FCC and ISED Test Report

Apple Inc
Model: A3241

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

TUV SUD Limited

Digitally signed by TUV SUD Limited
Date: 2024.11.29 15:10:54 Z

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

FCC ID: BCGA3241 IC: 579C-A3241

COMMERCIAL-IN-CONFIDENCE

Document 75962766-38 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Steve Marshall	Senior Engineer	Authorised Signatory	29 November 2024

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	29 November 2024	

FCC Accreditation
492497/UK2010 Octagon House, Fareham Test Laboratory
553713/UK2026 Concorde Park, Fareham Test Laboratory

ISED Accreditation
12669A/UK0003 Octagon House, Fareham Test Laboratory
28798/UK0003 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: 2023, ISED RSS-247: Issue 3 (2023-08) and ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02) 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. © 2024 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). Results of tests covered by our Flexible UKAS Accreditation Schedule are marked FS (Flexible Scope).

TÜV SÜD
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
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 2

1.1 Report Modification Record 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Product Information 4
1.5 Deviations from the Standard 5
1.6 Identification of the EUT 5
1.7 EUT Modification Record 6
1.8 Test Location 6

2 Test Details 8

2.1 Restricted Band Edges 8
2.2 Emission Bandwidth 47
2.3 Maximum Conducted Output Power 137
2.4 Authorised Band Edges 155
2.5 Spurious Radiated Emissions 170
2.6 Power Spectral Density 185

3 Measurement Uncertainty 199

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-November-2024

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
EUT/Sample Identification	Refer to section 1.6
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2023 ISED RSS-247: Issue 3 (2023-08) ISED RSS-GEN: Issue 5 (2018-04) + A2 (2021-02)
Start of Test	29-April-2024
Finish of Test	07-November-2024
Name of Engineer(s)	Akhil Rajendran Bhaskaran Nair, Manohar Thota, Mustafa Murad, Thomas Biddlecombe, Colin Brain and Vineeth Nagaraj, Elliot Callender, Ian Hart and Ioan-Alexandru Bogatu
Related Document(s)	ANSI C63.4 (2014) 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 Bluetooth LE/HDR/HDR						
-	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 (2020)
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2020)
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2020) KDB 662911 D01 v02r01
2.4	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2020)
2.5	15.209 and 15.247 (d)	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	ANSI C63.4 (2014) ANSI C63.10 (2020)
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2020) KDB 662911 D01 v02r01

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 Bluetooth radio supports SISO (Single Input/Single Output) and MIMO (Multiple Input/Multiple Output) operation on two different cores (Core 0 and Core 1). The EUT supports HDR4 (4-DH5), HDR8 (8-DH5), LE1M and LE2M. It also operates at two power settings: low power "iPA" and high power "ePA". The EUT uses different output powers per core dependent on how many cores are used.

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

SISO modes:

- HDR4 - iPA - Core 0
- HDR8 - iPA - Core 0
- LE1M - iPA - Core 1
- LE2M - iPA - Core 1
- HDR4 - ePA - Core 0
- HDR8 - ePA - Core 0
- LE1M - ePA - Core 0
- LE2M - ePA - Core 0

MIMO modes:

- HDR4 - iPA - Core 0 + Core 1
- HDR8 - iPA - Core 0 + Core1
- LE1M - iPA - Core 0 + Core 1
- LE2M - iPA - Core 0 + Core 1
- HDR4 - ePA - Core 0 + Core 1
- HDR8 - ePA - Core 0 + Core 1
- LE1M - ePA - Core 0 + Core 1
- LE2M - ePA - Core 0 + Core 1

With Spurious Radiated Emissions tests limited to the modes shown below, with the device configured to operate at maximum output power. As this was deemed to be worst case.

MIMO modes:

- LE1M - iPA - Core 0 + Core 1
- HDR4 - ePA - Core 0 + Core 1

1.4.3 Test Setup

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/receive test mode with the chipset manufacturer's test commands to ensure the measured signals were representative.

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	5.4	0.71
Core 1	2400 to 2480	5.1	0.71

Table 3

1.5 Deviations from the Standard

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

1.6 Identification of the EUT

The table below details identification of the EUT(s) that have been used to carry out the testing within this report.

Model: A3241		
Serial Number	Hardware Version	Software Version
G0Q65Y9HP6	REV1.0	24A12461c
FWKQMY7GHY	REV1.0	24A12461c
HJKCRQM3K9	REV1.0	24A12461c
K2K9N270NG	REV1.0	24A12461c
DT7LYX5QXT	REV1.0	24A12461c
GNF9559TWD	REV1.0	24A12461c

Table 4

1.7 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: A3241, Serial Number: K2K9N270NG			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3241, Serial Number: HJKCRQM3K9			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3241, Serial Number: DT7LYX5QXT			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3241, Serial Number: G0Q65Y9HP6			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3241, Serial Number: FWKQMY7GHY			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3241, Serial Number: GNF9559TWD			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 5

1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth LE/HDR/HDR		
Emission Bandwidth	Thomas Biddlecombe	UKAS
Maximum Conducted Output Power	Thomas Biddlecombe	UKAS
Power Spectral Density	Thomas Biddlecombe	UKAS

Table 6

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 Bluetooth LE/HDR/HDR		
Restricted Band Edges	Akhil Rajendran Bhaskaran Nair, Elliot Callender, Ian Hart, Ioan-Alexandru Bogatu and Manohar Thota	UKAS
Emission Bandwidth	Mustafa Murad	UKAS
Maximum Conducted Output Power	Mustafa Murad	UKAS
Authorised Band Edges	Akhil Rajendran Bhaskaran Nair and Manohar Thota	UKAS
Spurious Radiated Emissions	Akhil Rajendran Bhaskaran Nair, Colin Brain, Manohar Thota and Vineeth Nagaraj	UKAS
Power Spectral Density	Mustafa Murad	UKAS

Table 7

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

A3241, S/N: HJKCRQM3K9 - Modification State 0
A3241, S/N: GNF9559TWD - Modification State 0

2.1.3 Date of Test

29-April-2024 to 30-September-2024

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	20.4 - 23.2 °C
Relative Humidity	41.5 - 46.7 %

2.1.6 Test Results

2.4 GHz Bluetooth LE/HDR/HDR

iPA - Core 0 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	53.61	41.75
Static	HDR8	2404	2390	54.06	42.34
Static	LE1M	2402	2390	53.42	41.67
Static	LE2M	2402	2390	53.68	41.76
Static	HDR4	2476	2483.5	53.94	41.02
Static	HDR8	2476	2483.5	54.71	43.12
Static	LE1M	2478	2483.5	52.30	40.89
Static	LE2M	2478	2483.5	52.59	41.18
Static	LE1M	2480	2483.5	54.18	42.35
Static	LE2M	2480	2483.5	57.81	48.25

Table 8 - SISO Restricted Band Edge Results

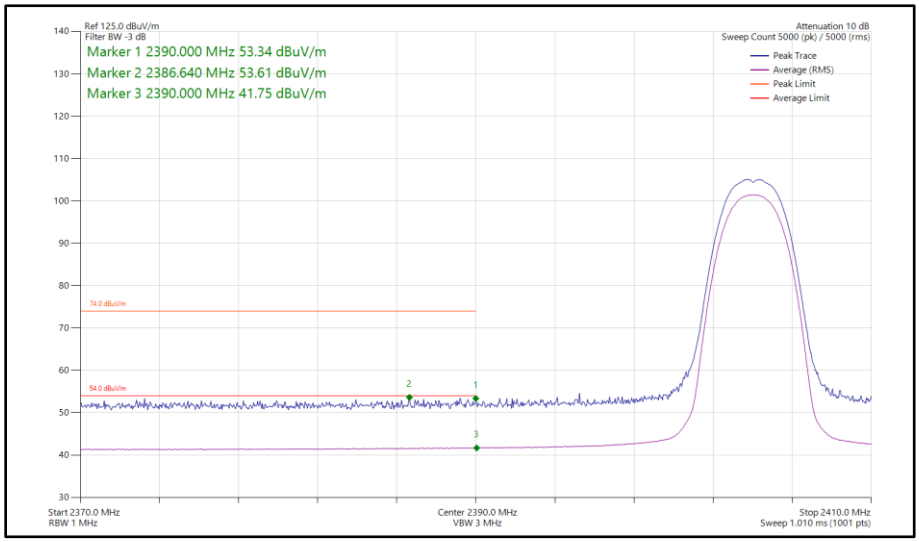

Figure 1 - Bluetooth HDR4, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

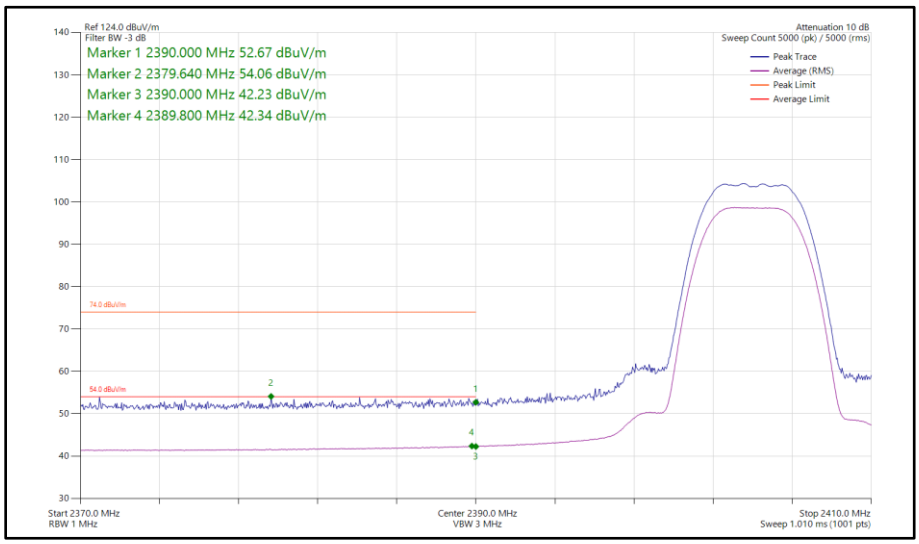

Figure 2 - Bluetooth HDR8, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

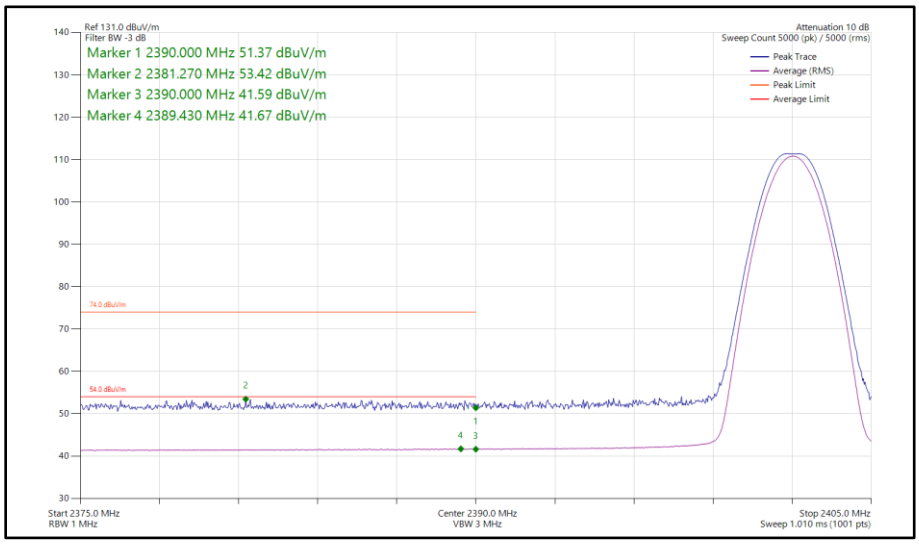

Figure 3 - Bluetooth LE1M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

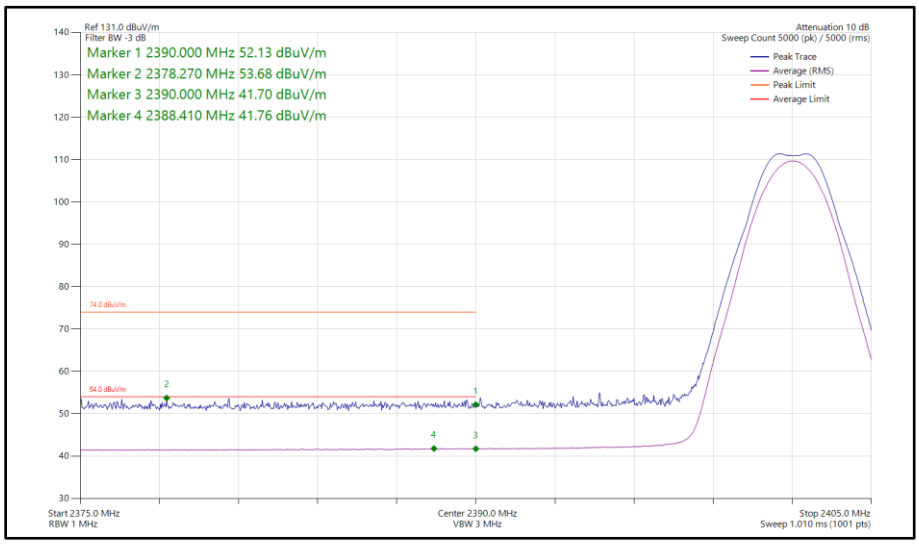

Figure 4 - Bluetooth LE2M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

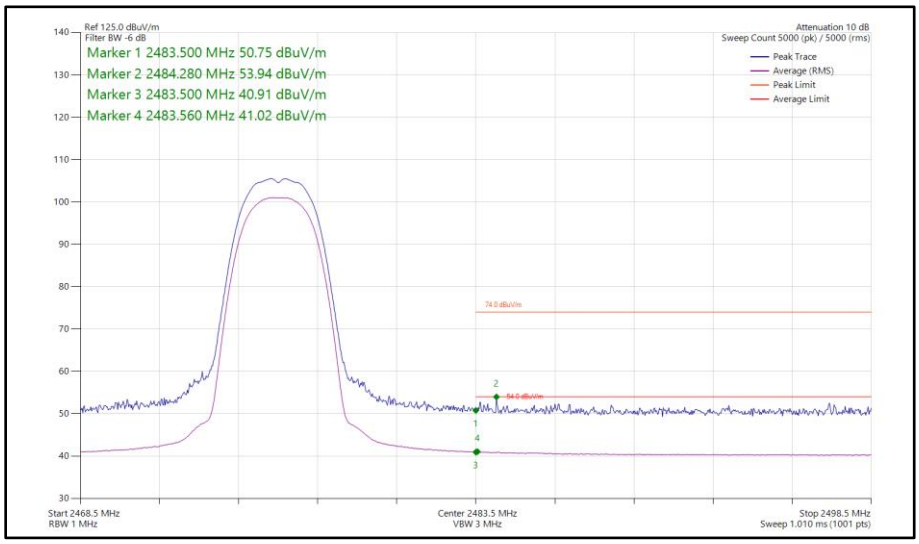

Figure 5 - Bluetooth HDR4, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

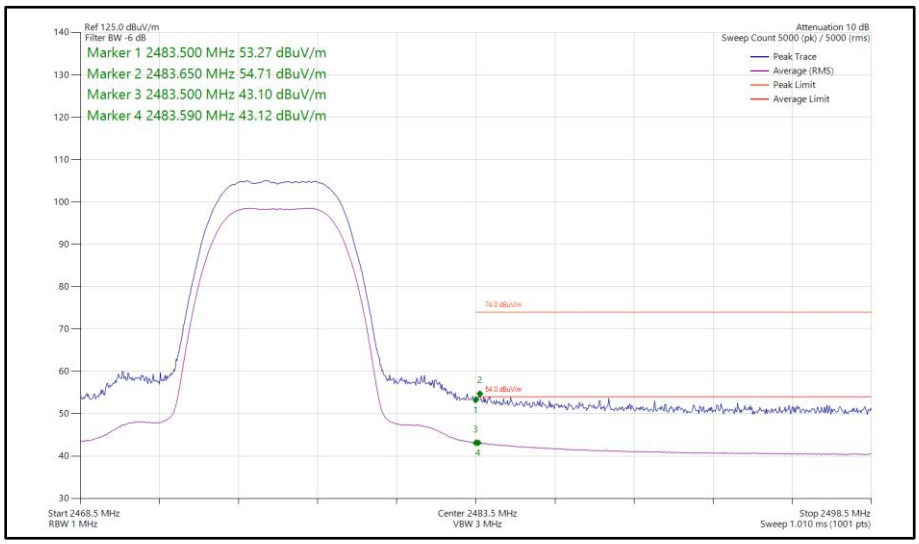

Figure 6 - Bluetooth HDR8, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

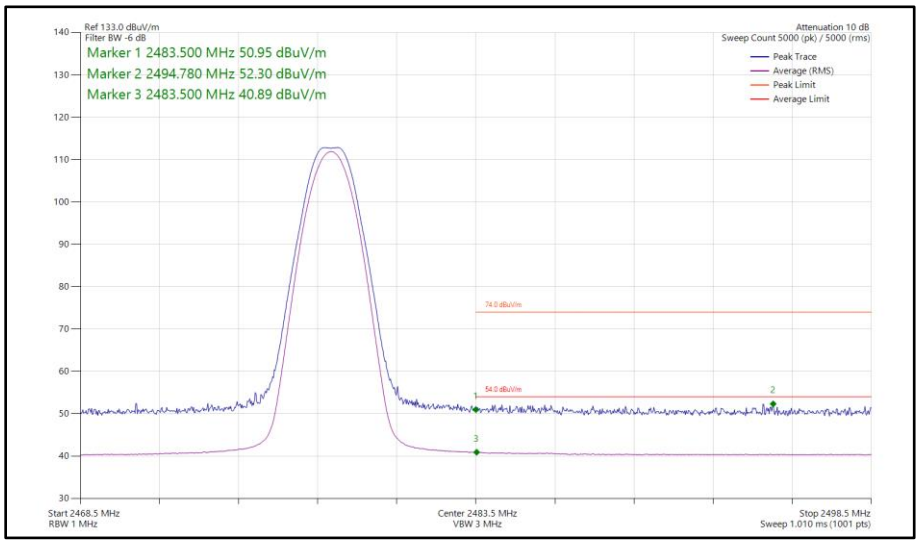

Figure 7 - Bluetooth LE1M, SISO, Core 0 - 2478 MHz
Band Edge Frequency 2483.5 MHz

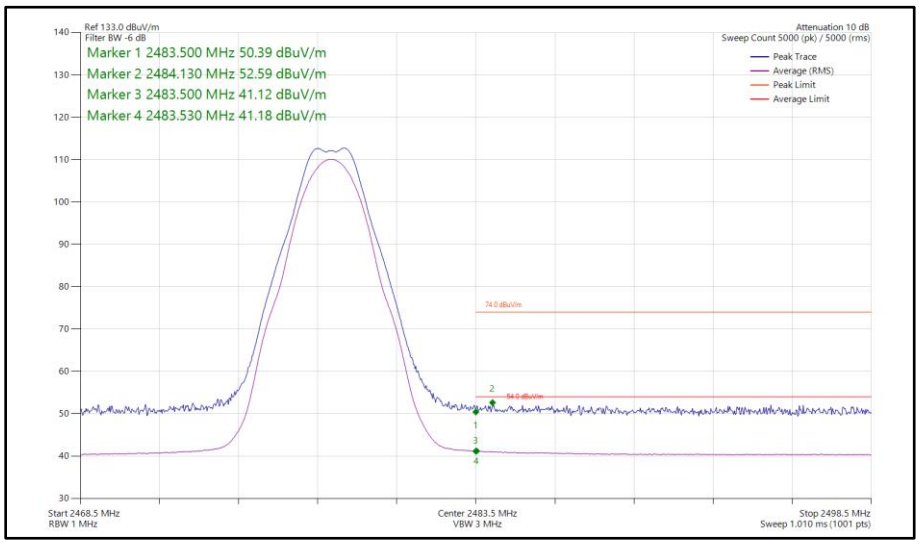

Figure 8 - Bluetooth LE2M, SISO, Core 0 - 2478 MHz
Band Edge Frequency 2483.5 MHz

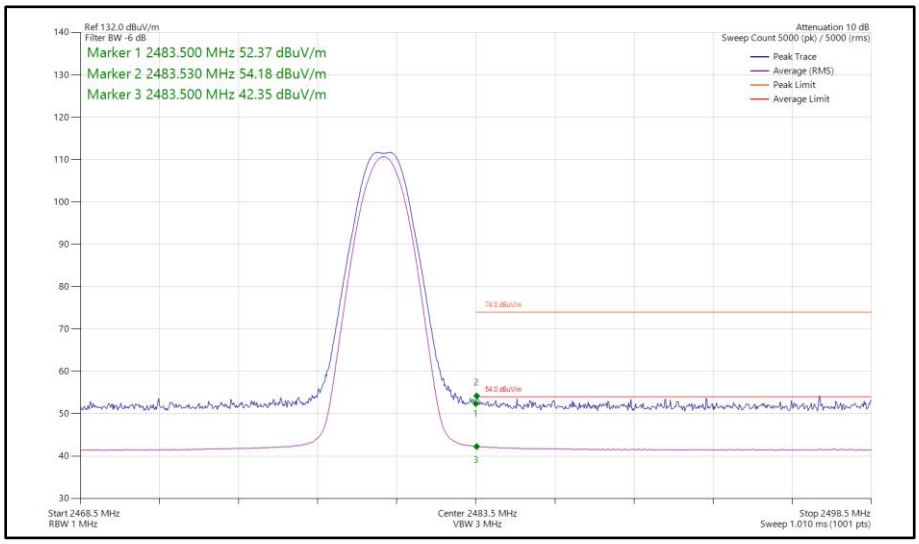

Figure 9 - Bluetooth LE1M, SISO, Core 0 - 2480 MHz
Band Edge Frequency 2483.5 MHz

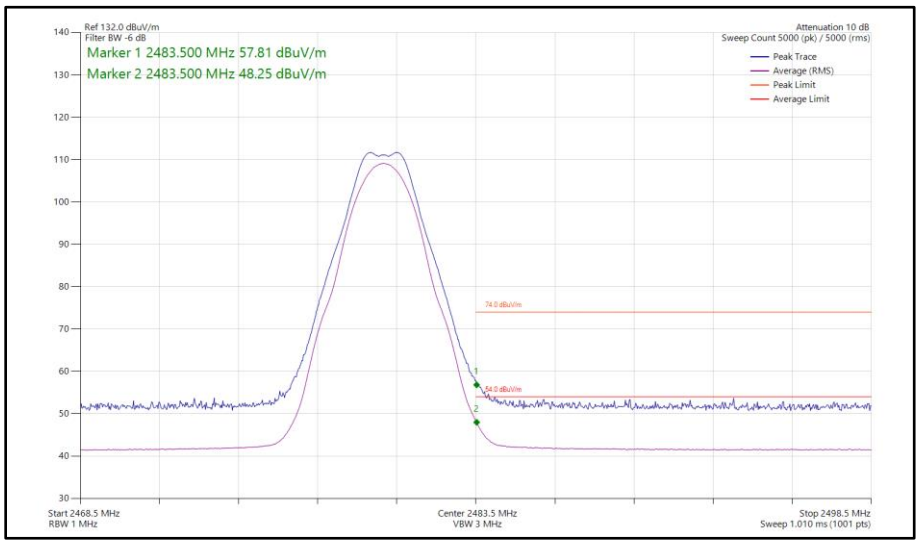

Figure 10 - Bluetooth LE2M, SISO, Core 0 - 2480 MHz
Band Edge Frequency 2483.5 MHz

iPA - Core 1 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	53.76	41.77
Static	HDR8	2404	2390	53.80	42.12
Static	LE1M	2402	2390	53.72	41.70
Static	LE2M	2402	2390	53.40	41.68
Static	HDR4	2476	2483.5	52.84	40.57
Static	HDR8	2476	2483.5	52.81	41.50
Static	LE1M	2478	2483.5	52.66	40.49
Static	LE2M	2478	2483.5	52.37	40.79
Static	LE1M	2480	2483.5	53.77	42.35
Static	LE2M	2480	2483.5	58.67	49.26

