

FCC and ISED Test Report

Apple Inc
Model: A2843

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

FCC ID: BCGA2843

IC: 579C-A2843

COMMERCIAL-IN-CONFIDENCE



Add value.
Inspire trust.

TUV SUD
Digitally signed by
TUV SUD
Date: 2022.10.03
14:59:46 +01'00'

Document 75954422-27 Issue 02

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Simon Bennett	Director of Test Operations	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	Hollie Marshall	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.



DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2022 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

TÜV SÜD
is a trading name of TÜV SÜD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TÜV SÜD 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

TÜV SÜD

TÜV®



Contents

1 Report Summary2

1.1 Report Modification Record.....2

1.2 Introduction.....2

1.3 Brief Summary of Results3

1.4 Product Information4

1.5 Deviations from the Standard.....5

1.6 EUT Modification Record5

1.7 Test Location6

2 Test Details7

2.1 Restricted Band Edges.....7

2.2 Emission Bandwidth28

2.3 Maximum Conducted Output Power44

2.4 Spurious Radiated Emissions58

2.5 Authorised Band Edges83

2.6 Power Spectral Density.....91

3 Measurement Uncertainty 99



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	30 September 2022
2	Updated IC on cover page, number of samples in Introduction and margins in Table 64	30 September 2022

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2843
Serial Number(s)	CVP4VD6WJV, YWL2C4T4WY, L3H7XJ0XXF & HRY7YXTQYQ
Hardware Version(s)	REV 1.0
Software Version(s)	20J42560n
Number of Samples Tested	4
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
Start of Test	28-March-2022
Finish of Test	28-September-2022
Name of Engineer(s)	Faisal Malyar, Thomas Biddlecombe, Daniel Cameron, Ian Hart, Elliot Callender, Taha Shafique, Danial Shafique Mohammad Malik, Colin Brain, Thomas Randall, James Woods and Elliot Callender
Related Document(s)	KDB 662911 D01 v02r01 ANSI C36.4 (2014) ANSI C63.10 (2013) ANSI C63.10 (2020)



1.3 Brief Summary of Results

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

Section	Specification Clause			Test Description	Result	Comments/Base Standard
	FCC 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®, Thread 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.

After preliminary investigations were performed, the EUT was therefore tested 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	0.10	0.70
Core 1	2400 to 2480	-0.75	0.70

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: A2843, Serial Number: CVP4VD6WJV			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2843, Serial Number: L3H7XJ0XXF			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2843, Serial Number: YWL2C4T4WY			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2843, Serial Number: HRY7YXTQYQ			
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	Faisal Malyar, Elliot Callender, Taha Shafique and Danial Shafique	UKAS
Emission Bandwidth	Thomas Biddlecombe and Daniel Cameron	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe and Daniel Cameron	UKAS
Authorised Band Edges	Faisal Malyar, Elliot Callender, Taha Shafique and Danial Shafique	UKAS
Power Spectral Density	Thomas Biddlecombe and Daniel Cameron	UKAS
Spurious Radiated Emissions	Ian Hart, Colin Brain, Mohammad Malik and James Woods	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	Mohammad Malik, James Woods, Elliot Callender and Taha Shafique	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

A2843, S/N: YWL2C4T4WY - Modification State 0

2.1.3 Date of Test

28-March-2022 to 23-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 dB μ V/m to μ V/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

2.1.5 Environmental Conditions

Ambient Temperature	20.1 - 23.4 °C
Relative Humidity	42.1 - 59.2 %



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	59.12	51.19
802.11b, Core 0	1 Mbps	-	-	2462	2483.5	57.40	47.27
802.11b, Core 0	1 Mbps	-	-	2467	2483.5	57.83	46.93
802.11b, Core 0	1 Mbps	-	-	2472	2483.5	60.26	48.51
802.11g, Core 0	54 Mbps	-	-	2412	2390.0	66.80	51.26
802.11g, Core 0	24 Mbps	-	-	2462	2483.5	66.86	51.17
802.11g, Core 0	24 Mbps	-	-	2467	2483.5	66.60	51.14
802.11g, Core 0	12 Mbps	-	-	2472	2483.5	67.08	51.45
802.11n HT20, Core 0	MCS7	-	-	2412	2390.0	66.48	51.31
802.11n HT20, Core 0	MCS2	-	-	2462	2483.5	66.50	51.19
802.11n HT20, Core 0	MCS2	-	-	2467	2483.5	64.75	50.85
802.11n HT20, Core 0	MCS7	-	-	2472	2483.5	67.46	51.44
802.11ax HE20, Core 0	MCS9x1	SU	-	2412	2400	66.52	51.22
802.11ax HE20, Core 0	MCS9x1	26	0	2412	2400	58.38	44.03
802.11ax HE20, Core 0	MCS2x1	SU	-	2462	2483.5	65.63	50.94
802.11ax HE20, Core 0	MCS9x1	26	8	2462	2483.5	55.70	43.85
802.11ax HE20, Core 0	MCS2x1	SU	-	2467	2483.5	68.57	51.14
802.11ax HE20, Core 0	MCS9x1	26	8	2467	2483.5	56.95	44.32
802.11ax HE20, Core 0	MCS2x1	SU	-	2472	2483.5	69.37	50.20
802.11ax HE20, Core 0	MCS9x1	26	8	2472	2483.5	69.28	48.29

