

FCC and ISED Test Report

Apple Inc
Model: A2991

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: BCGA2991

IC: 579C-A2991



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Document 75957632-70 Issue 02

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steven White	Senior Technical Specialist	Authorised Signatory	11 October 2023

Signatures in this approval box have checked this document in line with the requirements of TUV SUD 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	11 October 2023	

FCC Accreditation

553713/UK2026 Concorde Park, Fareham Test Laboratory

ISED Accreditation

28798 Concorde Park, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C: 2021, 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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ACCREDITATION

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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	15-September-2023
2	Sections 2.1 and 2.4 updated	11-October-2023

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2991
Serial Number(s)	N7RTH0WPW3, XNJWHY732L, LRYJMC4D4 and Y7RPXWJ9N9
Hardware Version(s)	REV 1.0
Software Version(s)	23A32390z, 23A32390z, 23A32390z and 23A32391n
Number of Samples Tested	4
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2021 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Start of Test	26-June-2023
Finish of Test	10-August-2023
Name of Engineer(s)	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Morsalin Hossain, Vineeth Nagaraj, Feda Hussein, Michael Evans, Tony Baby and Akhil Rajendran Bhaskaran Nair
Related Document(s)	ANSI C63.10 (2013) KDB 662911 D01 v02r01 ANSI C63.4 (2014)



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
	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	ANSI C63.10 (2013)
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	KDB 662911 D01 v02r01 ANSI C63.10 (2013)
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.5	15.209 and 15.247 (d)	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013) ANSI C63.4 (2014)
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	KDB 662911 D01 v02r01 ANSI C63.10 (2013)

Table 2



1.4 Product Information

1.4.1 Technical Description

The equipment under test (EUT) was a portable laptop computer.

1.4.2 Test Modes

The EUT's 2.4 GHz 802.11 radio supports SISO (Single Input/Single Output) 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 the transmit mode and how many cores are used. It uses the same power across all cores in any given mode.

After preliminary investigations were performed, the EUT was therefore tested in the following worst-case modes:

SISO Modes (Core 1):

- 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 was 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. 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	3.10	0.71
Core 1	2400 to 2480	5.30	0.71

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: A2991, Serial Number: N7RTH0WPW3			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2991, Serial Number: XNJWHY732L			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2991, Serial Number: Y7RPXWJ9N9			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2991, Serial Number: LRYJMC4D4			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4



1.7 Test Location

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		
Restricted Band Edges	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Morsalin Hossain and Vineeth Nagaraj	UKAS
Emission Bandwidth	Feda Hussein	UKAS
Maximum Conducted Output Power	Feda Hussein	UKAS
Authorised Band Edges	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Michael Evans, Morsalin Hossain, Tony Baby and Vineeth Nagaraj	UKAS
Spurious Radiated Emissions	Akhil Rajendran Bhaskaran Nair, Michael Evans and Vineeth Nagaraj	UKAS
Power Spectral Density	Feda Hussein	UKAS

Table 5

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

A2991, S/N: N7RTH0WPW3 - Modification State 0
A2991, S/N: XNJWHY732L - Modification State 0
A2991, S/N: LRYJMC4D4 - Modification State 0

2.1.3 Date of Test

26-June-2023 to 04-August-2023

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	22.4 - 24.2 °C
Relative Humidity	41.5 - 46.7 %



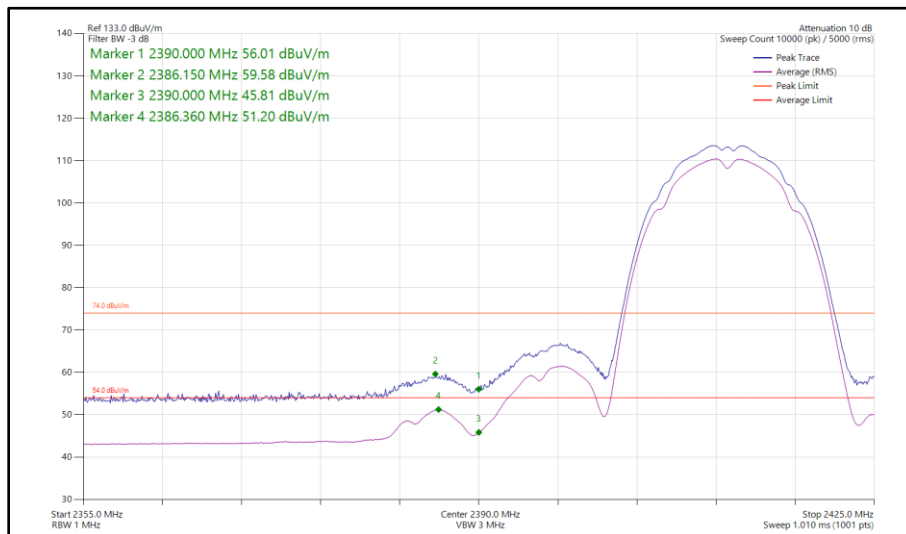
2.1.6 Test Results

2.4 GHz WLAN

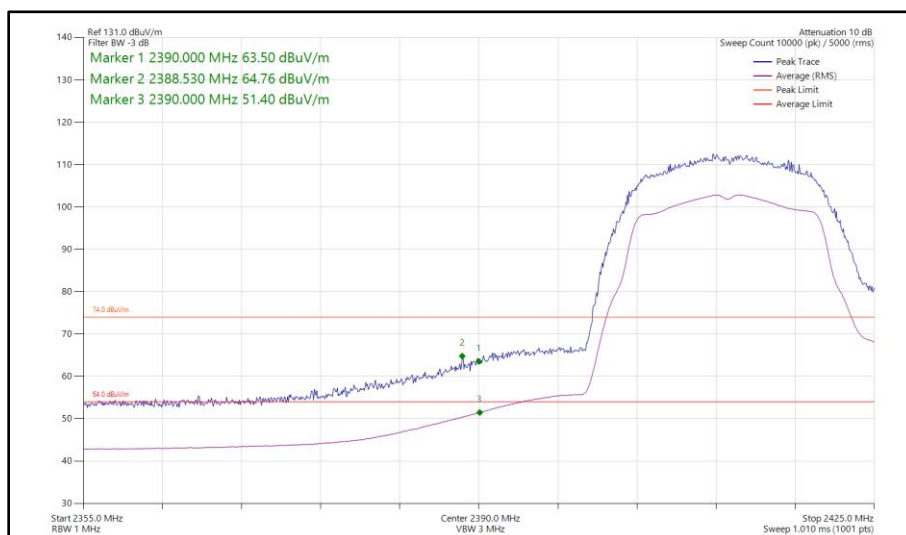
20 MHz Bandwidth - Core 0 (SISO)

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	1 Mbps	-	-	2412	2390	59.58	51.20
802.11g	12 Mbps	-	-	2412	2390	64.76	51.40
802.11n HT20	MCS2	-	-	2412	2390	65.21	50.82
802.11ax HE20	MCS2x1	SU	-	2412	2390	65.48	51.44
802.11ax HE20	MCS9x1	106	54	2412	2390	69.05	50.23
802.11b	1 Mbps	-	-	2462	2483.5	59.52	51.31
802.11b	1 Mbps	-	-	2467	2483.5	59.31	51.04
802.11b	1 Mbps	-	-	2472	2483.5	58.27	51.38
802.11g	24 Mbps	-	-	2462	2483.5	67.01	51.43
802.11g	24 Mbps	-	-	2467	2483.5	65.05	51.48
802.11g	24 Mbps	-	-	2472	2483.5	65.39	51.44
802.11n HT20	MCS4	-	-	2462	2483.5	65.69	50.96
802.11n HT20	MCS2	-	-	2467	2483.5	63.12	51.42
802.11n HT20	MCS7	-	-	2472	2483.5	65.56	51.44
802.11ax HE20	MCS2x1	SU	-	2462	2483.5	65.16	51.39
802.11ax HE20	MCS9x1	106	54	2462	2483.5	66.26	48.16
802.11ax HE20	MCS2x1	SU	-	2467	2483.5	63.16	51.31
802.11ax HE20	MCS9x1	106	54	2467	2483.5	69.48	47.67
802.11ax HE20	MCS2x1	SU	-	2472	2483.5	66.67	51.49
802.11ax HE20	MCS9x1	26	0	2472	2483.5	69.48	48.61

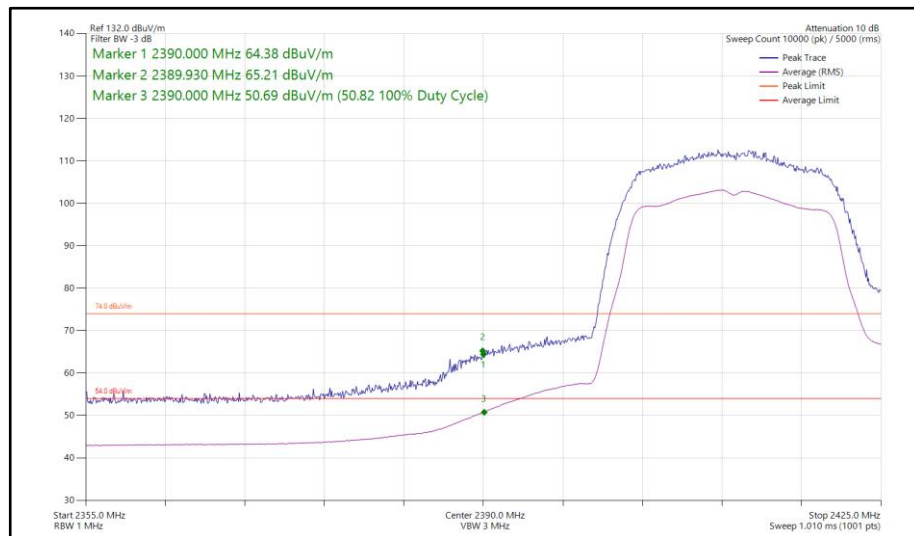
Table 6 - SISO Restricted Band Edge Results



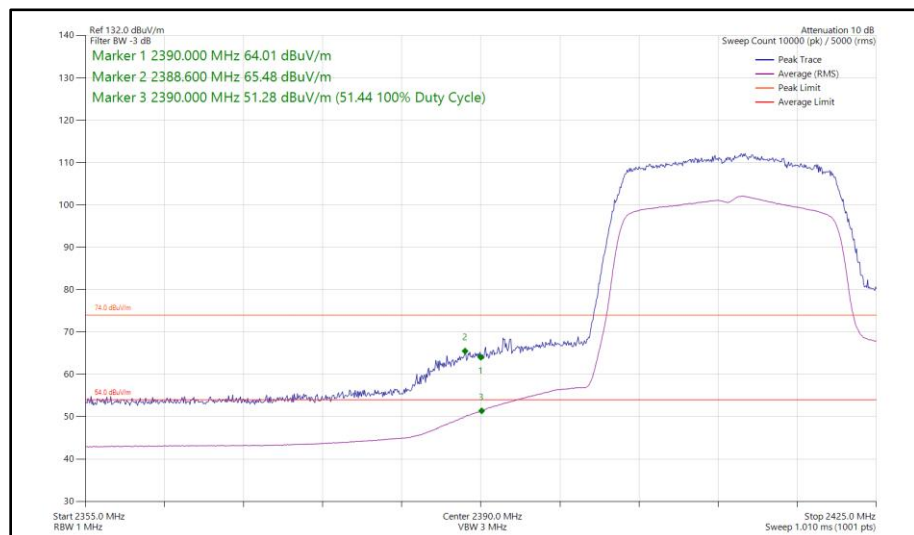
**Figure 1 - 802.11b, SISO, Core 0 - 2412 MHz
Band Edge Frequency 2390 MHz**



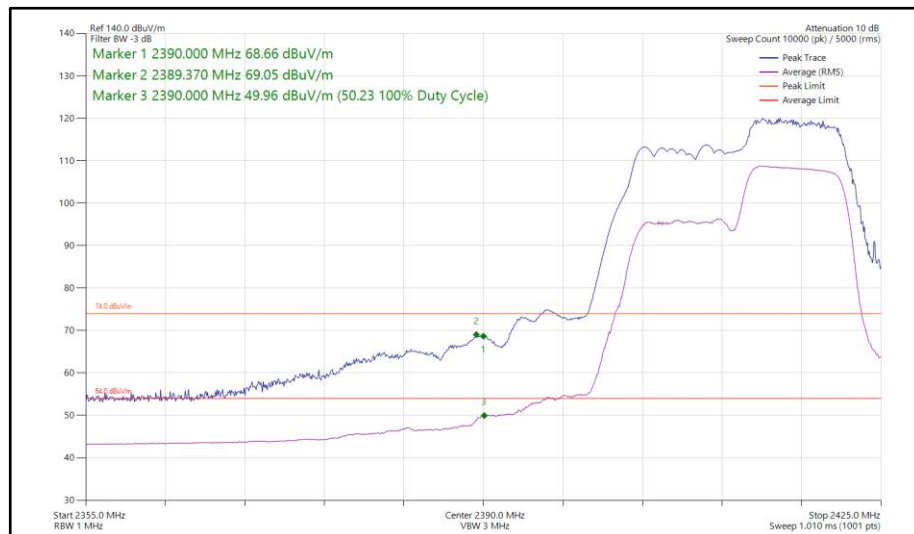
**Figure 2 - 802.11g, SISO, Core 0 - 2412 MHz
Band Edge Frequency 2390 MHz**



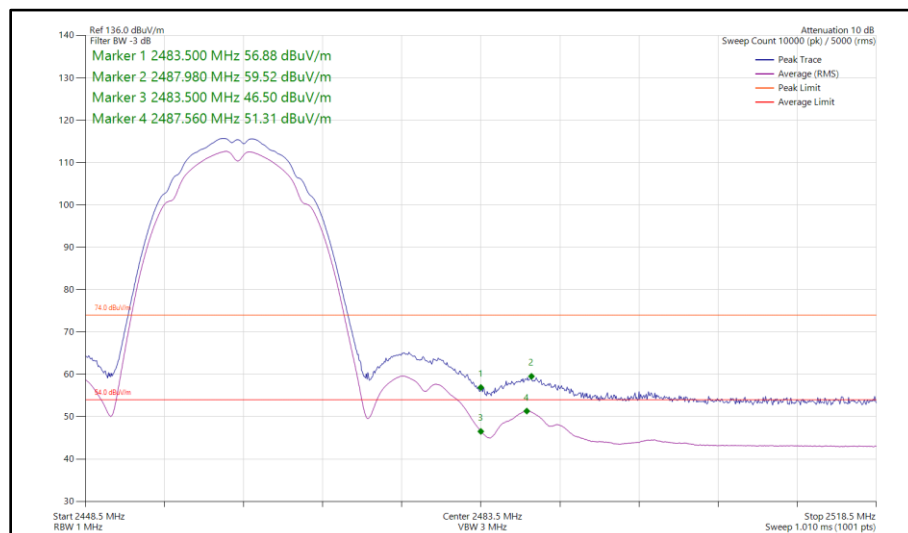
**Figure 3 - 802.11n HT20, SISO, Core 0 - 2412 MHz
Band Edge Frequency 2390 MHz**