Table 9 - SISO Restricted Band Edge Results

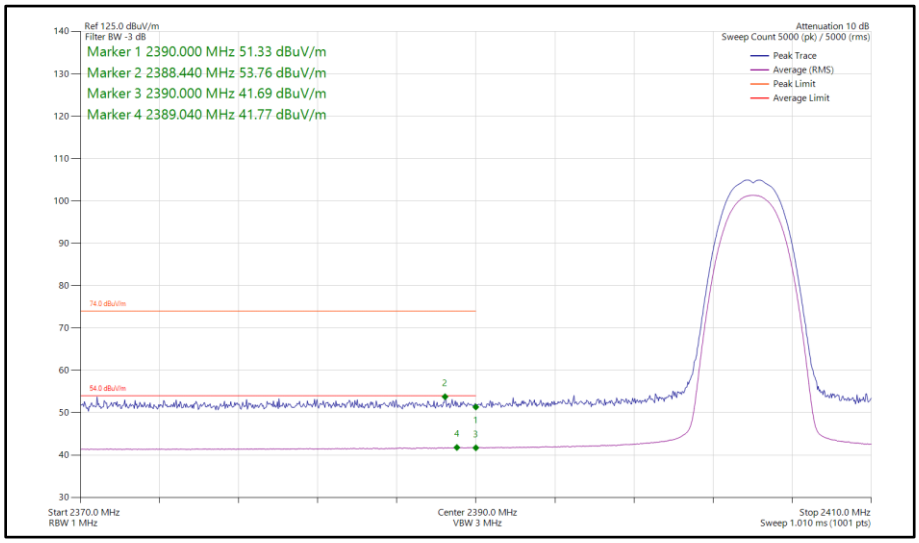

Figure 11 - Bluetooth HDR4, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

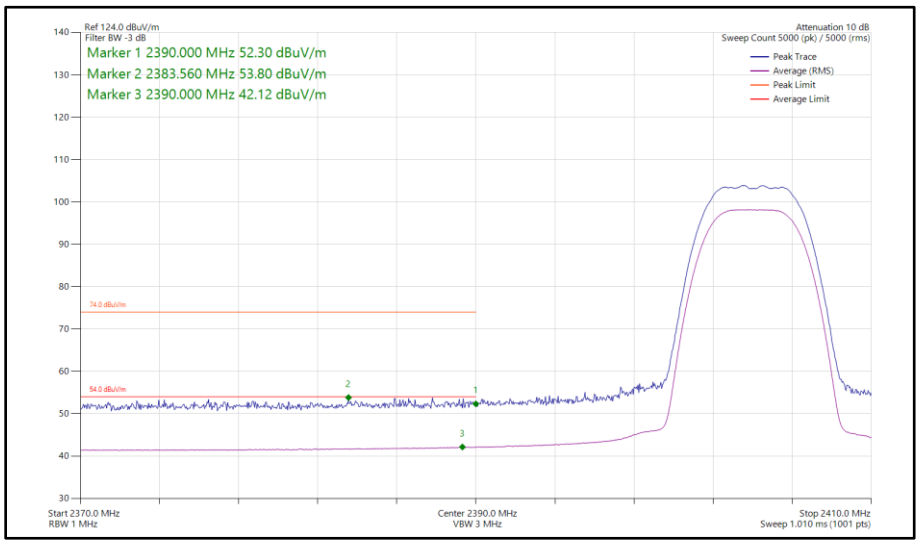

Figure 12 - Bluetooth HDR8, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

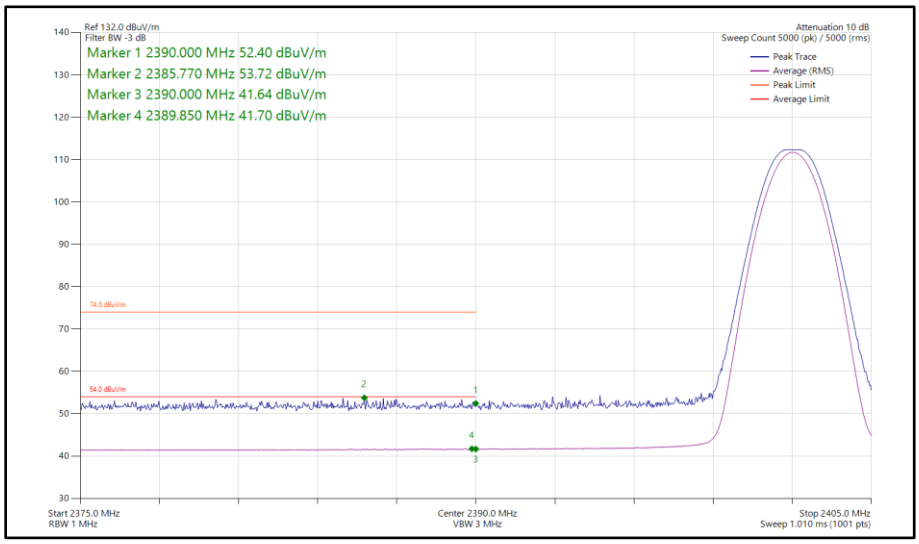

Figure 13 - Bluetooth LE1M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

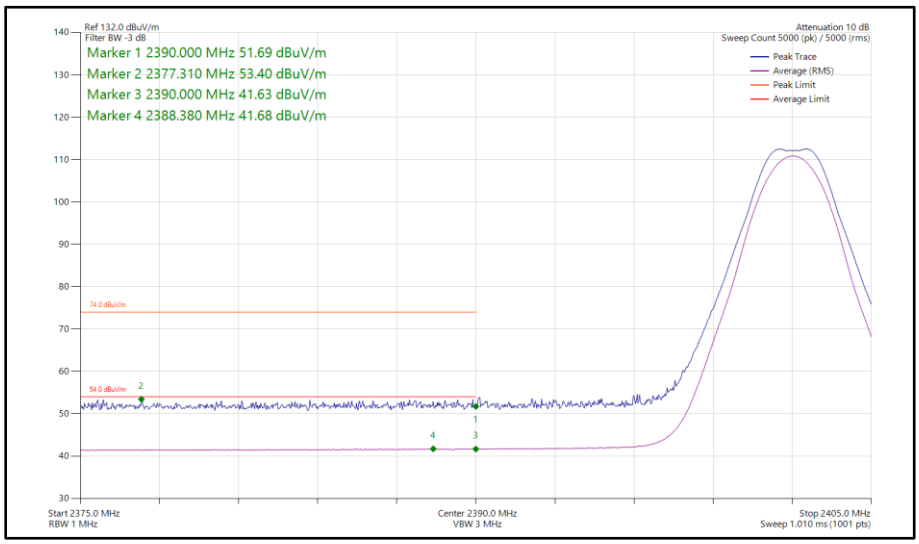

Figure 14 - Bluetooth LE2M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

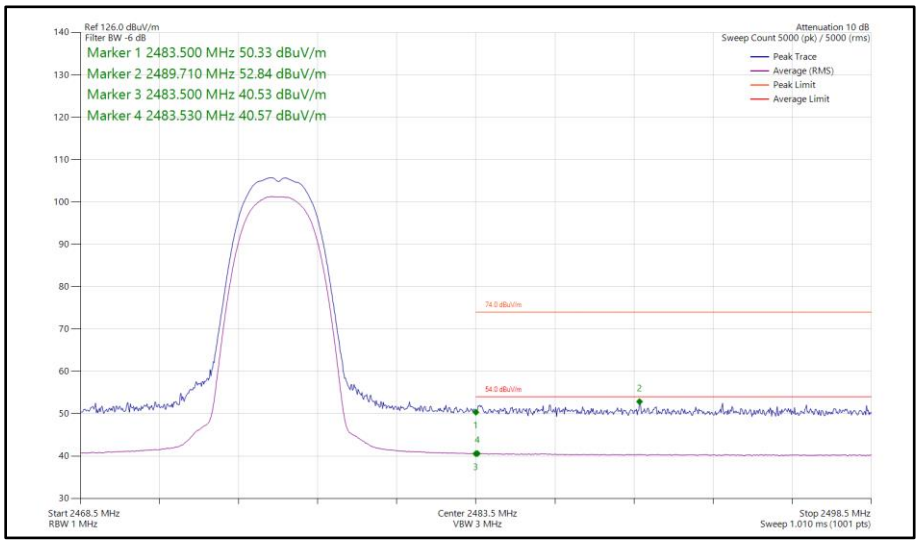

Figure 15 - Bluetooth HDR4, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

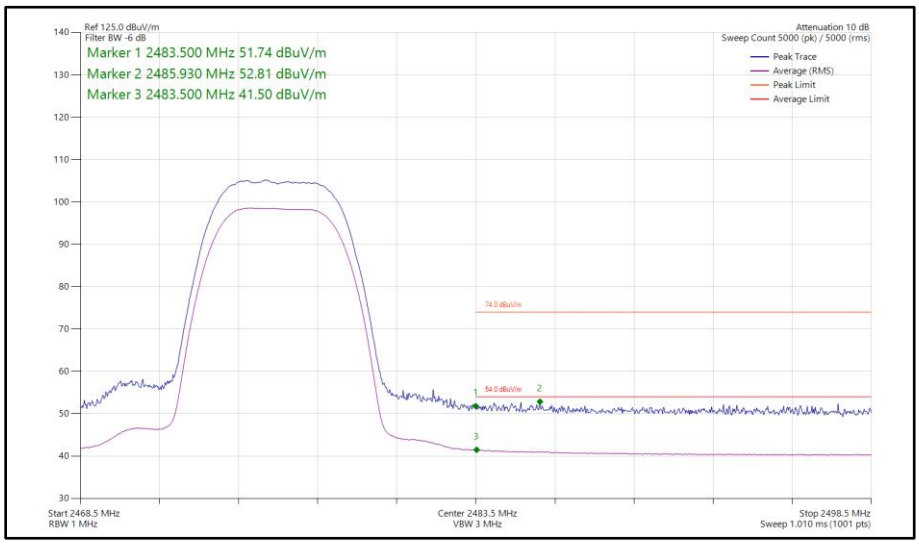

Figure 16 - Bluetooth HDR8, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

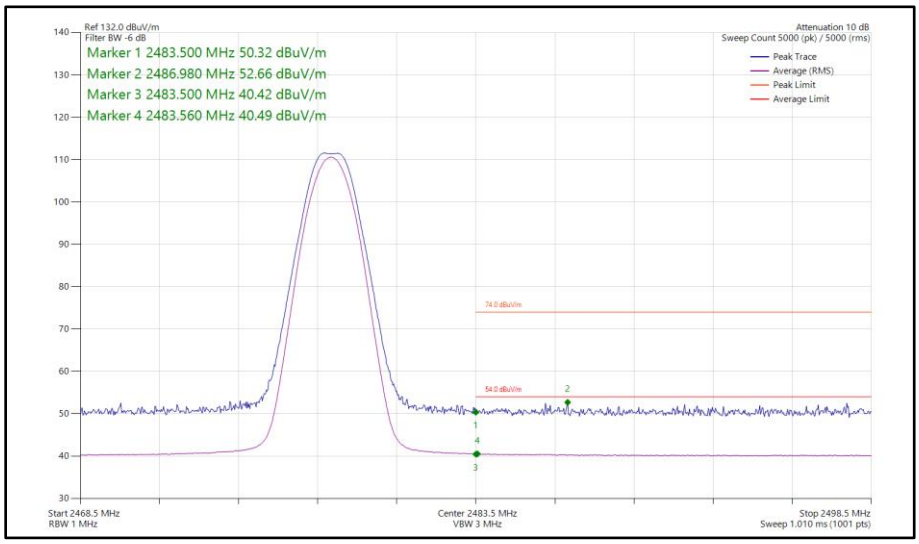

Figure 17 - Bluetooth LE1M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

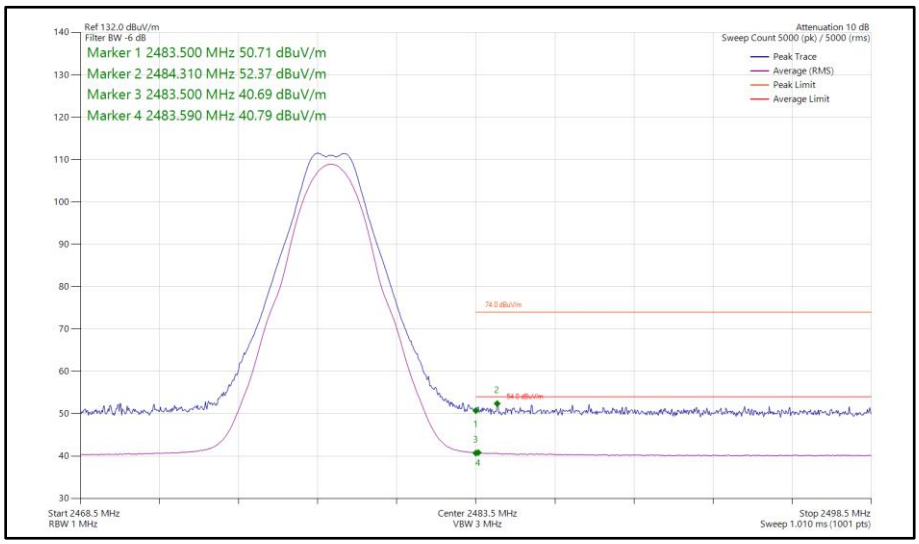

Figure 18 - Bluetooth LE2M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

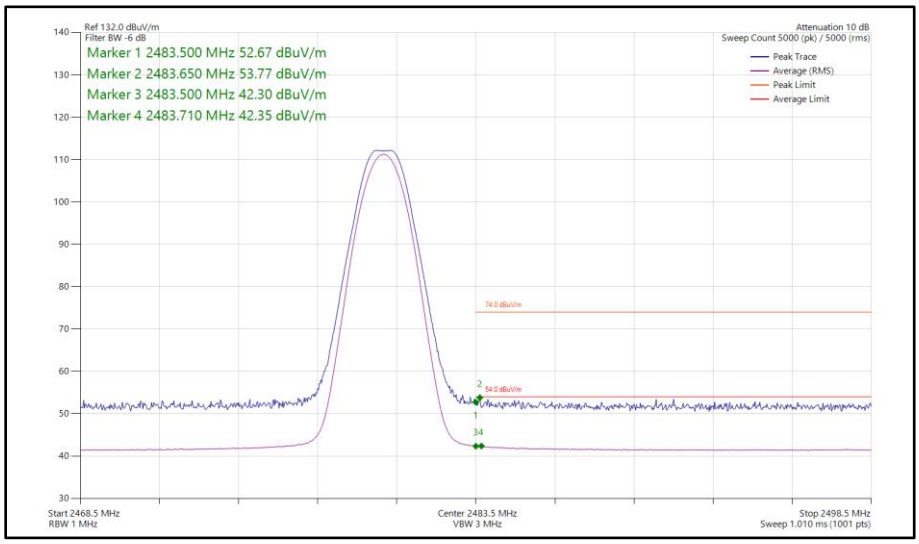

Figure 19 - Bluetooth LE1M, SISO, Core 1 - 2480 MHz
Band Edge Frequency 2483.5 MHz

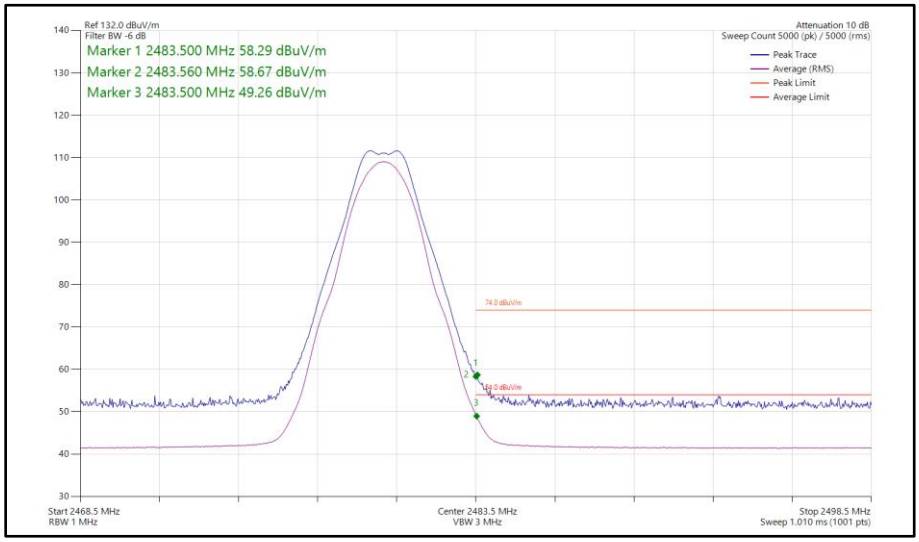

Figure 20 - Bluetooth LE2M, SISO, Core 1 - 2480 MHz
Band Edge Frequency 2483.5 MHz

iPA - Core 0 - Core 1 (MIMO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	54.42	42.07
Static	HDR8	2404	2390	54.45	42.89
Static	LE1M	2402	2390	54.95	42.62
Static	LE2M	2402	2390	53.78	42.08
Static	HDR4	2476	2483.5	52.69	41.23
Static	HDR8	2476	2483.5	54.79	43.59
Static	LE1M	2478	2483.5	54.08	42.33
Static	LE2M	2478	2483.5	54.25	42.64
Static	LE1M	2480	2483.5	53.23	41.37
Static	LE2M	2480	2483.5	53.27	41.60

