

# EMC TEST REPORT for Intentional Radiator

**No. 170301840SHA-001**

Applicant : Kustom Musical Amplification INC.  
3015 Kustom Drive, Hebron, Kentucky, 41048 USA

Manufacturer : Kustom Musical Amplification INC.  
3015 Kustom Drive, Hebron, Kentucky, 41048 USA

Factory : Hangzhou Samko Electronics Co., Ltd.  
No. 8, Jiaqi Road, Xianlin Street, Yuhang District,  
Hangzhou, 311122 China

Equipment : Power Amplifier

Type/Model : LP1440

## SUMMARY

The equipment complies with the requirements according to the following standard(s):

**47CFR Part 15 (2016):** Radio Frequency Devices

**ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of  
Unlicensed Wireless Devices

**RSS-247 Issue 2 (Feb. 2017):** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

**RSS-Gen Issue 4 (Nov. 2014):** General Requirements for compliance of radio apparatus

Date of issue: April 28, 2017

Prepared by:



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Reviewed by:



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## **1. General Information**

### **1.1 Applicant Information**

Applicant: Kustom Musical Amplification INC.  
3015 Kustom Drive, Hebron, Kentucky, 41048  
USA

Name of contact: Fred J Conrad

Tel: 859-817-7164

Fax: 859-817-7199

Manufacturer: Kustom Musical Amplification INC.  
3015 Kustom Drive, Hebron, Kentucky, 41048  
USA

Factory: Hangzhou Samko Electronics Co., Ltd.  
No. 8, Jiaqi Road, Xianlin Street, Yuhang  
District, Hangzhou, 311122 China

Sample received date : March 1, 2017  
Date of test : March 1 – 29, 2017

### **1.2 Identification of the EUT**

Equipment: Power Amplifier

Type/model: LP1440

FCC ID: 2AAVGHDRW1701A

IC: 11349A-DRW1701A

### 1.3 Technical specification

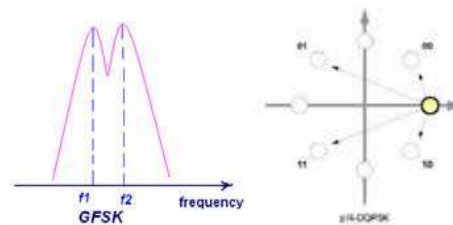
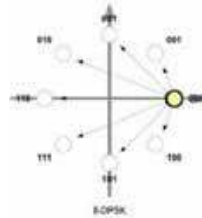
Operation Frequency Band:

2402 - 2480 MHz

Modulation:

GFSK,  $\pi/4$  DQPSK, 8DPSK

Technology:



GFSK is different from  $\pi/4$ DQPSK and 8DPSK. 8DPSK is similar with  $\pi/4$ DQPSK but more complex, and with a bigger data rate. So all tests except dwell time and number of hopping frequencies were performed with GFSK modulation and 8DPSK modulation for representative.

Antenna Designation:

PCB antenna, un-detachable

Gain of Antenna:

0dBi

Rating:

120 V ~, 60Hz, 80W, Class I

Description of EUT:

EUT is a Power Amplifier

Channel Description:

There are 79 channels in all. The designed channel spacing is 1MHz.

| Channel Identifier | Frequency (MHz) |
|--------------------|-----------------|
| low                | 2402            |
| middle             | 2441            |
| high               | 2480            |

### 1.4 Mode of operation during the test / Test peripherals used

While testing the transmitter mode of the EUT, the internal modulation is applied.  
All the functions of the host device except the BT module were set on stand-by mode.

## 2. Test Specification

### 2.1 Standards or specification

47CFR Part 15 (2016)  
ANSI C63.10 (2013)  
RSS-247 Issue 2 (Feb. 2017)  
RSS-Gen Issue 4 (Nov. 2014)

### 2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The lowest, middle and highest channel were tested as representatives.

| Freq. Band (MHz) | Modulation | Lowest (MHz) | Middle (MHz) | Highest (MHz) |
|------------------|------------|--------------|--------------|---------------|
| 2400-2483.5      | GFSK       | 2402         | 2441         | 2480          |
| 2400-2483.5      | 8DPSK      | 2402         | 2441         | 2480          |

### 2.3 Test software list

| Test Items         | Software | Manufacturer | Version |
|--------------------|----------|--------------|---------|
| Conducted emission | ESxS-K1  | R&S          | V2.1.0  |
| Radiated emission  | ES-K1    | R&S          | V1.71   |

### 2.4 Test peripherals list

| Item No. | Name            | Band and Model      | Description |
|----------|-----------------|---------------------|-------------|
| 1        | Laptop computer | HP, EliteBook 2530P | -           |

## 2.5 Instrument list

| Equipment              | Type                              | Manu.             | Internal no. | Due date   |
|------------------------|-----------------------------------|-------------------|--------------|------------|
| Test Receiver          | ESCS 30                           | R&S               | EC 2107      | 2017-10-19 |
| Test Receiver          | ESIB 26                           | R&S               | EC 3045      | 2017-10-19 |
| Voltage Probe          | ESH2-Z3                           | R&S               | EC 3405      | 2018-03-09 |
| Voltage Probe          | TK9420                            | Schwarzbeck       | EC 4888      | 2017-09-17 |
| A.M.N.                 | ESH2-Z5                           | R&S               | EC 3119      | 2017-12-01 |
| A.M.N.                 | ENV 216                           | R&S               | EC 3393      | 2017-07-27 |
| Absorbing clamp        | MDS 21                            | R&S               | EC 2108      | 2017-04-12 |
| Tri-loop               | HXYZ 9170                         | Schwarzbeck       | EC 3384      | 2017-06-02 |
| Bilog Antenna          | CBL 6112D                         | TESEQ             | EC 4206      | 2017-06-01 |
| Horn antenna           | HF 906                            | R&S               | EC 3049      | 2017-09-23 |
| Horn antenna           | 3117                              | ETS               | EC 4792-1    | 2017-08-24 |
| Horn antenna           | HAP18-26W                         | TOYO              | EC 4792-3    | 2017-06-11 |
| Pre-amplifier          | Pre-amp 18                        | R&S               | EC 5262      | 2017-06-29 |
| Semi-anechoic chamber  | -                                 | Albatross project | EC 3048      | 2017-09-09 |
| Fully-anechoic chamber | -                                 | Albatross project | EC 3047      | 2017-09-09 |
| Shielded room          | -                                 | Zhongyu           | EC 2838      | 2018-01-08 |
| Shielded room          | -                                 | Zhongyu           | EC 2839      | 2018-01-08 |
| High Pass Filter       | WHKX 1.0/15G-10SS                 | Wainwright        | EC4297-1     | 2018-01-09 |
| High Pass Filter       | WHKX 2.8/18G-12SS                 | Wainwright        | EC4297-2     | 2018-01-09 |
| High Pass Filter       | WHKX 7.0/1.8G-8SS                 | Wainwright        | EC4297-3     | 2018-01-09 |
| Band Reject Filter     | WRCGV 2400/2483-2390/2493-35/10SS | Wainwright        | EC4297-4     | 2018-01-09 |

## 2.6 Test Summary

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| TEST ITEM                                   | FCC REFERENCE     | IC REFERENCE                  | RESULT |
|---------------------------------------------|-------------------|-------------------------------|--------|
| 20 dB Bandwidth                             | 15.247(a)(1)      | RSS-247 Issue 2<br>Clause 5   | Tested |
| Carrier Frequency Separation                | 15.247(a)(1)      | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Maximum peak output power                   | 15.247(b)(1)      | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Radiated Spurious Emissions                 | 15.205 & 15.209   | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Conducted Spurious Emissions<br>& Band Edge | 15.247(d)         | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Power line conducted emission               | 15.207            | RSS-Gen Issue 4<br>Clause 8.8 | Pass   |
| Number of Hopping<br>Frequencies            | 15.247(a)(1)(iii) | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Dwell time                                  | 15.247(a)(1)(iii) | RSS-247 Issue 2<br>Clause 5   | Pass   |
| Occupied bandwidth                          | -                 | RSS-Gen Issue 4<br>Clause 6.6 | Tested |
| Antenna requirement                         | 15.203            | -                             | Pass   |

Notes: 1: NA =Not Applicable

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## 2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

| TEST ITEM                                                   | MEASUREMENT UNCERTAINTY |
|-------------------------------------------------------------|-------------------------|
| Maximum peak output power                                   | $\pm 0.74\text{dB}$     |
| Radiated Emissions in restricted frequency bands below 1GHz | $\pm 4.90\text{dB}$     |
| Radiated Emissions in restricted frequency bands above 1GHz | $\pm 5.02\text{dB}$     |
| Emission outside the frequency band                         | $\pm 2.89\text{dB}$     |
| Power line conducted emission                               | $\pm 3.19\text{dB}$     |

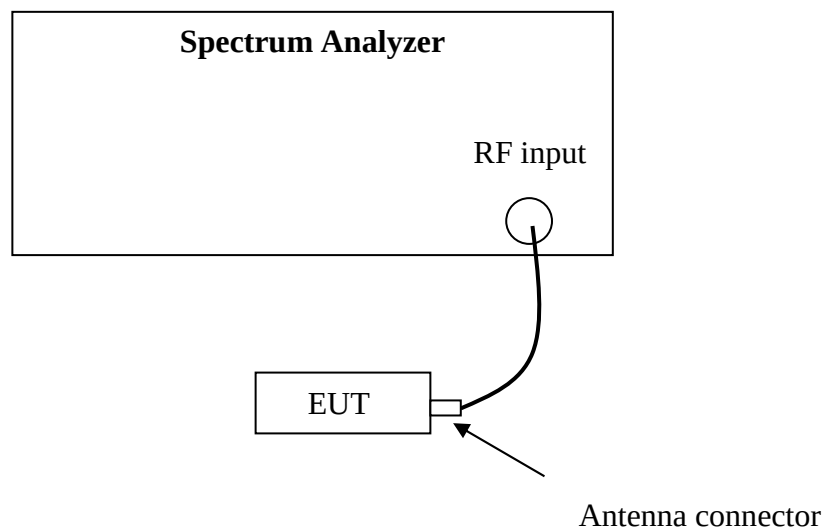
### 3. 20 dB Bandwidth

**Test result:**      **Tested**

#### 3.1 Limit

- ☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
- ☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

#### 3.2 Test Configuration



#### 3.3 Test Procedure and test setup

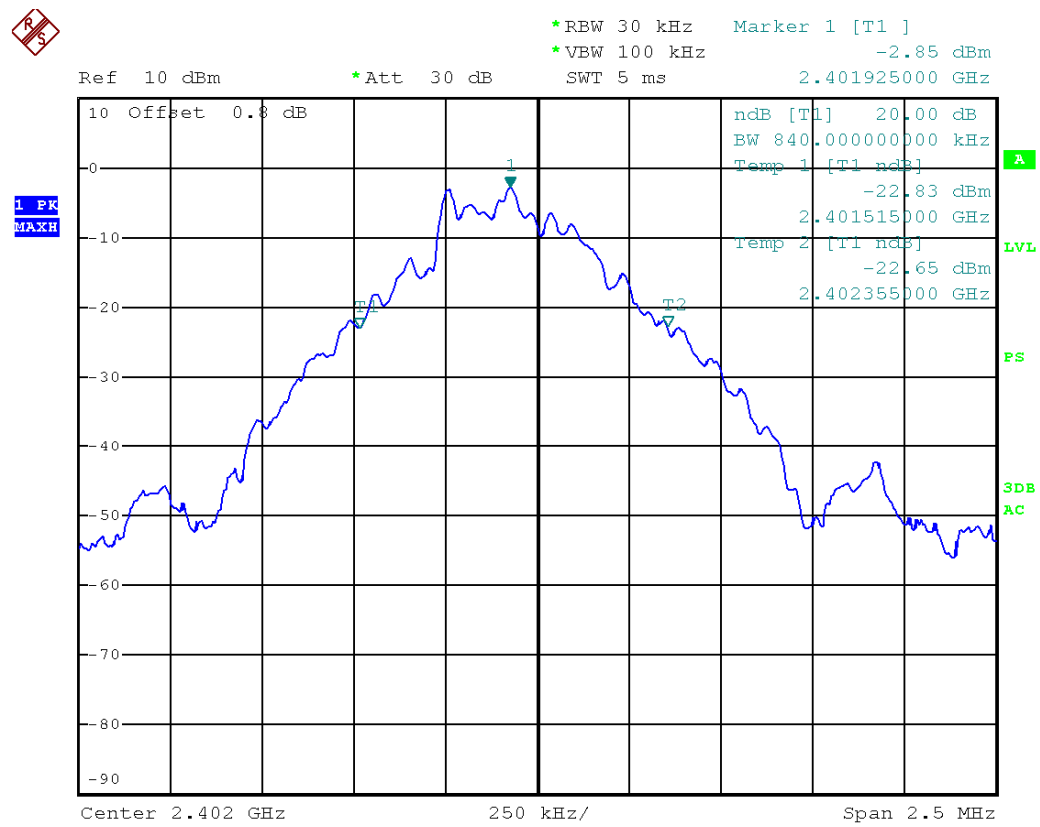
The 20 bandwidth per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span = 2 to 3 times the 20 dB bandwidth,  $RBW \geq 1\%$  of the 20 dB bandwidth,  $VBW \geq RBW$ , Sweep = auto, Detector = peak, Trace = max hold. The test was performed at 3 channels (lowest, middle and highest channel). The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

3.4 Test Protocol

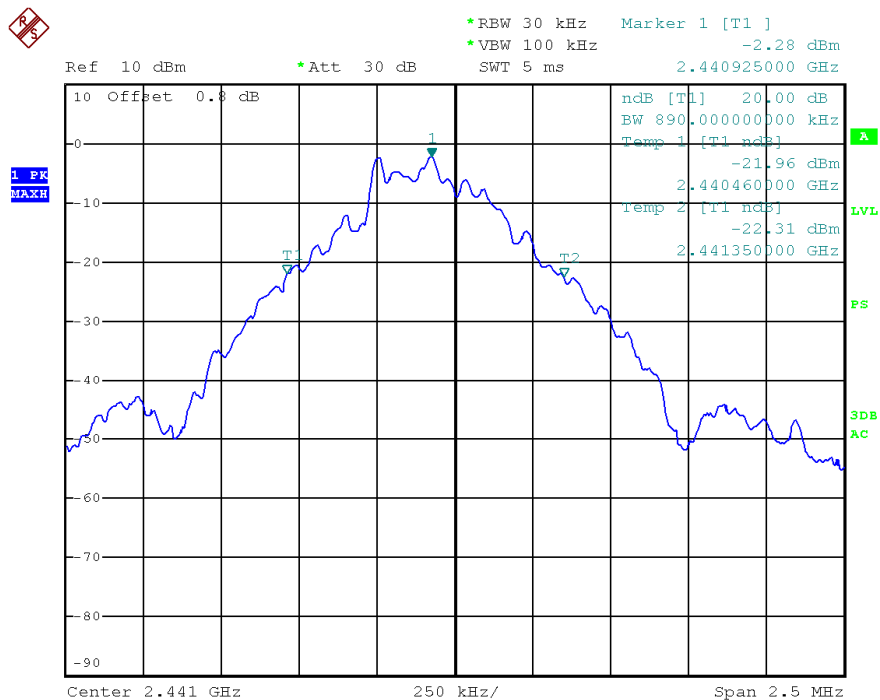
Temperature : 22°C  
Relative Humidity : 45 %

| Modulation | CH | Bandwidth<br>(kHz) | Two-thirds of Bandwidth<br>(kHz) |
|------------|----|--------------------|----------------------------------|
| GFSK       | L  | 840.00             | 560.00                           |
|            | M  | 890.00             | 593.33                           |
|            | H  | 890.00             | 593.33                           |

