FCC and ISED Test Report

Apple Inc
Model: A3238

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

TUV SUD Digitally signed by TUV SUD Date: 2024.08.29 12:48:27 +01'00'

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FCC ID: BCGA3238 IC: 579C-A3238

COMMERCIAL-IN-CONFIDENCE

Document 75961400-38 Issue 01

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

FCC Accreditation
553713/UK2026 Concorde Park, Fareham Test Laboratory

ISED Accreditation
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.

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Contents

1 Report Summary

1.1 Report Modification Record

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

Issue	Description of Change	Date of Issue
1	First Issue	29-August-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	07-June-2024
Finish of Test	09-August-2024
Name of Engineer(s)	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Manohar Thota, Vineeth Nagaraj, David Hill, Mahmud Bari Chowdhury, Akhil Rajendran Bhaskaran Nair, Ahmed Al Derdiri, Dale Hills and Tony Baby
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						
-	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 desktop computer.

1.4.2 Test Modes

The EUT's 2.4 GHz Bluetooth radio supports SISO (Single Input/Single Output) operation on three different cores (Core 0, 1, and 2). It also supports MIMO (Multiple Input/Multiple Output) beamforming operation on Cores 0+1. The EUT supports HDR4 (4-DH5), HDR8 (8-DH5), LE1M and LE2M.

Core 0 and Core 1 also operate at two power settings: low power "iPA" and high power "ePA", with core 2 only supporting the lower power mode. The EUT uses different output powers per core dependent on how many cores are used.

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

SISO modes:

- HDR4 (4-DH5) - iPA - Core 0
- HDR8 (8-DH5) - iPA - Core 0
- LE1M - iPA - Core 0
- LE2M - iPA - Core 0
- HDR4 (4-DH5) - iPA - Core 2
- HDR8 (8-DH5) - iPA - Core 2
- LE1M - iPA - Core 2
- LE2M - iPA - Core 2
- HDR4 (4-DH5) - ePA - Core 0
- HDR8 (8-DH5) - ePA - Core 0
- LE1M - ePA - Core 0
- LE2M - ePA - Core 0

MIMO modes:

- HDR4 (4-DH5) - iPA - Core 0 + Core 1
- HDR8 (8-DH5) - iPA - Core 0 + Core1
- LE1M - iPA - Core 0 + Core 1
- LE2M - iPA - Core 0 + Core 1
- HDR4 (4-DH5) - ePA - Core 0 + Core 1
- HDR8 (8-DH5) - 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	1.8	0.96
Core 1	2400 to 2480	1.1	0.96
Dedicated Core 2	2400 to 2480	0.2	0.96

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: A3238			
Serial Number	Hardware Version	Software Version	Firmware
NQMK2V7Q9C	REV1.0	24A42070q	22.1.80.569
V4KFHR9J44	REV1.0	24A42070q	22.1.80.569
N4N7KFP797	REV1.0	24A42070q	22.1.80.569
G76H79FX4L	REV1.0	24A42070q	22.1.80.569

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: A3238, Serial Number: NQMK2V7Q9C			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3238, Serial Number: V4KFHR9J44			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3238, Serial Number: N4N7KFP797			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A3238, Serial Number: G76H79FX4L			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 5

1.8 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 Bluetooth LE/HDR		
Restricted Band Edges	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Manohar Thota and Vineeth Nagaraj	UKAS
Emission Bandwidth	David Hill	UKAS
Maximum Conducted Output Power	Mahmud Bari Chowdhury	UKAS
Authorised Band Edges	Colin Brain, Elliot Callender, Ioan-Alexandru Bogatu, Manohar Thota and Vineeth Nagaraj	UKAS
Spurious Radiated Emissions	Akhil Rajendran Bhaskaran Nair, Ahmed Al Derdiri, Colin Brain, Dale Hills, Tony Baby and Vineeth Nagaraj	UKAS
Power Spectral Density	Mahmud Bari Chowdhury	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

A3238, S/N: NQMK2V7Q9C - Modification State 0
A3238, S/N: N4N7KFP797 - Modification State 0

2.1.3 Date of Test

07-June-2024 to 12-June-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	22.1 - 23.7 °C
Relative Humidity	23.7 - 46.6 %

2.1.6 Test Results

2.4 GHz Bluetooth LE/HDR

iPA - Core 0 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.10	44.17
Static	HDR8	2404	2390	56.15	44.24
Static	LE1M	2402	2390	56.48	44.23
Static	LE2M	2402	2390	56.44	44.22
Static	HDR4	2476	2483.5	54.96	43.20
Static	HDR8	2476	2483.5	55.22	43.30
Static	LE1M	2478	2483.5	55.07	43.22
Static	LE1M	2480	2483.5	55.55	43.34
Static	LE2M	2478	2483.5	55.28	43.23
Static	LE2M	2480	2483.5	55.50	45.09

Table 7 - SISO Restricted Band Edge Results

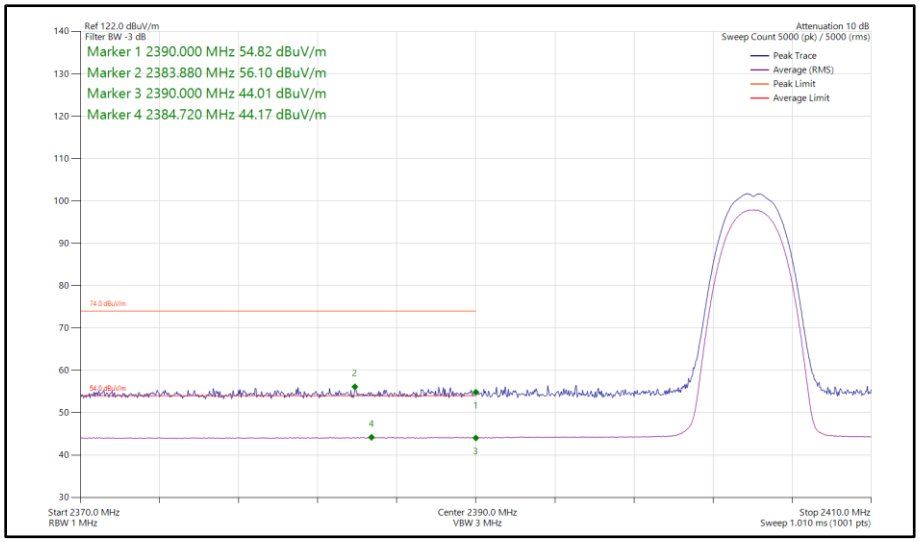

Figure 1 - Bluetooth HDR4, SISO, Core 0 - 2404 MHz Band Edge Frequency 2390 MHz

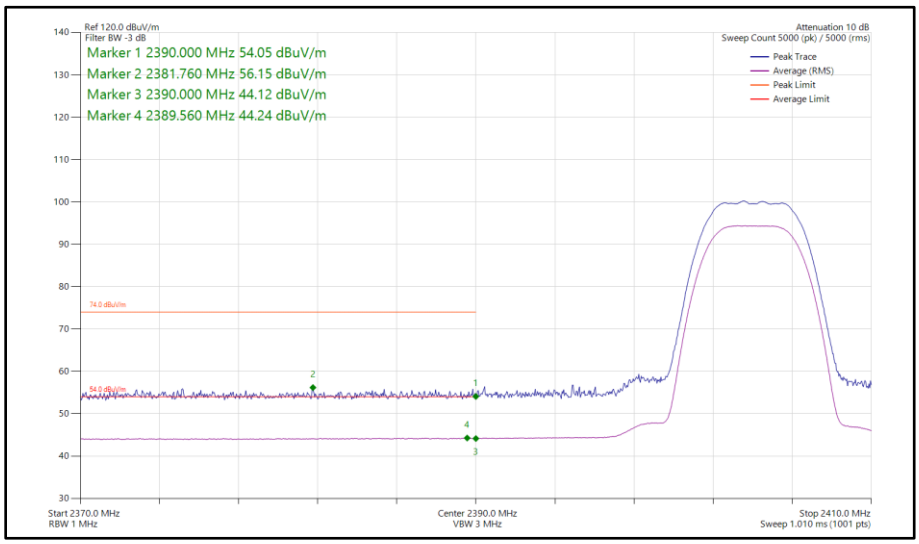

Figure 2 - Bluetooth HDR8, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

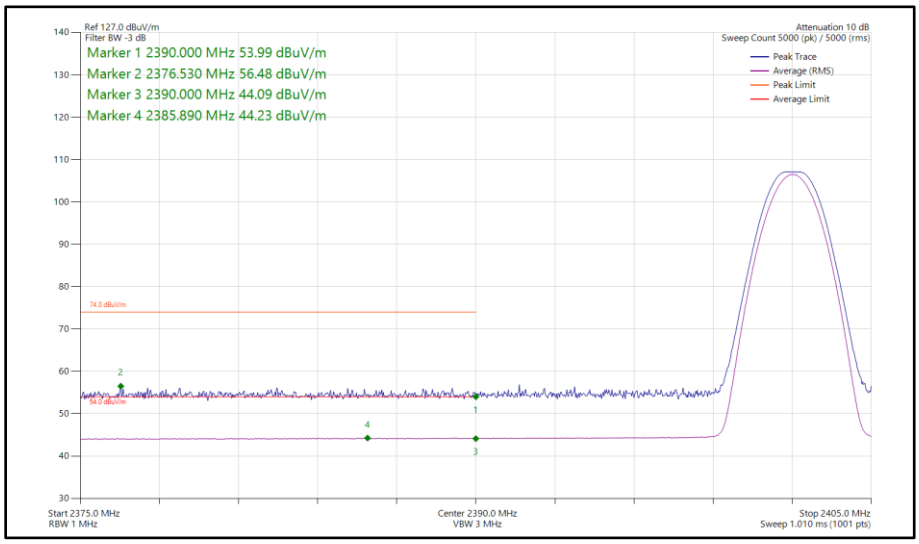

Figure 3 - Bluetooth LE1M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

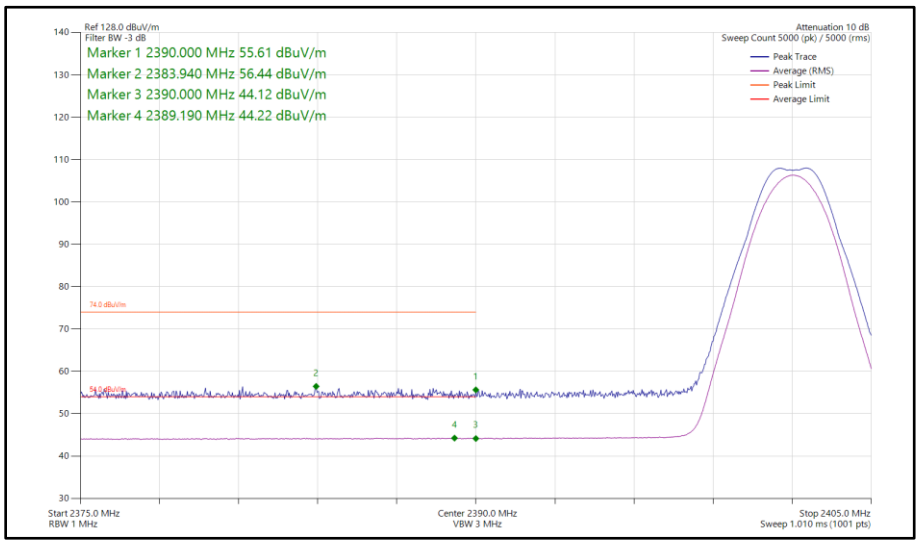

Figure 4 - Bluetooth LE2M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

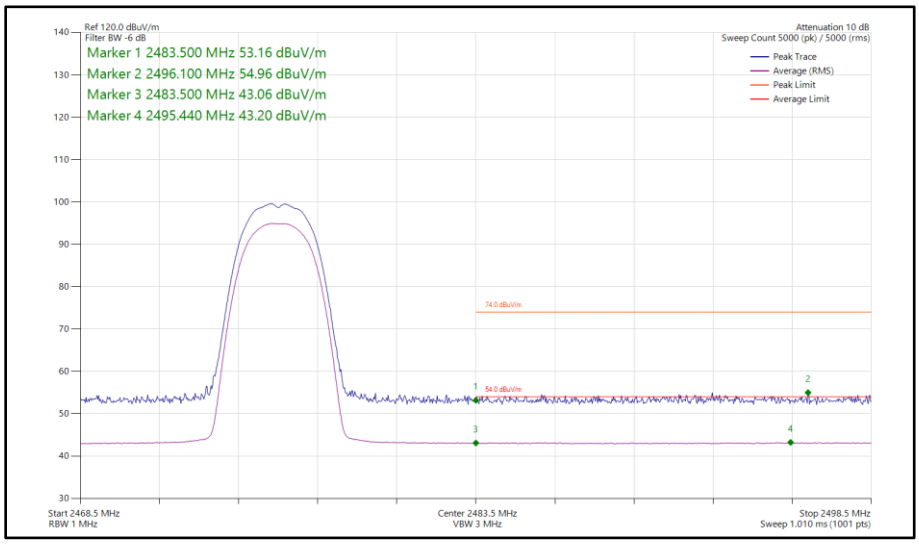

Figure 5 - Bluetooth HDR4, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

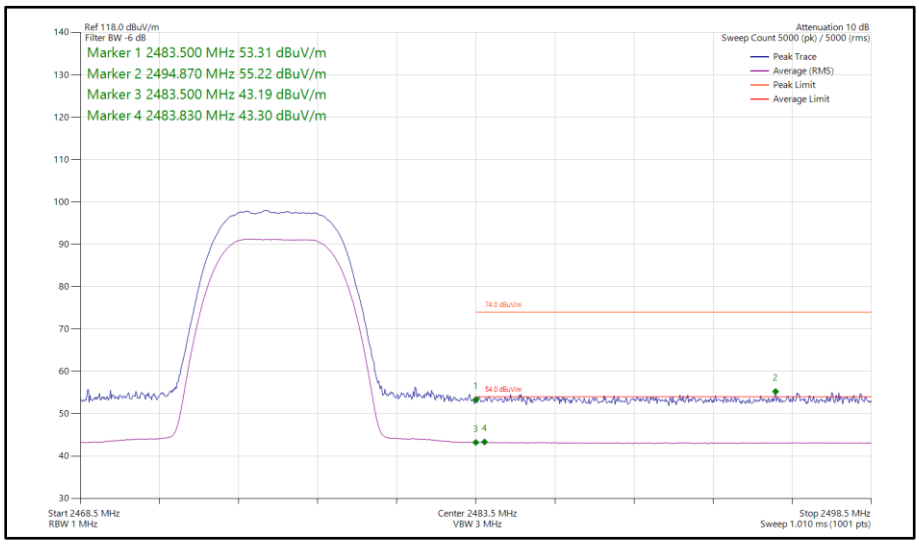

Figure 6 - Bluetooth HDR8, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

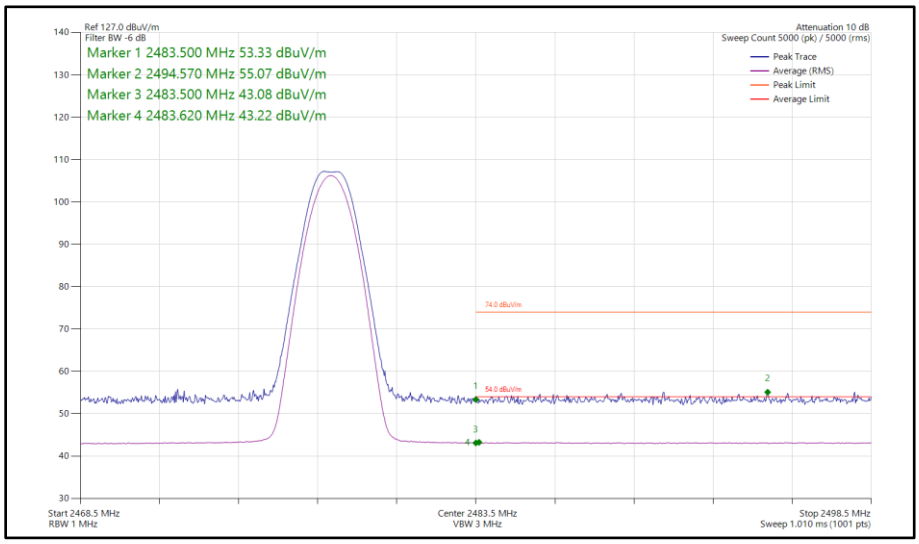

Figure 7 - Bluetooth LE1M, SISO, Core 0 - 2478 MHz
Band Edge Frequency 2483.5 MHz

