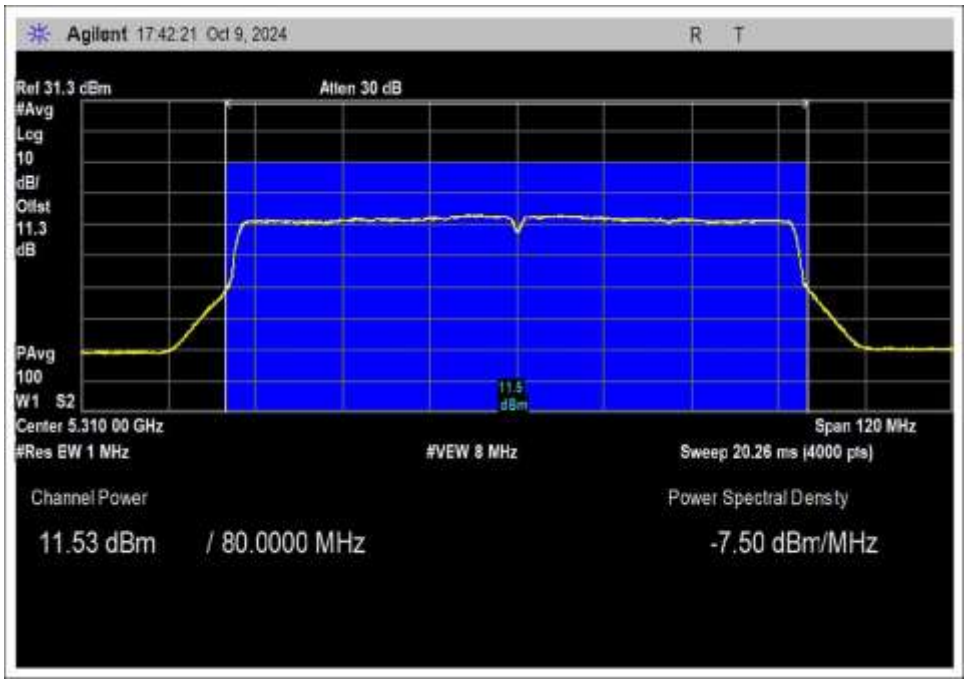


High Channel

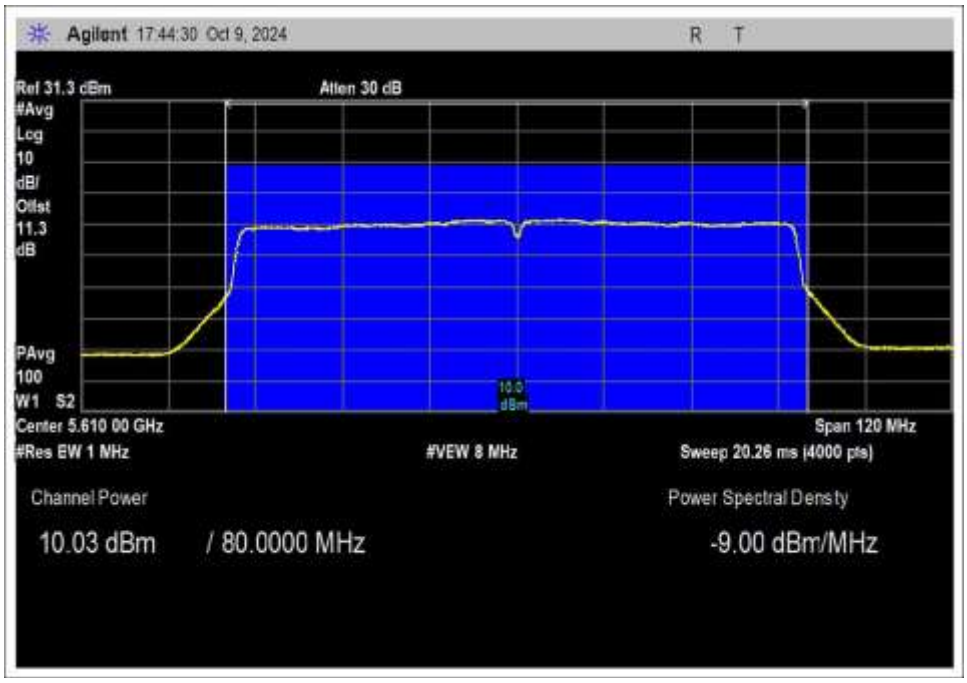


Addition Power Spectral Density on High Channel overlapping UNII 3

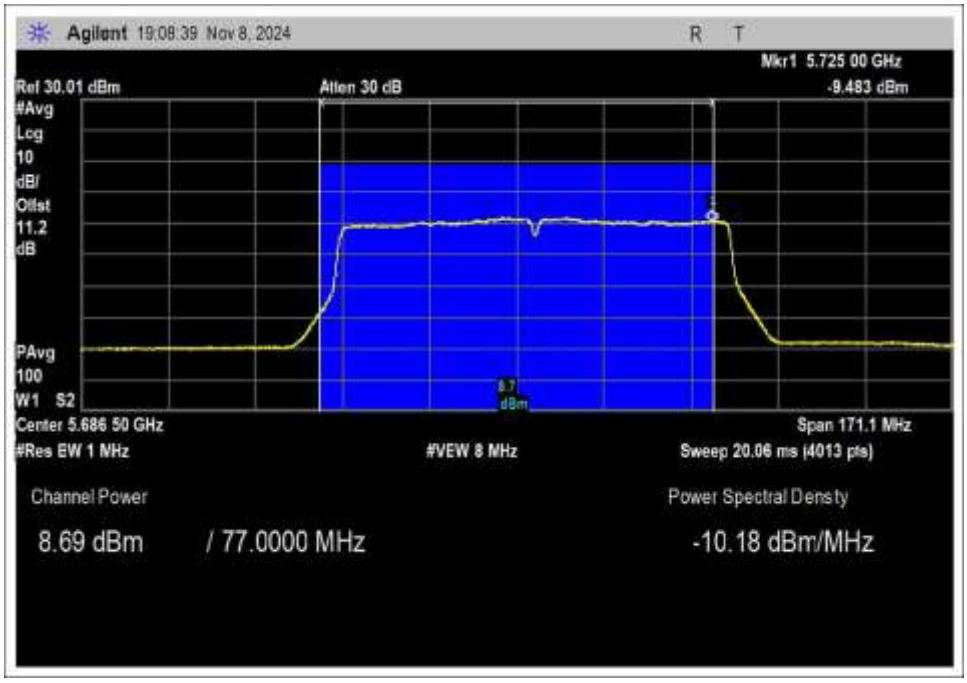
802.11ac 80MHz



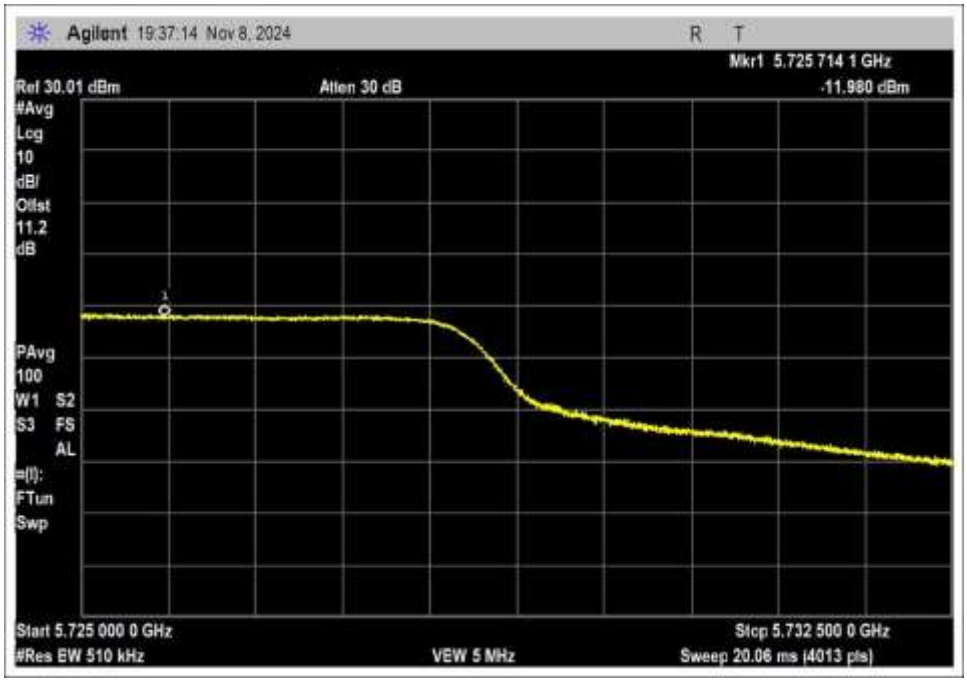
Low Channel



Middle Channel

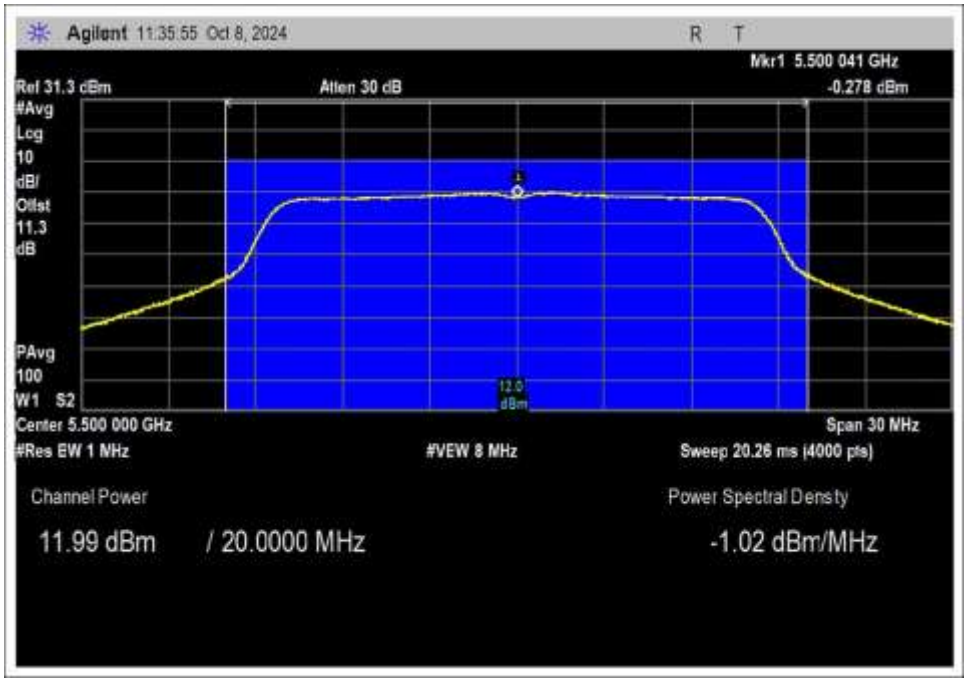


High Channel

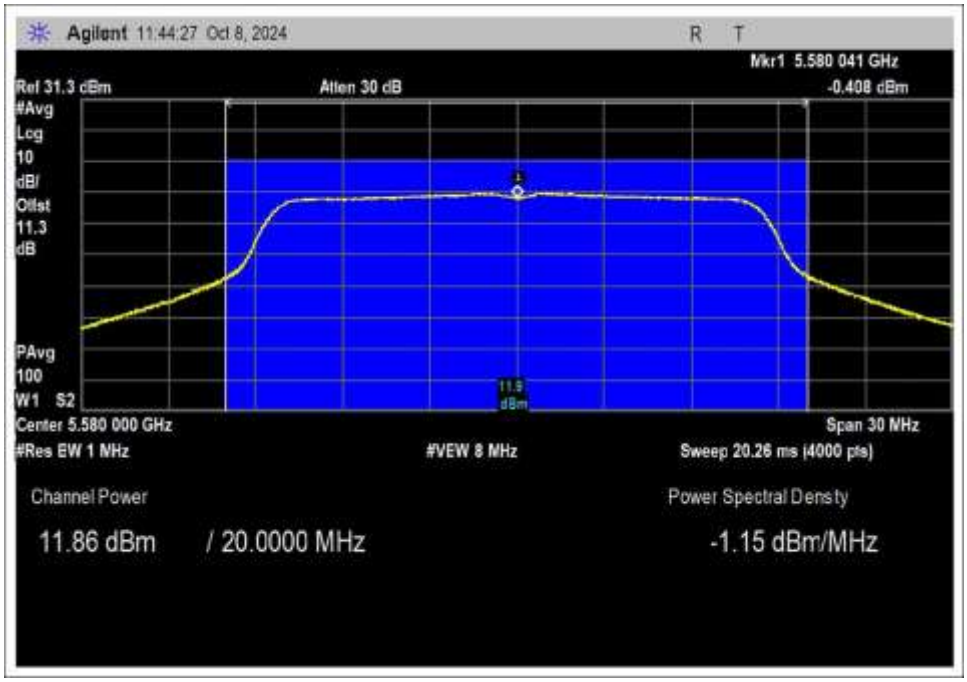


Addition Power Spectral Density on High Channel overlapping UNII 3

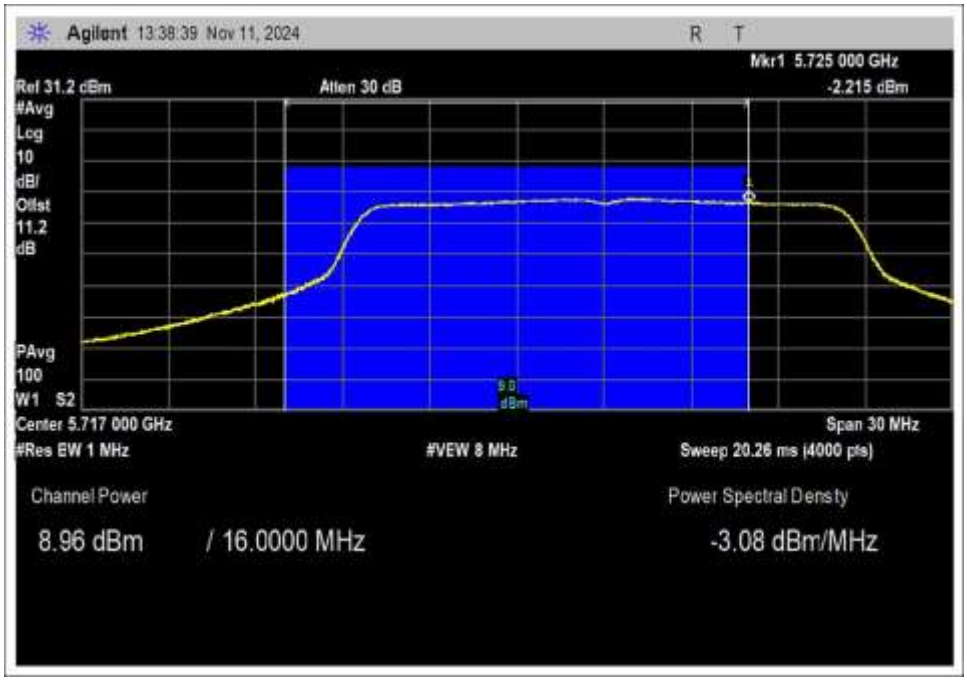
Chain 1
802.11a



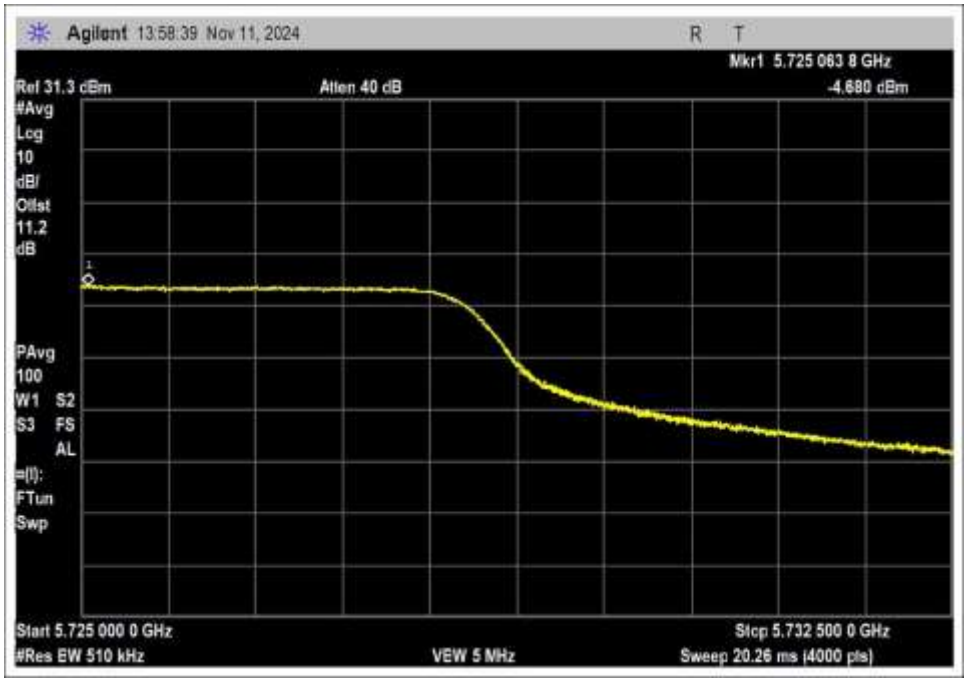
Low Channel



Middle Channel

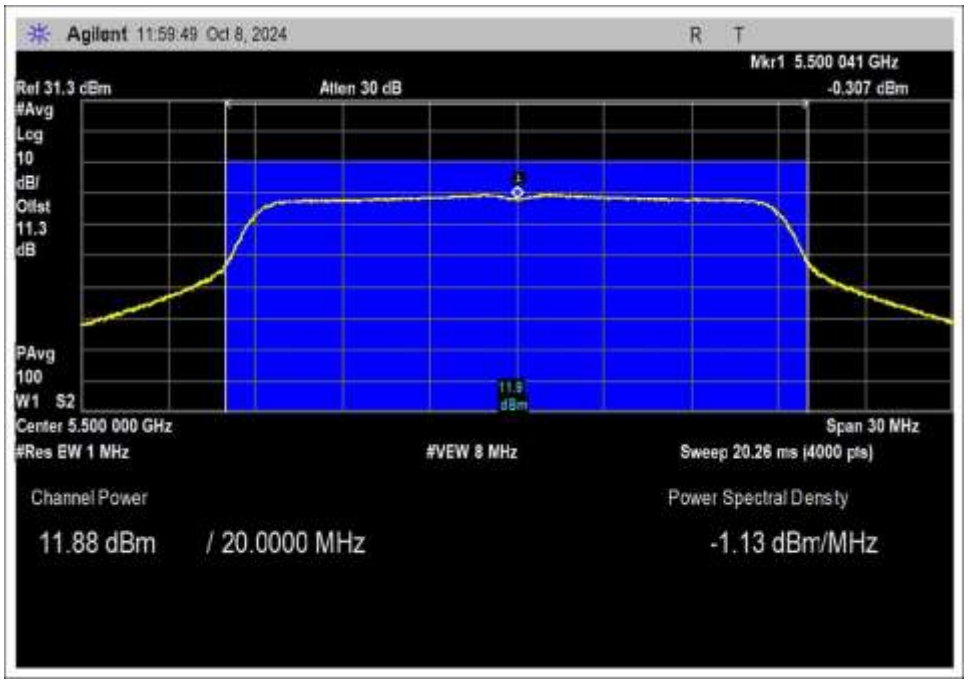


High channel

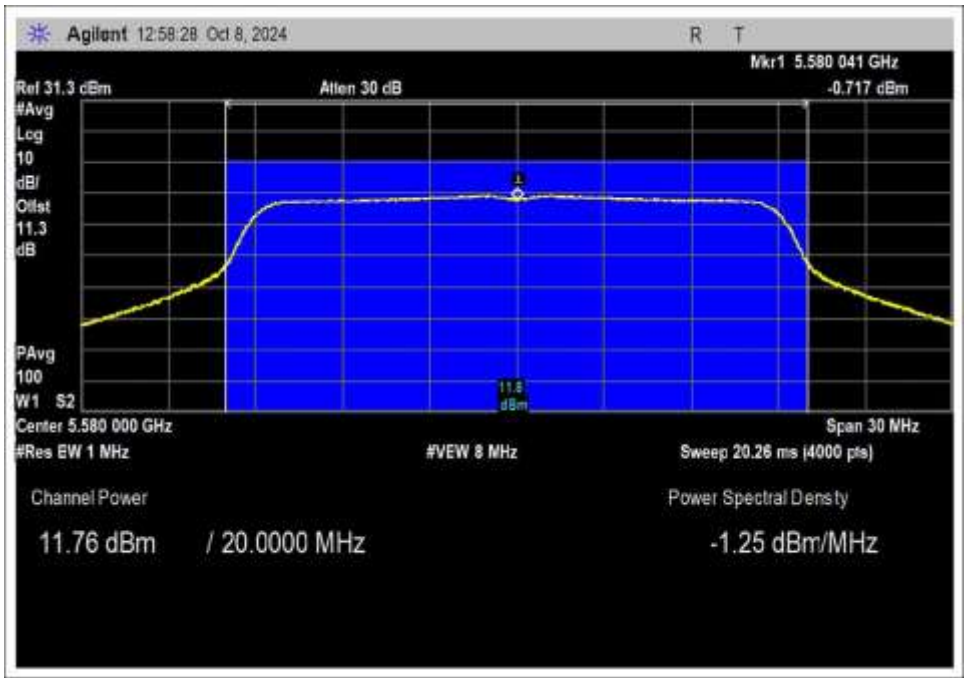


Addition Power Spectral Density on High Channel overlapping UNII 3

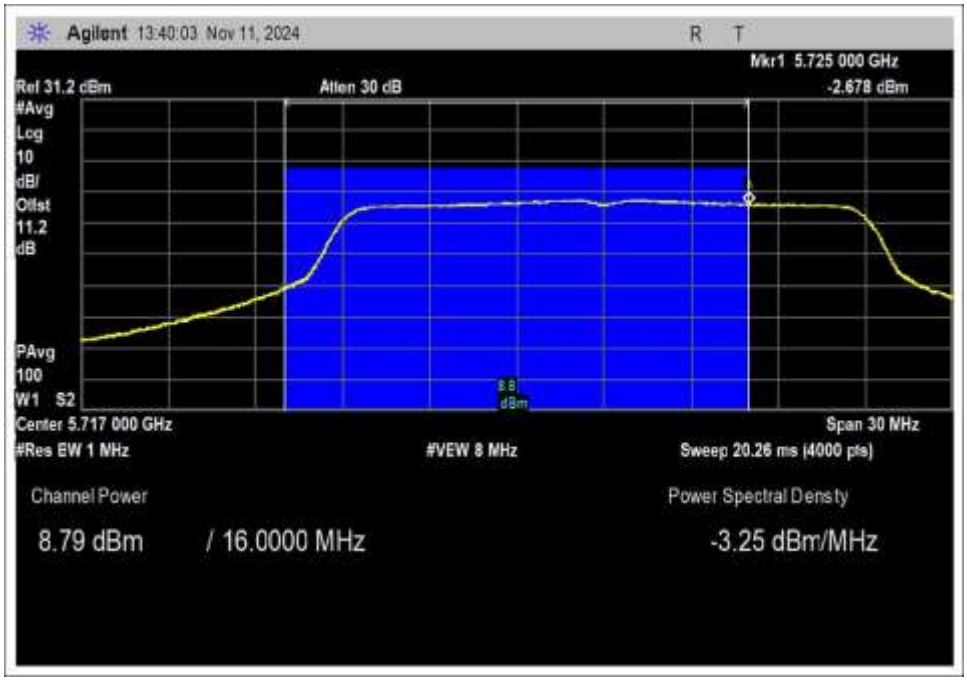
802.11n HT20



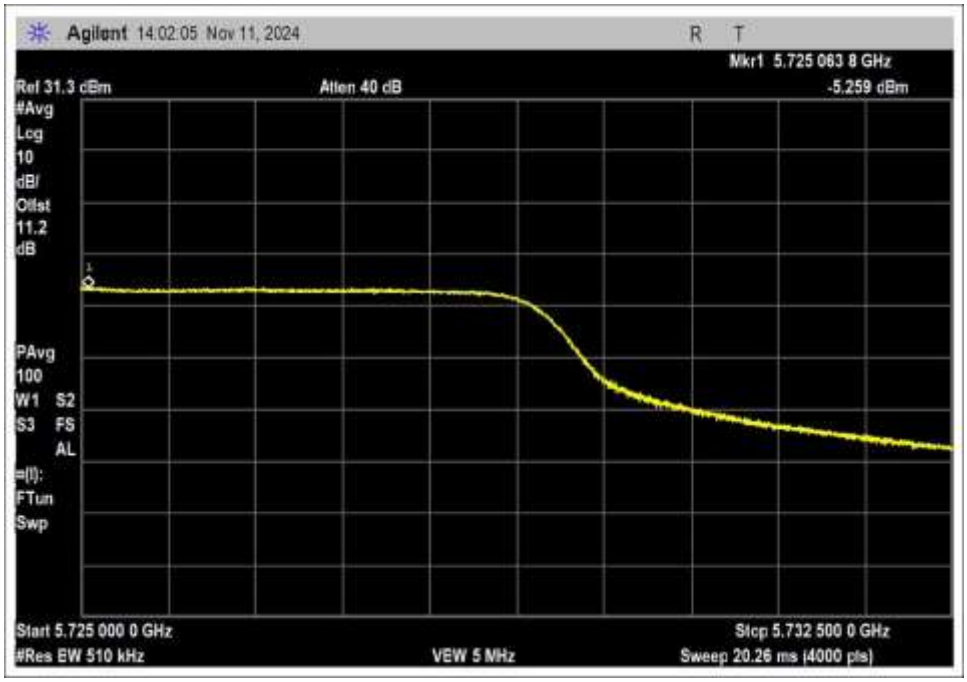
Low Channel



Middle Channel

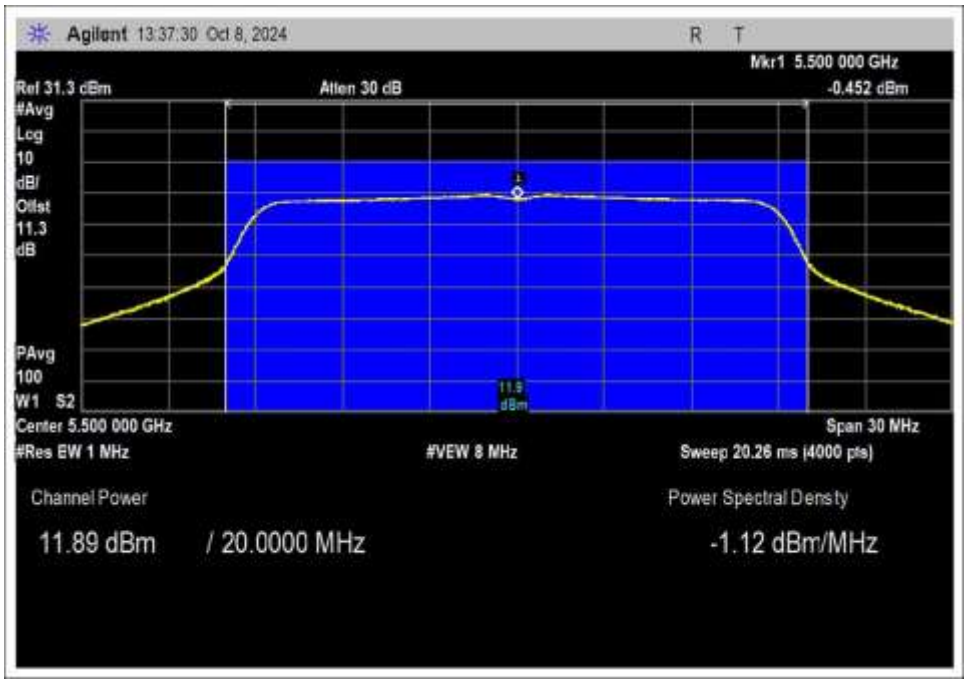


High Channel

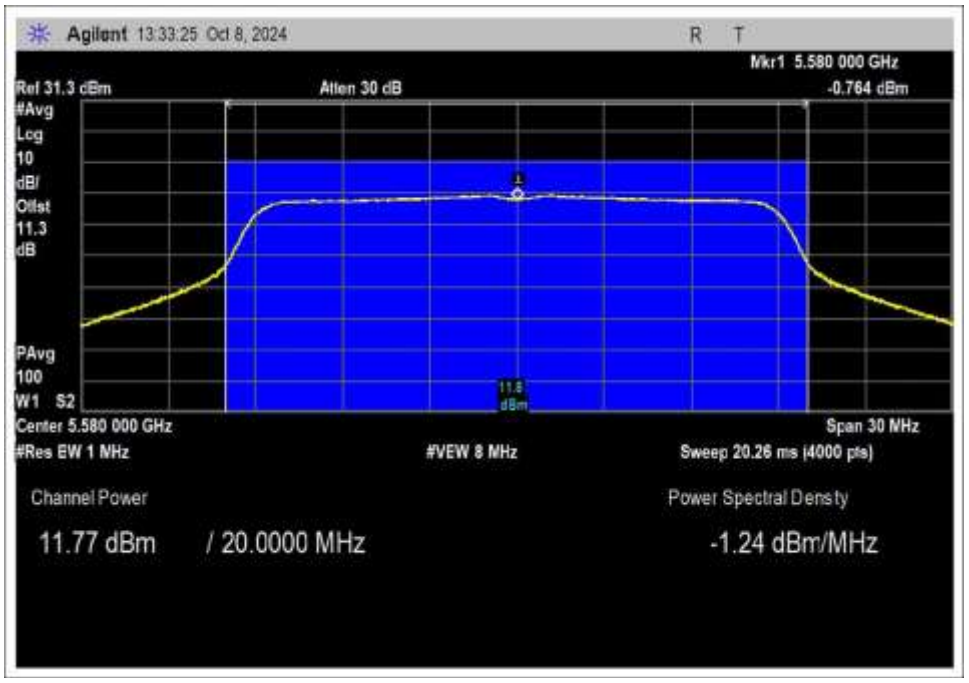


Addition Power Spectral Density on High Channel overlapping UNII 3

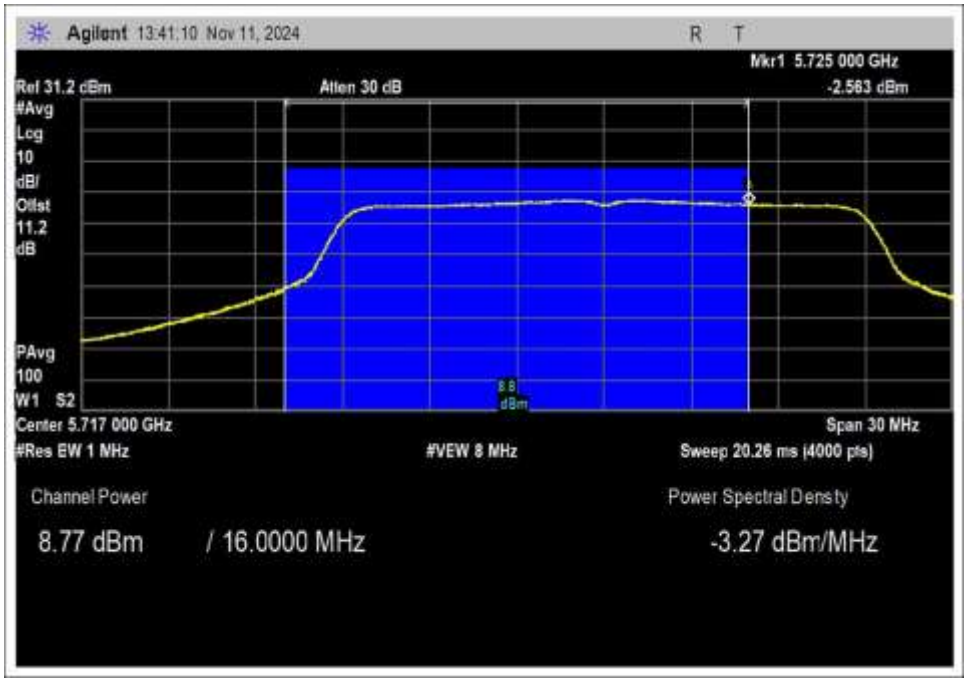
802.11ac 20MHz



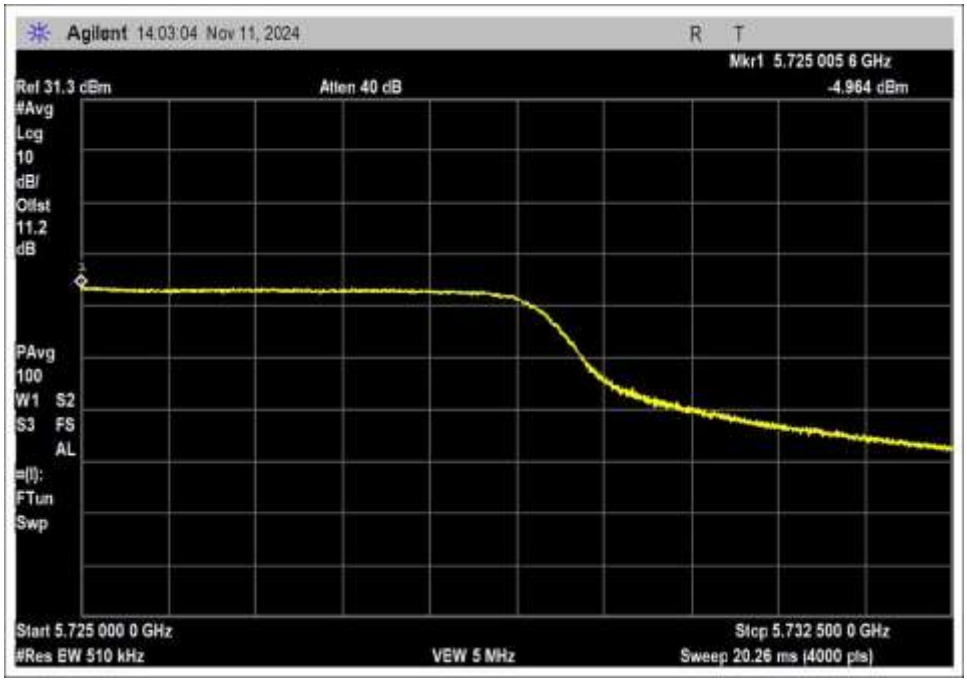
Low Channel



Middle Channel

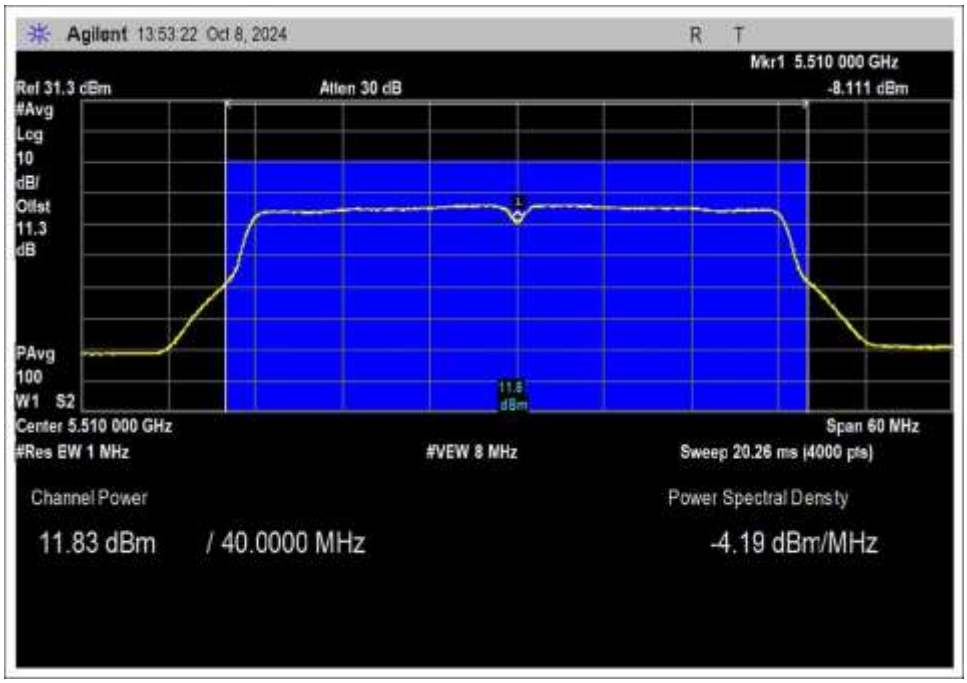


High Channel

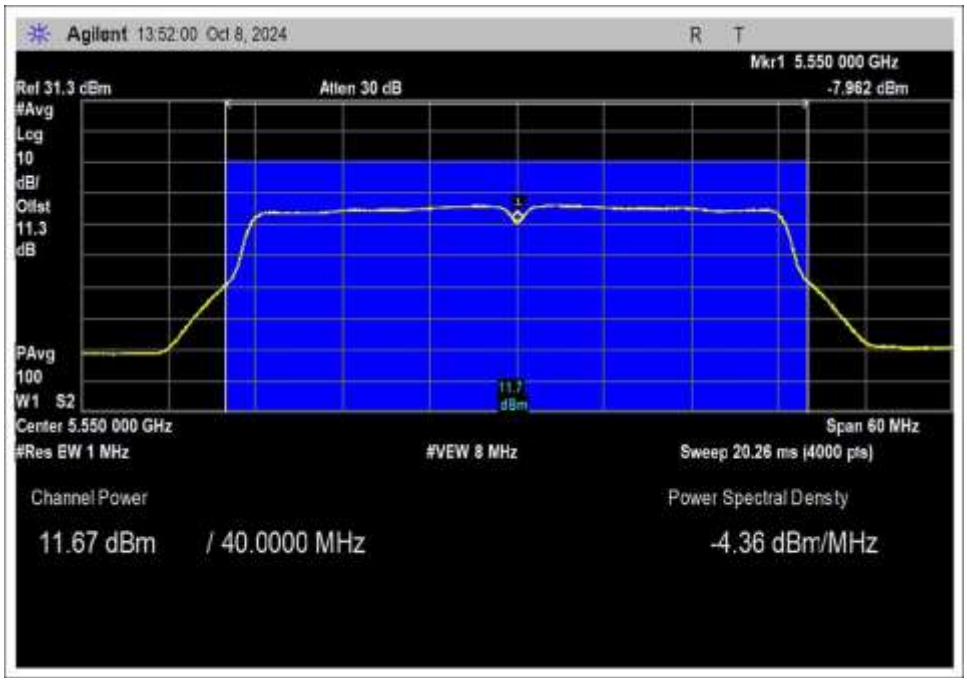


Addition Power Spectral Density on High Channel overlapping UNII 3

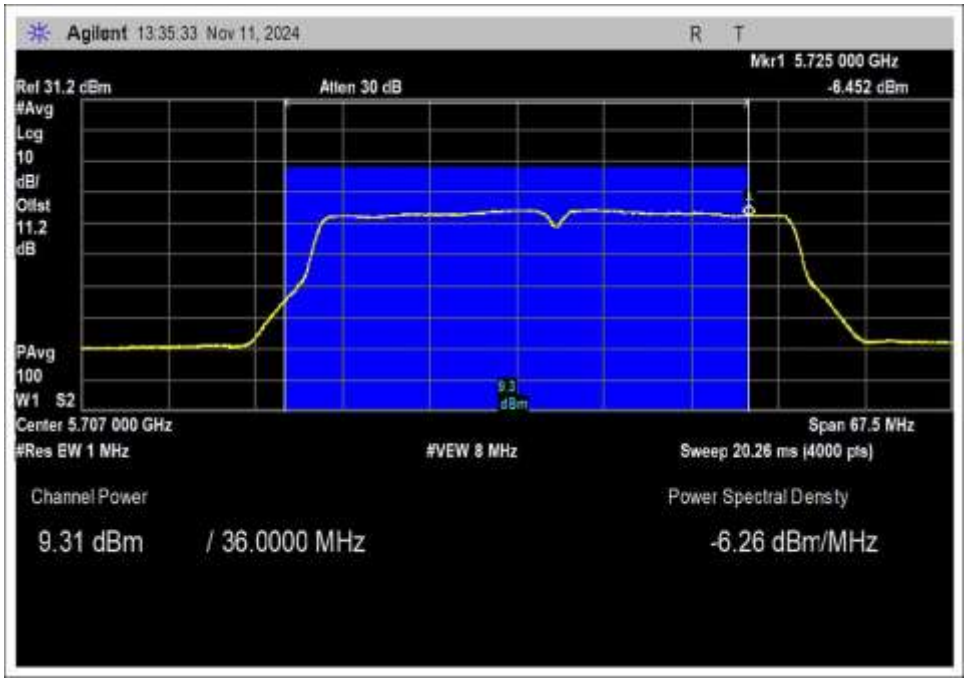
802.11 n HT40



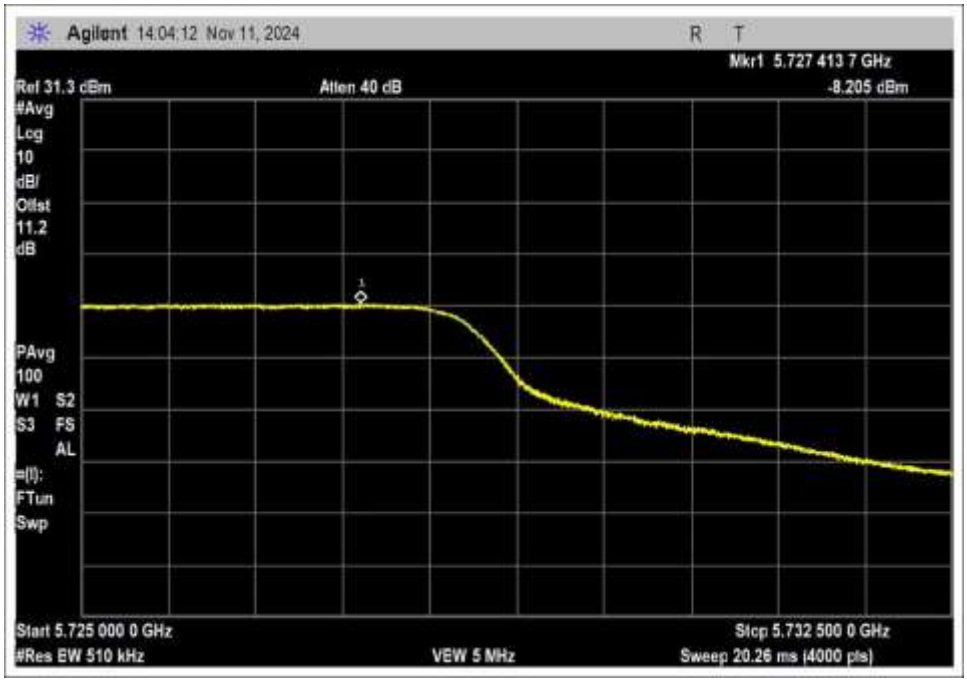
Low Channel



Middle Channel

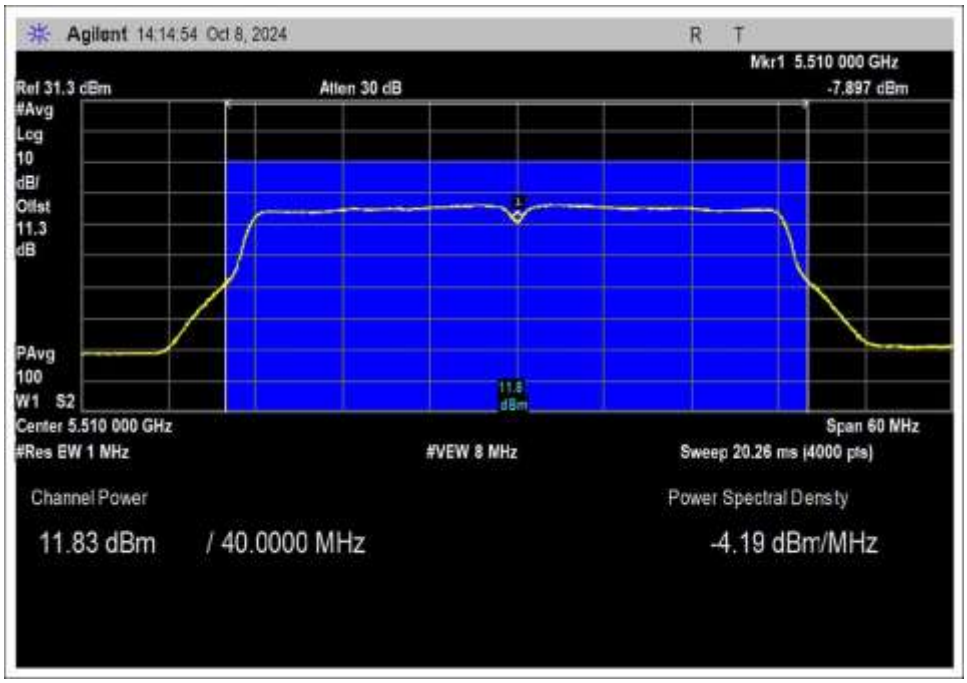


High Channel

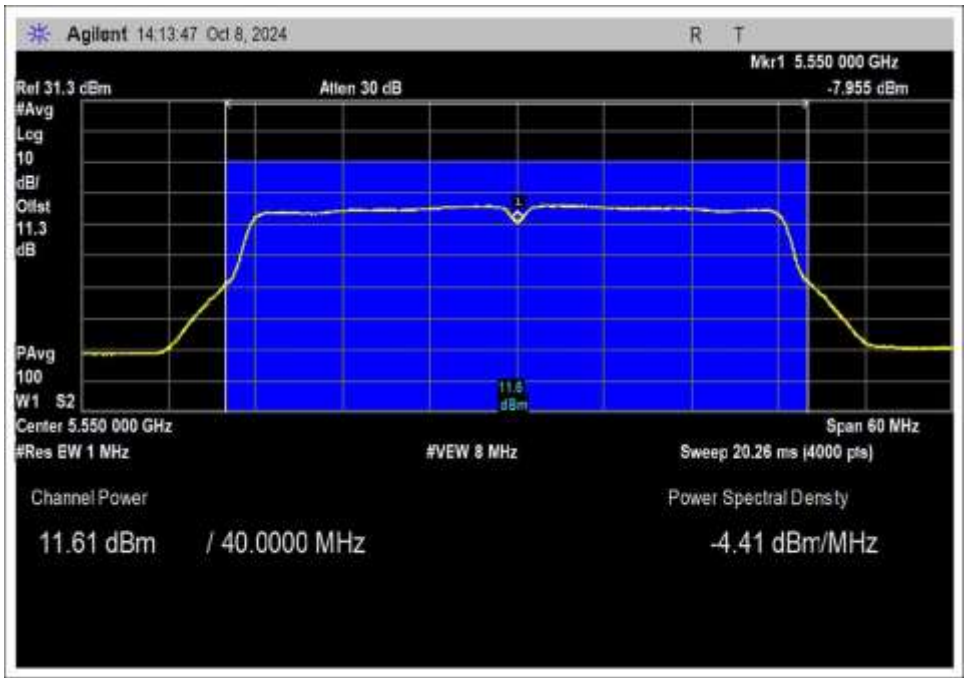


Addition Power Spectral Density on High Channel overlapping UNII 3

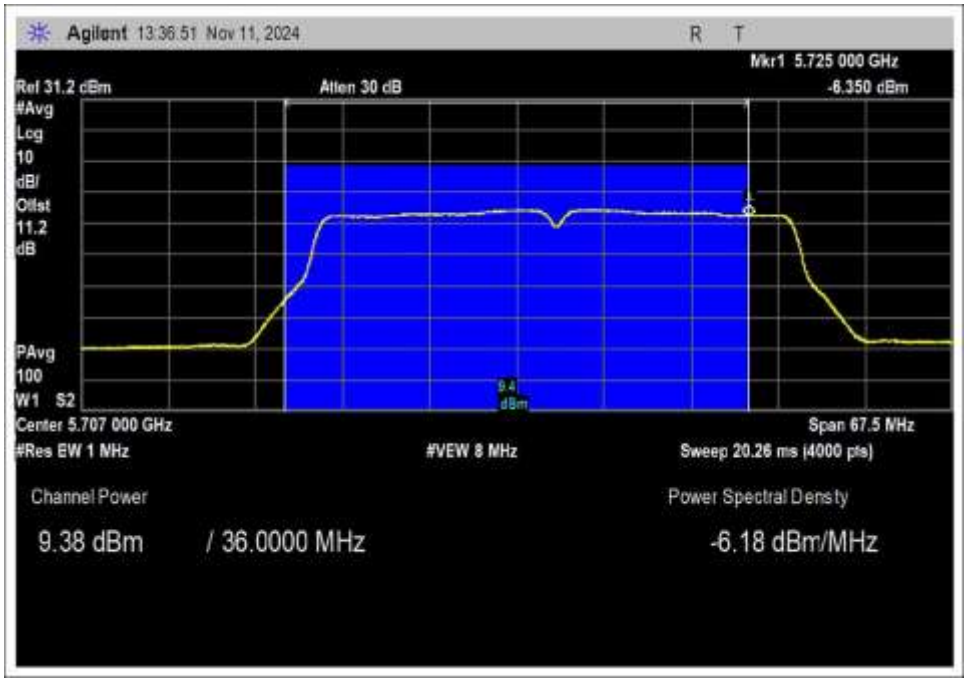
802.11ac 40MHz



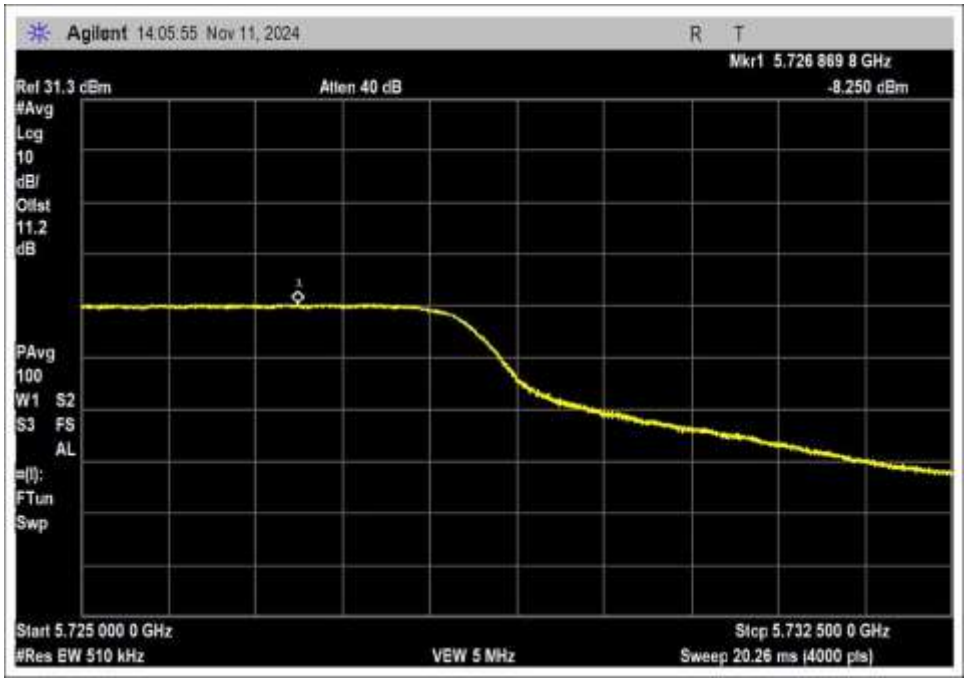
Low Channel



Middle Channel

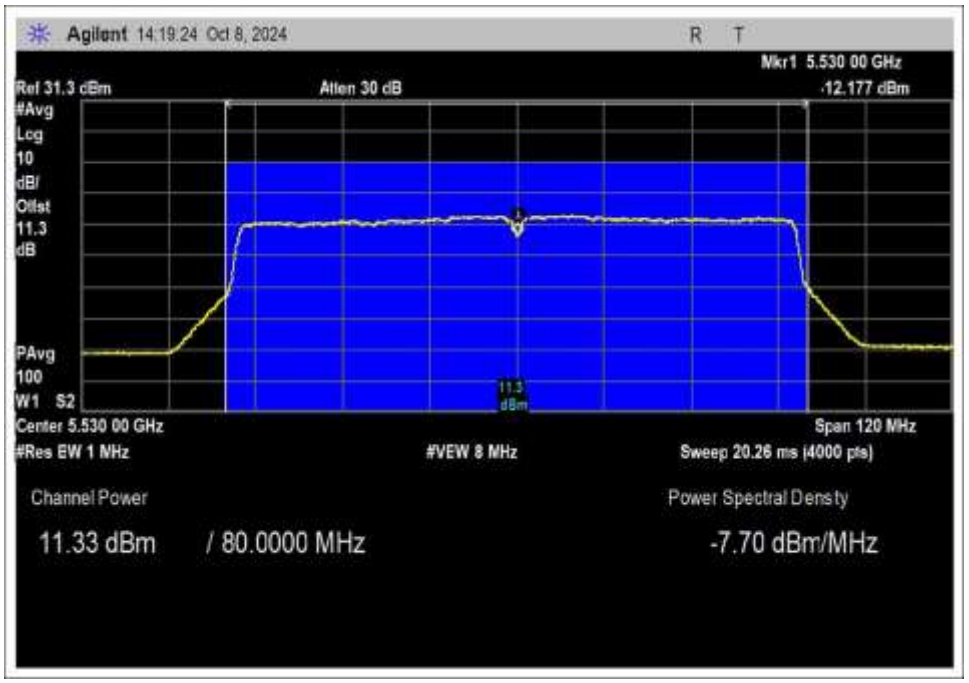


High Channel

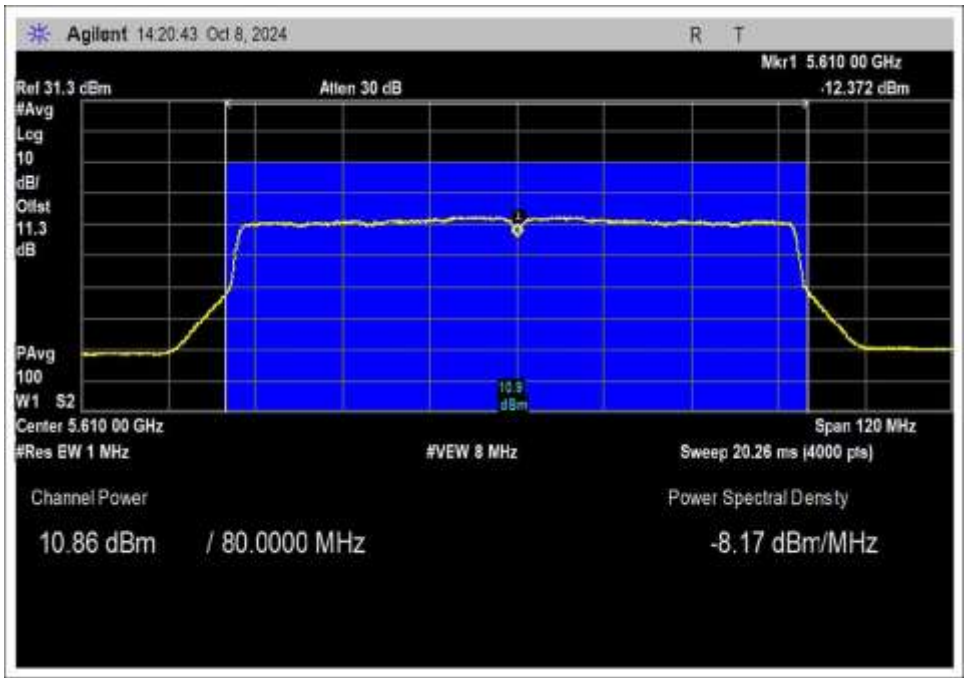


Addition Power Spectral Density on High Channel overlapping UNII 3

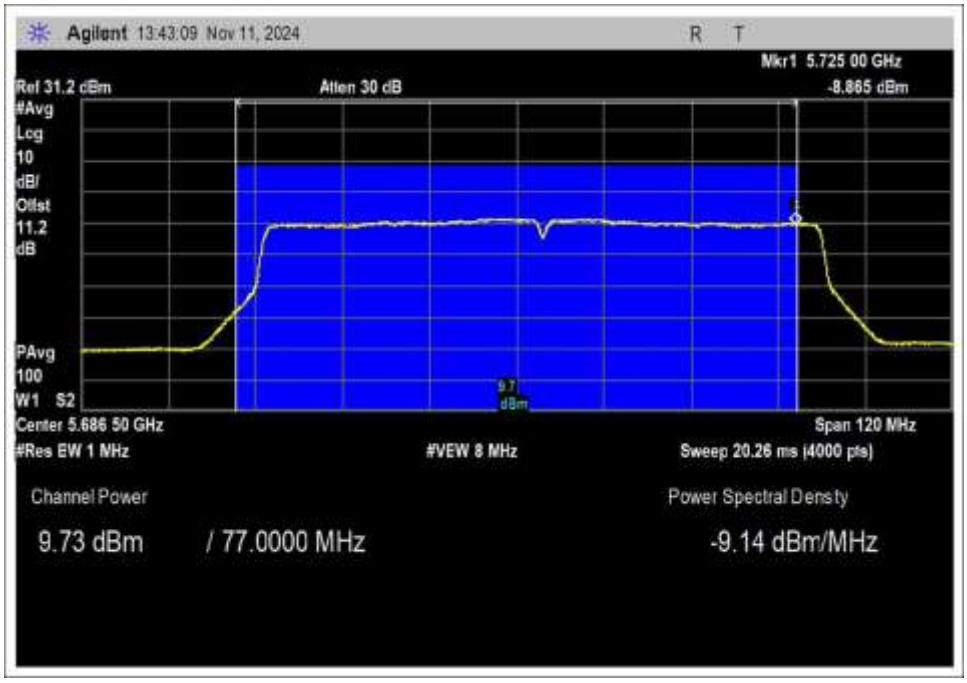
802.11ac 80MHz



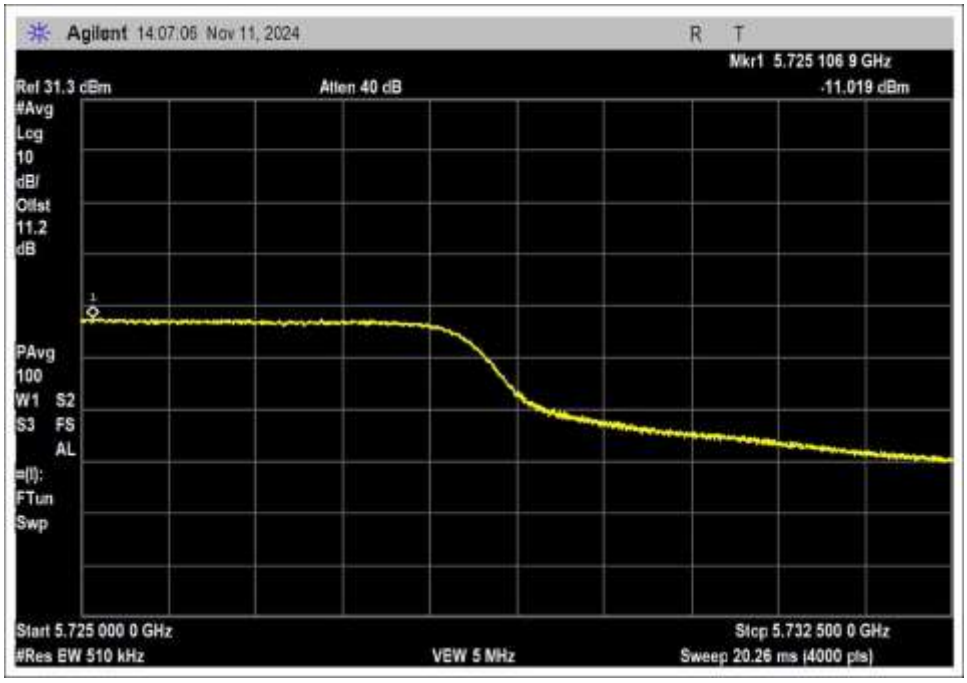
Low Channel



Middle Channel



High Channel



Addition Power Spectral Density on High Channel overlapping UNII 3

Test Setup Photo(s)

Test Setup

Test Setup, Close View

15.407(b) Radiated Emissions & Band Edge

Test Setup/Conditions			
Test Location:	Fremont Lab C3	Test Engineer:	Hieu Song Nguyenpham
Test Method:	ANSI C63.10 (2020), KDB 789033	Test Date(s):	10/30-31/2024 and 11/01-06/2024
Configuration:	1		
Note	1: Perform Radiated Emission on the Chain 0 only since Chain 0 is the worst case based on the investigation on RF output power for the band edge before measuring Radiated Spurious Emission. 2: The maximum emission is measured close to band edge. The emission at band edge is below limit as indicated in the plots below.		