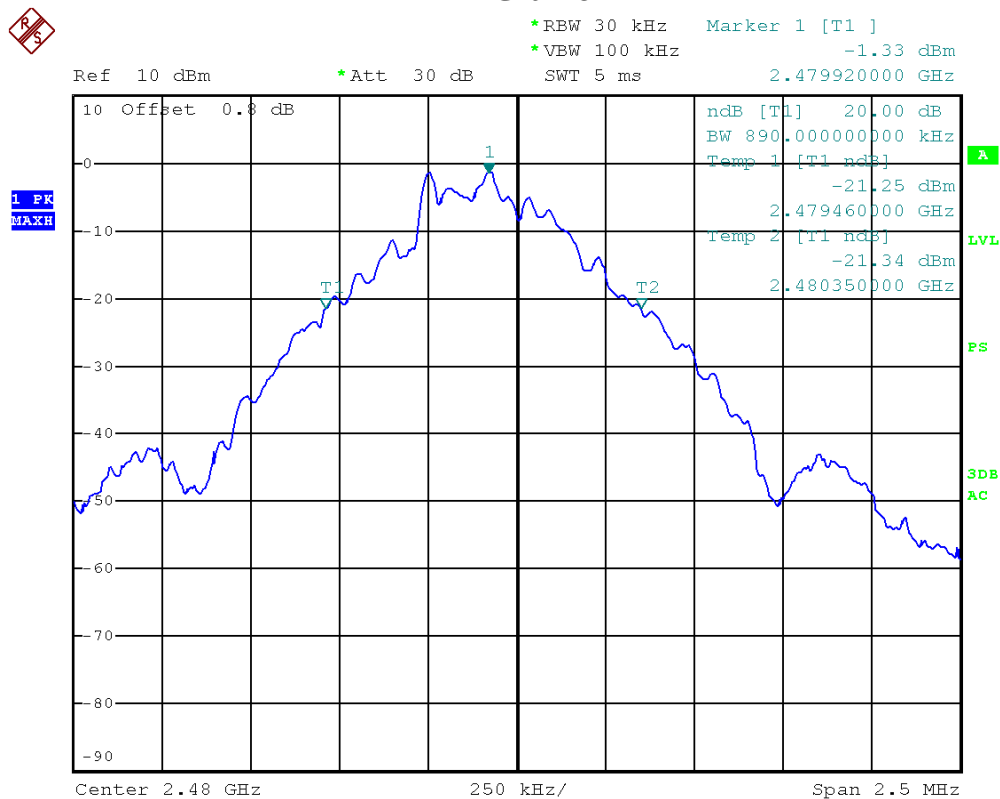
Channel L



Channel M



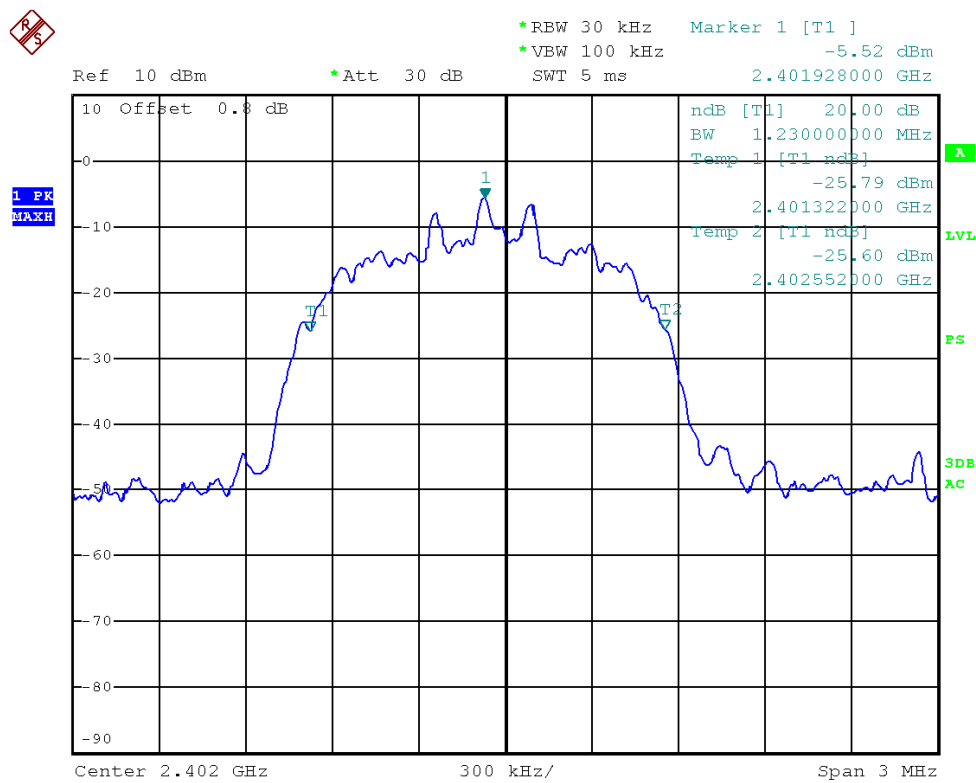
### Channel H



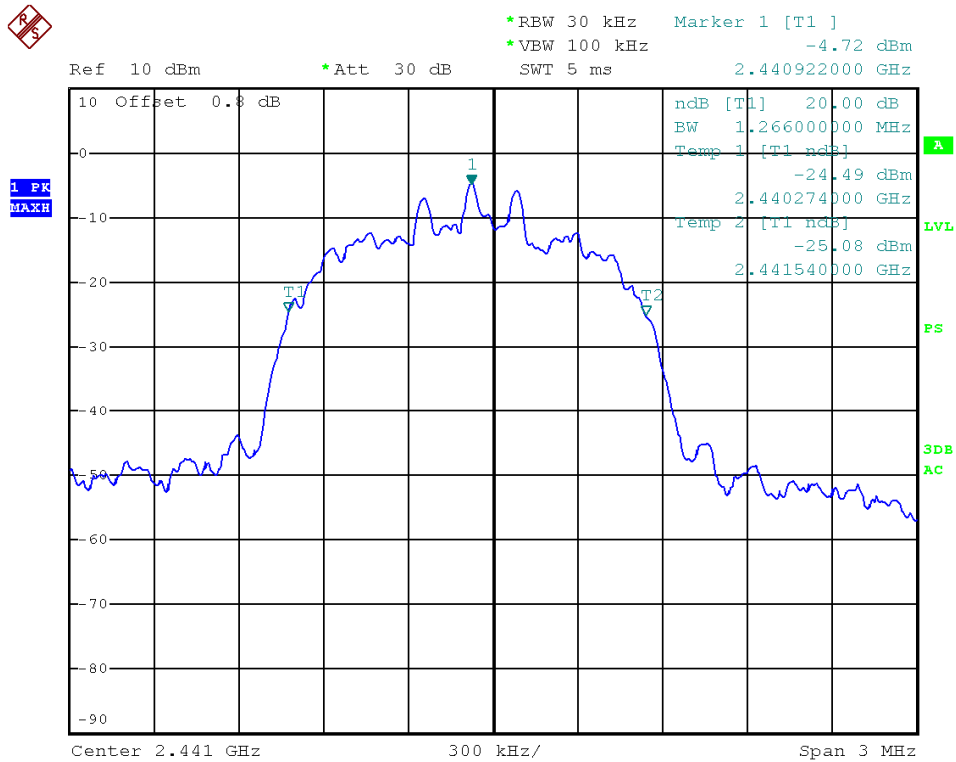
| Modulation | CH | Bandwidth<br>(kHz) | Two-thirds of Bandwidth<br>(kHz) |
|------------|----|--------------------|----------------------------------|
|            |    |                    |                                  |

|       |   |         |        |
|-------|---|---------|--------|
| 8DPSK | L | 1230.00 | 820.00 |
|       | M | 1266.00 | 844.00 |
|       | H | 1260.00 | 840.00 |

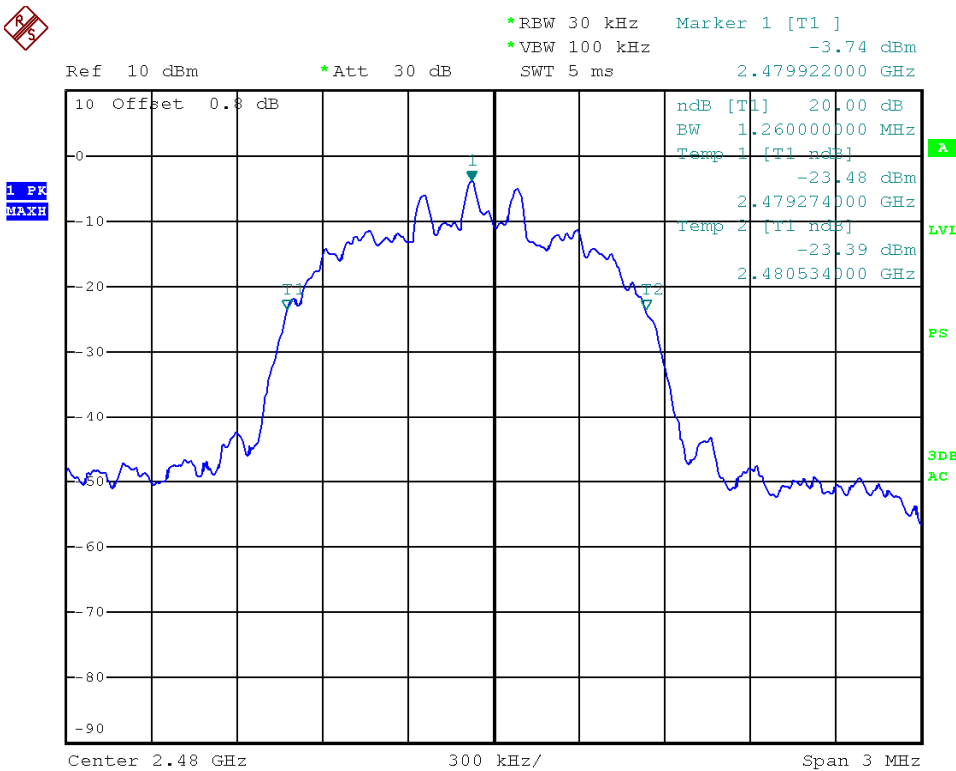
Channel L



Channel M



Channel H



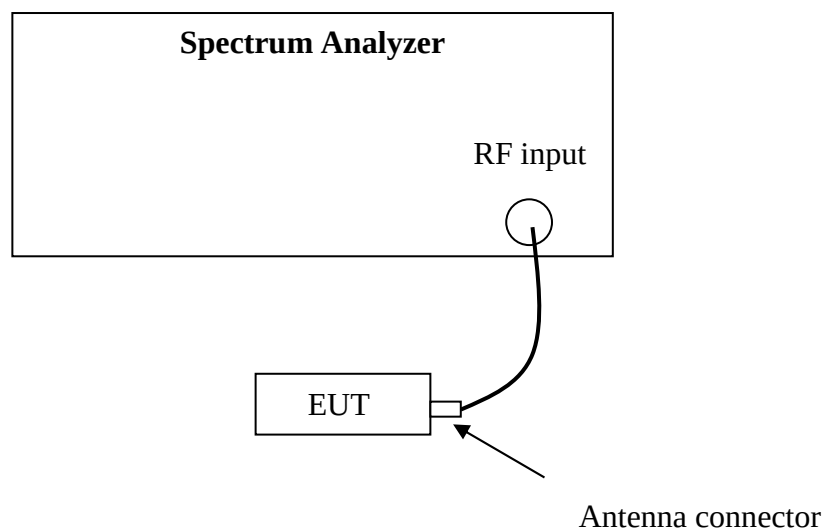
## 4. Carrier Frequency Separation

**Test result: Pass**

### 4.1 Limit

- ☐ Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
- ☒ Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW.

### 4.2 Test Configuration



### 4.3 Test Procedure and test setup

The Carrier Frequency Separation per FCC § 15.247(a)(1) is measured using the Spectrum Analyzer with Span can capture two adjacent channels,  $RBW \geq 1\%$  of the span,  $VBW \geq RBW$ , Sweep = auto, Detector = peak, Trace = max hold.

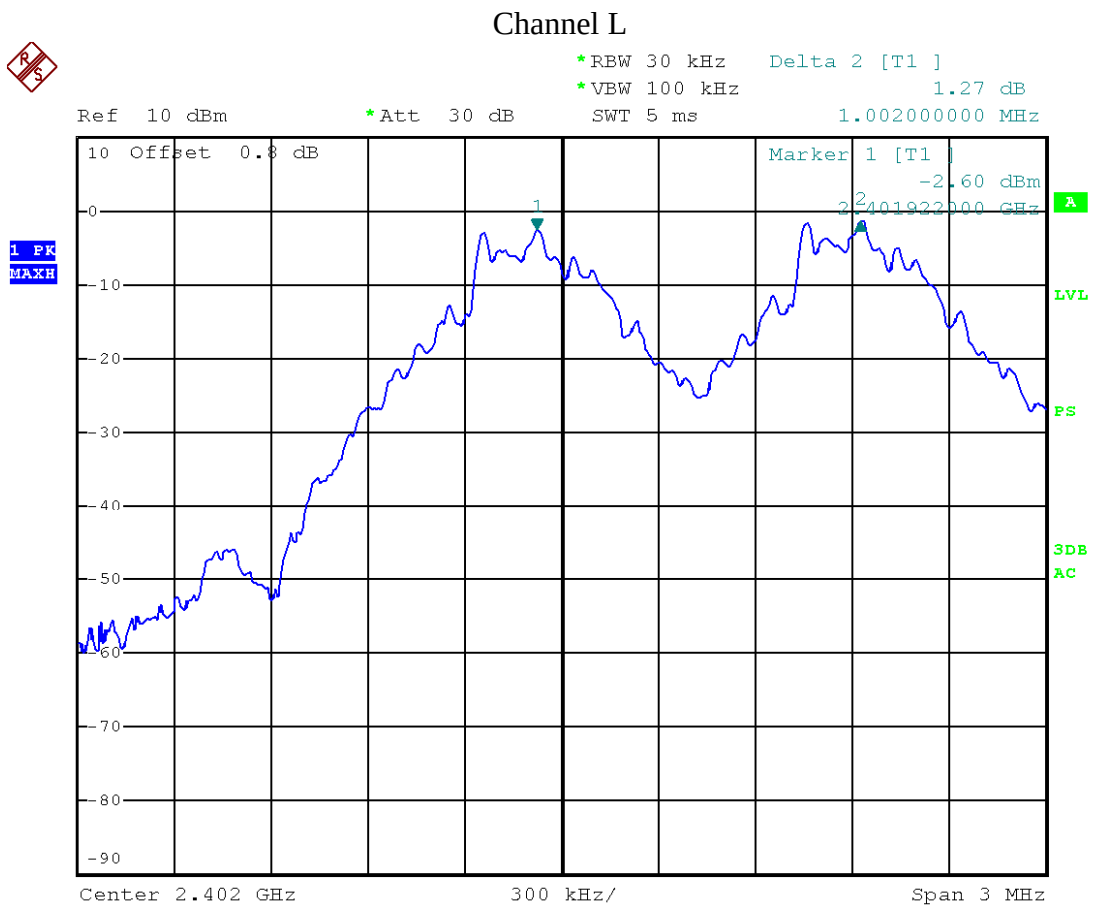
The test was performed at 3 channels (lowest, middle and highest channel).

The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

### 4.4 Test Protocol

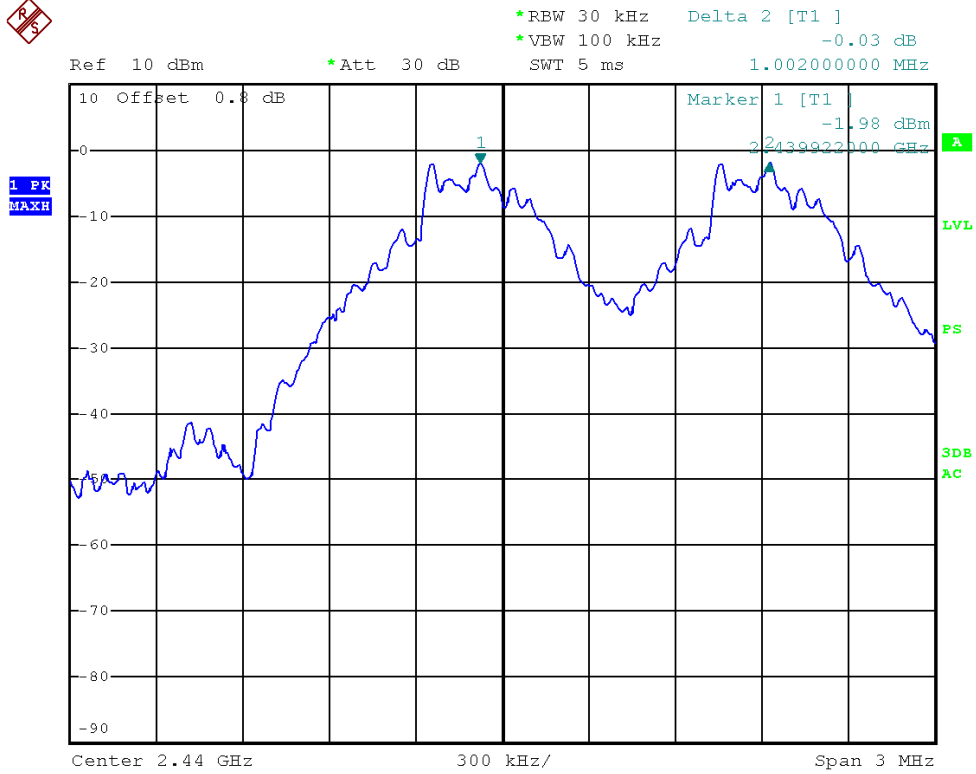
|                   |   |      |
|-------------------|---|------|
| Temperature       | : | 22°C |
| Relative Humidity | : | 45 % |

| Mode | CH | Frequency Separation<br>(kHz) | Limit<br>(kHz) |
|------|----|-------------------------------|----------------|
| GFSK | L  | 1002.00                       | $\geq 560.00$  |
|      | M  | 1002.00                       | $\geq 593.33$  |
|      | H  | 1002.00                       | $\geq 593.33$  |

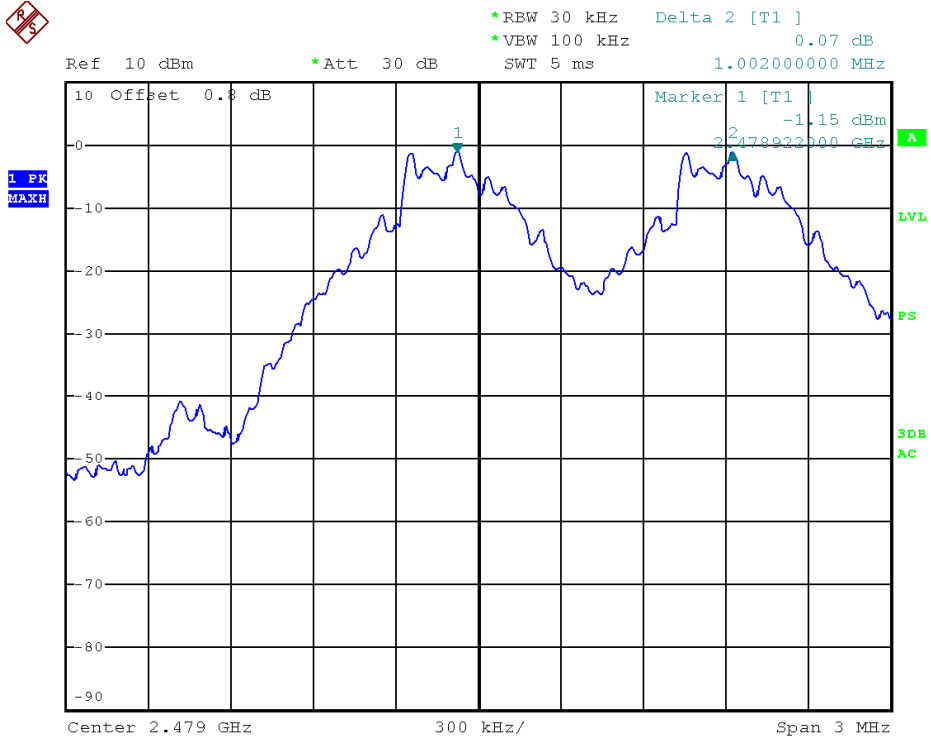




## Channel M



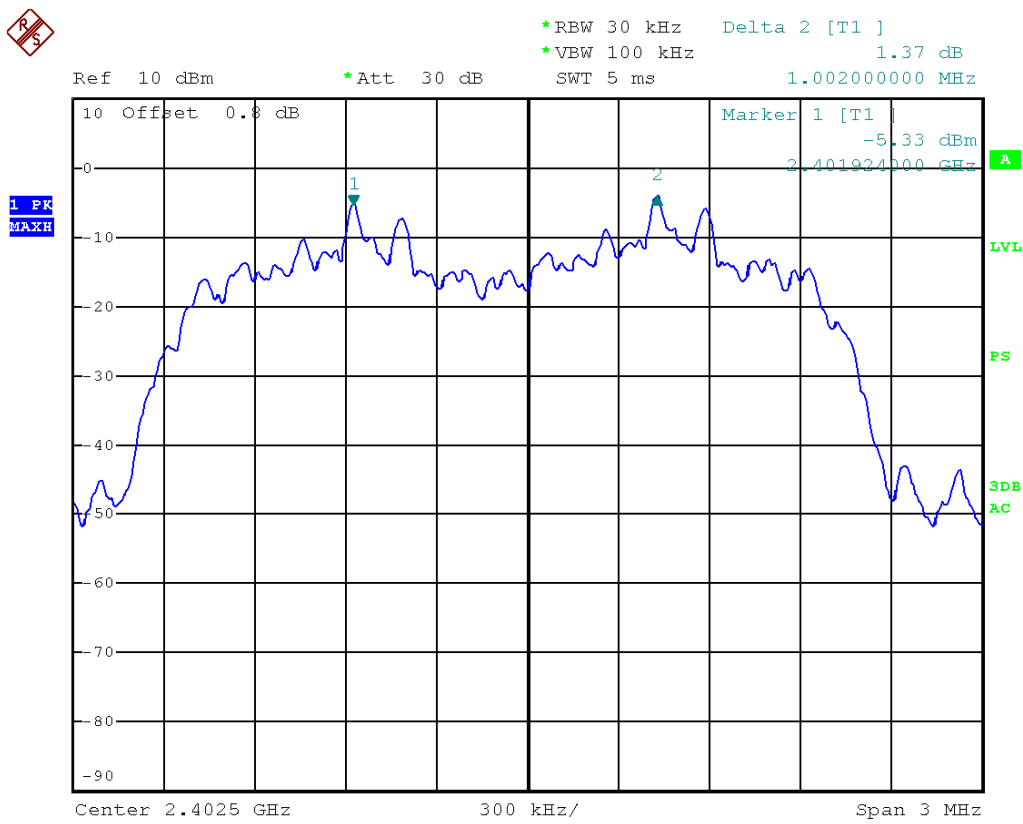
## Channel H



| Mode | CH | Frequency Separation | Limit |
|------|----|----------------------|-------|
|------|----|----------------------|-------|

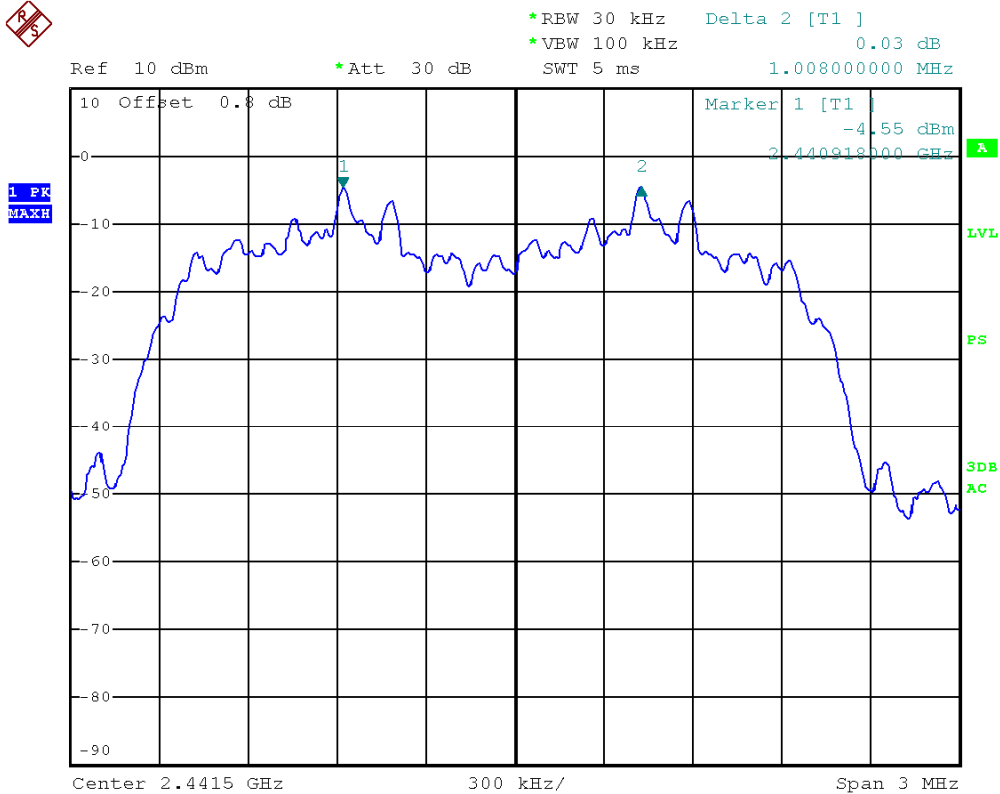
|       |   |         |               |
|-------|---|---------|---------------|
|       |   | (kHz)   | (kHz)         |
| 8DPSK | L | 1002.00 | $\geq 820.00$ |
|       | M | 1008.00 | $\geq 844.00$ |
|       | H | 1002.00 | $\geq 840.00$ |

Channel L

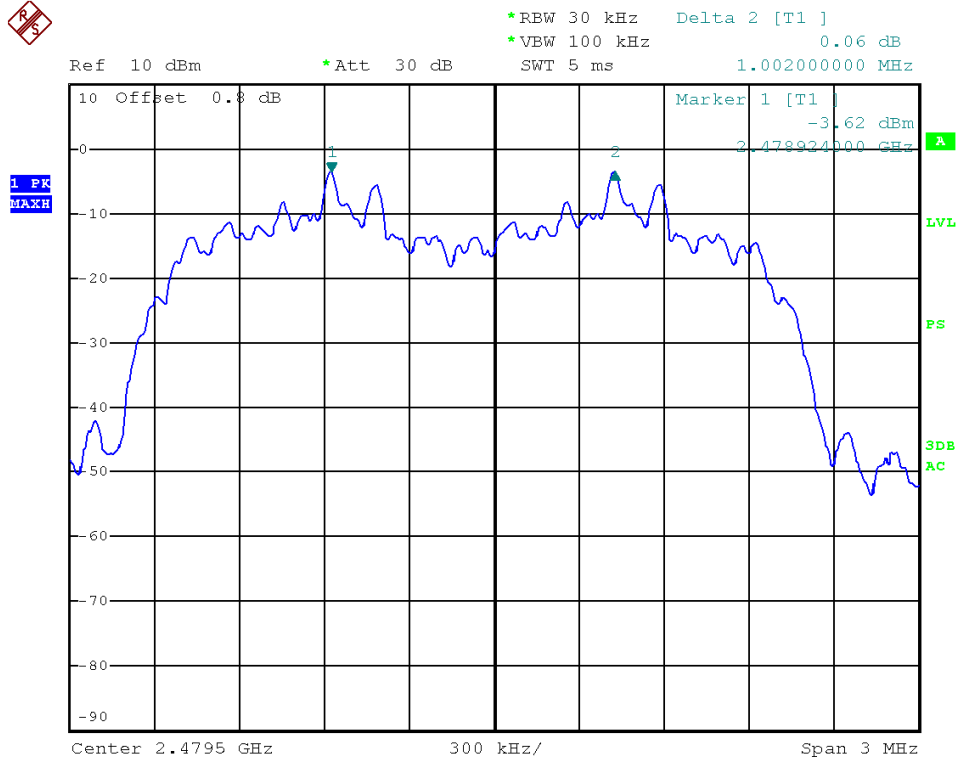




## Channel M



## Channel H



## 5. Maximum peak output power

**Test result: Pass**

### 5.1 Test limit

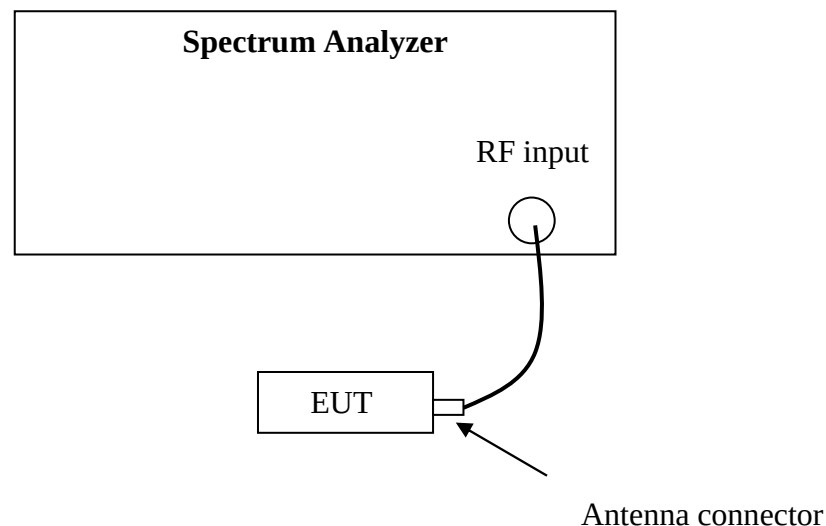
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

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

### 5.2 Test Configuration



### 5.3 Test procedure and test setup

The power output per FCC § 15.247(b) is measured using the Spectrum Analyzer with Span = 5 times the 20 dB bandwidth, RBW  $\geq$  the 20 dB bandwidth, VBW  $\geq$  RBW, Sweep = auto, Detector = peak, Trace = max hold.

The test was performed at 3 channels (lowest, middle and highest channel).

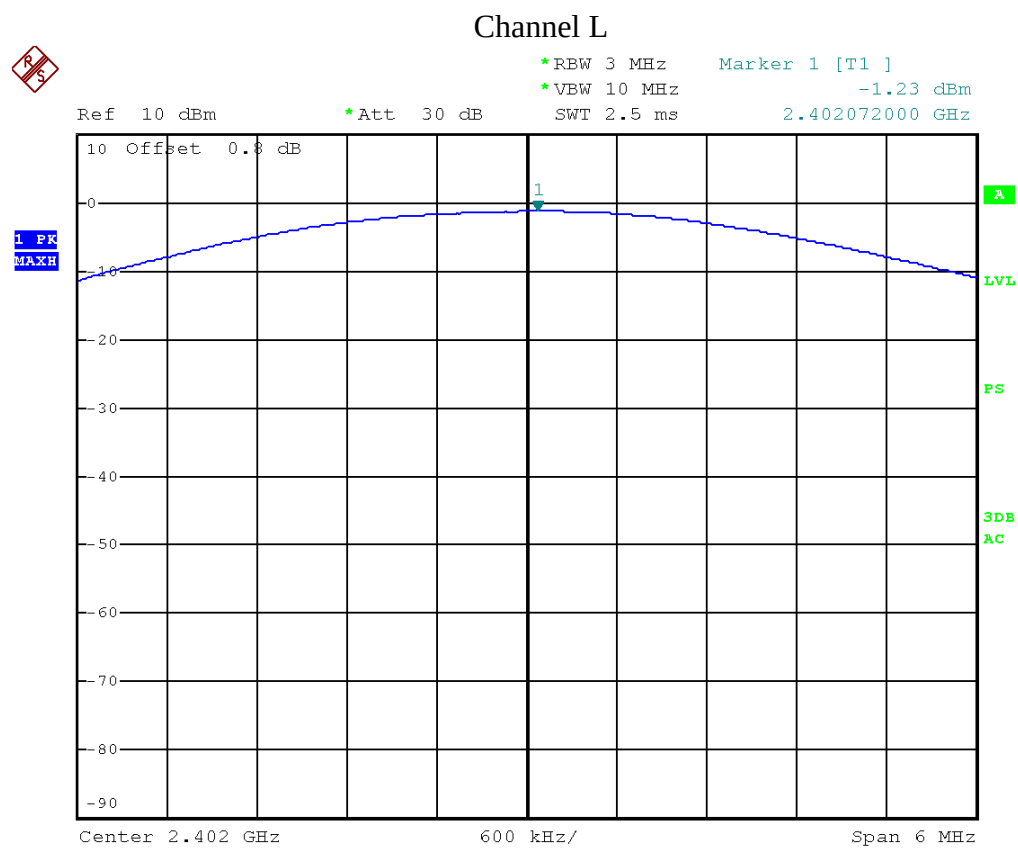
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

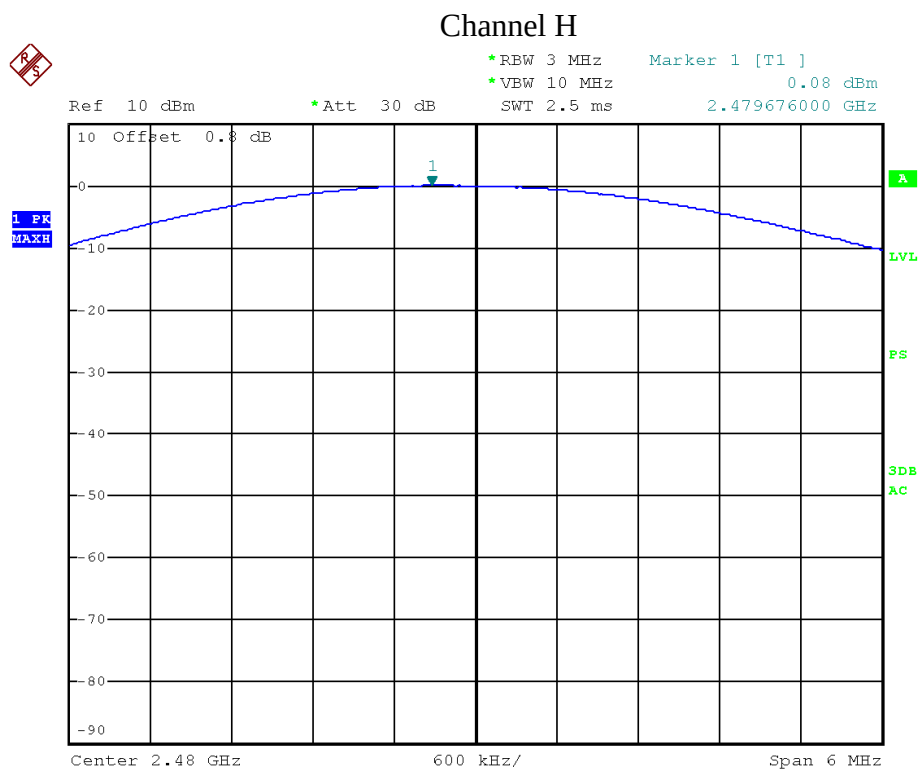
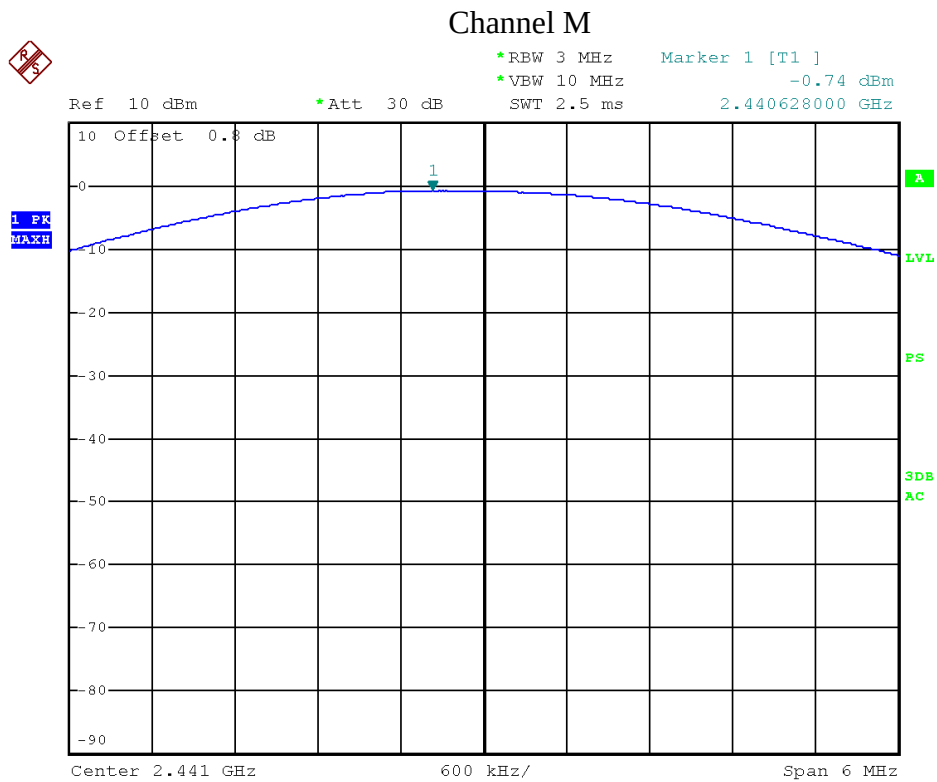
## 5.4 Test protocol