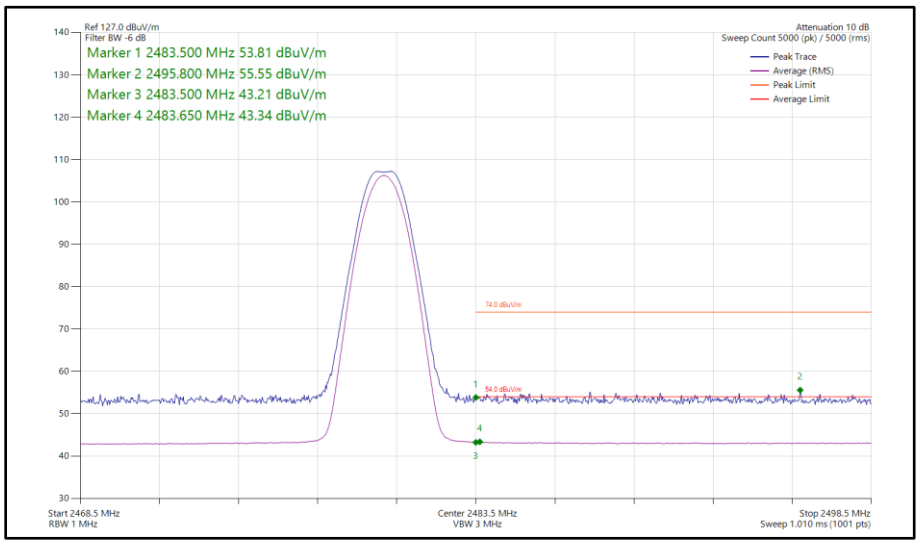

Figure 8 - Bluetooth LE1M, SISO, Core 0 - 2480 MHz Band Edge Frequency 2483.5 MHz

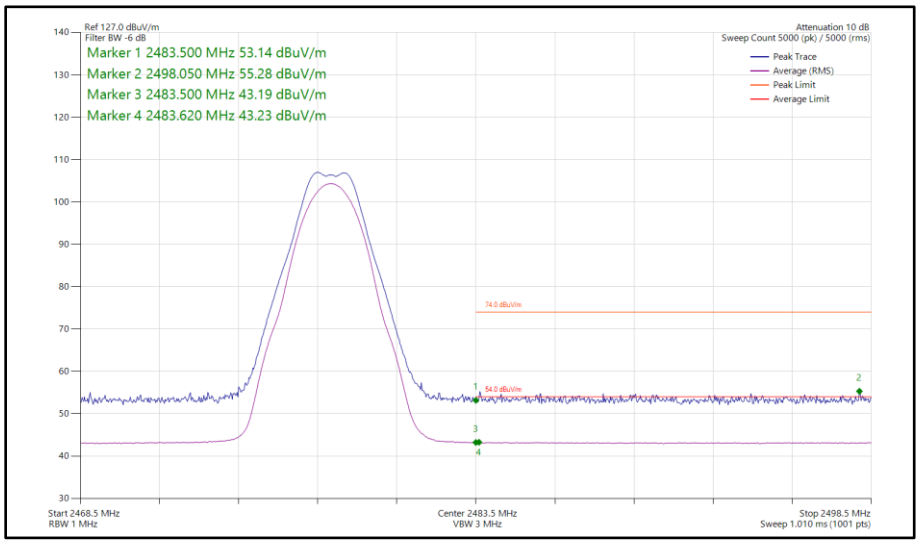

Figure 9 - Bluetooth LE2M, SISO, Core 0 - 2478 MHz Band Edge Frequency 2483.5 MHz

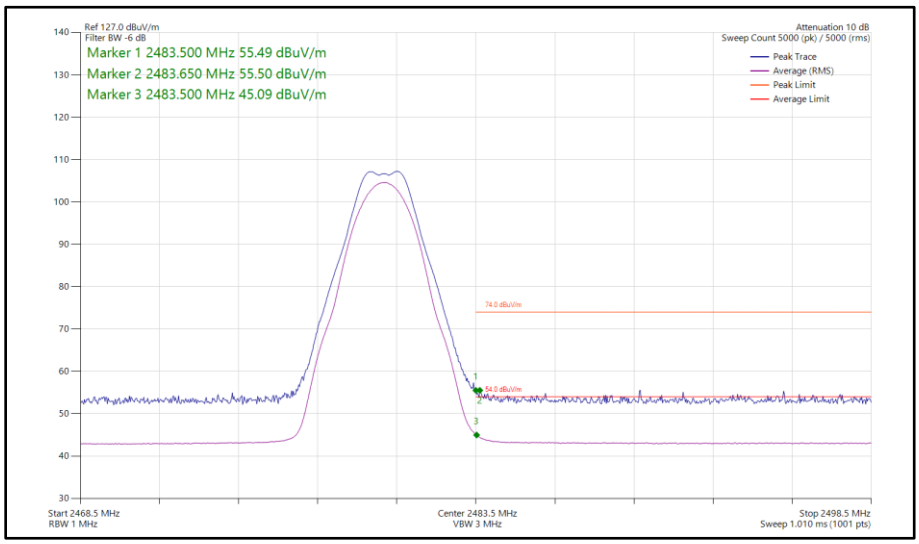

Figure 10 - Bluetooth LE2M, SISO, Core 0 - 2480 MHz Band Edge Frequency 2483.5 MHz

iPA - Core 1 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.60	44.17
Static	HDR8	2404	2390	56.39	44.23
Static	LE1M	2402	2390	56.44	44.23
Static	LE2M	2402	2390	56.54	44.24
Static	HDR4	2476	2483.5	55.41	43.18
Static	HDR8	2476	2483.5	55.04	43.37
Static	LE1M	2478	2483.5	54.91	43.23
Static	LE1M	2480	2483.5	55.11	43.40
Static	LE2M	2478	2483.5	55.31	43.26
Static	LE2M	2480	2483.5	59.94	50.02

Table 8 - SISO Restricted Band Edge Results

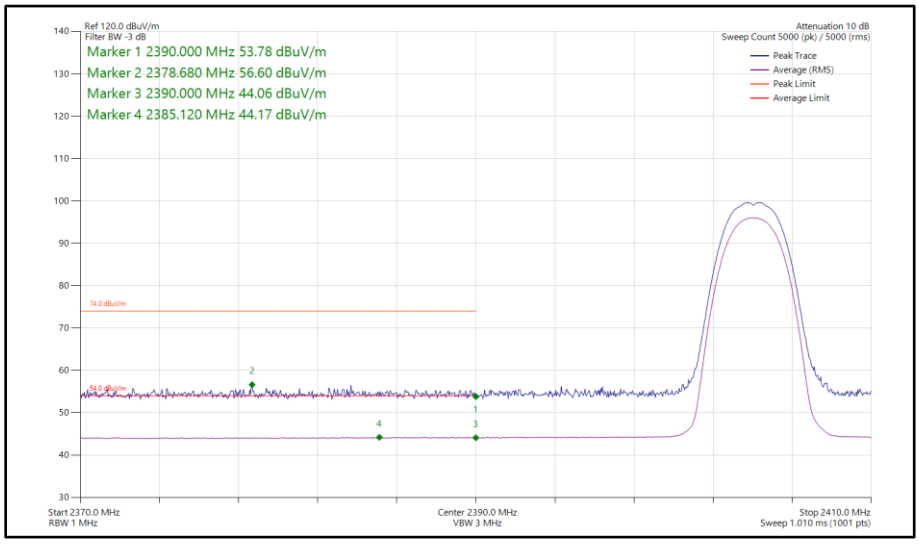

Figure 11 - Bluetooth HDR4, SISO, Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

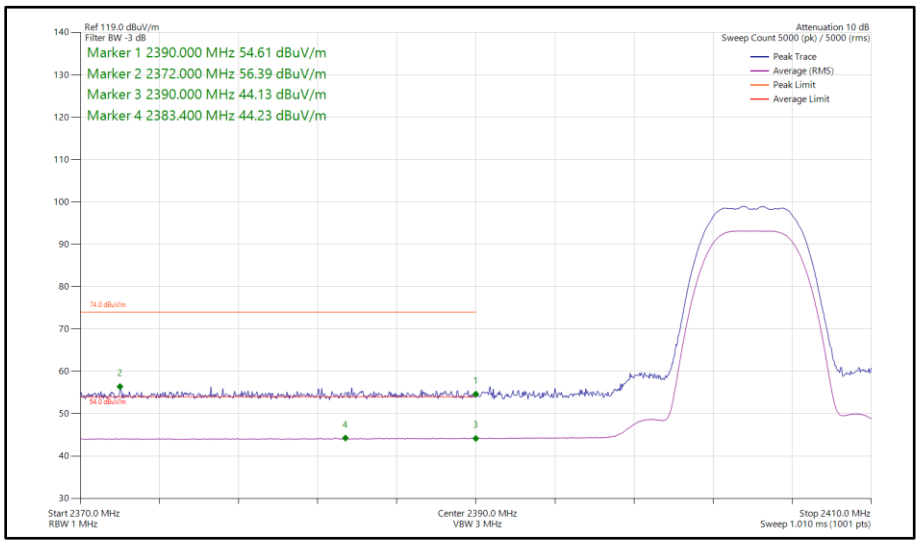

Figure 12 - Bluetooth HDR8, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

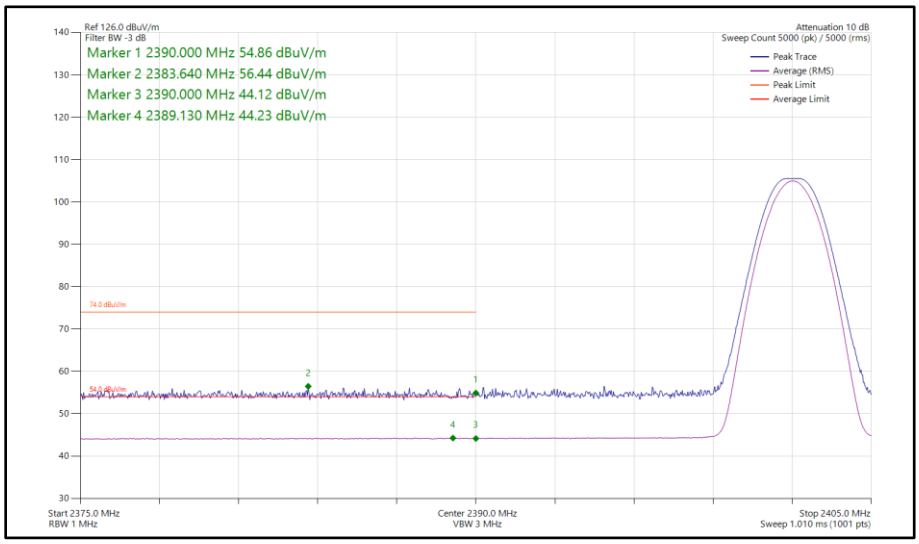

Figure 13 - Bluetooth LE1M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

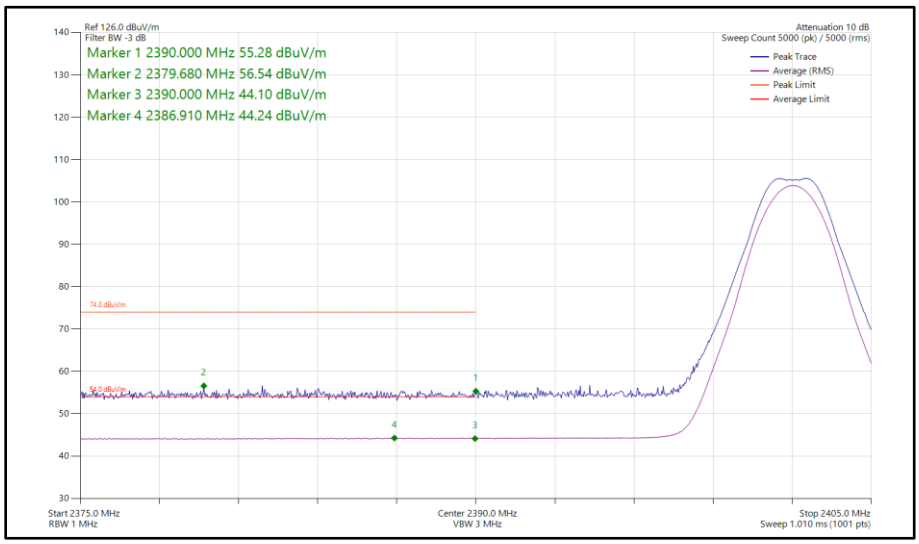

Figure 14 - Bluetooth LE2M, SISO, Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

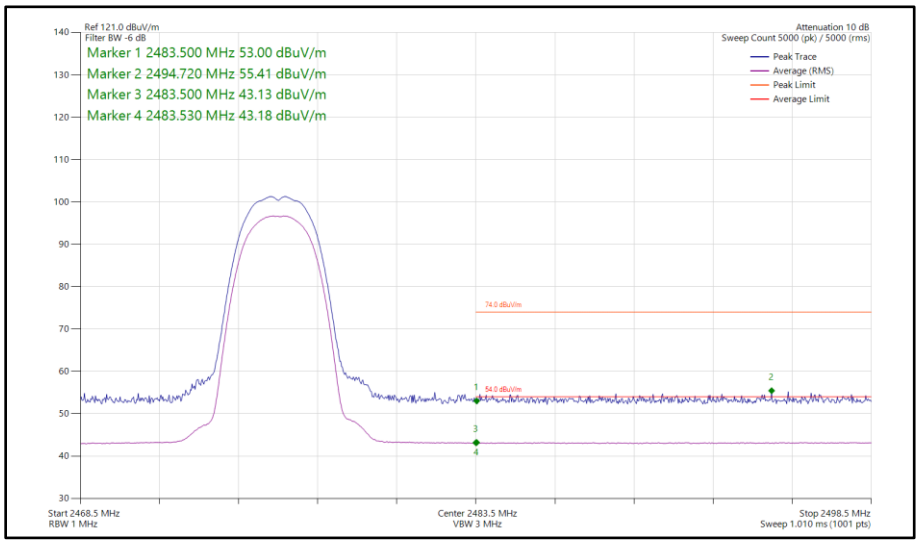

Figure 15 - Bluetooth HDR4, SISO, Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

