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# FCC Test Report

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Report No.: AGC14521220601FE03

**FCC ID** : Z4C-ML100A

**APPLICATION PURPOSE** : Original Equipment

**PRODUCT DESIGNATION** : BLUETOOTH HEADPHONES

**BRAND NAME** : MINELAB

**MODEL NAME** : ML 100

**APPLICANT** : Minelab Electronics Pty Ltd

**DATE OF ISSUE** : Jul. 05, 2022

**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           | /           | Jul. 05, 2022 | Valid         | Initial Release |

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## 1. VERIFICATION OF CONFORMITY

|                                 |                                                                 |
|---------------------------------|-----------------------------------------------------------------|
| <b>Applicant</b>                | Minelab Electronics Pty Ltd                                     |
| <b>Address</b>                  | 2 Second Avenue, Mawson Lakes, South Australia, 5095, Australia |
| <b>Manufacturer</b>             | Minelab Electronics Pty Ltd                                     |
| <b>Address</b>                  | 2 Second Avenue, Mawson Lakes, South Australia, 5095, Australia |
| <b>Factory</b>                  | Dongguan Desheng Industrial Co., Ltd.                           |
| <b>Address</b>                  | No.233, Shizhou Avenue, Shipai Town, Dongguan City, China       |
| <b>Product Designation</b>      | BLUETOOTH HEADPHONES                                            |
| <b>Brand Name</b>               | MINELAB                                                         |
| <b>Test Model</b>               | ML 100                                                          |
| <b>Date of test</b>             | Jun. 21, 2022 to Jul. 05, 2022                                  |
| <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 |  |               |
|             | Cool Cheng<br>(Project Engineer)                                                    | Jul. 05, 2022 |
| Reviewed By |  |               |
|             | Calvin Liu<br>(Reviewer)                                                            | Jul. 05, 2022 |
| Approved By |  |               |
|             | Max Zhang<br>(Authorized Officer)                                                   | Jul. 05, 2022 |

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## 2. GENERAL INFORMATION

### 2.1. PRODUCT DESCRIPTION

The EUT is designed as “BLUETOOTH HEADPHONES”. 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 2.480 GHz                                                                                                                                                                                                        |
| RF Output Power     | 1.529dBm (Max)                                                                                                                                                                                                                |
| Bluetooth Version   | V5.0                                                                                                                                                                                                                          |
| Modulation          | BR <input checked="" type="checkbox"/> GFSK, EDR <input checked="" type="checkbox"/> $\pi$ /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    | V1.1                                                                                                                                                                                                                          |
| Software Version    | V1.0                                                                                                                                                                                                                          |
| Antenna Designation | PCB Antenna (Comply with requirements of the FCC part 15.203)                                                                                                                                                                 |
| Antenna Gain        | 3.29dBi                                                                                                                                                                                                                       |
| Power Supply        | DC 3.7V by battery                                                                                                                                                                                                            |

### 2.2. TABLE OF CARRIER FREQUENCIES

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

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### 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 multi slot 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 send on the same frequency, it is send on the next frequency of the hopping sequence.

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

Example of a hopping sequence in data mode:

40, 21, 44, 23, 04, 15, 66, 56, 19, 78, 07, 28, 69, 55,  
36, 45, 05, 13, 43, 74, 57, 35, 67, 76, 02, 34, 54, 63,  
42, 11, 30, 06, 64, 25, 75, 48, 17, 33, 58, 01, 29, 14,  
51, 72, 03, 31, 50, 61, 77, 18, 10, 47, 12, 68, 08, 49,  
20, 00, 73, 09, 16, 60, 71, 41, 24, 53, 38, 26, 46, 37,  
65, 32, 70, 52, 27, 59, 22, 62, 39

### 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 24MSB's of the 48BD\_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 behavior action with other units only offset is 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 case it is implemented as 28 bits counter. For the deriving of the hopping sequence the entire. LAP (24 bits),4LSB's(4bits) (Input 1) and the 27MSB's of the clock (Input 2) are used. With this 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 transmission 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: Z4C-ML100A** 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.

## **2.10. ANTENNA REQUIREMENT**

This intentional radiator is designed with a permanently attached antenna of an antenna to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

For more information of the antenna, please refer to the APPENDIX B: PHOTOGRAPHS OF EUT.

### 3. MEASUREMENT UNCERTAINTY

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

| Item                                          | Measurement Uncertainty    |
|-----------------------------------------------|----------------------------|
| Uncertainty of Conducted Emission for AC Port | $U_c = \pm 3.1 \text{ dB}$ |
| Uncertainty of Radiated Emission below 1GHz   | $U_c = \pm 4.0 \text{ dB}$ |
| Uncertainty of Radiated Emission above 1GHz   | $U_c = \pm 4.8 \text{ dB}$ |
| Uncertainty of total RF power, conducted      | $U_c = \pm 0.8 \text{ dB}$ |
| Uncertainty of RF power density, conducted    | $U_c = \pm 2.6 \text{ dB}$ |
| Uncertainty of spurious emissions, conducted  | $U_c = \pm 2 \%$           |
| Uncertainty of Occupied Channel Bandwidth     | $U_c = \pm 2 \%$           |

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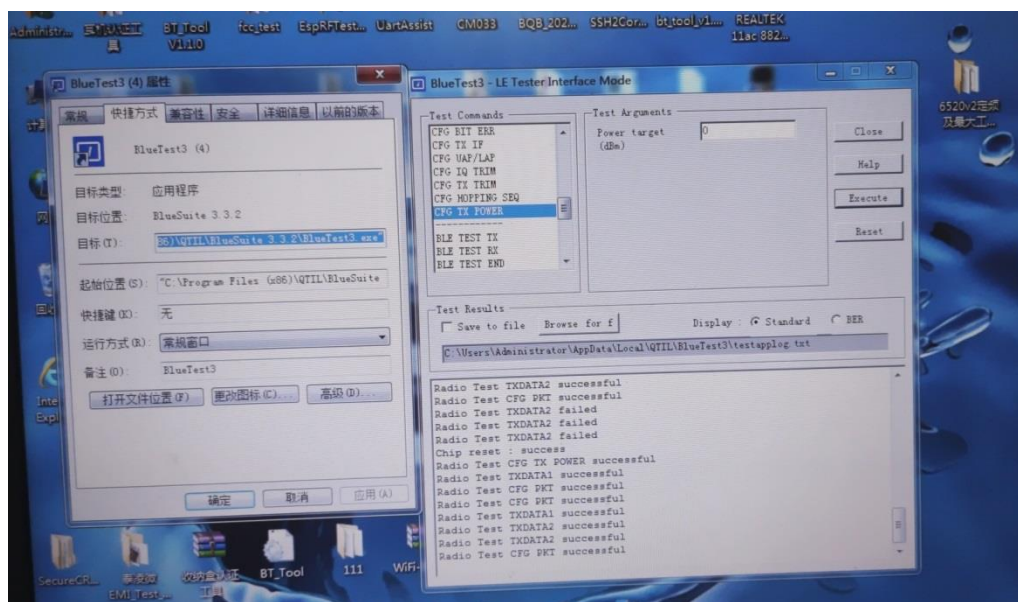
#### 4. DESCRIPTION OF TEST MODES

| 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.

#### Software Setting



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## 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    | BLUETOOTH HEADPHONES | ML 100    | Z4C-ML100A          | 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          | Not applicable |

Note: The BT function cannot transmit when 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      | Mar. 28, 2022 | Mar. 27, 2023 |
| EXA Signal Analyzer            | Aglient        | N9010A            | MY53470504 | Nov. 17, 2021 | Nov. 16, 2022 |
| 2.4GHz Filter                  | EM Electronics | 2400-2500MHz      | N/A        | Mar. 23, 2022 | Mar. 22, 2024 |
| Attenuator                     | ZHINAN         | E-002             | N/A        | Sep. 03, 2020 | Sep. 02, 2022 |
| Horn antenna                   | SCHWARZBECK    | BBHA 9170         | #768       | Oct. 31, 2021 | Oct. 30, 2023 |
| Active loop antenna (9K-30MHz) | ZHINAN         | ZN30900C          | 18051      | Mar. 12, 2022 | Mar. 11, 2024 |
| Double-Ridged Waveguide Horn   | ETS LINDGREN   | 3117              | 00034609   | Apr. 23, 2021 | Apr. 22, 2023 |
| Broadband Preamplifier         | ETS LINDGREN   | 3117PA            | 00225134   | Sep. 03, 2020 | Sep. 02, 2022 |
| ANTENNA                        | SCHWARZBECK    | VULB9168          | 494        | Jan. 08, 2021 | Jan. 07, 2023 |
| Test software                  | Tonscend       | JS32-RE (Ver.2.5) | N/A        | N/A           | N/A           |

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## 7. PEAK OUTPUT POWER

### 7.1. MEASUREMENT PROCEDURE

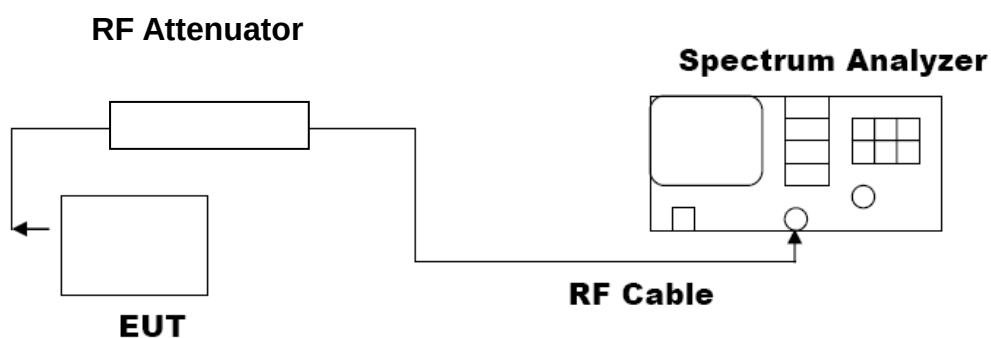
For peak power test:

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)

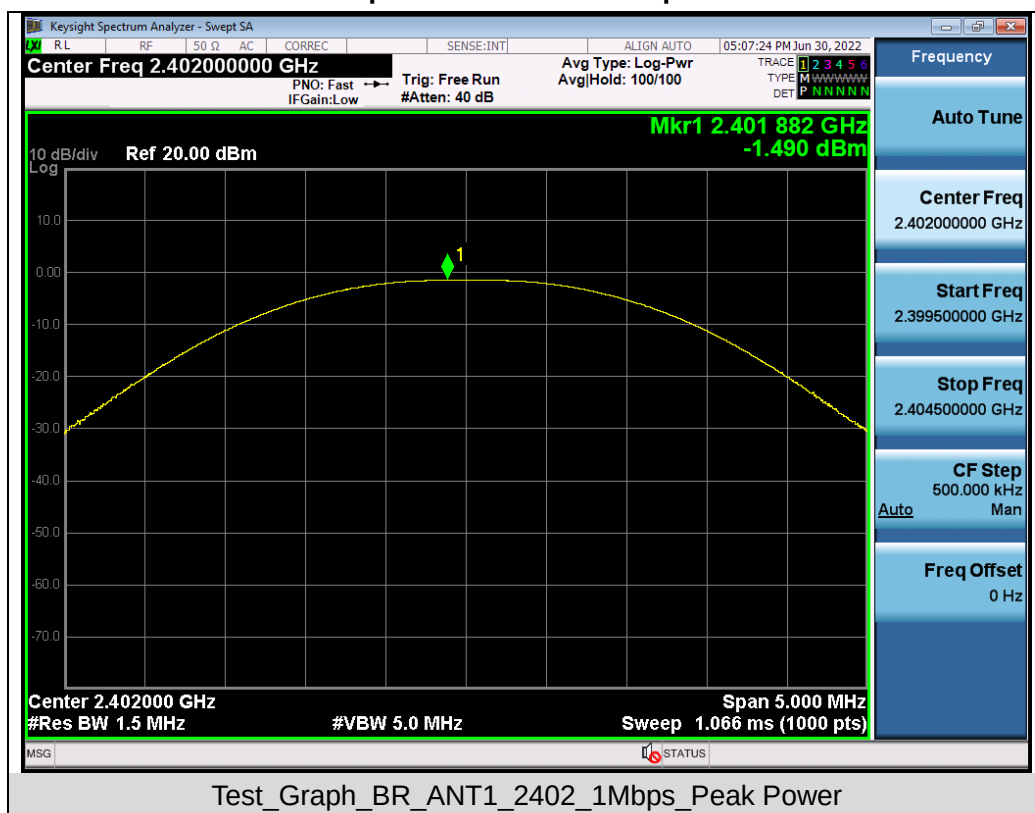
#### PEAK POWER TEST SETUP



### 7.3. LIMITS AND MEASUREMENT RESULT

| Test Data of Conducted Output Power |                    |                  |              |              |
|-------------------------------------|--------------------|------------------|--------------|--------------|
| Test Mode                           | Test Channel (MHz) | Peak Power (dBm) | Limits (dBm) | Pass or Fail |
| GFSK                                | 2402               | -1.490           | $\leq 21$    | Pass         |
|                                     | 2441               | -1.242           | $\leq 21$    | Pass         |
|                                     | 2480               | -1.093           | $\leq 21$    | Pass         |
| $\pi/4$ -DQPSK                      | 2402               | 0.515            | $\leq 21$    | Pass         |
|                                     | 2441               | 0.808            | $\leq 21$    | Pass         |
|                                     | 2480               | 0.948            | $\leq 21$    | Pass         |
| 8DPSK                               | 2402               | 0.984            | $\leq 21$    | Pass         |
|                                     | 2441               | 1.355            | $\leq 21$    | Pass         |
|                                     | 2480               | 1.529            | $\leq 21$    | Pass         |

Test Graphs of Conducted Output Power

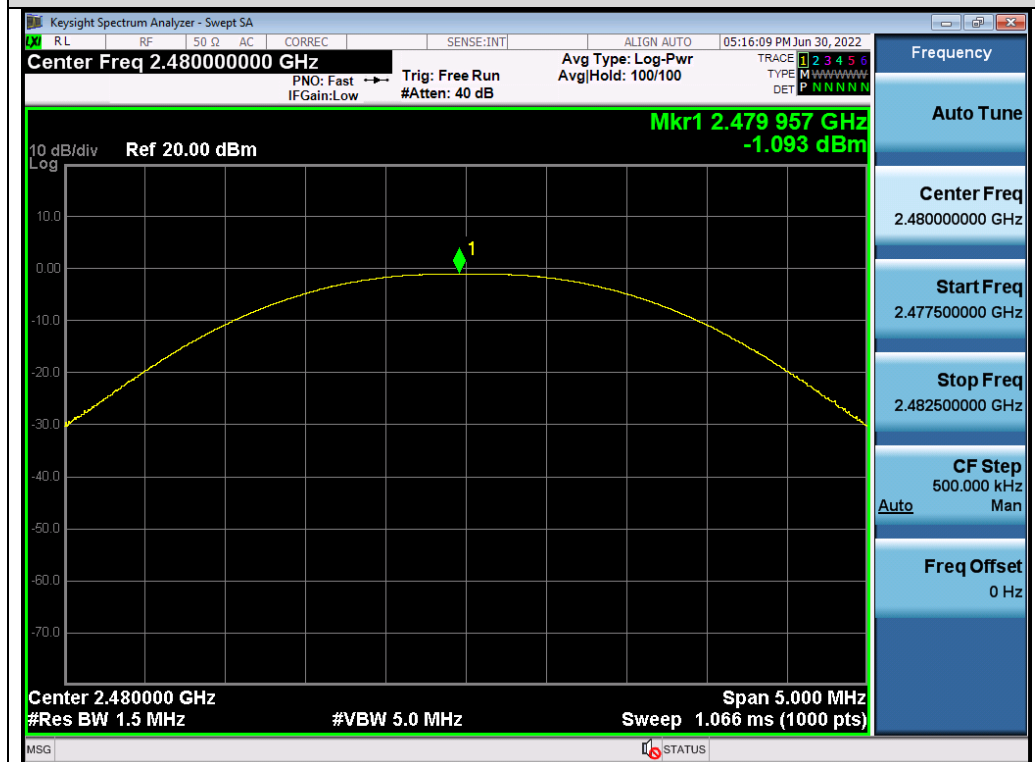
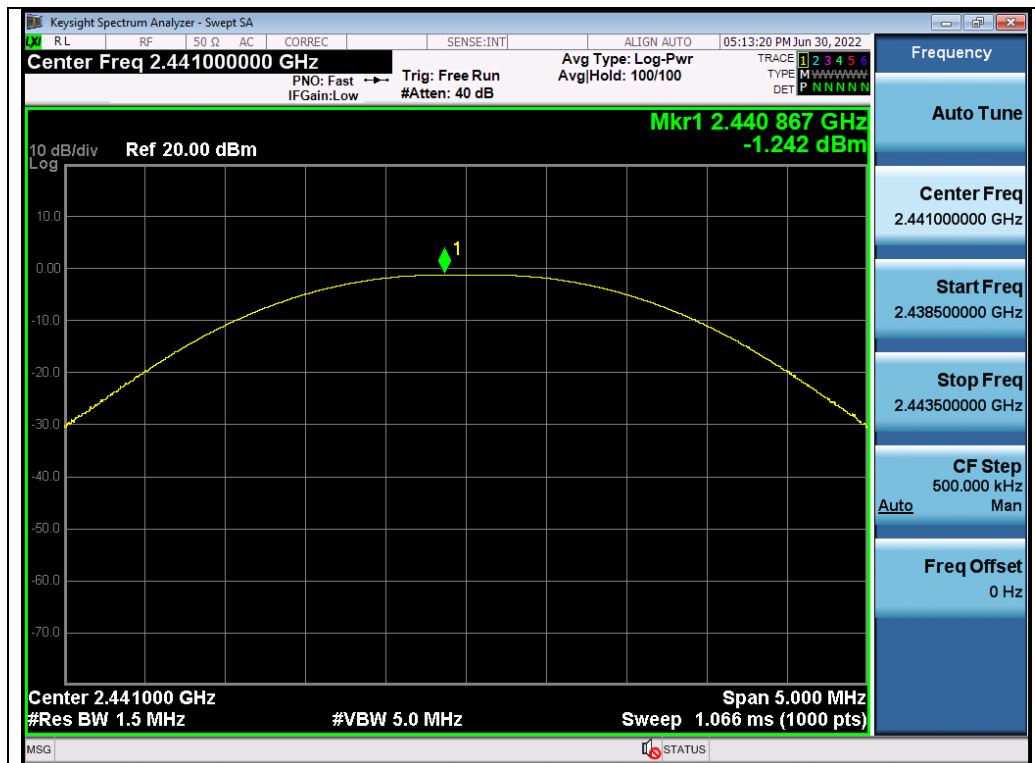


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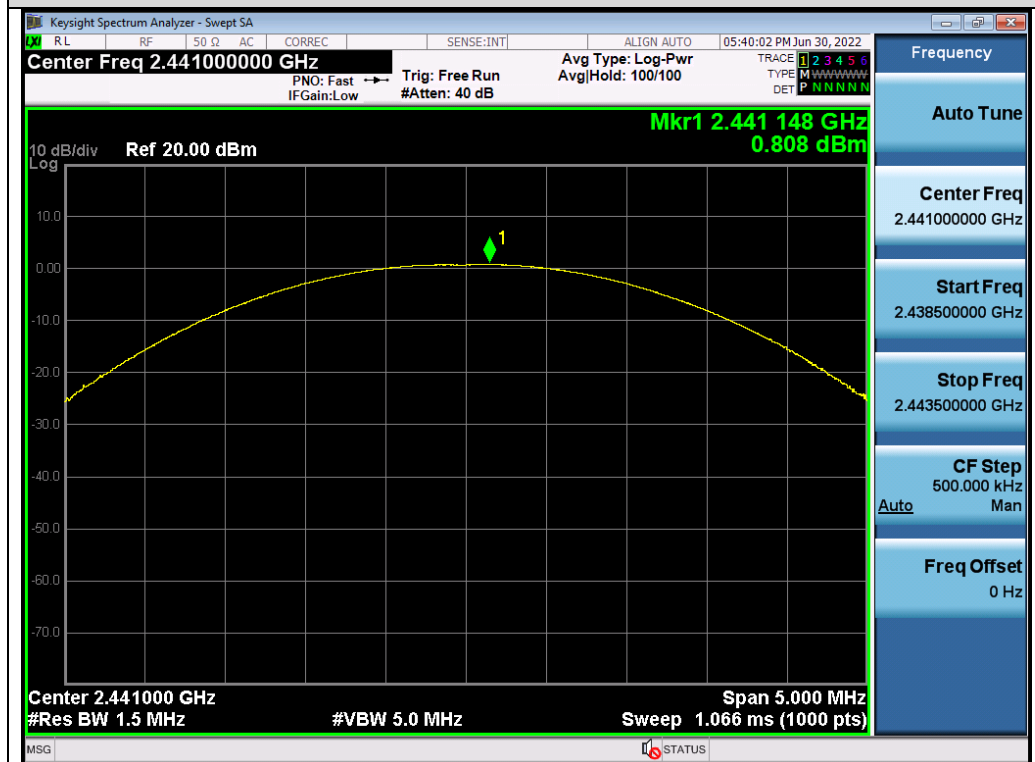
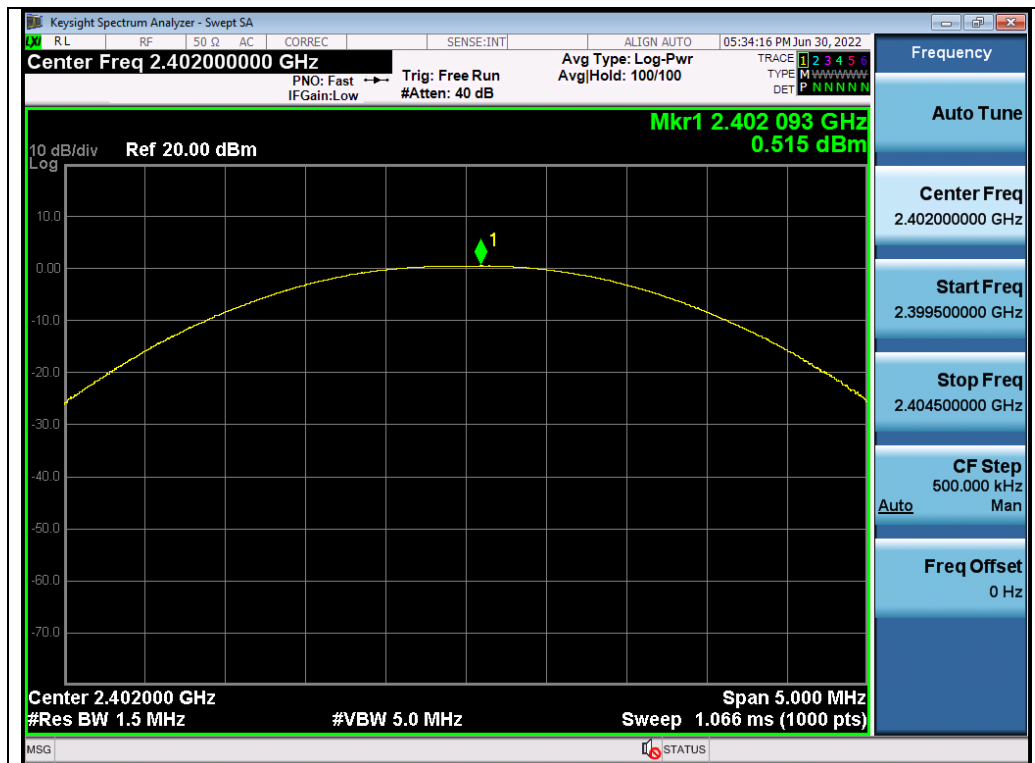
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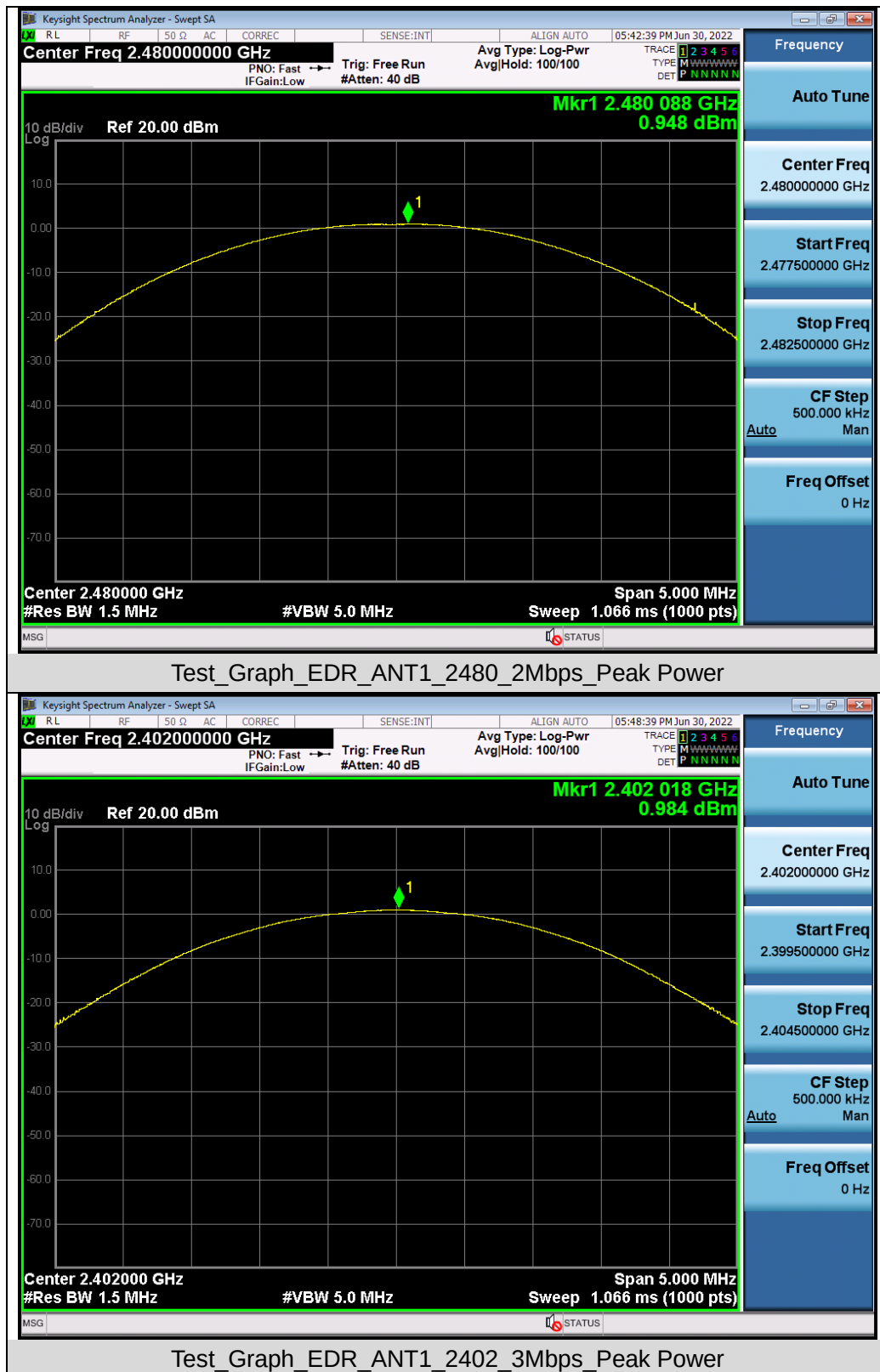
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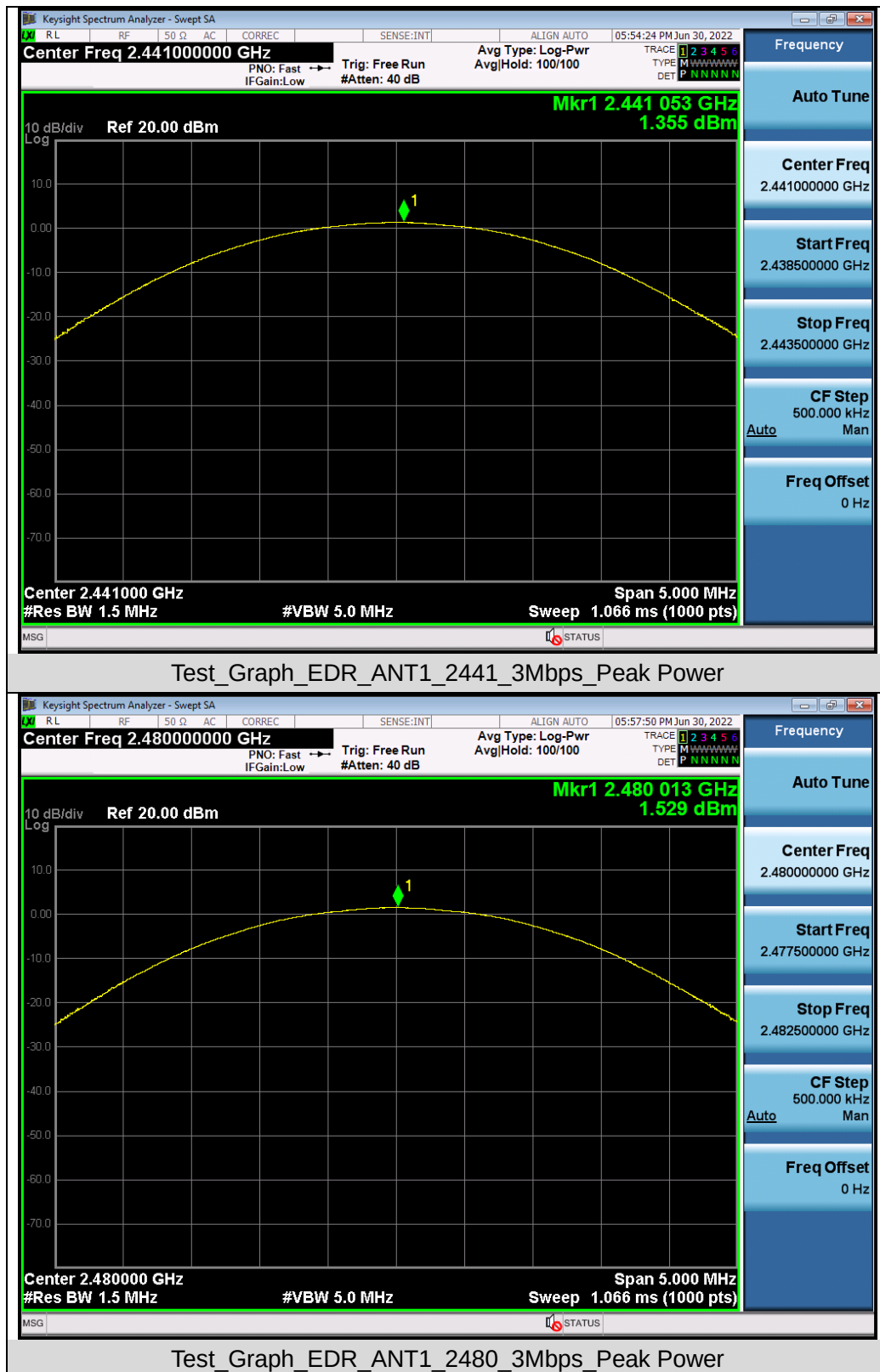
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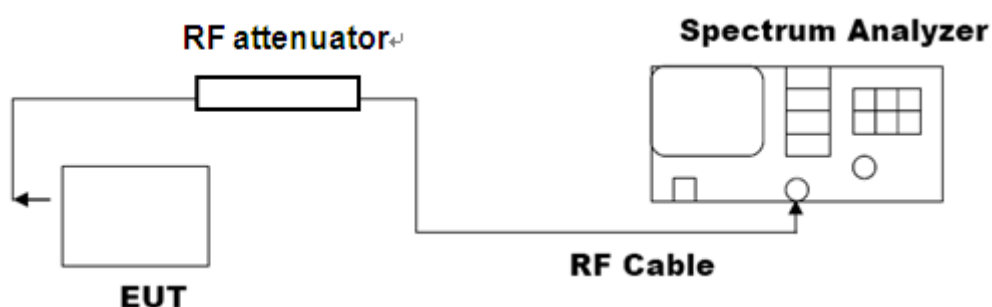
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## 8. 20DB BANDWIDTH

### 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)



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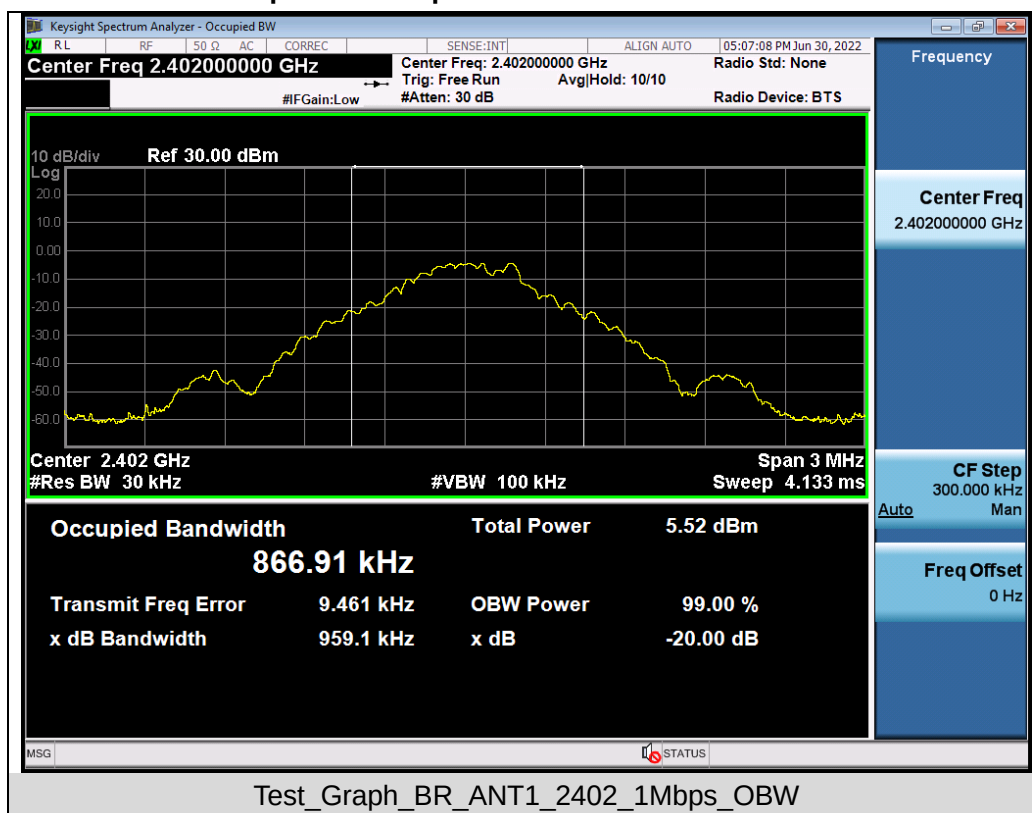
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### 8.3. LIMITS AND MEASUREMENT RESULTS

| Test Data of Occupied Bandwidth and -20dB Bandwidth |                    |                              |                       |        |              |
|-----------------------------------------------------|--------------------|------------------------------|-----------------------|--------|--------------|
| Test Mode                                           | Test Channel (MHz) | 99% Occupied Bandwidth (MHz) | -20dB Bandwidth (MHz) | Limits | Pass or Fail |
| GFSK                                                | 2402               | 0.867                        | 0.959                 | N/A    | Pass         |
|                                                     | 2441               | 0.863                        | 0.958                 | N/A    | Pass         |
|                                                     | 2480               | 0.862                        | 0.958                 | N/A    | Pass         |
| $\pi/4$ -DQPSK                                      | 2402               | 1.188                        | 1.332                 | N/A    | Pass         |
|                                                     | 2441               | 1.188                        | 1.332                 | N/A    | Pass         |
|                                                     | 2480               | 1.189                        | 1.332                 | N/A    | Pass         |
| 8DPSK                                               | 2402               | 1.183                        | 1.306                 | N/A    | Pass         |
|                                                     | 2441               | 1.183                        | 1.306                 | N/A    | Pass         |
|                                                     | 2480               | 1.182                        | 1.305                 | N/A    | Pass         |

Test Graphs of Occupied Bandwidth and -20 Bandwidth



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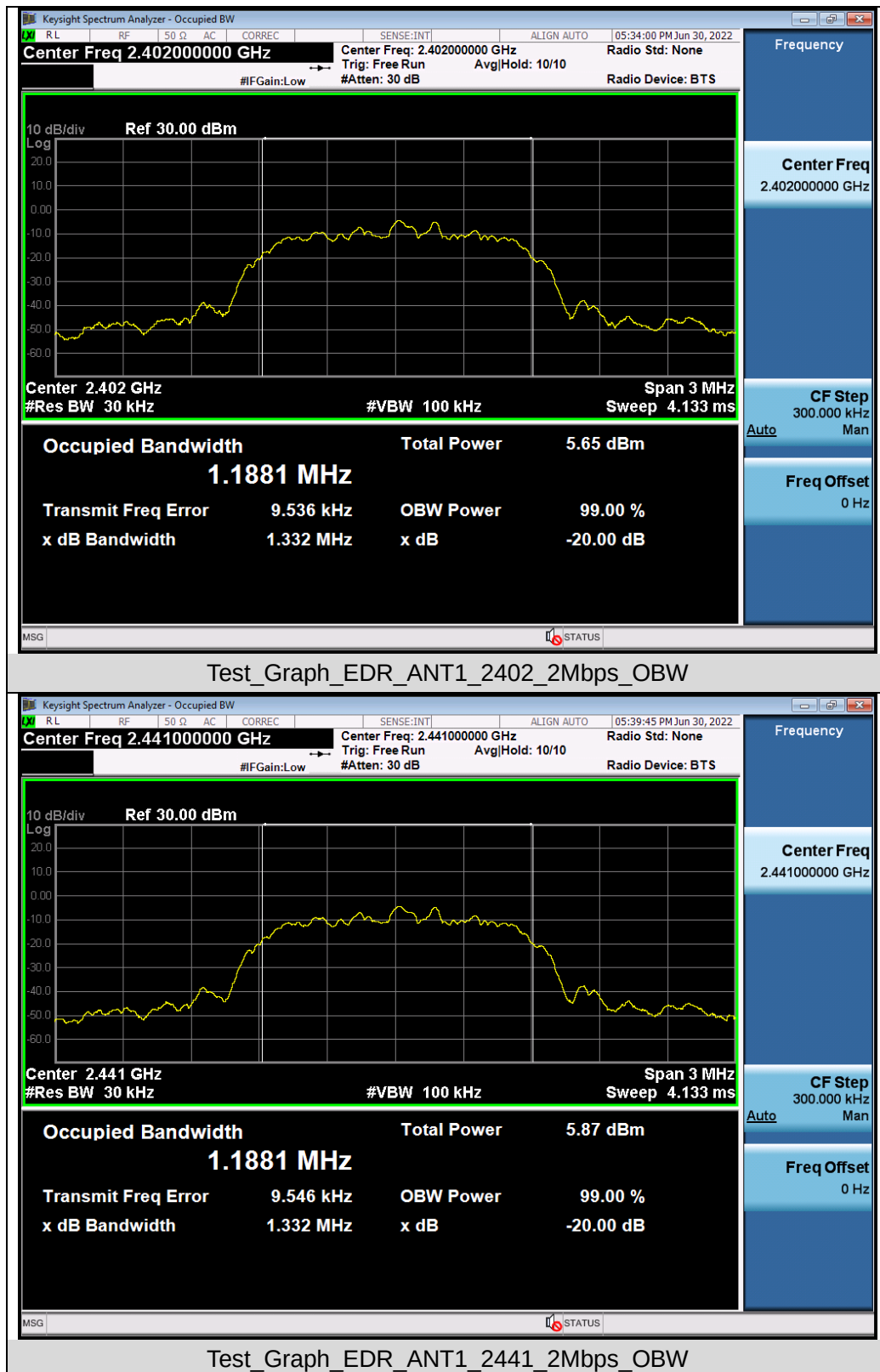
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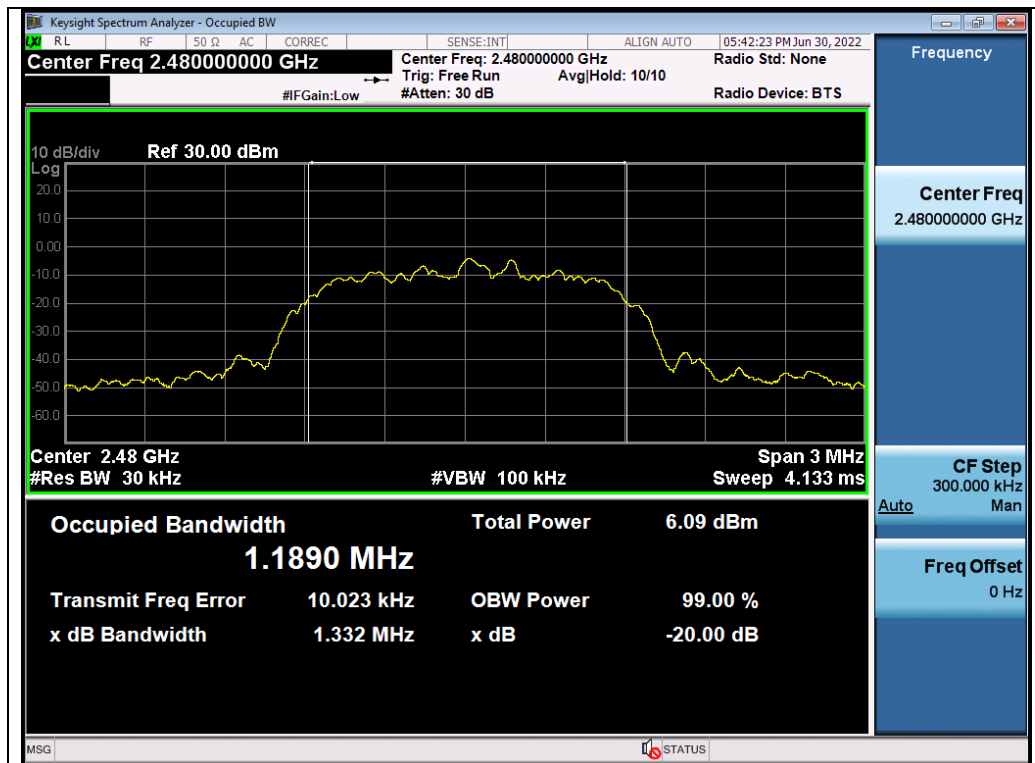
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Test\_Graph\_EDR\_ANT1\_2480\_2Mbps\_OBW



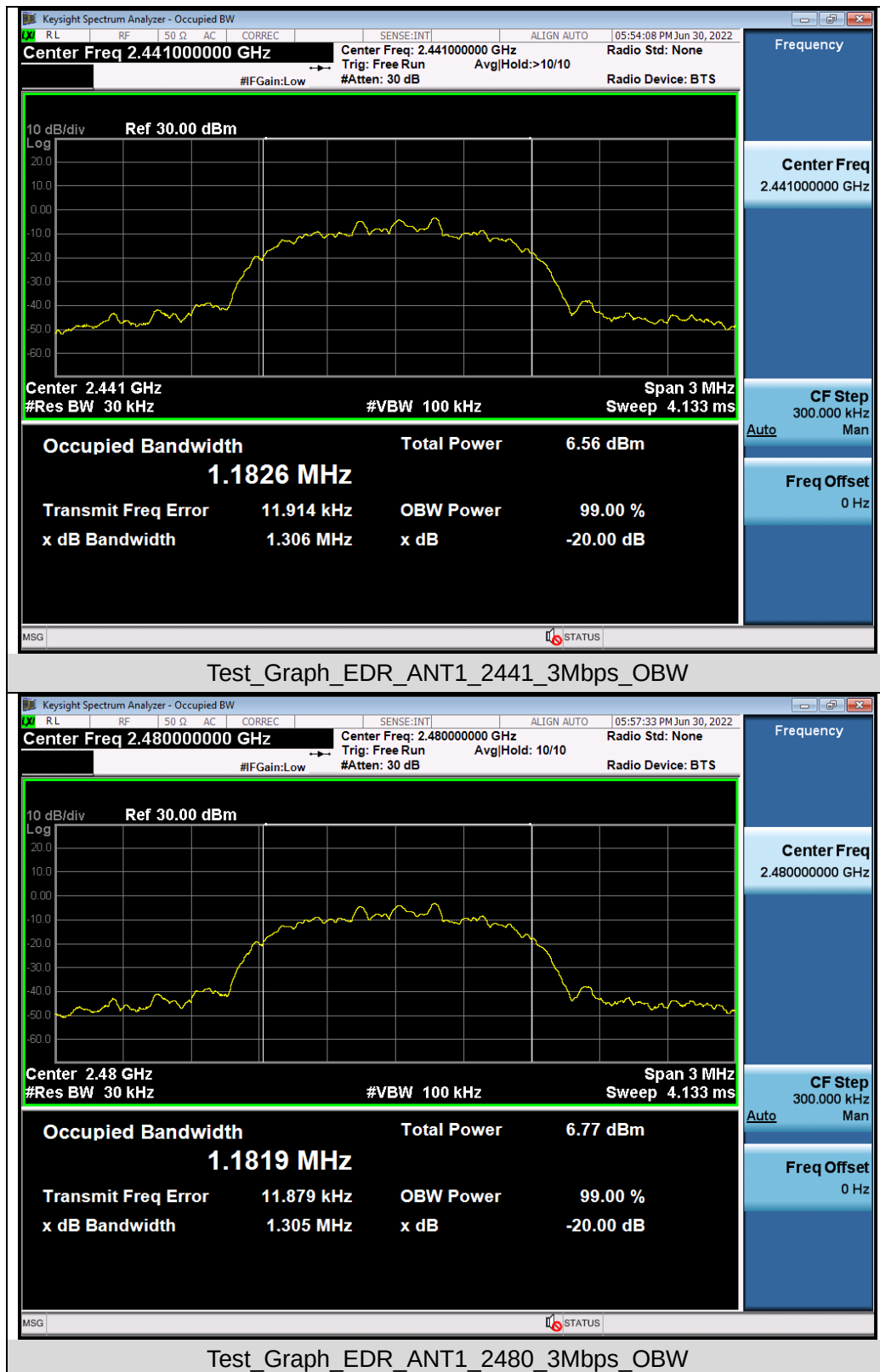
Test\_Graph\_EDR\_ANT1\_2402\_3Mbps\_OBW

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## 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

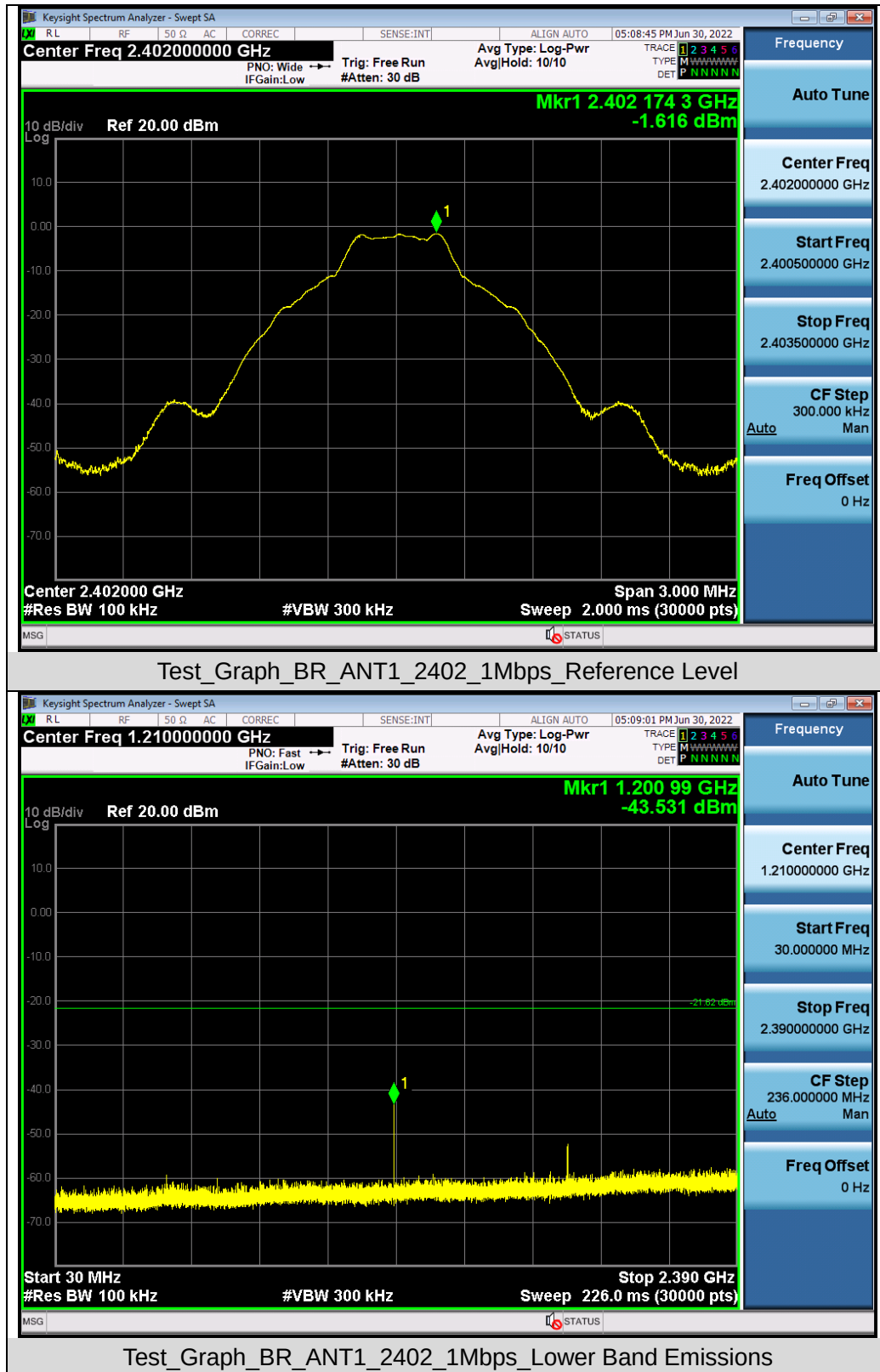
### 9.4. LIMITS AND MEASUREMENT RESULT

| 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     |

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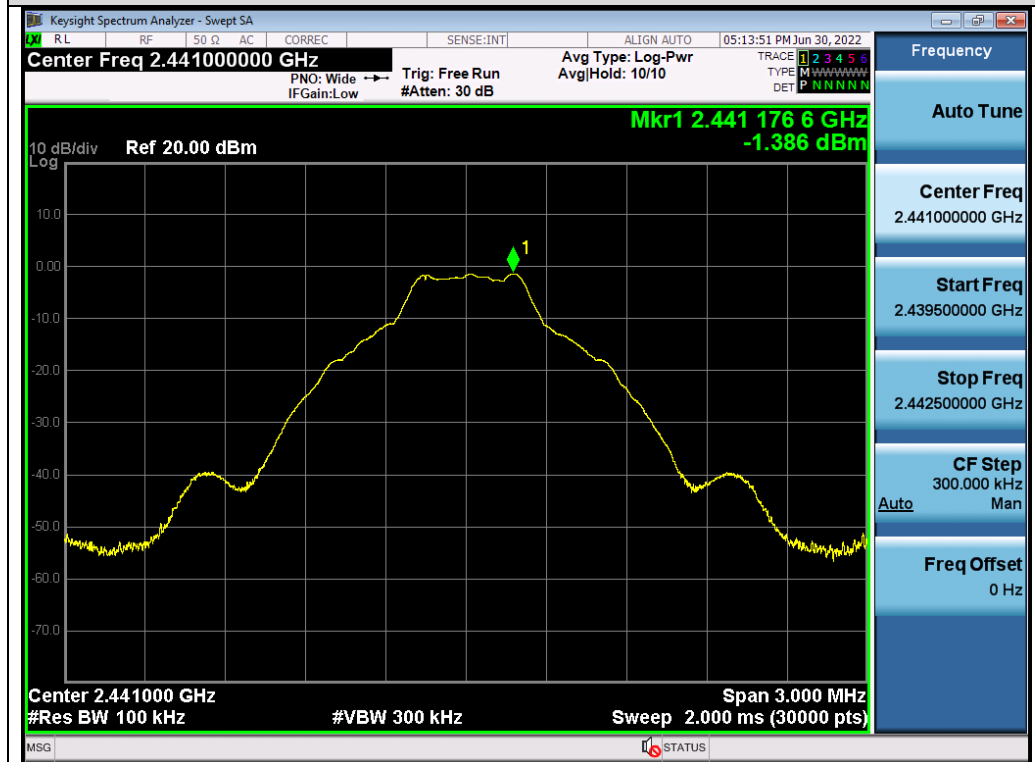
### Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands



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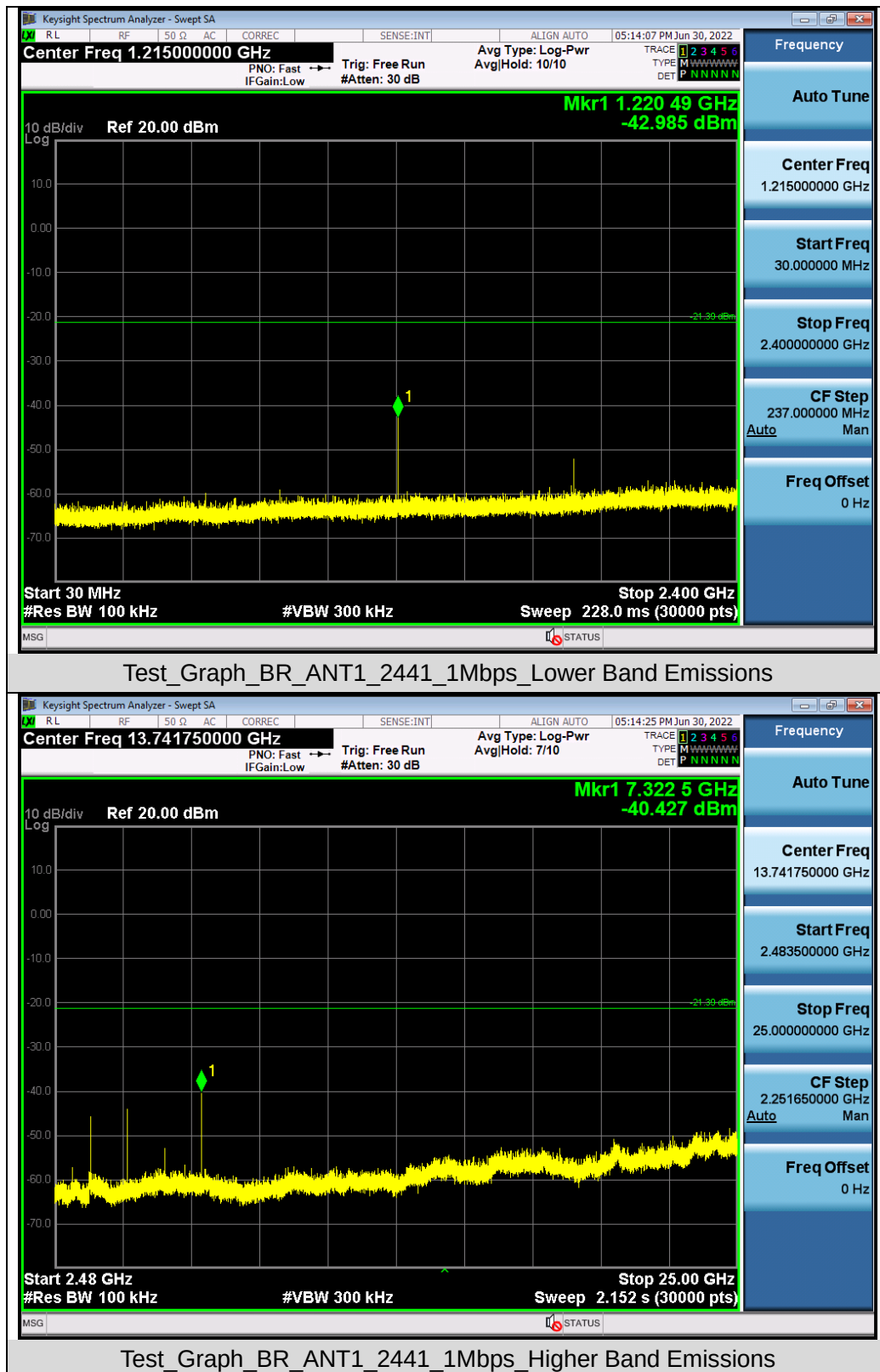


Test\_Graph\_BR\_ANT1\_2402\_1Mbps\_Higher Band Emissions

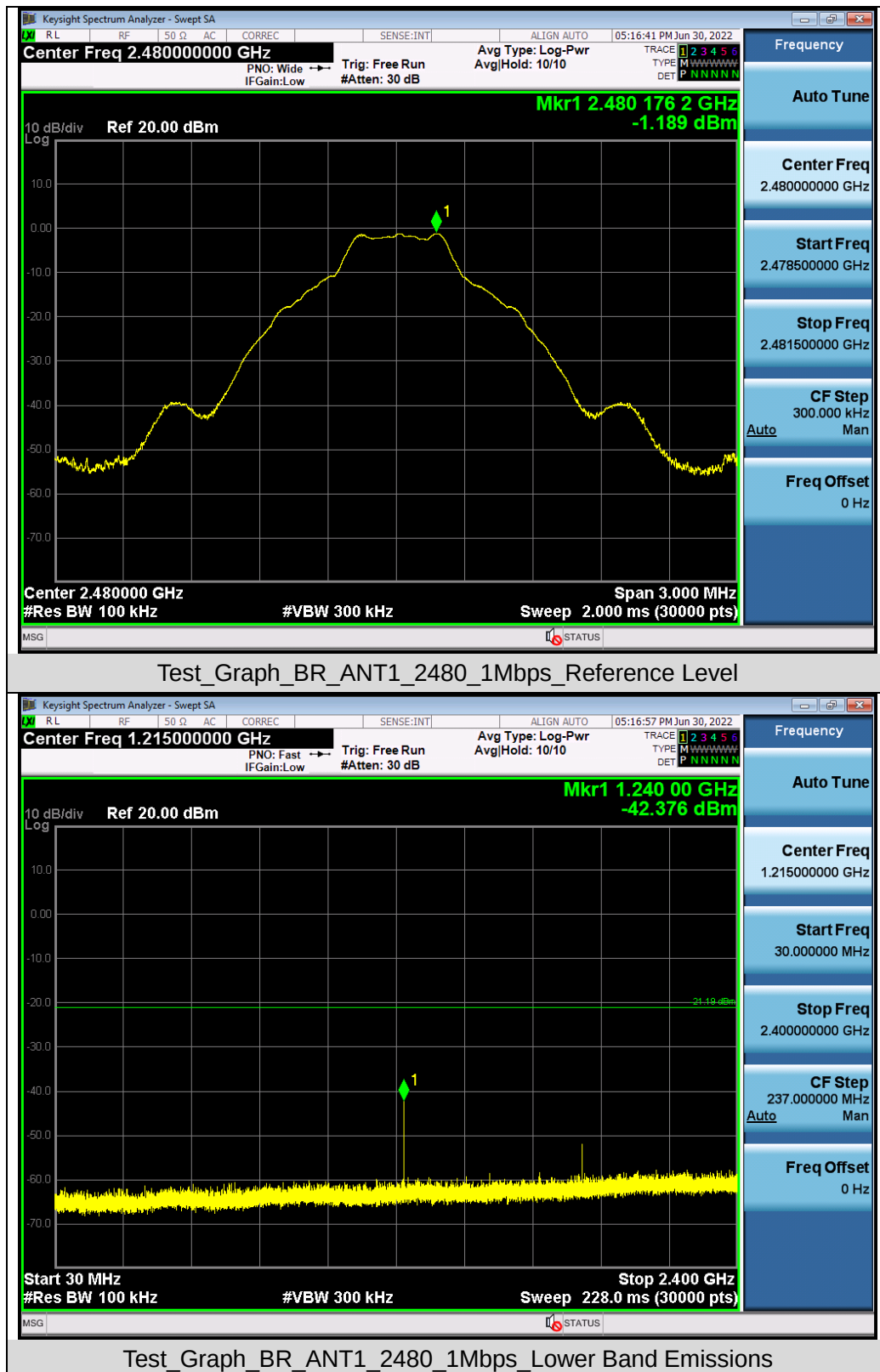


Test\_Graph\_BR\_ANT1\_2441\_1Mbps\_Reference Level

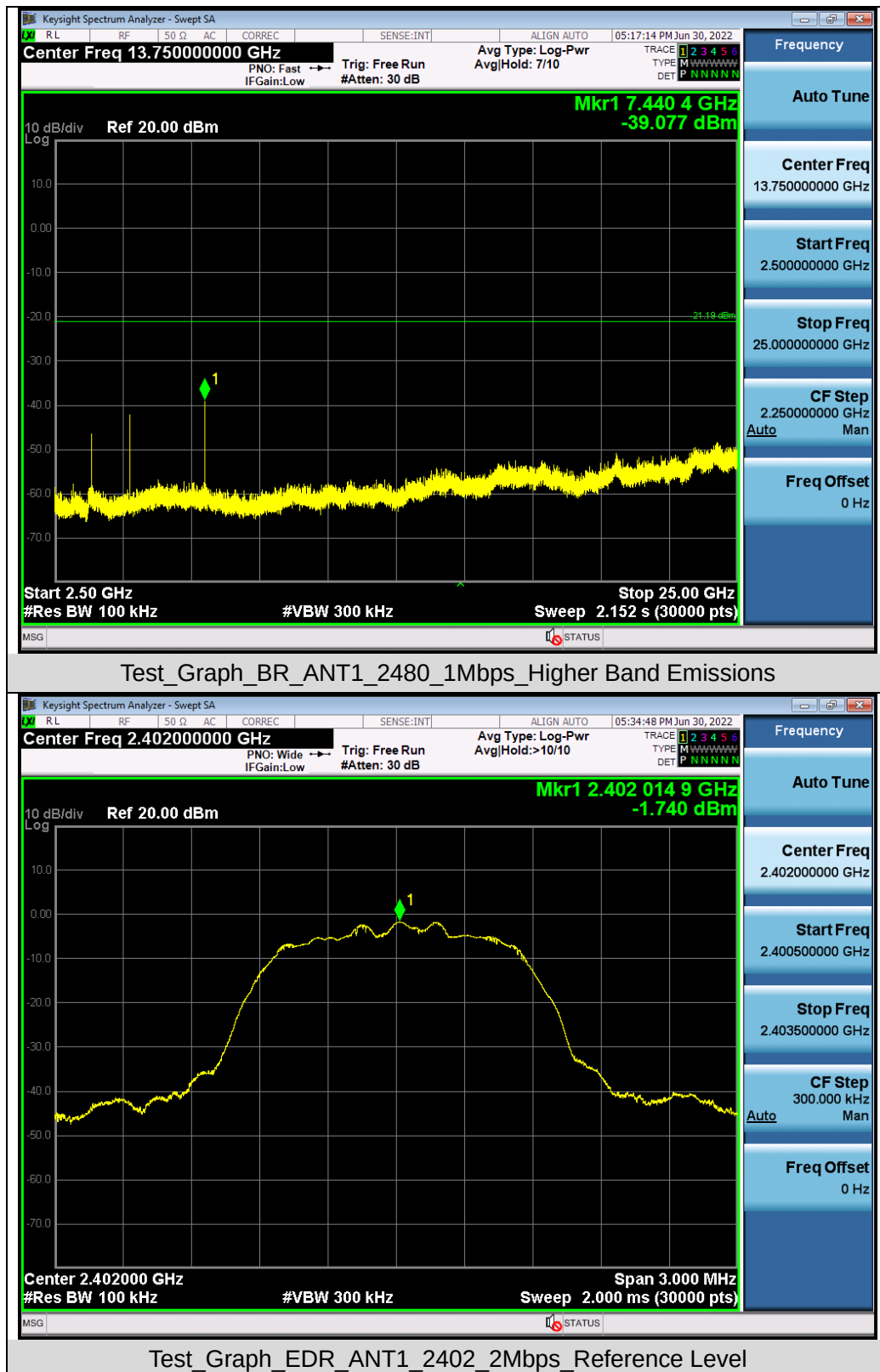
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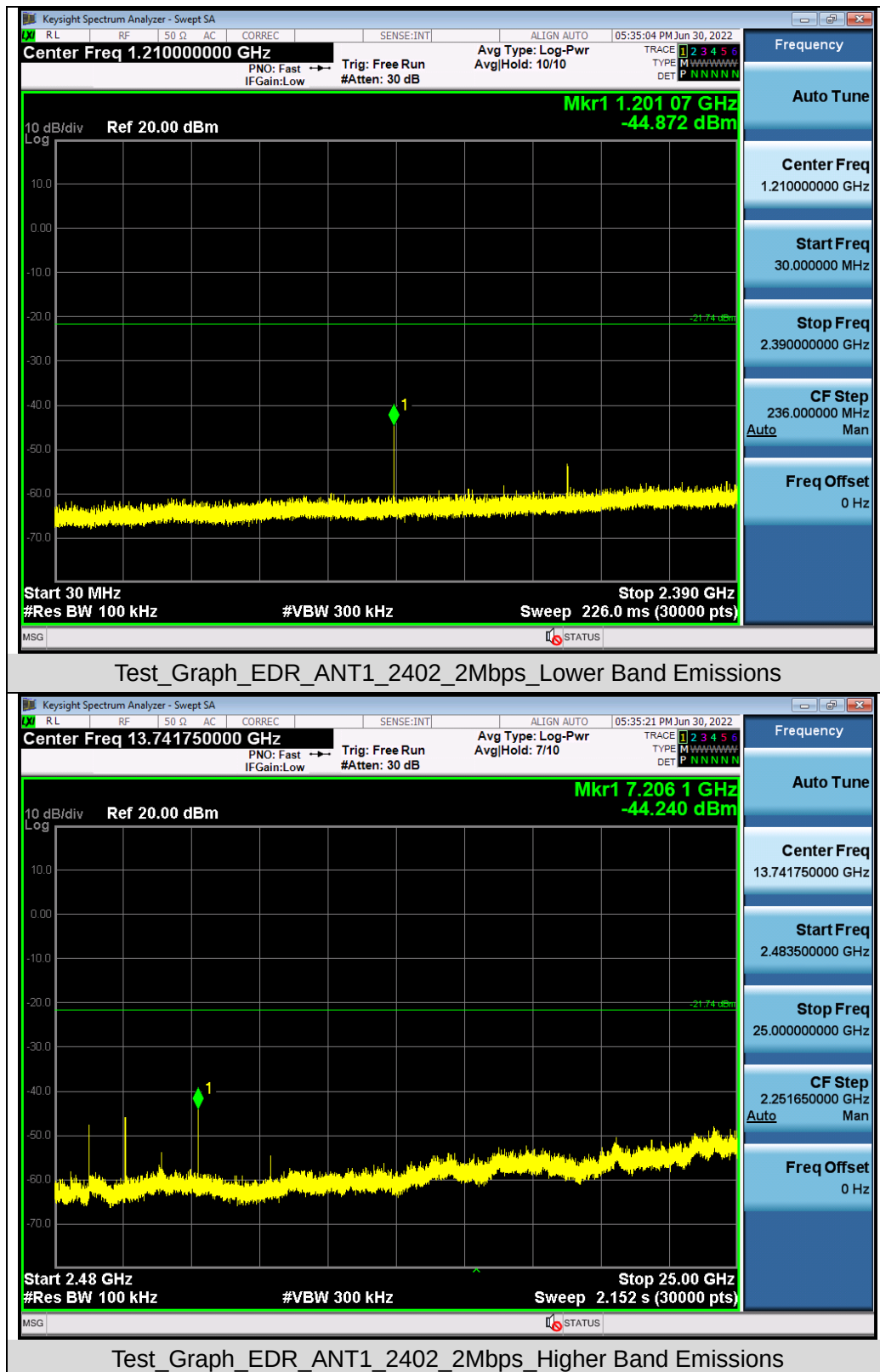
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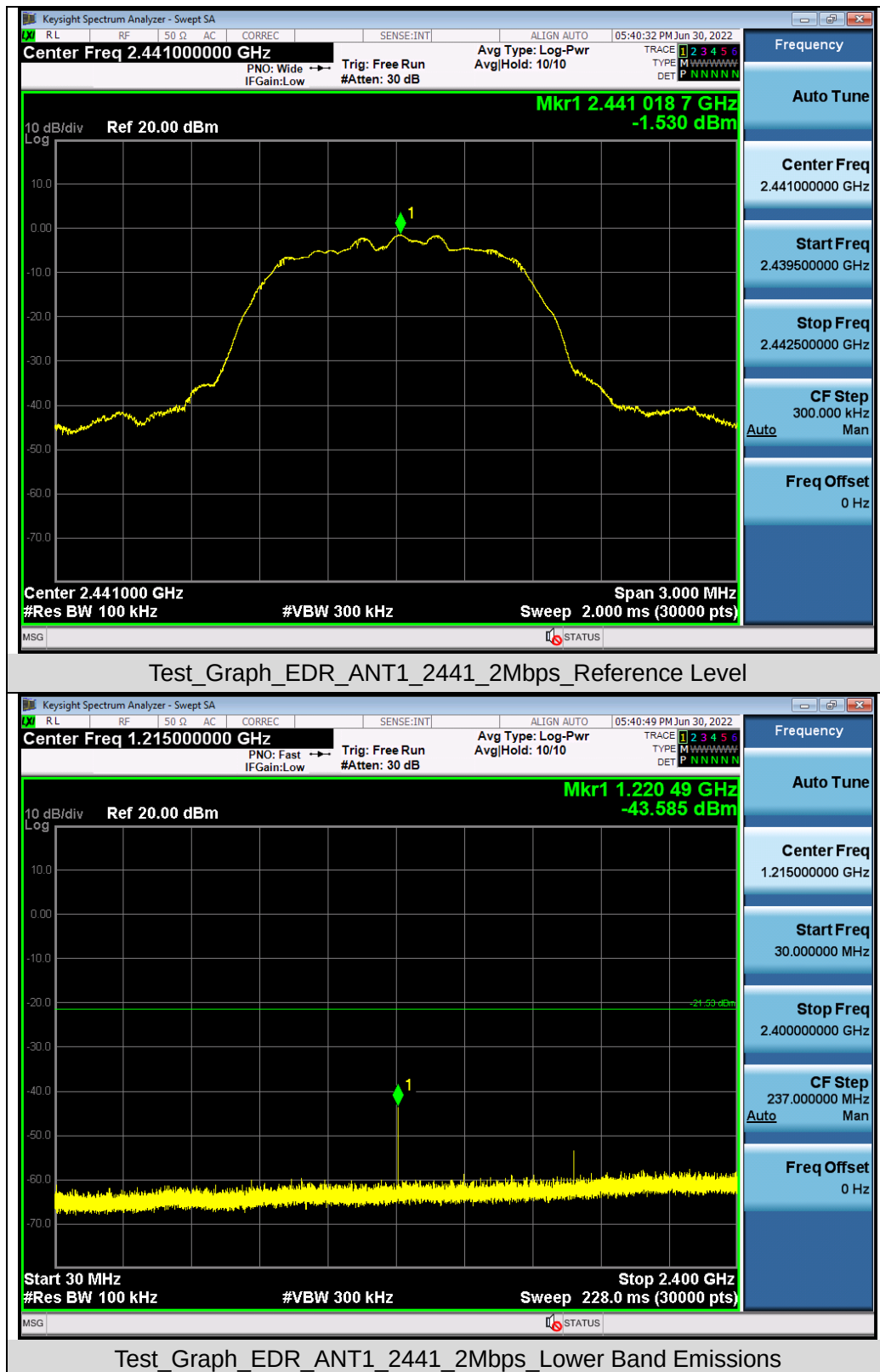
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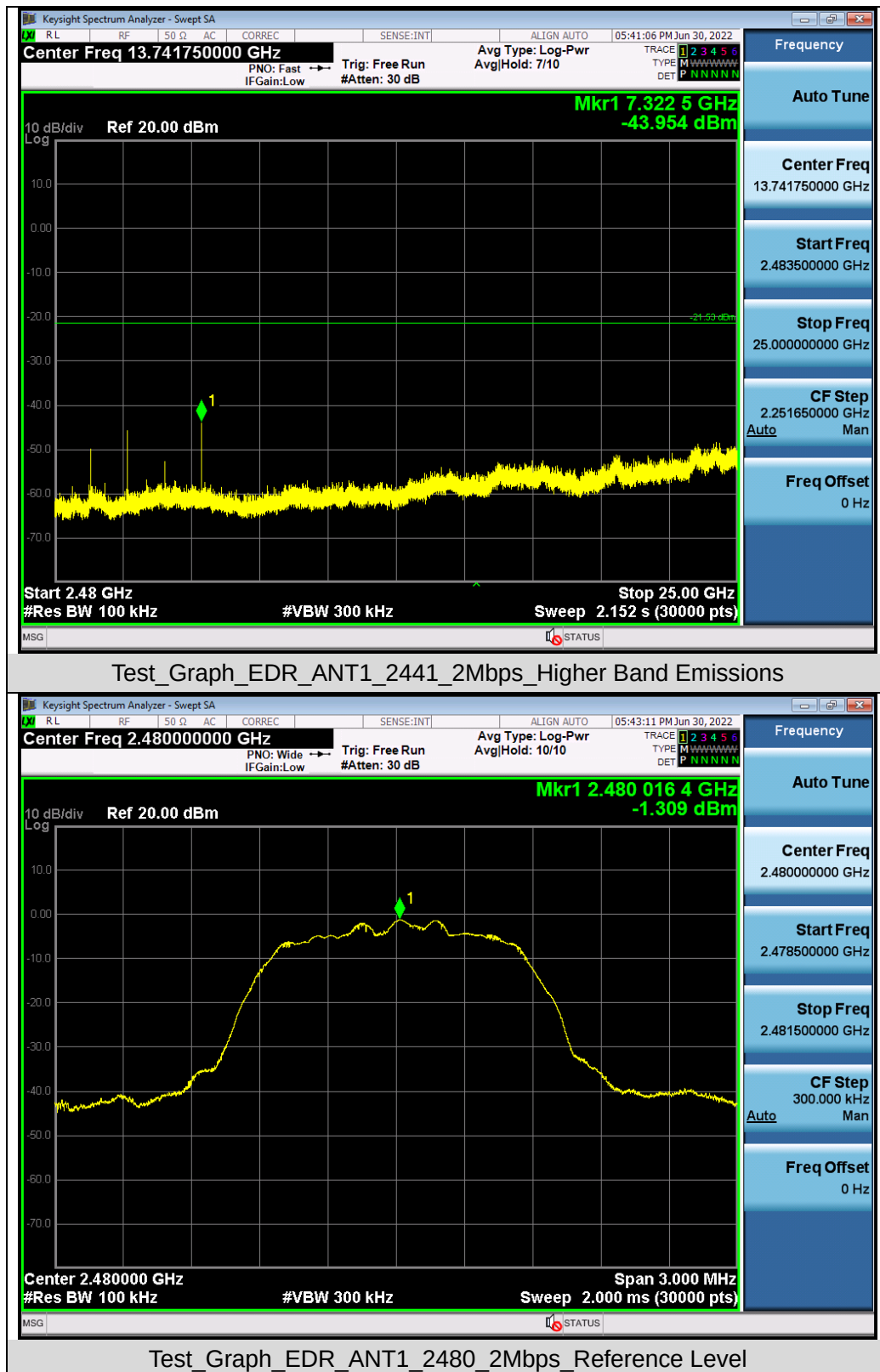
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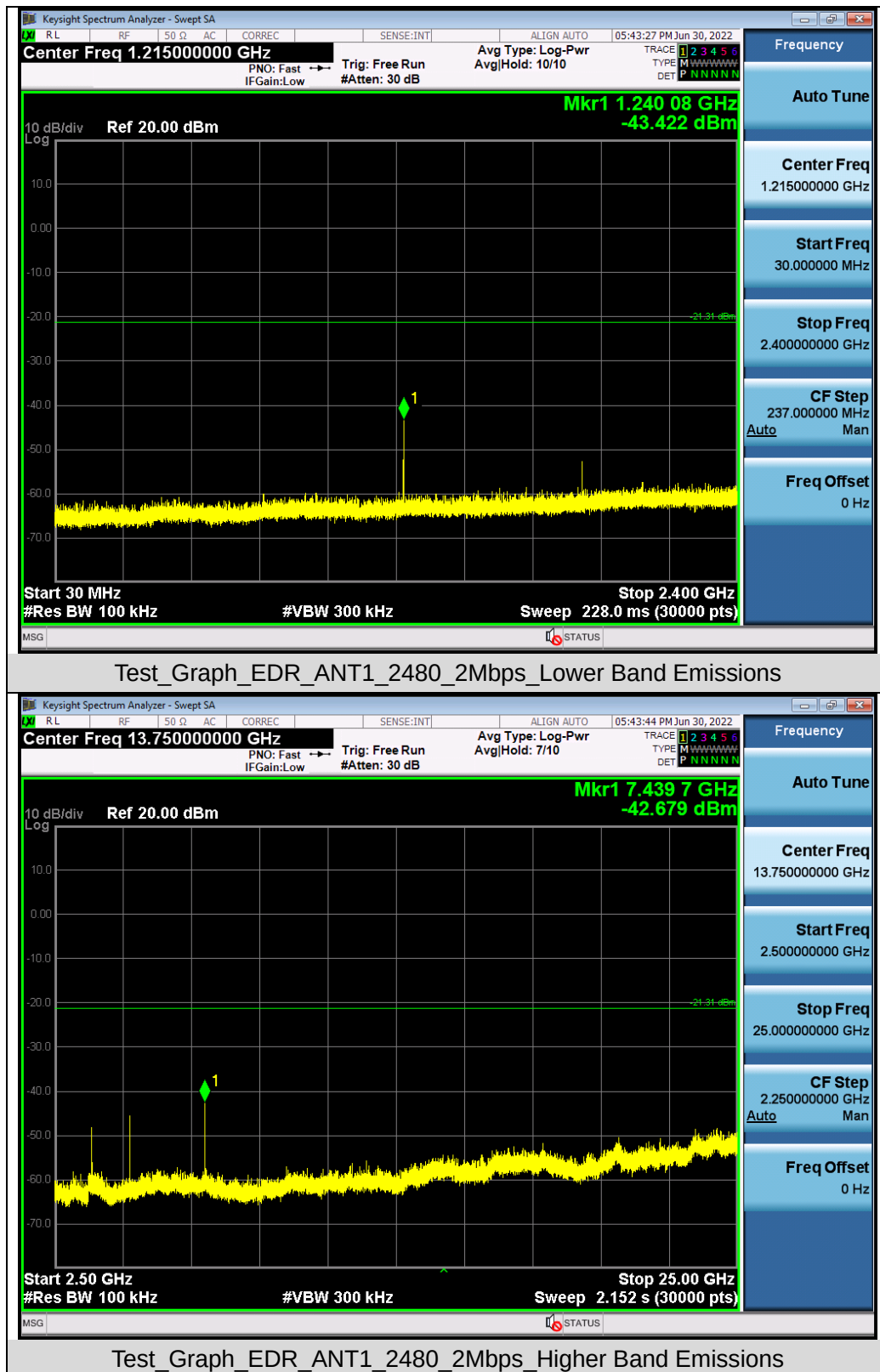
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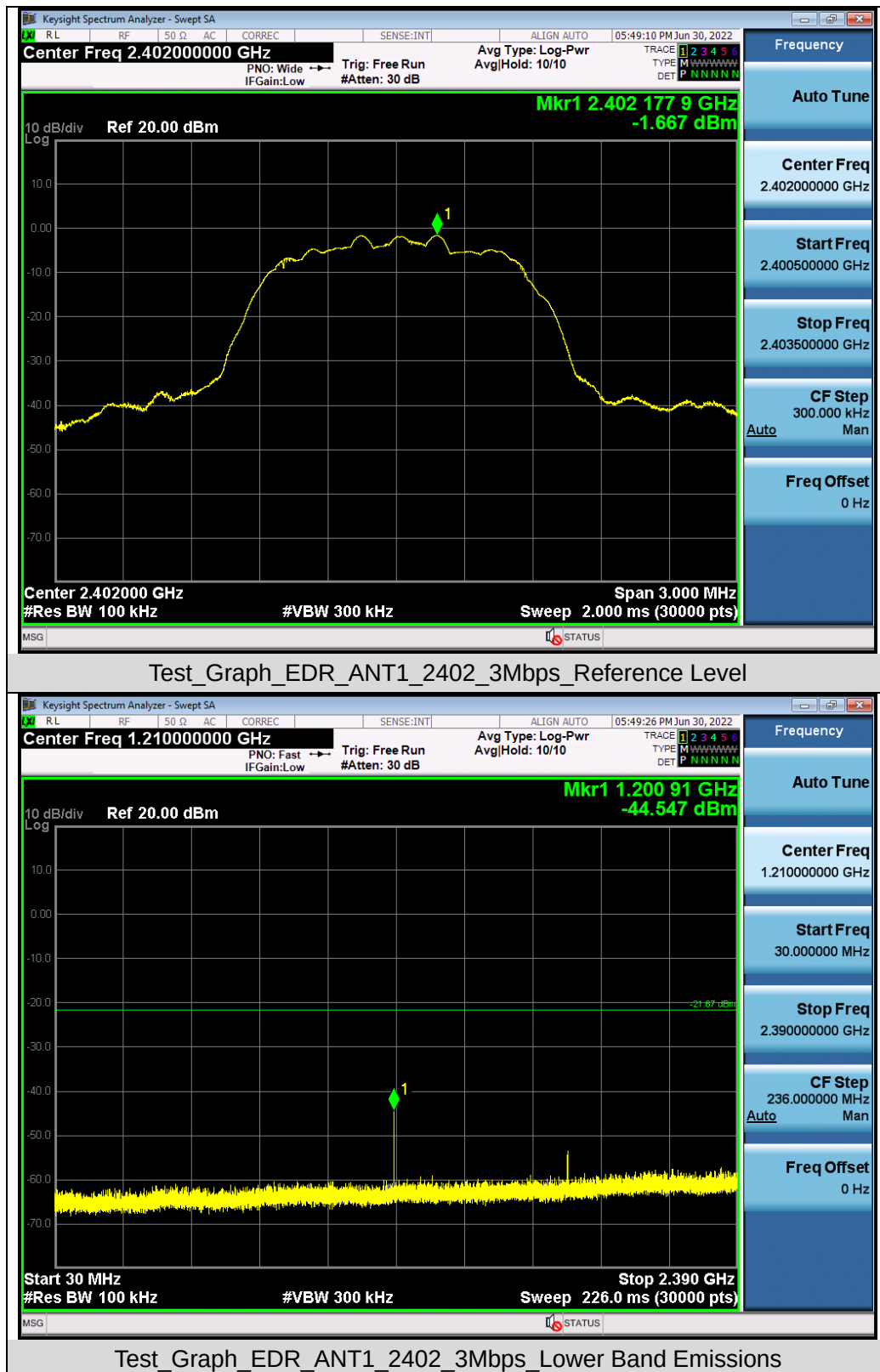
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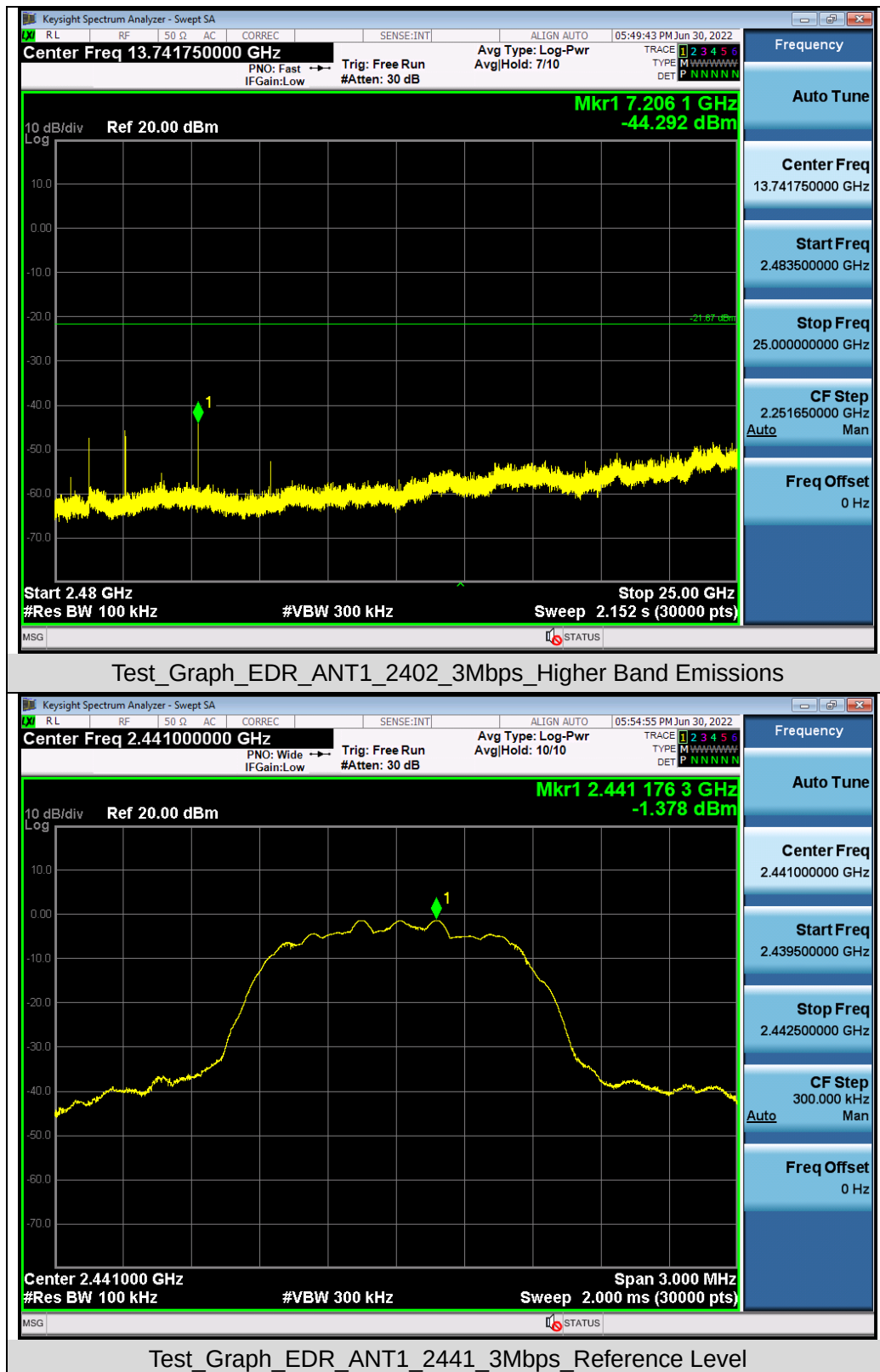
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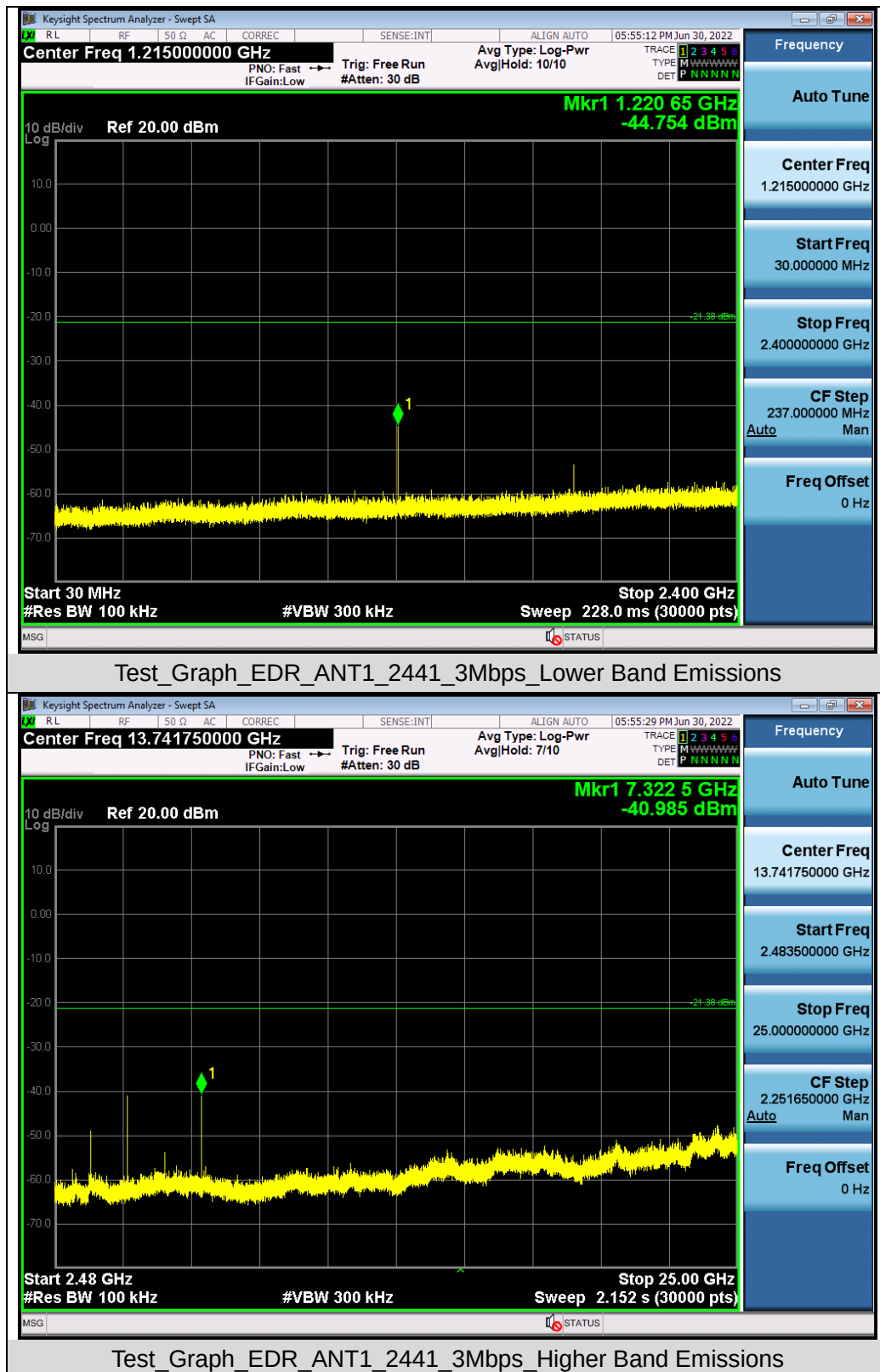
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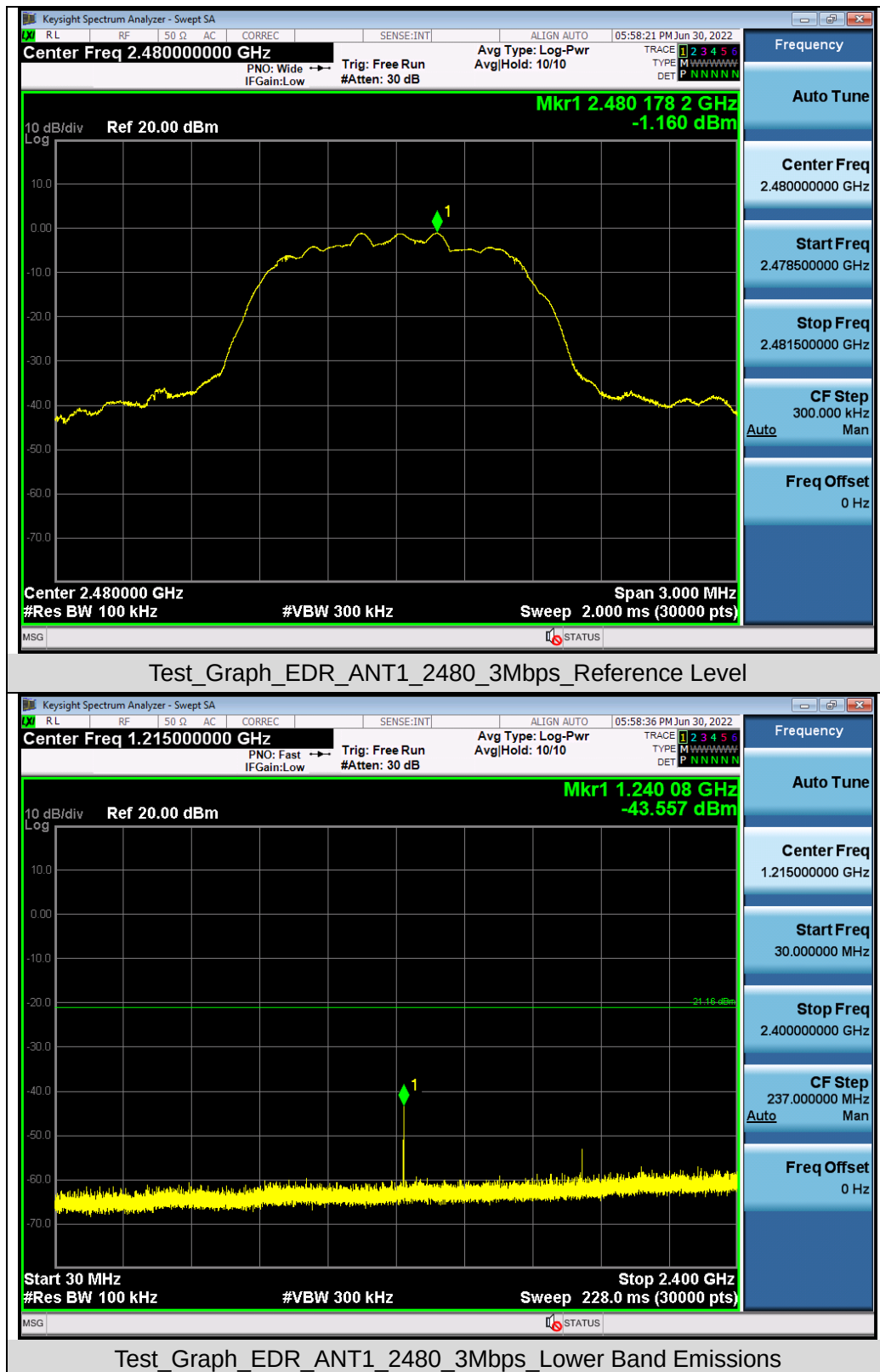
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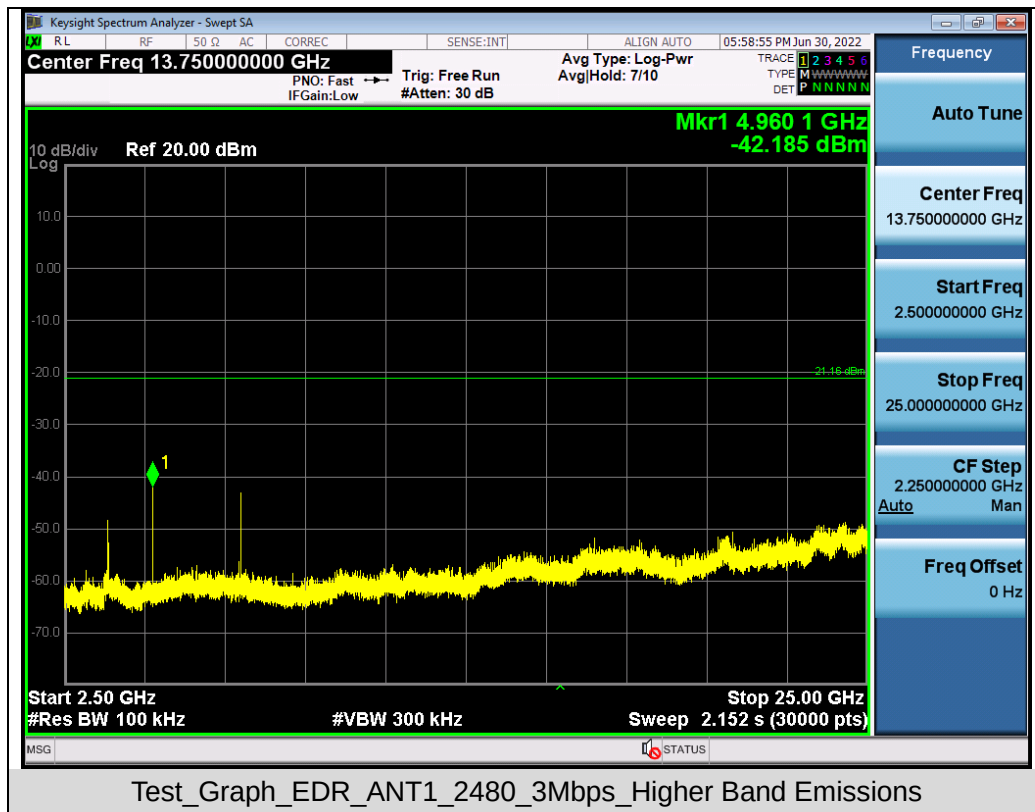
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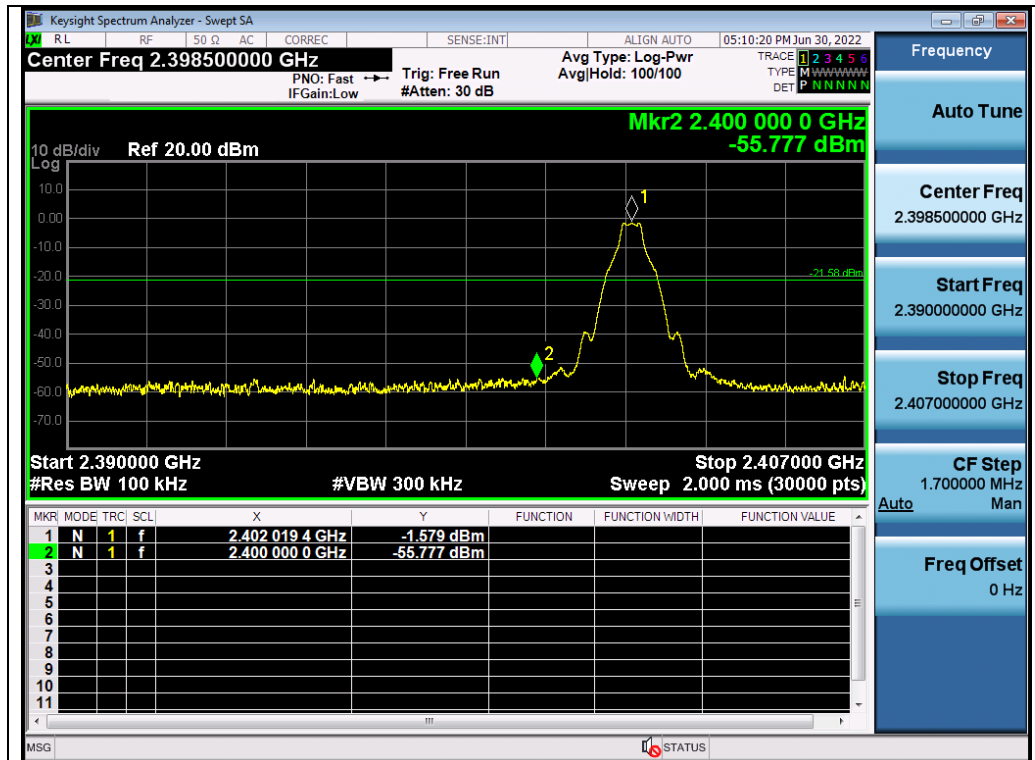
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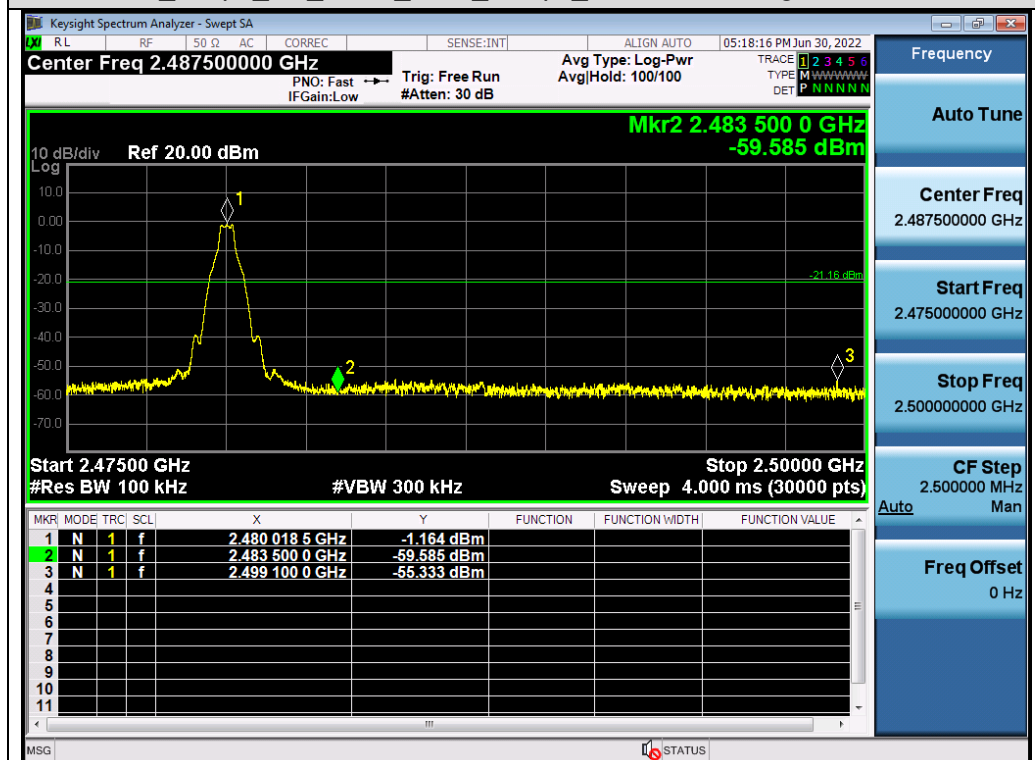
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### Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands

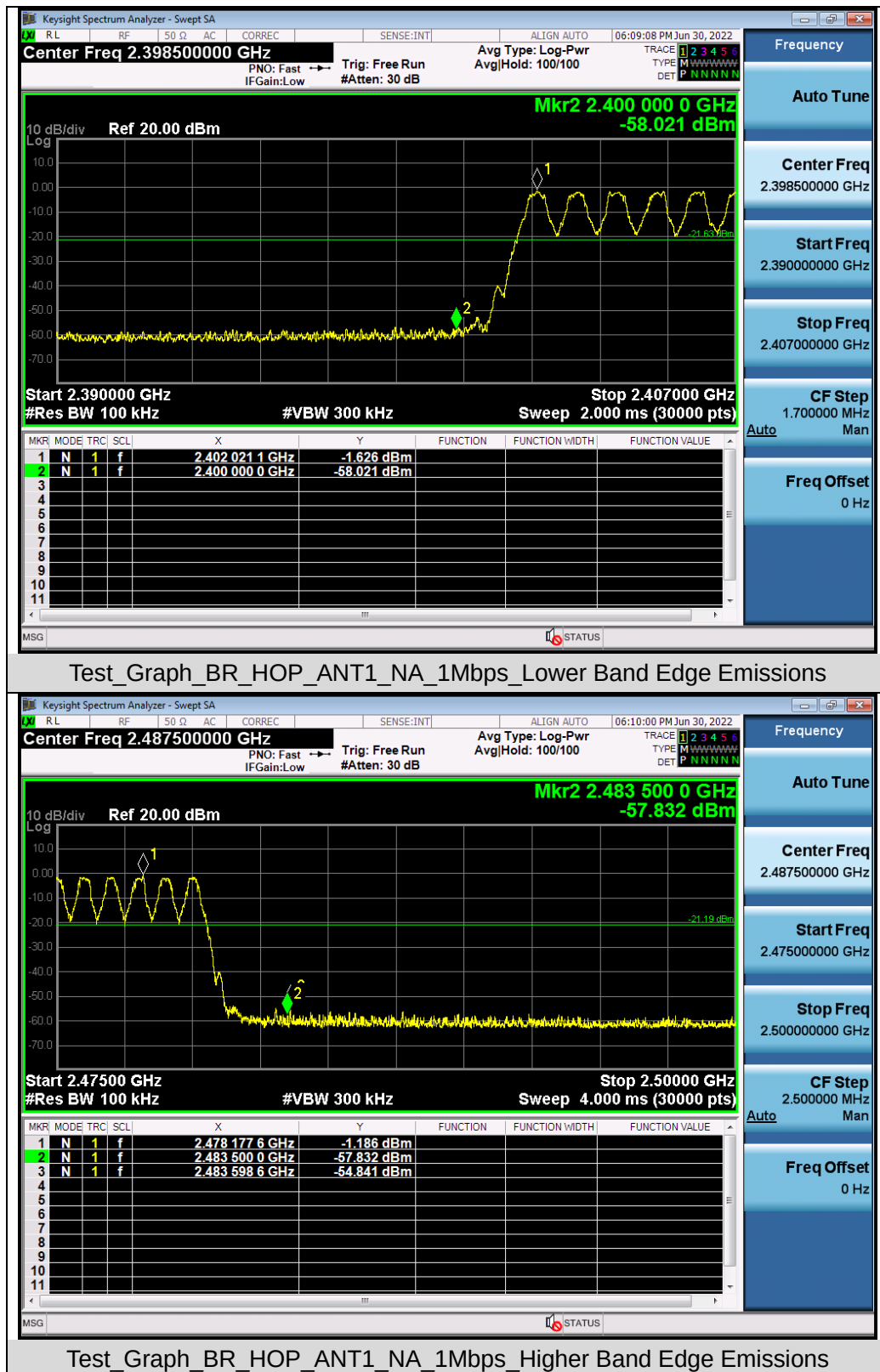


Test\_Graph\_BR\_ANT1\_2402\_1Mbps\_Lower Band Edge Emissions

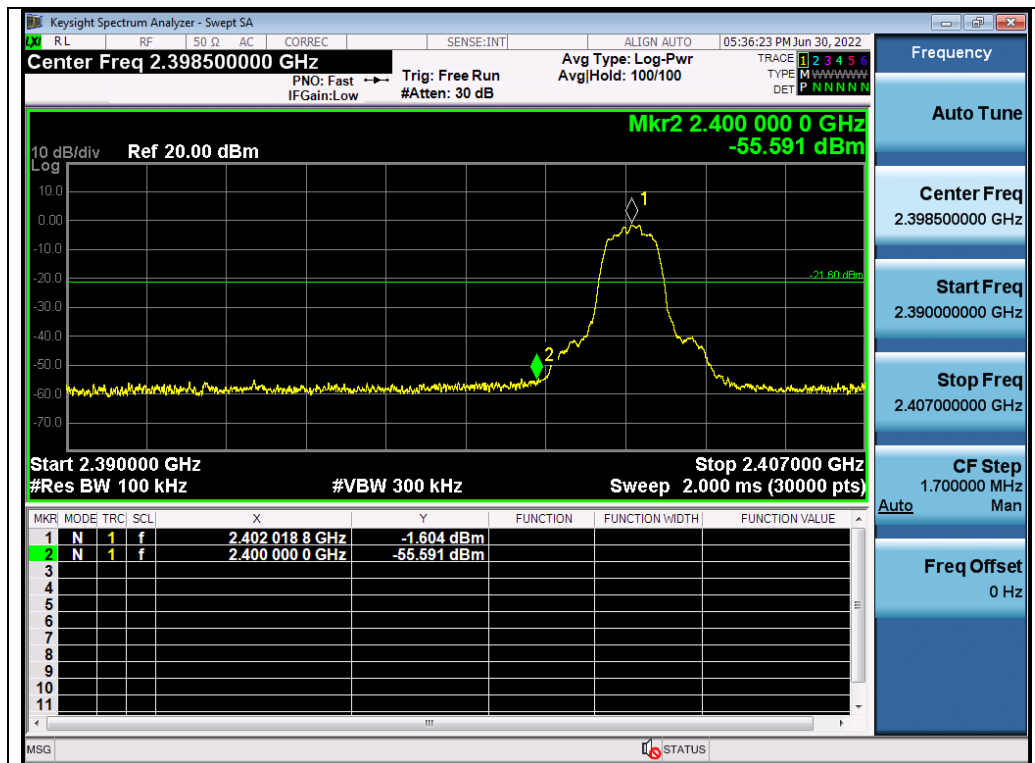


Test\_Graph\_BR\_ANT1\_2480\_1Mbps\_Higher Band Edge Emissions

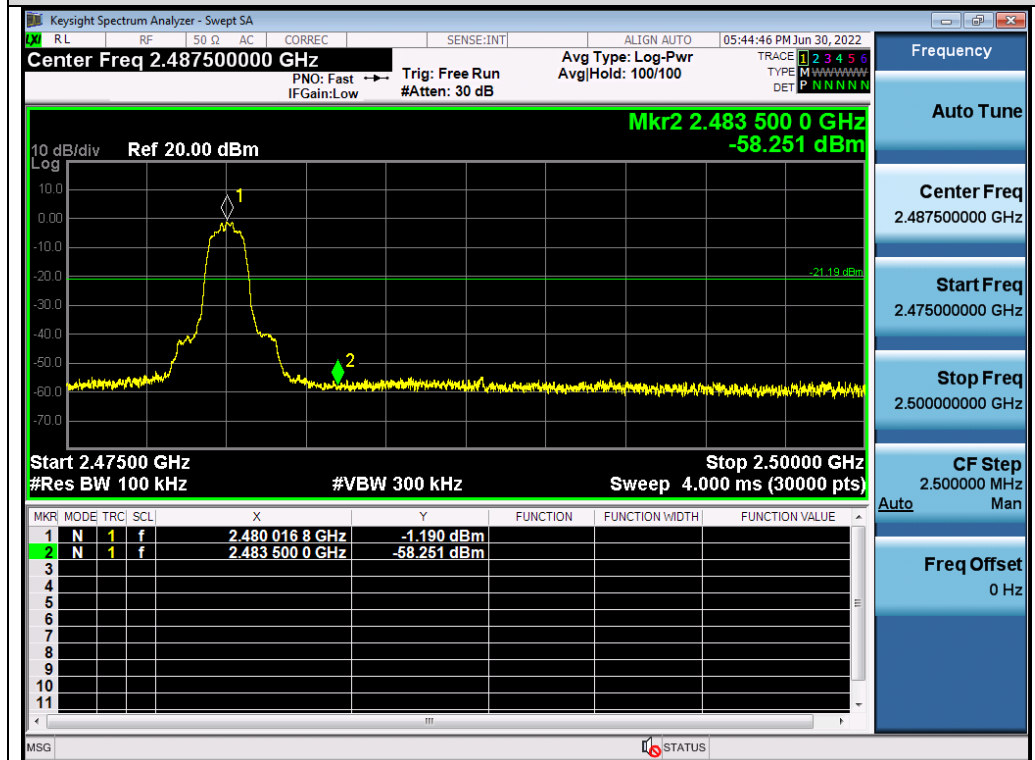
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Test\_Graph\_EDR\_ANT1\_2402\_2Mbps\_Lower Band Edge Emissions



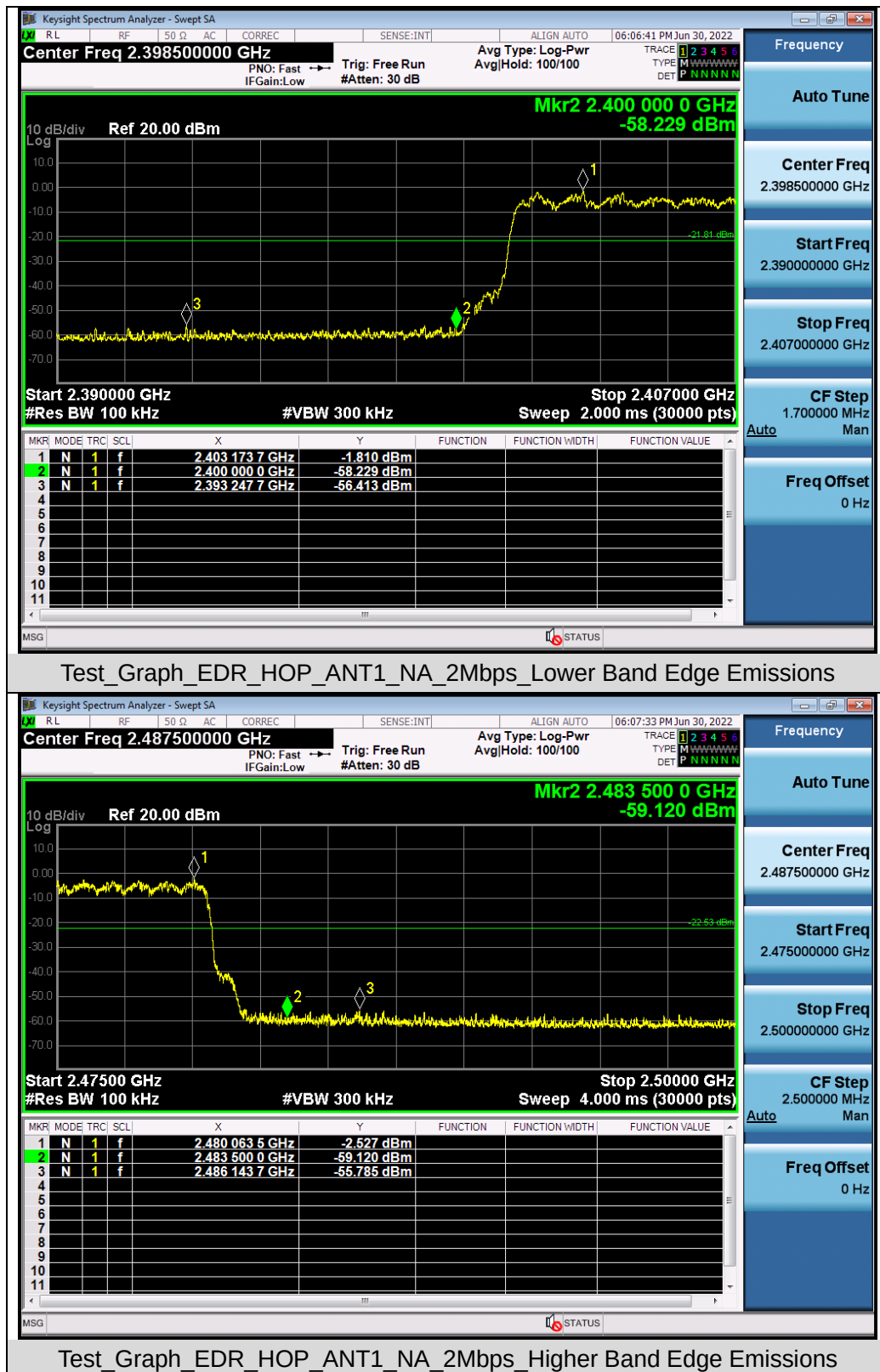
Test\_Graph\_EDR\_ANT1\_2480\_2Mbps\_Higher Band Edge Emissions

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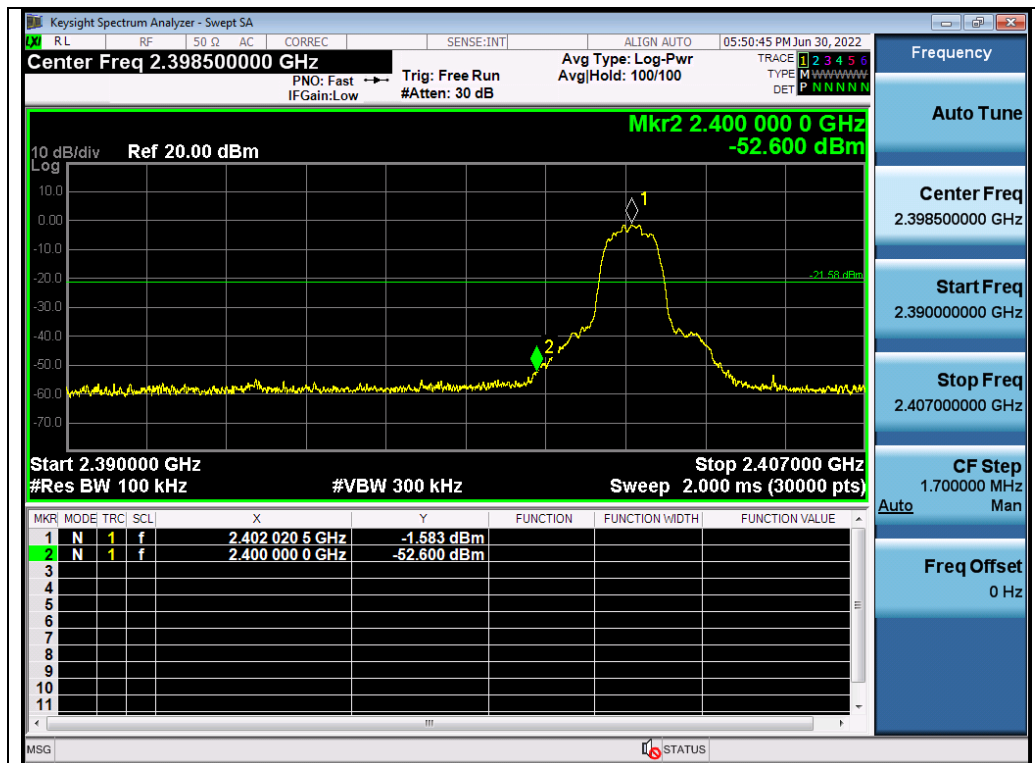
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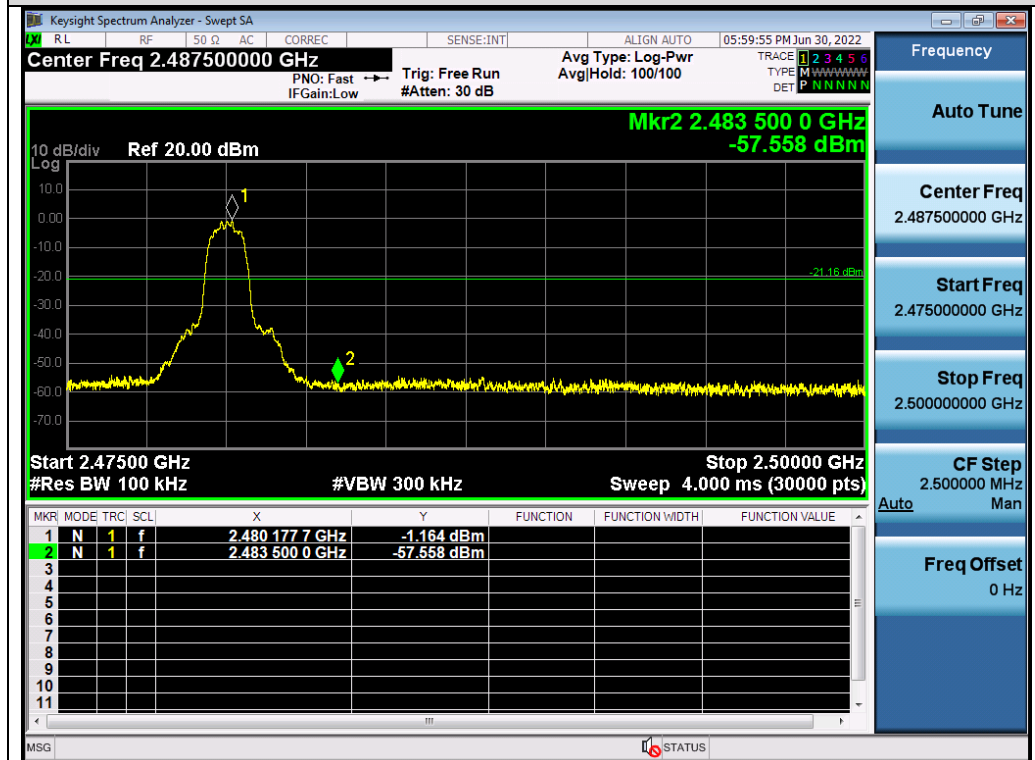
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Test\_Graph\_EDR\_ANT1\_2402\_3Mbps\_Lower Band Edge Emissions



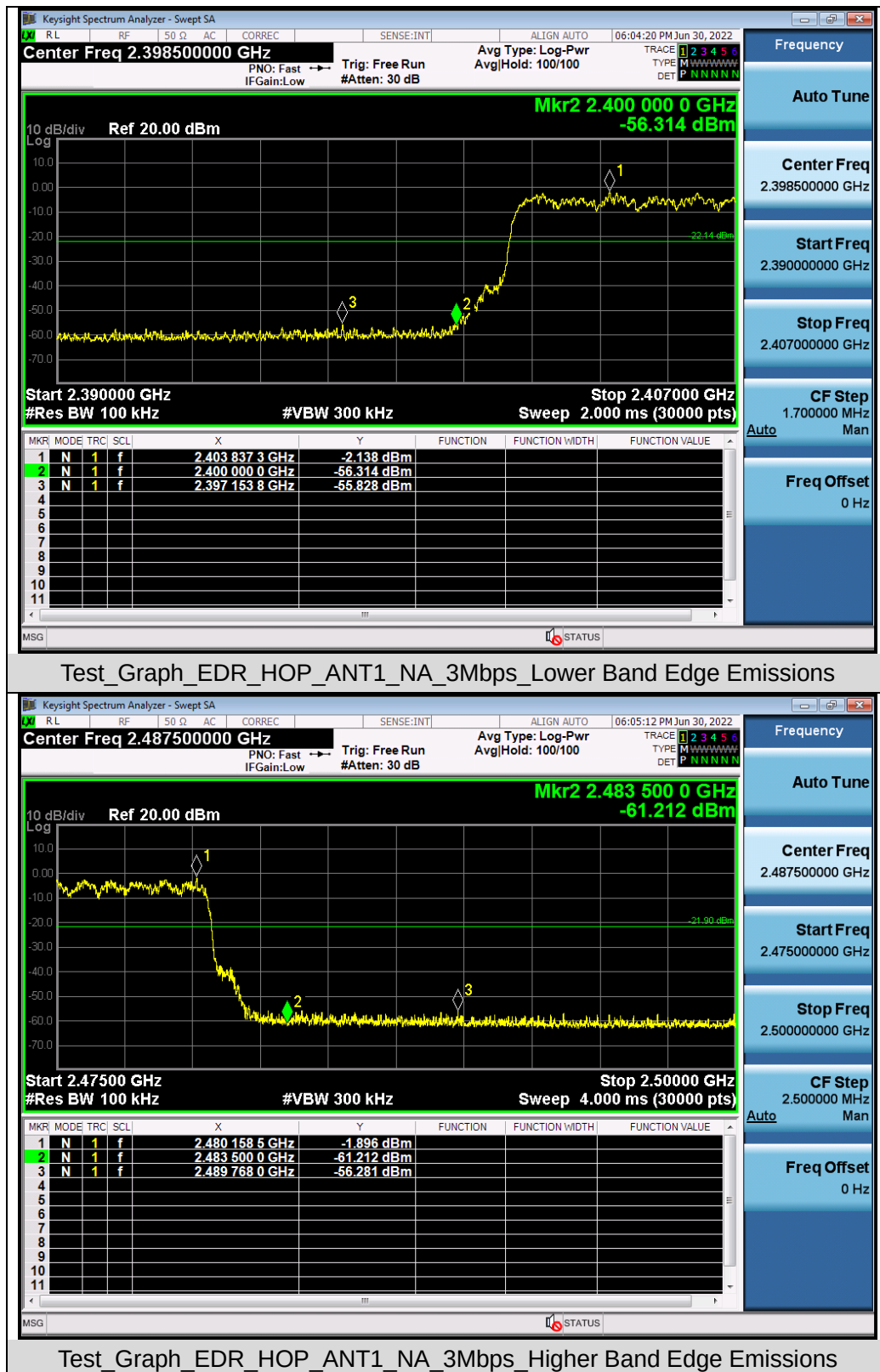
Test\_Graph\_EDR\_ANT1\_2480\_3Mbps\_Higher Band Edge Emissions

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## 10. RADIATED EMISSION

### 10.1. MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

| Spectrum Parameter    | Setting                                                   |
|-----------------------|-----------------------------------------------------------|
| Start ~Stop Frequency | 9KHz~150KHz/RB 200Hz for QP                               |
| Start ~Stop Frequency | 150KHz~30MHz/RB 9KHz for QP                               |
| Start ~Stop Frequency | 30MHz~1000MHz/RB 120KHz for QP                            |
| Start ~Stop Frequency | 1GHz~26.5GHz<br>1MHz/3MHz for Peak, 1MHz/3MHz for Average |

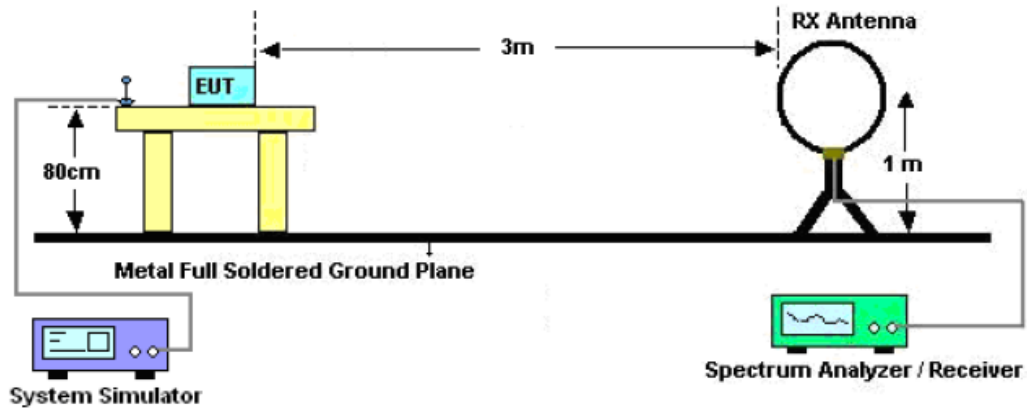
| Receiver Parameter    | Setting                        |
|-----------------------|--------------------------------|
| Start ~Stop Frequency | 9KHz~150KHz/RB 200Hz for QP    |
| Start ~Stop Frequency | 150KHz~30MHz/RB 9KHz for QP    |
| Start ~Stop Frequency | 30MHz~1000MHz/RB 120KHz for QP |

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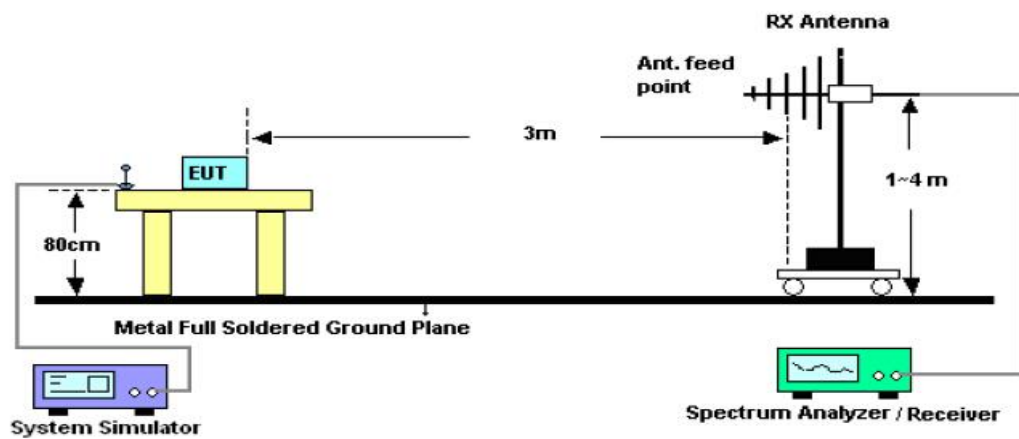
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## 10.2. TEST SETUP

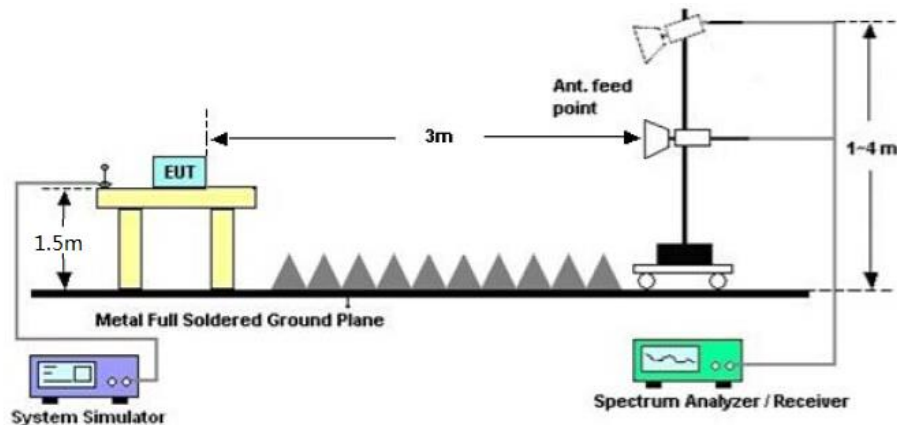
### Radiated Emission Test-Setup Frequency Below 30MHz



### RADIATED EMISSION TEST SETUP 30MHz-1000MHz



### RADIATED EMISSION TEST SETUP ABOVE 1000MHz



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### 10.3. LIMITS AND MEASUREMENT RESULT

15.209 Limit in the below table has to be followed

| Frequencies<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(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                                |

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

### 10.4. TEST RESULT

#### Radiated emission below 30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

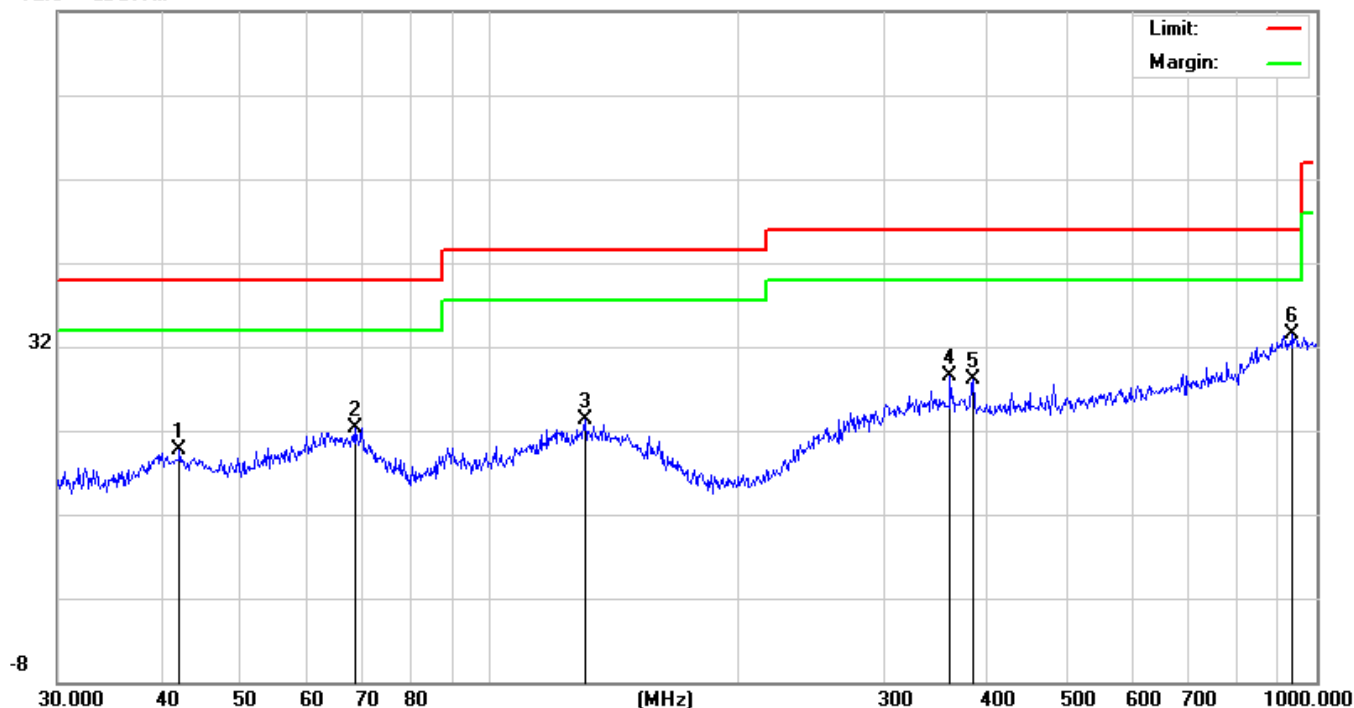
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### Radiated emission from 30MHz to 1000MHz

|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 9               | Antenna           | Horizontal     |

72.0 dBuV/m



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 42.1542      | 4.83                     | 14.80                   | 19.63                      | 40.00           | -20.37     | peak     |
| 2   |     | 68.6310      | 5.31                     | 17.02                   | 22.33                      | 40.00           | -17.67     | peak     |
| 3   |     | 130.3789     | 5.51                     | 17.80                   | 23.31                      | 43.50           | -20.19     | peak     |
| 4   |     | 360.4476     | 8.01                     | 20.58                   | 28.59                      | 46.00           | -17.41     | peak     |
| 5   |     | 383.9318     | 7.44                     | 20.64                   | 28.08                      | 46.00           | -17.92     | peak     |
| 6   | *   | 935.5463     | 5.52                     | 27.90                   | 33.42                      | 46.00           | -12.58     | peak     |

### RESULT: PASS

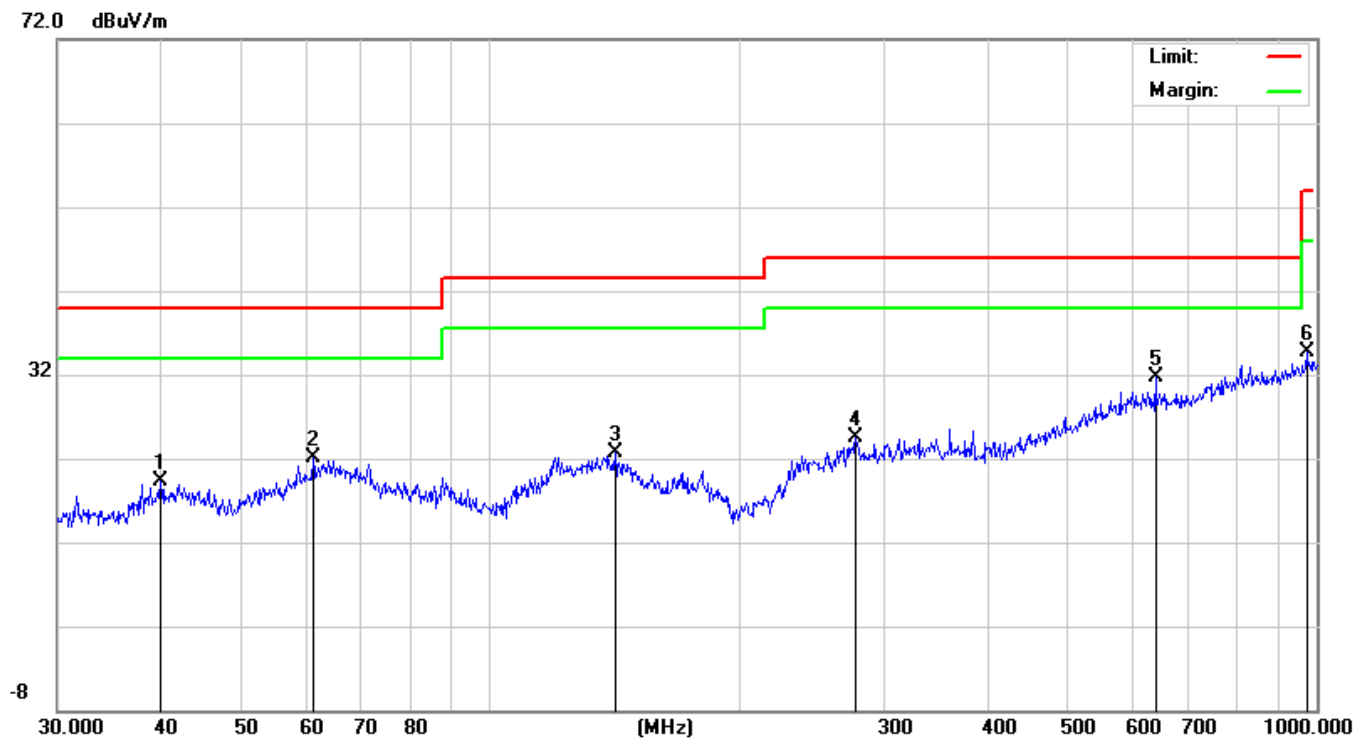
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|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 9               | Antenna           | Vertical       |



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 39.9942      | 4.20                     | 15.09                   | 19.29                      | 40.00           | -20.71     | peak     |
| 2   |     | 61.1316      | 5.11                     | 16.90                   | 22.01                      | 40.00           | -17.99     | peak     |
| 3   |     | 141.8262     | 4.60                     | 18.04                   | 22.64                      | 43.50           | -20.86     | peak     |
| 4   |     | 277.0935     | 4.80                     | 19.70                   | 24.50                      | 46.00           | -21.50     | peak     |
| 5   | *   | 638.3686     | 6.66                     | 25.03                   | 31.69                      | 46.00           | -14.31     | peak     |
| 6   |     | 972.3374     | 5.75                     | 29.03                   | 34.78                      | 54.00           | -19.22     | peak     |

## RESULT: PASS

**Note:** 1. Factor=Antenna Factor + Cable loss, Over=Measurement-Limit.

2. All test modes had been pre-tested. The mode 9 is the worst case and recorded in the report.

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### Radiated emission above 1GHz

|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 7               | <b>Antenna</b>           | Horizontal     |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000                                              | 44.25                   | 0.08           | 44.33                      | 74                 | -29.67         | peak       |
| 4804.000                                              | 37.16                   | 0.08           | 37.24                      | 54                 | -16.76         | AVG        |
| 7206.000                                              | 40.58                   | 2.21           | 42.79                      | 74                 | -31.21         | peak       |
| 7206.000                                              | 32.83                   | 2.21           | 35.04                      | 54                 | -18.96         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 7               | <b>Antenna</b>           | Vertical       |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4804.000                                              | 43.95                   | 0.08           | 44.03                      | 74                 | -29.97         | peak       |
| 4804.000                                              | 36.43                   | 0.08           | 36.51                      | 54                 | -17.49         | AVG        |
| 7206.000                                              | 40.04                   | 2.21           | 42.25                      | 74                 | -31.75         | peak       |
| 7206.000                                              | 31.52                   | 2.21           | 33.73                      | 54                 | -20.27         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

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|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 8               | <b>Antenna</b>           | Horizontal     |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4882.000                                              | 45.79                   | 0.14           | 45.93                      | 74                 | -28.07         | peak       |
| 4882.000                                              | 38.18                   | 0.14           | 38.32                      | 54                 | -15.68         | AVG        |
| 7323.000                                              | 41.62                   | 2.36           | 43.98                      | 74                 | -30.02         | peak       |
| 7323.000                                              | 34.26                   | 2.36           | 36.62                      | 54                 | -17.38         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 8               | <b>Antenna</b>           | Vertical       |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4882.000                                              | 45.27                   | 0.14           | 45.41                      | 74                 | -28.59         | peak       |
| 4882.000                                              | 37.63                   | 0.14           | 37.77                      | 54                 | -16.23         | AVG        |
| 7323.000                                              | 40.96                   | 2.36           | 43.32                      | 74                 | -30.68         | peak       |
| 7323.000                                              | 33.78                   | 2.36           | 36.14                      | 54                 | -17.86         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

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|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 9               | <b>Antenna</b>           | Horizontal     |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4960.000                                              | 46.57                   | 0.22           | 46.79                      | 74                 | -27.21         | peak       |
| 4960.000                                              | 38.44                   | 0.22           | 38.66                      | 54                 | -15.34         | AVG        |
| 7440.000                                              | 41.28                   | 2.64           | 43.92                      | 74                 | -30.08         | peak       |
| 7440.000                                              | 32.89                   | 2.64           | 35.53                      | 54                 | -18.47         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

|                    |                      |                          |                |
|--------------------|----------------------|--------------------------|----------------|
| <b>EUT</b>         | BLUETOOTH HEADPHONES | <b>Model Name</b>        | ML 100         |
| <b>Temperature</b> | 25°C                 | <b>Relative Humidity</b> | 55%            |
| <b>Pressure</b>    | 960hPa               | <b>Test Voltage</b>      | Normal Voltage |
| <b>Test Mode</b>   | Mode 9               | <b>Antenna</b>           | Vertical       |

| Frequency<br>(MHz)                                    | Meter Reading<br>(dBμV) | Factor<br>(dB) | Emission Level<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) | Value Type |
|-------------------------------------------------------|-------------------------|----------------|----------------------------|--------------------|----------------|------------|
| 4960.000                                              | 46.13                   | 0.22           | 46.35                      | 74                 | -27.65         | peak       |
| 4960.000                                              | 38.55                   | 0.22           | 38.77                      | 54                 | -15.23         | AVG        |
| 7440.000                                              | 40.78                   | 2.64           | 43.42                      | 74                 | -30.58         | peak       |
| 7440.000                                              | 31.94                   | 2.64           | 34.58                      | 54                 | -19.42         | AVG        |
|                                                       |                         |                |                            |                    |                |            |
|                                                       |                         |                |                            |                    |                |            |
| Remark:                                               |                         |                |                            |                    |                |            |
| Factor = Antenna Factor + Cable Loss – Pre-amplifier. |                         |                |                            |                    |                |            |

## RESULT: PASS

### Note:

The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.

Factor = Antenna Factor + Cable loss - Amplifier gain, Margin=Level-Limit.

The “Factor” value can be calculated automatically by software of measurement system.

All test modes had been tested. The 8DPSK modulation is the worst case and recorded in the report.

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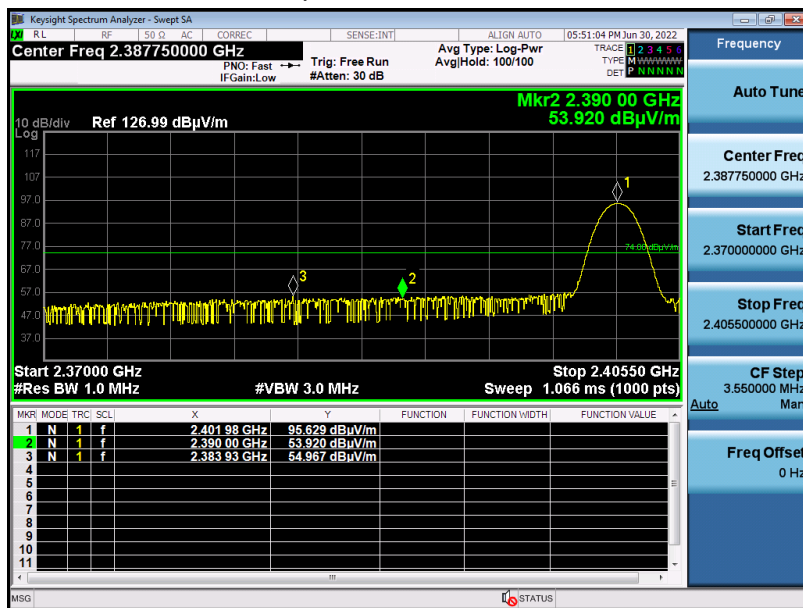
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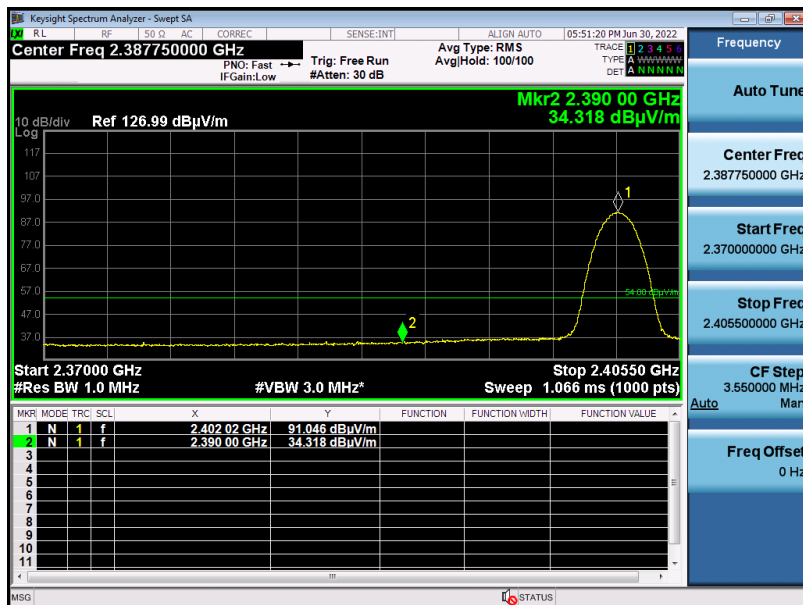
### Test result for band edge emission at restricted bands

|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 7               | Antenna           | Horizontal     |

### Test Graph for Peak Measurement



### Test Graph for Average Measurement



**RESULT: PASS**

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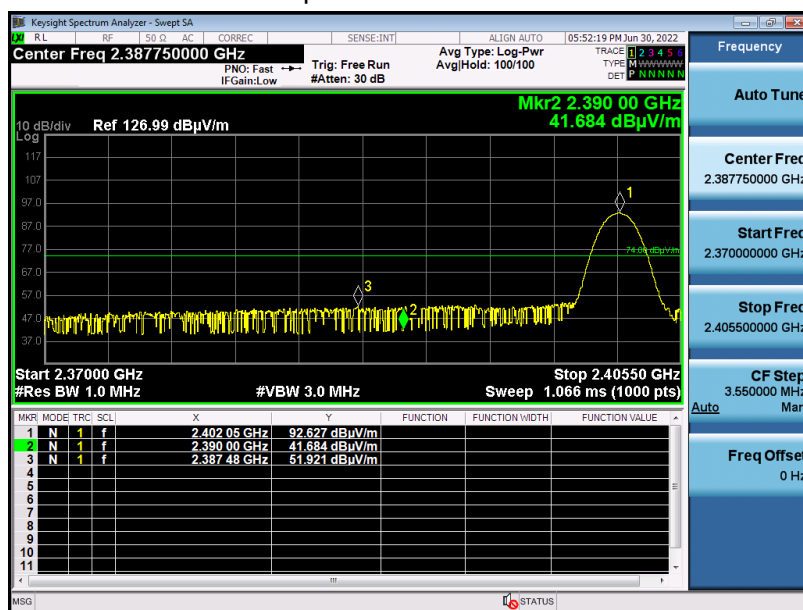
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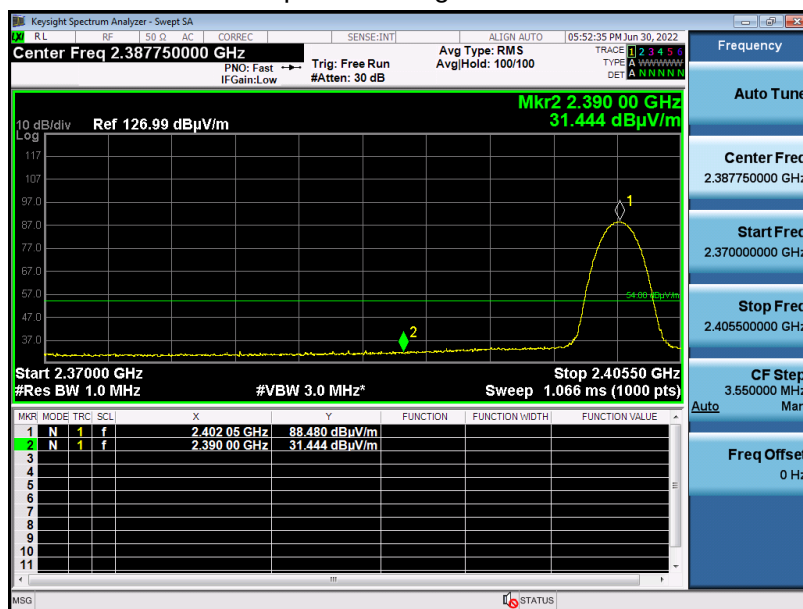
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|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 7               | Antenna           | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: PASS

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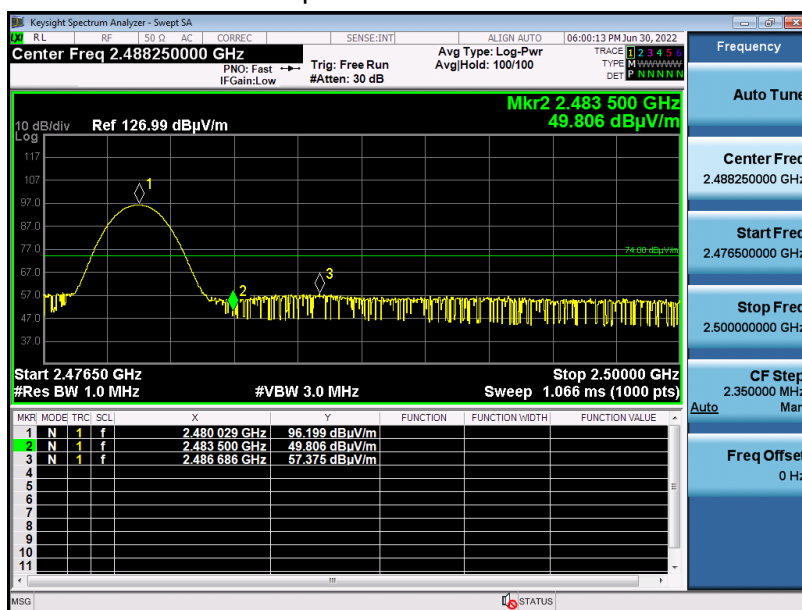
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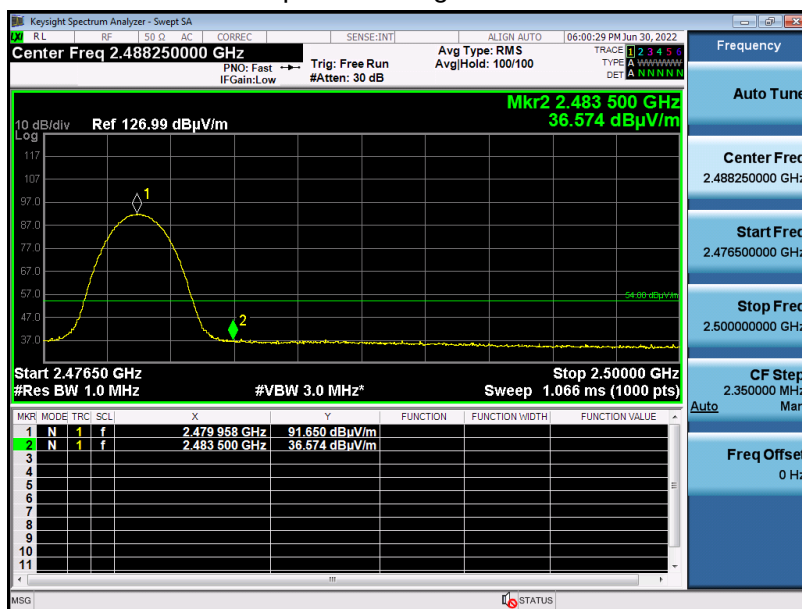
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|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 9               | Antenna           | Horizontal     |

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: PASS

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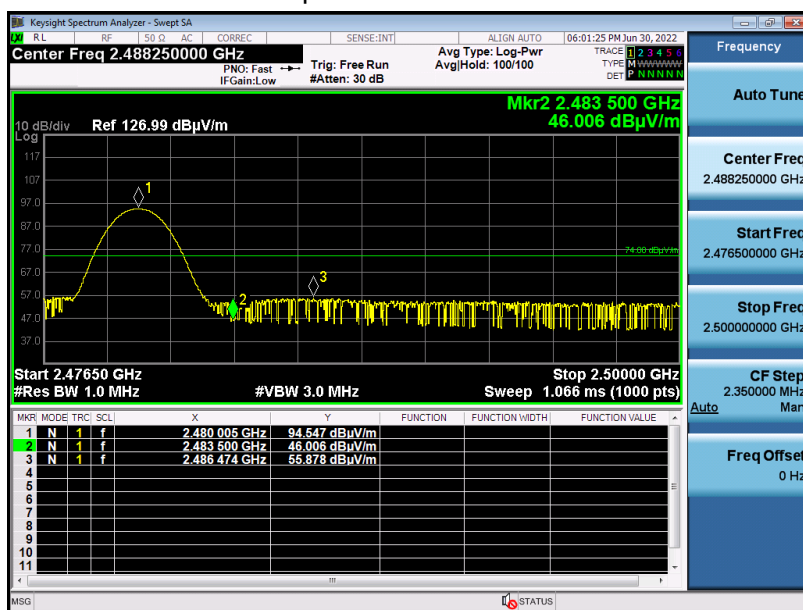
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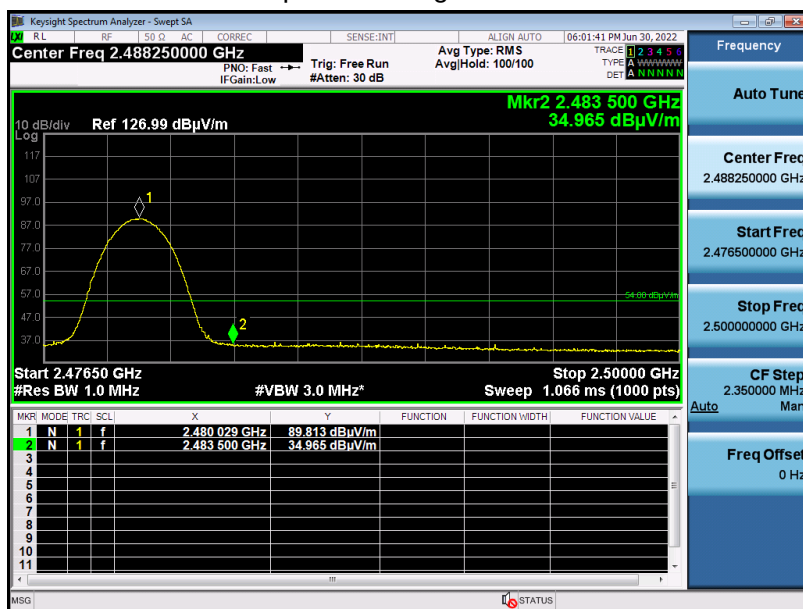
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|             |                      |                   |                |
|-------------|----------------------|-------------------|----------------|
| EUT         | BLUETOOTH HEADPHONES | Model Name        | ML 100         |
| Temperature | 25°C                 | Relative Humidity | 55%            |
| Pressure    | 960hPa               | Test Voltage      | Normal Voltage |
| Test Mode   | Mode 9               | Antenna           | Vertical       |

Test Graph for Peak Measurement



Test Graph for Average Measurement



## RESULT: PASS

Note: The factor had been edited in the “Input Correction” of the Spectrum Analyzer. The 8DPSK modulation is the worst case and recorded in the report.

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## 11. NUMBER OF HOPPING FREQUENCY

### 11.1. MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
2. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
3. VBW  $\geq$  RBW. Sweep: Auto. Detector function: Peak. Trace: Max hold.
4. Allow the trace to stabilize.

### 11.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

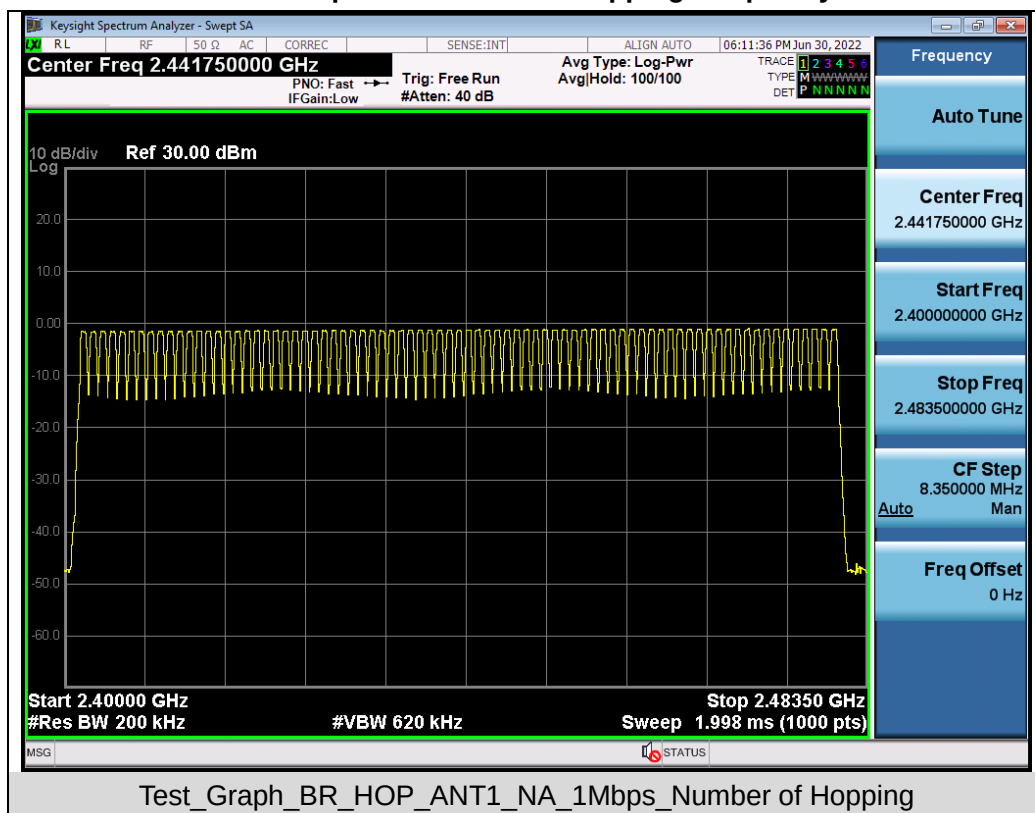
### 11.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

### 11.4. LIMITS AND MEASUREMENT RESULT

| Test Data of Number of Hopping Frequency |                             |           |              |
|------------------------------------------|-----------------------------|-----------|--------------|
| Test Mode                                | Number of Hopping Frequency | Limits    | Pass or Fail |
| GFSK Hopping                             | 79                          | $\geq 15$ | Pass         |

Test Graphs of Number of Hopping Frequency



Note: The GFSK modulation is the worst case and recorded in the report.

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## 12. TIME OF OCCUPANCY (DWELL TIME)

### 12.1. MEASUREMENT PROCEDURE

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span: Zero span, centered on a hopping channel.
2. RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1/T$ , where T is the expected dwell time per channel.
3. Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
4. Detector function: Peak. Trace: Max hold.
5. Use the marker-delta function to determine the transmit time per hop.
6. Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:  

$$(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$$
7. The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements.

### 12.2. TEST SETUP (BLOCK DIAGRAM OF CONFIGURATION)

Same as described in section 8.2

### 12.3. MEASUREMENT EQUIPMENT USED

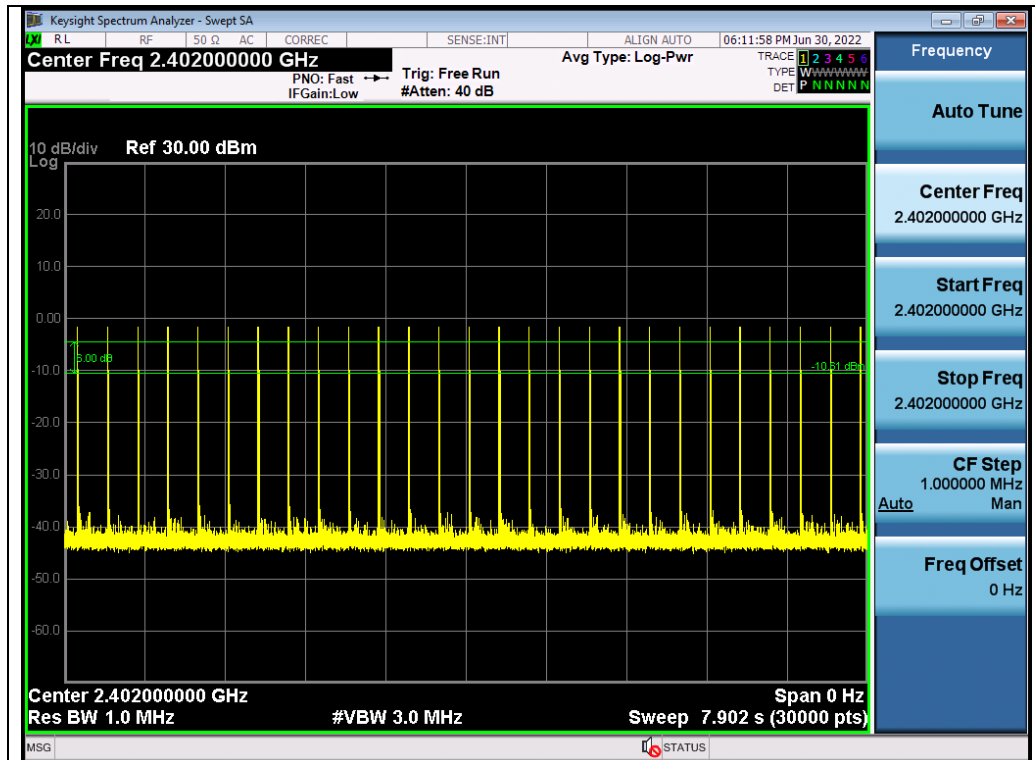
The same as described in section 6

### 12.4. LIMITS AND MEASUREMENT RESULT

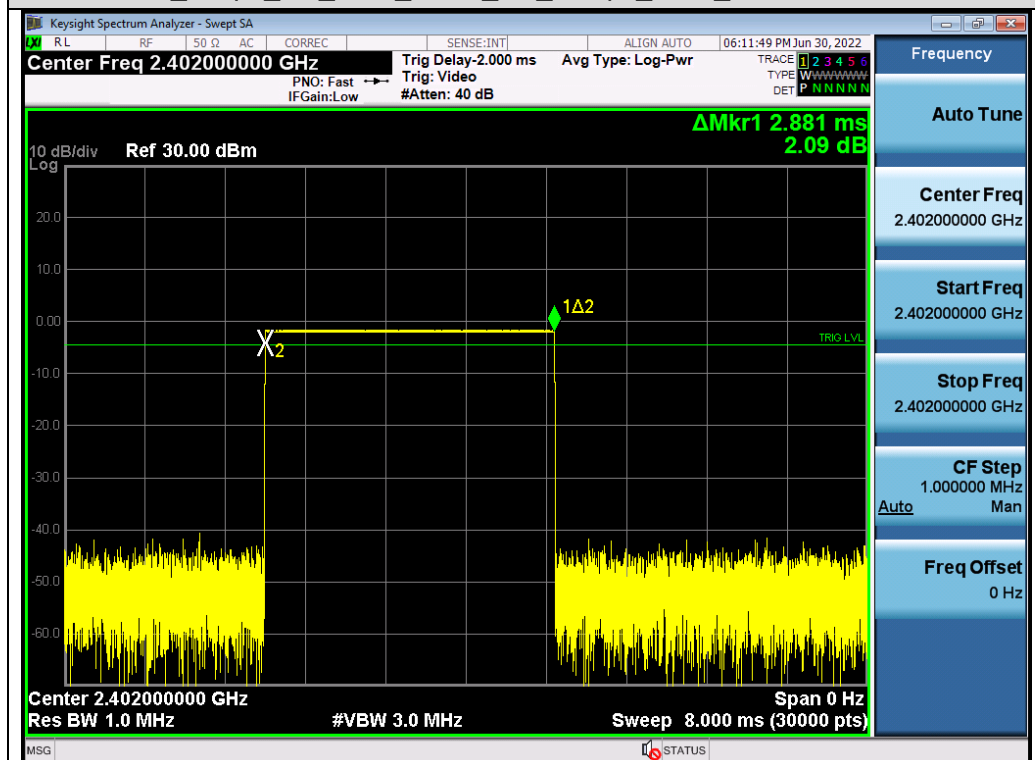
| Test Data of Dwell Time |                            |                                                            |                 |            |              |
|-------------------------|----------------------------|------------------------------------------------------------|-----------------|------------|--------------|
| Channel                 | Time of Pulse for DH5 (ms) | Number of hops in the period specified in the requirements | Sweep Time (ms) | Limit (ms) | Pass or Fail |
| 2402                    | 2.881                      | 27.0*4                                                     | 311.148         | 400        | Pass         |
| 2441                    | 2.881                      | 27.0*4                                                     | 311.148         | 400        | Pass         |
| 2480                    | 2.881                      | 26.0*4                                                     | 299.624         | 400        | Pass         |

Note: The 8DPSK modulation is the worst case and recorded in the report.

### Test Graphs of Dwell Time



Test\_Graph\_BR\_HOP\_ANT1\_NA\_1Mbps\_2402\_Number of Burst



Test\_Graph\_BR\_HOP\_ANT1\_NA\_1Mbps\_2402\_Time per Burst

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