**Figure 4 - 802.11ax HE20, SU, SISO, Core 0 - 2412 MHz
Band Edge Frequency 2390 MHz**



**Figure 5 - 802.11ax HE20, RU 106-54, SISO, Core 0 - 2412 MHz
Band Edge Frequency 2390 MHz**



**Figure 6 - 802.11b, SISO, Core 0 - 2462 MHz
Band Edge Frequency 2483.5 MHz**

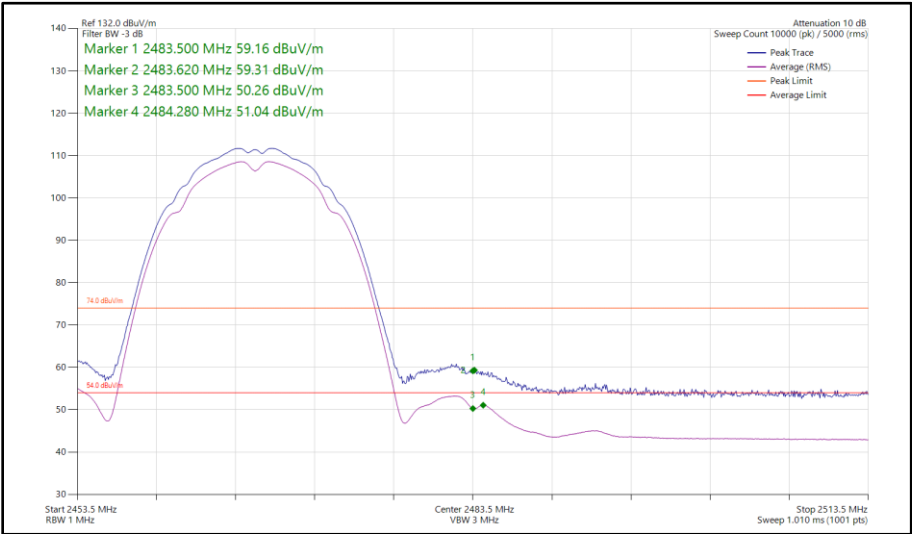


Figure 7 - 802.11b, SISO, Core 0 - 2467 MHz
Band Edge Frequency 2483.5 MHz

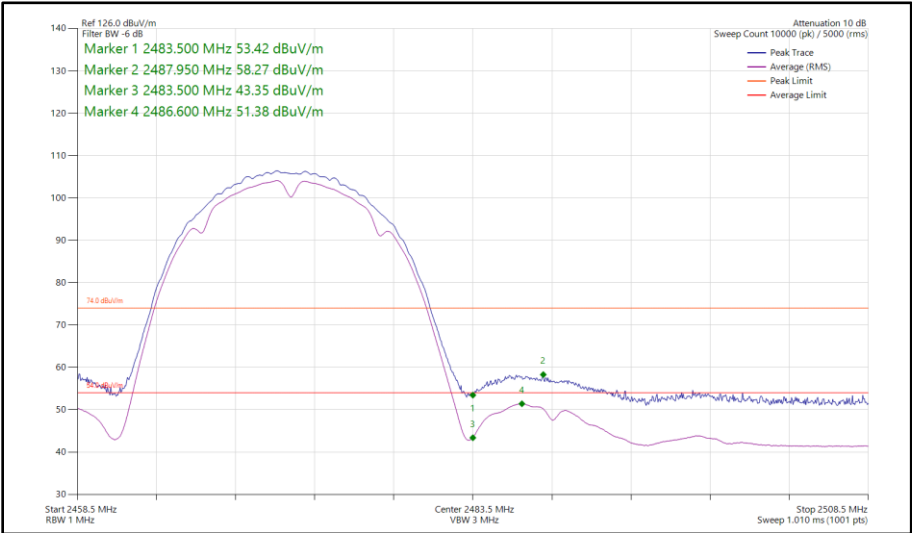
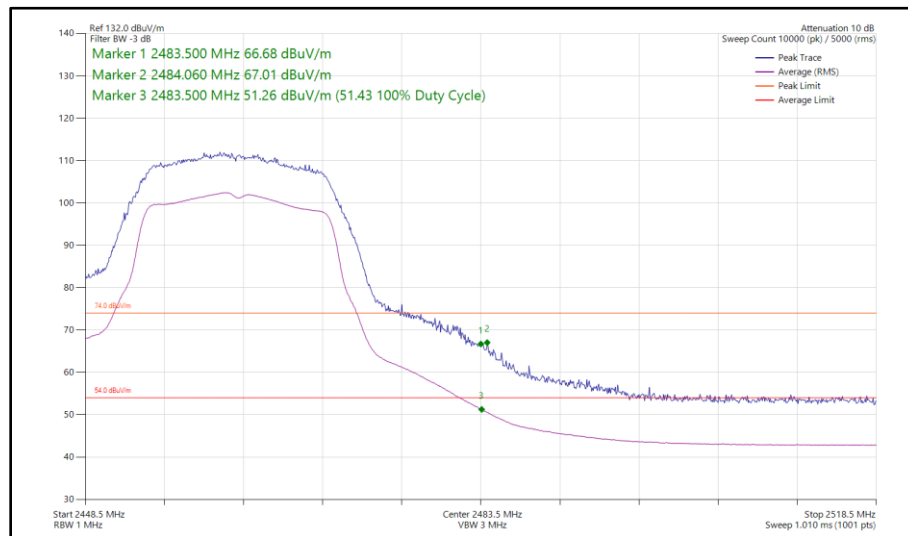
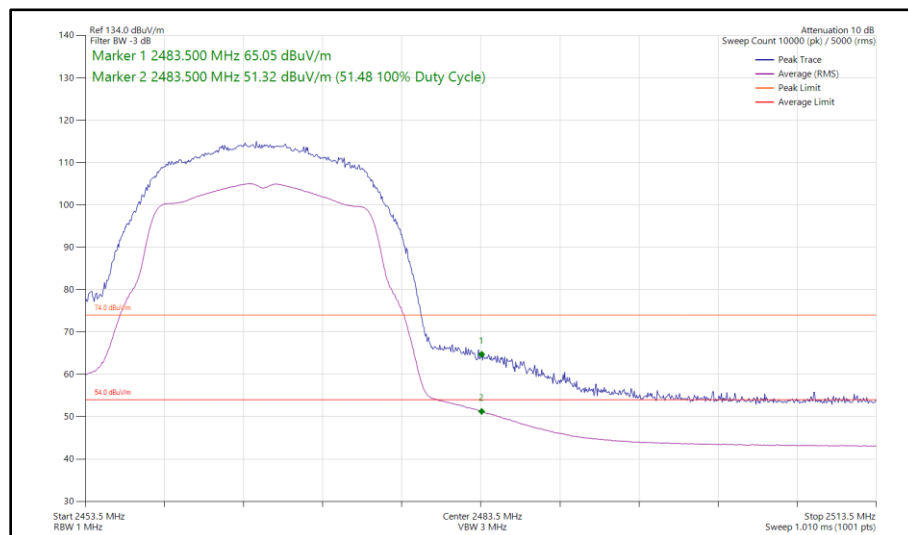


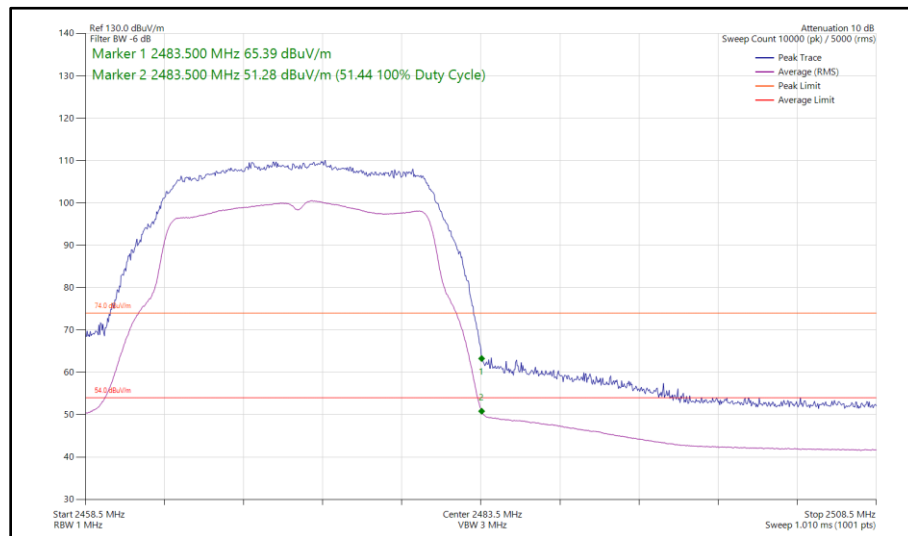
Figure 8 - 802.11b, SISO, Core 0 - 2472 MHz
Band Edge Frequency 2483.5 MHz



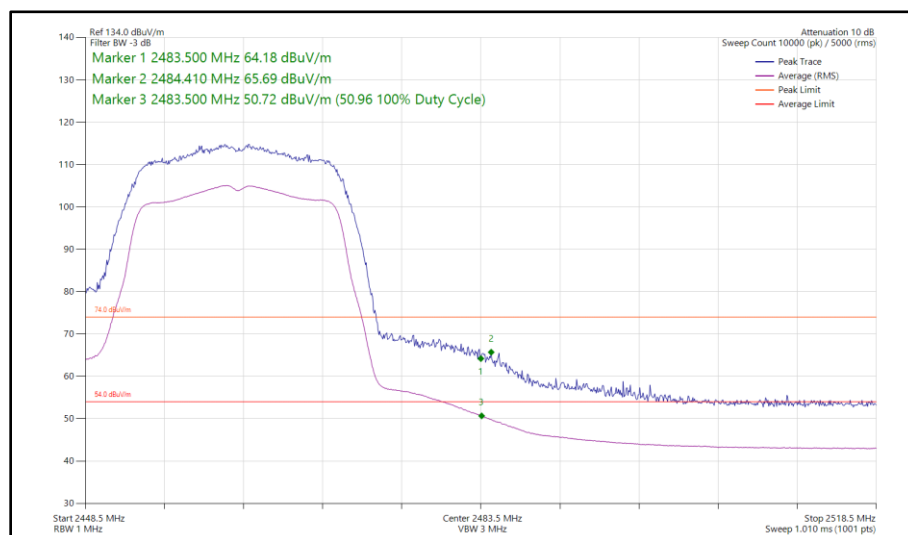
**Figure 9 - 802.11g, SISO, Core 0 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



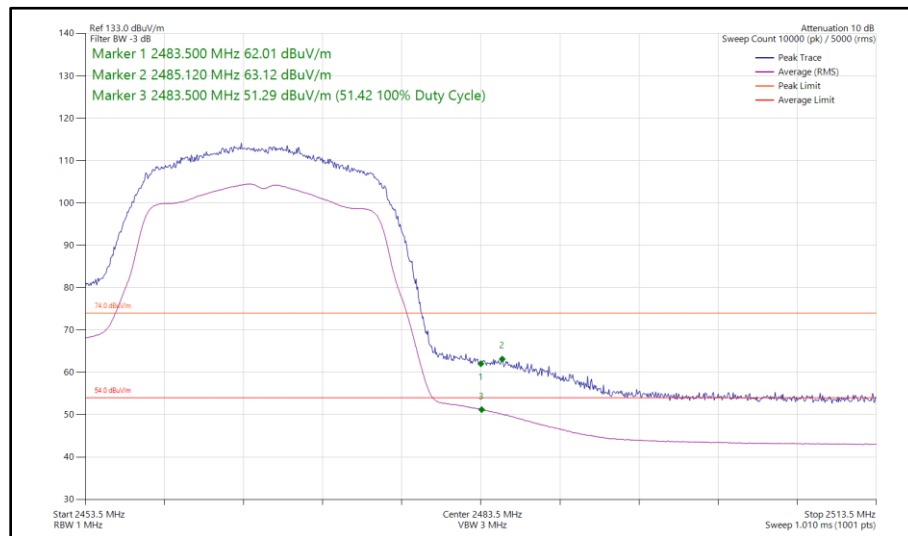
**Figure 10 - 802.11g, SISO, Core 0 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



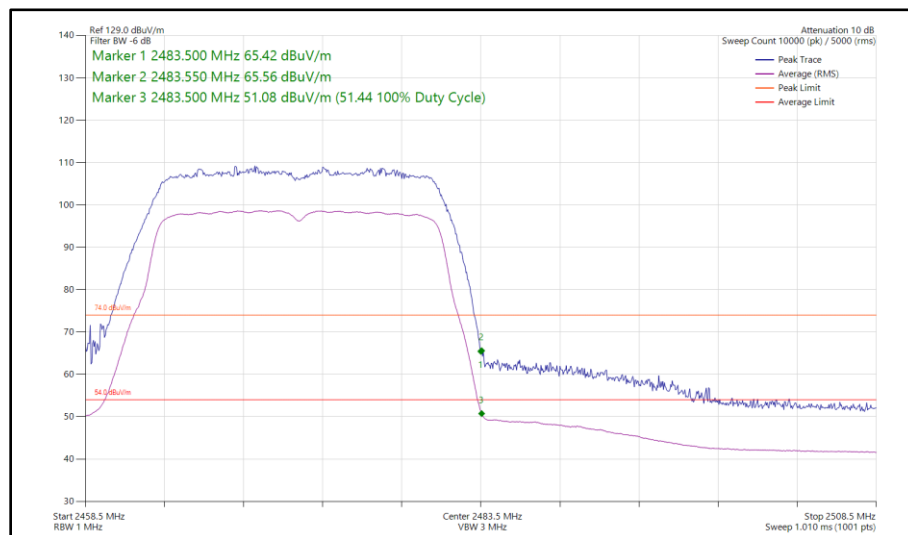
**Figure 11 - 802.11g, SISO, Core 0 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



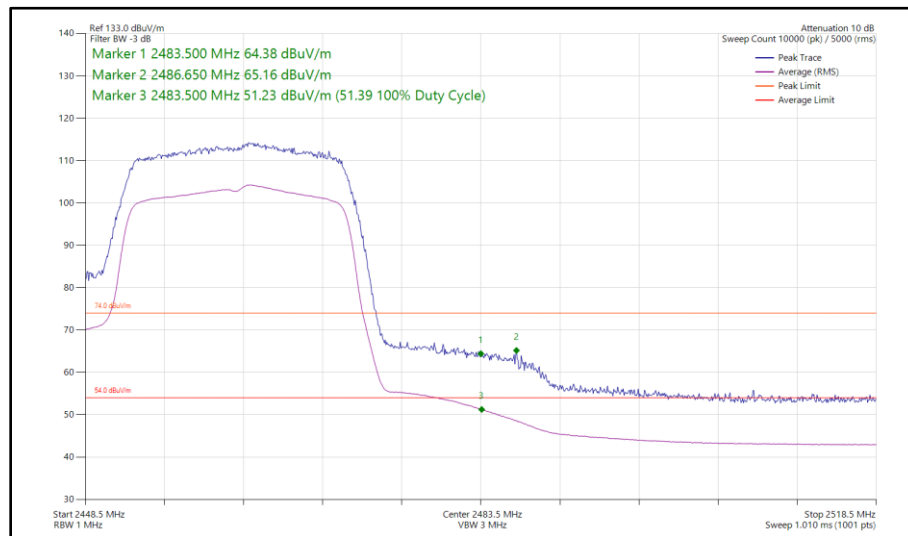
**Figure 12 - 802.11n HT20, SISO, Core 0 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



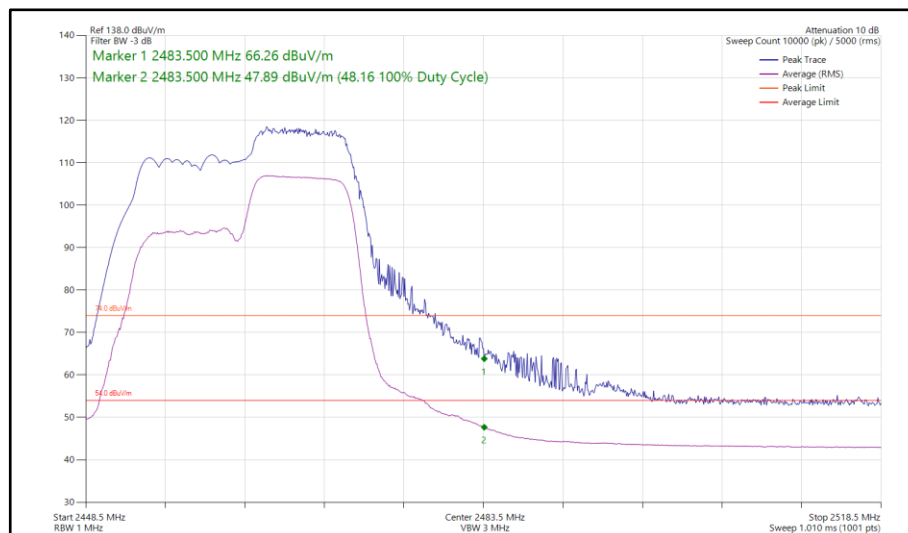
**Figure 13 - 802.11n HT20, SISO, Core 0 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



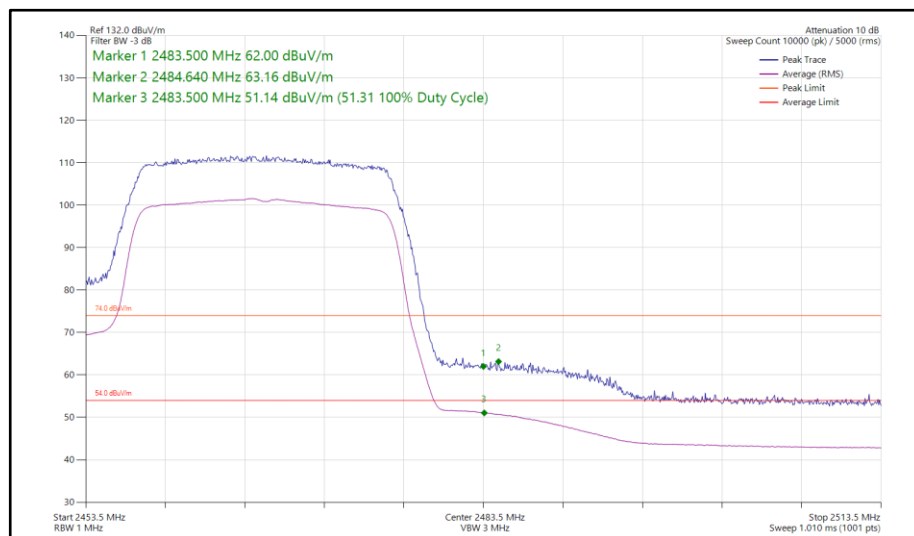
**Figure 14 - 802.11n HT20, SISO, Core 0 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



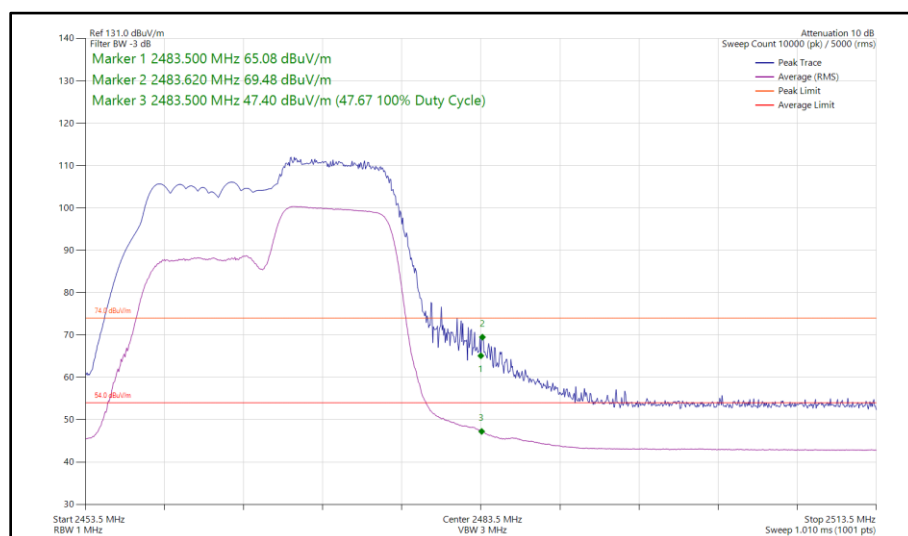
**Figure 15 - 802.11ax HE20, SU, SISO, Core 0 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



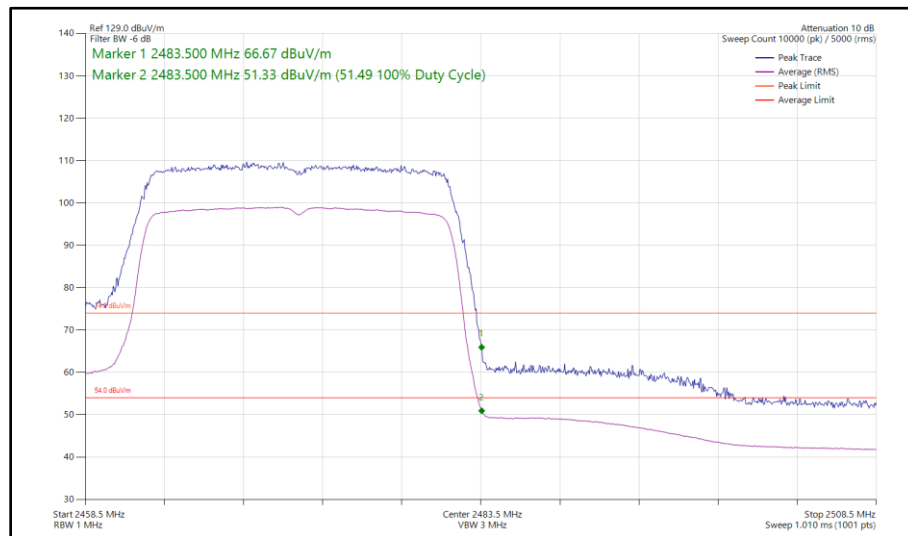
**Figure 16 - 802.11ax HE20, RU 106-54, SISO, Core 0 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



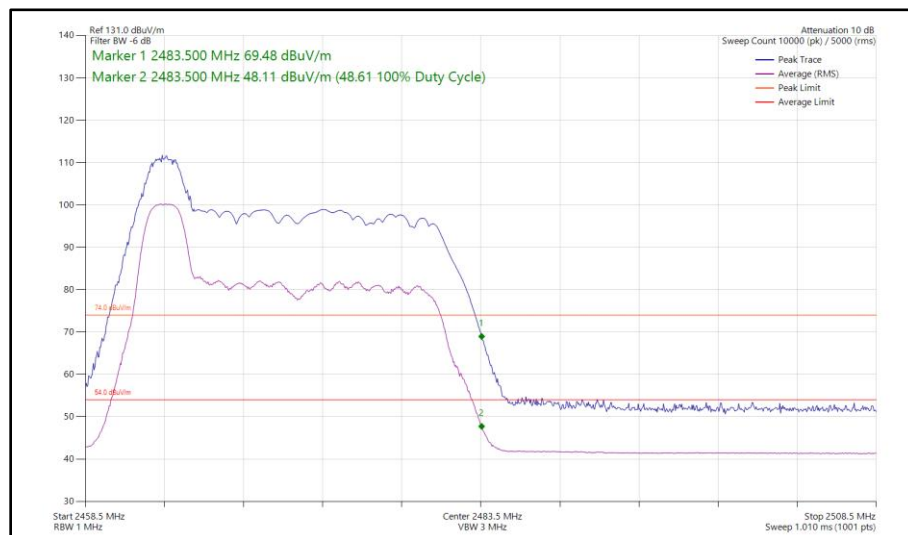
**Figure 17 - 802.11ax HE20, SU, SISO, Core 0 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 18 - 802.11ax HE20, RU 106-54, SISO, Core 0 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



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



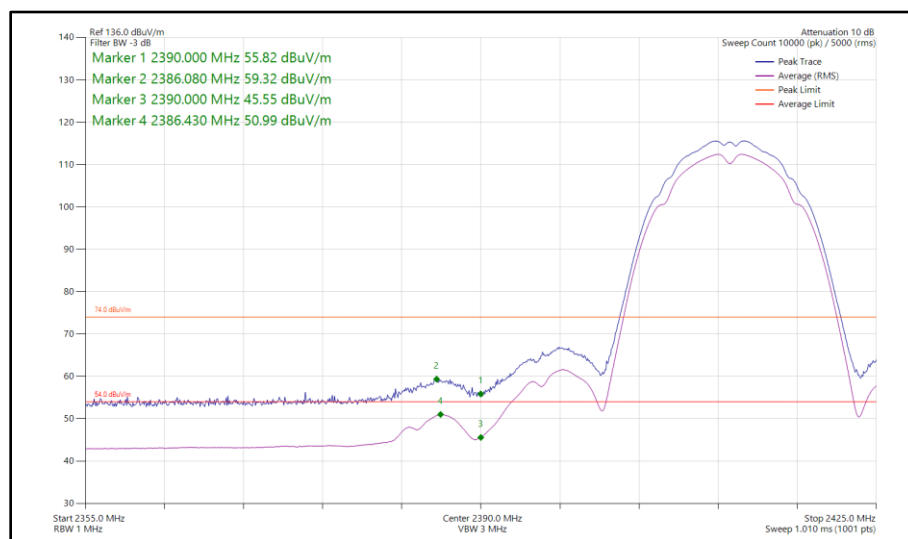
**Figure 20 - 802.11ax HE20, RU 26-0, SISO, Core 0 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



20 MHz Bandwidth - Core 1 (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	1 Mbps	-	-	2412	2390	59.32	50.99
802.11g	54 Mbps	-	-	2412	2390	69.14	51.41
802.11n HT20	MCS7	-	-	2412	2390	67.81	51.41
802.11ax HE20	MCS9x1	SU	-	2412	2390	66.55	51.45
802.11ax HE20	MCS9x1	106	54	2412	2390	69.34	49.39
802.11b	1 Mbps	-	-	2462	2483.5	59.85	51.15
802.11b	1 Mbps	-	-	2467	2483.5	59.54	51.42
802.11b	1 Mbps	-	-	2472	2483.5	58.61	51.24
802.11g	24 Mbps	-	-	2462	2483.5	66.05	51.17
802.11g	12 Mbps	-	-	2467	2483.5	64.32	51.48
802.11g	54 Mbps	-	-	2472	2483.5	66.50	51.39
802.11n HT20	MCS4	-	-	2462	2483.5	66.53	51.43
802.11n HT20	MCS7	-	-	2467	2483.5	66.43	51.18
802.11n HT20	MCS7	-	-	2472	2483.5	66.28	51.43
802.11ax HE20	MCS2x1	SU	-	2462	2483.5	64.59	51.45
802.11ax HE20	MCS9x1	106	54	2462	2483.5	67.32	48.99
802.11ax HE20	MCS9x1	SU	-	2467	2483.5	66.29	51.08
802.11ax HE20	MCS9x1	106	54	2467	2483.5	68.86	49.58
802.11ax HE20	MCS9x1	SU	-	2472	2483.5	67.11	51.36
802.11ax HE20	MCS9x1	52	37	2472	2483.5	69.27	49.84

Table 7 - SISO Restricted Band Edge Results



**Figure 21 - 802.11b, SISO, Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**

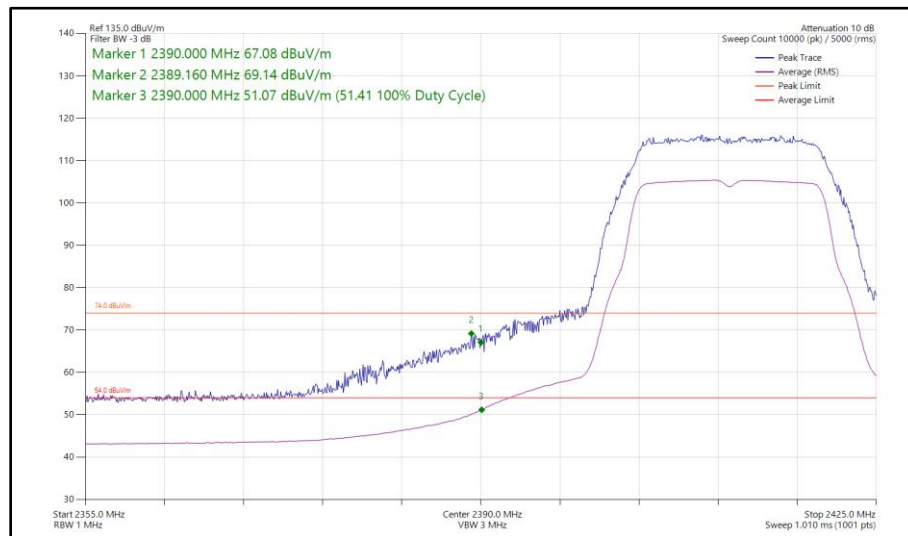


Figure 22 - 802.11g, SISO, Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz

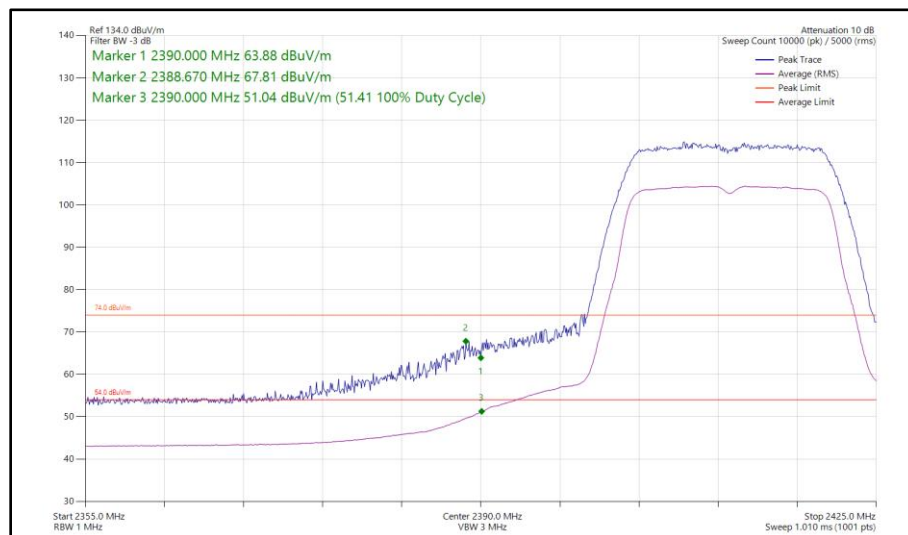
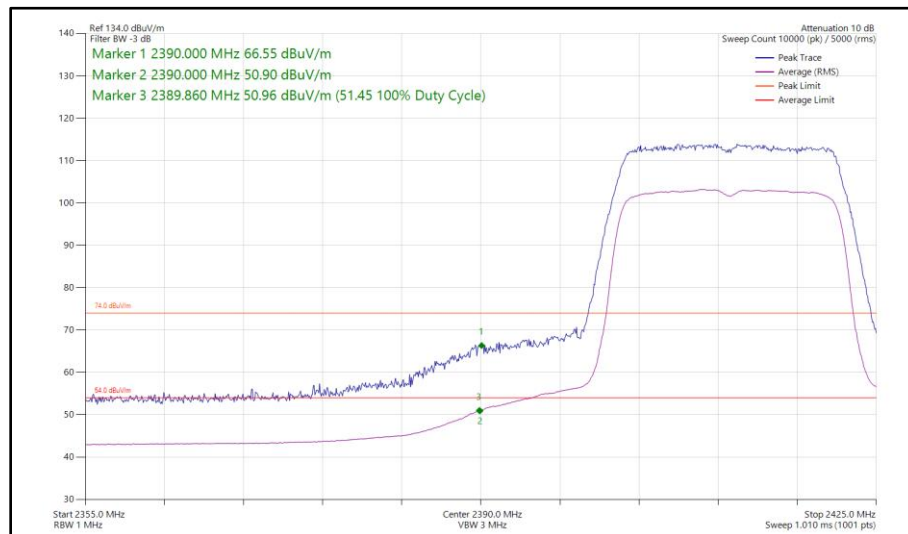
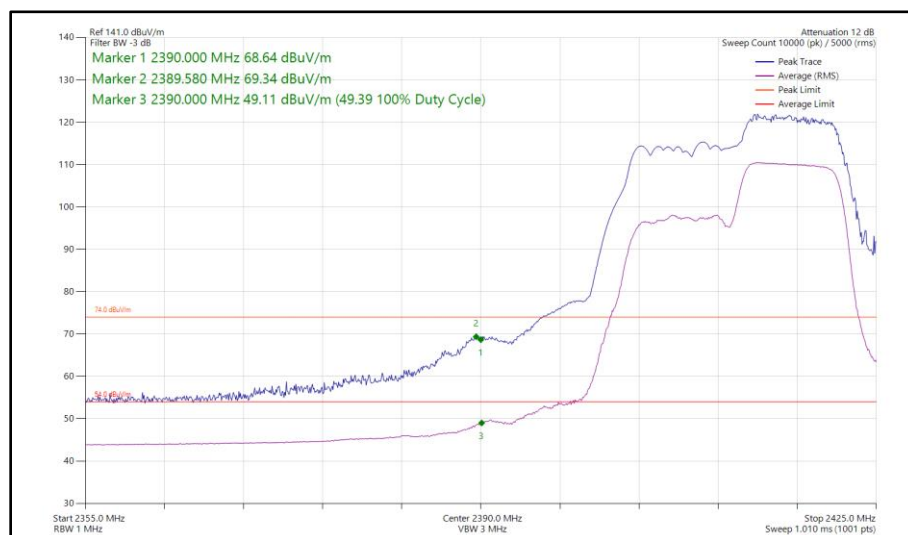


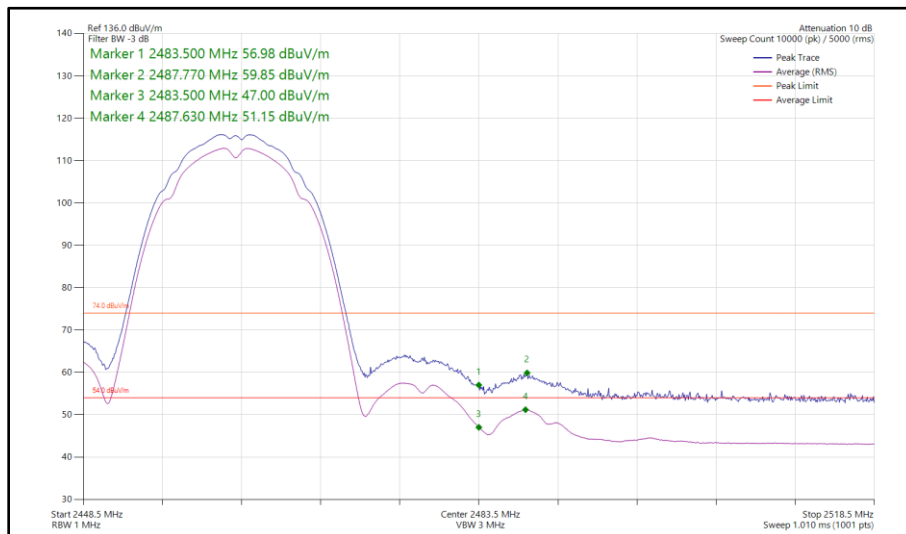
Figure 23 - 802.11n HT20, SISO, Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz



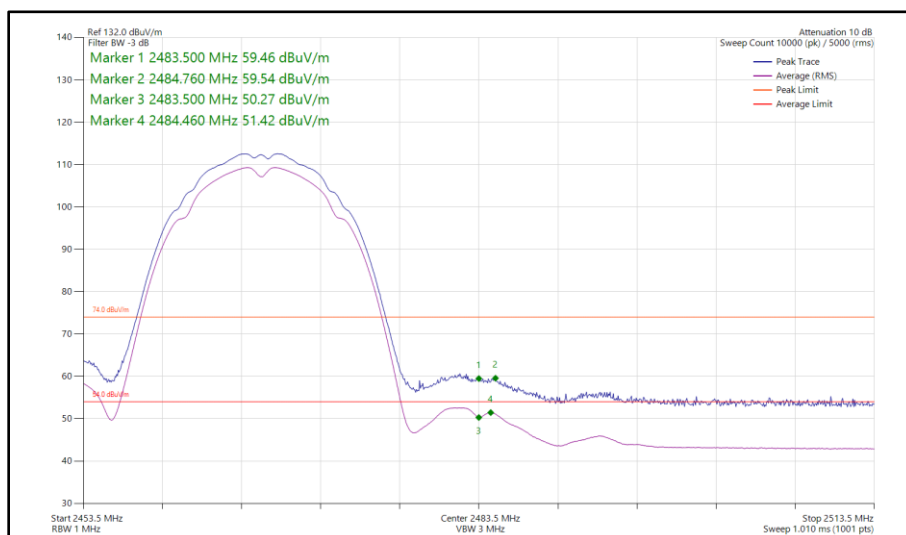
**Figure 24 - 802.11ax HE20, SU, SISO, Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**



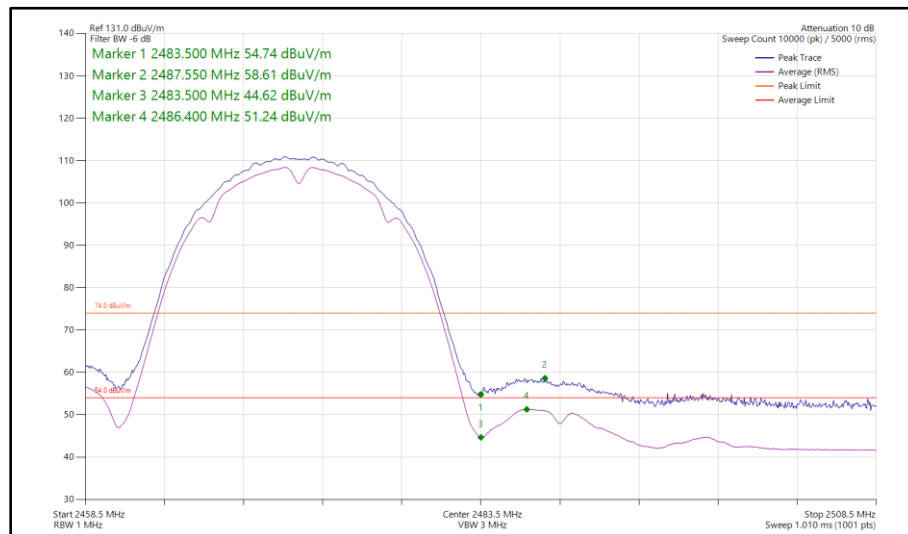
**Figure 25 - 802.11ax HE20, RU 106-54, SISO, Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**



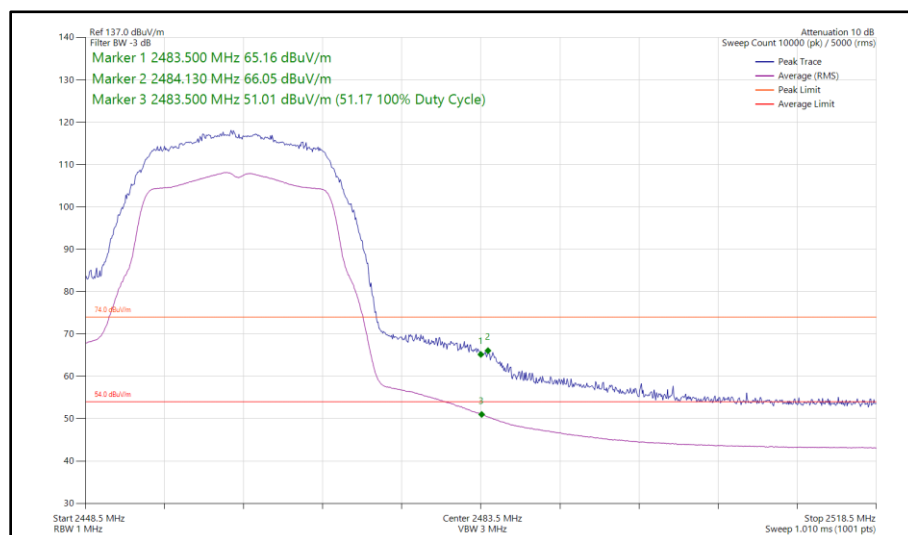
**Figure 26 - 802.11b, SISO, Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



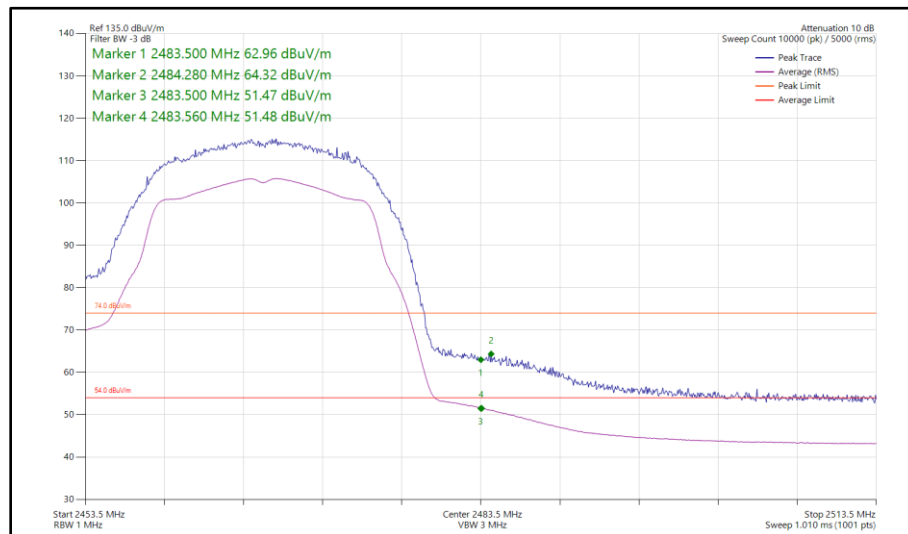
**Figure 27 - 802.11b, SISO, Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



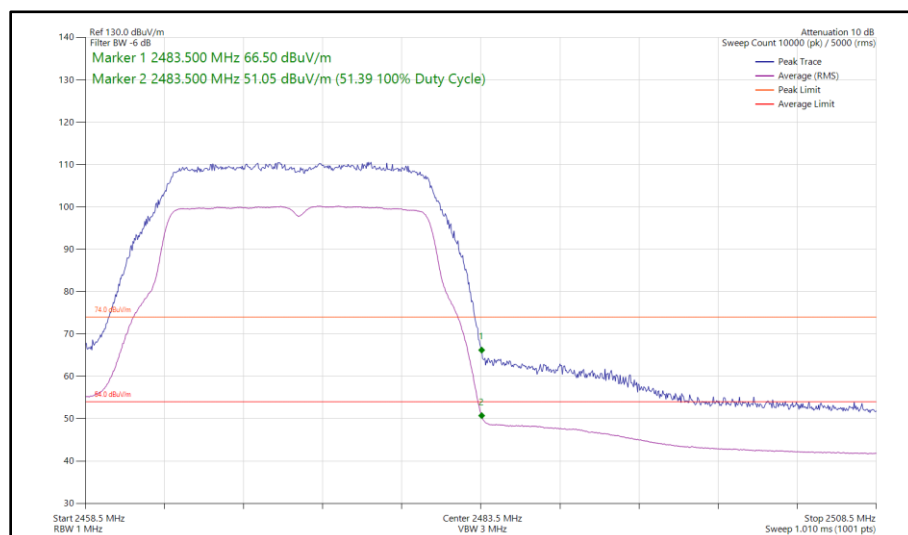
**Figure 28 - 802.11b, SISO, Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



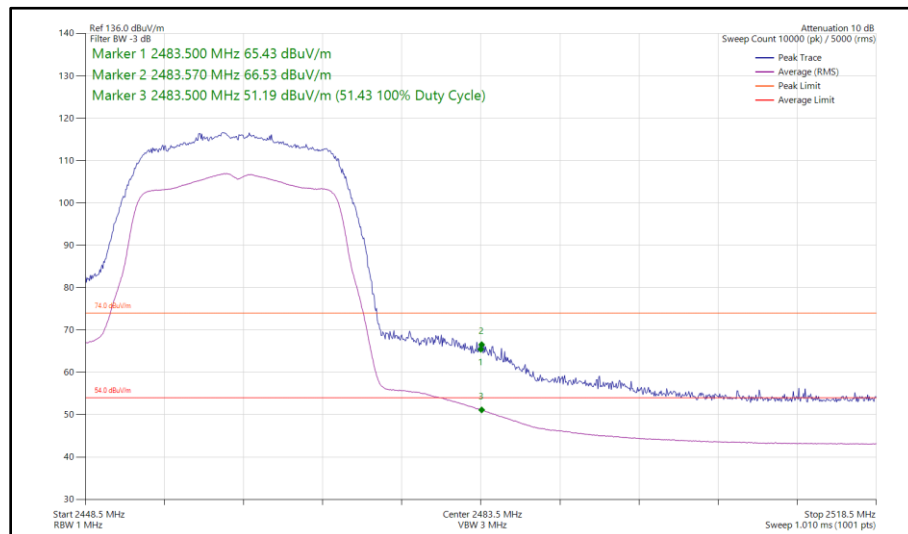
**Figure 29 - 802.11g, SISO, Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



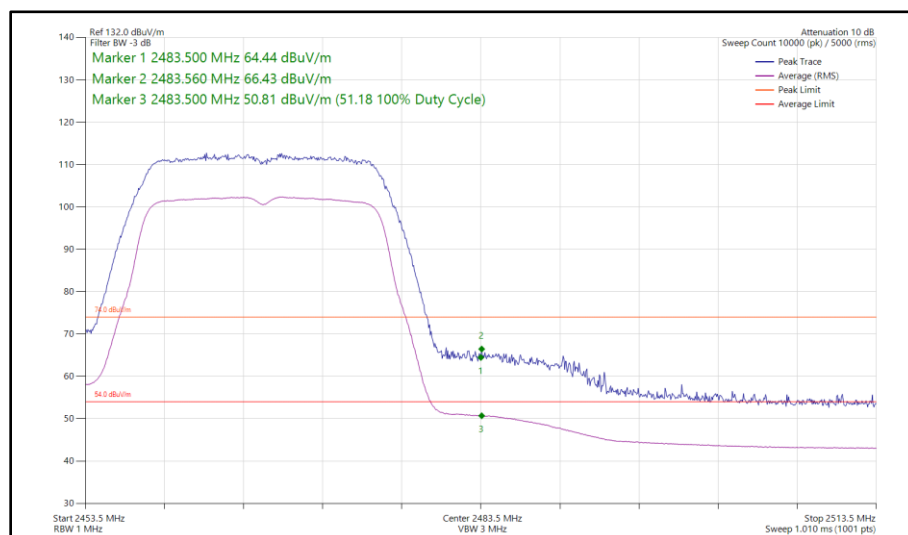
**Figure 30 - 802.11g, SISO, Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



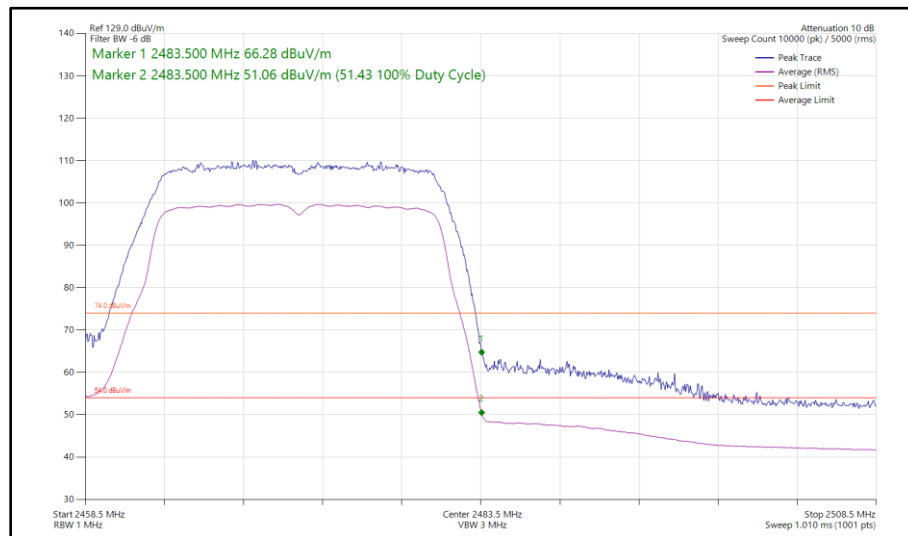
**Figure 31 - 802.11g, SISO, Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



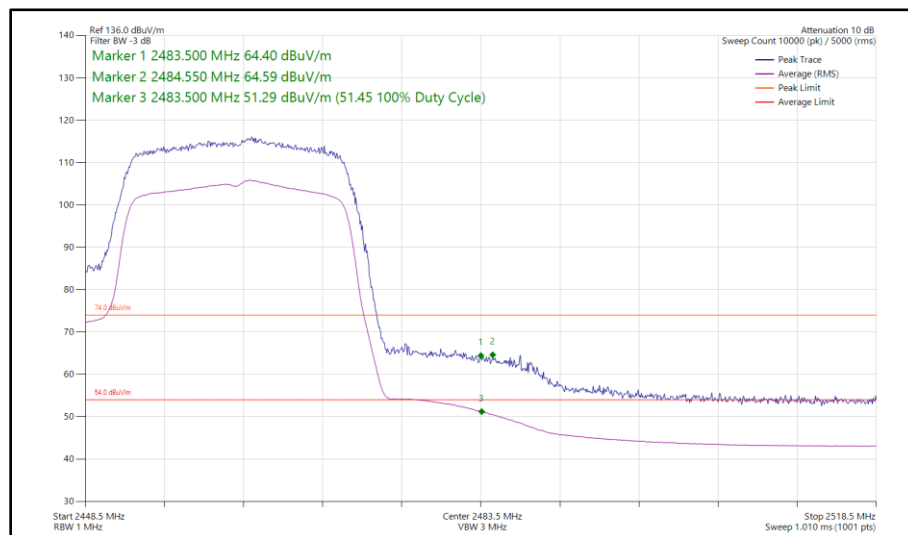
**Figure 32 - 802.11n HT20, SISO, Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



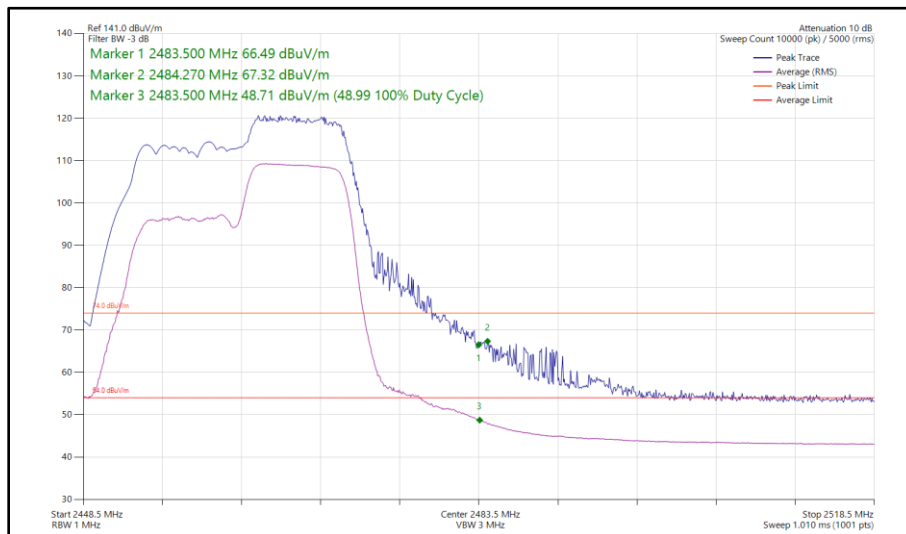
**Figure 33 - 802.11n HT20, SISO, Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



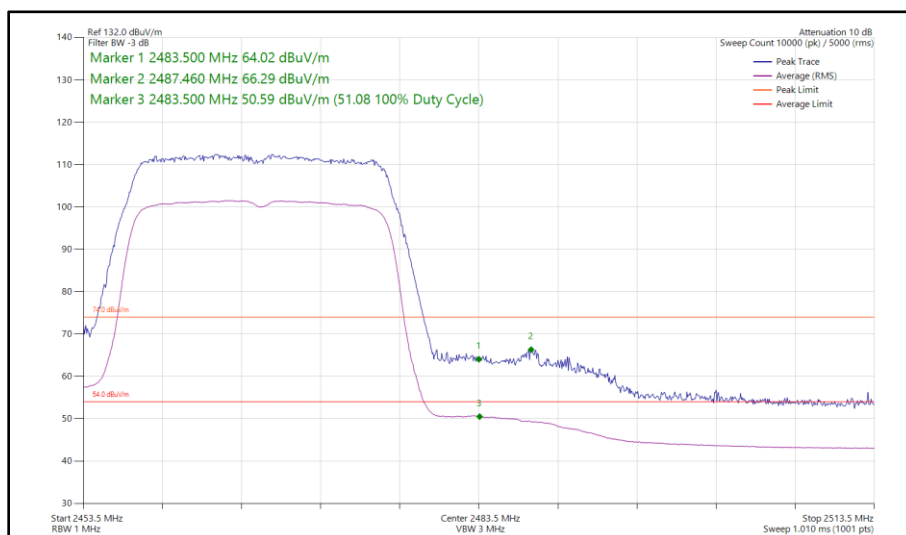
**Figure 34 - 802.11n HT20, SISO, Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



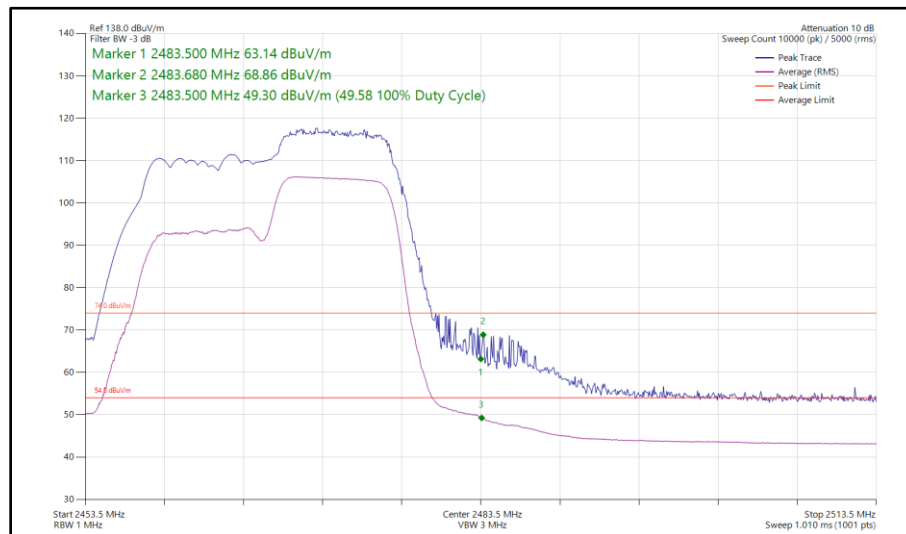
**Figure 35 - 802.11ax HE20, SU, SISO, Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



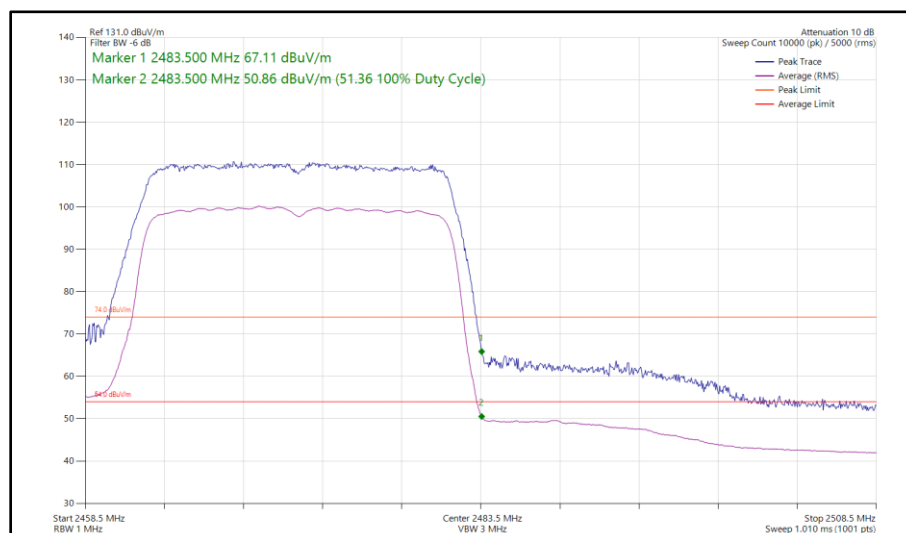
**Figure 36 - 802.11ax HE20, RU 106-54, SISO, Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