Table 7 - SISO Restricted Band Edge Results

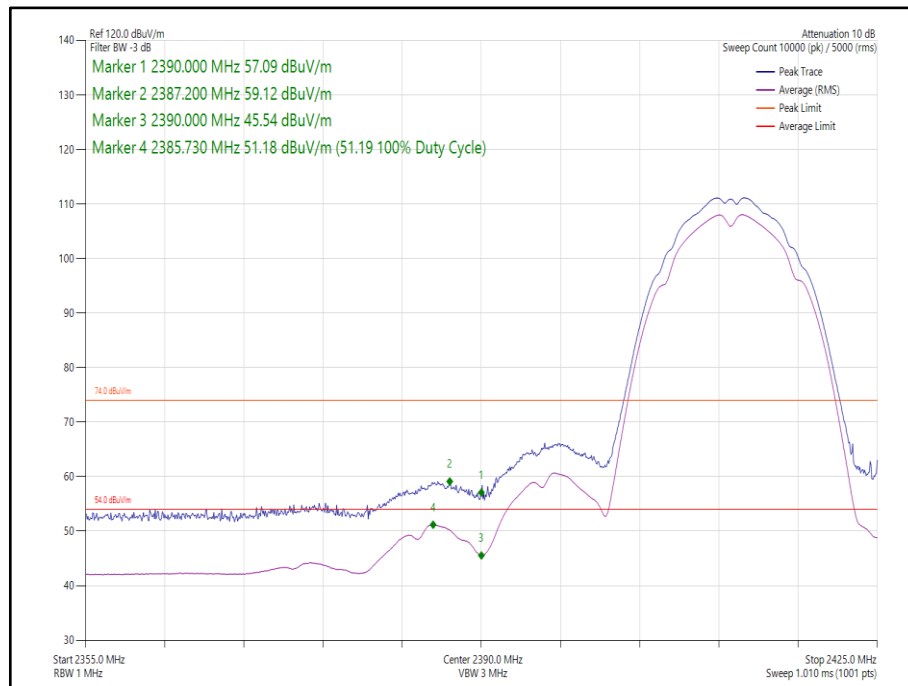


Figure 1 - 802.11b, Core 0 - 2412 MHz, Band Edge Frequency 2390.0 MHz

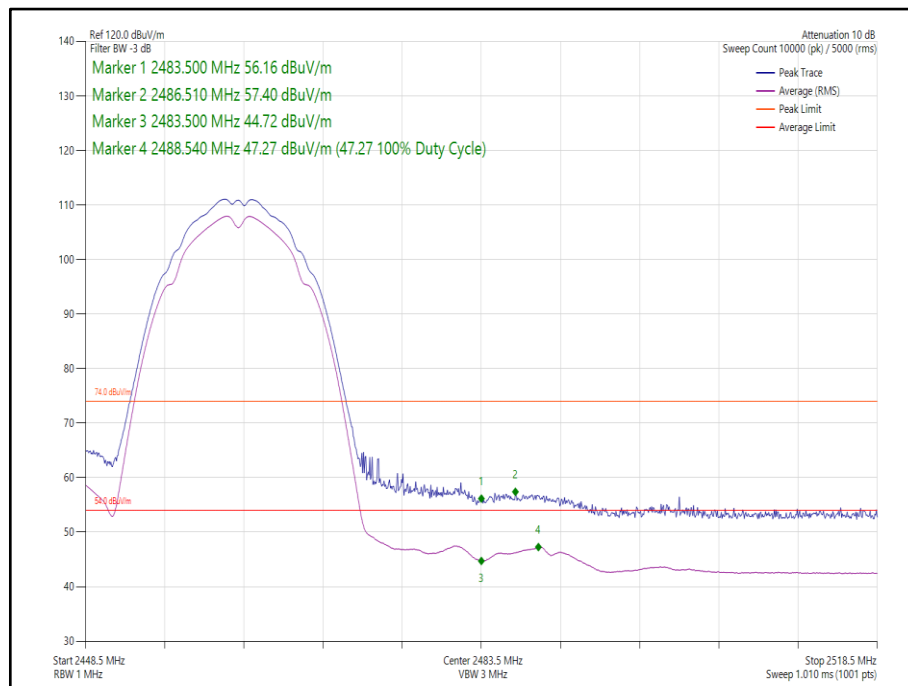


Figure 2 - 802.11b, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

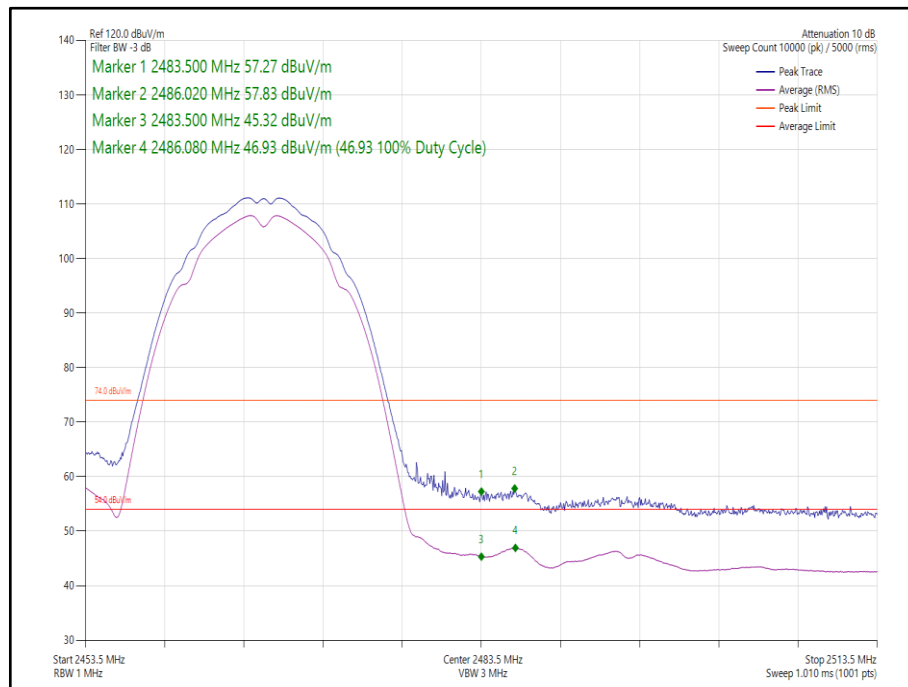


Figure 3 - 802.11b, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

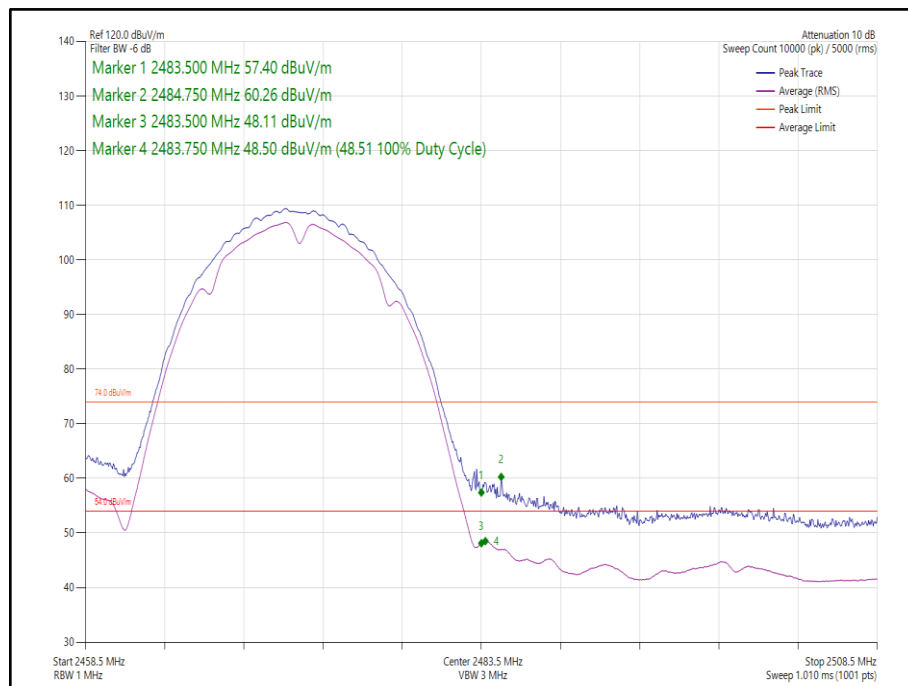


Figure 4 - 802.11b, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

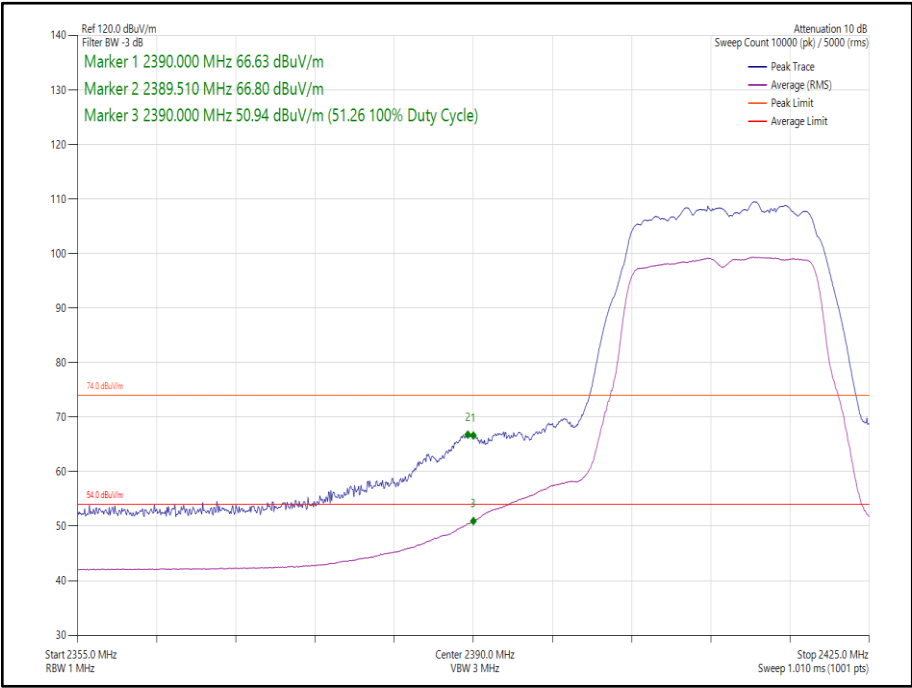


Figure 5 - 802.11g, Core 0 - 2412 MHz, Band Edge Frequency 2390.0 MHz

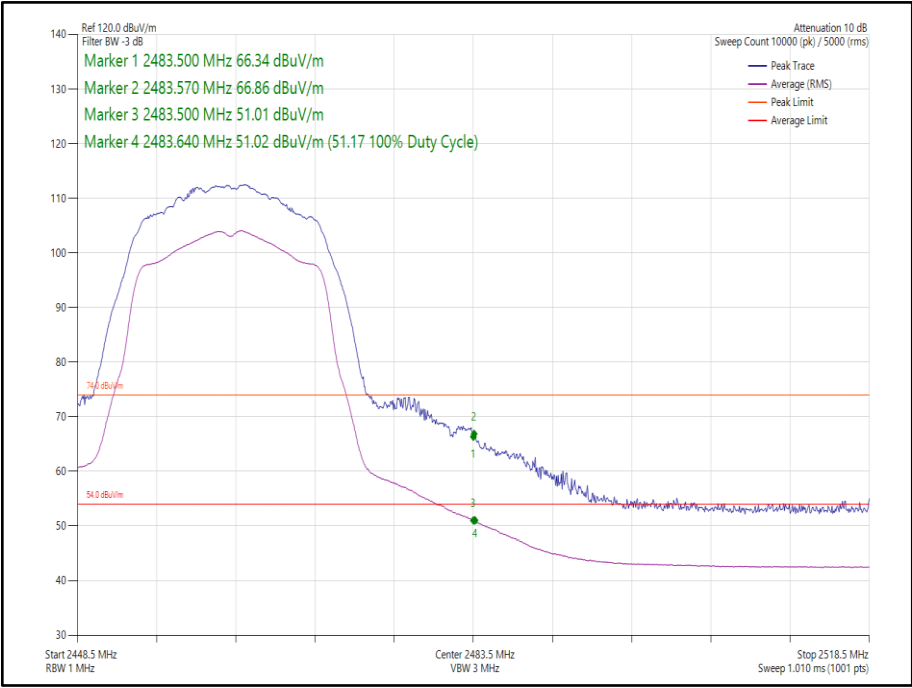


Figure 6 - 802.11g, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

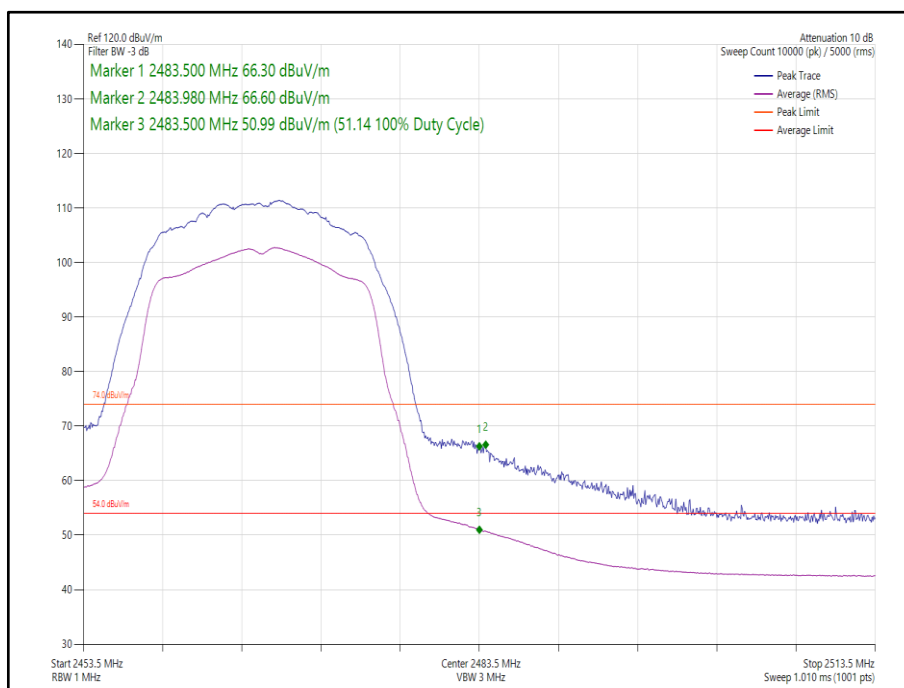


Figure 7 - 802.11g, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

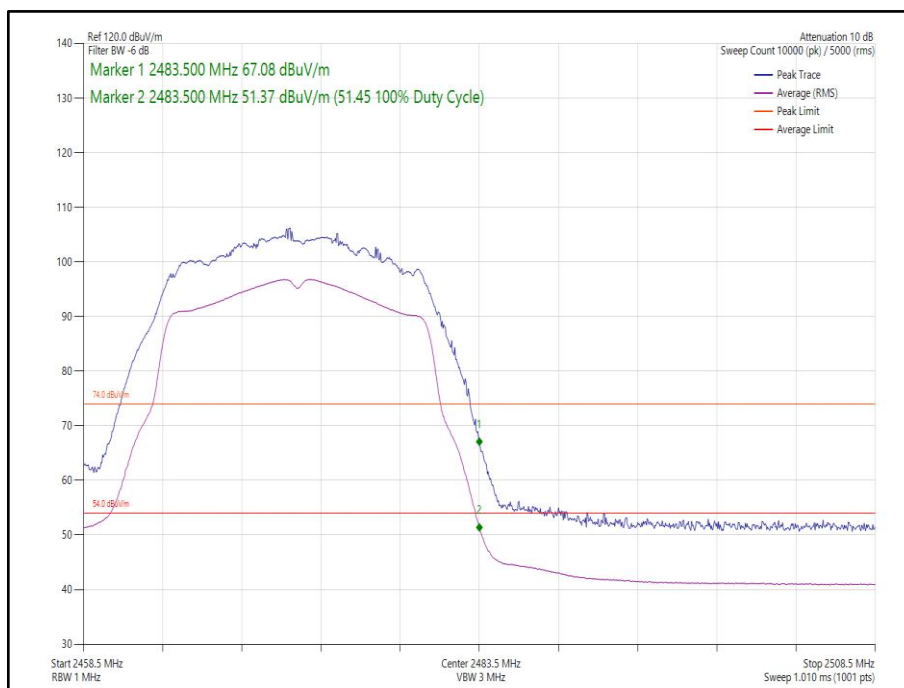


Figure 8 - 802.11g, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