Table 10 - MIMO Restricted Band Edge Results

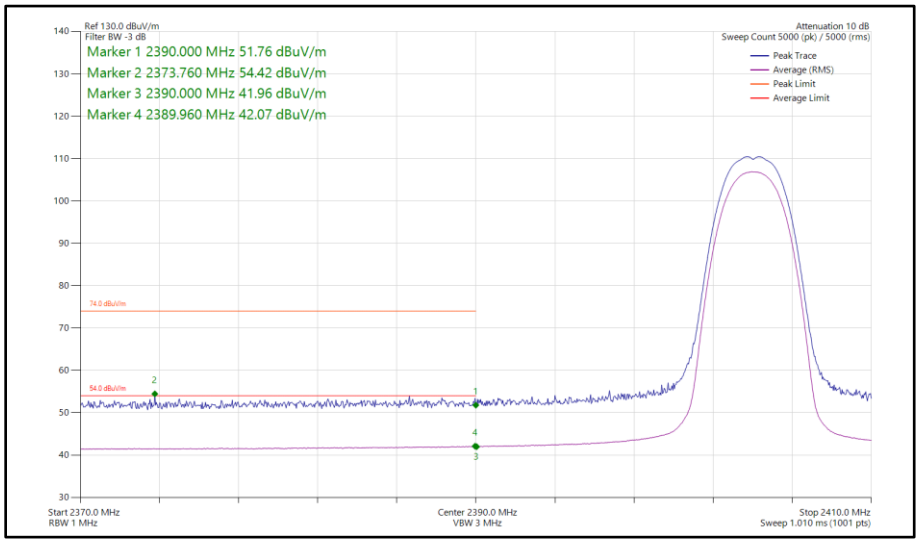

Figure 21 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

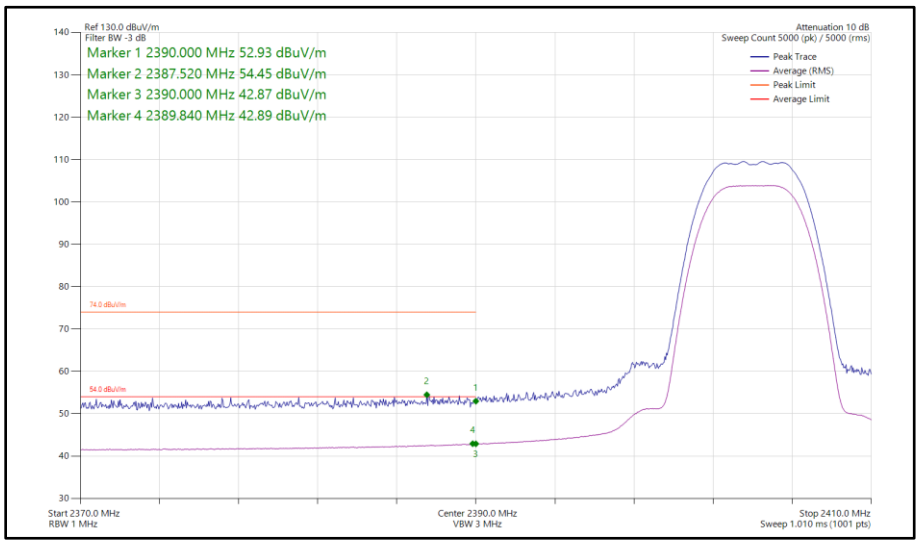

Figure 22 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

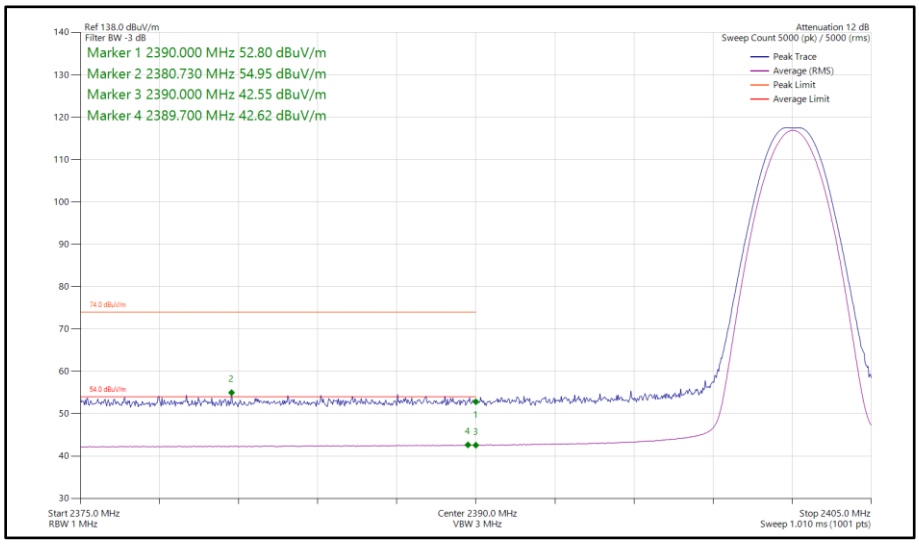

Figure 23 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

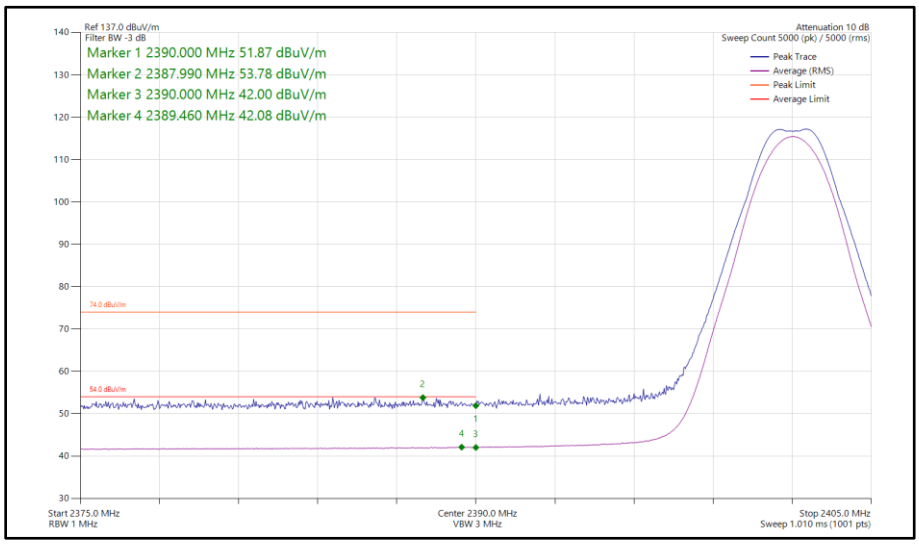

Figure 24 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

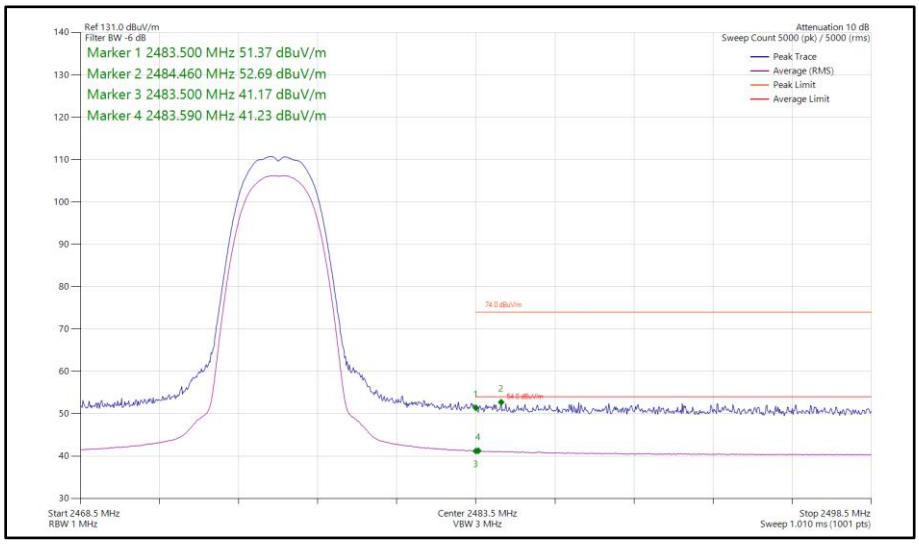

Figure 25 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

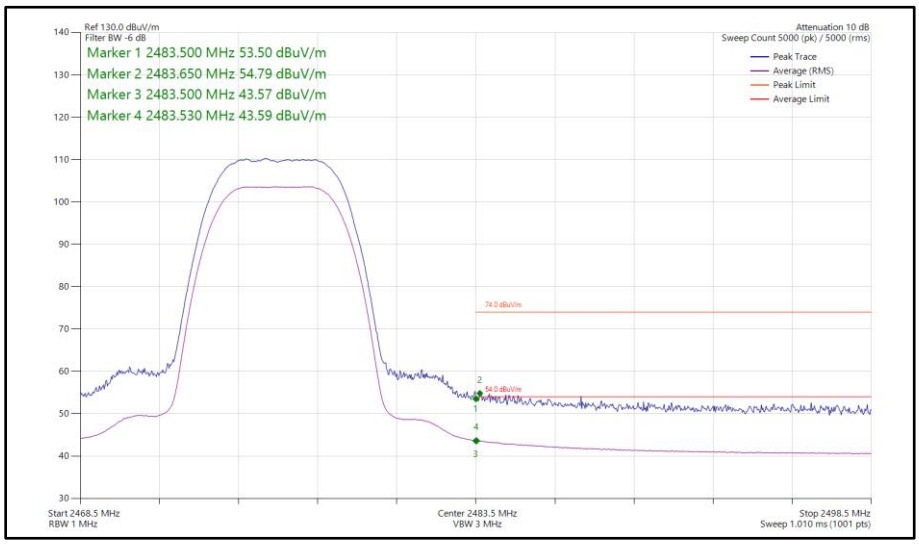

Figure 26 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

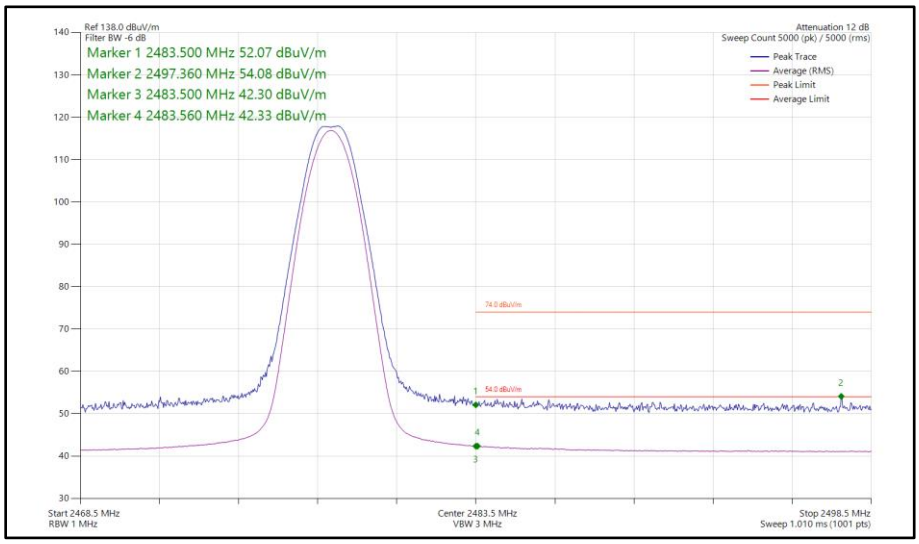

Figure 27 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

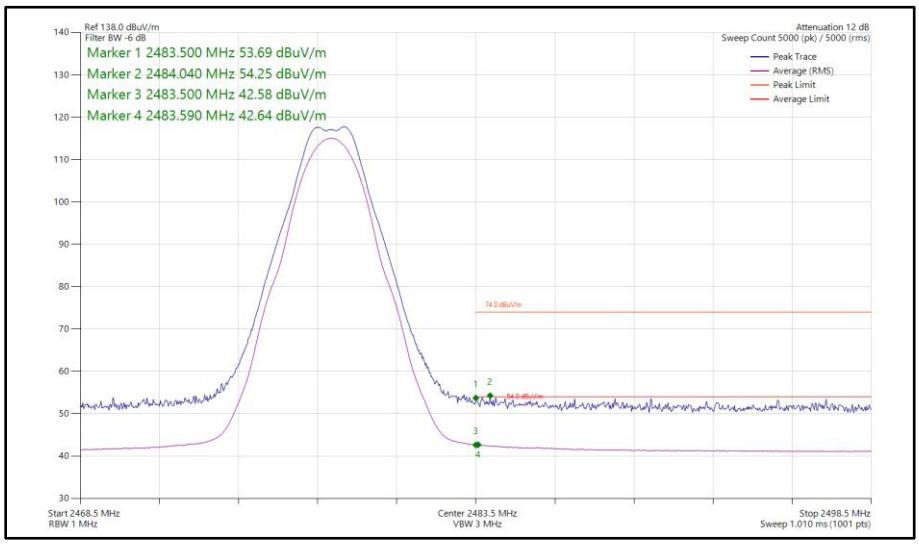

Figure 28 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

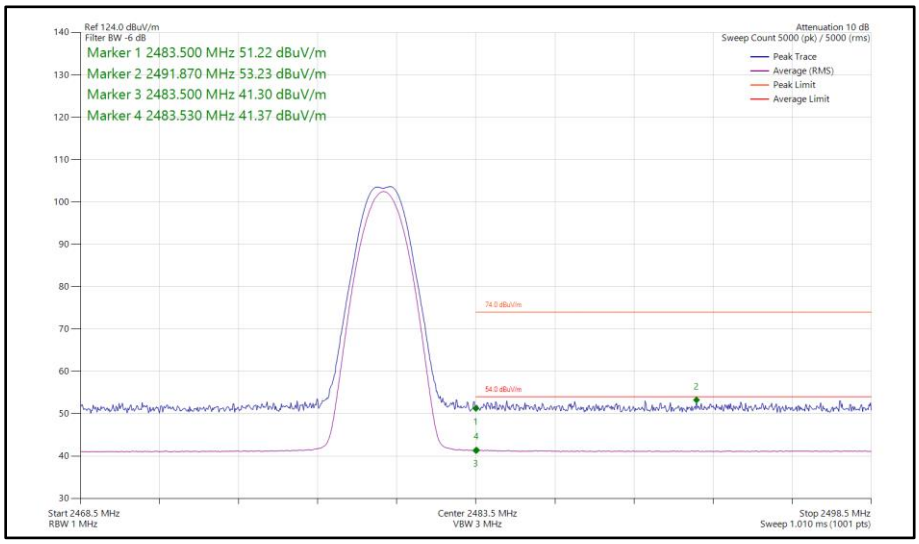

Figure 29 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

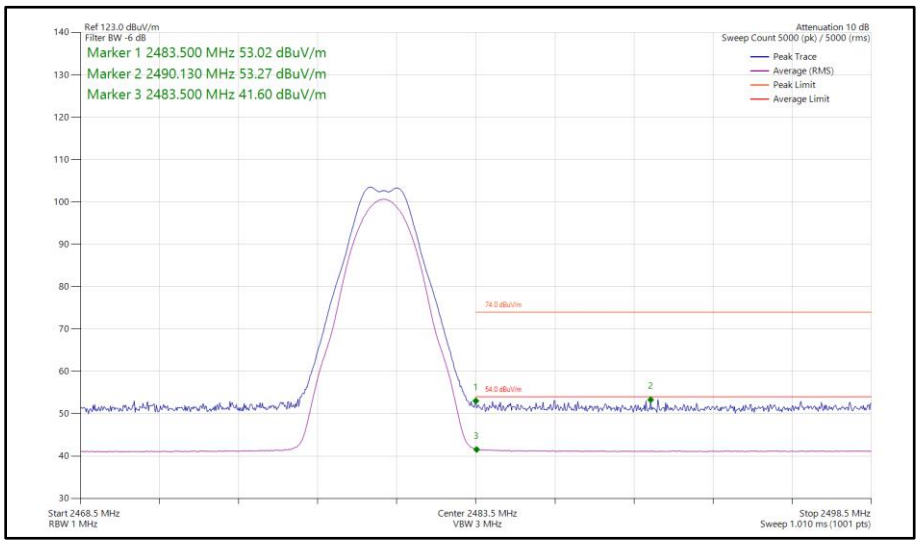

Figure 30 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

ePA - Core 0 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	55.04	43.34
Static	HDR8	2404	2390	57.38	45.99
Static	LE1M	2402	2390	56.80	45.27
Static	LE2M	2402	2390	57.07	45.56
Static	HDR4	2476	2483.5	55.52	44.71
Static	HDR8	2476	2483.5	61.95	50.58
Static	LE1M	2478	2483.5	57.09	46.15
Static	LE2M	2478	2483.5	57.92	46.95
Static	LE1M	2480	2483.5	58.65	47.04
Static	LE2M	2480	2483.5	60.05	50.31

Table 11 - SISO Restricted Band Edge Results

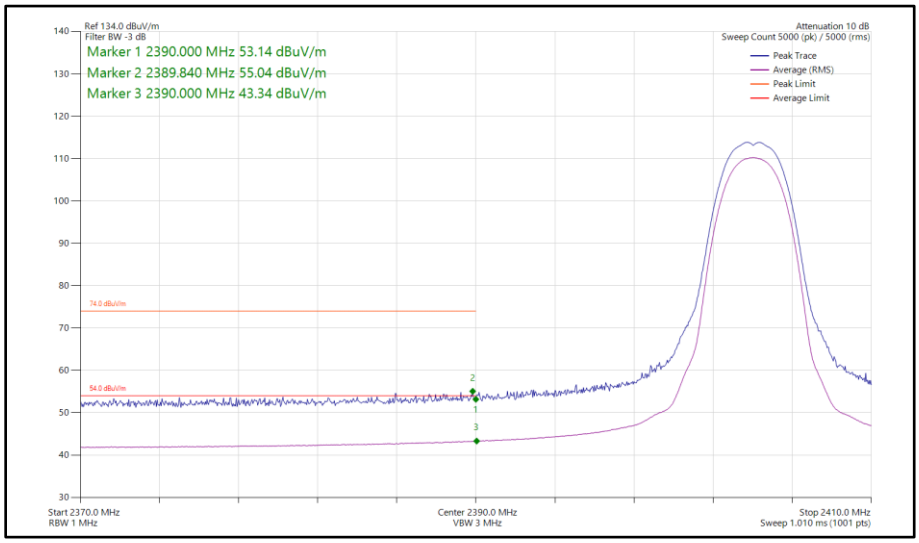

Figure 31 - Bluetooth HDR4, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

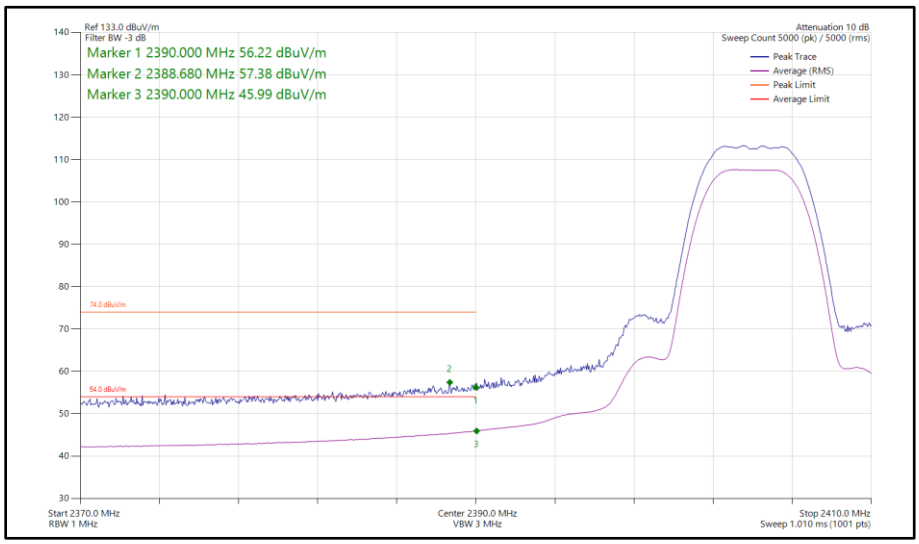

Figure 32 - Bluetooth HDR8, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

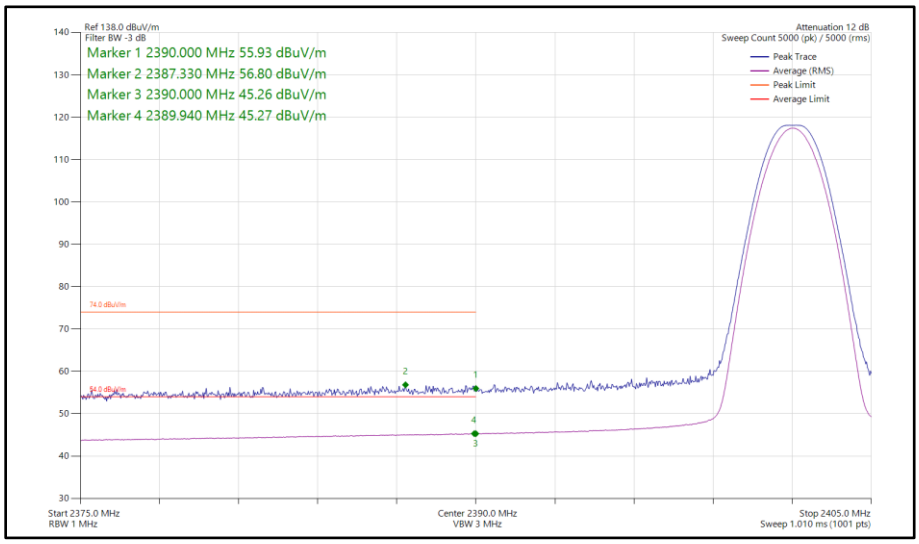

Figure 33 - Bluetooth LE1M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

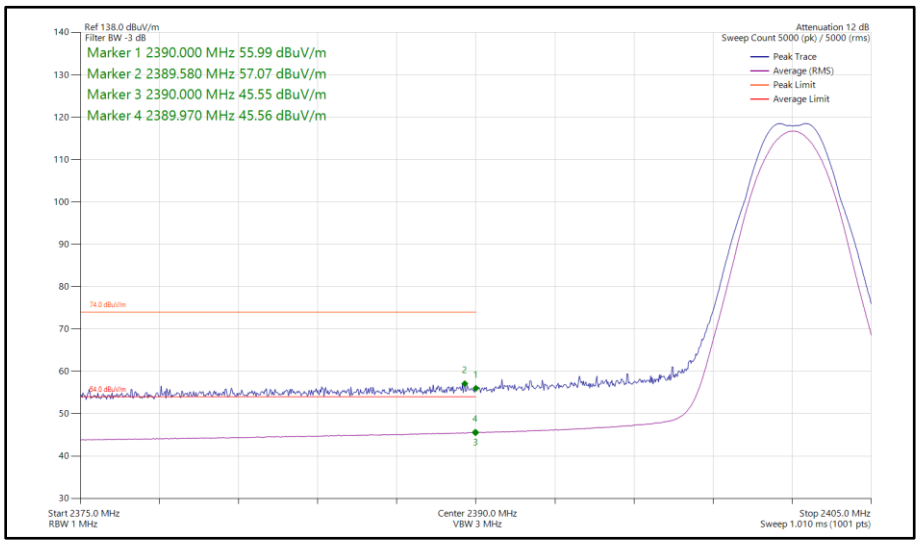

Figure 34 - Bluetooth LE2M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

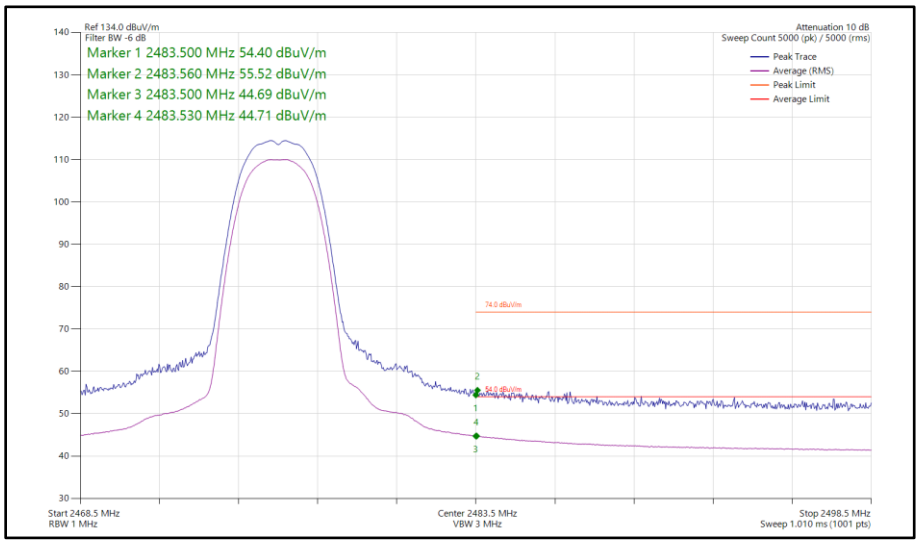

Figure 35 - Bluetooth HDR4, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

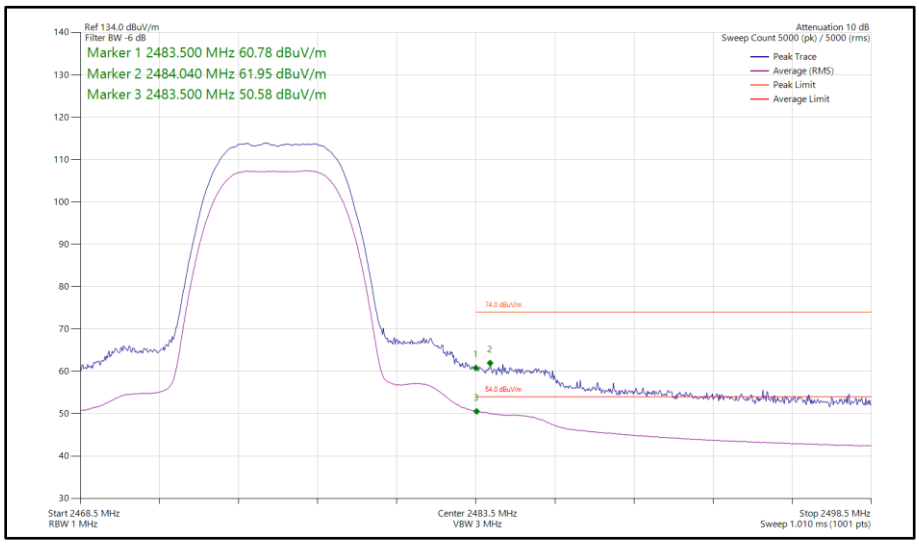

Figure 36 - Bluetooth HDR8, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

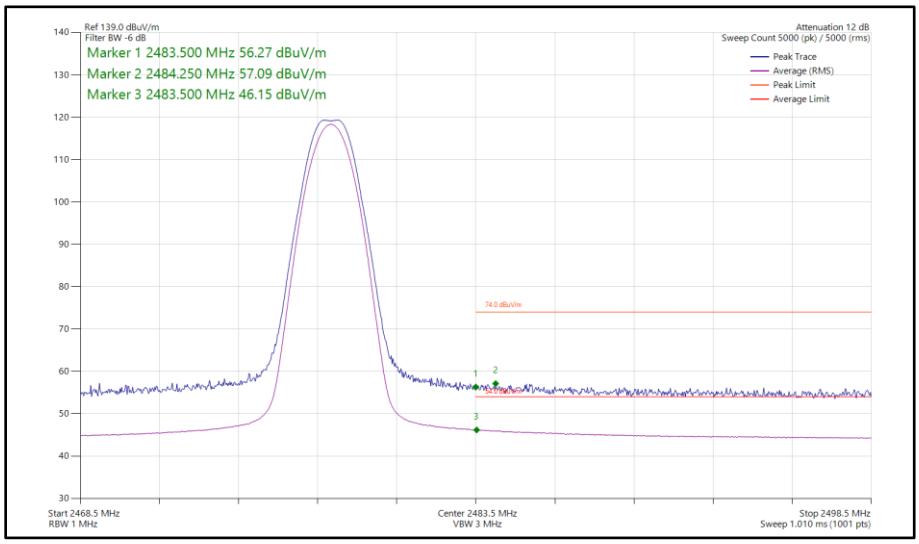

Figure 37 - Bluetooth LE1M, SISO, Core 0 - 2478 MHz
Band Edge Frequency 2483.5 MHz

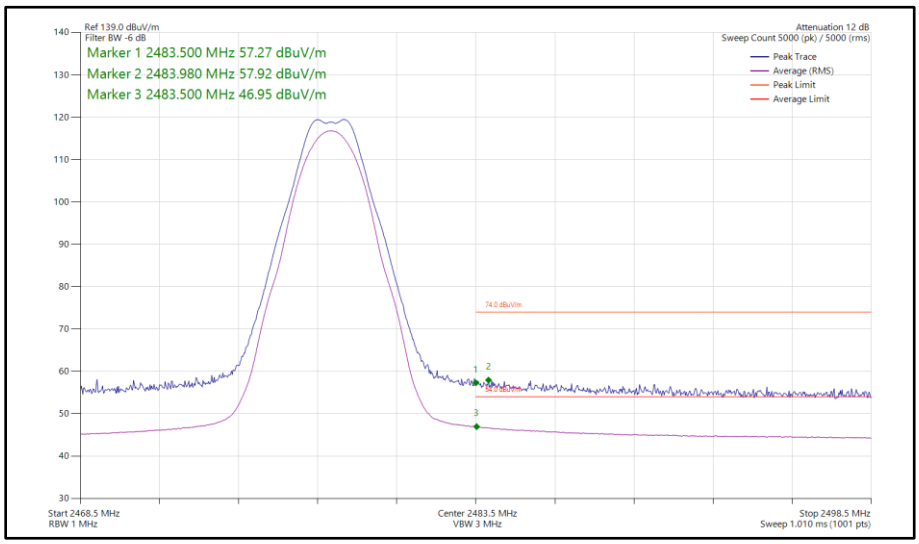

Figure 38 - Bluetooth LE2M, SISO, Core 0 - 2478 MHz
Band Edge Frequency 2483.5 MHz

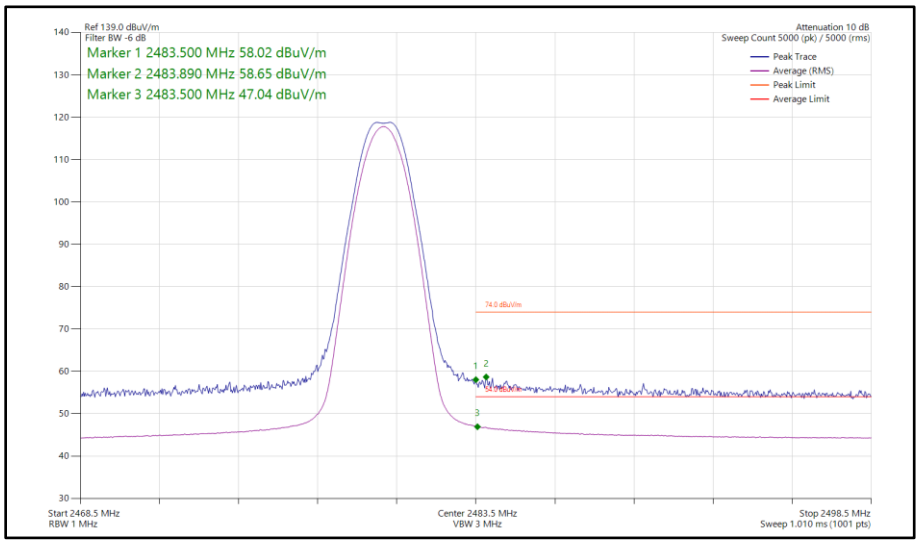

Figure 39 - Bluetooth LE1M, SISO, Core 0 - 2480 MHz
Band Edge Frequency 2483.5 MHz

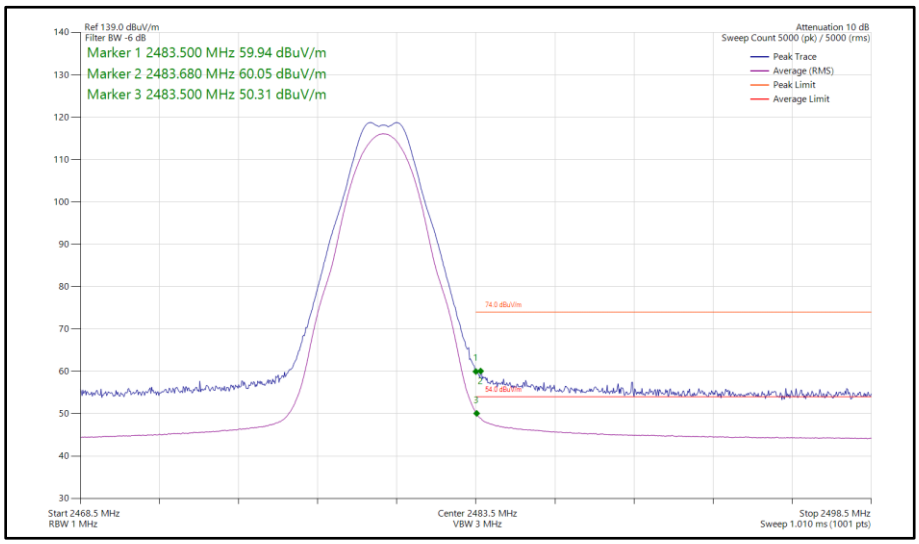

Figure 40 - Bluetooth LE2M, SISO, Core 0 - 2480 MHz
Band Edge Frequency 2483.5 MHz

ePA - Core 1 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	56.97	43.32
Static	HDR8	2404	2390	59.01	45.06
Static	LE1M	2402	2390	58.54	45.74
Static	LE2M	2402	2390	58.00	45.74
Static	HDR4	2476	2483.5	55.57	43.24
Static	HDR8	2476	2483.5	58.43	47.00
Static	LE1M	2478	2483.5	62.26	46.29
Static	LE2M	2478	2483.5	61.55	46.95
Static	LE1M	2480	2483.5	59.05	47.03
Static	LE2M	2480	2483.5	62.59	51.36

Table 12 - SISO Restricted Band Edge Results

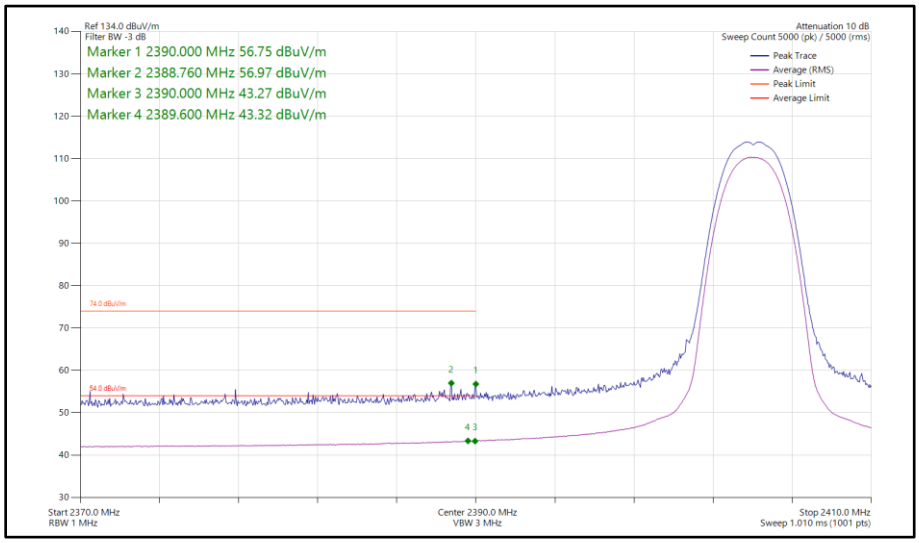

Figure 41 - Bluetooth HDR4, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

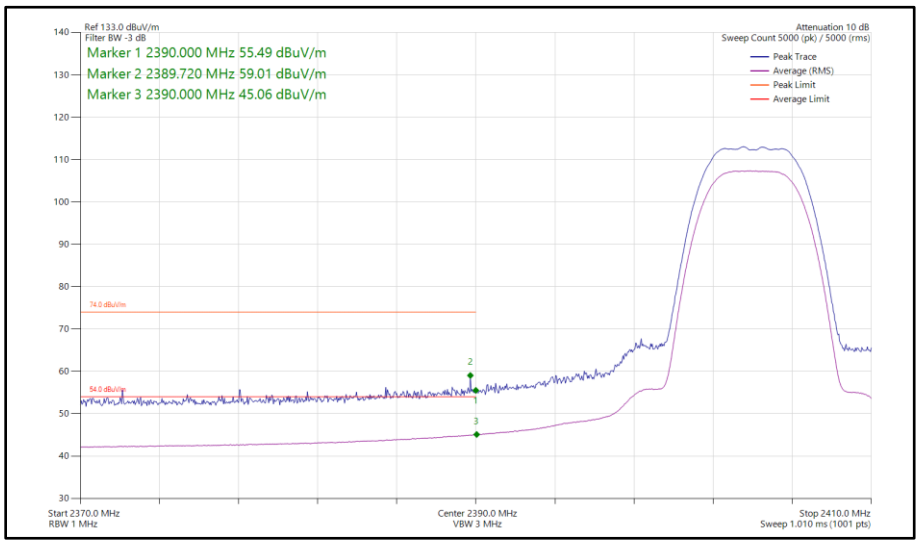

Figure 42 - Bluetooth HDR8, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

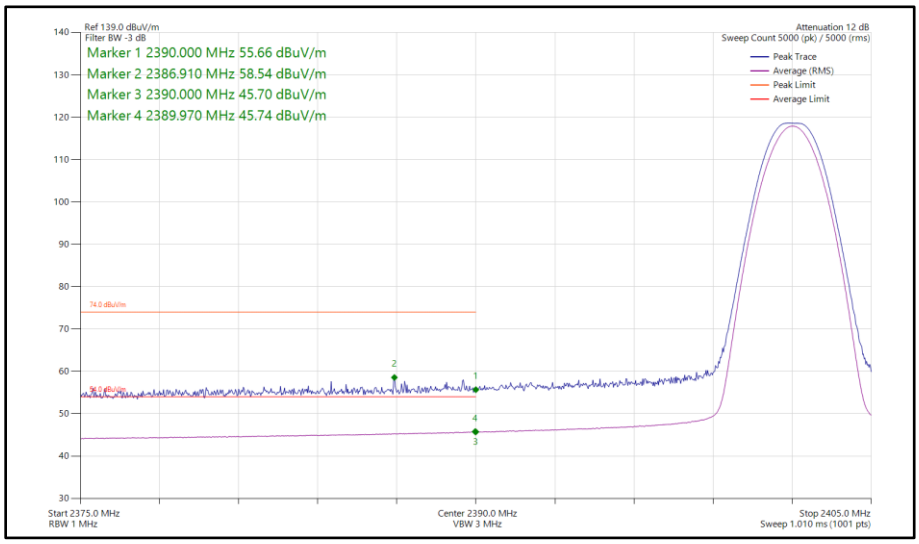

Figure 43 - Bluetooth LE1M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

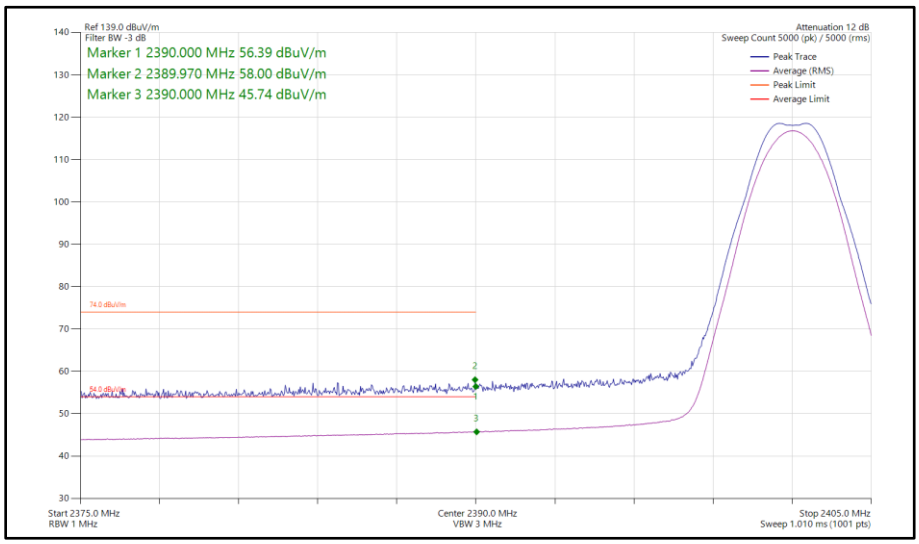

Figure 44 - Bluetooth LE2M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

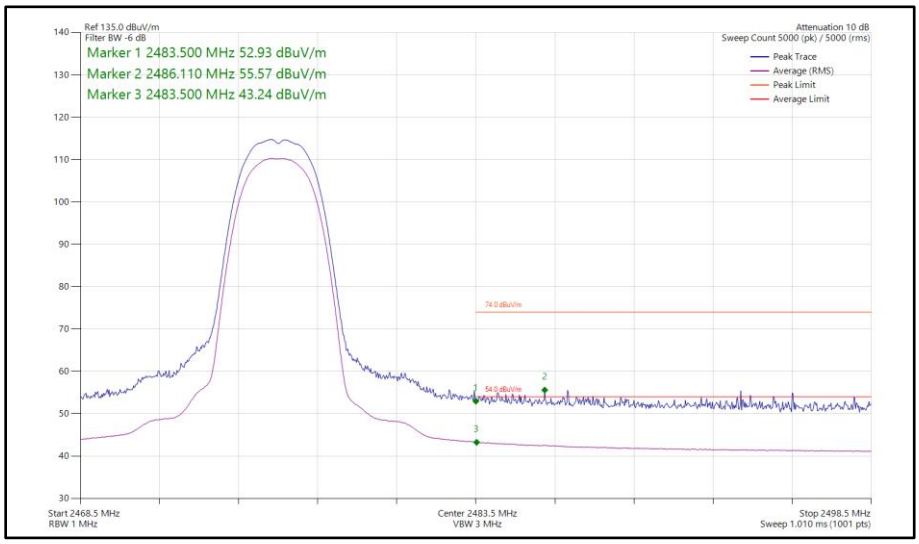

Figure 45 - Bluetooth HDR4, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

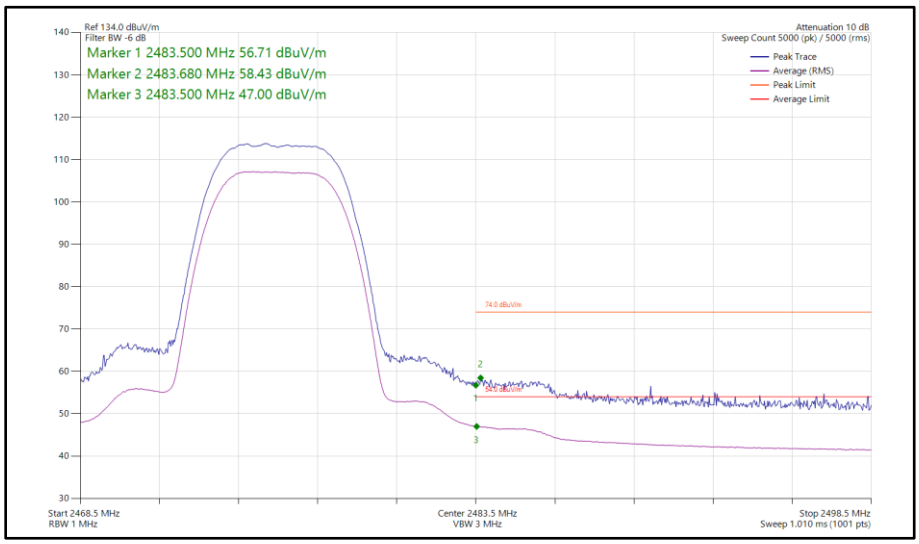

Figure 46 - Bluetooth HDR8, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

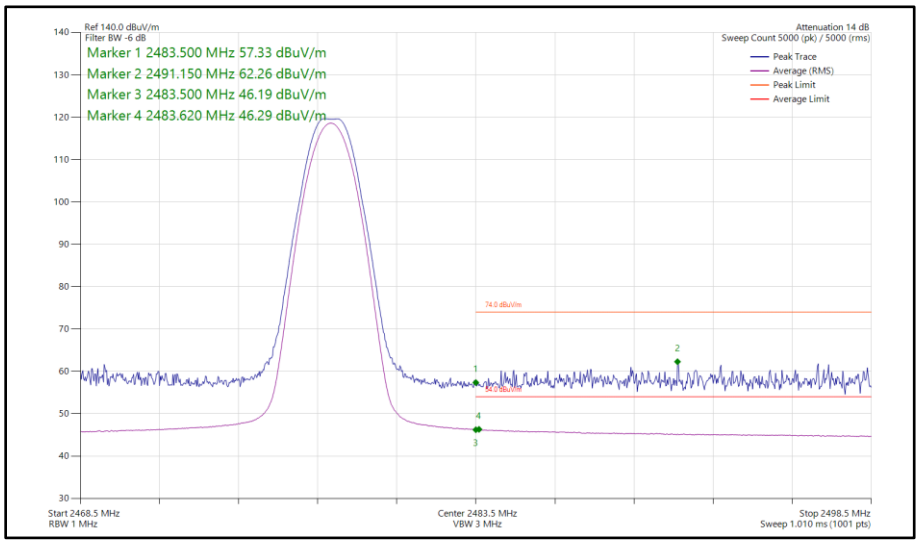

Figure 47 - Bluetooth LE1M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

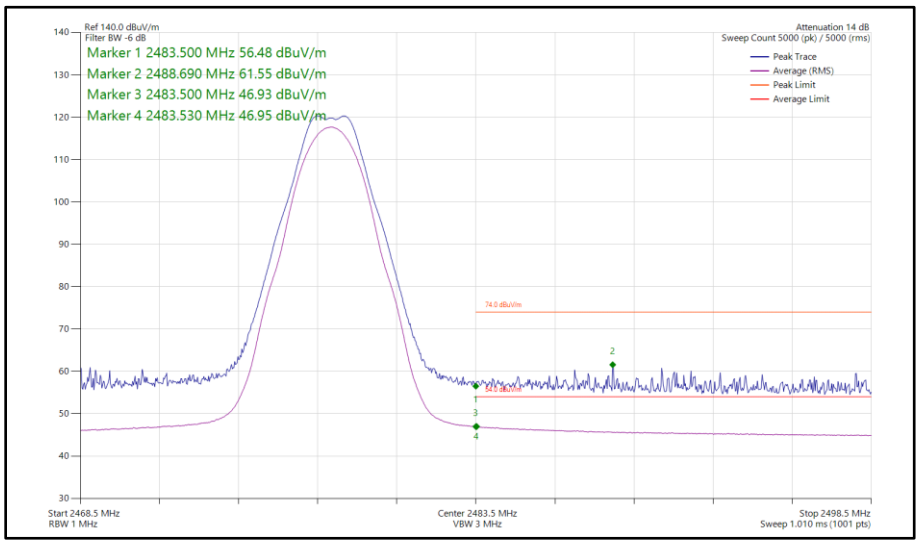

Figure 48 - Bluetooth LE2M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

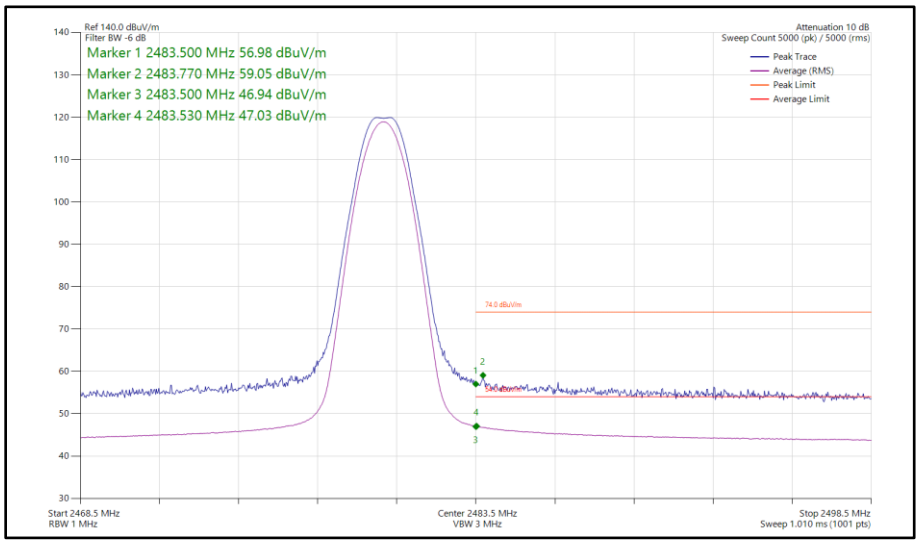

Figure 49 - Bluetooth LE1M, SISO, Core 1 - 2480 MHz
Band Edge Frequency 2483.5 MHz

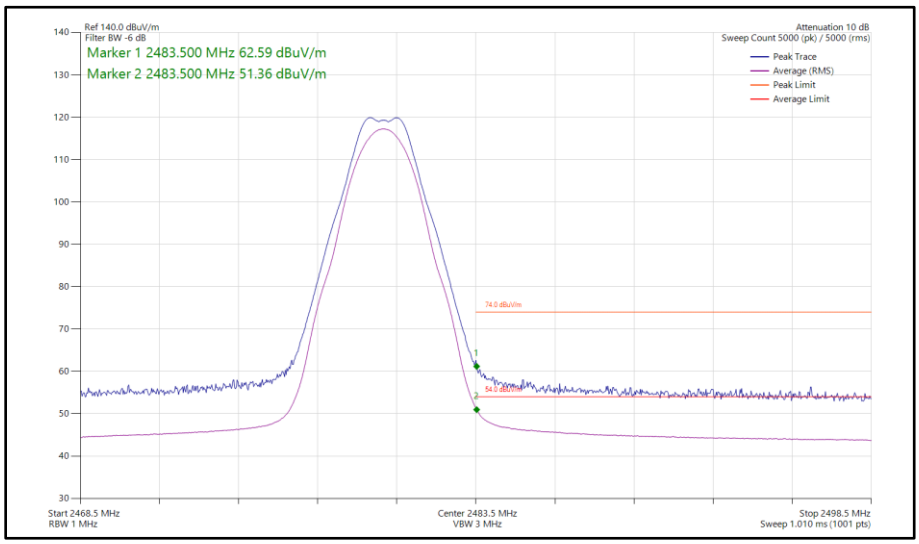

Figure 50 - Bluetooth LE2M, SISO, Core 1 - 2480 MHz
Band Edge Frequency 2483.5 MHz

ePA - Core 0 - Core 1 (MIMO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	HDR4	2404	2390	56.97	44.92
Static	HDR8	2404	2390	58.88	47.67
Static	LE1M	2402	2390	61.12	49.61
Static	LE2M	2402	2390	61.37	49.84
Static	HDR4	2476	2483.5	57.46	46.38
Static	HDR8	2476	2483.5	62.78	51.42
Static	LE1M	2478	2483.5	61.46	49.82
Static	LE2M	2478	2483.5	61.54	50.50
Static	LE1M	2480	2483.5	53.03	41.42
Static	LE2M	2480	2483.5	53.11	41.59