Environmental Conditions			
Temperature (ºC)	21.3-23.5	Relative Humidity (%):	39-48

Test Setup / Conditions / Data

Test Location: CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170
Customer: **Tonal**
Specification: **15.407(b) / 15.209 Radiated Spurious Emissions**
Work Order #: **110285** Date: 11/6/2024
Test Type: **Radiated Scan** Time: 15:01:58
Tested By: Hieu Song Nguyenpham Sequence#: 149
Software: EMITest 5.03.20

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 1GHz

Test Environment Conditions:
Temperature: 22.7°C
Humidity: 36%
Atmospheric Pressure: 101.8kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
WiFi transmitting continuously with modulation type as listed with pattern of 0s and 1s at power level 14 with duty cycle at 100%.

802.11a (18Mbps)-OFDM-5580MHz-Middle Channel

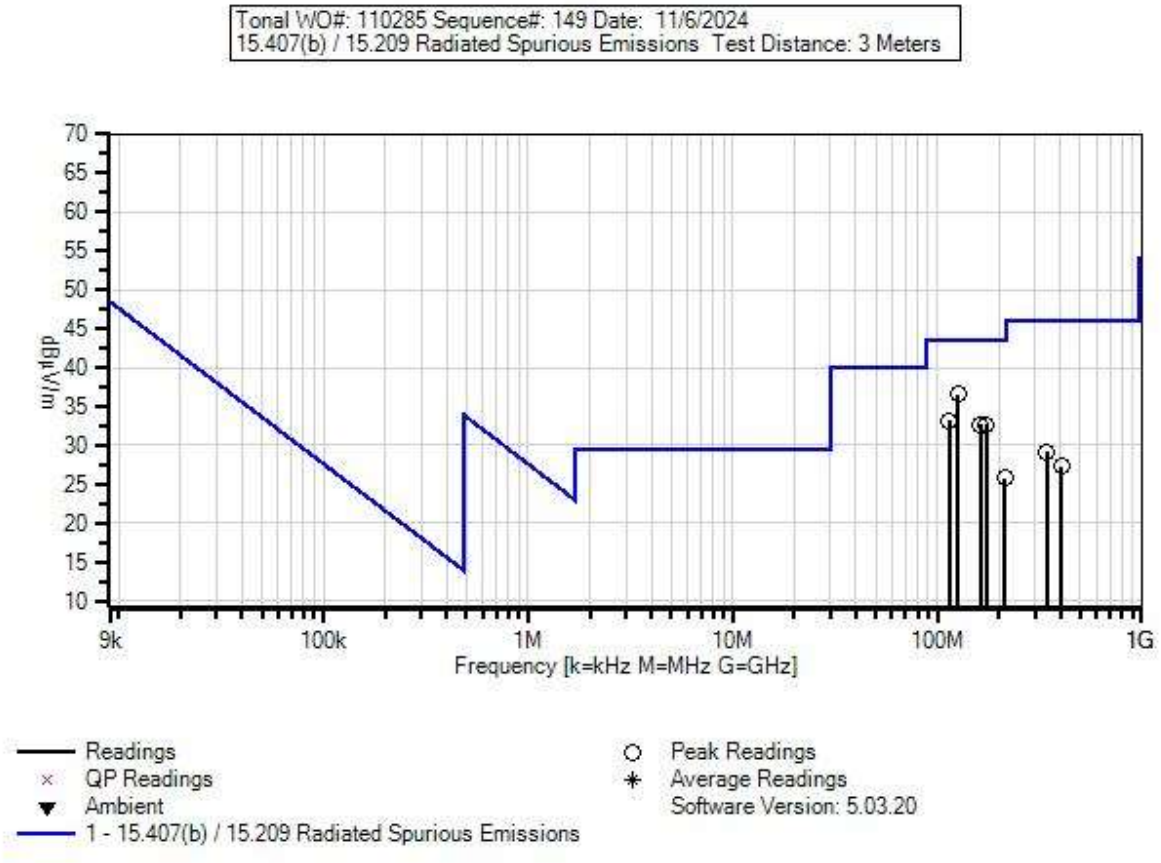
MIMO not enabled, manufacturer declares chain 0 and chain 1 transmit uncorrelated data.

Chain 0

Operational mode is representative of worst case.

No emissions from EUT has been found in 20dB tolerance in the frequency range 9kHz to 30MHz.

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	4/5/2024	4/5/2026
	AN00432	Loop Antenna	6502	7/10/2023	7/10/2025
T2	AN01995	Biconilog Antenna	CBL6111C	5/16/2024	5/16/2026
T3	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T4	ANP01187	Cable	CNT-195	7/3/2024	7/3/2026
T5	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	125.982M	49.2	-32.1 +0.4	+17.7	+1.1	+0.3	+0.0	36.6	43.5	-6.9	Horiz
2	114.049M	46.1	-32.0 +0.4	+17.3	+1.0	+0.3	+0.0	33.1	43.5	-10.4	Horiz
3	161.981M	46.2	-32.0 +0.4	+16.5	+1.2	+0.3	+0.0	32.6	43.5	-10.9	Horiz
4	173.934M	46.9	-32.0 +0.5	+15.6	+1.3	+0.3	+0.0	32.6	43.5	-10.9	Horiz
5	342.072M	37.8	-31.9 +0.6	+20.2	+1.9	+0.6	+0.0	29.2	46.0	-16.8	Vert
6	212.810M	40.6	-32.0 +0.5	+14.8	+1.4	+0.4	+0.0	25.7	43.5	-17.8	Vert
7	402.087M	33.7	-31.9 +0.7	+22.0	+2.0	+0.7	+0.0	27.2	46.0	-18.8	Vert

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**15.407(b)(3) / 15.209 Radated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/6/2024
Test Type:	**Radiated Scan**	Time:	10:30:31
Tested By:	Hieu Song Nguyenpham	Sequence#:	138
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 40GHz

Test Environment Conditions:
Temperature: 22.7°C
Humidity: 36%
Atmospheric Pressure: 101.8kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
WiFi transmitting continuously with modulation type as listed with pattern of 0s and 1s at power level 14

802.11a-OFDM-5.5GHz Band

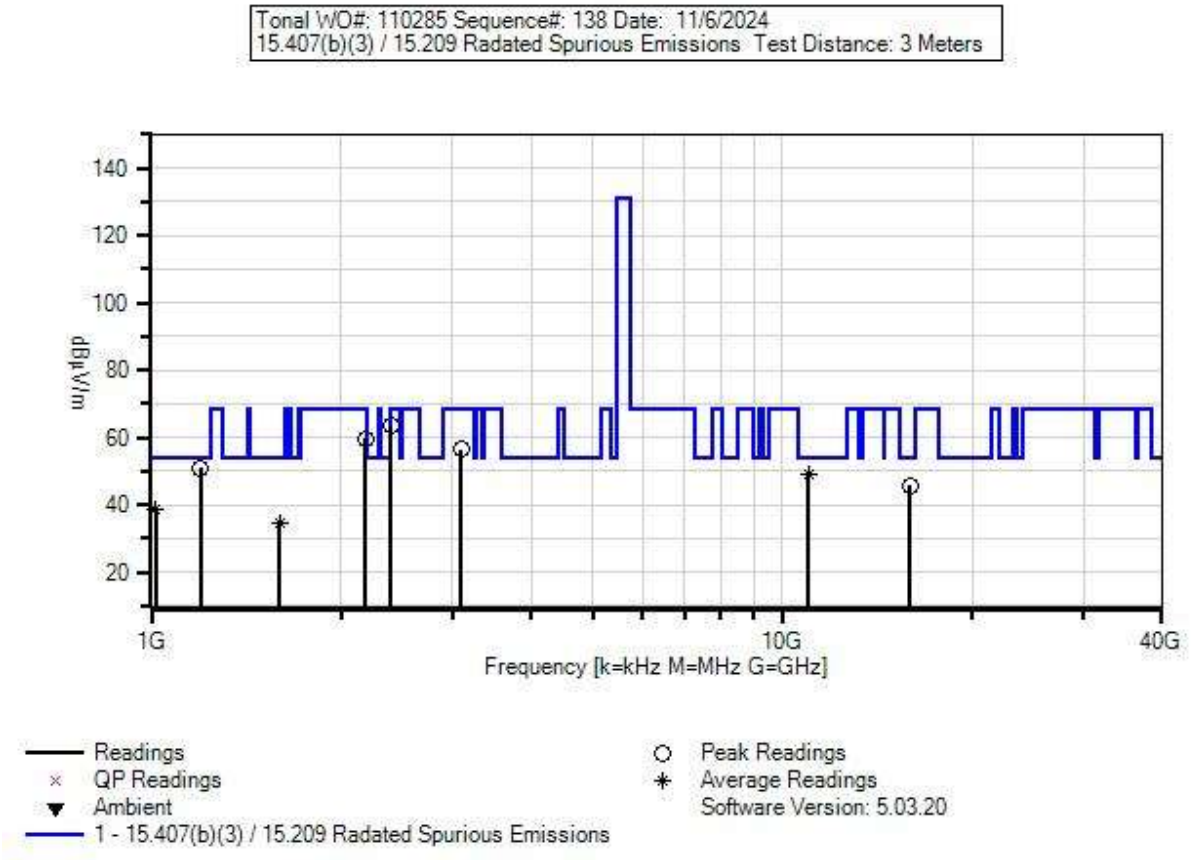
MIMO not enabled, manufacturer declares chain 0 and chain 1 transmit uncorrelated data.

Chain 0

Operational mode is representative of worst case.

Low Channel

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
T6	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
T7	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026
T8	ANP00928	Cable	various	1/26/2024	1/26/2026

	ANP00929	Cable	various	1/26/2024	1/26/2026
T9	ANP07698	Cable	32022-29094K-29094K-72TC	8/16/2024	8/16/2026
	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025
	AN03209	Preamp	83051A	8/22/2023	8/22/2025
	ANP07646	High Pass Filter	11SH10-6000/T1800-0/0	11/5/2024	11/5/2026
	AN02695	Active Horn Antenna	AMFW-5F-260400-33-8P	1/9/2024	1/9/2026
	ANP00930	Cable	various	1/26/2024	1/26/2026
T10	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1198.000M	41.6	+24.8 +0.6 +0.0	+0.9 +0.0 +9.9	+1.7 +0.0	-28.5 +0.0	+0.0	51.0	54.0	-3.0	Horiz
2	2400.000M	47.6	+28.3 +0.8 +0.0	+1.4 +0.0 +9.9	+2.5 +0.0	-27.1 +0.0	+0.0	63.4	68.2	-4.8	Vert
3	11001.950 M Ave	18.4	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.1 +0.0	-29.7 +0.0	+0.0	49.1	54.0	-4.9	Horiz
^	11001.950 M	29.0	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.1 +0.0	-29.7 +0.0	+0.0	59.7	54.0	+5.7	Horiz
5	11001.950 M Ave	18.2	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.1 +0.0	-29.7 +0.0	+0.0	48.9	54.0	-5.1	Vert
^	11001.950 M	30.7	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.1 +0.0	-29.7 +0.0	+0.0	61.4	54.0	+7.4	Vert
7	15936.000 M	50.4	+0.0 +0.0 +3.3	+0.0 +5.7 +0.0	+0.0 -14.2	+0.0 +0.5	+0.0	45.7	54.0	-8.3	Vert
8	2184.000M	44.2	+28.2 +0.8 +0.0	+1.3 +0.0 +9.9	+2.4 +0.0	-27.2 +0.0	+0.0	59.6	68.2	-8.6	Vert
9	3097.000M	37.3	+30.4 +0.9 +0.0	+1.6 +0.0 +9.9	+2.9 +0.0	-26.7 +0.0	+0.0	56.3	68.2	-11.9	Horiz
10	1016.000M Ave	30.2	+24.3 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	38.8	54.0	-15.2	Vert
^	1016.000M	48.4	+24.3 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	57.0	54.0	+3.0	Vert
12	1600.000M Ave	22.7	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	34.4	54.0	-19.6	Horiz
^	1600.000M	42.4	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	54.1	54.0	+0.1	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**15.407(b)(3) / 15.209 Radated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/6/2024
Test Type:	**Radiated Scan**	Time:	10:40:41
Tested By:	Hieu Song Nguyenpham	Sequence#:	139
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 40GHz

Test Environment Conditions:
Temperature: 22.7°C
Humidity: 36%
Atmospheric Pressure: 101.8kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
WiFi transmitting continuously with modulation type as listed with pattern of 0s and 1s at power level 14

802.11a-OFDM-5.5GHz Band

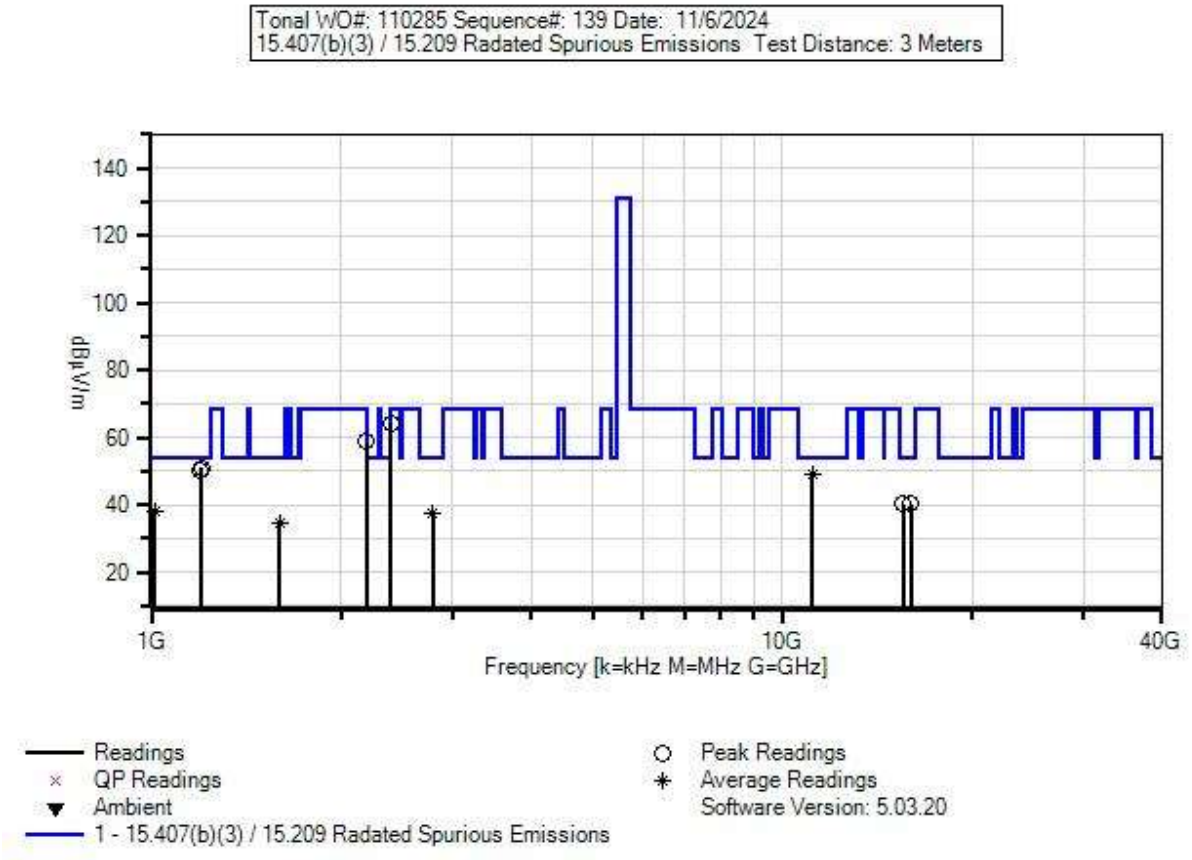
MIMO not enabled, manufacturer declares chain 0 and chain 1 transmit uncorrelated data.

Chain 0

Operational mode is representative of worst case.

Middle Channel

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
T6	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
T7	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026
T8	ANP00928	Cable	various	1/26/2024	1/26/2026

	ANP00929	Cable	various	1/26/2024	1/26/2026
T9	ANP07698	Cable	32022-29094K-29094K-72TC	8/16/2024	8/16/2026
	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025
	AN03209	Preamp	83051A	8/22/2023	8/22/2025
	ANP07646	High Pass Filter	11SH10-6000/T1800-0/0	11/5/2024	11/5/2026
	AN02695	Active Horn Antenna	AMFW-5F-260400-33-8P	1/9/2024	1/9/2026
	ANP00930	Cable	various	1/26/2024	1/26/2026
T10	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	1200.000M	41.5	+24.8 +0.6 +0.0	+0.9 +0.0 +9.9	+1.7 +0.0	-28.5 +0.0	+0.0	50.9	54.0	-3.1	Horiz
2	1196.000M	40.7	+24.8 +0.6 +0.0	+0.9 +0.0 +9.9	+1.7 +0.0	-28.5 +0.0	+0.0	50.1	54.0	-3.9	Horiz
3	2400.000M	48.4	+28.3 +0.8 +0.0	+1.4 +0.0 +9.9	+2.5 +0.0	-27.1 +0.0	+0.0	64.2	68.2	-4.0	Vert
4	11164.600 M Ave	18.7	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.0 +0.0	-29.7 +0.0	+0.0	49.3	54.0	-4.7	Horiz
^	11164.600 M	32.3	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.0 +0.0	-29.7 +0.0	+0.0	62.9	54.0	+8.9	Horiz
6	11164.350 M Ave	18.7	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.0 +0.0	-29.7 +0.0	+0.0	49.3	54.0	-4.7	Vert
^	11164.350 M	31.2	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+6.0 +0.0	-29.7 +0.0	+0.0	61.8	54.0	+7.8	Vert
8	2192.000M	43.4	+28.2 +0.8 +0.0	+1.3 +0.0 +9.9	+2.4 +0.0	-27.2 +0.0	+0.0	58.8	68.2	-9.4	Vert
9	15558.000 M	44.7	+0.0 +0.0 +3.3	+0.0 +5.6 +0.0	+0.0 -13.8	+0.0 +0.5	+0.0	40.3	54.0	-13.7	Horiz
10	15996.000 M	45.0	+0.0 +0.0 +3.3	+0.0 +5.7 +0.0	+0.0 -14.3	+0.0 +0.5	+0.0	40.2	54.0	-13.8	Vert
11	1012.000M Ave	29.7	+24.2 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	38.2	54.0	-15.8	Vert
^	1012.000M	47.9	+24.2 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	56.4	54.0	+2.4	Vert

13	2792.000M Ave	20.1	+29.4 +0.8 +0.0	+1.5 +0.0 +9.9	+2.7 +0.0	-26.8 +0.0	+0.0	37.6	54.0	-16.4	Vert
^	2792.000M	39.3	+29.4 +0.8 +0.0	+1.5 +0.0 +9.9	+2.7 +0.0	-26.8 +0.0	+0.0	56.8	54.0	+2.8	Vert
15	1600.000M Ave	22.8	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	34.5	54.0	-19.5	Horiz
^	1600.000M	43.2	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	54.9	54.0	+0.9	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**15.407(b)(3) / 15.209 Radated Spurious Emissions**		
Work Order #:	**110285**	Date:	11/6/2024
Test Type:	**Radiated Scan**	Time:	10:45:26
Tested By:	Hieu Song Nguyenpham	Sequence#:	140
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Radiated Emission
Frequency Range: 1GHz to 40GHz

Test Environment Conditions:
Temperature: 22.7°C
Humidity: 36%
Atmospheric Pressure: 101.8kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.
WiFi transmitting continuously with modulation type as listed with pattern of 0s and 1s at power level 14

802.11a-OFDM-5.5GHz Band

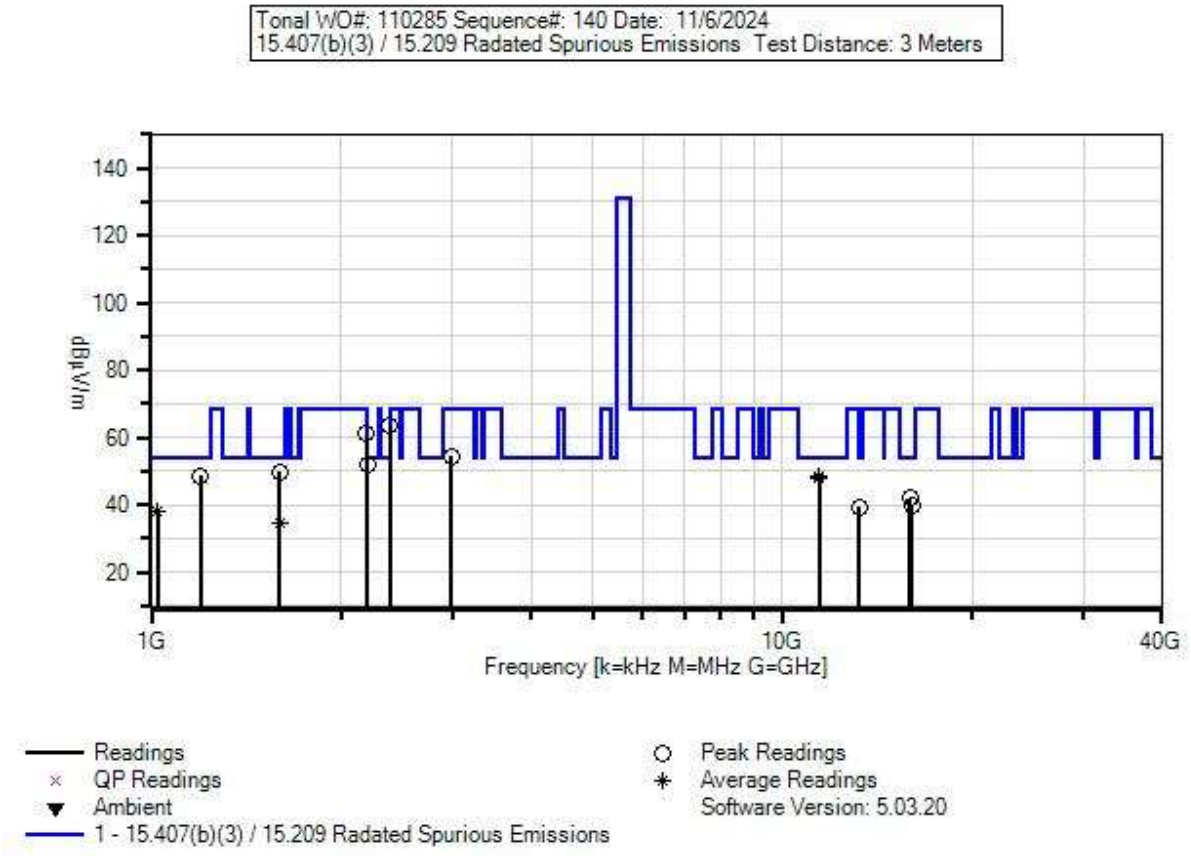
MIMO not enabled, manufacturer declares chain 0 and chain 1 transmit uncorrelated data.

Chain 0

Operational mode is representative of worst case.

High Channel

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
T6	ANP07701	Cable	32022-29094K-29094K-120TC	8/16/2024	8/16/2026
T7	AN02693	Active Horn Antenna	AMFW-5F-12001800-20-10P	1/9/2024	1/9/2026
	AN02694	Horn Antenna	AMFW-5F-18002650-20-10P	1/9/2024	1/9/2026
T8	ANP00928	Cable	various	1/26/2024	1/26/2026

	ANP00929	Cable	various	1/26/2024	1/26/2026
T9	ANP07698	Cable	32022-29094K-29094K-72TC	8/16/2024	8/16/2026
	AN03011	Cable	32022-2-2909K-24TC	3/23/2023	3/23/2025
	AN03209	Preamp	83051A	8/22/2023	8/22/2025
	ANP07646	High Pass Filter	11SH10-6000/T1800-0/0	11/5/2024	11/5/2026
	AN02695	Active Horn Antenna	AMFW-5F-260400-33-8P	1/9/2024	1/9/2026
	ANP00930	Cable	various	1/26/2024	1/26/2026
T10	ANP07365	Attenuator	54A-10	5/26/2023	5/26/2025

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9	T2 T6 T10	T3 T7	T4 T8	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2200.000M	36.5	+28.2 +0.8 +0.0	+1.3 +0.0 +9.9	+2.4 +0.0	-27.2 +0.0	+0.0	51.9	54.0	-2.1	Horiz
2	1600.000M	38.1	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	49.8	54.0	-4.2	Horiz
3	2392.000M	47.7	+28.3 +0.8 +0.0	+1.3 +0.0 +9.9	+2.5 +0.0	-27.1 +0.0	+0.0	63.4	68.2	-4.8	Vert
4	1196.000M	39.1	+24.8 +0.6 +0.0	+0.9 +0.0 +9.9	+1.7 +0.0	-28.5 +0.0	+0.0	48.5	54.0	-5.5	Horiz
5	11440.000 M Ave	17.9	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+5.9 +0.0	-29.9 +0.0	+0.0	48.2	54.0	-5.8	Horiz
^	11440.000 M	30.1	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+5.9 +0.0	-29.9 +0.0	+0.0	60.4	54.0	+6.4	Horiz
7	11440.000 M Ave	17.8	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+5.9 +0.0	-29.9 +0.0	+0.0	48.1	54.0	-5.9	Vert
^	11440.000 M	30.4	+39.4 +1.7 +0.0	+3.2 +0.0 +10.0	+5.9 +0.0	-29.9 +0.0	+0.0	60.7	54.0	+6.7	Vert
9	2192.000M	45.8	+28.2 +0.8 +0.0	+1.3 +0.0 +9.9	+2.4 +0.0	-27.2 +0.0	+0.0	61.2	68.2	-7.0	Vert
10	15939.000 M	46.5	+0.0 +0.0 +3.3	+0.0 +5.7 +0.0	+0.0 -14.2	+0.0 +0.5	+0.0	41.8	54.0	-12.2	Horiz
11	2992.000M	35.9	+30.1 +0.9 +0.0	+1.5 +0.0 +9.9	+2.8 +0.0	-26.7 +0.0	+0.0	54.4	68.2	-13.8	Vert
12	16056.000 M	44.6	+0.0 +0.0 +3.4	+0.0 +5.7 +0.0	+0.0 -14.4	+0.0 +0.5	+0.0	39.8	54.0	-14.2	Vert
13	13257.000 M	45.2	+0.0 +0.0 +3.1	+0.0 +5.1 +0.0	+0.0 -14.6	+0.0 +0.5	+0.0	39.3	54.0	-14.7	Horiz
14	1024.000M Ave	29.4	+24.3 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	38.0	54.0	-16.0	Vert
^	1024.000M	47.4	+24.3 +0.6 +0.0	+1.0 +0.0 +9.8	+1.6 +0.0	-28.7 +0.0	+0.0	56.0	54.0	+2.0	Vert

16	1596.000M Ave	23.1	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	34.8	54.0	-19.2	Vert
^	1596.000M	42.2	+26.1 +0.6 +0.0	+1.1 +0.0 +9.9	+2.0 +0.0	-28.0 +0.0	+0.0	53.9	54.0	-0.1	Vert

Band Edge

Band Edge Summary-Chain 0							
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Average (dBuV/m @3m)		Peak (dBuV/m @3m)		Results
			Measured	Limit	Measured	Limit	
5451.7*	802.11a	External/4.66	44.3	≤54	58.8	≤74	Pass
5925	802.11a	External/4.66	NA2	NA2	53.5	<68.2	Pass
5452*	802.11n HT20	External/4.66	44.3	≤54	57.5	≤74	Pass
5925	802.11n HT20	External/4.66	NA2	NA2	54.0	<68.2	Pass
5452*	802.11ac 20MHz	External/4.66	44.6	≤54	58.1	≤74	Pass
5925	802.11ac 20MHz	External/4.66	NA2	NA2	53.3	<68.2	Pass
5390.2*	802.11n HT40	External/4.66	42.4	≤54	59.6	≤74	Pass
5925	802.11n HT40	External/4.66	NA2	NA2	53.6	<68.2	Pass
5390.2*	802.11ac 40MHz	External/4.66	42.3	≤54	59.1	≤74	Pass
5925	802.11ac 40MHz	External/4.66	NA2	NA2	53.2	<68.2	Pass
5409.7*	802.11ac 80MHz	External/4.66	43.4	≤54	61.6	≤74	Pass
5925	802.11ac 80MHz	External/4.66	NA2	NA2	53.0	<68.2	Pass

Band Edge Summary-Chain 1							
Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Average (dBuV/m @3m)		Peak (dBuV/m @3m)		Results
			Measured	Limit	Measured	Limit	
5460*	802.11a	External/4.66	43.8	≤54	54	≤74	Pass
5925	802.11a	External/4.66	NA2	NA2	53.1	<68.2	Pass
5460*	802.11n HT20	External/4.66	44.1	≤54	53.3	≤74	Pass
5925	802.11n HT20	External/4.66	NA2	NA2	53.4	<68.2	Pass
5460*	802.11ac 20MHz	External/4.66	44.0	≤54	54.3	≤74	Pass
5925	802.11ac 20MHz	External/4.66	NA2	NA2	52.9	<68.2	Pass
5460*	802.11n HT40	External/4.66	44.1	≤54	55.3	≤74	Pass
5925	802.11n HT40	External/4.66	NA2	NA2	53.4	<68.2	Pass
5460*	802.11ac 40MHz	External/4.66	44.1	≤54	54.8	≤74	Pass
5925	802.11ac 40MHz	External/4.66	NA2	NA2	52.7	<68.2	Pass
5460*	802.11ac 80MHz	External/4.66	44.7	≤54	55.6	≤74	Pass
5925	802.11ac 80MHz	External/4.66	NA2	NA2	53.3	<68.2	Pass

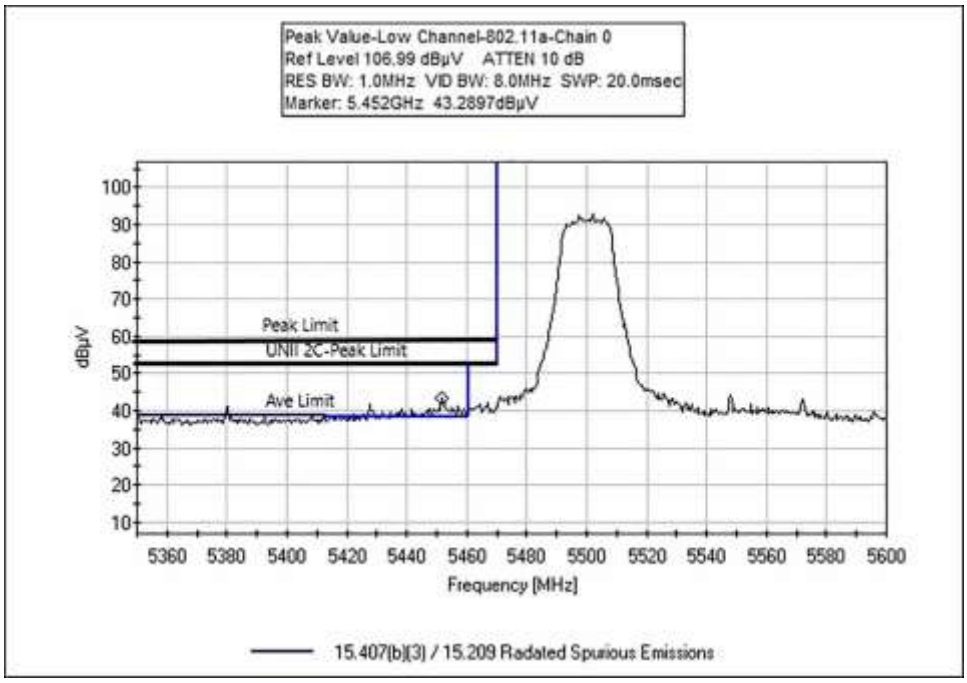
*Restricted band edge
** Devices which have OBW extending into 5725-5850 are allowed to meet BE limits at 5850 MHz.

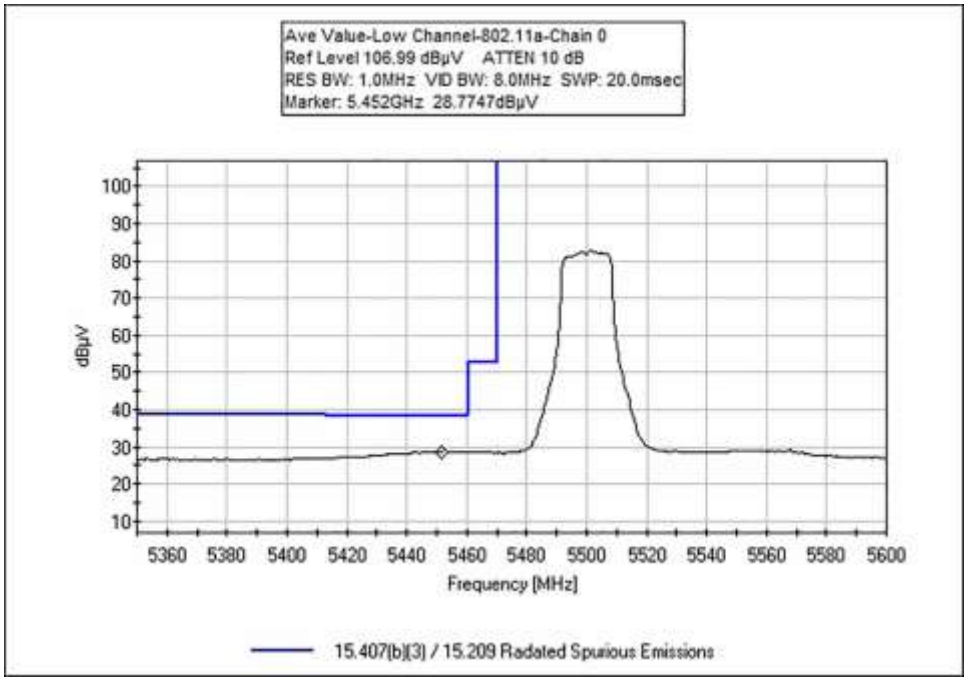
Notes:

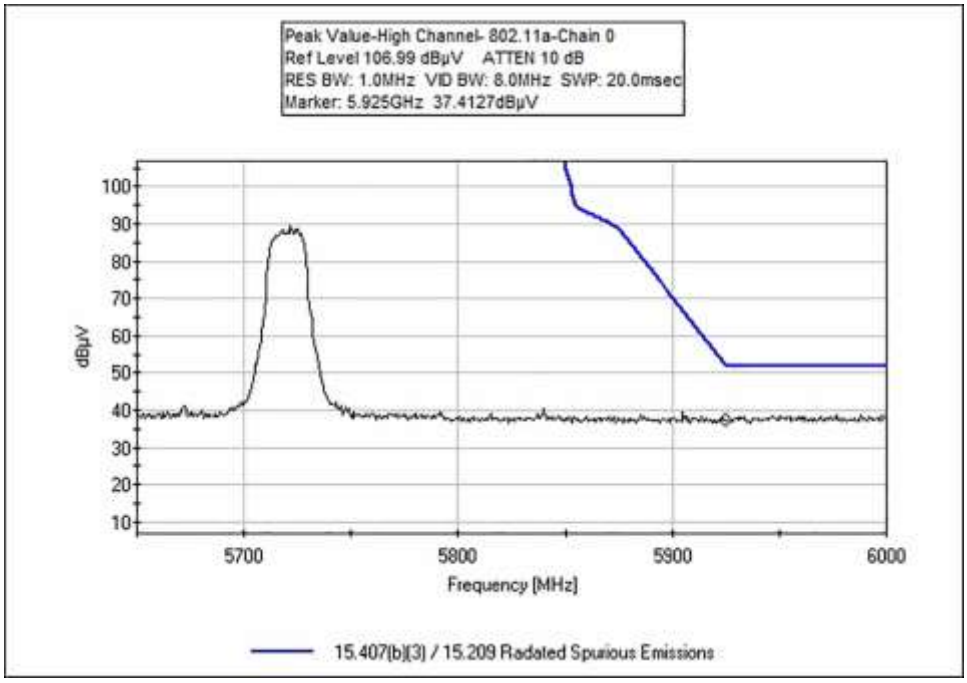
NA2	Average limit not applicable when applying -27dBm/MHz limit.

Band Edge Plots

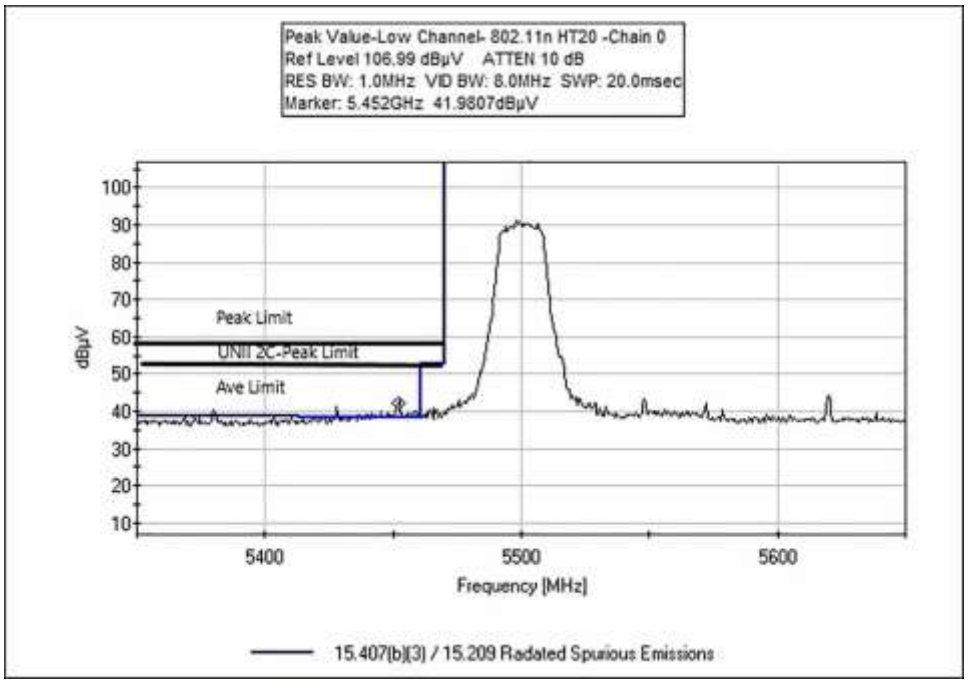
Chain 0
802.11a

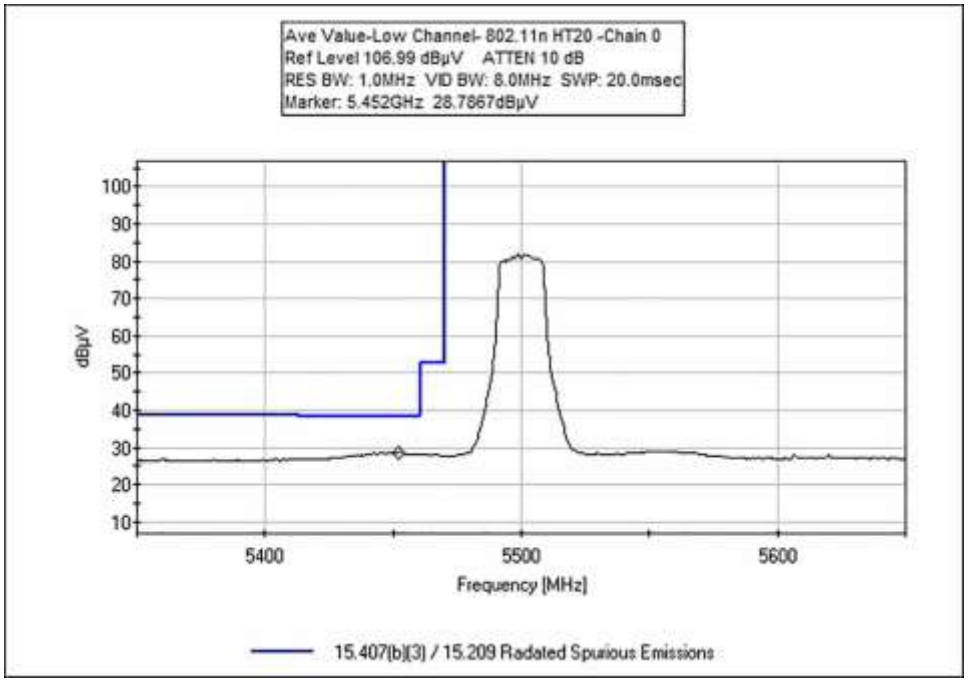





Peak Value-High Channel- 802.11a-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.4127dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

802.11n HT20


Peak Value-Low Channel- 802.11n HT20 -Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.452GHz 41.9807dBµV
Peak Limit
UNII 2C-Peak Limit
Ave Limit
dBµV
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions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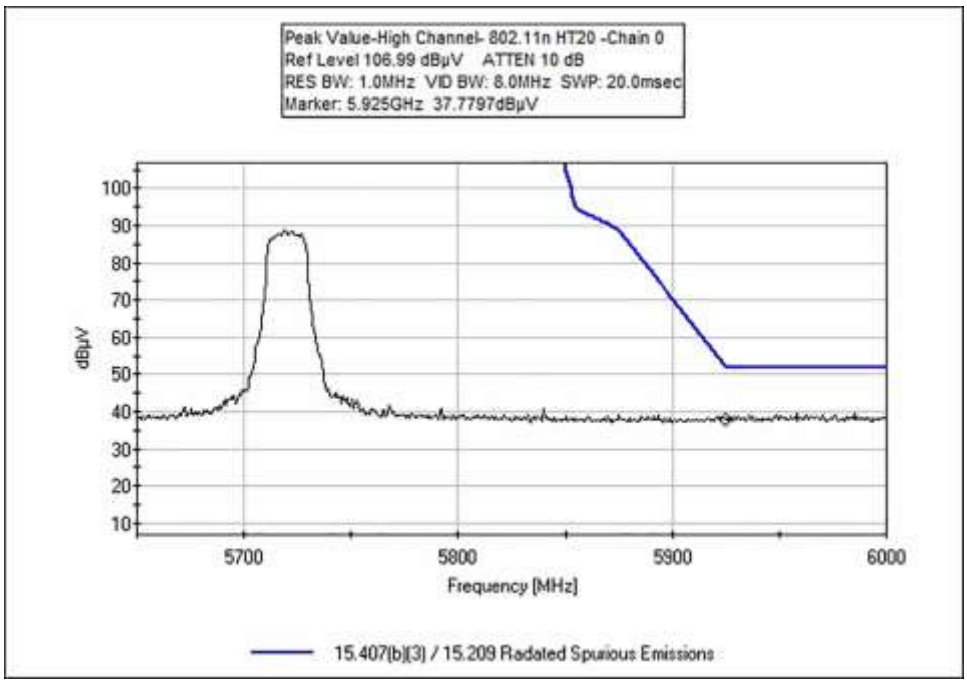
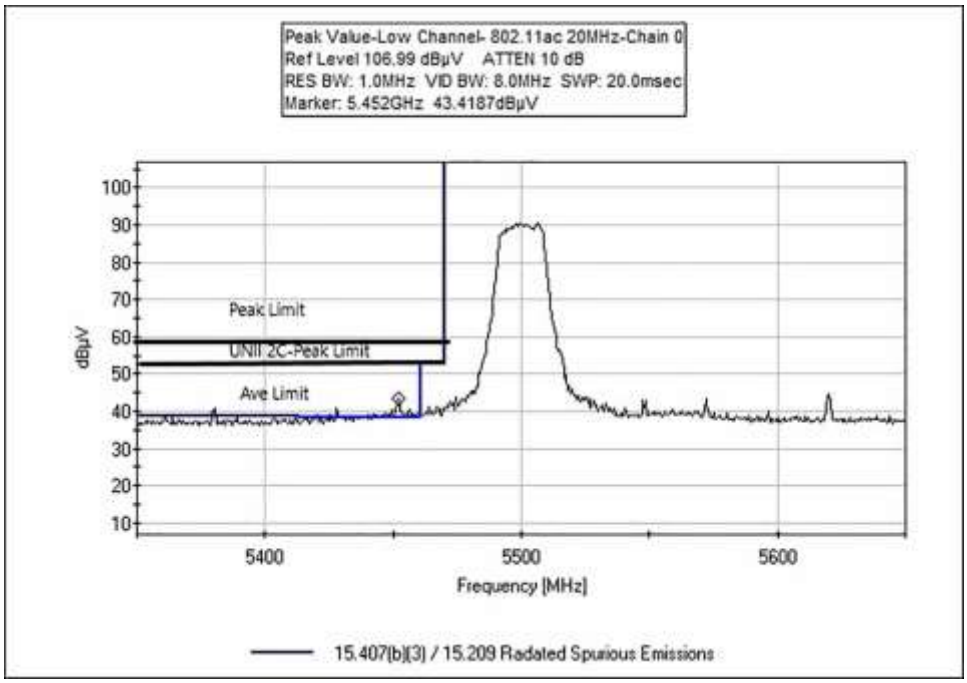
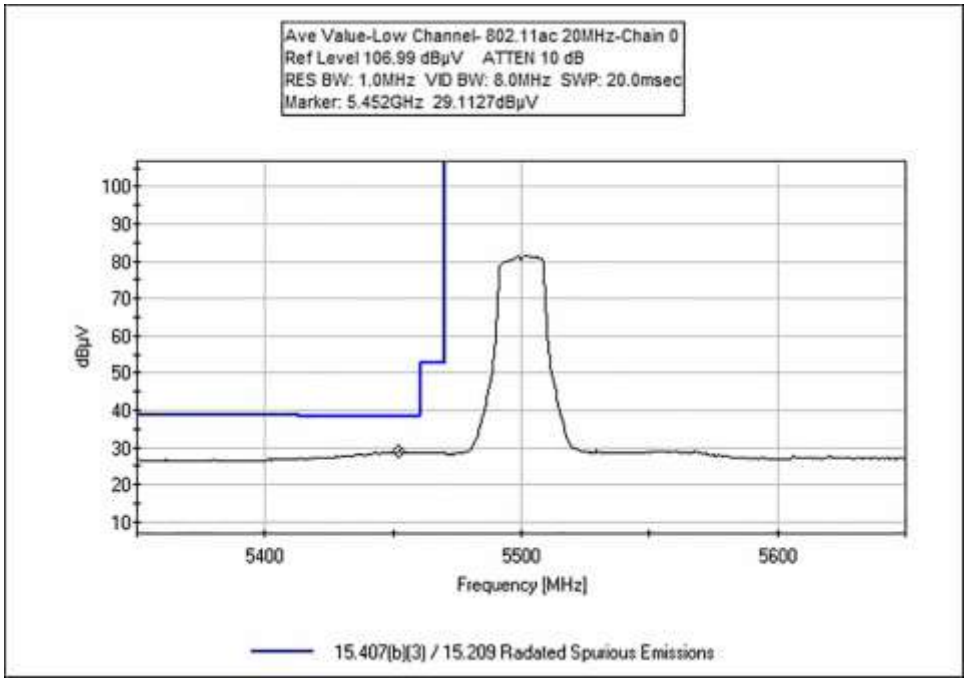
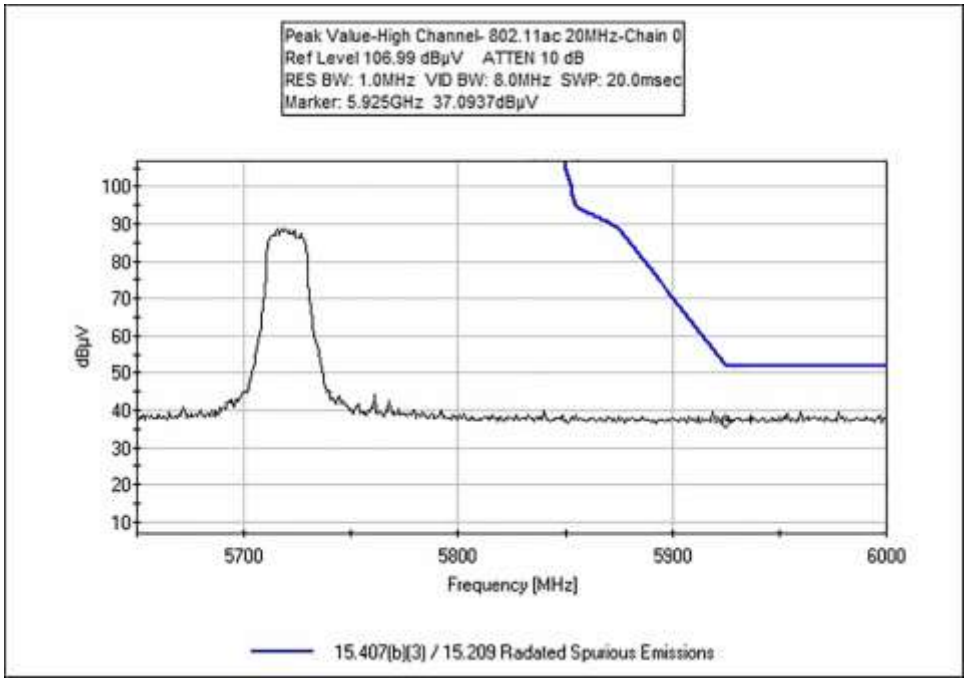
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.452GHz 28.7867dBµV
dBµV
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions


Peak Value-High Channel- 802.11n HT20 -Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.7797dBµV
100
90
80
70
60
50
40
30
20
10
dBµV
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

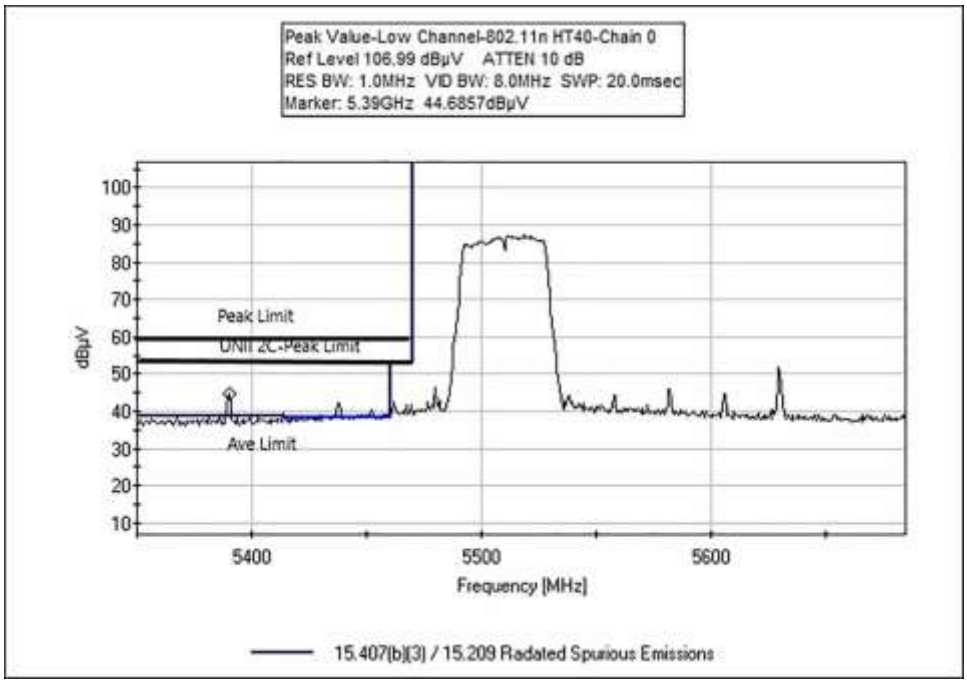
802.11ac 20MHz

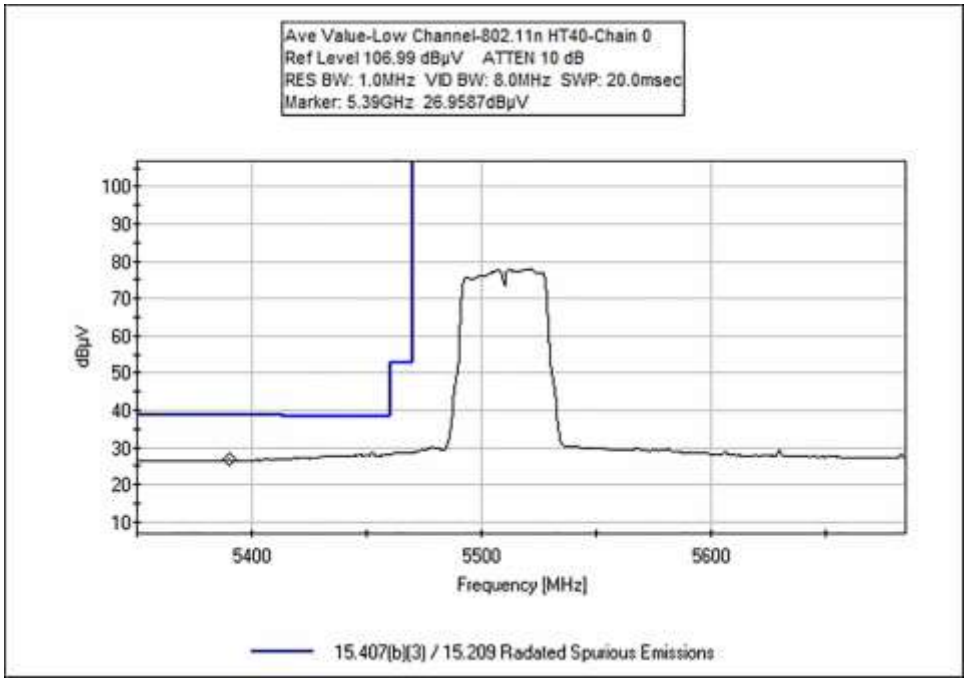


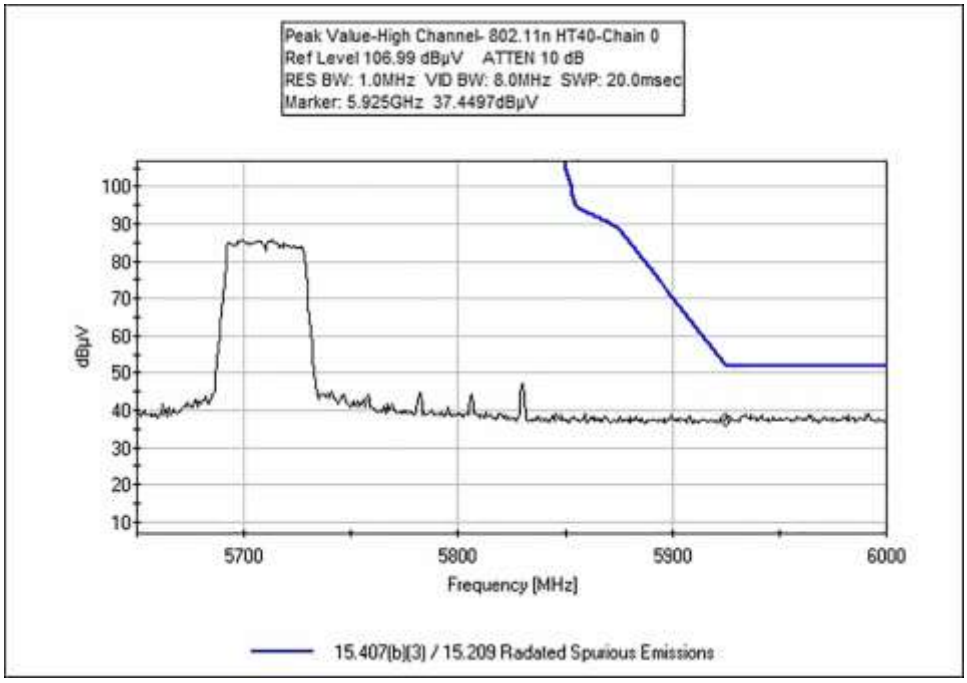



Peak Value-High Channel- 802.11ac 20MHz-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.0937dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

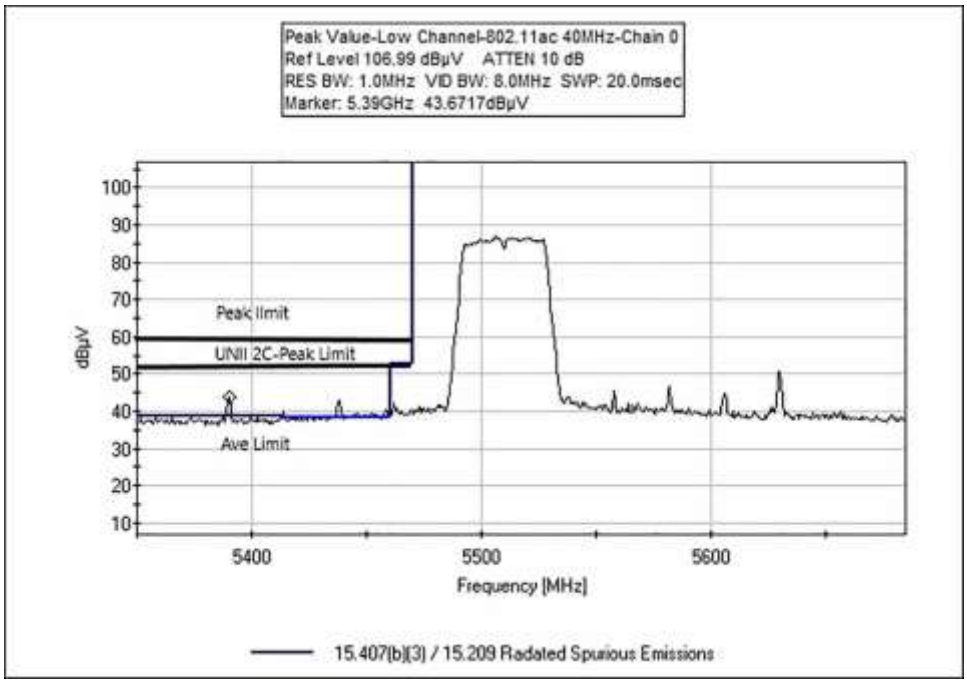
802.11 n HT40

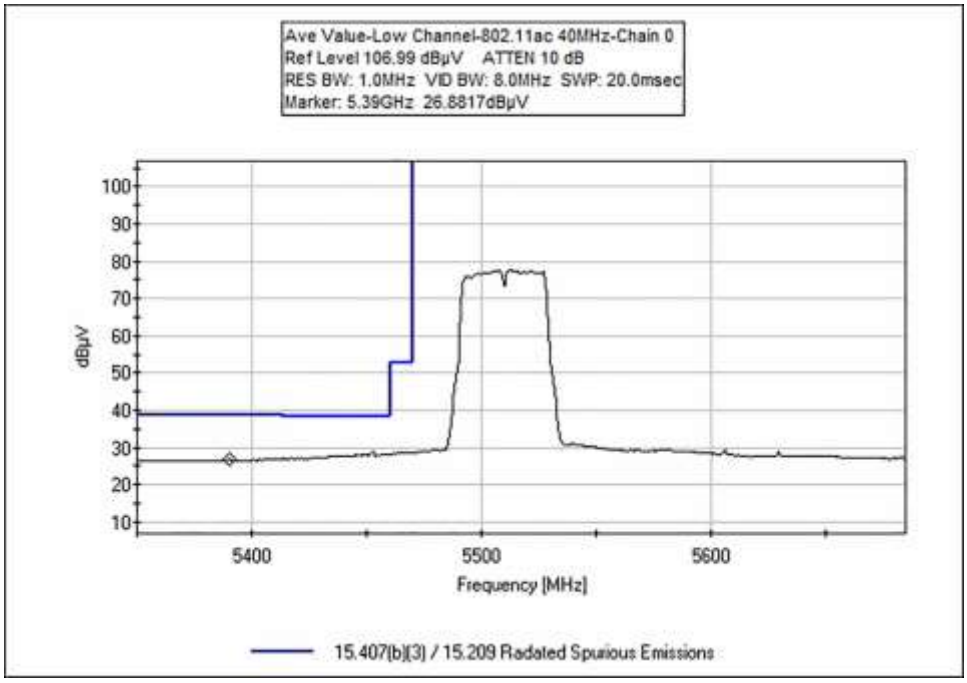

Peak Value-Low Channel-802.11n HT40-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.39GHz 44.6857dBµV
dBµV
Peak Limit
UNII 2C-Peak Limit
Ave Limit
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

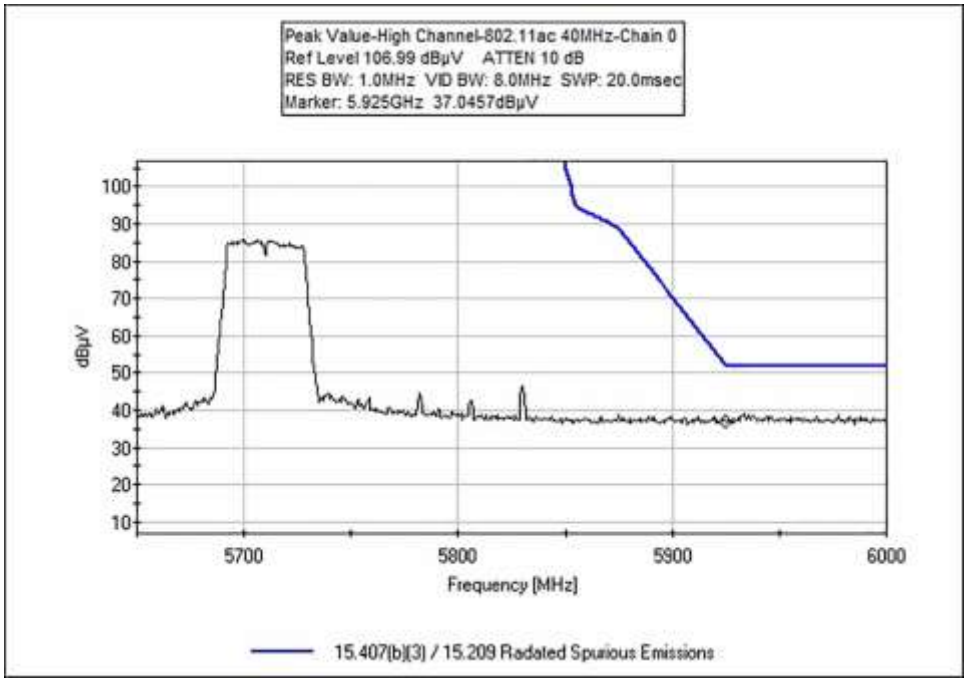

Ave Value-Low Channel-802.11n HT40-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.39GHz 26.9587dBµV
dBµV
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions


Peak Value-High Channel- 802.11n HT40-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.4497dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

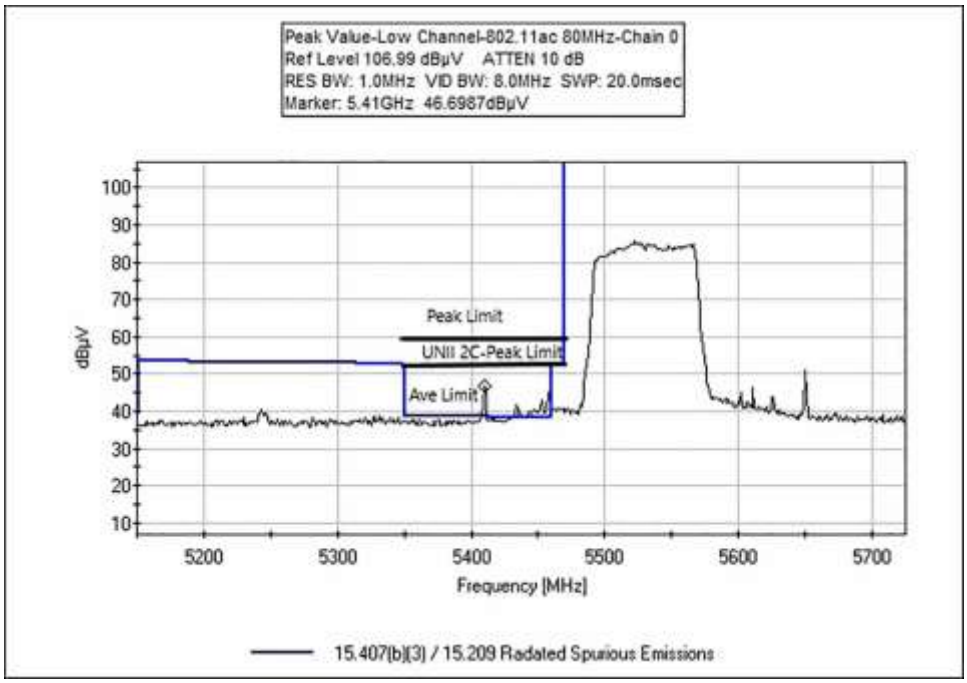
802.11ac 40MHz

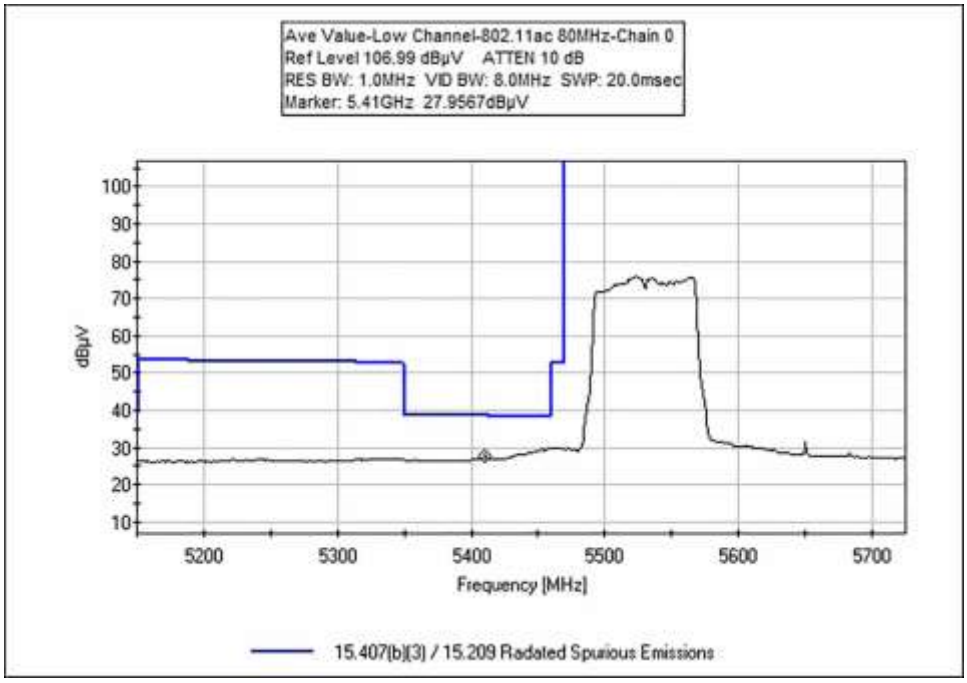


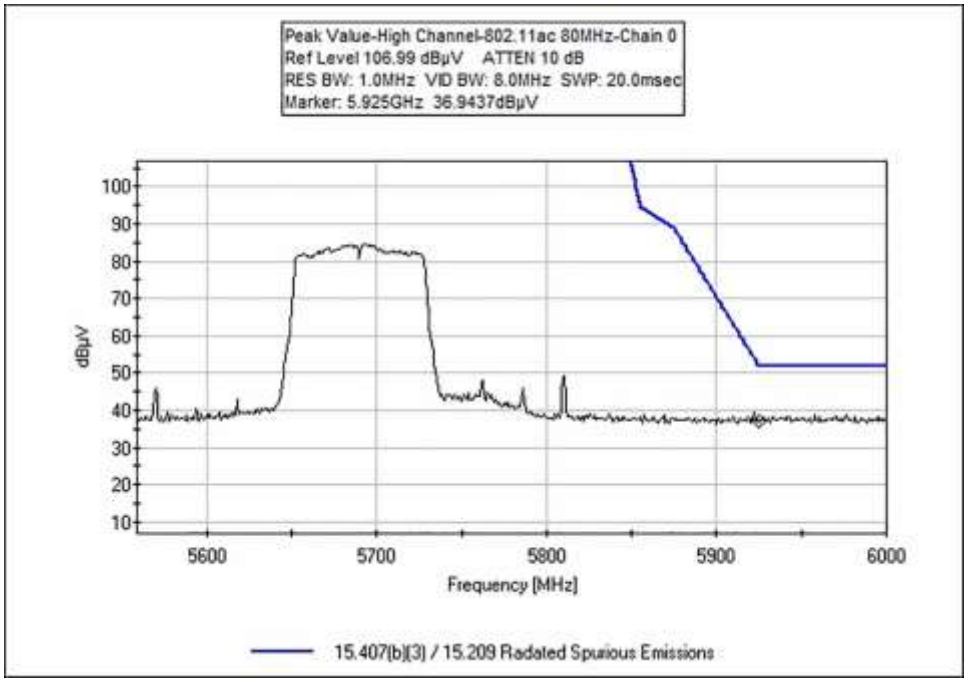



Peak Value-High Channel-802.11ac 40MHz-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.0457dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

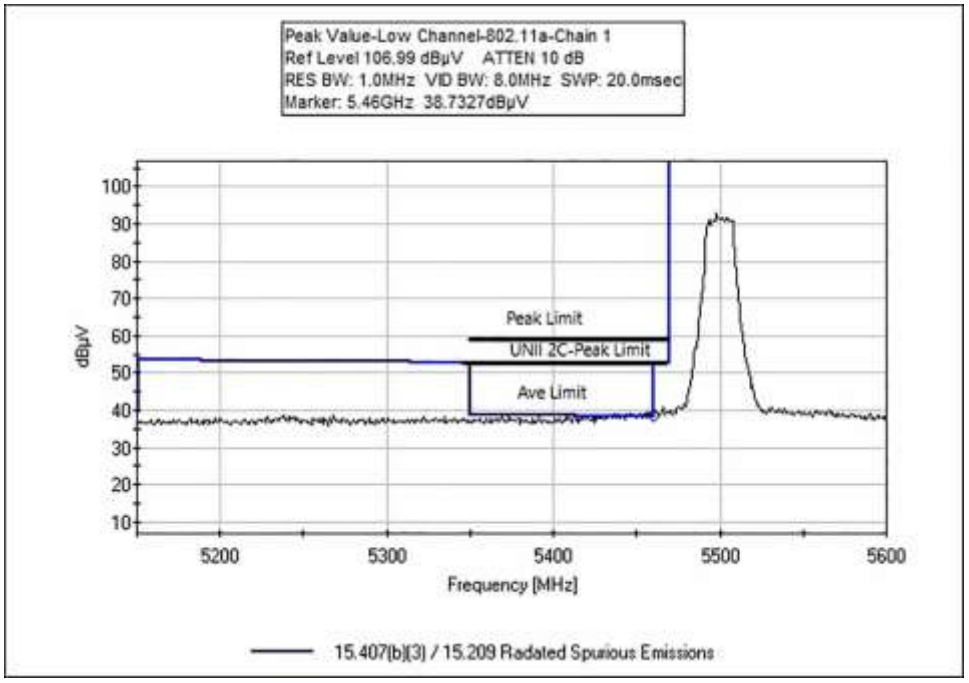
802.11ac 80MHz

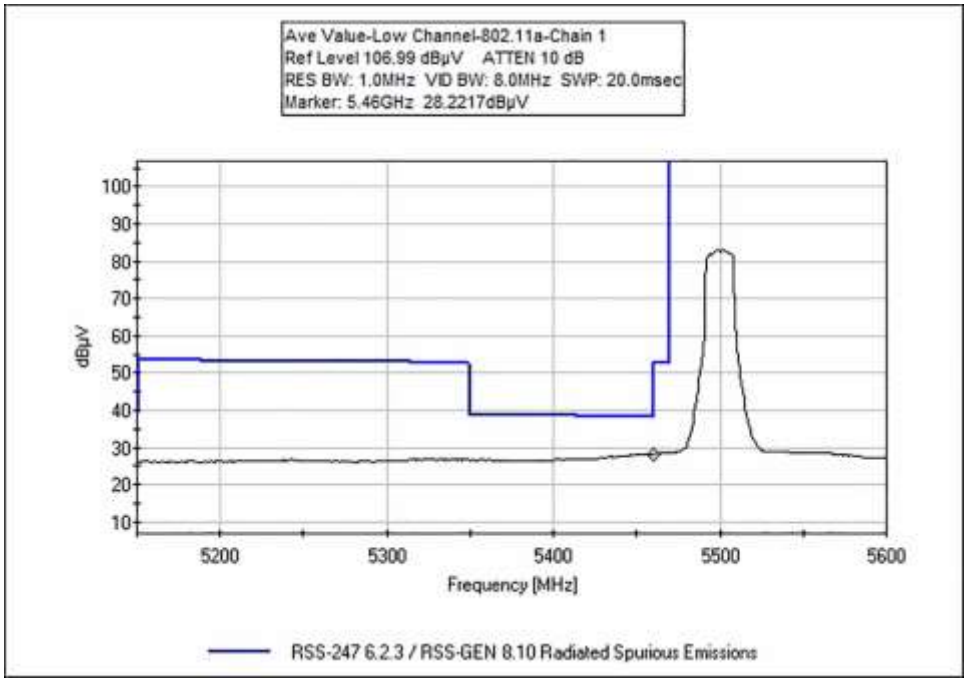


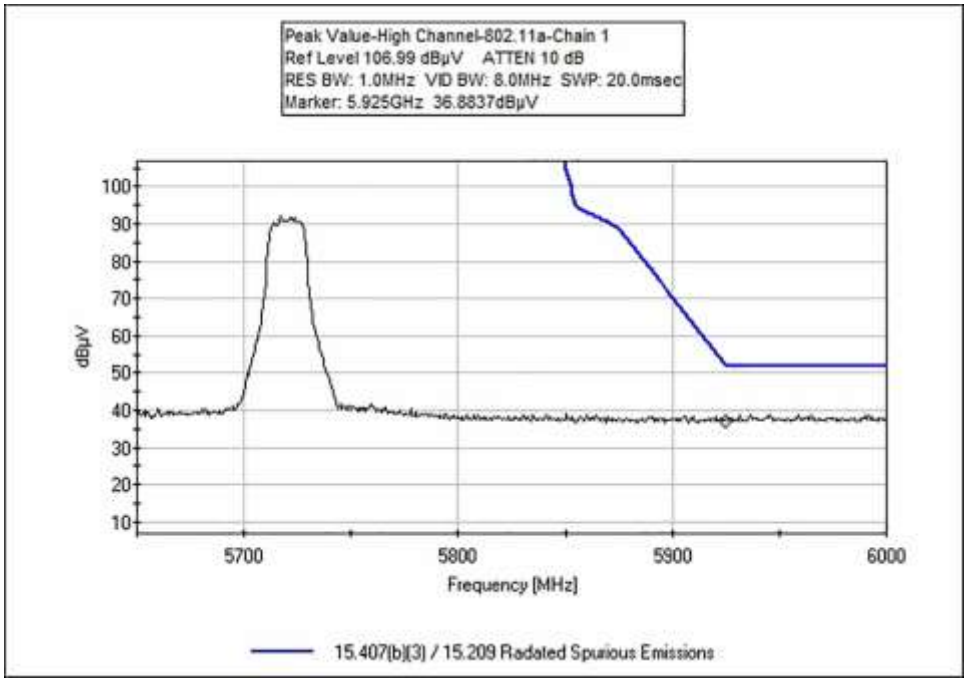



Peak Value-High Channel-802.11ac 80MHz-Chain 0
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 36.9437dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5600
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

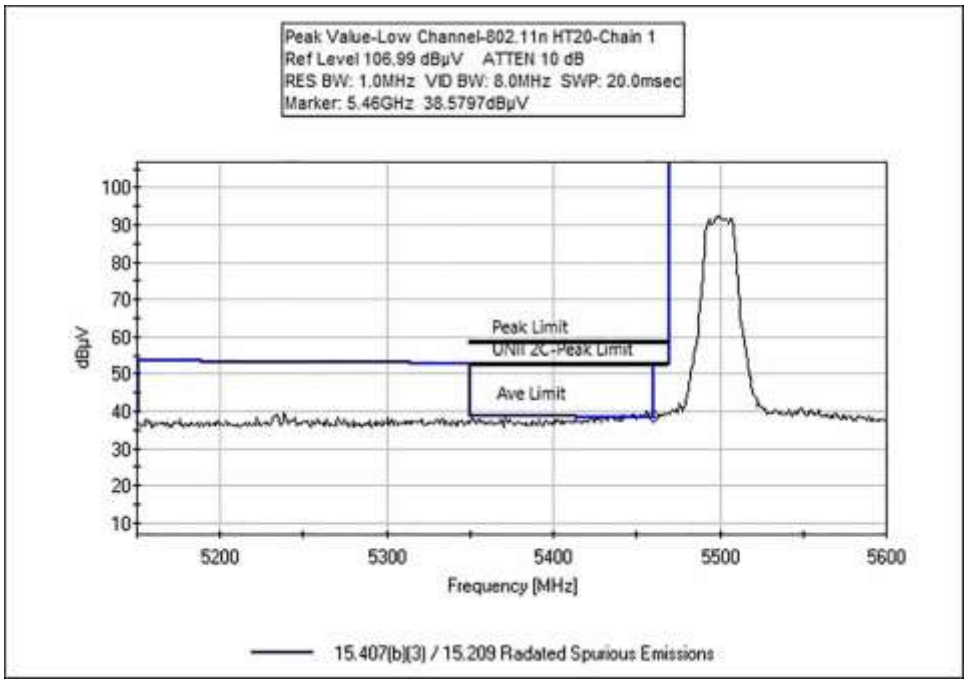
Chain 1
802.11a

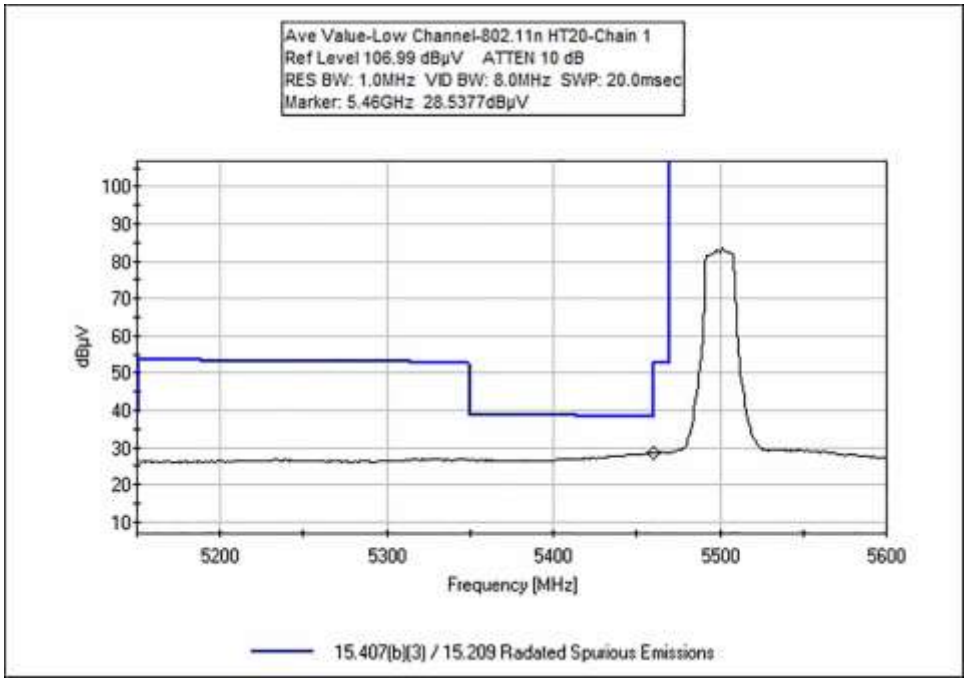


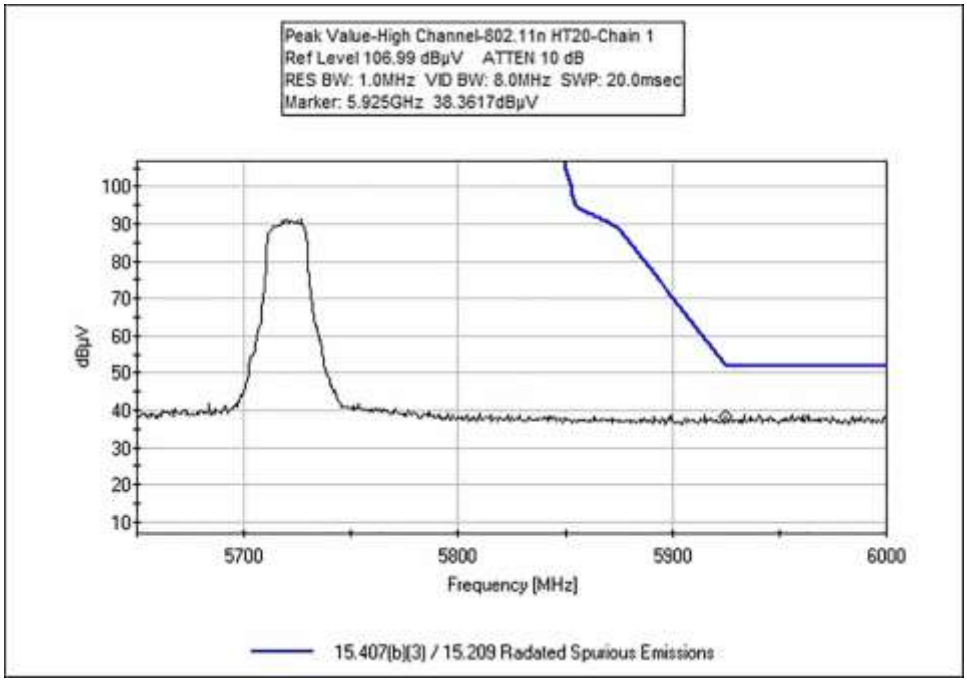



Peak Value-High Channel-802.11a-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 36.8837dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

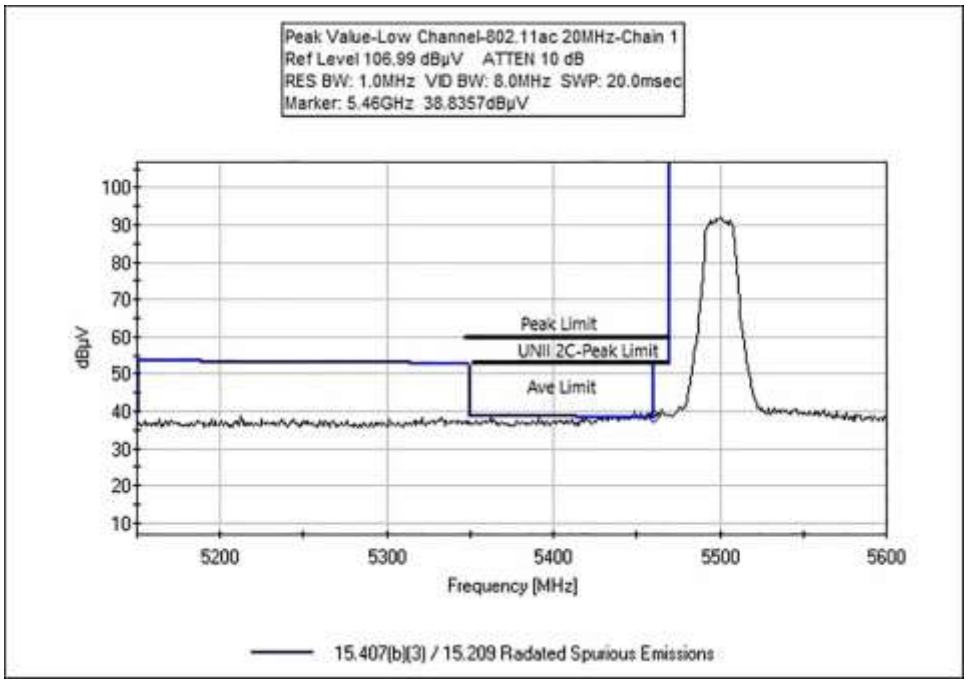
802.11n HT20

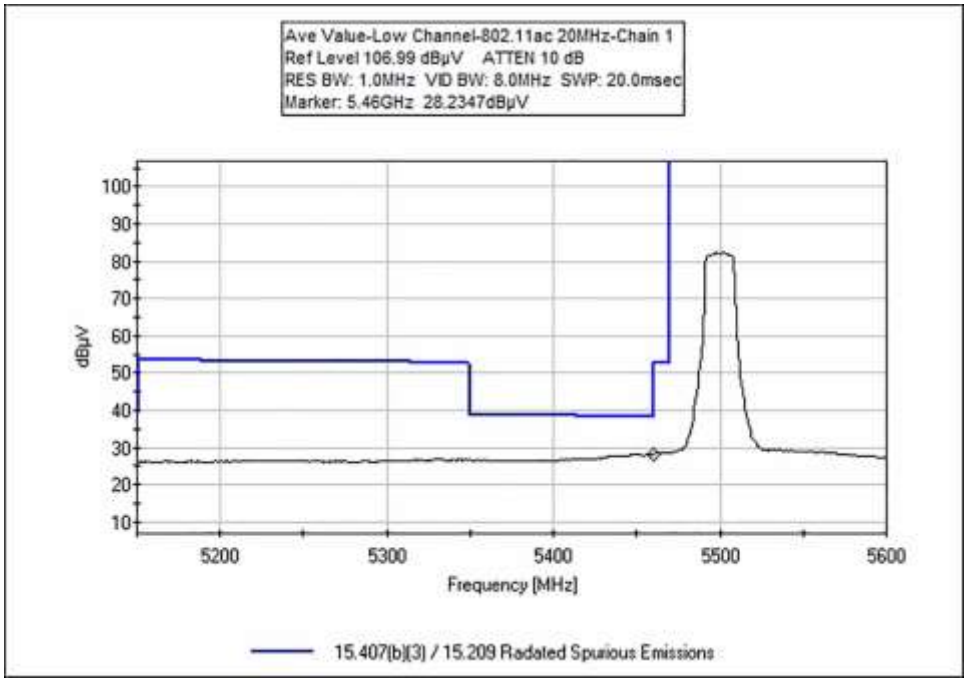

Peak Value-Low Channel-802.11n HT20-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.46GHz 38.5797dBµV
dBµV
Peak Limit
UNII 2C-Peak Limit
Ave Limit
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

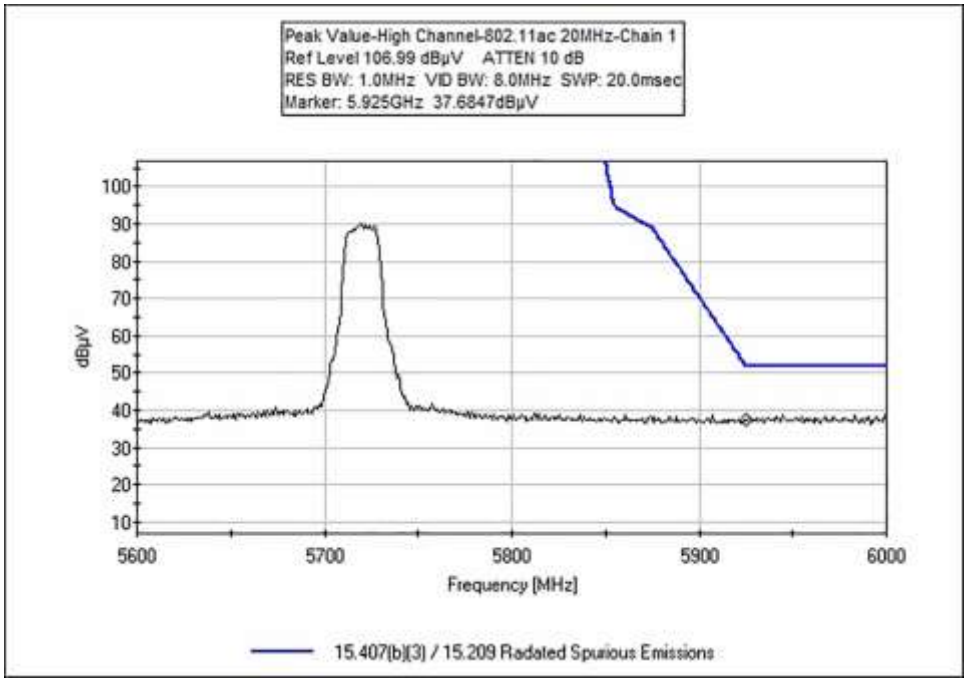

Ave Value-Low Channel-802.11n HT20-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.46GHz 28.5377dBµV
dBµV
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions


Peak Value-High Channel-802.11n HT20-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 38.3617dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

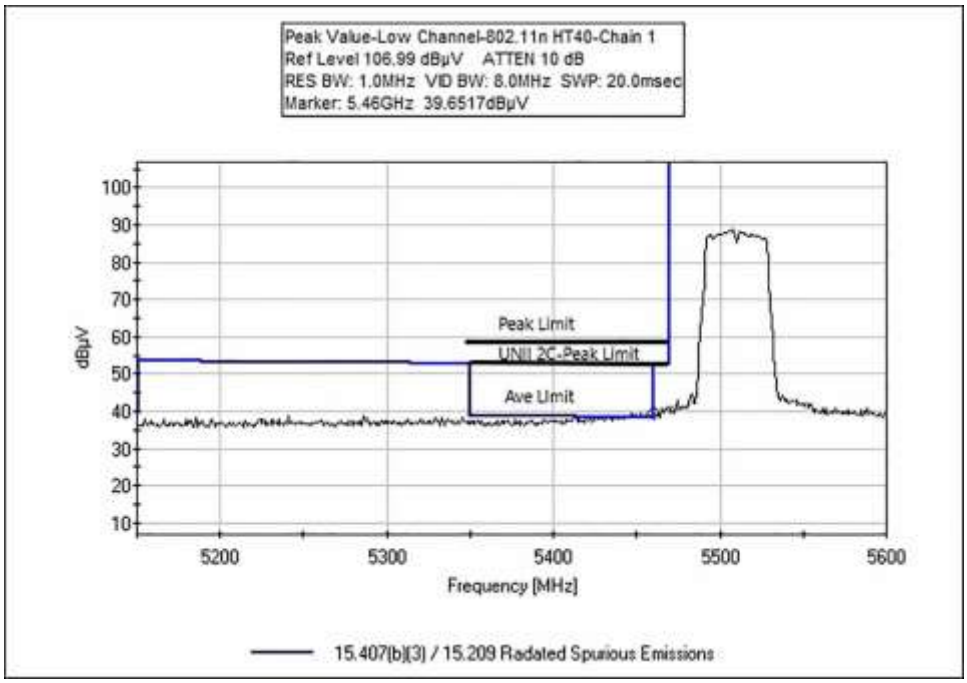
802.11ac 20MHz

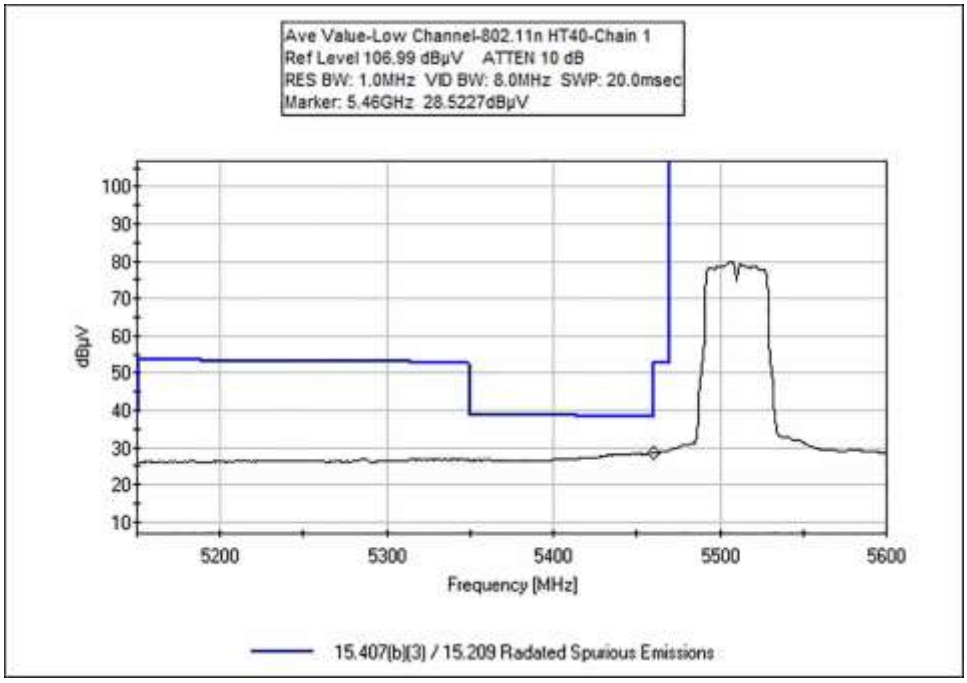


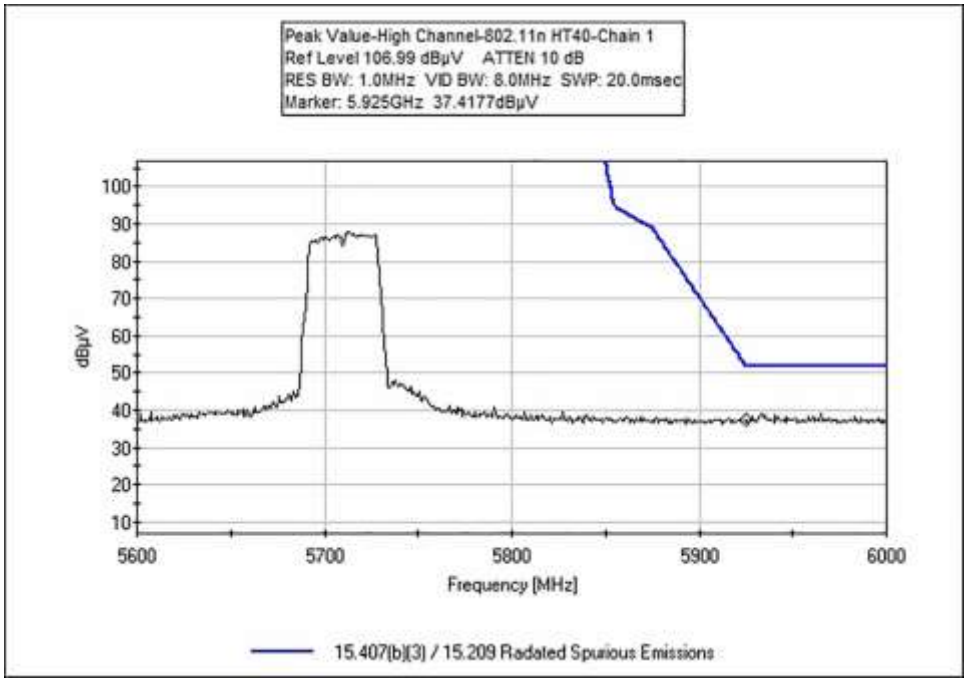



Peak Value-High Channel-802.11ac 20MHz-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.6847dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5600
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

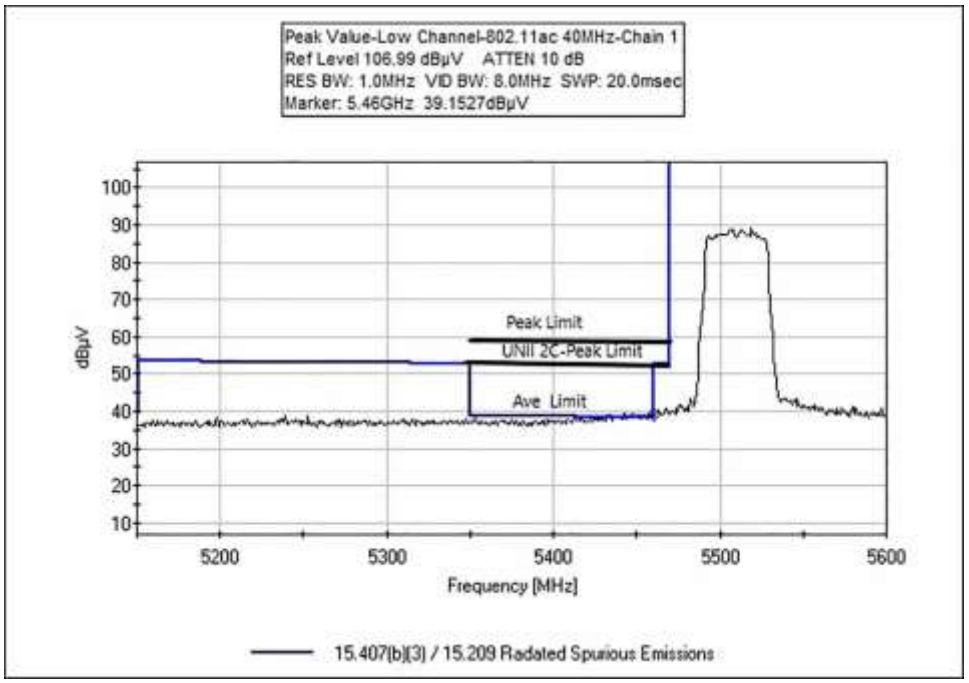
802.11 n HT40

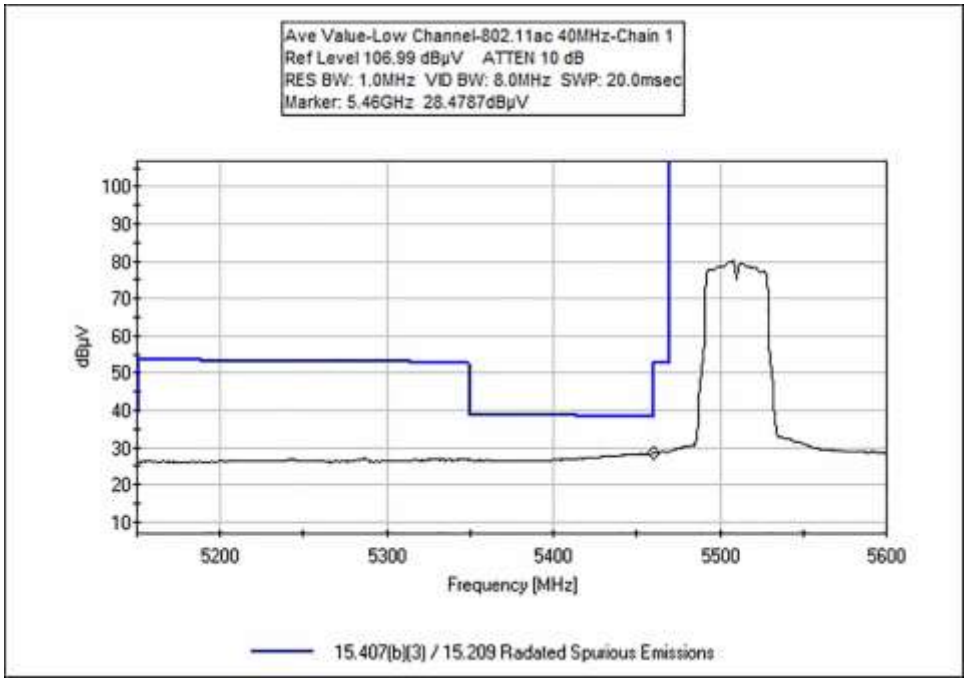

Peak Value-Low Channel-802.11n HT40-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.46GHz 39.6517dBµV
dBµV
Peak Limit
UNII 2C-Peak Limit
Ave Limit
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

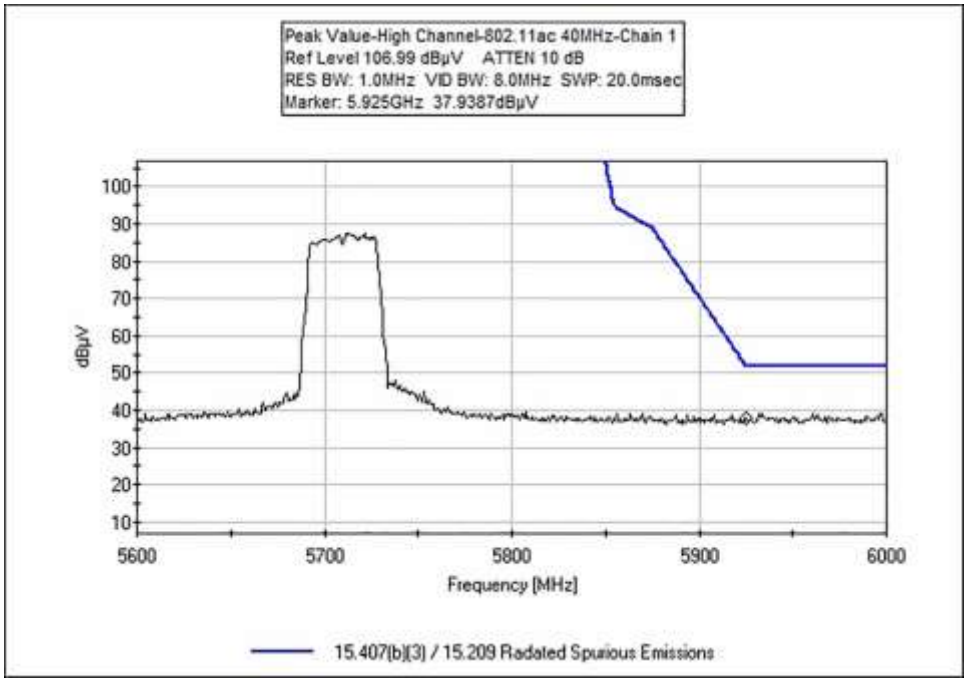

Ave Value-Low Channel-802.11n HT40-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.46GHz 28.5227dBµV
dBµV
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions


Peak Value-High Channel-802.11n HT40-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.4177dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5600
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

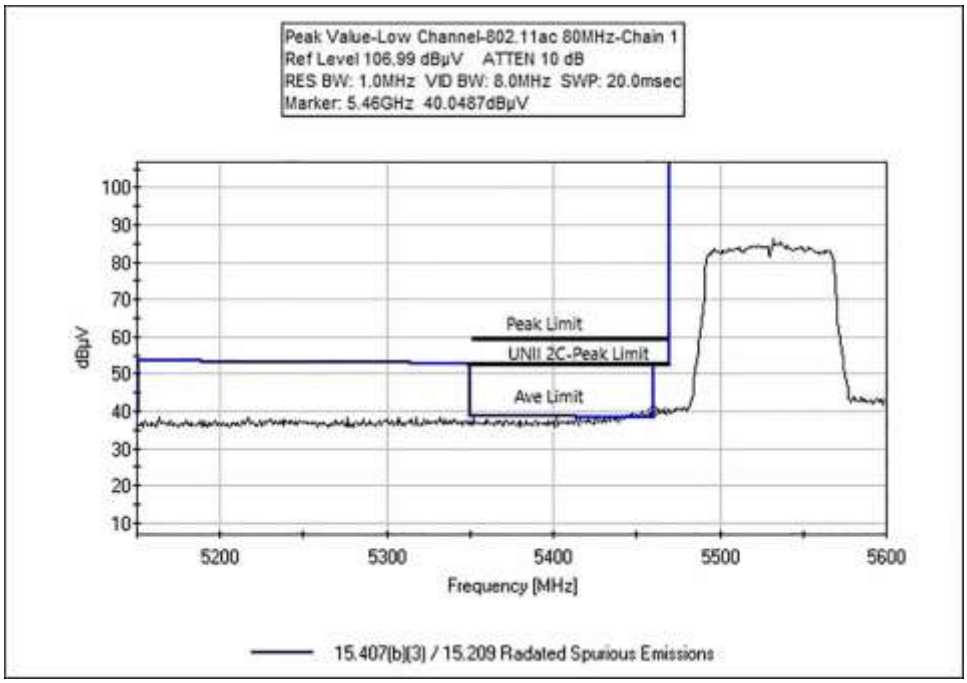
802.11ac 40MHz

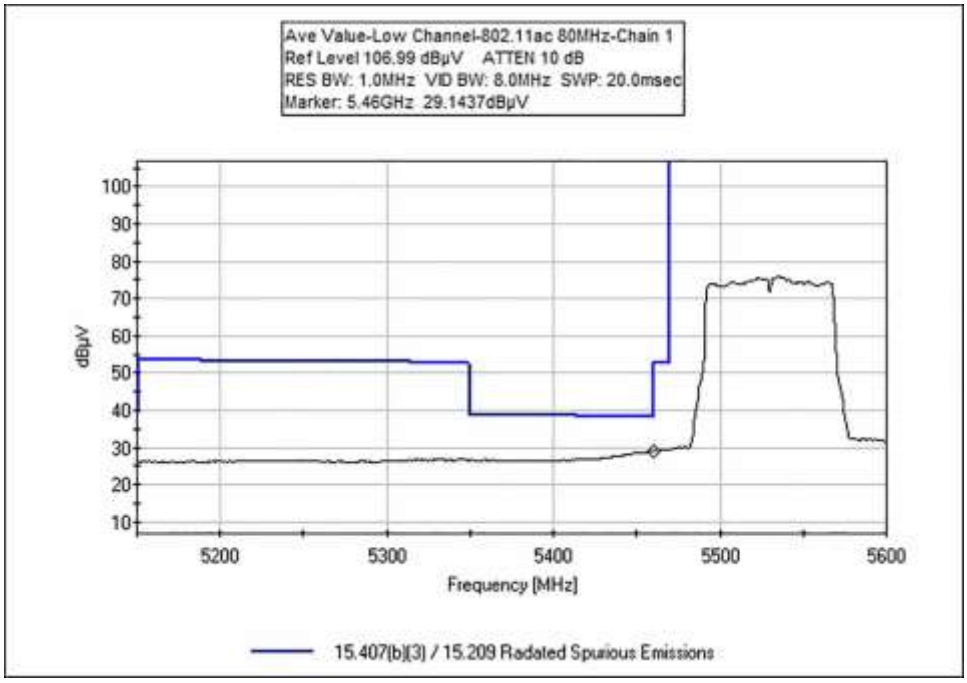


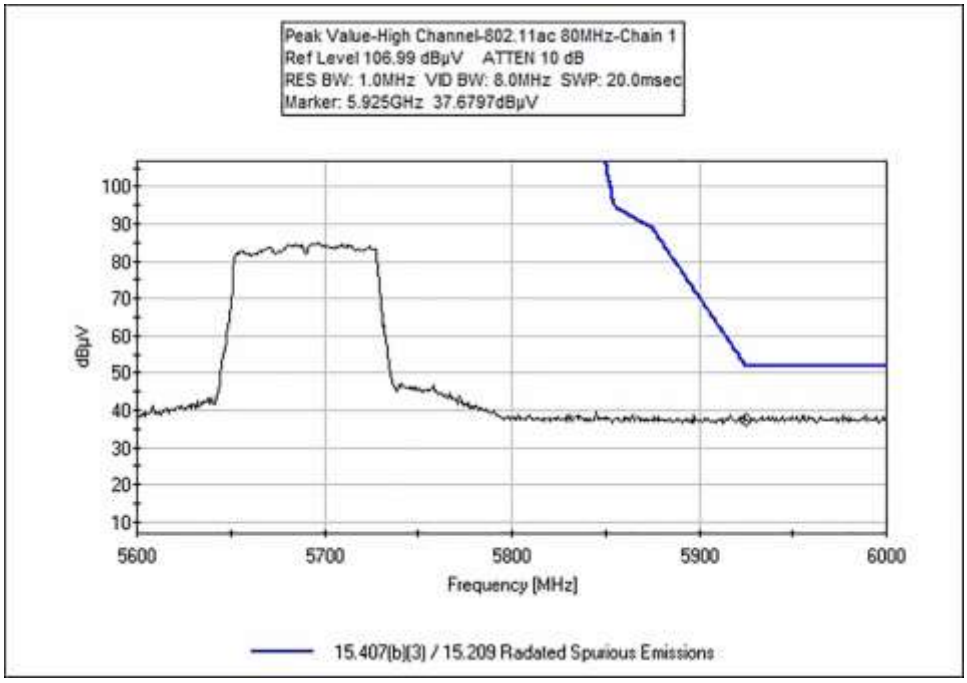



Peak Value-High Channel-802.11ac 40MHz-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.9387dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5600
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

802.11ac 80MHz






Peak Value-High Channel-802.11ac 80MHz-Chain 1
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 8.0MHz SWP: 20.0msec
Marker: 5.925GHz 37.6797dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
5600
5700
5800
5900
6000
Frequency [MHz]
15.407(b)(3) / 15.209 Radated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**Band Edge**		
Work Order #:	**110285**	Date:	10/31/2024
Test Type:	**Radiated Scan**	Time:	09:09:17
Tested By:	Hieu Song Nguyenpham	Sequence#:	16
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Band Edge

Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.

Note:
Chain 0

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	5451.700M	43.3	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	58.8	54.0 802.11a	+4.8	Horiz
2	5451.700M Ave	28.8	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	44.3	54.0 802.11a	-9.7	Horiz
3	5925.000M	37.3	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.5	68.2 802.11a	-14.7	Horiz
4	5925.000M	37.8	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	54.0	68.2 802.11n HT20	-14.2	Horiz
5	5452.000M	42.0	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	57.5	54.0 802.11n HT20	+3.5	Horiz
6	5452.000M Ave	28.8	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	44.3	54.0 802.11n HT20	-9.7	Horiz
7	5452.000M	42.6	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	58.1	54.0 802.11ac 20MHz	+4.1	Horiz
8	5452.000M Ave	29.1	+34.7 +1.2	+2.2	+3.8	-26.4	+0.0	44.6	54.0 802.11ac 20MHz	-9.4	Horiz
9	5925.000M	37.1	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.3	68.2 802.11ac 20MHz	-14.9	Horiz
10	5925.000M	37.4	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.6	68.2 802.11n HT40	-14.6	Horiz
11	5390.200M	44.2	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	59.6	54.0 802.11n HT40	+5.6	Horiz
12	5390.200M Ave	27.0	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	42.4	54.0 802.11n HT40	-11.6	Horiz
13	5390.200M	43.7	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	59.1	54.0 802.11ac 40MHz	+5.1	Horiz
14	5390.200M Ave	26.9	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	42.3	54.0 802.11ac 40MHz	-11.7	Horiz
15	5925.000M	37.0	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.2	68.2 802.11ac 40MHz	-15.0	Horiz
16	5925.000M	36.8	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.0	68.2 802.11ac 80MHz	-15.2	Horiz
17	5409.700M	46.2	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	61.6	54.0 802.11ac 80MHz	+7.6	Horiz
18	5409.700M Ave	28.0	+34.6 +1.2	+2.2	+3.8	-26.4	+0.0	43.4	54.0 802.11ac 80MHz	-10.6	Horiz

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	Band Edge		
Work Order #:	**110285**	Date:	10/31/2024
Test Type:	**Radiated Scan**	Time:	14:42:27
Tested By:	Hieu Song Nguyenpham	Sequence#:	19
Software:	EMITest 5.03.20		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Band Edge

Test Environment Conditions:
Temperature: 21.8°C
Humidity: 47%
Atmospheric Pressure: 101.5kPa

Highest Generated Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020), KDB 789033

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. One weight line is extended to the floor. Camera is on.

Note:
Chain 1

Test Equipment:

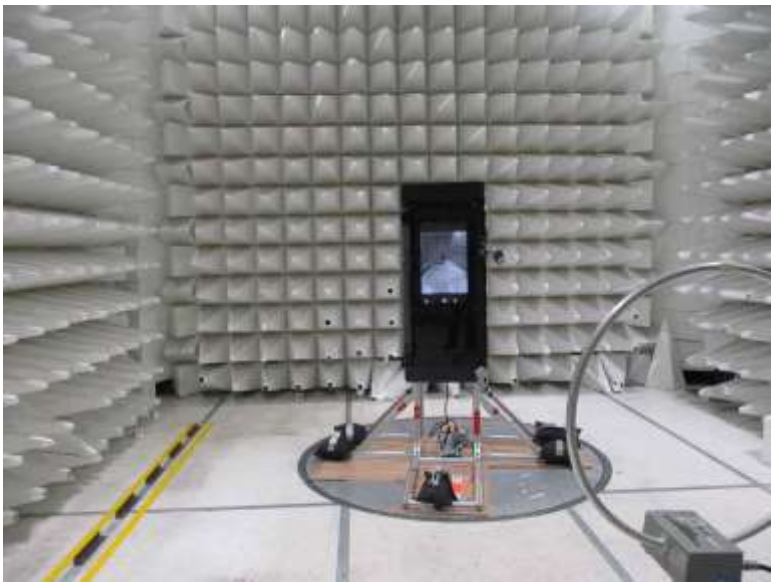
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02157	Horn Antenna-ANSI C63.5	3115	1/11/2023	1/11/2025
T2	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2024	1/9/2026
T3	ANP01210	Cable	FSJ1P-50A-4A	1/9/2024	1/9/2026
T4	AN02810	Preamp	83051A	4/6/2023	4/6/2025
T5	AN03013	Cable	32022-2-2909K-36TC	1/9/2024	1/9/2026
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024

Measurement Data: Reading listed by order taken. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	5460.000M	38.4	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	54.0	54.0 802.11a	+0.0	Horiz
2	5460.000M Ave	28.2	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	43.8	54.0 802.11a	-10.2	Horiz
3	5925.000M	36.9	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.1	68.2 802.11a	-15.1	Horiz
4	5925.000M	37.2	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.4	68.2 802.11n HT20	-14.8	Horiz
5	5460.000M	37.7	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	53.3	54.0 802.11n HT20	-0.7	Horiz
6	5460.000M Ave	28.5	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	44.1	54.0 802.11n HT20	-9.9	Horiz
7	5460.000M	38.7	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	54.3	54.0 802.11ac 20MHz	+0.3	Horiz
8	5460.000M Ave	28.4	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	44.0	54.0 802.11ac 20MHz	-10.0	Horiz
9	5925.000M	36.7	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	52.9	68.2 802.11ac 20MHz	-15.3	Horiz
10	5460.000M	39.7	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	55.3	54.0 802.11n HT40	+1.3	Horiz
11	5460.000M Ave	28.5	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	44.1	54.0 802.11n HT40	-9.9	Horiz
12	5925.000M	37.2	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.4	68.2 802.11n HT40	-14.8	Horiz
13	5925.000M	36.5	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	52.7	68.2 802.11ac 40MHz	-15.5	Horiz
14	5460.000M	39.2	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	54.8	54.0 802.11ac 40MHz	+0.8	Horiz
15	5460.000M Ave	28.5	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	44.1	54.0 802.11ac 40MHz	-9.9	Horiz
16	5460.000M	40.0	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	55.6	54.0 802.11ac 80MHz	+1.6	Horiz
17	5460.000M	29.1	+34.7 +1.2	+2.2	+3.8	-26.3	+0.0	44.7	54.0 802.11ac 80MHz	-9.3	Horiz
18	5925.000M	37.1	+34.9 +1.3	+2.3	+3.9	-26.2	+0.0	53.3	68.2 802.11ac 80MHz	-14.9	Horiz

Test Setup Photo(s)

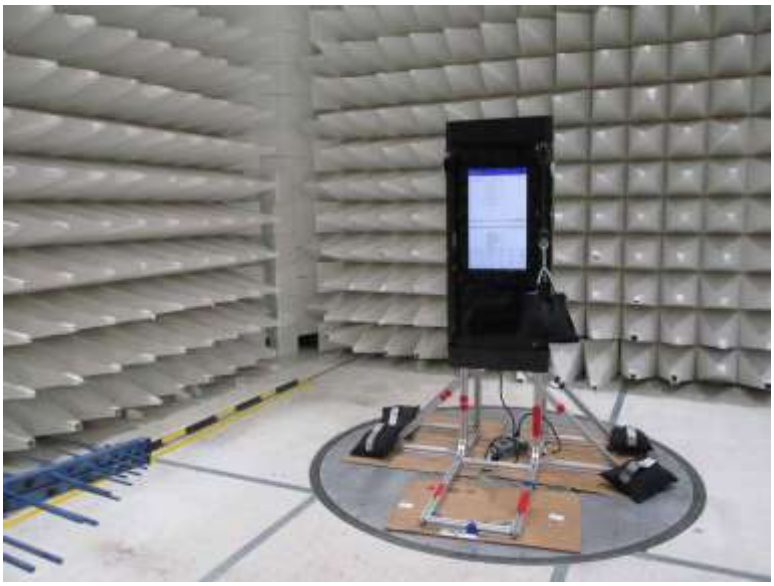
9kHz-1GHz



Front View

Back View

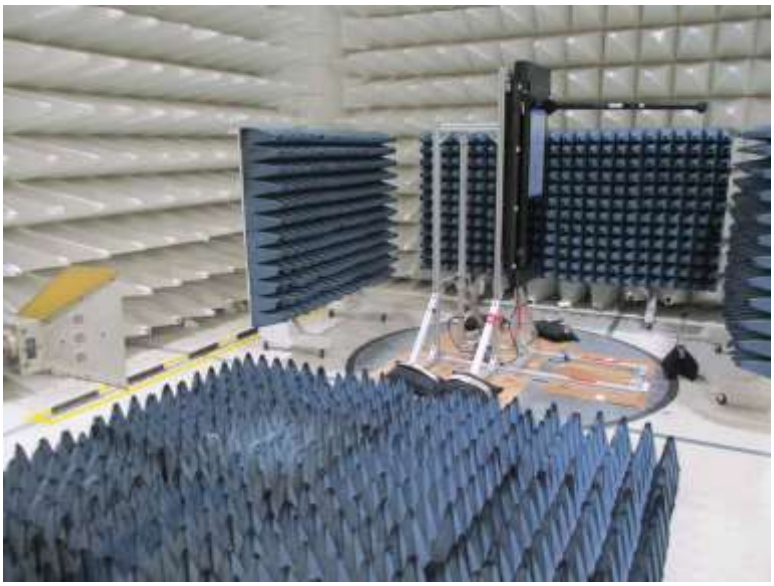
30MHz-1GHz



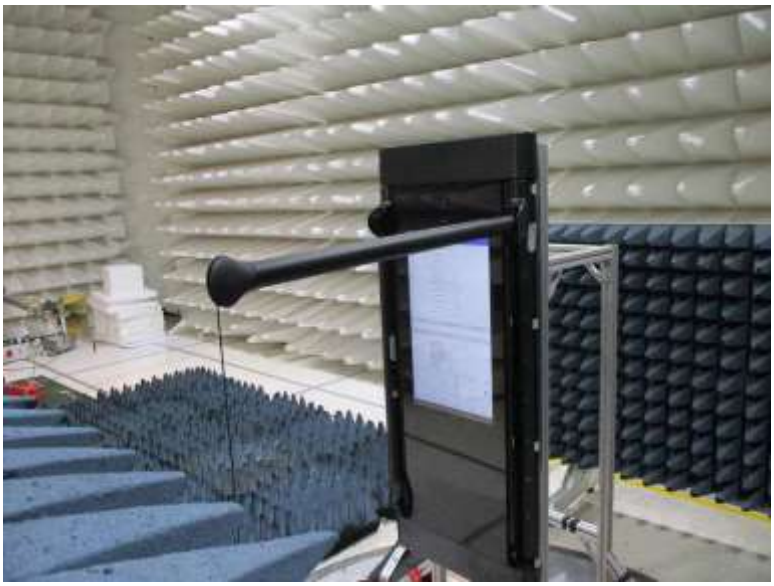
Front View

Back View

1GHz-12GHz

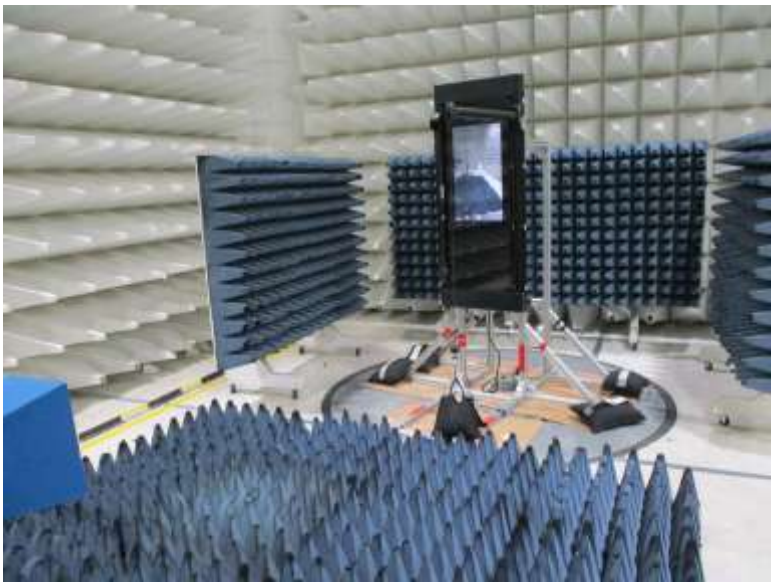


Front View

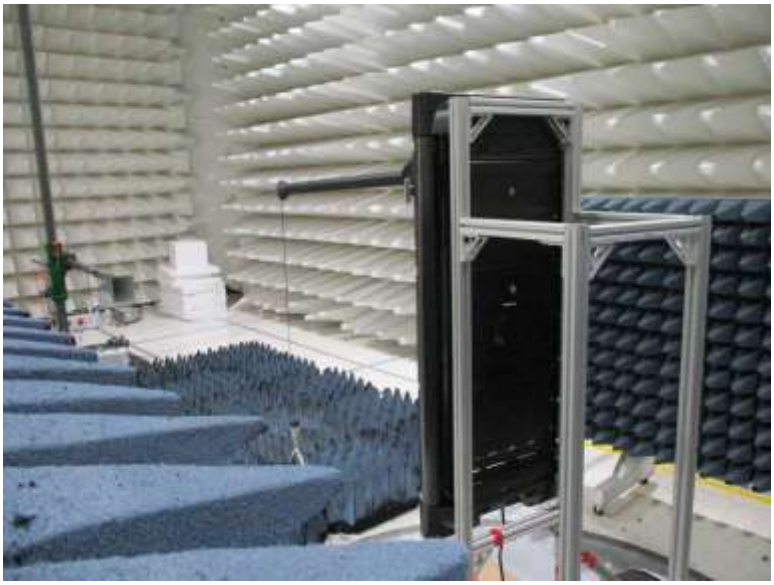


Back View

12GHz-40GHz



Front View



Back View

15.207 AC Conducted Emissions

Test Data

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**110285**	Date:	10/17/2024
Test Type:	**Conducted Emissions**	Time:	13:46:52
Tested By:	Hieu Song Nguyenpham	Sequence#:	170
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

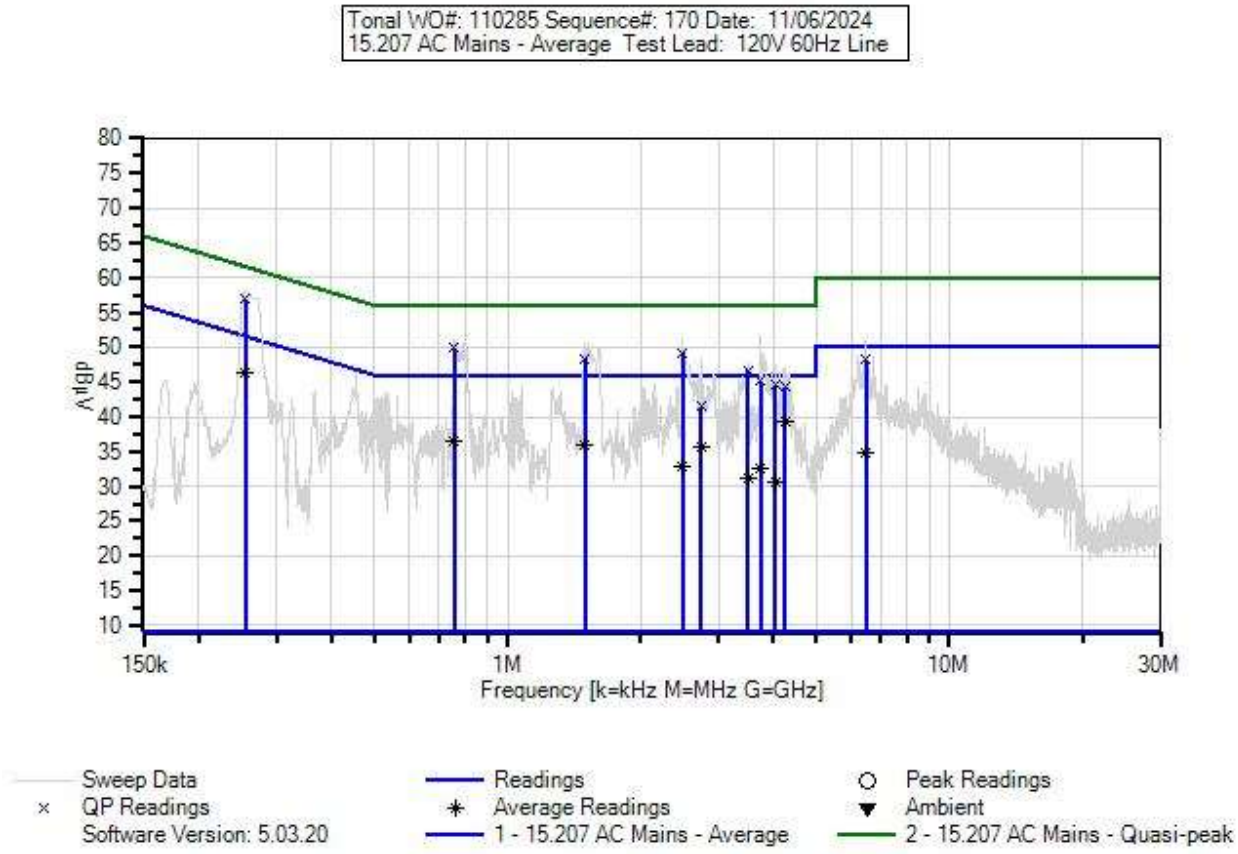
Conducted Emission
Frequency Range: 150kHz to 30MHz

Test Environment Conditions:
Temperature: 21.6°C
Humidity: 49%
Atmospheric Pressure: 101.4kPa

Highest Generation Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. It is set in a testing mode, lifting a weight on a loop. Video and Camera are On
All WIFI and Bluetooth modules are on

Modification #1 was in place during testing.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	12/2/2022	12/2/2024
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
T4	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN03814	50uH LISN-1PH-Neutral (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	5/6/2024	5/6/2026

Measurement Data: Reading listed by margin. Test Lead: Line

#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	254.718k QP	46.8	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	56.9	61.6	-4.7	Line
2	254.718k Ave	36.2	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	46.3	51.6	-5.3	Line
^	254.718k	48.1	+9.9 +0.1	+0.1	+0.0	+0.0	+0.0	58.2	51.6	+6.6	Line
4	758.671k QP	39.7	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	50.0	56.0	-6.0	Line
5	4.237M Ave	29.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	39.4	46.0	-6.6	Line
6	2.485M QP	39.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	49.2	56.0	-6.8	Line
7	1.494M QP	38.2	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	48.4	56.0	-7.6	Line
8	3.501M QP	36.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	46.6	56.0	-9.4	Line
9	758.671k Ave	26.2	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	36.5	46.0	-9.5	Line
^	758.671k	41.9	+9.9 +0.2	+0.1	+0.0	+0.1	+0.0	52.2	46.0	+6.2	Line
11	1.494M Ave	25.7	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	35.9	46.0	-10.1	Line
^	1.494M	41.0	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.2	46.0	+5.2	Line
13	2.744M Ave	25.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	35.8	46.0	-10.2	Line
14	3.739M QP	34.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	45.1	56.0	-10.9	Line
15	4.041M QP	34.1	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	44.5	56.0	-11.5	Line
16	4.237M QP	33.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	44.3	56.0	-11.7	Line
^	4.237M	41.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	51.6	46.0	+5.6	Line
18	6.463M QP	37.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	48.2	60.0	-11.8	Line
19	2.485M Ave	22.7	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	32.9	46.0	-13.1	Line
^	2.485M	41.1	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	51.3	46.0	+5.3	Line
21	3.739M Ave	22.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	32.6	46.0	-13.4	Line
^	3.739M	42.0	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.4	46.0	+6.4	Line

23 QP	2.744M	31.3	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	41.5	56.0	-14.5	Line
^	2.744M	36.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	46.8	46.0	+0.8	Line
25 Ave	3.501M	20.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	31.3	46.0	-14.7	Line
^	3.501M	39.8	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	50.2	46.0	+4.2	Line
27 Ave	6.463M	24.3	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	34.7	50.0	-15.3	Line
^	6.463M	41.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	52.1	50.0	+2.1	Line
29 Ave	4.041M	20.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	30.6	46.0	-15.4	Line
^	4.041M	39.1	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	49.5	46.0	+3.5	Line

Test Location:	CKC Laboratories, Inc. • 1120 Fulton Pl • Fremont, CA 94539 • (510) 249-1170		
Customer:	**Tonal**		
Specification:	**15.207 AC Mains - Average**		
Work Order #:	**110285**	Date:	10/17/2024
Test Type:	**Conducted Emissions**	Time:	14:16:33
Tested By:	Hieu Song Nguyenpham	Sequence#:	171
Software:	EMITest 5.03.20		120V 60Hz

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

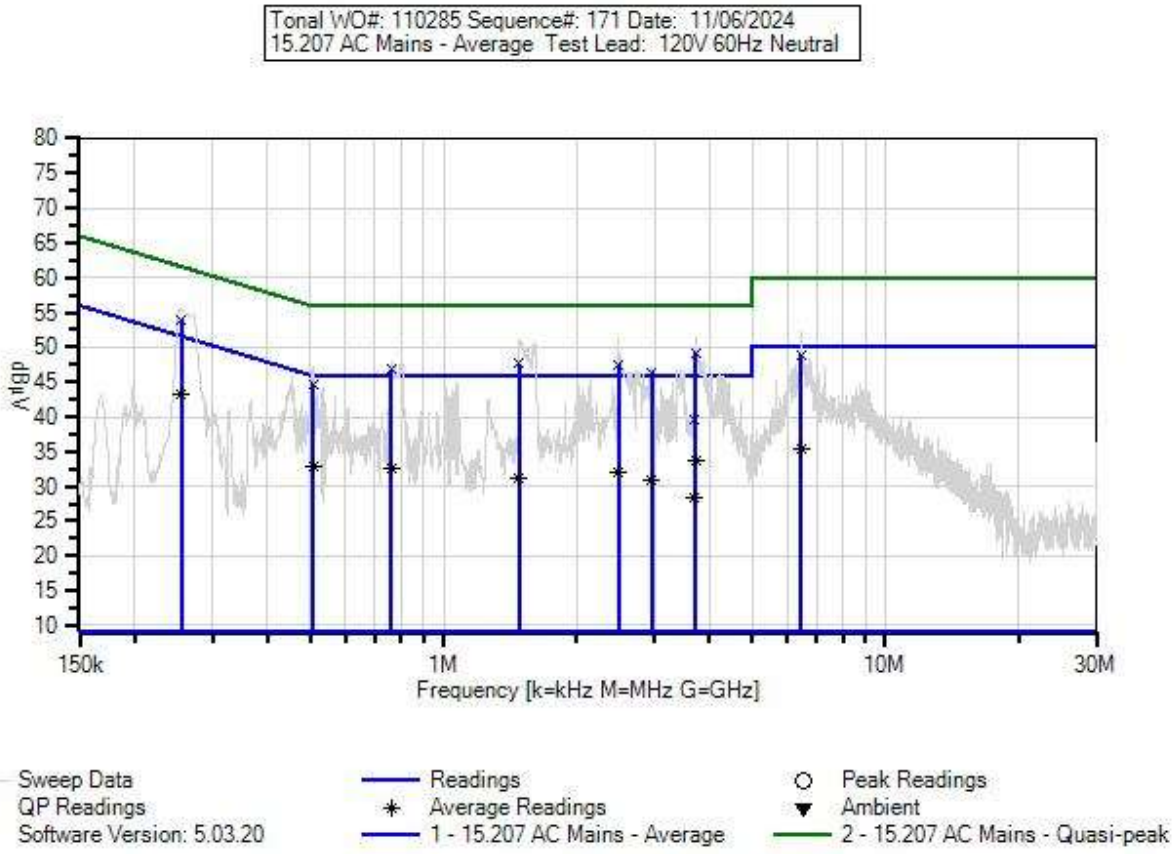
Conducted Emission
Frequency Range: 150kHz to 30MHz

Test Environment Conditions:
Temperature: 21.6°C
Humidity: 49%
Atmospheric Pressure: 101.4kPa

Highest Generation Frequency: 5.825GHz
Test Method: ANSI C63.10 (2020)

The unit is mounted to a floor standing rack as to simulate typical wall mounted setup. It is set in a testing mode, lifting a weight on a loop. Video and Camera are On
All WIFI and Bluetooth modules are on

Modification #1 was in place during testing.



Test Equipment:

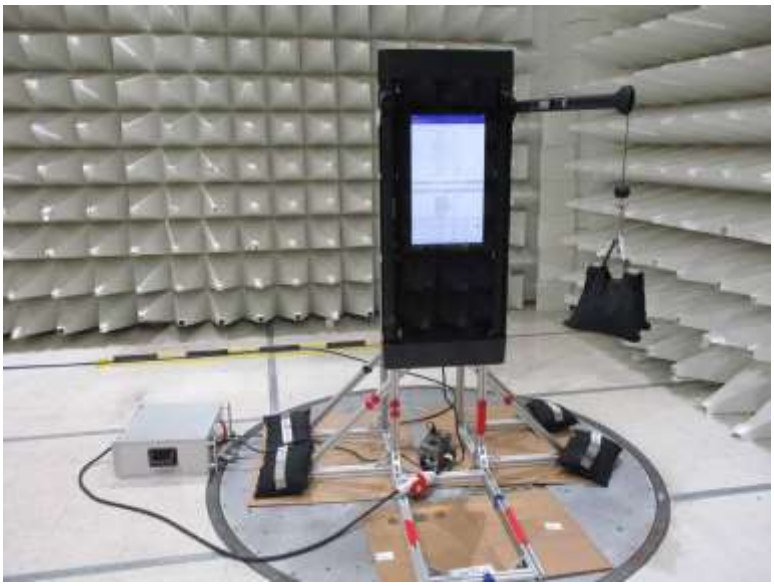
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP01211	Attenuator	23-10-34	12/2/2022	12/2/2024
T2	ANP00880	Cable	RG214U	3/26/2024	3/26/2026
T3	ANP06691	Cable	PE3062-180	3/20/2024	3/20/2026
	AN03814	50uH LISN-1PH-Line (dB)	NSLK 8126	1/4/2023	1/4/2025
T4	AN03814	50uH LISN-1PH-Neutral (dB)	NSLK 8126	1/4/2023	1/4/2025
	AN02660	Spectrum Analyzer	E4446A	12/6/2022	12/6/2024
T5	ANP05258	High Pass Filter	HE9615-150K-50-720B	5/6/2024	5/6/2026

Measurement Data: Reading listed by margin. Test Lead: Neutral

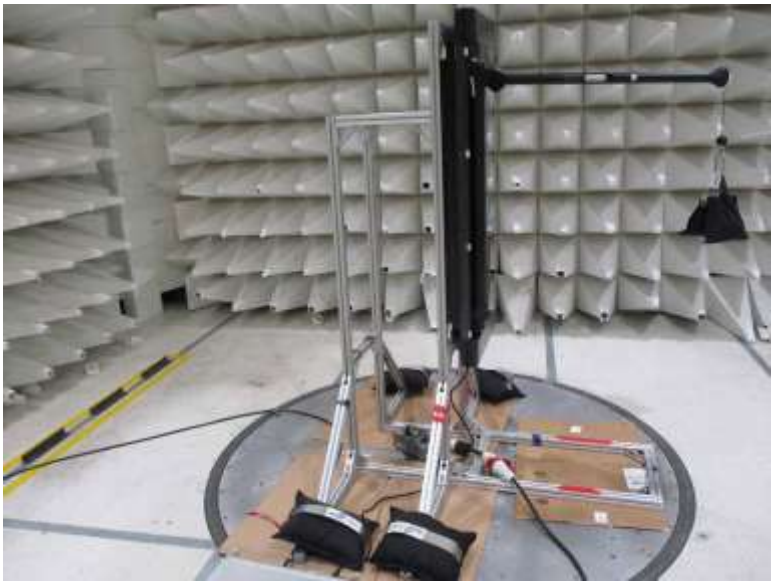
#	Freq	Rdng	T1 T5	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV	dBµV	dB	Ant
1	3.722M	38.8	+9.9	+0.2	+0.1	+0.1	+0.0	49.2	56.0	-6.8	Neutr
	QP		+0.1								
2	255.445k	44.0	+9.8	+0.1	+0.0	+0.0	+0.0	54.0	61.6	-7.6	Neutr
	QP		+0.1								
3	255.445k	33.3	+9.8	+0.1	+0.0	+0.0	+0.0	43.3	51.6	-8.3	Neutr
	Ave		+0.1								
^	255.445k	44.9	+9.8	+0.1	+0.0	+0.0	+0.0	54.9	51.6	+3.3	Neutr
			+0.1								
5	1.485M	37.4	+9.9	+0.1	+0.0	+0.1	+0.0	47.6	56.0	-8.4	Neutr
	QP		+0.1								
6	2.489M	37.3	+9.9	+0.1	+0.0	+0.1	+0.0	47.5	56.0	-8.5	Neutr
	QP		+0.1								
7	761.580k	36.7	+9.9	+0.1	+0.0	+0.0	+0.0	46.9	56.0	-9.1	Neutr
	QP		+0.2								
8	2.961M	36.2	+9.9	+0.1	+0.0	+0.1	+0.0	46.4	56.0	-9.6	Neutr
	QP		+0.1								
9	6.449M	38.5	+9.9	+0.2	+0.1	+0.1	+0.0	48.9	60.0	-11.1	Neutr
	QP		+0.1								
10	506.032k	34.5	+9.9	+0.1	+0.0	+0.0	+0.0	44.7	56.0	-11.3	Neutr
	QP		+0.2								
11	3.722M	23.3	+9.9	+0.2	+0.1	+0.1	+0.0	33.7	46.0	-12.3	Neutr
	Ave		+0.1								
^	3.722M	42.2	+9.9	+0.2	+0.1	+0.1	+0.0	52.6	46.0	+6.6	Neutr
			+0.1								
13	506.032k	22.6	+9.9	+0.1	+0.0	+0.0	+0.0	32.8	46.0	-13.2	Neutr
	Ave		+0.2								
^	506.032k	38.9	+9.9	+0.1	+0.0	+0.0	+0.0	49.1	46.0	+3.1	Neutr
			+0.2								
15	761.580k	22.4	+9.9	+0.1	+0.0	+0.0	+0.0	32.6	46.0	-13.4	Neutr
	Ave		+0.2								
^	761.580k	39.4	+9.9	+0.1	+0.0	+0.0	+0.0	49.6	46.0	+3.6	Neutr
			+0.2								
17	2.489M	21.8	+9.9	+0.1	+0.0	+0.1	+0.0	32.0	46.0	-14.0	Neutr
	Ave		+0.1								
^	2.489M	41.5	+9.9	+0.1	+0.0	+0.1	+0.0	51.7	46.0	+5.7	Neutr
			+0.1								
19	6.449M	25.0	+9.9	+0.2	+0.1	+0.1	+0.0	35.4	50.0	-14.6	Neutr
	Ave		+0.1								
^	6.449M	42.2	+9.9	+0.2	+0.1	+0.1	+0.0	52.6	50.0	+2.6	Neutr
			+0.1								
21	1.485M	21.0	+9.9	+0.1	+0.0	+0.1	+0.0	31.2	46.0	-14.8	Neutr
	Ave		+0.1								
^	1.485M	41.5	+9.9	+0.1	+0.0	+0.1	+0.0	51.7	46.0	+5.7	Neutr
			+0.1								

23	2.961M Ave	20.6	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	30.8	46.0	-15.2	Neutr
^	2.961M	38.9	+9.9 +0.1	+0.1	+0.0	+0.1	+0.0	49.1	46.0	+3.1	Neutr
25	3.705M QP	29.2	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	39.6	56.0	-16.4	Neutr
26	3.705M Ave	17.9	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	28.3	46.0	-17.7	Neutr
^	3.705M	39.7	+9.9 +0.1	+0.2	+0.1	+0.1	+0.0	50.1	46.0	+4.1	Neutr

Test Setup Photo(s)



Front View



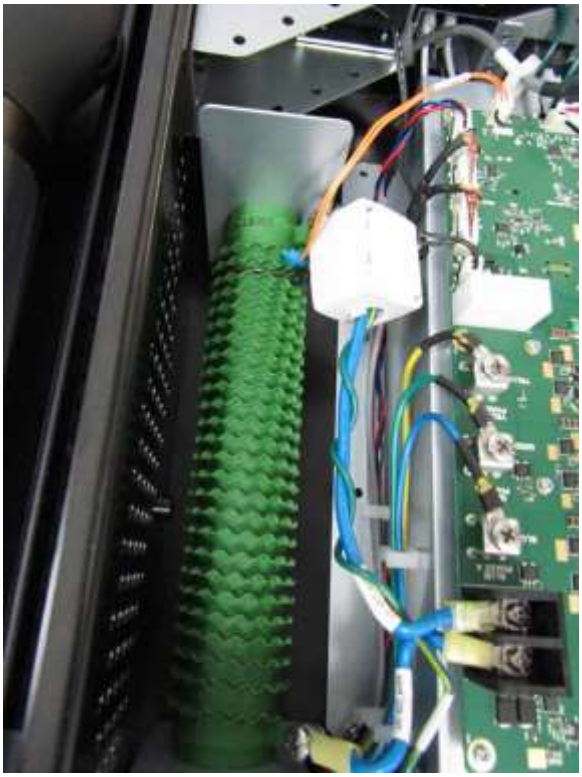
Side View

APPENDIX A: MODIFICATIONS MADE DURING TESTING

This list is a summary of the conditions noted for or modifications made to the equipment during testing.

Summary of Conditions
Modification #1 (Mod#1) = Added a ferrite (Wurth: 742 712 21) on lower resistor wire. Green Resistor.

Modifications listed above must be incorporated into all production units.



Modification #1

Supplemental Information

Measurement Uncertainty

Uncertainty Value	Parameter
5.77 dB	Radiated Emissions
0.673 dB	RF Conducted Measurements
5.77 x 10^{-10}	Frequency Deviation
0.00005 s	Time Deviation
3.18 dB	Mains Conducted Emissions

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.

End of Report