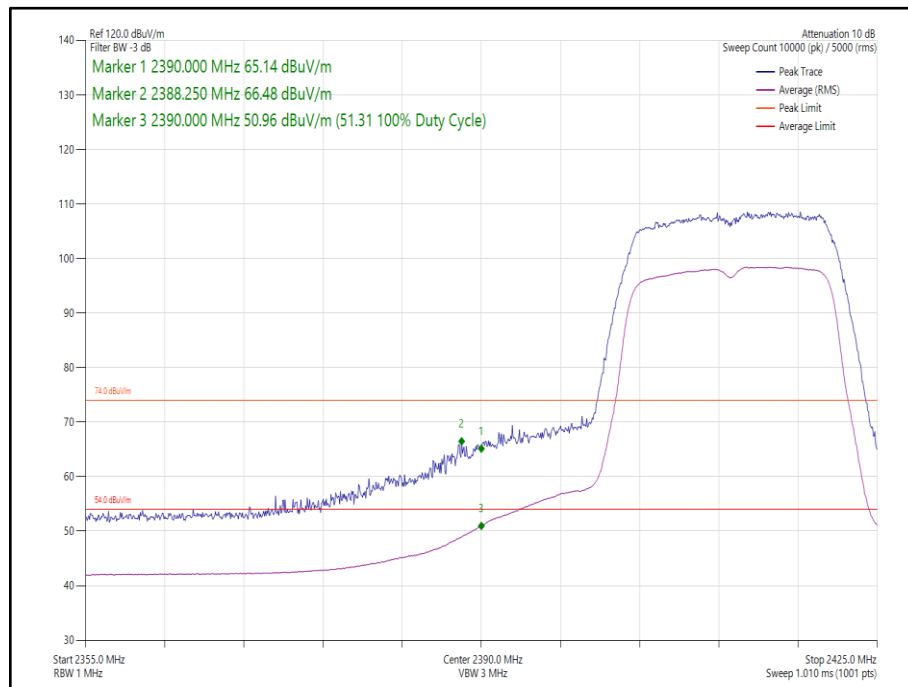


Figure 9 - 802.11n, HT20, Core 0 - 2412 MHz, Band Edge Frequency 2390 MHz

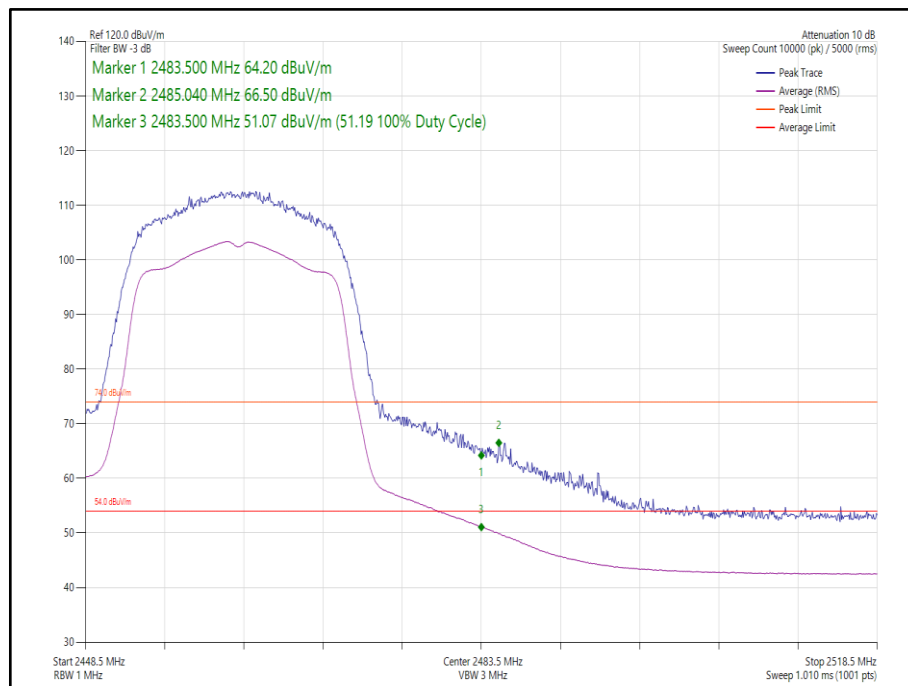


Figure 10 - 802.11n HT20, Core 0 - 2462 MHz, Band Edge Frequency 2483.5 MHz

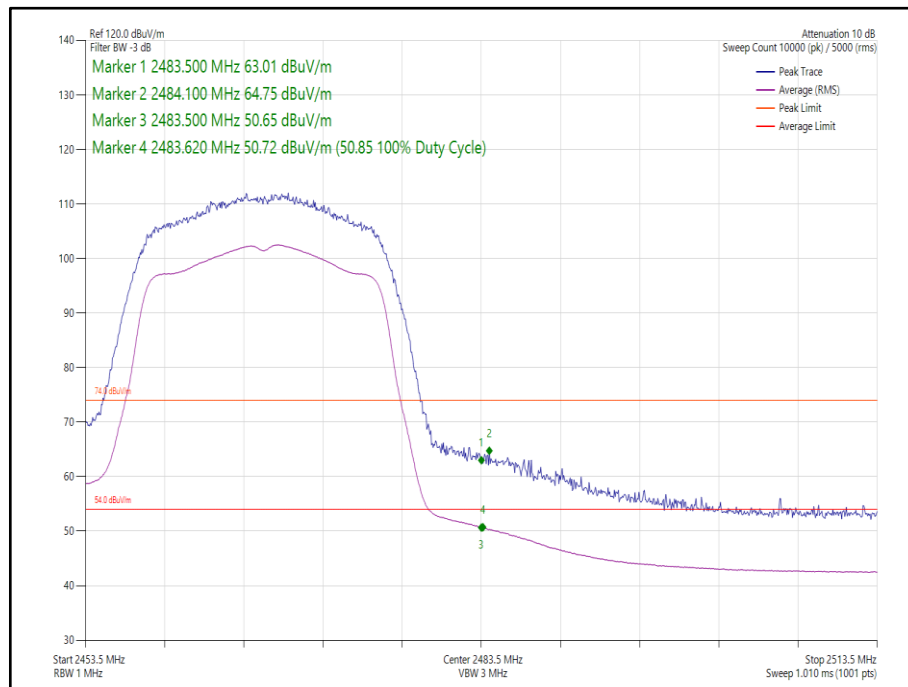


Figure 11 - 802.11n HT20, Core 0 - 2467 MHz, Band Edge Frequency 2483.5 MHz

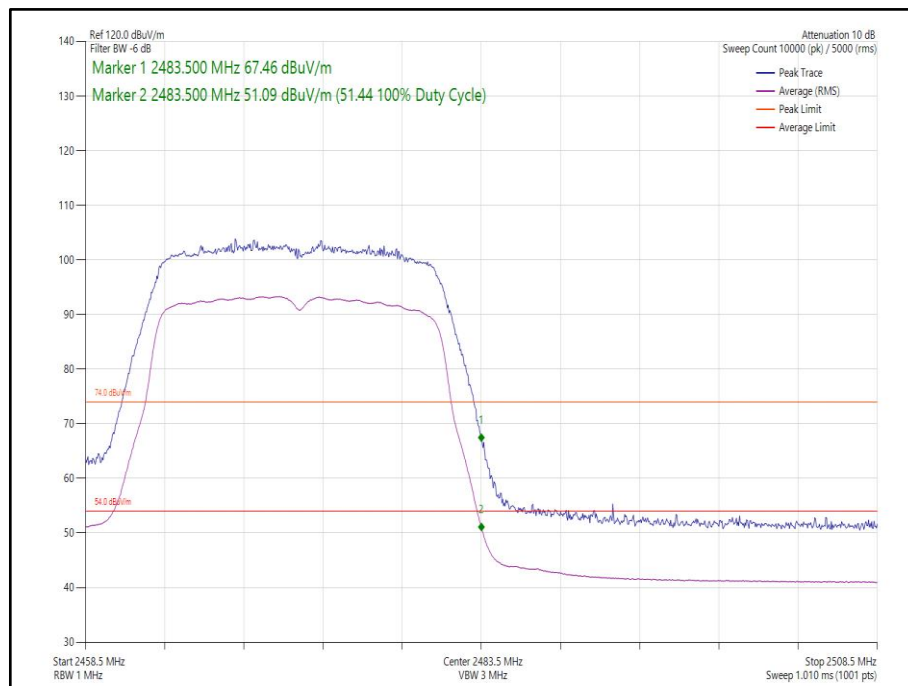


Figure 12 - 802.11n HT20, Core 0 - 2472 MHz, Band Edge Frequency 2483.5 MHz

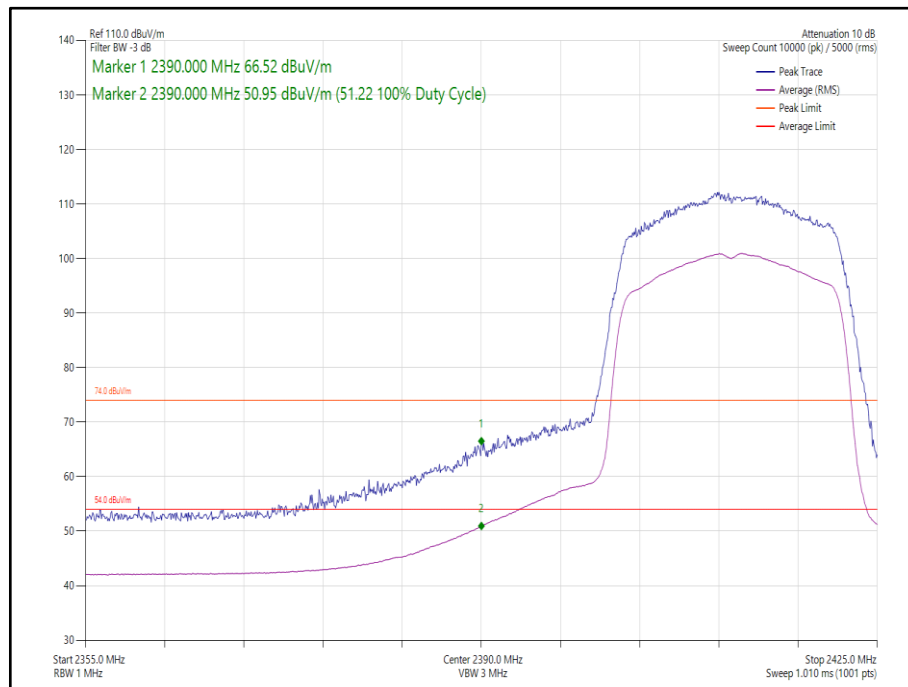


Figure 13 - 802.11ax HE20, Core 0, SU - 2412 MHz, Band Edge Frequency 2390 MHz

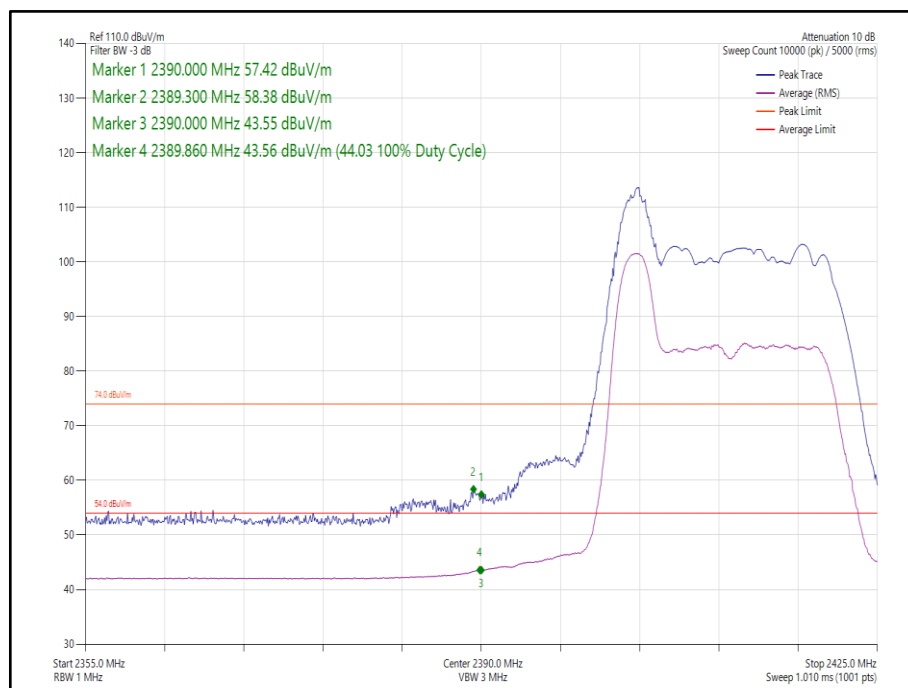


Figure 14 - 802.11ax HE20, Core 0, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz

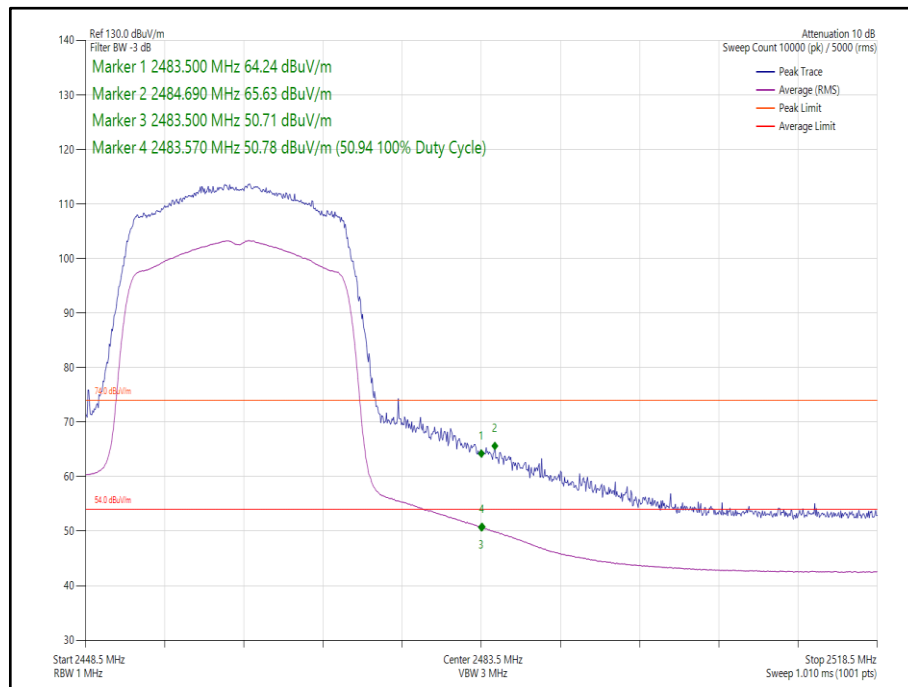


Figure 15 - 802.11ax HE20, Core 0, SU - 2462 MHz, Band Edge Frequency 2483.5 MHz

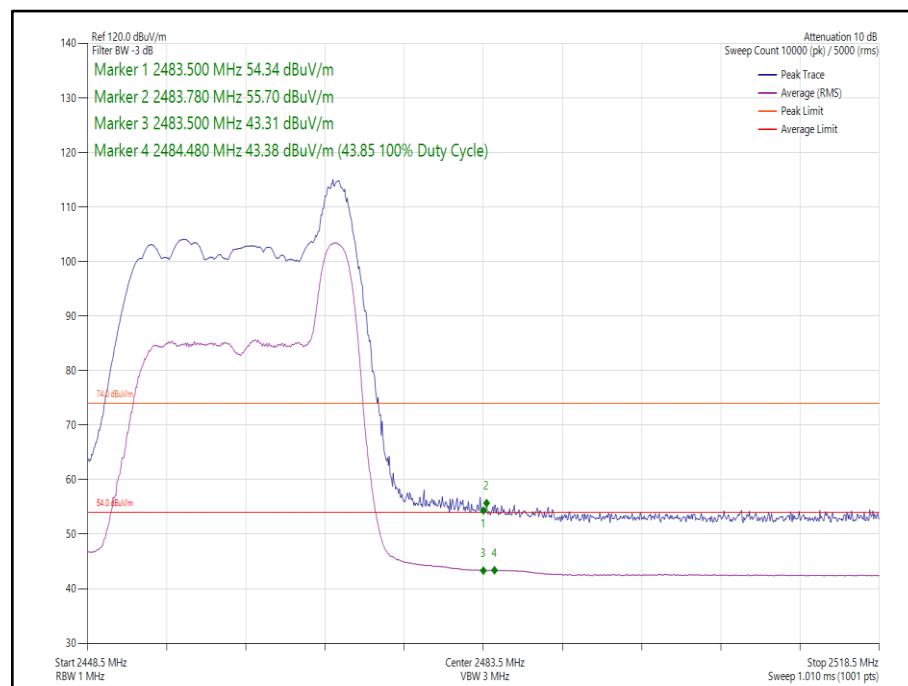


Figure 16 - 802.11ax HE20, Core 0, 26-8 - 2462 MHz, Band Edge Frequency 2483.5 MHz

