

FCC and ISEDC Test Report

Apple Inc
Model: A2289

In accordance with FCC 47 CFR Part 15C,
ISEDC RSS-247 and ISEDC RSS-GEN

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

FCC ID: BCGA2289

IC: 579C-A2289

COMMERCIAL-IN-CONFIDENCE

Document 75947591-11 Issue 01



Add value.
Inspire trust.

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Ryan Henley	Sales Manager – RF and Telecom	Authorised Signatory	14 February 2020

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, ISEDC RSS-247 and ISEDC RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Mehadi Choudhury	14 February 2020	
Testing	Ahmad Javid	14 February 2020	
Testing	Mohammad Malik	14 February 2020	
Testing	Jay Balendrarajah	14 February 2020	
Testing	Cristian Onaca	14 February 2020	
Testing	Mohamud Mohamud	14 February 2020	
Testing	Faisal Malyar	14 February 2020	

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory

ISEDC 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: 2018, ISEDC RSS-247: Issue 2 (2017-02) and ISEDC RSS-GEN: Issue 5 + (04-2018) + A1 (2019-03) 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. © 2020 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

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

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

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

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	6
1.5	Deviations from the Standard.....	6
1.6	EUT Modification Record	6
1.7	Test Location	7
2	Test Details	9
2.1	Maximum Conducted Output Power	9
2.2	Power Spectral Density	13
2.3	Emission Bandwidth	27
2.4	Spurious Radiated Emissions	41
2.5	Authorised Band Edges	53
2.6	Restricted Band Edges.....	61
3	Measurement Uncertainty	72



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	14 February 2020

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2179
Serial Number(s)	C02ZG009P09V, C02ZG00AP0CR and C02ZG00CP0C9
Hardware Version(s)	REV1.0
Software Version(s)	19C4 and 19D2013
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2018 ISED RSS-247, Issue 2 (2017-02) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number	0540187743
Date	18-December-2019
Date of Receipt of EUT	02-October 2019
Start of Test	19-November-2019
Finish of Test	31-January-2020
Name of Engineer(s)	Mehadi Choudhury and Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar
Related Document(s)	ANSI C63.10 (2013)



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 - LE1M						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.4	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz Bluetooth - LE2M						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)



Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth - HDR4 iPA						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz Bluetooth - HDR4 ePA						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)



Section	Specification Clause			Test Description	Result	Comments/Base Standard
	Part 15C	RSS-247	RSS-GEN			
Configuration and Mode: 2.4 GHz Bluetooth - HDR8 iPA						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)
Configuration and Mode: 2.4 GHz Bluetooth - HDR8 ePA						
2.1	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	ANSI C63.10 (2013)
2.2	15.247 (e)	5.2	6.12	Power Spectral Density	Pass	ANSI C63.10 (2013)
2.3	15.247 (a)(2)	5.2	6.7	Emission Bandwidth	Pass	ANSI C63.10 (2013)
2.5	15.247 (d)	5.5	-	Authorised Band Edges	Pass	ANSI C63.10 (2013)
2.6	15.205	-	8.10	Restricted Band Edges	Pass	ANSI C63.10 (2013)

Table 2



1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a laptop computer with Bluetooth, Bluetooth Low Energy and 802.11 a/b/g/n/ac capabilities in the 2.4 GHz and 5 GHz bands

1.4.2 Antenna Gain Table (BT, Core 0)

Frequency (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
2400 - 2480	1.92	1.0

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: A2289, Serial Number: C02ZG00CP0C9			
1	Firmware modified to test TxBF.	Philip Harrison	03-January-2020
Model: A2289, Serial Number: C02ZG009P09V			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2289, Serial Number: C02ZG00AP0CR			
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 - LE1M		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Spurious Radiated Emissions	Steven White	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - LE2M		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - HDR4 iPA		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - HDR4 ePA		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS



Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: 2.4 GHz Bluetooth - HDR8 iPA		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Configuration and Mode: 2.4 GHz Bluetooth - HDR8 ePA		
Maximum Conducted Output Power	Mehadi Choudhury	UKAS
Power Spectral Density	Mehadi Choudhury	UKAS
Emission Bandwidth	Mehadi Choudhury	UKAS
Authorised Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS
Restricted Band Edges	Ahmad Javid, Mohammad Malik, Jay Balendrarajah, Cristian Onaca, Mohamud Mohamud, Faisal Malyar	UKAS

Table 5

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom



2 Test Details

2.1 Maximum Conducted Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (b)
ISED RSS-247, Clause 5.4
ISED RSS-GEN, Clause 6.12

2.1.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG00CP0C9 - Modification State 1

2.1.3 Date of Test

13-January-2020 to 31-January-2020

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.1.1 (LE1M and LE2M) and ANSI C63.10, clause 11.9.2.2.5 (AVGSA-2A) (HDR4 and HDR8).

2.1.5 Environmental Conditions

Ambient Temperature	23.4 - 24.3 °C
Relative Humidity	32.7 - 35.5 %



2.1.6 Test Results

2.4 GHz Bluetooth - LE1M

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	7.50	5.62
2440	7.31	5.38
2480	7.34	5.42

Table 6 - Maximum Conducted Output Power Results

2.4 GHz Bluetooth - LE2M

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2402	7.65	5.82
2440	7.65	5.82
2480	7.55	5.69

Table 7 - Maximum Conducted Output Power Results

2.4 GHz Bluetooth - HDR4 iPA

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2404	2.96	1.98
2440	2.87	1.94
2478	3.01	2.00

Table 8 - Maximum Conducted Output Power Results

2.4 GHz Bluetooth - HDR4 ePA

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2404	9.68	9.29
2440	9.94	9.86
2478	9.45	8.81

Table 9 - Maximum Conducted Output Power Results



2.4 GHz Bluetooth - HDR8 iPA

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2404	2.97	1.98
2440	2.87	1.94
2478	3.20	2.10

Table 10 - Maximum Conducted Output Power Results

2.4 GHz Bluetooth - HDR8 ePA

Frequency (MHz)	Maximum Output Power	
	dBm	mW
2404	10.00	10.00
2440	9.98	9.95
2478	9.74	9.42

Table 11 - Maximum Conducted Output Power Results

FCC 47 CFR Part 15, Limit Clause 15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

ISED RSS-247, Limit Clause 5.4 (d)

For DTSS employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e) of the specification.



2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	23-Sep-2020
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	23-Sep-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Jan-2020
Cable (40 GHz)	Rosenberger	LU1-001-1000	5022	12	12-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5108	12	06-Oct-2020
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5280	12	09-Apr-2020

Table 12

O/P Mon – Output Monitored using calibrated equipment



2.2 Power Spectral Density

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (e)
ISED RSS-247, Clause 5.2
ISED RSS-GEN, Clause 6.12

2.2.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG00CP0C9 - Modification State 1

2.2.3 Date of Test

15-January-2020

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.10.2 (LE1M and LE2M) and ANSI C63.10, clause 11.10.6 (AVGPSD-2A) (HDR4 and HDR8).

2.2.5 Environmental Conditions

Ambient Temperature	23.7 °C
Relative Humidity	35.5 %

2.2.6 Test Results

2.4 GHz Bluetooth - LE1M

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2402	-8.37	3.0
2440	-8.51	3.0
2480	-8.09	3.0

Table 13 - Power Spectral Density

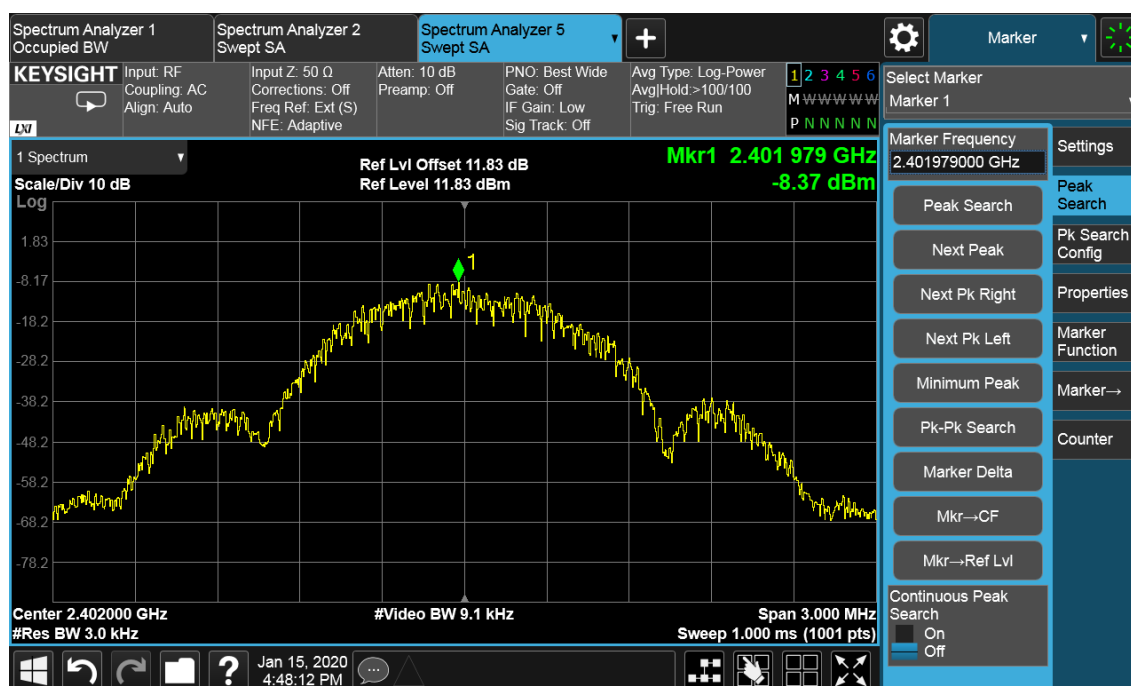


Figure 1 – 2402 MHz

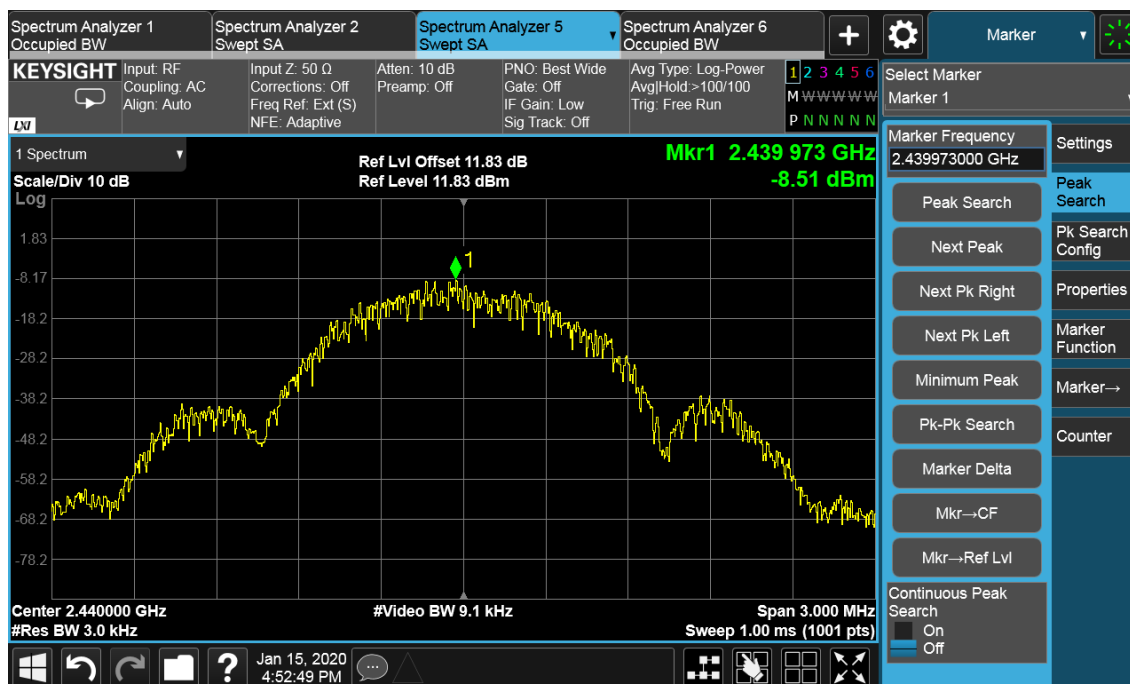


Figure 2 – 2440 MHz

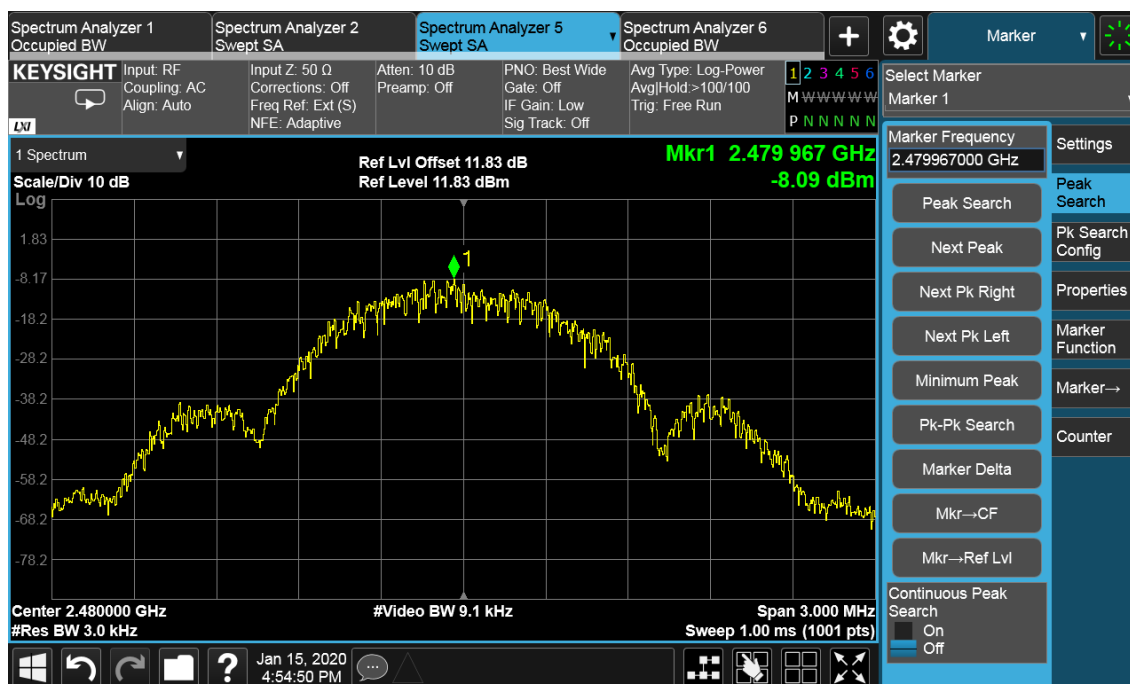
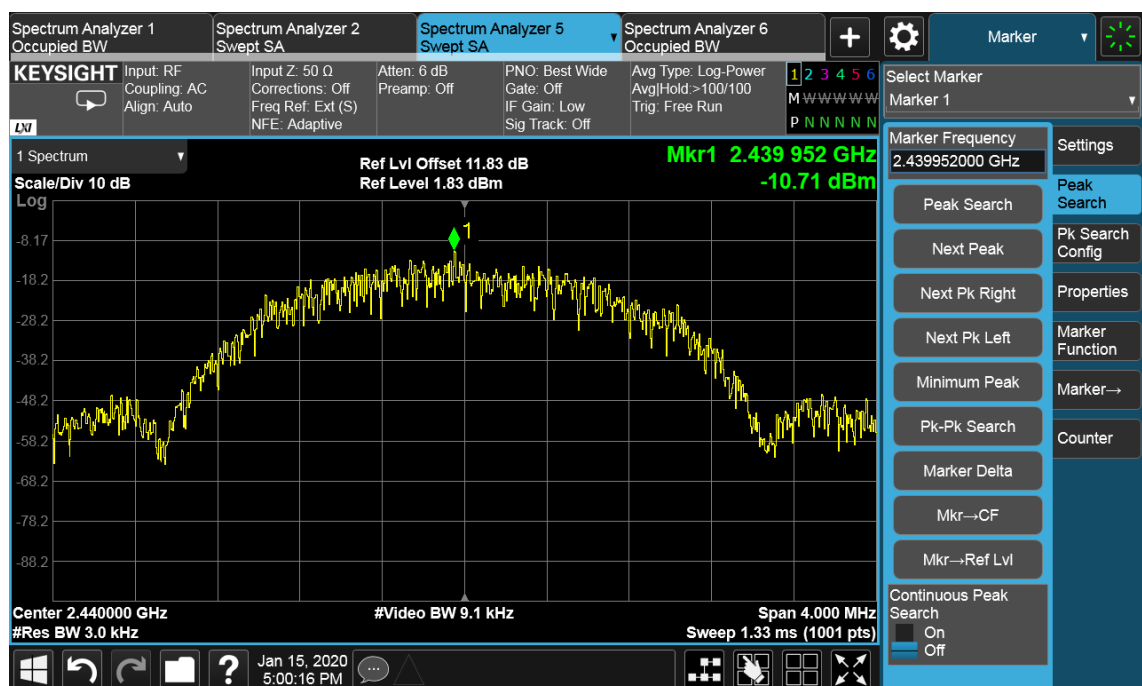
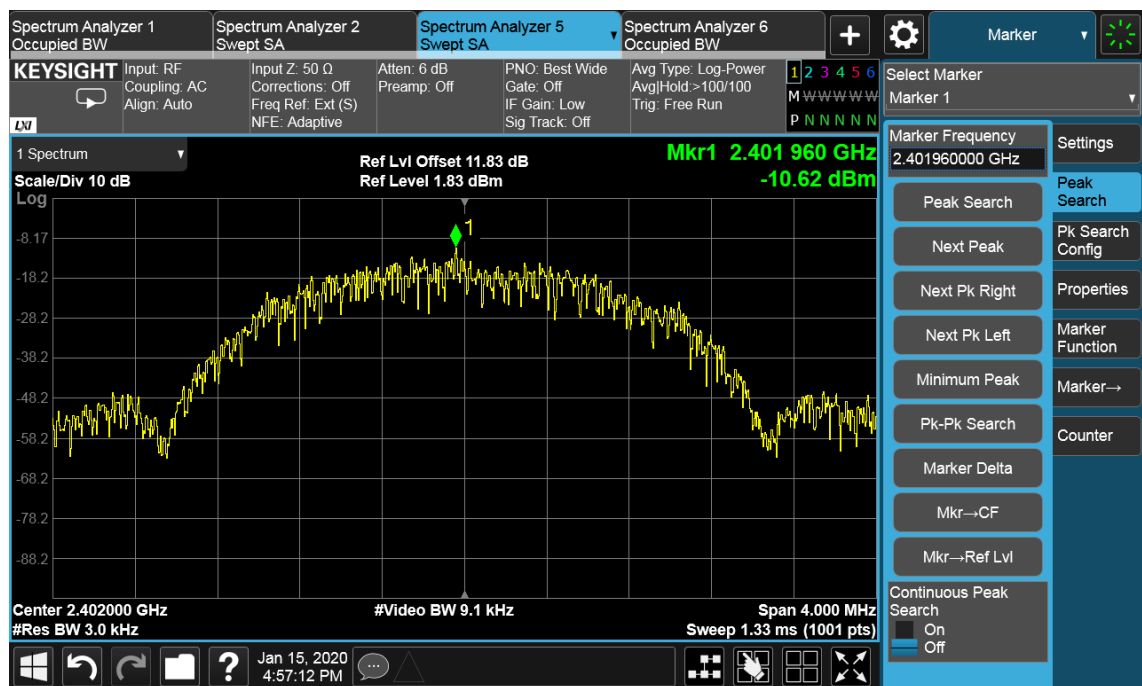


Figure 3 – 2480 MHz

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2402	-10.62	3.0
2440	-10.71	3.0
2480	-10.29	3.0



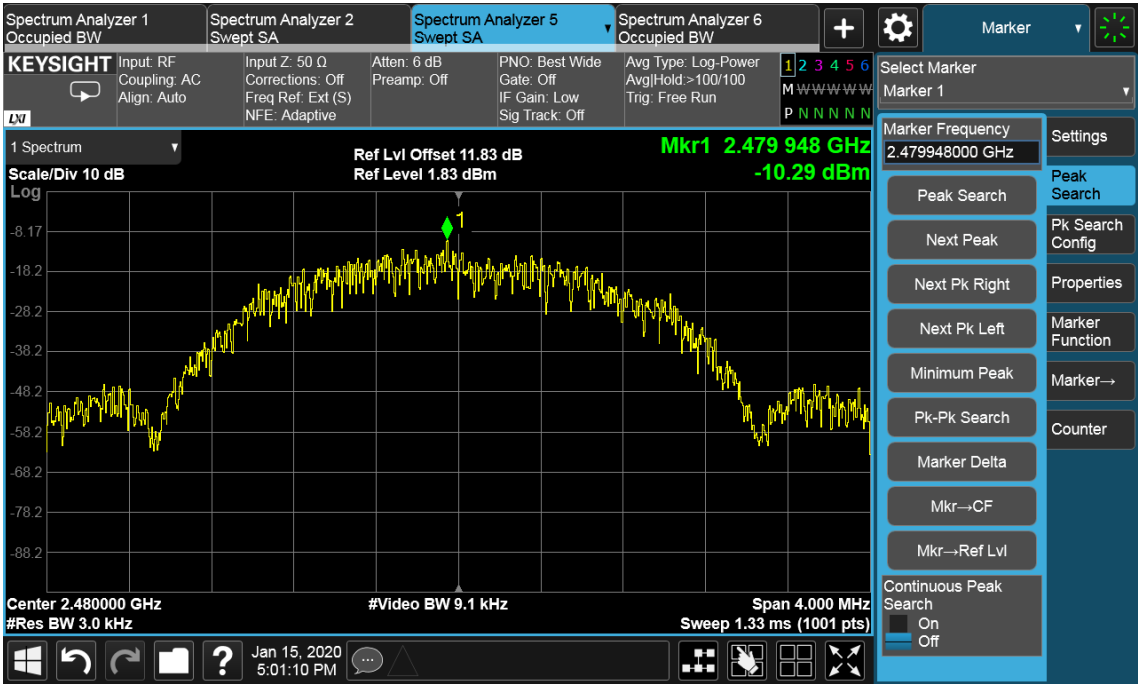


Figure 6 – 2480 MHz



2.4 GHz Bluetooth - HDR4 iPA

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2404	-8.92	62
2440	-9.26	62
2478	-9.12	62

Table 15 - Power Spectral Density

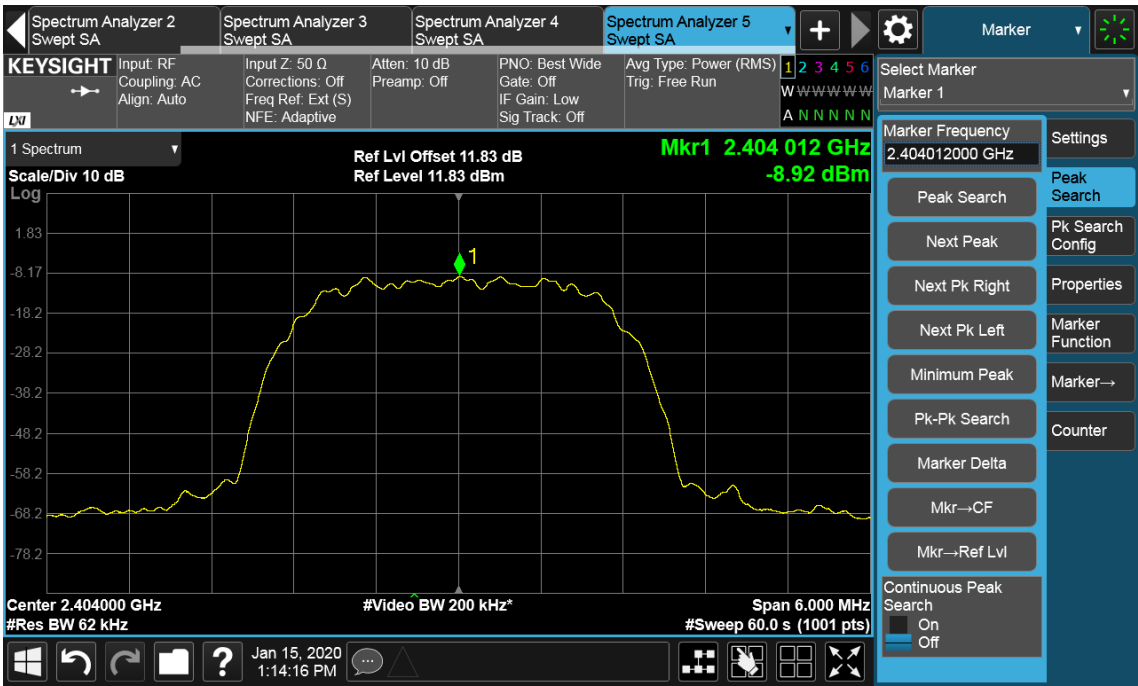


Figure 7 – 2404 MHz

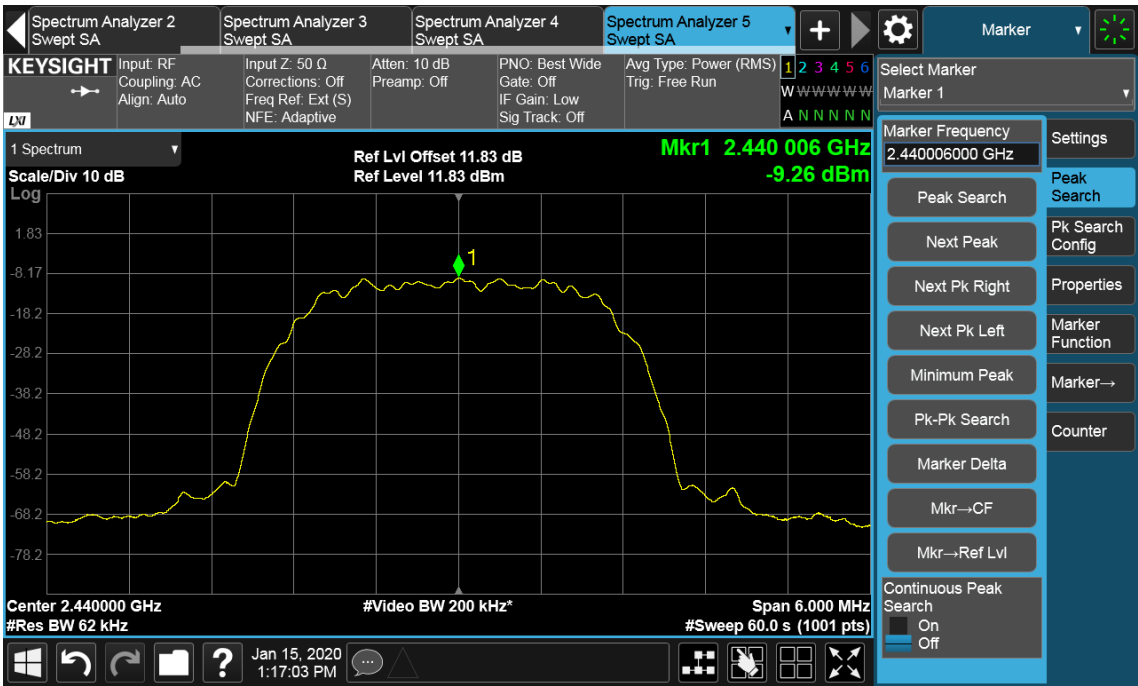


Figure 8 – 2440 MHz

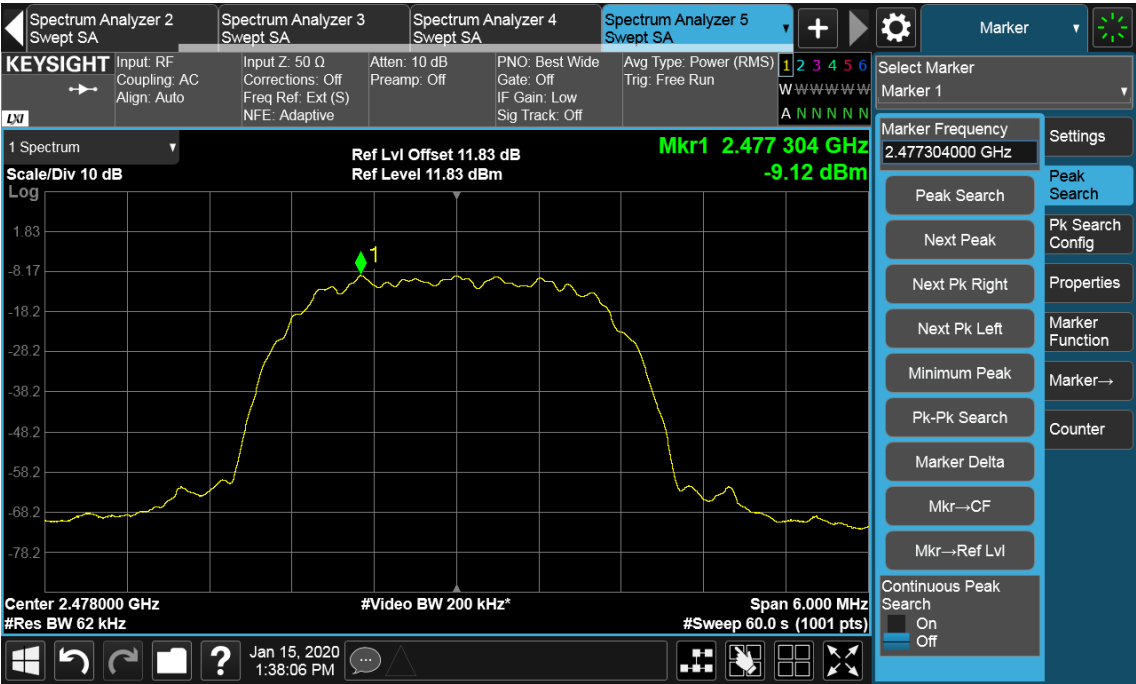


Figure 9 – 2478 MHz



2.4 GHz Bluetooth - HDR4 ePA

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2404	-4.13	62
2440	-4.27	62
2478	-4.21	62

Table 16 - Power Spectral Density

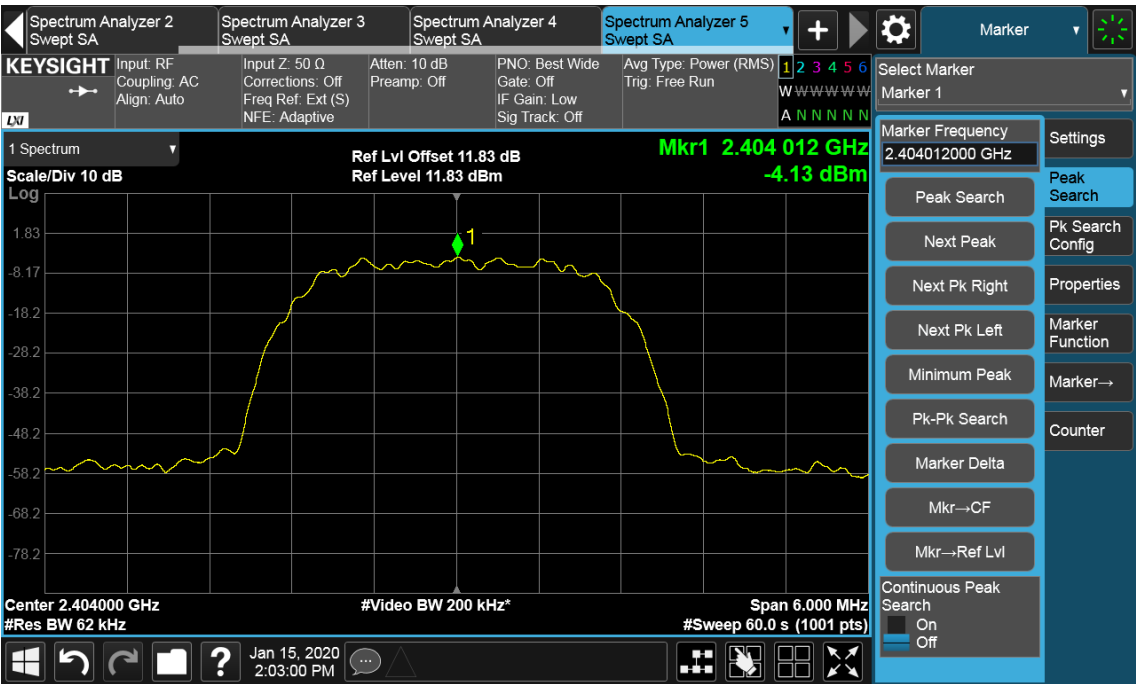


Figure 10 – 2404 MHz

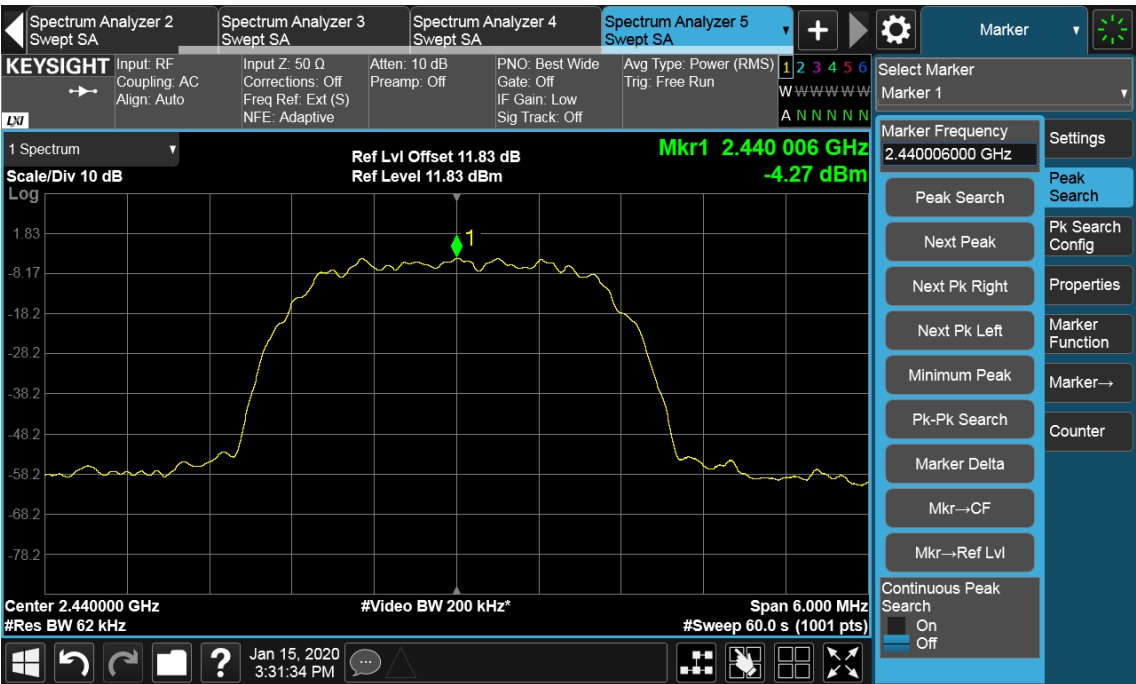


Figure 11 – 2440 MHz

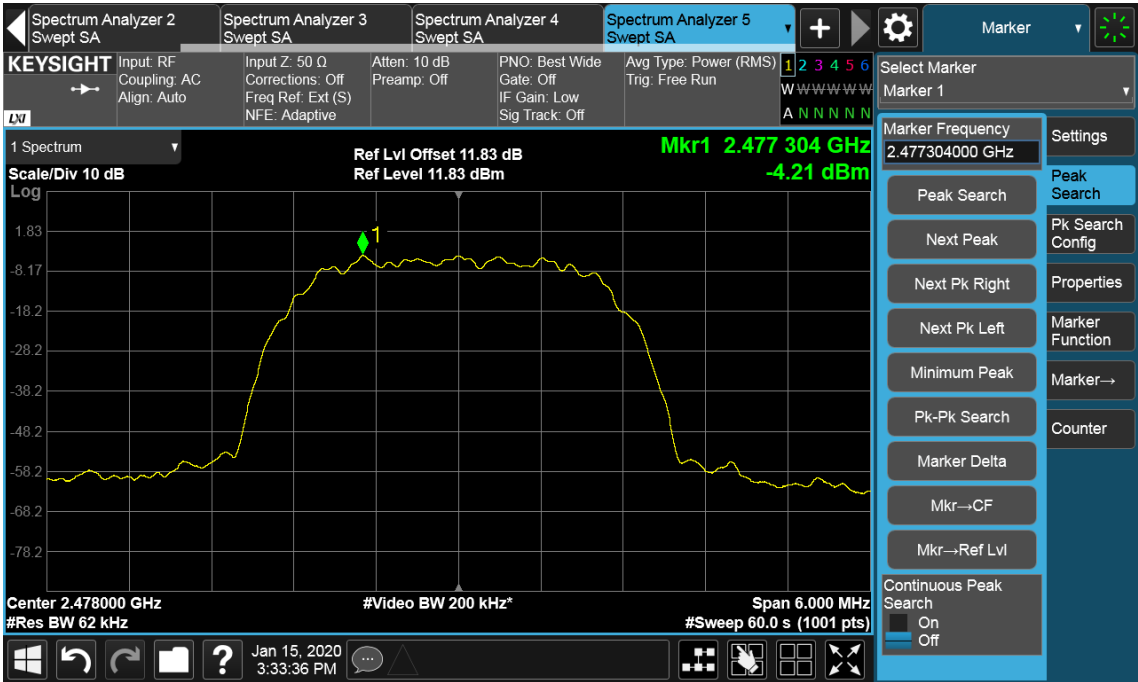


Figure 12 – 2478 MHz



2.4 GHz Bluetooth - HDR8 iPA

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2404	-9.10	100
2440	-9.28	100
2478	-9.30	100

Table 17 - Power Spectral Density

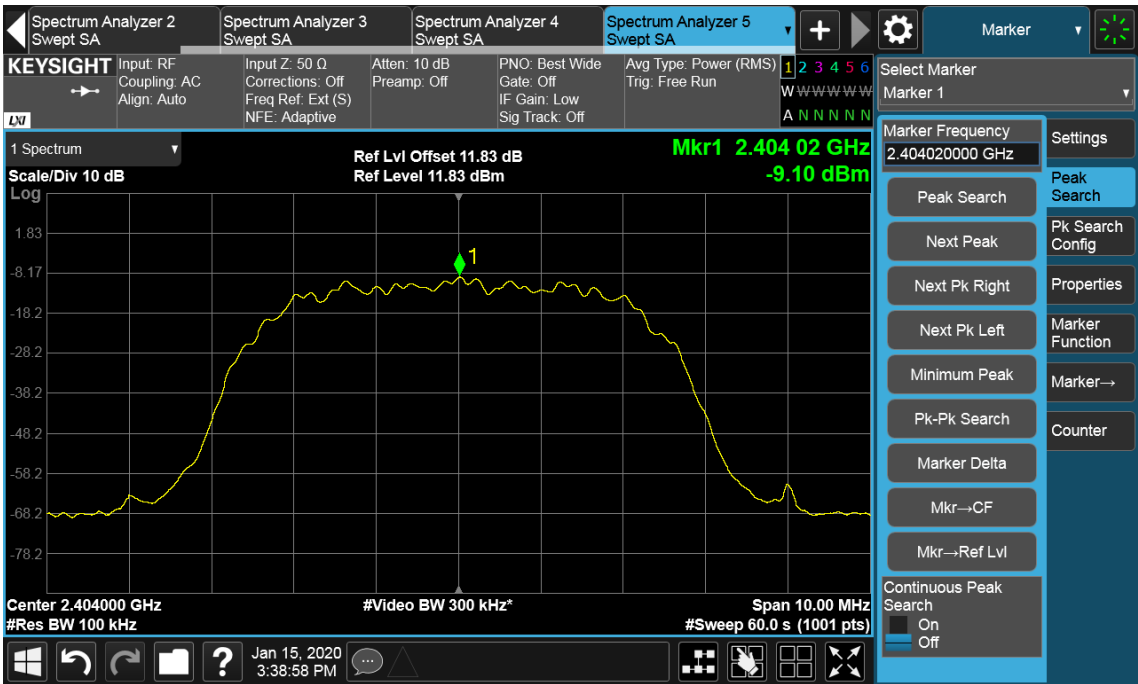


Figure 13 – 2404 MHz



Figure 14 – 2440 MHz



Figure 15 – 2478 MHz



2.4 GHz Bluetooth - HDR8 ePA

Frequency (MHz)	Power Spectral Density (dBm)	Measurement Bandwidth (kHz)
2404	-4.14	100
2440	-4.22	100
2478	-4.37	100

Table 18 - Power Spectral Density

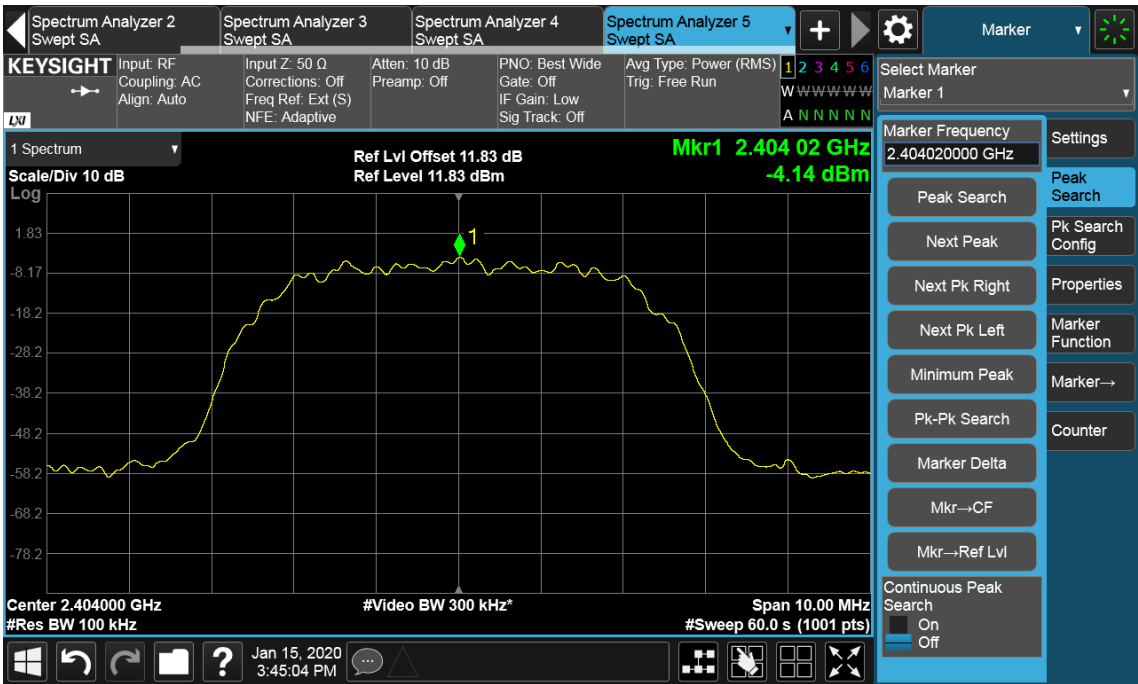


Figure 16 – 2404 MHz



Figure 17 – 2440 MHz

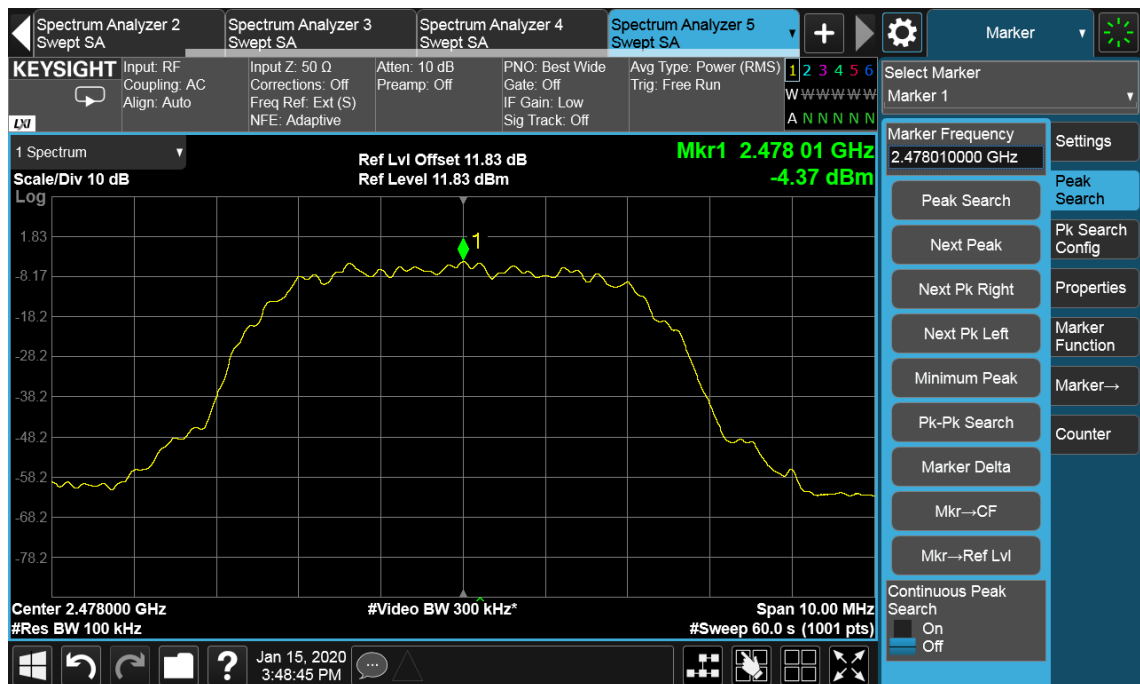


Figure 18 – 2478 MHz

FCC 47 CFR Part 15, Limit Clause 15.247 (e)

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

ISED RSS-247, Limit Clause 5.2(b)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission



2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	23-Sep-2020
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	23-Sep-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Jan-2020
Cable (40 GHz)	Rosenberger	LU1-001-1000	5022	12	12-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5108	12	06-Oct-2020
Attenuator (20 dB, 2 W)	Pasternack	PE7004-20	489	12	O/P Mon
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5280	12	09-Apr-2020

Table 19

O/P Mon – Output Monitored using calibrated equipment



2.3 Emission Bandwidth

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG00CP0C9 - Modification State 1

2.3.3 Date of Test

10-January-2020 to 15-January-2020

2.3.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 11.8.2

2.3.5 Environmental Conditions

Ambient Temperature 23.6 - 23.7 °C
Relative Humidity 27.0 - 35.5 %

2.3.6 Test Results

2.4 GHz Bluetooth - LE1M

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	0.7126	1.0746
2440	0.7072	1.0738
2480	0.7066	1.0735

Table 20 - Emission Bandwidth Results

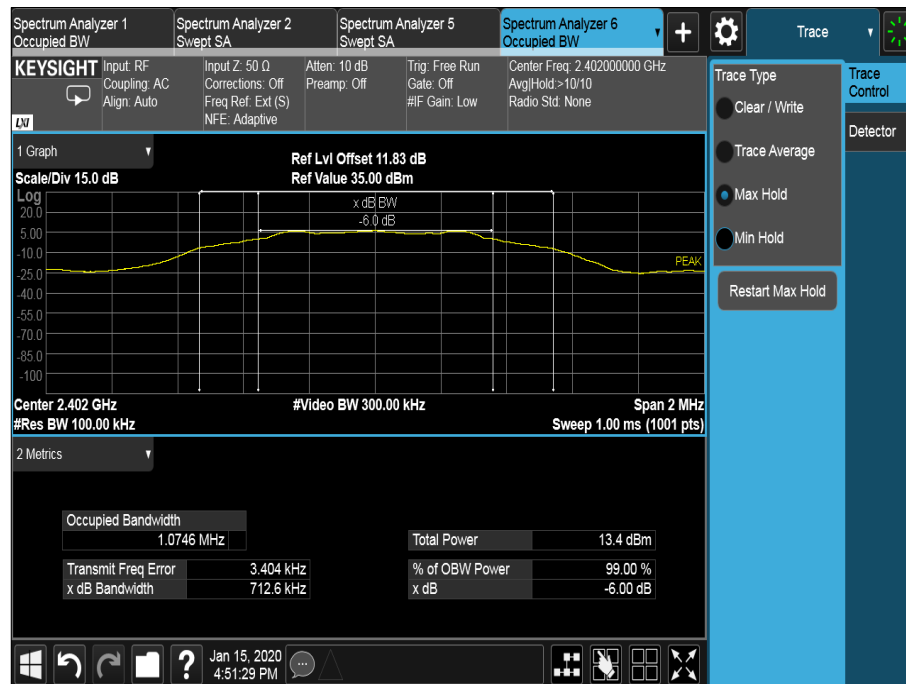


Figure 19 - 2402 MHz – Emission Bandwidth

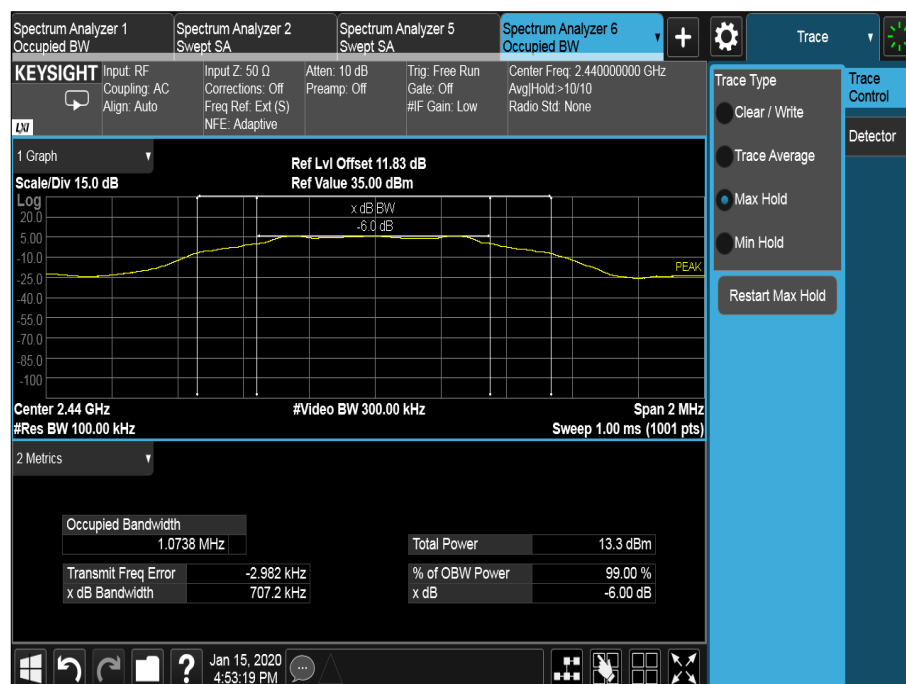


Figure 20 - 2440 MHz – Emission Bandwidth



Figure 21 - 2480 MHz – Emission Bandwidth

2.4 GHz Bluetooth - LE2M

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	1.258	2.0702
2440	1.257	2.0695
2480	1.257	2.0694

Table 21 - Emission Bandwidth Results



Figure 22 - 2402 MHz – Emission Bandwidth

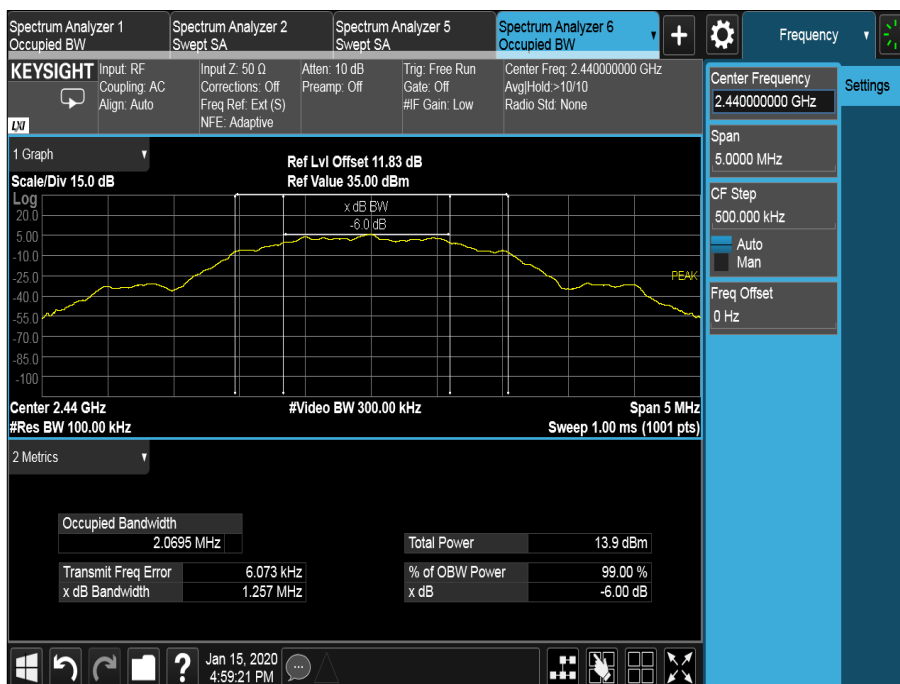


Figure 23 - 2440 MHz – Emission Bandwidth

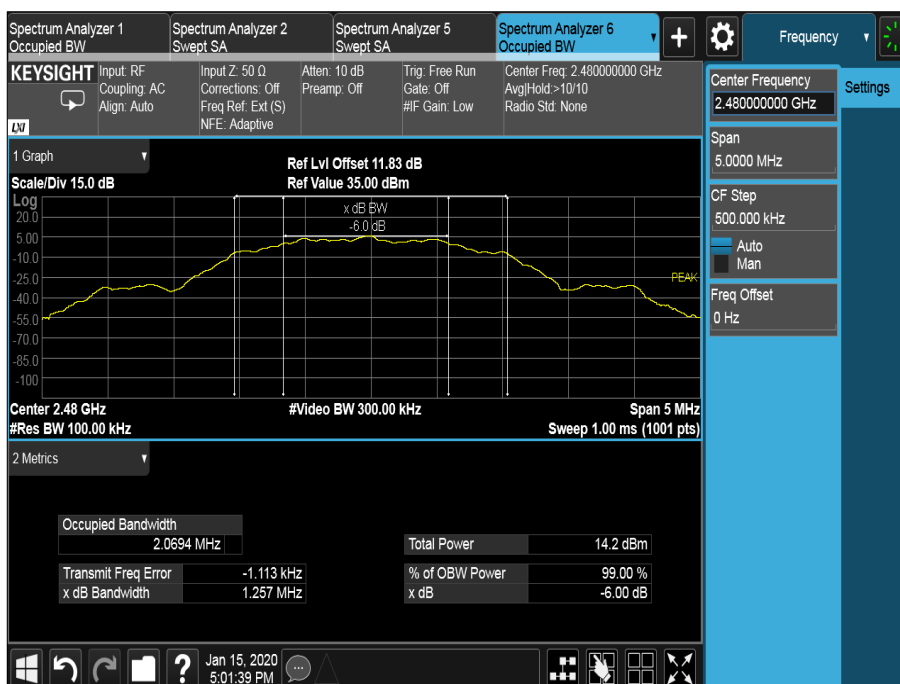


Figure 24 - 2480 MHz – Emission Bandwidth

2.4 GHz Bluetooth - HDR4 iPA

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2404	1.868	2.327
2441	1.858	2.327
2478	1.865	2.328

Table 22 - Emission Bandwidth Results

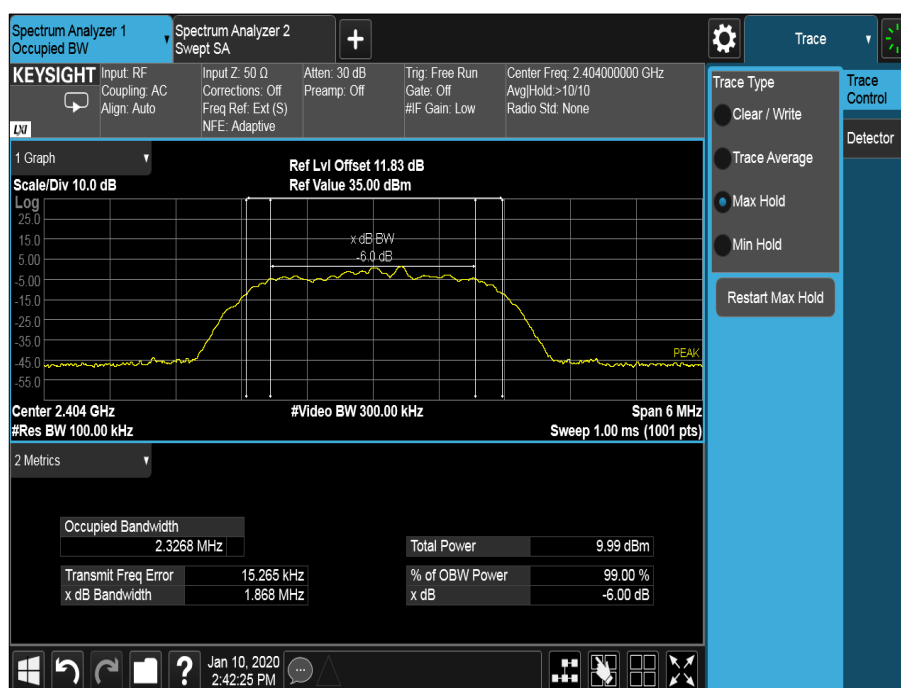


Figure 25 - 2404 MHz – Emission Bandwidth

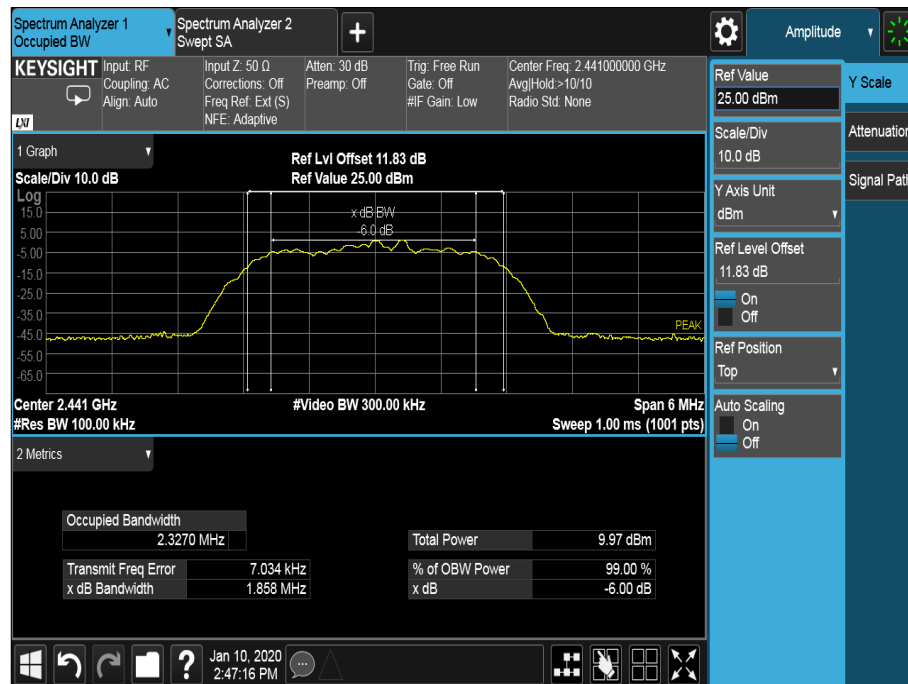


Figure 26 - 2441 MHz – Emission Bandwidth

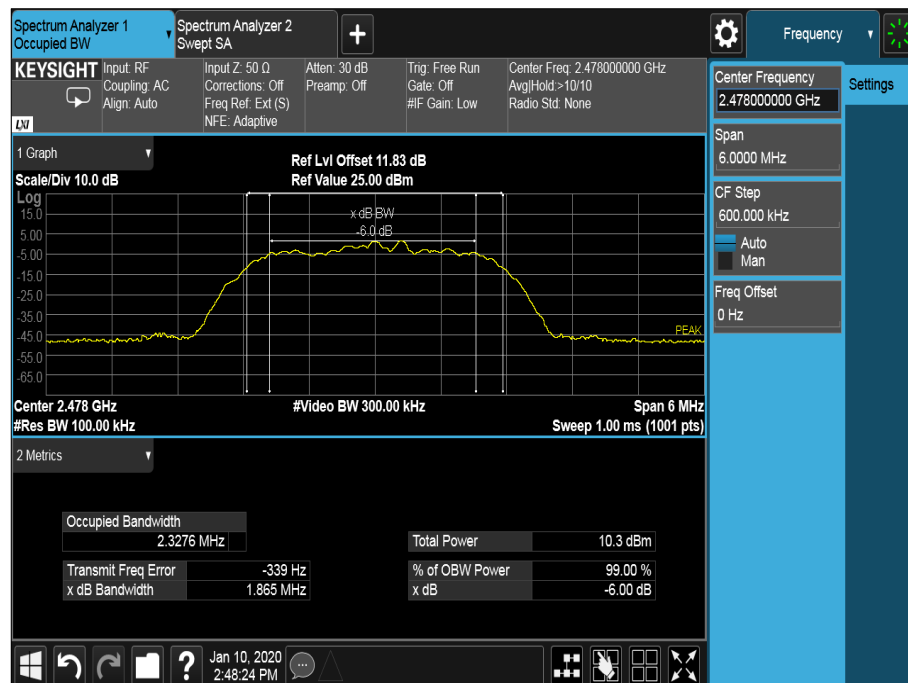


Figure 27 - 2478 MHz – Emission Bandwidth

2.4 GHz Bluetooth - HDR4 ePA

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2404	1.879	2.3249
2441	1.861	2.3221
2478	1.674	2.3226

Table 23 - Emission Bandwidth Results



Figure 28 - 2404 MHz – Emission Bandwidth

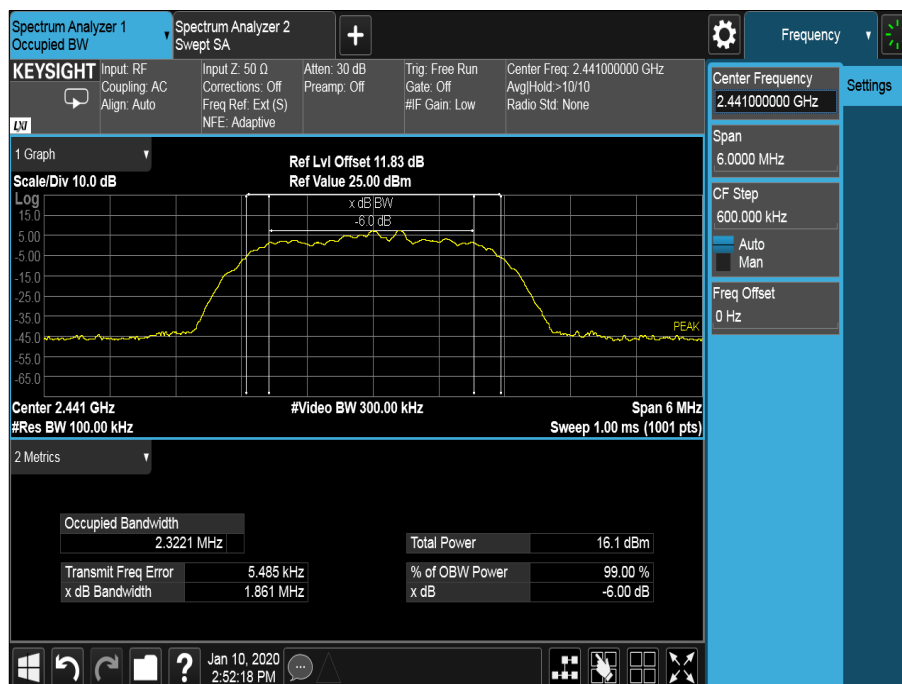


Figure 29 - 2441 MHz – Emission Bandwidth

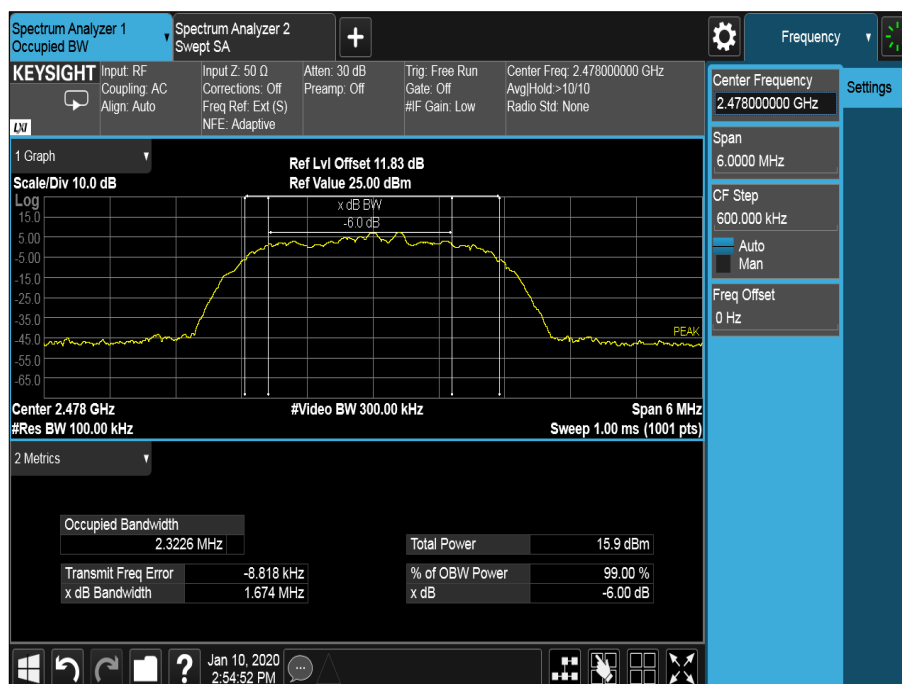


Figure 30 - 2478 MHz – Emission Bandwidth

2.4 GHz Bluetooth - HDR8 iPA

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2404	0.9339	4.8857
2441	0.9477	4.5897
2478	0.9355	4.5900

Table 24 - Emission Bandwidth Results

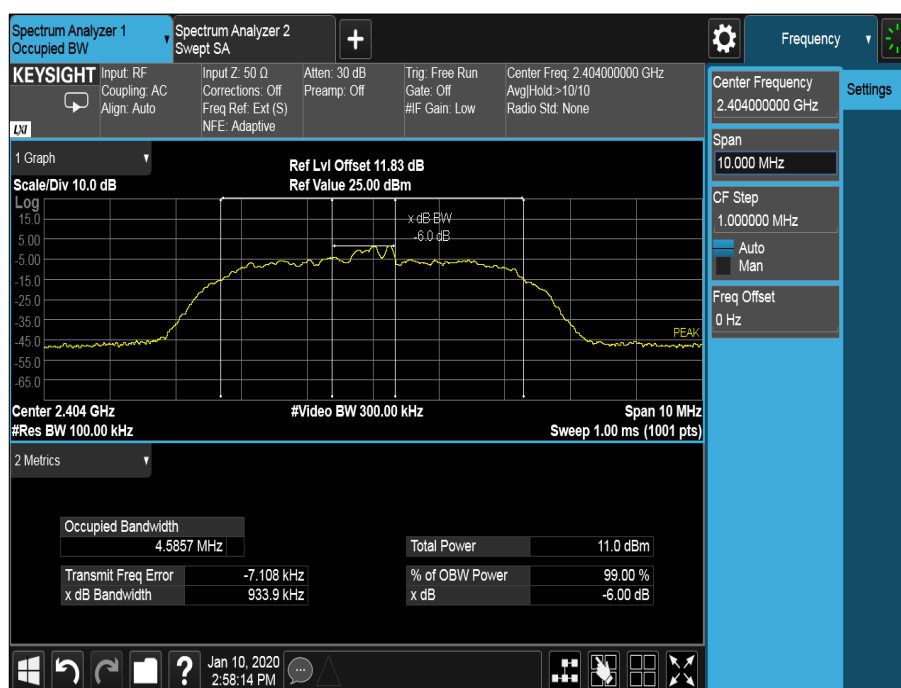


Figure 31 - 2404 MHz – Emission Bandwidth

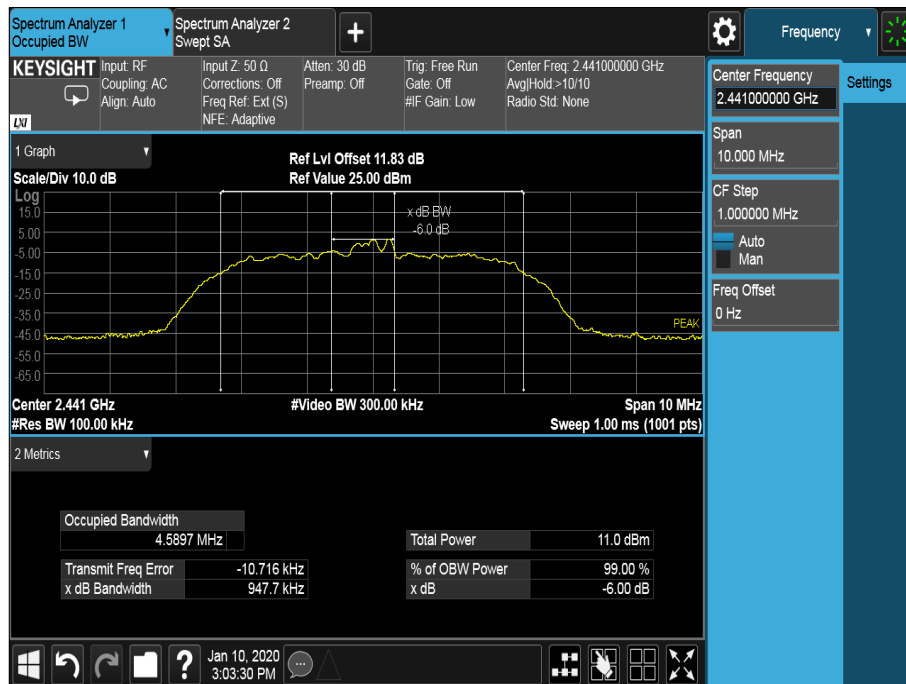


Figure 32 - 2441 MHz – Emission Bandwidth

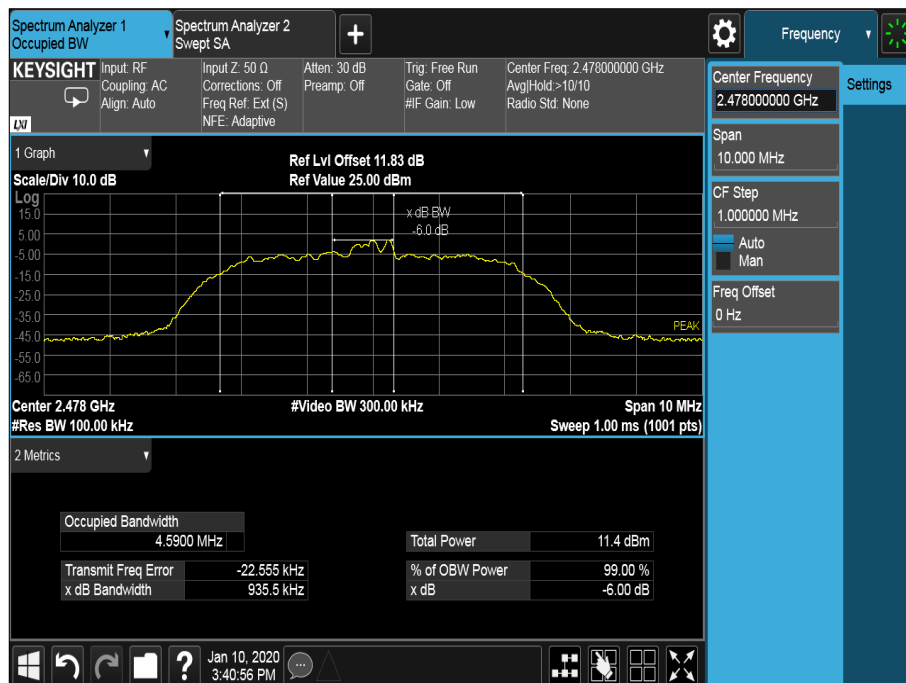


Figure 33 - 2478 MHz – Emission Bandwidth

2.4 GHz Bluetooth - HDR8 ePA

Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2404	0.9328	4.5819
2441	0.9884	4.5720
2478	1.0110	4.5811

Table 25 - Emission Bandwidth Results



Figure 34 - 2404 MHz – Emission Bandwidth



Figure 35 – 2441 MHz – Emission Bandwidth

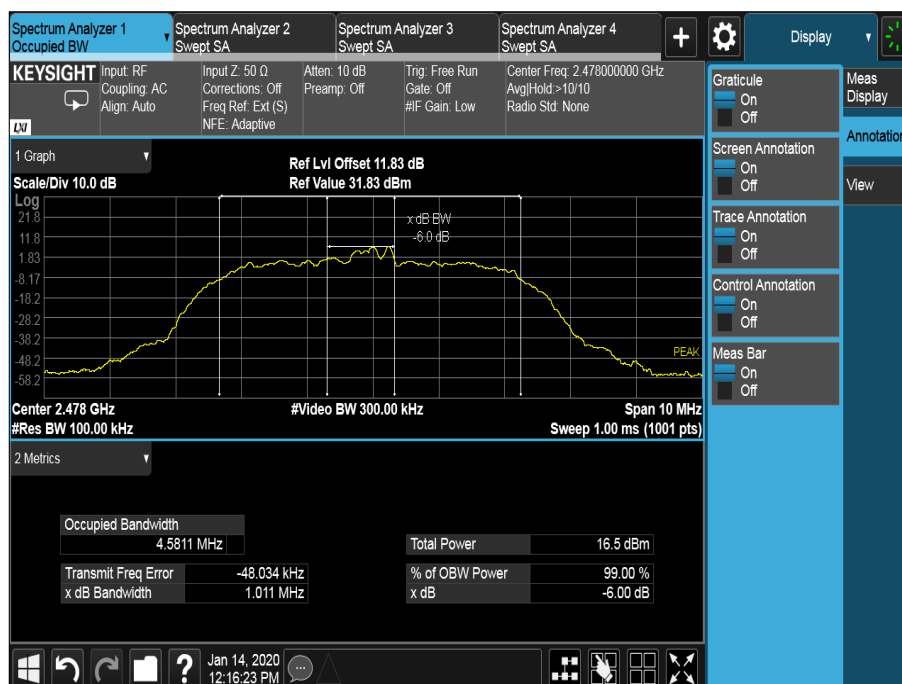


Figure 36 - 2478 MHz – Emission Bandwidth

FCC 47 CFR Part 15, Limit Clause 15.247(a)(2) and ISEDC RSS-247, Clause 5.2(a)

The minimum 6 dB Bandwidth shall be at least 500 kHz.



2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
2 metre SMA Cable	Florida Labs	SMS-235SP-78.8-SMS	4517	12	12-Nov-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	23-Sep-2020
Power splitter - 4 port	Mini-Circuits	ZN4PD1-63-S+	4744	12	23-Sep-2020
EXA	Keysight Technologies	N9010B	4969	24	21-Jan-2020
Cable (40 GHz)	Rosenberger	LU1-001-1000	5022	12	12-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5108	12	06-Oct-2020
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5235	-	O/P Mon
Power Splitter, 4 way	Mini-Circuits	ZN4PD1-63-S+	5236	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5280	12	09-Apr-2020

Table 26

O/P Mon – Output Monitored using calibrated equipment



2.4 Spurious Radiated Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.205
ISED RSS-247, Clause 5.5
ISED RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG009P09V - Modification State 0

2.4.3 Date of Test

14-December-2019

2.4.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.3, 6.5 and 6.6.

The EUT was placed on the non-conducting platform in a manner typical of a normal installation.

Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4. Multiple connectors of the same type and additional interconnecting cables were connected and pre-scans performed to determine whether the level of the emissions were increased by >2 dB.

For frequencies > 1 GHz, plots for average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.5 to characterize the EUT. Where emissions were detected, final average measurements were taken in accordance with ANSI C63.10 clause 4.1.4.2.2.

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (74/54 dBuV/m) when compared to 20 dBc outside restricted bands. The limits shown have been used as a threshold to determine where further measurements are necessary. Where results are within 10 dB of the limits shown on the plots, further investigation was carried out and reported in results tables.

The following conversion can be applied to convert from dBuV/m to uV/m:
 $10^{(\text{Field Strength in dBuV/m}/20)}$

Radiated emission measurements from 30 MHz to 1 GHz was limited to measurements on middle channel only.

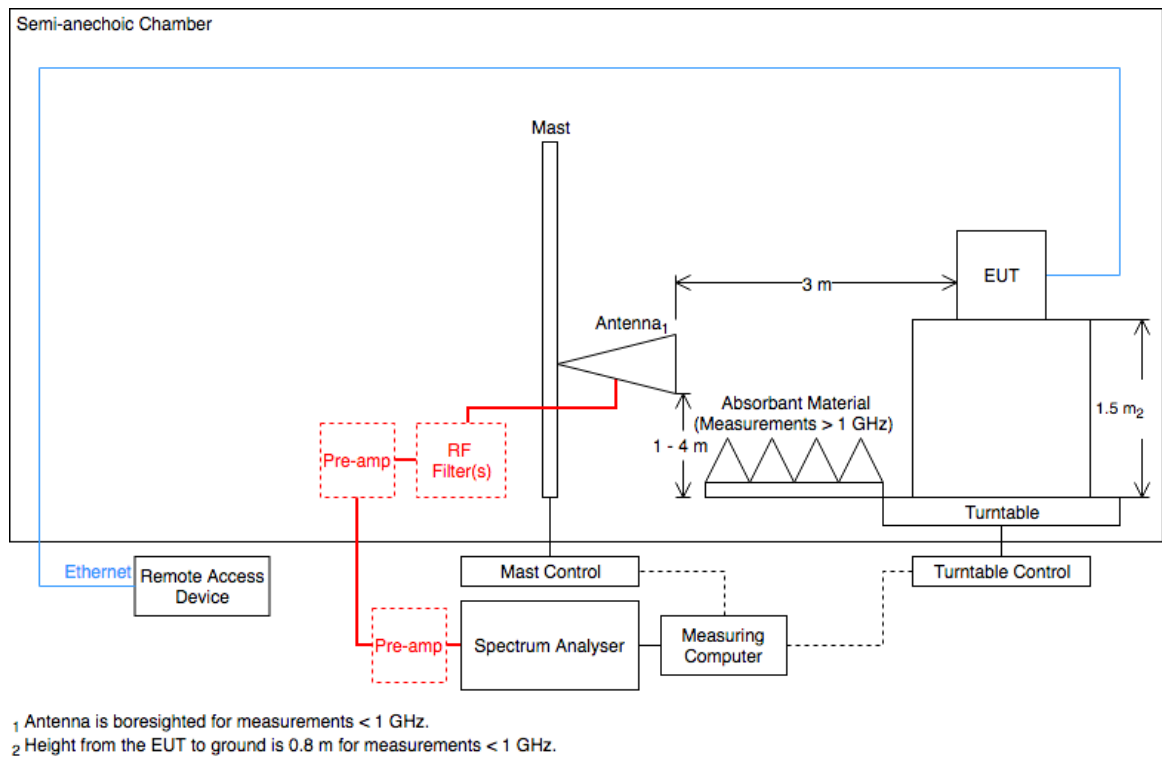


Figure 37- Radiated Emissions Test Setup Diagram

2.4.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	50.9 %



2.4.6 Test Results

2.4 GHz Bluetooth - LE1M

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 27 – 2440 MHz, 30 MHz to 1 GHz Radiated Emissions Results

*No emissions were detected within 10 dB of the limit

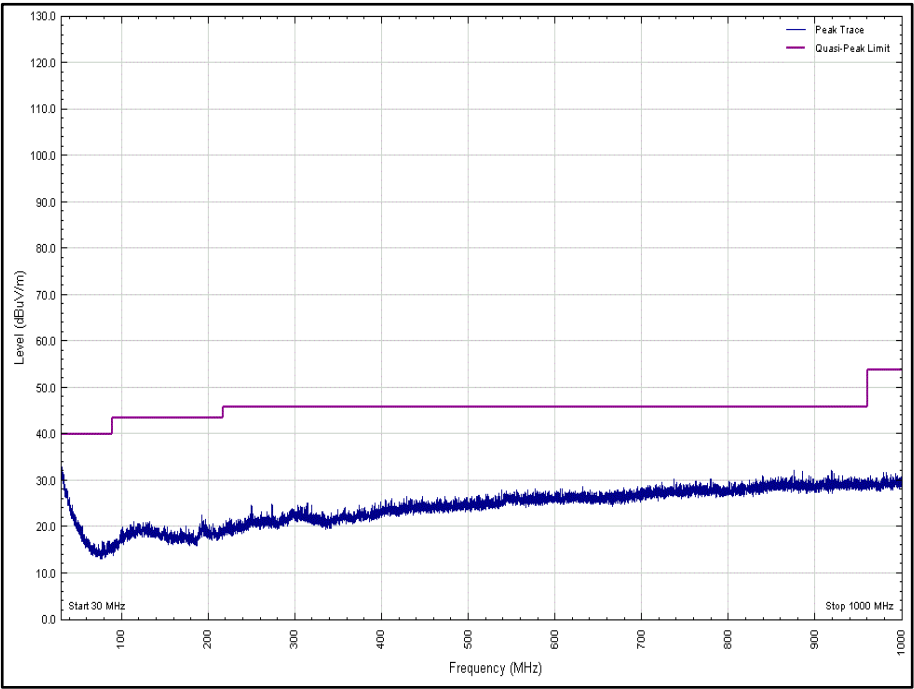


Figure 38 - 2440 MHz, 30 MHz to 1 GHz, Polarity: Horizontal

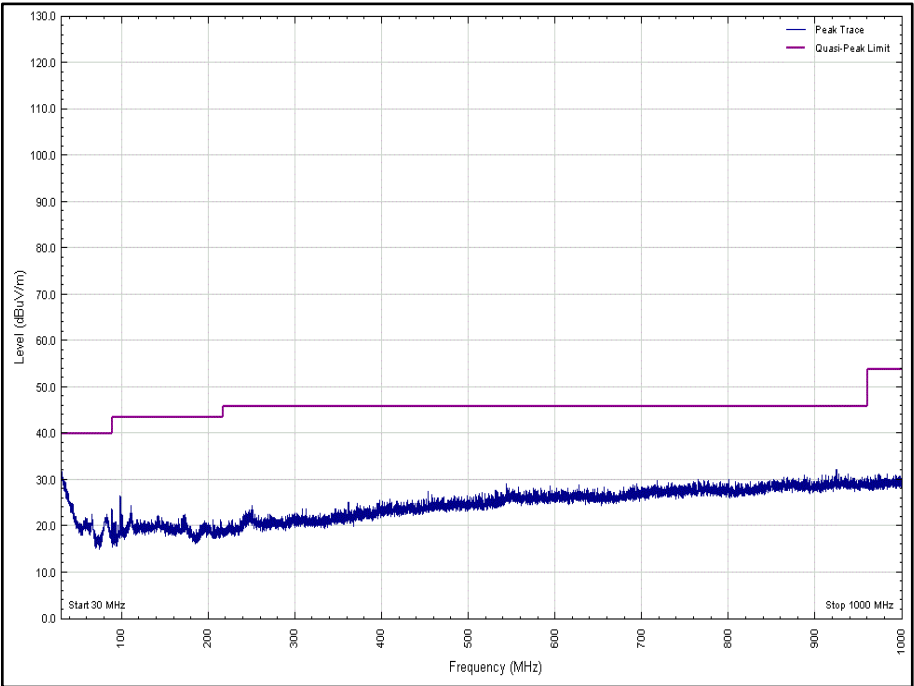


Figure 39 - 2440 MHz, 30 MHz to 1 GHz, Polarity: Vertical

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 28 - 2402 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

*No emissions were detected within 10 dB of the limit

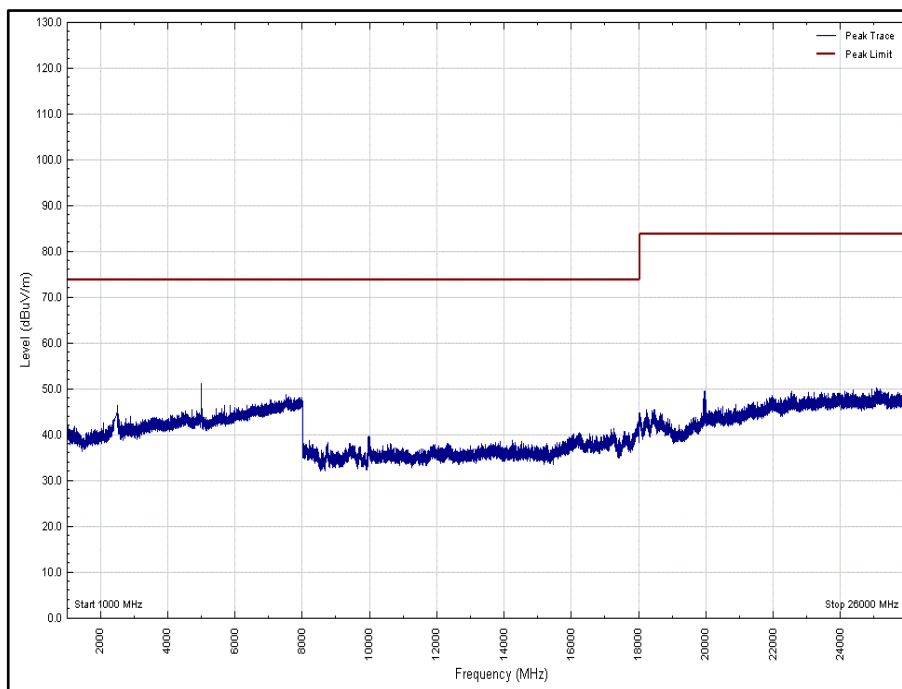


Figure 40 - 2402 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Peak)

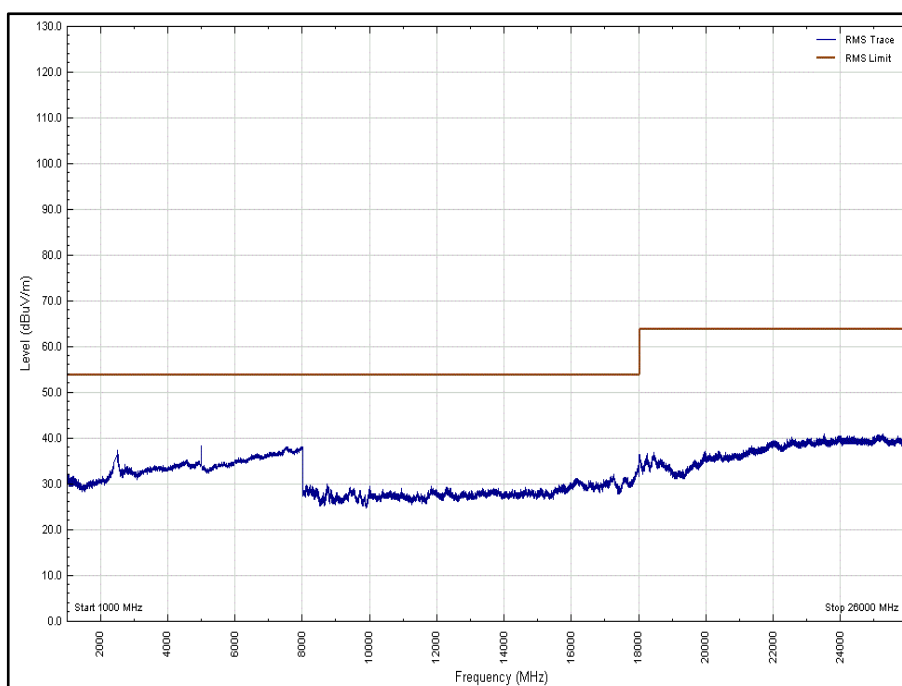


Figure 41 - 2402 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Average)

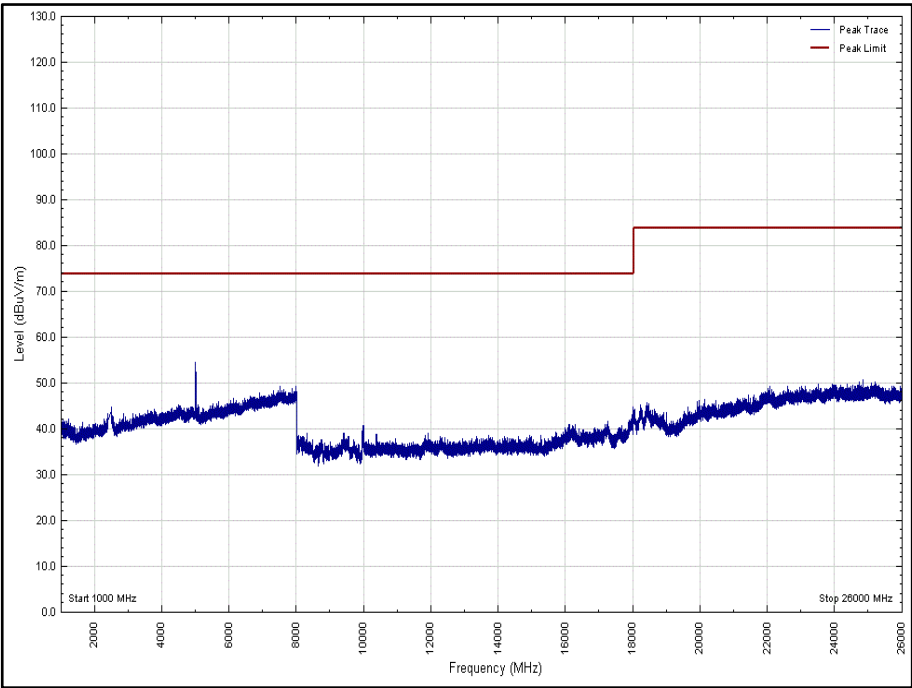


Figure 42 - 2402 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Peak)

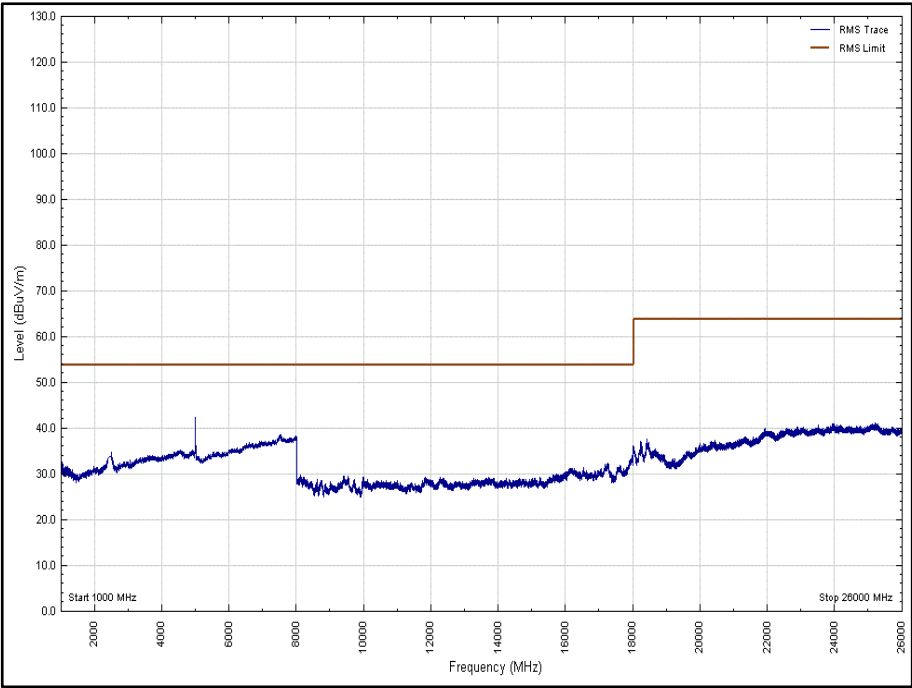


Figure 43 - 2402 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Average)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 29 - 2440 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

*No emissions were detected within 10 dB of the limit

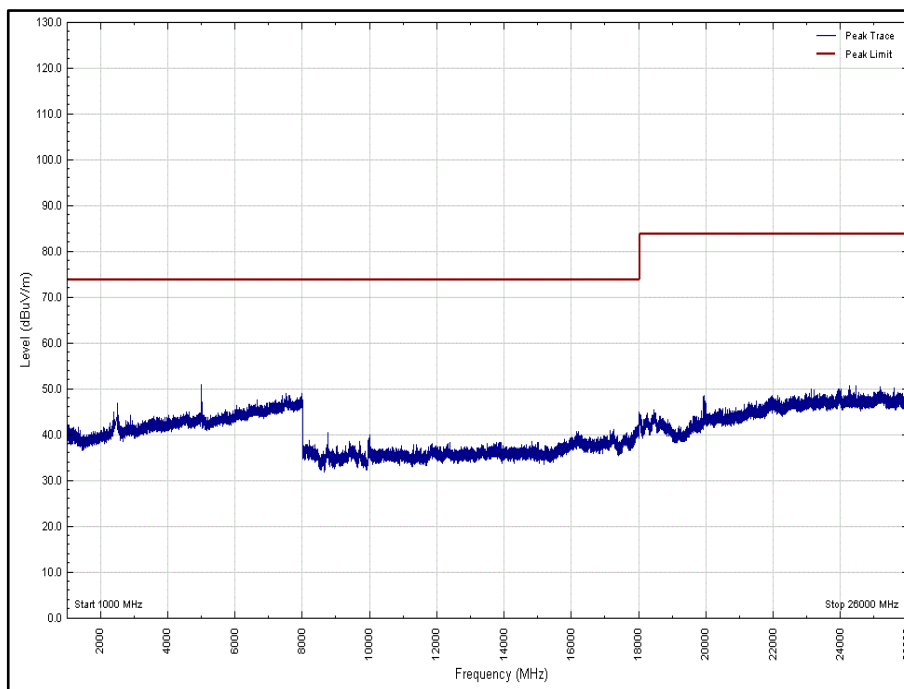


Figure 44 - 2440 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Peak)

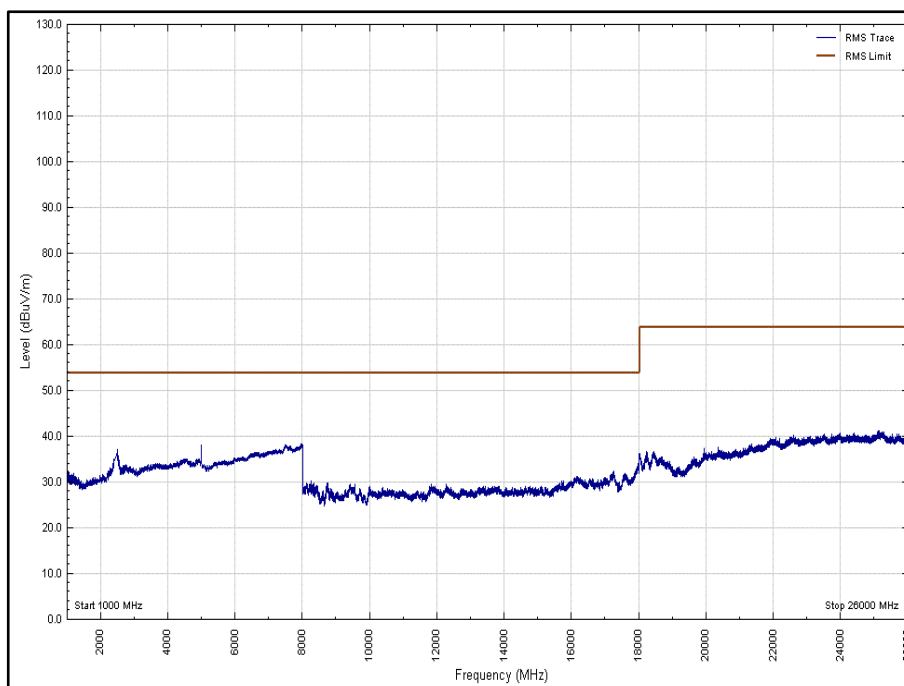


Figure 45 - 2440 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Average)

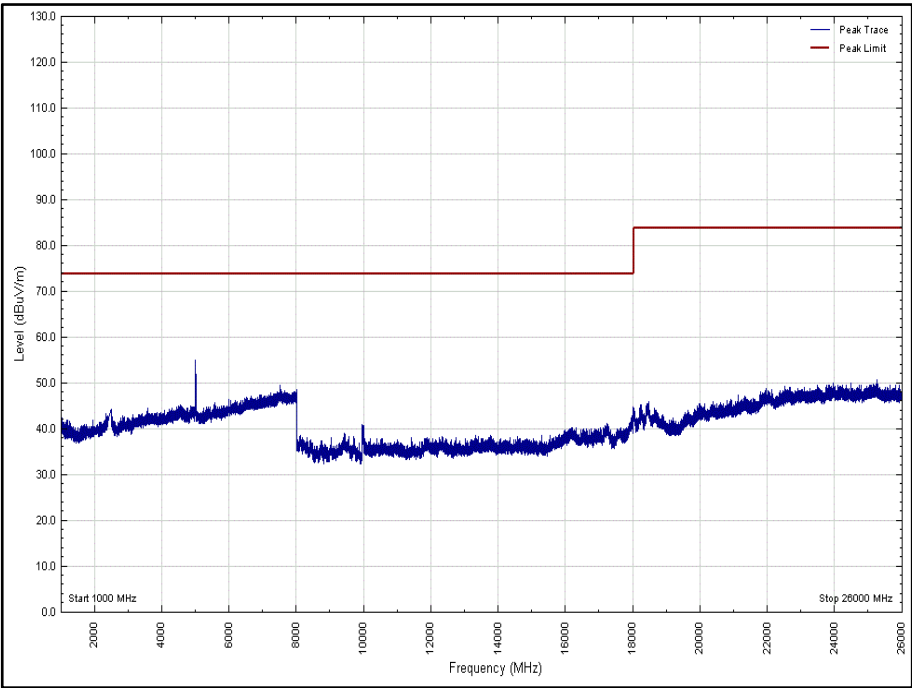


Figure 46 - 2440 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Peak)

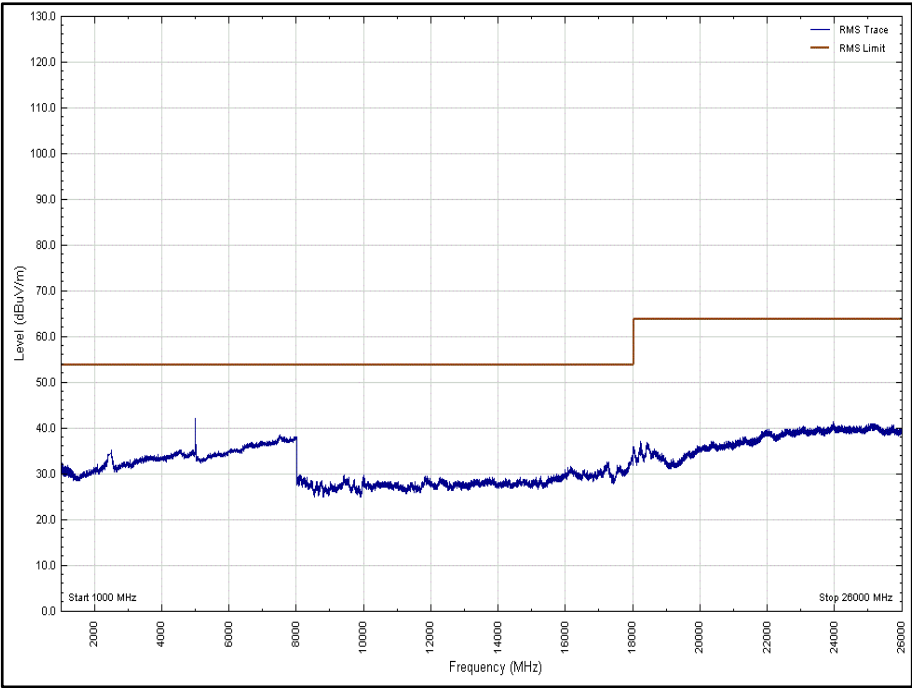


Figure 47 - 2440 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Average)

Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation	Orientation
*								

Table 30 - 2480 MHz - 1 GHz to 26 GHz – Radiated Emissions Results

*No emissions were detected within 10 dB of the limit

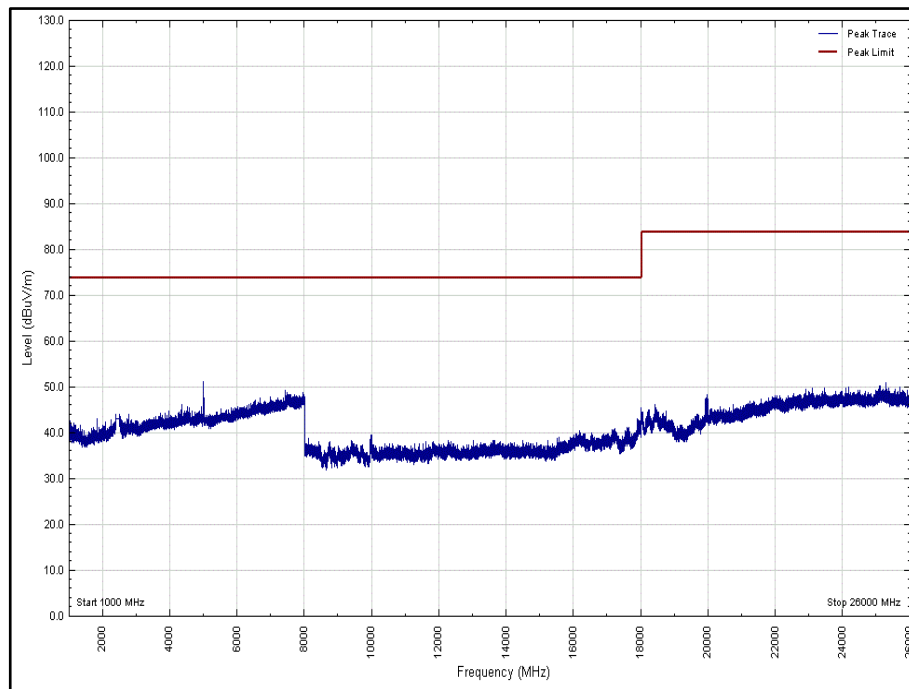


Figure 48 - 2480 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Peak)

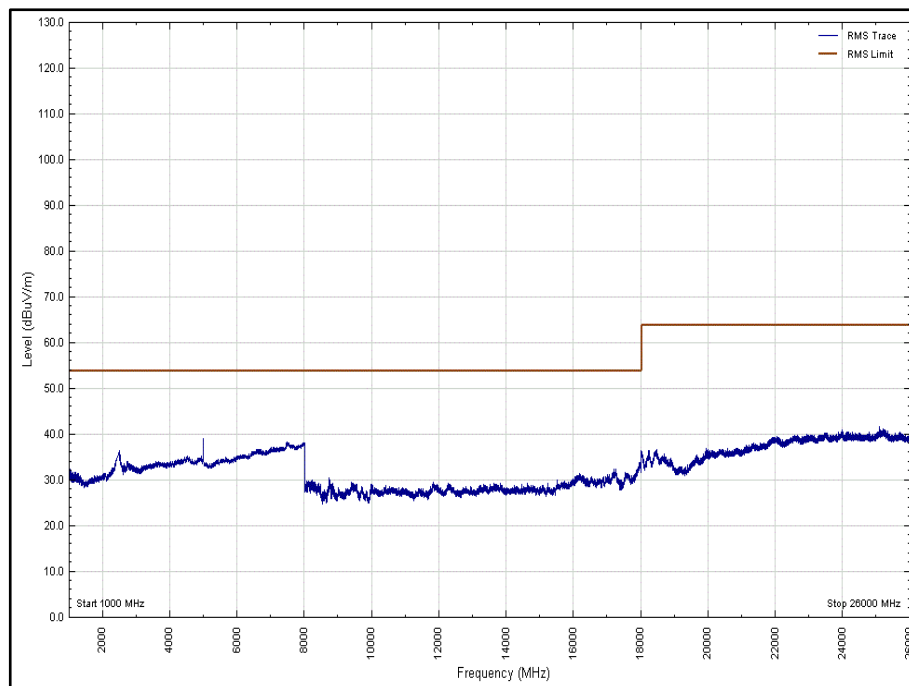


Figure 49 - 2480 MHz - 1 GHz to 26 GHz, Polarity: Horizontal (Average)

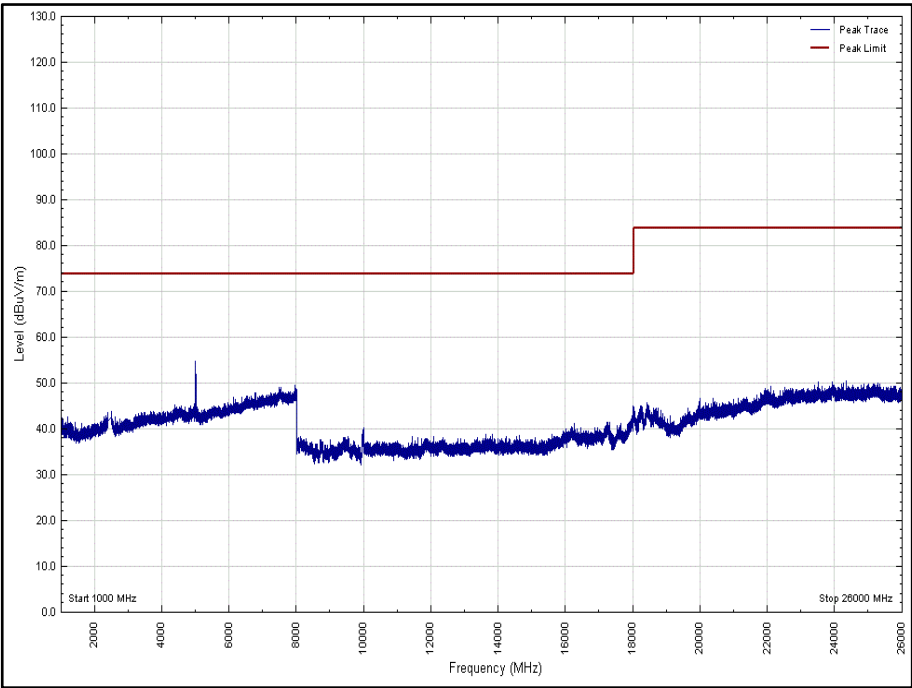


Figure 50 - 2480 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Peak)

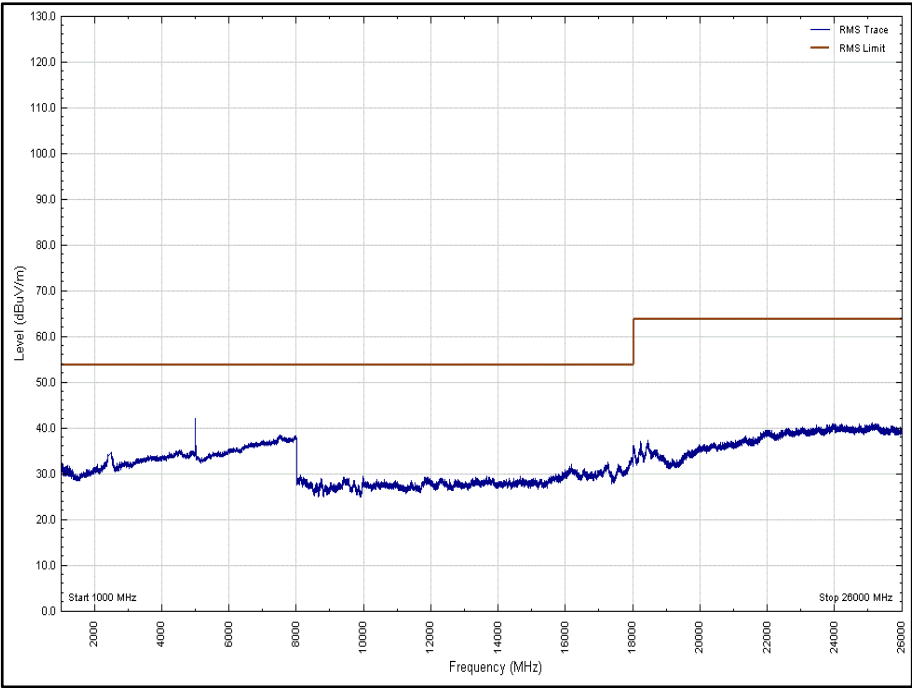


Figure 51 - 2480 MHz - 1 GHz to 26 GHz, Polarity: Vertical (Average)



FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in 15.209(a)

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.4.7 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 Due
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	15-May-2020
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
Pre-Amplifier	Phase One	PS04-0086	1533	12	08-Feb-2020
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
High Pass Filter (4GHz)	K&L Microwave	11SH10-4000/X18000-0/0	4599	12	05-Sep-2020
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5066	12	01-Oct-2020
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5068	12	01-Oct-2020
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	01-Oct-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
EmX Emissions Software	TUV SUD	EmX	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
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	11-Mar-2020
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	09-Apr-2020
Preamplifier (30dB 18-40GHz)	Schwarzbeck	BBV 9721	5218	12	09-Apr-2020

Table 31

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



2.5 Authorised Band Edges

2.5.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (d)
ISED RSS-247, Clause 5.5

2.5.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG009P09V - Modification State 0

2.5.3 Date of Test

19-November-2019 to 20-December-2019

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.10.4.

2.5.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	50.9 %



2.5.6 Test Results

2.4 GHz Bluetooth - LE1M

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	DH1	2402	2400.0	-58.97

Table 32

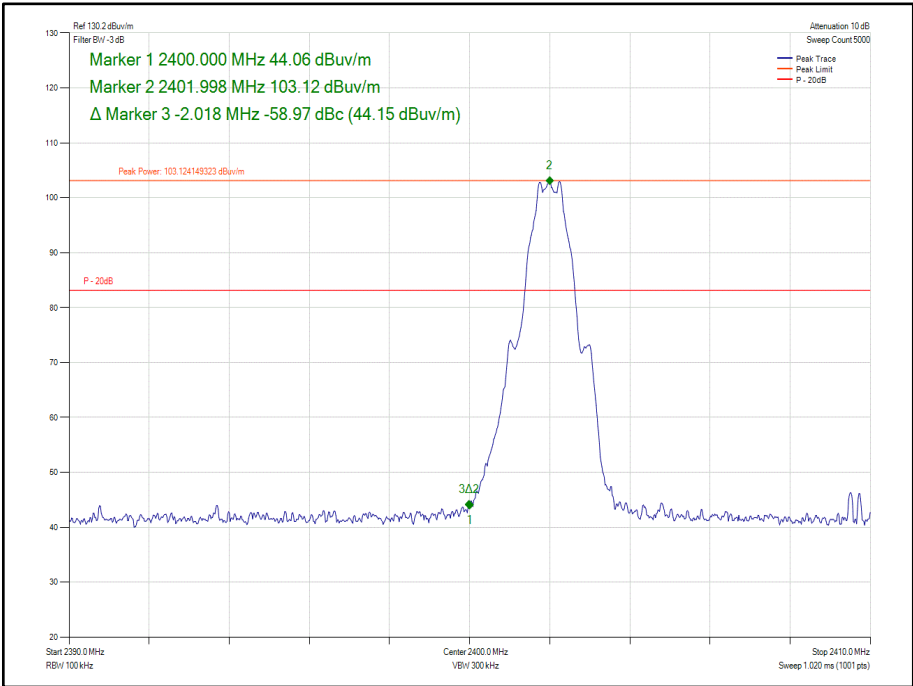


Figure 52 - GFSK/DH1- 2402 MHz – Band Edge Frequency 2400.0 MHz



2.4 GHz Bluetooth – LE2M

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	DH1	2402	2400.0	-43.57

Table 33

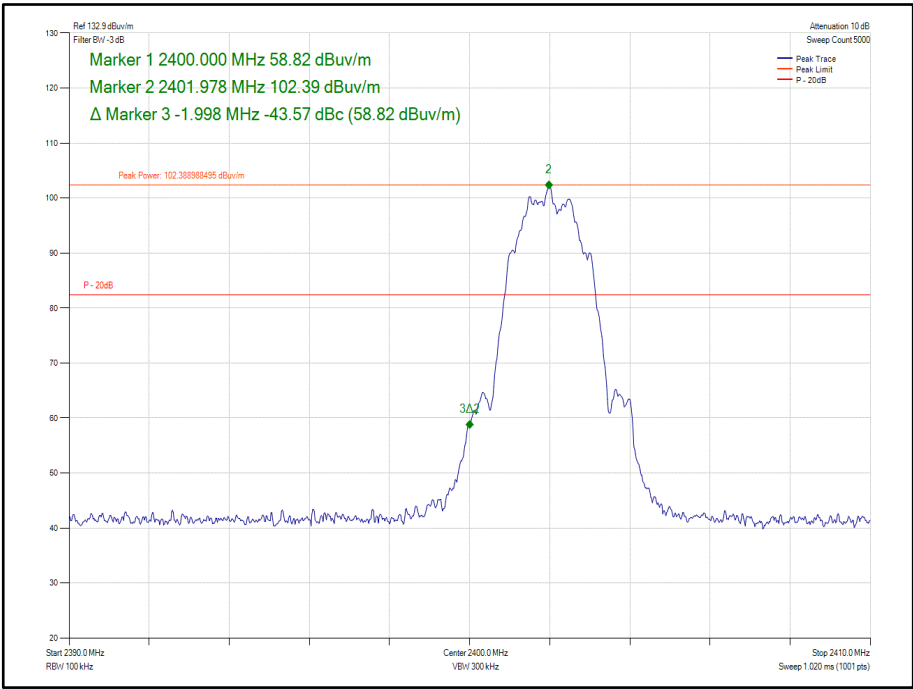


Figure 53 - GFSK/DH1 - 2402 MHz - Band Edge Frequency 2400.0 MHz

2.4 GHz Bluetooth - HDR4 iPA

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	4DH5	2404	2400.0	-56.13

Table 34

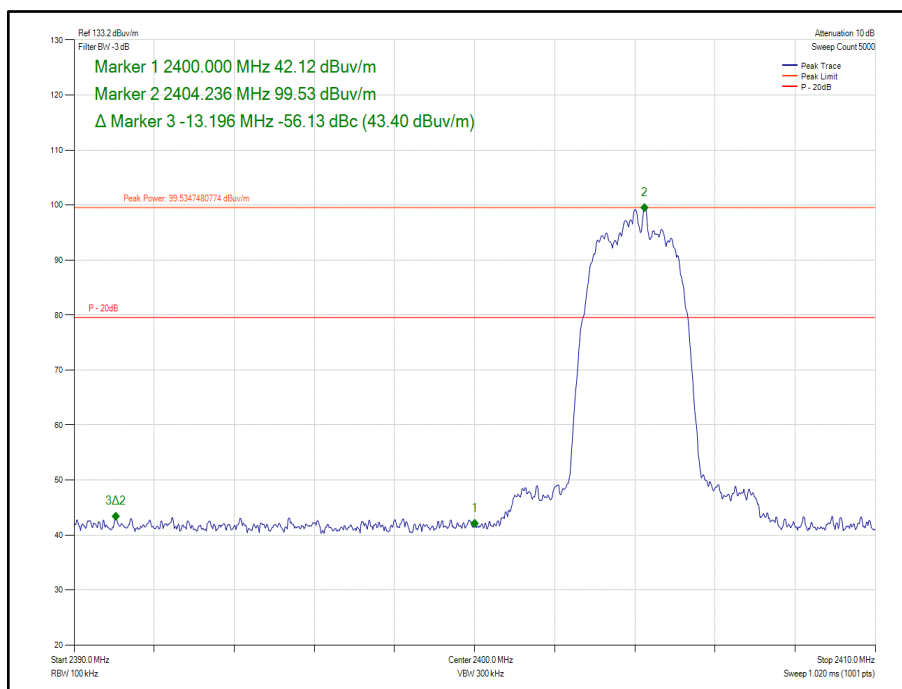


Figure 54 - GFSK/4DH5- 2404 MHz – Band Edge Frequency 2400.0 MHz
(Plot should show P- 30dB limit in place of P- 20dB)

2.4 GHz Bluetooth - HDR4 ePA

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	4DH5	2404	2400.0	-62.20

Table 35

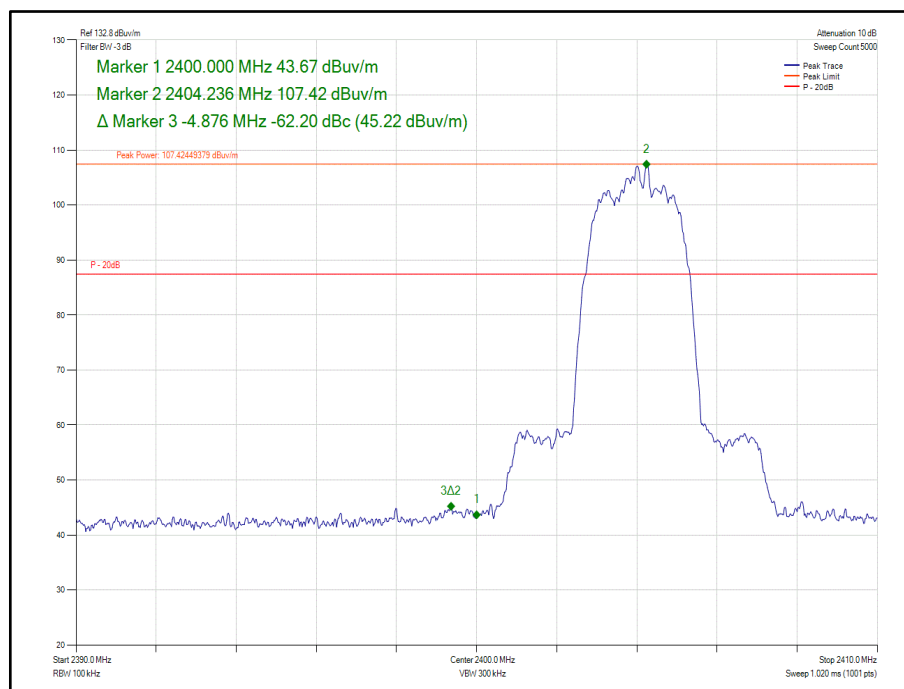


Figure 55 - GFSK/4DH5- 2404 MHz – Band Edge Frequency 2400.0 MHz
(Plot should show P- 30dB limit in place of P- 20dB)



2.4 GHz Bluetooth – HDR8 iPA

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	8DH5	2404	2400.0	-50.37

Table 36

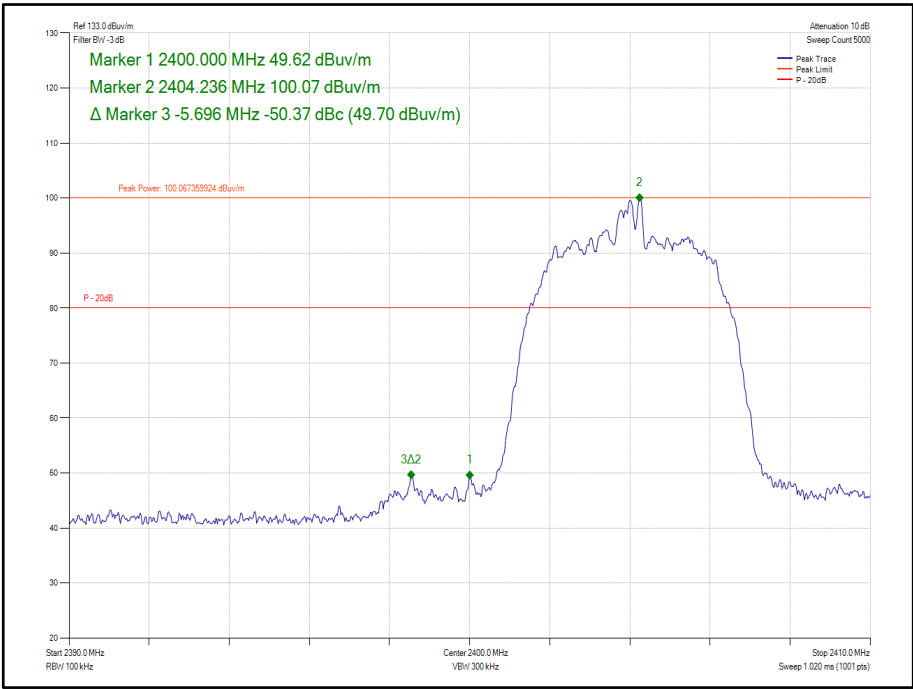


Figure 56 - GFSK/8DH5 - 2404 MHz - Band Edge Frequency 2400.0 MHz
(Plot should show P- 30dB limit in place of P- 20dB)

2.4 GHz Bluetooth – HDR8 ePA

Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
GFSK	8DH5	2404	2400.0	-51.55

Table 37

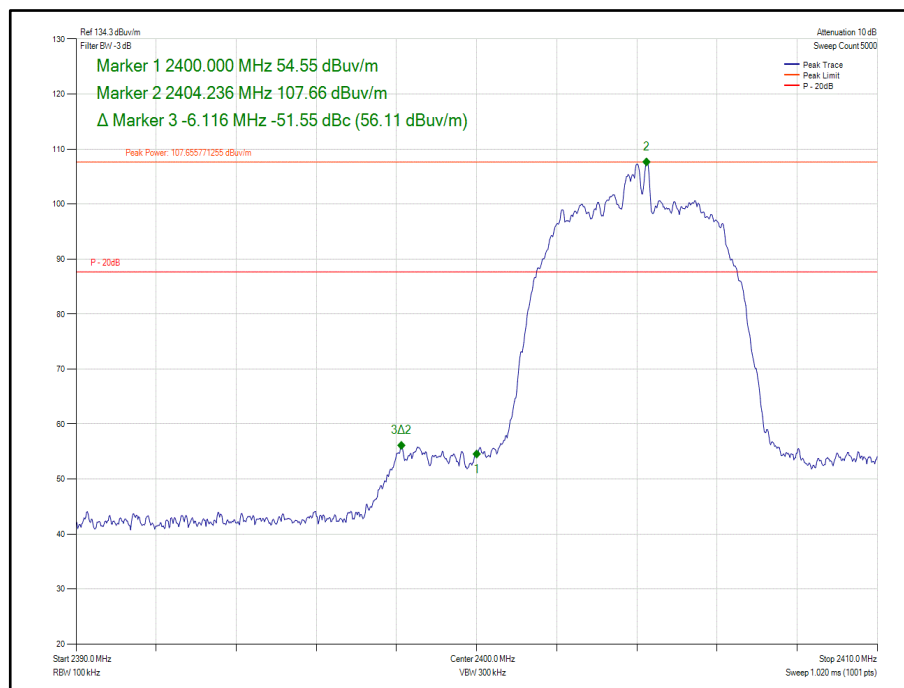


Figure 57 - GFSK/8DH5 - 2404 MHz - Band Edge Frequency 2400.0 MHz
(Plot should show P- 30dB limit in place of P- 20dB)

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

20 dB below the fundamental measured in a 100 kHz bandwidth using a peak detector. If the transmitter complies with the conducted power limits, based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB below the fundamental instead of 20 dB.

ISED RSS-247, Limit Clause 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



2.5.7 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 Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	O/P Mon
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	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
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	-	O/P Mon

Table 38

O/P Mon - Output Monitored using calibrated equipment

TU – Traceability Unscheduled



2.6 Restricted Band Edges

2.6.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.205
ISED RSS-GEN, Clause 8.10

2.6.2 Equipment Under Test and Modification State

A2289, S/N: C02ZG00AP0CR - Modification State 0

2.6.3 Date of Test

19-November-2019 to 20-December-2019

2.6.4 Test Method

This test was performed in accordance with ANSI C63.10, clause 6.10.5.

Plots for average measurements were taken in accordance with ANSI C63.10, clause 4.1.4.2.3.

These are shown for information purposes and were used to determine the worst-case measurement point. Final average measurements were then taken in accordance with ANSI C63.10 clause 4.1.4.2.2. to obtain the measurement result recorded in the test results tables.

The following conversion can be applied to convert from dB μ V/m to μ V/m:
 $10^{(\text{Field Strength in dB}\mu\text{V/m}/20)}$.

2.6.5 Environmental Conditions

Ambient Temperature	21.8 °C
Relative Humidity	50.9 %

2.6.6 Test Results

2.4 GHz Bluetooth - LE1M

Modulation	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	2390.0	54.07	39.24
GFSK/DH1	2480	2483.5	52.66	39.86

Table 39

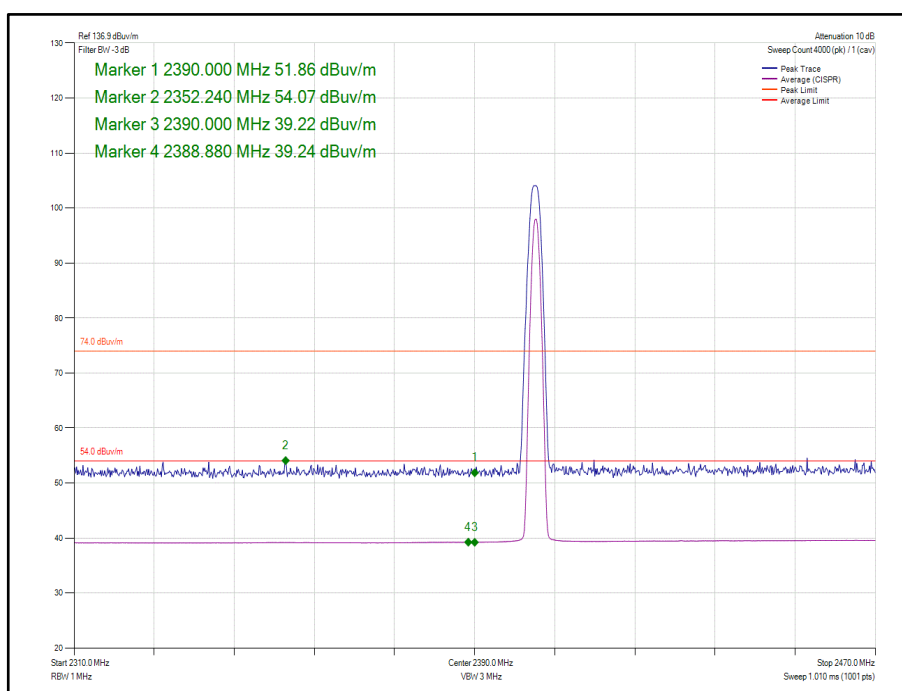


Figure 58 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

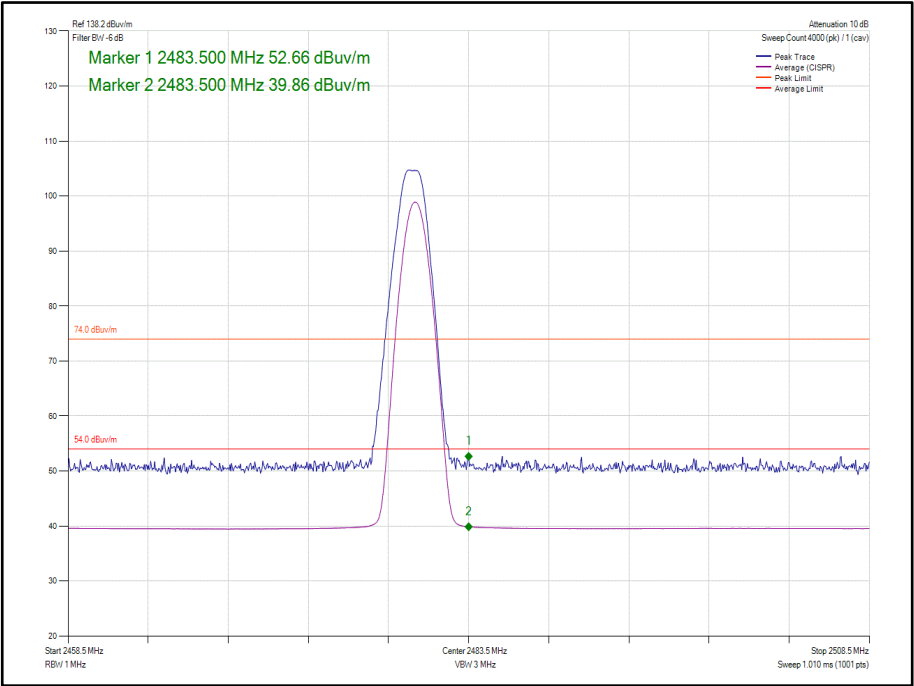


Figure 59 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz



2.4 GHz Bluetooth – LE2M

Modulation	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
GFSK/DH1	2402	2390	53.63	39.22
GFSK/DH1	2480	2483.5	52.80	39.88

Table 40 - Restricted Band Edge Results

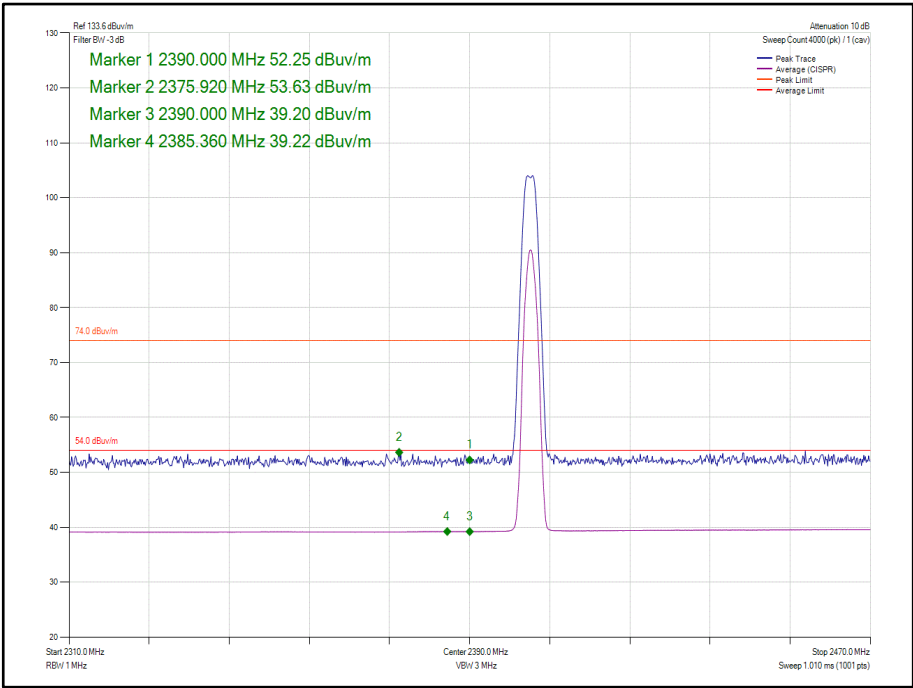


Figure 60 – GFSK/DH1 - 2402 MHz - Band Edge Frequency 2390.0 MHz

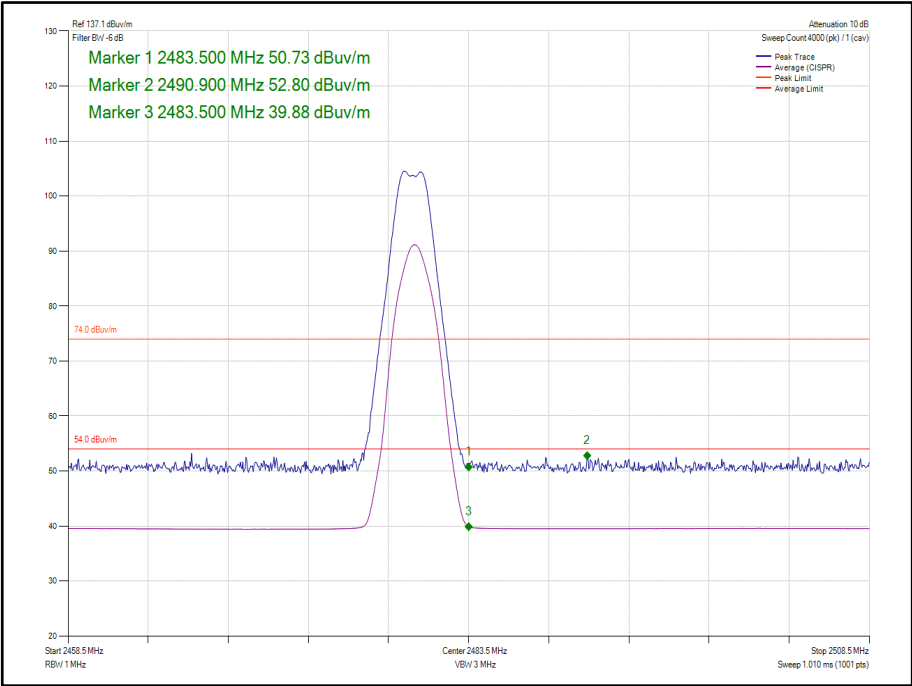


Figure 61 – GFSK/DH1 - 2480 MHz - Band Edge Frequency 2483.5 MHz

2.4 GHz Bluetooth - HDR4 iPA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
Static	GFSK	4DH5	2404	2390.0	54.42	39.24
Static	GFSK	4DH5	2478	2483.5	52.20	39.77

Table 41 - Restricted Band Edge Results

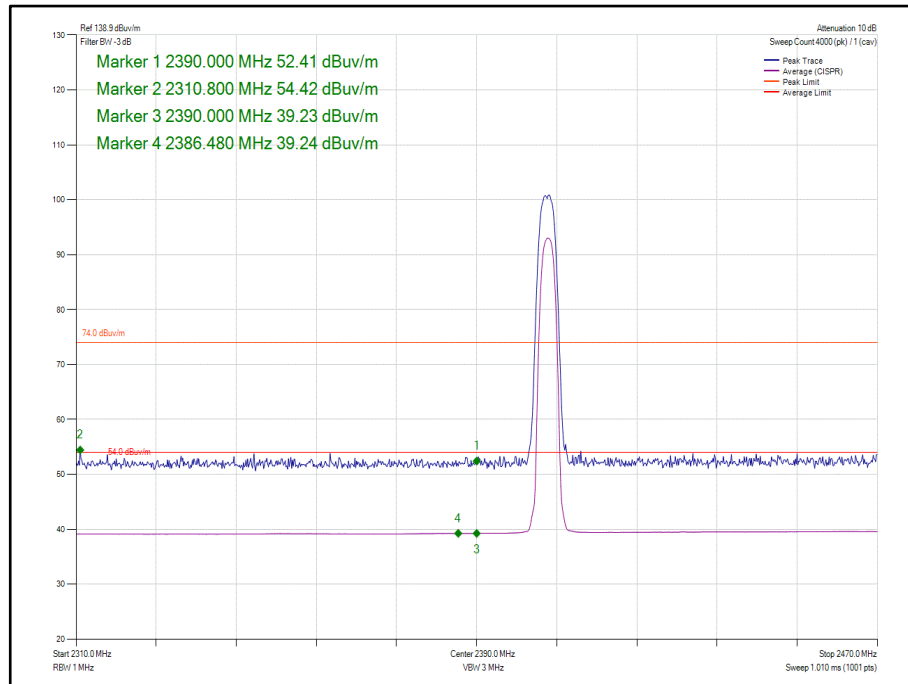


Figure 62 - Static - GFSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

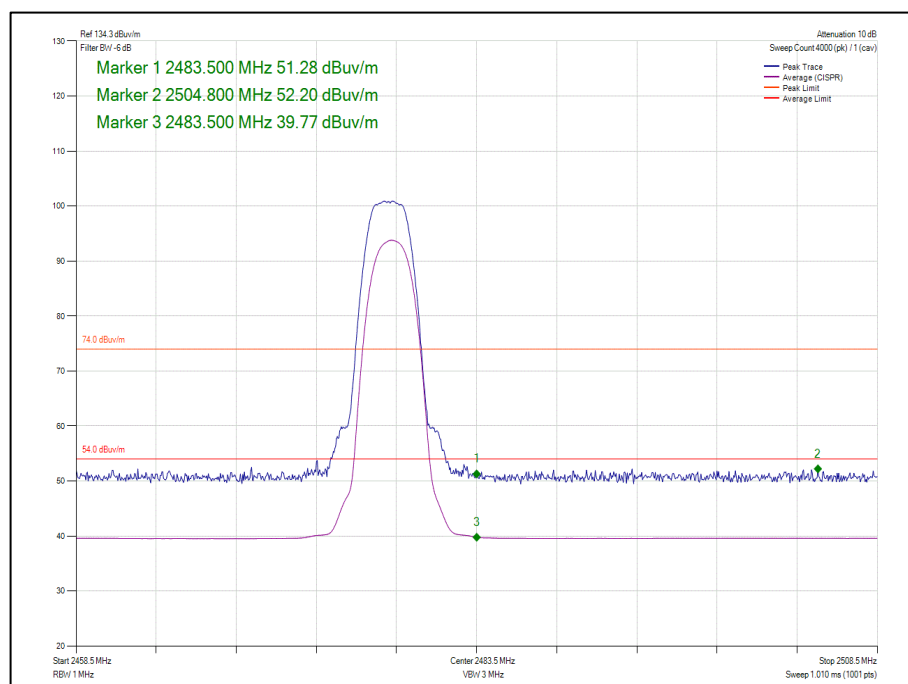


Figure 63 - Static - GFSK/4DH5 - 2478 MHz - Band Edge Frequency 2483.5 MHz

2.4 GHz Bluetooth - HDR4 ePA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dB μ V/m)	Average Level (dB μ V/m)
Static	GFSK	4DH5	2404	2390.0	53.89	39.59
Static	GFSK	4DH5	2478	2483.5	53.35	40.60

Table 42 - Restricted Band Edge Results

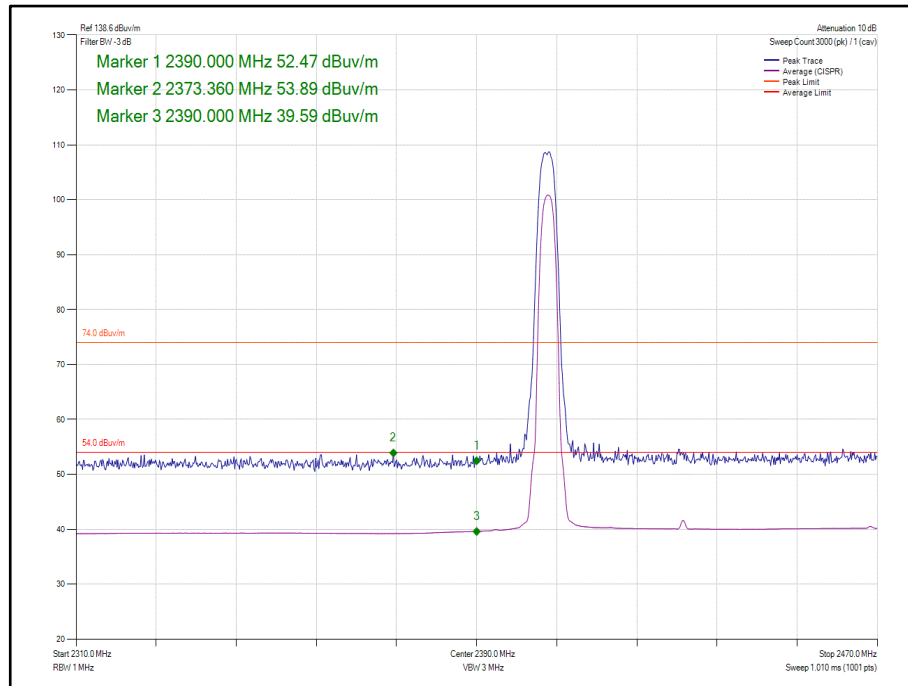


Figure 64 - Static - GFSK/4DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

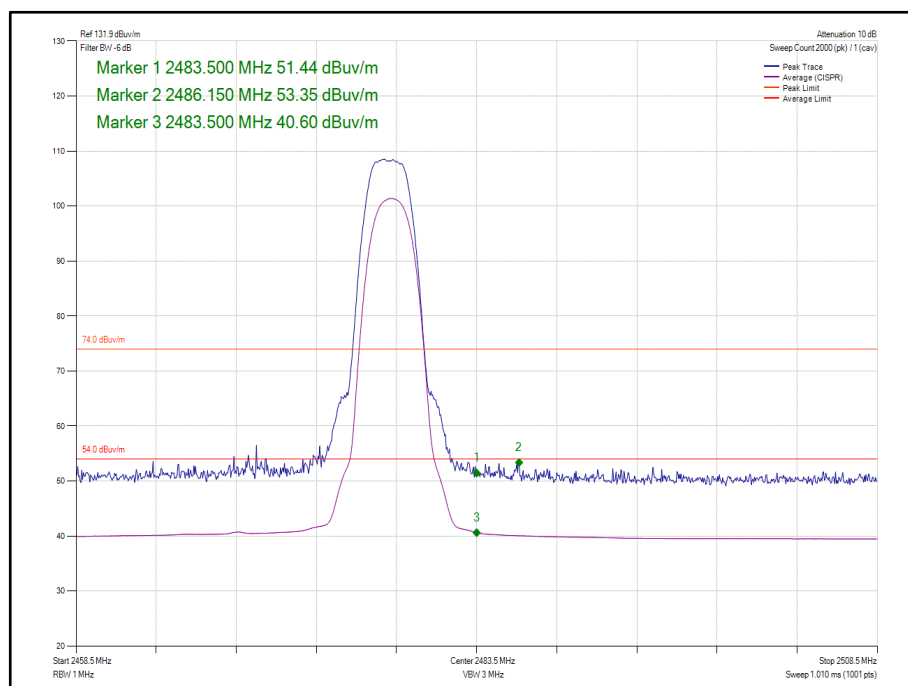


Figure 65 - Static - GFSK/4DH5 - 2478 MHz - Band Edge Frequency 2483.5 MHz

2.4 GHz Bluetooth – HDR8 iPA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	GFSK	8DH5	2404	2390.0	53.90	39.28
Static	GFSK	8DH5	2478	2483.5	59.94	45.70

Table 43 - Restricted Band Edge Results

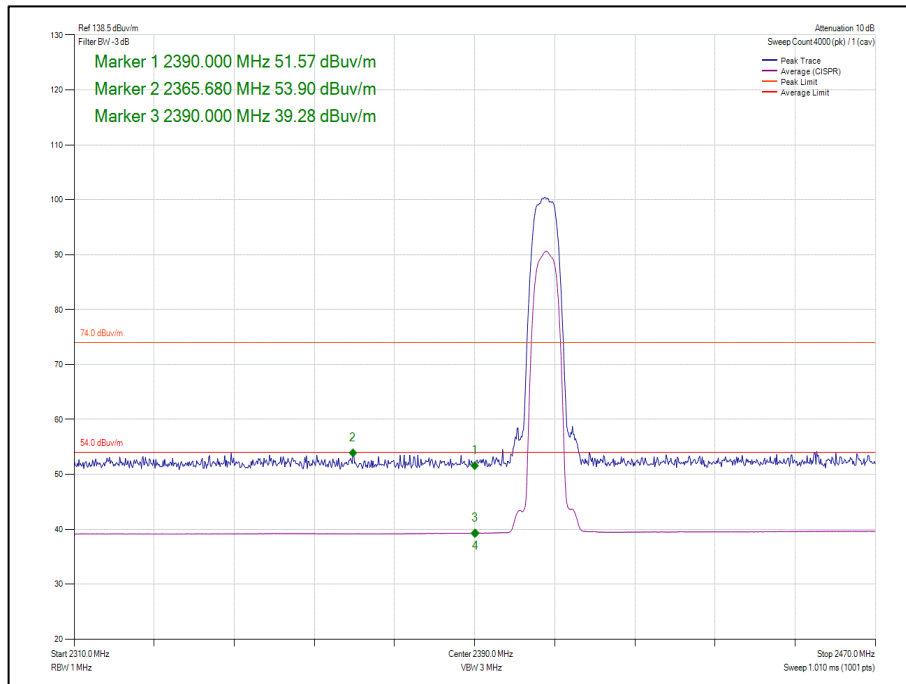


Figure 66 - Static - GFSK/8DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

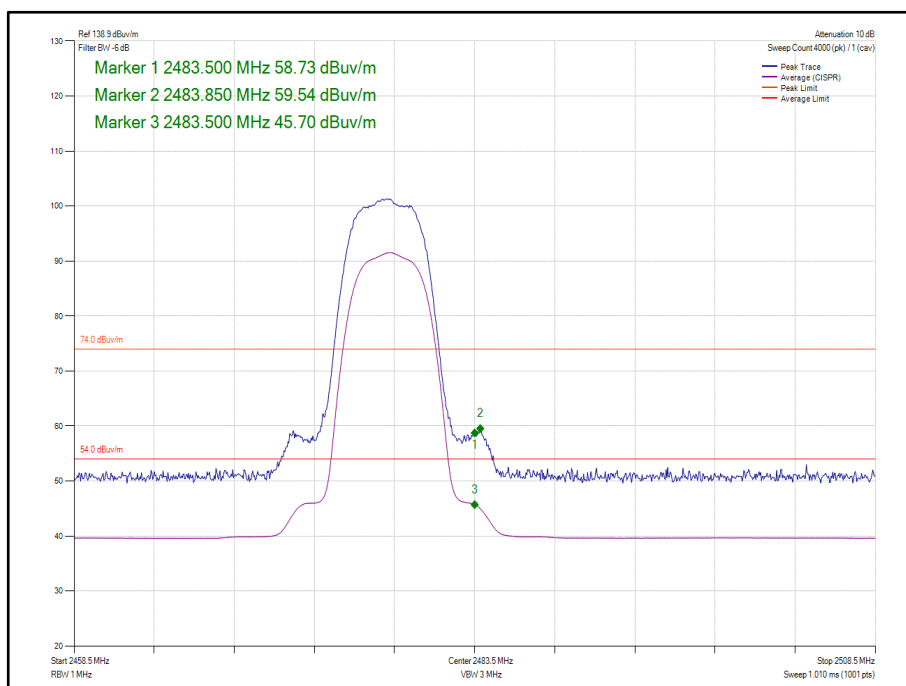


Figure 67 - Static - GFSK/8DH5 - 2478 MHz - Band Edge Frequency 2483.5 MHz

2.4 GHz Bluetooth – HDR8 ePA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBμV/m)	Average Level (dBμV/m)
Static	GFSK	8DH5	2404	2390.0	53.52	39.61
Static	GFSK	8DH5	2478	2483.5	62.92	50.18

Table 44 - Restricted Band Edge Results

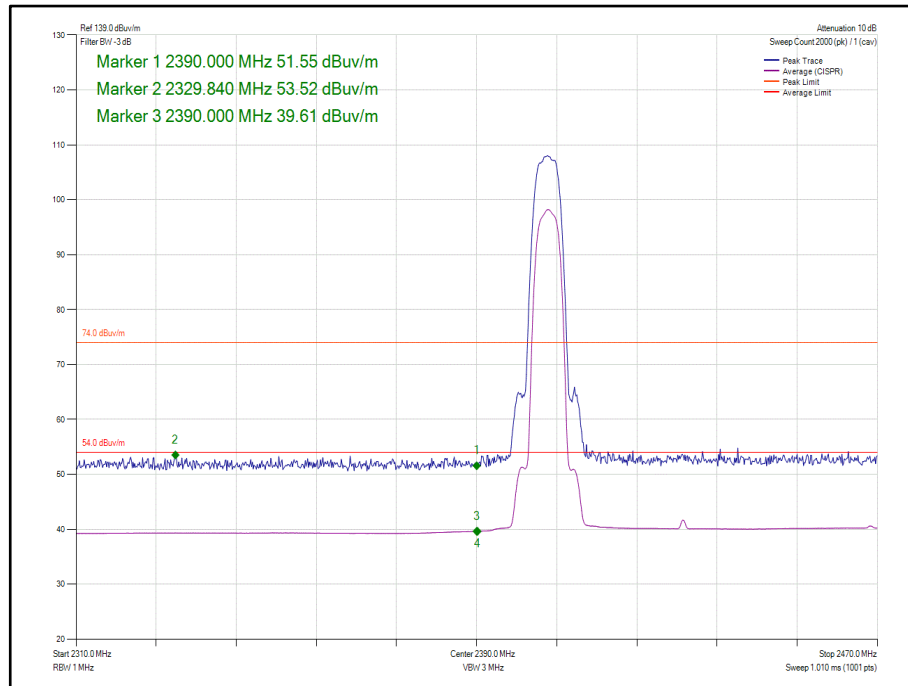


Figure 68 - Static - GFSK/8DH5 - 2404 MHz - Band Edge Frequency 2390.0 MHz

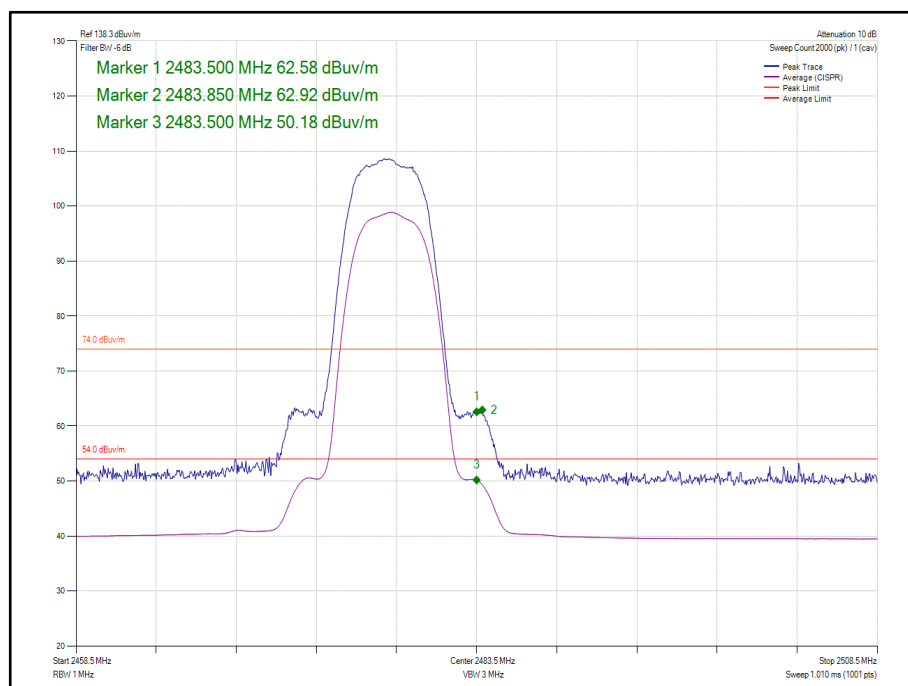


Figure 69 - Static - GFSK/8DH5 - 2478 MHz - Band Edge Frequency 2483.5 MHz



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 45

ISED RSS-GEN, Limit Clause 8.9

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

Table 46

*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.



2.6.7 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 Due
10dB/1W SMA Attenuator dc - 18GHz	Sealectro	60-674-1010-89	395	-	15-May-2020
1GHz to 8GHz Low Noise Amplifier	Wright Technologies	APS04-0085	4365	12	14-Nov-2020
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	11-Mar-2020
Hygrometer	Rotronic	HP21	4989	12	02-May-2020
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5105	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-071-2000	5107	12	06-Oct-2020
EmX Emissions Software	TUV SUD	EmX	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
8 Meter Cable	Teledyne	PR90-088-8MTR	5212	12	30-Aug-2020
Horn Antenna (1-10GHz)	Schwarzbeck	BBHA 9120 B	5215	12	11-Mar-2020
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	-	O/P Mon

Table 47

TU - Traceability Unscheduled

O/P Mon - Output Monitored using calibrated equipment



3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Test Name	Measurement Uncertainty
Restricted Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Spurious Radiated Emissions	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Emission Bandwidth	± 67.18 kHz
Power Spectral Density	± 3.2 dB
Maximum Conducted Output Power	± 3.2 dB

Table 48

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.