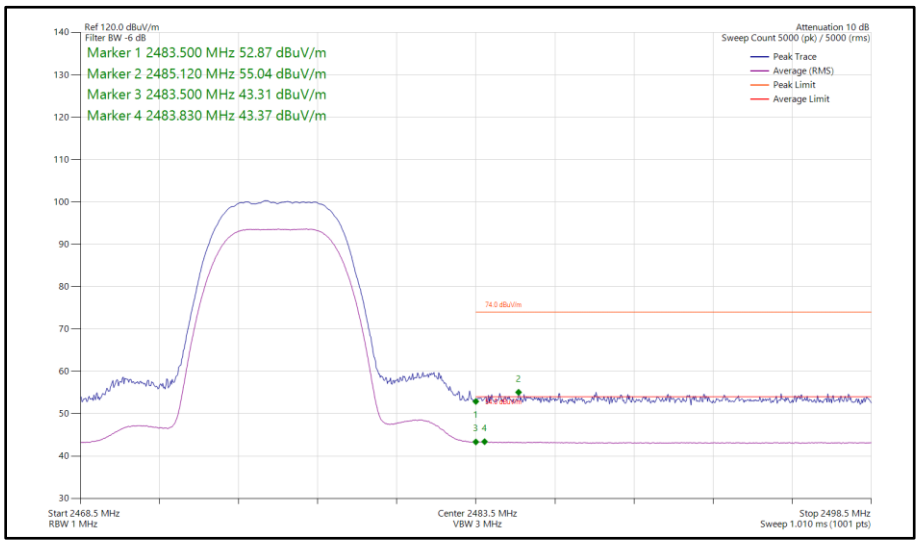

Figure 16 - Bluetooth HDR8, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

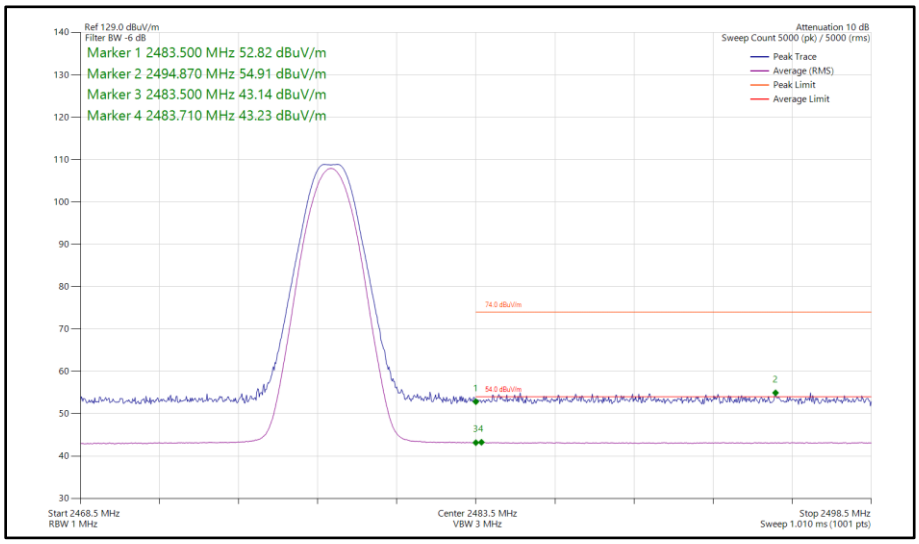

Figure 17 - Bluetooth LE1M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

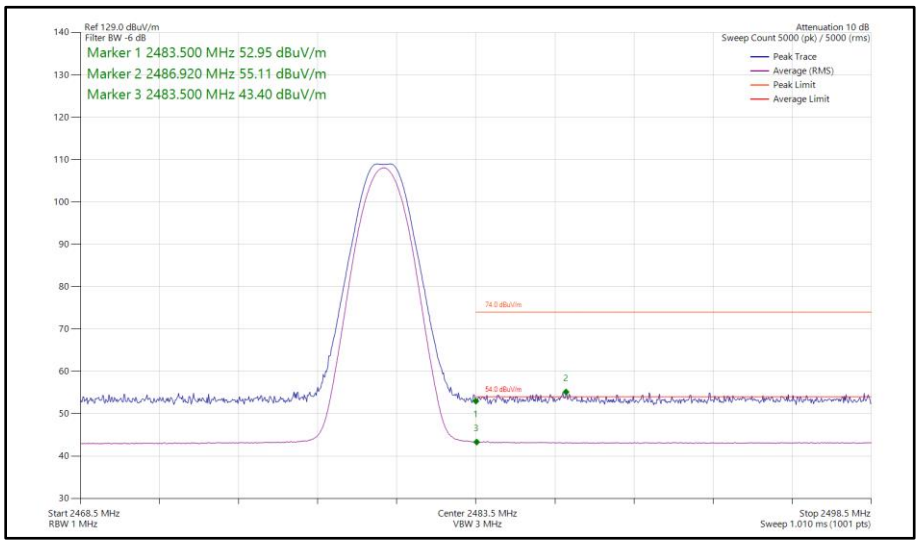

Figure 18 - Bluetooth LE1M, SISO, Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

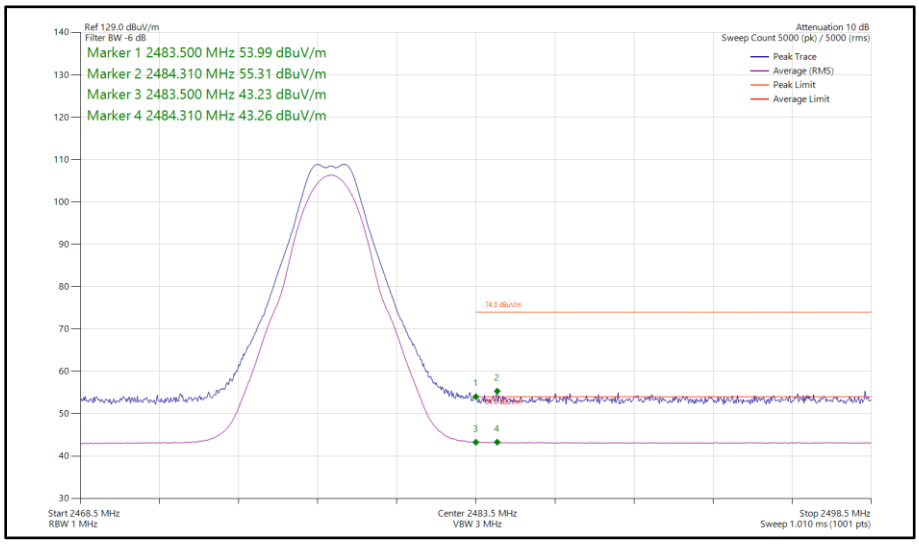

Figure 19 - Bluetooth LE2M, SISO, Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

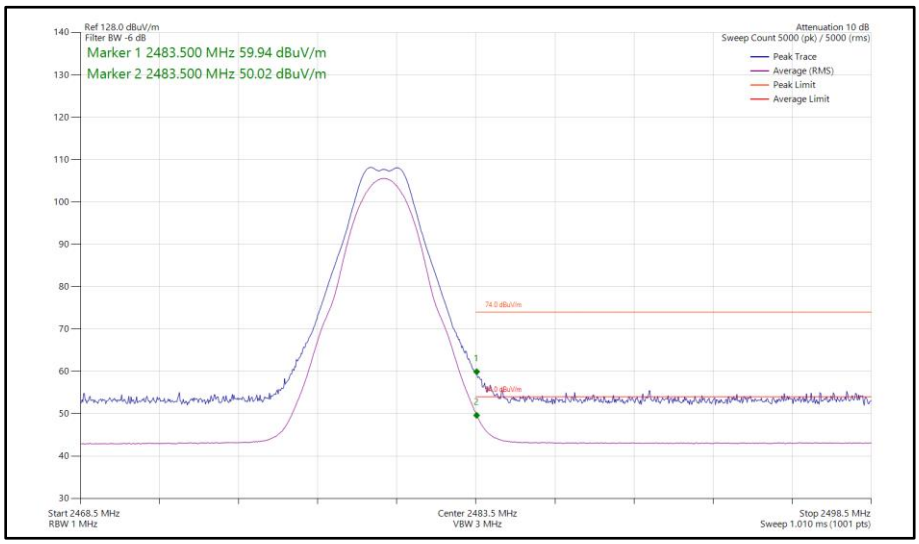

Figure 20 - Bluetooth LE2M, SISO, Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

iPA - Core 2 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.72	44.14
Static	HDR8	2404	2390	56.59	44.20
Static	LE1M	2402	2390	56.49	44.22
Static	LE2M	2402	2390	56.41	44.20
Static	HDR4	2476	2483.5	55.19	43.22
Static	HDR8	2476	2483.5	55.24	43.25
Static	LE1M	2478	2483.5	55.15	43.25
Static	LE1M	2480	2483.5	55.03	43.24
Static	LE2M	2478	2483.5	56.18	43.20
Static	LE2M	2480	2483.5	58.50	47.60

Table 9 - SISO Restricted Band Edge Results

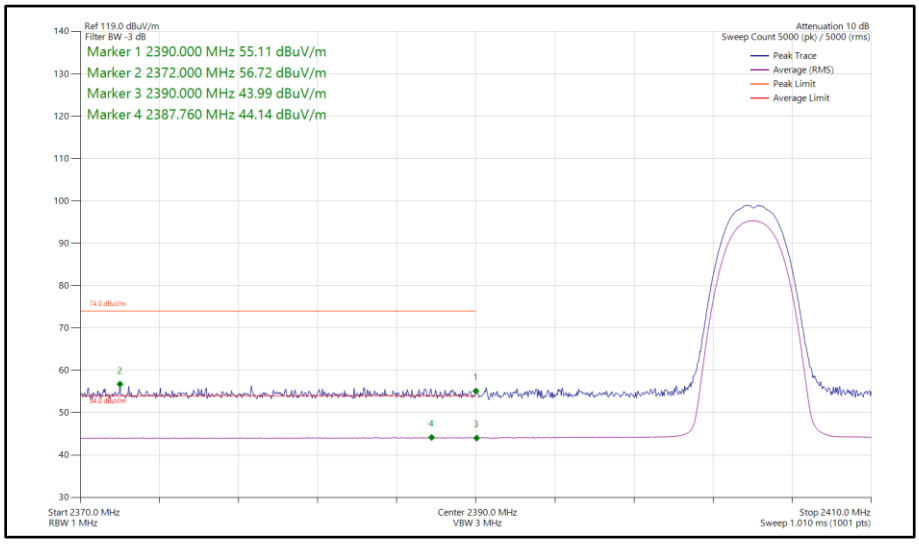

Figure 21 - Bluetooth HDR4, SISO, Core 2 - 2404 MHz Band Edge Frequency 2390 MHz

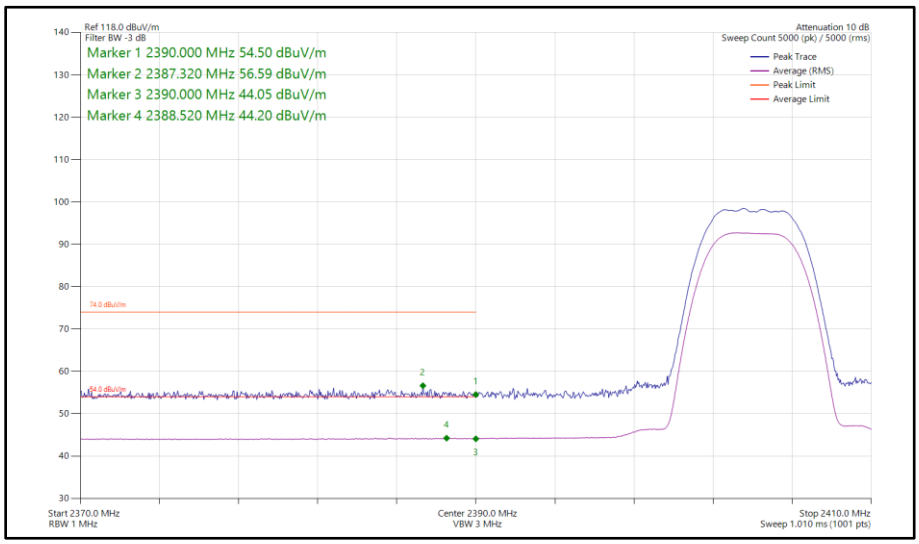

Figure 22 - Bluetooth HDR8, SISO, Core 2 - 2404 MHz
Band Edge Frequency 2390 MHz

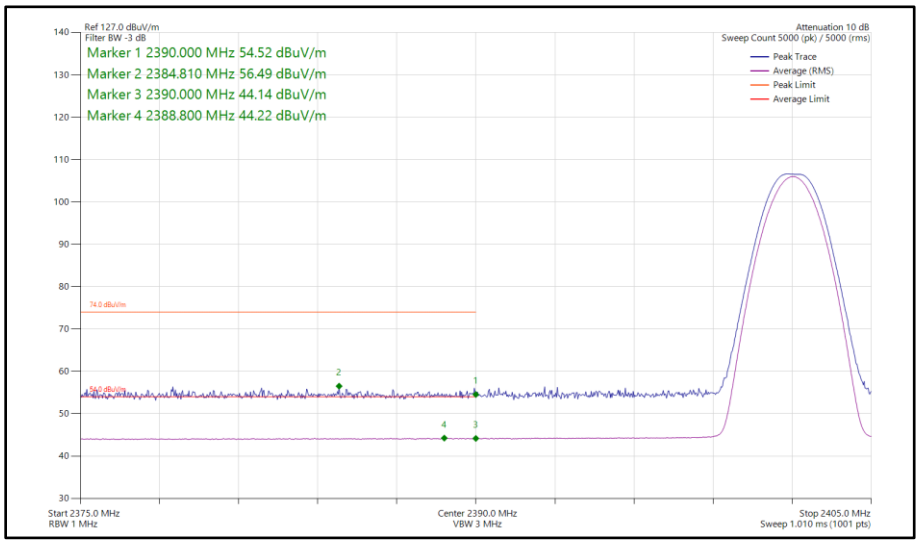

Figure 23 - Bluetooth LE1M, SISO, Core 2 - 2402 MHz
Band Edge Frequency 2390 MHz

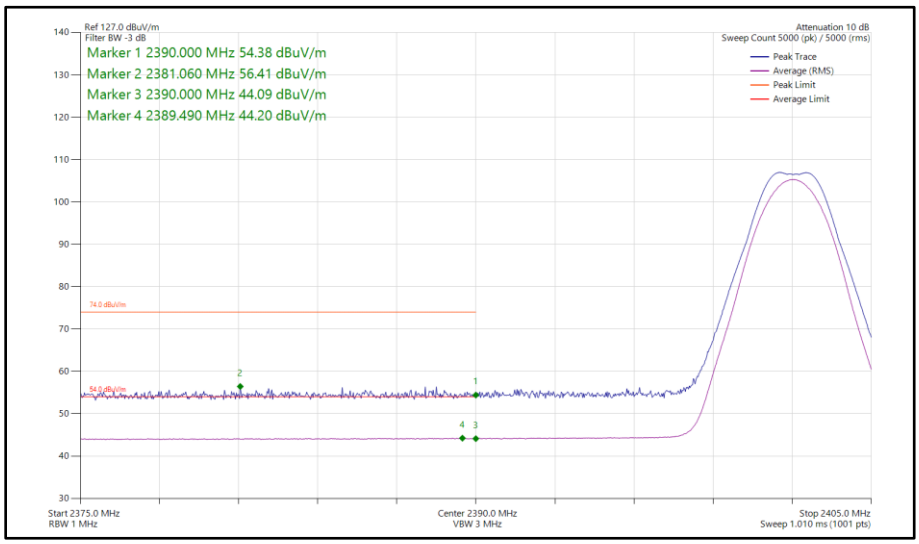

Figure 24 - Bluetooth LE2M, SISO, Core 2 - 2402 MHz
Band Edge Frequency 2390 MHz

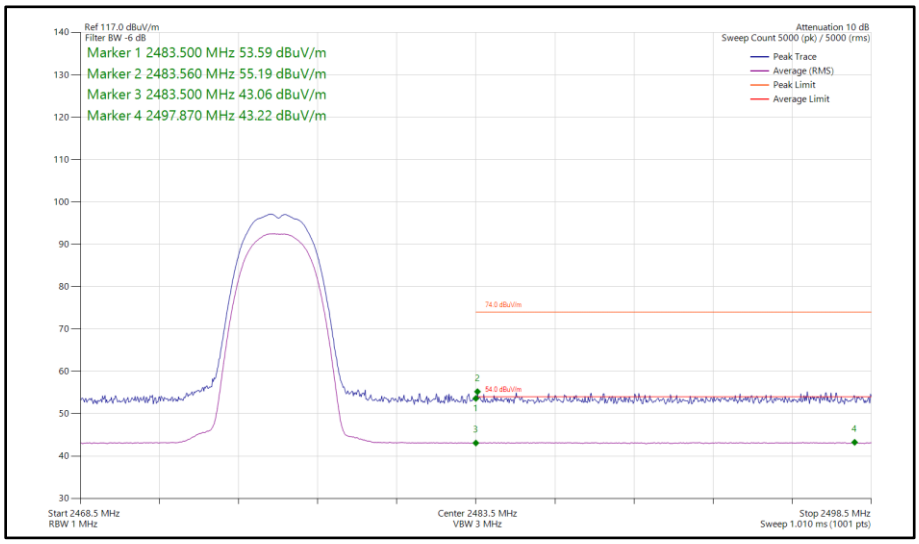

Figure 25 - Bluetooth HDR4, SISO, Core 2 - 2476 MHz
Band Edge Frequency 2483.5 MHz

