**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: 51929RRF.015

# Partial 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 | Headunit with radio and Bluetooth |
| (*) Trademark | Panasonic |
| (*) Model and /or type reference | MIB3E_MQB37w_BTWIFI |
| Other identification of the product | FCC ID: WUQ-MIB3VBTWIFI<br>IC: 216R-MIB3VBTWIFI<br>PN: 5E3.035.869<br>HW version: X85<br>SW version: X495 |
| (*) Features | Bluetooth, WLAN, FM, AM, DAB, USB. |
| Applicant | PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH<br>Robert Bosch Str. 27-29 – 63225 Langen - Germany |
| 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>-Emission limitations radiated (Transmitter).<br>USA FCC Part 15.209 10-1-18 Edition: Radiated emission limits; general requirements.<br>CANADA RSS-247 Issue 2 (February 2017).<br>-Emission limitations radiated (Transmitter).<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. |

| | |
|---|---|
| Approved by (name / position & signature) | A. Llamas<br>RF Lab. Manager<br>Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ<br>Fecha: 2019.08.13 09:39:52 +02'00' |
| Date of issue | 2019-08-13 |
| Report template No | FDT08_22<br>(*) "Data provided by the client" |

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# Competences and guarantees

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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.
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# 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 consists of an Automotive head unit to be installed in cars with the following features: Bluetooth, WLAN, FM, AM, DAB, USB.

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 results.

# 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 |
|---|---|---|---|---|
| 51929B/537 | Head unit with radio and Bluetooth | MIB3E_MQB37w_BTWIFI | PM6-00108.01.19413F0111 | 2019/06/05 |
| 51292B/538 | Harness | --- | --- | 2019/06/05 |

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

# Test sample description

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ports…… : | Port name and description | Cable | | | | | |
| | | Specified max length [m] | Attached during test | Shielded | Coupled to patient(3) | | |
| | | | ☐ | ☐ | ☐ | | |
| Rated power supply ……: | Voltage and Frequency | Reference poles | | | | | |
| | | L1 | L2 | L3 | N | PE | |
| | ☒ DC: 12 Vdc | | | | | | |
| Rated Power ……: | | | | | | | |
| Clock frequencies ……: | | | | | | | |
| Other parameters……: | | | | | | | |
| Software version ……: | X495 | | | | | | |
| Hardware version……: | X85 | | | | | | |
| Dimensions in cm (W x H x D)….: | | | | | | | |
| Mounting position……: | ☒ Other: Installed in cars | | | | | | |
| Modules/parts ……: | Module/parts of test item | Type | Manufacturer | | | | |
| | | | | | | | |
| Accessories (not part of the test item) ……: | Description | Type | Manufacturer | | | | |
| | | | | | | | |

| Documents as provided by the applicant.....: | Description | File name | Issue date |
|---|---|---|---|
| | | | |

(3) Only for Medical Equipment

## Identification of the client

PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH

Robert Bosch Str. 27-29 – 63225 Langen - Germany

## Testing period and place

| | |
|---|---|
| **Test Location** | DEKRA Testing and Certification S.A.U. |
| **Date (start)** | 2019-07-04 |
| **Date (finish)** | 2019-07-09 |

## Document history

| Report number | Date | Description |
|---|---|---|
| 51929RRF.015 | 2019-08-06 | 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 % |

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 % |

# Remarks and comments

The tests have been performed by the technical personnel: Ignacio Cabra, José Gabriel Pendón.

Used instrumentation:

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 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 ETS LINDGREN 3142E | 2017/09 | 2020/09 |
| 5. | Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40 | 2018/02 | 2020/02 |
| 6. | RF Pre-amplifier 30 dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A | 2019/04 | 2020/04 |
| 7. | RF Pre-amplifier, 30 dB, 18-40GHz BONN ELEKTRONIK BLMA 1840-1M | 2019/02 | 2021/02 |
| 8. | Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D | 2018/01 | 2021/01 |
| 9. | Broadband Horn antenna 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170 | 2018/07 | 2021/07 |
| 10. | DC Power Supply Keysight Technologies U8002A | --- | --- |
| 11. | Digital multimeter FLUKE 179 | 2019/06 | 2020/06 |

# 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 | N/M | (1) |
| Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) | Number of hopping channels | N/M | (1) |
| Section 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (d) | Time of occupancy (Dwell Time) | N/M | (1) |
| Section 15.247 Subclause (b) / RSS-247 5.4. (b) | Maximum peak output power and antenna gain | N/M | (1) |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Band-edge emissions compliance (Transmitter) | N/M | (1) |
| Section 15.247 Subclause (d) / RSS-247 5.5 | Emission limitations conducted (Transmitter) | N/A | |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Emission limitations radiated (Transmitter) | P | |
| Supplementary information and remarks:<br>(1) Test not requested. | | | |

## 2. Wi-Fi 2.4 GHz (802.11b/n20).

| FCC PART 15 PARAGRAPH / RSS-247 | | | |
|---|---|---|---|
| Requirement – Test case | | Verdict | Remark |
| Section 15.247 Subclause (a) (2) / RSS-247 5.2. (a) | 6 dB Bandwidth | N/M | (1) |
| Section 15.247 Subclause (b) / RSS-247 5.4. (d) | Maximum output power and antenna gain | N/M | (1) |
| Section 15.247 Subclause (d) / RSS-247 5.5 | Emission limitations conducted (Transmitter) | N/A | |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Band-edge emissions compliance (Transmitter) | N/M | (1) |
| Section 15.247 Subclause (e) / RSS-247 5.2. (b) | Power spectral density | N/M | (1) |
| Section 15.247 Subclause (d) / RSS-247 5.5. | Emission limitations radiated (Transmitter) | P | |
| Supplementary information and remarks:<br>(1) Test not requested. | | | |

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

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FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated (Transmitter) ..... 13

# TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 12 Vdc.

Type of Power Supply: External power supply (Battery).

Type of Antenna: Internal antenna.

Declared Gain for antenna RF (maximum): 1.3 dBi

TEST FREQUENCIES:

Low Channel: 2402 MHz

Middle Channel: 2441 MHz

High Channel: 2480 MHz

RADIATED MEASUREMENTS

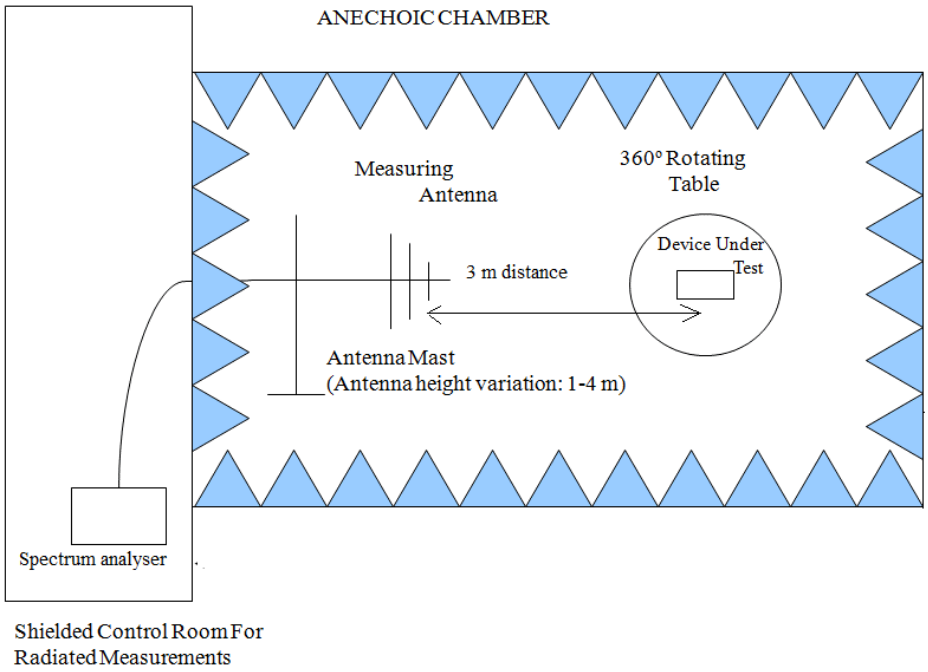
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

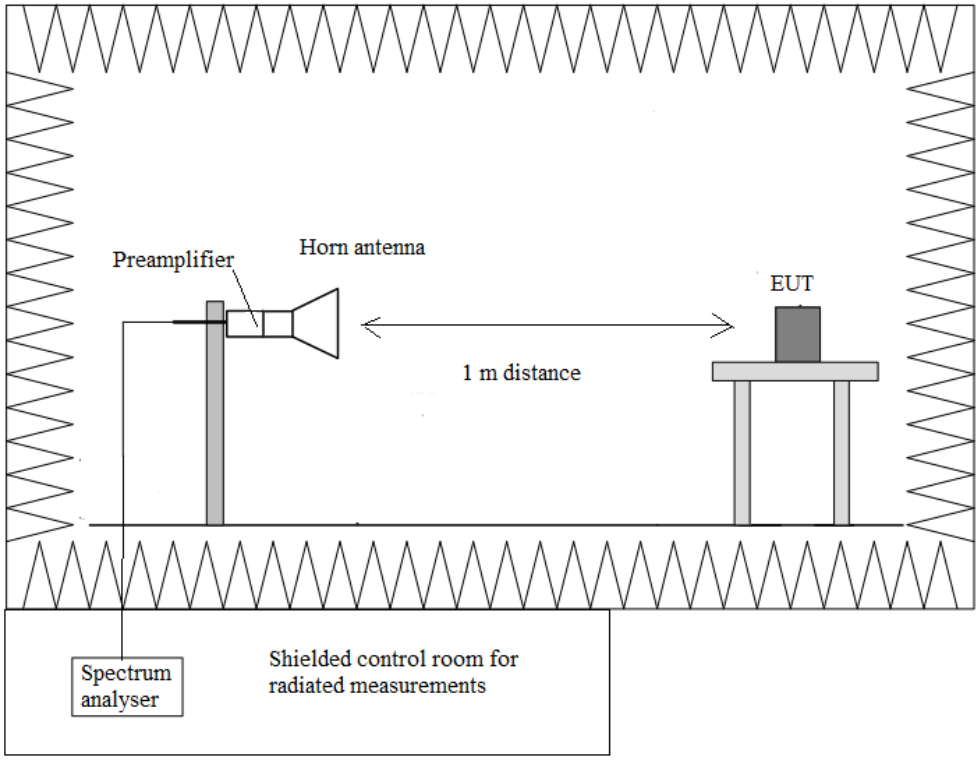
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:




Radiated measurements setup f > 1 GHz:



# 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 Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 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 - 10000 | 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-26 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:**

Note: The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious levels operating (radiated) closest to limit.

| Spurious frequency (MHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 188.870 | Quasi peak | 23.8 | H | <± 3.88 |
| 322.374 | Quasi peak | 35.1 | H | <± 3.88 |
| 574.995 | Quasi peak | 31.9 | V | <± 3.88 |
| 621.555 | Quasi peak | 37.0 | V | <± 3.88 |
| 725.021 | Quasi peak | 33.9 | V | <± 3.88 |
| 950.417 | Quasi peak | 26.8 | H | <± 3.88 |

**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 signals 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)

1. CHANNEL: LOWEST (2402 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86403 | Peak | 55.95 | V | <± 3.70 |
| | Average | 40.03 | | <± 3.70 |
| 2.13910 | Peak | 54.16 | H | <± 3.70 |
| | Average | 50.30 | | <± 3.70 |
| 3.09497 | Peak | 47.22 | V | <± 3.70 |
| 3.58170 | Peak | 40.52 | H | <± 3.70 |
| 3.74363 | Peak | 40.49 | V | <± 3.70 |
| 4.12677 | Peak | 38.14 | V | <± 3.70 |
| 4.35310 | Peak | 46.60 | H | <± 3.70 |
| 4.36897 | Peak | 47.48 | V | <± 3.70 |
| 5.57157 | Peak | 42.80 | V | <± 3.70 |
| 5.59537 | Peak | 45.42 | H | <± 3.70 |
| 6.19037 | Peak | 43.72 | H | <± 3.70 |
| 8.81910 | Peak | 45.55 | H | <± 3.70 |

2. CHANNEL: MIDDLE (2441 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86570 | Peak | 56.59 | V | <± 3.70 |
| | Average | 39.50 | | <± 3.70 |
| 2.19770 | Peak | 54.19 | H | <± 3.70 |
| | Average | 50.90 | | <± 3.70 |
| 3.08797 | Peak | 47.18 | V | <± 3.70 |
| 3.10990 | Peak | 45.77 | H | <± 3.70 |
| 3.50423 | Peak | 41.68 | V | <± 3.70 |
| 4.33723 | Peak | 46.04 | H | <± 3.70 |
| 4.35123 | Peak | 48.99 | V | <± 3.70 |
| 5.57763 | Peak | 45.03 | H | <± 3.70 |
| 6.37050 | Peak | 41.56 | H | <± 3.70 |
| 8.81910 | Peak | 44.62 | H | <± 3.70 |

3. CHANNEL: HIGHEST (2480 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.76503 | Peak | 54.97 | H | <± 3.70 |
| | Average | 37.68 | | <± 3.70 |
| 1.86283 | Peak | 57.26 | V | <± 3.70 |
| | Average | 39.84 | | <± 3.70 |
| 2.02743 | Peak | 56.27 | V | <± 3.70 |
| | Average | 53.75 | | <± 3.70 |
| 3.11083 | Peak | 47.60 | V | <± 3.70 |
| 3.50843 | Peak | 36.97 | V | <± 3.70 |
| 3.59803 | Peak | 39.40 | H | <± 3.70 |
| 4.33023 | Peak | 45.17 | H | <± 3.70 |
| 4.34610 | Peak | 47.43 | V | <± 3.70 |
| 5.56457 | Peak | 44.75 | H | <± 3.70 |
| 6.58983 | Peak | 44.96 | V | <± 3.70 |
| 8.81910 | Peak | 44.03 | H | <± 3.70 |

Verdict: PASS

Modulation Π/4-DQPSK (2DH5)

1. CHANNEL: LOWEST (2402 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86623 | Peak | 56.92 | V | <± 3.70 |
| | Average | 39.96 | | <± 3.70 |
| 3.09730 | Peak | 47.70 | V | <± 3.70 |
| 3.52757 | Peak | 42.06 | H | <± 3.70 |
| 4.33957 | Peak | 46.92 | V | <± 3.70 |
| 4.36570 | Peak | 46.42 | H | <± 3.70 |
| 5.56690 | Peak | 44.24 | V | <± 3.70 |
| 5.58790 | Peak | 47.05 | H | <± 3.70 |
| 6.66217 | Peak | 44.95 | V | <± 3.70 |
| 8.81910 | Peak | 43.63 | H | <± 3.70 |

2. CHANNEL: MIDDLE (2441 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86823 | Peak | 57.35 | V | <± 3.70 |
| | Average | 38.97 | | <± 3.70 |
| 2.15790 | Peak | 54.16 | H | <± 3.70 |
| | Average | 48.53 | | <± 3.70 |
| 3.08797 | Peak | 47.33 | V | <± 3.70 |
| 3.50470 | Peak | 42.58 | H | <± 3.70 |
| 4.33910 | Peak | 48.15 | V | <± 3.70 |
| 4.59997 | Peak | 46.53 | V | <± 3.70 |
| 5.57017 | Peak | 44.64 | V | <± 3.70 |
| 5.59957 | Peak | 42.56 | H | <± 3.70 |
| 6.89970 | Peak | 45.61 | V | <± 3.70 |
| 8.81910 | Peak | 44.14 | H | <± 3.70 |

3. CHANNEL: HIGHEST (2480 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.85577 | Peak | 57.34 | V | <± 3.70 |
| | Average | 40.18 | | <± 3.70 |
| 3.08797 | Peak | 48.48 | V | <± 3.70 |
| 3.10570 | Peak | 44.91 | H | <± 3.70 |
| 3.52757 | Peak | 40.73 | H | <± 3.70 |
| 4.35263 | Peak | 46.73 | V | <± 3.70 |
| 4.57570 | Peak | 45.61 | V | <± 3.70 |
| 5.57017 | Peak | 42.35 | H | <± 3.70 |
| 6.86377 | Peak | 45.06 | V | <± 3.70 |
| 8.81910 | Peak | 44.70 | H | <± 3.70 |

Verdict: PASS

Modulation: 8-DPSK (3DH5)

1. CHANNEL: LOWEST (2402 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.85810 | Peak | 56.71 | V | <± 3.70 |
| | Average | 40.07 | | <± 3.70 |
| 3.09963 | Peak | 46.77 | H | <± 3.70 |
| 3.11037 | Peak | 45.89 | V | <± 3.70 |
| 3.59617 | Peak | 40.48 | H | <± 3.70 |
| 3.71423 | Peak | 40.21 | V | <± 3.70 |
| 4.19397 | Peak | 40.60 | V | <± 3.70 |
| 4.32743 | Peak | 46.61 | H | <± 3.70 |
| 4.36150 | Peak | 46.85 | V | <± 3.70 |
| 5.55850 | Peak | 42.50 | H | <± 3.70 |
| 5.59163 | Peak | 41.96 | V | <± 3.70 |
| 6.29070 | Peak | 42.66 | H | <± 3.70 |
| 8.81910 | Peak | 44.34 | H | <± 3.70 |

