

FCC and ISED Test Report

Apple Inc. Model: A2165

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

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

FCC ID: BCGA2615 IC: 579C-A2615

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Document 75952325-10 Issue 01



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SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Steve Marshall	Senior Engineer	Authorised Signatory	02 February 2022

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

ENGINEERING STATEMENT

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

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Faisal Malyar	02 February 2022	
Testing	Danial Shafique	02 February 2022	
Testing	Jaiyanth Balendrarahah	02 February 2022	
Testing	Liang Tian	02 February 2022	
Testing	Taha Shafique	02 February 2022	
Testing	Daniel Cameron	02 February 2022	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

ISED Accreditation

12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

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



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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	02-February-2022

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2165
Serial Number(s)	P1F4F29DL4 and H617C20363
Hardware Version(s)	REV1.0
Software Version(s)	21B30220I
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2020 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021)
Order Number	0540220896
Date	25-May-2021
Date of Receipt of EUT	25- October-2021
Start of Test	25-October-2021
Finish of Test	05-January-2022
Name of Engineer(s)	Faisal Malyar, Danial Shafique, Liang Tian, Daniel Cameron, Taha Shafique and Jaiyanth Balendrarajah
Related Document(s)	ANSI C63.4 (2014) ANSI C63.10 (2013) 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 and 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 - DTS						
-	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	-	8.10	Restricted Band Edges	Pass	
2.2	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	
2.3	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.4	15.247 (d) and 15.209	3.3 and 5.5	6.13 and 8.9	Spurious Radiated Emissions	Pass	
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.6	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment under test (EUT) was a desktop computer with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac/ax capabilities in the 2.4 GHz and 5 GHz bands.

1.4.2 Test Set-up

For conducted tests, a conducted test point was provided by the manufacturer via a flex strip and UFL connector and cable. The loss of these test cables were known and compensated for in any conducted measurements.

For tests in SISO operation, conducted tests were performed on the BT Dedicated Core (Core 2) as well as the Core with the highest antenna gain as Core 0 and Core 1 are identical but with unequal antenna gains. The EUT supports TxBF on Core 0 + Core 1.

Bluetooth LE + HDR was assessed as a DTS system. The EUT supports Bluetooth on the following mode of operations across its antenna ports:

BT Dedicated Core (Core 2) – SISO (iPA)
BT Core 0 – SISO (iPA and ePA), TxBF (iPA and ePA)
BT Core 1 – SISO (iPA and ePA), TxBF (iPA and ePA)

For all tests, the EUT was put into a continuous transmit test mode with the manufacturer's test commands via a script running in the EUTs terminal application. The EUT then transmitted the required type of modulation/packet type on a static channel selected within the test script.

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

1.4.3 Antenna Gain Table

Antenna Port	Frequency Range (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
BT Dedicated Core (Core 2)	2400 to 2480	1.70	1.00
BT Core 0	2400 to 2480	2.20	1.00
BT Core 1	2400 to 2480	1.40	1.00

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: A2165, Serial Number: P1F4F29DL4			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2165, Serial Number: H617C20363			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 4

1.7 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth - DTS		
Restricted Band Edges	Faisal Malyar, Danial Shafique, Jaiyanth Balendrarajah and Liang Tian	UKAS
Emission Bandwidth	Daniel Cameron	UKAS
Maximum Conducted Output Power	Daniel Cameron	UKAS
Spurious Radiated Emissions	Jaiyanth Balendrarajah and Taha Shafique	UKAS
Authorised Band Edges	Faisal Malyar, Danial Shafique, Jaiyanth Balendrarajah and Liang Tian	UKAS
Power Spectral Density	Daniel Cameron	UKAS

Table 5

Office Address:

TÜV SÜD
Octagon House
Concorde Way
Fareham
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2 Test Details

2.1 Restricted Band Edges

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.2.05
ISED RSS-GEN, Clause 8.10

2.1.2 Equipment Under Test and Modification State

A2165, S/N: P1F4F29DL4 - Modification State 0

2.1.3 Date of Test

25-October-2021 to 27-October-2021

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:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$

2.1.5 Environmental Conditions

Ambient Temperature	20.4 - 22.8 °C
Relative Humidity	42.4 - 54.9 %

2.1.6 Test Results

2.4 GHz Bluetooth – DTS

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0	2390.0	52.73	40.87
GFSK/DH1	2480	Core 0	2483.5	53.57	41.45

Table 6 - Restricted Band Edge Results

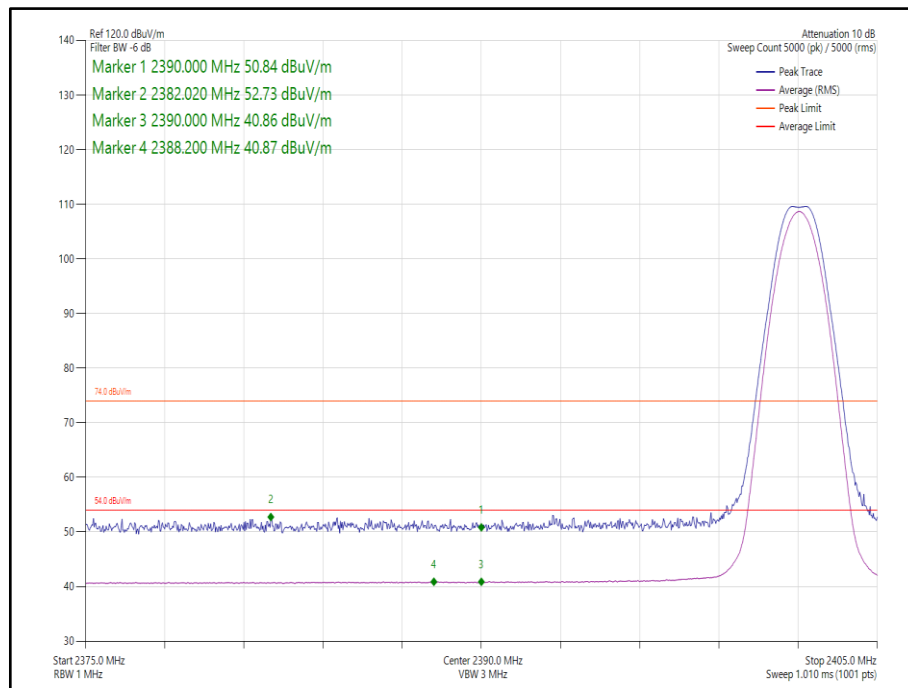


Figure 1 - Core 0 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

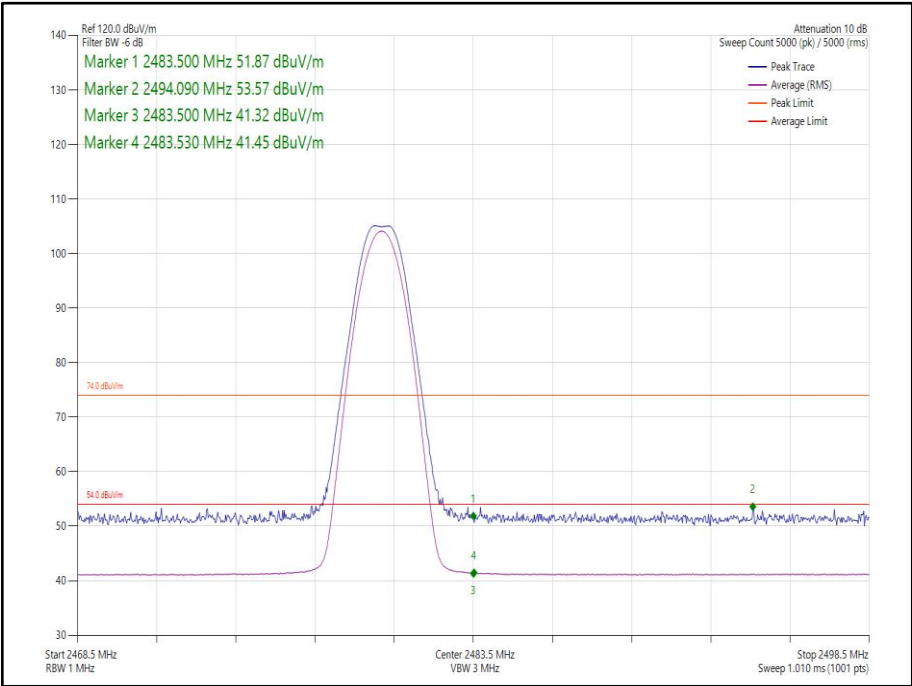


Figure 2 - Core 0 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

LE1M ePA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0	2390.0	53.84	41.31
GFSK/DH1	2480	Core 0	2483.5	53.56	42.31

Table 7 - Restricted Band Edge Results

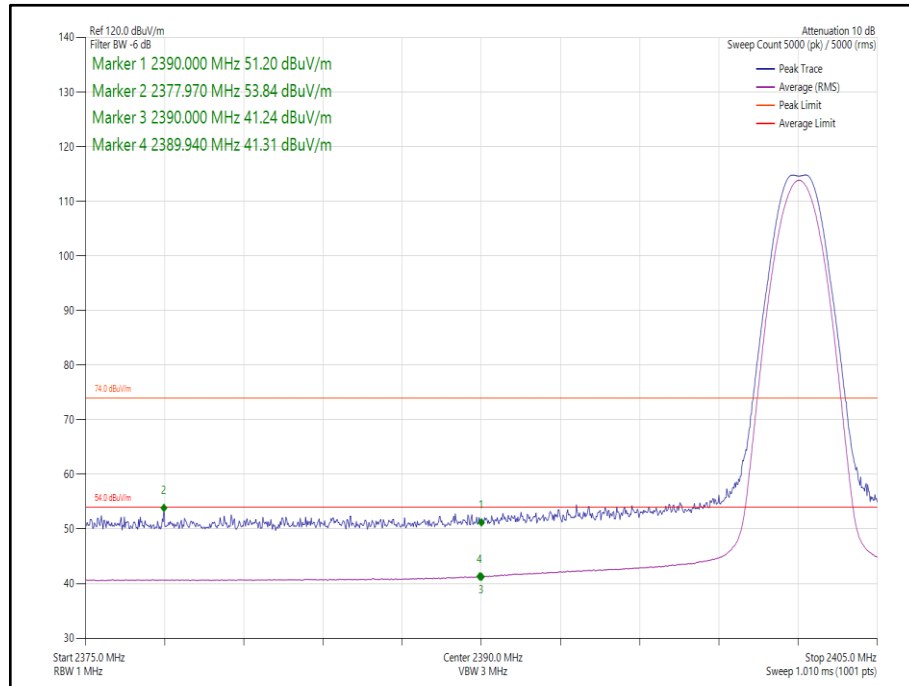


Figure 3 - Core 0 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

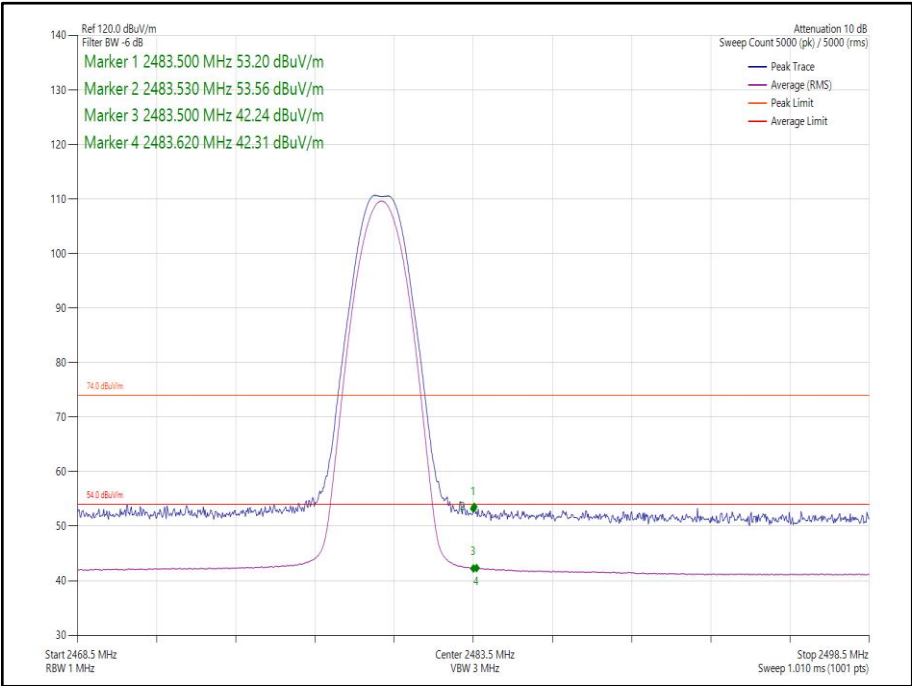


Figure 4 - Core 0 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



LE1M iPA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 2	2390.0	52.63	40.83
GFSK/DH1	2480	Core 2	2483.5	53.42	41.8

Table 8 - Restricted Band Edge Results

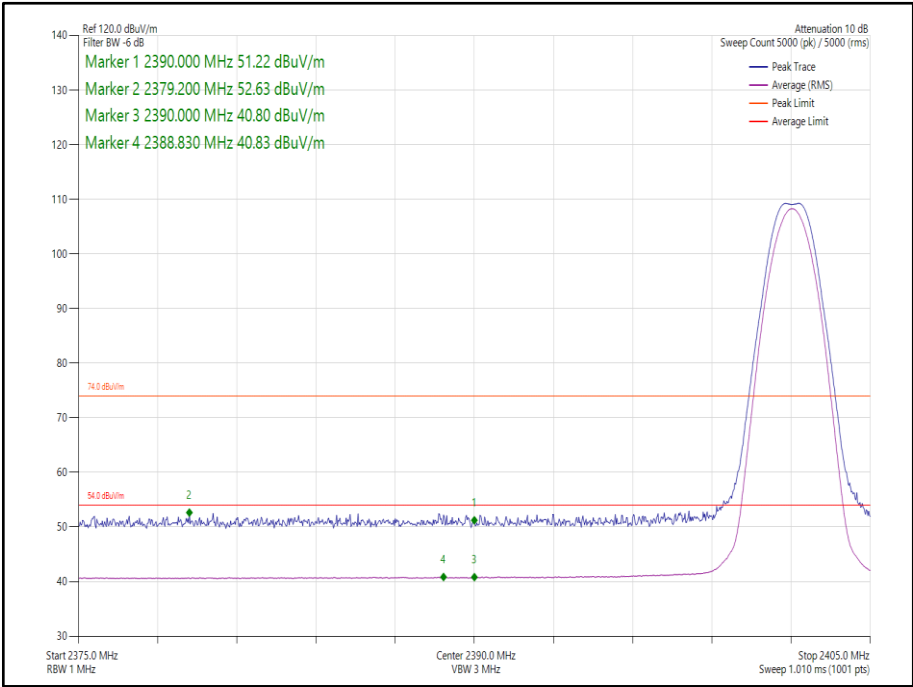


Figure 5 - Core 2 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

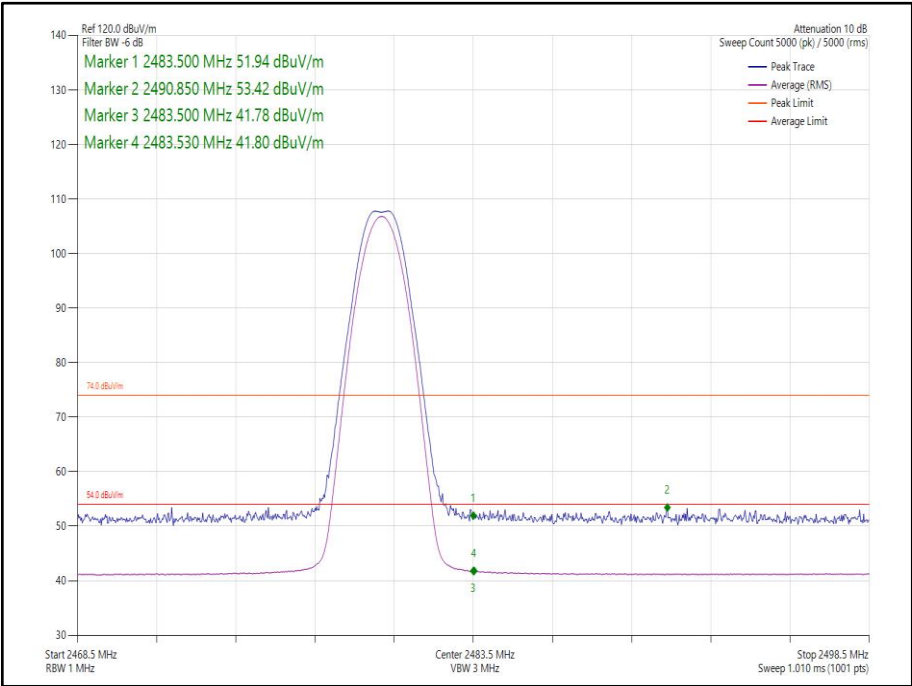


Figure 6 - Core 2 GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



LE1M iPA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0-1	2390.0	52.92	40.85
GFSK/DH1	2480	Core 0-1	2483.5	53.13	41.64

Table 9 - Restricted Band Edge Results

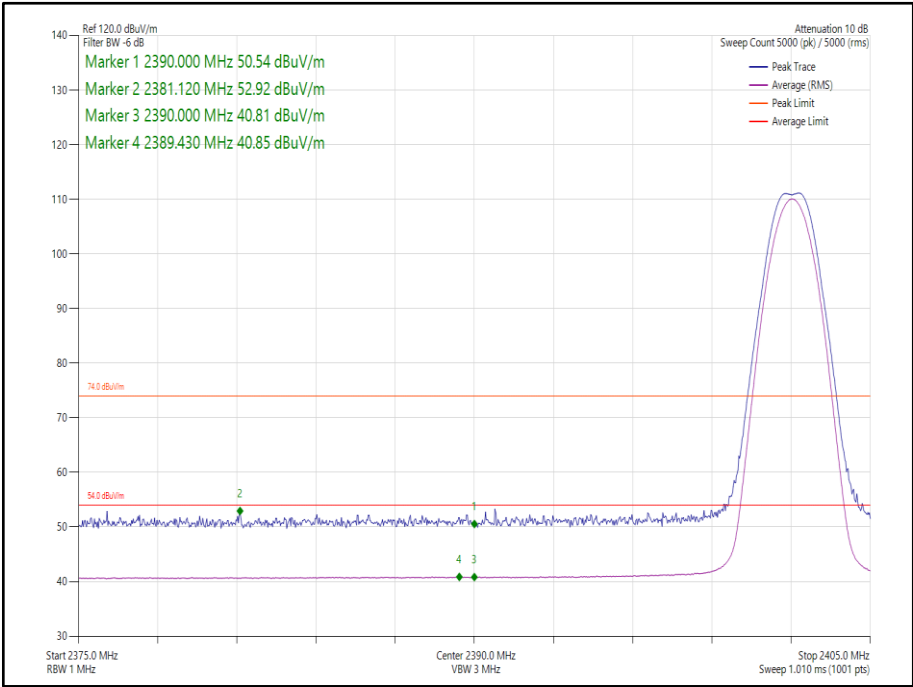


Figure 7 - Core 0-1 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

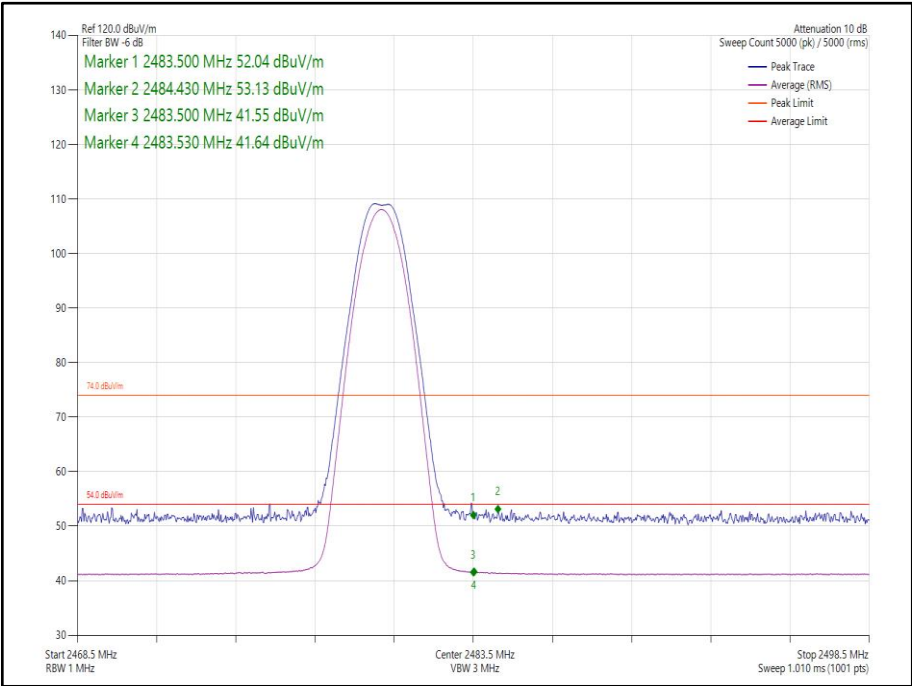


Figure 8 - Core 0-1 - GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

LE1M ePA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0-1	2390.0	53.18	41.29
GFSK/DH1	2480	Core 0-1	2483.5	54.32	42.77

Table 10 - Restricted Band Edge Results

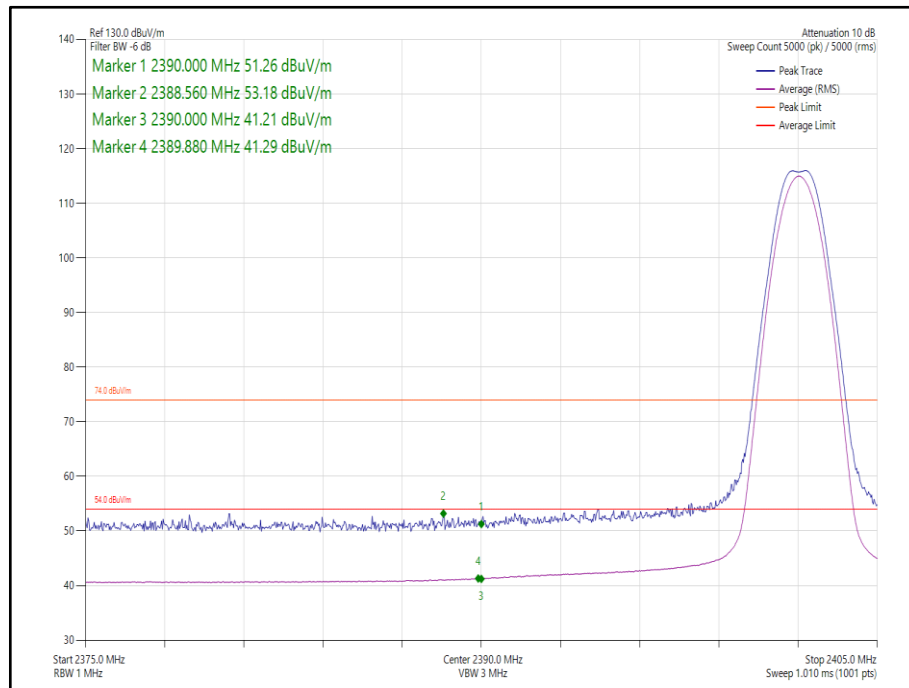


Figure 9 - Core 0-1 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

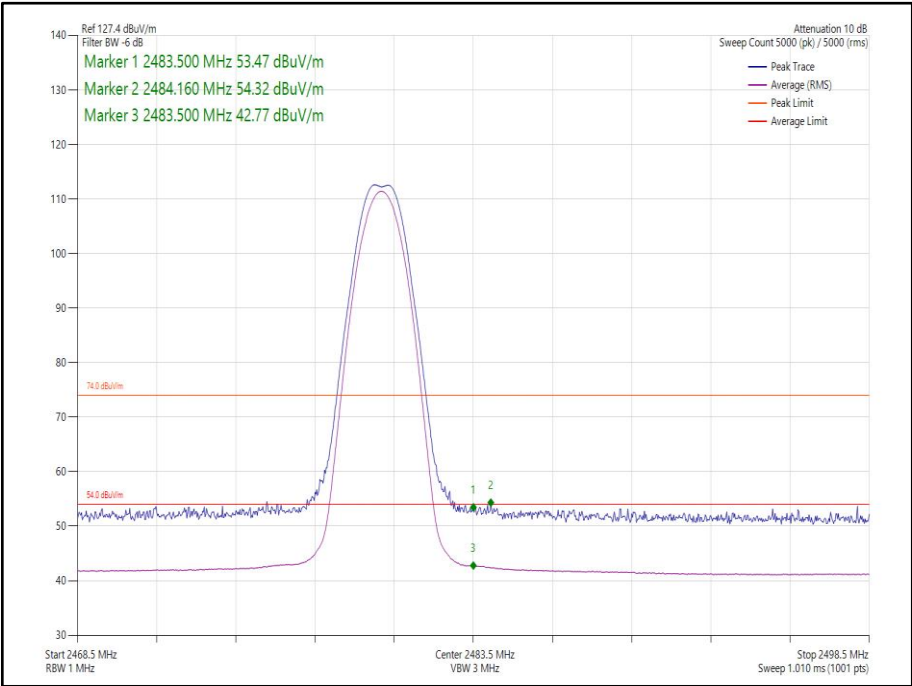


Figure 10 - Core 0-1 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



LE2M iPA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0	2390.0	52.69	40.91
GFSK/DH1	2480	Core 0	2483.5	55.97	43.67

Table 11 - Restricted Band Edge Results

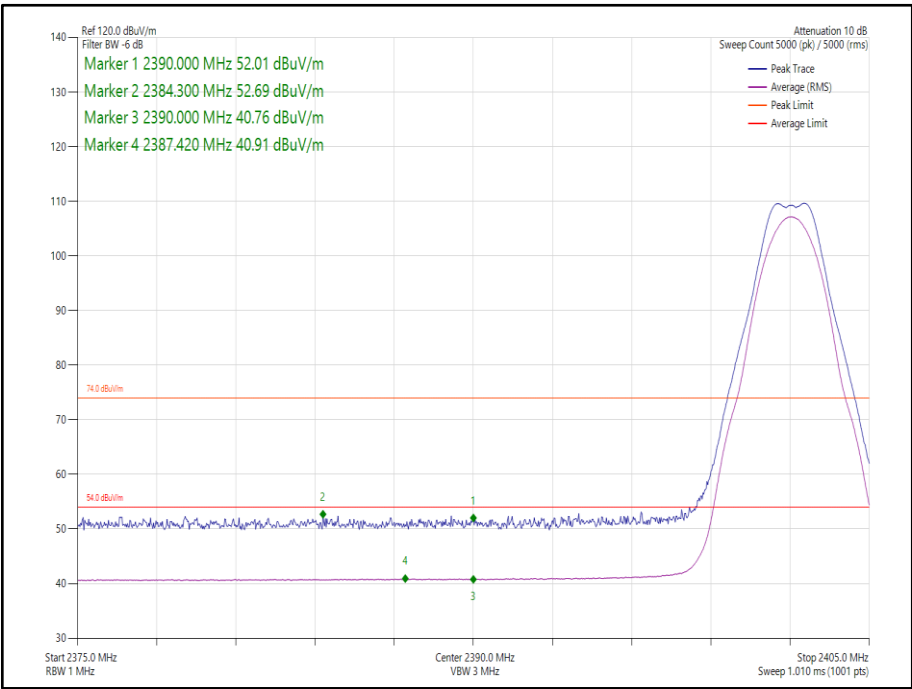


Figure 11 - Core 0 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

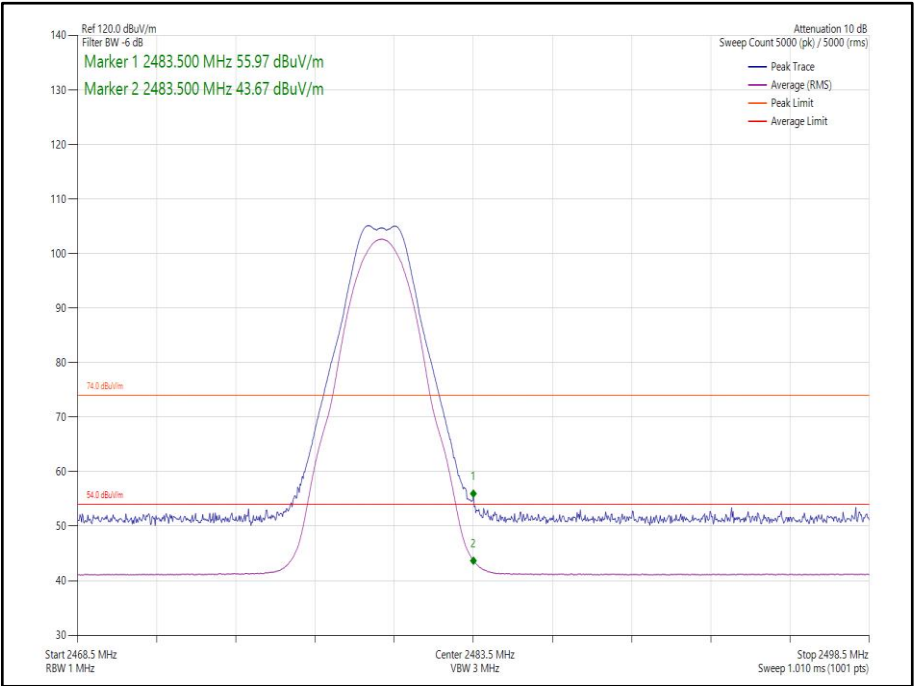


Figure 12 - Core 0 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



LE2M ePA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0	2390.0	52.56	41.37
GFSK/DH1	2480	Core 0	2483.5	56.06	44.00

Table 12 - Restricted Band Edge Results

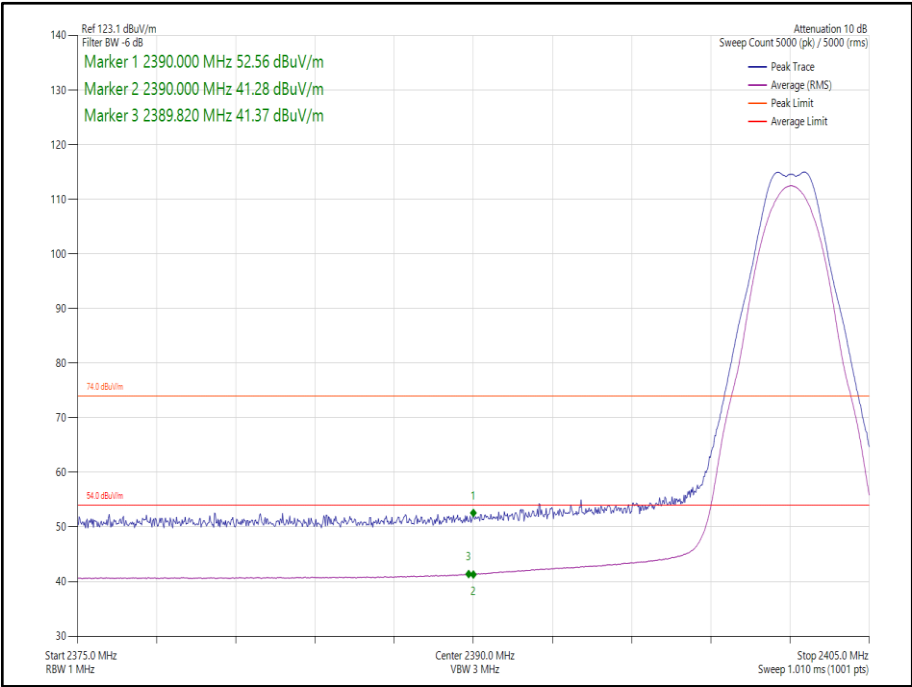


Figure 13 - Core 0 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

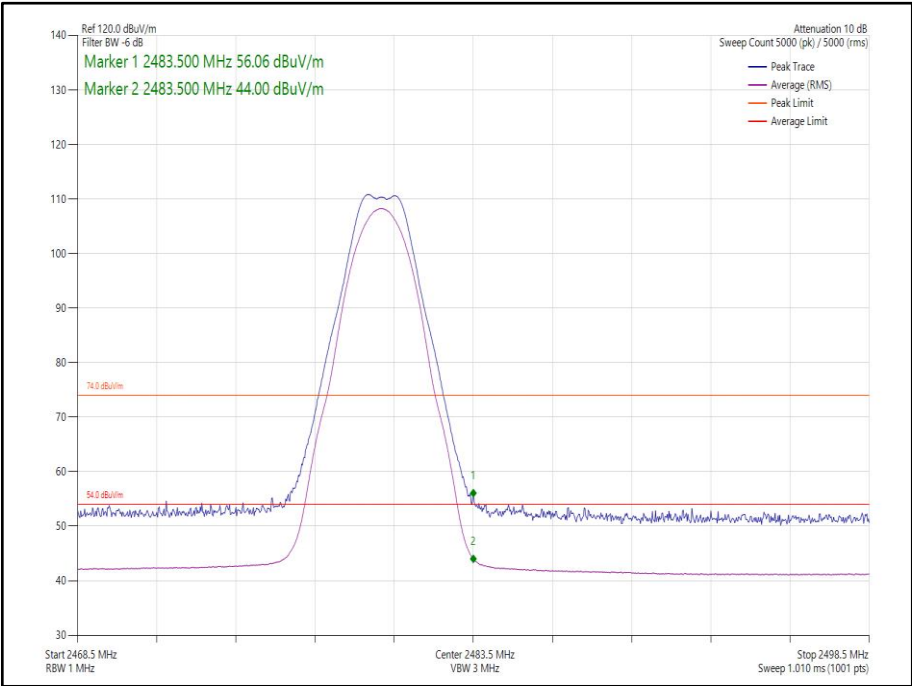


Figure 14 - Core 0 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



LE2M iPA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 2	2390.0	53	40.85
GFSK/DH1	2480	Core 2	2483.5	53.88	43.62

Table 13 - Restricted Band Edge Results

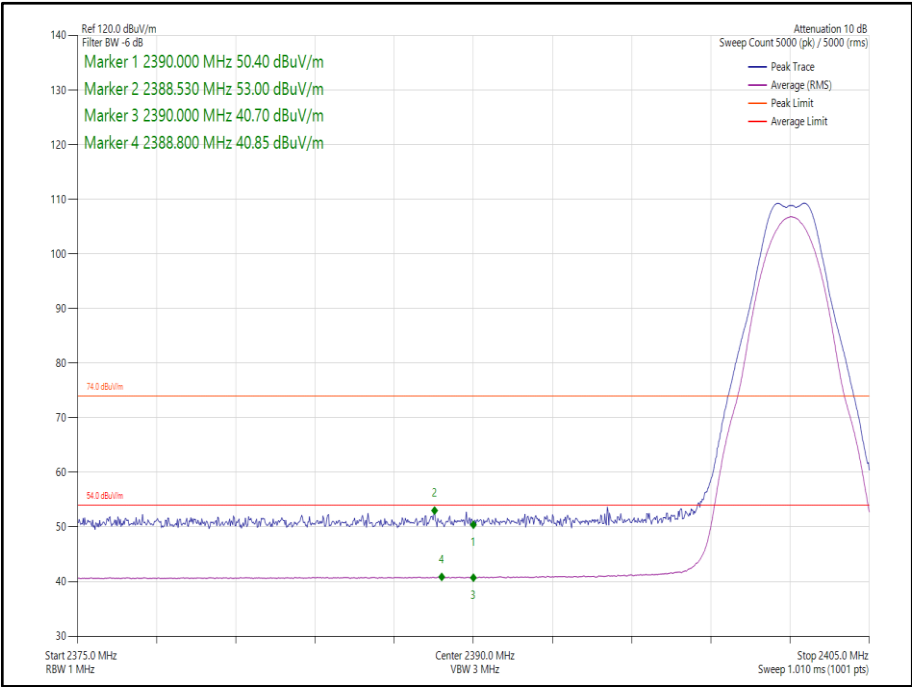


Figure 15 - Core 2 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

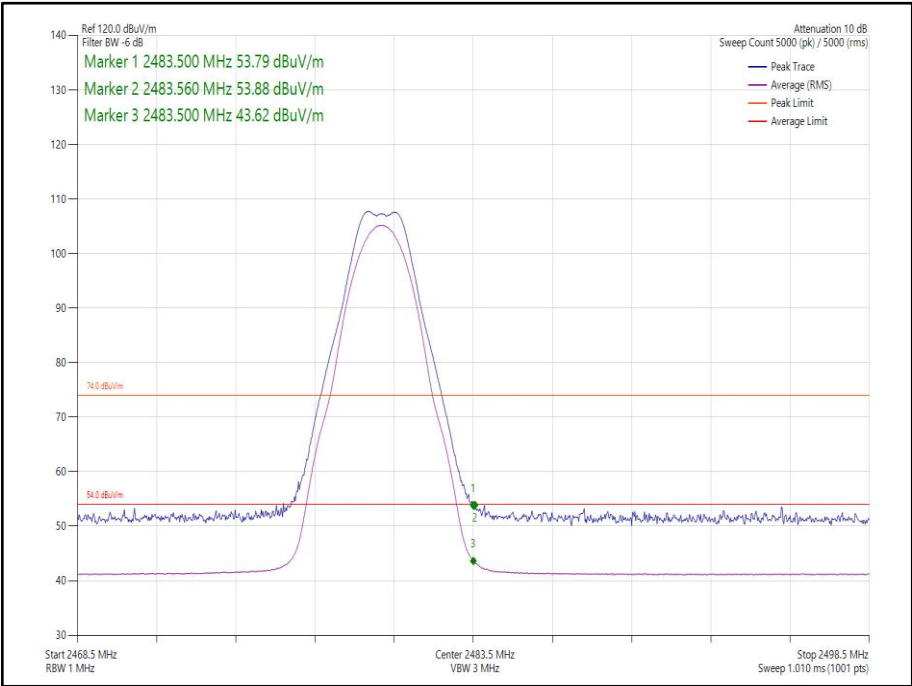


Figure 16 - Core 2 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

LE2M iPA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0-1	2390.0	52.59	40.88
GFSK/DH1	2480	Core 0-1	2483.5	54.8	43.75

Table 14 - Restricted Band Edge Results

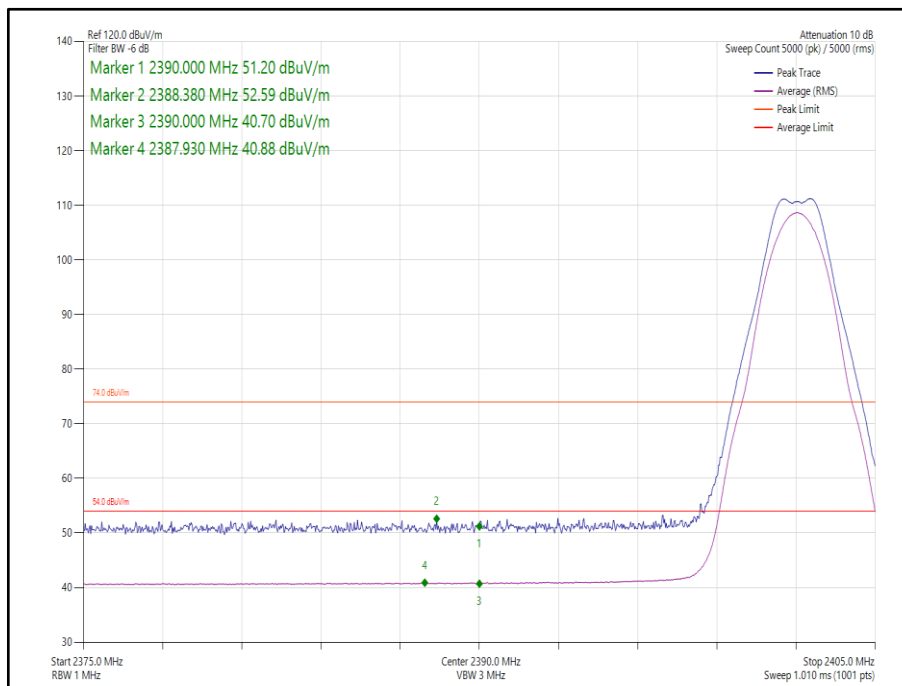


Figure 17 - Core 0-1 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

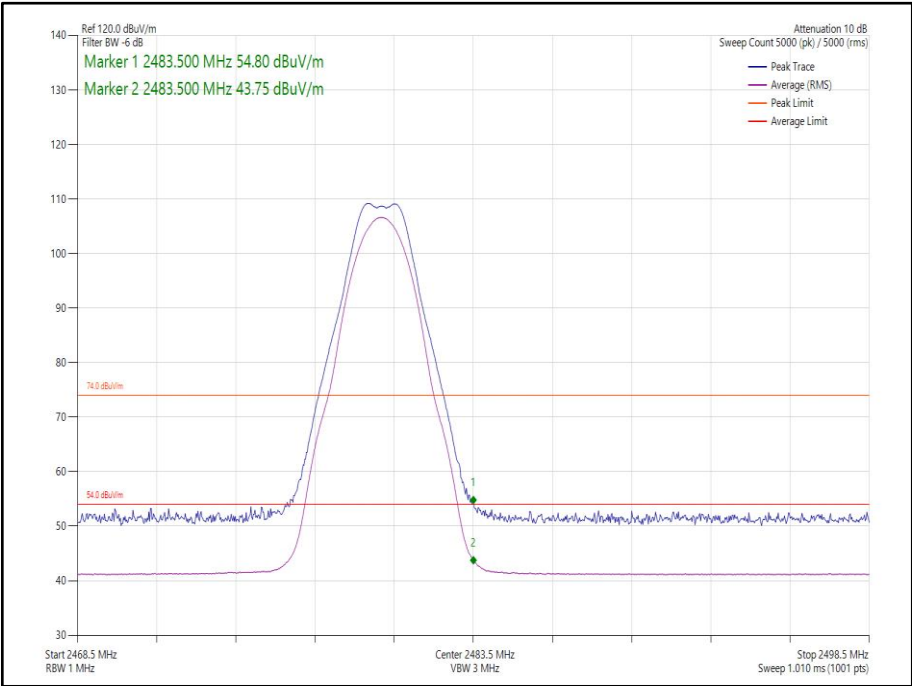


Figure 18 - Core 0-1 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

LE2M ePA

Modulation	Tx Frequency (MHz)	Core	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	Core 0-1	2390.0	52.51	41.39
GFSK/DH1	2480	Core 0-1	2483.5	55.88	45.51

Table 15 - Restricted Band Edge Results

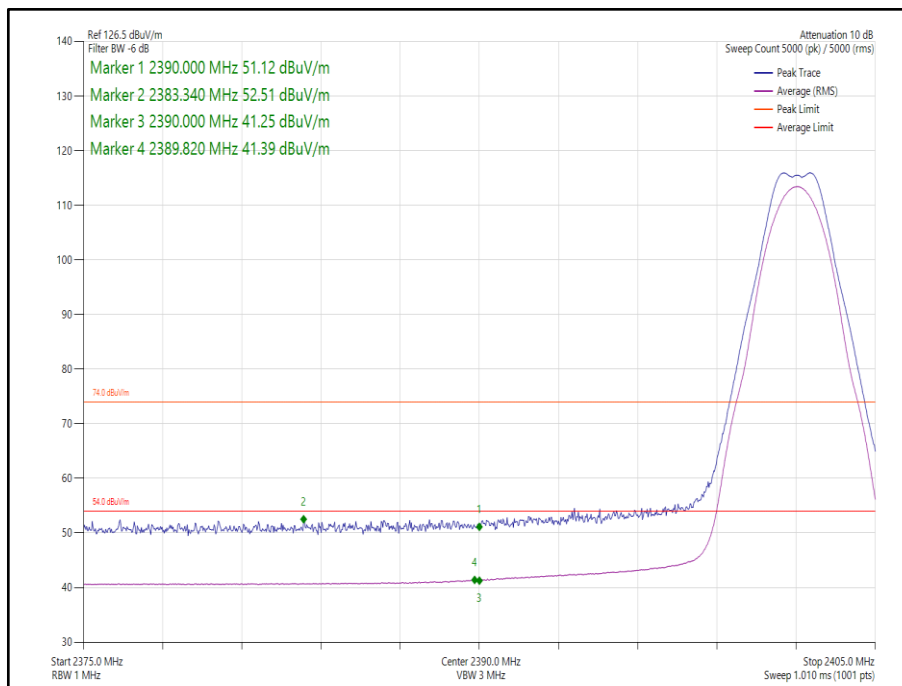


Figure 19 - Core 0-1 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

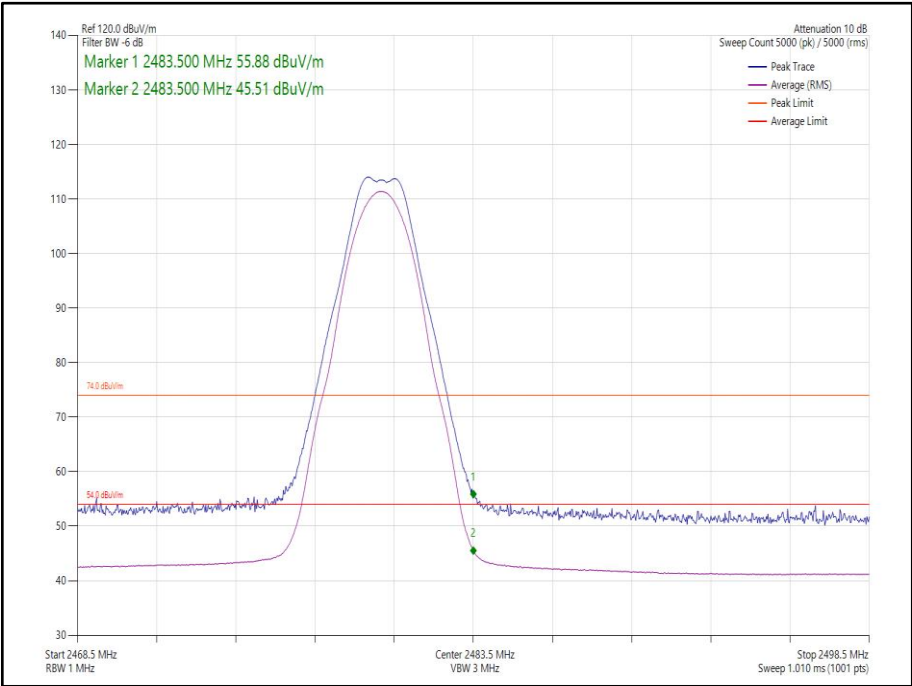


Figure 20 - Core 0-1 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

HDR4 ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0	4DH5	2404	2390.0	54.22	42.52
Static	$\pi/4$ -DQPSK	Core 0	4DH5	2476	2483.5	53.44	41.54

Table 16 - Restricted Band Edge Results

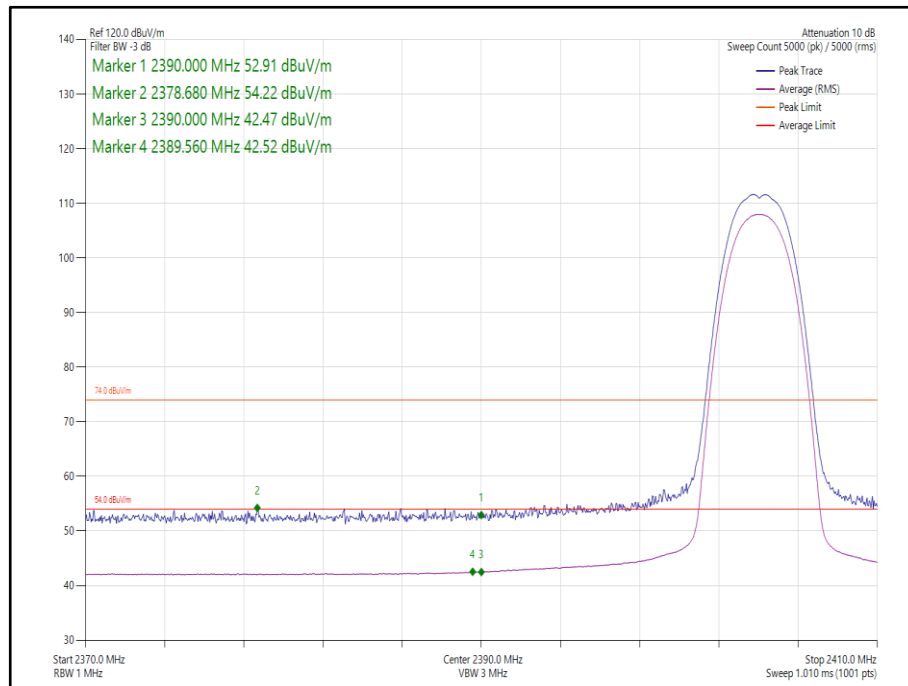


Figure 21 - Core 0 - Static - $\pi/4$ -DQPSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

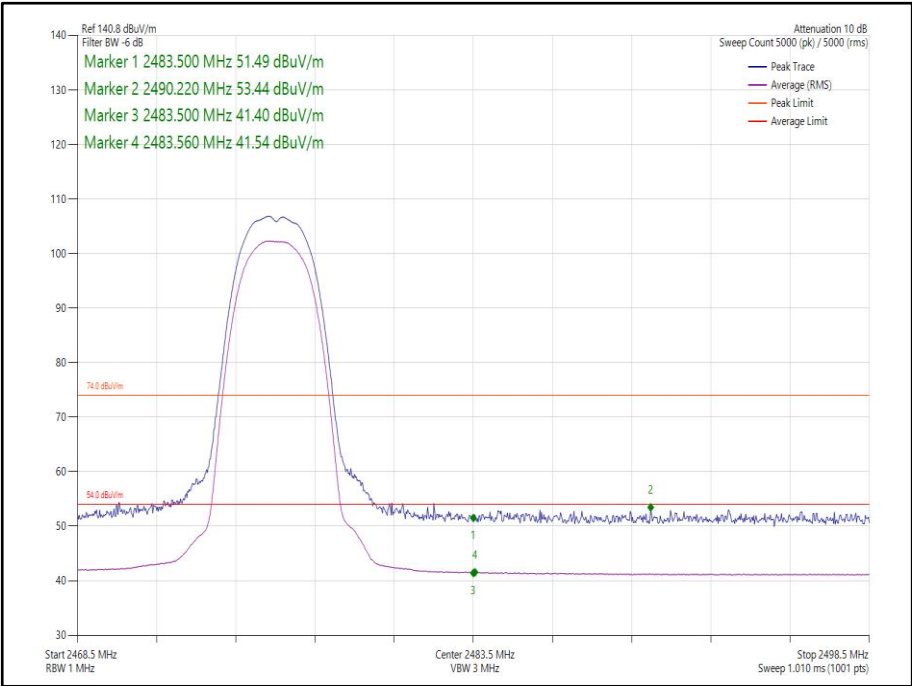


Figure 22 Core 0 - Static - $\pi/4$ -DQPSK/4DH5 - 2476 MHz - Band Edge Frequency 2483.5 MHz



HDR4 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	π/4-DQPSK	Core 0	4DH5	2404	2390.0	54.53	42.31
Static	π/4-DQPSK	Core 0	4DH5	2476	2483.5	53.25	41.27

Table 17 - Restricted Band Edge Results

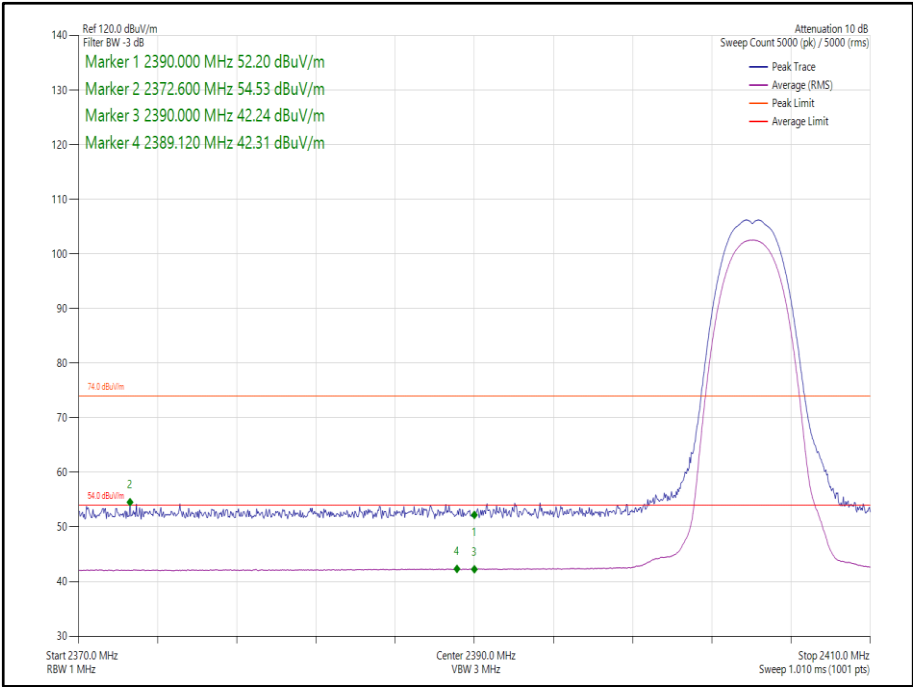


Figure 23 - Core 0- Static - π/4-DQPSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

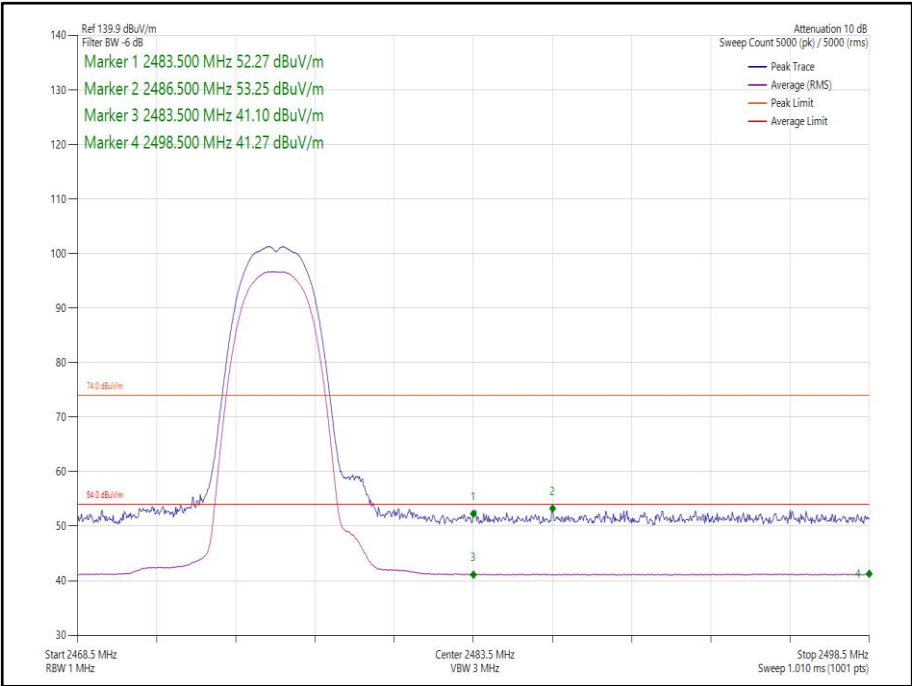


Figure 24 - Core 0- Static - $\pi/4$ -DQPSK/4DH5 - 2476 MHz - Band Edge Frequency 2483.5 MHz

HDR4 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 2	4DH5	2404	2390.0	54.33	42.3
Static	$\pi/4$ -DQPSK	Core 2	4DH5	2476	2483.5	53.51	41.27

Table 18 - Restricted Band Edge Results

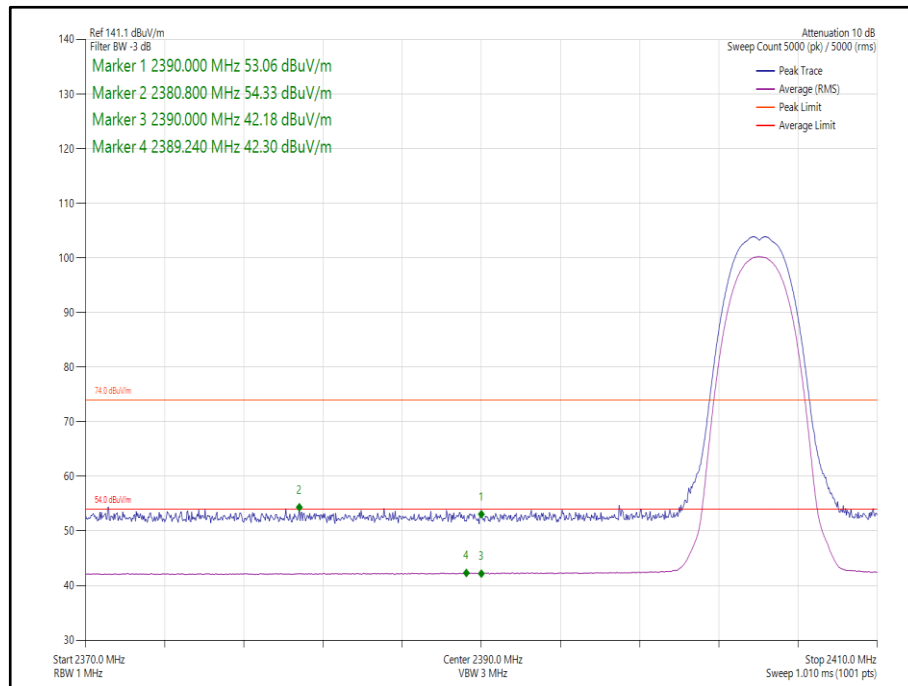


Figure 25 - Core 2- Static - $\pi/4$ -DQPSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

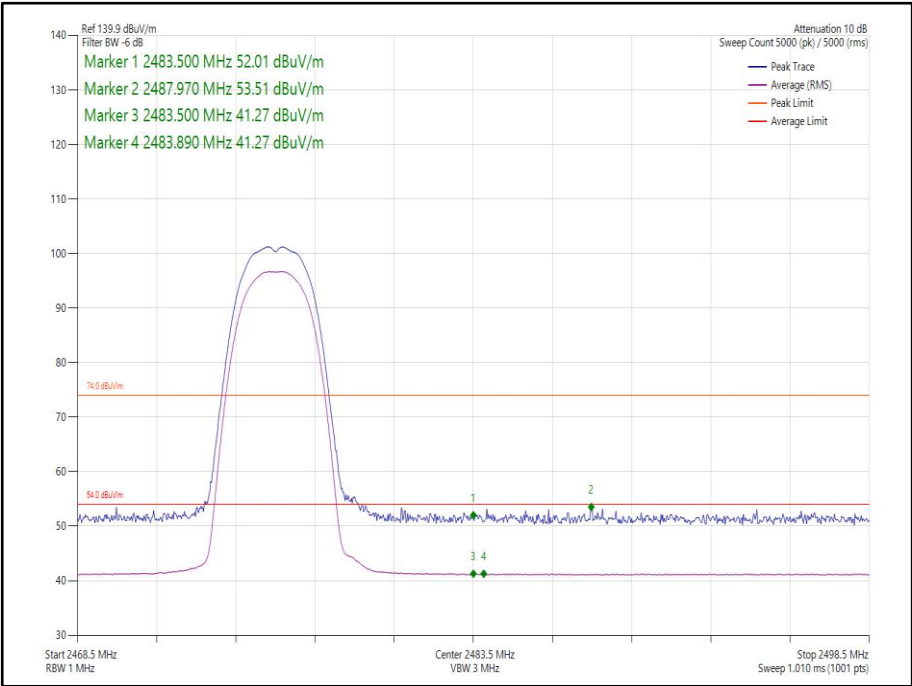


Figure 26 - Core 2- Static - $\pi/4$ -DQPSK/4DH5 - 2476 MHz - Band Edge Frequency 2483.5 MHz

HDR4 ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0-1	4DH5	2404	2390.0	53.94	42.55
Static	$\pi/4$ -DQPSK	Core 0-1	4DH5	2476	2483.5	53.1	42.16

Table 19 - Restricted Band Edge Results

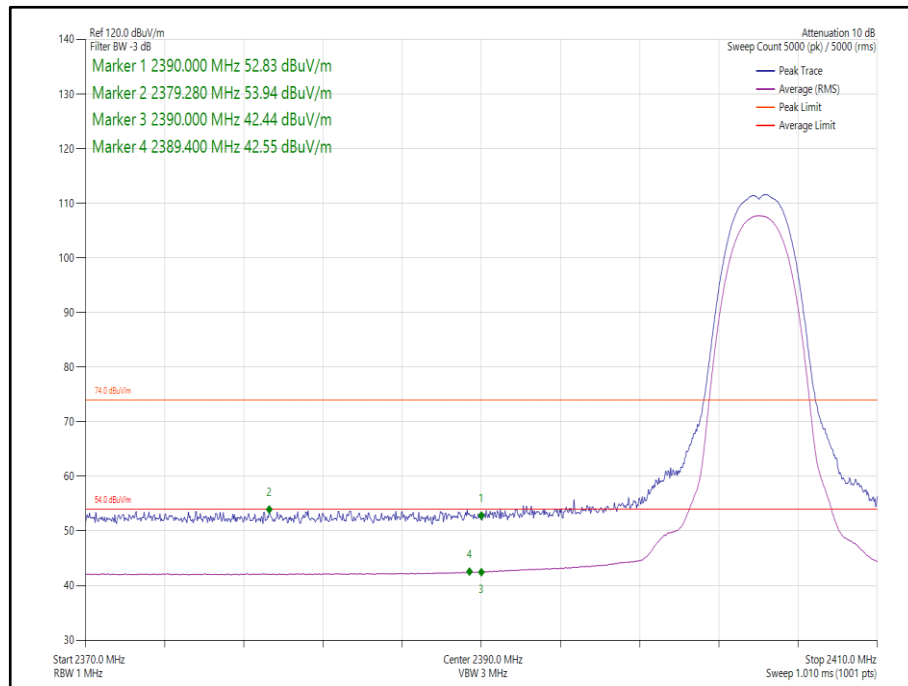


Figure 27- Core 0-1- Static - $\pi/4$ -DQPSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

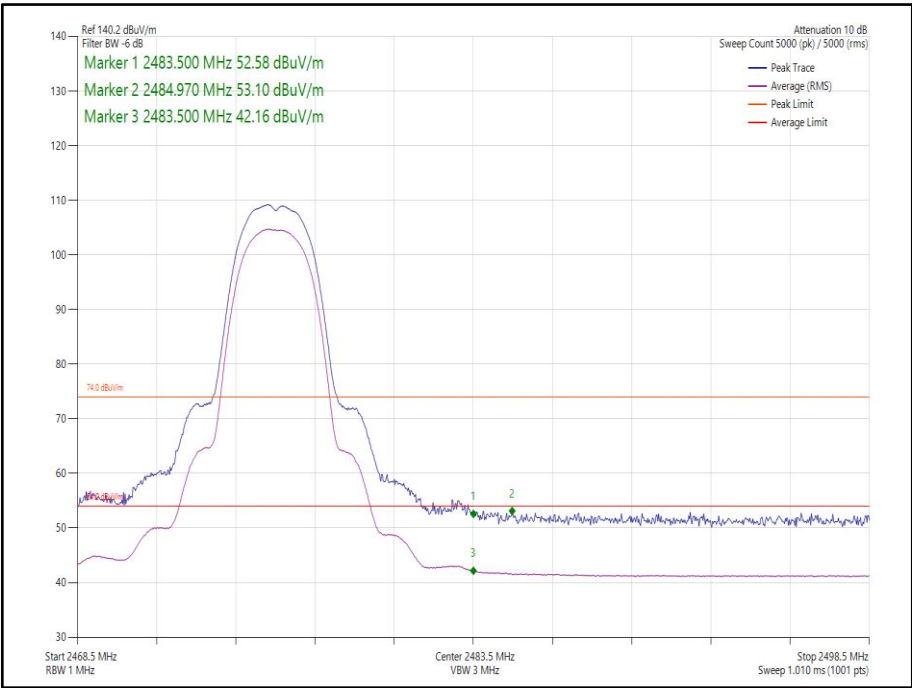
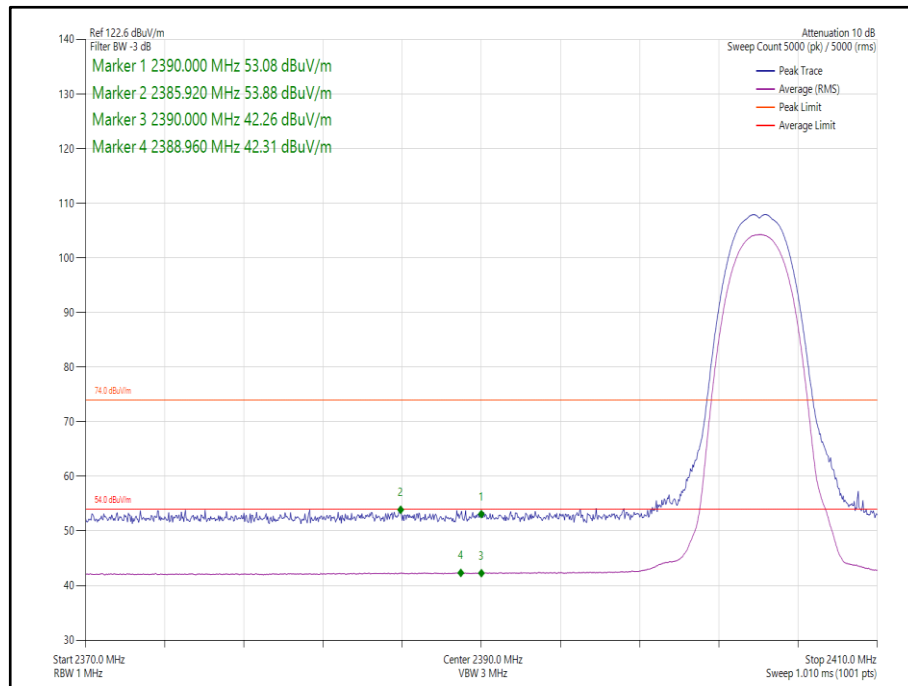


Figure 28 - Core 0-1- Static - $\pi/4$ -DQPSK/4DH5 - 2476 MHz -
Band Edge Frequency 2483.5 MHz

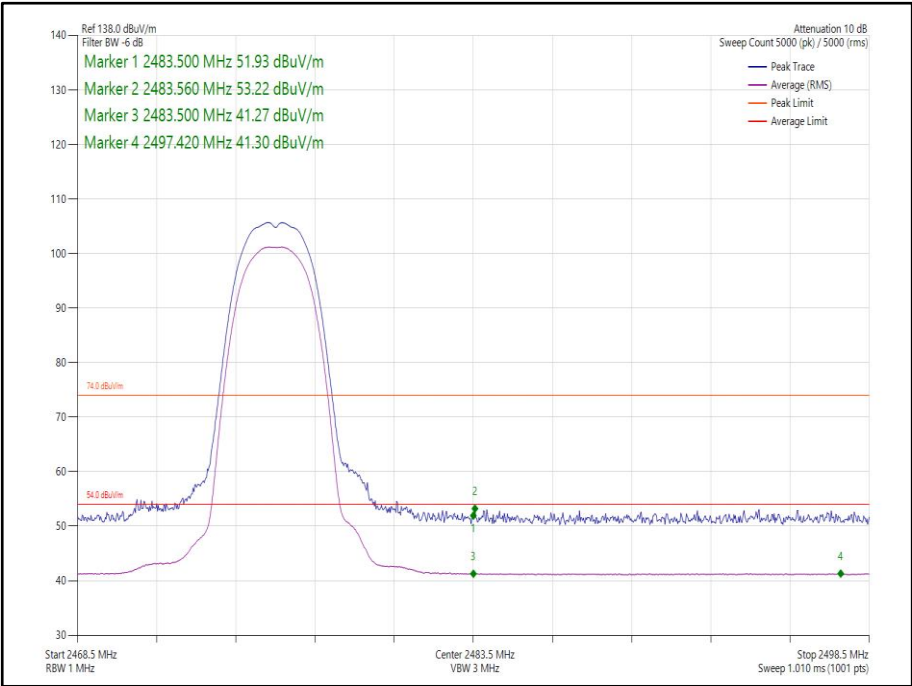
HDR4 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0-1	4DH5	2404	2390.0	53.88	42.31
Static	$\pi/4$ -DQPSK	Core 0-1	4DH5	2476	2483.5	53.22	41.3

Table 20 - Restricted Band Edge Results



**Figure 29 - Core 0-1- Static - $\pi/4$ -DQPSK/4DH5 - 2404 MHz -
Band Edge Frequency 2390.0 MHz**



**Figure 30 - Core 0-1- Static - $\pi/4$ -DQPSK/4DH5 - 2476 MHz -
Band Edge Frequency 2483.5 MHz**

HDR8 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0	8DH5	2404	2390.0	55.17	42.54
Static	$\pi/4$ -DQPSK	Core 0	8DH5	2476	2483.5	53.22	41.66

Table 21 - Restricted Band Edge Results

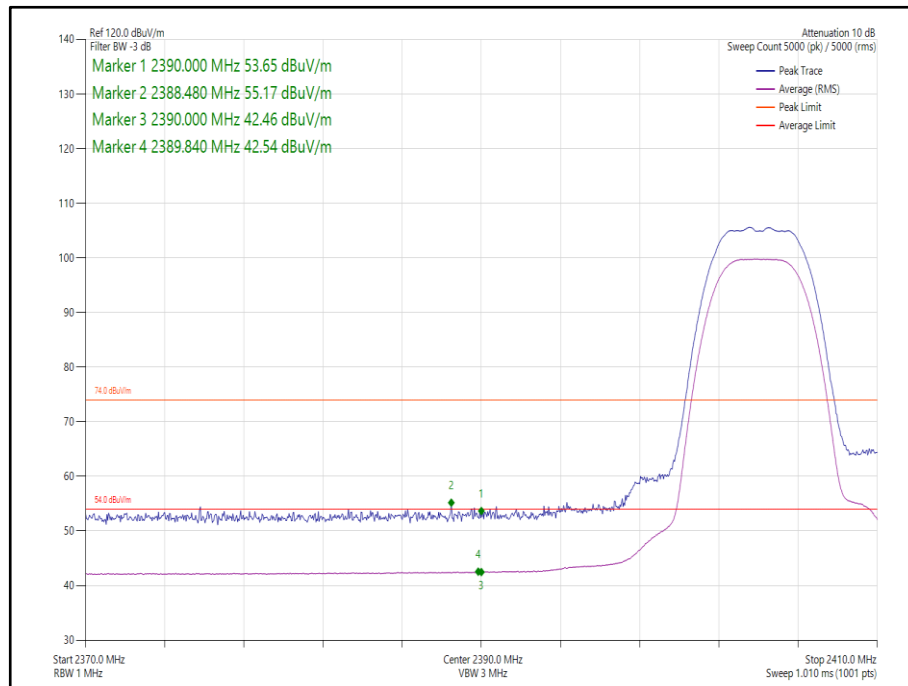


Figure 31 - Core 0- Static - $\pi/4$ -DQPSK/8DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

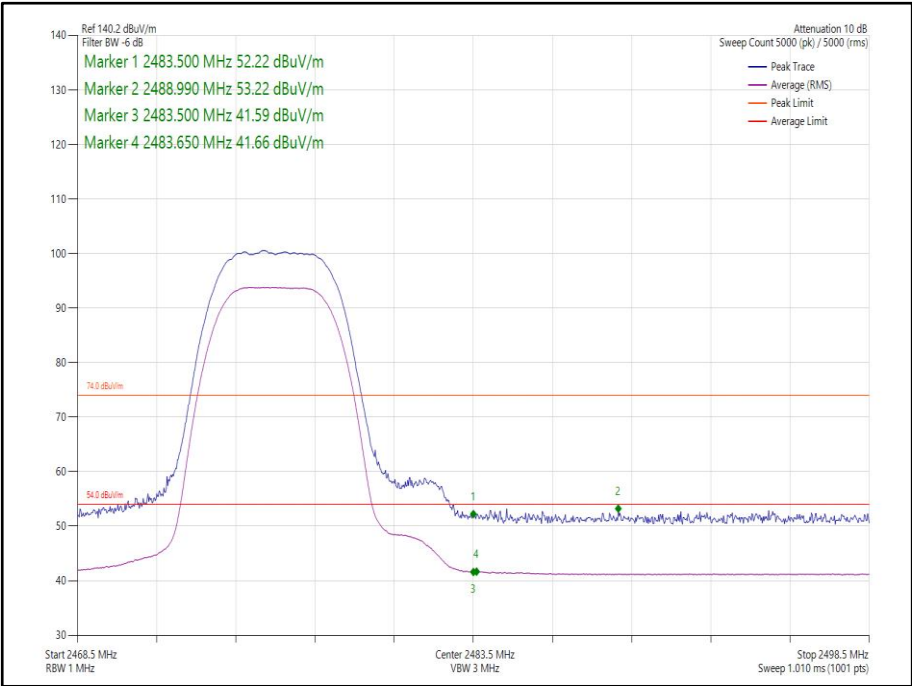


Figure 32 - Core 0- Static - $\pi/4$ -DQPSK/8DH5 - 2476 MHz -
Band Edge Frequency 2483.5 MHz

HDR8 ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0	8DH5	2404	2390.0	54.47	42.75
Static	$\pi/4$ -DQPSK	Core 0	8DH5	2476	2483.5	53.26	41.52

Table 22 - Restricted Band Edge Results

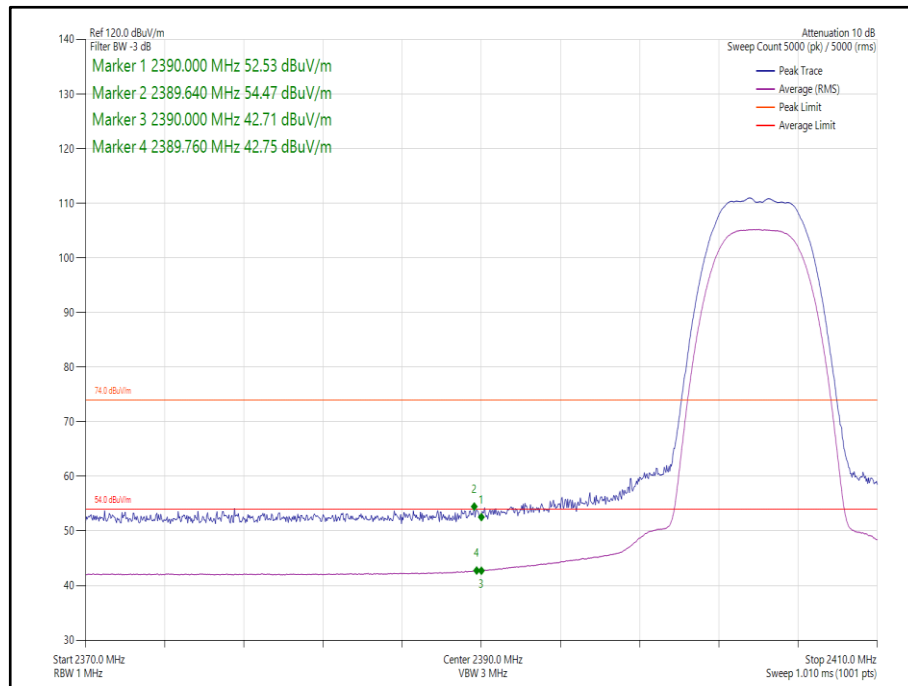


Figure 33 - Core 0- Static - $\pi/4$ -DQPSK/8DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

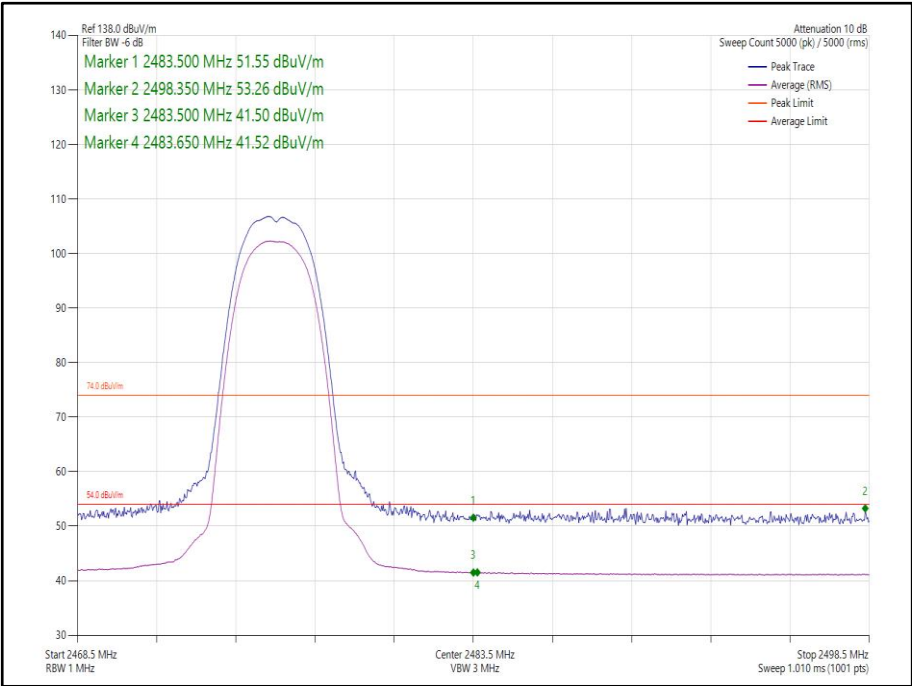


Figure 34 - Core 0- Static - $\pi/4$ -DQPSK/8DH5 - 2476 MHz -
Band Edge Frequency 2483.5 MHz



HDR8 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 2	8DH5	2404	2390.0	53.95	42.39
Static	$\pi/4$ -DQPSK	Core 2	8DH5	2476	2483.5	53.26	41.33

Table 23 - Restricted Band Edge Results

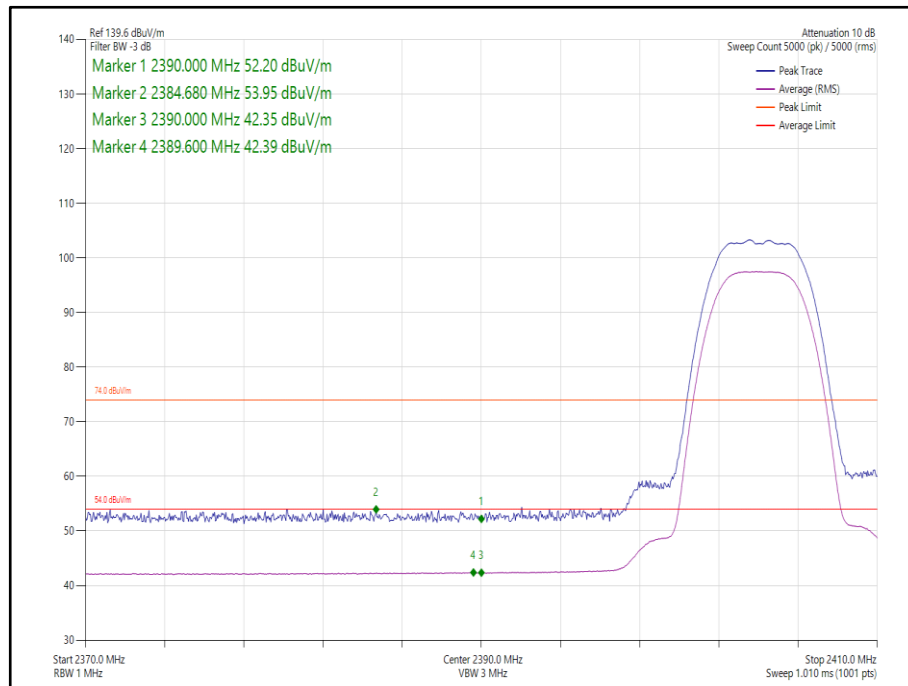


Figure 35 - Core 2- Static - $\pi/4$ -DQPSK/8DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

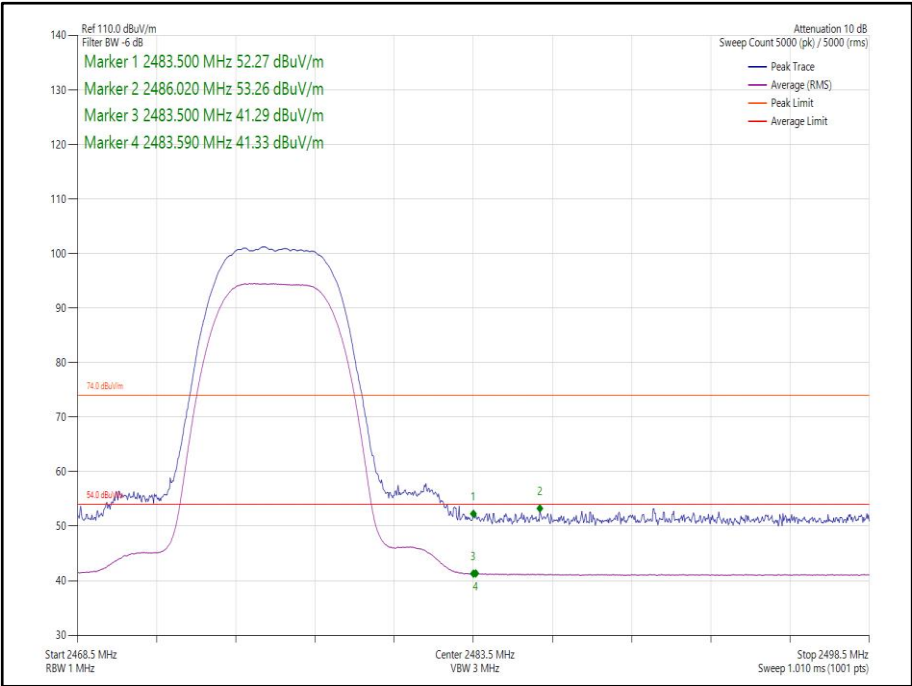
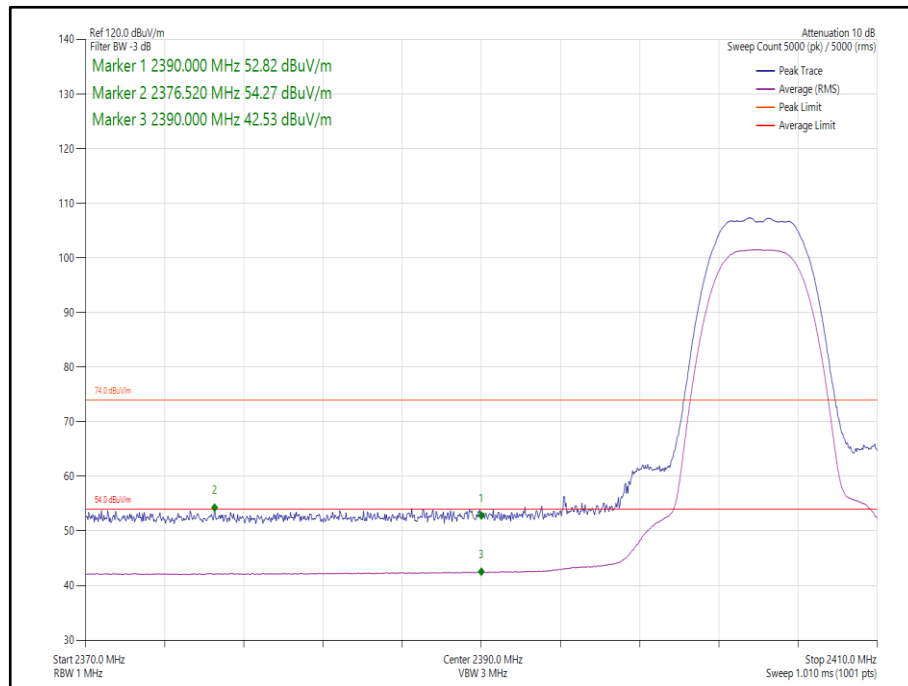


Figure 36 - Core 2- Static - $\pi/4$ -DQPSK/8DH5 - 2476 MHz - Band Edge Frequency 2483.5 MHz

HDR8 iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0-1	8DH5	2404	2390.0	54.27	42.53
Static	$\pi/4$ -DQPSK	Core 0-1	8DH5	2476	2483.5	53.69	41.77

Table 24 - Restricted Band Edge Results



**Figure 37 - Core 0-1- Static - $\pi/4$ -DQPSK/8DH5 - 2404 MHz -
Band Edge Frequency 2390.0 MHz**

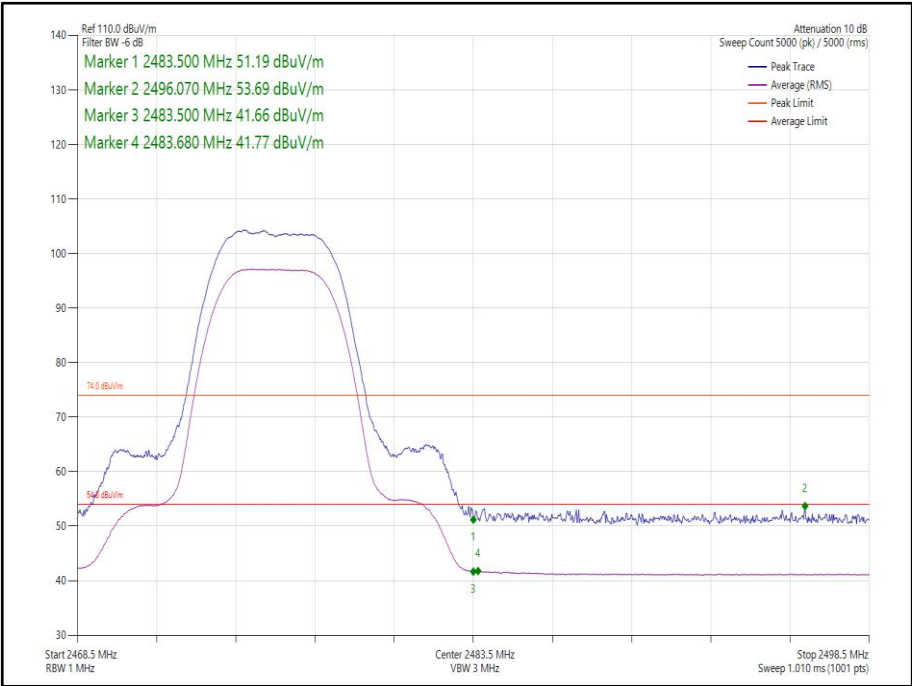
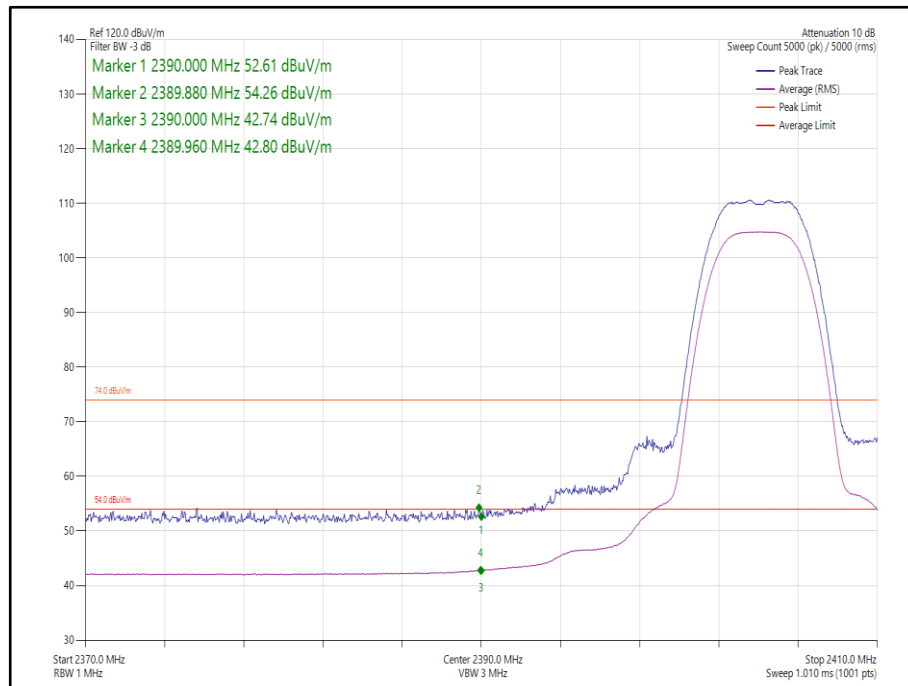


Figure 38 - Core 0-1- Static - $\pi/4$ -DQPSK/8DH5 - 2476 MHz -
Band Edge Frequency 2483.5 MHz

HDR8 ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	$\pi/4$ -DQPSK	Core 0-1	8DH5	2404	2390.0	54.26	42.8
Static	$\pi/4$ -DQPSK	Core 0-1	8DH5	2476	2483.5	53.54	42.35

Table 25 - Restricted Band Edge Results



**Figure 39 - Core 0-1- Static - $\pi/4$ -DQPSK/8DH5 - 2404 MHz -
Band Edge Frequency 2390.0 MHz**

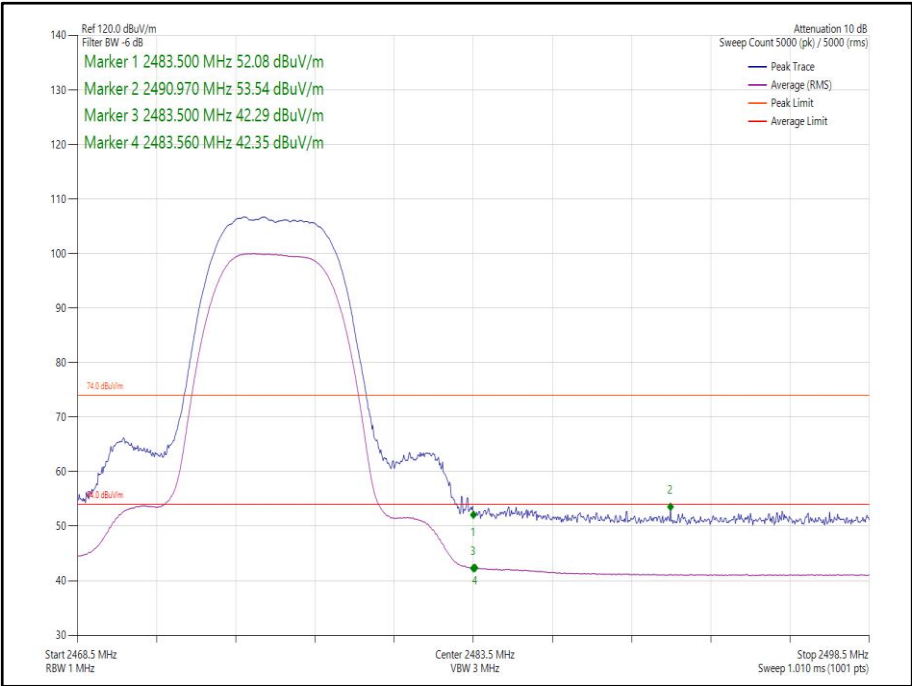


Figure 40 - Core 0-1- Static - $\pi/4$ -DQPSK/8DH5 - 2476 MHz - Band Edge Frequency 2483.5 MHz

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 26

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 27

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



2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Multimeter	Iso-tech	IDM101	2421	12	28-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	08-Mar-2022
Emissions Software	TUV SUD	EmX V2.1.11	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Mast	Maturo	TAM 4.0-P	5158	-	TU
Mast and Turntable Controller	Maturo	Maturo NCD	5159	-	TU
Turntable	Maturo	TT 15WF	5160	-	TU
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	01-Apr-2022
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	09-Apr-2022
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2022
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5604	12	22-Sep-2022

Table 28

TU - Traceability Unscheduled



2.2 Emission Bandwidth

2.2.1 Specification Reference

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

2.2.2 Equipment Under Test and Modification State

A2165, S/N: H617C20363 - Modification State 0

2.2.3 Date of Test

14-December-2021 to 05-January-2022

2.2.4 Test Method

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

2.2.5 Environmental Conditions

Ambient Temperature	21.4 – 22.2 °C
Relative Humidity	26.1 - 50.8 %



2.2.6 Test Results

2.4 GHz Bluetooth - DTS

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 $\pi/4$ 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	Minimum	
2404	1.896	-	-	-	1.896	≥ 500.0
2441	1.904	-	-	-	1.904	≥ 500.0
2476	1.904	-	-	-	1.904	≥ 500.0

Table 29 - 6 dB Bandwidth Results

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

Table 30 - 99% Bandwidth Results

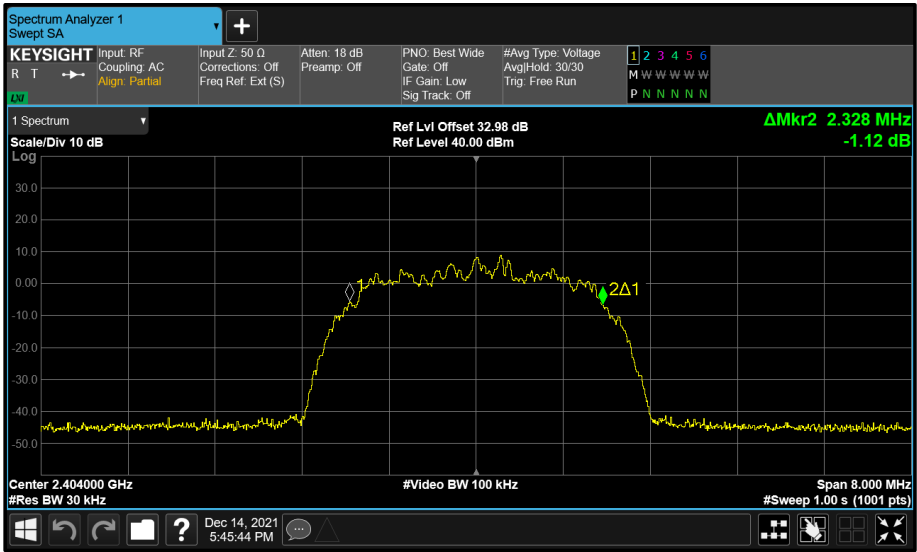


Figure 41 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

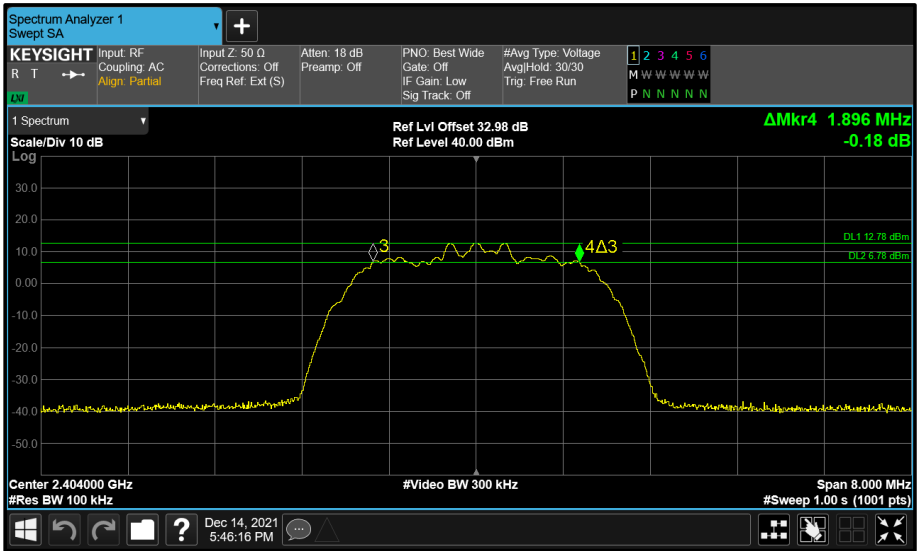


Figure 42 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

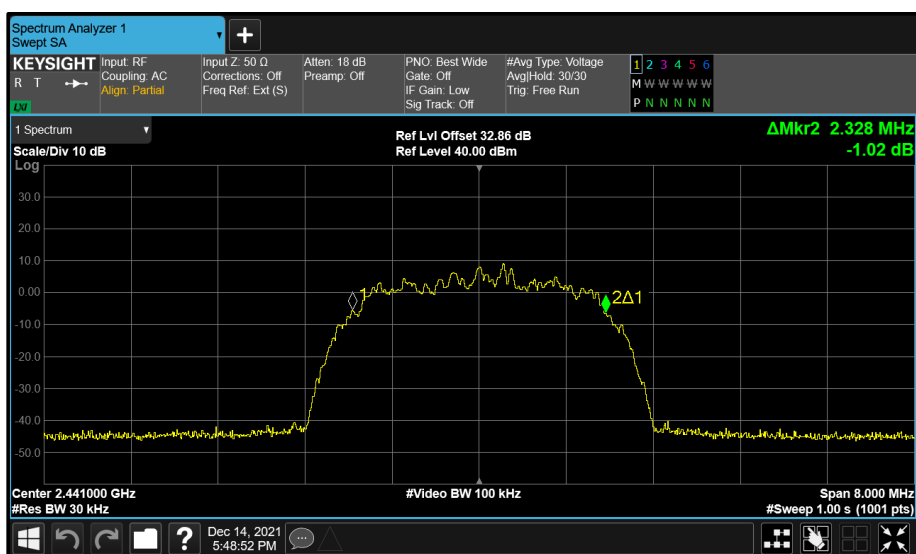


Figure 43 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

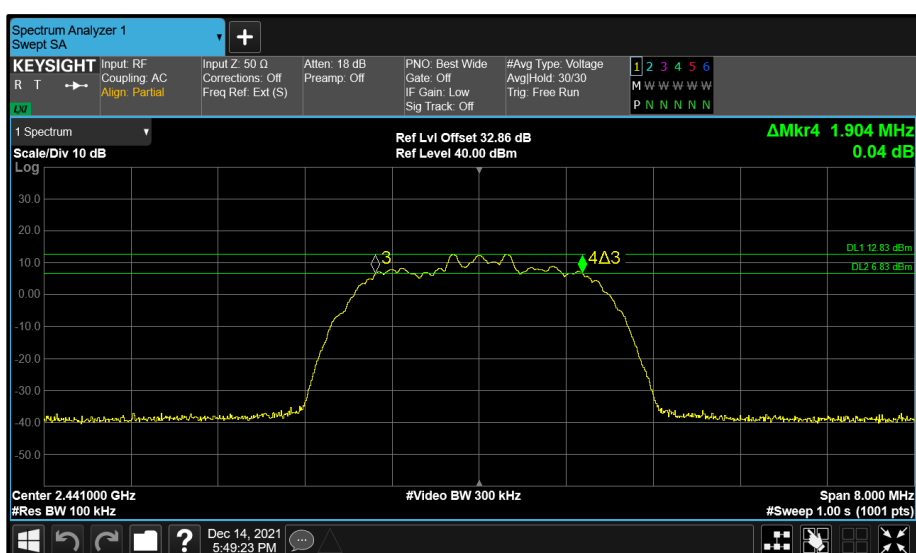


Figure 44 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth

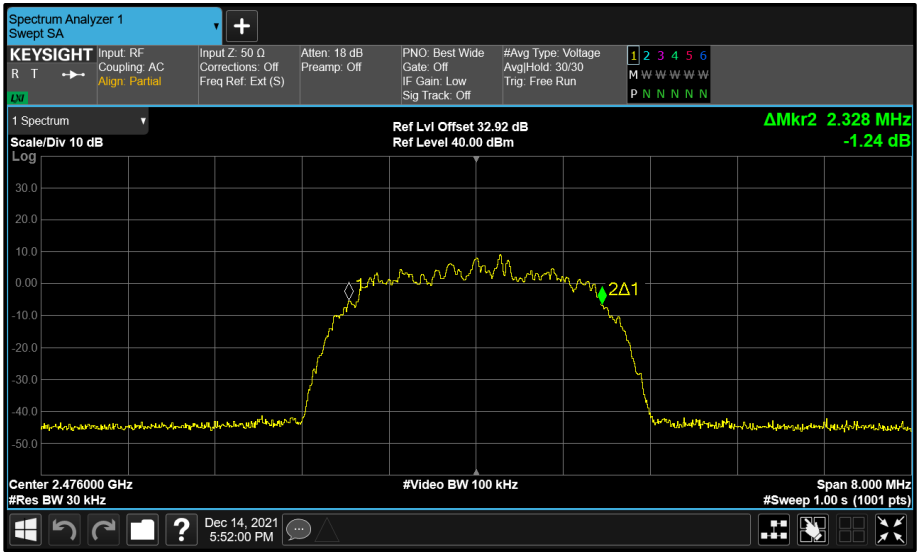


Figure 45 - Core 0 (A) 2476 MHz (CH74) 99% Bandwidth

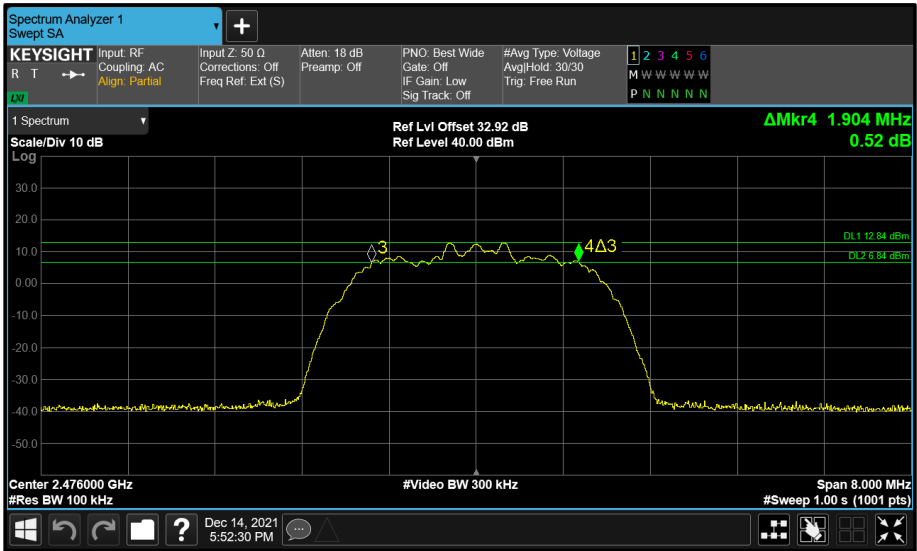


Figure 46 - Core 0 (A) 2476 MHz (CH74) 6 dB Bandwidth



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 $\pi/4$ 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	Minimum	
2404	1.020	-	-	-	1.020	≥ 500.0
2441	1.005	-	-	-	1.005	≥ 500.0
2476	1.020	-	-	-	1.020	≥ 500.0

Table 31 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	4.440	-	-	-	4.440	-
2441	4.425	-	-	-	4.425	-
2476	4.425	-	-	-	4.425	-

Table 32 - 99% Bandwidth Results

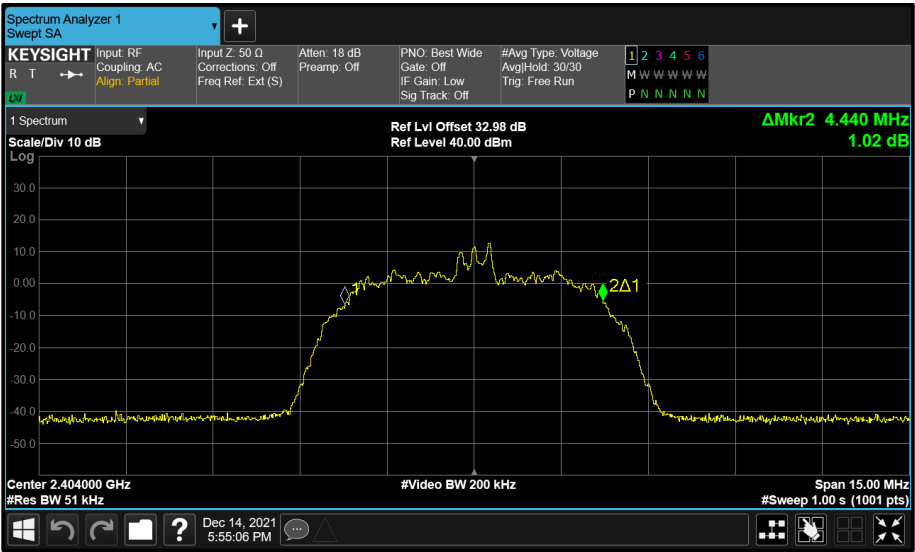


Figure 47 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

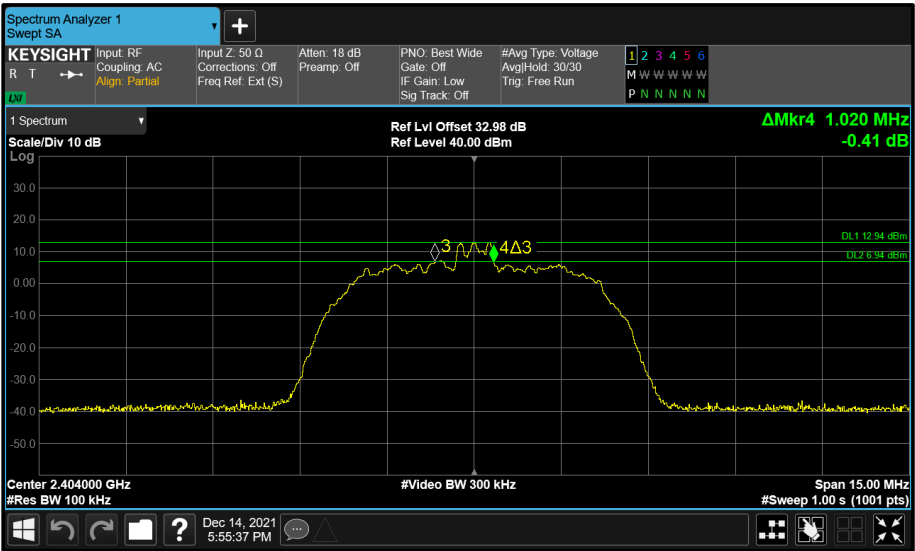


Figure 48 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

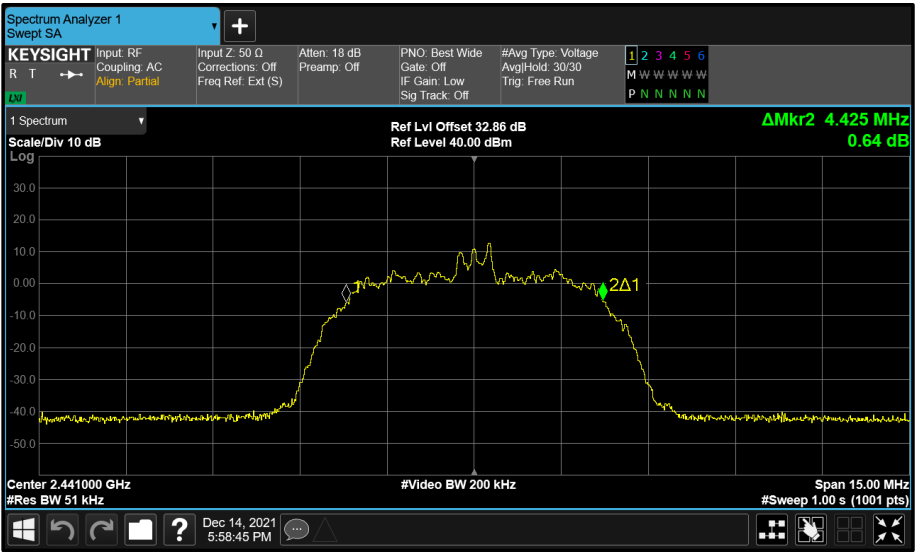


Figure 49 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

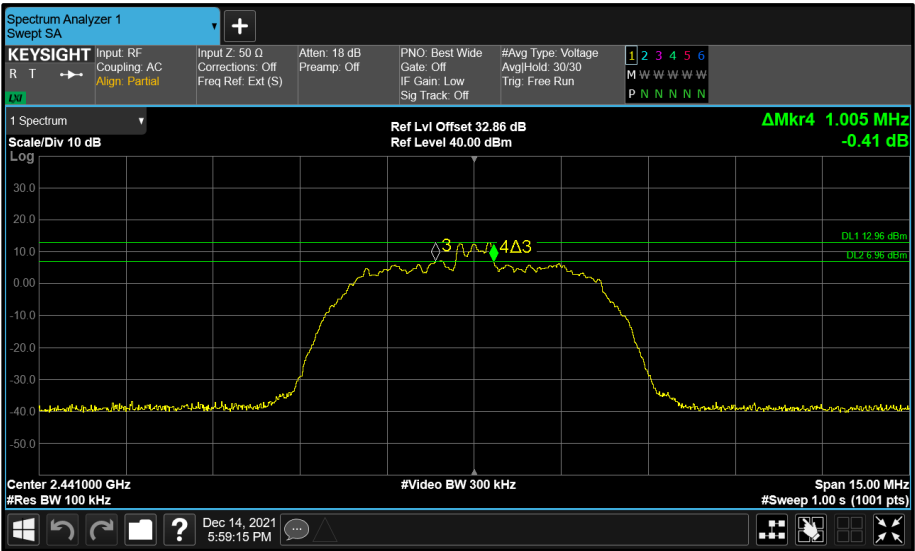


Figure 50 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth

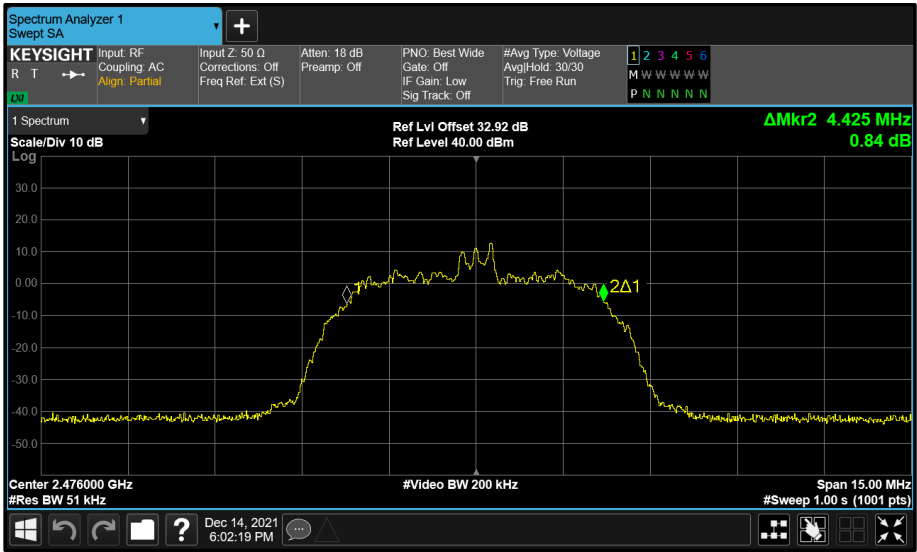


Figure 51 - Core 0 (A) 2476 MHz (CH74) 99% Bandwidth

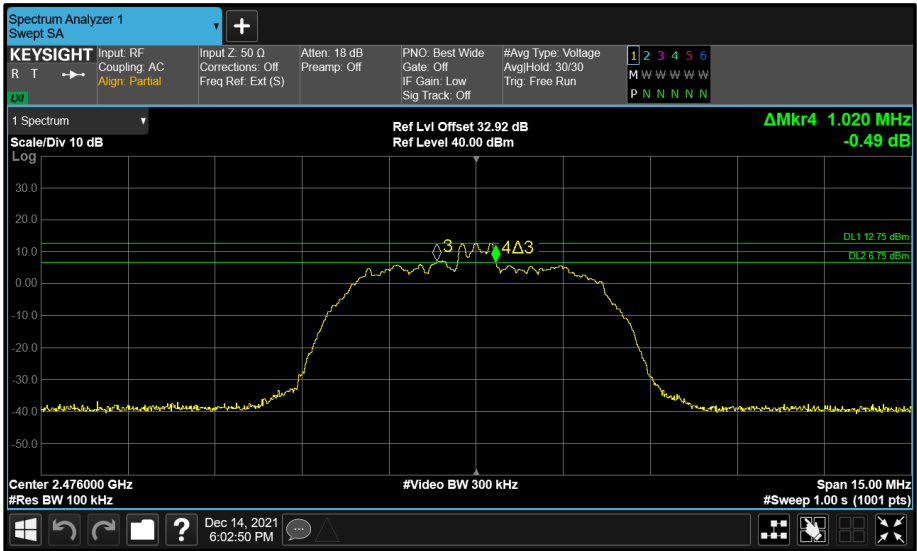


Figure 52 - Core 0 (A) 2476 MHz (CH74) 6 dB Bandwidth



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 $\pi/4$ DQPSK (4-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	B (Core 1)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	-	1.904	-	-	1.904	≥ 500.0
2441	-	1.904	-	-	1.904	≥ 500.0
2476	-	1.904	-	-	1.904	≥ 500.0

Table 33 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	-	2.336	-	-	2.336	-
2441	-	2.328	-	-	2.328	-
2476	-	2.328	-	-	2.328	-

Table 34 - 99% Bandwidth Results

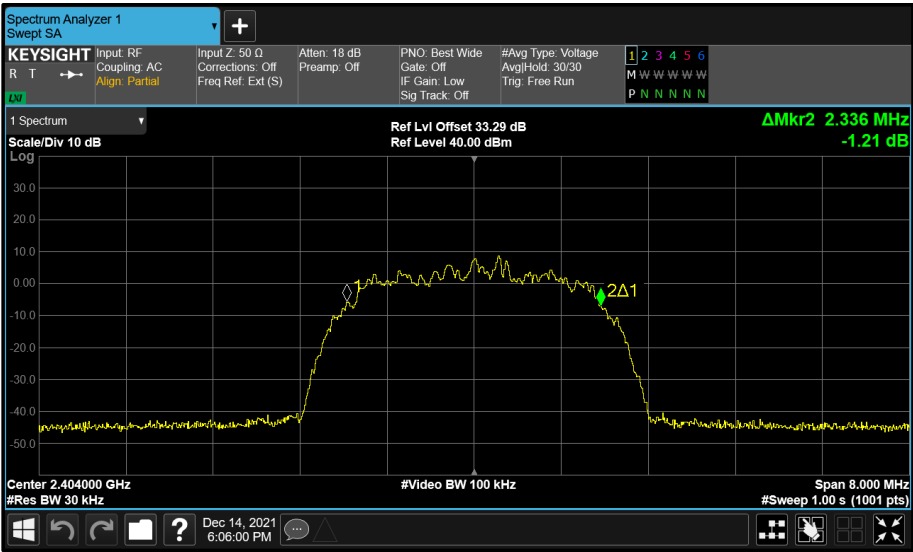


Figure 53 - Core 1 (B) 2404 MHz (CH2) 99% Bandwidth

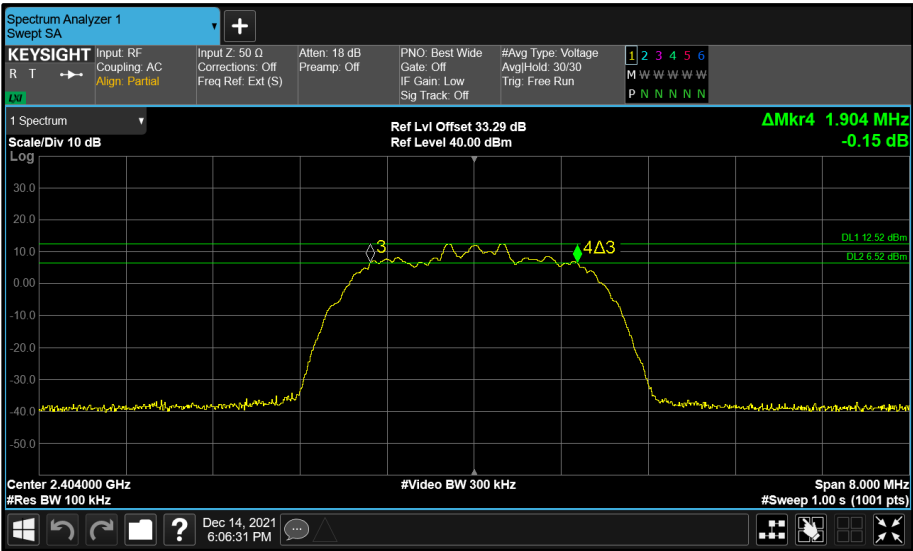


Figure 54 - Core 1 (B) 2404 MHz (CH2) 6 dB Bandwidth

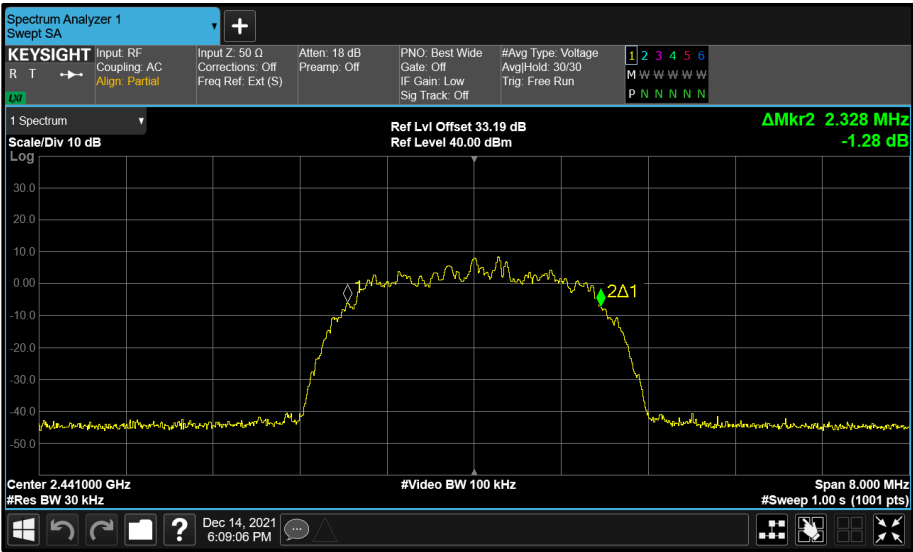


Figure 55 - Core 1 (B) 2441 MHz (CH39) 99% Bandwidth

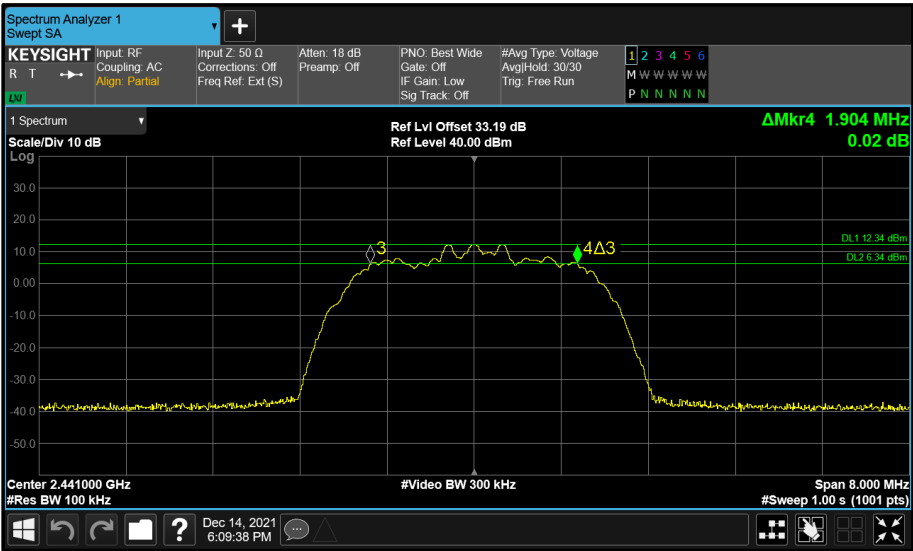


Figure 56 - Core 1 (B) 2441 MHz (CH39) 6 dB Bandwidth

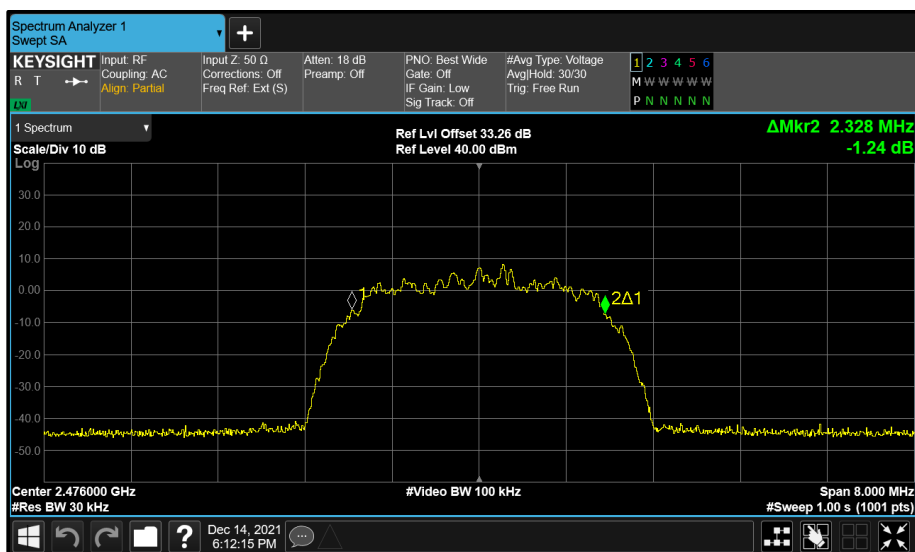


Figure 57 - Core 1 (B) 2476 MHz (CH74) 99% Bandwidth

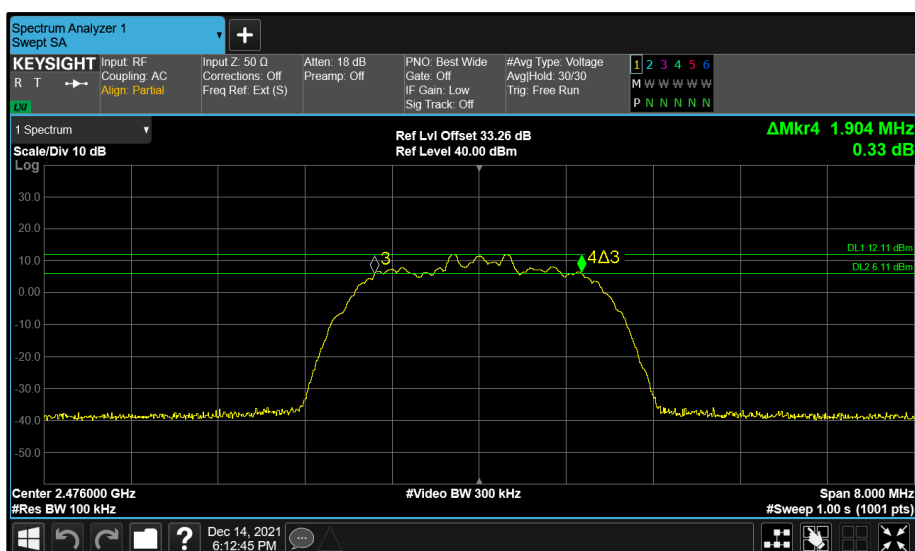


Figure 58 - Core 1 (B) 2476 MHz (CH74) 6 dB Bandwidth



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 $\pi/4$ DQPSK (8-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Port(s):	B (Core 1)	Peak Antenna Gain (dBi):	-

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

Table 35 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	-	4.440	-	-	4.440	-
2441	-	4.425	-	-	4.425	-
2476	-	4.455	-	-	4.455	-

Table 36 - 99% Bandwidth Results

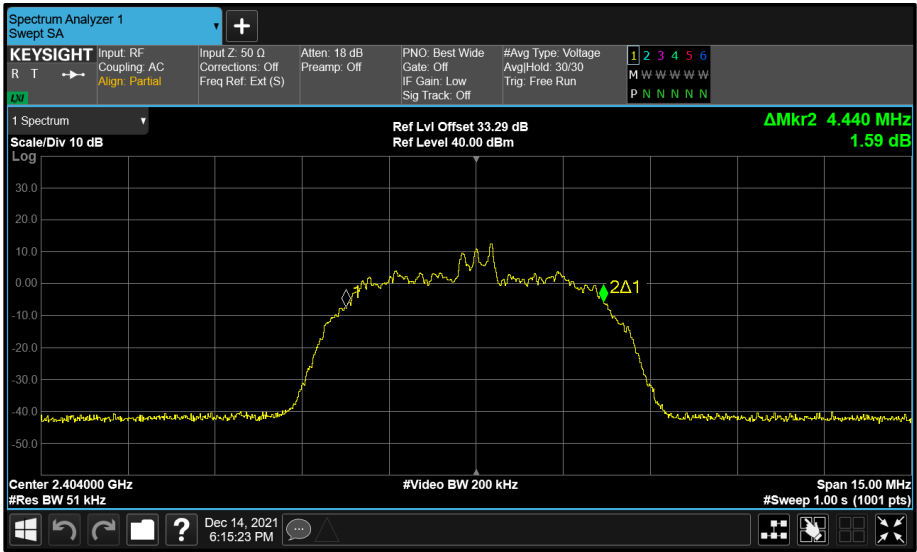


Figure 59 - Core 1 (B) 2404 MHz (CH2) 99% Bandwidth

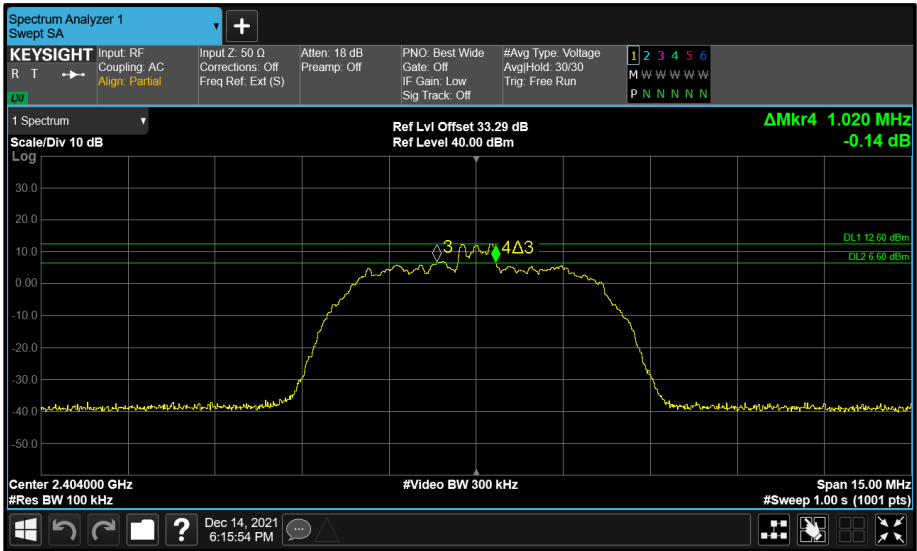


Figure 60 - Core 1 (B) 2404 MHz (CH2) 6 dB Bandwidth

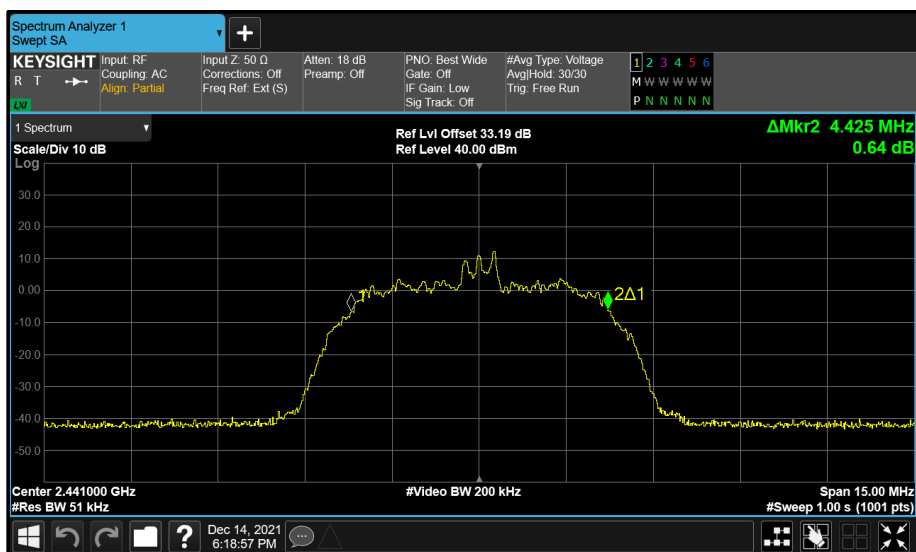


Figure 61 - Core 1 (B) 2441 MHz (CH39) 99% Bandwidth

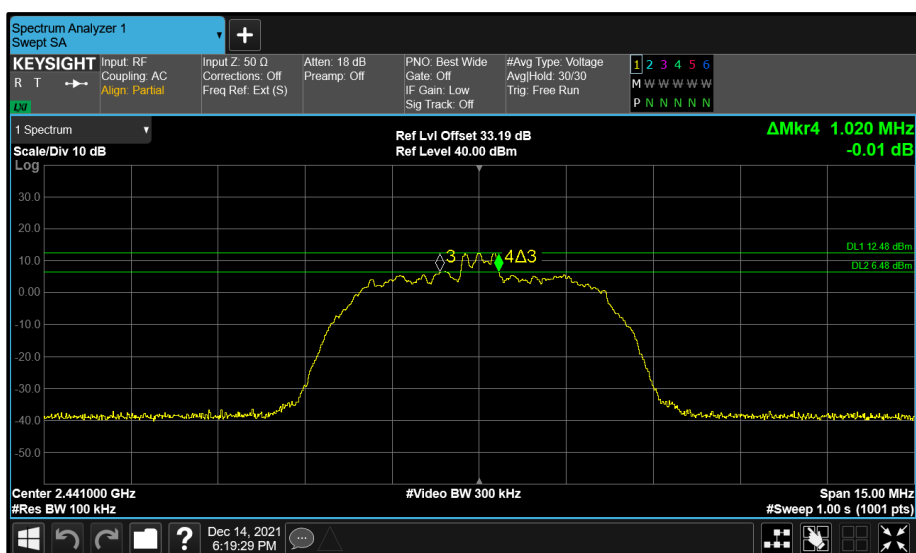


Figure 62 - Core 1 (B) 2441 MHz (CH39) 6 dB Bandwidth

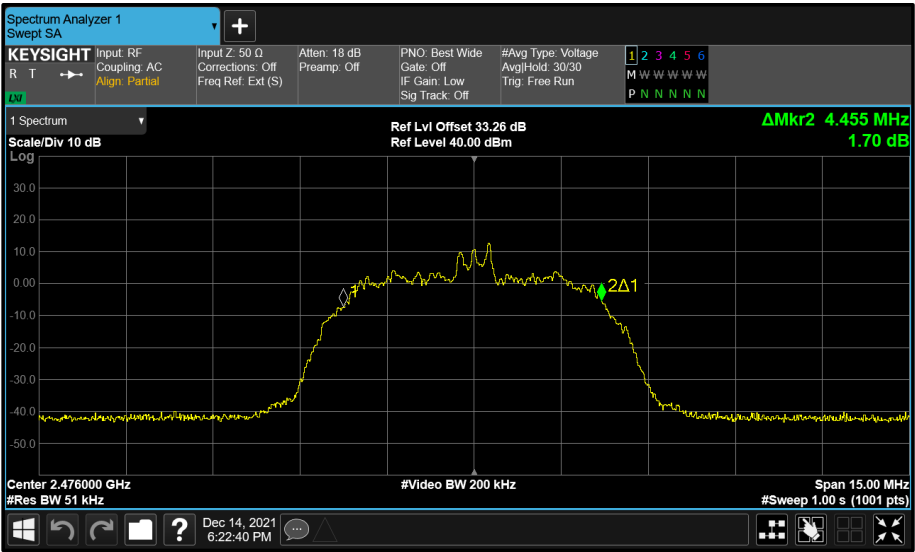


Figure 63 - Core 1 (B) 2476 MHz (CH74) 99% Bandwidth

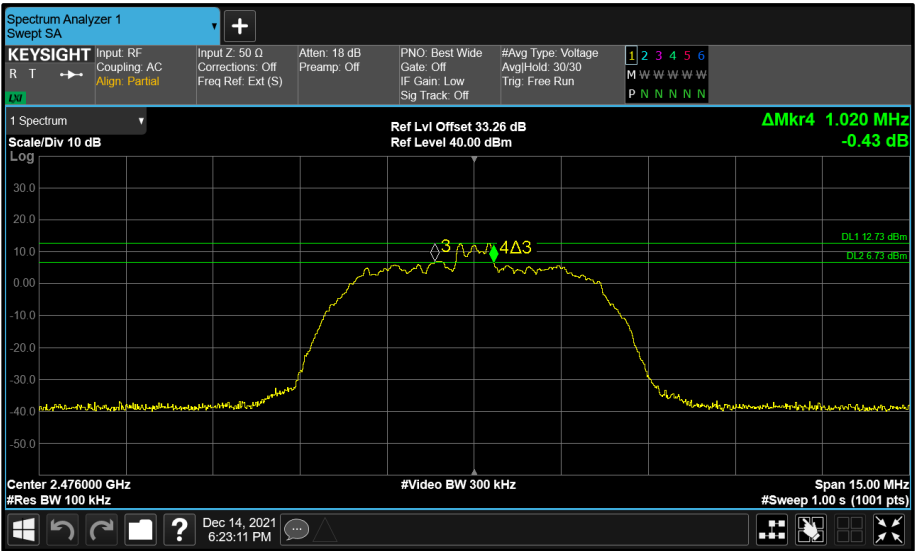


Figure 64 - Core 1 (B) 2476 MHz (CH74) 6 dB Bandwidth



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 $\pi/4$ DQPSK (4-DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Port(s):	A+B (Core 0 + Core 1)	Peak Antenna Gain (dBi):	-

Test Frequency (MHz)	6 dB Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	1.896	1.896	-	-	1.896	≥ 500.0
2441	1.880	1.896	-	-	1.880	≥ 500.0
2476	1.896	1.896	-	-	1.896	≥ 500.0

Table 37 - 6 dB Bandwidth Results

Test Frequency (MHz)	99% Bandwidth (MHz)					Limit (kHz)
	A	B	C	D	Minimum	
2404	2.328	2.336	-	-	2.328	-
2441	2.328	2.336	-	-	2.328	-
2476	2.328	2.328	-	-	2.328	-

Table 38 - 99% Bandwidth Results

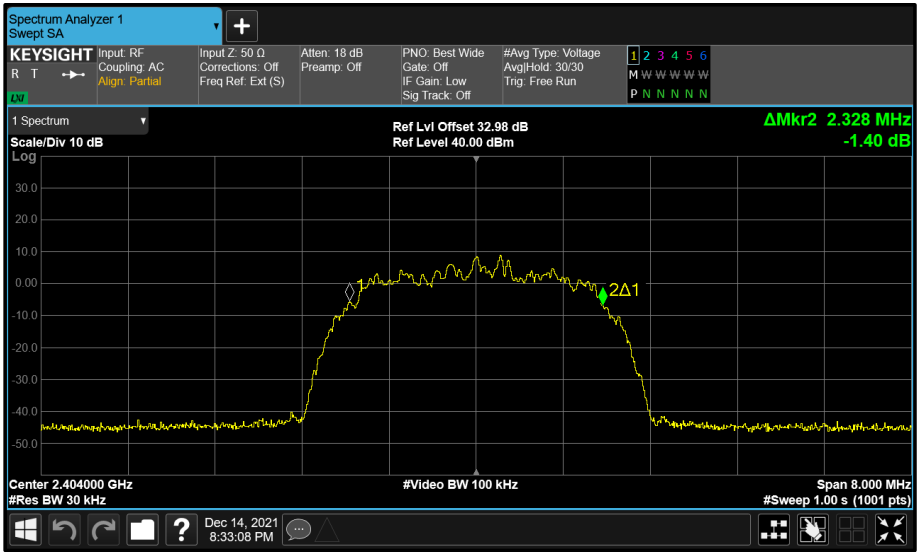


Figure 65 - Core 0 (A) 2404 MHz (CH2) 99% Bandwidth

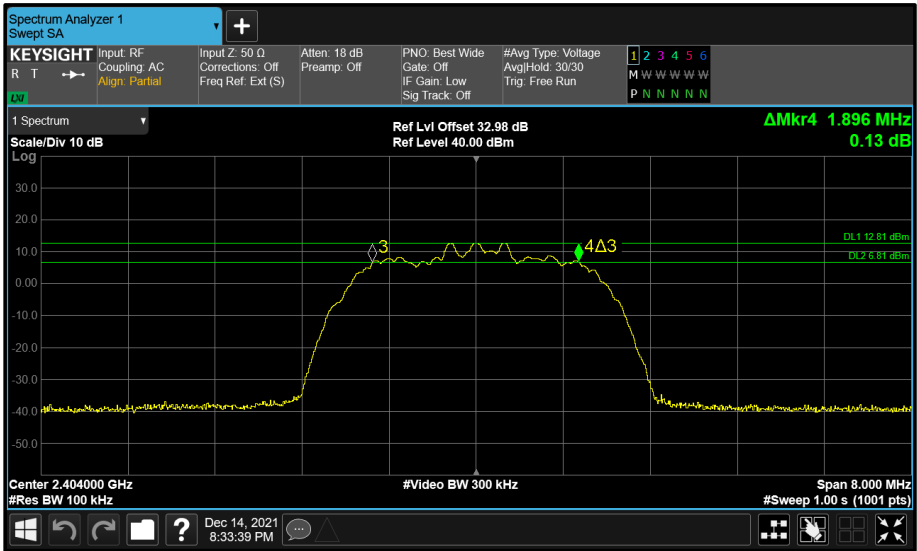


Figure 66 - Core 0 (A) 2404 MHz (CH2) 6 dB Bandwidth

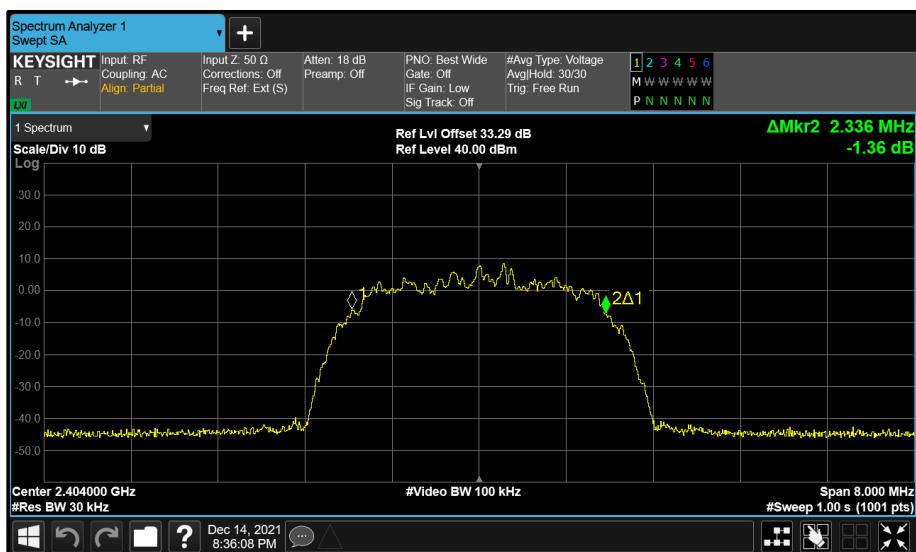


Figure 67 - Core 1 (B) 2404 MHz (CH2) 99% Bandwidth

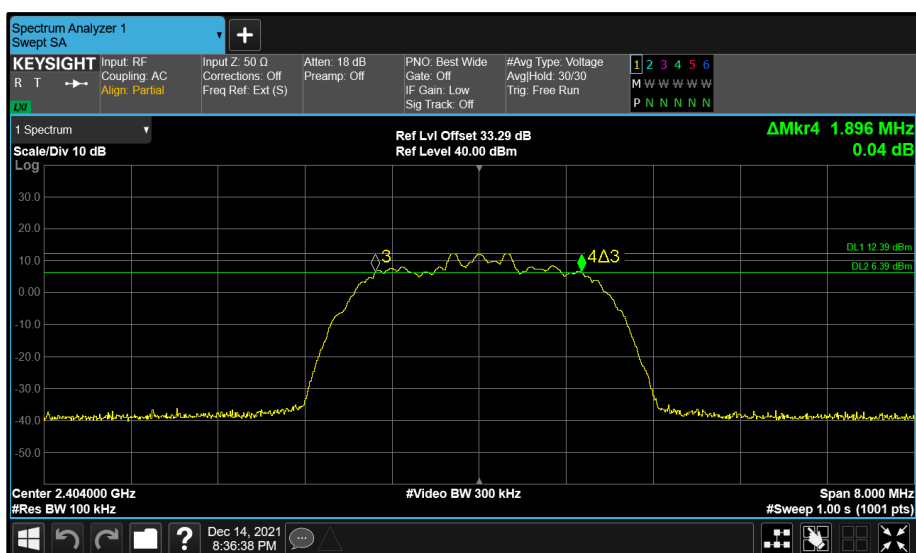


Figure 68 - Core 1 (B) 2404 MHz (CH2) 6 dB Bandwidth

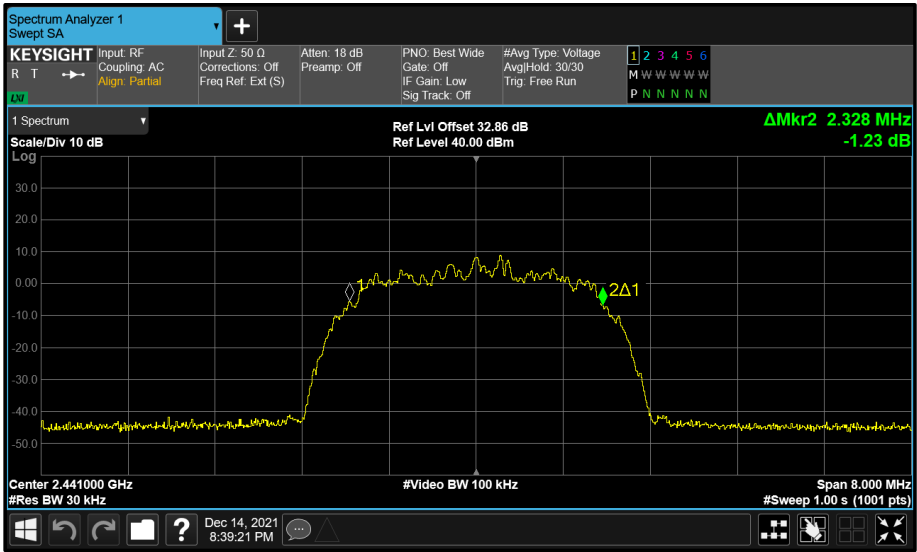


Figure 69 - Core 0 (A) 2441 MHz (CH39) 99% Bandwidth

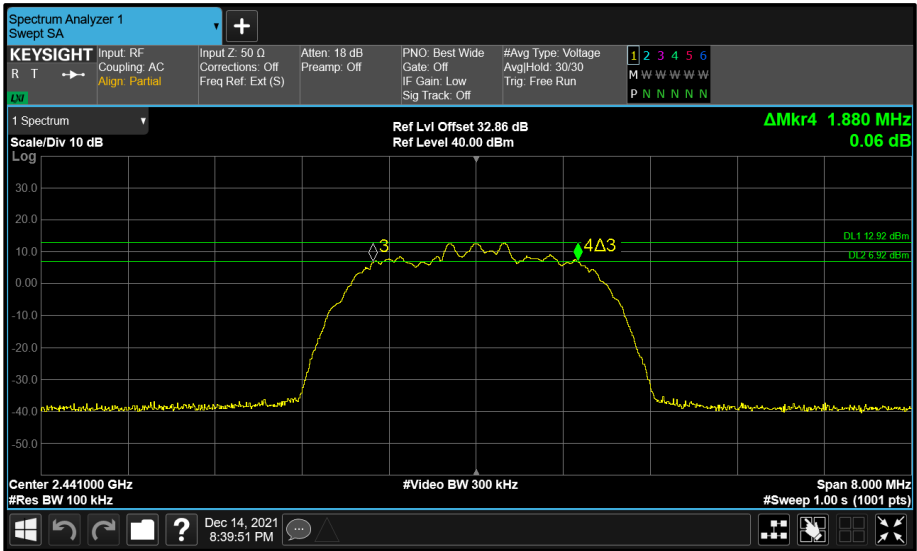


Figure 70 - Core 0 (A) 2441 MHz (CH39) 6 dB Bandwidth

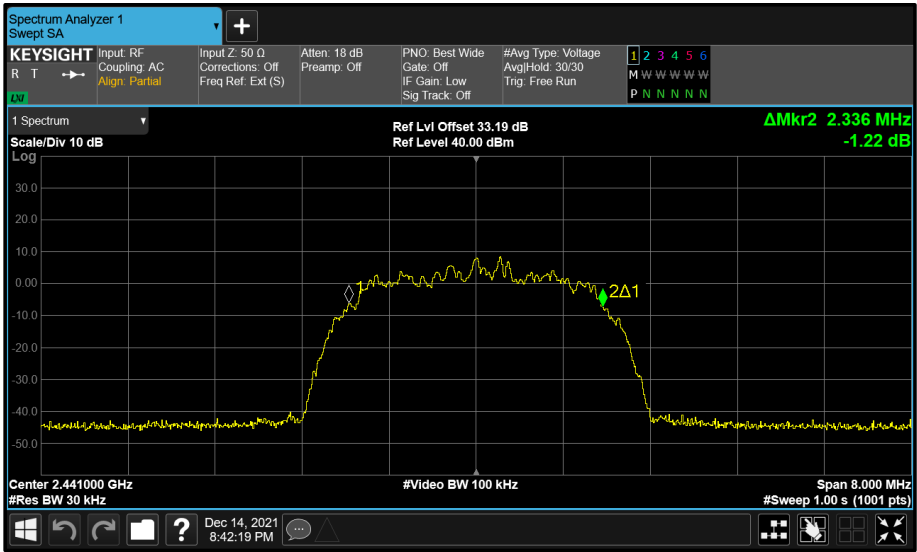


Figure 71 - Core 1 (B) 2441 MHz (CH39) 99% Bandwidth

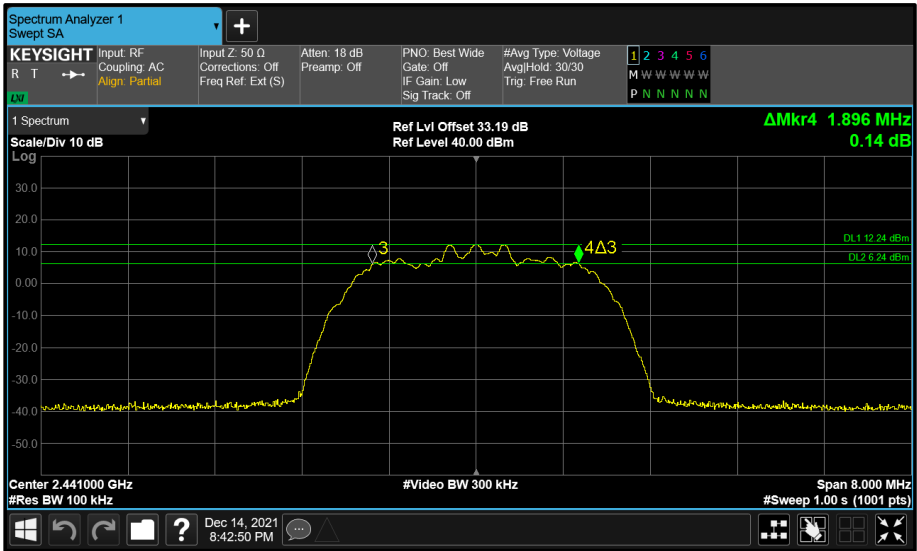


Figure 72 - Core 1 (B) 2441 MHz (CH39) 6 dB Bandwidth