Temperature : 22 °C  
Relative Humidity : 45 %

| Mode | CH | Cable loss (dB) | Corrected reading (dBm) | Limit (dBm) |
|------|----|-----------------|-------------------------|-------------|
| GFSK | L  | 0.80            | -1.23                   | ≤21.00      |
|      | M  | 0.80            | -0.74                   |             |
|      | H  | 0.80            | 0.08                    |             |

**Conclusion: The maximum EIRP = 0.08 = 1.019mW which is lower than the limit of 4W listed in RSS-210.**



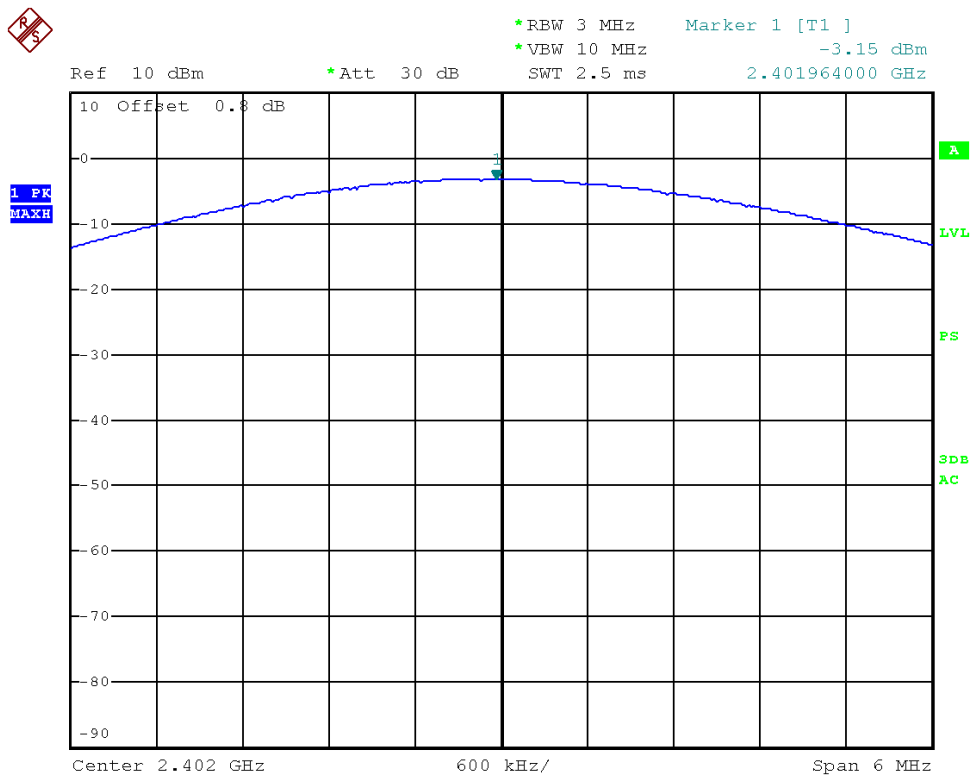


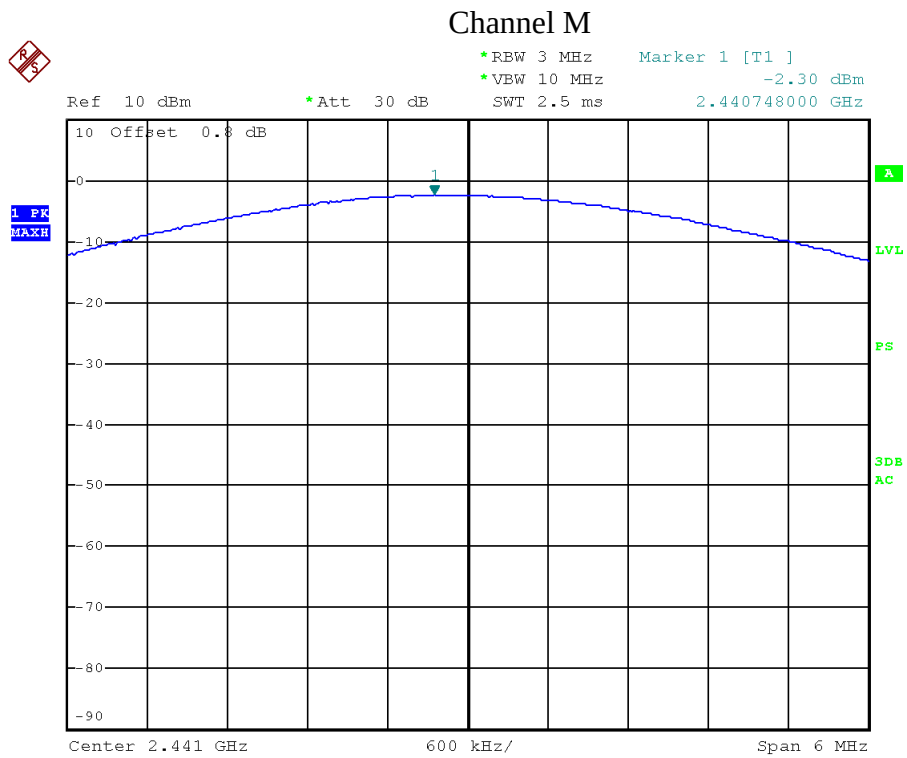
| Mode | CH | Cable loss<br>(dB) | Corrected reading<br>(dBm) | Limit<br>(dBm) |
|------|----|--------------------|----------------------------|----------------|
|------|----|--------------------|----------------------------|----------------|

|       |   |      |       |              |
|-------|---|------|-------|--------------|
| 8DPSK | L | 0.80 | -3.15 | $\leq 21.00$ |
|       | M | 0.80 | -2.30 |              |
|       | H | 0.80 | -1.35 |              |

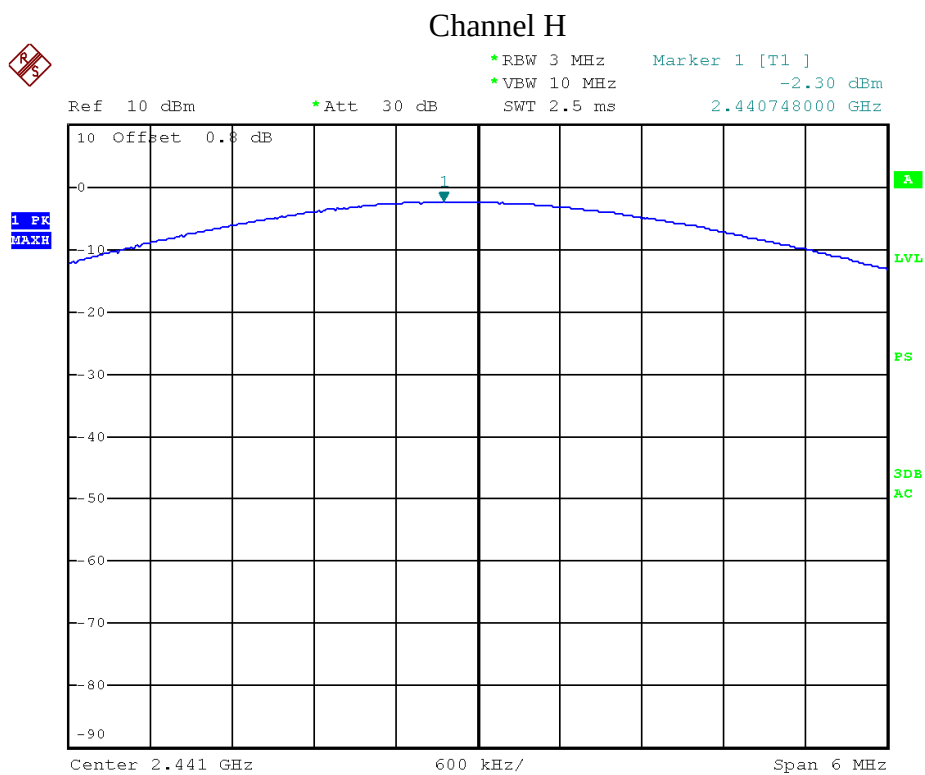
**Conclusion: The maximum EIRP = -1.35 = 0.733mW which is lower than the limit of 4W listed in RSS-210.**

### Channel L





Date: 13.MAR.2014 14:05:33



## 6. Radiated Spurious Emissions

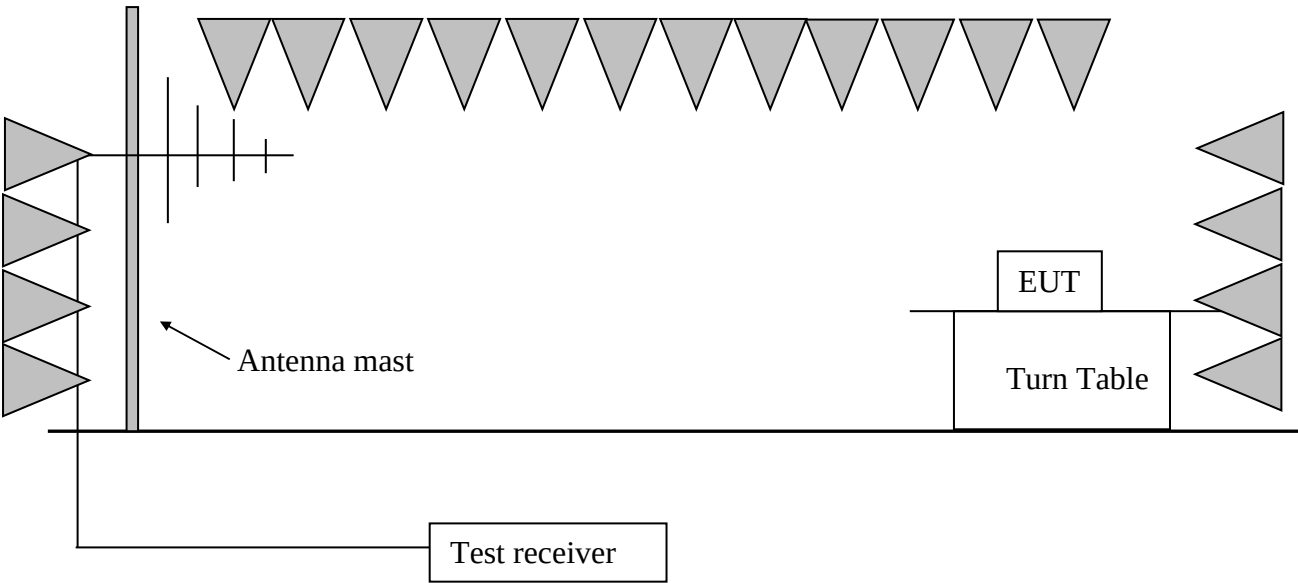
**Test result:**        **PASS**

### 6.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

| Frequency<br>(MHz) | Field Strength<br>(dBuV/m) | Measurement Distance<br>(m) |
|--------------------|----------------------------|-----------------------------|
| 30 - 88            | 40.0                       | 3                           |
| 88 - 216           | 43.5                       | 3                           |
| 216 - 960          | 46.0                       | 3                           |
| Above 960          | 54.0                       | 3                           |

### 6.2 Test Configuration



### 6.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 100kHz, VBW = 300kHz (30MHz~1GHz)

RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”.

## **6.4 Test protocol**

GFSK Modulation:

| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|----|---------|-----------------|-----------------------|----------------------------|----------------|-------------|----------|
| L  | H       | 2402.20         | 30.70                 | 88.30                      | Fundamental    | /           | PK       |
|    | H       | 119.42          | 15.30                 | 29.50                      | 43.50          | 14.00       | PK       |
|    | H       | 129.14          | 15.00                 | 32.30                      | 43.50          | 11.20       | PK       |
|    | V       | 329.36          | 16.00                 | 34.80                      | 46.00          | 11.20       | PK       |
|    | V       | 480.98          | 19.50                 | 32.20                      | 46.00          | 13.80       | PK       |
|    | H       | 1599.19         | -10.20                | 50.90                      | 54.00          | 3.10        | PK       |
|    | H       | 2390.00         | -8.00                 | 40.60                      | 54.00          | 13.40       | PK       |
|    | H       | 4806.18         | -1.50                 | 54.10                      | 74.00          | 19.90       | PK       |
|    | H       | 4805.87         | -1.50                 | 36.60                      | 54.00          | 17.40       | AV       |
| M  | H       | 2441.07         | 30.70                 | 88.90                      | Fundamental    | /           | PK       |
|    | H       | 119.42          | 15.30                 | 29.50                      | 43.50          | 14.00       | PK       |
|    | H       | 129.14          | 15.00                 | 32.30                      | 43.50          | 11.20       | PK       |
|    | V       | 329.36          | 16.00                 | 34.80                      | 46.00          | 11.20       | PK       |
|    | V       | 480.98          | 19.50                 | 32.20                      | 46.00          | 13.80       | PK       |
|    | H       | 1625.25         | -10.10                | 51.20                      | 54.00          | 2.80        | PK       |
|    | H       | 4885.77         | -1.10                 | 54.60                      | 74.00          | 19.40       | PK       |
|    | H       | 4885.23         | -1.10                 | 36.80                      | 54.00          | 17.20       | AV       |
| H  | H       | 2479.83         | 30.70                 | 89.80                      | Fundamental    | /           | PK       |
|    | H       | 119.42          | 15.30                 | 29.50                      | 43.50          | 14.00       | PK       |
|    | H       | 129.14          | 15.00                 | 32.30                      | 43.50          | 11.20       | PK       |
|    | V       | 329.36          | 16.00                 | 34.80                      | 46.00          | 11.20       | PK       |
|    | V       | 480.98          | 19.50                 | 32.20                      | 46.00          | 13.80       | PK       |
|    | H       | 1651.30         | -9.90                 | 50.40                      | 54.00          | 3.60        | PK       |
|    | H       | 2483.50         | -7.80                 | 40.20                      | 54.00          | 13.80       | PK       |
|    | H       | 4961.54         | -0.80                 | 54.30                      | 74.00          | 19.70       | PK       |
|    | H       | 4960.79         | -0.80                 | 36.50                      | 54.00          | 17.50       | AV       |

8DPSK Modulation:

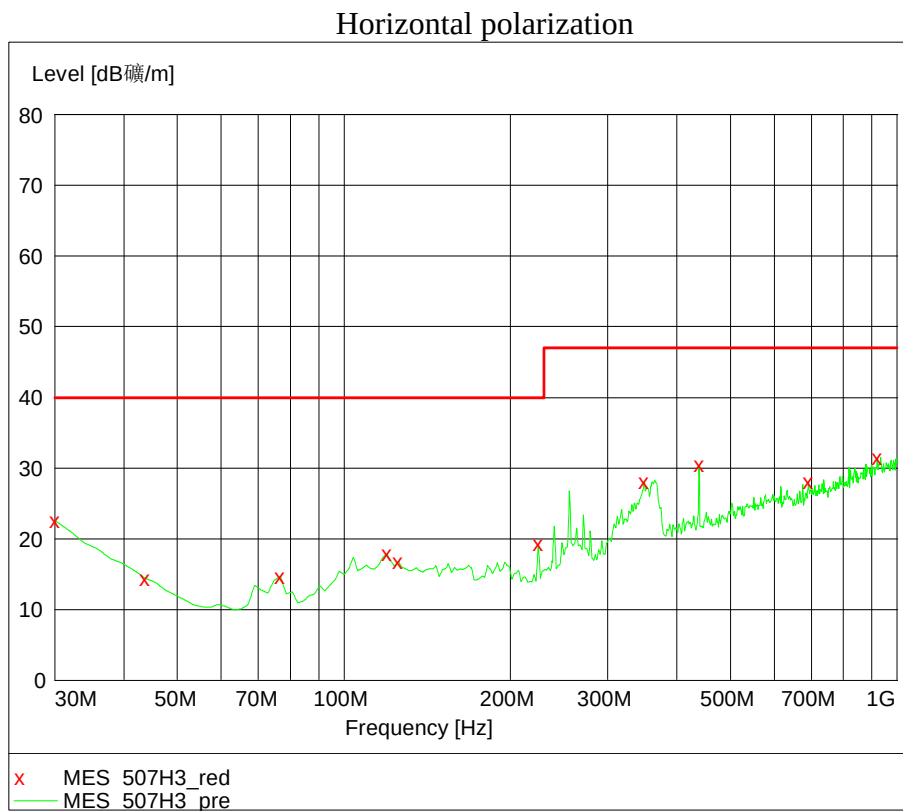
| CH | Antenna | Frequency (MHz) | Correct Factor (dB/m) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|----|---------|-----------------|-----------------------|----------------------------|----------------|-------------|----------|
|----|---------|-----------------|-----------------------|----------------------------|----------------|-------------|----------|

|   |   |         |        |       |             |       |    |
|---|---|---------|--------|-------|-------------|-------|----|
| L | H | 2402.20 | 30.70  | 86.30 | Fundamental | /     | PK |
|   | H | 101.93  | 12.40  | 17.20 | 43.50       | 25.8  | PK |
|   | H | 131.08  | 13.50  | 16.70 | 43.50       | 26.8  | PK |
|   | V | 348.80  | 17.10  | 27.40 | 46.00       | 18.6  | PK |
|   | V | 352.69  | 17.20  | 28.90 | 46.00       | 17.1  | PK |
|   | H | 1599.19 | -10.20 | 50.90 | 54.00       | 3.10  | PK |
|   | H | 2390.00 | -8.00  | 38.60 | 54.00       | 13.40 | PK |
|   | H | 4806.18 | -1.50  | 52.10 | 74.00       | 19.90 | PK |
|   | H | 4805.87 | -1.50  | 35.60 | 54.00       | 17.40 | AV |
| M | H | 2441.07 | 30.70  | 86.80 | Fundamental | /     | PK |
|   | H | 101.93  | 12.40  | 17.20 | 43.50       | 25.8  | PK |
|   | H | 131.08  | 13.50  | 16.70 | 43.50       | 26.8  | PK |
|   | V | 348.80  | 17.10  | 27.40 | 46.00       | 18.6  | PK |
|   | V | 352.69  | 17.20  | 28.90 | 46.00       | 17.1  | PK |
|   | H | 1625.25 | -10.10 | 51.20 | 54.00       | 2.80  | PK |
|   | H | 4885.77 | -1.10  | 53.60 | 74.00       | 19.40 | PK |
|   | H | 4885.23 | -1.10  | 35.80 | 54.00       | 17.20 | AV |
| H | H | 2479.83 | 30.70  | 87.80 | Fundamental | /     | PK |
|   | H | 101.93  | 12.40  | 17.20 | 43.50       | 25.8  | PK |
|   | H | 131.08  | 13.50  | 16.70 | 43.50       | 26.8  | PK |
|   | V | 348.80  | 17.10  | 27.40 | 46.00       | 18.6  | PK |
|   | V | 352.69  | 17.20  | 28.90 | 46.00       | 17.1  | PK |
|   | H | 1651.30 | -9.90  | 50.40 | 54.00       | 3.60  | PK |
|   | H | 2483.50 | -7.80  | 39.70 | 54.00       | 13.80 | PK |
|   | H | 4961.54 | -0.80  | 53.50 | 74.00       | 19.70 | PK |
|   | H | 4960.79 | -0.80  | 35.80 | 54.00       | 17.50 | AV |

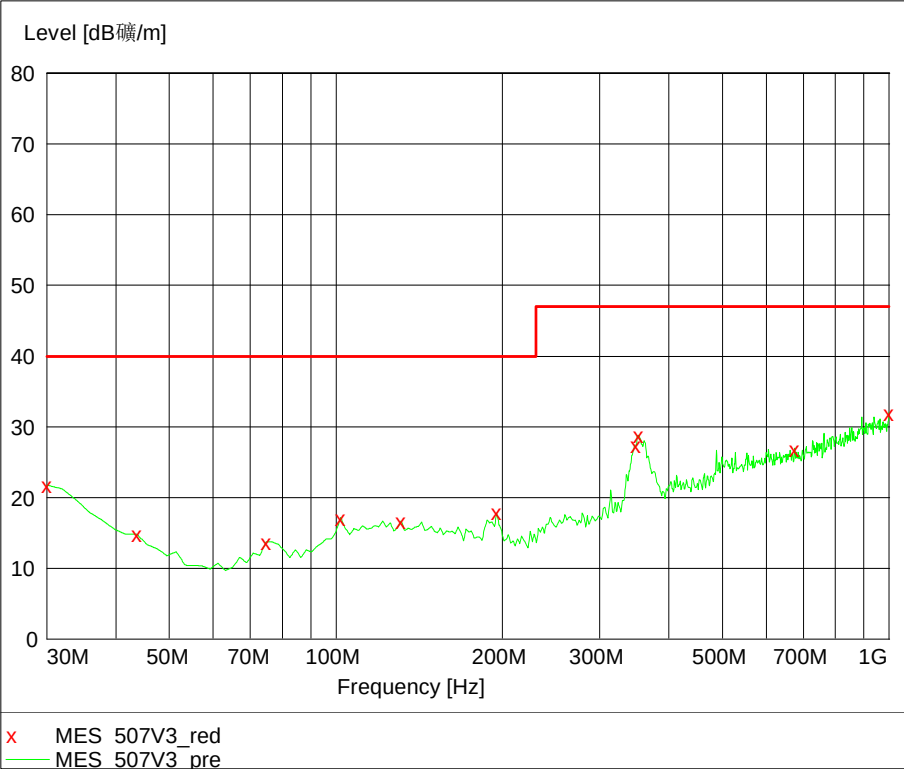
- Remark: 1. For fundamental emission, no amplifier is employed.  
2. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)  
3. Corrected Reading = Original Receiver Reading + Correct Factor  
4. Margin = limit – Corrected Reading  
5. If the PK reading is lower than AV limit, the AV test can be elided.

6. The emission was conducted from 30MHz to 25GHz.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,  
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.  
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading  
= 10dBuV + 0.20dB/m = 10.20dBuV/m  
Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then  
Margin = 54 -10.20 = 43.80dBuV/m



Vertical polarization



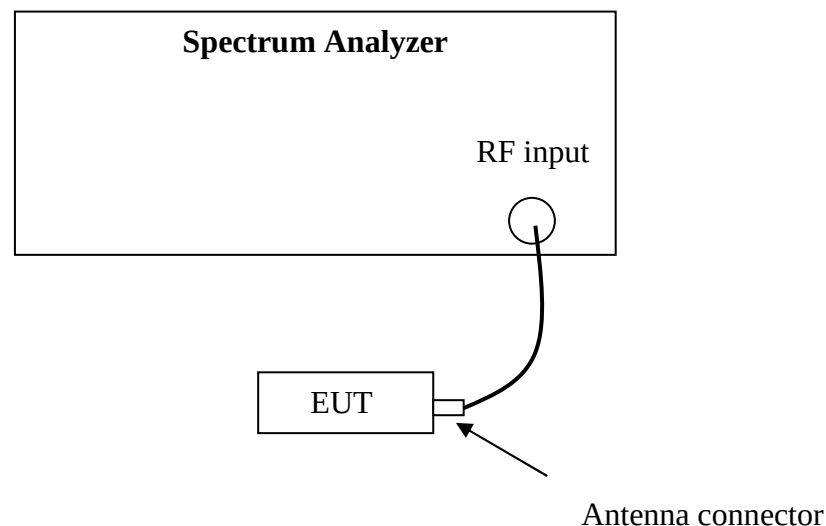
## 7. Conducted Spurious Emissions & Band Edge

**Test result:**      **PASS**

### 7.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

### 7.2 Test Configuration



### 7.3 Test procedure and test setup

The Conducted Spurious Emissions per FCC § 15.247(d) is measured using the Spectrum Analyzer with Span wide enough capturing all spurious from the lowest emission frequency of the EUT up to 10th harmonics,  $RBW = 100\text{kHz}$ ,  $VBW \geq RBW$ , Sweep = auto, Detector = peak, Trace = max hold.

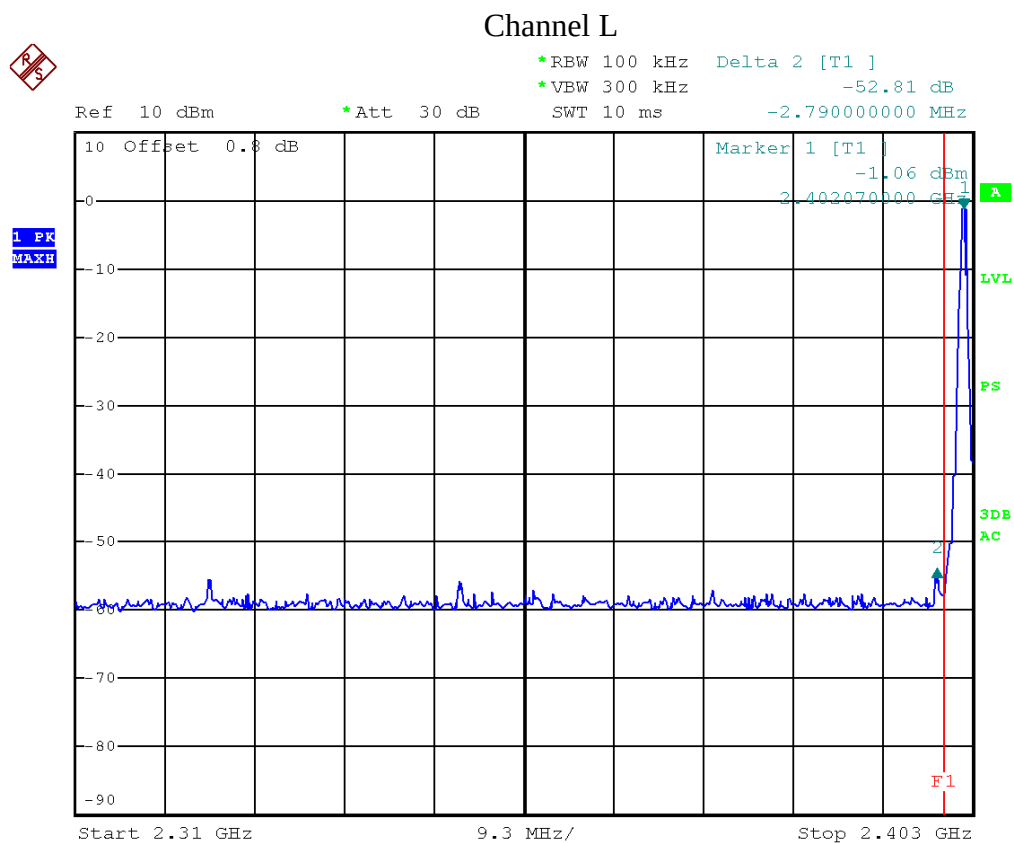
The test was performed at 3 channels (lowest, middle and highest channel).

The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

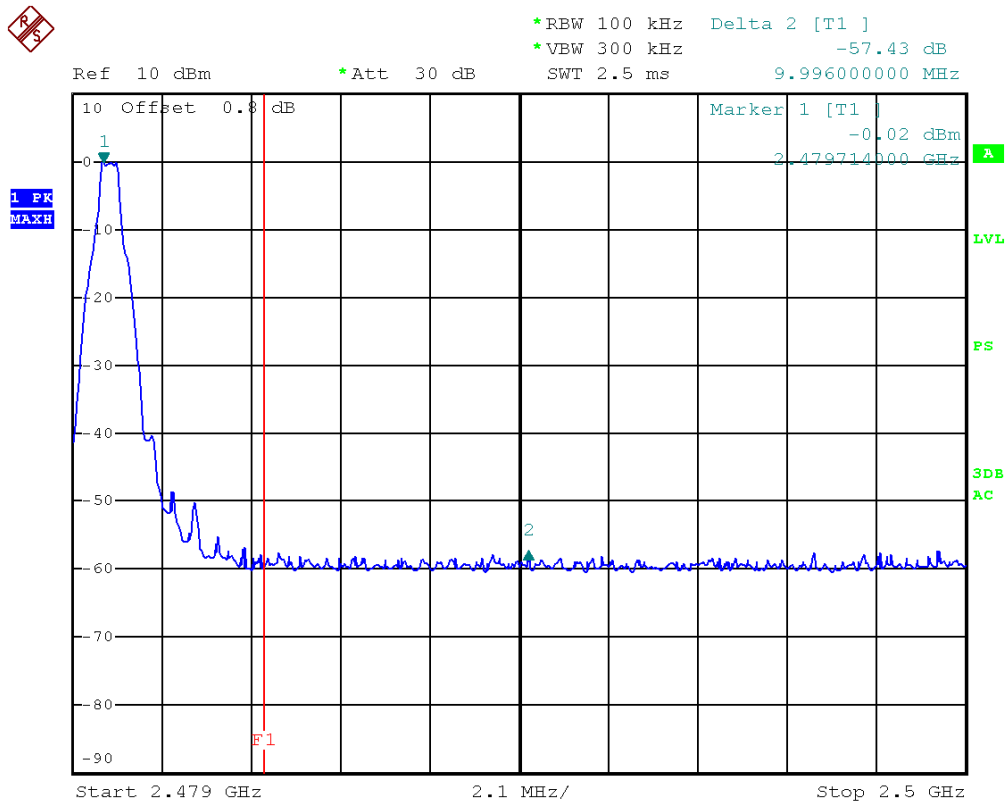
## 7.4 Test protocol

| Model | CH | Max reading<br>among band<br>(dBm) | The most restrict<br>Attenuation outside band<br>(dB) | Limit<br>(dB) |
|-------|----|------------------------------------|-------------------------------------------------------|---------------|
| GFSK  | L  | -1.06                              | 52.81                                                 | ≥20           |
|       | M  | -0.50                              | 51.56                                                 |               |
|       | H  | -0.02                              | 57.43                                                 |               |

Note: The test was performed from 9kHz to 26GHz and the worst data is listed here.



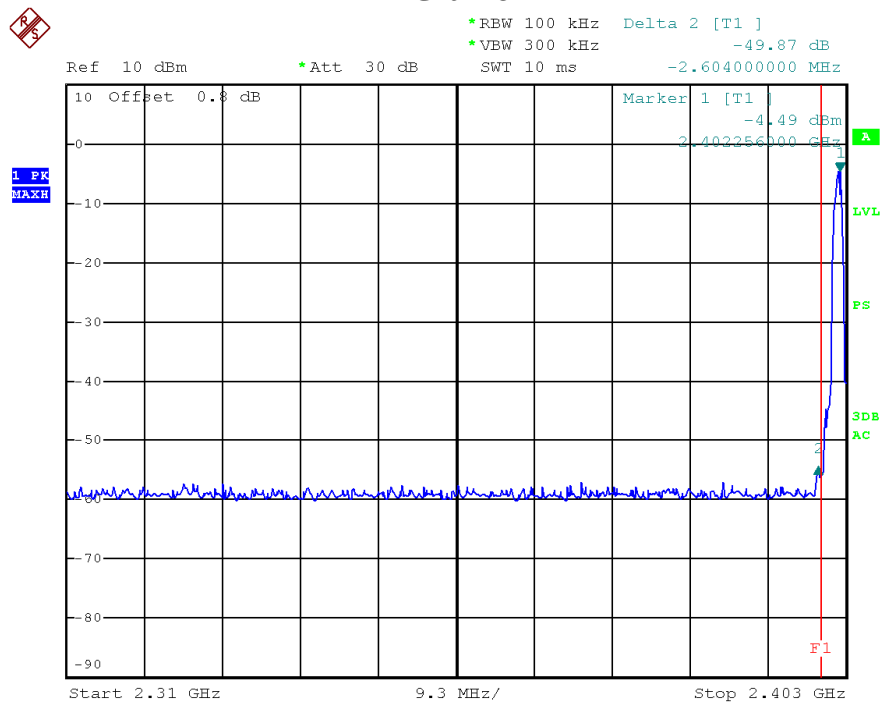
## Channel H



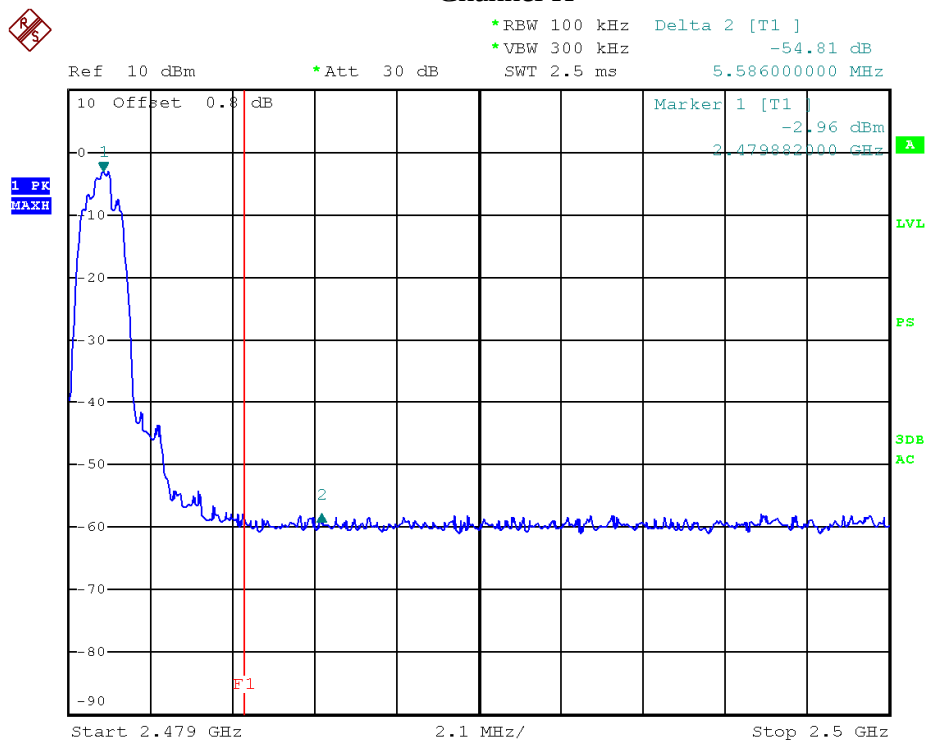
| Model | CH | Max reading<br>among band<br>(dBm) | The most restrict<br>Attenuation outside band<br>(dB) | Limit<br>(dB) |
|-------|----|------------------------------------|-------------------------------------------------------|---------------|
| 8DPSK | L  | -4.49                              | 49.87                                                 | ≥20           |
|       | M  | -3.72                              | 52.00                                                 |               |
|       | H  | -2.96                              | 54.81                                                 |               |

Note: The test was performed from 9kHz to 26GHz and the worst data is listed here.

## Channel L



## Channel H



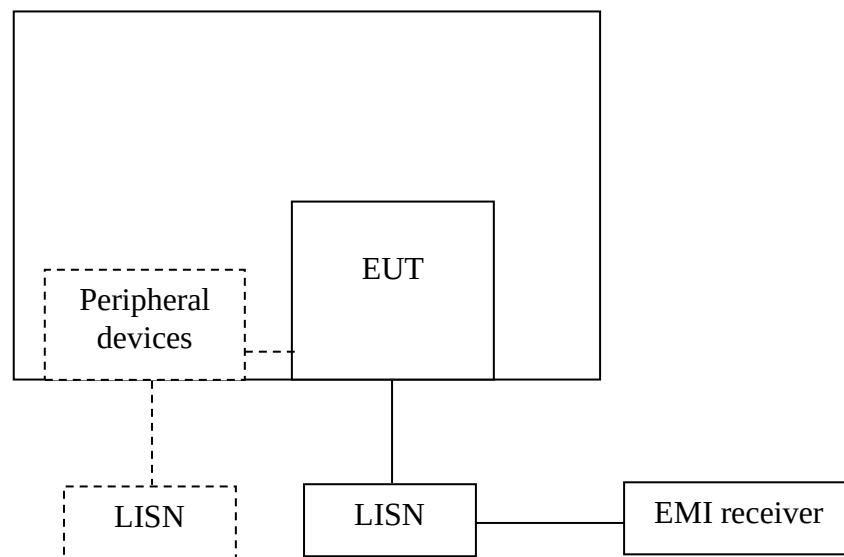
## 8. Power line conducted emission

Test result: Pass

### 8.1 Limit

| Frequency of Emission (MHz)                      | Conducted Limit (dBuV) |            |
|--------------------------------------------------|------------------------|------------|
|                                                  | QP                     | AV         |
| 0.15-0.5                                         | 66 to 56*              | 56 to 46 * |
| 0.5-5                                            | 56                     | 46         |
| 5-30                                             | 60                     | 50         |
| * Decreases with the logarithm of the frequency. |                        |            |

### 8.2 Test configuration



☐ For table top equipment, wooden support is 0.8m height table

☒ For floor standing equipment, wooden support is 0.12m height rack.

### 8.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement.

The bandwidth of the test receiver is set at 9 kHz.

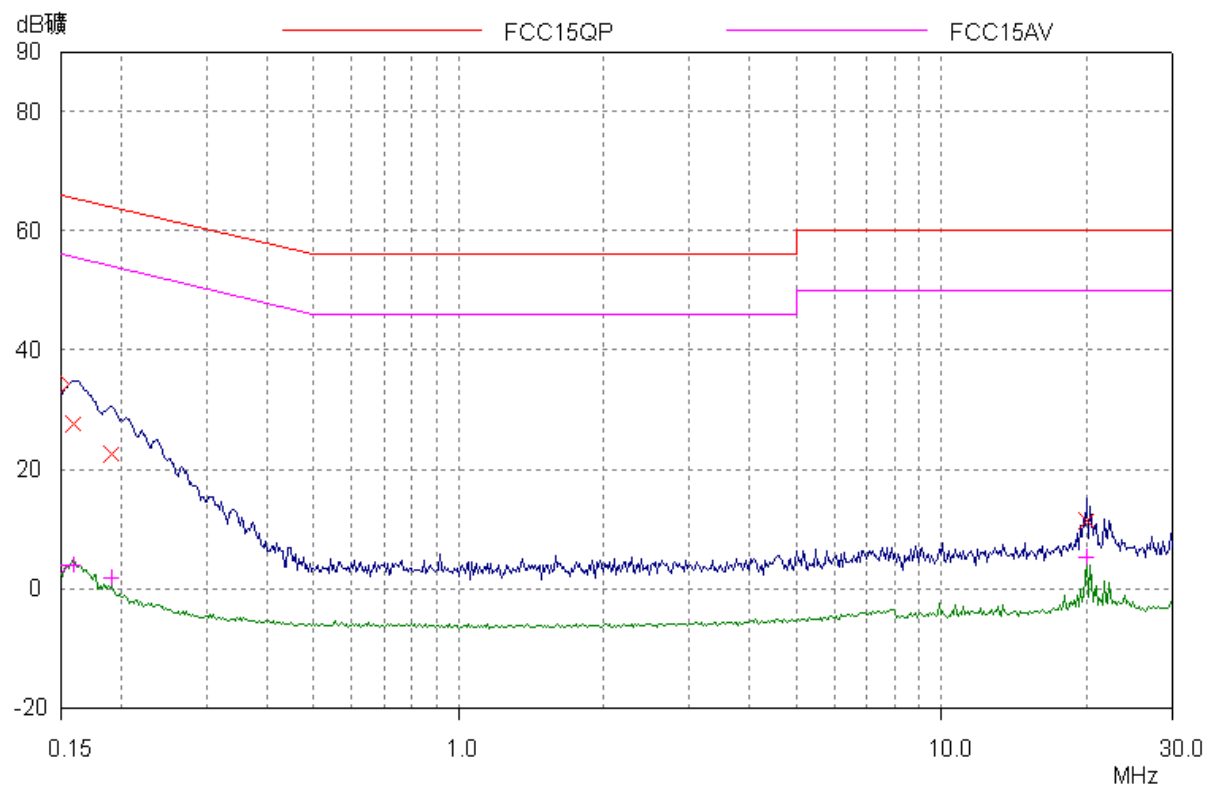
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems)

### 8.4 Test protocol

L&N:

| Frequency                                                                                                              | Correct Factor (dB) | Corrected Reading (dBuV) |      | Limit (dBuV) |       | Margin (dB) |       |
|------------------------------------------------------------------------------------------------------------------------|---------------------|--------------------------|------|--------------|-------|-------------|-------|
|                                                                                                                        |                     | QP                       | AV   | QP           | AV    | QP          | AV    |
| 0.15 (L)                                                                                                               | 0.27                | 27.65                    | 3.99 | 65.54        | 55.54 | 37.89       | 51.55 |
| 0.19 (L)                                                                                                               | 0.14                | 22.49                    | 1.68 | 64.01        | 54.01 | 41.52       | 52.33 |
| 19.87 (L)                                                                                                              | 0.94                | 11.41                    | 5.30 | 60.00        | 50.00 | 48.59       | 44.70 |
| 0.16 (N)                                                                                                               | 0.27                | 27.53                    | 4.04 | 65.54        | 55.54 | 38.01       | 51.50 |
| 0.19 (N)                                                                                                               | 0.14                | 22.26                    | 1.68 | 64.01        | 54.01 | 41.75       | 52.33 |
| 19.87 (N)                                                                                                              | 0.94                | 9.75                     | 5.40 | 60.00        | 50.00 | 50.25       | 44.60 |
| Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB).<br>2. Margin (dB) = Limit - Corrected Reading. |                     |                          |      |              |       |             |       |

L&N:



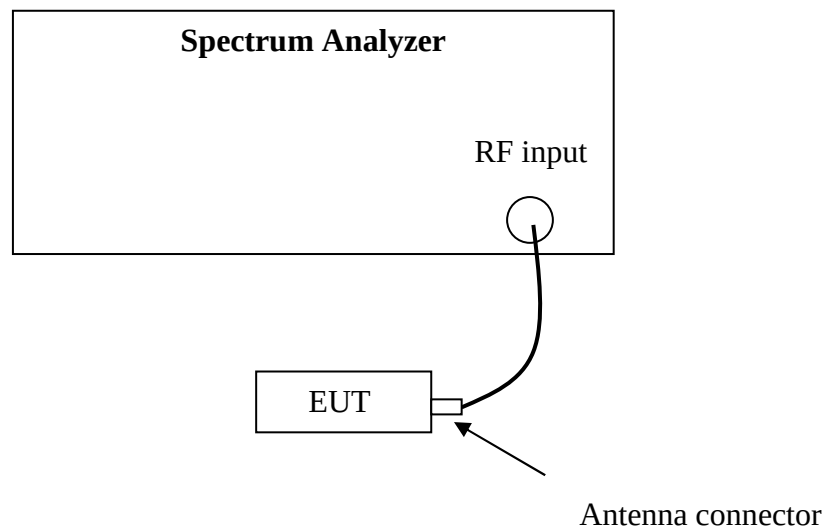
## 9. Number of Hopping Frequencies

**Test result:**      **Pass**

### 9.1 Limit

Number of Hopping Frequencies in the 2400-2483.5 MHz band shall use at least 15 channels.

### 9.2 Test Configuration



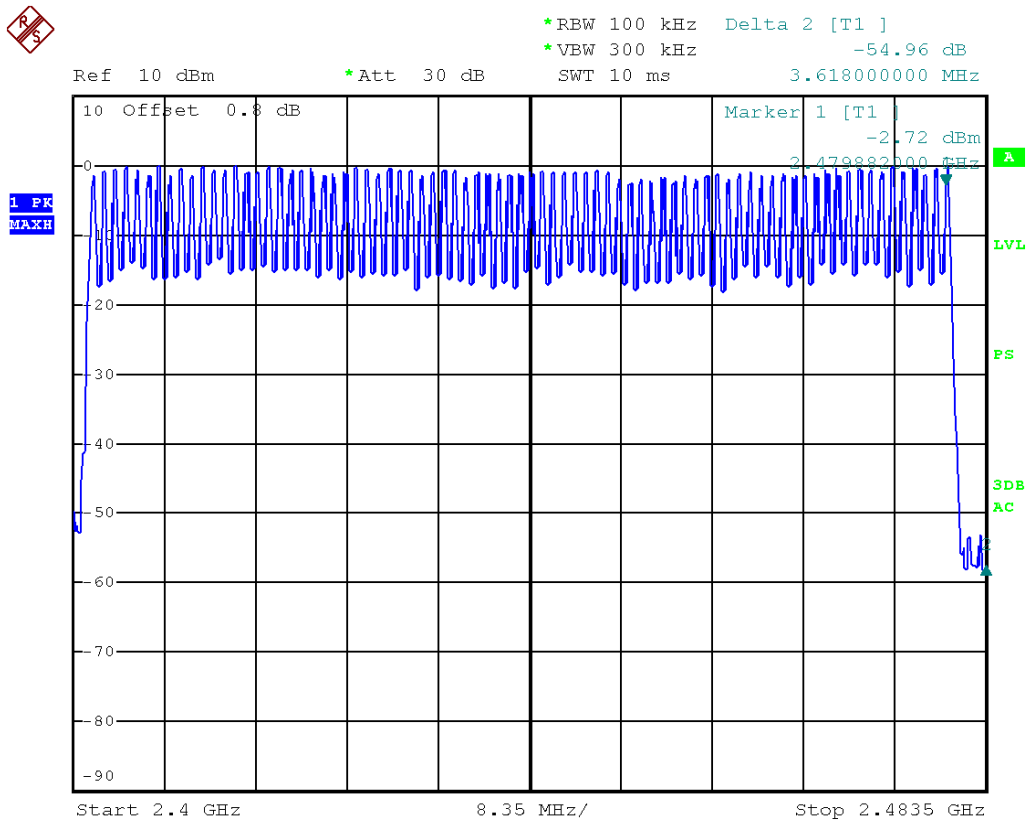
### 9.3 Test procedure and test setup

The channel number per FCC §15.247(a)(1)(iii) is measured using the Spectrum Analyzer with RBW=100kHz, VBW $\geq$ RBW, Sweep = auto, Detector = peak, Trace = max hold.

The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

9.4 Test protocol

| Channel Number | Limit |
|----------------|-------|
| 79             | ≥15   |



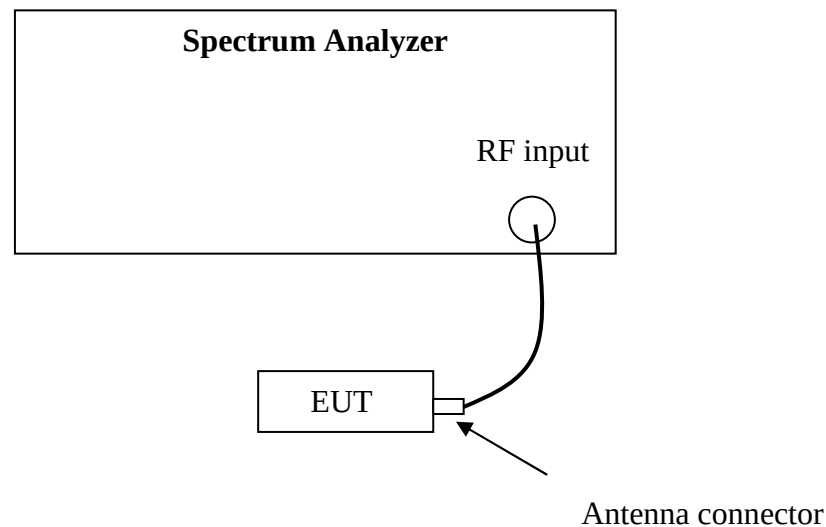
## 10. Dwell Time

**Test result:**      **Pass**

### 10.1 Limit

The dwell time on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 10.2 Test Configuration



### 10.3 Test procedure and test setup

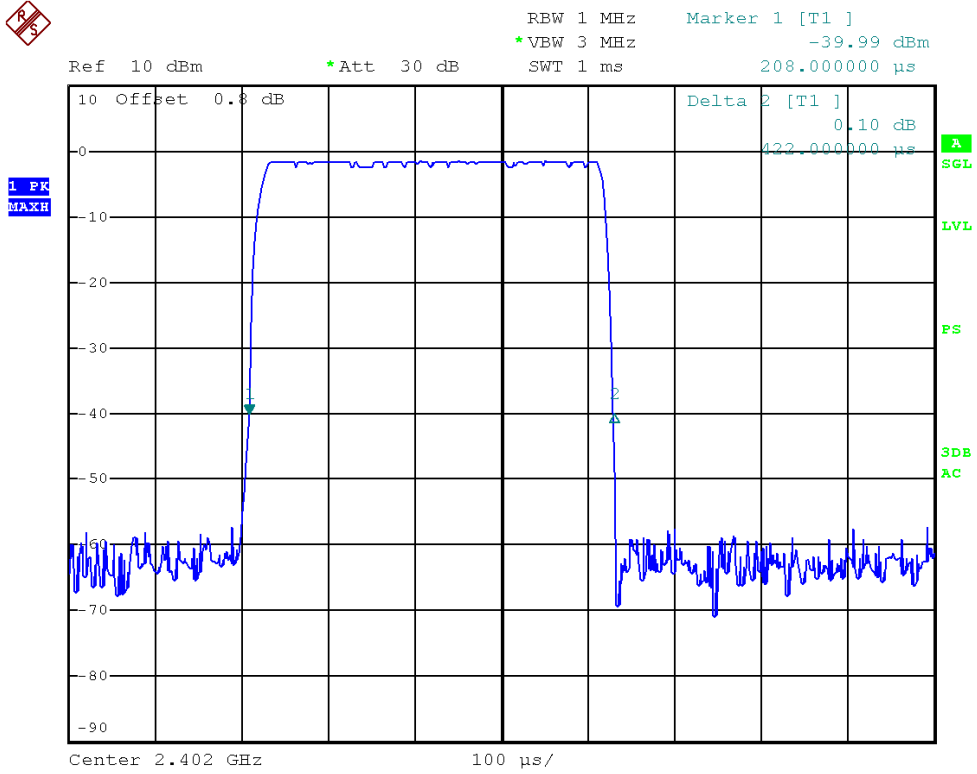
Dwell time per FCC § 15.247(a)(1)(iii) is measured using the Spectrum Analyzer with Span = 0, RBW=1MHz, VBW $\geq$ RBW, Sweep can capture the entire dwell time, Detector = peak, Trace = max hold.  
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

## 10.4 Test protocol

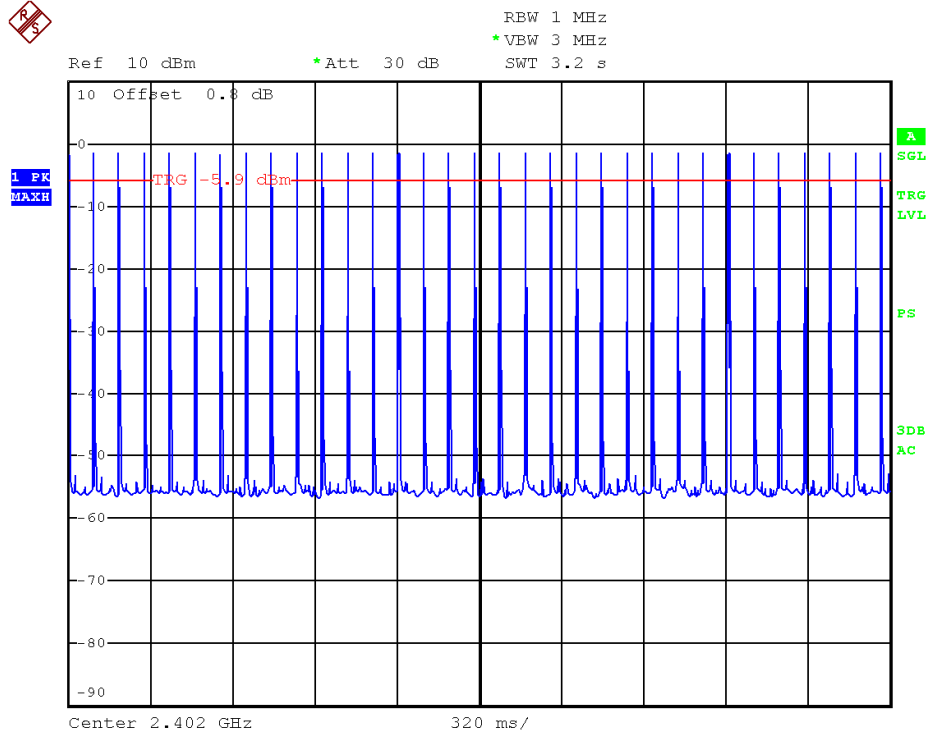
| Packet | Occupancy time<br>for single hop<br>(ms)<br><b>O</b> | CH | Real observed<br>period<br>(s)<br><b>P</b> | Hops among<br>Observed<br>period<br><b>I</b> | Dwell time<br>(s)<br><b>T</b> | Limit<br>(s) |
|--------|------------------------------------------------------|----|--------------------------------------------|----------------------------------------------|-------------------------------|--------------|
| DH1    | 0.422                                                | L  | 3.16                                       | 33                                           | 0.14                          | ≤0.4         |
|        |                                                      | M  | 3.16                                       | 33                                           | 0.14                          |              |
|        |                                                      | H  | 3.16                                       | 33                                           | 0.14                          |              |
| DH3    | 1.688                                                | L  | 3.16                                       | 17                                           | 0.29                          |              |
|        |                                                      | M  | 3.16                                       | 17                                           | 0.29                          |              |
|        |                                                      | H  | 3.16                                       | 17                                           | 0.29                          |              |
| DH5    | 2.924                                                | L  | 3.16                                       | 11                                           | 0.32                          |              |
|        |                                                      | M  | 3.16                                       | 11                                           | 0.32                          |              |
|        |                                                      | H  | 3.16                                       | 11                                           | 0.32                          |              |

Remark: 1. There are 79 channels in all. So the complete observed period  $P = 0.4 * 79 = 31.6$  s.

2. Average time of occupancy  $T = O * I * 31.6 / P$

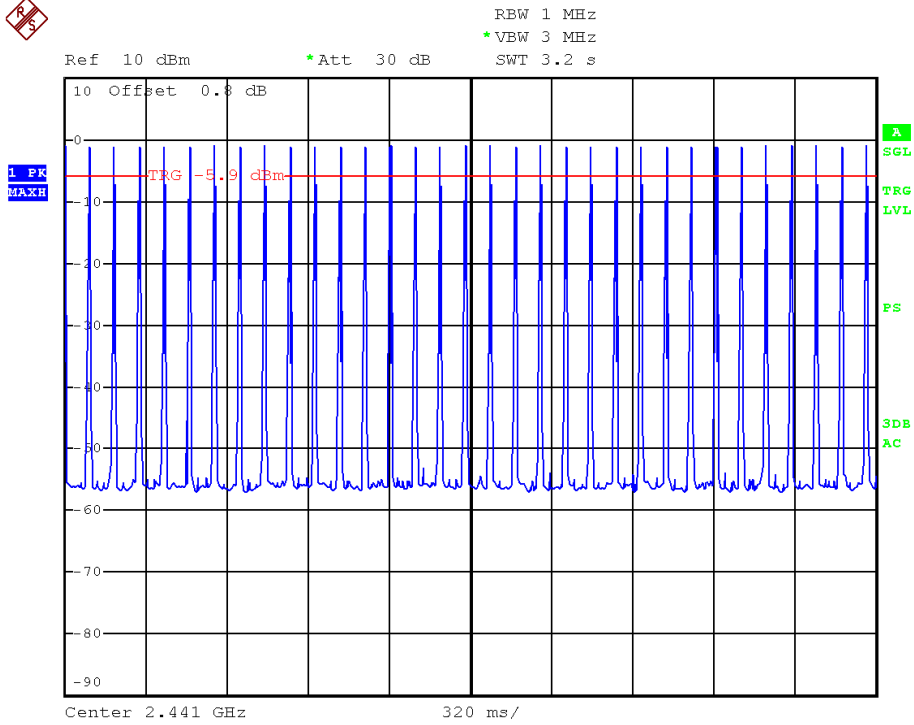


## Channel L

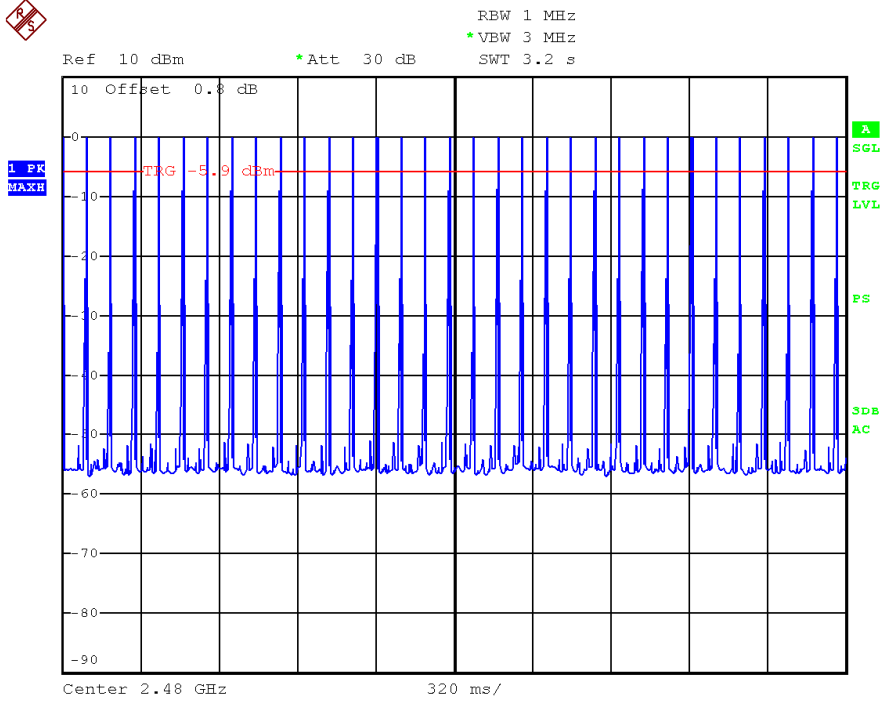




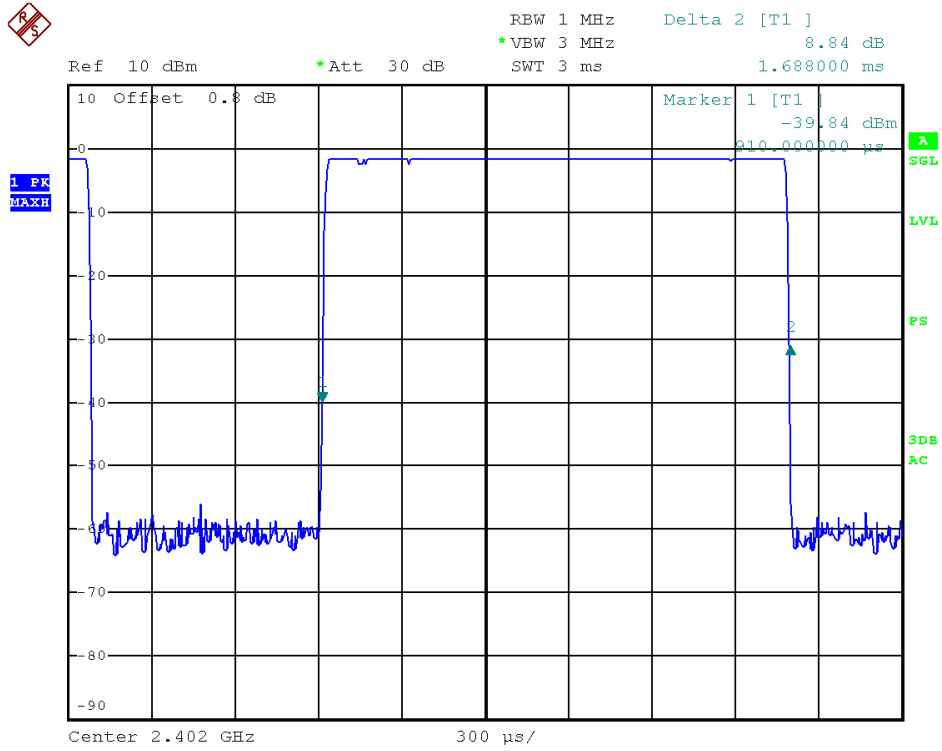
# Channel M



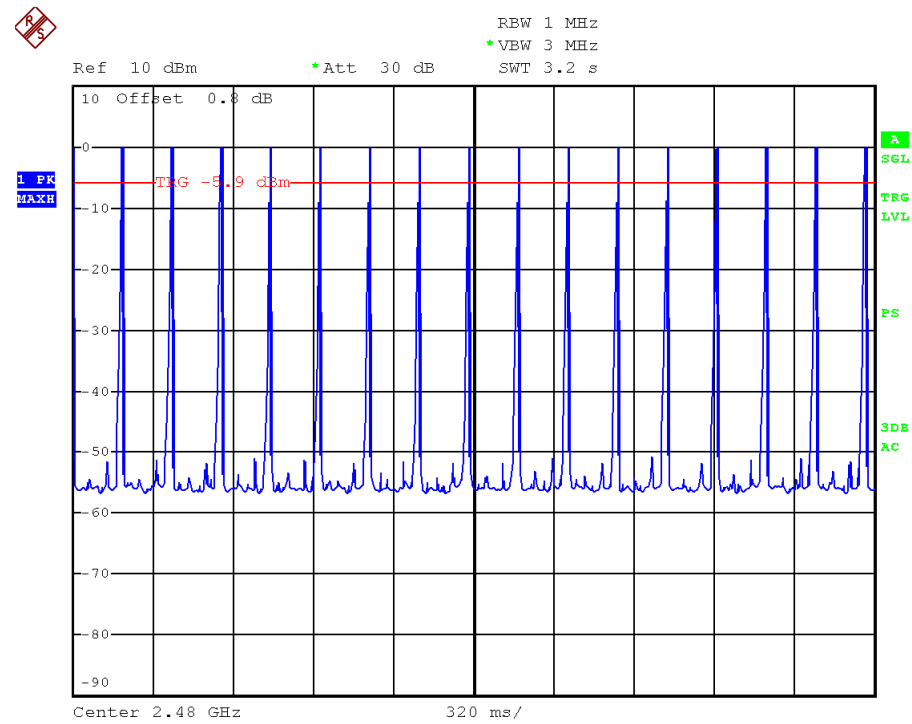
# Channel H



## DH3

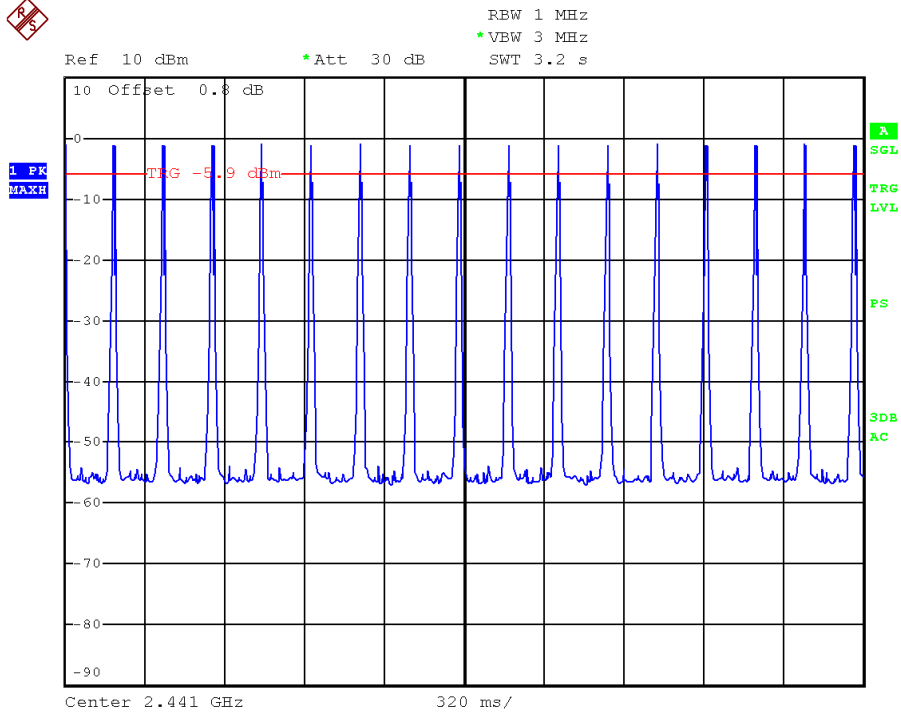


## Channel L

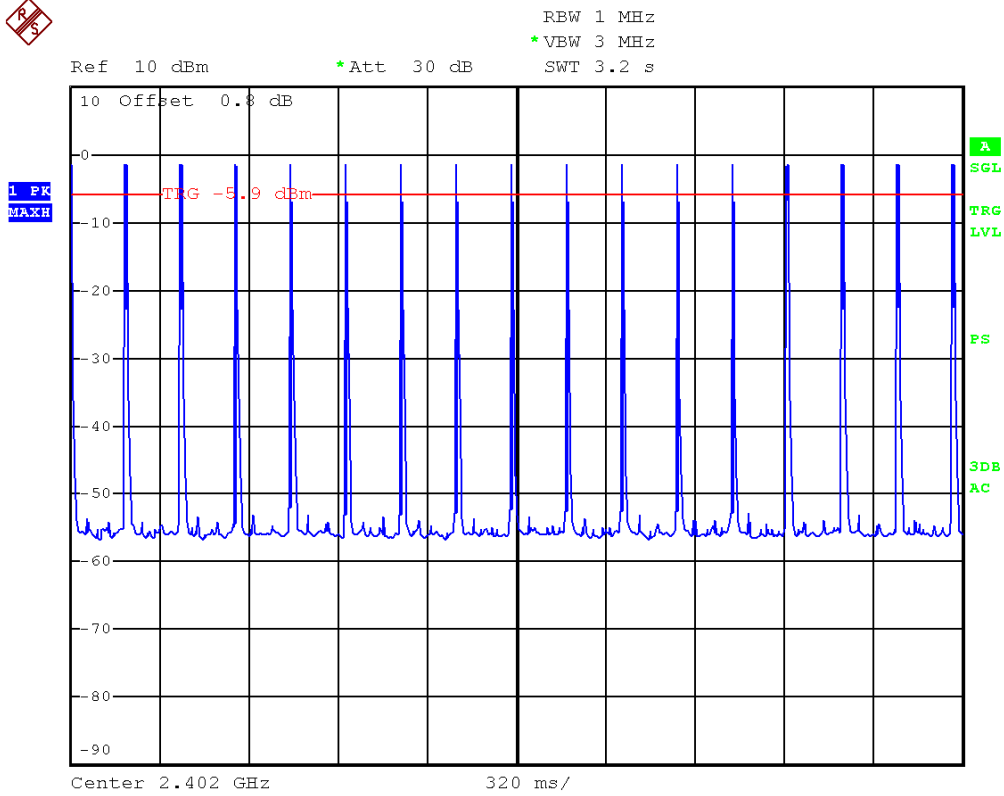




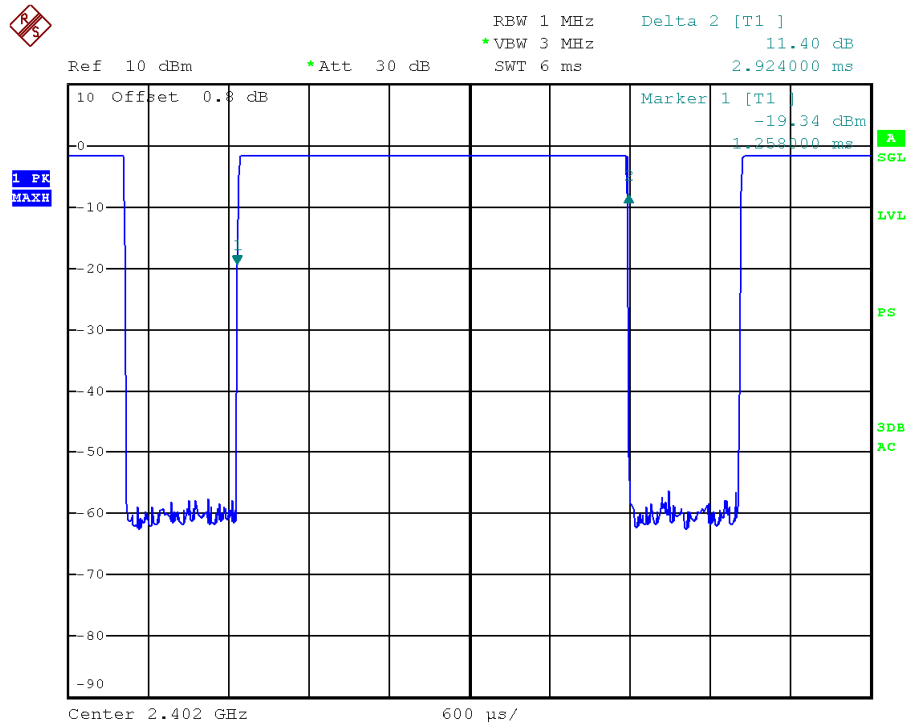
### Channel M



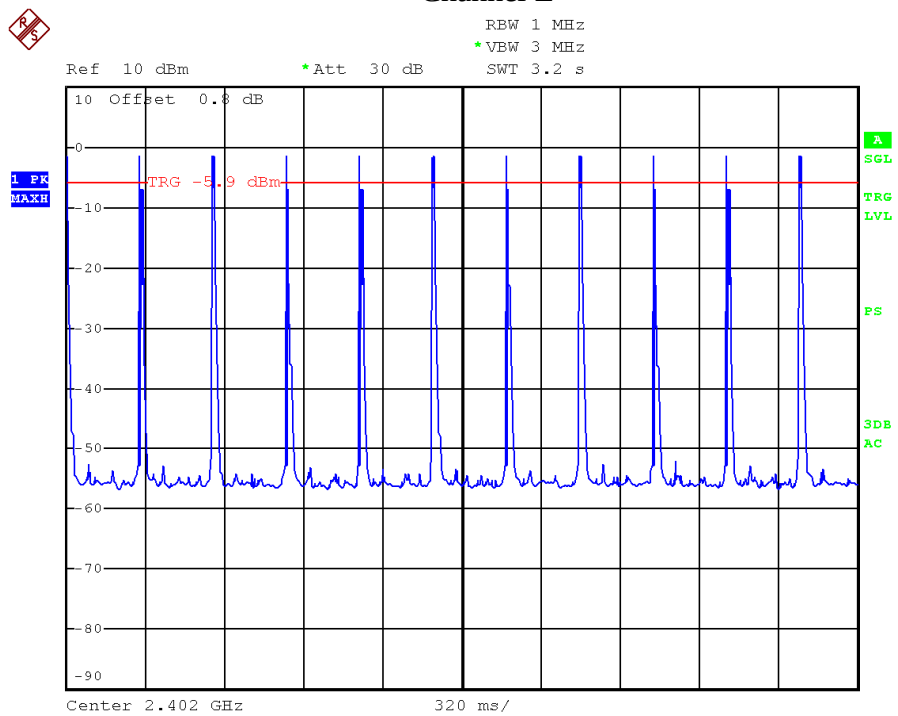
### Channel H



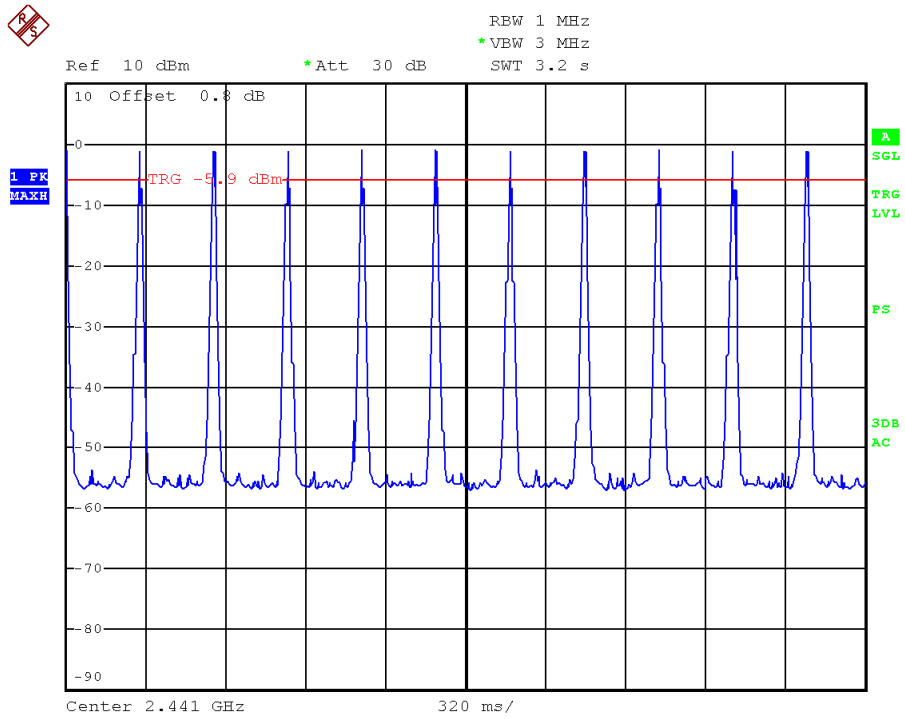
## DH5



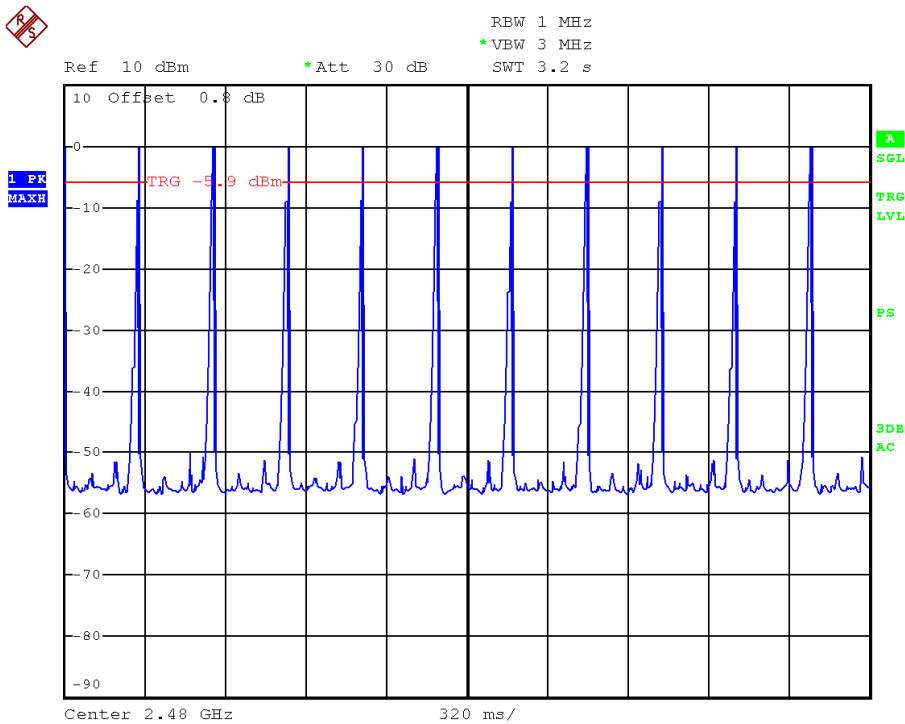
## Channel L



Channel M



Channel H



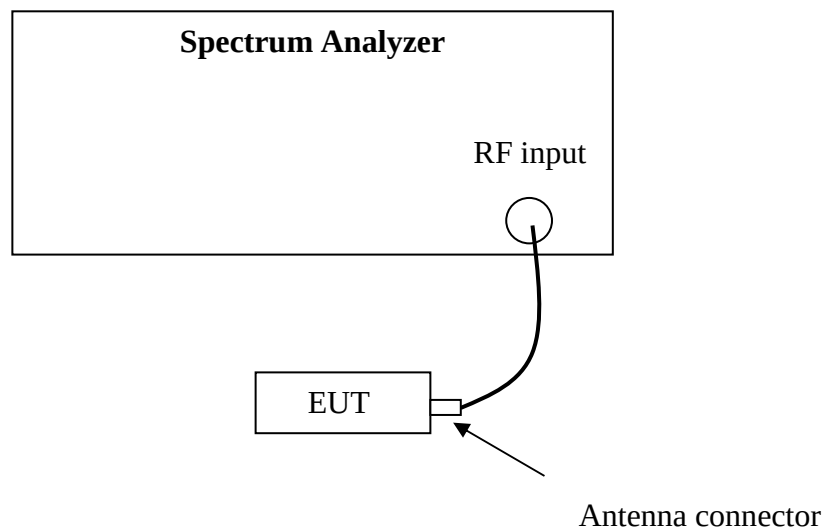
## 11. Occupied Bandwidth

Test Status: Tested

### 11.1 Test limit

None

### 11.2 Test Configuration



### 11.3 Test procedure and test setup

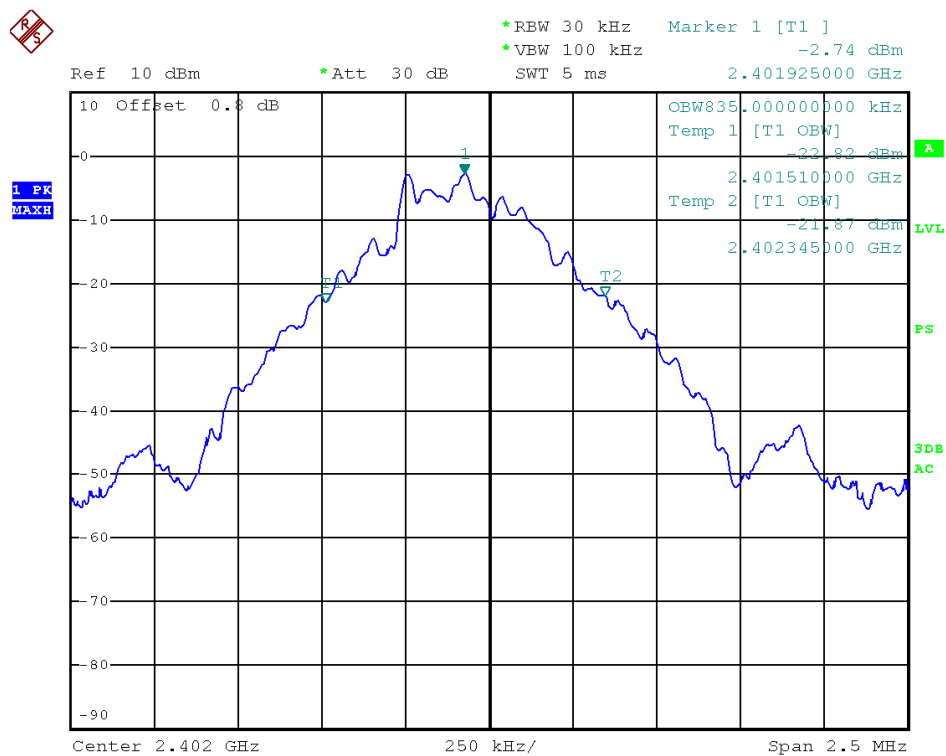
The occupied bandwidth per RSS-Gen Issue 3 Clause 4.6.1 was measured using the Spectrum Analyzer with the RBW close to 1% of the selected span,  $VBW = 3 * RBW$  Detector = Sample, Sweep = Auto.