2. CHANNEL: MIDDLE (2441 MHz).

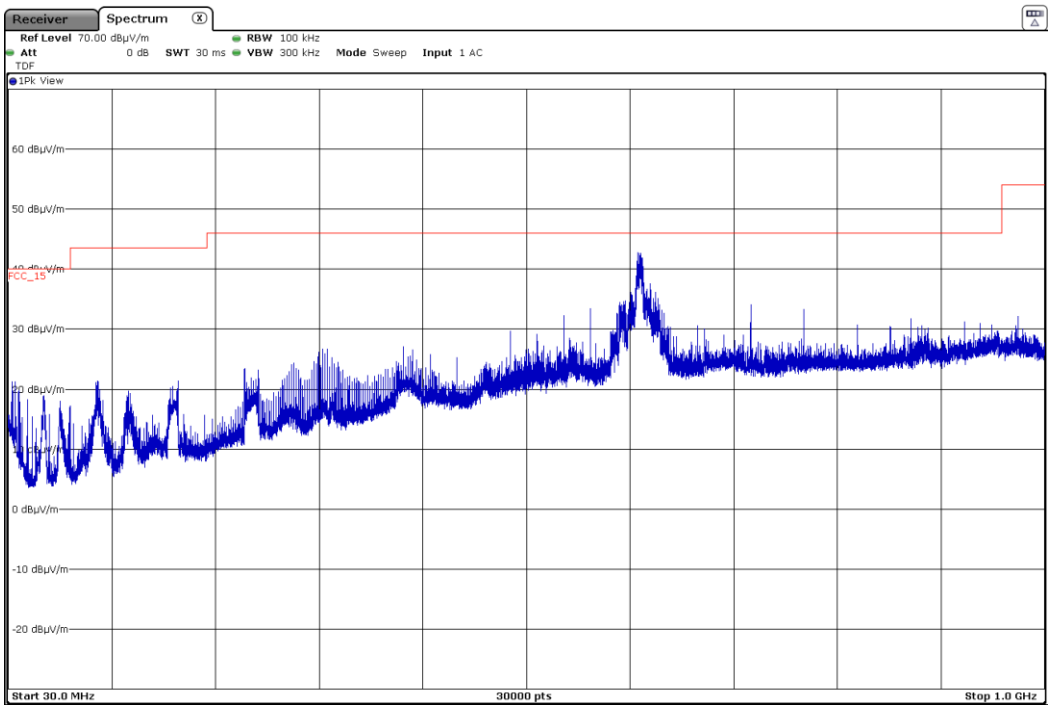
| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86063 | Peak | 56.75 | V | <± 3.70 |
| | Average | 39.11 | | <± 3.70 |
| 2.19910 | Peak | 54.82 | H | <± 3.70 |
| | Average | 50.96 | | <± 3.70 |
| 3.09123 | Peak | 46.63 | V | <± 3.70 |
| 3.57983 | Peak | 39.19 | H | <± 3.70 |
| 3.73803 | Peak | 39.71 | V | <± 3.70 |
| 4.36850 | Peak | 46.37 | V | <± 3.70 |
| 4.76517 | Peak | 47.20 | V | <± 3.70 |
| 5.58510 | Peak | 42.70 | V | <± 3.70 |
| 7.14750 | Peak | 41.76 | H | <± 3.70 |
| 8.81910 | Peak | 43.61 | H | <± 3.70 |

3. CHANNEL: HIGHEST (2480 MHz).

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.85330 | Peak | 57.17 | V | <± 3.70 |
| | Average | 40.00 | | <± 3.70 |
| 2.14323 | Peak | 54.03 | H | <± 3.70 |
| | Average | 50.28 | | <± 3.70 |
| 3.10383 | Peak | 47.42 | V | <± 3.70 |
| 3.57190 | Peak | 39.55 | H | <± 3.70 |
| 3.59523 | Peak | 37.41 | V | <± 3.70 |
| 4.33817 | Peak | 47.37 | H | <± 3.70 |
| 5.57857 | Peak | 42.55 | V | <± 3.70 |
| 8.81910 | Peak | 44.61 | H | <± 3.70 |

Verdict: PASS

## FREQUENCY RANGE 30 MHz - 1 GHz:

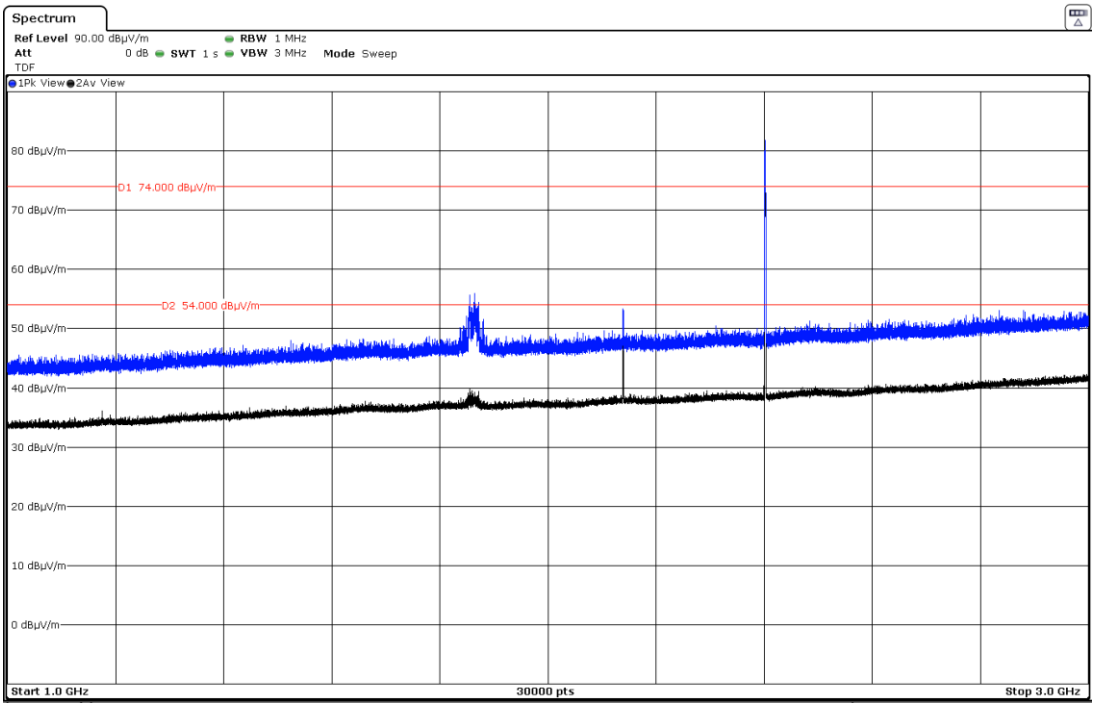



(This plot is valid for all three channels and all modulation modes).

## FREQUENCY RANGE 1 - 3 GHz:

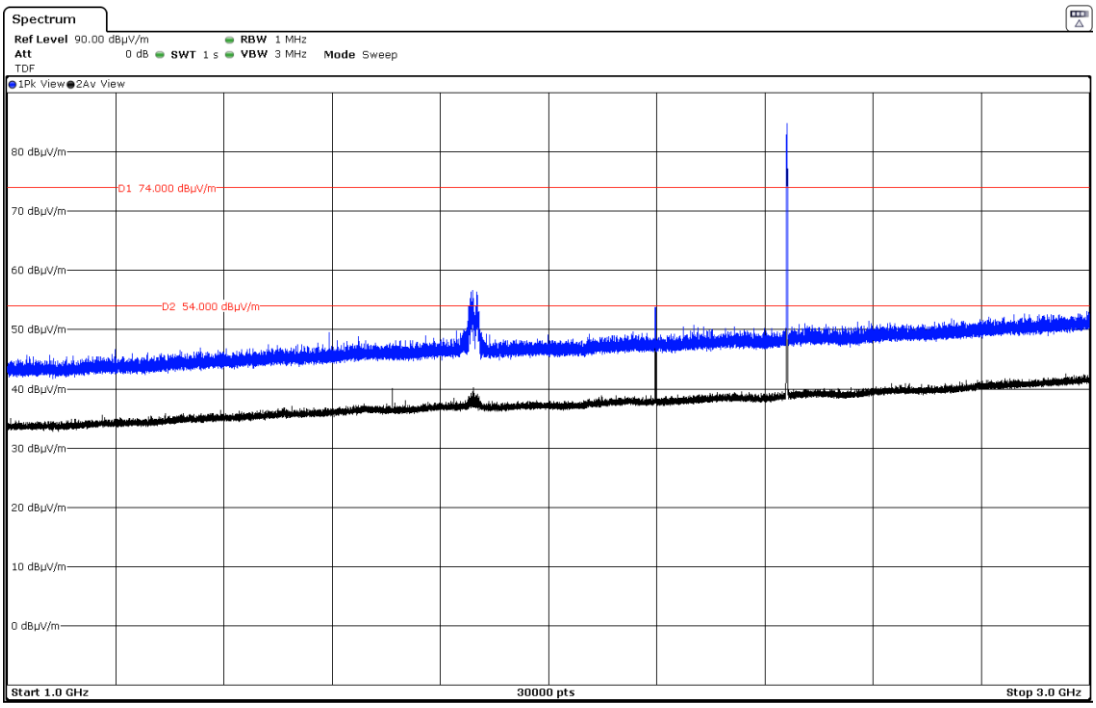
Modulation: GFSK (DH5)

CHANNEL: Lowest (2402 MHz)



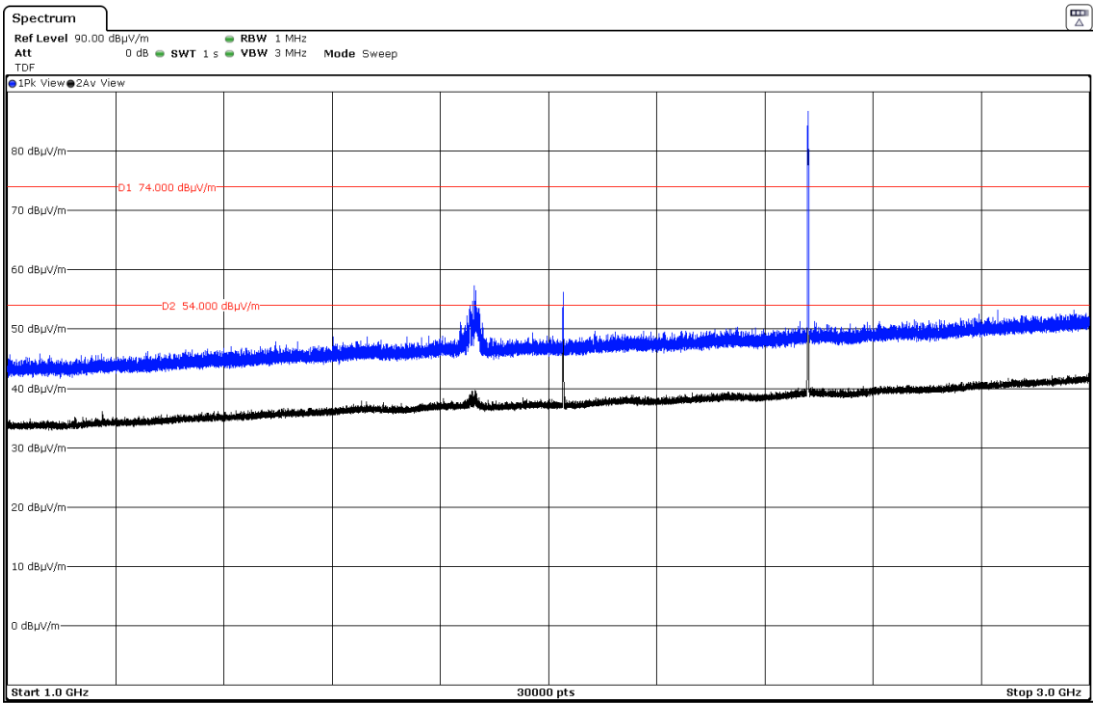

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)




The peak above the limit is the carrier frequency.

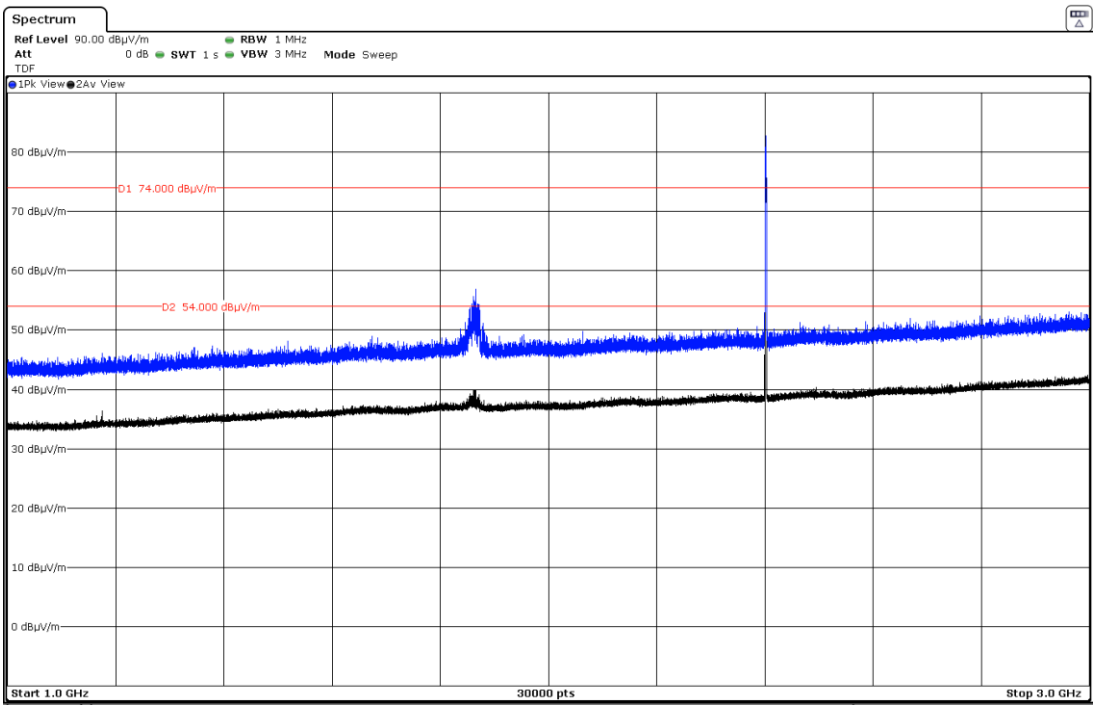
CHANNEL: Highest (2480 MHz)




The peak above the limit is the carrier frequency.

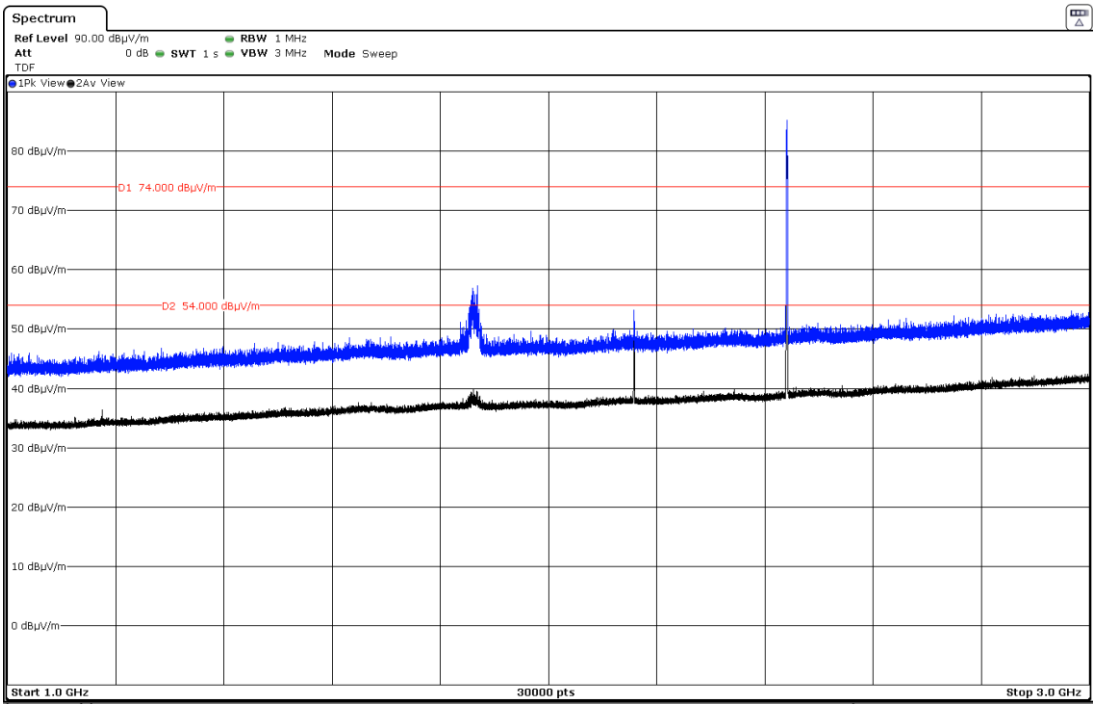
Modulation: Π/4-DQPSK (2DH5)

CHANNEL: Lowest (2402 MHz)



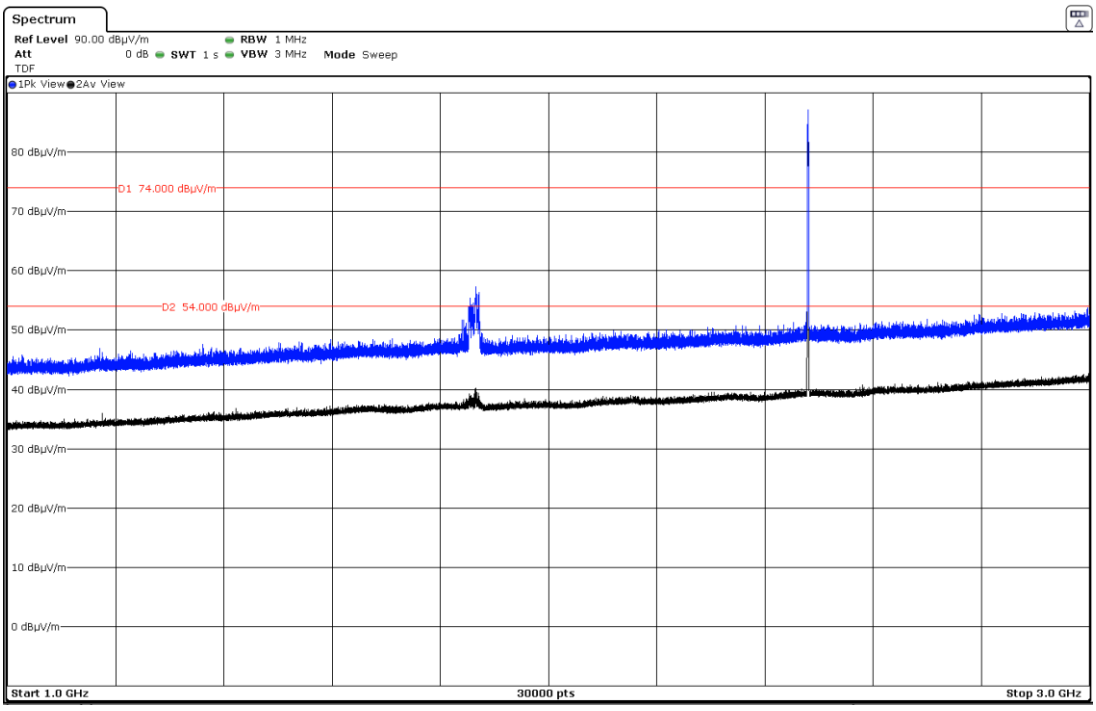

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)




The peak above the limit is the carrier frequency.

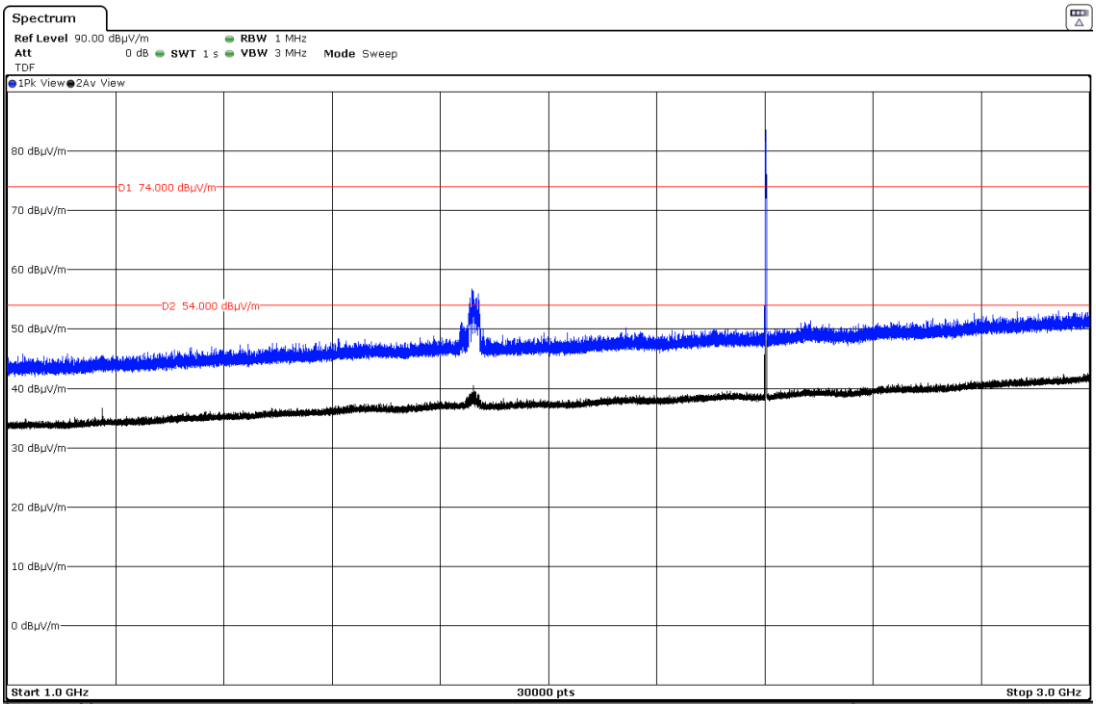
CHANNEL: Highest (2480 MHz)




The peak above the limit is the carrier frequency.

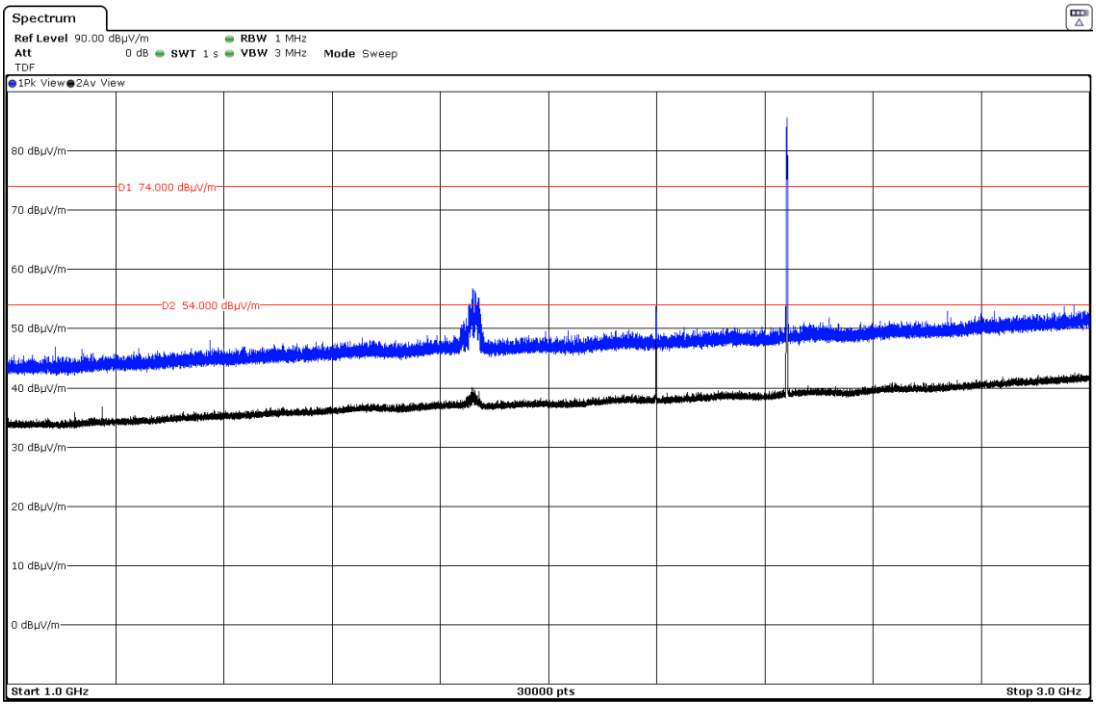
Modulation: 8-DPSK (3DH5)

CHANNEL: Lowest (2402 MHz)



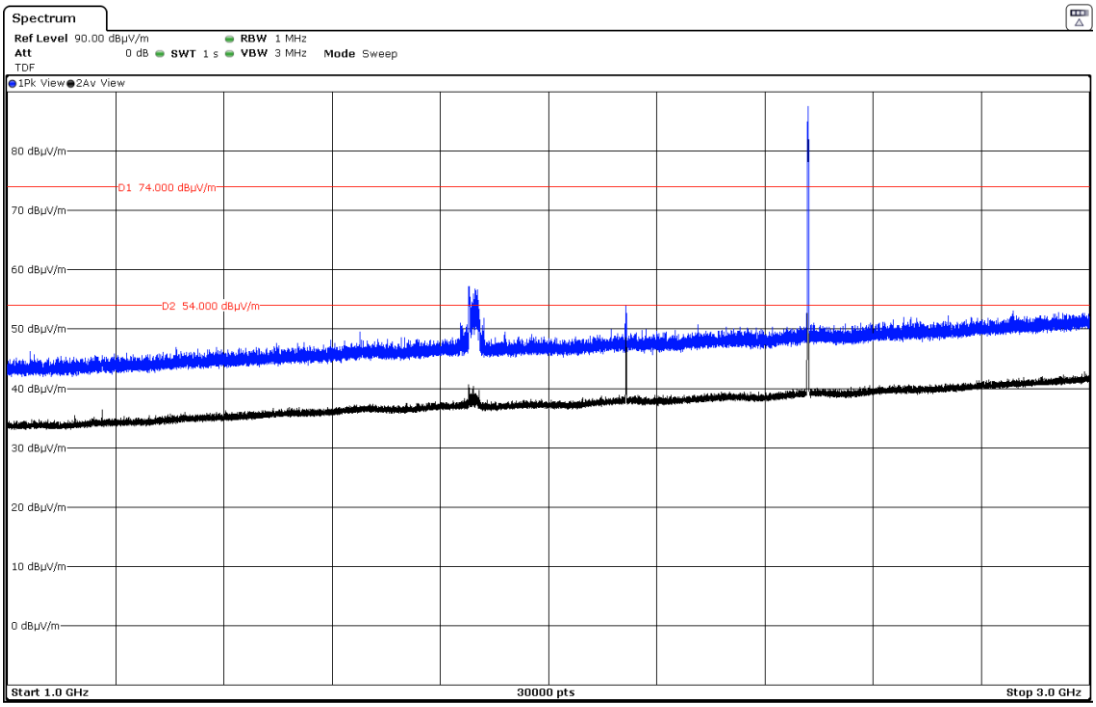

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)




The peak above the limit is the carrier frequency.

CHANNEL: Highest (2480 MHz)

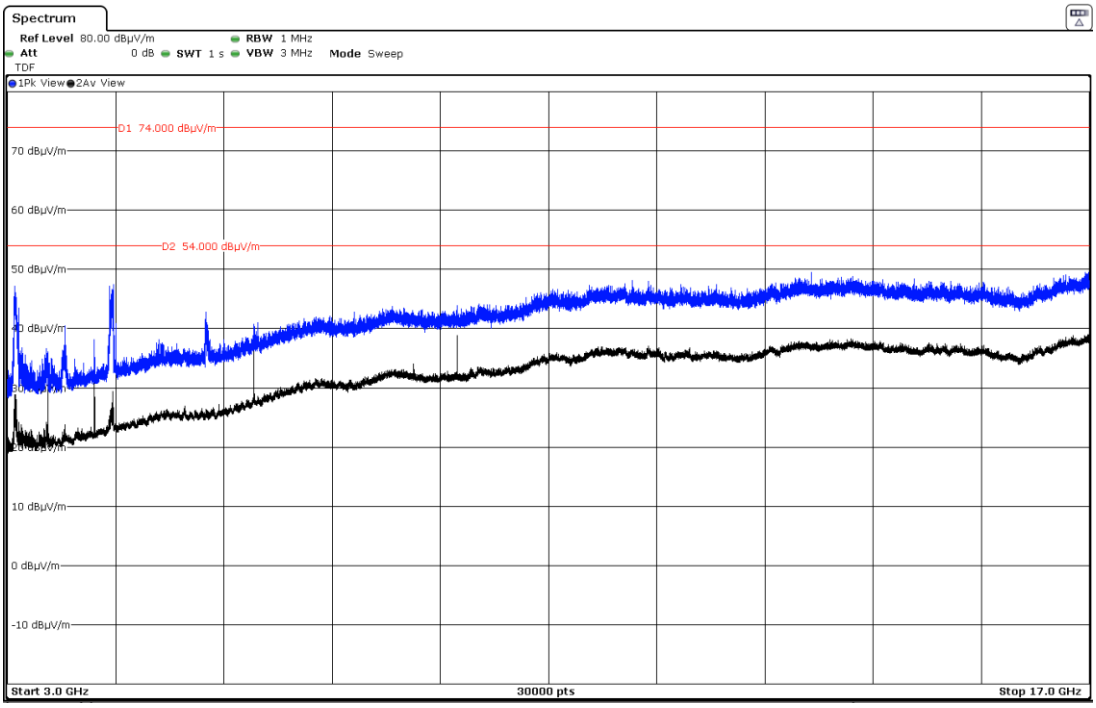



The peak above the limit is the carrier frequency.

## FREQUENCY RANGE 3 - 17 GHz:

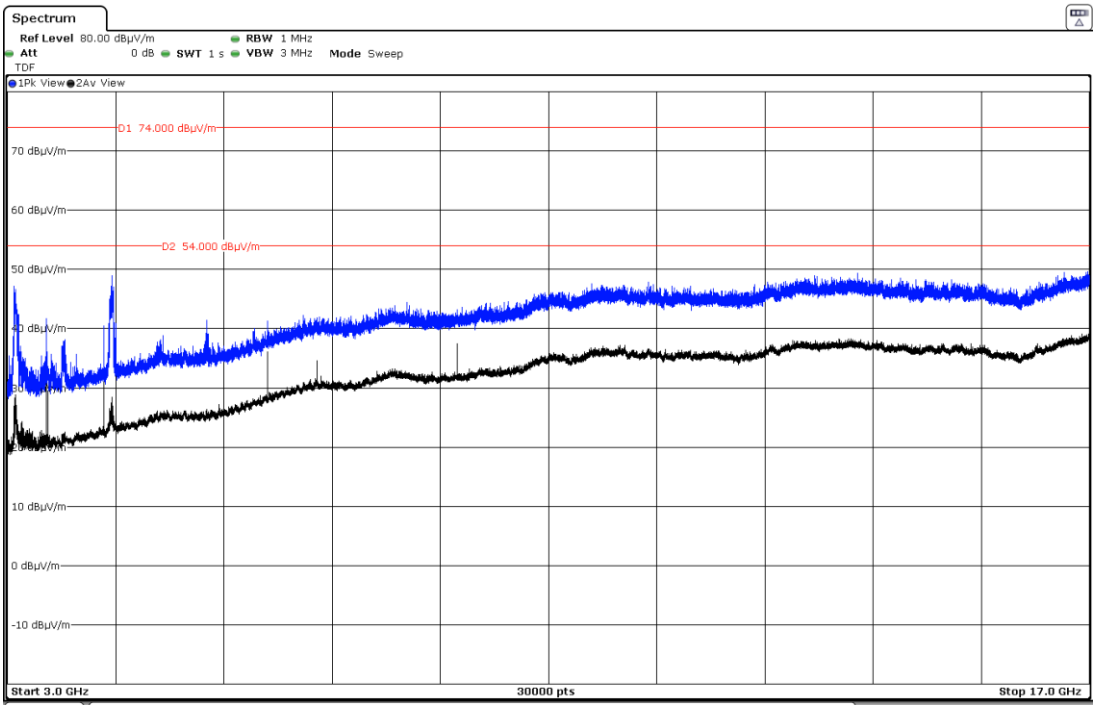
Modulation: GFSK (DH5)

CHANNEL: Lowest (2402 MHz)



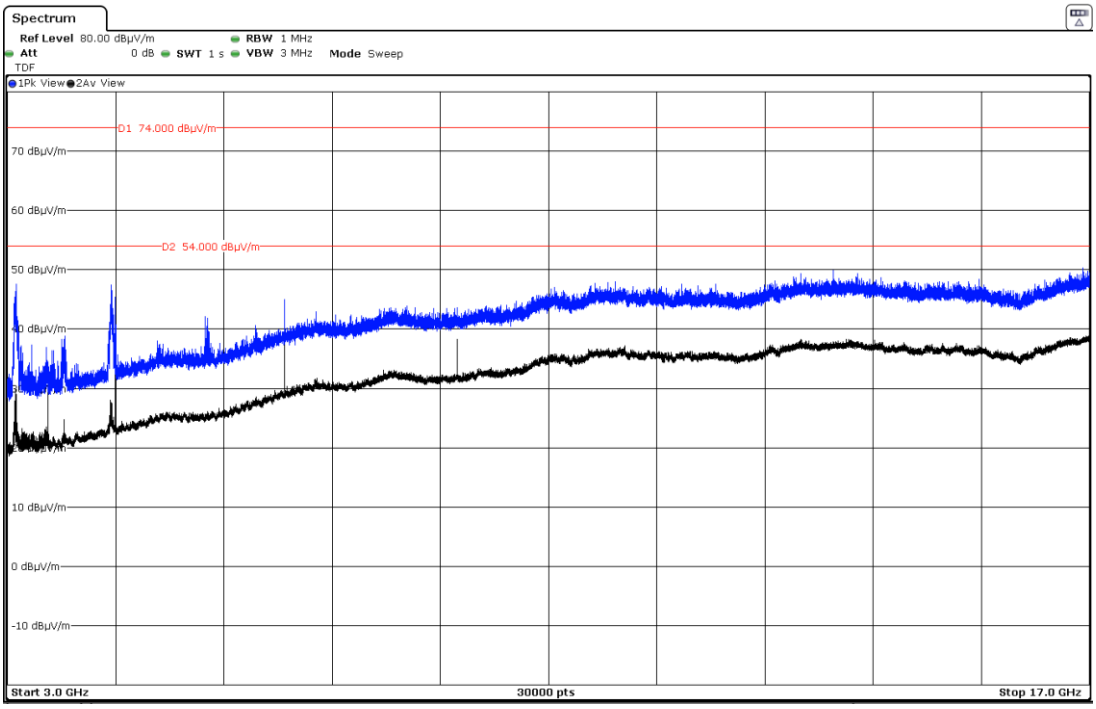

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)




The peak above the limit is the carrier frequency.

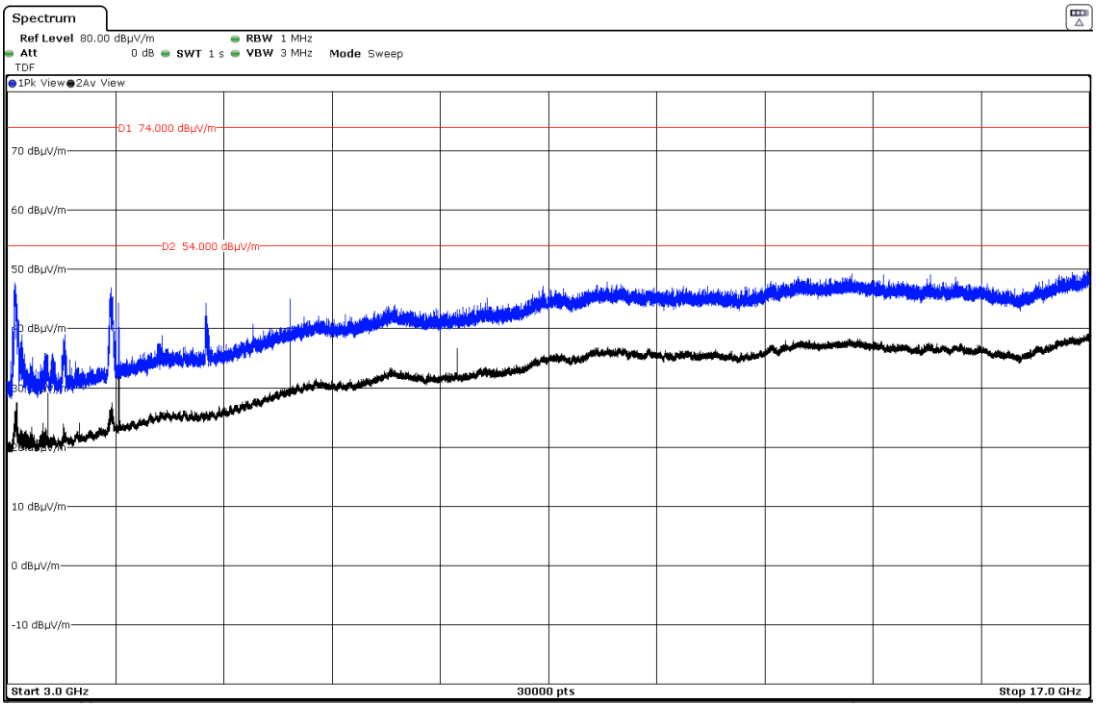
CHANNEL: Highest (2480 MHz)




The peak above the limit is the carrier frequency.

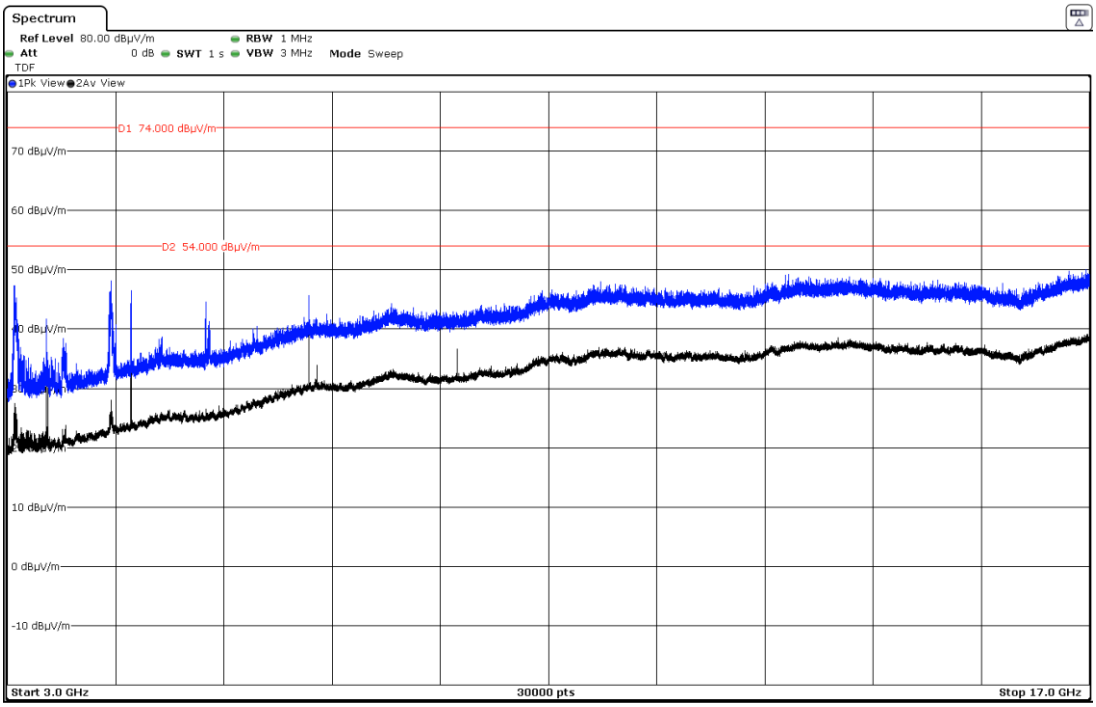
Modulation: Π/4-DQPSK (2DH5)

CHANNEL: Lowest (2402 MHz)



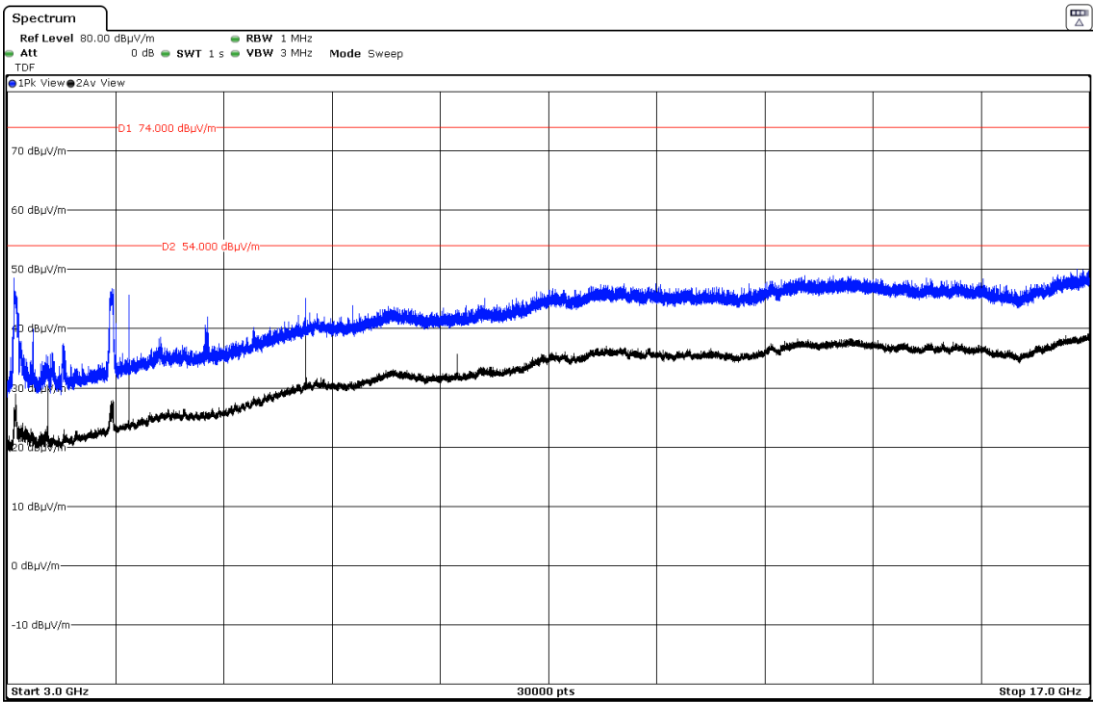

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)




The peak above the limit is the carrier frequency.

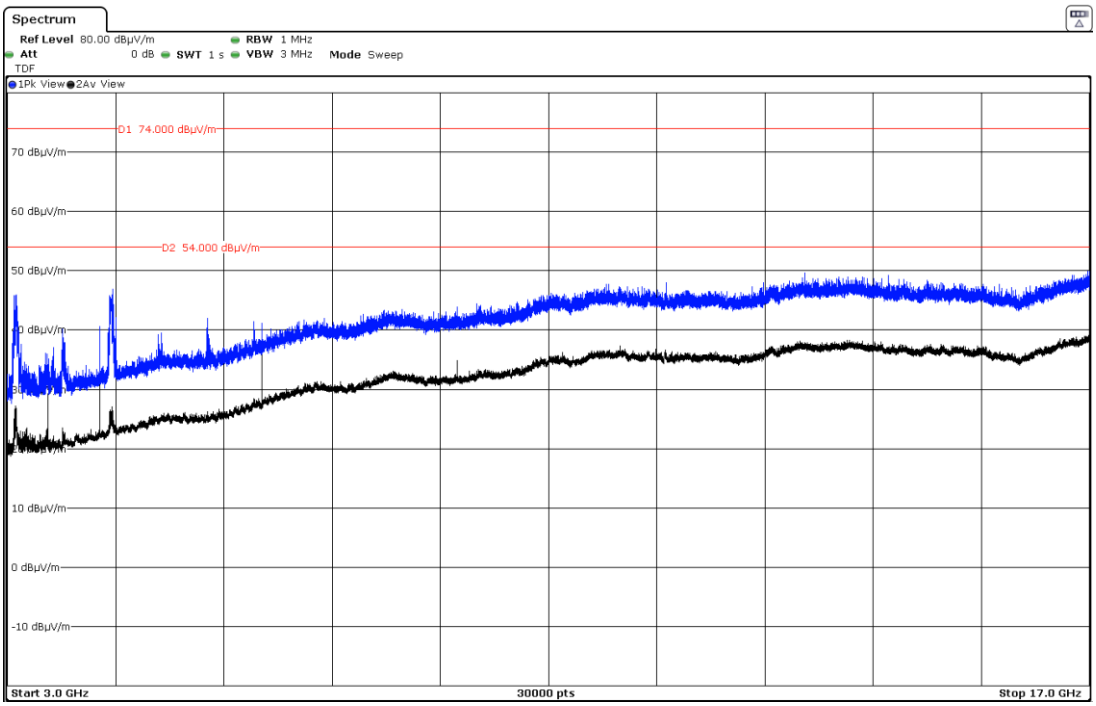
CHANNEL: Highest (2480 MHz)




The peak above the limit is the carrier frequency.

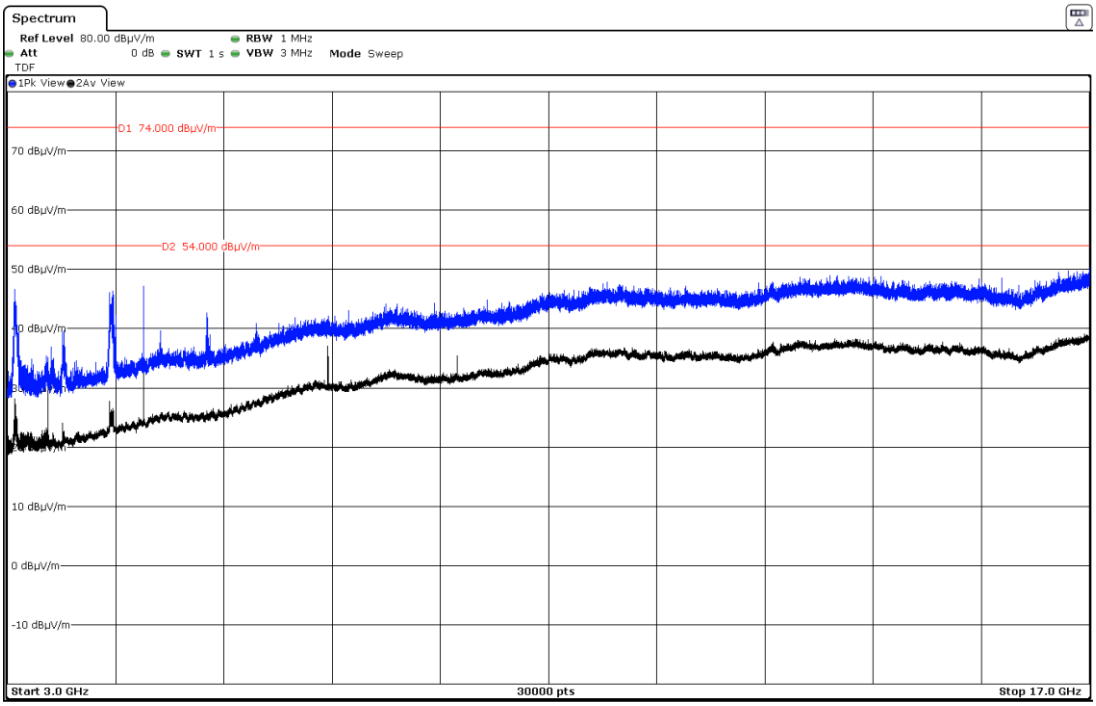
Modulation: 8-DPSK (3DH5)

CHANNEL: Lowest (2402 MHz)



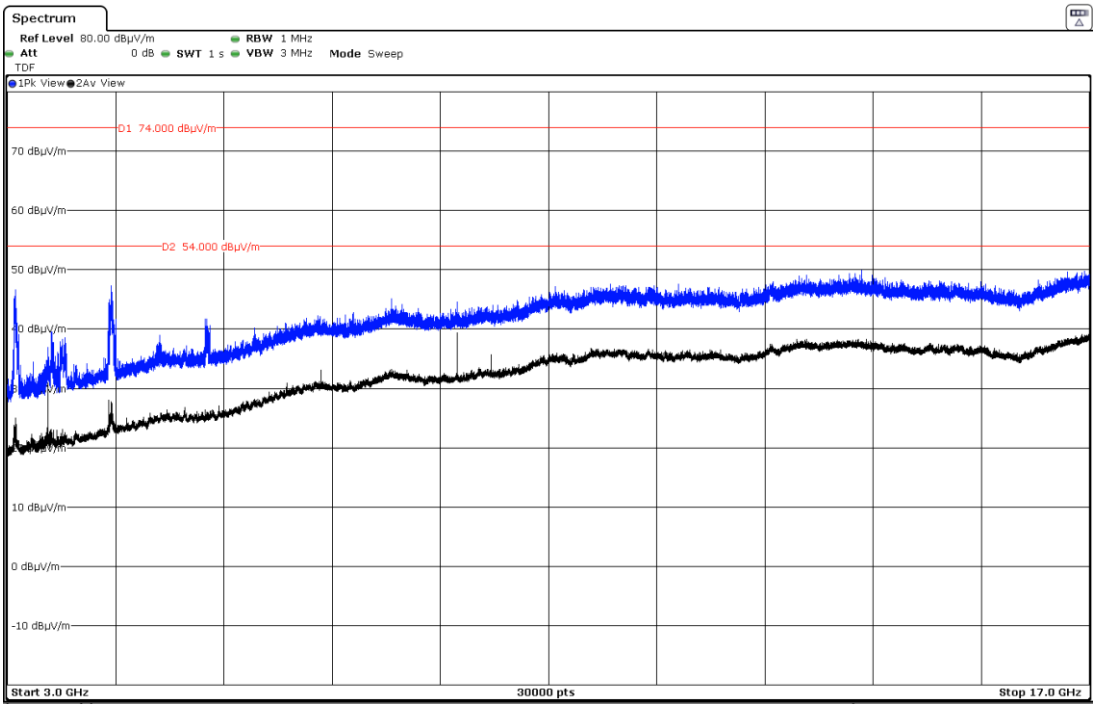

The peak above the limit is the carrier frequency.

CHANNEL: Middle (2441 MHz)



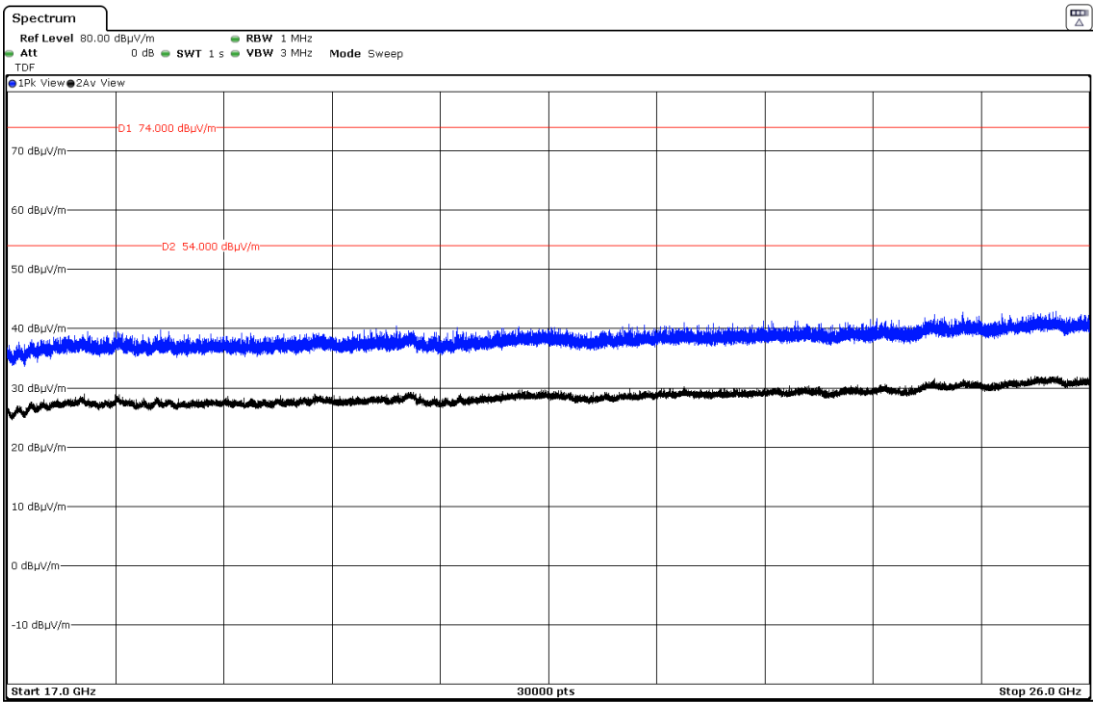

The peak above the limit is the carrier frequency.

CHANNEL: Highest (2480 MHz)




The peak above the limit is the carrier frequency.

**FREQUENCY RANGE 17 - 26 GHz:**

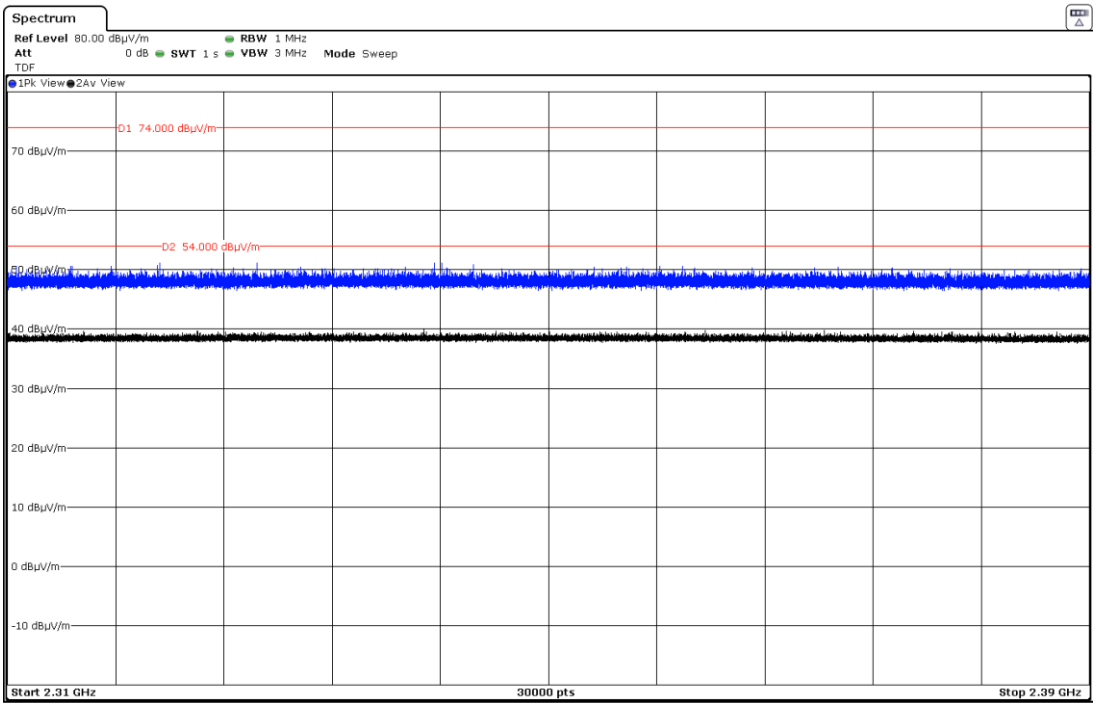



(This plot is valid for all three channels and all modulation modes).

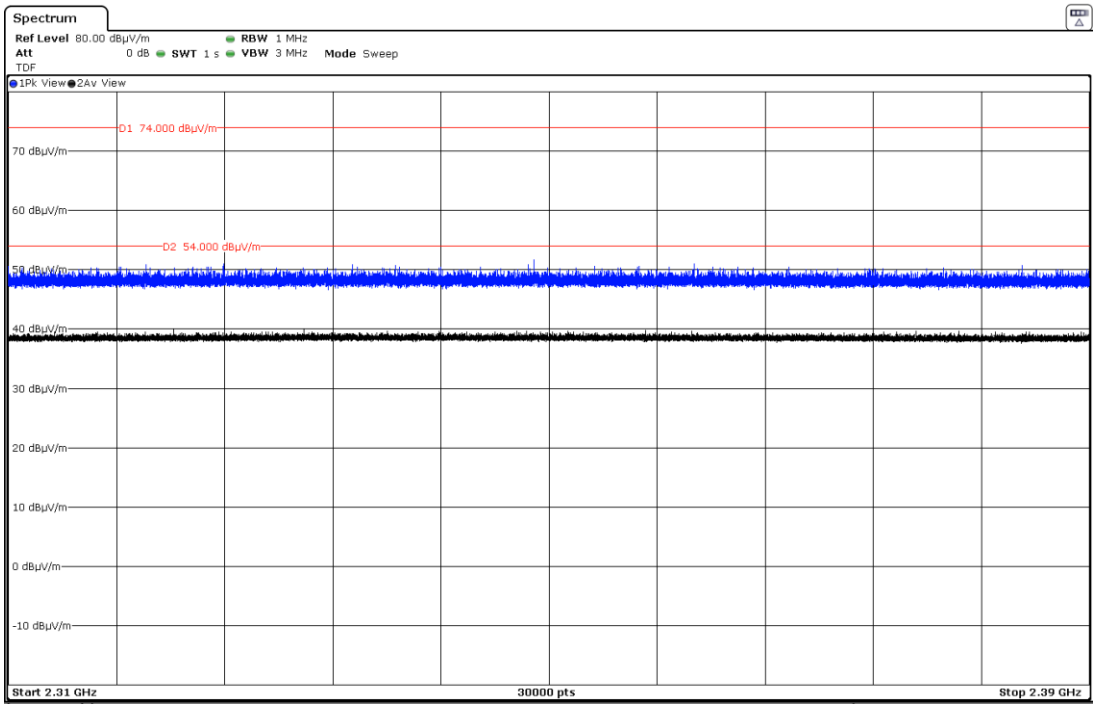
## FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

CHANNEL: Lowest (2402 MHz)

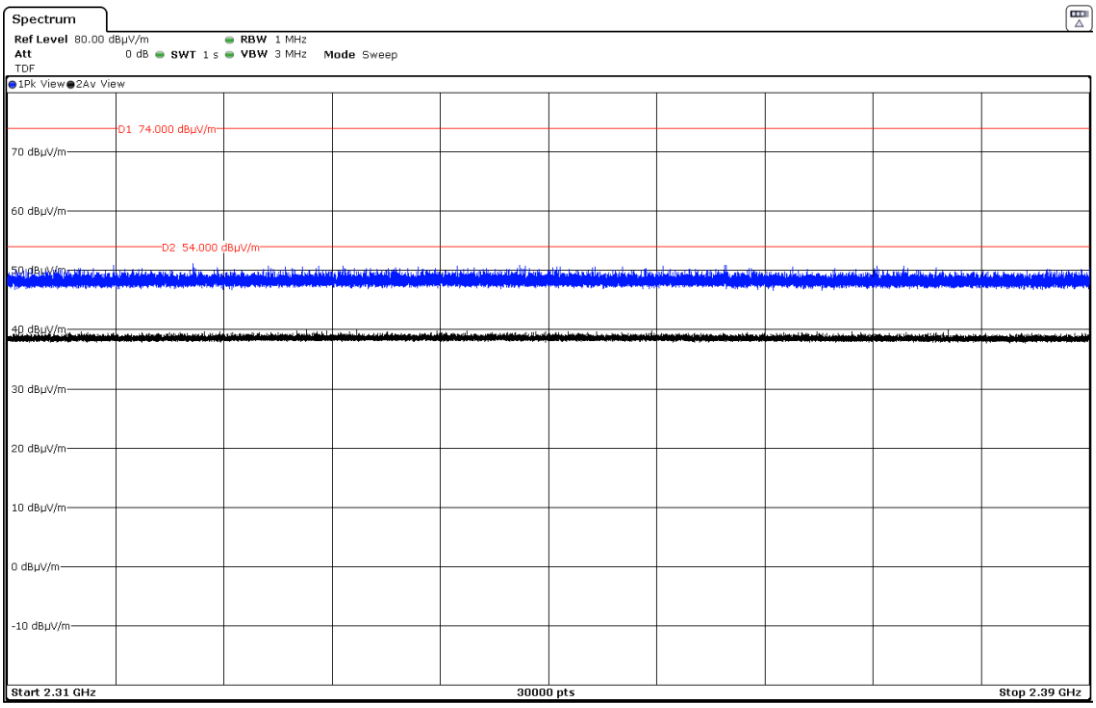
Modulation: GFSK (DH5)




Modulation: Π/4-DQPSK (2DH5)



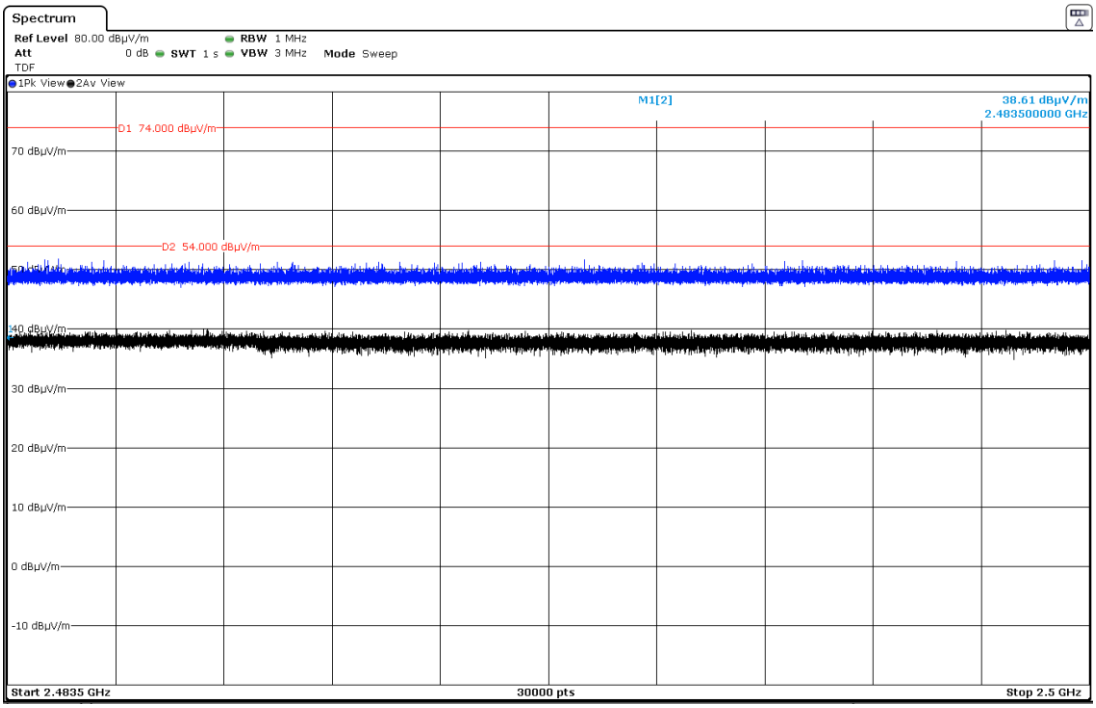
Modulation: 8-DPSK (3DH5)



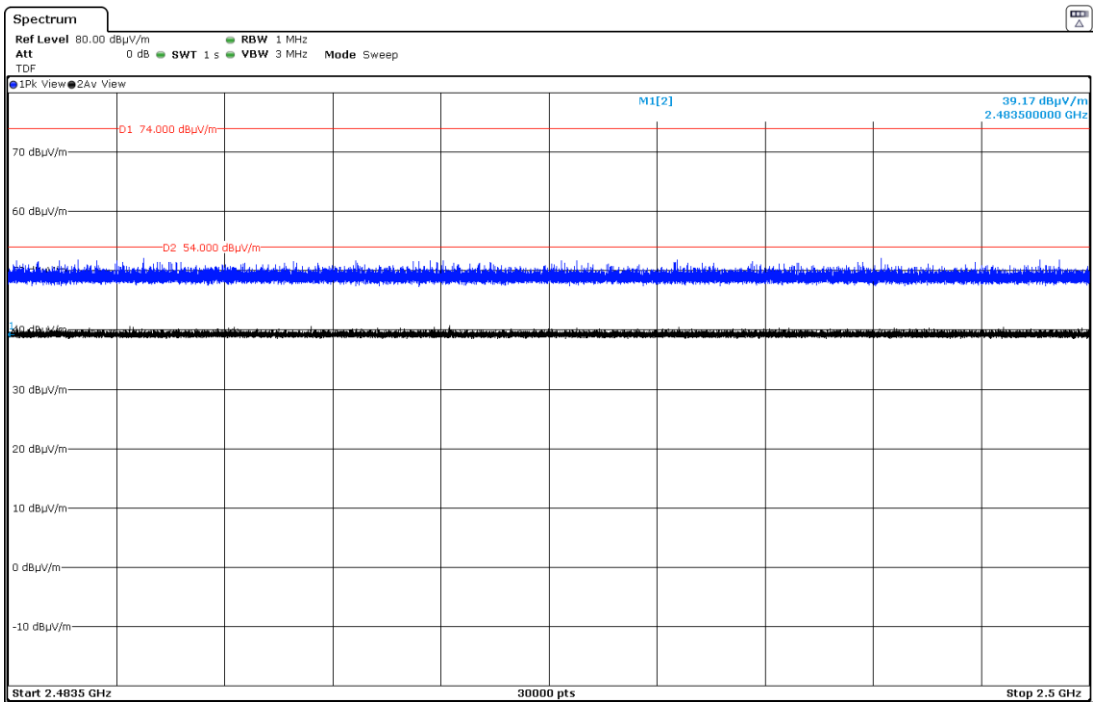

**FREQUENCY RANGE 2.4835-2.5 GHz (Restricted Band 2):**

CHANNEL: Highest (2480 MHz)

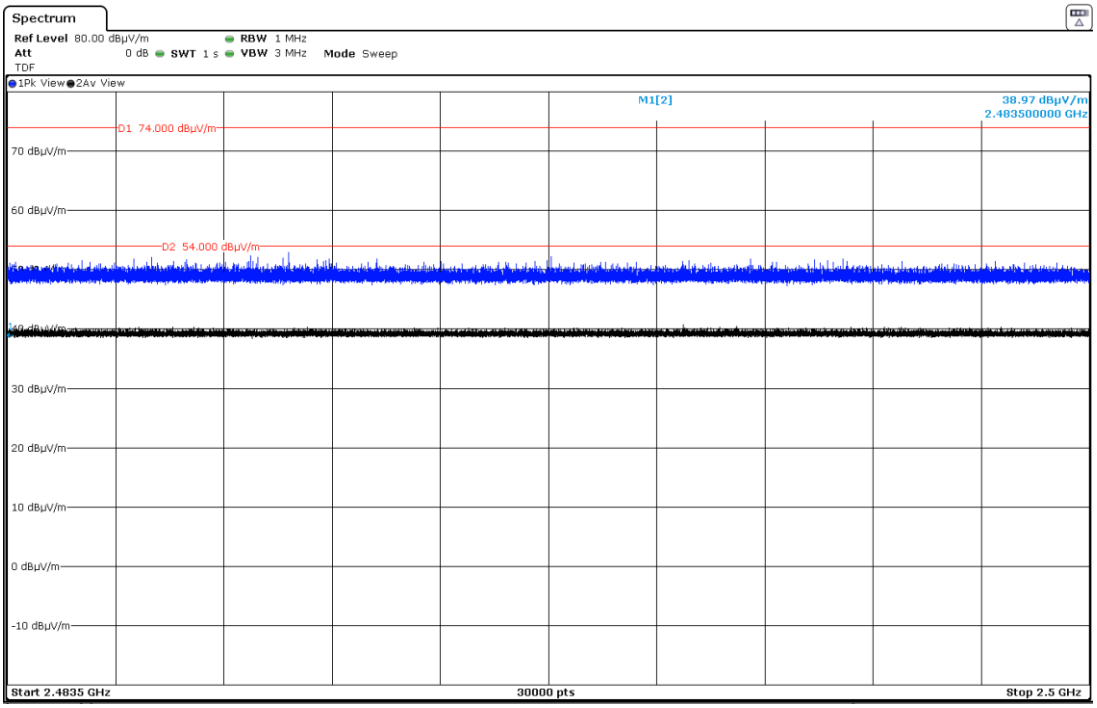
Modulation: GFSK (DH5)



Modulation: Π/4-DQPSK (2DH5)




Modulation: 8-DPSK (3DH5)



# **Appendix B:** Test results. . 802.11 b/n20

# INDEX

TEST CONDITIONS .....34
FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated (Transmitter) .....36

# TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 12 Vdc.

Type of Power Supply: External power supply (Battery).

Type of Antenna: Internal antenna.

Declared Gain for antenna RF (maximum): 0.4 dBi

TEST FREQUENCIES:

| | |
|---|---|
| Low Channel: | 2412 MHz |
| Middle Channel: | 2437 MHz |
| High Channel: | 2462 MHz |

RADIATED MEASUREMENTS

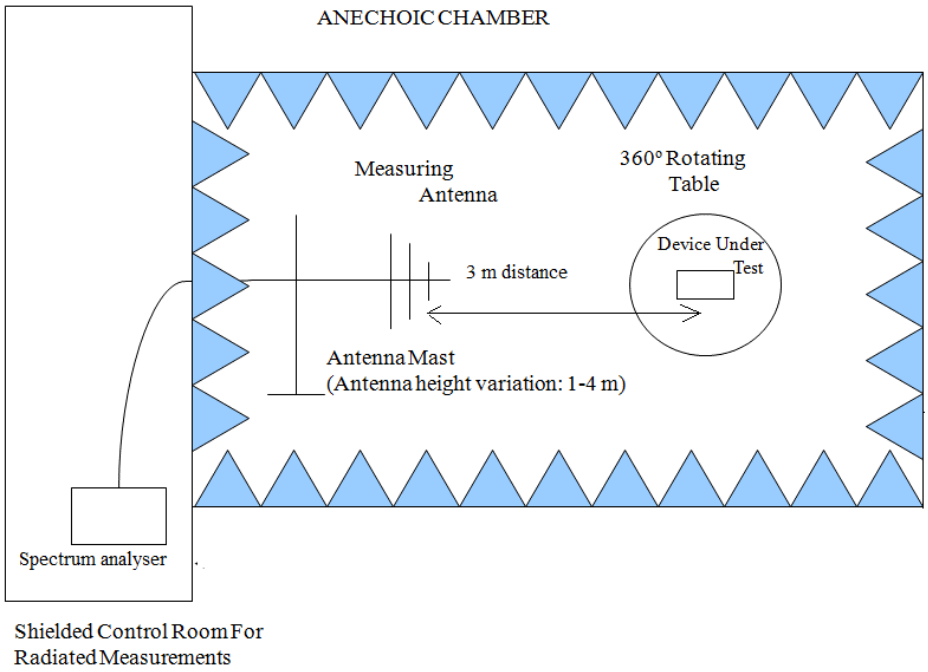
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

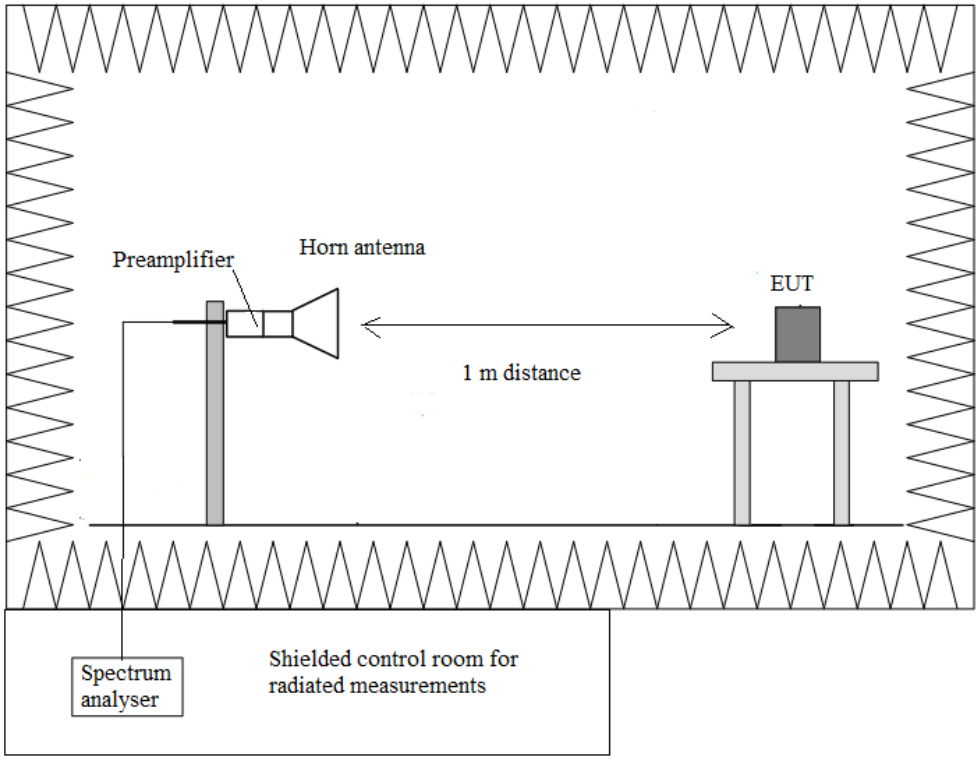
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:




Radiated measurements setup f > 1 GHz:



# 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 Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 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 - 10000 | 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-26 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.

Preliminary tests determined the worst case with a bit rate of 1 Mbps (Wi-Fi mode b) and index MSC0 (Wi-Fi mode n20).

- **Mode 802.11 b**

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

The spurious frequencies do not depend on the operating channel.

Spurious frequencies closest to the limit:

| Spurious frequency (MHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 188.838 | Quasi peak | 23.7 | H | <± 3.88 |
| 332.883 | Quasi peak | 36.7 | H | <± 3.88 |
| 620.940 | Quasi peak | 36.5 | V | <± 3.88 |
| 624.303 | Quasi peak | 34.6 | V | <± 3.88 |
| 725.021 | Quasi peak | 34.2 | V | <± 3.88 |

**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 signals 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.

- LOW CHANNEL. Spurious frequencies closest to the limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.38483 | Peak | 53.64 | V | <± 3.70 |
| 3.10710 | Peak | 49.25 | V | <± 3.70 |
| 4.35450 | Peak | 47.68 | V | <± 3.70 |
| 6.07650 | Peak | 41.62 | V | <± 3.70 |
| 7.23617 | Peak | 47.23 | H | <± 3.70 |
| 8.81910 | Peak | 44.28 | H | <± 3.70 |

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.85350 | Peak | 54.71 | H | <± 3.70 |
| | Average | 38.91 | | <± 3.70 |
| 3.11970 | Peak | 47.11 | H | <± 3.70 |
| 4.40957 | Peak | 47.45 | H | <± 3.70 |
| 6.07650 | Peak | 41.67 | V | <± 3.70 |
| 7.31177 | Peak | 46.90 | H | <± 3.70 |
| 8.81910 | Peak | 44.31 | H | <± 3.70 |

- HIGH CHANNEL. Spurious frequencies closest to the limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 2.02537 | Peak | 56.31 | V | <± 3.70 |
| | Average | 53.66 | | <± 3.70 |
| 3.10103 | Peak | 48.14 | V | <± 3.70 |
| 4.36523 | Peak | 46.20 | V | <± 3.70 |
| 4.40957 | Peak | 46.38 | H | <± 3.70 |
| 7.38783 | Peak | 46.21 | H | <± 3.70 |
| 8.81910 | Peak | 44.86 | H | <± 3.70 |

Verdict: PASS

- **Mode 802.11 n20**

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

The spurious frequencies do not depend on the operating channel.

Spurious frequencies closest to the limit:

| Spurious frequency (MHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 622.040 | Quasi peak | 36.8 | V | <± 3.88 |
| 725.021 | Quasi peak | 34.1 | V | <± 3.88 |

**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 signals 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.

- LOW CHANNEL. Spurious frequencies closest to the limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86550 | Peak | 56.95 | V | <± 3.70 |
| | Average | 39.02 | | <± 3.70 |
| 2.38993 | Peak | 53.55 | H | <± 3.70 |
| 3.09777 | Peak | 46.96 | V | <± 3.70 |
| 4.35450 | Peak | 47.18 | V | <± 3.70 |
| 8.81910 | Peak | 44.32 | H | <± 3.70 |

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86070 | Peak | 56.13 | V | <± 3.70 |
| | Average | 39.71 | | <± 3.70 |
| 3.10757 | Peak | 47.55 | V | <± 3.70 |
| 4.33723 | Peak | 46.88 | H | <± 3.70 |
| 4.35497 | Peak | 46.69 | V | <± 3.70 |
| 8.81910 | Peak | 44.47 | H | <± 3.70 |

- HIGH CHANNEL. Spurious frequencies closest to the limit:

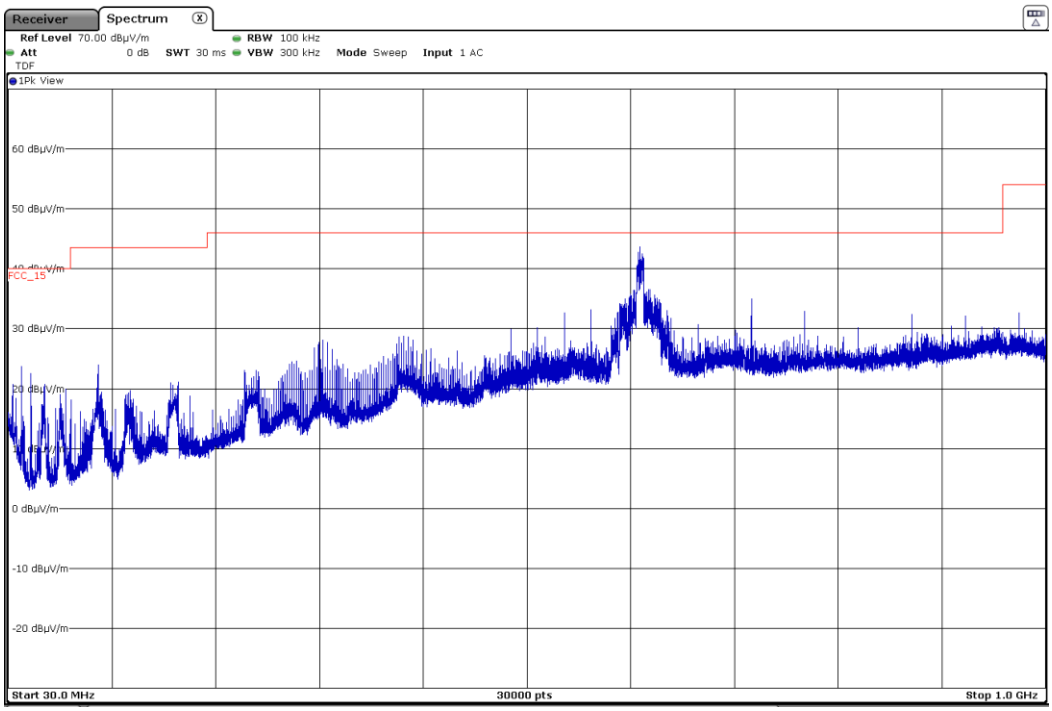
| Spurious frequency (GHz) | Detector | Emission Level (dBµV/m) | Polarization | Measurement Uncertainty (dB) |
|---|---|---|---|---|
| 1.86057 | Peak | 56.48 | H | <± 3.70 |
| | Average | 39.00 | | <± 3.70 |
| 2.48390 | Peak | 58.32 | V | <± 3.70 |
| | Average | 41.90 | | |
| 3.11363 | Peak | 47.23 | V | <± 3.70 |
| 4.33863 | Peak | 47.06 | H | <± 3.70 |
| 8.81810 | Peak | 45.06 | H | <± 3.70 |

Verdict: PASS

- **Mode 802.11 b.**

FREQUENCY RANGE 30 MHz - 1 GHz:

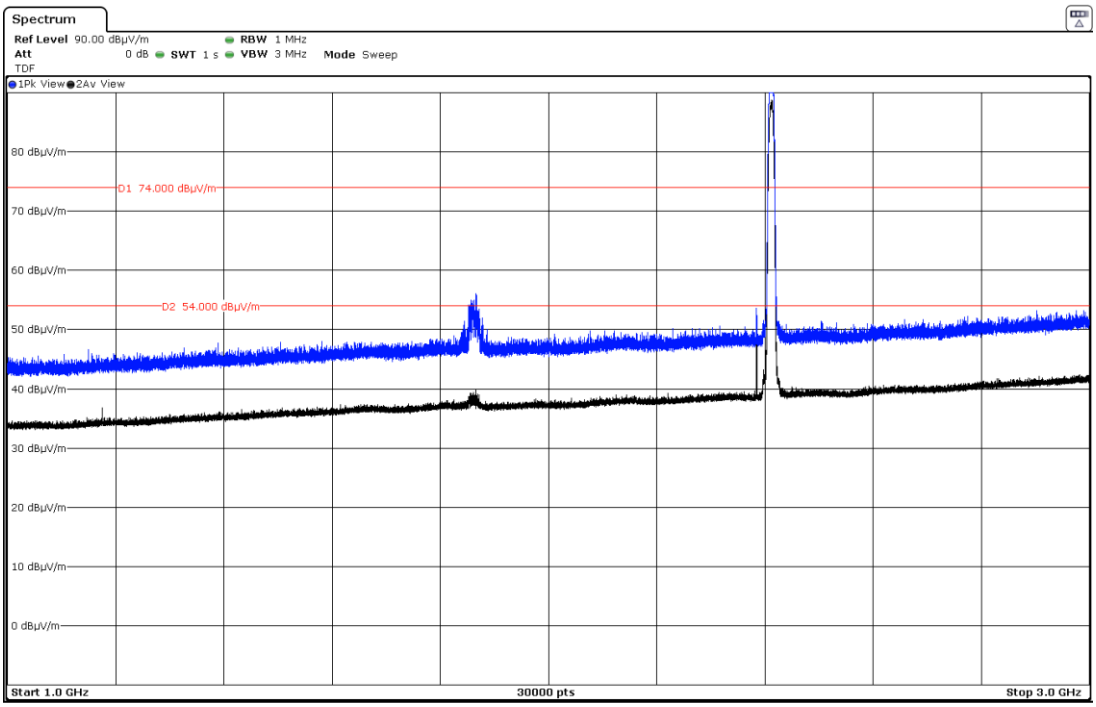
The spurious signals detected do not depend on the operating channel.




Note: This plot is valid for all three channels.

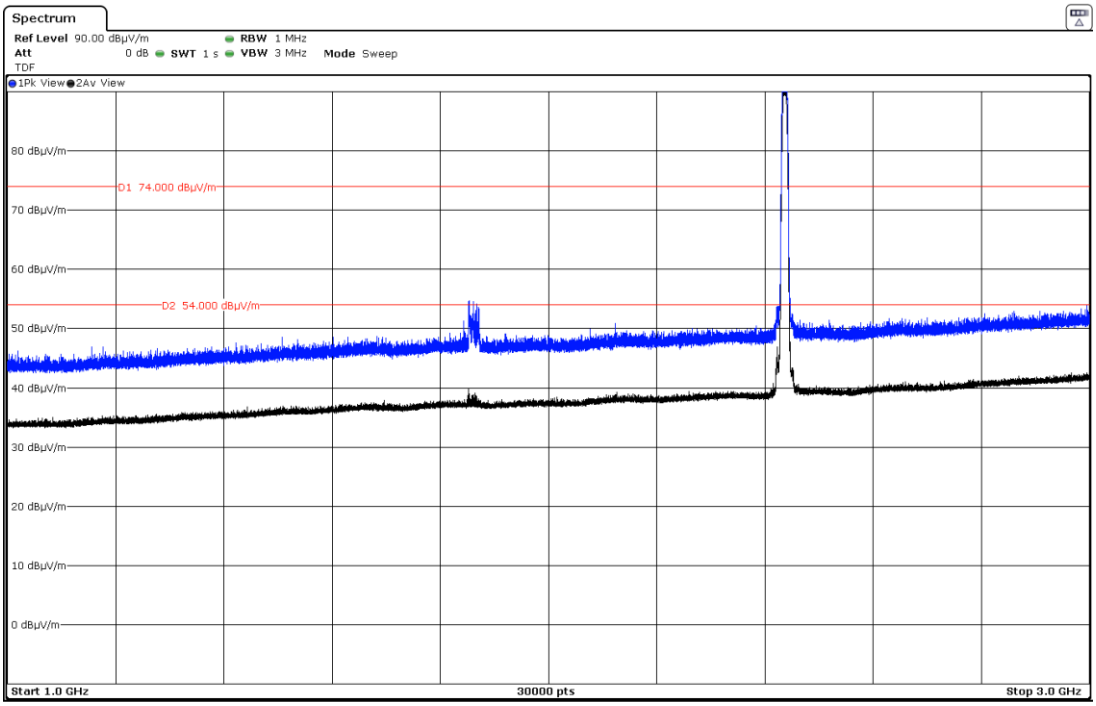
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



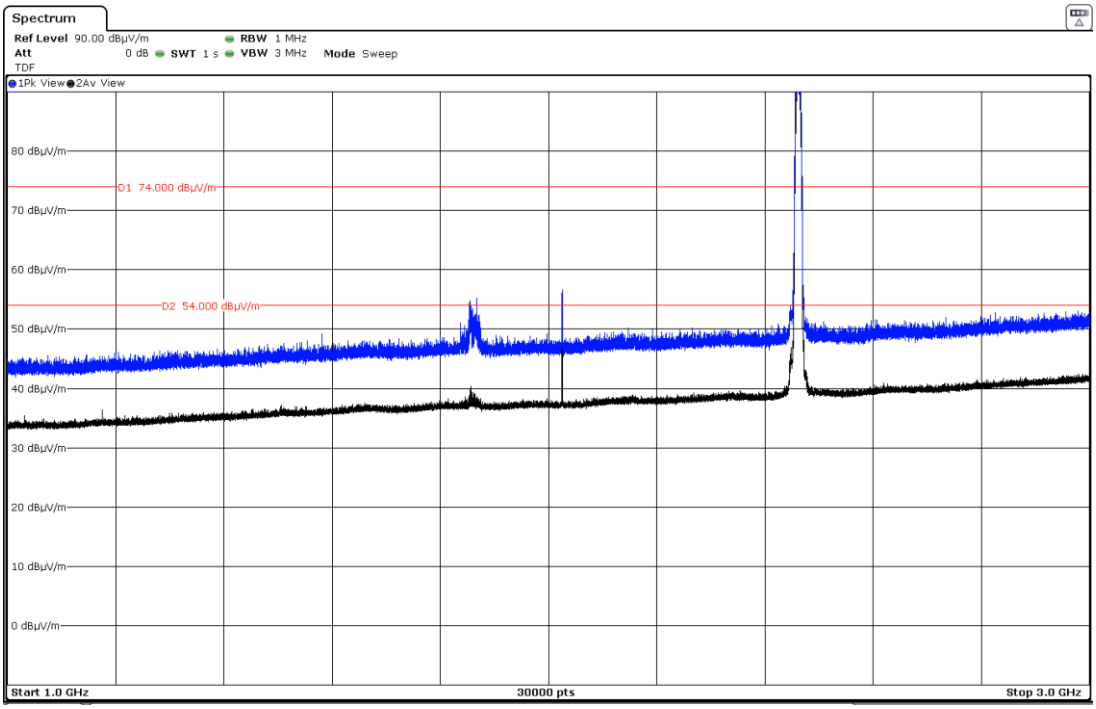

The peak above the limit is the carrier frequency.

- Middle Channel:




The peak above the limit is the carrier frequency.

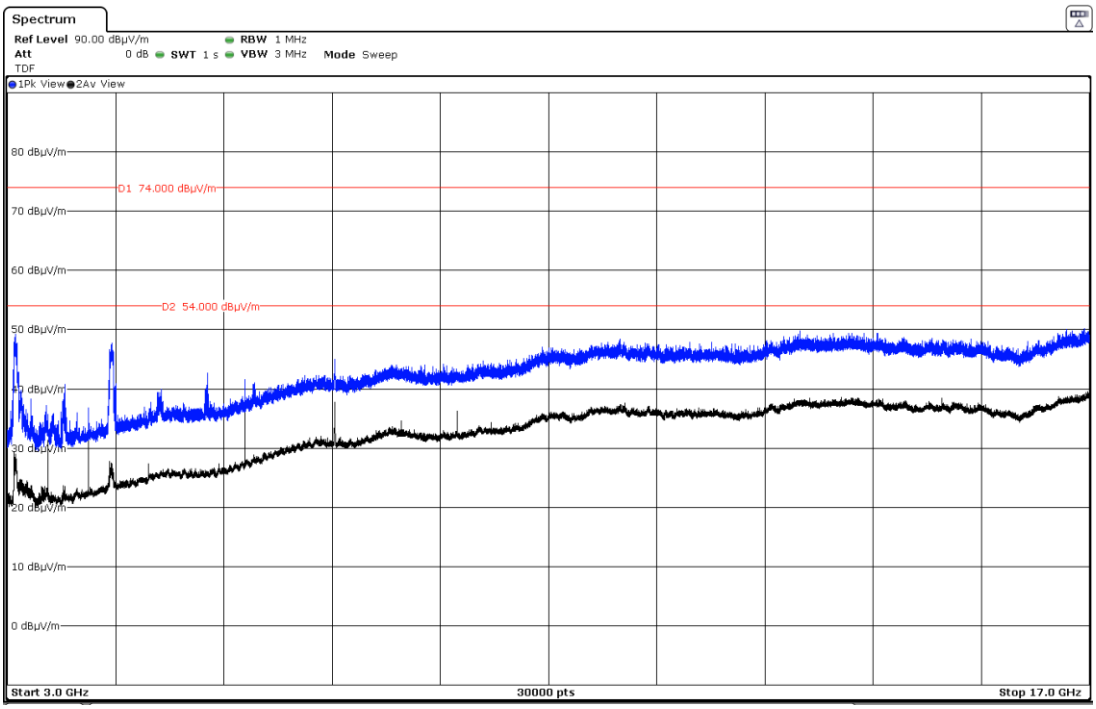
- High Channel:



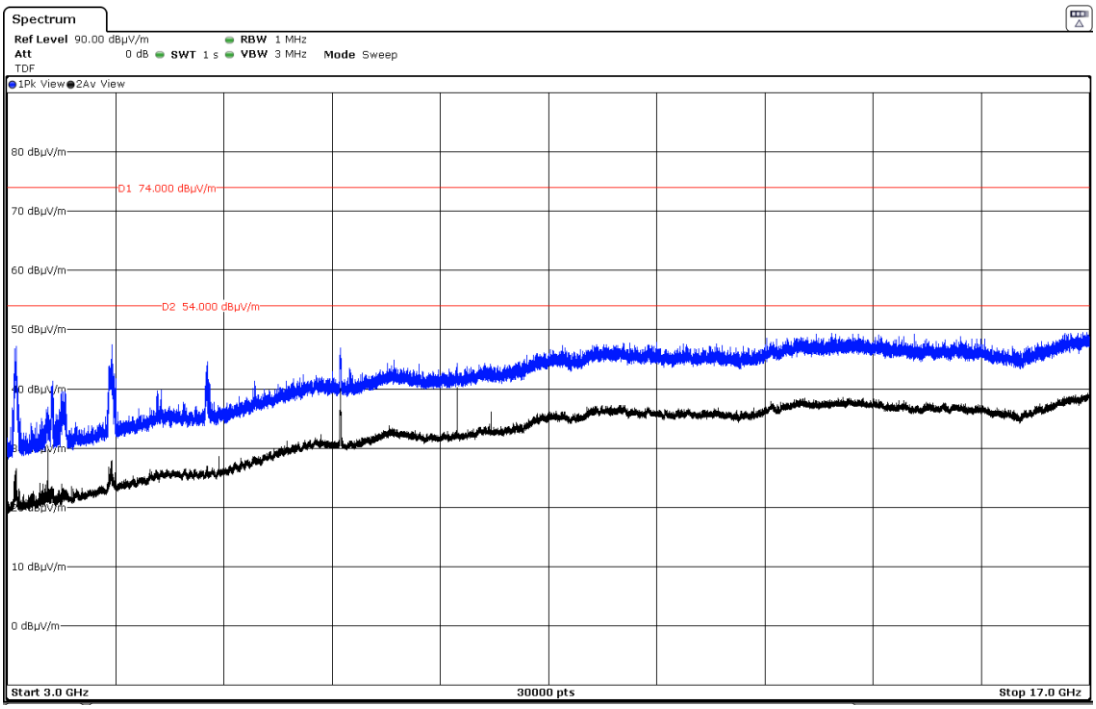

The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

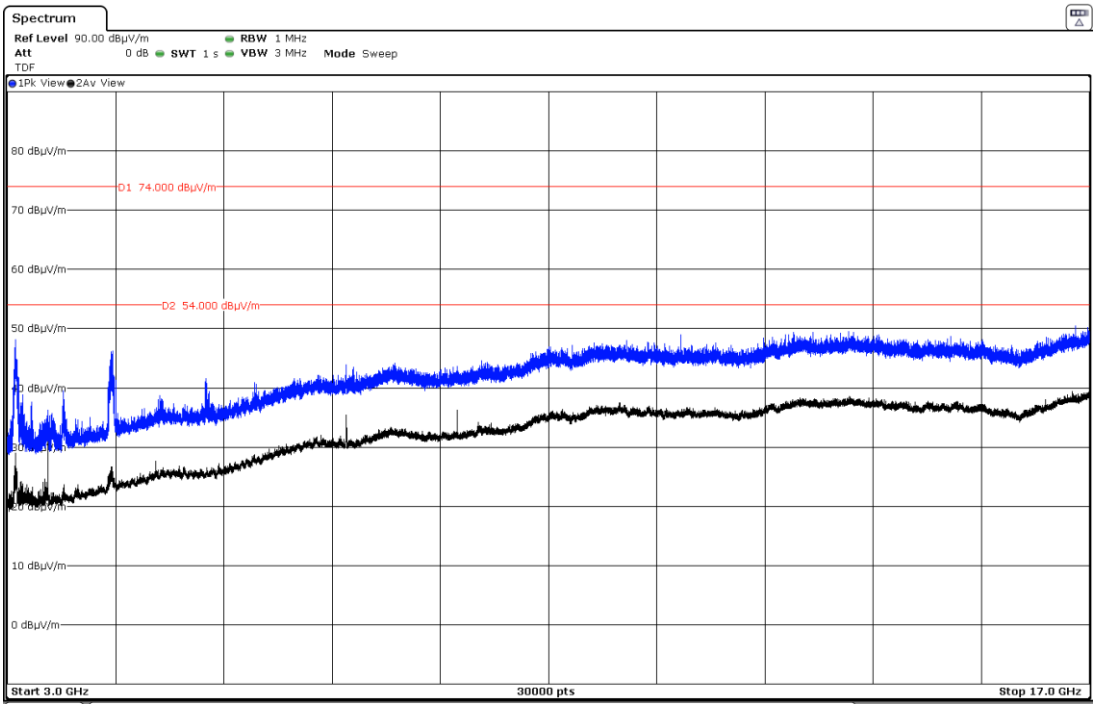
- Low Channel:




- Middle Channel:

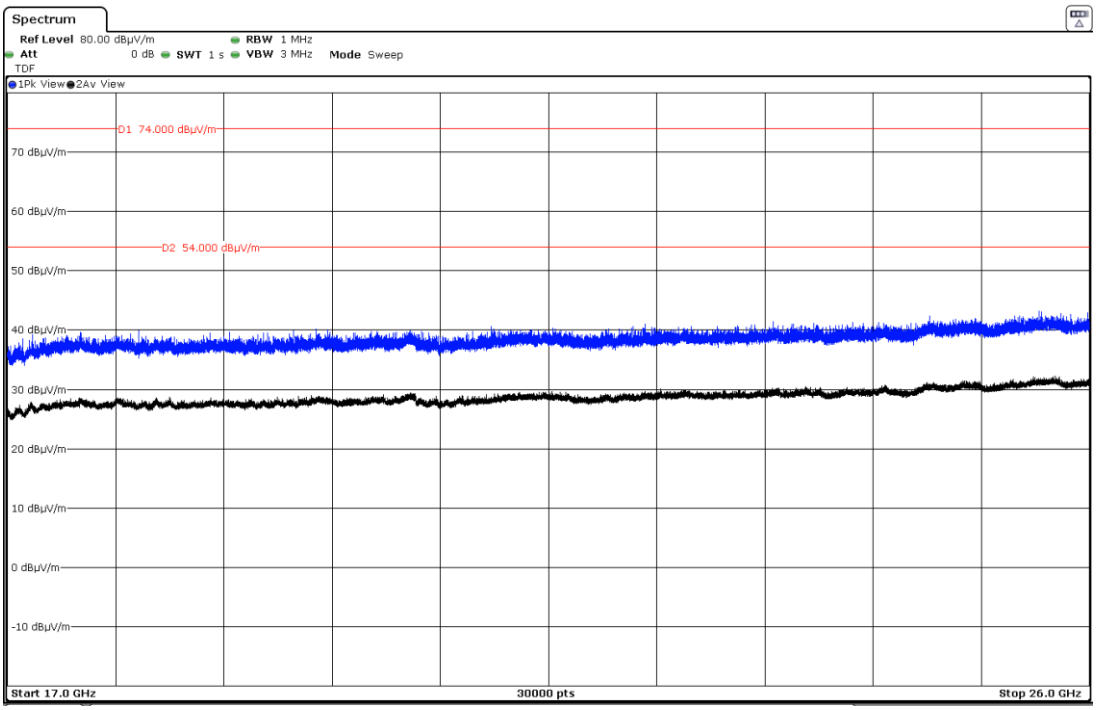


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

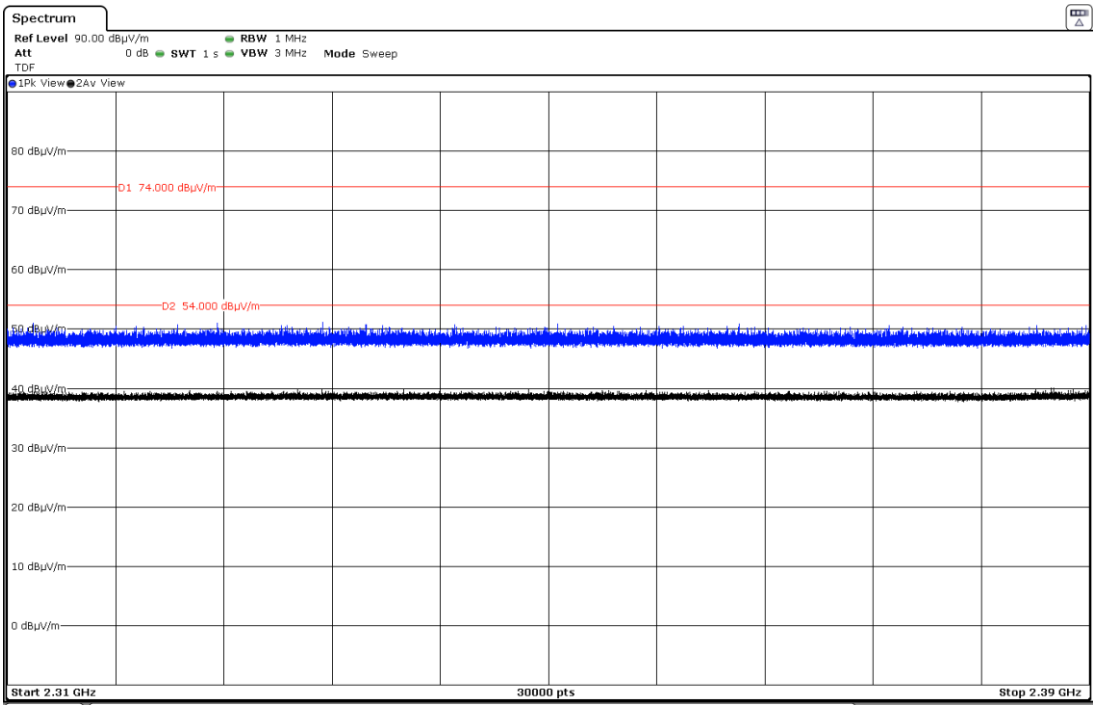
The spurious signals detected do not depend on the operating channel.




Note: This plot is valid for all three channels.

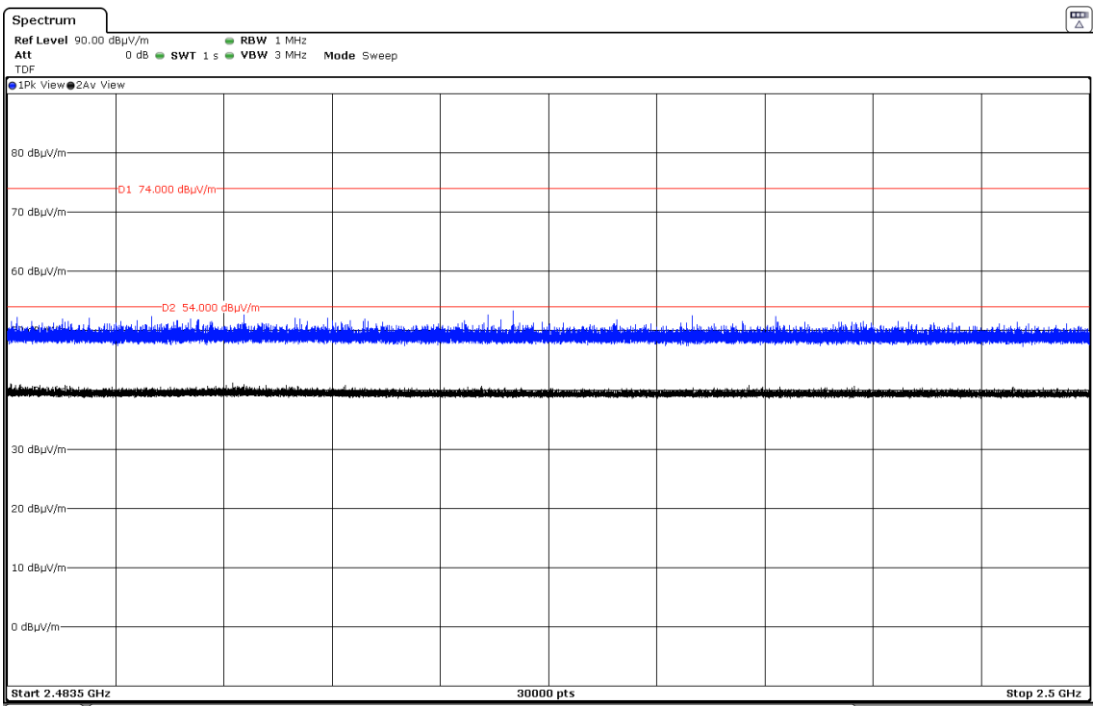
FREQUENCY RANGE 2.31-2.39 GHz (Restricted Band 1):

- Low Channel. CH 1:




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

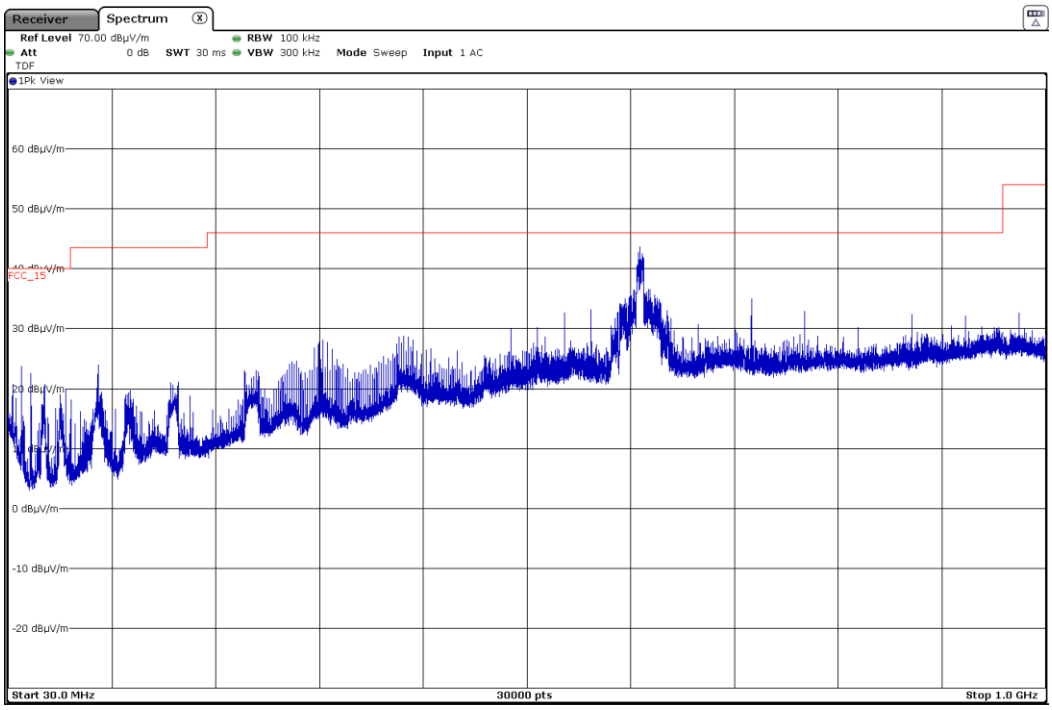
- High Channel. CH 11:



- **Mode 802.11 n20**

FREQUENCY RANGE 30 MHz - 1 GHz:

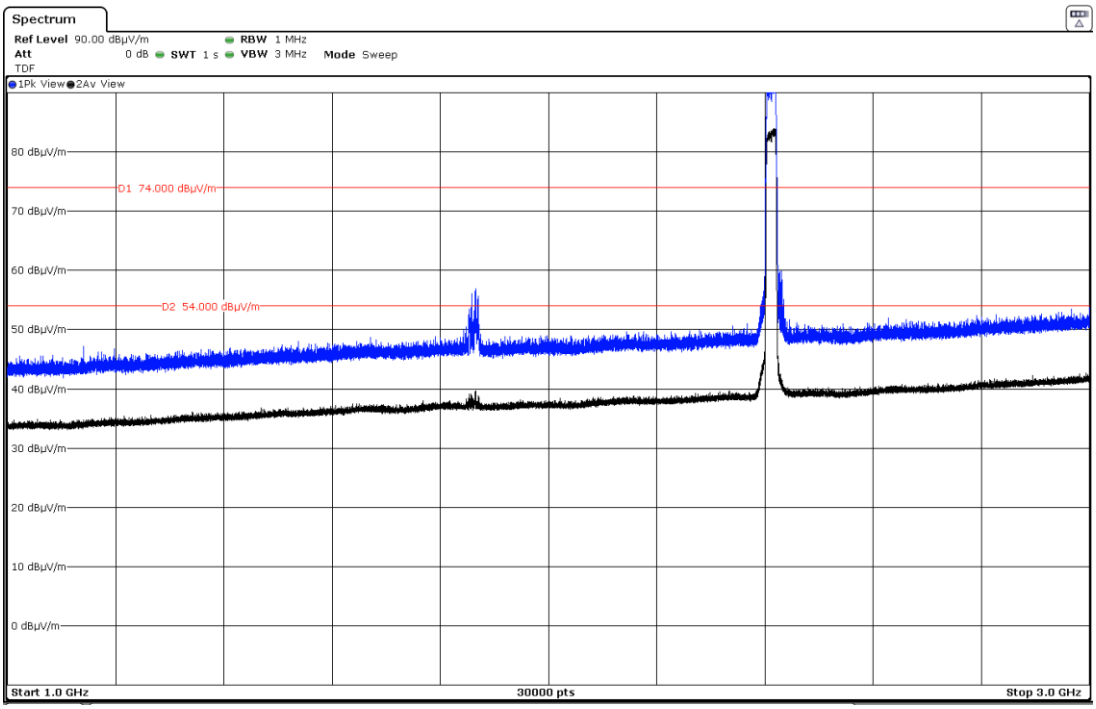
The spurious signals detected do not depend on the operating channel.




Note: This plot is valid for all three channels.

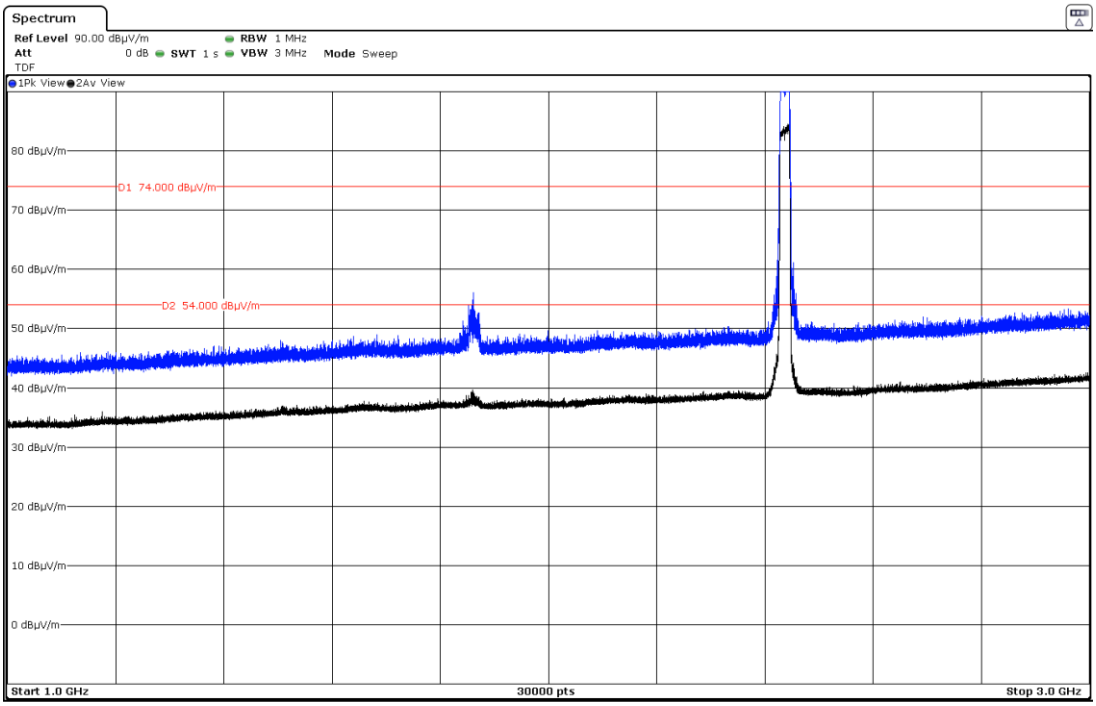
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



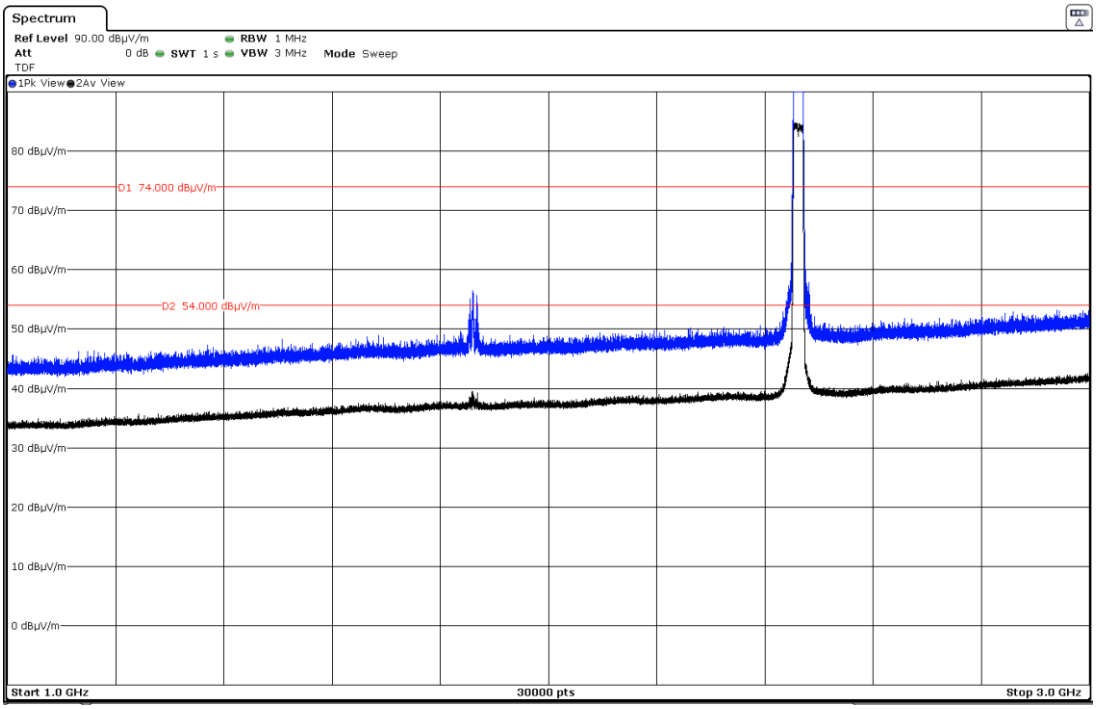

The peak above the limit is the carrier frequency.

- Middle Channel:




The peak above the limit is the carrier frequency.

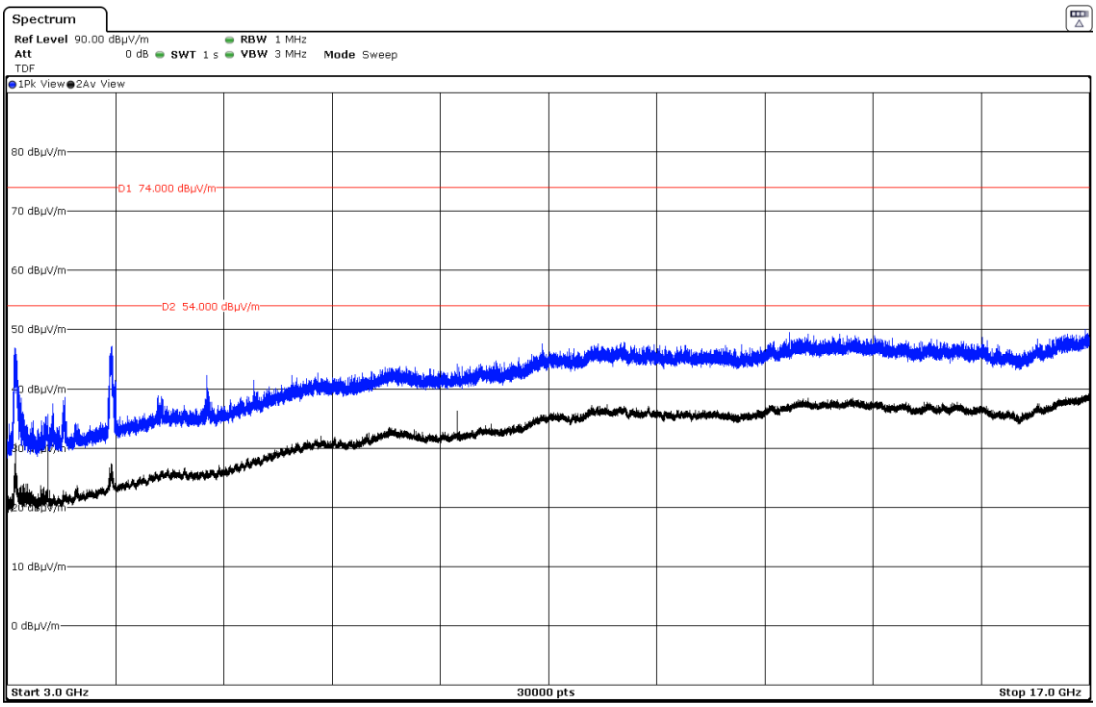
- High Channel:



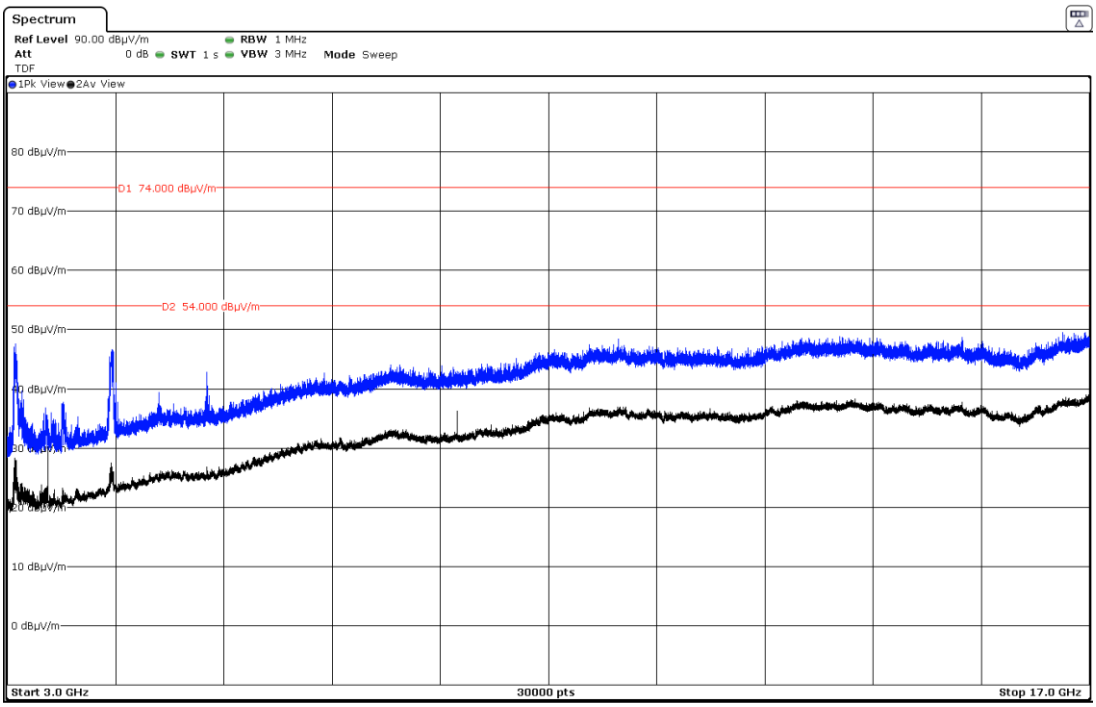

The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

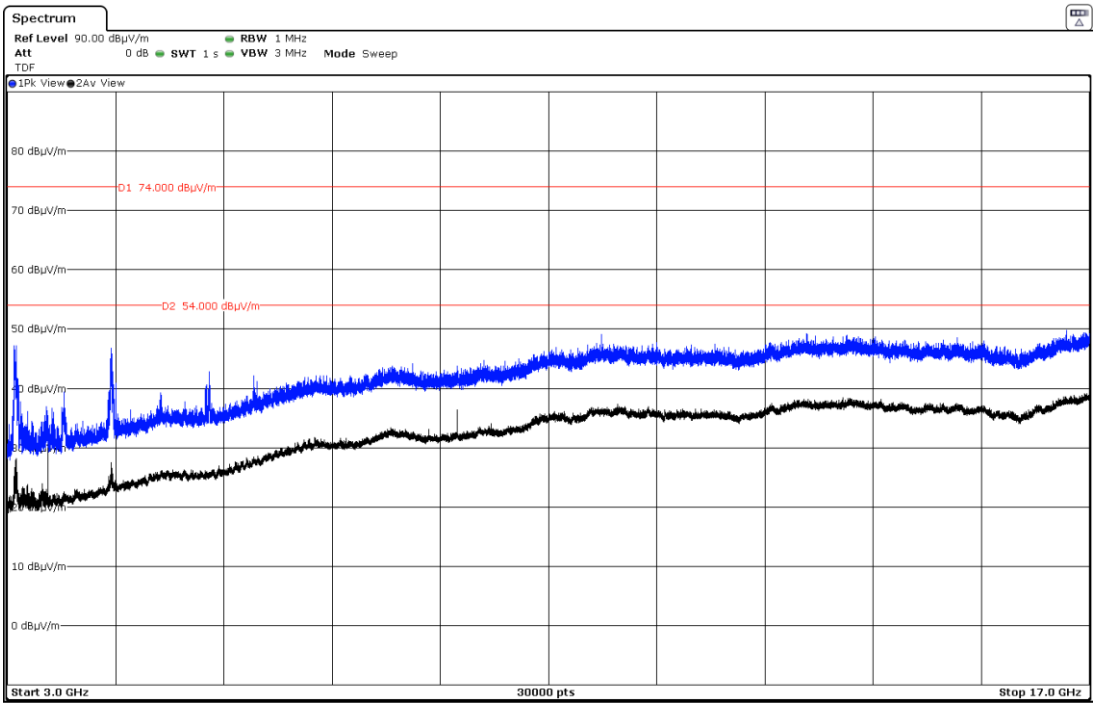
- Low Channel:




- Middle Channel:

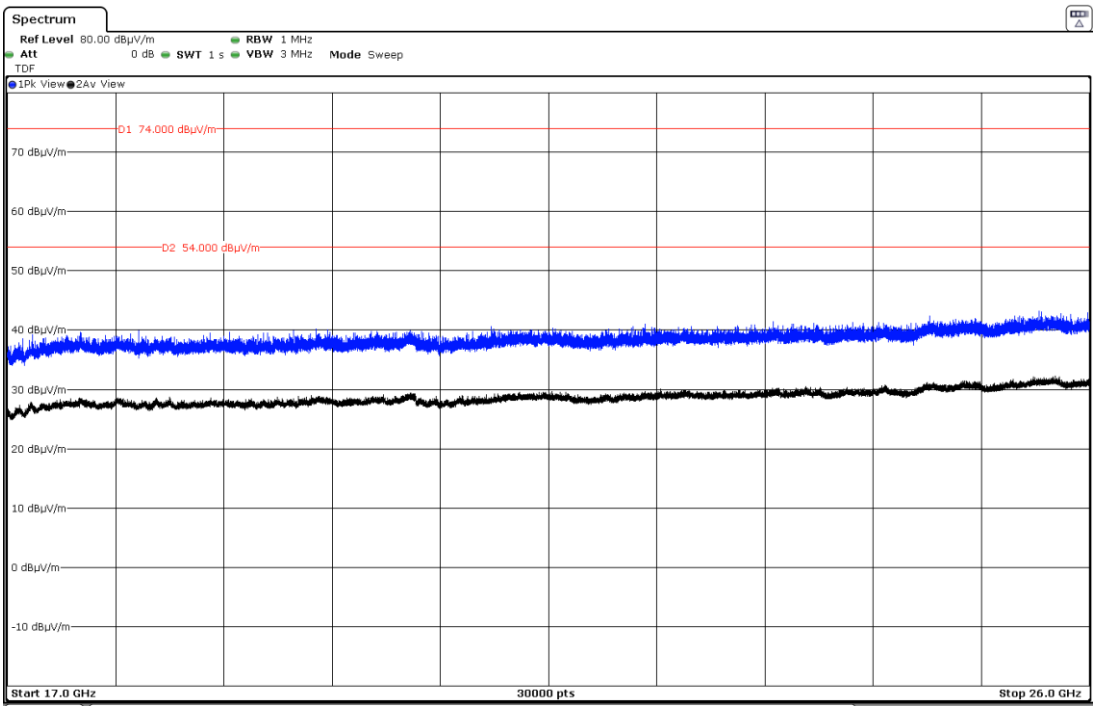


- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

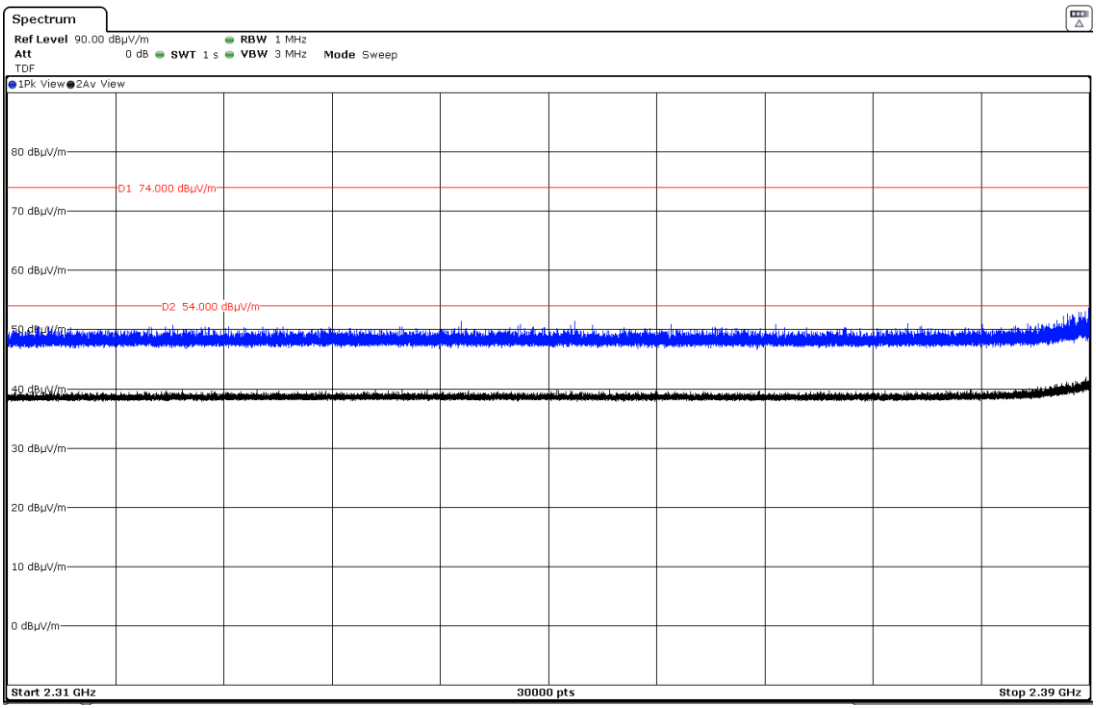
The spurious signals detected do not depend on the operating channel.

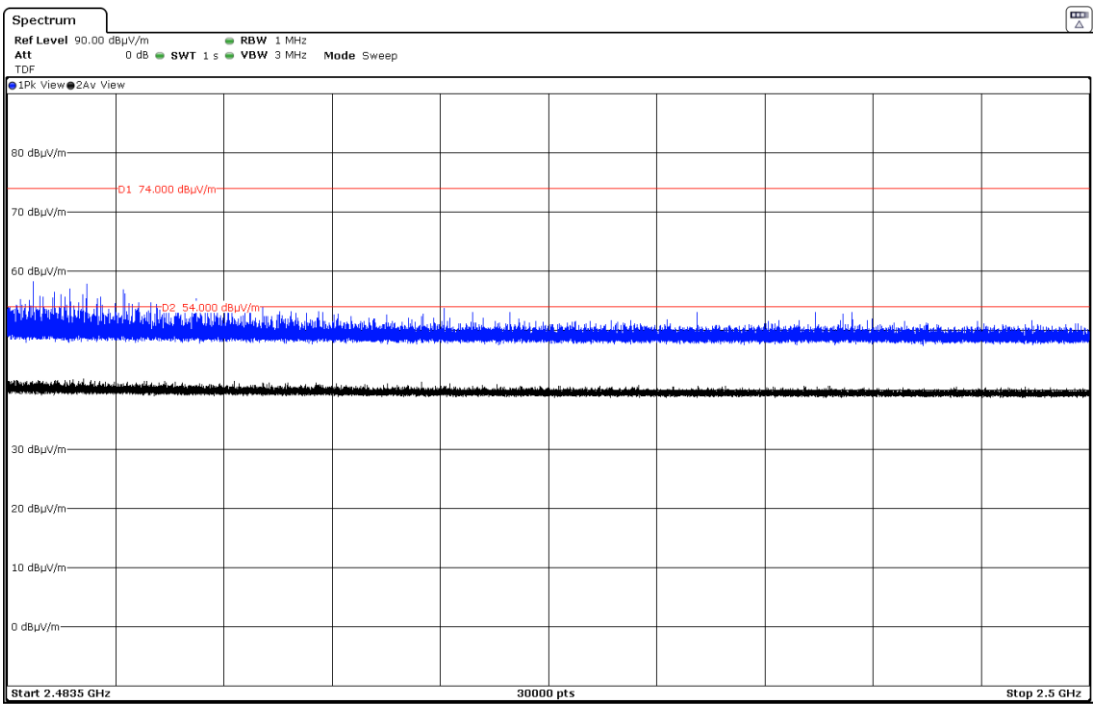



Note: This plot is valid for all three channels.

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

- Low Channel. CH 1:




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

- High Channel. CH 11: