

# 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

## COMMERCIAL-IN-CONFIDENCE

Document 75946858-09 Issue 01



### SIGNATURE

| 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.



#### DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2021 TÜV SÜD. This report relates only to the actual item/items tested.

#### ACCREDITATION

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

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

TÜV SÜD Ltd is a  
TÜV SÜD Group Company

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

TÜV SÜD  
Octagon House  
Concorde Way  
Fareham  
Hampshire PO15 5RL  
United Kingdom



## Contents

|          |                                                              |            |
|----------|--------------------------------------------------------------|------------|
| <b>1</b> | <b>Report Summary .....</b>                                  | <b>2</b>   |
| 1.1      | Report Modification Record.....                              | 2          |
| 1.2      | Introduction.....                                            | 2          |
| 1.3      | Brief Summary of Results .....                               | 3          |
| 1.4      | Product Information .....                                    | 4          |
| 1.5      | Deviations from the Standard.....                            | 5          |
| 1.6      | EUT Modification Record .....                                | 5          |
| 1.7      | Test Location .....                                          | 6          |
| <b>2</b> | <b>Test Details .....</b>                                    | <b>7</b>   |
| 2.1      | Frequency Hopping Systems - Average Time of Occupancy .....  | 7          |
| 2.2      | Frequency Hopping Systems - Channel Separation.....          | 12         |
| 2.3      | Frequency Hopping Systems - 20 dB Bandwidth .....            | 19         |
| 2.4      | Frequency Hopping Systems - Number of Hopping Channels ..... | 54         |
| 2.5      | Maximum Conducted Output Power .....                         | 57         |
| 2.6      | Authorised Band Edges .....                                  | 63         |
| 2.7      | Restricted Band Edges.....                                   | 92         |
| 2.8      | Spurious Radiated Emissions .....                            | 121        |
| <b>3</b> | <b>Measurement Uncertainty .....</b>                         | <b>161</b> |



# 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<br>ISED RSS-247: Issue 2 (02-2017)<br>ISED RSS-GEN: Issue 5 (04-2018) + A1 (03-2019)    |
| Order Number                  | 0540188556                                                                                                        |
| Date                          | 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)<br>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, ISSED RSS-247 and ISSED 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





Figure 5 -  $\pi/4$  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     |
| $\pi/4$ 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 -  $\pi/4$  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     |
| $\pi/4$ 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 -  $\pi/4$  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:  $\pi/4$  DQPSK (2-DH5)

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

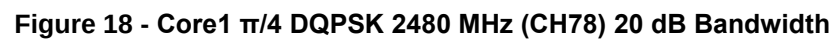
Table 15 - 20 dB Bandwidth Results



Figure 16 - Core1  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 17 - Core1  $\pi/4$  DQPSK 2441 MHz (CH39) 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:  $\pi/4$  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  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 29 - Core1  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 30 - Core0  $\pi/4$  DQPSK 2441 MHz (CH39) 20 dB Bandwidth



Figure 31 - Core1  $\pi/4$  DQPSK 2441 MHz (CH39) 20 dB Bandwidth



Figure 32 - Core0  $\pi/4$  DQPSK 2480 MHz (CH78) 20 dB Bandwidth



Figure 33 - Core1  $\pi/4$  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



## 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:  $\pi/4$  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  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 47 - Core1  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 48 - Core2  $\pi/4$  DQPSK 2441 MHz (CH39) 20 dB Bandwidth



Figure 49 - Core2  $\pi/4$  DQPSK 2480 MHz (CH78) 20 dB Bandwidth



Figure 50 - Core1  $\pi/4$  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:  $\pi/4$  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  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 64 - Core1  $\pi/4$  DQPSK 2402 MHz (CH0) 20 dB Bandwidth



Figure 65 - Core0  $\pi/4$  DQPSK 2441 MHz (CH39) 20 dB Bandwidth



Figure 66 - Core1  $\pi/4$  DQPSK 2441 MHz (CH39) 20 dB Bandwidth



Figure 67 - Core0  $\pi/4$  DQPSK 2480 MHz (CH78) 20 dB Bandwidth



Figure 68 - Core1  $\pi/4$  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 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 ISSED 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

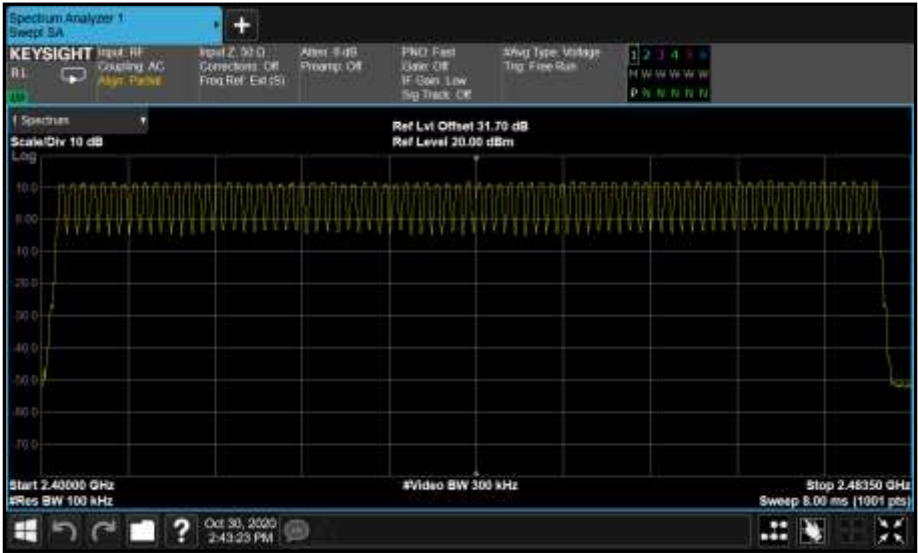


Figure 76 - GFSK (DH5) - Number of Hopping Channels

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:  
 $10 \log ([10^{(2.63/20)} + 10^{(2.60/20)}]^2 / 2) = 5.63 \text{ dBi}$ . 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:  $\pi/4$  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 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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:  $\pi/4$  DQPSK (2-DH5)

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |        |          |            |        |          |
|----------------------|--------------------------------------|--------|----------|------------|--------|----------|
|                      | Average Power                        |        |          | Peak Power |        |          |
|                      | Core 0                               | Core 1 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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:  $\pi/4$  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 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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:  $\pi/4$  DQPSK (2-DH5)

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |        |          |            |        |          |
|----------------------|--------------------------------------|--------|----------|------------|--------|----------|
|                      | Average Power                        |        |          | Peak Power |        |          |
|                      | Core 0                               | Core 1 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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 | $\Sigma$ | Core 0     | Core 1 | $\Sigma$ |
| 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  | $\pi/4$ 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 | $\pi/4$ 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**

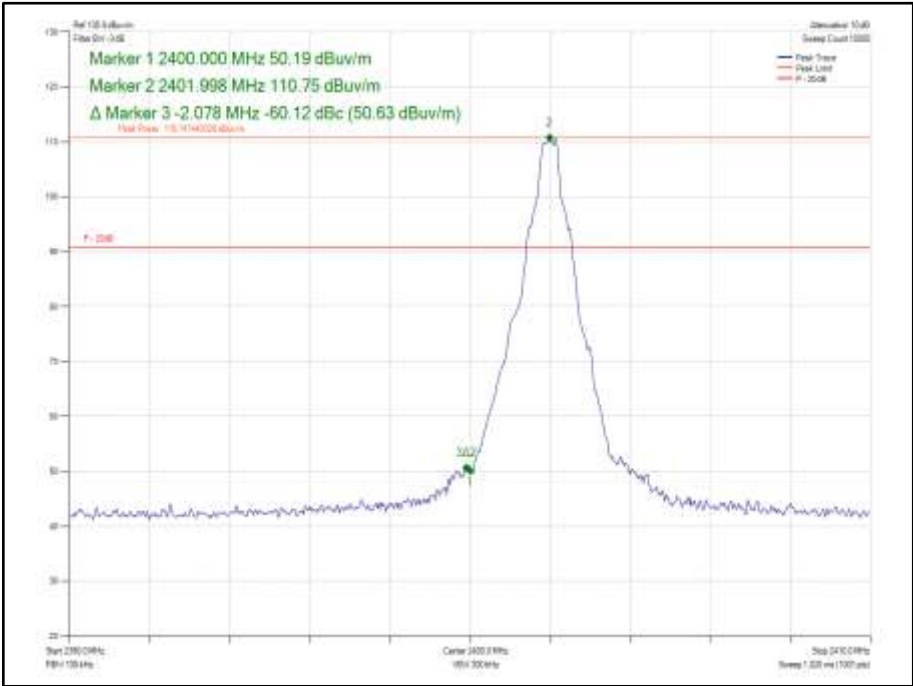


Figure 78 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

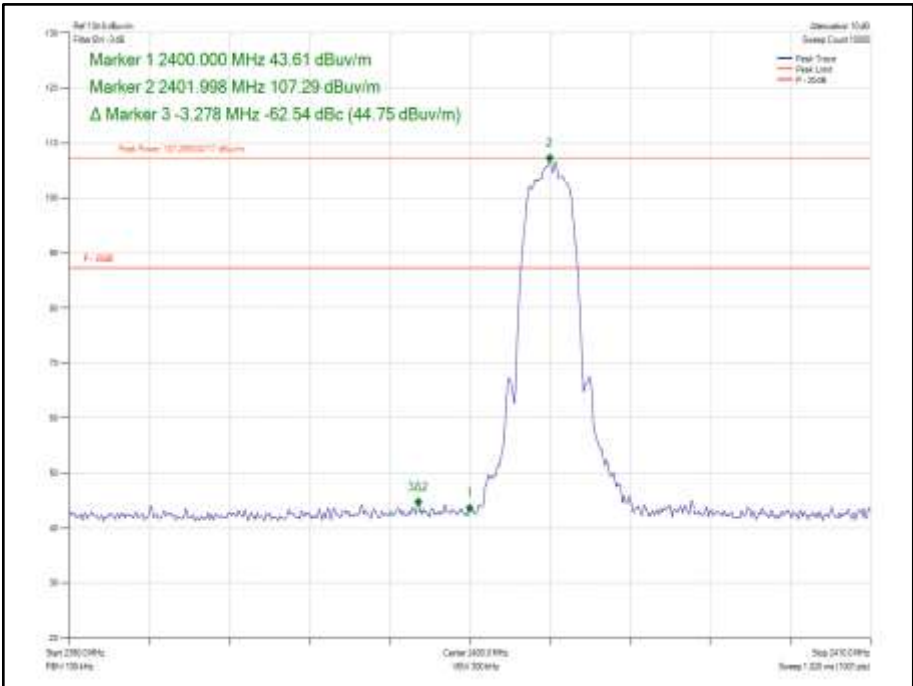


Figure 79 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

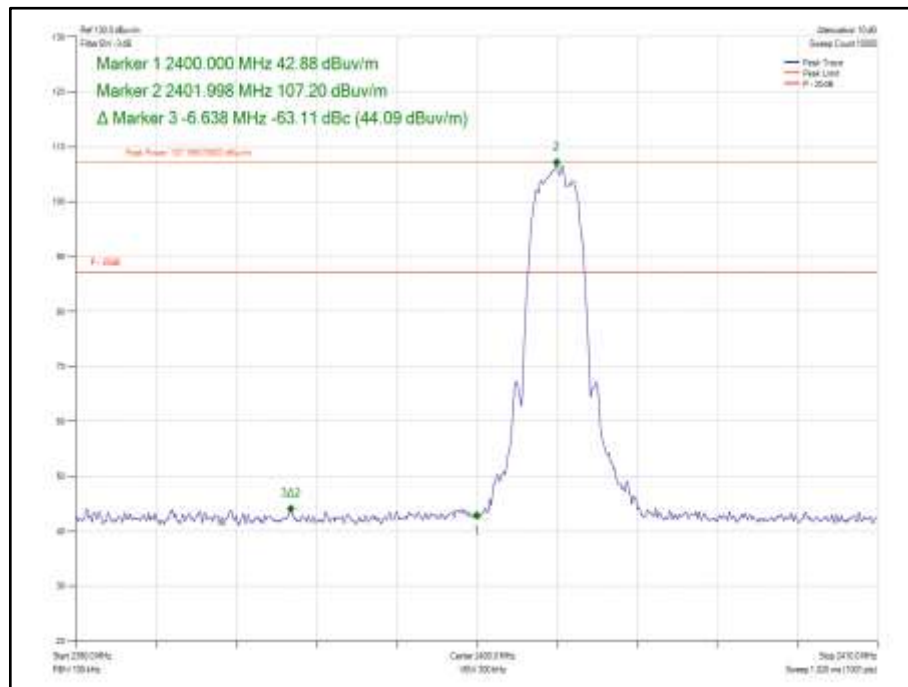


Figure 80 - Static Core 0- 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

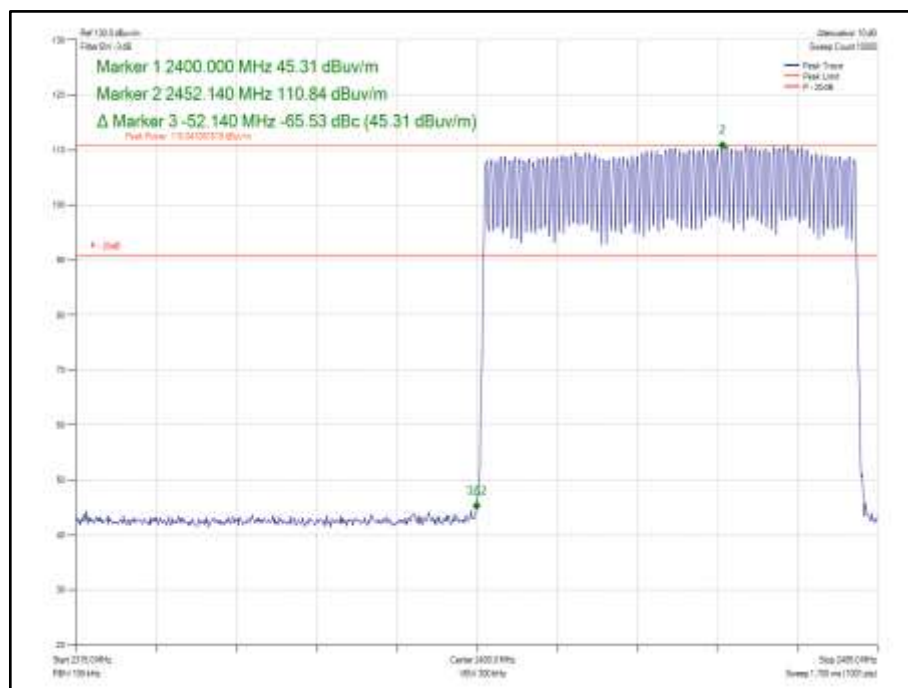


Figure 81 - Hopping Core 0 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

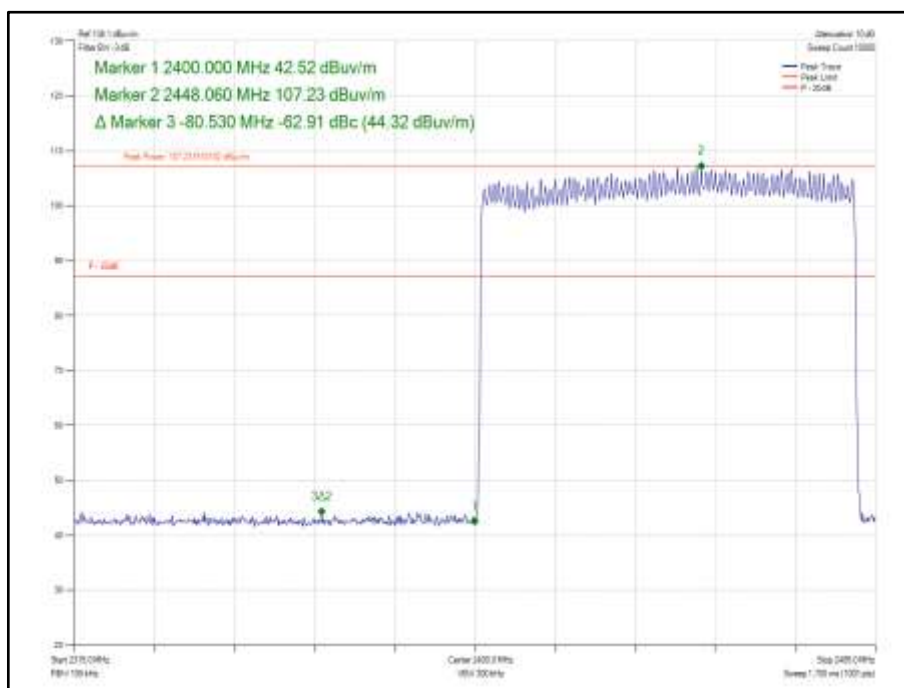


Figure 82 - Hopping Core 0 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

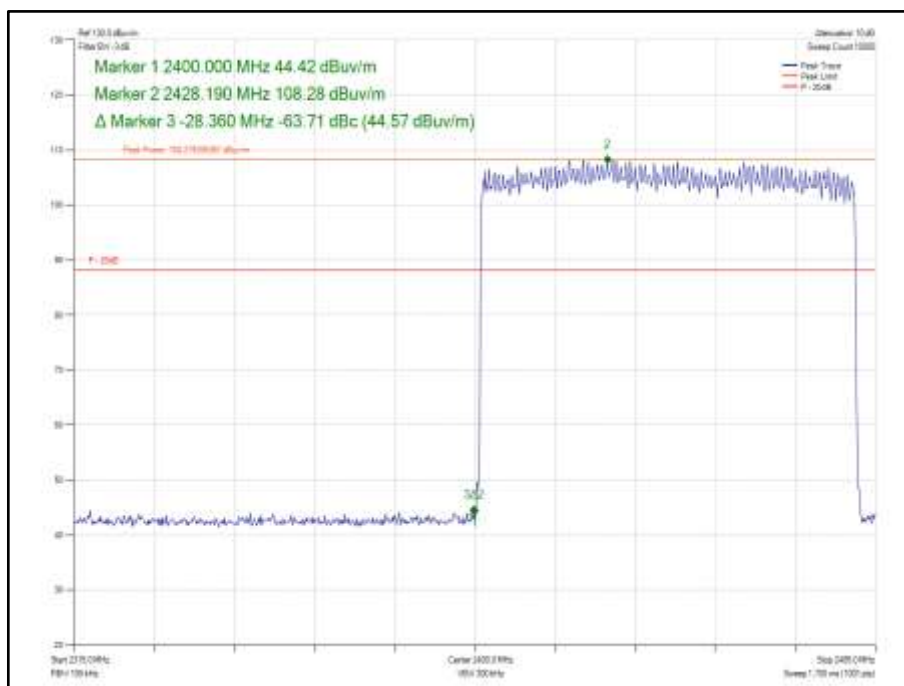
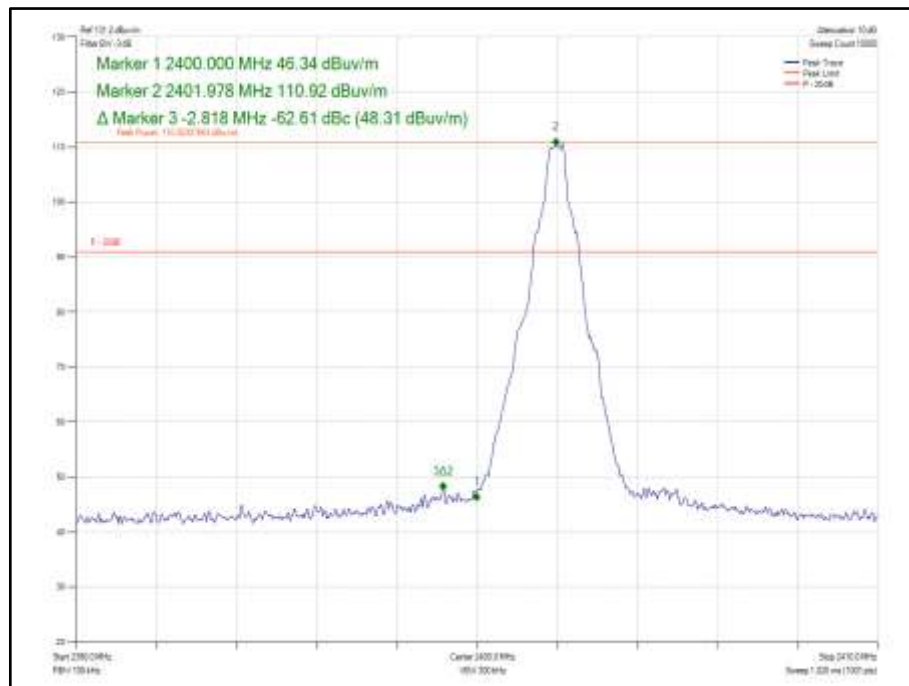


Figure 83 - Hopping Core 0 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

| 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  | $\pi/4$ 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 | $\pi/4$ 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**

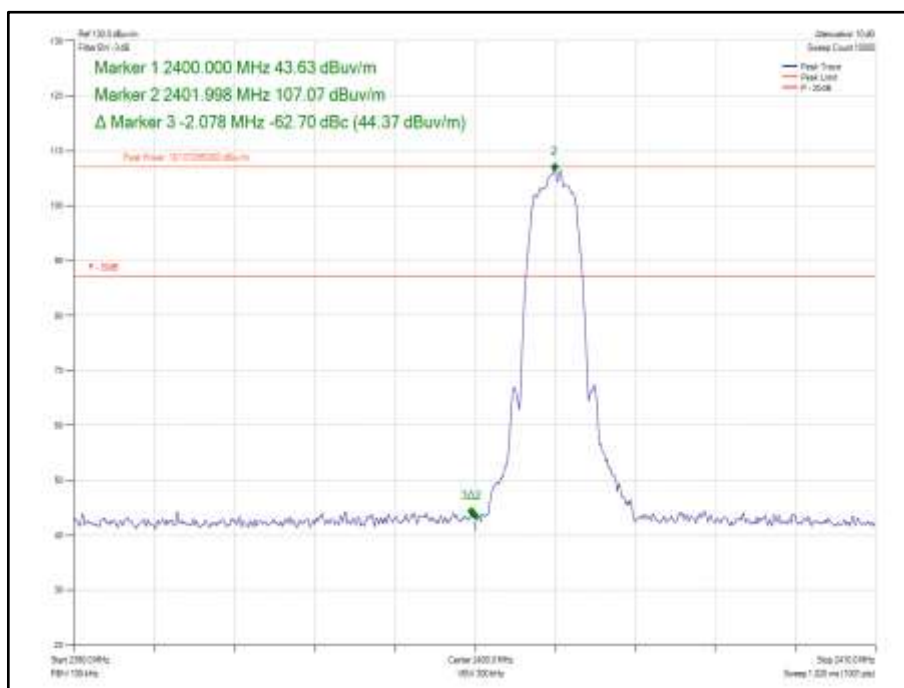


Figure 85 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

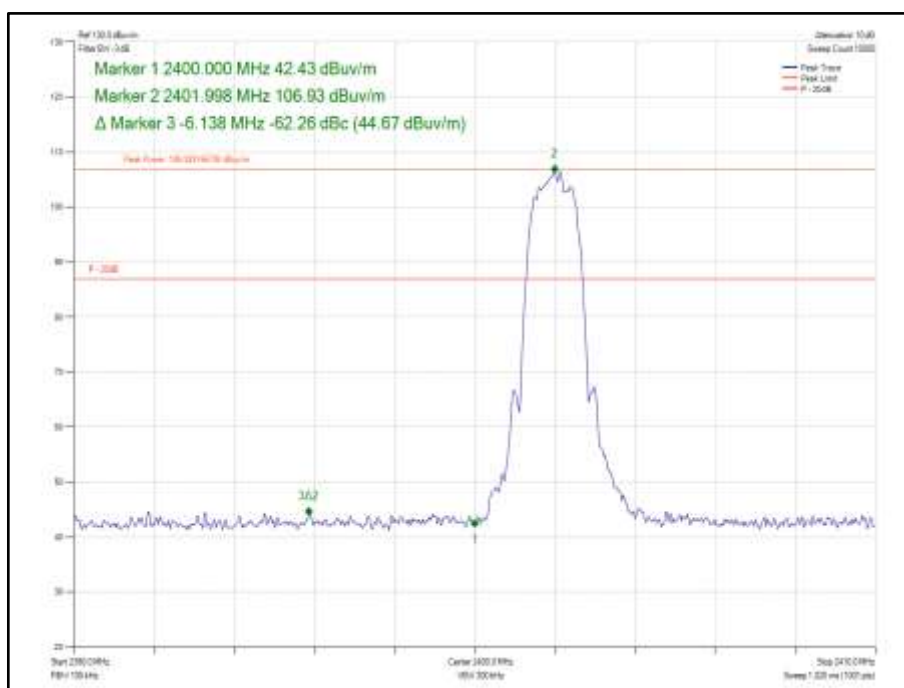


Figure 86 - Static Core 1- 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

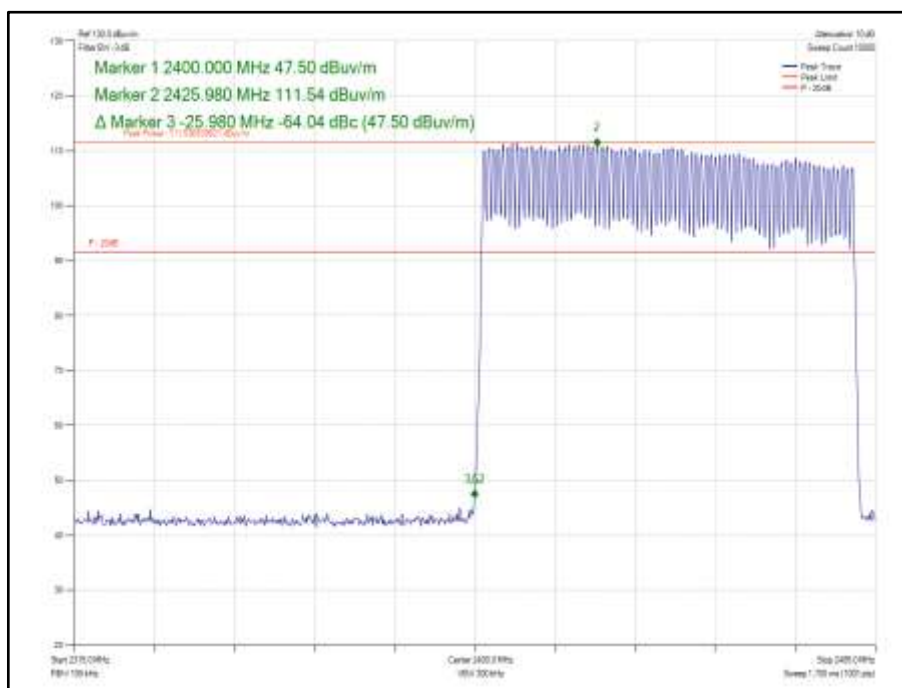


Figure 87 - Hopping Core 1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

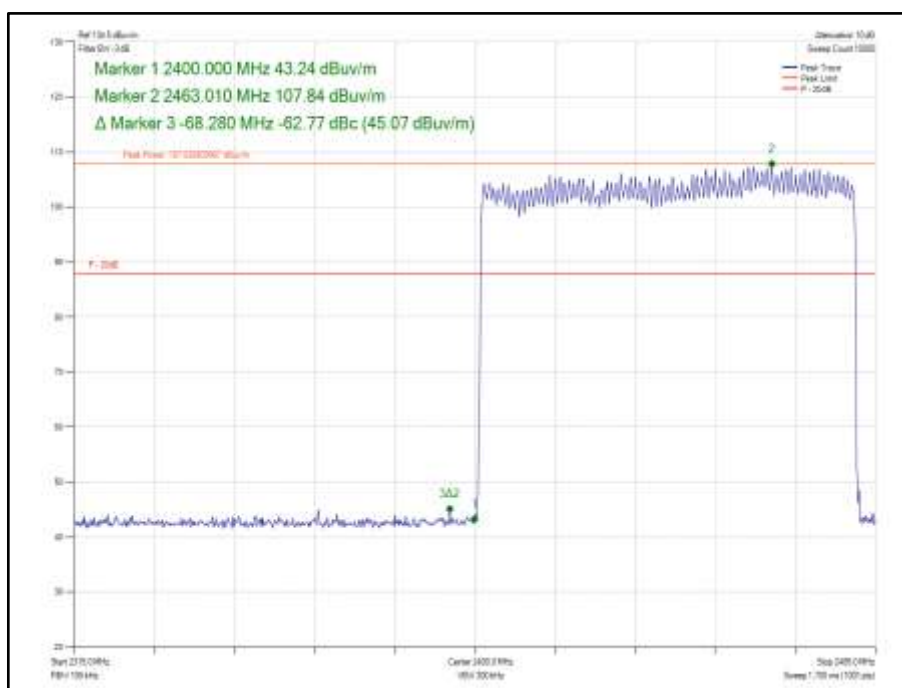


Figure 88 - Hopping Core 1 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

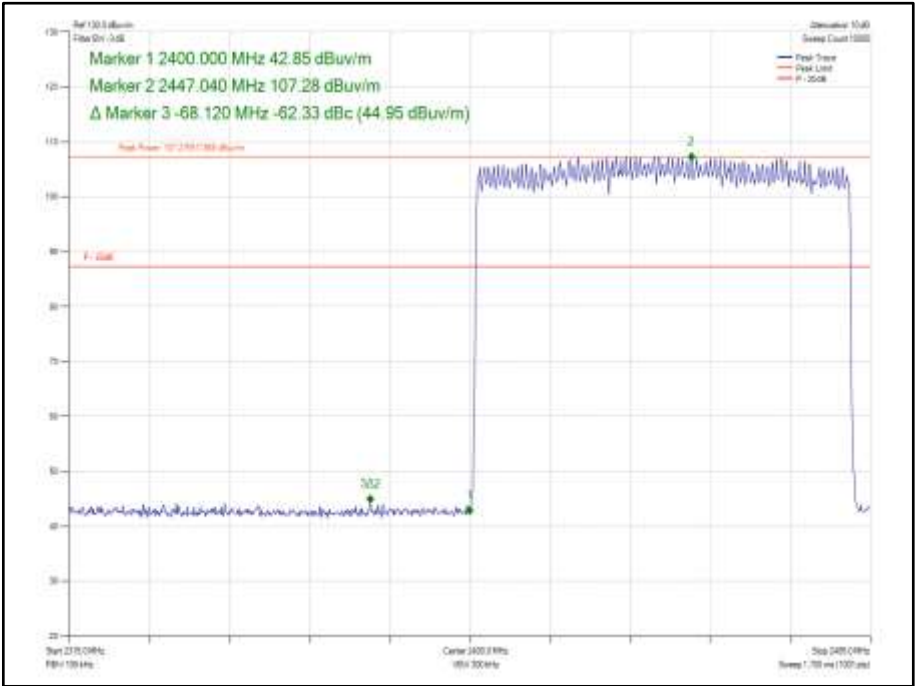
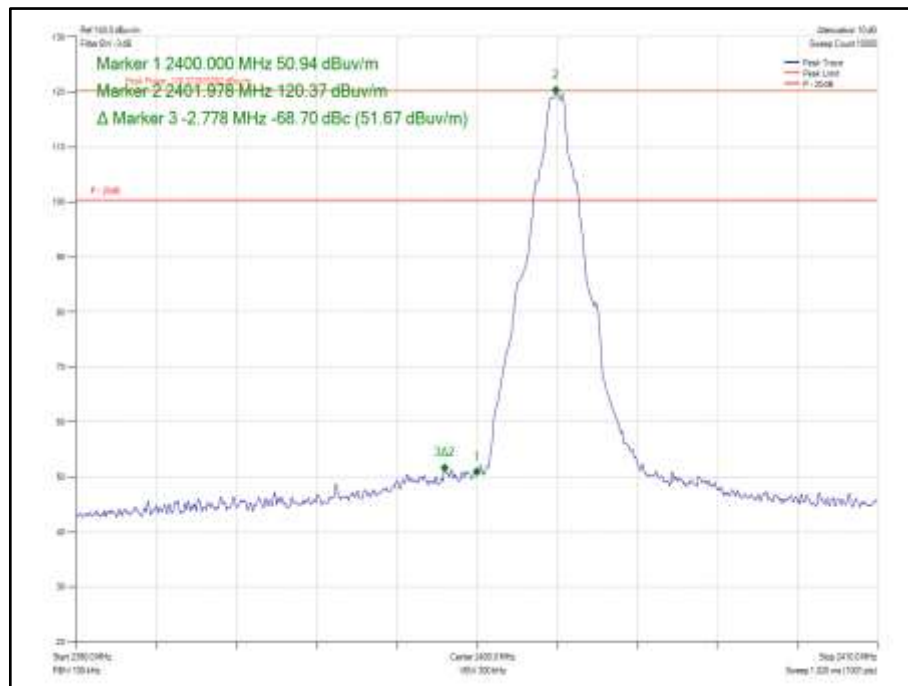


Figure 89 - Hopping Core 1 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

| 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  | $\pi/4$ 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 | $\pi/4$ 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**