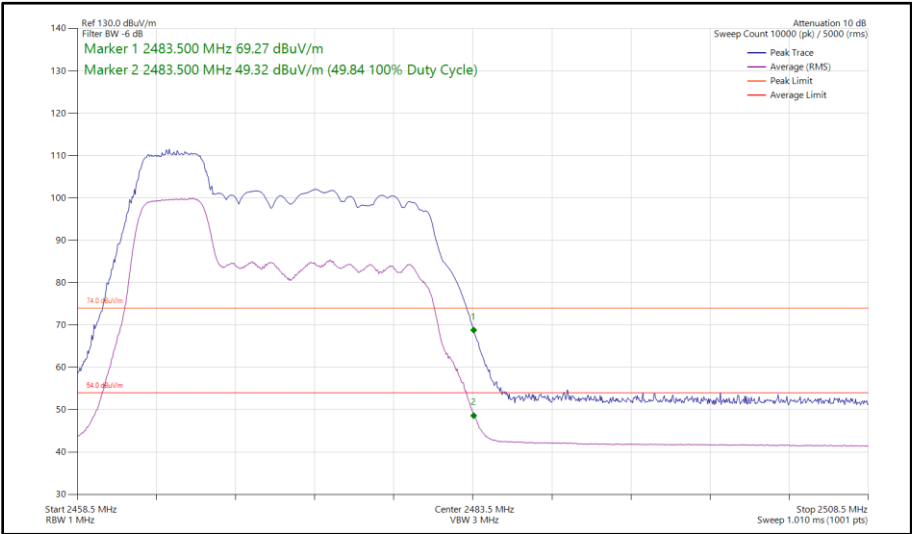
**Figure 37 - 802.11ax HE20, SU, SISO, Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 38 - 802.11ax HE20, RU 106-54, SISO, Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 39 - 802.11ax HE20, SU, SISO, Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



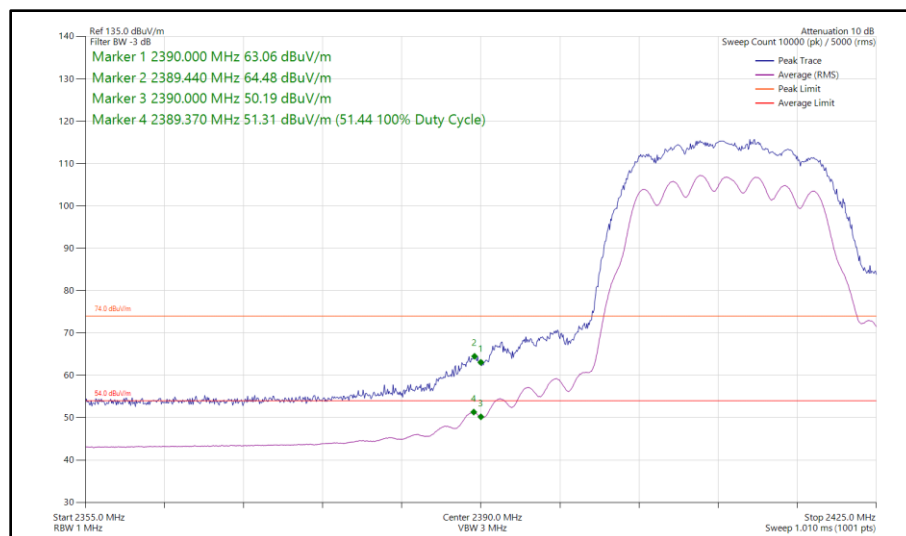
**Figure 40 - 802.11ax HE20, RU 52-37, SISO, Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



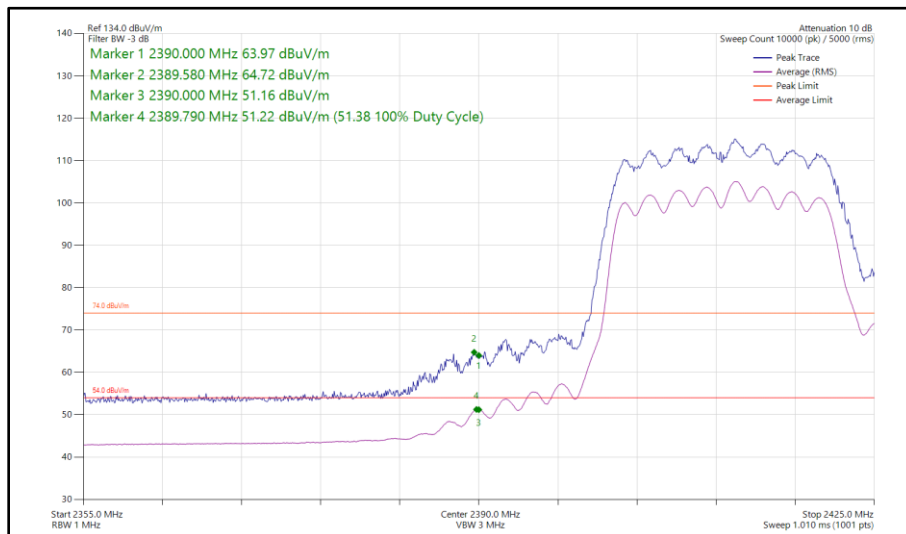
20 MHz Bandwidth - Core 0 + Core 1 (CDD)

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	MCS2	-	-	2412	2390	64.48	51.44
802.11ax HE20	MCS2x1	SU	-	2412	2390	64.72	51.38
802.11ax HE20	MCS9x1	106	54	2412	2390	69.38	49.31
802.11n HT20	MCS7	-	-	2462	2483.5	66.92	51.45
802.11n HT20	MCS7	-	-	2467	2483.5	66.22	51.49
802.11n HT20	MCS7	-	-	2472	2483.5	65.38	51.35
802.11ax HE20	MCS9x1	SU	-	2462	2483.5	66.74	51.35
802.11ax HE20	MCS9x1	106	54	2462	2483.5	67.68	51.47
802.11ax HE20	MCS9x1	SU	-	2467	2483.5	65.37	51.48
802.11ax HE20	MCS9x1	106	53	2467	2483.5	69.13	51.27
802.11ax HE20	MCS4x1	SU	-	2472	2483.5	66.58	51.35
802.11ax HE20	MCS9x1	52	37	2472	2483.5	69.37	49.27

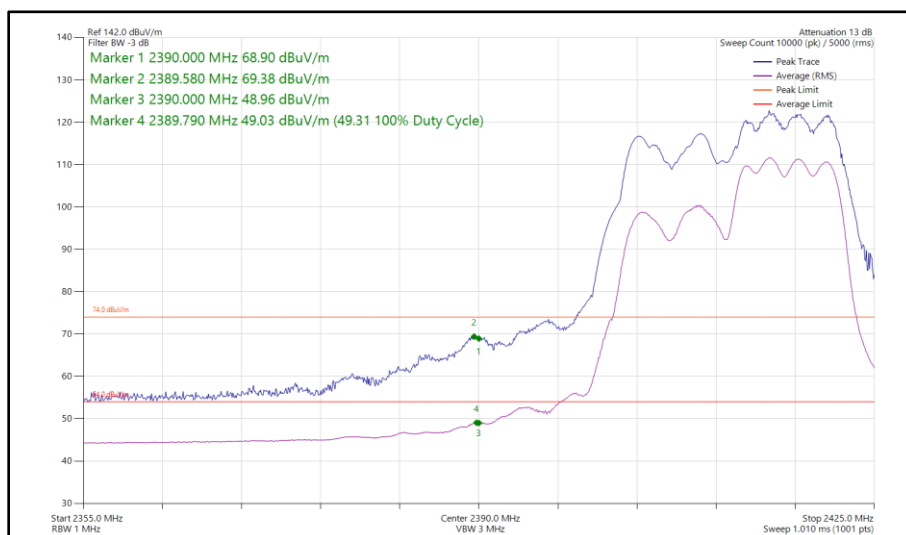
Table 8 - CDD Restricted Band Edge Results



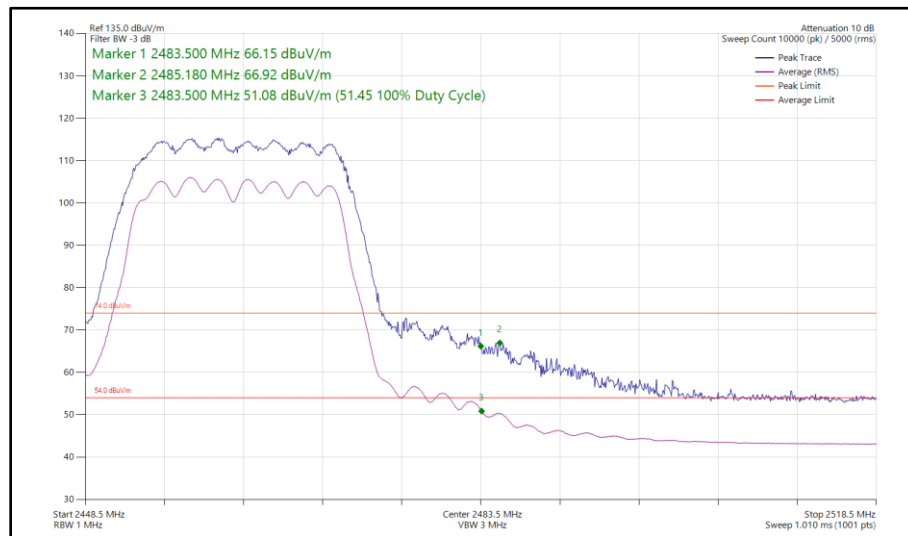
**Figure 41 - 802.11n HT20, CDD, Core 0 + Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**



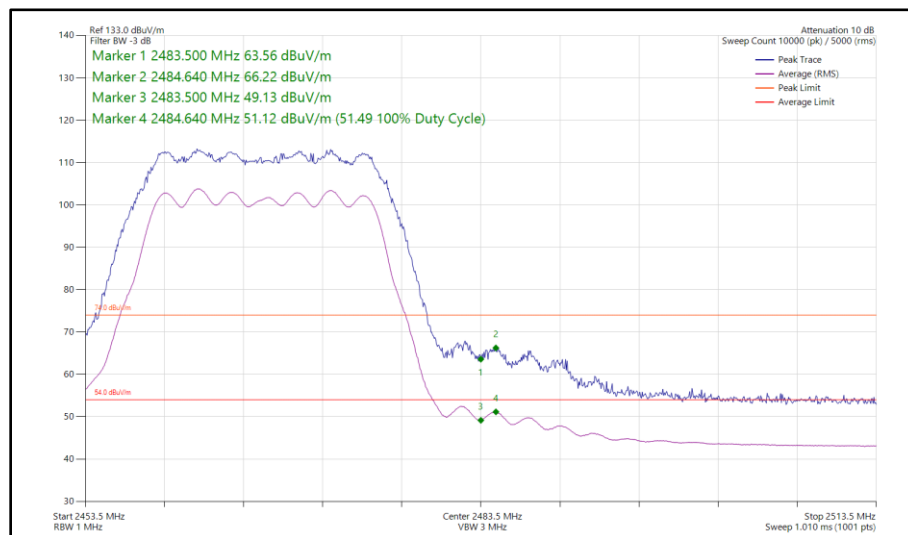
**Figure 42 - 802.11ax HE20, SU, CDD, Core 0 + Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**



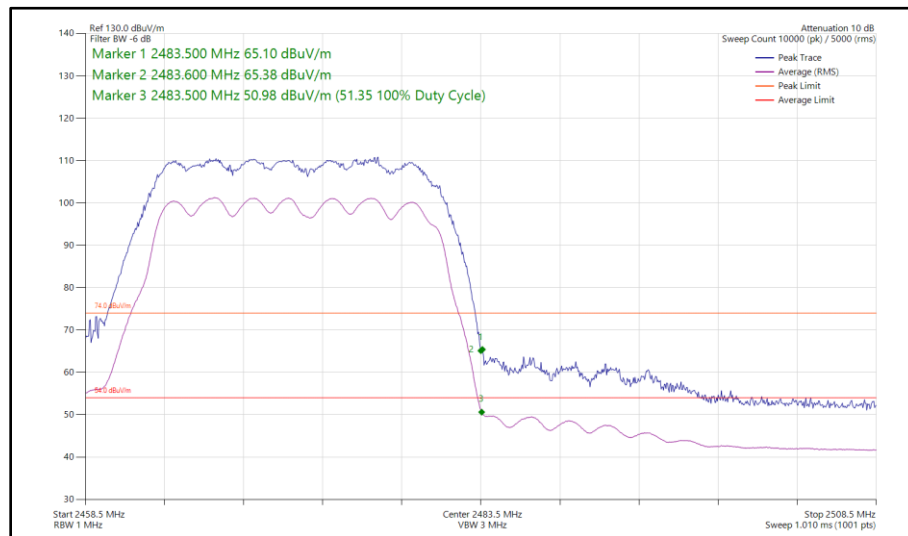
**Figure 43 - 802.11ax HE20, RU 106-54, CDD, Core 0 + Core 1 - 2412 MHz
Band Edge Frequency 2390 MHz**



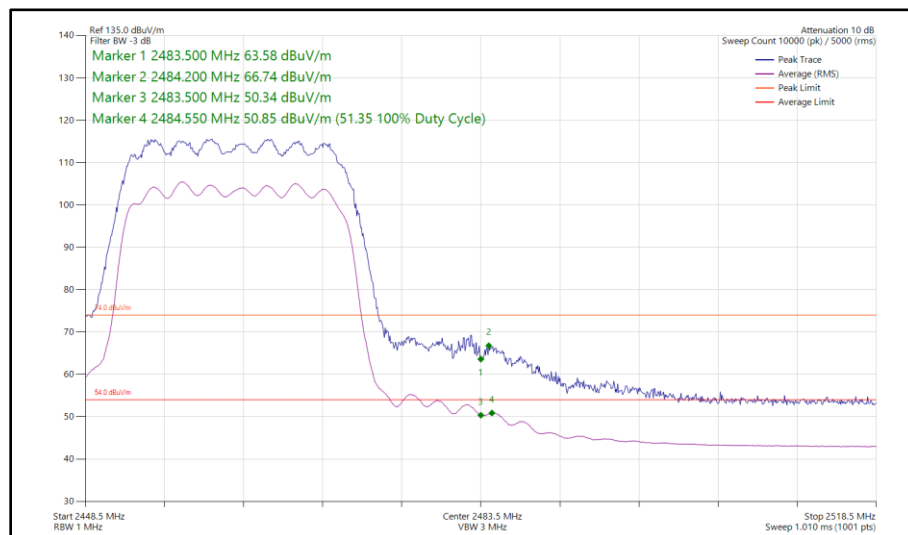
**Figure 44 - 802.11n HT20, CDD, Core 0 + Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



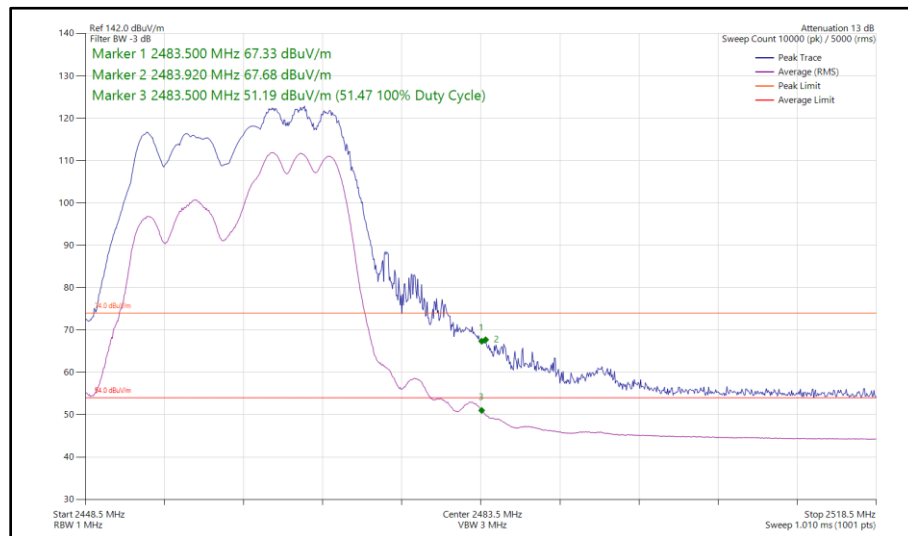
**Figure 45 - 802.11n HT20, CDD, Core 0 + Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



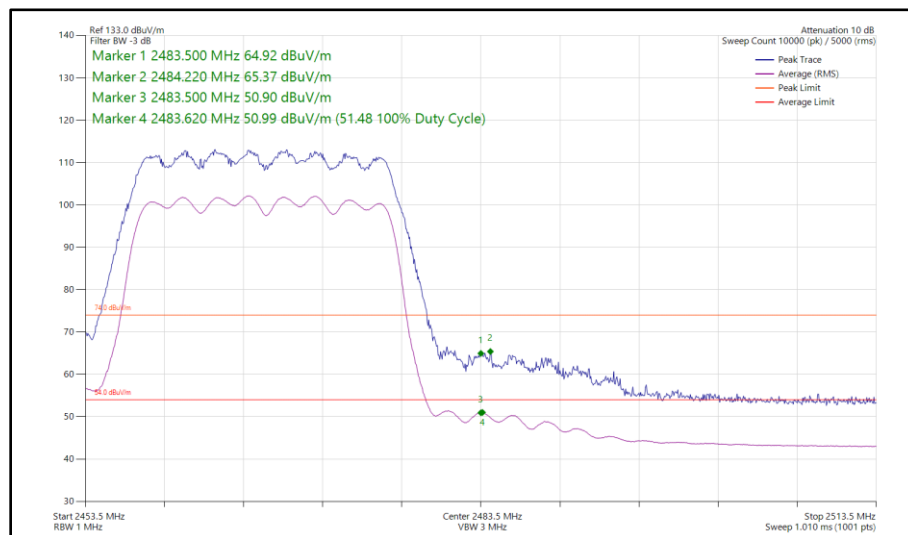
**Figure 46 - 802.11n HT20, CDD, Core 0 + Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 47 - 802.11ax HE20, SU, CDD, Core 0 + Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



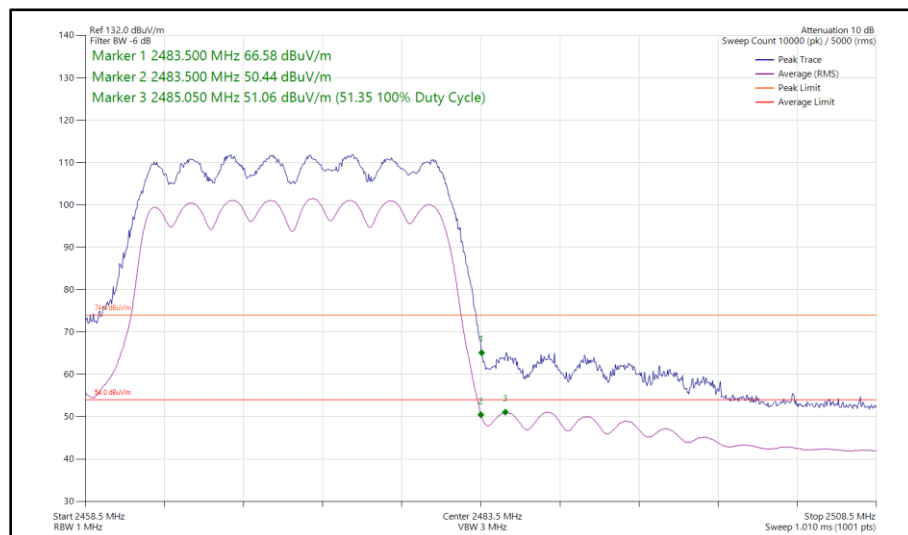
**Figure 48 - 802.11ax HE20, RU 106-54, CDD, Core 0 + Core 1 - 2462 MHz
Band Edge Frequency 2483.5 MHz**



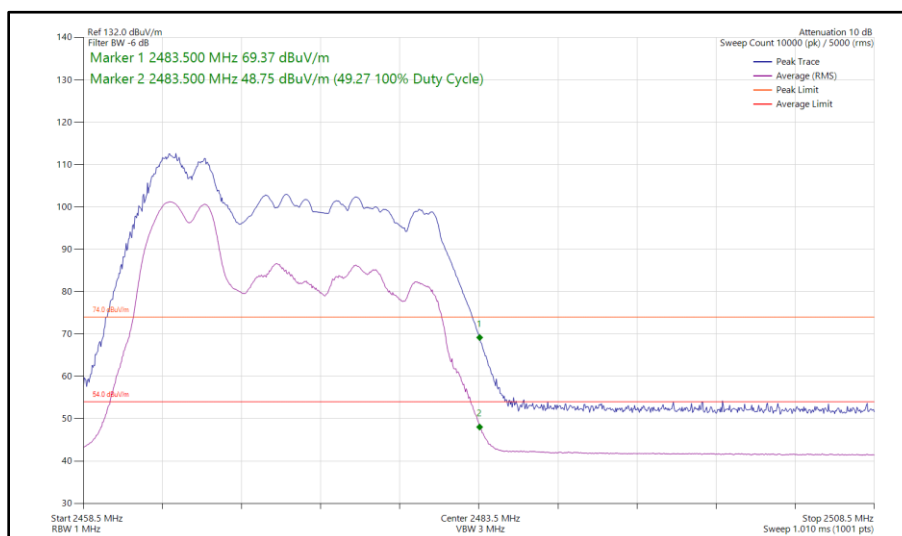
**Figure 49 - 802.11ax HE20, SU, CDD, Core 0 + Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 50 - 802.11ax HE20, RU 106-53, CDD, Core 0 + Core 1 - 2467 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 51 - 802.11ax HE20, SU, CDD, Core 0 + Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**



**Figure 52 - 802.11ax HE20, RU 52-37, CDD, Core 0 + Core 1 - 2472 MHz
Band Edge Frequency 2483.5 MHz**

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ 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 ($\mu\text{V}/\text{m}$ 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 14 and RF Chamber 15.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Cable (18 GHz)	Rosenberger	LU7-071-1000	5096	12	23-Oct-2023
Emissions Software	TUV SUD	EmX V3.1.12	5125	-	Software
Pre-amplifier (30 dB, 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	14-Apr-2024
EMI Test Receiver	Rohde & Schwarz	ESW44	5911	12	05-May-2024
Test Receiver	Rohde & Schwarz	ESW44	5914	12	24-Feb-2024
1500W (300V 12A) AC Power Supply	iTech	IT7324	5955	-	O/P Mon
1500W (300V 12A) AC Power Supply	iTech	IT7324	5956	-	O/P Mon
5m Semi-Anechoic Chamber (Dual-Axis)	Albatross Projects	RF Chamber 14	5958	36	26-Apr-2025
Compact Antenna Mast	Maturo Gmbh	CAM4.0-P	5959	-	TU
Mast & Turntable Controller	Maturo Gmbh	FCU3.0	5960	-	TU
Tilt Antenna Mast	Maturo Gmbh	BAM4.5-P	5961	-	TU
Turntable	Maturo Gmbh	TT1.5SI	5962	-	TU
5m Semi-Anechoic Chamber (Dual-Axis)	Albatross Projects	RF Chamber 15	5963	36	28-Apr-2025
Compact Antenna Mast	Maturo Gmbh	CAM4.0-P	5964	-	TU
Mast & Turntable Controller	Maturo Gmbh	FCU3.0	5966	-	TU
Tilt Antenna Mast	Maturo Gmbh	BAM4.5-P	5967	-	TU
Turntable	Maturo Gmbh	TT1.5SI	5968	-	TU
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5996	12	05-Jun-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5997	12	14-Sep-2023
Cable (SMA to SMA 6.5m)	Junkosha	MWX221-06500AMSAMS/B	6003	12	05-Jun-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6007	12	05-Jun-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6008	12	05-Jun-2024
Cable (N to N 1m)	Junkosha	MWX221-01000AMSAMS/B	6009	12	05-Jun-2024
Cable (SMA to SMA 6.5m)	Junkosha	MWX221-06500AMSAMS/B	6014	12	08-Aug-2023
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/B	6019	12	05-Jun-2024
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6140	12	21-Aug-2023
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6141	12	21-Aug-2023
SAC Switch Unit	TUV SUD	TUV_Ssu_001	6144	12	05-Dec-2023
Digital Multimeter	Fluke	115	6145	12	15-Jun-2024



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Digital Multimeter	Fluke	115	6147	12	16-Jun-2024
Humidity & Temperature meter	R.S Components	1364	6149	12	17-Sep-2023
SAC Switch Unit	TUV SUD	TUV_SSU_001	6191	12	12-Dec-2023
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6315	12	04-Feb-2024
Humidity and Temperature Meter	R.S Components	1364	6486	12	18-Apr-2024

Table 11

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment



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

A2991, S/N: Y7RPXWJ9N9 - Modification State 0

2.2.3 Date of Test

10-August-2023

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	22.2 °C
Relative Humidity	52.4 %

2.2.6 Test Results

2.4 GHz WLAN

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11b	8.640	9.120
802.11g	15.480	16.140
802.11n HT20	15.780	17.100
802.11ax HE20 SU	18.720	19.080

Table 12 - 6 dB Bandwidth Summary Results - SISO

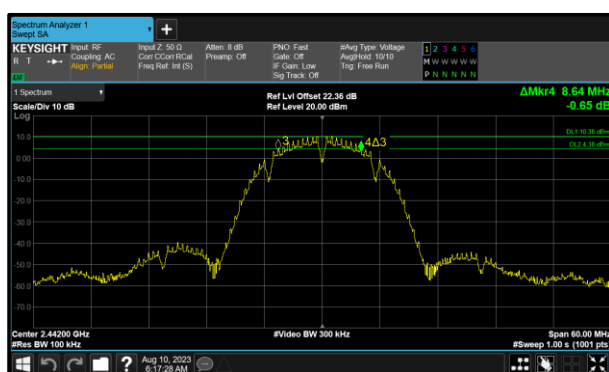


Figure 53 - 802.11b Minimum 6 dB EBW

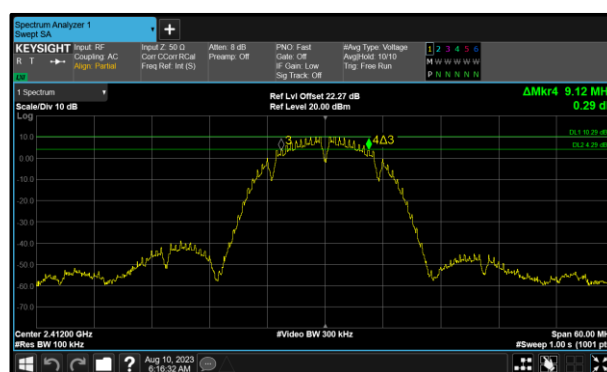


Figure 54 - 802.11b Maximum 6 dB EBW

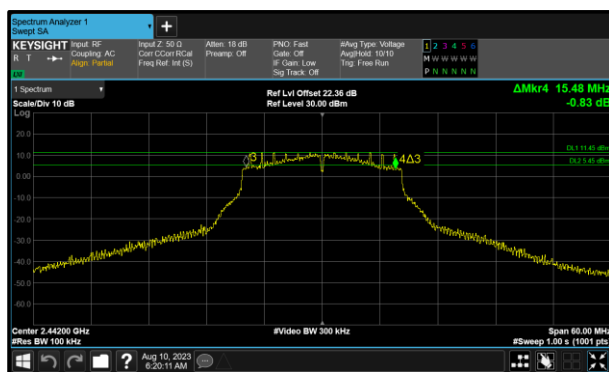


Figure 55 - 802.11g Minimum 6 dB EBW



Figure 56 - 802.11g Maximum 6 dB EBW

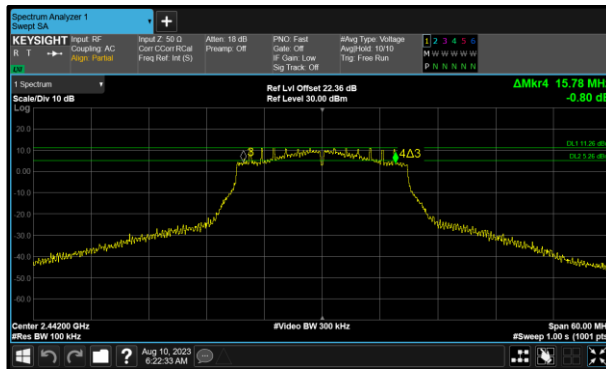


Figure 57 - 802.11n HT20 Minimum 6 dB EBW

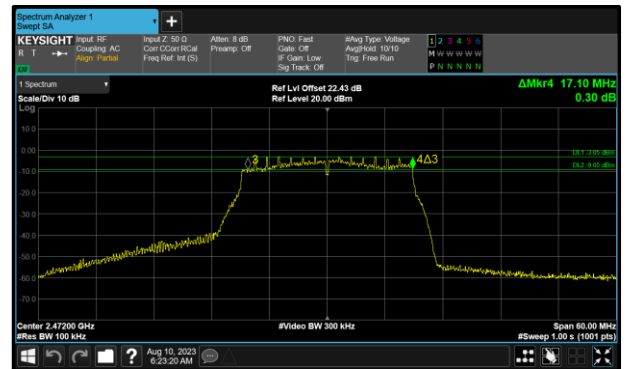


Figure 58 - 802.11n HT20 Maximum 6 dB EBW



Figure 59 - 802.11ax HE20 SU Minimum 6 dB
EBW

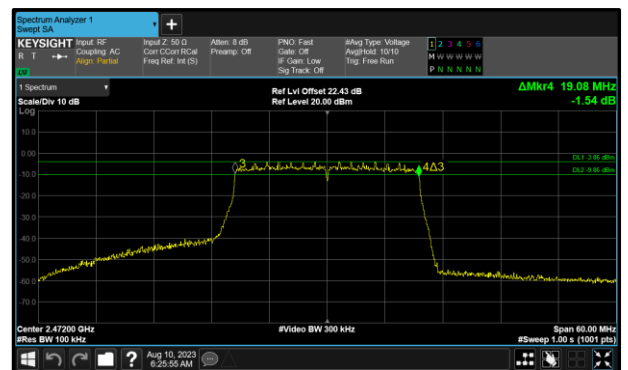


Figure 60 - 802.11ax HE20 SU Maximum 6 dB
EBW

Protocol	6 dB Bandwidth (MHz)	
	Minimum	Maximum
802.11n HT20	15.240	17.700
802.11ax HE20 SU	18.540	19.140

Table 13 - 6 dB Bandwidth Summary Results - MIMO CDD

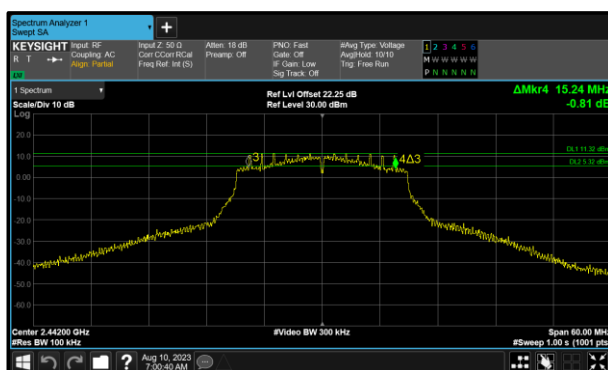


Figure 61 - 802.11n HT20 Minimum 6 dB EBW

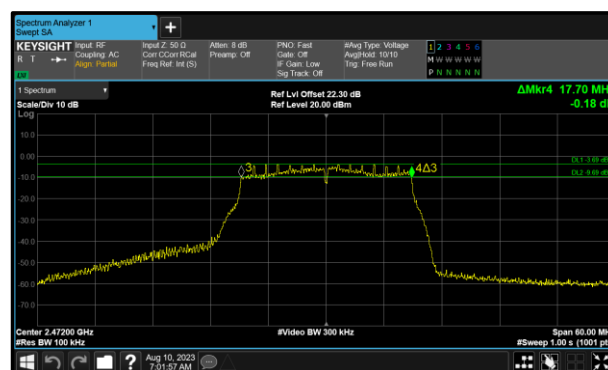


Figure 62 - 802.11n HT20 Maximum 6 dB EBW



Figure 63 - 802.11ax HE20 SU Minimum 6 dB EBW

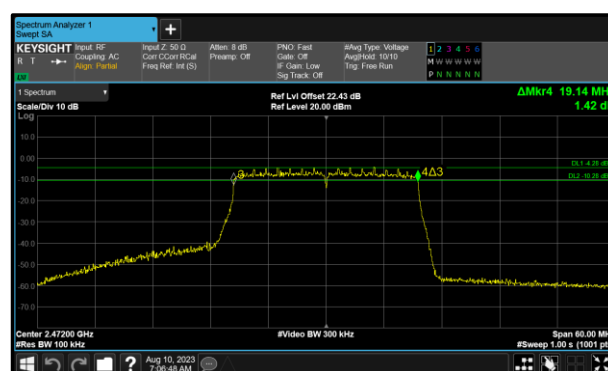


Figure 64 - 802.11ax HE20 SU Maximum 6 dB EBW

Protocol	99% Bandwidth (MHz)	
	Minimum	Maximum
802.11b	12.960	12.960
802.11g	16.380	16.620
802.11n HT20	17.580	17.700
802.11ax HE20 SU	18.960	18.960

Table 14 - 99% Bandwidth Summary Results - SISO

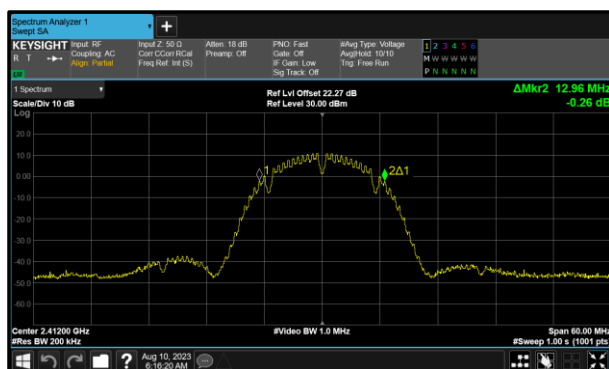


Figure 65 - 802.11b Minimum 99% OBW

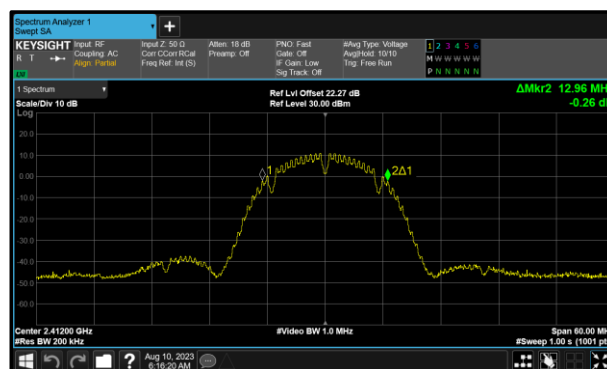


Figure 66 - 802.11b Maximum 99% OBW

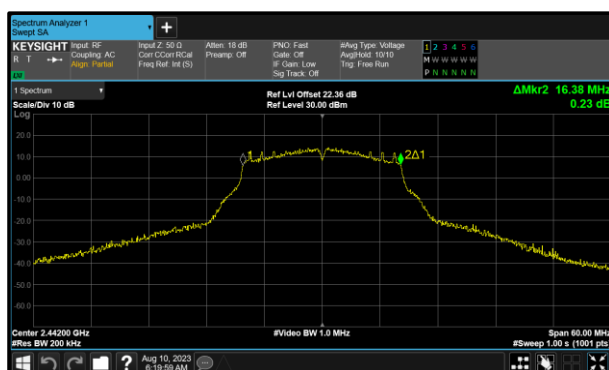


Figure 67 - 802.11g Minimum 99% OBW

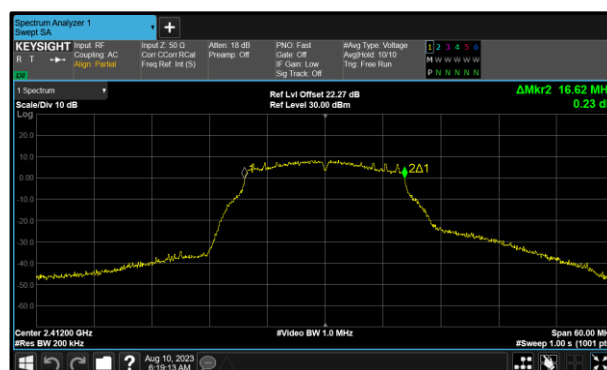


Figure 68 - 802.11g Maximum 99% OBW

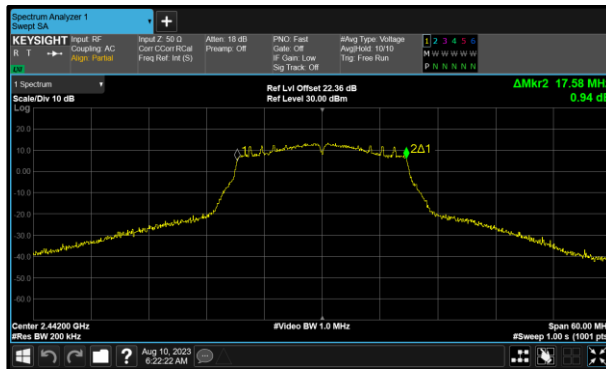


Figure 69 - 802.11n HT20 Minimum 99% OBW



Figure 70 - 802.11n HT20 Maximum 99% OBW

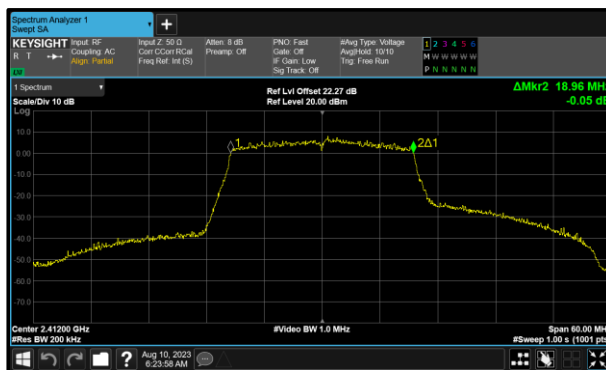


Figure 71 - 802.11ax HE20 SU Minimum 99% OBW

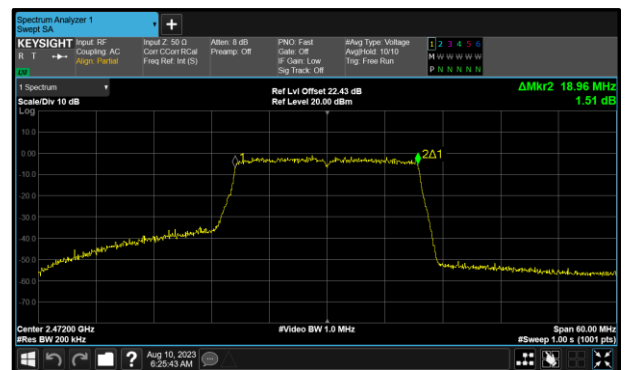


Figure 72 - 802.11ax HE20 SU Maximum 99% OBW

Protocol	99% Bandwidth (MHz)	
	Minimum	Maximum
802.11n HT20	17.580	17.700
802.11ax HE20 SU	18.900	18.960

Table 15 - 99% Bandwidth Summary Results - MIMO CDD

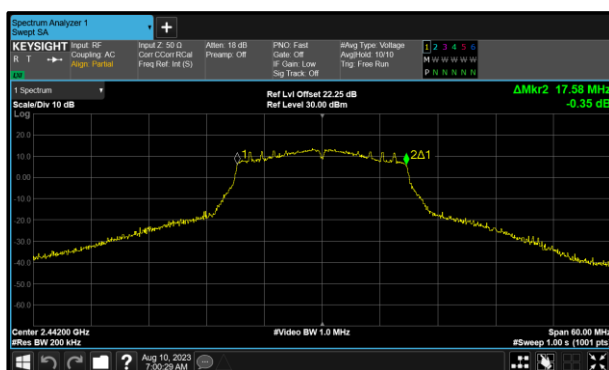


Figure 73 - 802.11n HT20 Minimum 99% OBW

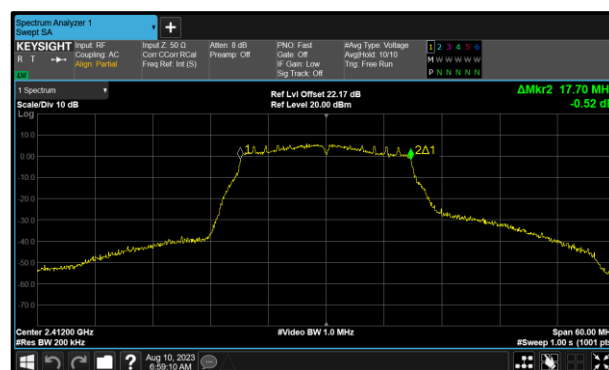


Figure 74 - 802.11n HT20 Maximum 99% OBW

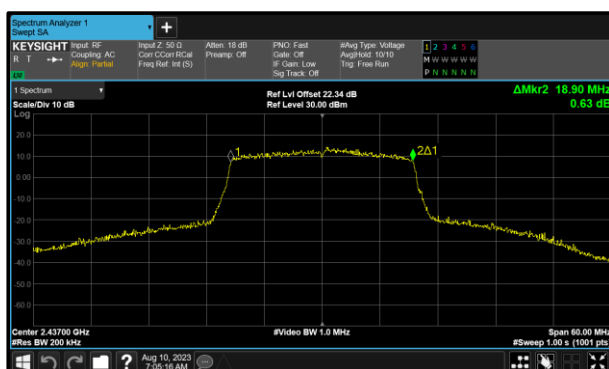


Figure 75 - 802.11ax HE20 SU Minimum 99% OBW

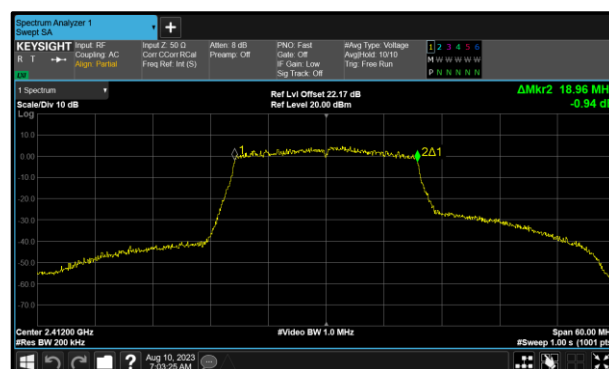


Figure 76 - 802.11ax HE20 SU Maximum 99% OBW



SISO

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):	C (Core 1)	Active Chain(s):	1

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	-	9.120	-	≥500.0
2442	-	-	8.640	-	≥500.0
2472	-	-	9.120	-	≥500.0

Table 16 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2412	-	-	12.960	-	-
2442	-	-	12.960	-	-
2472	-	-	12.960	-	-

Table 17 - 99% Bandwidth Results