FCC and ISED Test Report

Apple Inc
Model: A2169

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

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

FCC ID: BCGA2169 IC: 579C-A2169

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Document 75946858-09 Issue 01

SIGNATURE			
P Harrison			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Phil Harrison	Senior Engineer	Authorised Signatory	21 January 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	Mohammad Malik	21 January 2021	
Testing	Faisal Malyar	21 January 2021	
Testing	Ahmad Javid	21 January 2021	
Testing	Jaiyanth Balendrarajah	21 January 2021	
Testing	Ainsley Jenkins	21 January 2021	
Testing	Liang Tian	21 January 2021	
Testing	George Porter	21 January 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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Contents

1 Report Summary

1.1 Report Modification Record

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

Issue	Description of Change	Date of Issue
1	First Issue	21 January 2021

Table 1

1.2 Introduction

Applicant	Apple Inc
Manufacturer	Apple Inc
Model Number(s)	A2169
Serial Number(s)	C07CL0AMQ4TG and C07CM0EKQ4TG
Hardware Version(s)	REV1.0
Software Version(s)	18J42710o
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	0540188556 07-April-2020
Date of Receipt of EUT	01-June-2020 and 08-July-2020
Start of Test	24-June-2020
Finish of Test	30-October-2020
Name of Engineer(s)	Mohammad Malik, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins, Liang Tian and George Porter
Related Document(s)	ANSI C63.10 (2013) KDB 662911 D01 v02r01

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C, 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 comply with the provisions of this section, as it uses a permanently attached antenna.
2.1	15.205	-	8.10	Restricted Band Edges	Pass	
2.2	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Average Time of Occupancy	Pass	
2.3	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Channel Separation	Pass	
2.4	15.247 (a)(1)	5.1	6.7	Frequency Hopping Systems - 20 dB Bandwidth	Pass	
2.5	15.247 (a)(1)	5.1	-	Frequency Hopping Systems - Number of Hopping Channels	Pass	
2.6	15.247 (b)	5.4	6.12	Maximum Conducted Output Power	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 an Apple TV Set Top Box with Bluetooth, Bluetooth Low Energy, Thread 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 from Core 0 and Core 1 as these are understood to be identical but with unequal antenna gains.

SISO test were additionally performed on BT Core 2

The EUT also supports TxBF on Core 0 + Core 1.

In addition to the standard output level (iPA), cores 0 & 1 also supported an additional higher output power mode utilizing a different power amplifier (ePA). Therefore both modes are reported due to internal differences in the RF path.

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

- BT Core 0 – SISO (iPA and ePA)
- BT Core 1 – SISO (iPA and ePA)
- BT Core 0 + BT Core 1 - TxBF (iPA and ePA)
- BT Core 2 (iPA)

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)
BT Core 0	2400 to 2480	2.60	0.50
BT Core 1	2400 to 2480	2.63	0.50
BT Core 2	2400 to 2480	2.80	0.50

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: A2169, Serial Number: C07CL0AMQ4TG			
0	As supplied by the customer	Not Applicable	Not Applicable
Model: A2169, Serial Number: C07CM0EKQ4TG			
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	George Porter	UKAS
Frequency Hopping Systems - Channel Separation	George Porter	UKAS
Frequency Hopping Systems - 20 dB Bandwidth	George Porter	UKAS
Frequency Hopping Systems - Number of Hopping Channels	George Porter	UKAS
Maximum Conducted Output Power	George Porter	UKAS
Authorised Band Edges	Malik Mohammad, Faisal Malyar, Ahmad Javid, Jaiyanth Balendrarajah, Ainsley Jenkins and Liang Tian	UKAS
Restricted Band Edges		UKAS
Spurious Radiated Emissions		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

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.1.3 Date of Test

30-October-2020

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	22.4 °C
Relative Humidity	57.4 %

2.1.6 Test Results

2.4 GHz Bluetooth - FHSS

ePA

Antenna Port: Core 1

Modulation	2402 MHz		
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)
GFSK (DH5)	2.887	115	332.1

Table 6 - Time of Occupancy Results

Figure 1 - GFSK (DH5) 2402 MHz - Time of Occupancy Accumulated Transmit Time

iPA

Antenna Port: Core 2

Modulation	2402 MHz		
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)
GFSK (DH5)	2.887	111	320.4

Table 7 - Time of Occupancy Results

Figure 2 - GFSK (DH5) 2402 MHz - Time of Occupancy Accumulated Transmit Time

Antenna Port: Core 1

Modulation	2402 MHz		
	Dwell Time (ms)	Number of Transmissions	Time of Occupancy (ms)
GFSK (DH5)	2.887	101	291.6

Table 8 - Time of Occupancy Results

Figure 3 - GFSK (DH5) 2402 MHz - Time of Occupancy Accumulated Transmit Time

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

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.

ISED RSS-247, Limit Clause 5.1 (d)

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	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
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
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-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)
ISED RSS-247, Clause 5.1

2.2.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.2.3 Date of Test

30-October-2020

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	22.4 °C
Relative Humidity	57.4 %

2.2.6 Test Results

2.4 GHz Bluetooth - FHSS

ePA

Antenna Port: Core1

Modulation	F1C (MHz)	F2C (MHz)	FHS (MHz)
GFSK	2441.017	2442.016	0.999
π/4 DQPSK	2440.999	2441.999	1.000
8-DPSK	2441.007	2442.007	1.000

Table 10 - Hopping Frequency Separation Results

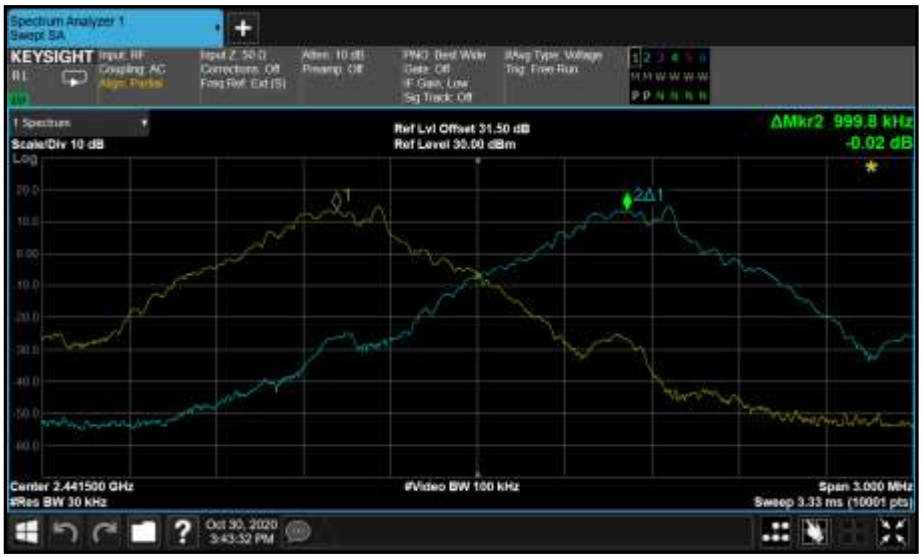

Figure 4 - GFSK - 2441 MHz (CH39)

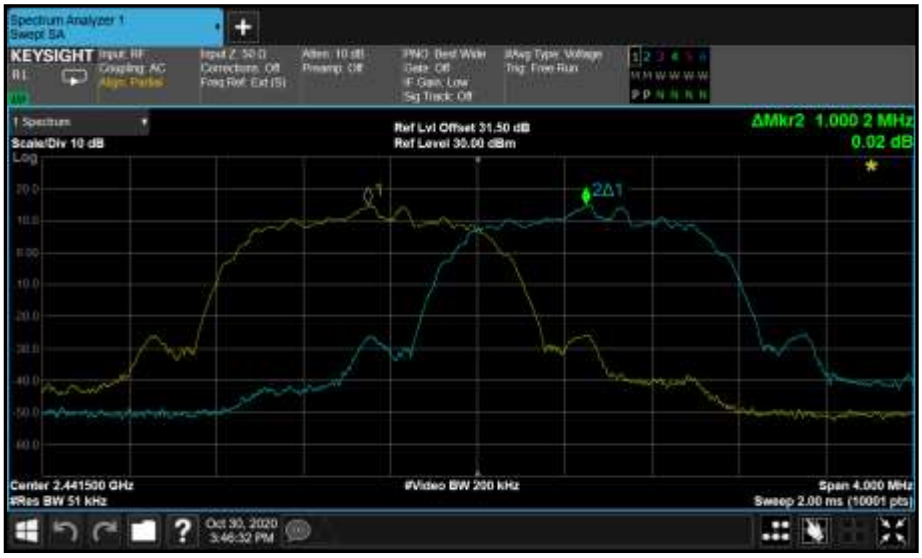

Figure 5 - π/4 DQPSK - 2441 MHz (CH39)

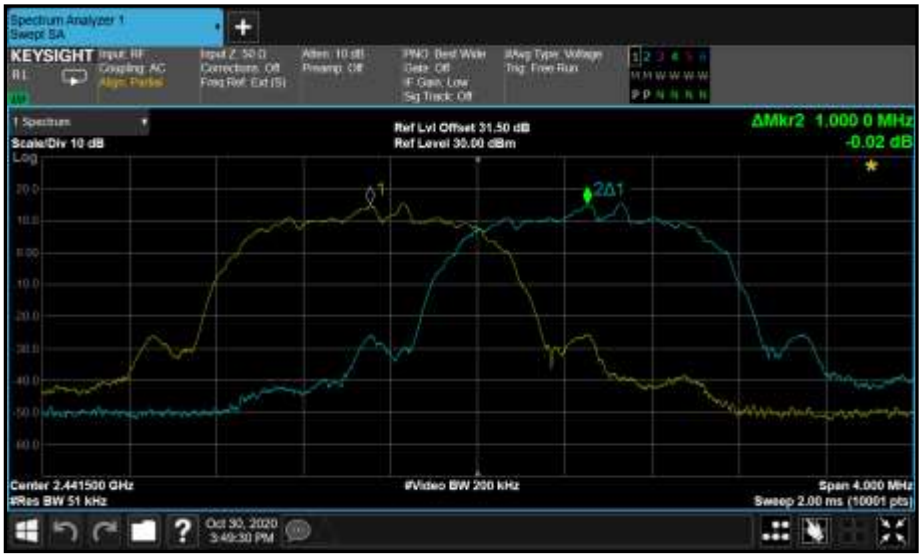

Figure 6 - 8-DPSK - 2441 MHz (CH39)

iPA

Antenna Port: Core2

Modulation	F1C (MHz)	F2C (MHz)	FHS (MHz)
GFSK	2441.019	2442.021	1.002
π/4 DQPSK	2441.003	2442.002	0.999
8-DPSK	2441.009	2442.009	1.000

Table 11 - Hopping Frequency Separation Results

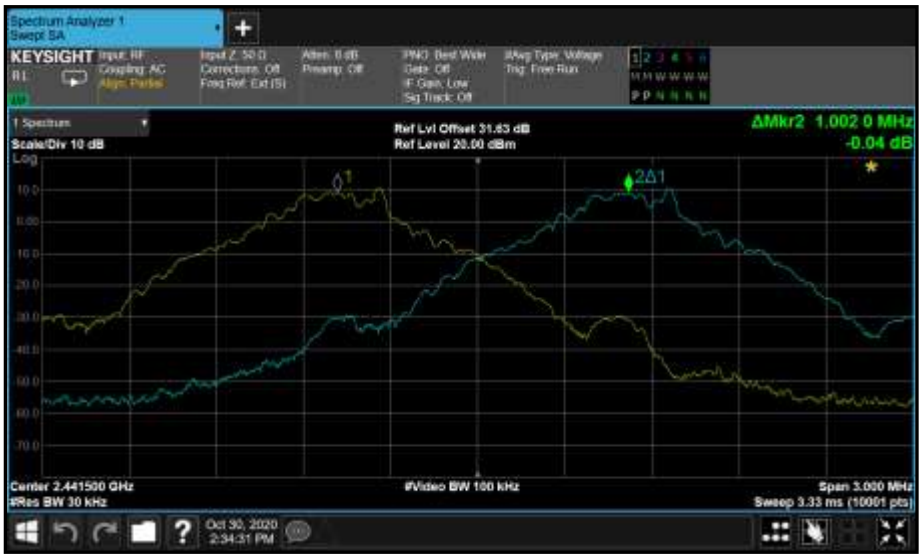

Figure 7 - GFSK - 2441 MHz (CH39)

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

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

Antenna Port: Core 1

Modulation	F1C (MHz)	F2C (MHz)	FHS (MHz)
GFSK	2441.019	2442.020	1.001
π/4 DQPSK	2441.001	2442.002	1.001
8-DPSK	2441.009	2442.009	1.000

Table 12 - Hopping Frequency Separation Results

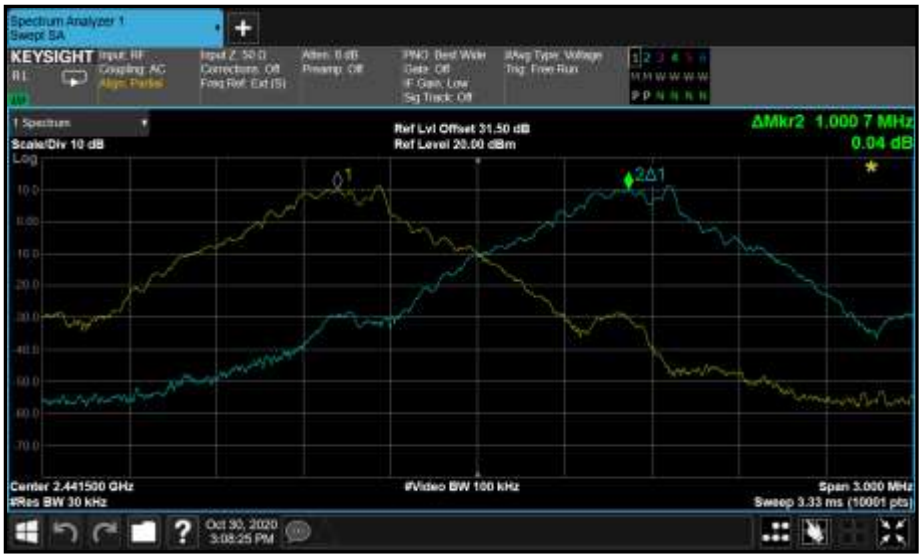

Figure 10 - GFSK - 2441 MHz (CH39)

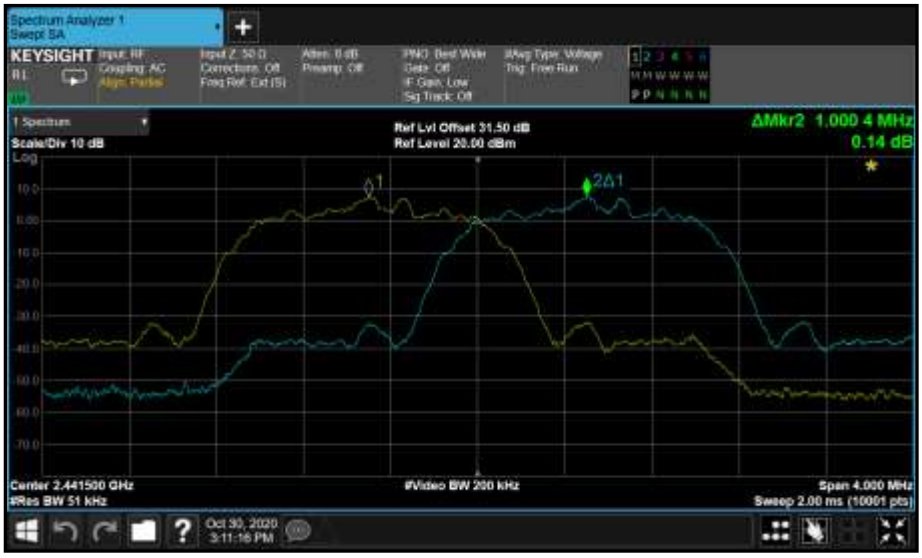

Figure 11 - π/4 DQPSK - 2441 MHz (CH39)

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

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

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

ISED RSS-247, Limit Clause 5.1 (c)

For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
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
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-2021

Table 13

O/P Mon – Output Monitored using calibrated equipment

2.3 Frequency Hopping Systems - 20 dB Bandwidth

2.3.1 Specification Reference

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

2.3.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.3.3 Date of Test

30-October-2020

2.3.4 Test Method

The test was performed in accordance with ANSI C63.10, clause 6.9.1.

2.3.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	57.4 %

2.3.6 Test Results

2.4 GHz Bluetooth - FHSS

ePA

Antenna Port Configuration: SISO

Modulation: GFSK (DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)
	Port(s)
	Core1
2402	888.0
2441	840.0
2480	885.0

Table 14 - 20 dB Bandwidth Results

Figure 13 - Core1 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 14 - Core1 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 15 - Core1 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)
	Port(s)
	Core1
2402	1335.0
2441	1335.0
2480	1330.0

Table 15 - 20 dB Bandwidth Results

Figure 16 - Core1 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 17 - Core1 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 18 - Core1 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)
	Port(s)
	Core1
2402	1275.0
2441	1280.0
2480	1275.0

Table 16 - 20 dB Bandwidth Results

Figure 19 - Core1 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

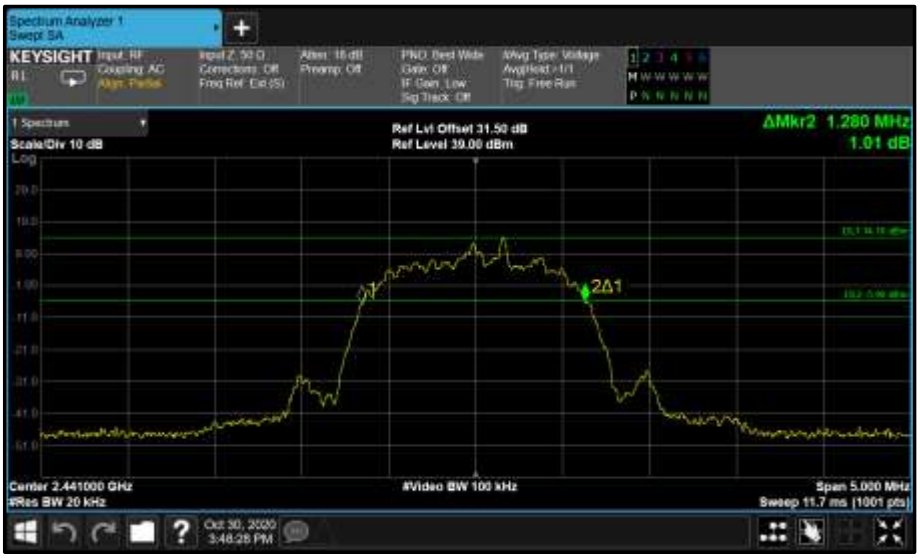

Figure 20 - Core1 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 21 - Core1 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

Antenna Port Configuration: Beamforming

Modulation: GFSK (DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	885.0	888.0
2441	843.0	843.0
2480	885.0	885.0

Table 17 - 20 dB Bandwidth Results

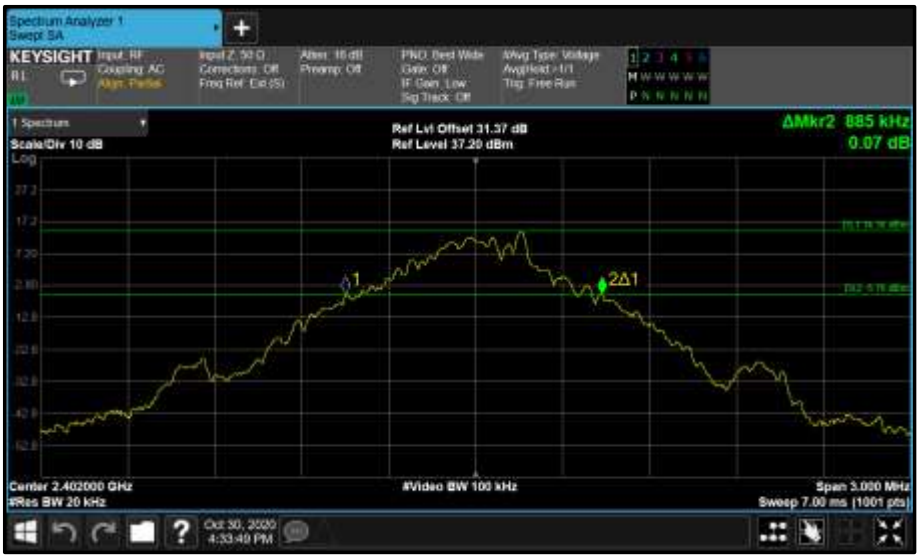

Figure 22 - Core0 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 23 - Core1 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 24 - Core0 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 25 - Core1 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 26 - Core0 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 27 - Core1 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	1330.0	1330.0
2441	1330.0	1330.0
2480	1335.0	1335.0

Table 18 - 20 dB Bandwidth Results

Figure 28 - Core0 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 29 - Core1 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 30 - Core0 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 31 - Core1 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 32 - Core0 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

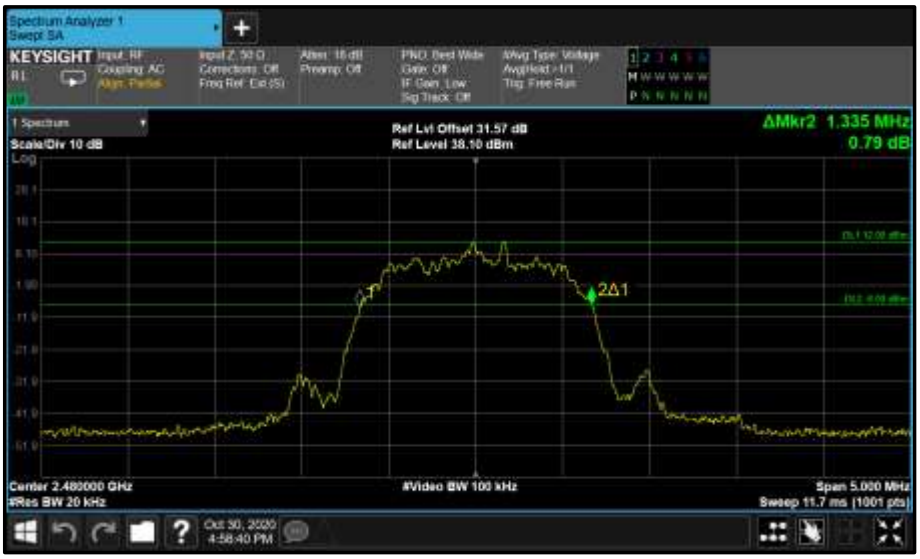

Figure 33 - Core1 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	1280.0	1275.0
2441	**1275.0**	**1275.0**
2480	**1275.0**	**1280.0**

Table 19- 20 dB Bandwidth Results

Figure 34 - Core0 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

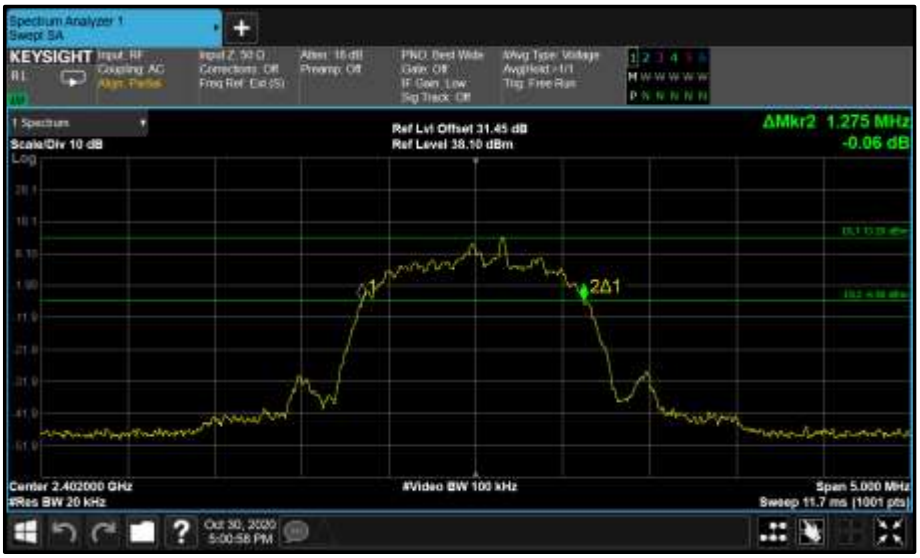

Figure 35 - Core1 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 36 - Core0 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 37 - Core1 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

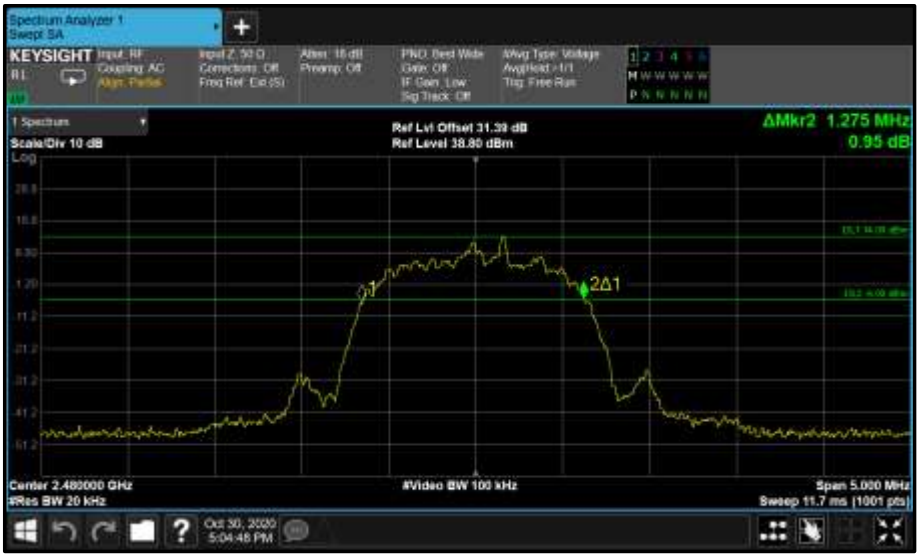

Figure 38 - Core0 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 39 - Core1 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

Bluetooth iPA

Antenna Port Configuration: SISO

Modulation: GFSK (DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core2	Core1
2402	888.0	891.0
2441	840.0	888.0
2480	888.0	891.0

Table 20 - 20 dB Bandwidth Results

Figure 40 - Core2 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 41 - Core1 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 42 - Core2 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 43 - Core1 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 44 - Core2 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 45 - Core1 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core2	Core1
2402	1335.0	1330.0
2441	1340.0	1330.0
2480	1340.0	1335.0

Table 21 - 20 dB Bandwidth Results

Figure 46 - Core2 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 47 - Core1 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 48 - Core2 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 49 - Core2 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 50 - Core1 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core2	Core1
2402	1270.0	1270.0
2441	1270.0	1270.0
2480	1270.0	1275.0

Table 22 - 20 dB Bandwidth Results

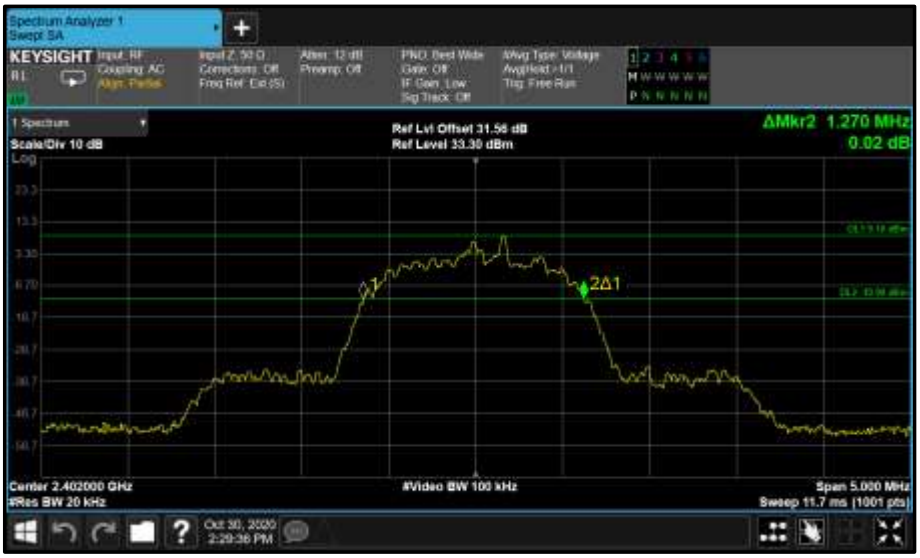

Figure 51 - Core2 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 52 - Core1 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

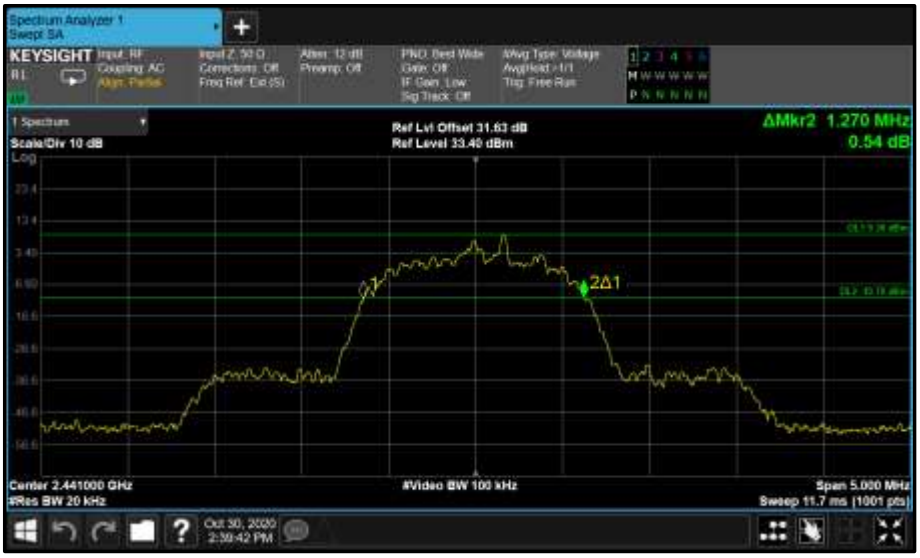

Figure 53 - Core2 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

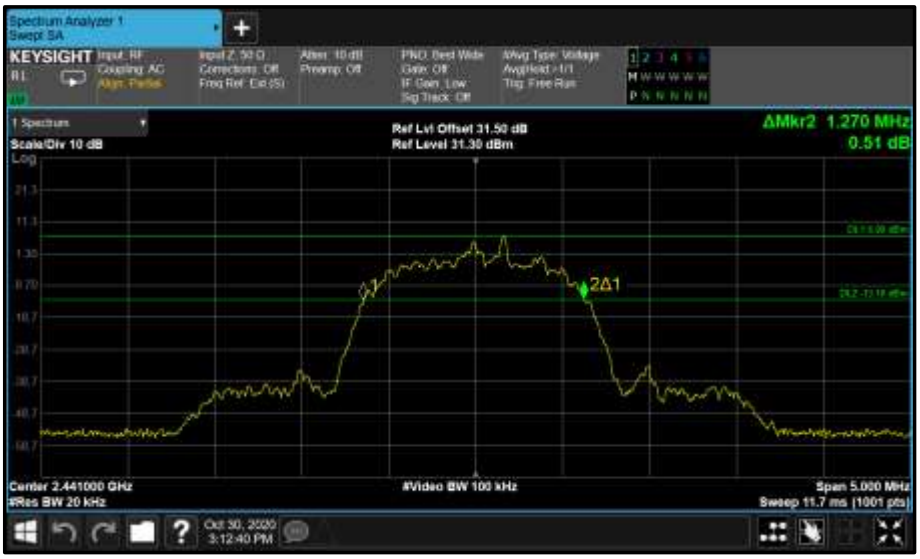

Figure 54 - Core1 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 55 - Core2 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

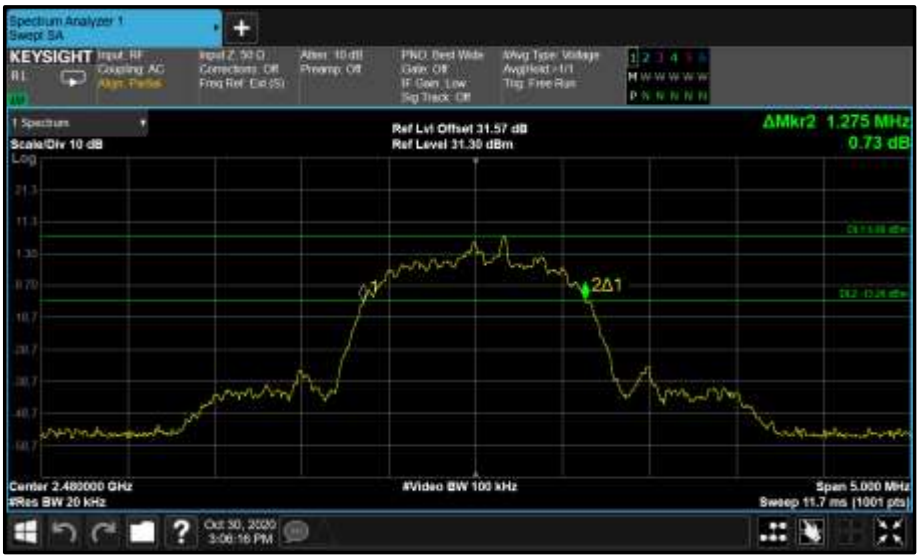

Figure 56 - Core1 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

Antenna Port Configuration: Beamforming

Modulation: GFSK (DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	888.0	888.0
2441	840.0	888.0
2480	840.0	888.0

Table 23 - 20 dB Bandwidth Results

Figure 57 - Core0 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 58 - Core1 GFSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 59 - Core0 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 60 - Core1 GFSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 61 - Core0 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 62 - Core1 GFSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	1335.0	1335.0
2441	1330.0	1330.0
2480	1330.0	1330.0

Table 24 - 20 dB Bandwidth Results

Figure 63 - Core0 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 64 - Core1 π/4 DQPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 65 - Core0 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 66 - Core1 π/4 DQPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 67 - Core0 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 68 - Core1 π/4 DQPSK 2480 MHz (CH78) 20 dB Bandwidth

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	20 dB Bandwidth (kHz)	
	Port(s)	
	Core0	Core1
2402	1275.0	1275.0
2441	1270.0	1270.0
2480	1270.0	1275.0

Table 25 - 20 dB Bandwidth Results

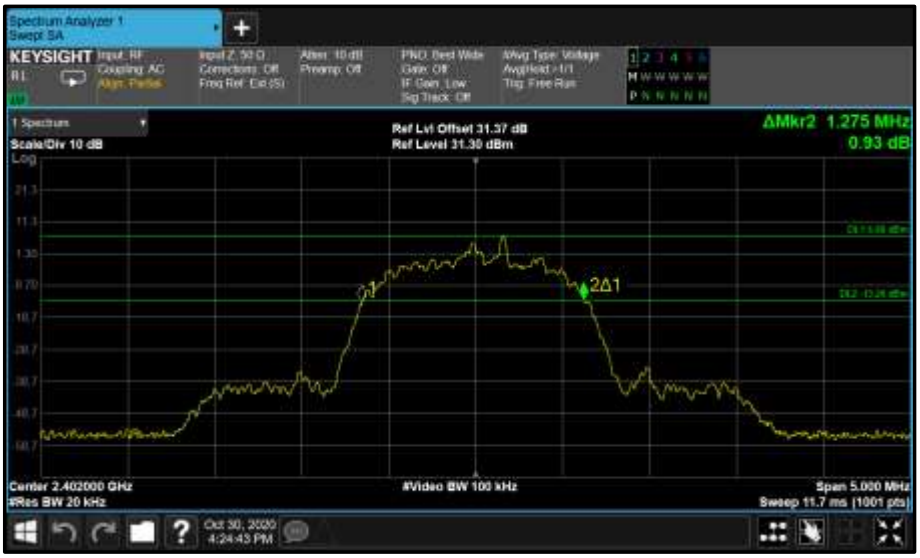

Figure 69- Core0 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 70- Core1 8-DPSK 2402 MHz (CH0) 20 dB Bandwidth

Figure 71- Core0 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 72- Core1 8-DPSK 2441 MHz (CH39) 20 dB Bandwidth

Figure 73- Core0 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

Figure 74- Core1 8-DPSK 2480 MHz (CH78) 20 dB Bandwidth

FCC 47 CFR Part 15 and RSS-247 Limit Clause

None specified.

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i) and ISED RSS-247, Limit Clause 5.1 (3)

The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
EXA	Keysight Technologies	N9010B	4969	24	03-Feb-2022
Cable (18 GHz)	Rosenberger	LU7-071-1000	5096	12	22-Jun-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
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5575	-	O/P Mon
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-2021

Table 26

O/P Mon – Output Monitored using calibrated equipment

2.4 Frequency Hopping Systems - Number of Hopping Channels

2.4.1 Specification Reference

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

2.4.2 Equipment Under Test and Modification State

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.4.3 Date of Test

30-October-2020

2.4.4 Test Method

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

2.4.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	57.4 %

2.4.6 Test Results

2.4 GHz Bluetooth - FHSS

ePA

Antenna Port: Core 1

Number of Hopping Channels: 79

Figure 75 - GFSK (DH5) - Number of Hopping Channels

Antenna Port: Core 2

Number of Hopping Channels: 79

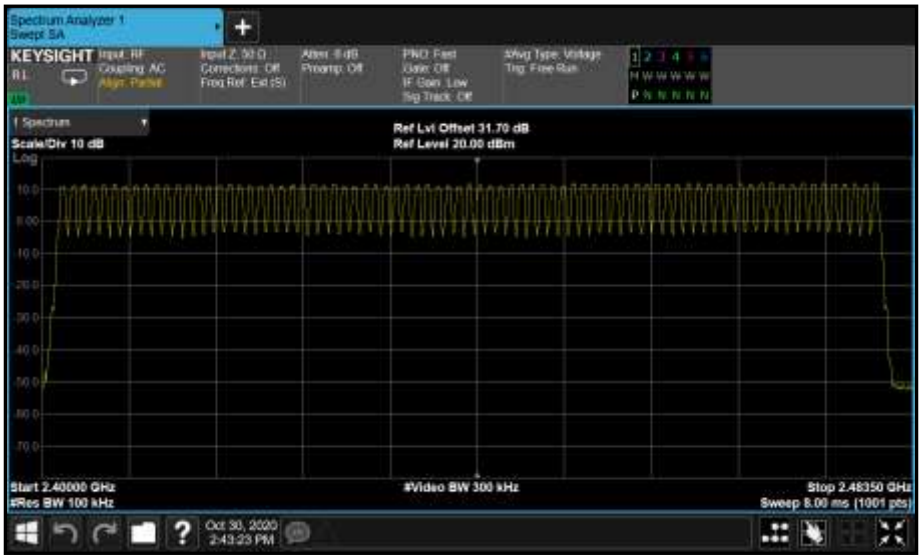

Figure 76 - GFSK (DH5) - Number of Hopping Channels

Antenna Port: Core 0

Number of Hopping Channels: 79

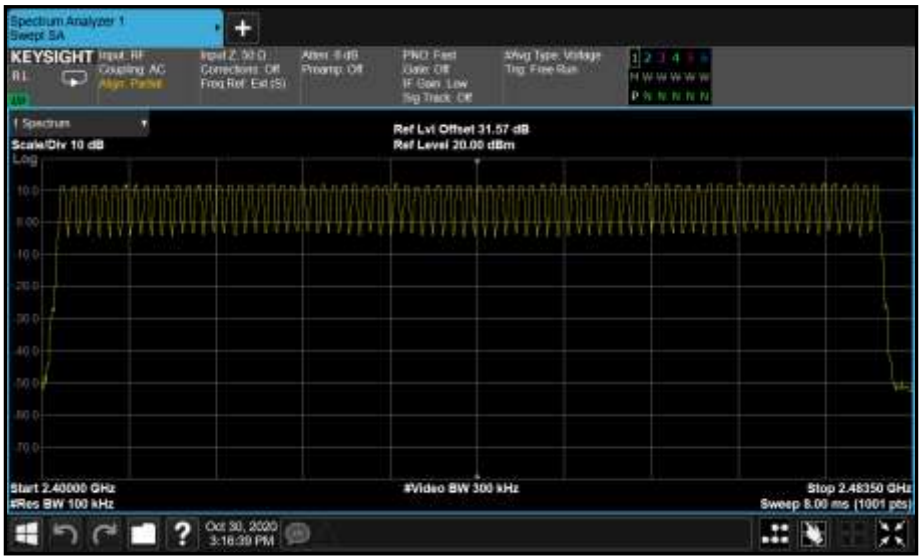

Figure 77 - GFSK (DH5) - Number of Hopping Channels

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

≥ 15 channels

ISED RSS-247, Limit Clause 5.1 (d)

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

FCC 47 CFR Part 15, Limit Clause 15.247 (a)(1)(i) and ISED RSS-247, Limit Clause 5.1 (3)

If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

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	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
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
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-2021

Table 27

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

A2169, S/N: C07CM0EKQ4TG - Modification State 0

2.5.3 Date of Test

30-October-2020

2.5.4 Test Method

The test was performed in accordance with ANSI C63.10 clause 11.9.1.3 Method PKPM1.

The antenna port/port combination with the highest antenna gain was tested in accordance with the supplied target powers.

Directional antenna gain calculation was performed in accordance with KDB 662911 D01, clause F)2)d)(i). Hence for beamforming modes the directional gain was calculated as:
$10 \log ([10^{(2.63/20)} + 10^{(2.60/20)}]^2 / 2) = 5.63$ dBi. Single core transmit antenna directional gains are as given in section 1.4.3. Since all directional gains are <6 dBi this results in an equivalent conducted limit of 30 dBm in all cases for both FCC and ISED.

Summing from multiple outputs of the transmitter was performed in accordance with KDB 662911 D01, clause E)1).

