

# FCC Test Report

Report No.: AGC04508200401FE03

**FCC ID** : 2ARPHTS-T5

**APPLICATION PURPOSE** : Original Equipment

**PRODUCT DESIGNATION** : True wireless stereo earbuds

**BRAND NAME** : N/A

**MODEL NAME** : TS-T5, V90, Air Plus, Lakoche bird, AstralEars RS, S90

**APPLICANT** : TUOSI ELECTRONICS CO., LTD.

**DATE OF ISSUE** : May 19, 2020

**STANDARD(S)** : FCC Part 15.247

**REPORT VERSION** : V1.0

## Attestation of Global Compliance (Shenzhen) Co., Ltd

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#### REPORT REVISE RECORD

| Report Version | Revise Time | Issued Date  | Valid Version | Notes           |
|----------------|-------------|--------------|---------------|-----------------|
| V1.0           | /           | May 19, 2020 | Valid         | Initial Release |



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## 1. VERIFICATION OF CONFORMITY

|                                 |                                                                                                                          |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Applicant</b>                | Tuosi Electronics Co., Ltd.                                                                                              |
| <b>Address</b>                  | Room501, 5/F, No.3 Building, Mengliyuan Technical Industrial Park Yousong Rd, Longhua District, Shenzhen , 518109, China |
| <b>Manufacturer</b>             | Tuosi Electronics Co., Ltd.                                                                                              |
| <b>Address</b>                  | Room501, 5/F, No.3 Building, Mengliyuan Technical Industrial Park Yousong Rd, Longhua District, Shenzhen , 518109, China |
| <b>Factory</b>                  | Tuosi Electronics Co., Ltd.                                                                                              |
| <b>Address</b>                  | Room501, 5/F, No.3 Building, Mengliyuan Technical Industrial Park Yousong Rd, Longhua District, Shenzhen , 518109, China |
| <b>Product Designation</b>      | True wireless stereo earbuds                                                                                             |
| <b>Brand Name</b>               | N/A                                                                                                                      |
| <b>Test Model</b>               | TS-T5                                                                                                                    |
| <b>Series Model</b>             | V90, Air Plus, Lakoche bird, AstralEars RS, S90                                                                          |
| <b>Difference description</b>   | All the same except for the model name                                                                                   |
| <b>Date of test</b>             | May 07, 2020 to May 18, 2020                                                                                             |
| <b>Deviation</b>                | No any deviation from the test method                                                                                    |
| <b>Condition of Test Sample</b> | Normal                                                                                                                   |
| <b>Test Result</b>              | Pass                                                                                                                     |
| <b>Report Template</b>          | AGCRT-US-BR/RF                                                                                                           |

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC PART 15.247.

Prepared By

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May 18, 2020

Reviewed By

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May 19, 2020

Approved By

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(Authorized Officer)

May 19, 2020



## 2. GENERAL INFORMATION

### 2.1. PRODUCT DESCRIPTION

The EUT is designed as “True wireless stereo earbuds”. It is designed by way of utilizing the GFSK , Pi/4 DQPSK and 8DPSK technology to achieve the system operation.

A major technical description of EUT is described as following

|                     |                                                                                                                                                                                                                           |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operation Frequency | 2.402 GHz to 2.480GHz                                                                                                                                                                                                     |
| RF Output Power     | 3.547dBm(Max)                                                                                                                                                                                                             |
| Bluetooth Version   | V 5.0                                                                                                                                                                                                                     |
| Modulation          | BR <input checked="" type="checkbox"/> GFSK, EDR <input checked="" type="checkbox"/> π /4-DQPSK, <input checked="" type="checkbox"/> 8DPSK<br>BLE <input type="checkbox"/> GFSK 1Mbps <input type="checkbox"/> GFSK 2Mbps |
| Number of channels  | 79                                                                                                                                                                                                                        |
| Hardware Version    | V3                                                                                                                                                                                                                        |
| Software Version    | V2                                                                                                                                                                                                                        |
| Antenna Designation | Ceramic Antenna(Comply with requirements of the FCC part 15.203)                                                                                                                                                          |
| Antenna Gain        | 3.09dBi                                                                                                                                                                                                                   |
| Power Supply        | DC 3.7V by battery or DC 5V by adapter                                                                                                                                                                                    |

Note: The EUT comprises left and right channel earphone, both are the same and have been tested, Only the test data of left earphone recorded in this report.

### 2.2. TABLE OF CARRIER FREQUENCIES

| Frequency Band | Channel Number | Frequency |
|----------------|----------------|-----------|
| 2402~2480MHZ   | 0              | 2402MHZ   |
|                | 1              | 2403MHZ   |
|                | :              | :         |
|                | 38             | 2440 MHZ  |
|                | 39             | 2441 MHZ  |
|                | 40             | 2442 MHZ  |
|                | :              | :         |
|                | 77             | 2479 MHZ  |
|                | 78             | 2480 MHZ  |



### 2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHz. In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection (e.g. single or multislot packet) is set up at the beginning of the connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be sent on the same frequency, it is sent on the next frequency of the hopping sequence.

### 2.4. EXAMPLE OF A HOPPING SEQUENCE IN DATA MODE

Example of a 79 hopping sequence in data mode:

40, 21, 44, 23, 42, 53, 46, 55, 48, 33, 52, 35, 50, 65, 54, 67  
56, 37, 60, 39, 58, 69, 62, 71, 64, 25, 68, 27, 66, 57, 70, 59  
72, 29, 76, 31, 74, 61, 78, 63, 01, 41, 05, 43, 03, 73, 07, 75  
09, 45, 13, 47, 11, 77, 15, 00, 64, 49, 66, 53, 68, 02, 70, 06  
01, 51, 03, 55, 05, 04

### 2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values:

1. LAP/UAP of the master of the connection.
2. Internal master clock

The LAP (lower address part) are the 24 LSB's of the 48 BD\_ADDRESS. The BD\_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP (upper address part) are the 24 MSB's of the 48 BD\_ADDRESS.

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For synchronization with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us. The clock has a cycle of about one day (23h30). In most cases it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire LAP (24 bits), 4 LSB's (4 bits) (Input 1) and the 27 MSB's of the clock (Input 2) are used. With these input values different mathematical procedures (permutations, additions, XOR-operations) are performed to generate the Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following behavior:

The first connection between the two devices is established, a hopping sequence was generated. For transmitting the wanted data the complete hopping sequence was not used. The connection ended.

The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmissions is longer (and it cannot be shorter) than the minimum resolution of the clock (312.5us). The hopping sequence will always differ from the first one.



## 2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2ARPHTS-T5** filing to comply with the FCC PART 15.247 requirements.

## 2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

## 2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

## 2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.



### 3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95%.

- Uncertainty of Conducted Emission,  $U_c = \pm 3.2$  dB
- Uncertainty of Radiated Emission below 1GHz,  $U_c = \pm 3.9$  dB
- Uncertainty of Radiated Emission above 1GHz,  $U_c = \pm 4.8$  dB
- Uncertainty of total RF power, conducted,  $U_c = \pm 0.8$  dB
- Uncertainty of spurious emissions, conducted,  $U_c = \pm 2.7$  dB
- Uncertainty of Occupied Channel Bandwidth:  $U_c = \pm 2$  %
- Uncertainty of Dwell Time:  $U_c = \pm 2$  %
- Uncertainty of Frequency:  $U_c = \pm 2$  %



#### 4. DESCRIPTION OF TEST MODES

| NO. | TEST MODE DESCRIPTION         |
|-----|-------------------------------|
| 1   | Low channel GFSK              |
| 2   | Middle channel GFSK           |
| 3   | High channel GFSK             |
| 4   | Low channel $\pi/4$ -DQPSK    |
| 5   | Middle channel $\pi/4$ -DQPSK |
| 6   | High channel $\pi/4$ -DQPSK   |
| 7   | Low channel 8DPSK             |
| 8   | Middle channel 8DPSK          |
| 9   | High channel 8DPSK            |
| 10  | Hopping mode GFSK             |
| 11  | Hopping mode $\pi/4$ -DQPSK   |
| 12  | Hopping mode 8DPSK            |

Note:

1. Only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.
3. For Conducted Test method, a temporary antenna connector is provided by the manufacture.
4. The test software is the AB153x\_Airoha\_Tool which can set the EUT into the individual test modes.



## 5. SYSTEM TEST CONFIGURATION

### 5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure :



### 5.2 EQUIPMENT USED IN TESTED SYSTEM

| Item | Equipment                    | Model No. | ID or Specification | Remark |
|------|------------------------------|-----------|---------------------|--------|
| 1    | True wireless stereo earbuds | TS-T5     | 2ARPHTS-T5          | EUT    |

### 5.3. SUMMARY OF TEST RESULTS

| FCC RULES          | DESCRIPTION OF TEST         | RESULT    |
|--------------------|-----------------------------|-----------|
| 15.247 (b)(1)      | Peak Output Power           | Compliant |
| 15.247 (a)(1)      | 20 dB Bandwidth             | Compliant |
| 15.247 (d)         | Conducted Spurious Emission | Compliant |
| 15.209             | Radiated Emission           | Compliant |
| 15.247 (a)(1)(iii) | Number of Hopping Frequency | Compliant |
| 15.247 (a)(1)(iii) | Time of Occupancy           | Compliant |
| 15.247 (a)(1)      | Frequency Separation        | Compliant |
| 15.207             | Conducted Emission          | N/A       |

Note: The EUT can not use the BT function with charging

## 6. TEST FACILITY

|                                          |                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Site</b>                         | Attestation of Global Compliance (Shenzhen) Co., Ltd                                                                                     |
| <b>Location</b>                          | 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China |
| <b>Designation Number</b>                | CN1259                                                                                                                                   |
| <b>FCC Test Firm Registration Number</b> | 975832                                                                                                                                   |
| <b>A2LA Cert. No.</b>                    | 5054.02                                                                                                                                  |
| <b>Description</b>                       | Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA                                                                |

## TEST EQUIPMENT OF RADIATED EMISSION TEST

| Equipment                      | Manufacturer   | Model               | S/N        | Cal. Date     | Cal. Due      |
|--------------------------------|----------------|---------------------|------------|---------------|---------------|
| TEST RECEIVER                  | R&S            | ESCI                | 10096      | Jun. 12, 2019 | Jun. 11, 2020 |
| EXA Signal Analyzer            | Aglient        | N9010A              | MY53470504 | Dec. 12, 2019 | Dec. 11, 2020 |
| 2.4GHz Fliter                  | EM Electronics | 2400-2500MHz        | N/A        | Mar. 23, 2020 | Mar. 22, 2022 |
| Attenuator                     | ZHINAN         | E-002               | N/A        | Sep. 09, 2019 | Sep. 08, 2020 |
| Horn antenna                   | SCHWARZBECK    | BBHA 9170           | #768       | Sep. 09, 2019 | Sep. 08, 2021 |
| Active loop antenna (9K-30MHz) | ZHINAN         | ZN30900C            | 18051      | Jun. 14, 2018 | Jun. 13, 2020 |
| Double-Ridged Waveguide Horn   | ETS LINDGREN   | 3117                | 00034609   | May. 26, 2018 | May. 25, 2020 |
| Broadband Preamplifier         | ETS LINDGREN   | 3117PA              | 00225134   | Oct. 15, 2019 | Oct. 16, 2020 |
| ANTENNA                        | SCHWARZBECK    | VULB9168            | 494        | Jan. 09, 2019 | Jan. 08, 2021 |
| Test software                  | FARA           | EZ-EMC (Ver RA-03A) | N/A        | N/A           | N/A           |