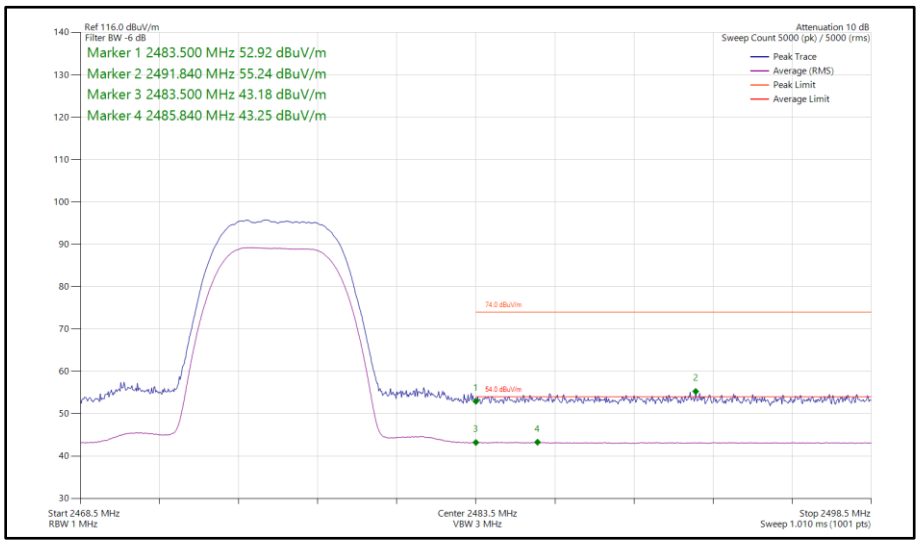

Figure 26 - Bluetooth HDR8, SISO, Core 2 - 2476 MHz
Band Edge Frequency 2483.5 MHz

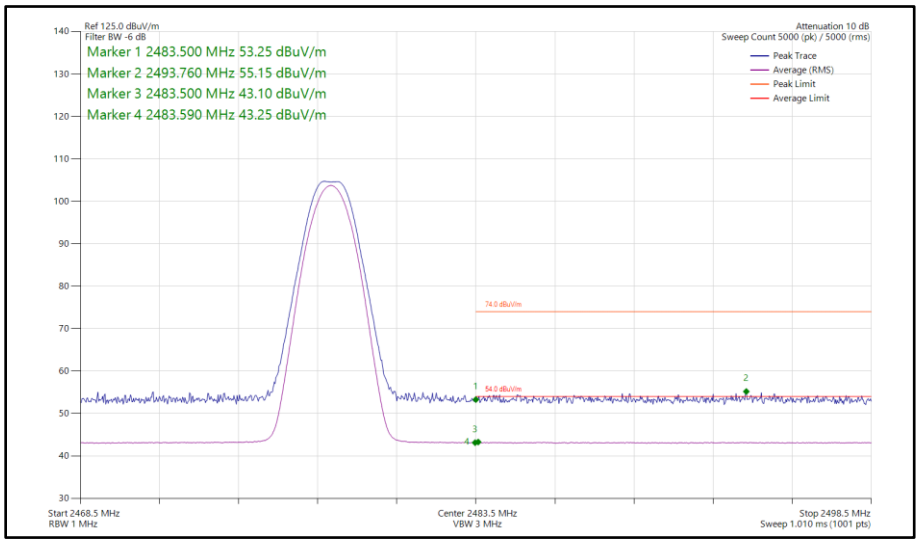

Figure 27 - Bluetooth LE1M, SISO, Core 2 - 2478 MHz
Band Edge Frequency 2483.5 MHz

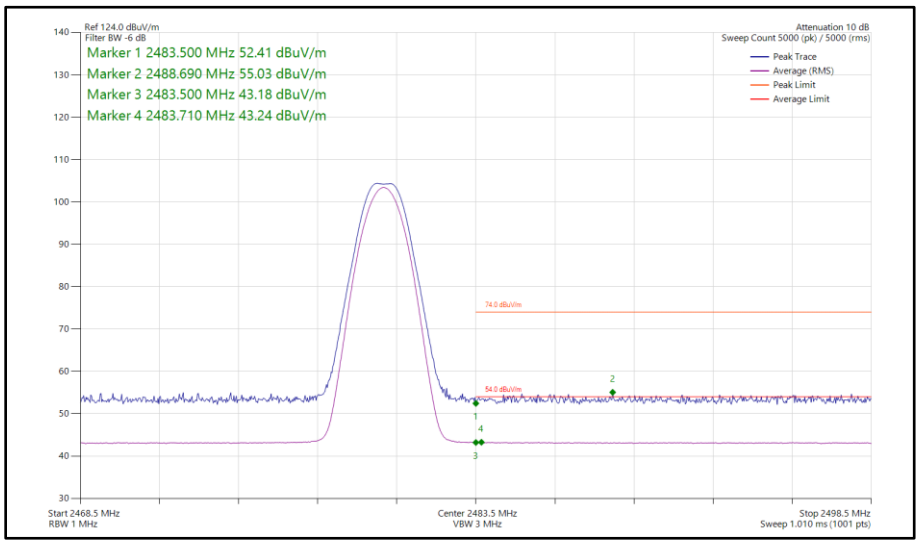

Figure 28 - Bluetooth LE1M, SISO, Core 2 - 2480 MHz Band Edge Frequency 2483.5 MHz

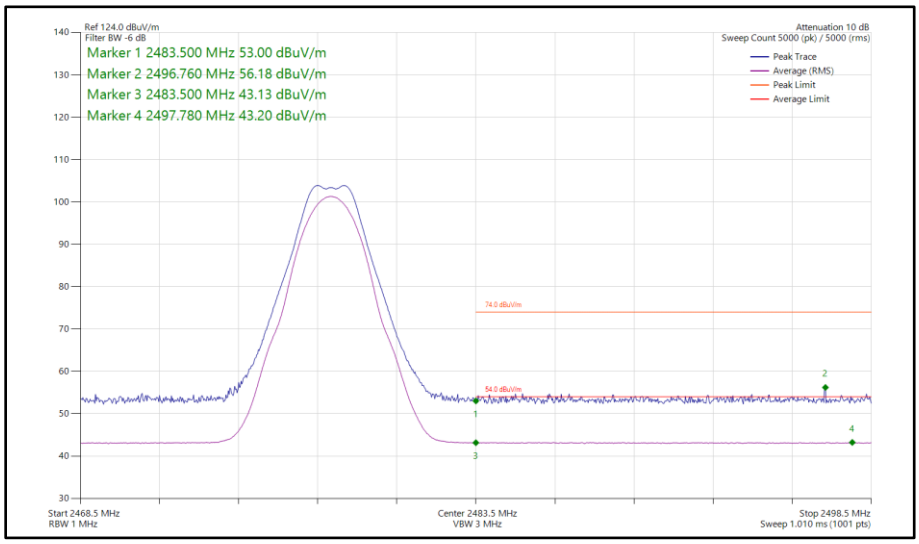

Figure 29 - Bluetooth LE2M, SISO, Core 2 - 2478 MHz Band Edge Frequency 2483.5 MHz

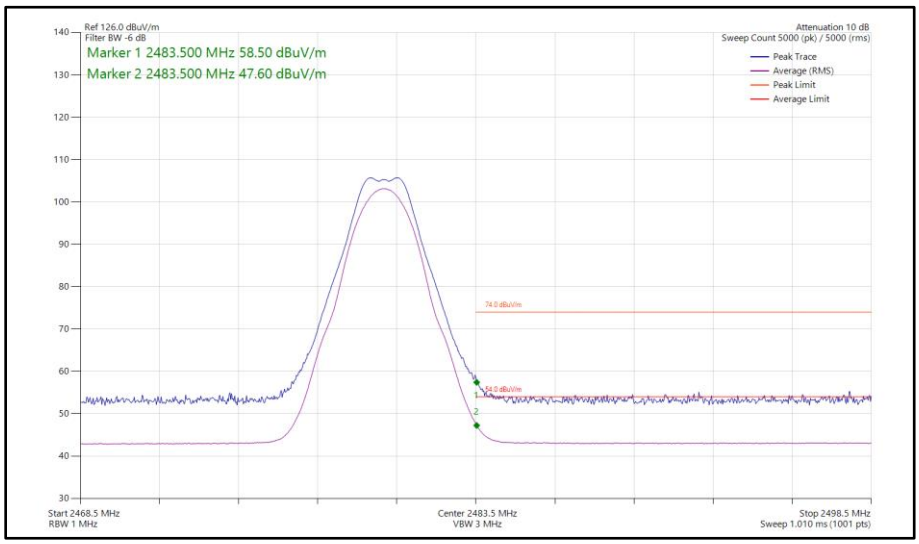

Figure 30 - Bluetooth LE2M, SISO, Core 2 - 2480 MHz Band Edge Frequency 2483.5 MHz

iPA - Core 0 - Core 1 (MIMO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	55.90	44.23
Static	HDR8	2404	2390	55.89	44.22
Static	LE1M	2402	2390	56.87	44.25
Static	LE2M	2402	2390	57.27	44.27
Static	HDR4	2476	2483.5	55.80	43.23
Static	HDR8	2476	2483.5	55.28	43.56
Static	LE1M	2478	2483.5	55.55	43.40
Static	LE1M	2480	2483.5	55.38	43.83
Static	LE2M	2478	2483.5	55.72	43.51
Static	LE2M	2480	2483.5	59.98	50.13

Table 10 - MIMO Restricted Band Edge Results

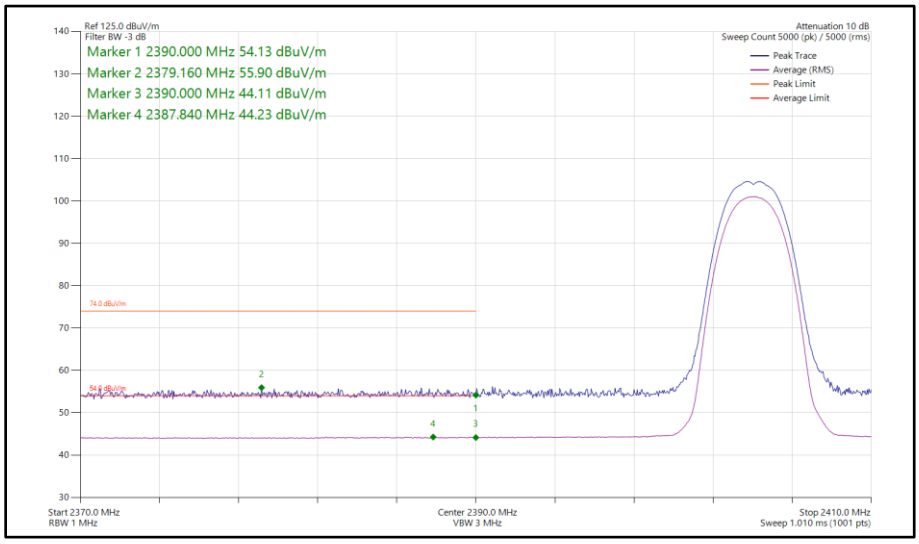

Figure 31 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

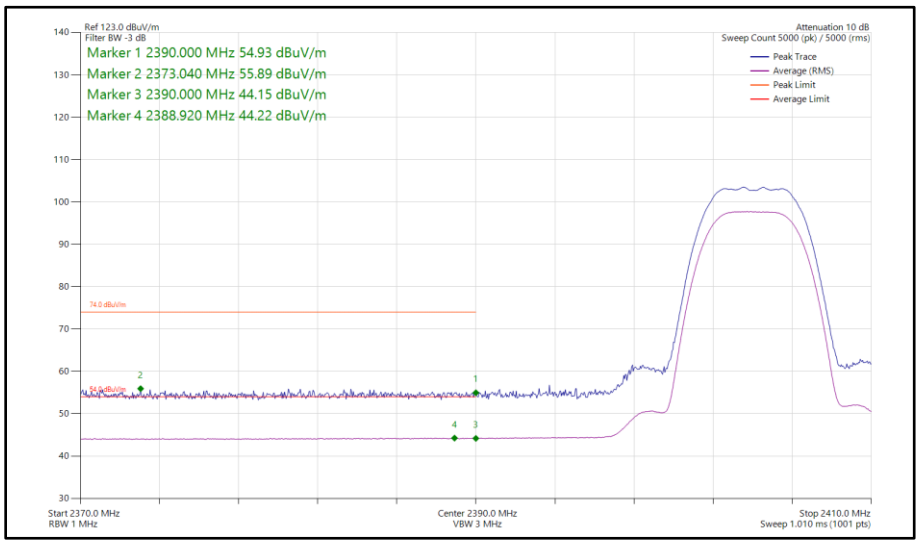

Figure 32 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

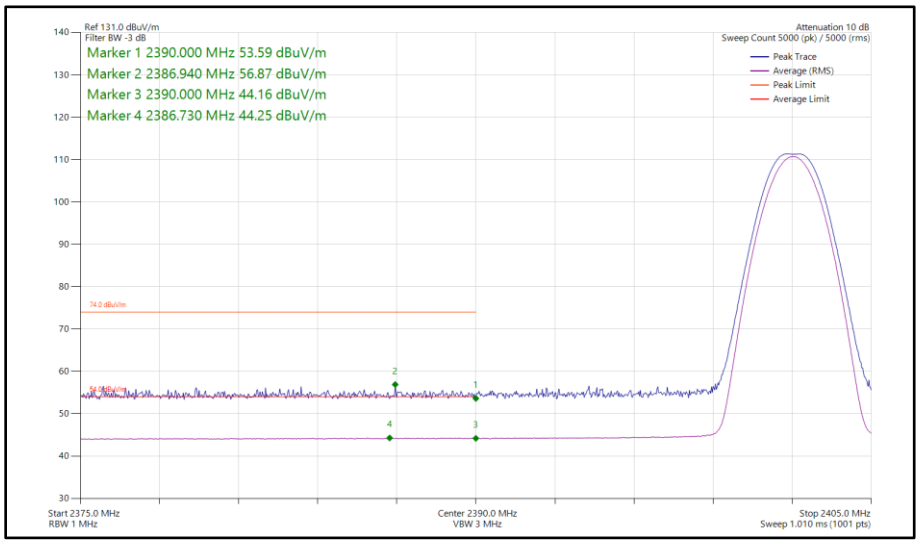

Figure 33 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

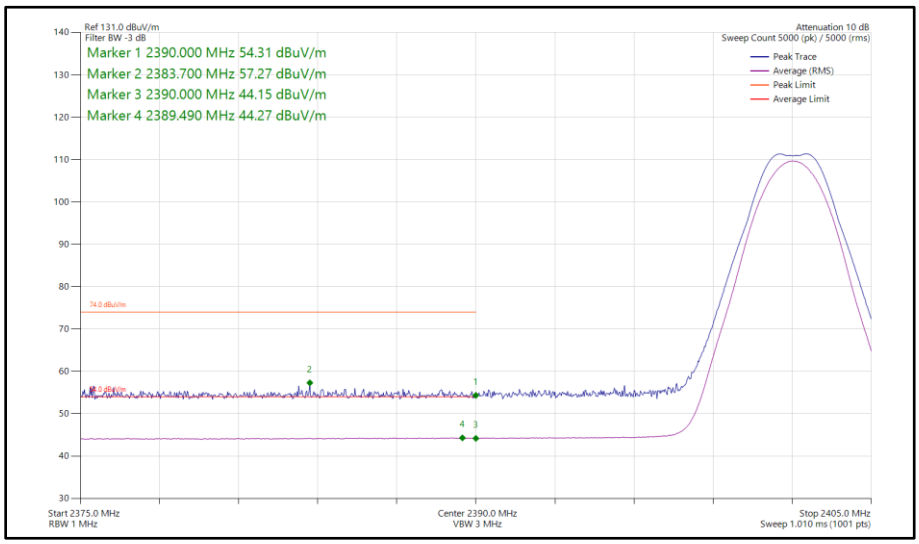

Figure 34 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2402 MHz Band Edge Frequency 2390 MHz