2.5.5 Environmental Conditions

Ambient Temperature	22.4 °C
Relative Humidity	57.4 %

2.5.6 Test Results

2.4 GHz Bluetooth - FHSS

ePA

Antenna Port Configuration: SISO

Modulation: GFSK (DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)	
	Average Power	Peak Power
	Core 1	Core 1
2402	16.0	17.3
2441	15.8	17.2
2480	16.1	17.4

Table 28 - Maximum Conducted Output Power Results

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)	
	Average Power	Peak Power
	Core 1	Core 1
2402	15.6	18.4
2441	15.9	18.7
2480	16.0	18.8

Table 29 - Maximum Conducted Output Power Results

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)	
	Average Power	Peak Power
	Core 1	Core 1
2402	15.6	18.7
2441	15.8	19.0
2480	15.9	19.1

Table 30 - Maximum Conducted Output Power Results

Antenna Port Configuration: Beamforming

Modulation: GFSK (DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	15.8	15.3	18.6	17.2	16.7	19.9
2441	15.6	15.3	18.4	16.8	16.6	19.7
2480	15.6	15.3	18.5	16.9	16.6	19.7

Table 31 - Maximum Conducted Output Power Results

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	15.8	15.1	18.5	18.7	17.9	21.3
2441	16.0	15.4	18.7	18.9	18.2	21.6
2480	15.7	15.3	18.5	18.6	18.1	21.4

Table 32 - Maximum Conducted Output Power Results

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	15.6	14.9	18.3	18.7	18.1	21.4
2441	16.0	15.3	18.7	19.1	18.5	21.8
2480	15.7	15.2	18.5	18.8	18.4	21.6

Table 33 - Maximum Conducted Output Power Results

iPA

Antenna Port Configuration: SISO

Modulation: GFSK (DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)			
	Average Power		Peak Power	
	Core 2	Core 1	Core 2	Core 1
2402	11.9	12.1	13.1	13.3
2441	11.6	12.2	12.8	13.4
2480	11.7	12.1	12.9	13.3

Table 34 - Maximum Conducted Output Power Results

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)			
	Average Power		Peak Power	
	Core 2	Core 1	Core 2	Core 1
2402	10.7	8.4	13.0	10.8
2441	10.9	8.5	13.1	11.0
2480	11.2	8.5	13.4	10.9

Table 35 - Maximum Conducted Output Power Results

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)			
	Average Power		Peak Power	
	Core 2	Core 1	Core 2	Core 1
2402	10.7	8.3	13.3	11.2
2441	10.8	8.5	13.4	11.3
2480	11.2	8.4	13.6	11.3

Table 36 - Maximum Conducted Output Power Results

Antenna Port Configuration: Beamforming

Modulation: GFSK (DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	12.2	11.4	14.8	13.3	12.6	16.0
2441	12.2	11.5	14.9	13.4	12.8	16.1
2480	12.4	12.3	15.4	13.4	13.5	16.4

Table 37 - Maximum Conducted Output Power Results

Modulation: π/4 DQPSK (2-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	8.1	7.1	10.6	10.5	9.6	13.1
2441	8.4	7.7	11.1	10.9	10.2	13.6
2480	8.3	8.1	11.2	10.8	10.6	13.7

Table 38 - Maximum Conducted Output Power Results

Modulation: 8-DPSK (3-DH5)

Test Frequency (MHz)	Maximum Conducted Output Power (dBm)					
	Average Power			Peak Power		
	Core 0	Core 1	∑	Core 0	Core 1	∑
2402	8.5	7.6	11.1	11.3	10.4	13.9
2441	8.4	7.7	11.1	11.2	10.5	13.9
2480	8.3	8.1	11.2	11.1	10.9	14.0

Table 39 - Maximum Conducted Output Power Results

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

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

ISED RSS-247, Limit Clause 5.4 (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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Hygrometer	Rotronic	I-1000	3220	12	16-Oct-2021
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	11-Dec-2020
1800-6000 MHz Power Splitter	Mini-Circuits	ZN2PD-63-S+	4055	-	O/P Mon
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	28-Nov-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
Power splitter - 2 port	Mini-Circuits	ZN2PD-63-S+	4743	12	23-Sep-2021
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	22-Jun-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5096	12	22-Jun-2021
USB Power Sensor	Boonton	RTP5006	5184	12	09-Jan-2021
USB Power Sensor	Boonton	RTP5006	5186	12	28-Nov-2020
USB Power Sensor	Boonton	RTP5006	5187	12	09-Jan-2021
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
AC Programmable Power Supply	iTech	IT7324	5227	-	O/P Mon
Power Splitter, 2 way	Mini-Circuits	ZN2PD2-63-S+	5238	-	O/P Mon
USB Power Sensor	Boonton	RTP5006	5278	12	27-Apr-2021
USB Power Sensor	Boonton	RTP5006	5279	12	27-Apr-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5417	12	22-Jun-2021
3.5 mm 1m Cable	Junkosha	MWX221-01000DMS	5418	12	22-Jun-2021
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5575	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5579	-	O/P Mon
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5580	-	O/P Mon
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-2021

Table 40

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

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.6.3 Date of Test

24-June-2020 to 27-June-2020

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	20.7 °C to 23.8 °C
Relative Humidity	44.8 % to 53.7 %

2.6.6 Test Results

2.4 GHz Bluetooth - FHSS

iPA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 0	GFSK	DH5	2402	2400.0	-60.12
Static Core 0	π/4 DQPSK	2DH5	2402	2400.0	-62.54
Static Core 0	8-DPSK	3DH5	2402	2400.0	-63.11
Hopping Core 0	GFSK	DH5	2402	2400.0	-65.53
Hopping Core 0	π/4 DQPSK	2DH5	2402	2400.0	-62.91
Hopping Core 0	8-DPSK	3DH5	2402	2400.0	-63.71

Table 41 - SISO Authorised Band Edge Results

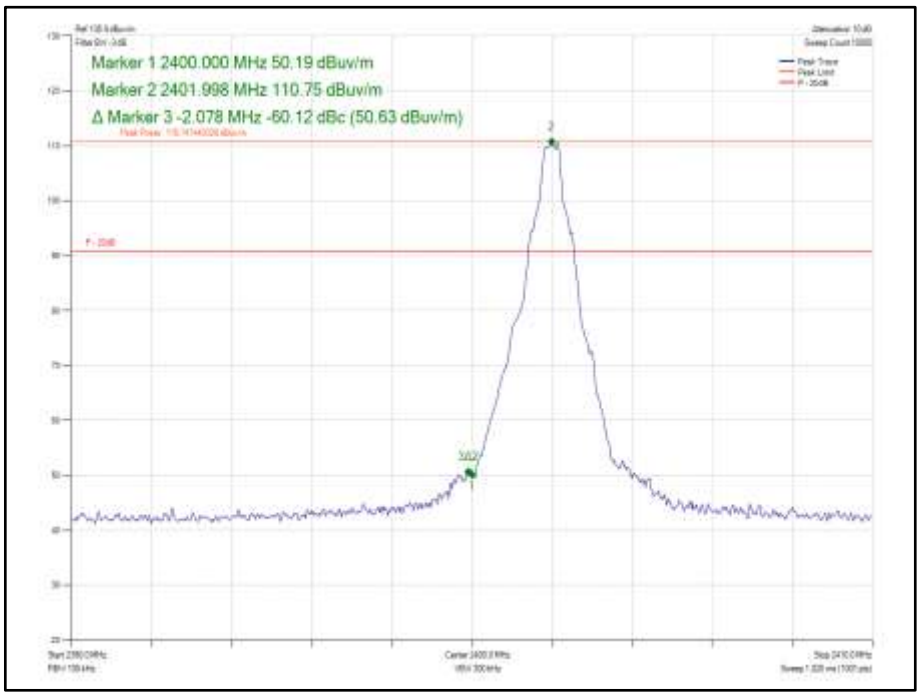

Figure 78 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

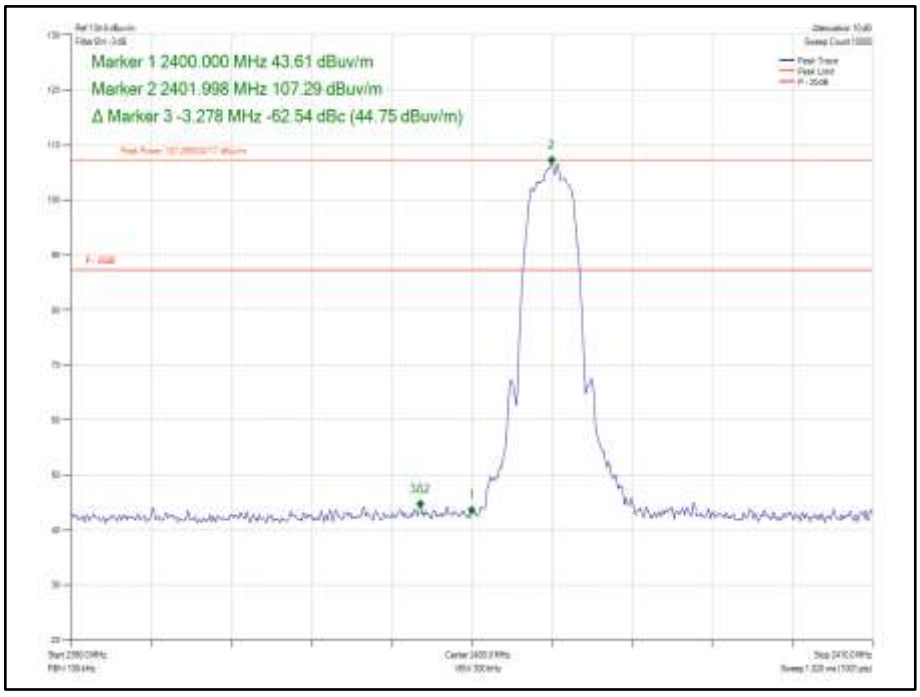

Figure 79 - Static Core 0 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

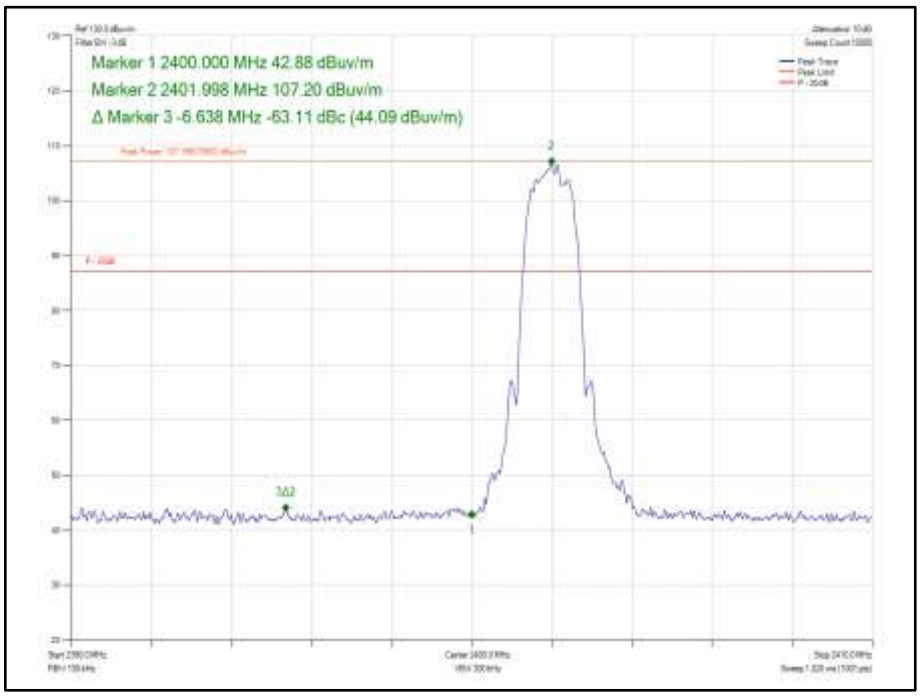

Figure 80 - Static Core 0- 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

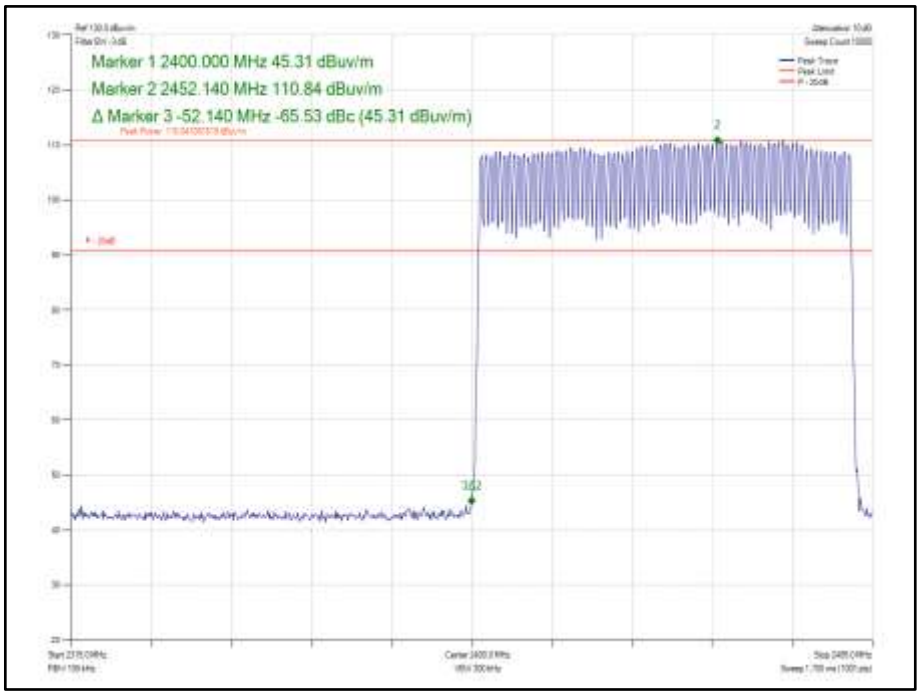

Figure 81 - Hopping Core 0 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

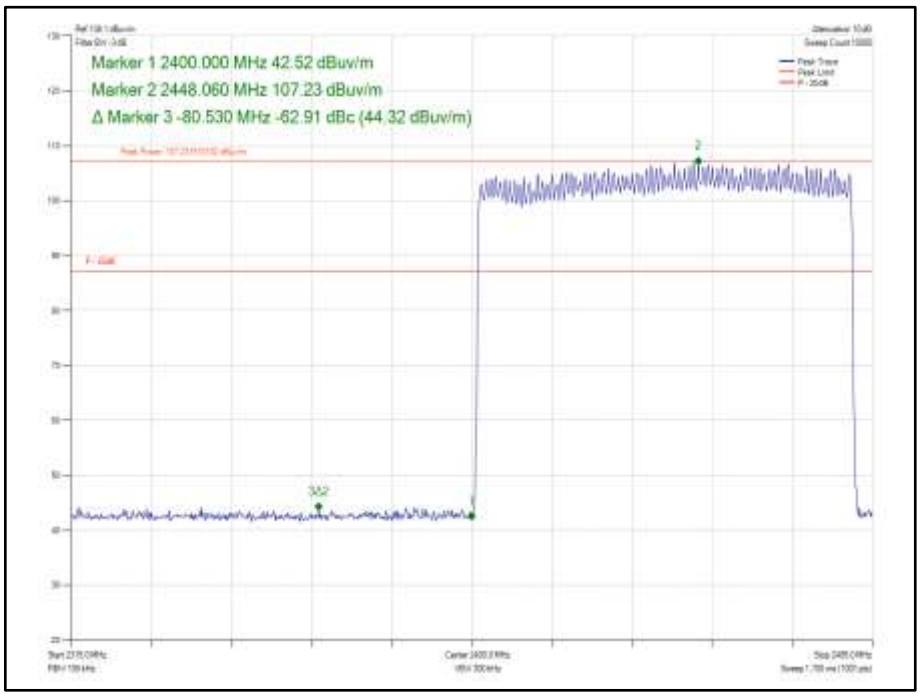

Figure 82 - Hopping Core 0 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

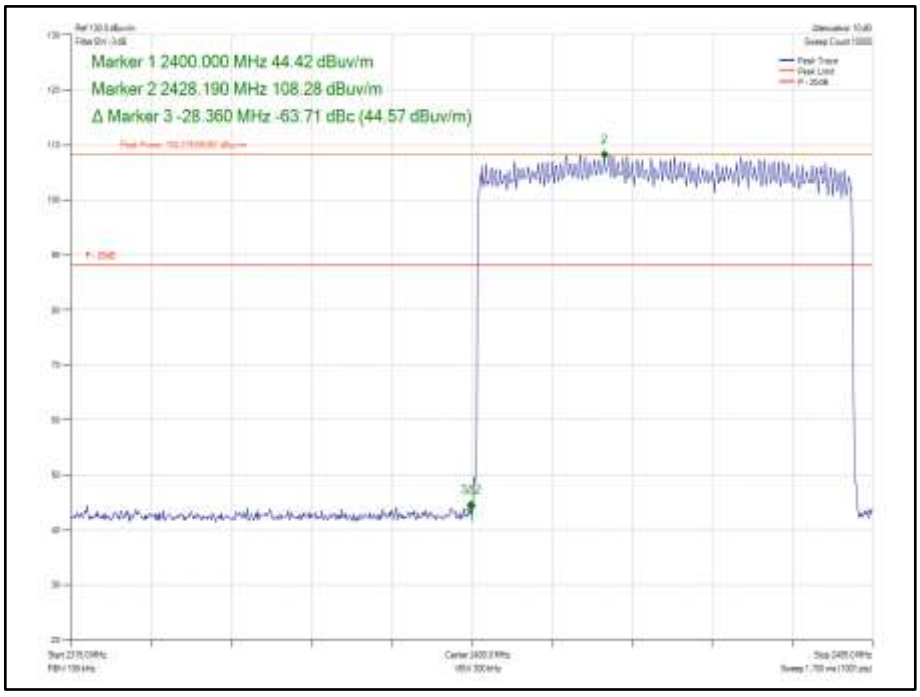

Figure 83 - Hopping Core 0 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 1	GFSK	DH5	2402	2400.0	-62.61
Static Core 1	π/4 DQPSK	2DH5	2402	2400.0	-62.70
Static Core 1	8-DPSK	3DH5	2402	2400.0	-62.26
Hopping Core 1	GFSK	DH5	2402	2400.0	-64.04
Hopping Core 1	π/4 DQPSK	2DH5	2402	2400.0	-62.77
Hopping Core 1	8-DPSK	3DH5	2402	2400.0	-62.33

Table 42 - SISO Authorised Band Edge Results

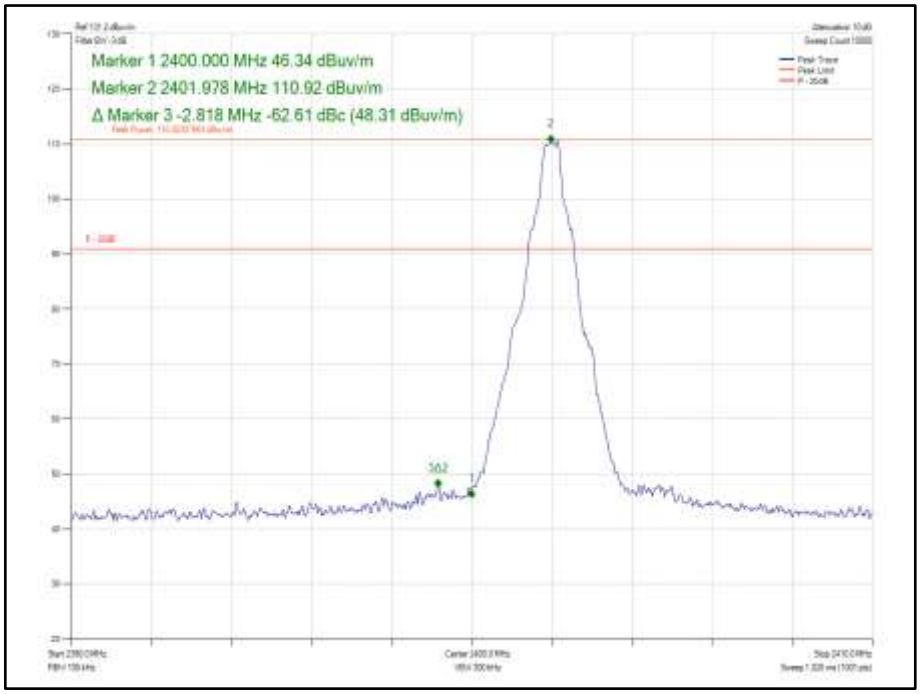

Figure 84 - Static Core 1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

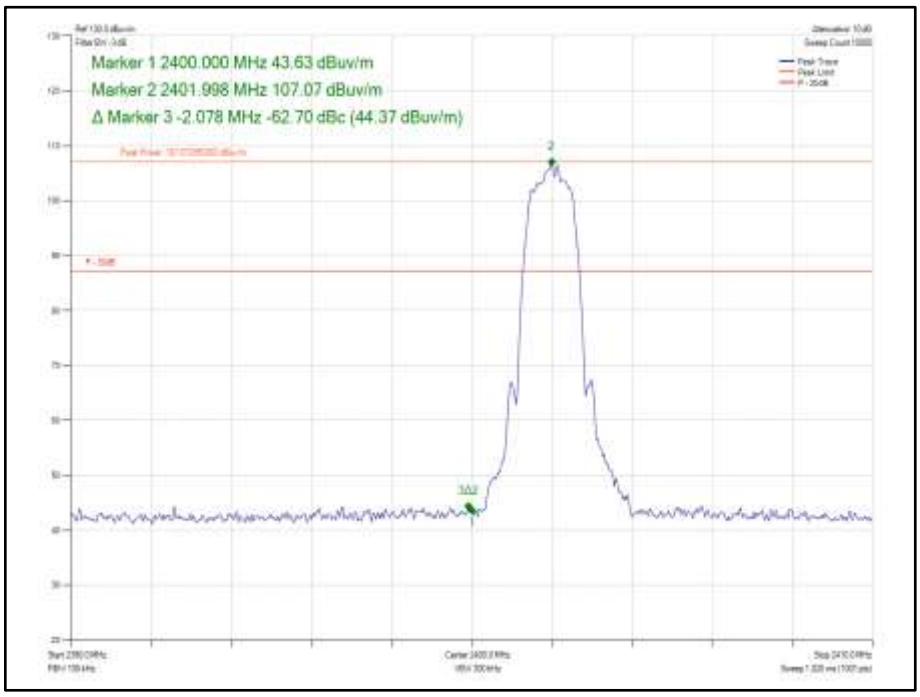

Figure 85 - Static Core 1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

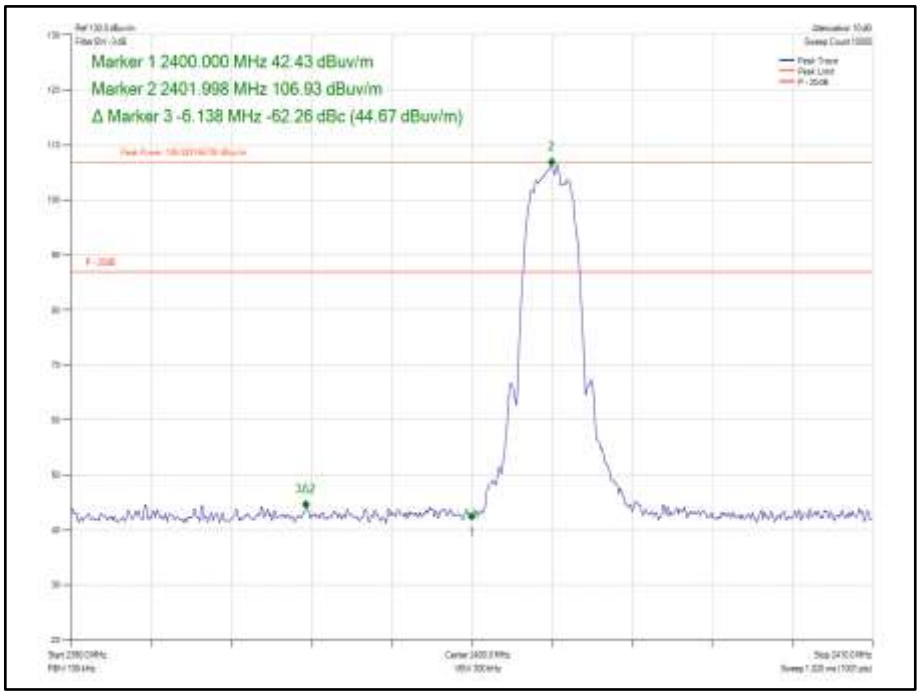

Figure 86 - Static Core 1- 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

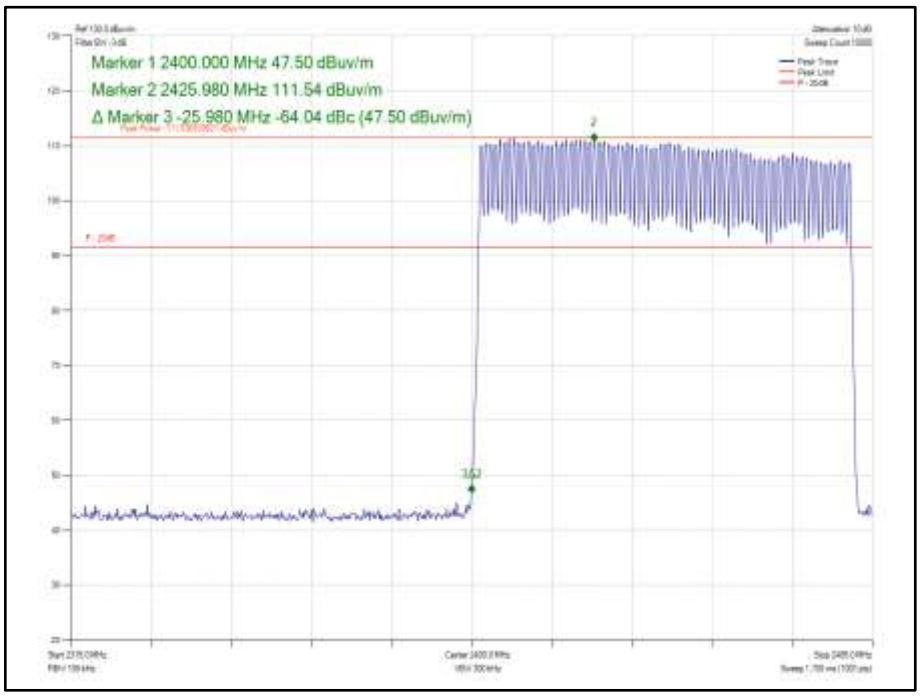

Figure 87 - Hopping Core 1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

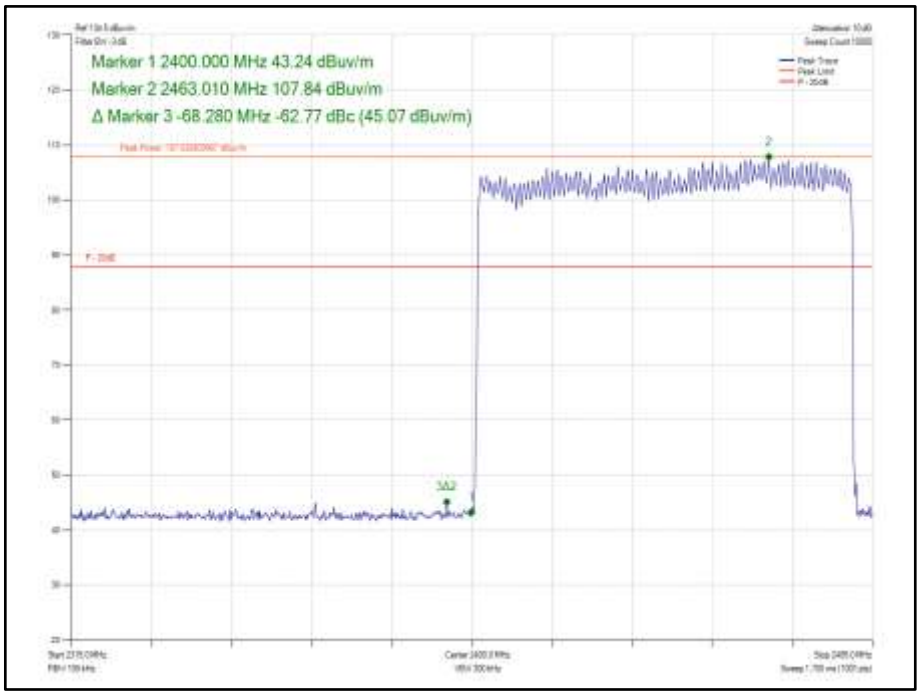

Figure 88 - Hopping Core 1 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

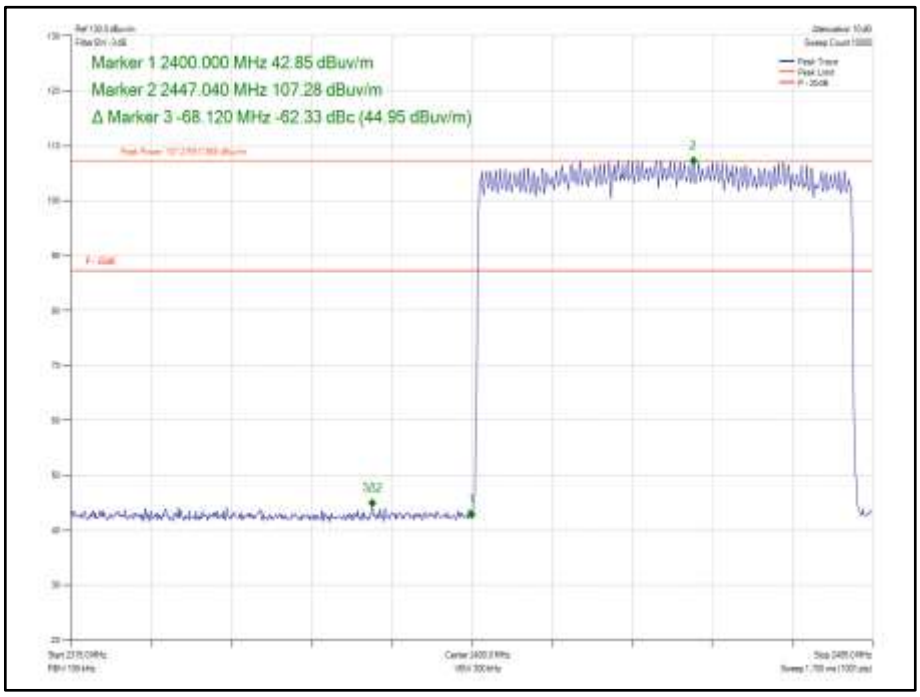

Figure 89 - Hopping Core 1 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 2	GFSK	DH5	2402	2400.0	-68.70
Static Core 2	π/4 DQPSK	2DH5	2402	2400.0	-63.44
Static Core 2	8-DPSK	3DH5	2402	2400.0	-64.06
Hopping Core 2	GFSK	DH5	2402	2400.0	-68.90
Hopping Core 2	π/4 DQPSK	2DH5	2402	2400.0	-67.97
Hopping Core 2	8-DPSK	3DH5	2402	2400.0	-67.98

Table 43 - SISO Authorised Band Edge Results

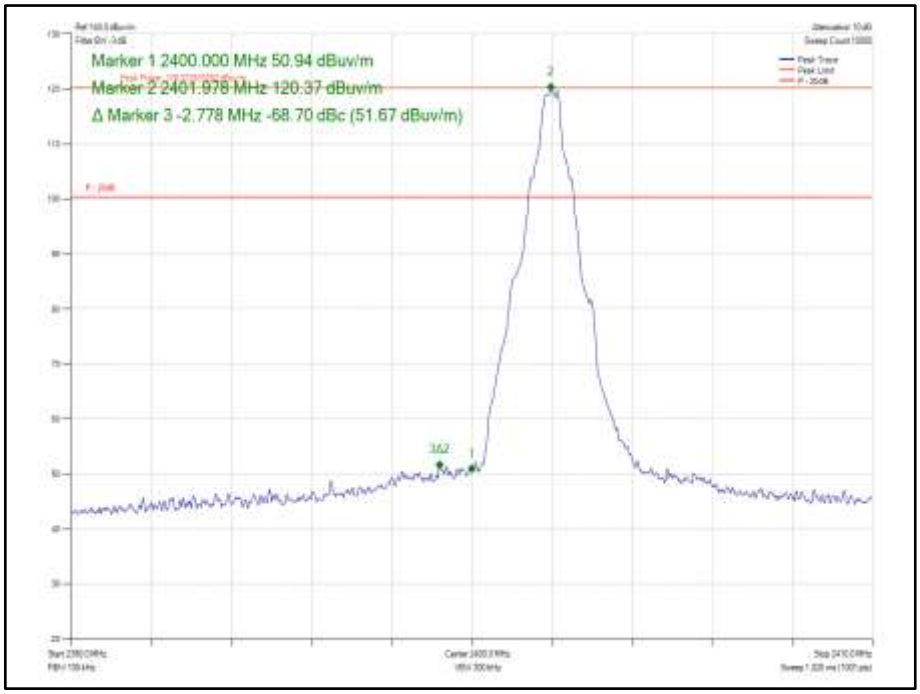

Figure 90 - Static Core 2 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

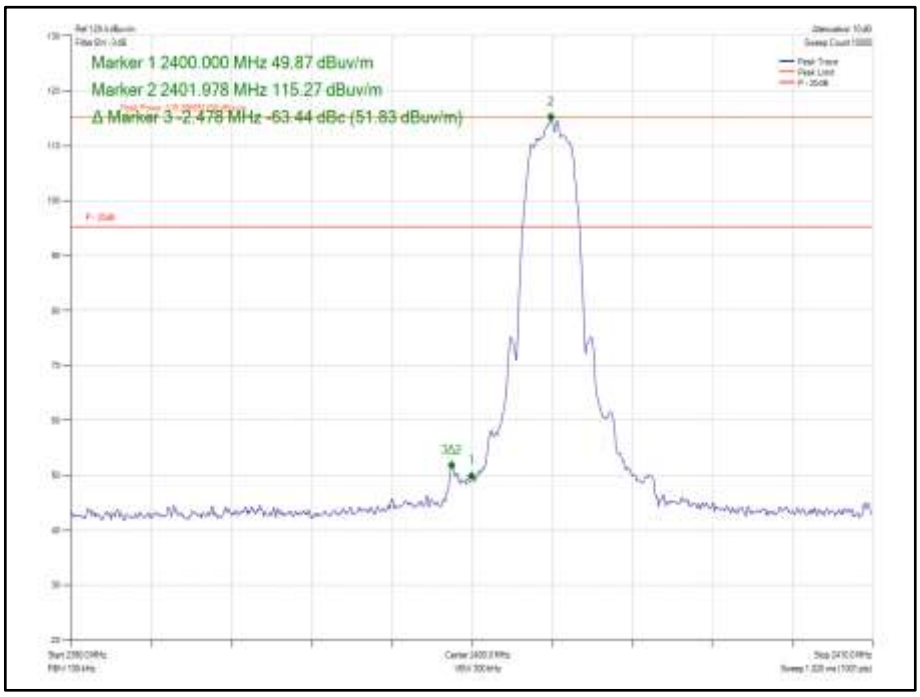

Figure 91 - Static Core 2 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

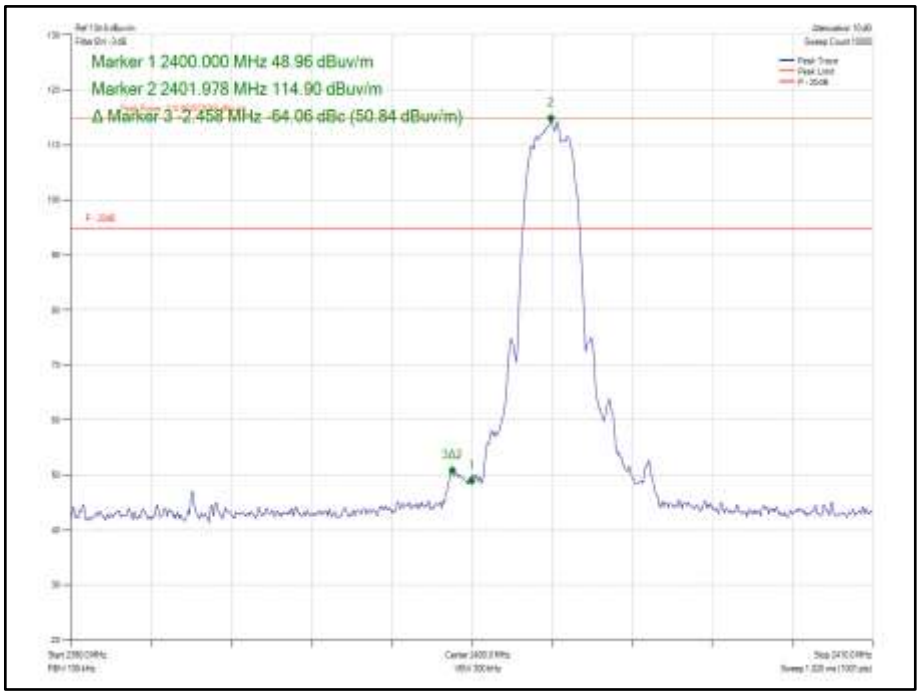

Figure 92 - Static Core 2 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

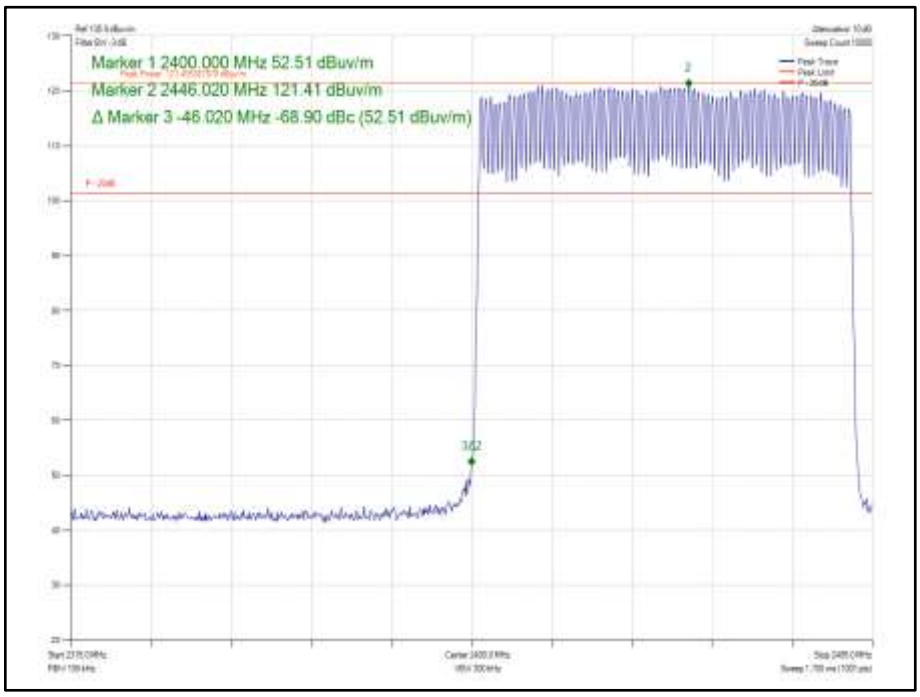

Figure 93 - Hopping Core 2 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

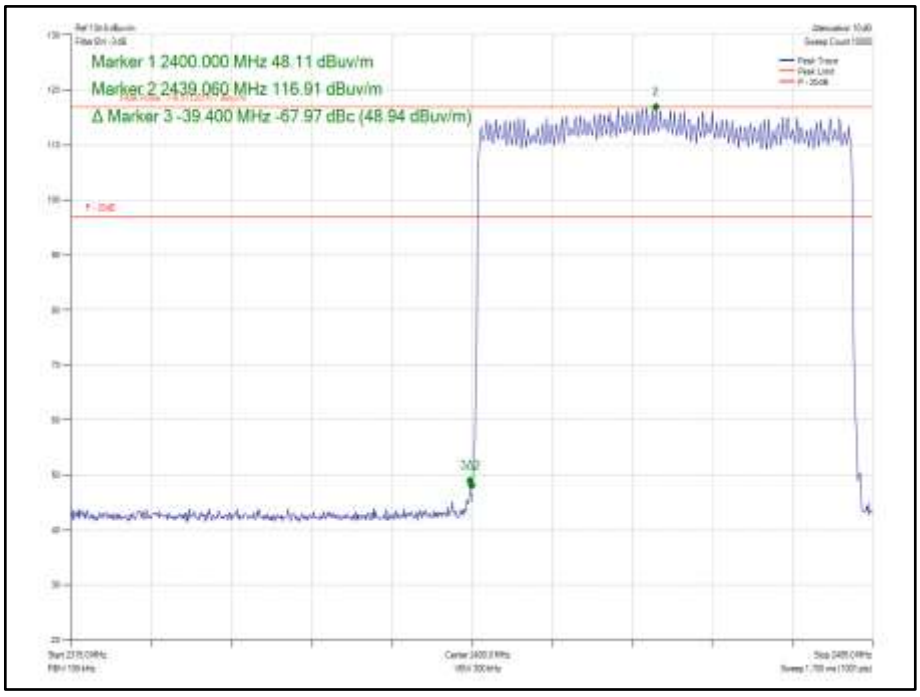

Figure 94 - Hopping Core 2 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

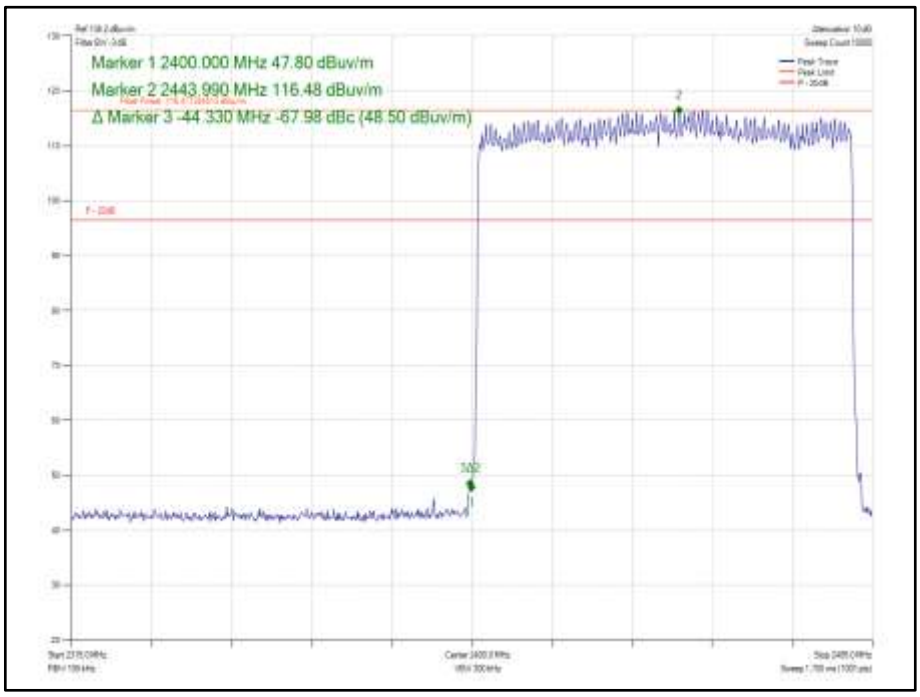

Figure 95 - Hopping Core 2- 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 0-1	GFSK	DH5	2402	2400.0	-61.06
Static Core 0-1	π/4 DQPSK	2DH5	2402	2400.0	-65.97
Static Core 0-1	8-DPSK	3DH5	2402	2400.0	-64.74
Hopping Core 0-1	GFSK	DH5	2402	2400.0	-66.55
Hopping Core 0-1	π/4 DQPSK	2DH5	2402	2400.0	-65.95
Hopping Core 0-1	8-DPSK	3DH5	2402	2400.0	-65.45

Table 44 - MIMO 2TX Authorised Band Edge Results

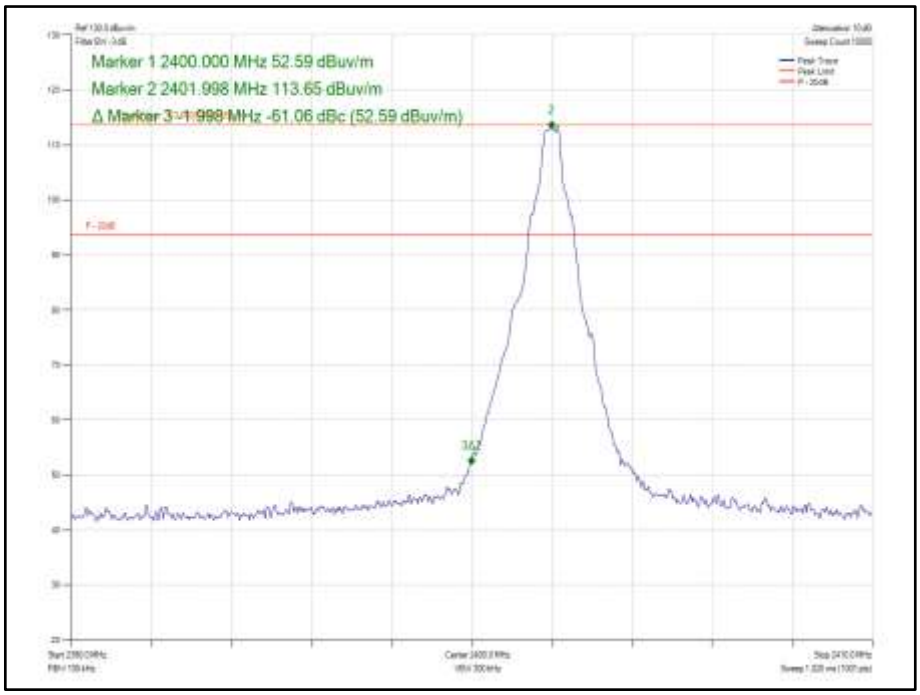

Figure 96 - Static Core 0-1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

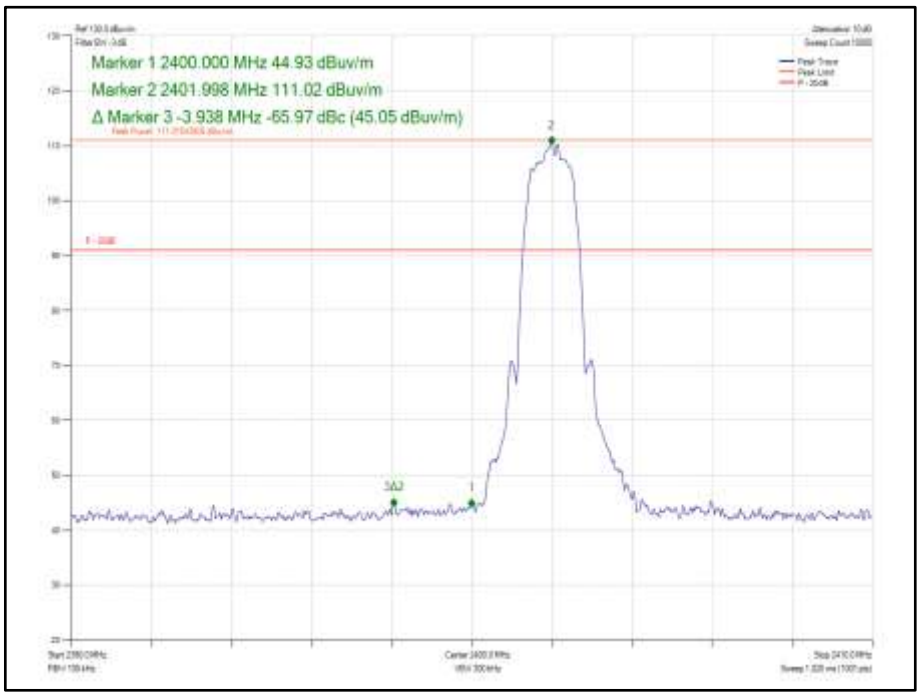

Figure 97 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

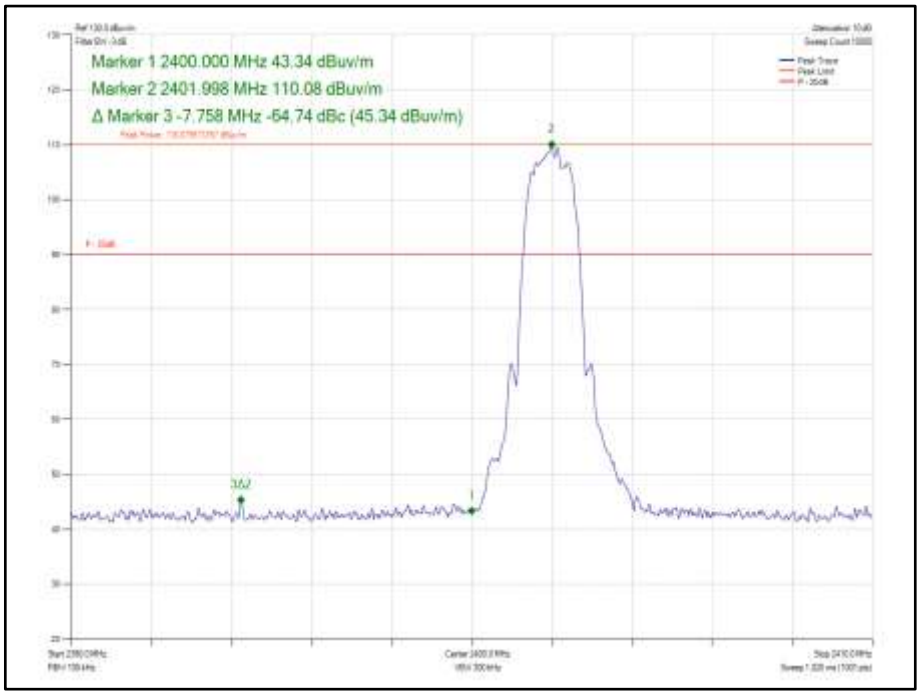

Figure 98 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

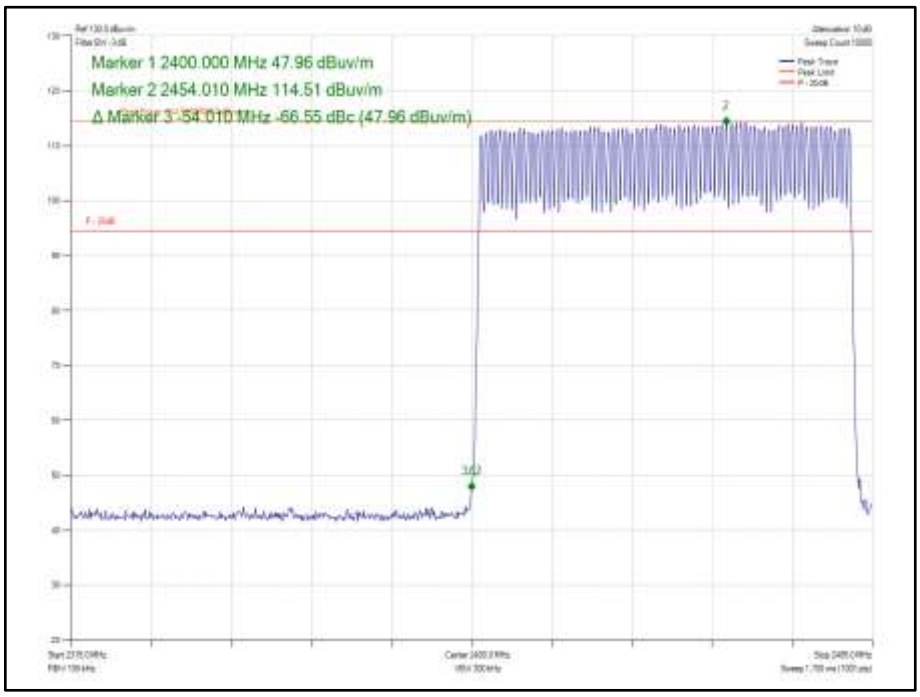

Figure 99 - Hopping Core 0-1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

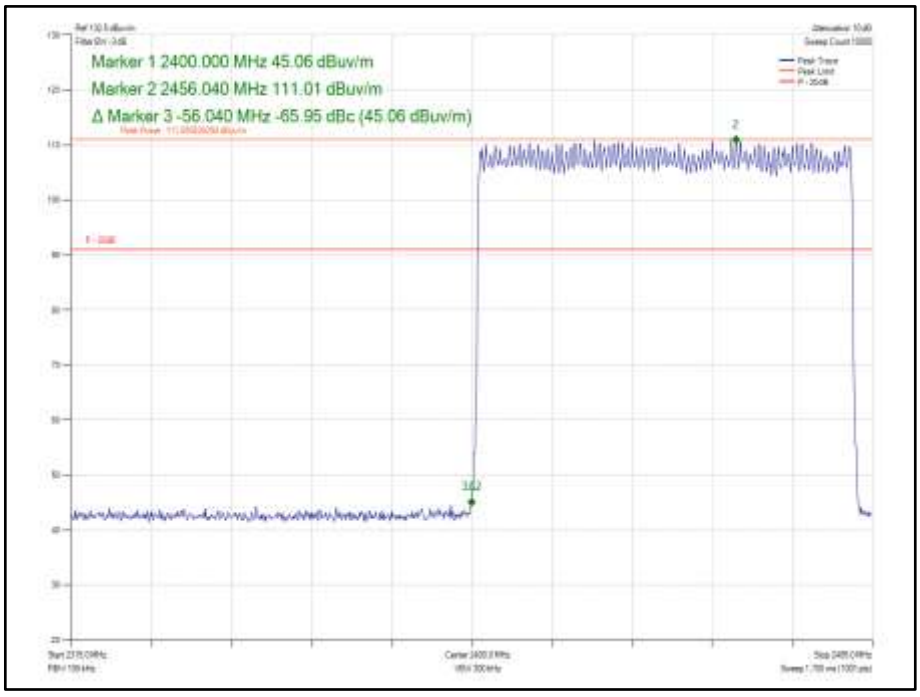

Figure 100 - Hopping Core 0-1 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

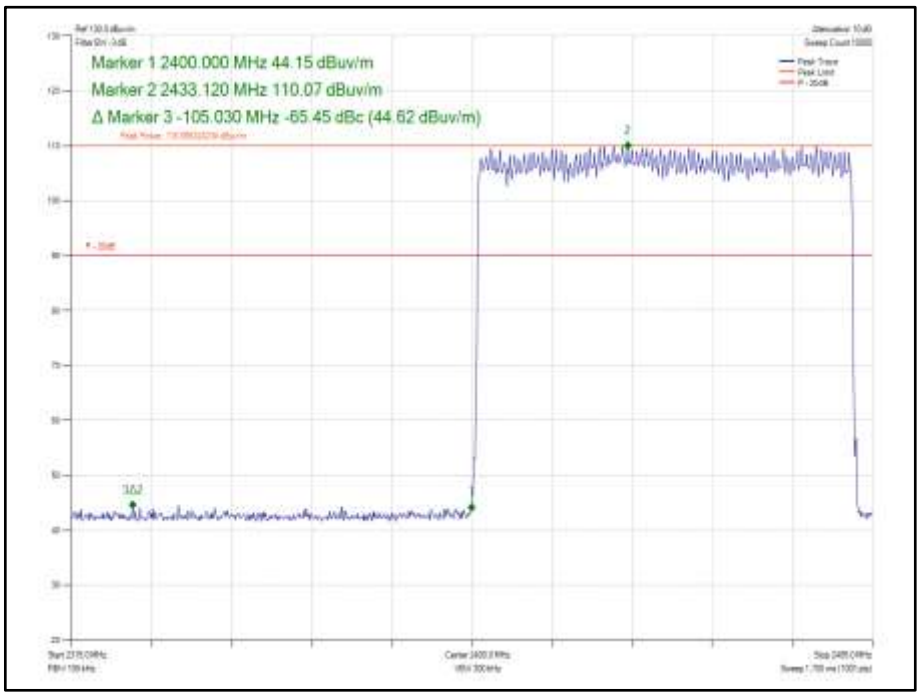

Figure 101 - Hopping Core 0-1- 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

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Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 0	GFSK	DH5	2402	2400.0	-65.49
Static Core 0	π/4 DQPSK	2DH5	2402	2400.0	-62.27
Static Core 0	8-DPSK	3DH5	2402	2400.0	-62.30
Hopping Core 0	GFSK	DH5	2402	2400.0	-68.88
Hopping Core 0	π/4 DQPSK	2DH5	2402	2400.0	-64.59
Hopping Core 0	8-DPSK	3DH5	2402	2400.0	-63.94

Table 45 - SISO Authorised Band Edge Results

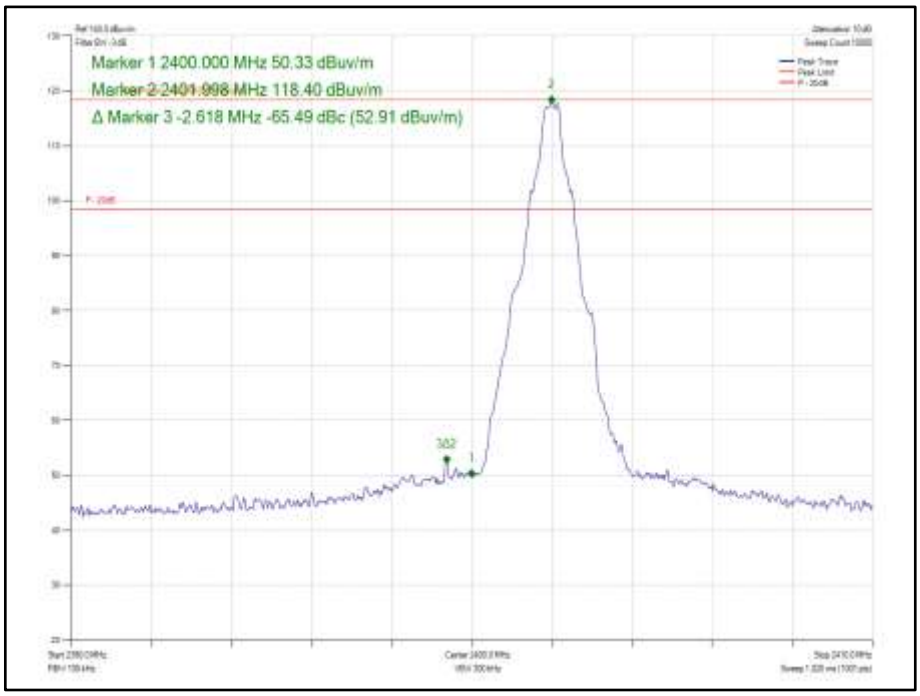

Figure 102 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

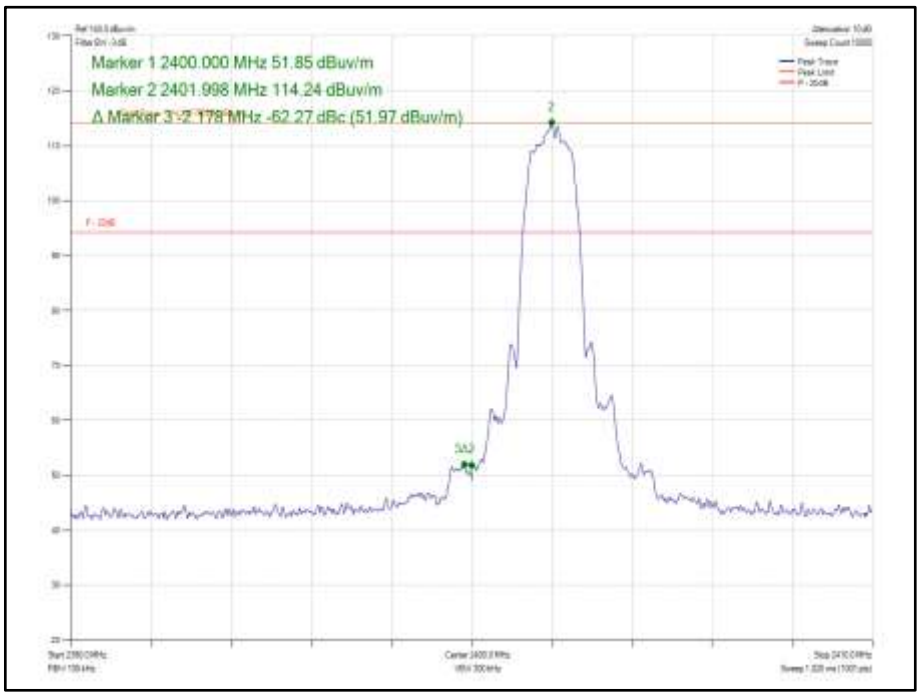

Figure 103 - Static Core 0 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

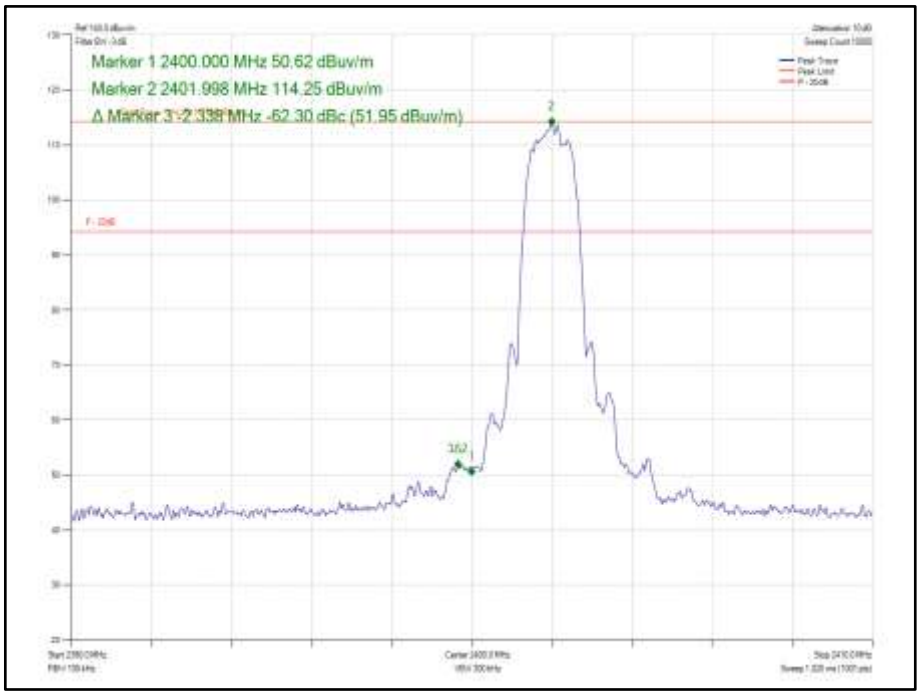

Figure 104 - Static Core 0 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

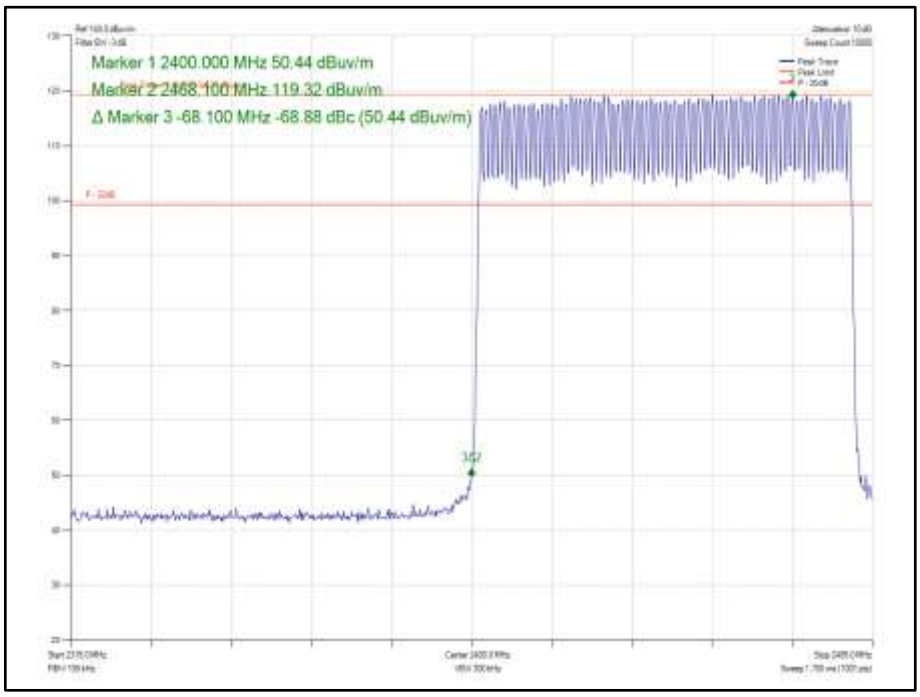

Figure 105 - Hopping Core 0 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

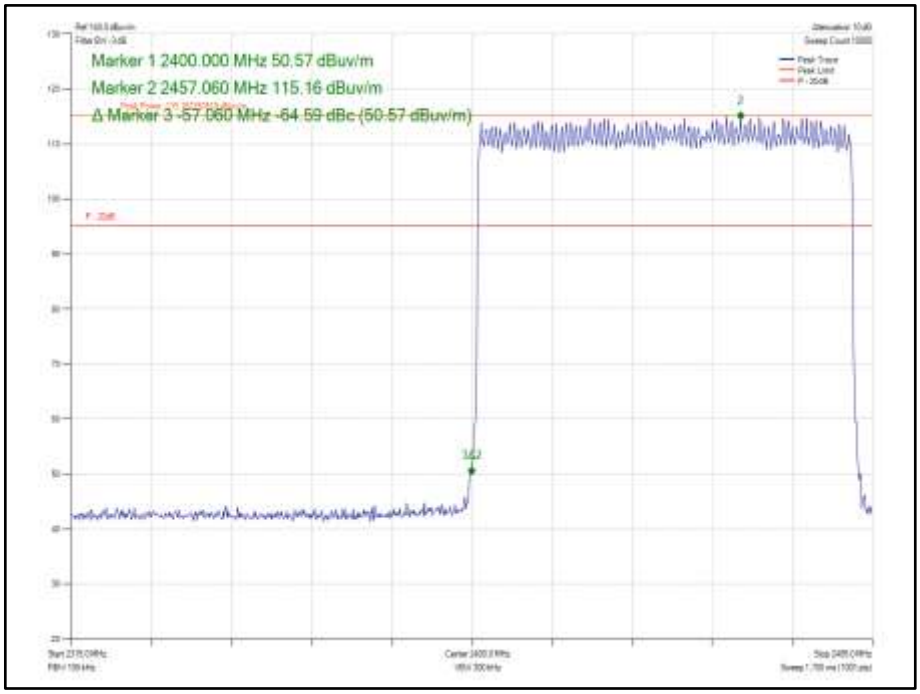

Figure 106 - Hopping Core 0 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

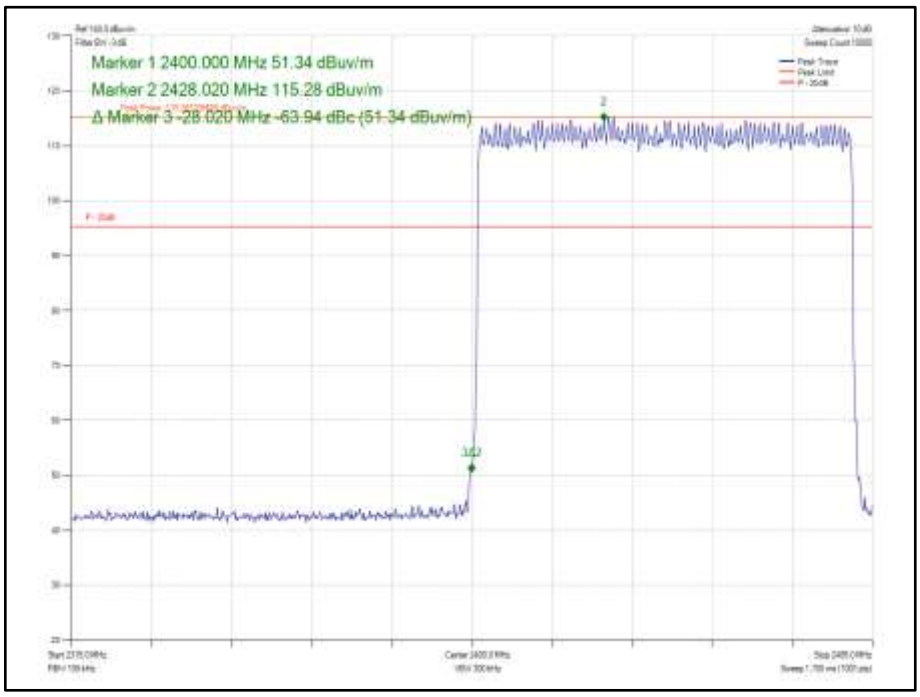

Figure 107 - Hopping Core 0 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 1	GFSK	DH5	2402	2400.0	-67.13
Static Core 1	π/4 DQPSK	2DH5	2402	2400.0	-63.61
Static Core 1	8-DPSK	3DH5	2402	2400.0	-63.35
Hopping Core 1	GFSK	DH5	2402	2400.0	-67.68
Hopping Core 1	π/4 DQPSK	2DH5	2402	2400.0	-66.20
Hopping Core 1	8-DPSK	3DH5	2402	2400.0	-66.11

Table 46 - SISO Authorised Band Edge Results

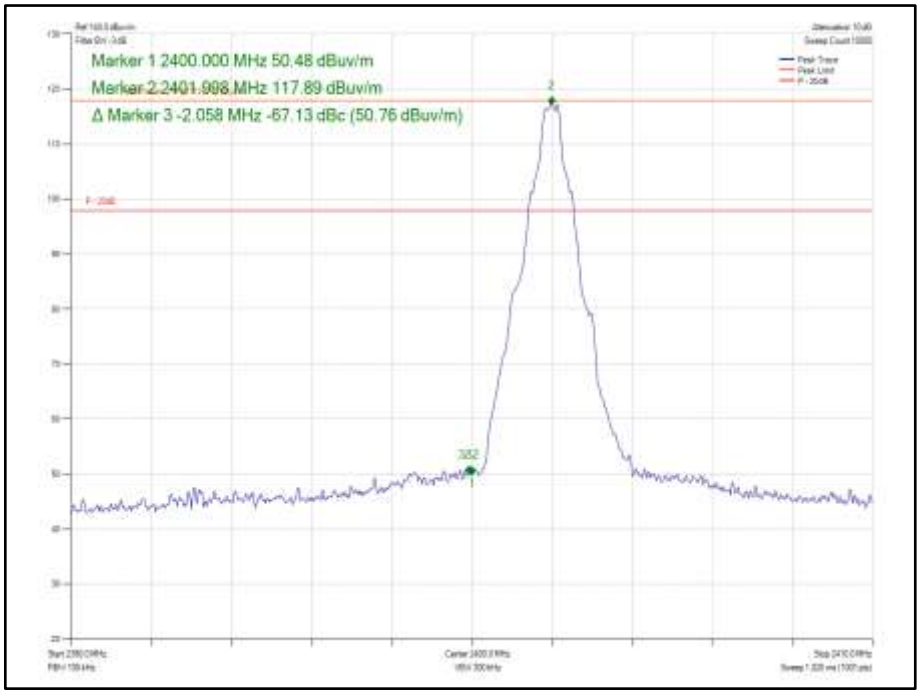

Figure 108 - Static Core 1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

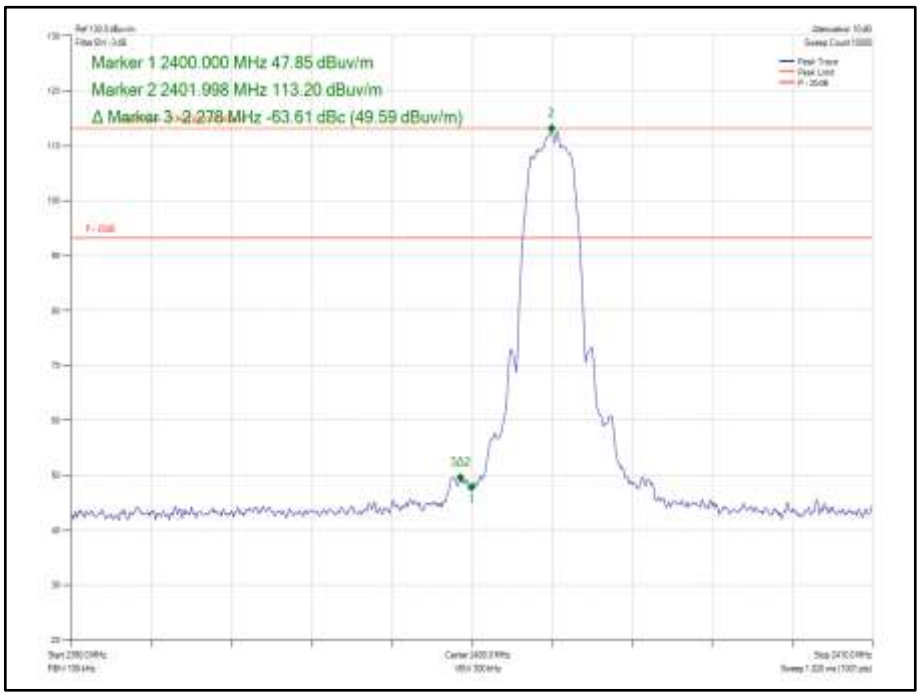

Figure 109 - Static Core 1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

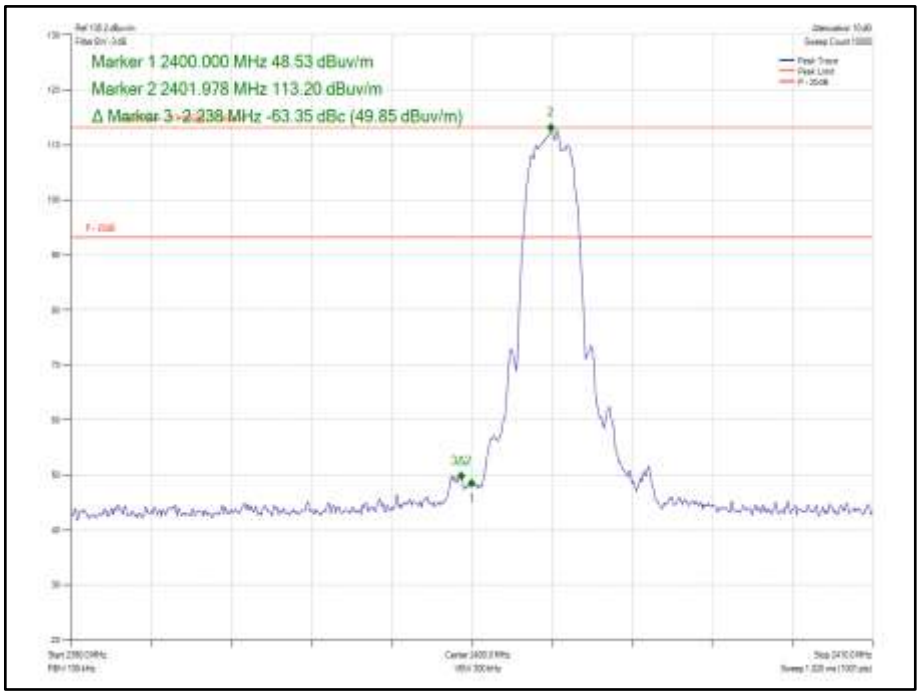

Figure 110 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

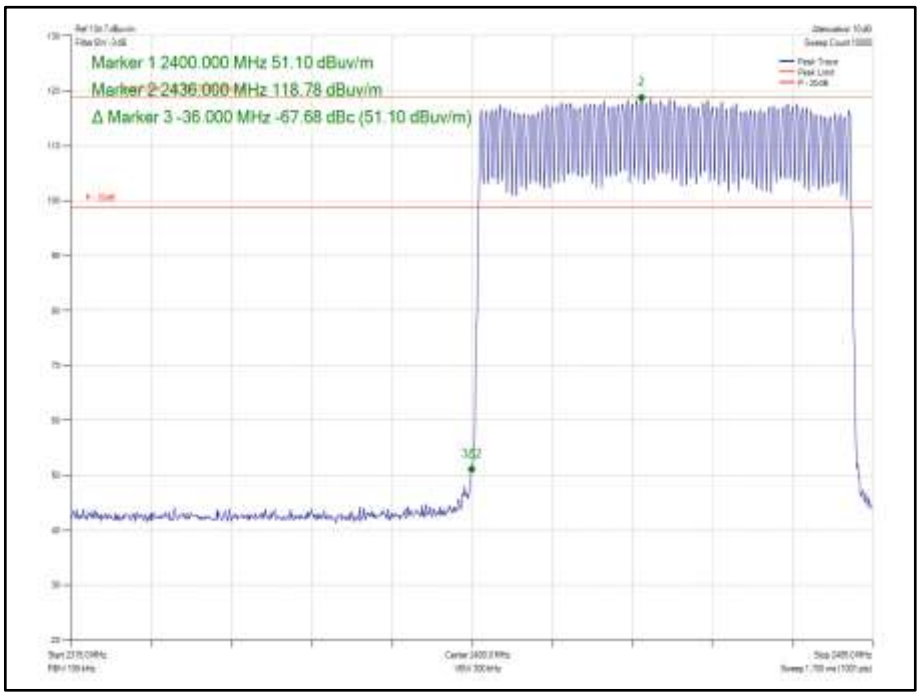

Figure 111 - Hopping Core 1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

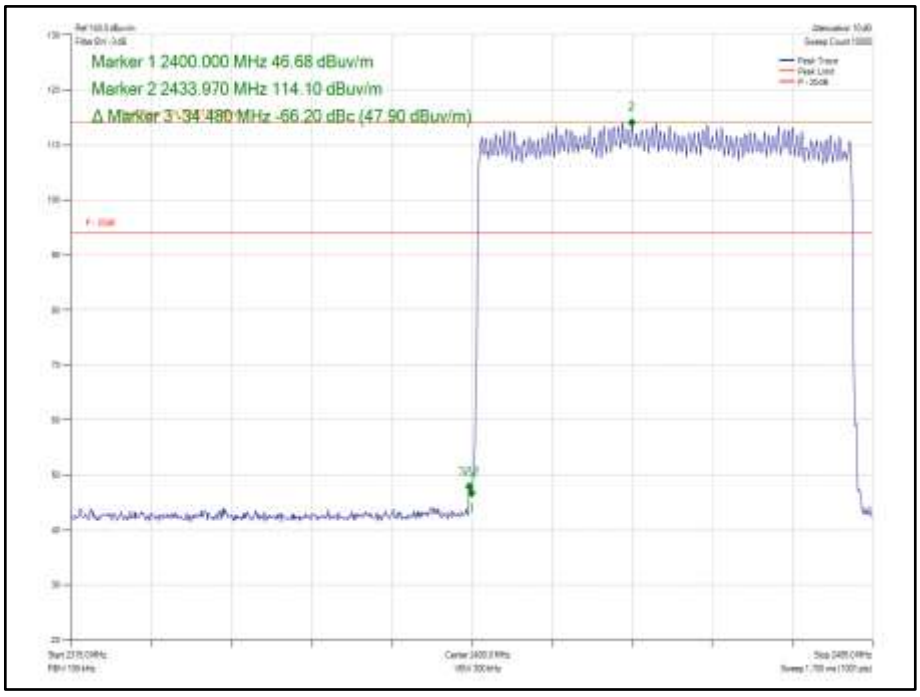

Figure 112 - Hopping Core 1 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

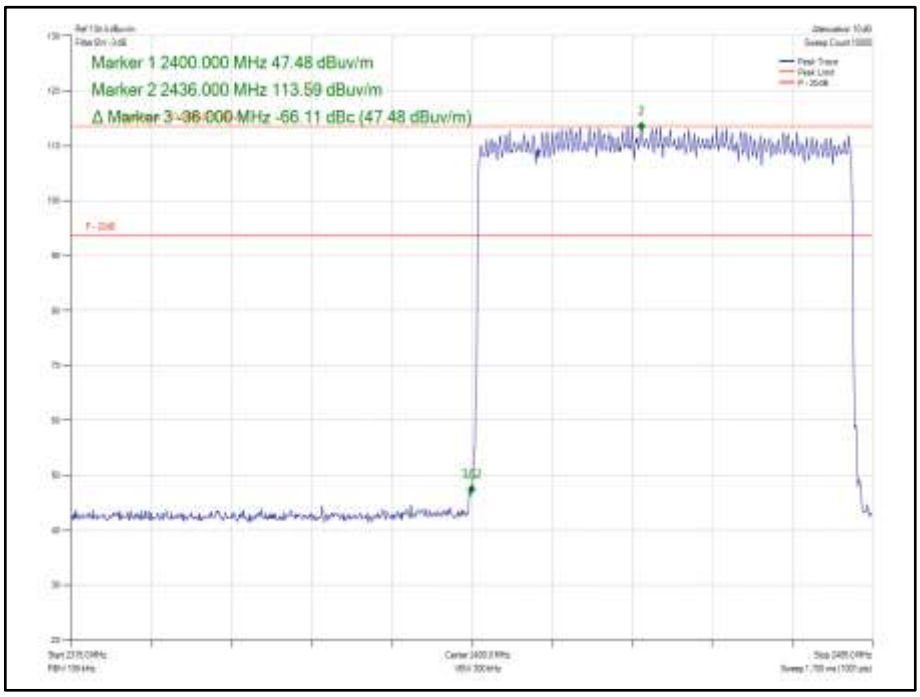

Figure 113 - Hopping Core 1 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Level (dBc)
Static Core 0-1	GFSK	DH5	2402	2400.0	-68.30
Static Core 0-1	π/4 DQPSK	2DH5	2402	2400.0	-62.86
Static Core 0-1	8-DPSK	3DH5	2402	2400.0	-62.93
Hopping Core 0-1	GFSK	DH5	2402	2400.0	-67.61
Hopping Core 0-1	π/4 DQPSK	2DH5	2402	2400.0	-64.68
Hopping Core 0-1	8-DPSK	3DH5	2402	2400.0	-64.91

Table 47 - MIMO 2TX Authorised Band Edge Results

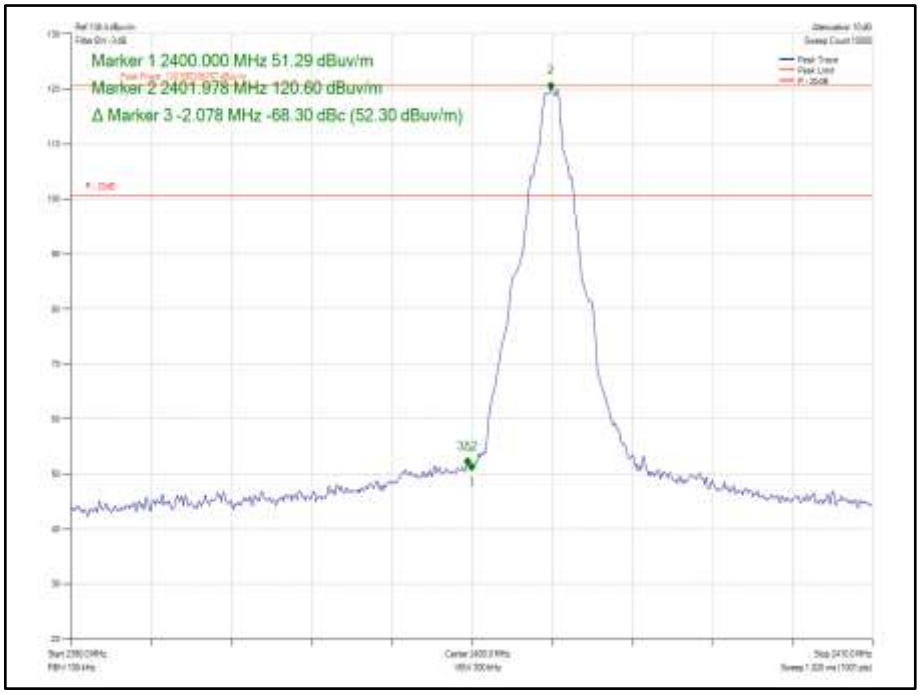

Figure 114 - Static Core 0-1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

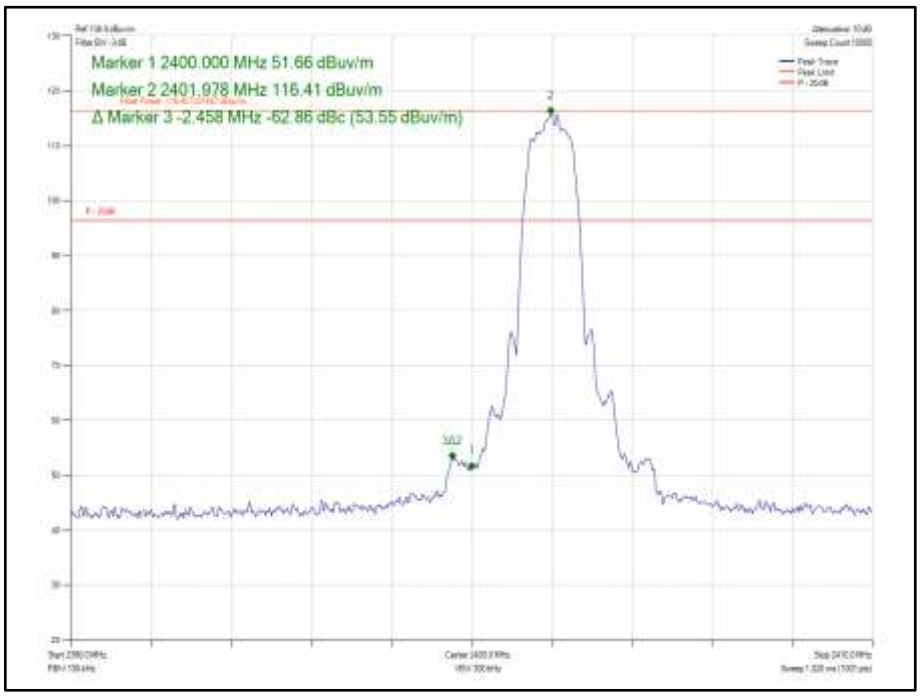

Figure 115 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

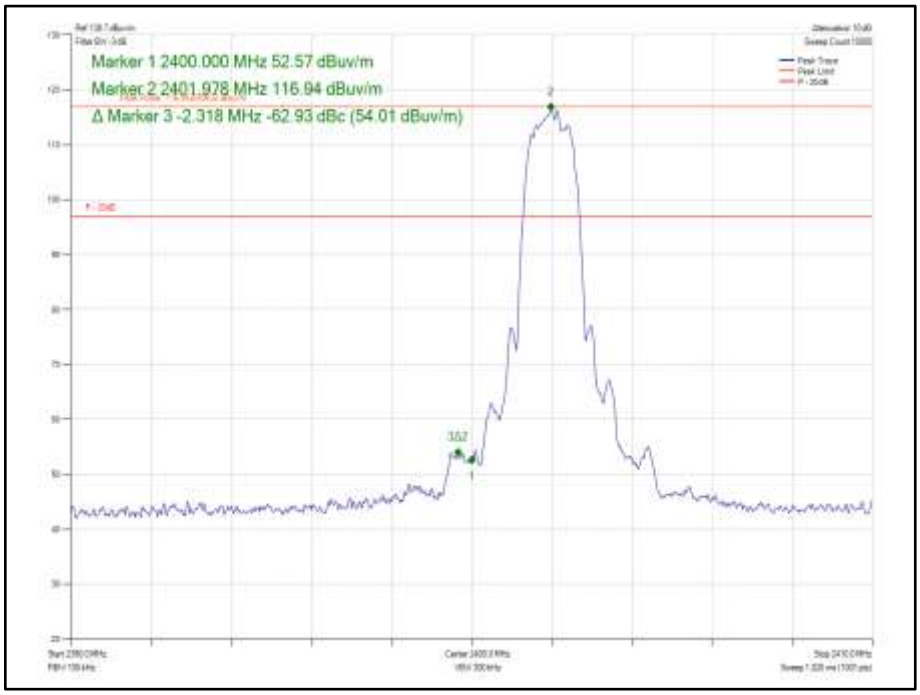

Figure 116 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

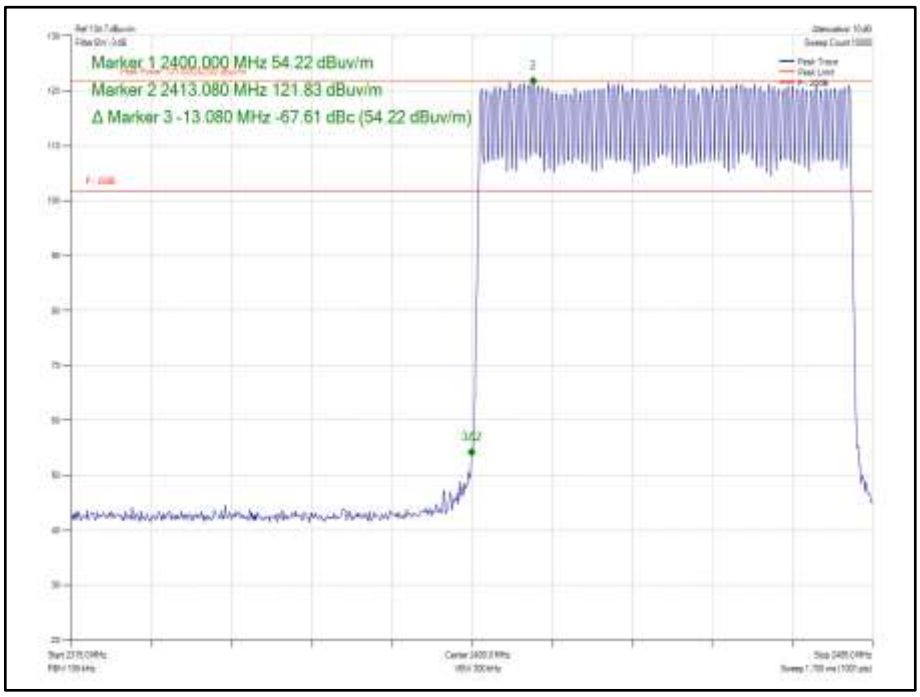

Figure 117 - Hopping Core 0-1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

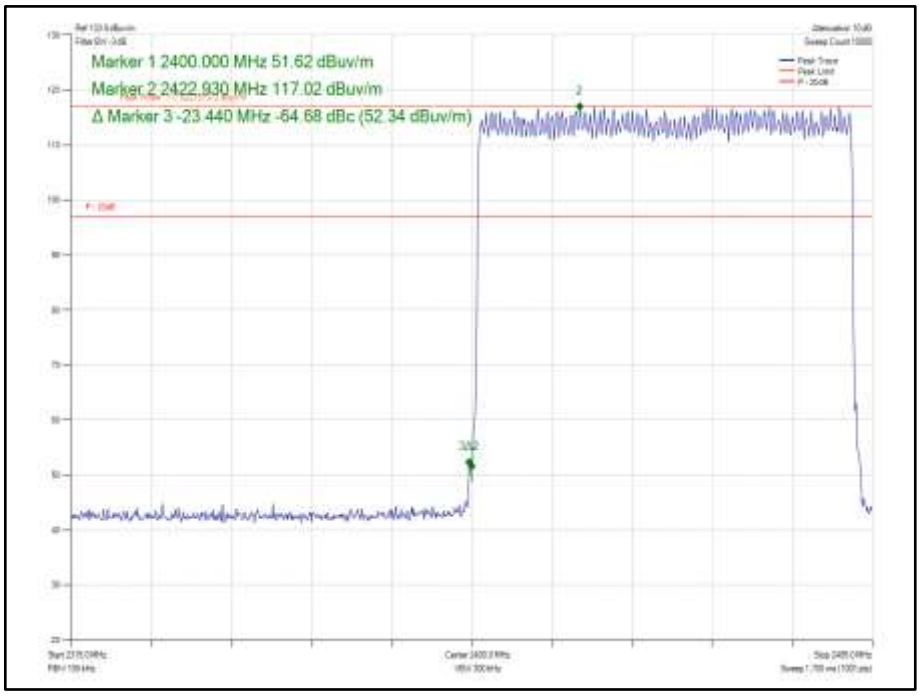

Figure 118 - Hopping Core 0-1 - π/4 DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

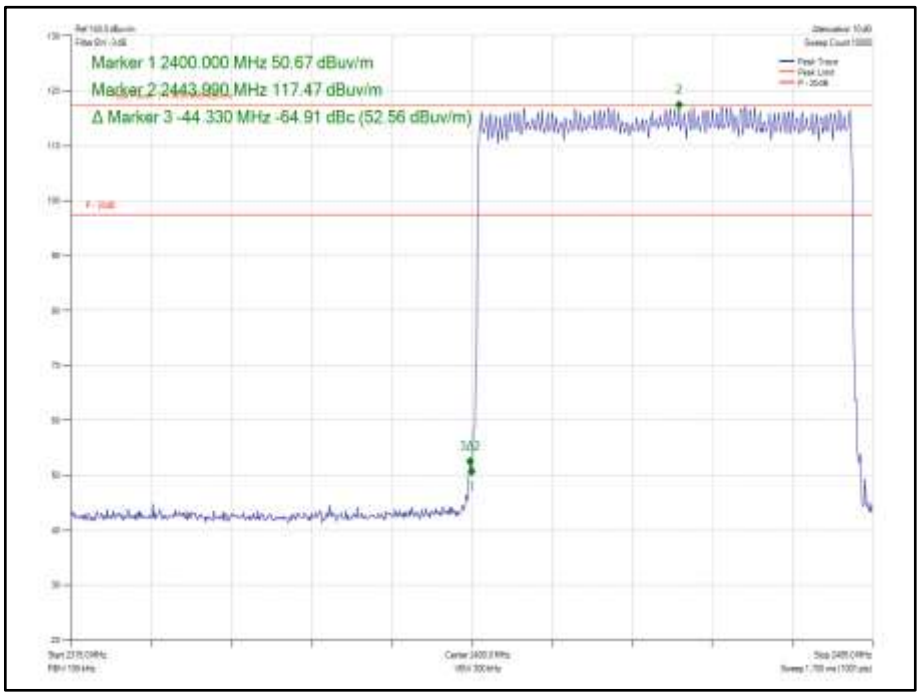

Figure 119 - Hopping Core 0-1- 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	08-Nov-2020
Multimeter	Iso-tech	IDM101	2424	12	12-Dec-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Nov-2020
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	19-Mar-2021
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
EmX Emissions Software	TUV SUD	V2.0.1	5125	-	Software
Screened Room (11)	Rainford	Rainford	5136	36	01-Nov-2021
Pressure Transducer	Omega	PXM409-002BAUSBH	5156	-	TU
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
AC Programmable Power Supply	iTech	IT7324	5225	-	O/P Mon
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	06-May-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5494	12	14-Apr-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
MXA Signal Analyser	Keysight Technologies	N9020B	5528	24	04-Mar-2022
Signal Commissioning Unit	TUV SUD	SCU001	5546	12	15-Apr-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	08-Sep-2021

Table 48

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

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

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.7.3 Date of Test

24-June-2020 to 27-June-2020

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).

2.7.5 Environmental Conditions

Ambient Temperature	20.7 °C to 23.8 °C
Relative Humidity	44.8 % to 53.7 %

2.7.6 Test Results

2.4 GHz Bluetooth - FHSS

iPA

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 0	GFSK	DH5	2402	2390.0	53.44	39.60
Static Core 0	π/4 DQPSK	2DH5	2402	2390.0	53.68	39.62
Static Core 0	8-DPSK	3DH5	2402	2390.0	53.77	39.59
Static Core 0	GFSK	DH5	2480	2483.5	56.07	41.41
Static Core 0	π/4 DQPSK	2DH5	2480	2483.5	52.70	40.28
Static Core 0	8-DPSK	3DH5	2480	2483.5	52.14	40.33

Table 49 - SISO Restricted Band Edge Results

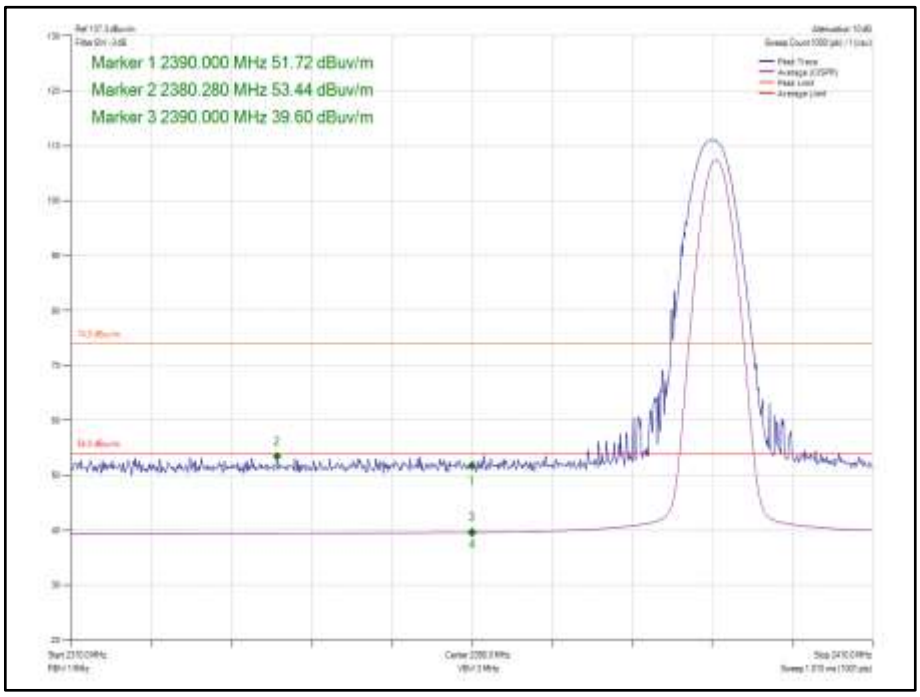

Figure 120 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

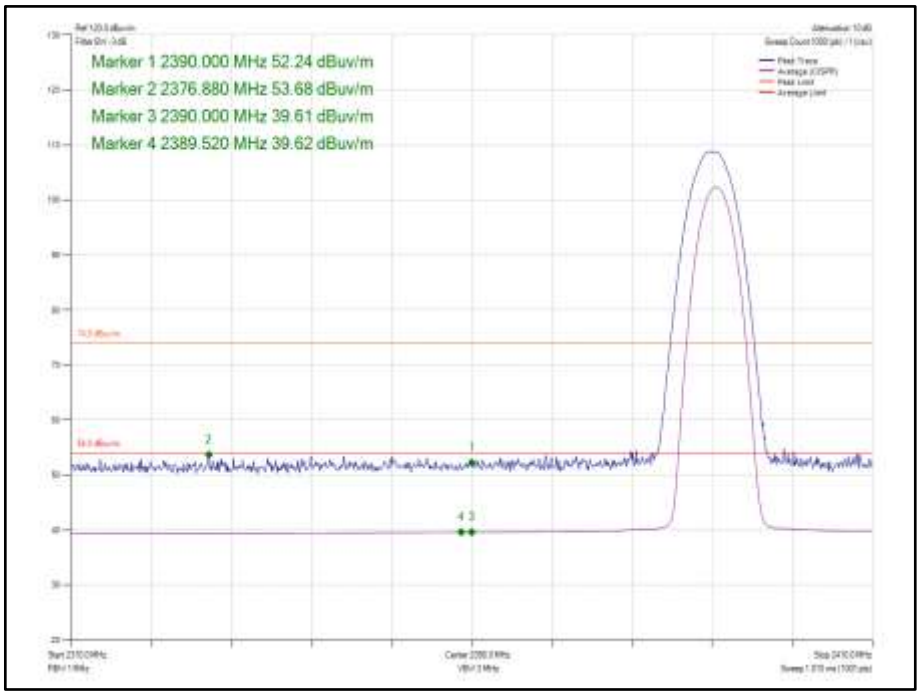

Figure 121 - Static Core 0 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

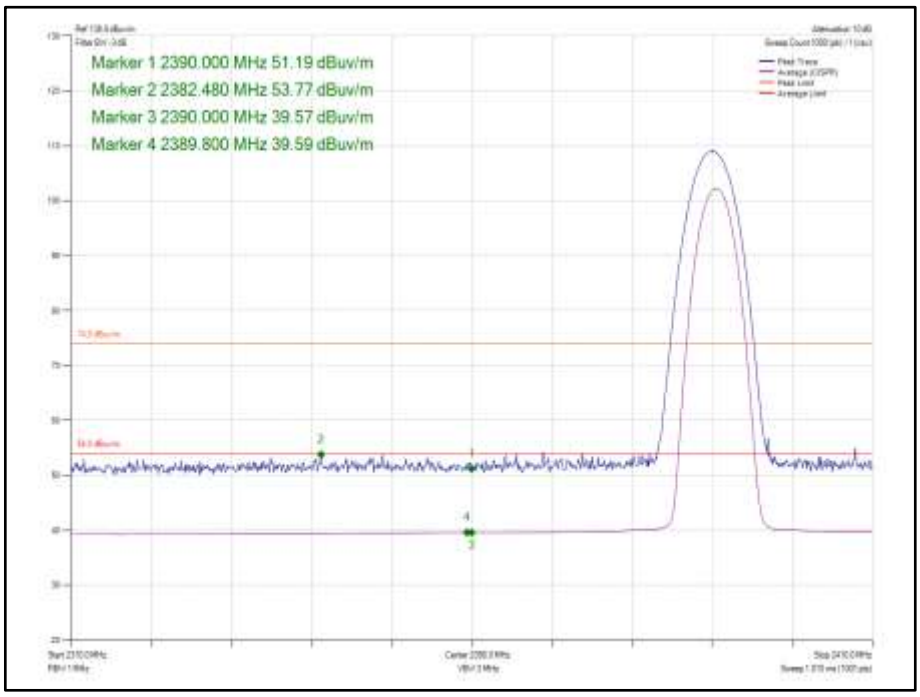

Figure 122 - Static Core 0 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

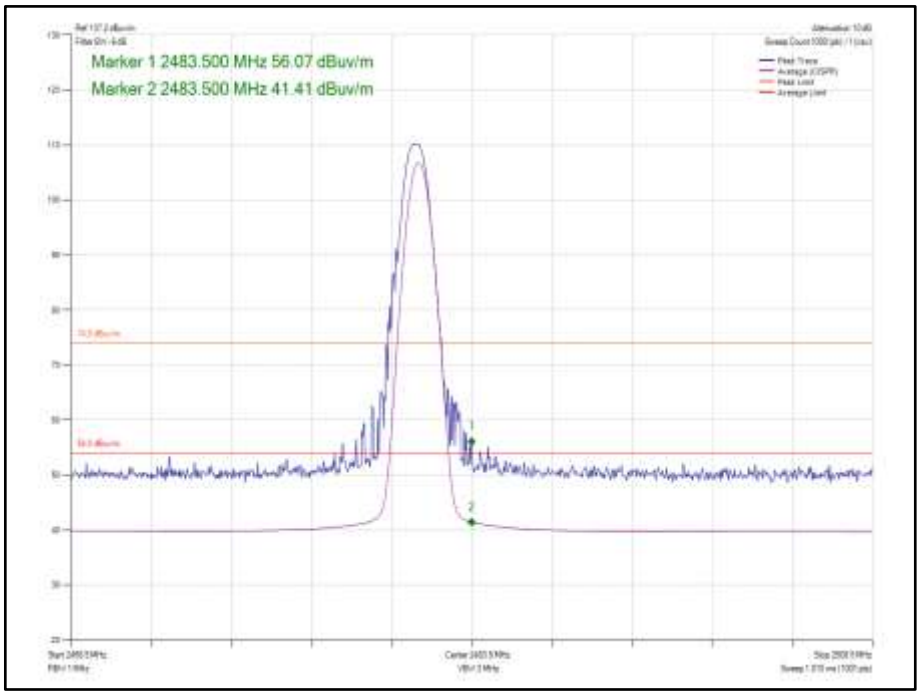

Figure 123 - Static Core 0 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

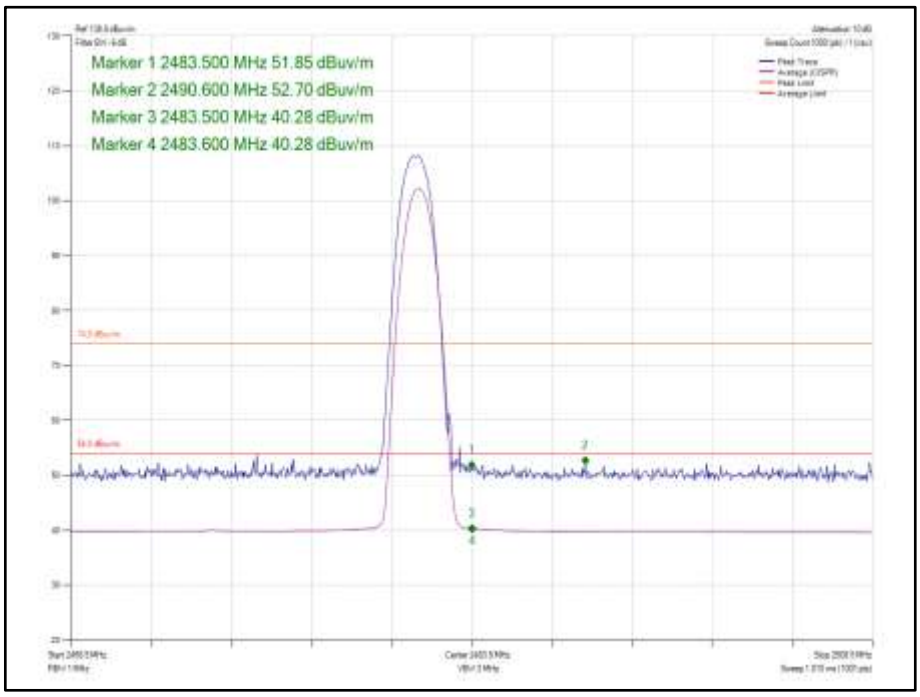

Figure 124 - Static Core 0 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

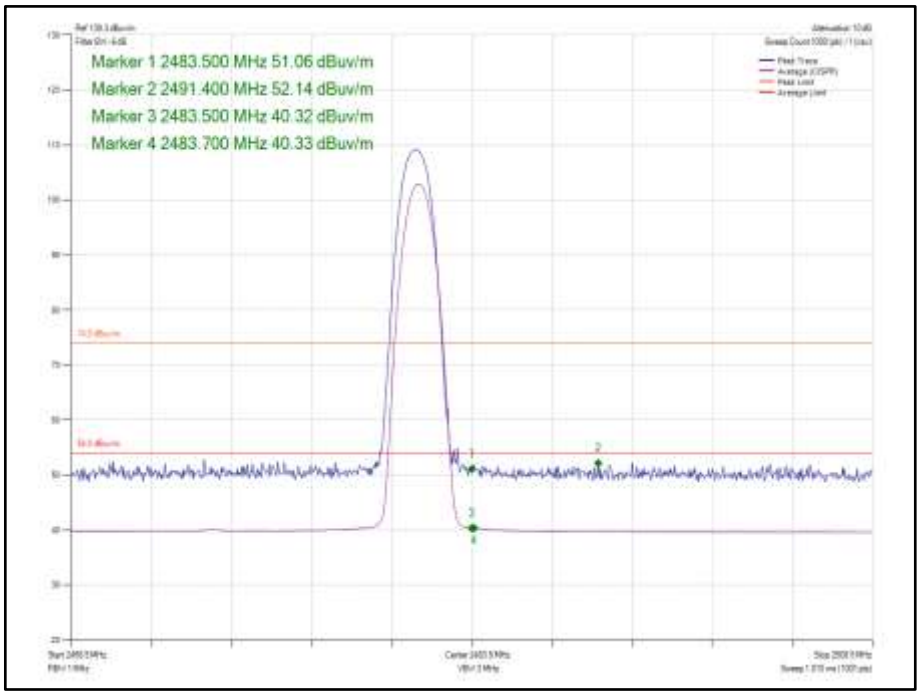

Figure 125 - Static Core 0 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 1	GFSK	DH5	2402	2390.0	54.51	39.64
Static Core 1	π/4 DQPSK	2DH5	2402	2390.0	53.71	39.70
Static Core 1	8-DPSK	3DH5	2402	2390.0	53.38	39.70
Static Core 1	GFSK	DH5	2480	2483.5	56.48	41.80
Static Core 1	π/4 DQPSK	2DH5	2480	2483.5	52.47	40.28
Static Core 1	8-DPSK	3DH5	2480	2483.5	52.36	40.22

Table 50 - SISO Restricted Band Edge Results

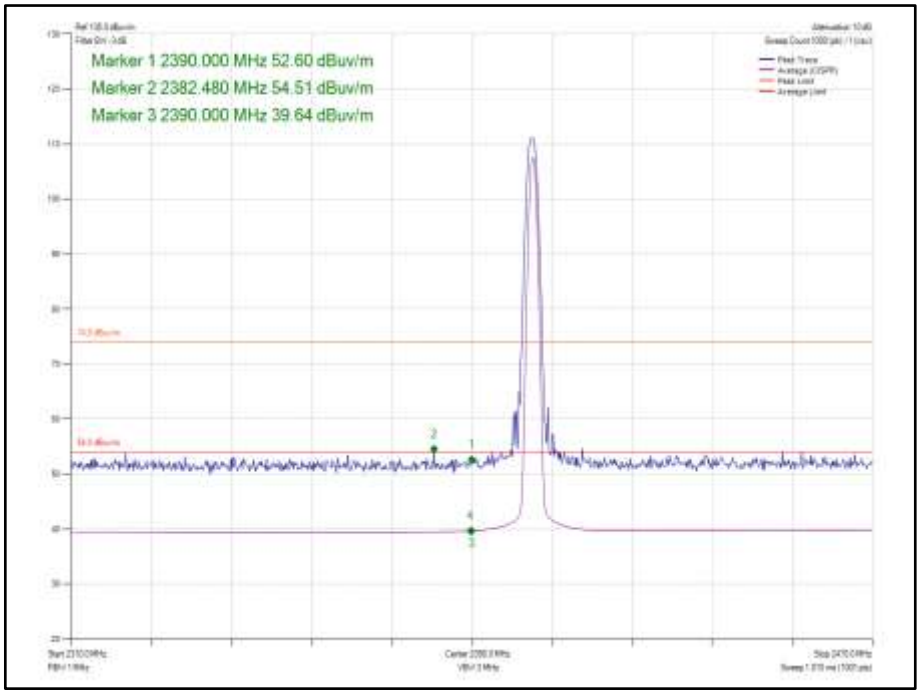

Figure 126 - Static Core 1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

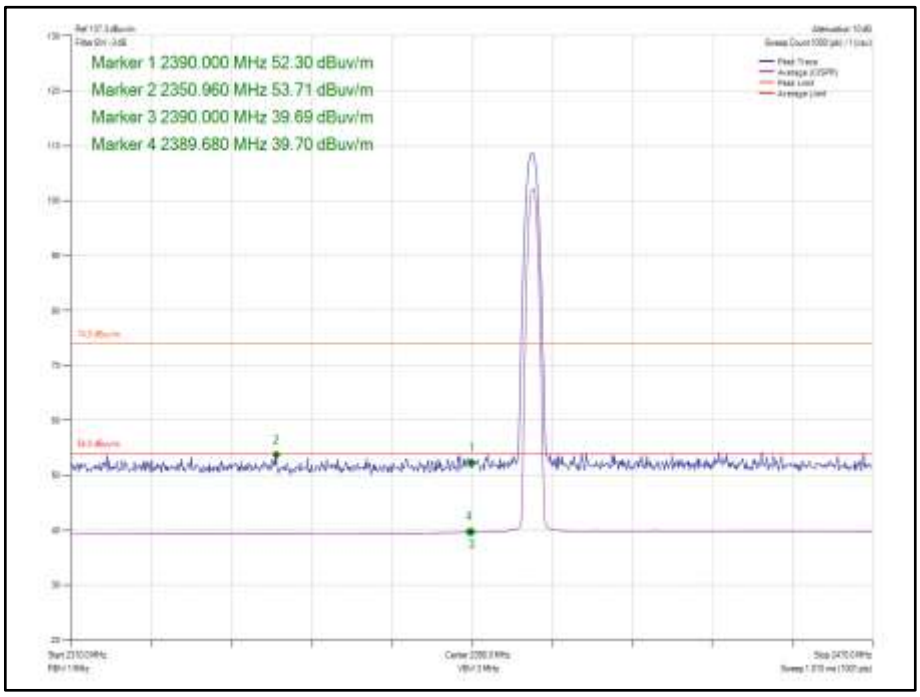

Figure 127 - Static Core 1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

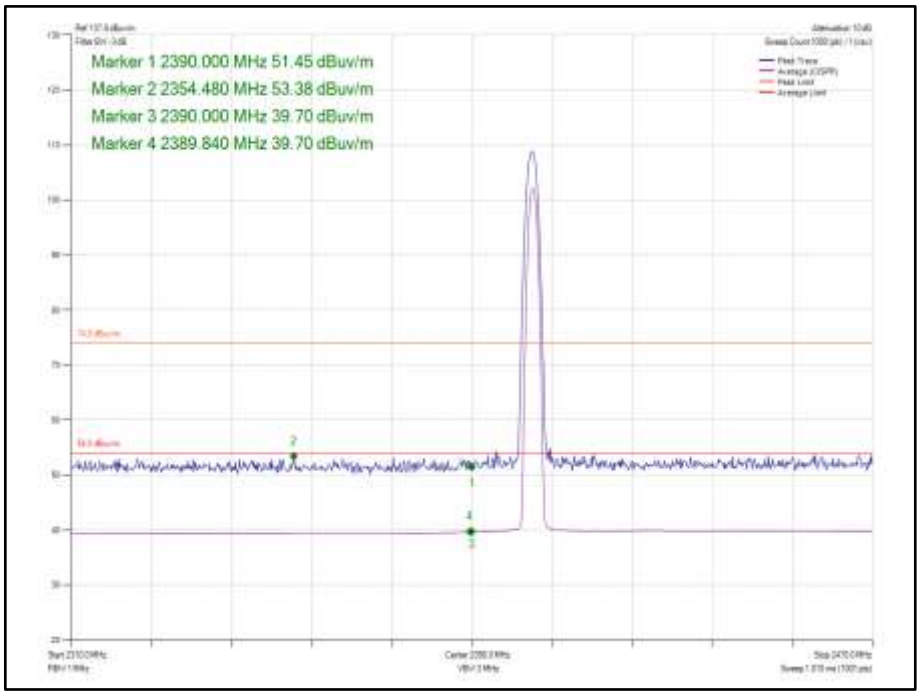

Figure 128 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

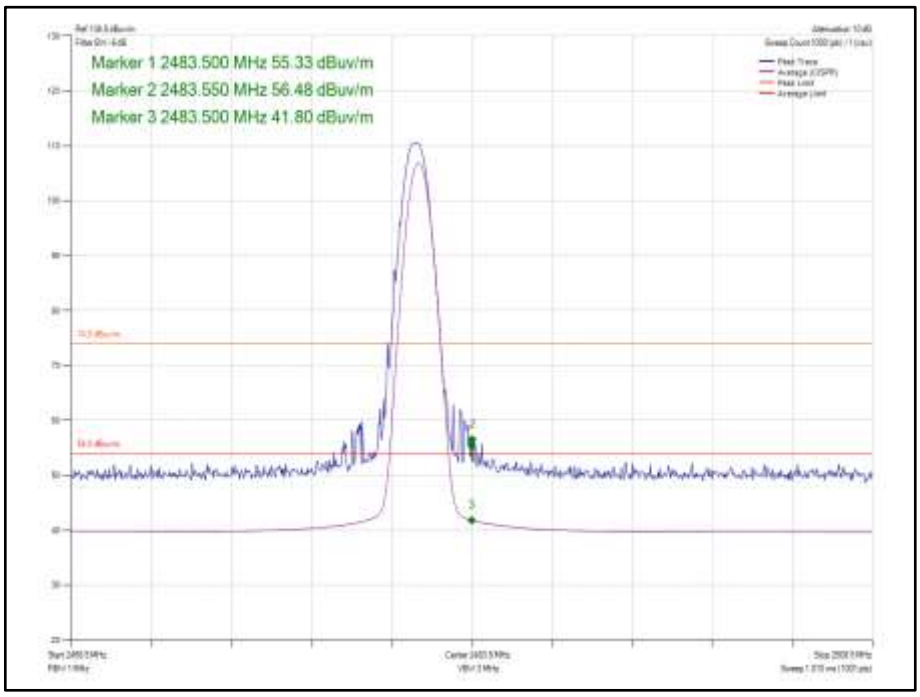

Figure 129 - Static Core 1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

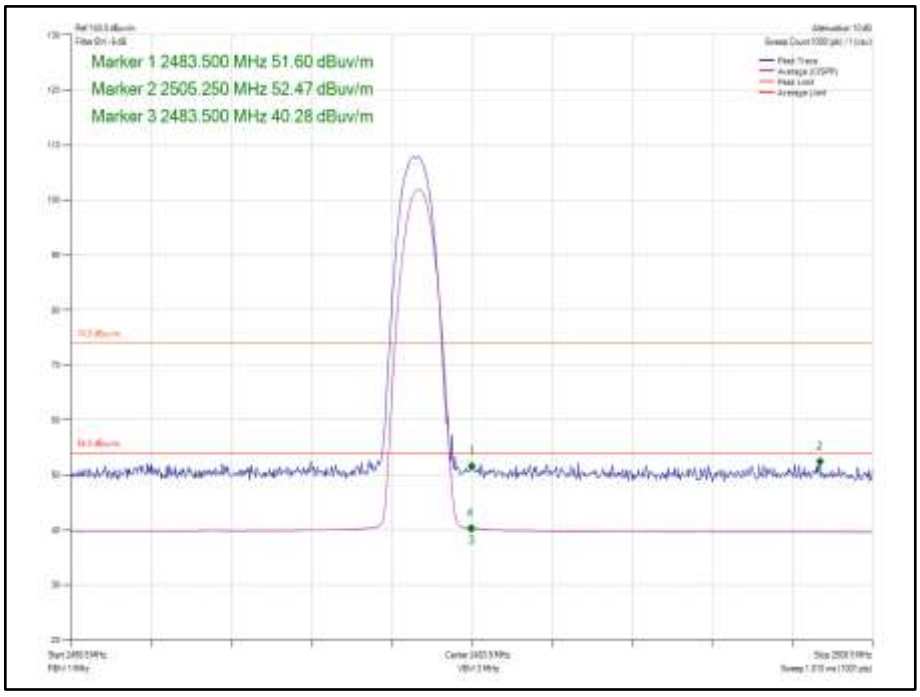

Figure 130 - Static Core 1 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

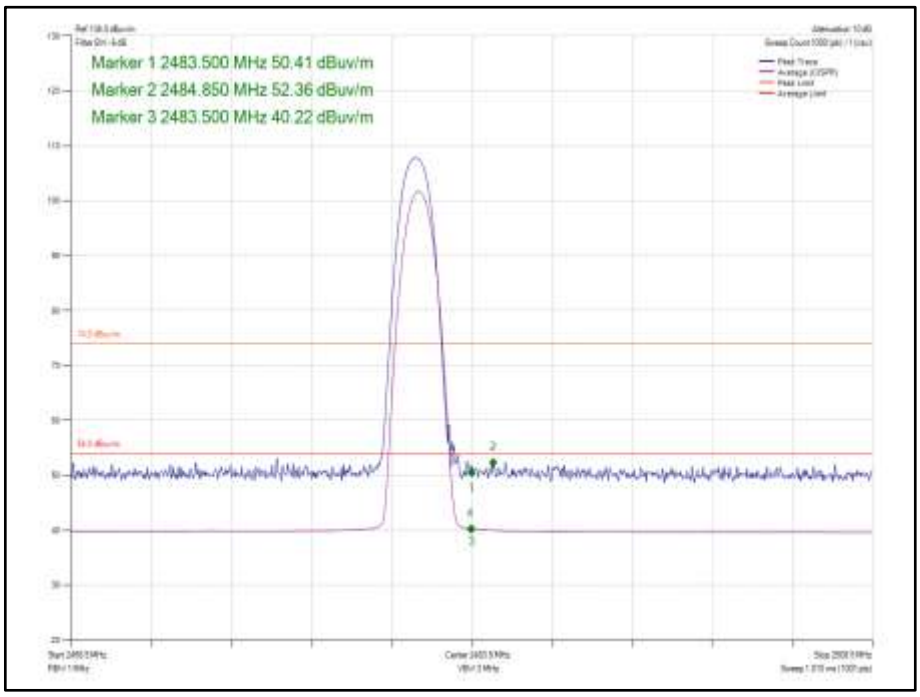

Figure 131 - Static Core 1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 2	GFSK	DH5	2402	2390.0	53.71	40.42
Static Core 2	π/4 DQPSK	2DH5	2402	2390.0	54.14	40.24
Static Core 2	8-DPSK	3DH5	2402	2390.0	54.08	40.17
Static Core 2	GFSK	DH5	2480	2483.5	56.83	43.64
Static Core 2	π/4 DQPSK	2DH5	2480	2483.5	54.93	42.23
Static Core 2	8-DPSK	3DH5	2480	2483.5	56.21	42.24

Table 51 - SISO Restricted Band Edge Results

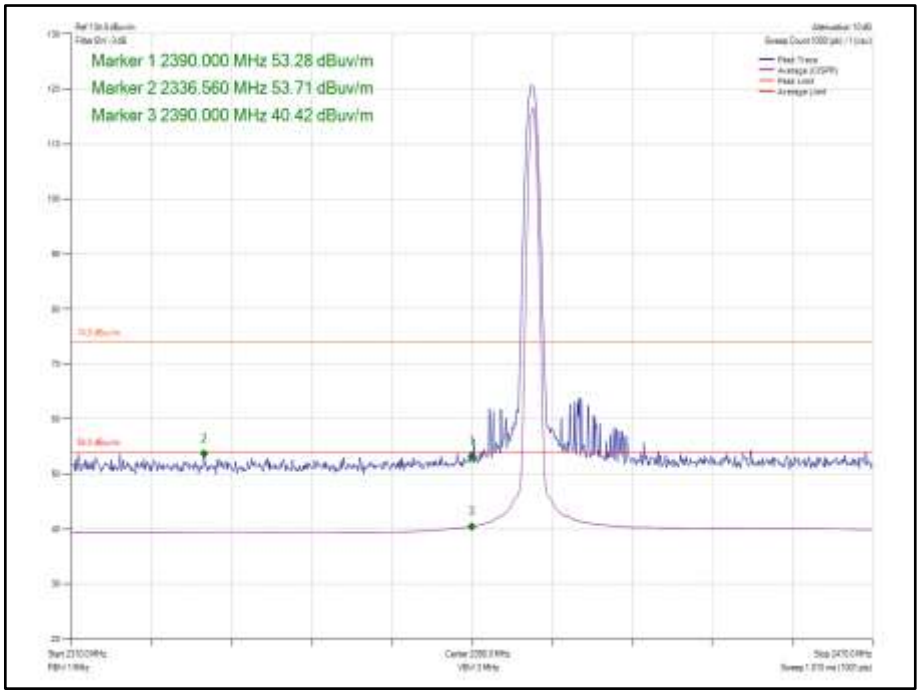

Figure 132 - Static Core 2 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

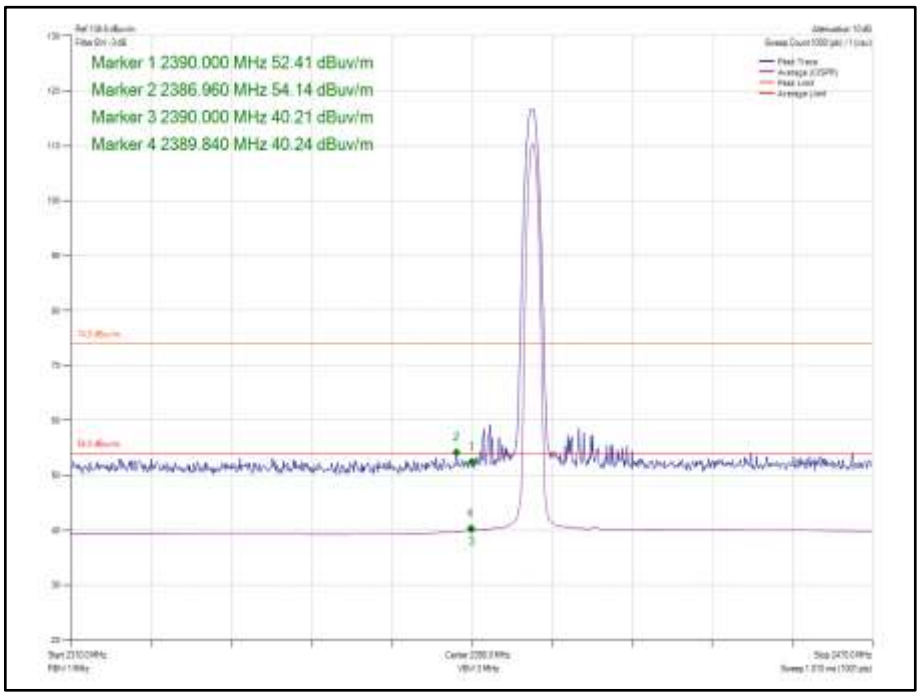

Figure 133 - Static Core 2 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

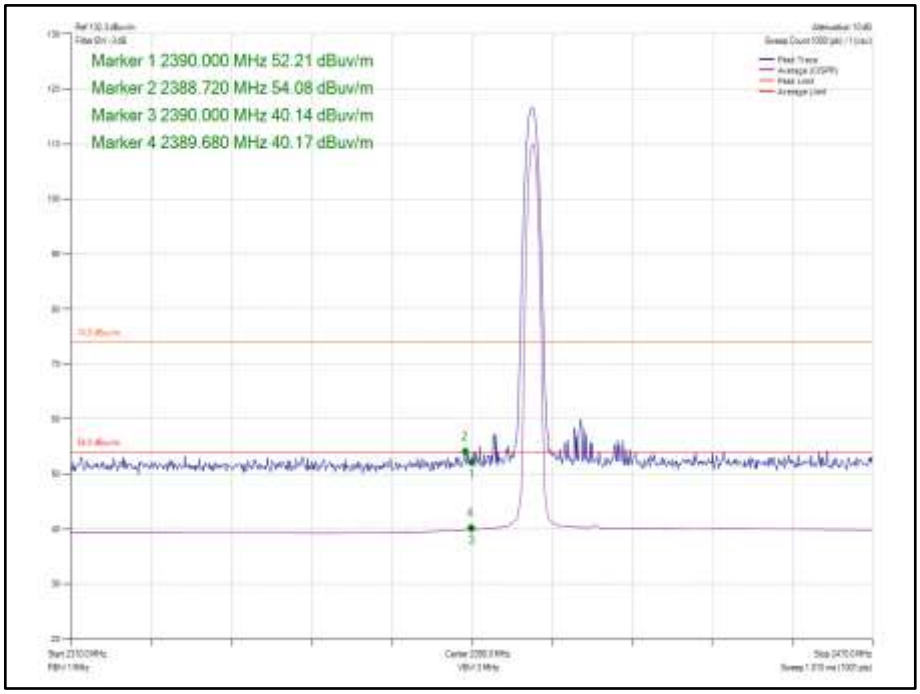

Figure 134 - Static Core 2 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

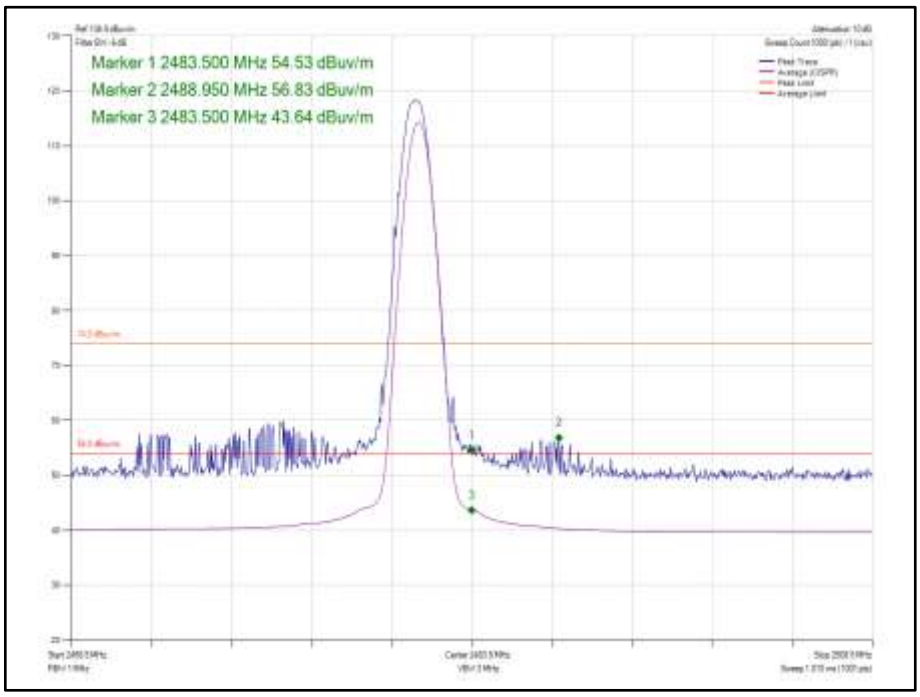

Figure 135 - Static Core 2 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

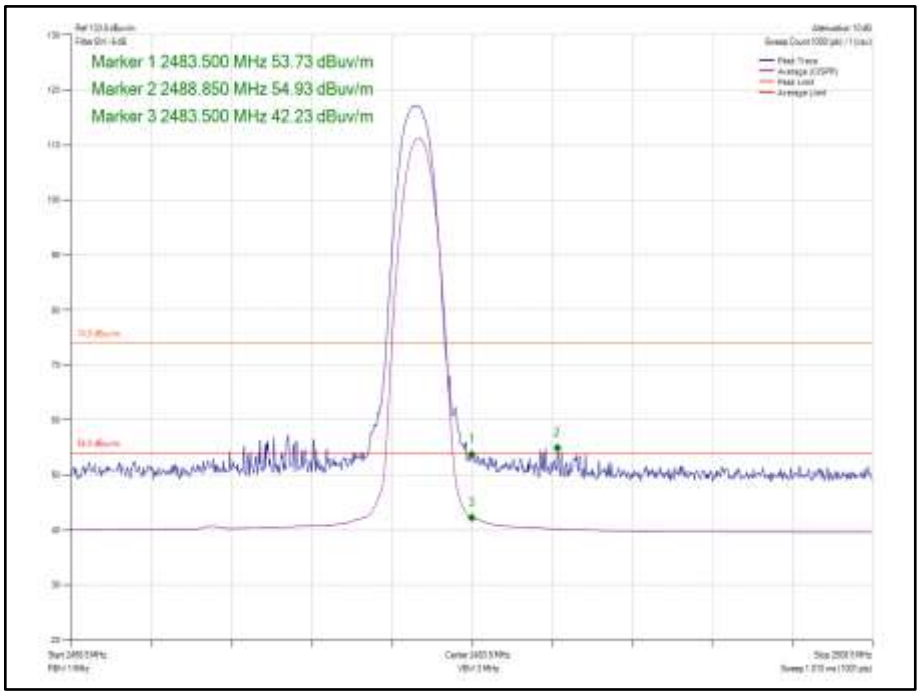

Figure 136 - Static Core 2 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

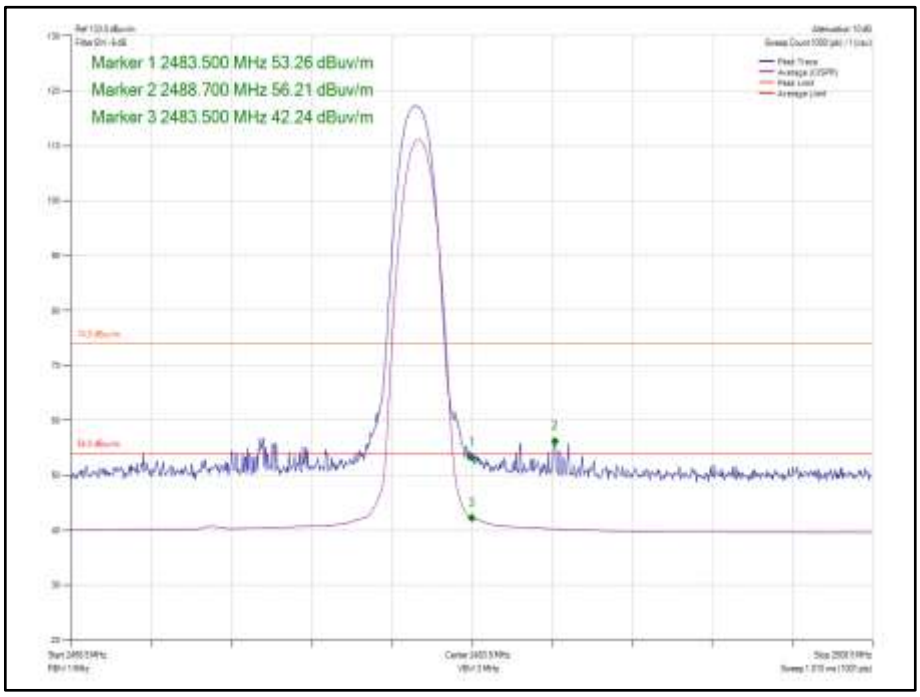

Figure 137 - Static Core 2 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 0-1	GFSK	DH5	2402	2390.0	54.69	39.78
Static Core 0-1	π/4 DQPSK	2DH5	2402	2390.0	53.35	39.73
Static Core 0-1	8-DPSK	3DH5	2402	2390.0	53.71	39.68
Static Core 0-1	GFSK	DH5	2480	2483.5	55.81	43.08
Static Core 0-1	π/4 DQPSK	2DH5	2480	2483.5	53.54	40.76
Static Core 0-1	8-DPSK	3DH5	2480	2483.5	53.64	40.63

Table 52 - MIMO 2Tx Restricted Band Edge Results

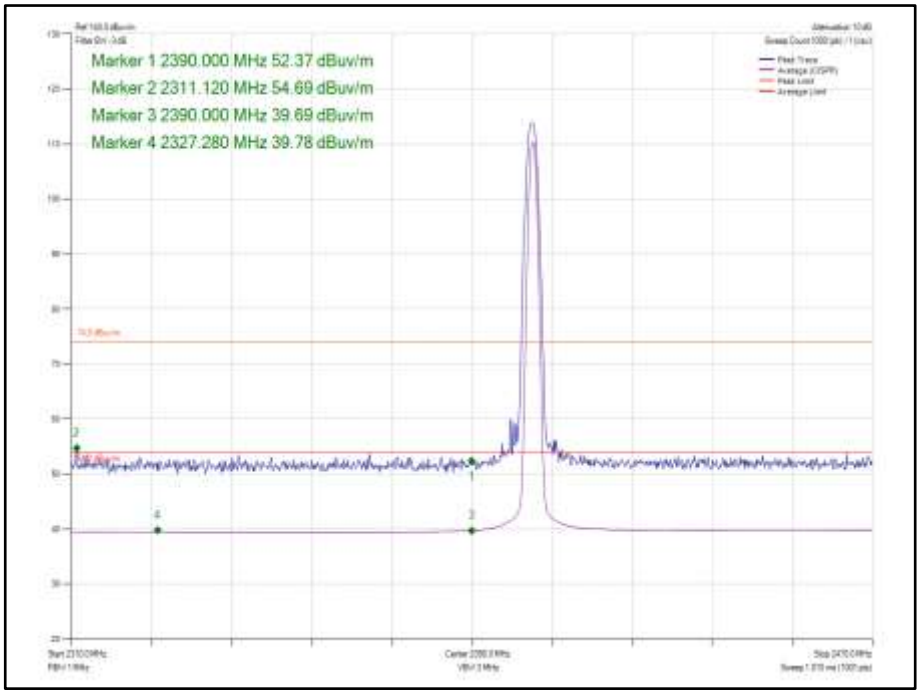

Figure 138 - Static Core 0-1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

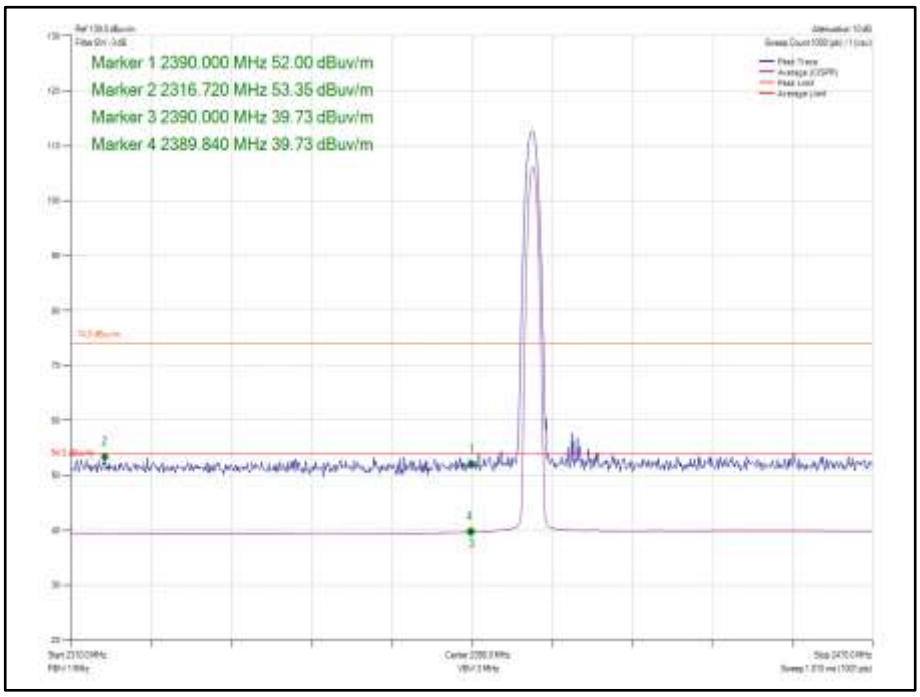

Figure 139 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

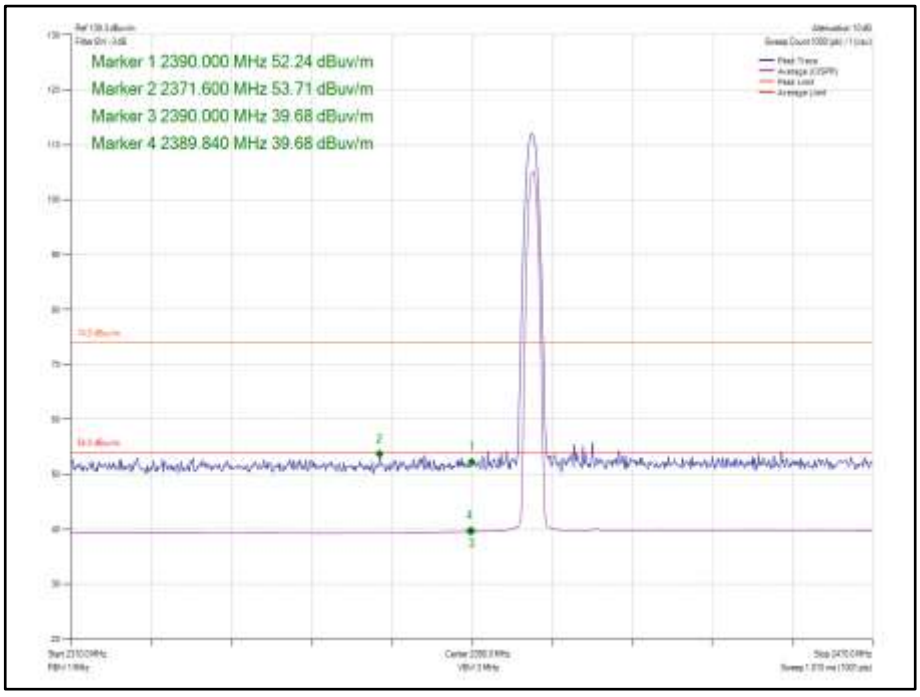

Figure 140 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

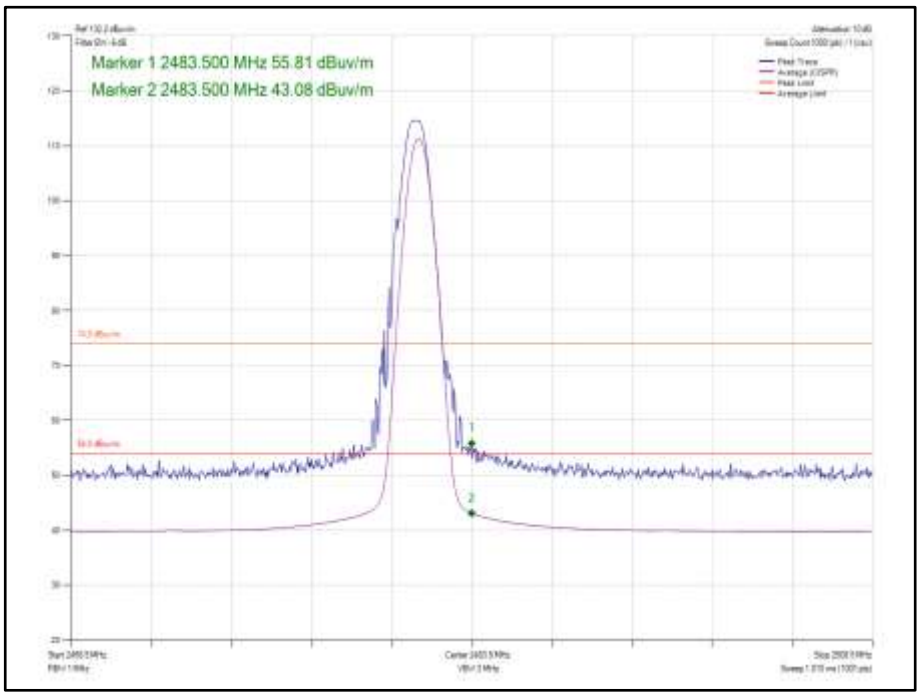

Figure 141 - Static Core 0-1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

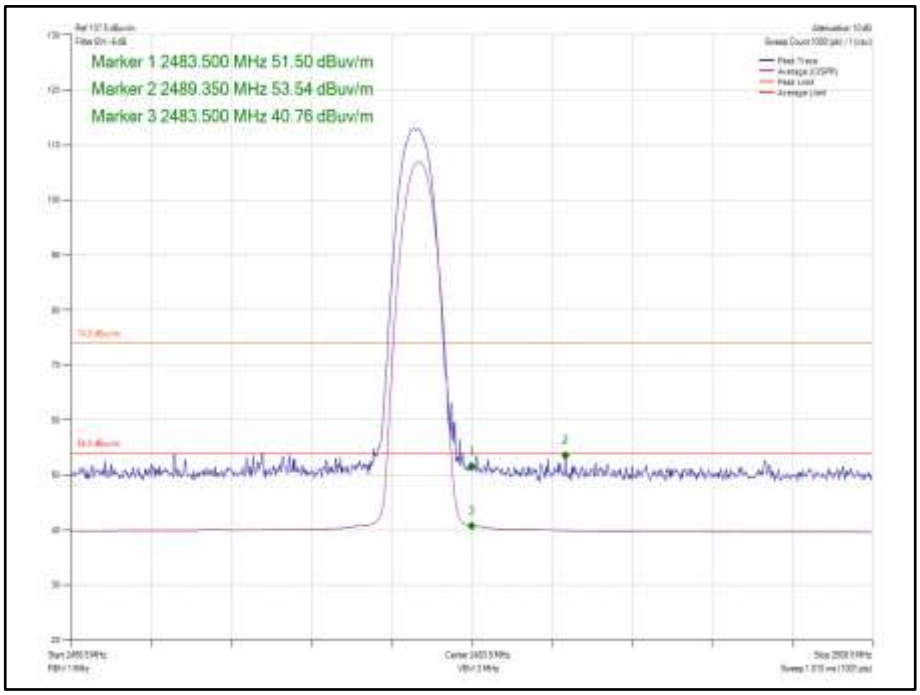

Figure 142 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

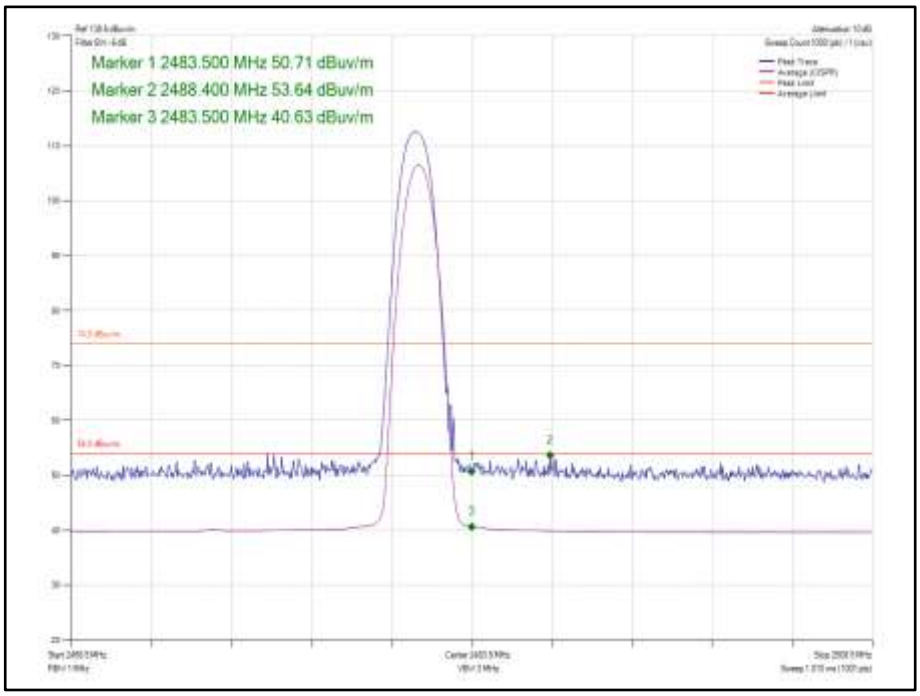

Figure 143 - Static Core 0-1- 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

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Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 0	GFSK	DH5	2402	2390.0	56.96	40.35
Static Core 0	π/4 DQPSK	2DH5	2402	2390.0	54.43	40.22
Static Core 0	8-DPSK	3DH5	2402	2390.0	54.05	40.23
Static Core 0	GFSK	DH5	2480	2483.5	56.80	44.22
Static Core 0	π/4 DQPSK	2DH5	2480	2483.5	55.53	43.08
Static Core 0	8-DPSK	3DH5	2480	2483.5	56.14	43.33

Table 53 - SISO Restricted Band Edge Results

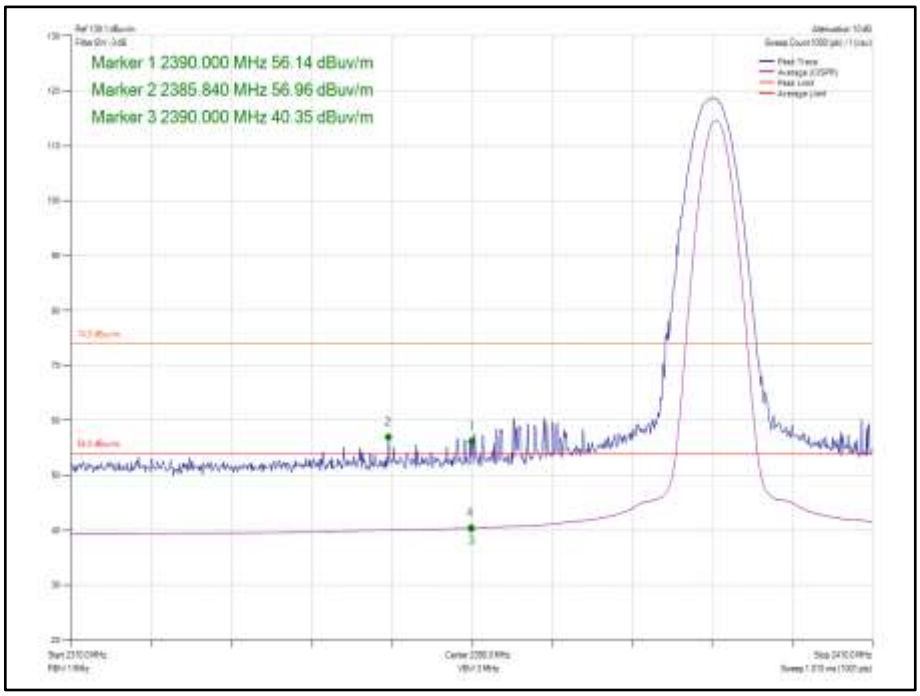

Figure 144 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

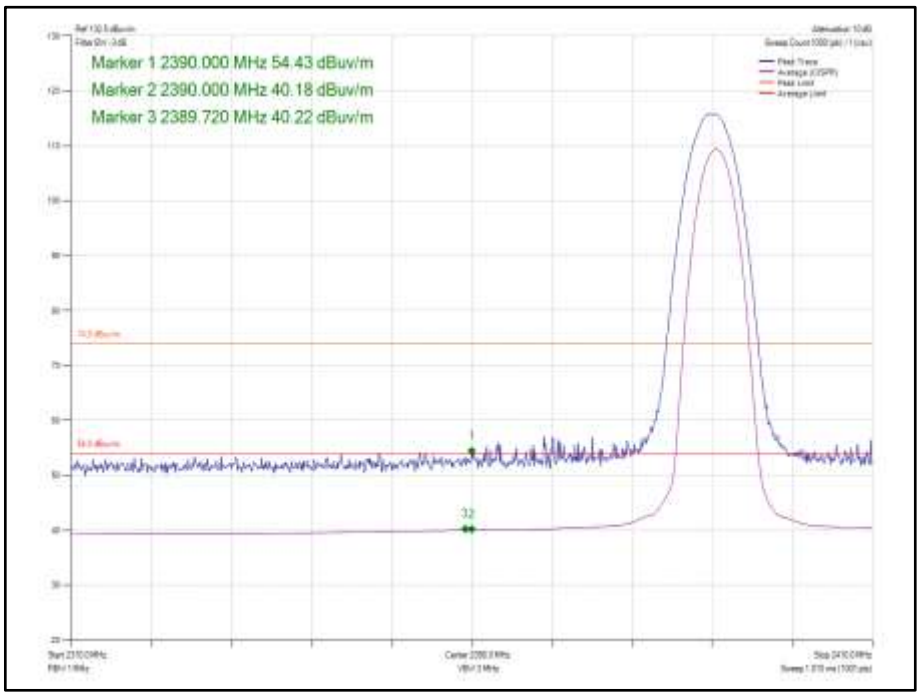

Figure 145 - Static Core 0 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

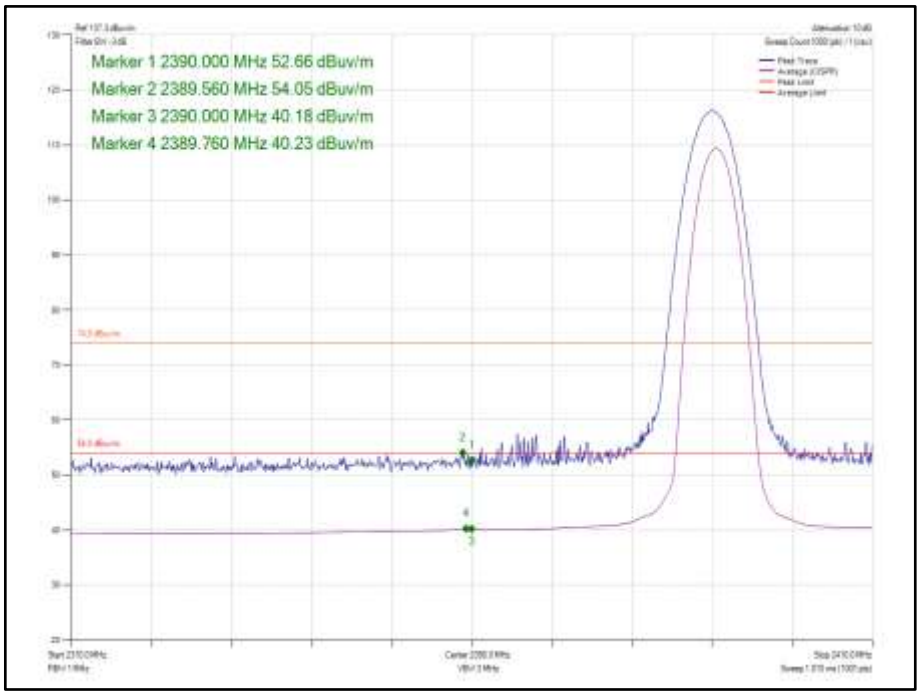

Figure 146 - Static Core 0 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

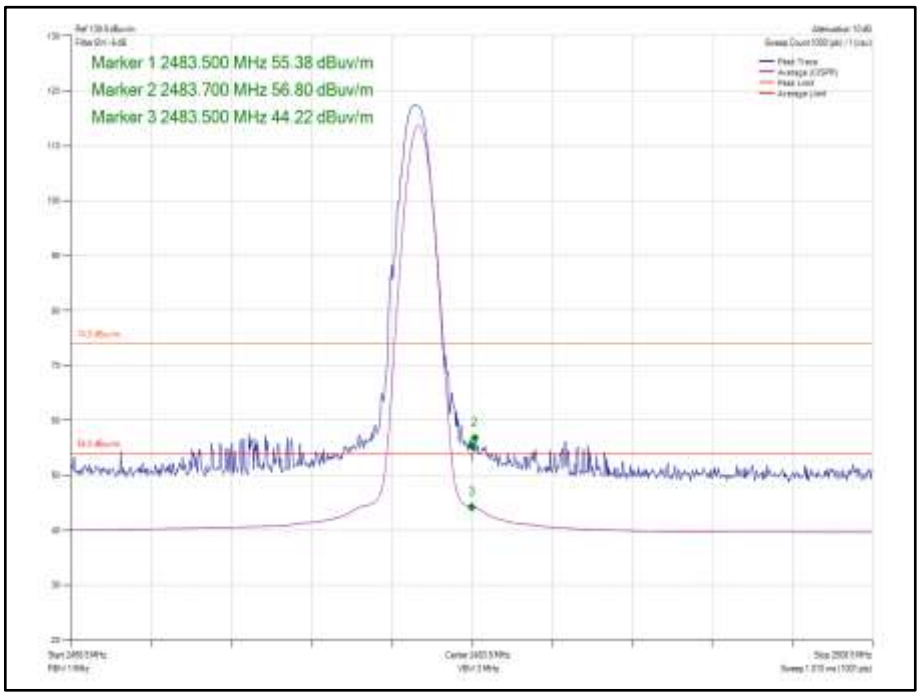

Figure 147 - Static Core 0 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

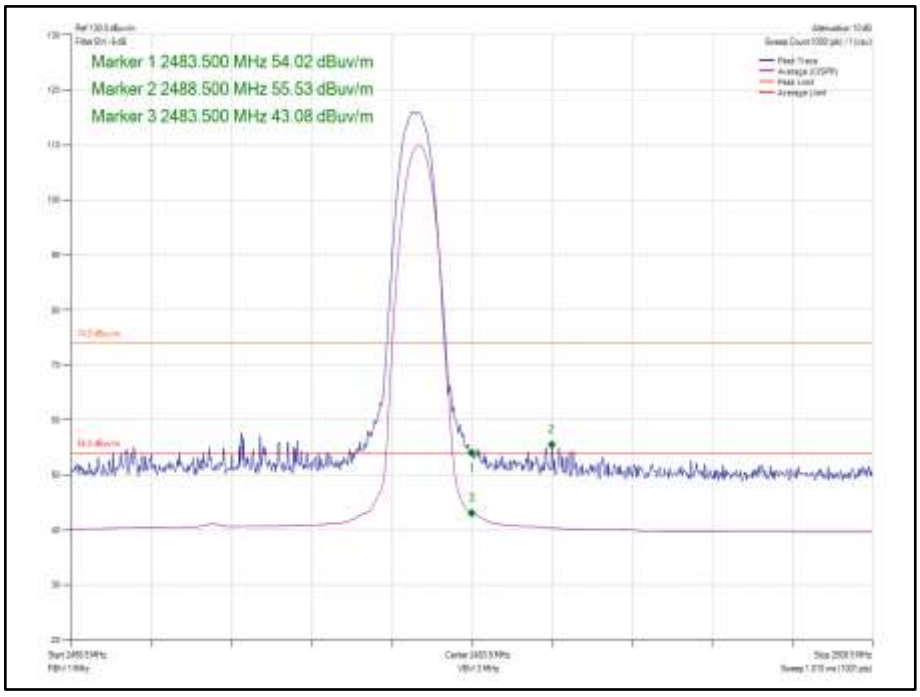

Figure 148 - Static Core 0 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

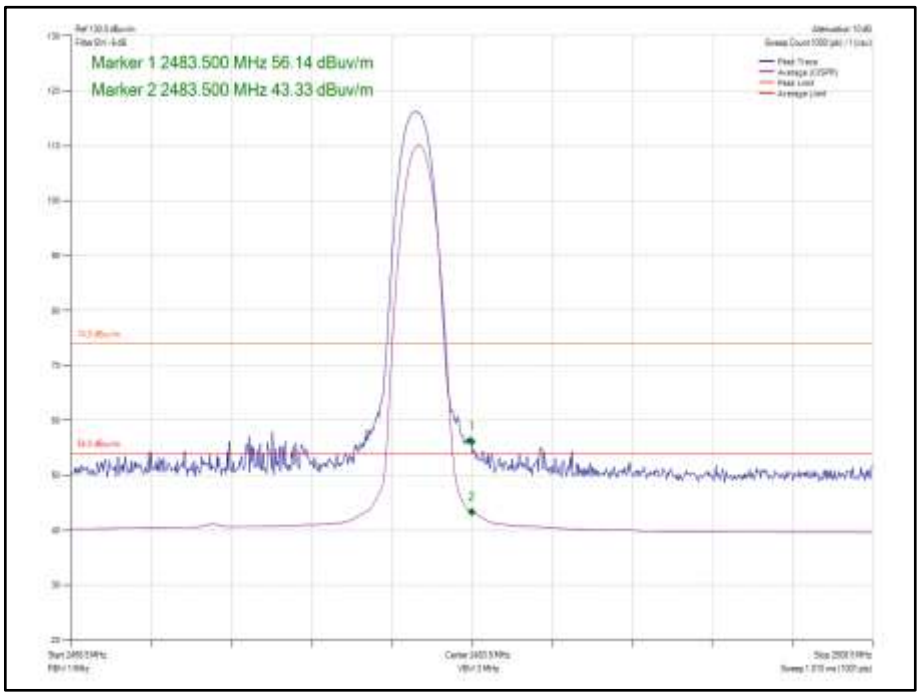

Figure 149 - Static Core 0 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 1	GFSK	DH5	2402	2390.0	59.96	40.60
Static Core 1	π/4 DQPSK	2DH5	2402	2390.0	53.69	40.26
Static Core 1	8-DPSK	3DH5	2402	2390.0	56.20	40.33
Static Core 1	GFSK	DH5	2480	2483.5	57.87	45.07
Static Core 1	π/4 DQPSK	2DH5	2480	2483.5	54.00	41.83
Static Core 1	8-DPSK	3DH5	2480	2483.5	54.85	41.87

Table 54 - SISO Restricted Band Edge Results

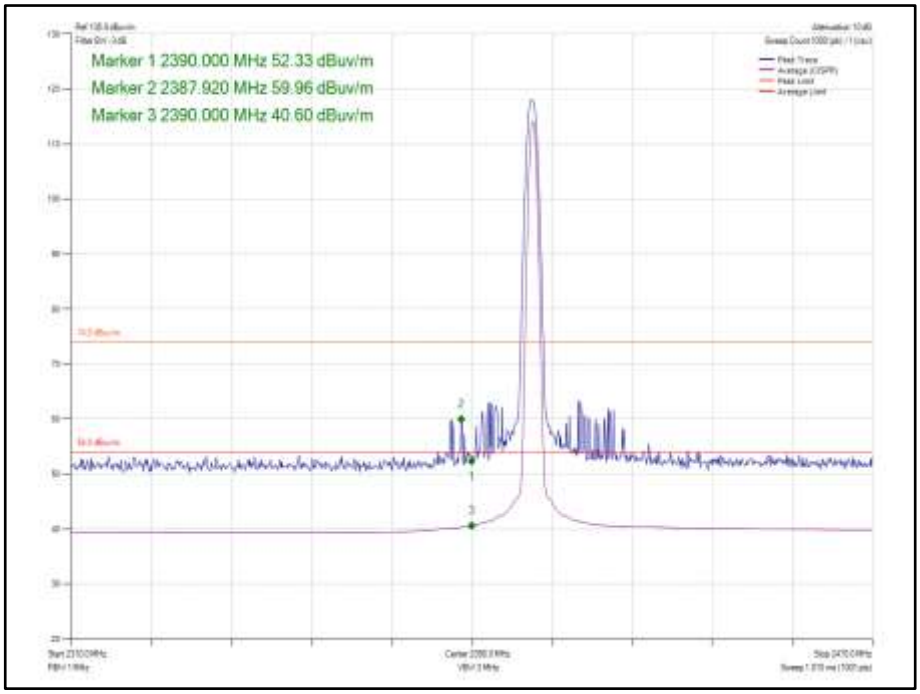

Figure 150 - Static Core 1- GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

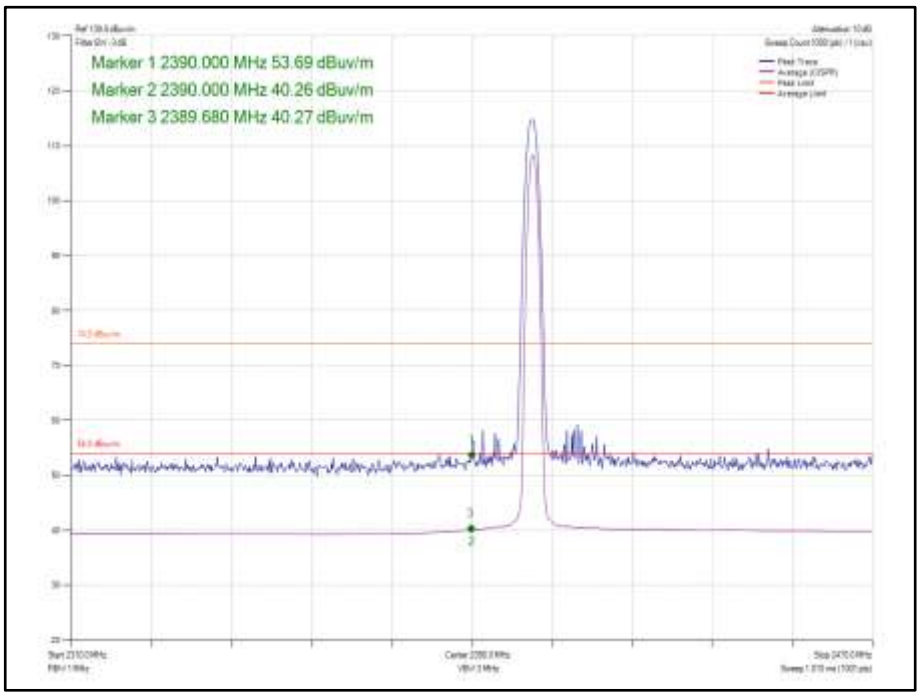

Figure 151 - Static Core 1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

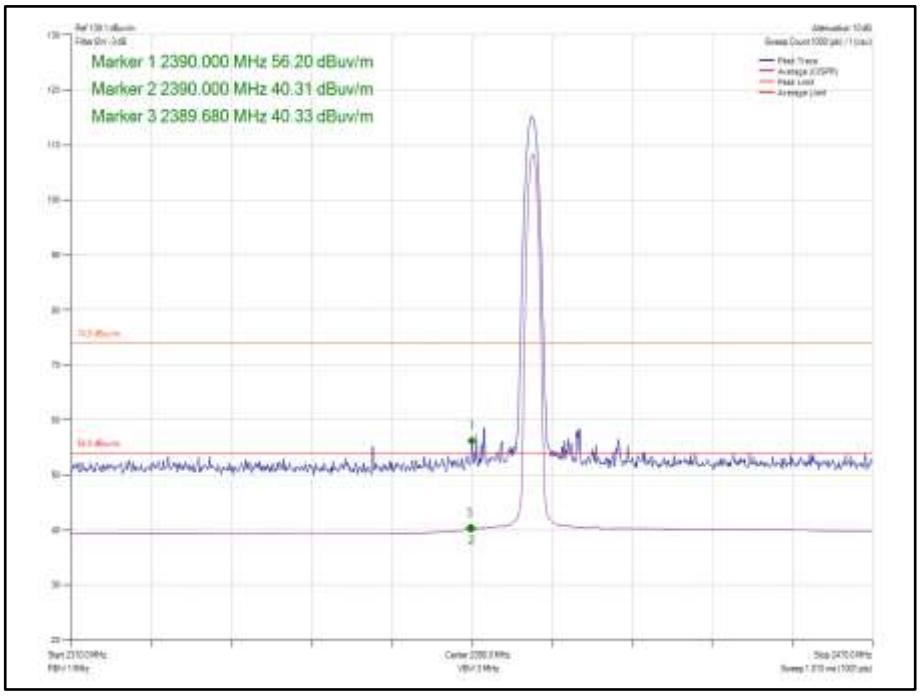

Figure 152 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

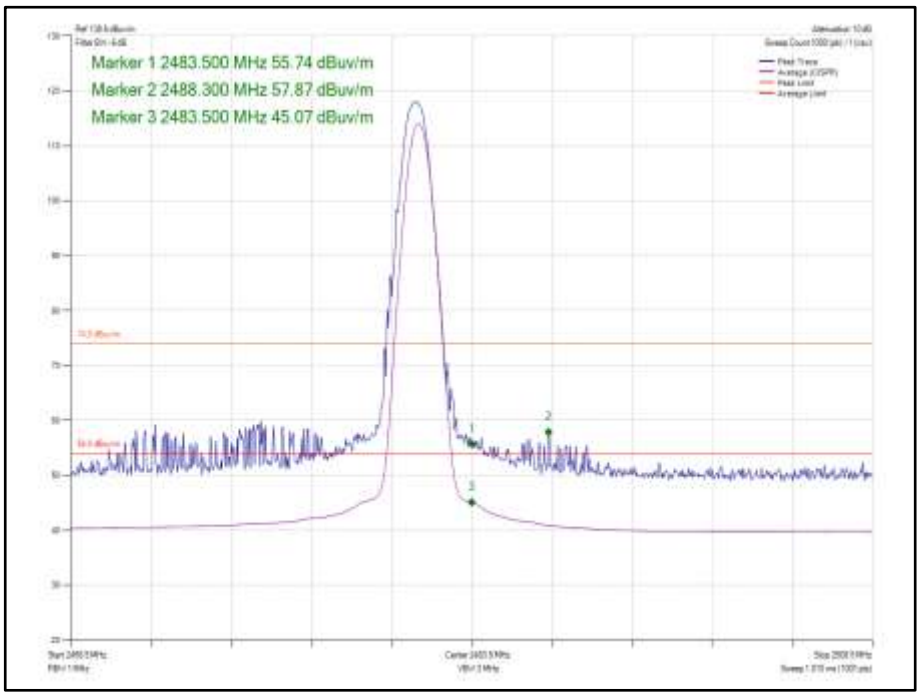

Figure 153 - Static Core 1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

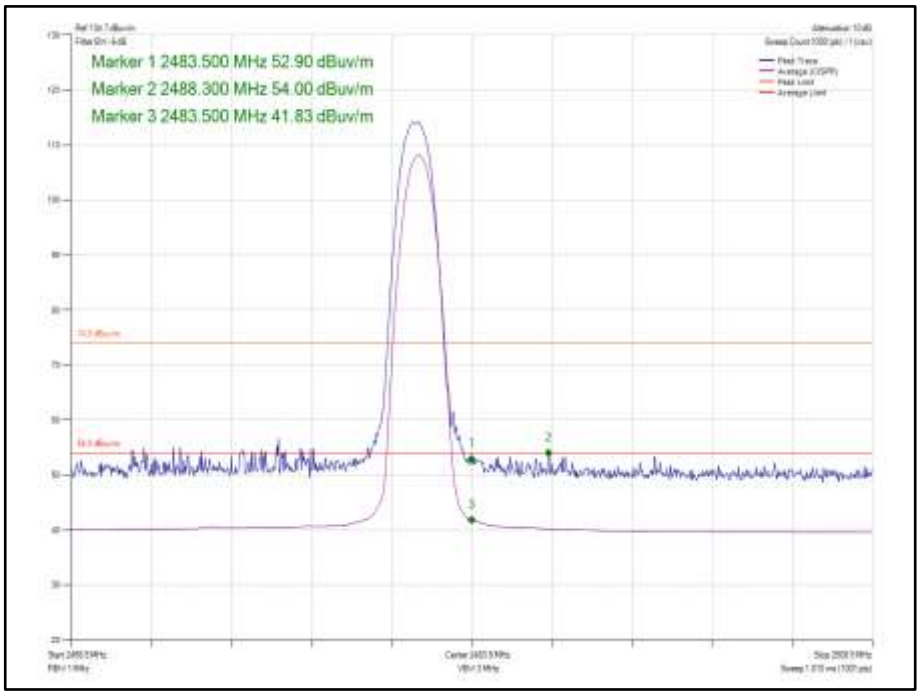

Figure 154 - Static Core 1 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

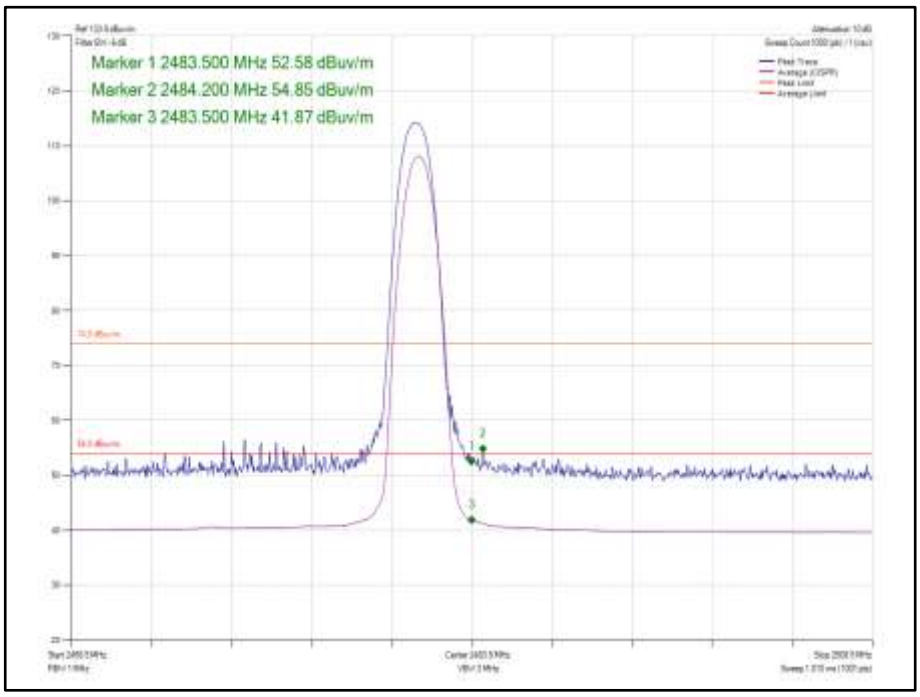

Figure 155 - Static Core 1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

Mode	Modulation	Packet Type	Tx Frequency (MHz)	Band Edge Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)
Static Core 0-1	GFSK	DH5	2402	2390.0	54.01	40.64
Static Core 0-1	π/4 DQPSK	2DH5	2402	2390.0	54.60	40.47
Static Core 0-1	8-DPSK	3DH5	2402	2390.0	54.65	40.55
Static Core 0-1	GFSK	DH5	2480	2483.5	58.73	46.33
Static Core 0-1	π/4 DQPSK	2DH5	2480	2483.5	56.98	43.36
Static Core 0-1	8-DPSK	3DH5	2480	2483.5	57.10	43.43

Table 55 - MIMO 2Tx Restricted Band Edge Results

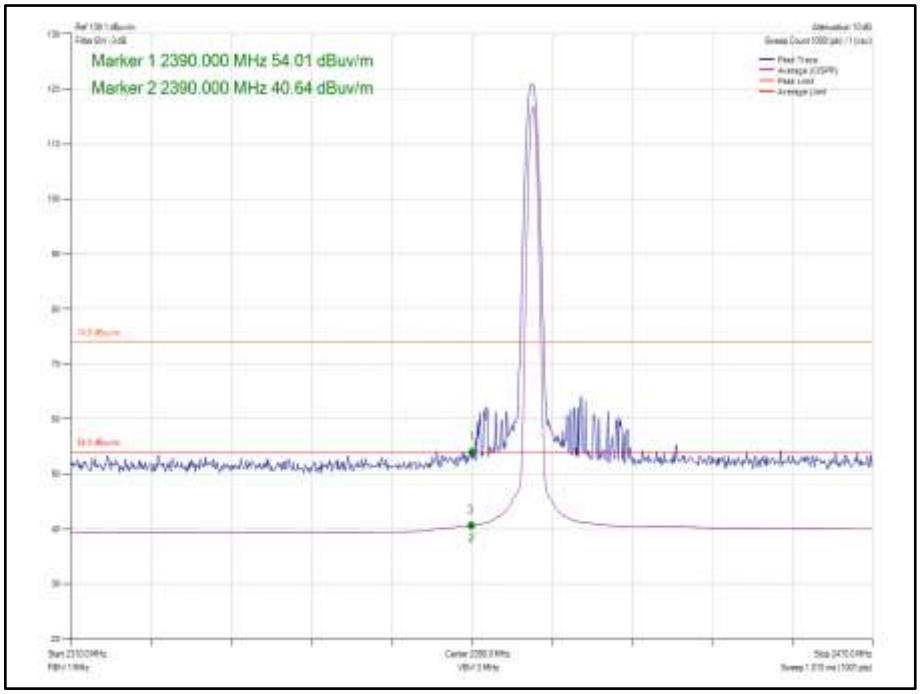

Figure 156 - Static Core 0-1 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

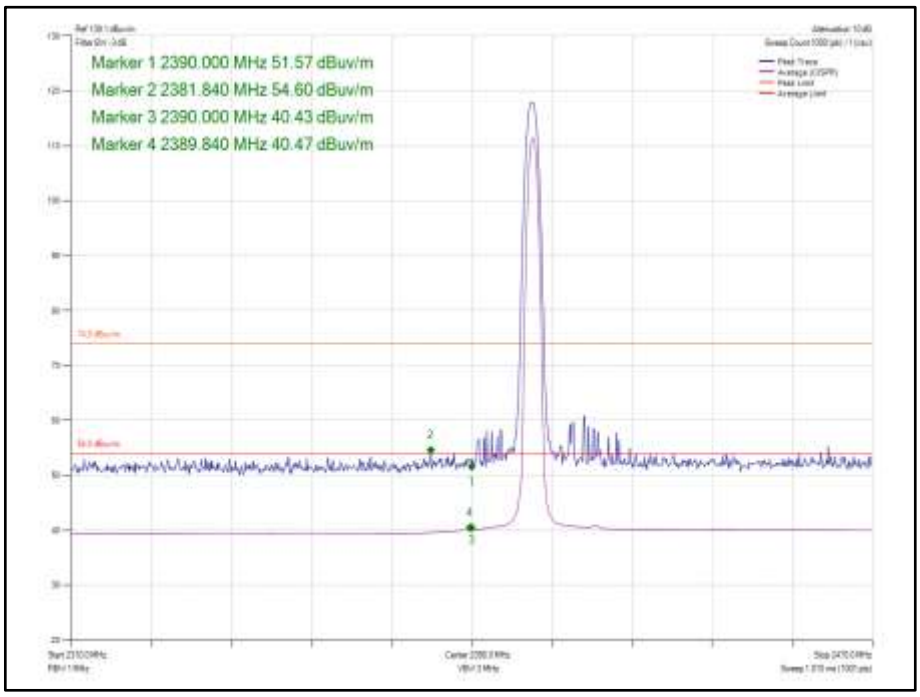

Figure 157 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

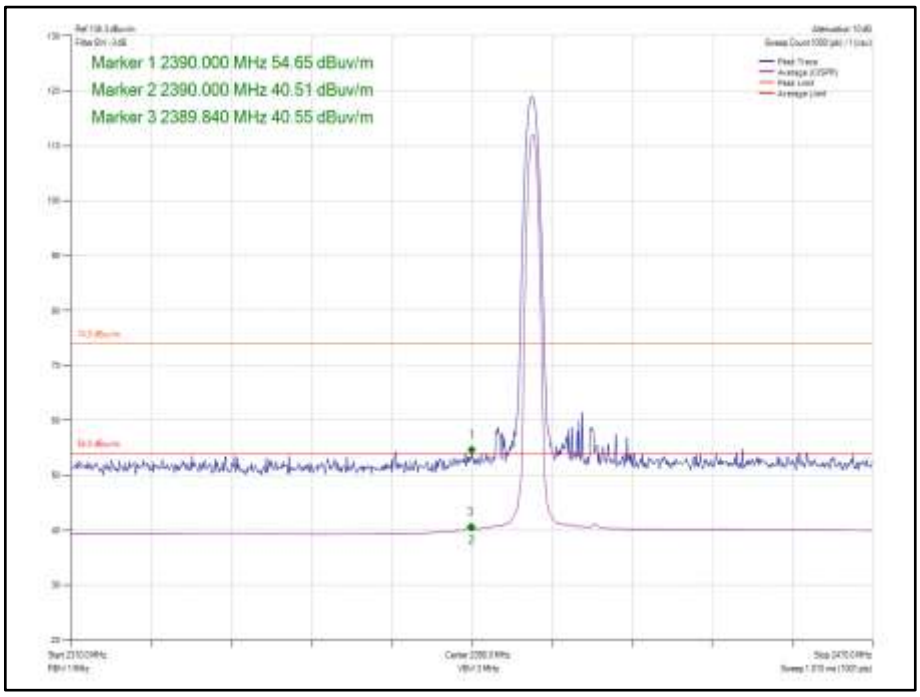

Figure 158 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

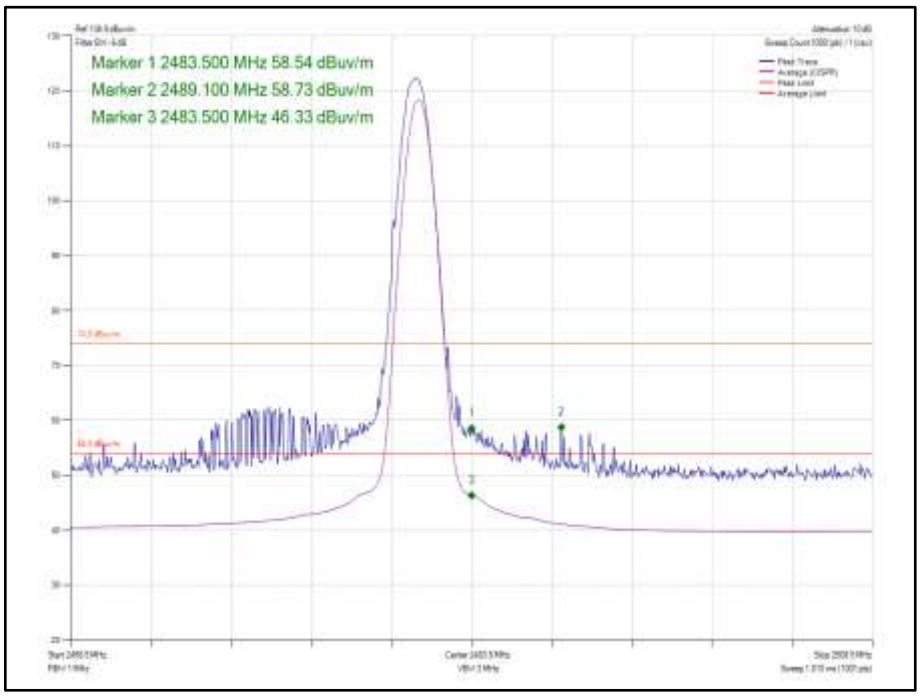

Figure 159 - Static Core 0-1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

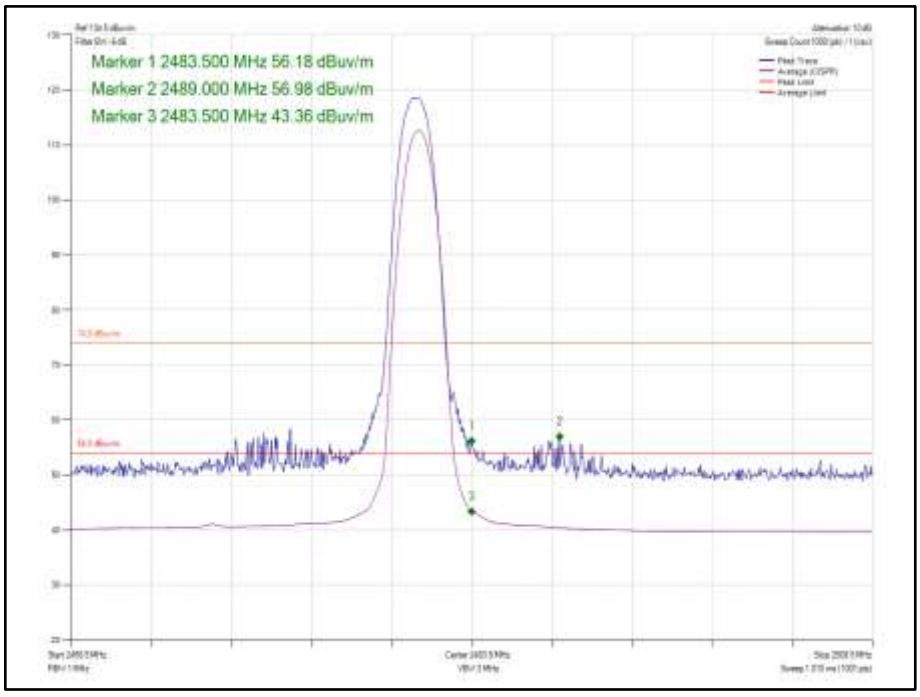

Figure 160 - Static Core 0-1 - π/4 DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

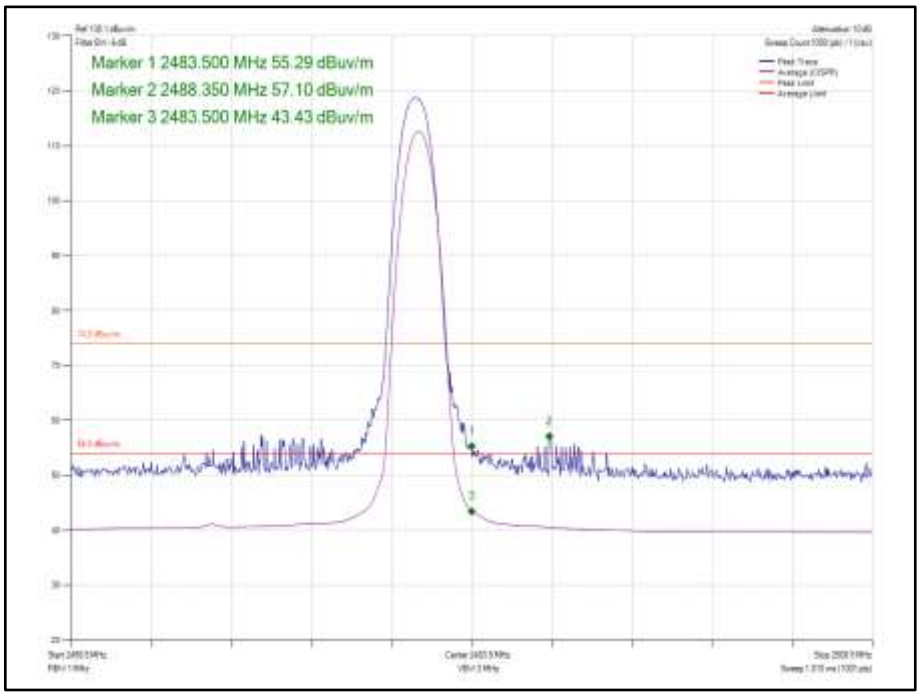

Figure 161 - Static Core 0-1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

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 56

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 57

*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
EMI Test Receiver	Rohde & Schwarz	ESW44	5084	12	28-Nov-2020
Cable (18 GHz)	Rosenberger	LU7-071-1000	5102	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5104	12	09-Dec-2020
EmX Emissions Software	TUV SUD	V2.0.1	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
Pre Amp 1 - 26.5 GHz	Agilent Technologies	8449B	5445	12	06-May-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	17-Mar-2021
Attenuator 5W 10dB DC-18GHz	Aaren	AT40A-4041-D18-10	5494	12	14-Apr-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 58

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

A2169, S/N: C07CL0AMQ4TG - Modification State 0

2.8.3 Date of Test

09-September-2020 to 06-October-2020

2.8.4 Test Method

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

In the 30 MHz to 1 GHz range pre-scans were only performed on the main radio mid channel (2441 MHz) and any emissions identified then measured on bottom (2402 MHz) and top (2480 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 @ 3 m and 64/84 dBuV/m @ 1 m) 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).

Measurements displayed within this report, have been limited to one mode only for each radio, as tests on other modes have been shown to provide a similar emissions profile.

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

2.8.5 Example Test Setup Diagram

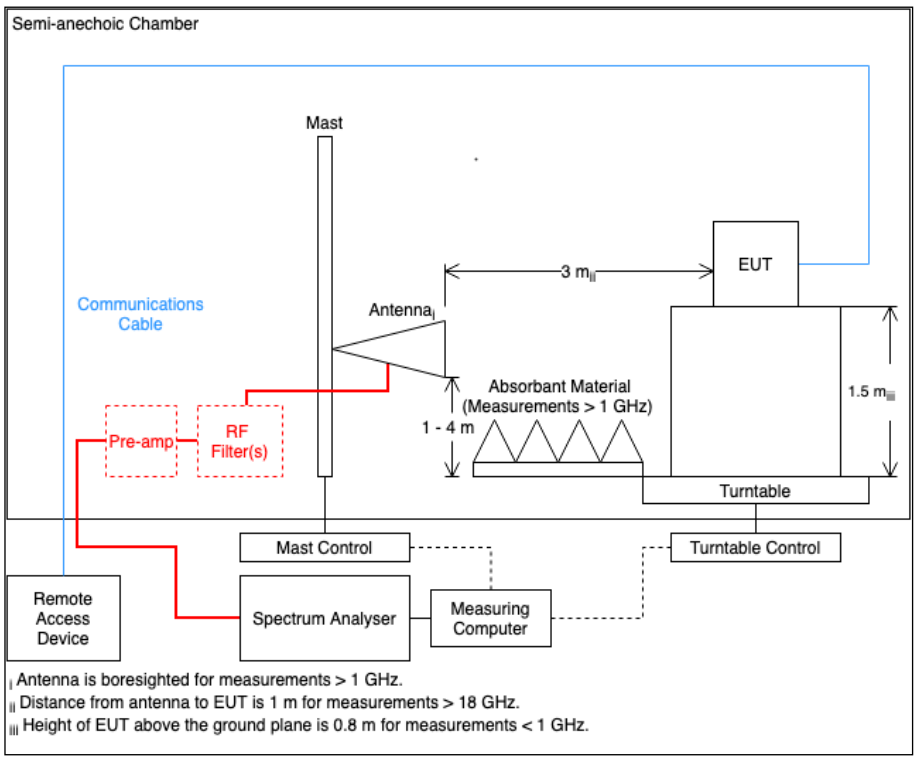

Figure 162

2.8.6 Environmental Conditions

Ambient Temperature	22.1 - 25.6 °C
Relative Humidity	44.3 - 60.1 %

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
7205.726	58.2	74.0	-15.8	Peak	230	137	Vertical

Table 59 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

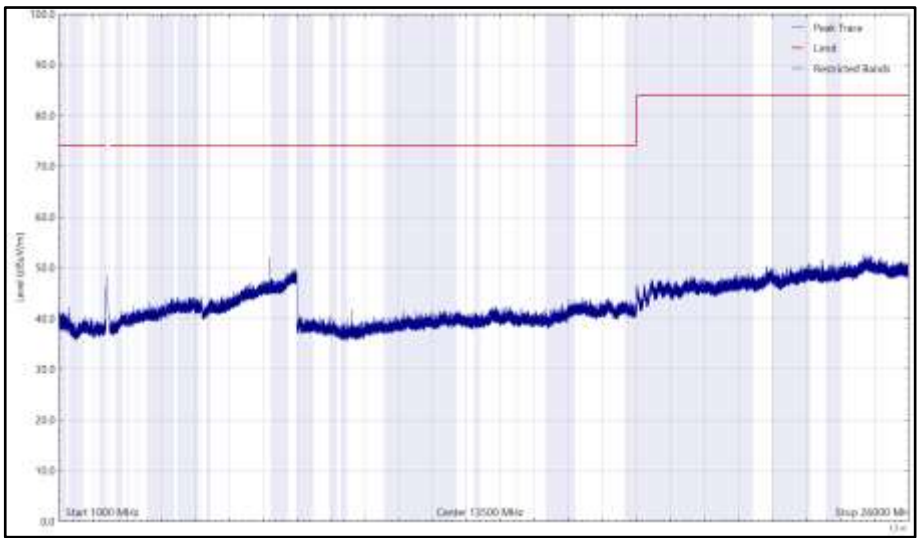

Figure 163 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

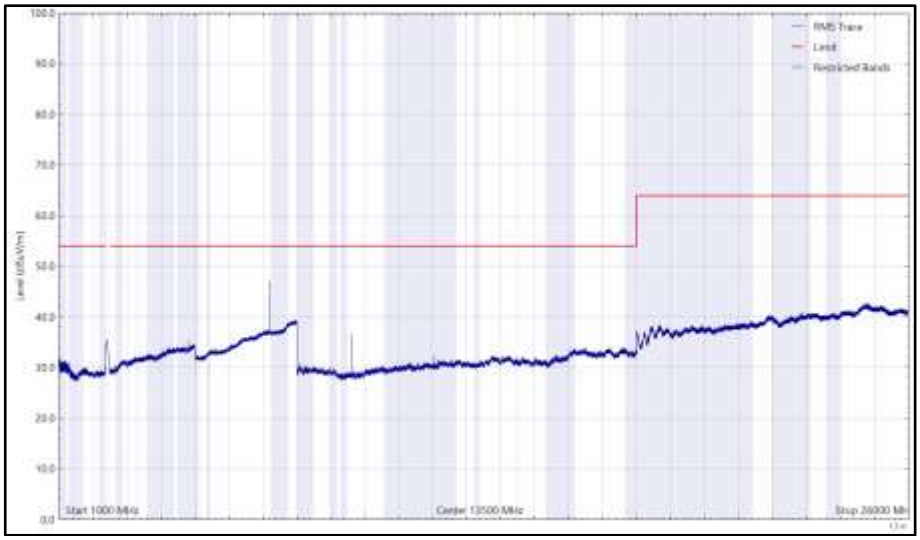

Figure 164 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

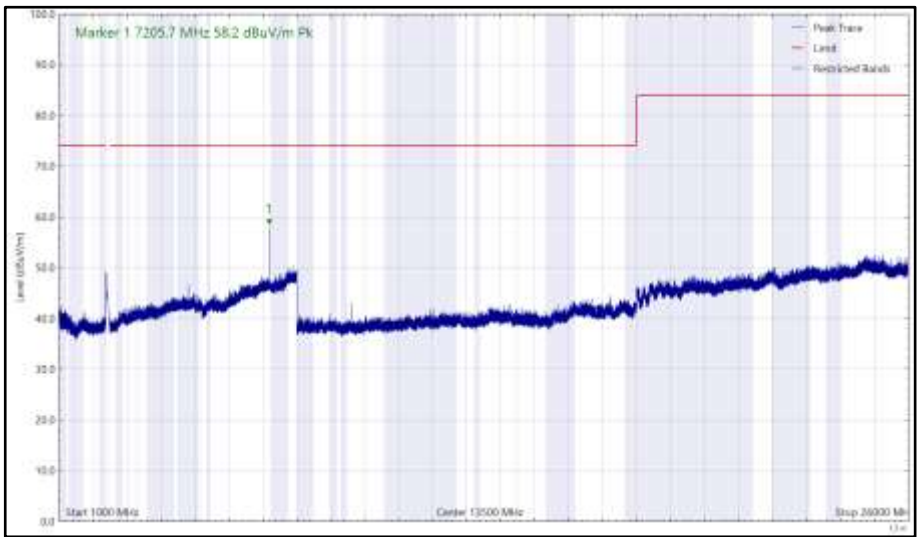

Figure 165 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

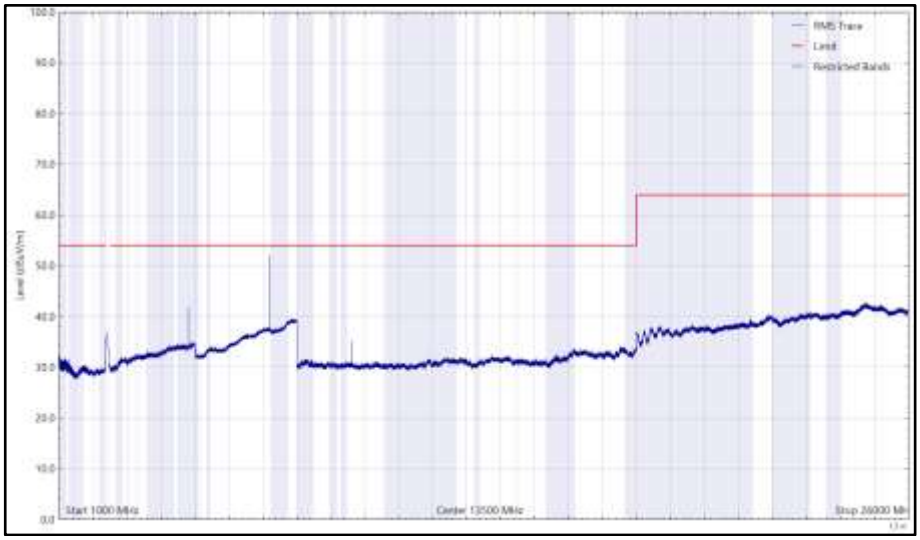

Figure 166 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4882.162	37.4	54.0	-16.6	CISPR Avg	356	146	Vertical
7323.057	37.6	54.0	-16.4	**(See note)**	78	265	Horizontal
7323.057	56.6	74.0	-17.4	Peak	78	265	Horizontal
7323.212	55.3	74.0	-18.7	Peak	357	105	Vertical

Table 60 - 2441 MHz (CH39), DH5, ePA, Core 0, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

Note: Average emission level was determined by subtracting
(DCCF = 20 * log (11.25 ms / 100 ms) = -19.0 dB) from the measured peak level in line with ANSI C63.10-2013, Section 7.5

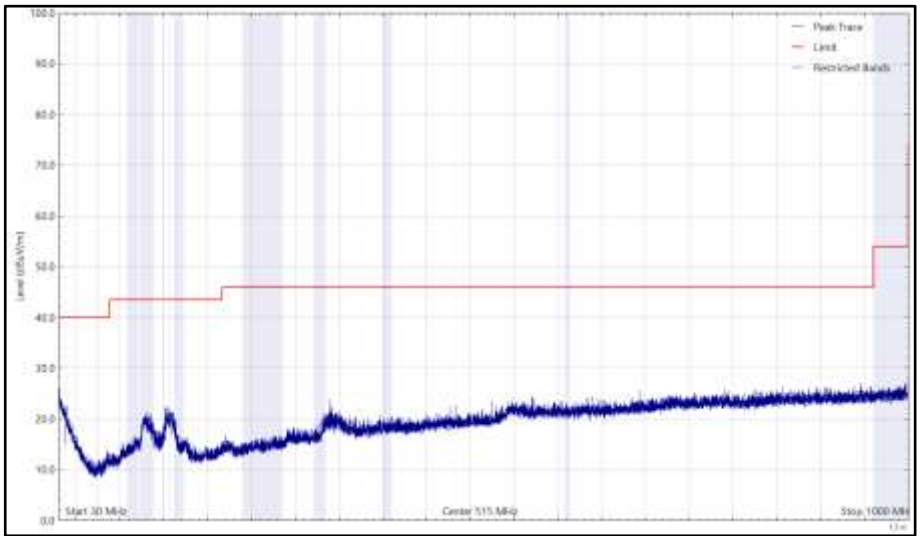

Figure 167 - 2441 MHz (CH39), DH5, ePA, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

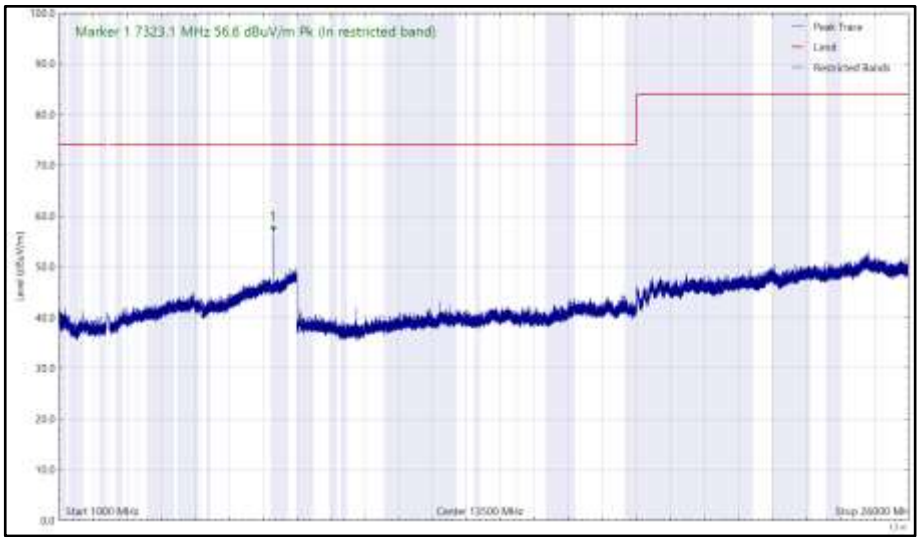

Figure 168 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

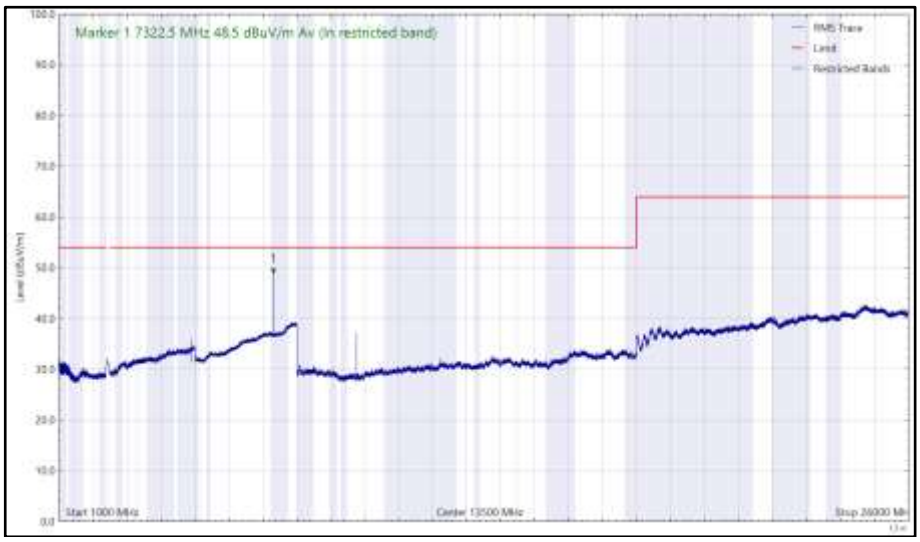

Figure 169 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

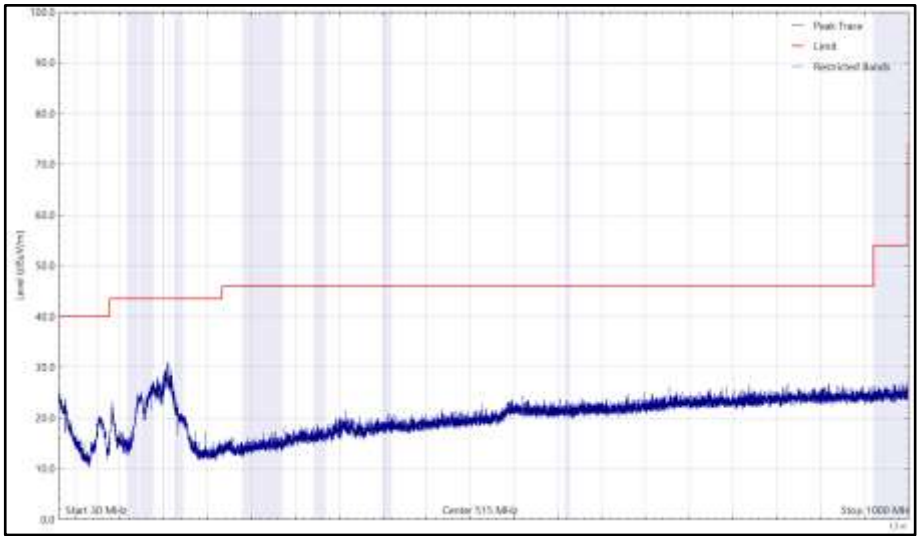

Figure 170 - 2441 MHz (CH39), DH5, ePA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

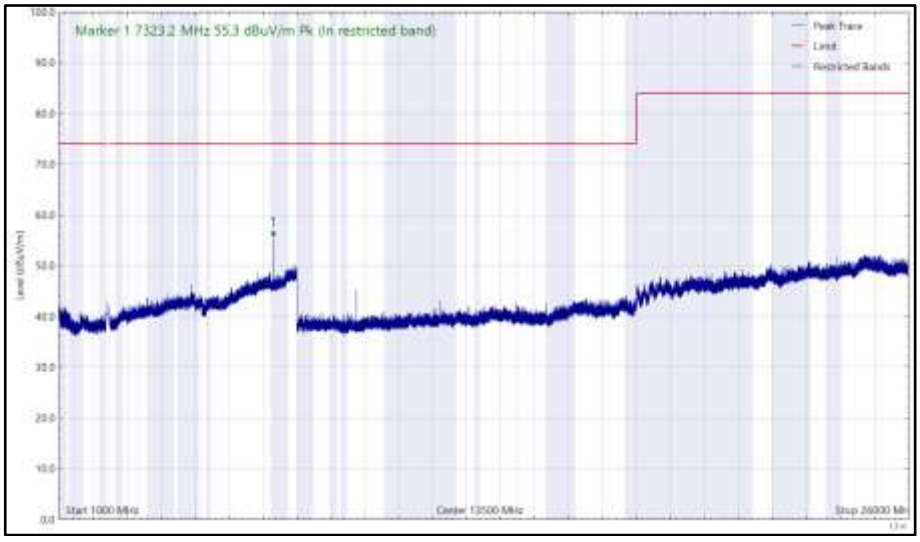

Figure 171 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

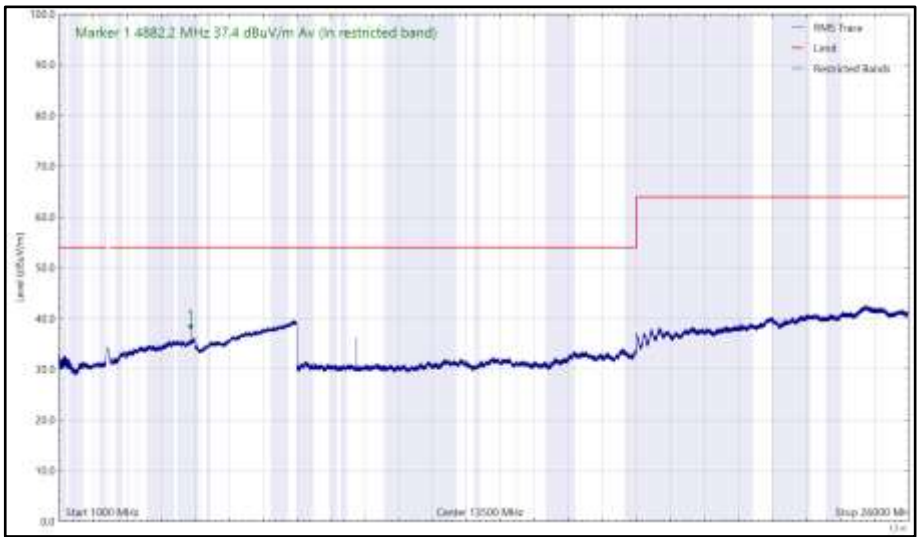

Figure 172 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4960.262	35.7	54.0	-18.3	CISPR Avg	100	104	Vertical

Table 61 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

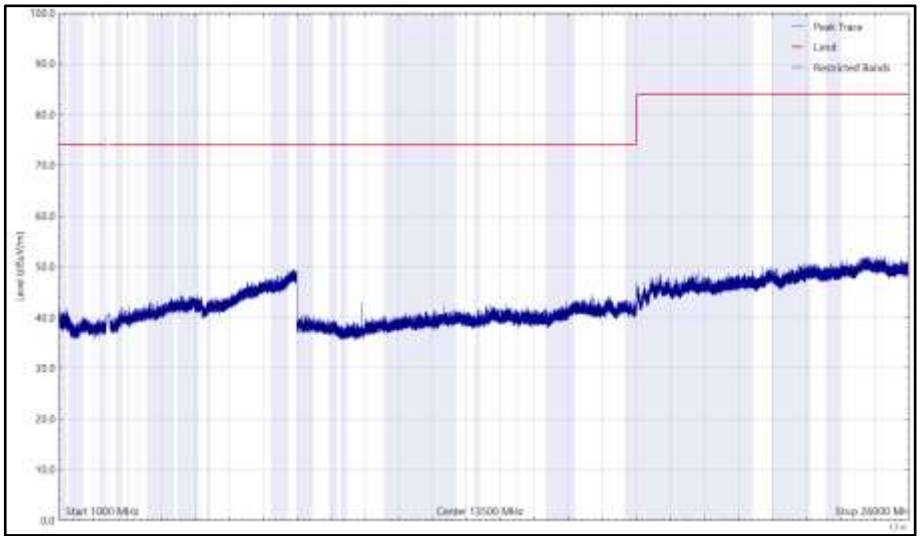

Figure 173 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

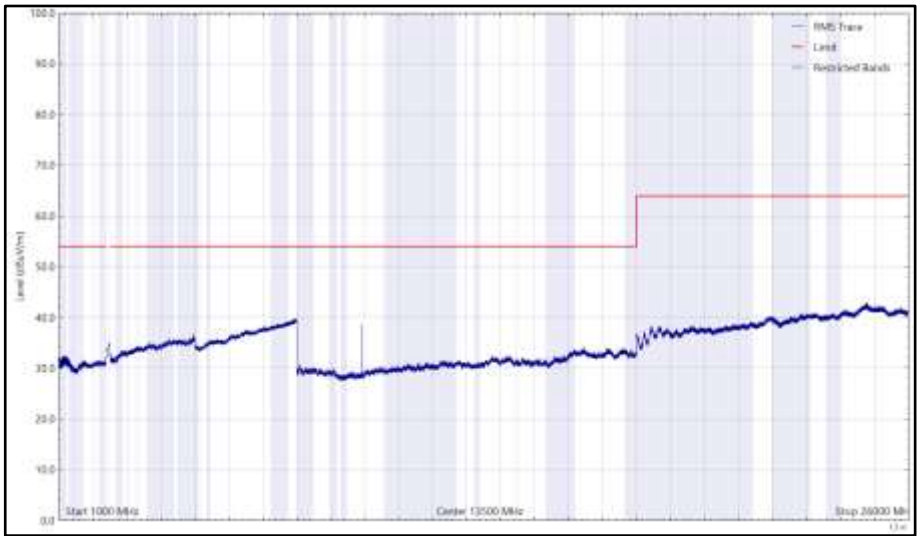

Figure 174 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

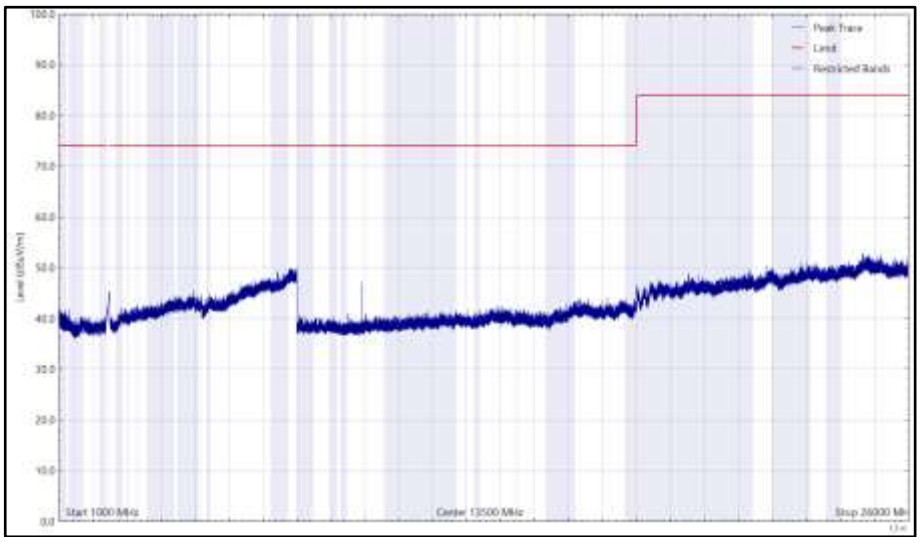

Figure 175 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

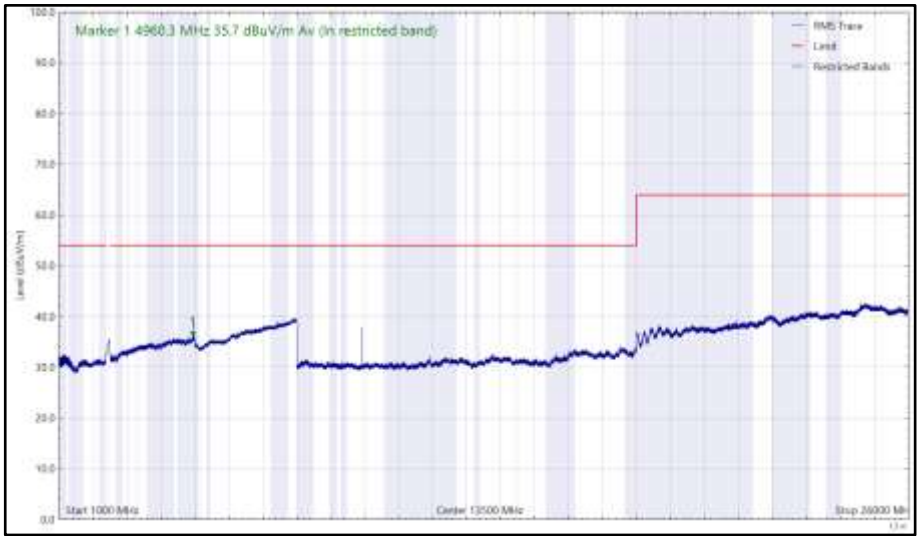

Figure 176 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4804.256	37.6	54.0	-16.4	CISPR Avg	341	100	Vertical

Table 62 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

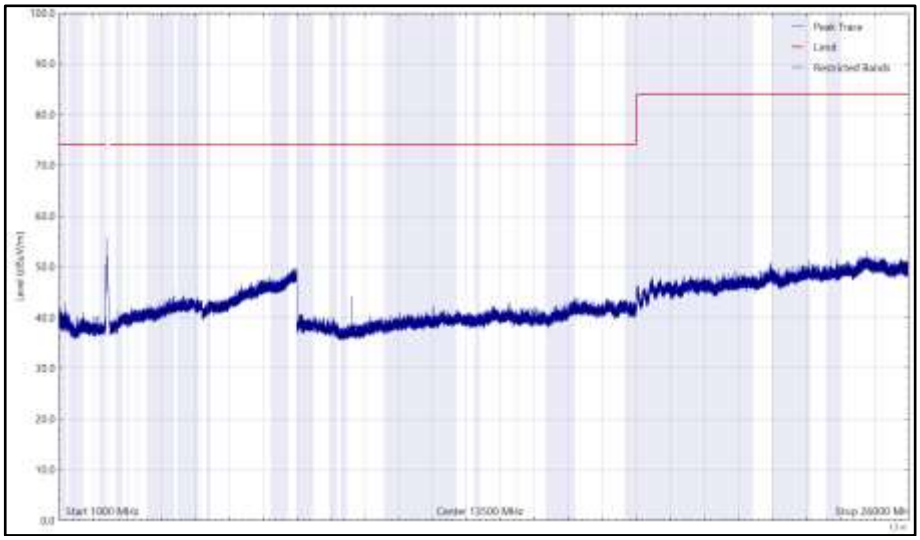

Figure 177 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

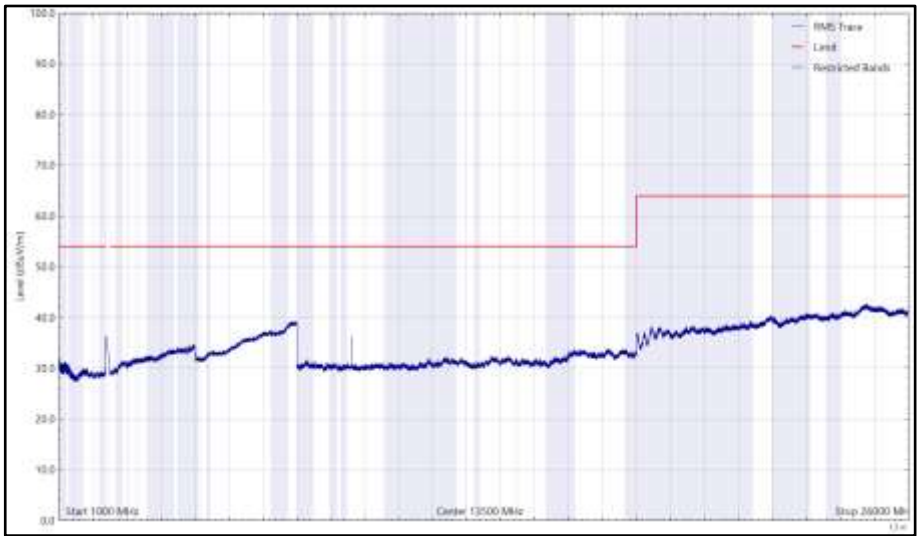

Figure 178 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

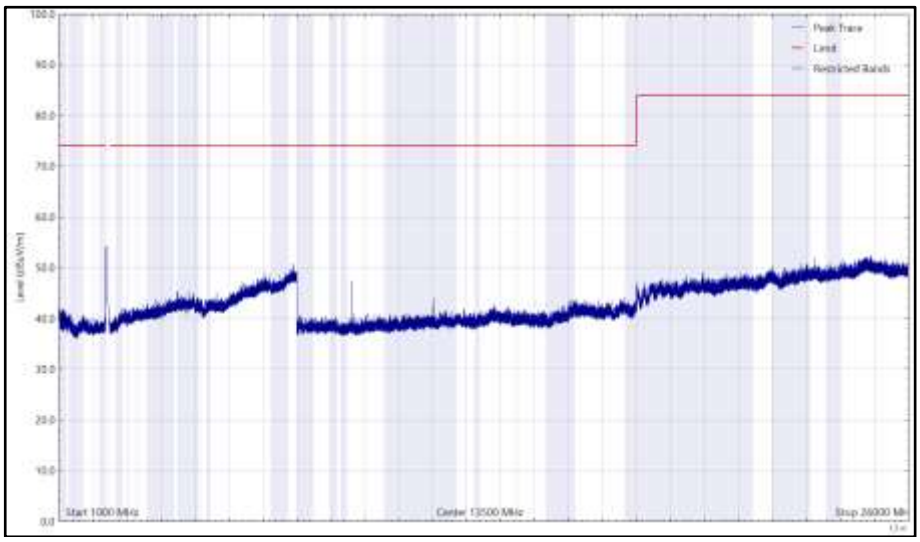

Figure 179 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

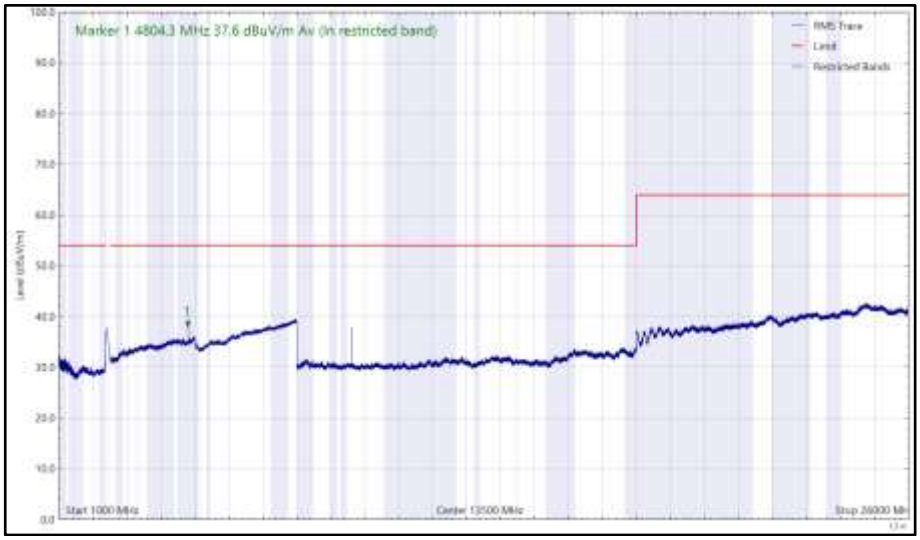

Figure 180 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4882.352	36.8	54.0	-17.3	CISPR Avg	349	100	Vertical

Table 63 - 2441 MHz (CH39), DH5, ePA, Core 1, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

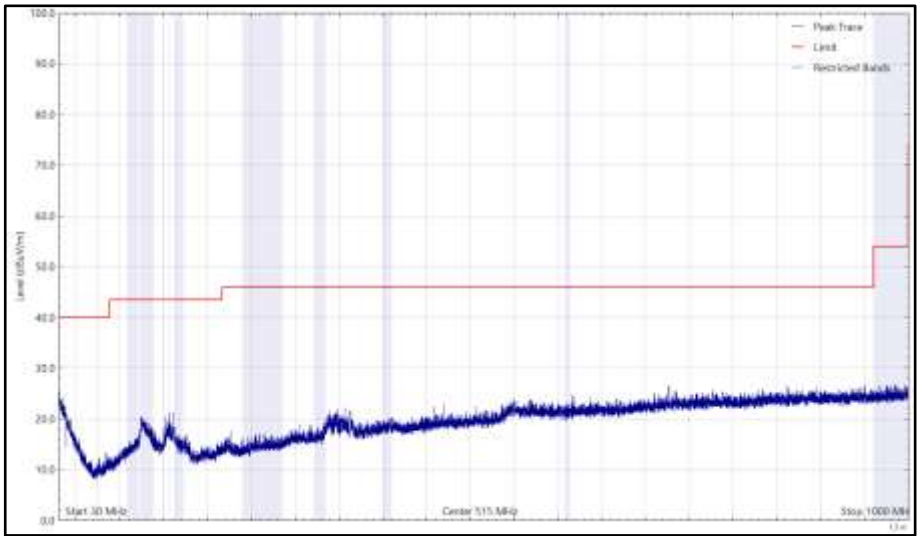

Figure 181 - 2441 MHz (CH39), DH5, ePA, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

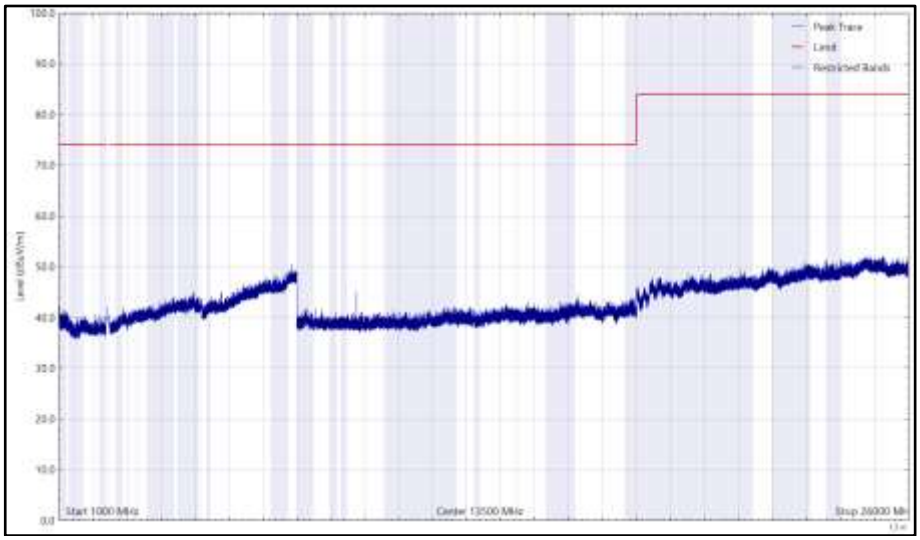

Figure 182 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

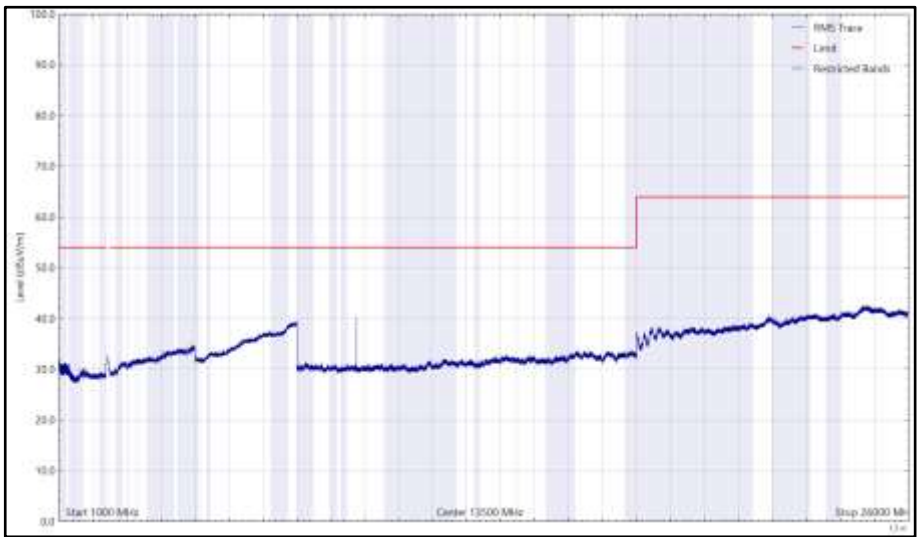

Figure 183 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

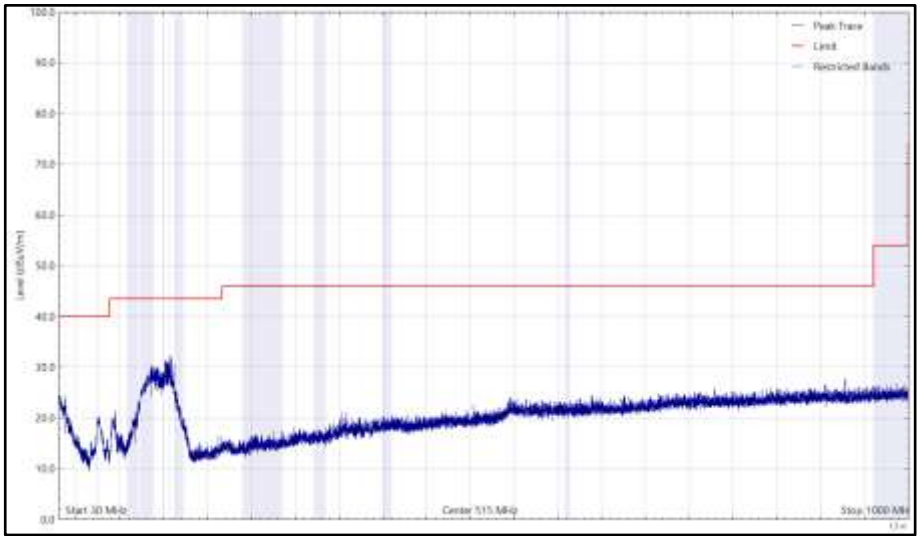

Figure 184 - 2441 MHz (CH39), DH5, ePA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

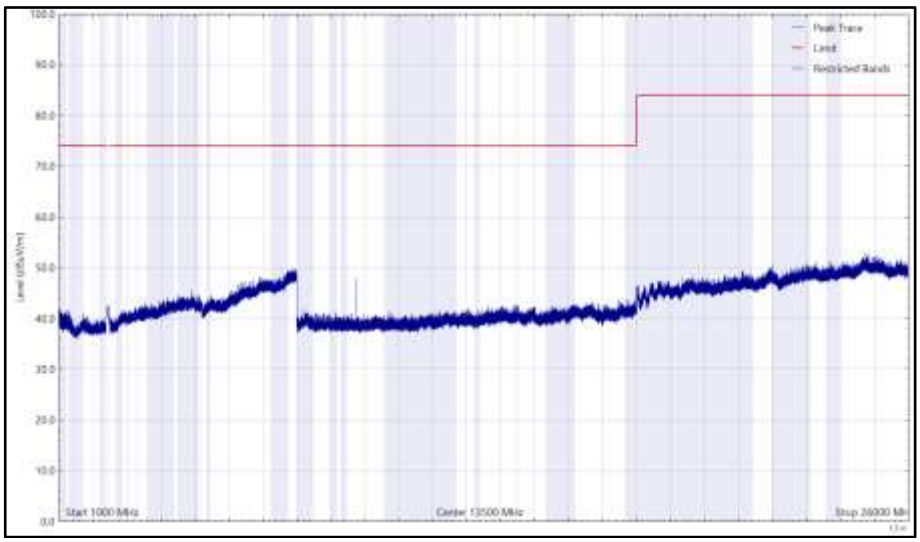

Figure 185 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

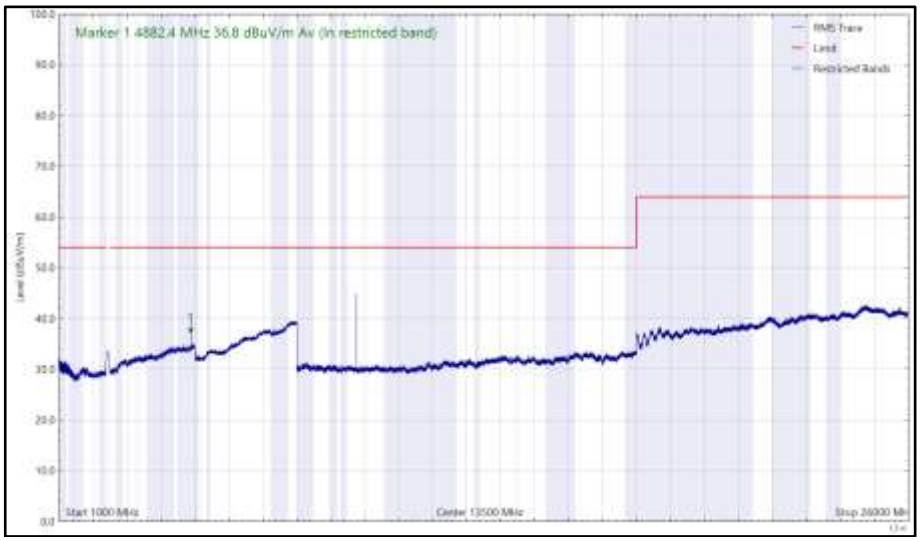

Figure 186 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

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

Table 64 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz

*No emissions found within 6 dB of the limit.

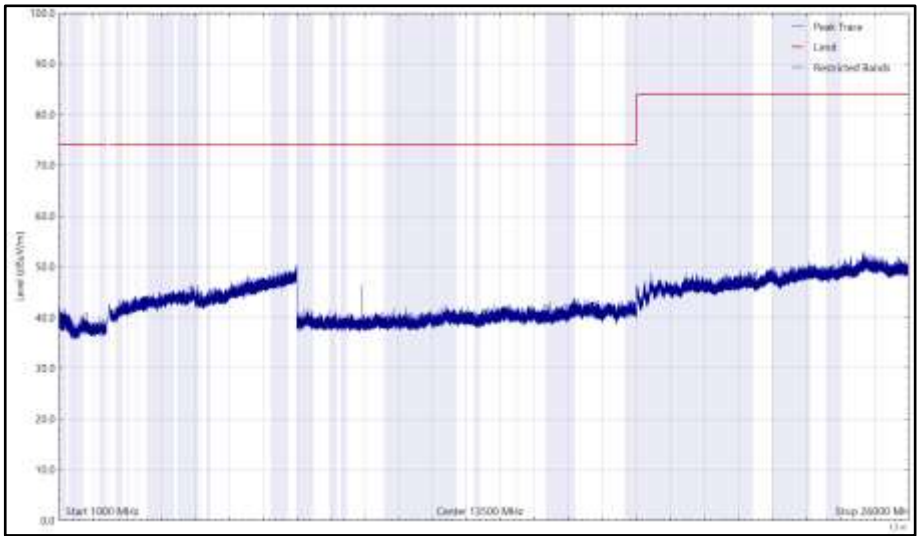

Figure 187 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

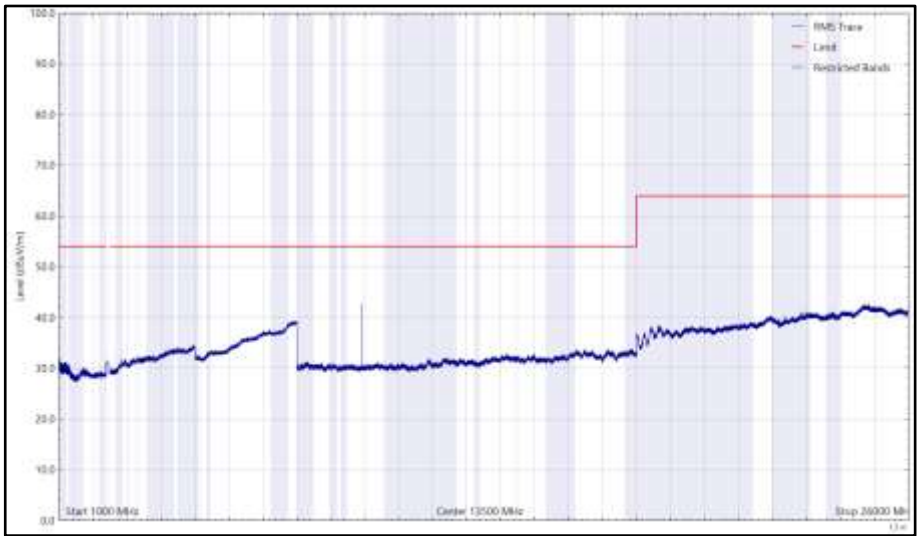

Figure 188 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

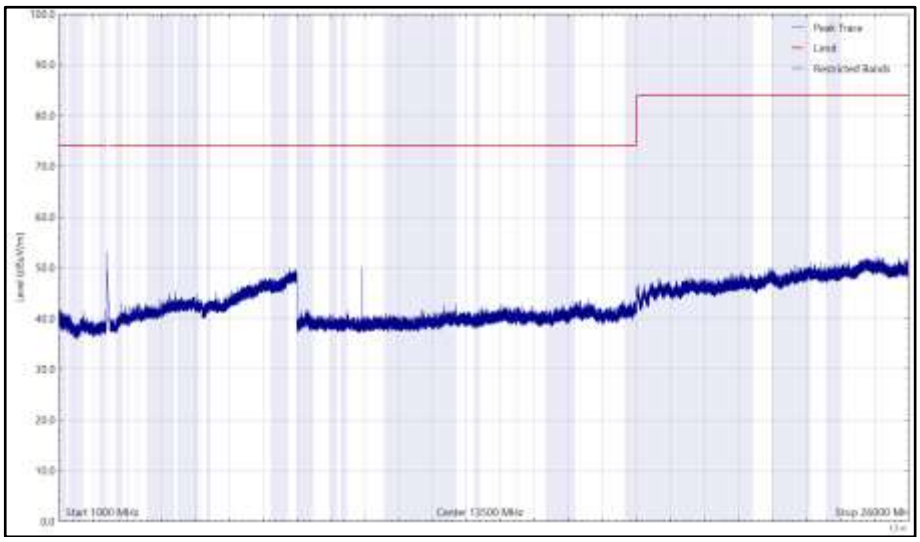

Figure 189 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

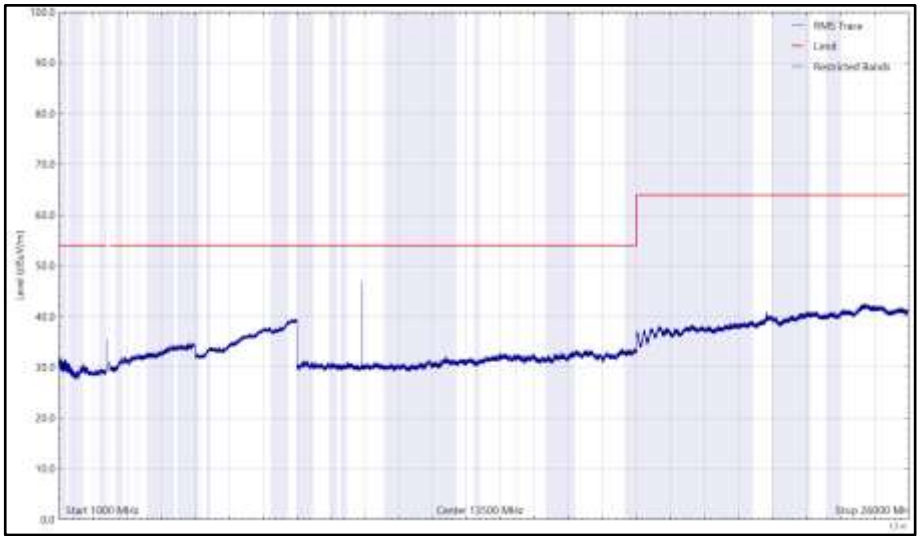

Figure 190 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4804.356	38.2	54.0	-15.8	CISPR Avg	0	103	Vertical

Table 65 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

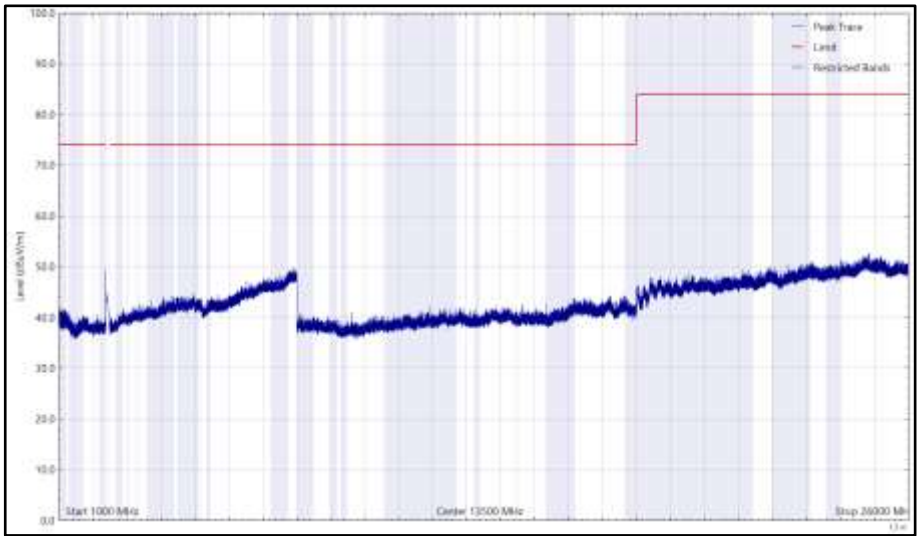

Figure 191 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

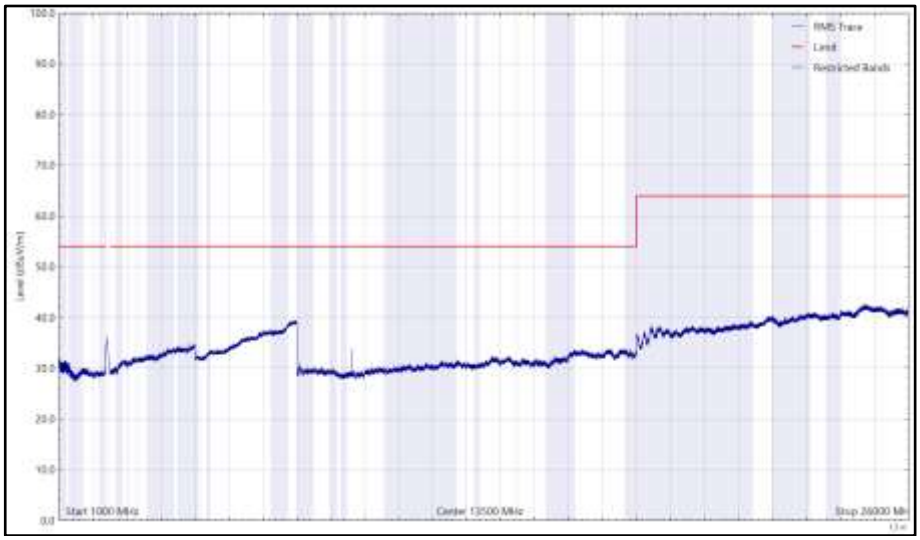

Figure 192 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

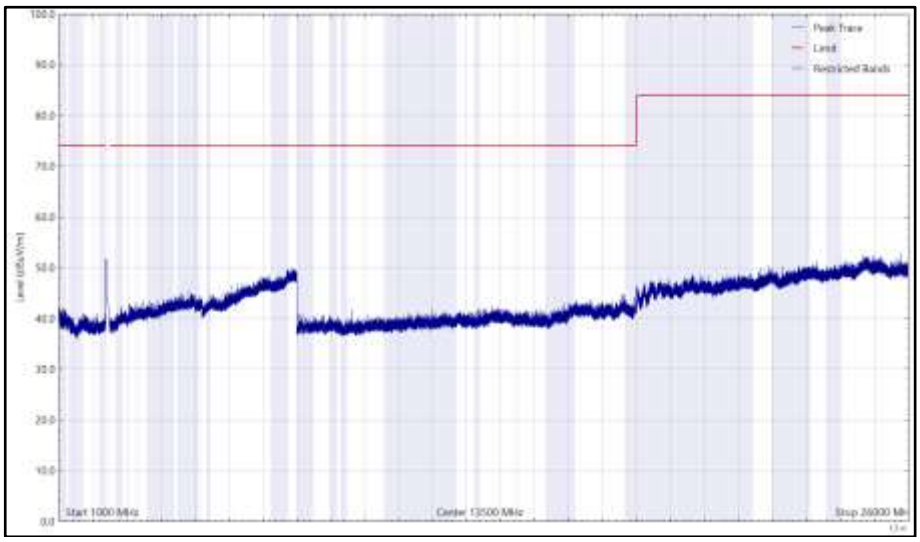

Figure 193 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

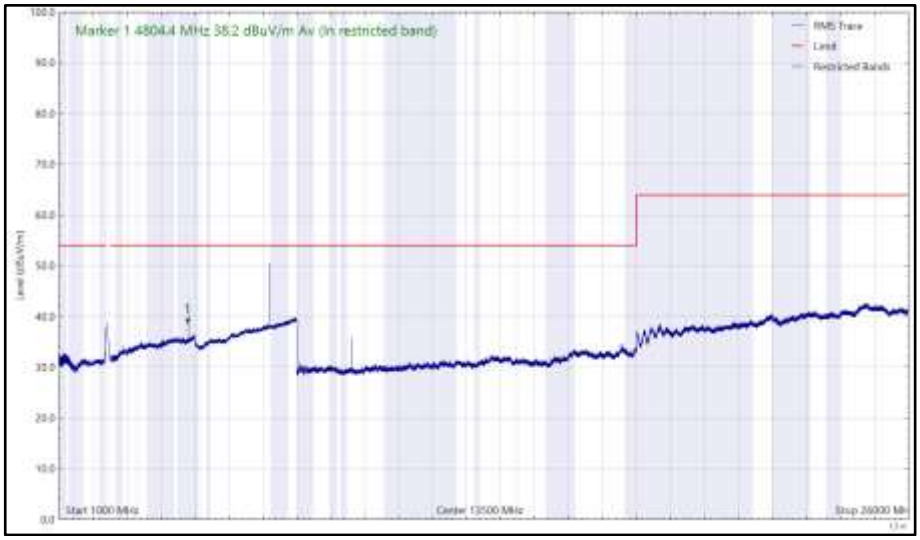

Figure 194 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4882.367	37.6	54.0	-16.4	CISPR Avg	349	100	Vertical
7322.975	43.4	54.0	-10.6	CISPR Avg	346	279	Vertical
7323.090	47.8	54.0	-6.2	CISPR Avg	346	290	Horizontal

Table 66 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

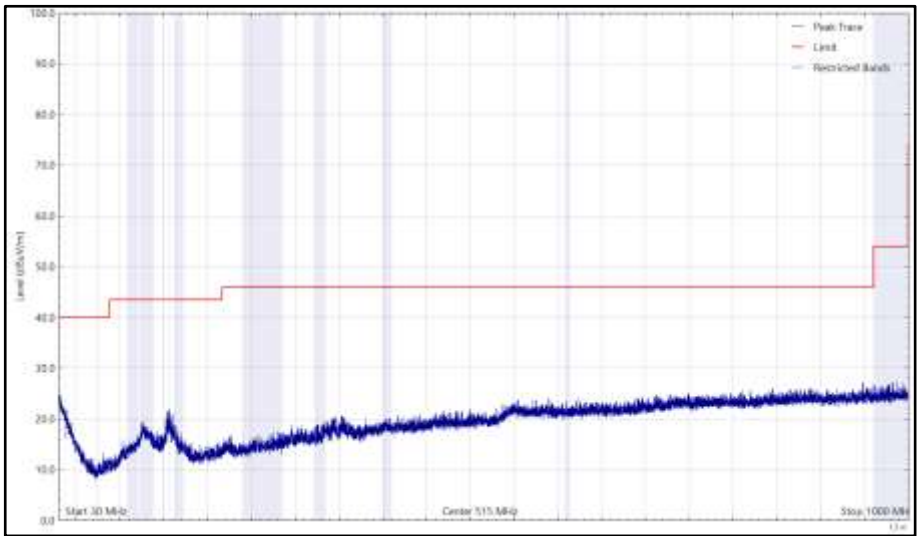

Figure 195 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 1 GHz, Horizontal (Peak)

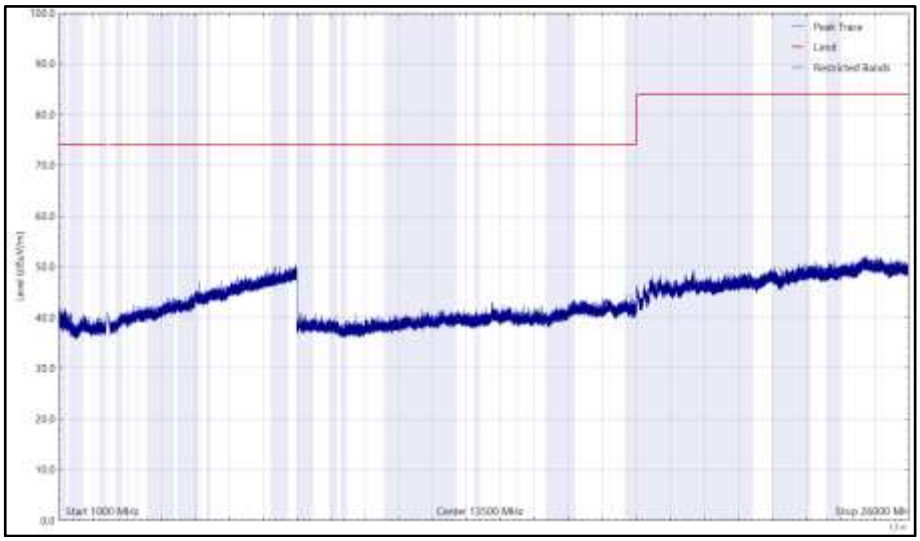

Figure 196 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

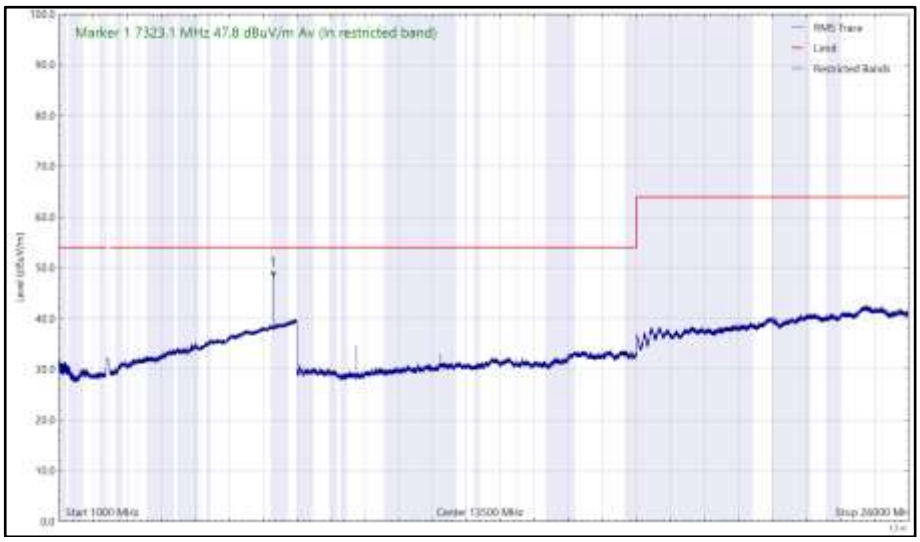

Figure 197 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

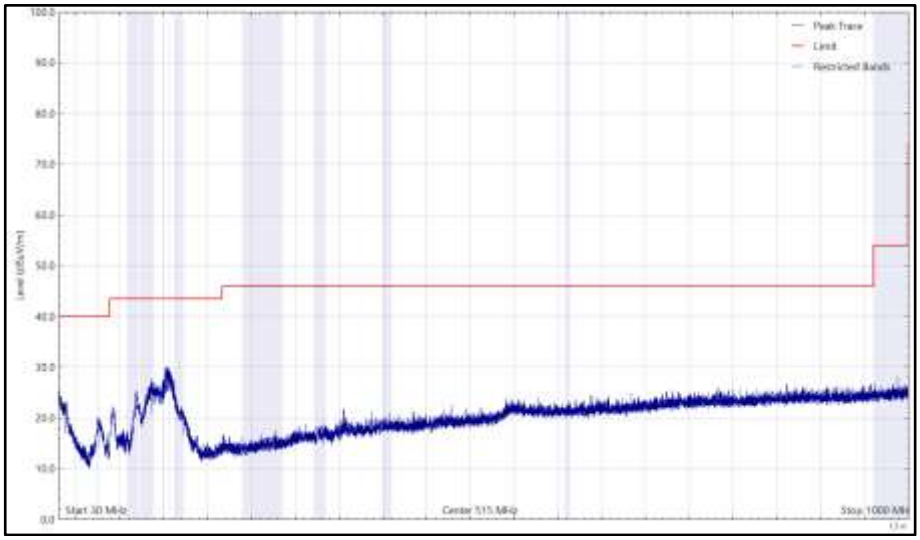

Figure 198 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

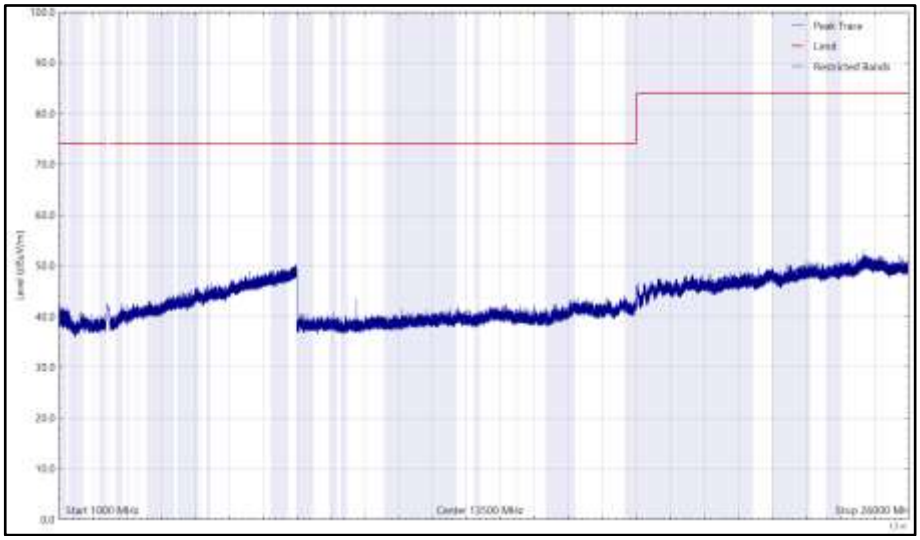

Figure 199 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

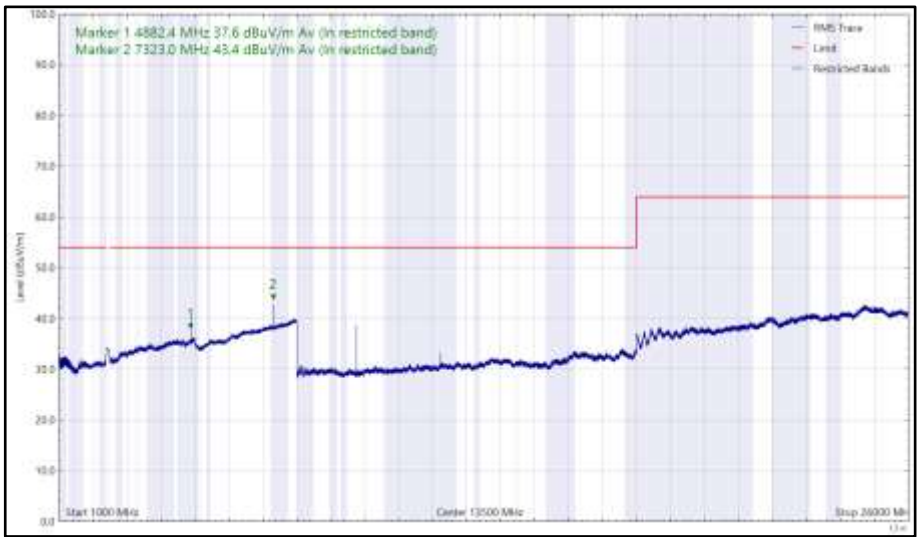

Figure 200 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4959.926	36.3	54.0	-17.7	CISPR Avg	354	104	Vertical
7439.674	36.8	54.0	-17.2	CISPR Avg	217	110	Vertical

Table 67 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

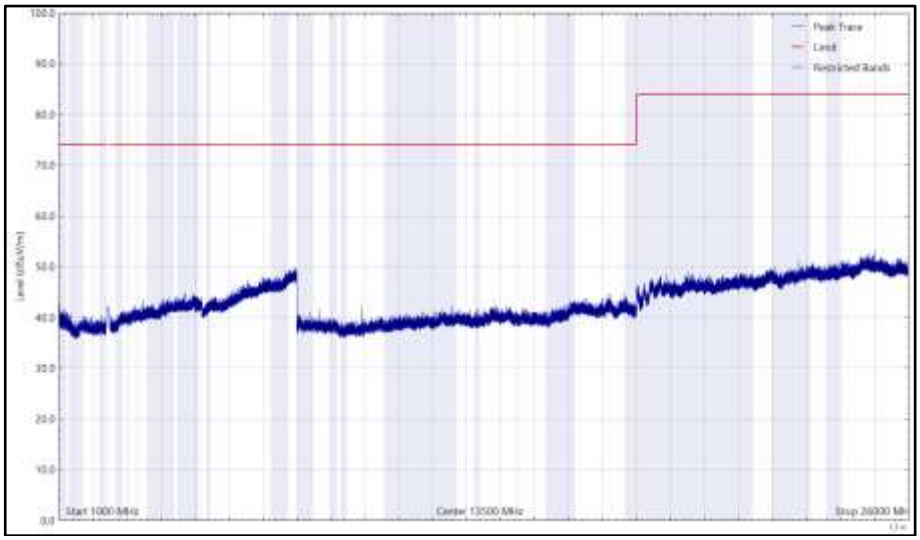

Figure 201 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

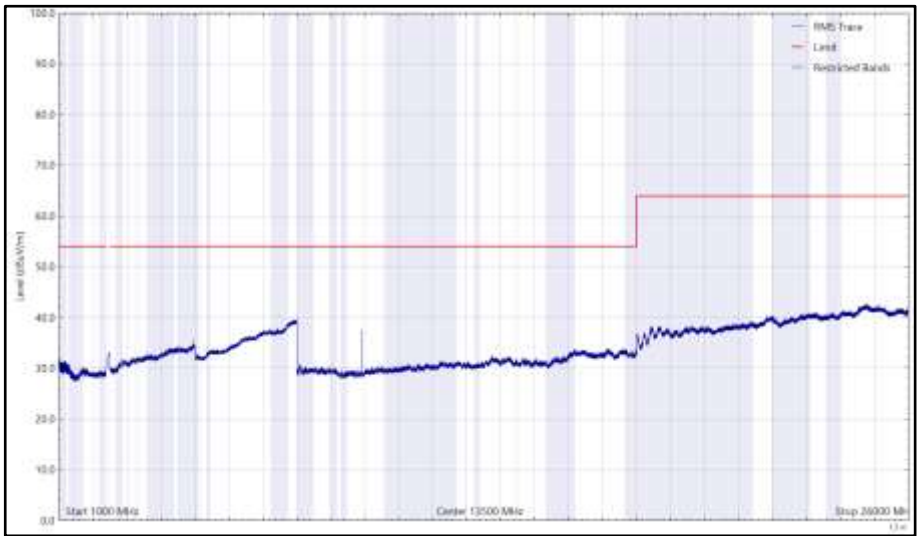

Figure 202 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

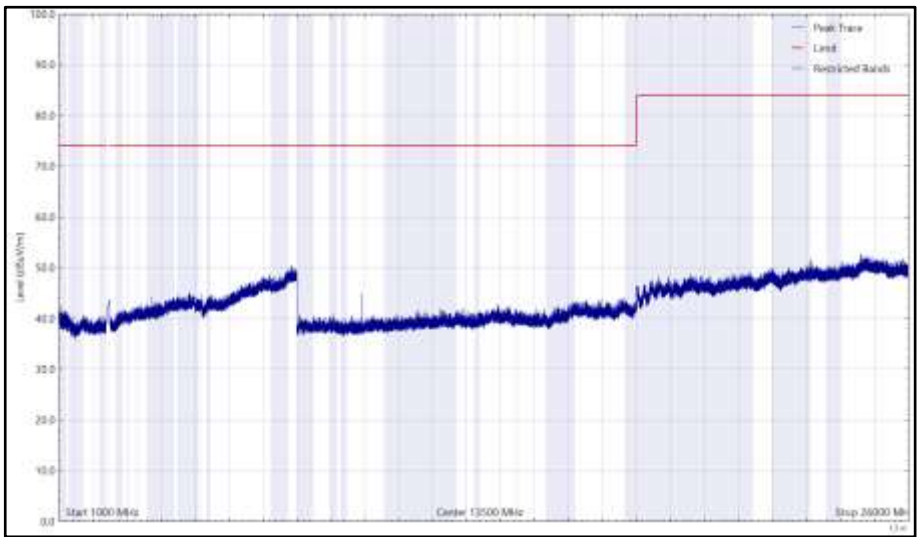

Figure 203 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

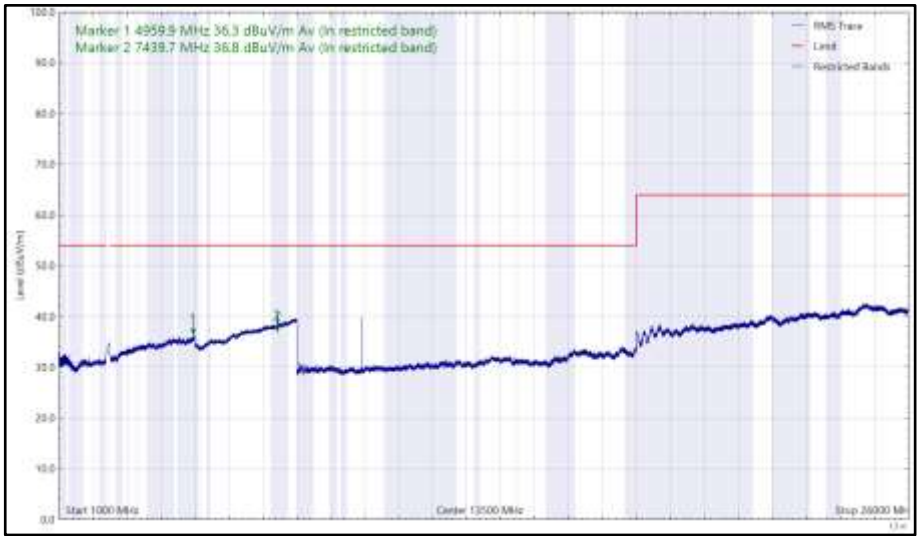

Figure 204 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4804.412	36.1	54.0	-17.9	CISPR Avg	345	105	Vertical

Table 68 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz

No other emissions found within 6 dB of the limit.

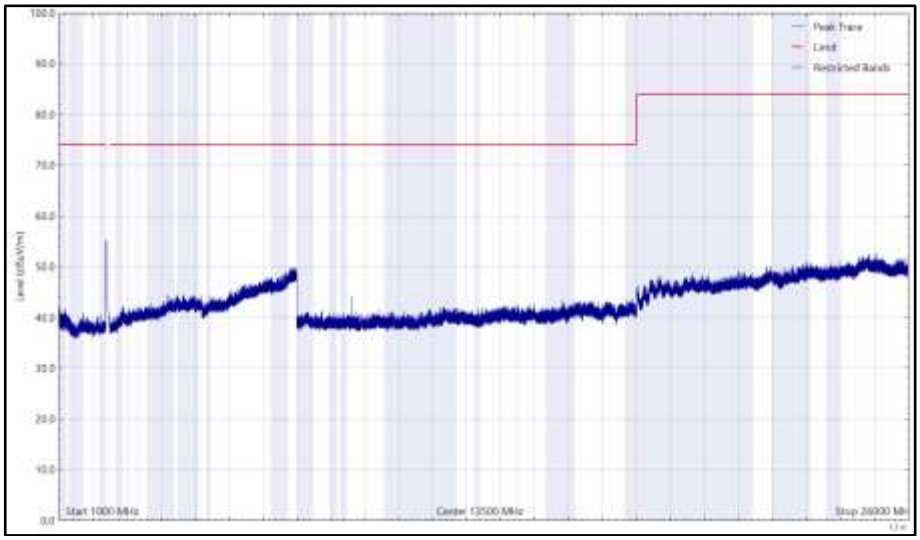

Figure 205 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

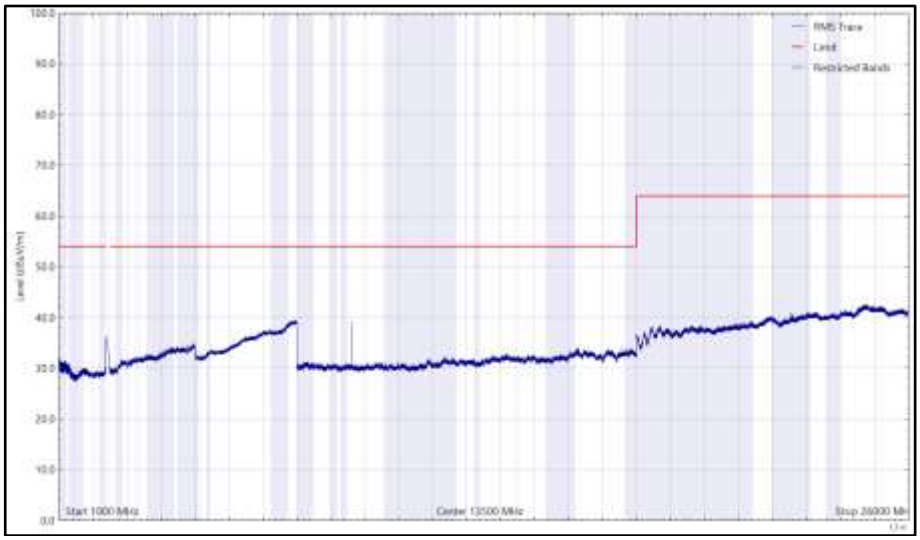

Figure 206 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

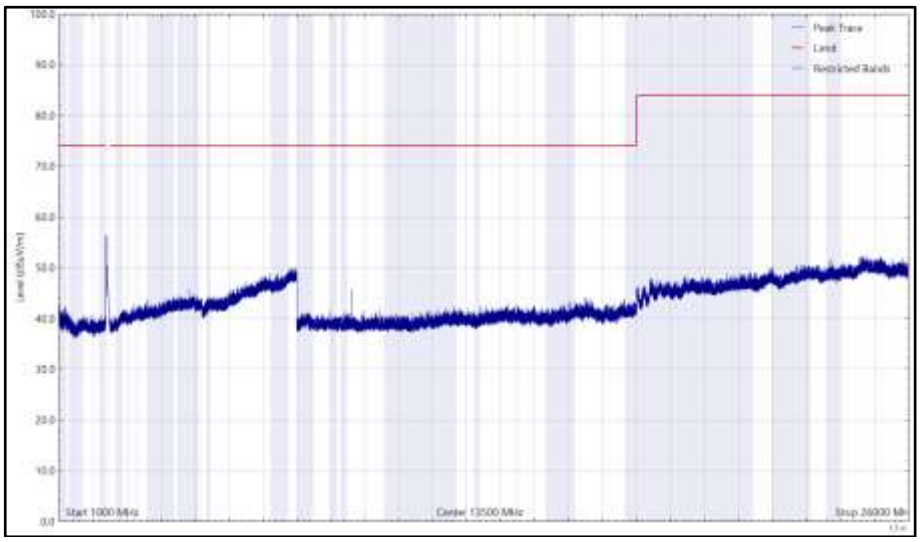

Figure 207 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

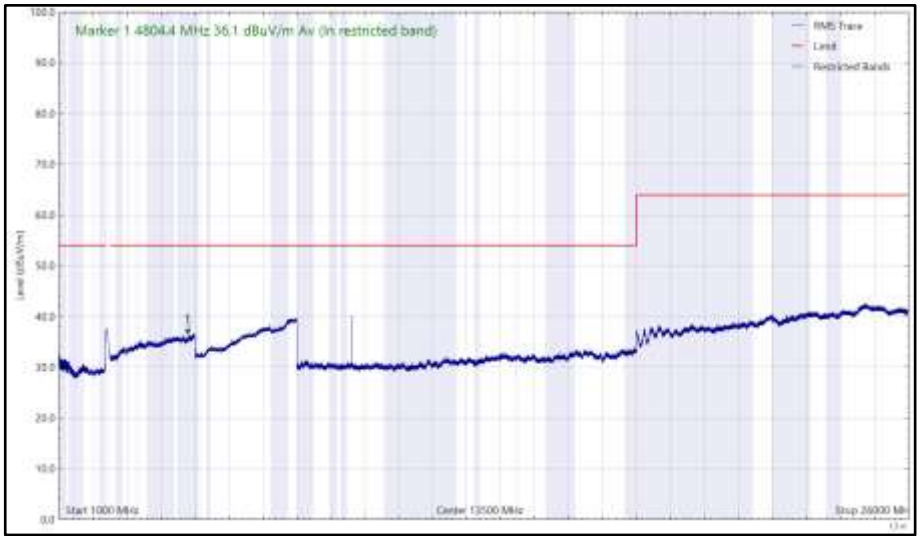

Figure 208 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

Frequency (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Angle (°)	Height (cm)	Polarisation
4881.743	37.4	54.0	-16.6	CISPR Avg	360	104	Vertical

Table 69 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 26 GHz

No other emissions found within 6 dB of the limit.

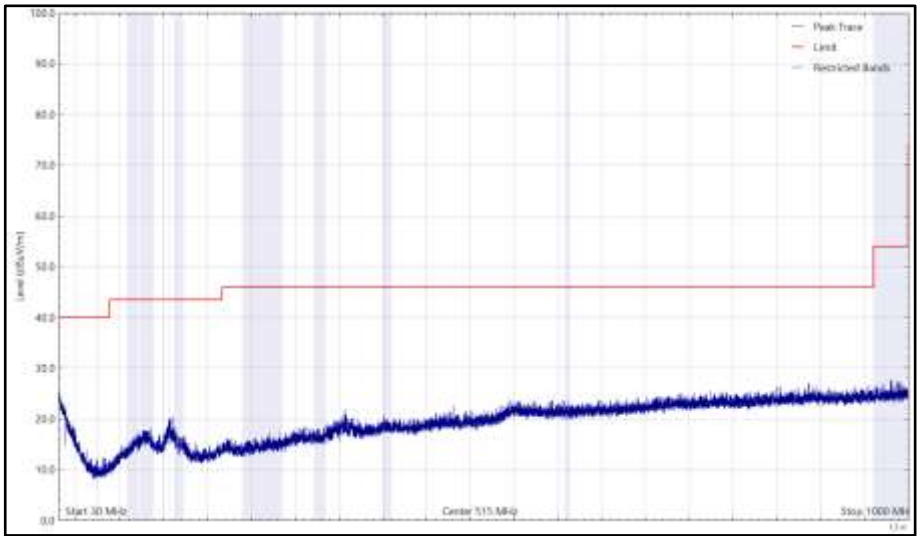

Figure 209 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

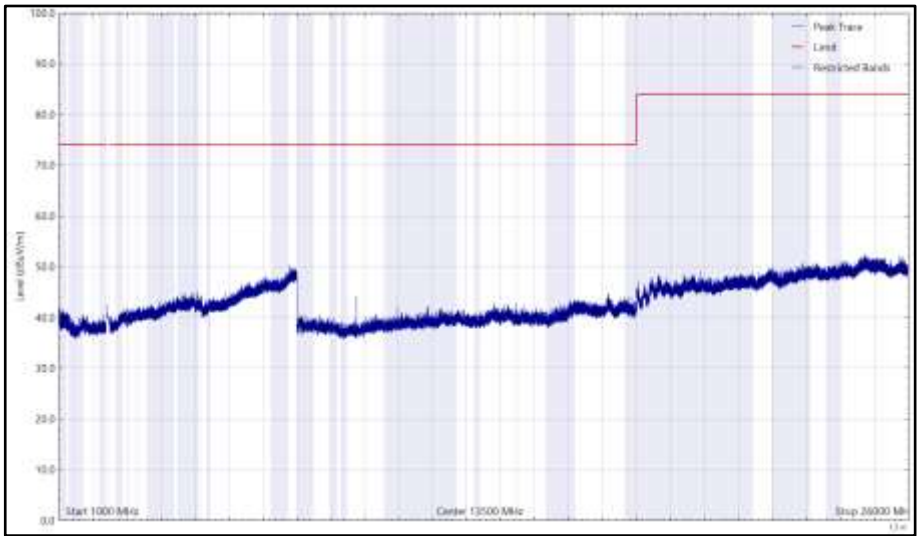

Figure 210 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

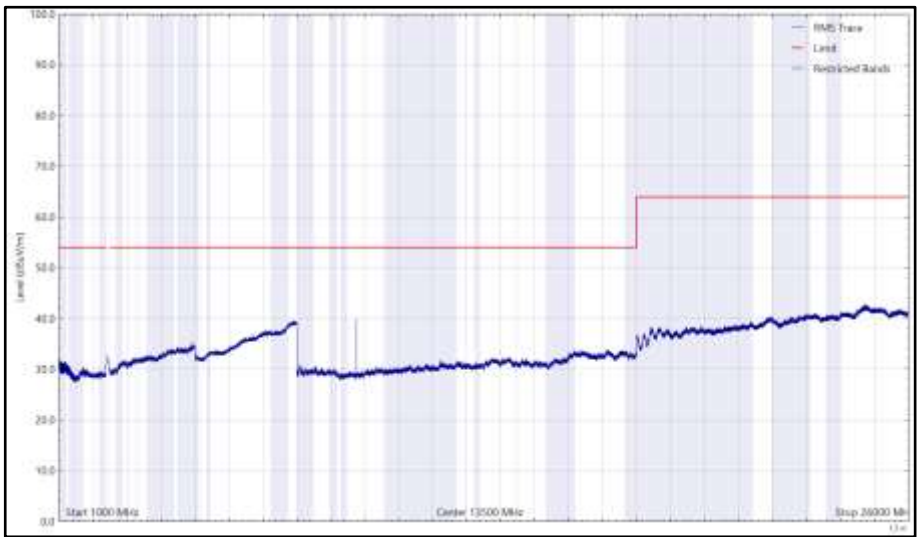

Figure 211 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

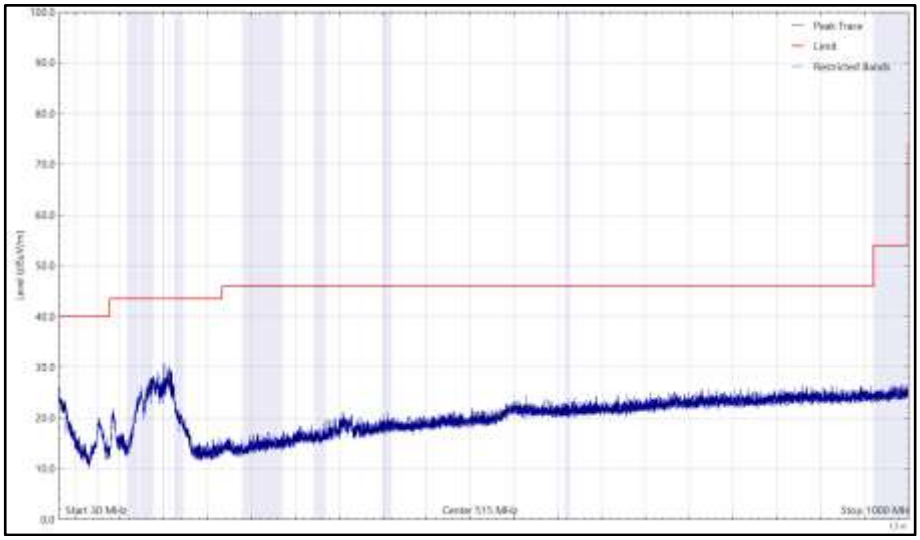

Figure 212 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

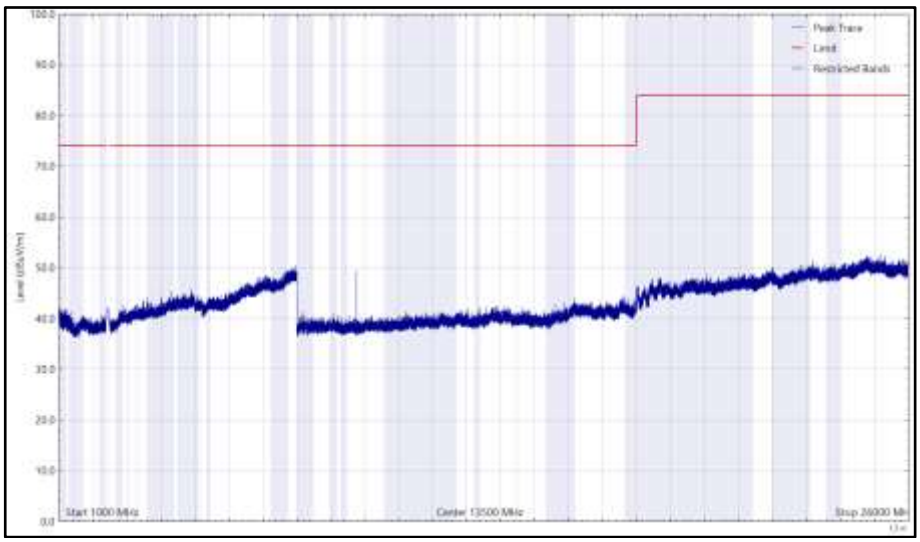

Figure 213 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

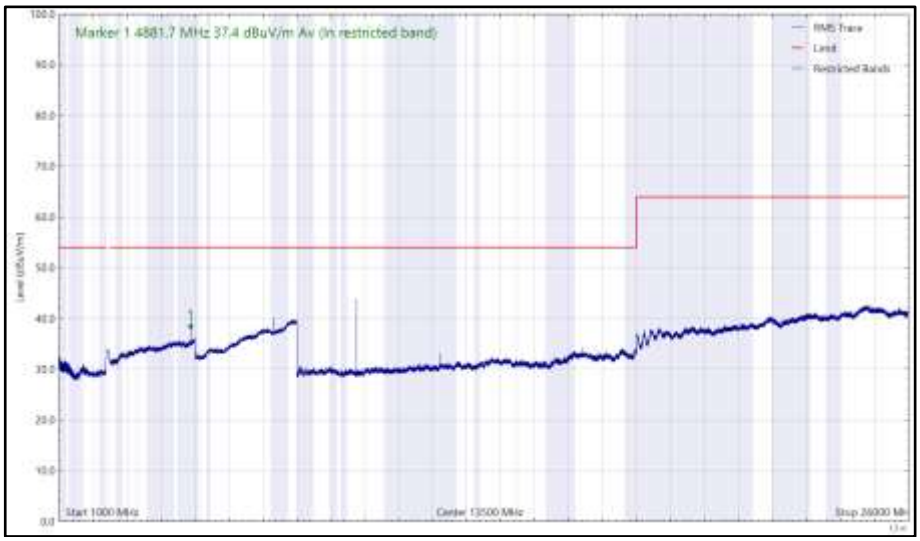

Figure 214 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

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

Table 70 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz

*No emissions found within 6 dB of the limit.

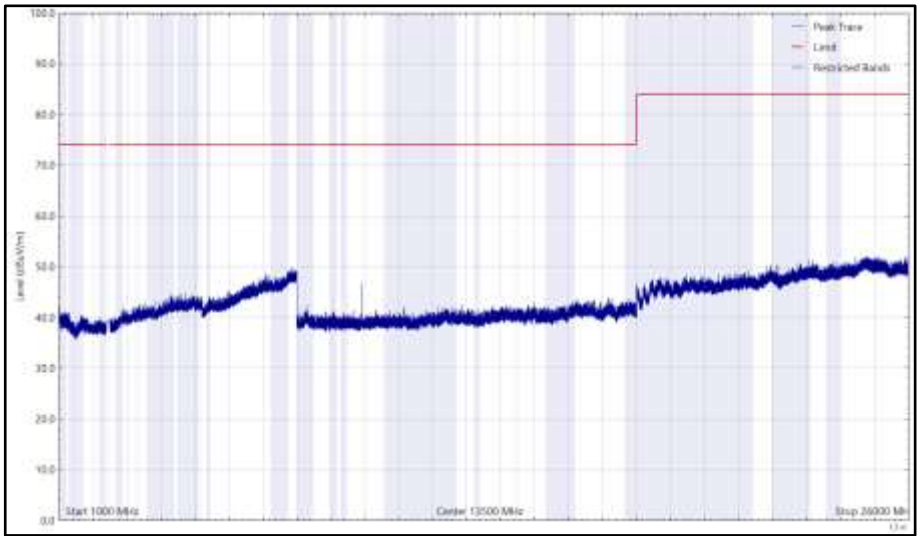

Figure 215 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

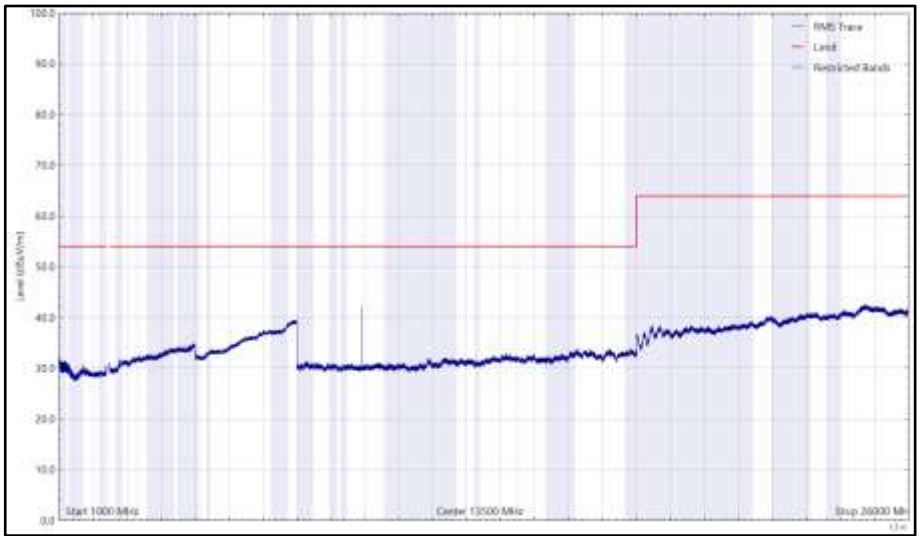

Figure 216 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

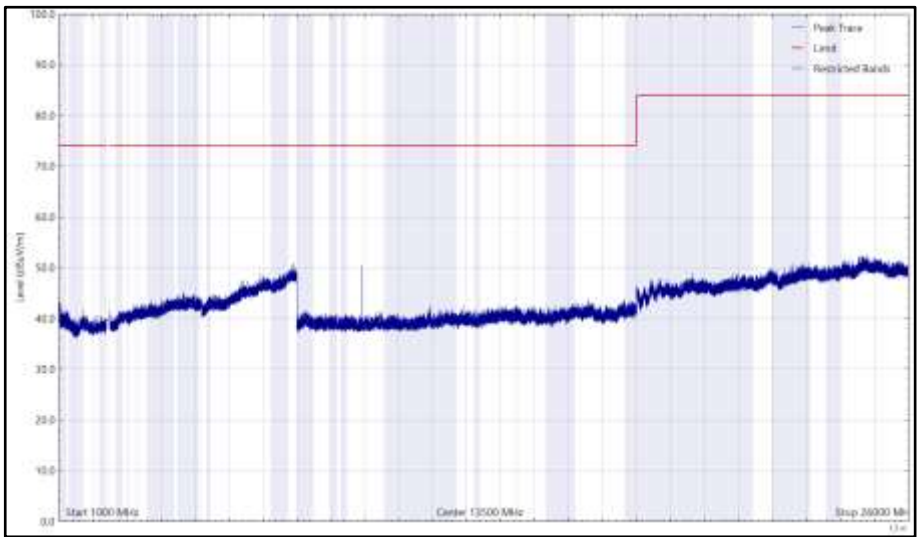

Figure 217 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

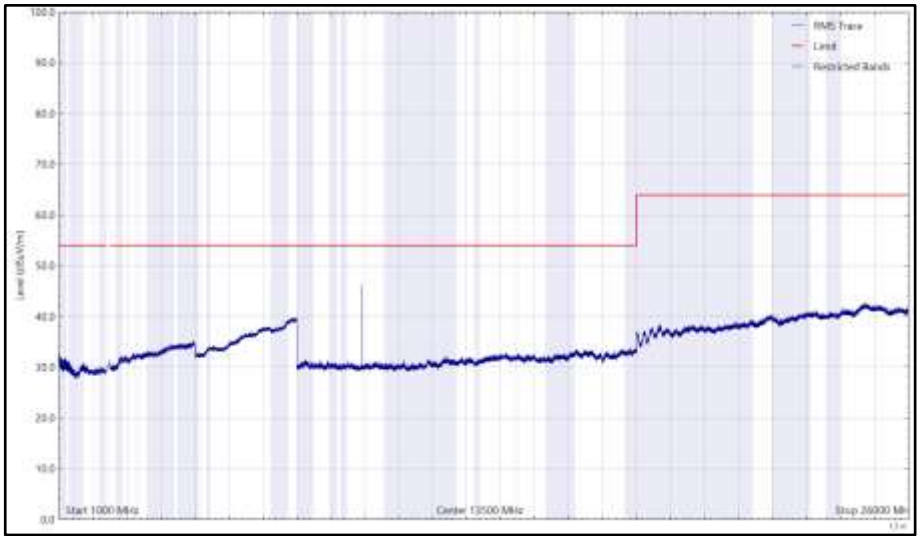

Figure 218 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

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

Table 71 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz

*No emissions found within 6 dB of the limit.

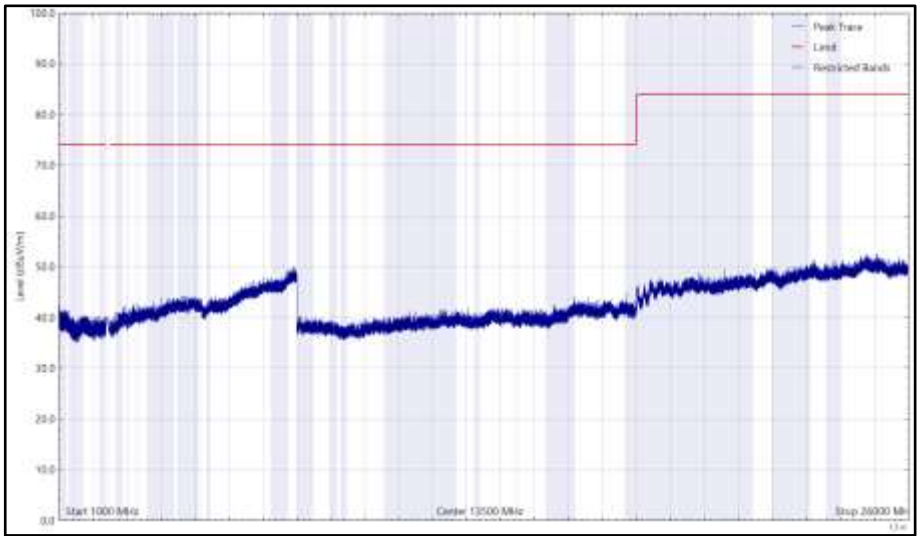

Figure 219 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

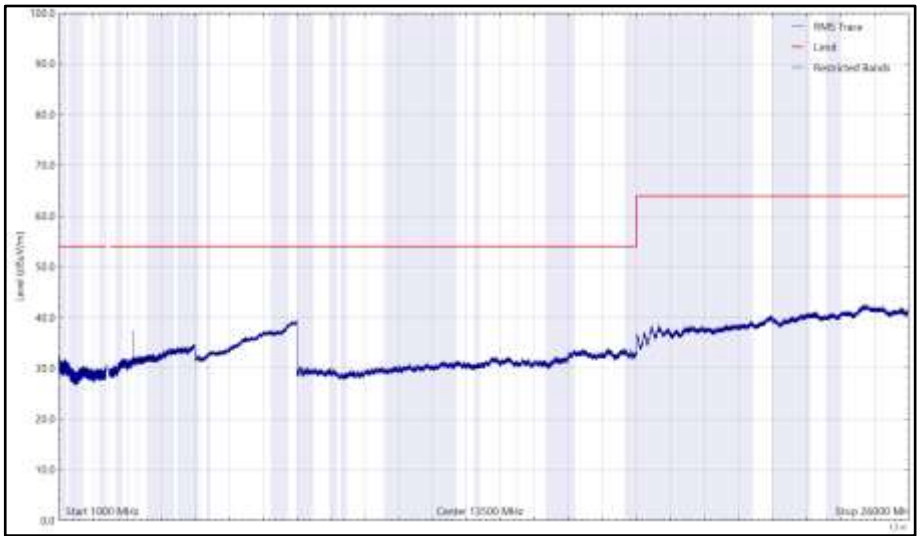

Figure 220 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

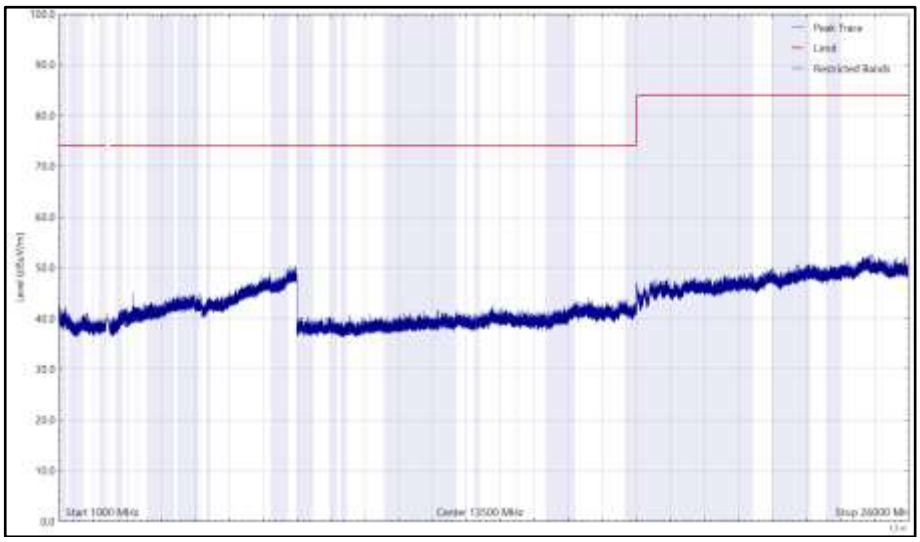

Figure 221 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

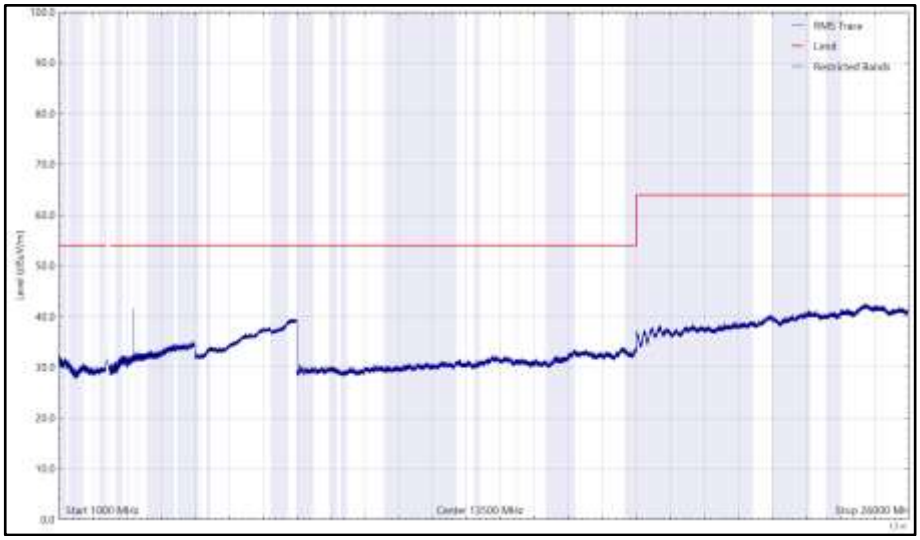

Figure 222 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)

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

Table 72 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 26 GHz

*No emissions found within 6 dB of the limit.

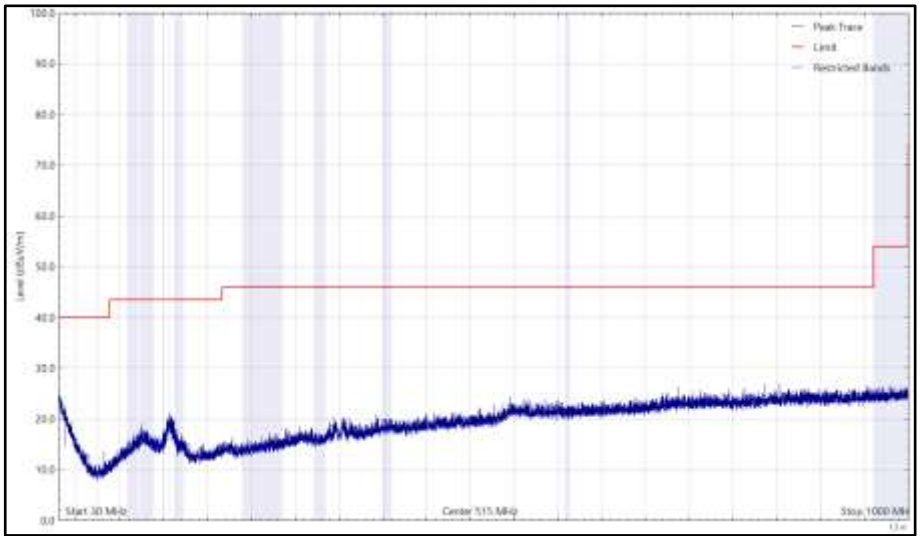

Figure 223 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)

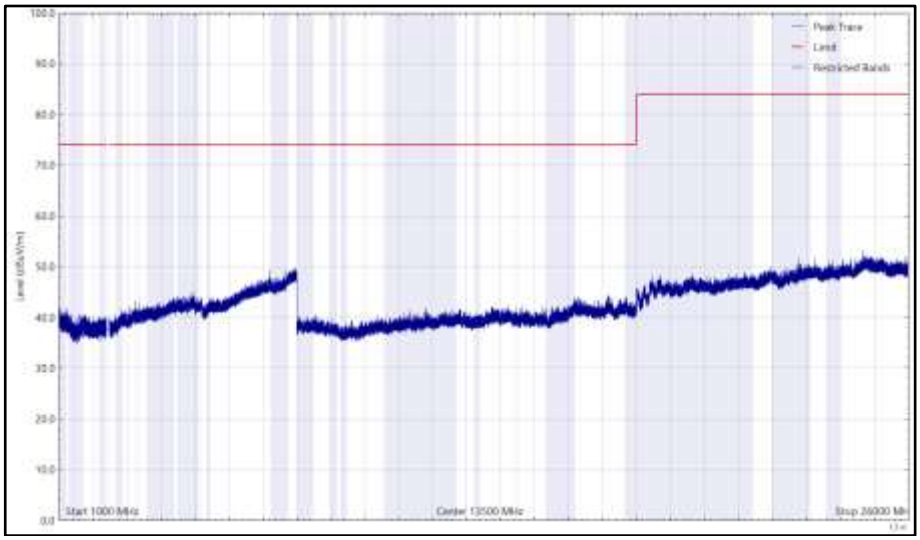

Figure 224 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

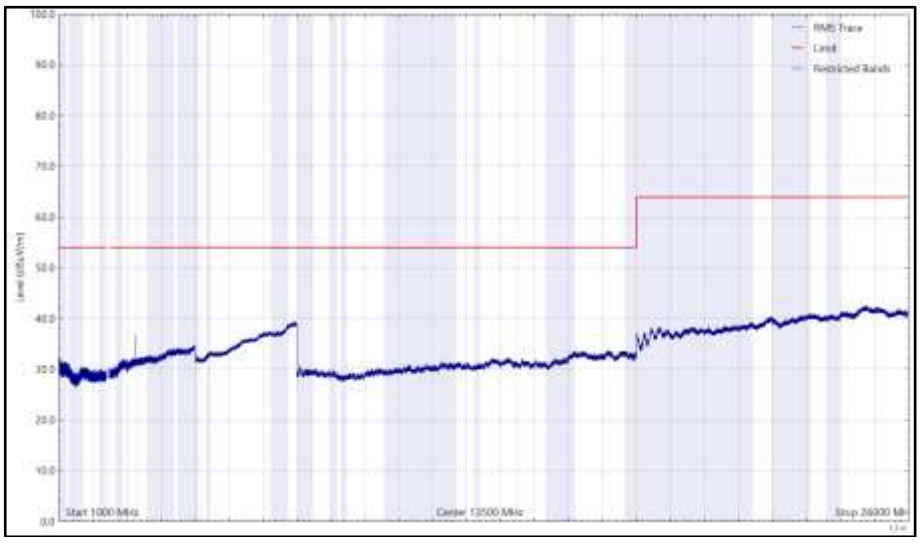

Figure 225 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

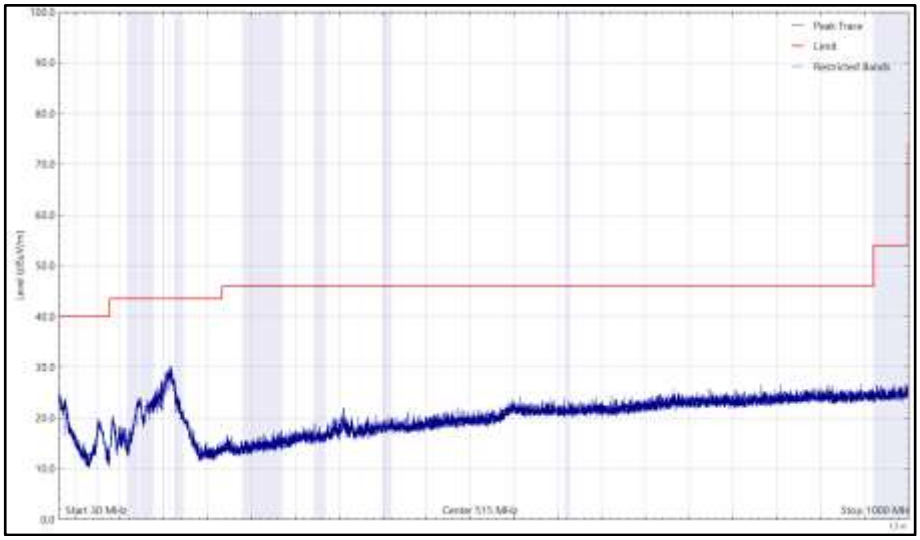

Figure 226 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

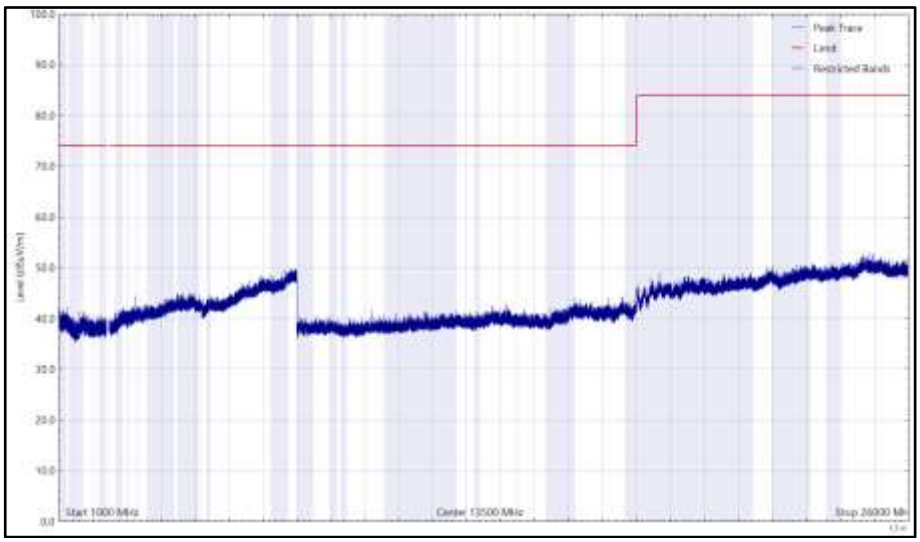

Figure 227 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

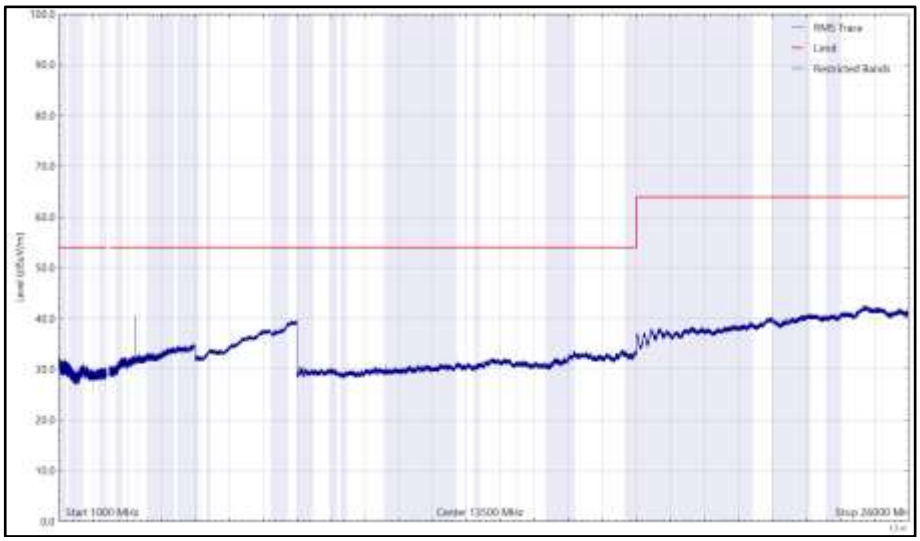

Figure 228 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)

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

Table 73 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz

*No emissions found within 6 dB of the limit.

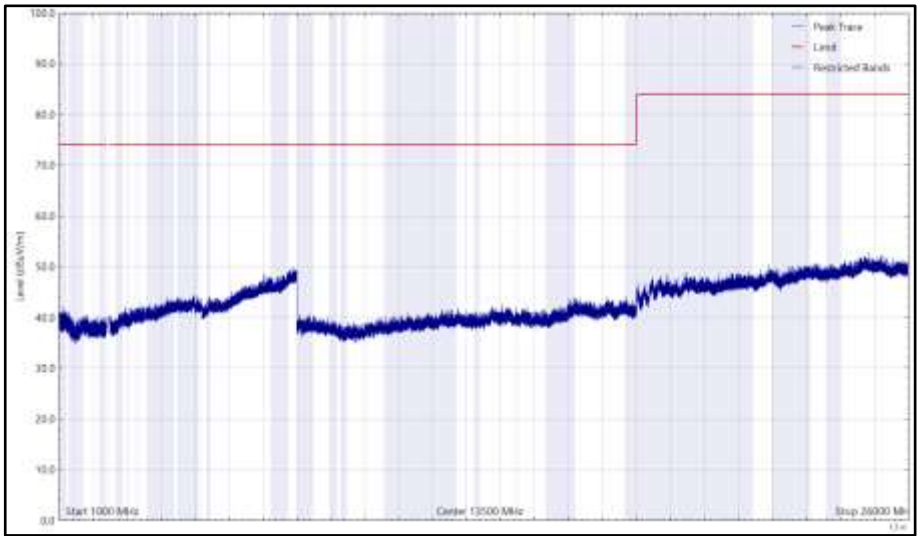

Figure 229 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

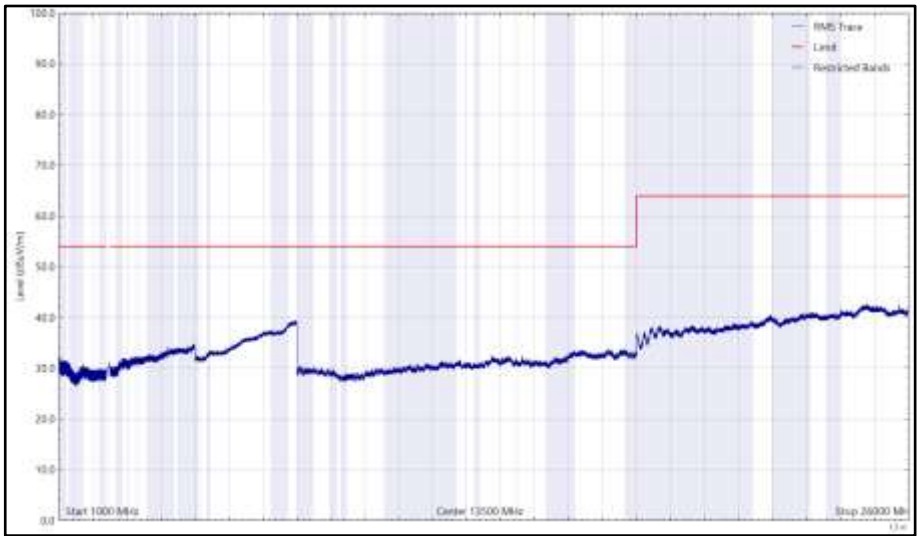

Figure 230 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

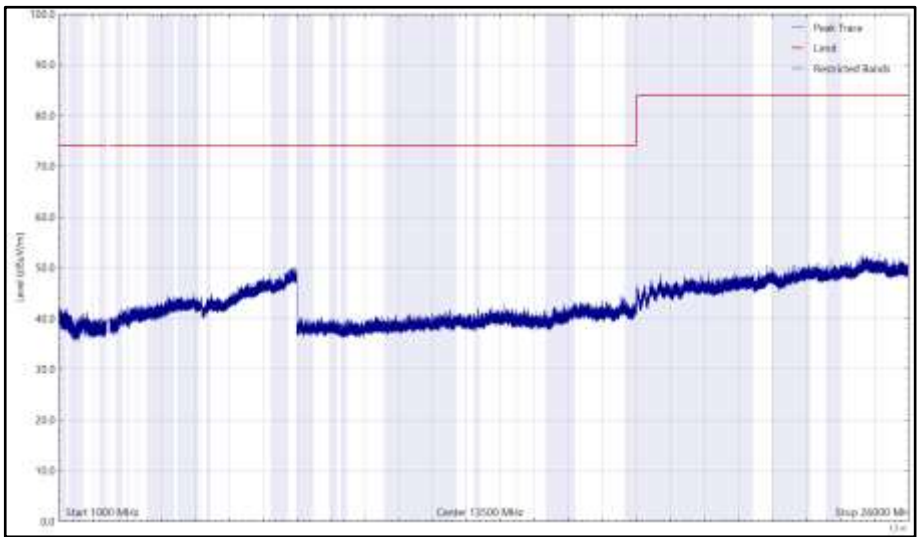

Figure 231 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

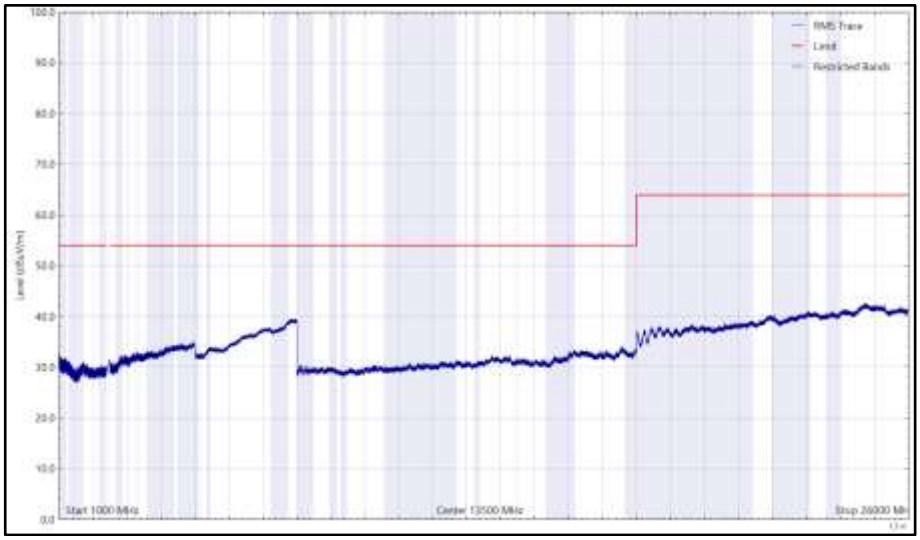

Figure 232 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)

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

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

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

ISED RSS-247, Limit Clause 5.5

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

2.8.8 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
Screened Room (5)	Rainford	Rainford	1545	36	23-Jan-2021
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Antenna with permanent attenuator (Bilog)	Chase	CBL6143	2904	24	30-Sep-2021
Mast Controller	Maturo Gmbh	NCD	4810	-	TU
Double Ridge Broadband Horn Antenna	Schwarzbeck	BBHA 9120 B	4848	12	10-Mar-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
Band Reject Filter - 5.795 GHz	Wainwright	WRCJV10-5725-5755-5835-5865-50SS	5071	12	30-Sept-2021
Band Reject Filter - 5.22 GHz	Wainwright	WRCJV12-5120-5150-5290-5320-50SS	5073	12	02-Oct-2021
Band Reject Filter - 5.28 GHz	Wainwright	WRCJV12-5180-5210-5350-5380-50SS	5075	12	30-Sep-2021
Band Reject Filter - 5.775 GHz	Wainwright	WRCJV10-5700-5735-5815-5850-50SS	5077	12	10-Oct-2021
Band Reject Filter - 5.570 GHz	Wainwright	WRCJV10-5440-5490-5650-5700-50SS	5079	12	10-Oct-2021
Band Reject Filter - 5.690 GHz	Wainwright	WRCJV8-5635-5670-5710-5745-50SS	5081	12	02-Oct-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5103	12	12-Oct-2021
DRG Horn Antenna (7.5-18GHz)	Schwarzbeck	HWRD750	5216	12	10-Mar-2021
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	5217	12	14-Oct-2021
Preamplifier (30dB 1GHz to 18GHz)	Schwarzbeck	BBV 9718 C	5261	12	07-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
1m -SMA Cable	Junkosha	MWX221-01000AMSAMS/A	5515	12	01-Apr-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5517	12	01-Apr-2021
2m SMA Cable	Junkosha	MWX221-02000AMSAMS/A	5518	12	01-Apr-2021

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
8m N-Type Cable	Junkosha	MWX221-08000NMSNMS/B	5520	12	24-Mar-2021
8m N Type Cable	Junkosha	MWX221-08000NMSNMS/B	5522	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
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5549	12	23-May-2021
7 GHz High pass Filter	Wainwright	WHKX12-5850-6800-18000-80SS	5550	12	23-May-2021
1200 MHz Low Pass Filter (01)	Mini-Circuits	VLF-1200+	5559	12	23-May-2021
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5595	12	25-Aug-2021
8 - 18 GHz Amplifier	Wright Technologies	APS06-0061	5596	12	25-Aug-2021

Table 74

TU - Traceability Unscheduled

3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
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
Maximum Conducted Output Power	± 3.2 dB
Frequency Hopping Systems - Average Time of Occupancy	-
Frequency Hopping Systems - Channel Separation	± 20.508 kHz
Frequency Hopping Systems - 20 dB Bandwidth	± 23.512 kHz
Frequency Hopping Systems - Number of Hopping Channels	-

Table 75

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.