## 7. PEAK OUTPUT POWER

### 7.1. MEASUREMENT PROCEDURE

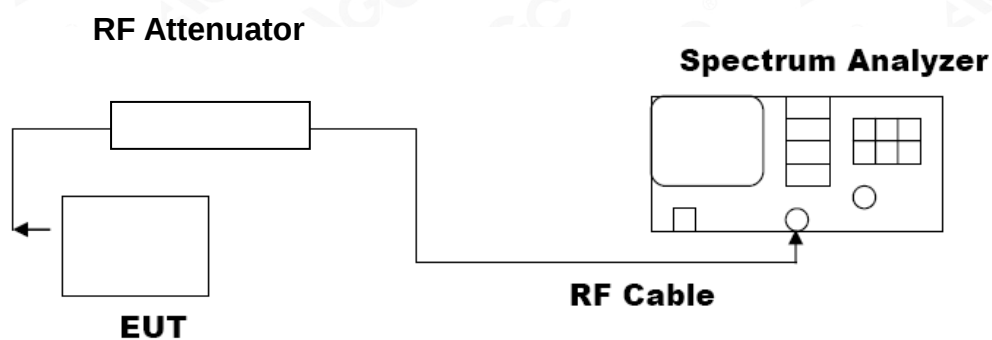
For peak power test:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. RBW > 20 dB bandwidth of the emission being measured.
4. VBW  $\geq$  RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

### 7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

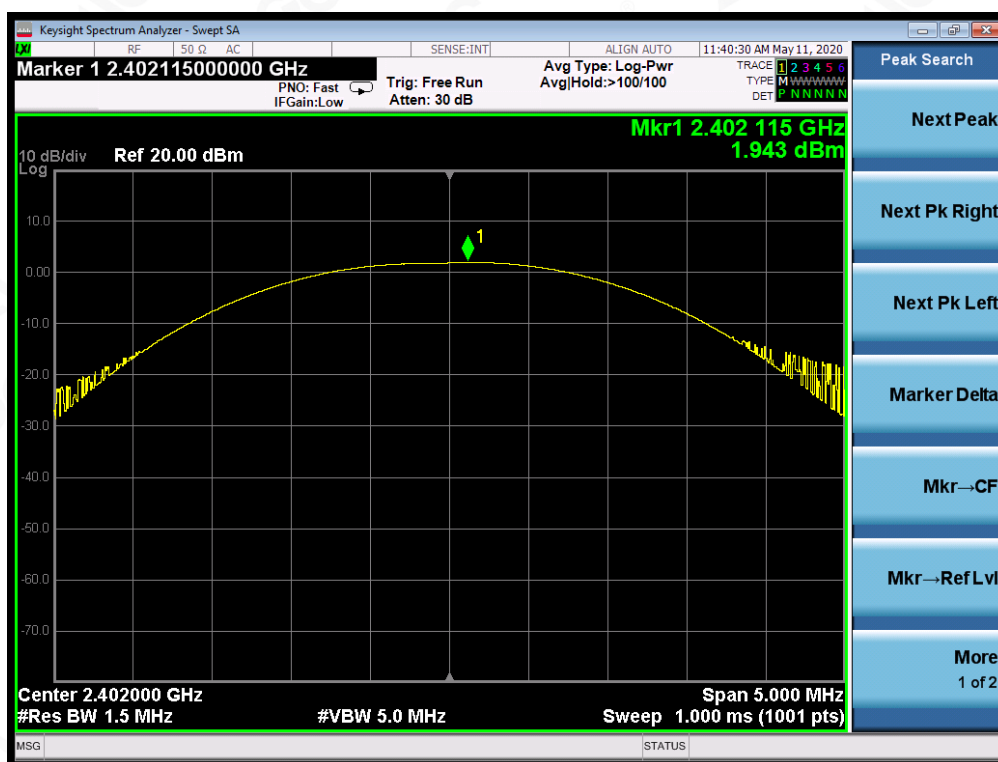
#### PEAK POWER TEST SETUP



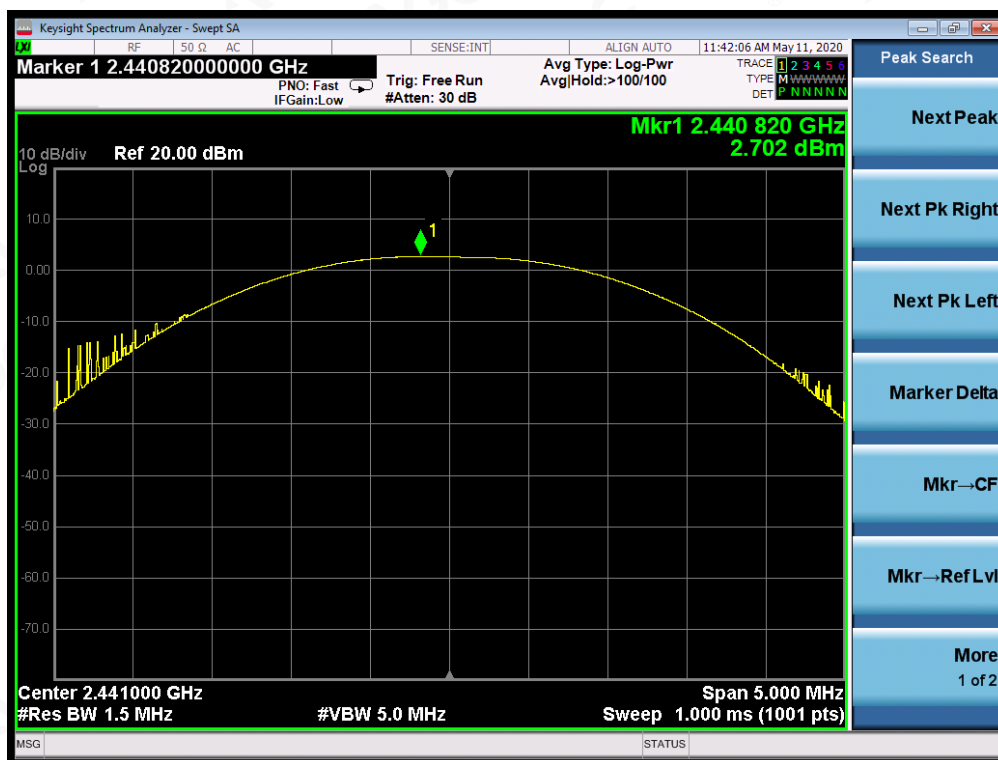
### 7.3. LIMITS AND MEASUREMENT RESULT

| PEAK OUTPUT POWER MEASUREMENT RESULT<br>FOR GFSK MODULATION |                     |                            |              |
|-------------------------------------------------------------|---------------------|----------------------------|--------------|
| Frequency<br>(GHz)                                          | Peak Power<br>(dBm) | Applicable Limits<br>(dBm) | Pass or Fail |
| 2.402                                                       | 1.943               | 30                         | Pass         |
| 2.441                                                       | 2.702               | 30                         | Pass         |
| 2.480                                                       | 3.142               | 30                         | Pass         |

CH0



CH39

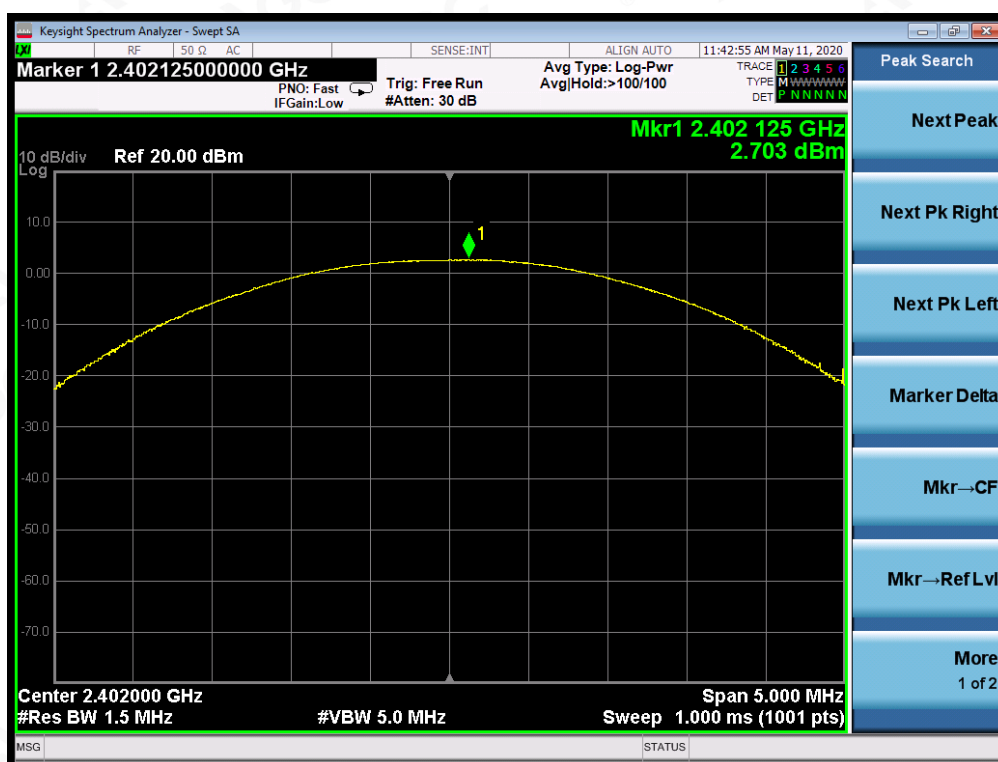


CH78

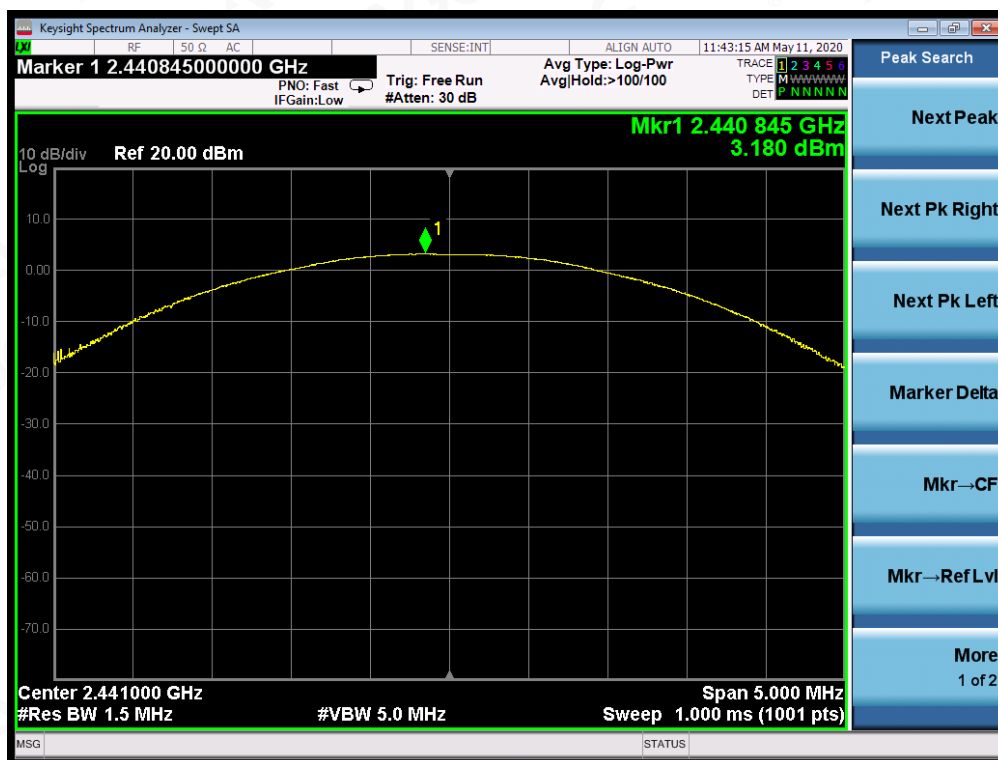


| PEAK OUTPUT POWER MEASUREMENT RESULT<br>FOR II /4-DQPSK MODULATION |                     |                            |              |
|--------------------------------------------------------------------|---------------------|----------------------------|--------------|
| Frequency<br>(GHz)                                                 | Peak Power<br>(dBm) | Applicable Limits<br>(dBm) | Pass or Fail |
| 2.402                                                              | 2.703               | 21                         | Pass         |
| 2.441                                                              | 3.180               | 21                         | Pass         |
| 2.480                                                              | 3.421               | 21                         | Pass         |

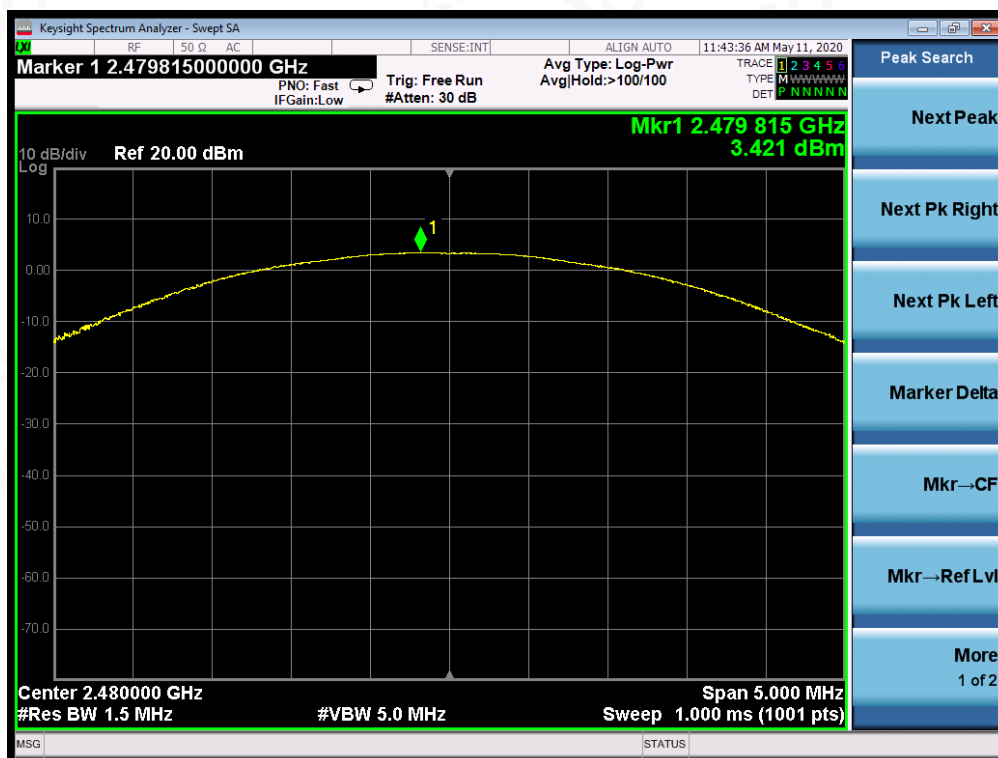
CH0



### CH39

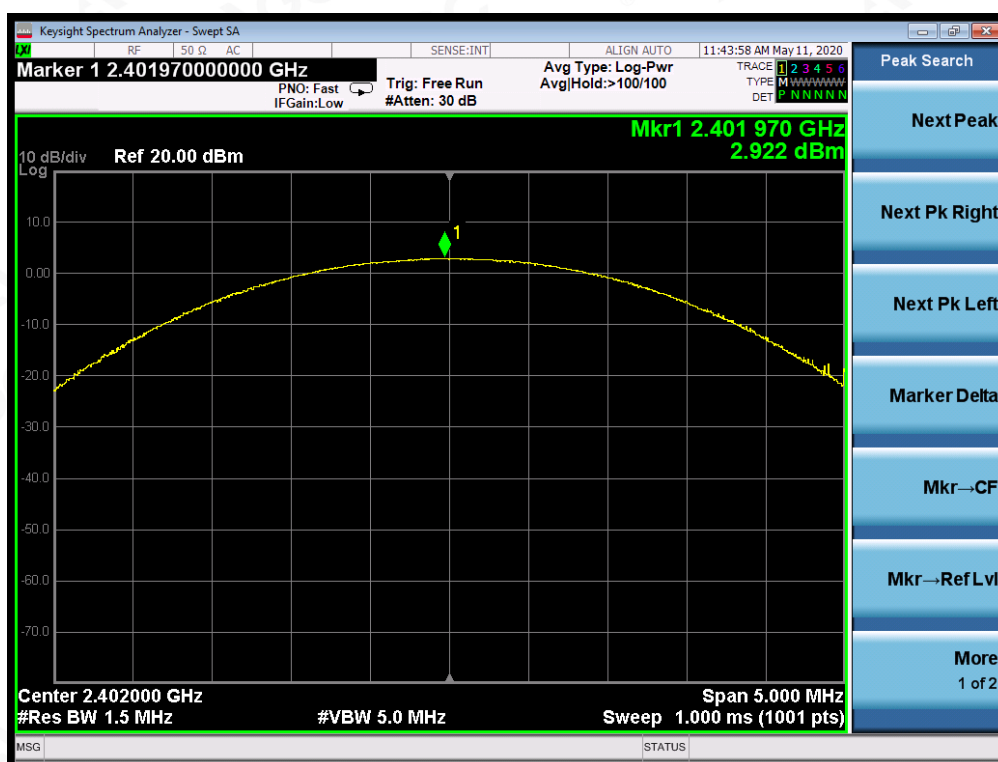


### CH78

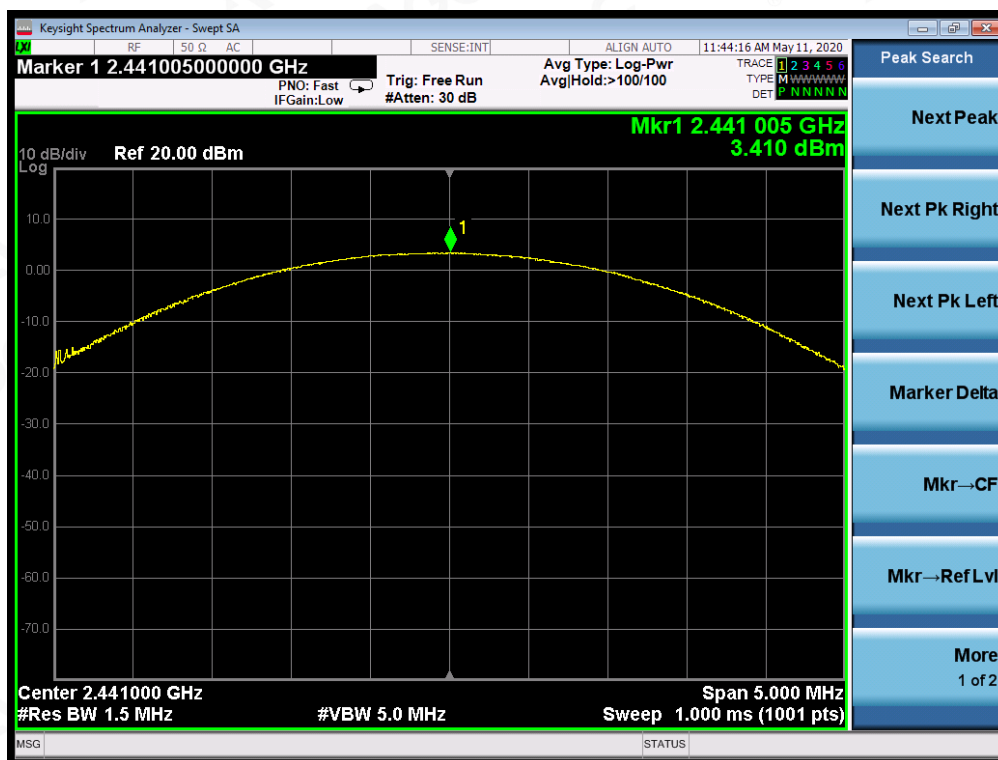


| PEAK OUTPUT POWER MEASUREMENT RESULT<br>FOR 8-DPSK MODULATION |                     |                            |              |
|---------------------------------------------------------------|---------------------|----------------------------|--------------|
| Frequency<br>(GHz)                                            | Peak Power<br>(dBm) | Applicable Limits<br>(dBm) | Pass or Fail |
| 2.402                                                         | 2.922               | 21                         | Pass         |
| 2.441                                                         | 3.410               | 21                         | Pass         |
| 2.480                                                         | 3.547               | 21                         | Pass         |

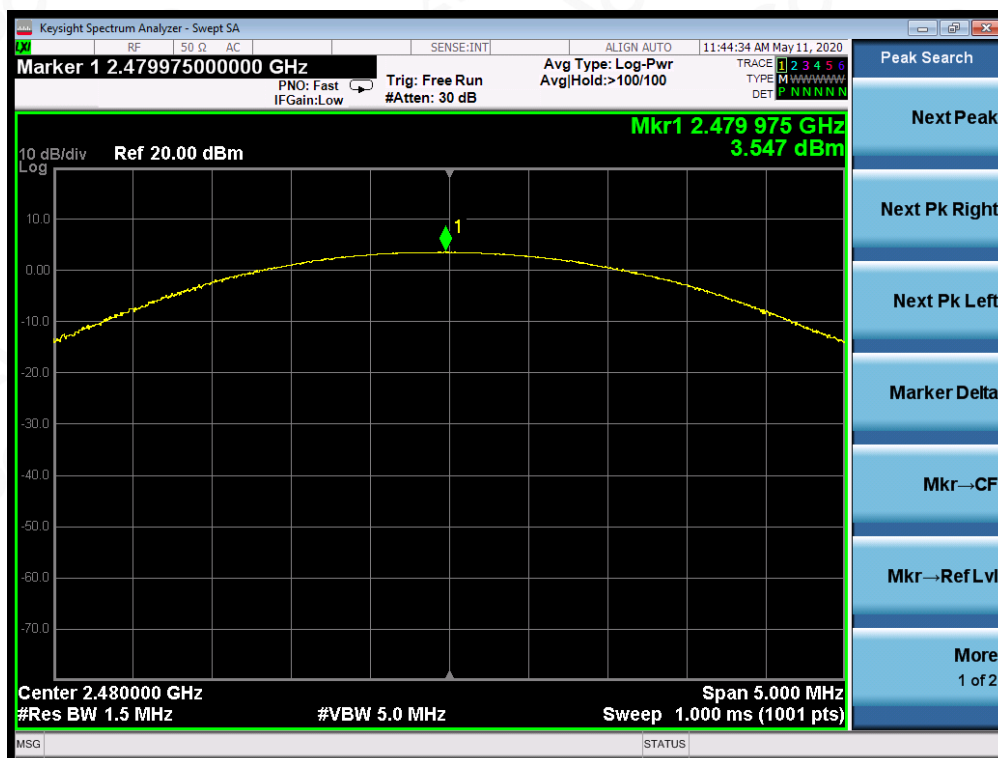
CH0



CH39



CH78

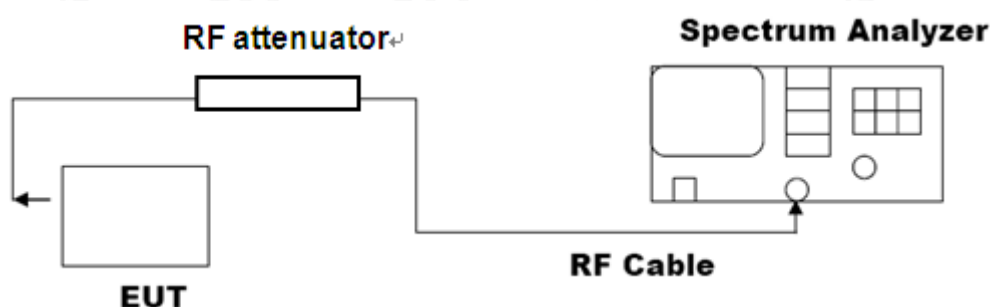


## 8. 20DB BANDWIDTH

### 8.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hopping channel  
The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

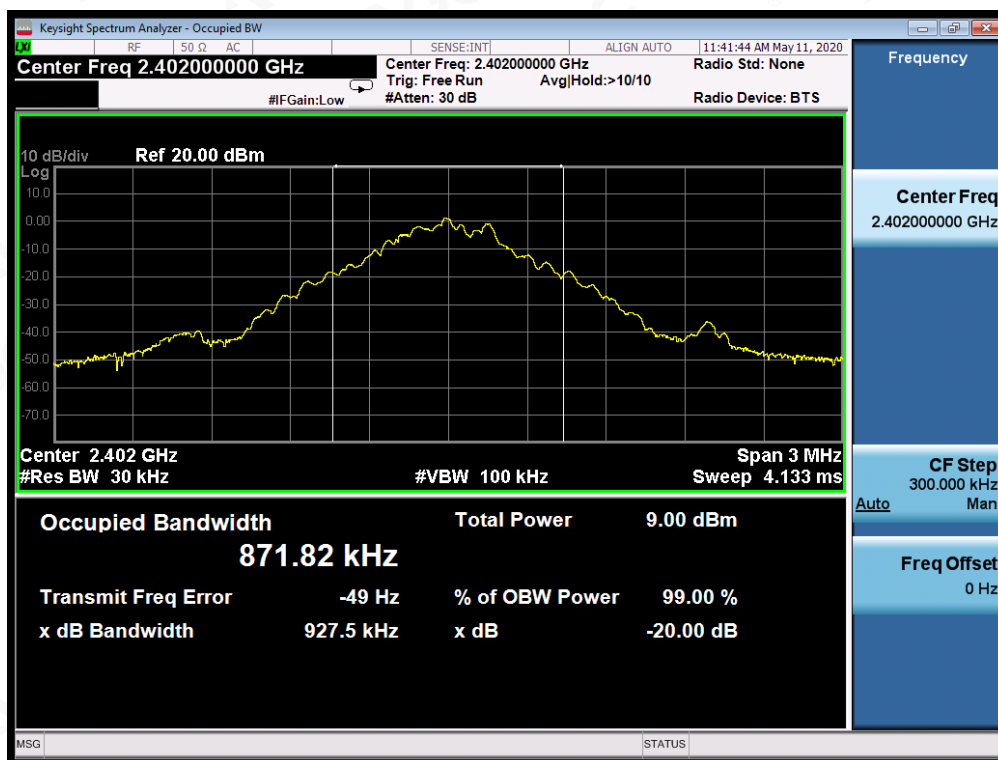
### 8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



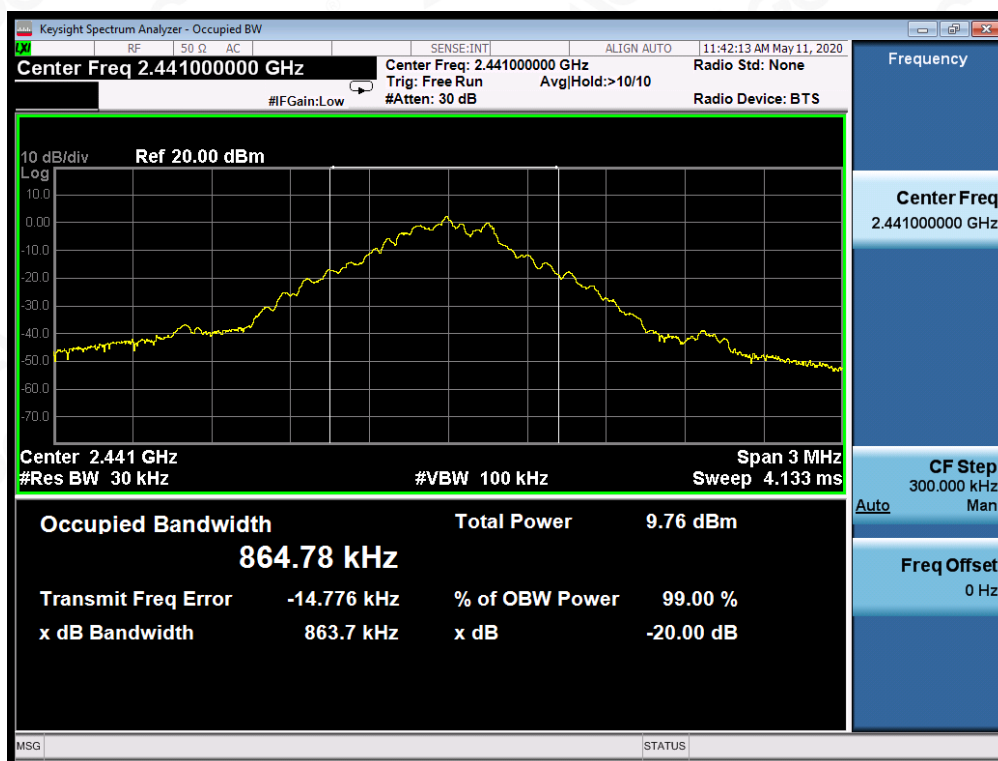
### 8.3. LIMITS AND MEASUREMENT RESULTS

| MEASUREMENT RESULT FOR GFSK MOUDULATION |                    |       |          |
|-----------------------------------------|--------------------|-------|----------|
| Applicable Limits                       | Measurement Result |       |          |
|                                         | Test Data (MHz)    |       | Criteria |
| N/A                                     | Low Channel        | 0.928 | PASS     |
|                                         | Middle Channel     | 0.864 | PASS     |
|                                         | High Channel       | 0.862 | PASS     |

### TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



### TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

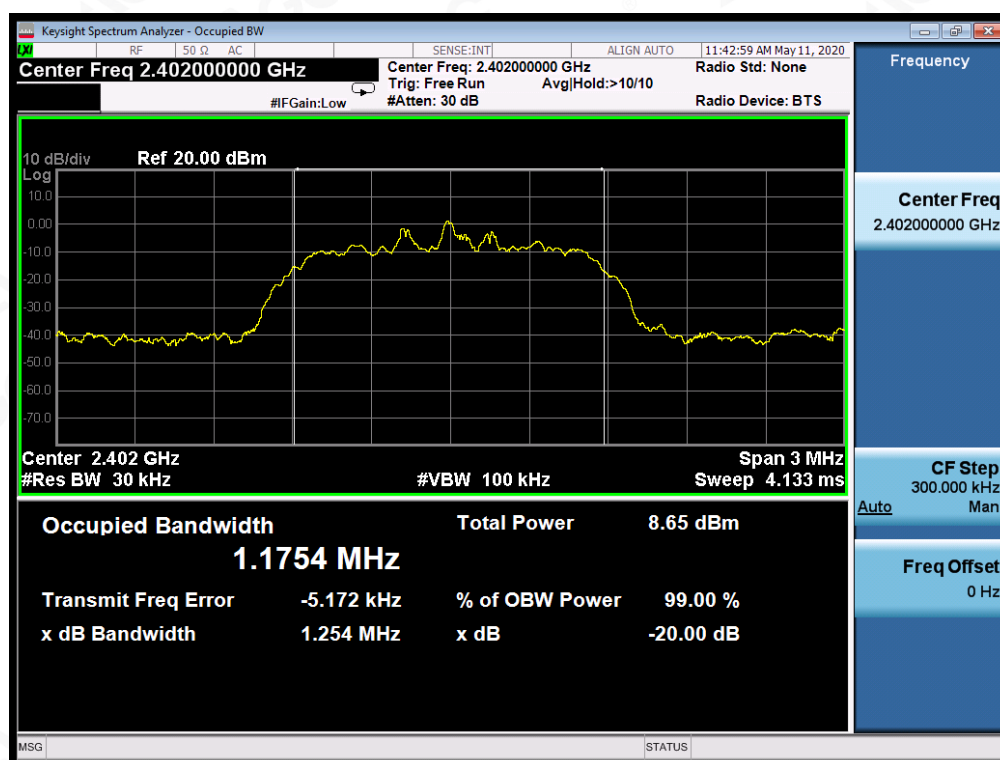


### TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

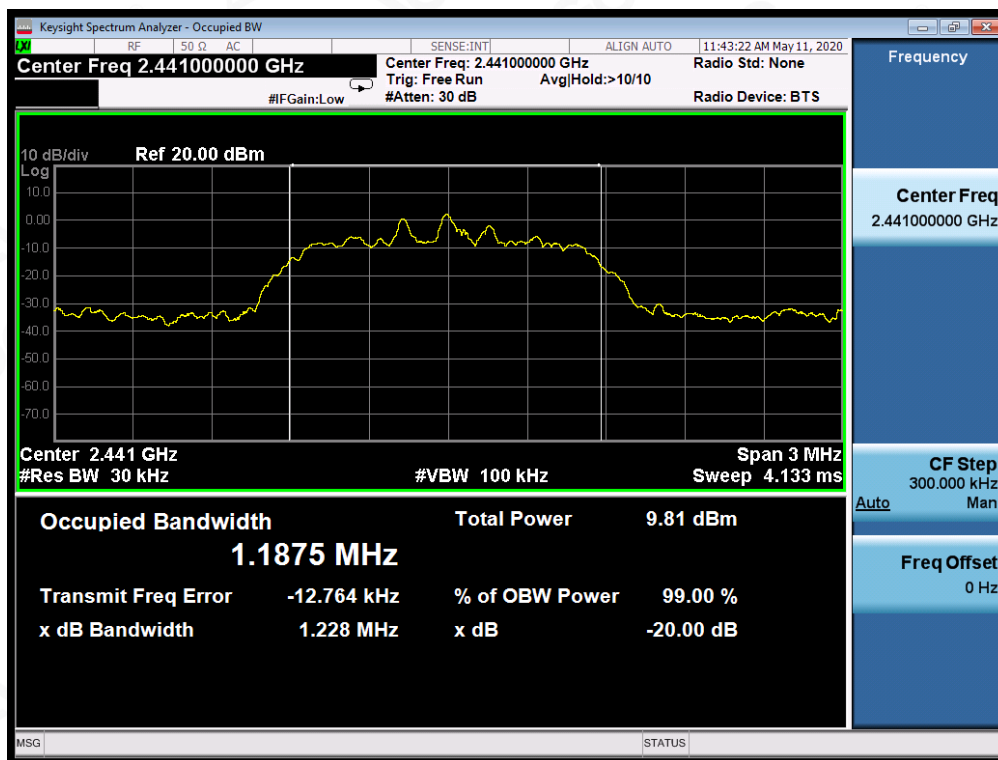


| MEASUREMENT RESULT FOR II /4-DQPSK MODULATION |                    |       |          |
|-----------------------------------------------|--------------------|-------|----------|
| Applicable Limits                             | Measurement Result |       |          |
|                                               | Test Data (MHz)    |       | Criteria |
| N/A                                           | Low Channel        | 1.254 | PASS     |
|                                               | Middle Channel     | 1.228 | PASS     |
|                                               | High Channel       | 1.244 | PASS     |

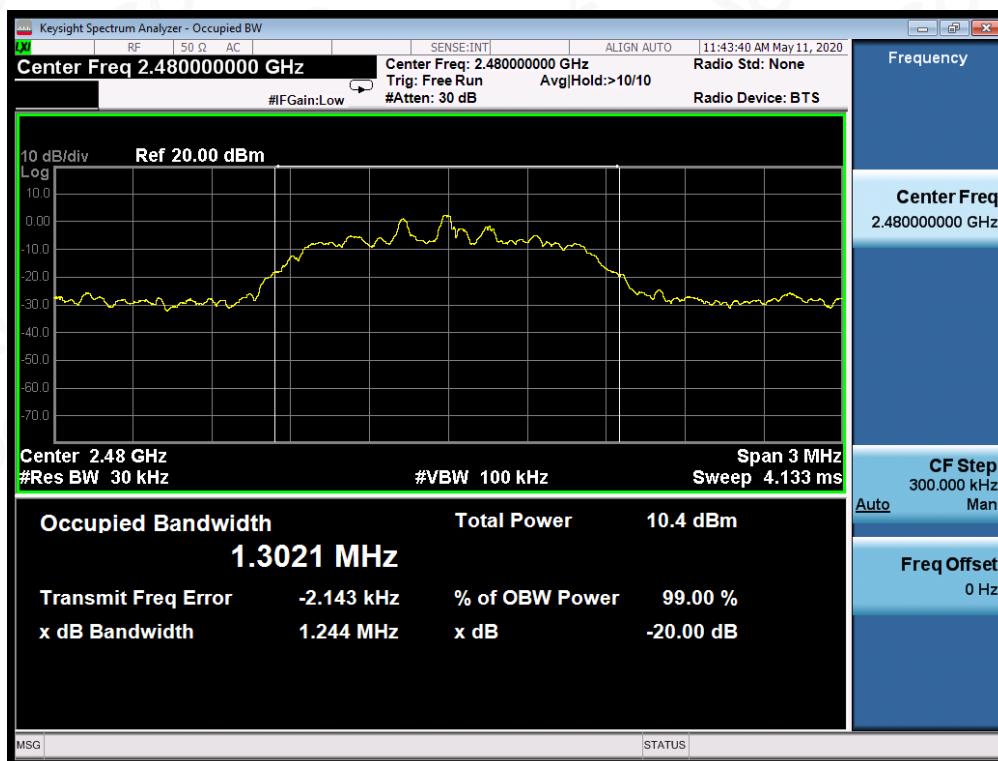
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



### TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

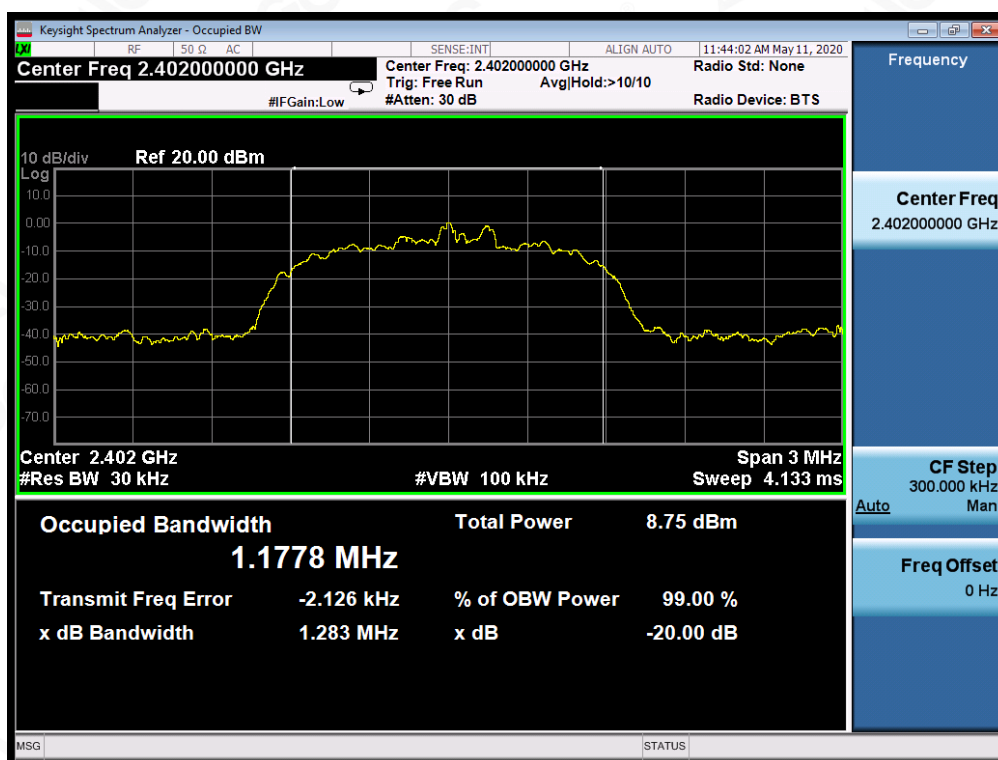


### TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL

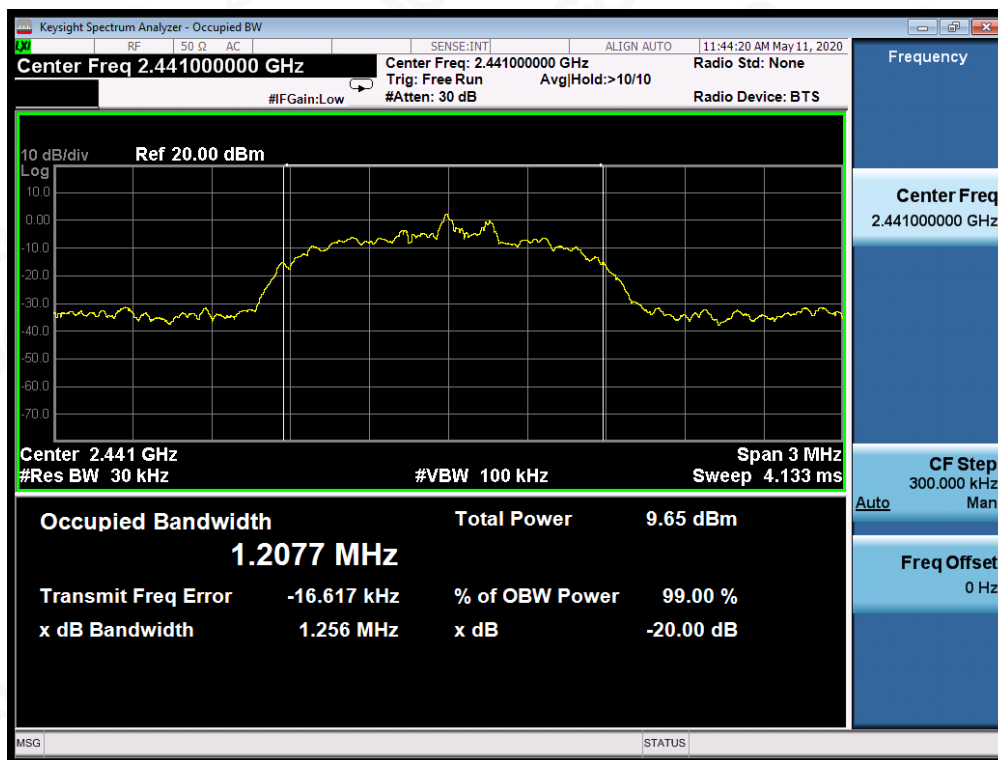


| MEASUREMENT RESULT FOR 8-DPSK MODULATION |                    |       |          |
|------------------------------------------|--------------------|-------|----------|
| Applicable Limits                        | Measurement Result |       |          |
|                                          | Test Data (MHz)    |       | Criteria |
| N/A                                      | Low Channel        | 1.283 | PASS     |
|                                          | Middle Channel     | 1.256 | PASS     |
|                                          | High Channel       | 1.264 | PASS     |

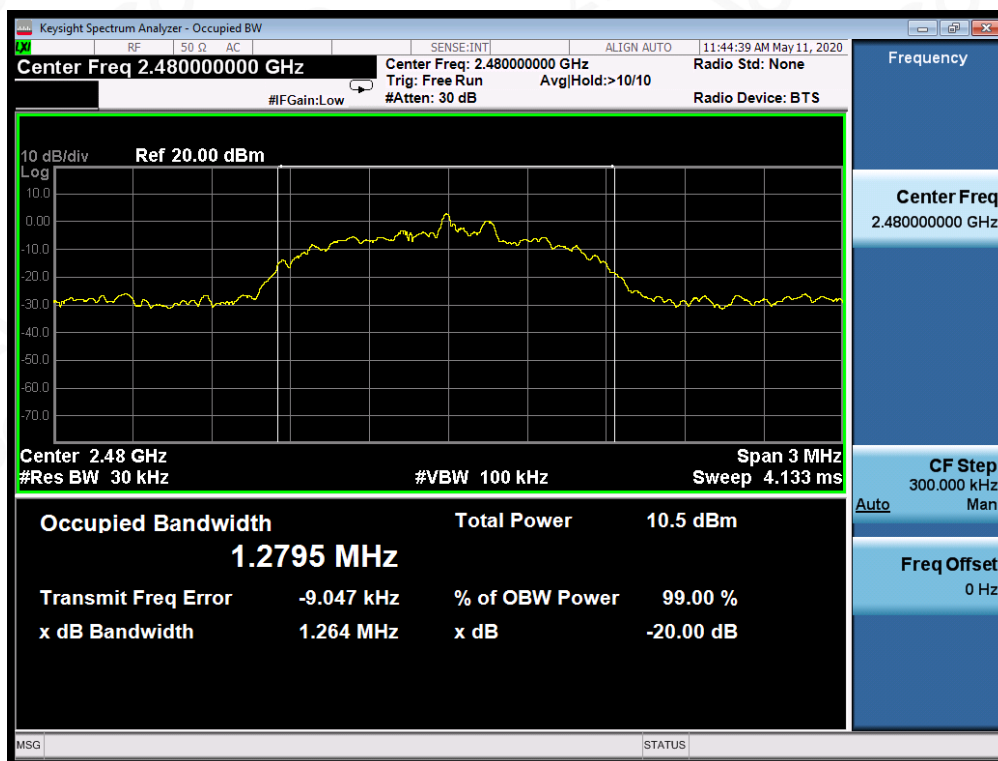
TEST PLOT OF BANDWIDTH FOR LOW CHANNEL



### TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL



### TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL



## 9. CONDUCTED SPURIOUS EMISSION

### 9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.  
RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
4. Set SPA Trace 1 Max hold, then View.

### 9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

### 9.3. MEASUREMENT EQUIPMENT USED

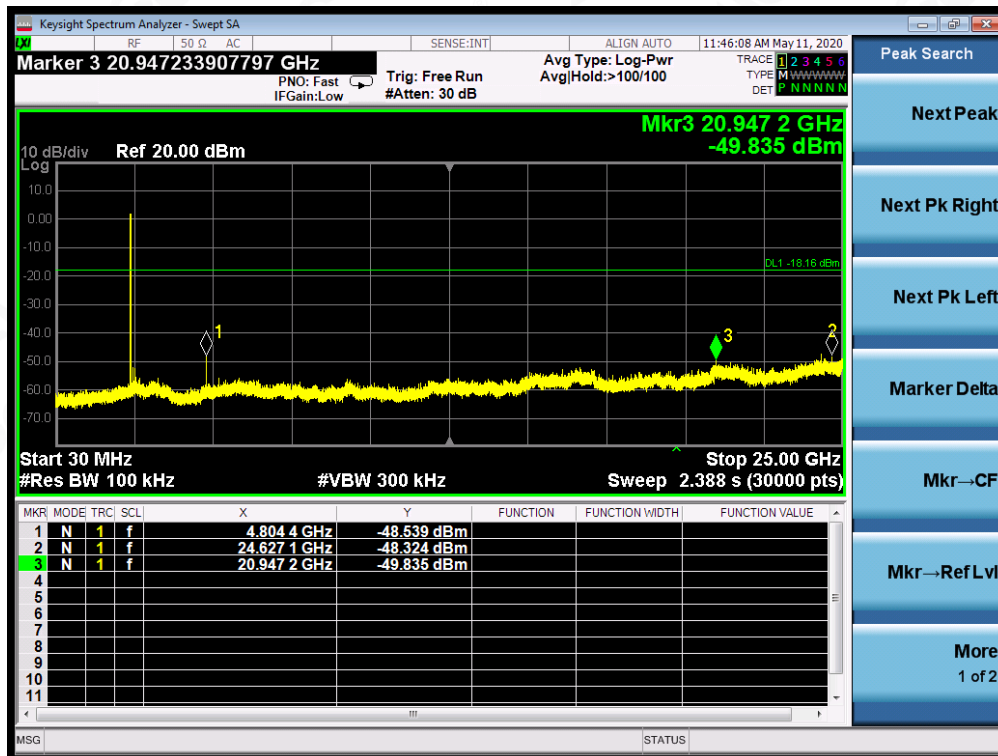
The same as described in section 6

### 9.4. LIMITS AND MEASUREMENT RESULT

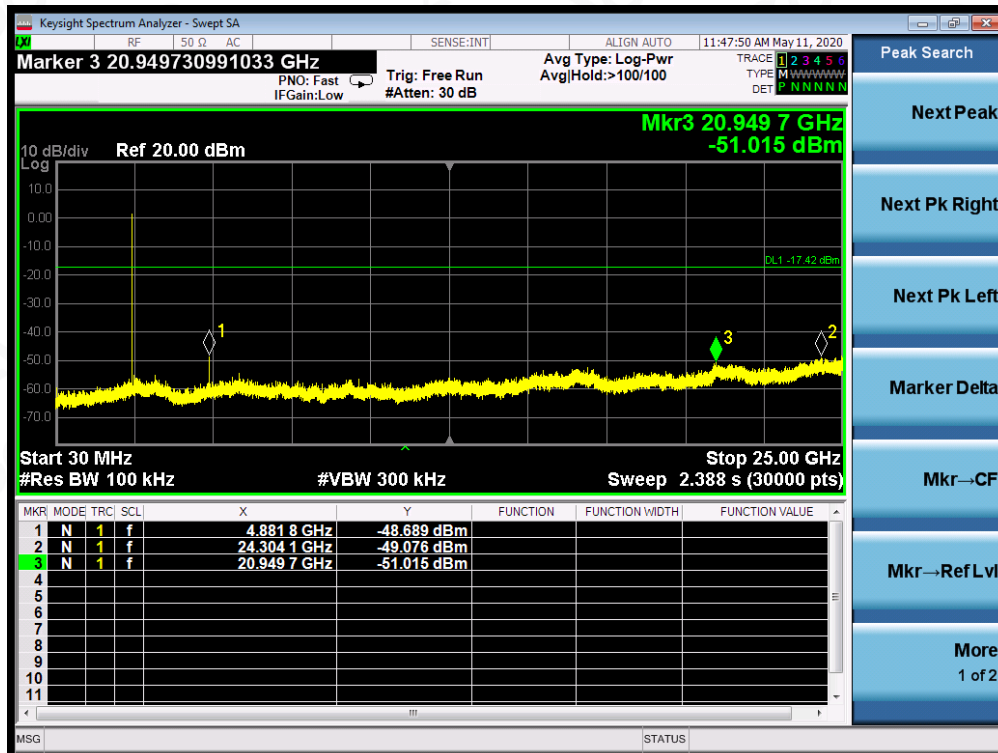
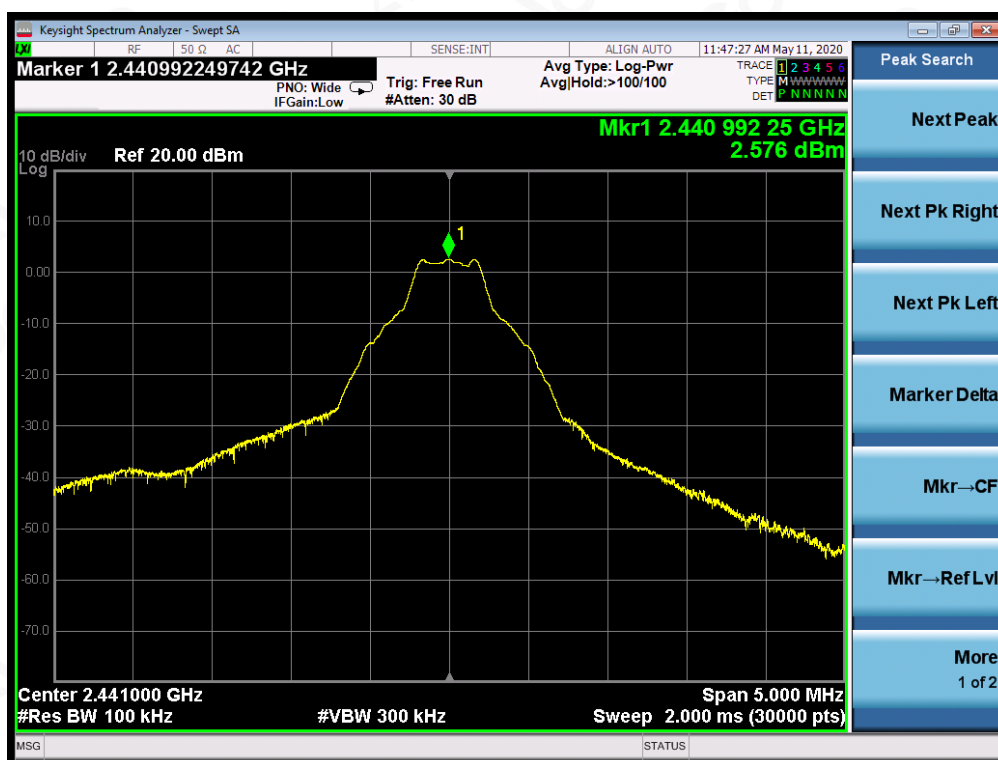
| LIMITS AND MEASUREMENT RESULT                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------|
| Applicable Limits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Measurement Result                                             |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Test Data                                                      | Criteria |
| In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power.<br>In addition, radiation 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)) | At least -20dBc than the limit Specified on the BOTTOM Channel | PASS     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | At least -20dBc than the limit Specified on the TOP Channel    | PASS     |



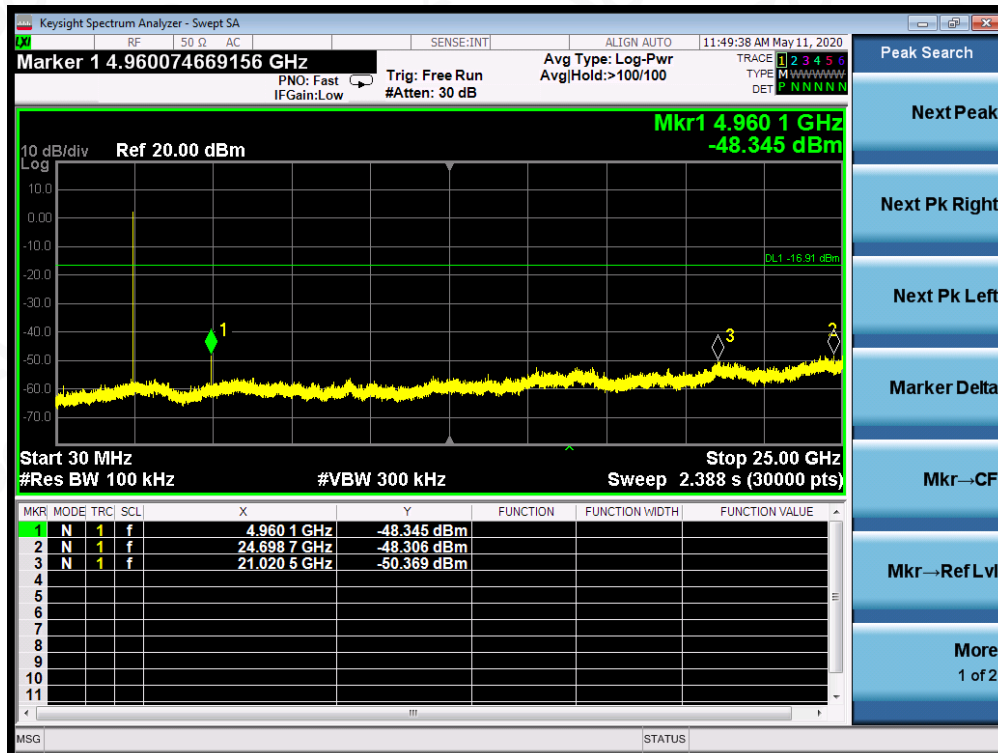
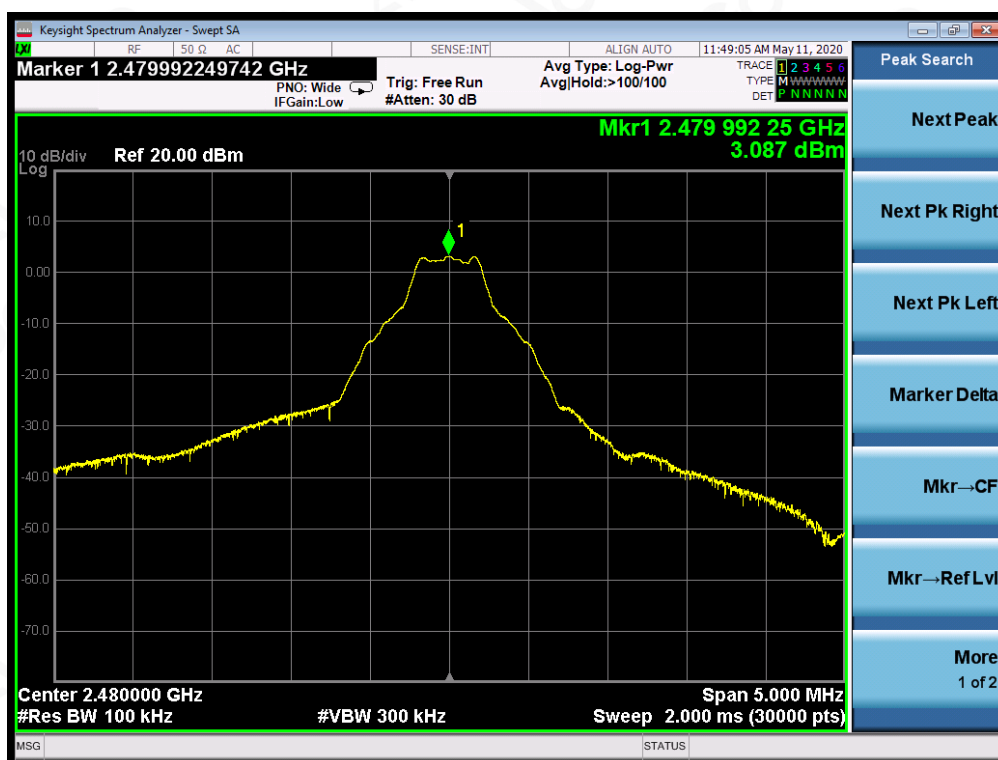
**TEST RESULT FOR ENTIRE FREQUENCY RANGE**  
**TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE**  
**OF GFSK MODULATION IN LOW CHANNEL**



### TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN MIDDLE CHANNEL



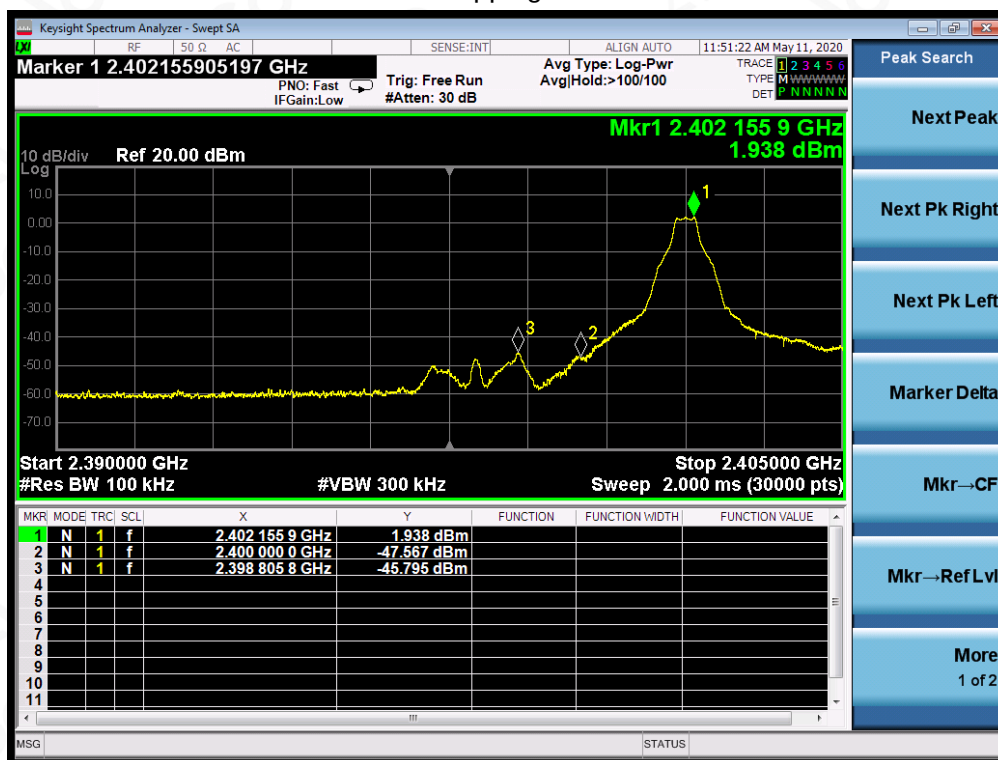
### TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN HIGH CHANNEL



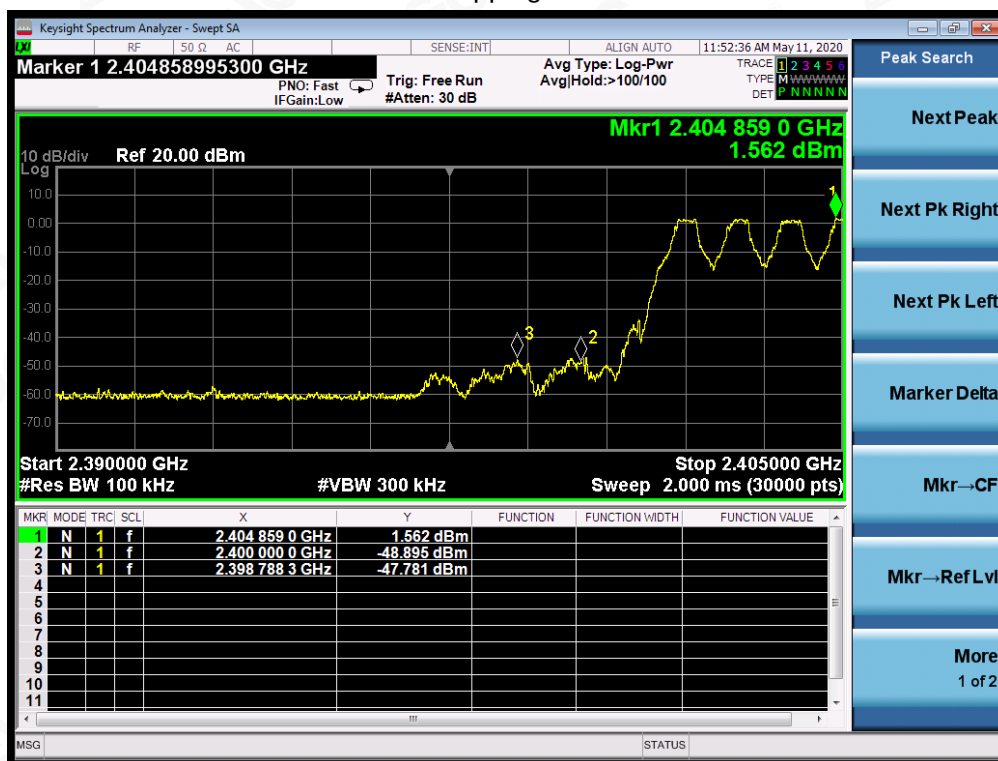
Note: The peak emissions without marker on the above plots are fundamental wave and need not to compare with the limit. The GFSK modulation is the worst case and only those data recorded in the report.



# TEST RESULT FOR BAND EDGE GFSK MODULATION IN LOW CHANNEL Hopping off

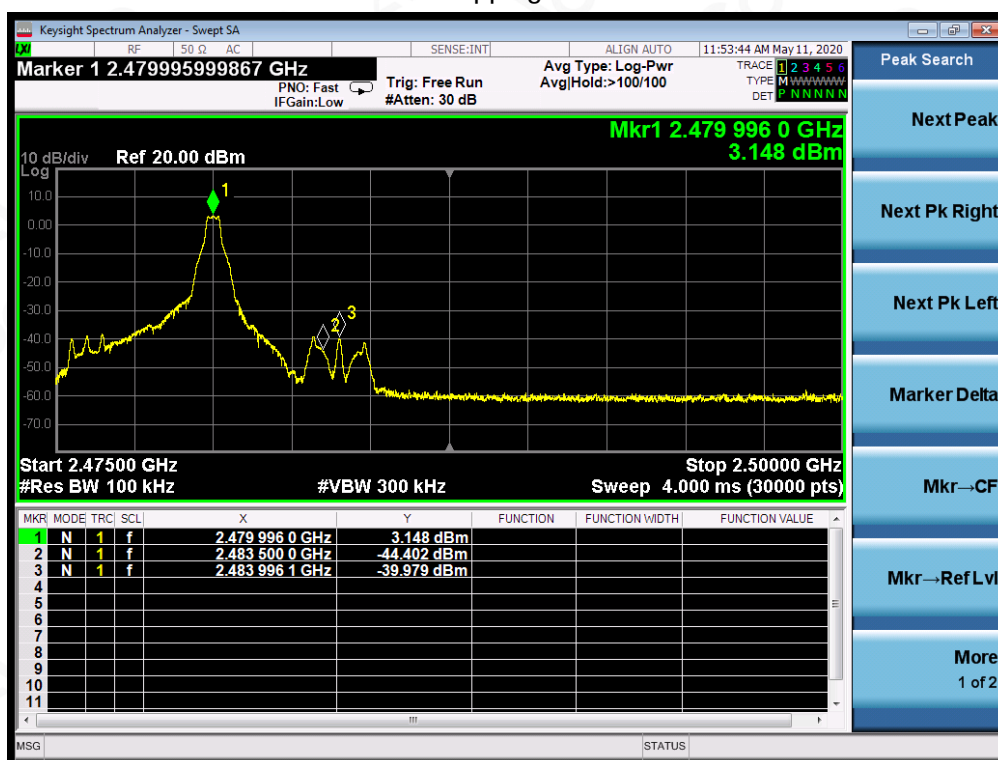


Hopping on

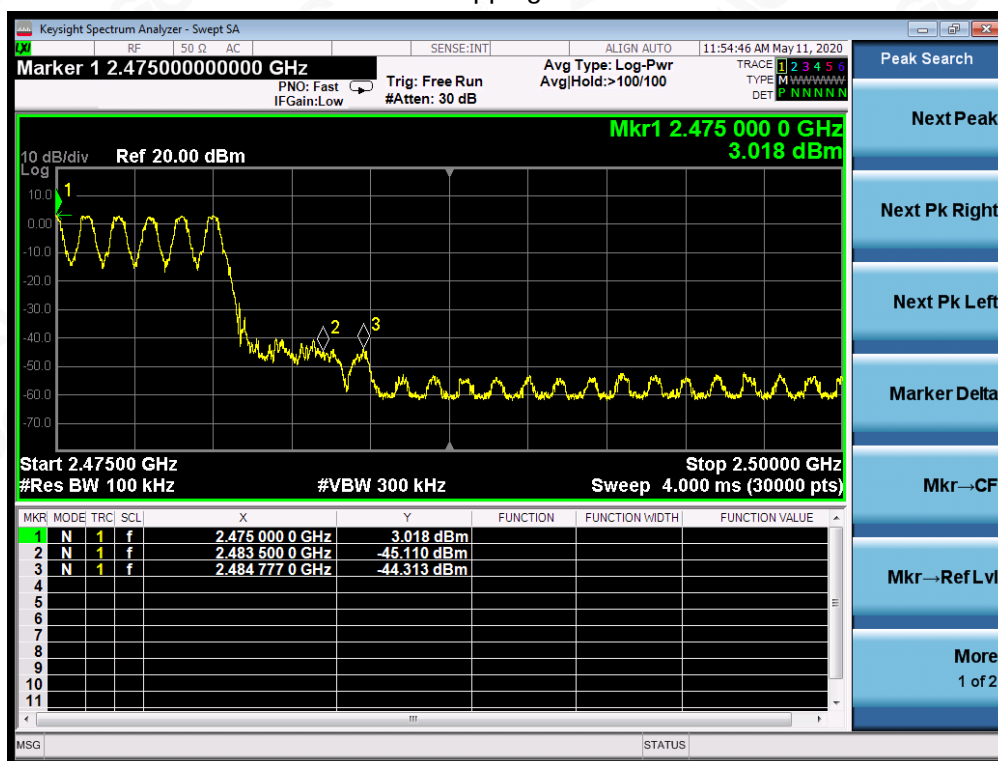


## GFSK MODULATION IN HIGH CHANNEL

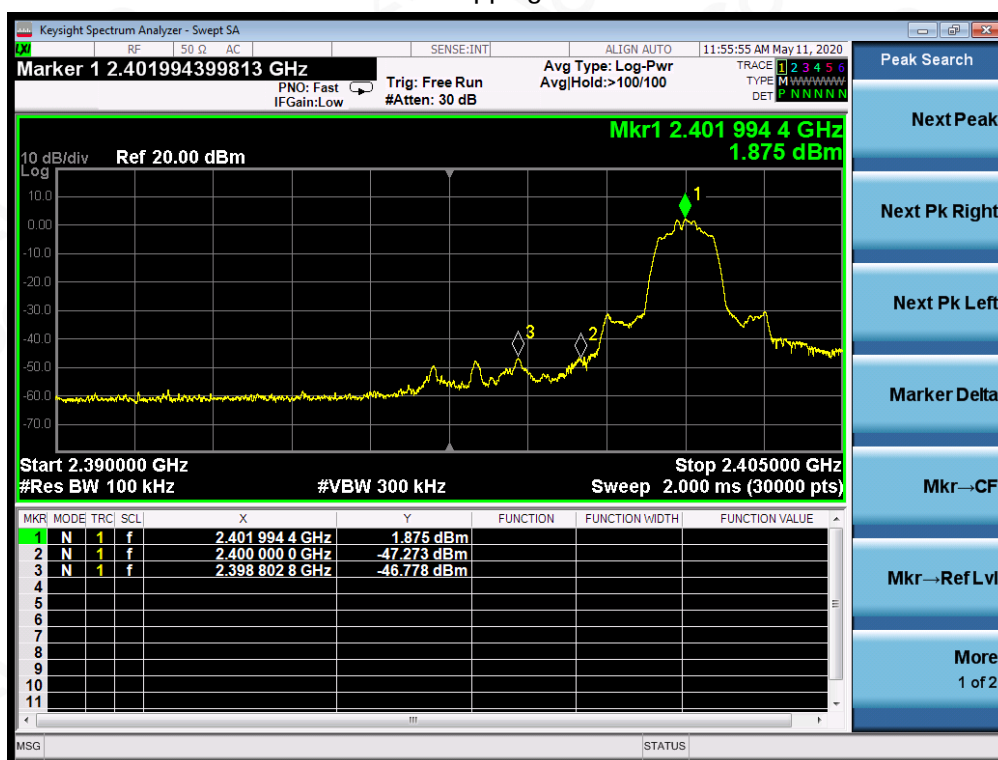
### Hopping off



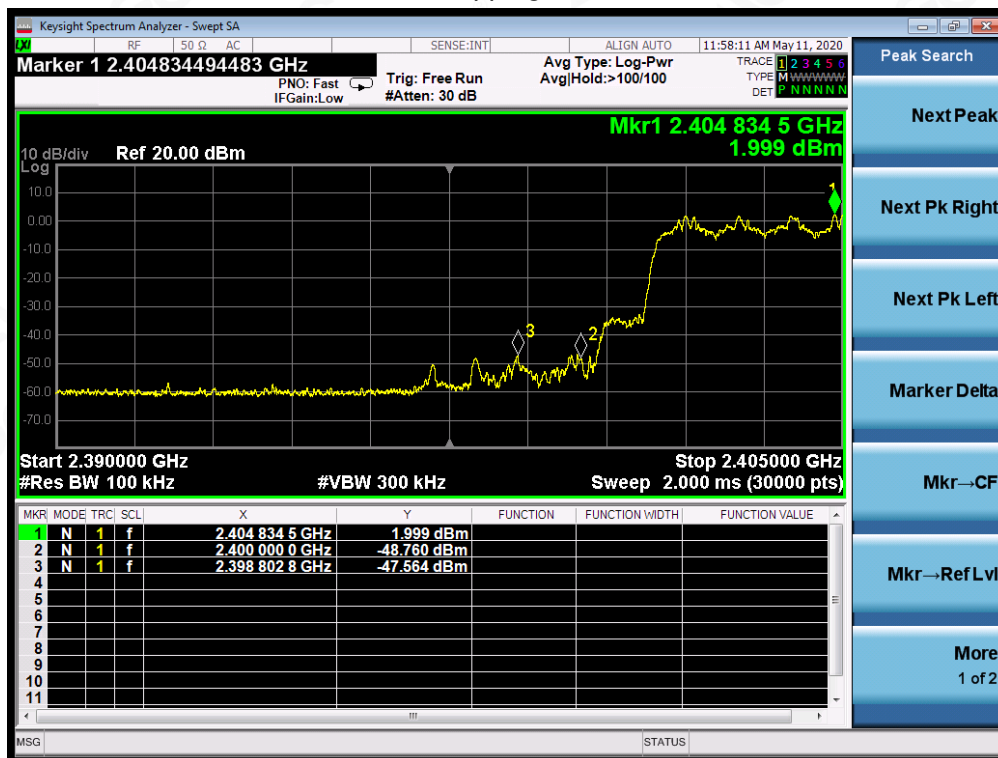
### Hopping on



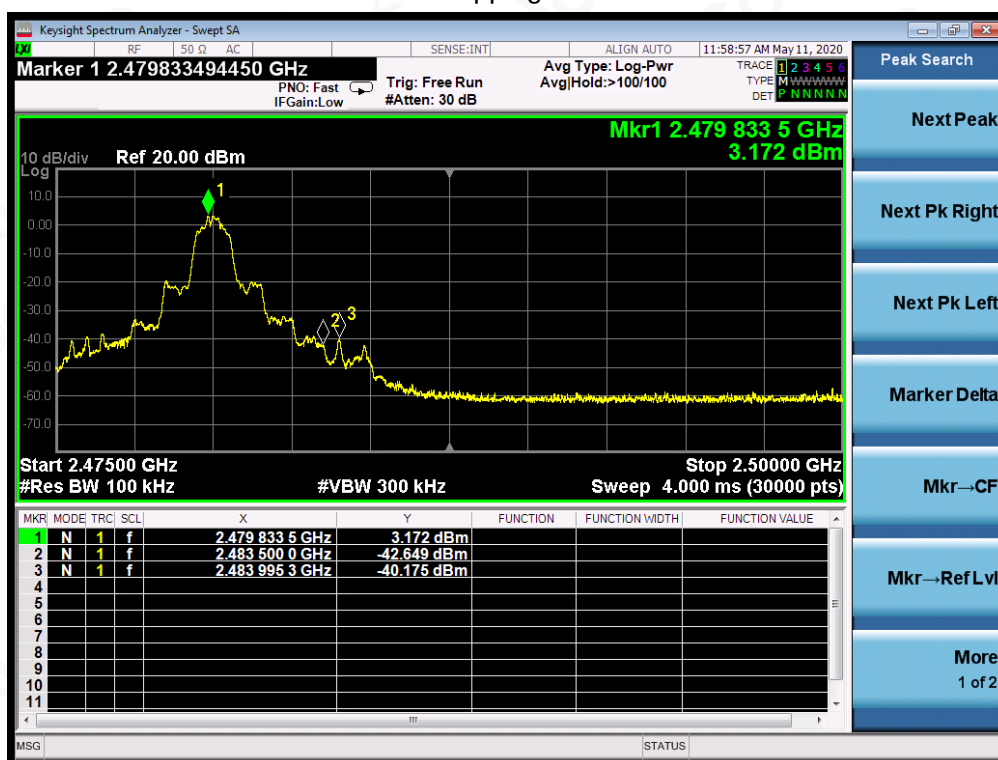
$\pi$  /4-DQPSK MODULATION IN LOW CHANNEL  
Hopping off



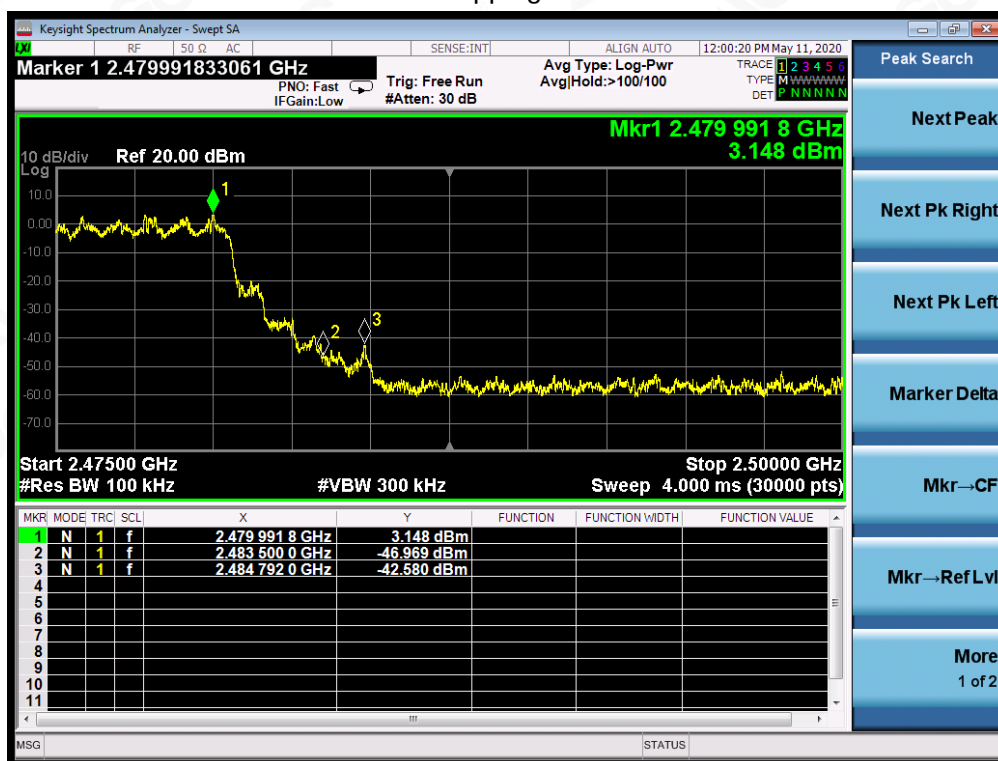
Hopping on



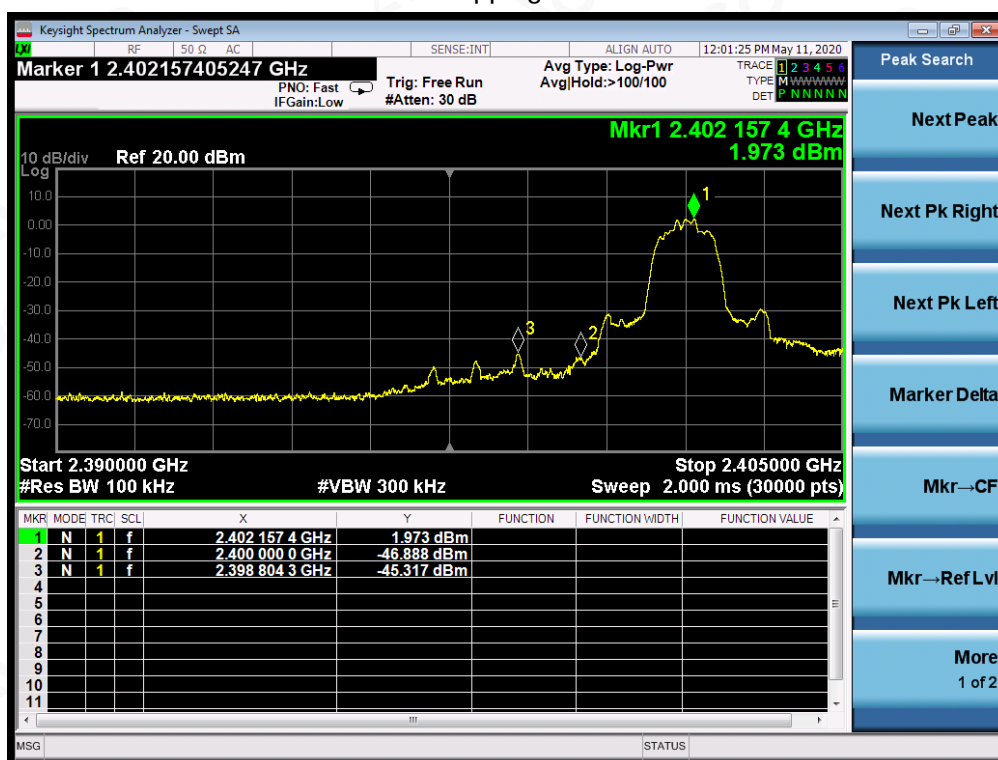
$\pi$  /4-DQPSK MODULATION IN HIGH CHANNEL  
Hopping off



Hopping on



## 8-DPSK MODULATION IN LOW CHANNEL Hopping off



## Hopping on

