# Nemko Korea Co., Ltd.

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## FCC and IC EVALUATION REPORT FOR CERTIFICATION

**Applicant :**
**Anam Electronics Co., Ltd.**
**27, Digital-ro, 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea.**
**Attn. : Byeong-Seob, Lee**

**Dates of Issue : March 20, 2020**
**Test Report No. : NK-20-R-016**
**Test Site : Nemko Korea Co., Ltd.**

| | |
|---|---|
| **FCC ID** | **MBBF1DQ3007** |
| **IC** | **11657A-F1DQ3007** |
| **Brand Name** | **ANAM** |
| **Contact Person** | **Anam Electronics Co., Ltd.**<br>**27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375,**<br>**Republic of Korea.**<br>**Byeong-Seob, Lee**<br>**Telephone No. : +82-2-6424-4881** |

| | |
|---|---|
| Applied Standard: | FCC 47 CFR Part 15.247<br>IC RSS-247 Issue 2 and IC RSS-GEN Issue 5 |
| Classification: | FCC Part 15 Spread Spectrum Transmitter (DSS) |
| EUT Type: | Bluetooth module |

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Mar. 20. 2020

Tested By : Yonghwan Kim
Engineer

Mar. 20. 2020

Reviewed By : Seungyong Shin
Technical Manager

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# 1. SCOPE

*Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15 and IC RSS-247 Issue2.*

| | |
|---|---|
| **Responsible Party :** | Anam Electronics Co., Ltd.<br>27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea |
| **Contact Person :** | Byeong Seob, Lee |
| **Manufacturer :** | Anam Electronics Co., Ltd.<br>27, Digital-ro 27ga-gil, Guro-gu, Seoul, 08375, Republic of Korea |

- FCC ID: MBBF1DQ3007
- IC: 11657A-F1DQ3007
- Model: F1DQ3007
- HVIN: F1DQ3007
- Brand Name: ANAM
- EUT Type: Bluetooth module
- Classification: Part 15 Spread Spectrum Transmitter (DSS)
- Applied Standard: FCC 47 CFR Part 15.247
  IC RSS-247 Issue 2 and IC RSS-GEN Issue 5
- Test Procedure(s): ANSI C63.10-2013
- Dates of Test: January 28, 2020 ~ February 10, 2020
- Place of Test: Nemko Korea Co., Ltd.

# 2. INTRODUCTION

## 2.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating from **Anam Electronics Co., Ltd. FCC ID : MBBF1DQ3007** and **IC : 11657A-F1DQ3007.**

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon-Eup, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.

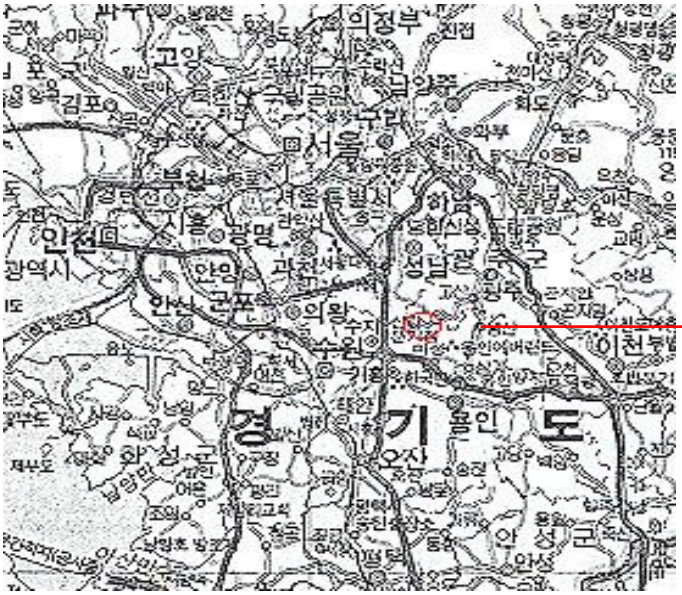


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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

## 2.2 Accreditation and listing

| Accreditation type | | Accreditation number |
|---|---|---|
| | CAB Accreditation for DOC | Designation No. KR0026 |
| | KOLAS Accredited Lab.<br>(Korea Laboratory Accreditation Scheme) | Registration No. 155 |
| Industry Canada | Canada IC Registered site | Site No. 2040E |
| | VCCI registration site(RE/CE/Telecom CE) | Member No. 2118 |
| | EMC CBTL | - |
| | KCC(RRL)Designated Lab. | Registration No. KR0026 |

# 3. TEST CONDITIONS & EUT INFORMATION

## 3.1 Operation During Test

The EUT is the transceiver which is Bluetooth 5.0 module supporting BDR/EDR/LE mode.
The Laptop was used to control the EUT to transmit the wanted TX channel continuously (duty cycle< 98%) by the testing program (Bluetest) supported by manufacturer.
The operating voltage of EUT was 3.3 Vdc supplied from jig board connected to USB port on Laptop PC.
The EUT was tested at the lowest, middle and the highest channels with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

### 3.1.1 Table of Test power setting

| Frequency | Mode | Modulation | Power setting Level |
|---|---|---|---|
| 2402 MHz ~ 2480 MHz | BDR | GFSK | 255/63 |
| 2402 MHz ~ 2480 MHz | EDR | π/4DQPSK | 255/63 |
| 2402 MHz ~ 2480 MHz | EDR | 8DPSK | 255/63 |

### 3.1.2 Table of Test channels

| Frequency band | Modulation | Test Channel (CH) | Frequency (MHz) |
|---|---|---|---|
| 2.4 GHz | GFSK, π/4DQPSK, 8DPSK | 0 | 2402 |
| | | 39 | 2441 |
| | | 78 | 2480 |

### 3.1.3 Antenna Information

| Frequency band | Modulation | Antenna TX mode | Support CDD | Support MIMO |
|---|---|---|---|---|
| 2.4 GHz | GFSK, π/4DQPSK, 8DPSK | ■ 1TX, □ 2TX | □ Yes, ■ No | □ Yes, ■ No |

### 3.1.4 Additional Information Related to Testing

The cable and attenuator loss from 30MHz to 26.5GHz was reflected in spectrum analyzer with correction factor for all conducted testing.

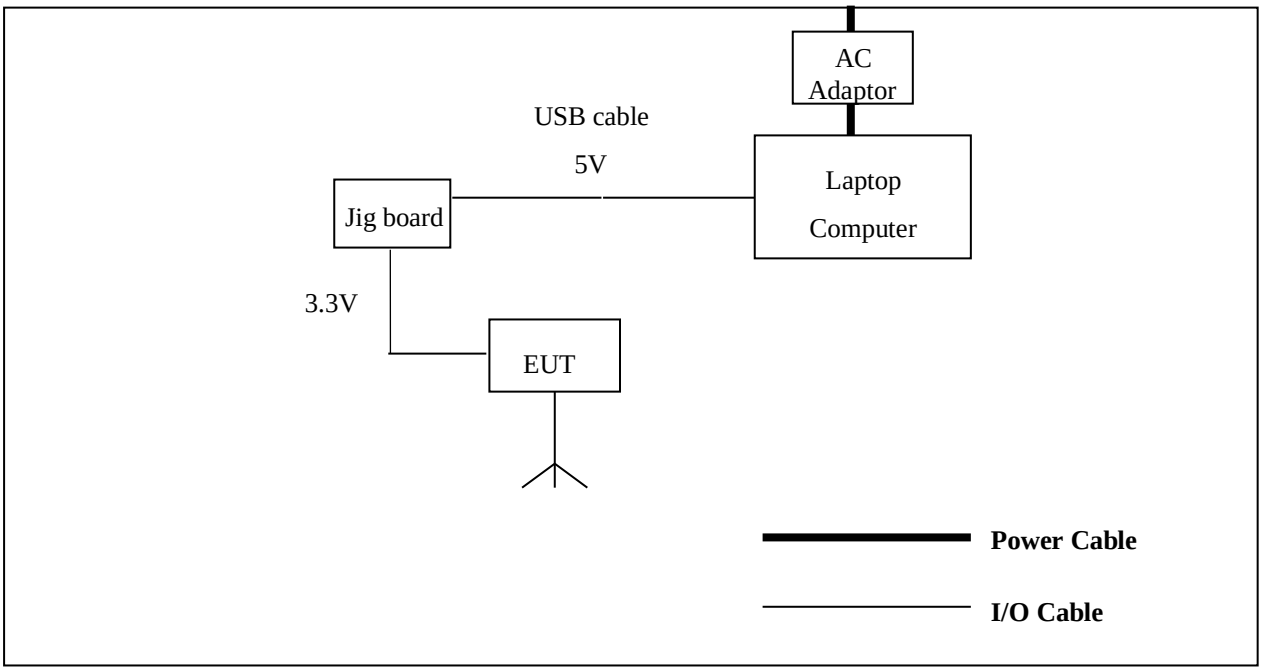
### 3.1.5 Table of Test modes

| Test Items | Modulation | Test Channel (CH) |
|---|---|---|
| Conducted Emissions | GFSK | 78 |
| Radiated Emissions | π/4DQPSK | 39 |
| 20 dB Bandwidth | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |
| Carrier Frequency Separation | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |
| Transmitter Average Time of Occupancy | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |
| Number of Hopping Channels | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |
| Peak Output Power and E.I.R.P | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |
| Conducted Spurious Emission, Radiated Spurious Emission, Band edge Emission | GFSK, π/4DQPSK, 8DPSK | 0/39/78 |

## 3.2 Support Equipment

| | | |
|---|---|---|
| EUT | Anam Electronics Co., Ltd.<br>Model : F1DQ3007 | S/N: N/A |
| Laptop Computer | HP<br>Model : G62-355TU | FCC DOC<br>S/N : CNF0452FN3 |
| AC/DC Adapter | HP<br>Model : PPP009D<br>1.5 m unshielded power cable | FCC DOC<br>S/N : WBGSV0ACXZH162 |

## 3.3 Setup Drawing



## 3.4 EUT Information

The EUT is the **Anam Electronics Co., Ltd. Bluetooth module FCC ID: MBBF1DQ3007, IC: 11657A-F1DQ3007.**

Specifications:

| | |
|---|---|
| EUT Type | Bluetooth module |
| Model Name | F1DQ3007 |
| Brand Name | ANAM |
| Frequency of Operation | 2402 MHz ~ 2480 MHz |
| Peak Output Power (Conducted) | 8.78 dBm |
| FCC Classification | FCC Part 15 Spread Spectrum Transmitter (DSS) |
| Spreading Method | Frequency Hopping Spread Spectrum (FHSS) |
| Number of Channels | 79 CH |
| Modulations | GFSK, π/4DQPSK, 8DPSK |
| Antenna Gain (peak) | 2.1 dBi |
| Antenna Setup | 1TX / 1RX |
| Voltage | 3.3 Vdc |
| Temperature Range | -10 ℃ ~ +70 ℃ |
| Size (W x H x D) | About 20.0 mm x 24.5 mm x 3.0 mm |
| Weight | About 2 g |
| HVIN<br>(Hardware Version Number) | F1DQ3007 |
| FVIN<br>(Firmware Version Identification Number) | BT01.20 |
| Remarks | - |

# 4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

| Name of Test | FCC Paragraph No. | IC Paragraph No. | Result | Remark |
|---|---|---|---|---|
| Conducted Emission | 15.207 | RSS-GEN Issue 5 8.8 | Complies | |
| Radiated Emission | 15.209 | RSS-GEN Issue 5 8.9 | Complies | |
| 20dB Bandwidth | 15.247(a)(1) | RSS-247 Issue 2 5.1 | Complies | |
| Carrier Frequency Separation | 15.247(a)(1) | RSS-247 Issue 2 5.1 | Complies | |
| Transmitter Average Time of Occupancy | 15.247(a)(1)(iii) | RSS-247 Issue 2 5.1 | Complies | |
| Peak Output Power and E.I.R.P | 15.247(b)(1) | RSS-247 Issue 2 5.4 | Complies | |
| Conducted Spurious Emission | 15.247(d) | RSS-247 Issue 2 5.5 | Complies | |
| Radiated Spurious Emission | 15.247(d) | RSS-247 Issue 2 5.5 | Complies | |
| Number of Hopping channels | 15.247(a)(1)(iii) | RSS-247 Issue 2 5.1 | Complies | |
| Maximum Permissible Exposure | 1.1307(b) | RSS-102 Issue 5 | Complies | |

# 5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Anam Electronics Co., Ltd. Bluetooth module FCC ID: MBBF1DQ3007, IC: 11657A-F1DQ3007** is in compliance with Part 15.247 of the FCC Rule and RSS-247 Issue 2 of the IC Specification.

# 6. ANTENNA REQUIREMENTS

**§15.203 of the FCC Rules part 15 Subpart C**
**:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The antenna of the **Anam Electronics Co., Ltd. Bluetooth module FCC ID: MBBF1DQ3007, IC: 11657A-F1DQ3007** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

| Used Antenna | |
|---|---|
| Model name | Max. gain (dBi) |
| F1-FR4 ANT(F1304L) | 2.10 |

# 7. DESCRIPTION OF TESTS

## 7.1 Conducted Emissions

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure. It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room. Rohde & Schwarz (ENV216) of the 50 ohm/50 µH Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN (ENV216). Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ". If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentinefashion) to a 1 meter length. Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time. The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCI). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.
Each EME reported was calibrated using the R&S signal generator.

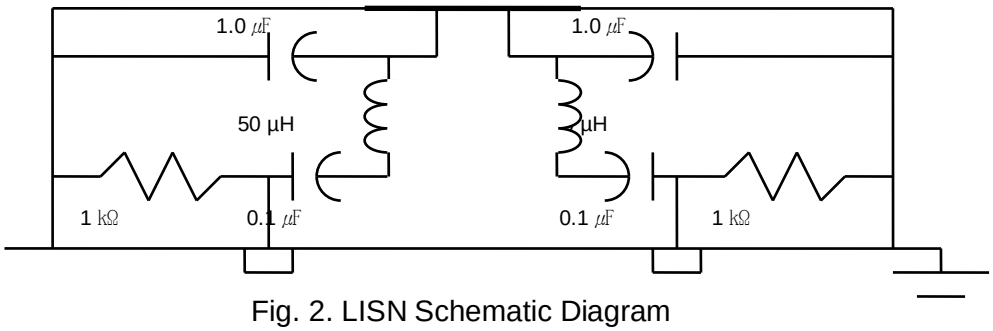



Fig. 2. LISN Schematic Diagram

## 7.2 Radiated Emissions

The measurement was performed at the test site that is specified in accordance with ANSI C63.10-2013.
The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz) was used.
For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0˚ to 360˚ and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

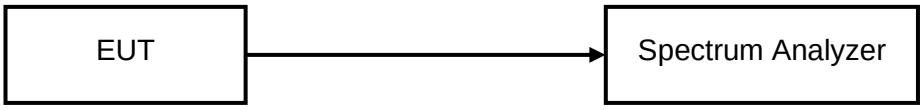
At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection. At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in ANSI 63.10-2013 section 11.12. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3kHz, Detector = Peak, Trace mode = max hold. Allow max hold to run for at least 50 times (1/duty cycle) traces.

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 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 | 3 |
| 88–216 | 150 | 3 |
| 216–960 | 200 | 3 |
| Above 960 | 500 | 3 |

Radiated Emissions Limits per 47 CFR 15.209(a) and RSS-GEN Issue 5 8.9

## 7.3 20 dB Bandwidth

### Test Setup

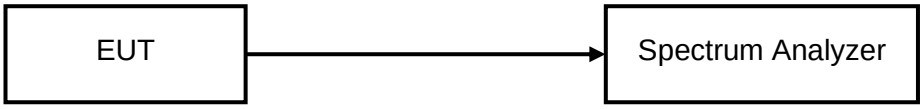



### Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the spectrum analyzer.
Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel
RBW = 1% to 5% of the OBW
VBW = approximately 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold

## 7.4 Carrier Frequency Separation

### Test Setup

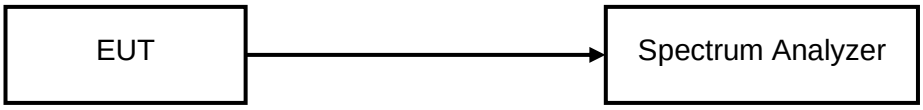



### Test Procedure

The EUT must have its hopping function enabled. The following spectrum analyzer setting is used.
Span = wide enough to capture the peaks of two adjacent channels
RBW ≥ approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

## 7.5 Transmitter Average Time of Occupancy

### Test Setup

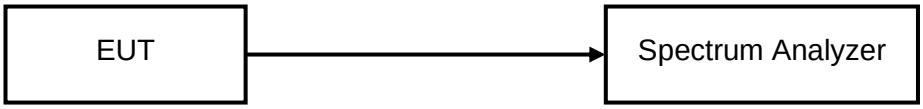



### Test Procedure

The transmitter output is connected to a spectrum analyzer. The following spectrum analyzer setting is used.
Span = Zero span, centered on a hopping channel
RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = Peak
Trace = Single sweep
Use the marker-delta function to determine the width of pulse

## 7.6 Number of Hopping Channels

### Test Setup

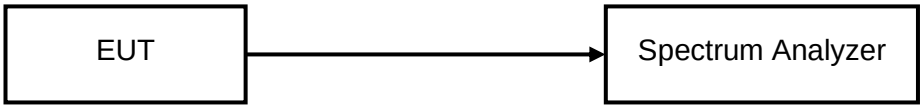



### Test Procedure

Span = The frequency band of operation.
RBW = less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW ≥ RBW
Sweep = Auto
Detector function = Peak
Trace = Max hold

## 7.7 Peak Output Power and E.I.R.P

### Test Setup

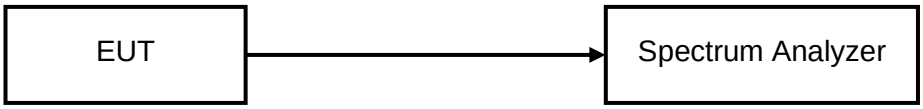



### Test Procedure

The transmitter is set to the Low, Middle, High channels is connected to the spectrum analyzer.
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
E.I.R.P is calculated according to KDB412172 D01 Determining ERP and EIRP v01r01

## 7.8 Conducted Spurious Emission

### Test Setup




### Test Procedure

Measurements are made over the 30 MHz to 26.5 GHz range with the transmitter set to the Lowest, middle and highest channels.
RBW = 100kHz
VBW = 300kHz
Sweep = auto
Detector function = peak
Trace = max hold

# 8. TEST DATA

## 8.1 Conducted Emissions

### FCC §15.207, RSS-GEN Issue 5 8.8

### Result

| Frequency | Level (dBμV) | | *) Factor | **) Line | Limit (dBμV) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|
| (MHz) | Q-Peak | Average | (dB) | | Q-Peak | Average | Q-Peak | Average |
| 0.16 | 44.4 | 32.3 | 10.00 | L | 65.2 | 55.2 | 20.8 | 22.9 |
| 0.22 | 40.4 | 33.6 | 9.80 | L | 62.8 | 52.8 | 22.4 | 19.2 |
| 0.44 | 38.3 | 32.3 | 9.90 | L | 56.9 | 46.9 | 18.6 | 14.6 |
| 0.50 | 39.3 | 25.0 | 9.90 | N | 56.0 | 46.0 | 16.7 | 21.0 |
| 0.65 | 36.0 | 25.8 | 9.90 | L | 56.0 | 46.0 | 20.0 | 20.2 |
| 2.03 | 35.6 | 31.5 | 9.70 | N | 56.0 | 46.0 | 20.4 | 14.5 |

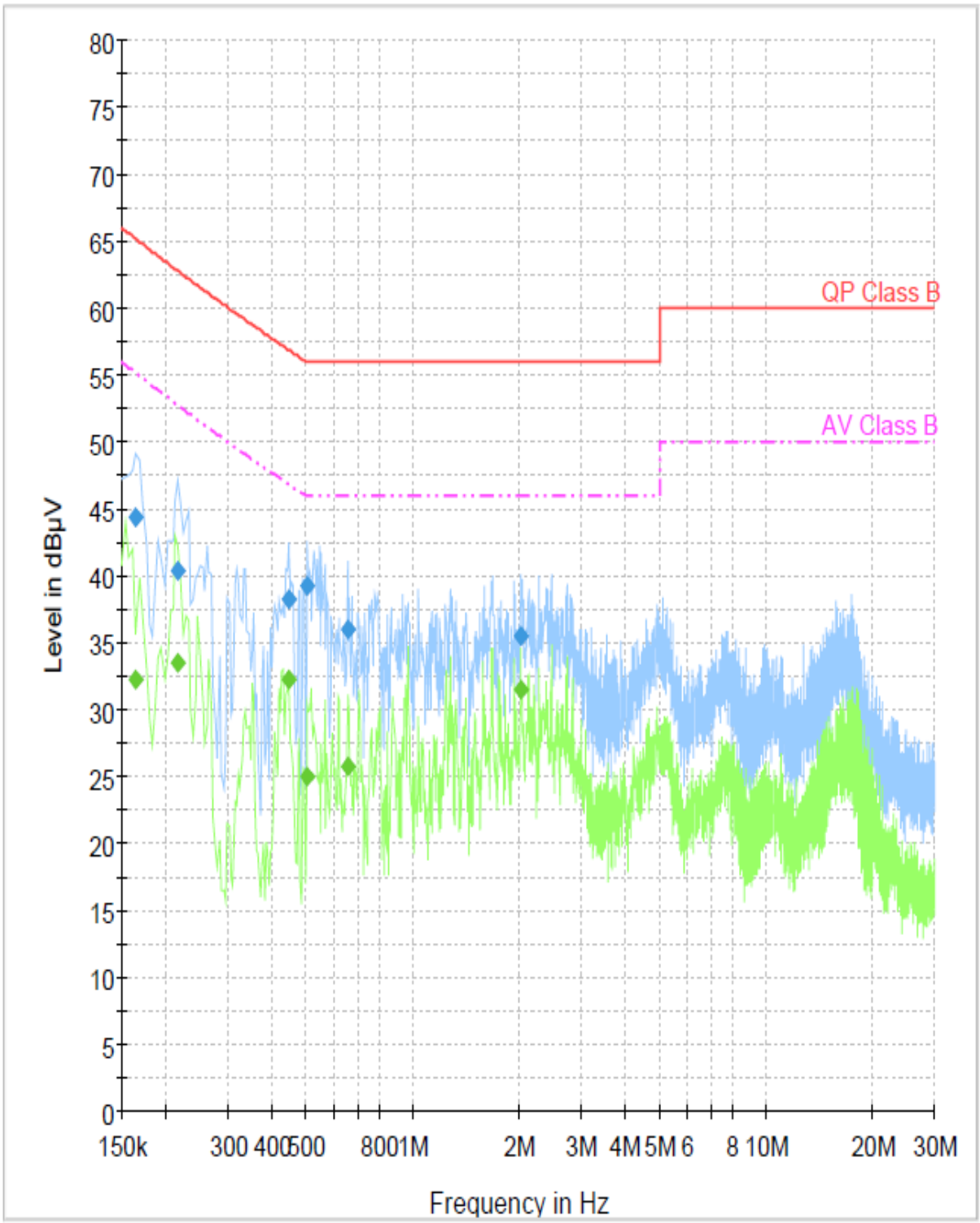
**Line Conducted Emissions Tabulated Data**

***Notes:***

*1. Measurements using CISPR quasi-peak mode & average mode.*
*2. All modes of operation were investigated and the worst -case emission are reported. See attached Plots.*
*3. *) Factor = LISN + Cable Loss*
*4. **) LINE : L = Line , N = Neutral*
*5. The limit is on the FCC §15.207(a) and IC RSS-GEN issue5 8.8.*

# PLOTS OF EMISSIONS

***Conducted Emission at the Mains port (Line + Neutral)***



# TEST DATA

## 8.2 Radiated Emissions

### FCC §15.209, IC RSS-Gen Issue 5 8.9

### Result

| Frequency | Reading | Pol* | Antenna Heights | Turntable | AF+CL+Amp | Result | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV/m) | (H/V) | (cm) | Angles (°) | (dB)** | (dBµV/m) | (dBµV/m) | (dB) |
| 69.02 | 56.25 | H | 400 | 334 | -26.4 | 29.9 | 40.0 | 10.2 |
| 71.98 | 54.07 | H | 300 | 174 | -27.2 | 26.9 | 40.0 | 13.1 |
| 191.72 | 52.14 | H | 200 | 214 | -24.9 | 27.2 | 43.5 | 16.3 |
| 277.08 | 53.19 | H | 100 | 0 | -21.8 | 31.4 | 46.0 | 14.6 |
| 599.98 | 43.67 | V | 100 | 159 | -13.4 | 30.3 | 46.0 | 15.7 |
| 899.98 | 43.49 | V | 100 | 330 | -10.5 | 33.0 | 46.0 | 13.0 |

**Radiated Measurements at 3meters**

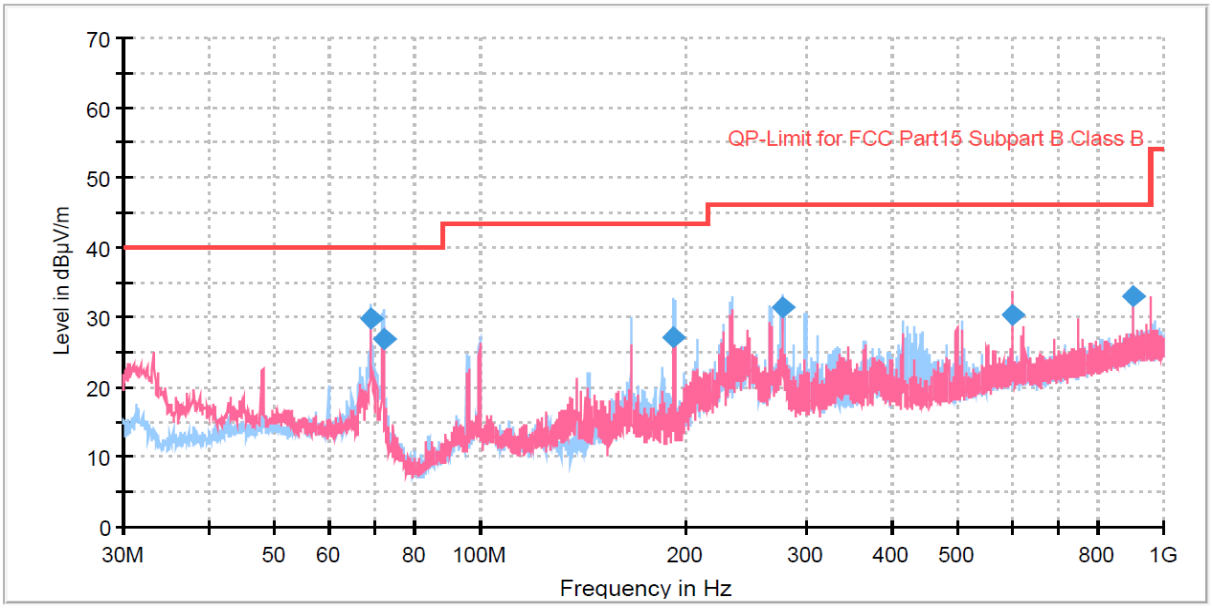
***Notes:***

1. *All modes were measured and the worst-case emission was reported.*
2. **Pol. H = Horizontal, V = Vertical*
3. ***AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*
4. *Measurements using CISPR quasi-peak mode below 1 GHz.*
5. *The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded. (Z-axis below 1GHz)*
6. *Middle channel (2441MHz) in π/4DQPSK modulation is the worst case.*
7. *No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).*
8. *The limit is on the FCC §15.209 and RSS-Gen Issue5 8.9.*

# PLOTS OF EMISSIONS

***Worst Case***

***Radiated emission below 1GHz_2441 MHz_ π/4DQPSK modulation***



## 8.3 20 dB Bandwidth

**FCC §15.247(a)(2), IC RSS-247 Issue 2 5.2**

**Test Mode : Set to Lowest channel, Middle channel and Highest channel,**

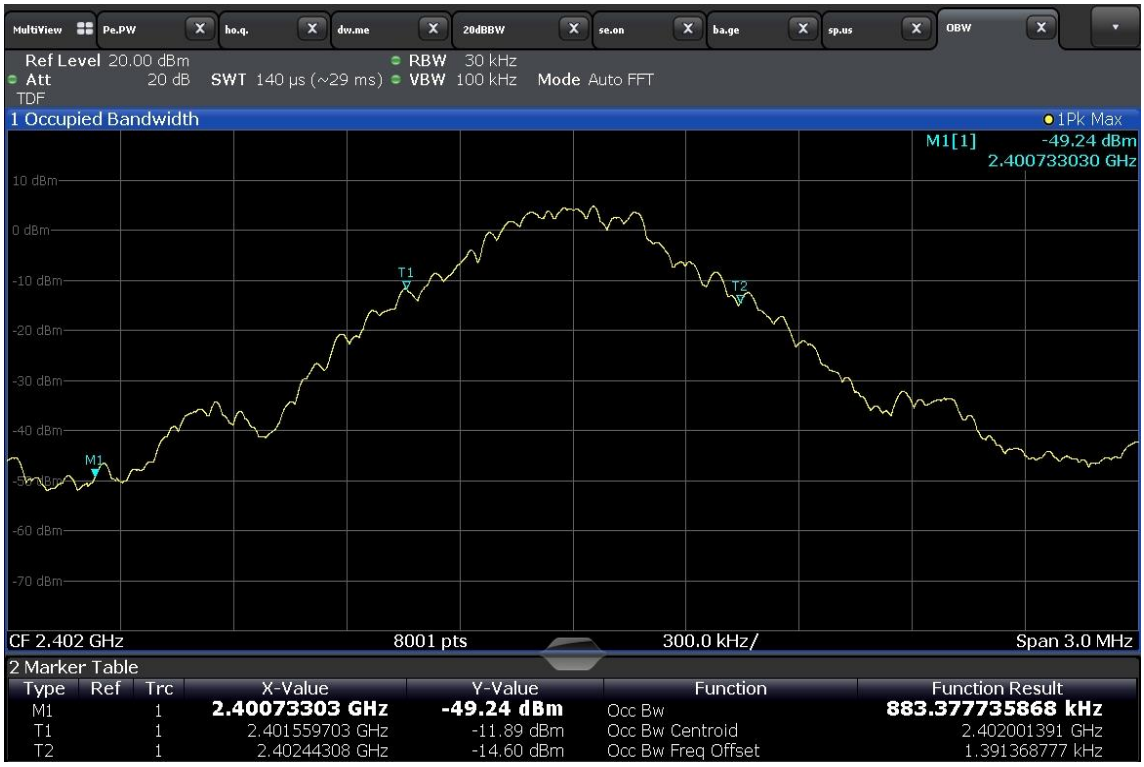
**Result**

| Modulation | Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) | Limit (MHz) | 99% emission bandwidth (MHz) |
|---|---|---|---|---|---|
| GFSK | Lowest | 2402 | 0.96 | Non Specified | 0.88 |
| GFSK | Middle | 2441 | 0.91 | Non Specified | 0.88 |
| GFSK | Highest | 2480 | 0.96 | Non Specified | 0.88 |
| π/4DQPSK | Lowest | 2402 | 1.32 | Non Specified | 1.20 |
| π/4DQPSK | Middle | 2441 | 1.33 | Non Specified | 1.20 |
| π/4DQPSK | Highest | 2480 | 1.33 | Non Specified | 1.20 |
| 8DPSK | Lowest | 2402 | 1.32 | Non Specified | 1.20 |
| 8DPSK | Middle | 2441 | 1.32 | Non Specified | 1.21 |
| 8DPSK | Highest | 2480 | 1.32 | Non Specified | 1.22 |

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, GFSK modulation, Lowest Channel (2402 MHz)

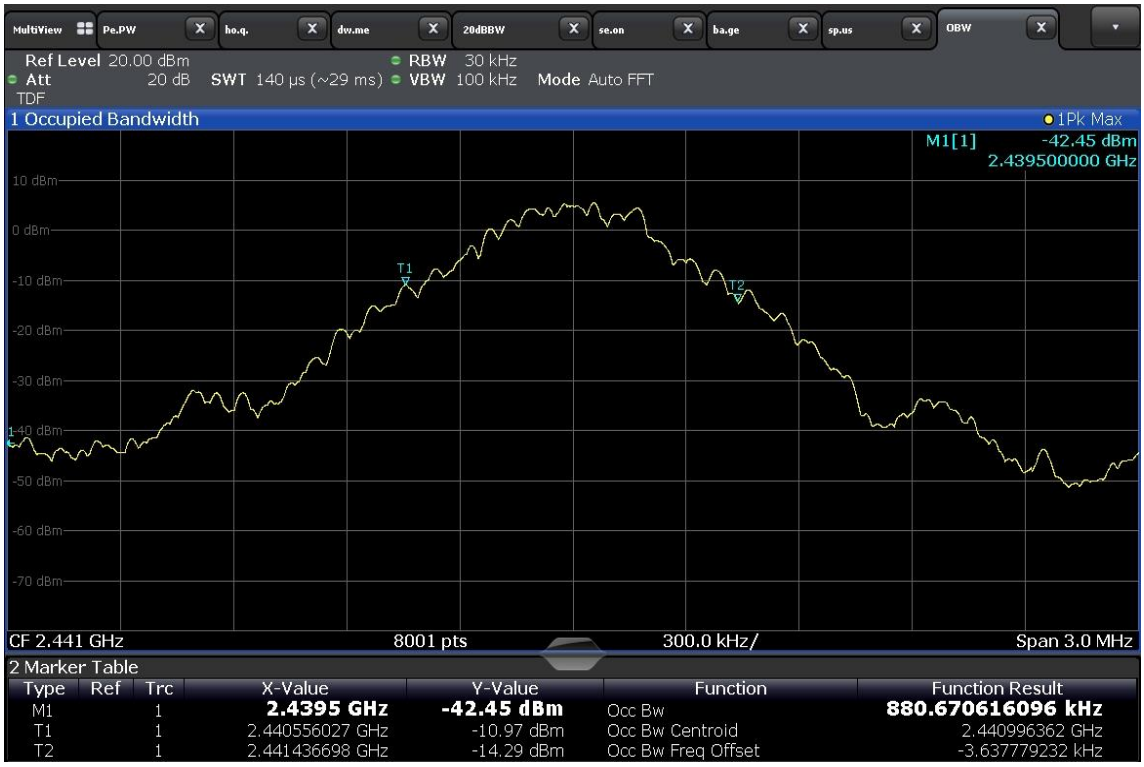

### 99% Bandwidth, GFSK modulation, Lowest Channel (2402 MHz)



# PLOTS OF EMISSIONS

### 20 dB Bandwidth, GFSK modulation, Middle Channel (2441 MHz)

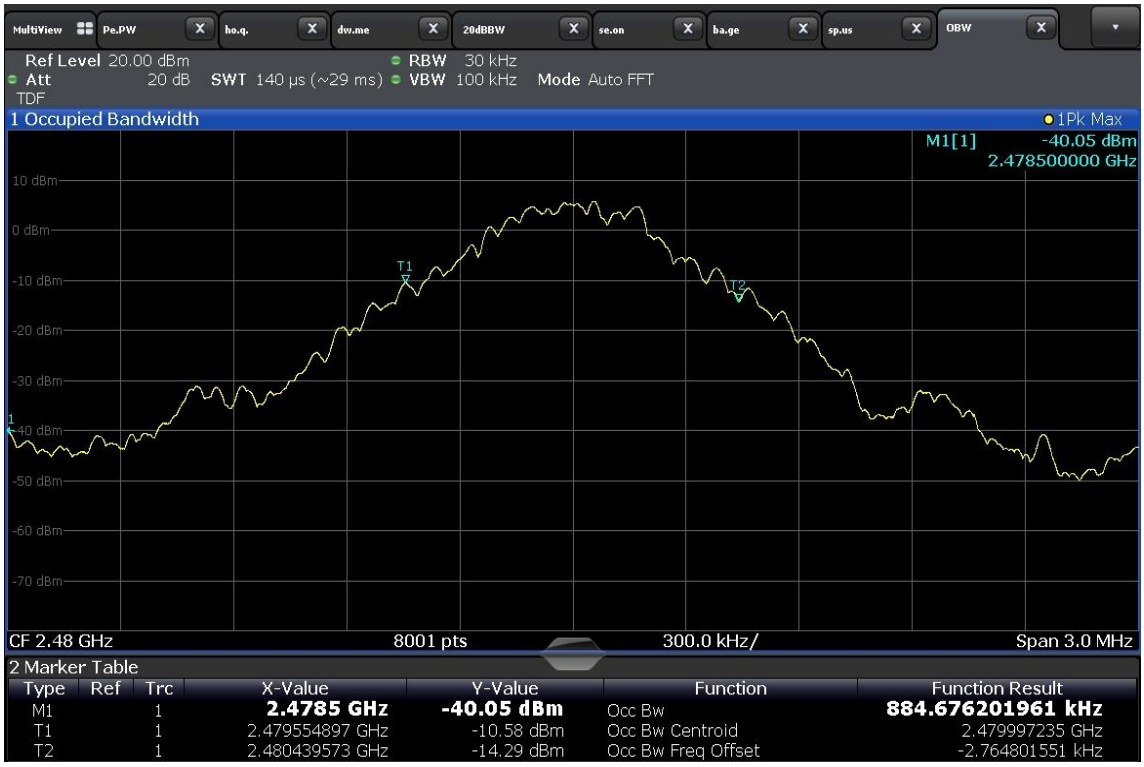

### 99% Bandwidth, GFSK modulation, Middle Channel (2441 MHz)



# PLOTS OF EMISSIONS

### 20 dB Bandwidth, GFSK modulation, Highest Channel (2480 MHz)


### 99% Bandwidth, GFSK modulation, Highest Channel (2480 MHz)



# PLOTS OF EMISSIONS

### 20 dB Bandwidth, π/4DQPSK modulation, Lowest Channel (2402 MHz)


### 99% Bandwidth, π/4DQPSK modulation, Lowest Channel (2402 MHz)

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, π/4DQPSK modulation, Middle Channel (2441 MHz)


### 99% Bandwidth, π/4DQPSK modulation, Middle Channel (2441 MHz)

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, π/4DQPSK modulation, Highest Channel (2480 MHz)


### 99% Bandwidth, π/4DQPSK modulation, Highest Channel (2480 MHz)

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, 8DPSK modulation, Lowest Channel (2402 MHz)


### 99% Bandwidth, 8DPSK modulation, Lowest Channel (2402 MHz)

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, 8DPSK modulation, Middle Channel (2441 MHz)


### 99% Bandwidth, 8DPSK modulation, Middle Channel (2441 MHz)

# PLOTS OF EMISSIONS

### 20 dB Bandwidth, 8DPSK modulation, Highest Channel (2480 MHz)


### 99% Bandwidth, 8DPSK modulation, Highest Channel (2480 MHz)

## 8.4 Carrier Frequency Separation

**FCC §15.247(a)(1), IC RSS-247 Issue 2 5.1**

**Test Mode : Set to Hopping mode**

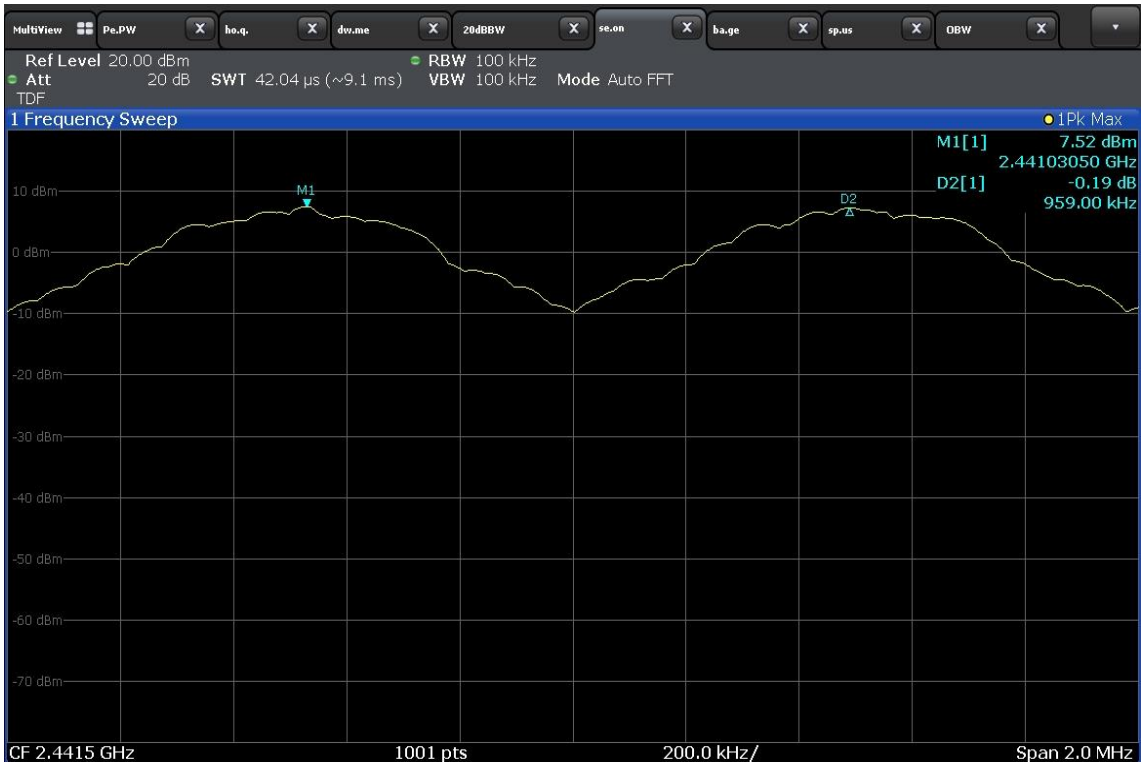
**Result**

| Modulation | Carrier Frequency Separation (kHz) | Limit (2/3 of 20dB Bandwidth) (kHz) |
|---|---|---|
| GFSK | 0.96 | 0.61 |
| π/4DQPSK | 1.02 | 0.88 |
| 8DPSK | 1.08 | 0.88 |

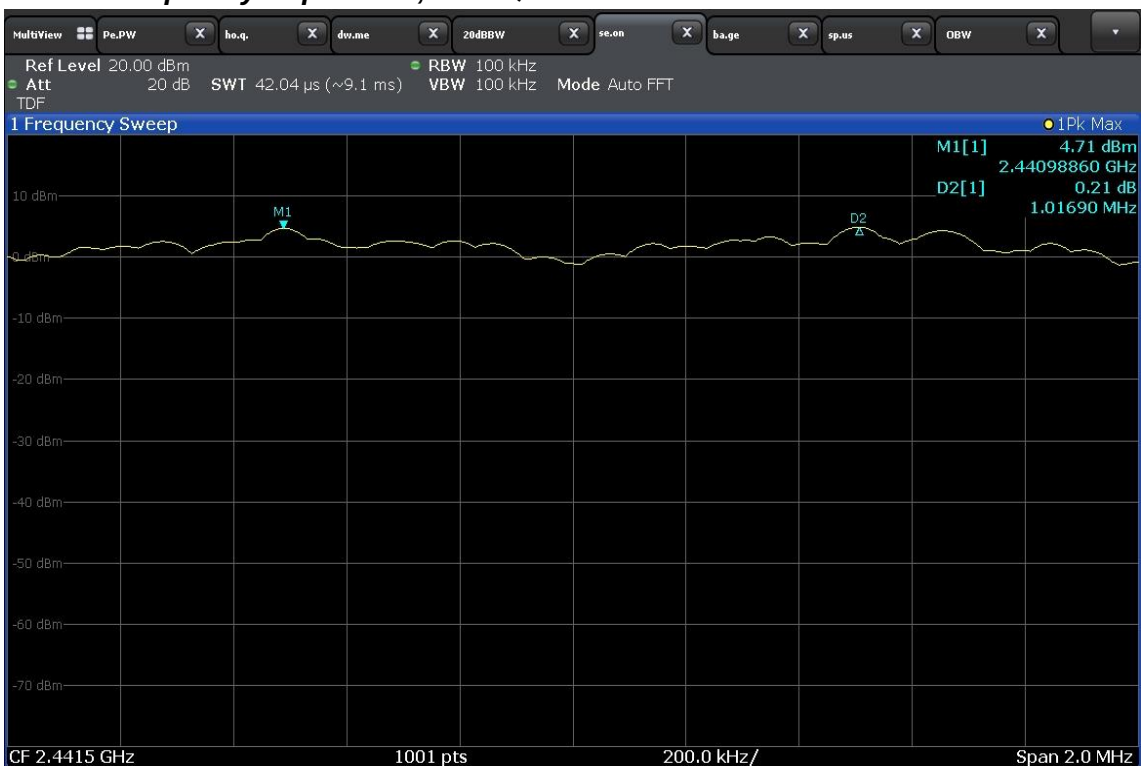
***Note:***
*The EUT complies with the minimum channel separation requirement when it is operating **1x/EDR mode using 79 channels** and when operating in **AFH mode using 20 channels**.*

# PLOTS OF EMISSIONS

### Carrier Frequency Separation, GFSK modulation

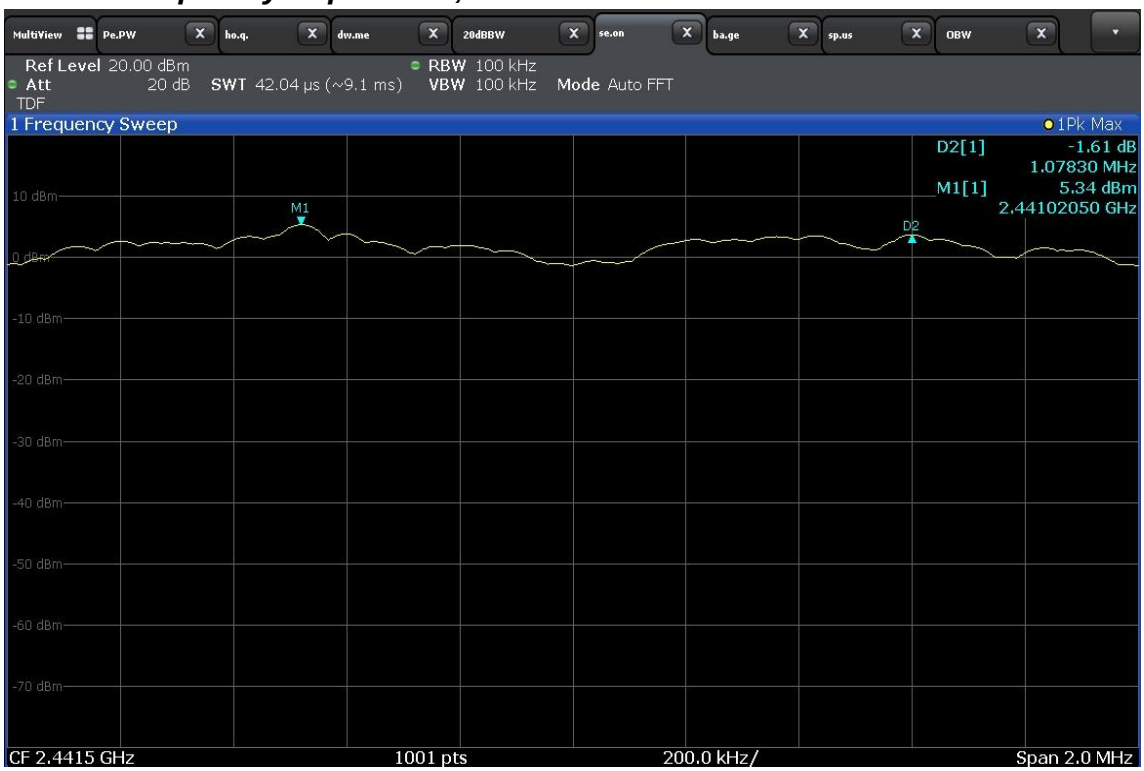



### Carrier Frequency Separation, π/4DQPSK modulation



# PLOTS OF EMISSIONS

### Carrier Frequency Separation, 8DPSK modulation



## 8.5 Transmitter Average Time of Occupancy

**FCC §15.247(a)(1), IC RSS-247 Issue 2 5.1**

**Test mode : Set to Hopping mode**

**Result**

| Mode | Pulse width (ms) | *) Numbers of slots | **) Average time of Occupancy (ms) | Limit (ms) | Margin (ms) |
|---|---|---|---|---|---|
| 1x/EDR | 2.88 | 106.67 | 307.52 | 400 | 92.48 |
| AFH | 2.88 | 53.33 | 153.60 | 400 | 246.40 |

**1x/EDR mode**

1) This result was measured at DH5 mode in **1x/EDR mode**, which has longest time in one transmission burst.
2) Bluetooth 1x/EDR mode has a channel hopping rate of 1600 hops/s and 79 hopping channels.
3) The average time of occupancy in the specified 31.6 second period (79 channels x 0.4 s) is equal to pulse width x (hopping rate / 6) / 79 x (0.4 x hopping channels).
4) *) Numbers of slots in 31.6 sec = (1600 / 6) / 79 x 31.6
5) **) Average time of Occupancy = 2.88 ms x 106.67 = 307.52 ms

**AFH mode**

1) This result was measured at DH5 mode in **AFH mode**, which has longest time in one transmission burst.
2) Bluetooth AFH mode has a channel hopping rate of 800 hops/s and 20 hopping channels.
3) The average time of occupancy in the specified 8 second period (20 channels x 0.4 s) is equal to pulse width x (hopping rate / 6) / 20 x (0.4 x hopping channels).
4) *) Numbers of slots in 20 sec = (800 / 6) / 20 x 8
5) **) Average time of Occupancy = 2.88 ms x 53.33 = 153.60 ms

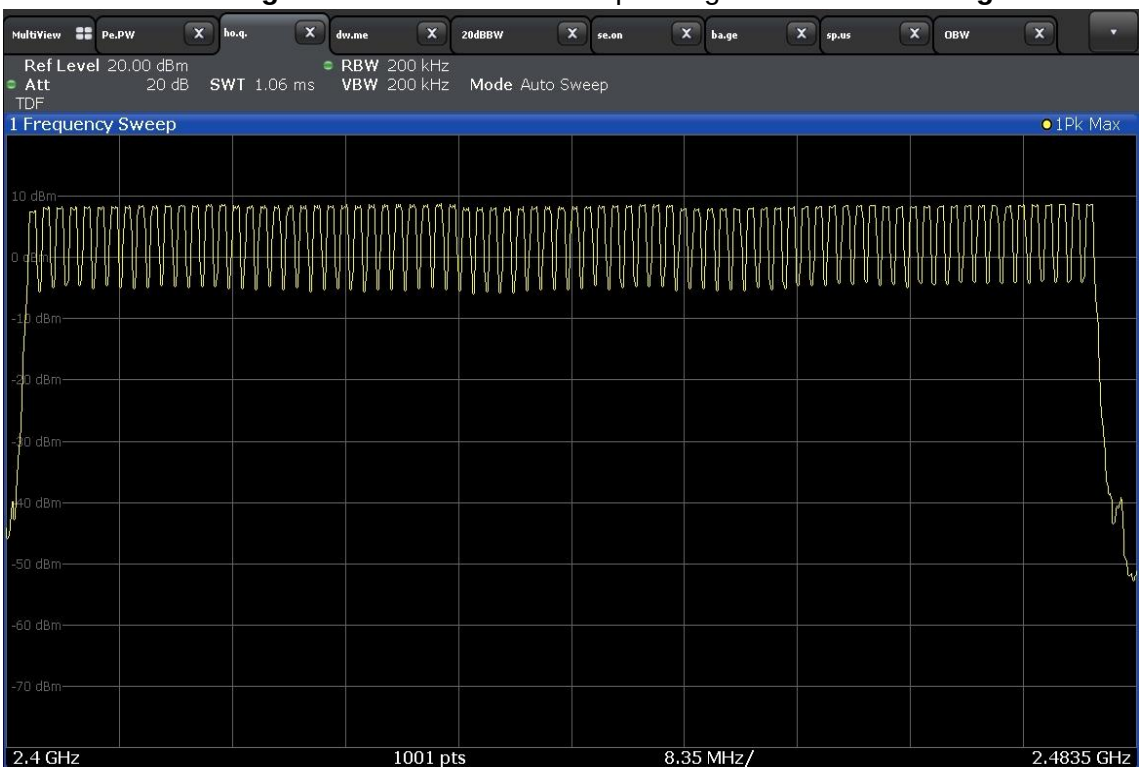
## 8.6 Number of Hopping Channels

### FCC §15.247(a)(1)(iii), IC RSS-247 Issue 2 5.1

### Test mode : Set to Hopping mode

### Result

The EUT complies with the minimum number of hopping channels when it is operating **1x/EDR mode using 79 channels** and when operating in **AFH mode using 20 channels**.



## 8.7 Peak Output Power and E.I.R.P.

**FCC §15.247(b)(3), IC RSS-247 Issue 2 5.4**

**Test Mode : Set to Lowest channel, Middle channel and Highest channel,**

**Result**

| Modulation | Channel | Frequency (MHz) | Peak Output Power (dBm) | Limit (dBm) | E.I.R.P (dBm) | E.I.R.P Limit (dBm) |
|---|---|---|---|---|---|---|
| GFSK | Lowest | 2402 | 7.90 | 30.00 | 10.00 | 36.00 |
| GFSK | Middle | 2441 | 8.50 | 30.00 | 10.60 | 36.00 |
| GFSK | Highest | 2480 | 8.78 | 30.00 | 10.88 | 36.00 |
| π/4DQPSK | Lowest | 2402 | 6.74 | 30.00 | 8.84 | 36.00 |
| π/4DQPSK | Middle | 2441 | 7.62 | 30.00 | 9.72 | 36.00 |
| π/4DQPSK | Highest | 2480 | 7.91 | 30.00 | 10.01 | 36.00 |
| 8DPSK | Lowest | 2402 | 7.05 | 30.00 | 9.15 | 36.00 |
| 8DPSK | Middle | 2441 | 7.89 | 30.00 | 9.99 | 36.00 |
| 8DPSK | Highest | 2480 | 8.19 | 30.00 | 10.29 | 36.00 |

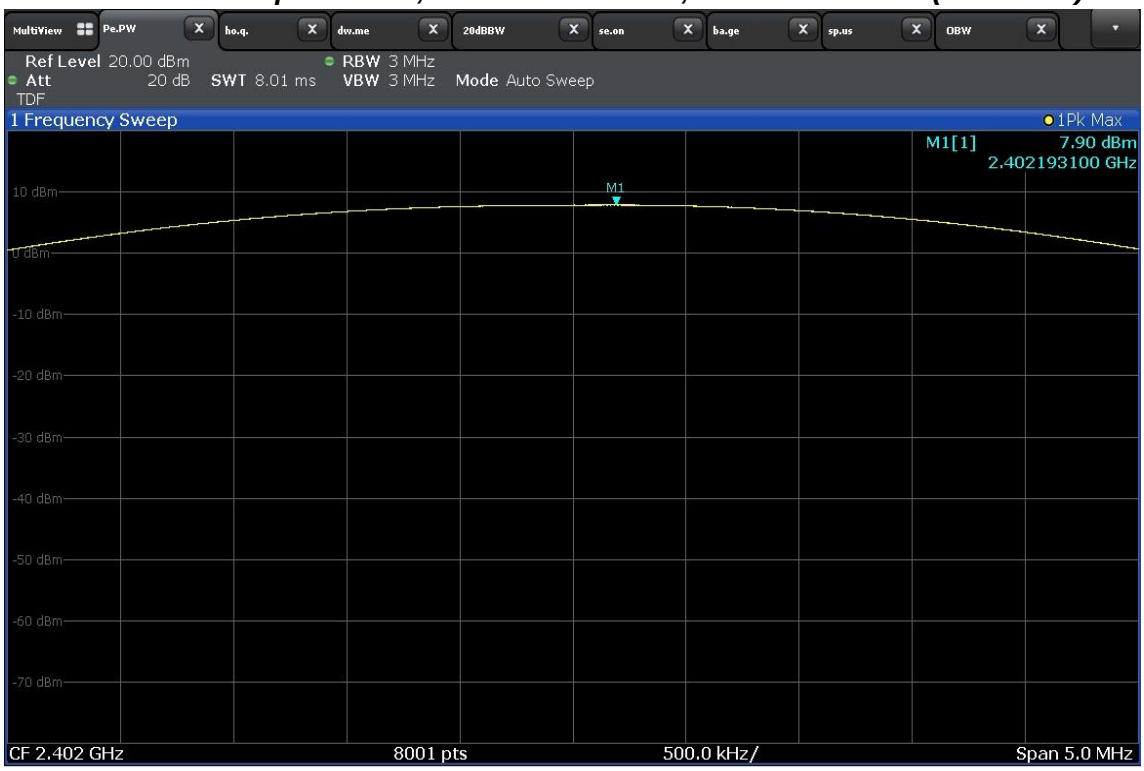
# TEST DATA

***Note:***

1. *E.I.R.P was calculated by following equation according to KDB412172 D01 Determining ERP and EIRP v01r01.*
   *E.I.R.P = $P_T$ + $G_T$ – Lc*
   *$P_T$ = Peak outputpower (dBm)*
   *$G_T$ = Gain of the transmitting antenna in dBi, Directional antenna gain is **2.10 dBi.***
   *$L_C$ = Signal attenuation in the connecting cable between the transmitter and antenna in dB. This factor of an integral antenna is negligible.*
2. *The following equation was used for spectrum offset:*
   *Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)*

# PLOTS OF EMISSIONS

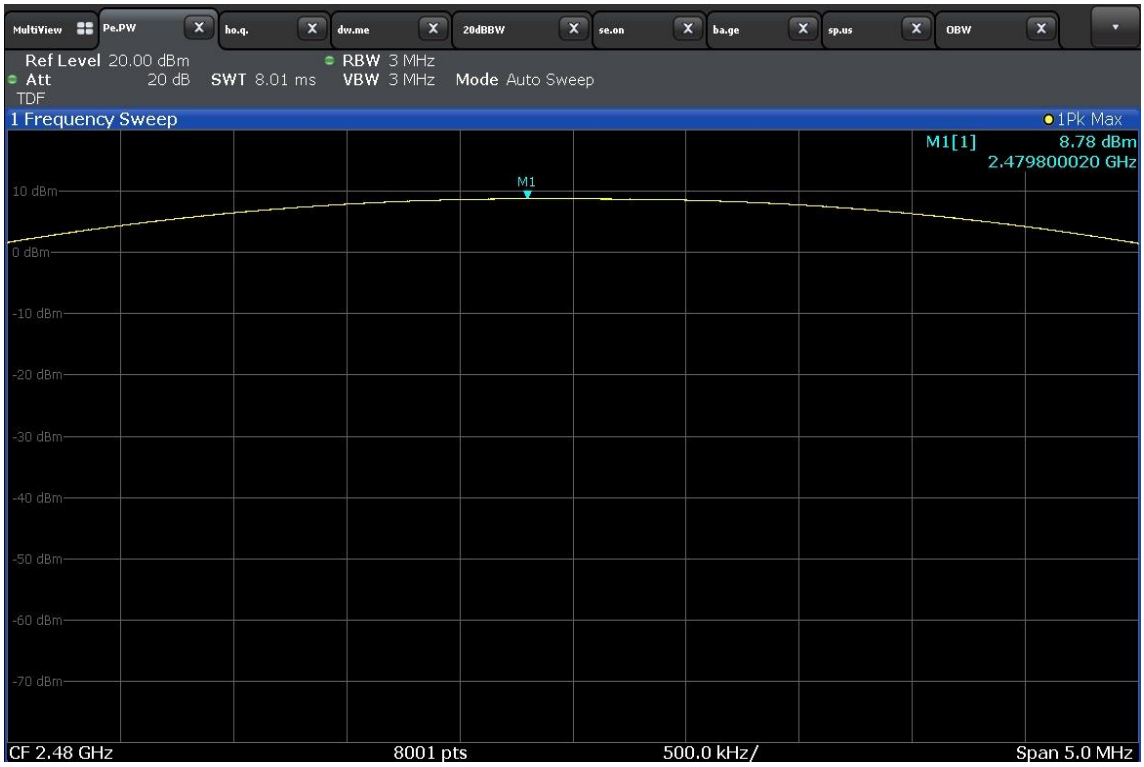
***Maximum Peak Output Power, GFSK modulation, Lowest Channel (2402 MHz)***



