**DEKRA Testing and Certification, S.A.U.**
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

ENAC ENSAYOS Nº 51/LE147

Test report No:

NIE: 60327RRF.002

# Test Report

## USA FCC Part 15.247, 15.209
## CANADA RSS-247, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.
General Requirements and Information for the Certification of Radio Apparatus.

| | |
|---|---|
| (*) Identification of item tested | A Bluetooth dongle designed for pairing with a mobile phone to have audio communication in a hearing protection system |
| (*) Trademark | INVISIO® |
| (*) Model and /or type reference | BD |
| Other identification of the product | HW version: 1<br>SW version: 1<br>FCC ID: 2AUGTASM17582<br>IC: 25405-ASM17582 |
| (*) Features | Classic Bluetooth |
| Applicant | INVISIO COMMUNICATIONS A/S<br>Stamholmen 157, 2650 Hvidovre, Denmark |
| Test method requested, standard | USA FCC Part 15.247 (10-1-18 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.<br>USA FCC Part 15.209 (10-1-18 Edition): Radiated emission limits; general requirements.<br>CANADA RSS-247 Issue 2 (February 2017).<br>CANADA RSS-Gen Issue 5 (April 2018).<br>Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019.<br>ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices. |
| Summary | IN COMPLIANCE |
| Approved by (name / position & signature) | Rafael López<br>EMC Consumer & RF Lab. Manager<br>RAFAEL LÓPEZ MARTÍN 2019.10.18 13:14:22 +02'00' |
| Date of issue | 2019-10-18 |
| Report template No | FDT08_22<br>(*) "Data provided by the client" |

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# Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.
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# General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

# Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

# Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of the BD INV is a product family, which consists of Bluetooth dongle designed for pairing with a mobile phone to have audio communication in a hearing protection system.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

# Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

| Control Nº | Description | Model | Serial Nº | Date of reception |
|---|---|---|---|---|
| 60327/014 | Bluetooth Dongle | BD | -- | 2019/06/05 |

Sample S/01 has undergone the following test(s): All RADIATED tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

| Control Nº | Description | Model | Serial Nº | Date of reception |
|---|---|---|---|---|
| 60327/008 | Bluetooth Dongle | BD | -- | 2019/06/05 |

Sample S/02 has undergone the following test(s): All CONDUCTED tests indicated in Appendix A.

# Test sample description

| | | | | | |
|---|---|---|---|---|---|
| Ports…… : | Port name and description | Cable | | | |
| | | Specified max length [m] | Attached during test | Shielded | Coupled to patient(3) |
| | ODU connector | 1 | ☒ | ☒ | ☐ |
| | Radio connector | 1 | ☒ | ☒ | ☐ |
| | | | ☐ | ☐ | ☐ |
| | | | ☐ | ☐ | ☐ |
| | | | ☐ | ☐ | ☐ |
| | | | ☐ | ☐ | ☐ |
| Supplementary information to the ports…… : | The cables are soldered on the Bluetooth Dongle. | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rated power supply .....: | Voltage and Frequency | | Reference poles | | | | |
| | | | L1 | L2 | L3 | N | PE |
| | ☐ | AC: | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | AC: | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☒ | DC: 3.6-12V | | | | | |
| | ☐ | DC: | | | | | |

| | | |
|---|---|---|
| Rated Power .....: | 72 mW | |
| Clock frequencies .....: | 26 MHz | |
| Other parameters.....: | - | |
| Software version .....: | - | |
| Hardware version.....: | - | |
| Dimensions in cm (W x H x D)....: | 5x1.5x1.5 cm | |
| Mounting position.....: | ☐ | Table top equipment |
| | ☐ | Wall/Ceiling mounted equipment |
| | ☐ | Floor standing equipment |
| | ☐ | Hand-held equipment |
| | ☒ | Other: personal carried |

| | | | |
|---|---|---|---|
| Modules/parts .....: | Module/parts of test item | Type | Manufacturer |
| | 60327-013 | BD INVxxxxx | INVISIO |
| | 60327-012 | BD INVxxxxx | INVISIO |
| | …… | | |
| | | | |
| Accessories (not part of the test item) .....: | Description | Type | Manufacturer |
| | Battery compartment | PS30 | INVISIO |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| Documents as provided by the applicant.....: | Description | File name | Issue date |
| | | | |
| | | | |
| | | | |
| | | | |

# Identification of the client

INVISIO COMMUNICATIONS A/S
Stamholmen 157, 2650 Hvidovre, Denmark

# Testing period and place

| | |
|---|---|
| **Test Location** | DEKRA Testing and Certification S.A.U. |
| **Date (start)** | 2019-06-11 |
| **Date (finish)** | 2019-06-24 |

# Document history

| Report number | Date | Description |
|---|---|---|
| 60327RRF.002 | 2019-10-18 | First release |

# Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 75 % |
| **Air pressure** | Min. = 860 mbar<br>Max. = 1060 mbar |

In the semianechoic chamber, the following limits were not exceeded during the test.

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 75 % |
| **Air pressure** | Min. = 860 mbar<br>Max. = 1060 mbar |

In the chamber for conducted measurements, the following limits were not exceeded during the test:

| | |
|---|---|
| **Temperature** | Min. = 15 ºC<br>Max. = 35 ºC |
| **Relative humidity** | Min. = 20 %<br>Max. = 35 % |
| **Air pressure** | Min. = 860 mbar<br>Max. = 1060 mbar |

# Remarks and comments

The tests have been performed by the technical personnel: José Manuel Jiménez, José Gabriel Pendón, Jaime Barranquero, Cristina Calle and Miguel Ángel Torres.

Used instrumentation:

Conducted Measurements:

| | | Last Calibration | Due Calibration |
|---|---|---|---|
| 1. | Bluetooth Test Set ANRITSU MT8852B | N.A. | N.A. |
| 2. | Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40 | 2018/02 | 2020/02 |
| 3. | DC Power Supply 40V/40A Rohde & Schwarz NGPE40 | 2018/02 | 2021/02 |

Radiated Measurements:

| | | Last Calibration | Due Calibration |
|---|---|---|---|
| 1. | Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP | N.A. | N.A. |
| 2. | EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7 | 2018/10 | 2020/10 |
| 3. | RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N | 2019/02 | 2020/08 |
| 4. | Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E | 2017/09 | 2020/09 |
| 5. | Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40 | 2018/02 | 2020/02 |
| 6. | RF Pre-amplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A | 2019/04 | 2020/04 |
| 7. | Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D | 2018/01 | 2021/01 |
| 8. | Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500 | 2019/02 | 2020/02 |
| 9. | Bluetooth Test Set ANRITSU MT8852B | N.A. | N.A. |

# Testing verdicts

| | |
|---|---|
| Not applicable: | N/A |
| Pass: | P |
| Fail: | F |
| Not measured: | N/M |

# Summary

## 1. Bluetooth EDR

| FCC PART 15 PARAGRAPH / RSS-247 | | | |
|---|---|---|---|
| **Requirement – Test case** | | **Verdict** | **Remark** |
| Section 15.247 Subclause (a) (1) / RSS-247 5.1. (b) | 20 dB Bandwidth and Carrier frequency separation | P | |
| Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) | Number of hopping channels | P | |
| Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) | Time of occupancy (Dwell Time) | P | |
| Section 15.247 Subclause (b) / RSS-247 5.4. (b) | Maximum peak output power and antenna gain | P | |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Band-edge emissions compliance (Transmitter) | P | |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Emission limitations radiated (Transmitter) | P | |
| Supplementary information and remarks:<br>None. | | | |

# **Appendix A:** Test results. Bluetooth EDR (GFSK, Pi/4 DQPSK, 8DPSK)

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# TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 3.6 - 12 Vdc

Type of Power Supply: Internal battery.

Type of Antenna: Internal (Folded monopole).

Maximum Declared Antenna Gain: -5 dBi to -7 dBi (includes a saw filter with -2 dBi)

TEST FREQUENCIES:

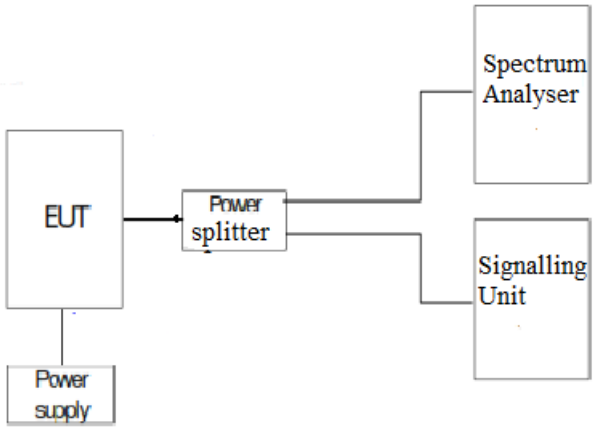
Low Channel: 2402 MHz

Middle Channel: 2441 MHz

High Channel: 2480 MHz

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to a Bluetooth signalling unit (Bluetooth test set) and to the spectrum analyzer using a 6 dB power splitter. The reading in the spectrum analyzer is corrected taking into account the power splitter loss.




The DC supply voltage is applied using an external calibrated power supply with a multimeter.

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

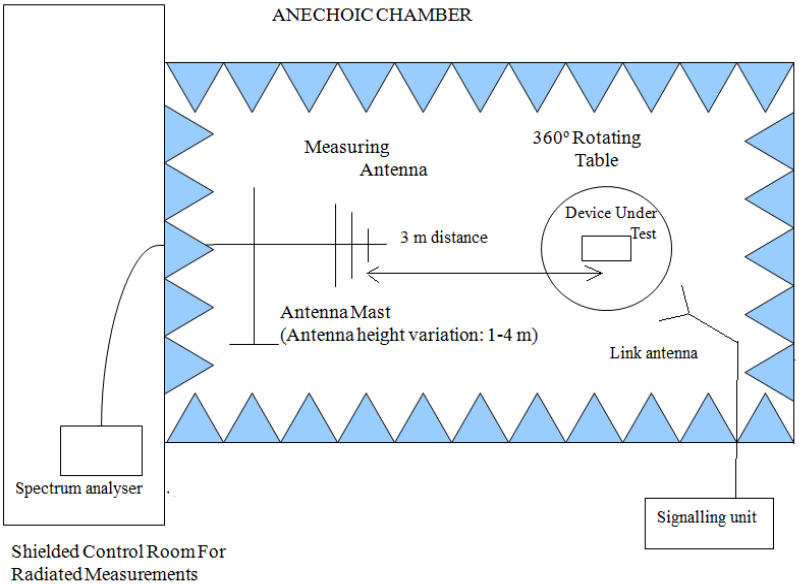
For radiated emissions in the range 1 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

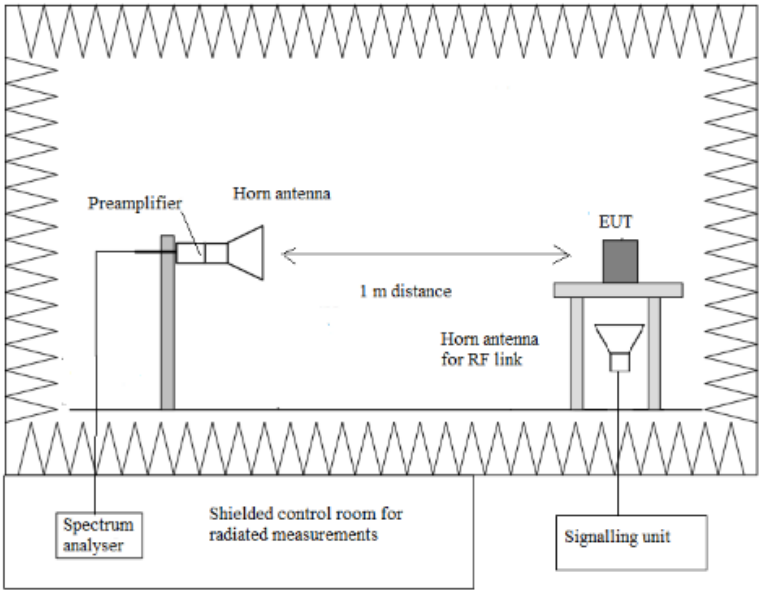
Measurements were made in both horizontal and vertical planes of polarization.

An additional horn antenna is used to control the equipment under test with the Bluetooth signalling unit (Bluetooth test set).

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup f > 1 GHz:



# FCC Section 15.247 Subclause (a) (1) / RSS-247 Clause 5.1. (b) 20 dB Bandwidth and Carrier frequency separation.

SPECIFICATION:

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 2400-2483.5 MHz band 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 125 mW.

RESULTS:

- **GFSK**

| | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| 20 dB Spectrum Bandwidth (kHz) | 948.3 | 908.6 | 899.8 |
| Measurement uncertainty (kHz) | <±5.0 | | |

- **Pi/4 DQPSK**

| | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| 20 dB Spectrum Bandwidth (kHz) | 1245.5 | 1262.8 | 1277.5 |
| Measurement uncertainty (kHz) | <±5.0 | | |

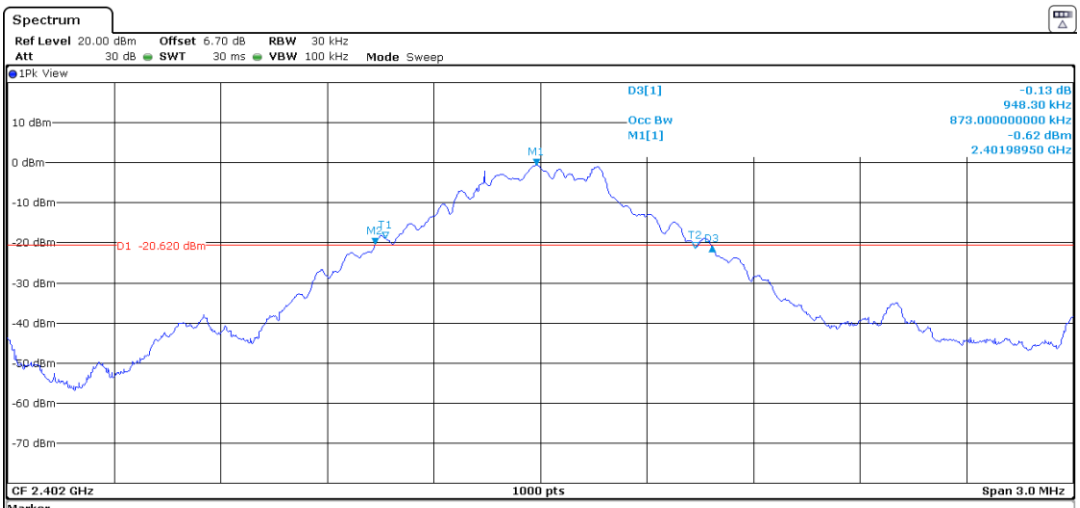
- **8DPSK**

| | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| 20 dB Spectrum Bandwidth (kHz) | 1274.5 | 1264.3 | 1266.9 |
| Measurement uncertainty (kHz) | <±5.0 | | |

Verdict: PASS

- **GFSK – Bandwidths**

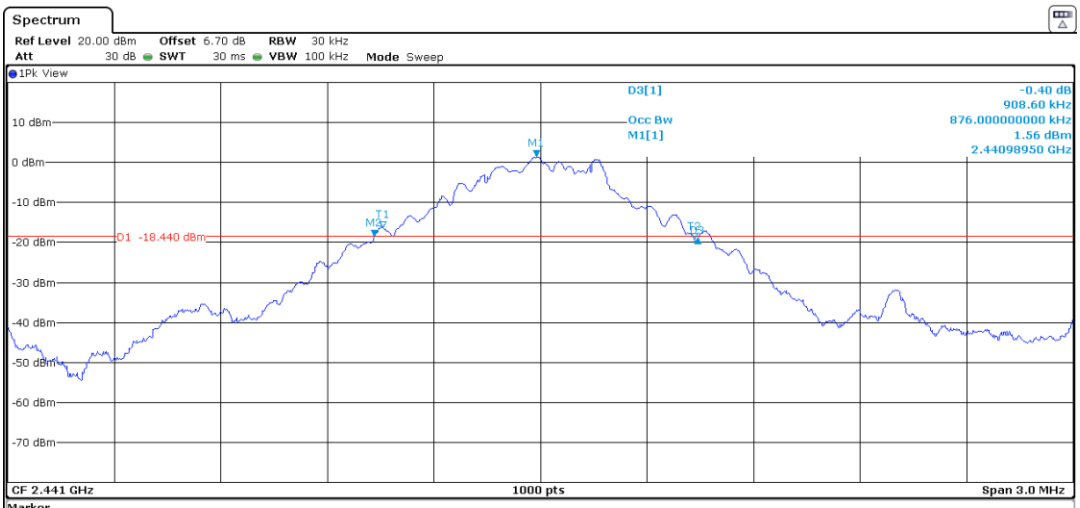
- Low Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4019895 GHz | -0.62 dBm | | |
| T1 | | 1 | 2.4015635 GHz | -18.81 dBm | Occ Bw | 873.0 kHz |
| T2 | | 1 | 2.4024365 GHz | -21.31 dBm | | |
| M2 | | 1 | 2.4015346 GHz | -20.63 dBm | | |
| D3 | M2 | 1 | 948.3 kHz | -0.13 dB | | |

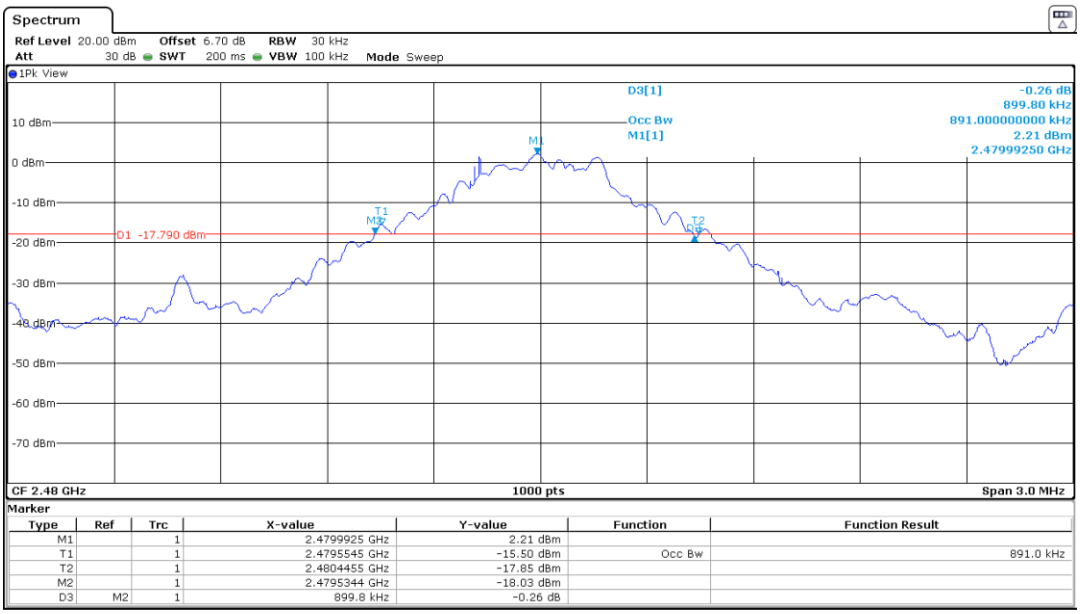
- Middle Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4409895 GHz | 1.56 dBm | | |
| T1 | | 1 | 2.4405575 GHz | -16.26 dBm | Occ Bw | 876.0 kHz |
| T2 | | 1 | 2.4414335 GHz | -19.29 dBm | | |
| M2 | | 1 | 2.4405342 GHz | -18.52 dBm | | |
| D3 | M2 | 1 | 908.6 kHz | -0.40 dB | | |

- High Channel:

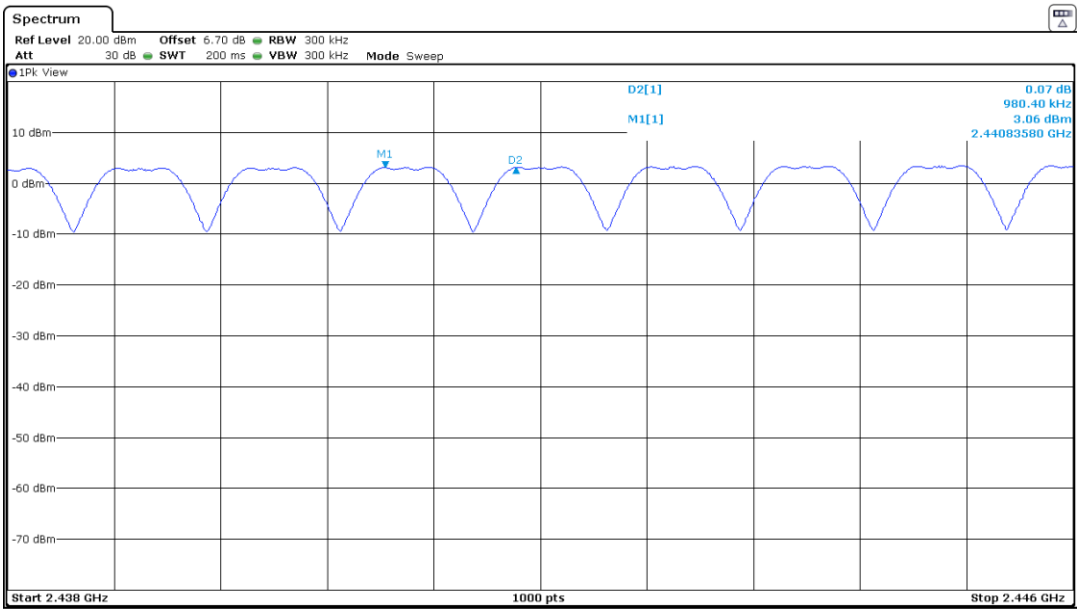



Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4799925 GHz | 2.21 dBm | | |
| T1 | | 1 | 2.4795545 GHz | -15.50 dBm | Occ Bw | 891.0 kHz |
| T2 | | 1 | 2.4804455 GHz | -17.85 dBm | | |
| M2 | | 1 | 2.4795344 GHz | -18.03 dBm | | |
| D3 | M2 | 1 | 899.8 kHz | -0.26 dB | | |

### Carrier frequency separation - GFSK

Carrier frequency separation: 980.4 kHz

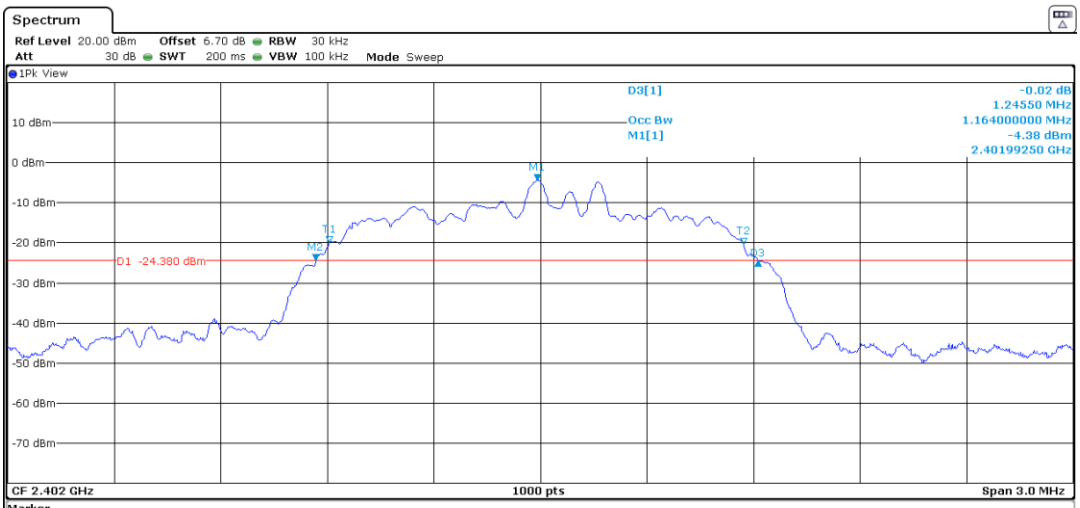



The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

- **Pi/4 DQPSK – Bandwidths**

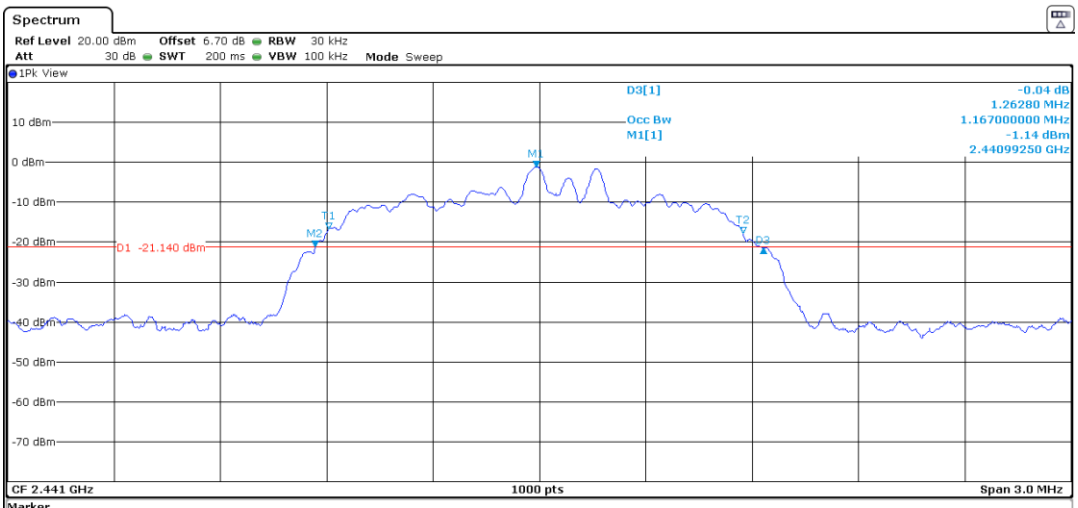
- Low Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4019925 GHz | -4.38 dBm | | |
| T1 | | 1 | 2.4014075 GHz | -19.96 dBm | Occ Bw | 1.164 MHz |
| T2 | | 1 | 2.4025715 GHz | -20.39 dBm | | |
| M2 | | 1 | 2.4013682 GHz | -24.41 dBm | | |
| D3 | M2 | 1 | 1.2455 MHz | -0.02 dB | | |

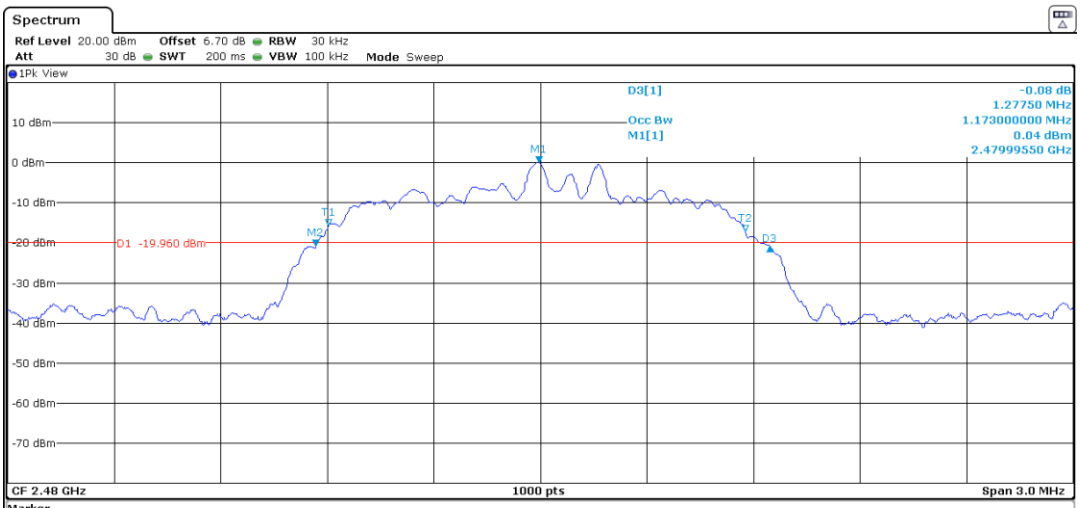
- Middle Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4409925 GHz | -1.14 dBm | | |
| T1 | | 1 | 2.4404075 GHz | -16.71 dBm | Occ Bw | 1.167 MHz |
| T2 | | 1 | 2.4415745 GHz | -17.78 dBm | | |
| M2 | | 1 | 2.4403687 GHz | -21.34 dBm | | |
| D3 | M2 | 1 | 1.2628 MHz | -0.04 dB | | |

- High Channel:

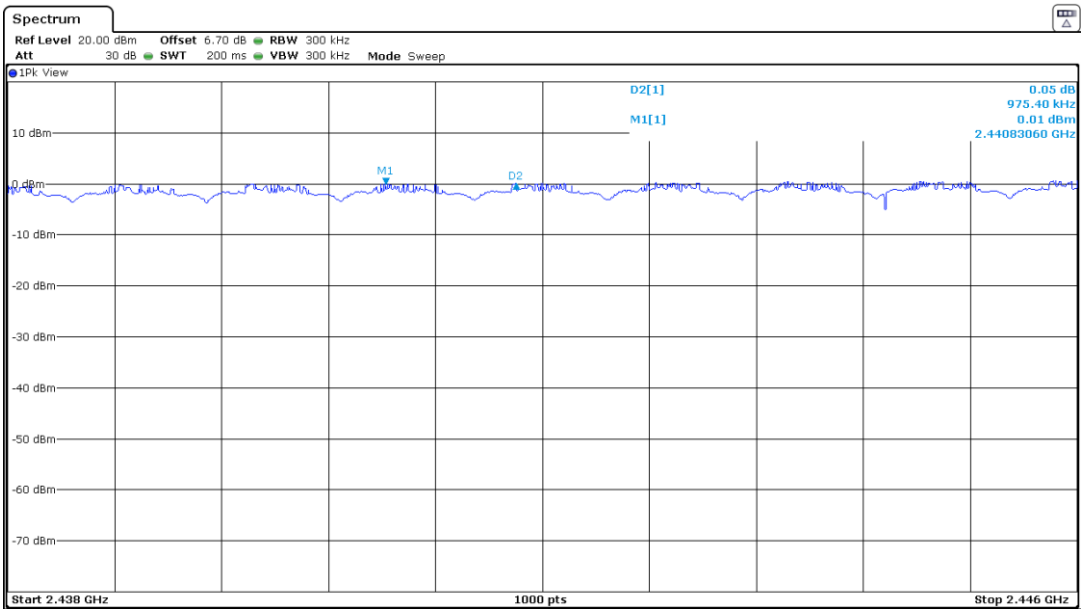



Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4799955 GHz | 0.04 dBm | | |
| T1 | | 1 | 2.4794045 GHz | -15.75 dBm | Occ Bw | 1.173 MHz |
| T2 | | 1 | 2.4805775 GHz | -17.15 dBm | | |
| M2 | | 1 | 2.4793675 GHz | -20.68 dBm | | |
| D3 | M2 | 1 | 1.2775 MHz | -0.08 dB | | |

## Carrier frequency separation - Pi/4 DQPSK

Carrier frequency separation: 975.4 kHz

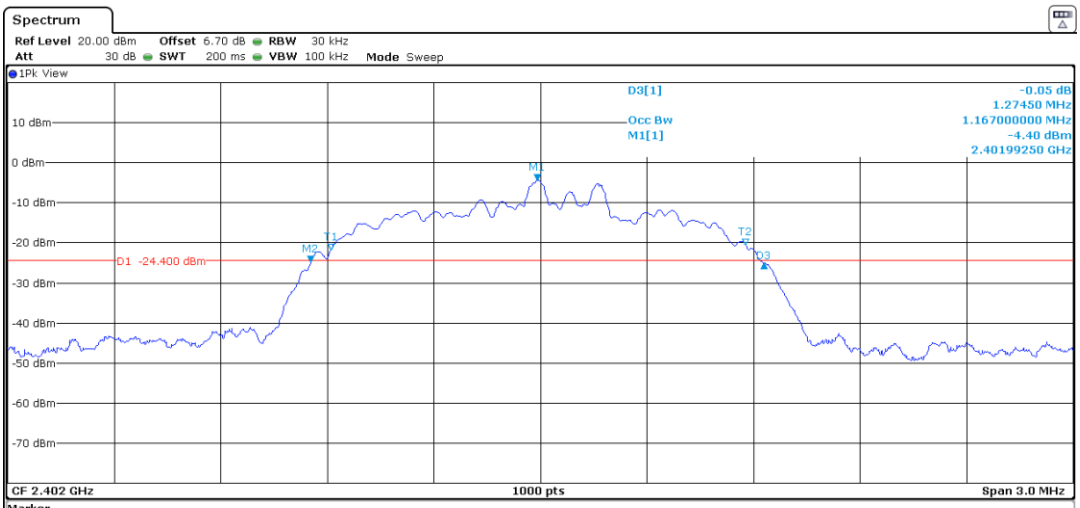



The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

- **8DPSK – Bandwidths**

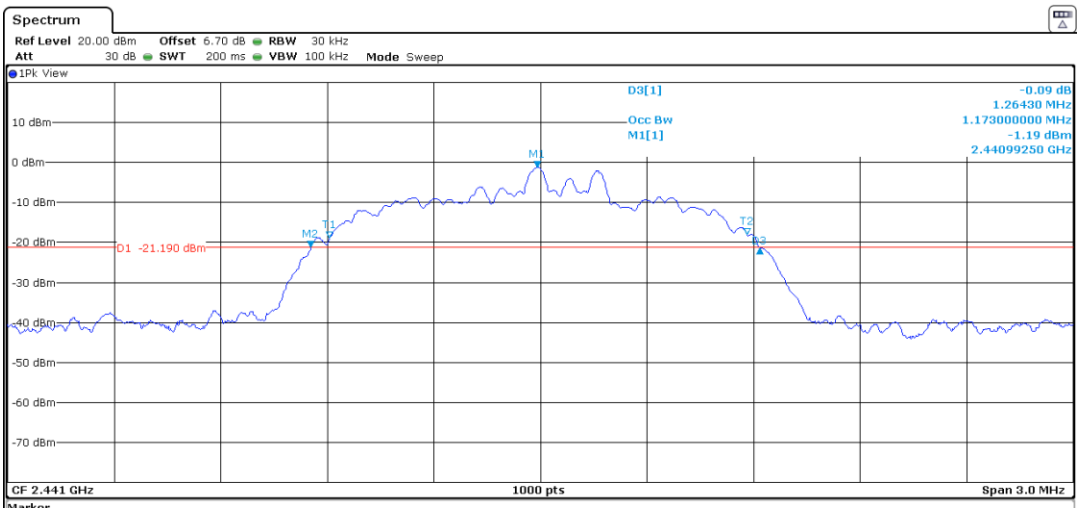
- Low Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4019925 GHz | -4.40 dBm | | |
| T1 | | 1 | 2.4014105 GHz | -21.78 dBm | Occ Bw | 1.167 MHz |
| T2 | | 1 | 2.4025775 GHz | -20.52 dBm | | |
| M2 | | 1 | 2.4013548 GHz | -24.86 dBm | | |
| D3 | M2 | 1 | 1.2745 MHz | -0.05 dB | | |

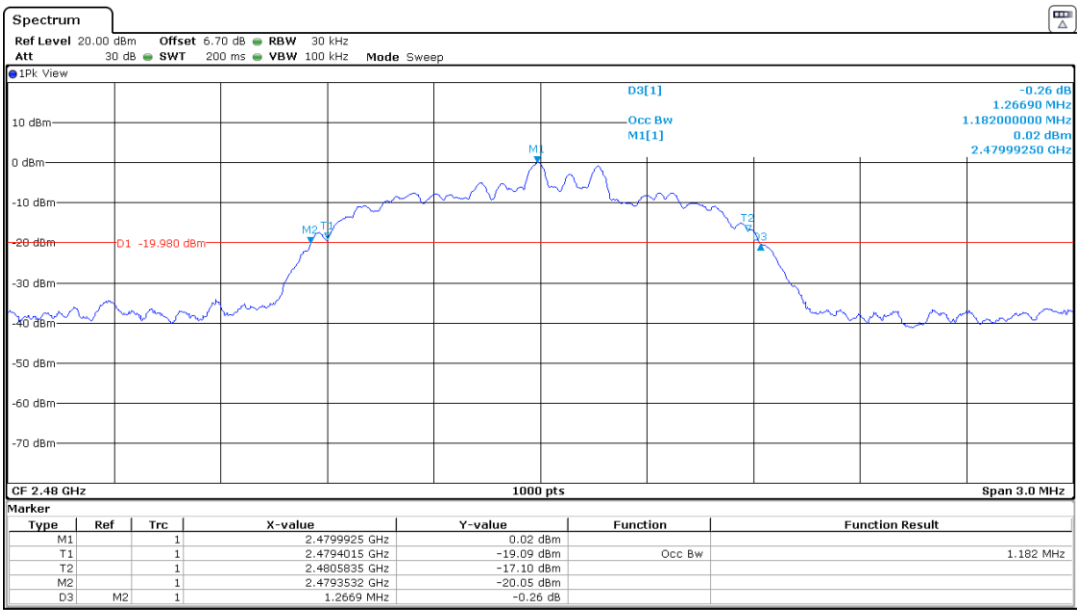
- Middle Channel:




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4409925 GHz | -1.19 dBm | | |
| T1 | | 1 | 2.4404075 GHz | -18.76 dBm | Occ Bw | 1.173 MHz |
| T2 | | 1 | 2.4415805 GHz | -18.02 dBm | | |
| M2 | | 1 | 2.4403536 GHz | -21.23 dBm | | |
| D3 | M2 | 1 | 1.2643 MHz | -0.09 dB | | |

- High Channel:

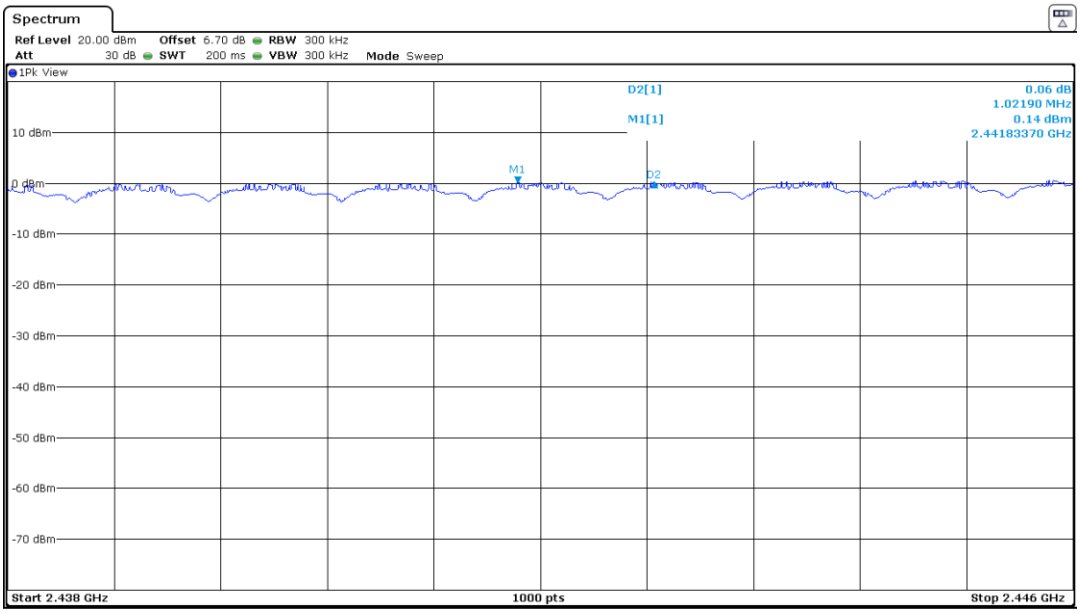



Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4799925 GHz | 0.02 dBm | | |
| T1 | | 1 | 2.4794015 GHz | -19.09 dBm | Occ Bw | 1.182 MHz |
| T2 | | 1 | 2.4805835 GHz | -17.10 dBm | | |
| M2 | | 1 | 2.4793532 GHz | -20.05 dBm | | |
| D3 | M2 | 1 | 1.2669 MHz | -0.26 dB | | |

### Carrier frequency separation - 8DPSK

Carrier frequency separation: 1021.9 kHz




The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

Verdict: PASS

# FCC Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) Number of hopping channels.

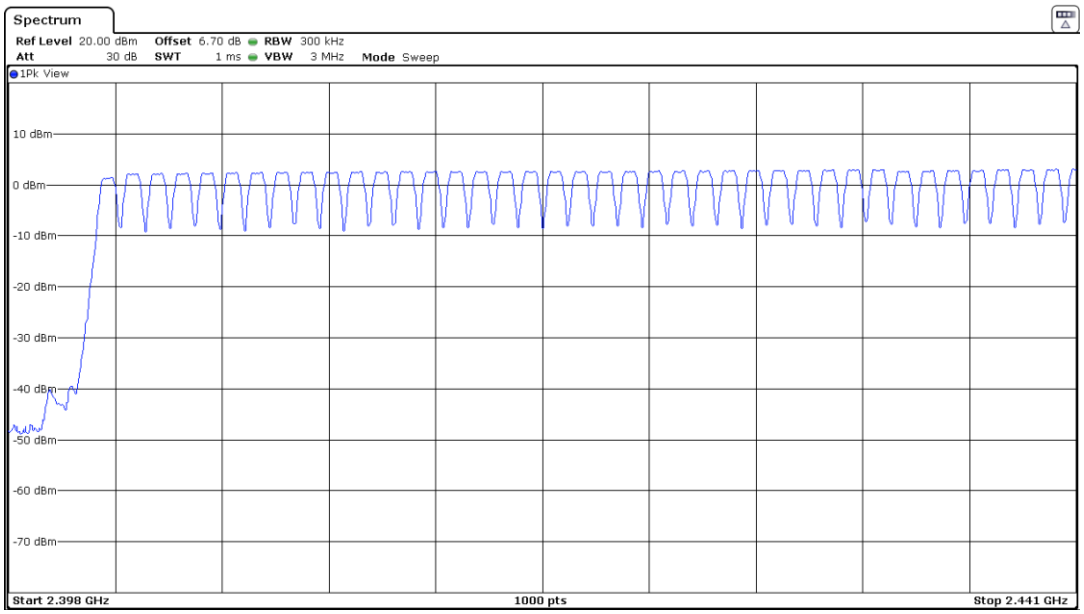
SPECIFICATION:

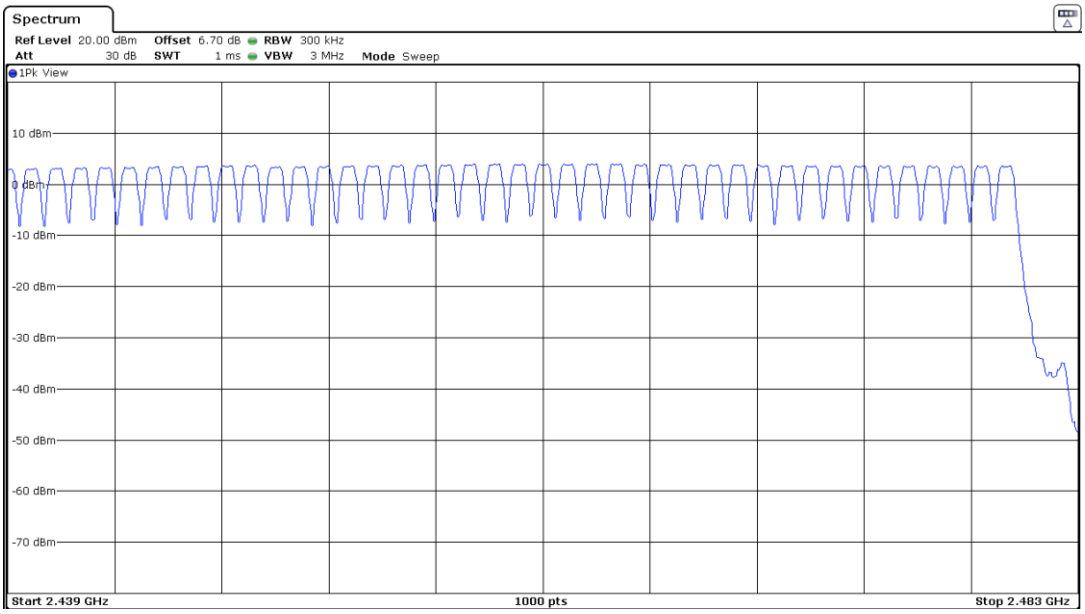
Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 channels.

RESULTS:

The number of hopping channels is 79 for all three modes.

- **GFSK – Number of hopping channels**

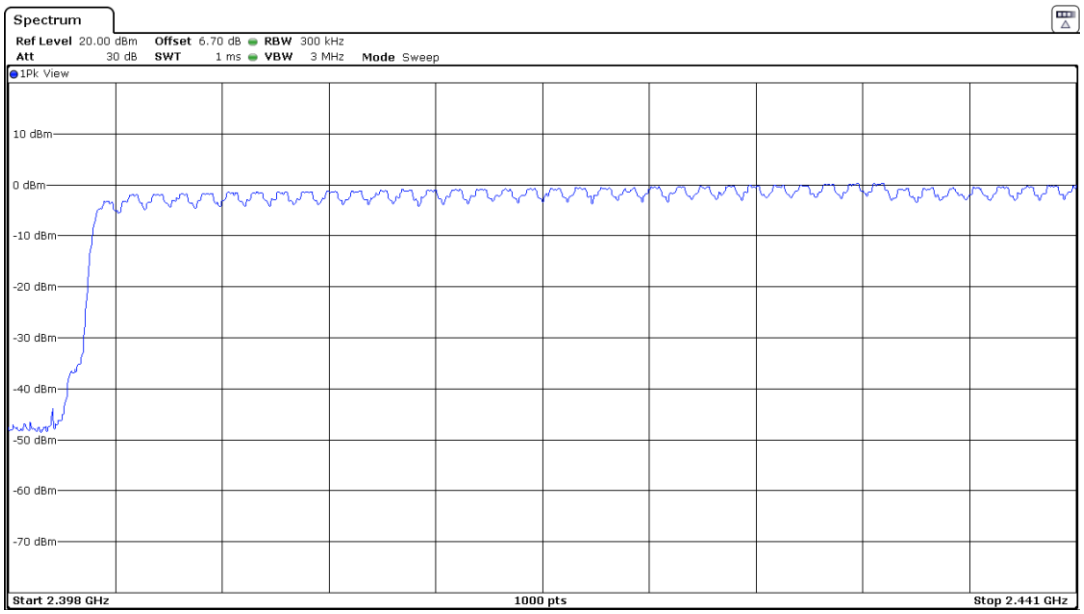


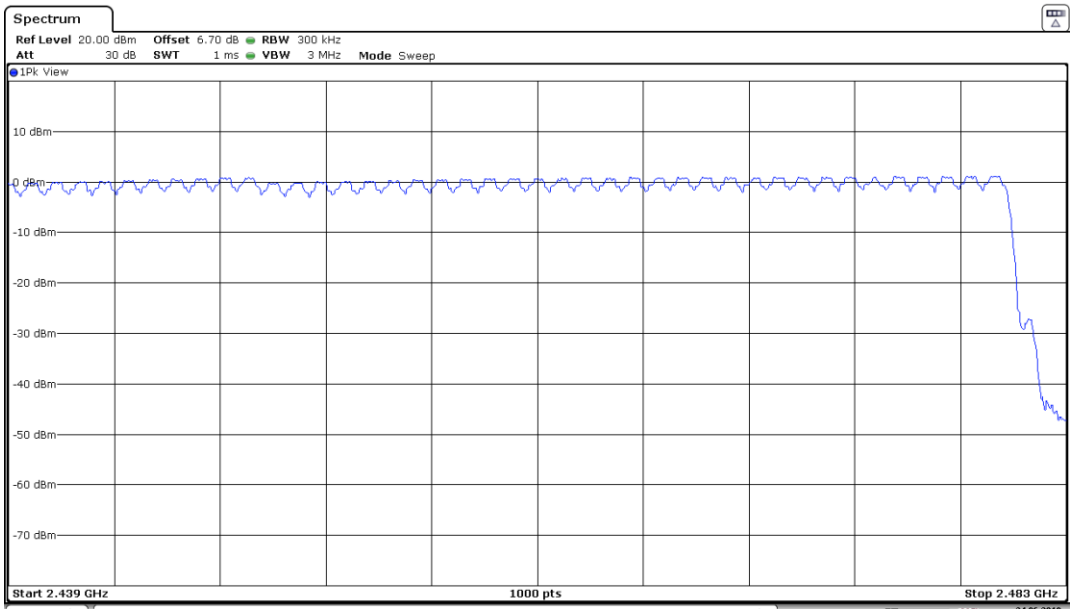




**Total number of hopping channels 79**

Verdict: PASS

- **Pi/4 DQPSK – Number of hopping channels**
-

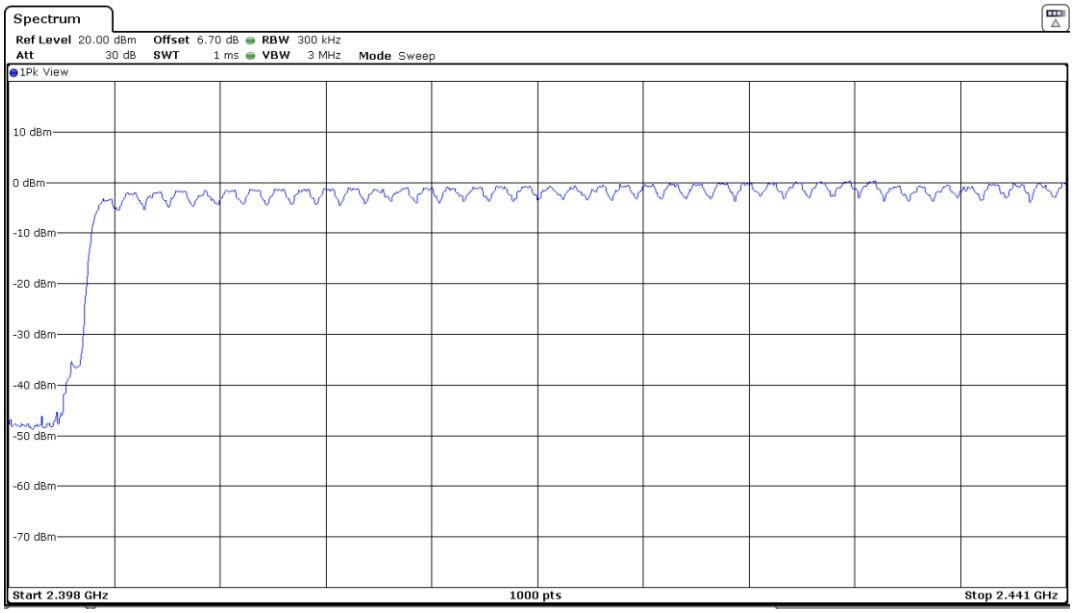


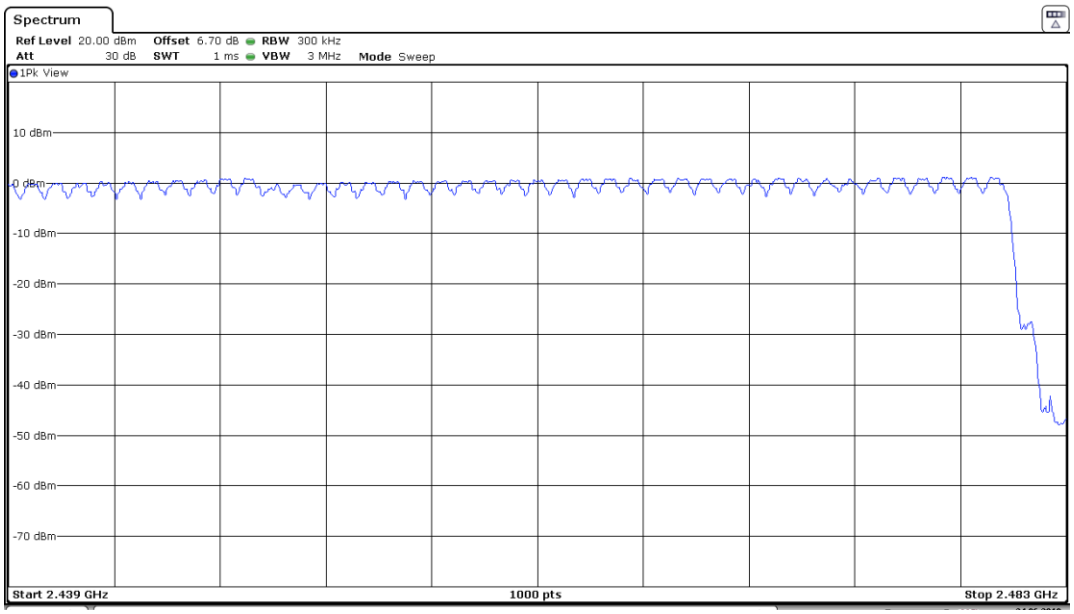




**Total number of hopping channels 79**

Verdict: PASS

- **8DPSK – Number of hopping channels**




**Total number of hopping channels 79**

Verdict: PASS

# FCC Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) Time of occupancy (Dwell Time).

SPECIFICATION:

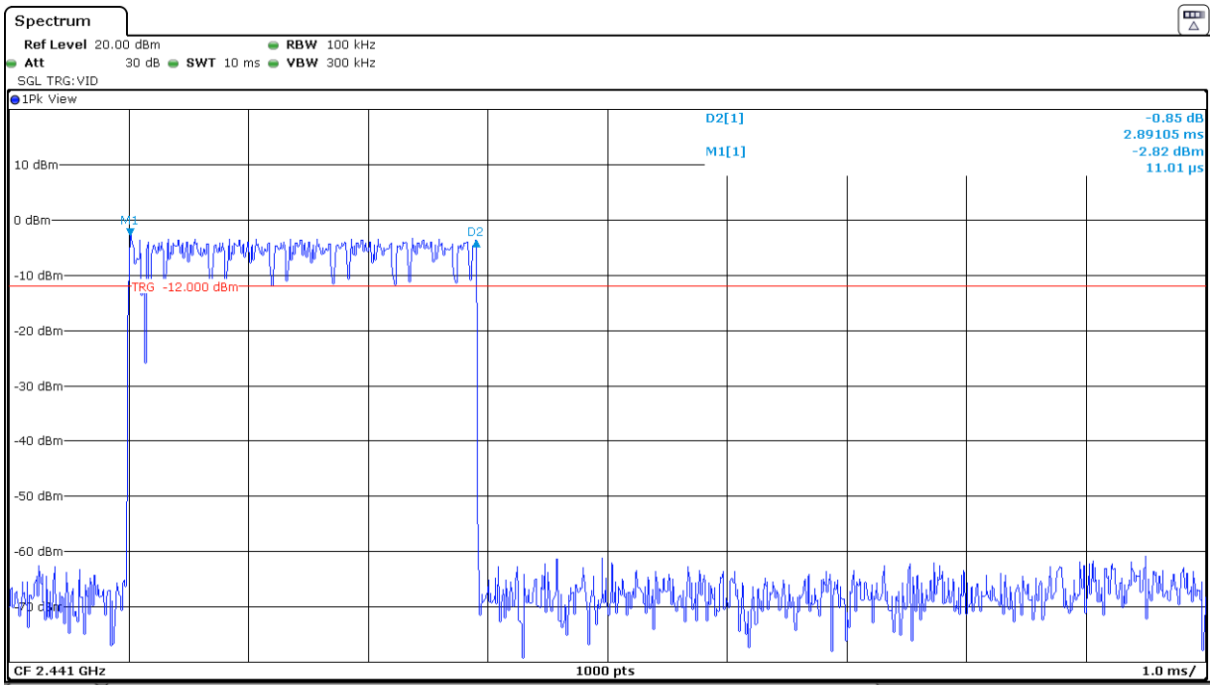
The average time of occupancy on any channel shall not be greater than 0.4 seconds (400 ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed = 0.4 x 79= 31.6 seconds.

RESULTS:

- **GFSK (packet type DH5) – Time of Occupancy (Dwell Time)**

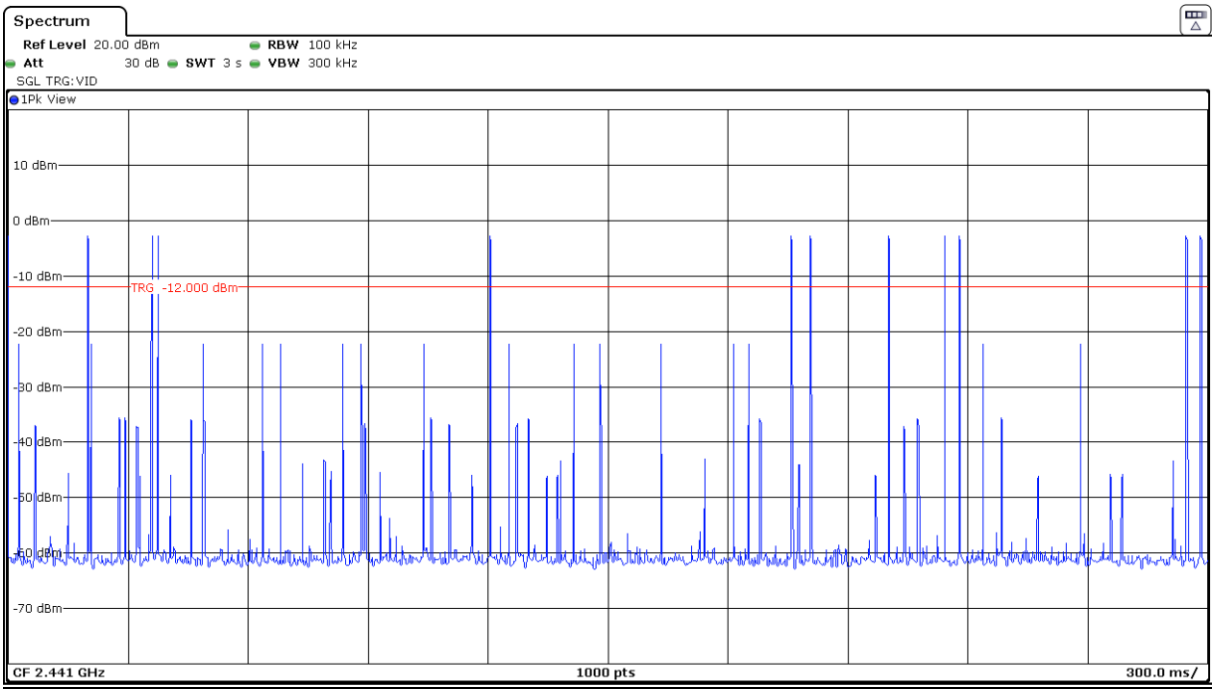
  - Transmit Time per Hop:

| 2.89105 | ms |
|---|---|



- Time of Occupancy:

| | | |
|---|---|---|
| Nº of hops on spectrum analyzer | 11 | |
| Nº of hops over the period | 115.8666667 | |
| Average Time of Occupancy | 334.9763267 | ms |



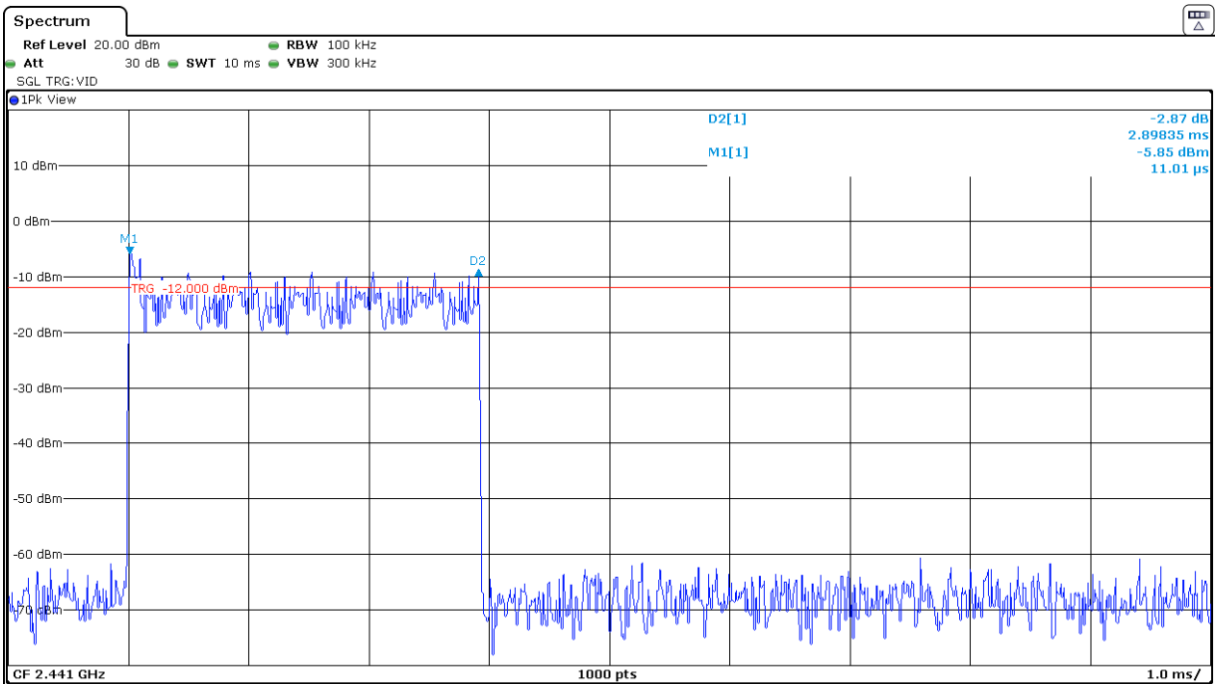

| | |
|---|---|
| Measurement uncertainty (%) | <±0.01 |

Verdict: PASS

- **Pi/4 DQPSK (packet type 2DH5) – Time of Occupancy (Dwell Time)**

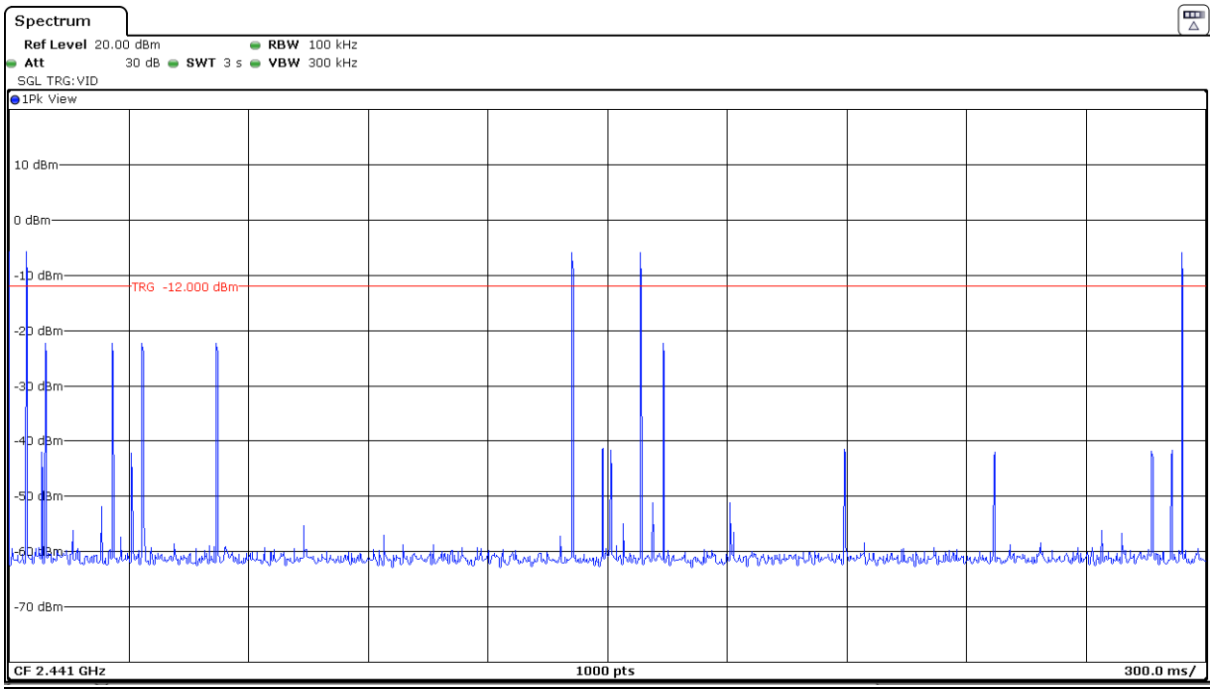
  - Transmit Time per Hop:

| 2.898 | ms |
|---|---|



- Time of Occupancy:

| | | |
|---|---|---|
| Nº of hops on spectrum analyzer | 4 | |
| Nº of hops over the period | 42.13333333 | |
| Average Time of Occupancy | 122.1024 | ms |



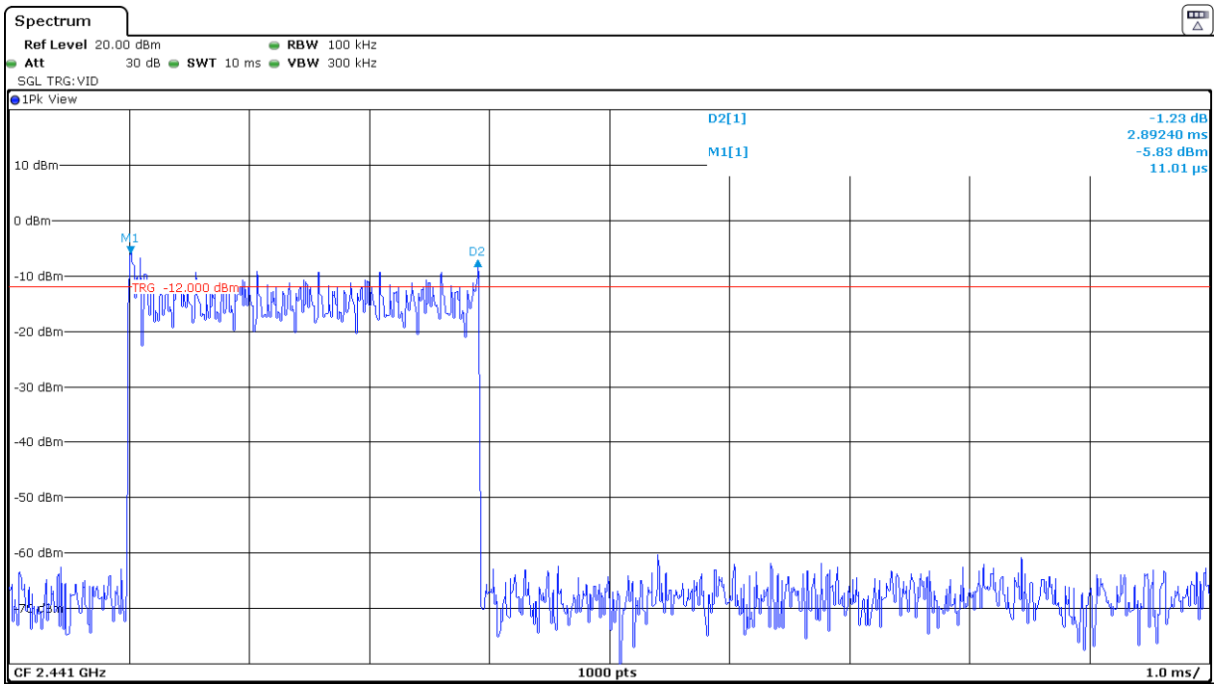

| | |
|---|---|
| Measurement uncertainty (%) | <±0.01 |

Verdict: PASS

- **8DPSK (packet type 3DH5) – Time of Occupancy (Dwell Time)**

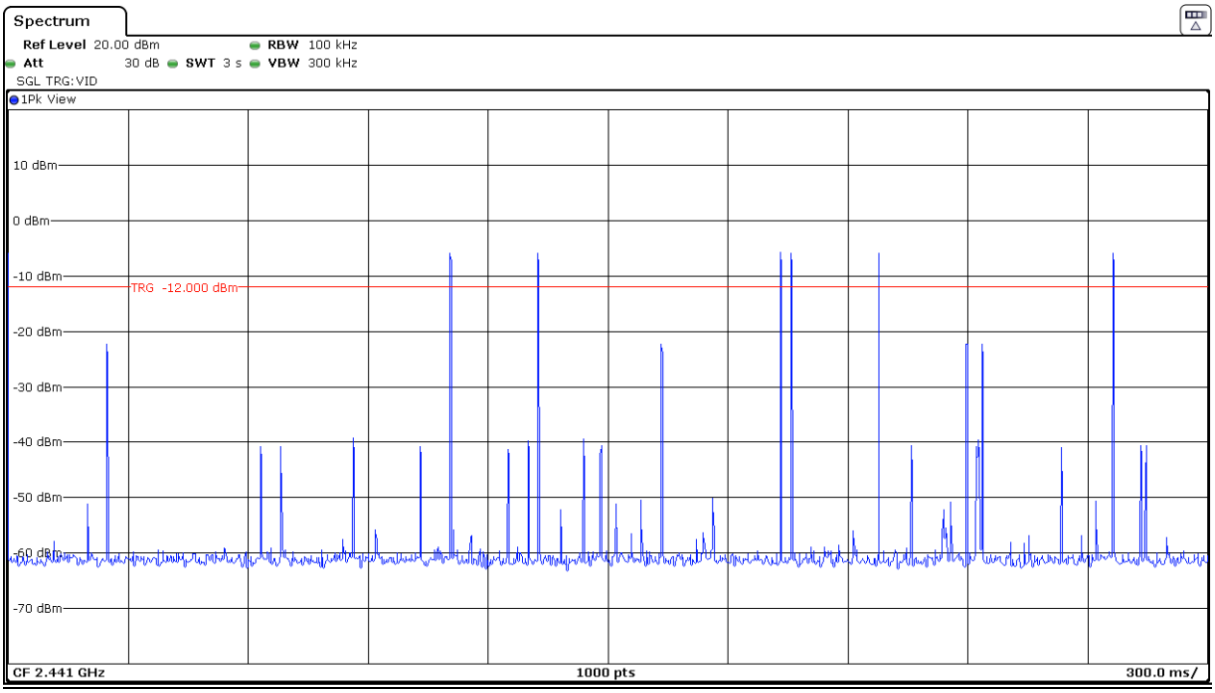
  - Transmit Time per Hop:

| 2.892 | ms |
|---|---|



- Time of Occupancy:

| | | |
|---|---|---|
| Nº of hops on spectrum analyzer | 6 | |
| Nº of hops over the period | 63.2 | |
| Average Time of Occupancy | 182.7744 | ms |




| | |
|---|---|
| Measurement uncertainty (%) | <±0.01 |

Verdict: PASS

# FCC Section 15.247 Subclause (b) / RSS-247 Clause 5.4 (b) Maximum peak output power and antenna gain

SPECIFICATION:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (RSS-247).

RESULTS:

The EIRP power (dBm) is calculated by adding the maximum declared antenna gain to the measured conducted power.

Maximum Declared Antenna Gain: -5 dBi

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values

- **GFSK** (1 Mbps)

| Peak Conducted Output Power | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| Maximum Conducted Power (dBm) | 1.69 | 3.41 | 3.79 |
| Maximum EIRP Power (dBm) | -3.31 | -1.59 | -1.21 |
| Measurement uncertainty (dB) | <±0.78 | | |

- **Pi/4 DQPSK** (2 Mbps)

| Peak Conducted Output Power | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| Maximum Conducted Power (dBm) | -1.68 | 1.39 | 2.32 |
| Maximum EIRP Power (dBm) | -6.68 | -3.61 | -2.68 |
| Measurement uncertainty (dB) | <±0.78 | | |

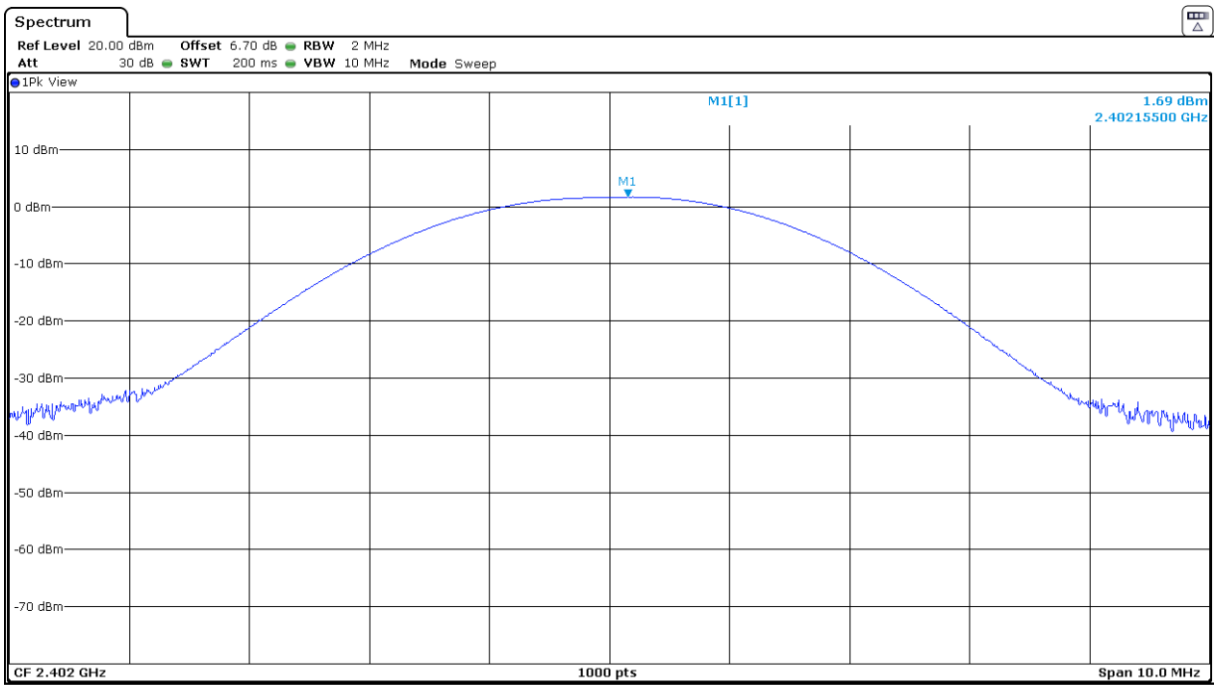
- **8DPSK** (3 Mbps)

| Peak Conducted Output Power | Low Channel 2402 MHz | Middle Channel 2441 MHz | High Channel 2480 MHz |
|---|---|---|---|
| Maximum Conducted Power (dBm) | -1.2 | 1.78 | 2.59 |
| Maximum EIRP Power (dBm) | -6.2 | -3.22 | -2.41 |
| Measurement uncertainty (dB) | <±0.78 | | |

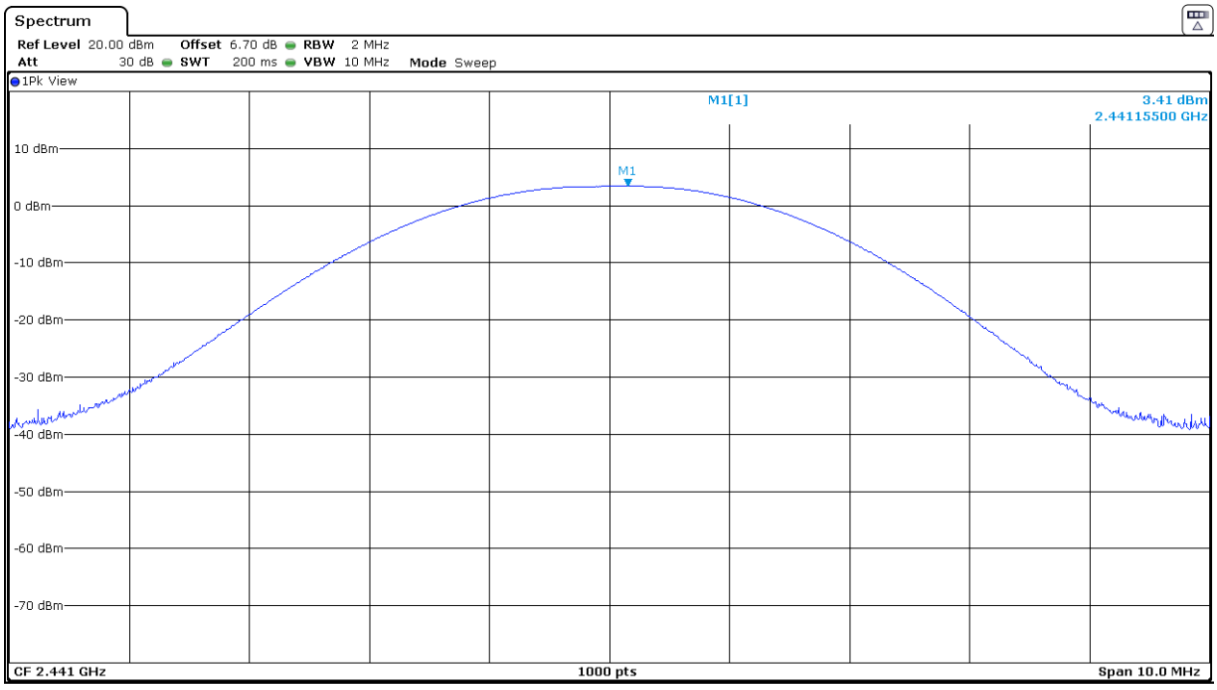
Verdict: PASS

- **GFSK – Peak Output Power**

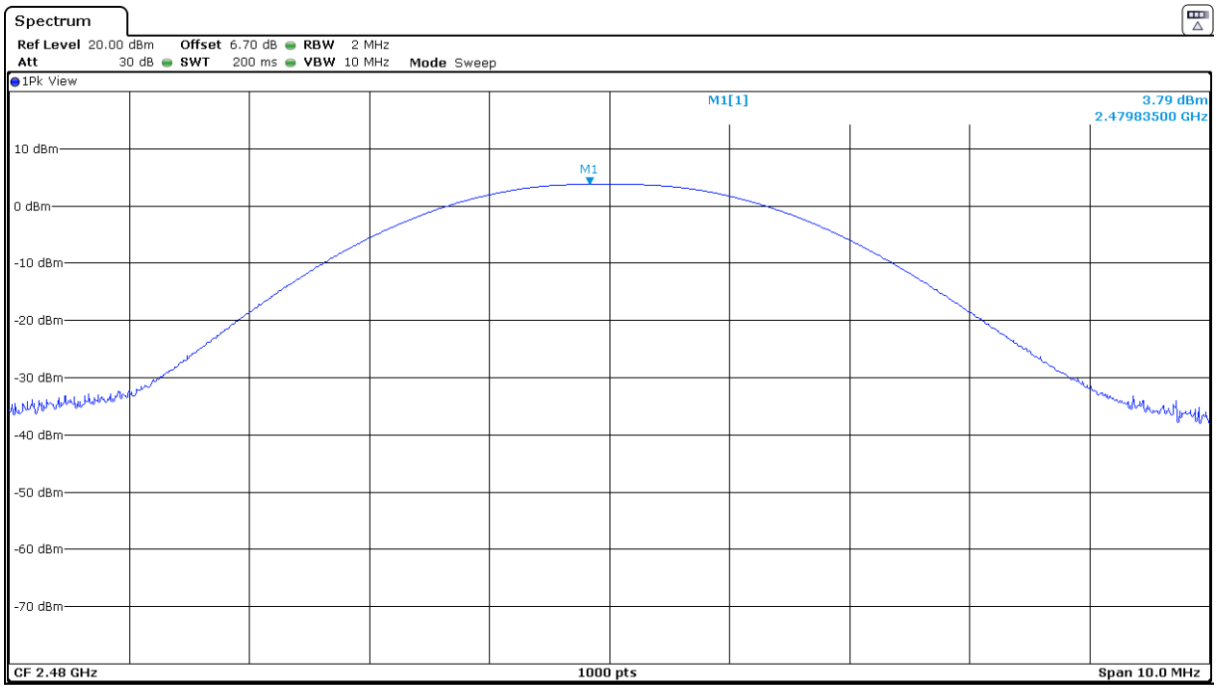
- Low Channel:




- Middle Channel:

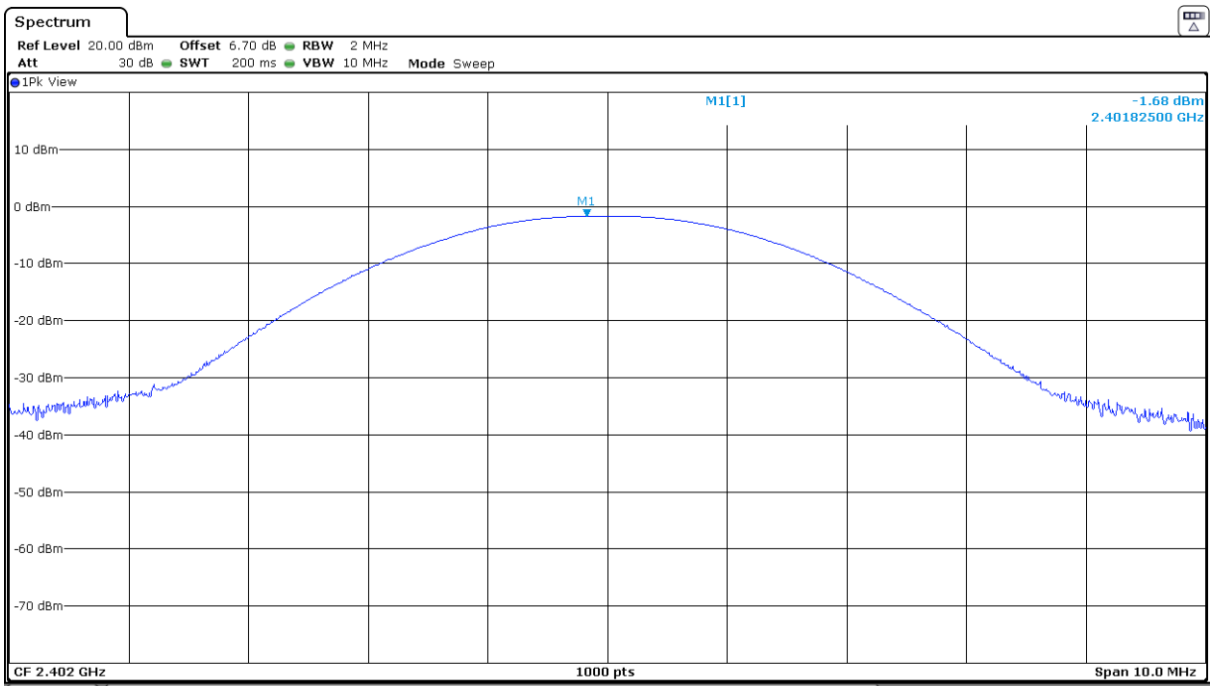


- High Channel:

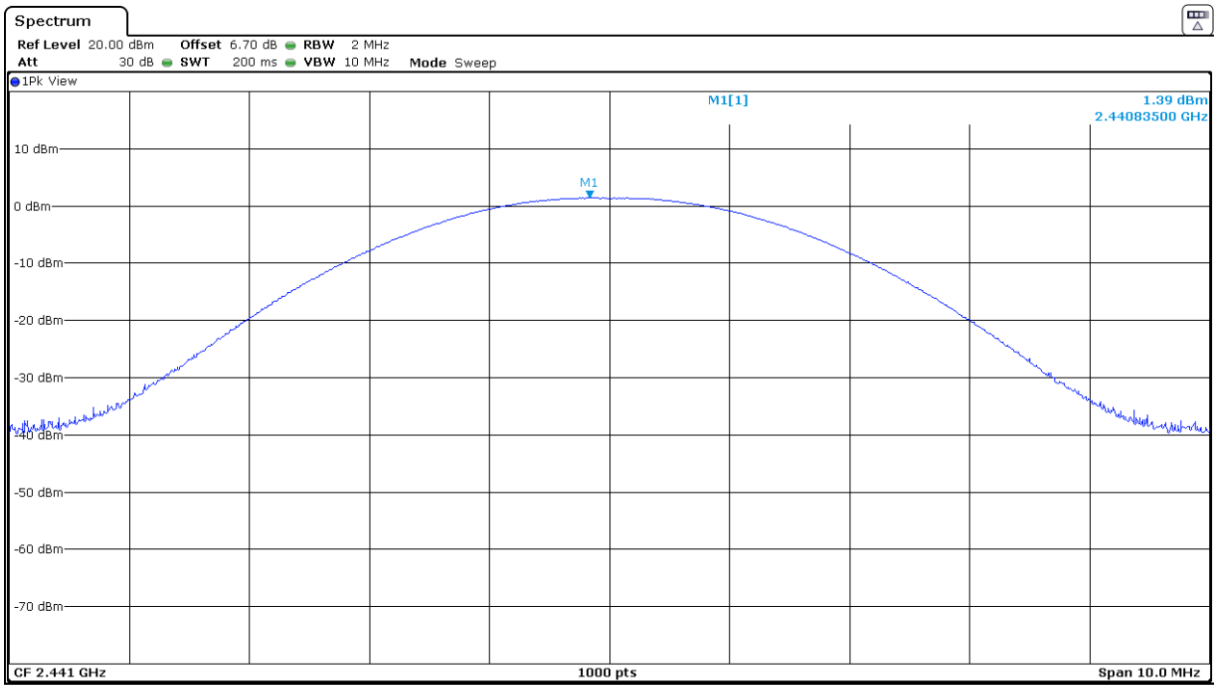



- **Pi/4 DQPSK – Peak Output Power**

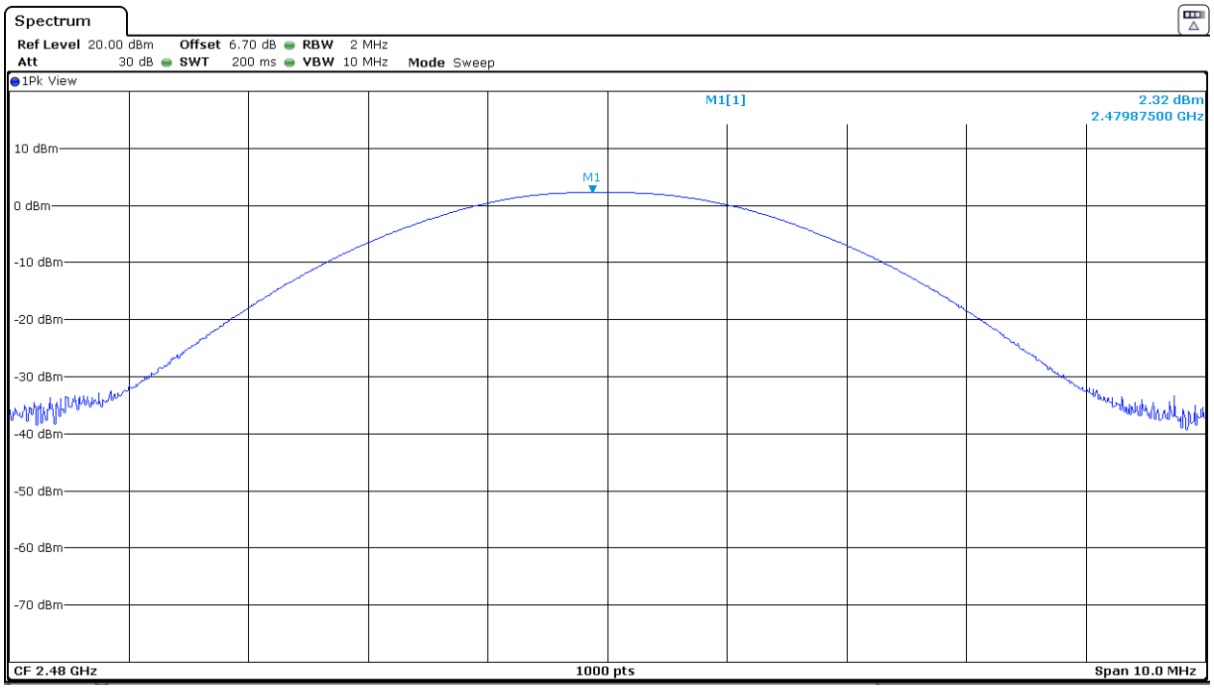
- Low Channel:



- Middle Channel:

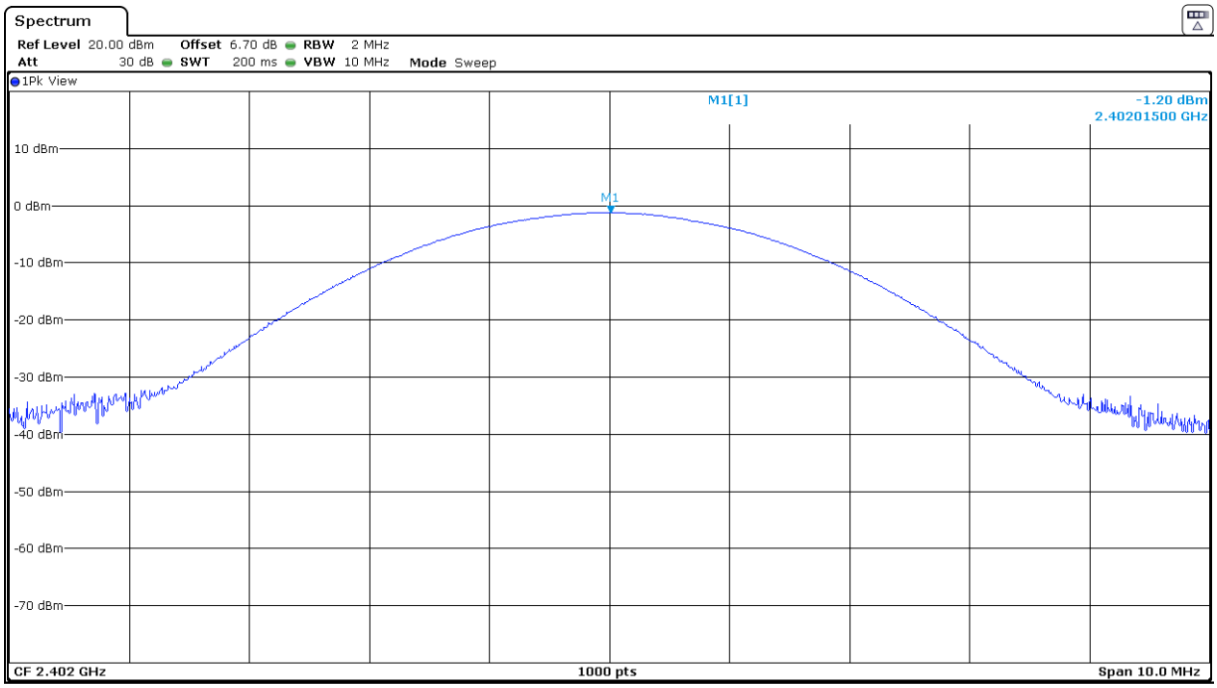



- High Channel:

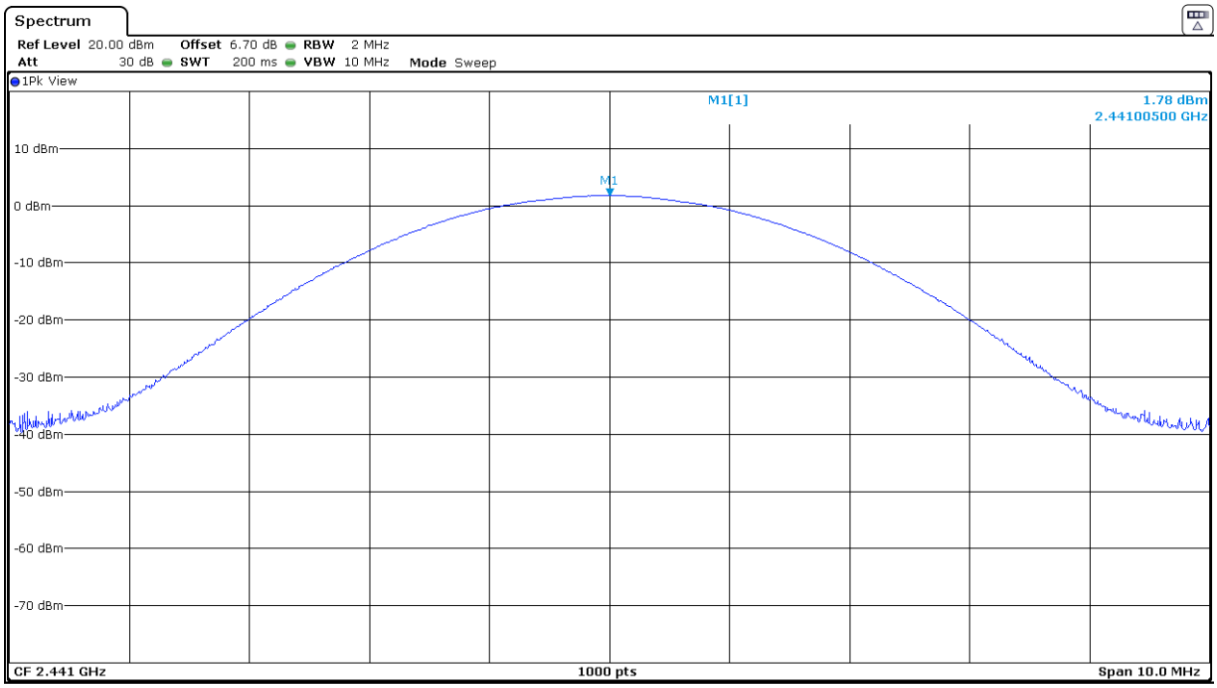


- **8DPSK – Peak Output Power**

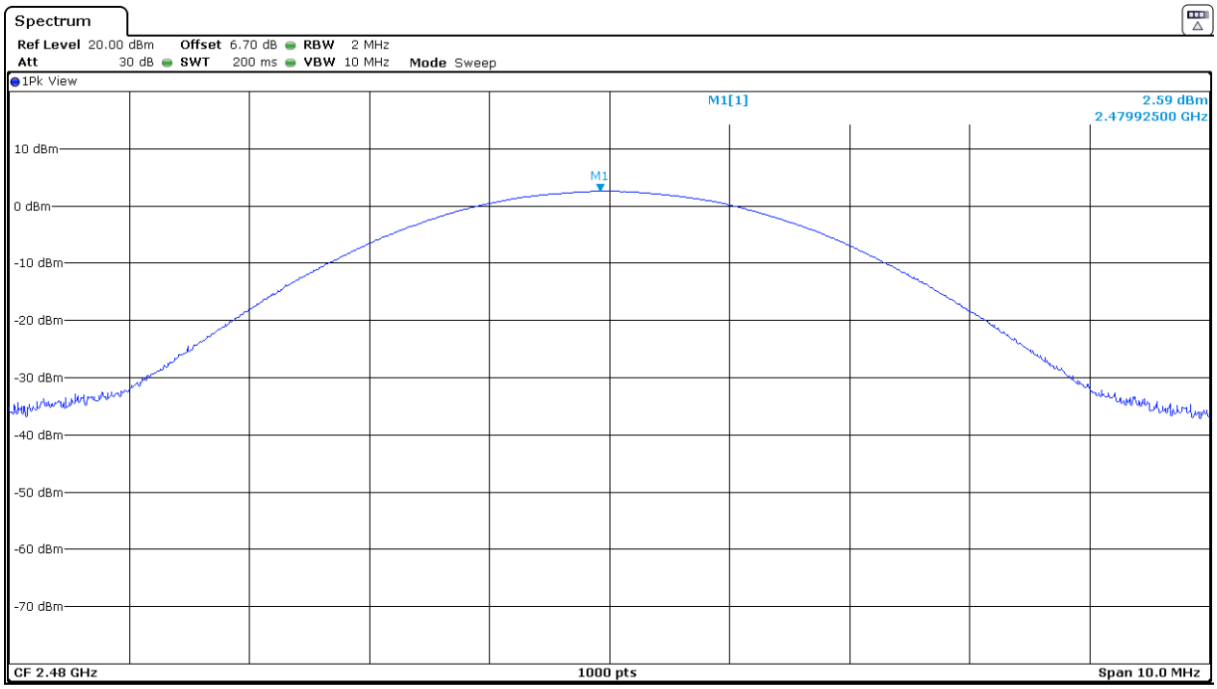
- Low Channel:




- Middle Channel:



- High Channel:



# FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Band-edge emissions compliance (Transmitter) (conducted)

SPECIFICATION:

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20 dB below the highest level of the desired power.

RESULTS:

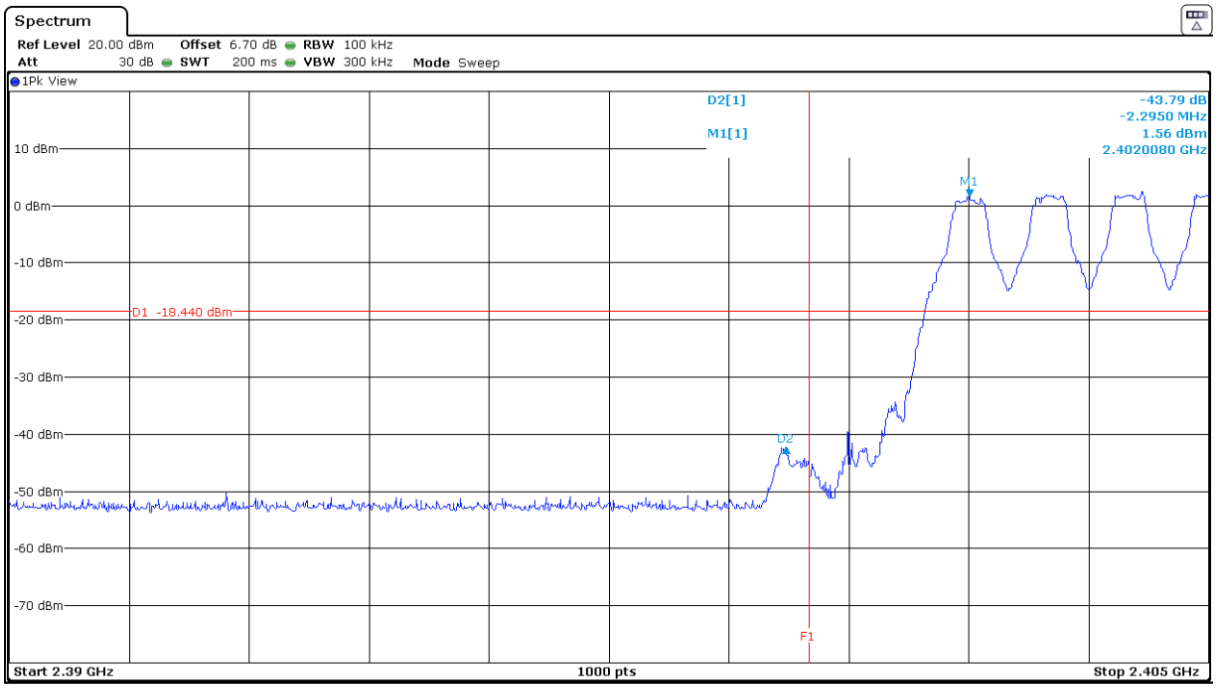
Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

| | |
|---|---|
| Measurement uncertainty (dB) | <±2.03 |

- **GFSK – Band-edge emissions compliance**

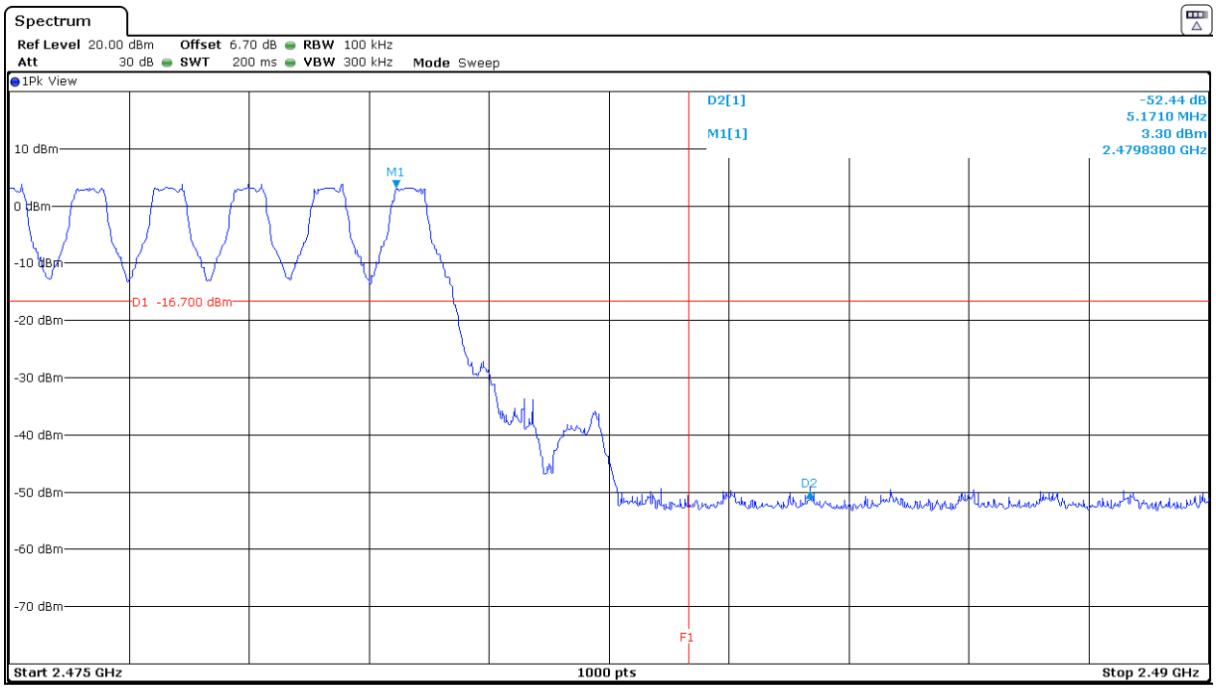
❖ HOPPING ON:

▪ Low Frequency Section 2402 MHz:




Verdict: PASS

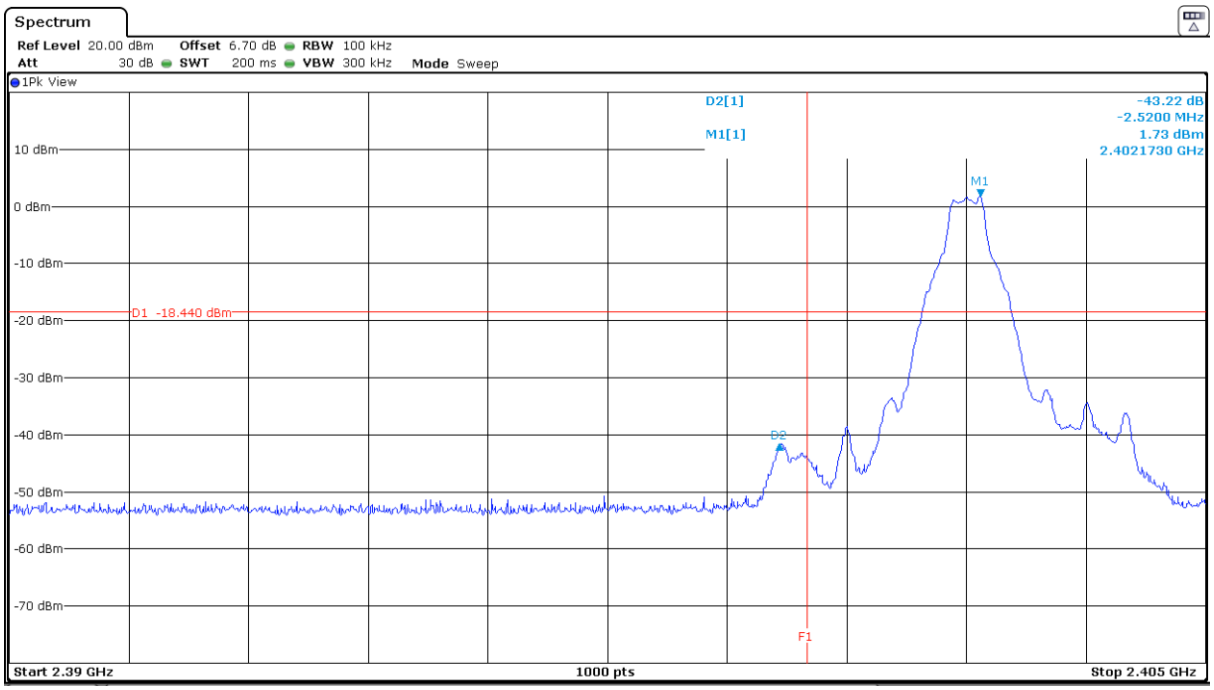
▪ High Frequency Section 2480 MHz:




Verdict: PASS

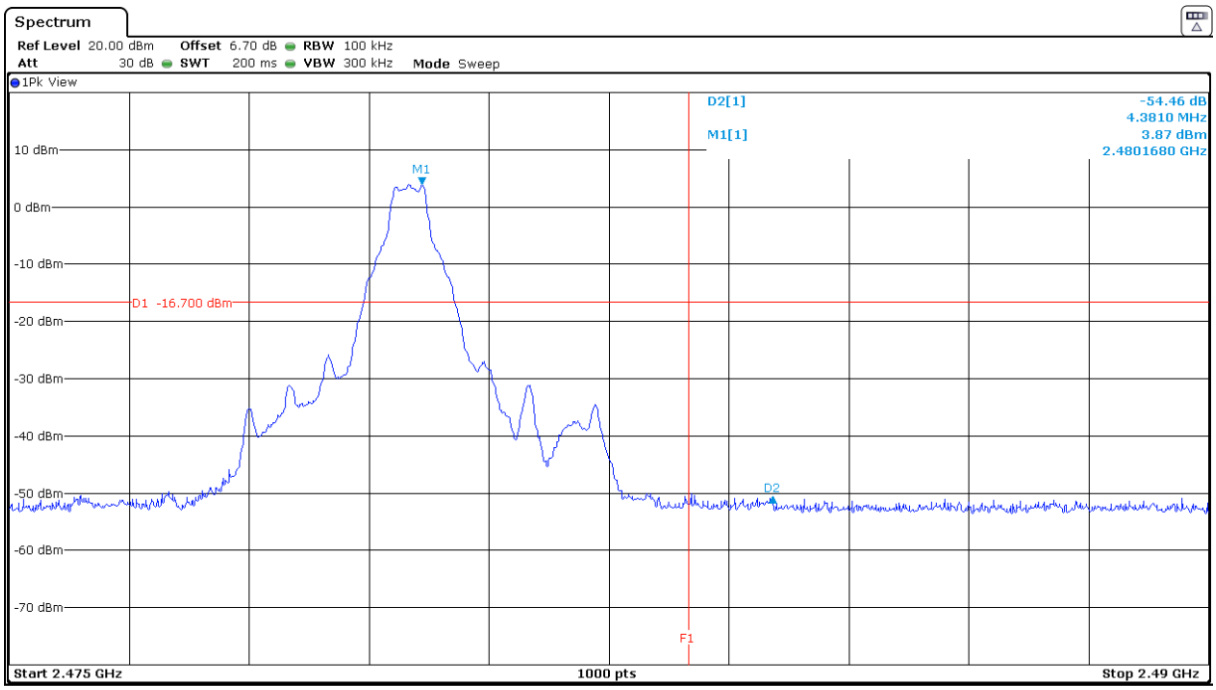
❖ HOPPING OFF:

- Low Frequency Section 2402 MHz:




Verdict: PASS

- High Frequency Section 2480 MHz:

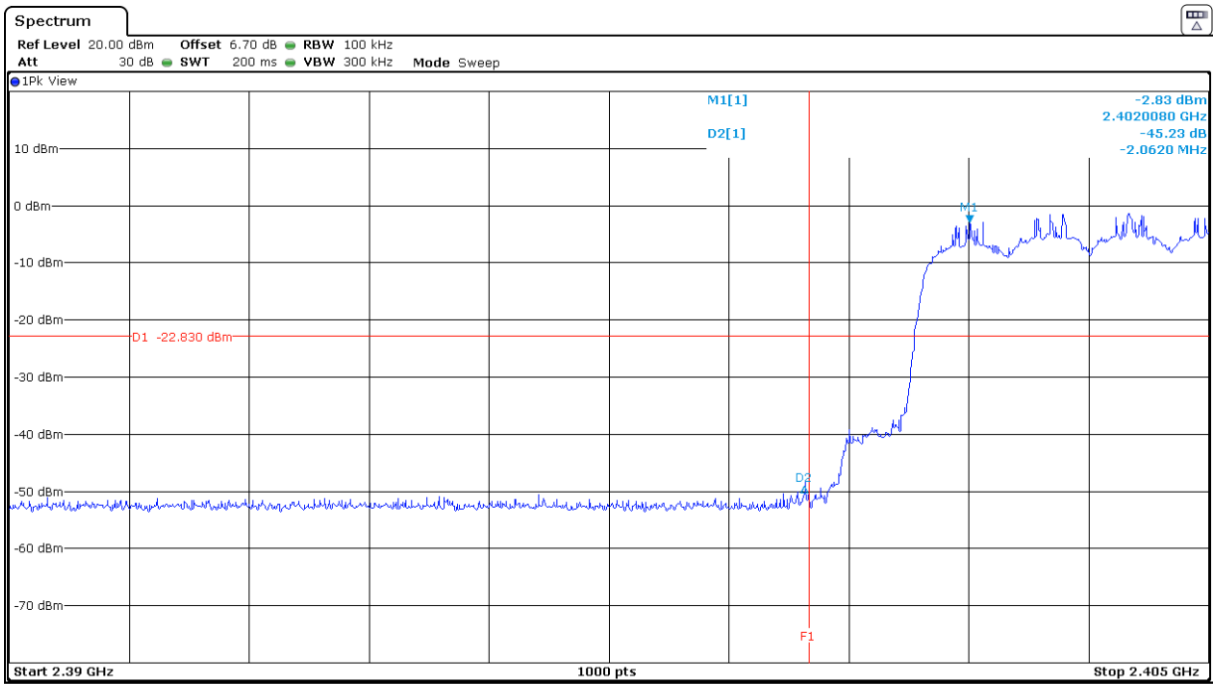



Verdict: PASS

- **Pi/4 DQPSK – Band-edge emissions compliance**

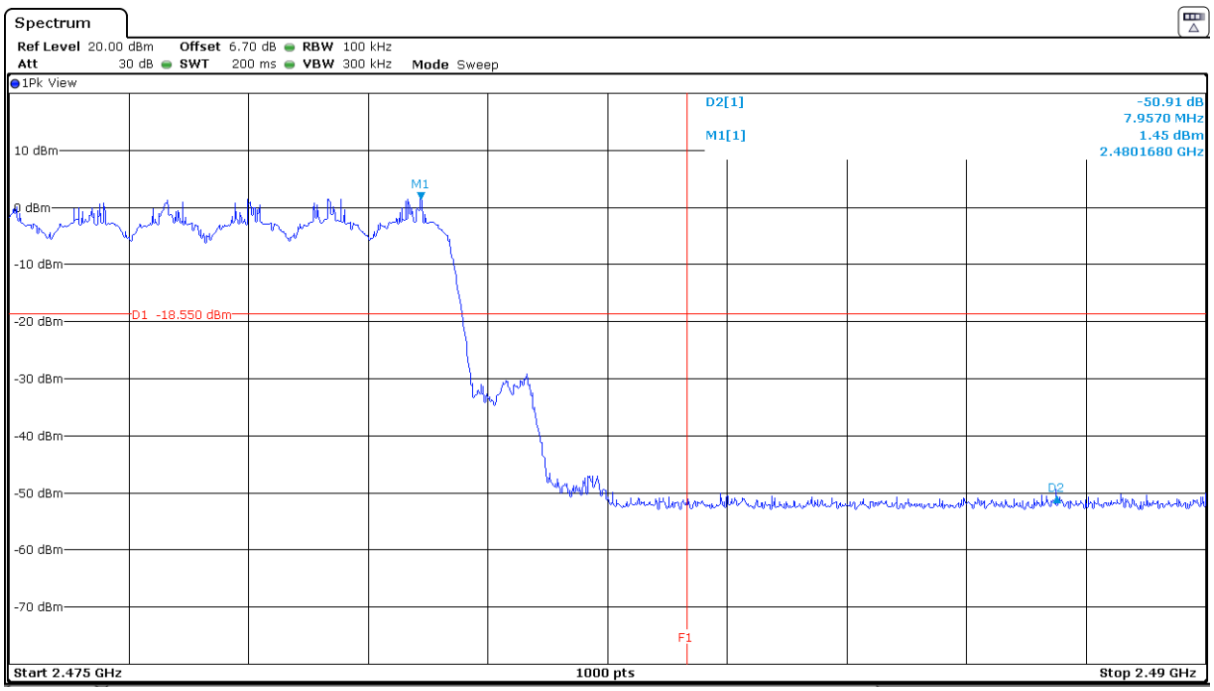
❖ HOPPING ON:

▪ Low Frequency Section 2402 MHz:




Verdict: PASS

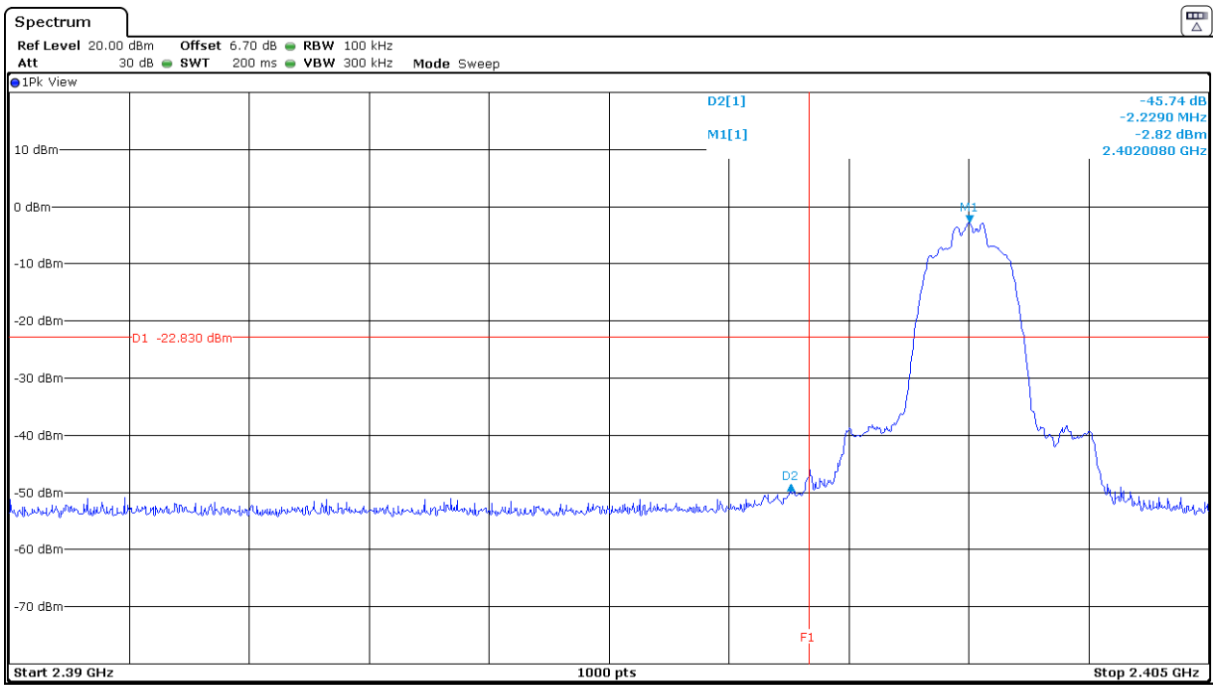
▪ High Frequency Section 2480 MHz:




Verdict: PASS

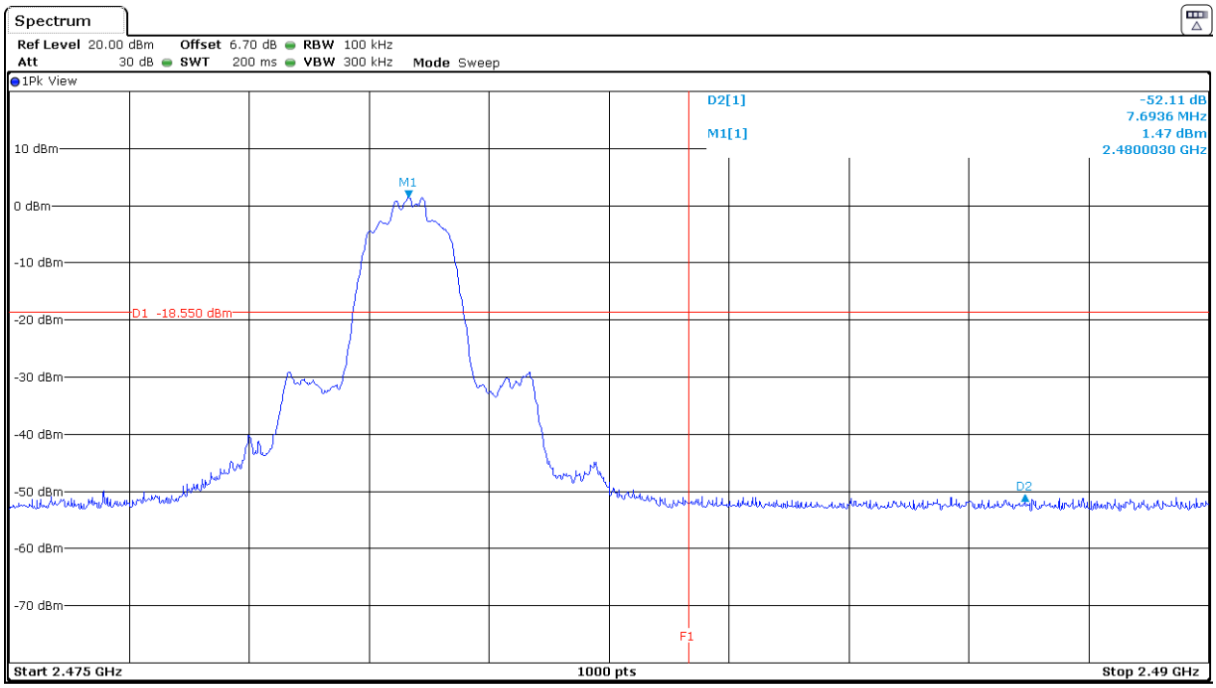
❖ HOPPING OFF:

- Low Frequency Section 2402 MHz:




Verdict: PASS

- High Frequency Section 2480 MHz:

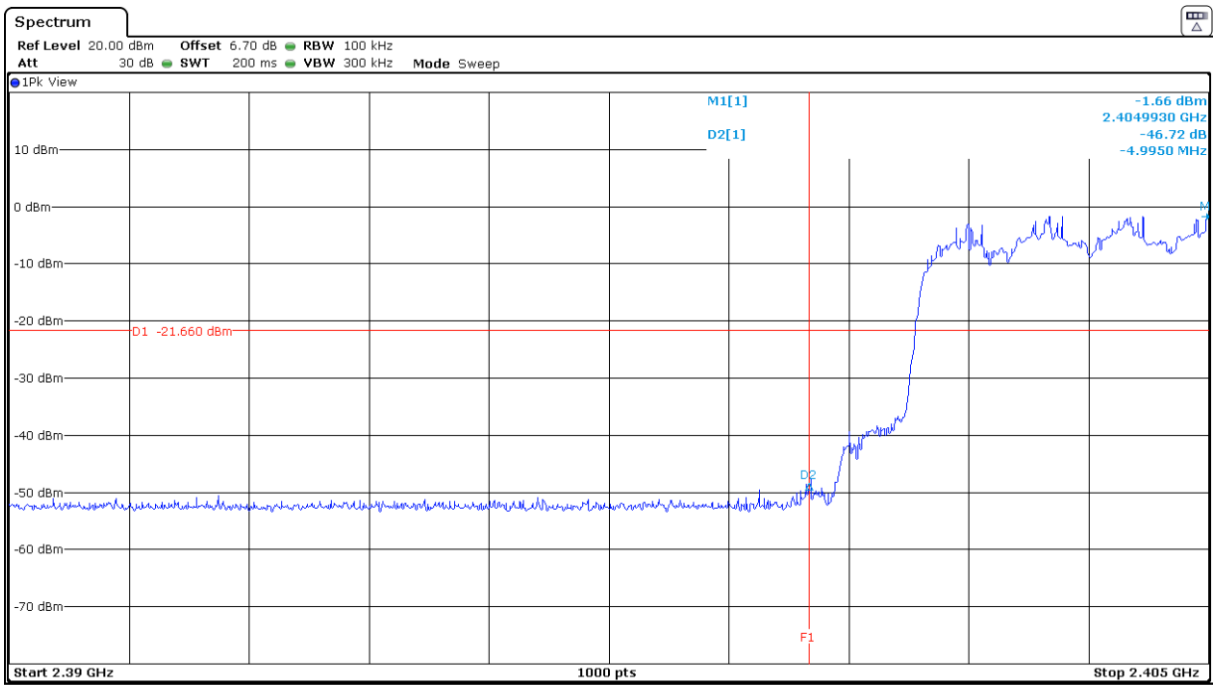



Verdict: PASS

- **8DPSK – Band-edge emissions compliance**

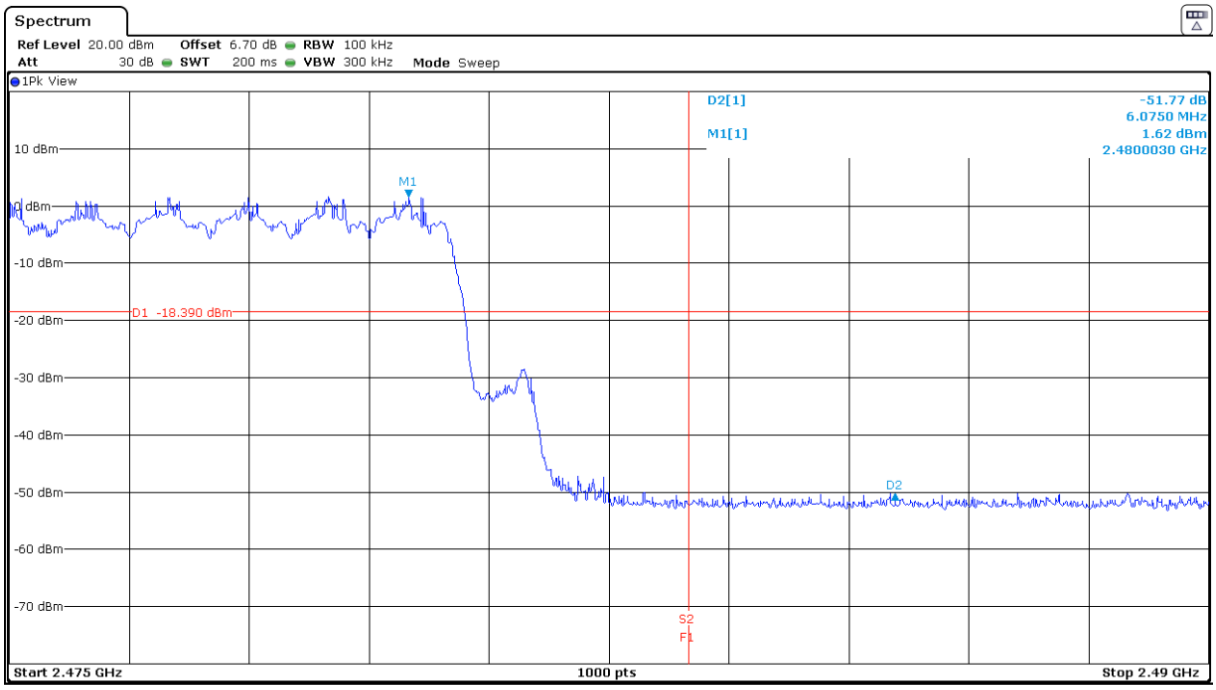
❖ HOPPING ON:

▪ Low Frequency Section 2402 MHz:




Verdict: PASS

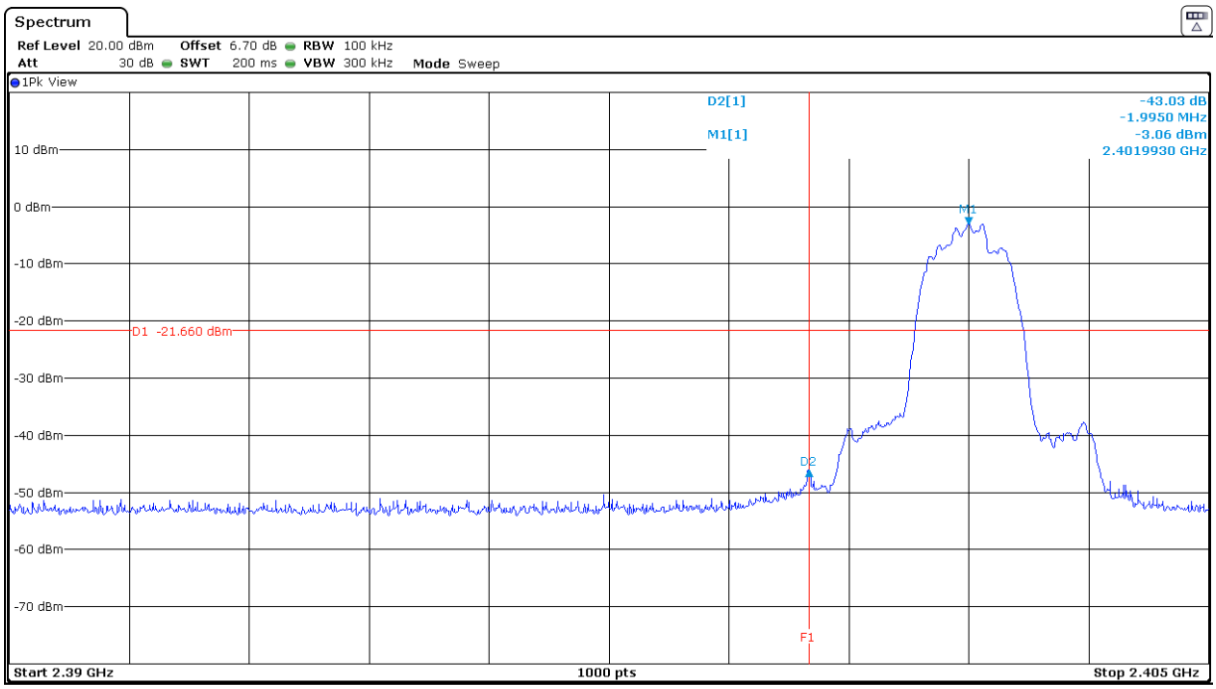
▪ High Frequency Section 2480 MHz:




Verdict: PASS

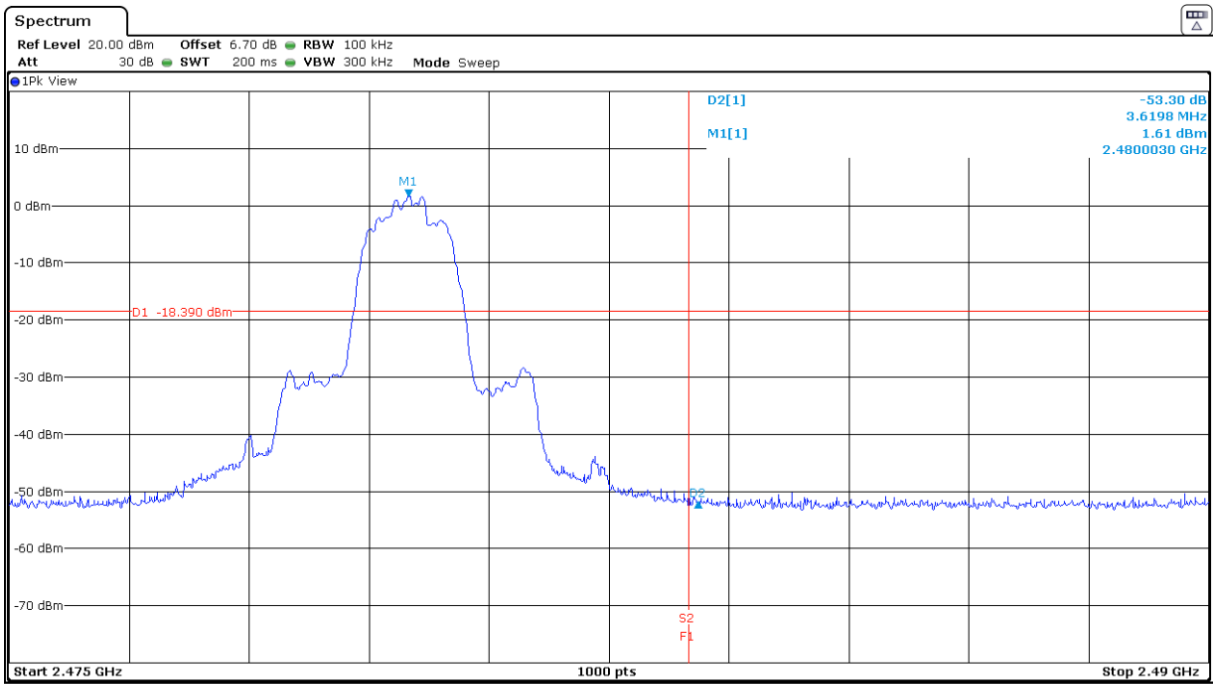
❖ HOPPING OFF:

- Low Frequency Section 2402 MHz:




Verdict: PASS

- High Frequency Section 2480 MHz:




Verdict: PASS

# FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated. (Transmitter)

SPECIFICATION:

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) (see §15.205(c)/RSS-Gen):

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 30 |
| 1.705 - 30.0 | 30 | - | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| 960 - 25000 | 500 | 54 | 3 |

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

**Frequency range 30 MHz - 1 GHz:**

The spurious emissions below 1 GHz do not depend neither on the operating channel nor the modulation mode selected in the EUT.

No spurious frequencies operating (radiated) detected at less than 20 dB below limit.

**Frequency range 1 - 26 GHz:**

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious frequencies with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- **Modulation: GFSK (DH5)**

- Low Channel (2402 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.497985 | Peak | 54.76 | H | <± 3.70 |
| | Average | 49.00 | | <± 3.70 |
| 2.530167 | Peak | 54.86 | H | <± 3.70 |
| | Average | 51.83 | | <± 3.70 |
| 2.562033 | Peak | 52.51 | H | <± 3.70 |
| 4.803900 | Peak | 39.78 | V | <± 3.70 |
| 7.205830 | Peak | 50.71 | H | <± 3.70 |

- Middle Channel (2441 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.311991 | Peak | 50.49 | H | <± 3.70 |
| 2.343996 | Peak | 51.57 | H | <± 3.70 |
| 2.375872 | Peak | 50.76 | H | <± 3.70 |
| 2.504033 | Peak | 51.39 | H | <± 3.70 |
| 2.535900 | Peak | 53.80 | H | <± 3.70 |
| 2.567833 | Peak | 53.10 | H | <± 3.70 |
| 4.881830 | Peak | 39.43 | V | <± 3.70 |
| 7.323430 | Peak | 50.92 | H | <± 3.70 |

- High Channel (2480 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.351999 | Peak | 51.8 | H | <± 3.70 |
| 2.384169 | Peak | 52.13 | H | <± 3.70 |
| 2.576033 | Peak | 51.57 | H | <± 3.70 |
| 2.608203 | Peak | 51.40 | V | <± 3.70 |
| 4.960230 | Peak | 37.24 | V | <± 3.70 |
| 7.439630 | Peak | 51.52 | H | <± 3.70 |

Verdict: PASS

- **Modulation PI/4-DQPSK (2DH5)**

- Low Channel (2402 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.497893 | Peak | 54.79 | H | <± 3.70 |
| | Average | 49.27 | | <± 3.70 |
| 2.498082 | Peak | 51.71 | H | <± 3.70 |
| 2.53030 | Peak | 54.57 | H | <± 3.70 |
| | Average | 48.82 | | <± 3.70 |
| 2.562113 | Peak | 51.74 | H | <± 3.70 |
| 4.803900 | Peak | 35.02 | V | <± 3.70 |
| 7.205480 | Peak | 42.42 | H | <± 3.70 |

- Middle Channel (2441 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.504767 | Peak | 52.14 | H | <± 3.70 |
| 2.536967 | Peak | 52.43 | H | <± 3.70 |
| 2.568967 | Peak | 51.78 | H | <± 3.70 |
| 4.88234 | Peak | 35.53 | V | <± 3.70 |
| 7.32283 | Peak | 43.35 | H | <± 3.70 |

- High Channel (2480 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.383775 | Peak | 49.51 | H | <± 3.70 |
| 2.576167 | Peak | 50.29 | H | <± 3.70 |
| 2.607500 | Peak | 51.38 | H | <± 3.70 |
| 4.959860 | Peak | 36.36 | V | <± 3.70 |
| 7.439570 | Peak | 42.80 | H | <± 3.70 |

Verdict: PASS

- **Modulation: 8-DPSK (3DH5)**

- Low Channel (2402 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.497994 | Peak | 54.87 | H | <± 3.70 |
| | Average | 49.74 | | <± 3.70 |
| 2.529900 | Peak | 55.41 | H | <± 3.70 |
| | Average | 52.35 | | <± 3.70 |
| 2.562192 | Peak | 50.07 | H | <± 3.70 |
| 4.804530 | Peak | 34.86 | V | <± 3.70 |

- Middle Channel (2441 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.505193 | Peak | 51.64 | H | <± 3.70 |
| 2.5367 | Peak | 53.40 | H | <± 3.70 |
| 2.569033 | Peak | 52.52 | H | <± 3.70 |
| 4.88183 | Peak | 37.16 | V | <± 3.70 |
| 7.3225 | Peak | 43.80 | H | <± 3.70 |

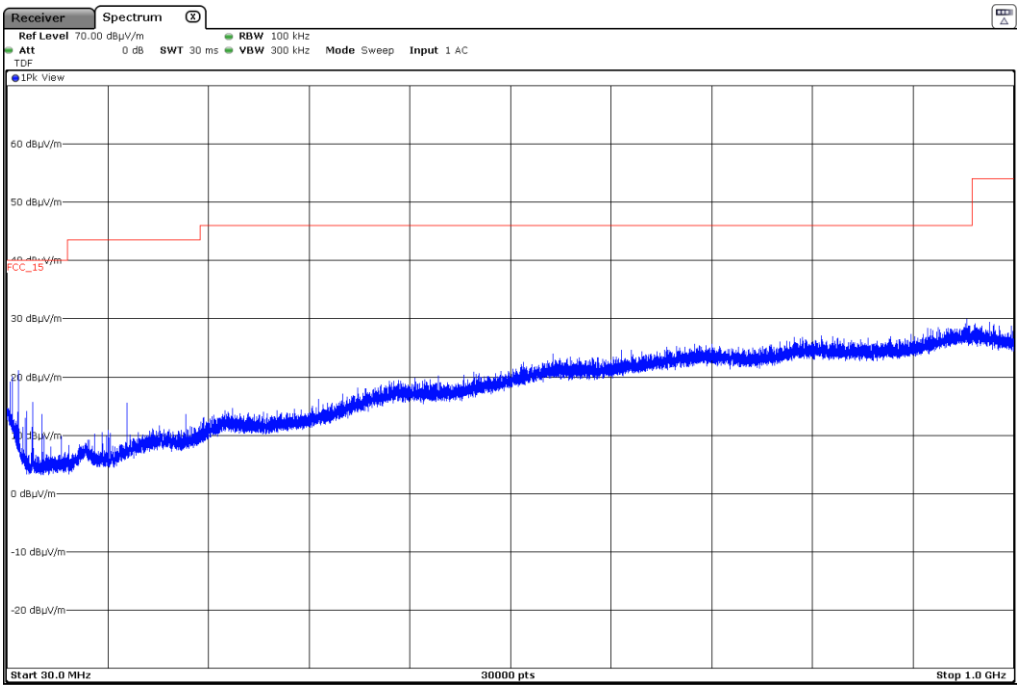
- High Channel (2480 MHz). Spurious frequencies operating (radiated) detected at less than 20 dB below limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.383732 | Peak | 50.39 | H | <± 3.70 |
| 2.576167 | Peak | 51.38 | H | <± 3.70 |
| 2.607900 | Peak | 51.46 | H | <± 3.70 |
| 4.960430 | Peak | 36.63 | V | <± 3.70 |
| 7.440570 | Peak | 42.01 | H | <± 3.70 |

Verdict: PASS

## FREQUENCY RANGE 30 MHz - 1 GHz:

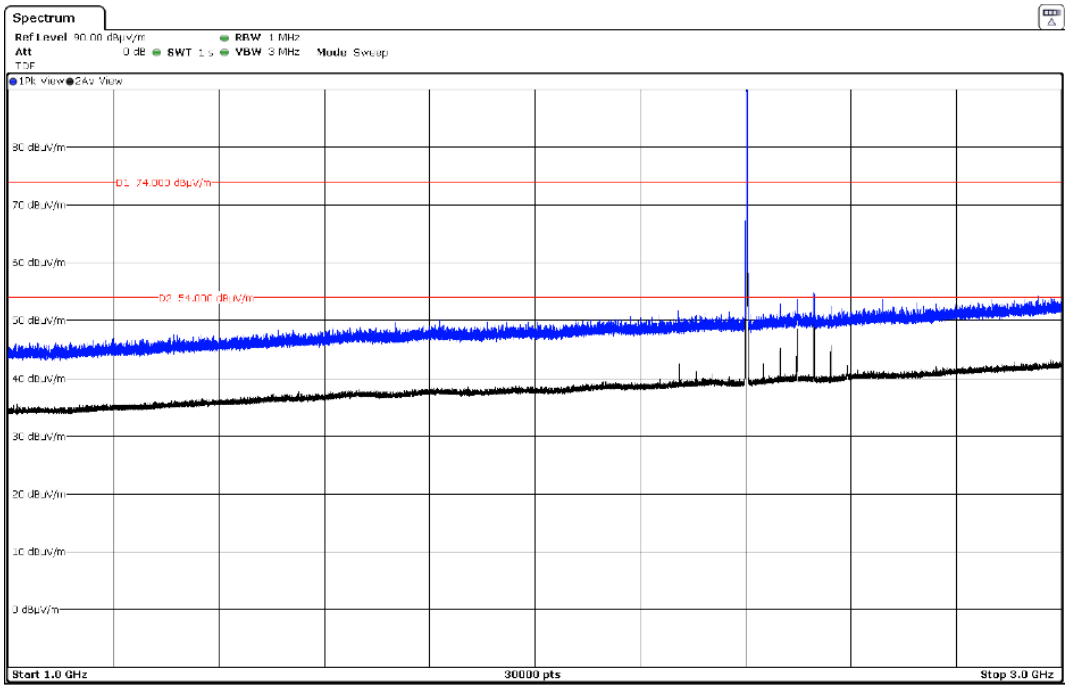
This plot is valid for the Low, Middle and High Channels and all modulation modes.



## FREQUENCY RANGE 1 - 3 GHz:

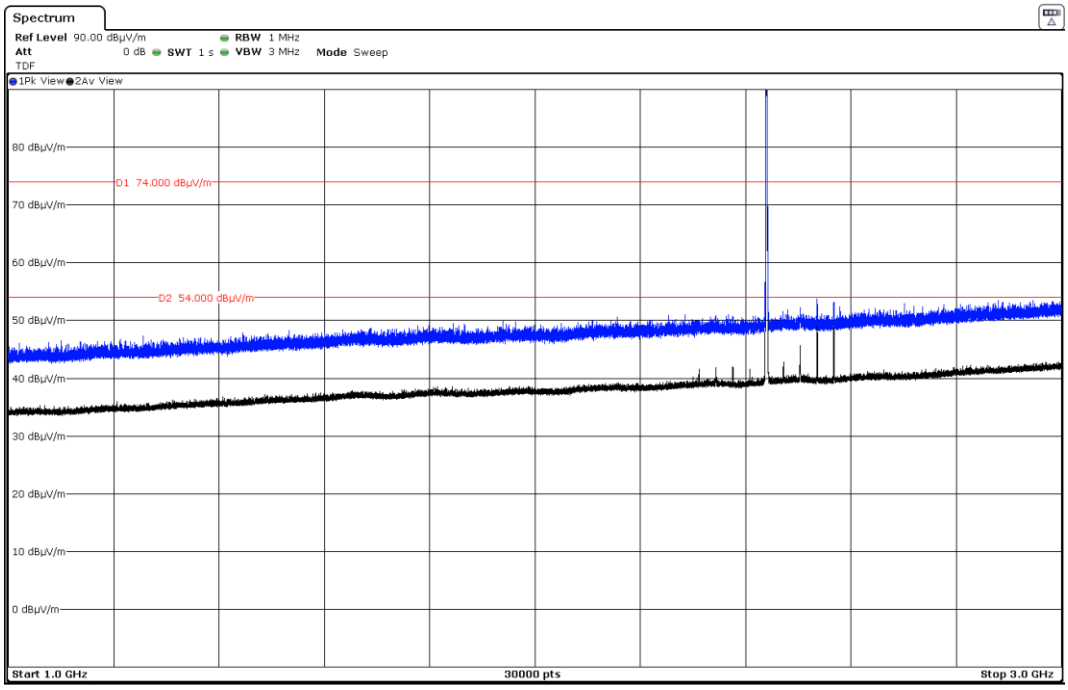
- **Modulation: GFSK (DH5)**

- Low Channel (2402 MHz):



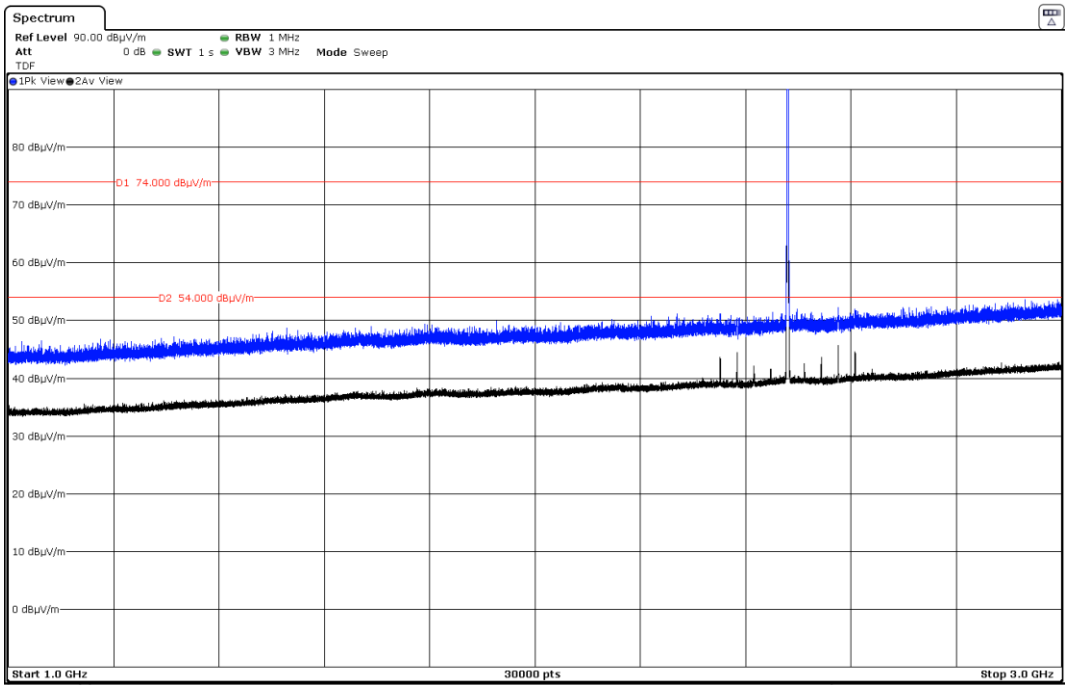

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

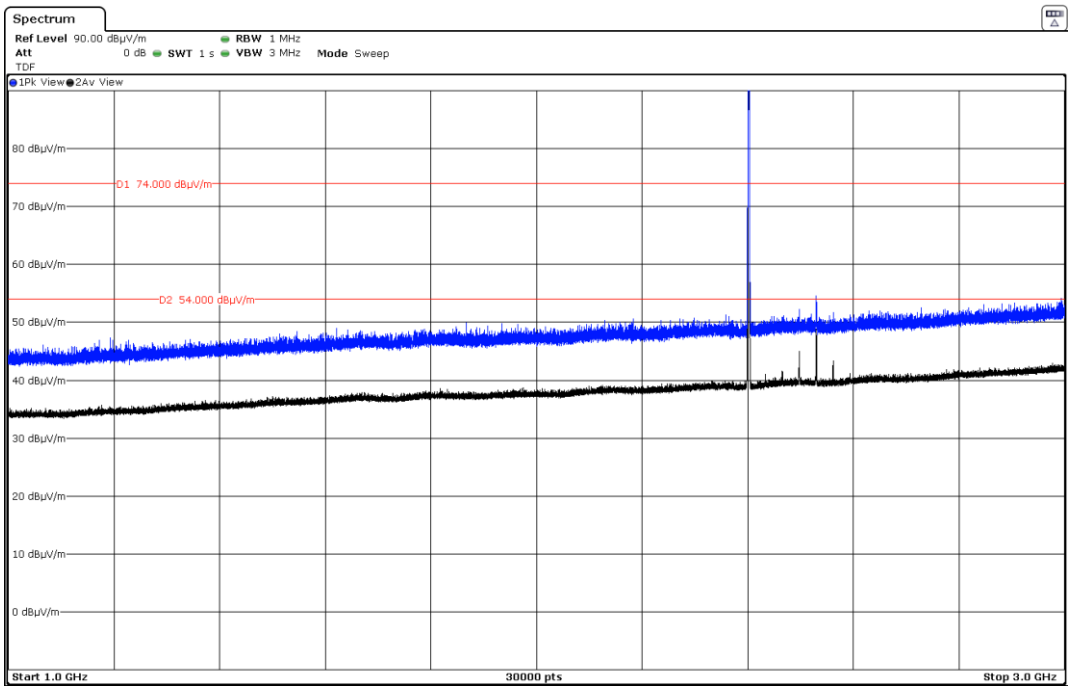
- High Channel (2480 MHz):




The peak above the limit is the carrier frequency.

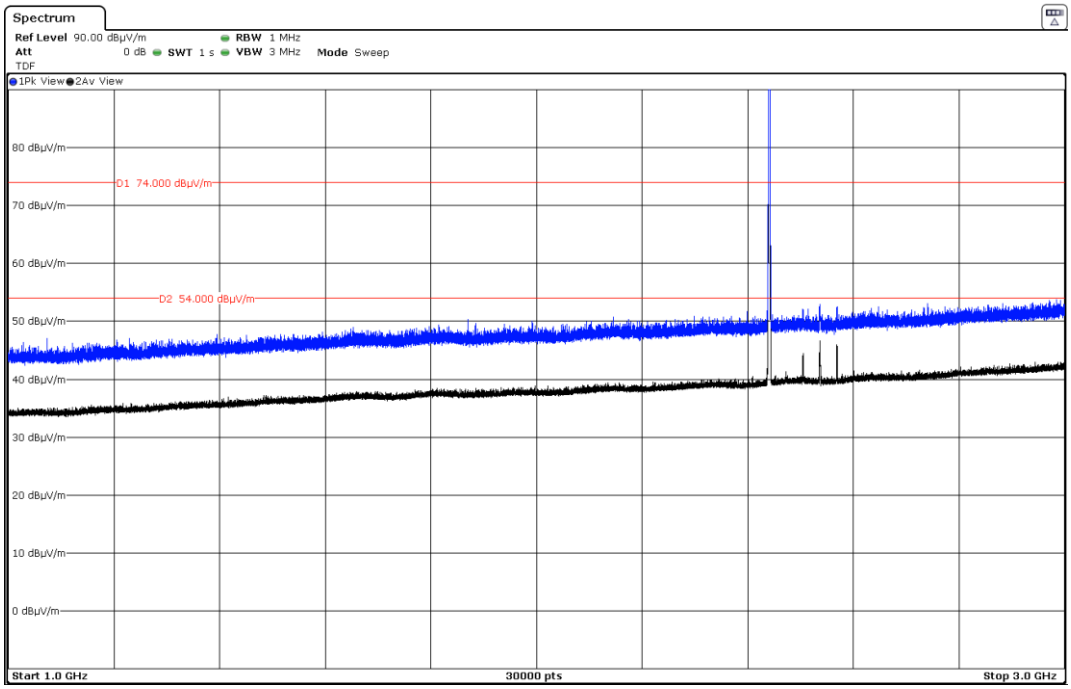
- **Modulation: PI/4-DQPSK (2DH5)**

- Low Channel (2402 MHz):



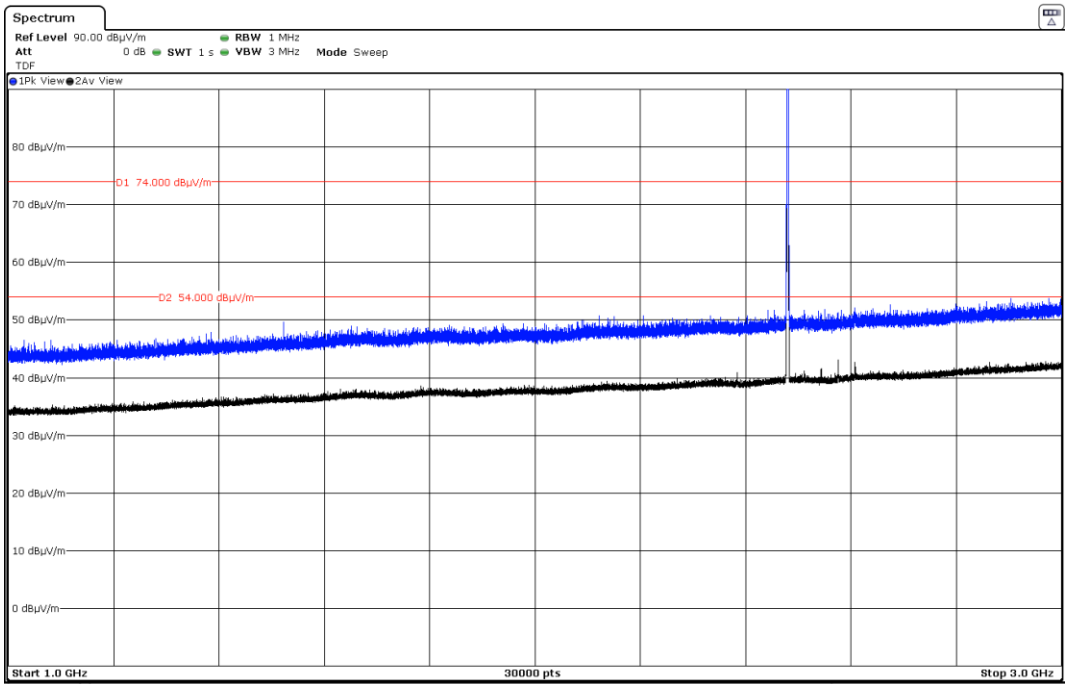

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

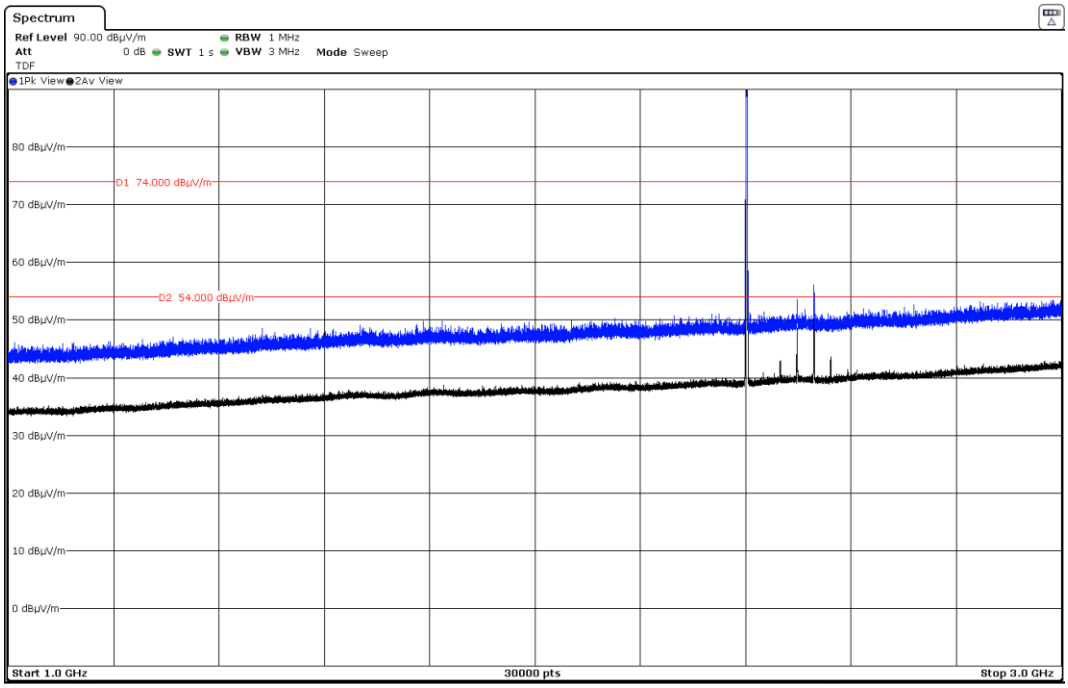
- High Channel (2480 MHz):




The peak above the limit is the carrier frequency.

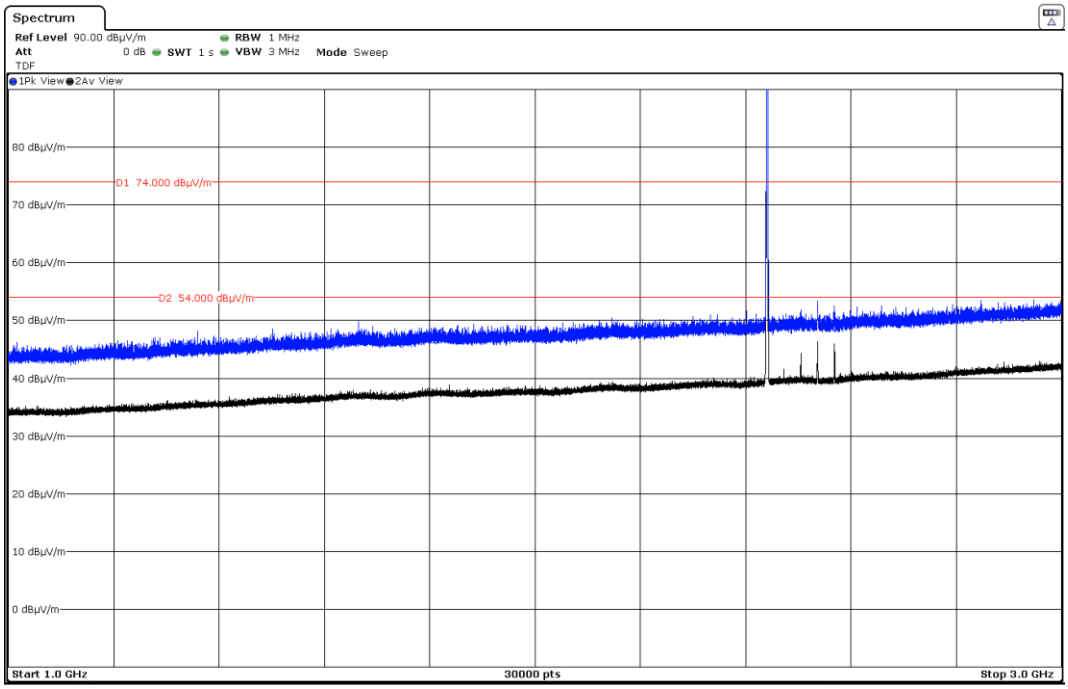
- **Modulation: 8-DPSK (3DH5)**

- Low Channel (2402 MHz):



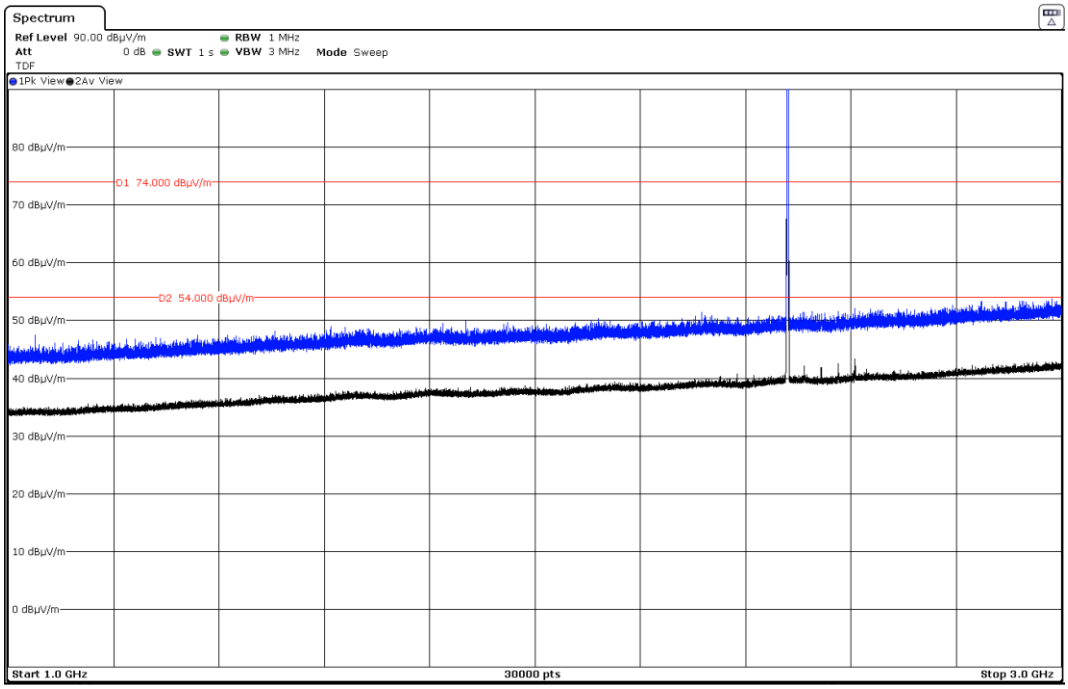

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

- High Channel (2480 MHz):



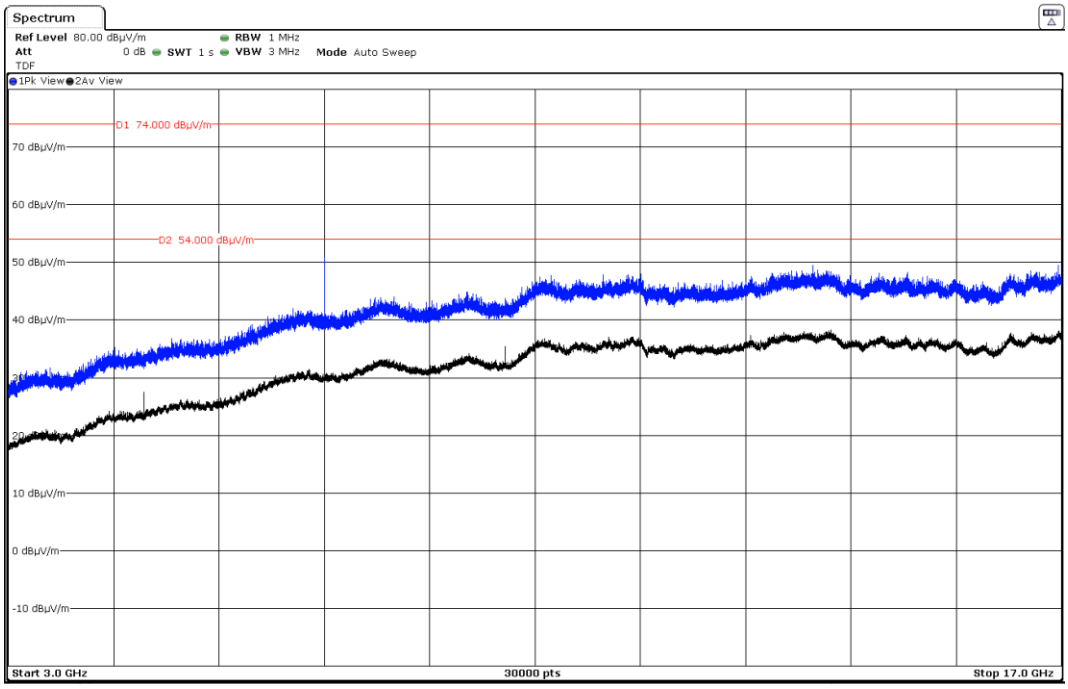

The peak above the limit is the carrier frequency.

## FREQUENCY RANGE 3 - 17 GHz:

- **Modulation: GFSK (DH5)**

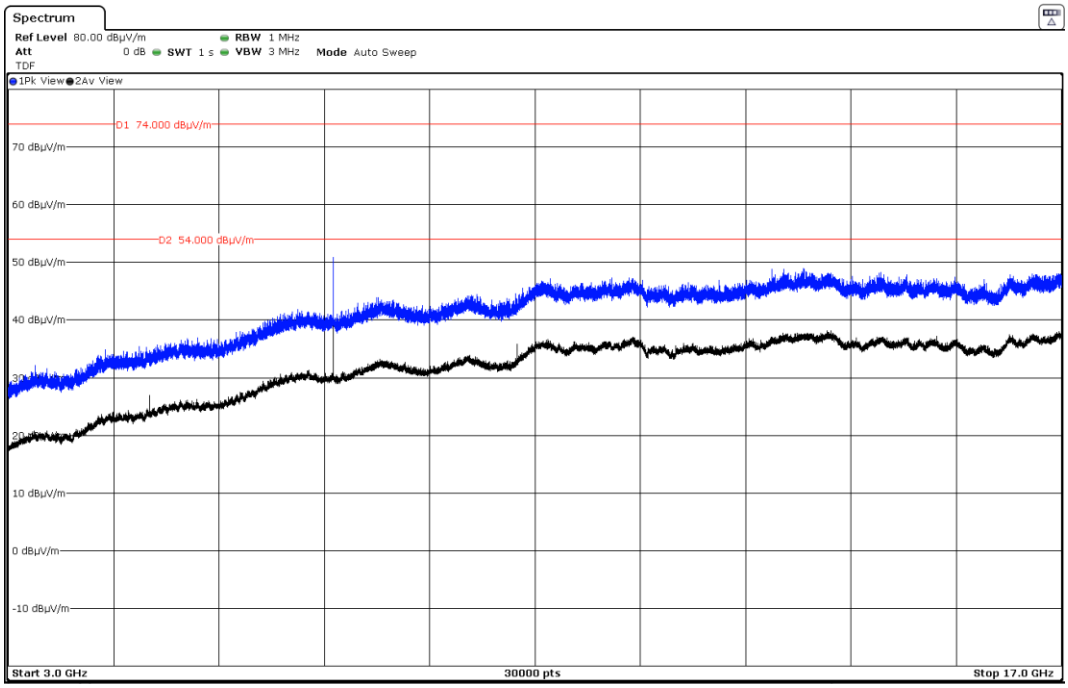
- Low Channel (2402 MHz):

9



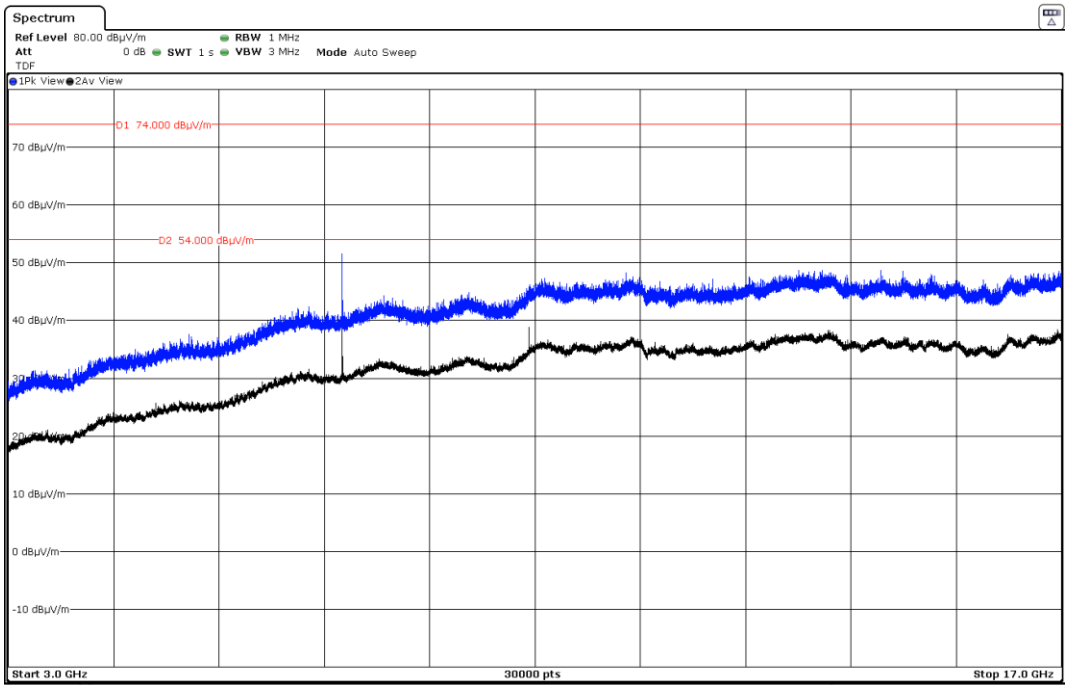

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

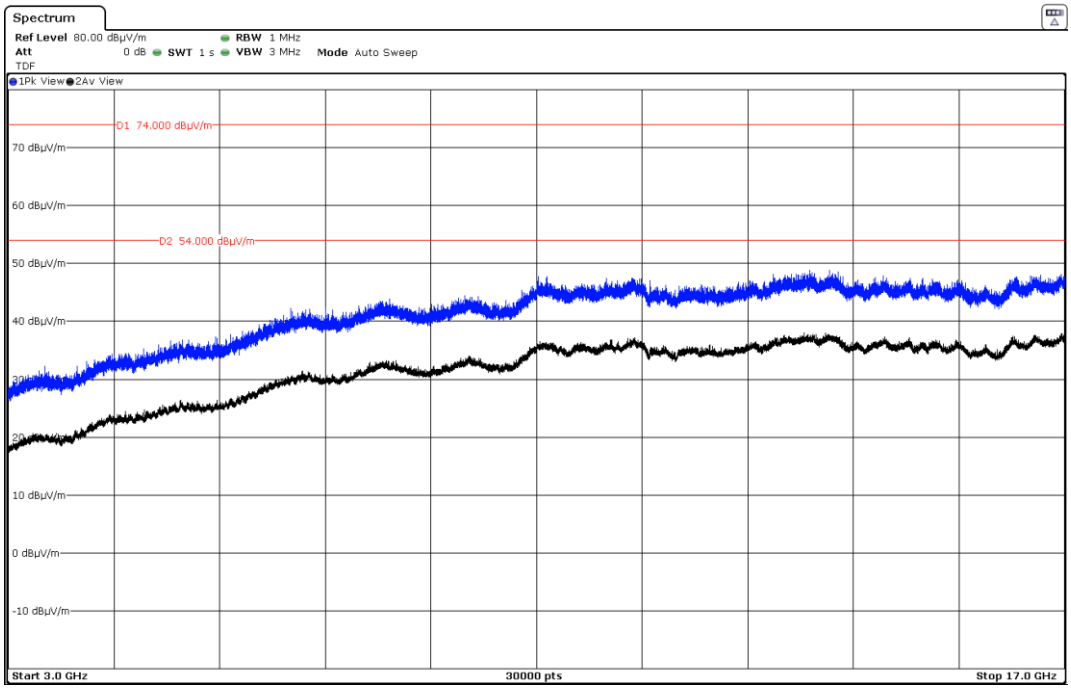
- High Channel (2480 MHz):




The peak above the limit is the carrier frequency.

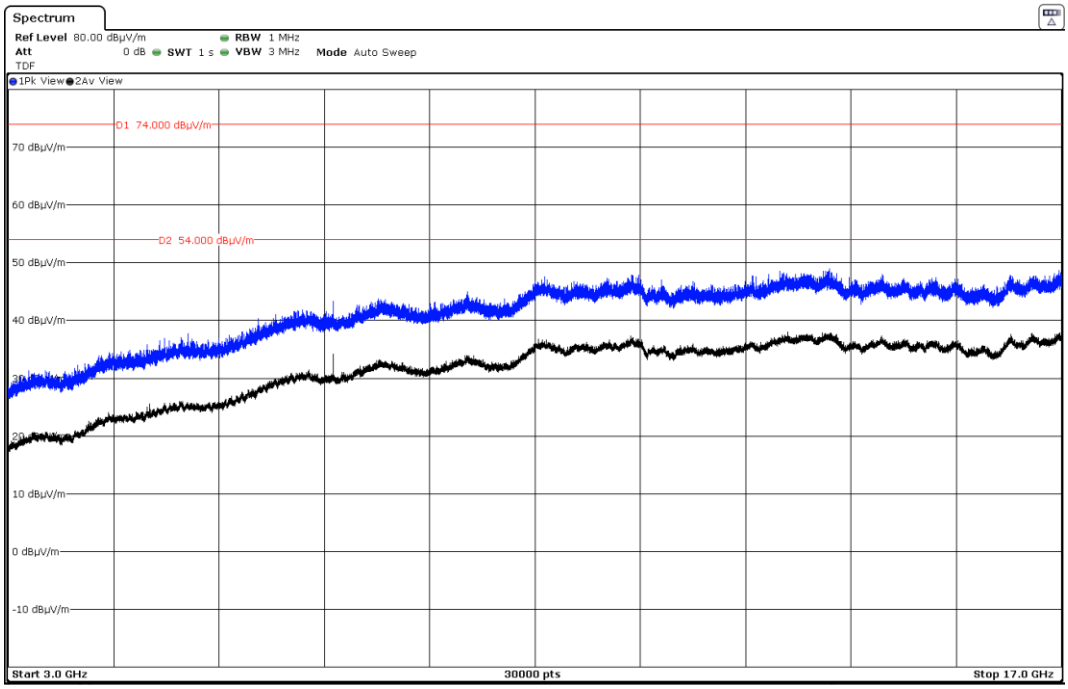
- **Modulation: PI/4-DQPSK (2DH5)**

- Low Channel (2402 MHz):



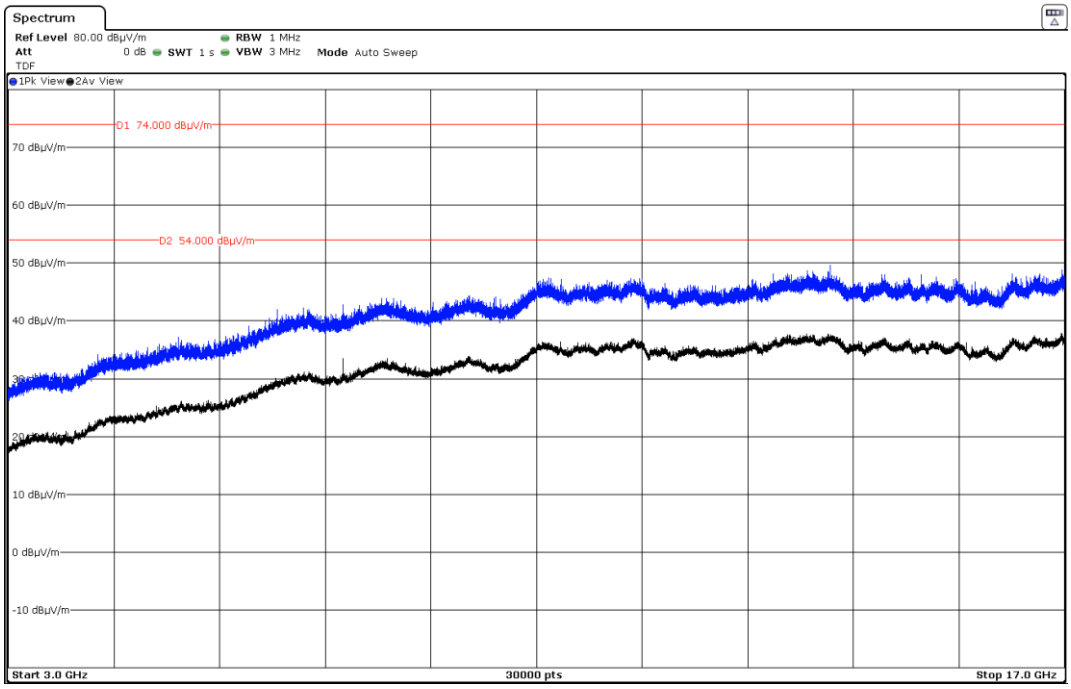

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

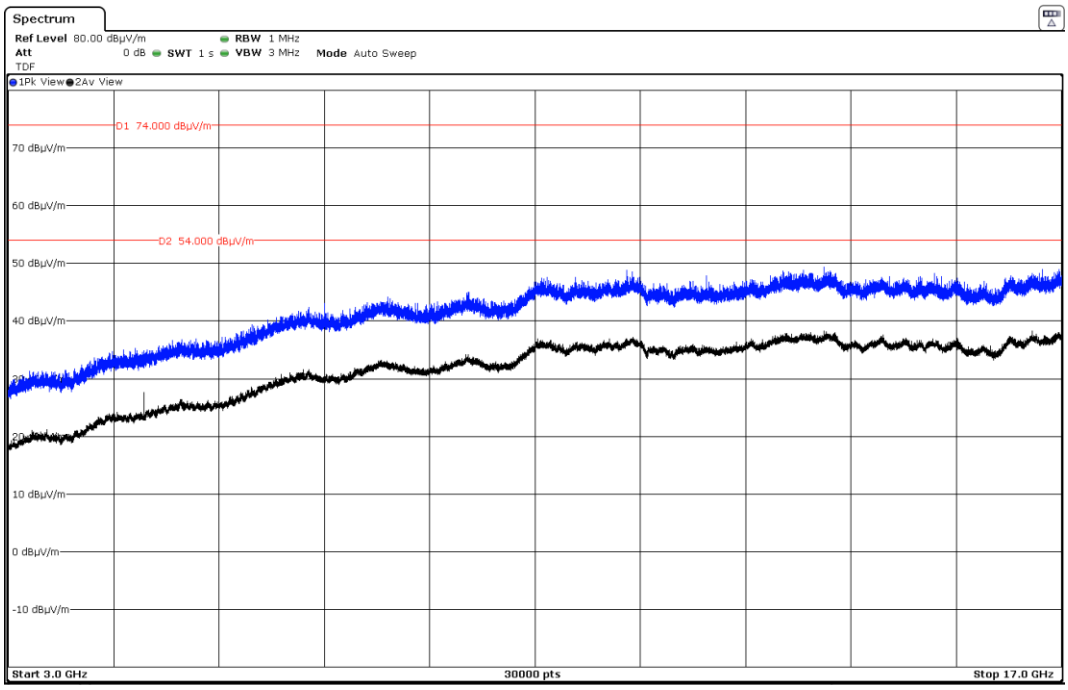
- High Channel (2480 MHz):




The peak above the limit is the carrier frequency.

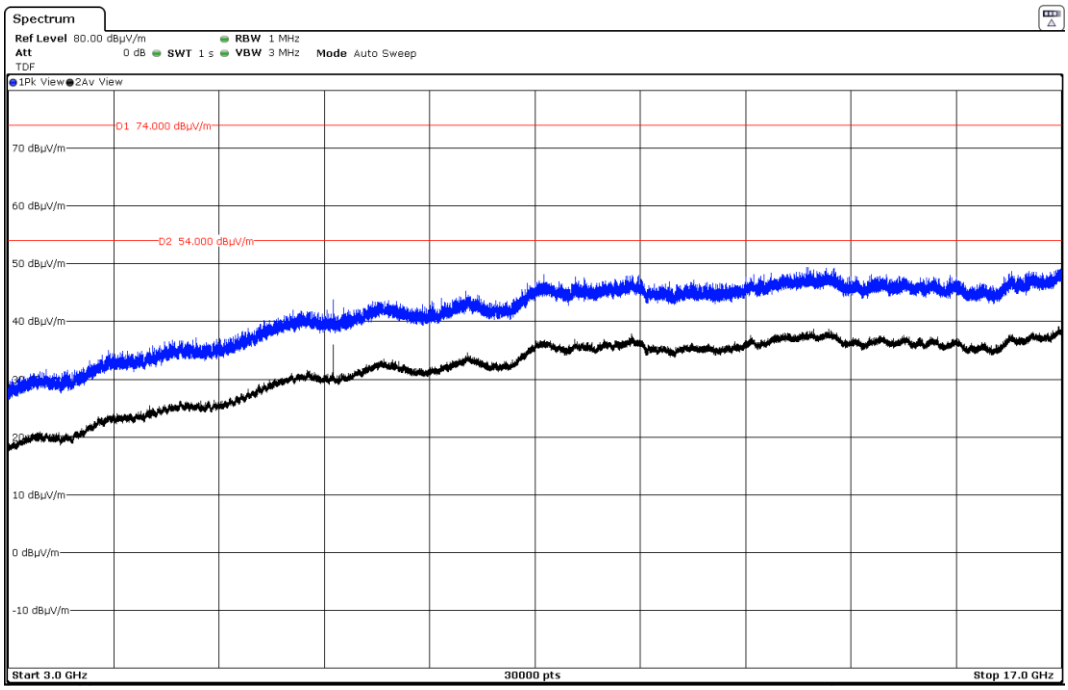
- **Modulation: 8-DPSK (3DH5)**

- Low Channel (2402 MHz):



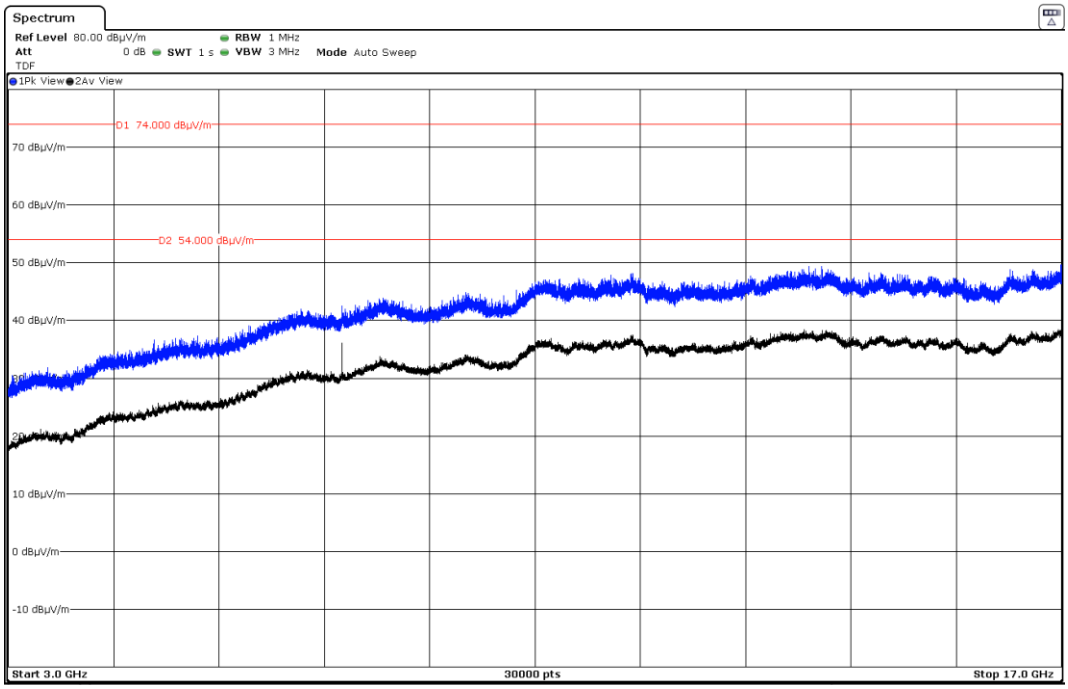

The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):




The peak above the limit is the carrier frequency.

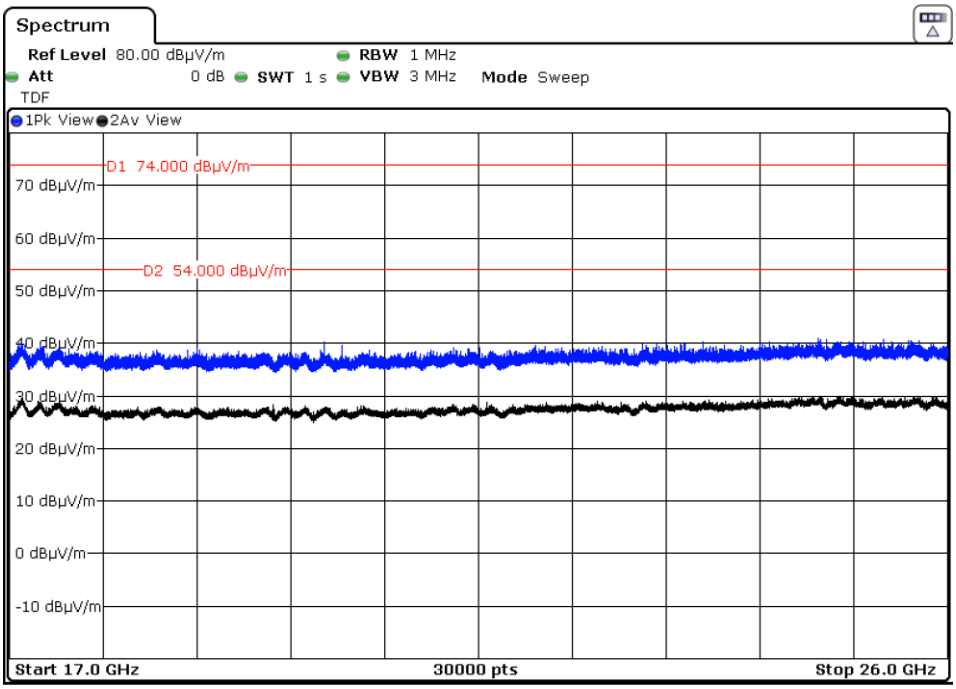
- High Channel (2480 MHz):




The peak above the limit is the carrier frequency.

## FREQUENCY RANGE 17 - 26 GHz:

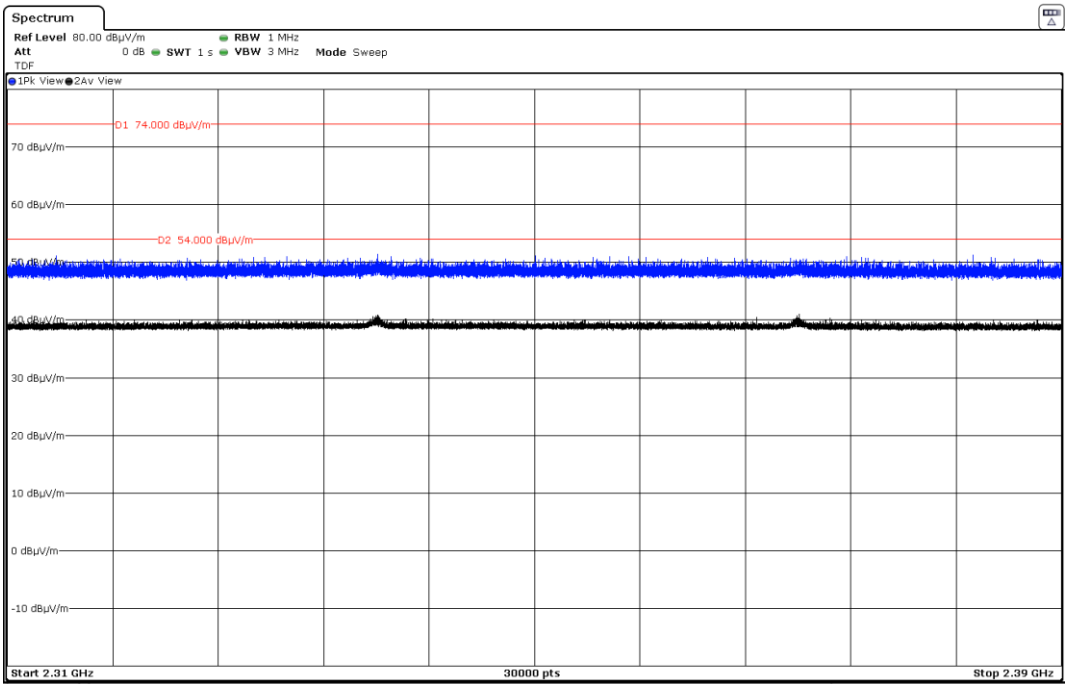
This plot is valid for the Low, Middle and High Channels and all modulation modes.



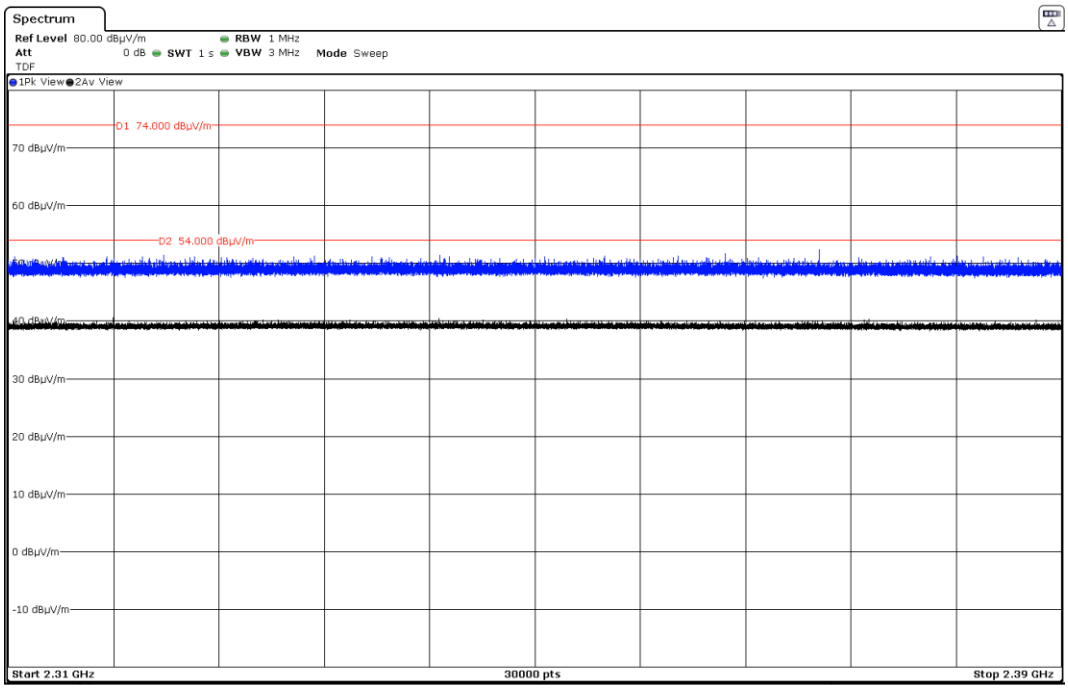
## FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

- Low Channel (2402 MHz):

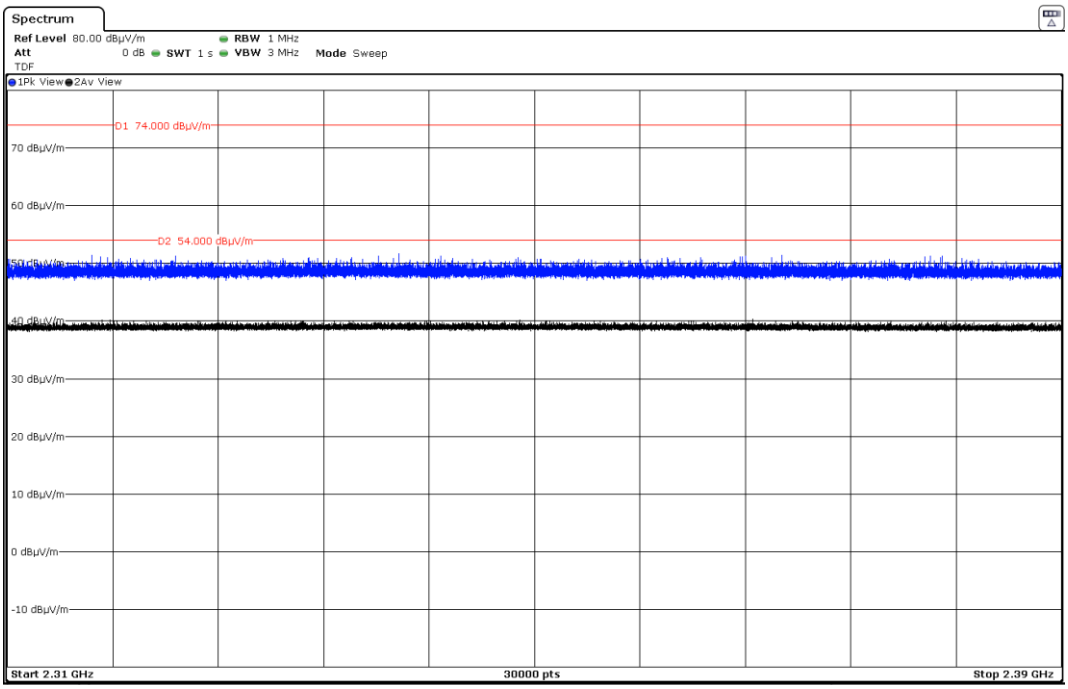
- **Modulation: GFSK (DH5)**




- **Modulation: PI/4-DQPSK (2DH5)**

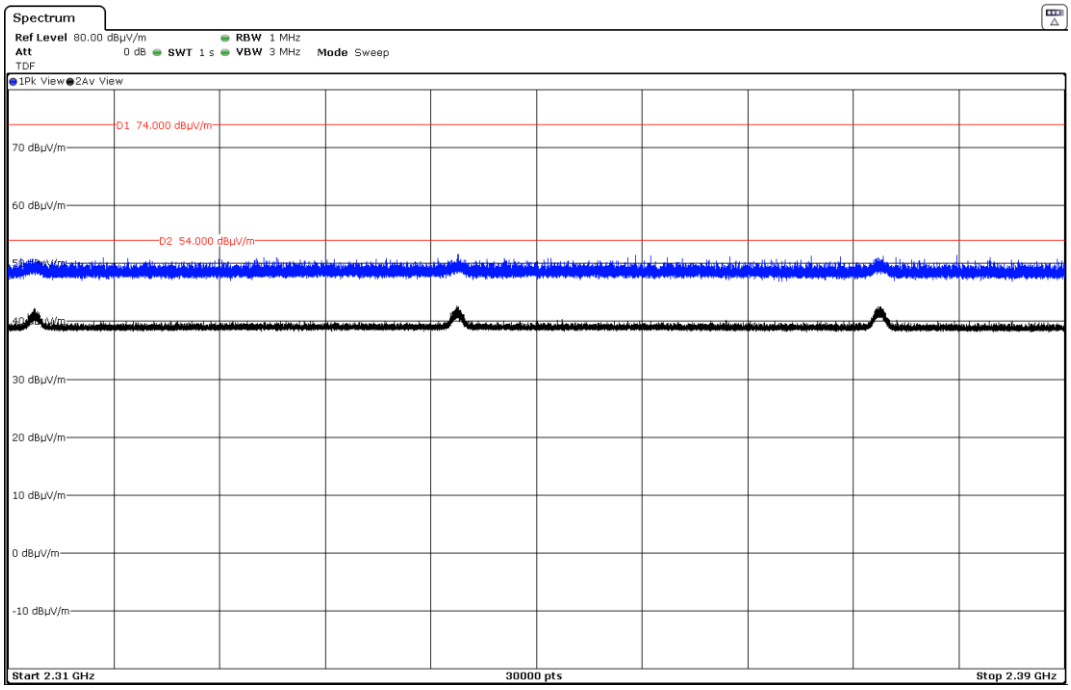


- **Modulation: 8-DPSK (3DH5)**

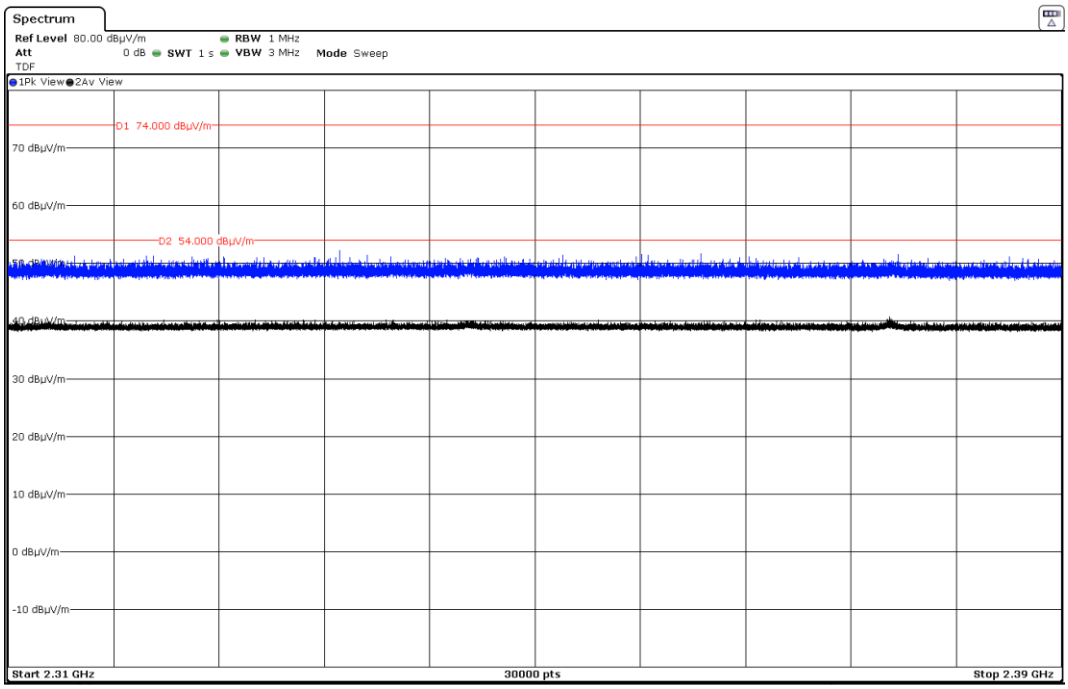



- Middle Channel (2441 MHz):

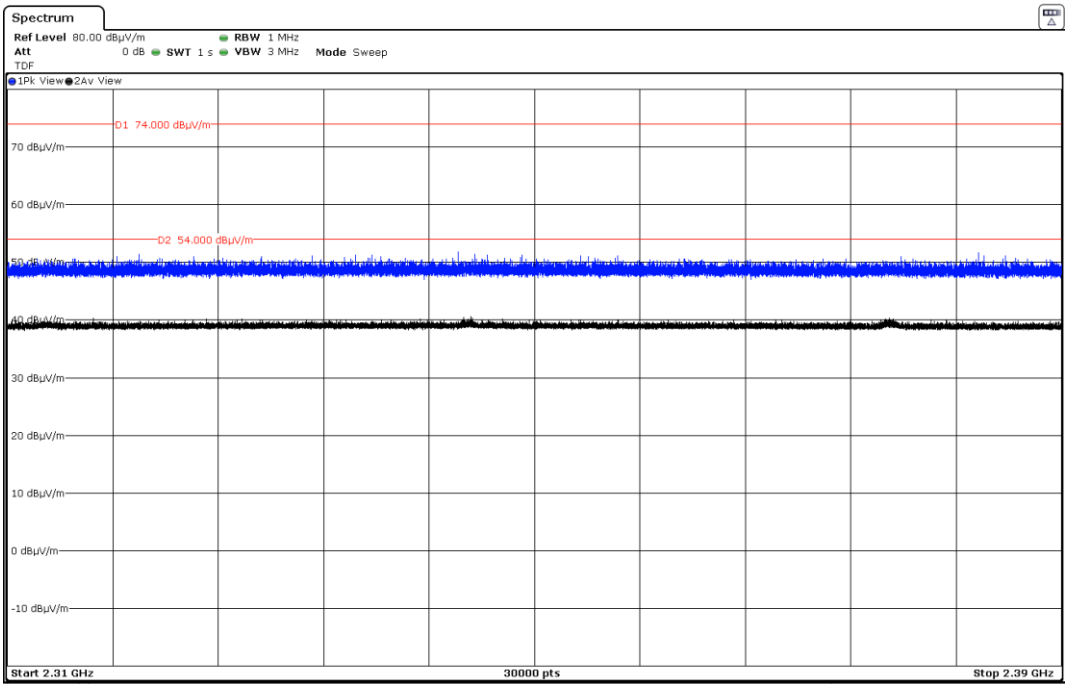
- **Modulation: GFSK (DH5)**



- **Modulation: PI/4-DQPSK (2DH5)**

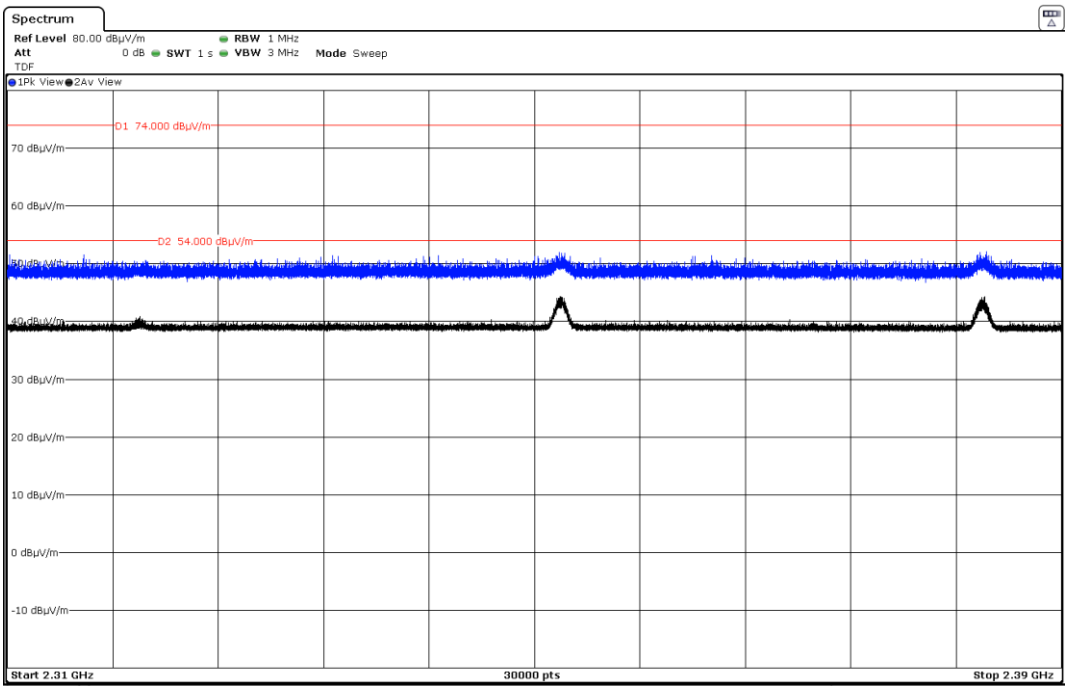



- **Modulation: 8-DPSK (3DH5)**

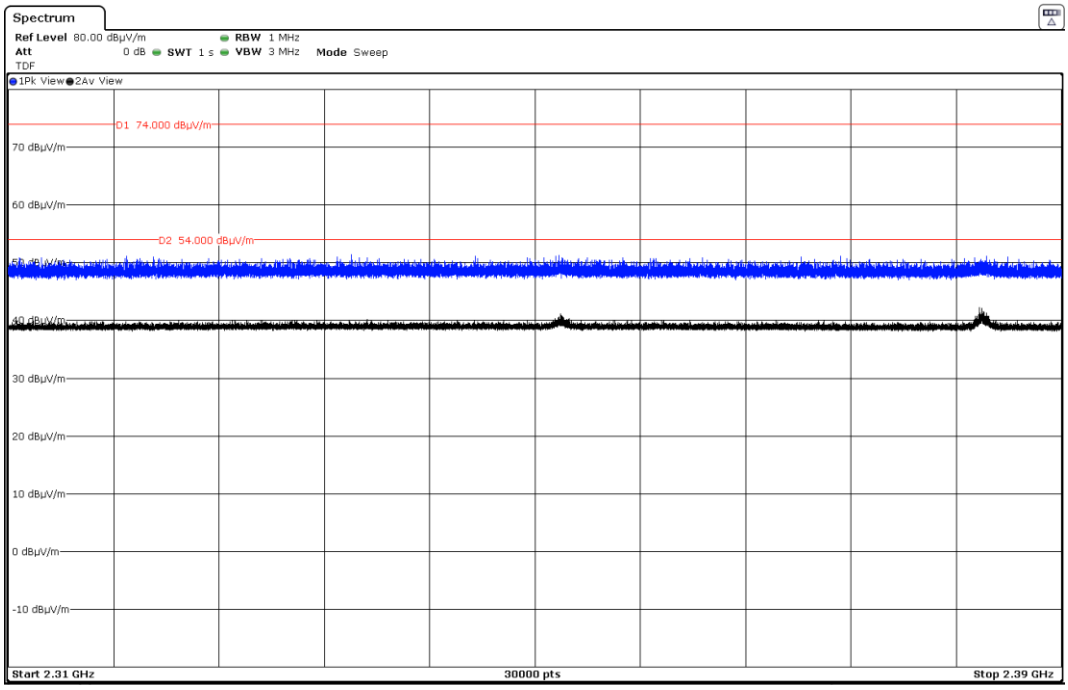


- High Channel (2480 MHz):

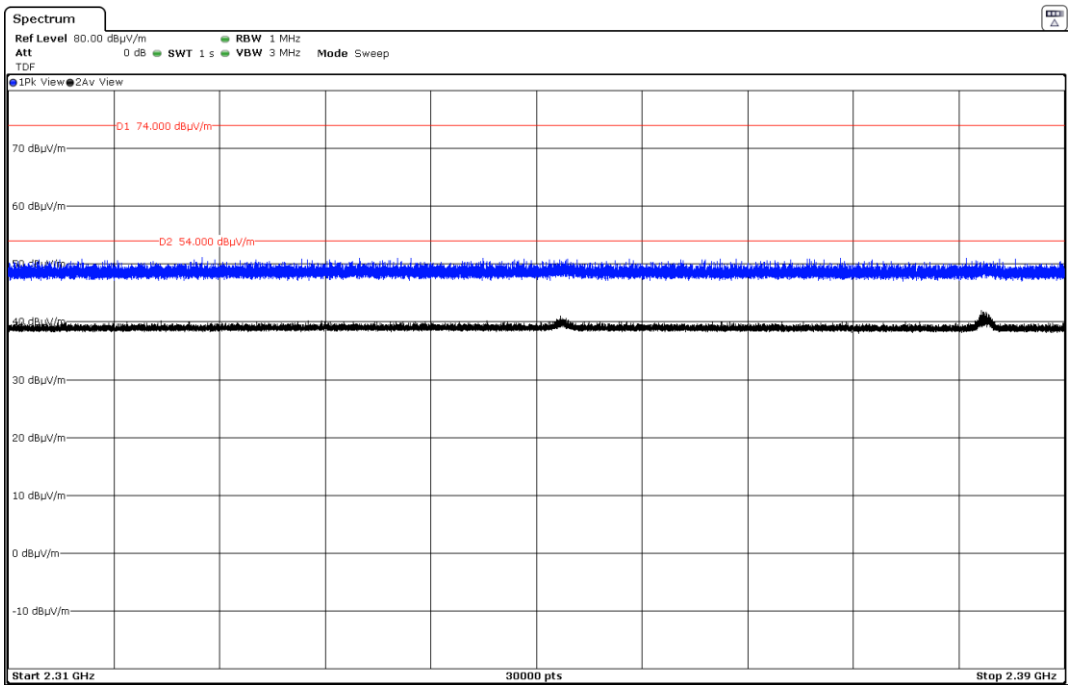
- **Modulation: GFSK (DH5)**




- **Modulation: PI/4-DQPSK (2DH5)**



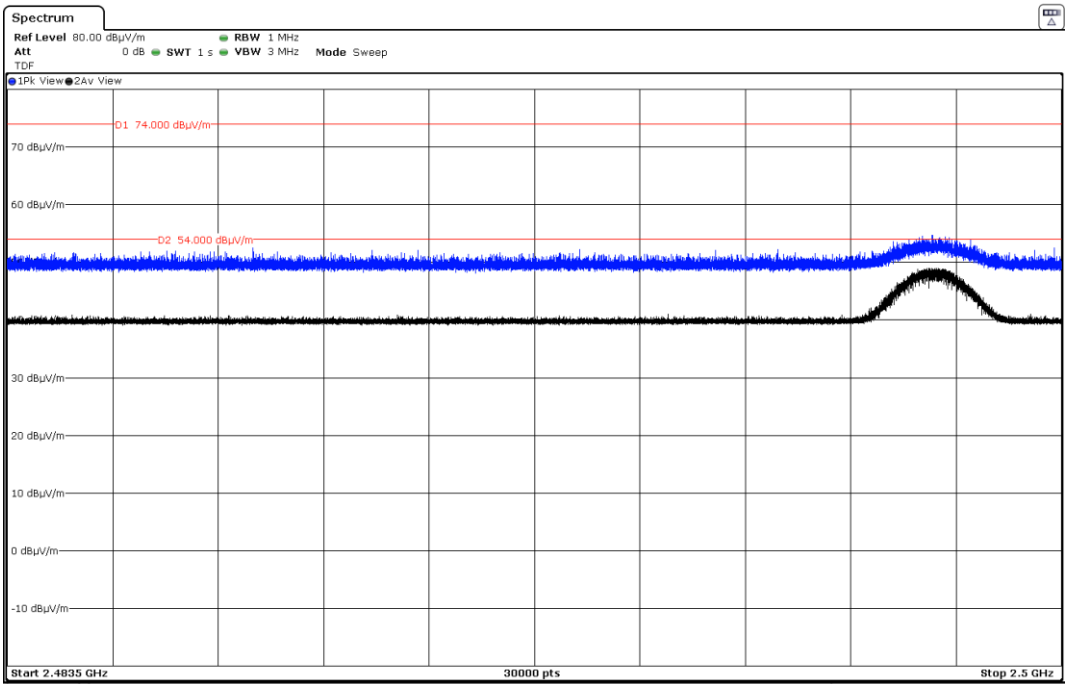
- **Modulation: 8-DPSK (3DH5)**



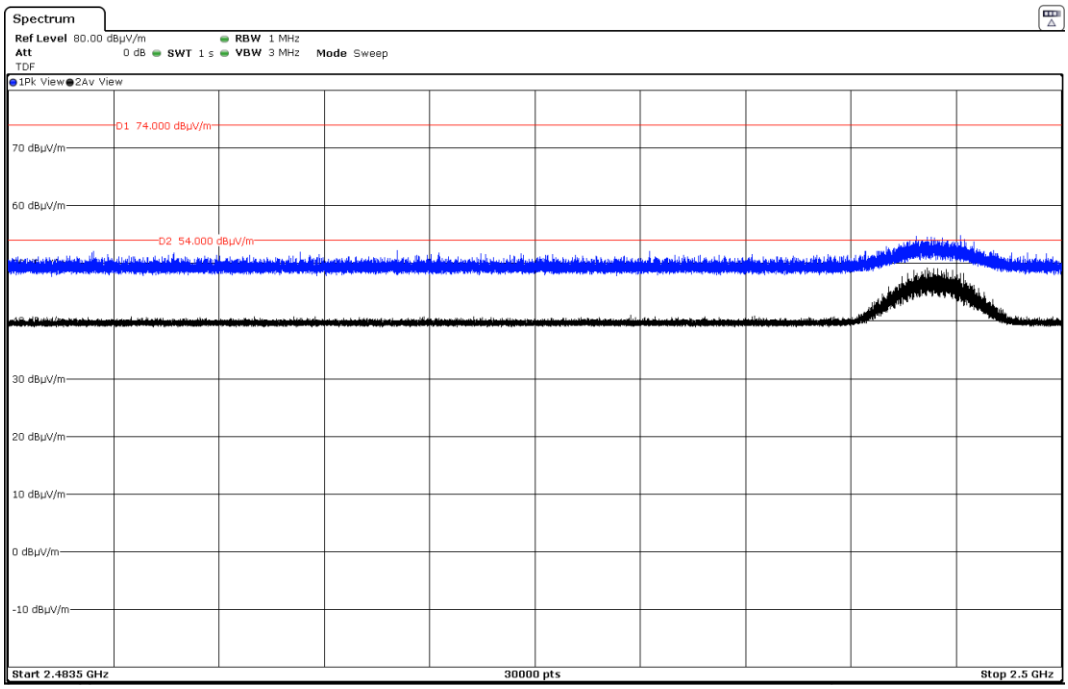
## FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band 2):

- Low Channel (2402 MHz):

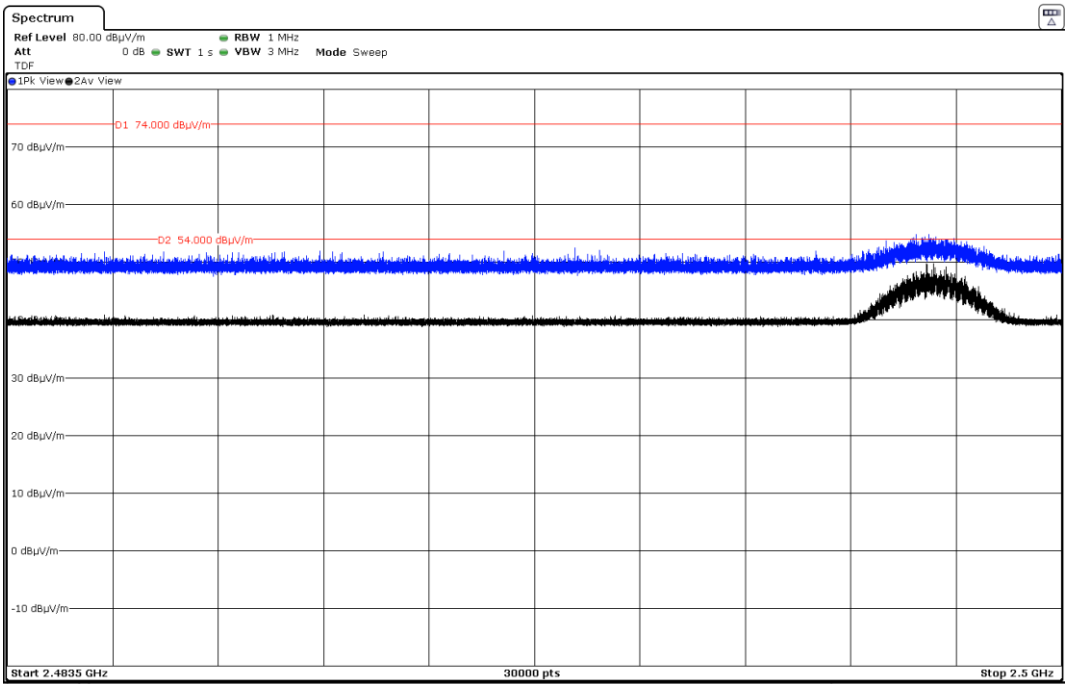
- **Modulation: GFSK (DH5)**




- **Modulation: PI/4-DQPSK (2DH5)**

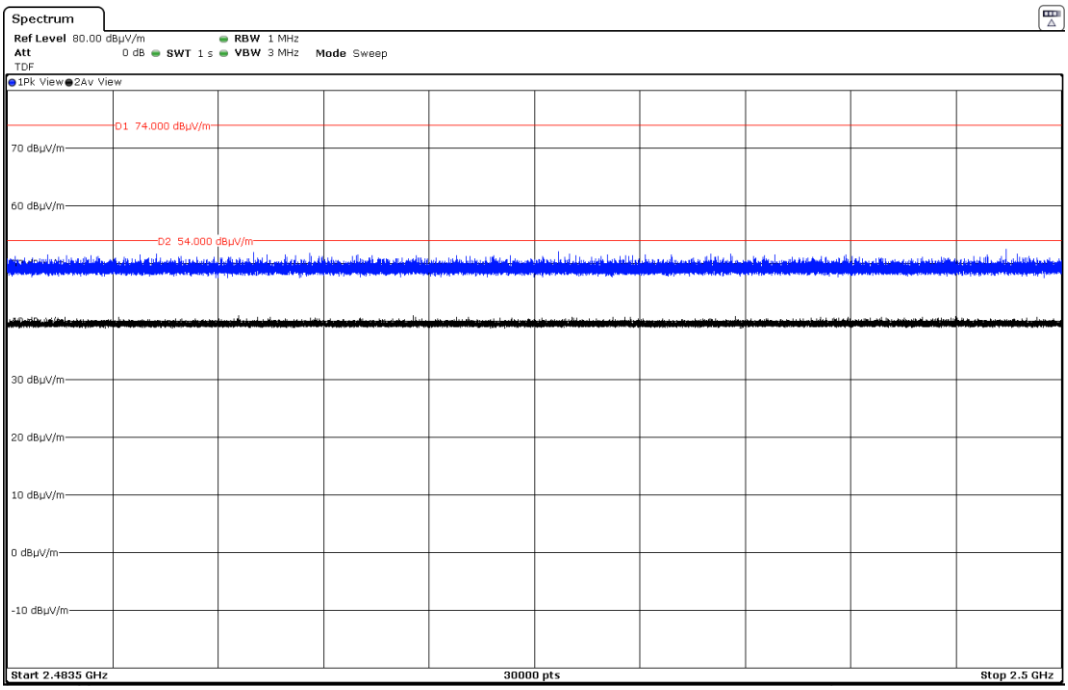


- **Modulation: 8-DPSK (3DH5)**

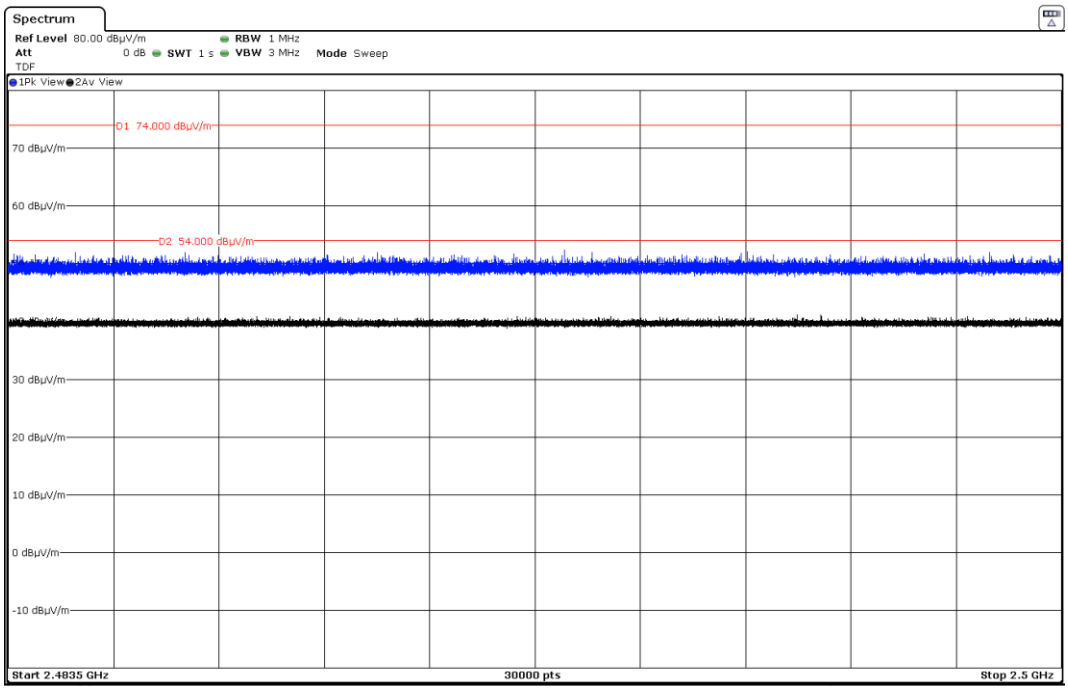


- Middle Channel (2441 MHz):

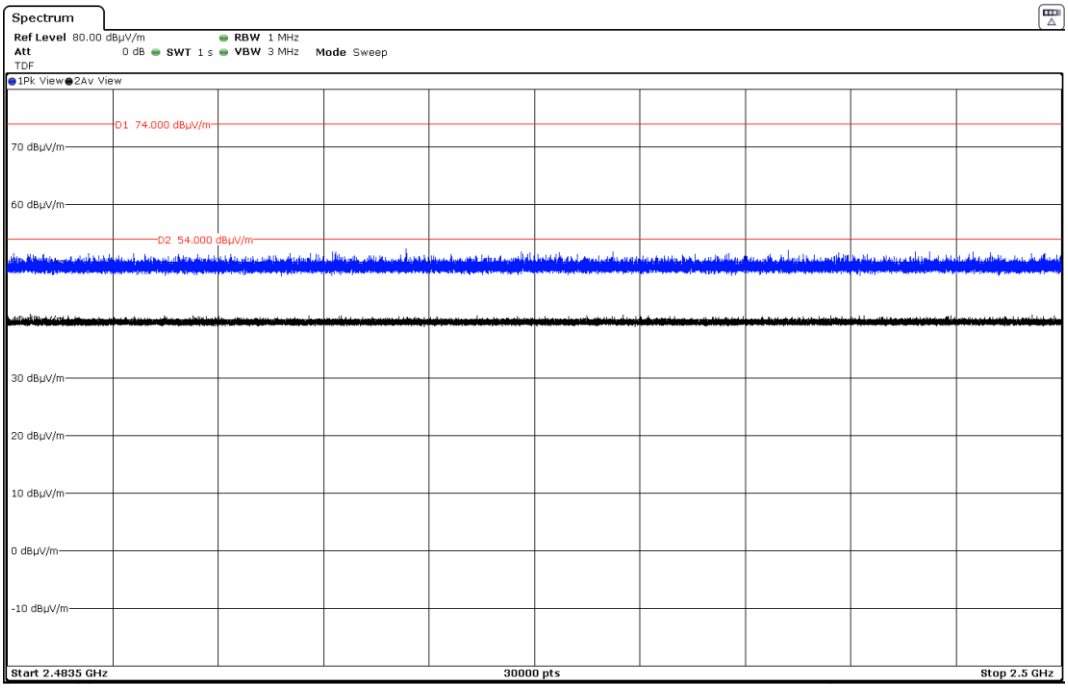
- **Modulation: GFSK (DH5)**




- **Modulation: PI/4-DQPSK (2DH5)**

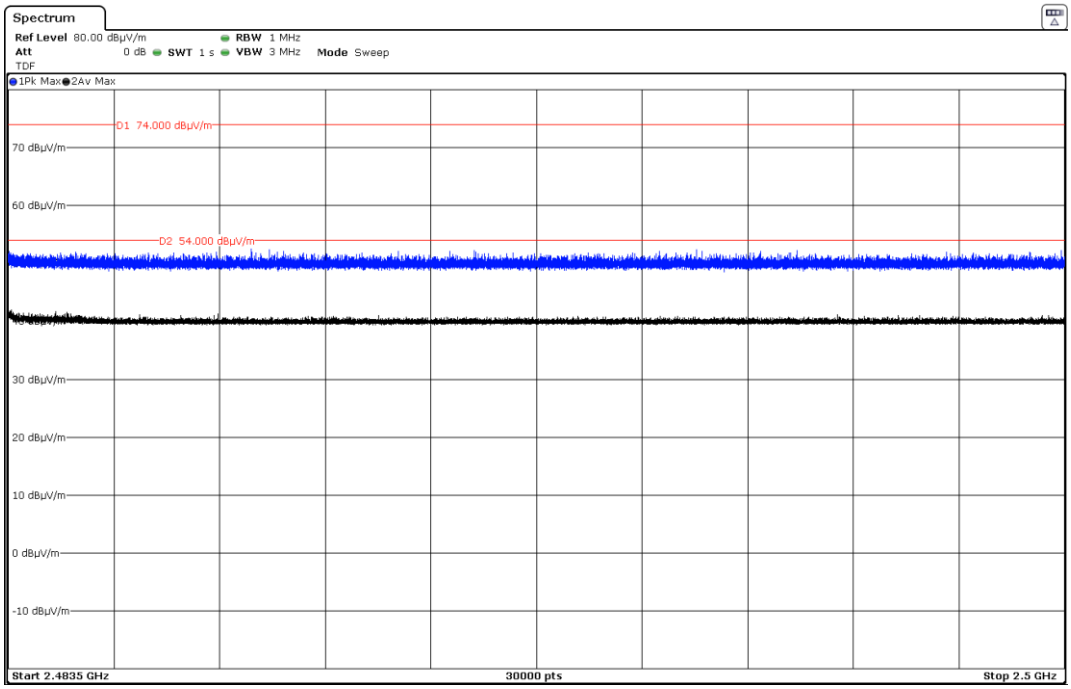


- **Modulation: 8-DPSK (3DH5)**

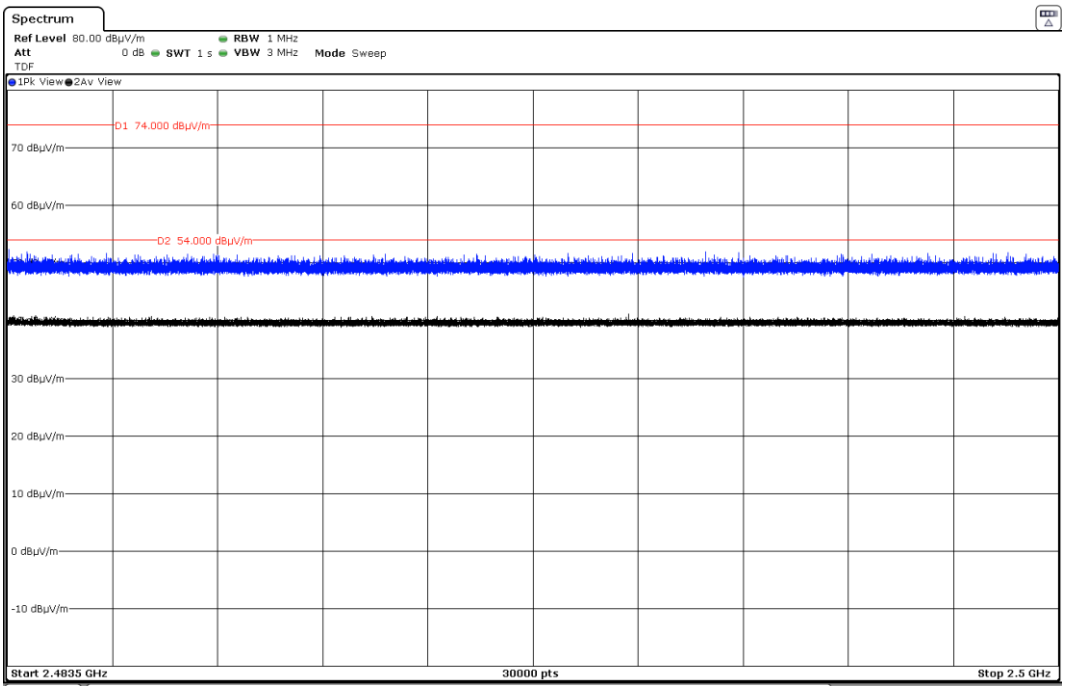
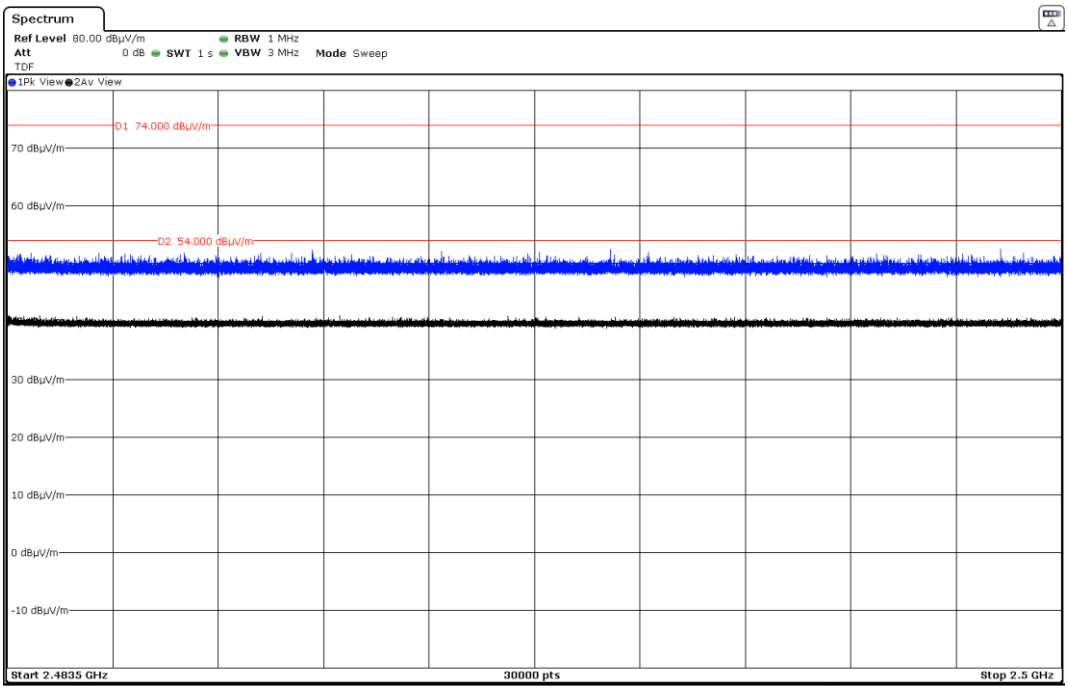


- High Channel (2480 MHz):

- **Modulation: GFSK (DH5)**




- **Modulation: PI/4-DQPSK (2DH5)**



- **Modulation: 8-DPSK (3DH5)**