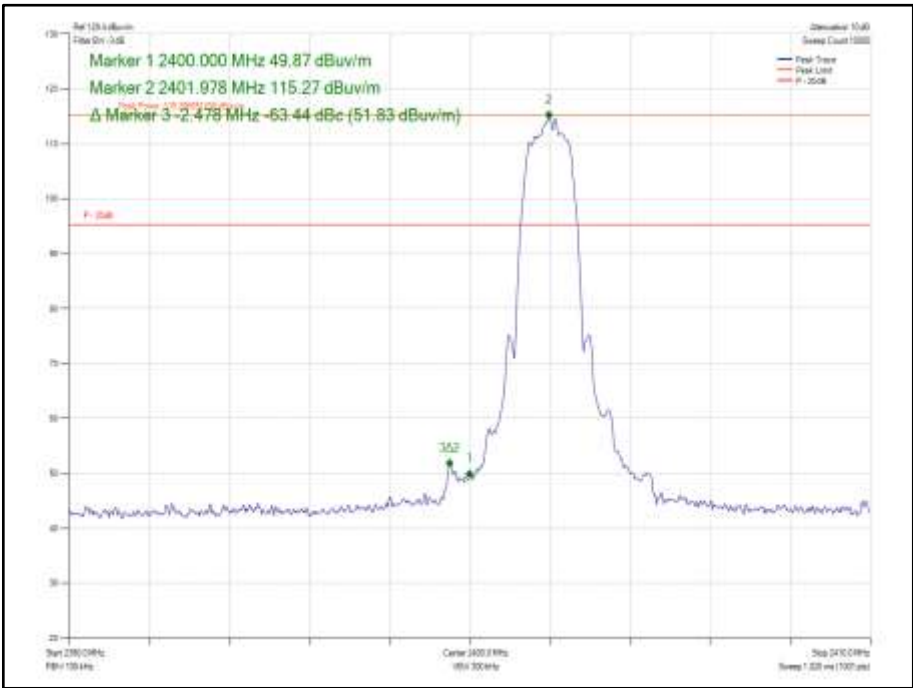


Figure 91 - Static Core 2 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

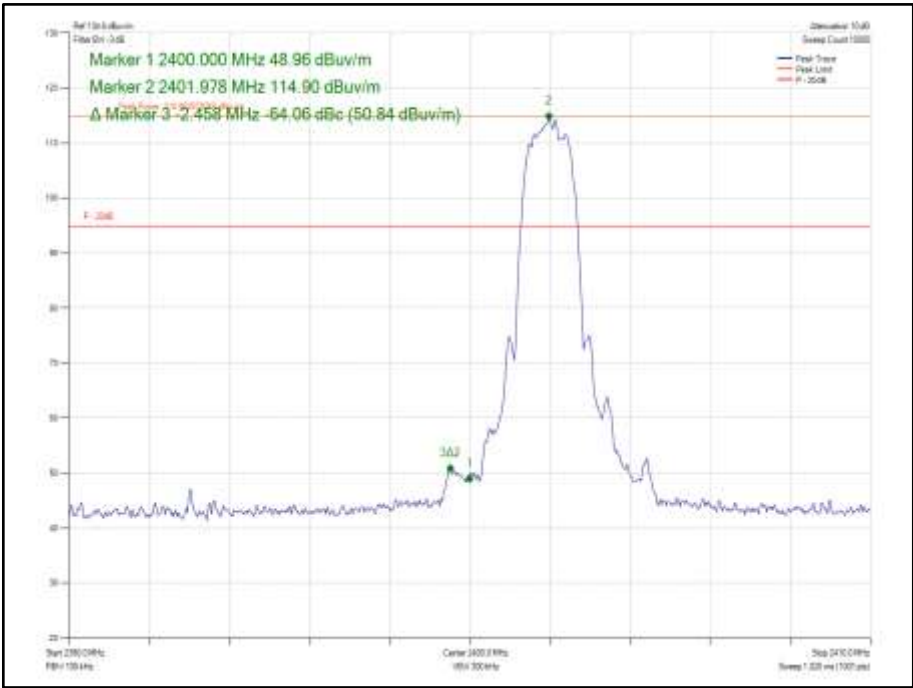


Figure 92 - Static Core 2 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

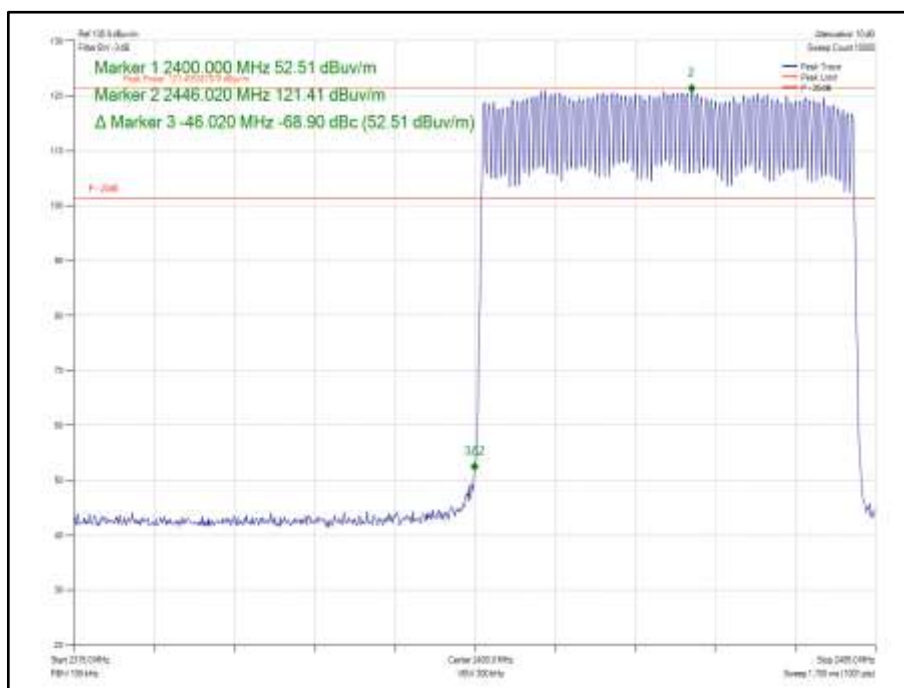


Figure 93 - Hopping Core 2 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

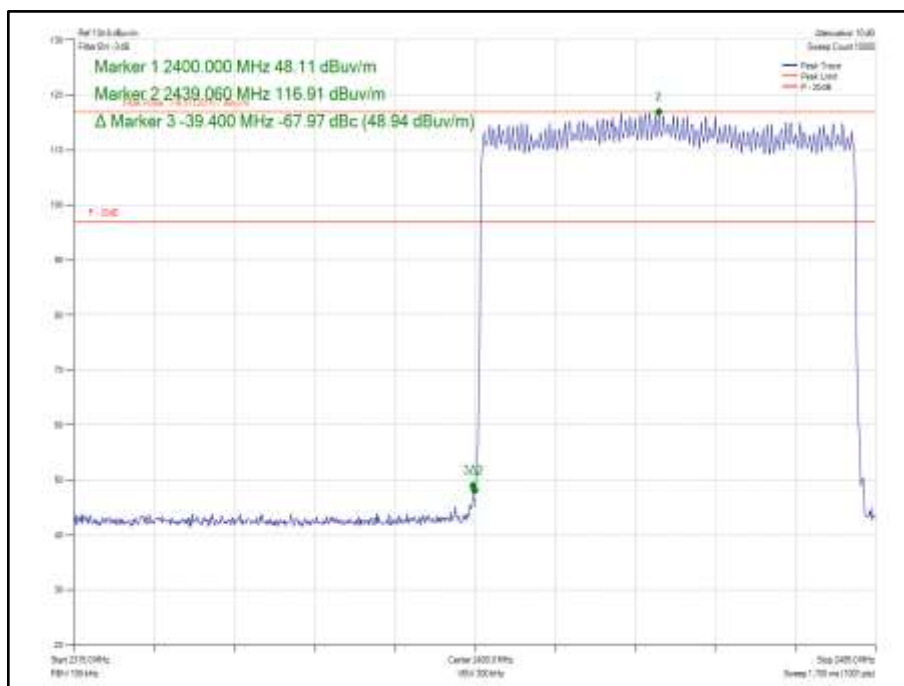


Figure 94 - Hopping Core 2 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

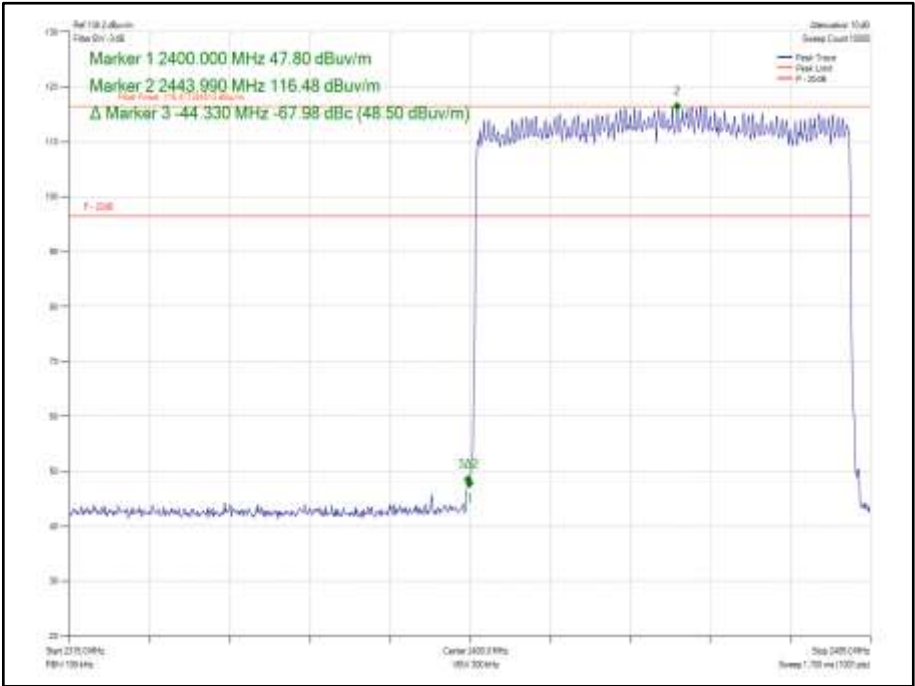
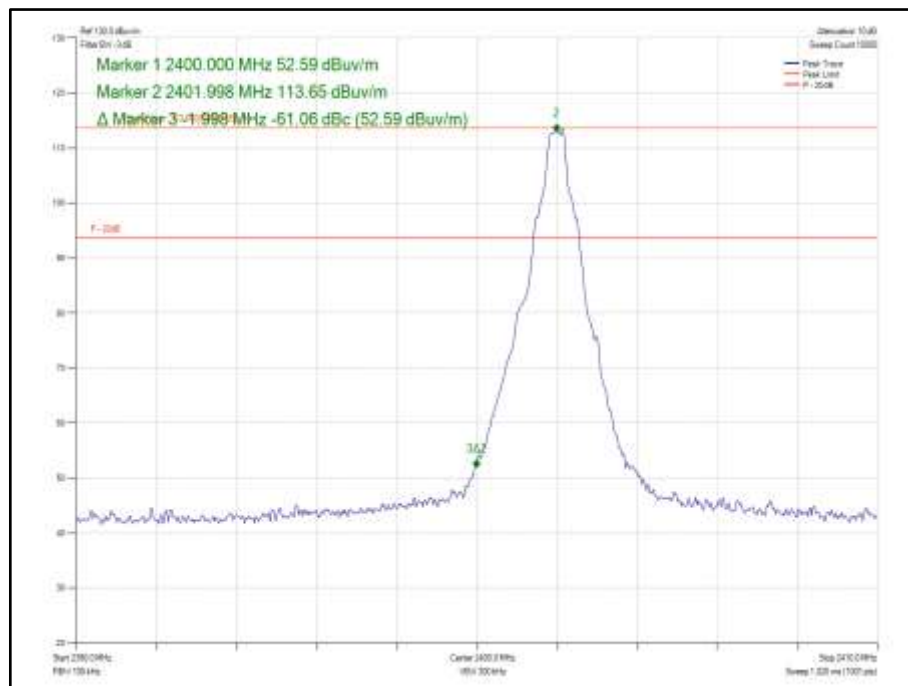


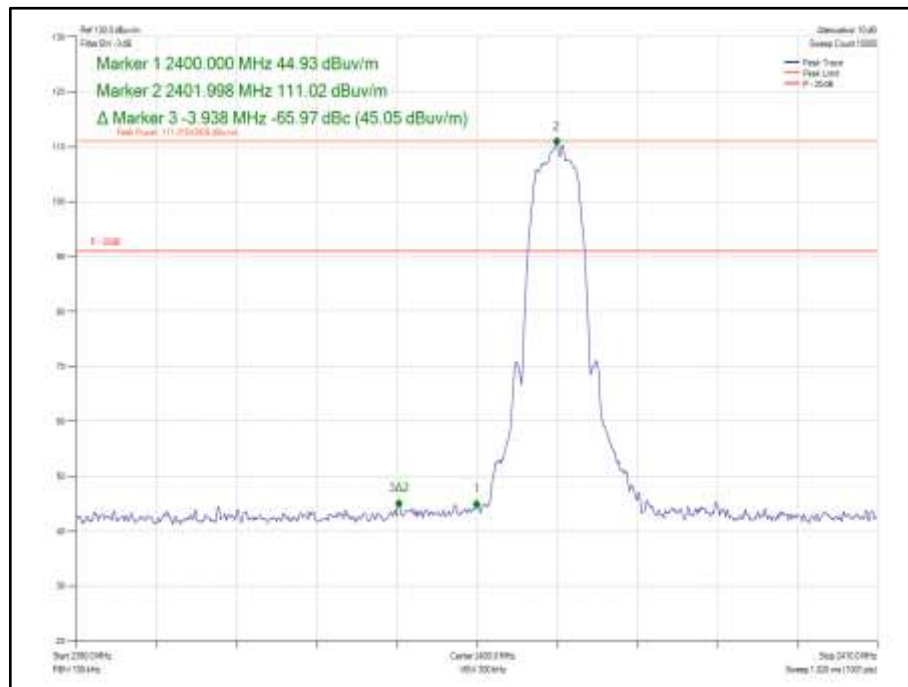
Figure 95 - Hopping Core 2- 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

| 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  | $\pi/4$ 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 | $\pi/4$ DQPSK | 2DH5        | 2402               | 2400.0                    | -65.95      |
| Hopping Core 0-1 | 8-DPSK        | 3DH5        | 2402               | 2400.0                    | -65.45      |

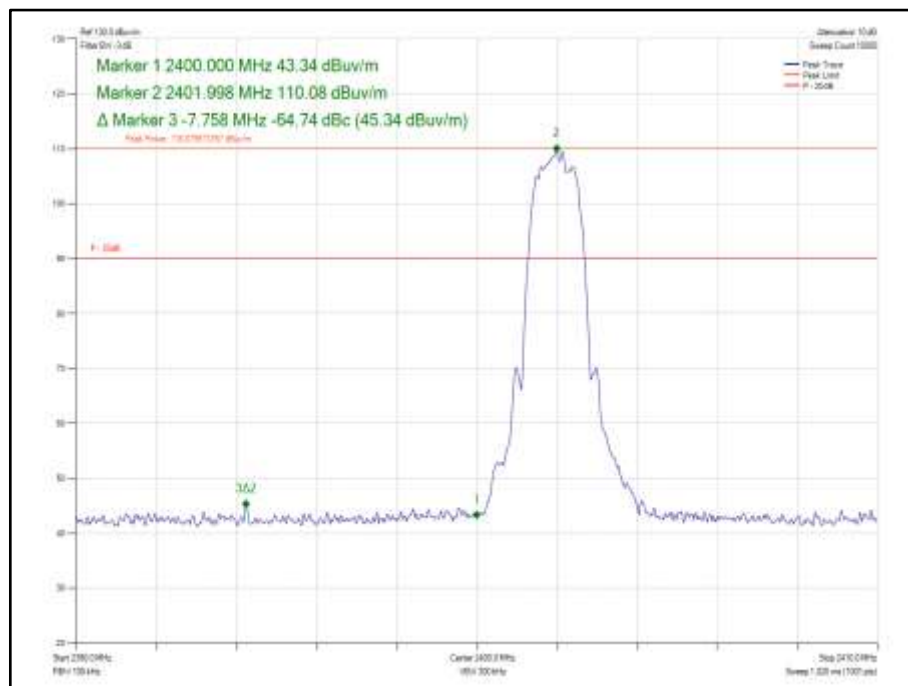
**Table 44 - MIMO 2TX Authorised Band Edge Results**



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



**Figure 97 - Static Core 0-1 -  $\pi/4$  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**

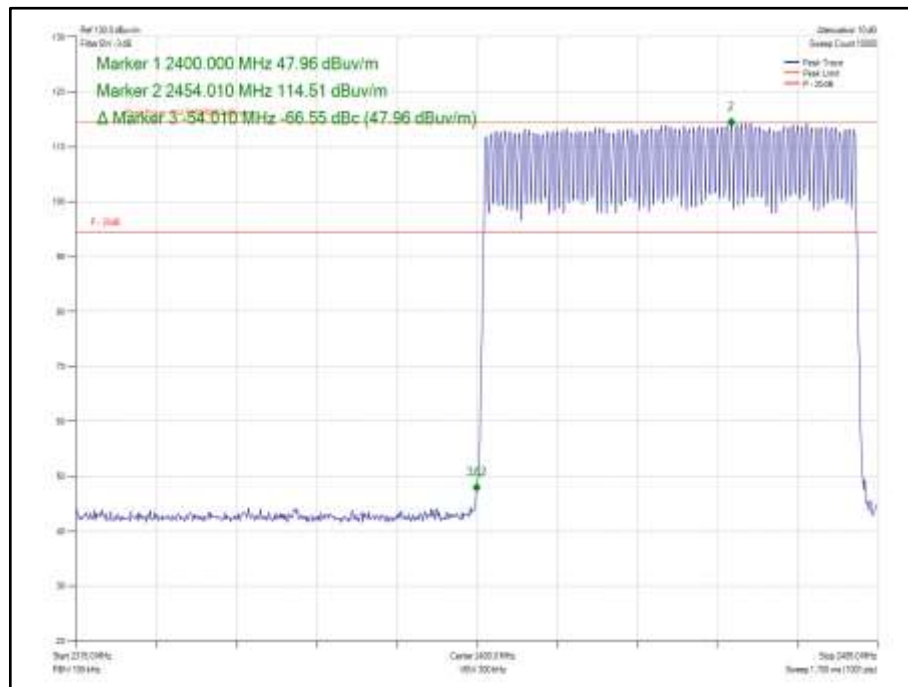


Figure 99 - Hopping Core 0-1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

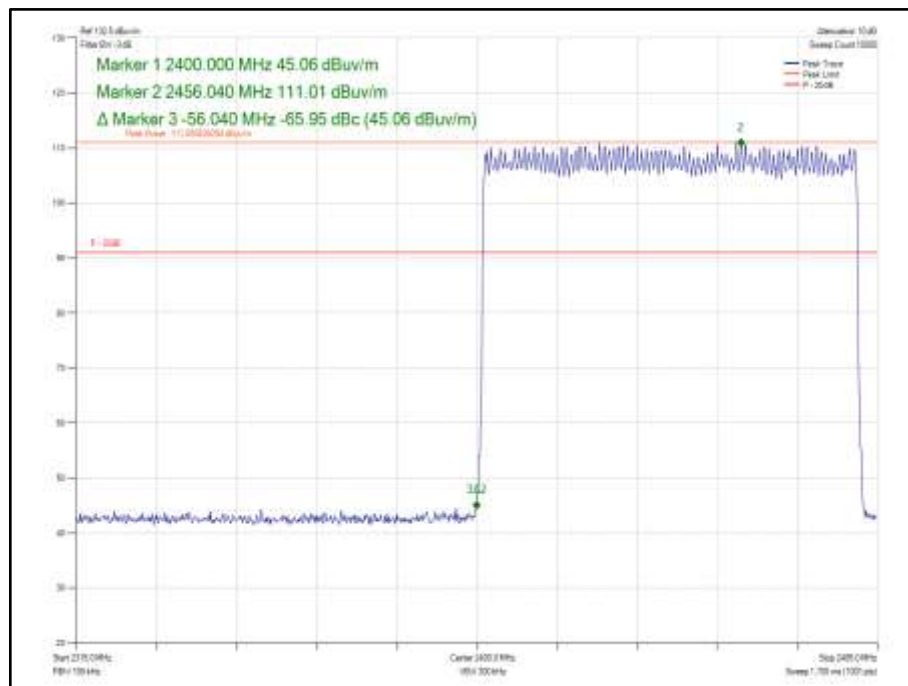


Figure 100 - Hopping Core 0-1 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

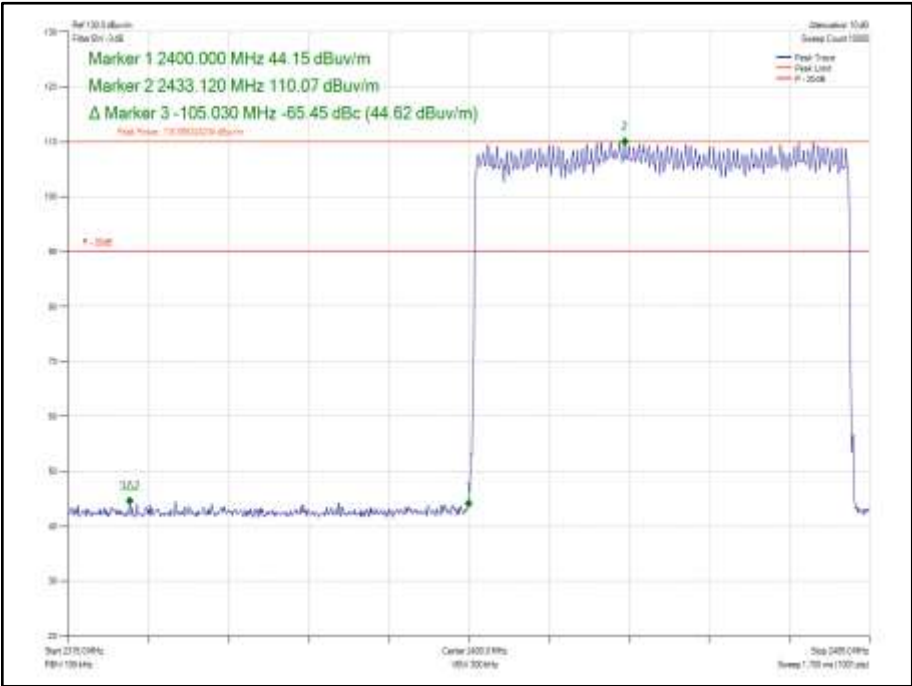


Figure 101 - Hopping Core 0-1- 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

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

Page 79 of 161

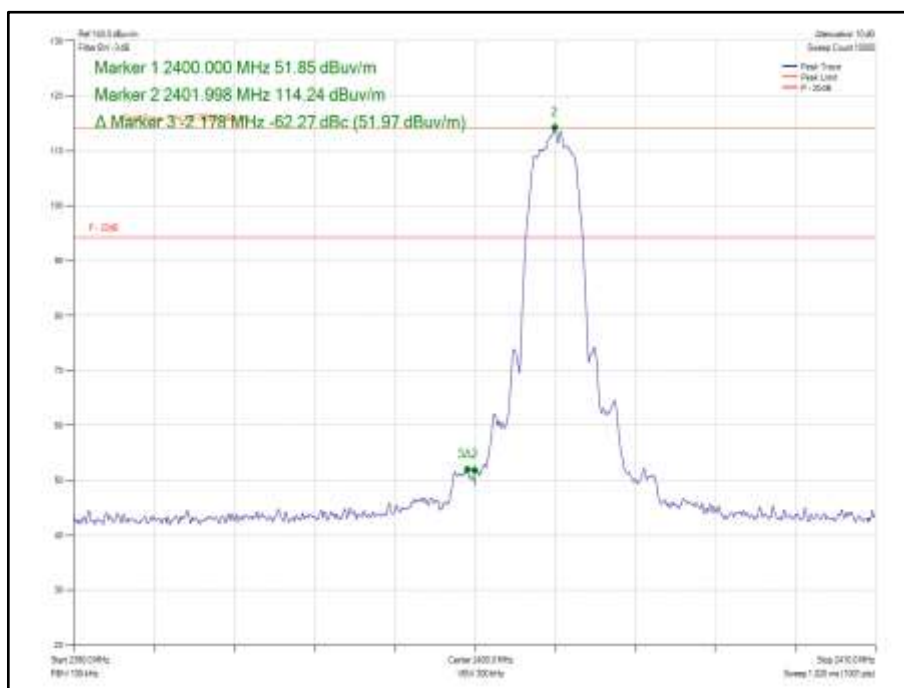


Figure 103 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

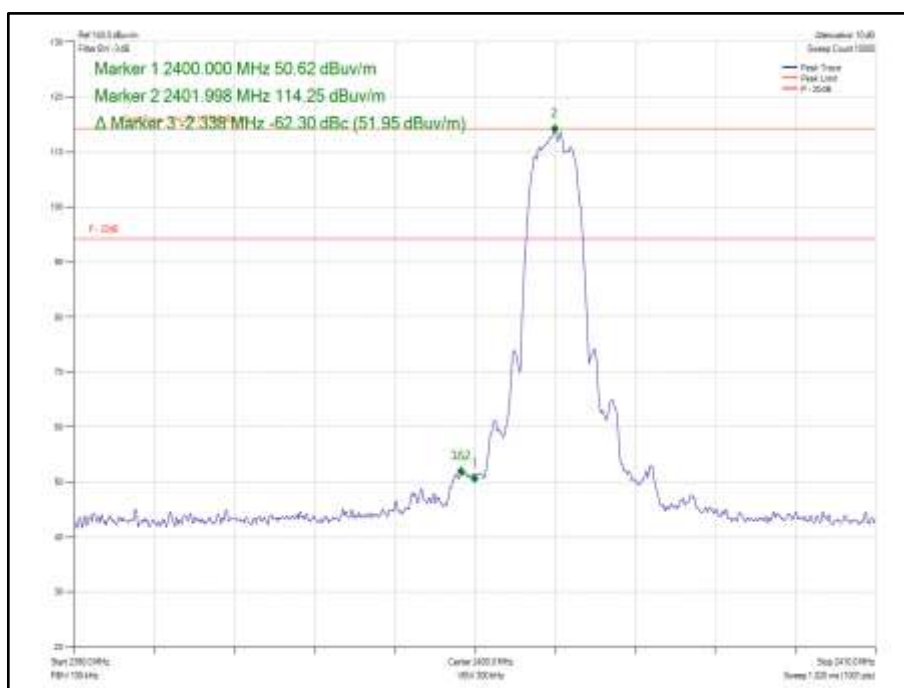


Figure 104 - Static Core 0 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

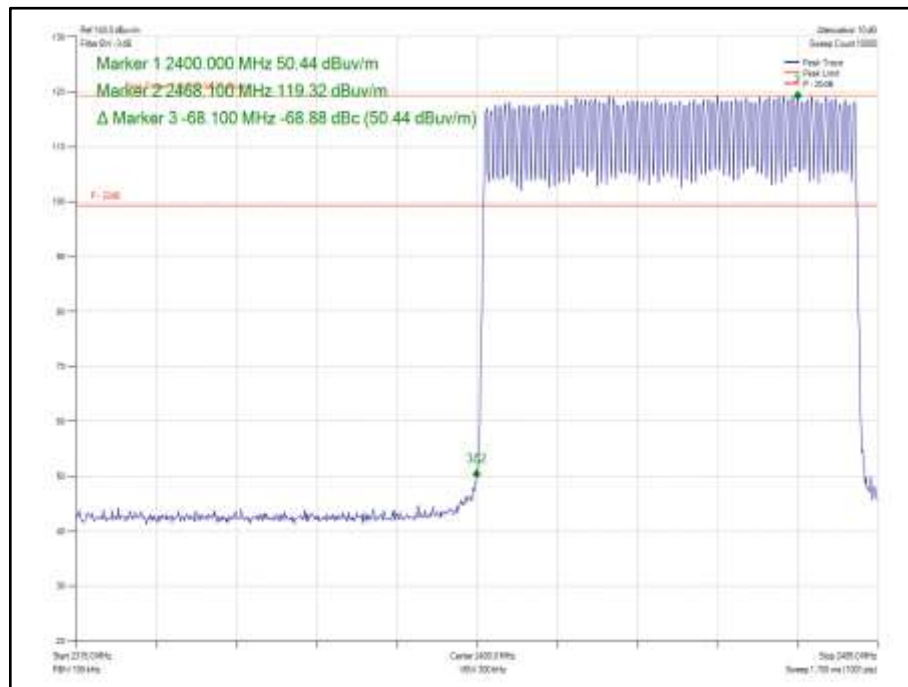


Figure 105 - Hopping Core 0 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

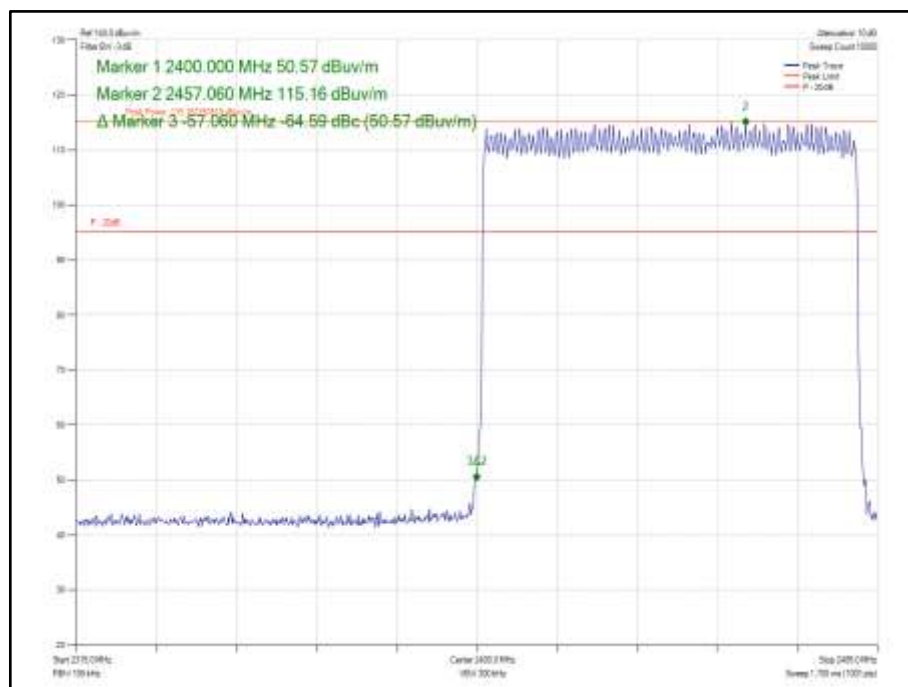


Figure 106 - Hopping Core 0 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

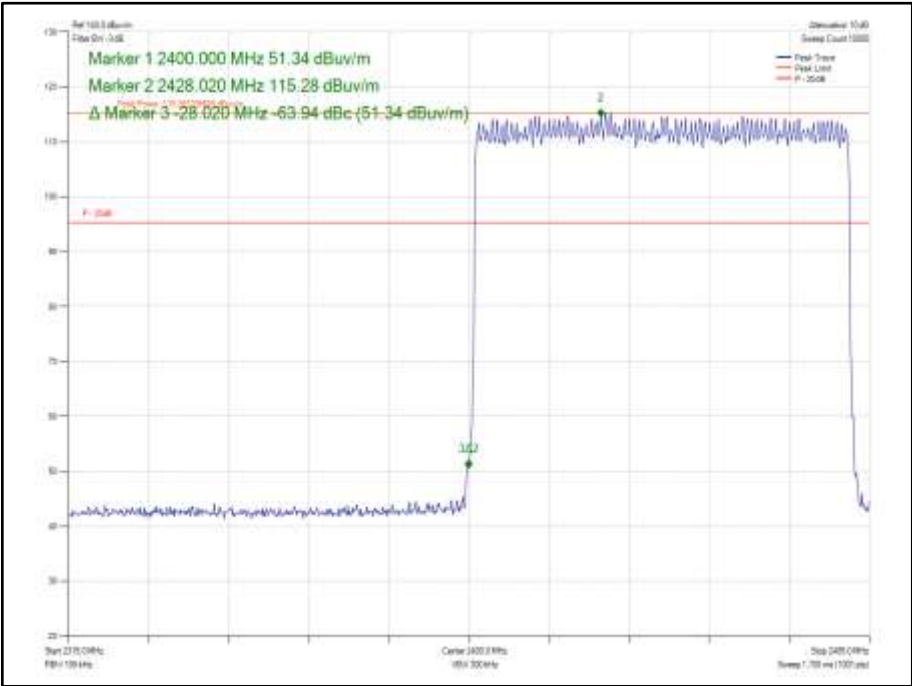
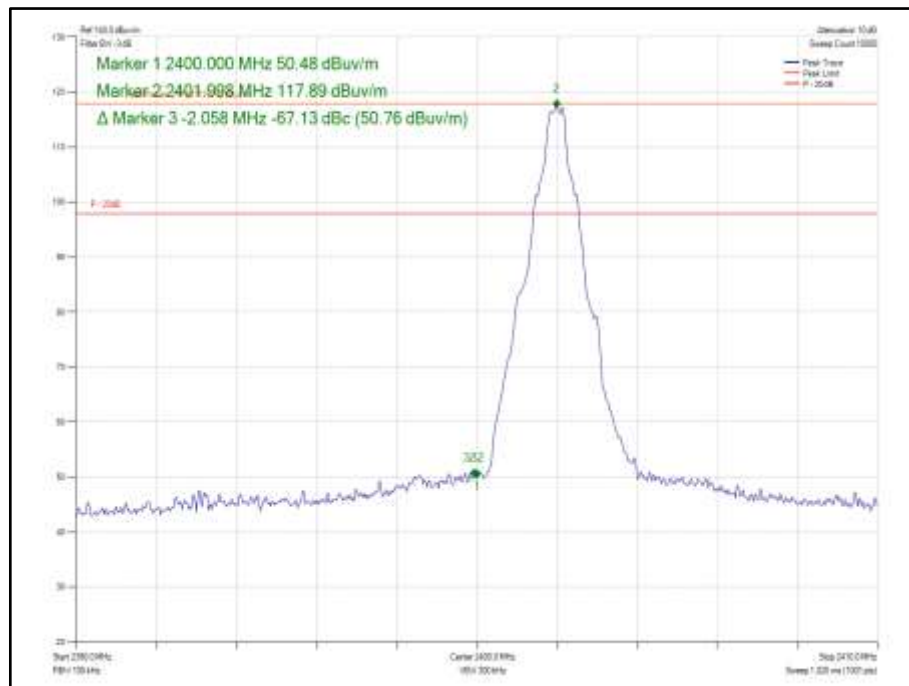


Figure 107 - Hopping Core 0 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

| 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  | $\pi/4$ 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 | $\pi/4$ 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**

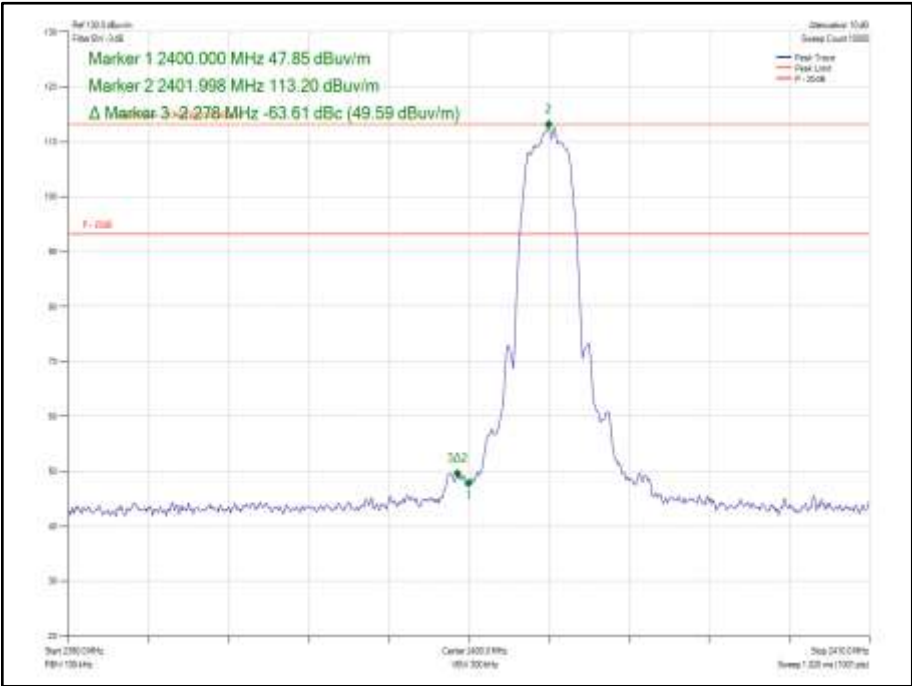


Figure 109 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

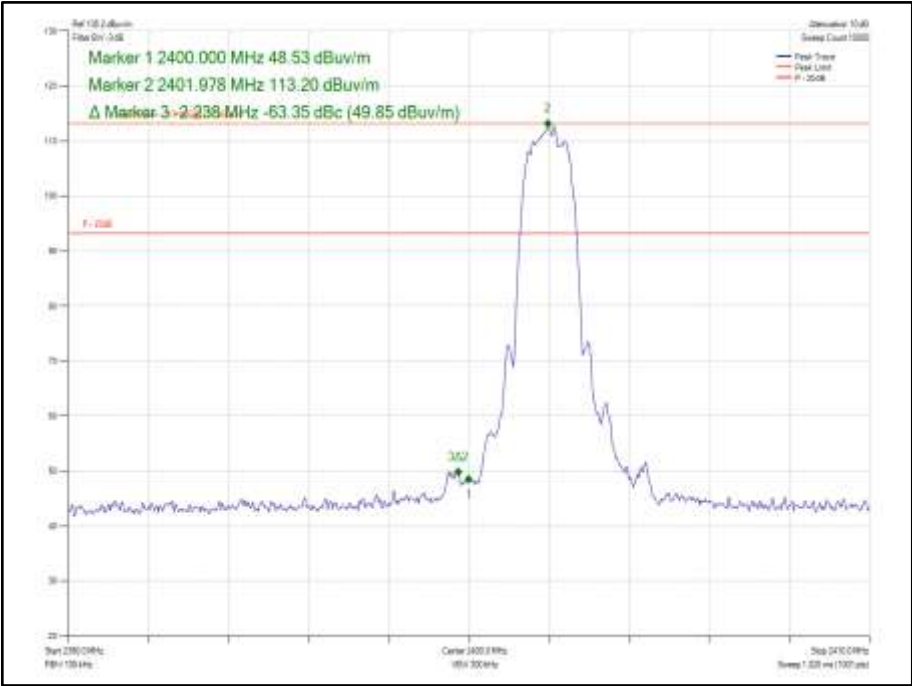


Figure 110 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

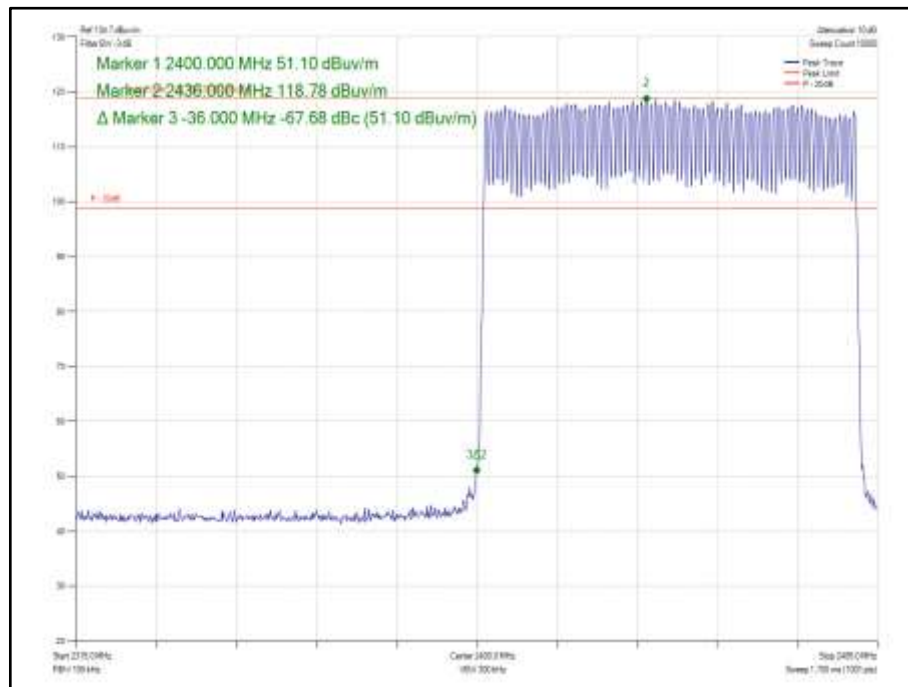


Figure 111 - Hopping Core 1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

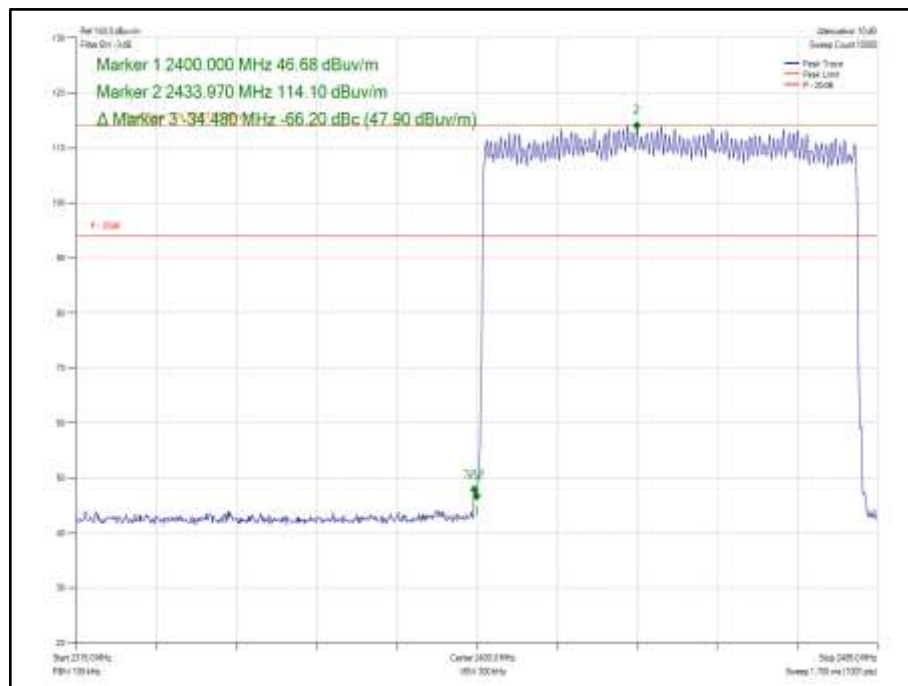


Figure 112 - Hopping Core 1 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

