

## FCC&IC RF TEST REPORT

**No. 170401638SHA-001**

Applicant : DYNAUDIO A/S.  
Sverigesvej 15, 8660 Skanderborg, Denmark.

Manufacturer : GoerTek Dynaudio Co., Ltd.  
No. 8877 Yingqian Road, High-tech Industrial  
Development District, Weifang Shandong Province,  
China

Product Name : Intelligent Wireless Music System

Type/Model : Music 3

**TEST RESULT : PASS**

### SUMMARY

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

**47CFR Part 15 (2014):** Radio Frequency Devices

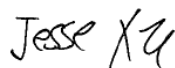
**ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

**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 (December 2014):** General Requirements for Compliance of Radio Apparatus

Date of issue: June 29, 2017

Prepared by:



Jesse Xu (*Project Engineer*)

Reviewed by:



Daniel Zhao (*Reviewer*)

## Description of Test Facility

Name: Intertek Testing Service Limited Shanghai  
Address: Building No.86, 1198 Qinzhou Road(North), Shanghai 200233, P.R.  
China

FCC Registration Number: 236597  
IC Assigned Code: 2402B-1

Name of contact: Jonny Jing  
Tel: 86 21 61278271  
Fax: 86 21 54262353

## Content

|                                                   |           |
|---------------------------------------------------|-----------|
| <b>SUMMARY.....</b>                               | <b>1</b>  |
| <b>1 GENERAL INFORMATION .....</b>                | <b>5</b>  |
| 1.1 Description of Client.....                    | 5         |
| 1.2 Identification of the EUT .....               | 5         |
| 1.3 Technical Specification.....                  | 6         |
| <b>2 TEST SPECIFICATIONS.....</b>                 | <b>7</b>  |
| 2.1 Standards or specification .....              | 7         |
| 2.2 Mode of operation during the test.....        | 7         |
| 2.3 Test software list .....                      | 7         |
| 2.4 Test peripherals list .....                   | 7         |
| 2.5 Instrument list .....                         | 8         |
| 2.6 Test Summary .....                            | 9         |
| 2.7 Measurement uncertainty.....                  | 10        |
| <b>3 20 DB BANDWIDTH.....</b>                     | <b>11</b> |
| 3.1 Limit.....                                    | 11        |
| 3.2 Test Configuration .....                      | 11        |
| 3.3 Test Procedure and test setup.....            | 11        |
| 3.4 Test Protocol .....                           | 12        |
| <b>4 CARRIER FREQUENCY SEPARATION .....</b>       | <b>18</b> |
| 4.1 Test limit .....                              | 18        |
| 4.2 Test Configuration .....                      | 18        |
| 4.3 Test procedure and test setup.....            | 18        |
| 4.4 Test protocol .....                           | 19        |
| <b>5 MAXIMUM PEAK OUTPUT POWER .....</b>          | <b>25</b> |
| 5.1 Test limit .....                              | 25        |
| 5.2 Test Configuration .....                      | 25        |
| 5.3 Test procedure and test setup.....            | 25        |
| 5.4 Test Protocol .....                           | 26        |
| <b>6 EMISSION OUTSIDE THE FREQUENCY BAND.....</b> | <b>27</b> |
| 6.1 Test limit .....                              | 27        |
| 6.2 Test Configuration .....                      | 27        |
| 6.3 Test procedure and test setup.....            | 27        |
| 6.4 Test Protocol .....                           | 28        |
| <b>7 NUMBER OF HOPPING FREQUENCIES .....</b>      | <b>47</b> |
| 7.1 Test limit .....                              | 47        |
| 7.2 Test Configuration .....                      | 47        |
| 7.3 Test procedure and test setup.....            | 47        |
| 7.4 Test Protocol .....                           | 48        |
| <b>8 DWELL TIME.....</b>                          | <b>49</b> |
| 8.1 Test limit .....                              | 49        |
| 8.2 Test Configuration .....                      | 49        |
| 8.3 Test procedure and test setup.....            | 49        |
| 8.4 Test Protocol .....                           | 50        |
| <b>9 RADIATED EMISSIONS.....</b>                  | <b>54</b> |
| 9.1 Test limit .....                              | 54        |
| 9.2 Test Configuration .....                      | 54        |

|           |                                            |           |
|-----------|--------------------------------------------|-----------|
| 9.3       | Test procedure and test setup .....        | 56        |
| 9.4       | Test Protocol .....                        | 57        |
| <b>10</b> | <b>POWER LINE CONDUCTED EMISSION .....</b> | <b>62</b> |
| 10.1      | Limit.....                                 | 62        |
| 10.2      | Test configuration .....                   | 62        |
| 10.3      | Test procedure and test set up .....       | 63        |
| 10.4      | Test protocol .....                        | 64        |
| <b>11</b> | <b>OCCUPIED BANDWIDTH .....</b>            | <b>65</b> |
| 11.1      | Test limit .....                           | 65        |
| 11.2      | Test Configuration .....                   | 65        |
| 11.3      | Test procedure and test setup .....        | 65        |
| 11.4      | Test protocol .....                        | 66        |

## **1 GENERAL INFORMATION**

### **1.1 Description of Client**

Applicant : DYNAUDIO A/S.  
Sverigesvej 15, 8660 Skanderborg, Denmark.

Name of contact : Krestian Pedersen

Tel : +45 8652 3411

Fax : -

Email : KMP@dynaudio.com

Manufacturer : GoerTek Dynaudio Co., Ltd.  
No. 8877 Yingqian Road, High-tech Industrial  
Development District, Weifang Shandong Province,  
China

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

Product Name : Intelligent Wireless Music System

Type/model : Music 3

FCC ID : 2AK4D-M003

IC : 12734A-M003

### 1.3 Technical Specification

Operation Frequency : 2400 – 2483.5 MHz  
Band  
Protocol : Bluetooth Base Rate + EDR  
Type of Modulation : GFSK,  $\pi/4$ -DQPSK, 8DPSK  
Channel Number : 79 channels  
Description of EUT : EUT is a bluetooth+WIFI device. This report is only assessed for BT function. We tested it and listed the worst data in this report.  
  
Antenna : PCB antenna, 2.0dBi  
Rating : 100-240V~, 50/60Hz, 80W  
Category of EUT : Class B  
EUT type : ☒ Table top  
☐ Floor standing  
Sample received date : May 15, 2017  
Date of test : May 16, 2017 – June 05, 2017

## 2 TEST SPECIFICATIONS

### 2.1 Standards or specification

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

### 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          |
|                  | $\pi/4$ -DQPSK | 2402         | 2441         | 2480          |
|                  | 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        | Mobile phone    | Iphone              |             |
|          |                 |                     |             |

## 2.5 Instrument list

| Selected                            | Instrument                  | EC no.    | Model               | Valid until date |
|-------------------------------------|-----------------------------|-----------|---------------------|------------------|
| <input checked="" type="checkbox"/> | Shielded room               | EC 2838   | GB88                | 2018-1-8         |
| <input checked="" type="checkbox"/> | EMI test receiver           | EC 2107   | ESCS 30             | 2017-10-19       |
| <input checked="" type="checkbox"/> | A.M.N.                      | EC 3119   | ESH2-Z5             | 2017-12-16       |
| <input type="checkbox"/>            | A.M.N.                      | EC 3394   | ENV 216             | 2017-8-1         |
| <input checked="" type="checkbox"/> | Semi anechoic chamber       | EC 3048   | -                   | 2018-5-11        |
| <input checked="" type="checkbox"/> | EMI test receiver           | EC 3045   | ESIB26              | 2017-10-19       |
| <input checked="" type="checkbox"/> | Broadband antenna           | EC 4206   | CBL 6112D           | 2018-4-27        |
| <input checked="" type="checkbox"/> | Horn antenna                | EC 3049   | HF906               | 2018-4-27        |
| <input type="checkbox"/>            | Horn antenna                | EC 4792-1 | 3117                | 2018-4-21        |
| <input checked="" type="checkbox"/> | Horn antenna                | EC 4792-3 | HAP18-26W           | 2018-6-11        |
| <input type="checkbox"/>            | Pre-amplifier               | EC 5262   | pre-amp 18          | 2018-5-25        |
| <input checked="" type="checkbox"/> | Pre-amplifier               | EC 4792-2 | TPA0118-40          | 2018-4-10        |
| <input type="checkbox"/>            | High Pass Filter            | EC 4797-1 | WHKX 1.0/15G-10SS   | 2018-1-8         |
| <input checked="" type="checkbox"/> | High Pass Filter            | EC 4797-2 | WHKX 2.8/18G-12SS   | 2018-1-8         |
| <input type="checkbox"/>            | High Pass Filter            | EC 4797-3 | WHKX 7.0/1.8G-8SS   | 2018-1-8         |
| <input checked="" type="checkbox"/> | Band Reject Filter          | EC 4797-4 | WRCGV2400/2483/10SS | 2018-1-8         |
| <input type="checkbox"/>            | Test Receiver               | EC 4501   | ESCI 7              | 2018-1-13        |
| <input checked="" type="checkbox"/> | PXA Signal Analyzer         | EC5338    | N9030A              | 2018-5-14        |
| <input checked="" type="checkbox"/> | Power sensor/Power meter    | EC4318    | N1911A/N1921A       | 2018-4-8         |
| <input type="checkbox"/>            | Power sensor                | EC5338-1  | U2021XA             | 2018-3-5         |
| <input type="checkbox"/>            | MXG Analog Signal Generator | EC5338-2  | N5181A              | 2018-3-5         |
| <input type="checkbox"/>            | MXG Vector Signal Generator | EC5175    | N51812B             | 2018-1-8         |

## 2.6 Test Summary

**This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.**

| TEST ITEM                              | FCC<br>REFERENCE  | IC<br>REFERENCE               | RESULT |
|----------------------------------------|-------------------|-------------------------------|--------|
| 20 dB bandwidth                        | 15.247(a)(1)      | RSS-247 Issue 2<br>Clause 5.1 | Tested |
| Carrier frequency<br>separation        | 15.247(a)(1)      | RSS-247 Issue 2<br>Clause 5.1 | Pass   |
| Maximum peak output<br>power           | 15.247(b)(1)      | RSS-247 Issue 2<br>Clause 5.4 | Pass   |
| Radiated emissions                     | 15.205 & 15.209   | RSS-Gen Issue 4<br>Clause 8.9 | Pass   |
| Emission outside the<br>frequency band | 15.247(d)         | RSS-247 Issue 2<br>Clause 5.5 | Pass   |
| Number of hopping<br>frequencies       | 15.247(a)(1)(iii) | RSS-247 Issue 2<br>Clause 5.1 | Pass   |
| Dwell time                             | 15.247(a)(1)(iii) | RSS-247 Issue 2<br>Clause 5.1 | Pass   |
| Power line conducted<br>emission       | 15.207            | RSS-Gen Issue 4<br>Clause 8.8 | Pass   |
| Occupied bandwidth                     | -                 | RSS-Gen Issue 4<br>Clause 6.6 | Tested |

Notes: 1: NA =Not Applicable

2: This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

## 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

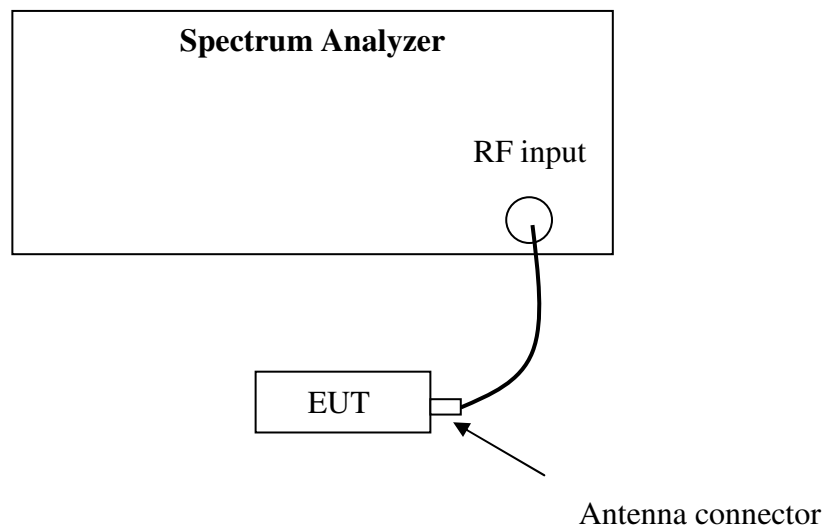
**Test result: Pass**

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

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.

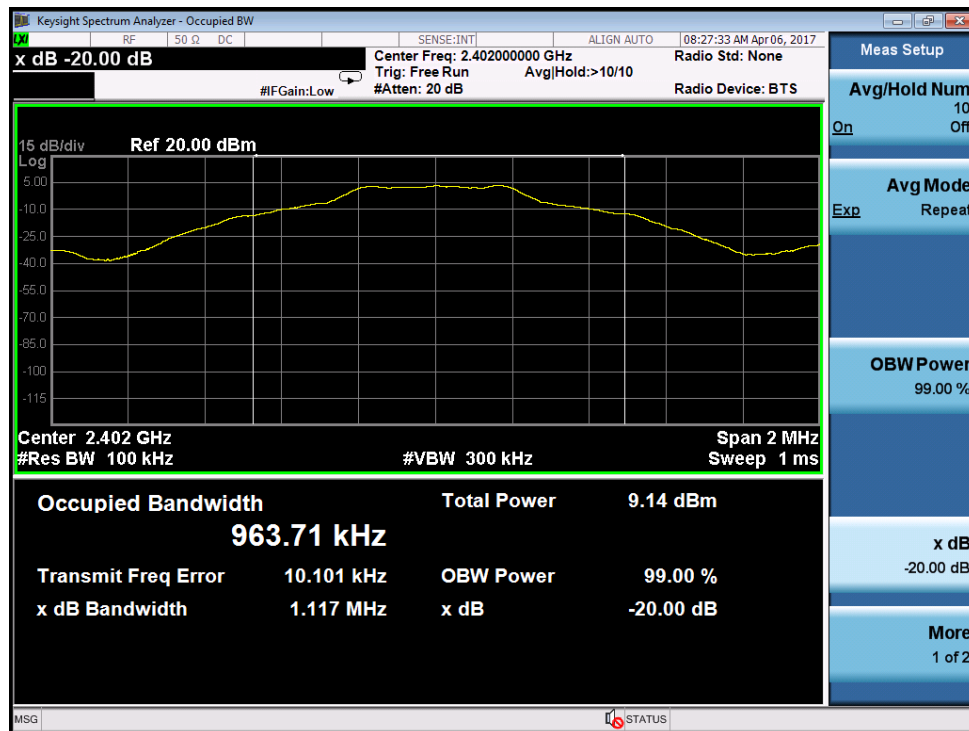
The test was performed at 3 channels (lowest, middle and highest channel).

### 3.4 Test Protocol

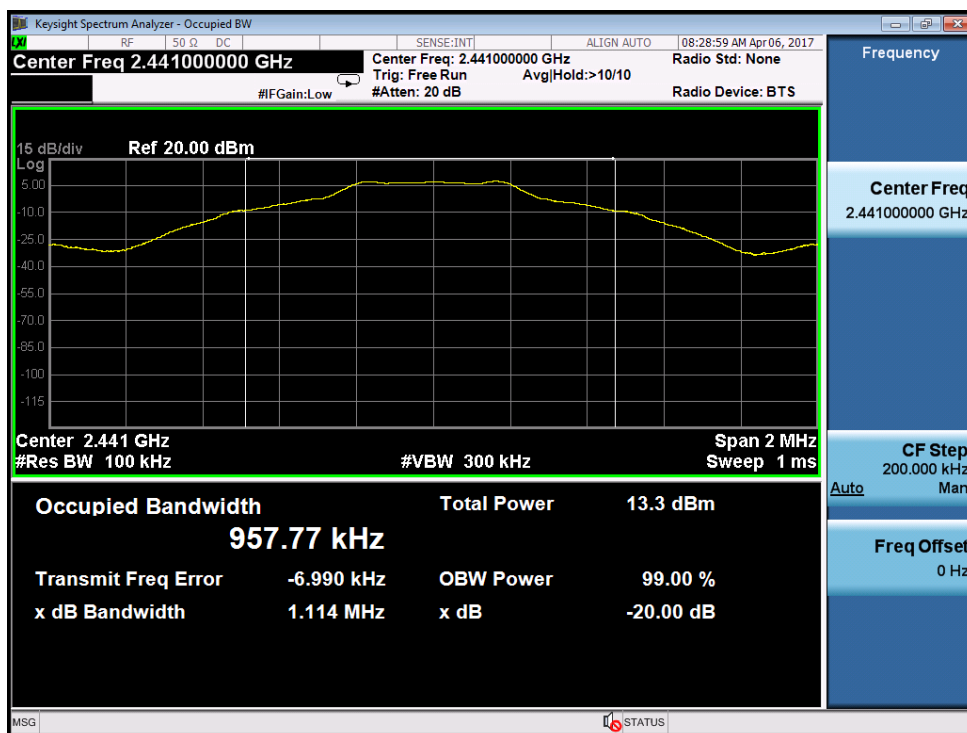
Temperature: 22°C  
Relative Humidity: 54%

| Modulation | Channel | 20dB Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|------------|---------|----------------------|-------------------------------|
| GFSK       | L       | 1117                 | 744.67                        |
|            | M       | 1114                 | 742.70                        |
|            | H       | 1113                 | 742.03                        |

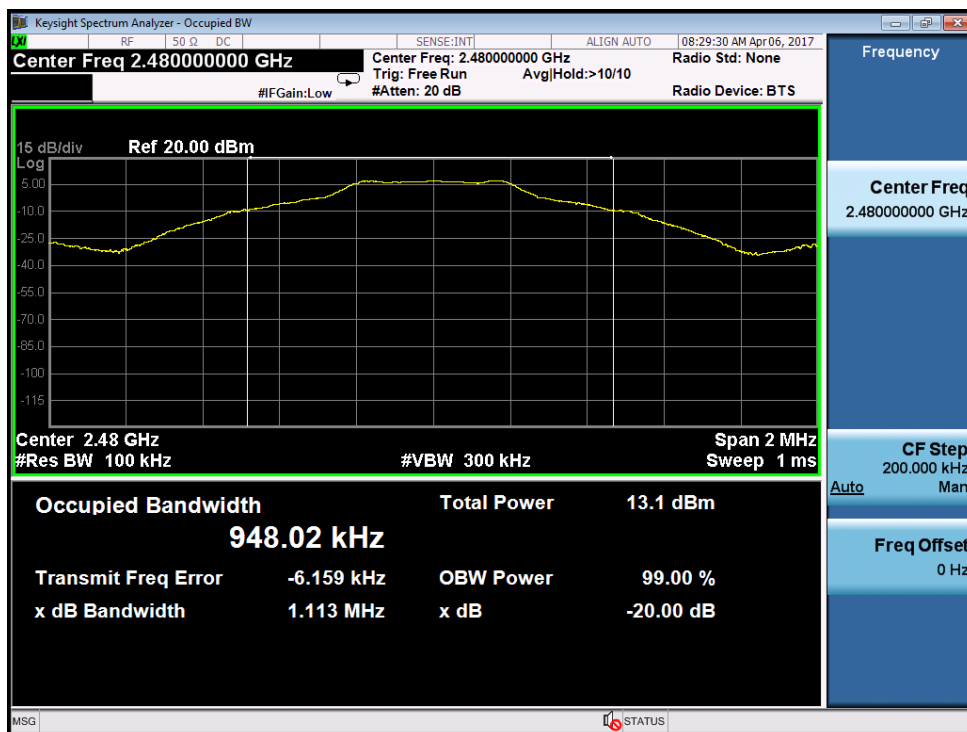
Channel L



## Channel M

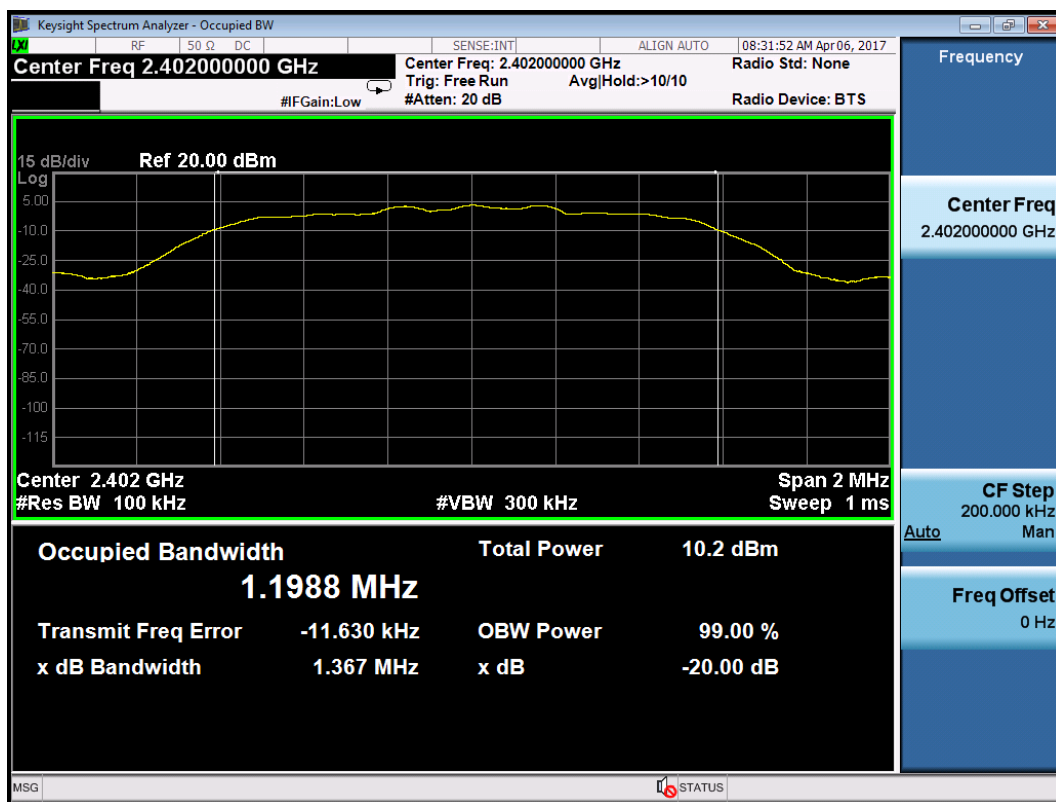


## Channel H

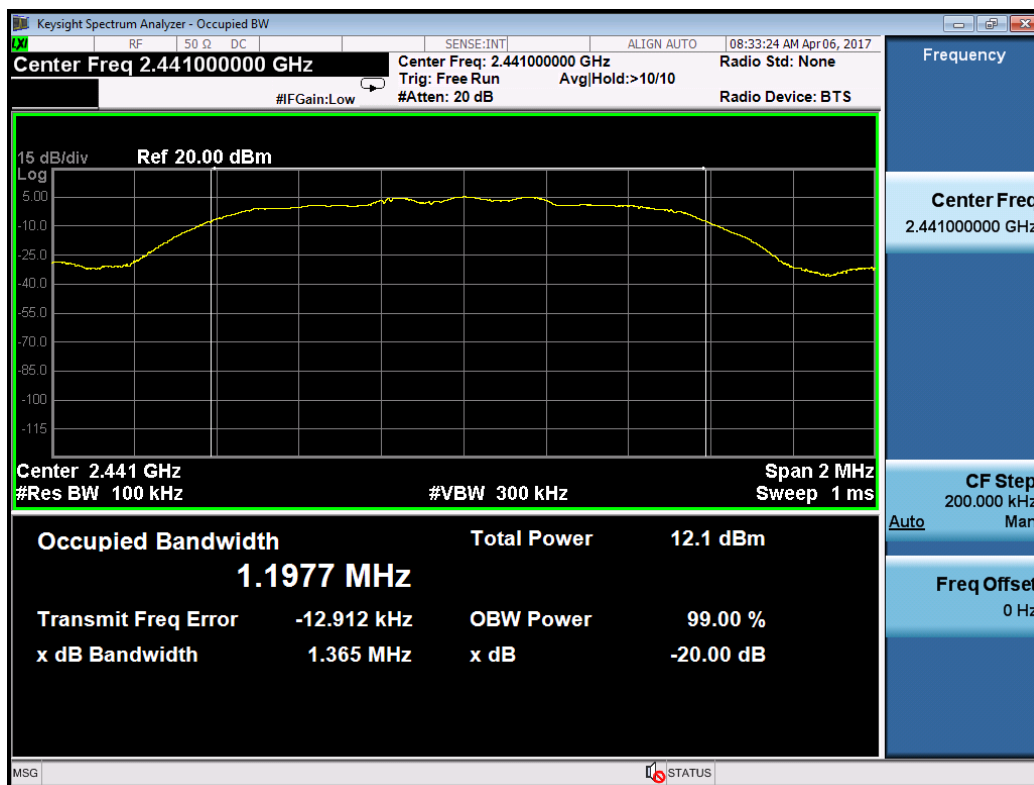


| Modulation     | Channel | 20dB Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|----------------|---------|----------------------|-------------------------------|
| $\pi/4$ -DQPSK | L       | 1367                 | 911.37                        |
|                | M       | 1365                 | 910.04                        |
|                | H       | 1365                 | 910.04                        |

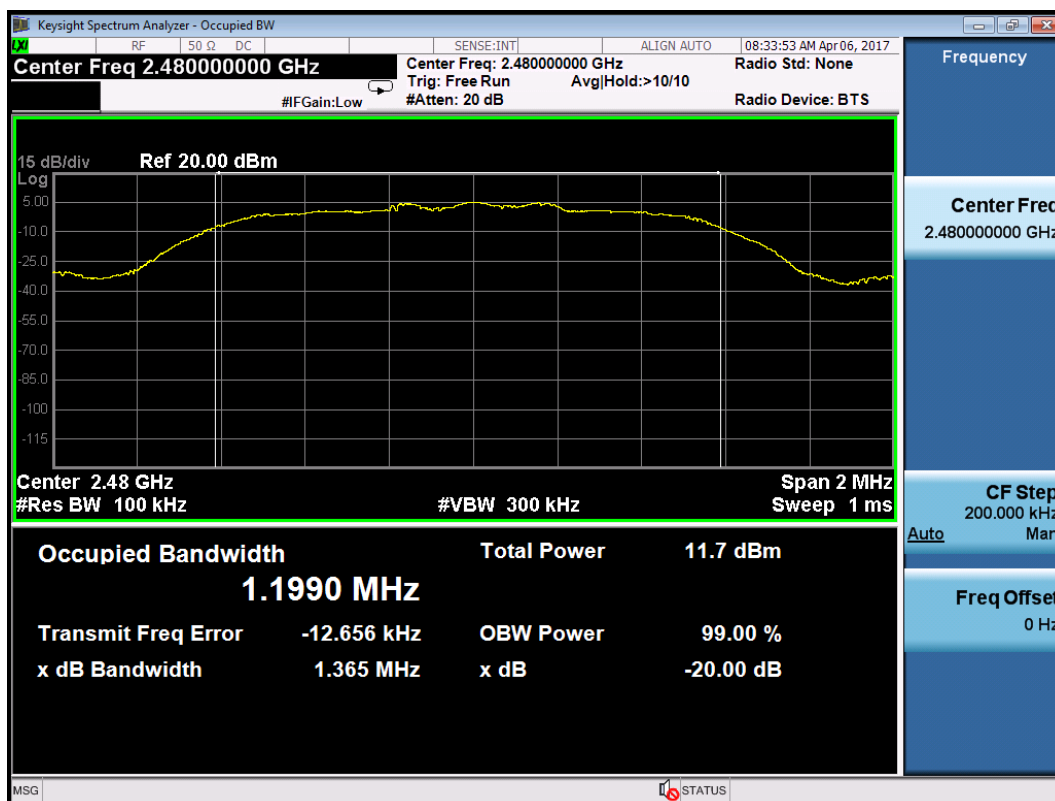
### Channel L



### Channel M

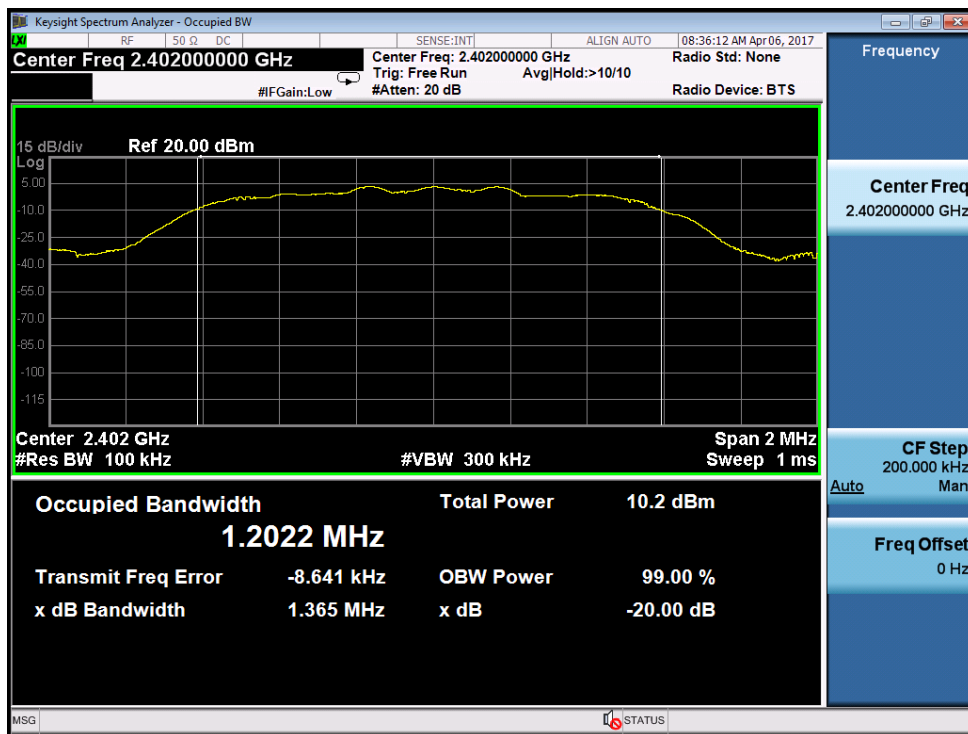


### Channel H

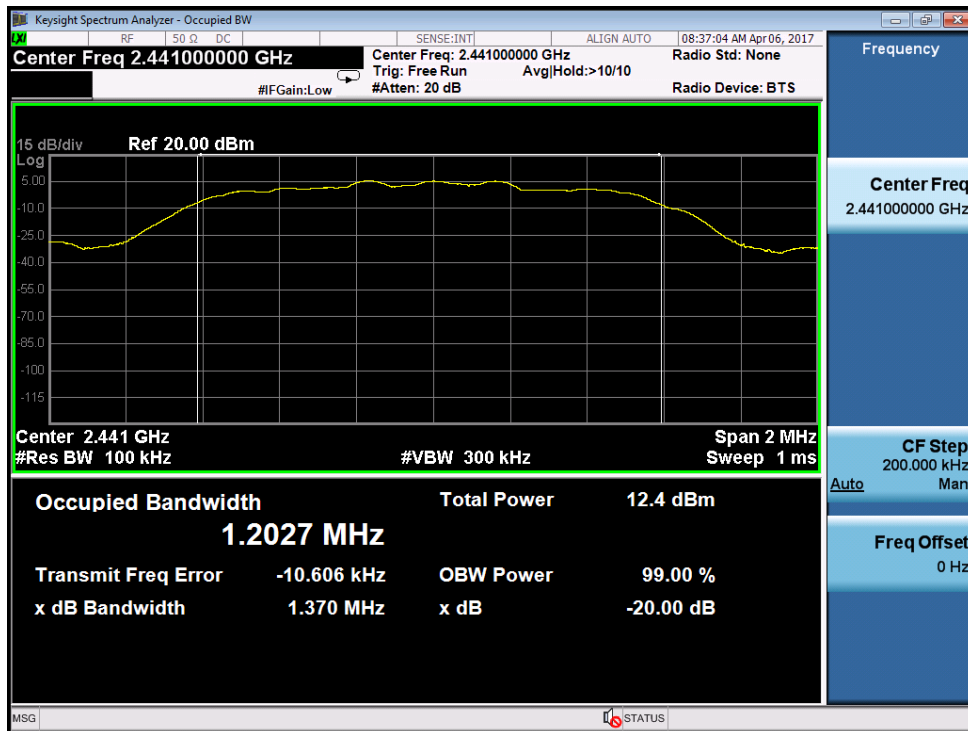


| Modulation | Channel | 20dB Bandwidth (kHz) | Two-thirds of Bandwidth (kHz) |
|------------|---------|----------------------|-------------------------------|
| 8DPSK      | L       | 1365                 | 910.00                        |
|            | M       | 1370                 | 913.37                        |
|            | H       | 1367                 | 911.37                        |

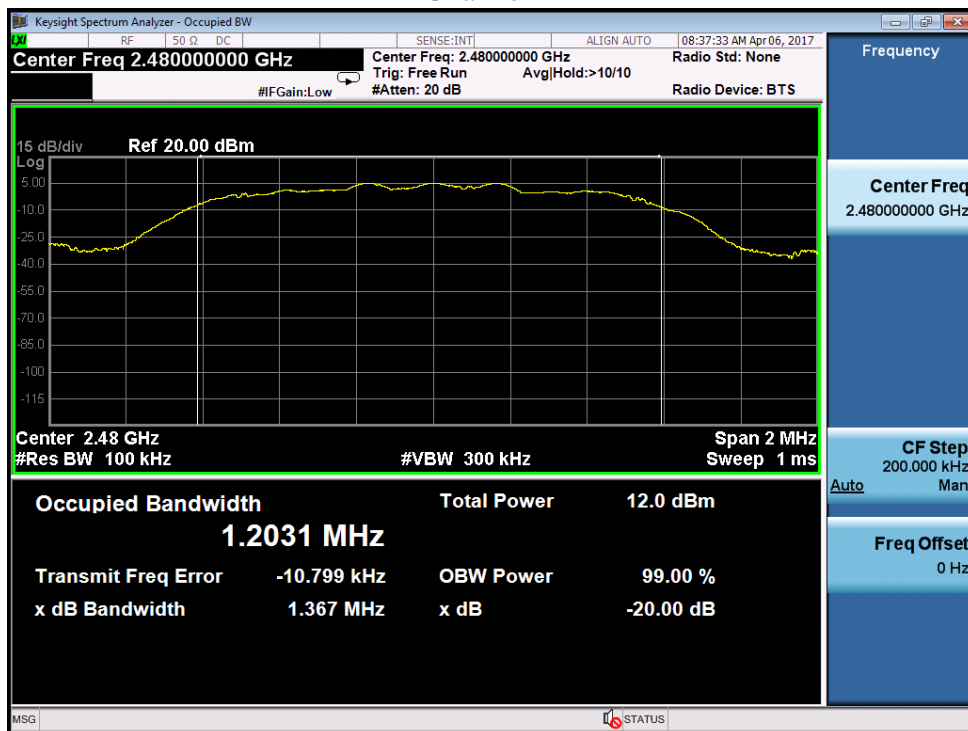
### Channel L



## Channel M



## Channel H



## 4 Carrier frequency separation

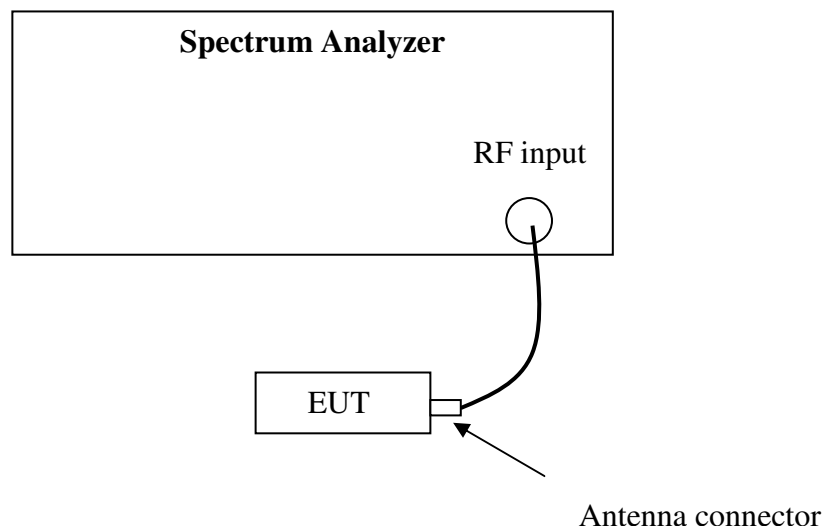
**Test result:** Pass

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

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).

#### 4.4 Test protocol

Temperature: 22 °C

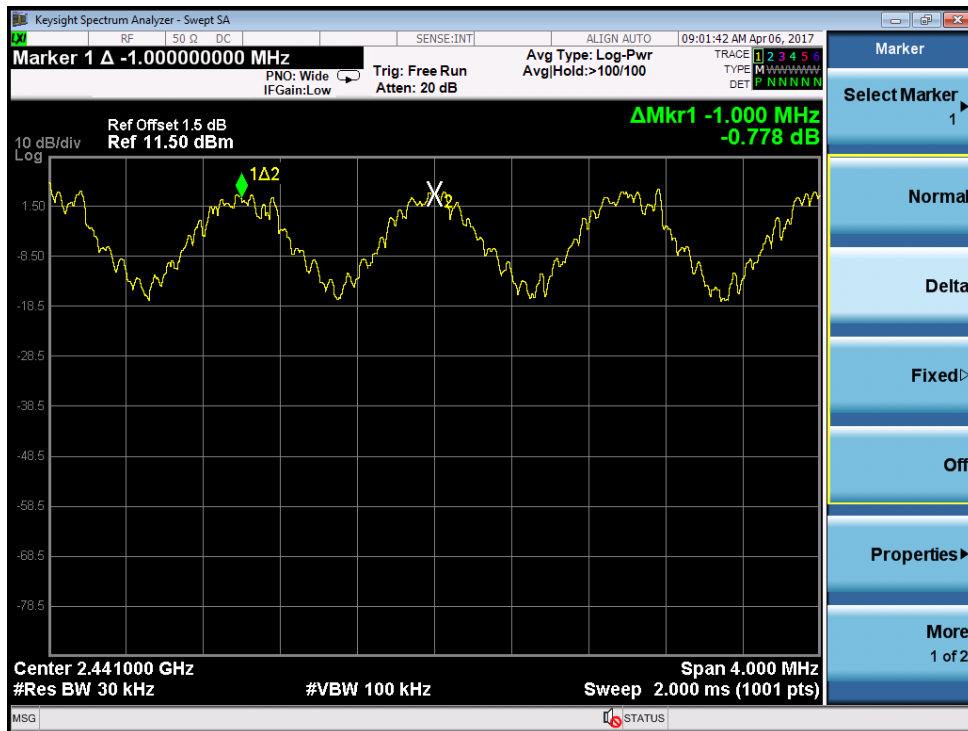
Relative Humidity: 54 %

| Modulation | Channel | Frequency Separation (kHz) | Limit (kHz)   |
|------------|---------|----------------------------|---------------|
| GFSK       | L       | 1004                       | $\geq 744.67$ |
|            | M       | 1000                       | $\geq 742.70$ |
|            | H       | 1000                       | $\geq 742.03$ |

Channel L



## Channel M

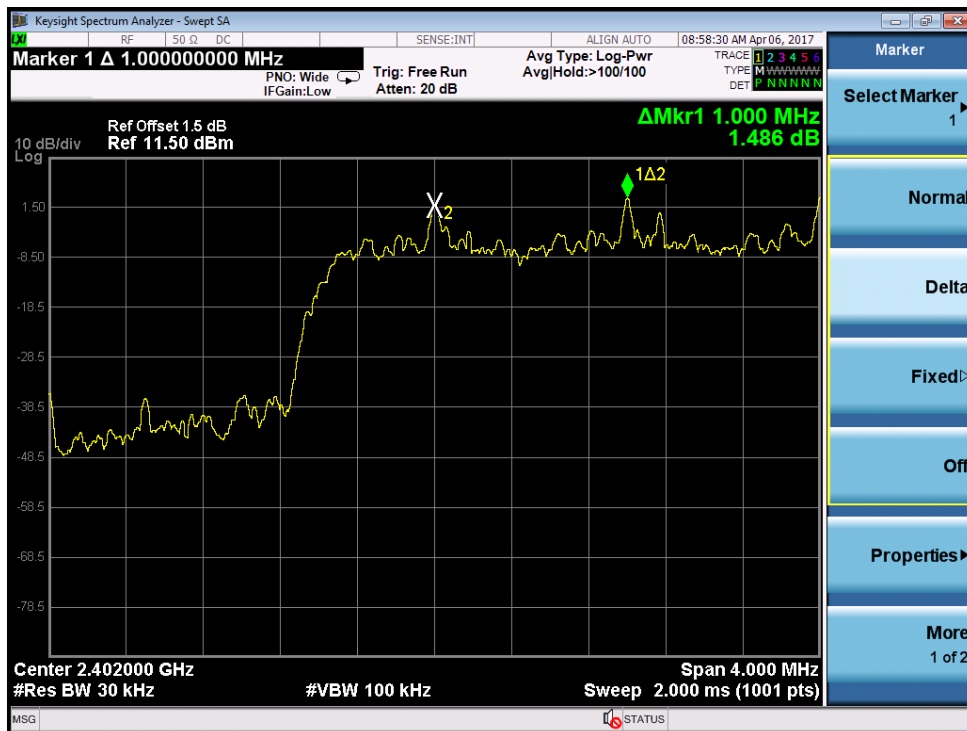


## Channel H

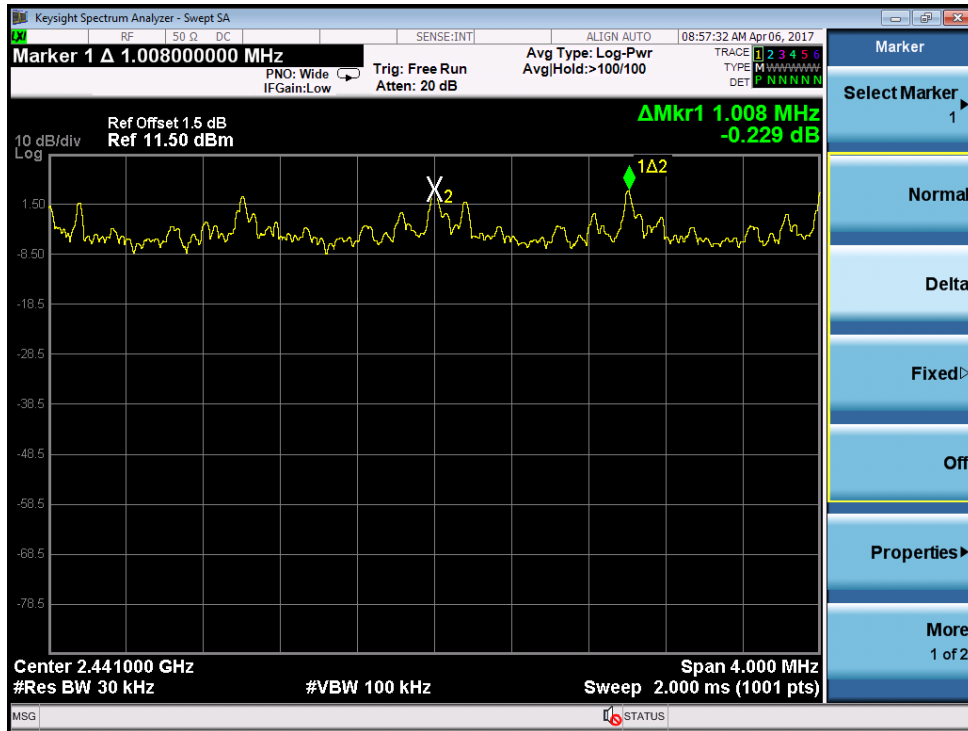


| Modulation     | Channel | Frequency Separation (kHz) | Limit (kHz)   |
|----------------|---------|----------------------------|---------------|
| $\pi/4$ -DQPSK | L       | 1000                       | $\geq 911.37$ |
|                | M       | 1008                       | $\geq 910.04$ |
|                | H       | 1008                       | $\geq 910.04$ |

### Channel L



### Channel M



### Channel H

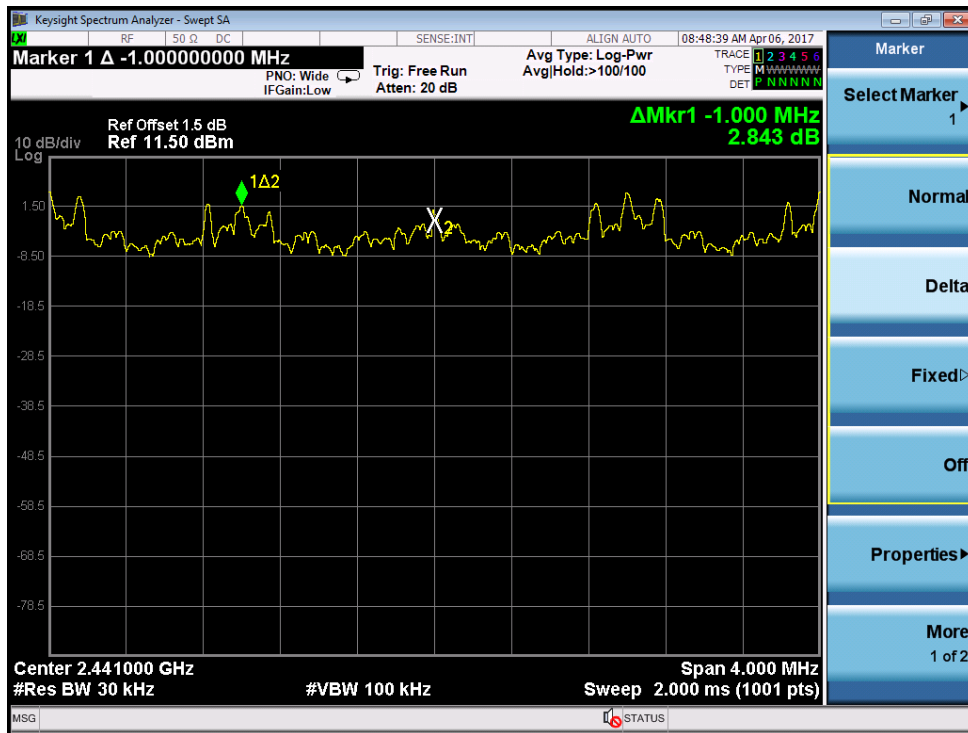


| Modulation | Channel | Frequency Separation (kHz) | Limit (kHz)   |
|------------|---------|----------------------------|---------------|
| 8DPSK      | L       | 1004                       | $\geq 910.00$ |
|            | M       | 1000                       | $\geq 913.37$ |
|            | H       | 1004                       | $\geq 911.37$ |

### Channel L



### Channel M



### Channel H



## 5 Maximum peak output power

**Test result:** Pass

### 5.1 Test limit

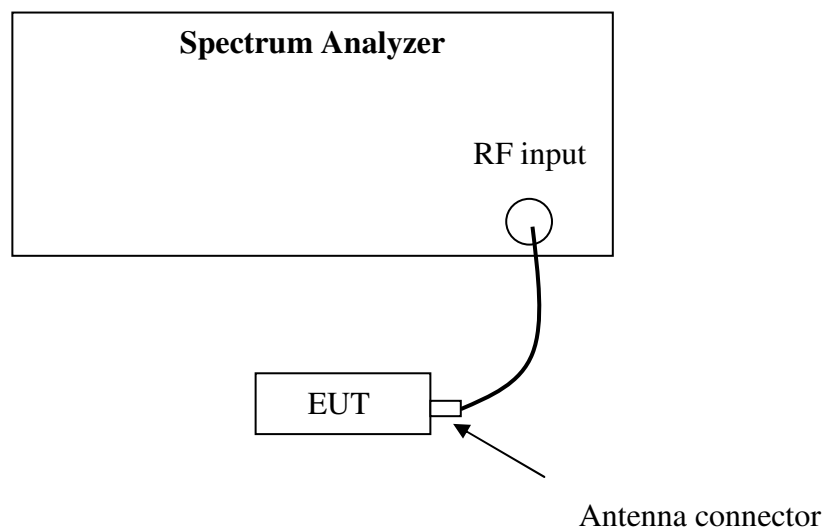
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

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

The Maximum peak output power 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).

## 5.4 Test Protocol

Temperature: 22°C  
Relative Humidity: 54%

| Modulation | Channel | Conducted Power (dBm) | Limit (dBm)  |
|------------|---------|-----------------------|--------------|
| GFSK       | L       | 7.23                  | $\leq 21.00$ |
|            | M       | 8.52                  | $\leq 21.00$ |
|            | H       | 8.40                  | $\leq 21.00$ |

**Conclusion: The maximum EIRP = 8.52dBm+2.0dBi = 11.27mW which is lower than the limit of 4W listed in RSS-247.**

| Modulation     | Channel | Conducted Power (dBm) | Limit (dBm)  |
|----------------|---------|-----------------------|--------------|
| $\pi/4$ -DQPSK | L       | 4.87                  | $\leq 21.00$ |
|                | M       | 6.88                  | $\leq 21.00$ |
|                | H       | 6.68                  | $\leq 21.00$ |

**Conclusion: The maximum EIRP = 6.88dBm+2.0dBi = 7.72mW which is lower than the limit of 4W listed in RSS-247.**

| Modulation | Channel | Conducted Power (dBm) | Limit (dBm)  |
|------------|---------|-----------------------|--------------|
| 8DPSK      | L       | 4.92                  | $\leq 21.00$ |
|            | M       | 6.95                  | $\leq 21.00$ |
|            | H       | 6.69                  | $\leq 21.00$ |

**Conclusion: The maximum EIRP = 6.95dBm+2.0dBi = 7.85mW which is lower than the limit of 4W listed in RSS-247.**

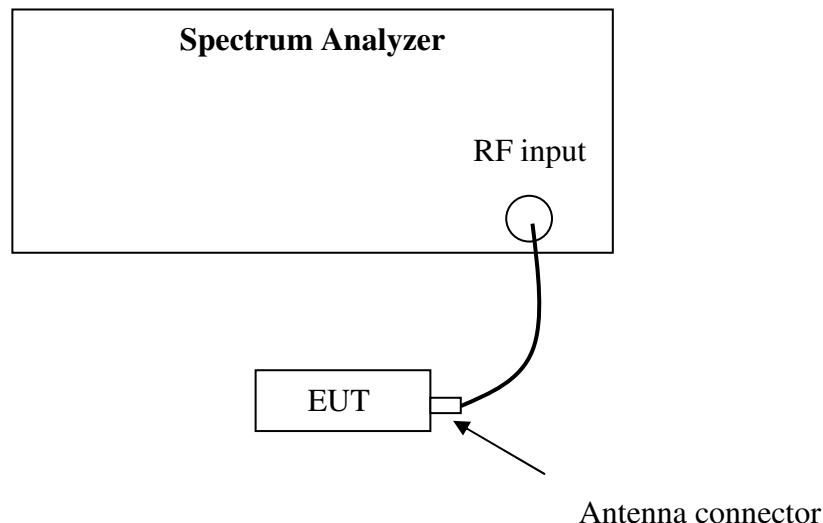
## 6 Emission outside the frequency band

**Test result:** Pass

### 6.1 Test 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.

### 6.2 Test Configuration



### 6.3 Test procedure and test setup

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

The Emission outside the frequency band 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 = 100kHz, VBW ≥ RBW, Sweep = auto, Detector = peak, Trace = max hold.

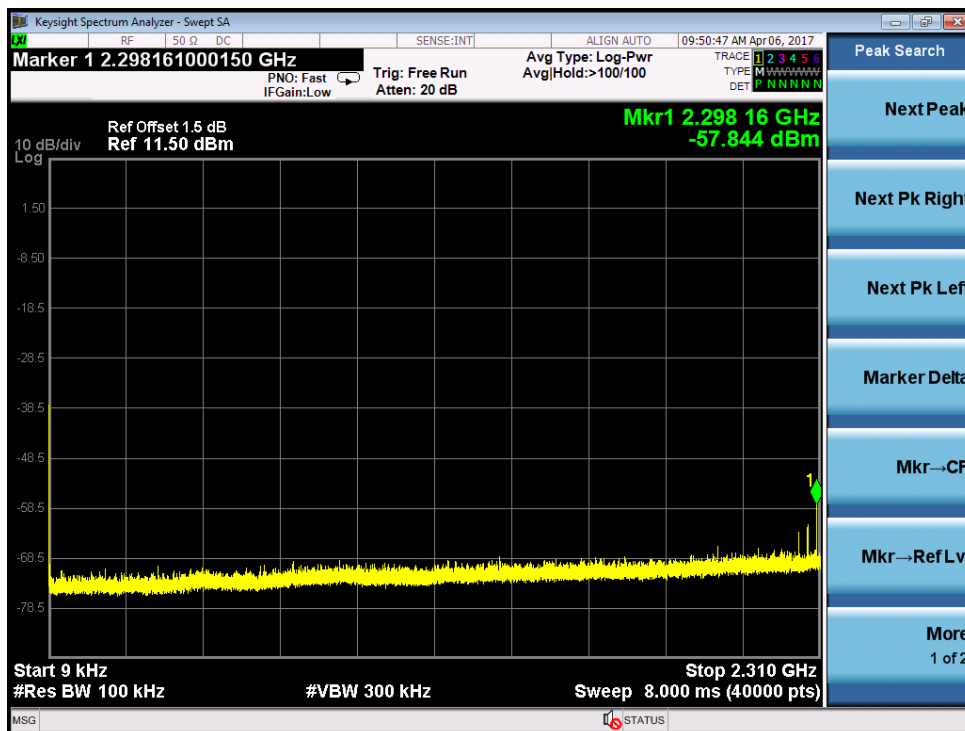
The test was performed at 3 channels (lowest, middle and highest channel).

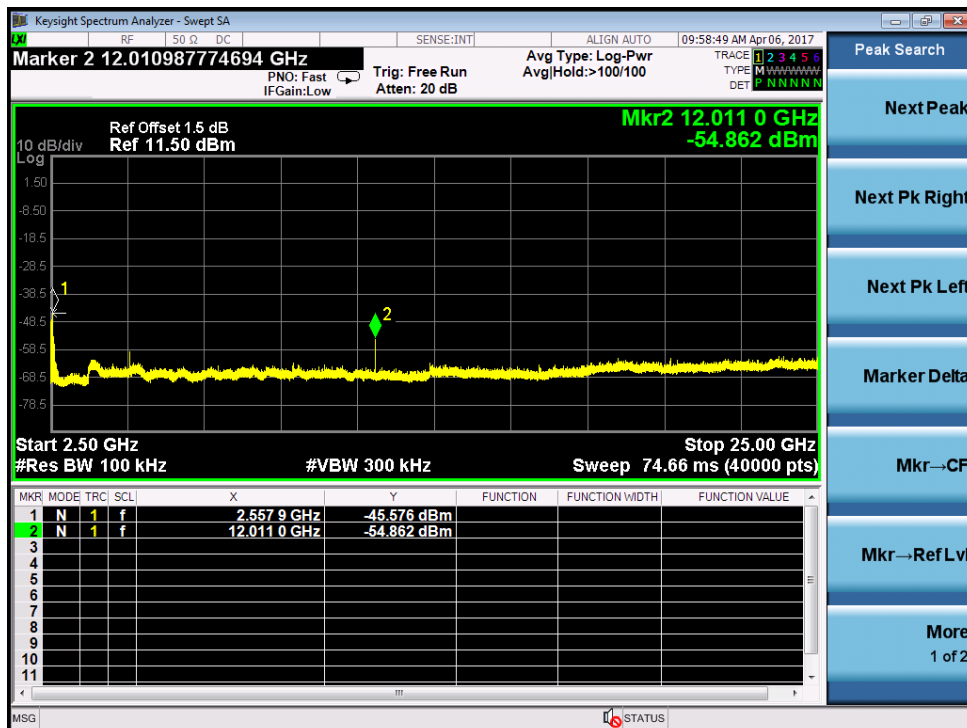
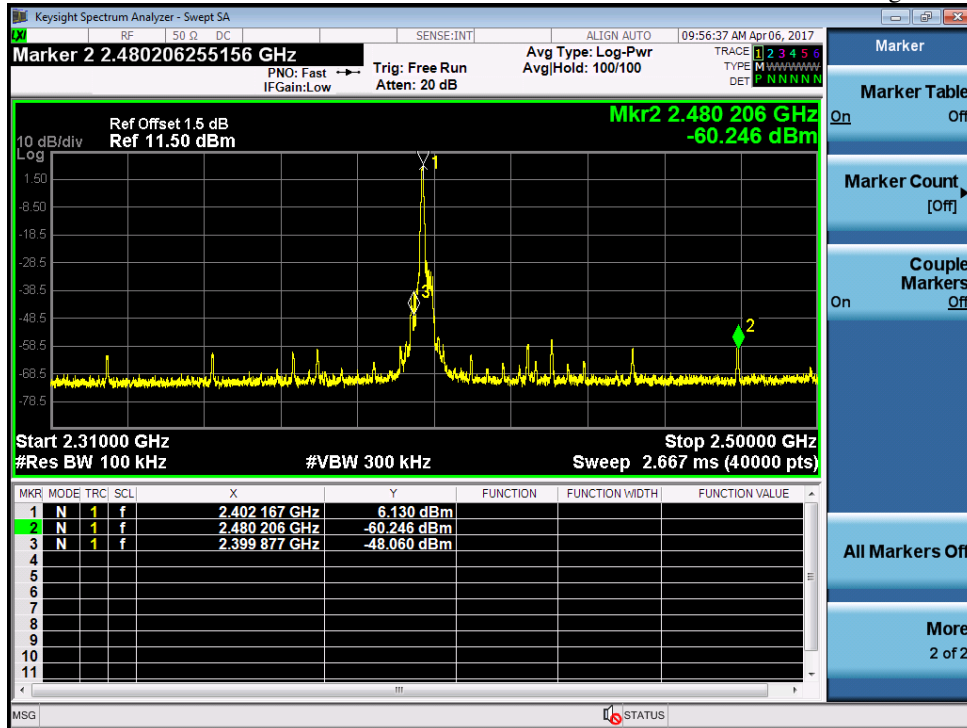
## 6.4 Test Protocol

Temperature: 22°C  
Relative Humidity: 54%

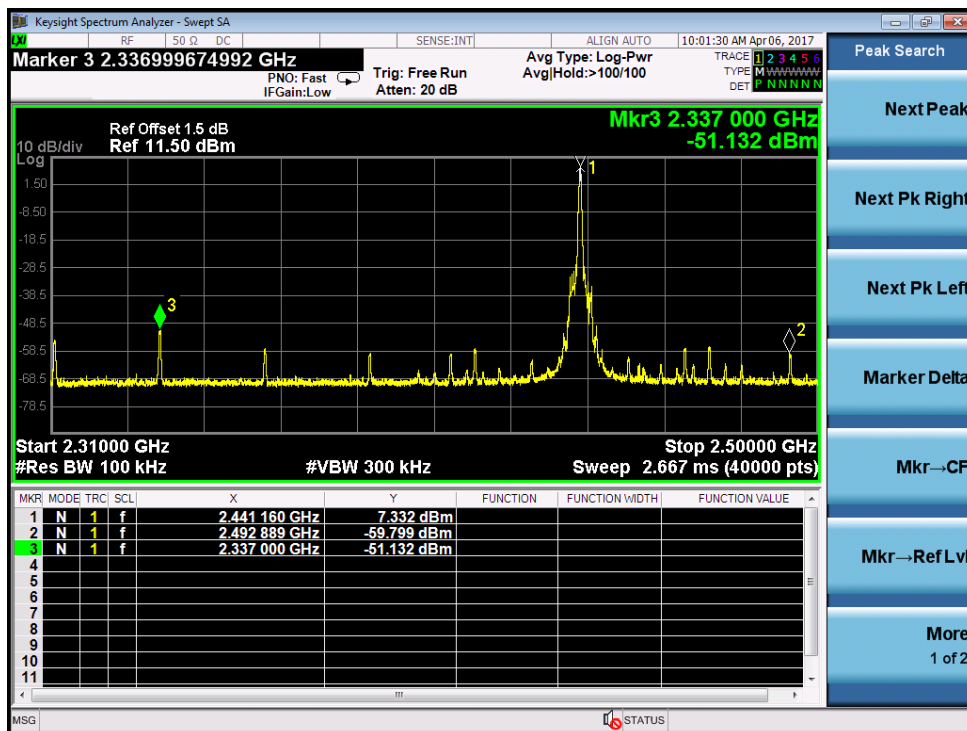
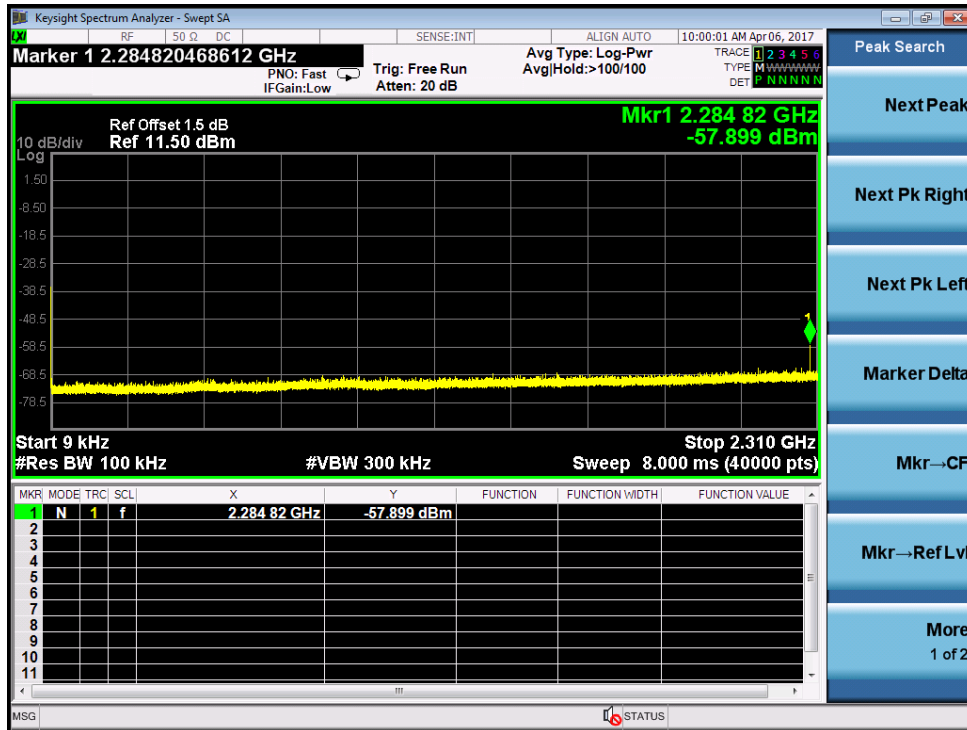
| Modulation | Channel | Max reading among band (dBm) | Results | Limit (dBm) |
|------------|---------|------------------------------|---------|-------------|
| GFSK       | L       | 6.130                        | Pass    | $\geq 20$   |
|            | M       | 7.332                        | Pass    | $\geq 20$   |
|            | H       | 7.166                        | Pass    | $\geq 20$   |
|            | Hopping | 7.381                        | Pass    | $\geq 20$   |

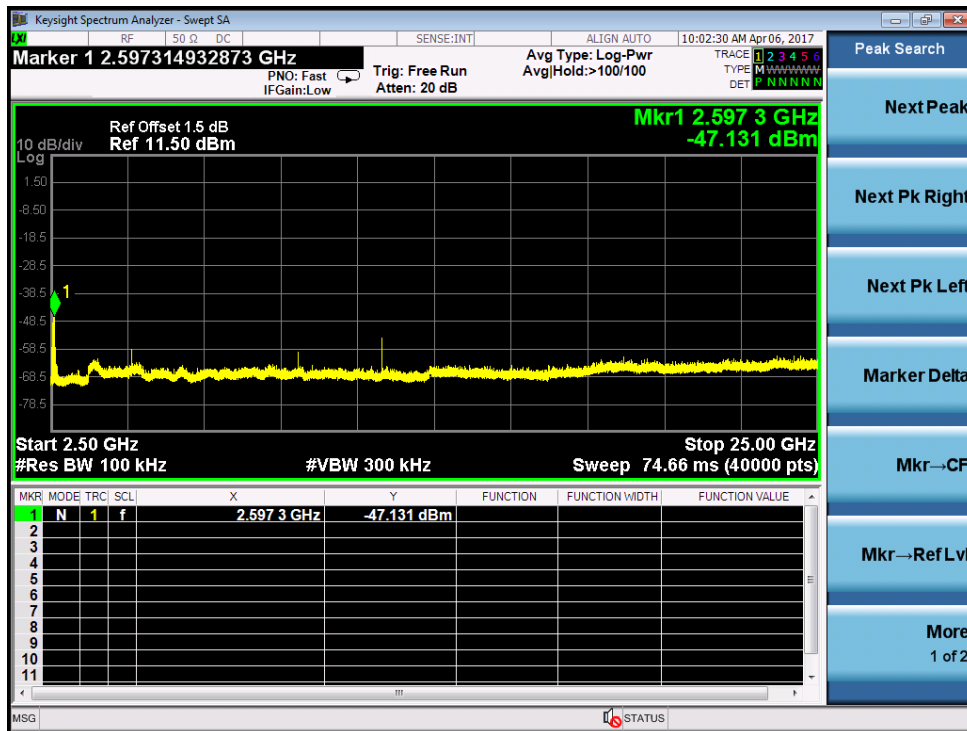
### Channel L



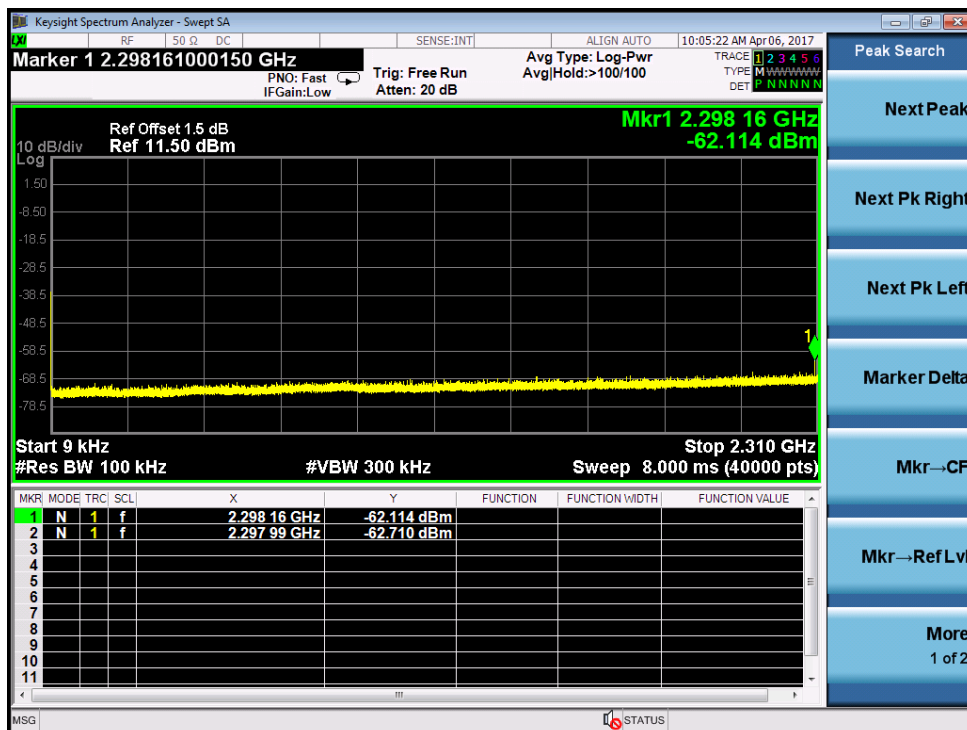


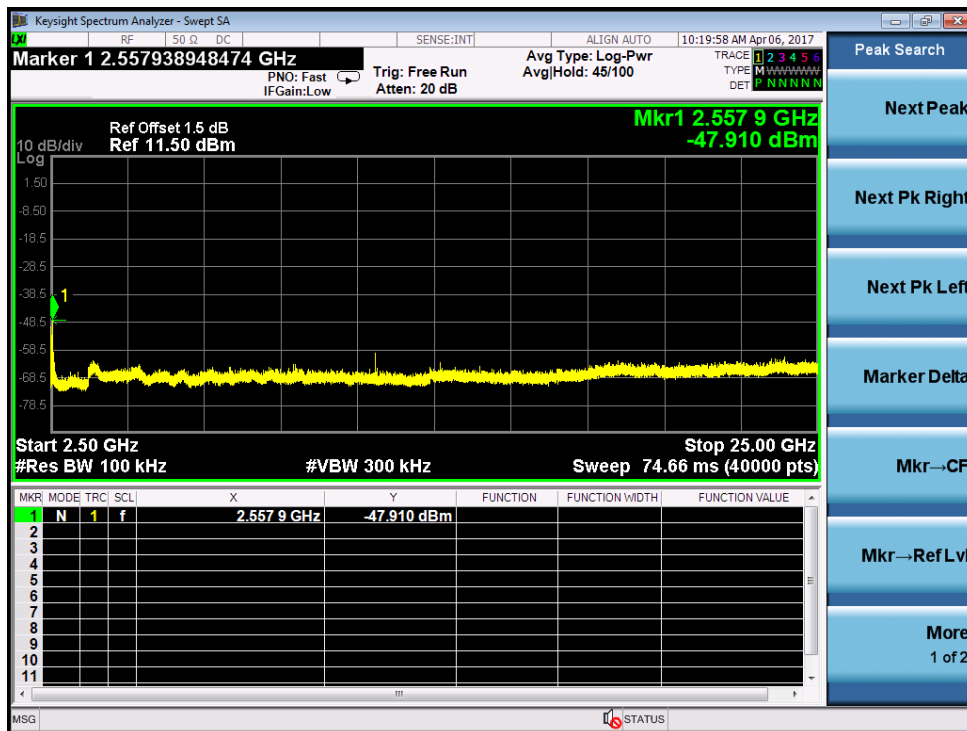
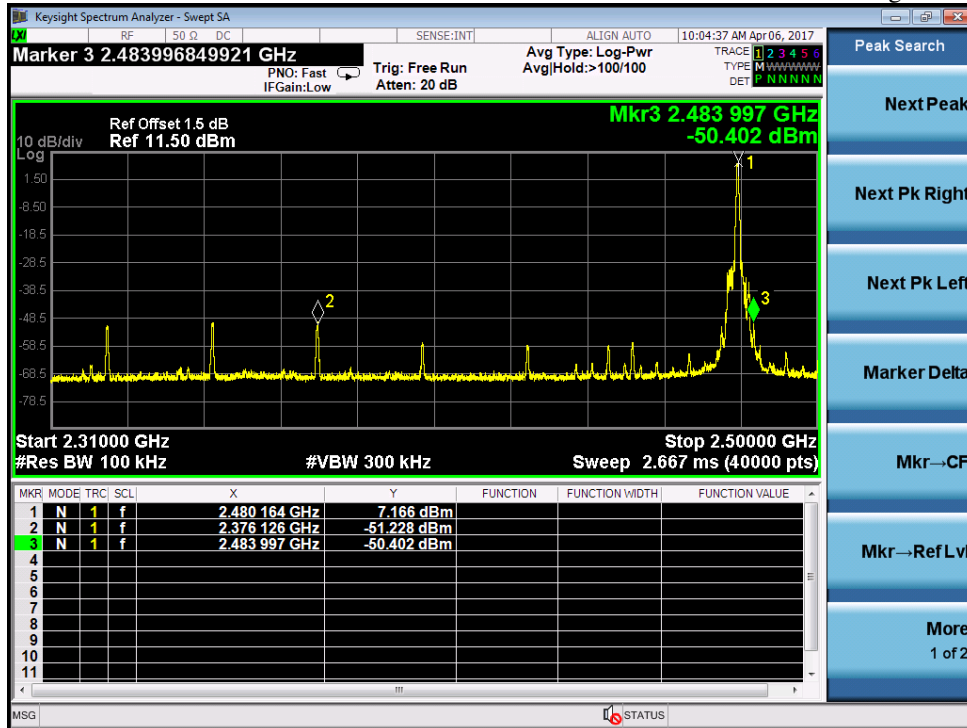
## Channel M



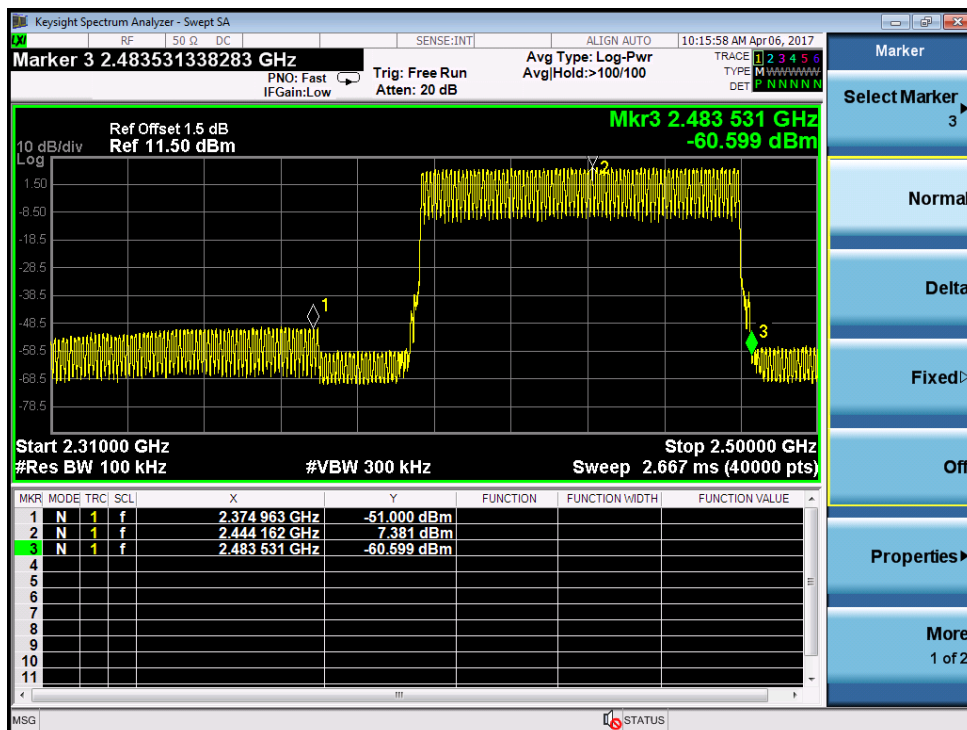
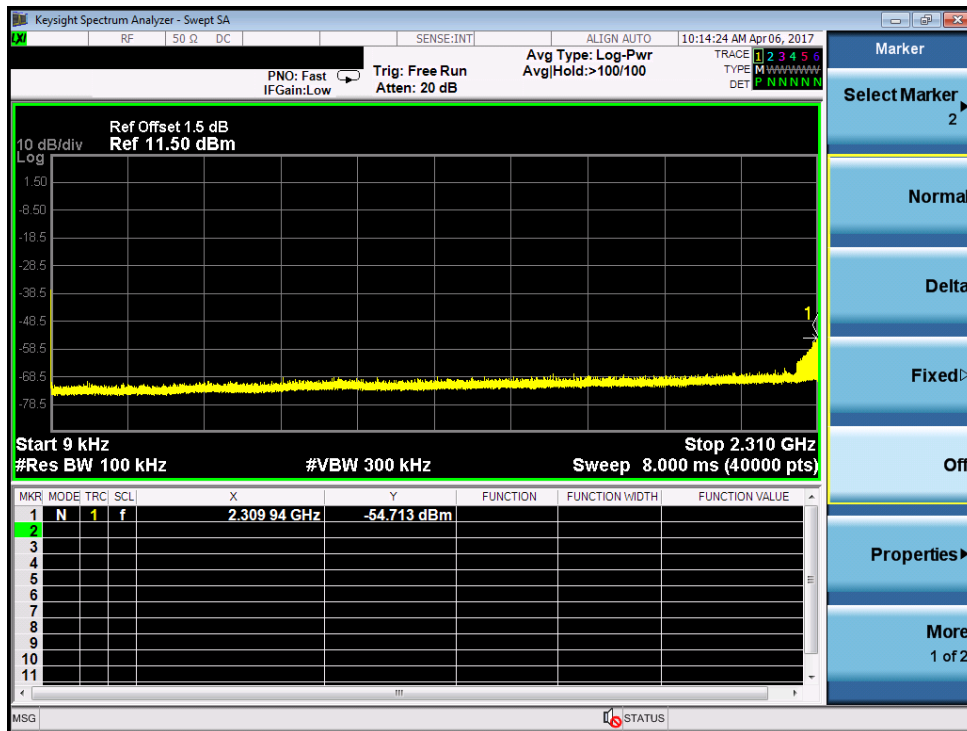


Channel H



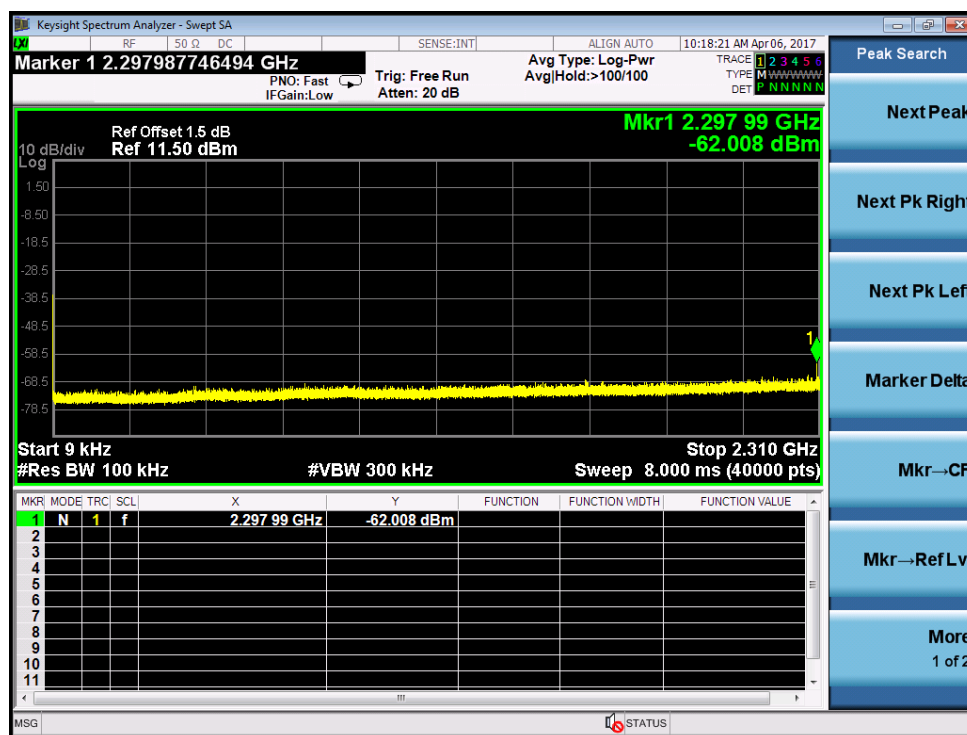


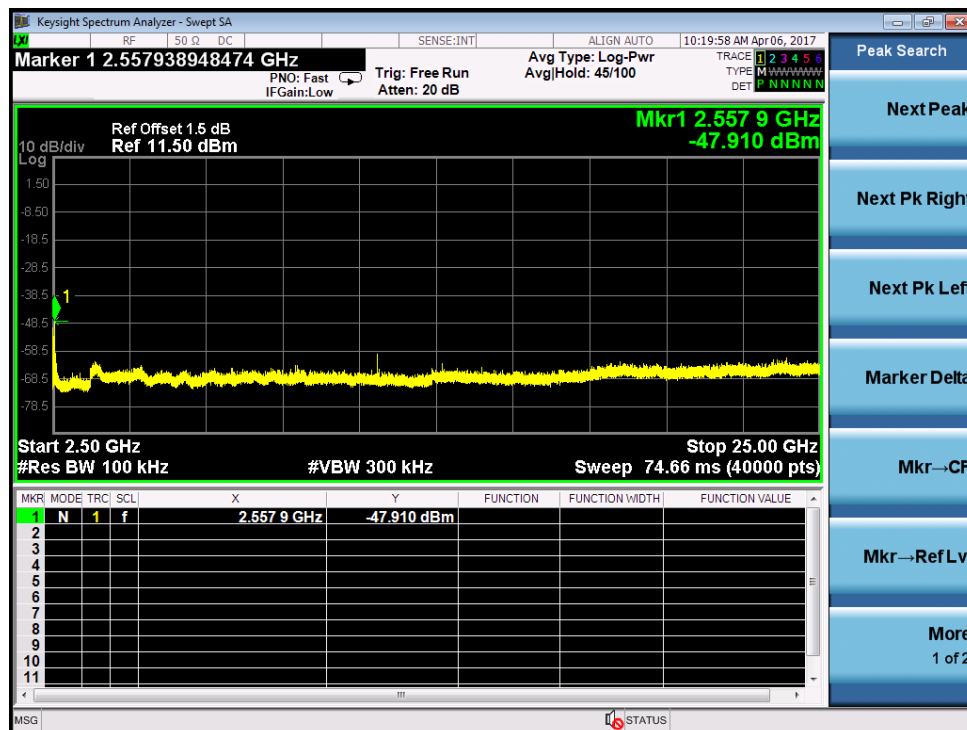
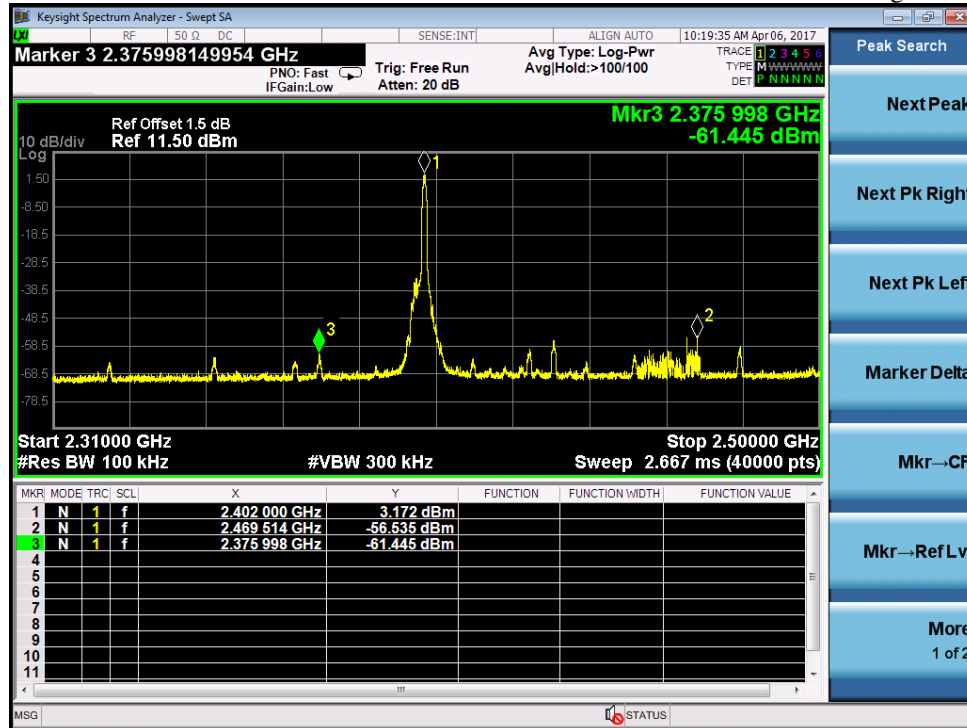
## Hopping



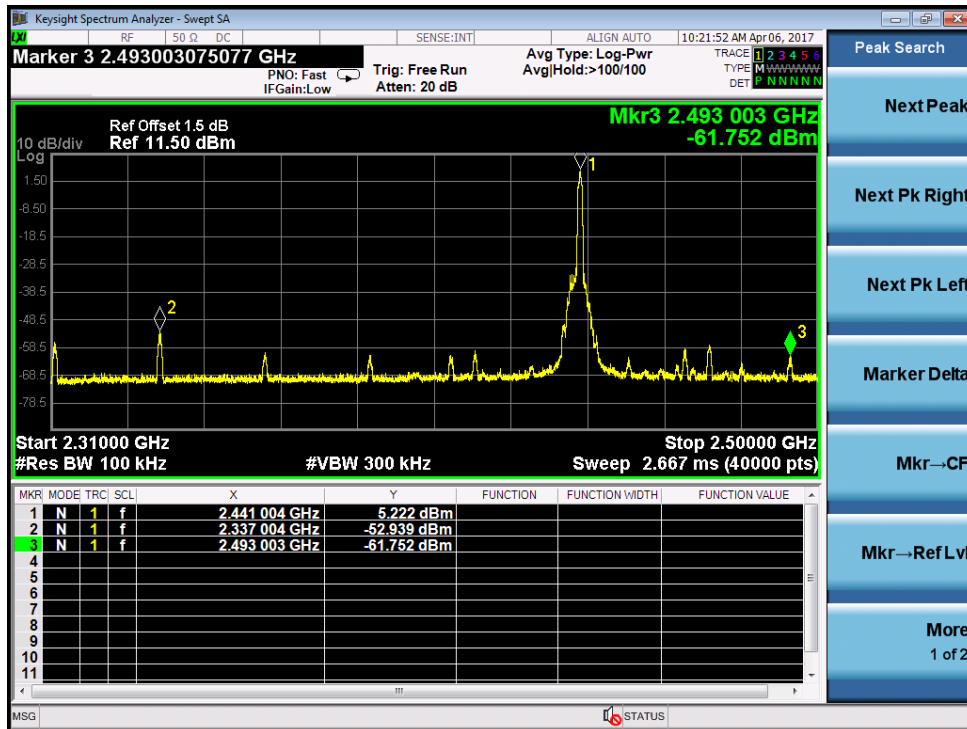
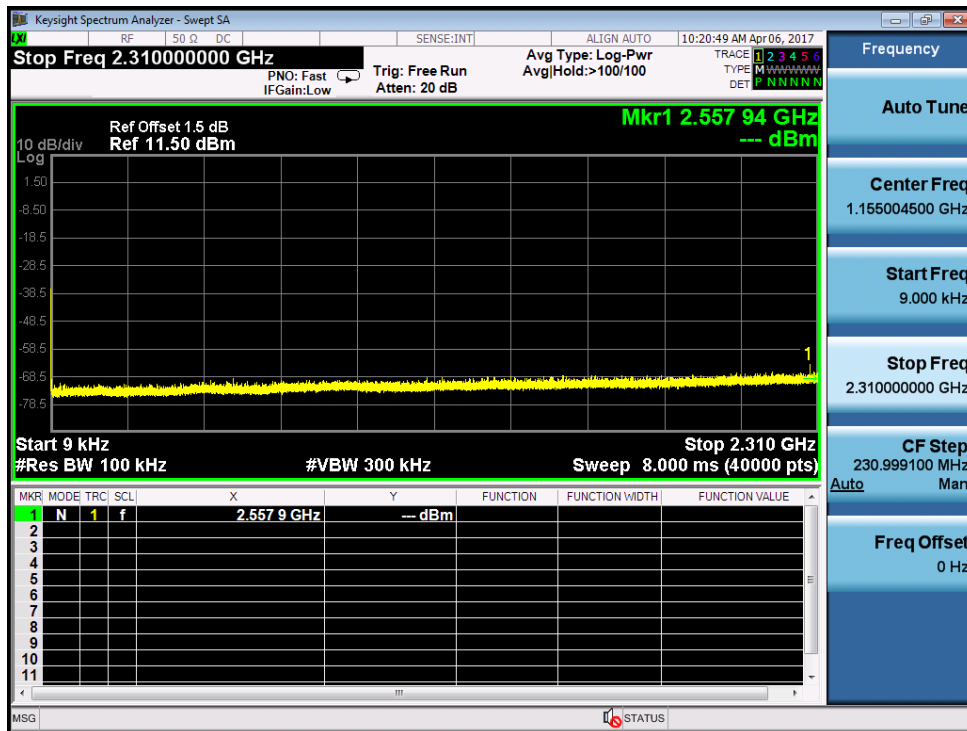
| Modulation     | Channel | Max reading among band (dBm) | Results | Limit (dBm) |
|----------------|---------|------------------------------|---------|-------------|
| $\pi/4$ -DQPSK | L       | 3.172                        | Pass    | $\geq 20$   |
|                | M       | 5.222                        | Pass    | $\geq 20$   |
|                | H       | 4.949                        | Pass    | $\geq 20$   |
|                | Hopping | 4.347                        | Pass    | $\geq 20$   |

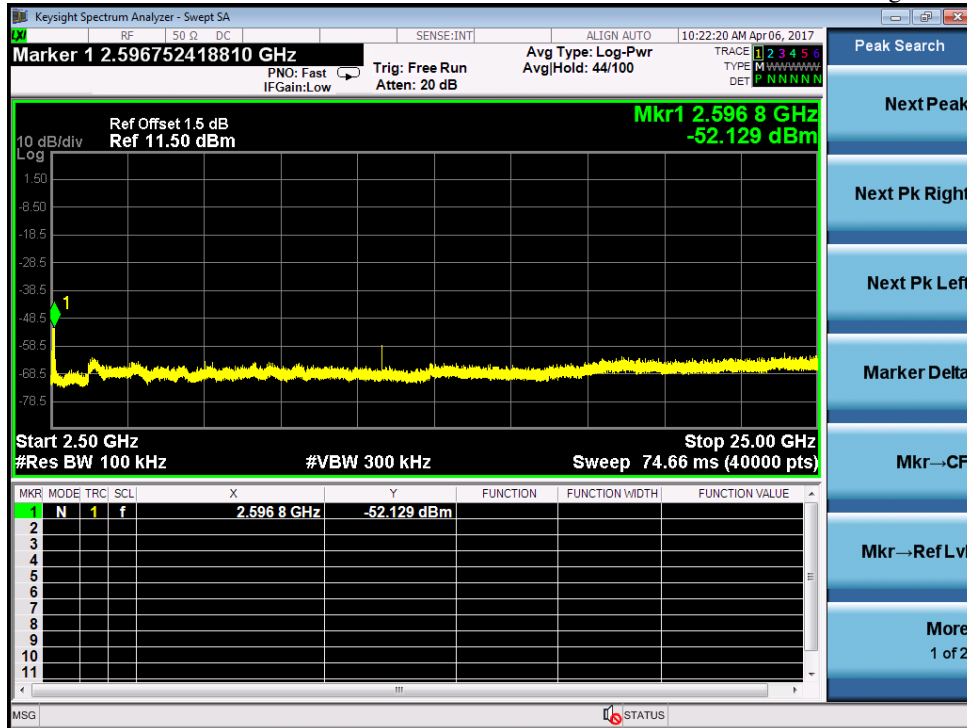
### Channel L



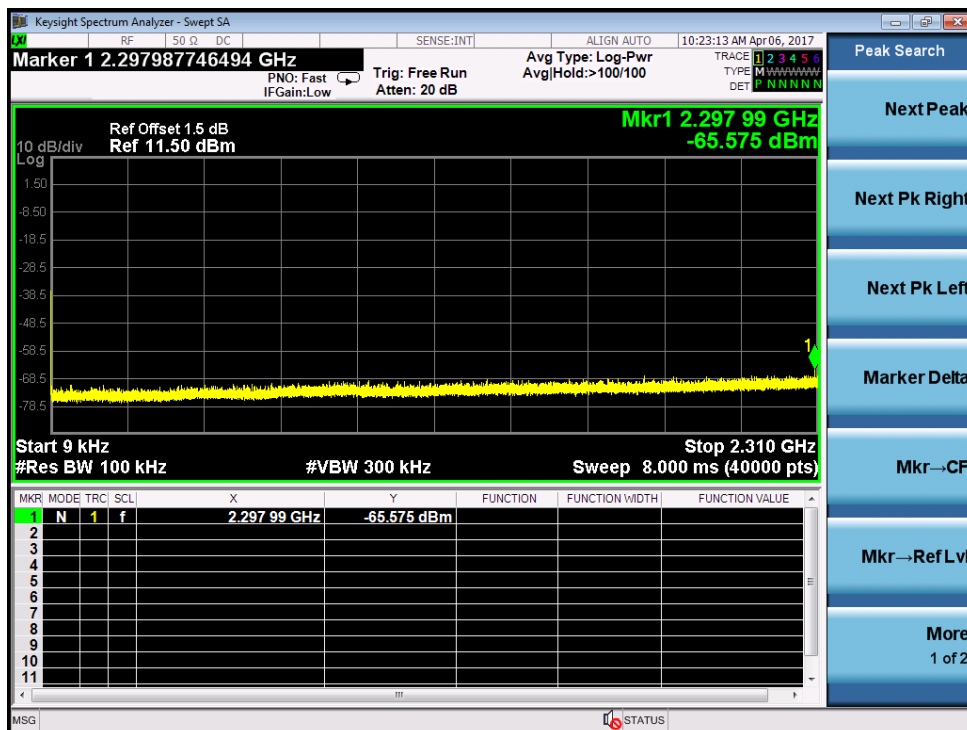


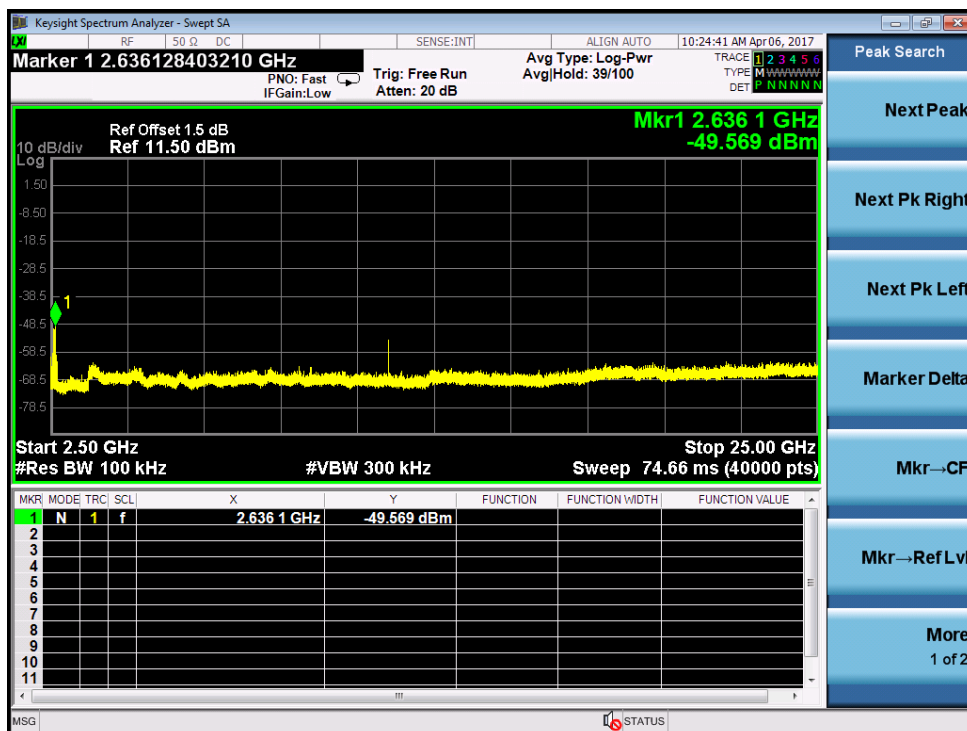
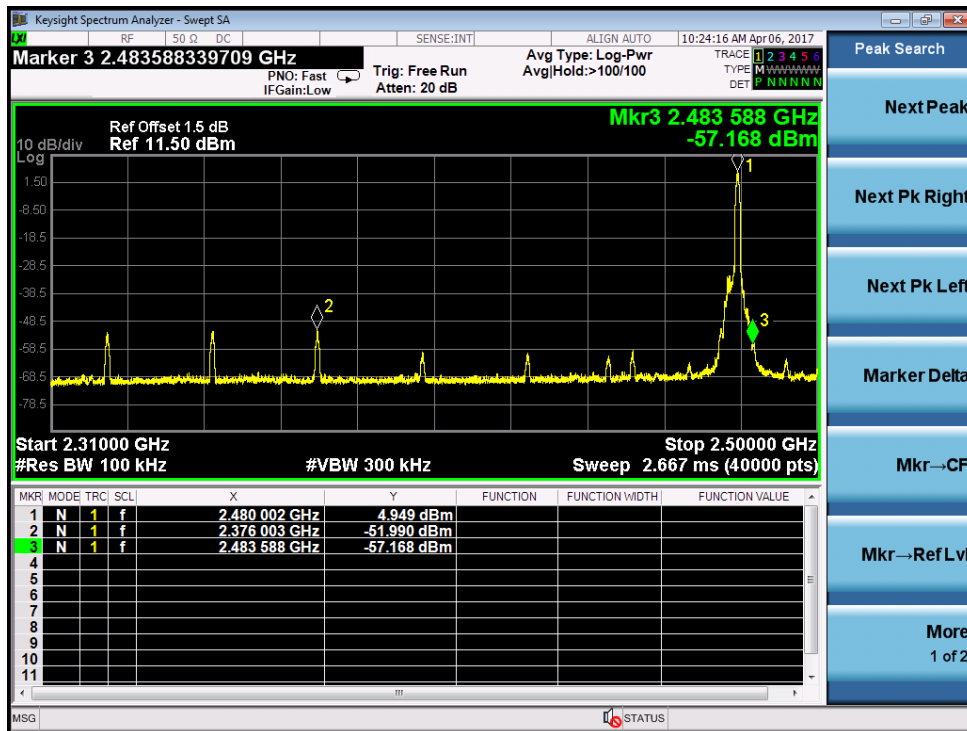
Channel M



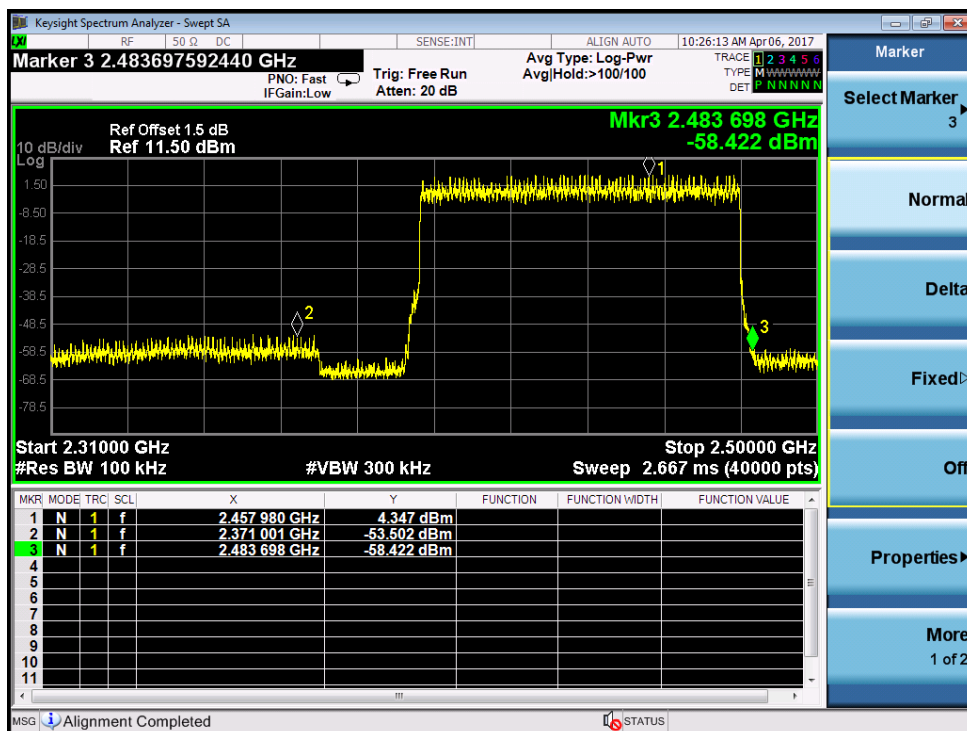
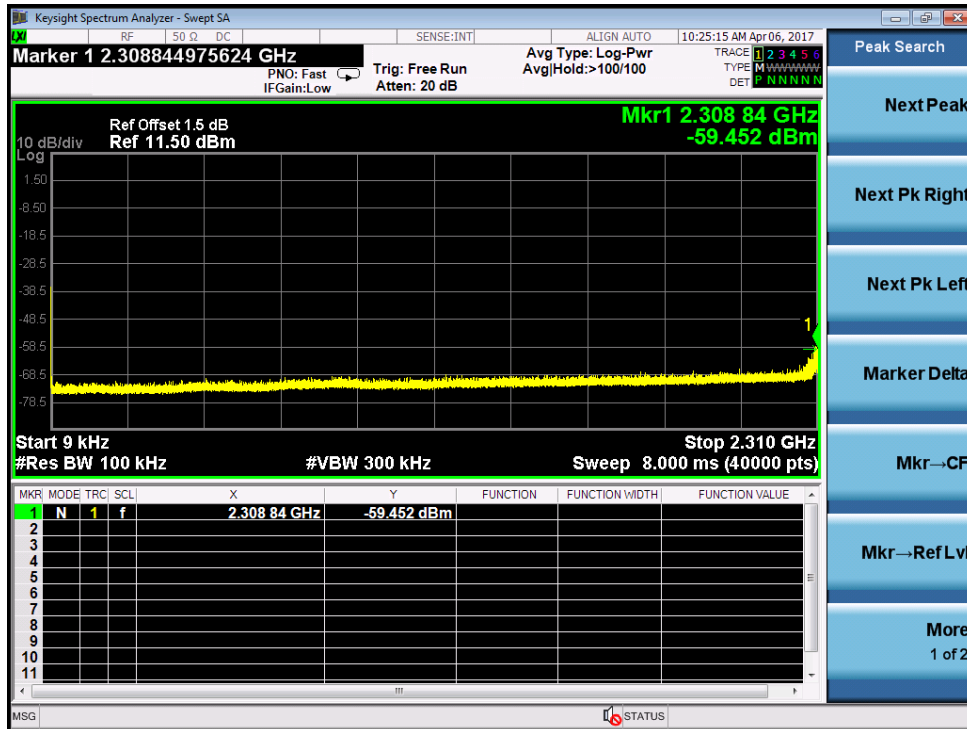


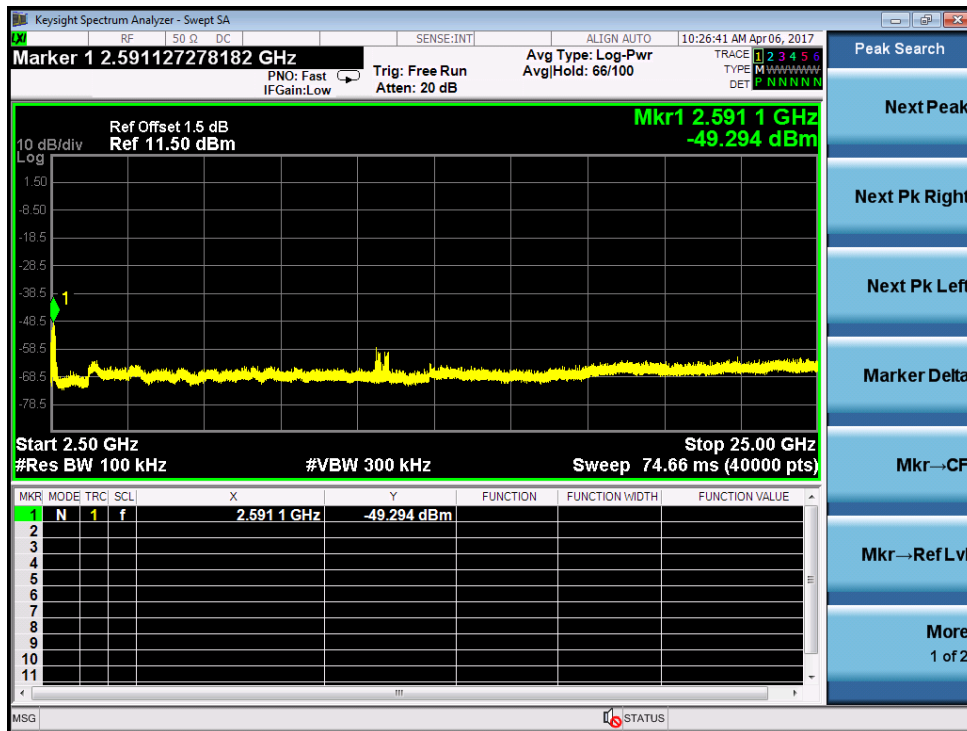
## Channel H





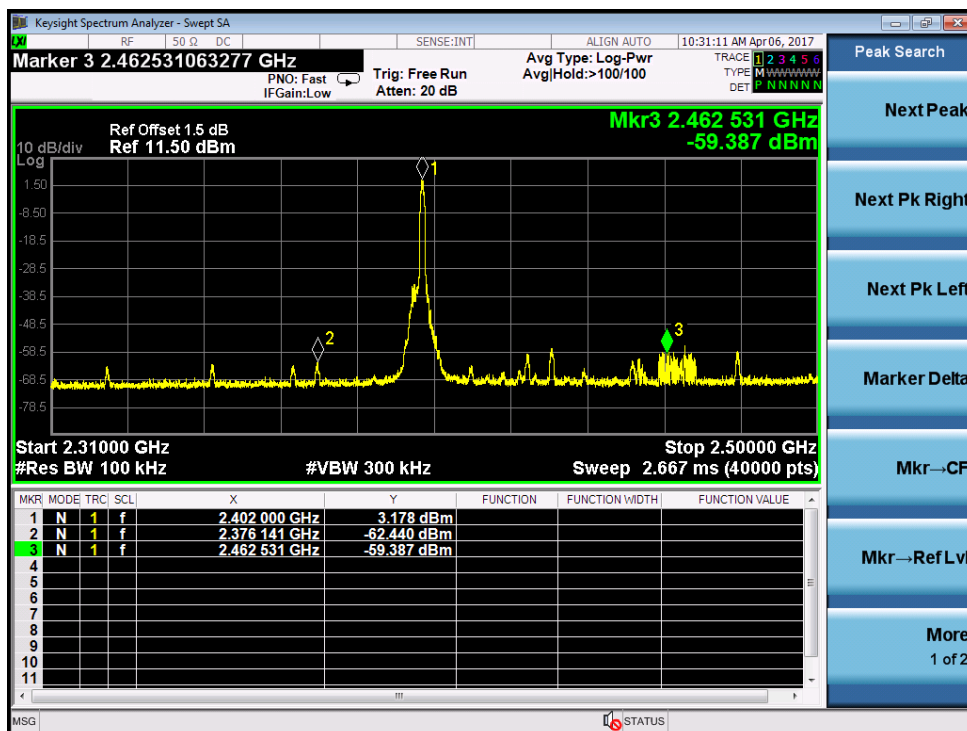
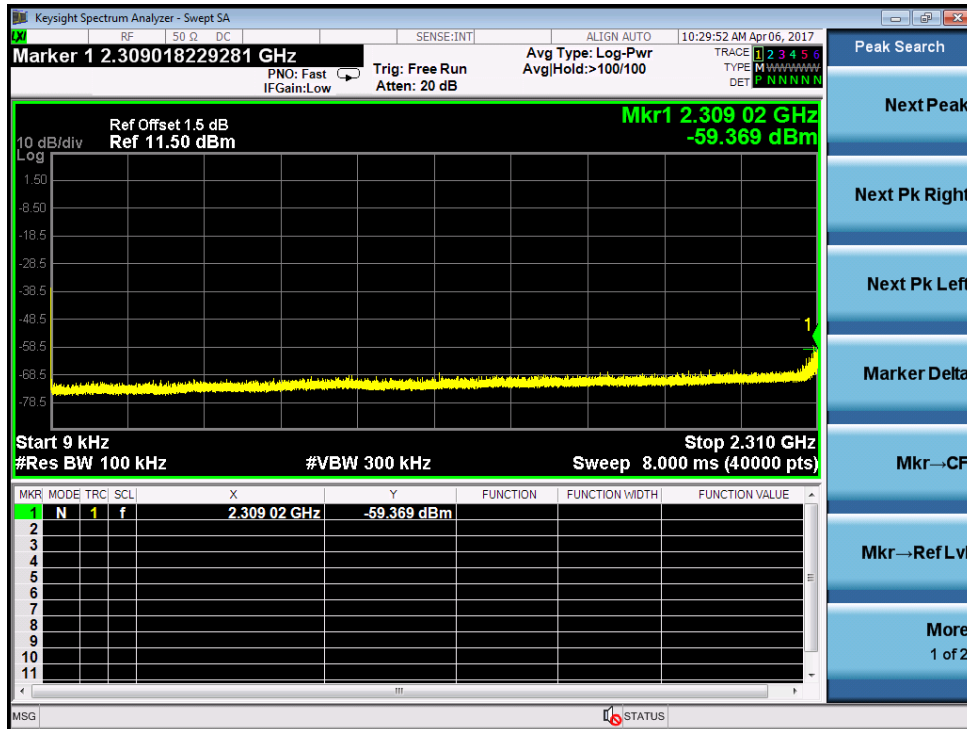
## Hopping

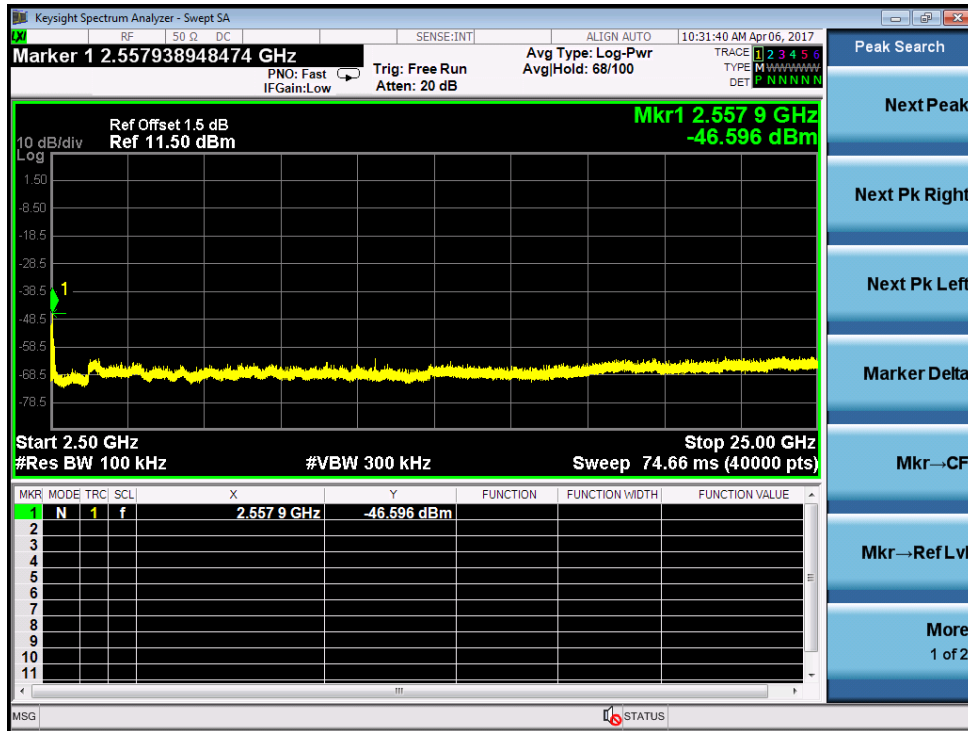




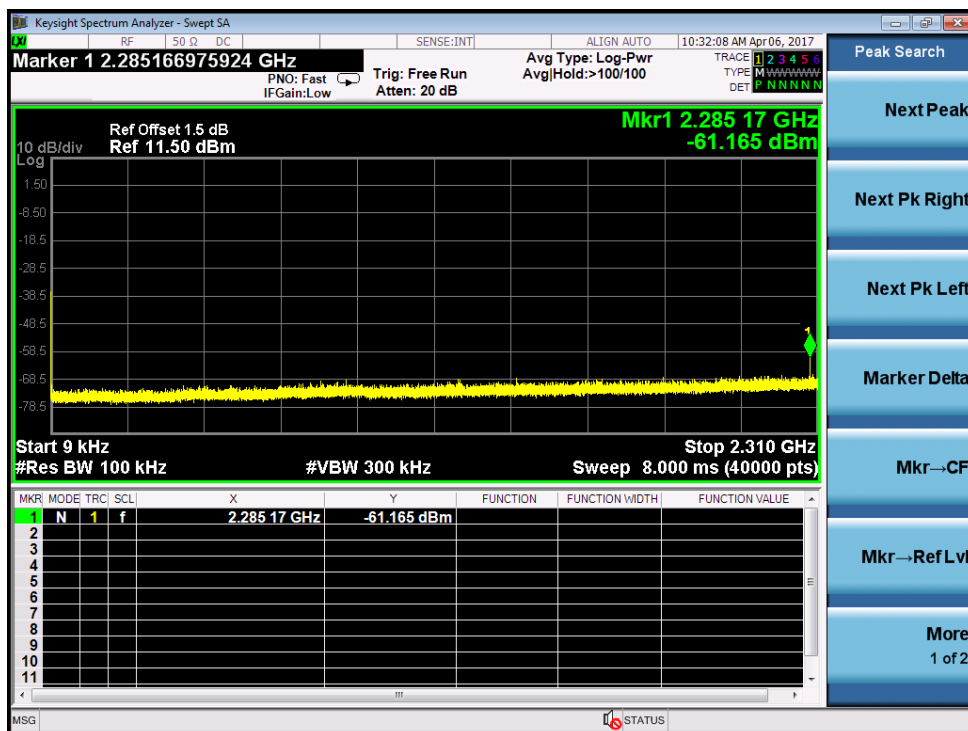
| Modulation | Channel | Max reading among band (dBm) | Results | Limit (dBm) |
|------------|---------|------------------------------|---------|-------------|
| 8DPSK      | L       | 3.178                        | Pass    | $\geq 20$   |
|            | M       | 5.208                        | Pass    | $\geq 20$   |
|            | H       | 4.949                        | Pass    | $\geq 20$   |
|            | Hopping | 5.192                        | Pass    | $\geq 20$   |

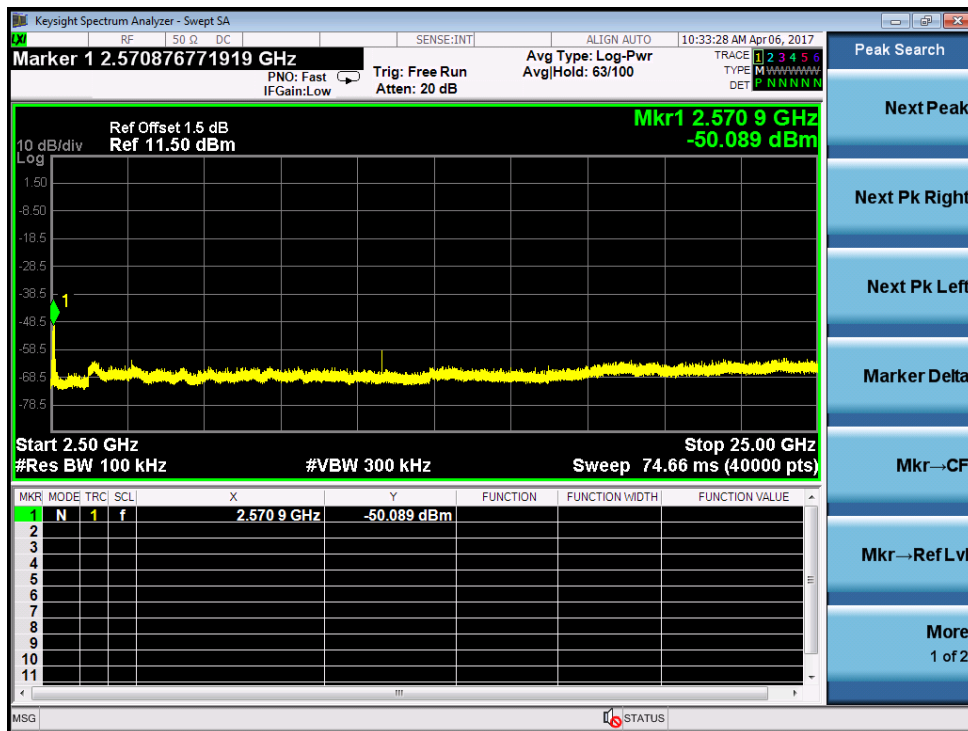
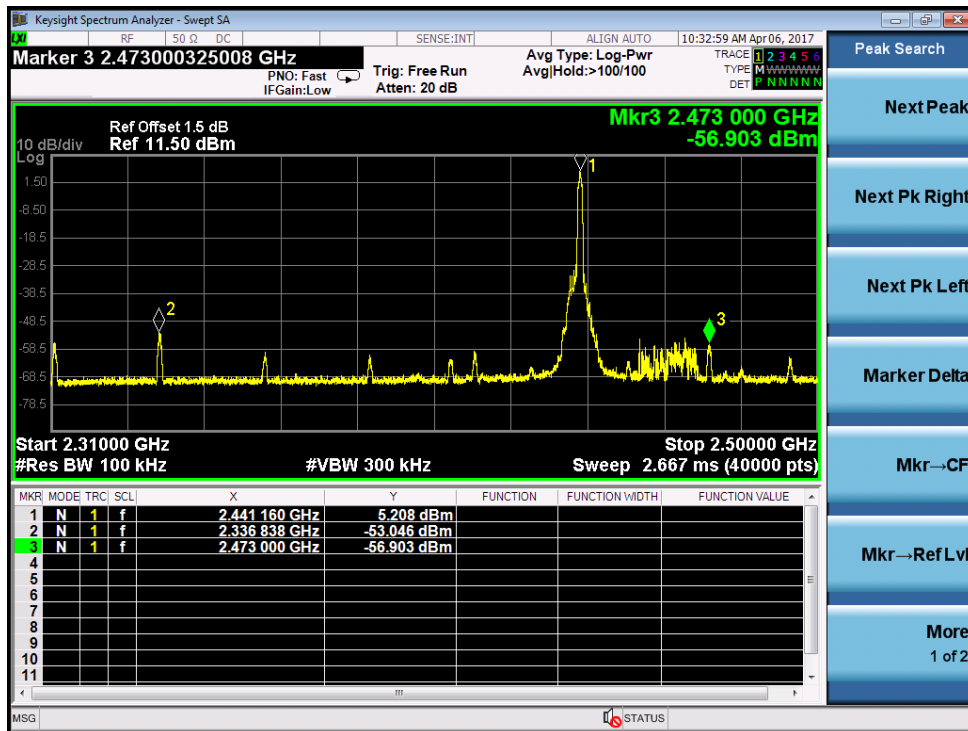
Channel L



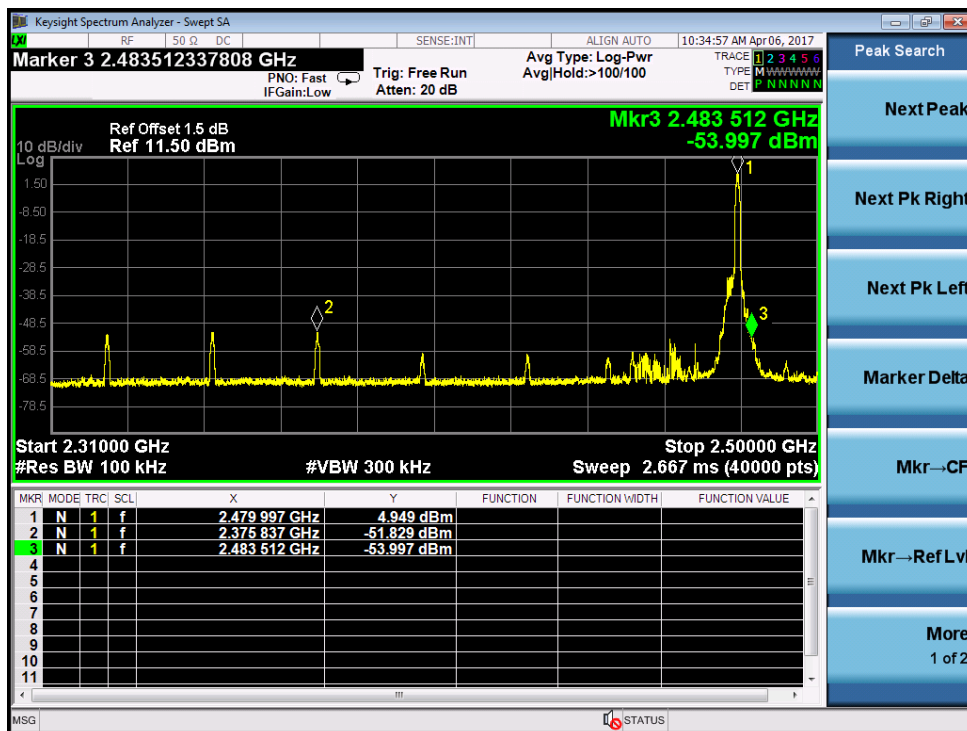
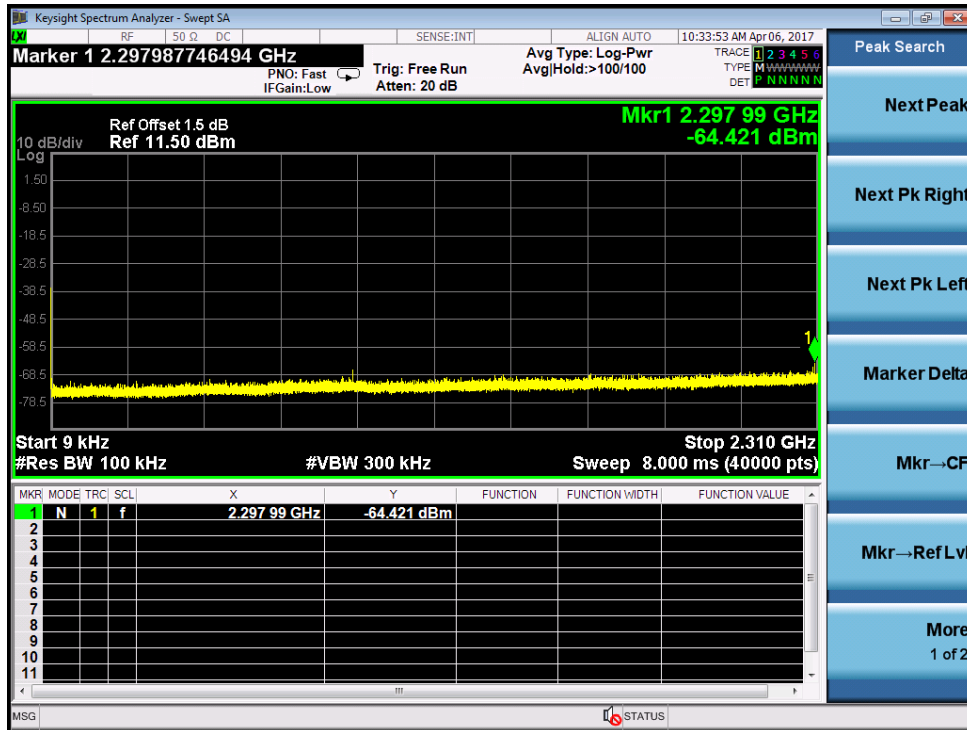


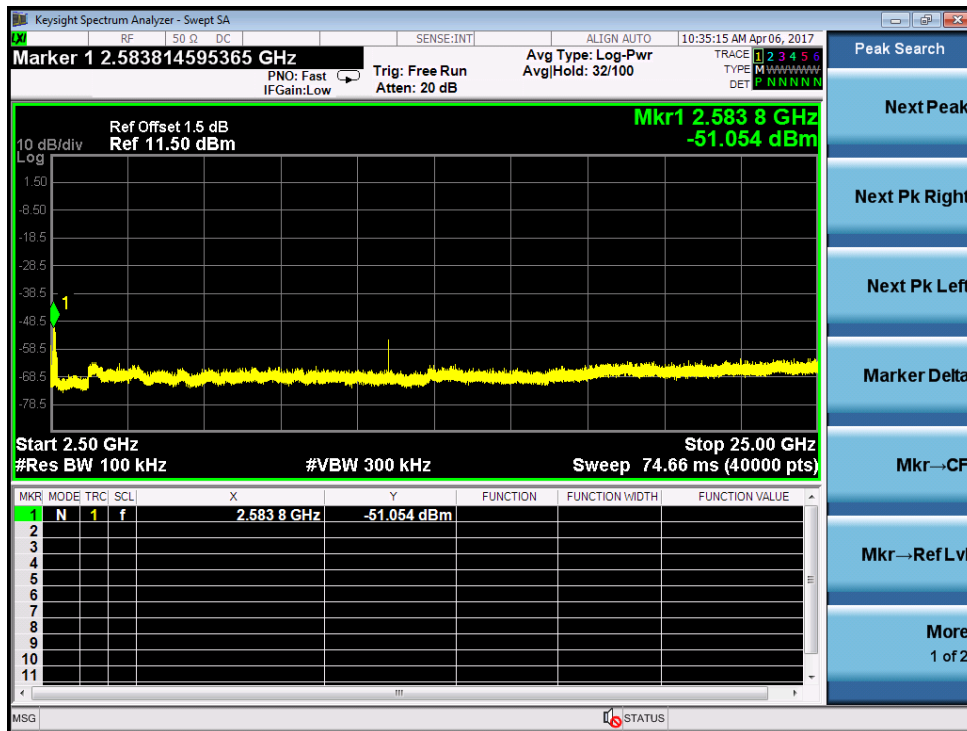
Channel M



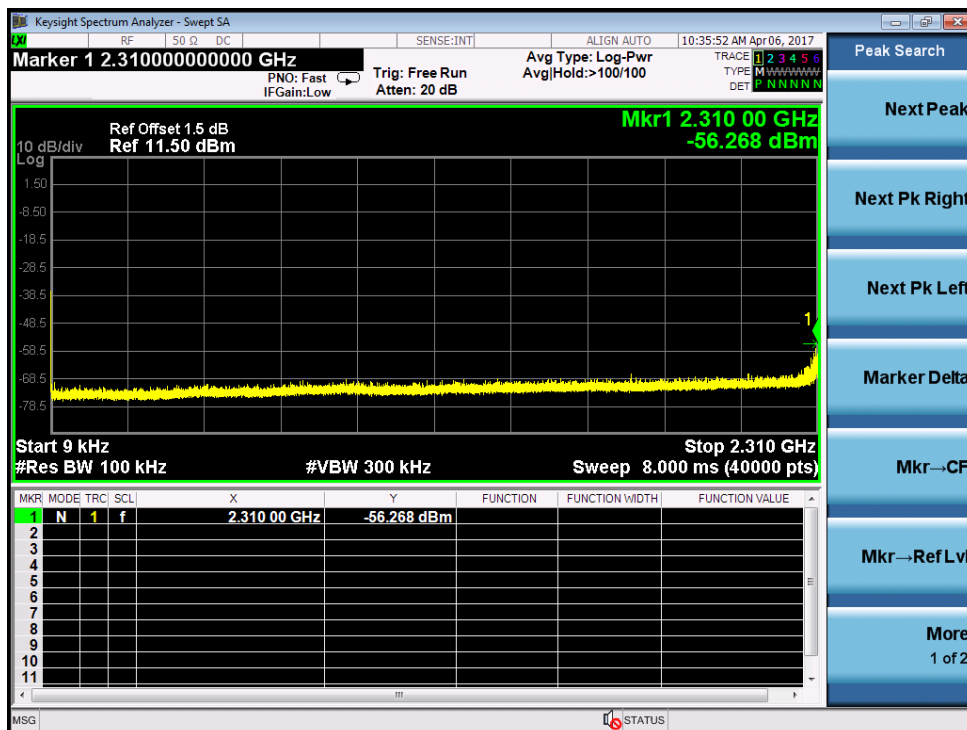


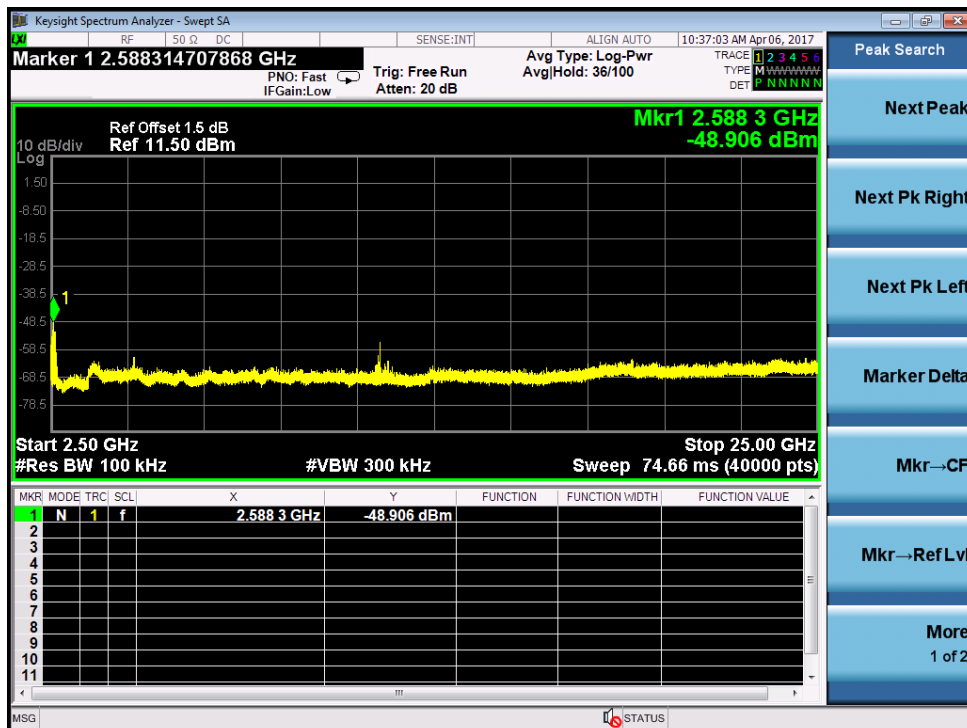
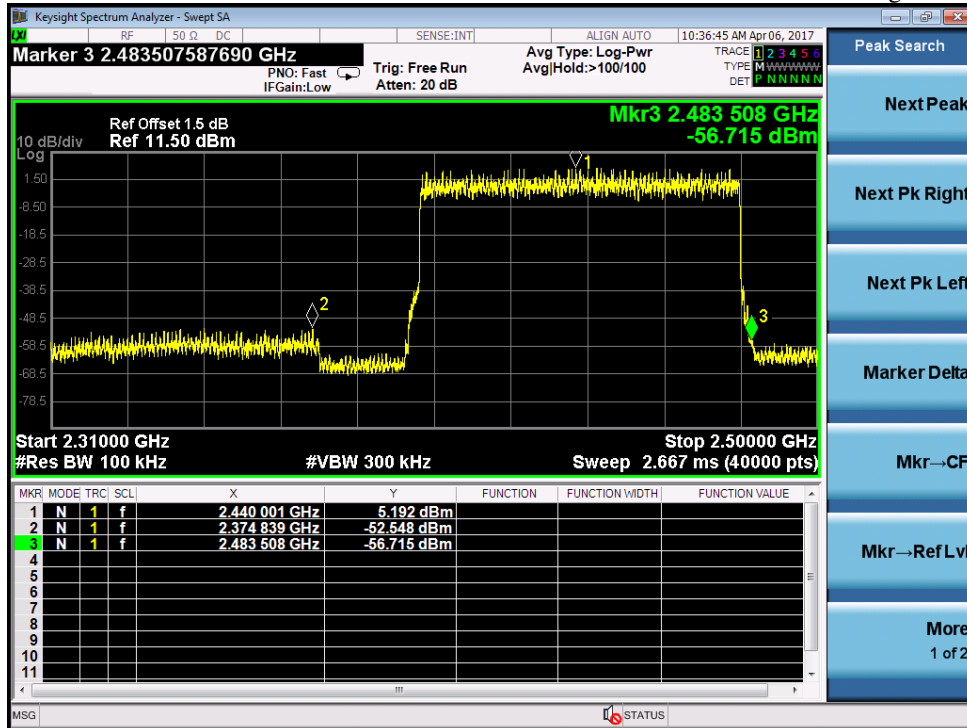
## Channel H





### Hopping





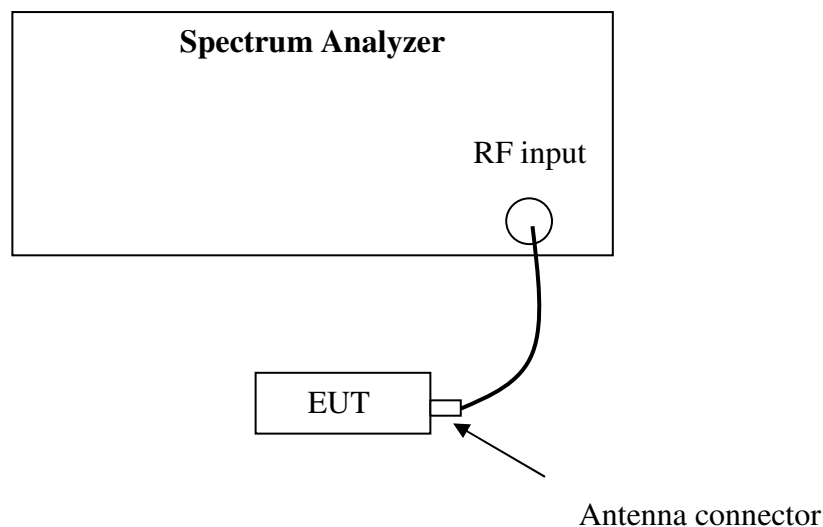
## 7 Number of hopping frequencies

**Test result:** Pass

### 7.1 Test limit

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

### 7.2 Test Configuration



### 7.3 Test procedure and test setup

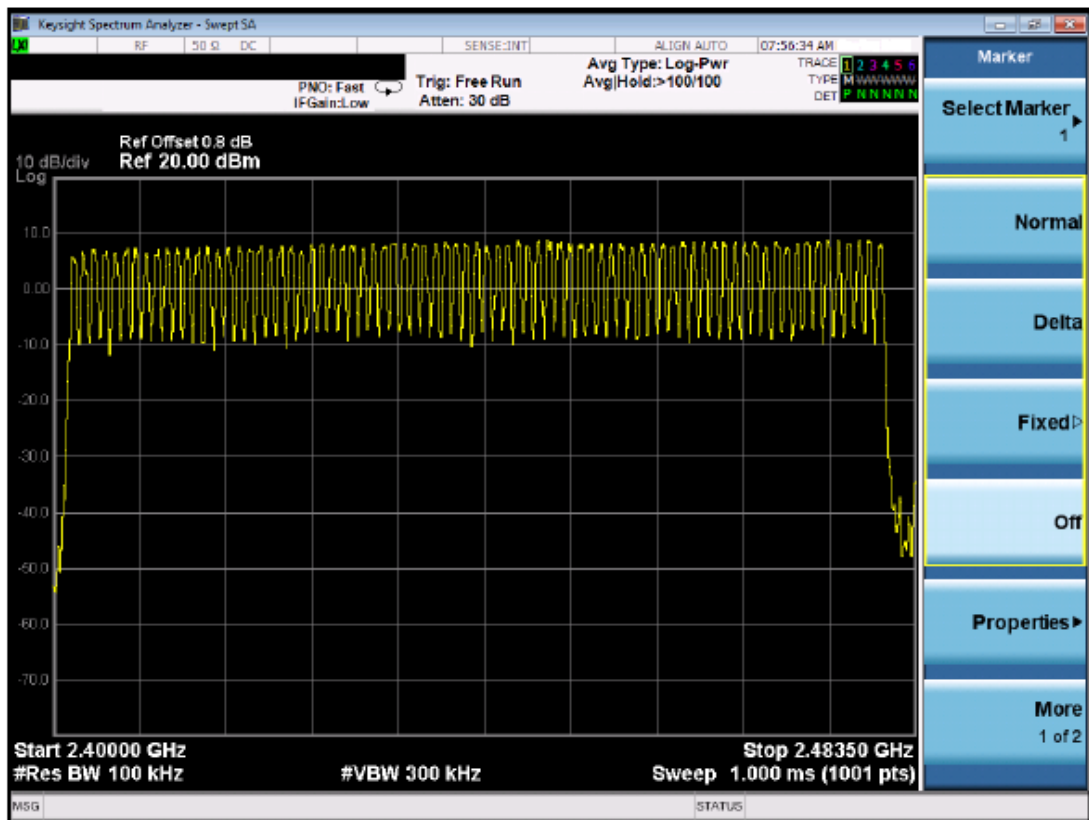
The EUT was tested according to DA 00-705 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).

The Number of hopping frequencies 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.

## 7.4 Test Protocol

Temperature: 22°C  
Relative Humidity: 54%

| Number of Hopping Frequencies | Limit |
|-------------------------------|-------|
| 79                            | ≥15   |



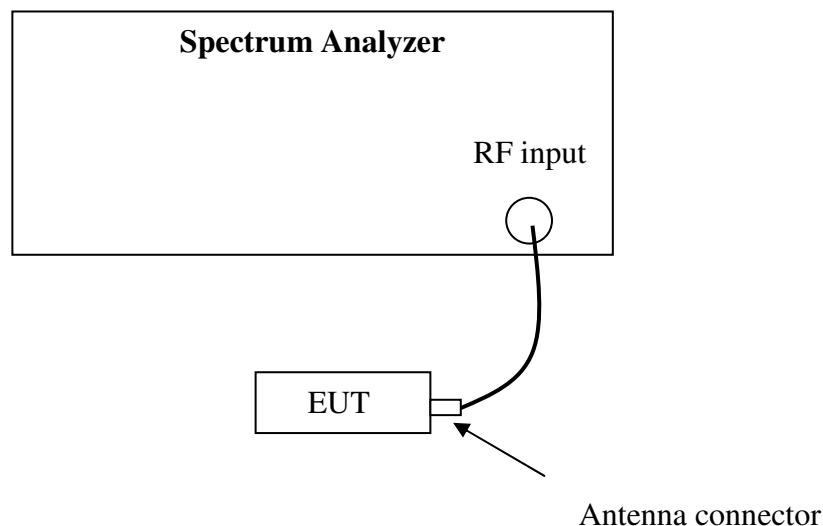
## 8 Dwell time

**Test result:** Pass

### 8.1 Test 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.

### 8.2 Test Configuration



### 8.3 Test procedure and test setup

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

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.

#### 8.4 Test Protocol

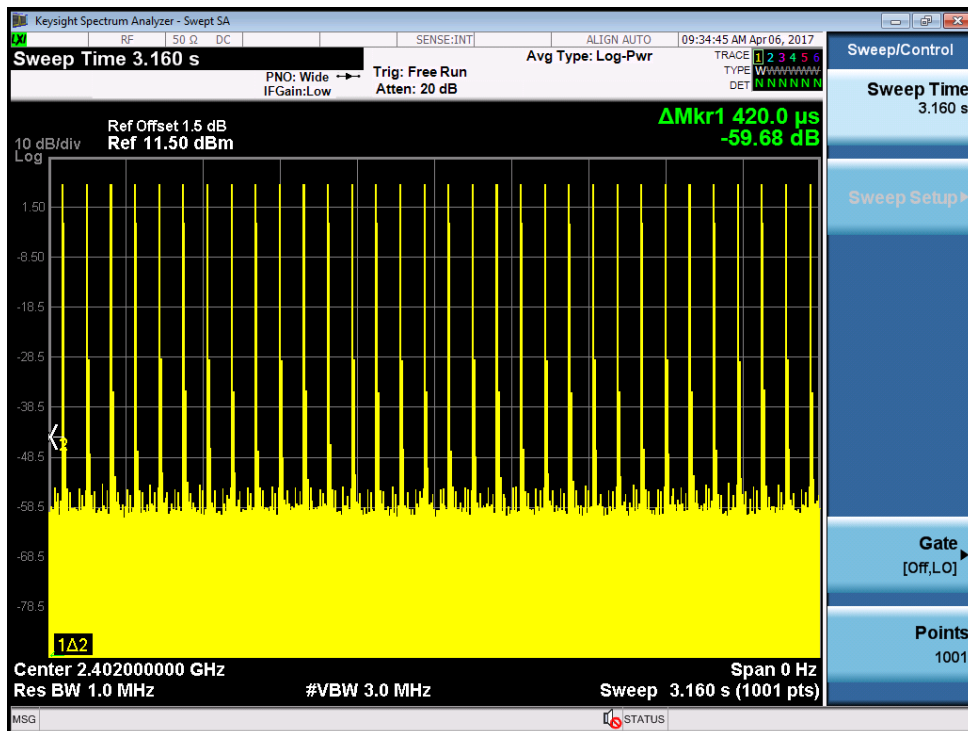
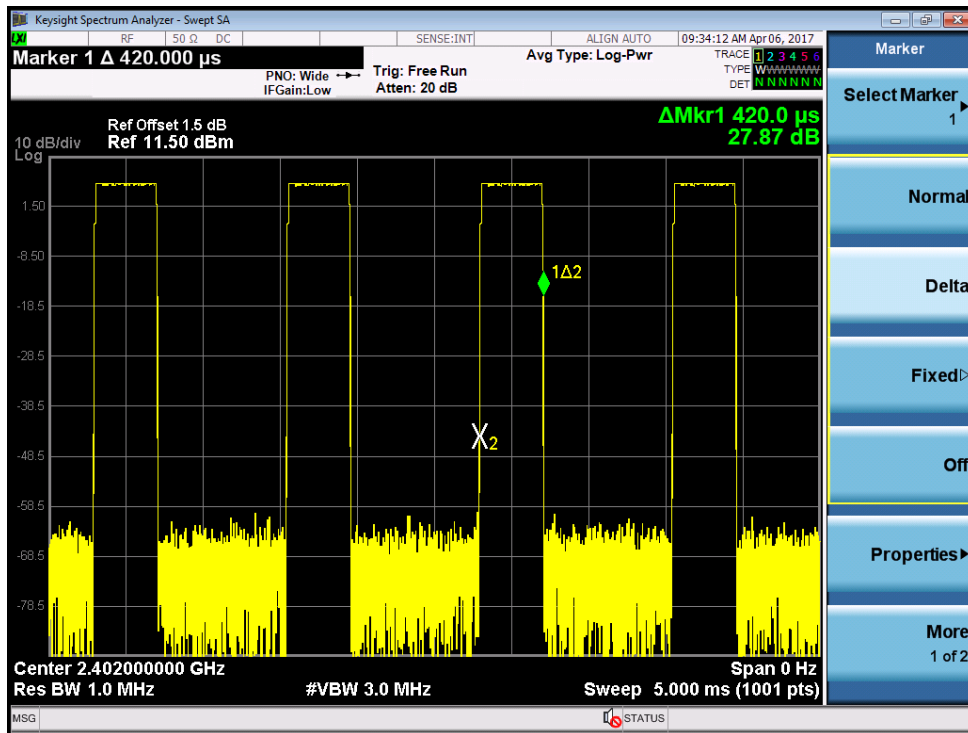
Temperature: 22°C  
Relative Humidity: 54%

| Packet | Occupancy time<br>for single hop<br>(ms)<br>O | Channel | Real observed<br>period<br>(s)<br>P | Hops among<br>Observed<br>period<br>I | Dwell time<br>(ms)<br>T | Limit<br>(s) |
|--------|-----------------------------------------------|---------|-------------------------------------|---------------------------------------|-------------------------|--------------|
| DH1    | 0.420                                         | L       | 3.16                                | 32                                    | 134.40                  | ≤0.4         |
|        |                                               | M       | 3.16                                | 32                                    | 134.40                  |              |
|        |                                               | H       | 3.16                                | 32                                    | 134.40                  |              |
| DH3    | 1.650                                         | L       | 3.16                                | 16                                    | 264.00                  |              |
|        |                                               | M       | 3.16                                | 16                                    | 264.00                  |              |
|        |                                               | H       | 3.16                                | 16                                    | 264.00                  |              |
| DH5    | 3.00                                          | L       | 3.16                                | 10                                    | 300                     |              |
|        |                                               | M       | 3.16                                | 10                                    | 300                     |              |
|        |                                               | H       | 3.16                                | 10                                    | 300                     |              |

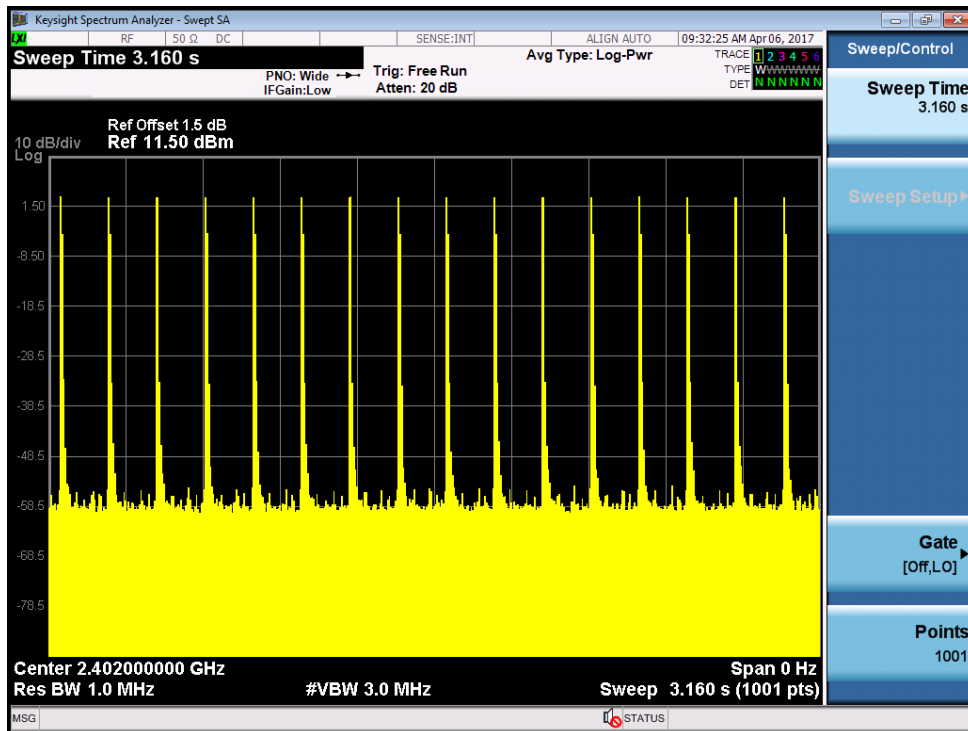
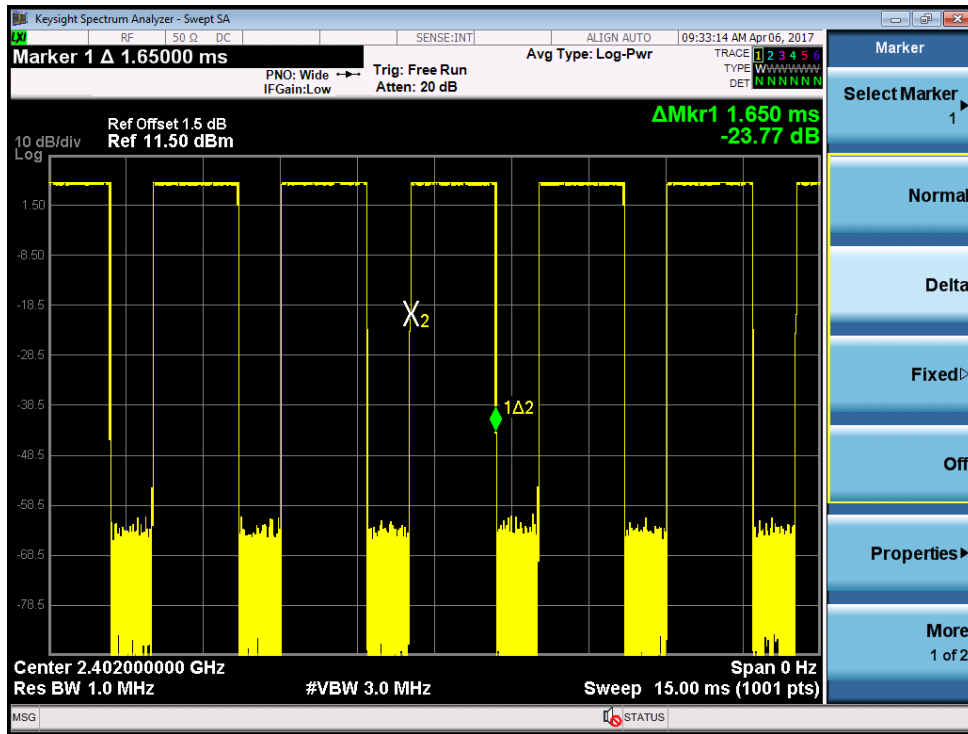
Remark: 1. There are 79 channels in all. So the complete observed period  $P = 0.4 * 79 = 31.6$  s.

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

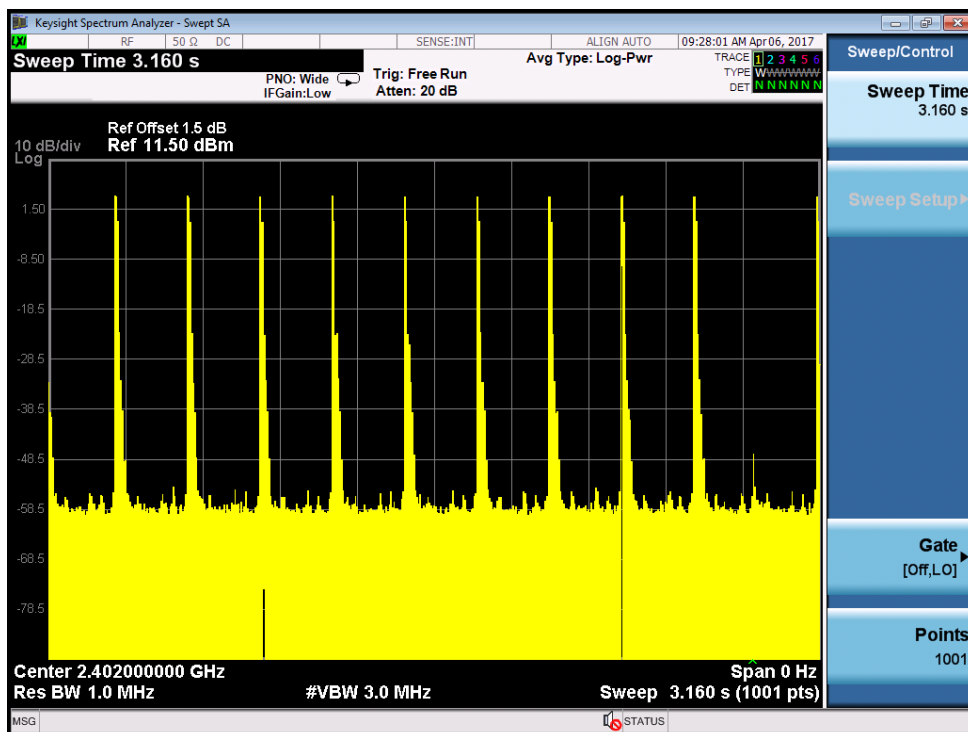
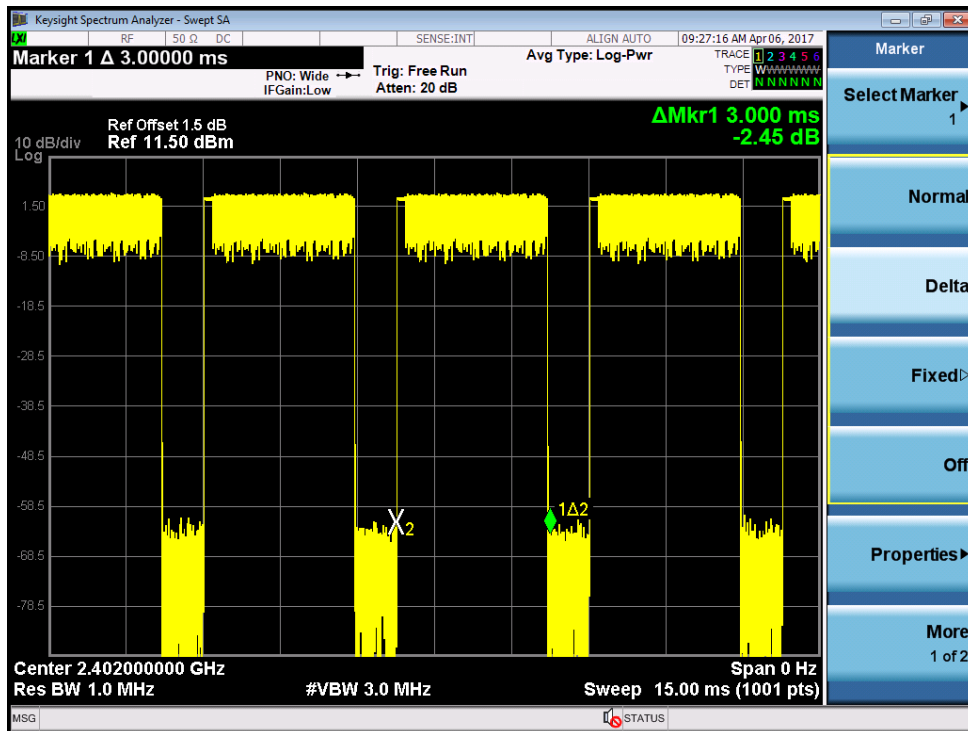
# DH1



DH3



DH5



## 9 Radiated Emissions

**Test result:** Pass

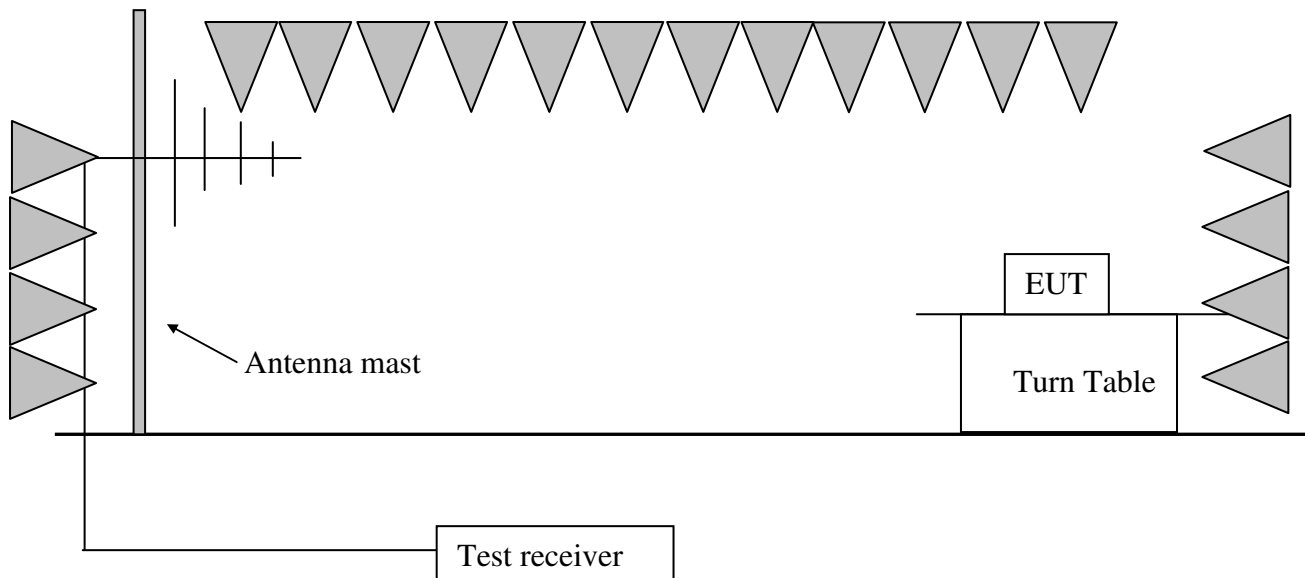
### 9.1 Test limit

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:

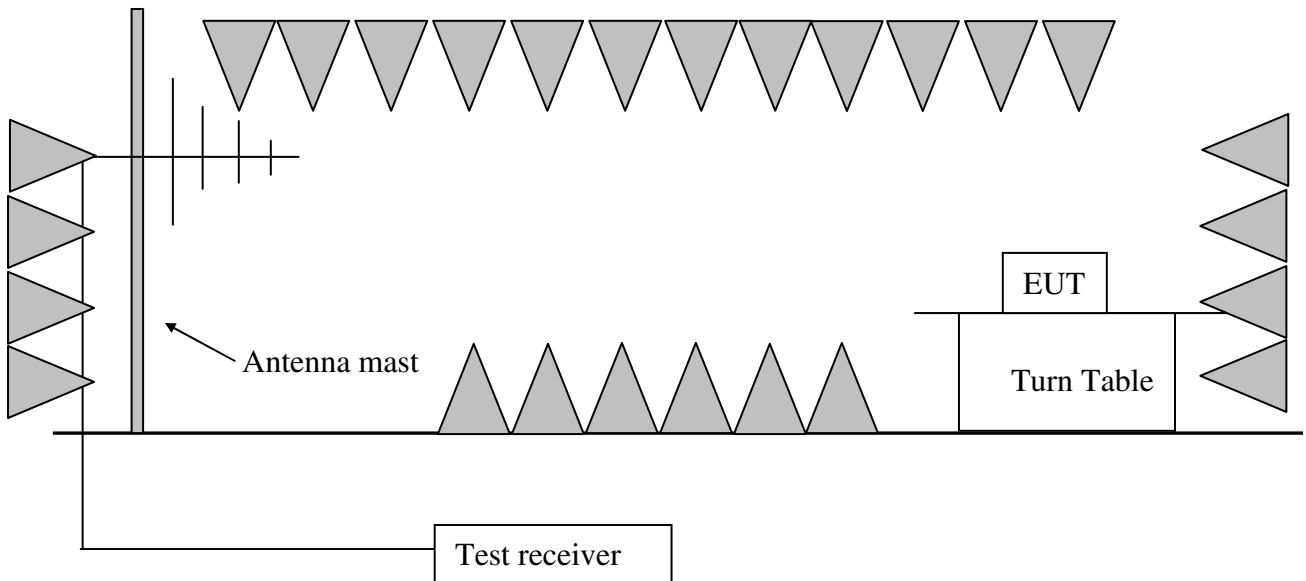
| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009 ~ 0.490     | 2400/F(kHz)                       | 300                           |
| 0.490 ~ 1.705     | 24000/F(kHz)                      | 30                            |
| 1.705 ~ 30.0      | 30                                | 30                            |
| 30 ~ 88           | 100                               | 3                             |
| 88 ~ 216          | 150                               | 3                             |
| 216 ~ 960         | 200                               | 3                             |
| Above 960         | 500                               | 3                             |

### 9.2 Test Configuration

Frequency range below 1GHz:



Frequency range above 1GHz:



### 9.3 Test procedure and test setup

The radiated emissions were tested according to the procedure of ANSI C63.10 for compliance to FCC 47CFR 15.247 requirements.

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.

Tabletop devices shall be placed on a nonconducting platform with nominal top surface dimensions 1 m by 1.5 m. For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

The turntable 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 1 meter to 4 meters to find out the maximum emission level.

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

RBW = 300 Hz, VBW = 1 kHz (9 kHz~150 kHz);  
RBW = 10 kHz, VBW = 30 kHz (150 kHz~30MHz);  
RBW = 100 kHz, VBW = 300 kHz (30MHz~1GHz for PK)  
RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

Remark:

1. Factor= Antenna Factor + Cable Loss (-Amplifier, is employed)
2. Measured level= Original Receiver Reading + Factor
3. Margin = Limit – Measured level
4. If the PK measured level is lower than AV limit, the AV test can be elided.

Example:

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

## 9.4 Test Protocol

Temperature: 22°C

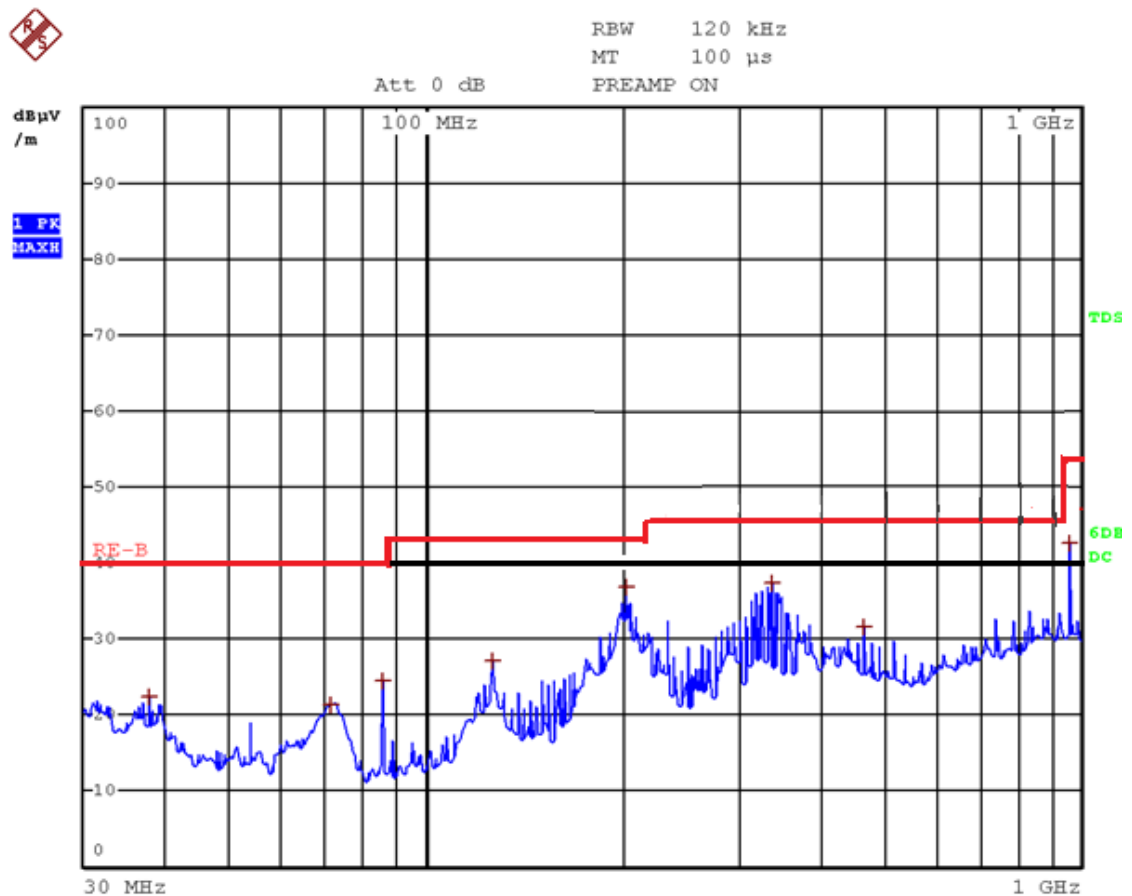
Relative Humidity: 54%

All the two models of product were tested and the worst data was listed in the report.

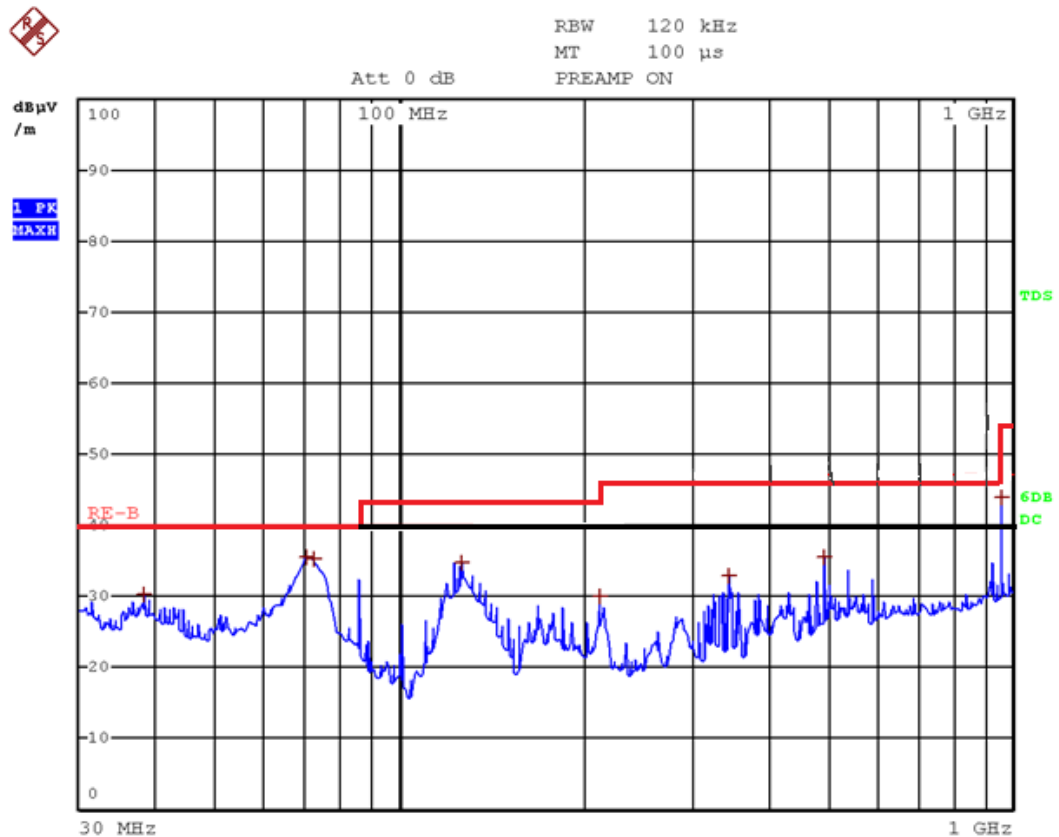
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz (GFSK, 2402MHz) is listed as below:

Horizontal



### Vertical



### Test result below 1GHz:

| Channel                                                          | Antenna | Frequency (MHz) | Corrected Reading (dBUV/m) | Correct Factor (dB/m) | Limit (dBUV/m) | Margin (dB) | Detector |
|------------------------------------------------------------------|---------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| H                                                                | H       | 114.44          | 34.20                      | 13.18                 | 43.50          | 9.30        | QP       |
|                                                                  | H       | 195.88          | 34.70                      | 24.79                 | 43.50          | 8.80        | QP       |
|                                                                  | H       | 596.00          | 42.01                      | 19.86                 | 46.00          | 3.99        | QP       |
|                                                                  | V       | 30.00           | 35.45                      | 21.40                 | 40.00          | 4.55        | QP       |
|                                                                  | V       | 55.15           | 37.19                      | 12.70                 | 40.00          | 2.81        | QP       |
|                                                                  | V       | 58.95           | 34.00                      | 10.22                 | 40.00          | 6.00        | QP       |
|                                                                  | V       | 112.44          | 34.50                      | 9.30                  | 43.50          | 9.00        | QP       |
|                                                                  | V       | 960.00          | 43.10                      | 20.70                 | 46.00          | 2.90        | QP       |
| Remark: If the margin higher than 20dB, it would be marked as *. |         |                 |                            |                       |                |             |          |

### Test result above 1GHz:

The emission within the frequency range of 1GHz to 25GHz was tested.

GFSK:

| Channel | Antenna | Frequency (MHz) | Corrected Reading (dBuV/m) | Correct Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---------|---------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| L       | H       | 2402.20         | 94.40                      | 34.34                 | Fundamental    | /           | PK       |
|         | H       | 2389.30         | 45.20                      | 34.29                 | 74.00          | 28.80       | PK       |
|         | H       | 4803.61         | 48.20                      | -3.55                 | 74.00          | 25.80       | PK       |
| M       | H       | 2441.20         | 95.80                      | 34.60                 | Fundamental    | /           | PK       |
|         | H       | 4883.77         | 50.14                      | -3.35                 | 74.00          | 23.86       | PK       |
| H       | H       | 2480.20         | 95.92                      | 34.62                 | Fundamental    | /           | PK       |
|         | H       | 2483.80         | 50.40                      | 34.63                 | 74.00          | 23.60       | PK       |
|         | H       | 4963.93         | 50.60                      | -3.16                 | 74.00          | 23.40       | PK       |

$\pi/4$ -DQPSK:

| Channel | Antenna | Frequency (MHz) | Corrected Reading (dBuV/m) | Correct Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---------|---------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| L       | H       | 2402.20         | 93.20                      | 34.34                 | Fundamental    | /           | PK       |
|         | H       | 2385.20         | 49.00                      | 34.25                 | 74.00          | 25.00       | PK       |
|         | H       | 4803.61         | 48.50                      | -3.55                 | 74.00          | 25.50       | PK       |
| M       | H       | 2441.20         | 93.60                      | 34.60                 | Fundamental    | /           | PK       |
|         | H       | 4883.77         | 47.50                      | -3.35                 | 74.00          | 26.50       | PK       |
| H       | H       | 2480.20         | 93.45                      | 34.62                 | Fundamental    | /           | PK       |
|         | H       | 2483.72         | 50.65                      | 34.65                 | 74.00          | 23.35       | PK       |
|         | H       | 4963.93         | 52.20                      | -3.16                 | 74.00          | 21.80       | PK       |

8DPSK:

| Channel | Antenna | Frequency (MHz) | Corrected Reading (dBuV/m) | Correct Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---------|---------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| L       | H       | 2402.20         | 93.40                      | 34.34                 | Fundamental    | /           | PK       |
|         | H       | 2389.00         | 52.30                      | 34.30                 | 74.00          | 21.70       | PK       |
|         | H       | 4803.61         | 48.80                      | -3.55                 | 74.00          | 25.20       | PK       |
| M       | H       | 2441.20         | 92.84                      | 34.60                 | Fundamental    | /           | PK       |
|         | H       | 4883.77         | 49.50                      | -3.35                 | 74.00          | 24.50       | PK       |
| H       | H       | 2480.20         | 94.14                      | 34.62                 | Fundamental    | /           | PK       |
|         | H       | 2483.72         | 51.65                      | 34.65                 | 74.00          | 22.35       | PK       |
|         | H       | 4963.93         | 51.70                      | -3.16                 | 74.00          | 22.30       | PK       |

**Test mode: with WIFI connected(worst case list as below)**

| Channel | Antenna | Frequency (MHz) | Corrected Reading (dBuV/m) | Correct Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|---------|---------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| L       | H       | 2402.20         | 93.20                      | 34.34                 | Fundamental    | /           | PK       |
|         | H       | 2389.27         | 54.20                      | 34.30                 | 74.00          | 19.80       | PK       |
|         | H       | 4803.61         | 48.80                      | -3.55                 | 74.00          | 25.20       | PK       |
| M       | H       | 2441.20         | 92.84                      | 34.60                 | Fundamental    | /           | PK       |
|         | H       | 4883.77         | 49.50                      | -3.35                 | 74.00          | 24.50       | PK       |
| H       | H       | 2480.20         | 94.14                      | 34.62                 | Fundamental    | /           | PK       |
|         | H       | 2484.60         | 51.00                      | 34.65                 | 74.00          | 23.00       | PK       |
|         | H       | 4963.93         | 51.70                      | -3.16                 | 74.00          | 22.30       | PK       |

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)  
 2. Corrected Reading = Original Receiver Reading + Correct Factor  
 3. Margin = limit – Corrected Reading

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

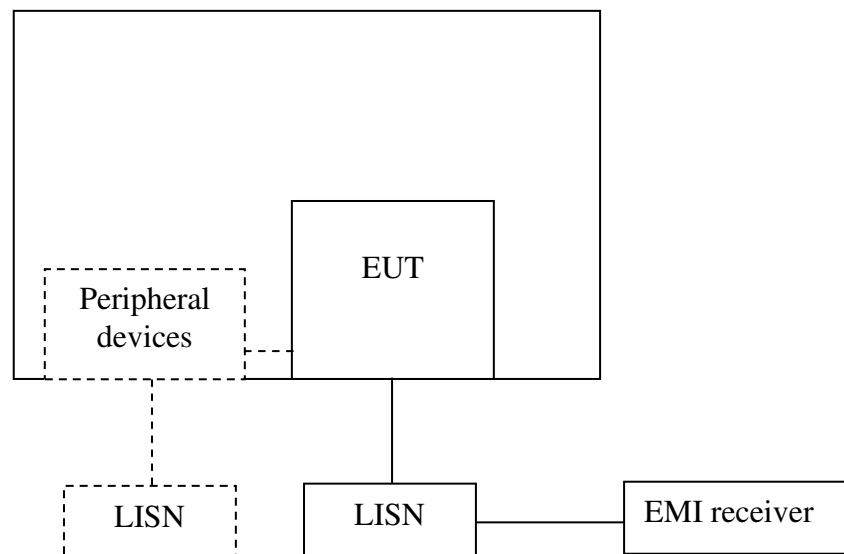
## 10 Power line conducted emission

**Test result:** Pass

### 10.1 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. |                        |            |

### 10.2 Test configuration



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

☐ For floor standing equipment, wooden support is 0.1m height rack.

### 10.3 Test procedure and test set up

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  loads.

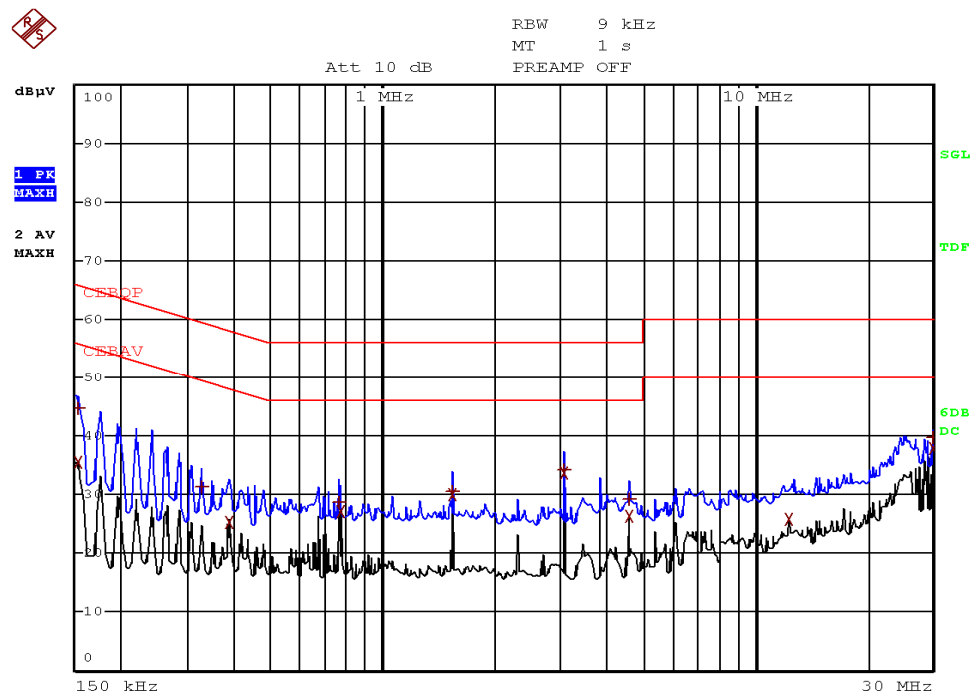
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

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

## 10.4 Test protocol

Temperature: 22°C  
Relative Humidity: 54%

All the three models of product were tested and the worst data (GFSK, 2402MHz) was listed in the report.



Test Data:

| Frequency<br>(MHz)                                               | Quasi-peak      |                 |                | Average         |                 |                |
|------------------------------------------------------------------|-----------------|-----------------|----------------|-----------------|-----------------|----------------|
|                                                                  | level<br>dB(μV) | Limit<br>dB(μV) | Margin<br>(dB) | level<br>dB(μV) | limit<br>dB(μV) | Margin<br>(dB) |
| 0.15                                                             | *               | *               | *              | *               | *               | *              |
| 0.663                                                            | *               | *               | *              | *               | *               | *              |
| 1.167                                                            | *               | *               | *              | *               | *               | *              |
| 1.719                                                            | *               | *               | *              | *               | *               | *              |
| 2.229                                                            | *               | *               | *              | *               | *               | *              |
| 25.863                                                           | *               | *               | *              | *               | *               | *              |
| Remark: If the margin higher than 20dB, it would be marked as *. |                 |                 |                |                 |                 |                |

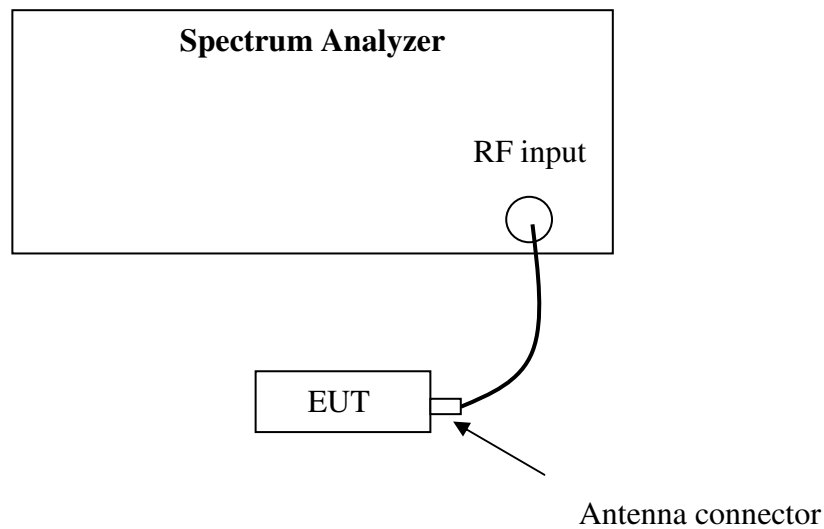
## 11 Occupied Bandwidth

**Test Status: Tested**

### 11.1 Test limit

None

### 11.2 Test Configuration



### 11.3 Test procedure and test setup

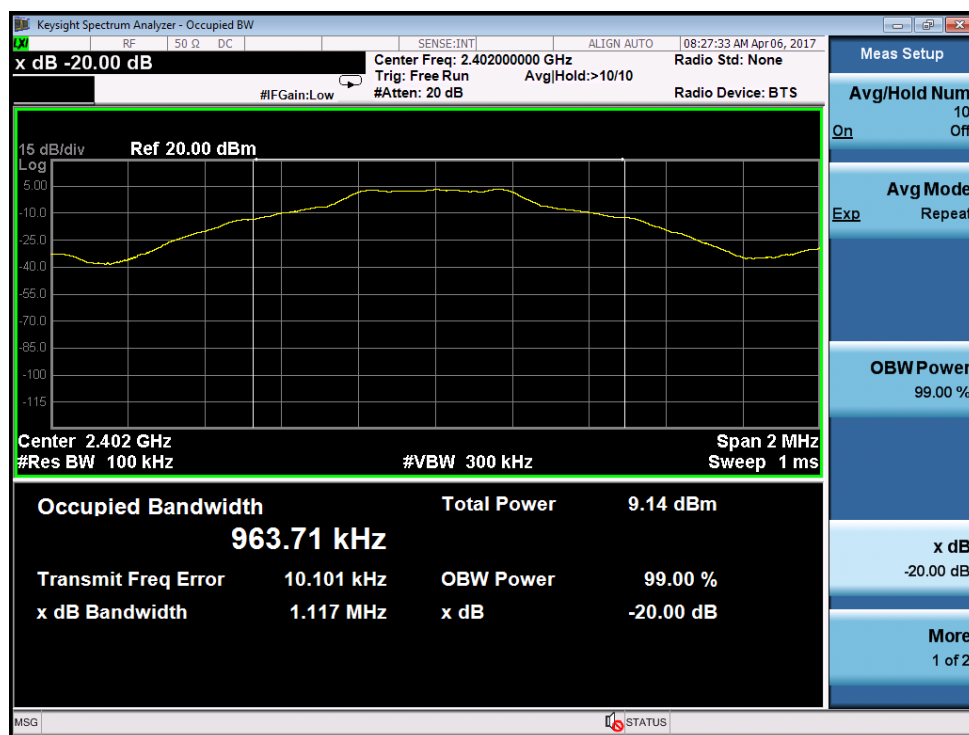
The occupied bandwidth per RSS-Gen Issue 4 Clause 6.6 was measured using the Spectrum Analyzer.

## 11.4 Test protocol

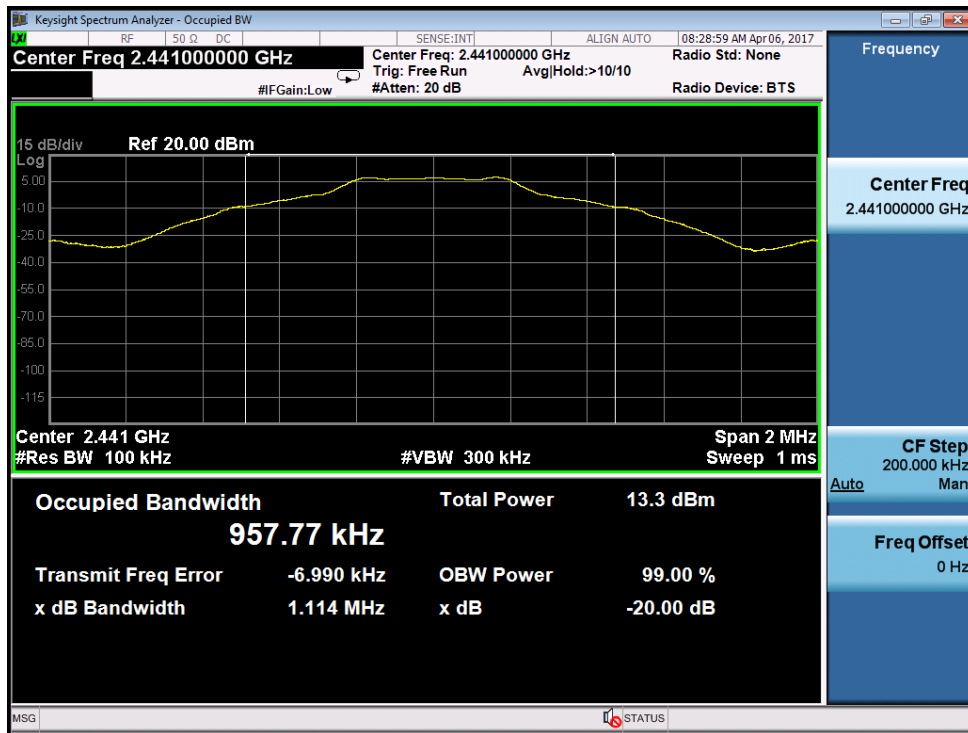
Temperature : 25 °C  
Relative Humidity : 55 %

| Modulation | Mode | 99% Bandwidth (KHz) |
|------------|------|---------------------|
| GFSK       | L    | 963.71              |
|            | M    | 957.77              |
|            | H    | 948.02              |

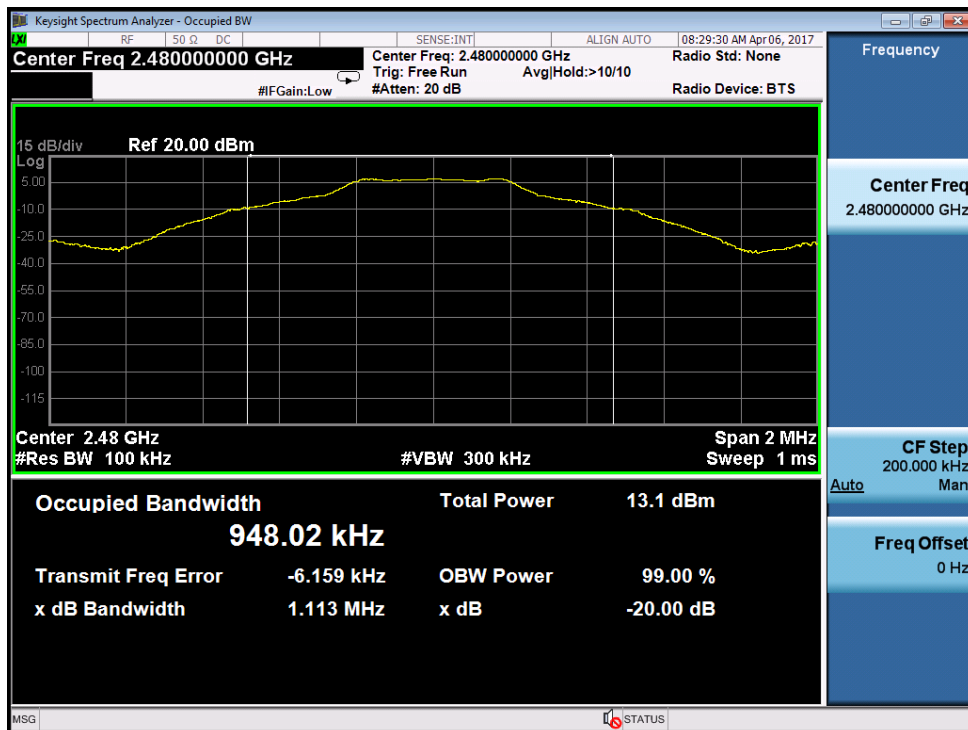
Channel L



### Channel M

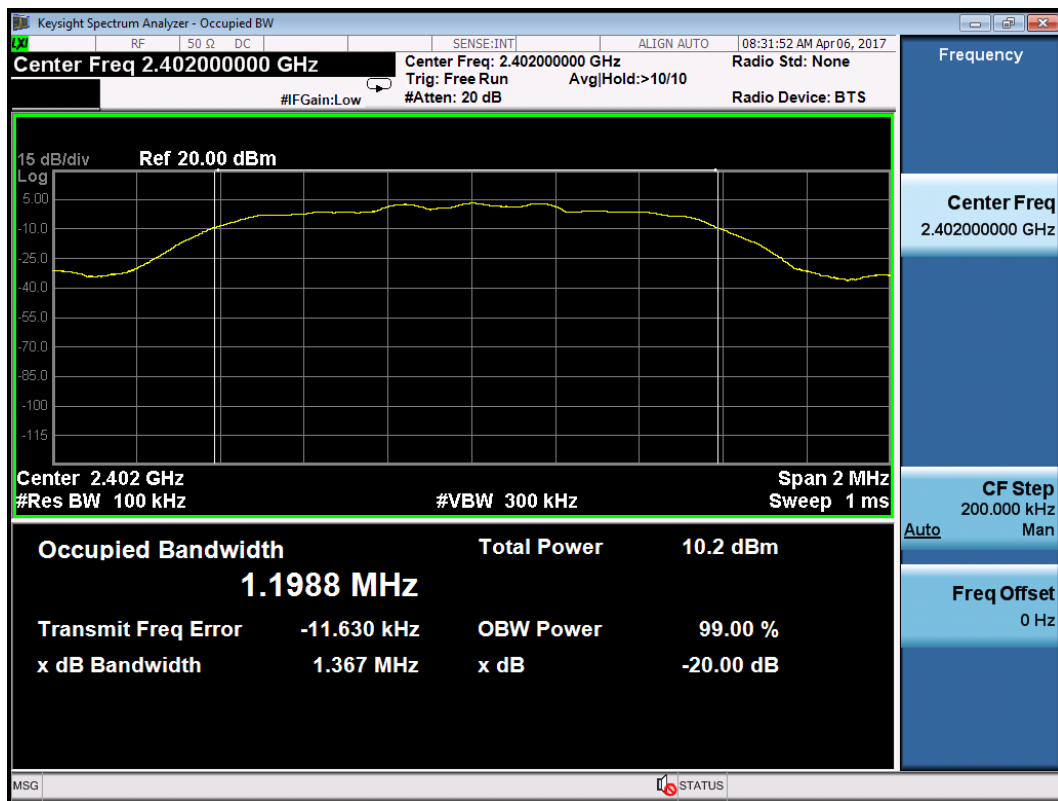


### Channel H

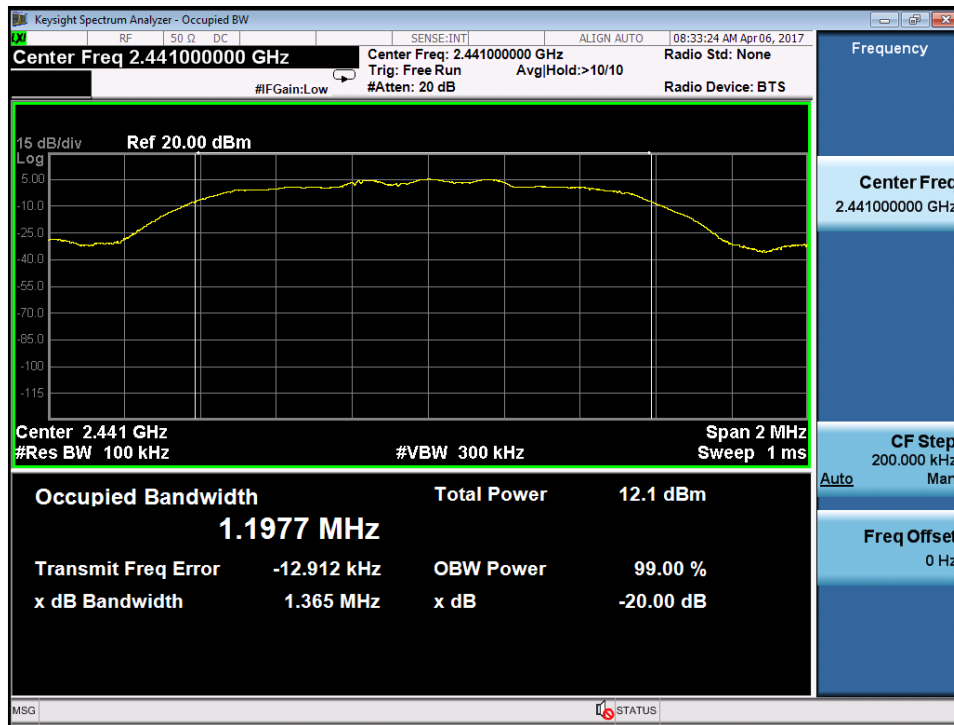


| Modulation     | Mode | 99% Bandwidth (MHz) |
|----------------|------|---------------------|
| $\pi/4$ -DQPSK | L    | 1.1988              |
|                | M    | 1.1977              |
|                | H    | 1.1990              |

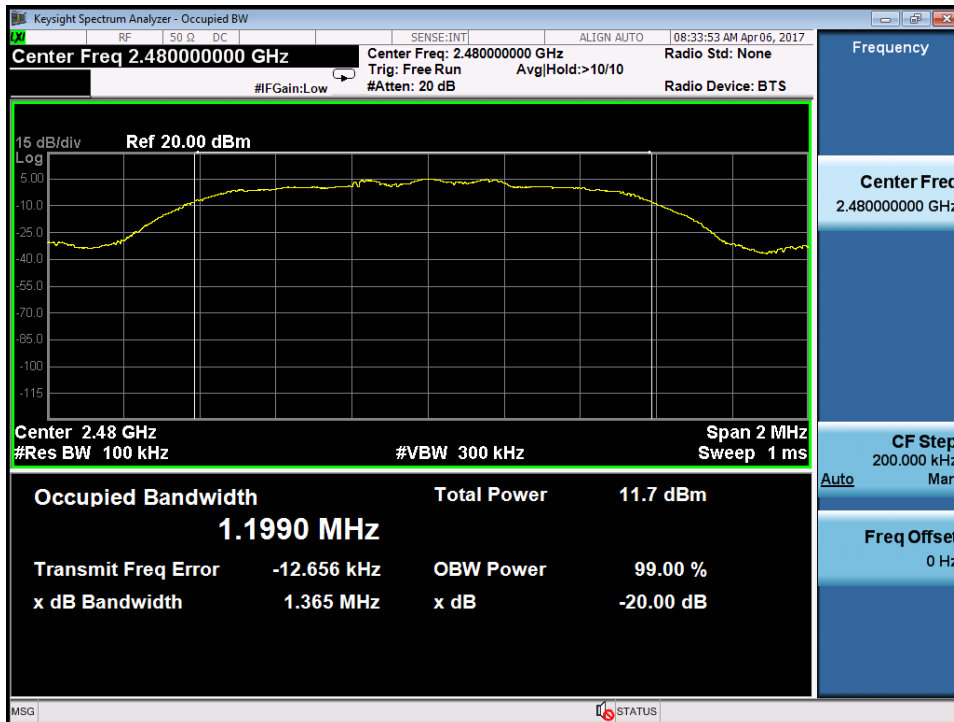
### Channel L



### Channel M

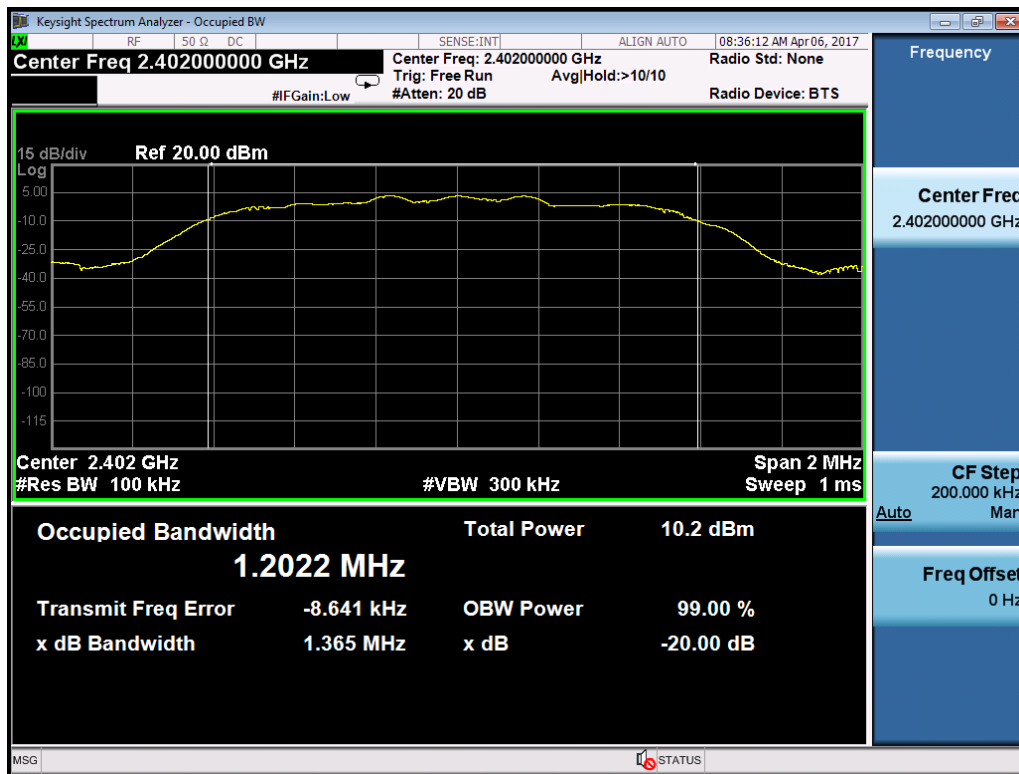


### Channel H

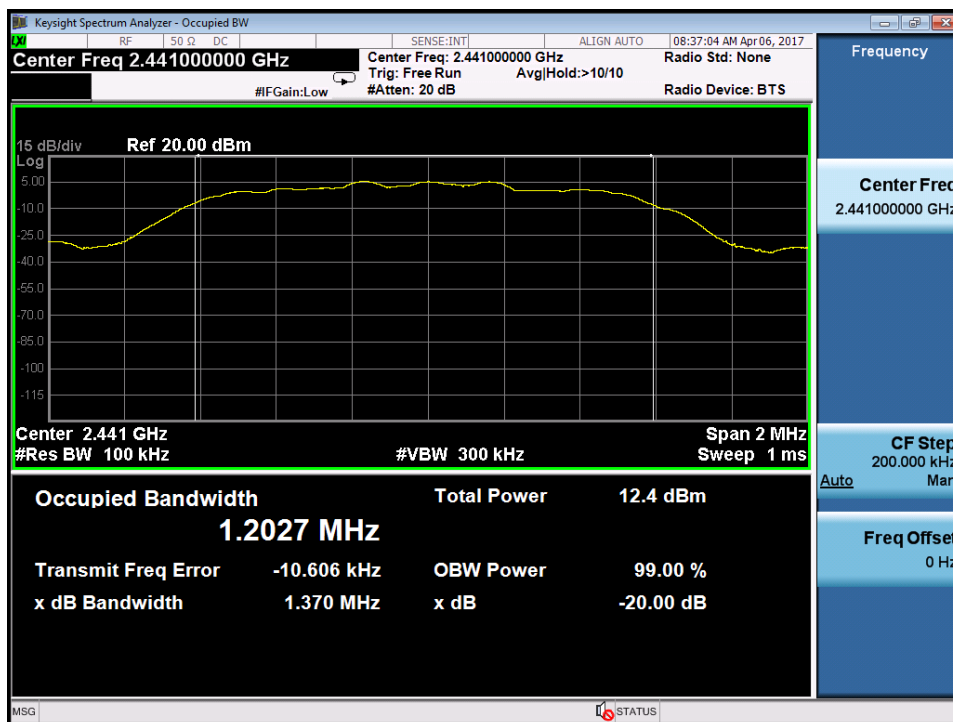


| Modulation | Mode | 99% Bandwidth (MHz) |
|------------|------|---------------------|
| 8DPSK      | L    | 1.2022              |
|            | M    | 1.2027              |
|            | H    | 1.2031              |

### Channel L



## Channel M



## Channel H