### 11.4 Test protocol

Temperature : 22 °C  
Relative Humidity : 45 %

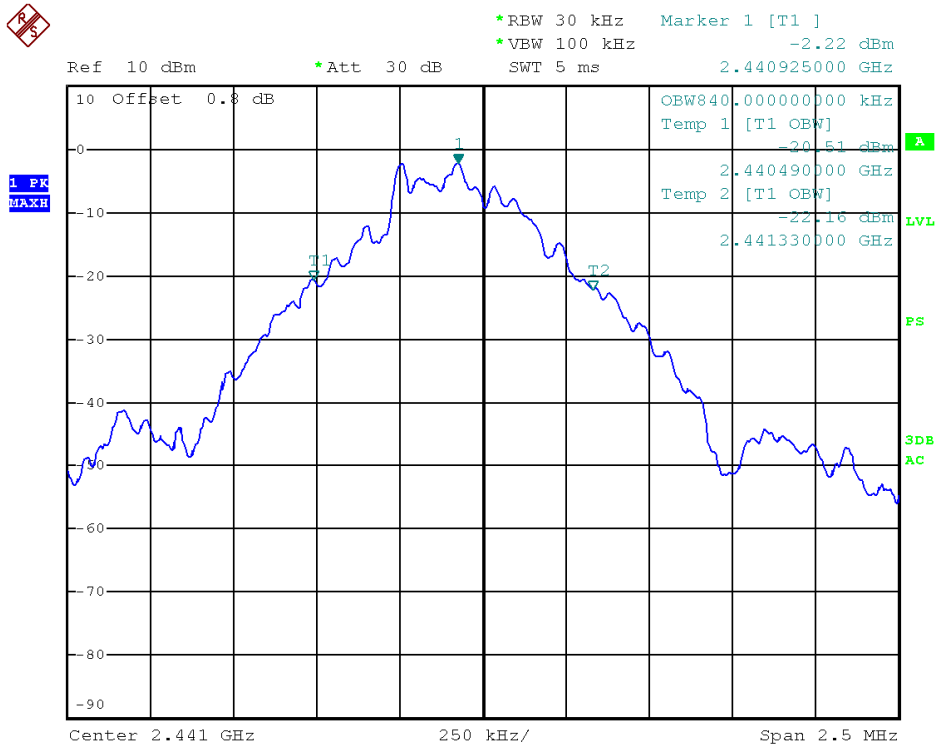
| Modulation | Channel | Occupied Bandwidth (kHz) |
|------------|---------|--------------------------|
| GFSK       | L       | 835.00                   |
|            | M       | 840.00                   |
|            | H       | 840.00                   |

## Channel L

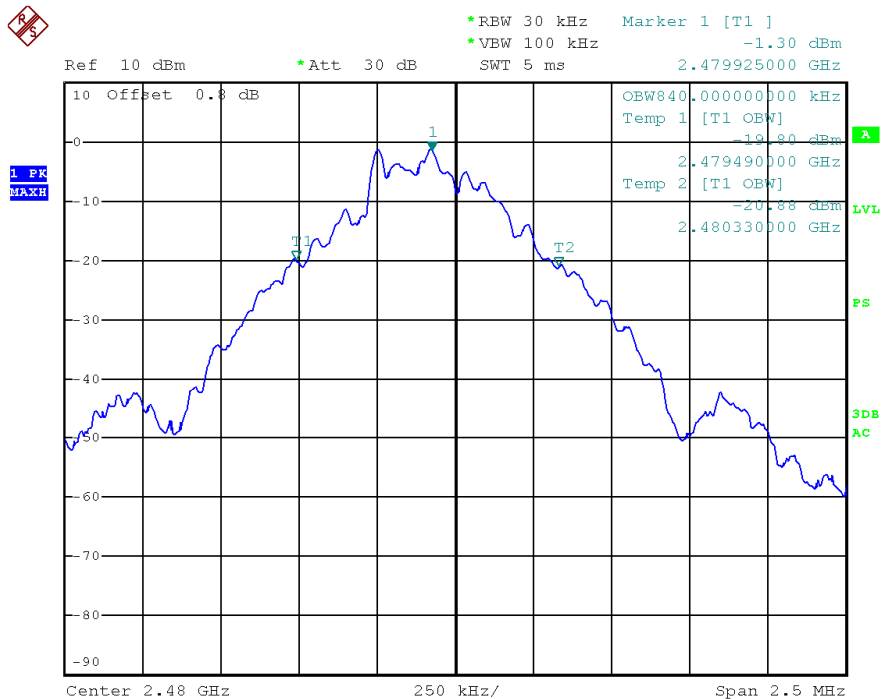




## Channel M



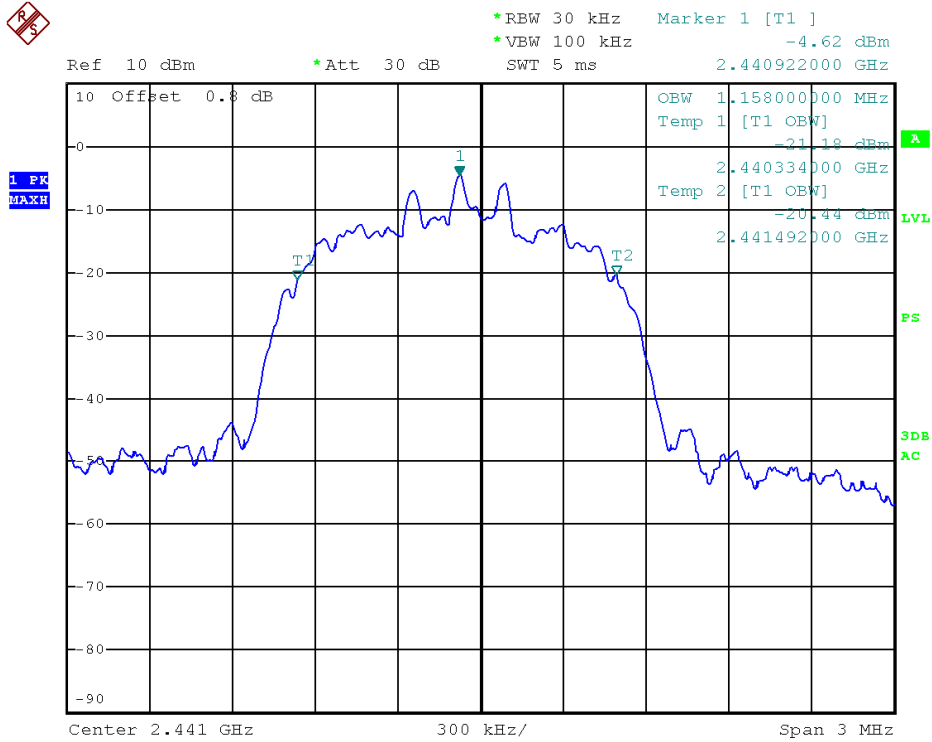
## Channel H



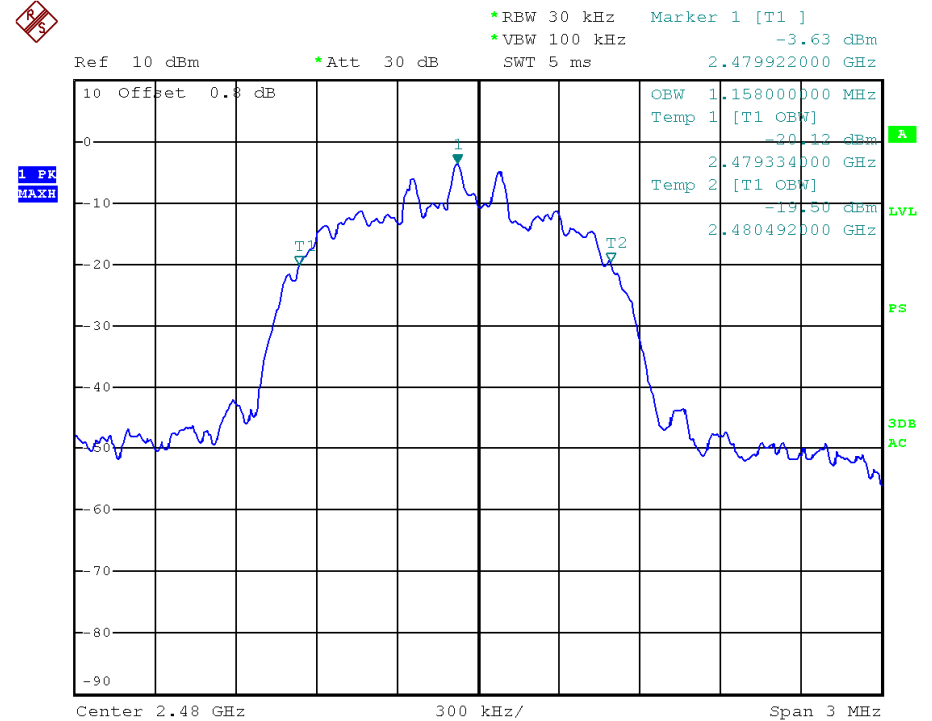
| Modulation | Channel | Occupied Bandwidth (kHz) |
|------------|---------|--------------------------|
|------------|---------|--------------------------|



Channel M



Channel H



## **12. Antenna requirement**

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.

Result:

EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.



**FCC ID: 2AAVGDRW1701A**  
**IC: 11349A-DRW1701A**