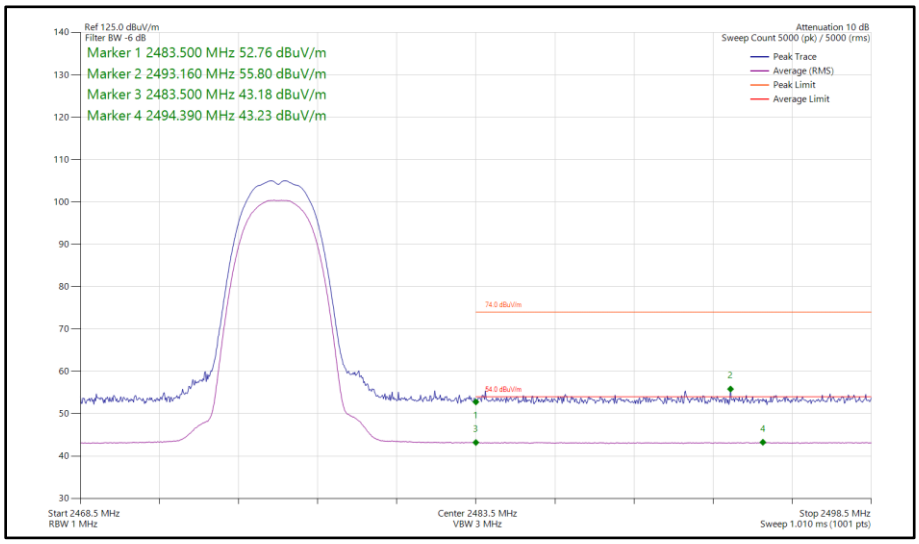

Figure 35 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

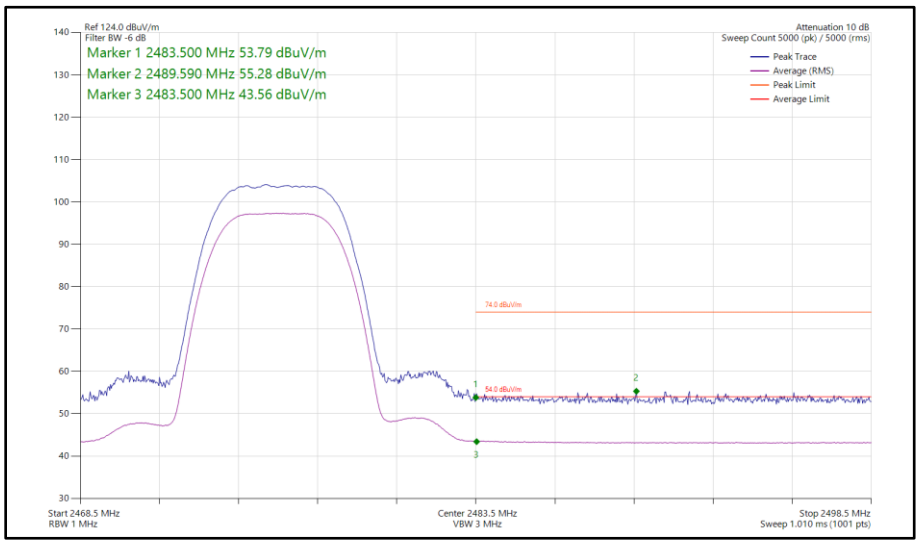

Figure 36 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

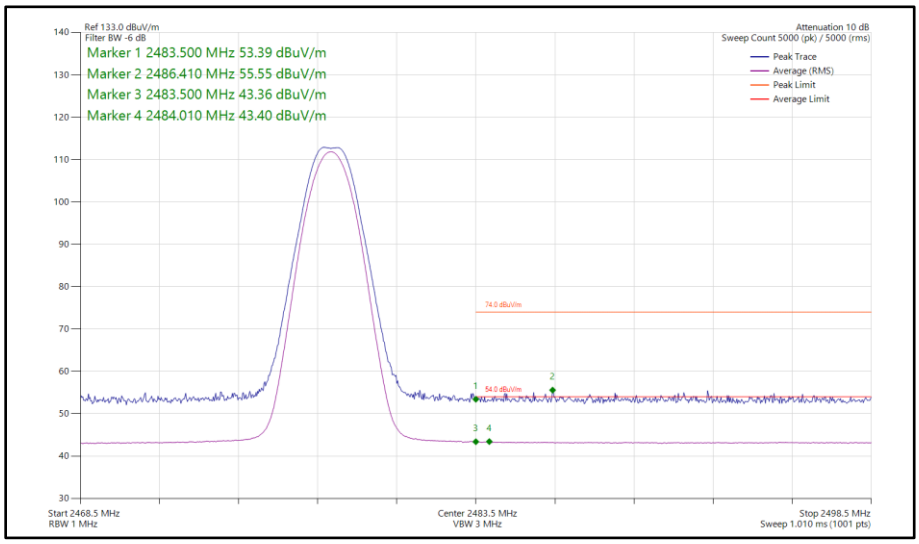

Figure 37 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

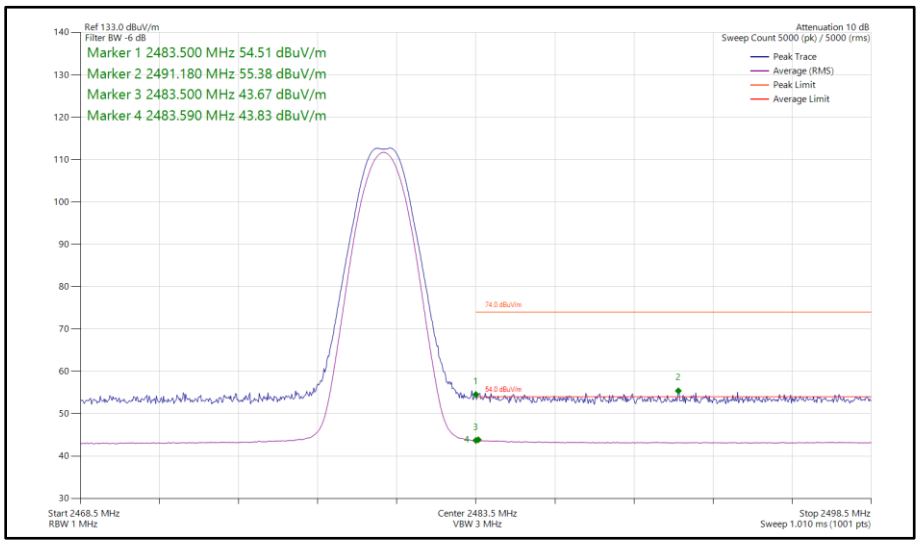

Figure 38 - Bluetooth LE1M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

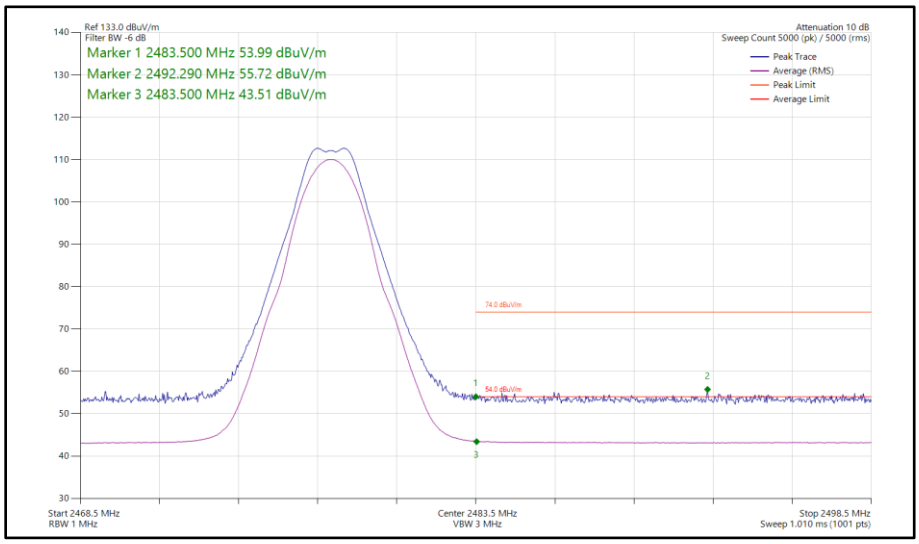

Figure 39 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

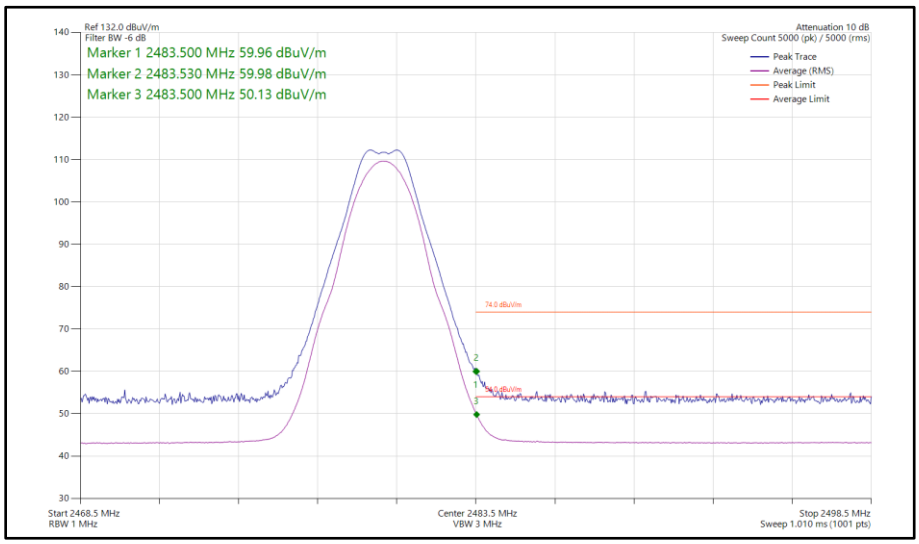

Figure 40 - Bluetooth LE2M, MIMO, Core 0 - Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

ePA - Core 0 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.93	44.65
Static	HDR8	2404	2390	57.86	45.49
Static	LE1M	2402	2390	56.66	45.07
Static	LE2M	2402	2390	57.06	45.09
Static	HDR4	2476	2483.5	55.81	44.30
Static	HDR8	2476	2483.5	59.04	48.09
Static	LE1M	2478	2483.5	56.65	44.88
Static	LE1M	2480	2483.5	57.32	45.71
Static	LE2M	2478	2483.5	57.48	45.44
Static	LE2M	2480	2483.5	59.44	49.30

Table 11 - SISO Restricted Band Edge Results

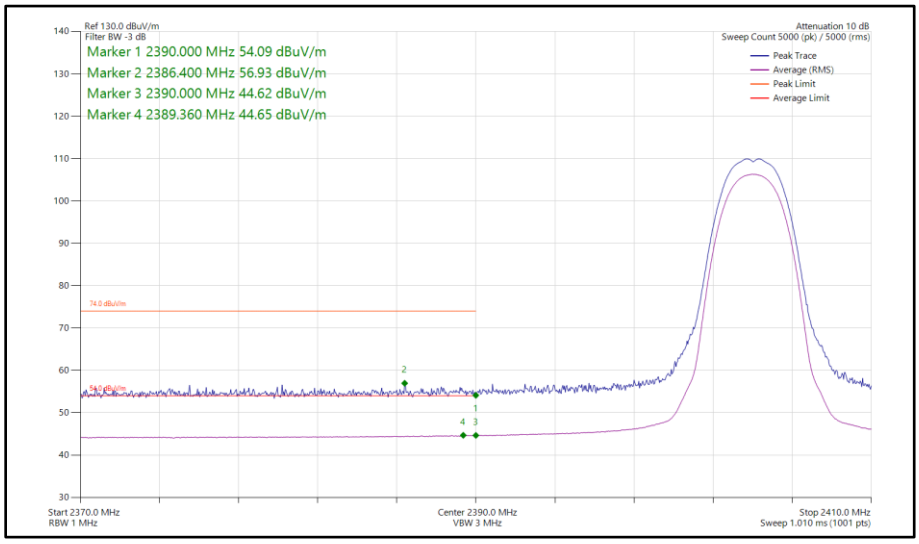

Figure 41 - Bluetooth HDR4, SISO, Core 0 - 2404 MHz Band Edge Frequency 2390 MHz

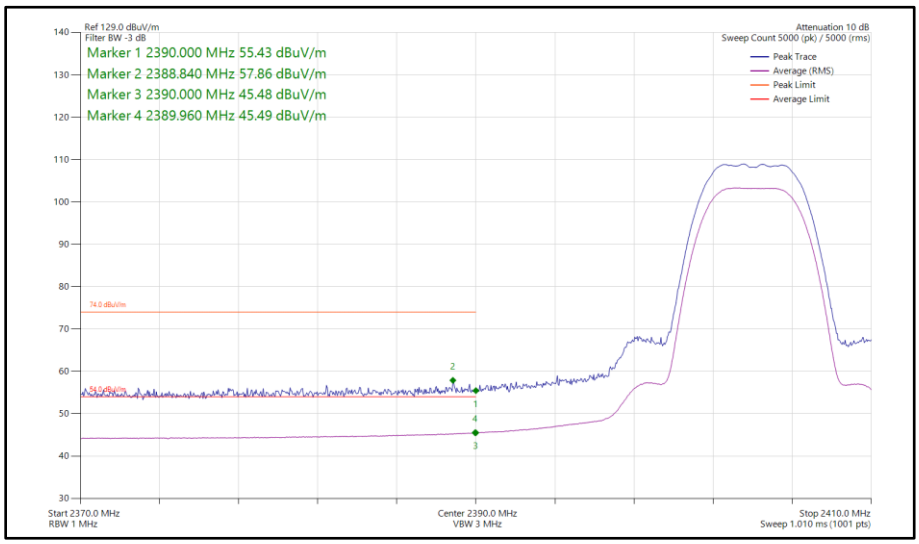

Figure 42 - Bluetooth HDR8, SISO, Core 0 - 2404 MHz
Band Edge Frequency 2390 MHz

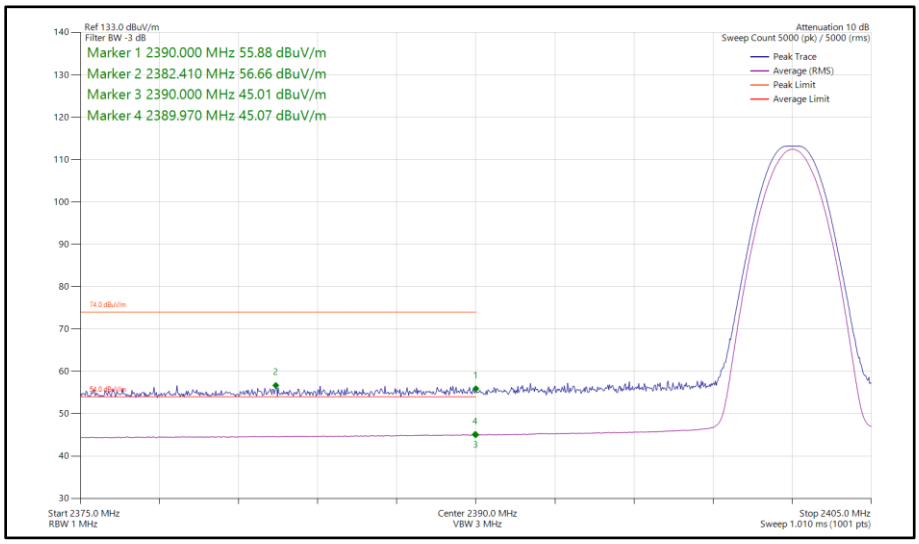

Figure 43 - Bluetooth LE1M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

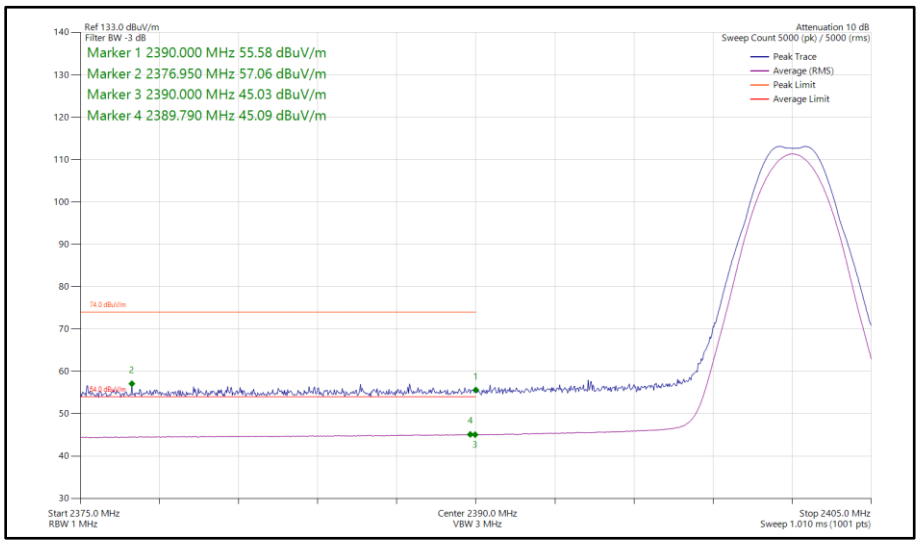

Figure 44 - Bluetooth LE2M, SISO, Core 0 - 2402 MHz
Band Edge Frequency 2390 MHz

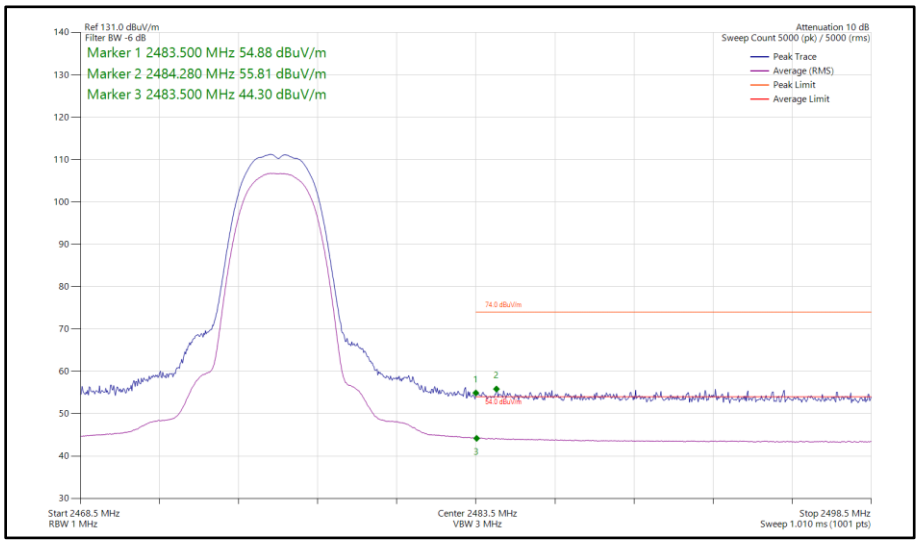

Figure 45 - Bluetooth HDR4, SISO, Core 0 - 2476 MHz
Band Edge Frequency 2483.5 MHz

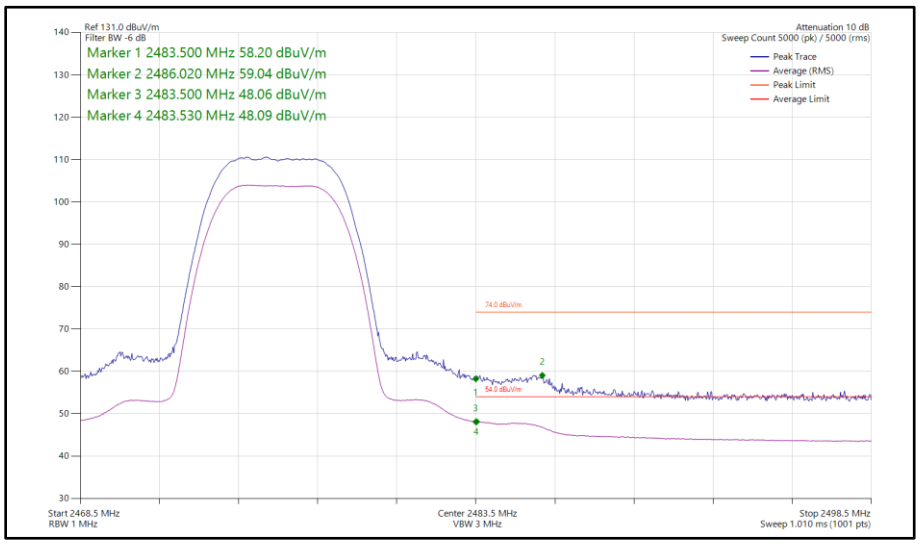

Figure 46 - Bluetooth HDR8, SISO, Core 0 - 2476 MHz Band Edge Frequency 2483.5 MHz

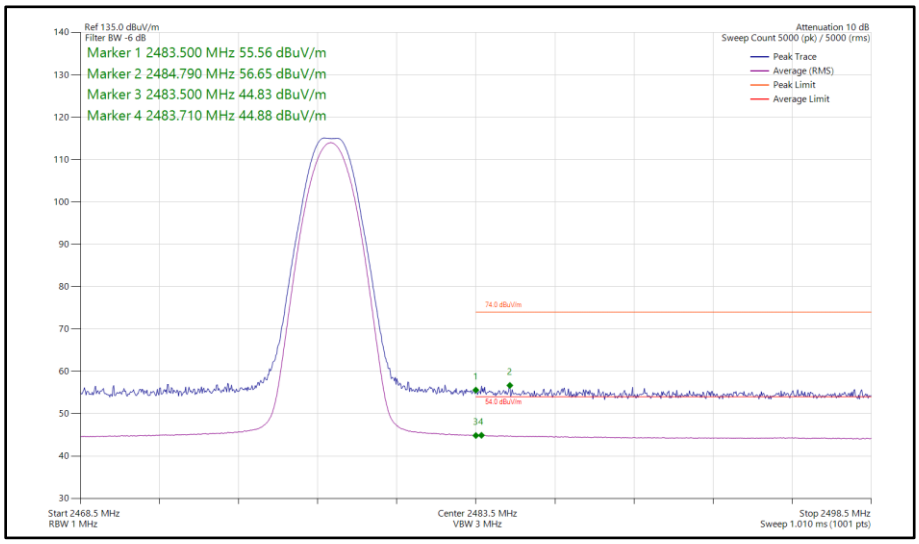

Figure 47 - Bluetooth LE1M, SISO, Core 0 - 2478 MHz Band Edge Frequency 2483.5 MHz

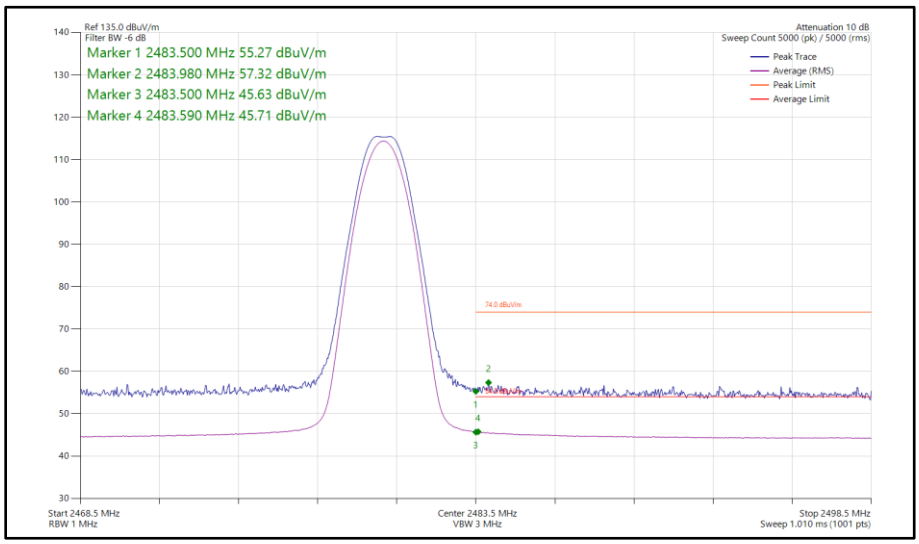

Figure 48 - Bluetooth LE1M, SISO, Core 0 - 2480 MHz Band Edge Frequency 2483.5 MHz

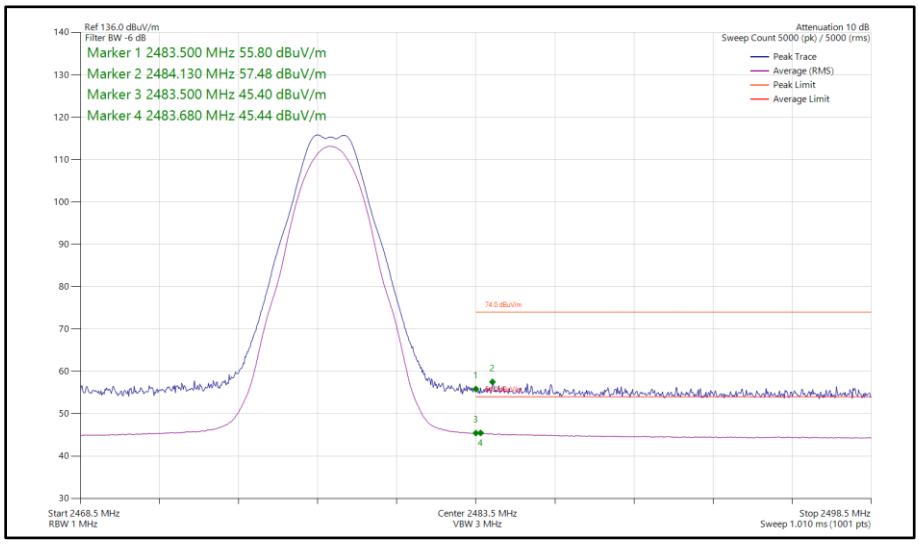

Figure 49 - Bluetooth LE2M, SISO, Core 0 - 2478 MHz Band Edge Frequency 2483.5 MHz

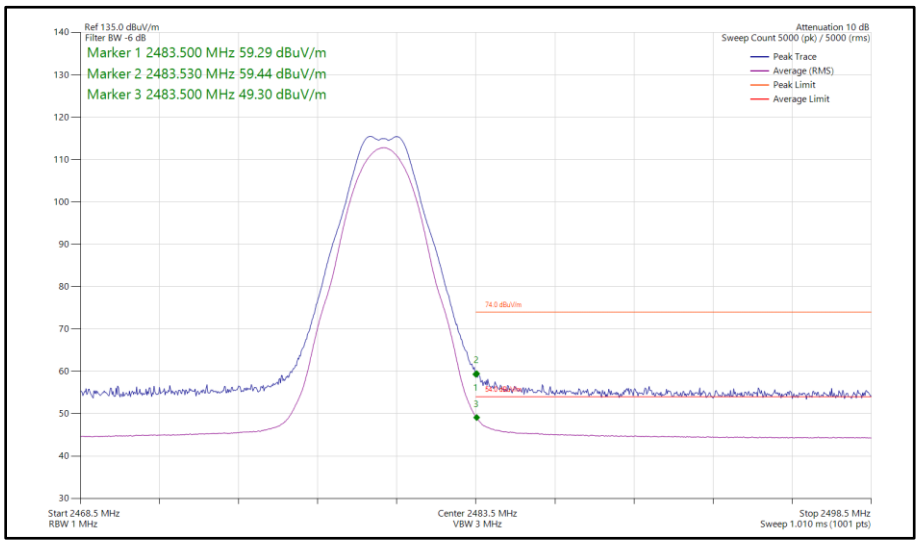

Figure 50 - Bluetooth LE2M, SISO, Core 0 - 2480 MHz Band Edge Frequency 2483.5 MHz

ePA - Core 1 (SISO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.40	44.69
Static	HDR8	2404	2390	56.46	45.24
Static	LE1M	2402	2390	56.77	45.15
Static	LE2M	2402	2390	57.52	45.16
Static	HDR4	2476	2483.5	56.18	43.95
Static	HDR8	2476	2483.5	59.27	47.42
Static	LE1M	2478	2483.5	56.32	44.74
Static	LE1M	2480	2483.5	57.00	45.71
Static	LE2M	2478	2483.5	56.61	45.12
Static	LE2M	2480	2483.5	59.60	49.11

Table 12 - SISO Restricted Band Edge Results

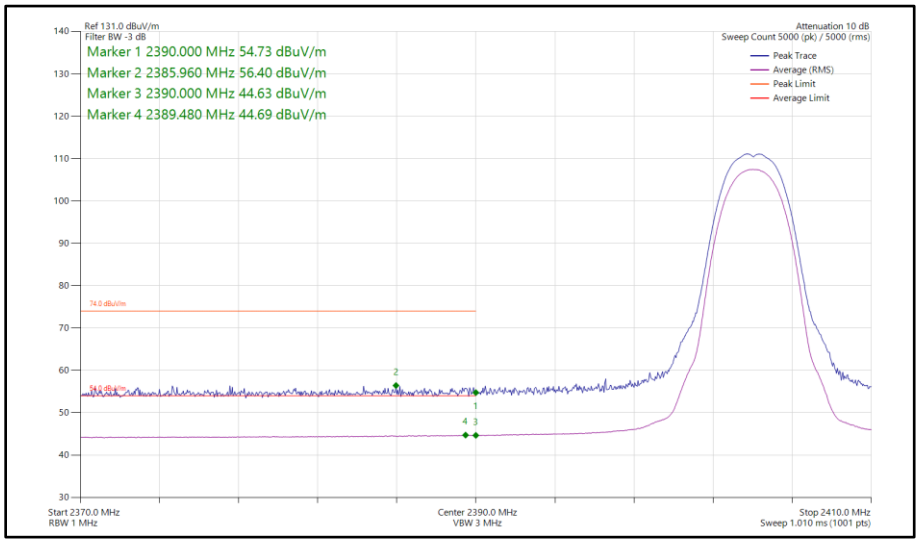

Figure 51 - Bluetooth HDR4, SISO, Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

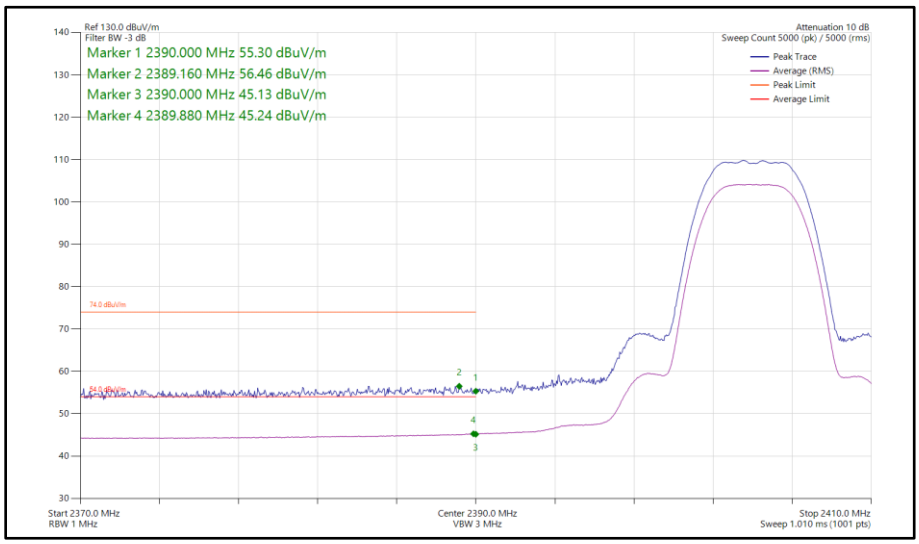

Figure 52 - Bluetooth HDR8, SISO, Core 1 - 2404 MHz
Band Edge Frequency 2390 MHz

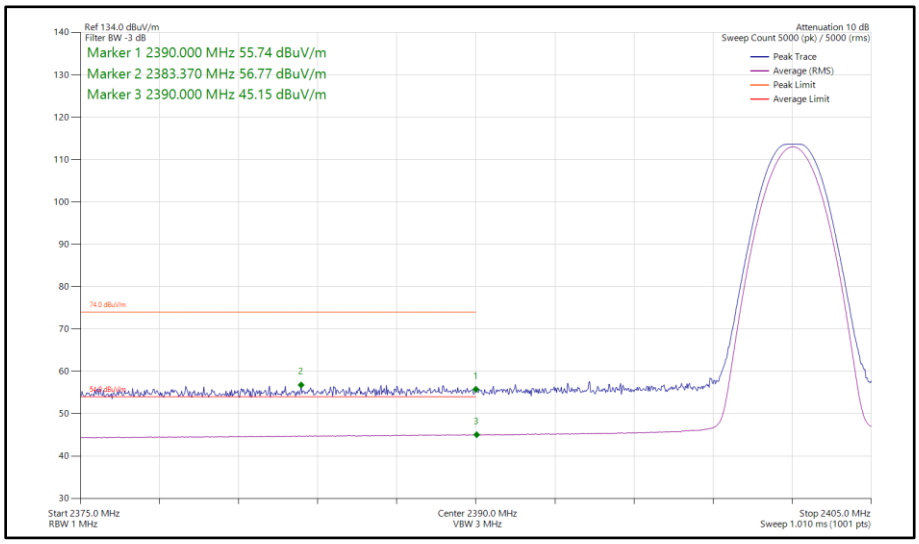

Figure 53 - Bluetooth LE1M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

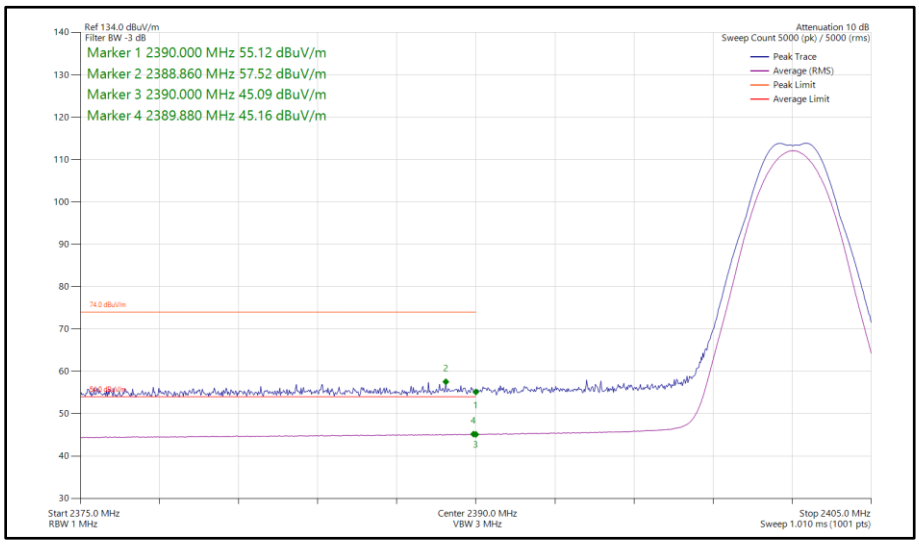

Figure 54 - Bluetooth LE2M, SISO, Core 1 - 2402 MHz
Band Edge Frequency 2390 MHz

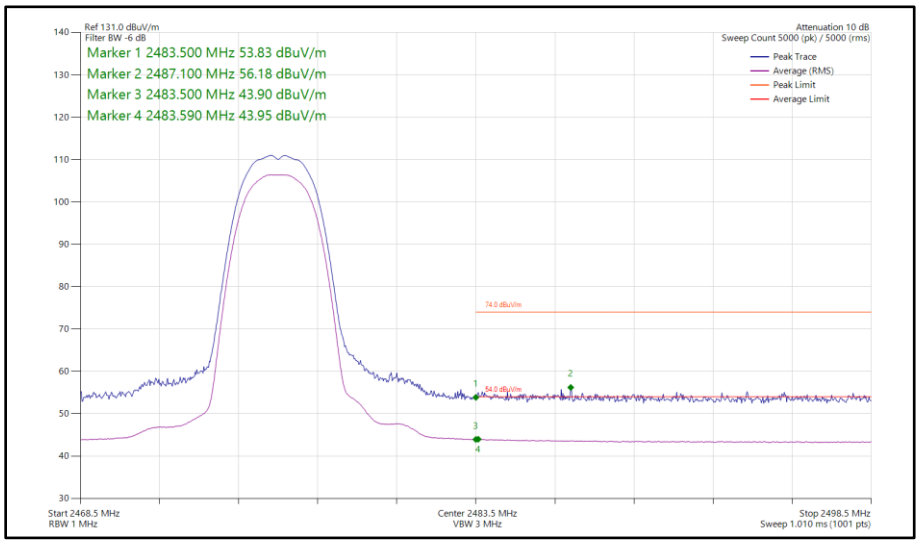

Figure 55 - Bluetooth HDR4, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

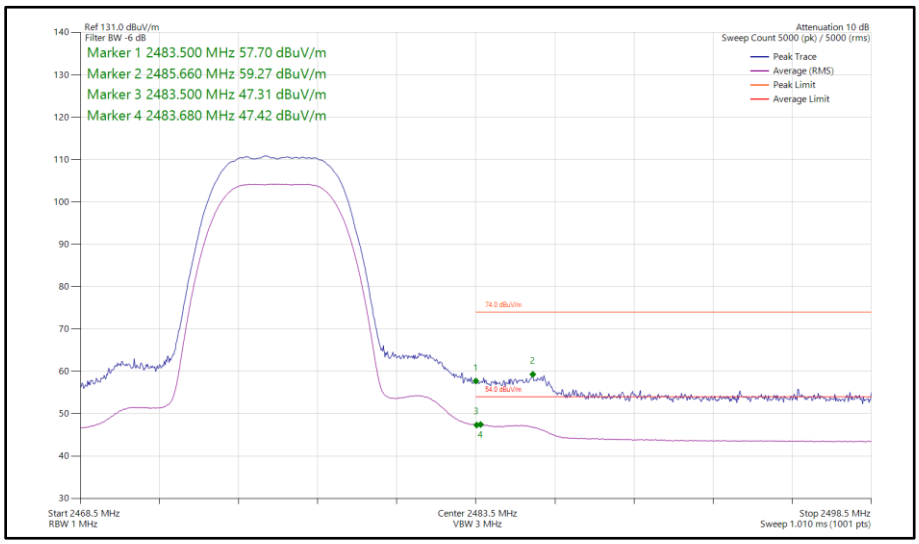

Figure 56 - Bluetooth HDR8, SISO, Core 1 - 2476 MHz
Band Edge Frequency 2483.5 MHz

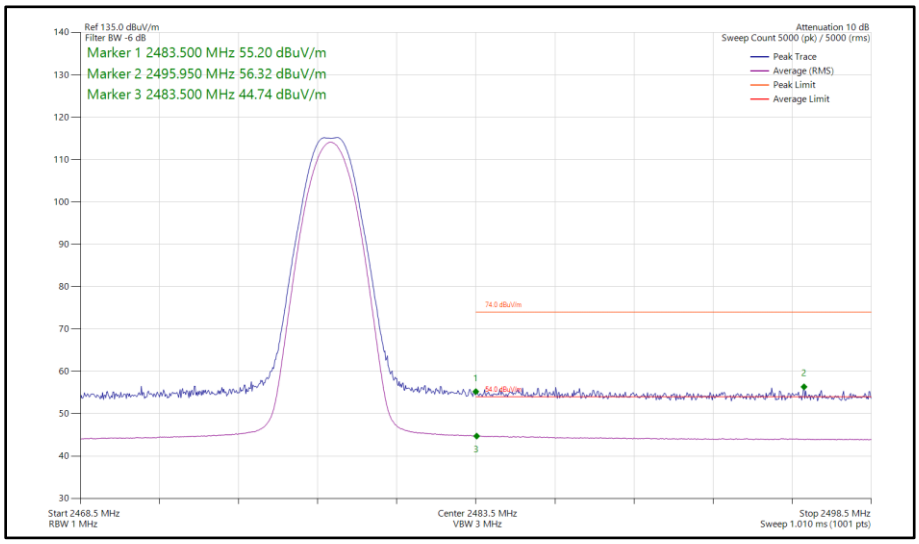

Figure 57 - Bluetooth LE1M, SISO, Core 1 - 2478 MHz
Band Edge Frequency 2483.5 MHz

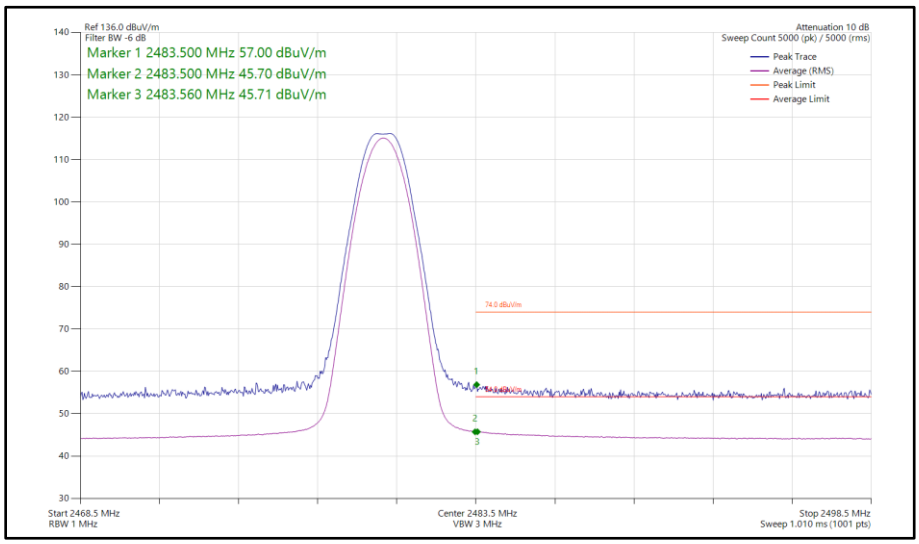

Figure 58 - Bluetooth LE1M, SISO, Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

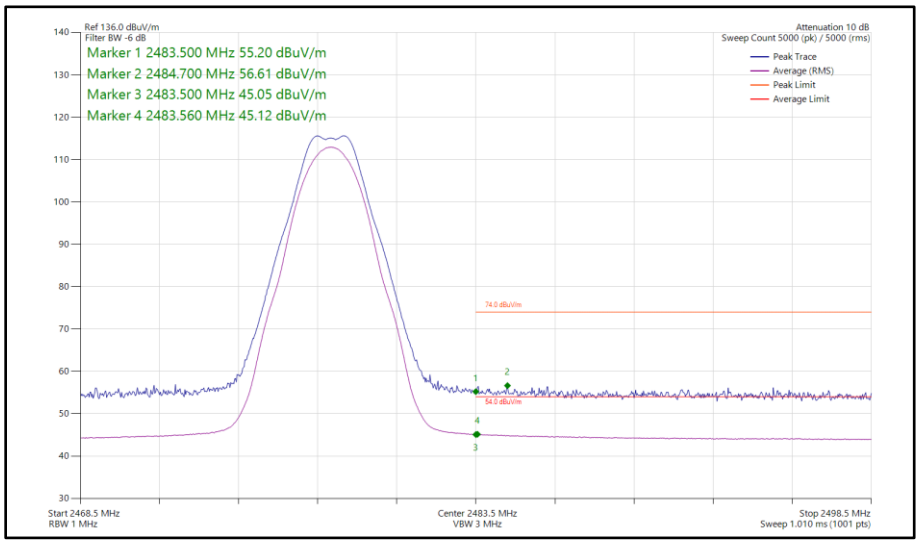

Figure 59 - Bluetooth LE2M, SISO, Core 1 - 2478 MHz Band Edge Frequency 2483.5 MHz

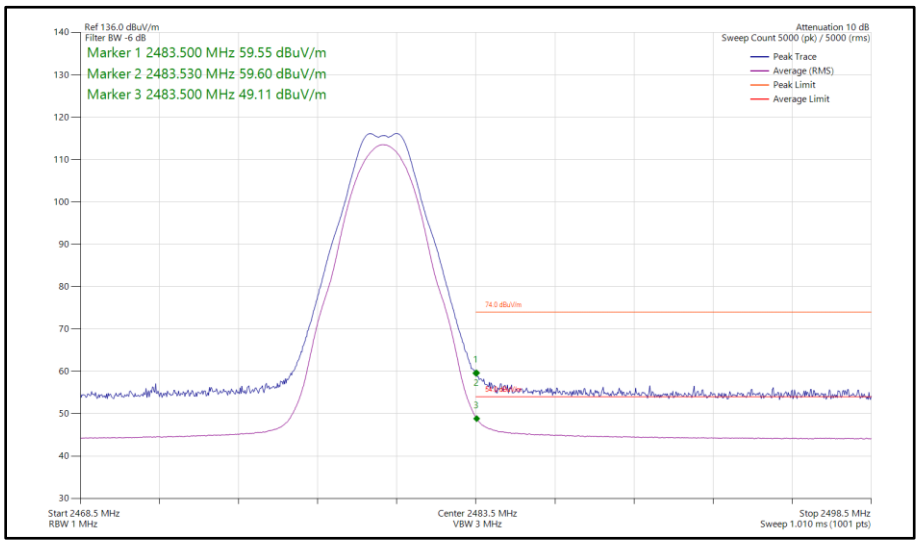

Figure 60 - Bluetooth LE2M, SISO, Core 1 - 2480 MHz Band Edge Frequency 2483.5 MHz

ePA - Core 0 - Core 1 (MIMO)

Mode	Packet Type	TX Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBuV/m)
Static	HDR4	2404	2390	56.30	44.81
Static	HDR8	2404	2390	57.17	45.75
Static	HDR4	2476	2483.5	56.26	44.40
Static	HDR8	2476	2483.5	60.25	48.78

Table 13 - MIMO Restricted Band Edge Results

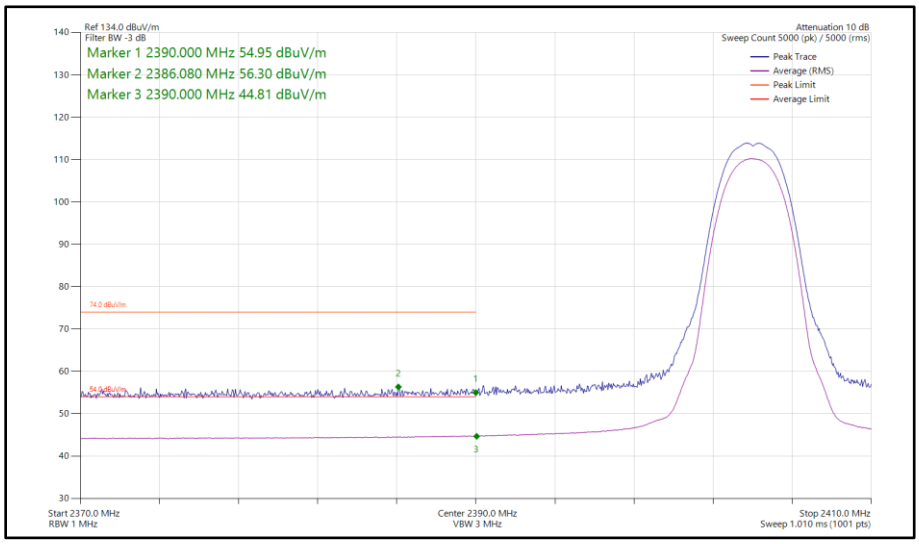

Figure 61 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

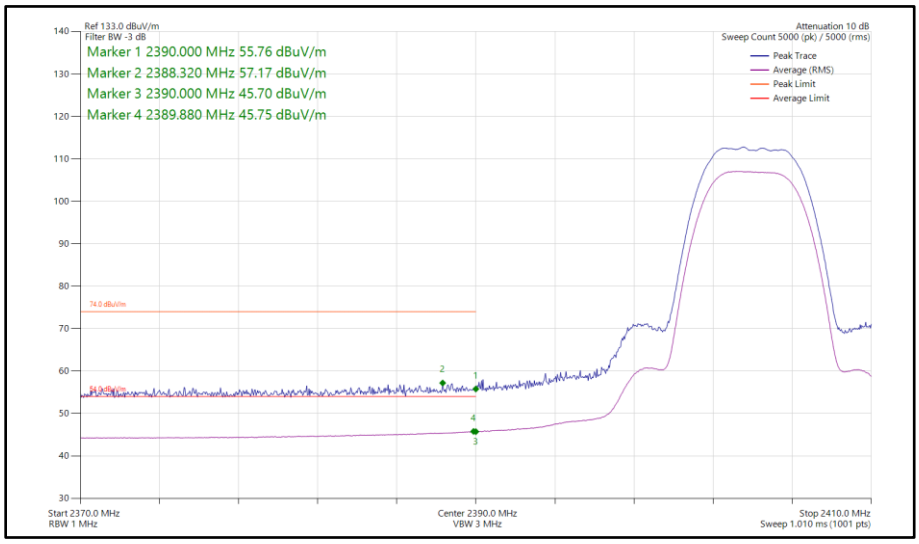

Figure 62 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2404 MHz Band Edge Frequency 2390 MHz

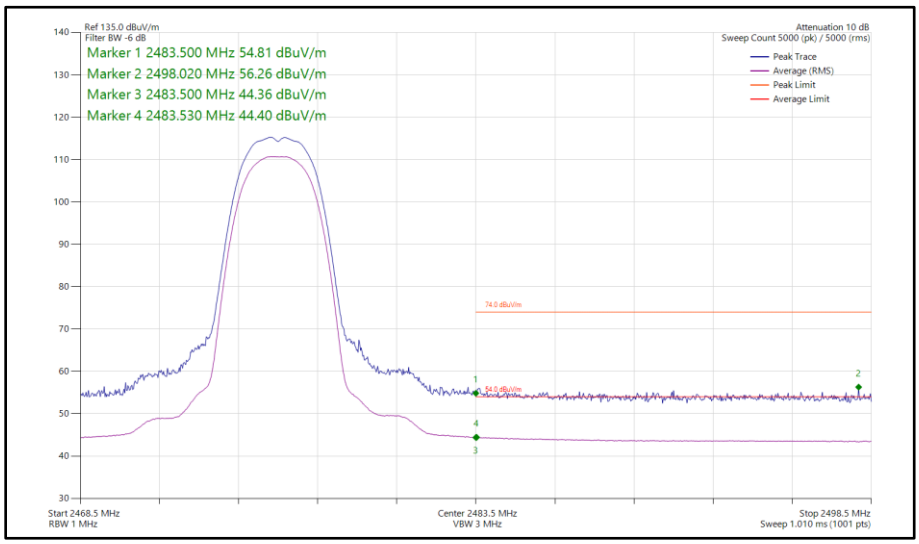

Figure 63 - Bluetooth HDR4, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

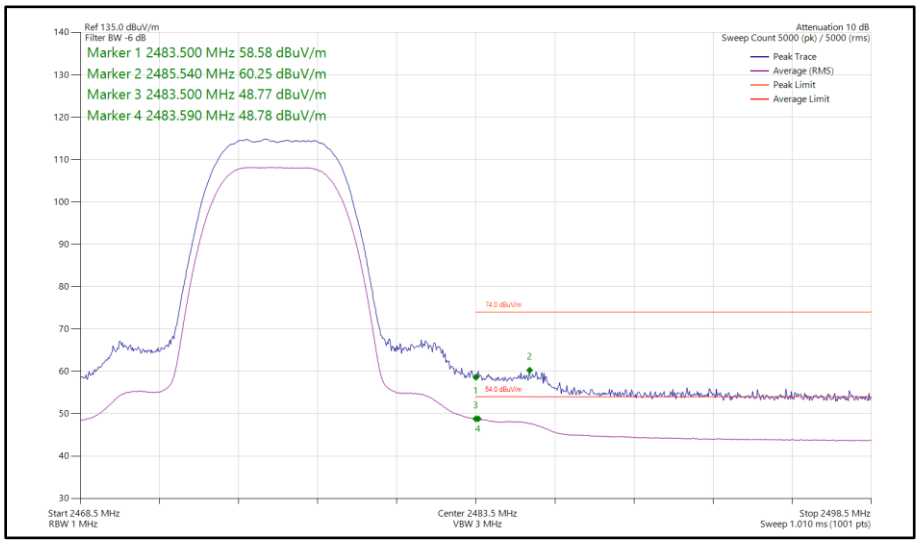

Figure 64 - Bluetooth HDR8, MIMO, Core 0 - Core 1 - 2476 MHz Band Edge Frequency 2483.5 MHz

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 14 and RF Chamber 15.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Expiry Date
Emissions Software	TUV SUD	EmX V3.2.0	5125	-	Software
EMI Test Receiver	Rohde & Schwarz	ESW44	5911	12	11-Sep-2024
EMI Test Receiver	Rohde & Schwarz	ESW44	5912	12	05-Jul-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), Chamber 15	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	20-May-2025
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5997	12	14-Sep-2024
Cable (SMA to SMA 4.5m)	Junkosha	MWX221-04500AMSAMS/A	6002	12	14-Sep-2024
Cable (SMA to SMA 3m)	Junkosha	MWX221-03000AMSAMS/A	6021	12	14-Sep-2024
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6141	12	05-May-2025
Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA9120B	6142	12	05-May-2025
Digital Multimeter	Fluke	115	6145	12	06-Jun-2025
Digital Multimeter	Fluke	115	6147	12	06-Jun-2025
Humidity & Temperature meter	R.S Components	1364	6149	12	07-Jul-2024
SAC Switch Unit	TUV SUD	TUV_SSU_001	6190	12	22-Dec-2024
Cable (SMA to SMA 3m)	Junkosha	MWX221-03000AMSAMS/A	6316	12	04-Feb-2025
Humidity and Temperature Meter	R.S Components	1364	6486	12	04-Jun-2025
1m Cable	Junkosha	MWX241-01000AMSAMS/B	6740	12	01-Feb-2025
1m Cable	Junkosha	MWX241-01000AMSAMS/B	6741	12	01-Feb-2025
6.5m Cable	Junkosha	MWX221-06500AMSAMS/B	6744	12	01-Feb-2025

Table 16

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

A3238, S/N: G76H79FX4L - Modification State 0

2.2.3 Date of Test

08-August-2024 to 09-August-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 °C
Relative Humidity	55.8 - 62.9 %

2.2.6 Test Results

2.4 GHz Bluetooth LE/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:	iPA 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	1.880	-	-	-	≥500.0
2441	1.896	-	-	-	≥500.0
2476	1.888	-	-	-	≥500.0

Table 17 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)				Limit (kHz)
	A	B	C	D	
2404	2.328	-	-	-	-
2441	2.328	-	-	-	-
2476	2.320	-	-	-	-

Table 18 - 99% Bandwidth Results

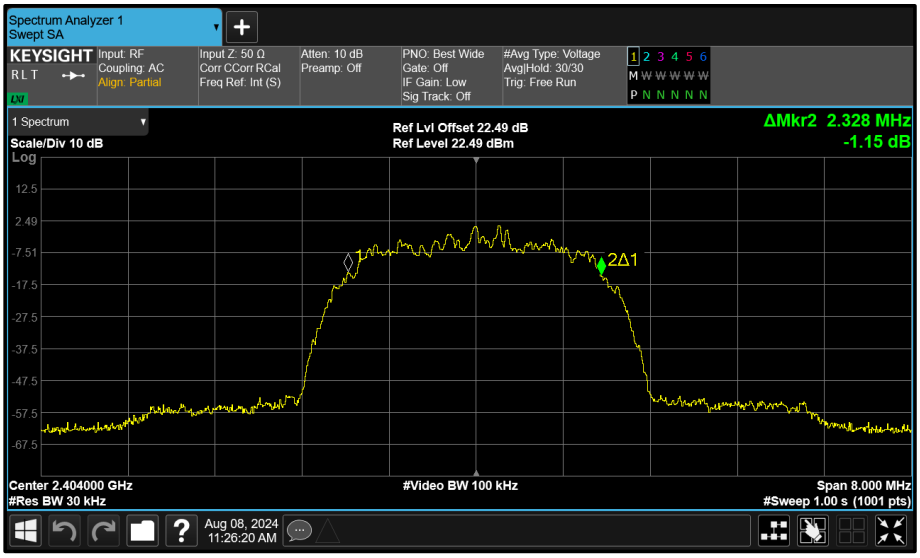

Figure 65 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

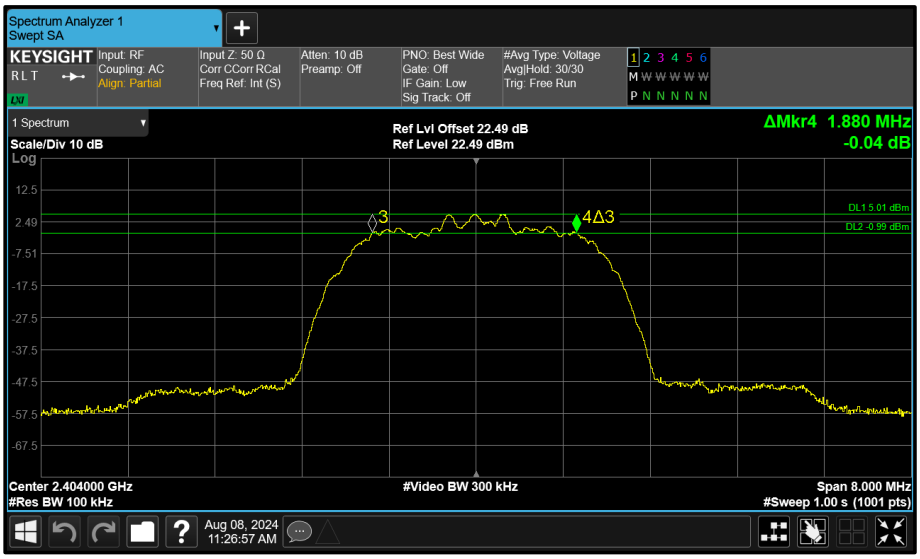

Figure 66 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

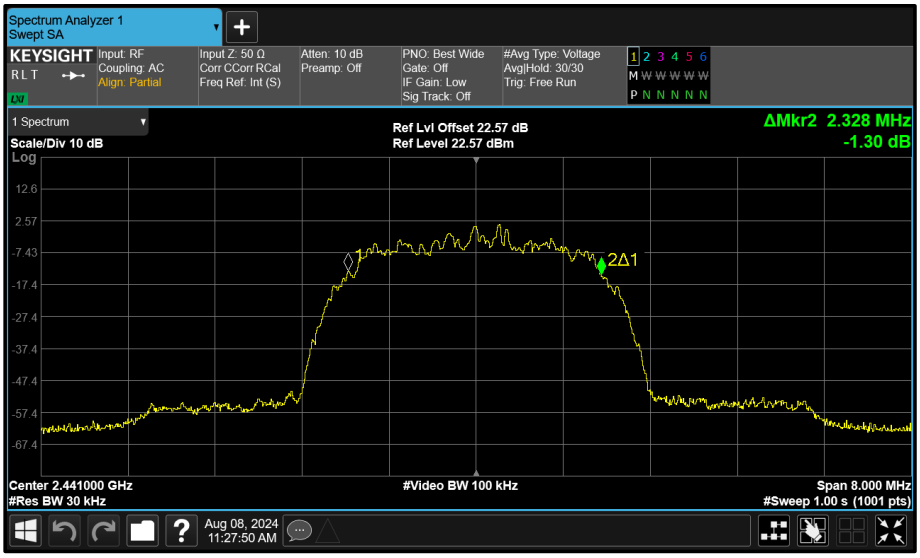

Figure 67 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

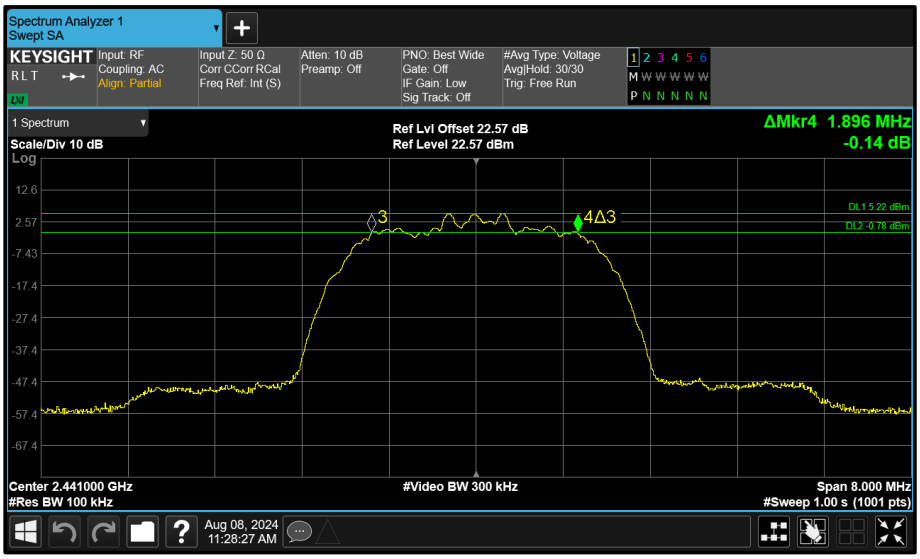

Figure 68 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth