FCC and ISED Test Report

Apple Inc
Model: A2737

In accordance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN (2.4 GHz WLAN)

Prepared for: Apple Inc
One Apple Park Way
Cupertino, California
95014, USA

Add value.
Inspire trust.

FCC ID: BCGA2737 IC: 579C-A2737

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Document 75954422-11 Issue 02

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	30 September 2022

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

ENGINEERING STATEMENT
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Report Generation	Lauren Walters	30 September 2022	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED Accreditation
12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C:2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.

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Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuvsud.com/en

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom

Contents

1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	29-September-2022
2	Updated Number of samples to 3	30-September-2022

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2737
Serial Number(s)	MW5QG9Q771, QQRXMCWXL5 & H32RX9W726
Hardware Version(s)	REV 1.0
Software Version(s)	20J42560n
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	540246998
Date of Receipt of EUT	06-May-2022
Start of Test	10-May-2022
Finish of Test	28-September-2022
Name of Engineer(s)	Daniel Cameron, Thomas Randall, Mohammad Malik, Ian Hart, Elliot Callender, Faisal Malyar, Danial Shafique, Taha Shafique and Mohammad Malik
Related Document(s)	ANSI C63.4 (2014) ANSI C63.10 (2013) ANSI C63.10 (2020) KDB 662911 D01 v02r01

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN is shown below.

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz WLAN						
-	15.203	-	-	Antenna Requirement	N/T	The device complies with the provisions of this section, as it uses permanently attached integral antennas.
2.1	15.205	3.3	8.10	Restricted Band Edges	Pass	
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.4	15.247 (d) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	

Table 2

1.4 Product Information

1.4.1 Technical Description

The equipment under test was an Apple TV Set Top Box with Bluetooth® and IEEE 802.11 a/b/g/n/ac/ax Wi-Fi capabilities in the 2.4GHz and 5GHz bands.

1.4.2 Test Modes

The EUT's 2.4 GHz 802.11 radio supports Single Input/Single Output (SISO) and 2x2 MIMO (Multiple Input/Multiple Output). It supports 802.11b and g for SISO and 802.11n and ax at 20 MHz channel bandwidths for SISO and MIMO. 802.11ax supports RU 26/52/106/242.

The EUT uses different output powers per core dependent on how many cores are used. It uses the same conducted power across all cores in any given mode, but due to the different antenna gains the radiated powers per core differs.

Radiated Spurious emissions were performed in the following modes, as these were deemed to be worst case.

SISO Modes (Core 0 / Core 1)
- 802.11b 1 Mbps
- 802.11g 12 Mbps

2x2 MIMO Modes (Core 0 + Core 1):
- 802.11n HT20 MCS0
- 802.11ax HE20 MCS0 (RU26)

Band edge tests were performed with multiple modulation types, with only the worst-cases reported.

SISO Modes (Core 0):
- 802.11b 1 Mbps
- 802.11g 12 Mbps, 24 Mbps & 54 Mbps
- 802.11n HT20 MCS2 & MCS4
- 802.11ax HE20 MCS2x1, MCS4x1 & MCS9x1 (SU & RU26)

2x2 MIMO Modes (Core 0 + Core 1):
- 802.11n HT20 MCS2, MCS7 & MCS4
- 802.11ax HE20 MCS2x1, MCS4x1 MCS9x1 (SU & RU26)

After preliminary investigations, conducted tests were performed on the EUT in the following worst-case modes:

SISO Modes (Core 0):
- 802.11b 1 Mbps
- 802.11g 12 Mbps
- 802.11n HT20 MCS2
- 802.11ax HE20 MCS2x1 SU, RU26/52/106*

2x2 MIMO Modes (Core 0 + Core 1):
- 802.11n HT20 MCS2 – CDD
- 802.11ax HE20 MCS2x1 CDD SU, RU26/52/106*

*Note: The RU offset for bottom and middle channels were placed in the lowest position and on the top channel, the offset was placed in the upper most position.

1.4.3 Test Set-up

For conducted tests the EUT antennas were disconnected and replaced with U.FL to SMA test cables to enable conducted testing on each core. The loss of these test cables were known and compensated for in any conducted measurements.

For all tests, the EUT was put into a continuous transmit test mode with the chipset manufacturer's test commands via a script running in the EUTs terminal application. The EUT then transmitted the required type of packeted 802.11 data frames of fixed length, containing the standard headers and with pseudo-random data content, ensuring the measured signals were representative and contained all the symbols at the highest power control level.

All testing was performed with the EUT powered via a 120 V AC, 60 Hz source.

1.4.4 Antenna Gain Table

Antenna Port	Frequency Range (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
Core 0	2400 to 2480	-0.21	0.7
Core 1	2400 to 2480	-1.02	0.7

Table 3

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: A2737, Serial Number: MW5QG9Q771			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2737, Serial Number: QQRXMCWXL5			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2737, Serial Number: H32RX9W726			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.7 Test Location

TÜV SÜD conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz WLAN		
Restricted Band Edges	Thomas Randall, Mohammad Malik, Ian Hart, Elliot Callender, Faisal Malyar and Danial Shafique	UKAS
Emission Bandwidth	Daniel Cameron	UKAS
Maximum Conducted Output Power	Daniel Cameron	UKAS
Authorised Band Edges	Thomas Randall, Mohammad Malik, Ian Hart, Elliot Callender, Faisal Malyar and Danial Shafique	UKAS
Power Spectral Density	Daniel Cameron	UKAS
Spurious Radiated Emissions	Danial Shafique, Taha Shafique and Elliot Callender	UKAS

Table 5

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire
PO15 5RL
United Kingdom

TÜV SÜD conducted the following tests at our Concorde Park Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz WLAN		
Spurious Radiated Emissions	Ian Hart, Danial Shafique, Taha Shafique, Elliot Callender, Thomas Randall and Mohammad Malik	UKAS

Table 6

Office Address:

TÜV SÜD
Concorde Park
Concorde Way
Fareham
Hampshire
PO15 5FG
United Kingdom

2 Test Details

2.1 Restricted Band Edges

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
ISED RSS-247, Clause 3.3
ISED RSS-GEN, Clause, 8.10

2.1.2 Equipment Under Test and Modification State

A2737, S/N: QQRXMCWXL5 - Modification State 0

2.1.3 Date of Test

10-May-2022 to 24-May-2022

2.1.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5 and 11.12.1.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 11.12.2.5.2.

The following conversion can be applied to convert from dBµV/m to µV/m:
10^(Field Strength in dBµV/m/20).

2.1.5 Environmental Conditions

Ambient Temperature	21.5 - 25.7 °C
Relative Humidity	36.8 - 50.7 %

2.1.6 Test Results

2.4 GHz WLAN

SISO

Mode	Data Rate /MCS	Resource Size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
802.11b, Core 0	1 Mbps	-	-	2412	2390.0	57.29	47.78
802.11b, Core 0	1 Mbps	-	-	2462	2483.5	57.86	45.87
802.11b, Core 0	1 Mbps	-	-	2467	2483.5	59.72	47.40
802.11b, Core 0	1 Mbps	-	-	2472	2483.5	61.75	49.73
802.11g, Core 0	12 Mbps	-	-	2412	2390.0	63.55	51.05
802.11g, Core 0	12 Mbps	-	-	2462	2483.5	65.03	50.87
802.11g, Core 0	24 Mbps	-	-	2467	2483.5	67.00	51.24
802.11g, Core 0	54 Mbps	-	-	2472	2483.5	66.21	51.38
802.11n HT20, Core 0	MCS2	-	-	2412	2390.0	64.16	51.30
802.11n HT20, Core 0	MCS4	-	-	2462	2483.5	69.12	51.07
802.11n HT20, Core 0	MCS4	-	-	2467	2483.5	67.30	51.39
802.11n HT20, Core 0	MCS2	-	-	2472	2483.5	67.32	51.16
802.11ax HE20, Core 0	MCS9x1	SU	-	2412	2390.0	67.52	51.03
802.11ax HE20, Core 0	MCS9x1	26	0	2412	2390.0	56.27	43.65
802.11ax HE20, Core 0	MCS2x1	SU	-	2462	2483.5	65.03	50.94
802.11ax HE20, Core 0	MCS9x1	26	8	2462	2483.5	56.20	43.84
802.11ax HE20, Core 0	MCS2x1	SU	-	2467	2483.5	64.81	51.49
802.11ax HE20, Core 0	MCS9x1	26	8	2467	2483.5	58.30	44.57
802.11ax HE20, Core 0	MCS2x1	SU	-	2472	2483.5	69.20	49.72
802.11ax HE20, Core 0	MCS9x1	26	8	2472	2483.5	69.90	48.63

Table 7 - SISO Restricted Band Edge Results

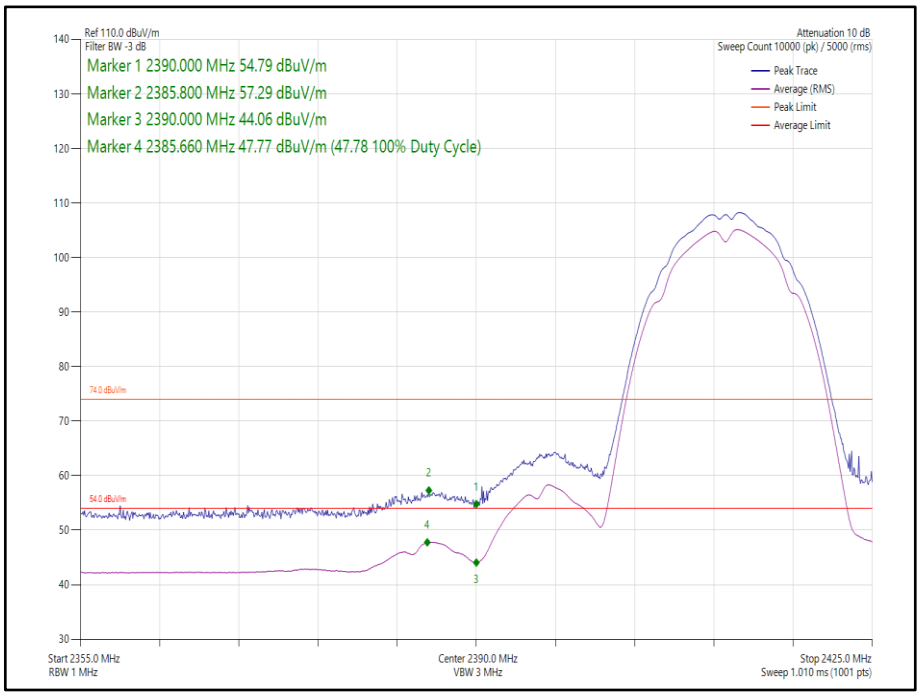

Figure 1 - 802.11b, Core 0 - 2412 Hz, Band Edge Frequency 2390.0 MHz

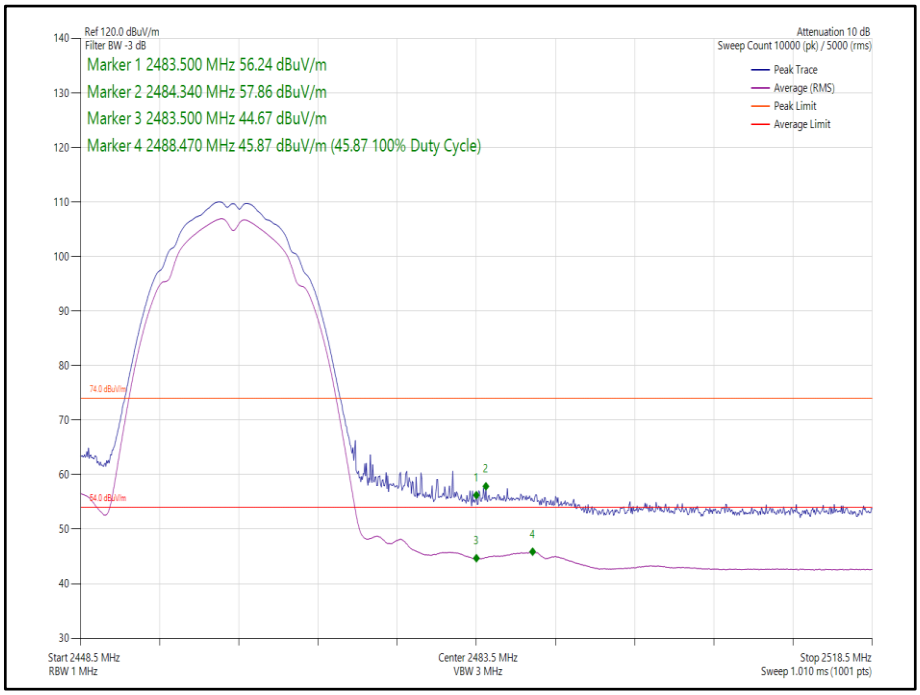

Figure 2 - 802.11b, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

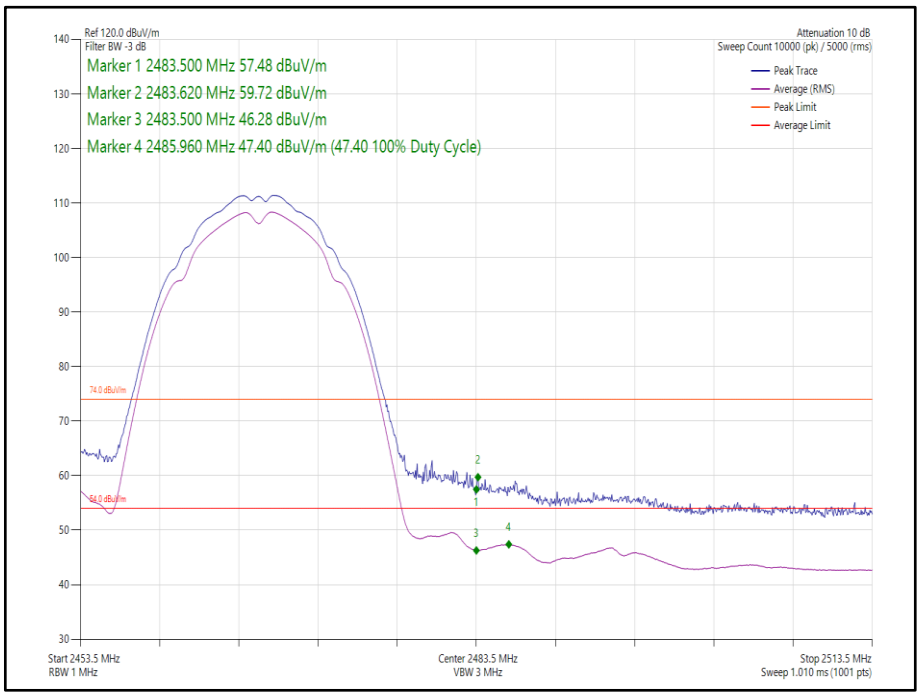

Figure 3 - 802.11b, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

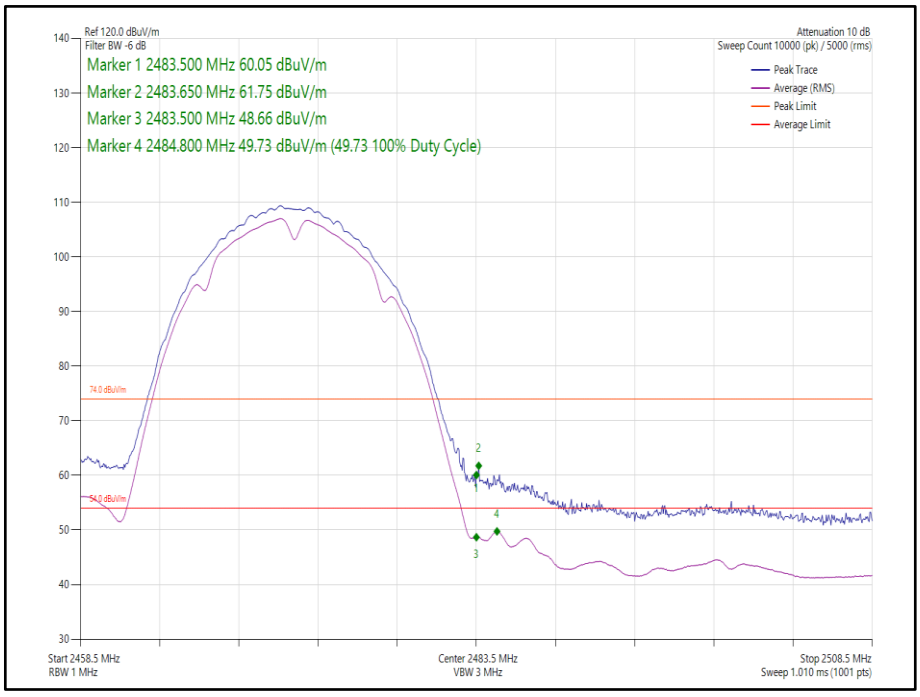

Figure 4 - 802.11b, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

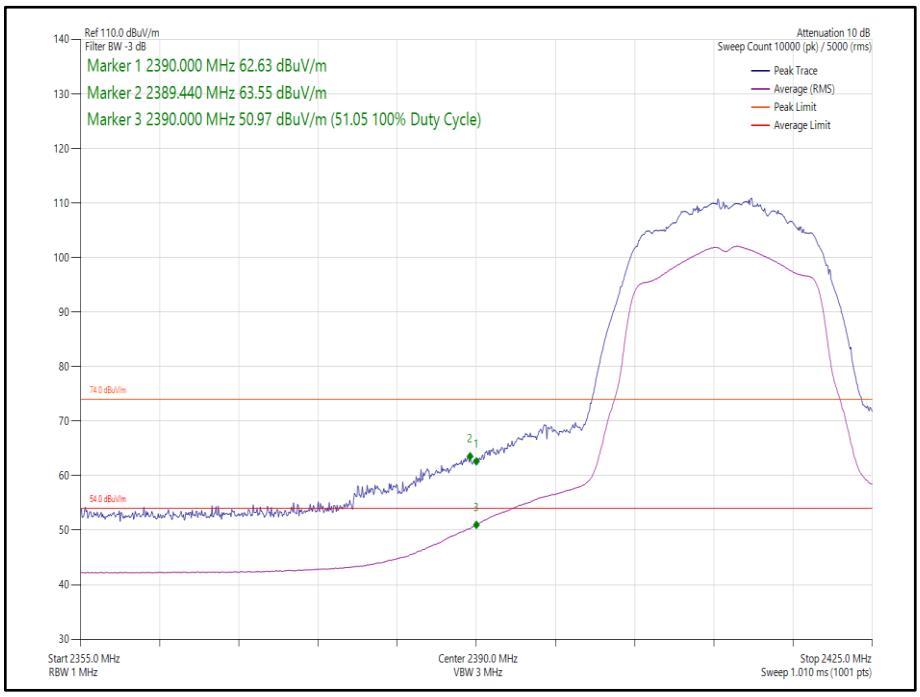

Figure 5 - 802.11g, Core 0 - 2412 MHz, Band Edge Frequency 2390.0 MHz

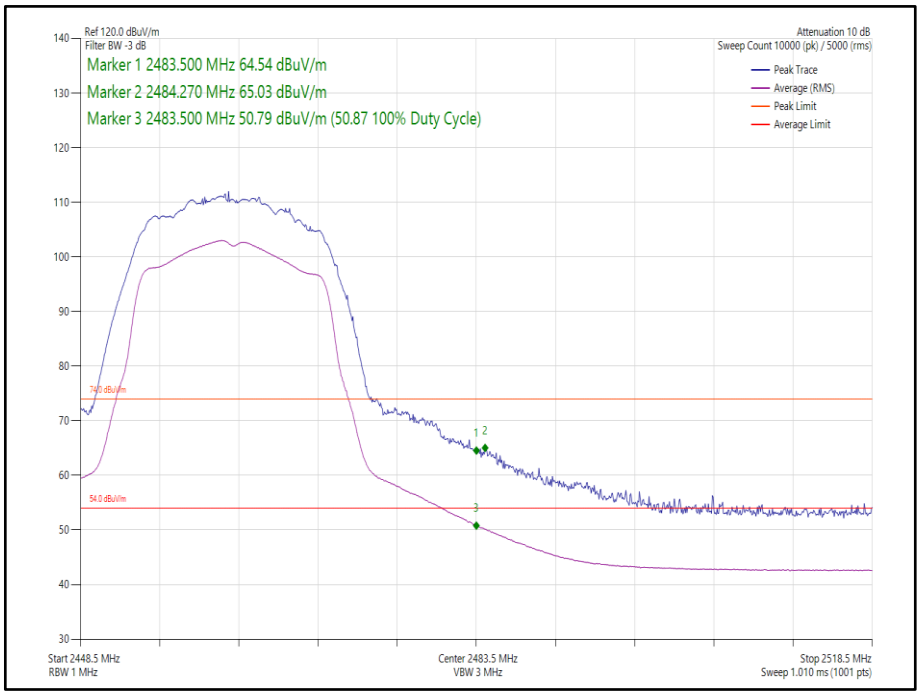

Figure 6 - 802.11g, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

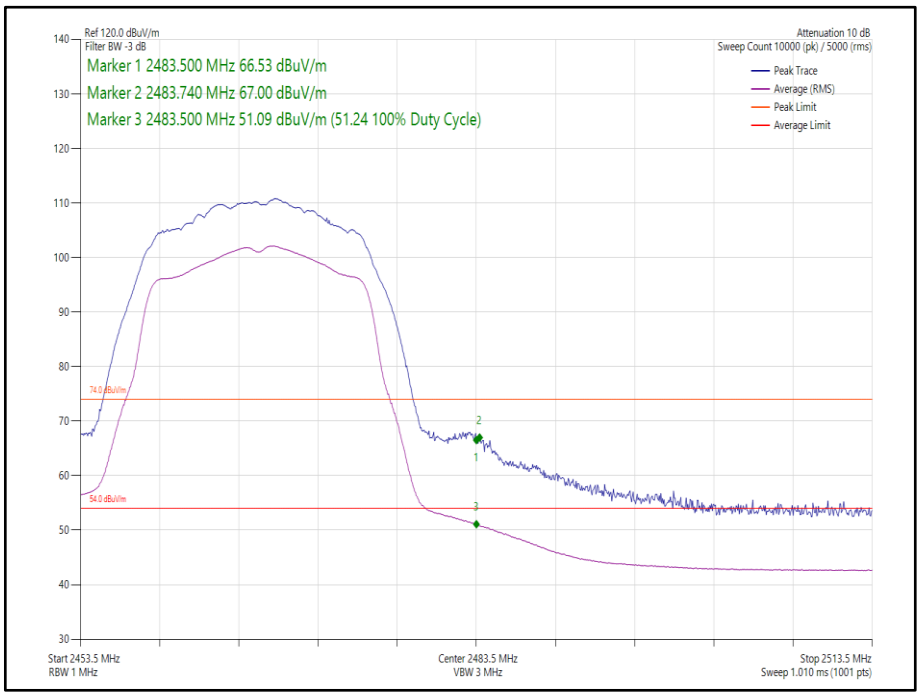

Figure 7 - 802.11g, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

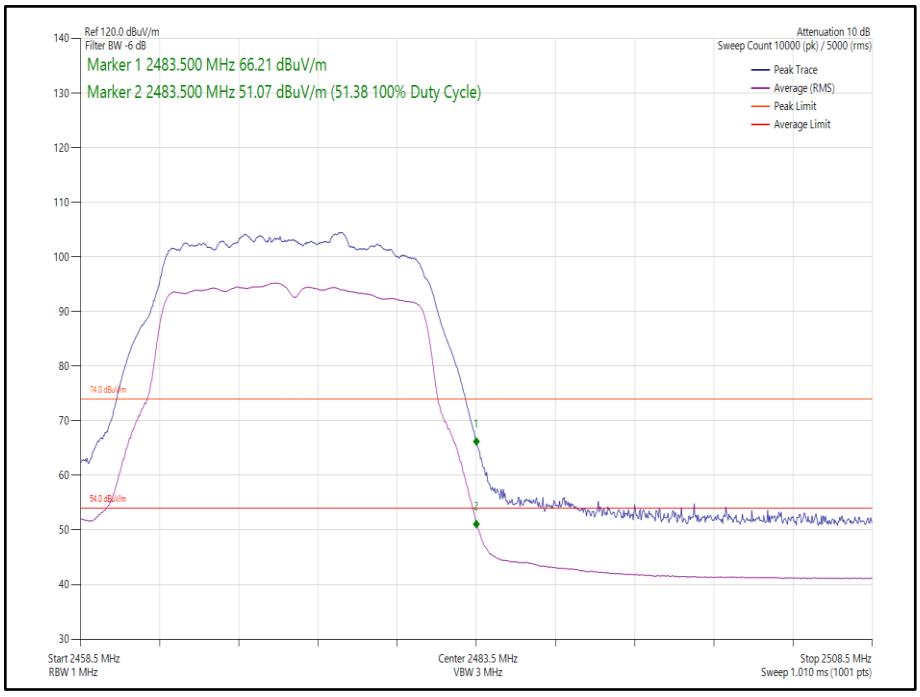

Figure 8 - 802.11g, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

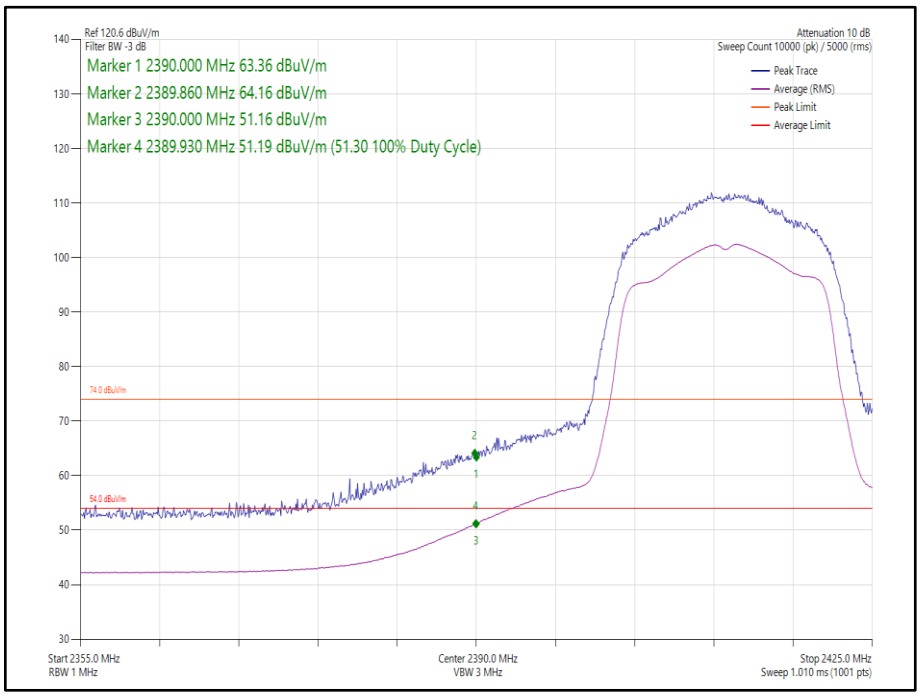

Figure 9 - 802.11n, HT20, Core 0 - 2412 MHz, Band Edge Frequency 2390 MHz

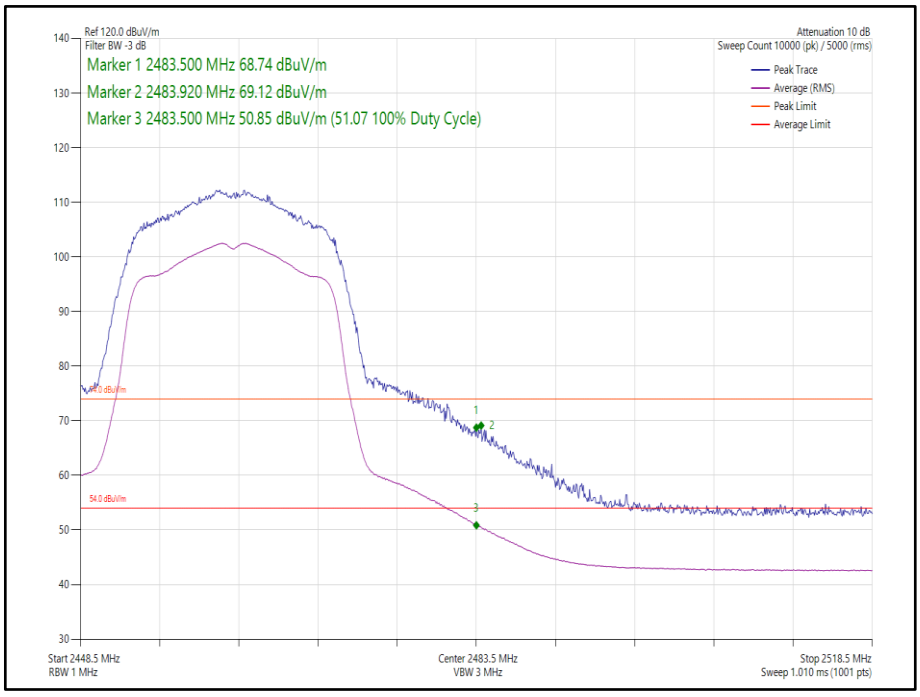

Figure 10 - 802.11n HT20, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

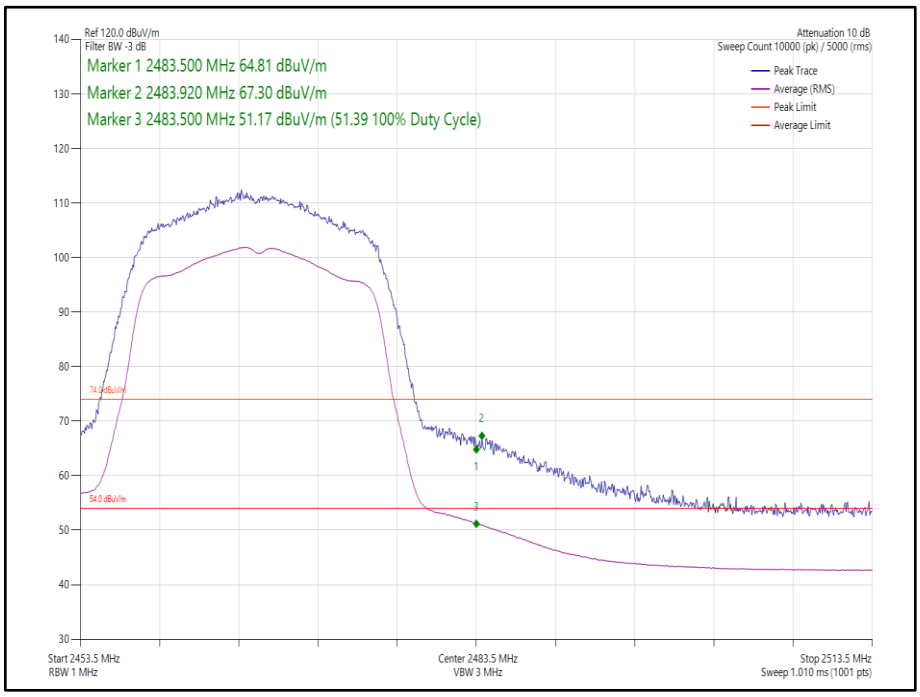

Figure 11 - 802.11n HT20, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

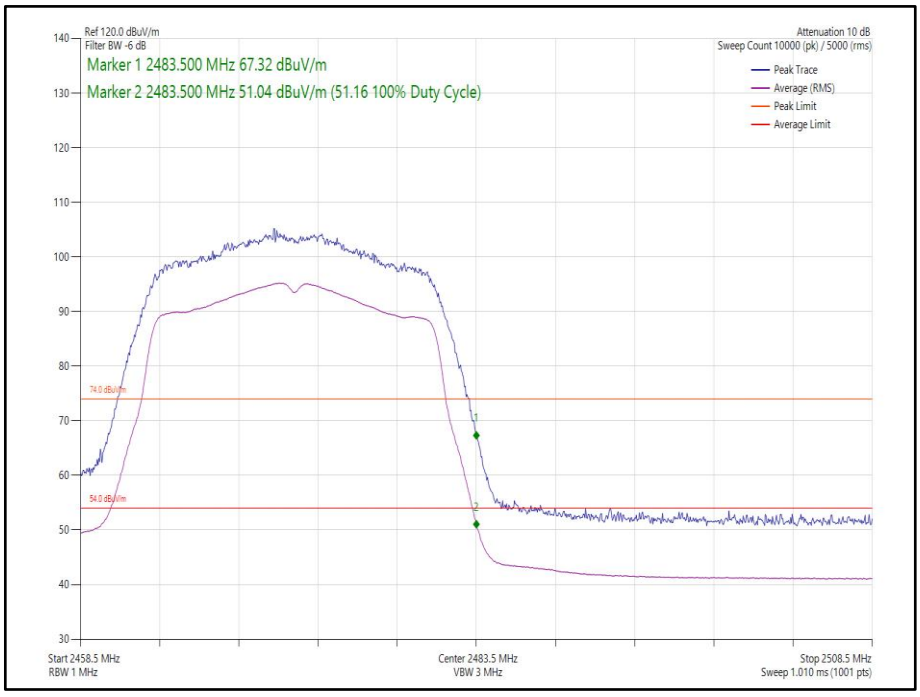

Figure 12 - 802.11n HT20, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

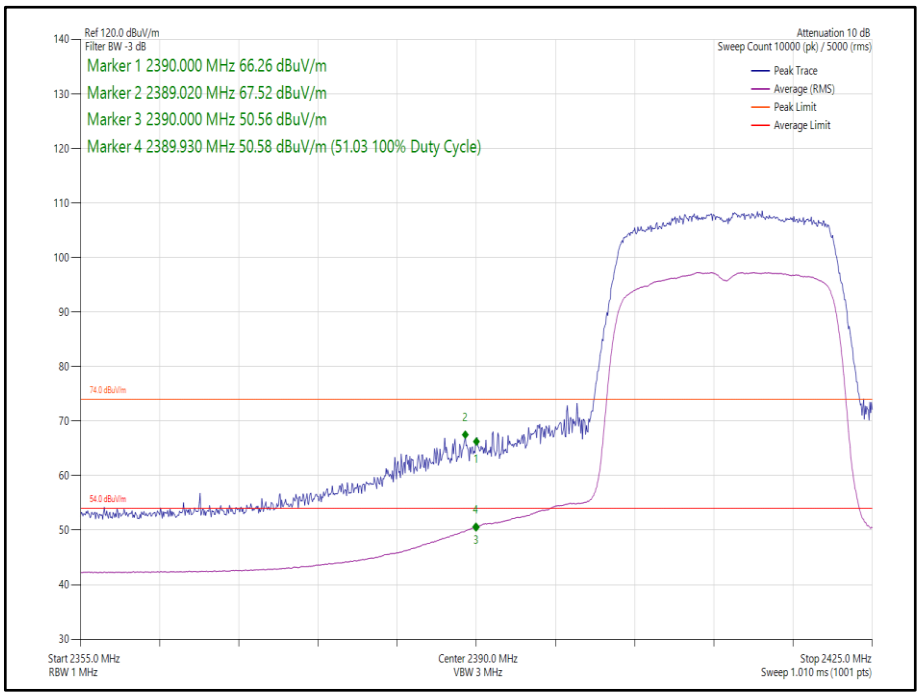

Figure 13 - 802.11ax HE20, Core 0, SU - 2412 MHz, Band Edge Frequency 2390 MHz

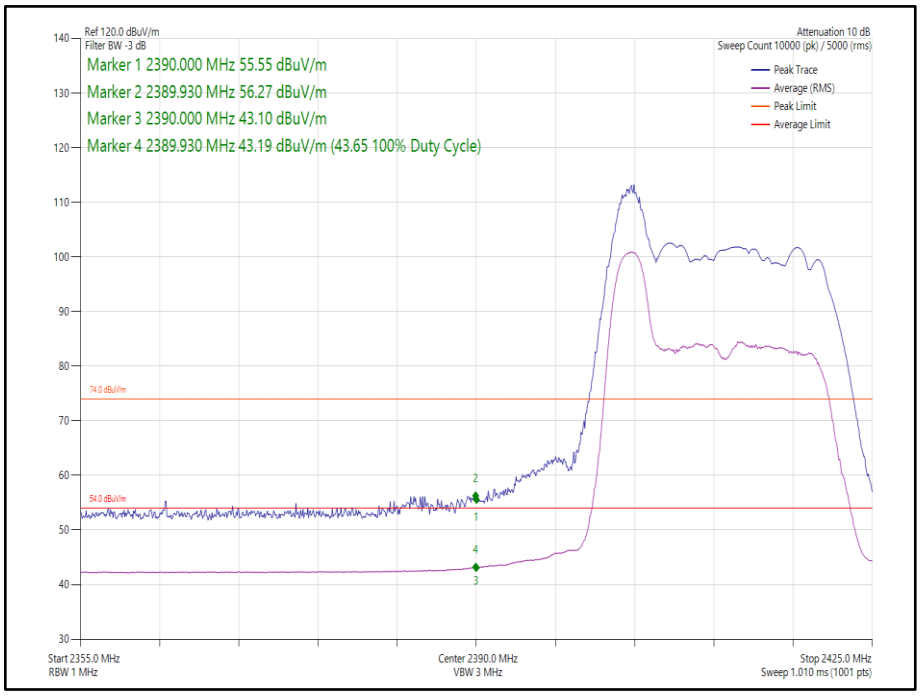

Figure 14 - 802.11ax HE20, Core 0, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz

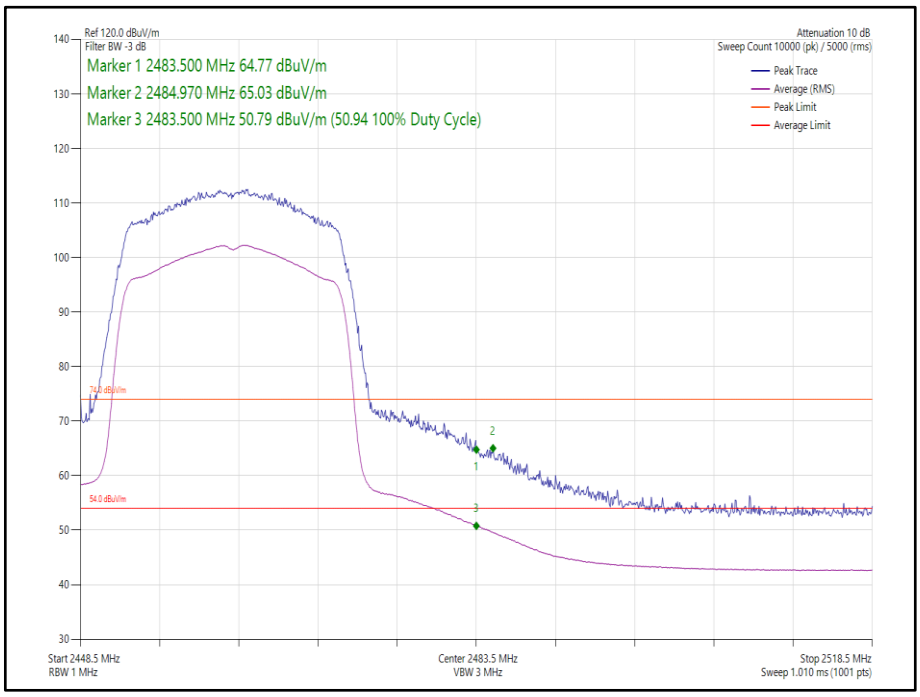

Figure 15 - 802.11ax HE20, Core 0, SU - 2462 MHz, Band Edge Frequency 2483.5 MHz

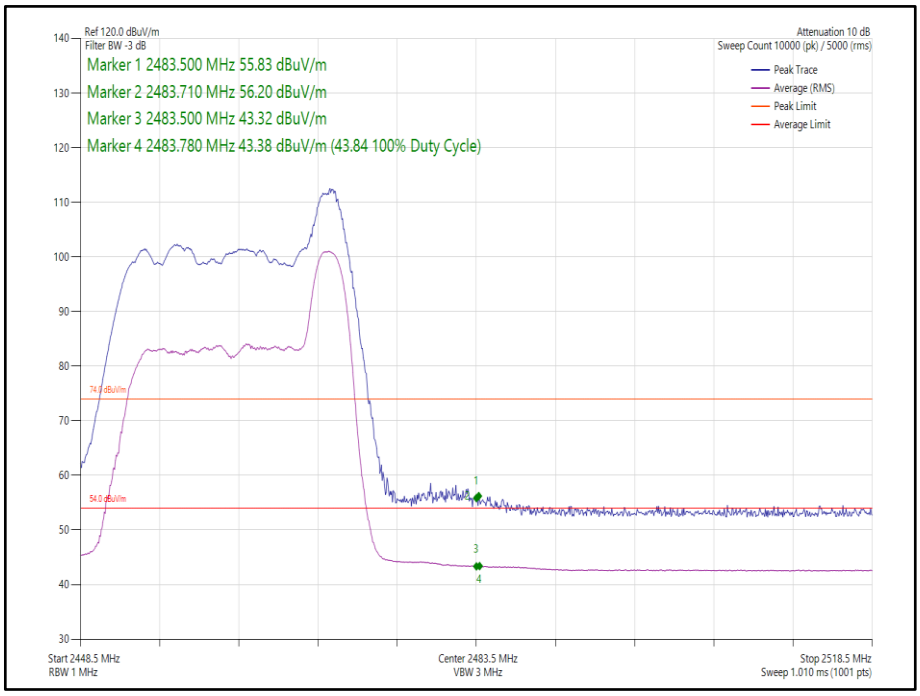

Figure 16 - 802.11ax HE20, Core 0, 26-8 - 2462 MHz, Band Edge Frequency 2483.5 MHz

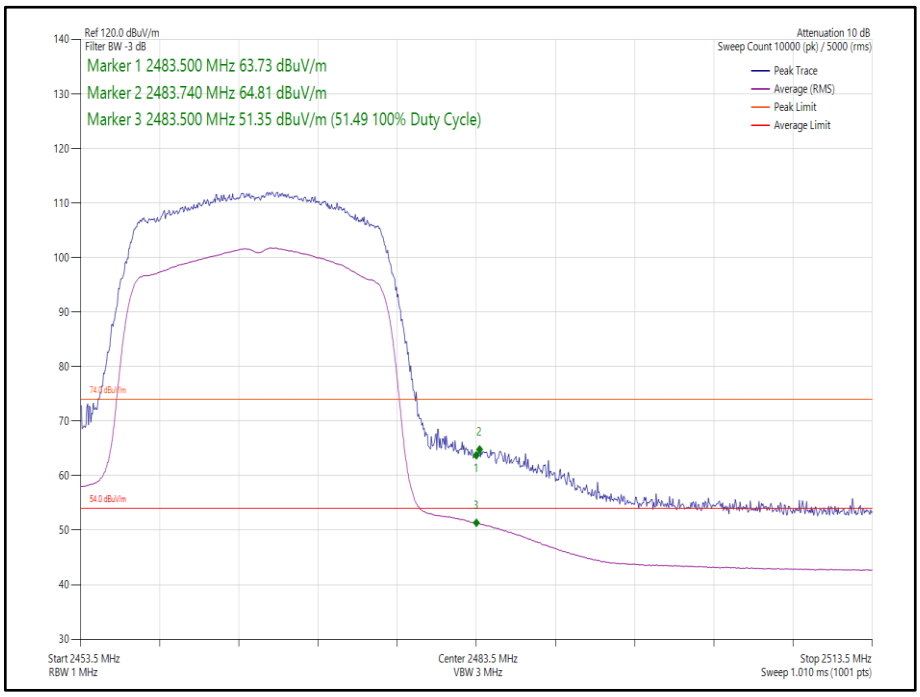

Figure 17 - 802.11ax HE20, Core 0, SU - 2467 MHz, Band Edge Frequency 2483.5 MHz

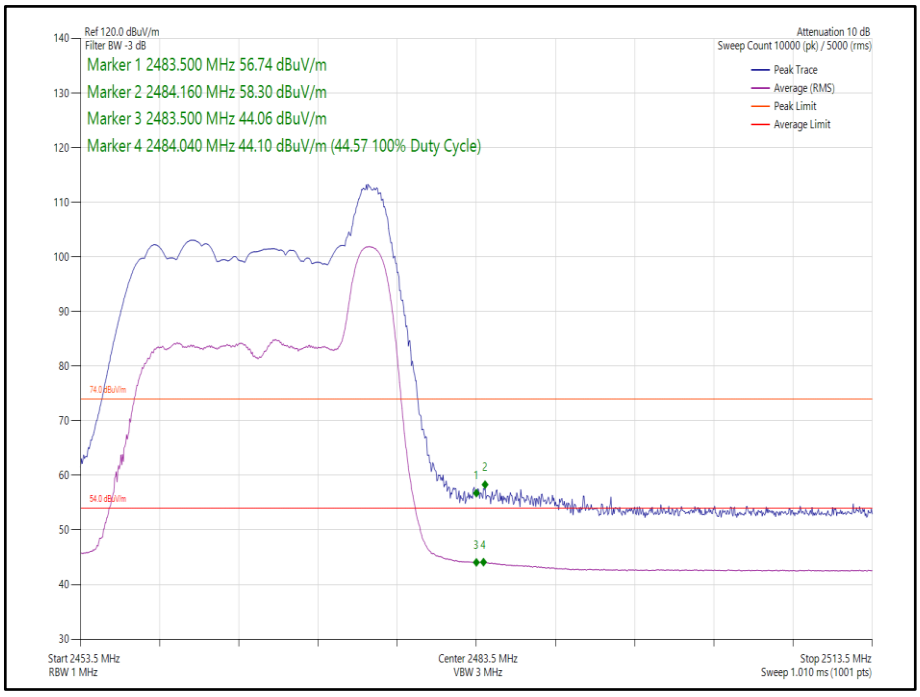

Figure 18 - 802.11ax HE20, Core 0, 26-8 - 2467 MHz, Band Edge Frequency 2483.5 MHz

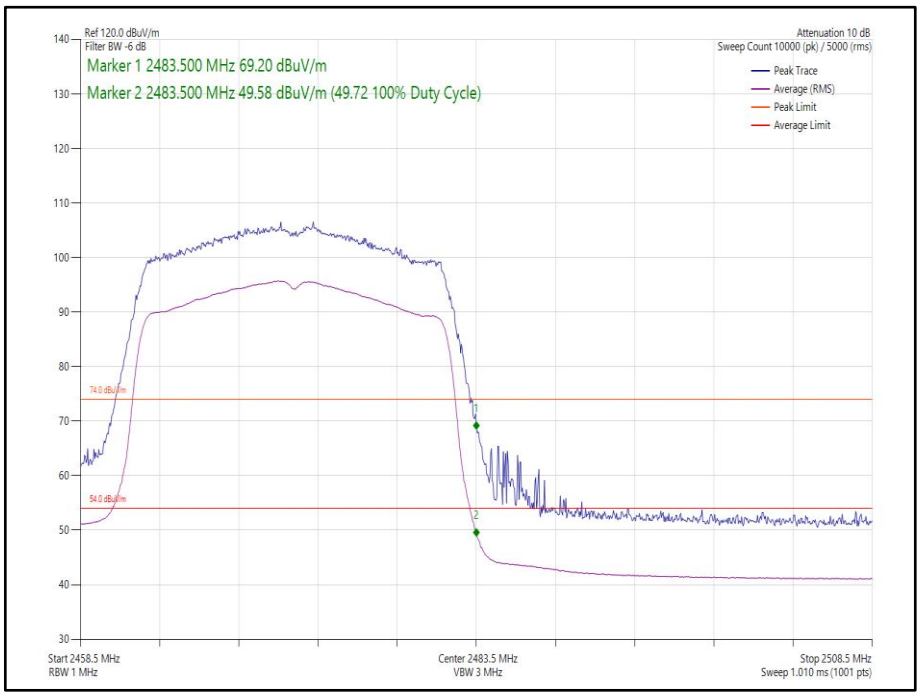

Figure 19 - 802.11ax HE20, Core 0, SU - 2472 MHz, Band Edge Frequency 2483.5 MHz

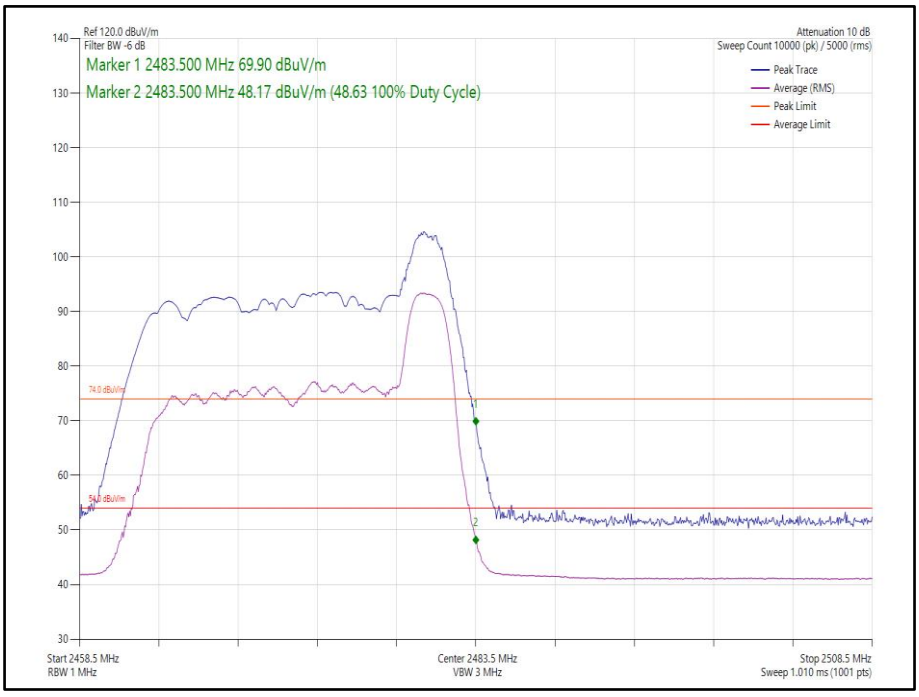

Figure 20 - 802.11ax HE20, Core 0, 26-8 - 2472 MHz, Band Edge Frequency 2483.5 MHz

2TX MIMO

Mode	Data Rate/ MCS	Resource Size	Resource Index	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
802.11n HT20, Core 0-1	MCS7	-	-	2412	2390.0	67.66	51.32
802.11n HT20, Core 0-1	MCS2	-	-	2462	2483.5	66.67	51.16
802.11n HT20, Core 0-1	MCS7	-	-	2467	2483.5	68.67	51.39
802.11n HT20, Core 0-1	MCS4	-	-	2472	2483.5	67.31	51.22
802.11ax HE20, Core 0-1	MCS9x1	SU	-	2412	2400.0	65.74	51.46
802.11ax HE20, Core 0-1	MCS9x1	26	0	2412	2400.0	61.77	45.04
802.11ax HE20, Core 0-1	MCS2x1	SU	-	2462	2483.5	66.25	51.40
802.11ax HE20, Core 0-1	MCS9x1	26	8	2462	2483.5	60.15	48.55
802.11ax HE20, Core 0-1	MCS4x1	SU	-	2467	2483.5	65.41	51.29
802.11ax HE20, Core 0-1	MCS9x1	26	8	2467	2483.5	61.48	48.93
802.11ax HE20, Core 0-1	MCS9x1	SU	-	2472	2483.5	69.13	51.19
802.11ax HE20, Core 0-1	MCS9x1	26	8	2472	2483.5	68.36	50.28

Table 8 – MIMO 2TX Restricted Band Edge Results

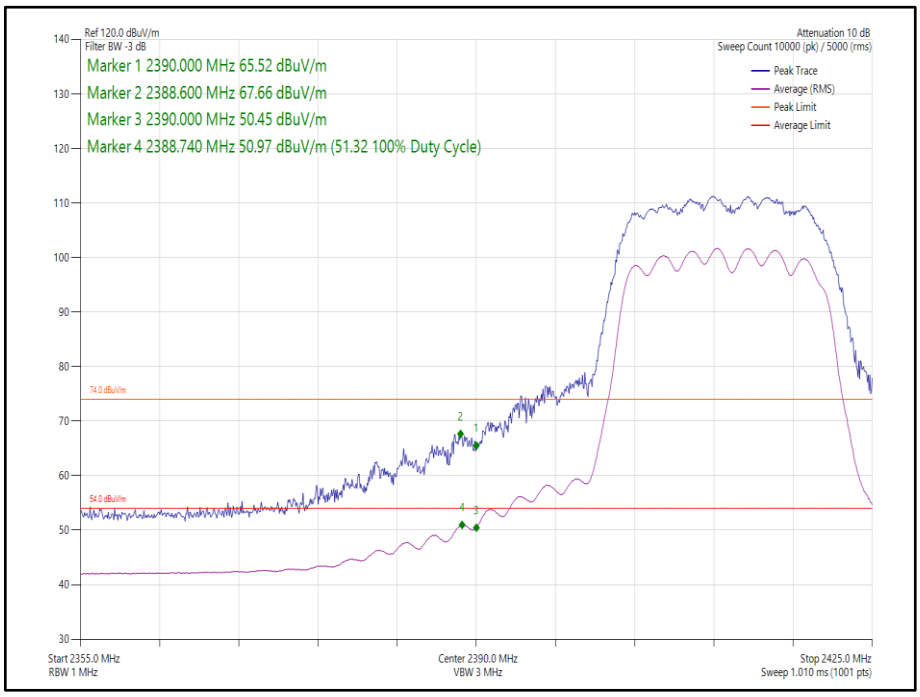

Figure 21 - 802.11n HT20, Core 0-1 - 2412 MHz, Band Edge Frequency 2390 MHz

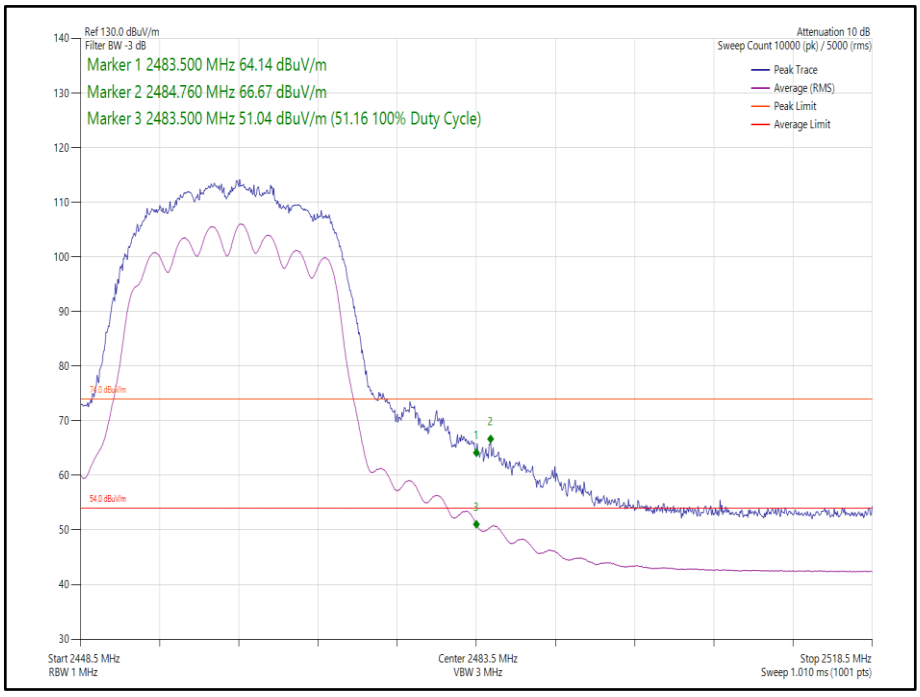

Figure 22 - 802.11n HT20, Core 0-1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

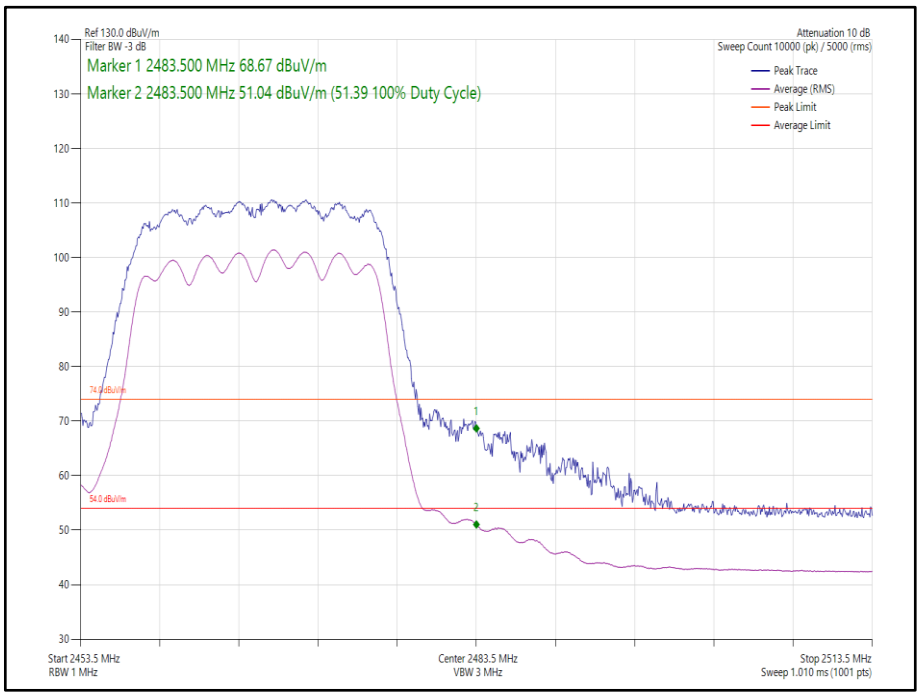

Figure 23 - 802.11n HT20, Core 0-1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

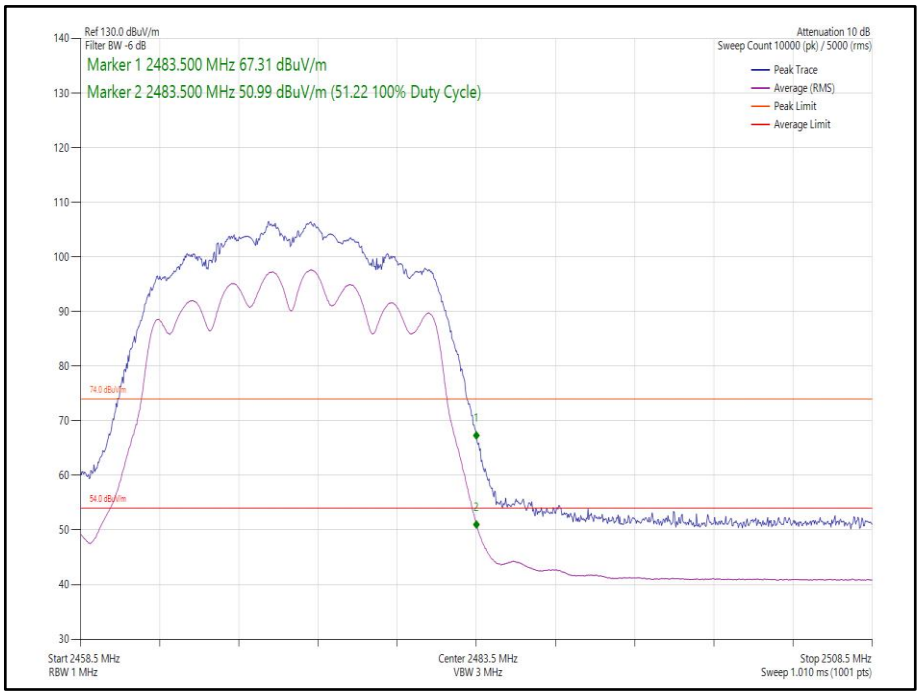

Figure 24 - 802.11n HT20, Core 0-1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

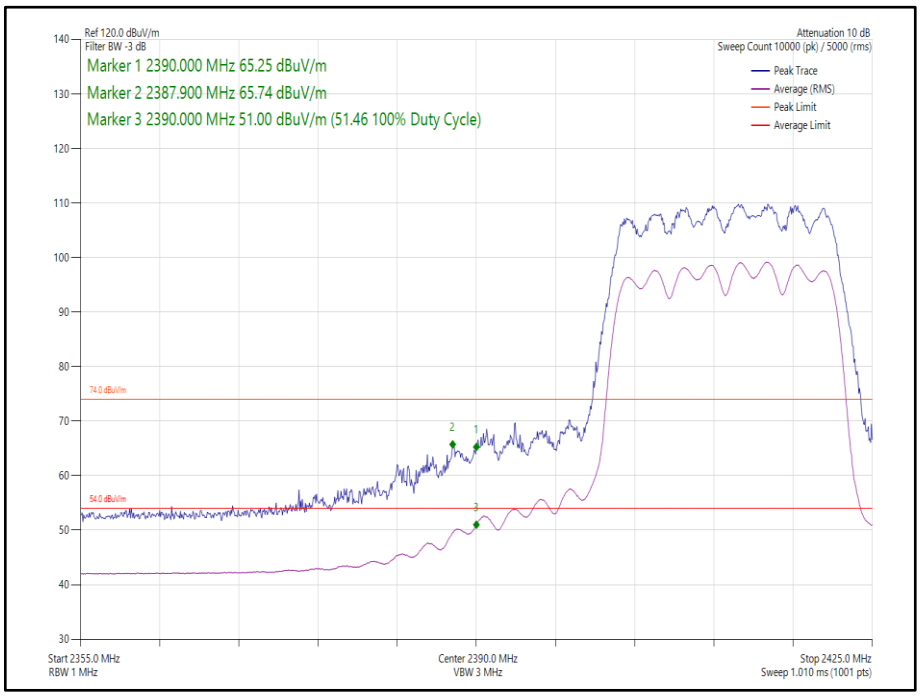

Figure 25 - 802.11ax HE20, Core 0-1, SU - 2412 MHz, Band Edge Frequency 2390 MHz

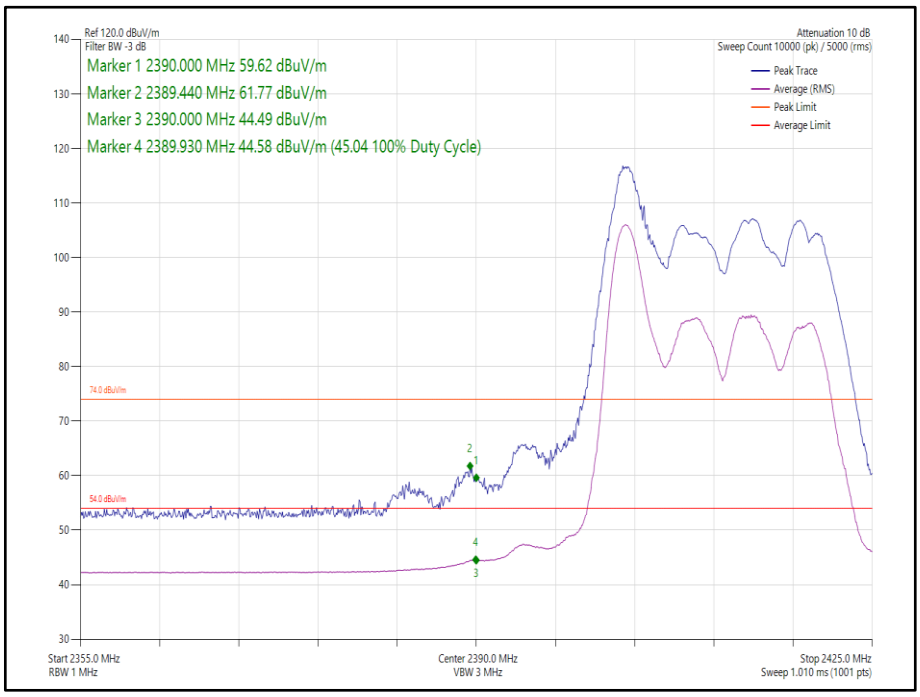

Figure 26 - 802.11ax HE20, Core 0-1, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz

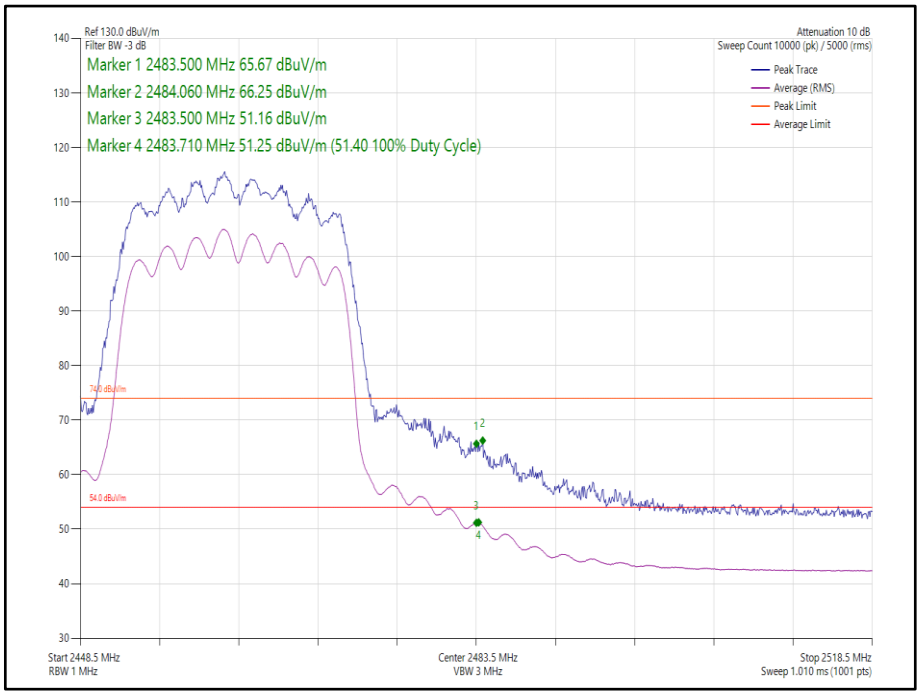

Figure 27 - 802.11ax HE20, Core 0-1, SU - 2462 MHz, Band Edge Frequency 2483.5 MHz

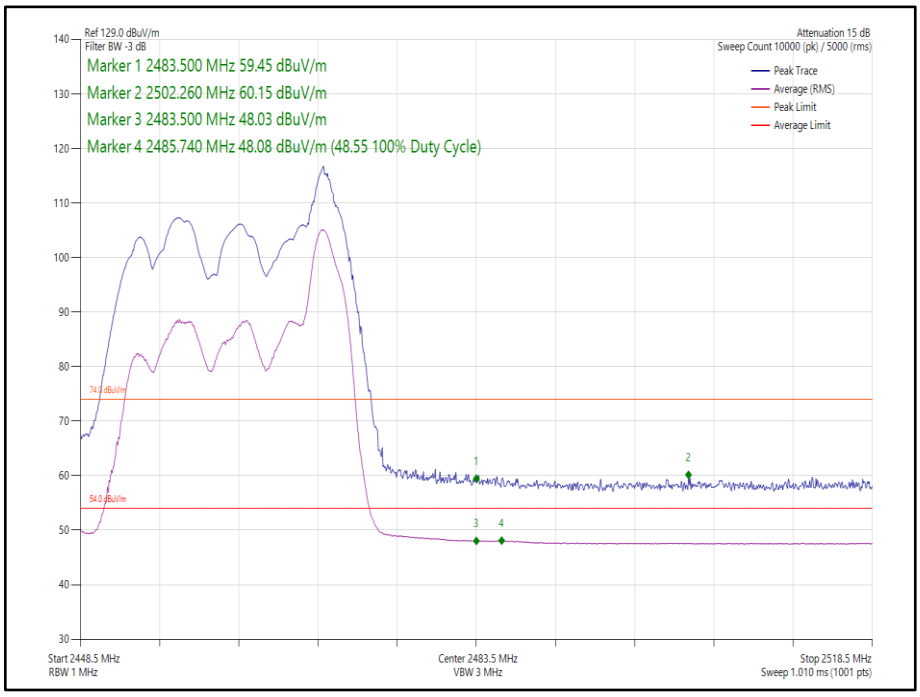

Figure 28 - 802.11ax HE20, Core 0-1, 26-8 - 2462 MHz, Band Edge Frequency 2483.5 MHz

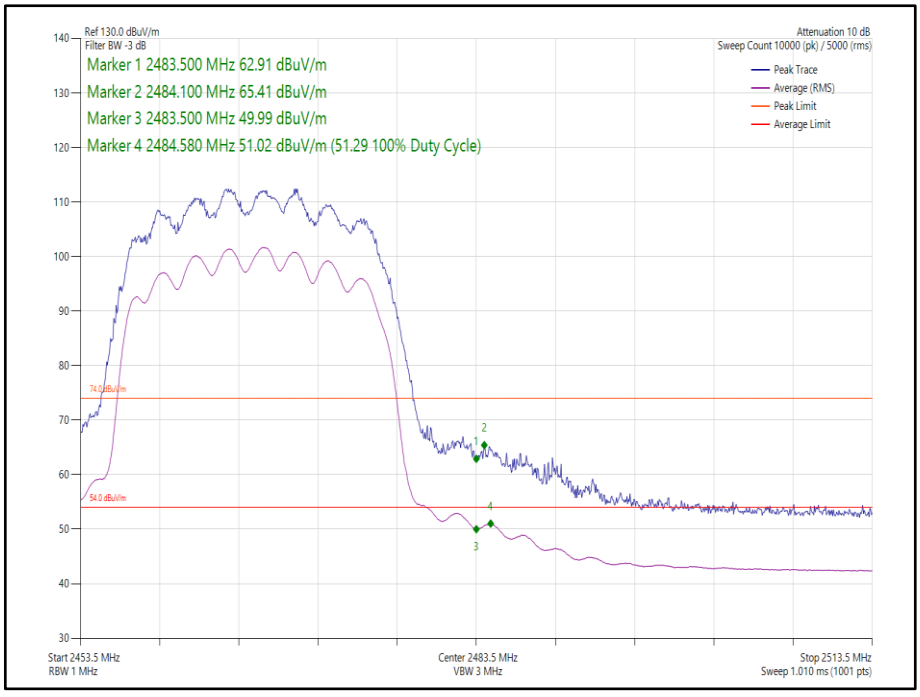

Figure 29 - 802.11ax HE20, Core 0-1, SU - 2467 MHz, Band Edge Frequency 2483.5 MHz

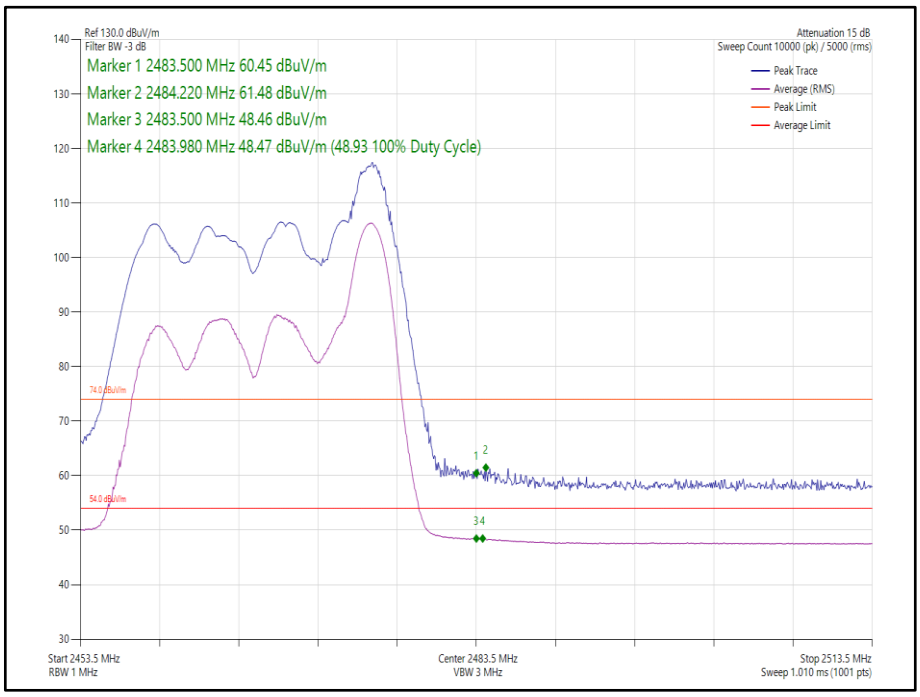

Figure 30 - 802.11ax HE20, Core 0-1, 26-8 - 2467 MHz, Band Edge Frequency 2483.5 MHz

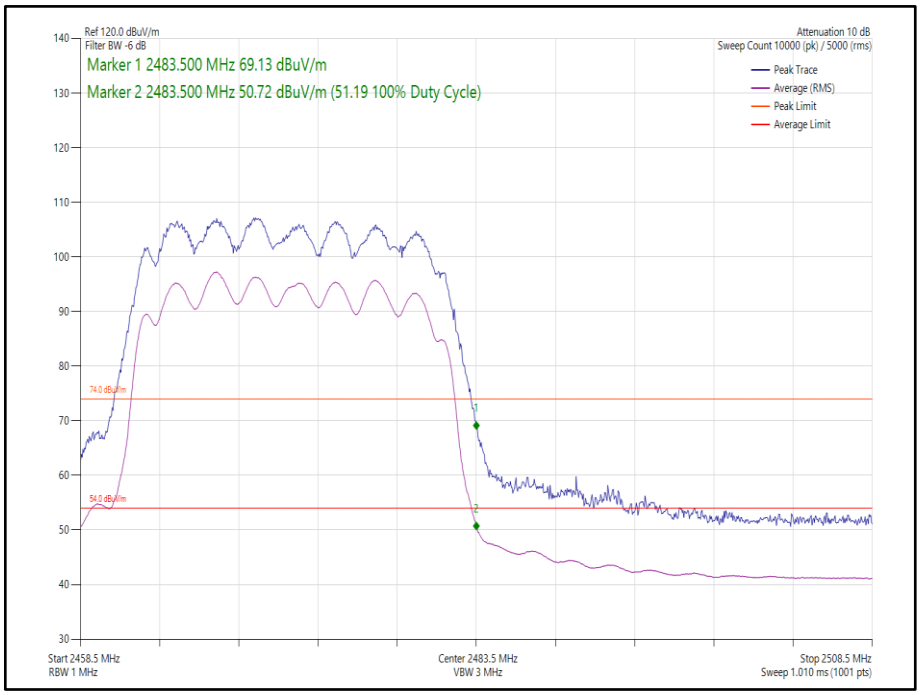

**Figure 31 - 802.11ax HE20, Core 0-1, SU - 2472 MHz,
Band Edge Frequency 2483.5 MHz**

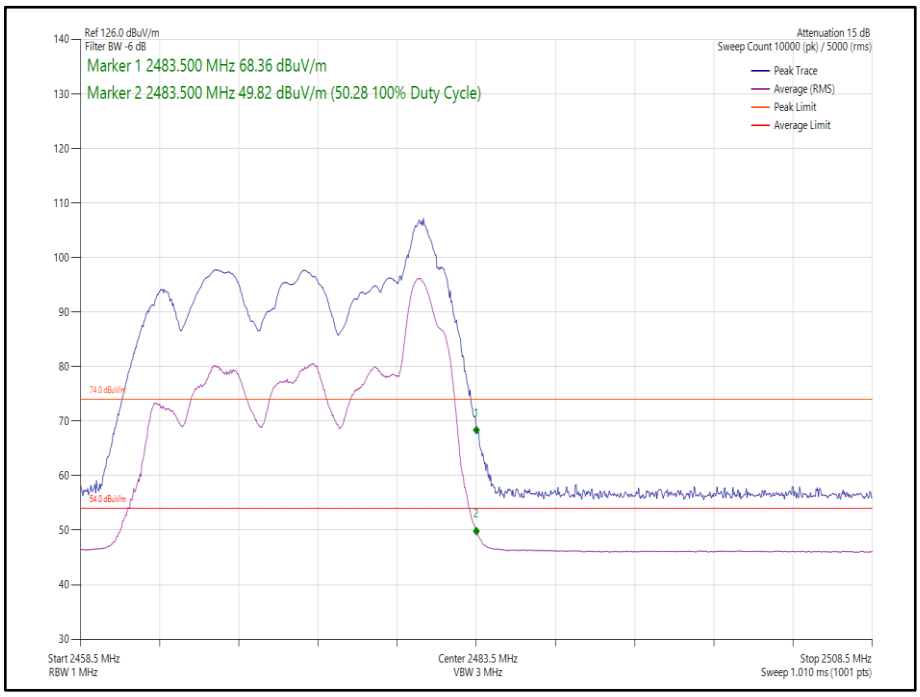

Figure 32 - 802.11ax HE20, Core 0-1, 26-8 - 2472 MHz, Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 9

ISED RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960*	500

Table 10

*Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

2.1.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	22-Mar-2022
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	17-May-2023
Screened Room (5)	Rainford	Rainford	1545	36	15-Apr-2024
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Tilt Antenna Mast	Maturo Gmbh	TAM 4.0-P	4811	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	4848	12	28-May-2022
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5492	12	11-Apr-2023
Emissions Software	TUV SUD	EmX V3.1.4	5125	-	Software
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	08-Apr-2023
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5513	12	12-Apr-2023
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5517	12	12-Apr-2023
8m N-Type Cable	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-Mar-2023
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	22-Sep-2022

Table 11

TU - Traceability Unscheduled

2.2 Emission Bandwidth

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(2)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause, 6.7

2.2.2 Equipment Under Test and Modification State

A2737, S/N: MW5QG9Q771 - Modification State 0

2.2.3 Date of Test

20-September-2022

2.2.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.1 for 6 dB BW and 6.9.3 for 99% occupied bandwidth measurements.

2.2.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	51.1 %

2.2.6 Test Results

2.4 GHz WLAN

SISO

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11b	8.160	8.640
802.11g	15.240	15.240
802.11n HT20	15.240	15.240
802.11ax HE20 SU	16.320	17.760

Table 12 - 6 dB Bandwidth Summary Results

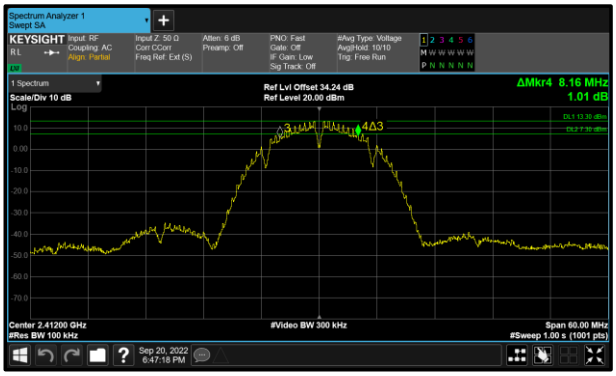

Figure 33 - 802.11b Minimum 6 dB EBW

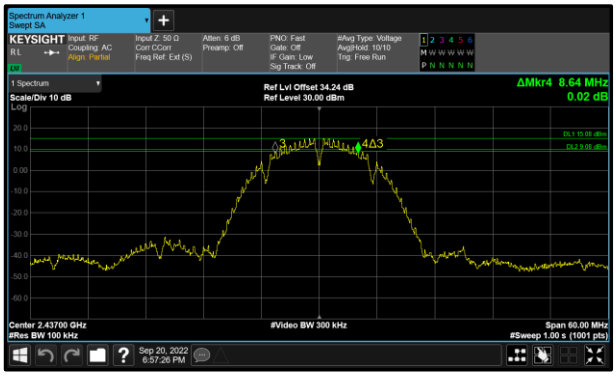

Figure 34 - 802.11b Maximum 6 dB EBW

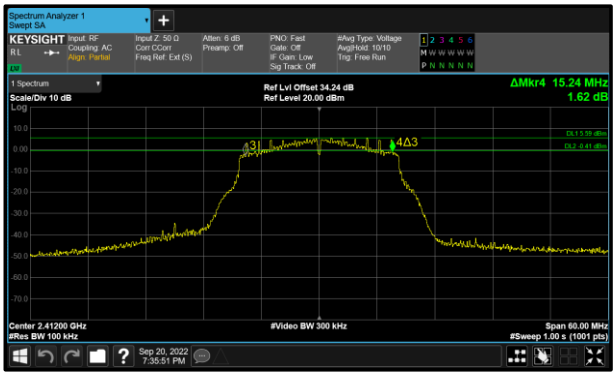

Figure 35 - 802.11g Minimum 6 dB EBW

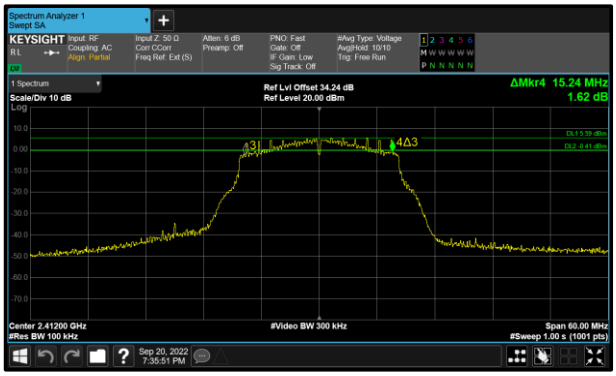

Figure 36 - 802.11g Maximum 6 dB EBW

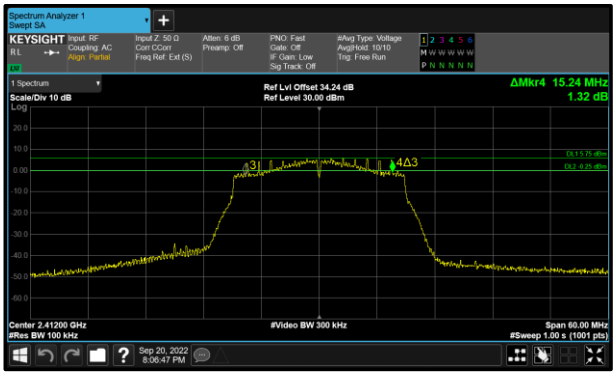

Figure 37 - 802.11n HT20 Minimum 6 dB EBW

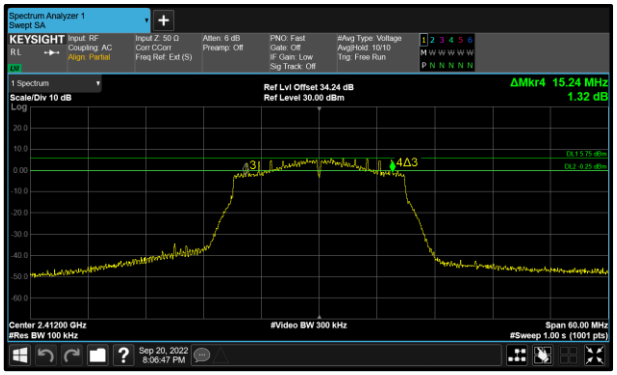

Figure 38 - 802.11n HT20 Maximum 6 dB EBW

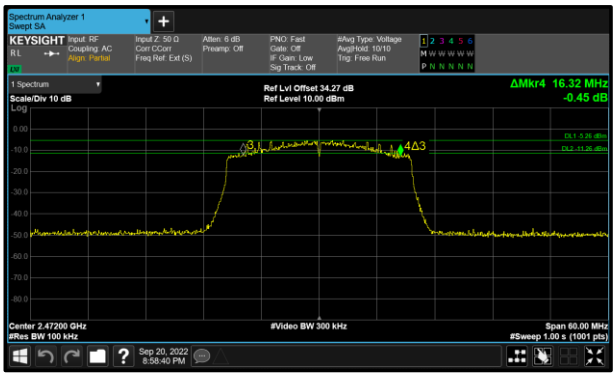

Figure 39 - 802.11ax HE20 SU Minimum 6 dB EBW

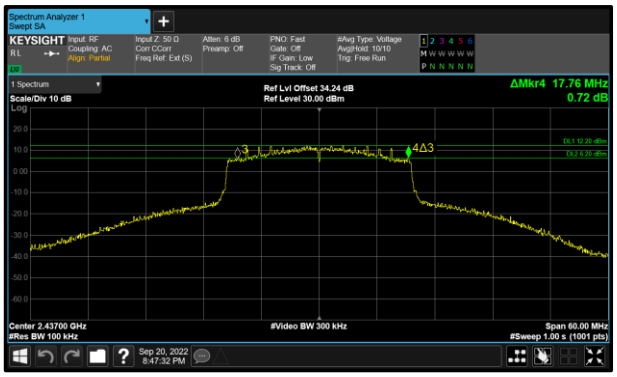

Figure 40 - 802.11ax HE20 SU Maximum 6 dB EBW

Protocol	99% Bandwidth (MHz)	
	Minimum	Maximum
802.11b	12.840	13.080
802.11g	16.320	16.440
802.11n HT20	17.460	17.640
802.11ax HE20 SU	18.660	18.840

Table 13 - 99% Bandwidth Summary Results

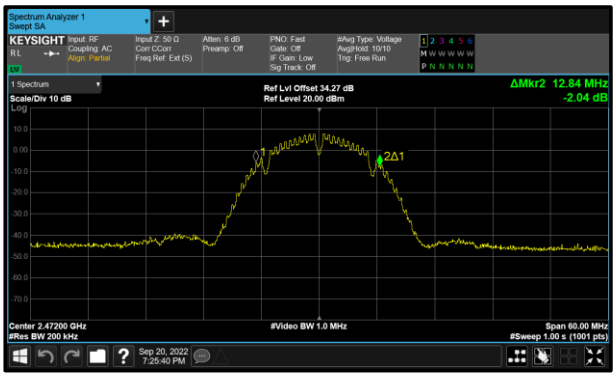

Figure 41 - 802.11b Minimum 99% OBW

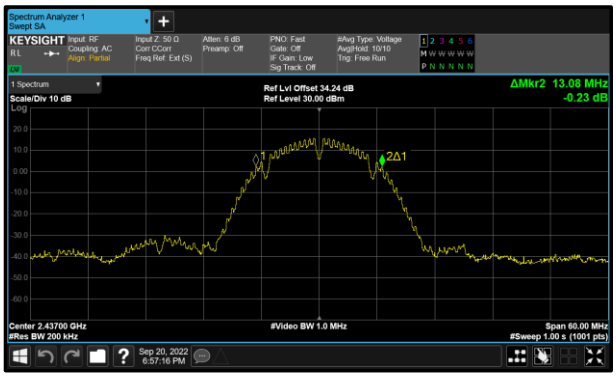

Figure 42 - 802.11b Maximum 99% OBW

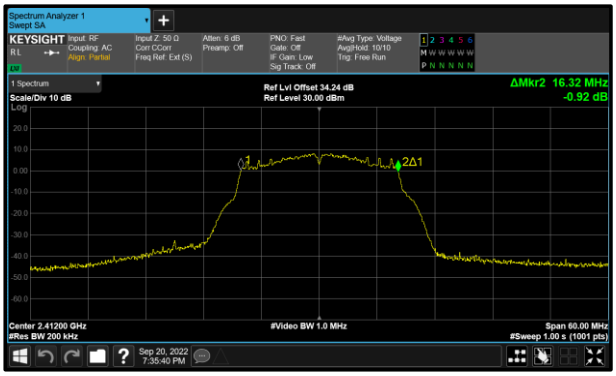

Figure 43 - 802.11g Minimum 99% OBW

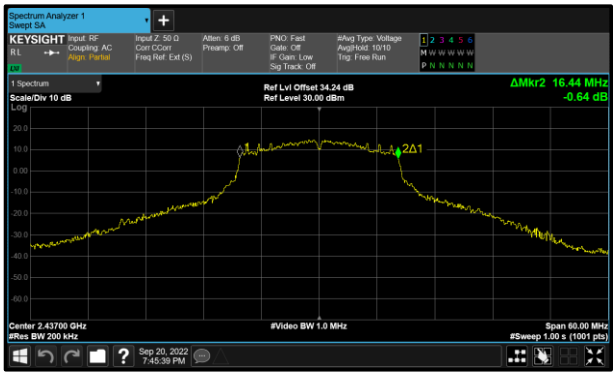

Figure 44 - 802.11g Maximum 99% OBW

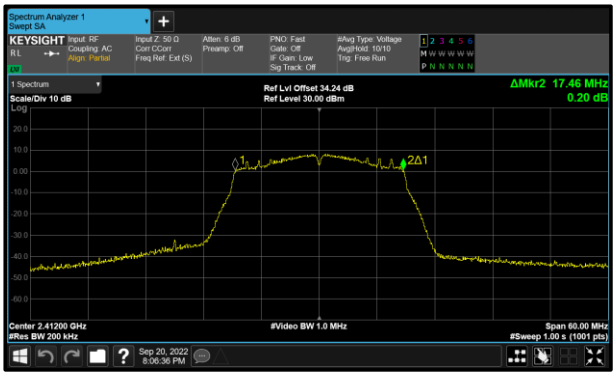

Figure 45 - 802.11n HT20 Minimum 99% OBW

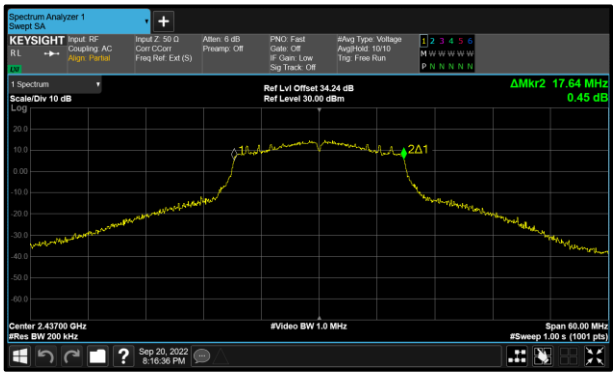

Figure 46 - 802.11n HT20 Maximum 99% OBW

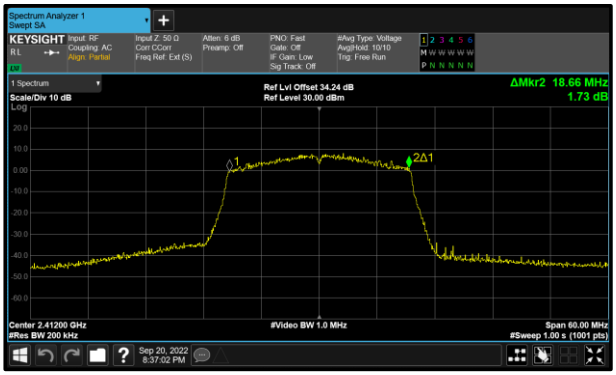

Figure 47 - 802.11ax HE20 SU Minimum 99% OBW

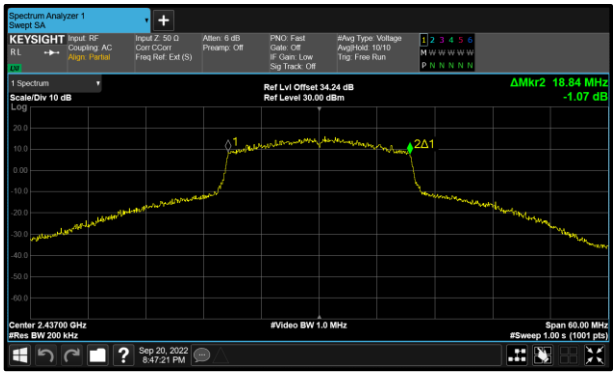

Figure 48 - 802.11ax HE20 SU Maximum 99% OBW

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11b	Duty Cycle (%):	-
Data Rate:	1 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	8.160	-	-	≥500.0
2437	-	8.640	-	-	≥500.0
2472	-	8.160	-	-	≥500.0

Table 14 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	12.900	-	-	-
2437	-	13.080	-	-	-
2472	-	12.840	-	-	-

Table 15 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11g	Duty Cycle (%):	-
Data Rate:	12 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	15.240	-	-	≥500.0
2437	-	15.240	-	-	≥500.0
2472	-	15.240	-	-	≥500.0

Table 16 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	16.320	-	-	-
2437	-	16.440	-	-	-
2472	-	16.320	-	-	-

Table 17 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11n HT20	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	15.240	-	-	≥500.0
2437	-	15.240	-	-	≥500.0
2472	-	15.240	-	-	≥500.0

Table 18 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	17.460	-	-	-
2437	-	17.640	-	-	-
2472	-	17.460	-	-	-

Table 19 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 SU	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	16.560	-	-	≥500.0
2437	-	17.760	-	-	≥500.0
2472	-	16.320	-	-	≥500.0

Table 20 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	18.660	-	-	-
2437	-	18.840	-	-	-
2472	-	18.720	-	-	-

Table 21 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU26	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	14.640	-	-	≥500.0
2437	-	2.160	-	-	≥500.0
2472	-	2.160	-	-	≥500.0

Table 22 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	18.360	-	-	-
2437	-	18.300	-	-	-
2472	-	18.180	-	-	-

Table 23 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU52	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	17.100	-	-	≥500.0
2437	-	14.640	-	-	≥500.0
2472	-	14.640	-	-	≥500.0

Table 24 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	18.240	-	-	-
2437	-	18.180	-	-	-
2472	-	18.060	-	-	-

Table 25 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU106	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	17.160	-	-	≥500.0
2437	-	17.160	-	-	≥500.0
2472	-	17.220	-	-	≥500.0

Table 26 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	18.120	-	-	-
2437	-	18.120	-	-	-
2472	-	18.060	-	-	-

Table 27 - 99% Bandwidth Results

MIMO CDD

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11n HT20	15.240	15.840
802.11ax HE20 SU	15.240	17.640

Table 28 - 6 dB Bandwidth Summary Results

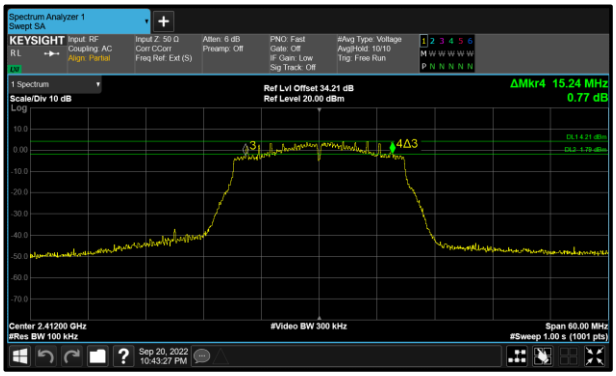

Figure 49 - 802.11n HT20 Minimum 6 dB EBW

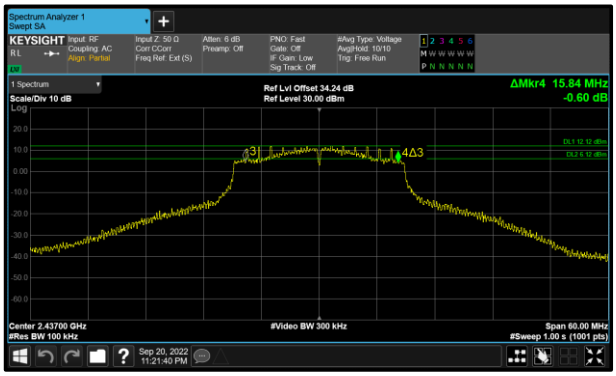

Figure 50 - 802.11n HT20 Maximum 6 dB EBW

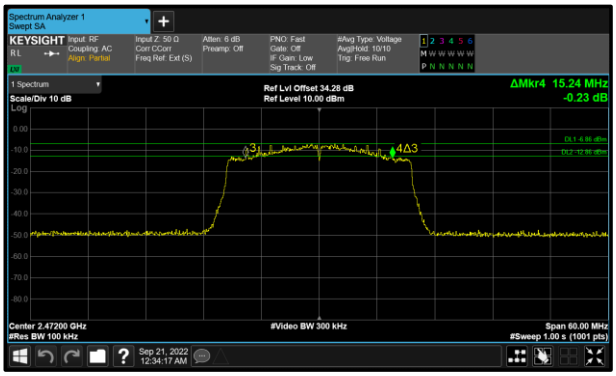

Figure 51 - 802.11ax HE20 SU Minimum 6 dB EBW

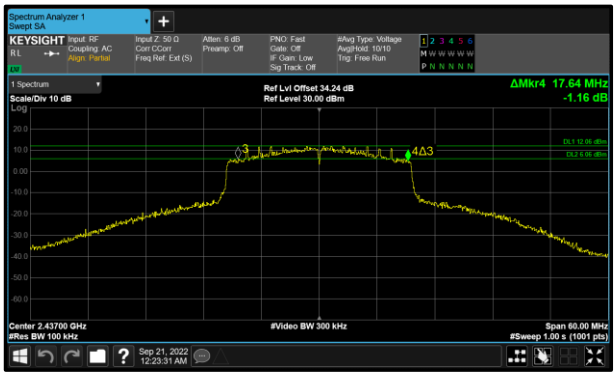

Figure 52 - 802.11ax HE20 SU Maximum 6 dB EBW

Protocol	99% Bandwidth (MHz)	
	Minimum	Maximum
802.11n HT20	17.460	17.640
802.11ax HE20 SU	18.660	18.840

Table 29 - 99% Bandwidth Summary Results

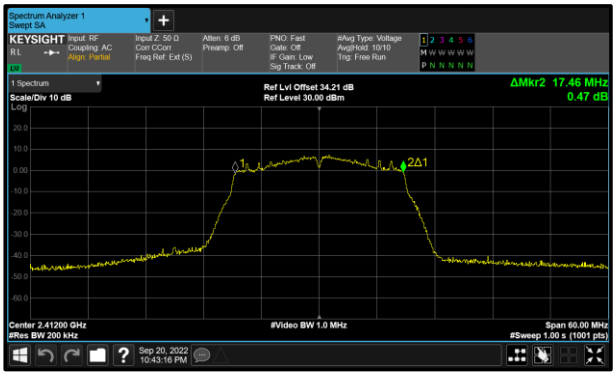

Figure 53 - 802.11n HT20 Minimum 99% OBW

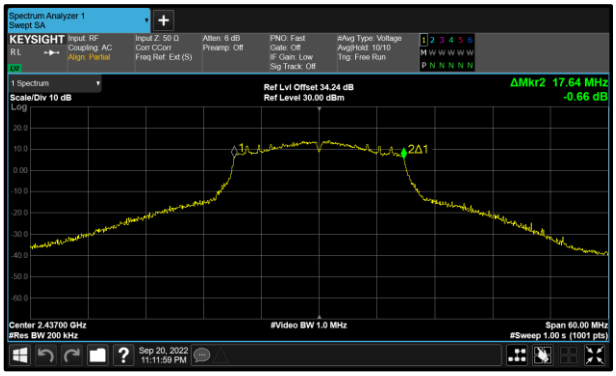

Figure 54 - 802.11n HT20 Maximum 99% OBW

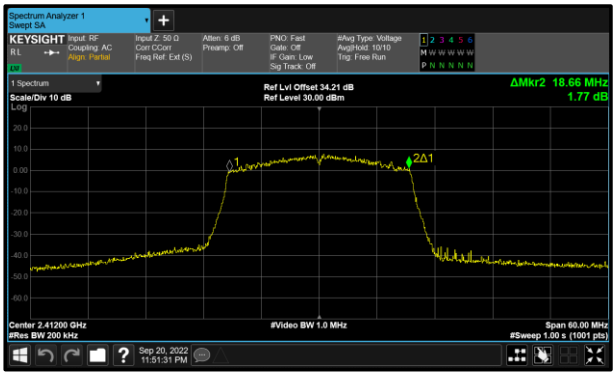

Figure 55 - 802.11ax HE20 SU Minimum 99% OBW

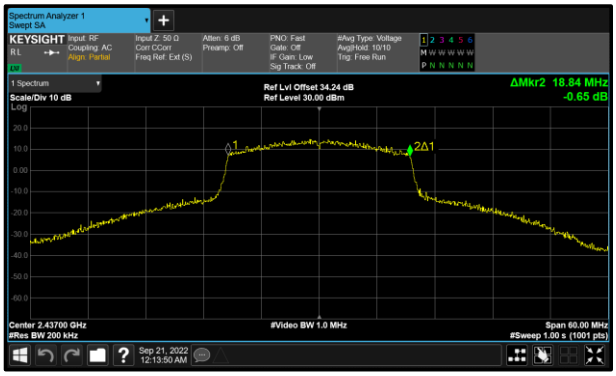

Figure 56 - 802.11ax HE20 SU Maximum 99% OBW

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11n HT20	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2	DCCF (dB):	-
Antenna Configuration:	MIMO CDD	Peak Antenna Gain (dBi):	-
Active Port(s):	A+B (2.4GHz Core 1 + 2.4GHz Core 0)	Active Chain(s):	0+1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	15.240	15.240	-	-	≥500.0
2437	15.300	15.840	-	-	≥500.0
2472	15.240	15.240	-	-	≥500.0

Table 30 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	17.460	17.460	-	-	-
2437	17.640	17.640	-	-	-
2472	17.460	17.460	-	-	-

Table 31 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 SU	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	MIMO CDD	Peak Antenna Gain (dBi):	-
Active Port(s):	A+B (2.4GHz Core 1 + 2.4GHz Core 0)	Active Chain(s):	0+1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	15.420	16.920	-	-	≥500.0
2437	17.040	17.640	-	-	≥500.0
2472	15.240	17.160	-	-	≥500.0

Table 32 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	18.660	18.660	-	-	-
2437	18.840	18.840	-	-	-
2472	18.720	18.720	-	-	-

Table 33 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU26	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	MIMO CDD	Peak Antenna Gain (dBi):	-
Active Port(s):	A+B (2.4GHz Core 1 + 2.4GHz Core 0)	Active Chain(s):	0+1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	14.640	12.120	-	-	≥500.0
2437	2.160	2.160	-	-	≥500.0
2472	2.160	2.160	-	-	≥500.0

Table 34 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	18.360	18.360	-	-	-
2437	18.300	18.300	-	-	-
2472	18.240	18.180	-	-	-

Table 35 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU52	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	MIMO CDD	Peak Antenna Gain (dBi):	-
Active Port(s):	A+B (2.4GHz Core 1 + 2.4GHz Core 0)	Active Chain(s):	0+1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	17.160	17.160	-	-	≥500.0
2437	17.040	17.040	-	-	≥500.0
2472	14.580	14.640	-	-	≥500.0

Table 36 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	18.180	18.240	-	-	-
2437	18.060	18.180	-	-	-
2472	18.000	18.060	-	-	-

Table 37 - 99% Bandwidth Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (a)(2) RSS-247 5.2 a)	Test Method(s):	C63.10 6.9.3 C63.10 11.8.1
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11ax HE20 RU106	Duty Cycle (%):	-
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	MIMO CDD	Peak Antenna Gain (dBi):	-
Active Port(s):	A+B (2.4GHz Core 1 + 2.4GHz Core 0)	Active Chain(s):	0+1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	17.220	17.220	-	-	≥500.0
2437	17.160	17.220	-	-	≥500.0
2472	17.160	17.220	-	-	≥500.0

Table 38 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	18.120	18.120	-	-	-
2437	18.060	18.180	-	-	-
2472	18.000	18.060	-	-	-

Table 39 - 99% Bandwidth Results

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISED RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Multimeter	Fluke	79 Series III	611	12	21-Dec-2022
Hygrometer	Rotronic	I-1000	3220	12	05-Nov-2022
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	01-Feb-2023
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	21-Mar-2024
Signal Conditioning Unit	TUV SUD	SPECTRUM SCU001	5546	12	06-Apr-2023

Table 40

O/P Mon – Output Monitored using calibrated equipment

2.3 Maximum Conducted Output Power

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause, 6.12

2.3.2 Equipment Under Test and Modification State

A2737, S/N: MW5QG9Q771 - Modification State 0

2.3.3 Date of Test

20-September-2022

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.2.3.2 Method AVGPM-G.

MIMO output port summing was performed in accordance with KDB 662911 D01. For the CDD results, the Directional Gain was calculated in accordance with clause F)2)f)(ii) using the calculations from F)2)f)(i) with worst-case individual gain and an array gain of zero.

2.3.5 Environmental Conditions

Ambient Temperature	22.0 °C
Relative Humidity	51.1 %

2.3.6 Test Results

2.4 GHz WLAN

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	C63.10 11.9.2.3.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11b	Duty Cycle (%):	98.8
Data Rate:	1 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-0.21
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2412	-	20.22	-	-	-	30.00	-9.78
2437	-	22.36	-	-	-	30.00	-7.64
2472	-	14.34	-	-	-	30.00	-15.66

Table 41 - FCC Maximum Conducted (average) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2412	-	20.22	-	-	-	30.00	-9.78	20.01	36.00	-15.99
2437	-	22.36	-	-	-	30.00	-7.64	22.15	36.00	-13.85
2472	-	14.34	-	-	-	30.00	-15.66	14.13	36.00	-21.87

Table 42 - ISED Maximum Conducted (average) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	C63.10 11.9.2.3.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11g	Duty Cycle (%):	97.8
Data Rate:	12 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-0.21
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2412	-	15.91	-	-	-	30.00	-14.09
2437	-	22.49	-	-	-	30.00	-7.51
2472	-	4.79	-	-	-	30.00	-25.21

Table 43 - FCC Maximum Conducted (average) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2412	-	15.91	-	-	-	30.00	-14.09	15.70	36.00	-20.30
2437	-	22.49	-	-	-	30.00	-7.51	22.28	36.00	-13.72
2472	-	4.79	-	-	-	30.00	-25.21	4.58	36.00	-31.42

Table 44 - ISED Maximum Conducted (average) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Limit Clause(s):	15.247 (b)(3) RSS-247 5.4 d)	Test Method(s):	C63.10 11.9.2.3.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	802.11n HT20	Duty Cycle (%):	96.7
Modulation Coding Scheme:	MCS2	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	-0.21
Active Port(s):	B (2.4GHz Core 0)	Active Chain(s):	1

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2412	-	15.99	-	-	-	30.00	-14.01
2437	-	22.28	-	-	-	30.00	-7.72
2472	-	4.76	-	-	-	30.00	-25.24

Table 45 - FCC Maximum Conducted (average) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2412	-	15.99	-	-	-	30.00	-14.01	15.78	36.00	-20.22
2437	-	22.28	-	-	-	30.00	-7.72	22.07	36.00	-13.93
2472	-	4.76	-	-	-	30.00	-25.24	4.55	36.00	-31.45

Table 46 - ISED Maximum Conducted (average) Output Power Results