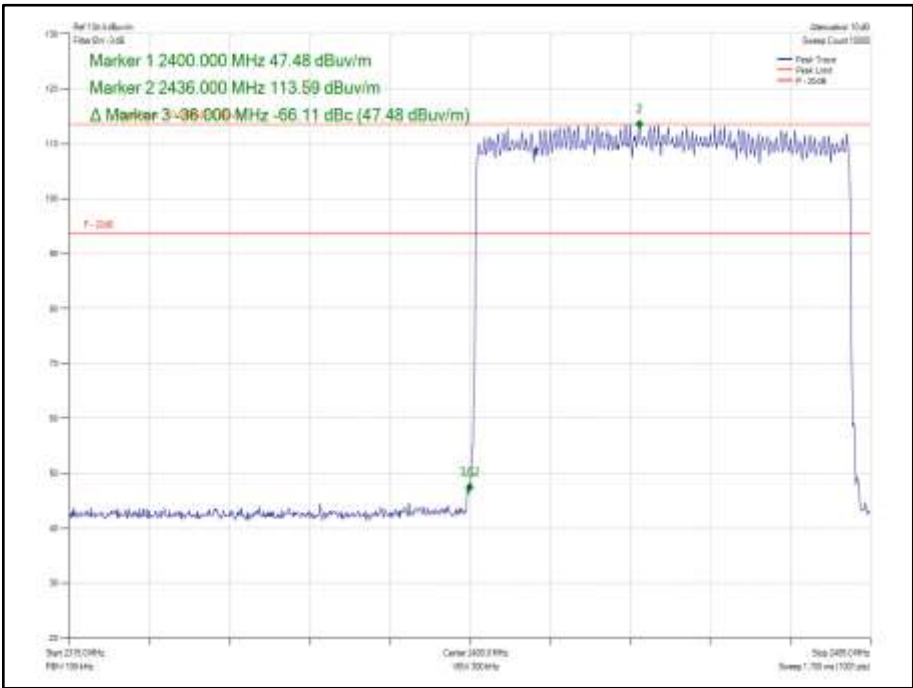
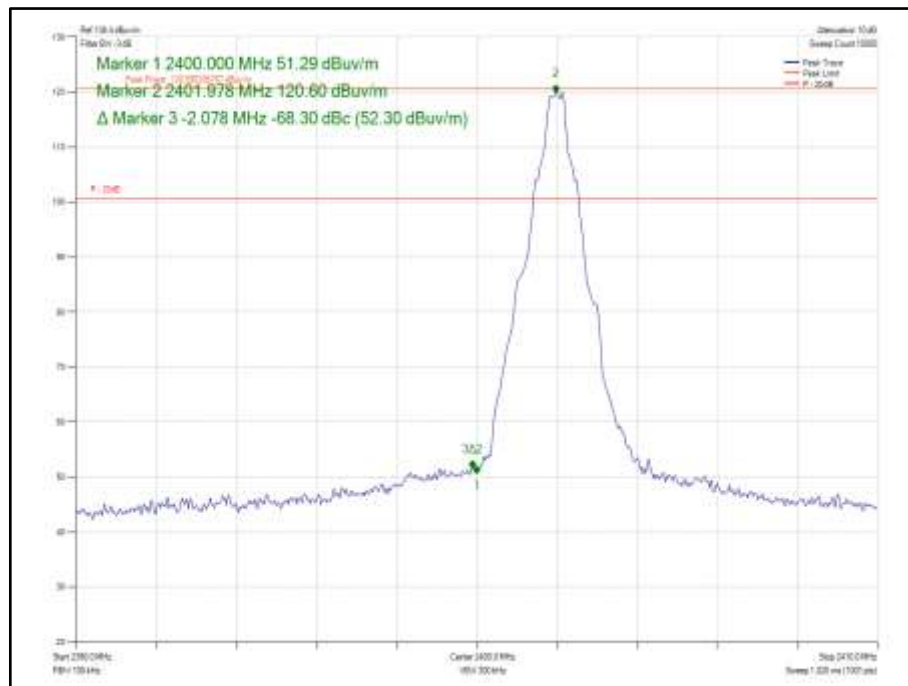


Figure 113 - Hopping Core 1 - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

| 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  | $\pi/4$ 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 | $\pi/4$ 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**

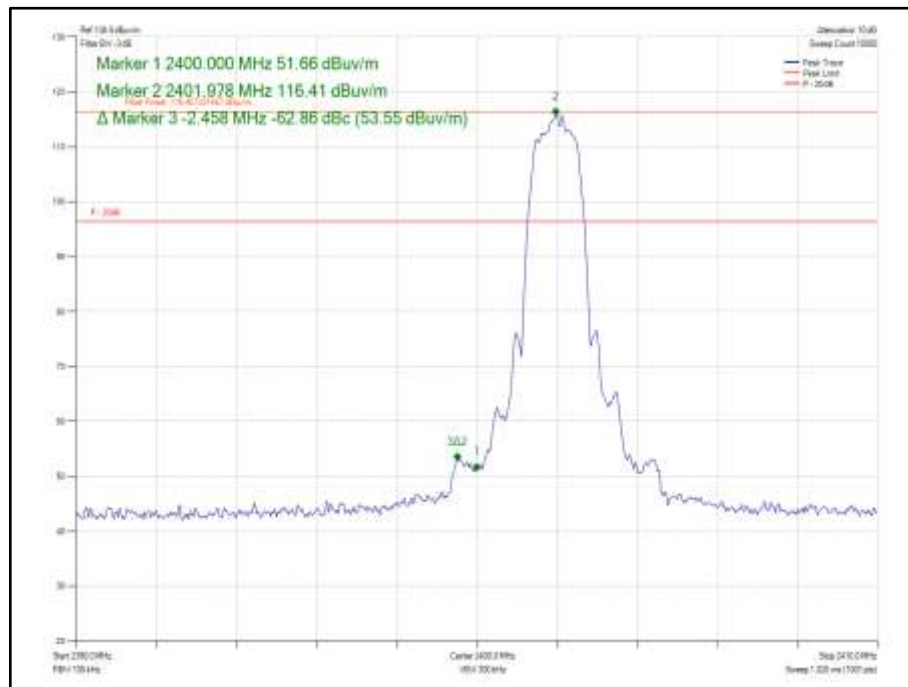


Figure 115 - Static Core 0-1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

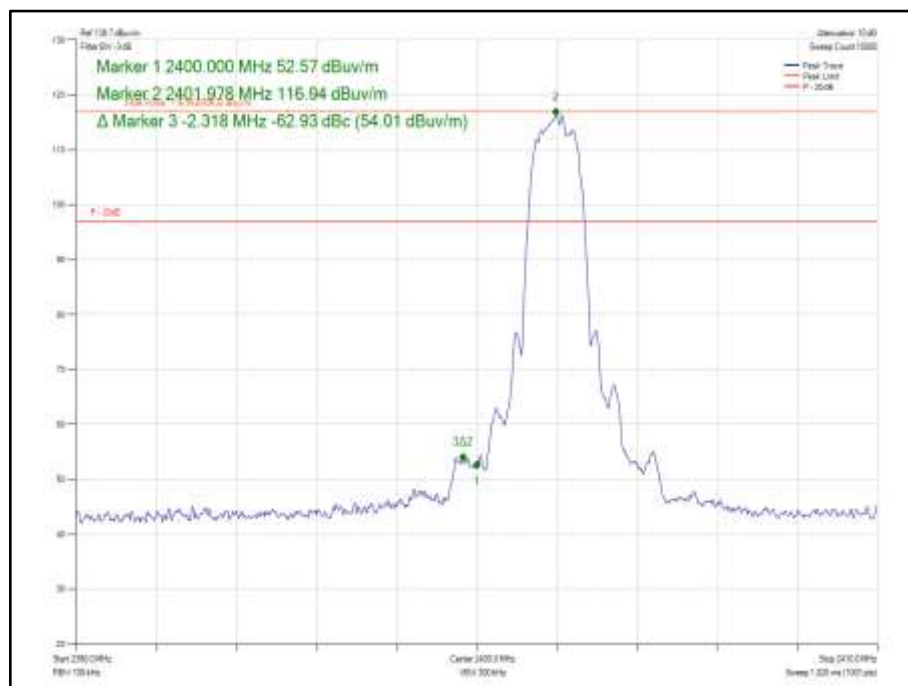


Figure 116 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

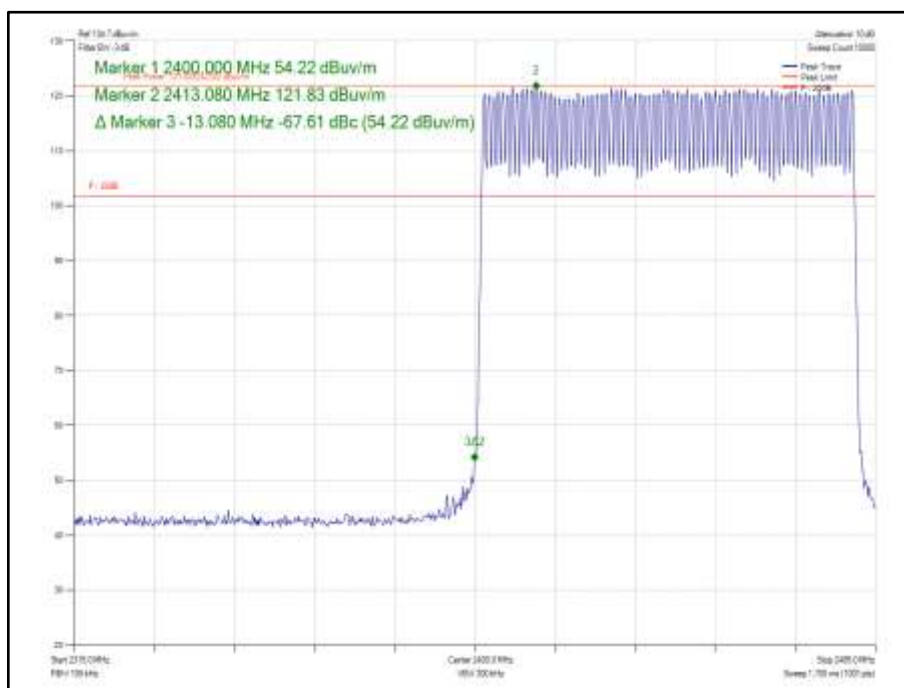


Figure 117 - Hopping Core 0-1 - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

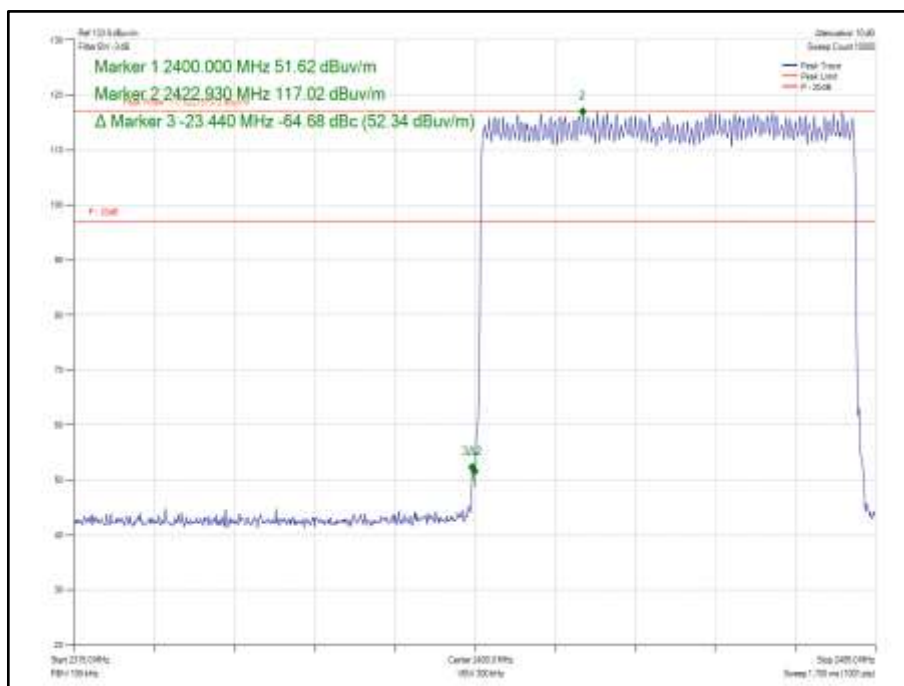
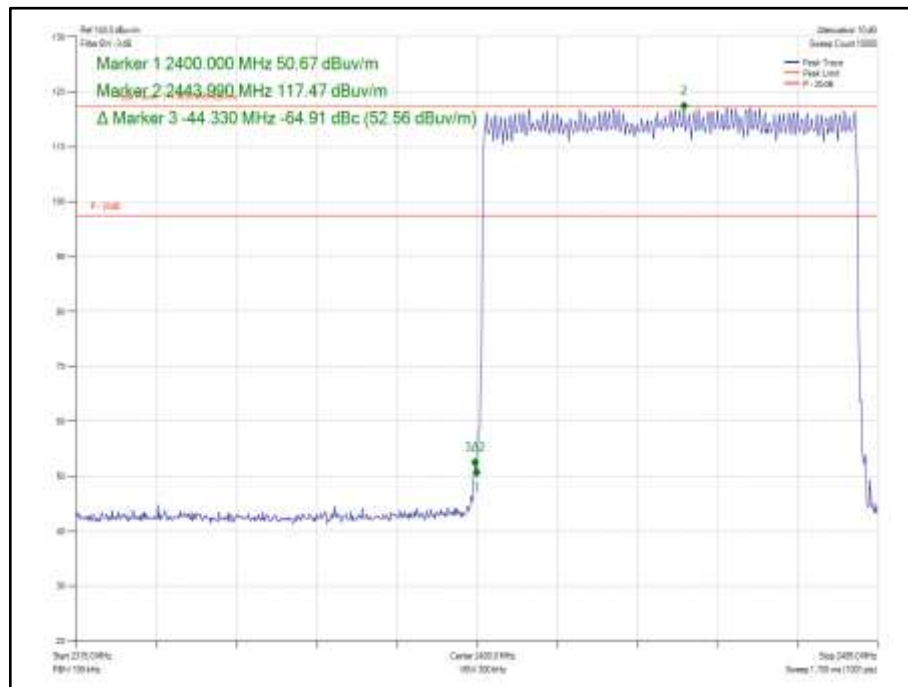


Figure 118 - Hopping Core 0-1 -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz



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

### 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**

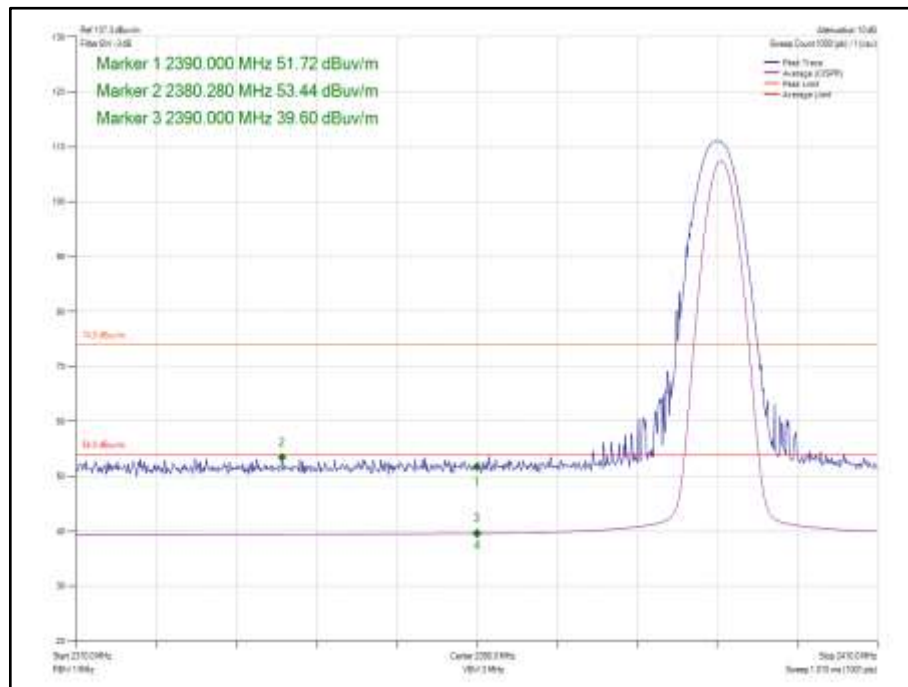


Figure 120 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

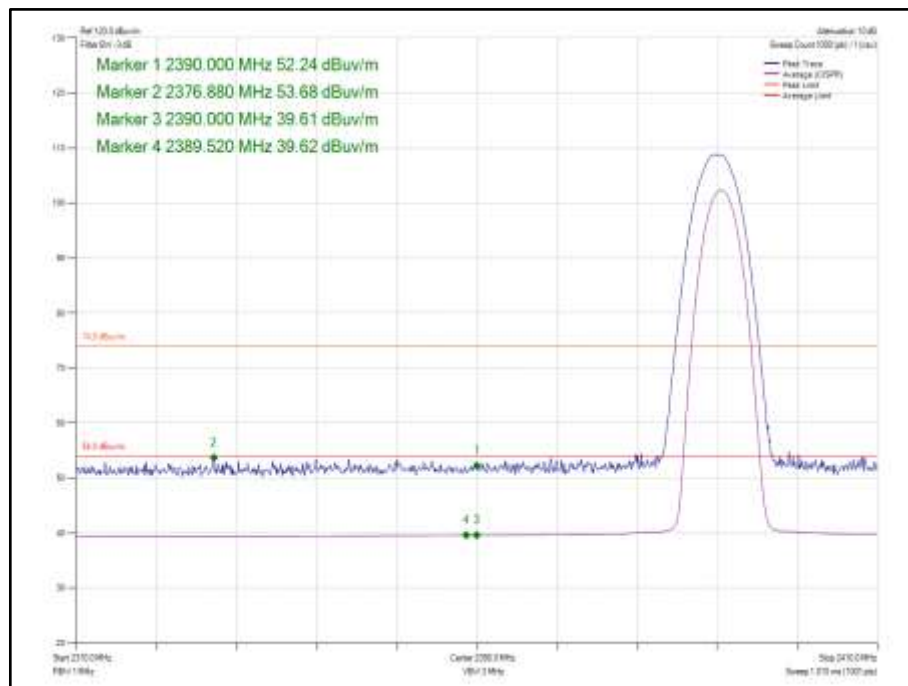
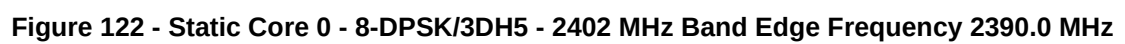


Figure 121 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz



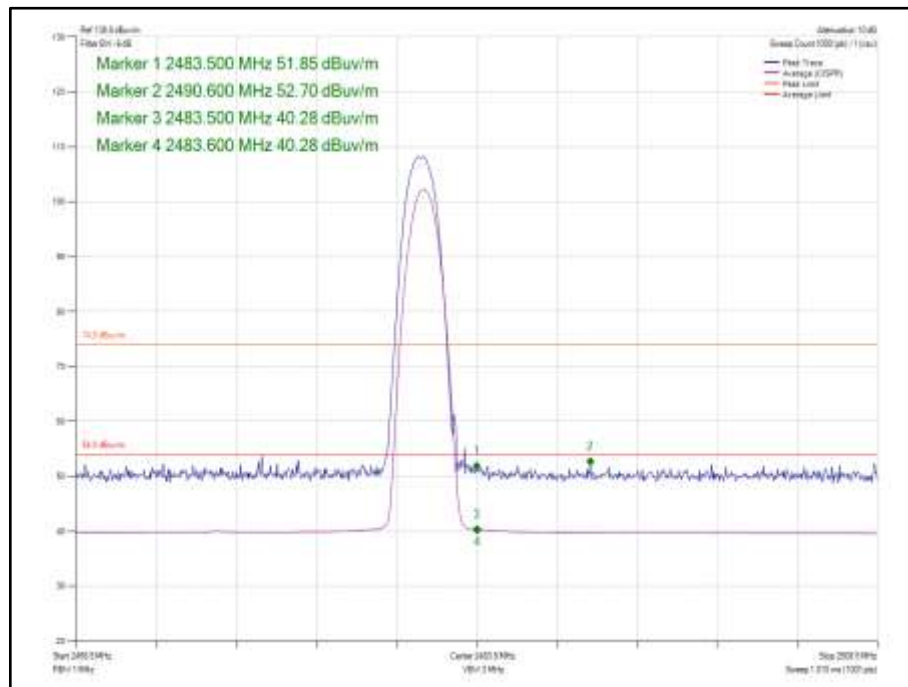


Figure 124 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

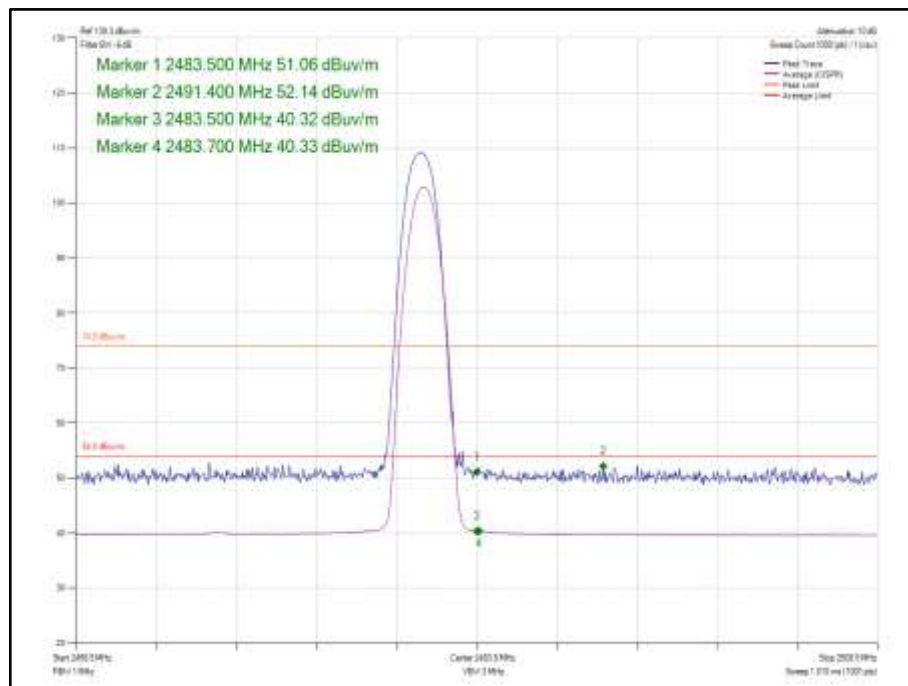
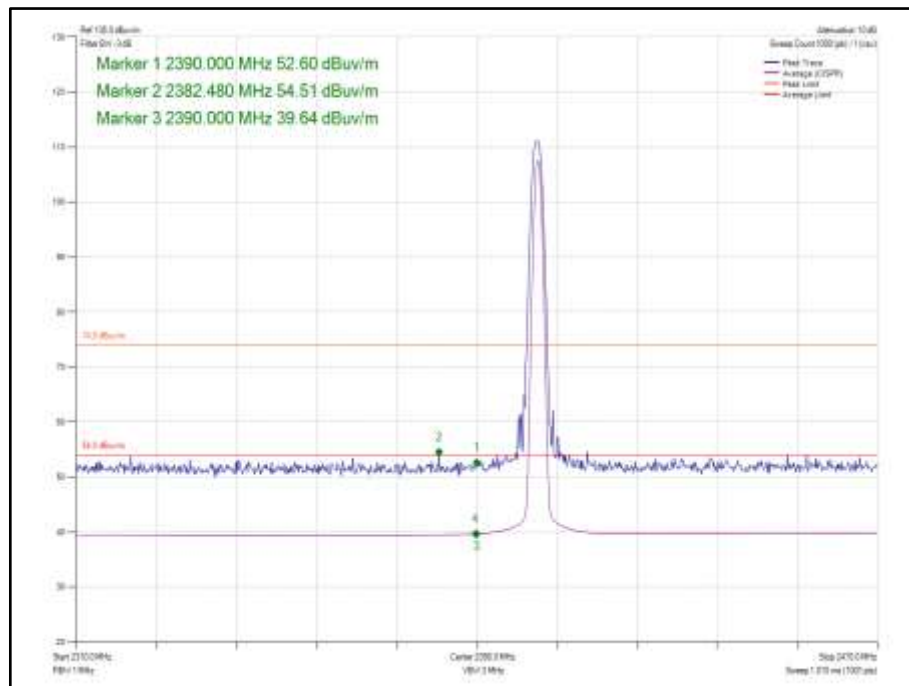


Figure 125 - Static Core 0 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

| 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 | $\pi/4$ 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 | $\pi/4$ 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**

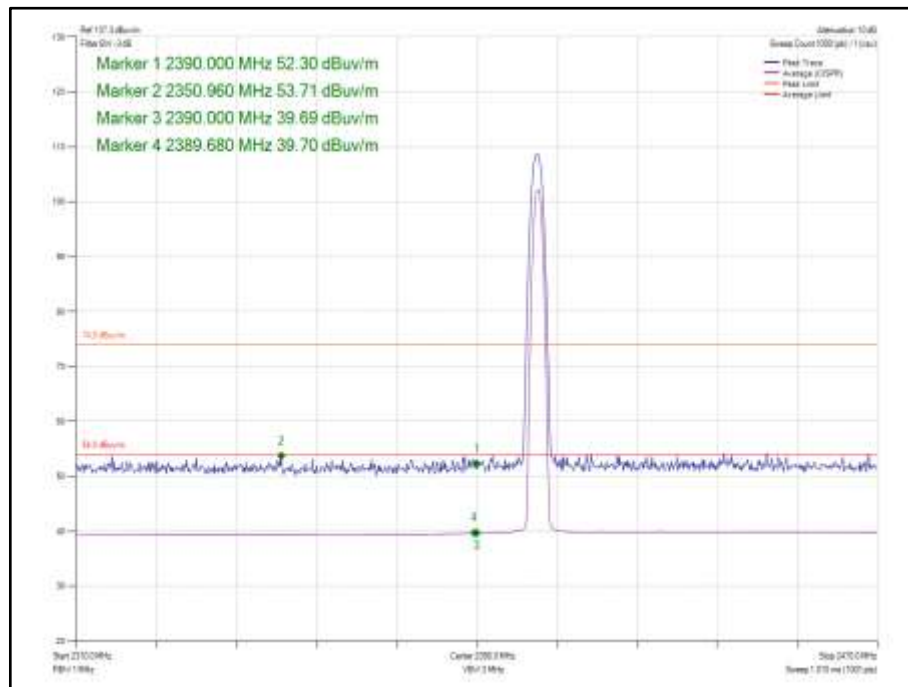


Figure 127 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

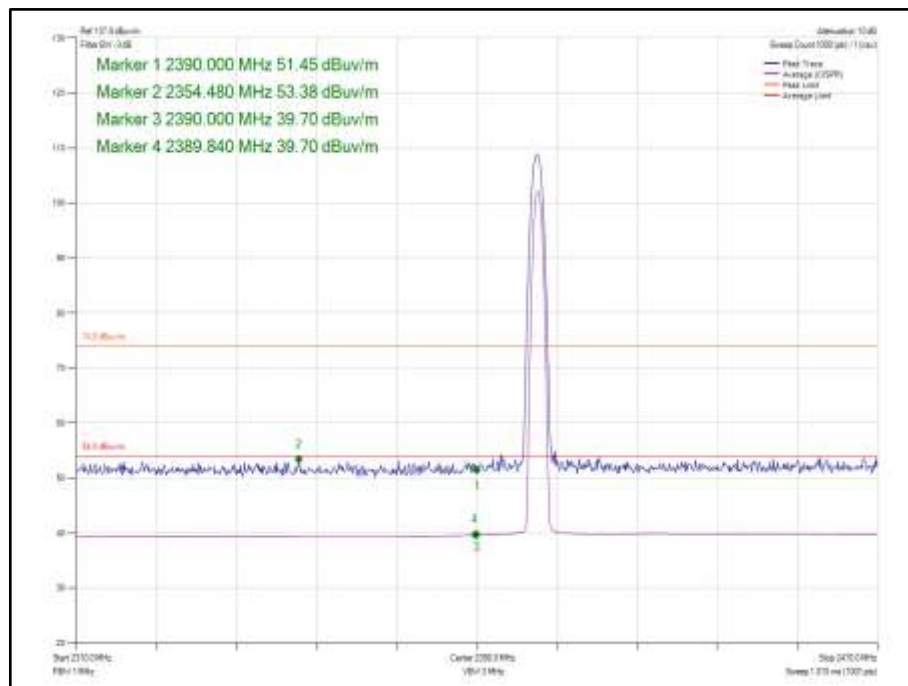


Figure 128 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

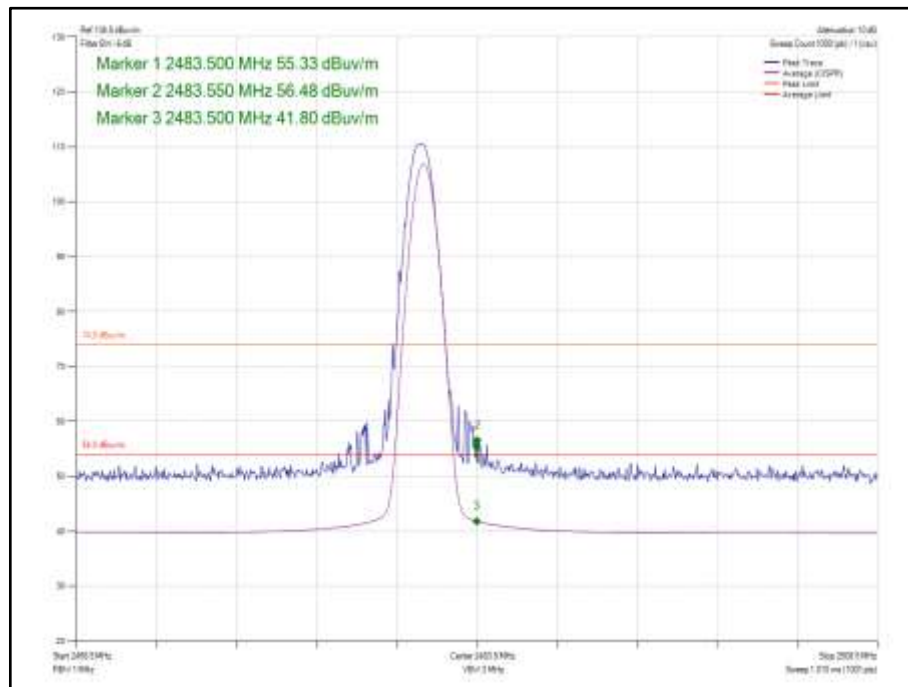


Figure 129 - Static Core 1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

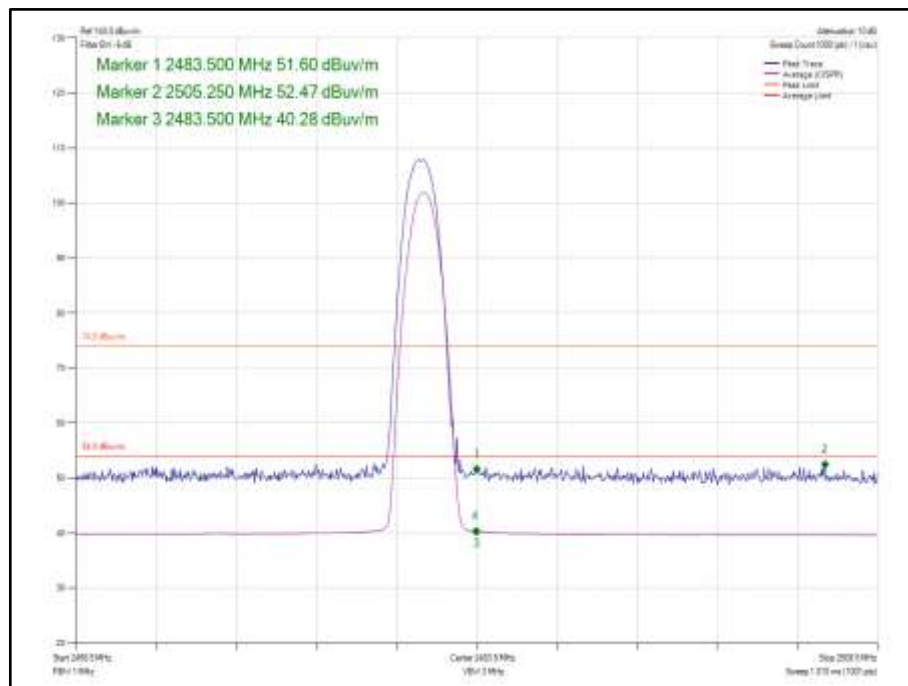


Figure 130 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

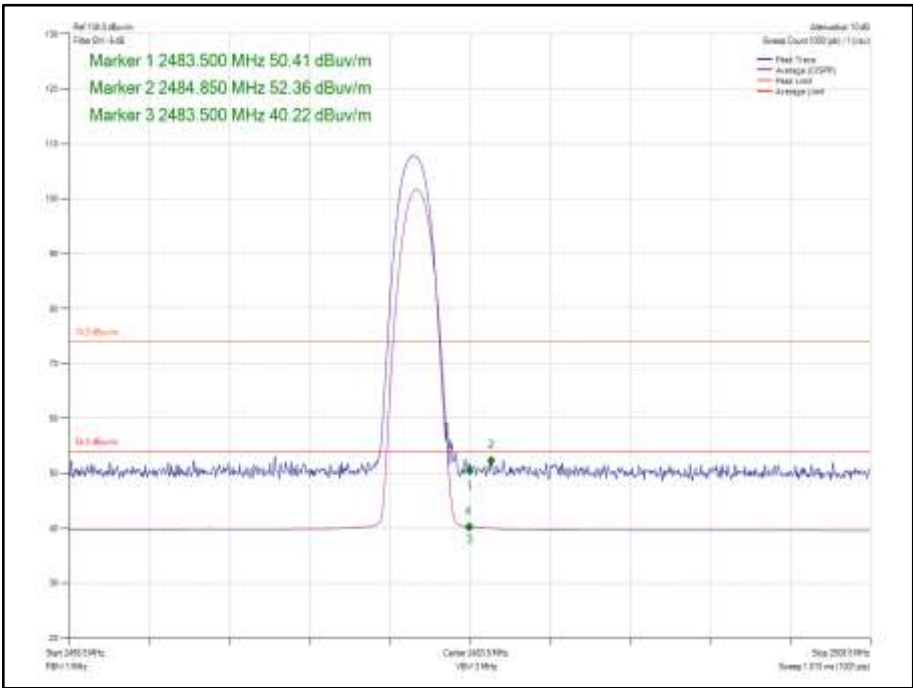
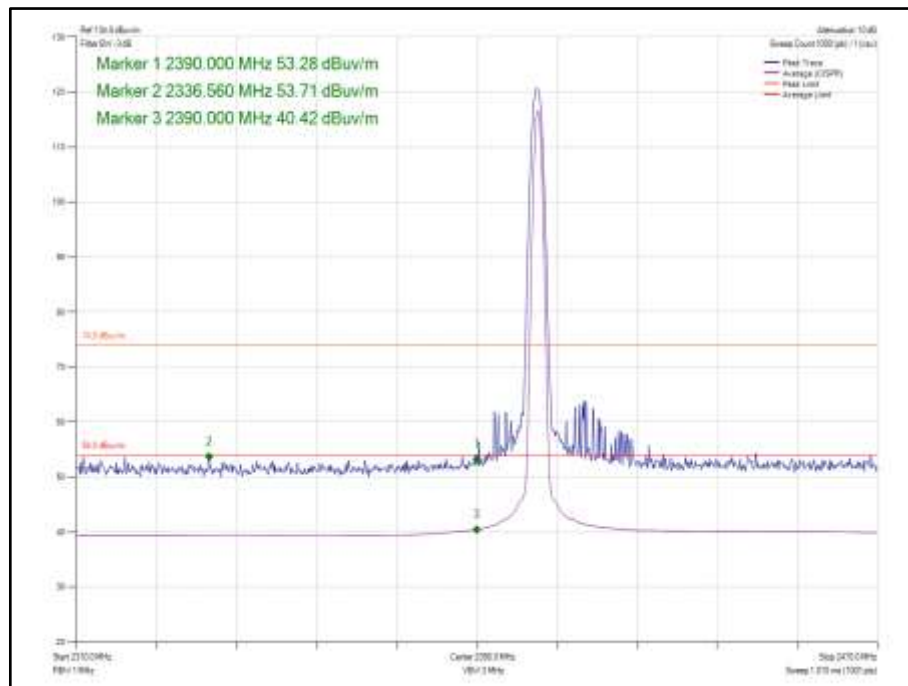


Figure 131 - Static Core 1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

| 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 | $\pi/4$ 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 | $\pi/4$ 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**

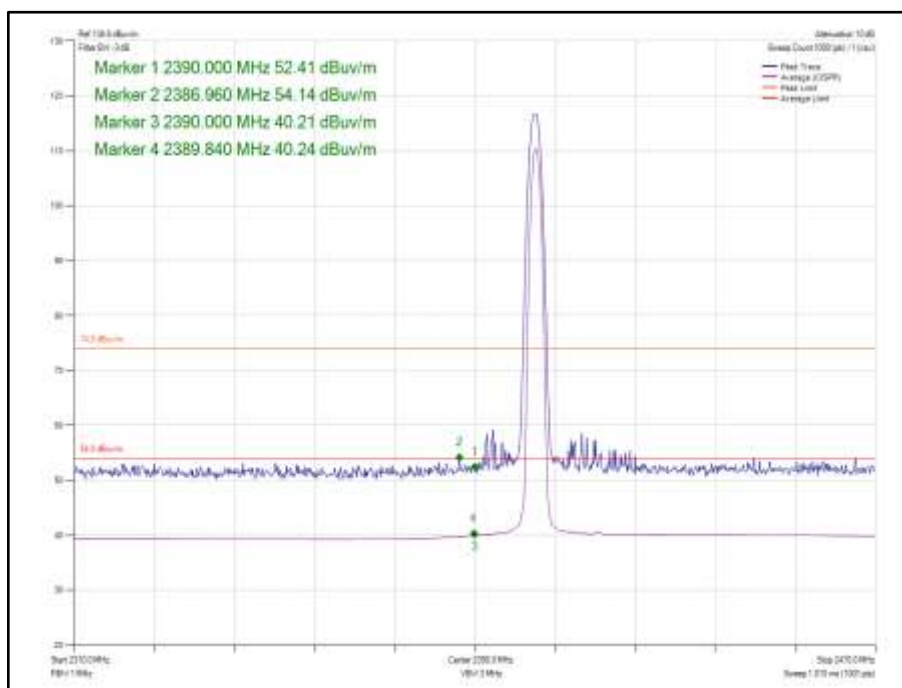


Figure 133 - Static Core 2 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

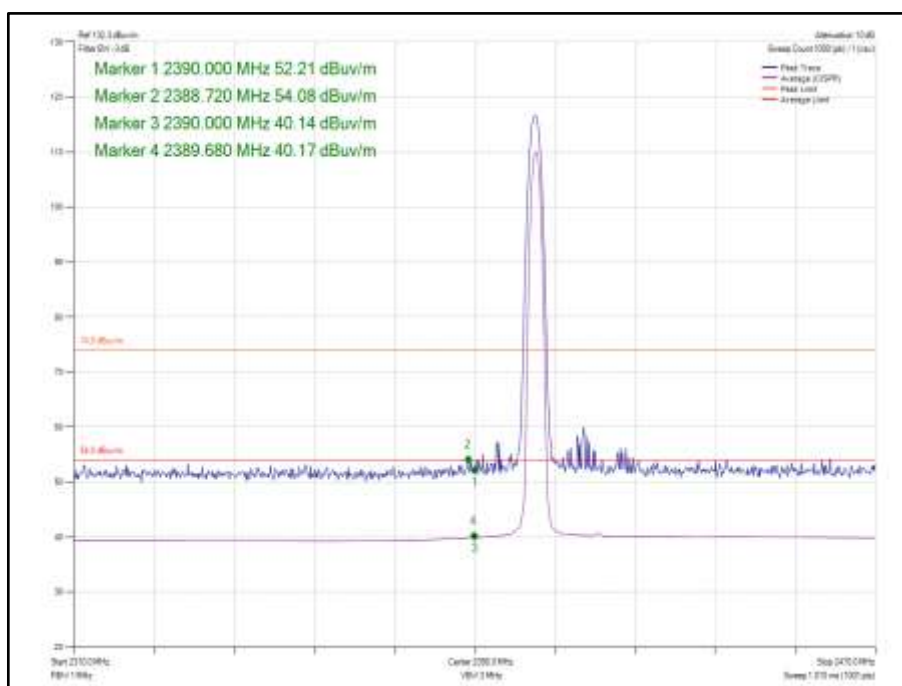


Figure 134 - Static Core 2 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

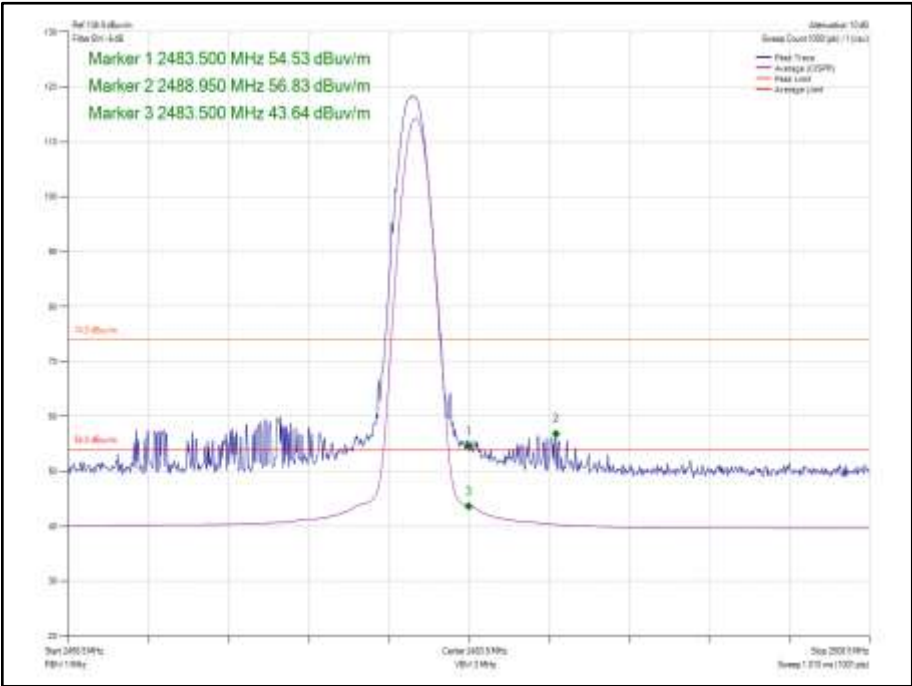


Figure 135 - Static Core 2 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

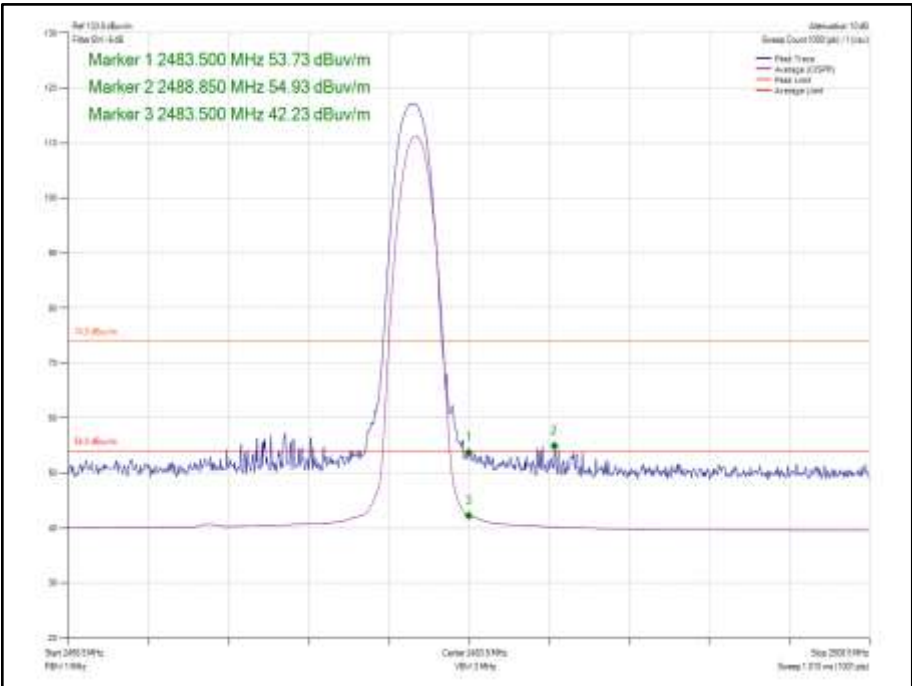


Figure 136 - Static Core 2 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

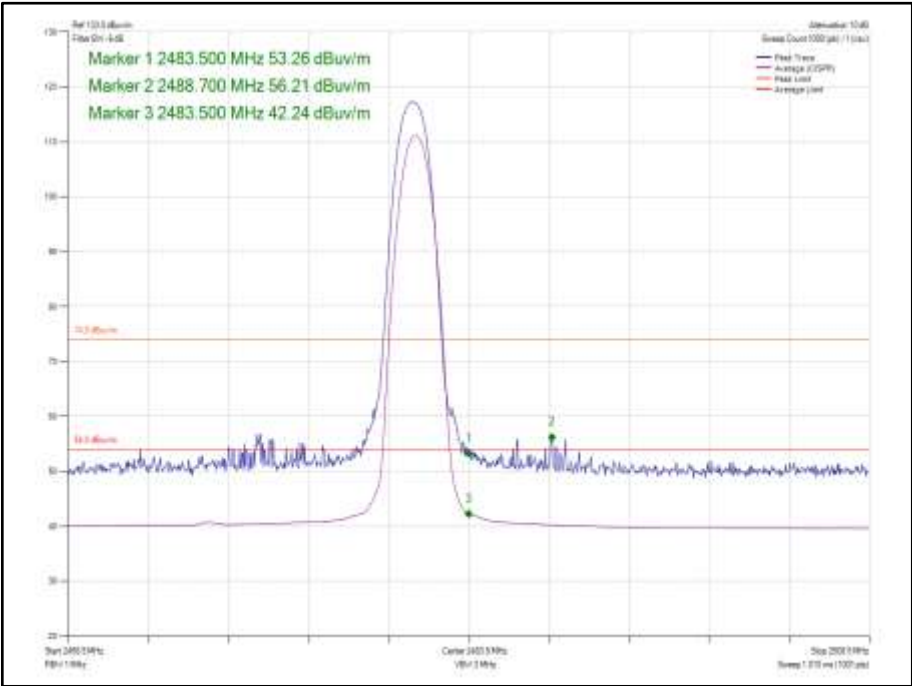
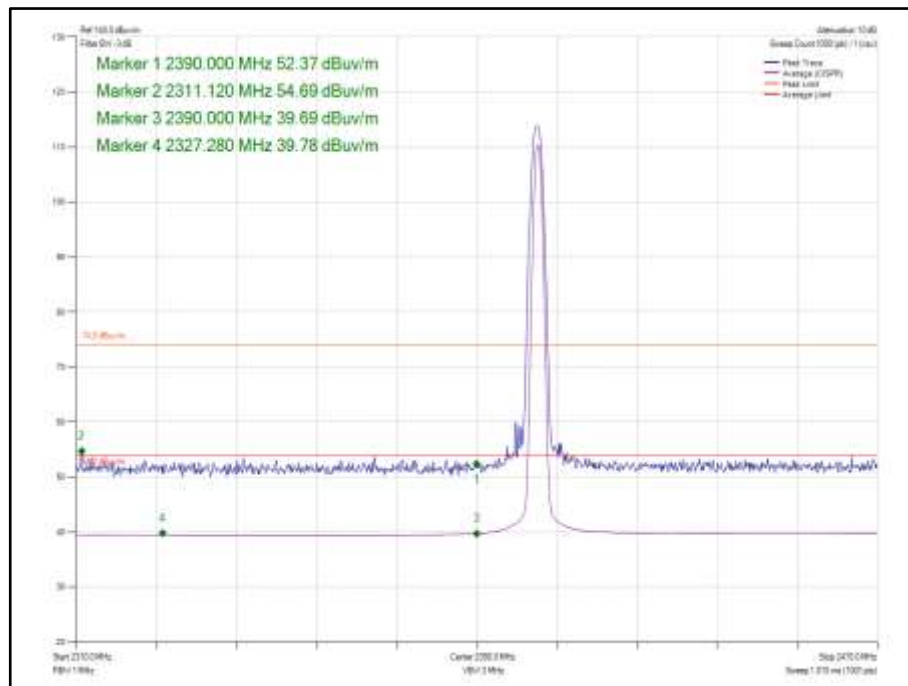


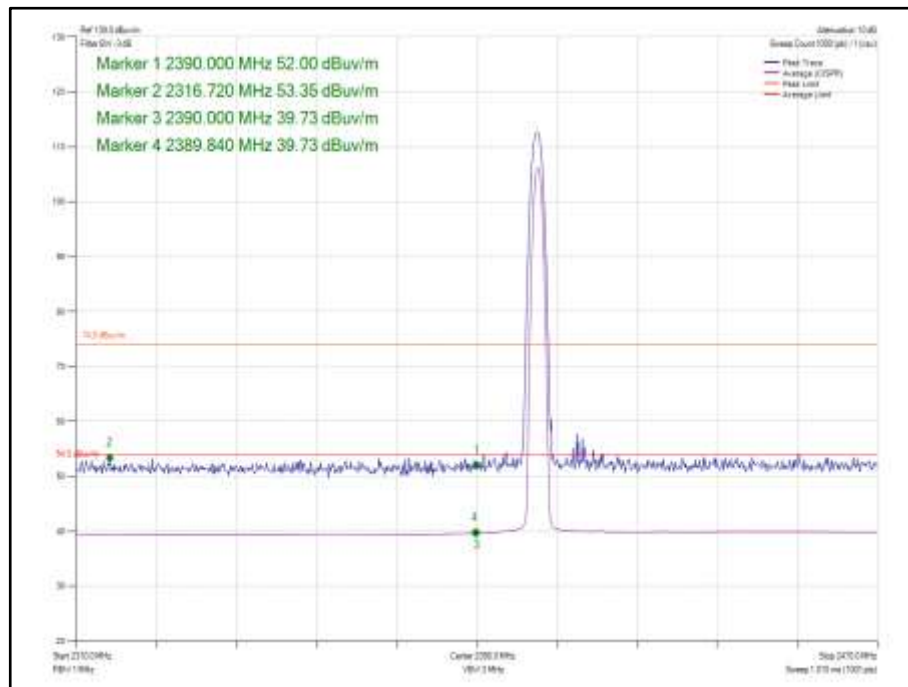
Figure 137 - Static Core 2 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

| 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 | $\pi/4$ 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 | $\pi/4$ DQPSK | 2DH5        | 2480               | 2483.5                    | 53.54               | 40.76                  |
| Static Core 0-1 | 8-DPSK        | 3DH5        | 2480               | 2483.5                    | 53.64               | 40.63                  |

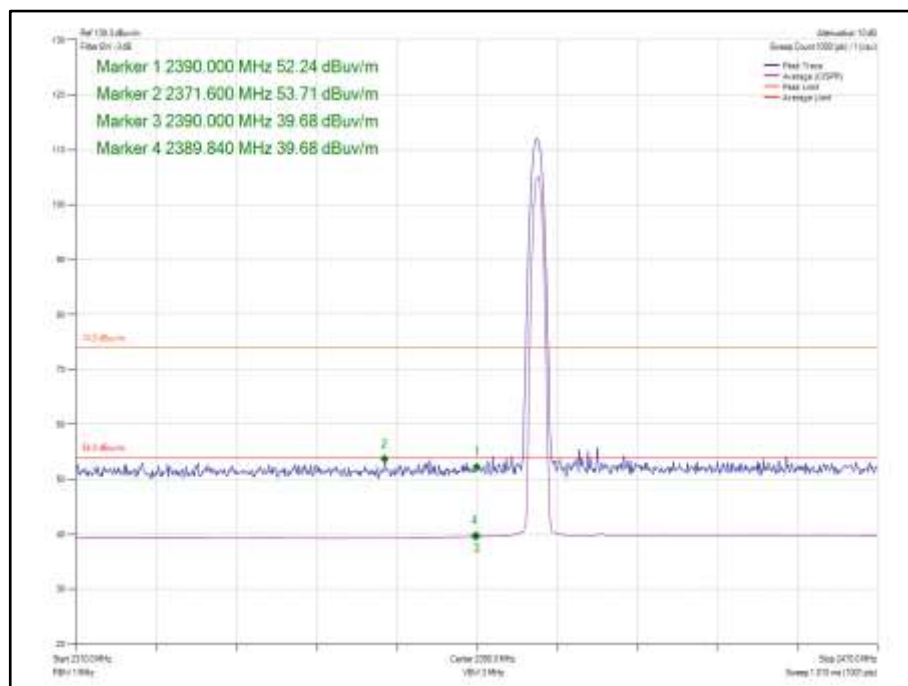
**Table 52 - MIMO 2Tx Restricted Band Edge Results**



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



**Figure 139 - Static Core 0-1 -  $\pi/4$  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**

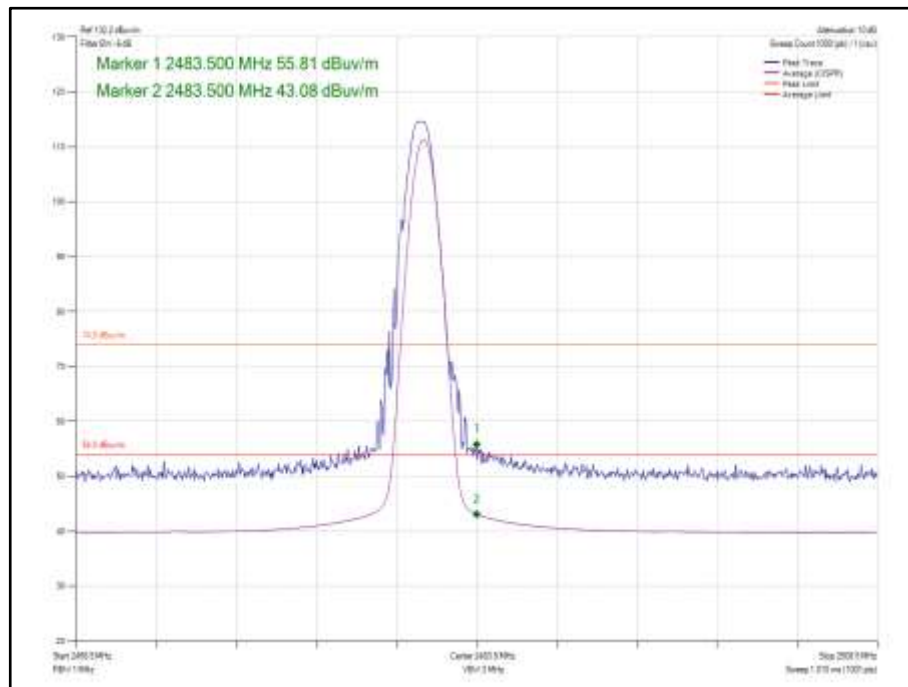


Figure 141 - Static Core 0-1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

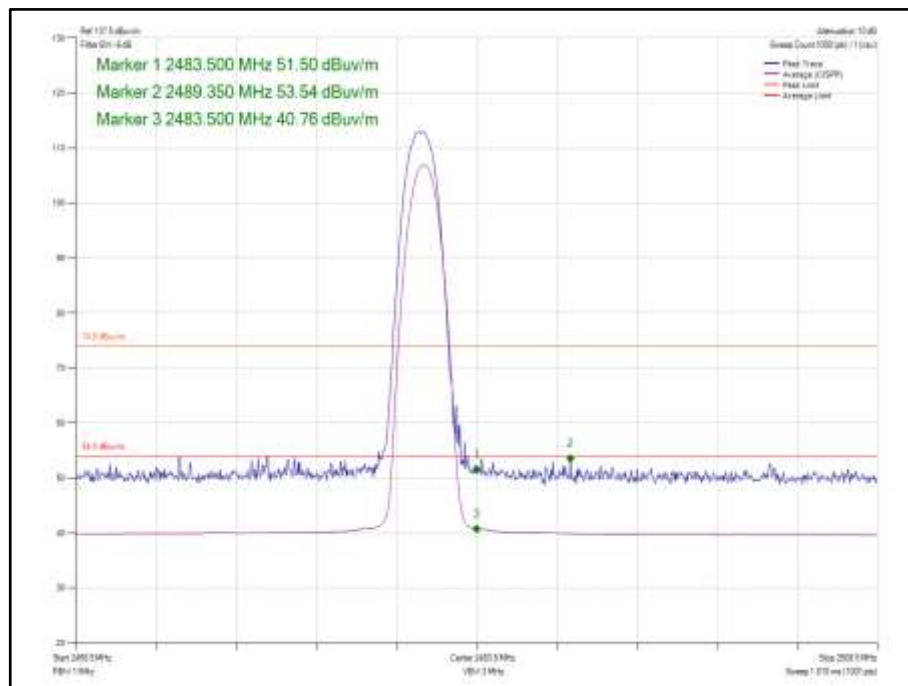


Figure 142 - Static Core 0-1 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

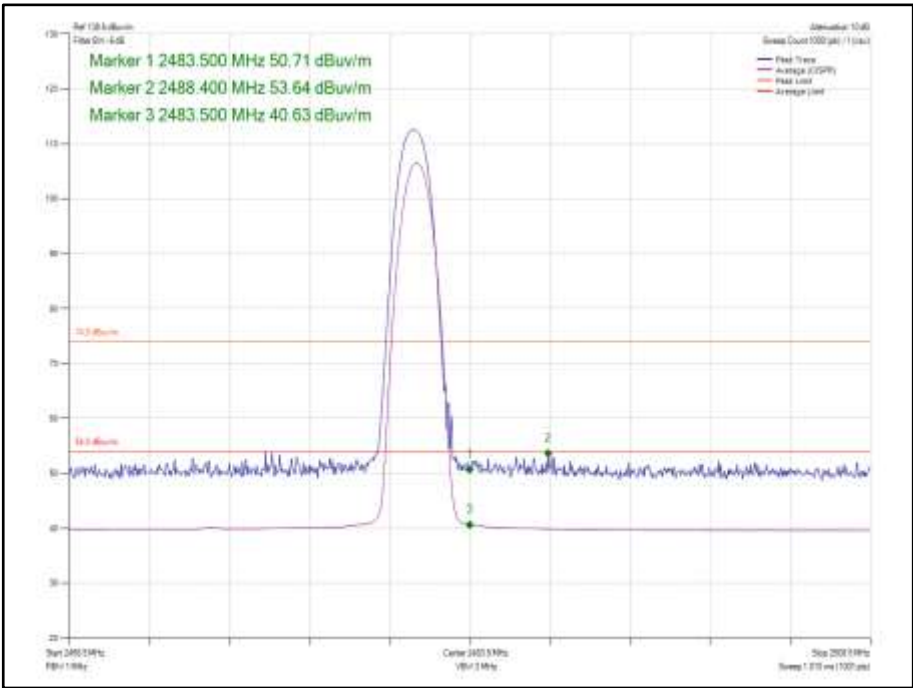


Figure 143 - Static Core 0-1- 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

ePA

| 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 | $\pi/4$ 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 | $\pi/4$ 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

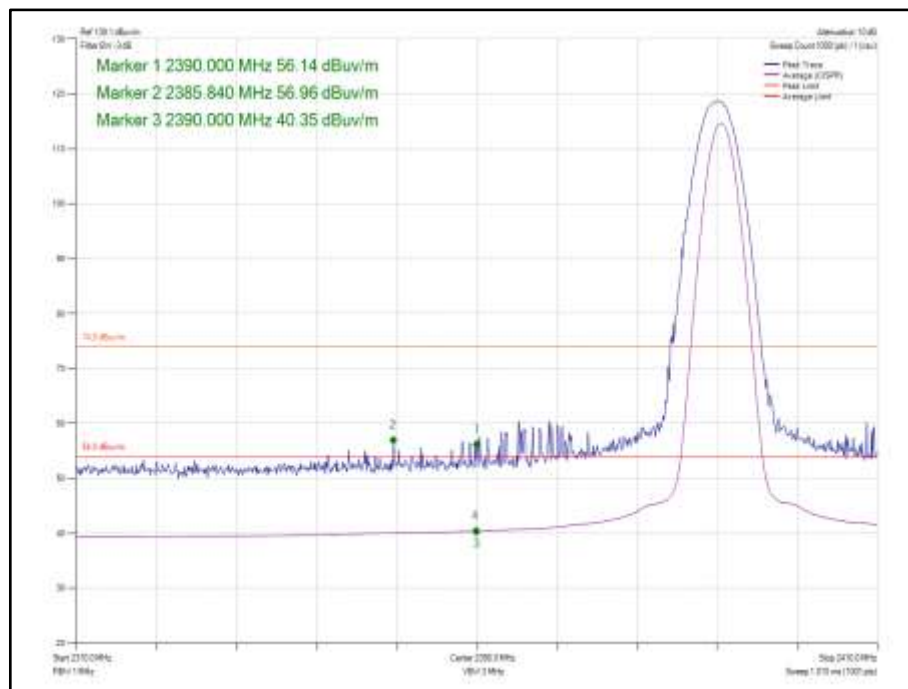


Figure 144 - Static Core 0 - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

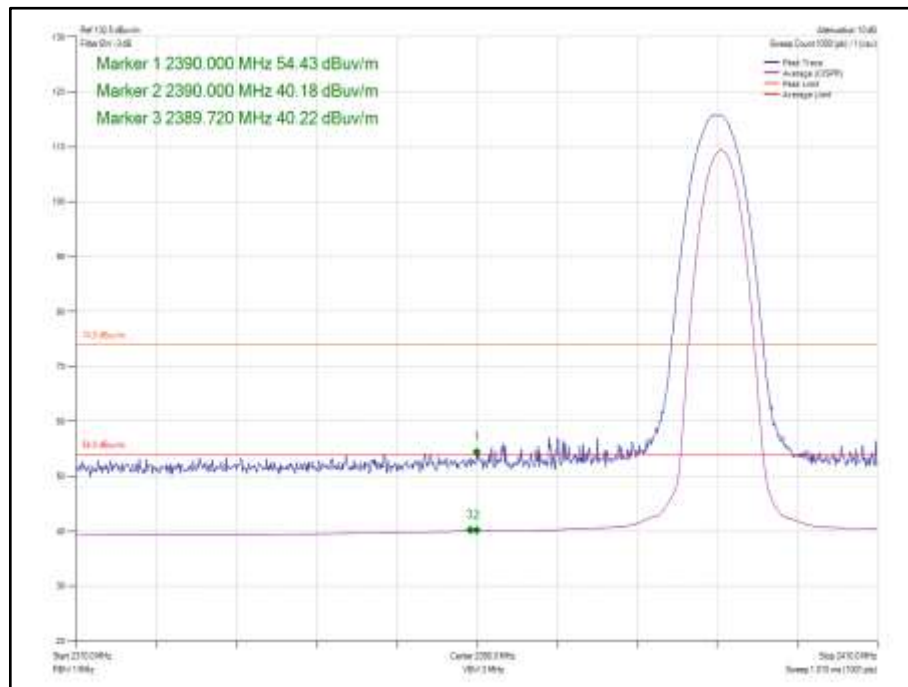


Figure 145 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

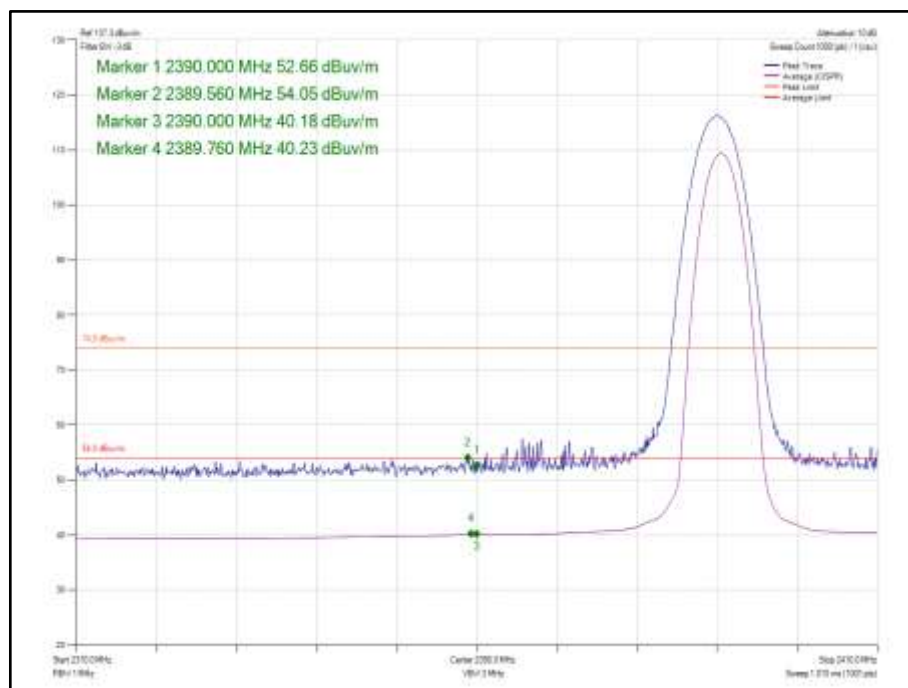


Figure 146 - Static Core 0 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

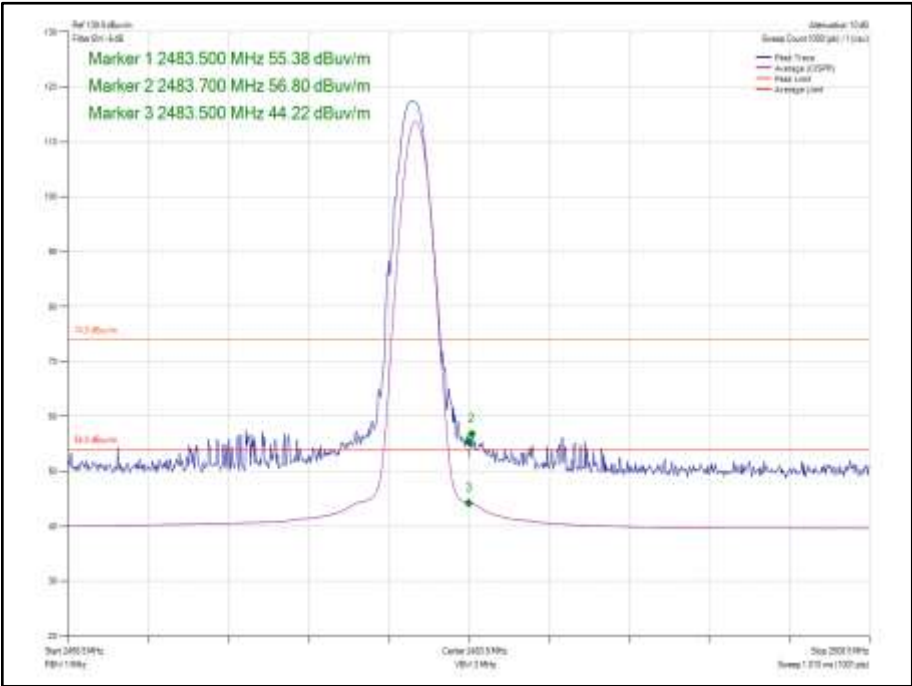


Figure 147 - Static Core 0 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

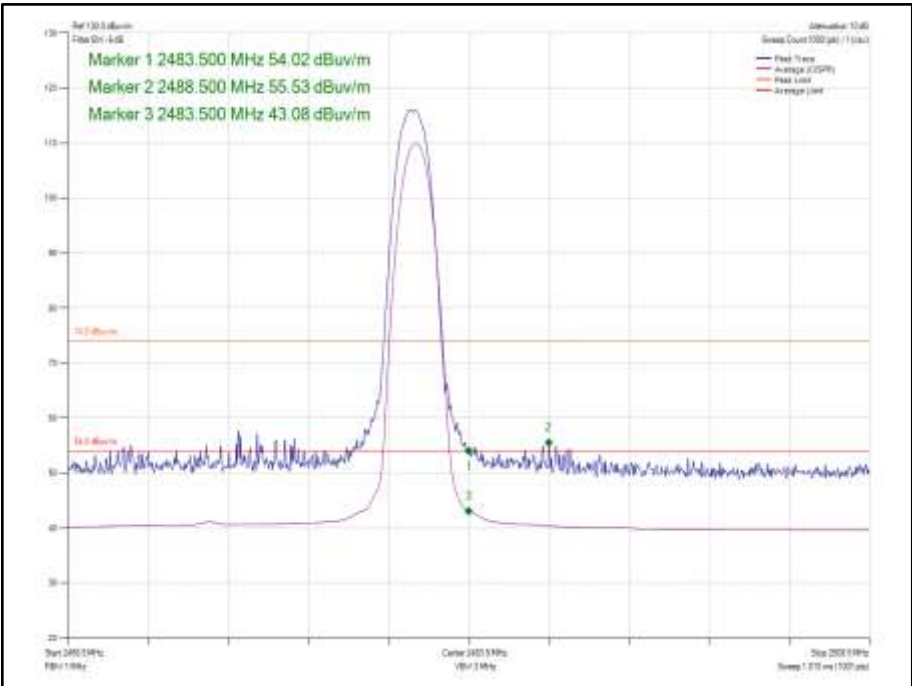


Figure 148 - Static Core 0 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

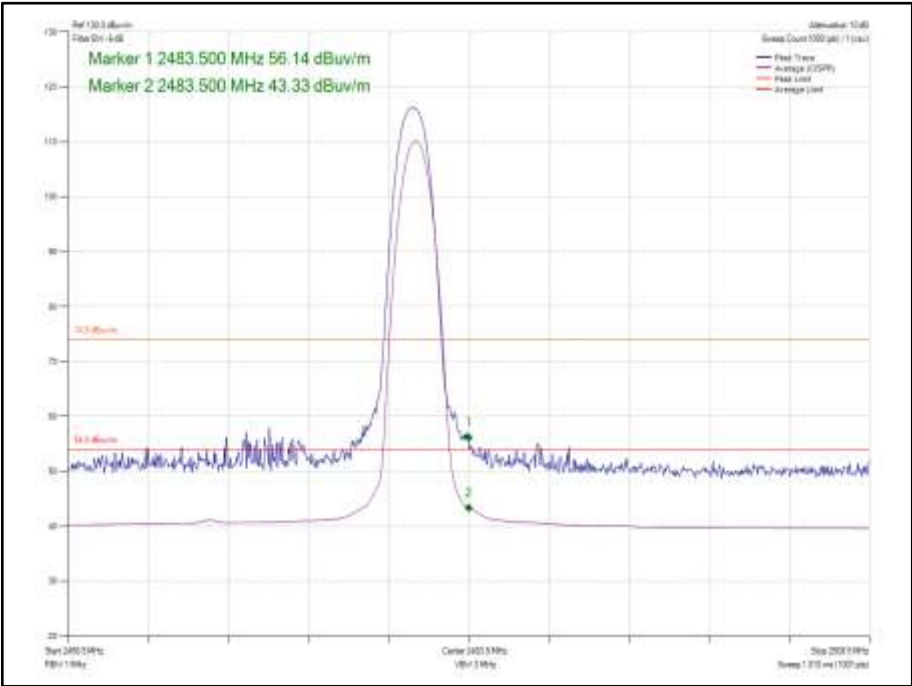
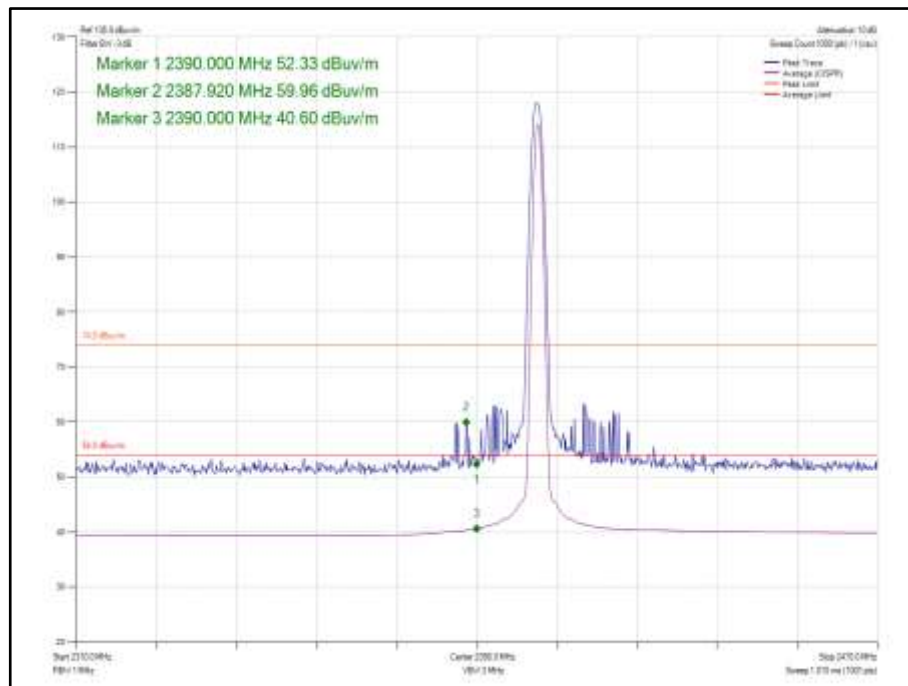


Figure 149 - Static Core 0 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

| 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 | $\pi/4$ 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 | $\pi/4$ 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**

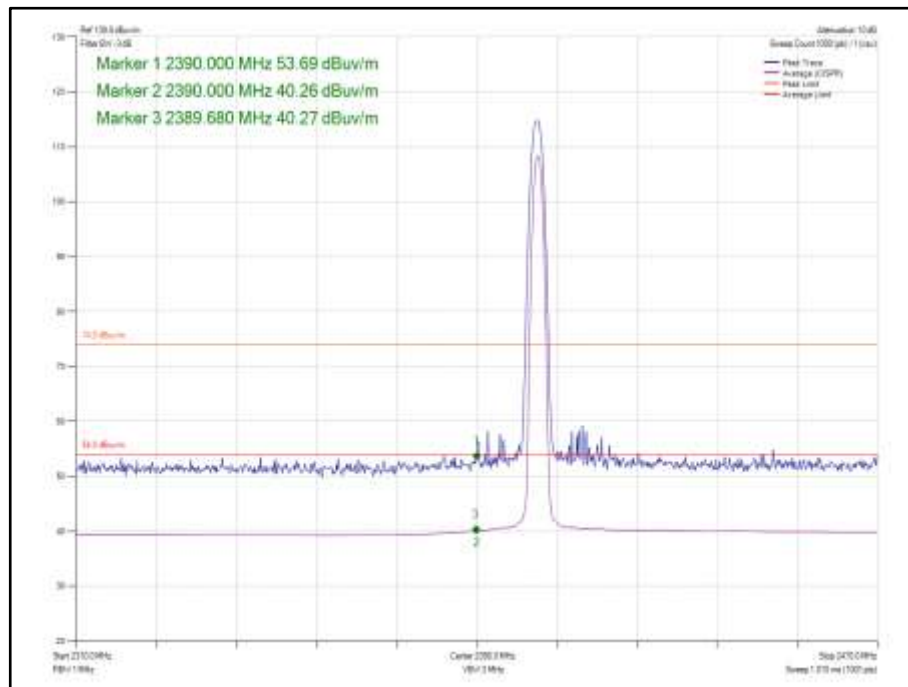


Figure 151 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

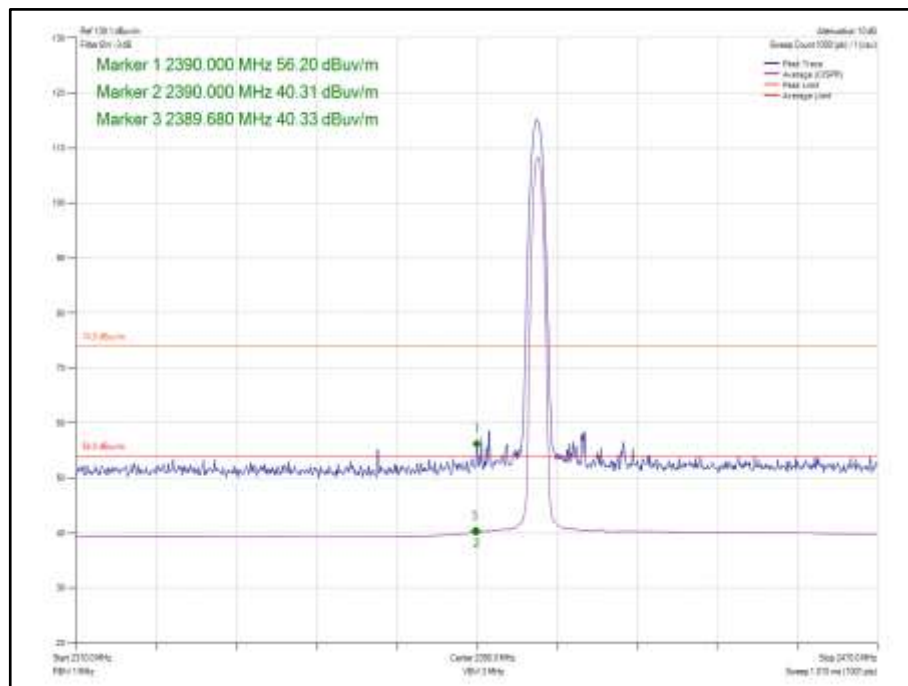


Figure 152 - Static Core 1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

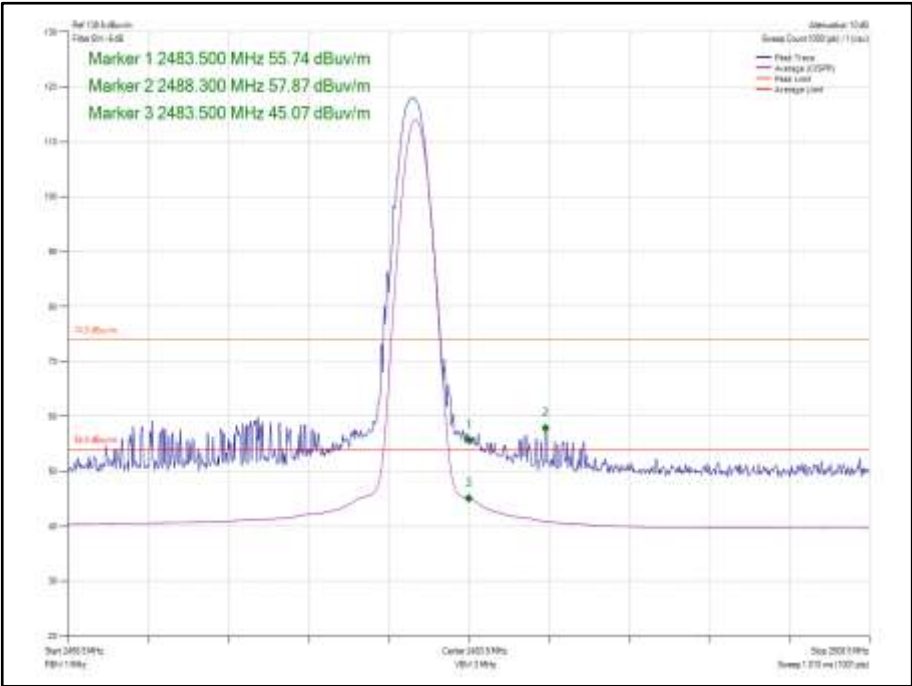


Figure 153 - Static Core 1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

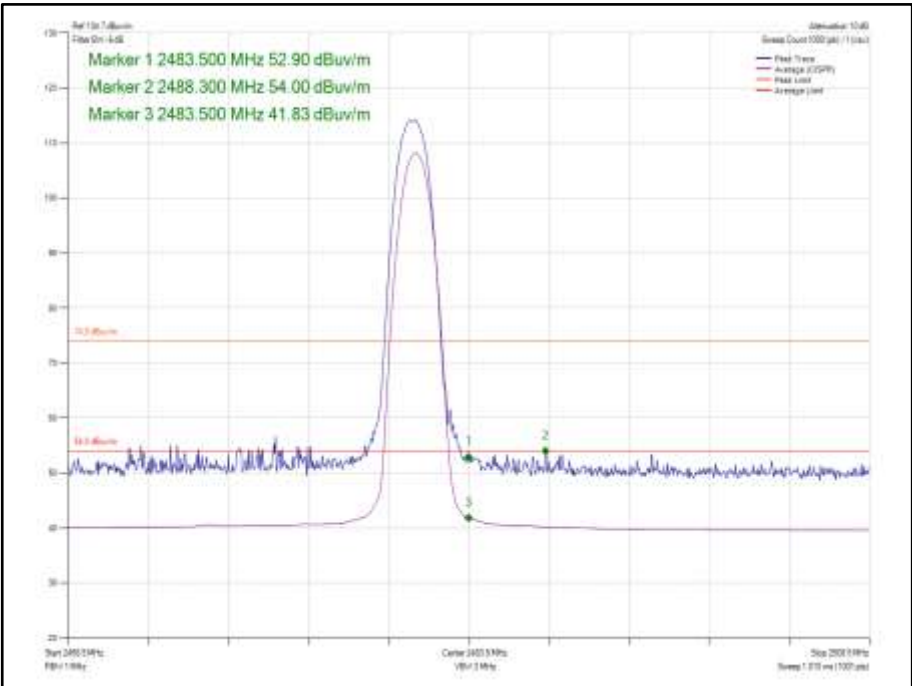


Figure 154 - Static Core 1 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

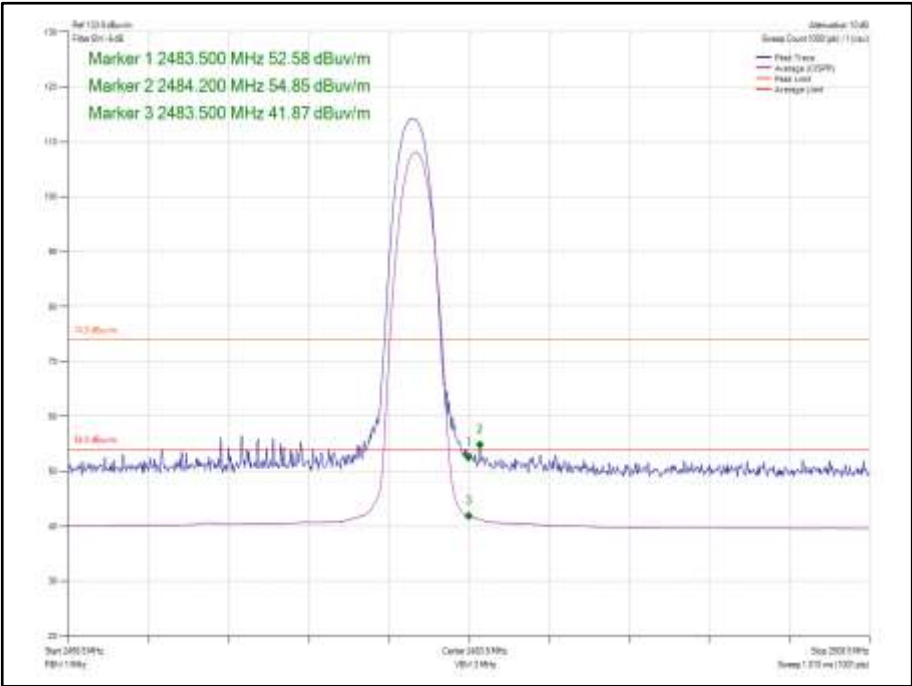
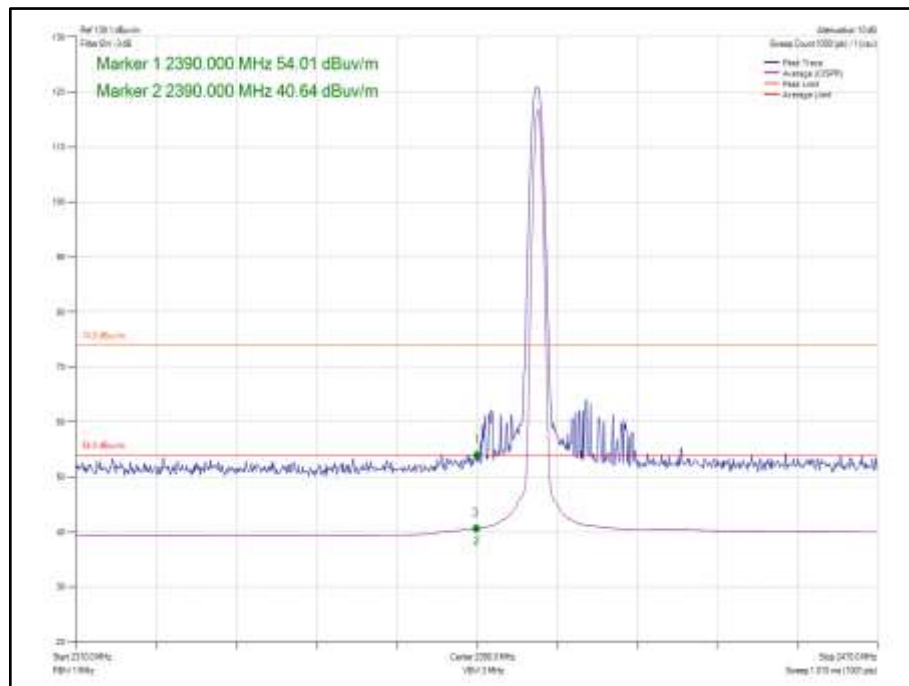


Figure 155 - Static Core 1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

| 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**

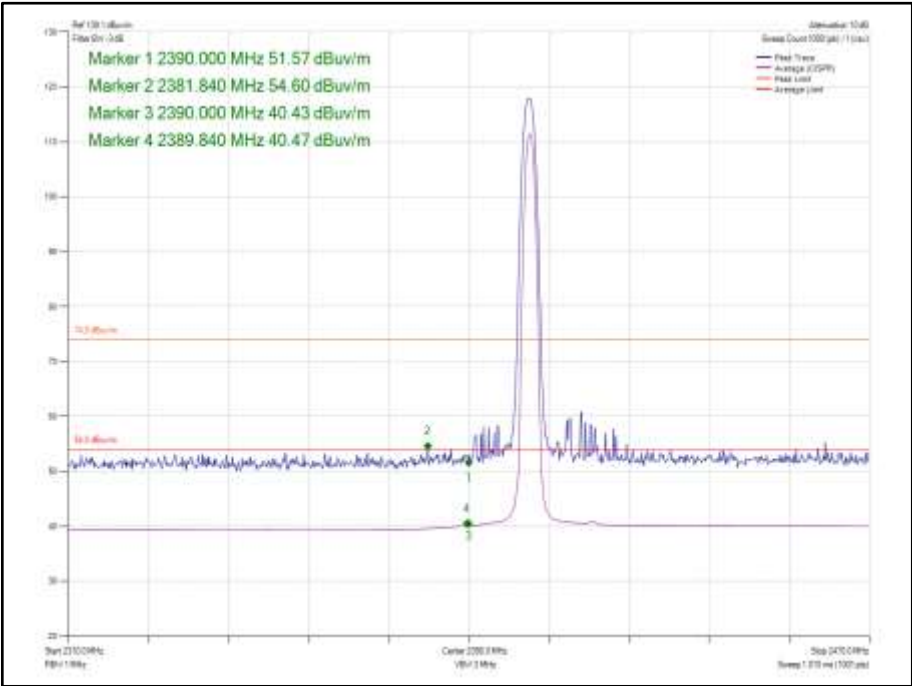


Figure 157 - Static Core 0-1 -  $\pi/4$  DQPSK/2DH5 - 2402 MHz -  
Band Edge Frequency 2390.0 MHz

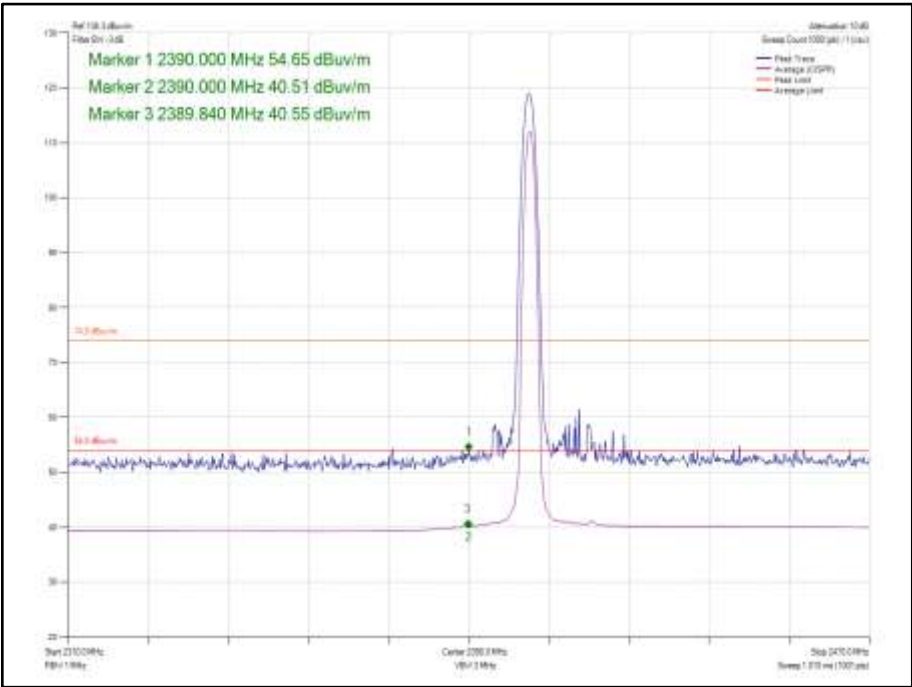


Figure 158 - Static Core 0-1 - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

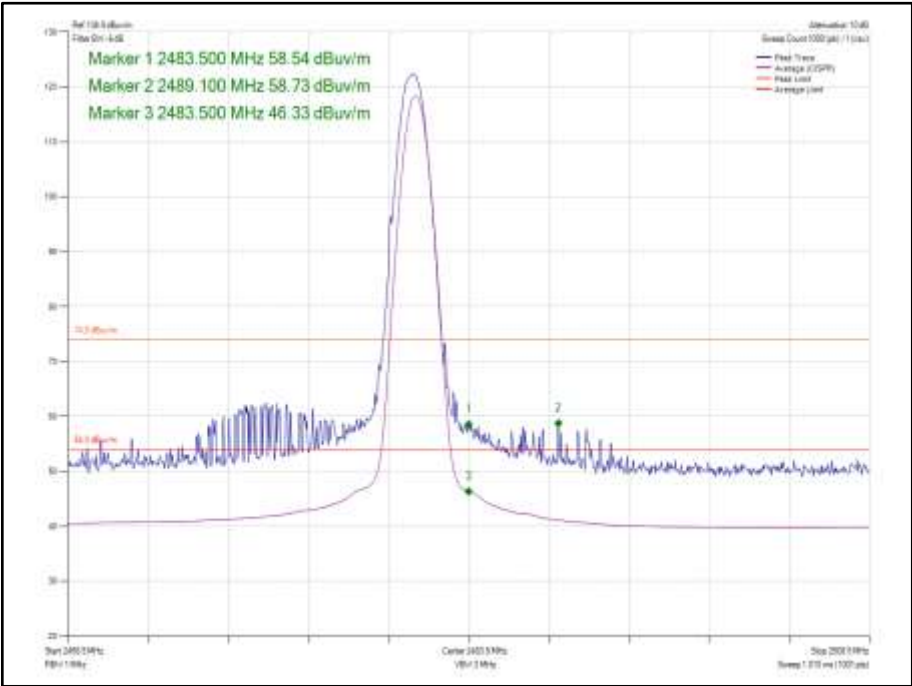


Figure 159 - Static Core 0-1 - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

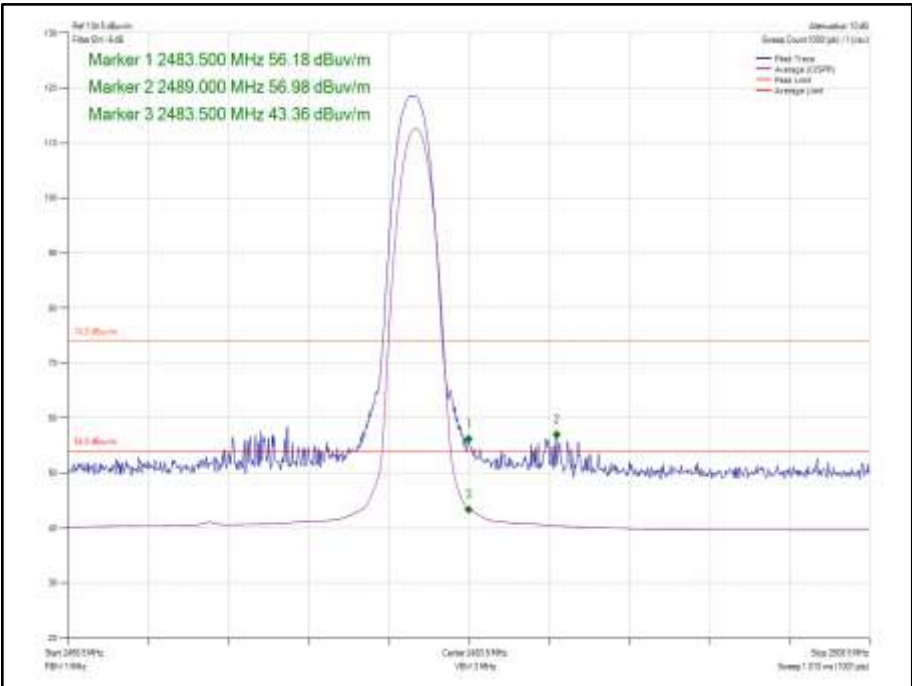


Figure 160 - Static Core 0-1 -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

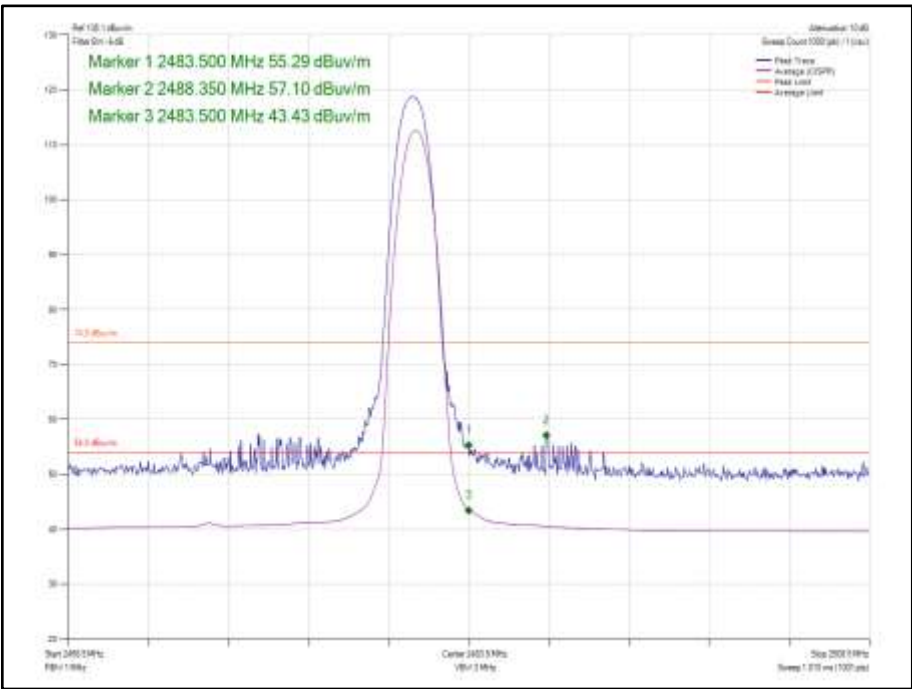


Figure 161 - Static Core 0-1 - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

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

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

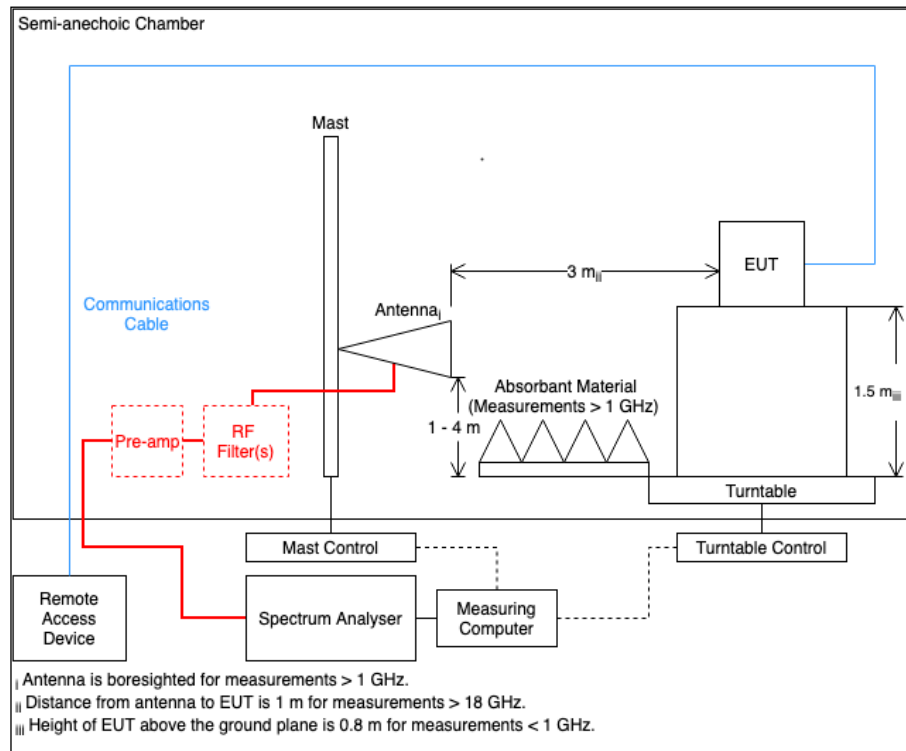


Figure 162

## 2.8.6 Environmental Conditions

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

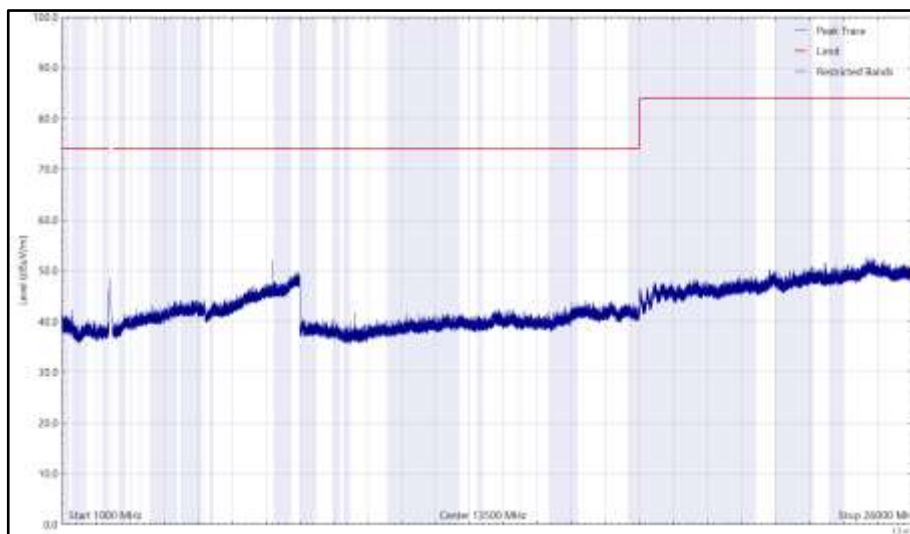
## 2.8.7 Test Results

### 2.4 GHz Bluetooth - FHSS

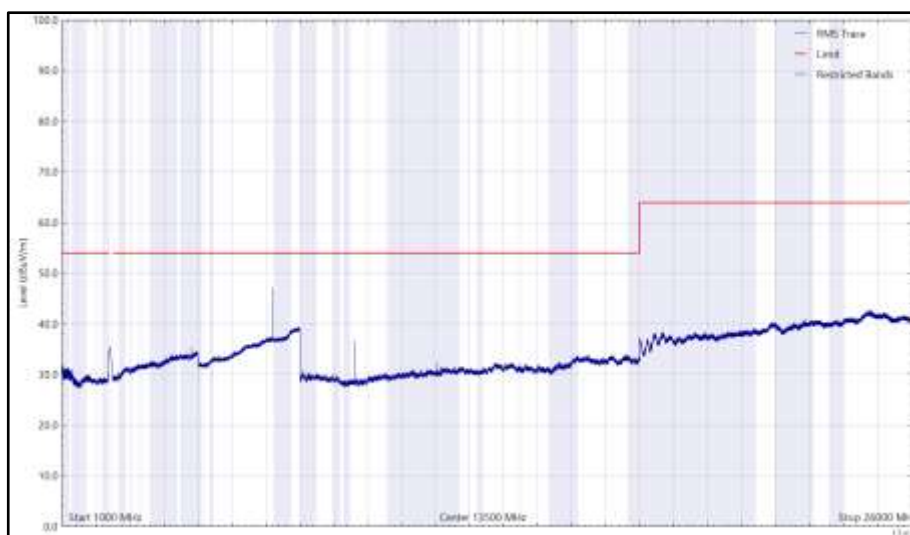
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| 7205.726        | 58.2           | 74.0           | -15.8       | 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)**

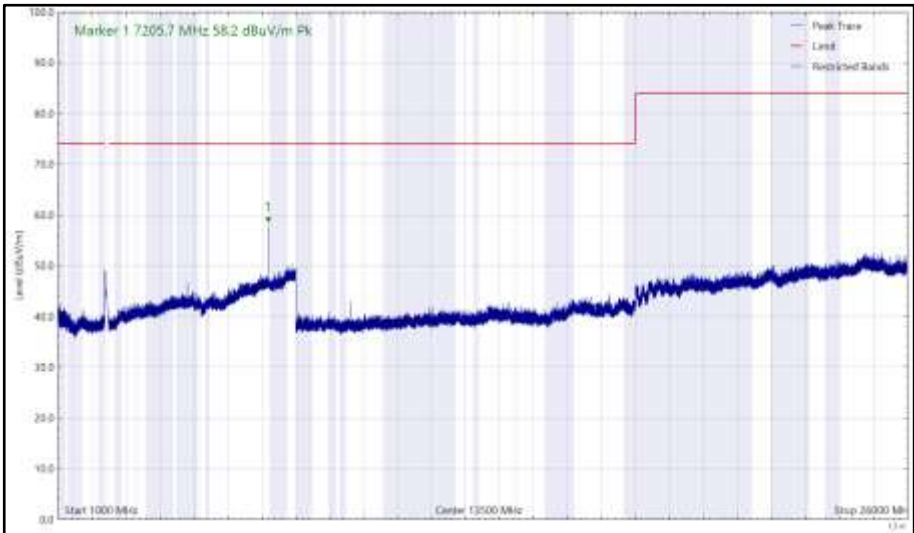


Figure 165 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

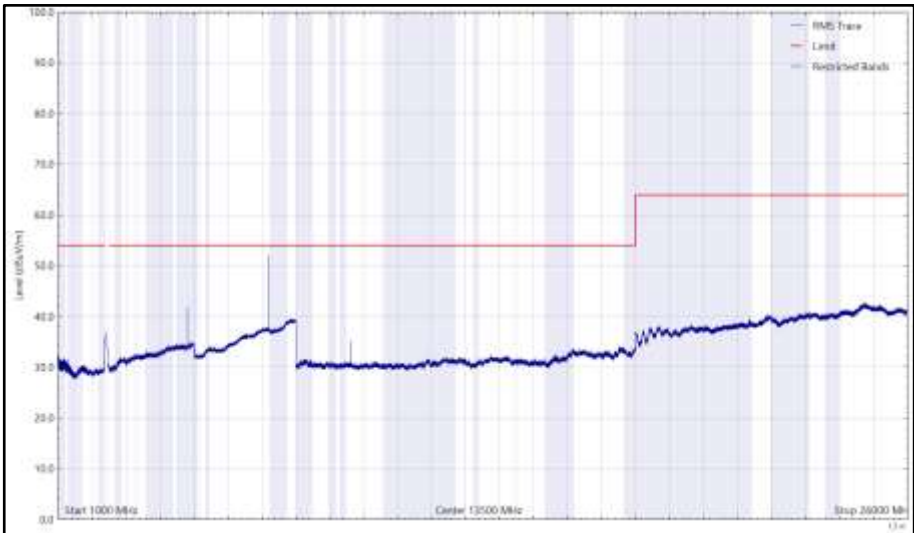


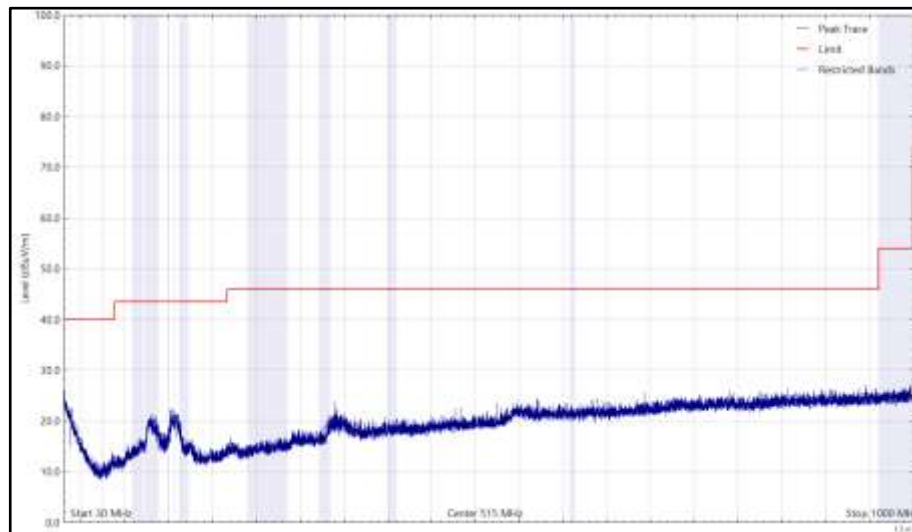
Figure 166 - 2402 MHz (CH0), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

| 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     |

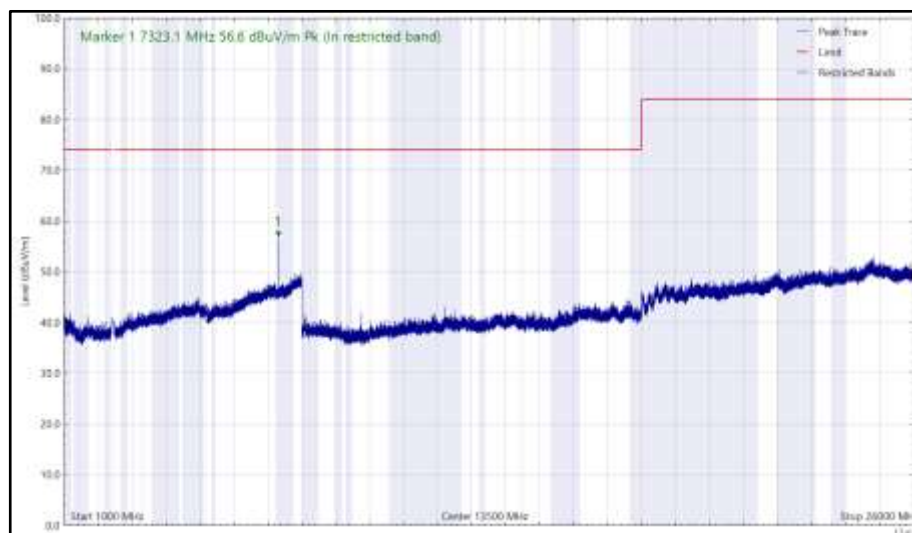
**Table 60 - 2441 MHz (CH39), DH5, ePA, Core 0, 30 MHz to 26 GHz**

No other emissions found within 6 dB of the limit.

**Note:** Average emission level was determined by subtracting  
(DCCF =  $20 * \log(11.25 \text{ ms} / 100 \text{ ms}) = -19.0 \text{ dB}$ ) 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)**

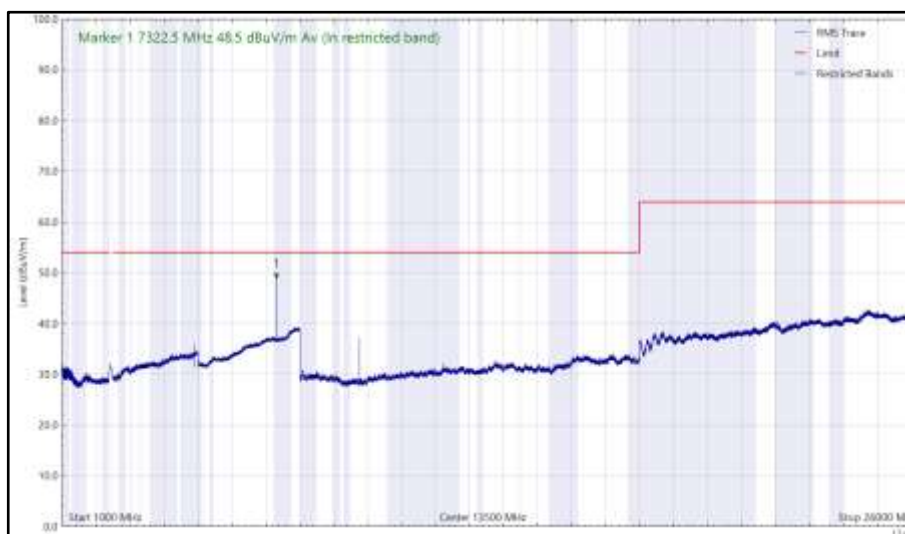


Figure 169 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

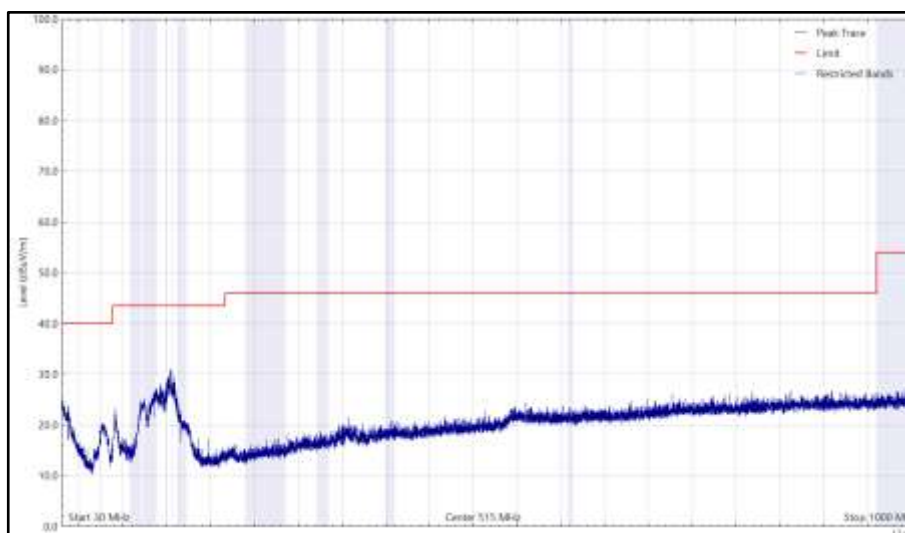


Figure 170 - 2441 MHz (CH39), DH5, ePA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

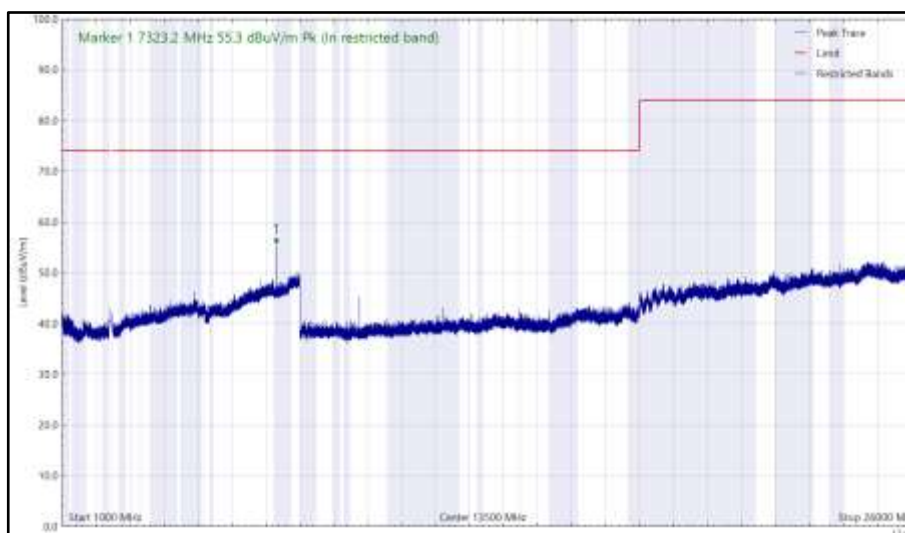


Figure 171 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

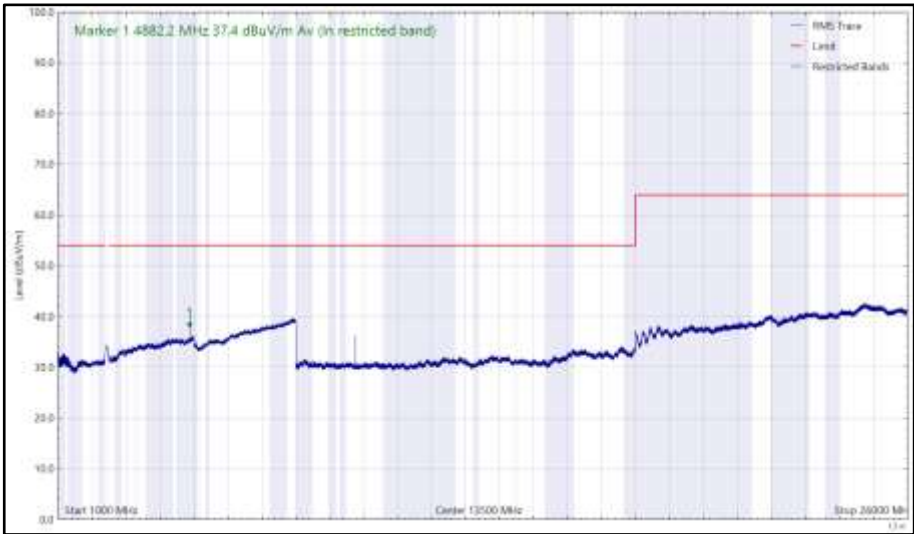


Figure 172 - 2441 MHz (CH39), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)



| 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.

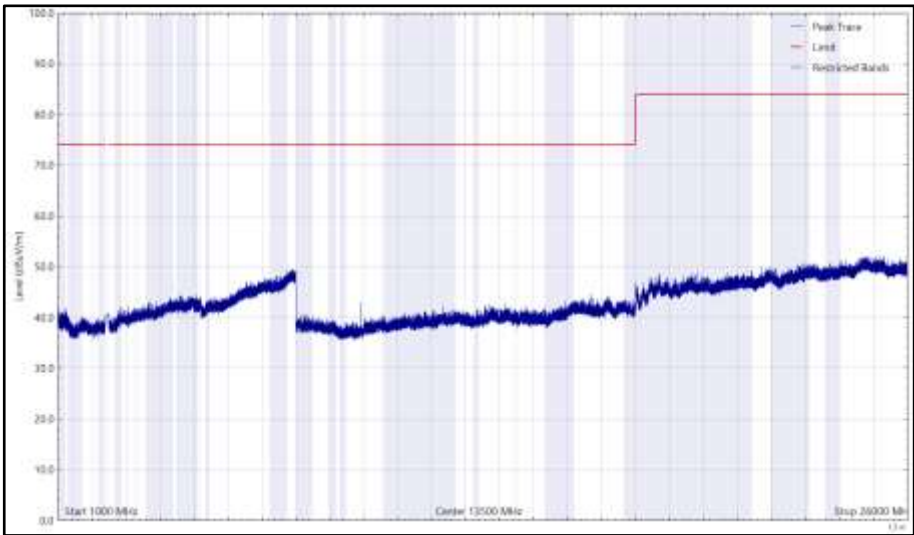


Figure 173 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Peak)

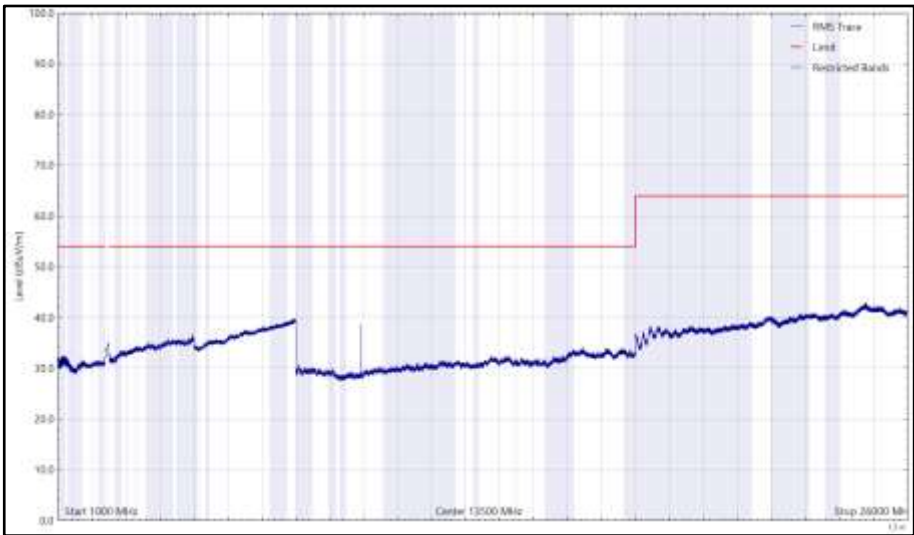


Figure 174 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

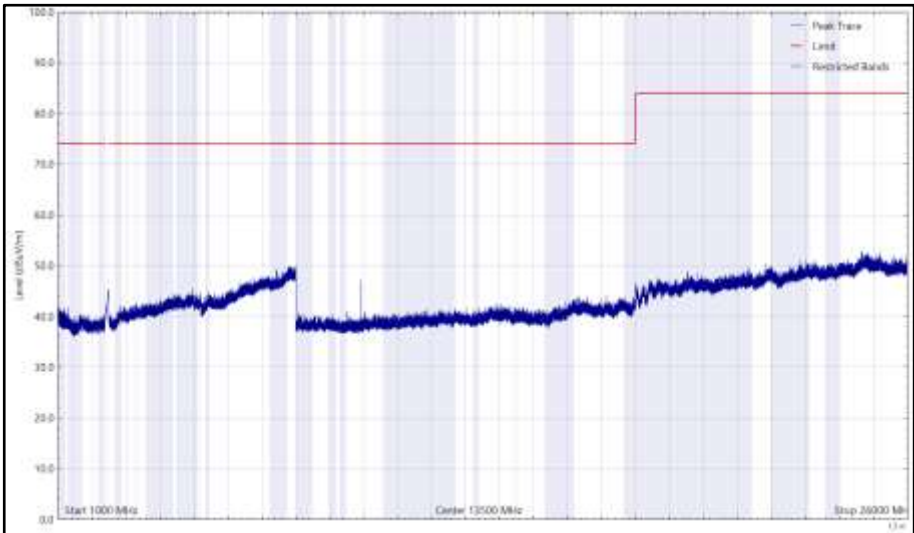


Figure 175 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

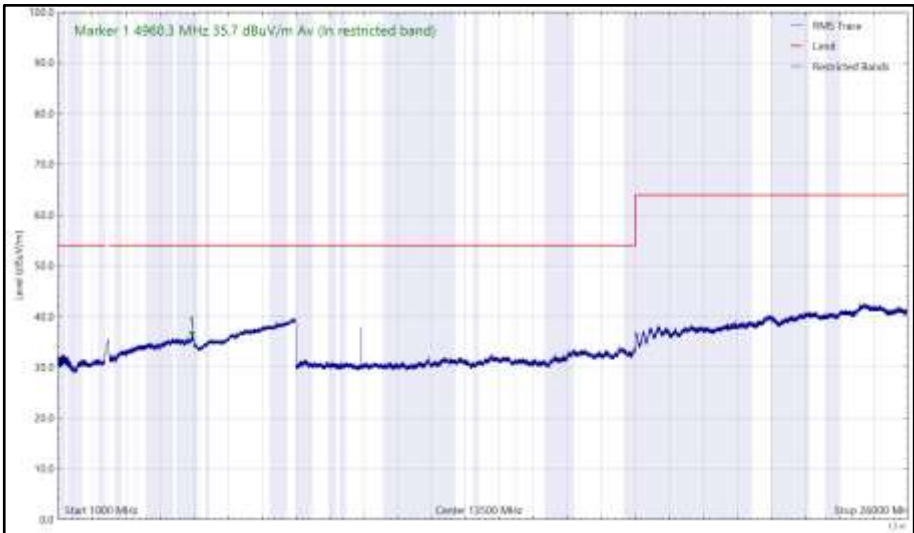
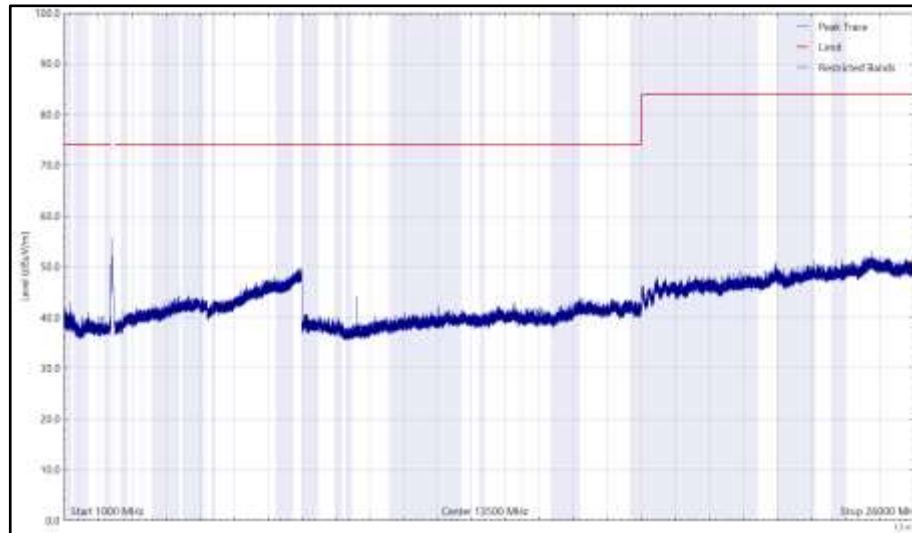


Figure 176 - 2480 MHz (CH78), DH5, ePA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

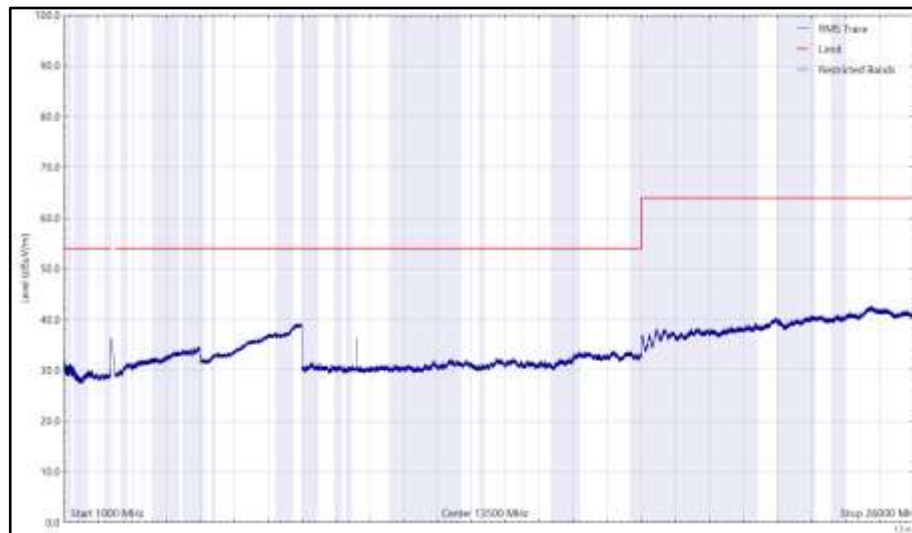
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4804.256        | 37.6           | 54.0           | -16.4       | 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)**

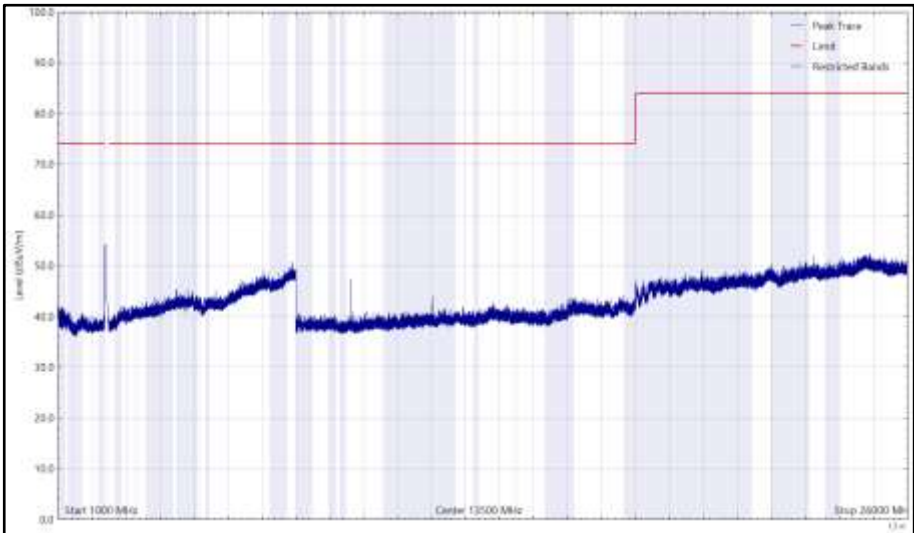


Figure 179 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

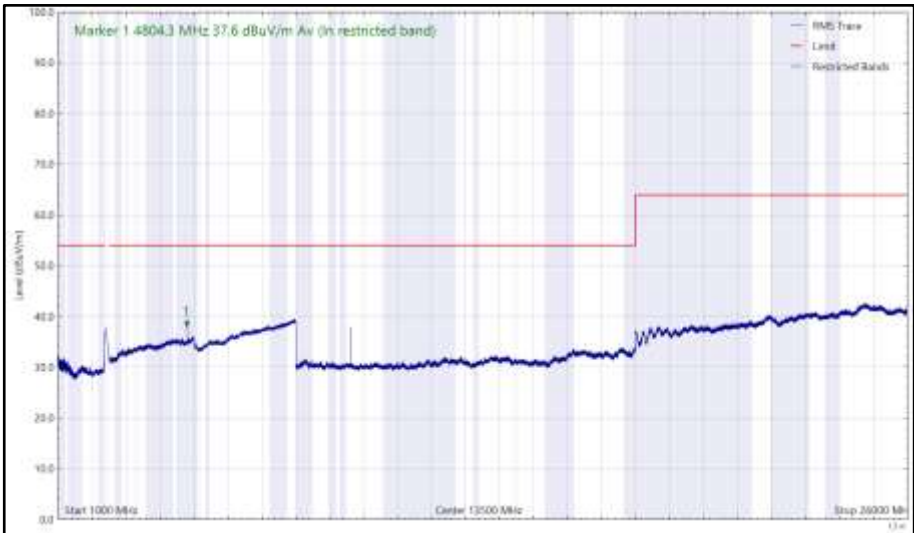
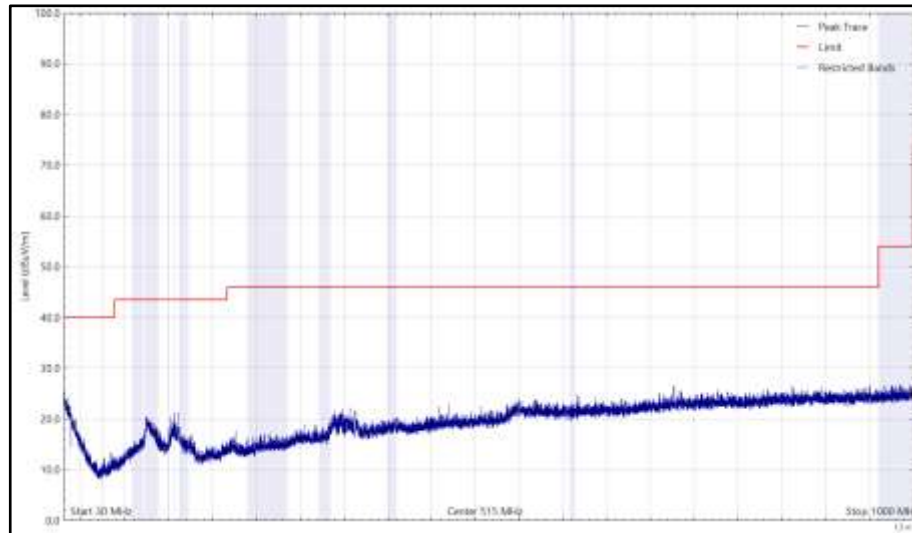


Figure 180 - 2402 MHz (CH0), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

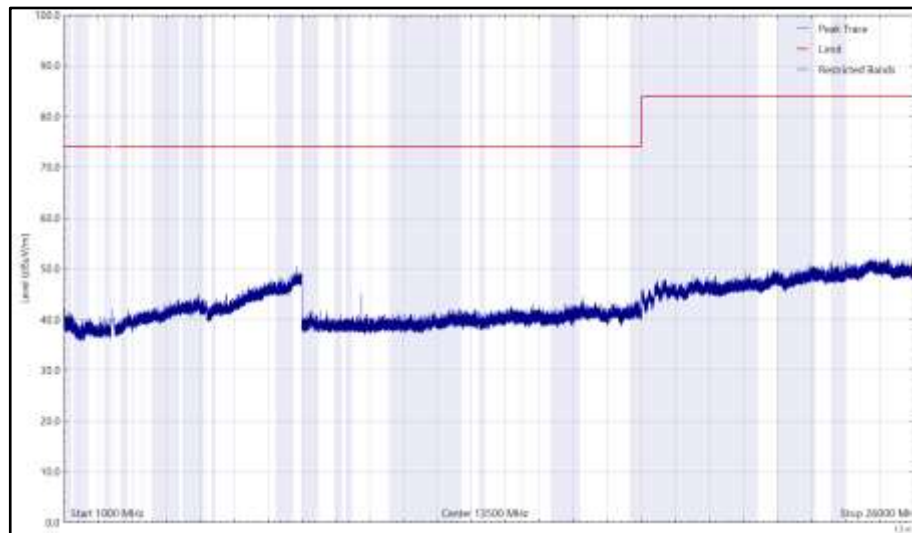
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4882.352        | 36.8           | 54.0           | -17.3       | 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)**

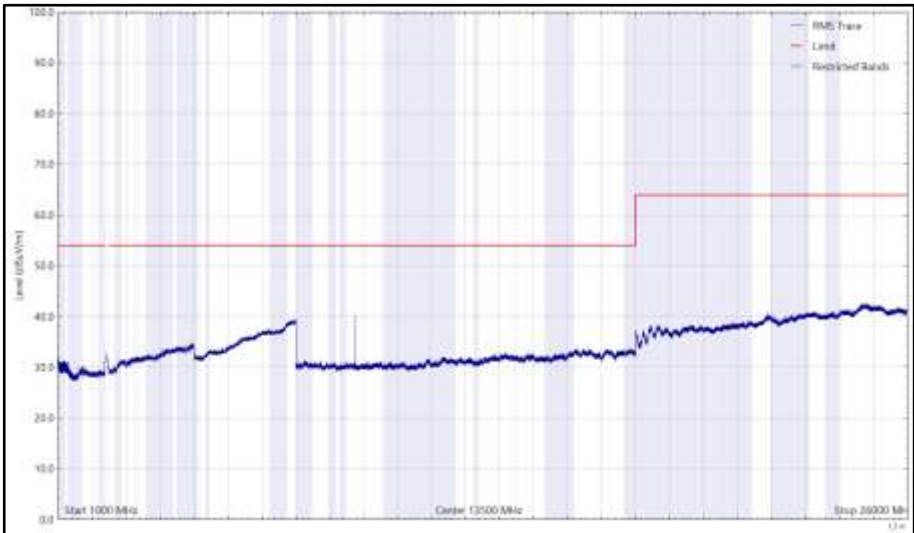


Figure 183 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

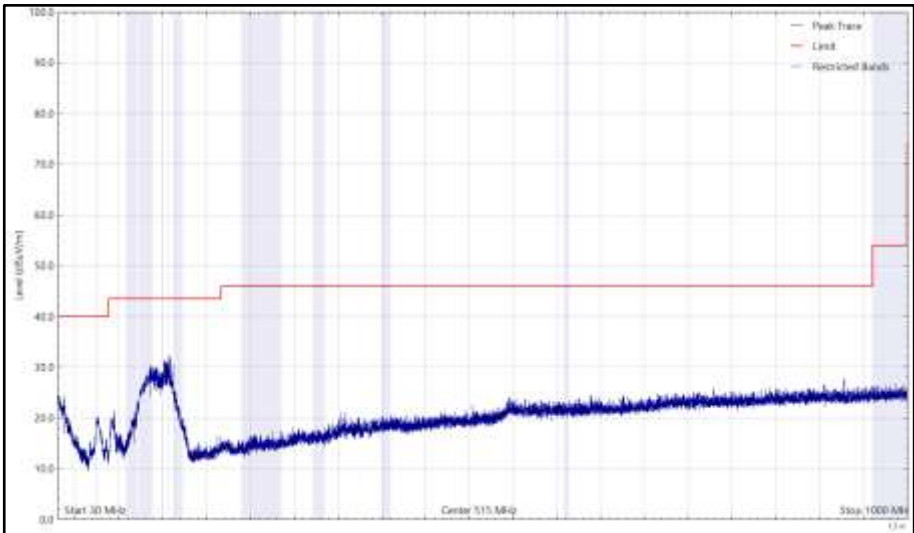


Figure 184 - 2441 MHz (CH39), DH5, ePA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

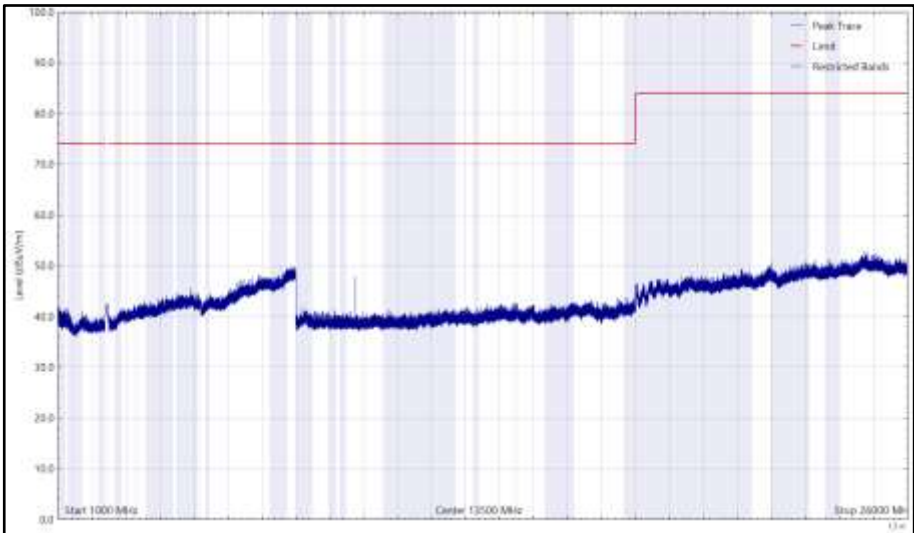


Figure 185 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

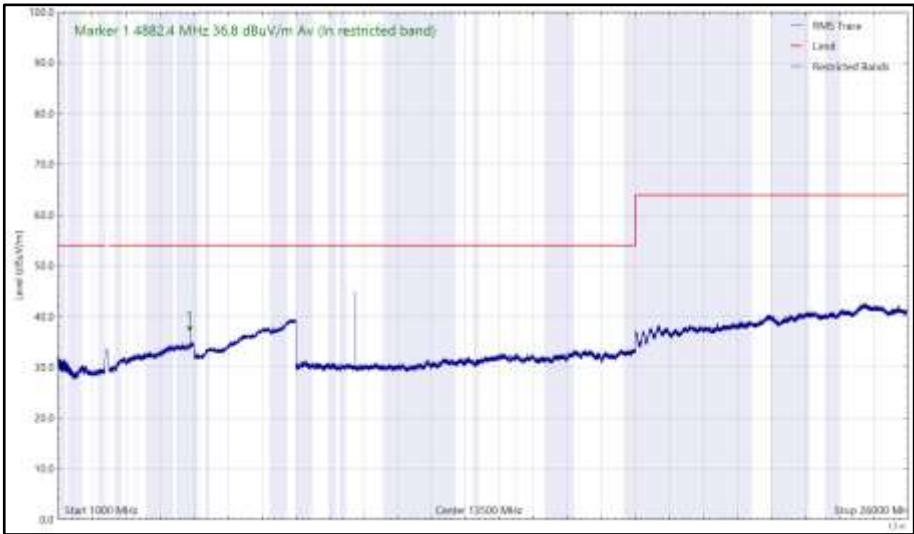


Figure 186 - 2441 MHz (CH39), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)



| 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.

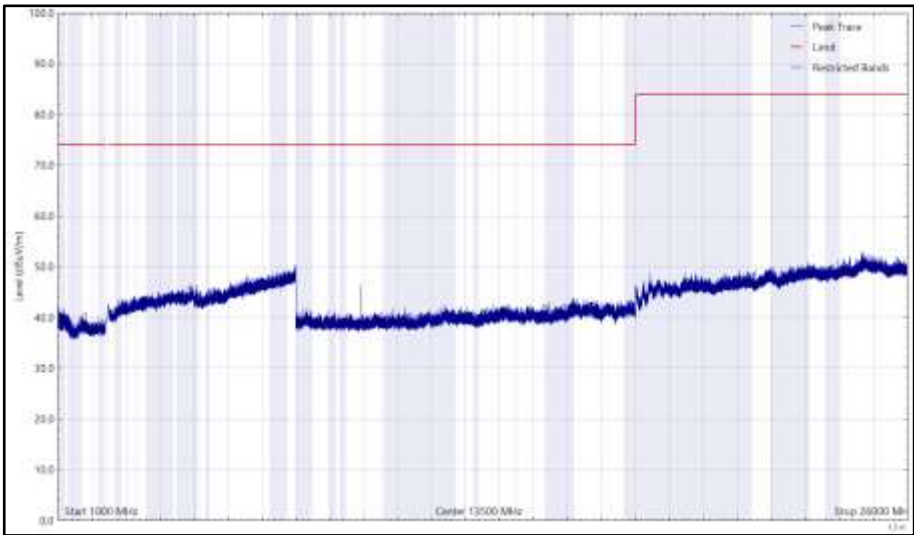


Figure 187 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

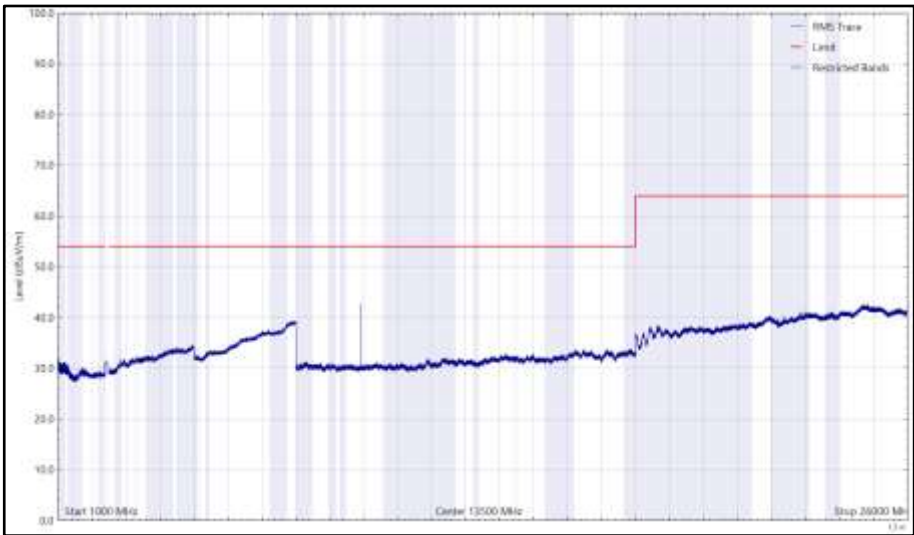


Figure 188 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

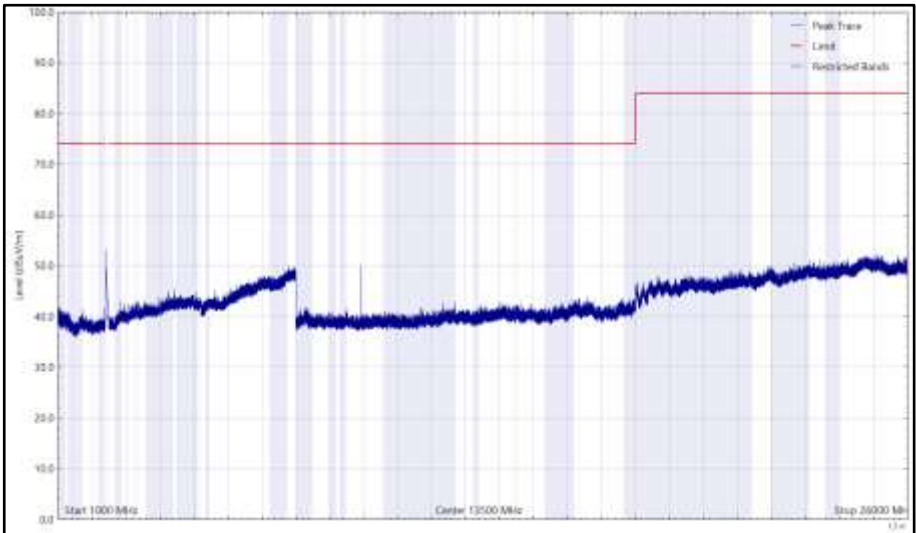


Figure 189 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

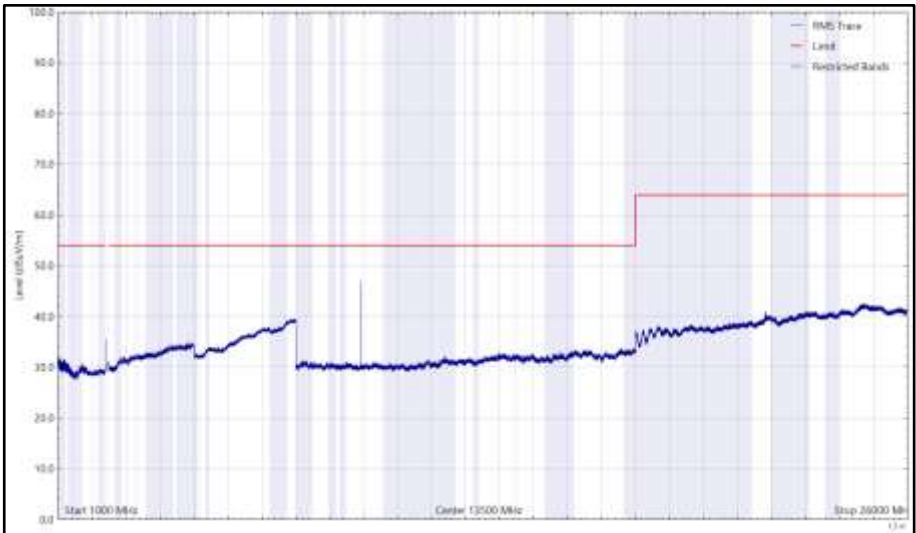
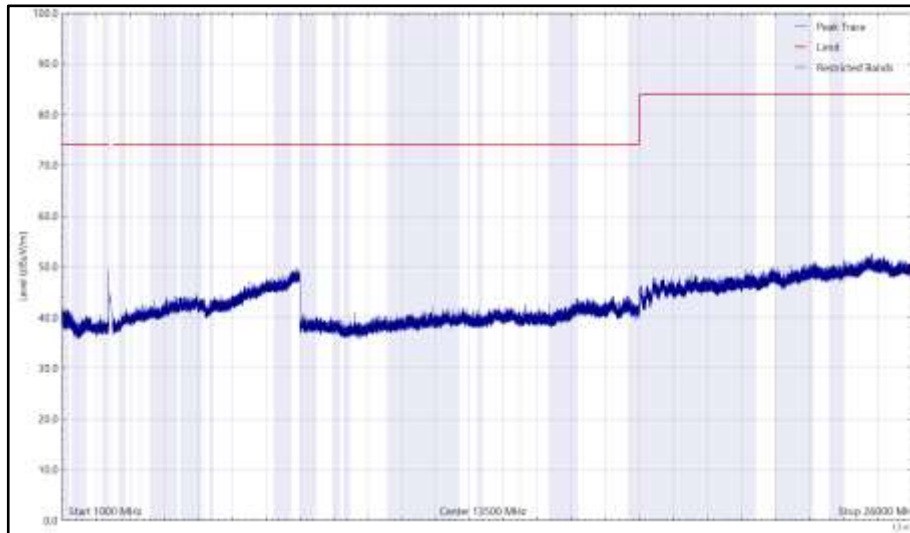


Figure 190 - 2480 MHz (CH78), DH5, ePA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

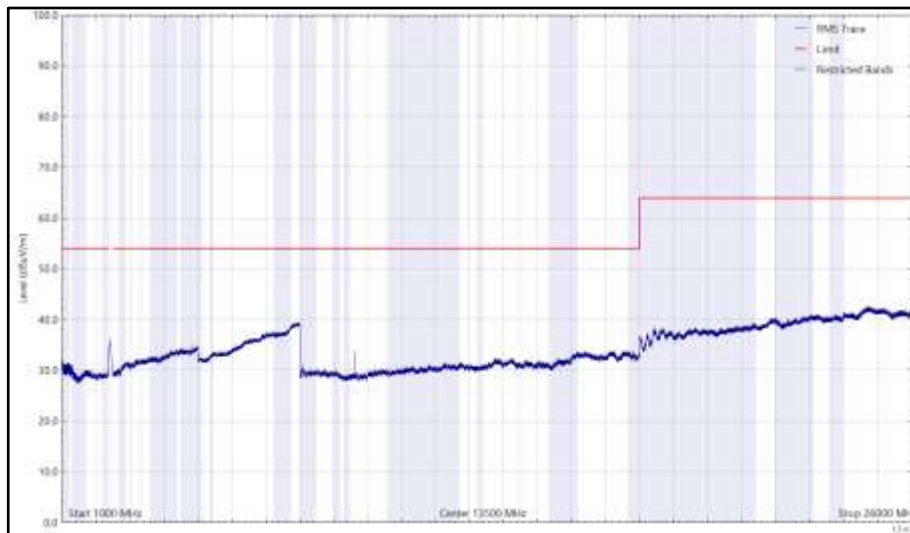
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4804.356        | 38.2           | 54.0           | -15.8       | 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)**

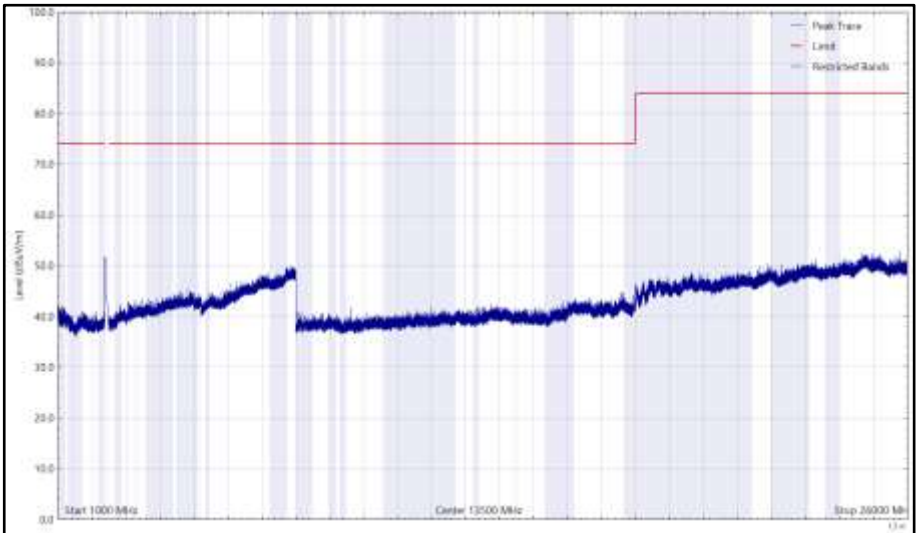


Figure 193 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

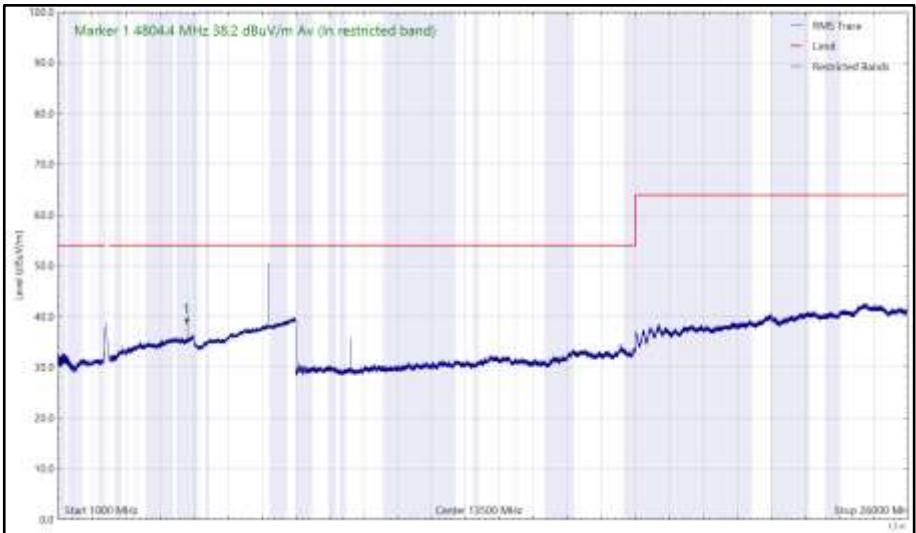
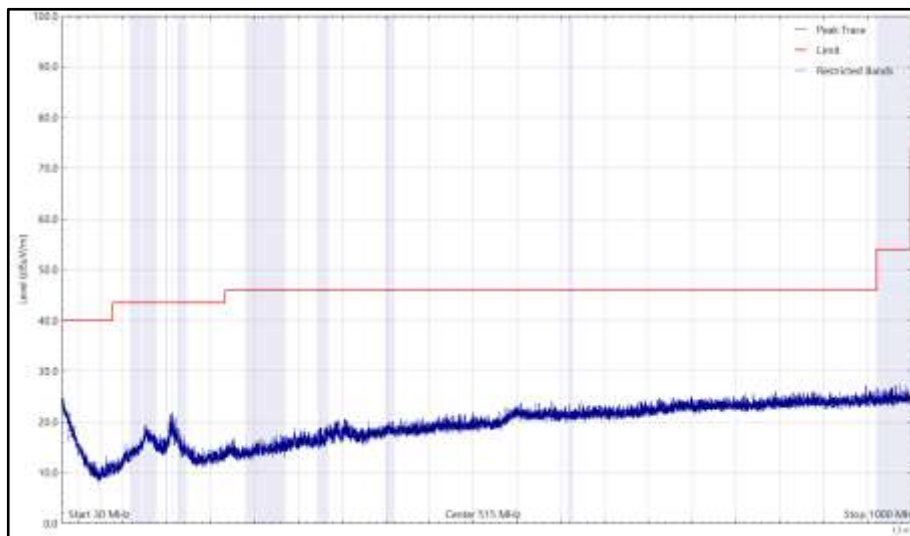


Figure 194 - 2402 MHz (CH0), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

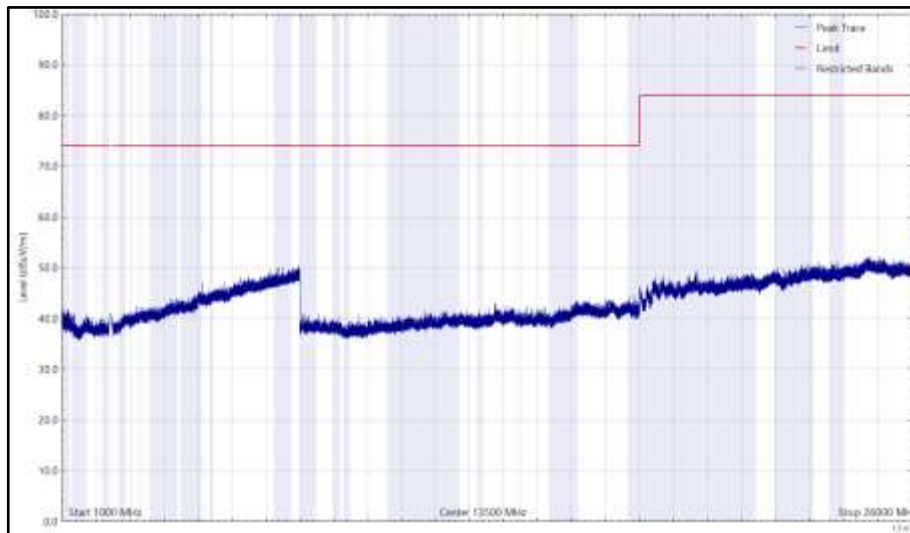
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4882.367        | 37.6           | 54.0           | -16.4       | 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)**

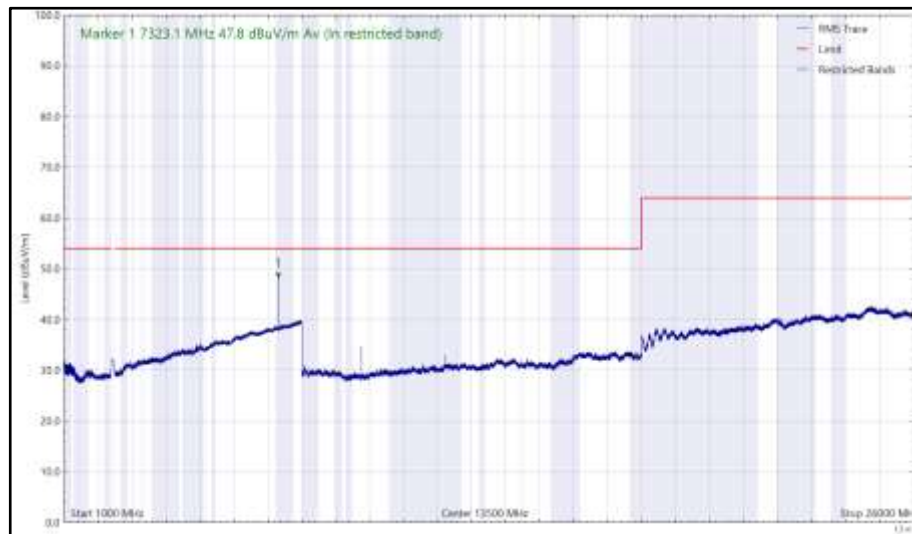


Figure 197 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Horizontal (Average)

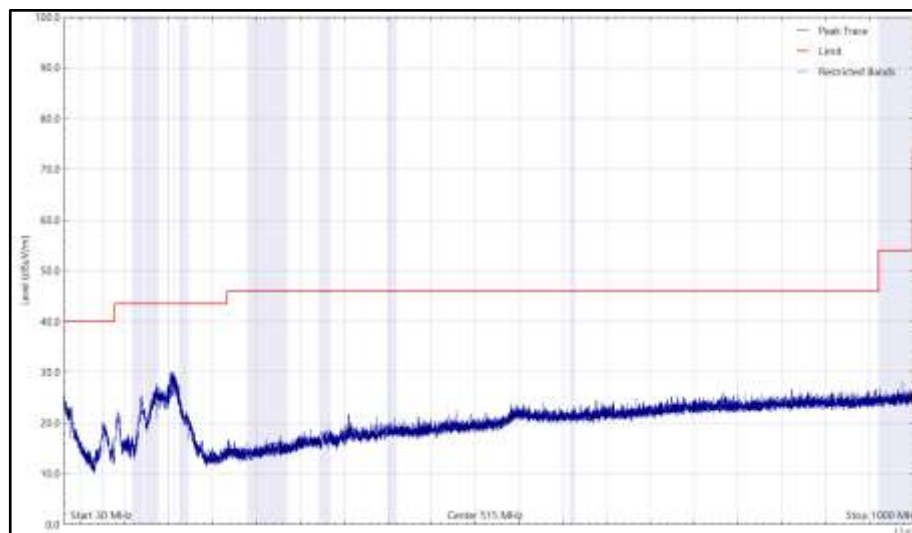


Figure 198 - 2441 MHz (CH39), DH5, iPA, Core 0, 30 MHz to 1 GHz, Vertical (Peak)

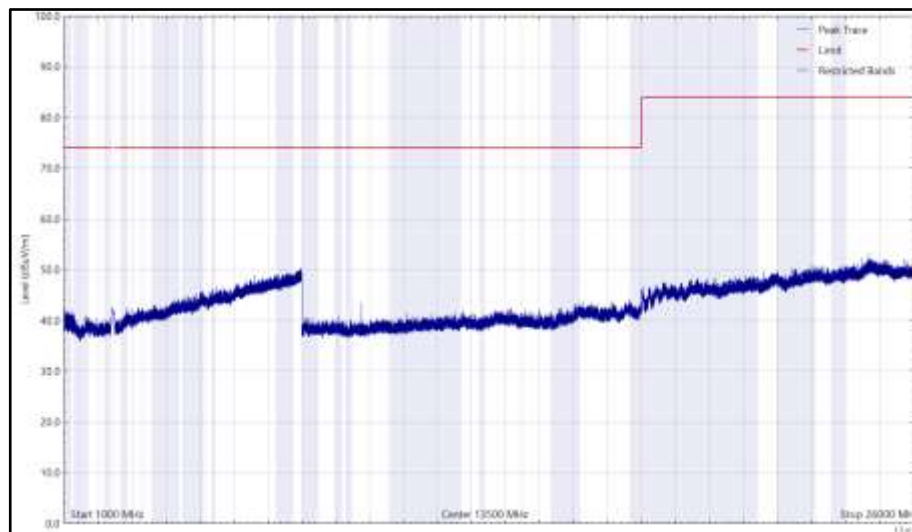


Figure 199 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

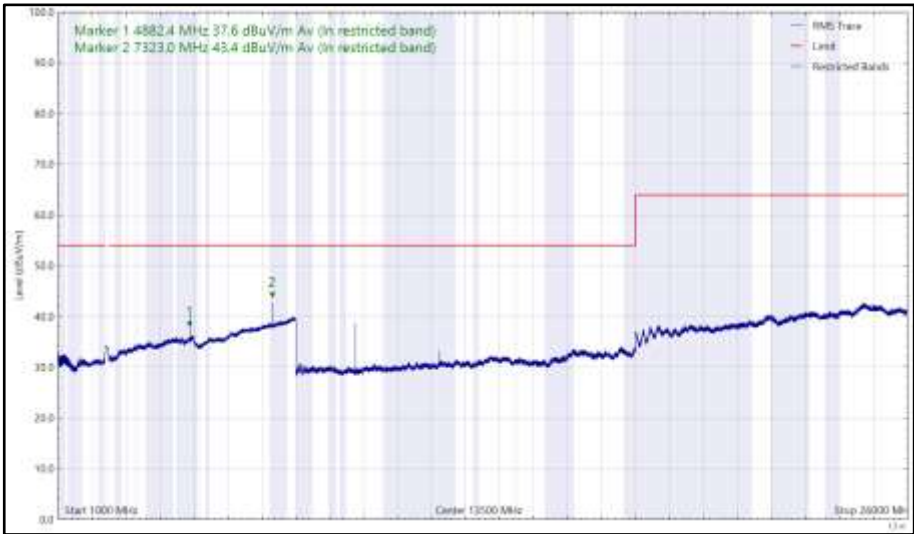
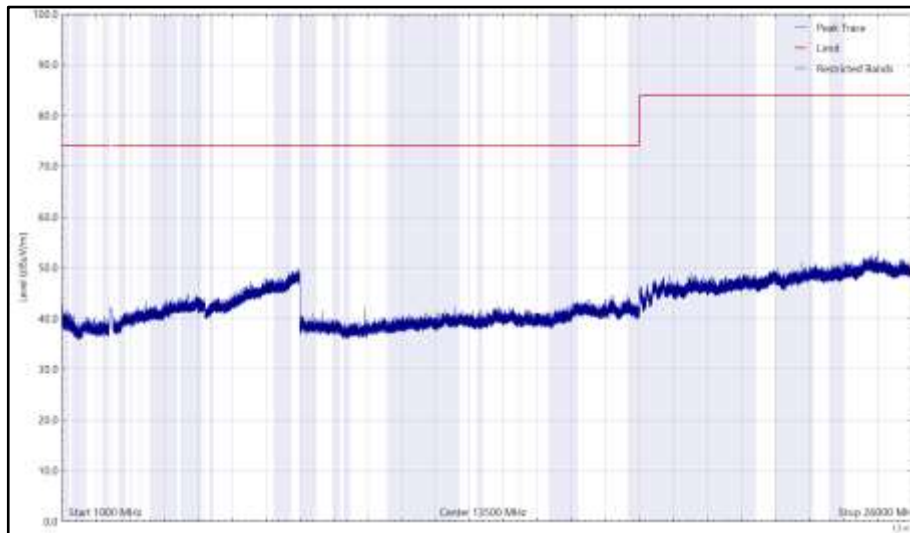


Figure 200 - 2441 MHz (CH39), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

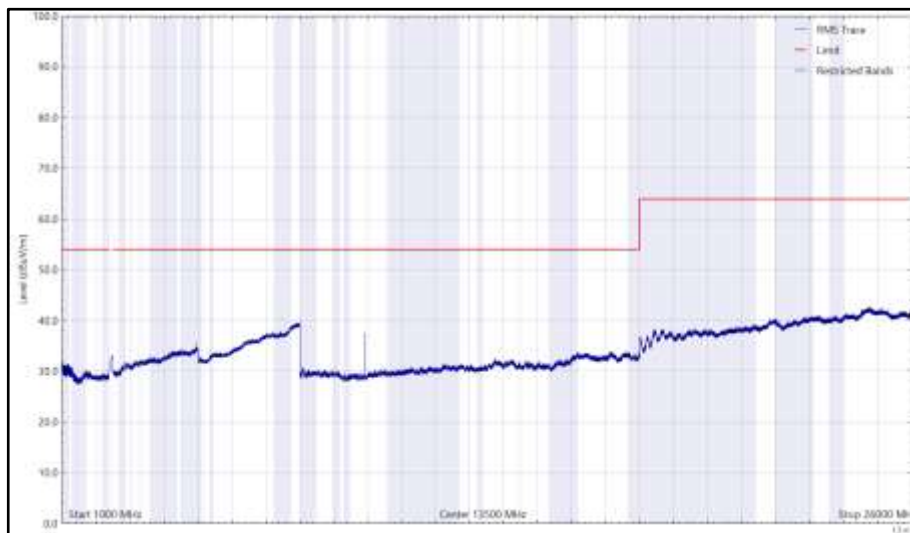
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4959.926        | 36.3           | 54.0           | -17.7       | 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)**

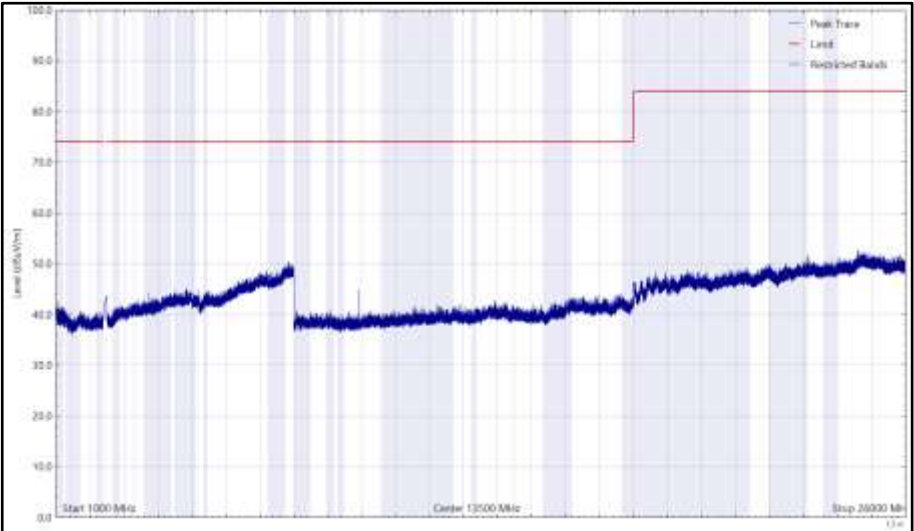


Figure 203 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Peak)

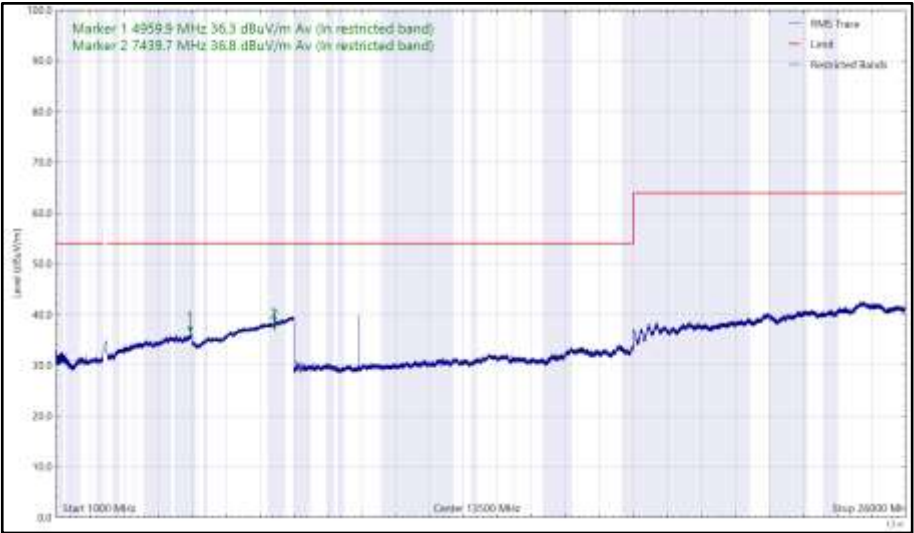
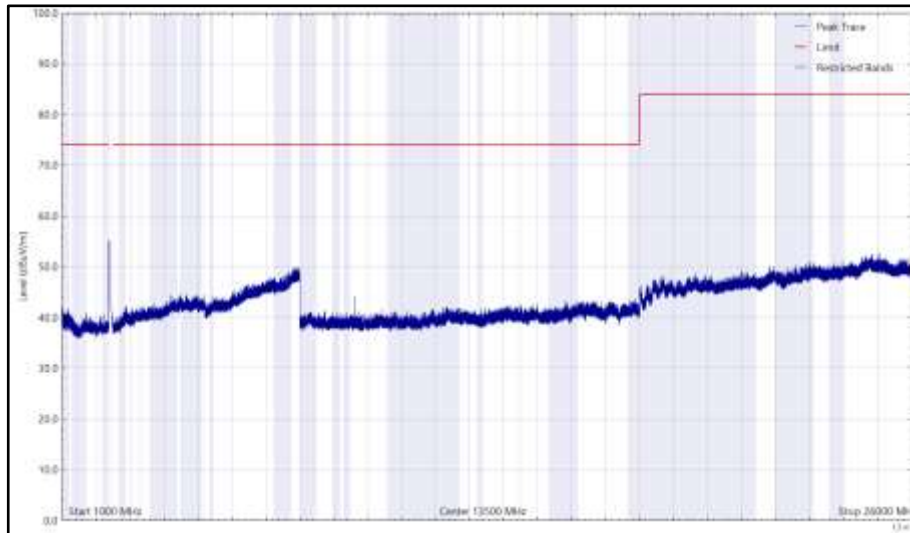


Figure 204 - 2480 MHz (CH78), DH5, iPA, Core 0, 1 GHz to 26 GHz, Vertical (Average)

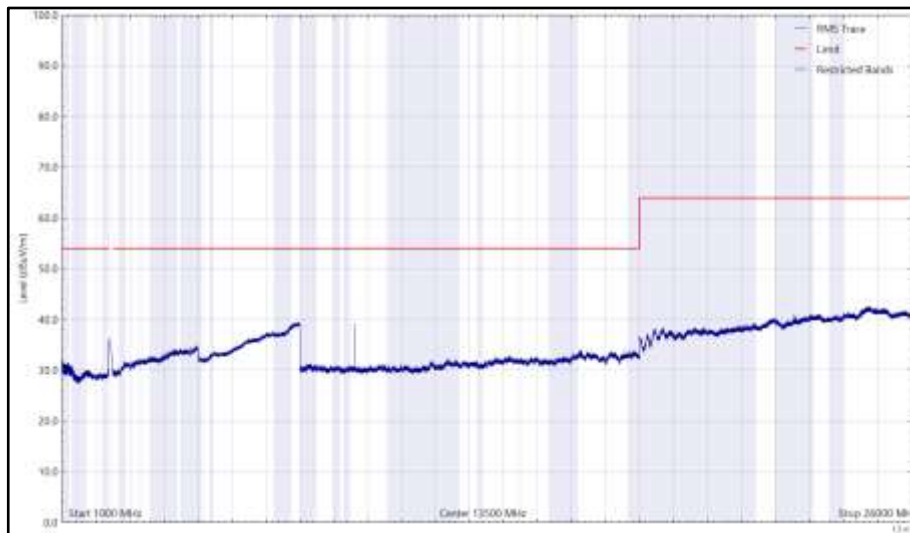
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4804.412        | 36.1           | 54.0           | -17.9       | 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)**

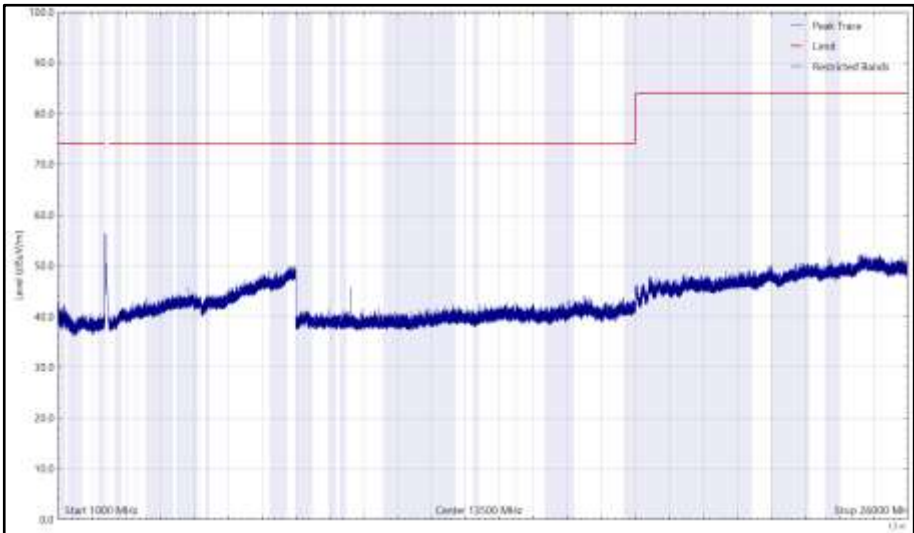


Figure 207 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

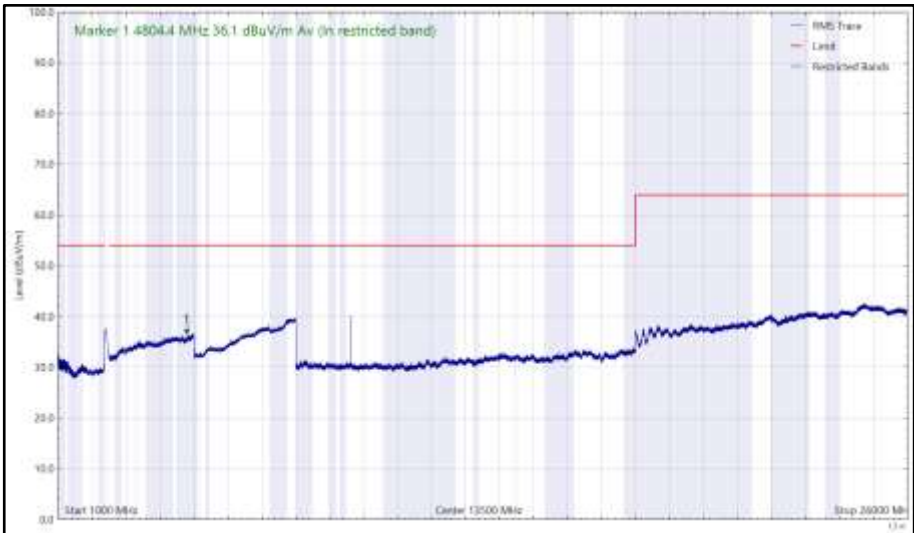
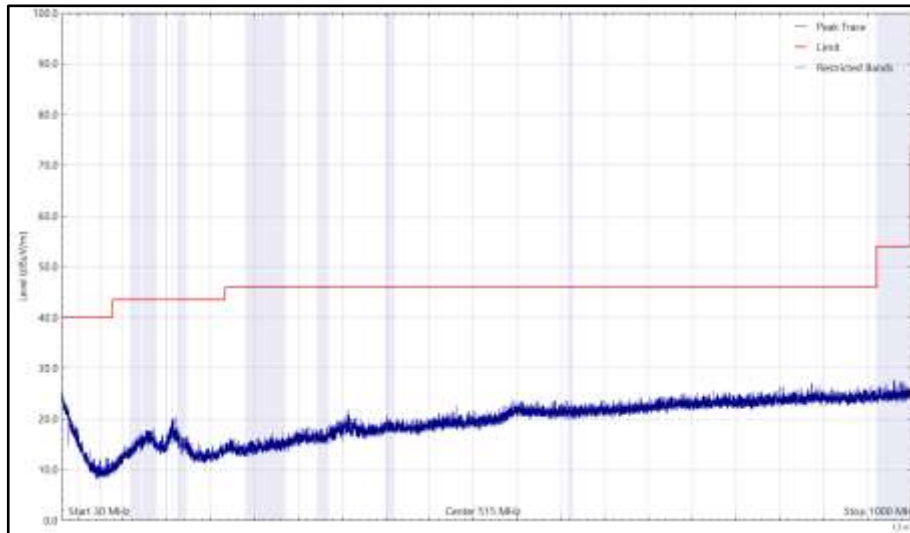


Figure 208 - 2402 MHz (CH0), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)

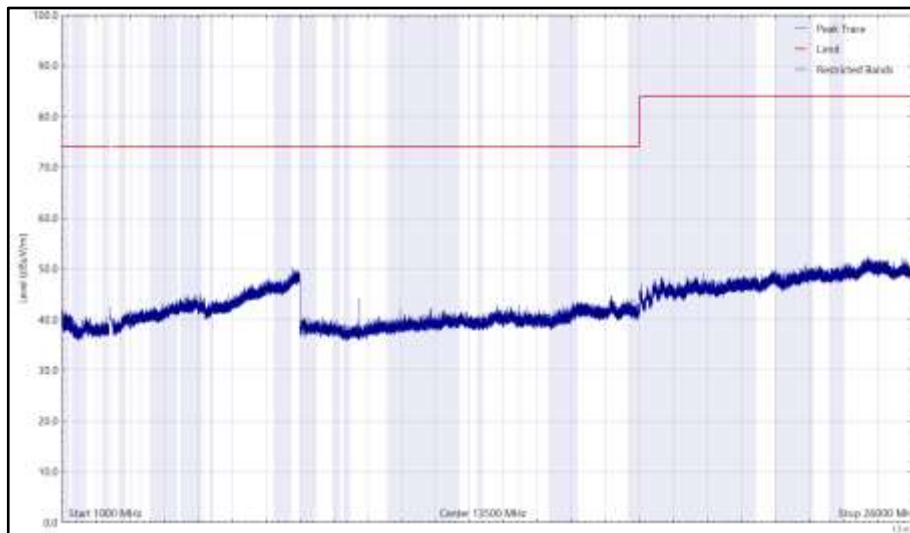
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector  | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|-----------|-----------|-------------|--------------|
| 4881.743        | 37.4           | 54.0           | -16.6       | 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)**

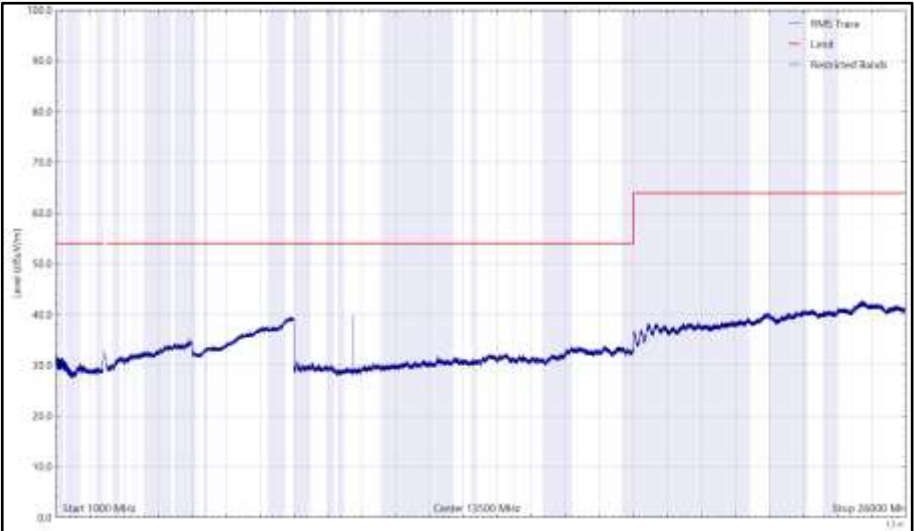


Figure 211 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

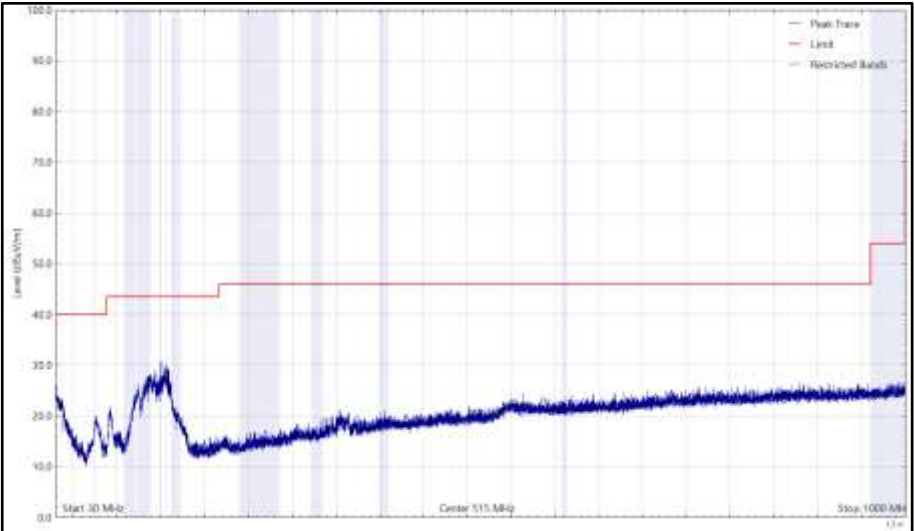


Figure 212 - 2441 MHz (CH39), DH5, iPA, Core 1, 30 MHz to 1 GHz, Vertical (Peak)

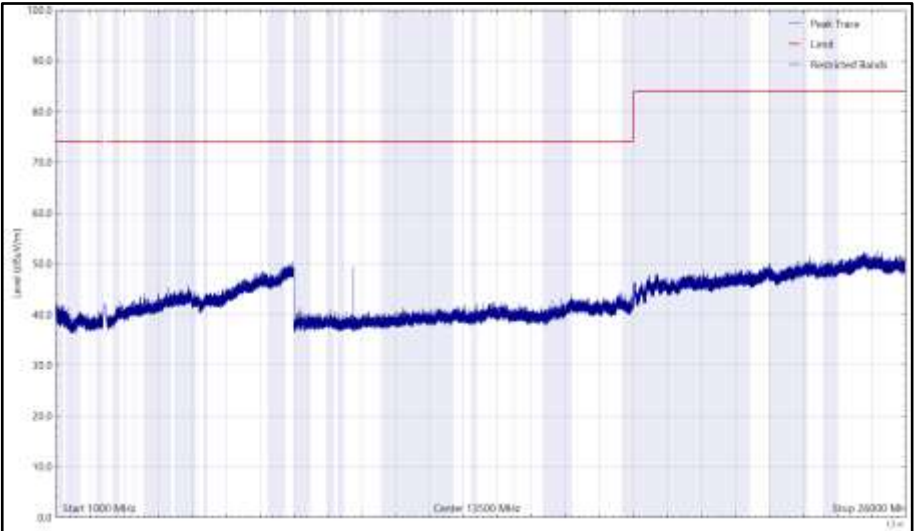


Figure 213 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

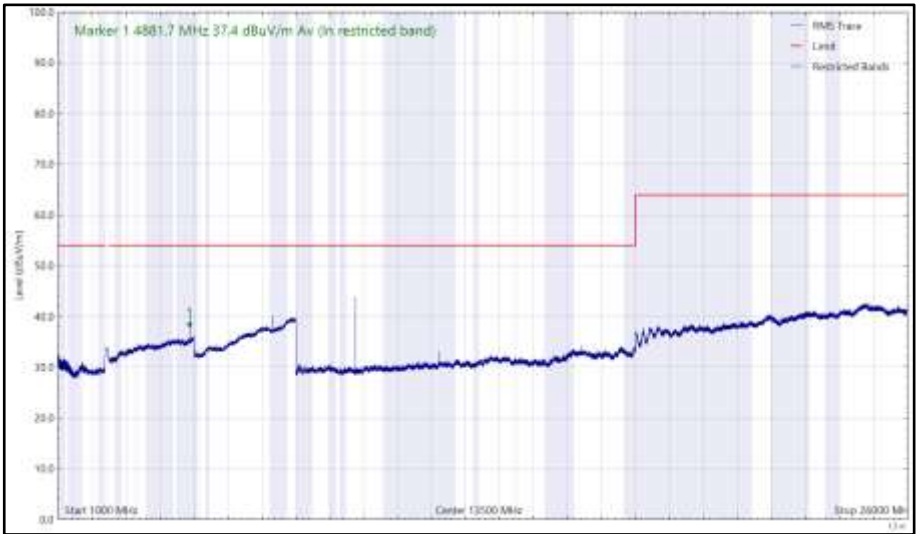


Figure 214 - 2441 MHz (CH39), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)



| 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.

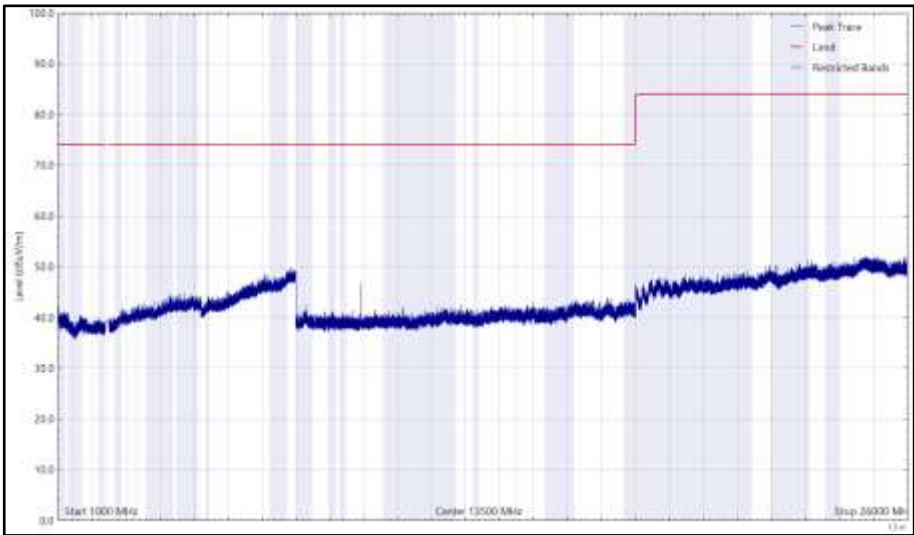


Figure 215 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Peak)

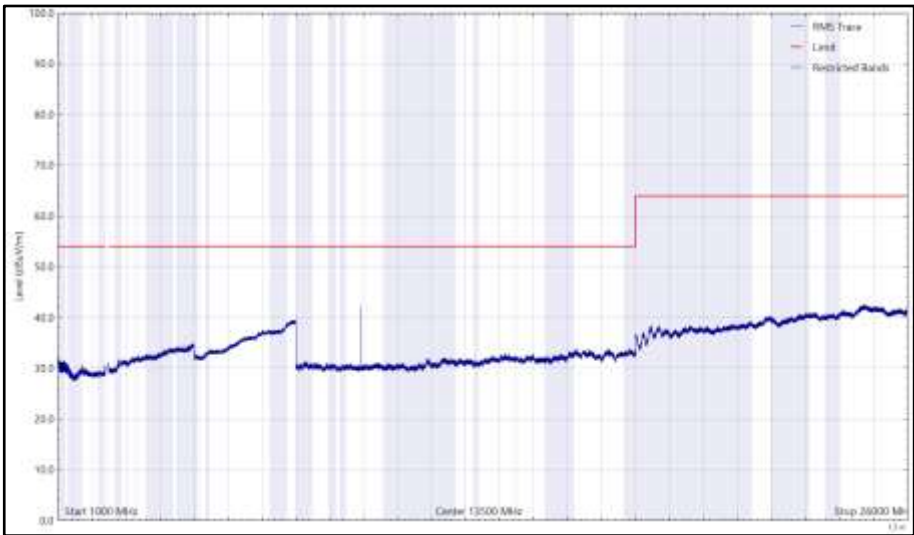


Figure 216 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Horizontal (Average)

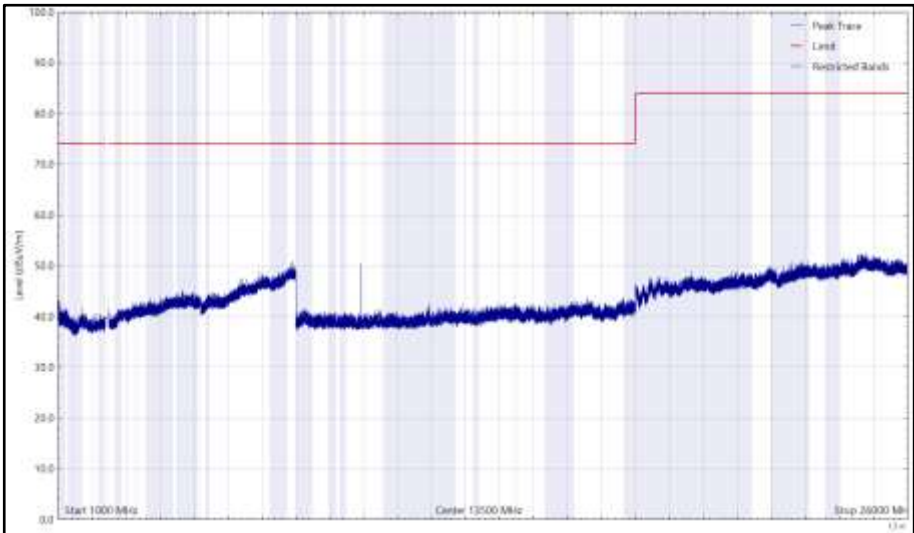


Figure 217 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Peak)

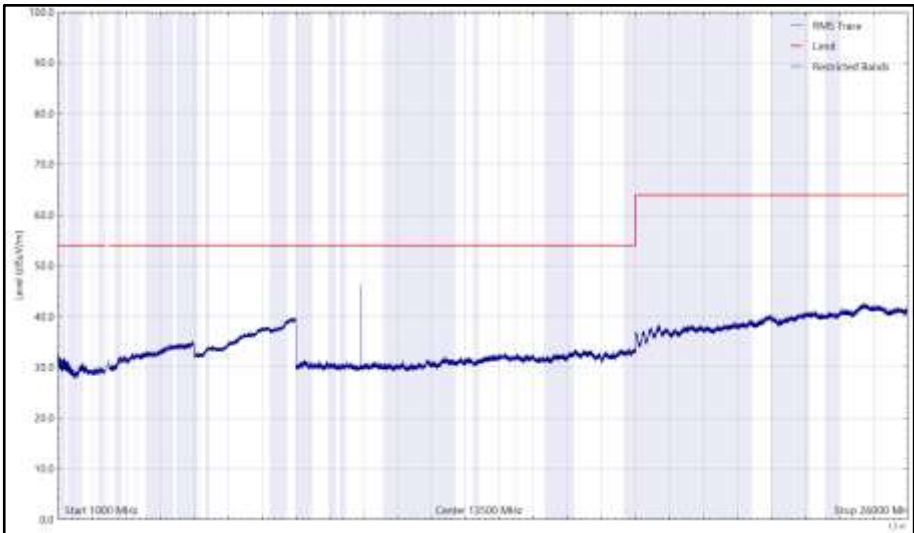


Figure 218 - 2480 MHz (CH78), DH5, iPA, Core 1, 1 GHz to 26 GHz, Vertical (Average)



| 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.

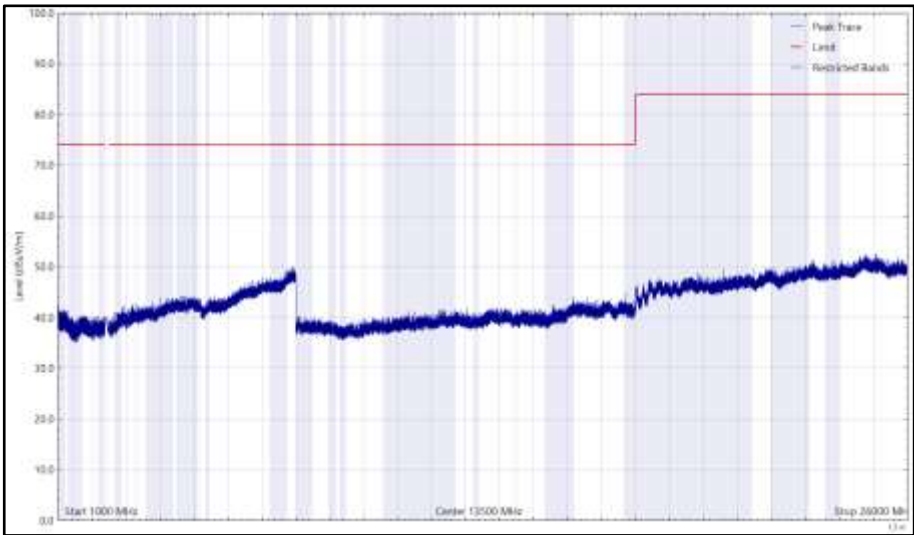


Figure 219 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

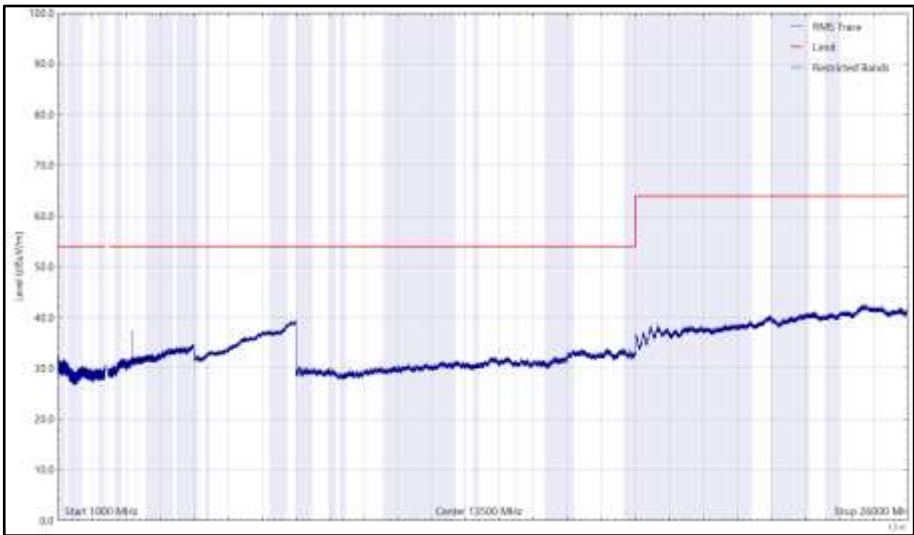


Figure 220 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

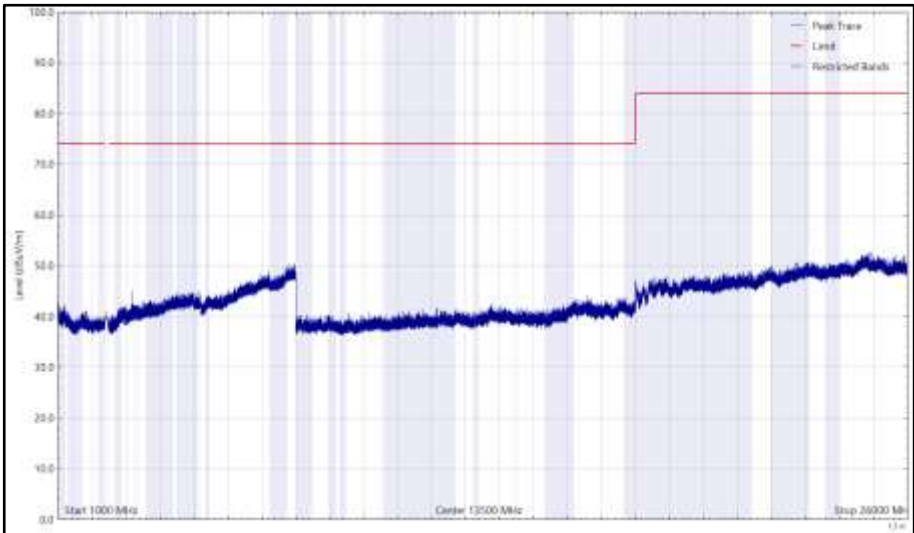


Figure 221 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

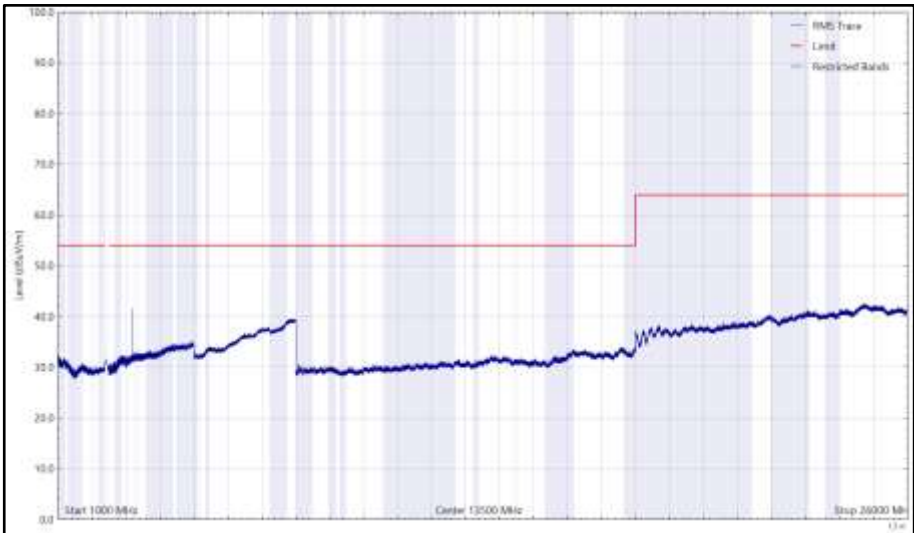


Figure 222 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)



| 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.

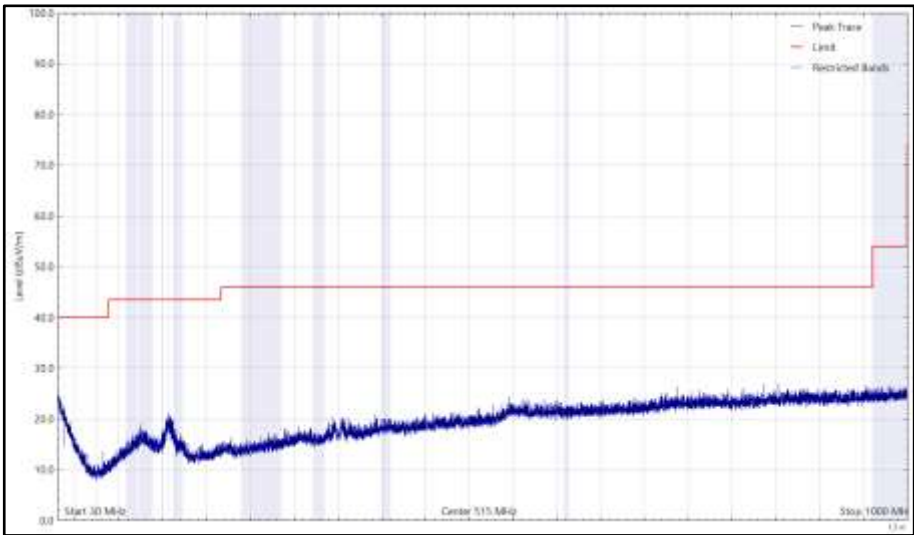


Figure 223 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)

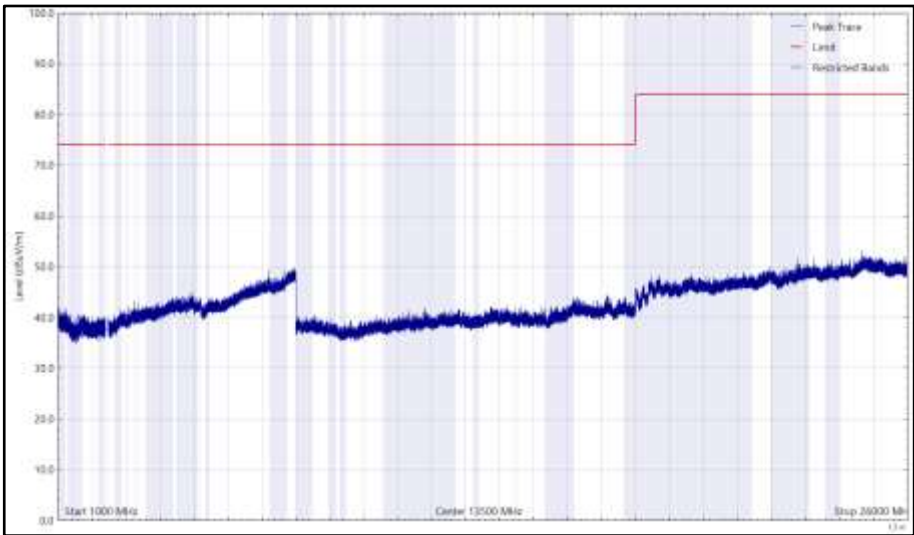


Figure 224 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

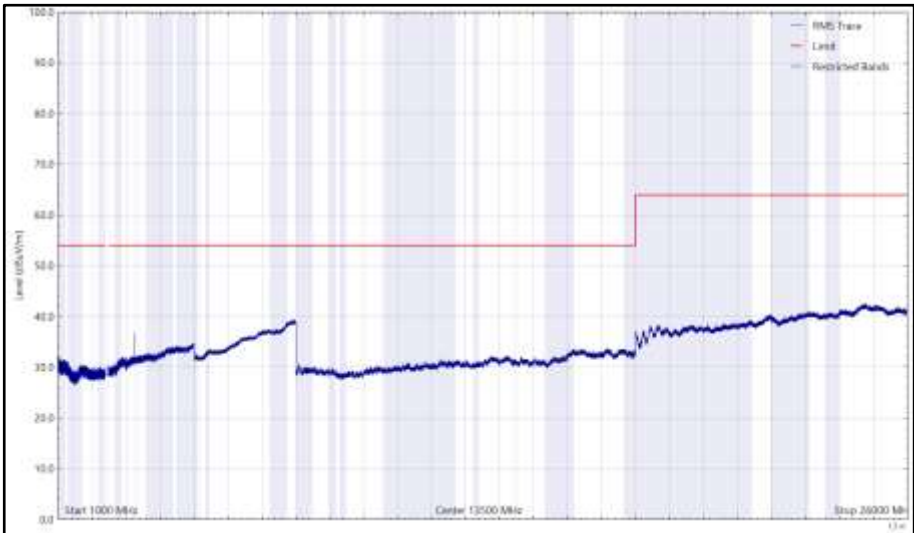


Figure 225 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

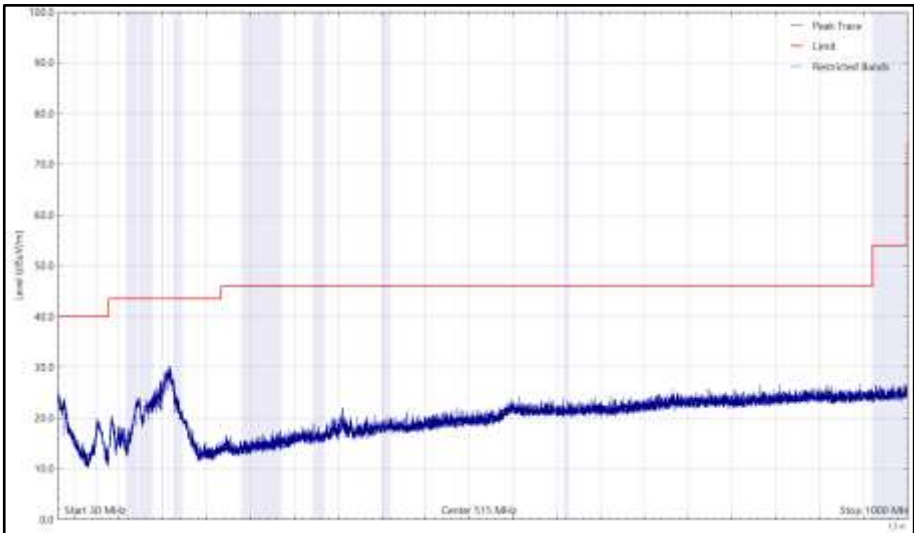


Figure 226 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

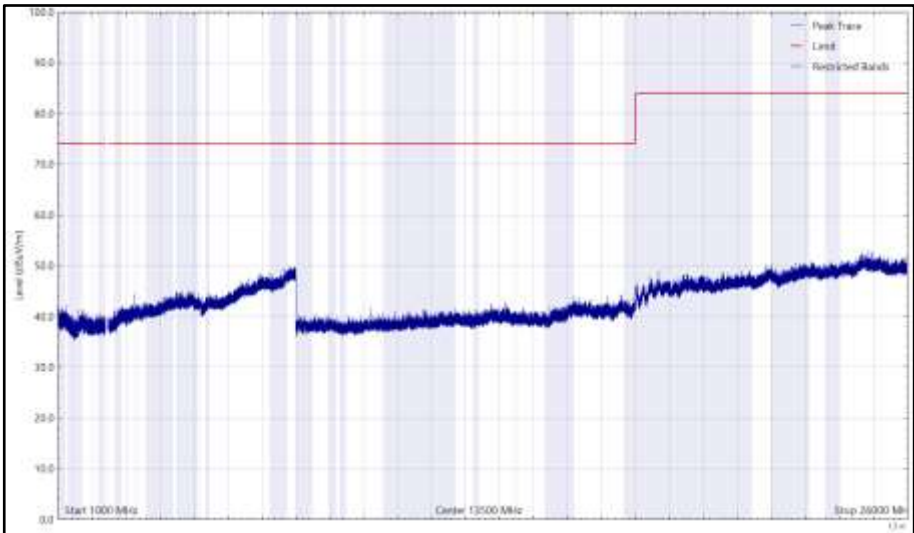


Figure 227 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

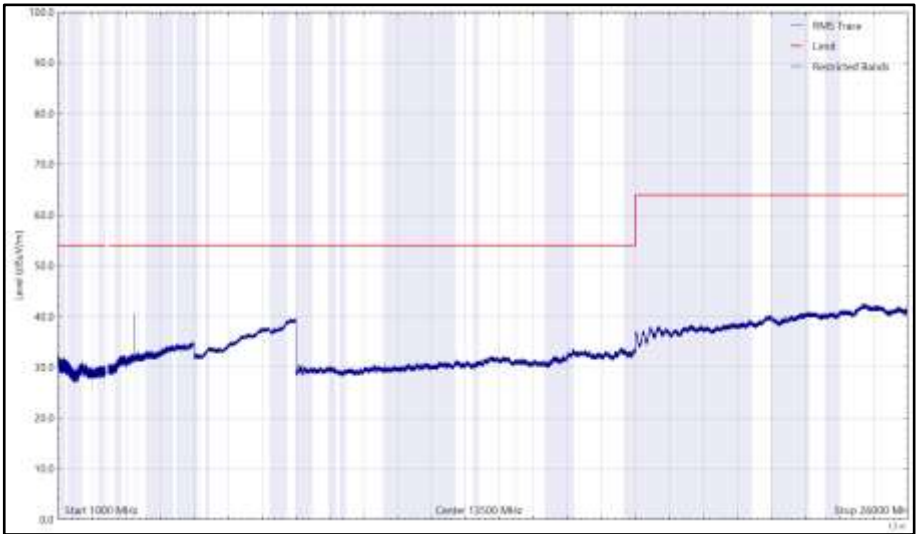


Figure 228 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)



| 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.

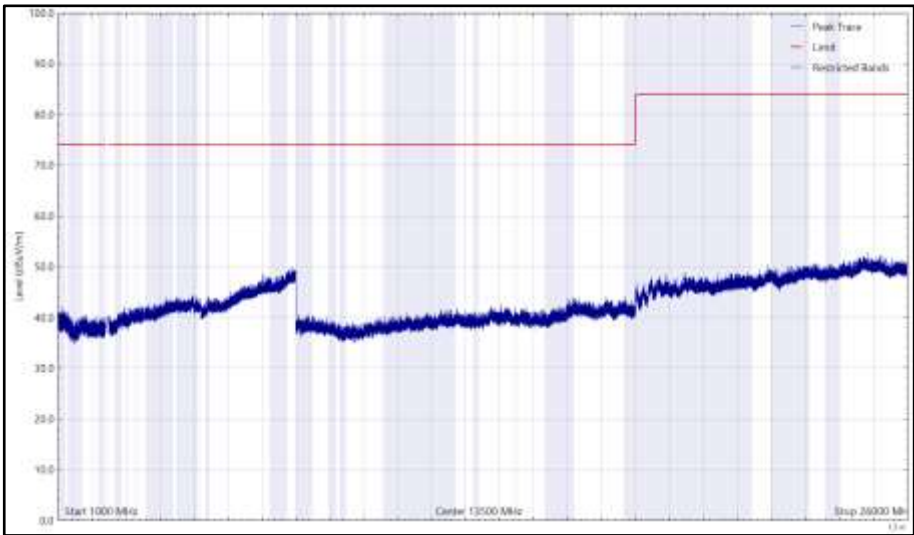


Figure 229 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Peak)

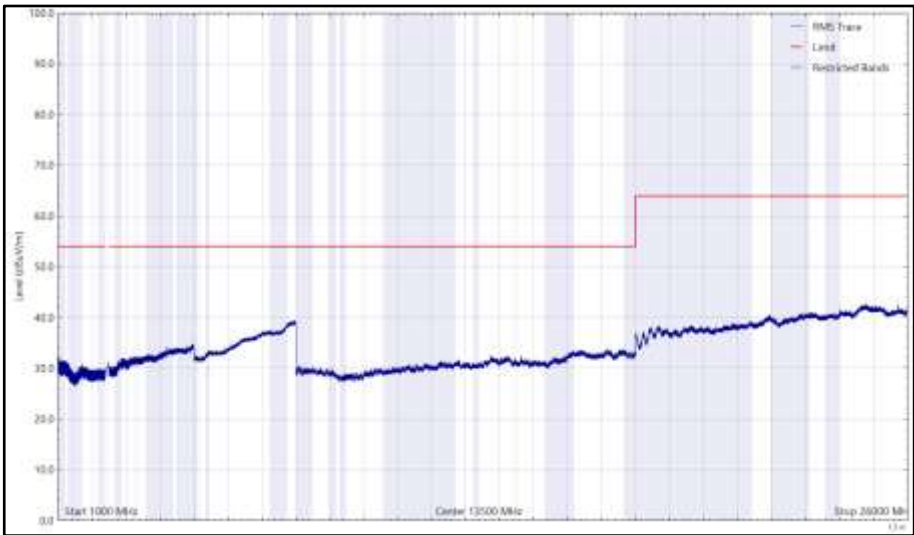


Figure 230 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal (Average)

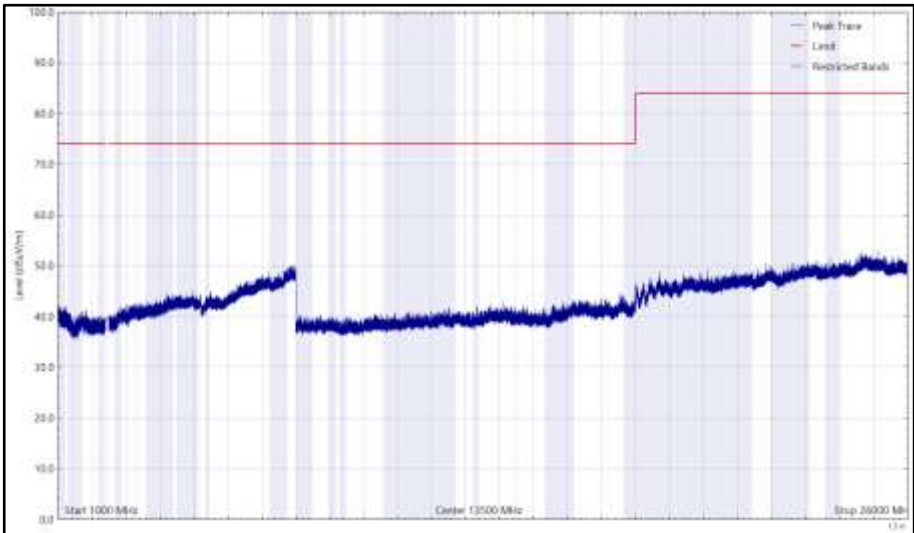


Figure 231 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Peak)

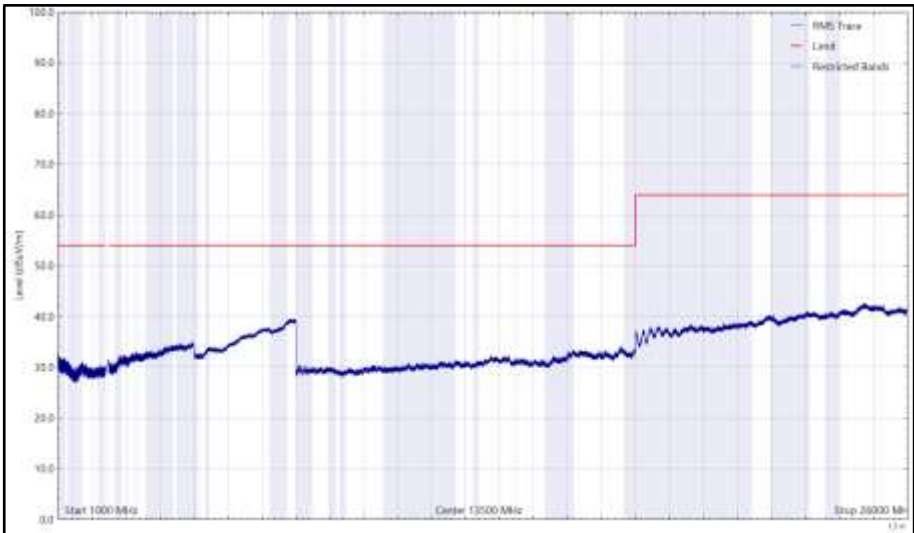


Figure 232 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical (Average)



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: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Restricted Band Edges                                  | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Spurious Radiated Emissions                            | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Maximum Conducted Output Power                         | $\pm 3.2$ dB                                                   |
| Frequency Hopping Systems - Average Time of Occupancy  | -                                                              |
| Frequency Hopping Systems - Channel Separation         | $\pm 20.508$ kHz                                               |
| Frequency Hopping Systems - 20 dB Bandwidth            | $\pm 23.512$ 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.