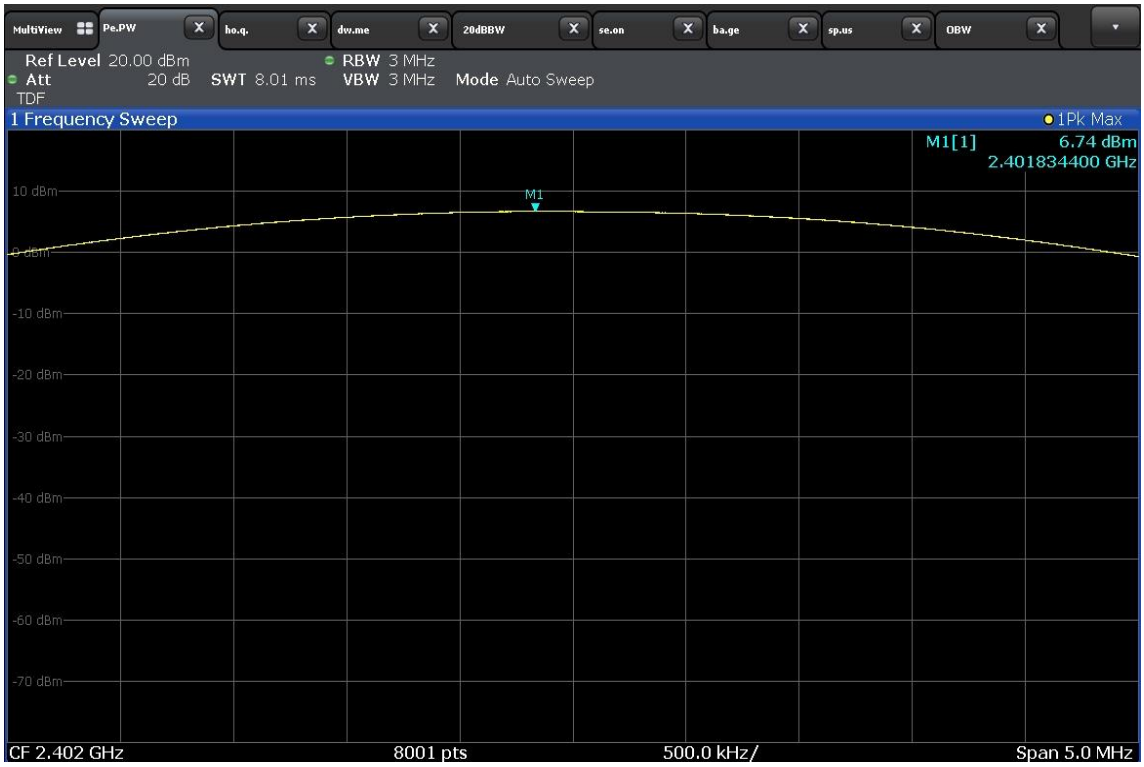

***Maximum Peak Output Power, GFSK modulation, Middle Channel (2441 MHz)***

# PLOTS OF EMISSIONS

***Maximum Peak Output Power, GFSK modulation, Highest Channel (2480 MHz)***

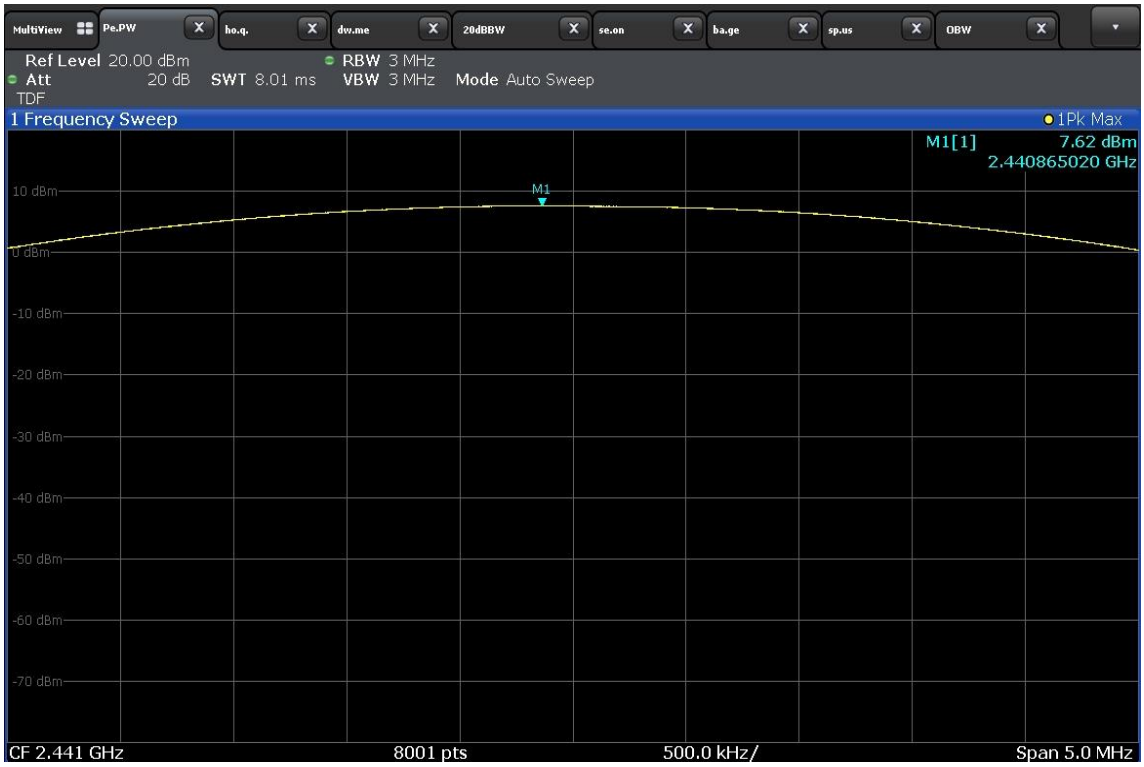



***Maximum Peak Output Power, π/4DQPSK modulation, Lowest Channel (2402 MHz)***

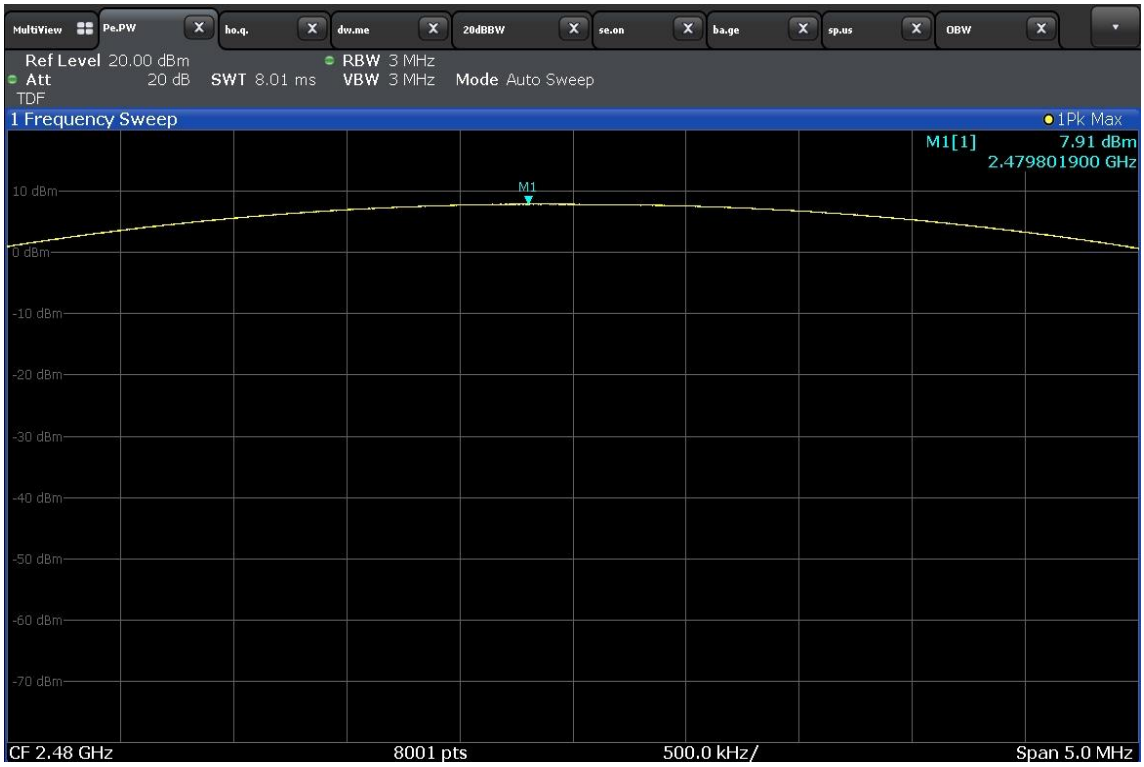


# PLOTS OF EMISSIONS

***Maximum Peak Output Power, π/4DQPSK modulation, Middle Channel (2441 MHz)***

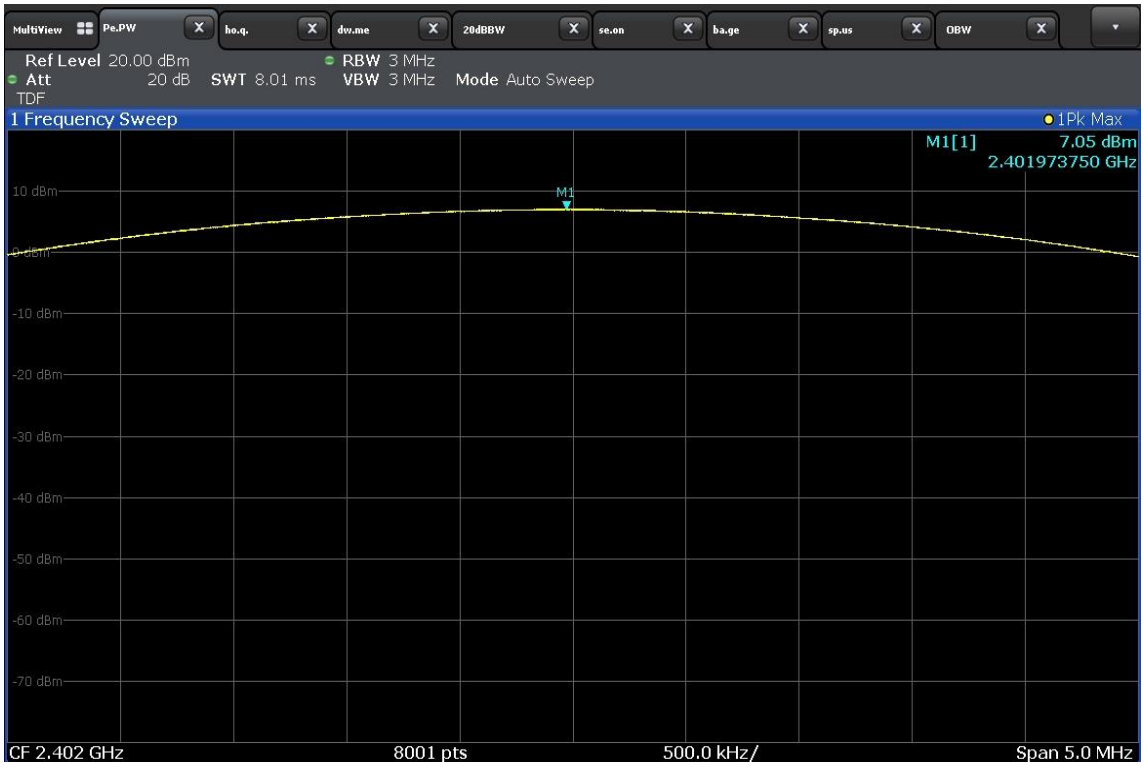



***Maximum Peak Output Power, π/4DQPSK modulation, Highest Channel (2480 MHz)***

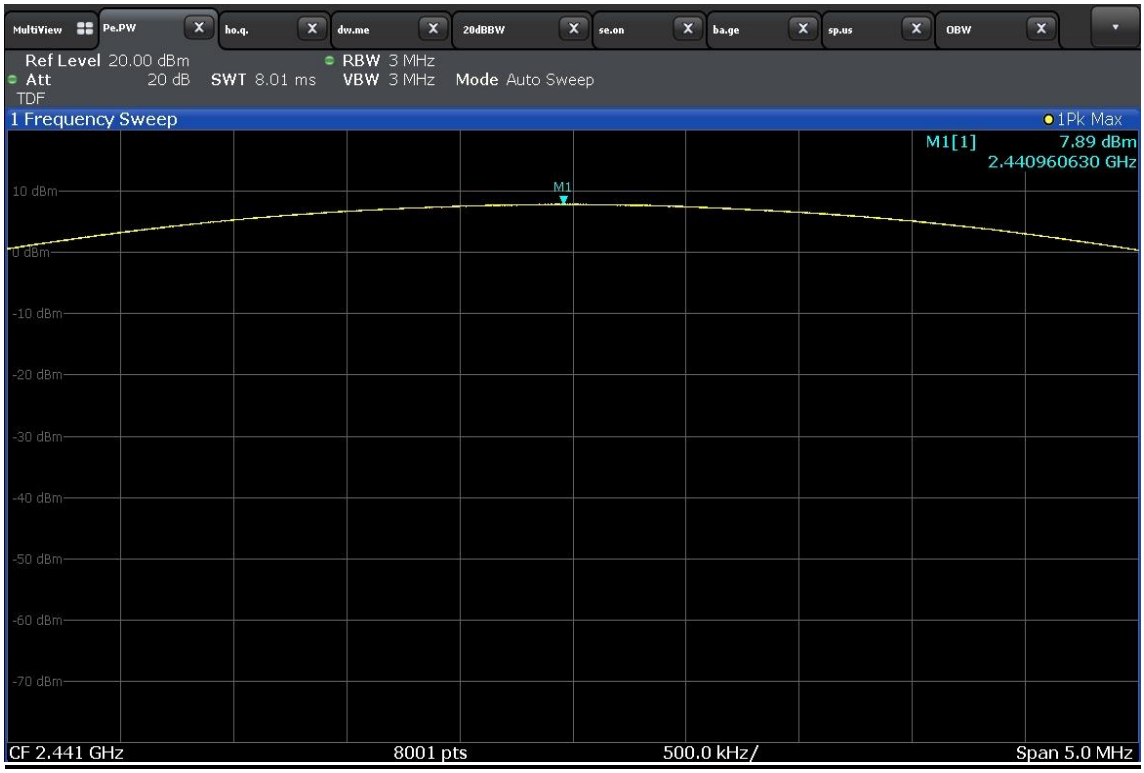


# PLOTS OF EMISSIONS

***Maximum Peak Output Power, 8DPSK modulation, Lowest Channel (2402 MHz)***

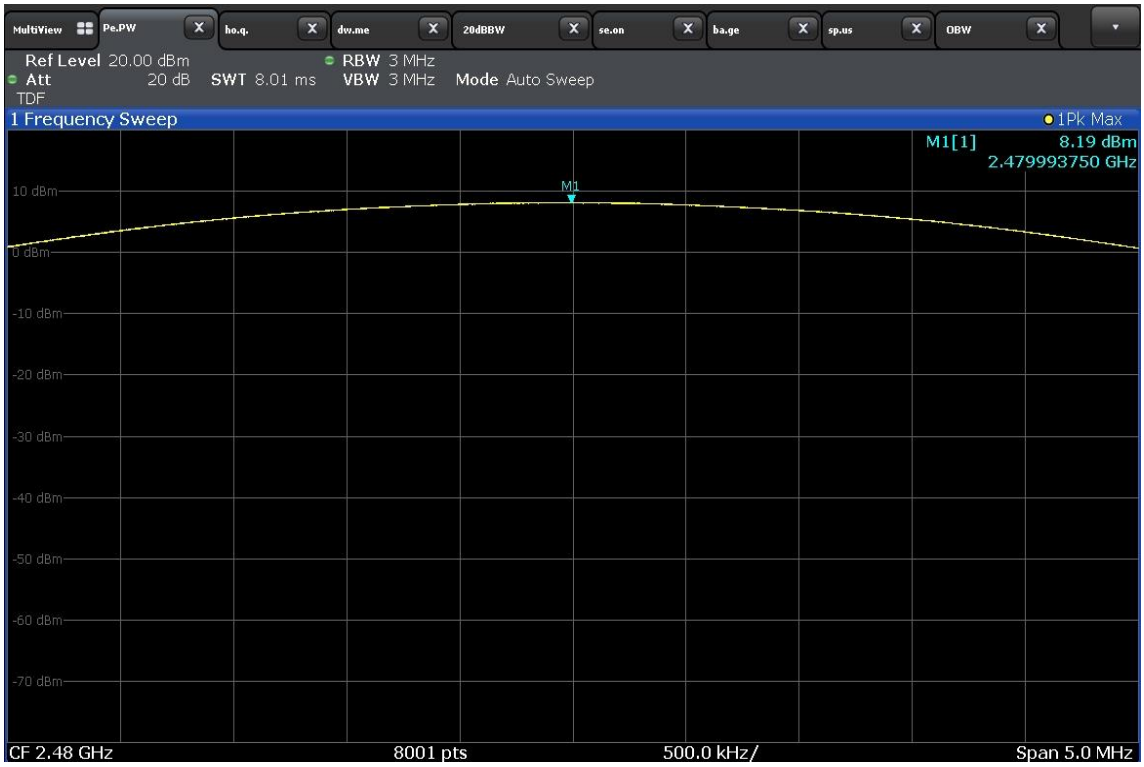



***Maximum Peak Output Power, 8DPSK modulation, Middle Channel (2441 MHz)***



# PLOTS OF EMISSIONS

***Maximum Peak Output Power, 8DPSK modulation, Highest Channel (2480 MHz)***



## 8.8 Conducted Spurious Emissions

**FCC §15.247(d), IC RSS-247 Issue 2 5.5**

**Test Mode : Set to Lowest channel, Middle channel and Highest channel,**

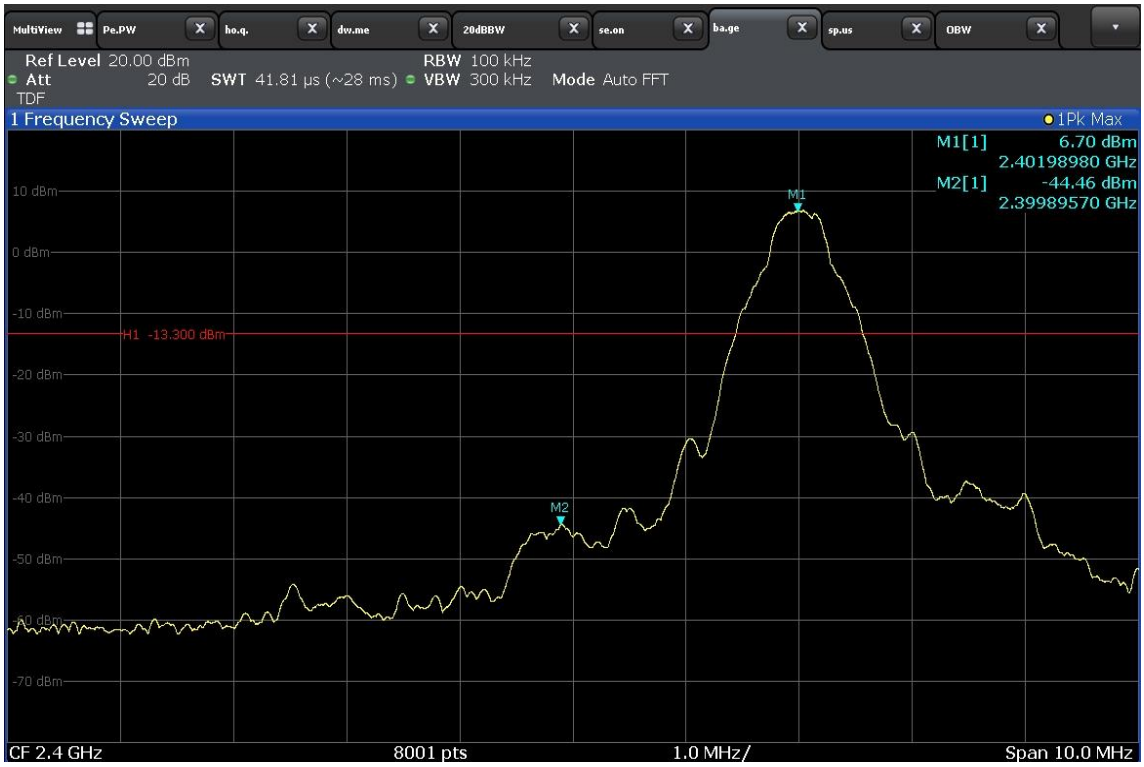
**Result**

| Modulation | Channel | Frequency (MHz) | Conducted Spurious Emissions (dBc) | Limit (dBc) |
|---|---|---|---|---|
| GFSK | Lowest | 2402 | More than 20 dBc | 20 |
| GFSK | Middle | 2441 | More than 20 dBc | 20 |
| GFSK | Highest | 2480 | More than 20 dBc | 20 |
| π/4DQPSK | Lowest | 2402 | More than 20 dBc | 20 |
| π/4DQPSK | Middle | 2441 | More than 20 dBc | 20 |
| π/4DQPSK | Highest | 2480 | More than 20 dBc | 20 |
| 8DPSK | Lowest | 2402 | More than 20 dBc | 20 |
| 8DPSK | Middle | 2441 | More than 20 dBc | 20 |
| 8DPSK | Highest | 2480 | More than 20 dBc | 20 |

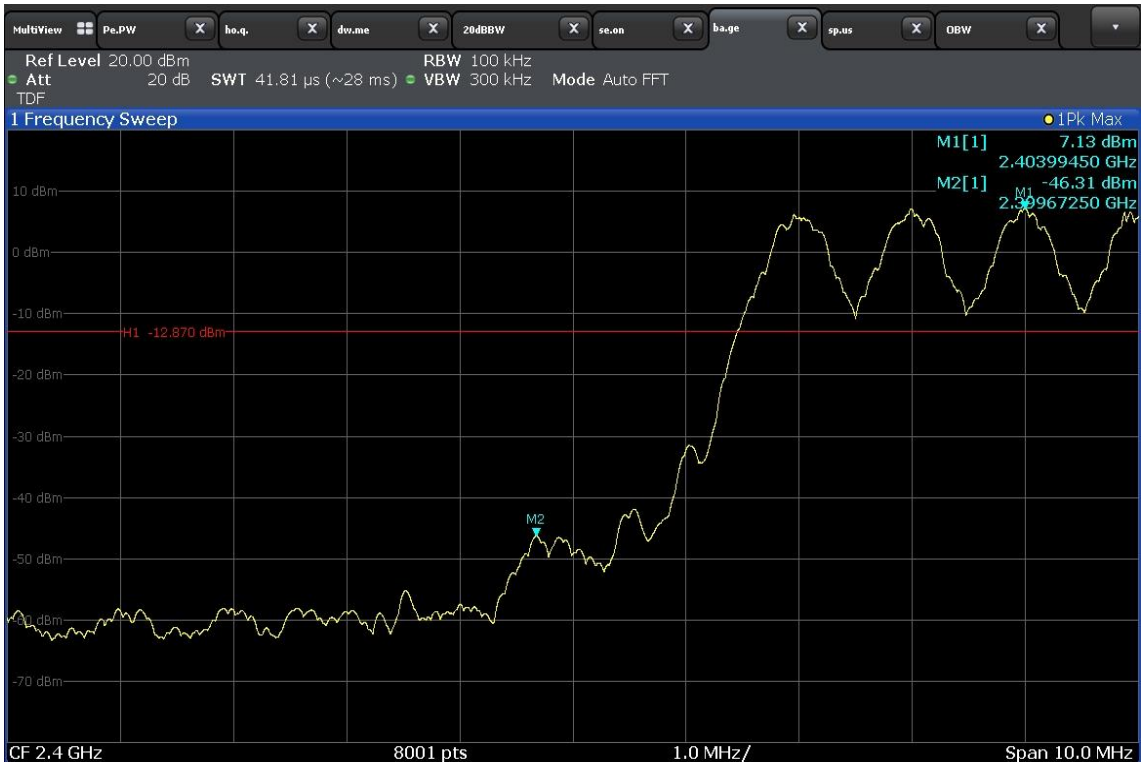
***Notes:***
*The cable and attenuator loss from 30 MHz to 26.5 GHz was reflected in spectrum analyzer with correction factor for the spurious emissions test.*

# PLOTS OF EMISSIONS

***Band Edge, Single channel mode, GFSK modulation, Lowest Channel (2402 MHz)***

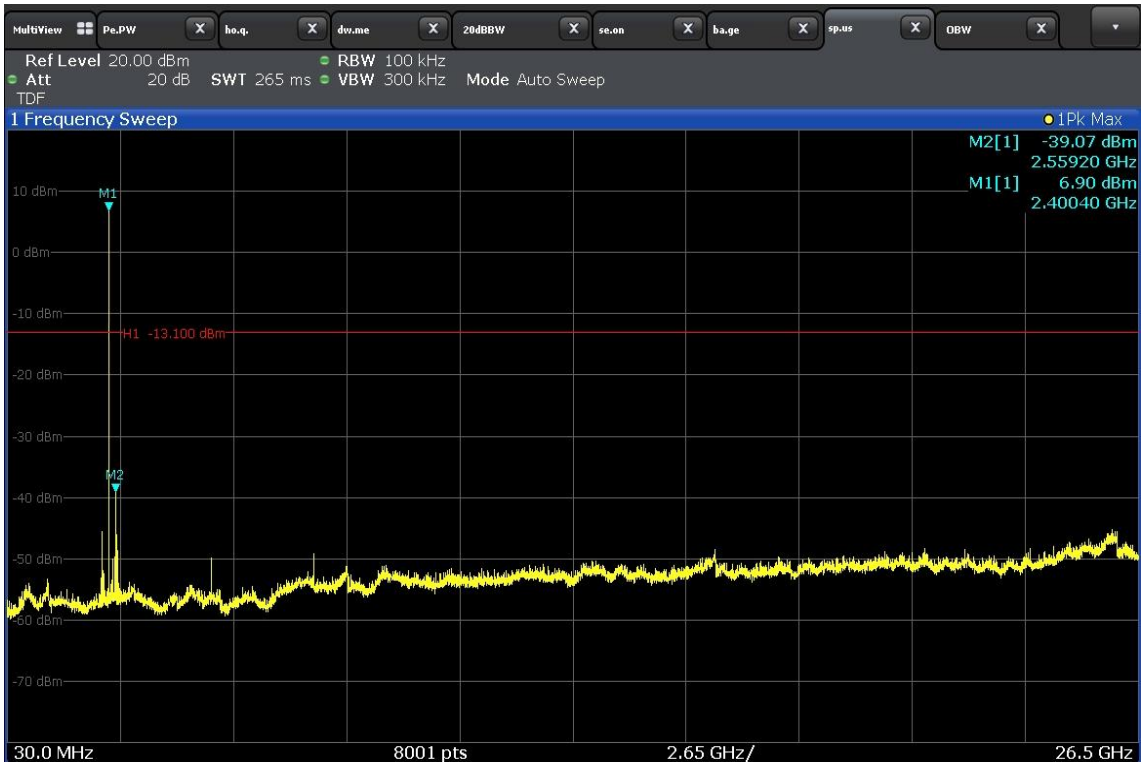



***Band Edge, Hopping mode, GFSK modulation, Lowest Channel (2402 MHz)***

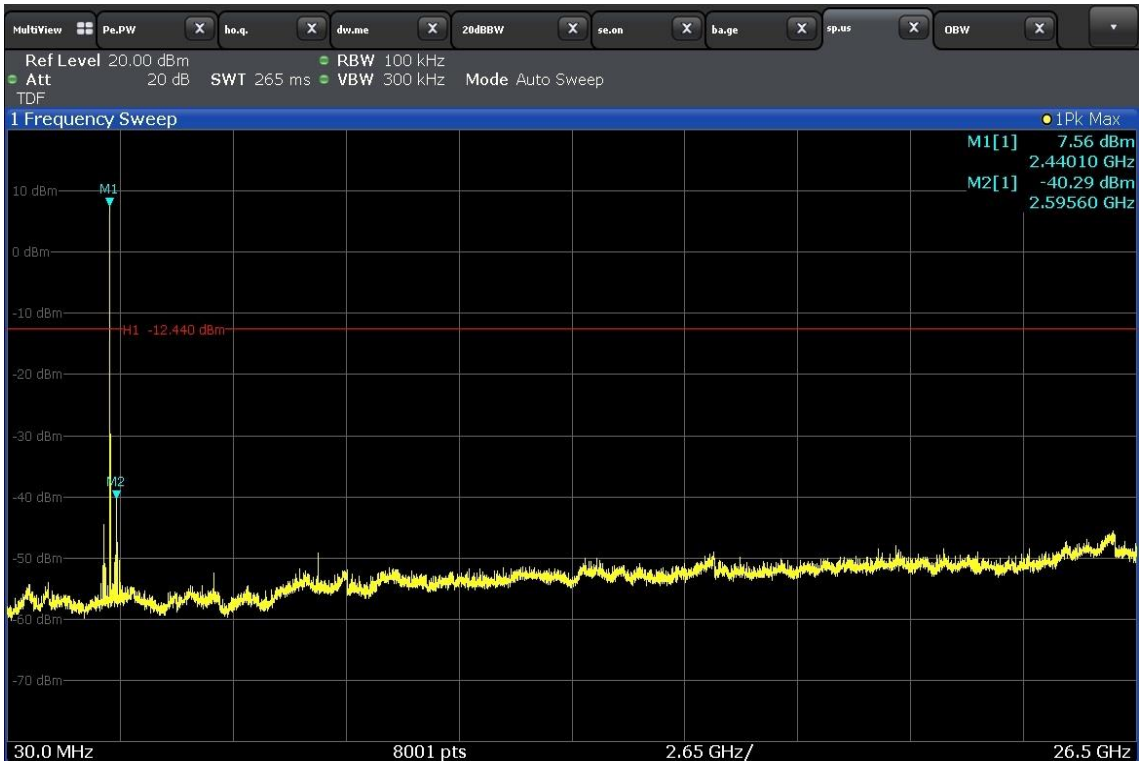


# PLOTS OF EMISSIONS

***Conducted Spurious Emissions, GFSK modulation, Lowest channel (2402MHz)***

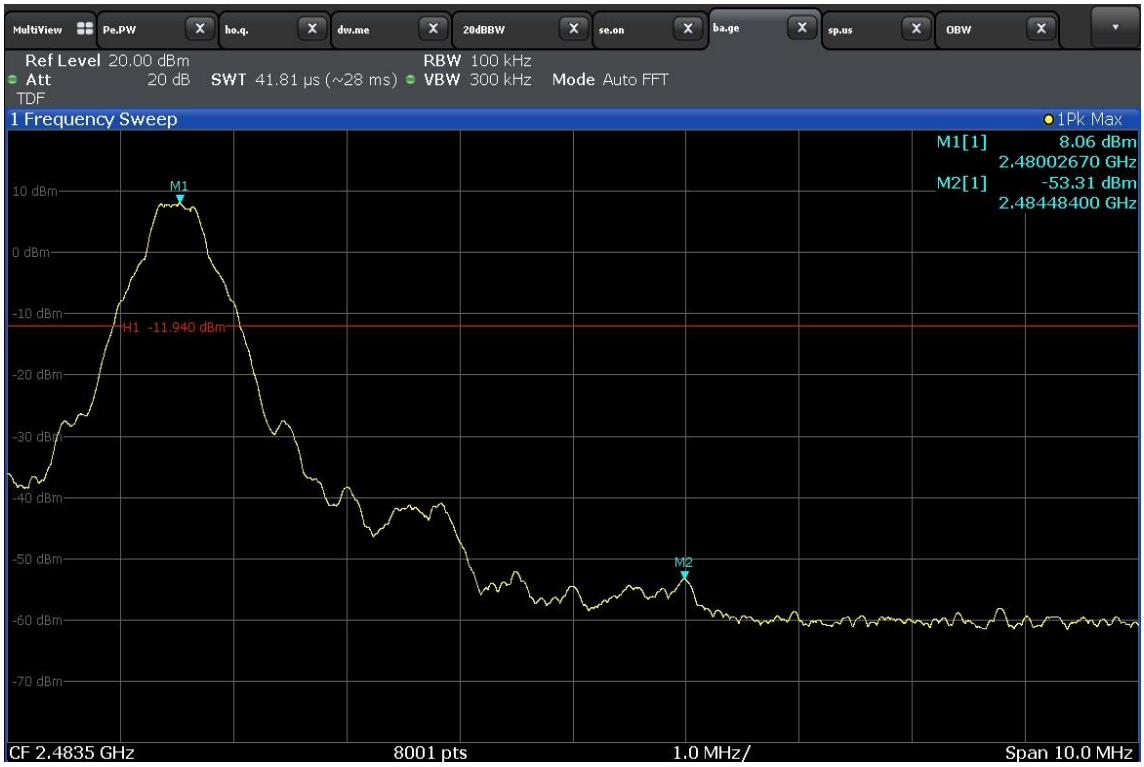



***Conducted Spurious Emissions, GFSK modulation, Middle channel (2441MHz)***

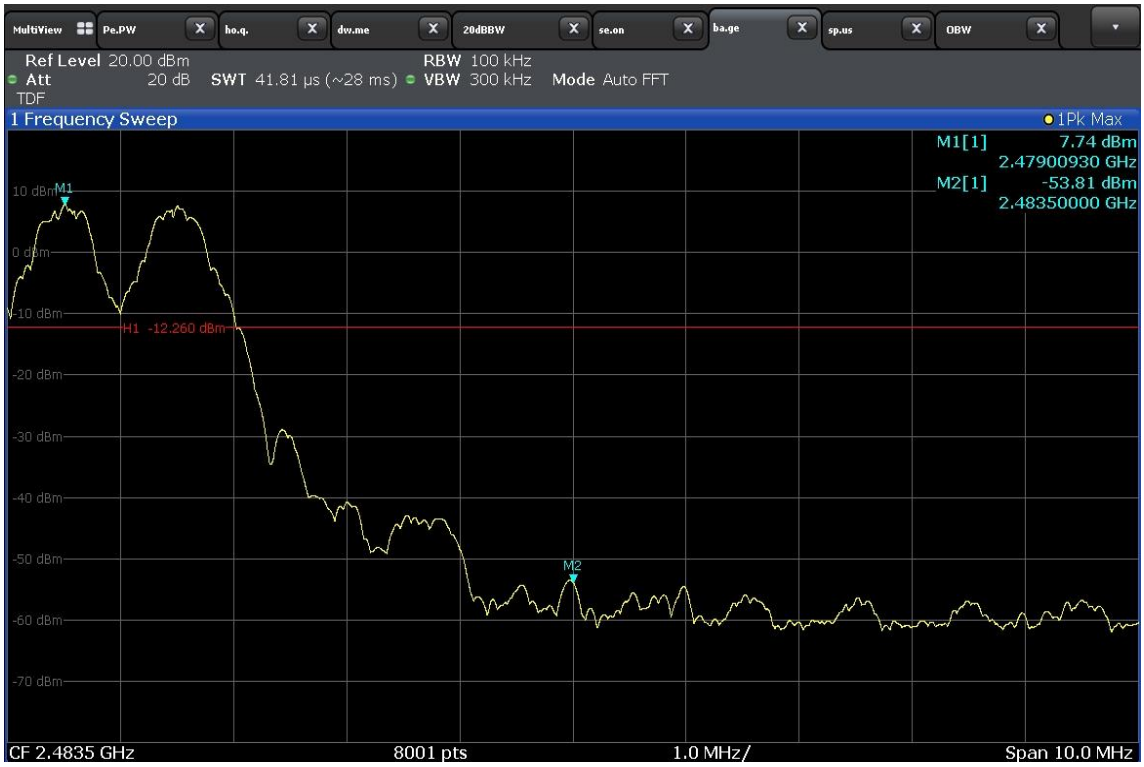


# PLOTS OF EMISSIONS

***Band Edge, Single channel mode, GFSK modulation, Highest Channel (2480 MHz)***

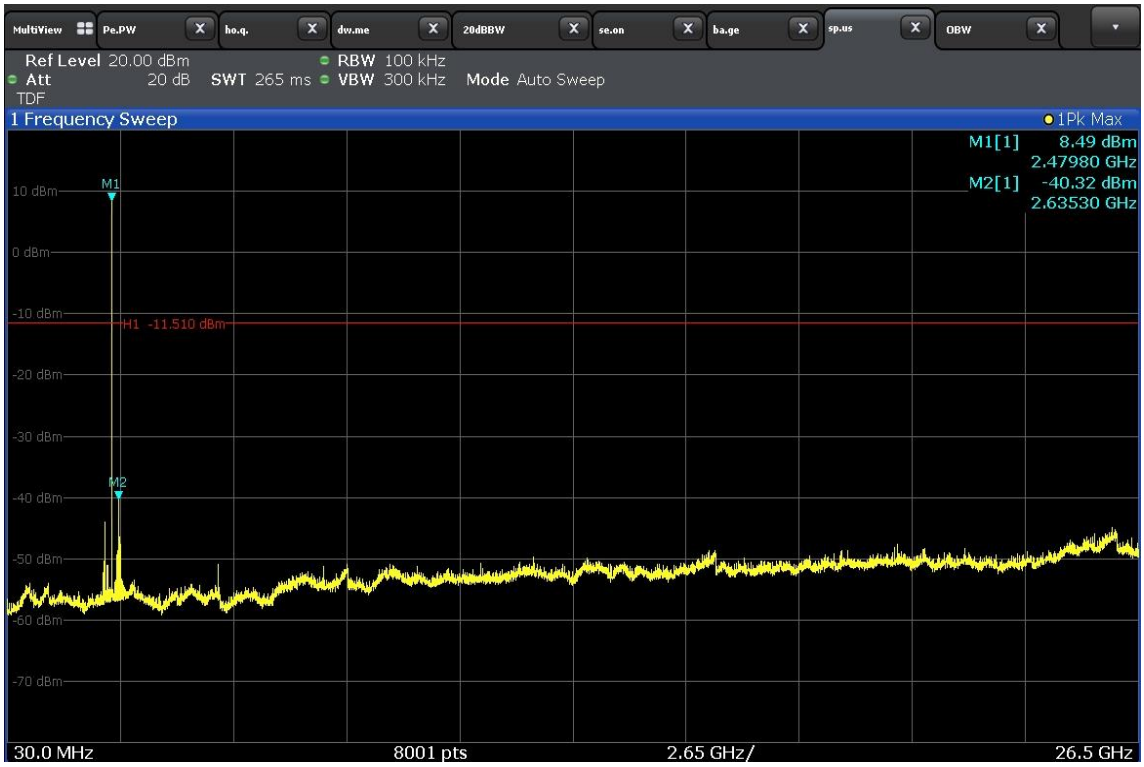



***Band Edge, Hopping mode, GFSK modulation, Highest Channel (2480 MHz)***

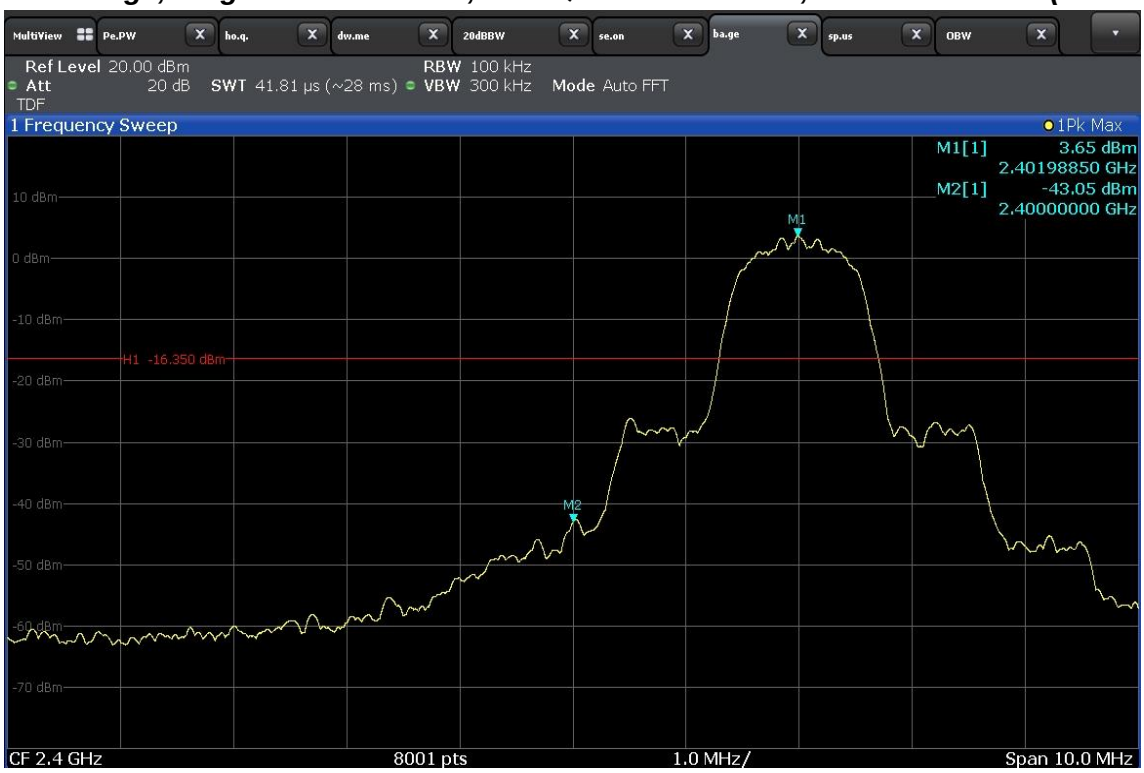


# PLOTS OF EMISSIONS

***Conducted Spurious Emissions, GFSK modulation, Highest channel (2480MHz)***

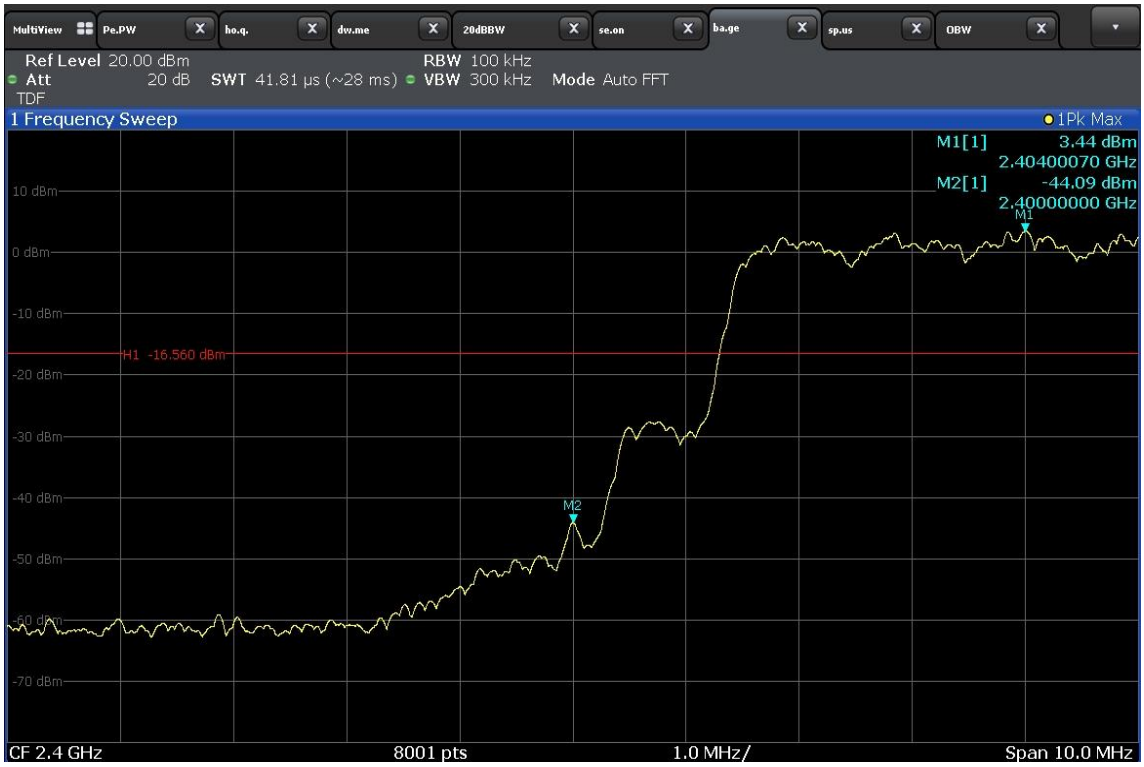



***Band Edge, Single channel mode, π/4DQPSK modulation, Lowest Channel (2402 MHz)***

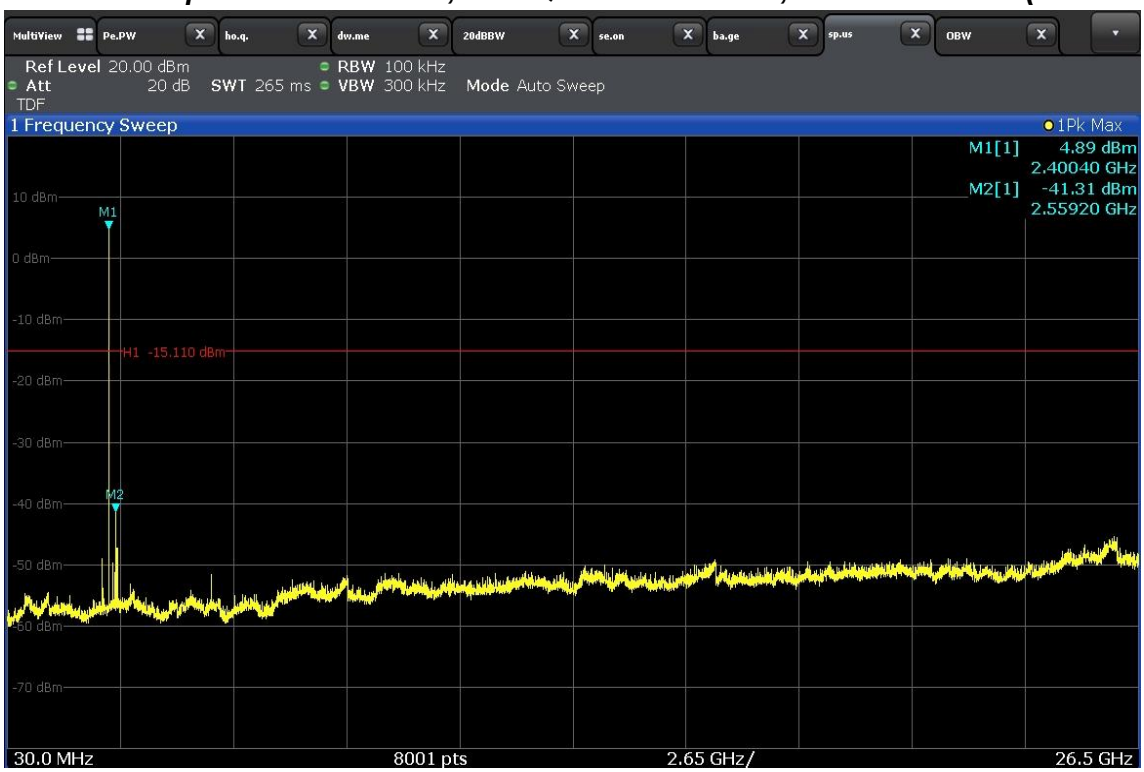


# PLOTS OF EMISSIONS

***Band Edge, Hopping mode, π/4DQPSK modulation, Lowest Channel (2402 MHz)***

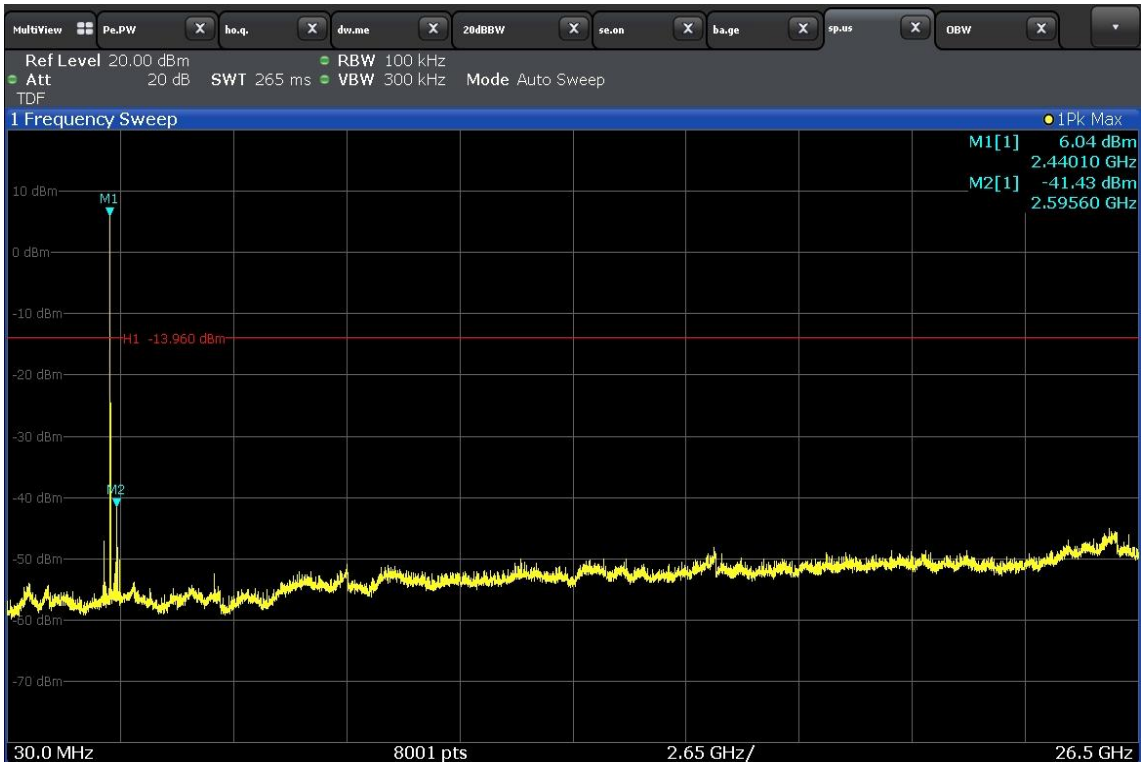



***Conducted Spurious Emissions, π/4DQPSK modulation, Lowest channel (2402MHz)***

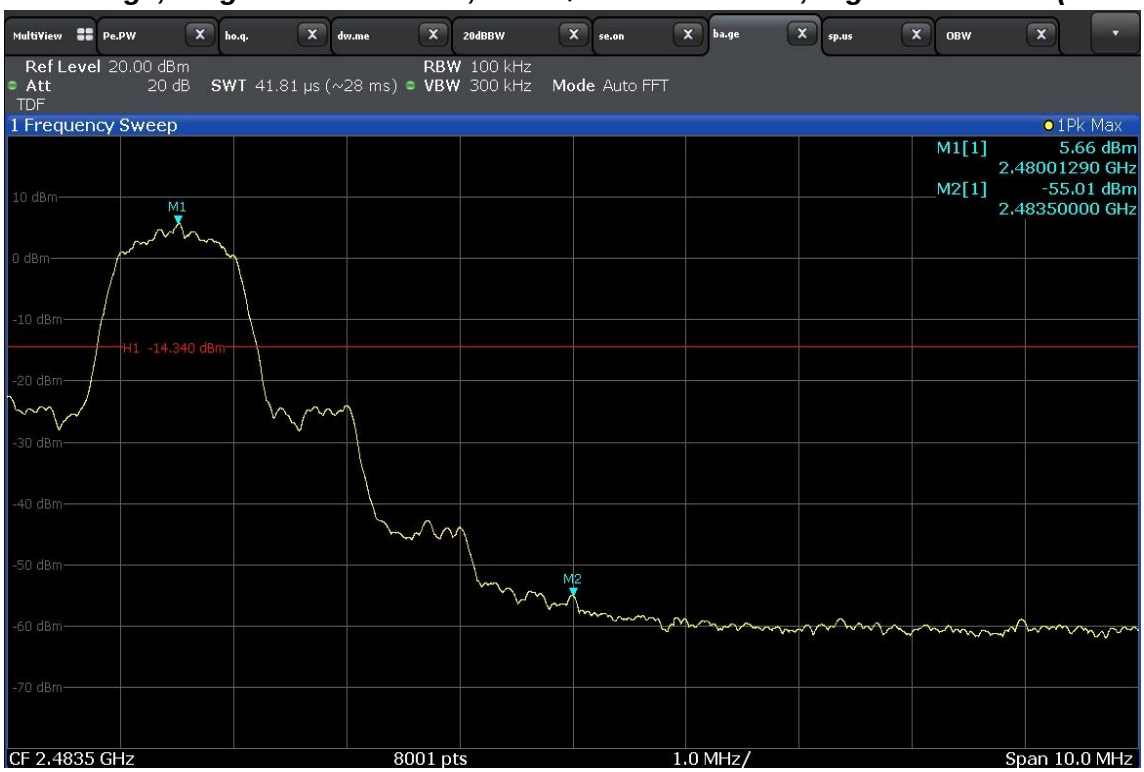


# PLOTS OF EMISSIONS

***Conducted Spurious Emissions, π/4DQPSK modulation, Middle channel (2441MHz)***

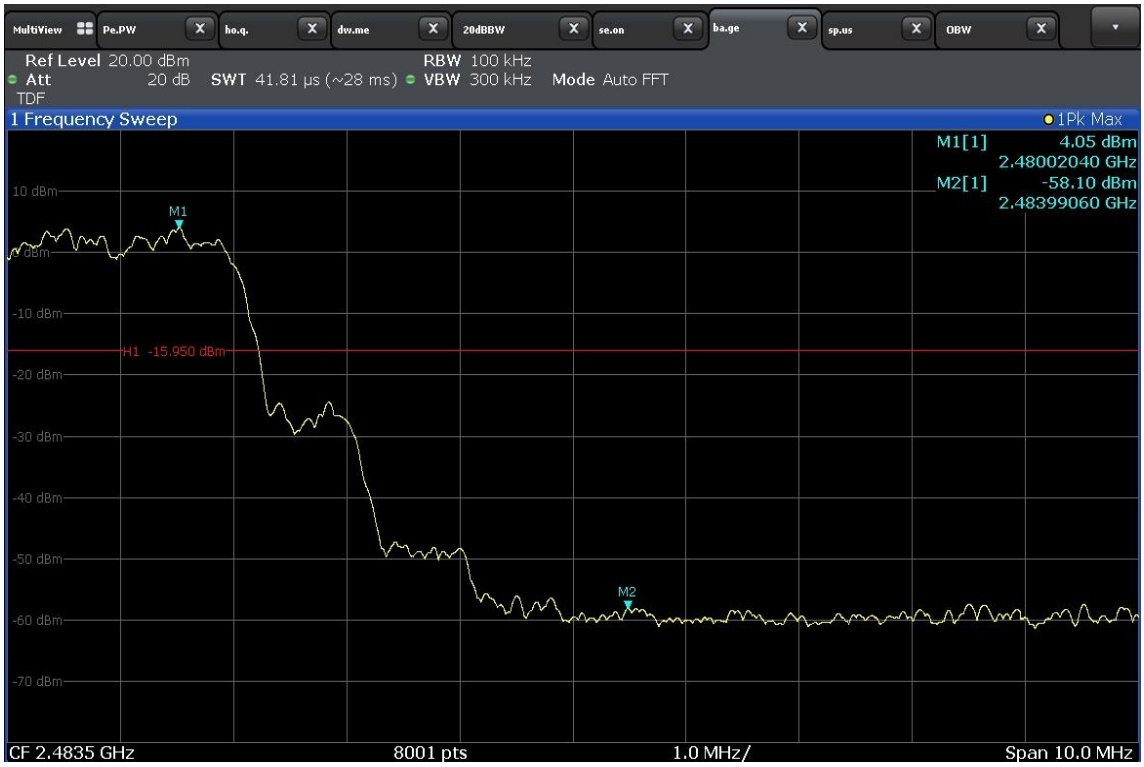



***Band Edge, Single channel mode, π/4DQPSK modulation, Highest Channel (2480 MHz)***

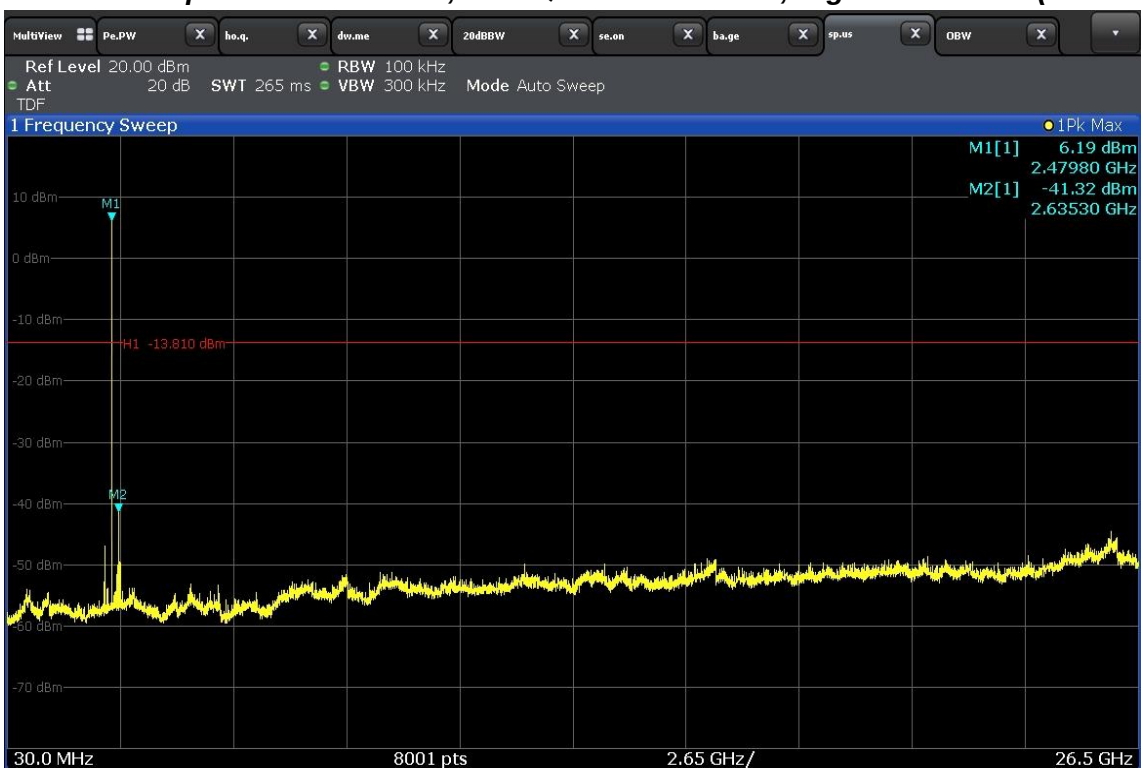


# PLOTS OF EMISSIONS

***Band Edge, Hopping mode, π/4DQPSK modulation, Highest Channel (2480 MHz)***

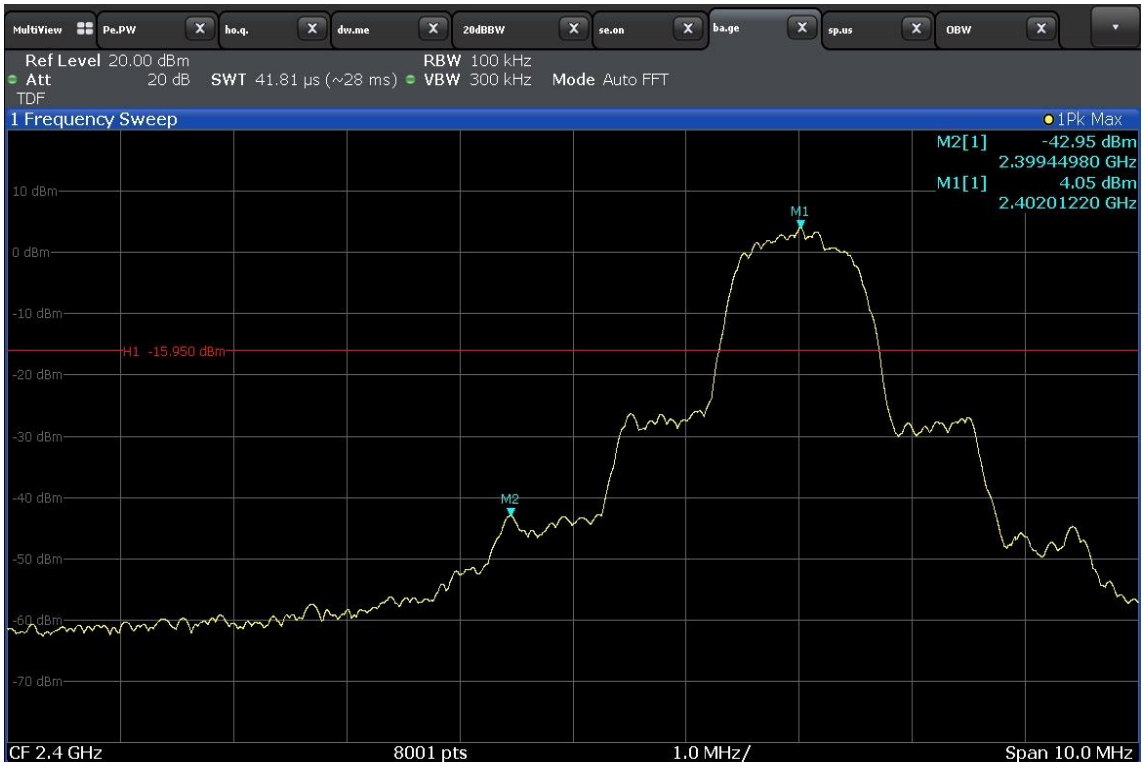



***Conducted Spurious Emissions, π/4DQPSK modulation, Highest Channel (2480 MHz)***

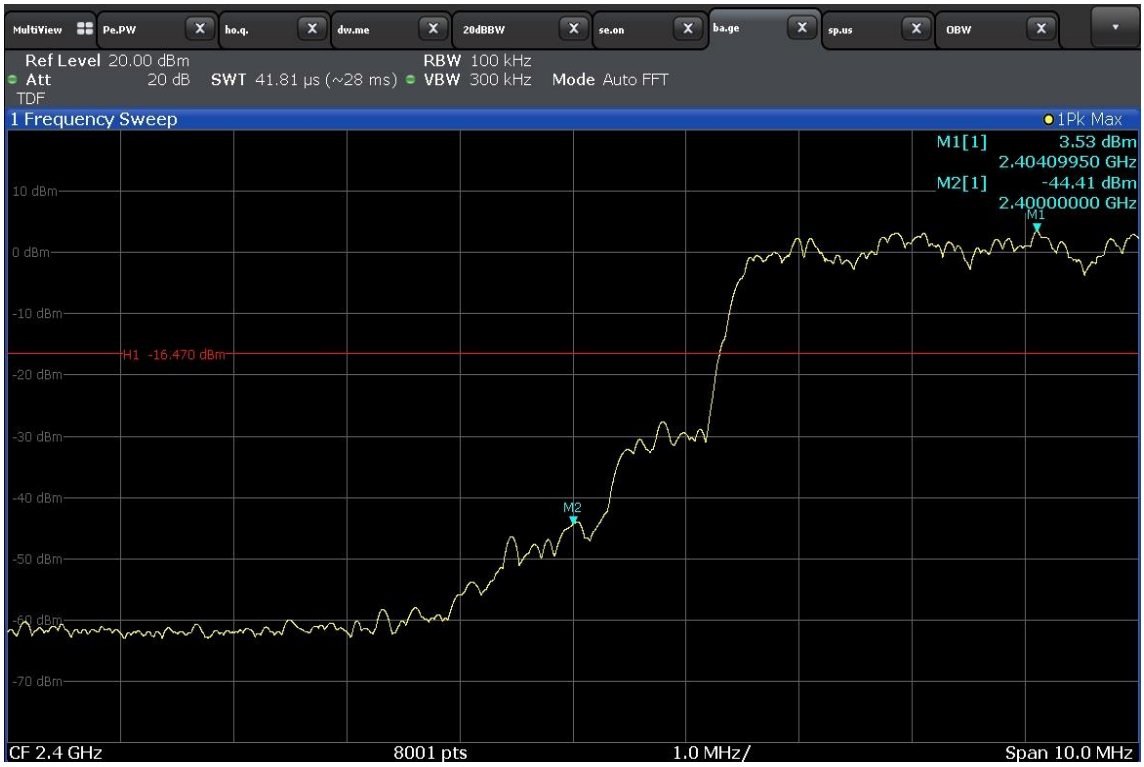


# PLOTS OF EMISSIONS

***Band Edge, Single channel mode, 8DPSK modulation, Lowest Channel (2402 MHz)***

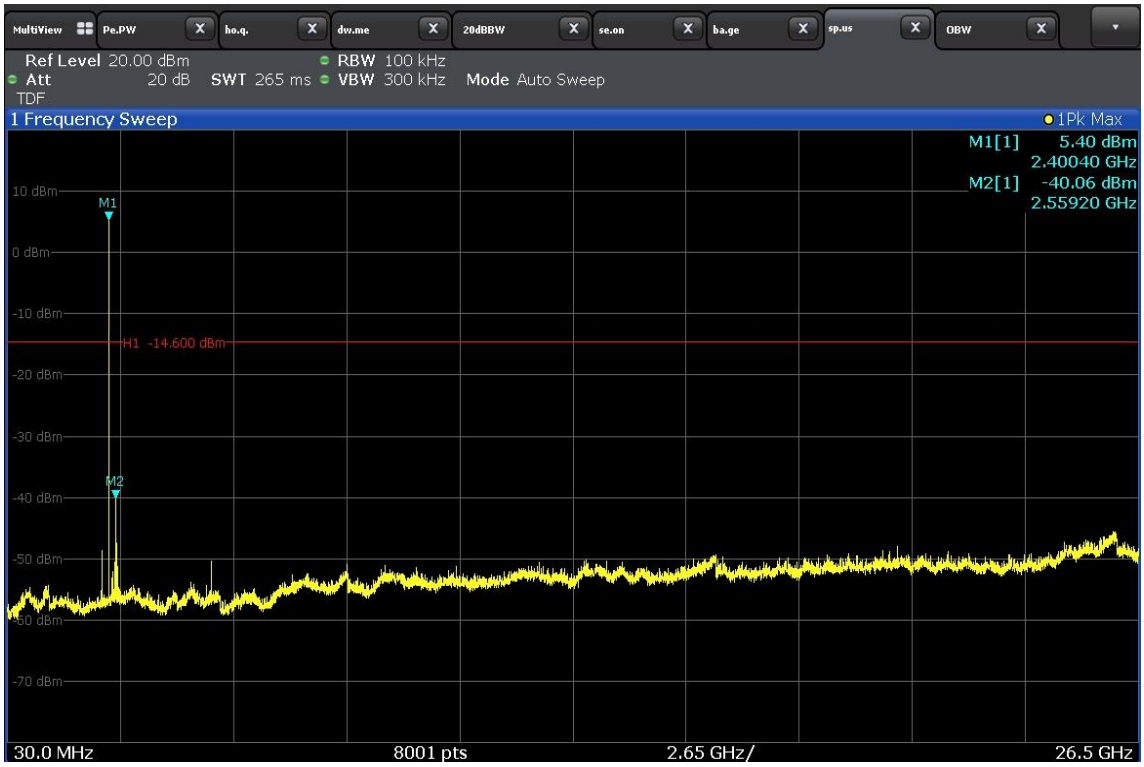



***Band Edge, Hopping mode, 8DPSK modulation, Lowest Channel (2402 MHz)***

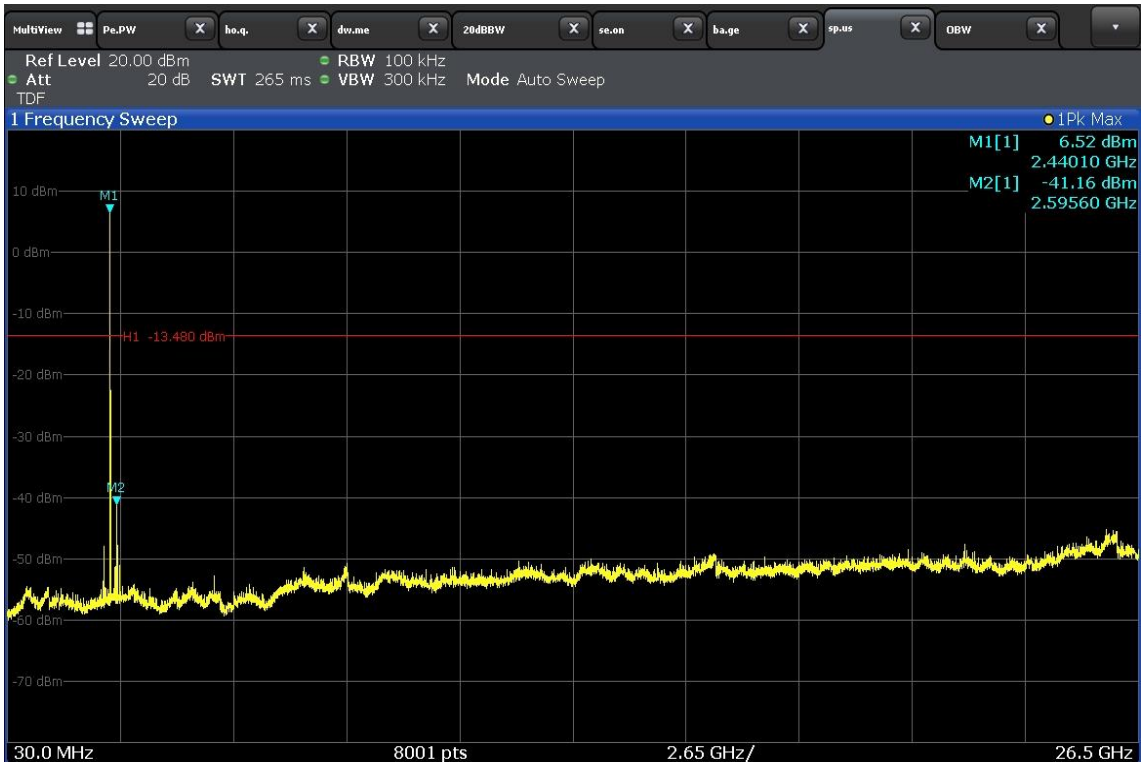


# PLOTS OF EMISSIONS

***Conducted Spurious Emissions, 8DPSK modulation, Lowest channel (2402MHz)***

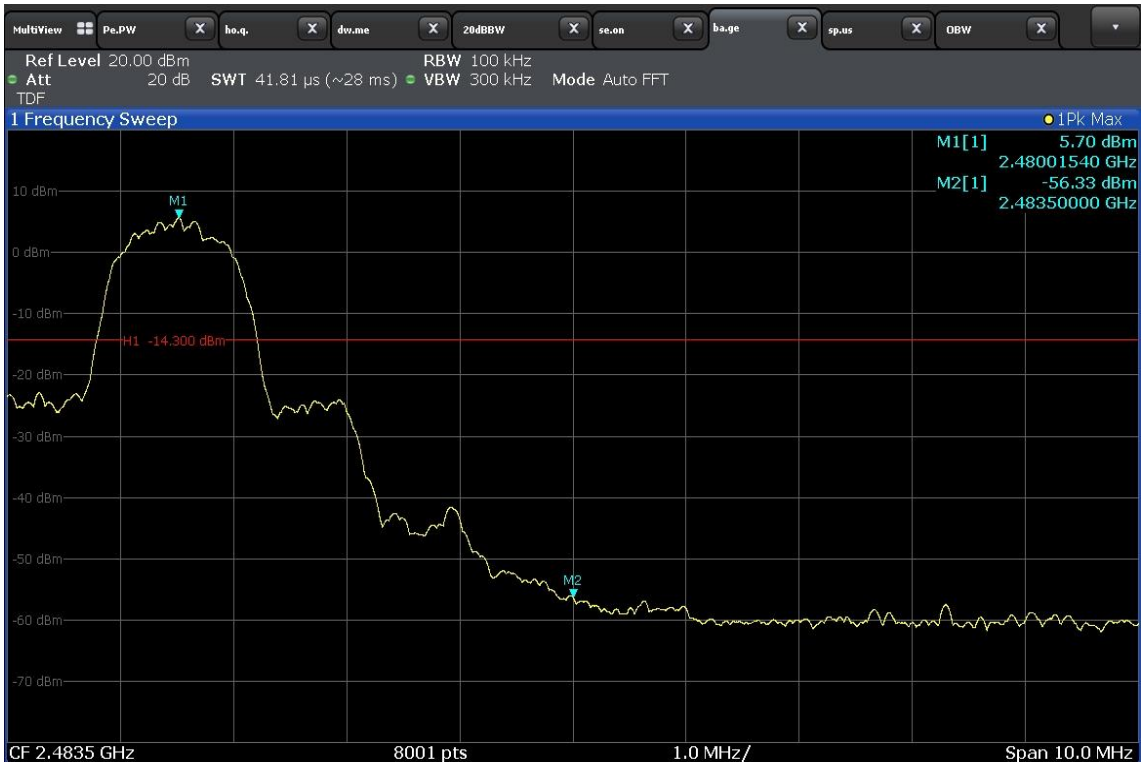



***Conducted Spurious Emissions, 8DPSK modulation, Middle channel (2441MHz)***

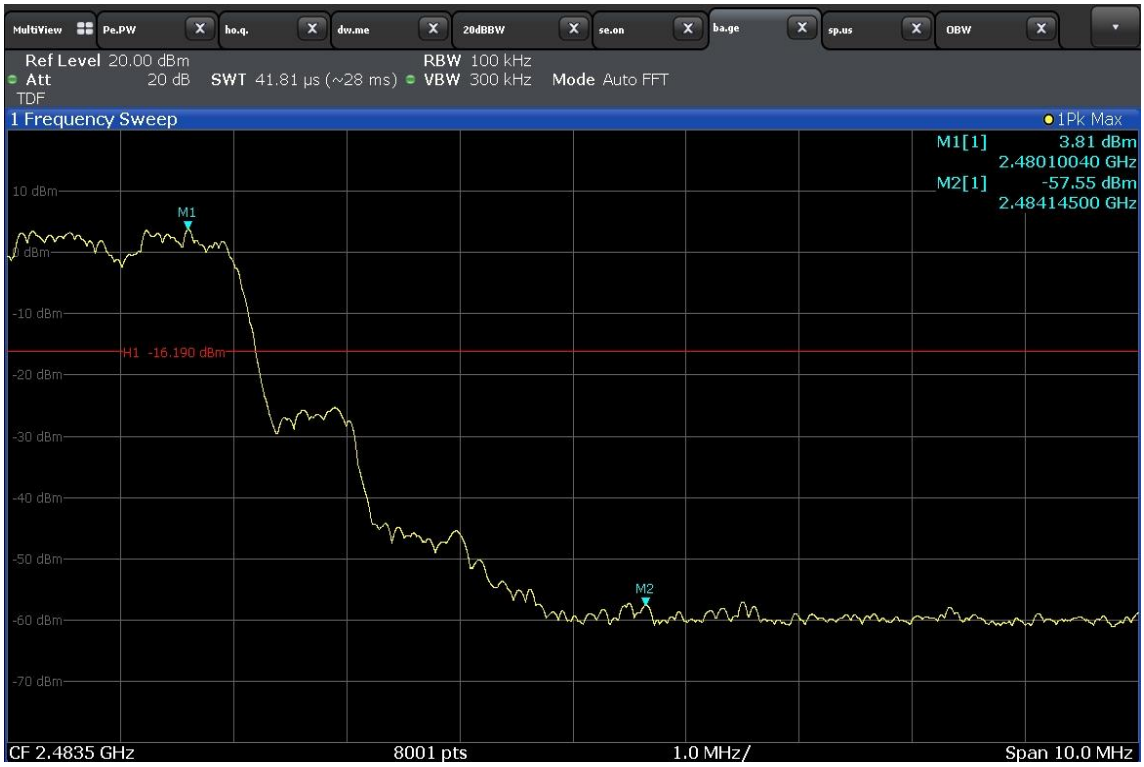


# PLOTS OF EMISSIONS

***Band Edge, Single channel mode, 8DPSK modulation, Highest Channel (2480 MHz)***

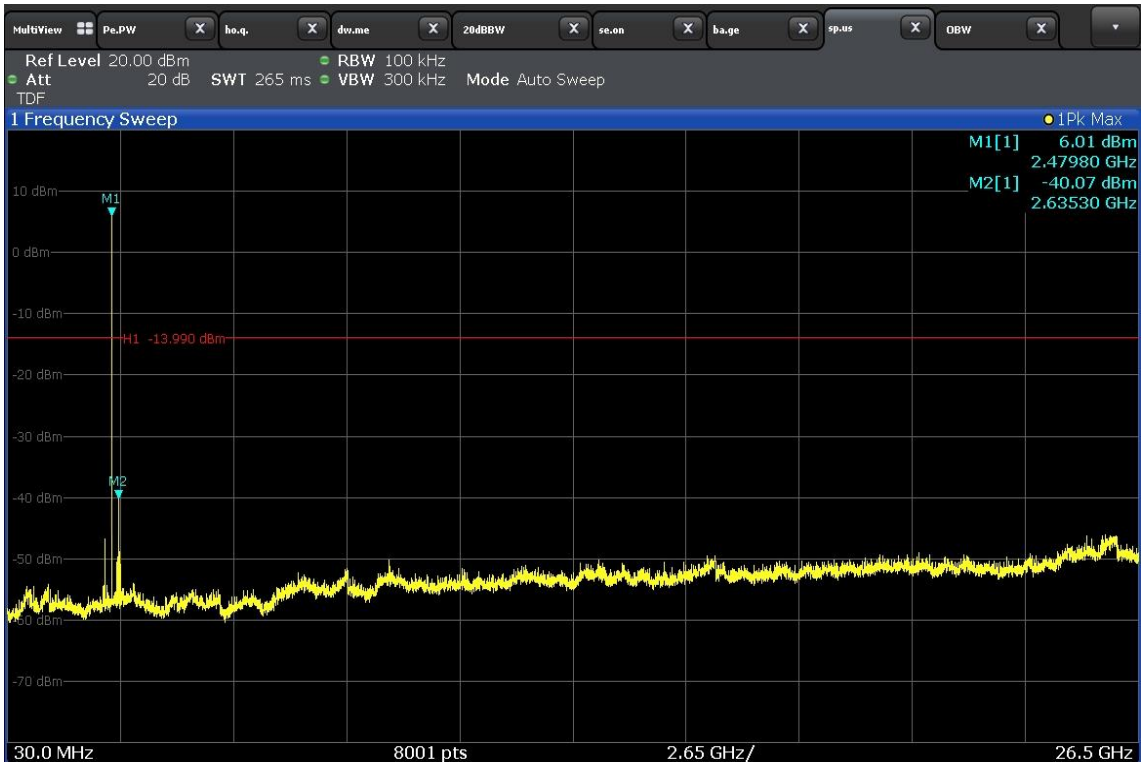



***Band Edge, Hopping mode, 8DPSK modulation, Highest Channel (2480 MHz)***



# PLOTS OF EMISSIONS

***Conducted Spurious Emissions, 8DPSK modulation, Highest channel (2480MHz)***



## 8.9 Radiated Spurious Emissions

**FCC §15.247(d), IC RSS-247 Issue 2 5.5**

**Test Mode : Set to Lowest channel, Middle channel and Highest channel,**

**Result**

**π /4DQPSK modulation_Lowest Channel**

| Frequency (MHz) | Reading (dBµV) | Pol* (H/V) | mode | AF+CL+Amp (dB)** | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 7742.50 | 39.8 | V | peak | 9.2 | 49.0 | 74.0 | 25.0 |

**π /4DQPSK modulation_Middle Channel**

| Frequency (MHz) | Reading (dBµV) | Pol* (H/V) | mode | AF+CL+Amp (dB)** | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 7746.67 | 40.4 | V | peak | 9.2 | 49.6 | 74.0 | 24.4 |

**π /4DQPSK modulation_Highest Channel**

| Frequency (MHz) | Reading (dBµV) | Pol* (H/V) | mode | AF+CL+Amp (dB)** | Result (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 7735.00 | 39.8 | H | peak | 9.3 | 49.1 | 74.0 | 24.9 |

***Note:***

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

*3. Average measurement was not performed when peak-detected emission complies with the average limit.*

*4. Other spurious was under 20 dB below Fundamental.*

*5. Middle channel (2441MHz) in π/4DQPSK modulation was the worst condition. For other modes, peak-detected emissions have enough margin more than 20dBc, therefore the results were not recorded in this report*

*6. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded. (Z-axis Above 1GHz)*

*7. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.*

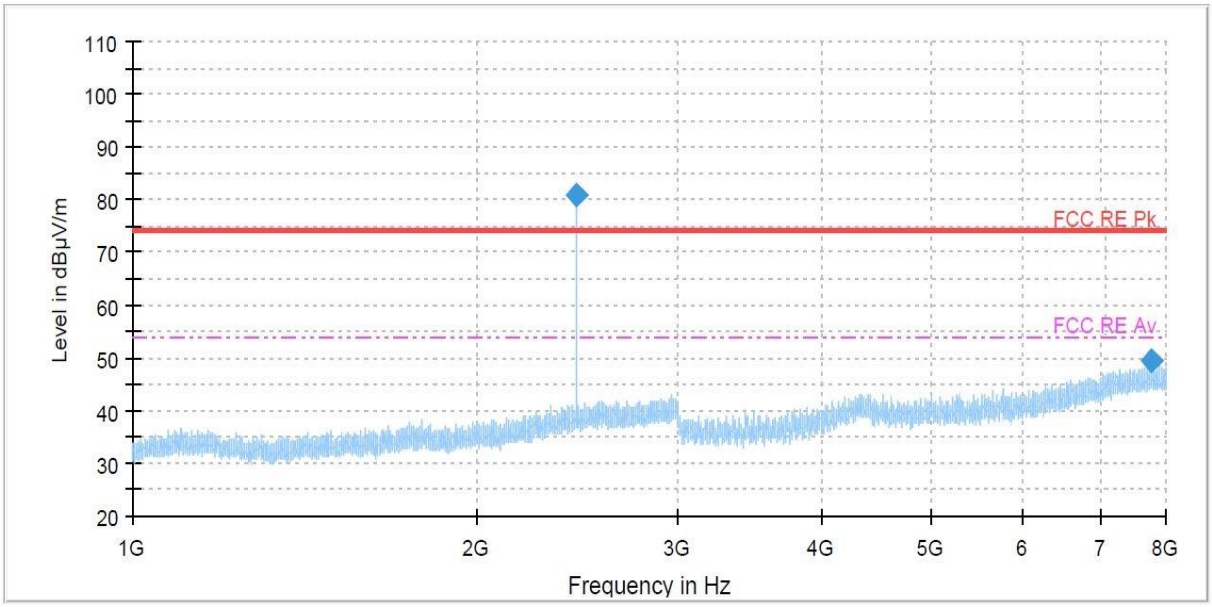
*8. Average emissions were measured using RBW = 1 MHz, VBW = 3 kHz, Detector = Peak.*

*9. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 3rd harmonic for this device.*

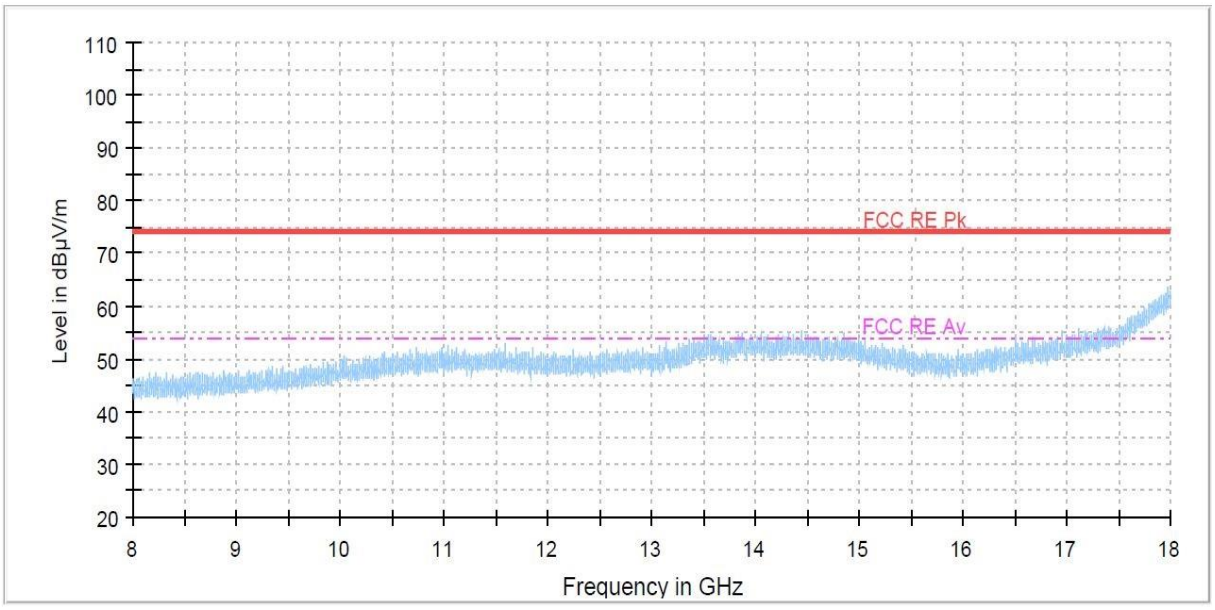
# PLOTS OF EMISSIONS

***Worst Case***

**Middle *channel : 1 GHz to 8 GHz_Peak***

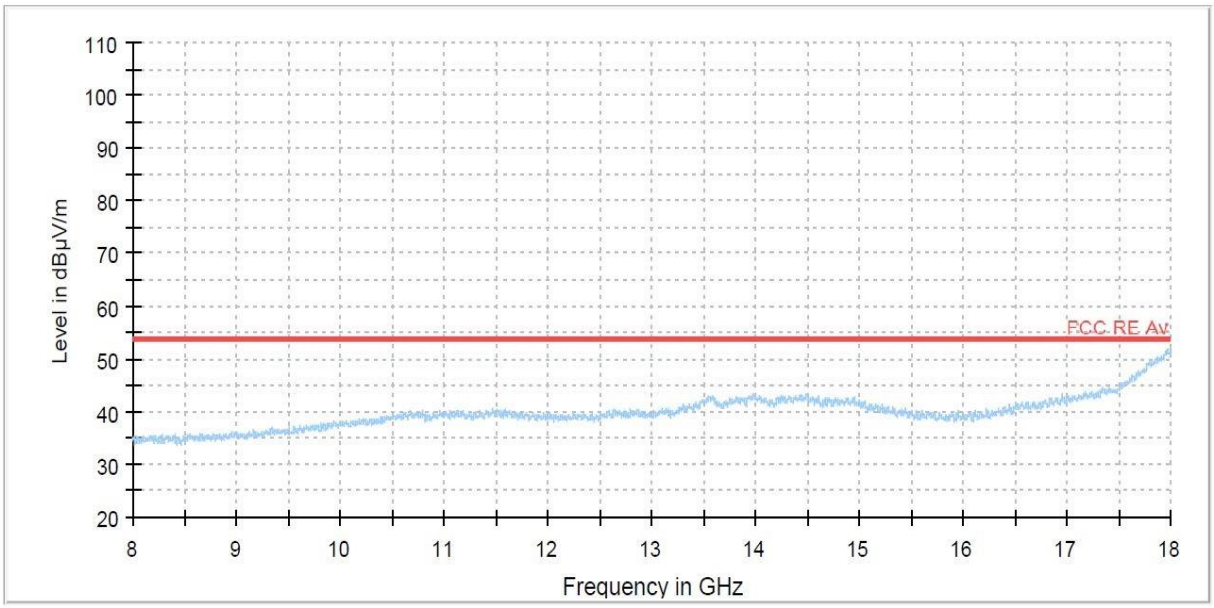



**Middle *channel : 8 GHz to 18 GHz_Peak***

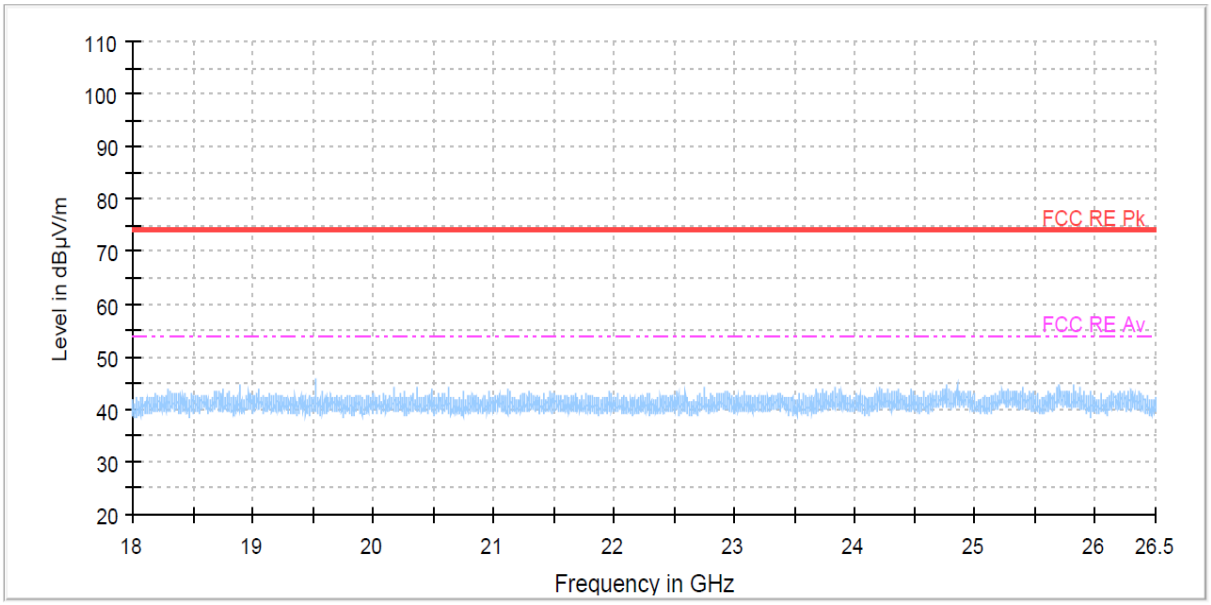


# PLOTS OF EMISSIONS

**Middle *channel : 8 GHz to 18 GHz_Average***




**Middle *channel : 18 GHz to 26.5 GHz_Peak***



## 8.10 Radiated Band Edge

**FCC §15.247(d), IC RSS-247 Issue 2 5.5**

**Test Mode : Set to Lowest channel and Highest channel**

**Result**

**π/4DQPSK modulation_Lowest Channel**

| Frequency (MHz) | Reading (dBμV) | Pol* (H/V) | mode | AF+CL+Amp (dB)** | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 2381.80 | 46.0 | H | peak | -7.9 | 38.1 | 74.0 | 35.9 |
| 2390.00 | 42.9 | V | peak | -7.8 | 35.1 | 74.0 | 38.9 |

**π/4DQPSK modulation_Highest Channel**

| Frequency (MHz) | Reading (dBμV) | Pol* (H/V) | mode | AF+CL+Amp (dB)** | Result (dBμV/m) | Limit (dBμV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 2483.50 | 41.2 | V | peak | -7.6 | 33.6 | 74.0 | 40.4 |
| 2494.01 | 42.4 | H | peak | -7.5 | 34.9 | 74.0 | 39.1 |

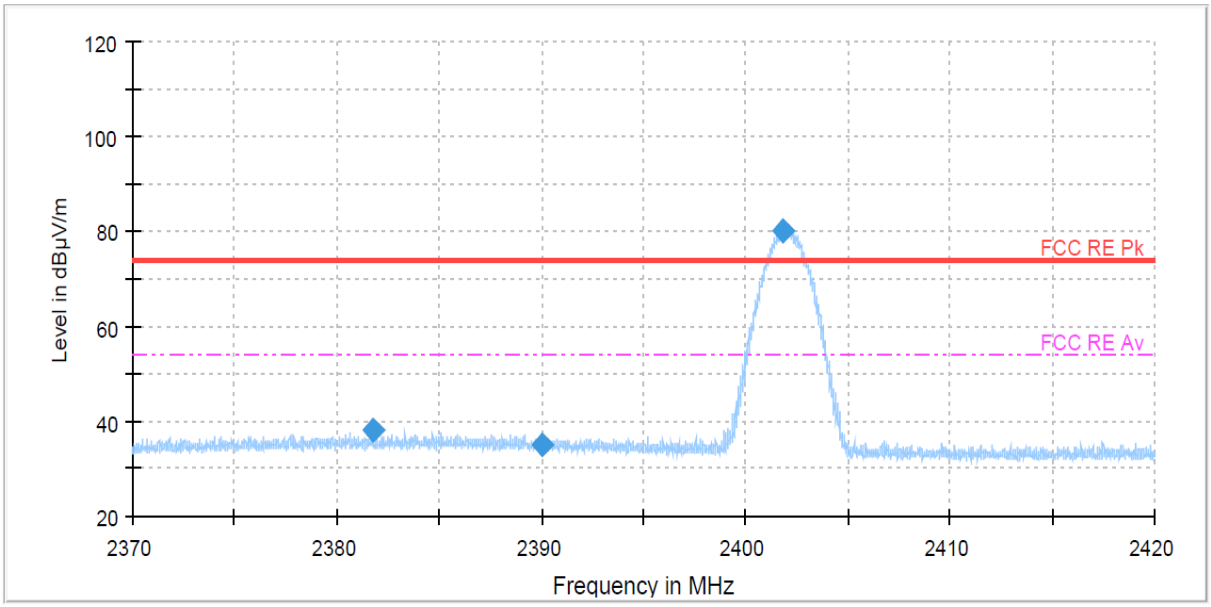
***Note:***

*1. *Pol. H = Horizontal V = Vertical*
*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*
*3. Average measurement was not performed when peak-detected emission complies with the average limit.*
*4. Other spurious was under 20 dB below Fundamental.*
*5. Lowest channel (2402MHz) mode in π/4DQPSK modulation was the worst condition. For other modes, peak-detected emissions have enough margin more than 20dBc, therefore the results were not recorded in this report*
*6. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, Vertical polarization. The worst data was recorded. (Z-axis Above 1GHz)*
*7. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.*
*8. Average emissions were measured using RBW = 1 MHz, VBW = 3 kHz, Detector = Peak.*

# PLOT OF TEST DATA

***Worst Case***

***Lowest Channel_Peak***



# 9. TEST EQUIPMENT

| No. | Instrument | Manufacturer | Model | Serial No. | Calibration Date | Calibration Interval |
|---|---|---|---|---|---|---|
| 1 | *Test Receiver | R & S | ESU 40 | 100202 | Apr. 02 2019 | 1 year |
| 2 | *Test Receiver | R & S | ESCI | 101041 | Apr. 02 2019 | 1 year |
| 3 | Attenuator | PASTERNACK | PE7395-10 | 1441-1 | Jul. 11 2019 | 1 year |
| 4 | *Attenuator | FAIRVIEW | SA3N5W-06 | N/A | Apr. 03 2019 | 1 year |
| 5 | *Attenuator | FAIRVIEW | SA3N5W-10 | N/A | Apr. 03 2019 | 1 year |
| 6 | *Attenuator | API technologies | 40A2W-10 | 1912 | Apr. 17 2019 | 1 year |
| 7 | *Amplifier | R & S | SCU 01 | 10029 | Apr. 02 2019 | 1 year |
| 8 | *Amplifier | R & S | SCU18F | 180025 | Apr. 02 2019 | 1 year |
| 9 | *Amplifier | R & S | SCU26 | 10011 | Jul. 15 2019 | 1 year |
| 10 | Amplifier | R & S | SCU40 | 100380 | Jul. 15 2019 | 1 year |
| 11 | *Spectrum Analyzer | R & S | FSW43 | 100732 | Apr. 02 2019 | 1 year |
| 12 | Spectrum Analyzer | Agilent | E4440A | MY44022567 | Oct. 10 2019 | 1 year |
| 13 | *Spectrum Analyzer | R & S | FSW43 | 104084 | Apr. 02 2019 | 1 year |
| 14 | *Loop Antenna | R & S | HFH2-Z2 | 100279 | Feb. 13 2019 | 2 year |
| 15 | *Horn Antenna | SCHWARZBECK | BBHA9120D | 9120D-508 | Mar. 26 2019 | 2 year |
| 16 | *Horn Antenna | Q-par Angus | QSH20S20 | 8179 | Jul. 15 2019 | 2 year |
| 17 | Horn Antenna | Q-par Angus | QSH22K20 | 8180 | Jul. 15 2019 | 2 year |
| 18 | *Trilog-Broadband Antenna | SCHWARZBECK | VULB 9163 | 946 | May. 18 2019 | 2 year |
| 19 | *LISN | R & S | ENV216 | 101156 | Apr. 02 2019 | 1 year |
| 20 | *Position Controller | INNCO | CO2000 | 12480406/L | N/A | N/A |
| 21 | *Controller | INNCO | CO3000 | CO3000/937/38330516/L | N/A | N/A |
| 22 | *Turn Table | INNCO | DS1200S | N/A | N/A | N/A |
| 23 | *Turn Table | INNCO | DT2000-2t | N/A | N/A | N/A |
| 24 | *Antenna Mast | INNCO | MA4000 | N/A | N/A | N/A |
| 25 | *TILT Antenna Mast | INNCO | MA4640-XP-EP | N/A | N/A | N/A |
| 26 | *Open Switch And Control Unit | R & S | OSP-120 | 100081 | N/A | N/A |
| 27 | *Open Switch And Control Unit | R & S | OSP-120 | 101766 | N/A | N/A |
| 28 | *Shielded Room | Seo-Young EMC | N/A | N/A | N/A | N/A |
| 29 | *Anechoic Chamber | Seo-Young EMC | N/A | N/A | N/A | N/A |
| 30 | *WiFi Filter Bank | R & S | U083 | N/A | N/A | N/A |
| 31 | WiFi Filter Bank | R & S | U082 | N/A | N/A | N/A |

*) Test equipment used during the test

# 10. ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

## 1. Conducted Uncertainty Calculation

| Source of Uncertainty | Xi | Uncertainty of Xi | | Coverage factor k | u(Xi) (dB) | Ci | Ci u(Xi) (dB) |
|---|---|---|---|---|---|---|---|
| | | Value (dB) | Probability Distribution | | | | |
| Receiver reading | RI | ± 0.1 | normal 1 | 1.000 | 0.1 | 1 | 0.1 |
| Attenuation AMN-Receiver | LC | ± 0.08 | normal 2 | 2.000 | 0.04 | 1 | 0.04 |
| AMN Voltage division factor | LAMN | ± 0.8 | normal 2 | 2.000 | 0.4 | 1 | 0.4 |
| Sine wave voltage | dVSW | ± 2.00 | normal 2 | 2.000 | 1.00 | 1 | 1.00 |
| Pulse amplitude response | dVPA | ± 1.50 | rectangular | 1.732 | 0.87 | 1 | 0.87 |
| Pulse repetition rate response | dVPR | ± 1.50 | rectangular | 1.732 | 0.87 | 1 | 0.87 |
| Noise floor proximity | dVNF | ± 0.00 | - | - | 0.00 | 1 | 0.00 |
| AMN Impedance | dZ | ± 1.80 | triangular | 2.449 | 0.73 | 1 | 0.73 |
| ⓐ Mismatch | M | + 0.70 | U-Shaped | 1.414 | 0.49 | 1 | 0.49 |
| ⓑ Mismatch | M | - 0.80 | U-Shaped | 1.414 | - 0.56 | 1 | - 0.56 |
| Measurement System Repeatability | RS | 0.05 | normal 1 | 1.000 | 0.05 | 1 | 0.05 |
| Remark | ⓐ: AMN-Receiver Mismatch : +<br>ⓑ: AMN-Receiver Mismatch : - | | | | | | |
| Combined Standard Uncertainty | Normal | | | ± 1.88 | | | |
| Expended Uncertainty U | Normal ($k$ = 2) | | | ± 3.76 | | | |

## 2. Radiation Uncertainty Calculation

| Source of Uncertainty | Xi | Uncertainty of Xi | | Coverage factor k | u(Xi) (dB) | Ci | Ci u(Xi) (dB) |
|---|---|---|---|---|---|---|---|
| | | Value (dB) | Probability Distribution | | | | |
| Measurement System Repeatability | **RS** | 0.34 | normal 1 | 1.00 | 0.34 | 1 | 0.34 |
| Receiver reading | **Ri** | ± 0.02 | normal 2 | 2.00 | 0.01 | 1 | 0.01 |
| Sine wave voltage | **dVsw** | ± 0.17 | normal 2 | 2.00 | 0.09 | 1 | 0.09 |
| Pulse amplitude response | **dVpa** | ± 0.92 | normal 2 | 2.00 | 0.46 | 1 | 0.46 |
| Pulse repetition rate response | **dVpr** | ± 0.35 | normal 2 | 2.00 | 0.18 | 1 | 0.18 |
| Noise floor proximity | **dVnf** | ± 0.50 | normal 2 | 2.00 | 0.25 | 1 | 0.25 |
| Antenna Factor Calibration | **AF** | ± 2.00 | rectangular | $\sqrt{3}$ | 1.15 | 1 | 1.15 |
| Cable Loss | **CL** | ± 1.00 | normal 2 | 2.00 | 0.50 | 1 | 0.50 |
| Antenna Directivity | **AD** | ± 0.00 | rectangular | $\sqrt{3}$ | 0.00 | 1 | 0.00 |
| Antenna Factor Height Dependence | **AH** | ± 2.00 | rectangular | $\sqrt{3}$ | 1.15 | 1 | 1.15 |
| Antenna Phase Centre Variation | **AP** | ± 0.20 | rectangular | $\sqrt{3}$ | 0.12 | 1 | 0.12 |
| Antenna Factor Frequency Interpolation | **Ai** | ± 0.25 | rectangular | $\sqrt{3}$ | 0.14 | 1 | 0.14 |
| Site Imperfections | **Si** | ± 4.00 | triangular | $\sqrt{6}$ | 1.63 | 1 | 1.63 |
| Measurement Distance Variation | **DV** | ± 0.60 | rectangular | $\sqrt{3}$ | 0.35 | 1 | 0.35 |
| Antenna Balance | **Dbal** | ± 0.90 | rectangular | $\sqrt{3}$ | 0.52 | 1 | 0.52 |
| Cross Polarisation | **DCross** | ± 0.00 | rectangular | $\sqrt{3}$ | 0.00 | 1 | 0.18 |
| Mismatch | **M** | + 0.98<br>- 1.11 | U-Shaped | $\sqrt{2}$ | 0.74 | 1 | 0.74 |
| EUT Volume Diameter | **Vd** | 0.33 | normal 1 | 1.00 | 0.33 | 1 | 0.11 |
| Remark | | | | | | | |
| Combined Standard Uncertainty | Normal | | | | | | |
| Expended Uncertainty U | Normal ($k$ = 2) | | | | | | |