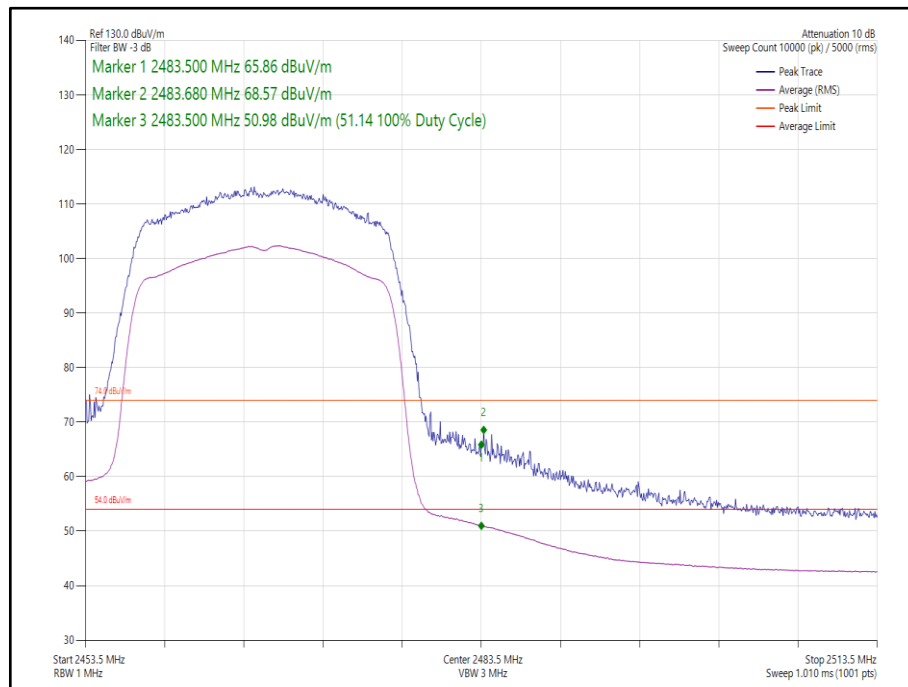


Figure 17 - 802.11ax HE20, Core 0, SU - 2467 MHz, Band Edge Frequency 2483.5 MHz

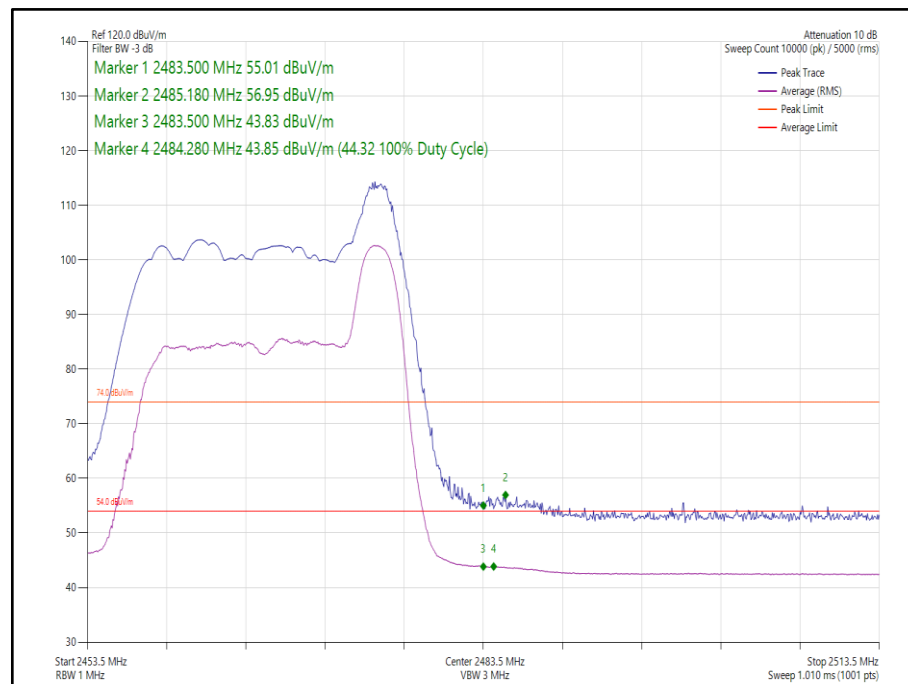


Figure 18 - 802.11ax HE20, Core 0, 26-8 - 2467 MHz, Band Edge Frequency 2483.5 MHz

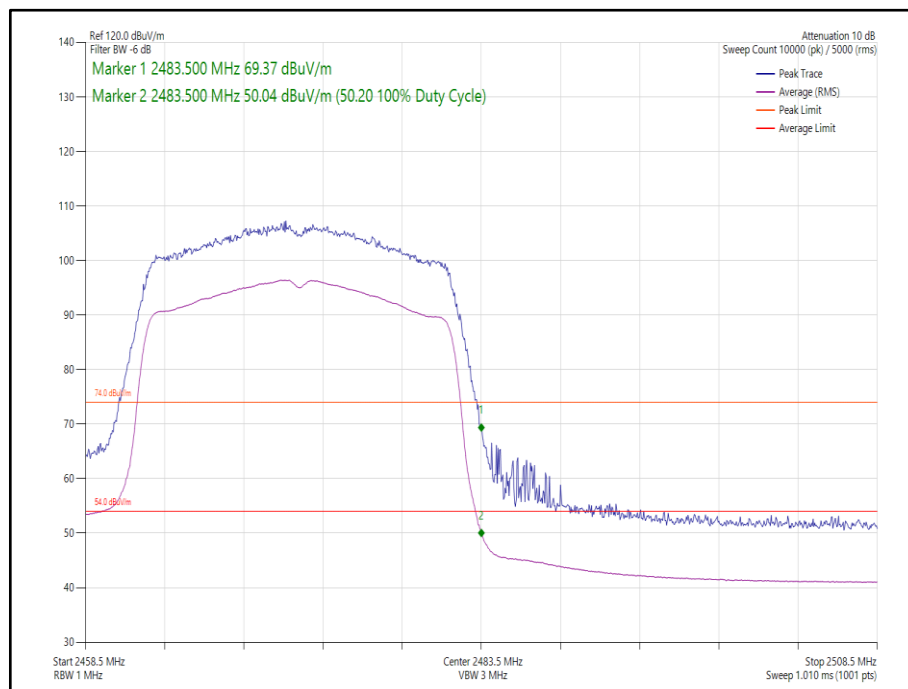


Figure 19 - 802.11ax HE20, Core 0, SU - 2472 MHz, Band Edge Frequency 2483.5 MHz

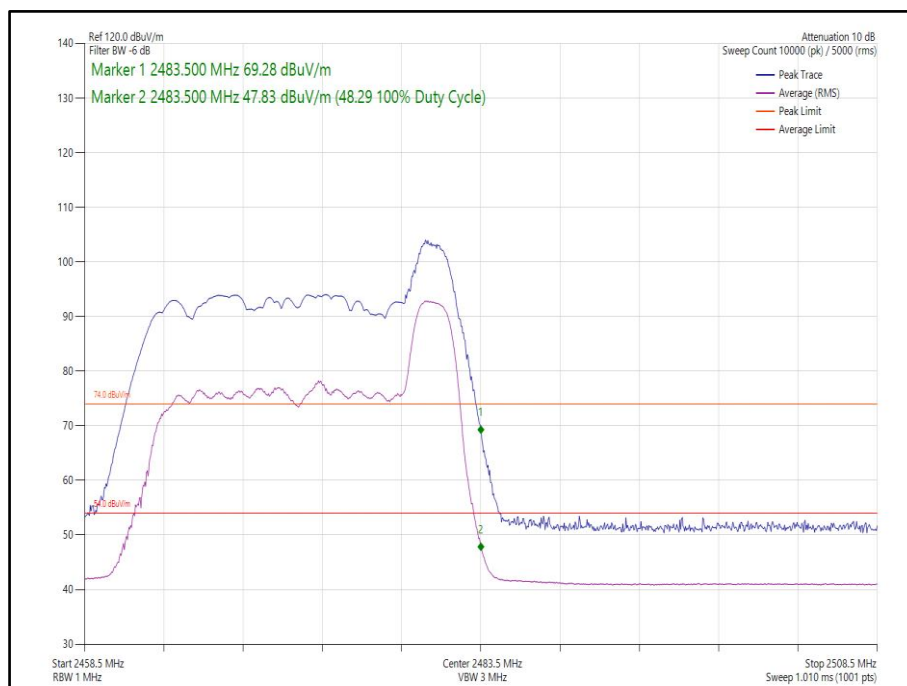


Figure 20 - 802.11ax HE20, Core 0, 26-8 - 2472 MHz, Band Edge Frequency 2483.5 MHz



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	MCS2	-	-	2412	2390.0	64.85	51.29
802.11n HT20, Core 0-1	MCS2	-	-	2462	2483.5	65.77	51.29
802.11n HT20, Core 0-1	MCS2	-	-	2467	2483.5	64.52	51.15
802.11n HT20, Core 0-1	MCS2	-	-	2472	2483.5	67.09	51.22
802.11ax HE20, Core 0-1	MCS4x1	SU	-	2412	2400	65.54	51.20
802.11ax HE20, Core 0-1	MCS9x1	26	0	2412	2400	59.37	44.92
802.11ax HE20, Core 0-1	MCS4x1	SU	-	2462	2483.5	66.68	51.13
802.11ax HE20, Core 0-1	MCS9x1	26	8	2462	2483.5	56.92	44.60
802.11ax HE20, Core 0-1	MCS4x1	SU	-	2467	2483.5	64.92	51.37
802.11ax HE20, Core 0-1	MCS9x1	26	8	2467	2483.5	60.40	45.74
802.11ax HE20, Core 0-1	MCS9x1	SU	-	2472	2483.5	69.35	51.39
802.11ax HE20, Core 0-1	MCS9x1	26	8	2472	2483.5	68.18	48.27

Table 8 – MIMO 2TX Restricted Band Edge Results

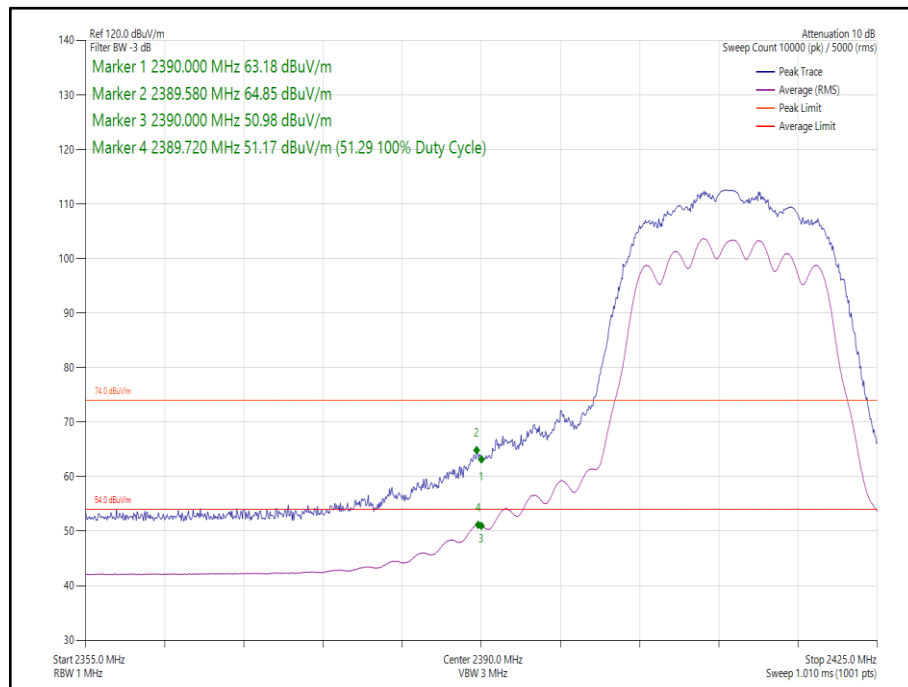


Figure 21 - 802.11n HT20, Core 0-1 - 2412 MHz, Band Edge Frequency 2390 MHz

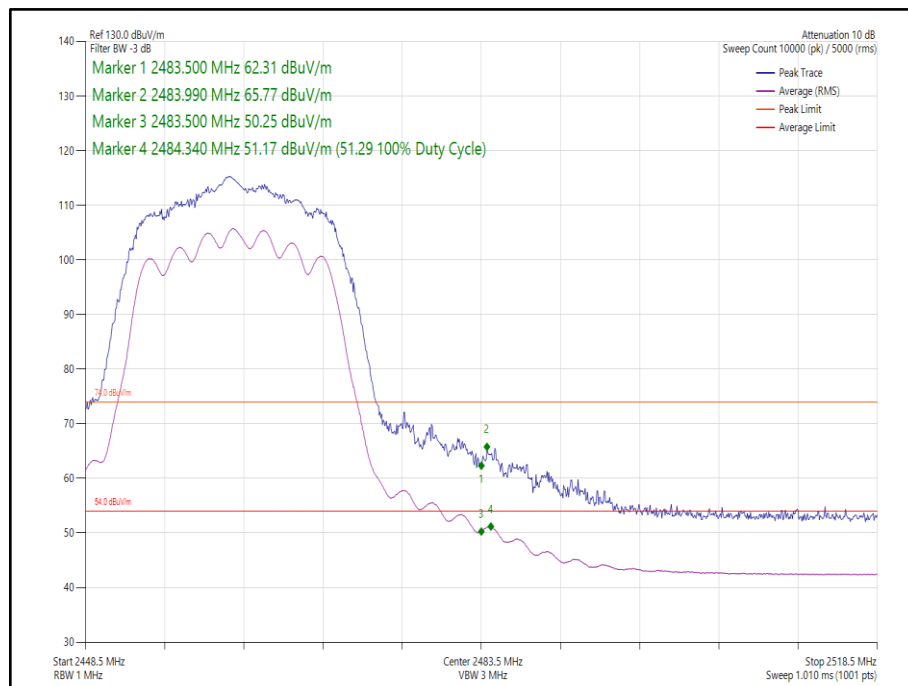


Figure 22 - 802.11n HT20, Core 0-1 - 2462 MHz, Band Edge Frequency 2483.5 MHz

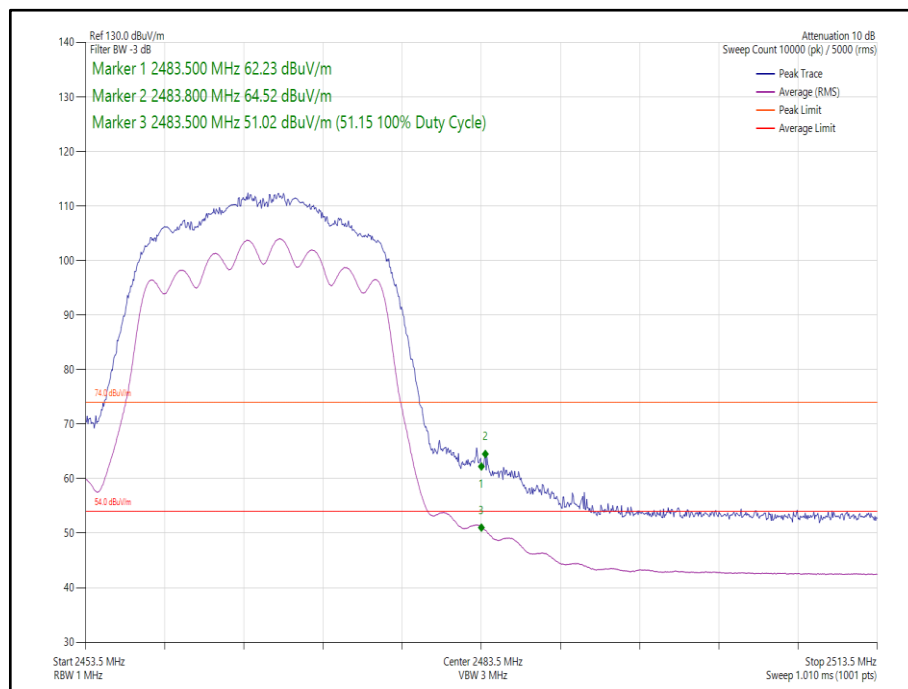


Figure 23 - 802.11n HT20, Core 0-1 - 2467 MHz, Band Edge Frequency 2483.5 MHz

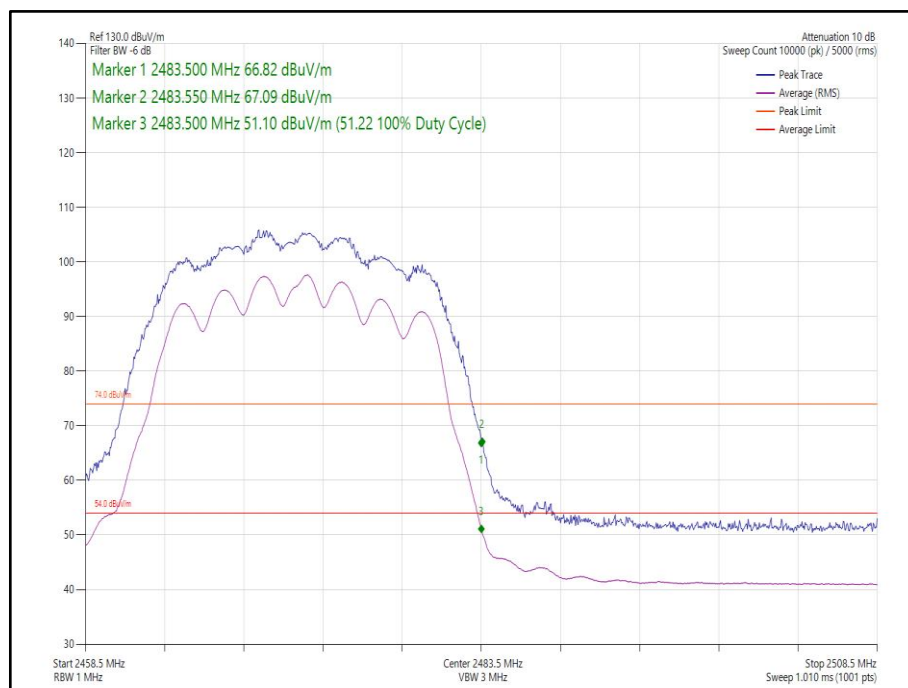


Figure 24 - 802.11n HT20, Core 0-1 - 2472 MHz, Band Edge Frequency 2483.5 MHz

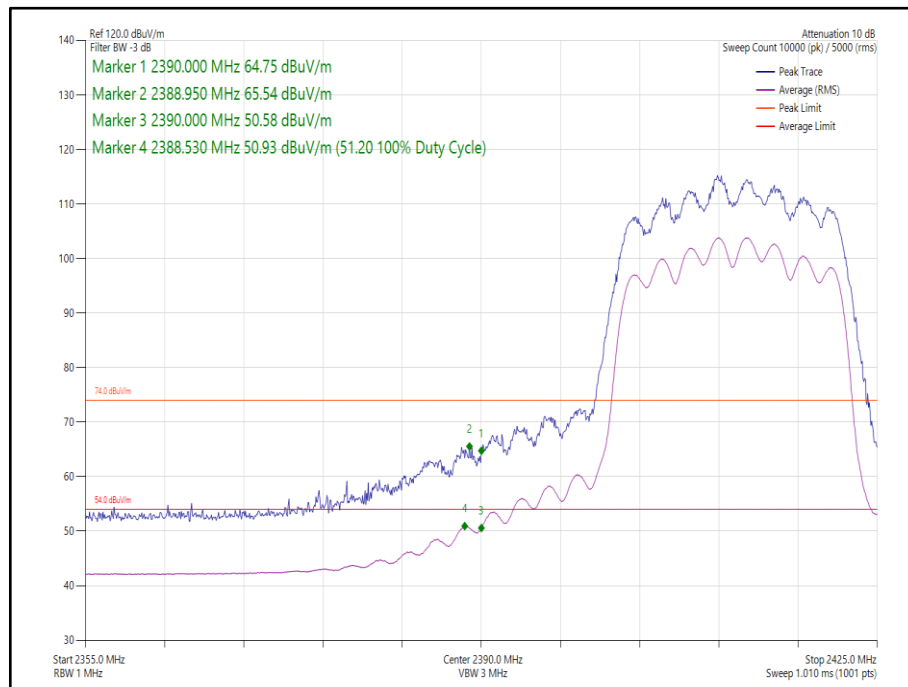


Figure 25 - 802.11ax HE20, Core 0-1, SU - 2412 MHz, Band Edge Frequency 2390 MHz

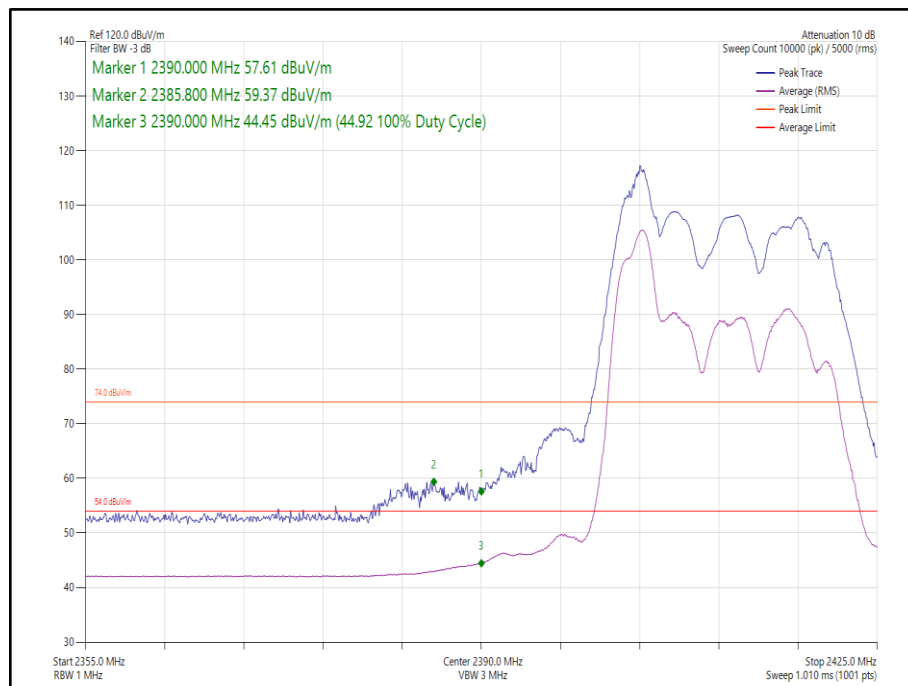
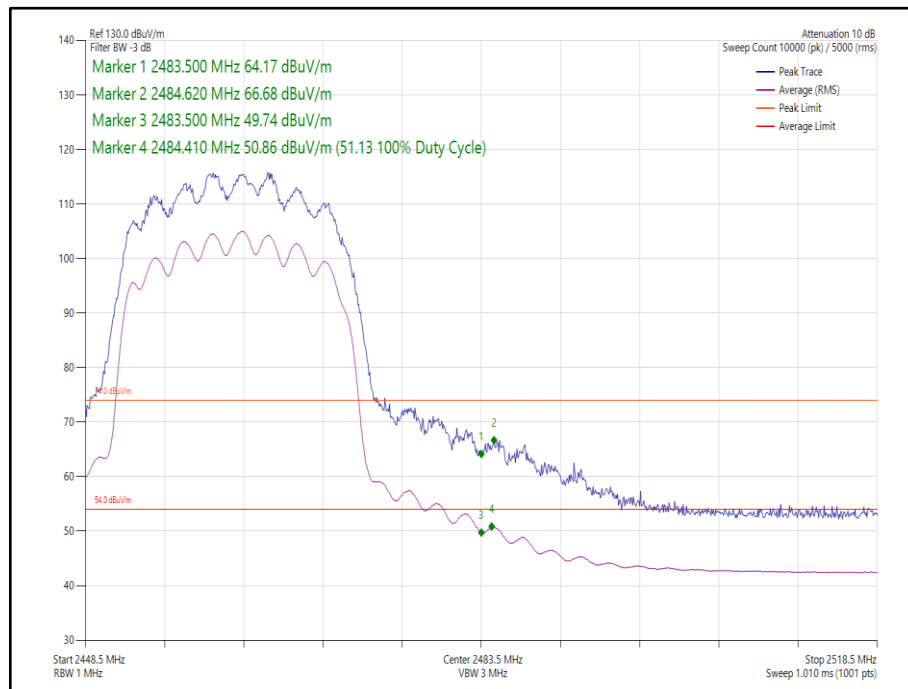
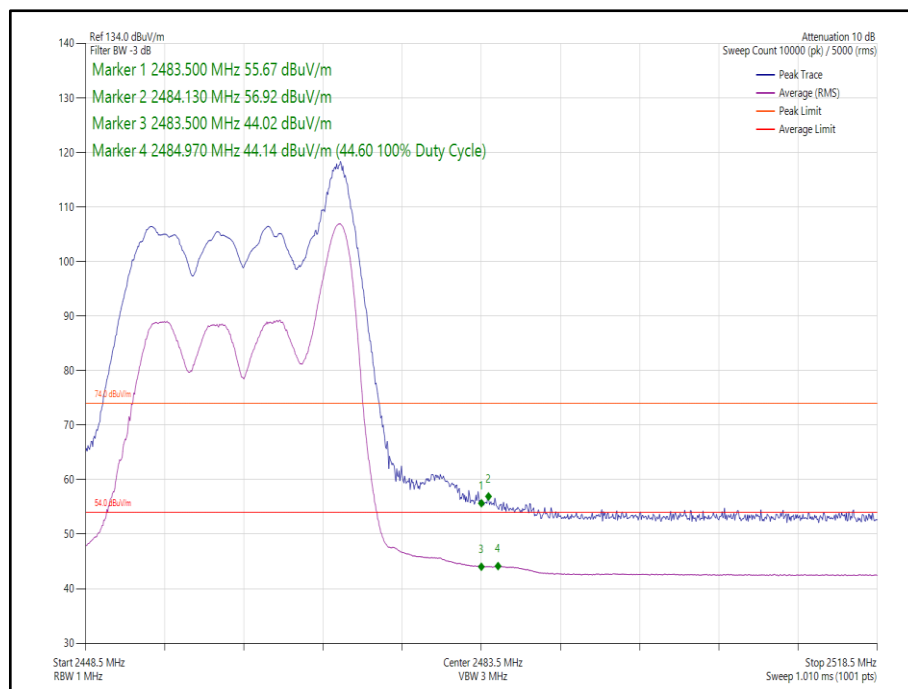


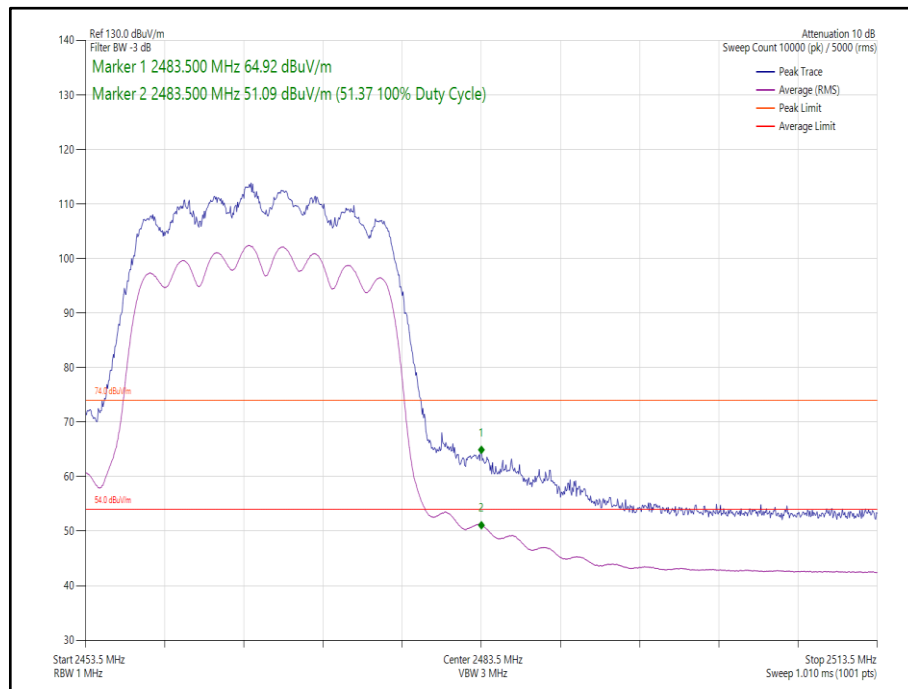
Figure 26 - 802.11ax HE20, Core 0-1, 26-0 - 2412 MHz, Band Edge Frequency 2390 MHz



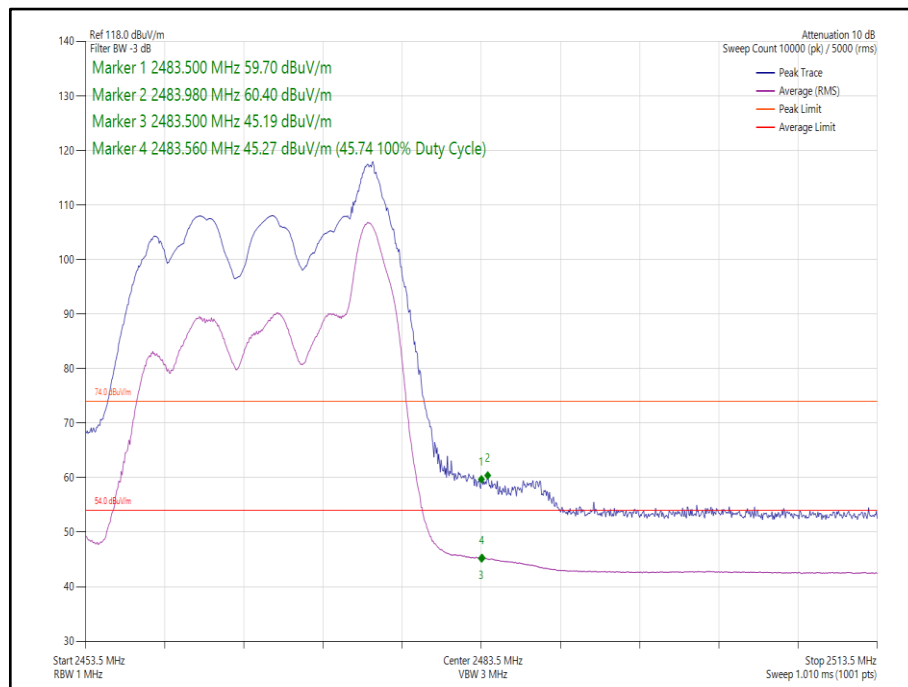
**Figure 27 - 802.11ax HE20, Core 0-1, SU - 2462 MHz,
Band Edge Frequency 2483.5 MHz**



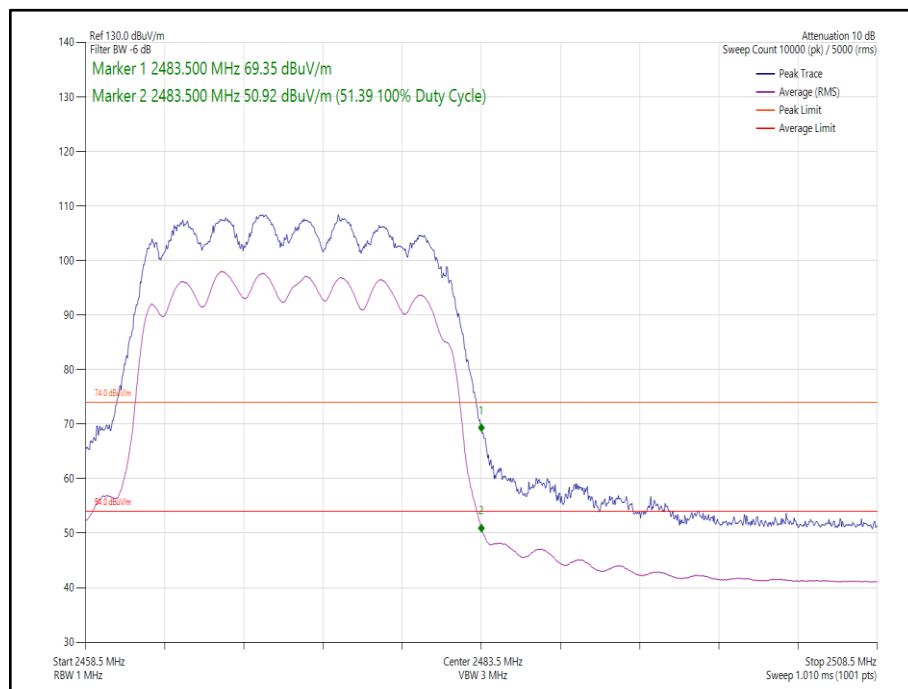
**Figure 28 - 802.11ax HE20, Core 0-1, 26-8 - 2462 MHz,
Band Edge Frequency 2483.5 MHz**



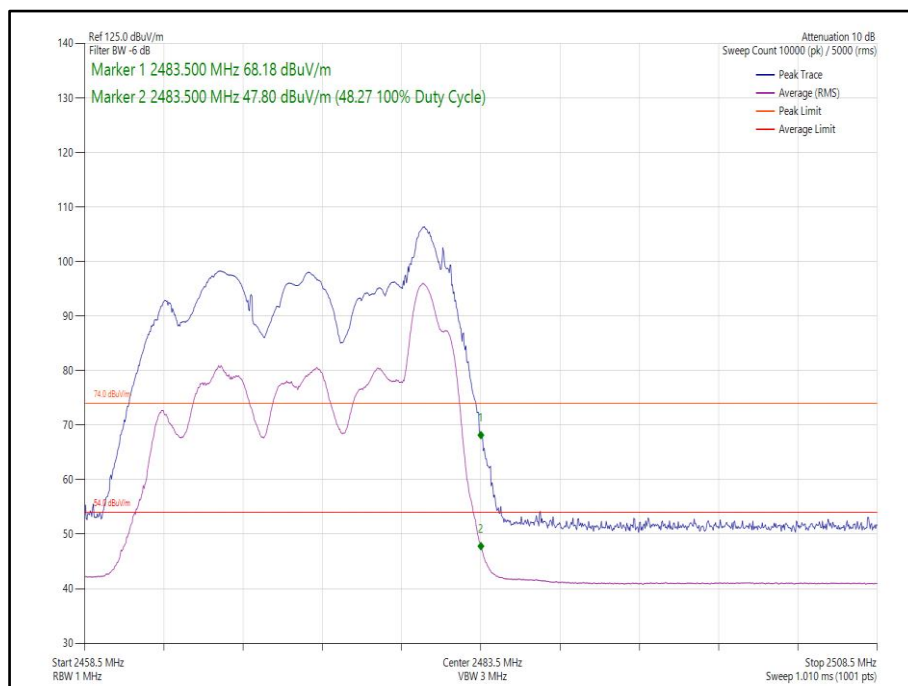
**Figure 29 - 802.11ax HE20, Core 0-1, SU - 2467 MHz,
Band Edge Frequency 2483.5 MHz**



**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 ($\mu\text{V/m}$ 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 ($\mu\text{V/m}$ 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 RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	17-May-2023
Screened Room (11)	Rainford	Rainford	5136	36	24-Nov-2024
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Antenna (DRG 1-10.5GHz)	Schwarzbeck	BBHA9120B	5215	12	28-May-2022
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	12-May-2022
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	12-May-2023
10dB/5W Attenuator	Aaren	AT40A-404-D18-10	5486	12	11-Apr-2022
10dB/5W Attenuator	Aaren	AT40A-404-D18-10	5486	12	11-Apr-2023
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5514	12	12-Apr-2022
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5514	12	12-Apr-2023
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	12-Apr-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	12-Apr-2023
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	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

A2843, S/N: CVP4VD6WJV - Modification State 0
A2843, S/N: L3H7XJ0XXF - Modification State 0

2.2.3 Date of Test

27-July-2022 to 21-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	22.4 - 23.3 °C
Relative Humidity	44.0 - 50.0 %



2.2.6 Test Results

2.4 GHz WLAN

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11b	8.100	8.160
802.11g	15.240	15.240
802.11n HT20	15.240	15.240
802.11ax HE20 SU	15.540	17.700

Table 12 - 6 dB Bandwidth Summary Results

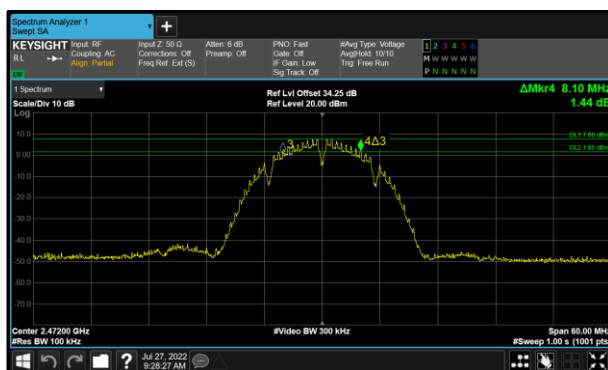


Figure 33 - 802.11b Minimum 6 dB EBW

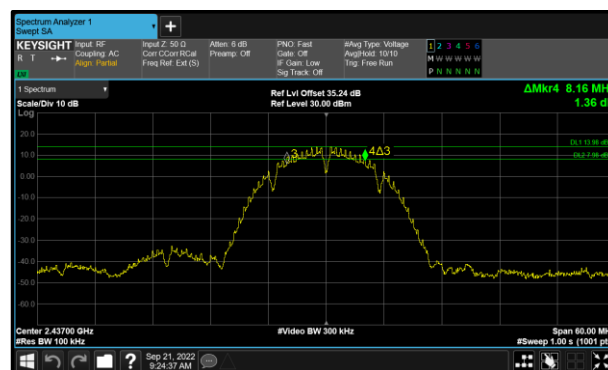


Figure 34 - 802.11b Maximum 6 dB EBW

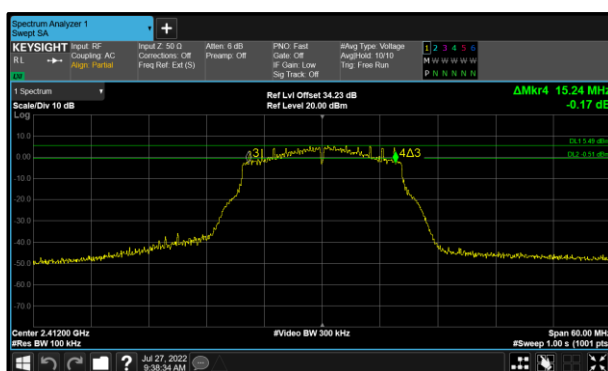


Figure 35 - 802.11g Minimum 6 dB EBW

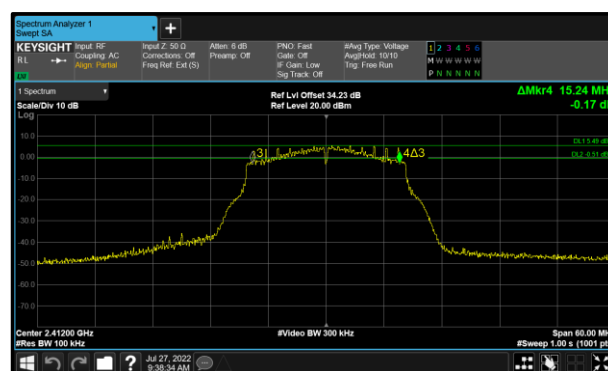


Figure 36 - 802.11g Maximum 6 dB EBW

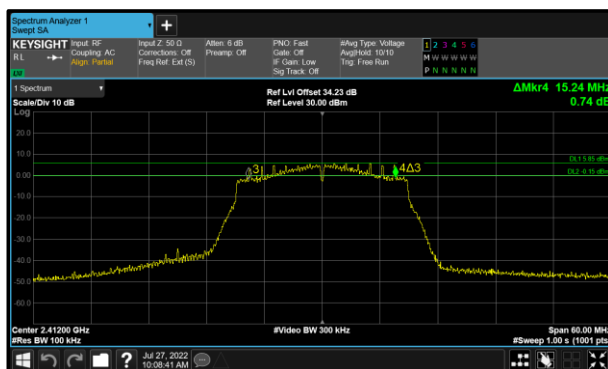


Figure 37 - 802.11n HT20 Minimum 6 dB EBW

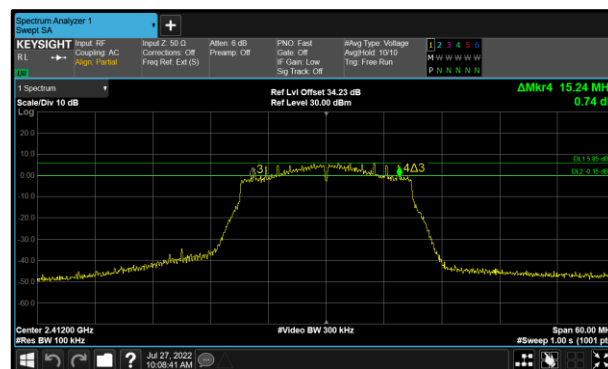


Figure 38 - 802.11n HT20 Maximum 6 dB EBW

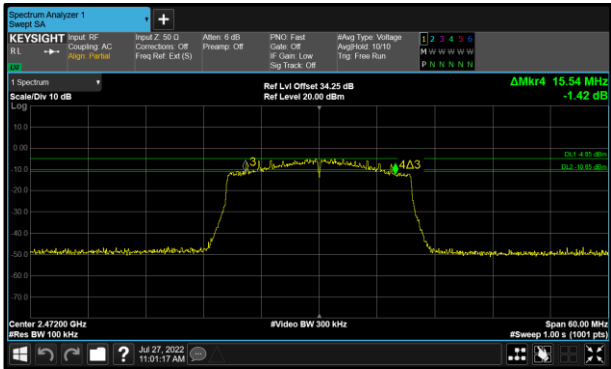


Figure 39 - 802.11ax HE20 SU Minimum 6 dB
EBW

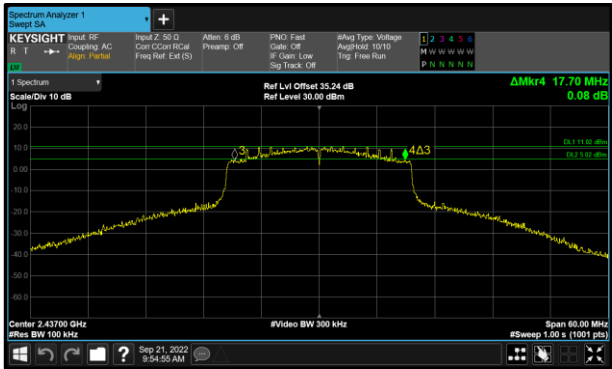


Figure 40 - 802.11ax HE20 SU Maximum 6 dB
EBW



Protocol	99% Bandwidth (MHz)	
	Minimum	Maximum
802.11b	12.780	13.020
802.11g	16.260	16.440
802.11n HT20	17.460	17.640
802.11ax HE20 SU	18.660	18.840

Table 13 - 99% Bandwidth Summary Results

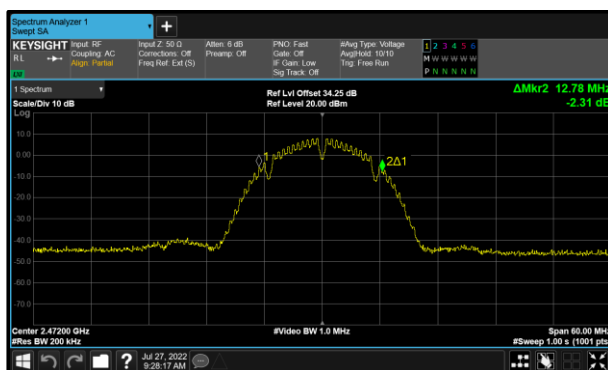


Figure 41 - 802.11b Minimum 99% OBW

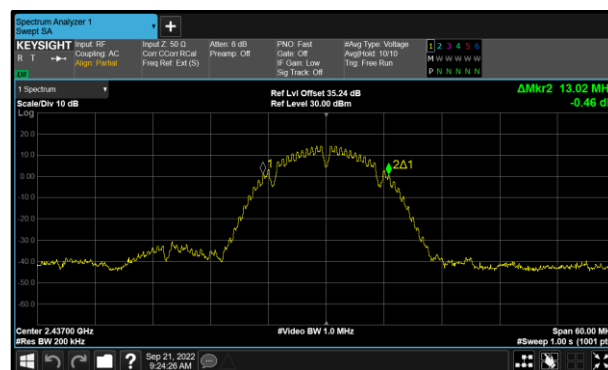


Figure 42 - 802.11b Maximum 99% OBW

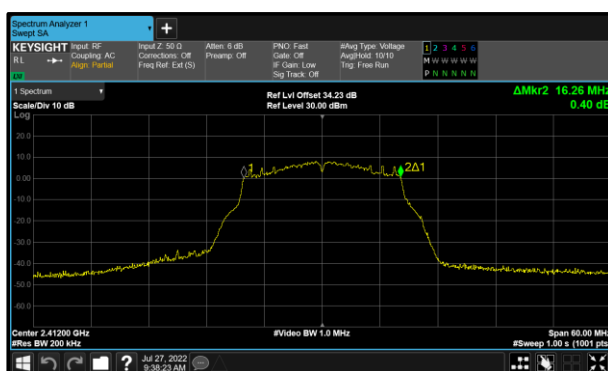


Figure 43 - 802.11g Minimum 99% OBW

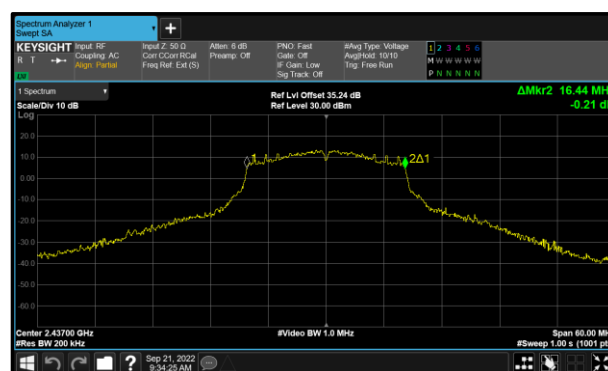


Figure 44 - 802.11g Maximum 99% OBW

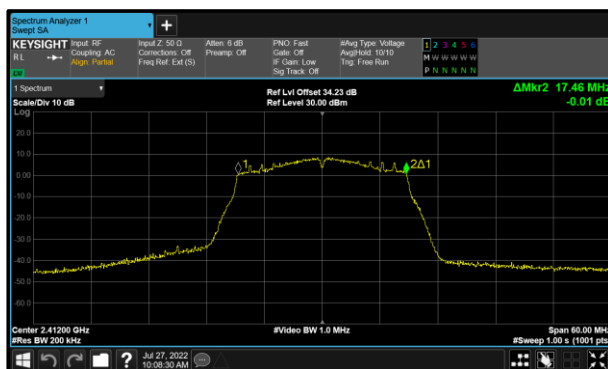


Figure 45 - 802.11n HT20 Minimum 99% OBW

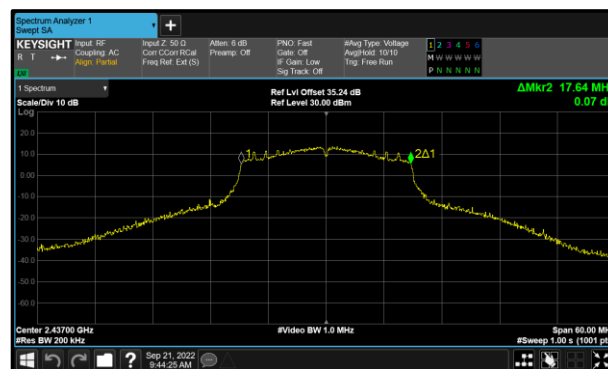


Figure 46 - 802.11n HT20 Maximum 99% OBW

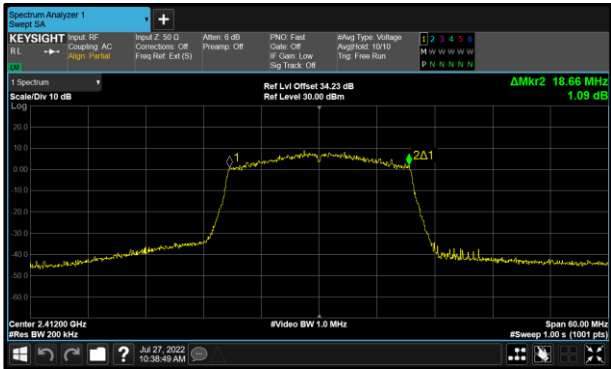


Figure 47 - 802.11ax HE20 SU Minimum 99% OBW

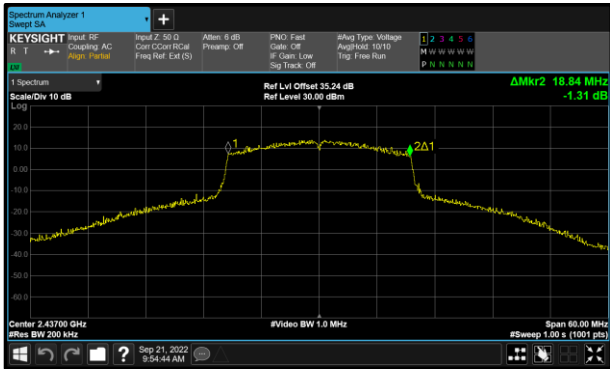


Figure 48 - 802.11ax HE20 SU Maximum 99% OBW



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	-	8.160	-	-	≥500.0
2472	-	8.100	-	-	≥500.0

Table 14 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	12.900	-	-	-
2437	-	13.020	-	-	-
2472	-	12.780	-	-	-

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	-	16.260	-	-	-
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	-	16.920	-	-	≥500.0
2437	-	17.700	-	-	≥500.0
2472	-	15.540	-	-	≥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

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11n HT20	15.240	15.300
802.11ax HE20 SU	16.080	17.760

Table 22 - 6 dB Bandwidth Summary Results

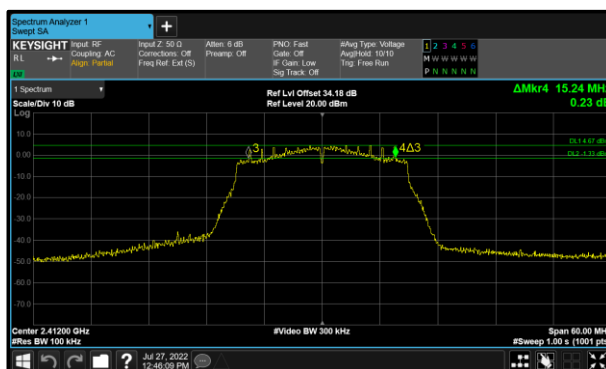


Figure 49 - 802.11n HT20 Minimum 6 dB EBW

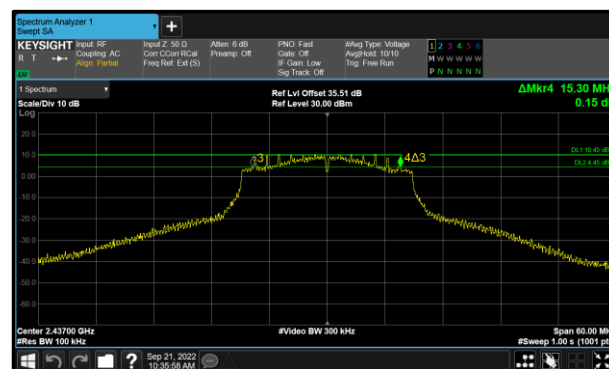


Figure 50 - 802.11n HT20 Maximum 6 dB EBW

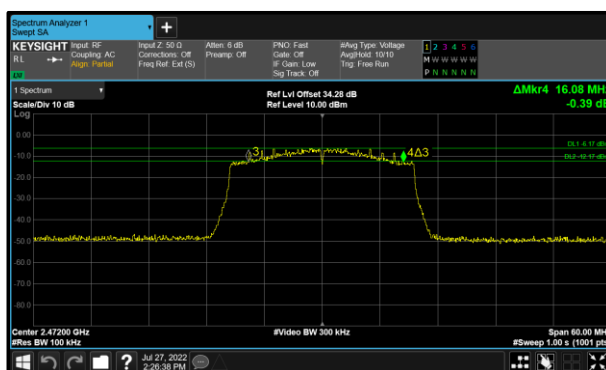


Figure 51 - 802.11ax HE20 SU Minimum 6 dB EBW

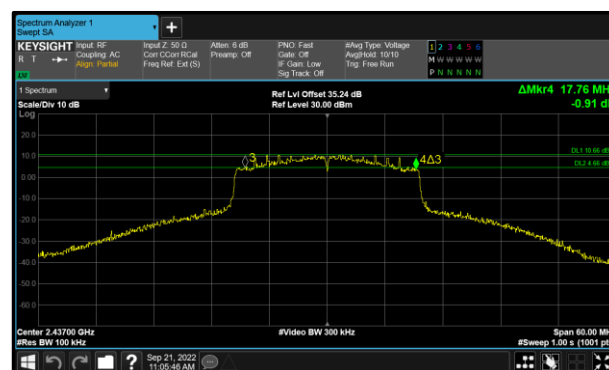


Figure 52 - 802.11ax HE20 SU Maximum 6 dB EBW

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

Table 23 - 99% Bandwidth Summary Results

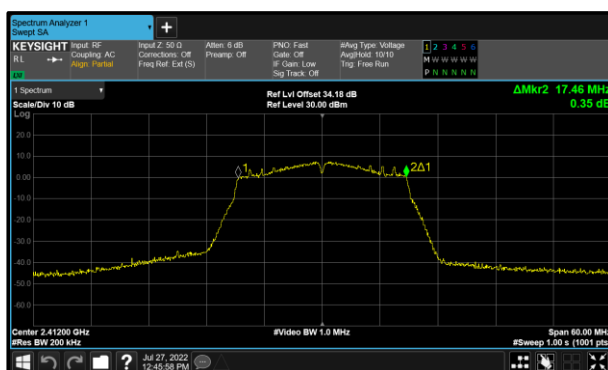


Figure 53 - 802.11n HT20 Minimum 99% OBW

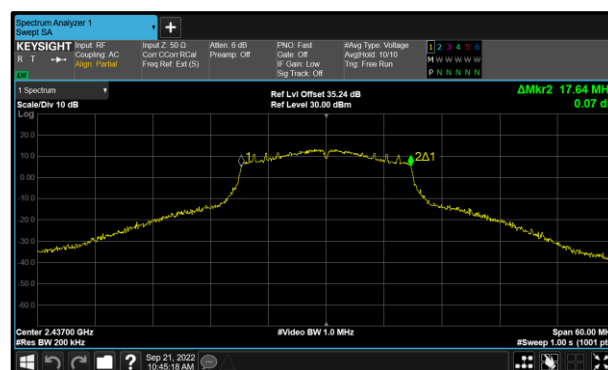


Figure 54 - 802.11n HT20 Maximum 99% OBW

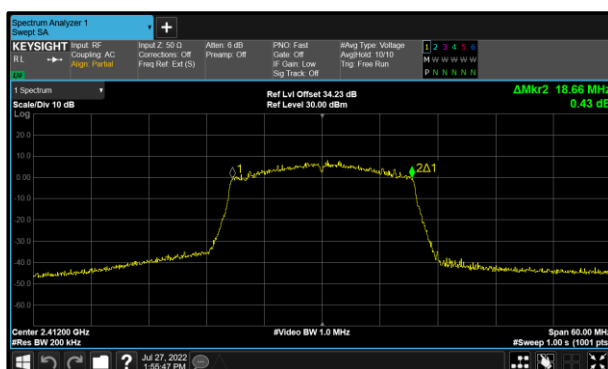


Figure 55 - 802.11ax HE20 SU Minimum 99% OBW

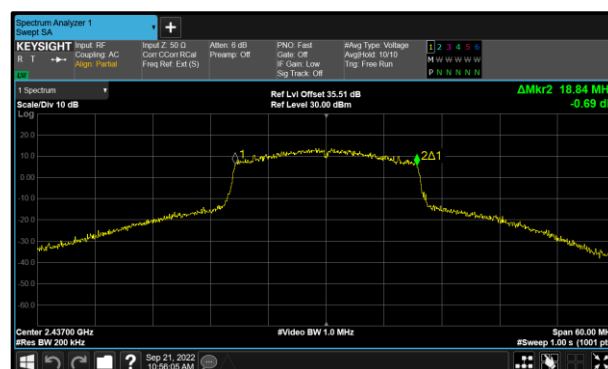


Figure 56 - 802.11ax HE20 SU Maximum 99% OBW



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	15.240	-	-	≥500.0
2472	15.240	15.240	-	-	≥500.0

Table 24 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	17.460	17.460	-	-	-
2437	17.580	17.640	-	-	-
2472	17.460	17.460	-	-	-

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 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	16.200	17.400	-	-	≥500.0
2437	16.740	17.760	-	-	≥500.0
2472	16.080	17.820	-	-	≥500.0

Table 26 - 6 dB Bandwidth Results

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

Table 27 - 99% Bandwidth Results

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISSED 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 1.

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
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 28

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

A2843, S/N: CVP4VD6WJV - Modification State 0
A2843, S/N: L3H7XJ0XXF - Modification State 0

2.3.3 Date of Test

27-July-2022 to 21-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	22.4 - 23.3 °C
Relative Humidity	44.0 - 50.0 %



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):	0.10
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	Σ		
2412	-	20.36	-	-	-	30.00	-9.64
2437	-	22.28	-	-	-	30.00	-7.72
2472	-	14.31	-	-	-	30.00	-15.69

Table 29 - 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	Σ					
2412	-	20.36	-	-	-	30.00	-9.64	20.46	36.00	-15.54
2437	-	22.28	-	-	-	30.00	-7.72	22.38	36.00	-13.62
2472	-	14.31	-	-	-	30.00	-15.69	14.41	36.00	-21.59

Table 30 - ISSED 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 (%):	97.7
Data Rate:	12 Mbps	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	0.10
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	Σ		
2412	-	15.67	-	-	-	30.00	-14.33
2437	-	22.38	-	-	-	30.00	-7.62
2472	-	4.79	-	-	-	30.00	-25.21

Table 31 - 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	Σ					
2412	-	15.67	-	-	-	30.00	-14.33	15.77	36.00	-20.23
2437	-	22.38	-	-	-	30.00	-7.62	22.48	36.00	-13.52
2472	-	4.79	-	-	-	30.00	-25.21	4.89	36.00	-31.11

Table 32 - ISSED 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 (%):	96.6
Modulation Coding Scheme:	MCS2	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	0.10
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	Σ		
2412	-	15.87	-	-	-	30.00	-14.13
2437	-	22.48	-	-	-	30.00	-7.52
2472	-	4.66	-	-	-	30.00	-25.34

Table 33 - 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	Σ					
2412	-	15.87	-	-	-	30.00	-14.13	15.97	36.00	-20.03
2437	-	22.48	-	-	-	30.00	-7.52	22.58	36.00	-13.42
2472	-	4.66	-	-	-	30.00	-25.34	4.76	36.00	-31.24

Table 34 - ISSED 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:	802.11ax HE20 SU	Duty Cycle (%):	95.9
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	0.10
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	Σ		
2412	-	14.86	-	-	-	30.00	-15.14
2437	-	22.27	-	-	-	30.00	-7.73
2472	-	4.92	-	-	-	30.00	-25.08

Table 35 - 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	Σ					
2412	-	14.86	-	-	-	30.00	-15.14	14.96	36.00	-21.04
2437	-	22.27	-	-	-	30.00	-7.73	22.37	36.00	-13.63
2472	-	4.92	-	-	-	30.00	-25.08	5.02	36.00	-30.98

Table 36 - ISSED 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:	802.11ax HE20 RU26	Duty Cycle (%):	96.6
Modulation Coding Scheme:	MCS2x1	DCCF (dB):	-
Antenna Configuration:	SISO	Peak Antenna Gain (dBi):	0.10
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	Σ		
2412	-	13.38	-	-	-	30.00	-16.62
2437	-	13.36	-	-	-	30.00	-16.64
2472	-	4.81	-	-	-	30.00	-25.19

Table 37 - 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	Σ					
2412	-	13.38	-	-	-	30.00	-16.62	13.48	36.00	-22.52
2437	-	13.36	-	-	-	30.00	-16.64	13.46	36.00	-22.54
2472	-	4.81	-	-	-	30.00	-25.19	4.91	36.00	-31.09

Table 38 - ISSED Maximum Conducted (average) Output Power Results