

# C and ISED Test Report

Apple Inc

Model: A2442

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: BCGA2442

IC: 579C-A2442

**COMMERCIAL-IN-CONFIDENCE**

Document 75952057-09 Issue 01

Stephen  
Marshall

Digitally signed by  
Stephen Marshall  
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## SIGNATURE

| NAME       | JOB TITLE       | RESPONSIBLE FOR      | ISSUE DATE        |
|------------|-----------------|----------------------|-------------------|
| S Marshall | Senior Engineer | Authorised Signatory | 22 September 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         | 22 September 2021 |           |
| Testing         | George Porter          | 22 September 2021 |           |
| Testing         | Liang Tian             | 22 September 2021 |           |
| Testing         | Taha Shafique          | 22 September 2021 |           |
| Testing         | Jaiyanth Balendrarahaj | 22 September 2021 |           |
| Testing         | Ahmad Javid            | 22 September 2021 |           |
| Testing         | Jason Hicks            | 22 September 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: 2020, ISED RSS-247: Issue 2 (02-2017) and ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) for the tests detailed in section 1.3.



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## 1 Report Summary

### 1.1 Report Modification Record

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

| Issue | Description of Change | Date of Issue     |
|-------|-----------------------|-------------------|
| 1     | First Issue           | 22-September-2021 |

**Table 1**

### 1.2 Introduction

|                               |                                                                                                               |
|-------------------------------|---------------------------------------------------------------------------------------------------------------|
| Applicant                     | Apple Inc                                                                                                     |
| Manufacturer                  | Apple Inc                                                                                                     |
| Model Number(s)               | A2442                                                                                                         |
| Serial Number(s)              | DNQHW6Y3WY and XH2DGXFKY6                                                                                     |
| Hardware Version(s)           | REV1.0                                                                                                        |
| Software Version(s)           | DNQHW6Y3WY: 21A102280p<br>XH2DGXFKY6: 21A102281b                                                              |
| Number of Samples Tested      | 2                                                                                                             |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C:2020<br>ISED RSS-247: Issue 2 (02-2017)<br>ISED RSS-GEN: Issue 5 (04-2018) + A2 (02-2021) |
| Order Number                  | 0540218229                                                                                                    |
| Date                          | 22-April-2021                                                                                                 |
| Date of Receipt of EUT        | 31-March-2021 and 16-July-2021                                                                                |
| Start of Test                 | 29-June-2021                                                                                                  |
| Finish of Test                | 08-September-2021                                                                                             |
| Name of Engineer(s)           | Mohammad Malik, George Porter, Liang Tian, Taha Shafique, Jaiyanth Balendrarajah, Ahmad Javid and Jason Hicks |
| Related Document(s)           | ANSI C63.4 (2014)<br>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 device complies with the provisions of this section, as it uses permanently attached integral antennas. |
| 2.1                                              | 15.205                | -           | 8.10         | Restricted Band Edges                                  | Pass   |                                                                                                             |
| 2.2                                              | 15.247 (a)(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         | -            | Frequency Hopping Systems - Number of Hopping Channels | Pass   |                                                                                                             |
| 2.5                                              | 15.247 (a)(1)         | 5.1         | 6.7          | Frequency Hopping Systems - 20 dB Bandwidth            | Pass   |                                                                                                             |
| 2.6                                              | 15.247 (b)            | 5.4         | 6.12         | Maximum Conducted Output Power                         | Pass   |                                                                                                             |
| 2.7                                              | 15.247 (d) and 15.209 | 3.3 and 5.5 | 6.13 and 8.9 | Spurious Radiated Emissions                            | Pass   |                                                                                                             |
| 2.8                                              | 15.247 (d)            | 5.5         | -            | Authorised Band Edges                                  | Pass   |                                                                                                             |

**Table 2**



## 1.4 Product Information

### 1.4.1 Technical Description

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

### 1.4.2 Test Setup

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

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

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

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

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

| Antenna Port               | Frequency Range (MHz) | Peak Gain (dBi) | Conducted Cable Loss (dB) |
|----------------------------|-----------------------|-----------------|---------------------------|
| BT Dedicated Core (Core 2) | 2400 to 2480          | 6.10            | 1.00                      |
| BT Core 0                  | 2400 to 2480          | 7.60            | 1.00                      |
| BT Core 1                  | 2400 to 2480          | 6.70            | 1.00                      |

**Table 3**

## 1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.



## 1.6 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State                      | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|-----------------------------------------|-------------------------------------------------|------------------------|--------------------------|
| Model: A2442, Serial Number: DNQHW6Y3WY |                                                 |                        |                          |
| 0                                       | As supplied by the customer                     | Not Applicable         | Not Applicable           |
| Model: A2442, Serial Number: XH2DGXFKY6 |                                                 |                        |                          |
| 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       |                                                                       |               |
| Restricted Band Edges                                  | Mohammad Malik, Taha Shafique, Jaiyanth Balendrarajah and Ahmad Javid | UKAS          |
| Frequency Hopping Systems - Average Time of Occupancy  | George Porter                                                         | UKAS          |
| Frequency Hopping Systems - Channel Separation         | George Porter and Jason Hicks                                         | UKAS          |
| Frequency Hopping Systems - Number of Hopping Channels | George Porter                                                         | UKAS          |
| Frequency Hopping Systems - 20 dB Bandwidth            | George Porter and Jason Hicks                                         | UKAS          |
| Maximum Conducted Output Power                         | George Porter and Jason Hicks                                         | UKAS          |
| Spurious Radiated Emissions                            | Liang Tian                                                            | UKAS          |
| Authorised Band Edges                                  | Mohammad Malik, Taha Shafique, Jaiyanth Balendrarajah and Ahmad Javid | UKAS          |

**Table 5**

Office Address:

TÜV SÜD  
Octagon House  
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Hampshire  
PO15 5RL  
United Kingdom



## 2 Test Details

### 2.1 Restricted Band Edges

#### 2.1.1 Specification Reference

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

#### 2.1.2 Equipment Under Test and Modification State

A2442, S/N: DNQHW6Y3WY - Modification State 0

#### 2.1.3 Date of Test

29-June-2021 to 08-July-2021

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

#### 2.1.5 Environmental Conditions

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 19.6 - 23.6 °C |
| Relative Humidity   | 44.1 - 58.0 %  |

## 2.1.6 Test Results

### 2.4 GHz Bluetooth (FHSS)

iPA

| Mode   | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBμV/m) | Average Level (dBμV/m) |
|--------|---------------|------|-------------|--------------------|---------------------------|---------------------|------------------------|
| Static | GFSK          | 0    | DH5         | 2402               | 2390.0                    | 54.06               | 40.16                  |
| Static | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2390.0                    | 54.61               | 39.87                  |
| Static | 8-DPSK        | 0    | 3DH5        | 2402               | 2390.0                    | 54.61               | 39.87                  |
| Static | GFSK          | 0    | DH5         | 2480               | 2483.5                    | 55.15               | 41.95                  |
| Static | $\pi/4$ DQPSK | 0    | 2DH5        | 2480               | 2483.5                    | 55.73               | 42.24                  |
| Static | 8-DPSK        | 0    | 3DH5        | 2480               | 2483.5                    | 54.61               | 42.38                  |

Table 6 - Restricted Band Edge Results

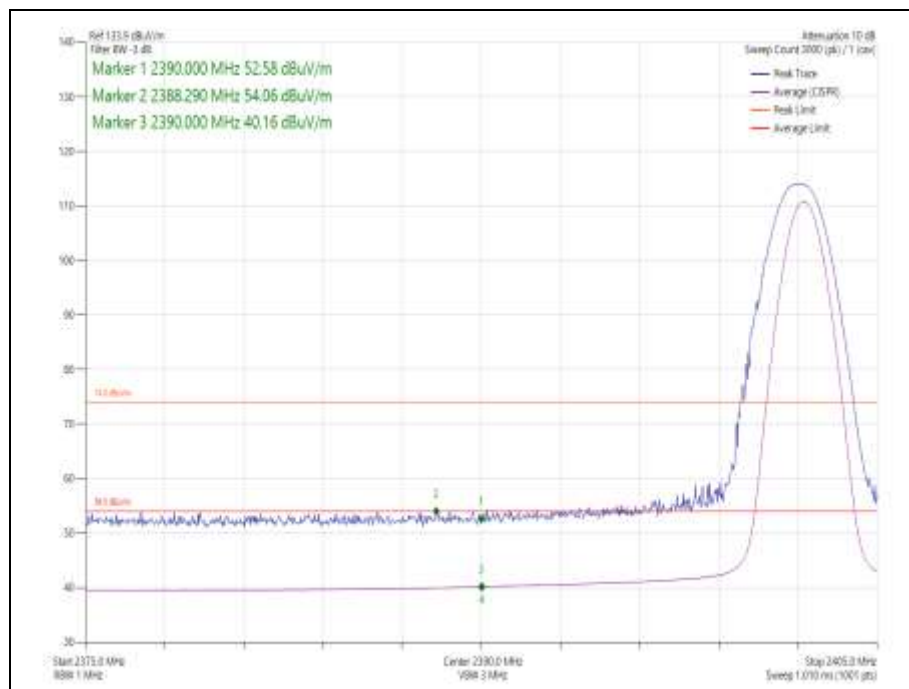


Figure 1 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

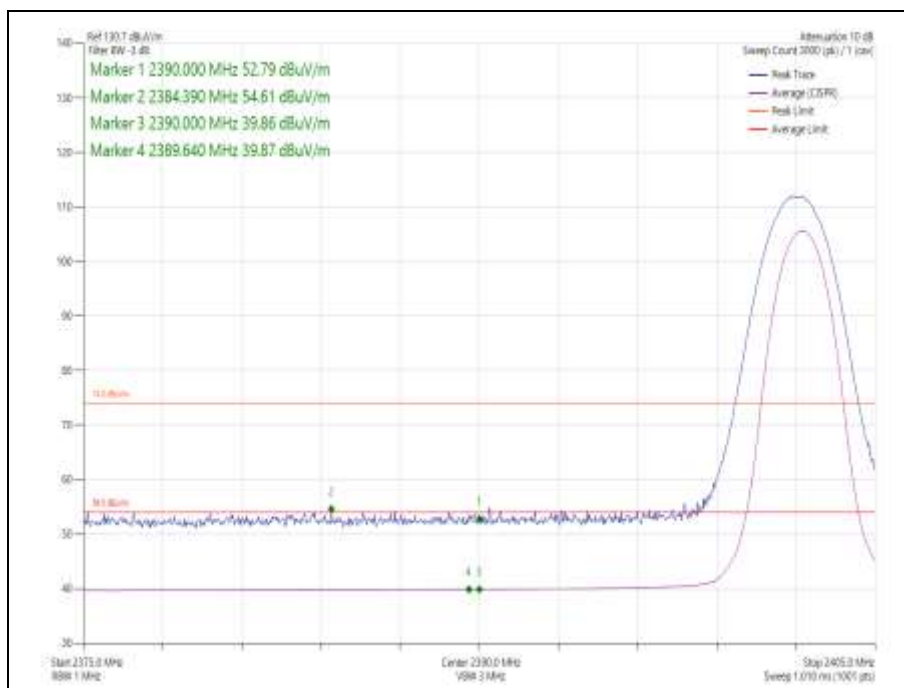


Figure 2 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

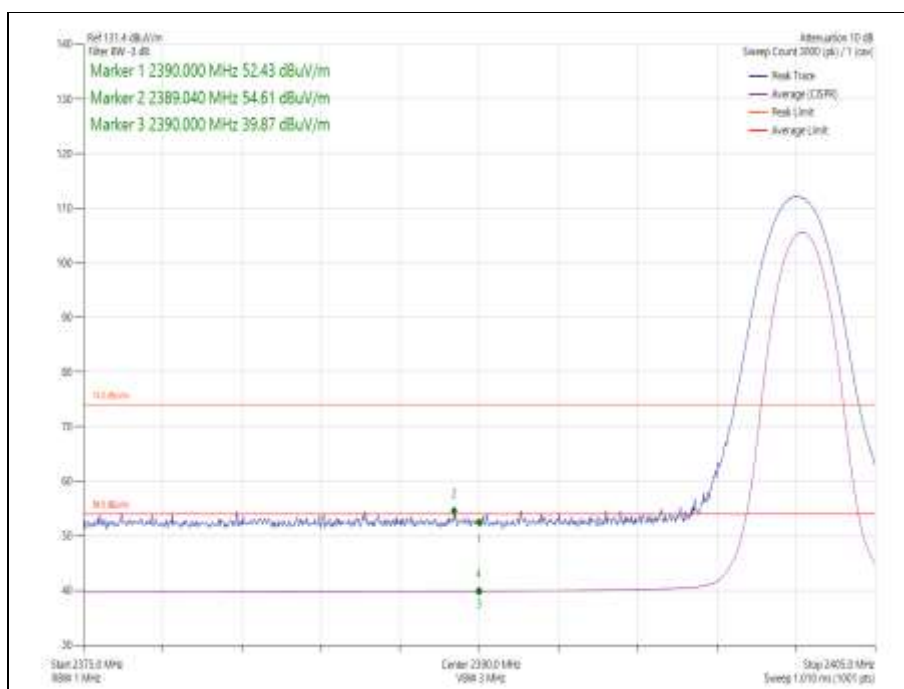


Figure 3 - Static - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

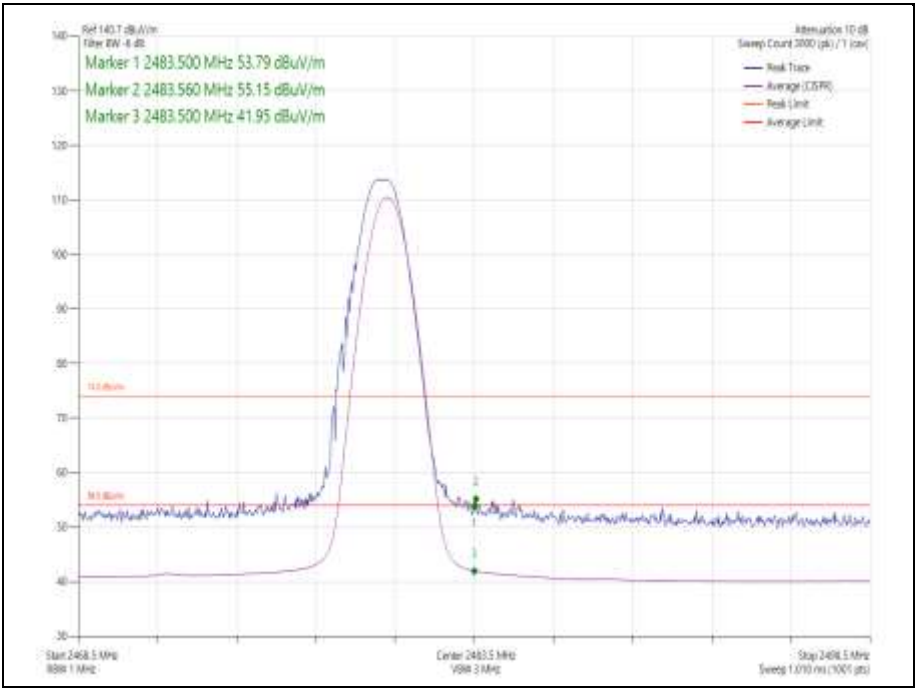


Figure 4 - Static - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

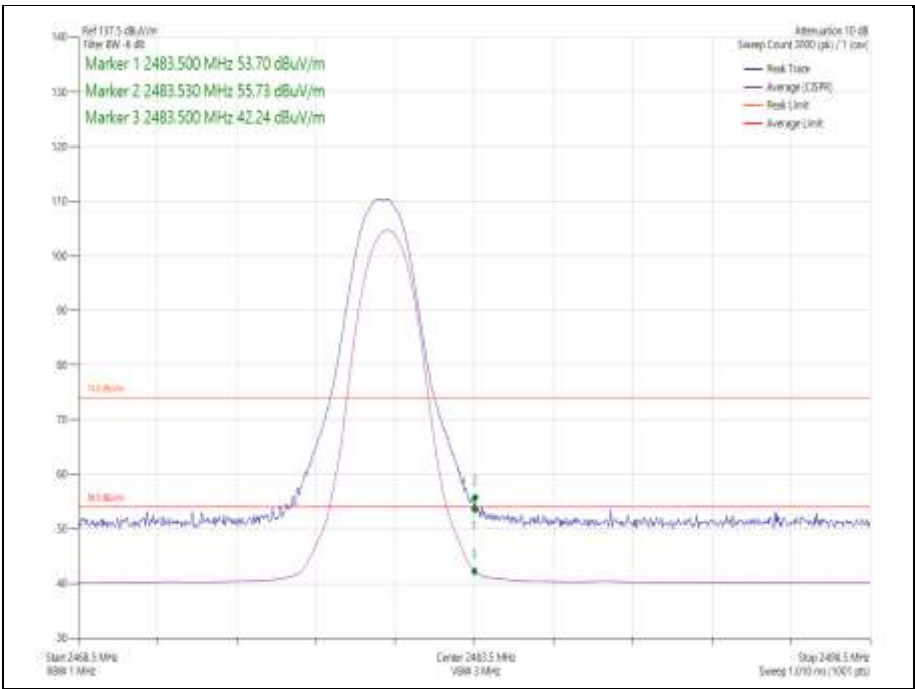


Figure 5 - Static -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

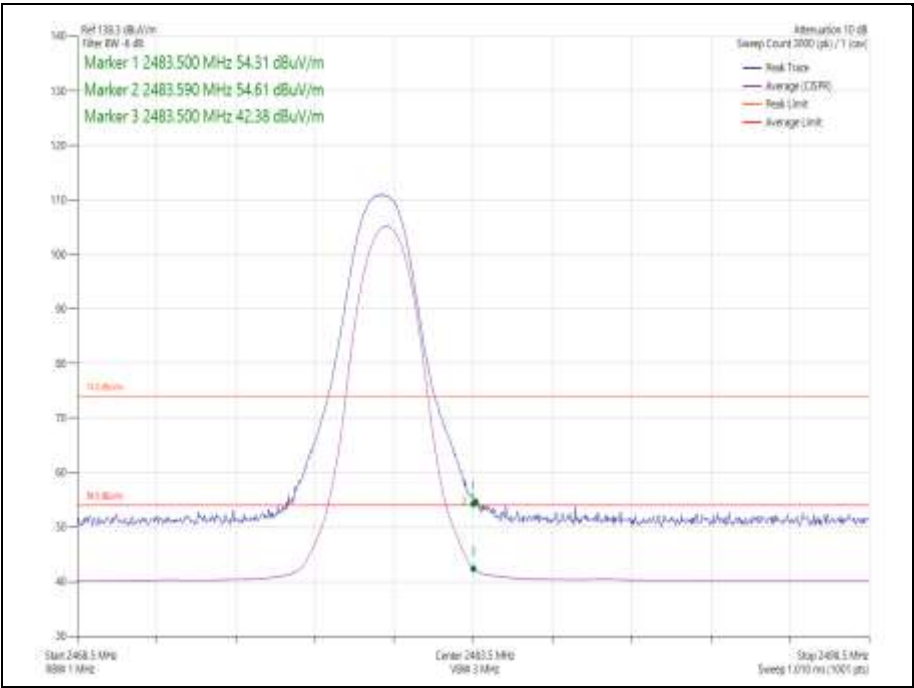


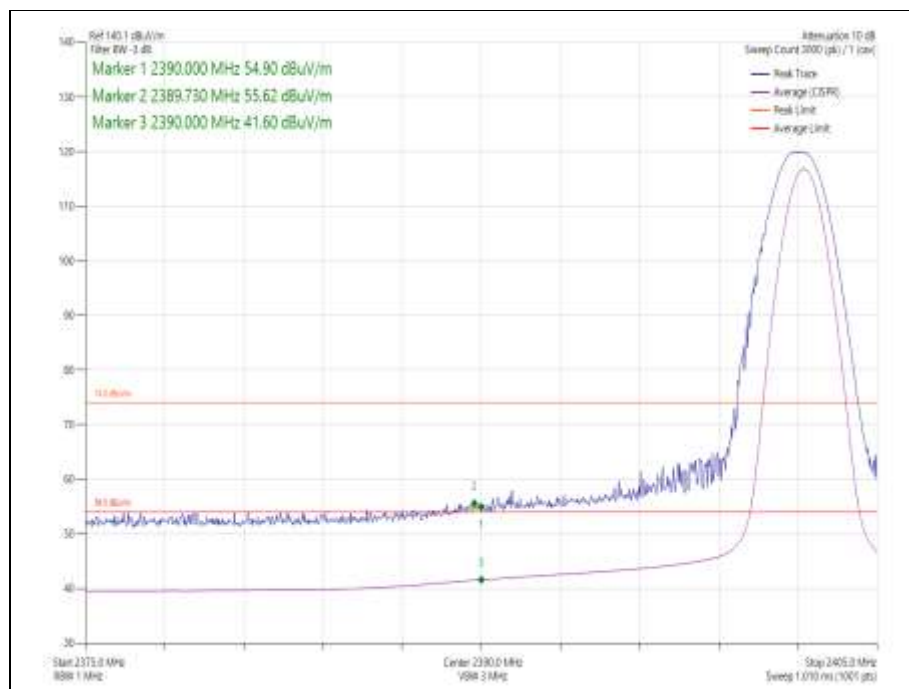
Figure 6 - Static - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

## 2.4 GHz Bluetooth (FHSS)

### ePA

| Mode   | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBμV/m) | Average Level (dBμV/m) |
|--------|---------------|------|-------------|--------------------|---------------------------|---------------------|------------------------|
| Static | GFSK          | 0    | DH5         | 2402               | 2390.0                    | 55.62               | 41.60                  |
| Static | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2390.0                    | 55.52               | 40.91                  |
| Static | 8-DPSK        | 0    | 3DH5        | 2402               | 2390.0                    | 56.53               | 40.91                  |
| Static | GFSK          | 0    | DH5         | 2480               | 2483.5                    | 60.43               | 44.92                  |
| Static | $\pi/4$ DQPSK | 0    | 2DH5        | 2480               | 2483.5                    | 58.37               | 44.24                  |
| Static | 8-DPSK        | 0    | 3DH5        | 2480               | 2483.5                    | 59.90               | 44.15                  |

**Table 7 - Restricted Band Edge Results**



**Figure 7 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz**

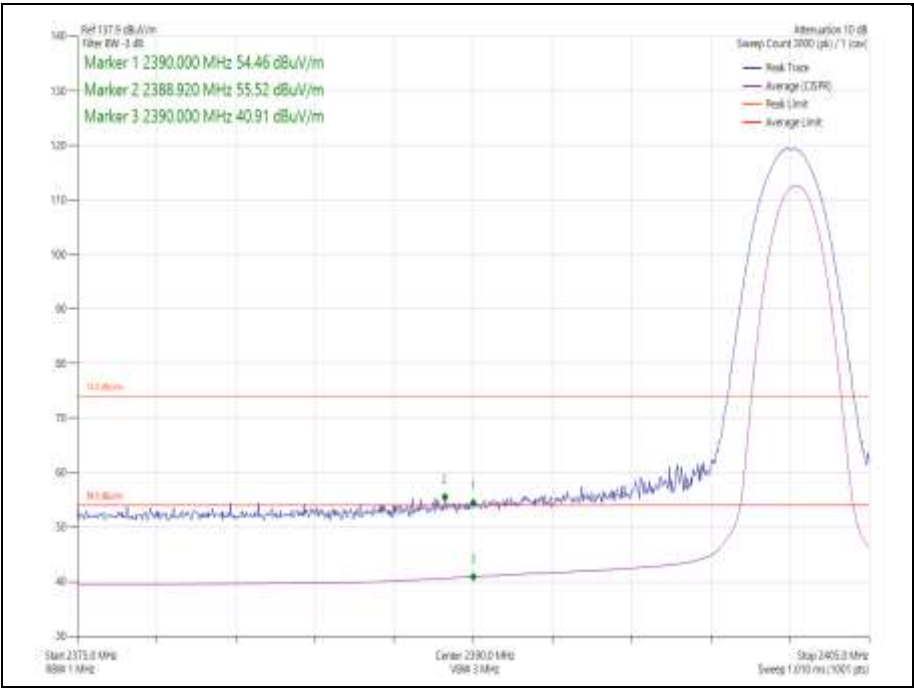


Figure 8 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

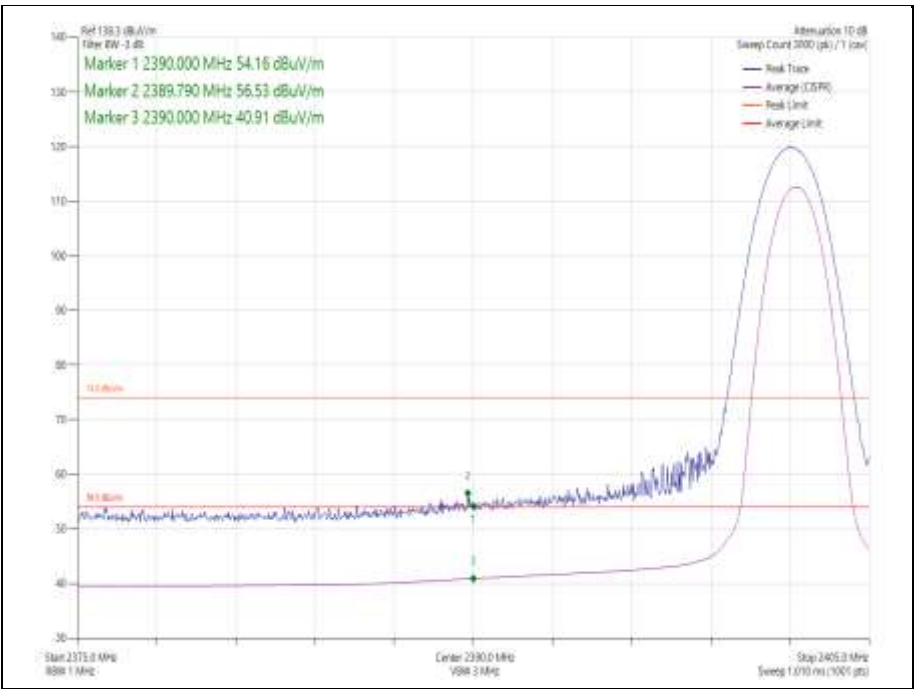


Figure 9 - Static - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

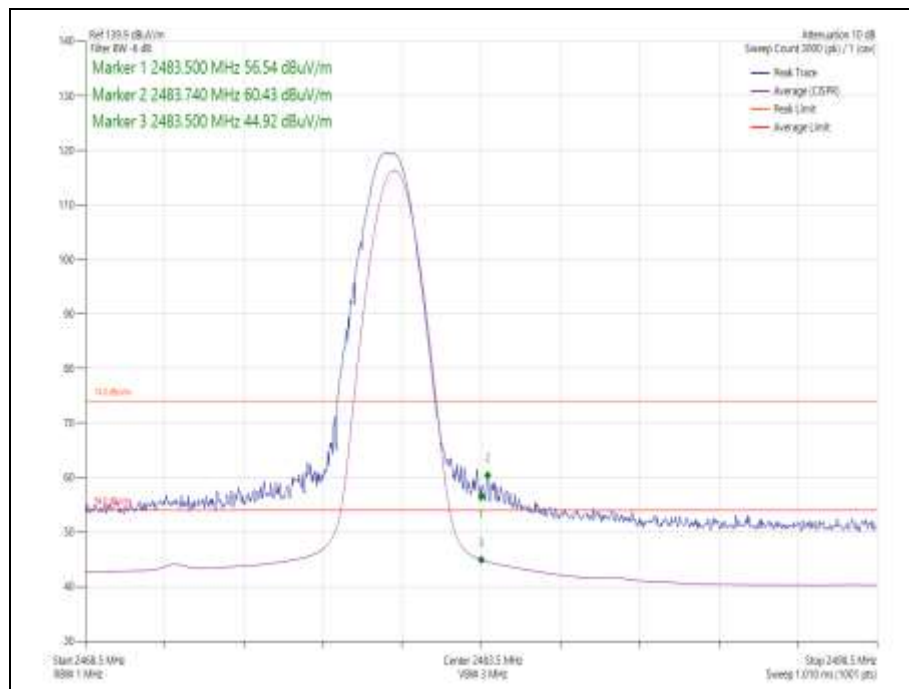


Figure 10 - Static - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

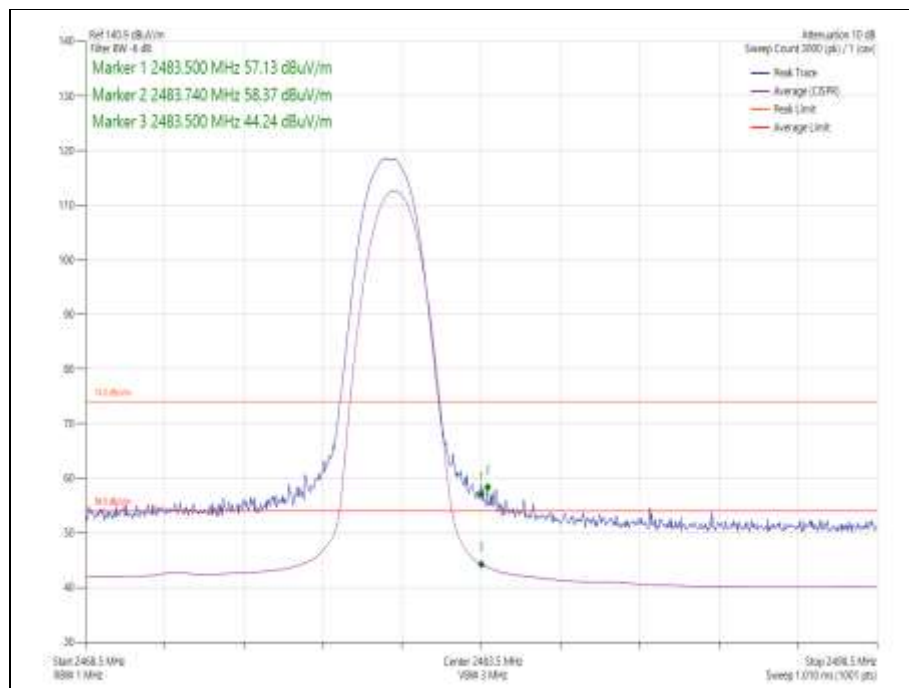


Figure 11 - Static -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

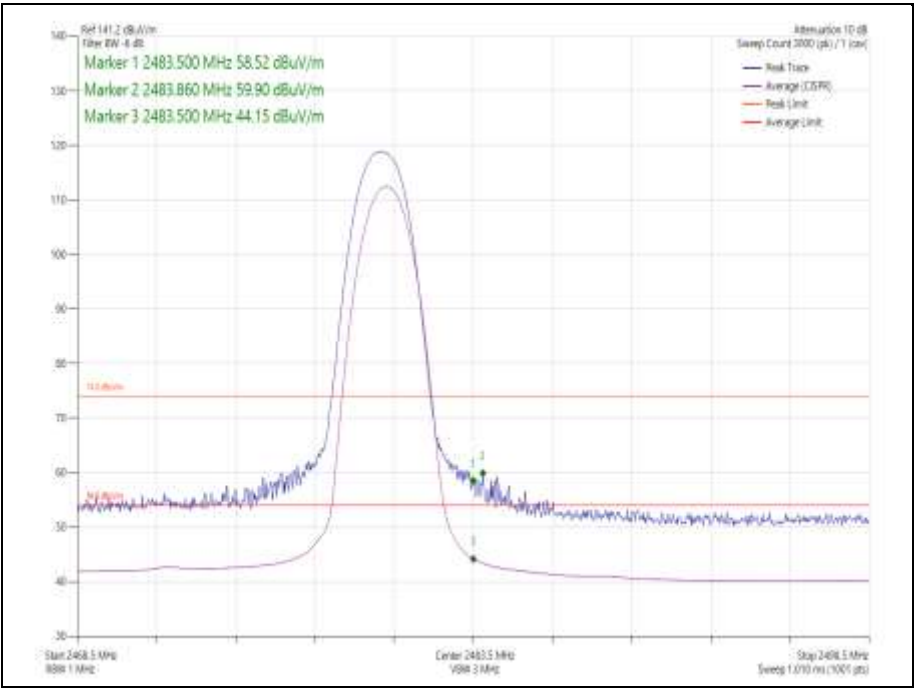


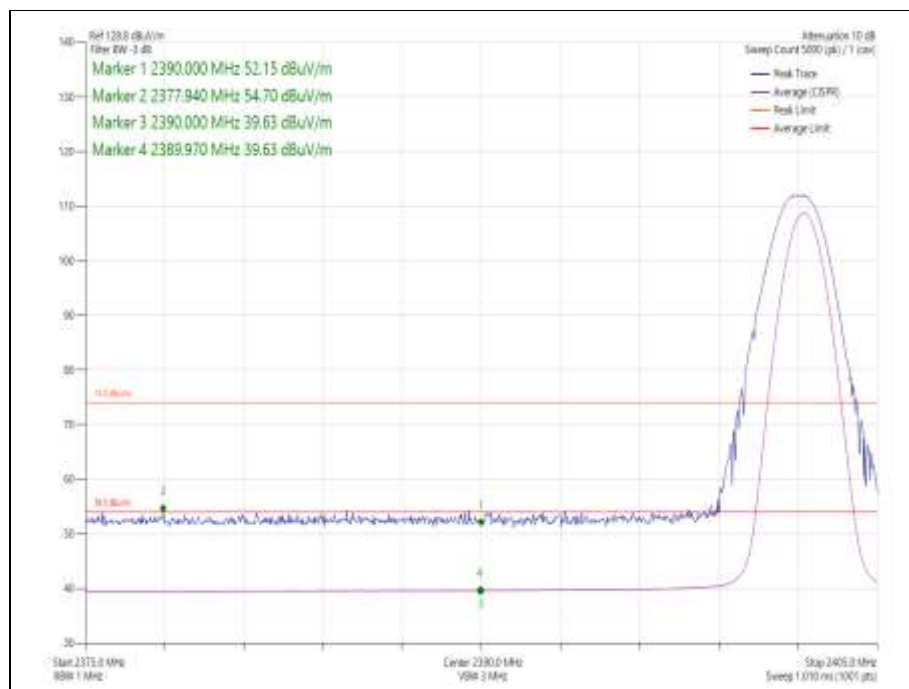
Figure 12 - Static - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

## 2.4 GHz Bluetooth (FHSS)

### iPA

| Mode   | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBμV/m) | Average Level (dBμV/m) |
|--------|---------------|------|-------------|--------------------|---------------------------|---------------------|------------------------|
| Static | GFSK          | 2    | DH5         | 2402               | 2390.0                    | 54.70               | 39.63                  |
| Static | $\pi/4$ DQPSK | 2    | 2DH5        | 2402               | 2390.0                    | 54.84               | 39.72                  |
| Static | 8-DPSK        | 2    | 3DH5        | 2402               | 2390.0                    | 54.10               | 39.75                  |
| Static | GFSK          | 2    | DH5         | 2480               | 2483.5                    | 53.46               | 40.97                  |
| Static | $\pi/4$ DQPSK | 2    | 2DH5        | 2480               | 2483.5                    | 53.80               | 41.29                  |
| Static | 8-DPSK        | 2    | 3DH5        | 2480               | 2483.5                    | 54.54               | 41.41                  |

**Table 8 - Restricted Band Edge Results**



**Figure 13 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz**

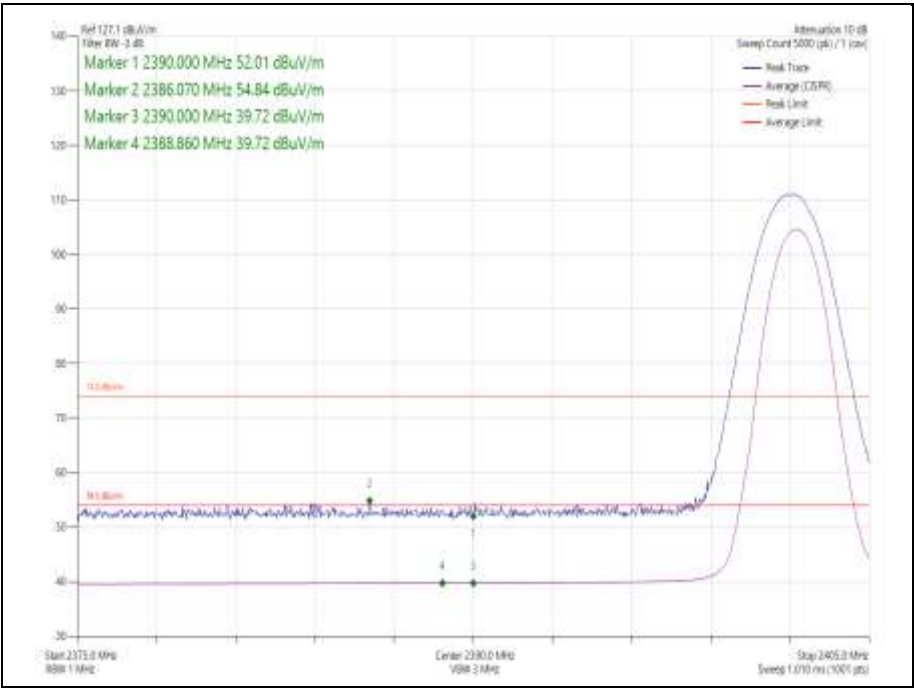


Figure 14 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

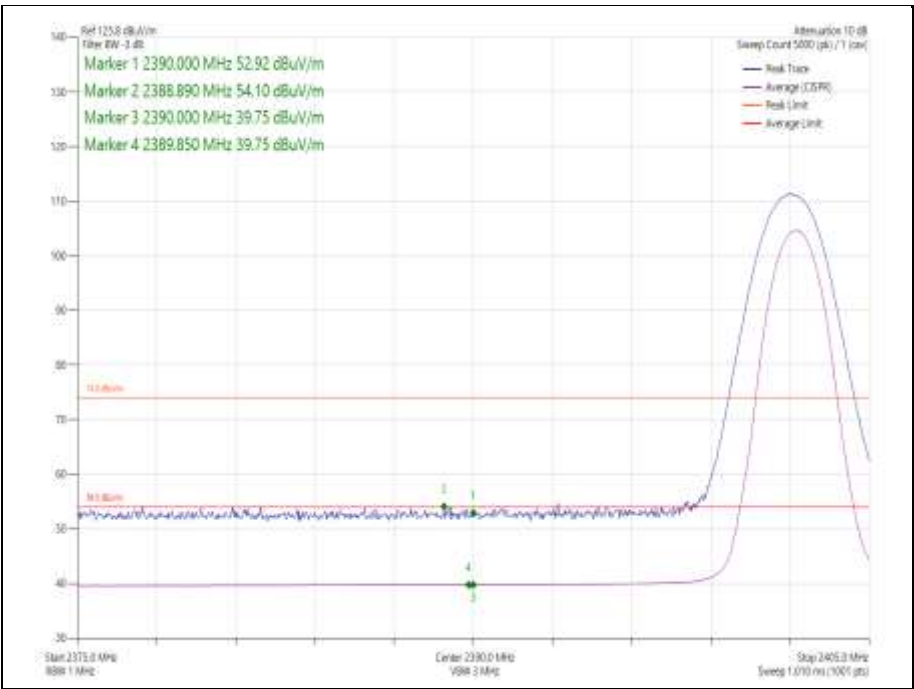


Figure 15 - Static - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

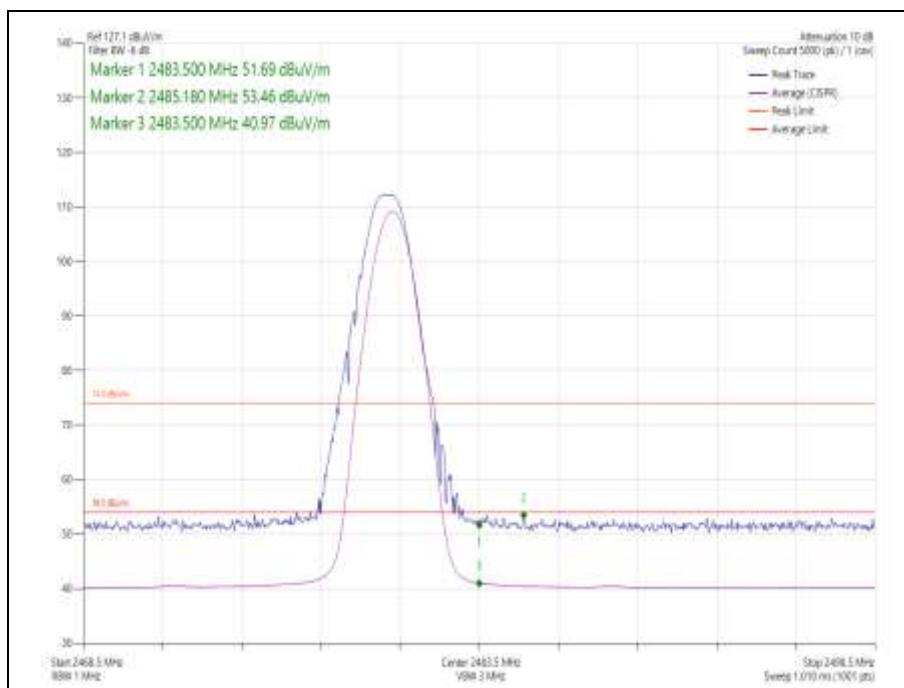


Figure 16 - Static - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

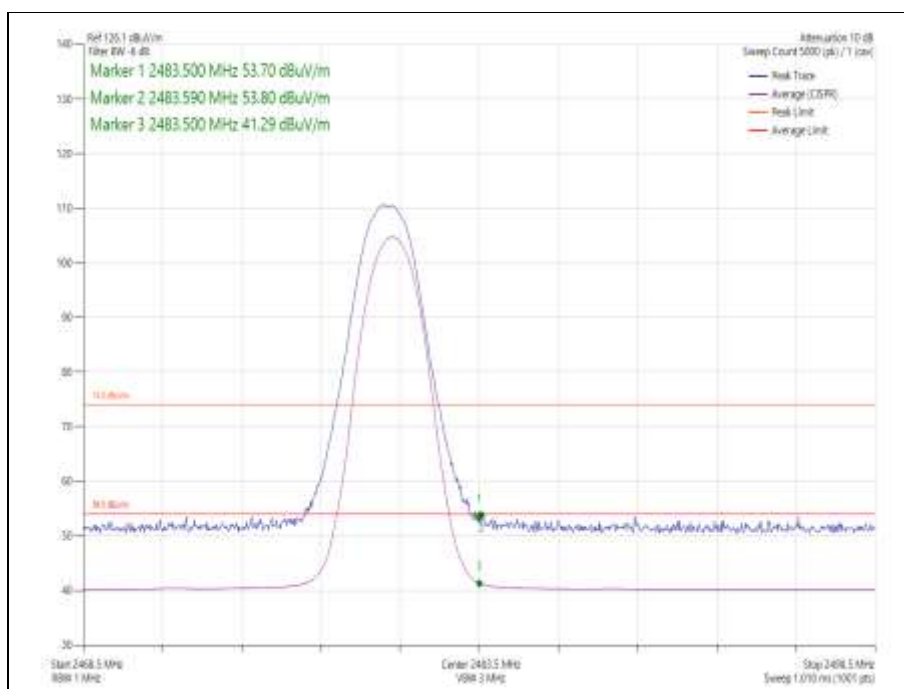


Figure 17 - Static -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

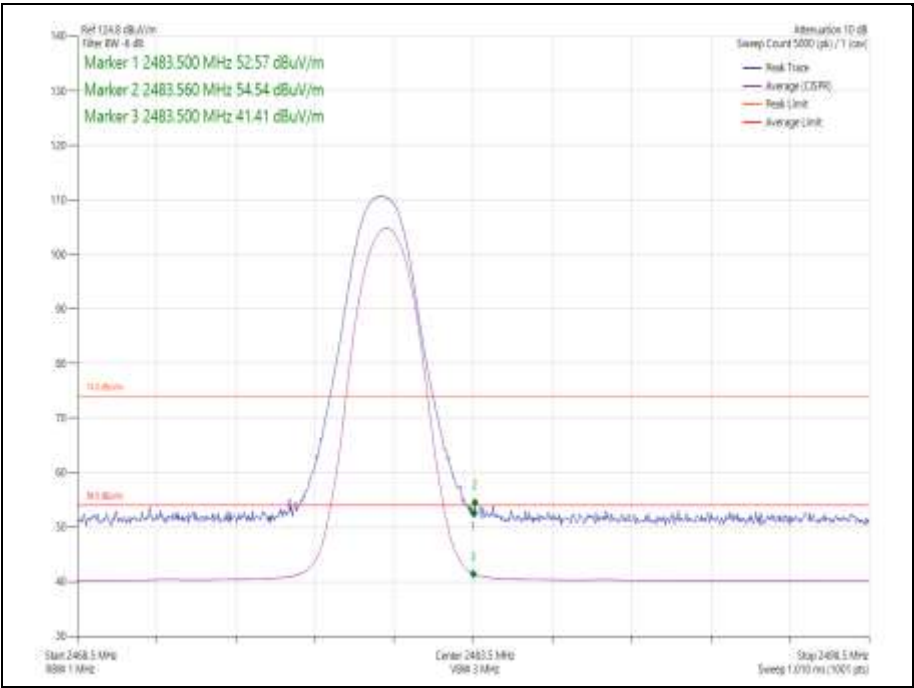


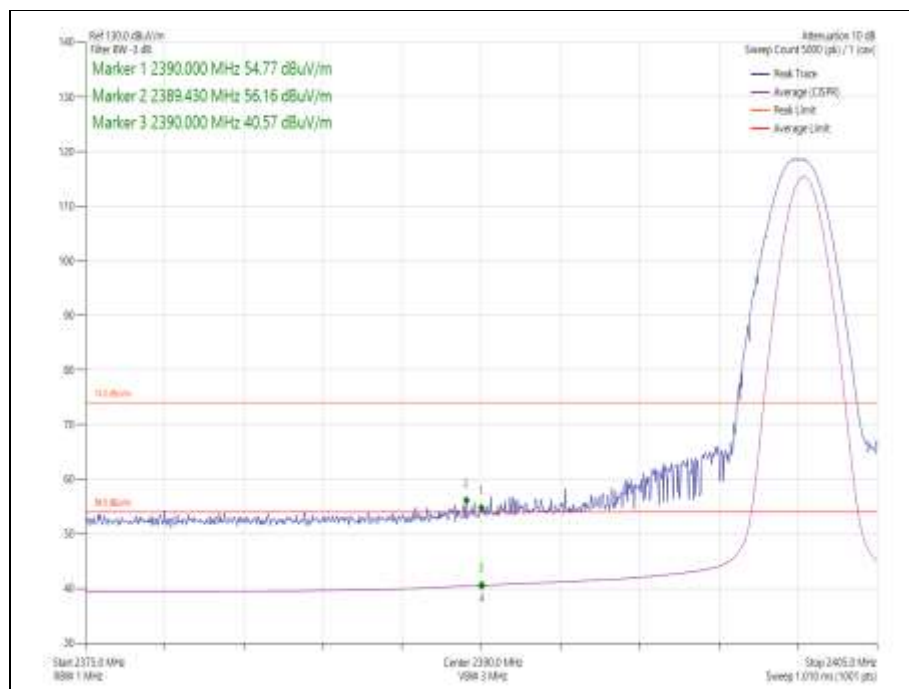
Figure 18 - Static - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

## 2.4 GHz Bluetooth (FHSS)

### iPA

| Mode   | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBμV/m) | Average Level (dBμV/m) |
|--------|---------------|------|-------------|--------------------|---------------------------|---------------------|------------------------|
| Static | GFSK          | 0-1  | DH5         | 2402               | 2390.0                    | 56.16               | 40.57                  |
| Static | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2390.0                    | 55.29               | 40.03                  |
| Static | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2390.0                    | 55.60               | 40.07                  |
| Static | GFSK          | 0-1  | DH5         | 2480               | 2483.5                    | 59.51               | 43.25                  |
| Static | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2480               | 2483.5                    | 59.82               | 43.25                  |
| Static | 8-DPSK        | 0-1  | 3DH5        | 2480               | 2483.5                    | 62.23               | 43.53                  |

**Table 9 - Restricted Band Edge Results**



**Figure 19 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz**



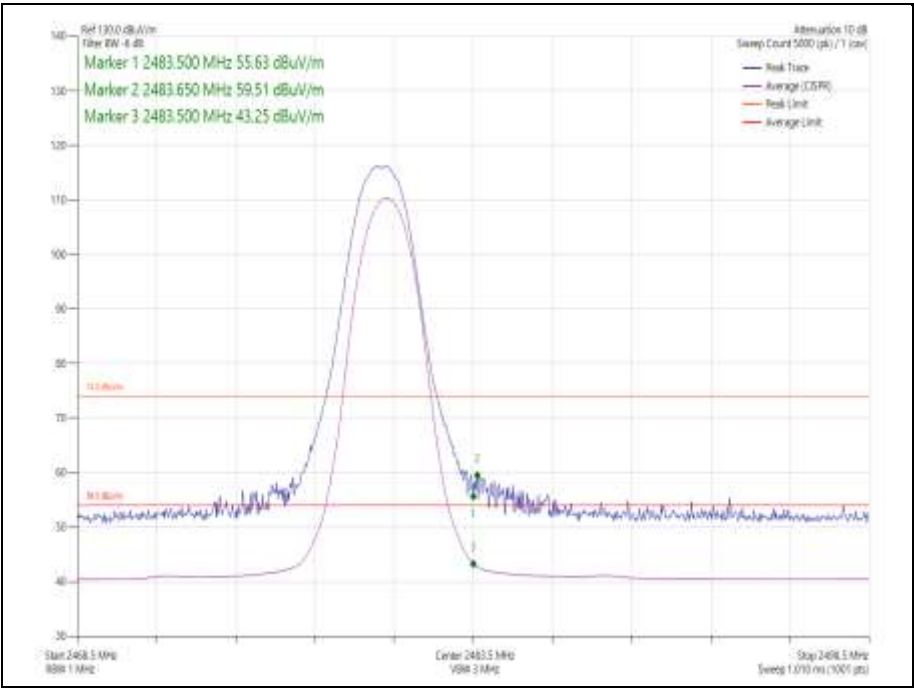


Figure 22 - Static - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

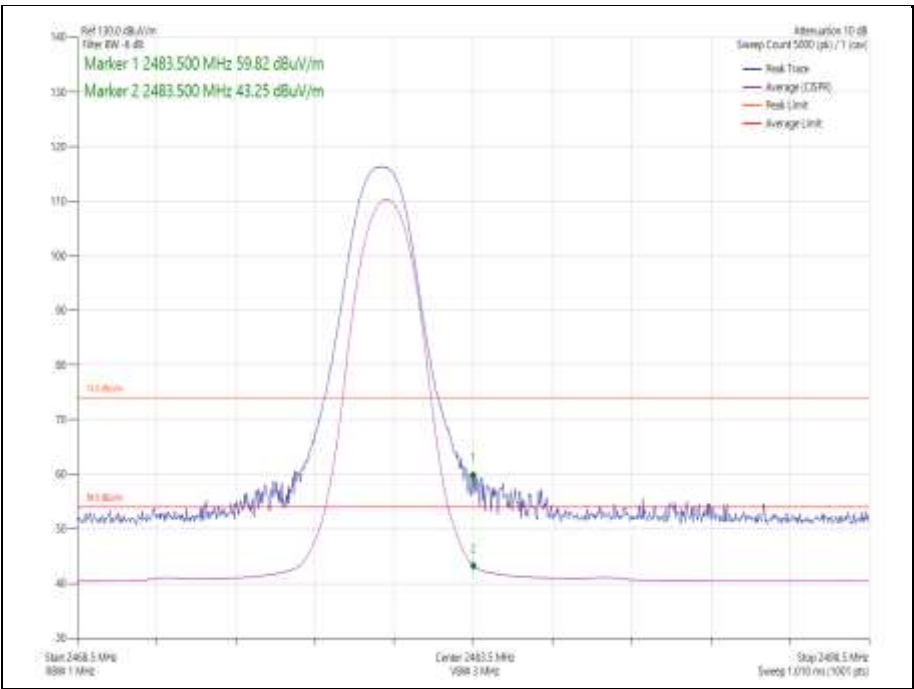


Figure 23 - Static -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

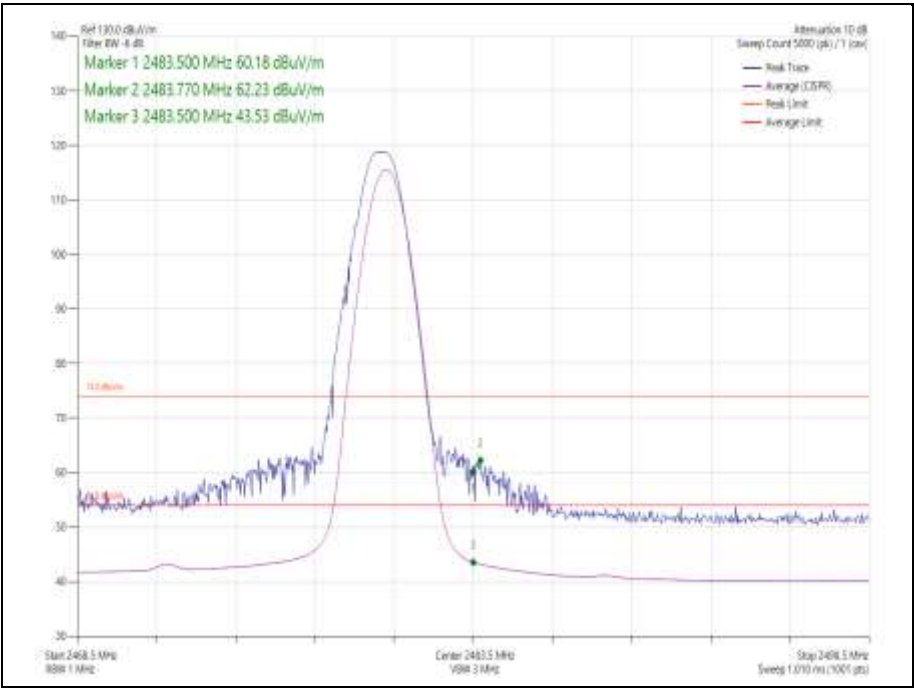


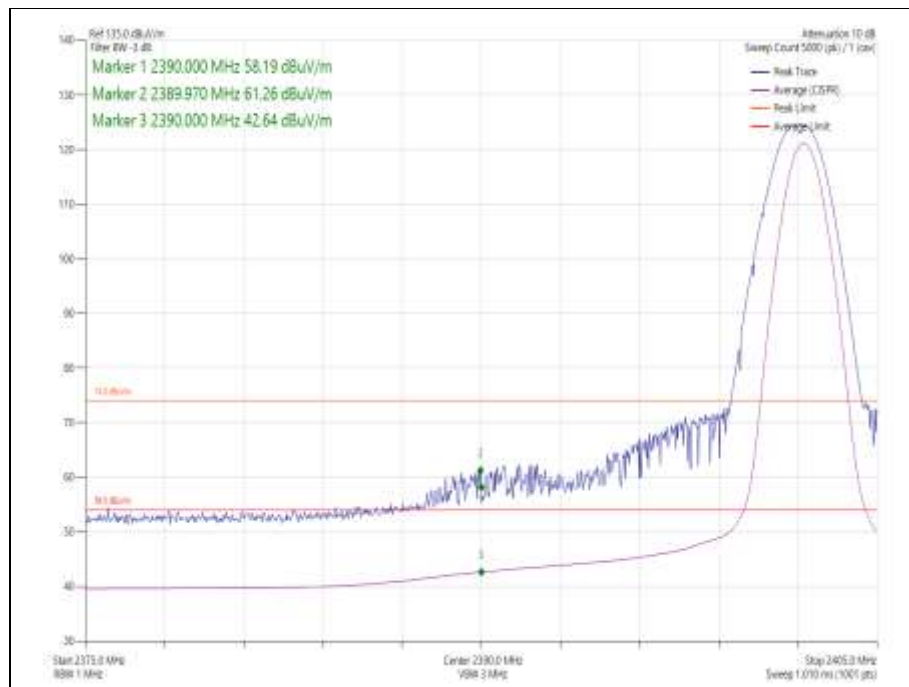
Figure 24 - Static - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

## 2.4 GHz Bluetooth (FHSS)

### ePA

| Mode   | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Peak Level (dBμV/m) | Average Level (dBμV/m) |
|--------|---------------|------|-------------|--------------------|---------------------------|---------------------|------------------------|
| Static | GFSK          | 0-1  | DH5         | 2402               | 2390.0                    | 61.26               | 42.64                  |
| Static | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2390.0                    | 60.10               | 41.95                  |
| Static | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2390.0                    | 61.62               | 41.84                  |
| Static | GFSK          | 0-1  | DH5         | 2480               | 2483.5                    | 67.17               | 47.44                  |
| Static | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2480               | 2483.5                    | 66.44               | 46.50                  |
| Static | 8-DPSK        | 0-1  | 3DH5        | 2480               | 2483.5                    | 67.05               | 46.58                  |

**Table 10 - Restricted Band Edge Results**



**Figure 25 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz**

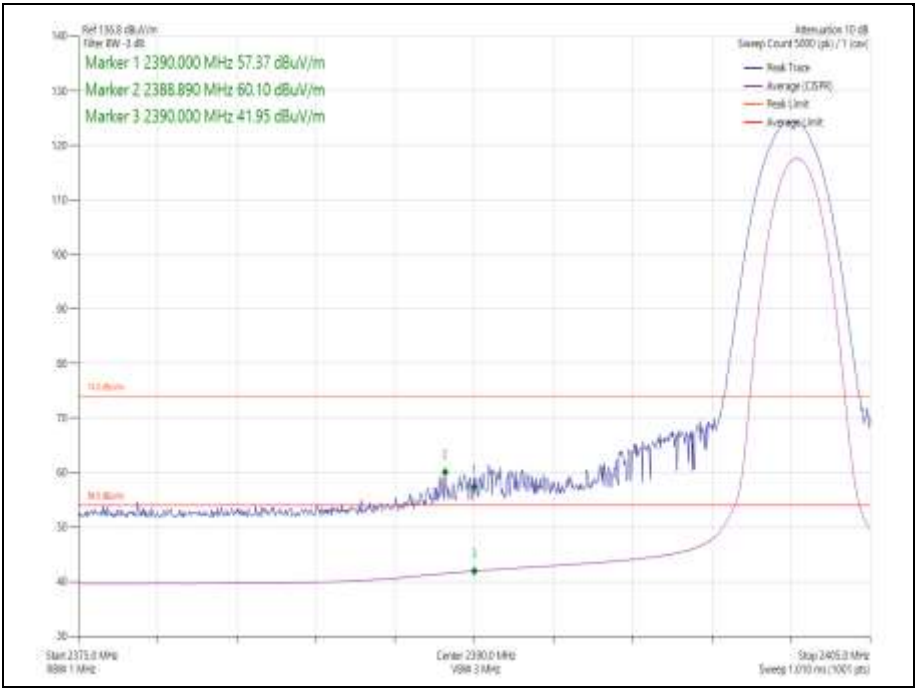


Figure 26 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2390.0 MHz

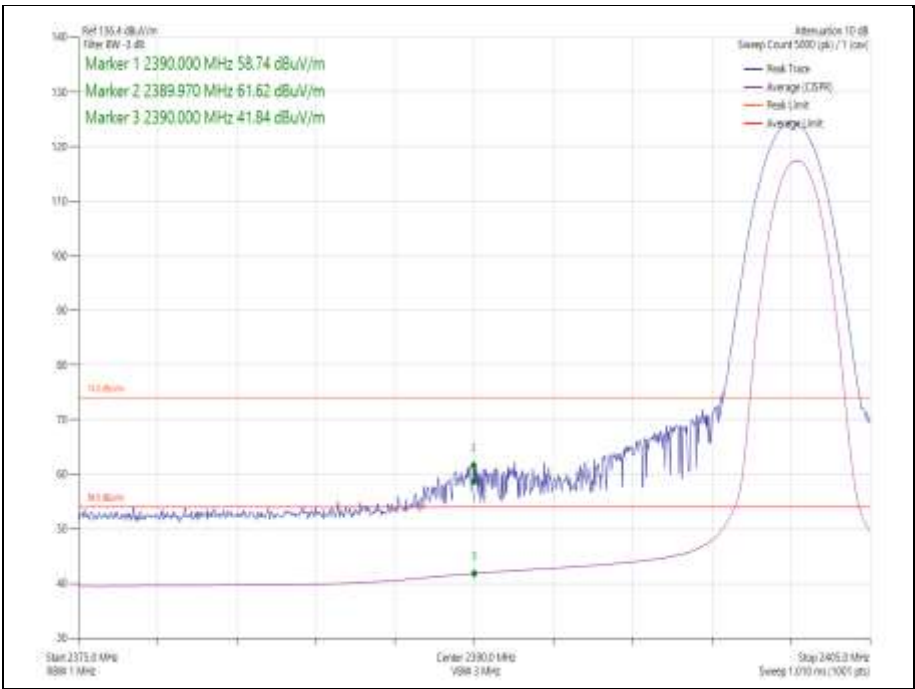


Figure 27 - Static - 8-DPSK/3DH5 - 2402 MHz Band Edge Frequency 2390.0 MHz

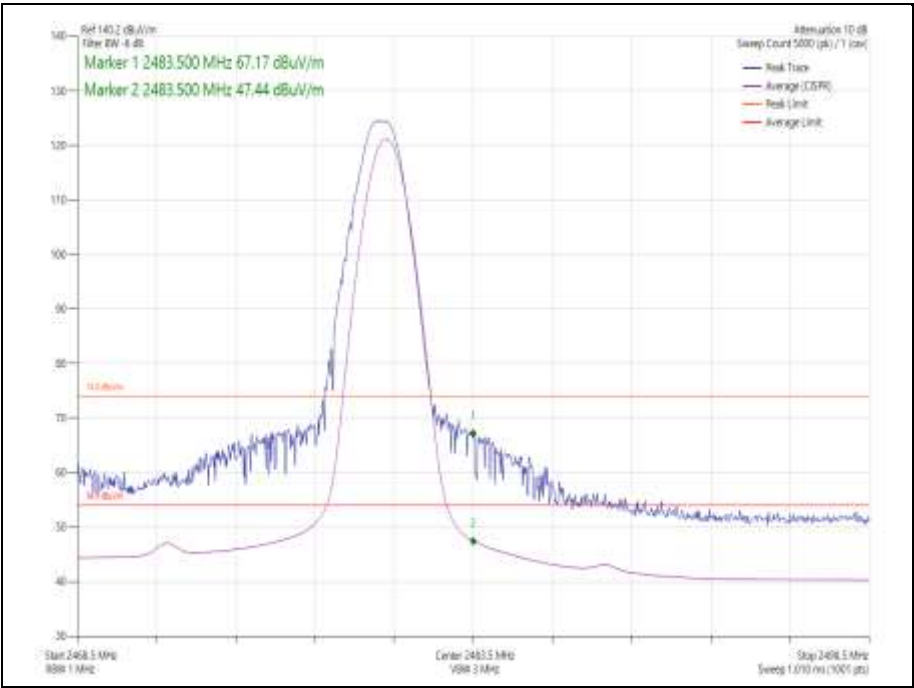


Figure 28 - Static - GFSK/DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

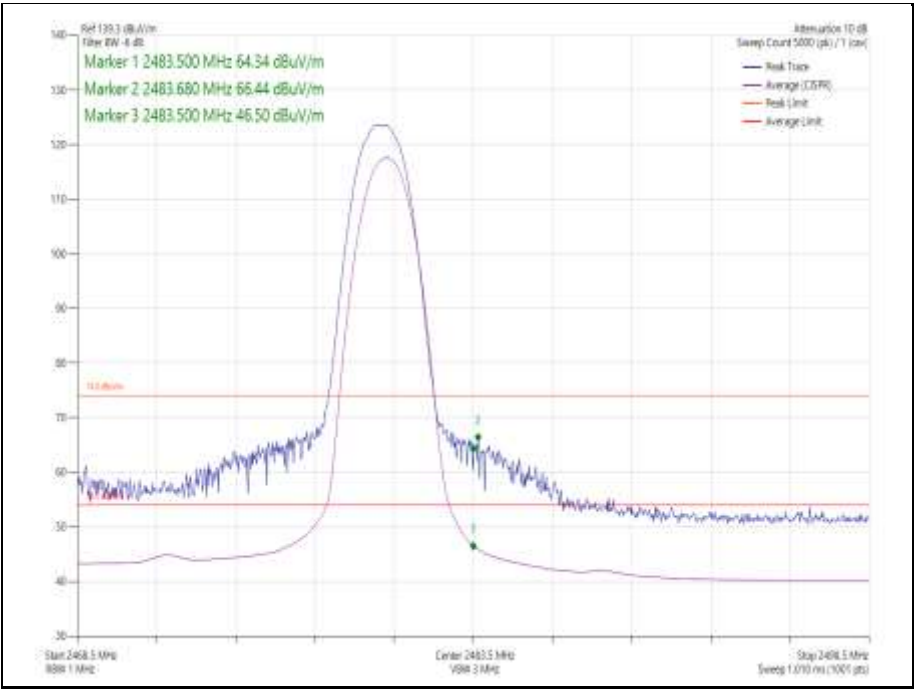


Figure 29 - Static -  $\pi/4$  DQPSK/2DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

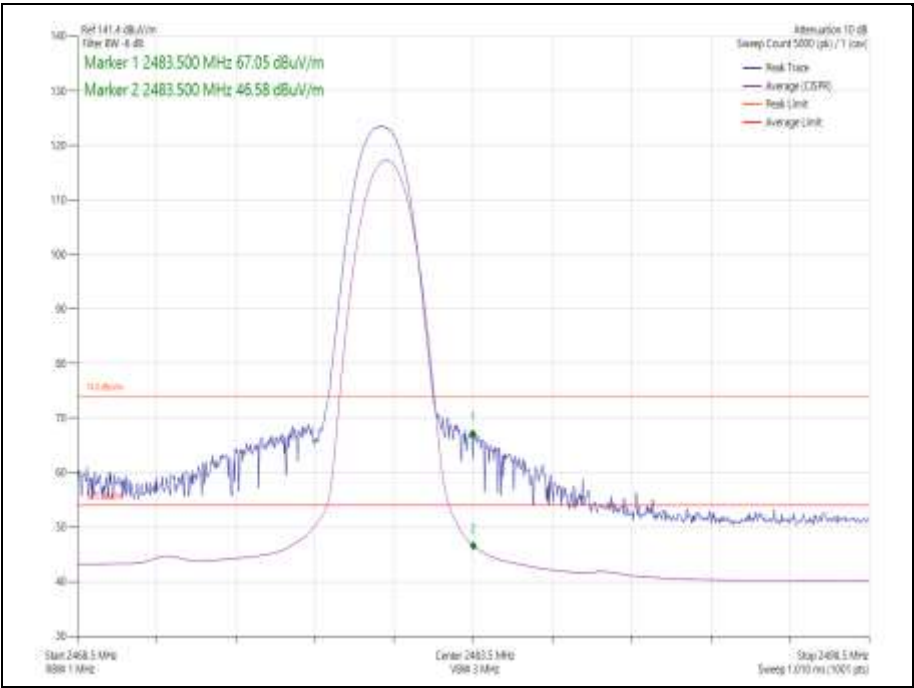


Figure 30 - Static - 8-DPSK/3DH5 - 2480 MHz - Band Edge Frequency 2483.5 MHz

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 11

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 12

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



### 2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

| Instrument                    | Manufacturer    | Type No              | TE No | Calibration Period (months) | Calibration Expires |
|-------------------------------|-----------------|----------------------|-------|-----------------------------|---------------------|
| EMI Test Receiver             | Rohde & Schwarz | ESW44                | 5084  | 12                          | 08-Mar-2022         |
| Cable (18 GHz)                | Rosenberger     | LU7-071-2000         | 5107  | 12                          | 09-Jul-2022         |
| EmX Emissions Software        | TUV SUD         | V2.1.11              | 5125  | -                           | Software            |
| Screened Room (11)            | Rainford        | Rainford             | 5136  | 36                          | 01-Nov-2021         |
| Mast and Turntable Controller | Maturo          | Maturo NCD           | 5159  | -                           | TU                  |
| Turntable                     | Maturo          | TT 15WF              | 5160  | -                           | TU                  |
| Horn Antenna (1-10GHz)        | Schwarzbeck     | BBHA 9120 B          | 5215  | 12                          | 01-Apr-2022         |
| 8m N Type Cable               | Junkosha        | MWX221-08000NMSNMS/B | 5522  | 12                          | 24-Mar-2022         |
| Thermo-Hygro-Barometer        | PCE Instruments | PCE-THB 40           | 5604  | 12                          | 08-Sep-2021         |

**Table 13**

TU - Traceability Unscheduled



## **2.2 Frequency Hopping Systems - Average Time of Occupancy**

### **2.2.1 Specification Reference**

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

### **2.2.2 Equipment Under Test and Modification State**

A2442, S/N: XH2DGXFKY6 - Modification State 0

### **2.2.3 Date of Test**

01-September-2021

### **2.2.4 Test Method**

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

### **2.2.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 22.2 °C |
| Relative Humidity   | 51.9 %  |



## 2.2.6 Test Results

### 2.4 GHz Bluetooth - FHSS

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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | ePA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | -    |

| Test Frequency<br>(MHz) | Time of Occupancy  |                         |                           | Limit<br>(ms) |
|-------------------------|--------------------|-------------------------|---------------------------|---------------|
|                         | Dwell Time<br>(ms) | Number of Transmissions | Time of Occupancy<br>(ms) |               |
| 2402                    | 2.888              | 95                      | 274.4                     | 400.0         |

Table 14 - Time of Occupancy Results



Figure 31 - GFSK - 2402 MHz Accumulated Transmit Time



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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | -    |

| Test Frequency<br>(MHz) | Time of Occupancy  |                         |                           | Limit<br>(ms) |
|-------------------------|--------------------|-------------------------|---------------------------|---------------|
|                         | Dwell Time<br>(ms) | Number of Transmissions | Time of Occupancy<br>(ms) |               |
| 2402                    | 2.888              | 101                     | 291.7                     | 400.0         |

**Table 15 - Time of Occupancy Results**



**Figure 32 - GFSK - 2402 MHz Accumulated Transmit Time**



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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | C (Core 2)     | Peak Antenna Gain (dBi): | -    |

| Test Frequency (MHz) | Time of Occupancy |                         |                        | Limit (ms) |
|----------------------|-------------------|-------------------------|------------------------|------------|
|                      | Dwell Time (ms)   | Number of Transmissions | Time of Occupancy (ms) |            |
| 2402                 | 2.888             | 113                     | 326.3                  | 400.0      |

**Table 16 - Time of Occupancy Results**



**Figure 33 - GFSK - 2402 MHz 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.

Industry Canada 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.



### 2.2.7 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 Expires          |
|------------------------------|-----------------------|---------|-------|-----------------------------|------------------------------|
| Multimeter                   | Iso-tech              | IDM101  | 2421  | 12                          | 30-Oct-2021                  |
| Hygrometer                   | Rotronic              | I-1000  | 3220  | 12                          | 16-Oct-2021                  |
| AC Programmable Power Supply | iTech                 | IT7324  | 5225  | -                           | AC Programmable Power Supply |
| MXA Signal Analyser          | Keysight Technologies | N9020B  | 5529  | 24                          | 04-Mar-2022                  |
| Signal Commissioning Unit    | TUV SUD               | SCU002  | 5759  | 12                          | 30-Jun-2022                  |

**Table 17**



## **2.3 Frequency Hopping Systems - Channel Separation**

### **2.3.1 Specification Reference**

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

### **2.3.2 Equipment Under Test and Modification State**

A2442, S/N: XH2DGXFKY6 - Modification State 0

### **2.3.3 Date of Test**

01-September-2021

### **2.3.4 Test Method**

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

### **2.3.5 Environmental Conditions**

|                     |         |
|---------------------|---------|
| Ambient Temperature | 22.2 °C |
| Relative Humidity   | 51.9 %  |

## 2.3.6 Test Results

### 2.4 GHz Bluetooth - FHSS

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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | ePA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 0.855                 | 2441.003                           | 2442.003 | 1.000 | ≥570.0      |

Table 18 - Carrier Frequency Separation Results



Figure 34 - GFSK - 2441 MHz (CH39)



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | ePA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz)  |
|----------------------|-----------------------|------------------------------------|----------|-------|--------------|
|                      |                       | F1C                                | F2C      | FHS   |              |
| 2441                 | 1.325                 | 2440.986                           | 2441.986 | 1.000 | $\geq 883.3$ |

Table 19 - Carrier Frequency Separation Results



Figure 35 -  $\pi/4$  DQPSK - 2441 MHz (CH39)



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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | ePA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 1.260                 | 2440.994                           | 2441.994 | 1.000 | ≥840.0      |

Table 20 - Carrier Frequency Separation Results



Figure 36 - 8-DPSK - 2441 MHz (CH39)



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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 0.855                 | 2441.004                           | 2442.004 | 1.000 | ≥570.0      |

Table 21 - Carrier Frequency Separation Results



Figure 37 - GFSK - 2441 MHz (CH39)



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz)  |
|----------------------|-----------------------|------------------------------------|----------|-------|--------------|
|                      |                       | F1C                                | F2C      | FHS   |              |
| 2441                 | 1.325                 | 2440.986                           | 2441.985 | 0.999 | $\geq 883.3$ |

Table 22 - Carrier Frequency Separation Results



Figure 38 -  $\pi/4$  DQPSK - 2441 MHz (CH39)



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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 1.265                 | 2440.993                           | 2441.994 | 1.001 | ≥843.3      |

Table 23 - Carrier Frequency Separation Results



Figure 39 - 8-DPSK - 2441 MHz (CH39)



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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 0.855                 | 2441.004                           | 2442.004 | 1.000 | ≥620.6      |

Table 24 - Carrier Frequency Separation Results



Figure 40 - GFSK - 2441 MHz (CH39)



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz)  |
|----------------------|-----------------------|------------------------------------|----------|-------|--------------|
|                      |                       | F1C                                | F2C      | FHS   |              |
| 2441                 | 1.325                 | 2440.985                           | 2441.985 | 1.000 | $\geq 883.3$ |

Table 25 - Carrier Frequency Separation Results



Figure 41 -  $\pi/4$  DQPSK - 2441 MHz (CH39)



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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) | Carrier Frequency Separation (MHz) |          |       | Limit (kHz) |
|----------------------|-----------------------|------------------------------------|----------|-------|-------------|
|                      |                       | F1C                                | F2C      | FHS   |             |
| 2441                 | 1.265                 | 2440.993                           | 2441.994 | 1.001 | ≥843.3      |

Table 26 - Carrier Frequency Separation Results



Figure 42 - 8-DPSK - 2441 MHz (CH39)



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

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

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

ISED RSS-247, Limit Clause 5.1 (b)

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

### 2.3.7 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 Expires          |
|------------------------------|-----------------------|---------------------------|-------|-----------------------------|------------------------------|
| Rubidium Standard            | Rohde & Schwarz       | XSRM                      | 1316  | 6                           | 03-Dec-2021                  |
| Multimeter                   | Iso-tech              | IDM101                    | 2421  | 12                          | 30-Oct-2021                  |
| Hygrometer                   | Rotronic              | I-1000                    | 3220  | 12                          | 16-Oct-2021                  |
| Frequency Standard           | Spectracom            | SecureSync 1200-0408-0601 | 4393  | 6                           | 03-Dec-2021                  |
| AC Programmable Power Supply | iTech                 | IT7324                    | 5225  | -                           | AC Programmable Power Supply |
| MXA Signal Analyser          | Keysight Technologies | N9020B                    | 5529  | 24                          | 04-Mar-2022                  |
| Signal Commissioning Unit    | TUV SUD               | SCU002                    | 5759  | 12                          | 30-Jun-2022                  |

**Table 27**



## **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**

A2442, S/N: XH2DGXFKY6 - Modification State 0

### **2.4.3 Date of Test**

01-September-2021

### **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 | 22.2 °C |
| Relative Humidity   | 51.9 %  |



## 2.4.6 Test Results

### 2.4 GHz Bluetooth - FHSS

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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | ePA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

|                               |       |
|-------------------------------|-------|
| Number of Hopping Frequencies | Limit |
| 79                            | ≥15.0 |

**Table 28 - Number of Hopping Frequencies Results**



**Figure 43 - GFSK (DH5) - Number of Hopping Channels**



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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

| Number of Hopping Frequencies | Limit |
|-------------------------------|-------|
| 79                            | ≥15.0 |

**Table 29 - Number of Hopping Frequencies Results**



**Figure 44 - GFSK (DH5) - Number of Hopping Channels**



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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)     | Peak Antenna Gain (dBi): | - |

| Number of Hopping Frequencies | Limit |
|-------------------------------|-------|
| 79                            | ≥15.0 |

Table 30 - Number of Hopping Frequencies Results



Figure 45 - 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)

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



#### 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 Expires          |
|------------------------------|-----------------------|---------------------------|-------|-----------------------------|------------------------------|
| Rubidium Standard            | Rohde & Schwarz       | XSRM                      | 1316  | 6                           | 03-Dec-2021                  |
| Multimeter                   | Iso-tech              | IDM101                    | 2421  | 12                          | 30-Oct-2021                  |
| Hygrometer                   | Rotronic              | I-1000                    | 3220  | 12                          | 16-Oct-2021                  |
| Frequency Standard           | Spectracom            | SecureSync 1200-0408-0601 | 4393  | 6                           | 03-Dec-2021                  |
| AC Programmable Power Supply | iTech                 | IT7324                    | 5225  | -                           | AC Programmable Power Supply |
| MXA Signal Analyser          | Keysight Technologies | N9020B                    | 5529  | 24                          | 04-Mar-2022                  |
| Signal Commissioning Unit    | TUV SUD               | SCU002                    | 5759  | 12                          | 30-Jun-2022                  |

**Table 31**



## **2.5 Frequency Hopping Systems - 20 dB Bandwidth**

### **2.5.1 Specification Reference**

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

### **2.5.2 Equipment Under Test and Modification State**

A2442, S/N: XH2DGXFKY6 - Modification State 0

### **2.5.3 Date of Test**

07-September-2021 to 08-September-2021

### **2.5.4 Test Method**

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

### **2.5.5 Environmental Conditions**

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 22.2 - 23.5 °C |
| Relative Humidity   | 45.0 - 66.9 %  |



## 2.5.6 Test Results

### 2.4 GHz Bluetooth - FHSS

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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | ePA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 0.855                 | - | - | - |
| 2441                 | 0.855                 | - | - | - |
| 2480                 | 0.855                 | - | - | - |

**Table 32 - 20 dB Bandwidth Results**

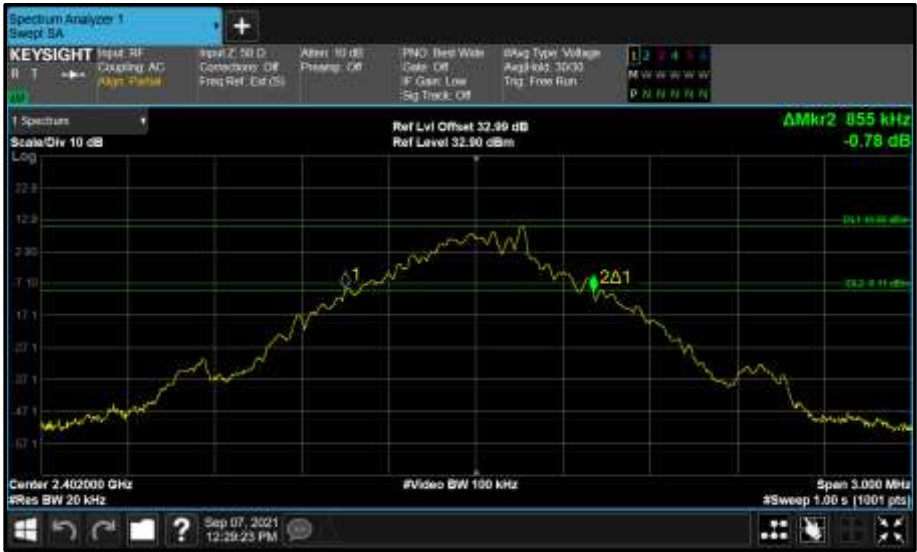


Figure 46 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth

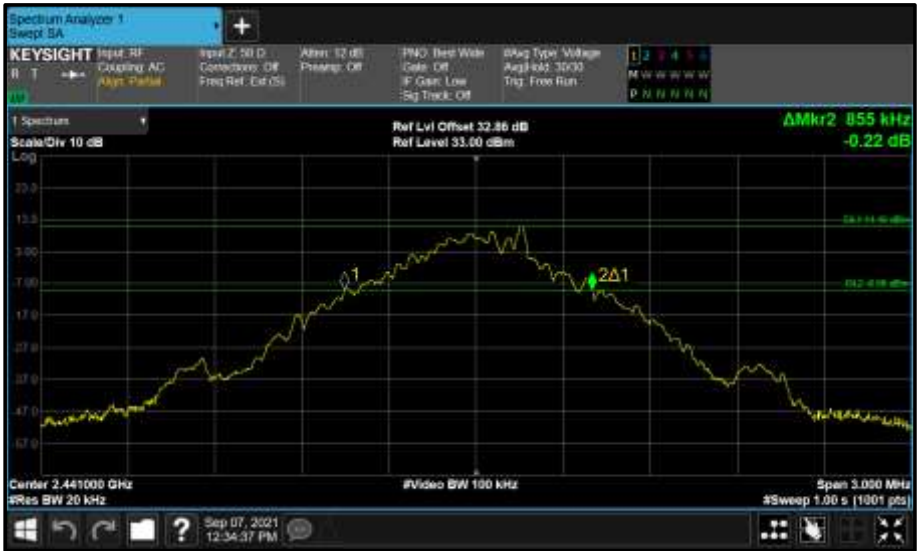


Figure 47 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth

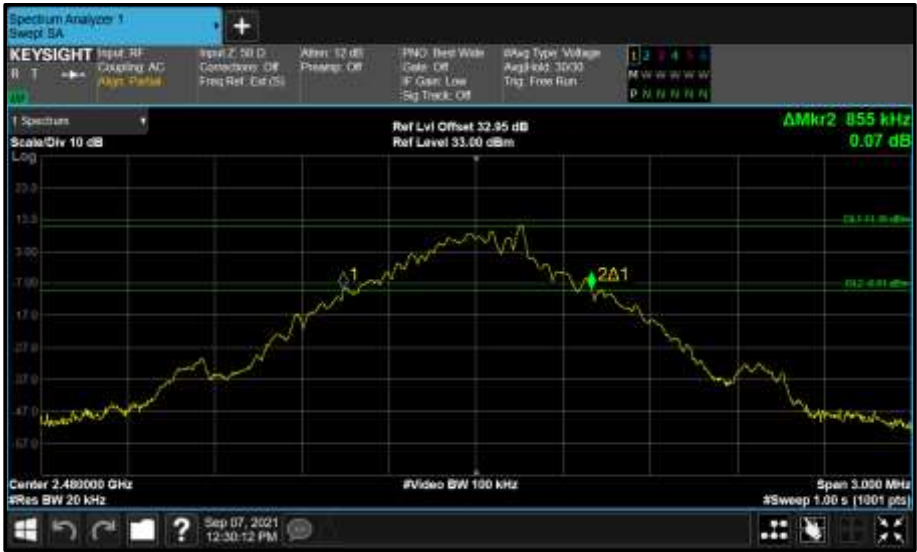


Figure 48 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                       |                          |   |
|------------------------|-----------------------|--------------------------|---|
| Mode:                  | ePA GFSK (DH5)        | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 0.855                 | 0.855 | - | - |
| 2441                 | 0.855                 | 0.855 | - | - |
| 2480                 | 0.855                 | 0.852 | - | - |

**Table 33 - 20 dB Bandwidth Results**



Figure 49 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth

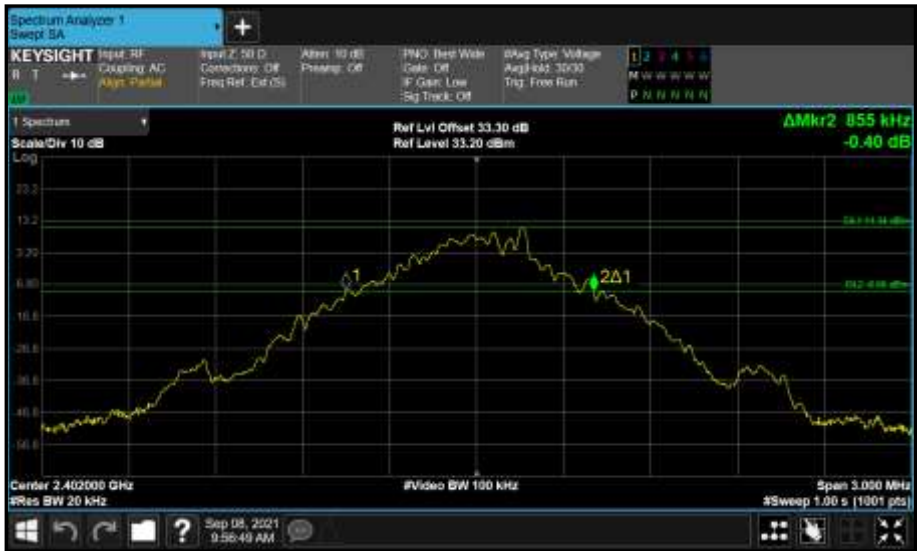


Figure 50 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 51 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 52 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth



Figure 53 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



Figure 54 - Core 1 (B) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | ePA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 1.330                 | - | - | - |
| 2441                 | 1.325                 | - | - | - |
| 2480                 | 1.330                 | - | - | - |

**Table 34 - 20 dB Bandwidth Results**





Figure 57 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | ePA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 1.260                 | - | - | - |
| 2441                 | 1.260                 | - | - | - |
| 2480                 | 1.260                 | - | - | - |

**Table 35 - 20 dB Bandwidth Results**



Figure 58 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 59 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth

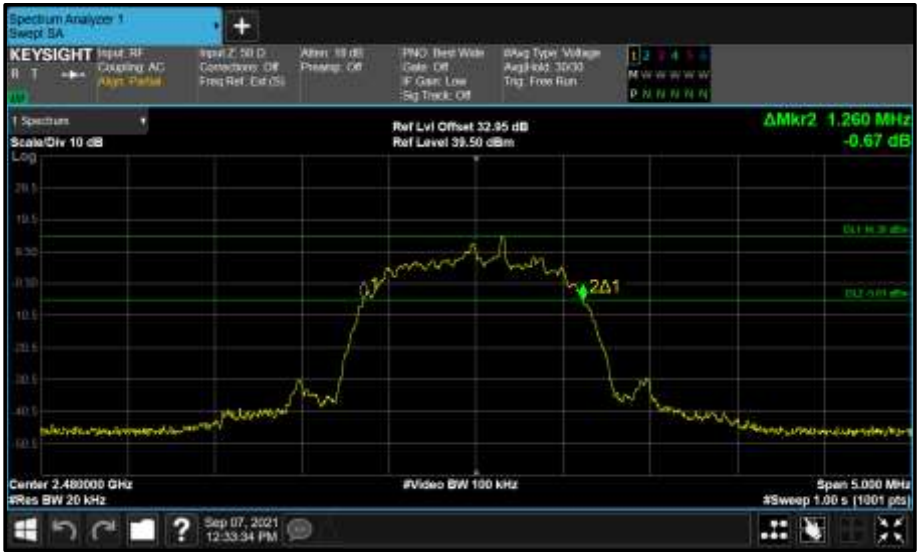


Figure 60 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | ePA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming               | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 1.330                 | 1.330 | - | - |
| 2441                 | 1.325                 | 1.325 | - | - |
| 2480                 | 1.330                 | 1.330 | - | - |

**Table 36 - 20 dB Bandwidth Results**



Figure 61 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 62 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 63 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 64 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth





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

| DUT Configuration      |                       |                          |   |
|------------------------|-----------------------|--------------------------|---|
| Mode:                  | ePA 8-DPSK (3-DH5)    | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 1.260                 | 1.260 | - | - |
| 2441                 | 1.260                 | 1.260 | - | - |
| 2480                 | 1.260                 | 1.265 | - | - |

**Table 37 - 20 dB Bandwidth Results**



Figure 67 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 68 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 69 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 70 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth



Figure 71 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



Figure 72 - Core 1 (B) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 0.855                 | - | - | - |
| 2441                 | 0.855                 | - | - | - |
| 2480                 | 0.855                 | - | - | - |

**Table 38 - 20 dB Bandwidth Results**

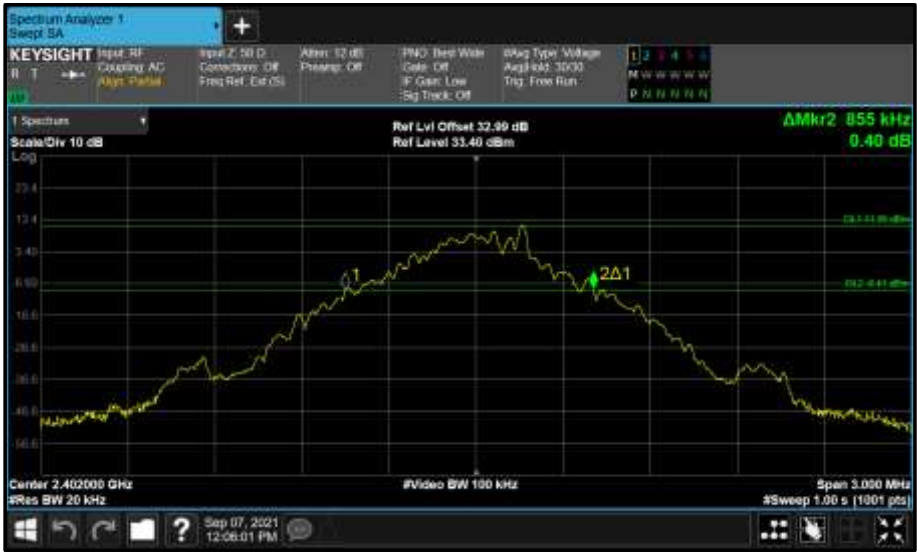


Figure 73 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth

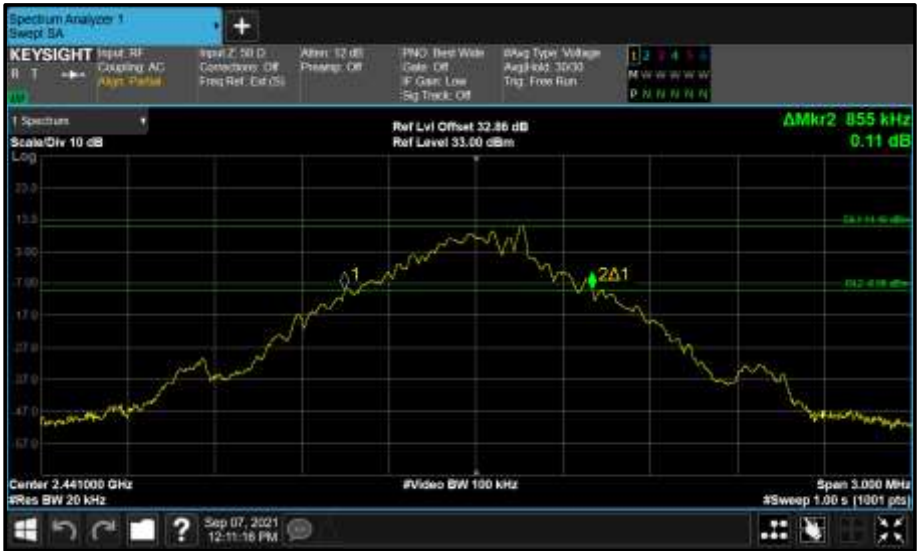


Figure 74 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth





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

| DUT Configuration      |                |                          |   |
|------------------------|----------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO           | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |       |   |
|----------------------|-----------------------|---|-------|---|
|                      | A                     | B | C     | D |
| 2402                 | -                     | - | 0.855 | - |
| 2441                 | -                     | - | 0.855 | - |
| 2480                 | -                     | - | 0.855 | - |

**Table 39 - 20 dB Bandwidth Results**

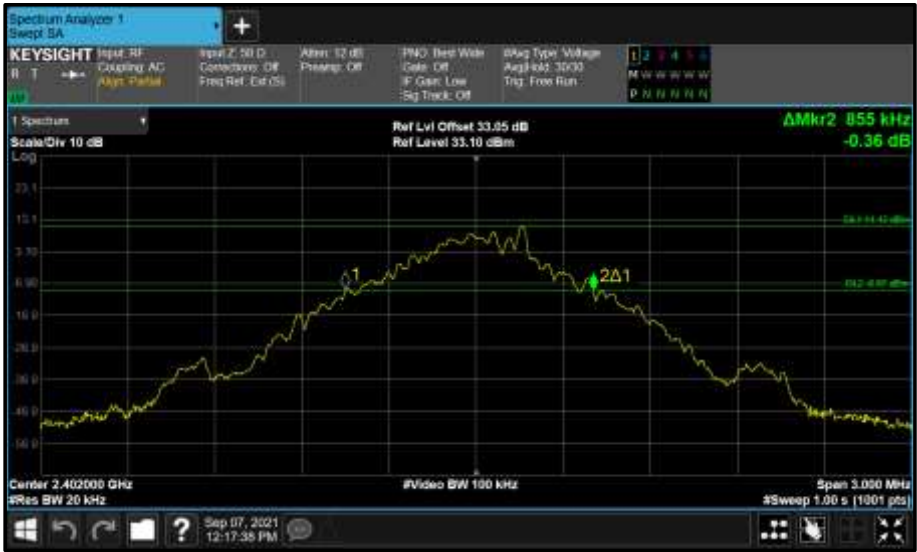


Figure 76 - Core 2 (C) 2402 MHz (CH0) 20 dB Bandwidth

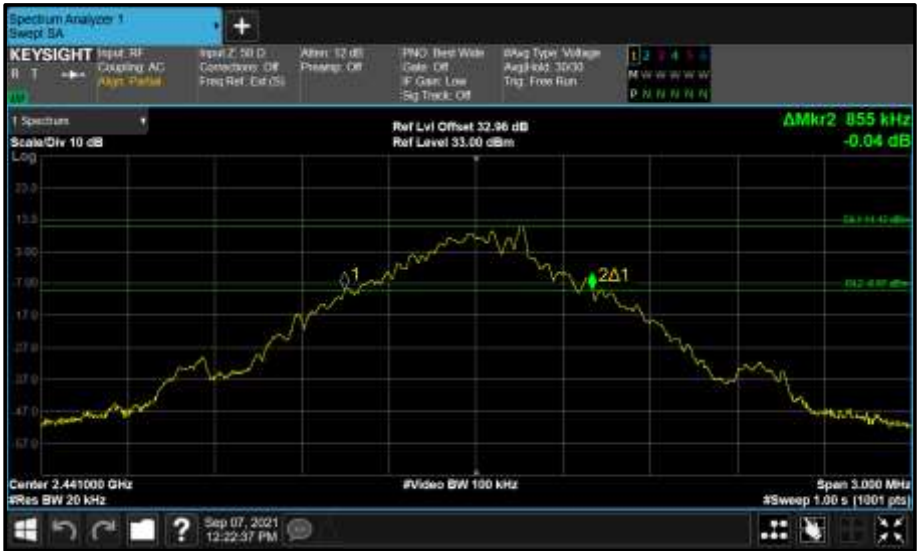


Figure 77 - Core 2 (C) 2441 MHz (CH39) 20 dB Bandwidth

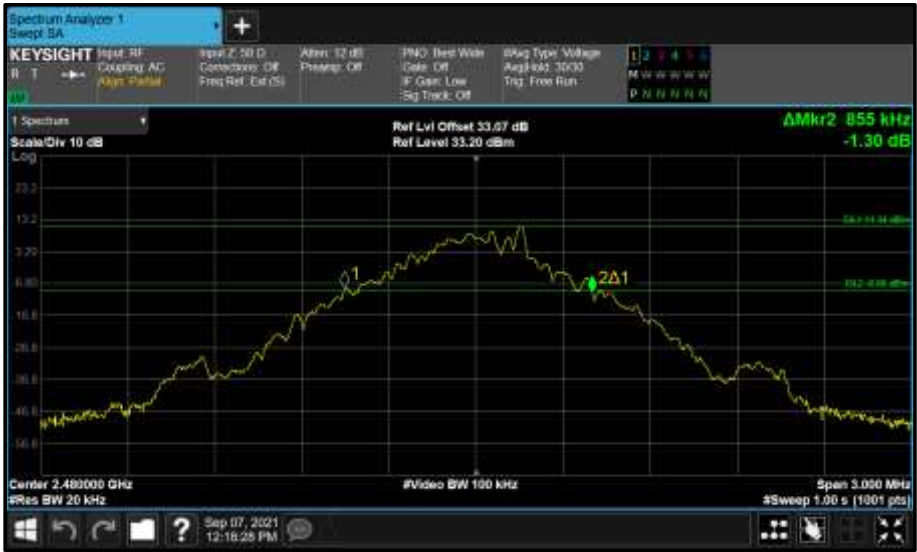


Figure 78 - Core 2 (C) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                       |                          |   |
|------------------------|-----------------------|--------------------------|---|
| Mode:                  | iPA GFSK (DH5)        | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 0.855                 | 0.855 | - | - |
| 2441                 | 0.852                 | 0.855 | - | - |
| 2480                 | 0.858                 | 0.858 | - | - |

**Table 40 - 20 dB Bandwidth Results**



Figure 79 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 80 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 81 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 82 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth



Figure 83 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



Figure 84 - Core 1 (B) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 1.325                 | - | - | - |
| 2441                 | 1.325                 | - | - | - |
| 2480                 | 1.325                 | - | - | - |

**Table 41 - 20 dB Bandwidth Results**



Figure 85 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 86 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth





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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |   |   |
|----------------------|-----------------------|---|---|---|
|                      | A                     | B | C | D |
| 2402                 | 1.260                 | - | - | - |
| 2441                 | 1.265                 | - | - | - |
| 2480                 | 1.260                 | - | - | - |

**Table 42 - 20 dB Bandwidth Results**



Figure 88 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 89 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 90 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO                      | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)                | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |       |   |
|----------------------|-----------------------|---|-------|---|
|                      | A                     | B | C     | D |
| 2402                 | -                     | - | 1.325 | - |
| 2441                 | -                     | - | 1.325 | - |
| 2480                 | -                     | - | 1.325 | - |

**Table 43 - 20 dB Bandwidth Results**





Figure 93 - Core 2 (C) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                    |                          |   |
|------------------------|--------------------|--------------------------|---|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | SISO               | DCCF (dB):               | - |
| Active Port(s):        | C (Core 2)         | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |   |       |   |
|----------------------|-----------------------|---|-------|---|
|                      | A                     | B | C     | D |
| 2402                 | -                     | - | 1.260 | - |
| 2441                 | -                     | - | 1.260 | - |
| 2480                 | -                     | - | 1.260 | - |

**Table 44 - 20 dB Bandwidth Results**



Figure 94 - Core 2 (C) 2402 MHz (CH0) 20 dB Bandwidth



Figure 95 - Core 2 (C) 2441 MHz (CH39) 20 dB Bandwidth



Figure 96 - Core 2 (C) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                           |                          |   |
|------------------------|---------------------------|--------------------------|---|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming               | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1)     | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 1.325                 | 1.325 | - | - |
| 2441                 | 1.330                 | 1.325 | - | - |
| 2480                 | 1.325                 | 1.325 | - | - |

**Table 45 - 20 dB Bandwidth Results**



Figure 97 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 98 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 99 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 100 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth



Figure 101 - Core 0 (A) 2480 MHz (CH78) 20 dB Bandwidth



Figure 102 - Core 1 (B) 2480 MHz (CH78) 20 dB Bandwidth



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

| DUT Configuration      |                       |                          |   |
|------------------------|-----------------------|--------------------------|---|
| Mode:                  | iPA 8-DPSK (3-DH5)    | Duty Cycle (%):          | - |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | - |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | - |

| Test Frequency (MHz) | 20 dB Bandwidth (MHz) |       |   |   |
|----------------------|-----------------------|-------|---|---|
|                      | A                     | B     | C | D |
| 2402                 | 1.260                 | 1.260 | - | - |
| 2441                 | 1.265                 | 1.265 | - | - |
| 2480                 | 1.260                 | 1.260 | - | - |

**Table 46 - 20 dB Bandwidth Results**



Figure 103 - Core 0 (A) 2402 MHz (CH0) 20 dB Bandwidth



Figure 104 - Core 1 (B) 2402 MHz (CH0) 20 dB Bandwidth



Figure 105 - Core 0 (A) 2441 MHz (CH39) 20 dB Bandwidth



Figure 106 - Core 1 (B) 2441 MHz (CH39) 20 dB Bandwidth



None specified.



## 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 Expires          |
|------------------------------|-----------------------|---------------------------|-------|-----------------------------|------------------------------|
| Rubidium Standard            | Rohde & Schwarz       | XSRM                      | 1316  | 6                           | 03-Dec-2021                  |
| Multimeter                   | Iso-tech              | IDM101                    | 2421  | 12                          | 30-Oct-2021                  |
| Hygrometer                   | Rotronic              | I-1000                    | 3220  | 12                          | 16-Oct-2021                  |
| Frequency Standard           | Spectracom            | SecureSync 1200-0408-0601 | 4393  | 6                           | 03-Dec-2021                  |
| AC Programmable Power Supply | iTech                 | IT7324                    | 5225  | -                           | AC Programmable Power Supply |
| MXA Signal Analyser          | Keysight Technologies | N9020B                    | 5529  | 24                          | 04-Mar-2022                  |
| Signal Commissioning Unit    | TUV SUD               | SCU002                    | 5759  | 12                          | 30-Jun-2022                  |

**Table 47**



## **2.6 Maximum Conducted Output Power**

### **2.6.1 Specification Reference**

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

### **2.6.2 Equipment Under Test and Modification State**

A2442, S/N: XH2DGXFKY6 - Modification State 0

### **2.6.3 Date of Test**

07-September-2021 to 08-September-2021

### **2.6.4 Test Method**

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

MIMO output port summing was performed in accordance with KDB 662911 D01.

### **2.6.5 Environmental Conditions**

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 22.2 - 23.5 °C |
| Relative Humidity   | 45.0 - 66.9 %  |



## 2.6.6 Test Results

### 2.4 GHz Bluetooth - FHSS

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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | ePA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |   | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|---|-------------|-------------|
|                      | A                                    | B | C | D | Σ |             |             |
| 2402                 | 12.92                                | - | - | - | - | 28.40       | -15.48      |
| 2441                 | 12.99                                | - | - | - | - | 28.40       | -15.41      |
| 2480                 | 12.96                                | - | - | - | - | 28.40       | -15.44      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |   | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|---|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | Σ |             |             |            |                  |                  |
| 2402                 | 12.92                                | - | - | - | - | 30.00       | -17.08      | 20.52      | 36.00            | -15.48           |
| 2441                 | 12.99                                | - | - | - | - | 30.00       | -17.01      | 20.59      | 36.00            | -15.41           |
| 2480                 | 12.96                                | - | - | - | - | 30.00       | -17.04      | 20.56      | 36.00            | -15.44           |

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



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

| DUT Configuration      |                       |                          |       |
|------------------------|-----------------------|--------------------------|-------|
| Mode:                  | ePA GFSK (DH5)        | Duty Cycle (%):          | 76.7  |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 13.30                                | 13.17 | - | - | 16.20    | 25.83       | -9.62       |
| 2441                 | 13.30                                | 13.10 | - | - | 16.19    | 25.83       | -9.63       |
| 2480                 | 12.95                                | 12.83 | - | - | 15.88    | 25.83       | -9.95       |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 13.30                                | 13.17 | - | - | 16.20    | 30.00       | -13.80      | 26.38      | 36.00            | -9.62            |
| 2441                 | 13.30                                | 13.10 | - | - | 16.19    | 30.00       | -13.81      | 26.37      | 36.00            | -9.63            |
| 2480                 | 12.95                                | 12.83 | - | - | 15.88    | 30.00       | -14.12      | 26.05      | 36.00            | -9.95            |

**Table 51 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                           |                          |      |
|------------------------|---------------------------|--------------------------|------|
| Mode:                  | ePA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | 76.8 |
| Antenna Configuration: | SISO                      | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |
| 2402                 | 18.92                                | - | - | - | -        | 28.40       | -9.48       |
| 2441                 | 19.18                                | - | - | - | -        | 28.40       | -9.22       |
| 2480                 | 19.04                                | - | - | - | -        | 28.40       | -9.36       |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 18.92                                | - | - | - | -        | 30.00       | -11.08      | 26.52      | 36.00            | -9.48            |
| 2441                 | 19.18                                | - | - | - | -        | 30.00       | -10.82      | 26.78      | 36.00            | -9.22            |
| 2480                 | 19.04                                | - | - | - | -        | 30.00       | -10.96      | 26.64      | 36.00            | -9.36            |

**Table 53 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                    |                          |      |
|------------------------|--------------------|--------------------------|------|
| Mode:                  | ePA 8-DPSK (3-DH5) | Duty Cycle (%):          | 76.9 |
| Antenna Configuration: | SISO               | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |
| 2402                 | 19.74                                | - | - | - | -        | 28.40       | -8.66       |
| 2441                 | 19.77                                | - | - | - | -        | 28.40       | -8.63       |
| 2480                 | 19.54                                | - | - | - | -        | 28.40       | -8.86       |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 19.74                                | - | - | - | -        | 30.00       | -10.26      | 27.34      | 36.00            | -8.66            |
| 2441                 | 19.77                                | - | - | - | -        | 30.00       | -10.23      | 27.37      | 36.00            | -8.63            |
| 2480                 | 19.54                                | - | - | - | -        | 30.00       | -10.46      | 27.14      | 36.00            | -8.86            |

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



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

| DUT Configuration      |                           |                          |       |
|------------------------|---------------------------|--------------------------|-------|
| Mode:                  | ePA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | 77.1  |
| Antenna Configuration: | Beamforming               | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1)     | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 16.01                                | 15.87 | - | - | 18.94    | 25.83       | -6.89       |
| 2441                 | 15.81                                | 15.41 | - | - | 18.61    | 25.83       | -7.22       |
| 2480                 | 16.01                                | 15.67 | - | - | 18.83    | 25.83       | -6.99       |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 16.01                                | 15.87 | - | - | 18.94    | 30.00       | -11.06      | 29.11      | 36.00            | -6.89            |
| 2441                 | 15.81                                | 15.41 | - | - | 18.61    | 30.00       | -11.39      | 28.78      | 36.00            | -7.22            |
| 2480                 | 16.01                                | 15.67 | - | - | 18.83    | 30.00       | -11.17      | 29.01      | 36.00            | -6.99            |

**Table 57 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                       |                          |       |
|------------------------|-----------------------|--------------------------|-------|
| Mode:                  | ePA 8-DPSK (3-DH5)    | Duty Cycle (%):          | 76.9  |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 16.15                                | 16.09 | - | - | 19.07    | 25.83       | -6.75       |
| 2441                 | 16.39                                | 16.11 | - | - | 19.21    | 25.83       | -6.61       |
| 2480                 | 16.59                                | 16.24 | - | - | 19.39    | 25.83       | -6.44       |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 16.15                                | 16.09 | - | - | 19.07    | 30.00       | -10.93      | 29.25      | 36.00            | -6.75            |
| 2441                 | 16.39                                | 16.11 | - | - | 19.21    | 30.00       | -10.79      | 29.39      | 36.00            | -6.61            |
| 2480                 | 16.59                                | 16.24 | - | - | 19.39    | 30.00       | -10.61      | 29.56      | 36.00            | -6.44            |

**Table 59 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)     | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |
| 2402                 | 13.42                                | - | - | - | -        | 28.40       | -14.98      |
| 2441                 | 12.98                                | - | - | - | -        | 28.40       | -15.42      |
| 2480                 | 12.96                                | - | - | - | -        | 28.40       | -15.44      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 13.42                                | - | - | - | -        | 30.00       | -16.58      | 21.02      | 36.00            | -14.98           |
| 2441                 | 12.98                                | - | - | - | -        | 30.00       | -17.02      | 20.58      | 36.00            | -15.42           |
| 2480                 | 12.96                                | - | - | - | -        | 30.00       | -17.04      | 20.56      | 36.00            | -15.44           |

**Table 61 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                |                          |      |
|------------------------|----------------|--------------------------|------|
| Mode:                  | iPA GFSK (DH5) | Duty Cycle (%):          | 76.7 |
| Antenna Configuration: | SISO           | DCCF (dB):               | -    |
| Active Port(s):        | C (Core 2)     | Peak Antenna Gain (dBi): | 6.10 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |
| 2402                 | -                                    | - | 13.06 | - | -        | 29.90       | -16.84      |
| 2441                 | -                                    | - | 12.98 | - | -        | 29.90       | -16.92      |
| 2480                 | -                                    | - | 13.19 | - | -        | 29.90       | -16.71      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | -                                    | - | 13.06 | - | -        | 30.00       | -16.94      | 19.16      | 36.00            | -16.84           |
| 2441                 | -                                    | - | 12.98 | - | -        | 30.00       | -17.02      | 19.08      | 36.00            | -16.92           |
| 2480                 | -                                    | - | 13.19 | - | -        | 30.00       | -16.81      | 19.29      | 36.00            | -16.71           |

**Table 63 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                       |                          |       |
|------------------------|-----------------------|--------------------------|-------|
| Mode:                  | iPA GFSK (DH5)        | Duty Cycle (%):          | 76.7  |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 13.25                                | 13.12 | - | - | 16.17    | 25.83       | -9.65       |
| 2441                 | 13.32                                | 13.05 | - | - | 16.16    | 25.83       | -9.66       |
| 2480                 | 12.90                                | 12.74 | - | - | 15.81    | 25.83       | -10.02      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 13.25                                | 13.12 | - | - | 16.17    | 30.00       | -13.83      | 26.35      | 36.00            | -9.65            |
| 2441                 | 13.32                                | 13.05 | - | - | 16.16    | 30.00       | -13.84      | 26.34      | 36.00            | -9.66            |
| 2480                 | 12.90                                | 12.74 | - | - | 15.81    | 30.00       | -14.19      | 25.98      | 36.00            | -10.02           |

**Table 65 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                           |                          |      |
|------------------------|---------------------------|--------------------------|------|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | 77.1 |
| Antenna Configuration: | SISO                      | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)                | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |
| 2402                 | 12.09                                | - | - | - | -        | 28.40       | -16.31      |
| 2441                 | 11.69                                | - | - | - | -        | 28.40       | -16.71      |
| 2480                 | 11.80                                | - | - | - | -        | 28.40       | -16.60      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 12.09                                | - | - | - | -        | 30.00       | -17.91      | 19.69      | 36.00            | -16.31           |
| 2441                 | 11.69                                | - | - | - | -        | 30.00       | -18.31      | 19.29      | 36.00            | -16.71           |
| 2480                 | 11.80                                | - | - | - | -        | 30.00       | -18.20      | 19.40      | 36.00            | -16.60           |

**Table 67 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                    |                          |      |
|------------------------|--------------------|--------------------------|------|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | 76.9 |
| Antenna Configuration: | SISO               | DCCF (dB):               | -    |
| Active Port(s):        | A (Core 0)         | Peak Antenna Gain (dBi): | 7.60 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |
| 2402                 | 12.47                                | - | - | - | -        | 28.40       | -15.93      |
| 2441                 | 12.11                                | - | - | - | -        | 28.40       | -16.29      |
| 2480                 | 12.23                                | - | - | - | -        | 28.40       | -16.17      |

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

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 12.47                                | - | - | - | -        | 30.00       | -17.53      | 20.07      | 36.00            | -15.93           |
| 2441                 | 12.11                                | - | - | - | -        | 30.00       | -17.89      | 19.71      | 36.00            | -16.29           |
| 2480                 | 12.23                                | - | - | - | -        | 30.00       | -17.77      | 19.83      | 36.00            | -16.17           |

**Table 69 - ISED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                           |                          |      |
|------------------------|---------------------------|--------------------------|------|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | 76.8 |
| Antenna Configuration: | SISO                      | DCCF (dB):               | -    |
| Active Port(s):        | C (Core 2)                | Peak Antenna Gain (dBi): | 6.10 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |
| 2402                 | -                                    | - | 11.77 | - | -        | 29.90       | -18.13      |
| 2441                 | -                                    | - | 11.60 | - | -        | 29.90       | -18.30      |
| 2480                 | -                                    | - | 11.82 | - | -        | 29.90       | -18.08      |

**Table 70 - FCC Maximum Conducted (peak) Output Power Results**

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | -                                    | - | 11.77 | - | -        | 30.00       | -18.23      | 17.87      | 36.00            | -18.13           |
| 2441                 | -                                    | - | 11.60 | - | -        | 30.00       | -18.40      | 17.70      | 36.00            | -18.30           |
| 2480                 | -                                    | - | 11.82 | - | -        | 30.00       | -18.18      | 17.92      | 36.00            | -18.08           |

**Table 71 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                    |                          |      |
|------------------------|--------------------|--------------------------|------|
| Mode:                  | iPA 8-DPSK (3-DH5) | Duty Cycle (%):          | 76.9 |
| Antenna Configuration: | SISO               | DCCF (dB):               | -    |
| Active Port(s):        | C (Core 2)         | Peak Antenna Gain (dBi): | 6.10 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |
| 2402                 | -                                    | - | 12.18 | - | -        | 29.90       | -17.72      |
| 2441                 | -                                    | - | 12.00 | - | -        | 29.90       | -17.90      |
| 2480                 | -                                    | - | 12.22 | - | -        | 29.90       | -17.68      |

**Table 72 - FCC Maximum Conducted (peak) Output Power Results**

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |   |       |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|---|-------|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B | C     | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | -                                    | - | 12.18 | - | -        | 30.00       | -17.82      | 18.28      | 36.00            | -17.72           |
| 2441                 | -                                    | - | 12.00 | - | -        | 30.00       | -18.00      | 18.10      | 36.00            | -17.90           |
| 2480                 | -                                    | - | 12.22 | - | -        | 30.00       | -17.78      | 18.32      | 36.00            | -17.68           |

**Table 73 - ISSED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                           |                          |       |
|------------------------|---------------------------|--------------------------|-------|
| Mode:                  | iPA $\pi/4$ DQPSK (2-DH5) | Duty Cycle (%):          | 76.8  |
| Antenna Configuration: | Beamforming               | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1)     | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 11.87                                | 12.06 | - | - | 14.94    | 25.83       | -10.89      |
| 2441                 | 11.73                                | 11.53 | - | - | 14.59    | 25.83       | -11.23      |
| 2480                 | 11.86                                | 11.66 | - | - | 14.75    | 25.83       | -11.08      |

**Table 74 - FCC Maximum Conducted (peak) Output Power Results**

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 11.87                                | 12.06 | - | - | 14.94    | 30.00       | -15.06      | 25.11      | 36.00            | -10.89           |
| 2441                 | 11.73                                | 11.53 | - | - | 14.59    | 30.00       | -15.41      | 24.77      | 36.00            | -11.23           |
| 2480                 | 11.86                                | 11.66 | - | - | 14.75    | 30.00       | -15.25      | 24.92      | 36.00            | -11.08           |

**Table 75 - ISED Maximum Conducted (peak) Output Power Results**



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

| DUT Configuration      |                       |                          |       |
|------------------------|-----------------------|--------------------------|-------|
| Mode:                  | iPA 8-DPSK (3-DH5)    | Duty Cycle (%):          | 76.9  |
| Antenna Configuration: | Beamforming           | DCCF (dB):               | -     |
| Active Port(s):        | A+B (Core 0 + Core 1) | Peak Antenna Gain (dBi): | 10.17 |

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |
| 2402                 | 12.39                                | 12.58 | - | - | 15.47    | 25.83       | -10.36      |
| 2441                 | 12.16                                | 12.01 | - | - | 15.07    | 25.83       | -10.76      |
| 2480                 | 12.25                                | 12.20 | - | - | 15.20    | 25.83       | -10.63      |

**Table 76 - FCC Maximum Conducted (peak) Output Power Results**

| Test Frequency (MHz) | Maximum Conducted Output Power (dBm) |       |   |   |          | Limit (dBm) | Margin (dB) | EIRP (dBm) | EIRP Limit (dBm) | EIRP Margin (dB) |
|----------------------|--------------------------------------|-------|---|---|----------|-------------|-------------|------------|------------------|------------------|
|                      | A                                    | B     | C | D | $\Sigma$ |             |             |            |                  |                  |
| 2402                 | 12.39                                | 12.58 | - | - | 15.47    | 30.00       | -14.53      | 25.64      | 36.00            | -10.36           |
| 2441                 | 12.16                                | 12.01 | - | - | 15.07    | 30.00       | -14.93      | 25.24      | 36.00            | -10.76           |
| 2480                 | 12.25                                | 12.20 | - | - | 15.20    | 30.00       | -14.80      | 25.37      | 36.00            | -10.63           |

**Table 77 - ISED Maximum Conducted (peak) Output Power Results**

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

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

ISED RSS-247, Limit Clause 5.4 (b)

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



## 2.6.7 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 Expires |
|------------------------------|--------------|---------|-------|-----------------------------|---------------------|
| Multimeter                   | Iso-tech     | IDM101  | 2421  | 12                          | 30-Oct-2021         |
| Hygrometer                   | Rotronic     | I-1000  | 3220  | 12                          | 16-Oct-2021         |
| AC Programmable Power Supply | iTech        | IT7324  | 5225  | -                           | O/P Mon             |
| Signal Commissioning Unit    | TUV SUD      | SCU002  | 5759  | 12                          | 30-Jun-2022         |
| USB Power Sensor             | Boonton      | RTP5008 | 5830  | 12                          | 10-May-2022         |
| USB Power Sensor             | Boonton      | RTP5008 | 5832  | 12                          | 10-May-2022         |
| USB Power Sensor             | Boonton      | RTP5008 | 5833  | 12                          | 10-May-2022         |

**Table 78**

O/P Mon – Output Monitored using calibrated equipment



## **2.7 Spurious Radiated Emissions**

### **2.7.1 Specification Reference**

FCC 47 CFR Part 15C, Clause 15.247 (d) and 15.209  
ISED RSS-247, Clause 3.3 and 5.5  
ISED RSS-GEN, Clause 6.13, 8.9

### **2.7.2 Equipment Under Test and Modification State**

A2442, S/N: DNQHW6Y3WY - Modification State 0

### **2.7.3 Date of Test**

03-August-2021 to 07-August-2021

### **2.7.4 Test Method**

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

The EUT was placed on the non-conducting platform in a manner typical of a normal installation. Ports on the EUT were terminated with loads as described in ANSI C63.4 clause 6.2.4. One port of each type was loaded with a suitable ancillary/accessory.

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

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

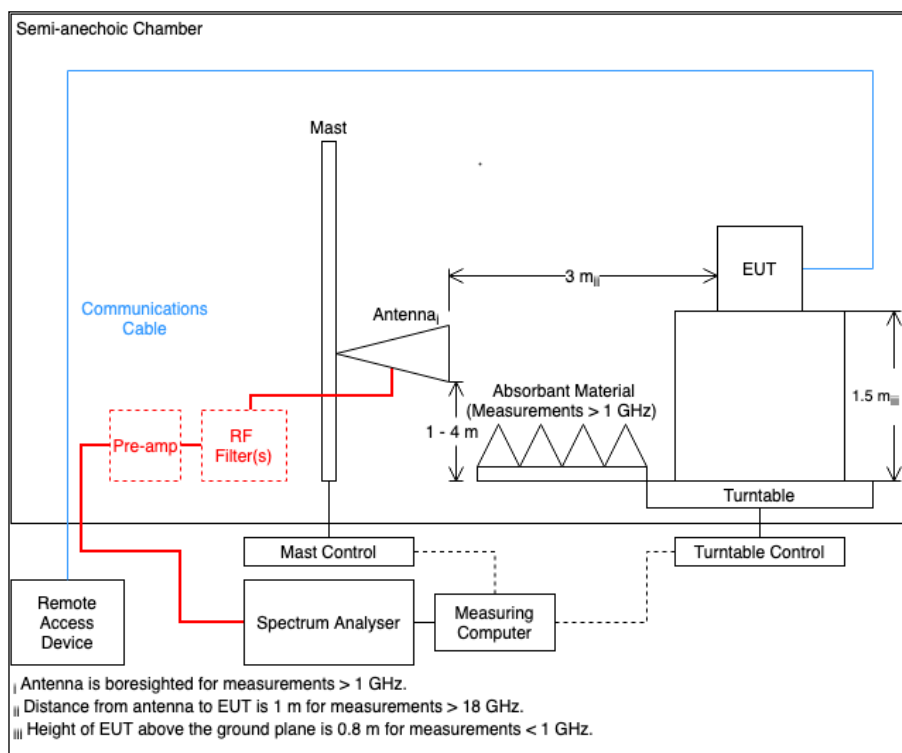
The following conversion can be applied to convert from dBuV/m to uV/m:  
 $10^{(\text{Field Strength in dBuV/m}/20)}$

At a measurement distance of 1 meter the limit line was increased by  $20 \cdot \text{LOG}(3/1) = 9.54$  dB.

Where formal measurements have been necessary, the results have been presented in the emissions table.

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

### 2.7.5 Example Test Setup Diagram



**Figure 109**

### 2.7.6 Environmental Conditions

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 20.8 - 23.4 °C |
| Relative Humidity   | 50.5 - 60.9 %  |

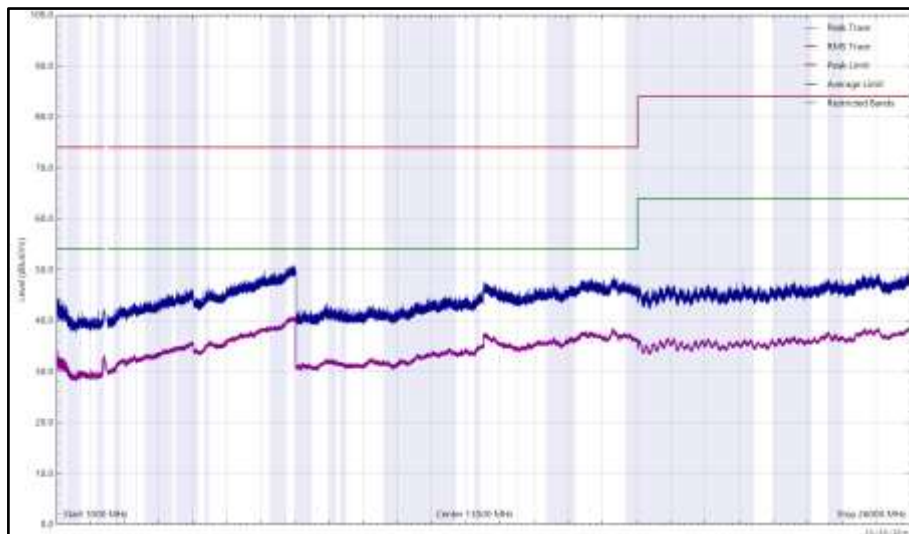
## 2.7.7 Test Results

### 2.4 GHz Bluetooth - FHSS

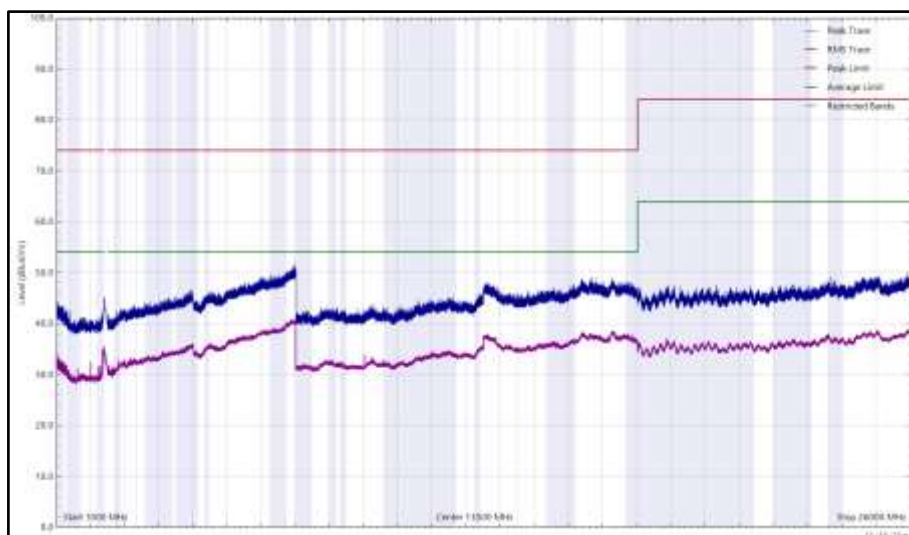
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

**Table 79 - 2402 MHz (CH0), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz**

\*No emissions found within 6 dB of the limit.



**Figure 110 - 2402 MHz (CH0), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal**



**Figure 111 - 2402 MHz (CH0), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical**



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

Table 80 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz

\*No emissions found within 6 dB of the limit.

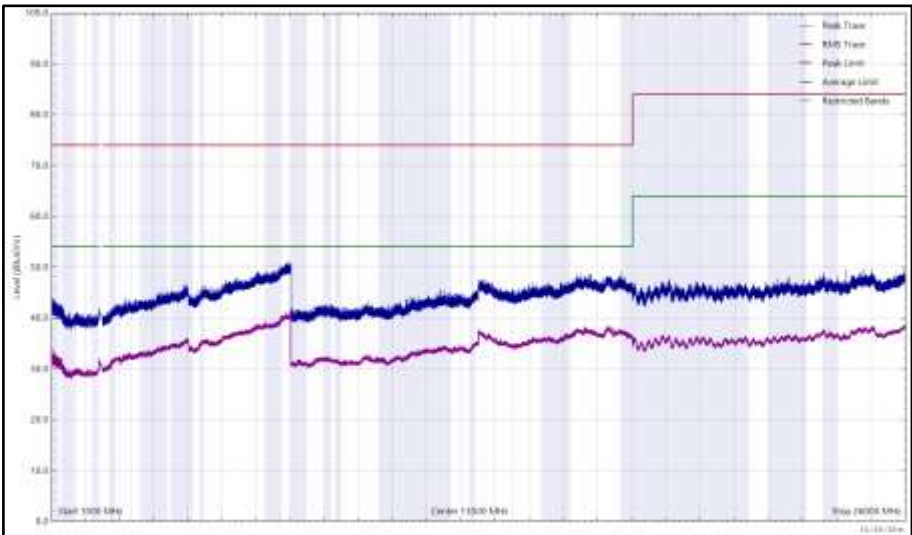


Figure 112 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal

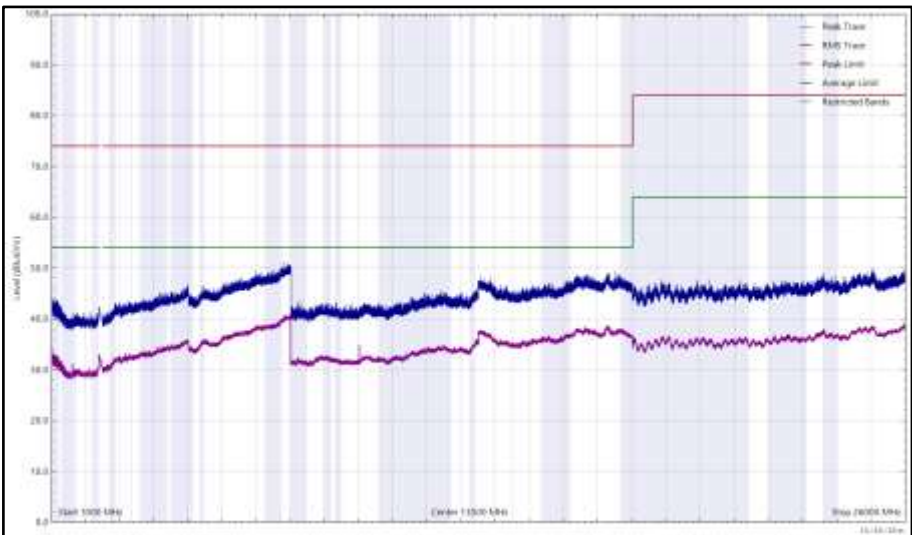


Figure 113 - 2402 MHz (CH0), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical



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

Table 81 - 2402 MHz (CH0), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz

\*No emissions found within 6 dB of the limit.

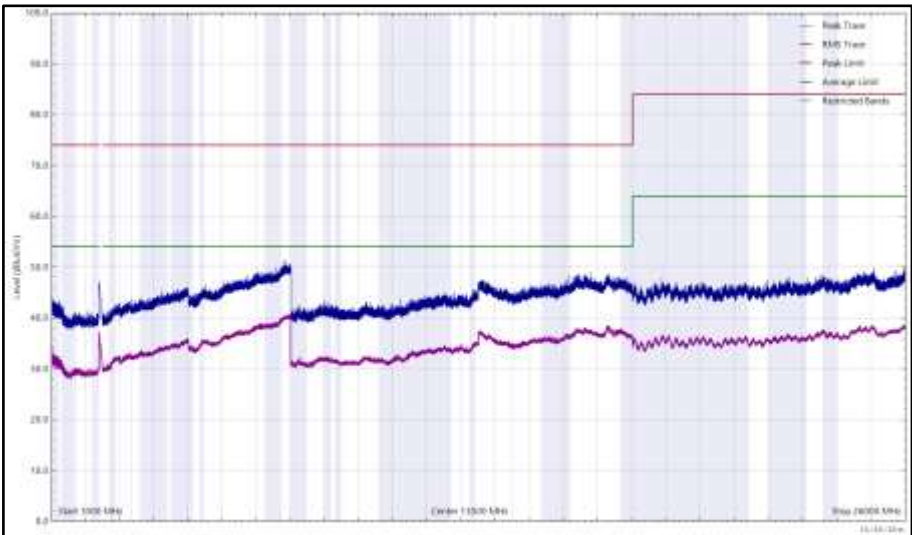


Figure 114 - 2402 MHz (CH0), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal

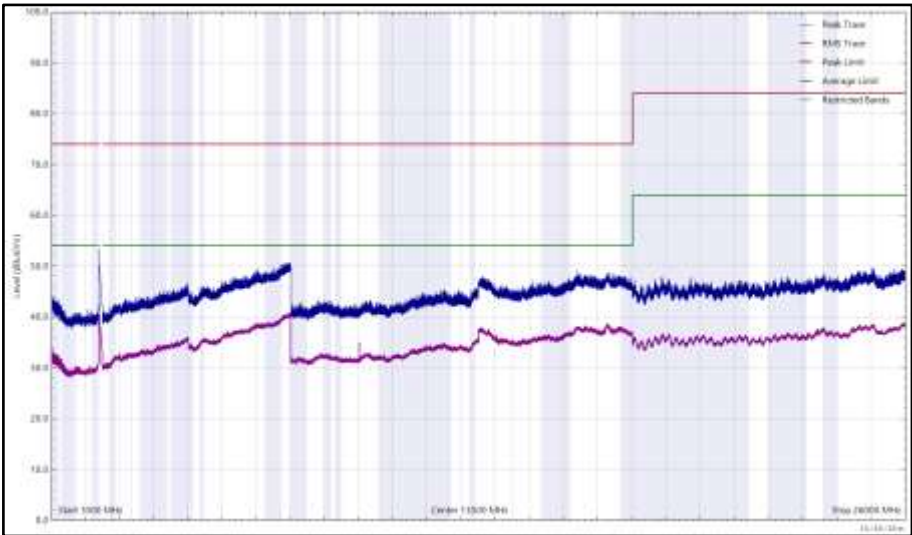


Figure 115 - 2402 MHz (CH0), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical



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

Table 82 - 2441 MHz (CH39), DH5, iPA, Core 0 + Core 1, 30 MHz to 26 GHz

\*No emissions found within 6 dB of the limit.

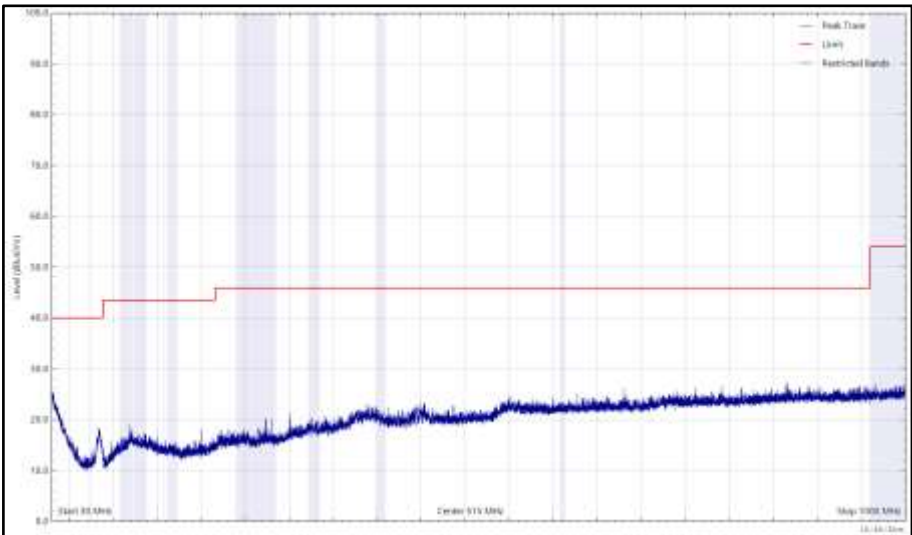


Figure 116 - 2441 MHz (CH39), DH5, iPA, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)

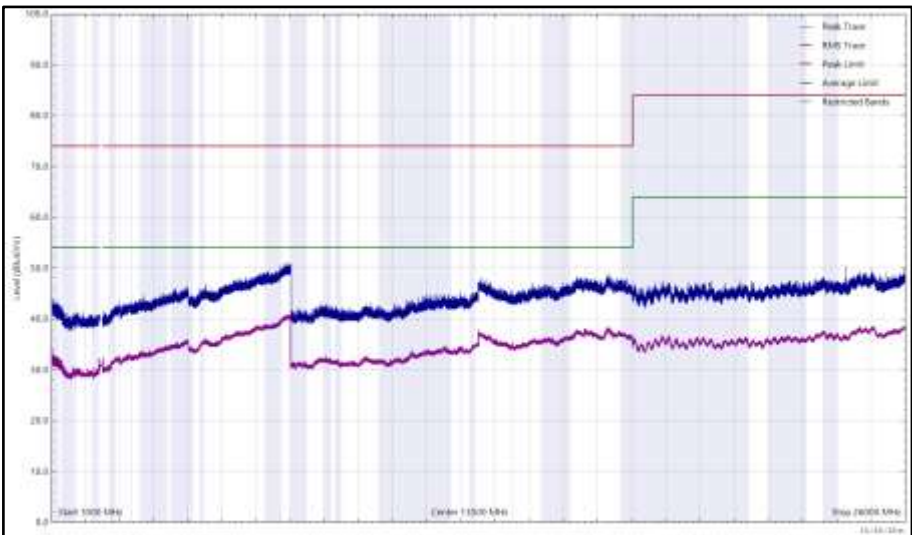


Figure 117 - 2441 MHz (CH39), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal

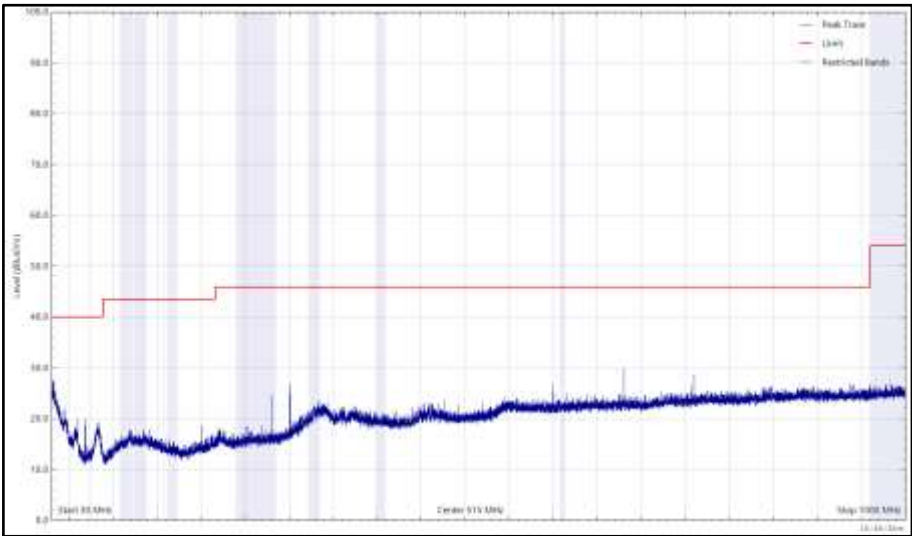


Figure 118 - 2441 MHz (CH39), DH5, iPA, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

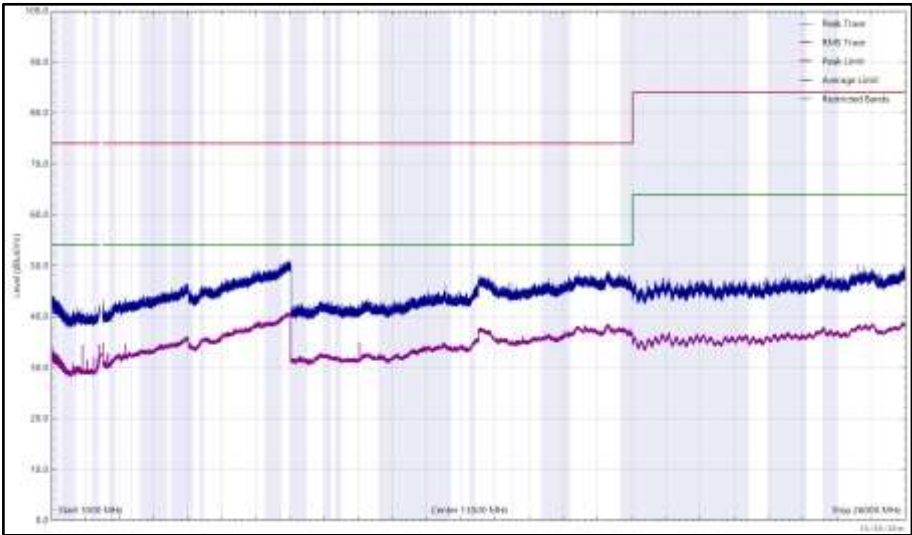
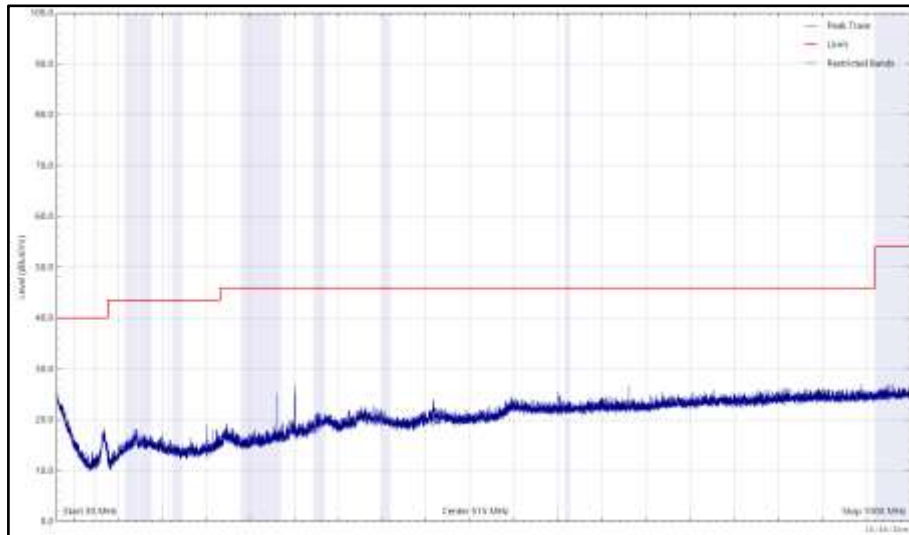


Figure 119 - 2441 MHz (CH39), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical

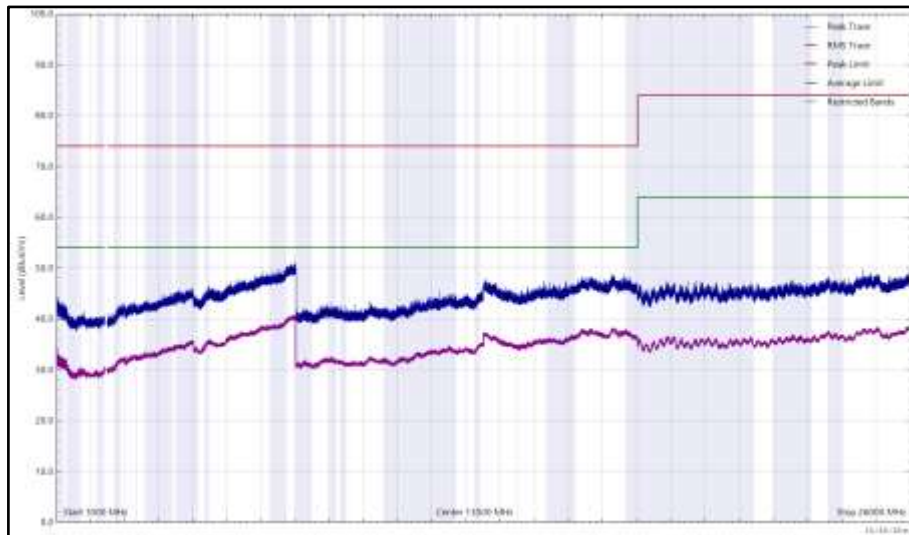
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

**Table 83 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 26 GHz**

\*No emissions found within 6 dB of the limit.



**Figure 120 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 121 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal**

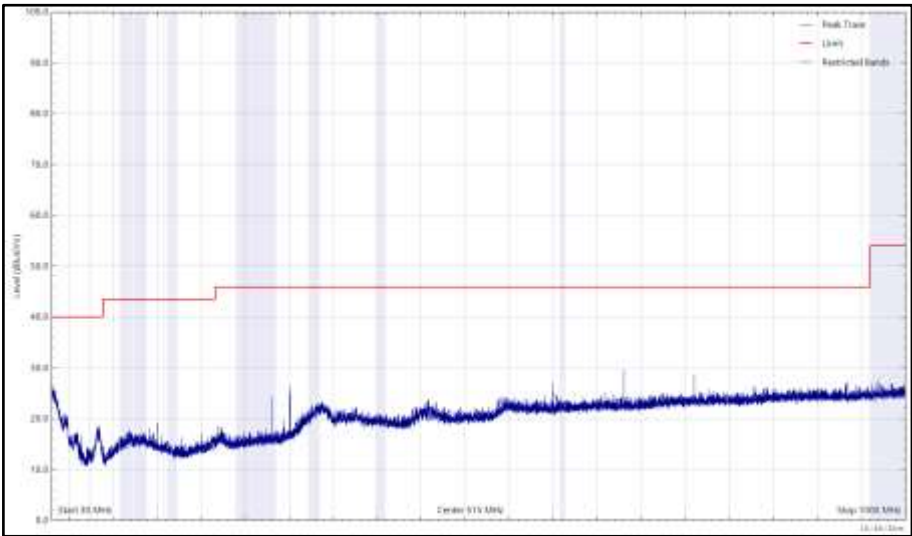


Figure 122 - 2441 MHz (CH39), DH5, iPA, Core 2, 30 MHz to 1 GHz, Vertical (Peak)

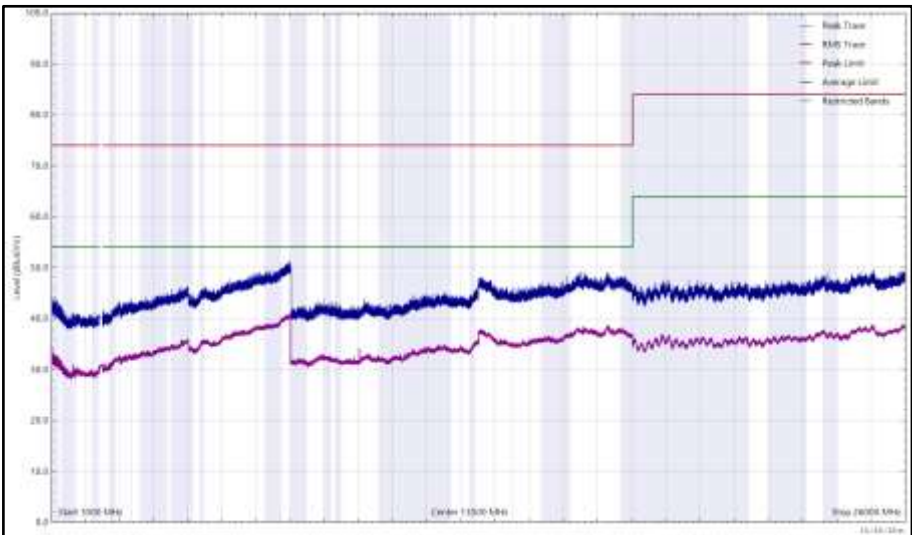
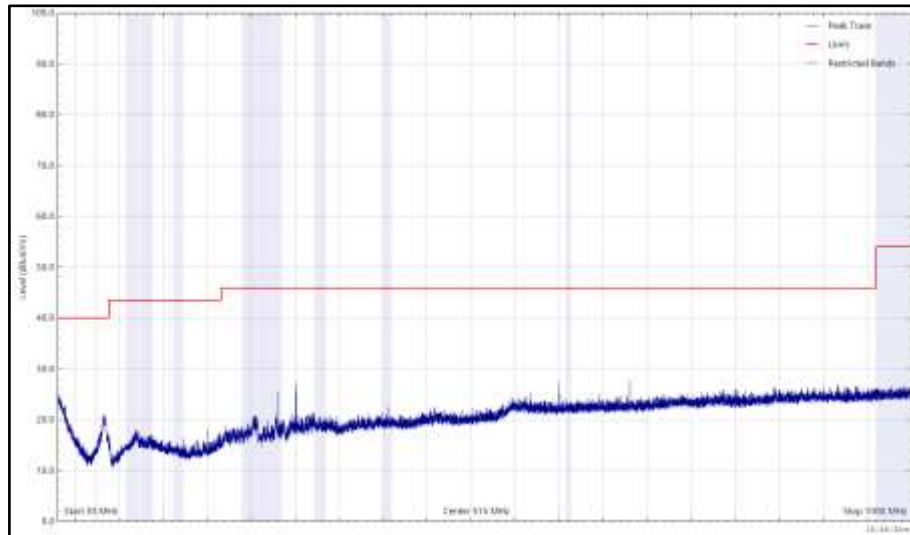


Figure 123 - 2441 MHz (CH39), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical

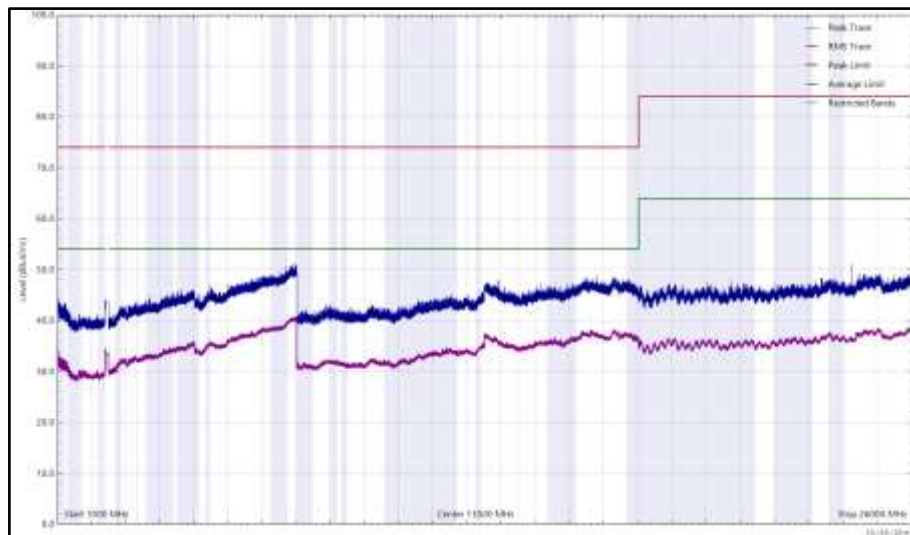
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

**Table 84 - 2441 MHz (CH39), 2DH5, ePA, Core 0 + Core 1, 30 MHz to 26 GHz**

\*No emissions found within 6 dB of the limit.



**Figure 124 - 2441 MHz (CH39), 2DH5, ePA, Core 0 + Core 1, 30 MHz to 1 GHz, Horizontal (Peak)**



**Figure 125 - 2441 MHz (CH39), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal**

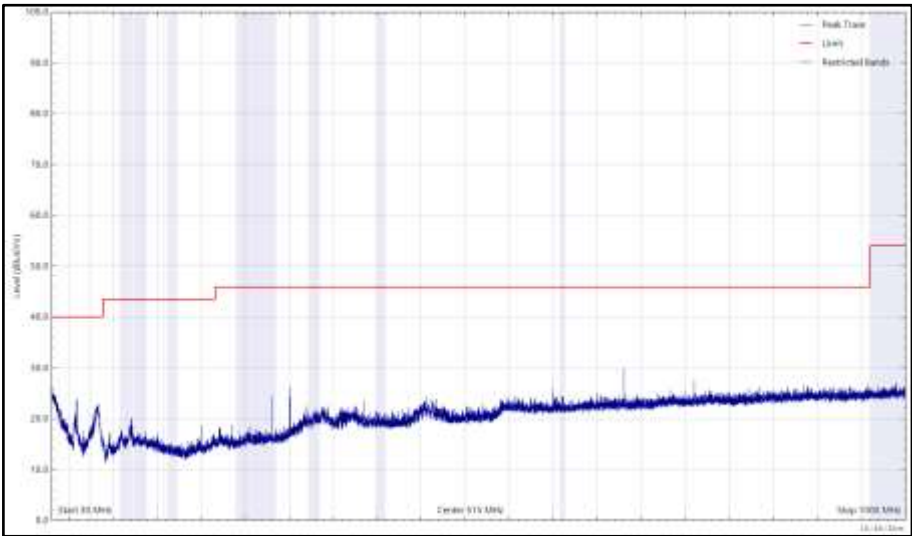


Figure 126 - 2441 MHz (CH39), 2DH5, ePA, Core 0 + Core 1, 30 MHz to 1 GHz, Vertical (Peak)

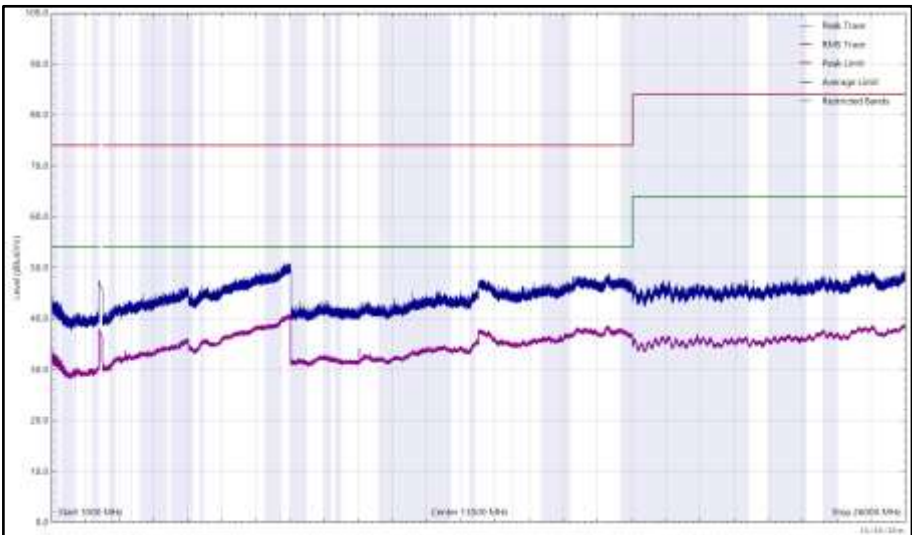
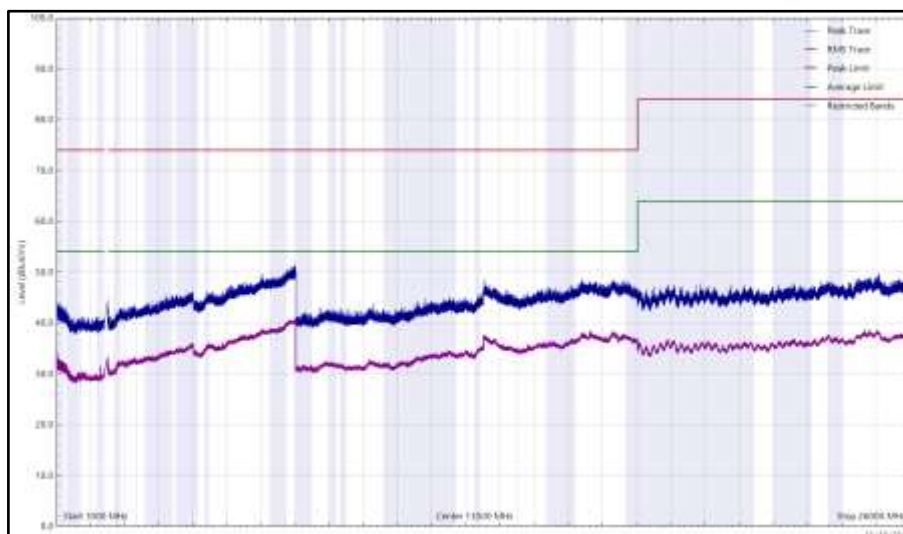


Figure 127 - 2441 MHz (CH39), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical

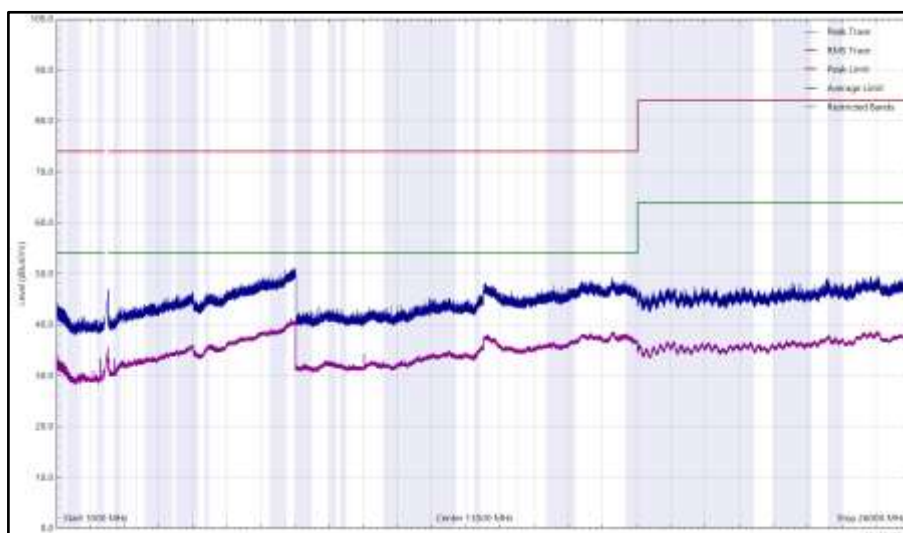
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

**Table 85 - 2480 MHz (CH78), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz**

\*No emissions found within 6 dB of the limit.



**Figure 128 - 2480 MHz (CH78), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal**

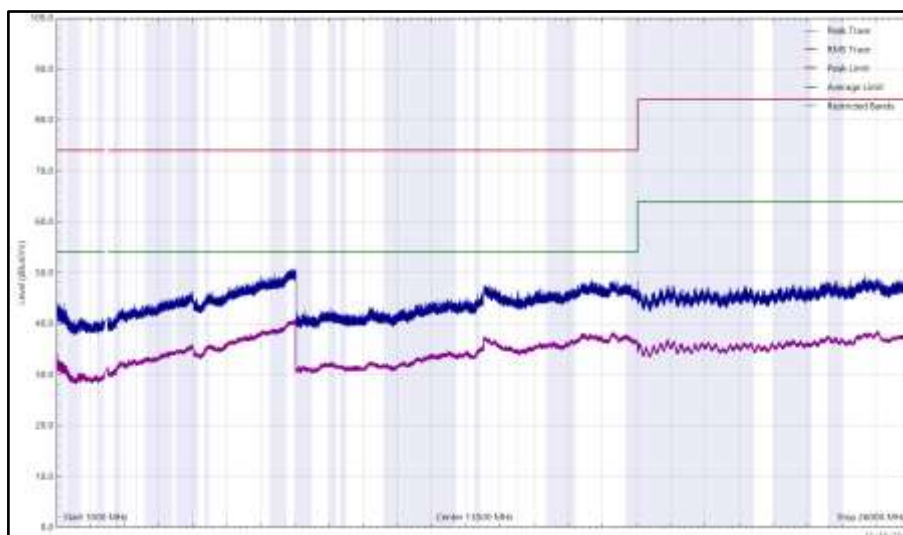


**Figure 129 - 2480 MHz (CH78), DH5, iPA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical**

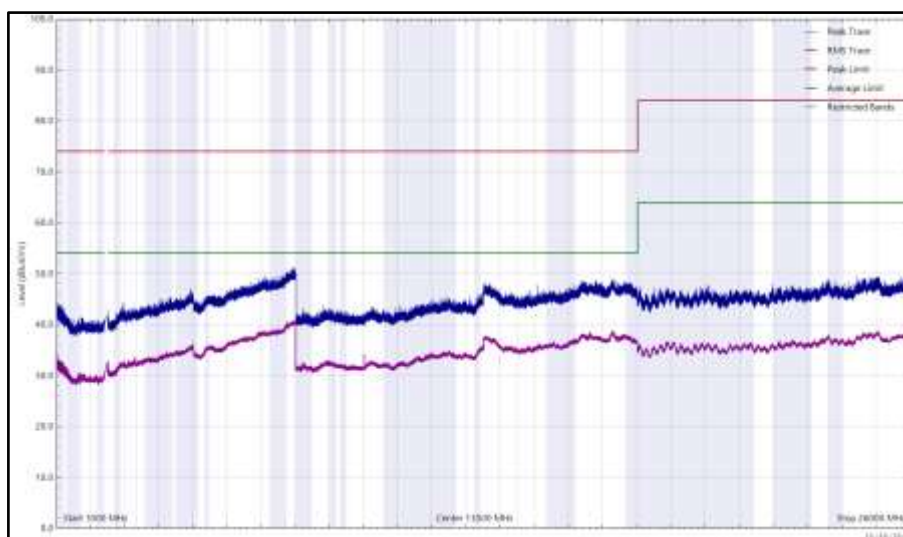
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

**Table 86 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz**

\*No emissions found within 6 dB of the limit.



**Figure 130 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Horizontal**

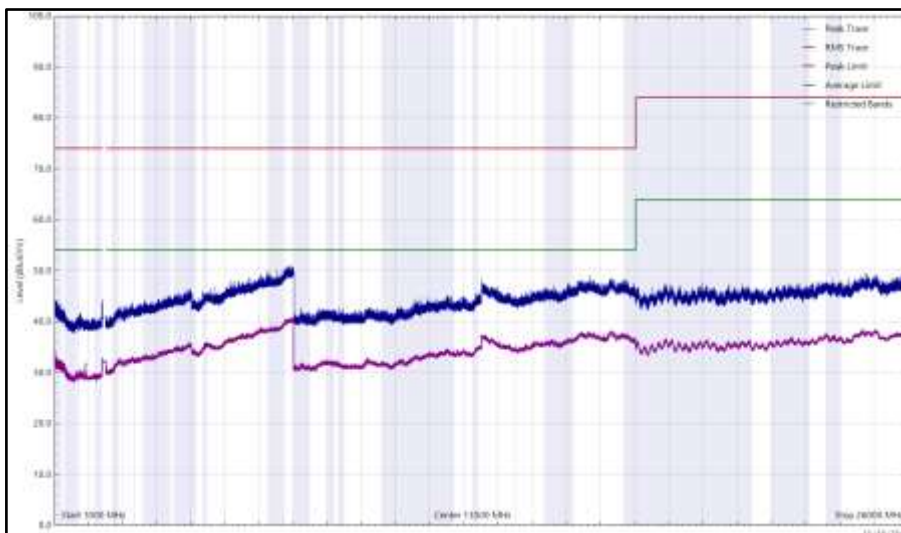


**Figure 131 - 2480 MHz (CH78), DH5, iPA, Core 2, 1 GHz to 26 GHz, Vertical**

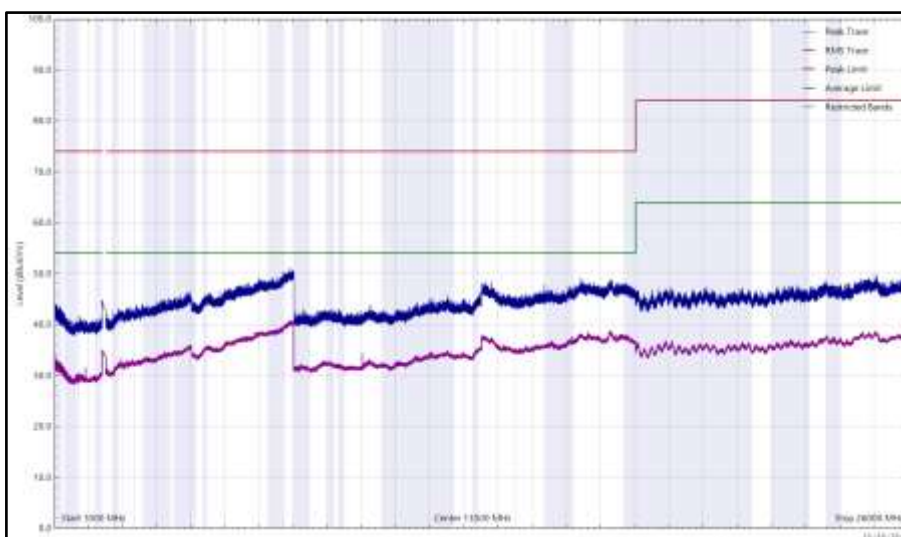
| Frequency (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Angle (°) | Height (cm) | Polarisation |
|-----------------|----------------|----------------|-------------|----------|-----------|-------------|--------------|
| *               |                |                |       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

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

\*No emissions found within 6 dB of the limit.



**Figure 132 - 2480 MHz (CH78), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Horizontal**



**Figure 133 - 2480 MHz (CH78), 2DH5, ePA, Core 0 + Core 1, 1 GHz to 26 GHz, Vertical**



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.

In addition, radiated emissions which fall in the restricted bands, as defined in RSS-GEN, clause 8.10, must also comply with the radiated emission limits specified in RSS-GEN clause 8.9.



## 2.7.8 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

| Instrument                                | Manufacturer        | Type No                                  | TE No | Calibration Period (months) | Calibration Expires |
|-------------------------------------------|---------------------|------------------------------------------|-------|-----------------------------|---------------------|
| Screened Room (5)                         | Rainford            | Rainford                                 | 1545  | 36                          | 15-Apr-2024         |
| Turntable Controller                      | Inn-Co GmbH         | CO 1000                                  | 1606  | -                           | TU                  |
| Programmable Power Supply                 | Iso-tech            | IPS 2010                                 | 2437  | -                           | O/P Mon             |
| Antenna with permanent attenuator (Bilog) | Chase               | CBL6143                                  | 2904  | 24                          | 30-Sep-2021         |
| Tilt Antenna Mast                         | Maturo GmbH         | TAM 4.0-P                                | 3916  | -                           | TU                  |
| Mast Controller                           | Maturo GmbH         | NCD                                      | 3917  | -                           | TU                  |
| True RMS Multimeter                       | Fluke               | 179                                      | 4007  | 12                          | 29-Oct-2021         |
| Cable 1503 2M 2.92(P)m 2.92(P)m           | Rhophase            | KPS-1503A-2000-KPS                       | 4293  | 12                          | 16-Nov-2021         |
| Double Ridge Broadband Horn Antenna       | Schwarzbeck         | BBHA 9120 B                              | 4848  | 12                          | 01-Apr-2022         |
| 4dB Attenuator                            | Pasternack          | PE7047-4                                 | 4935  | 24                          | 30-Sep-2021         |
| 8 - 18 GHz pre amp                        | Wright Technologies | PS06-0061/PS06-0060                      | 4971  | 6                           | 04-Nov-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         |
| EmX Emissions Software                    | TUV SUD             | V2.1.11                                  | 5125  | -                           | Software            |
| 3 GHz High pass filter                    | Wainwright          | WHKX12-2580-3000-18000-80SS              | 5220  | 12                          | 26-Mar-2022         |
| Preamplifier (30dB 1GHz to 18GHz)         | Schwarzbeck         | BBV 9718 C                               | 5261  | 12                          | 08-Apr-2022         |
| Antenna (DRG Horn 7.5-18GHz)              | Schwarzbeck         | HWRD750                                  | 5348  | 12                          | 22-Sep-2021         |
| 1m -SMA Cable                             | Junkosha            | MWX221-01000AMSAMS/A                     | 5513  | 12                          | 09-Apr-2022         |
| 1m -SMA Cable                             | Junkosha            | MWX221-01000AMSAMS/A                     | 5514  | 12                          | 09-Apr-2022         |
| 2m SMA Cable                              | Junkosha            | MWX221-02000AMSAMS/A                     | 5517  | 12                          | 09-Apr-2022         |
| 8m N-Type Cable                           | Junkosha            | MWX221-08000NMSNMS/B                     | 5520  | 12                          | 24-Mar-2022         |
| EMI Test Receiver                         | Rohde & Schwarz     | ESW44                                    | 5527  | 12                          | 15-Apr-2022         |
| 7 GHz High pass Filter                    | Wainwright          | WHKX12-5850-6800-18000-80SS              | 5549  | 12                          | 20-May-2022         |
| 1200 MHz Low Pass Filter (01)             | Mini-Circuits       | VLF-1200+                                | 5559  | 12                          | 24-May-2022         |



| Instrument                   | Manufacturer | Type No   | TE No | Calibration Period (months) | Calibration Expires |
|------------------------------|--------------|-----------|-------|-----------------------------|---------------------|
| Preamplifier (30dB 18-40GHz) | Schwarzbeck  | BBV 9721  | 5608  | 12                          | 14-Oct-2021         |
| Horn Antenna (15-40GHz)      | Schwarzbeck  | BBHA 9170 | 5609  | 12                          | 14-Oct-2021         |

**Table 88**

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



## **2.8 Authorised Band Edges**

### **2.8.1 Specification Reference**

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

### **2.8.2 Equipment Under Test and Modification State**

A2442, S/N: DNQHW6Y3WY - Modification State 0

### **2.8.3 Date of Test**

29-June-2021 to 08-July-2021

### **2.8.4 Test Method**

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

### **2.8.5 Environmental Conditions**

|                     |                |
|---------------------|----------------|
| Ambient Temperature | 19.6 - 23.6 °C |
| Relative Humidity   | 43.2 - 58.8 %  |

## 2.8.6 Test Results

### 2.4 GHz Bluetooth (FHSS)

iPA

| Mode    | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---------|---------------|------|-------------|--------------------|---------------------------|-------------|
| Static  | GFSK          | 0    | DH5         | 2402               | 2400.0                    | -66.22      |
| Static  | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2400.0                    | -54.36      |
| Static  | 8-DPSK        | 0    | 3DH5        | 2402               | 2400.0                    | -54.70      |
| Hopping | GFSK          | 0    | DH5         | 2402               | 2400.0                    | -66.33      |
| Hopping | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2400.0                    | -57.30      |
| Hopping | 8-DPSK        | 0    | 3DH5        | 2402               | 2400.0                    | -57.47      |

Table 89 - Authorised Band Edge Results

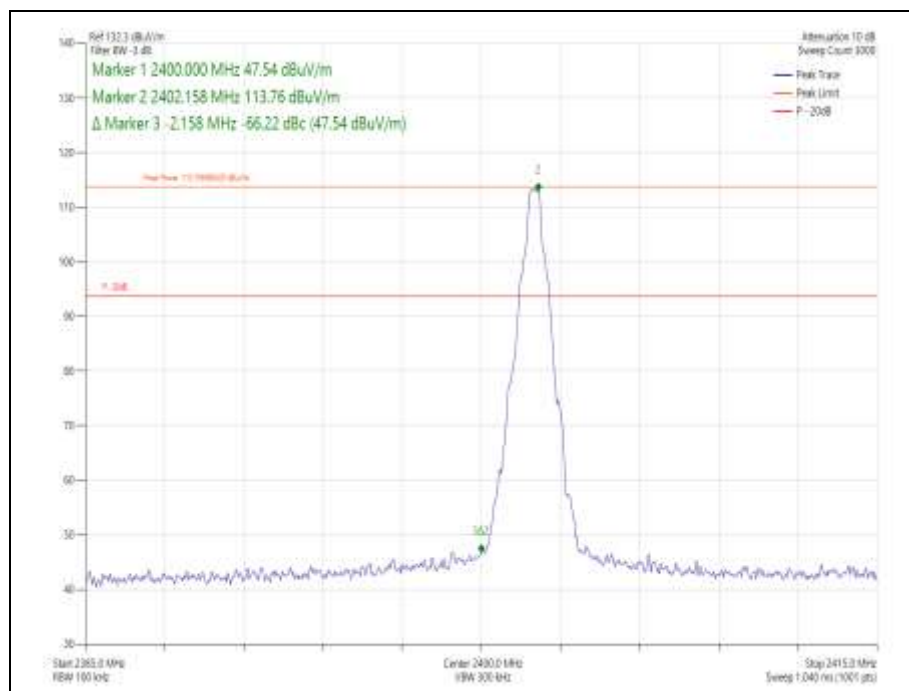


Figure 134 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

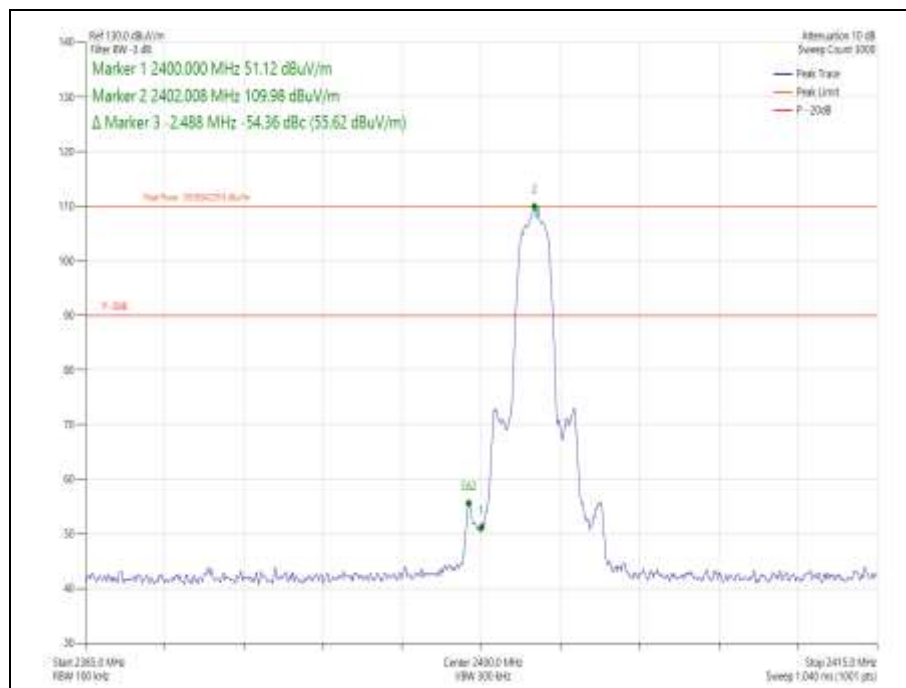


Figure 135 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

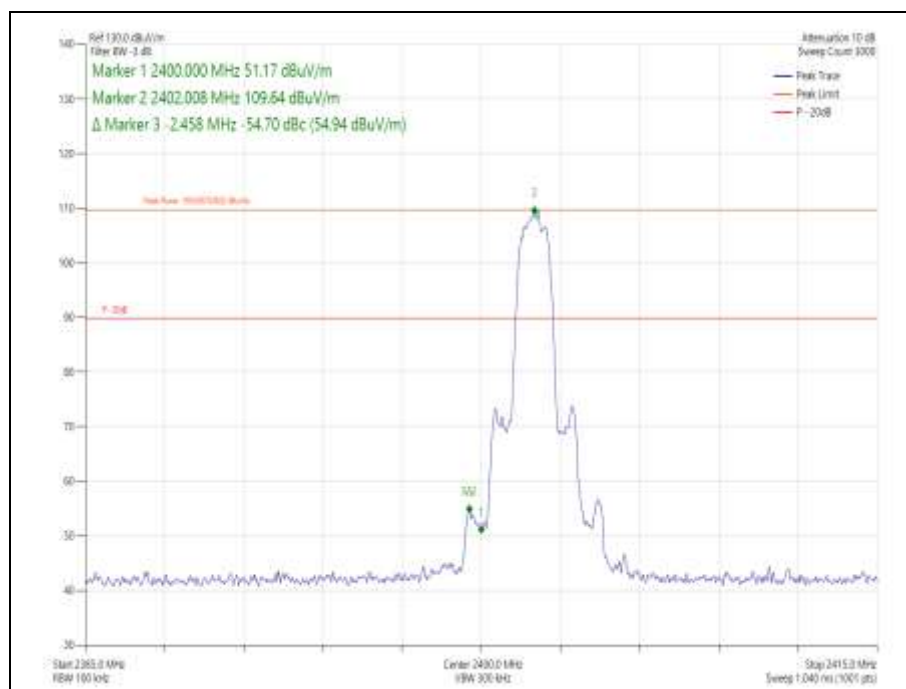


Figure 136 - Static - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

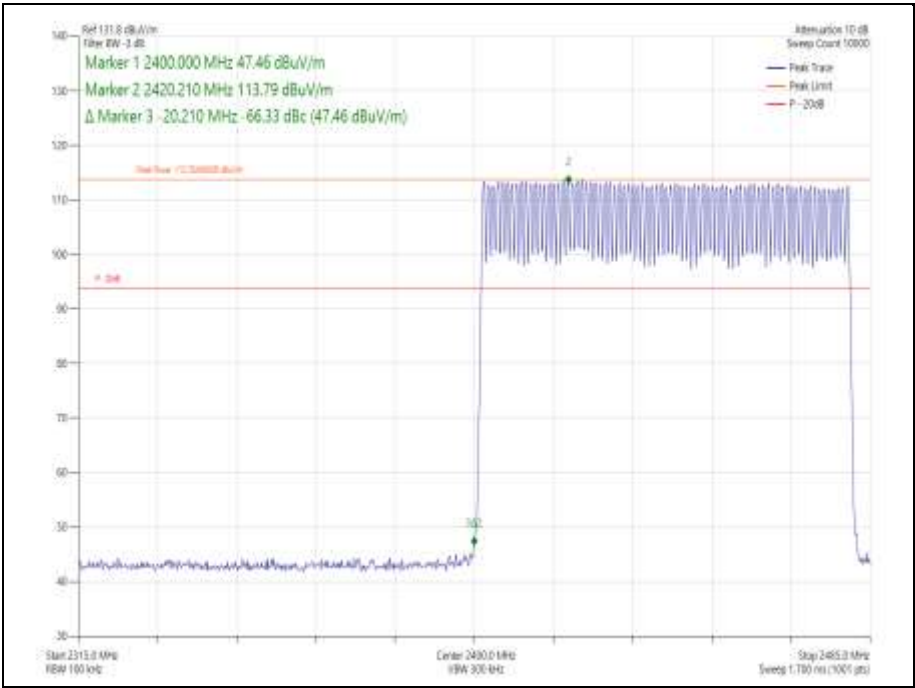


Figure 137 - Hopping - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

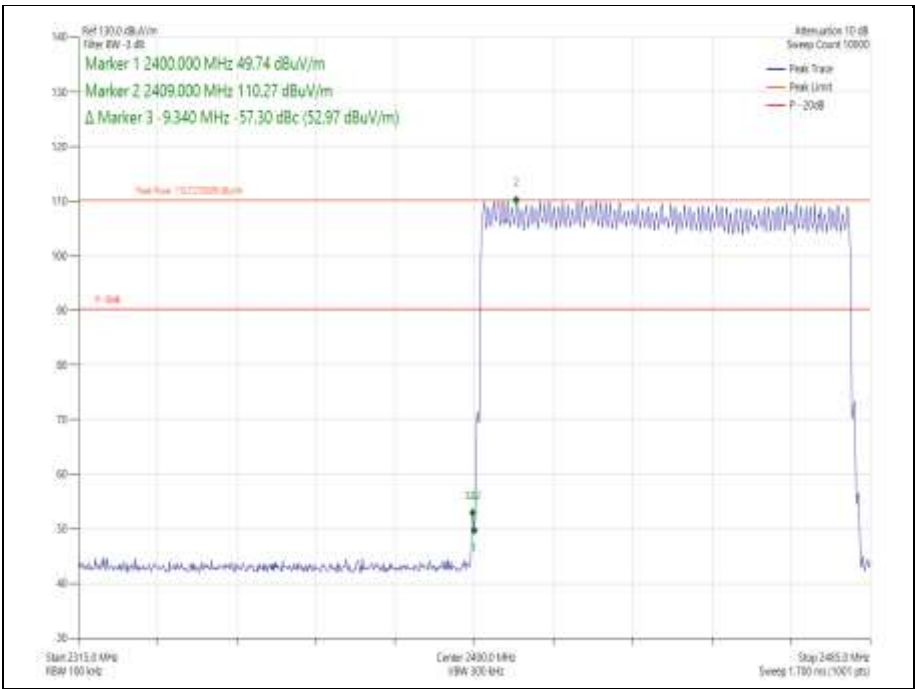


Figure 138 - Hopping -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

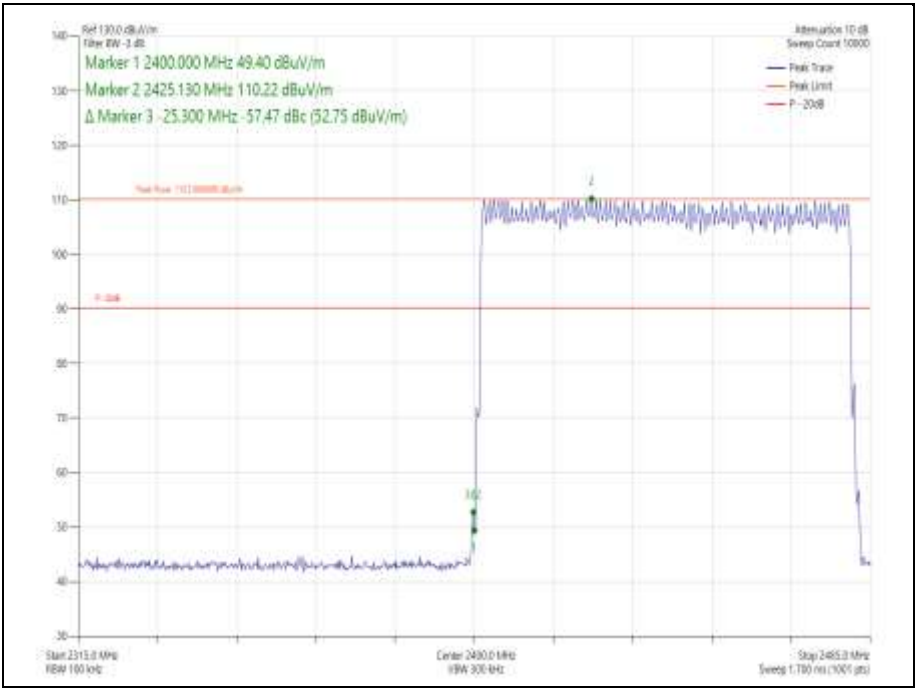


Figure 139 - Hopping - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

## 2.4 GHz Bluetooth (FHSS)

### ePA

| Mode    | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---------|---------------|------|-------------|--------------------|---------------------------|-------------|
| Static  | GFSK          | 0    | DH5         | 2402               | 2400.0                    | -67.27      |
| Static  | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2400.0                    | -62.65      |
| Static  | 8-DPSK        | 0    | 3DH5        | 2402               | 2400.0                    | -62.19      |
| Hopping | GFSK          | 0    | DH5         | 2402               | 2400.0                    | -66.49      |
| Hopping | $\pi/4$ DQPSK | 0    | 2DH5        | 2402               | 2400.0                    | -65.02      |
| Hopping | 8-DPSK        | 0    | 3DH5        | 2402               | 2400.0                    | -64.24      |

Table 90 - Authorised Band Edge Results

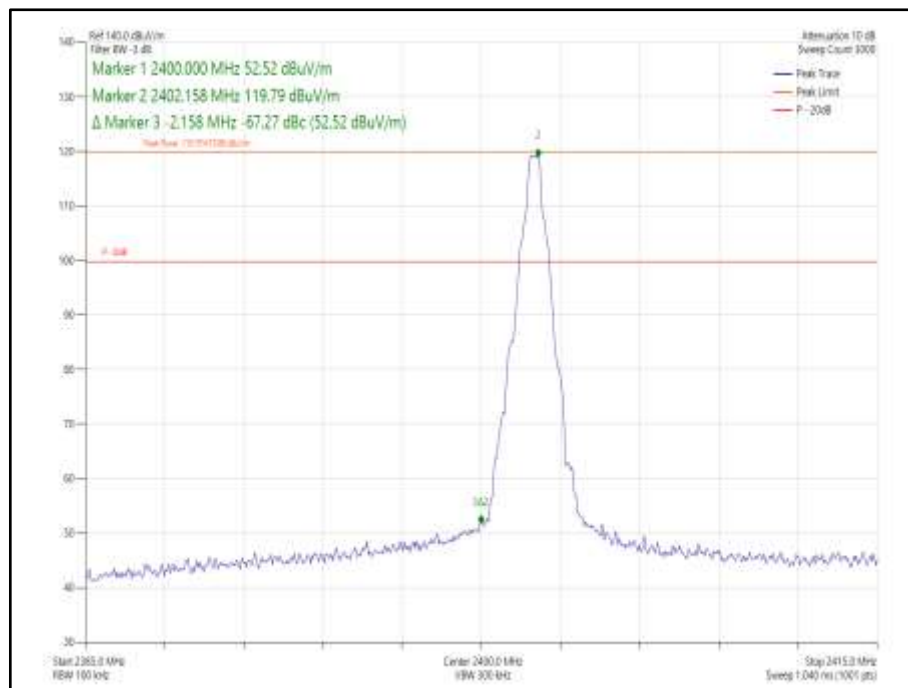


Figure 140 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

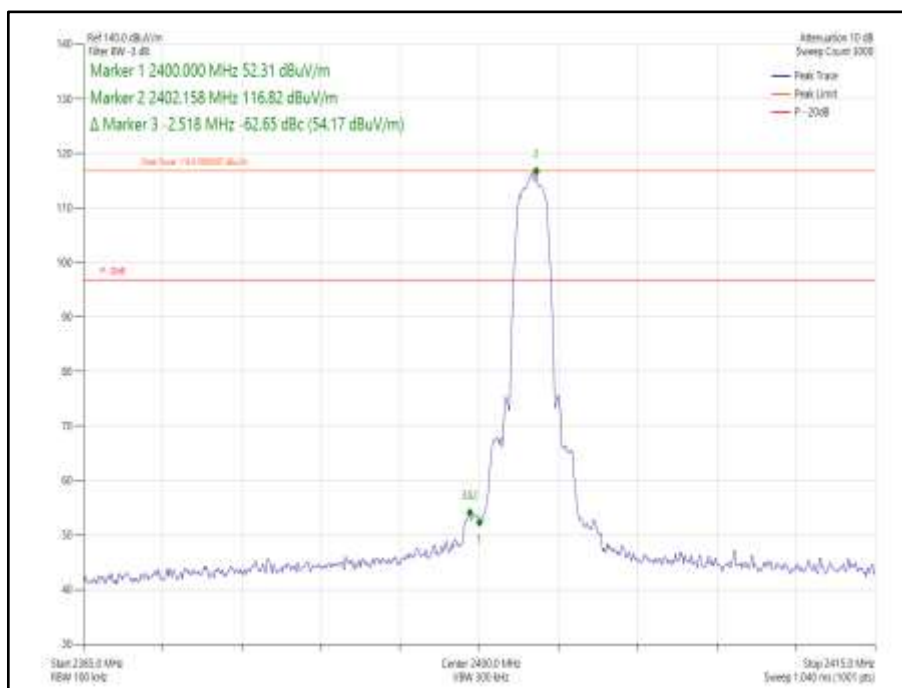


Figure 141 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

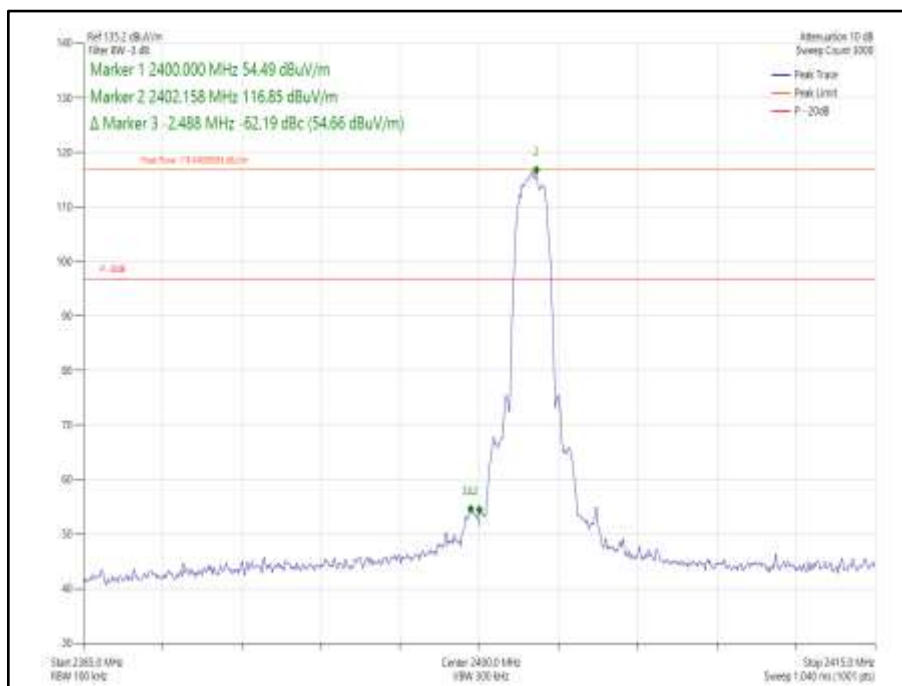


Figure 142 - Static - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

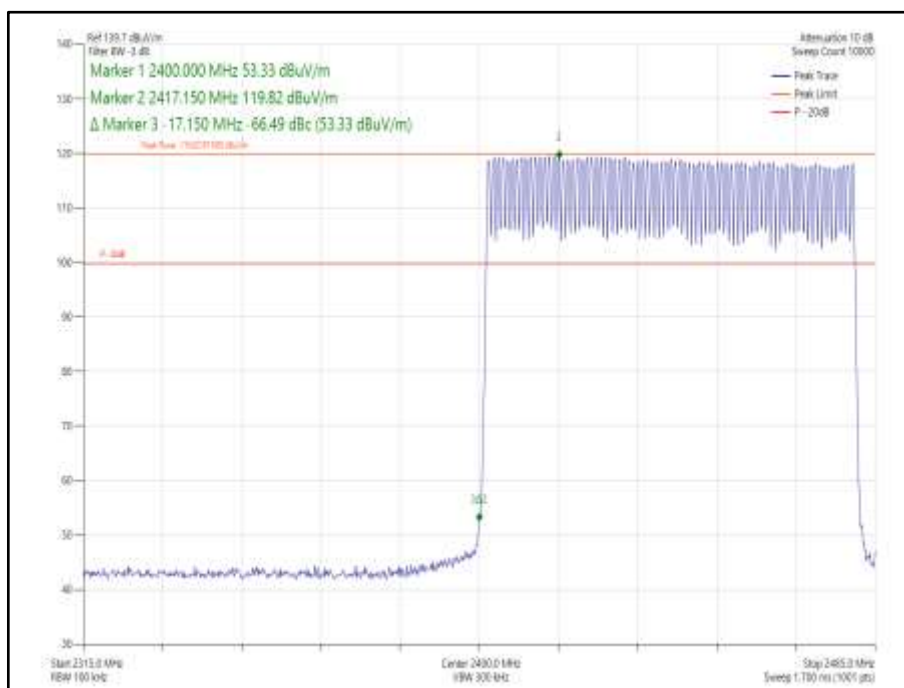


Figure 143 - Hopping - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

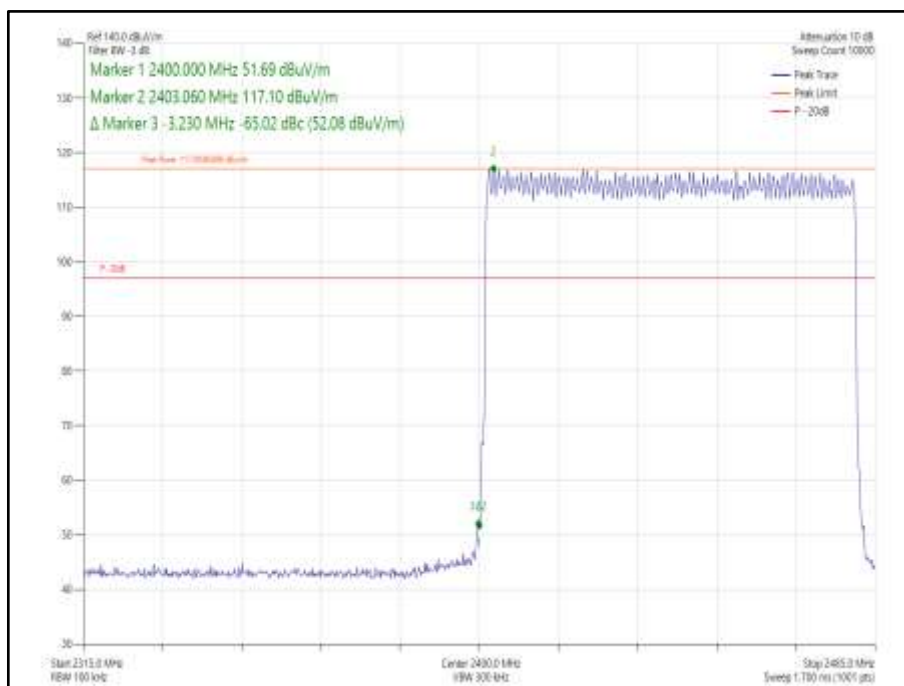


Figure 144 - Hopping -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

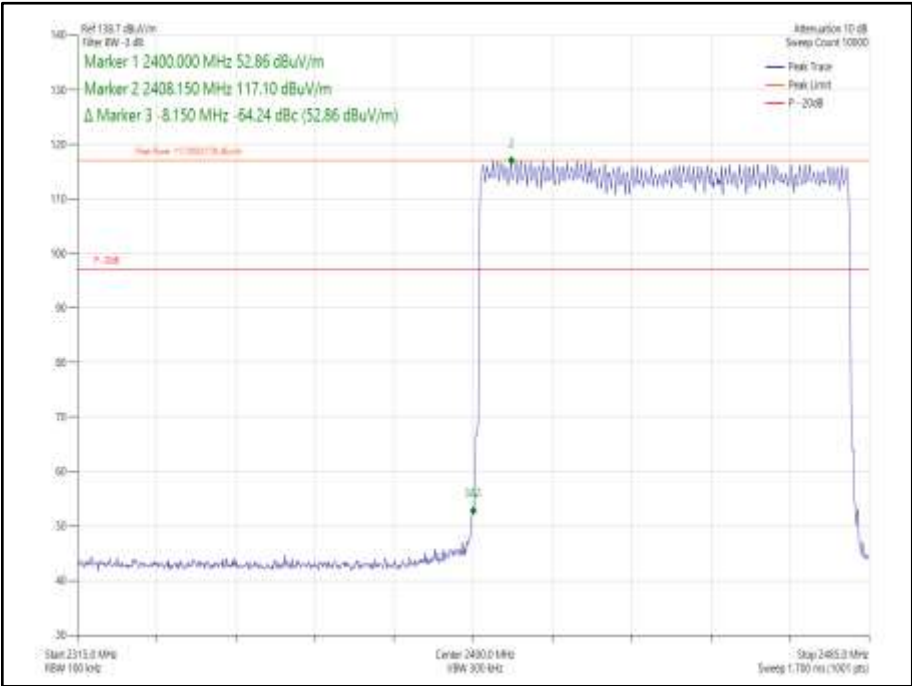


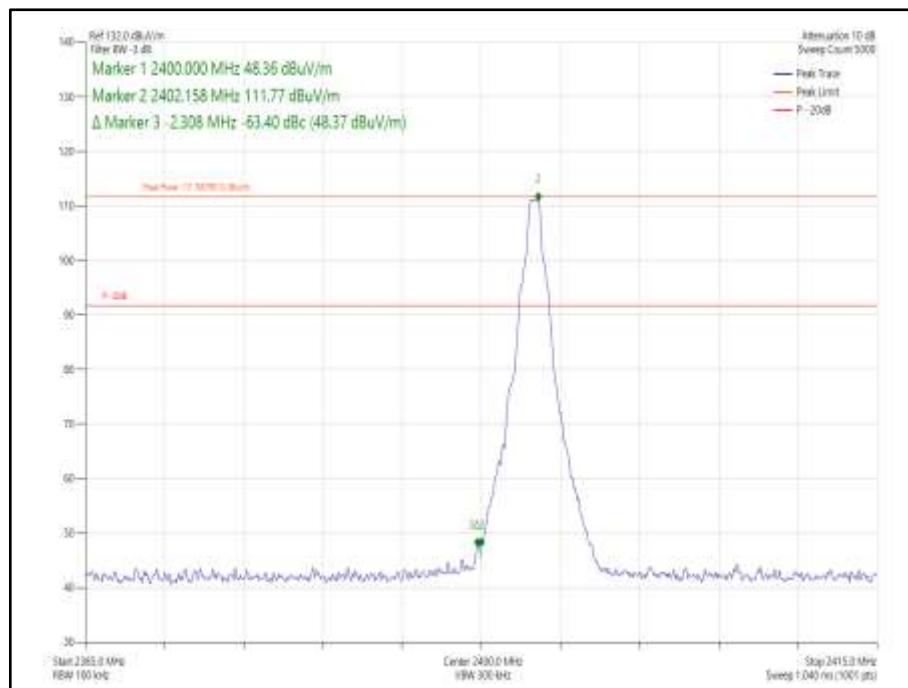
Figure 145 - Hopping - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

## 2.4 GHz Bluetooth (FHSS)

### iPA

| Mode    | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---------|---------------|------|-------------|--------------------|---------------------------|-------------|
| Static  | GFSK          | 2    | DH5         | 2402               | 2400.0                    | -63.40      |
| Static  | $\pi/4$ DQPSK | 2    | 2DH5        | 2402               | 2400.0                    | -59.12      |
| Static  | 8-DPSK        | 2    | 3DH5        | 2402               | 2400.0                    | -58.62      |
| Hopping | GFSK          | 2    | DH5         | 2402               | 2400.0                    | -63.14      |
| Hopping | $\pi/4$ DQPSK | 2    | 2DH5        | 2402               | 2400.0                    | -61.32      |
| Hopping | 8-DPSK        | 2    | 3DH5        | 2402               | 2400.0                    | -60.69      |

**Table 91 - Authorised Band Edge Results**



**Figure 146 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz**

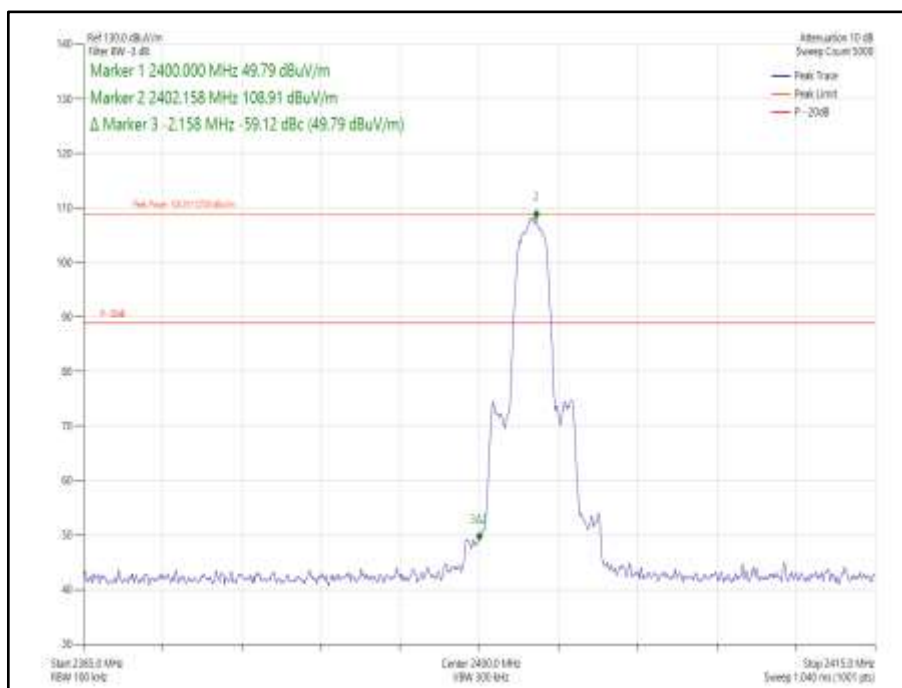


Figure 147 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

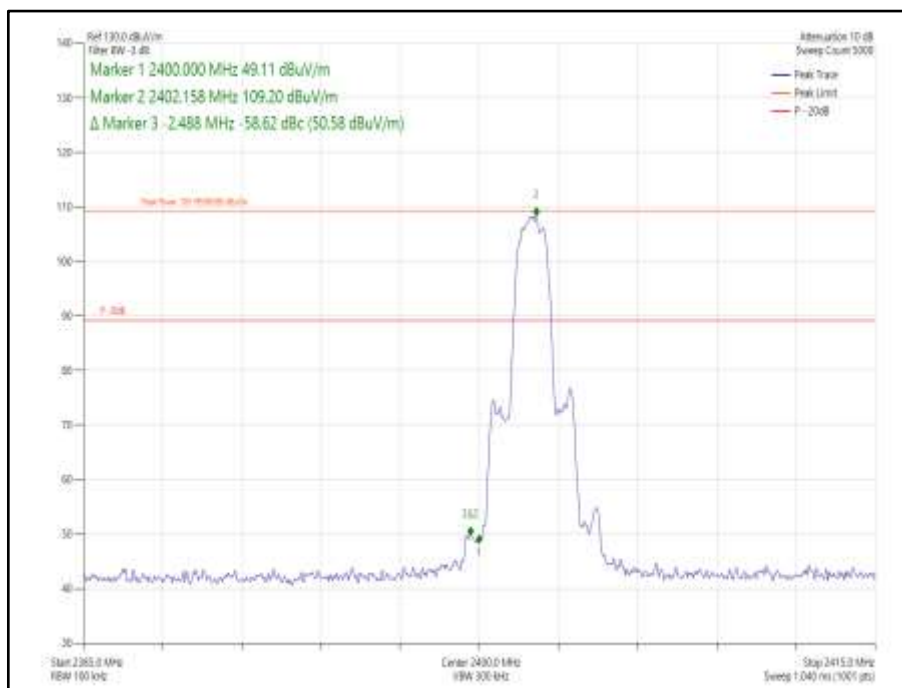


Figure 148 - Static - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

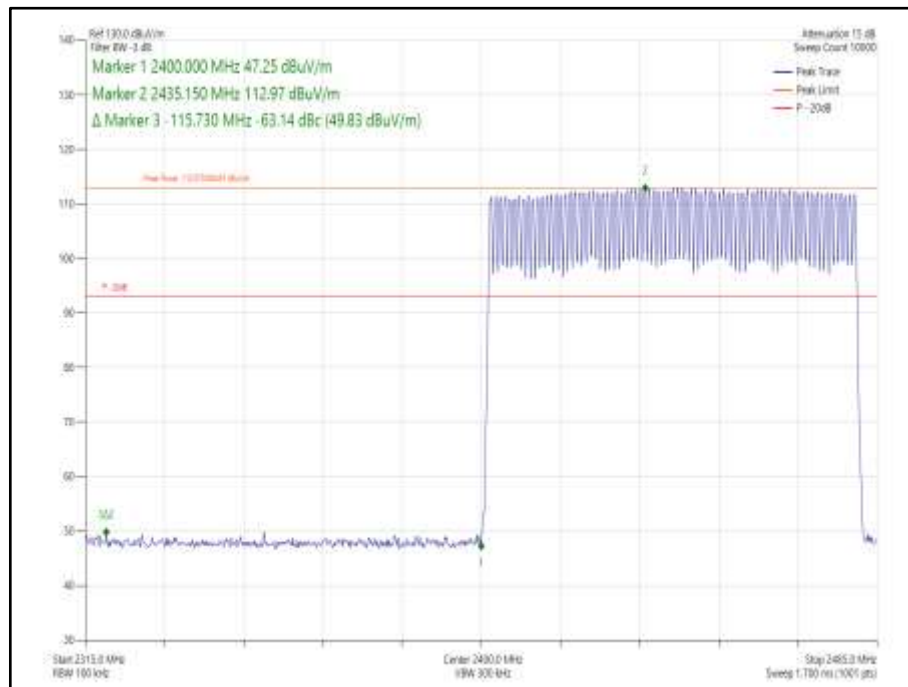


Figure 149 - Hopping - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

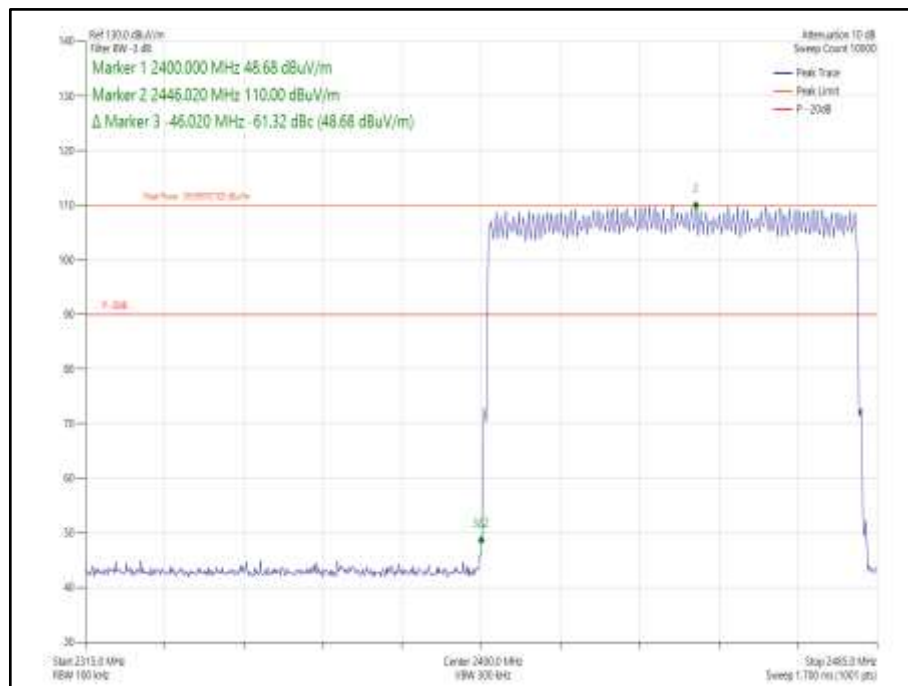


Figure 150 - Hopping -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

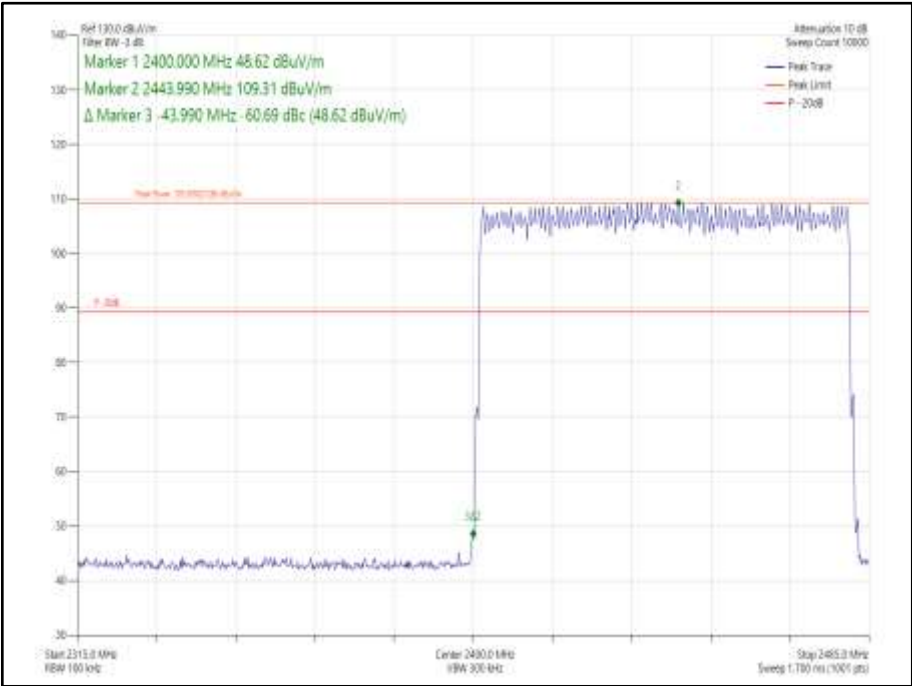


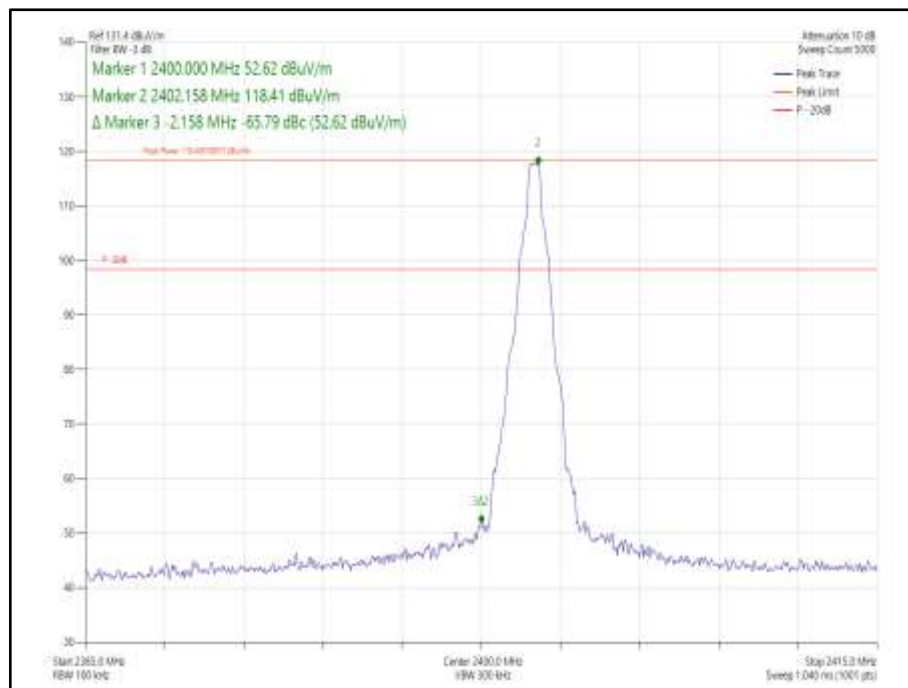
Figure 151 - Hopping - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

## 2.4 GHz Bluetooth (FHSS)

### iPA

| Mode    | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---------|---------------|------|-------------|--------------------|---------------------------|-------------|
| Static  | GFSK          | 0-1  | DH5         | 2402               | 2400.0                    | -65.79      |
| Static  | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2400.0                    | -59.37      |
| Static  | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2400.0                    | -59.42      |
| Hopping | GFSK          | 0-1  | DH5         | 2402               | 2400.0                    | -67.58      |
| Hopping | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2400.0                    | -63.69      |
| Hopping | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2400.0                    | -63.74      |

**Table 92 - Authorised Band Edge Results**



**Figure 152 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz**

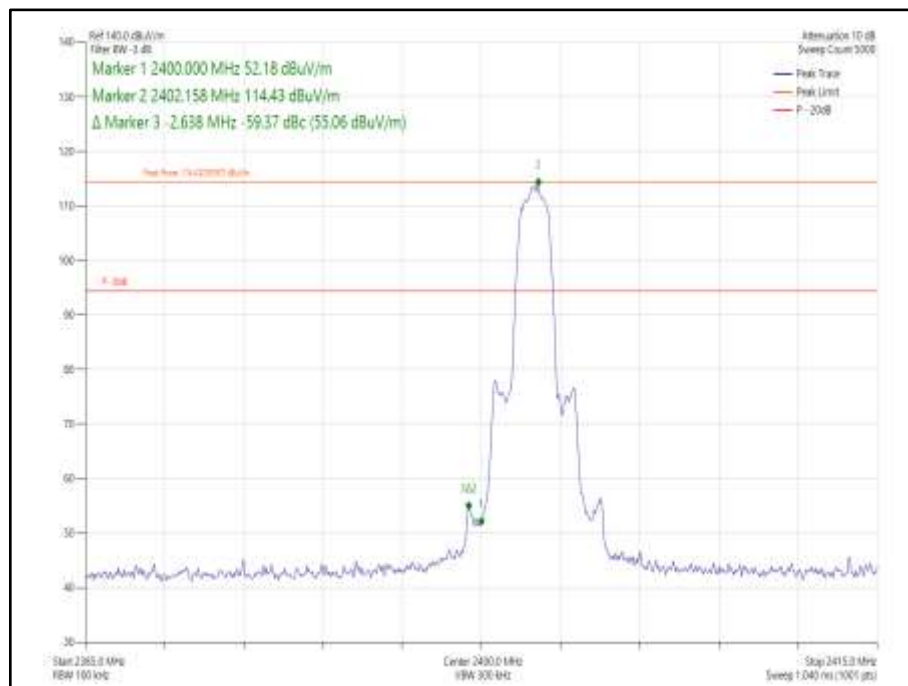


Figure 153 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

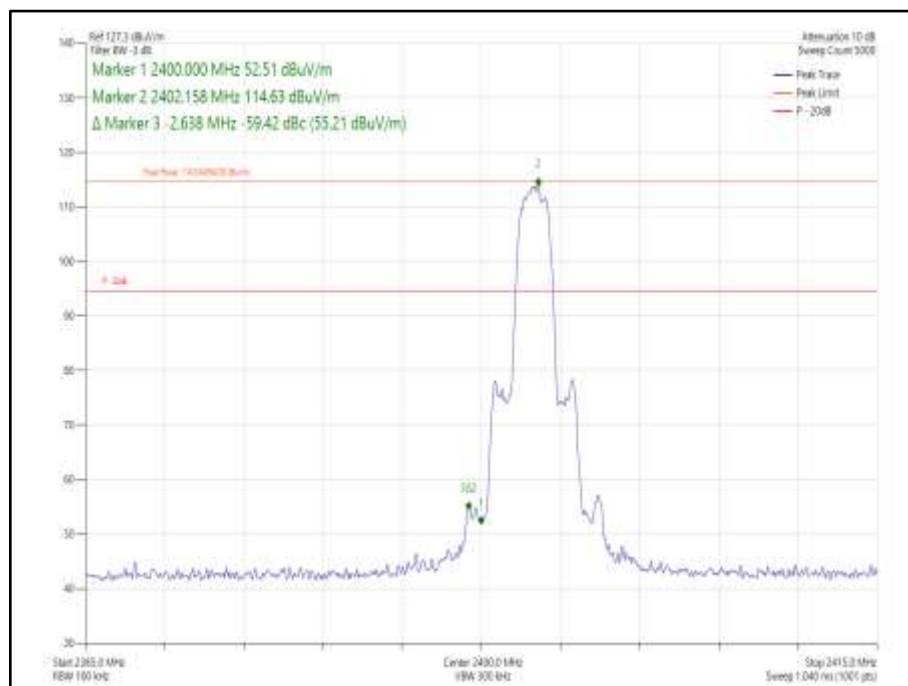


Figure 154 - Static - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

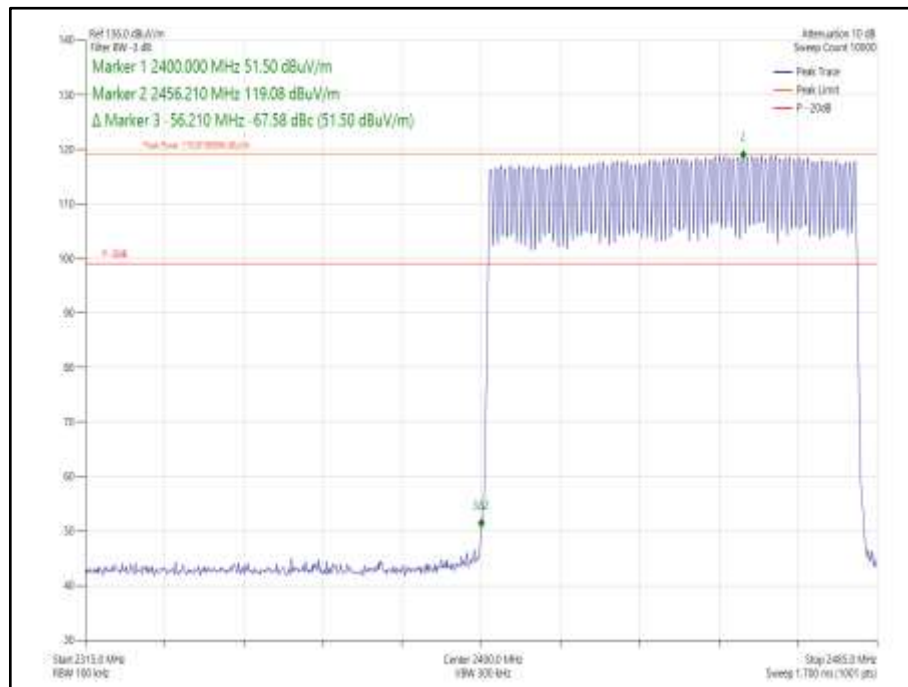


Figure 155 - Hopping - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

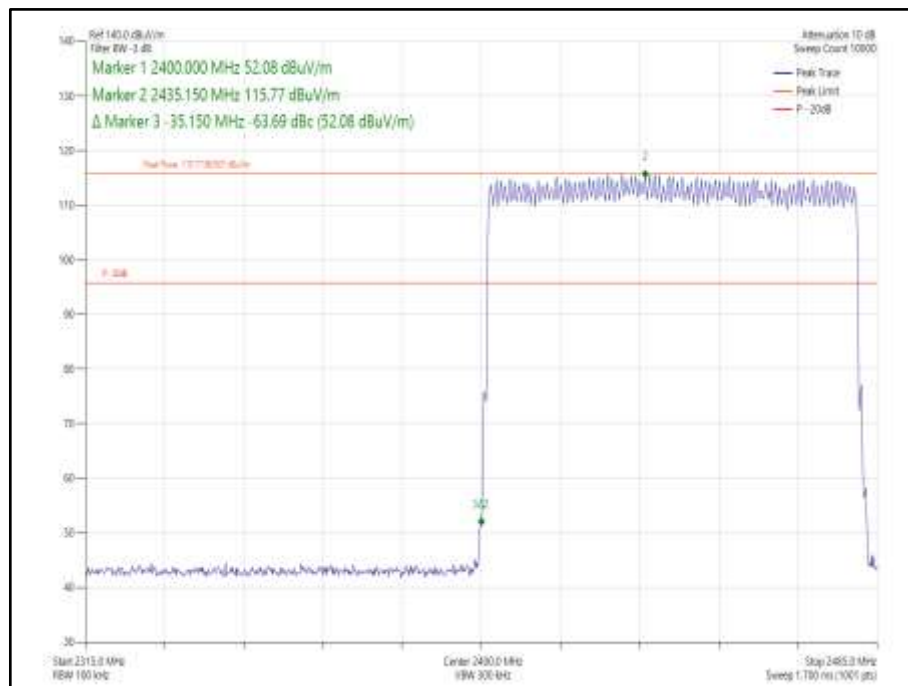


Figure 156 - Hopping -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz

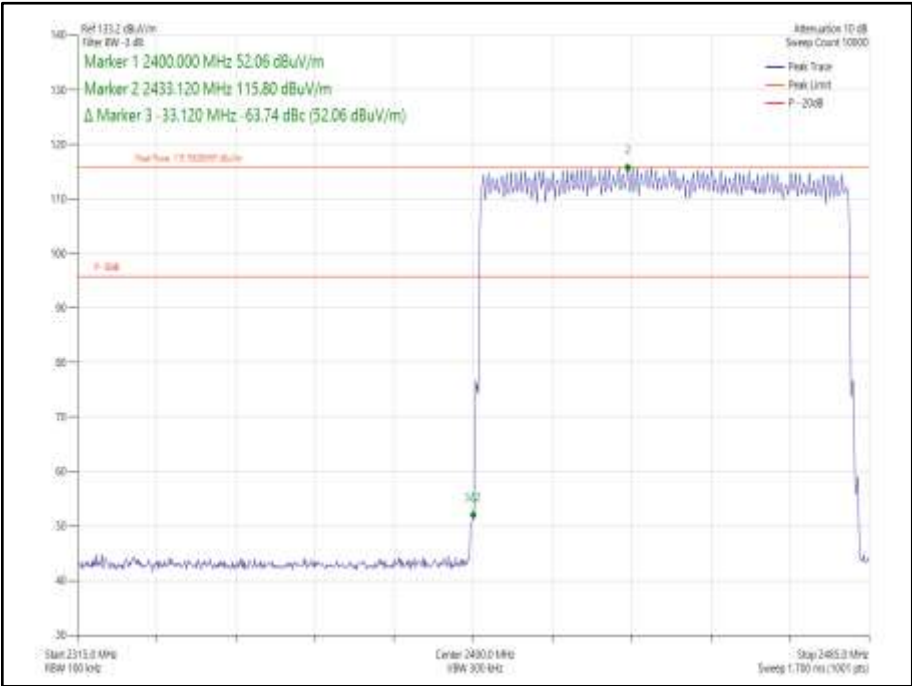


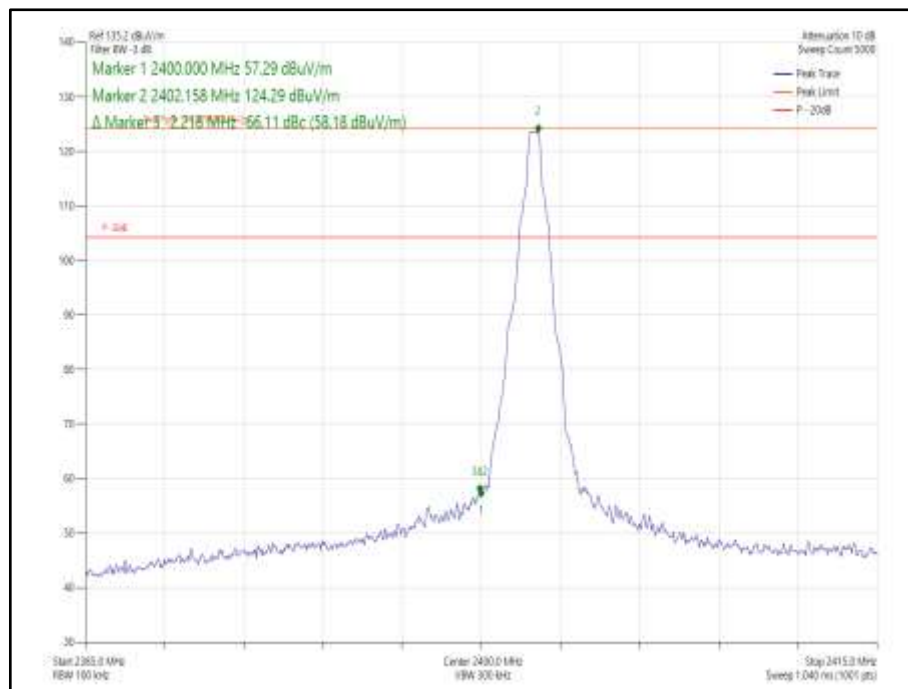
Figure 157 - Hopping - 8-DPSK/3DH5 - Band Edge Frequency 2400.0 MHz

## 2.4 GHz Bluetooth (FHSS)

### ePA

| Mode    | Modulation    | Core | Packet Type | Tx Frequency (MHz) | Band Edge Frequency (MHz) | Level (dBc) |
|---------|---------------|------|-------------|--------------------|---------------------------|-------------|
| Static  | GFSK          | 0-1  | DH5         | 2402               | 2400.0                    | -66.11      |
| Static  | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2400.0                    | -63.99      |
| Static  | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2400.0                    | -63.10      |
| Hopping | GFSK          | 0-1  | DH5         | 2402               | 2400.0                    | -69.67      |
| Hopping | $\pi/4$ DQPSK | 0-1  | 2DH5        | 2402               | 2400.0                    | -64.75      |
| Hopping | 8-DPSK        | 0-1  | 3DH5        | 2402               | 2400.0                    | -64.27      |

**Table 93 - Authorised Band Edge Results**



**Figure 158 - Static - GFSK/DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz**

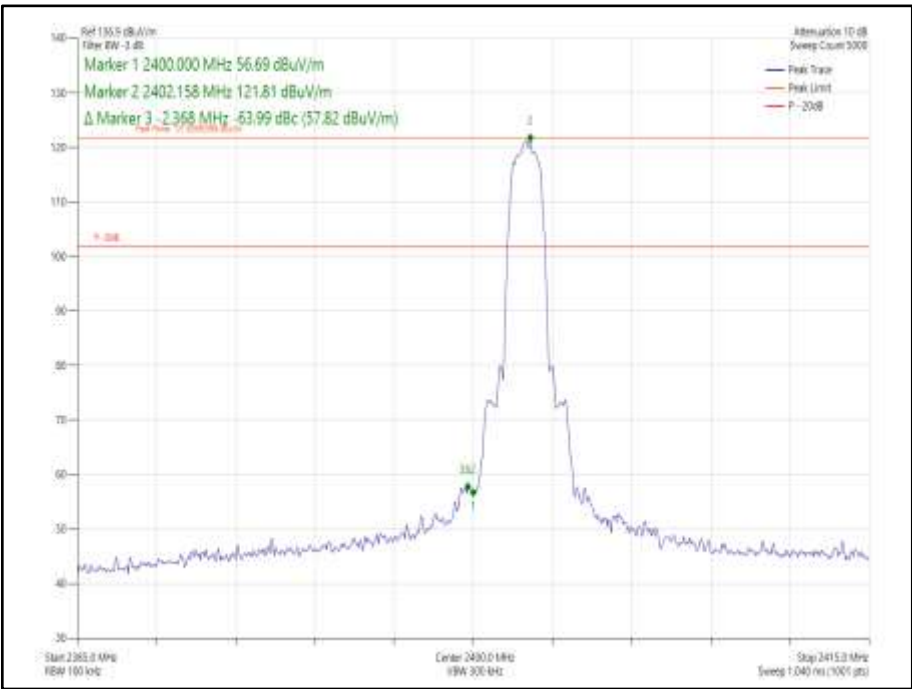


Figure 159 - Static -  $\pi/4$  DQPSK/2DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

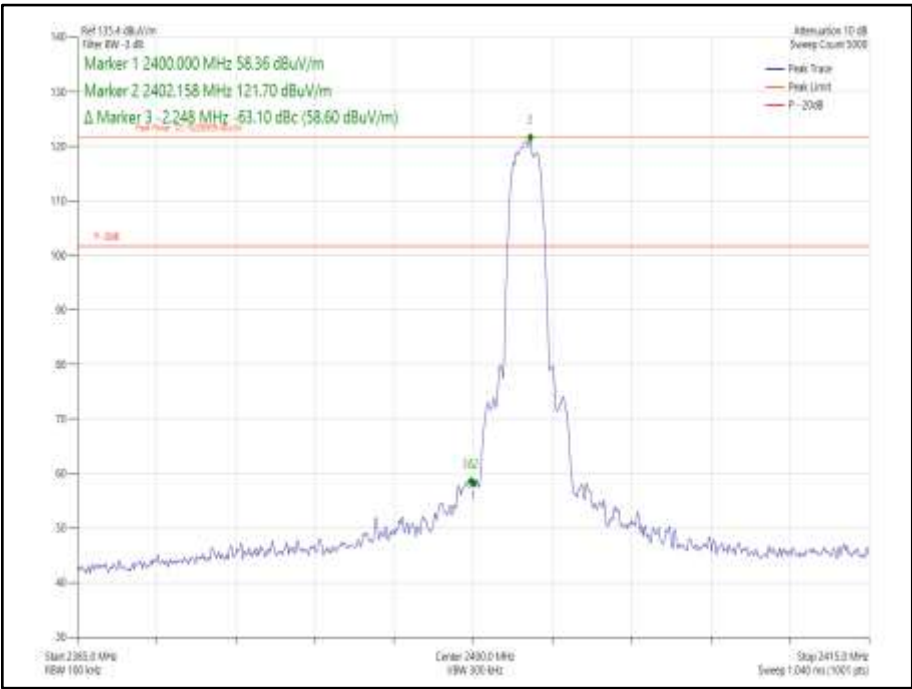


Figure 160 - Static - 8-DPSK/3DH5 - 2402 MHz - Band Edge Frequency 2400.0 MHz

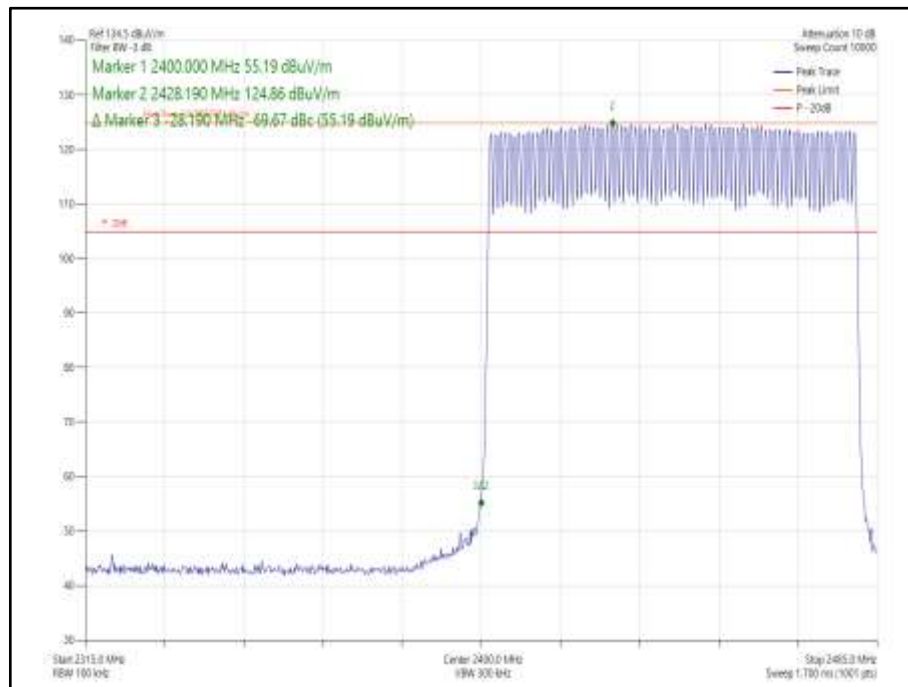


Figure 161 - Hopping - GFSK/DH5 - Band Edge Frequency 2400.0 MHz

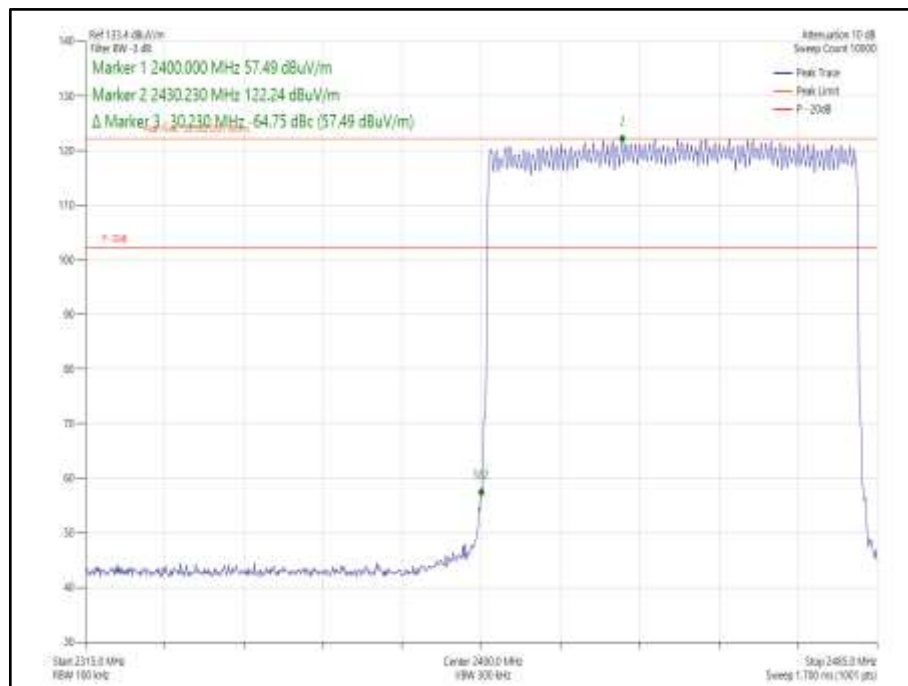
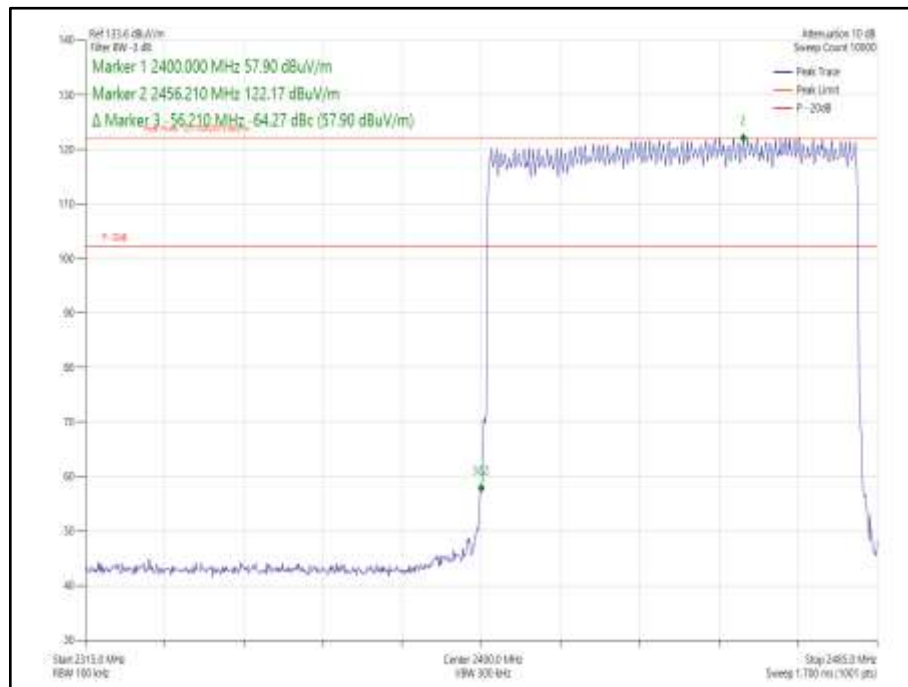


Figure 162 - Hopping -  $\pi/4$  DQPSK/2DH5 - Band Edge Frequency 2400.0 MHz



**Figure 163 - Hopping - 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.



## 2.8.7 Test Location and Test Equipment Used

This test was carried out in RF Chamber 11.

| Instrument                    | Manufacturer    | Type No              | TE No | Calibration Period (months) | Calibration Expires |
|-------------------------------|-----------------|----------------------|-------|-----------------------------|---------------------|
| EMI Test Receiver             | Rohde & Schwarz | ESW44                | 5084  | 12                          | 08-Mar-2022         |
| Cable (18 GHz)                | Rosenberger     | LU7-071-2000         | 5107  | 12                          | 09-Jul-2022         |
| EmX Emissions Software        | TUV SUD         | V2.1.11              | 5125  | -                           | Software            |
| Screened Room (11)            | Rainford        | Rainford             | 5136  | 36                          | 01-Nov-2021         |
| Mast and Turntable Controller | Maturo          | Maturo NCD           | 5159  | -                           | TU                  |
| Turntable                     | Maturo          | TT 15WF              | 5160  | -                           | TU                  |
| Horn Antenna (1-10GHz)        | Schwarzbeck     | BBHA 9120 B          | 5215  | 12                          | 01-Apr-2022         |
| 8m N Type Cable               | Junkosha        | MWX221-08000NMSNMS/B | 5522  | 12                          | 24-Mar-2022         |
| Thermo-Hygro-Barometer        | PCE Instruments | PCE-THB 40           | 5604  | 12                          | 08-Sep-2021         |

**Table 94**

TU - Traceability Unscheduled



### 3 Measurement Uncertainty

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

| Test Name                                              | Measurement Uncertainty                                        |
|--------------------------------------------------------|----------------------------------------------------------------|
| Restricted Band Edges                                  | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Frequency Hopping Systems - Average Time of Occupancy  | -                                                              |
| Frequency Hopping Systems - Channel Separation         | $\pm 20.508$ kHz (Same as 20 dB Bandwidth)                     |
| Frequency Hopping Systems - Number of Hopping Channels | -                                                              |
| Frequency Hopping Systems - 20 dB Bandwidth            | $\pm 20.508$ kHz                                               |
| Maximum Conducted Output Power                         | $\pm 3.2$ dB                                                   |
| Spurious Radiated Emissions                            | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |
| Authorised Band Edges                                  | 30 MHz to 1 GHz: $\pm 5.2$ dB<br>1 GHz to 40 GHz: $\pm 6.3$ dB |

**Table 95**

#### 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.