Table 13 - MIMO Restricted Band Edge Results

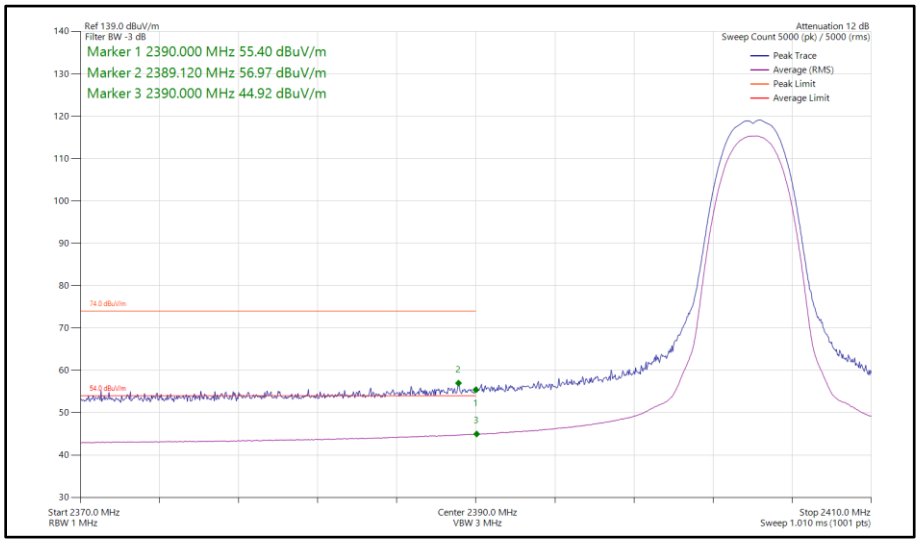

Figure 51 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

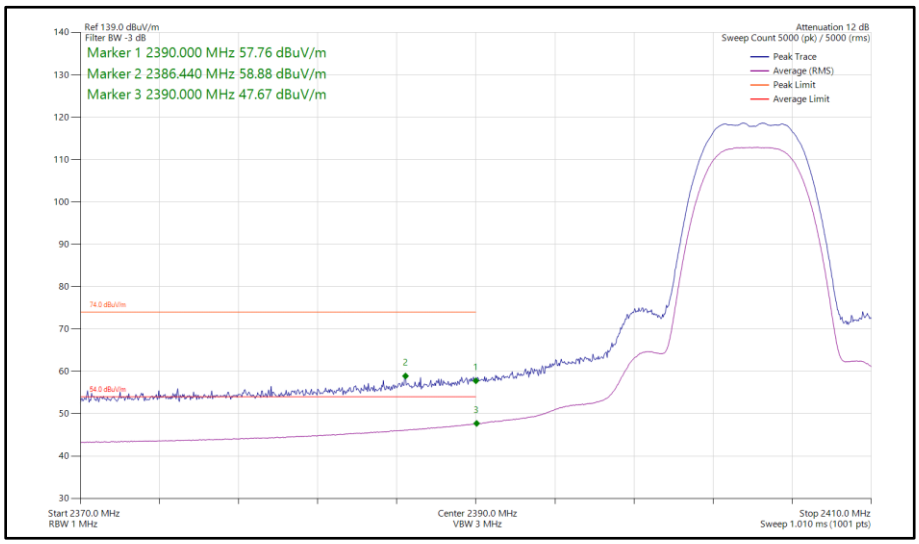

Figure 52 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

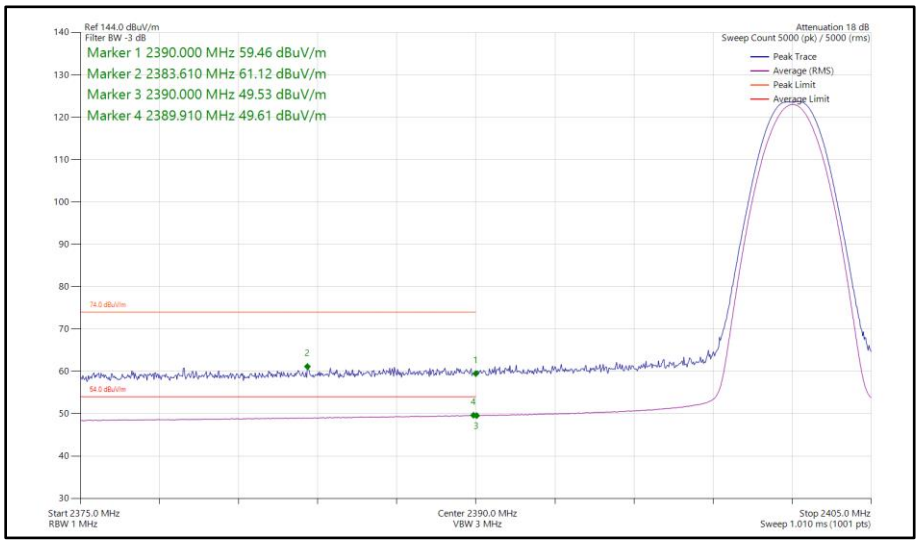

Figure 53 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

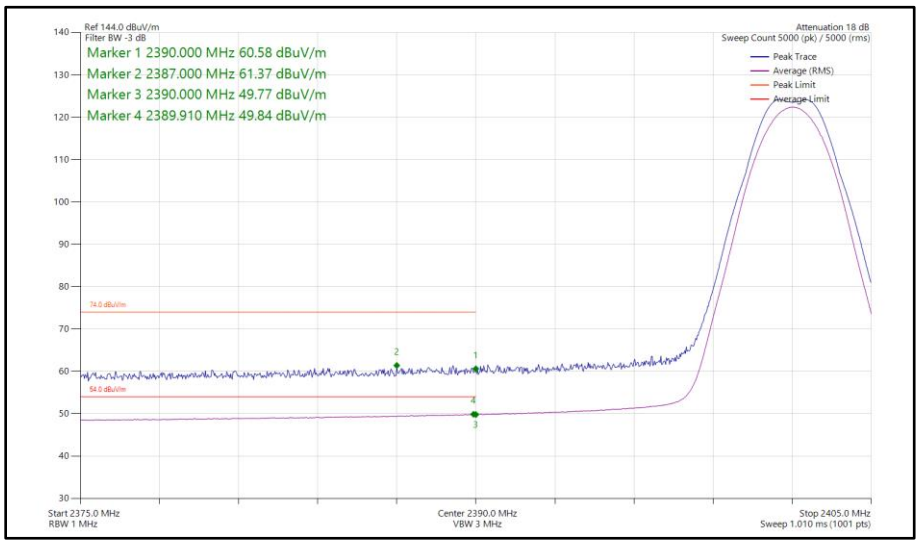

Figure 54 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

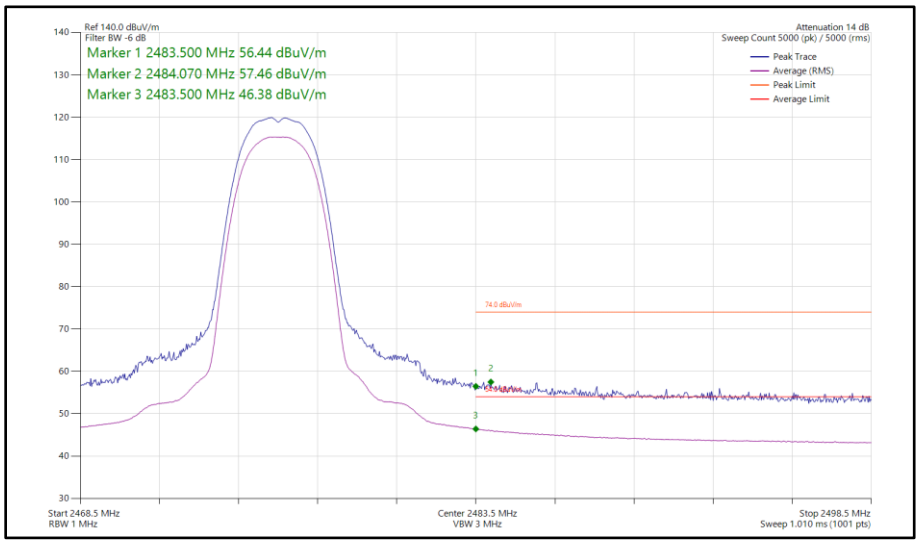

Figure 55 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

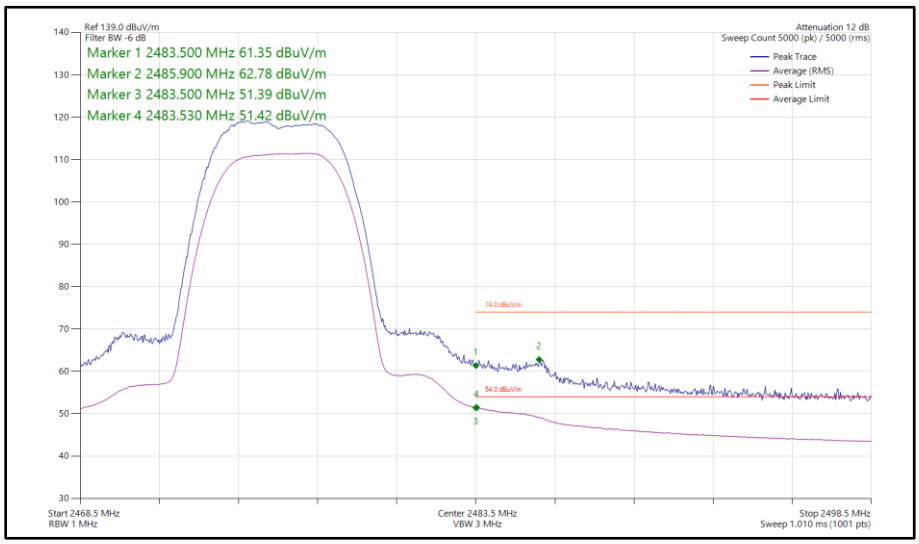

Figure 56 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

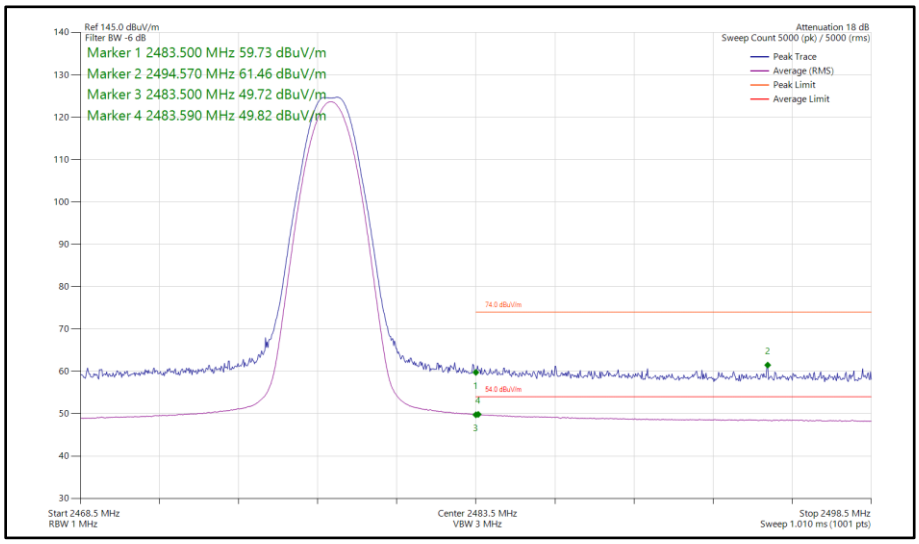

Figure 57 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

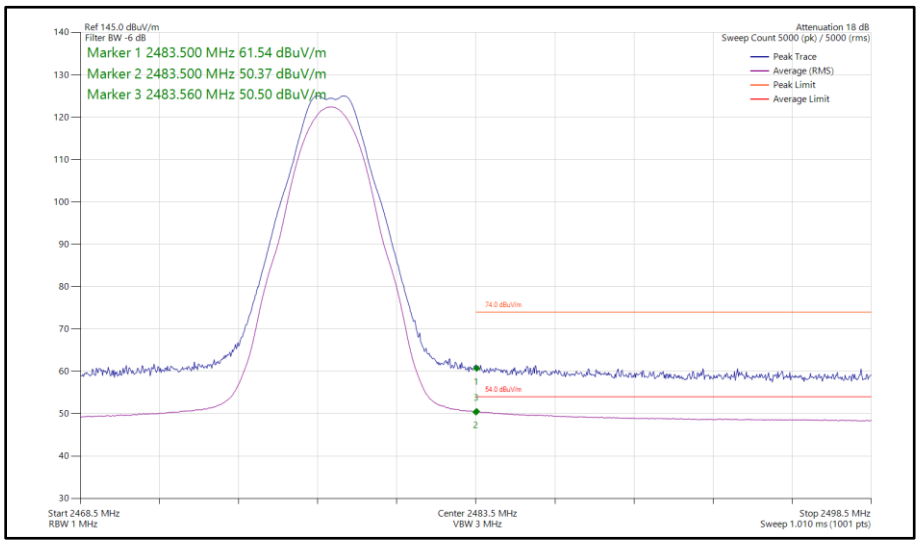

Figure 58 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

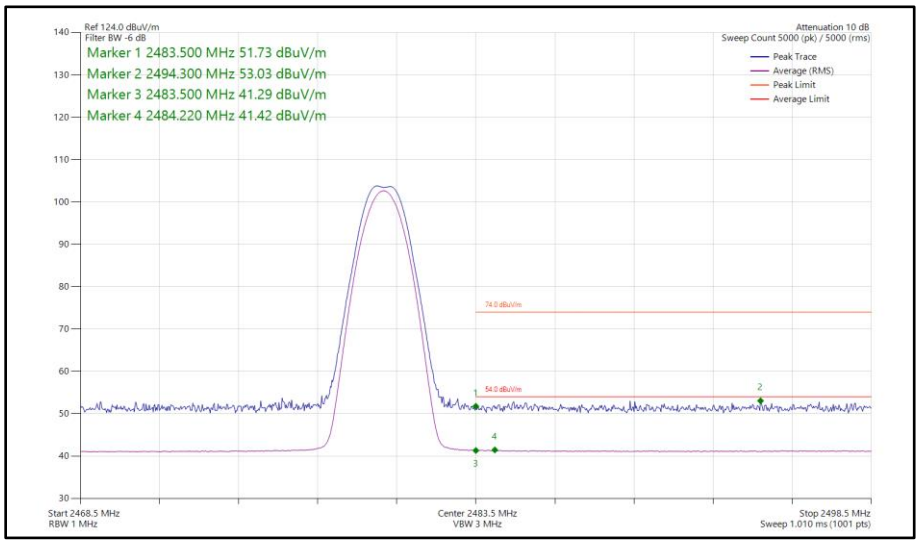

Figure 59 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

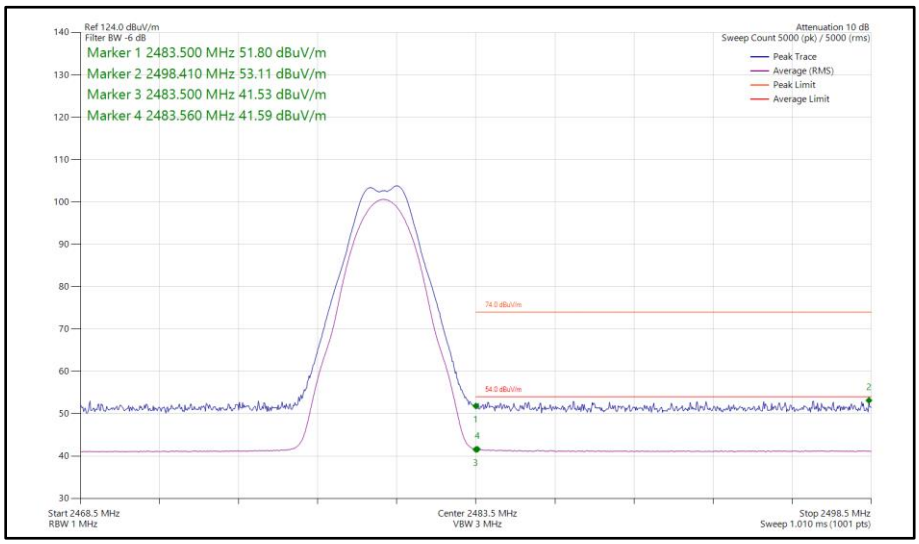

Figure 60 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

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 14

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 15

*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 16 and RF Chamber 17.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Emissions Software	TUV SUD	EmX V3.4.2	5125	-	Software
Test Receiver	Rohde & Schwarz	ESW44	5379	12	12-Dec-2024
Cable 2.92m	Junkosha	MWX241-01000KMS	5413	12	21-May-2024*
Cable 2.92m	Junkosha	MWX241-01000KMS	5413	12	23-May-2025*
EMI Test Receiver	Rohde & Schwarz	ESW44	5912	12	05-Jul-2024*
EMI Test Receiver	Rohde & Schwarz	ESW44	5912	12	07-Aug-2025*
1500W (300V 12A) AC Power Supply	iTech	IT7324	5957	-	O/P Mon
3m Semi-Anechoic Chamber, Chamber16	Albatross Projects	RF Chamber 16	5972	36	24-May-2025
Mast & Turntable Controller	Maturo Gmbh	FCU3.0	5973	-	TU
Tilt Antenna Mast	Maturo Gmbh	BAM4.5-P	5974	-	TU
Turntable	Maturo Gmbh	TT1.5SI	5975	-	TU
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6008	12	05-Jun-2024*
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6008	12	20-May-2025*
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6142	12	26-Aug-2024*
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6142	12	05-May-2025*
SAC Switch Unit	TUV SUD	TUV_SSU_001	6144	12	11-Dec-2024
Digital Multimeter	Fluke	115	6147	12	16-Jun-2024*
Digital Multimeter	Fluke	115	6147	12	06-Jun-2025*
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	6315	12	04-Feb-2025
Cable (SMA to SMA 8m)	Junkosha	MWX221-08000AMSAMS/B	6319	12	04-Feb-2025
SAC Switch Unit	TUV SUD	TUV_SSU_004 PLC	6349	12	01-May-2024*
SAC Switch Unit	TUV SUD	TUV_SSU_004 PLC	6349	12	07-May-2025*
USB Spectrum Analyser	Signal Hound	SA124B	6383	-	TU
Horn Antenna (1–10.5 GHz)	Schwarzbeck	BBHA 9120 B	6457	12	09-Jul-2024*
Horn Antenna (1–10.5 GHz)	Schwarzbeck	BBHA 9120 B	6457	12	05-May-2025*
AC Power Supply	iTech	IT7324	6657	-	O/P Mon
3m Semi-Anechoic Chamber	Albatross Projects	RF Chamber 17	6658	36	28-Jan-2026
Mast and Turntable Controller	Maturo Gmbh	FCU3.0	6659	-	TU
Tilt Antenna Mast	Maturo Gmbh	BAM4.5-P	6660	-	TU
Turntable	Maturo Gmbh	TT1.5SI	6661	-	TU

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
8m Cable	Junkosha	MWX221-08000AMSAMS/B	6748	12	01-Feb-2025
8M SMA Cable	Junkosha	MWX221-08000AMSAMS/B	6833	12	14-Aug-2025*
Handheld Hygrometer	Fluke	971	6838	12	27-Aug-2025*
Cable Assembly	SpecTech	PE300-60	6857	-	TU
Cable Assembly	SpecTech	PE300-60	6858	-	TU

Table 16

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

*NOTE: Only used within calibration period.

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

A3241, S/N: G0Q65Y9HP6 - Modification State 0
A3241, S/N: FWKQMY7GHY - Modification State 0

2.2.3 Date of Test

05-November-2024 to 07-November-2024

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	21.1 - 21.9 °C
Relative Humidity	49.6 - 53.2 %

2.2.6 Test Results

2.4 GHz Bluetooth LE/HDR/HDR

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:	ePA π/4 DQPSK (4-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (Core 0)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	1.912	-	-	-	≥500.0
2441	1.920	-	-	-	≥500.0
2476	1.912	-	-	-	≥500.0

Table 17 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	2.344	-	-	-	-
2441	2.344	-	-	-	-
2476	2.352	-	-	-	-

Table 18 - 99% Bandwidth Results

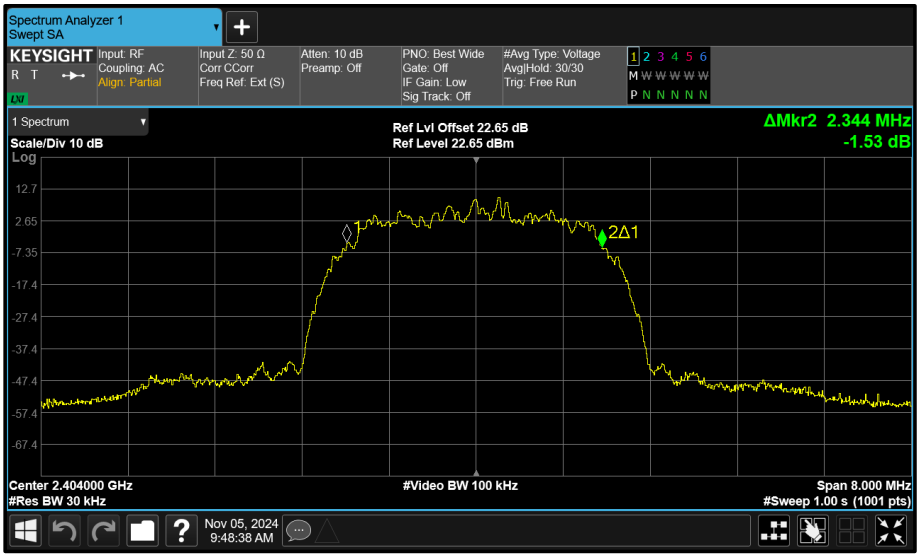

Figure 61 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

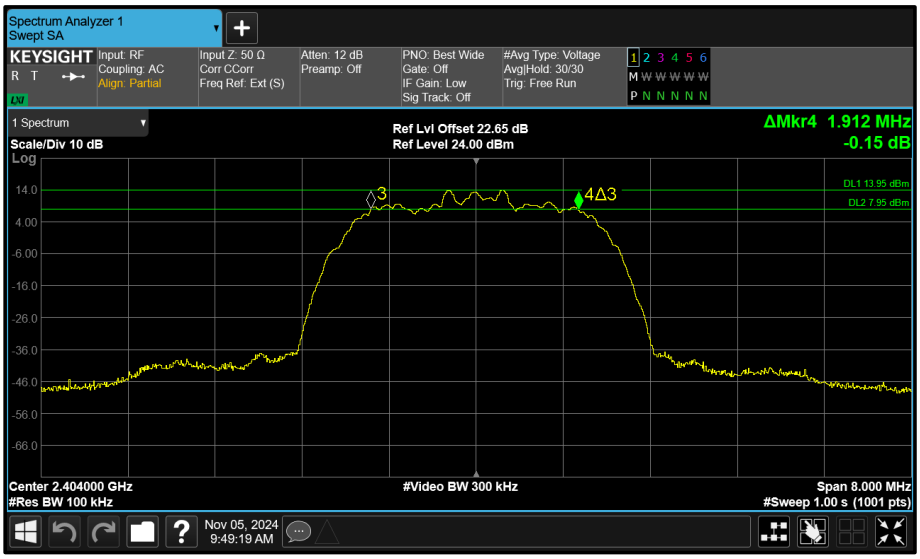

Figure 62 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

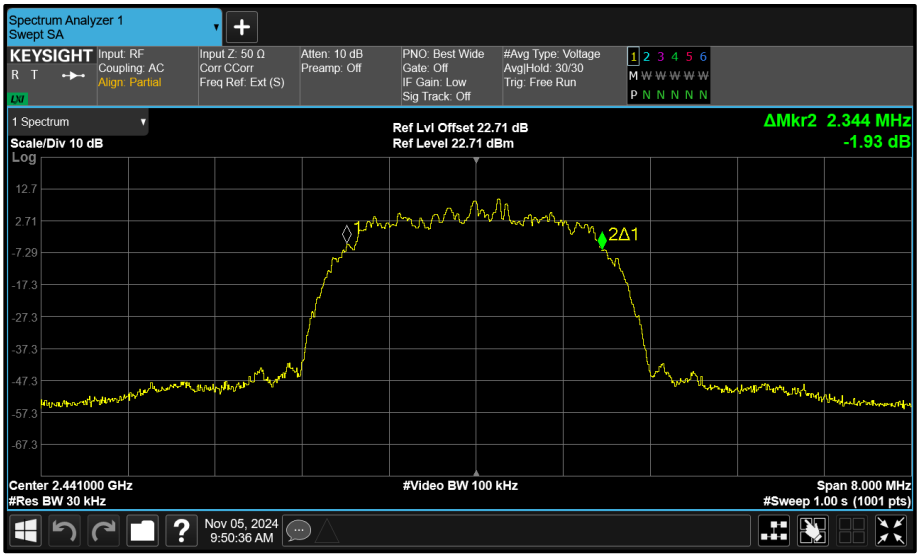

Figure 63 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

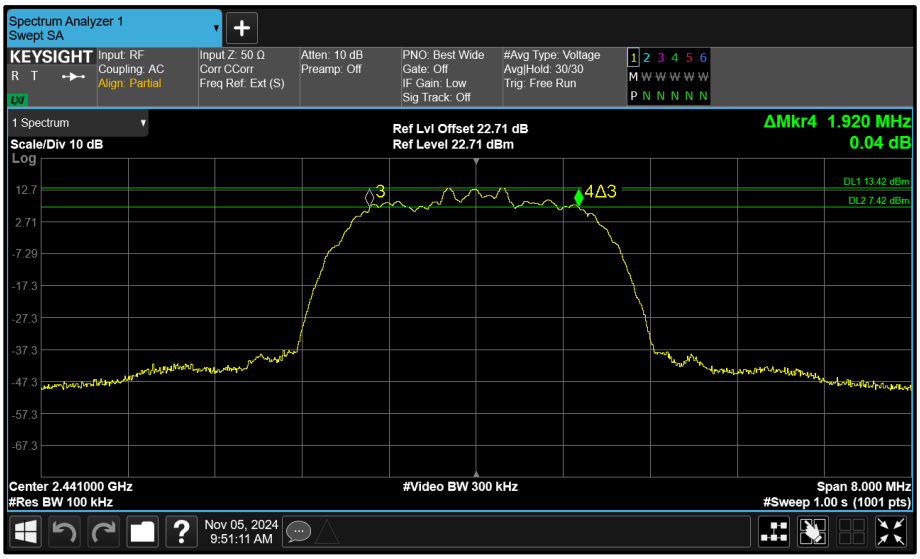

Figure 64 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth

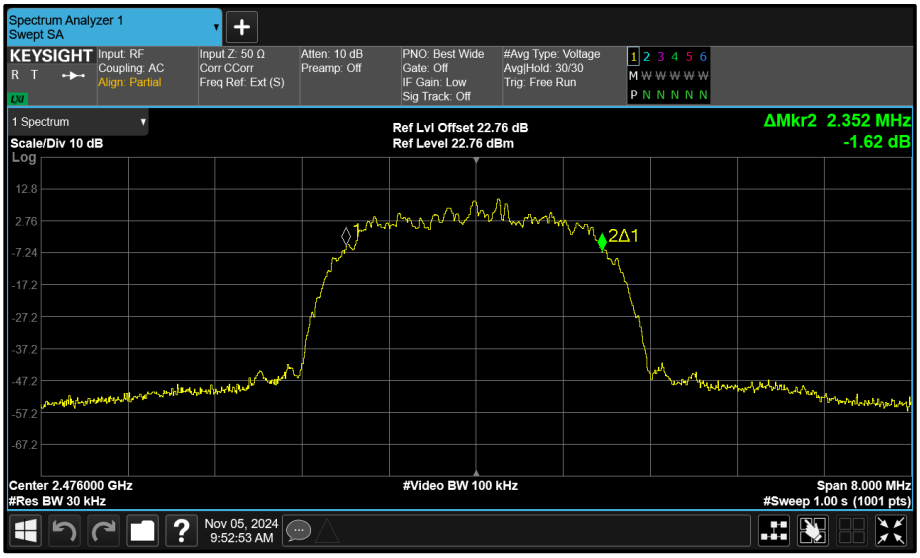

Figure 65 - Core 0 (A) 2476 MHz (CH74) 99% Bandwidth

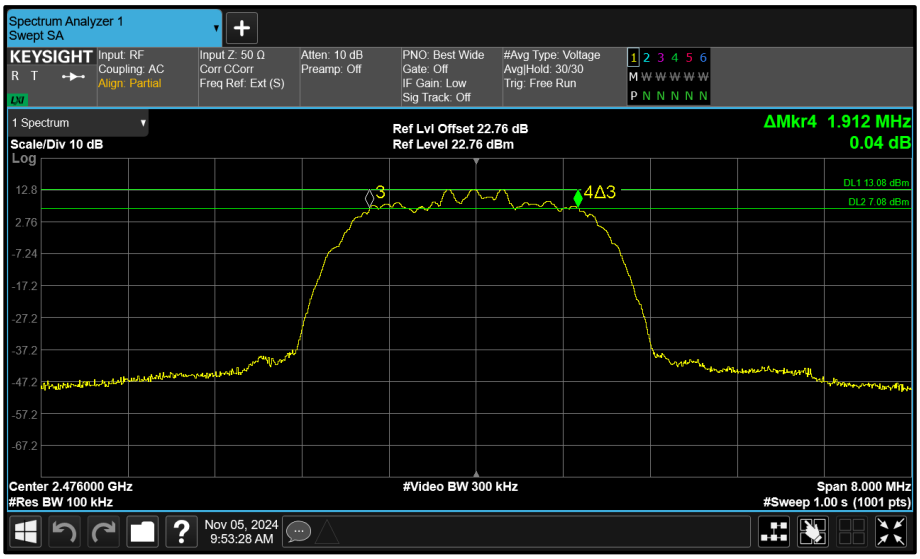

Figure 66 - Core 0 (A) 2476 MHz (CH74) 6 dB Bandwidth

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:	ePA π/4 DQPSK (8-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	A (Core 0)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	1.020	-	-	-	≥500.0
2441	1.020	-	-	-	≥500.0
2476	1.020	-	-	-	≥500.0

Table 19 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	4.710	-	-	-	-
2441	4.710	-	-	-	-
2476	4.710	-	-	-	-

Table 20 - 99% Bandwidth Results

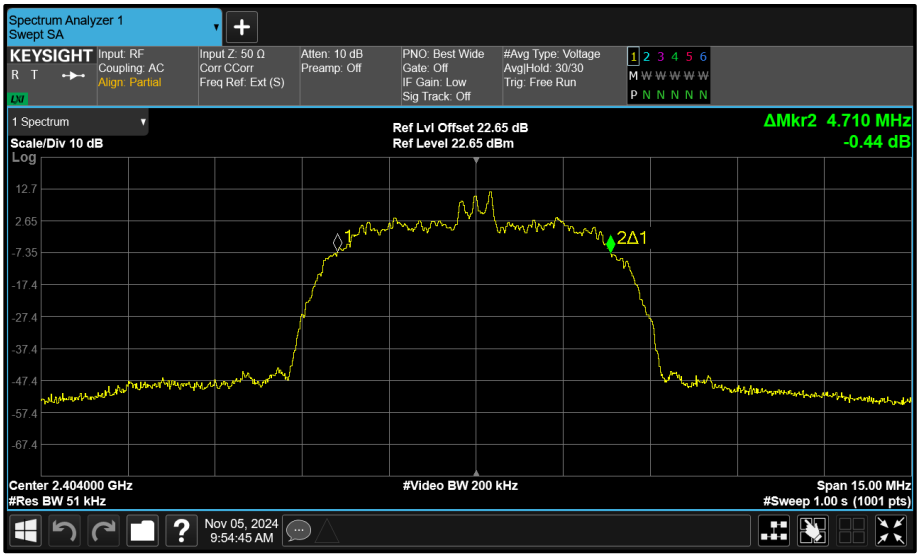

Figure 67 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

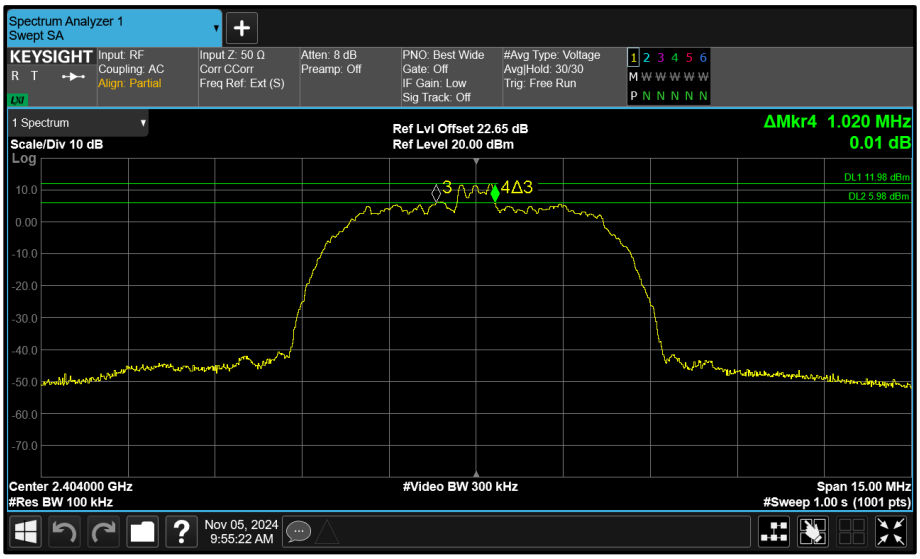

Figure 68 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

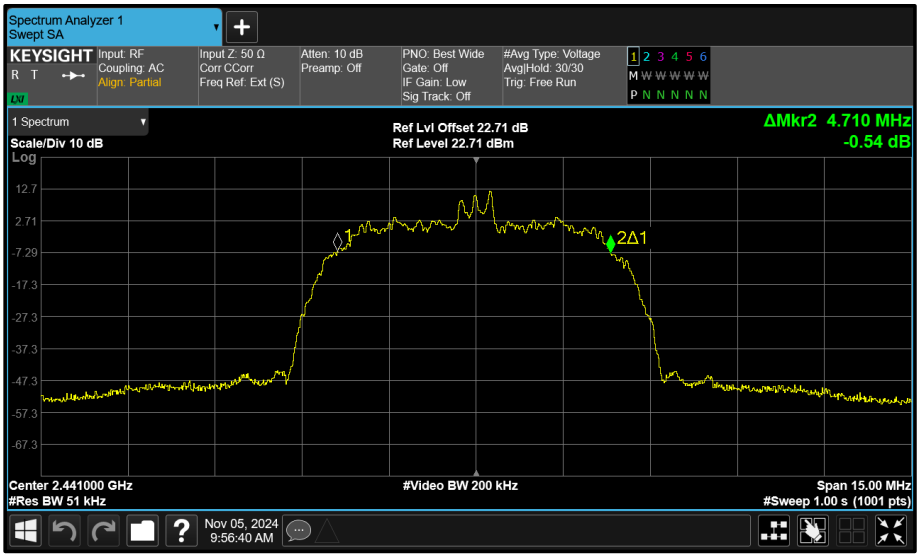

Figure 69 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

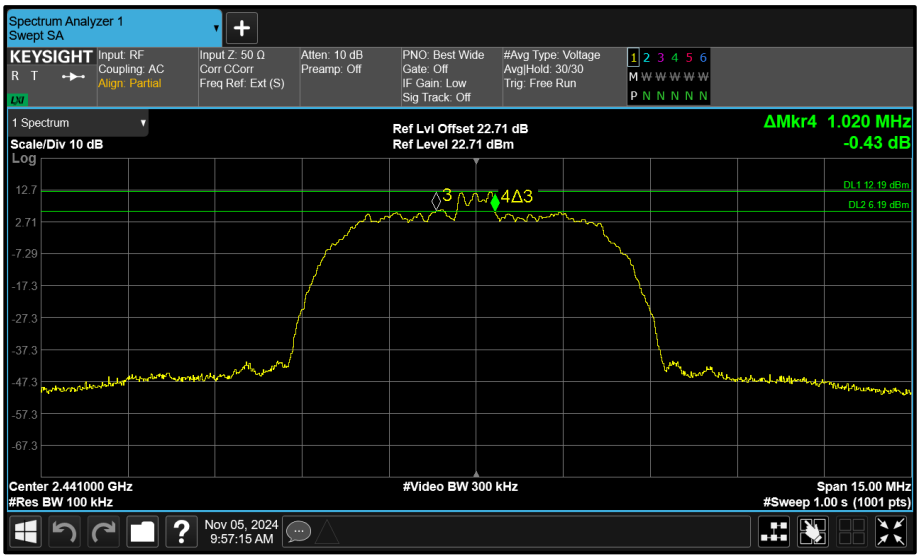

Figure 70 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth