FCC and ISED Test Report
Apple Inc
Model: A2439
In accordance with FCC 47 CFR Part 15C, ISED RSS-247 and ISED RSS-GEN (2.4 GHz Bluetooth FHSS)

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

FCC ID: BCGA2439 IC: 579C-A2439

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Document 75949506-09 Issue 01

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SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Neil Rousell	Senior Engineer	Authorised Signatory	16 February 2021

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	Daniel Cameron	16 February 2021	
Testing	Connor Lee	16 February 2021	
Testing	Aasim Butt	16 February 2021	
Testing	Colin Brain	16 February 2021	
Testing	Liang Tian	16 February 2021	
Testing	Jaiyanth Balendrarajah	16 February 2021	
Testing	Mohammad Malik	16 February 2021	

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: 2019, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019) 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	16 February 2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2439
Serial Number(s)	C02DM00P0FTP and C02DM00M0FTN
Hardware Version(s)	REV 1.0
Software Version(s)	20W430340t
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 15C: 2019 ISED RSS-247: Issue 2 (02-2017) ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)
Order Number Date	0540205414 13-July-2020
Date of Receipt of EUT	09-October-2020
Start of Test	09-November-2020
Finish of Test	15-February-2021
Name of Engineer(s)	Daniel Cameron, Connor Lee, Aasim Butt, Colin Brain, Liang Tian, Jaiyanth Balendrarajah and Mohammad Malik
Related Document(s)	ANSI C63.10 (2013) ANSI C63.4 (2014) 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 - FHSS						
-	15.203	-	-	Antenna Requirement	N/T	The devices complies with the provisions of this section, as it uses a permanently attached integral antennas.
2.1	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	
2.4	15.247 (a)(1)	5.1	6.7	Frequency Hopping Systems - 20 dB Bandwidth	Pass	
2.5	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	Pass	
2.6	15.205	-	8.10	Restricted Band Edges	Pass	
2.7	15.247 (d)	5.5	-	Authorised Band Edges	Pass	
2.8	15.247 (d) and 15.205	5.5	6.13	Spurious Radiated Emissions	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 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 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. SISO tests were also performed on the BT Dedicated Core.

Bluetooth BDR/EDR was assessed as a FHSS system. The EUT supports Bluetooth on the following mode of operations across it's antenna ports:

- BT Core 0 – SISO (iPA and ePA)
- BT Core 1 – SISO (iPA and ePA)
- BT Dedicated Core – SISO (iPA)
- BT Core 0 + BT Core 1 - 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 either a static channel selected within the test script or frequency hopping over the maximum number of supported channels.

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

1.4.3 Antenna Gain Table (2.4GHz Bluetooth)

Antenna Port	Frequency Range (MHz)	Peak Gain (dBi)	Conducted Cable Loss (dB)
Core 0	2400 to 2480	3.33	1.90
Core 1	2400 to 2480	-0.10	1.90
BT Dedicated Core	2400 to 2480	1.00	1.80

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: A2439, Serial Number: C02DM00P0FTP			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2439, Serial Number: C02DM00M0FTN			
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 - FHSS		
Frequency Hopping Systems - Average Time of Occupancy	Daniel Cameron	UKAS
Frequency Hopping Systems - Channel Separation	Daniel Cameron	UKAS
Frequency Hopping Systems - Number of Hopping Channels	Daniel Cameron	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	Daniel Cameron	UKAS
Maximum Conducted Output Power	Daniel Cameron	UKAS
Authorised Band Edges	Connor Lee, Aasim Butt, Colin Brain, Liang Tian, Jaiyanth Balendrarajah, Mohammad Malik	UKAS
Restricted Band Edges	Connor Lee, Aasim Butt, Colin Brain, Liang Tian, Jaiyanth Balendrarajah, Mohammad Malik	UKAS
Spurious Radiated Emissions	Connor Lee, Aasim Butt, Colin Brain and Liang Tian.	UKAS

Table 5

Office Address:

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

2 Test Details

2.1 Frequency Hopping Systems - Average Time of Occupancy

2.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1

2.1.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00P0FTP - Modification State 0

2.1.3 Date of Test

05-January-2021

2.1.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.4.

2.1.5 Environmental Conditions

Ambient Temperature	24.0 °C
Relative Humidity	24.1 %

2.1.6 Test Results

2.4 GHz Bluetooth - FHSS

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.4
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	Time of Occupancy			Limit (ms)
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)	
2402	2.887	107	308.9	400.0

Table 6 - Time of Occupancy Results

Figure 1 - GFSK - 2402 MHz Accumulated Transmit Time

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.4
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	Time of Occupancy			Limit (ms)
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)	
2402	2.887	92	265.6	400.0

Table 7 - Time of Occupancy Results

Figure 2 - GFSK - 2402 MHz Accumulated Transmit Time

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.4
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	Time of Occupancy			Limit (ms)
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)	
2402	2.887	108	311.8	400.0

Table 8 - Time of Occupancy Results

Figure 3 - GFSK - 2402 MHz Accumulated Transmit Time

<u>FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)</u>

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

<u>ISED RSS-247, Limit Clause 5.1 (d)</u>

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

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	17-May-2021
Multimeter	Iso-tech	IDM101	2424	12	14-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 9

O/P Mon – Output Monitored using calibrated equipment

2.2 Frequency Hopping Systems - Channel Separation

2.2.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1) and
ISED RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00P0FTP - Modification State 0

2.2.3 Date of Test

05-January-2021

2.2.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.2.

2.2.5 Environmental Conditions

Ambient Temperature 24.0 °C
Relative Humidity 24.1 %

2.2.6 Test Results

2.4 GHz Bluetooth - FHSS

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	0.9276	2441.030	2442.029	0.999	≥618.4

Table 10 - Carrier Frequency Separation Results

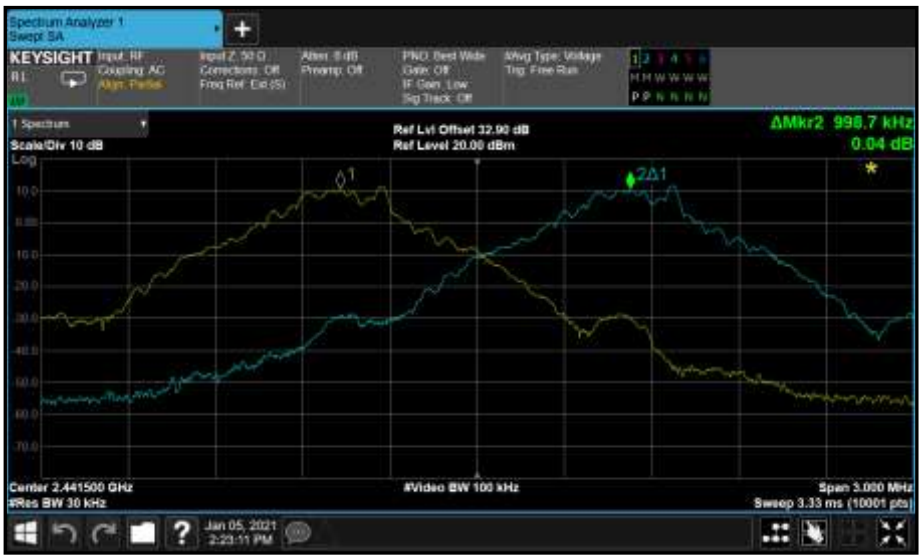

Figure 4 - GFSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3536	2441.011	2442.011	1.000	≥902.4

Table 11 - Carrier Frequency Separation Results

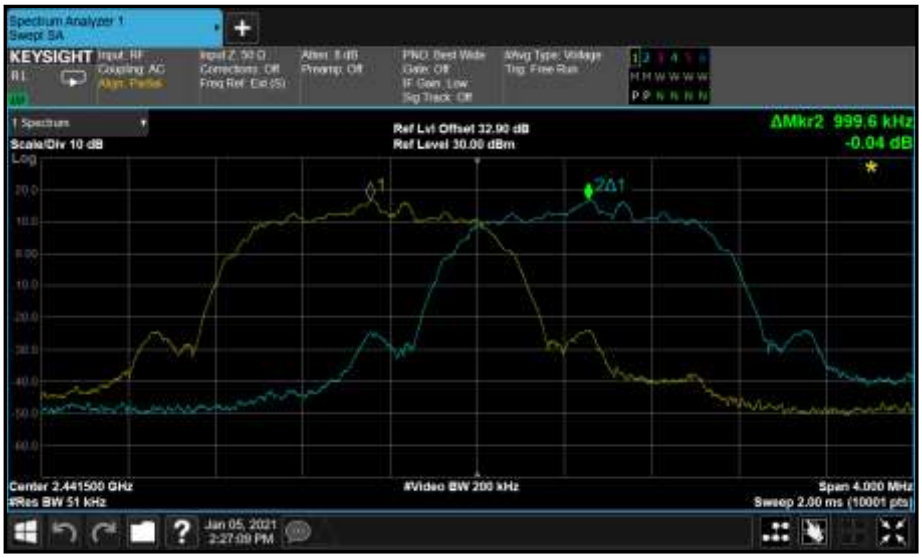

Figure 5 - π/4 DQPSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3284	2441.018	2442.019	1.001	≥885.6

Table 12 - Carrier Frequency Separation Results

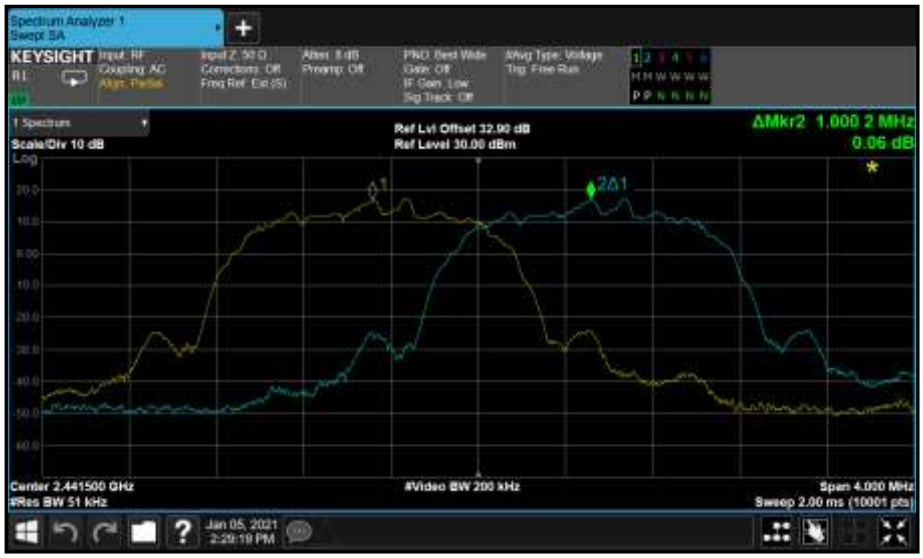

Figure 6 - 8-DPSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	0.9234	2441.031	2442.031	1.000	≥615.6

Table 13 - Carrier Frequency Separation Results

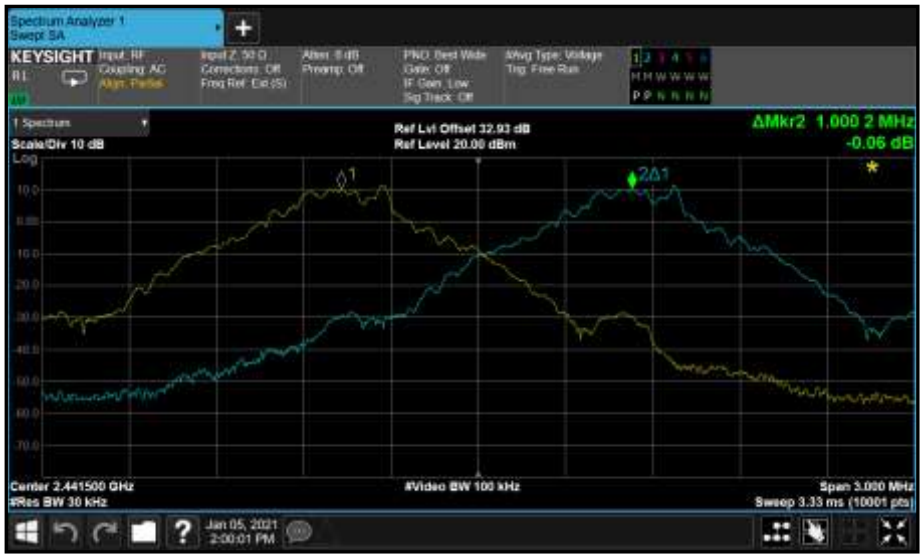

Figure 7 - GFSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3516	2441.013	2442.014	1.001	≥901.1

Table 14 - Carrier Frequency Separation Results

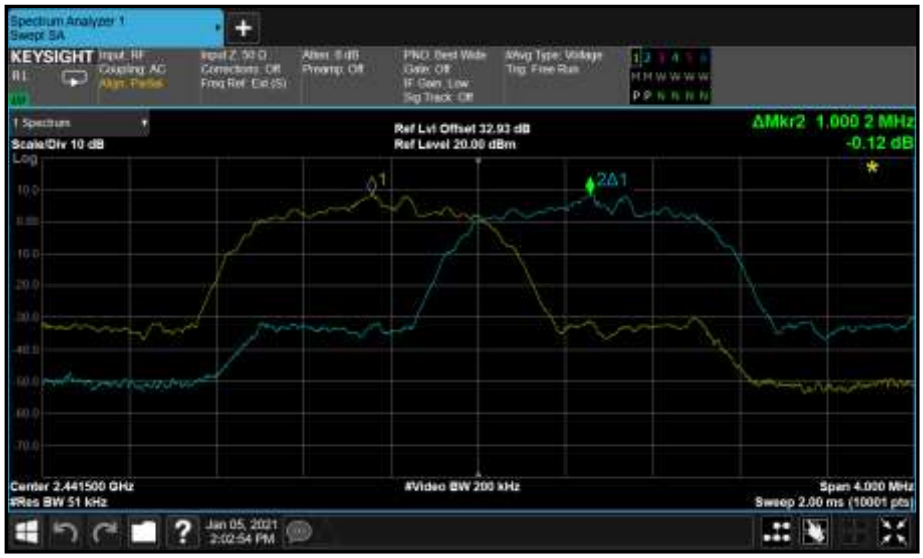

Figure 8 - π/4 DQPSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3260	2441.021	2442.021	1.000	≥884.0

Table 15 - Carrier Frequency Separation Results

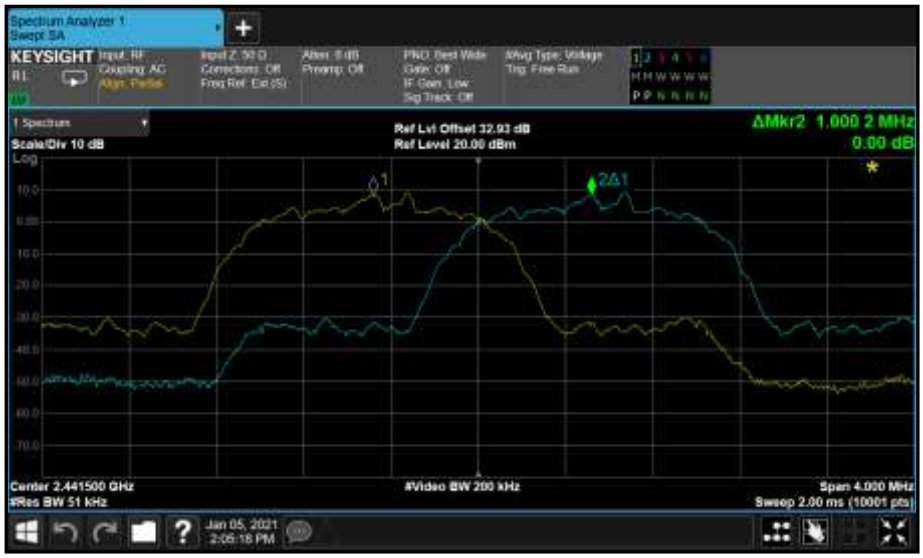

Figure 9 - 8-DPSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	0.9252	2441.032	2442.032	1.000	≥616.8

Table 16 - Carrier Frequency Separation Results

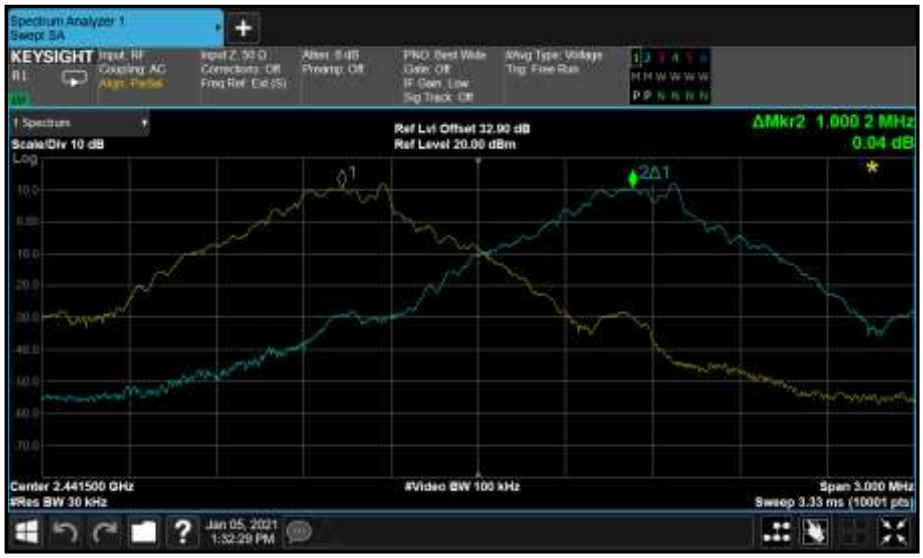

Figure 10 - GFSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3496	2441.014	2442.014	1.000	≥899.7

Table 17 - Carrier Frequency Separation Results

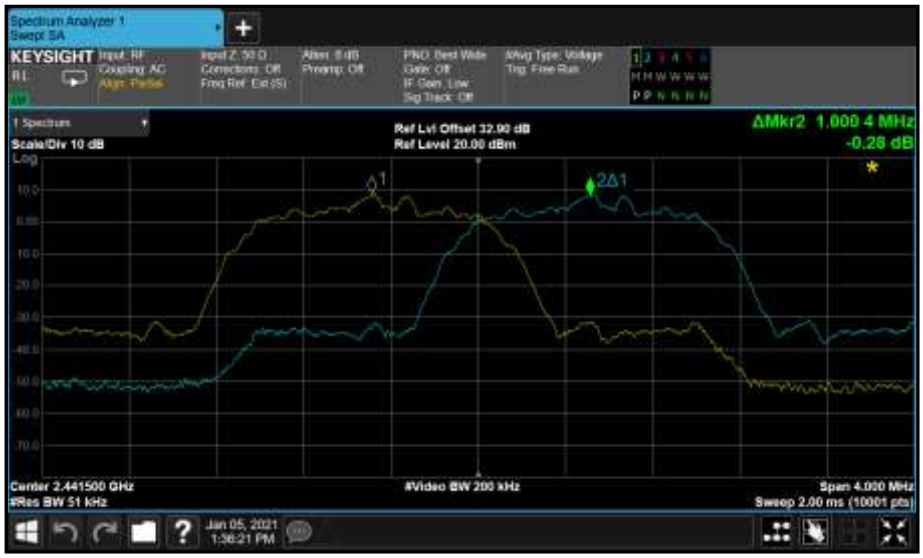

Figure 11 - π/4 DQPSK - 2441 MHz (CH39)

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1 b)	Test Method(s):	C63.10 7.8.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)	Carrier Frequency Separation (MHz)			Limit (kHz)
		F1C	F2C	FHS	
2441	1.3256	2441.022	2442.022	1.000	≥883.7

Table 18 - Carrier Frequency Separation Results

Figure 12 - 8-DPSK - 2441 MHz (CH39)

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

ISED RSS-247, Limit Clause 5.1 (b)

FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

2.2.7 Test Location and Test Equipment Used

This test was carried out RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Multimeter	Iso-tech	IDM101	2424	12	14-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 19

O/P Mon – Output Monitored using calibrated equipment

2.3 Frequency Hopping Systems - Number of Hopping Channels

2.3.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1

2.3.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00P0FTP - Modification State 0

2.3.3 Date of Test

05-January-2021

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 7.8.3.

2.3.5 Environmental Conditions

Ambient Temperature 24.0 °C
Relative Humidity 24.1 %

2.3.6 Test Results

2.4 GHz Bluetooth - FHSS

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.3
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Number of Hopping Frequencies	Limit
79	15

Table 20 - Number of Hopping Frequencies Results

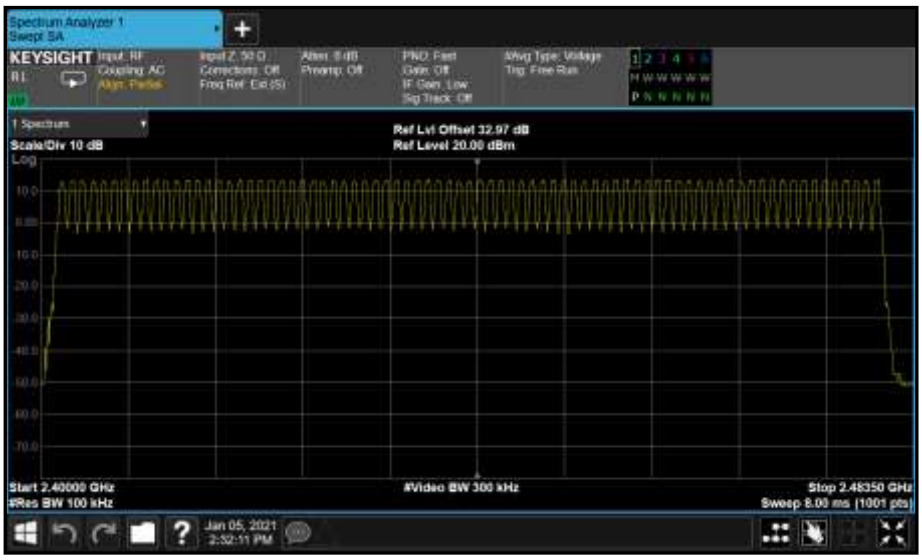

Figure 13 - GFSK (DH5) - Number of Hopping Channels

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.3
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Number of Hopping Frequencies	Limit
79	15

Table 21 - Number of Hopping Frequencies Results

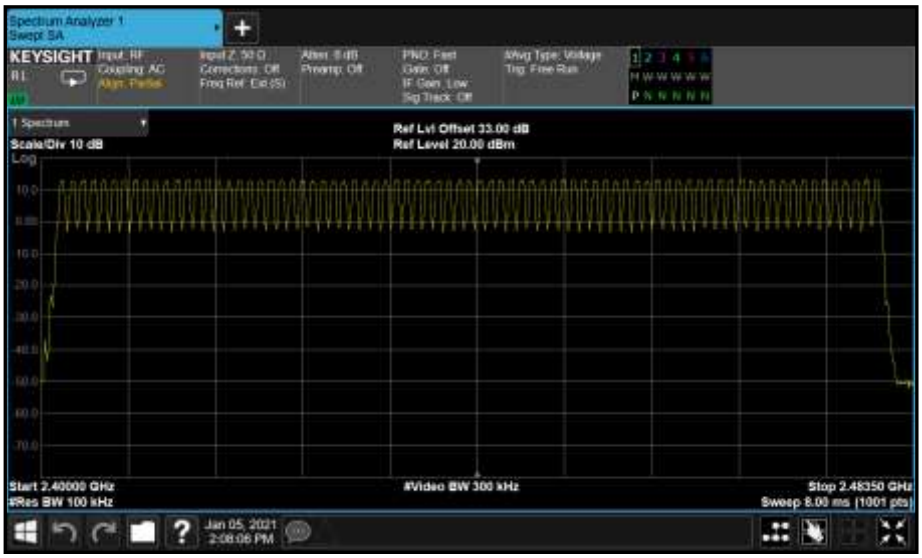

Figure 14 - GFSK (DH5) - Number of Hopping Channels

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)(iii) RSS-247 5.1 d)	Test Method(s):	C63.10 7.8.3
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Number of Hopping Frequencies	Limit
79	15

Table 22 - Number of Hopping Frequencies Results

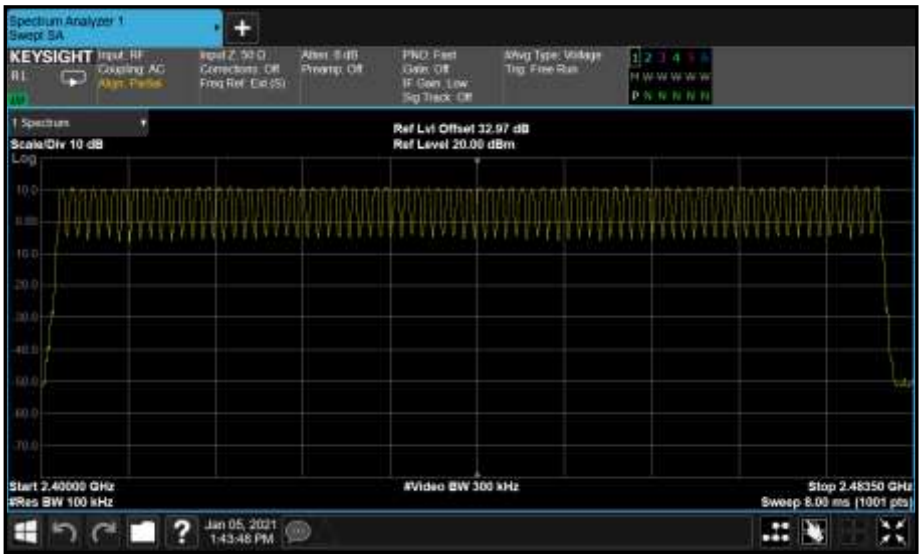

Figure 15 - GFSK (DH5) - Number of Hopping Channels

<u>FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(iii)</u>

≥ 15 channels

<u>ISED RSS-247, Limit Clause 5.1 (d)</u>

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels.

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	17-May-2021
Multimeter	Iso-tech	IDM101	2424	12	14-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 23

O/P Mon – Output Monitored using calibrated equipment

2.4 Frequency Hopping Systems - 20 dB Bandwidth

2.4.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.247 (a)(1)
ISED RSS-247, Clause 5.1
ISED RSS-GEN, Clause 6.7

2.4.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00P0FTP - Modification State 0

2.4.3 Date of Test

05-January-2021

2.4.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.2.

2.4.5 Environmental Conditions

Ambient Temperature 24.0 °C
Relative Humidity 24.1 %

2.4.6 Test Results

2.4 GHz Bluetooth - FHSS

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1)	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	0.888	-
2441	-	-	0.885	-
2480	-	-	0.840	-

Table 24 - 20 dB Bandwidth Results

Figure 16 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 17 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 18 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	0.885	0.840	-
2441	-	0.885	0.840	-
2480	-	0.852	0.891	-

Table 25 - 20 dB Bandwidth Results

Figure 19 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

Figure 20 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 21 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

Figure 22 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 23 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

Figure 24 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	1.335	-
2441	-	-	1.330	-
2480	-	-	1.330	-

Table 26 - 20 dB Bandwidth Results

Figure 25 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

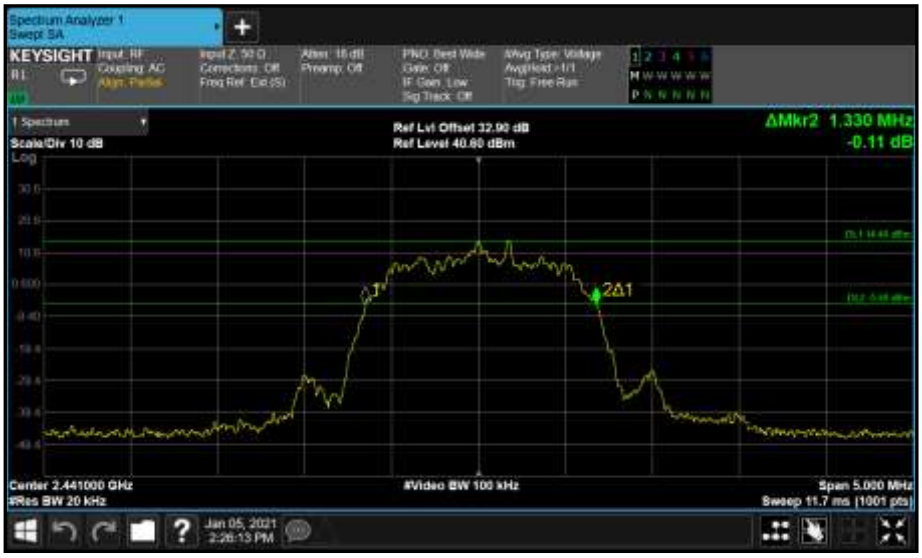

Figure 26 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 27 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	1.275	-
2441	-	-	1.275	-
2480	-	-	1.275	-

Table 27 - 20 dB Bandwidth Results

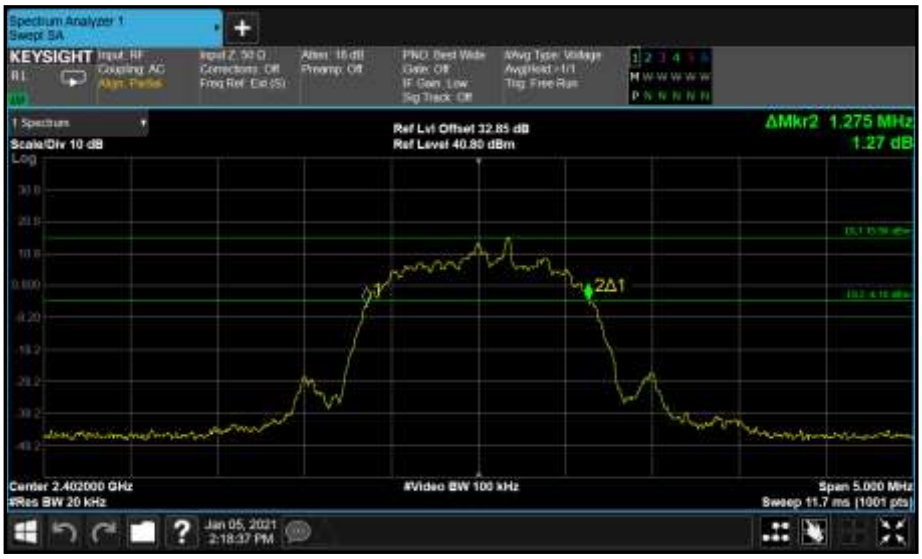

Figure 28 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 29 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 30 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	1.330	1.330	-
2441	-	1.335	1.330	-
2480	-	1.335	1.335	-

Table 28 - 20 dB Bandwidth Results

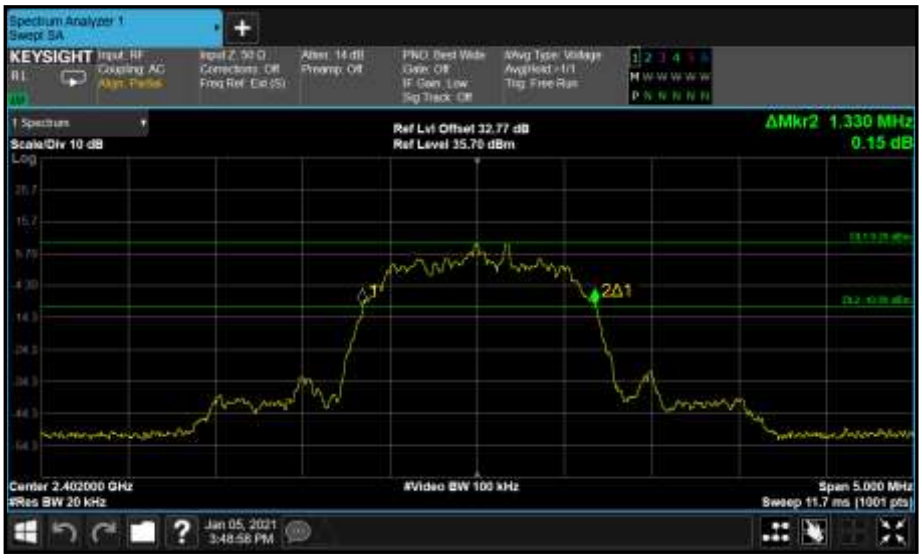

Figure 31 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

Figure 32 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 33 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

Figure 34 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 35 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

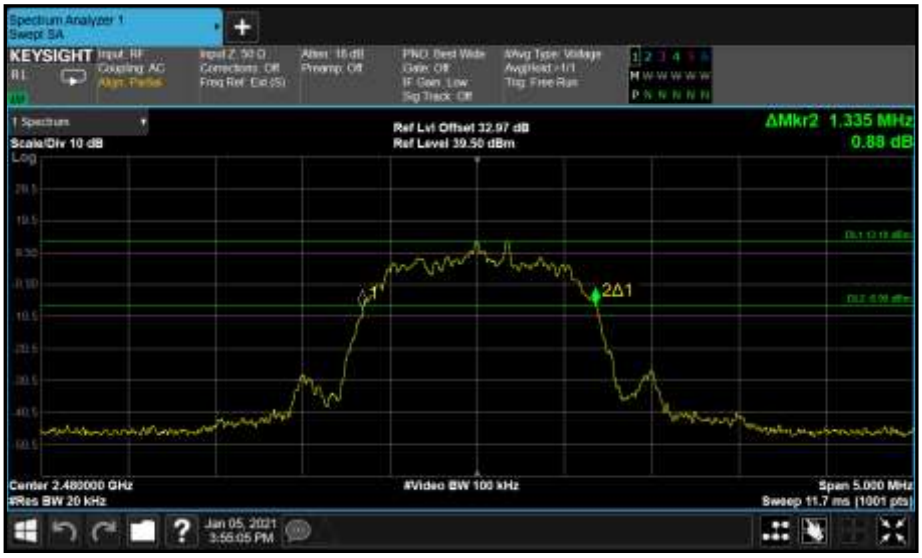

Figure 36 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	1.275	1.270	-
2441	-	1.280	1.275	-
2480	-	1.280	1.270	-

Table 29 - 20 dB Bandwidth Results

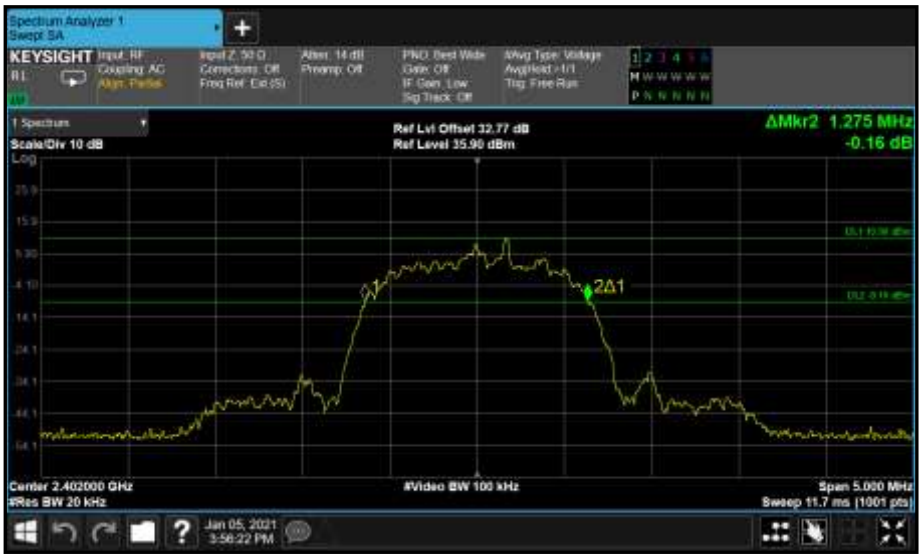

Figure 37 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

Figure 38 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

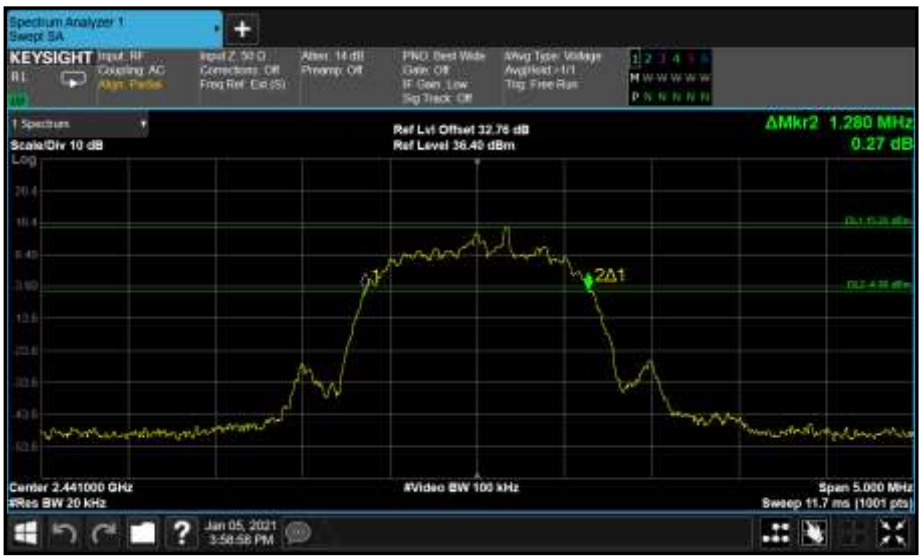

Figure 39 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

Figure 40 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 41 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

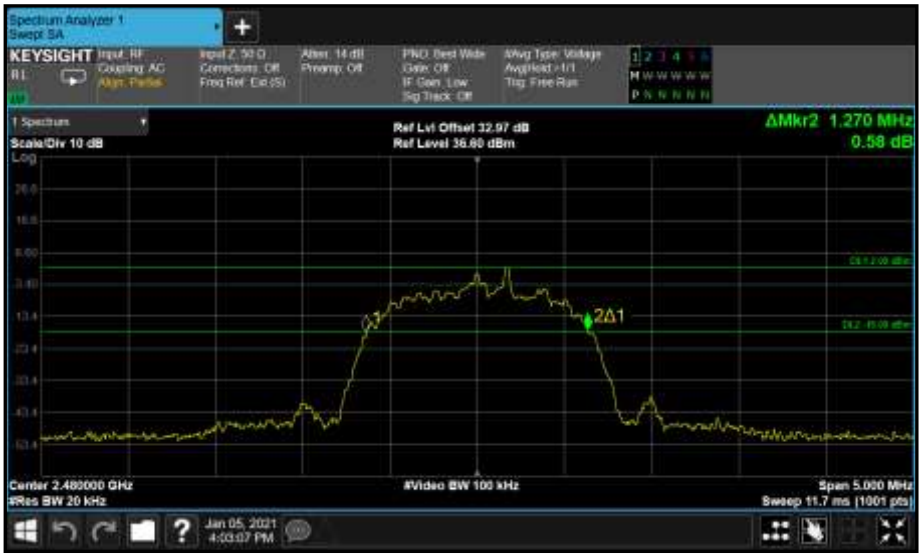

Figure 42 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	0.888	-	-	-
2441	0.888	-	-	-
2480	0.888	-	-	-

Table 30 - 20 dB Bandwidth Results

Figure 43 - Core2 (A) 2402 MHz (CH0) 20 dB Bandwidth

Figure 44 - Core2 (A) 2441 MHz (CH39) 20 dB Bandwidth

Figure 45 - Core2 (A) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	0.840	-
2441	-	-	0.840	-
2480	-	-	0.882	-

Table 31 - 20 dB Bandwidth Results

Figure 46 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 47 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 48 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	0.885	0.840	-
2441	-	0.885	0.927	-
2480	-	0.840	0.888	-

Table 32 - 20 dB Bandwidth Results

Figure 49 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

Figure 50 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 51 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

Figure 52 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 53 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

Figure 54 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	1.330	-	-	-
2441	1.335	-	-	-
2480	1.330	-	-	-

Table 33 - 20 dB Bandwidth Results

Figure 55 - Core2 (A) 2402 MHz (CH0) 20 dB Bandwidth

Figure 56 - Core2 (A) 2441 MHz (CH39) 20 dB Bandwidth

Figure 57 - Core2 (A) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	1.270	-	-	-
2441	1.270	-	-	-
2480	1.270	-	-	-

Table 34 - 20 dB Bandwidth Results

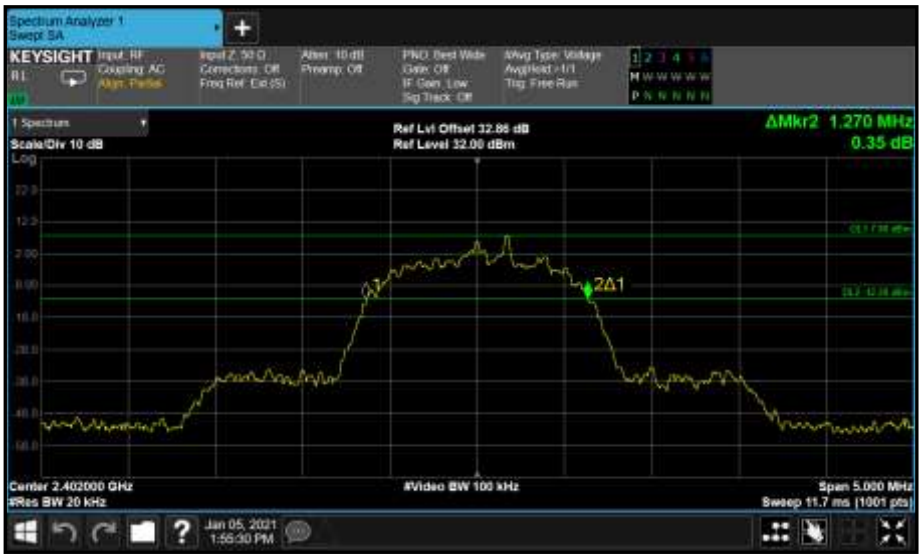

Figure 58 - Core2 (A) 2402 MHz (CH0) 20 dB Bandwidth

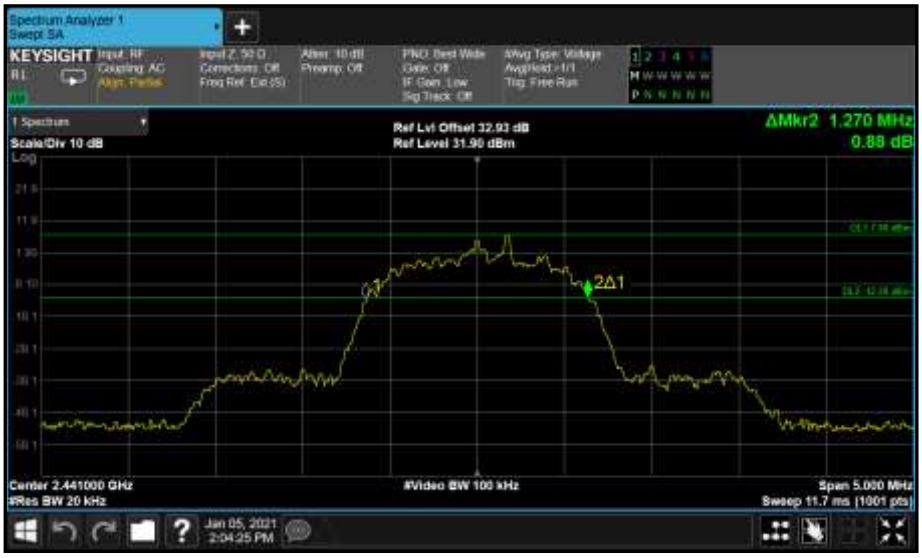

Figure 59 - Core2 (A) 2441 MHz (CH39) 20 dB Bandwidth

Figure 60 - Core2 (A) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	1.335	-
2441	-	-	1.330	-
2480	-	-	1.330	-

Table 35 - 20 dB Bandwidth Results

Figure 61 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 62 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 63 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	-	1.270	-
2441	-	-	1.265	-
2480	-	-	1.270	-

Table 36 - 20 dB Bandwidth Results

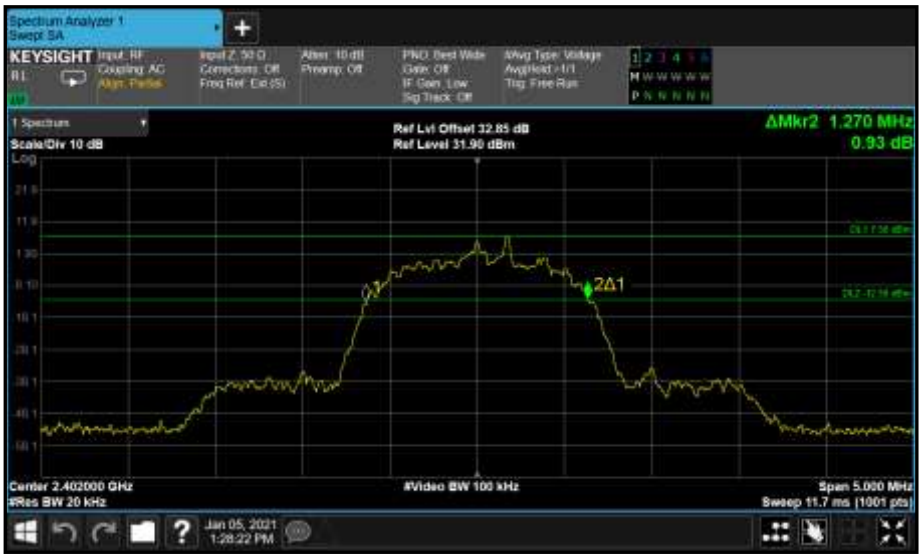

Figure 64 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

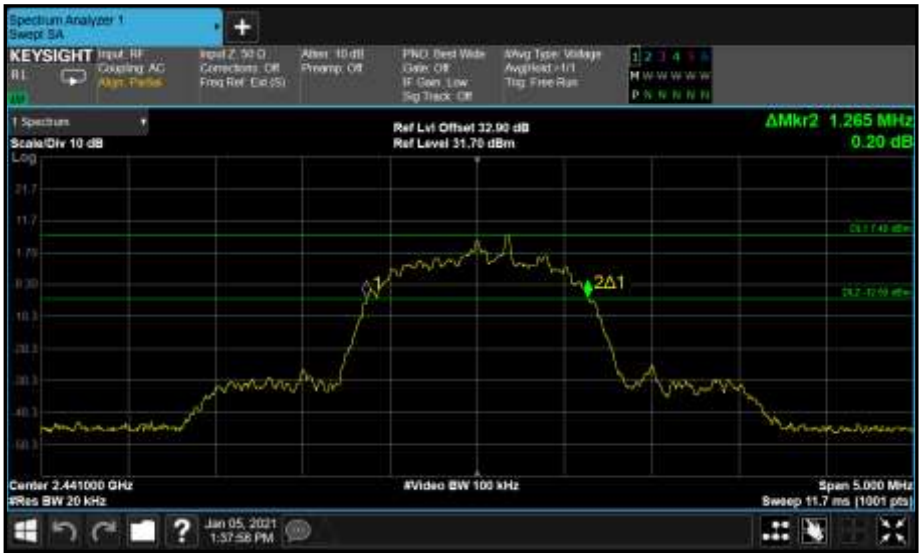

Figure 65 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 66 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	1.330	1.330	-
2441	-	1.330	1.330	-
2480	-	1.335	1.330	-

Table 37 - 20 dB Bandwidth Results

Figure 67 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

Figure 68 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 69 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

Figure 70 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 71 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

Figure 72 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	FCC 15.247 (a)(1) RSS-247 5.1	Test Method(s):	C63.10 6.9.2
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	-
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	-

Test Frequency (MHz)	20 dB Bandwidth (MHz)			
	A	B	C	D
2402	-	1.270	1.270	-
2441	-	1.270	1.270	-
2480	-	1.270	1.265	-

Table 38 - 20 dB Bandwidth Results

Figure 73 - Core1 (B) 2402 MHz (CH0) 20 dB Bandwidth

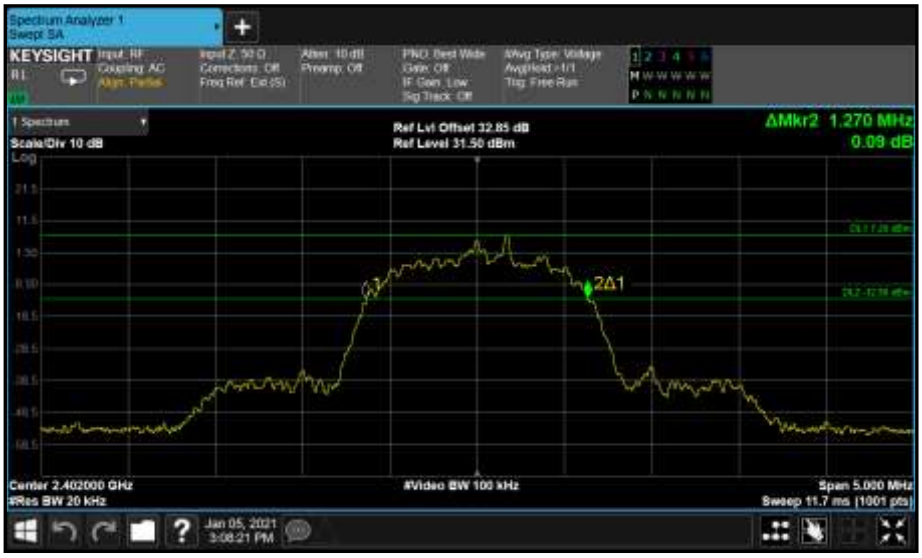

Figure 74 - Core0 (C) 2402 MHz (CH0) 20 dB Bandwidth

Figure 75 - Core1 (B) 2441 MHz (CH39) 20 dB Bandwidth

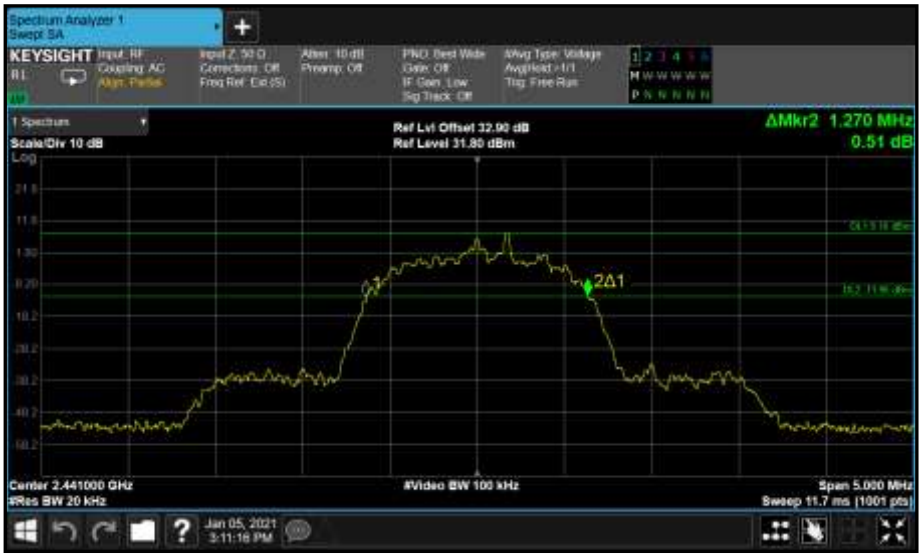

Figure 76 - Core0 (C) 2441 MHz (CH39) 20 dB Bandwidth

Figure 77 - Core1 (B) 2480 MHz (CH78) 20 dB Bandwidth

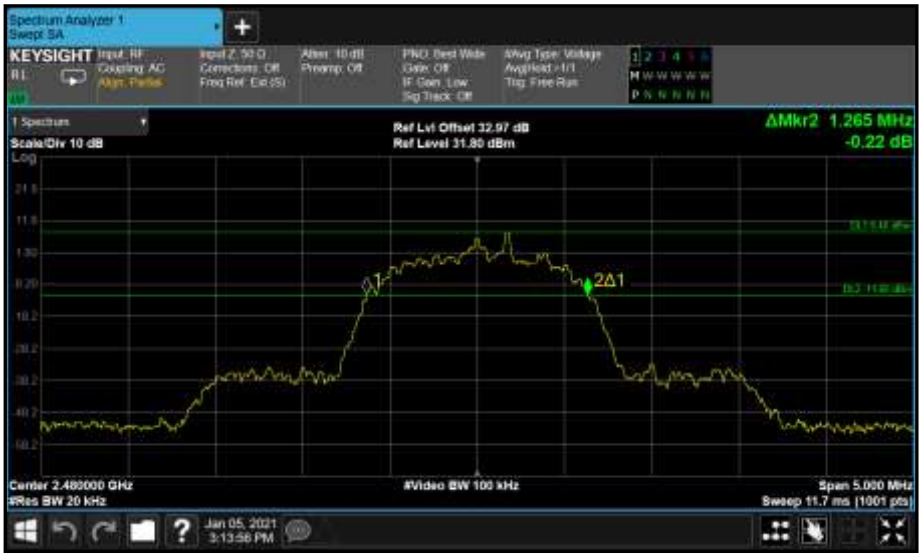

Figure 78 - Core0 (C) 2480 MHz (CH78) 20 dB Bandwidth

FCC 47 CFR Part 15 and RSS-247 Limit Clause

None specified.

2.4.7 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	17-May-2021
Multimeter	Iso-tech	IDM101	2424	12	14-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 39

O/P Mon – Output Monitored using calibrated equipment

2.5 Maximum Conducted Output Power

2.5.1 Specification Reference

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

2.5.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00P0FTP - Modification State 0

2.5.3 Date of Test

15-February-2021

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10, Clause 7.8.5.

2.5.5 Environmental Conditions

Ambient Temperature	22.7 °C
Relative Humidity	38.8 %

2.5.6 Test Results

2.4 GHz Bluetooth - FHSS

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	13.66	-	-	30.00	-16.34
2441	-	-	13.64	-	-	30.00	-16.36
2480	-	-	13.76	-	-	30.00	-16.24

Table 40 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	13.66	-	-	30.00	-16.34	16.99	36.00	-19.01
2441	-	-	13.64	-	-	30.00	-16.36	16.97	36.00	-19.03
2480	-	-	13.76	-	-	30.00	-16.24	17.09	36.00	-18.91

Table 41 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	ePa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	13.52	13.39	-	16.42	30.00	-13.58
2441	-	13.09	13.58	-	16.31	30.00	-13.69
2480	-	12.70	13.52	-	16.12	30.00	-13.88

Table 42 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	13.52	13.39	-	16.42	30.00	-13.58	21.21	36.00	-14.79
2441	-	13.09	13.58	-	16.31	30.00	-13.69	21.10	36.00	-14.90
2480	-	12.70	13.52	-	16.12	30.00	-13.88	20.91	36.00	-15.09

Table 43 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa π/4 DQPSK (2-DH5)	Duty Cycle (%):	77.0
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	20.30	-	-	30.00	-9.70
2441	-	-	20.60	-	-	30.00	-9.40
2480	-	-	20.65	-	-	30.00	-9.35

Table 44 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	20.30	-	-	30.00	-9.70	23.63	36.00	-12.37
2441	-	-	20.60	-	-	30.00	-9.40	23.93	36.00	-12.07
2480	-	-	20.65	-	-	30.00	-9.35	23.98	36.00	-12.02

Table 45 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	ePa 8-DPSK (3-DH5)	Duty Cycle (%):	77.1
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	20.79	-	-	30.00	-9.21
2441	-	-	20.91	-	-	30.00	-9.09
2480	-	-	20.84	-	-	30.00	-9.16

Table 46 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	20.79	-	-	30.00	-9.21	24.12	36.00	-11.88
2441	-	-	20.91	-	-	30.00	-9.09	24.24	36.00	-11.76
2480	-	-	20.84	-	-	30.00	-9.16	24.17	36.00	-11.83

Table 47 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	ePa π/4 DQPSK (2-DH5)	Duty Cycle (%):	77.0
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	15.66	16.24	-	18.99	30.00	-11.01
2441	-	15.70	16.45	-	19.07	30.00	-10.93
2480	-	16.27	16.52	-	19.39	30.00	-10.61

Table 48 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	15.66	16.24	-	18.99	30.00	-11.01	23.78	36.00	-12.22
2441	-	15.70	16.45	-	19.07	30.00	-10.93	23.86	36.00	-12.14
2480	-	16.27	16.52	-	19.39	30.00	-10.61	24.18	36.00	-11.82

Table 49 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	ePa 8-DPSK (3-DH5)	Duty Cycle (%):	77.1
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	15.92	16.60	-	19.35	30.00	-10.65
2441	-	16.42	16.75	-	19.67	30.00	-10.33
2480	-	16.68	16.61	-	19.71	30.00	-10.29

Table 50 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	15.92	16.60	-	19.35	30.00	-10.65	24.15	36.00	-11.85
2441	-	16.42	16.75	-	19.67	30.00	-10.33	24.47	36.00	-11.53
2480	-	16.68	16.61	-	19.71	30.00	-10.29	24.50	36.00	-11.50

Table 51 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	1.00

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	13.36	-	-	-	-	30.00	-16.64
2441	13.34	-	-	-	-	30.00	-16.66
2480	13.48	-	-	-	-	30.00	-16.52

Table 52 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	13.36	-	-	-	-	30.00	-16.64	14.36	36.00	-21.64
2441	13.34	-	-	-	-	30.00	-16.66	14.34	36.00	-21.66
2480	13.48	-	-	-	-	30.00	-16.52	14.48	36.00	-21.52

Table 53 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	13.68	-	-	30.00	-16.32
2441	-	-	13.85	-	-	30.00	-16.15
2480	-	-	13.74	-	-	30.00	-16.26

Table 54 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	13.68	-	-	30.00	-16.32	17.01	36.00	-18.99
2441	-	-	13.85	-	-	30.00	-16.15	17.18	36.00	-18.82
2480	-	-	13.74	-	-	30.00	-16.26	17.07	36.00	-18.93

Table 55 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	iPa GFSK (DH5)	Duty Cycle (%):	76.9
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	13.77	13.36	-	16.73	30.00	-13.27
2441	-	13.51	13.79	-	16.63	30.00	-13.37
2480	-	13.16	13.77	-	16.46	30.00	-13.54

Table 56 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	13.77	13.36	-	16.73	30.00	-13.27	21.52	36.00	-14.48
2441	-	13.51	13.79	-	16.63	30.00	-13.37	21.42	36.00	-14.58
2480	-	13.16	13.77	-	16.46	30.00	-13.54	21.25	36.00	-14.75

Table 57 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	77.0
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	1.00

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	11.71	-	-	-	-	30.00	-18.29
2441	11.68	-	-	-	-	30.00	-18.32
2480	11.42	-	-	-	-	30.00	-18.58

Table 58 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	11.71	-	-	-	-	30.00	-18.29	12.71	36.00	-23.29
2441	11.68	-	-	-	-	30.00	-18.32	12.68	36.00	-23.32
2480	11.42	-	-	-	-	30.00	-18.58	12.42	36.00	-23.58

Table 59 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	77.1
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	A (Core2)	Antenna Gain (dBi):	1.00

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	11.99	-	-	-	-	30.00	-18.01
2441	11.92	-	-	-	-	30.00	-18.08
2480	11.75	-	-	-	-	30.00	-18.25

Table 60 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	11.99	-	-	-	-	30.00	-18.01	12.99	36.00	-23.01
2441	11.92	-	-	-	-	30.00	-18.08	12.92	36.00	-23.08
2480	11.75	-	-	-	-	30.00	-18.25	12.75	36.00	-23.25

Table 61 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	77.0
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	11.57	-	-	30.00	-18.43
2441	-	-	11.84	-	-	30.00	-18.16
2480	-	-	11.43	-	-	30.00	-18.57

Table 62 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	11.57	-	-	30.00	-18.43	14.90	36.00	-21.10
2441	-	-	11.84	-	-	30.00	-18.16	15.17	36.00	-20.83
2480	-	-	11.43	-	-	30.00	-18.57	14.76	36.00	-21.24

Table 63 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	-		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	77.1
Antenna Configuration:	SISO	DCCF (dB):	-
Active Ports(s):	C (Core0)	Antenna Gain (dBi):	3.33

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	-	11.86	-	-	30.00	-18.14
2441	-	-	11.73	-	-	30.00	-18.27
2480	-	-	11.72	-	-	30.00	-18.28

Table 64 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	-	11.86	-	-	30.00	-18.14	15.19	36.00	-20.81
2441	-	-	11.73	-	-	30.00	-18.27	15.06	36.00	-20.94
2480	-	-	11.72	-	-	30.00	-18.28	15.05	36.00	-20.95

Table 65 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	iPa π/4 DQPSK (2-DH5)	Duty Cycle (%):	77.0
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	11.55	11.12	-	14.34	30.00	-15.66
2441	-	11.30	11.73	-	14.50	30.00	-15.50
2480	-	10.59	11.47	-	14.02	30.00	-15.98

Table 66 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	11.55	11.12	-	14.34	30.00	-15.66	19.13	36.00	-16.87
2441	-	11.30	11.73	-	14.50	30.00	-15.50	19.30	36.00	-16.70
2480	-	10.59	11.47	-	14.02	30.00	-15.98	18.81	36.00	-17.19

Table 67 - ISED Maximum Conducted (peak) Output Power Results

Test Configuration			
Frequency Range:	2400-2483.5 MHz	Band:	2.4 GHz
Specification Clause(s):	15.247 (b)(1) RSS-247 5.4 b)	Test Method(s):	C63.10 7.8.5
Additional Reference(s):	662911 D01 v02r01 F)2)d)(i), 662911 D01 v02r01 E)1)		

DUT Configuration			
Mode:	iPa 8-DPSK (3-DH5)	Duty Cycle (%):	77.1
Antenna Configuration:	Beamforming	DCCF (dB):	-
Active Ports(s):	B+C (Core1 + Core0)	Antenna Gain (dBi):	4.79

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)
	A	B	C	D	∑		
2402	-	11.88	11.46	-	14.66	30.00	-15.34
2441	-	11.19	11.83	-	14.51	30.00	-15.49
2480	-	10.90	11.78	-	14.35	30.00	-15.65

Table 68 - FCC Maximum Conducted (peak) Output Power Results

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					Limit (dBm)	Margin (dB)	EIRP (dBm)	EIRP Limit (dBm)	EIRP Margin (dB)
	A	B	C	D	∑					
2402	-	11.88	11.46	-	14.66	30.00	-15.34	19.45	36.00	-16.55
2441	-	11.19	11.83	-	14.51	30.00	-15.49	19.30	36.00	-16.70
2480	-	10.90	11.78	-	14.35	30.00	-15.65	19.14	36.00	-16.86

Table 69 - ISED Maximum Conducted (peak) 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 (b)

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.

2.5.7 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
Multimeter	Iso-tech	IDM101	2424	12	14-Dec-2021
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
USB Power Sensor	Boonton	RTP5006	5187	12	09-Jan-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5278	12	27-Apr-2021
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021

Table 70

O/P Mon – Output Monitored using calibrated equipment

2.6 Authorised Band Edges

2.6.1 Specification Reference

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

2.6.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00M0FTN - Modification State 0

2.6.3 Date of Test

09-November-2020 to 10-January-2021

2.6.4 Test Method

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

2.6.5 Environmental Conditions

Ambient Temperature 19.3 - 25.9 ˚C
Relative Humidity 25.0 – 36.0 %

2.6.6 Test Results

2.4 GHz Bluetooth - FHSS

iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	GFSK	1	DH5	2402	2400.0	-63.07
Static	π/4 DQPSK	1	2DH5	2402	2400.0	-60.91
Static	8-DPSK	1	3DH5	2402	2400.0	-60.68
Hopping	GFSK	1	DH5	2402	2400.0	-65.56
Hopping	π/4 DQPSK	1	2DH5	2402	2400.0	-61.70
Hopping	8-DPSK	1	3DH5	2402	2400.0	-61.77

Table 71 - Authorised Band Edge Results

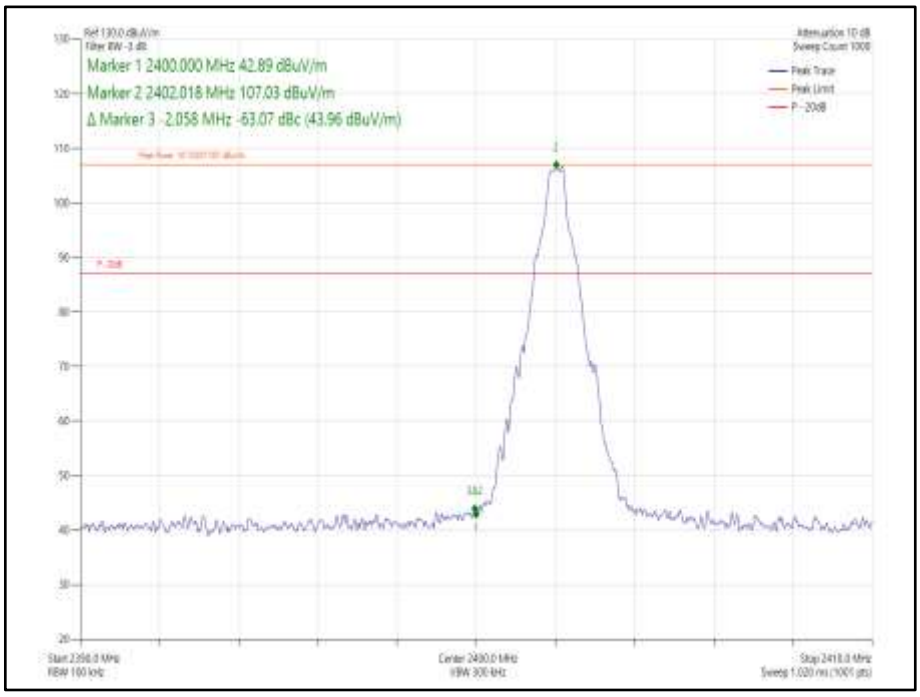

Figure 79 - Static – Core 1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

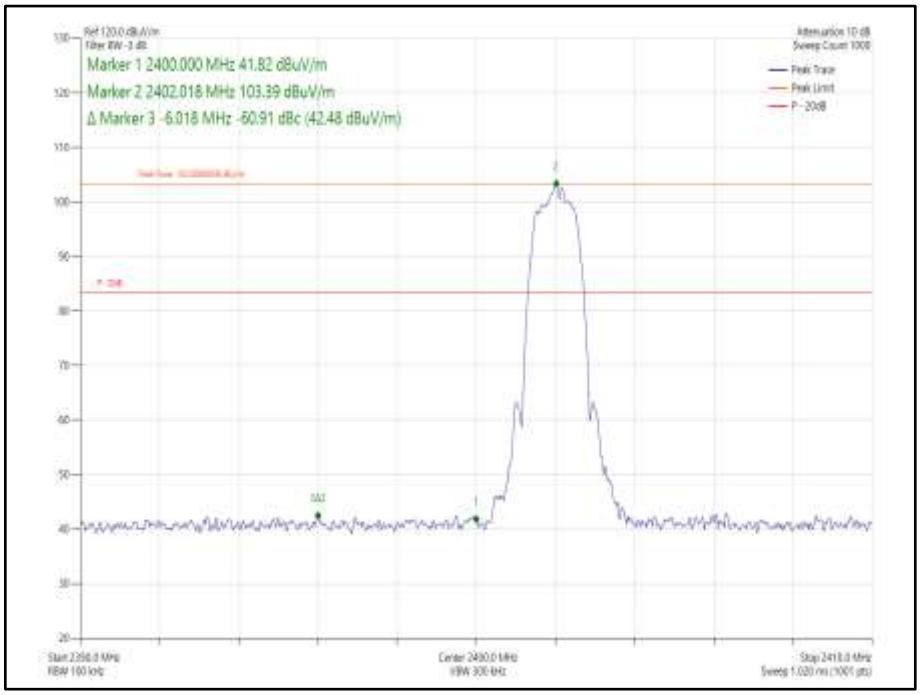

Figure 80 - Static - Core 1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

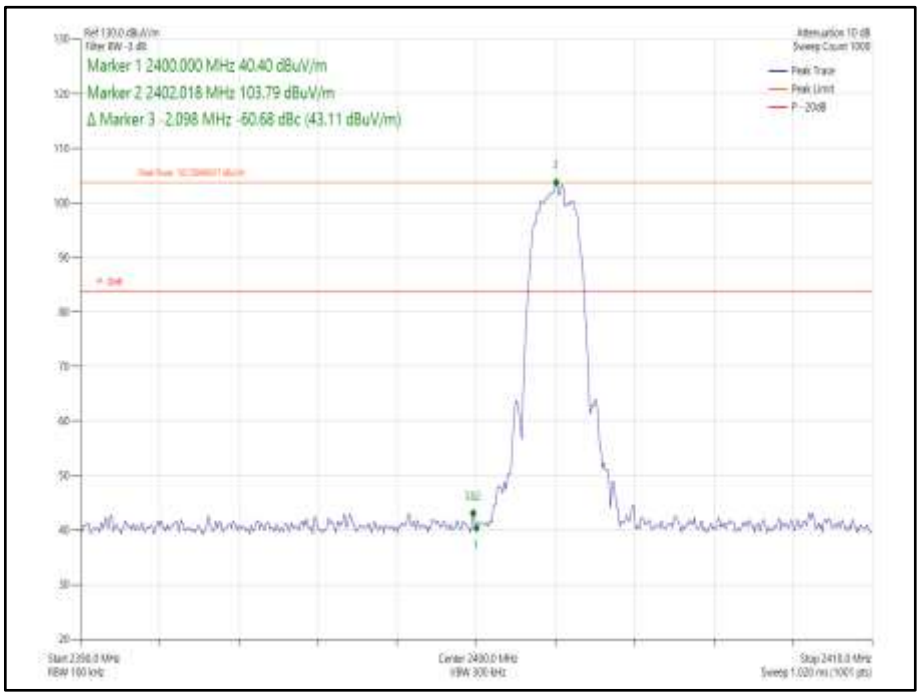

Figure 81 - Static - Core 1, 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

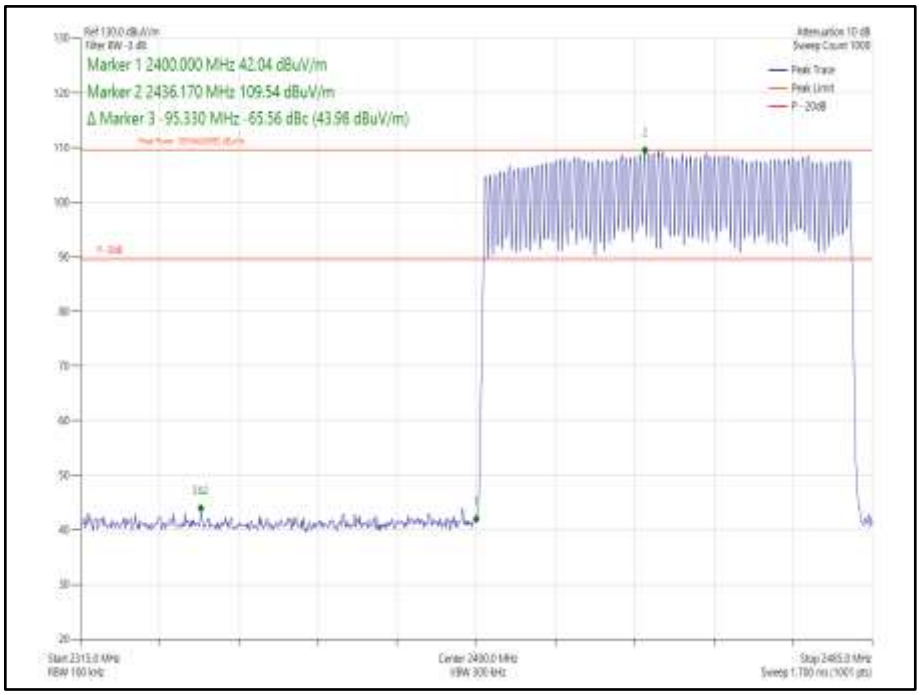

Figure 82 - Hopping - Core 1, GFSK/DH5 - Band Edge Frequency 2400.0 MHz

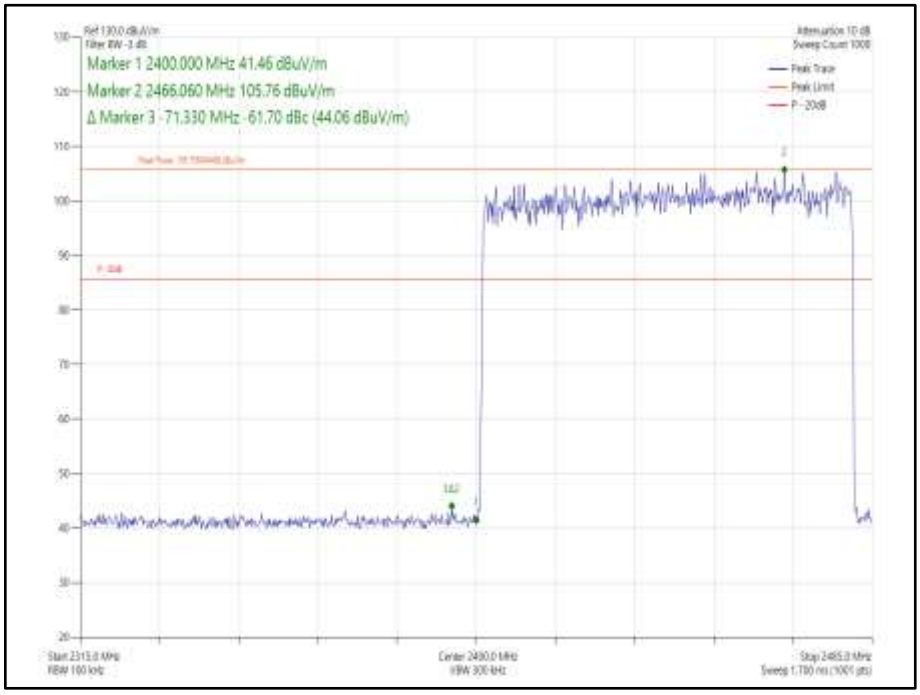

Figure 83 - Hopping - Core 1, π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

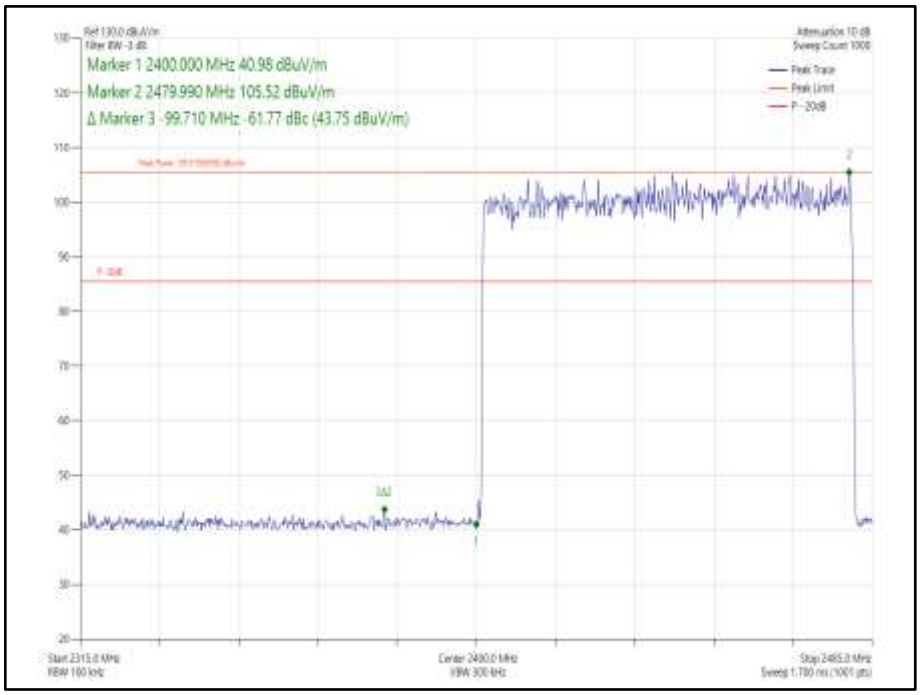

Figure 84 - Hopping - Core 1, 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	GFSK	2	DH5	2402	2400.0	-61.89
Static	π/4 DQPSK	2	2DH5	2402	2400.0	-53.27
Static	8-DPSK	2	3DH5	2402	2400.0	-54.20
Hopping	GFSK	2	DH5	2402	2400.0	-66.13
Hopping	π/4 DQPSK	2	2DH5	2402	2400.0	-58.65
Hopping	8-DPSK	2	3DH5	2402	2400.0	-60.48

Table 72 - Authorised Band Edge Results

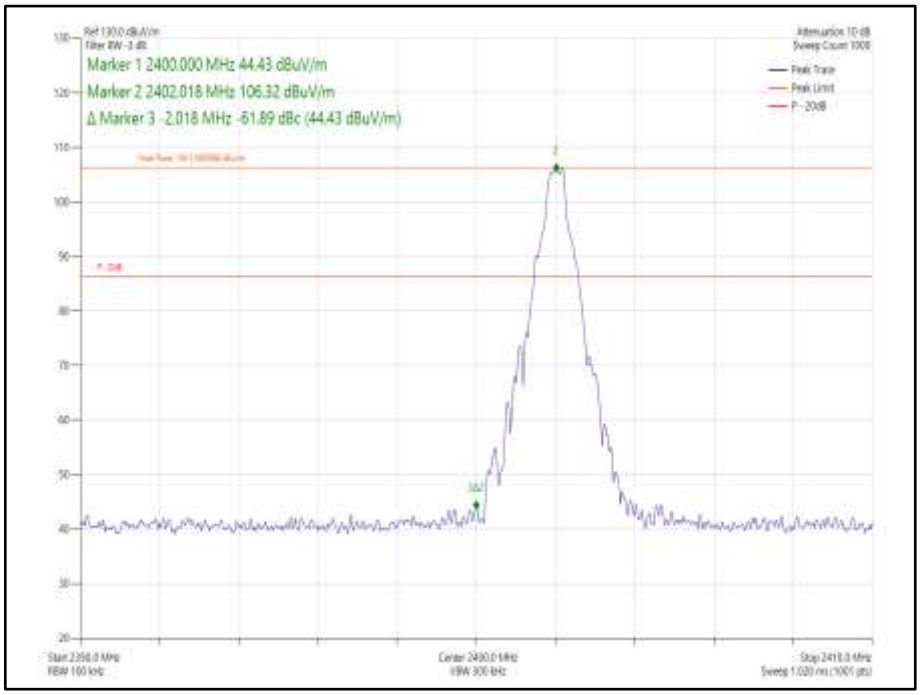

Figure 85 - Static - Core 2, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

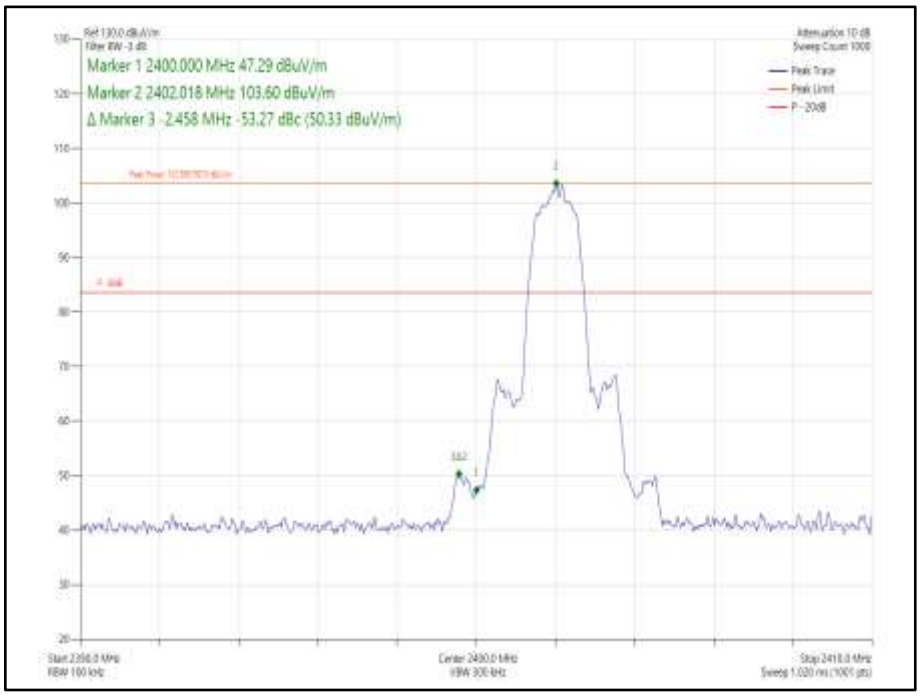

Figure 86 - Static - Core 2, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

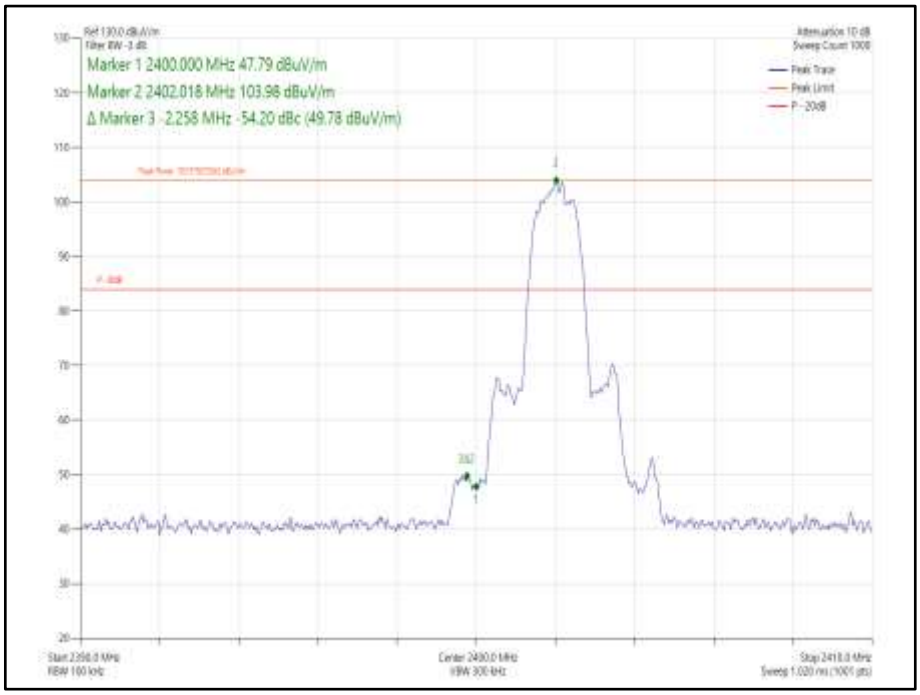

Figure 87 - Static - Core 2, 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

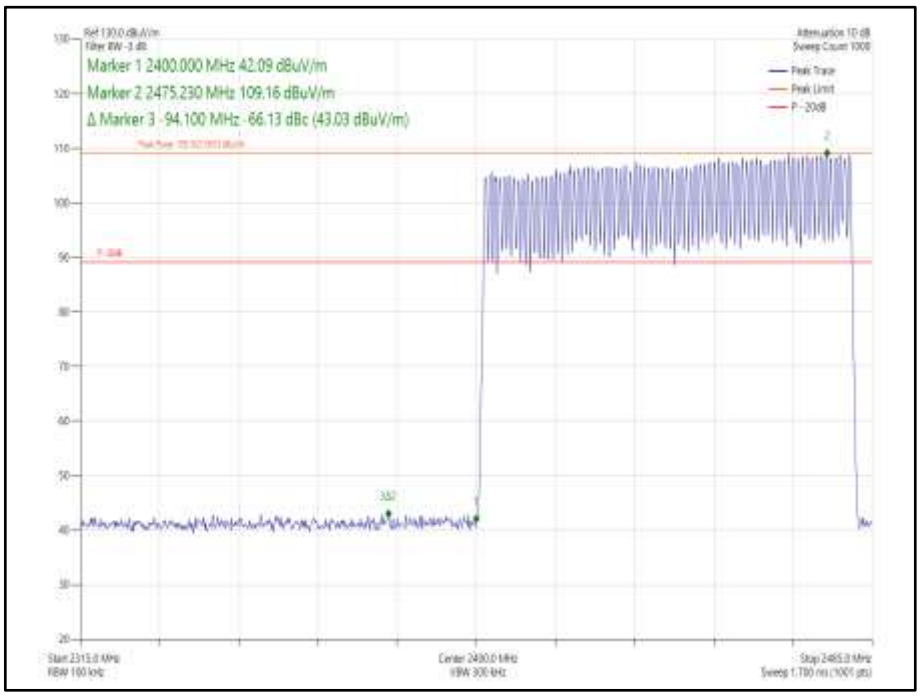

Figure 88 - Hopping - Core 2, GFSK/DH5 - Band Edge Frequency 2400.0 MHz

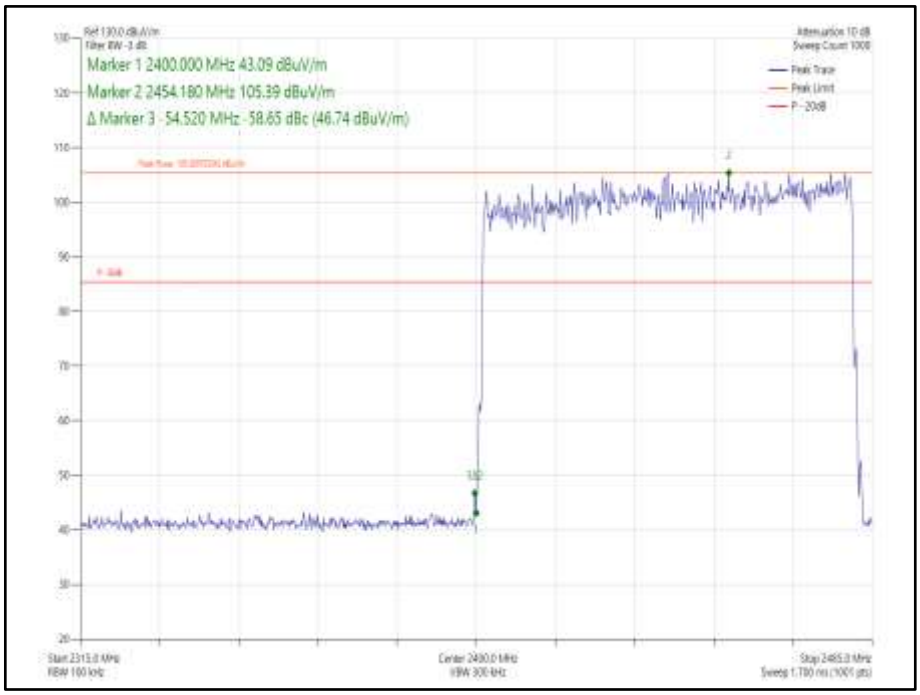

Figure 89 - Hopping - Core 2, π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

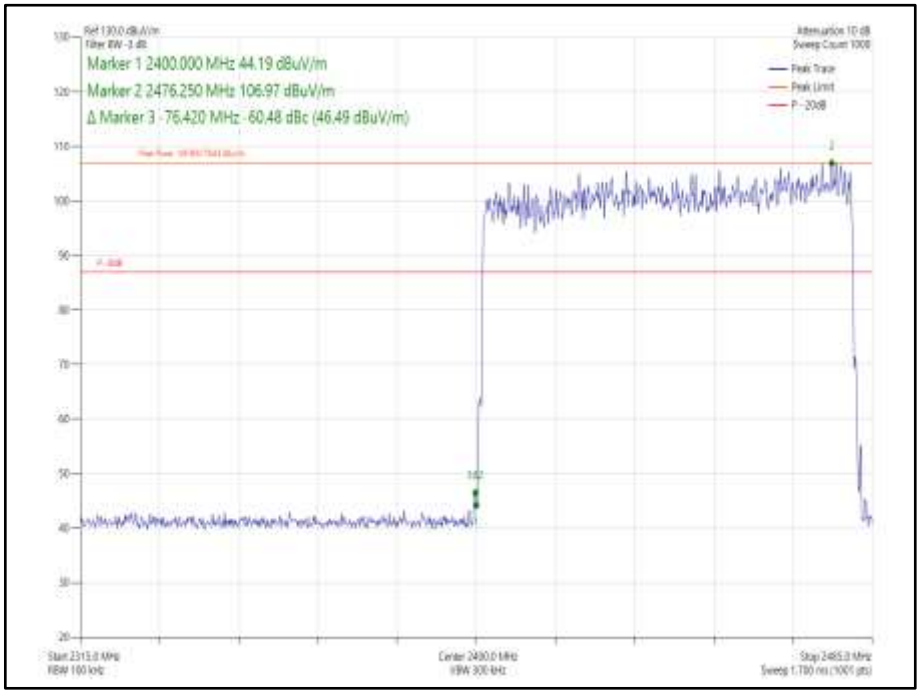

Figure 90 - Hopping - Core 2, 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	GFSK	0-1	DH5	2402	2400.0	-65.34
Static	π/4 DQPSK	0-1	2DH5	2402	2400.0	-56.04
Static	8-DPSK	0-1	3DH5	2402	2400.0	-57.46
Hopping	GFSK	0-1	DH5	2402	2400.0	-66.17
Hopping	π/4 DQPSK	0-1	2DH5	2402	2400.0	-62.91
Hopping	8-DPSK	0-1	3DH5	2402	2400.0	-59.59

Table 73 - Authorised Band Edge Results

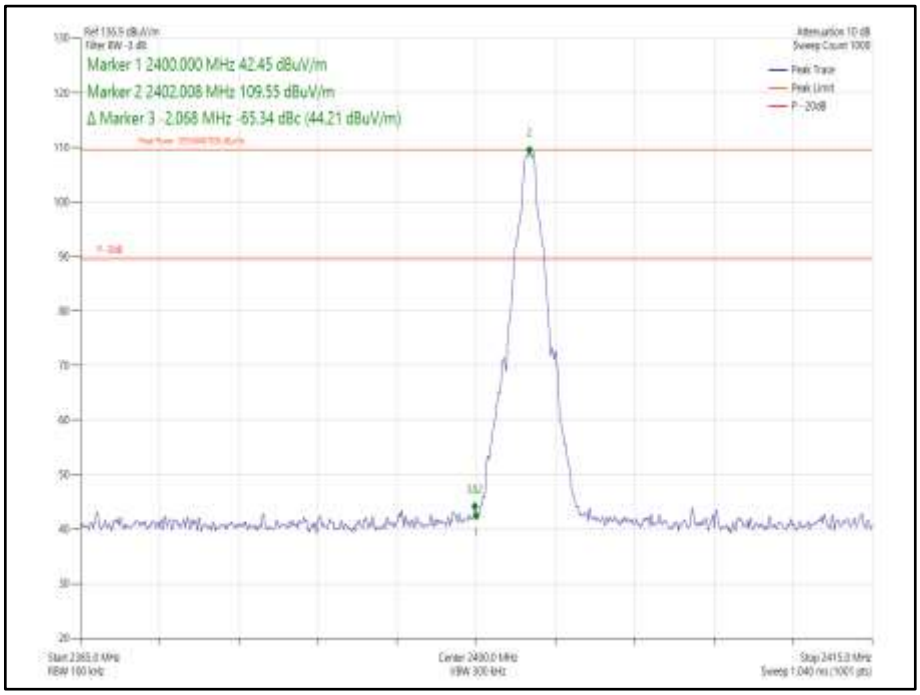

Figure 91 - Static - Core 0-1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

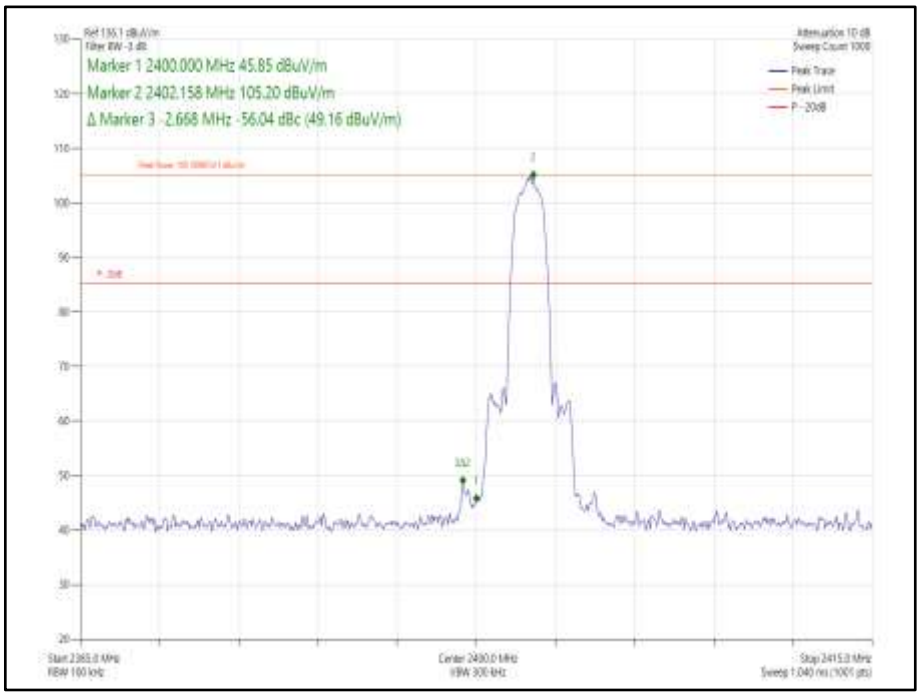

Figure 92 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

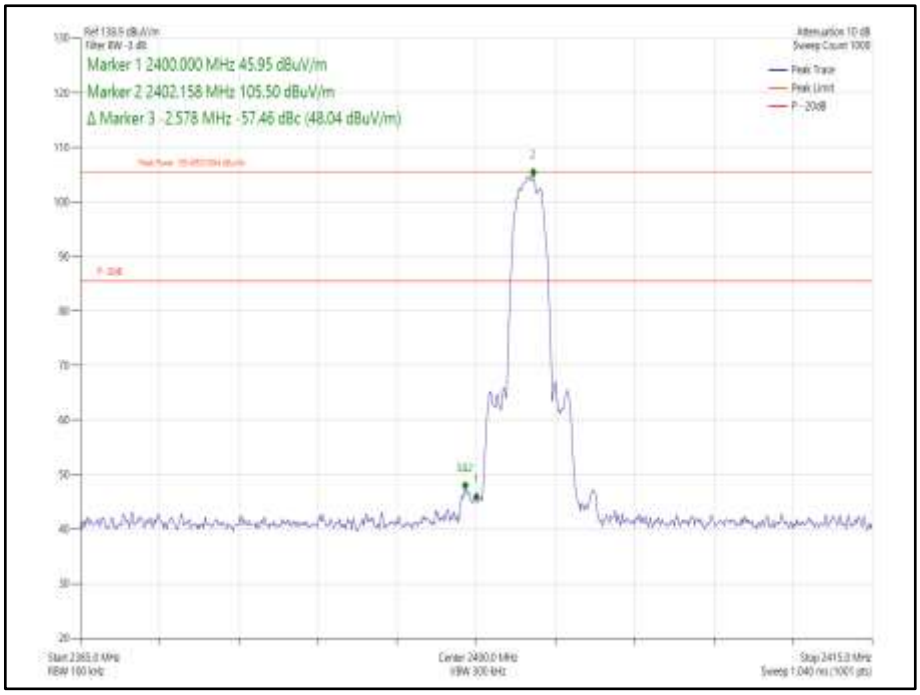

Figure 93 - Static - Core 0-1, 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

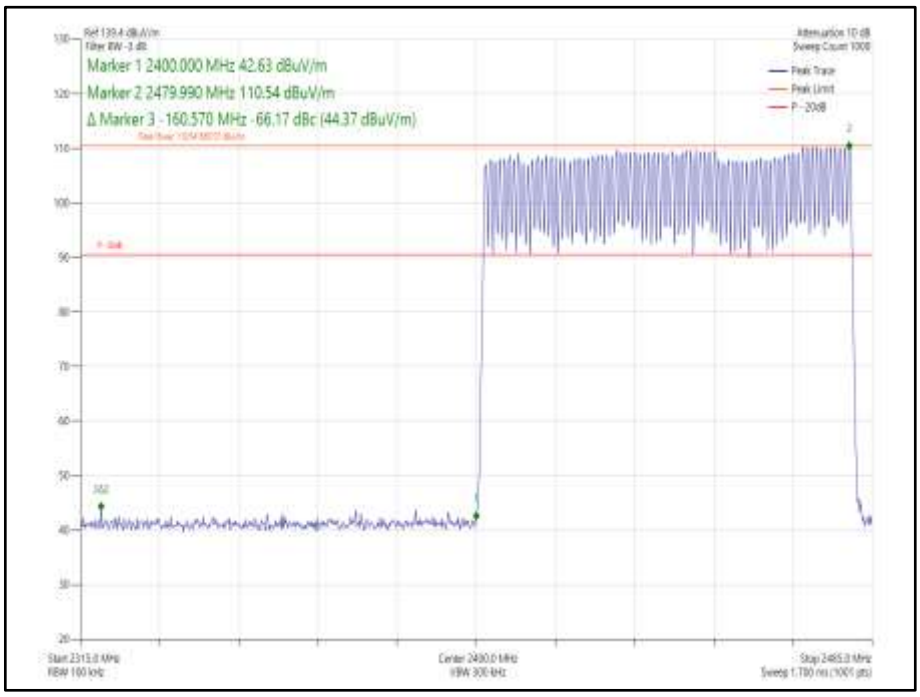

Figure 94 - Hopping - Core 0-1, GFSK/DH5 - Band Edge Frequency 2400.0 MHz

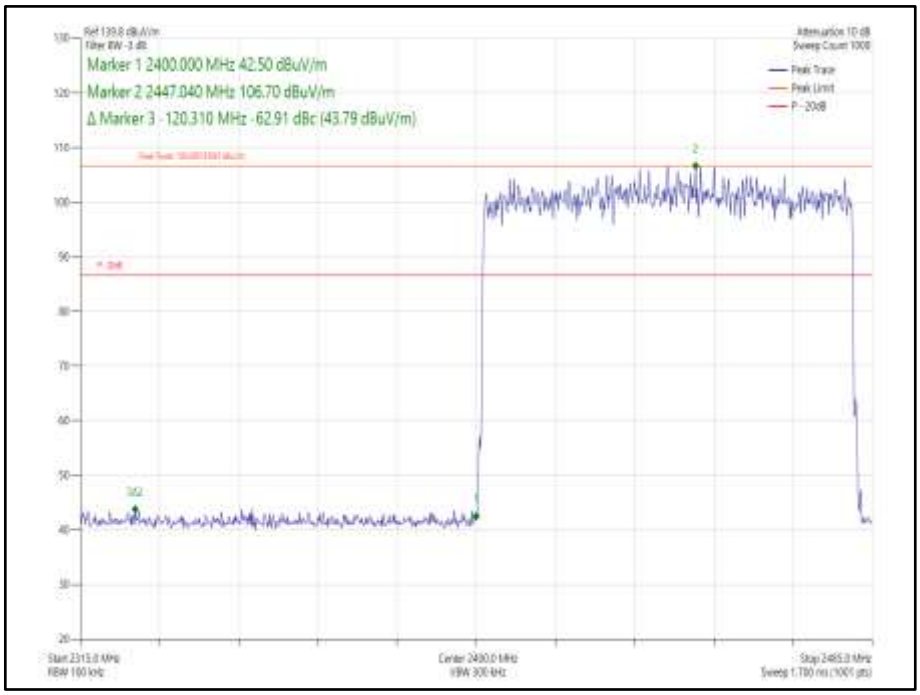

Figure 95 - Hopping - Core 0-1, π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

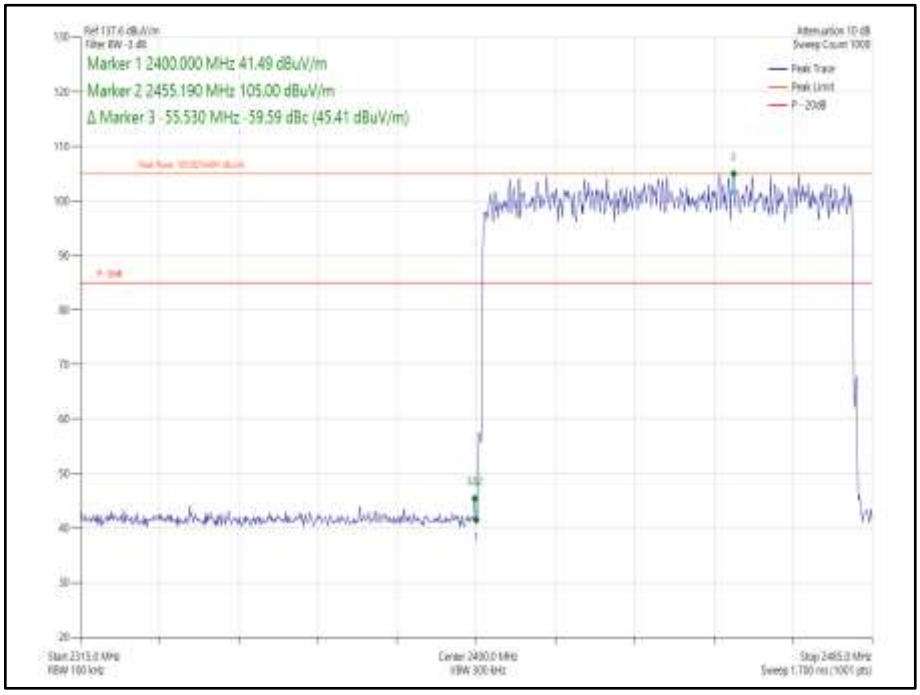

Figure 96 - Hopping - Core 0-1, 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	GFSK	1	DH5	2402	2400.0	-67.02
Static	π/4 DQPSK	1	2DH5	2402	2400.0	-65.27
Static	8-DPSK	1	3DH5	2402	2400.0	-64.56
Hopping	GFSK	1	DH5	2402	2400.0	-70.98
Hopping	π/4 DQPSK	1	2DH5	2402	2400.0	-68.42
Hopping	8-DPSK	1	3DH5	2402	2400.0	-68.26

Table 74 - Authorised Band Edge Results

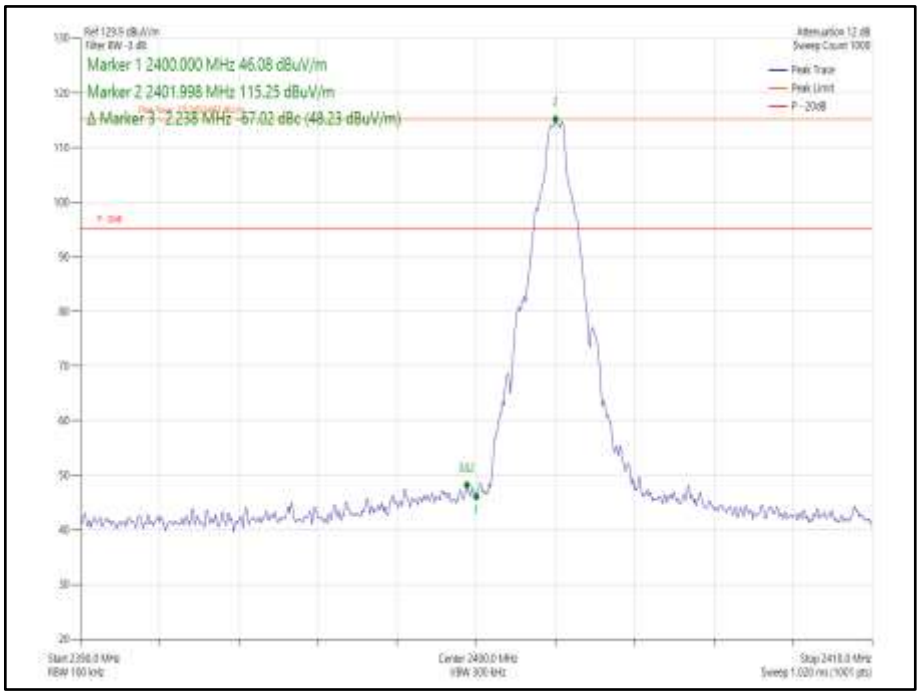

Figure 97 - Static - Core 1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

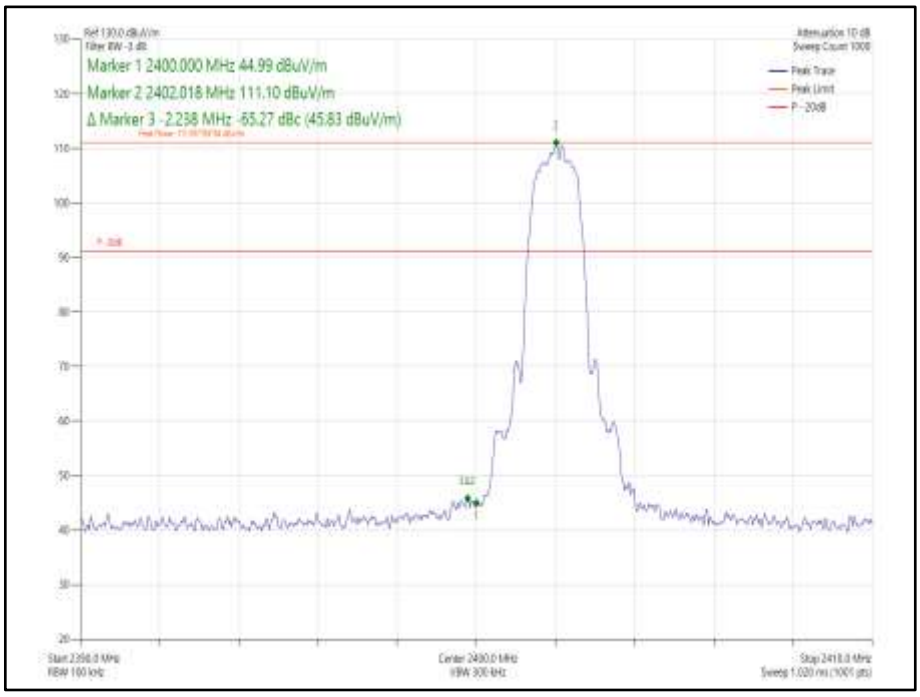

Figure 98 - Static - Core 1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

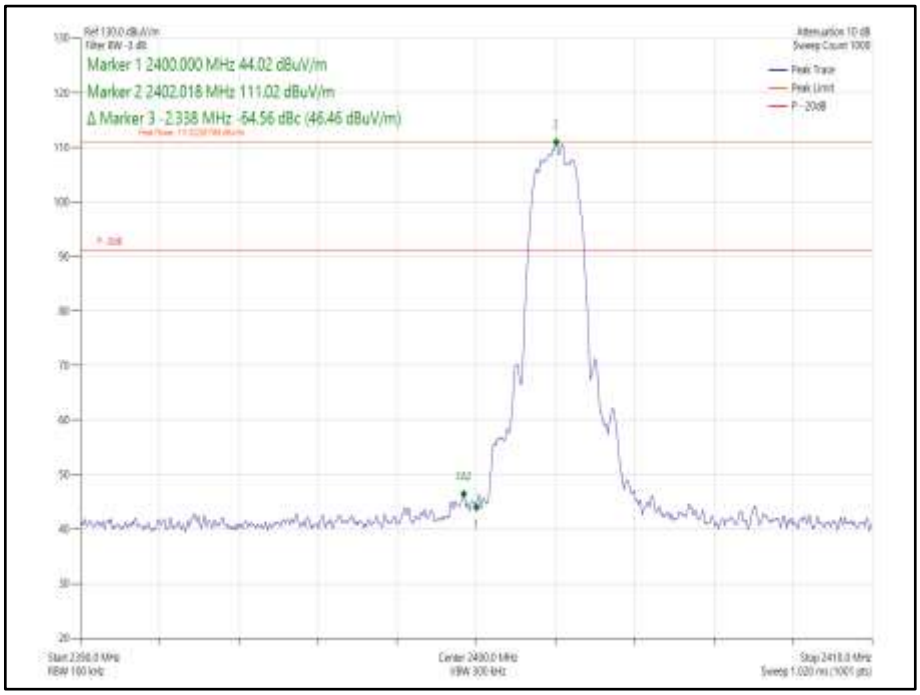

Figure 99 - Static - Core 1, 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

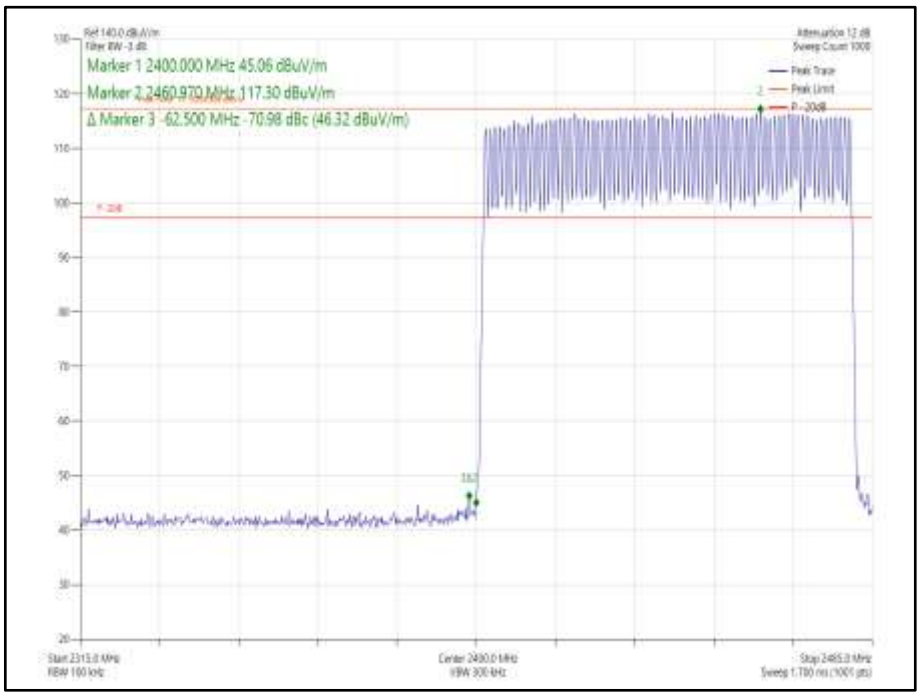

Figure 100 - Hopping - Core 1, GFSK/DH5 - Band Edge Frequency 2400.0 MHz

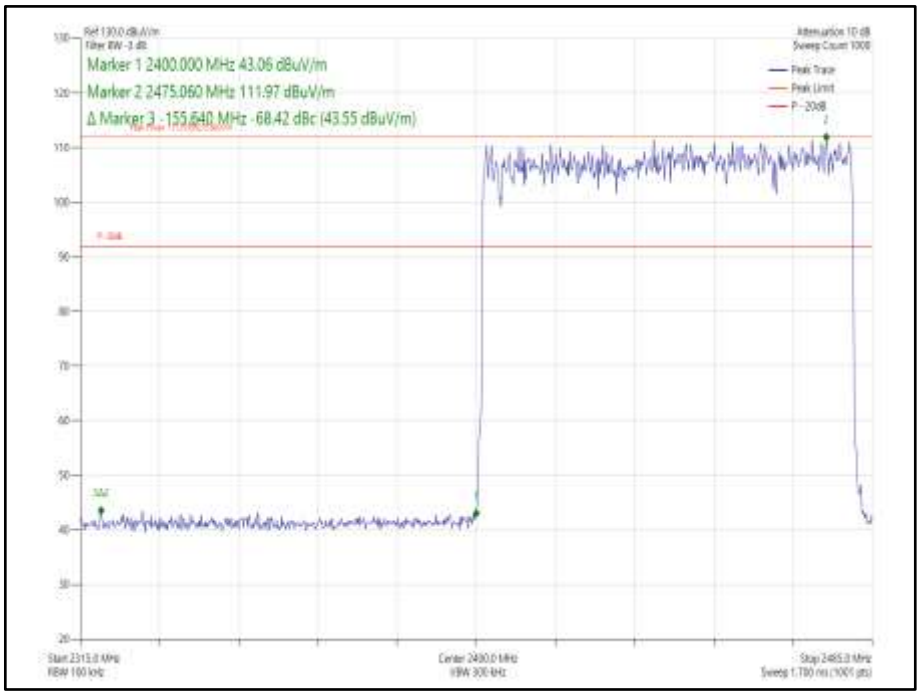

Figure 101 - Hopping - Core 1, π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

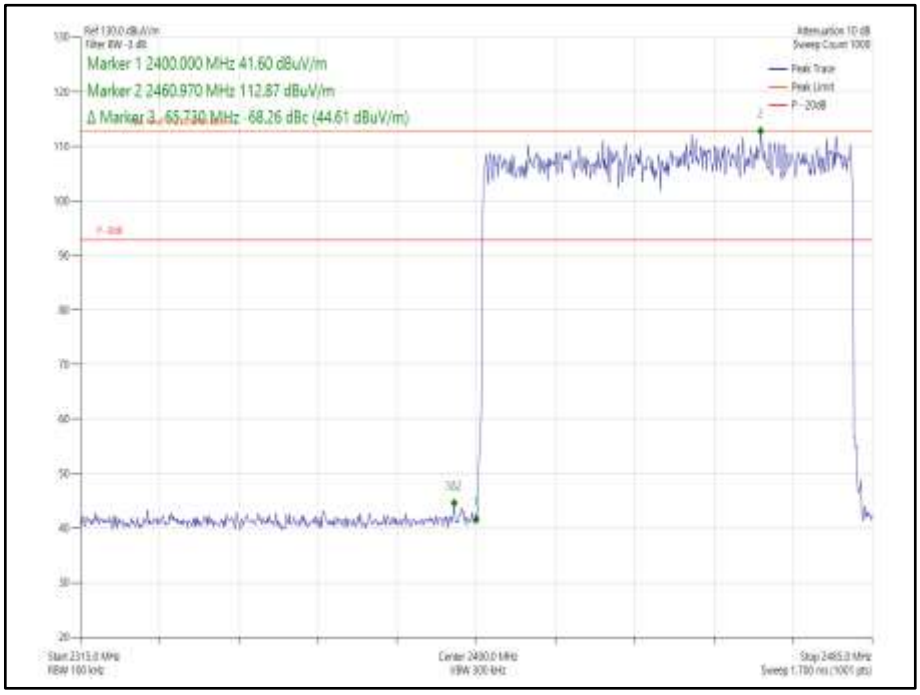

Figure 102 - Hopping - Core 1, 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static	GFSK	0-1	DH5	2402	2400.0	-67.11
Static	π/4 DQPSK	0-1	2DH5	2402	2400.0	-64.55
Static	8-DPSK	0-1	3DH5	2402	2400.0	-64.36
Hopping	GFSK	0-1	DH5	2402	2400.0	-71.73
Hopping	π/4 DQPSK	0-1	2DH5	2402	2400.0	-68.13
Hopping	8-DPSK	0-1	3DH5	2402	2400.0	-66.58

Table 75 - Authorised Band Edge Results

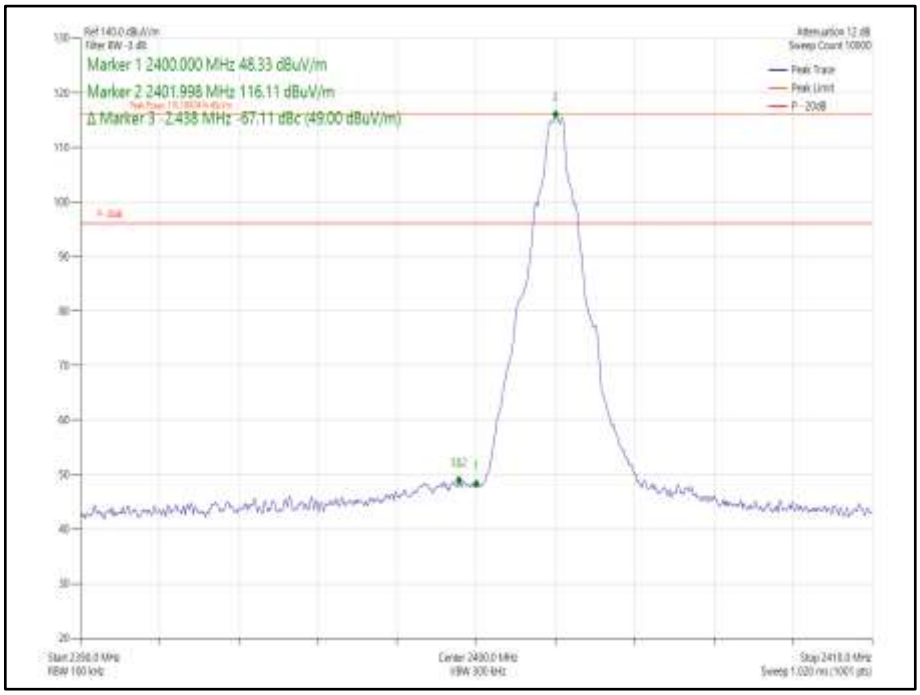

Figure 103 - Static - Core 0-1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

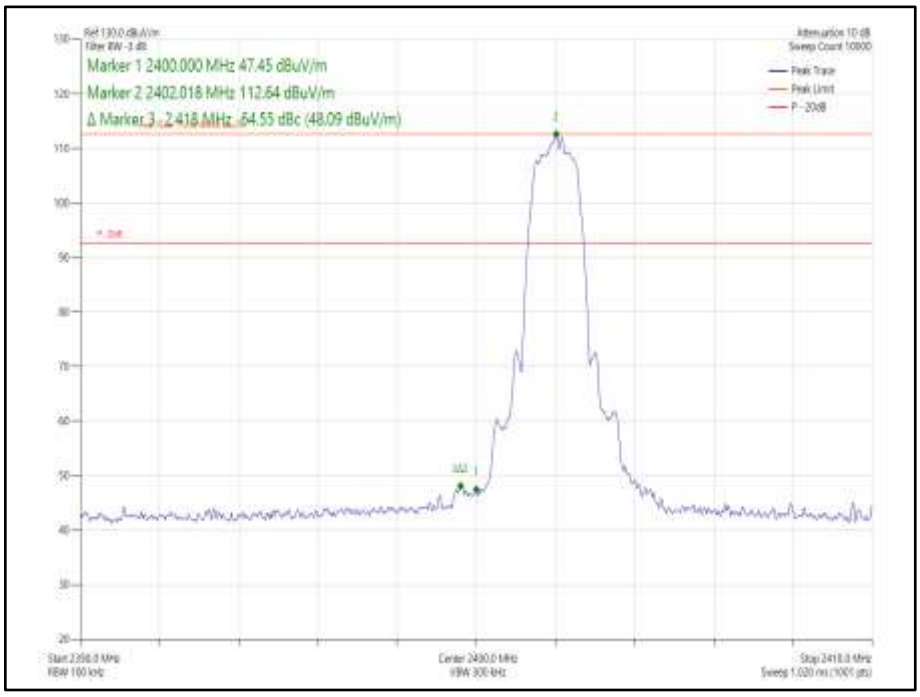

Figure 104 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

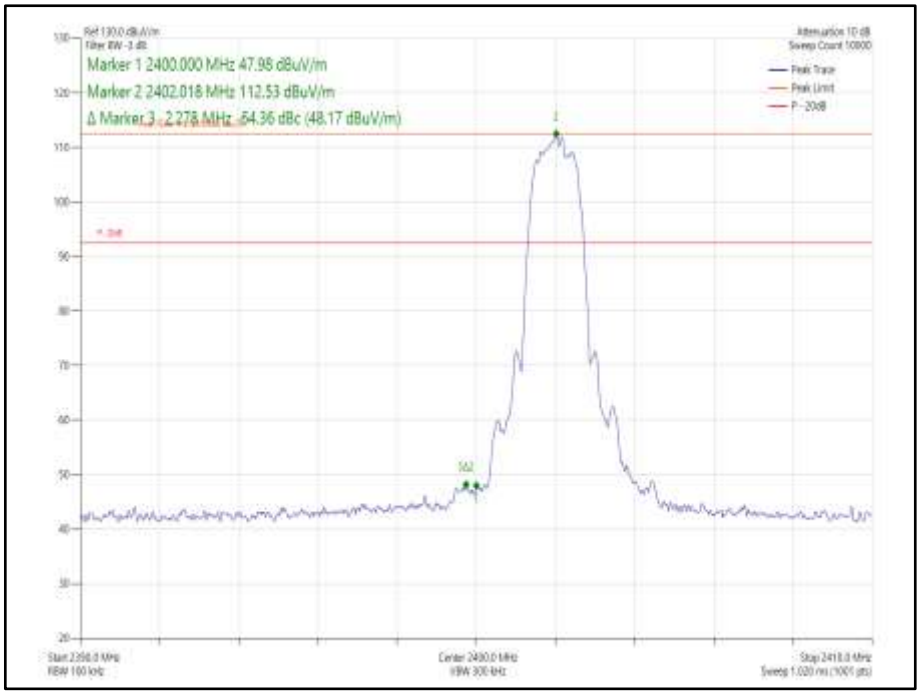

Figure 105 - Static - Core 0-1, 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

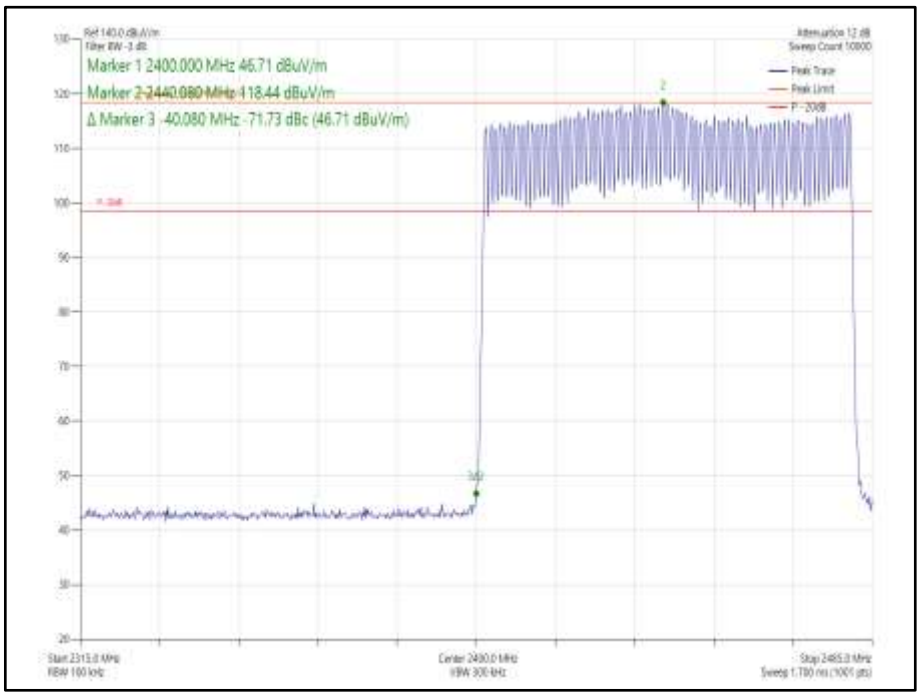

Figure 106 - Hopping - Core 0-1, GFSK/DH5 - Band Edge Frequency 2400.0 MHz

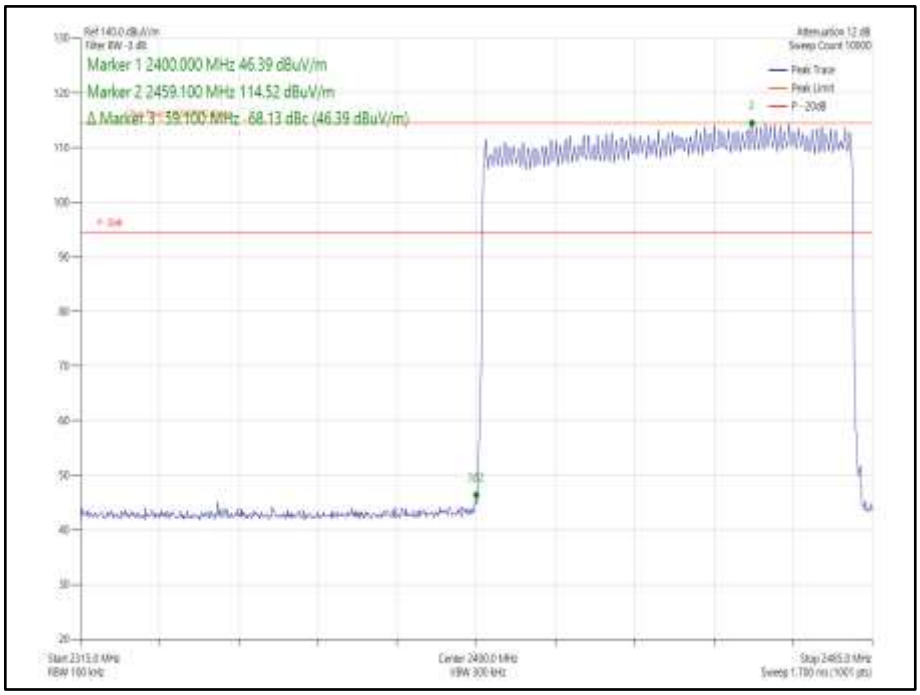

Figure 107 - Hopping - Core 0-1, π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

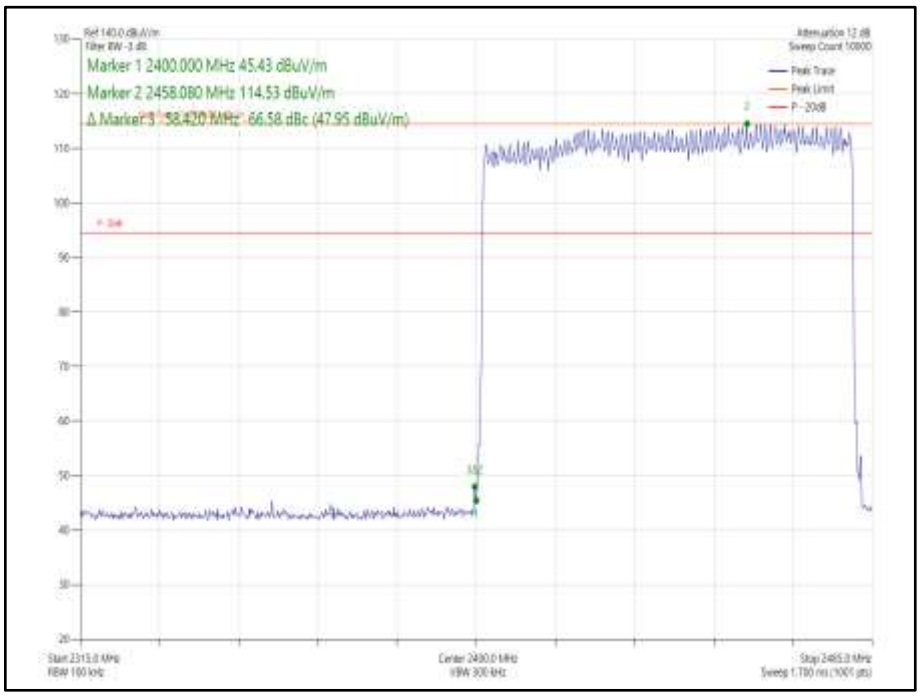

Figure 108 - Hopping - Core 0-1, 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

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.

2.6.7 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
True RMS Multimeter	Fluke	179	4007	12	29-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	04-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.0	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	10-Mar-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	01-Apr-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2021

Table 76

TU - Traceability Unscheduled

2.7 Restricted Band Edges

2.7.1 Specification Reference

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

2.7.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00M0FTN - Modification State 0

2.7.3 Date of Test

09-November-2020 to 10-January-2021

2.7.4 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 4.1.4.2.5.

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 dBµV/m to µV/m:

10^(Field Strength in dBµV/m/20).

Restricted band edge measurements were performed, with the device operating in SISO and MIMO configurations, across the various modes supported by the device.

The measurements displayed within this report, have been limited to those modes which have been shown to be worst case.

Further measurements are held on file by TÜV SÜD and are available if required.

2.7.5 Environmental Conditions

Ambient Temperature	19.3 - 25.9 ˚C
Relative Humidity	25.0 – 36.0 %

2.7.6 Test Results

2.4 GHz Bluetooth - FHSS

iPA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	GFSK	1	DH5	2402	2390.0	54.16	39.14
Static	π/4 DQPSK	1	2DH5	2402	2390.0	53.25	39.20
Static	8-DPSK	1	3DH5	2402	2390.0	54.34	39.19
Static	GFSK	1	DH5	2480	2483.5	59.94	40.99
Static	π/4 DQPSK	1	2DH5	2480	2483.5	53.80	39.94
Static	8-DPSK	1	3DH5	2480	2483.5	53.09	39.93

Table 77 - Restricted Band Edge Results

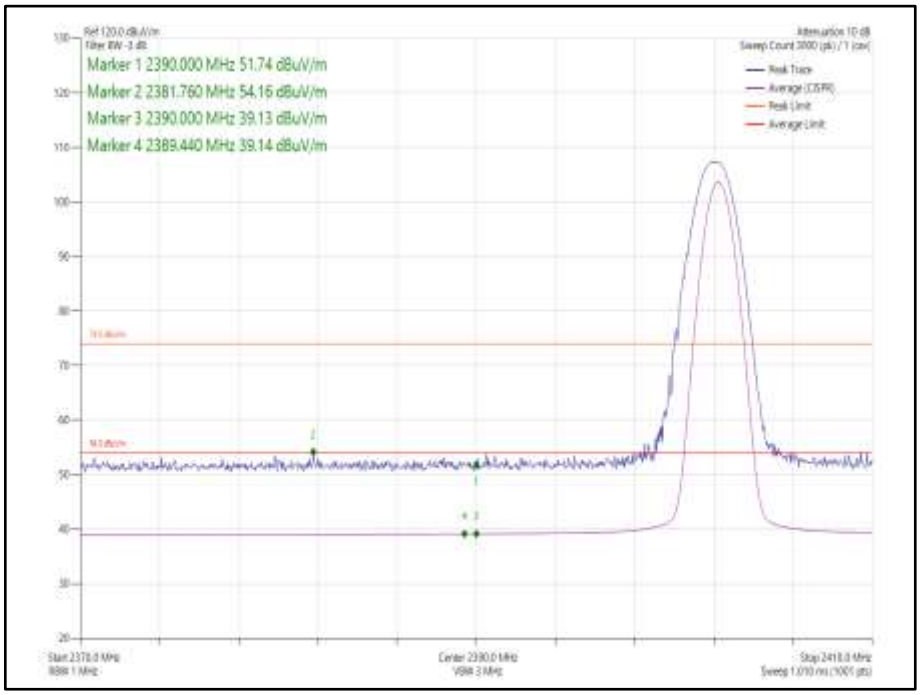

Figure 109 - Static - Core 1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

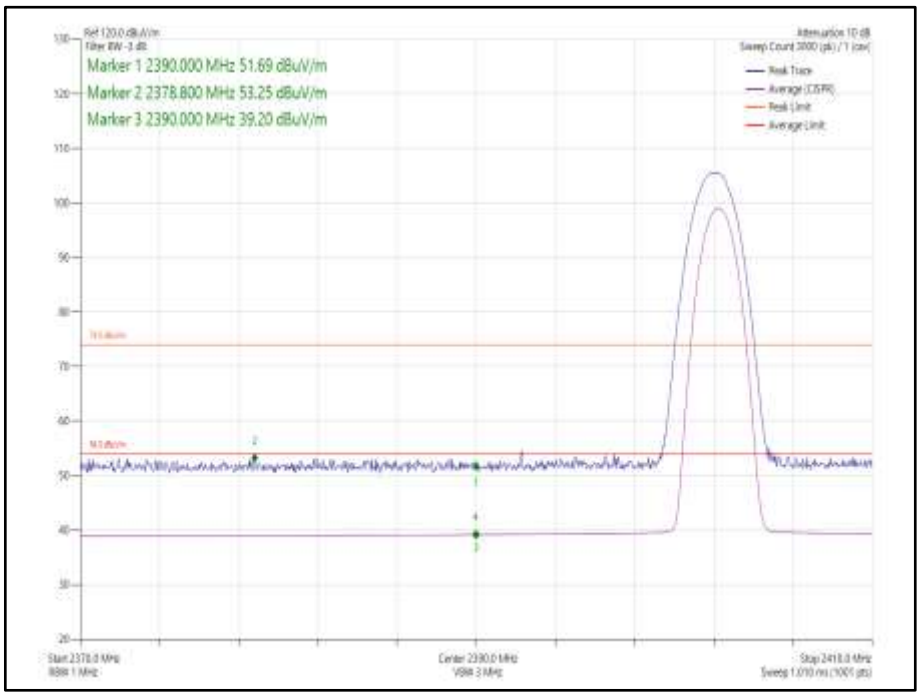

Figure 110 - Static - Core 1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

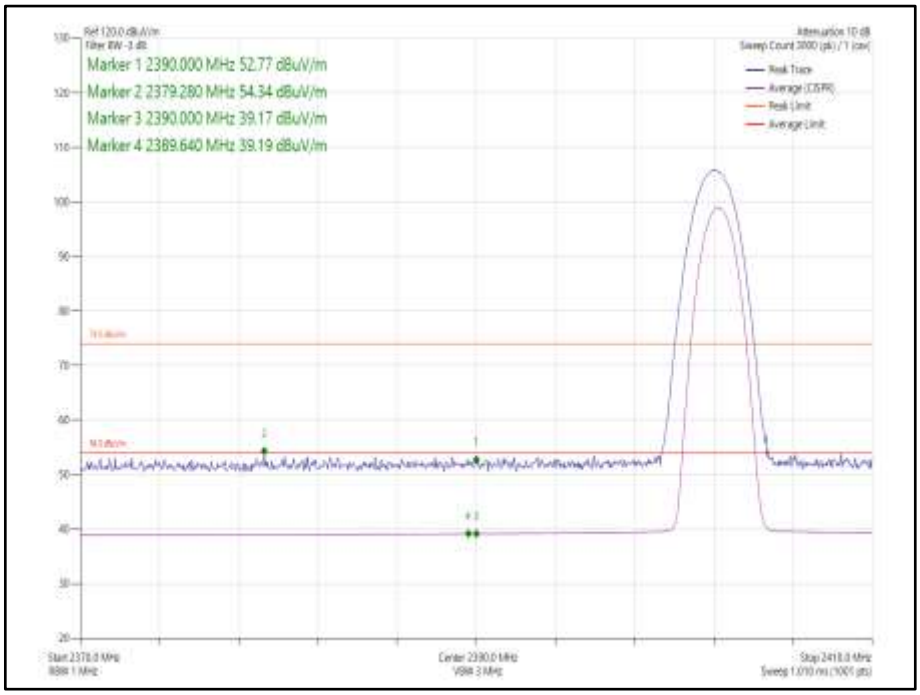

Figure 111 - Static - Core 1, 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

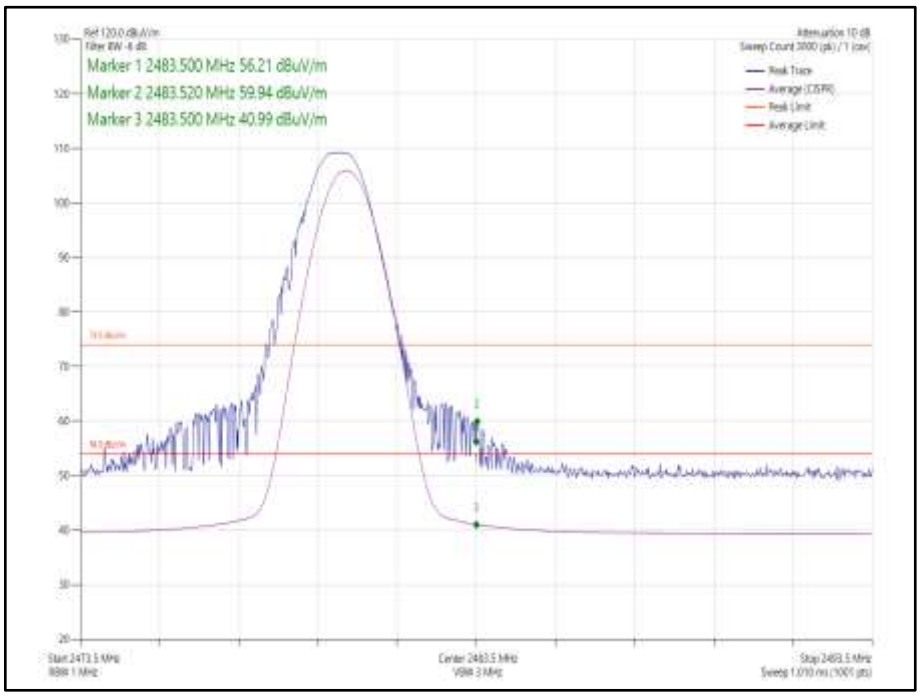

Figure 112 - Static - Core 1, GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

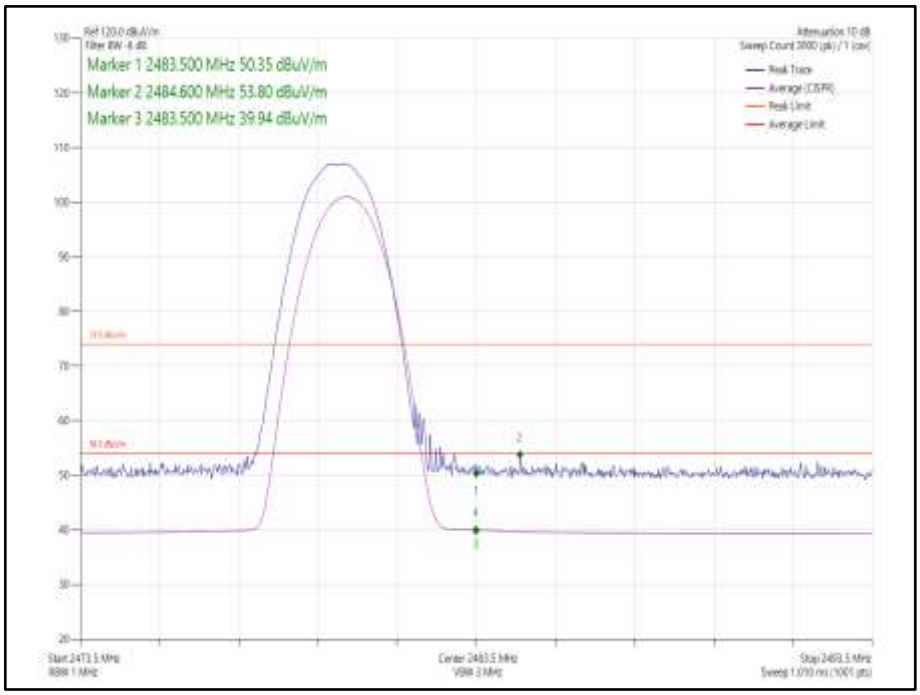

Figure 113 - Static - Core 1, π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

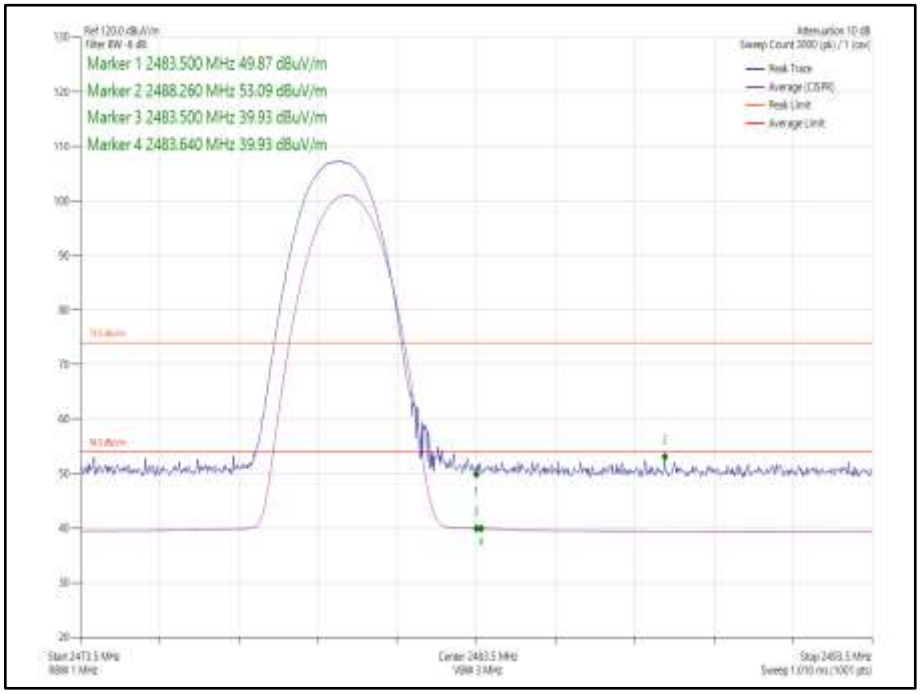

Figure 114 - Static - Core 1, 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	GFSK	2	DH5	2402	2390.0	53.79	39.11
Static	π/4 DQPSK	2	2DH5	2402	2390.0	53.39	39.12
Static	8-DPSK	2	3DH5	2402	2390.0	53.80	39.13
Static	GFSK	2	DH5	2480	2483.5	56.01	39.75
Static	π/4 DQPSK	2	2DH5	2480	2483.5	52.92	41.02
Static	8-DPSK	2	3DH5	2480	2483.5	54.18	41.09

Table 78 - Restricted Band Edge Results

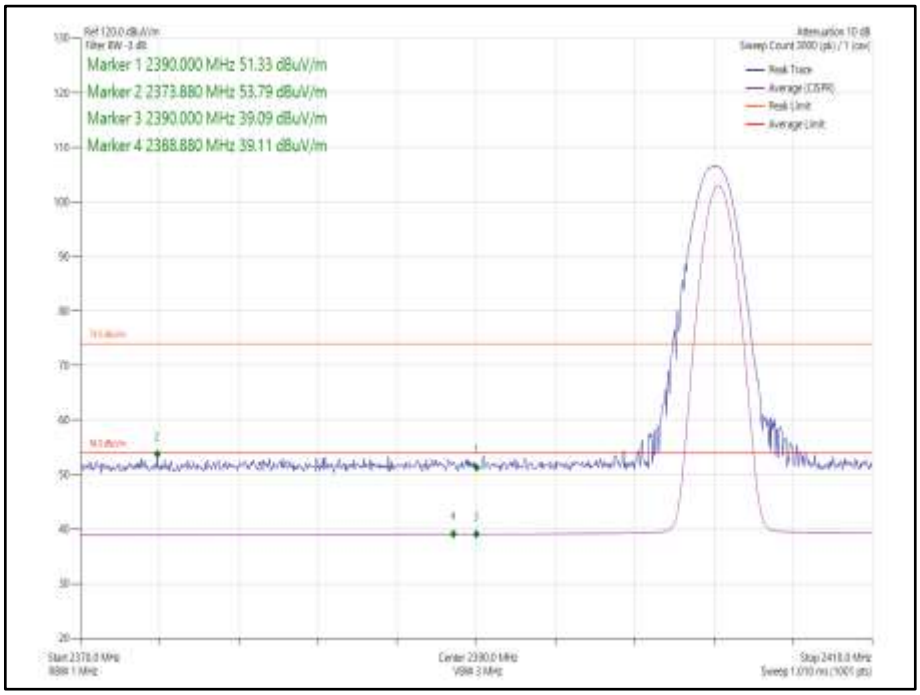

Figure 115 - Static - Core 2, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

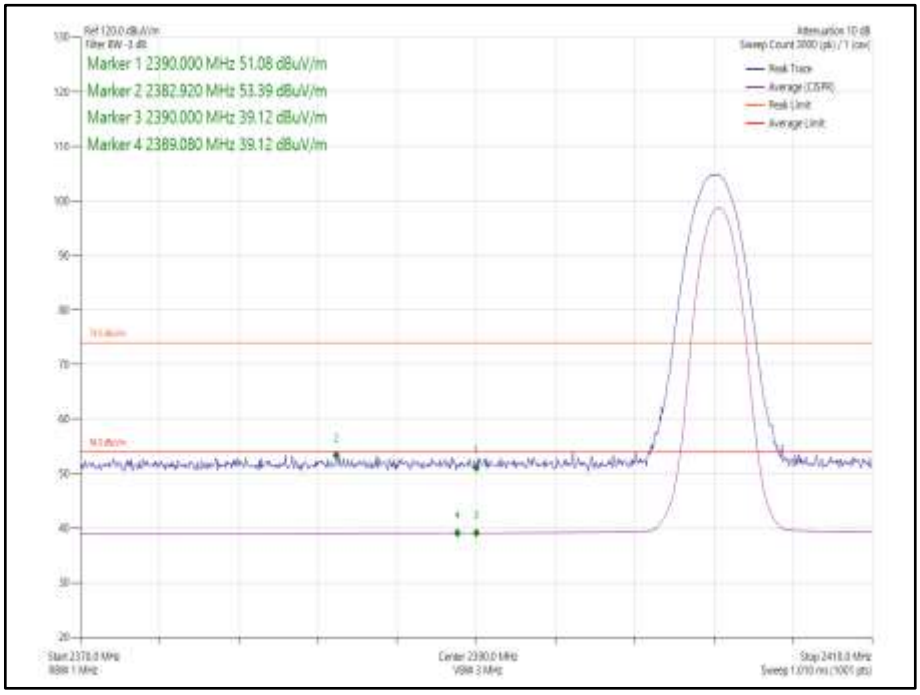

Figure 116 - Static - Core 2, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

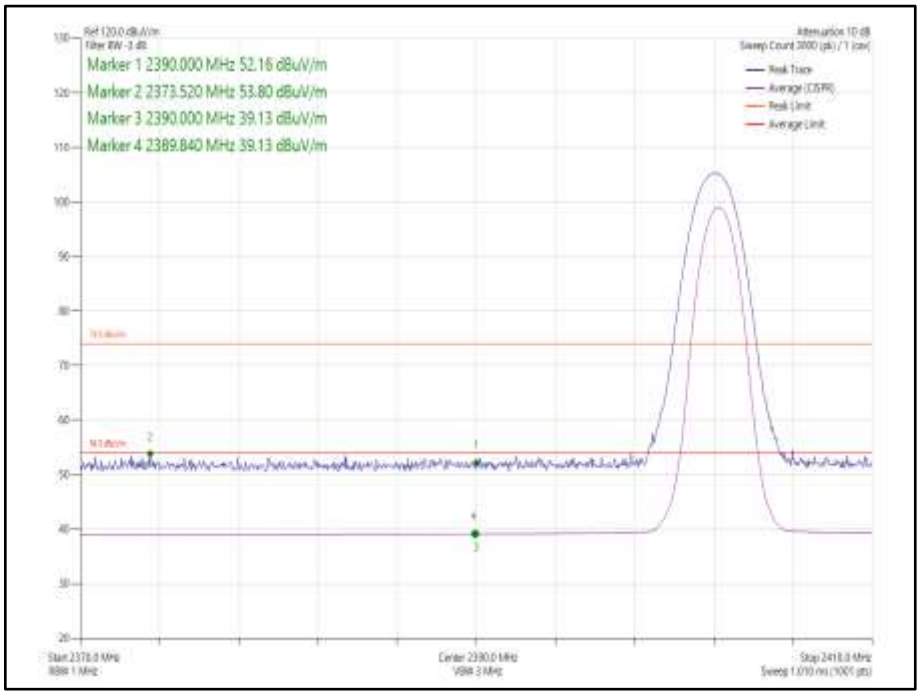

Figure 117 - Static - Core 2, 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

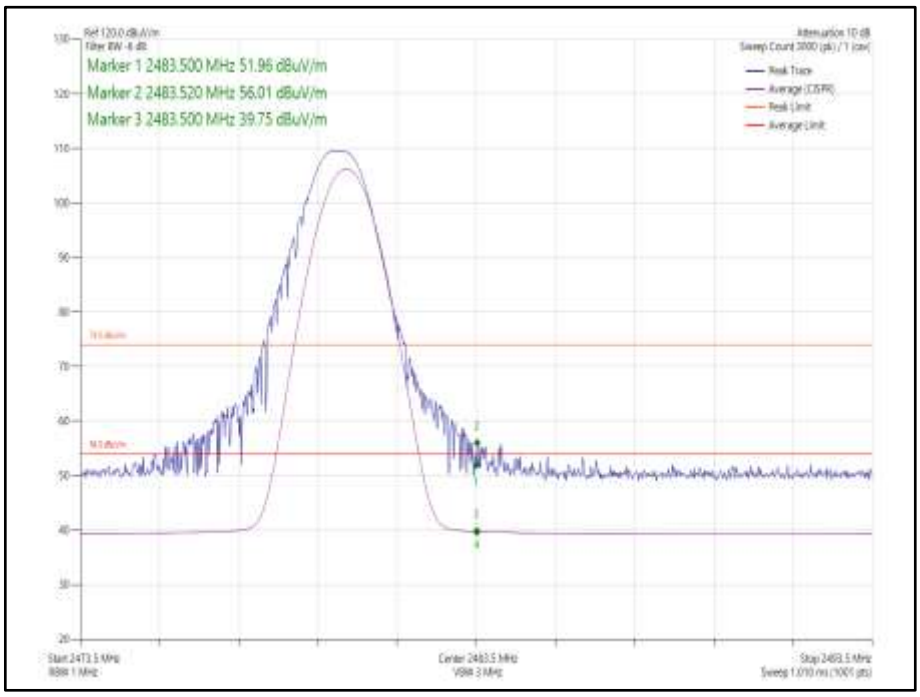

Figure 118 - Static - Core 2, GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

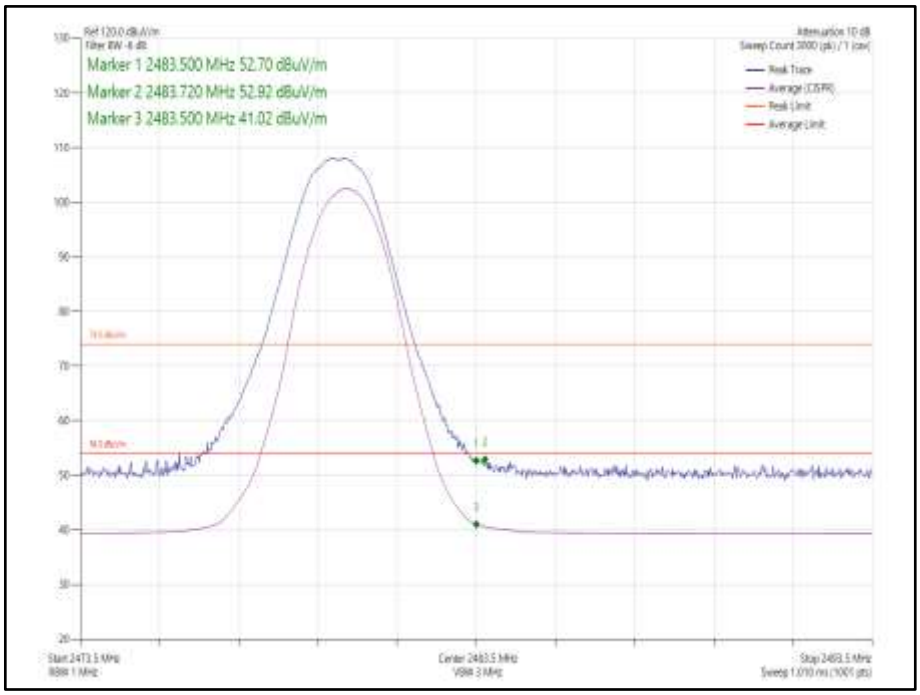

Figure 119 - Static - Core 2, π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

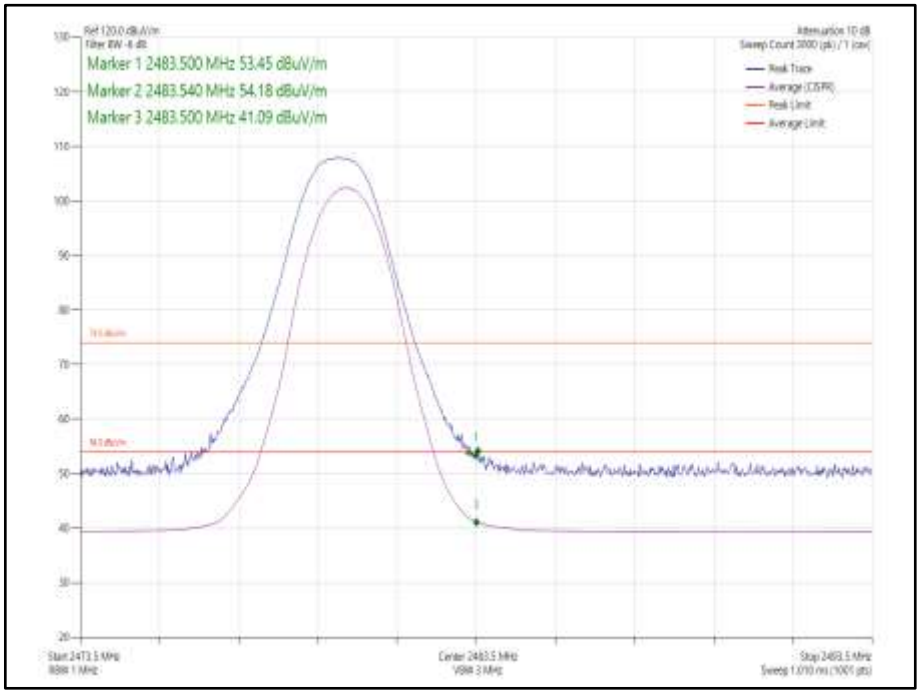

Figure 120 - Static - Core 2, 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	GFSK	0-1	DH5	2402	2390.0	54.29	39.17
Static	π/4 DQPSK	0-1	2DH5	2402	2390.0	53.87	39.52
Static	8-DPSK	0-1	3DH5	2402	2390.0	54.23	39.53
Static	GFSK	0-1	DH5	2480	2483.5	52.74	40.23
Static	π/4 DQPSK	0-1	2DH5	2480	2483.5	53.99	40.13
Static	8-DPSK	0-1	3DH5	2480	2483.5	53.44	40.15

Table 79 - Restricted Band Edge Results

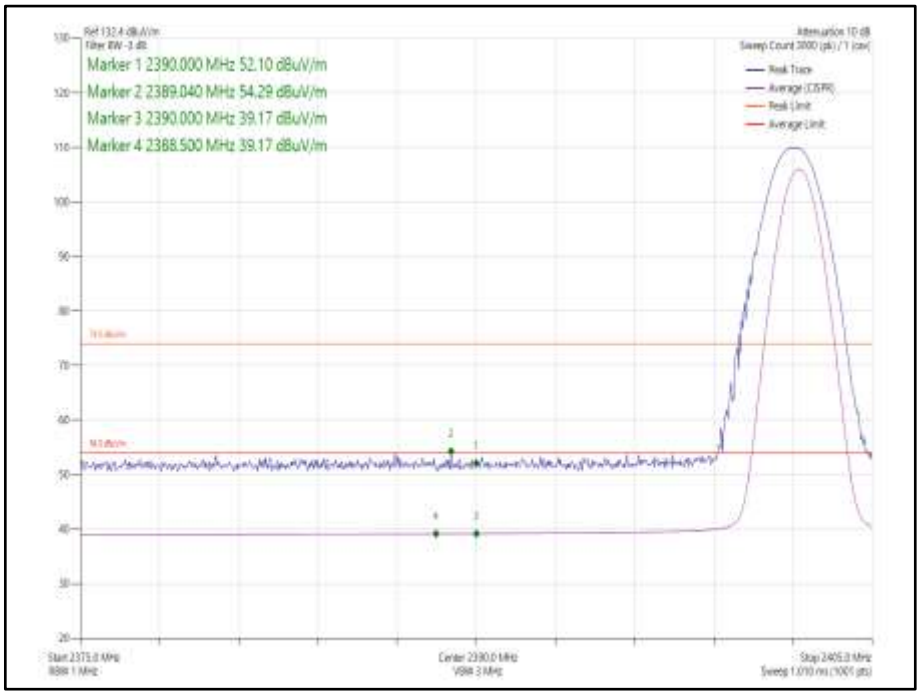

Figure 121 - Static - Core 0-1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

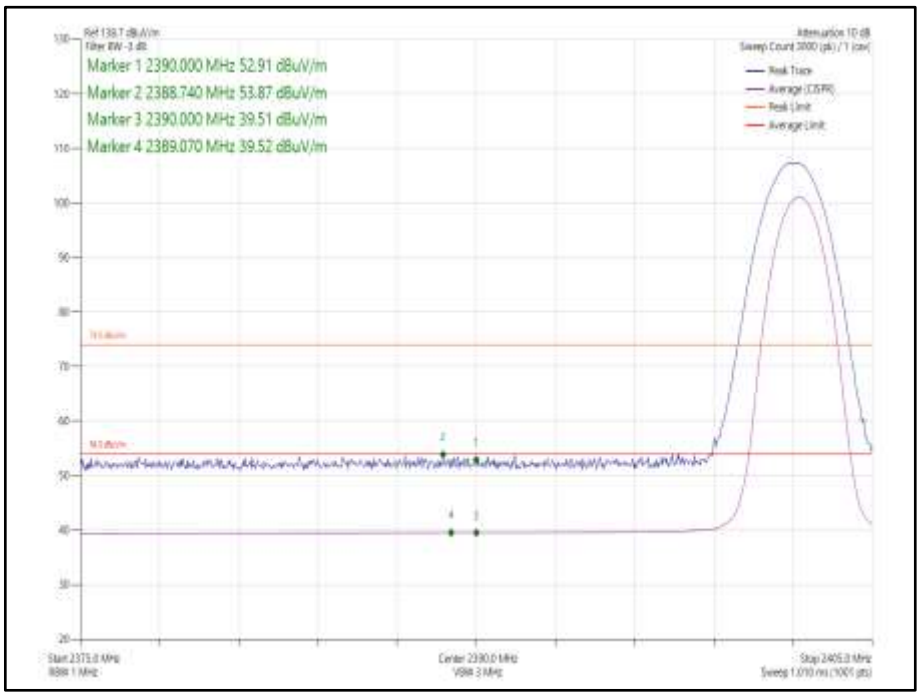

Figure 122 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

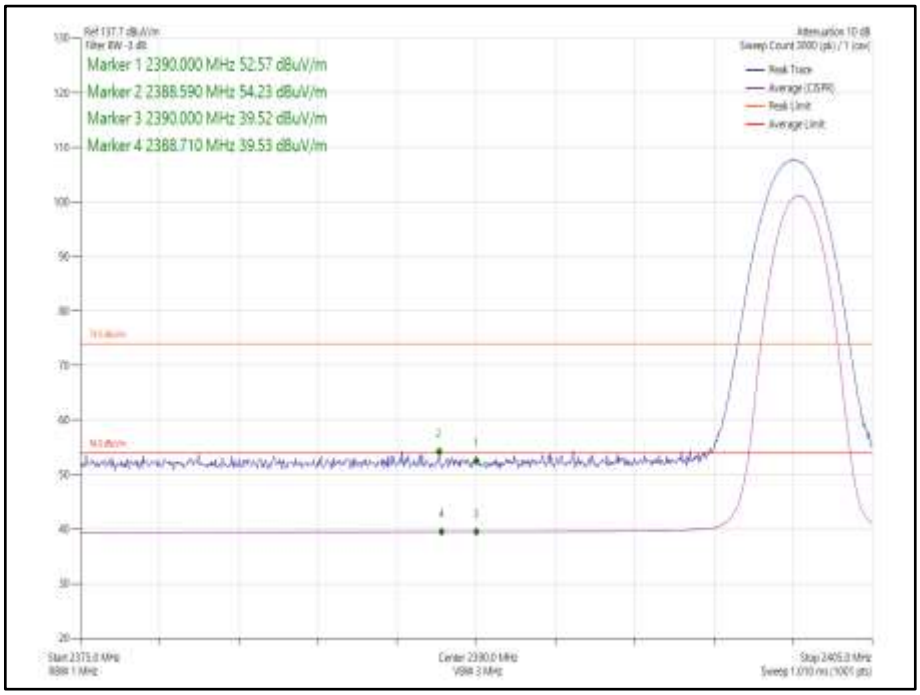

Figure 123 - Static - Core 0-1, 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

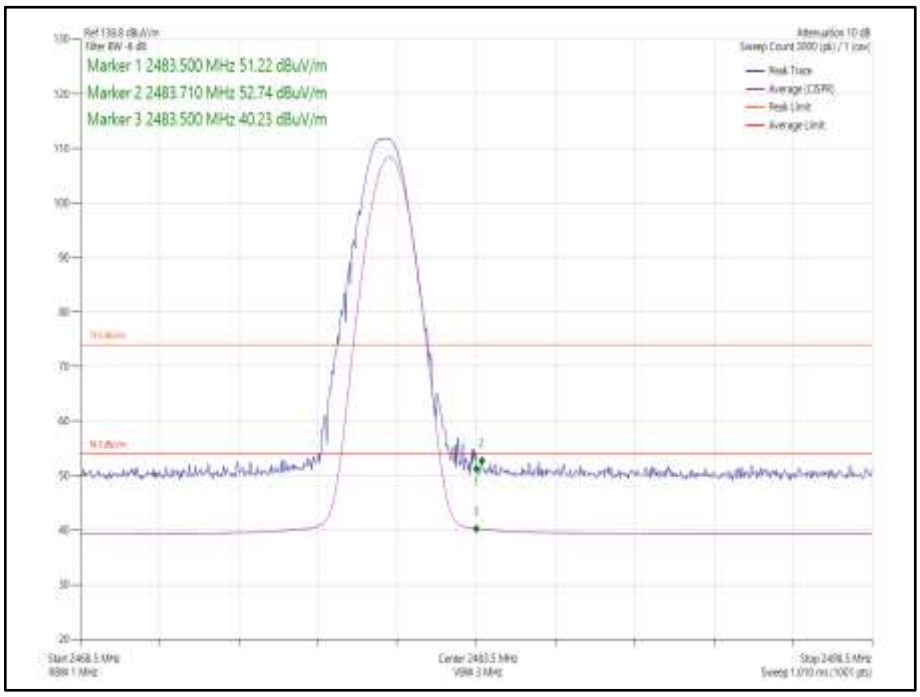

Figure 124 - Static - Core 0-1, GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

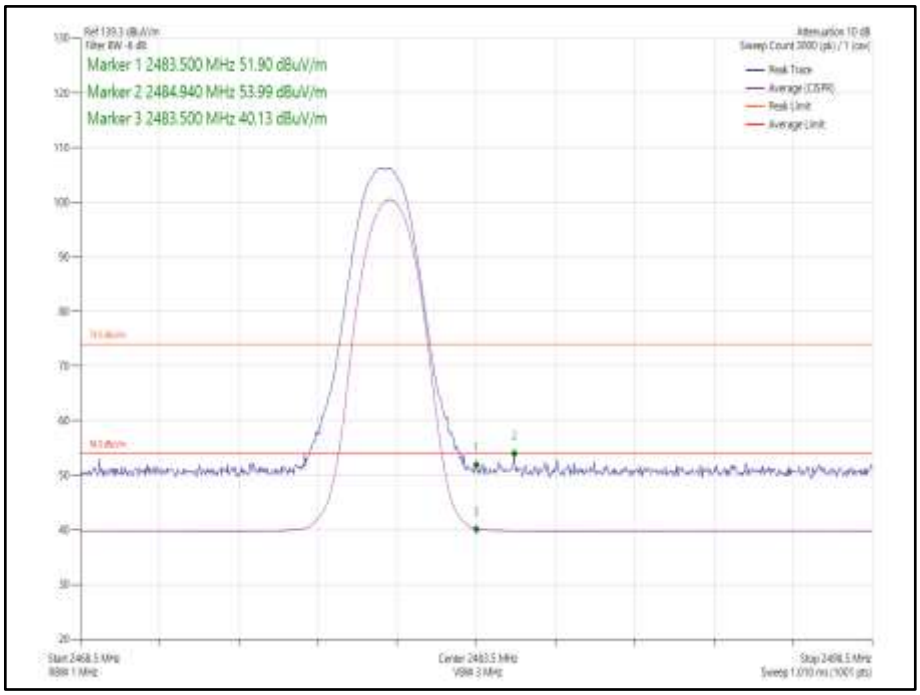

Figure 125 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

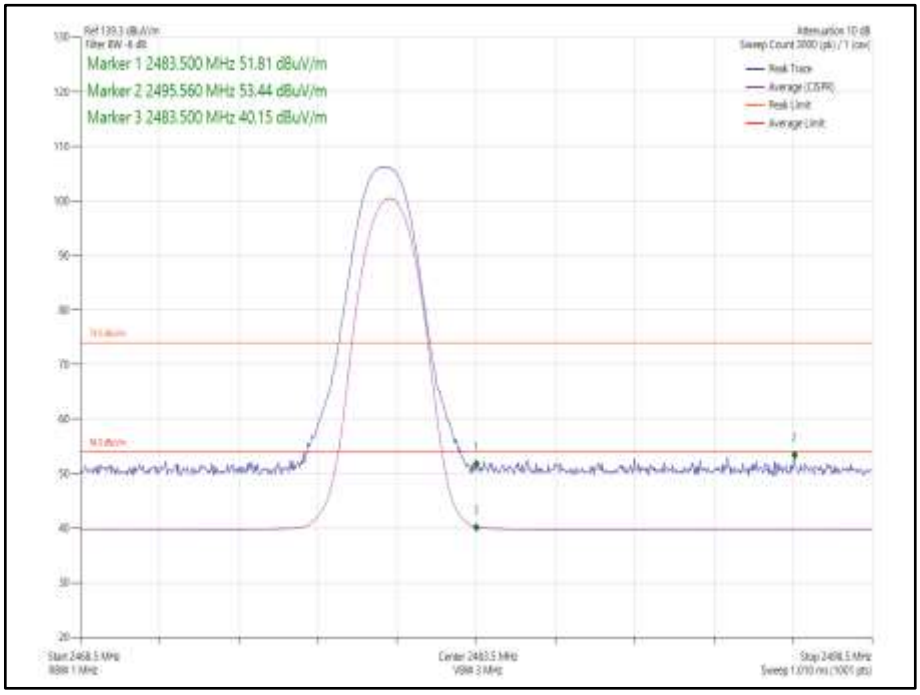

Figure 126 - Static - Core 0-1, 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

ePA

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	GFSK	1	DH5	2402	2390.0	57.00	39.46
Static	π/4 DQPSK	1	2DH5	2402	2390.0	53.81	39.50
Static	8-DPSK	1	3DH5	2402	2390.0	53.72	39.49
Static	GFSK	1	DH5	2480	2483.5	59.73	45.38
Static	π/4 DQPSK	1	2DH5	2480	2483.5	57.06	42.17
Static	8-DPSK	1	3DH5	2480	2483.5	57.90	42.21

Table 80 - Restricted Band Edge Results

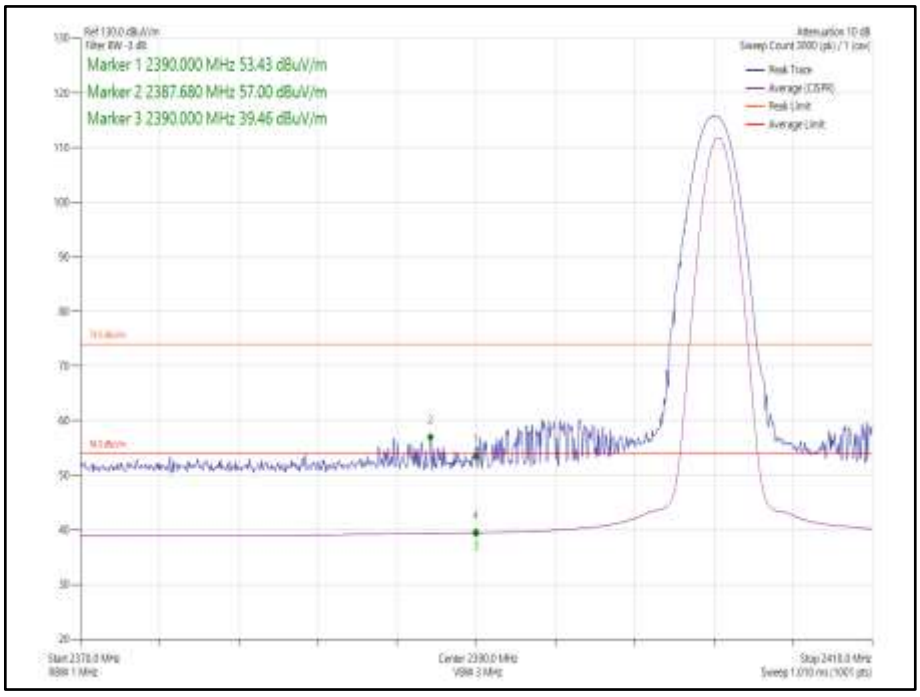

Figure 127 - Static - Core 1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

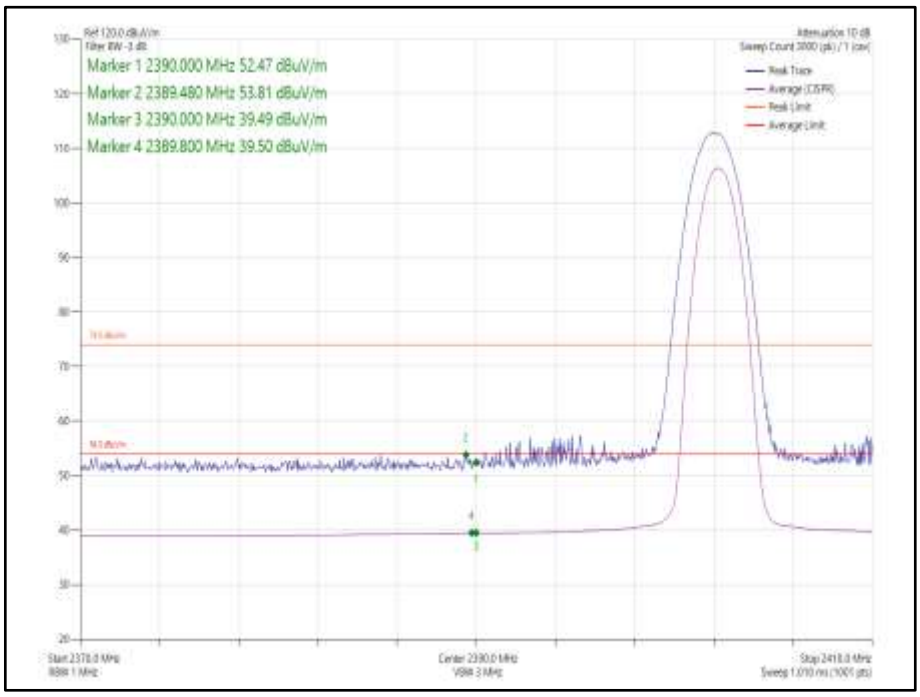

Figure 128 - Static - Core 1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

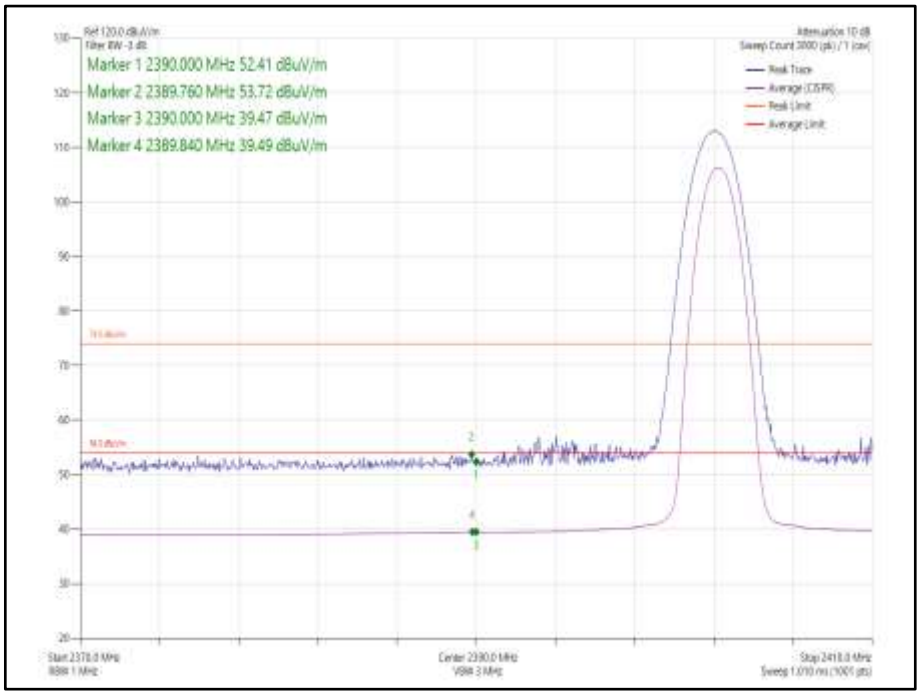

Figure 129 - Static - Core 1, 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

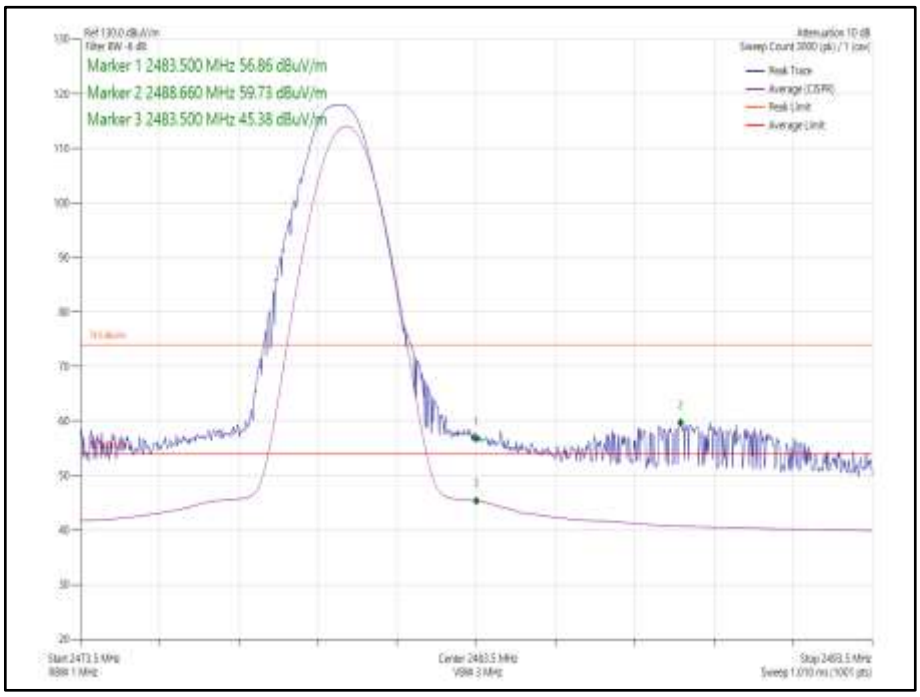

Figure 130 - Static - Core 1, GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

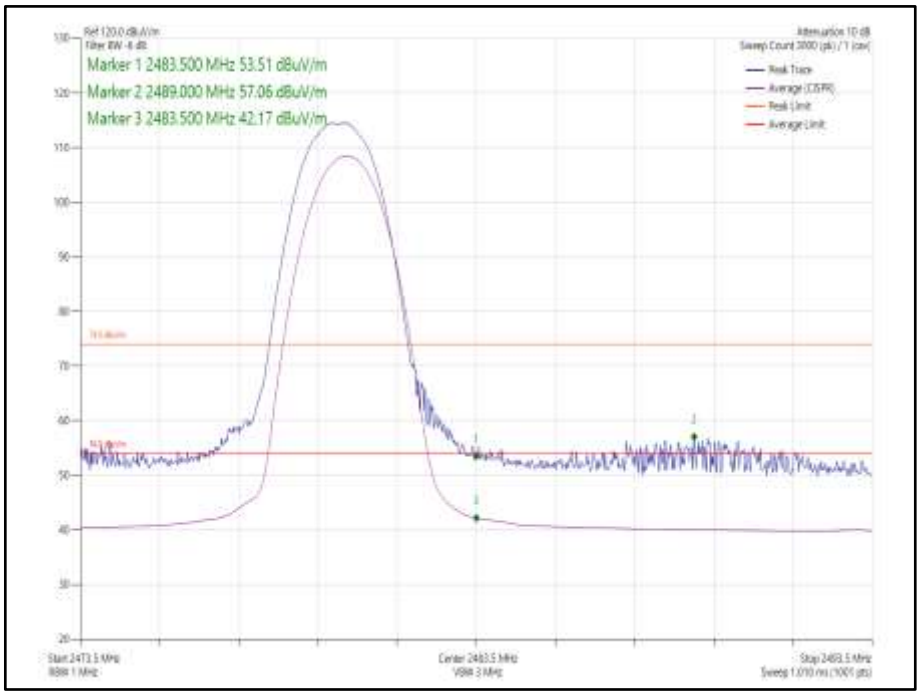

Figure 131 - Static - Core 1, π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

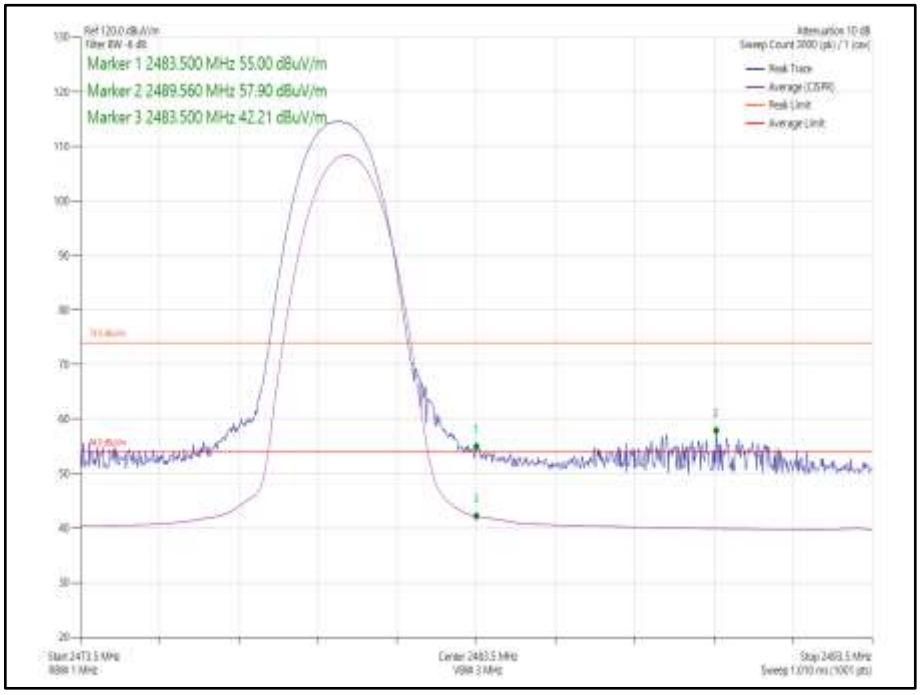

Figure 132 - Static - Core 1, 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Core	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static	GFSK	0-1	DH5	2402	2390.0	57.52	39.69
Static	π/4 DQPSK	0-1	2DH5	2402	2390.0	54.06	39.72
Static	8-DPSK	0-1	3DH5	2402	2390.0	54.09	39.72
Static	GFSK	0-1	DH5	2480	2483.5	57.98	45.35
Static	π/4 DQPSK	0-1	2DH5	2480	2483.5	56.23	42.78
Static	8-DPSK	0-1	3DH5	2480	2483.5	56.35	42.58

Table 81 - Restricted Band Edge Results

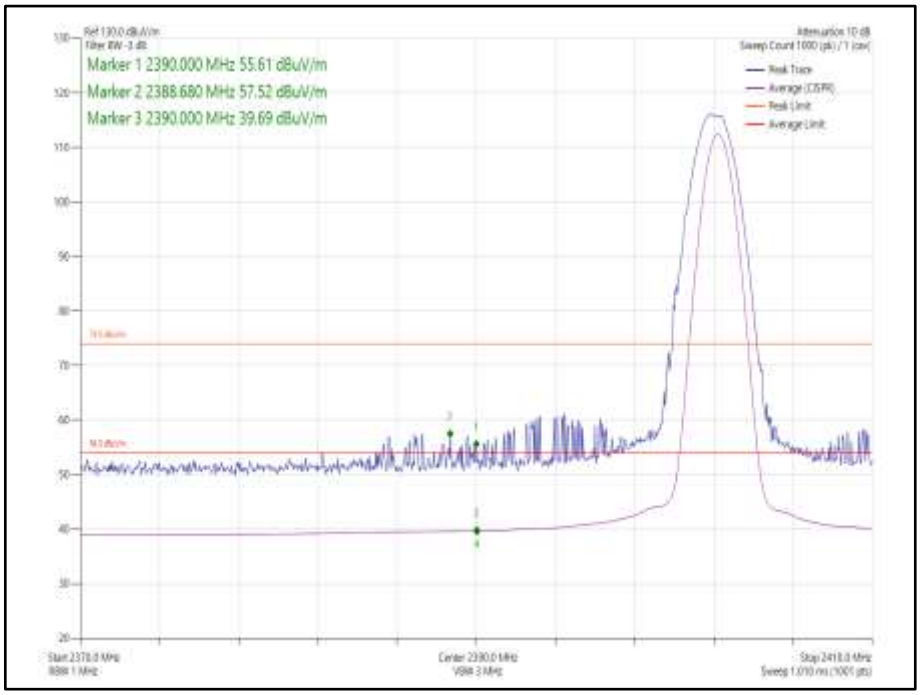

Figure 133 - Static - Core 0-1, GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

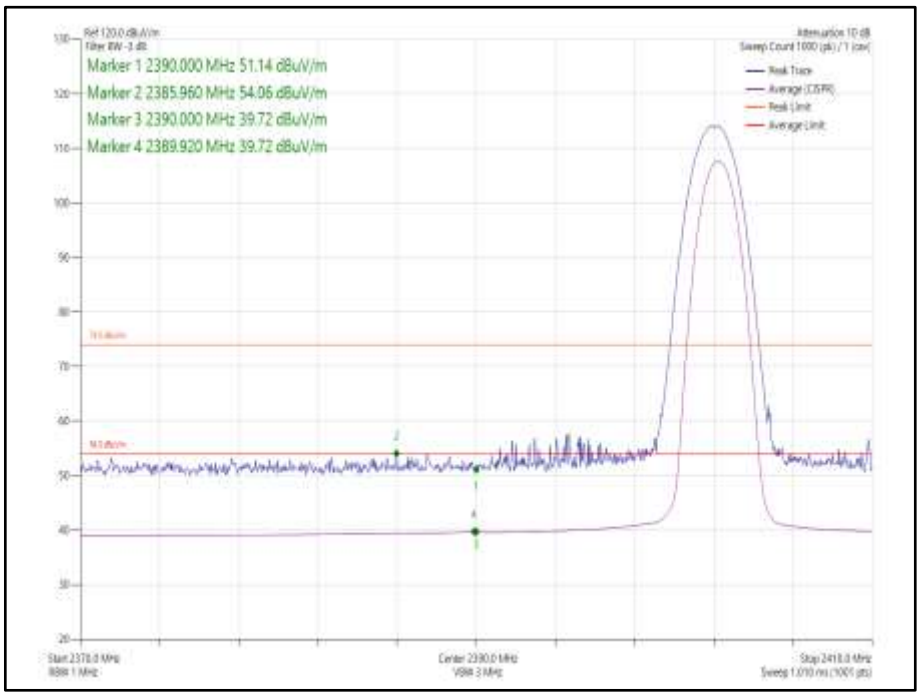

Figure 134 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

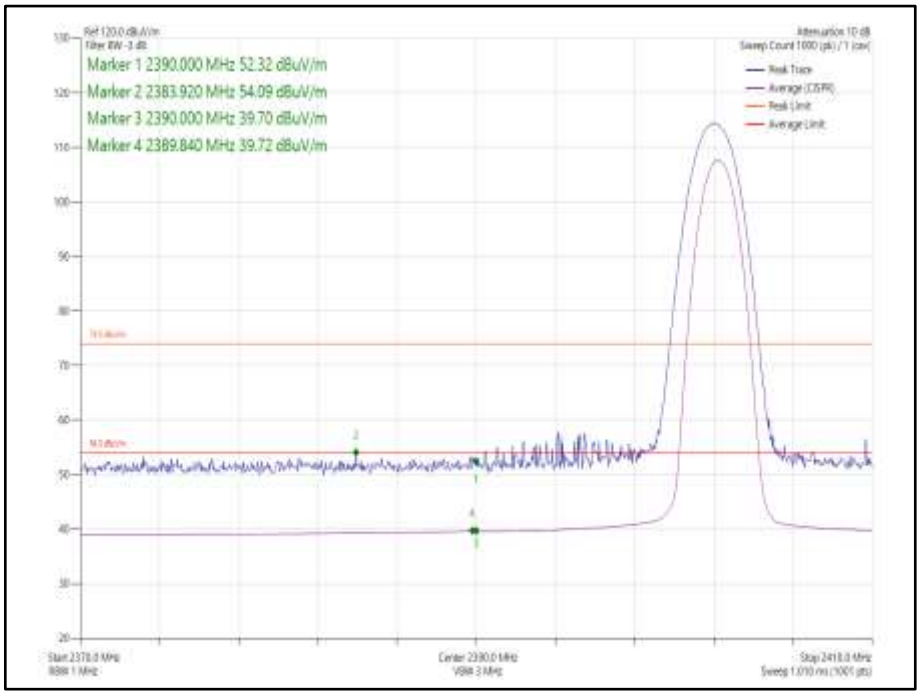

Figure 135 - Static - Core 0-1, 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

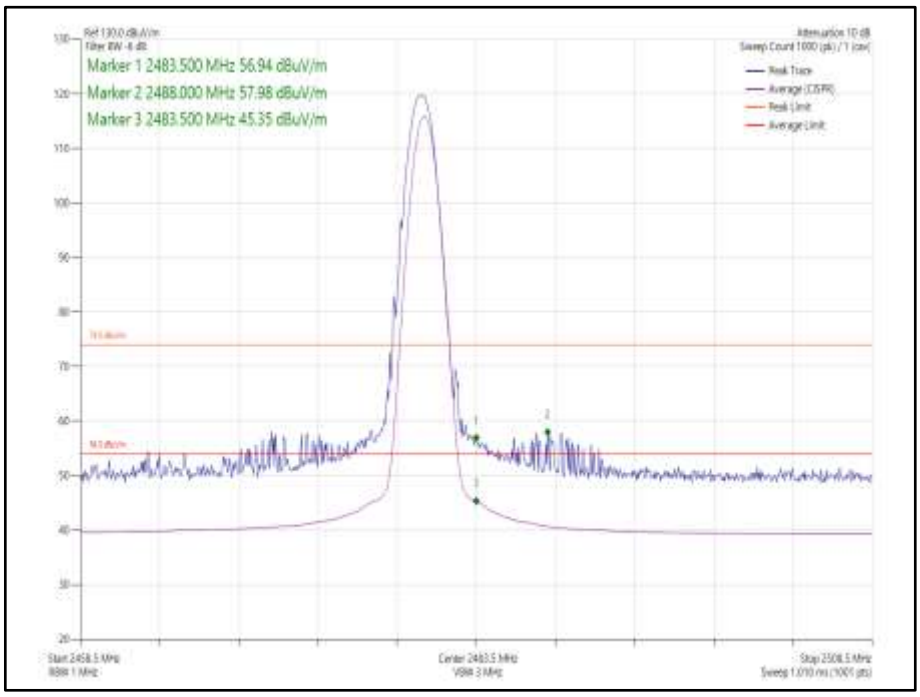

Figure 136 - Static - Core 0-1, GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

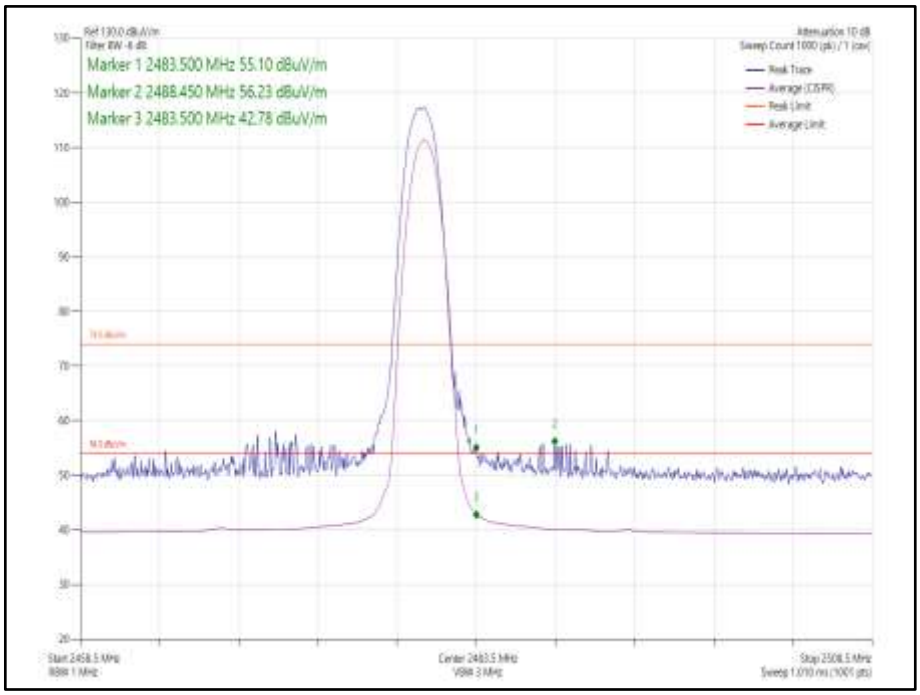

Figure 137 - Static - Core 0-1, π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

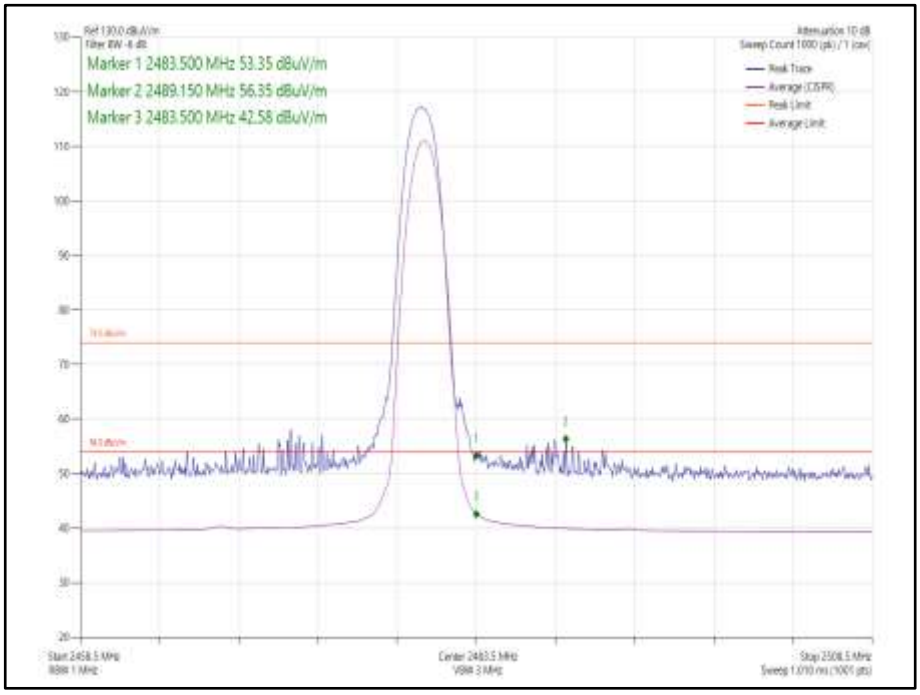

Figure 138 - Static - Core 0-1, 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

FCC 47 CFR Part 15, Limit Clause 15.209

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 to 88	100
88 to 216	150
216 to 960	200
Above 960	500

Table 82

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 83

*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.

2.7.7 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
True RMS Multimeter	Fluke	179	4007	12	29-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	04-Feb-2021
EmX Emissions Software	TUV SUD	V2.1.0	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	10-Mar-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	01-Apr-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	12	24-Mar-2021

Table 84

TU - Traceability Unscheduled

2.8 Spurious Radiated Emissions

2.8.1 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

2.8.2 Equipment Under Test and Modification State

A2439, S/N: C02DM00M0FTN - Modification State 0

2.8.3 Date of Test

21-December-2020 to 11-January-2021

2.8.4 Test Method

Testing 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 for each type of port on the EUT.

In the 30 MHz to 1 GHz range pre-scans were only performed on the main radio mid channel (2441 MHz).

The plots shown are the characterization of the EUT. The limits on the plots represent the most stringent case for restricted bands, (54/74 dBuV/m @ 3m and 64/84 dBuV/m @ 1m) when compared to 20 dBc (Peak) and 30 dBc (Average) 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 dBµV/m to µV/m:
10^(Field Strength in dBµV/m / 20).

Above 18 GHz, the measurement distance was reduced to 1 m. The limit line was increased by 20*LOG(3/1) = 9.54 dB.

2.8.5 Example Test Setup Diagram

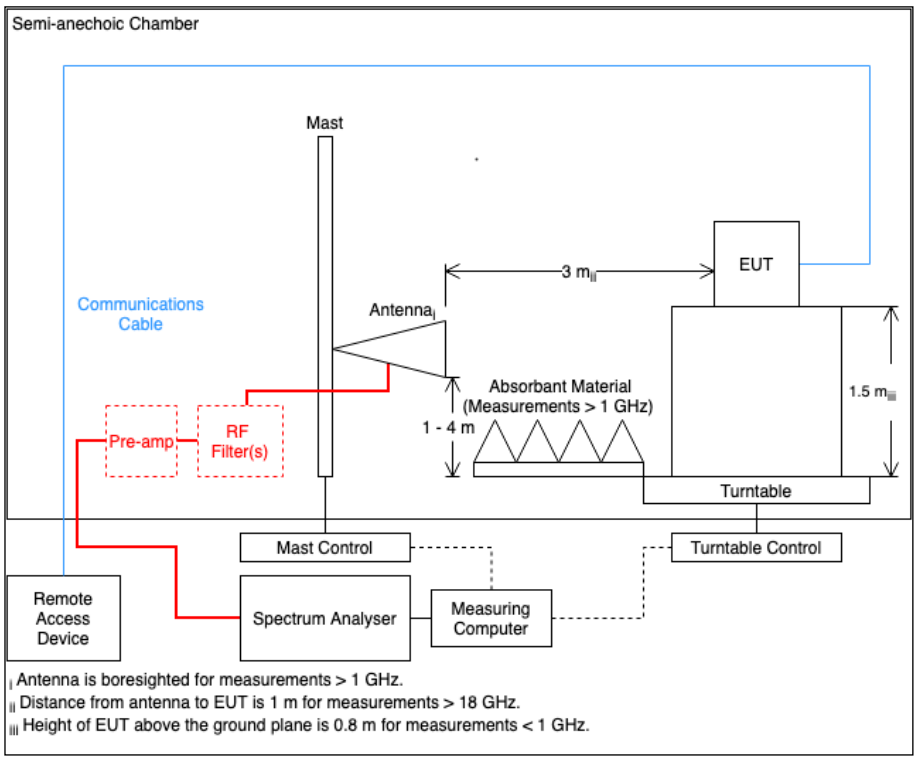

Figure 139

2.8.6 Environmental Conditions

Ambient Temperature	16.9 - 25.0 °C
Relative Humidity	29.5 - 50.0 %

2.8.7 Test Results

2.4 GHz Bluetooth - FHSS

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

Table 85 - 2402 MHz (CH0), 2DH5, ePA, Core 0, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

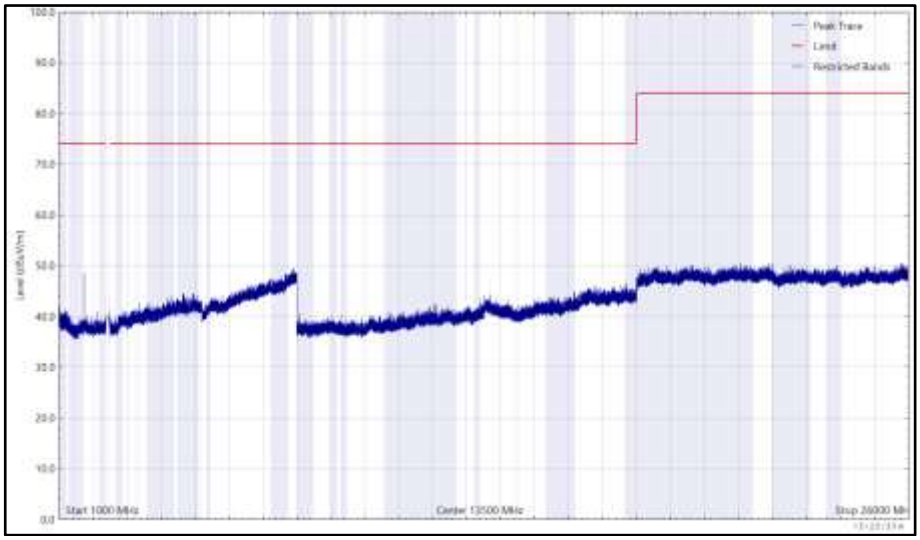

Figure 140 - 2402 MHz (CH0), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

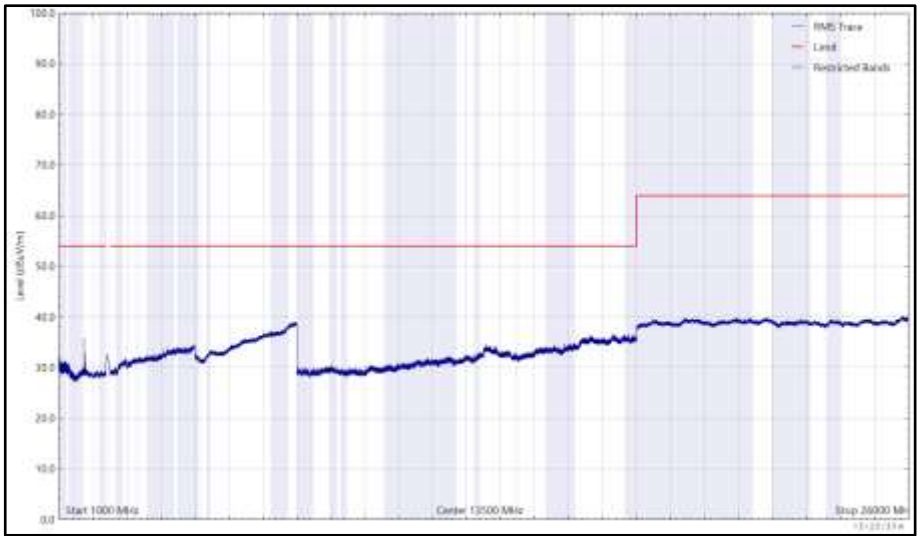

Figure 141 - 2402 MHz (CH0), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

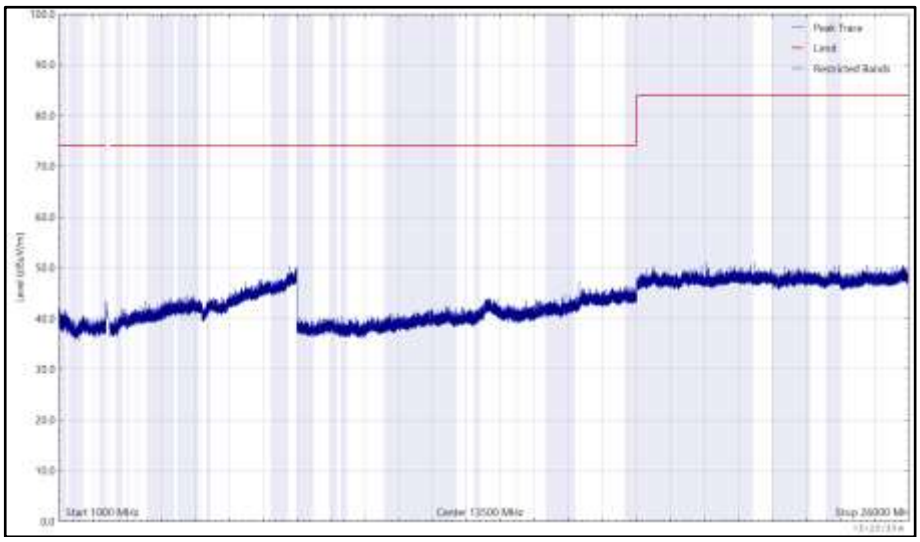

Figure 142 - 2402 MHz (CH0), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

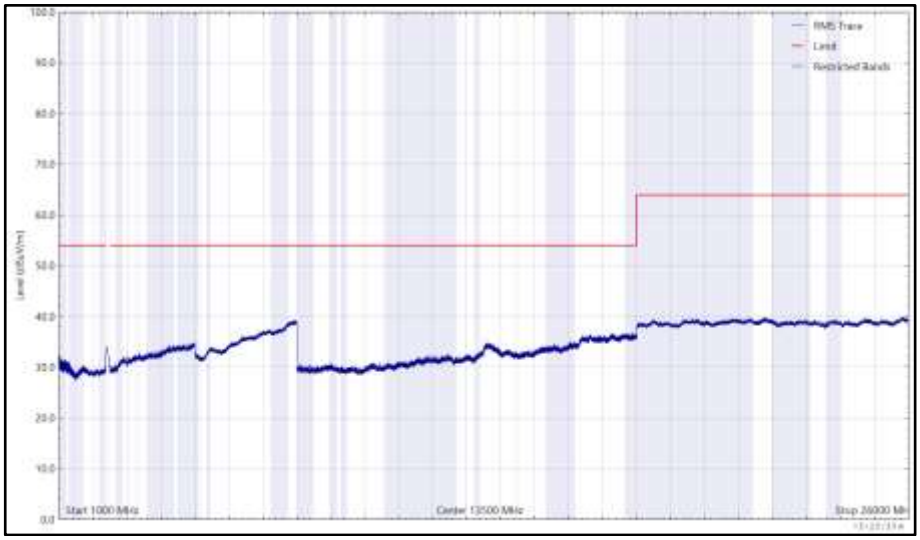

Figure 143 - 2402 MHz (CH0), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

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

Table 86 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

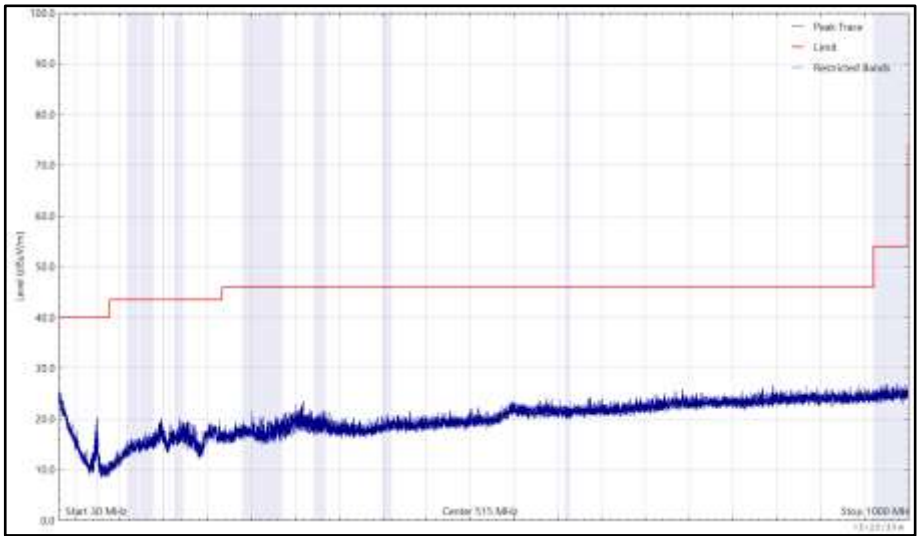

Figure 144 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

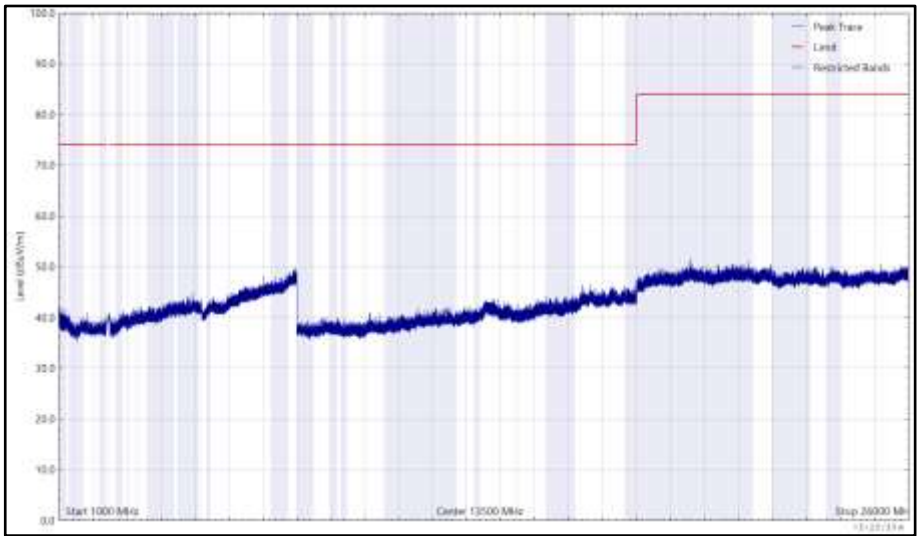

Figure 145 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

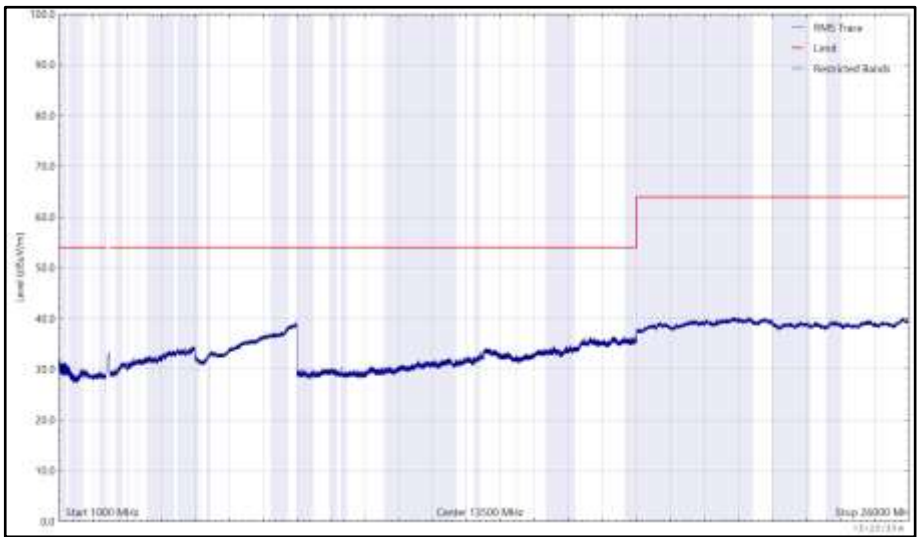

Figure 146 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

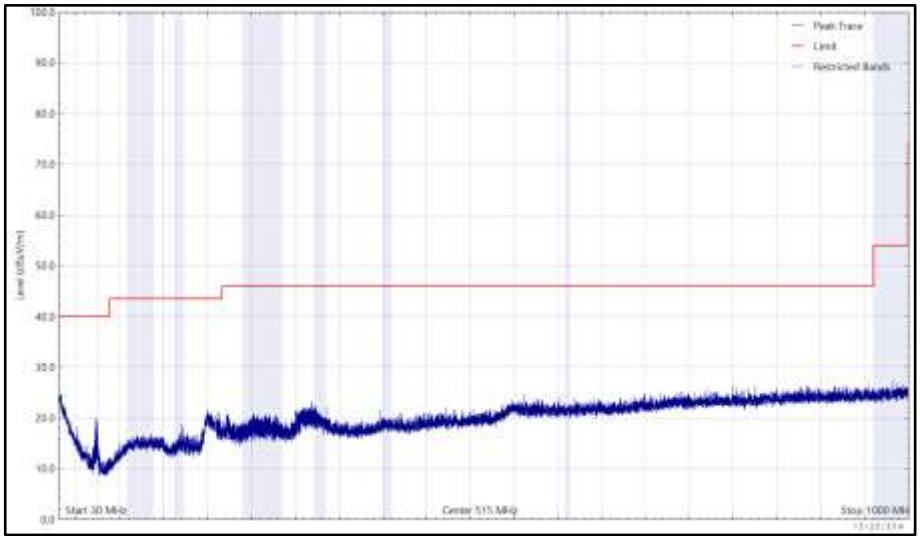

Figure 147 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

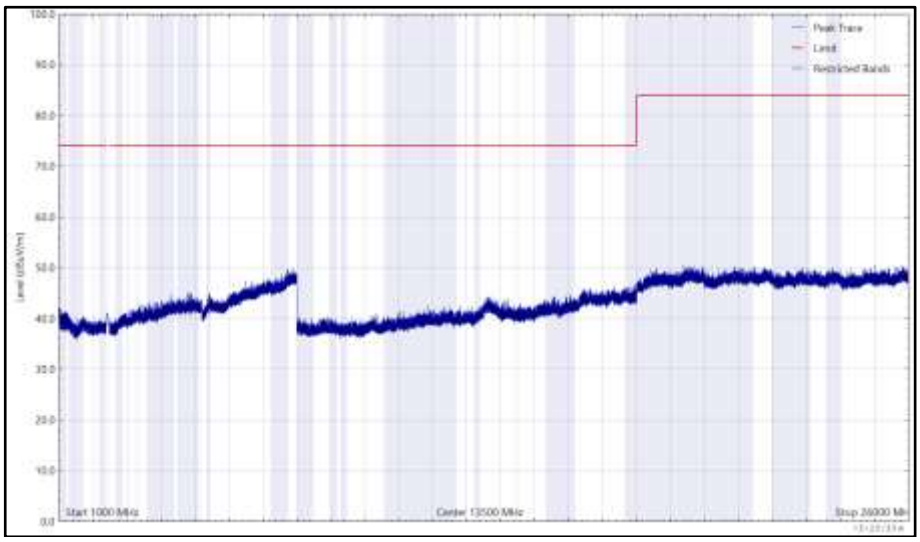

Figure 148 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

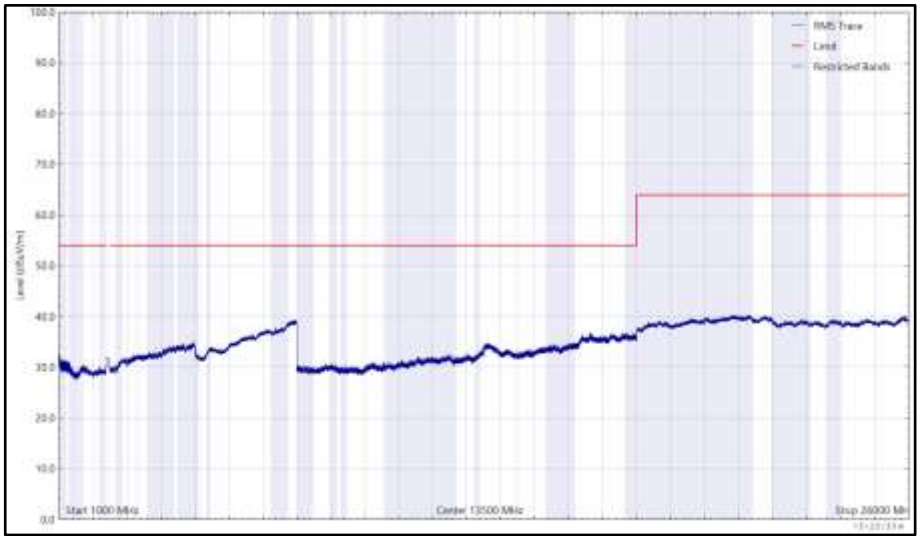

Figure 149 - 2441 MHz (CH39), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

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

Table 87 - 2480 MHz (CH78), 2DH5, ePA, Core 0, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

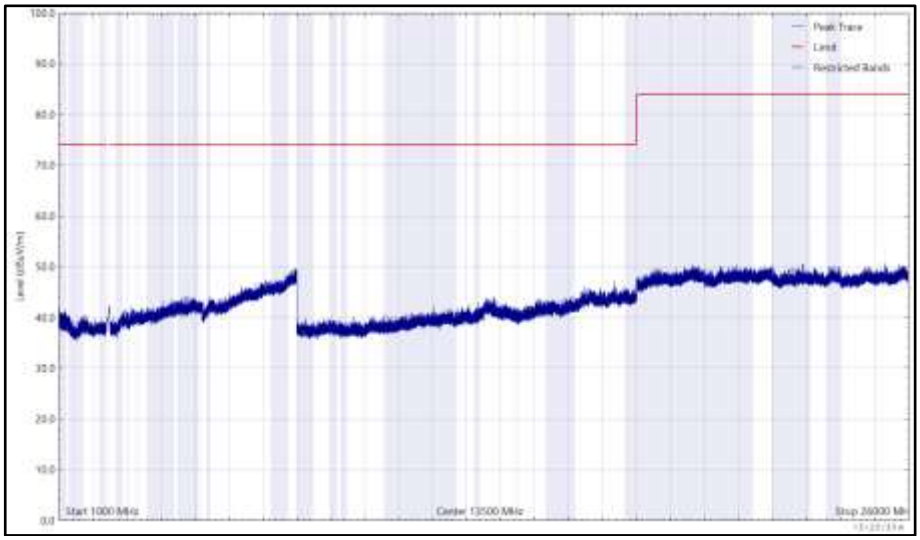

Figure 150 - 2480 MHz (CH78), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

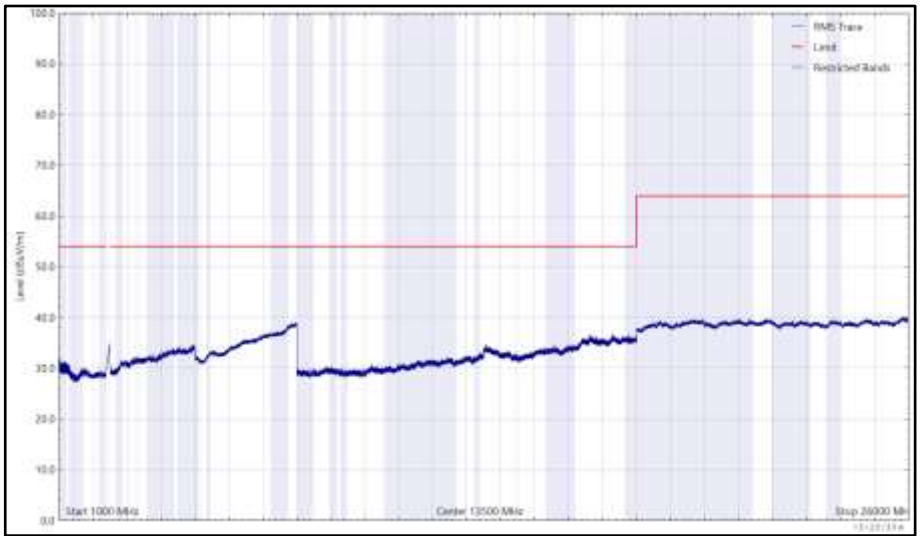

Figure 151 - 2480 MHz (CH78), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

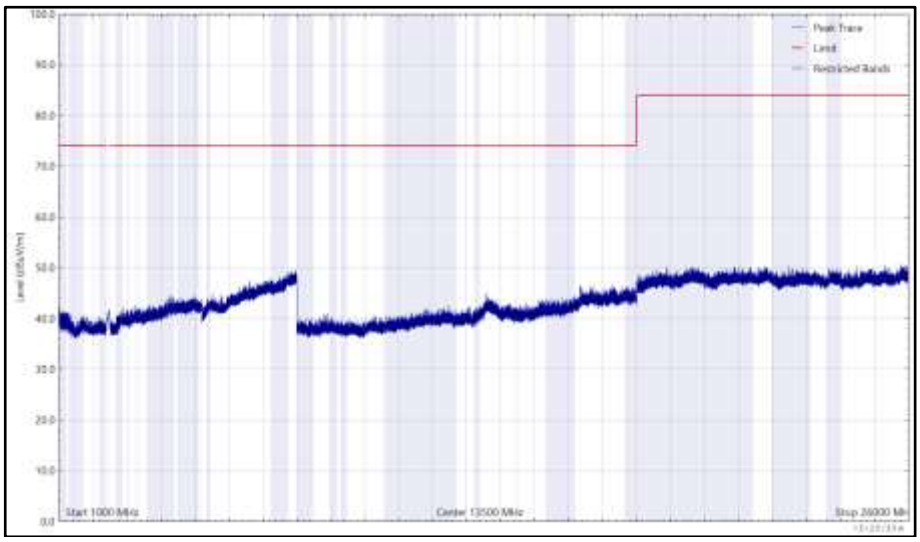

Figure 152 - 2480 MHz (CH78), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

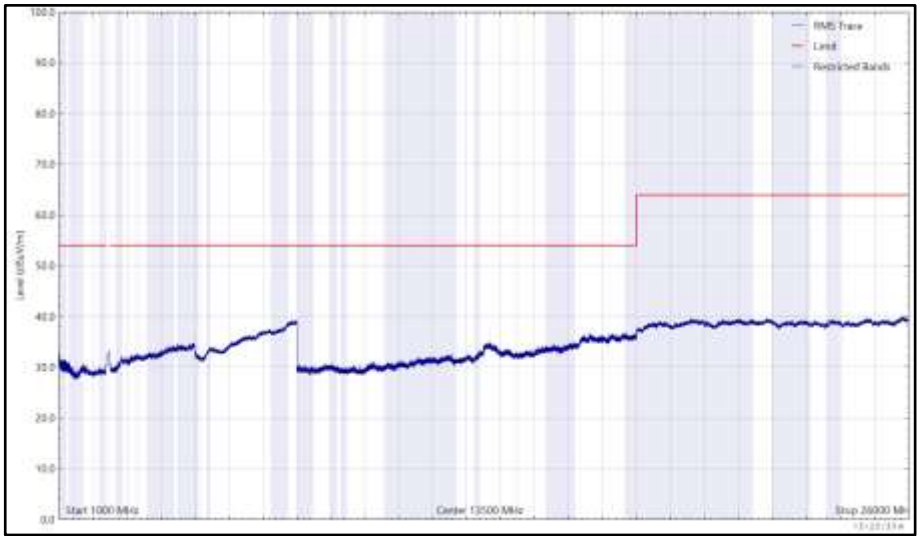

Figure 153 - 2480 MHz (CH78), 2DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

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

Table 88 - 2402 MHz (CH0), 2DH5, ePA, Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

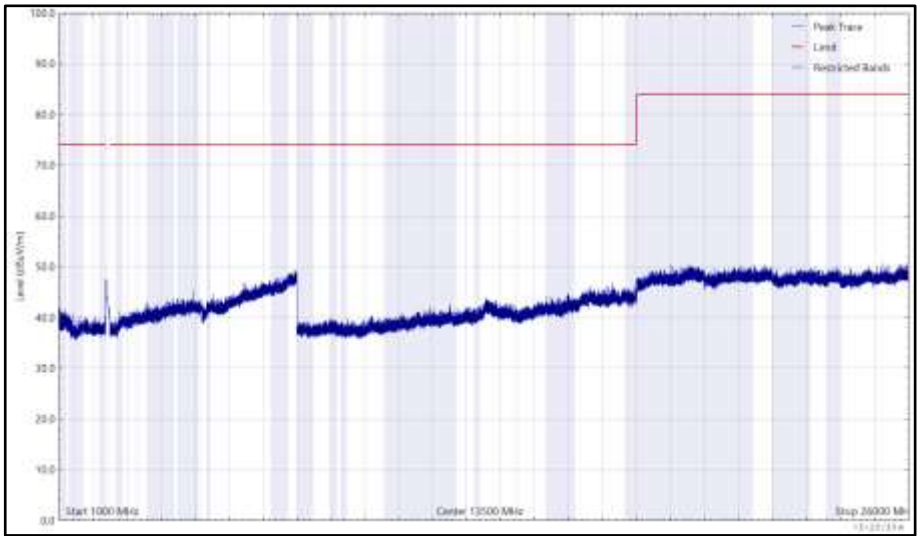

Figure 154 - 2402 MHz (CH0), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

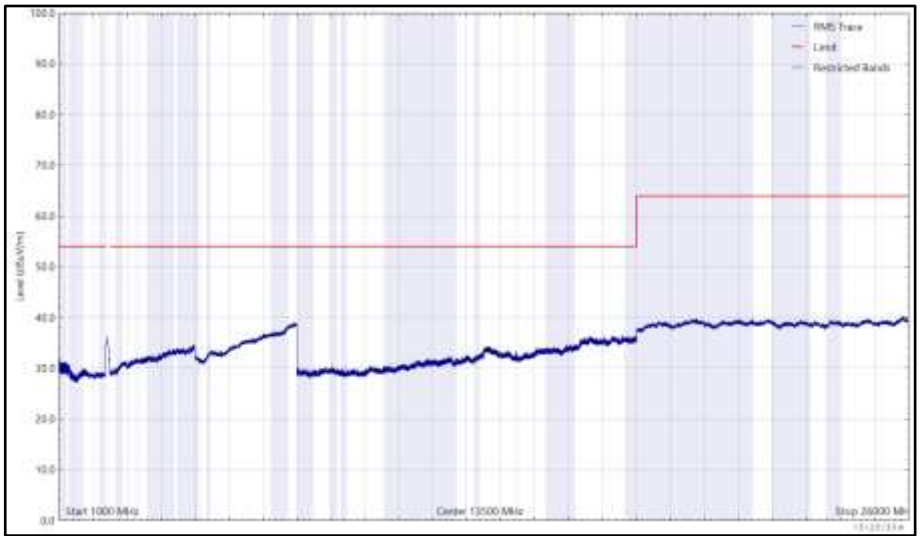

Figure 155 - 2402 MHz (CH0), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

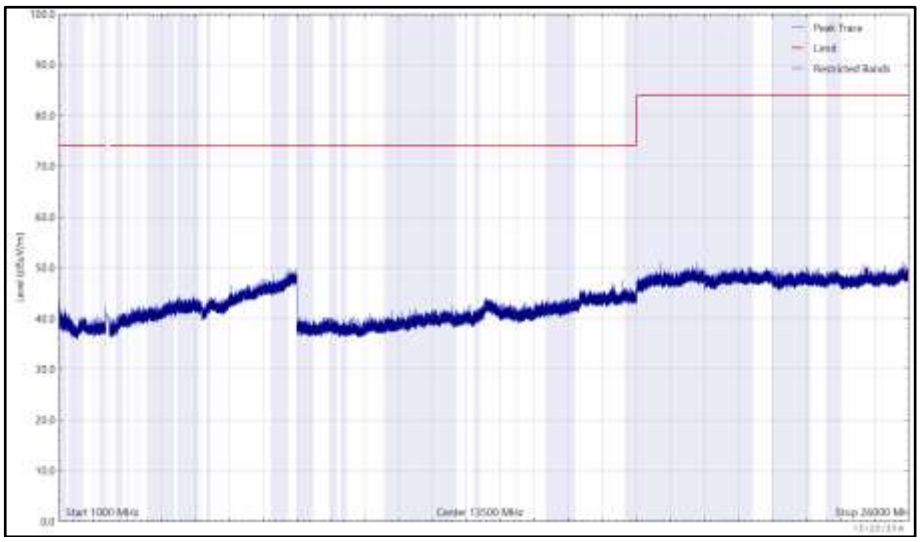

Figure 156 - 2402 MHz (CH0), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

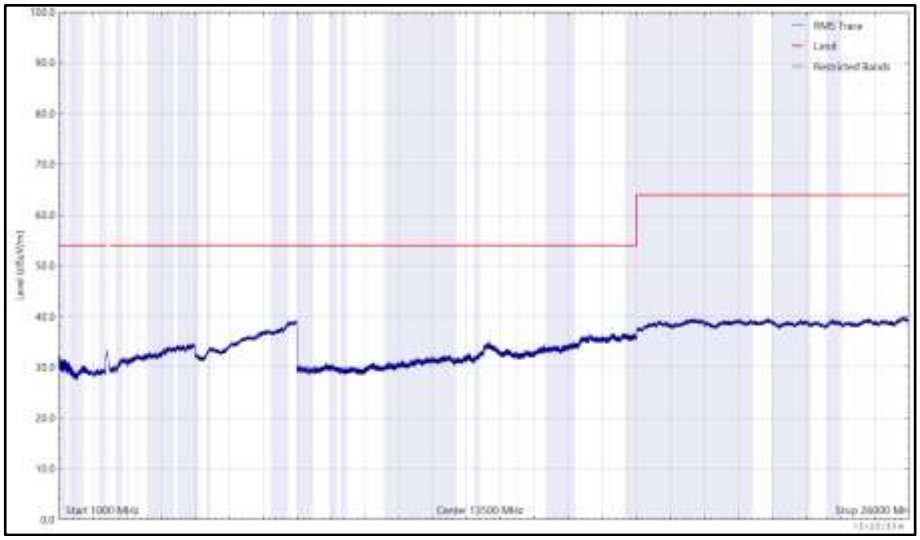

Figure 157 - 2402 MHz (CH0), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

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

Table 89 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

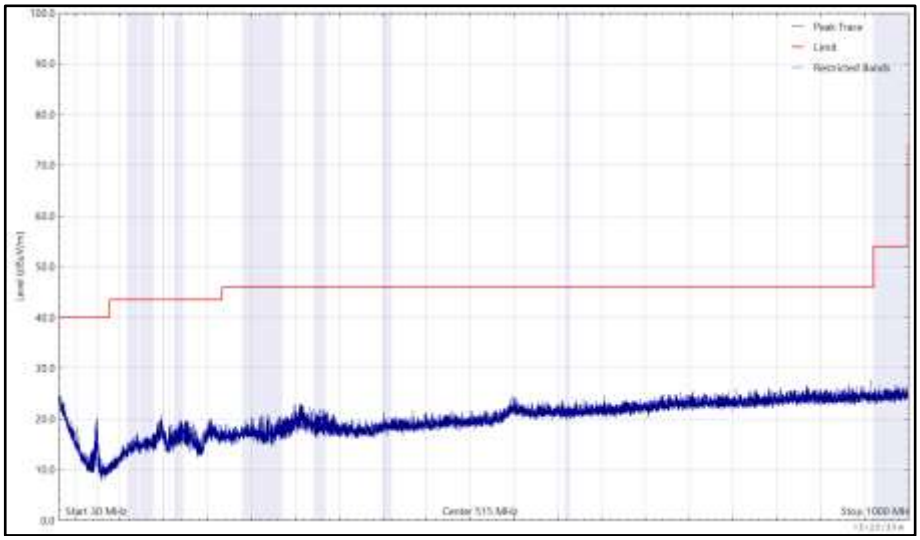

Figure 158 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

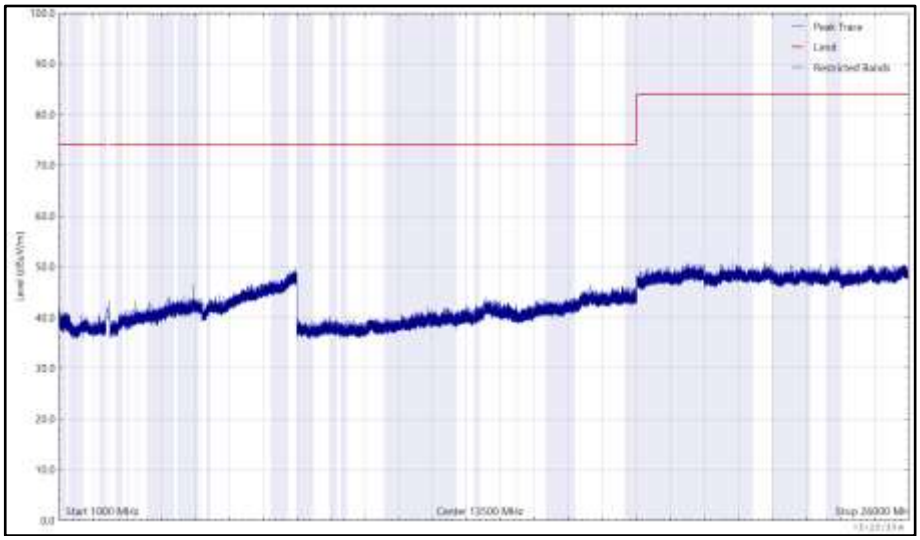

Figure 159 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

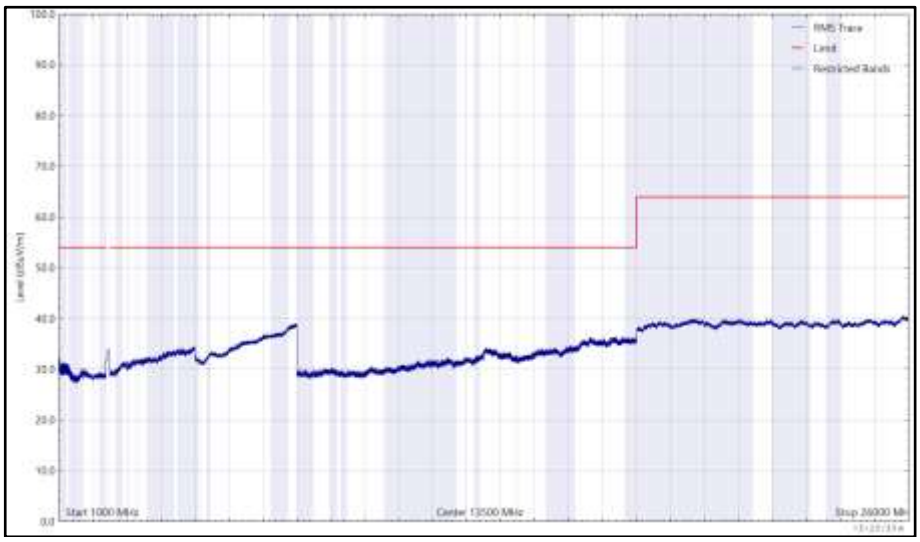

Figure 160 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

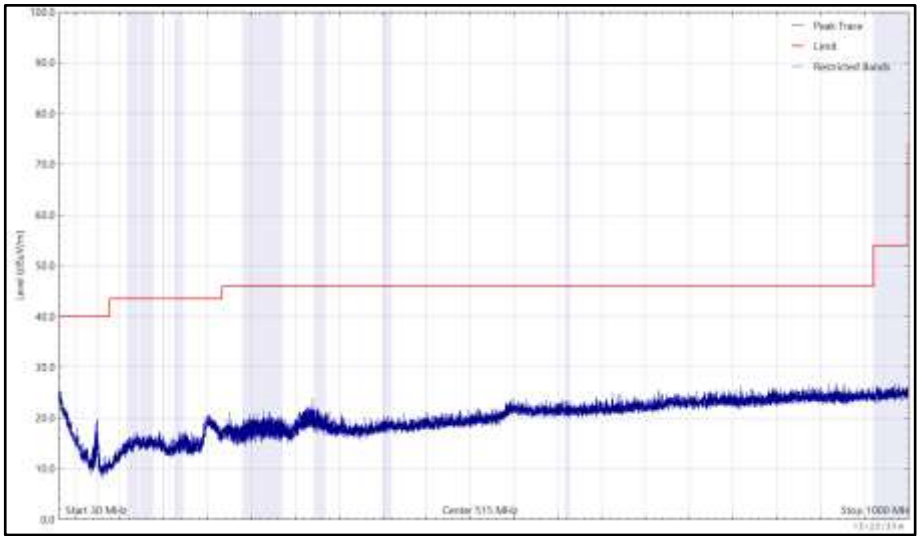

Figure 161 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

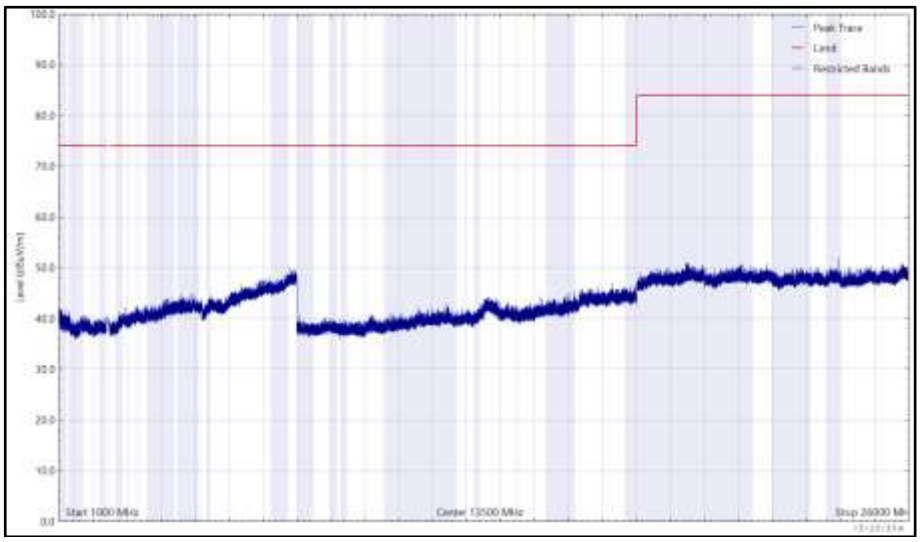

Figure 162 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

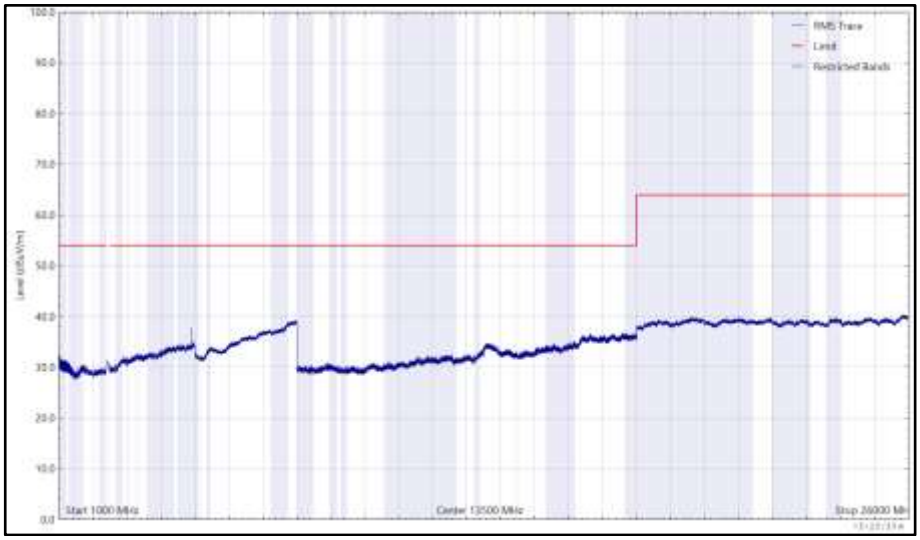

Figure 163 - 2441 MHz (CH39), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

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

Table 90 - 2480 MHz (CH78), 2DH5, ePA, Core 1, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

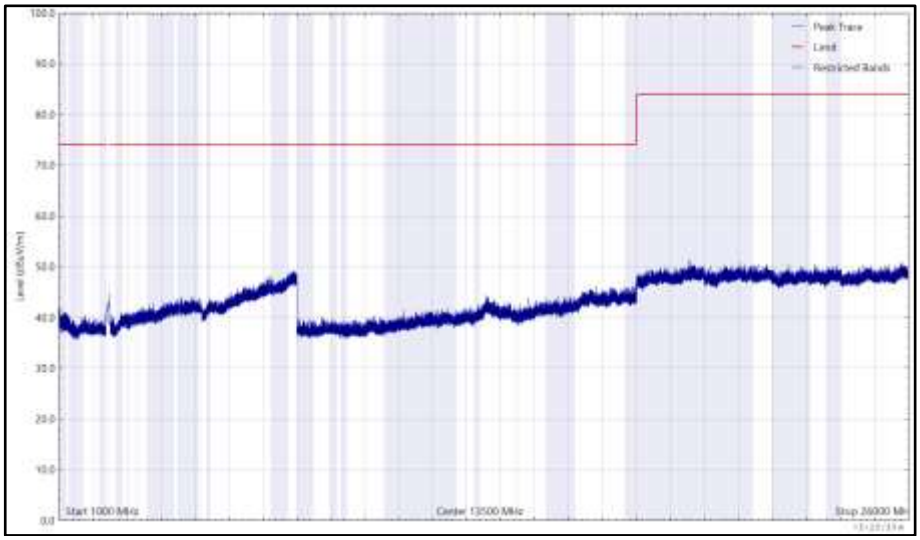

Figure 164 - 2480 MHz (CH78), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

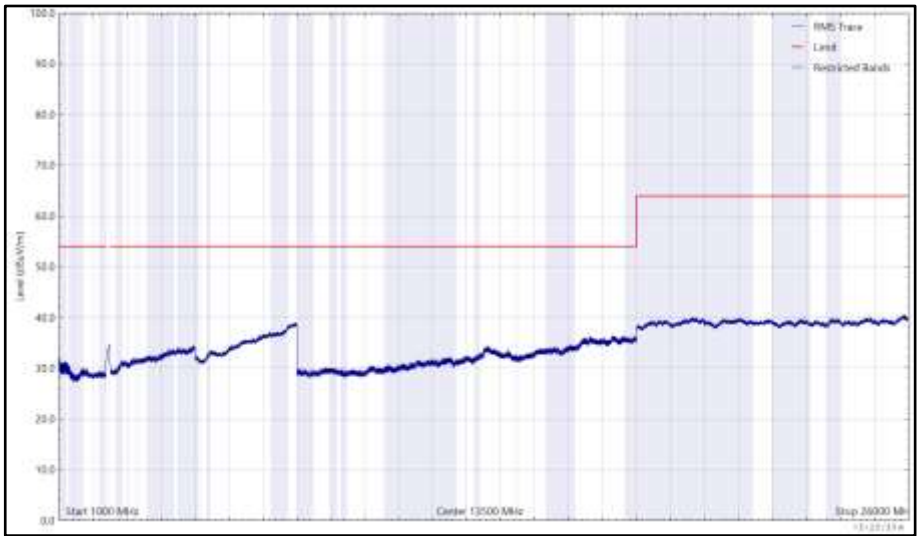

Figure 165 - 2480 MHz (CH78), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

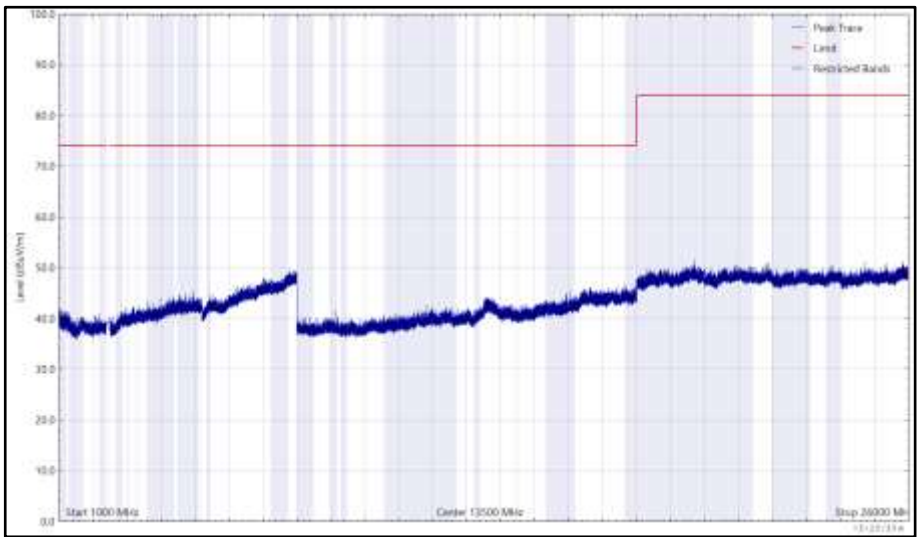

Figure 166 - 2480 MHz (CH78), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

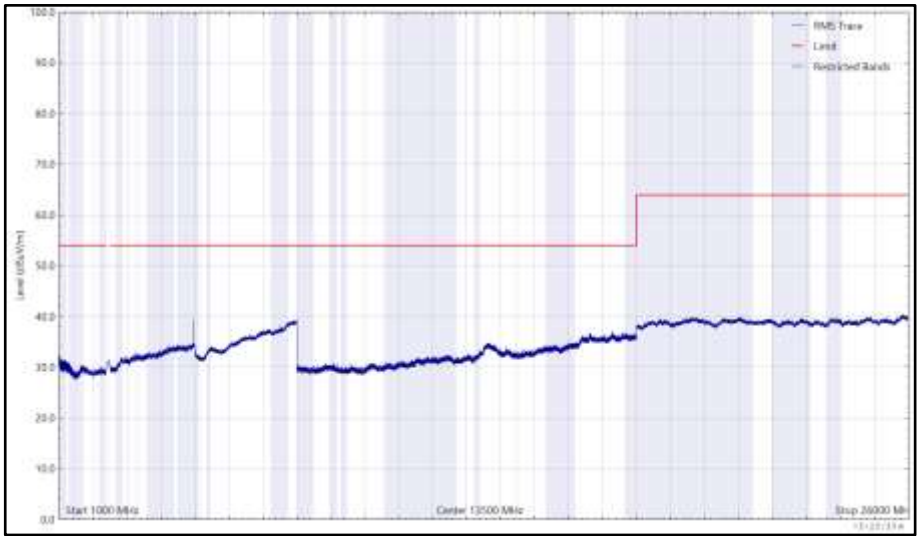

Figure 167 - 2480 MHz (CH78), 2DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

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

Table 91 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

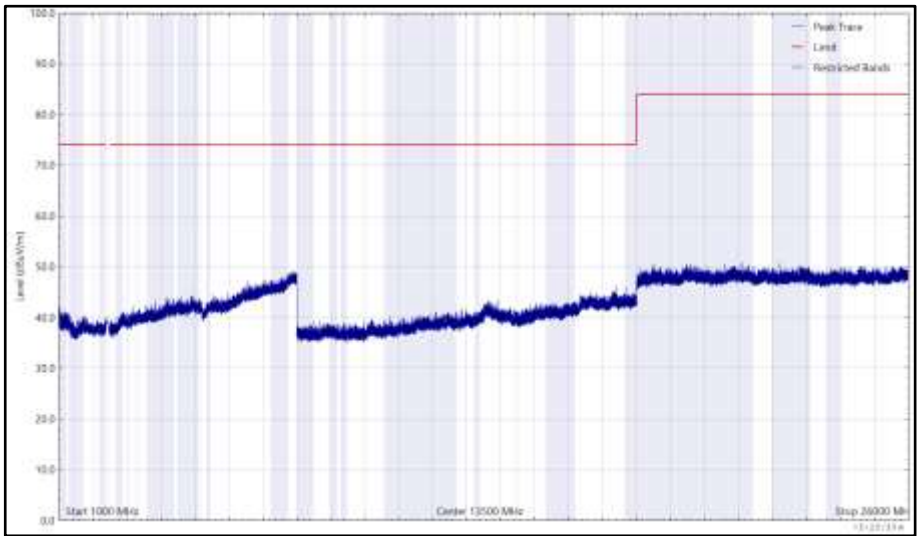

Figure 168 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

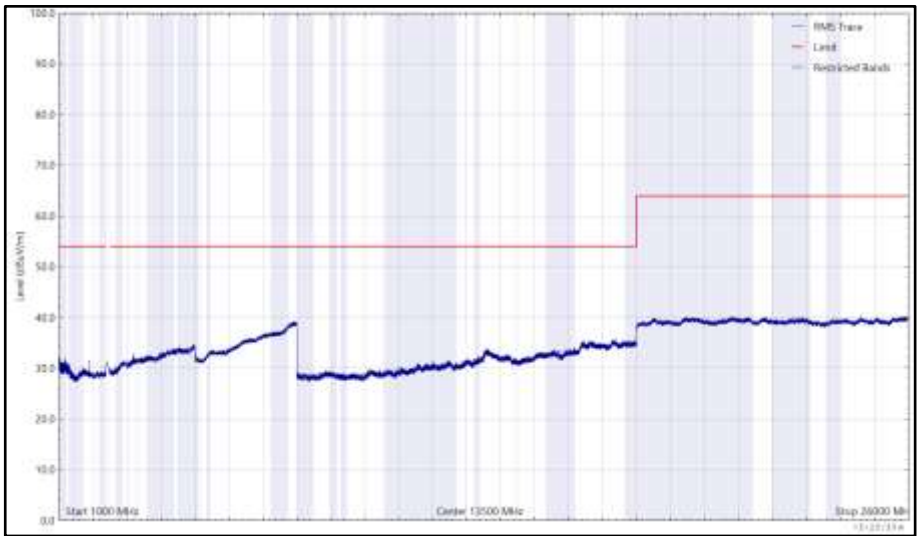

Figure 169 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

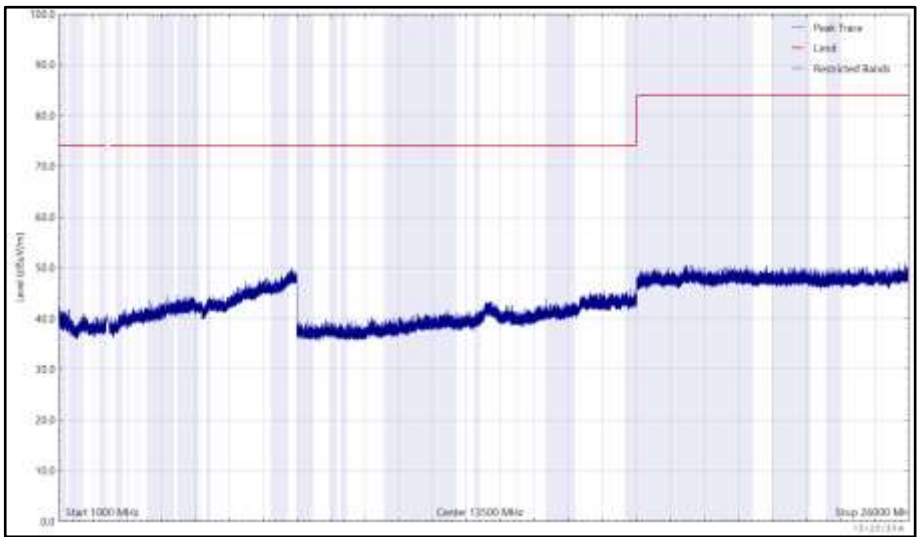

Figure 170 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

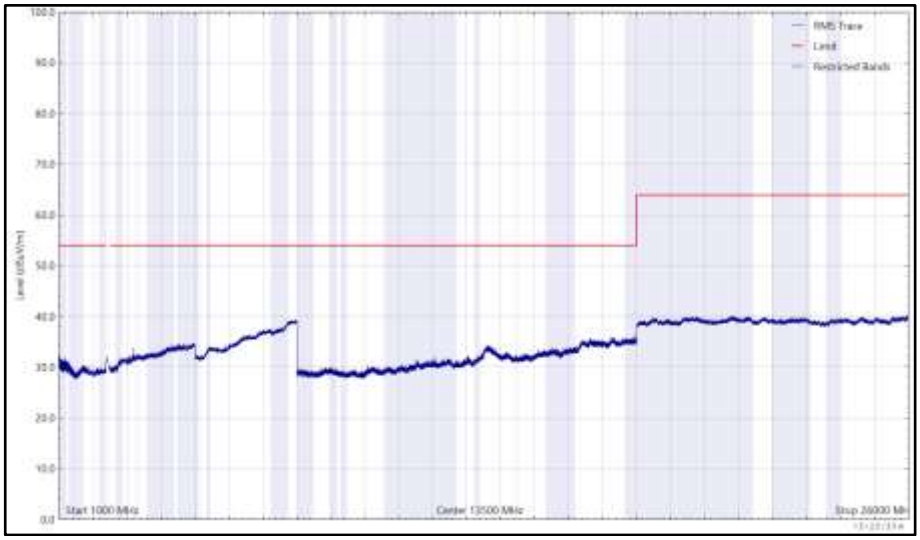

Figure 171 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

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

Table 92 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

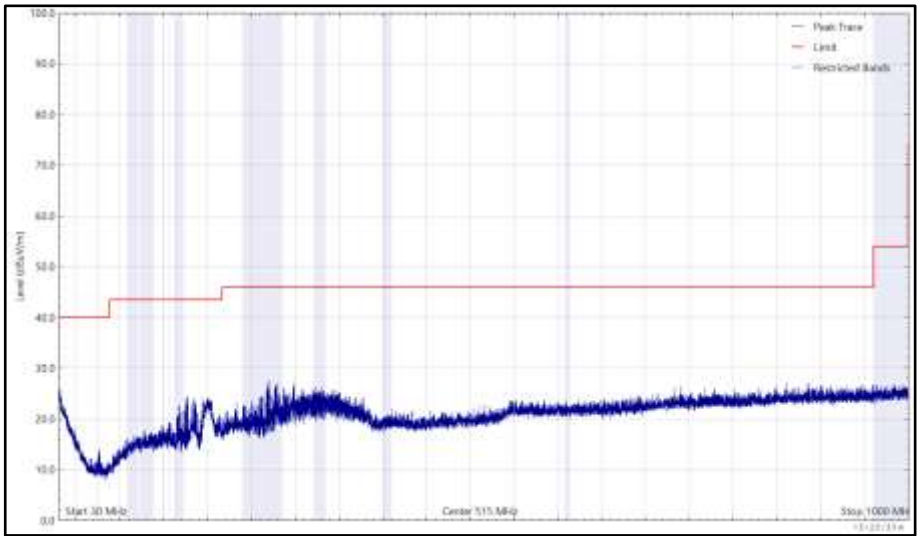

Figure 172 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

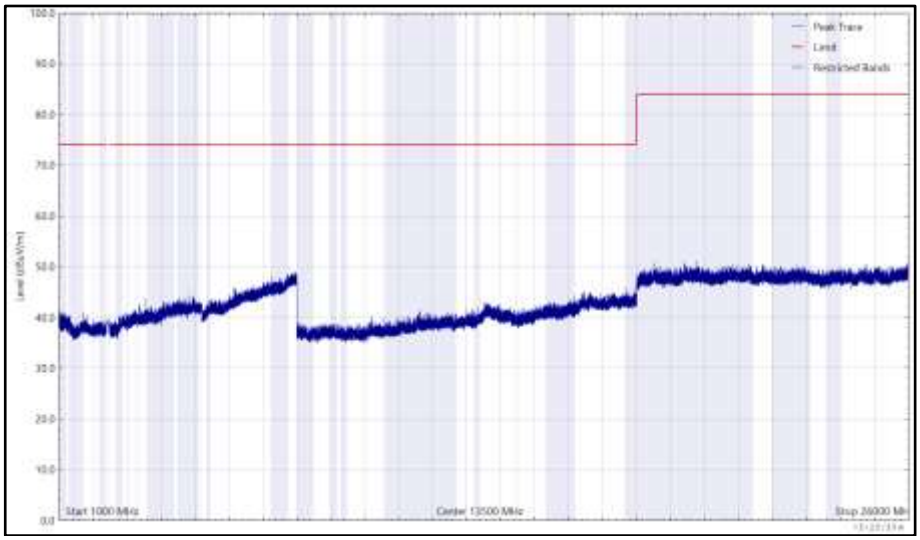

Figure 173 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

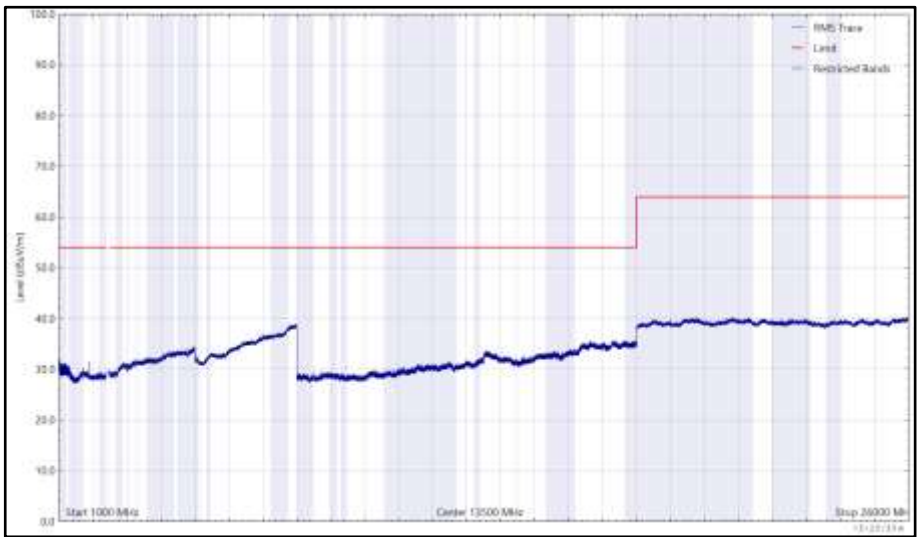

Figure 174 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

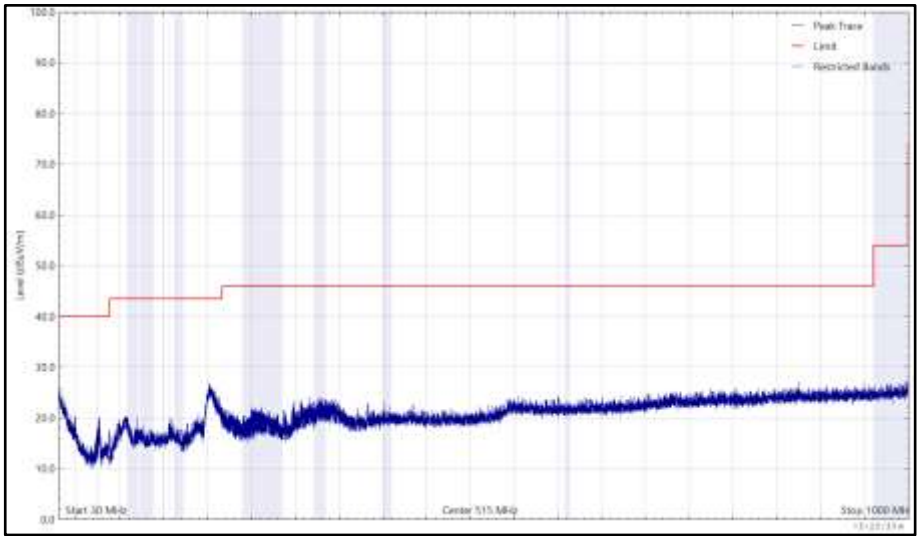

Figure 175 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

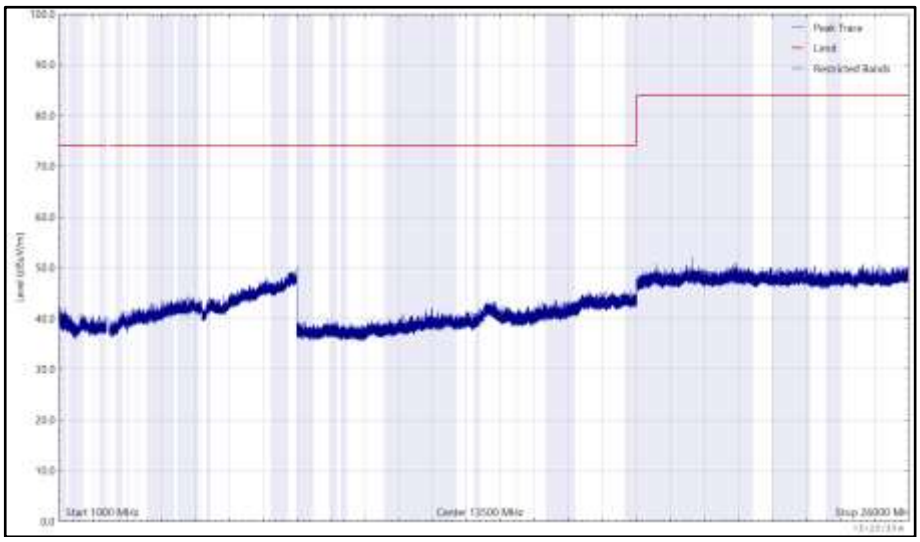

Figure 176 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

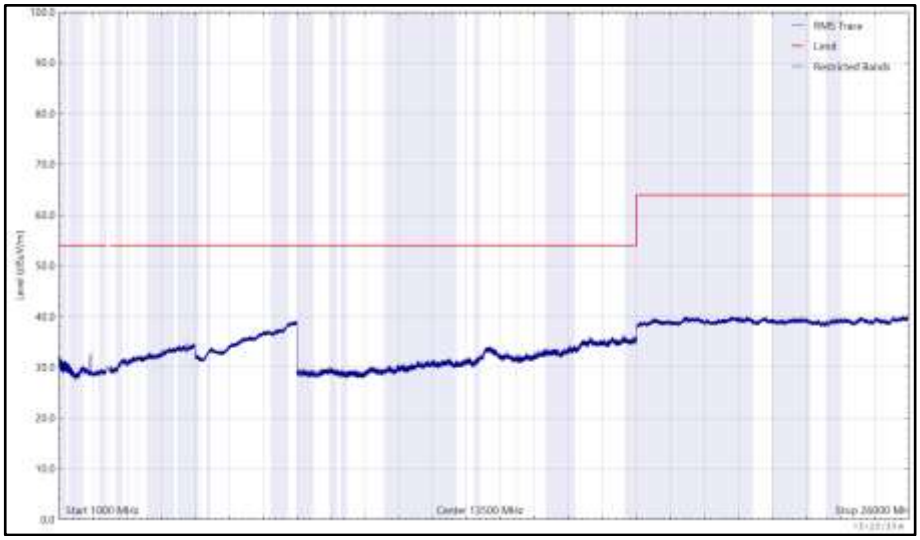

Figure 177 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

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

Table 93 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

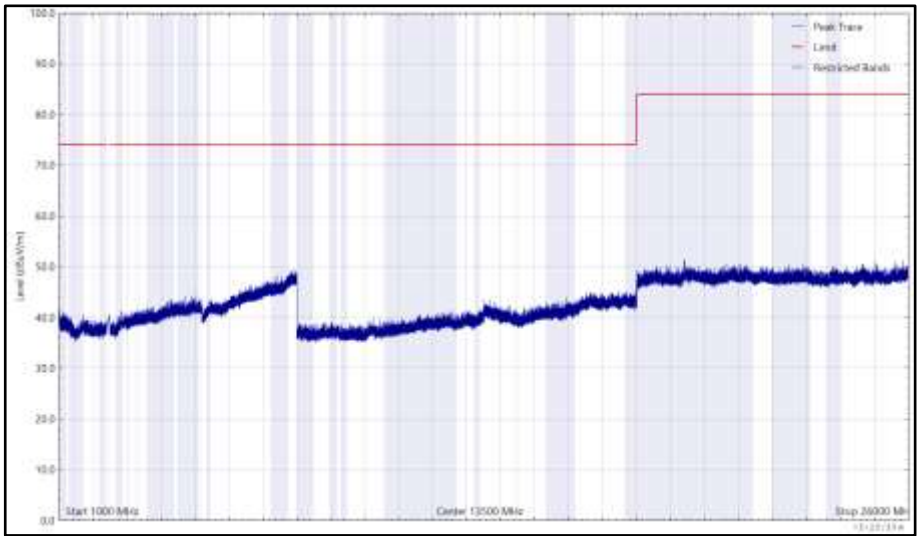

Figure 178 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

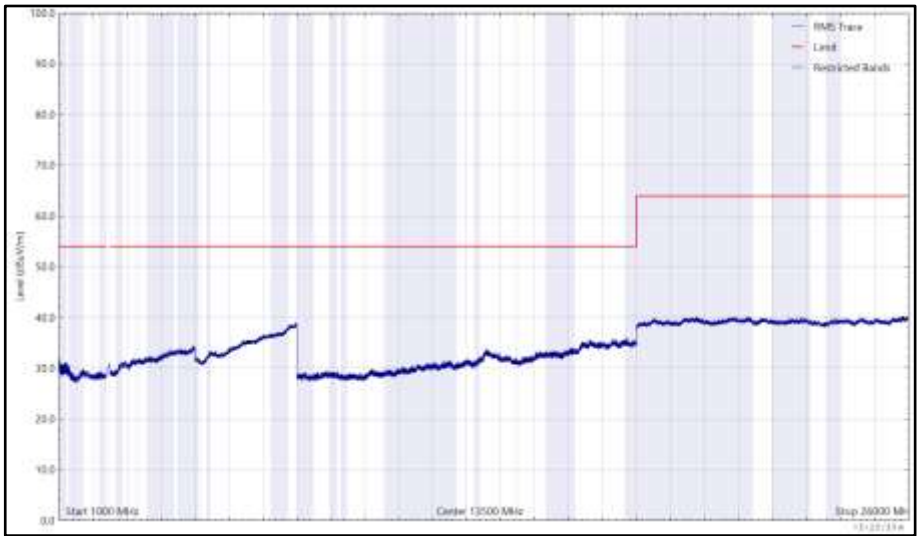

Figure 179 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (rms)

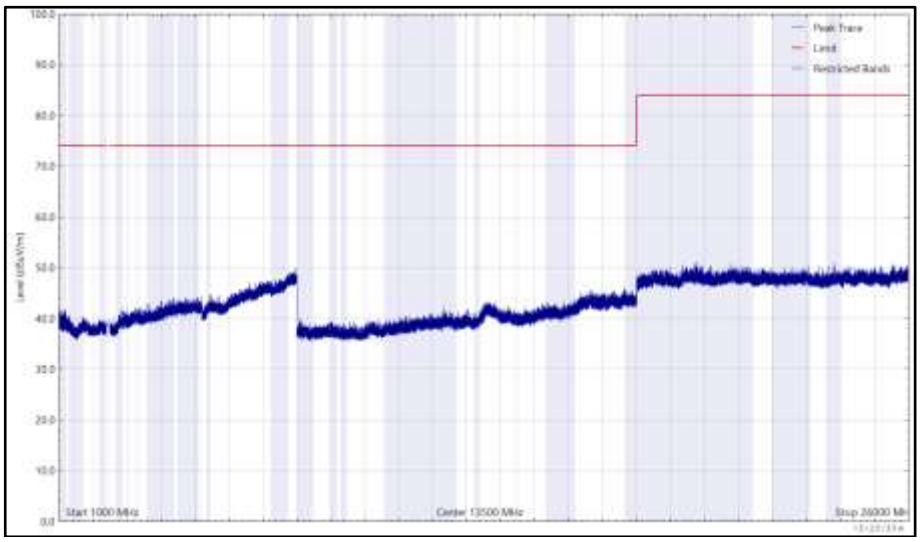

Figure 180 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

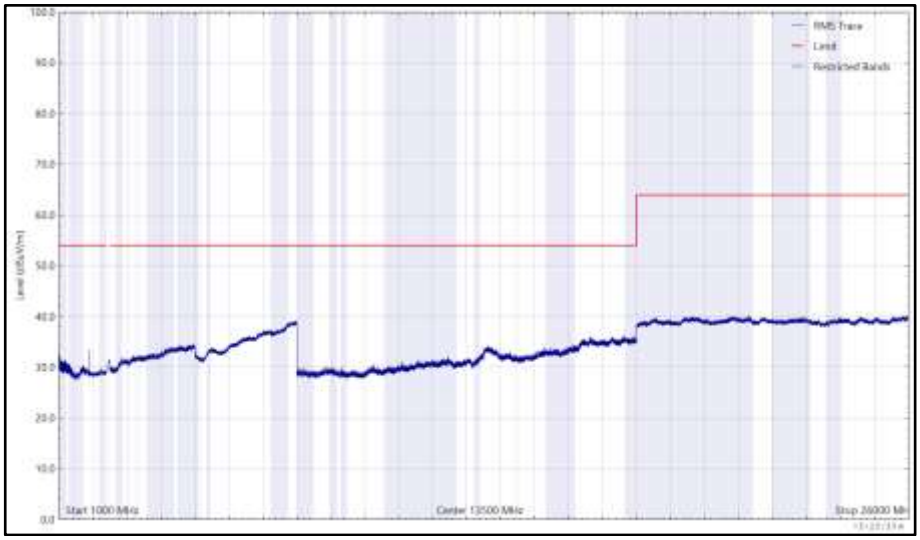

Figure 181 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2802.353	37.0	54.0	-17.0	RMS	346	192	Horizontal

Table 94 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

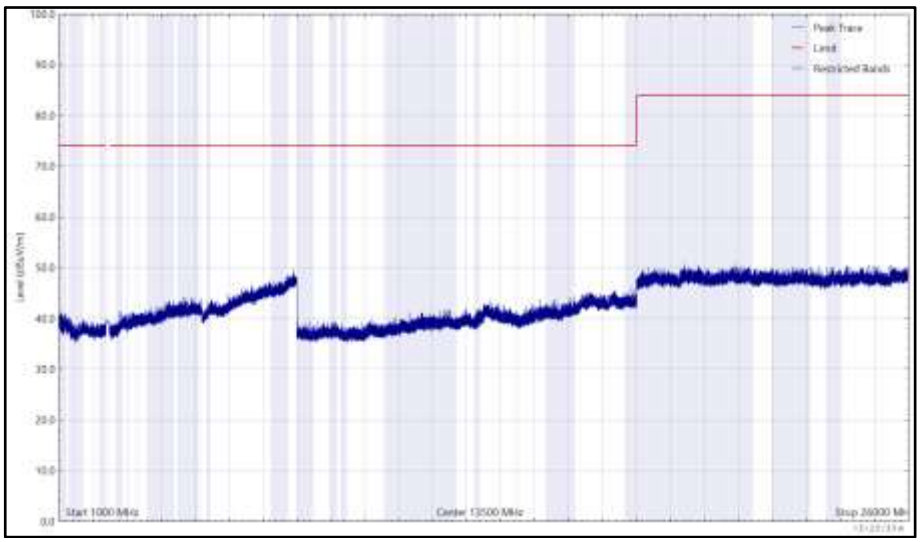

Figure 182 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

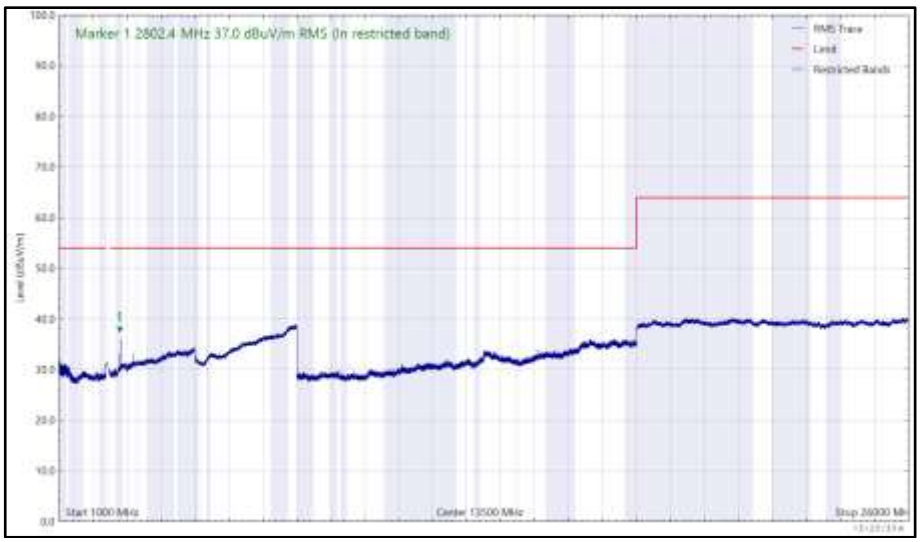

Figure 183 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

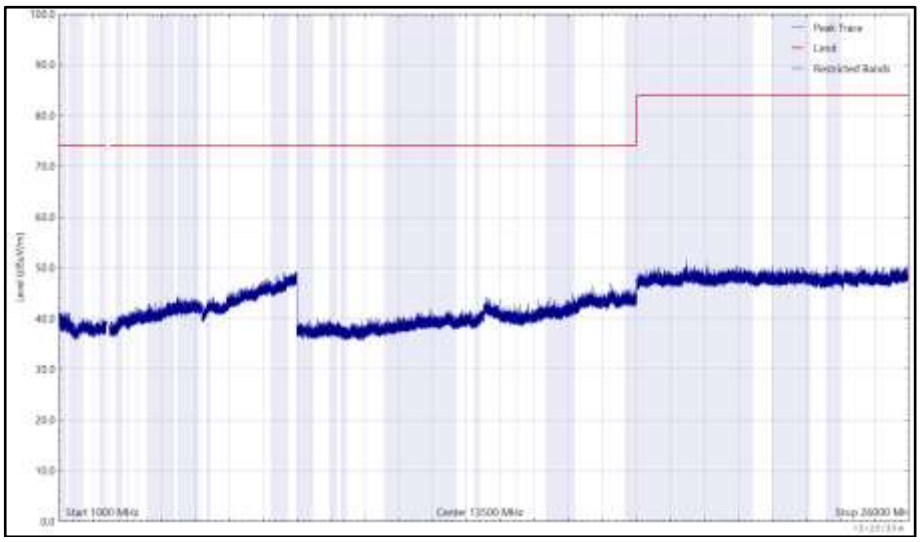

Figure 184 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

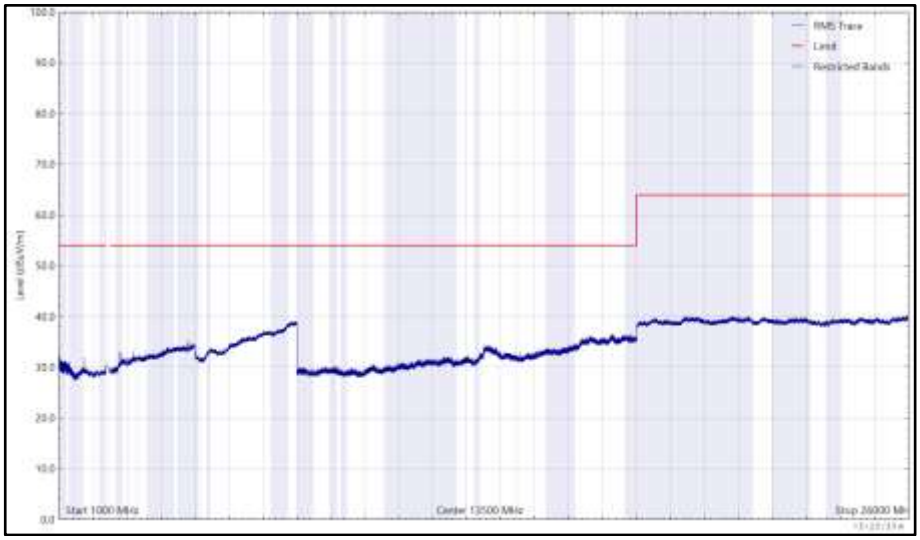

Figure 185 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

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

Table 95 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 26 GHz

*No emissions found within 10 dB of the limit.

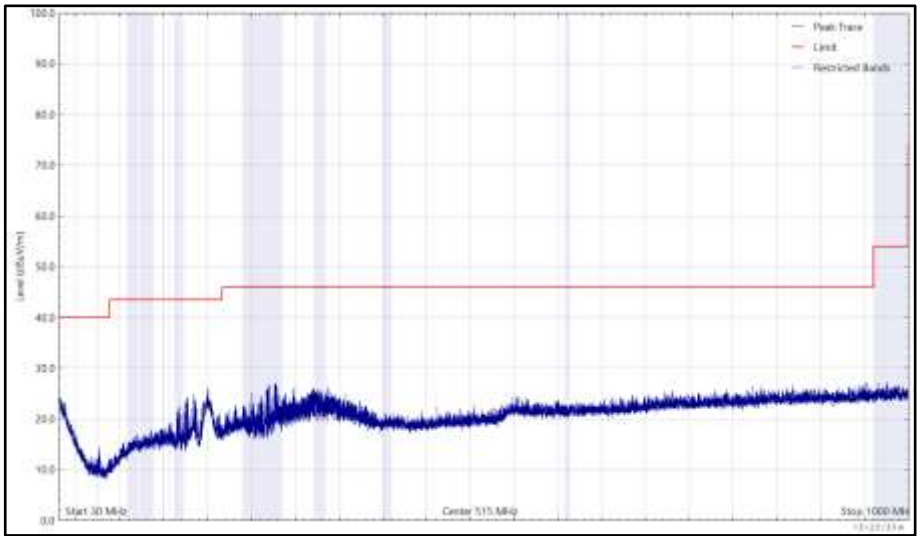

Figure 186 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

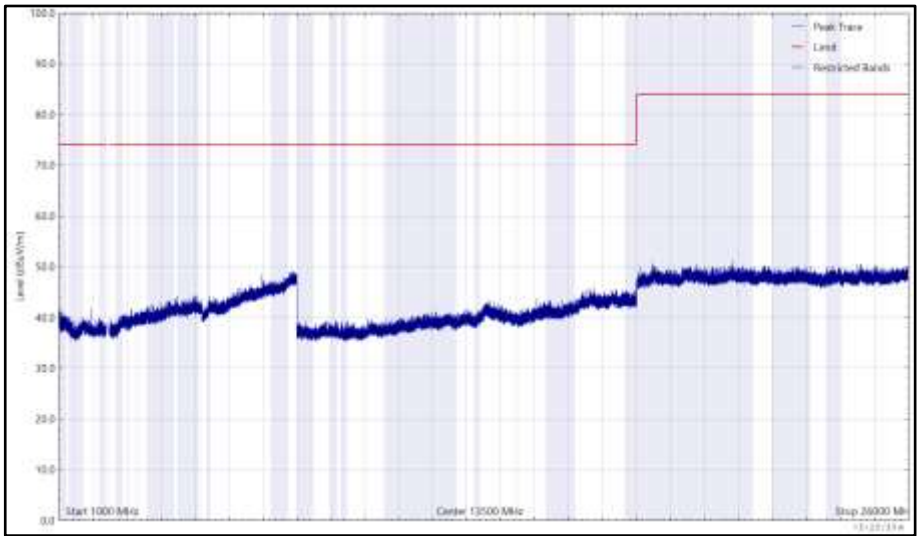

Figure 187 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

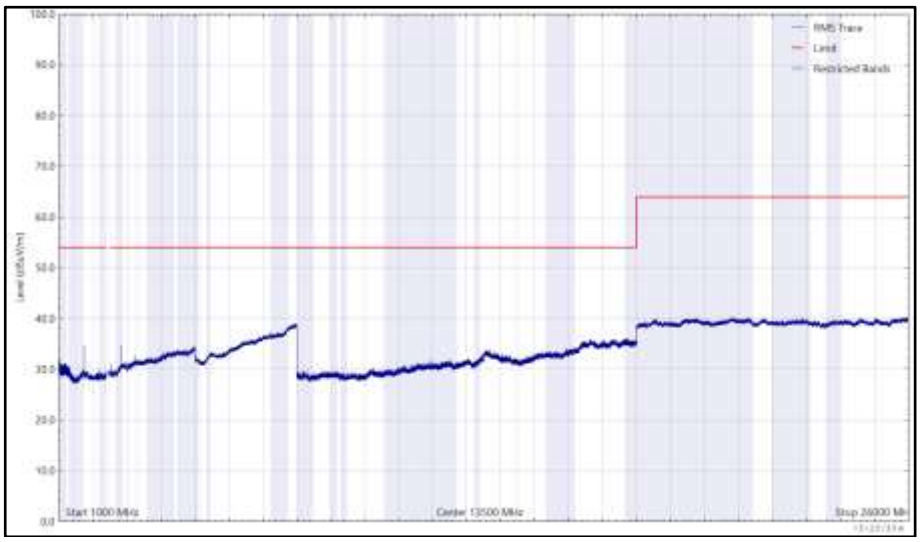

Figure 188 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

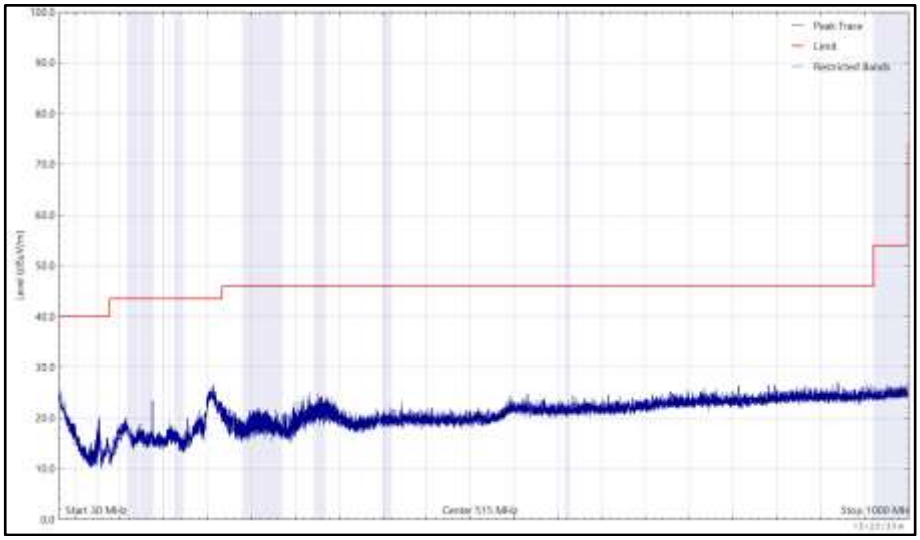

Figure 189 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

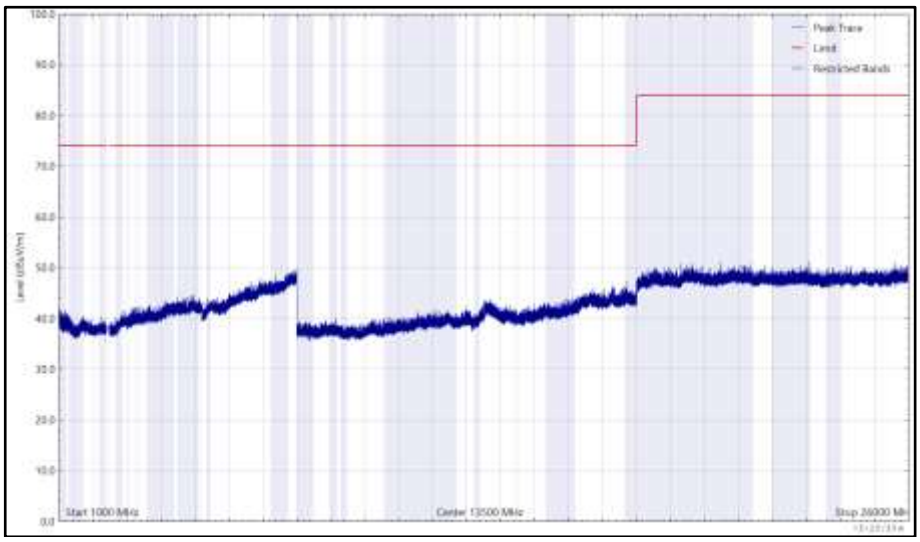

Figure 190 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

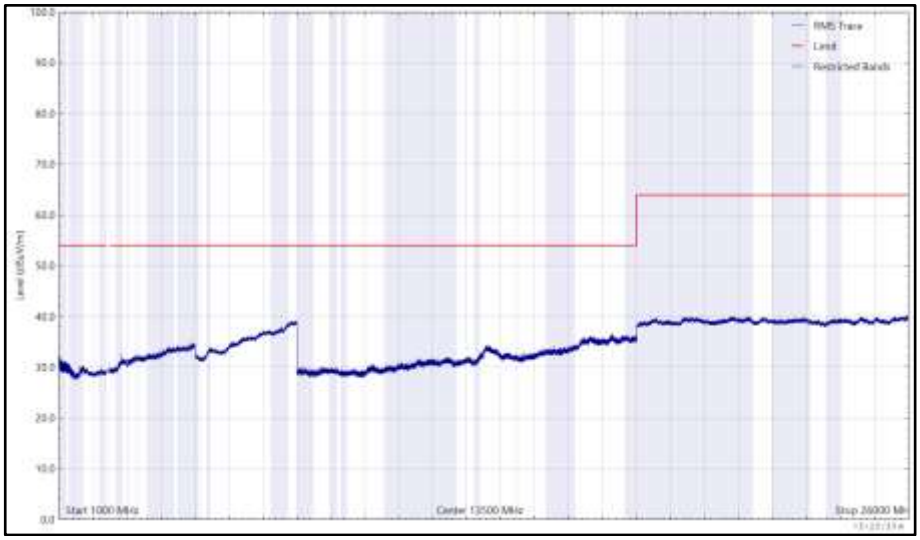

Figure 191 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2893.382	35.8	54.0	-18.2	RMS	355	260	Horizontal

Table 96 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

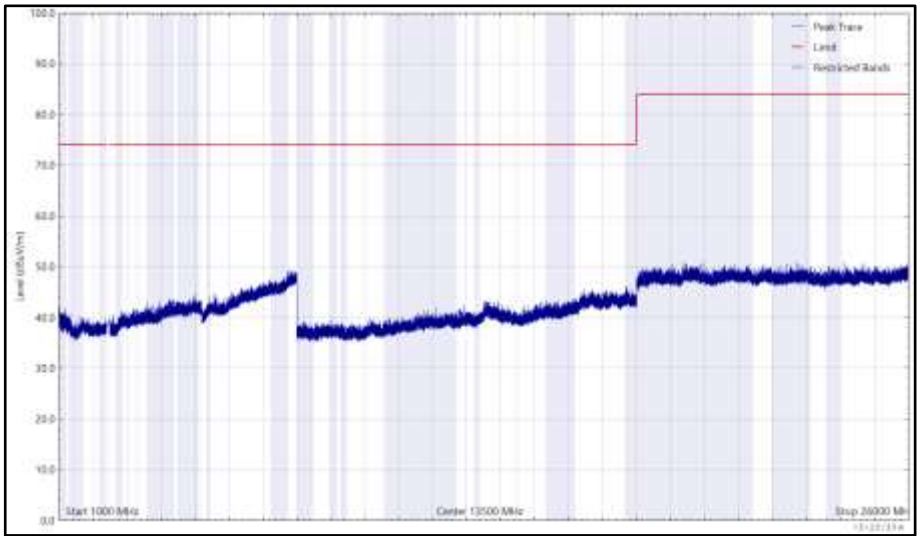

Figure 192 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

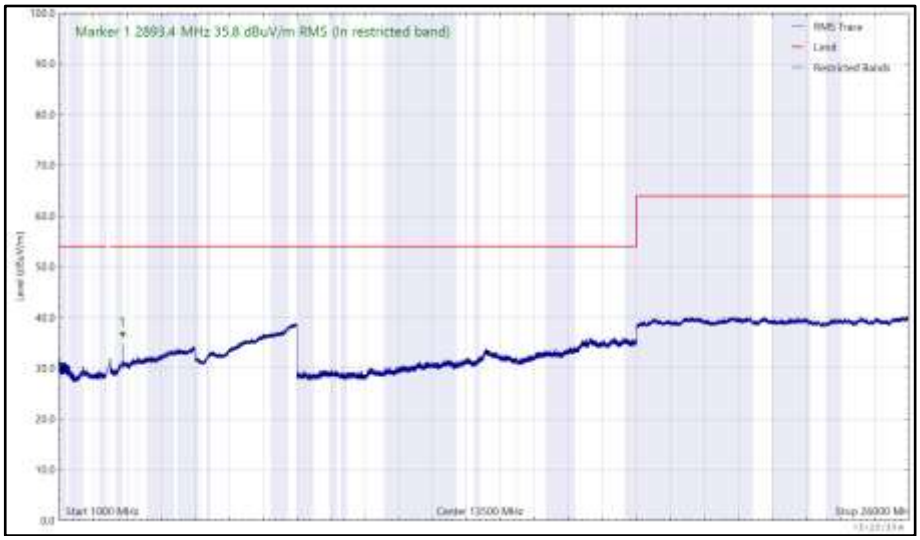

Figure 193 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (rms)

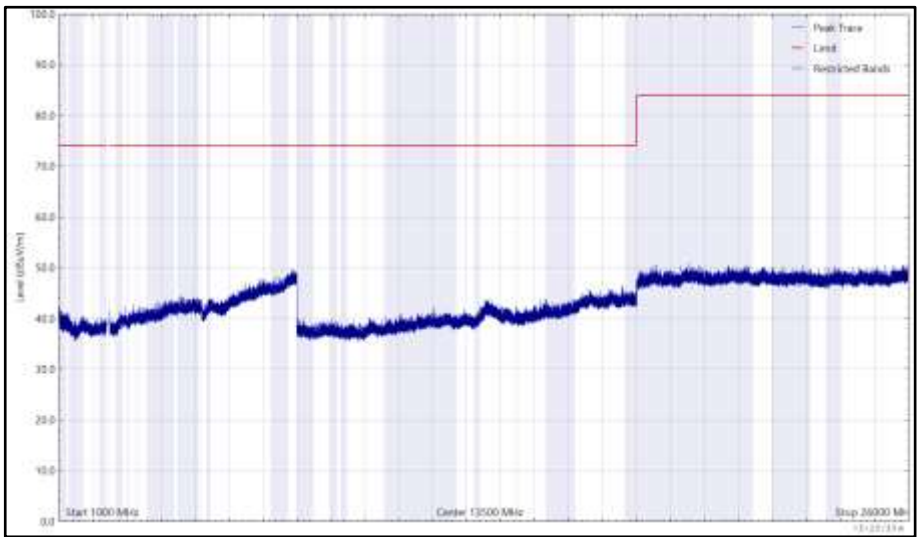

Figure 194 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

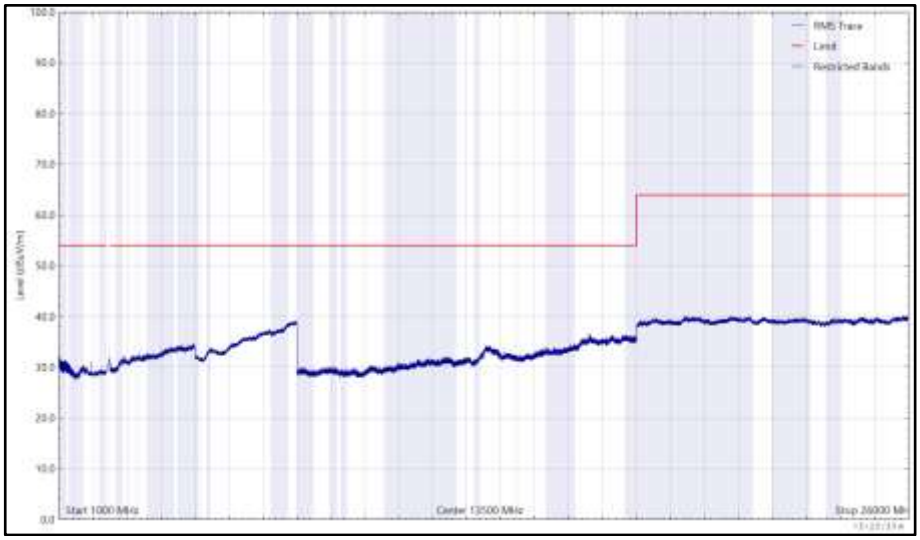

Figure 195 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2802.393	37.9	54.0	-16.1	RMS	282	219	Horizontal

Table 97 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz

No other emissions found within 10 dB of the limit.

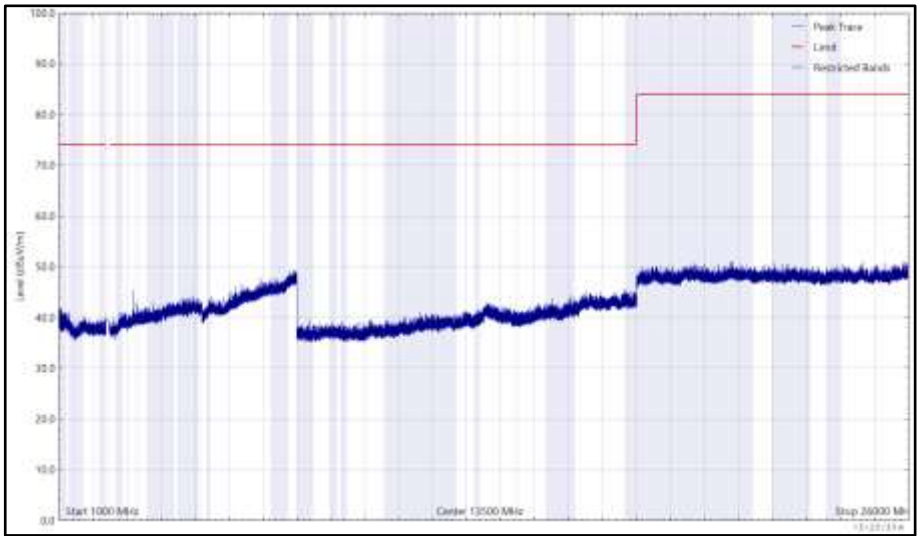

Figure 196 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

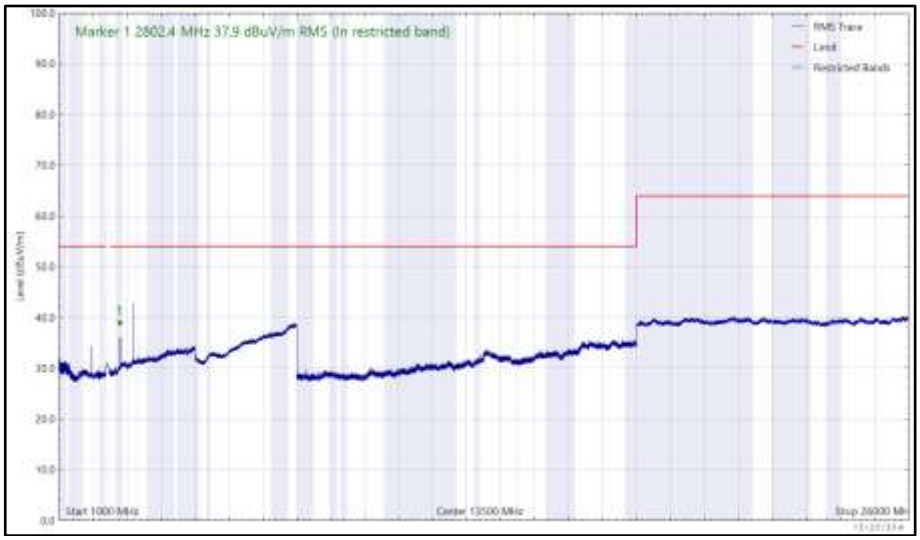

Figure 197 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (rms)

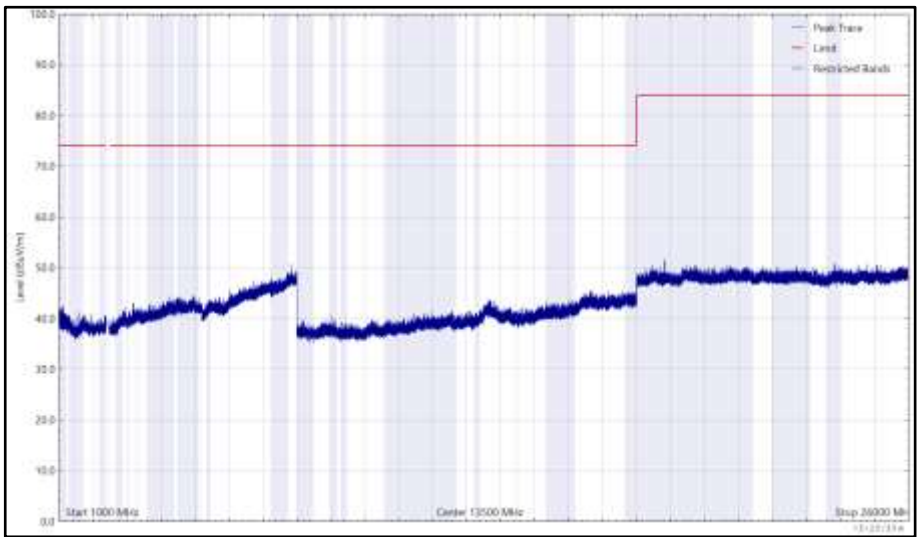

Figure 198 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

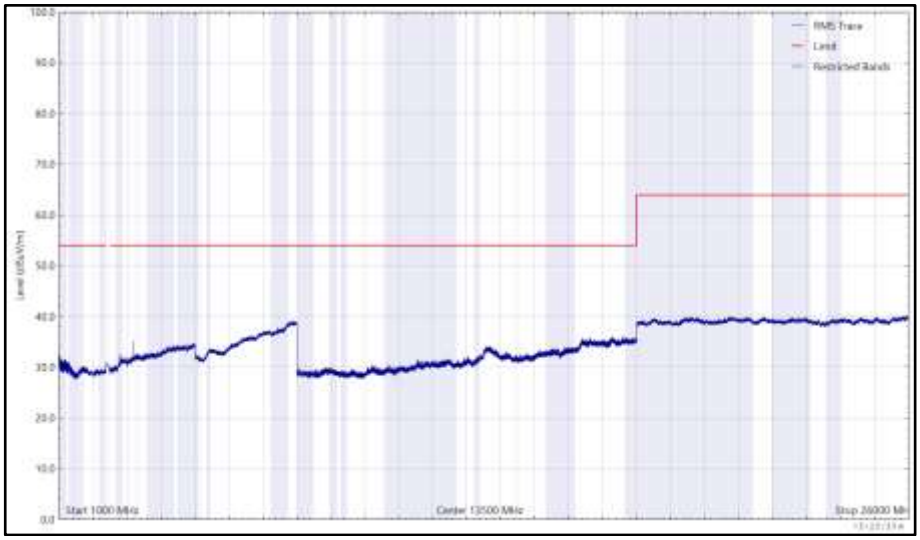

Figure 199 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (rms)

Frequency (MHz)	Level (dBuv/m)	Limit (dBuv/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
2847.952	35.8	54.0	-18.2	RMS	326	246	Horizontal

Table 98 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 26 GHz

No other emissions found within 10 dB of the limit.

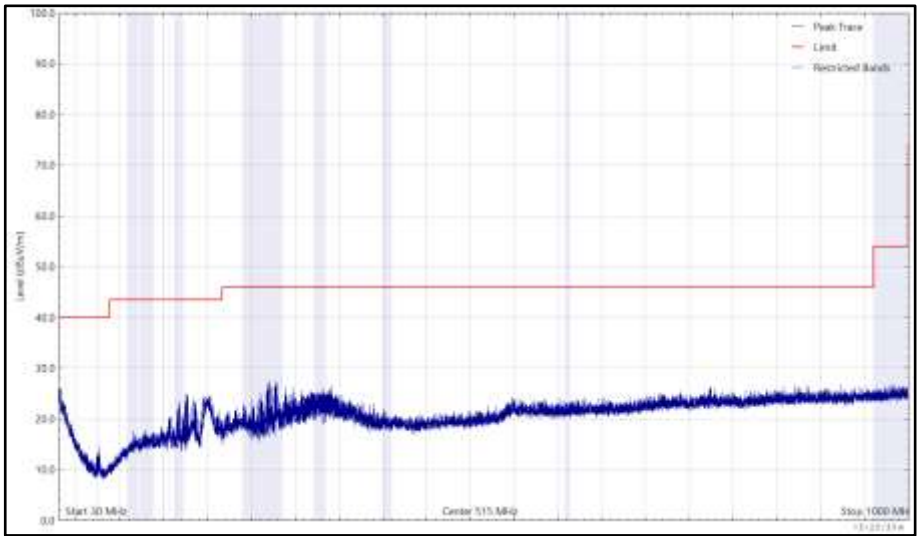

Figure 200 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)

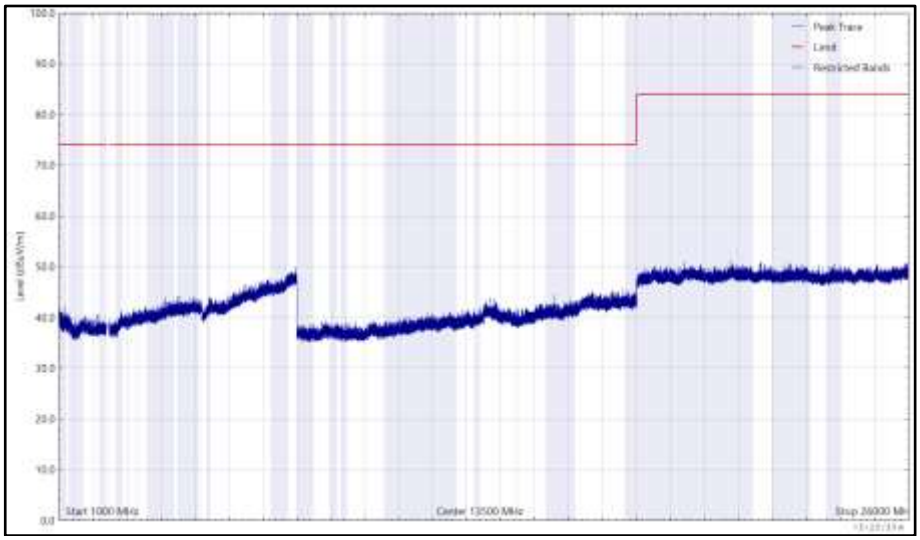

Figure 201 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

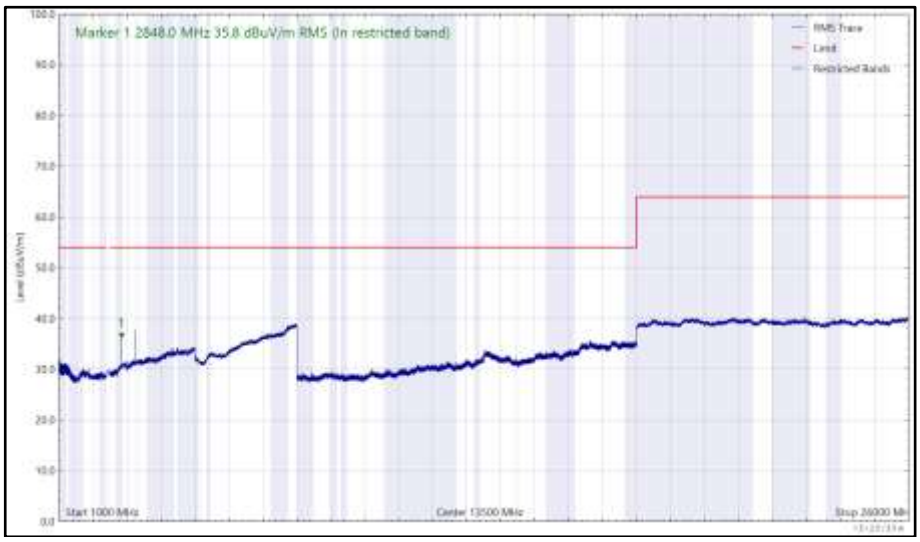

Figure 202 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (rms)

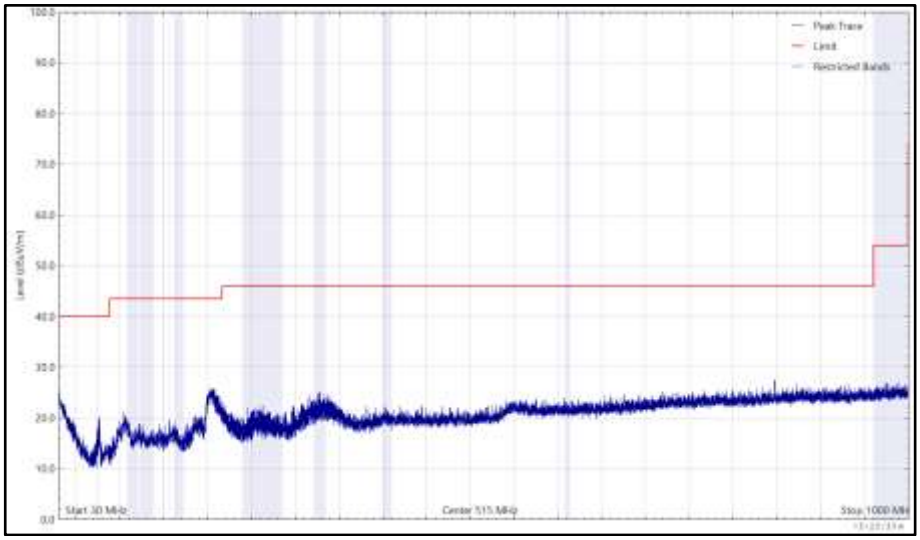

Figure 203 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

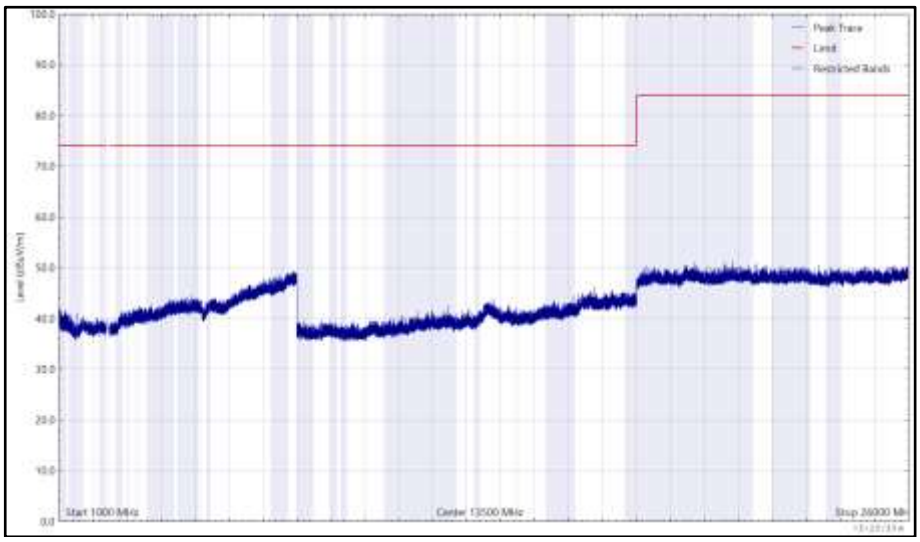

Figure 204 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

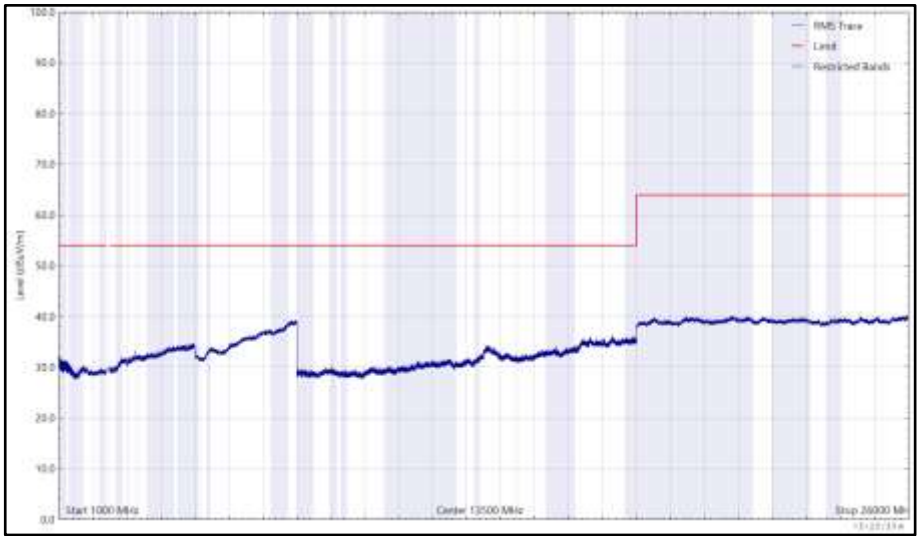

Figure 205 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (rms)

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

Table 99 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz

*No emissions found within 10 dB of the limit.

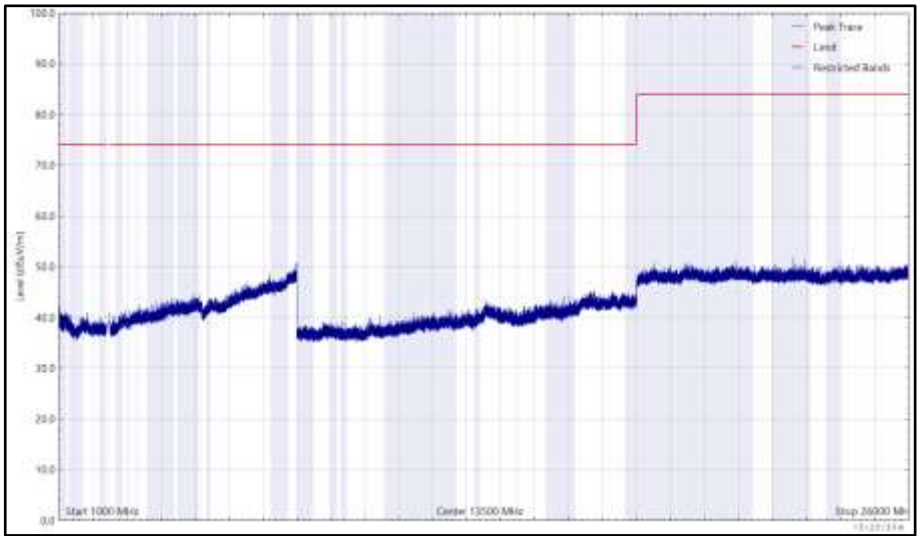

Figure 206 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

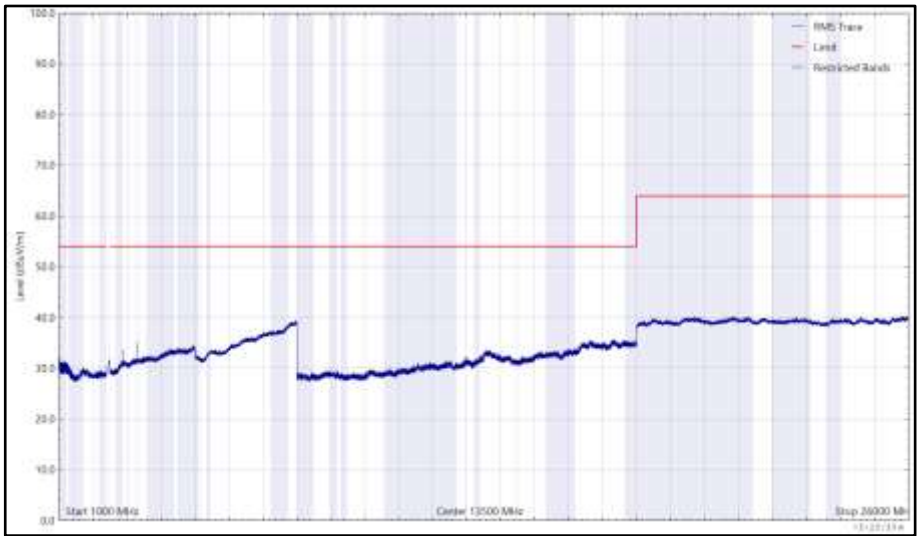

Figure 207 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (rms)

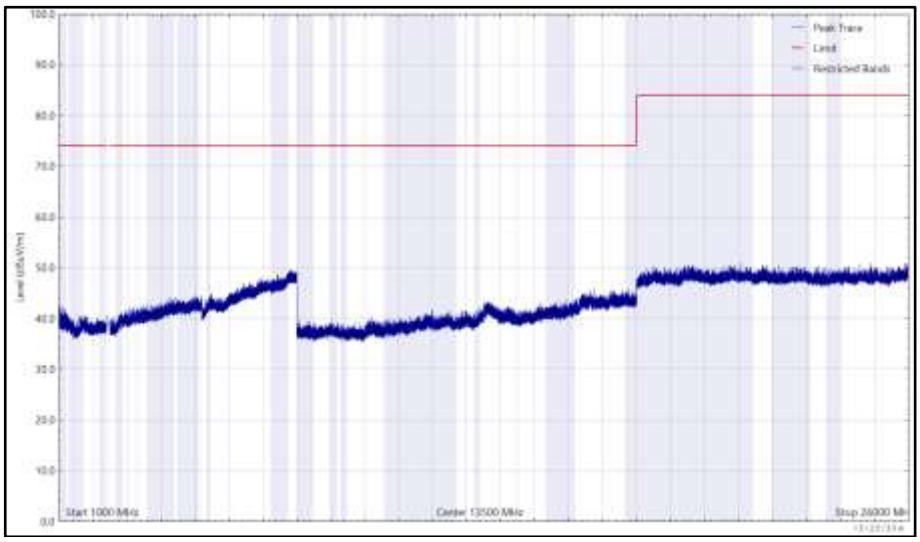

Figure 208 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

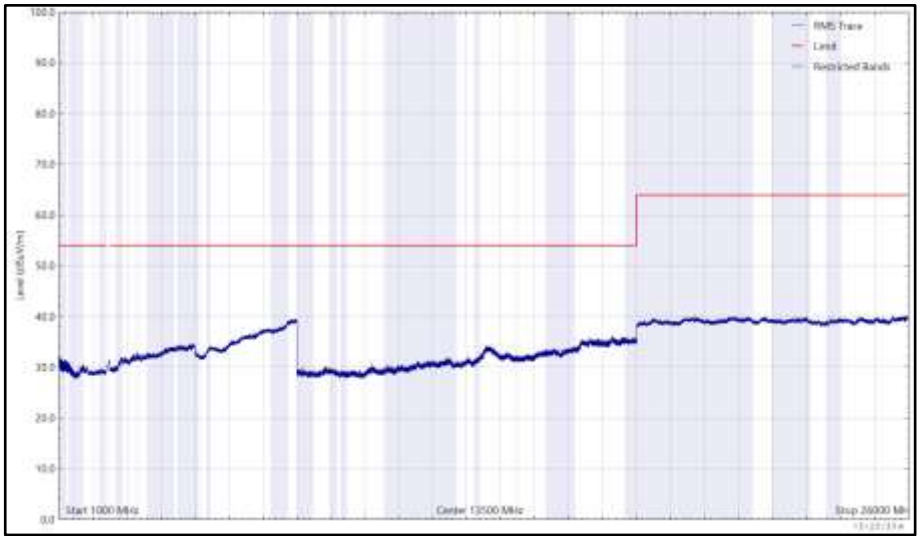

Figure 209 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (rms)

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.

2.8.8 Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Antenna 18-40GHz (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	27-Jul-2022
18GHz - 40GHz Pre-Amplifier	Phase One	PSO4-0087	1534	12	18-Feb-2021
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
True RMS Multimeter	Fluke	179	4007	12	29-Oct-2021
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-2021
8 - 18 GHz pre amp	Wright Technologies	PS06-0061/PS06-0060	4971	6	04-May-2021
Band Reject Filter - 2.425 GHz	Wainwright	WRCGV14-2390-2400-2450-2460-50SS	5067	12	02-Oct-2021
Band Reject Filter - 2.4585 GHz	Wainwright	WRCGV14-2423.5-2433.5-2483.5-2493.5-50SS	5069	12	12-Oct-2021
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	07-Apr-2021
Antenna (DRG Horn 7.5-18GHz)	Schwarzbeck	HWRD750	5348	12	22-Sep-2021
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	16-Mar-2021
1m K-Type Cable	Junkosha	MWX241-01000KMSKMS/A	5511	12	03-Apr-2021
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5513	12	01-Apr-2021
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5514	12	01-Apr-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5517	12	01-Apr-2021
8m N-Type Cable	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-Mar-2021
2 m K Type Cable	Junkosha	MWX241-02000KMSKMS/A	5523	12	03-Apr-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5527	12	06-Feb-2021
3 GHz High pass Filter	Wainwright	WHKX12-2580-3000-18000-80SS	5548	12	05-May-2021
1200 MHz Low Pass Filter (01)	Mini-Circuits	VLF-1200+	5559	12	23-May-2021

Table 100

3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 42.31 kHz
Frequency Hopping Systems - Number of Hopping Channels	-
Frequency Hopping Systems - 20 dB Bandwidth	± 45.99 kHz
Maximum Conducted Output Power	± 3.2 dB
Authorised Band Edges	30 MHz to 1 GHz: ± 5.2 dB 1 GHz to 40 GHz: ± 6.3 dB
Restricted 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

Table 101

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.