

# RF TEST REPORT

**Applicant**      Quectel Wireless Solutions Co., Ltd.

**FCC ID**          XMR2023FGS060N

**Product**        Wi-Fi, Bluetooth & 802.15.4 Module

**Brand**           Quectel

**Model**           FGS060N

**Report No.**     R2304A0500-R1V2

**Issue Date**     November 30, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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*Prepared by: Xu Ying*

*Approved by: Xu Kai*

**TA Technology (Shanghai) Co., Ltd.**

*Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China*

*TEL: +86-021-50791141/2/3*

*FAX: +86-021-50791141/2/3-8000*

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| Version                                                                                                                                                                                                                                  | Revision Description          | Issue Date        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------|
| Rev.0                                                                                                                                                                                                                                    | Initial issue of report.      | November 24, 2023 |
| Rev.1                                                                                                                                                                                                                                    | Update Main Test Instruments. | November 27, 2023 |
| Rev.2                                                                                                                                                                                                                                    | Update data.                  | November 30, 2023 |
| <p>Note: This revised report (Report No.: R2304A0500-R1V2) supersedes and replaces the previously issued report (Report No.: R2304A0500-R1V1). Please discard or destroy the previously issued report and dispose of it accordingly.</p> |                               |                   |

## Summary of Measurement Results

| Number                                                                                                                                                                                                                                                                                | Test Case                       | Clause in FCC rules        | Verdict |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------------------|---------|
| 1                                                                                                                                                                                                                                                                                     | Maximum output power            | 15.247(b)(3)               | PASS    |
| 2                                                                                                                                                                                                                                                                                     | 99% Bandwidth and 6dB Bandwidth | 15.247(a)(2)<br>C63.10 6.9 | PASS    |
| 3                                                                                                                                                                                                                                                                                     | Power spectral density          | 15.247(e)                  | PASS    |
| 4                                                                                                                                                                                                                                                                                     | Band Edge                       | 15.247(d)                  | PASS    |
| 5                                                                                                                                                                                                                                                                                     | Spurious RF Conducted Emissions | 15.247(d)                  | PASS    |
| 6                                                                                                                                                                                                                                                                                     | Unwanted Emissions              | 15.247(d),15.205,15.209    | PASS    |
| 7                                                                                                                                                                                                                                                                                     | Conducted Emissions             | 15.207                     | NA      |
| Date of Testing: June 2, 2023 ~ November 30, 2023                                                                                                                                                                                                                                     |                                 |                            |         |
| Date of Sample Received: May 31, 2023                                                                                                                                                                                                                                                 |                                 |                            |         |
| Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. |                                 |                            |         |

# 1. Test Laboratory

## 1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

## 1.2. Test Facility

### FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

### A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

## 1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.

Address: Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China

City: Shanghai

Post code: 201201

Country: P. R. China

Contact: Xu Kai

Telephone: +86-021-50791141/2/3

Fax: +86-021-50791141/2/3-8000

Website: <http://www.ta-shanghai.com>

E-mail: [xukai@ta-shanghai.com](mailto:xukai@ta-shanghai.com)

## 2. General Description of Equipment Under Test

### 2.1. Applicant and Manufacturer Information

|                      |                                                                                                                        |
|----------------------|------------------------------------------------------------------------------------------------------------------------|
| Applicant            | Quectel Wireless Solutions Co., Ltd.                                                                                   |
| Applicant address    | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233 |
| Manufacturer         | Quectel Wireless Solutions Co., Ltd.                                                                                   |
| Manufacturer address | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233 |

### 2.2. General Information

| EUT Description                                                                                                |                                                                                                                                                        |                 |
|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| Model                                                                                                          | FGS060N                                                                                                                                                |                 |
| SN                                                                                                             | Conducted                                                                                                                                              | E1Y23EC27000023 |
|                                                                                                                | Radiated                                                                                                                                               | E1Y23EC27000037 |
| Hardware Version                                                                                               | R1.0                                                                                                                                                   |                 |
| Software Version                                                                                               | NA                                                                                                                                                     |                 |
| Power Supply                                                                                                   | External power supply                                                                                                                                  |                 |
| Antenna Type                                                                                                   | External Antenna                                                                                                                                       |                 |
| Antenna Connector                                                                                              | SMA Male (Center Pin) (module use unique antenna connector meet with the standard FCC Part 15.203 unique antenna connector requirement)                |                 |
| Antenna Gain                                                                                                   | Wi-Fi 2.4G/Thread: 0.73 dBi<br>Bluetooth LE: 0.73 dBi                                                                                                  |                 |
| Additional Beamforming Gain                                                                                    | NA                                                                                                                                                     |                 |
| Operating Frequency Range(s)                                                                                   | 802.11b/g/n(HT20)/ax(HE20): 2412 ~ 2462 MHz<br>802.11n(HT40)/ax(HE40): 2422 ~ 2452 MHz<br>Thread: 2405 ~ 2480 MHz<br>Bluetooth LE V5.3: 2402 ~2480 MHz |                 |
| Modulation Type                                                                                                | 802.11b: DSSS<br>802.11g/n: OFDM<br>802.11ax SU: OFDM<br>802.11ax TB/ERSU: OFDMA<br>Thread: O-QPSK<br>Bluetooth LE: GFSK                               |                 |
| Max. Output Power                                                                                              | Wi-Fi 2.4G: 16.18 dBm<br>Bluetooth LE: 2.83 dBm<br>Thread: 4.73 dBm                                                                                    |                 |
| Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant. |                                                                                                                                                        |                 |

### 3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**Test standards:**

**FCC CFR47 Part 15C (2022) Radio Frequency Devices**

**ANSI C63.10-2013**

**Reference standard:**

**KDB 558074 D01 15.247 Meas Guidance v05r02**

## 4. Test Configuration

### Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT polarization (horizontal and vertical). The worst emission was found in lie-down position (horizontal axis) and the loop antenna is vertical, the others are vertical and horizontal. and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

| Test Mode                    | Data Rate    |
|------------------------------|--------------|
| Bluetooth (Low Energy)       | 1Mbps; 2Mbps |
| Bluetooth (Low Energy) (S=2) | 500kbps      |
| Bluetooth (Low Energy) (S=8) | 125kbps      |
| 802.11b                      | 1 Mbps       |
| 802.11g                      | 6 Mbps       |
| 802.11n HT20                 | MCS0         |
| 802.11n HT40                 | MCS0         |
| 802.11ax HE20                | MCS0         |
| 802.11ax HE40                | MCS0         |
| Thread                       | 250kbps      |

## 5. Test Case Results

### 5.1. Maximum output power

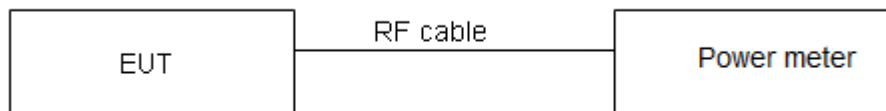
#### Ambient Condition

| Temperature | Relative humidity |
|-------------|-------------------|
| 20°C ~ 25°C | 45% ~ 50%         |

#### Methods of Measurement

During the process of the testing, The EUT was connected to Power meter with a known loss. The EUT is max power transmission with proper modulation.

#### Test Setup



#### Limits

Rule Part 15.247 (b) (3) specifies that " For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz: 1 Watt."

| Average Output Power | $\leq 1\text{W}$ (30dBm) |
|----------------------|--------------------------|
|----------------------|--------------------------|

#### Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 2$ ,  $U = 0.44$  dB.

## Test Results

| Power Index |         |         |                 |                  |         |                 |                  |
|-------------|---------|---------|-----------------|------------------|---------|-----------------|------------------|
| Channel     | 802.11b | 802.11g | 802.11n<br>HT20 | 802.11ax<br>HE20 | Channel | 802.11n<br>HT40 | 802.11ax<br>HE40 |
| CH1         | 16      | 15      | 14              | 14               | CH3     | 13              | 14               |
| CH2         | /       | 16      | /               | /                | CH4     | 14              | /                |
| CH6         | 16      | 16      | 14              | 14               | CH6     | 14              | 14               |
| CH9         | /       | /       | /               | /                | CH7     | 14              | /                |
| CH10        | /       | 16      | /               | /                | CH8     | 13.5            | /                |
| CH11        | 16      | 15      | 14              | 14               | CH9     | 13.5            | 14               |

| Test Mode                                                                      | Duty cycle | Duty cycle correction Factor (dB) |
|--------------------------------------------------------------------------------|------------|-----------------------------------|
| 802.11b                                                                        | 0.999      | 0.00                              |
| 802.11g                                                                        | 0.990      | 0.00                              |
| 802.11n HT20                                                                   | 0.989      | 0.00                              |
| 802.11n HT40                                                                   | 0.978      | 0.10                              |
| 802.11ax HE20                                                                  | 0.985      | 0.00                              |
| 802.11ax HE40                                                                  | 0.973      | 0.12                              |
| Note: when Duty cycle $\geq 0.98$ , Duty cycle correction Factor not required. |            |                                   |

| Test Mode                                                                                   | Carrier frequency (MHz) / Channel | Average Power Measured (dBm) | Average Power with duty factor (dBm) | Limit (dBm) | Conclusion |
|---------------------------------------------------------------------------------------------|-----------------------------------|------------------------------|--------------------------------------|-------------|------------|
| 802.11b                                                                                     | 2412/CH1                          | 14.80                        | 14.80                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 14.86                        | 14.86                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 14.92                        | 14.92                                | 30          | PASS       |
| 802.11g                                                                                     | 2412/CH1                          | 14.82                        | 14.82                                | 30          | PASS       |
|                                                                                             | 2417/CH2                          | 15.75                        | 15.75                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 15.45                        | 15.45                                | 30          | PASS       |
|                                                                                             | 2457/CH10                         | 16.18                        | 16.18                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 15.10                        | 15.10                                | 30          | PASS       |
| 802.11n<br>HT20                                                                             | 2412/CH1                          | 13.79                        | 13.79                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 13.42                        | 13.42                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 13.76                        | 13.76                                | 30          | PASS       |
| 802.11n<br>HT40                                                                             | 2422/CH3                          | 12.76                        | 12.86                                | 30          | PASS       |
|                                                                                             | 2427/CH4                          | 13.76                        | 13.86                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 13.29                        | 13.39                                | 30          | PASS       |
|                                                                                             | 2442/CH7                          | 13.38                        | 13.48                                | 30          | PASS       |
|                                                                                             | 2447/CH8                          | 13.14                        | 13.24                                | 30          | PASS       |
|                                                                                             | 2452/CH9                          | 13.26                        | 13.36                                | 30          | PASS       |
| 802.11ax<br>HE20                                                                            | 2412/CH1                          | 13.80                        | 13.80                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 13.35                        | 13.35                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 13.68                        | 13.68                                | 30          | PASS       |
| 802.11ax<br>HE40                                                                            | 2422/CH3                          | 13.55                        | 13.67                                | 30          | PASS       |
|                                                                                             | 2437/CH6                          | 13.67                        | 13.79                                | 30          | PASS       |
|                                                                                             | 2452/CH9                          | 13.78                        | 13.90                                | 30          | PASS       |
| Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor |                                   |                              |                                      |             |            |

| Power Index |        |
|-------------|--------|
| Channel     | Thread |
| CH11        | 4      |
| CH18        | 4      |
| CH26        | 4      |

| Test Mode                                                                      | Duty cycle | Duty cycle correction Factor (dB) |
|--------------------------------------------------------------------------------|------------|-----------------------------------|
| Thread                                                                         | 0.265      | 5.766                             |
| Note: when Duty cycle $\geq 0.98$ , Duty cycle correction Factor not required. |            |                                   |

| Test Mode                                                                                   | Carrier frequency (MHz) / Channel | Average Power Measured (dBm) | Average Power with duty factor (dBm) | Limit (dBm) | Conclusion |
|---------------------------------------------------------------------------------------------|-----------------------------------|------------------------------|--------------------------------------|-------------|------------|
| Thread                                                                                      | 2405/CH11                         | -1.04                        | 4.73                                 | 30          | PASS       |
|                                                                                             | 2440/CH18                         | -1.24                        | 4.53                                 | 30          | PASS       |
|                                                                                             | 2480/CH26                         | -5.14                        | 0.63                                 | 30          | PASS       |
| Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor |                                   |                              |                                      |             |            |

**TB Mode**

| SISO Antenna Power Index |                             |                             |                              |                              |         |                              |                              |
|--------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|---------|------------------------------|------------------------------|
| Channel                  | 802.11ax<br>HE20<br>26-Tone | 802.11ax<br>HE20<br>52-Tone | 802.11ax<br>HE20<br>106-Tone | 802.11ax<br>HE20<br>242-Tone | Channel | 802.11ax<br>HE20<br>242-Tone | 802.11ax<br>HE20<br>242-Tone |
| CH1                      | 14                          | 14                          | 14                           | 13                           | CH3     | 12                           | 12                           |
| CH6                      | 14                          | 14                          | 14                           | /                            | CH9     | 12                           | 12                           |
| CH11                     | 14                          | 14                          | 14                           | 13                           | /       | /                            | /                            |

| Test Mode                                                                      | Duty cycle | Duty cycle correction Factor (dB) |
|--------------------------------------------------------------------------------|------------|-----------------------------------|
| 802.11ax HE20 26-Tone:RU Index 0                                               | 0.954      | 0.21                              |
| 802.11ax HE20 26-Tone:RU Index 4                                               | 0.954      | 0.21                              |
| 802.11ax HE20 26-Tone:RU Index 8                                               | 0.954      | 0.21                              |
| 802.11ax HE20 52-Tone:RU Index 37                                              | 0.954      | 0.21                              |
| 802.11ax HE20 52-Tone:RU Index 38                                              | 0.954      | 0.21                              |
| 802.11ax HE20 52-Tone:RU Index 40                                              | 0.954      | 0.21                              |
| 802.11ax HE20 106-Tone:RU Index 53                                             | 0.954      | 0.21                              |
| 802.11ax HE20 106-Tone:RU Index 54                                             | 0.954      | 0.21                              |
| 802.11ax HE20 242-Tones:RU Index 61                                            | 0.954      | 0.21                              |
| 802.11ax HE40 26-Tones:RU Index 0                                              | 0.954      | 0.21                              |
| 802.11ax HE40 26-Tones:RU Index 17                                             | 0.954      | 0.21                              |
| 802.11ax HE40 484-Tones:RU Index 65                                            | 0.954      | 0.21                              |
| Note: when Duty cycle $\geq 0.98$ , Duty cycle correction Factor not required. |            |                                   |

| Test Mode                                                                                   | Carrier frequency (MHz) / Channel | RU Index | Average Power Measured (dBm) | Average Power with duty factor (dBm) | Limit (dBm) | Conclusion |
|---------------------------------------------------------------------------------------------|-----------------------------------|----------|------------------------------|--------------------------------------|-------------|------------|
| 802.11ax HE20<br>26-Tone                                                                    | 2412/CH 1                         | 0        | 13.22                        | 13.43                                | 30          | PASS       |
|                                                                                             | 2437/CH 6                         | 4        | 13.71                        | 13.92                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 8        | 13.74                        | 13.95                                | 30          | PASS       |
| 802.11ax HE20<br>52-Tone                                                                    | 2412/CH 1                         | 37       | 13.60                        | 13.81                                | 30          | PASS       |
|                                                                                             | 2437/CH 6                         | 38       | 14.06                        | 14.27                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 40       | 13.88                        | 14.09                                | 30          | PASS       |
| 802.11ax HE20<br>106-Tone                                                                   | 2412/CH 1                         | 53       | 13.82                        | 14.03                                | 30          | PASS       |
|                                                                                             | 2437/CH 6                         | 53       | 13.76                        | 13.97                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 54       | 14.00                        | 14.21                                | 30          | PASS       |
| 802.11ax HE20<br>242-Tone                                                                   | 2412/CH 1                         | 61       | 12.25                        | 12.46                                | 30          | PASS       |
|                                                                                             | 2462/CH11                         | 61       | 12.34                        | 12.55                                | 30          | PASS       |
| 802.11ax HE40<br>26-Tone                                                                    | 2422/CH 3                         | 0        | 10.6                         | 10.81                                | 30          | PASS       |
|                                                                                             | 2452/CH 9                         | 17       | 11.2                         | 11.41                                | 30          | PASS       |
| 802.11ax HE40<br>484-Tone                                                                   | 2422/CH 3                         | 65       | 11.43                        | 11.64                                | 30          | PASS       |
|                                                                                             | 2452/CH 9                         | 65       | 11.25                        | 11.46                                | 30          | PASS       |
| Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor |                                   |          |                              |                                      |             |            |

**ERSU Mode**

| SISO Antenna Power Index |                            |
|--------------------------|----------------------------|
| Channel                  | 802.11ax HE20<br>242-Tones |
| CH1                      | 13                         |
| CH6                      | 13                         |
| CH11                     | 13                         |

| Test Mode                                                                      | Duty cycle | Duty cycle correction Factor (dB) |
|--------------------------------------------------------------------------------|------------|-----------------------------------|
| 802.11ax HE20<br>242-Tones                                                     | 0.954      | 0.21                              |
| Note: when Duty cycle $\geq 0.98$ , Duty cycle correction Factor not required. |            |                                   |

| Test Mode                  | Carrier frequency<br>(MHz) / Channel | RU Index | Average Power<br>Measured<br>(dBm) | Average Power<br>with duty factor<br>(dBm) | Limit<br>(dBm) | Conclusion |
|----------------------------|--------------------------------------|----------|------------------------------------|--------------------------------------------|----------------|------------|
| 802.11ax HE20<br>242-Tones | 2412/CH 1                            | 61       | 12.87                              | 13.08                                      | 30             | PASS       |
|                            | 2437/CH 6                            | 61       | 13.19                              | 13.40                                      | 30             | PASS       |
|                            | 2462/CH11                            | 61       | 13.72                              | 13.93                                      | 30             | PASS       |

| Power Index |                        |
|-------------|------------------------|
| Channel     | Bluetooth (Low Energy) |
| CH0         | 3                      |
| CH19        | 3                      |
| CH39        | 3                      |

| Test Mode                                                                      | Duty cycle | Duty cycle correction Factor (dB) |
|--------------------------------------------------------------------------------|------------|-----------------------------------|
| Bluetooth LE (1M)                                                              | 0.621      | 2.07                              |
| Bluetooth LE (2M)                                                              | 0.431      | 3.66                              |
| Bluetooth LE (S=2)                                                             | 0.853      | 0.69                              |
| Bluetooth LE (S=8)                                                             | 0.827      | 0.83                              |
| Note: when Duty cycle $\geq 0.98$ , Duty cycle correction Factor not required. |            |                                   |

| Test Mode                                                                                   | Carrier frequency (MHz) / Channel | Average Power Measured (dBm) | Average Power with duty factor (dBm) | Limit (dBm) | Conclusion |
|---------------------------------------------------------------------------------------------|-----------------------------------|------------------------------|--------------------------------------|-------------|------------|
| Bluetooth (Low Energy) (1M)                                                                 | 2402/CH0                          | 0.67                         | 2.74                                 | 30          | PASS       |
|                                                                                             | 2440/CH19                         | 0.33                         | 2.40                                 | 30          | PASS       |
|                                                                                             | 2480/CH39                         | 0.36                         | 2.43                                 | 30          | PASS       |
| Bluetooth (Low Energy) (2M)                                                                 | 2402/CH0                          | -0.83                        | 2.83                                 | 30          | PASS       |
|                                                                                             | 2440/CH19                         | -1.25                        | 2.41                                 | 30          | PASS       |
|                                                                                             | 2480/CH39                         | -1.16                        | 2.50                                 | 30          | PASS       |
| Bluetooth (Low Energy) (S=2)                                                                | 2402/CH0                          | 1.97                         | 2.66                                 | 30          | PASS       |
|                                                                                             | 2440/CH19                         | 1.62                         | 2.31                                 | 30          | PASS       |
|                                                                                             | 2480/CH39                         | 1.97                         | 2.66                                 | 30          | PASS       |
| Bluetooth (Low Energy) (S=8)                                                                | 2402/CH0                          | 1.83                         | 2.66                                 | 30          | PASS       |
|                                                                                             | 2440/CH19                         | 1.51                         | 2.34                                 | 30          | PASS       |
|                                                                                             | 2480/CH39                         | 1.68                         | 2.51                                 | 30          | PASS       |
| Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor |                                   |                              |                                      |             |            |

## 5.2. 99% Bandwidth and 6dB Bandwidth

### Ambient Condition

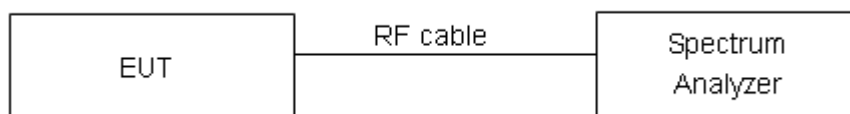
| Temperature | Relative humidity |
|-------------|-------------------|
| 20°C ~ 25°C | 45% ~ 50%         |

### Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 100 kHz; VBW is set to 300 kHz on spectrum analyzer. Dector=Peak, Trace mode=max hold.

The EUT was connected to the spectrum analyzer through a known loss cable. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value.

### Test Setup



### Limits

Rule Part 15.247 (a) (2) specifies that “Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.”

|                        |           |
|------------------------|-----------|
| minimum 6 dB bandwidth | ≥ 500 kHz |
|------------------------|-----------|

### Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 2$ ,  $U = 936$  Hz.

**Test Results:**

| Test Mode        | Carrier frequency (MHz) / Channel | 99% bandwidth (MHz) | Minimum 6 dB bandwidth (MHz) | Limit (kHz) | Conclusion |
|------------------|-----------------------------------|---------------------|------------------------------|-------------|------------|
| 802.11b          | 2412/CH1                          | 13.436              | 10.058                       | 500         | PASS       |
|                  | 2437/CH6                          | 13.436              | 9.704                        | 500         | PASS       |
|                  | 2462/CH11                         | 13.414              | 9.625                        | 500         | PASS       |
| 802.11g          | 2412/CH1                          | 16.693              | 16.333                       | 500         | PASS       |
|                  | 2417/CH2                          | 16.707              | 16.346                       | 500         | PASS       |
|                  | 2437/CH6                          | 16.805              | 16.346                       | 500         | PASS       |
|                  | 2457/CH10                         | 16.744              | 16.343                       | 500         | PASS       |
|                  | 2462/CH11                         | 16.715              | 16.337                       | 500         | PASS       |
| 802.11n<br>HT20  | 2412/CH1                          | 17.652              | 17.537                       | 500         | PASS       |
|                  | 2437/CH6                          | 17.713              | 17.551                       | 500         | PASS       |
|                  | 2462/CH11                         | 17.676              | 17.387                       | 500         | PASS       |
| 802.11n<br>HT40  | 2422/CH3                          | 36.284              | 35.368                       | 500         | PASS       |
|                  | 2427/CH4                          | 36.222              | 35.790                       | 500         | PASS       |
|                  | 2437/CH6                          | 36.232              | 35.336                       | 500         | PASS       |
|                  | 2442/CH7                          | 37.608              | 36.772                       | 500         | PASS       |
|                  | 2447/CH8                          | 37.528              | 36.759                       | 500         | PASS       |
|                  | 2452/CH9                          | 37.700              | 36.569                       | 500         | PASS       |
| 802.11ax<br>HE20 | 2412/CH1                          | 18.784              | 18.084                       | 500         | PASS       |
|                  | 2437/CH6                          | 18.814              | 18.552                       | 500         | PASS       |
|                  | 2462/CH11                         | 18.835              | 18.188                       | 500         | PASS       |
| 802.11ax<br>HE40 | 2422/CH3                          | 37.678              | 36.082                       | 500         | PASS       |
|                  | 2437/CH6                          | 37.610              | 37.046                       | 500         | PASS       |
|                  | 2452/CH9                          | 37.555              | 36.168                       | 500         | PASS       |

| Test Mode | Carrier frequency (MHz) | 99% bandwidth (MHz) | Minimum 6 dB bandwidth (MHz) | Limit (kHz) | Conclusion |
|-----------|-------------------------|---------------------|------------------------------|-------------|------------|
| Thread    | 2405                    | 2.380               | 1.581                        | 500         | PASS       |
|           | 2440                    | 2.368               | 1.589                        | 500         | PASS       |
|           | 2480                    | 2.253               | 1.545                        | 500         | PASS       |

**TB Mode**

| Test Mode                 | Carrier frequency (MHz) | RU Index | 99% bandwidth (MHz) | Minimum 6 dB bandwidth (MHz) | Limit (kHz) | Conclusion |
|---------------------------|-------------------------|----------|---------------------|------------------------------|-------------|------------|
| 802.11ax HE20<br>26-Tone  | 2412                    | 0        | 17.726              | 1.940                        | 500         | PASS       |
|                           | 2437                    | 4        | 15.945              | 2.688                        | 500         | PASS       |
|                           | 2462                    | 8        | 18.028              | 1.990                        | 500         | PASS       |
| 802.11ax HE20<br>52-Tone  | 2412                    | 37       | 17.789              | 15.687                       | 500         | PASS       |
|                           | 2437                    | 38       | 16.897              | 15.035                       | 500         | PASS       |
|                           | 2462                    | 40       | 17.537              | 16.874                       | 500         | PASS       |
| 802.11ax HE20<br>106-Tone | 2412                    | 53       | 17.468              | 16.983                       | 500         | PASS       |
|                           | 2437                    | 53       | 17.787              | 15.737                       | 500         | PASS       |
|                           | 2462                    | 54       | 17.323              | 16.924                       | 500         | PASS       |
| 802.11ax HE20<br>242-Tone | 2412                    | 61       | 18.790              | 18.334                       | 500         | PASS       |
|                           | 2462                    | 61       | 18.809              | 18.236                       | 500         | PASS       |
| 802.11ax HE40<br>26-Tone  | 2422                    | 0        | 22.306              | 2.682                        | 500         | PASS       |
|                           | 2452                    | 17       | 21.920              | 2.011                        | 500         | PASS       |
| 802.11ax HE40<br>484-Tone | 2422                    | 65       | 37.508              | 36.076                       | 500         | PASS       |
|                           | 2452                    | 65       | 37.580              | 37.103                       | 500         | PASS       |

**ERSU Mode**

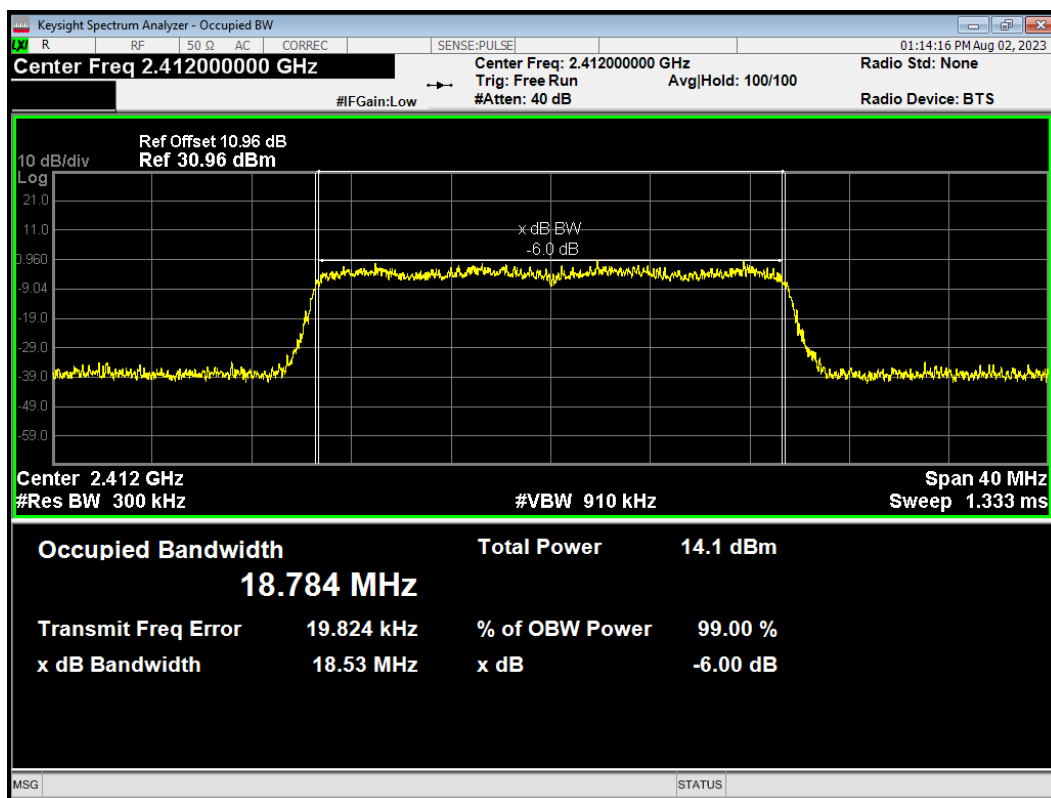
| Test Mode                  | Carrier frequency (MHz) | RU Index | 99% bandwidth (MHz) | Minimum 6 dB bandwidth (MHz) | Limit (kHz) | Conclusion |
|----------------------------|-------------------------|----------|---------------------|------------------------------|-------------|------------|
| 802.11ax HE20<br>242-Tones | 2412                    | 61       | 18.810              | 18.303                       | 500         | PASS       |
|                            | 2437                    | 61       | 18.812              | 18.176                       | 500         | PASS       |
|                            | 2462                    | 61       | 18.795              | 18.197                       | 500         | PASS       |

| Test Mode                          | Carrier frequency (MHz) | 99% bandwidth (MHz) | Minimum 6 dB bandwidth (MHz) | Limit (kHz) | Conclusion |
|------------------------------------|-------------------------|---------------------|------------------------------|-------------|------------|
| Bluetooth<br>(Low Energy)<br>(1M)  | 2402                    | 1.035               | 0.695                        | 500         | PASS       |
|                                    | 2440                    | 1.034               | 0.699                        | 500         | PASS       |
|                                    | 2480                    | 1.037               | 0.689                        | 500         | PASS       |
| Bluetooth<br>(Low Energy)<br>(2M)  | 2402                    | 2.059               | 1.131                        | 500         | PASS       |
|                                    | 2440                    | 2.086               | 1.209                        | 500         | PASS       |
|                                    | 2480                    | 2.065               | 1.149                        | 500         | PASS       |
| Bluetooth<br>(Low Energy)<br>(S=2) | 2402                    | 1.019               | 0.664                        | 500         | PASS       |
|                                    | 2440                    | 1.021               | 0.660                        | 500         | PASS       |
|                                    | 2480                    | 1.020               | 0.666                        | 500         | PASS       |

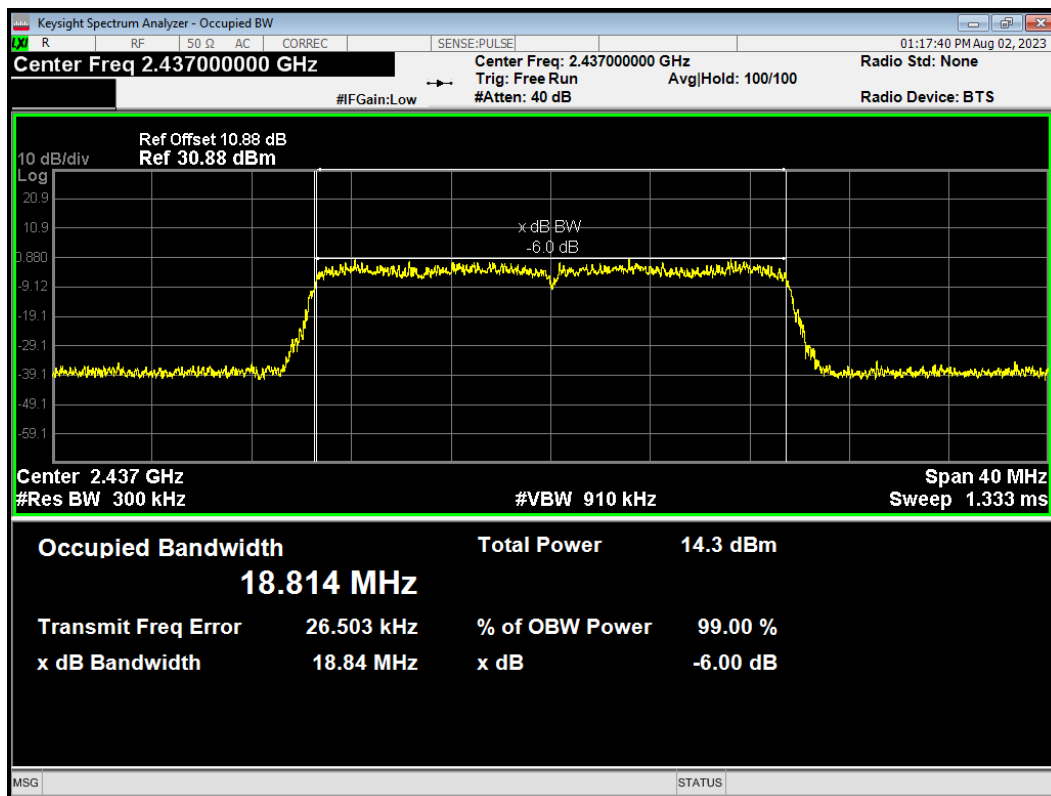
|                                    |      |       |       |     |      |
|------------------------------------|------|-------|-------|-----|------|
| Bluetooth<br>(Low Energy)<br>(S=8) | 2402 | 1.055 | 0.646 | 500 | PASS |
|                                    | 2440 | 1.053 | 0.649 | 500 | PASS |
|                                    | 2480 | 1.061 | 0.648 | 500 | PASS |

99%bandwidth

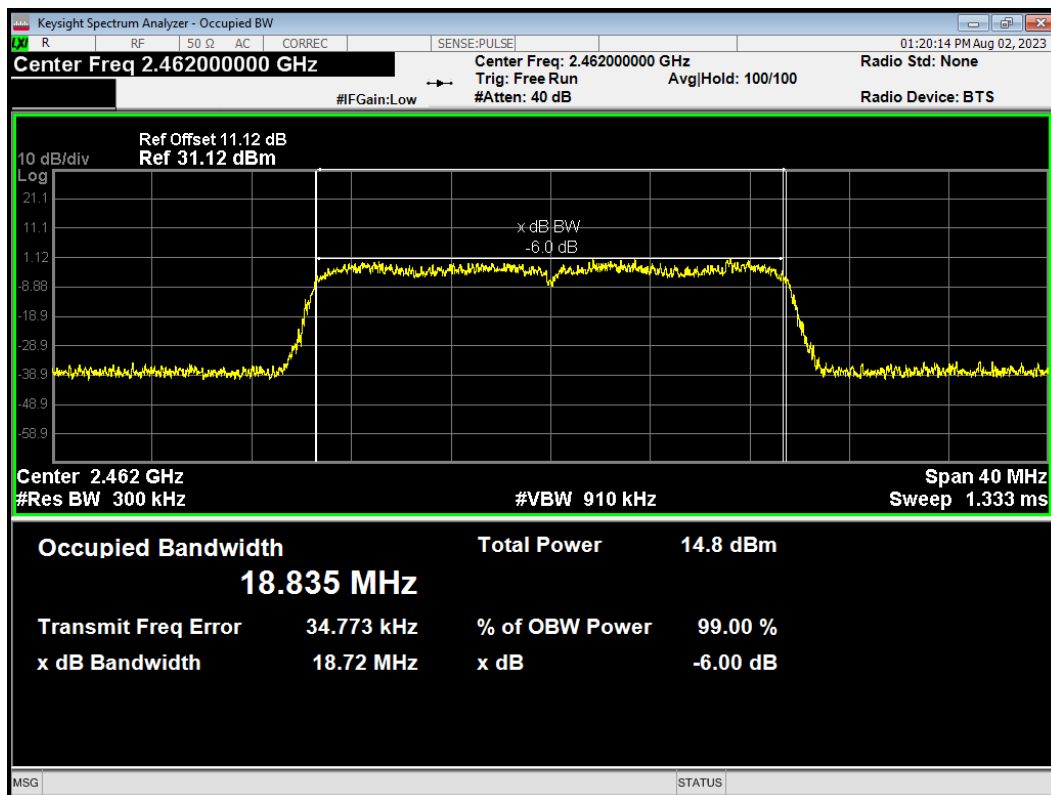
OBW 802.11ax(HE20) 2412MHz



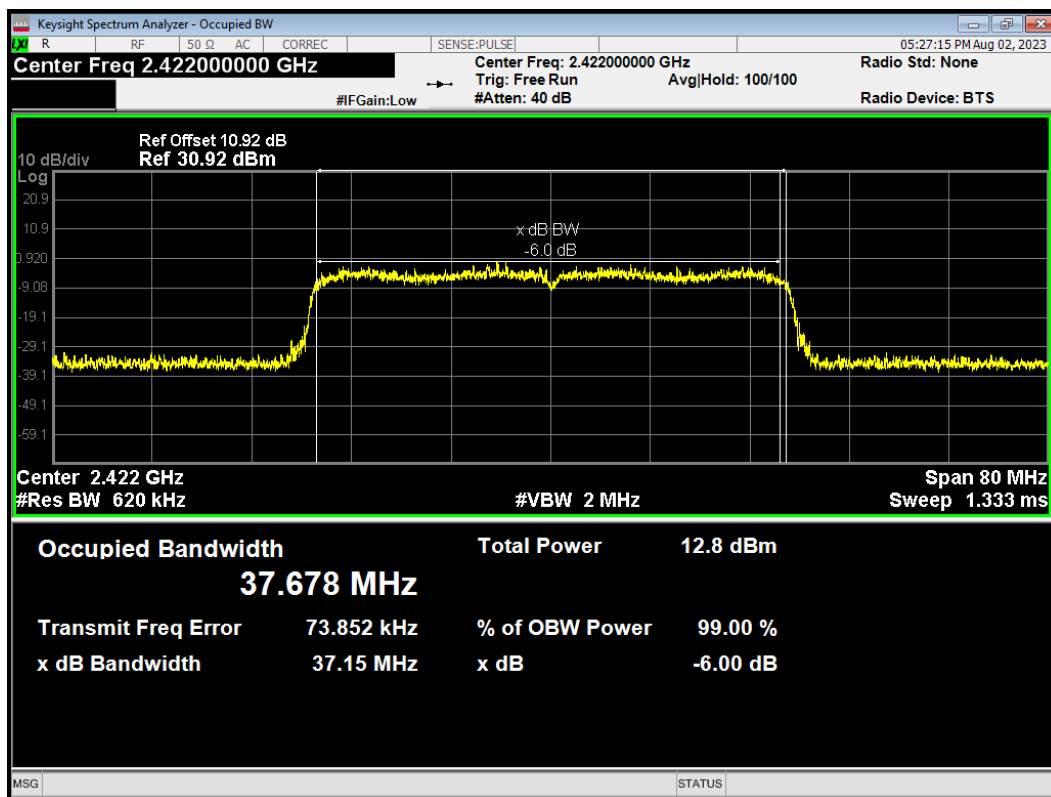
OBW 802.11ax(HE20) 2437MHz



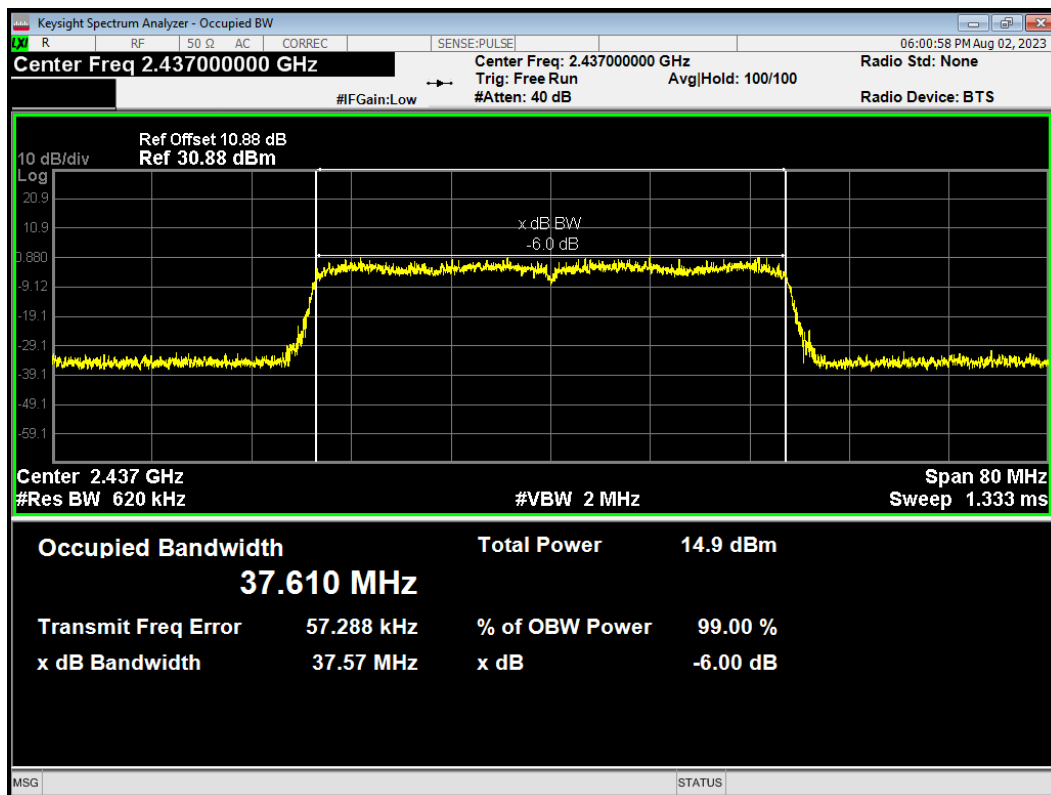
OBW 802.11ax(HE20) 2462MHz



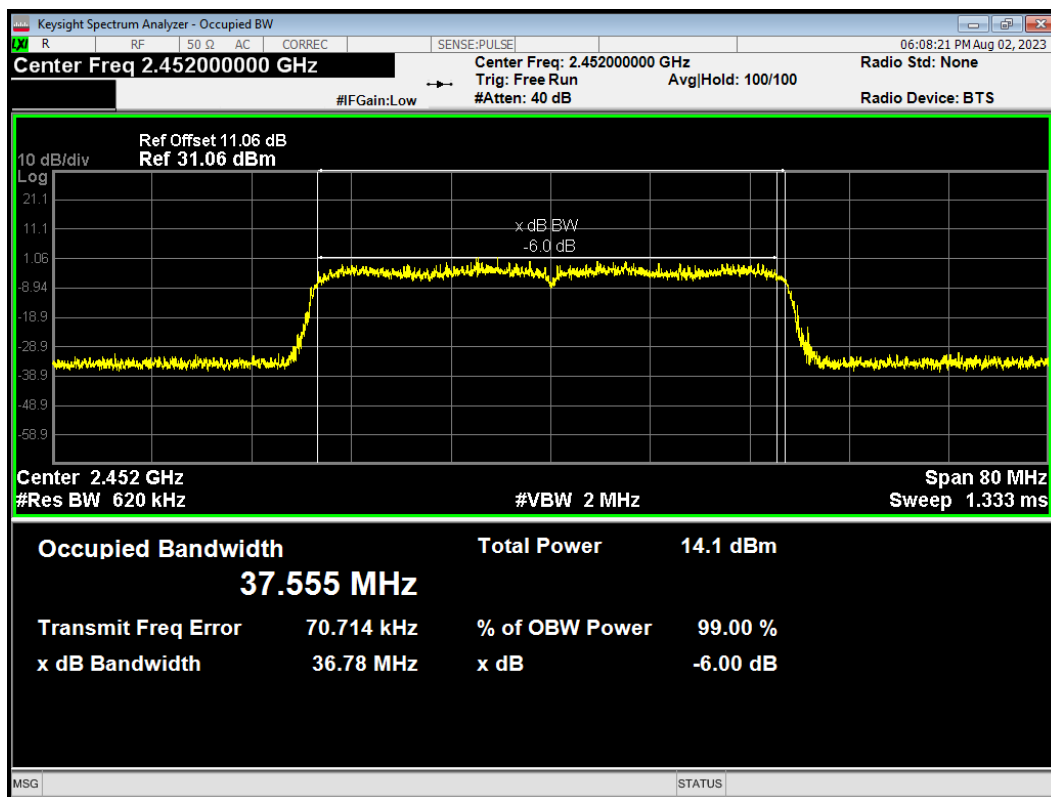
OBW 802.11ax(HE40) 2422MHz



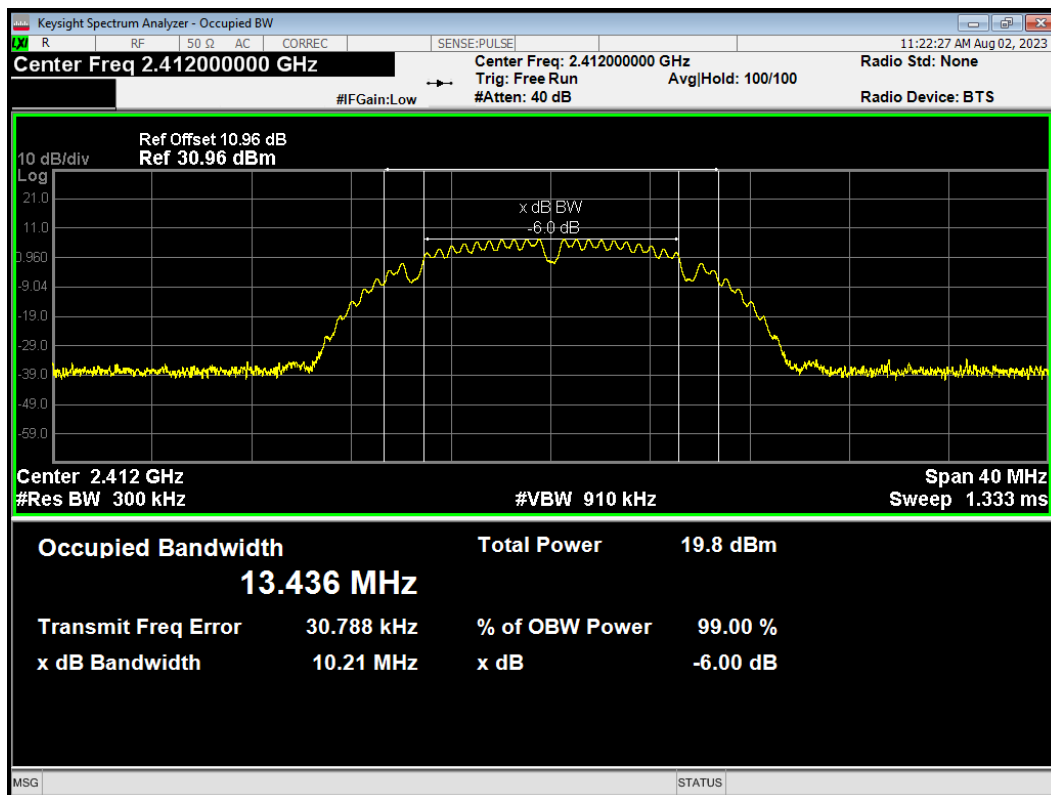
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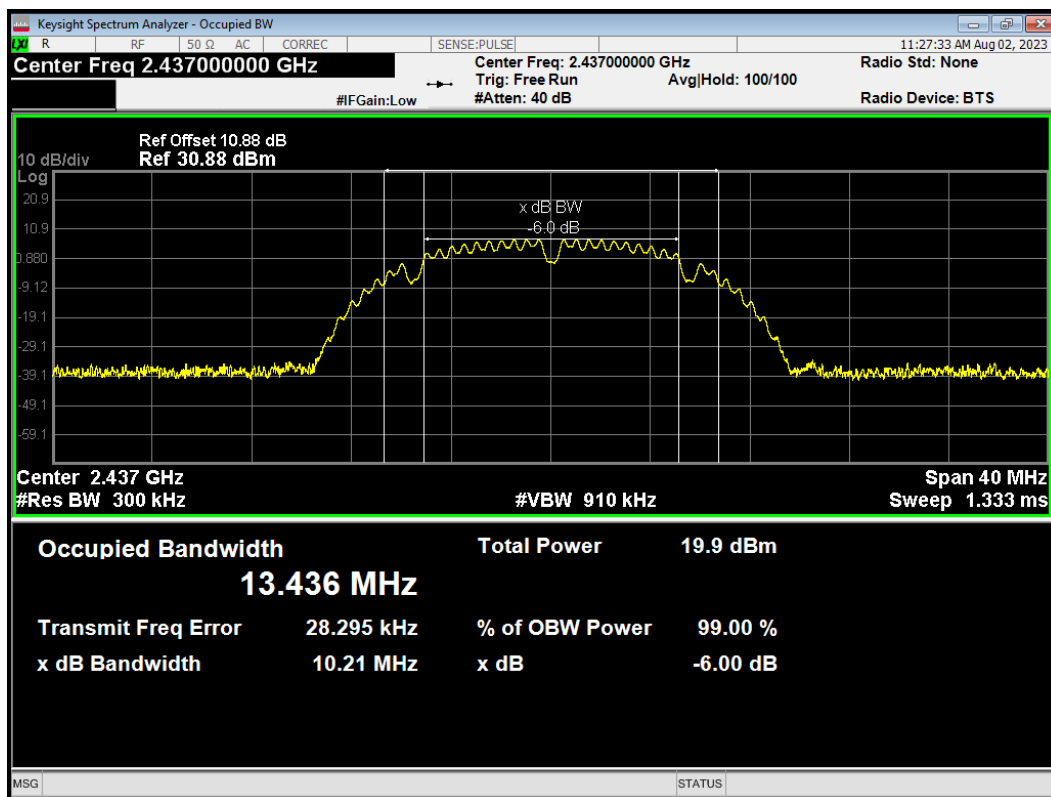
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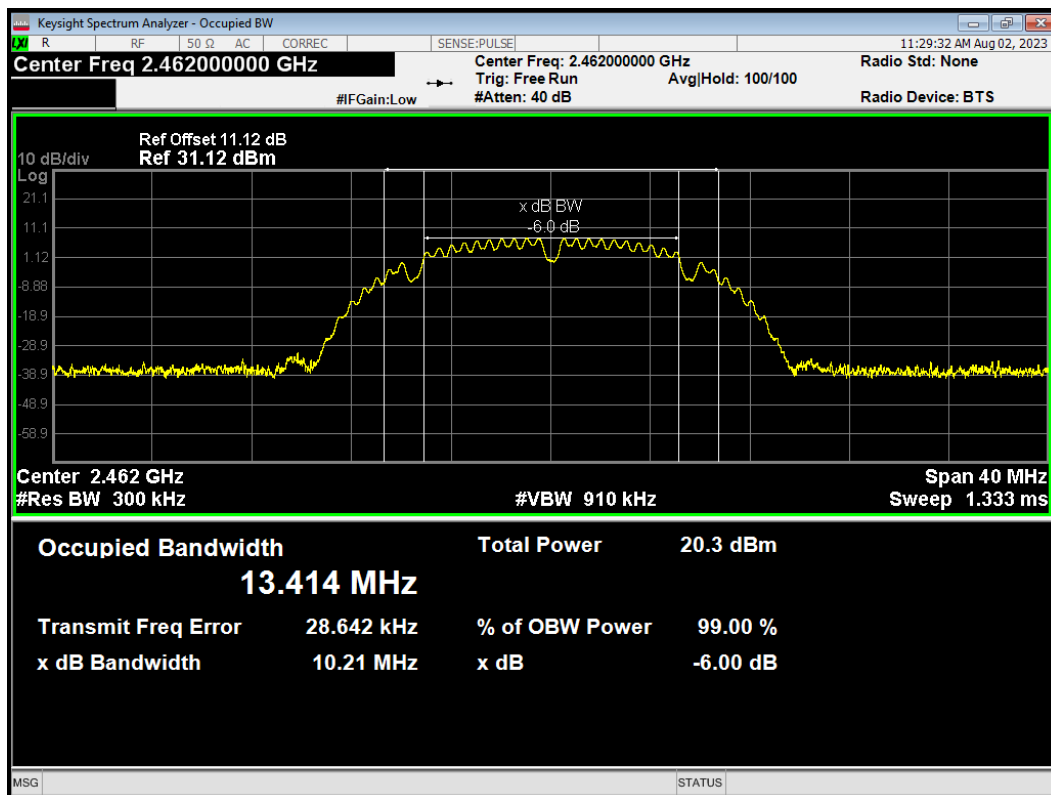
OBW 802.11b 2412MHz



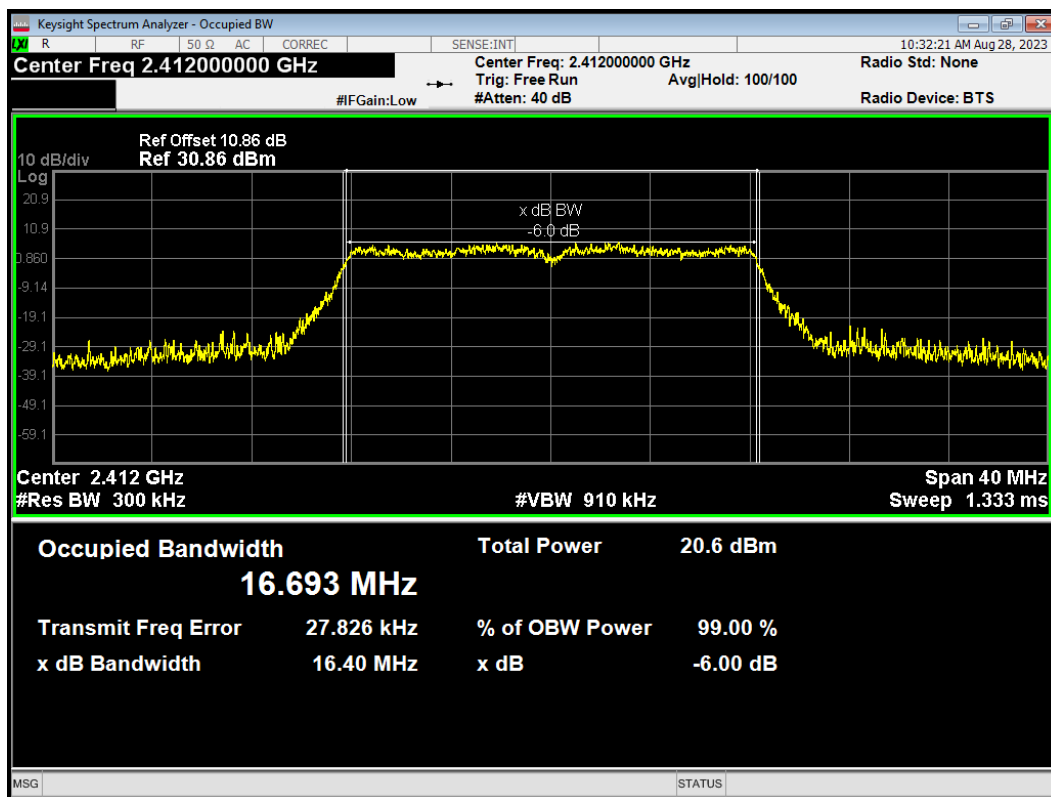
OBW 802.11b 2437MHz



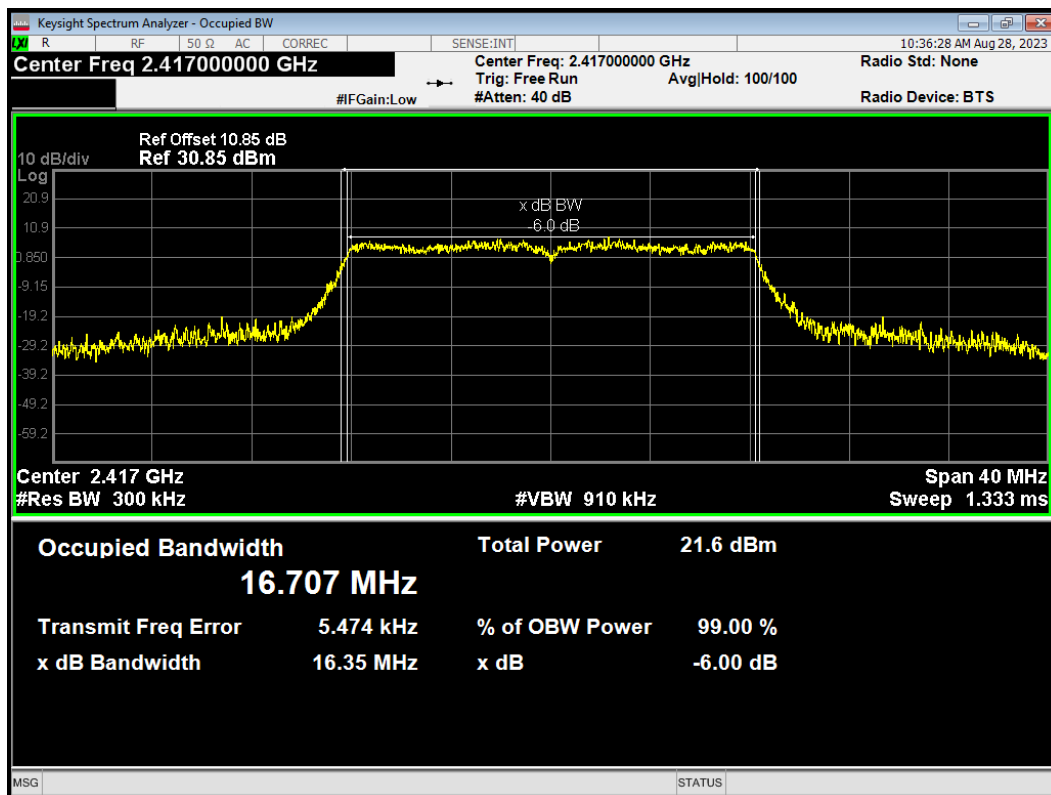
OBW 802.11b 2462MHz



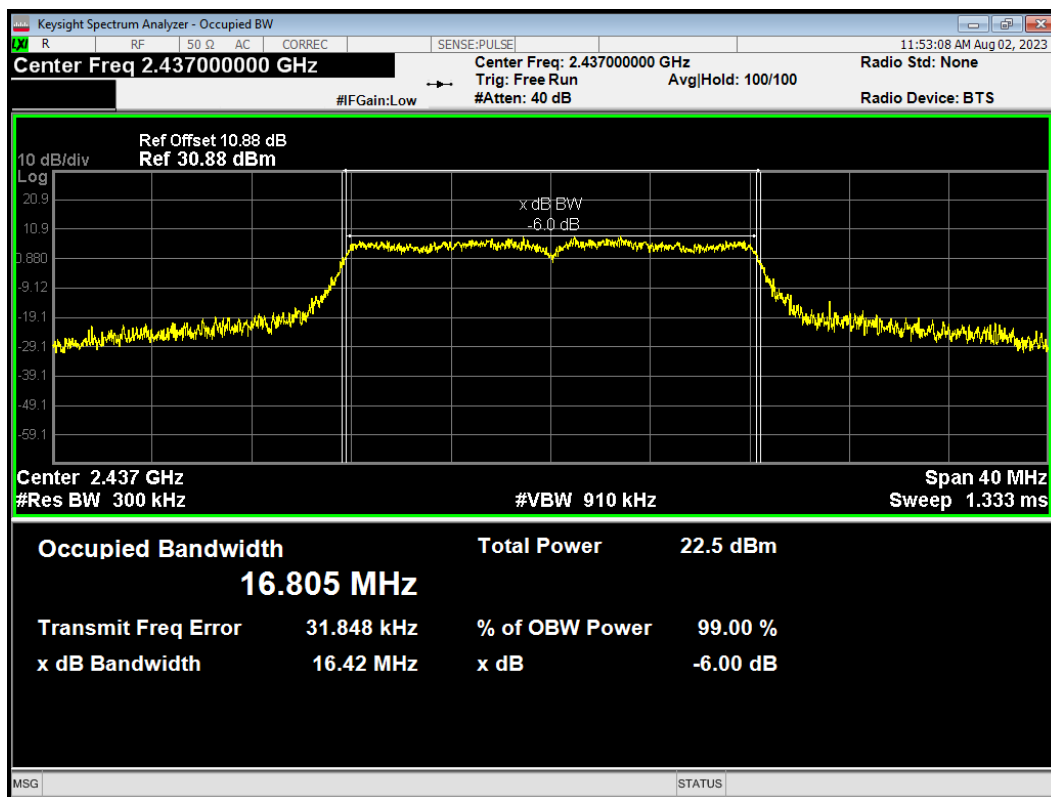
OBW 802.11g 2412MHz



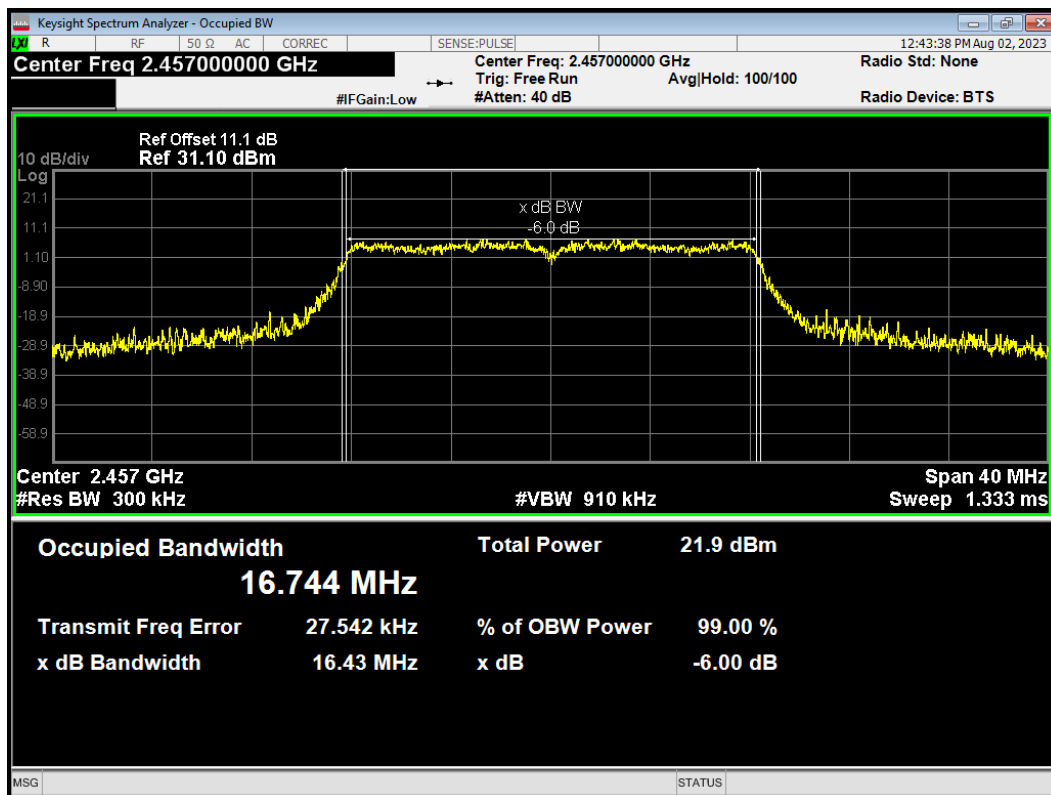
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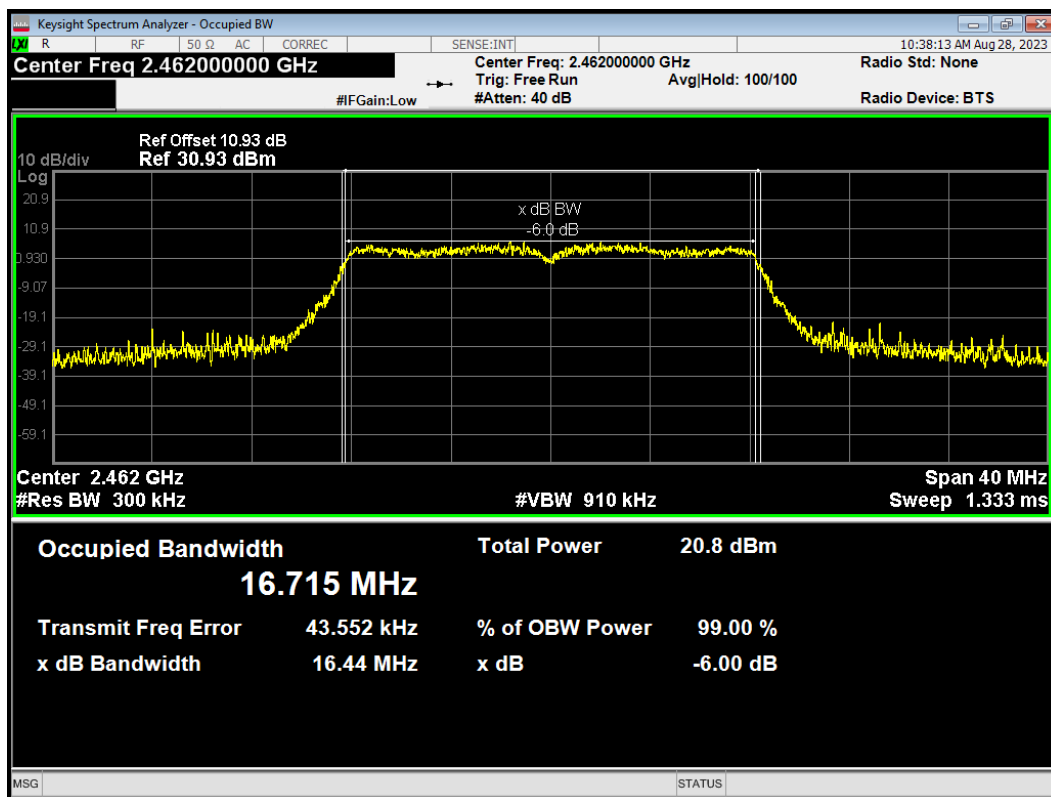
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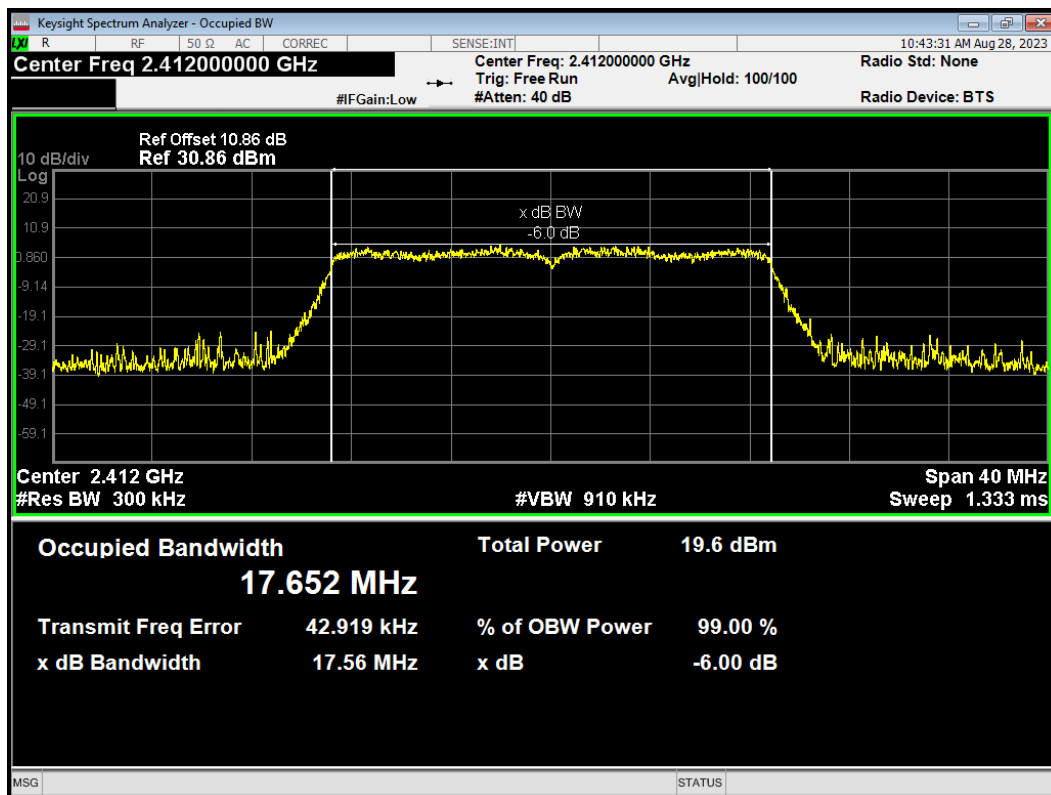
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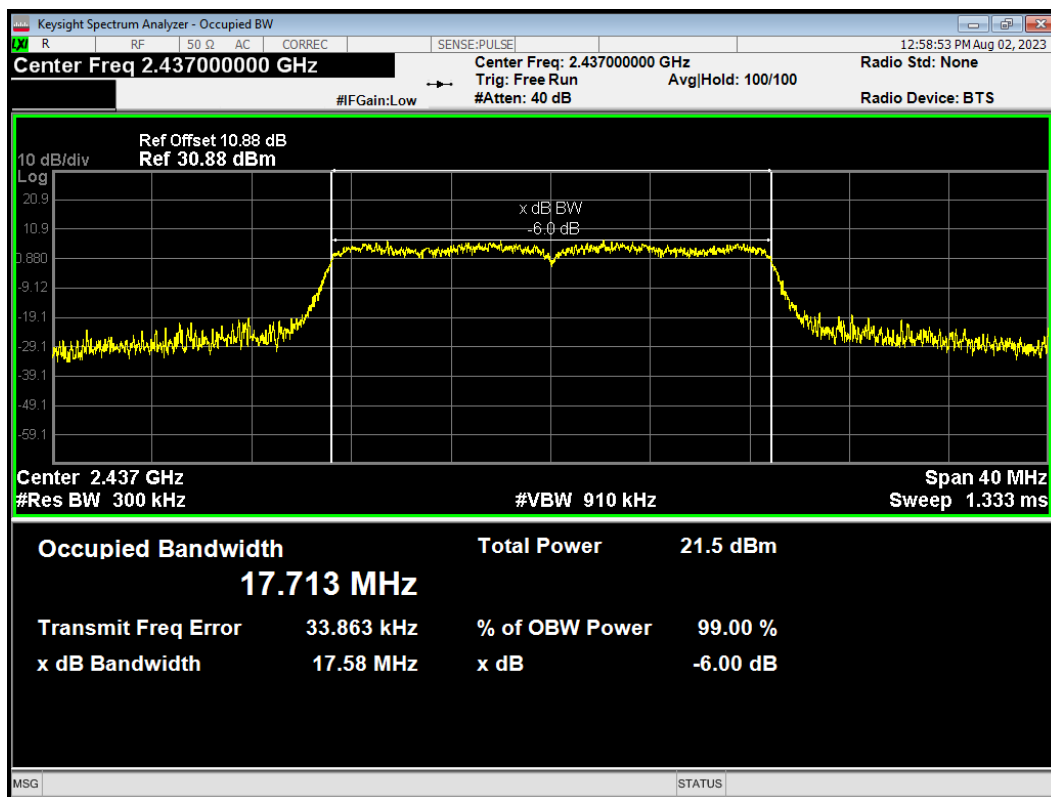
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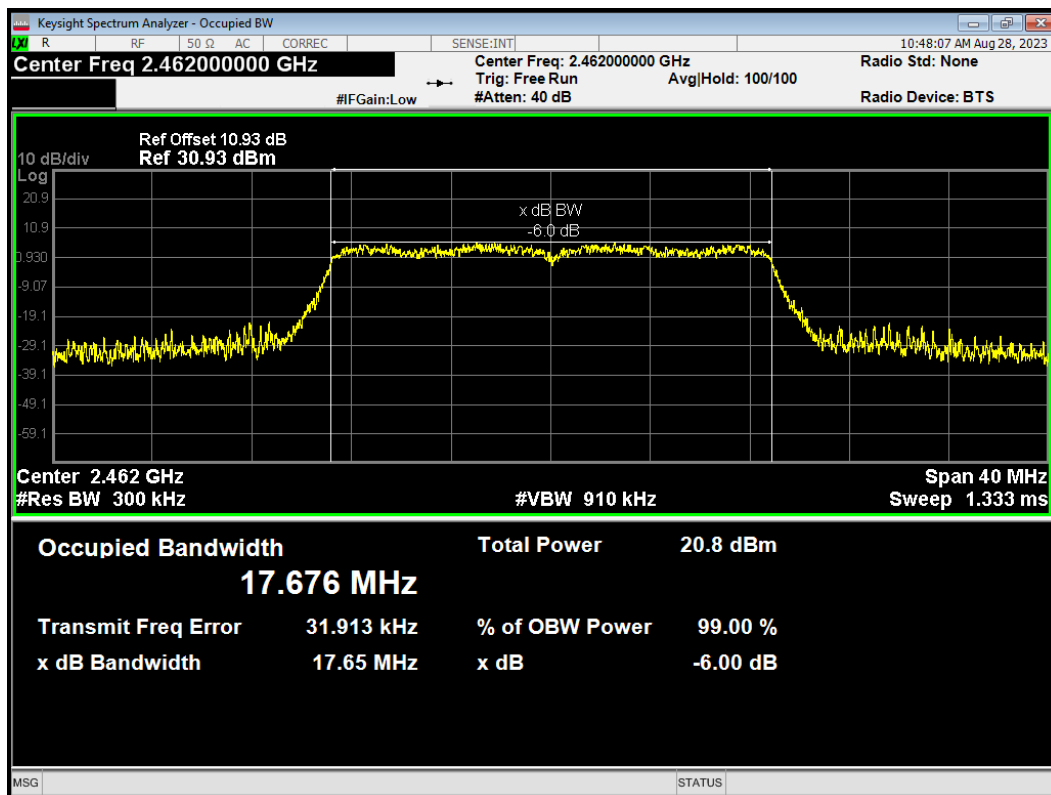
OBW 802.11n(HT20) 2412MHz



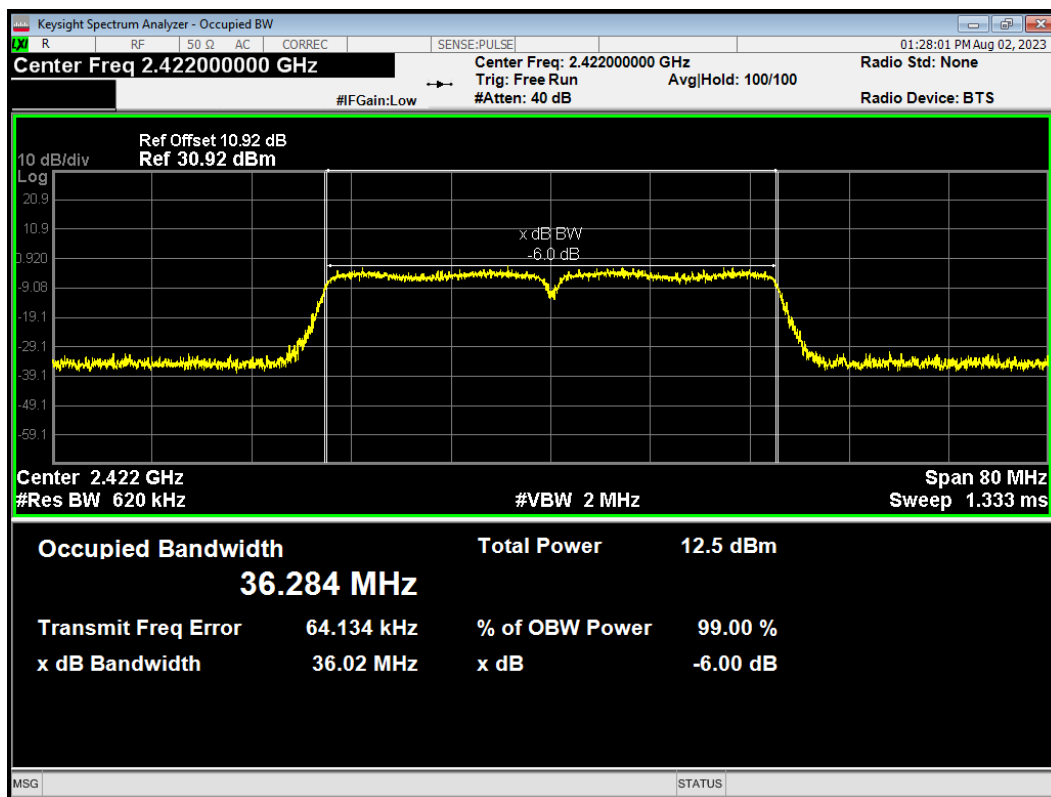
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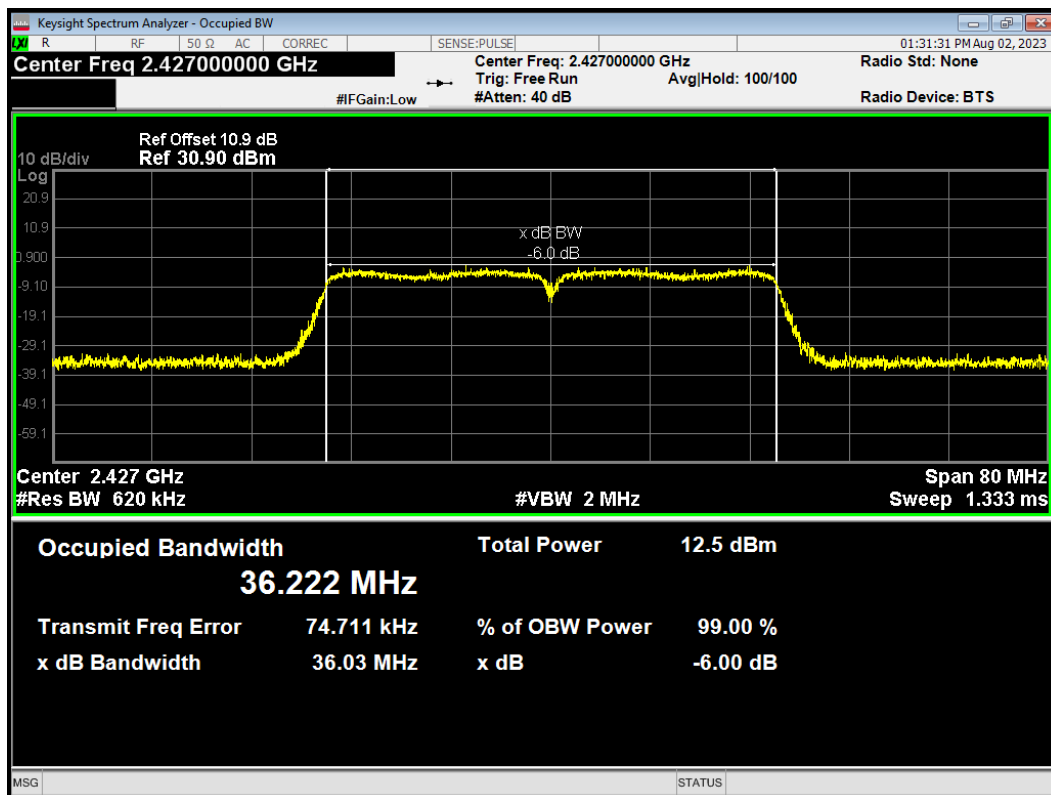
OBW 802.11n(HT20) 2462MHz



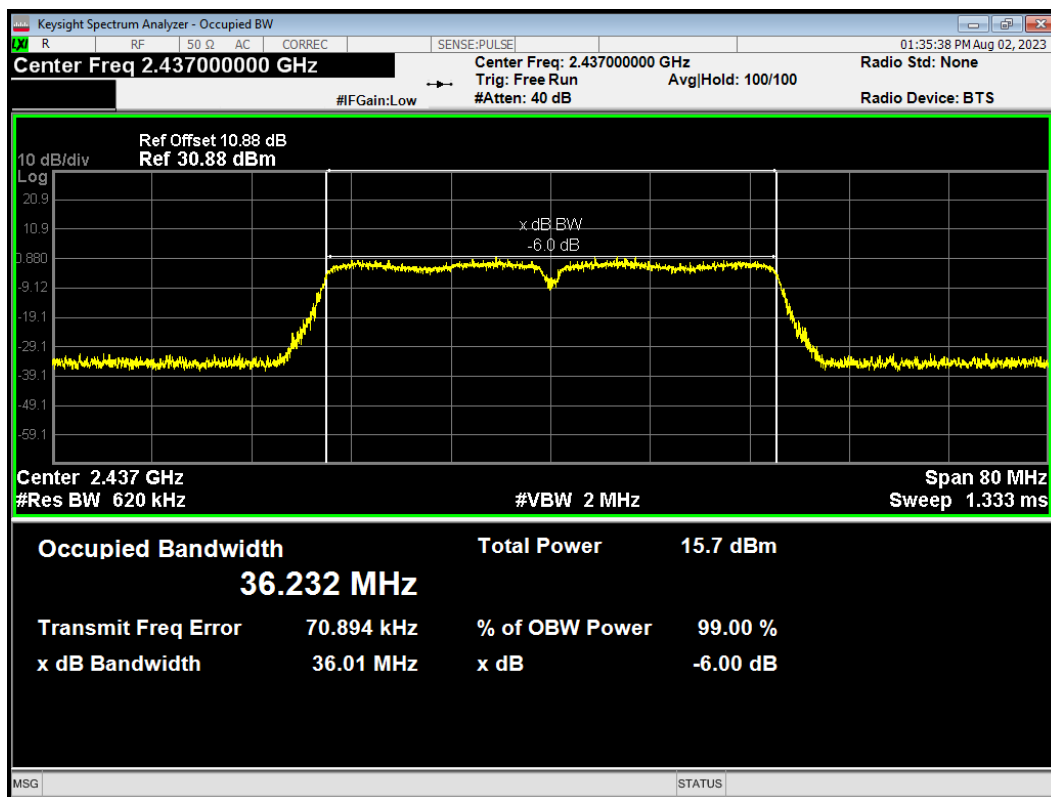
OBW 802.11n(HT40) 2422MHz



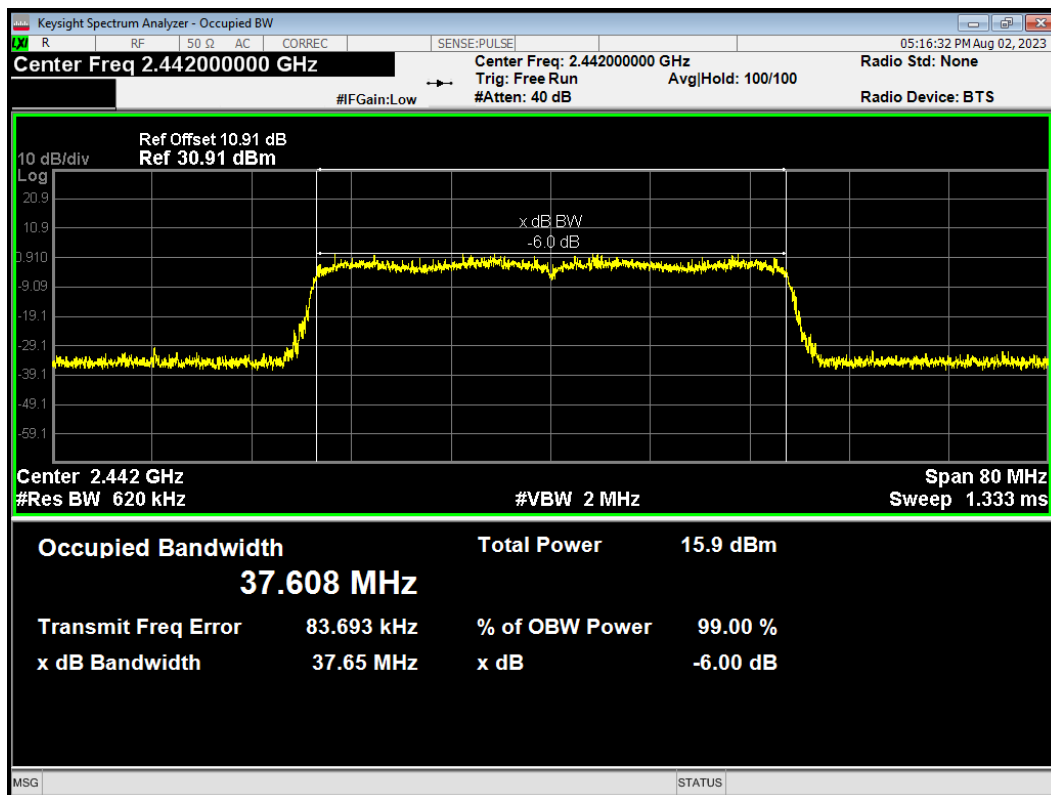
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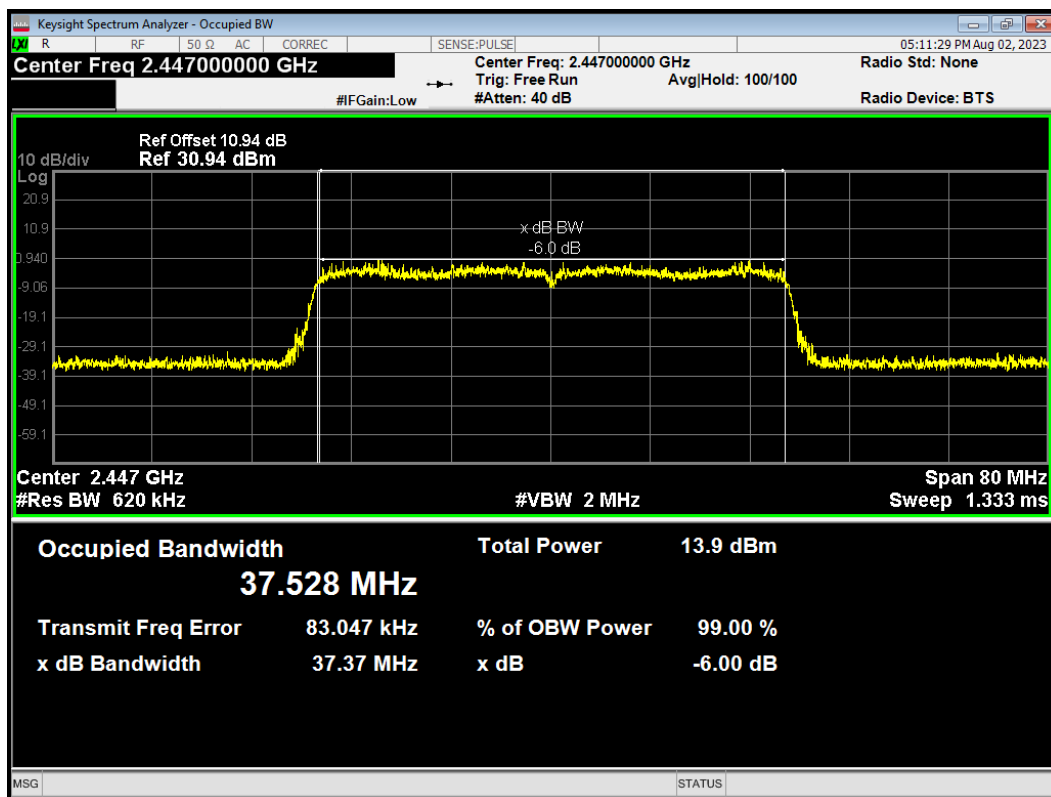
OBW 802.11n(HT40) 2437MHz



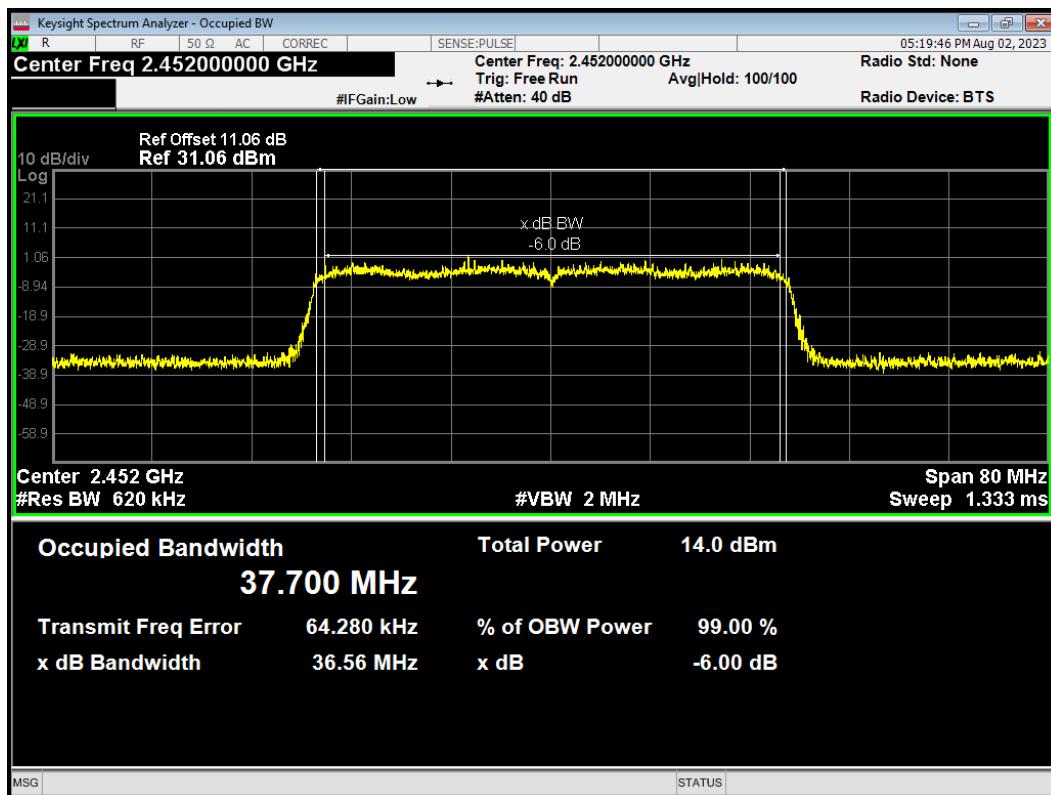
OBW 802.11n(HT40) 2442MHz



OBW 802.11n(HT40) 2447MHz

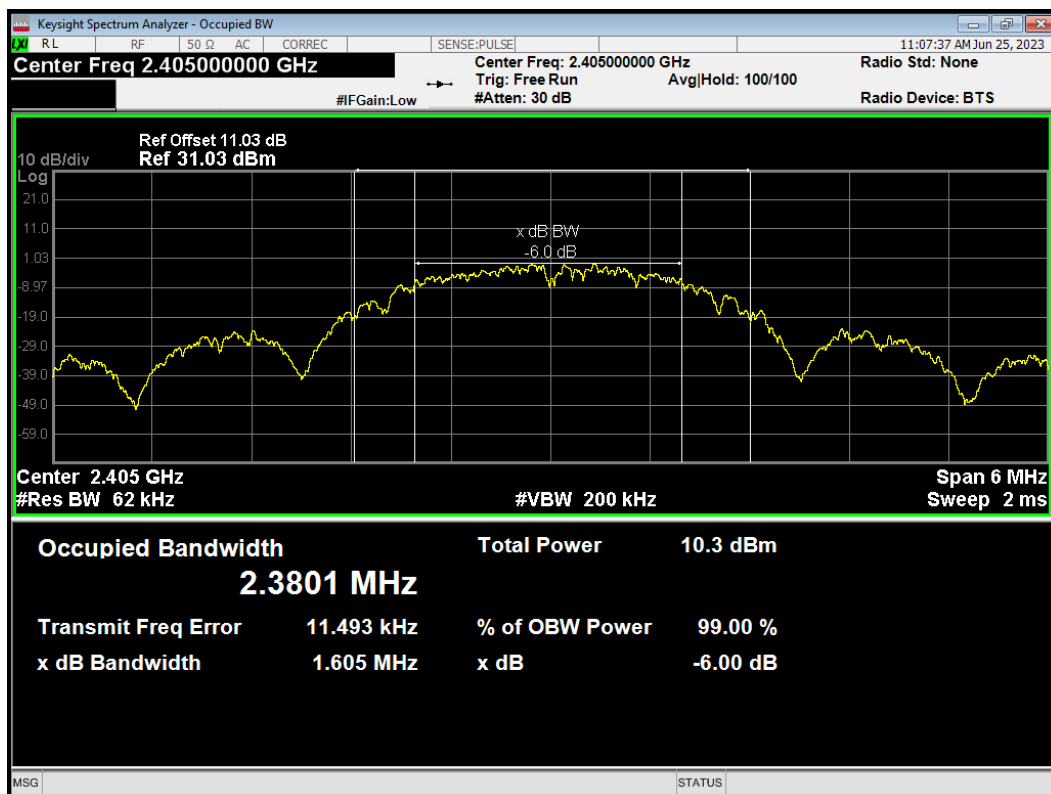


OBW 802.11n(HT40) 2452MHz

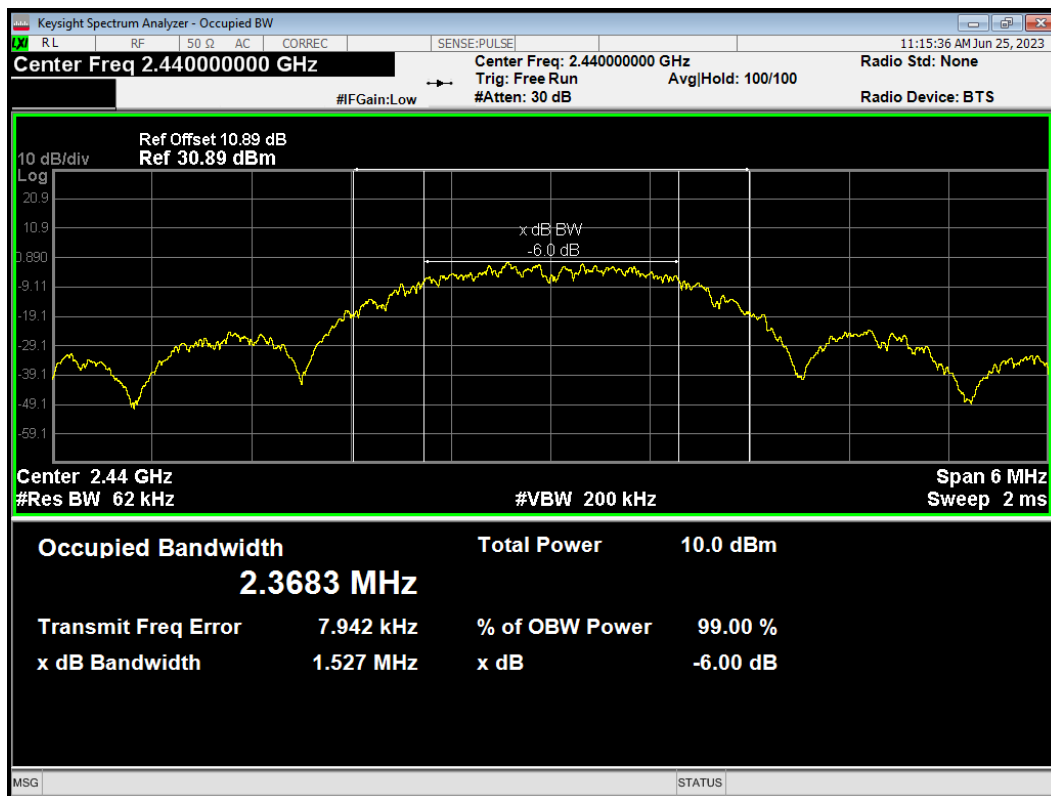


# Thread

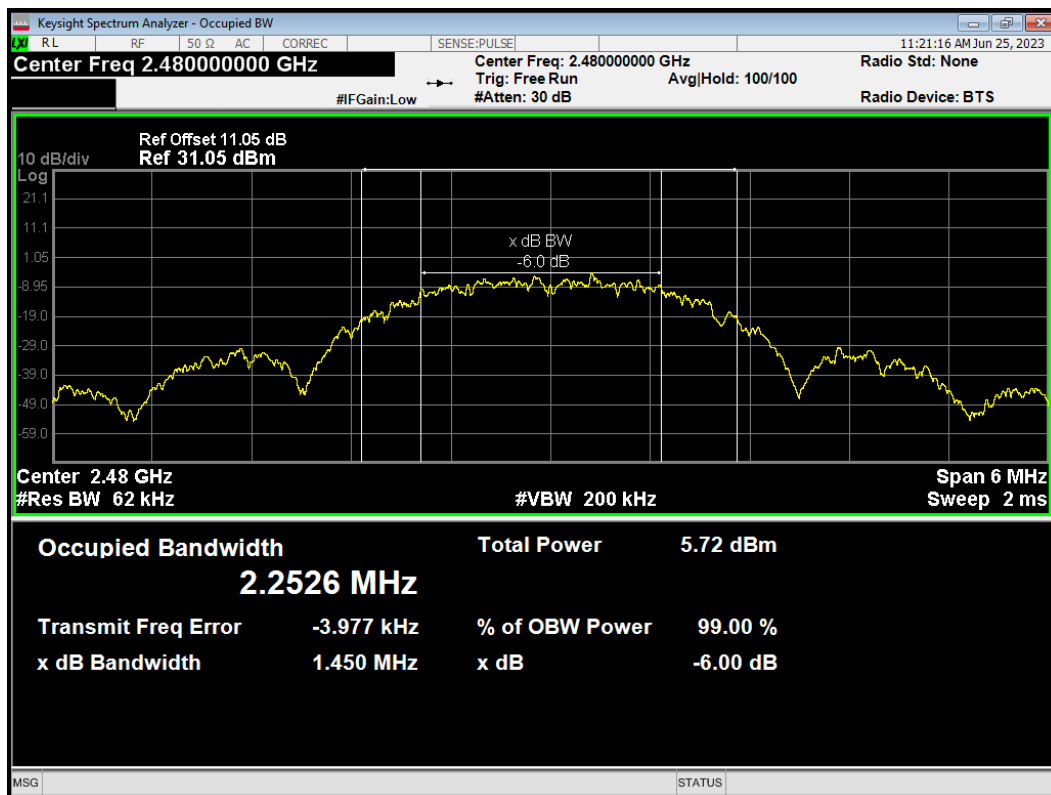
## OBW thread 2405MHz



## OBW thread 2440MHz

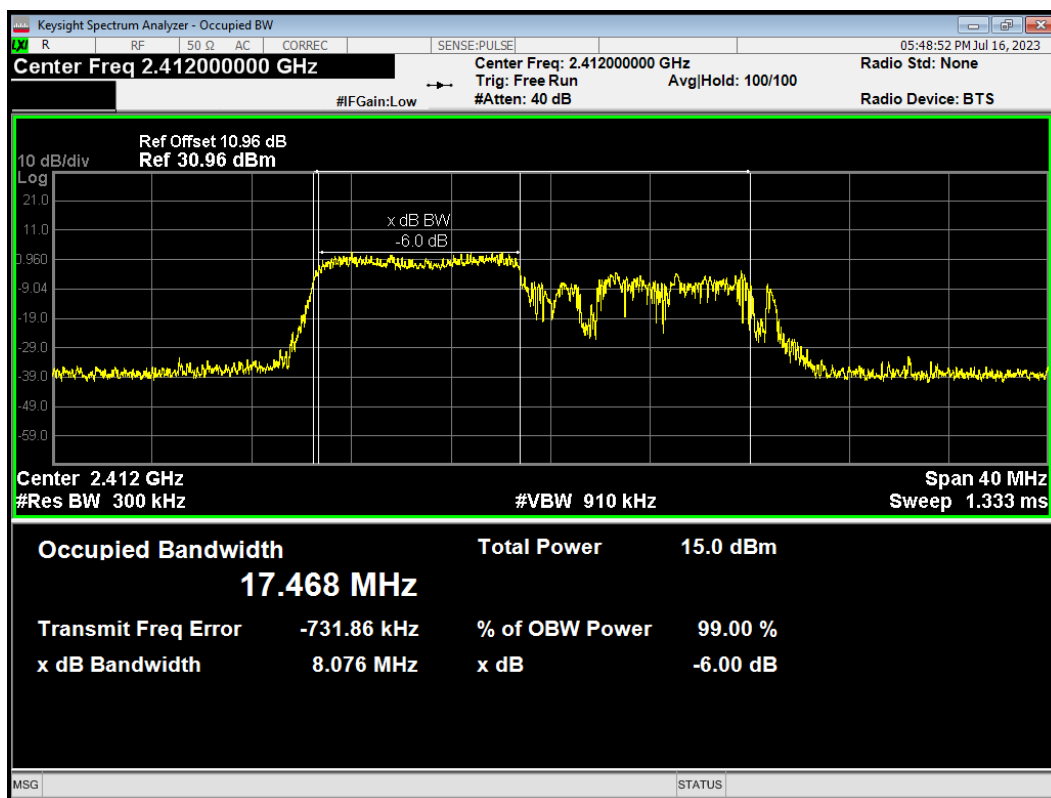


OBW thread 2480MHz

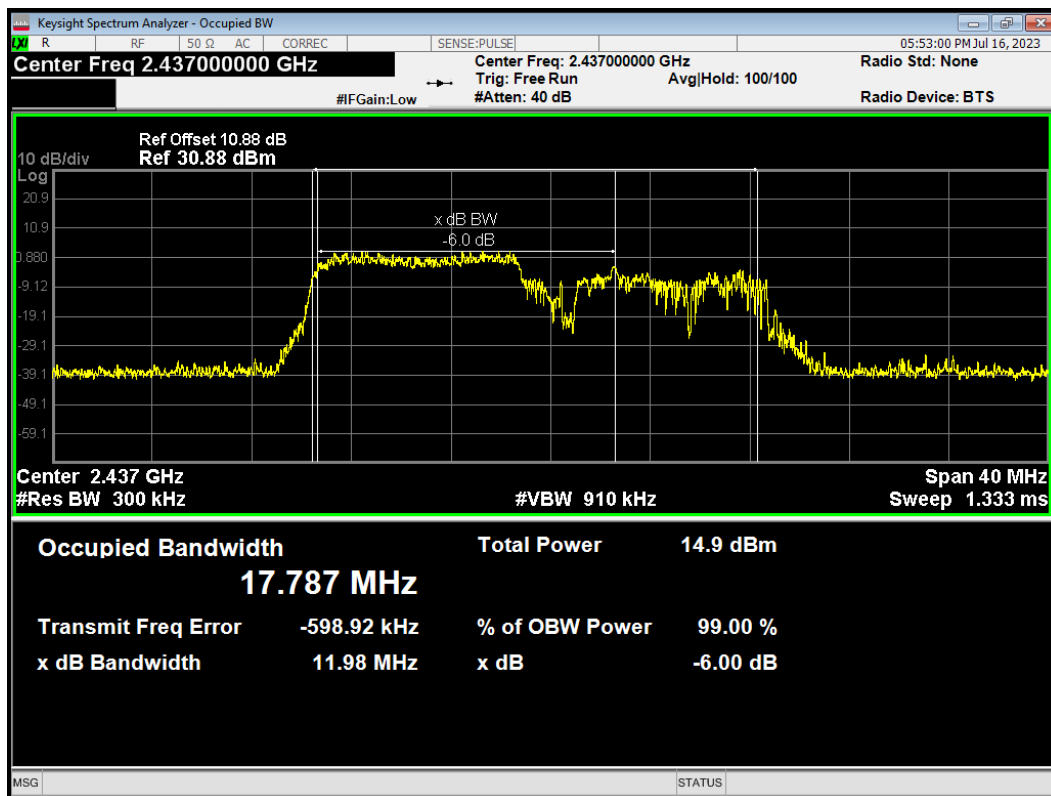


TB Mode

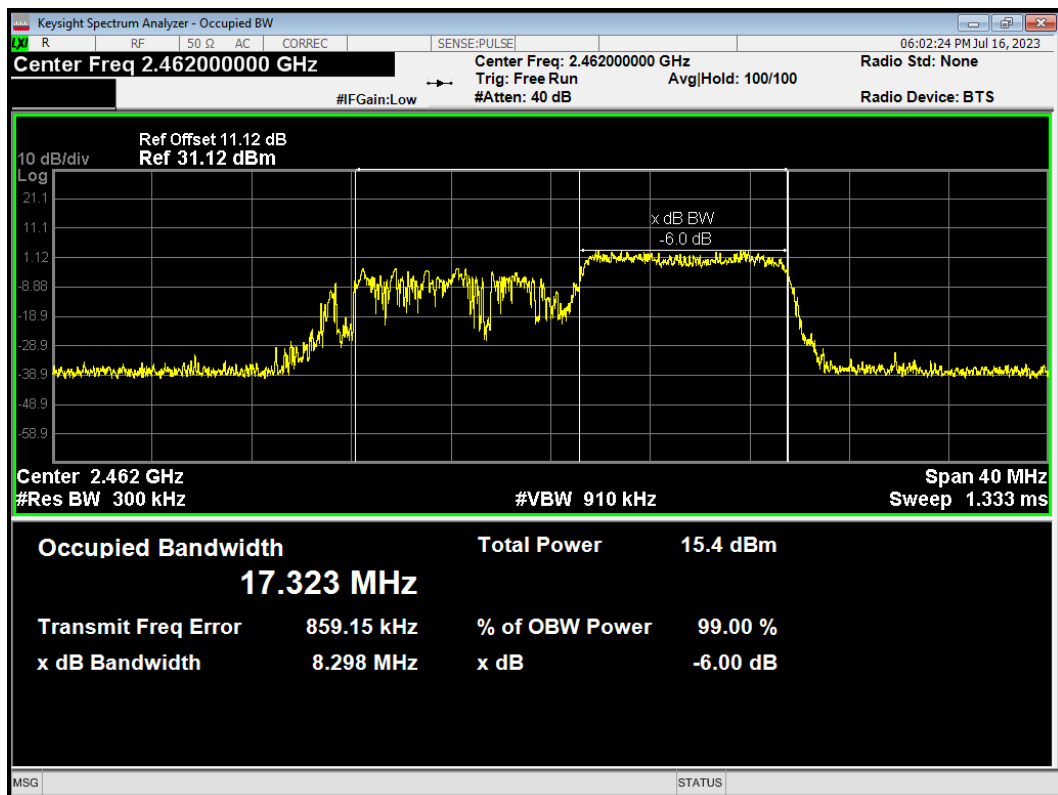
OBW 802.11ax HE20 106-Tones 2412MHz



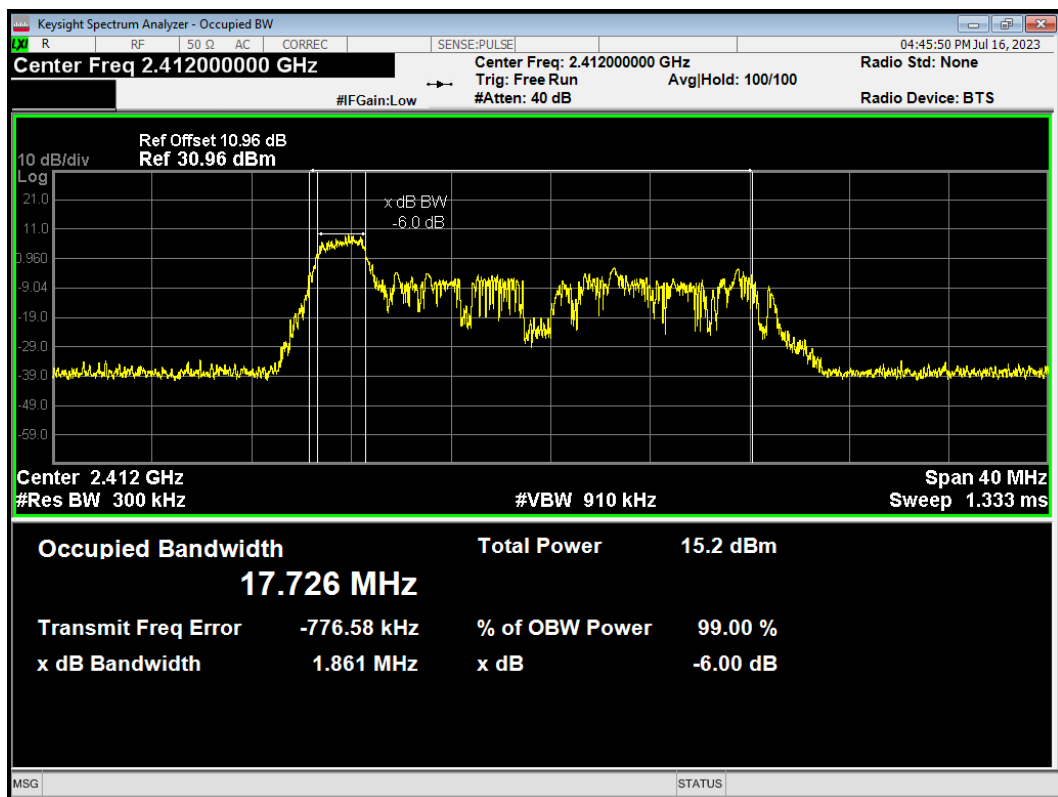
OBW 802.11ax HE20 106-Tones 2437MHz



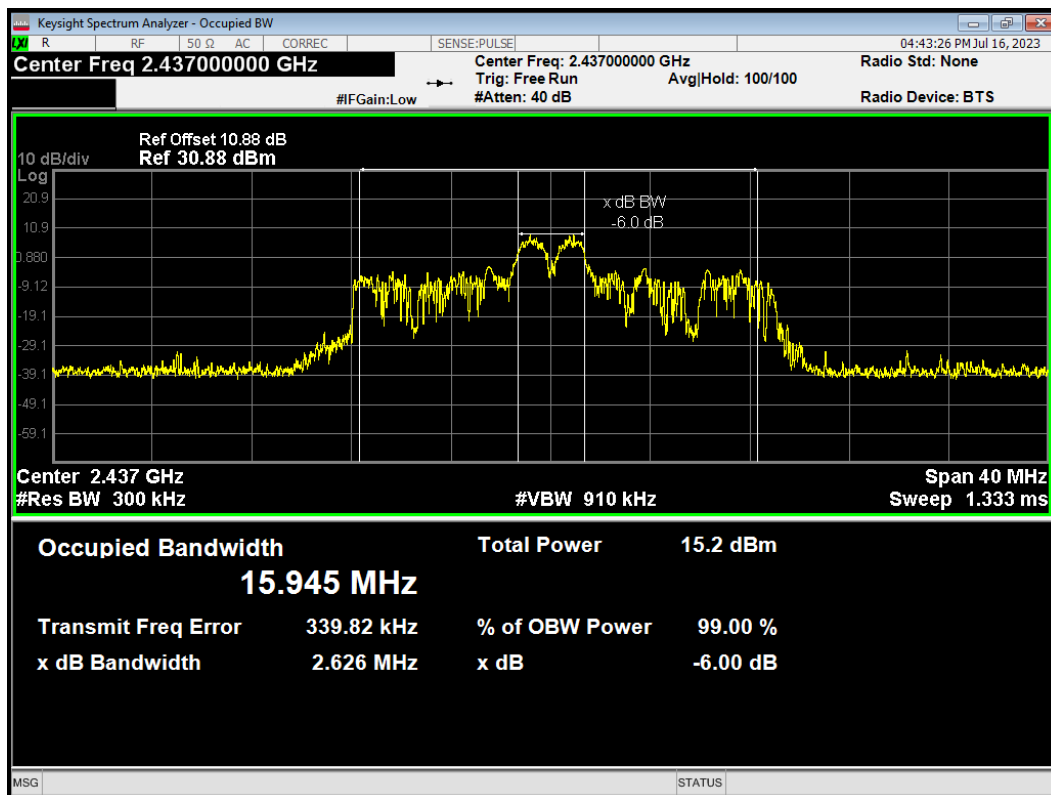
OBW 802.11ax HE20 106-Tones 2462MHz



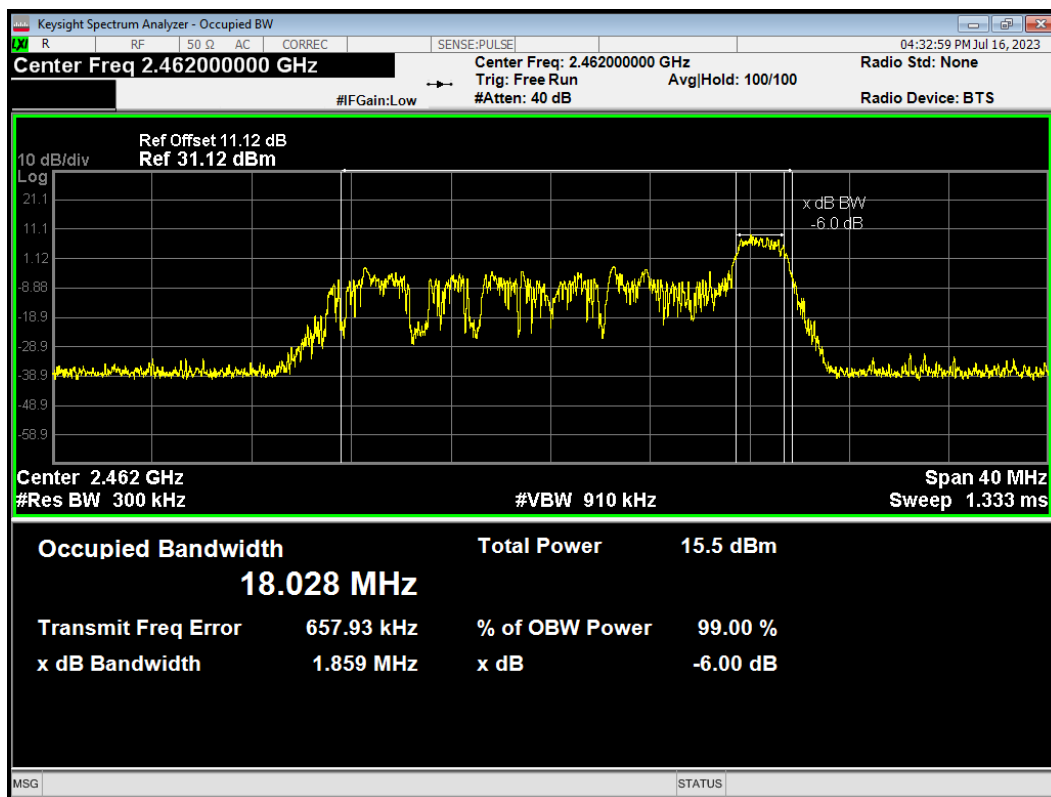
OBW 802.11ax HE20 26-Tones 2412MHz



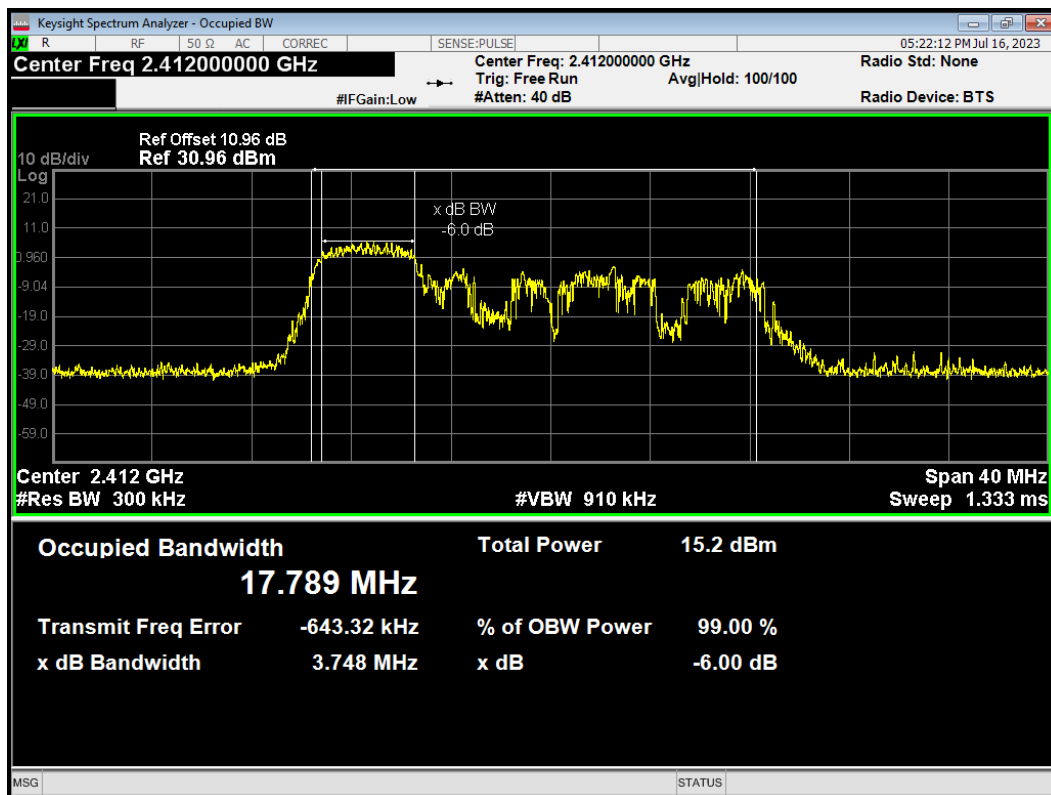
OBW 802.11ax HE20 26-Tones 2437MHz



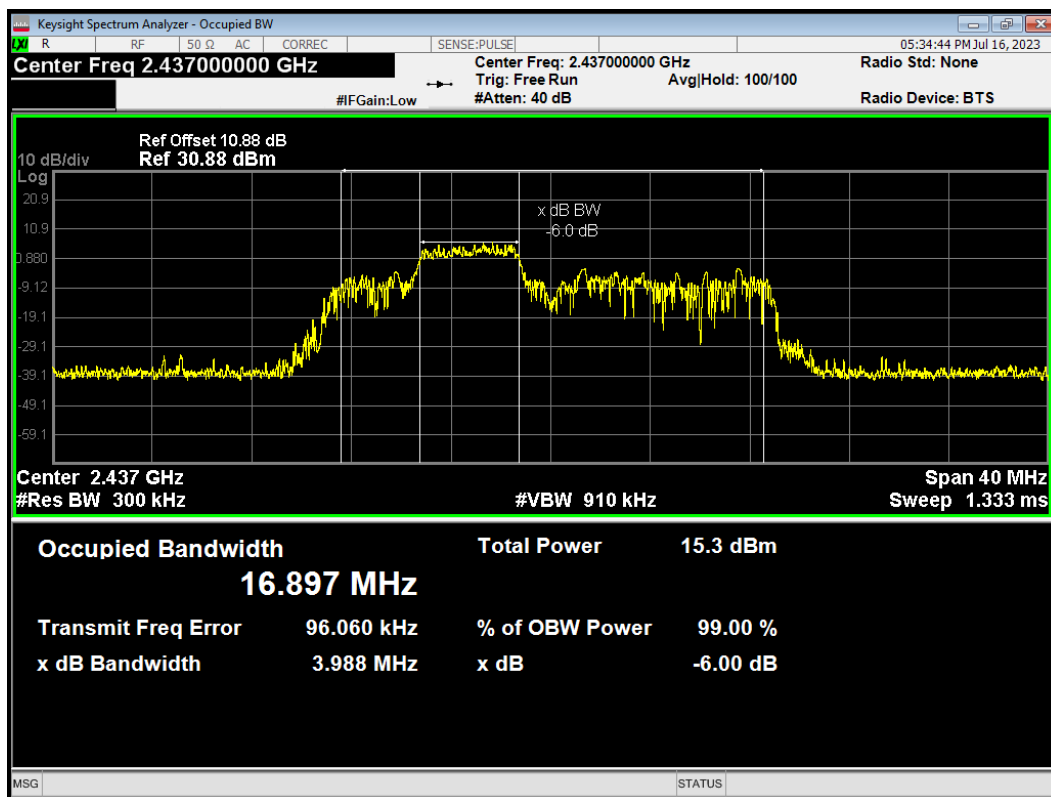
OBW 802.11ax HE20 26-Tones 2462MHz



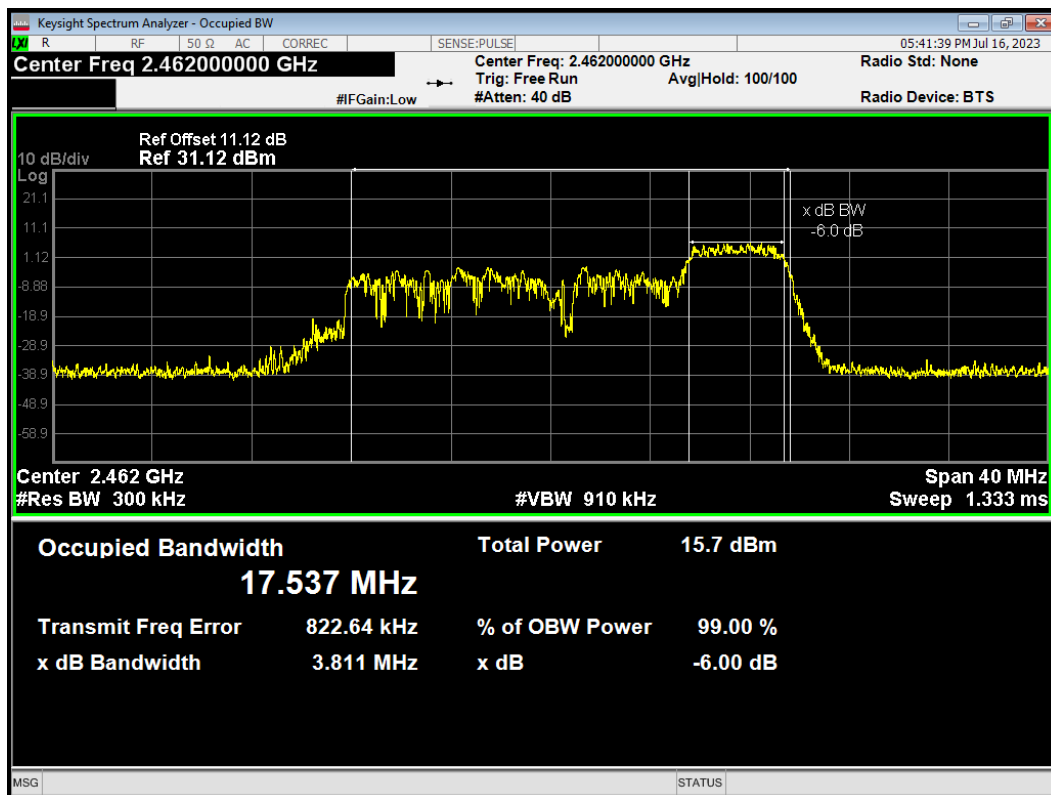
OBW 802.11ax HE20 52-Tones 2412MHz



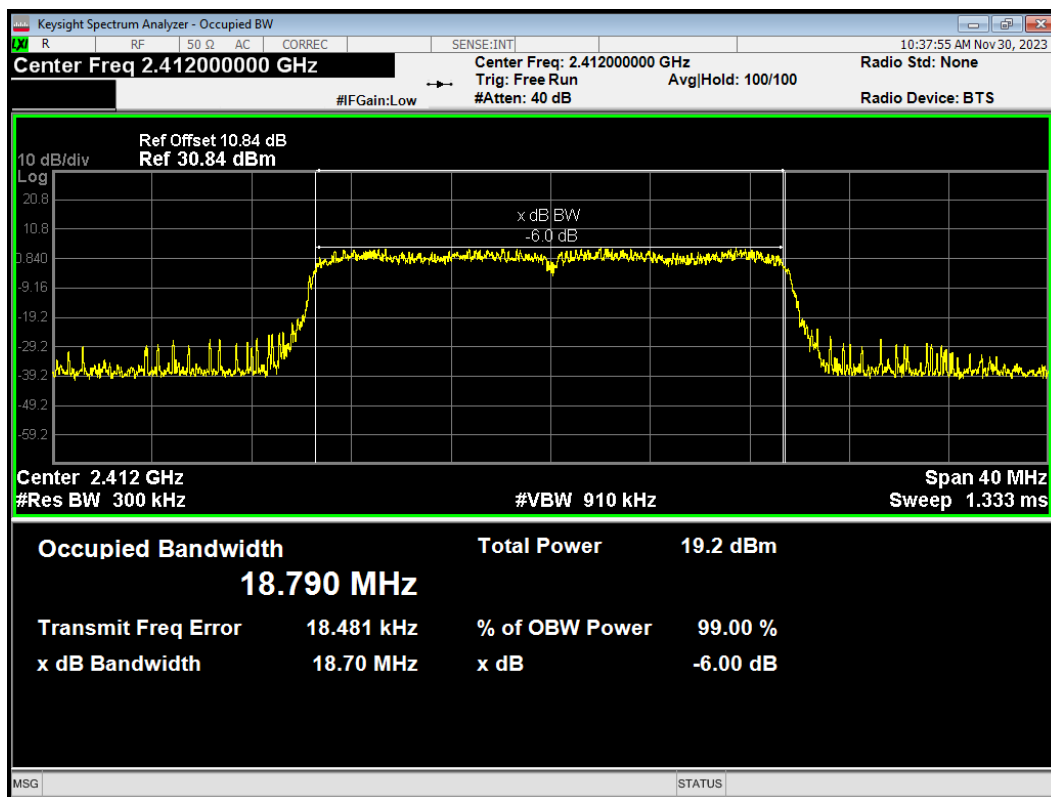
OBW 802.11ax HE20 52-Tones 2437MHz



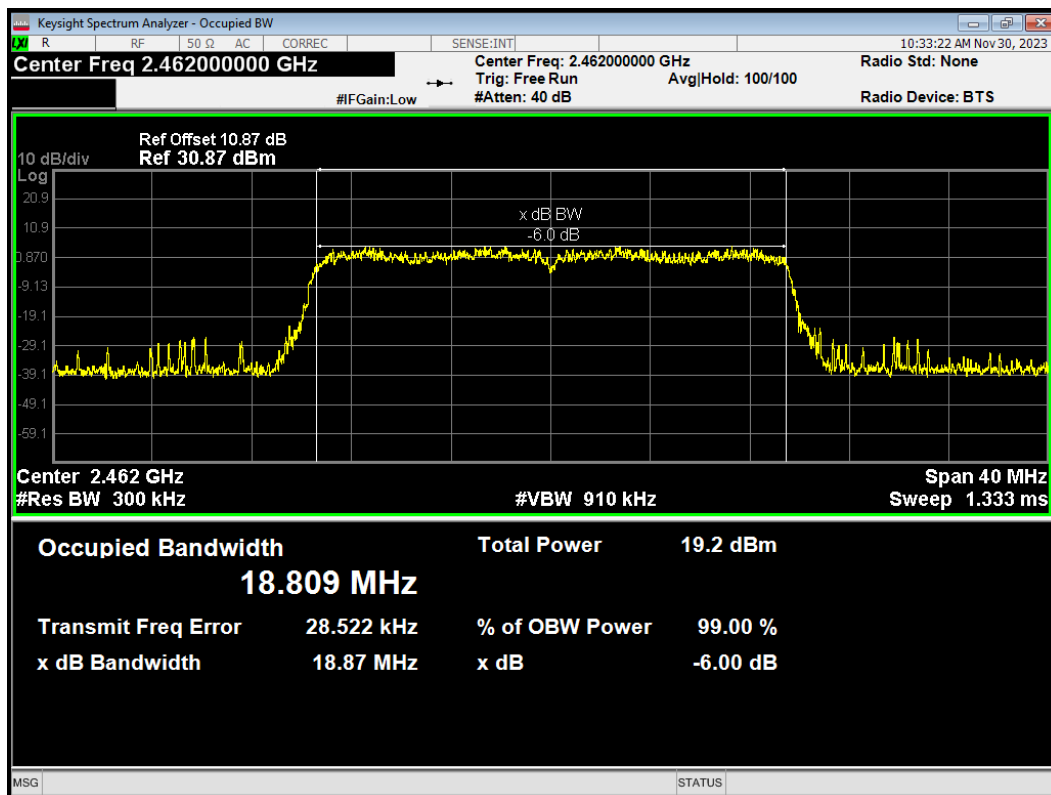
OBW 802.11ax HE20 52-Tones 2462MHz



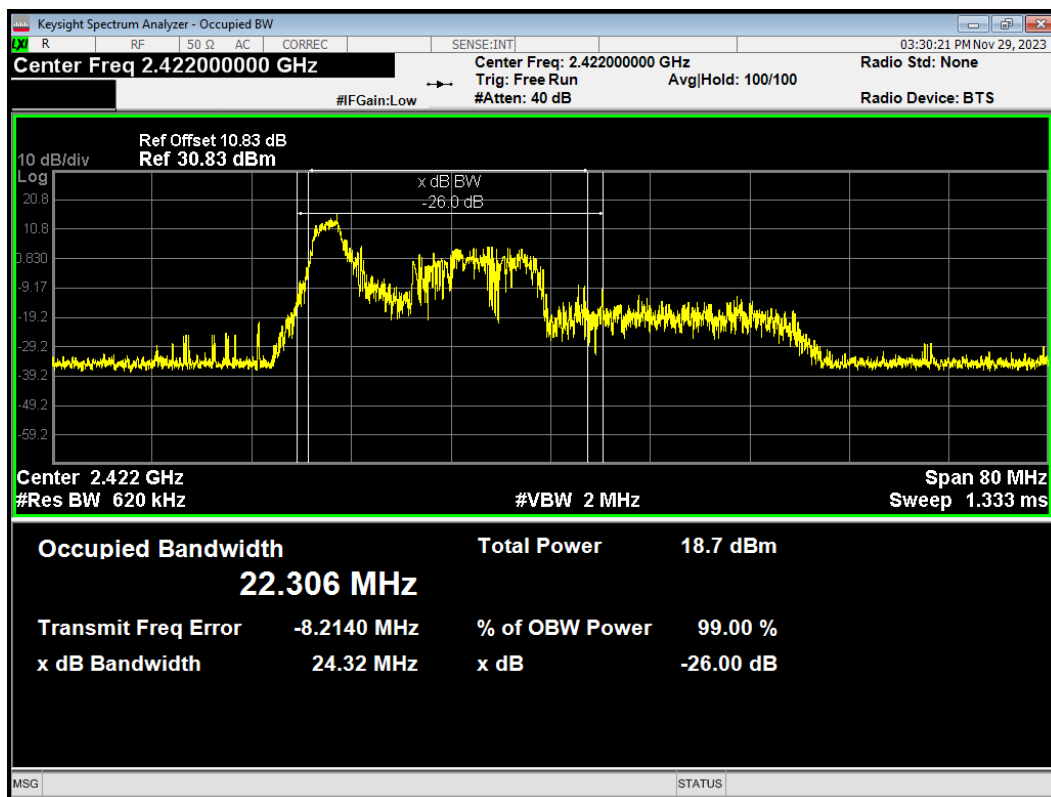
OBW 802.11ax HE20 242-Tones 2412MHz



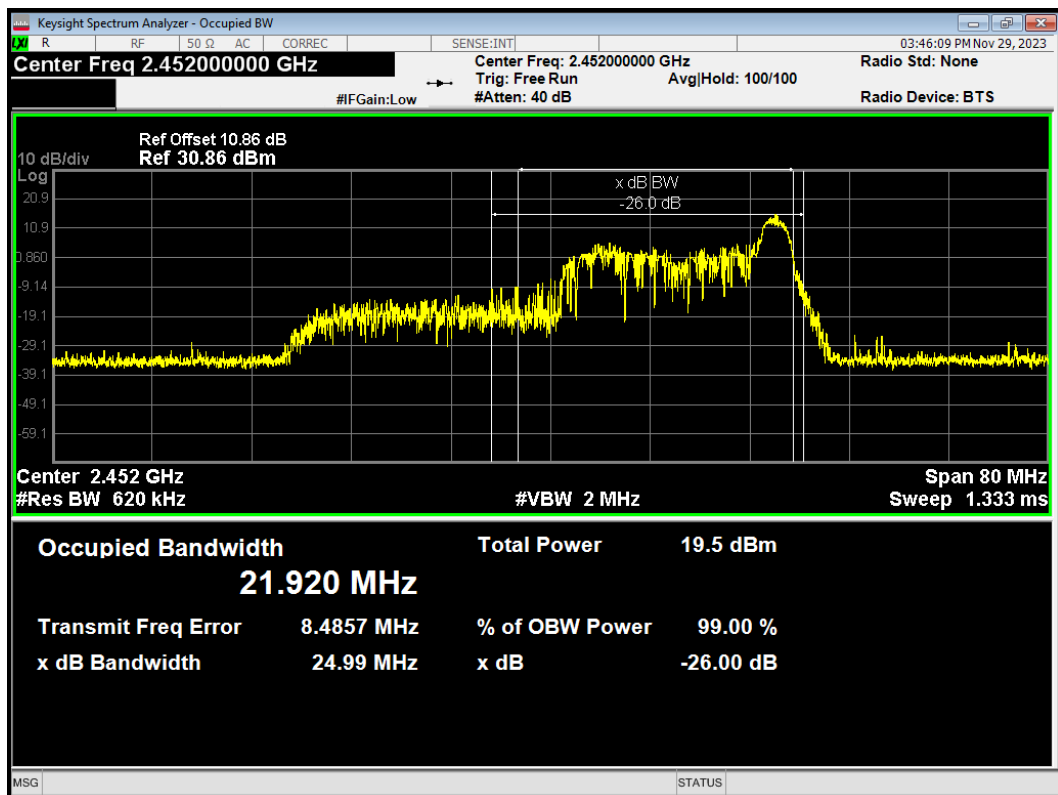
OBW 802.11ax HE20 242-Tones 2462MHz



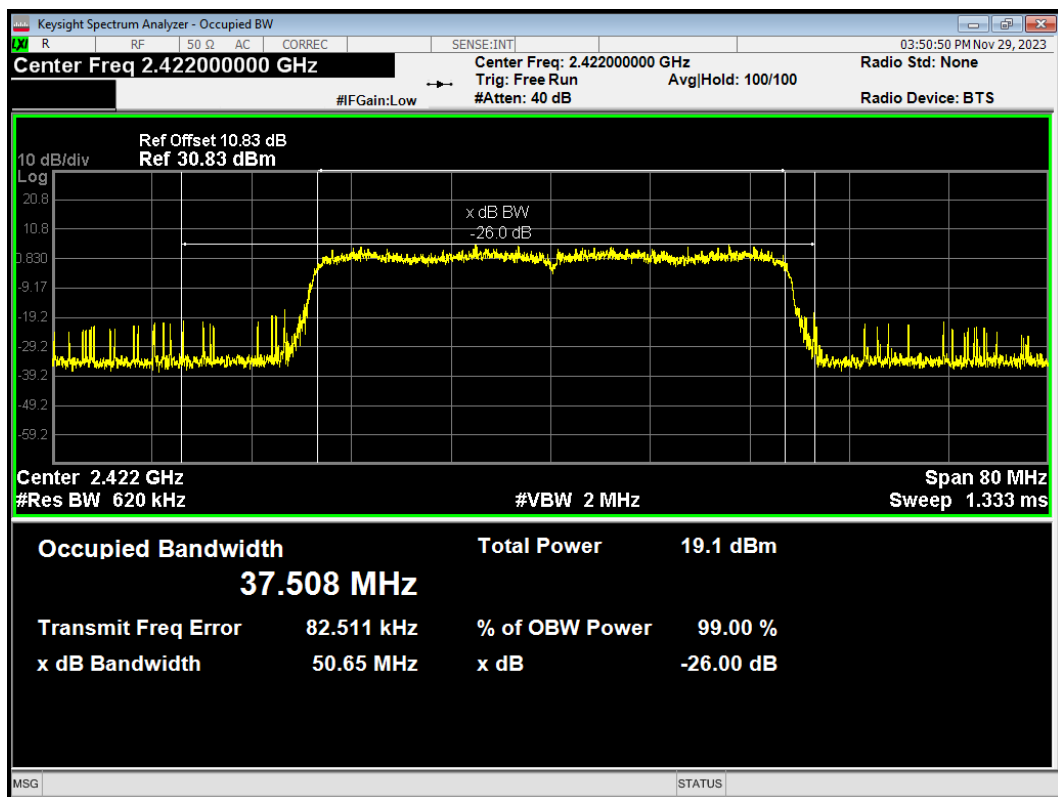
OBW 802.11ax HE40 26-Tones 2422MHz



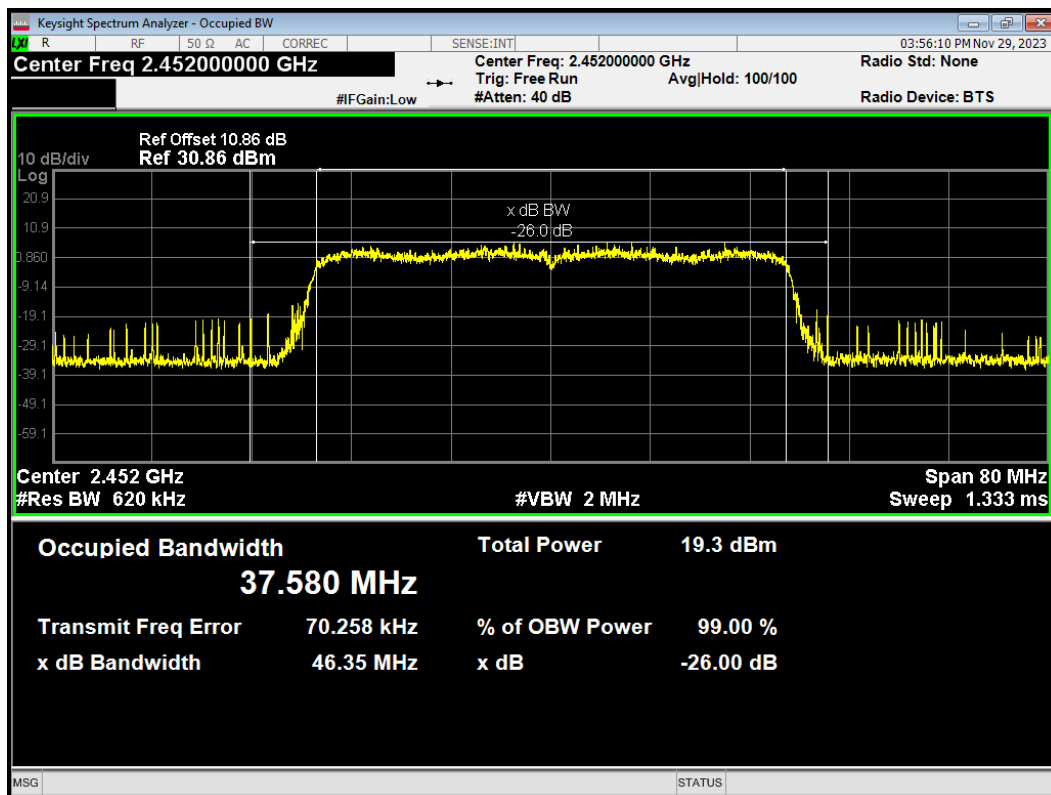
OBW 802.11ax HE40 26-Tones 2452MHz



OBW 802.11ax HE40 484-Tones 2422MHz

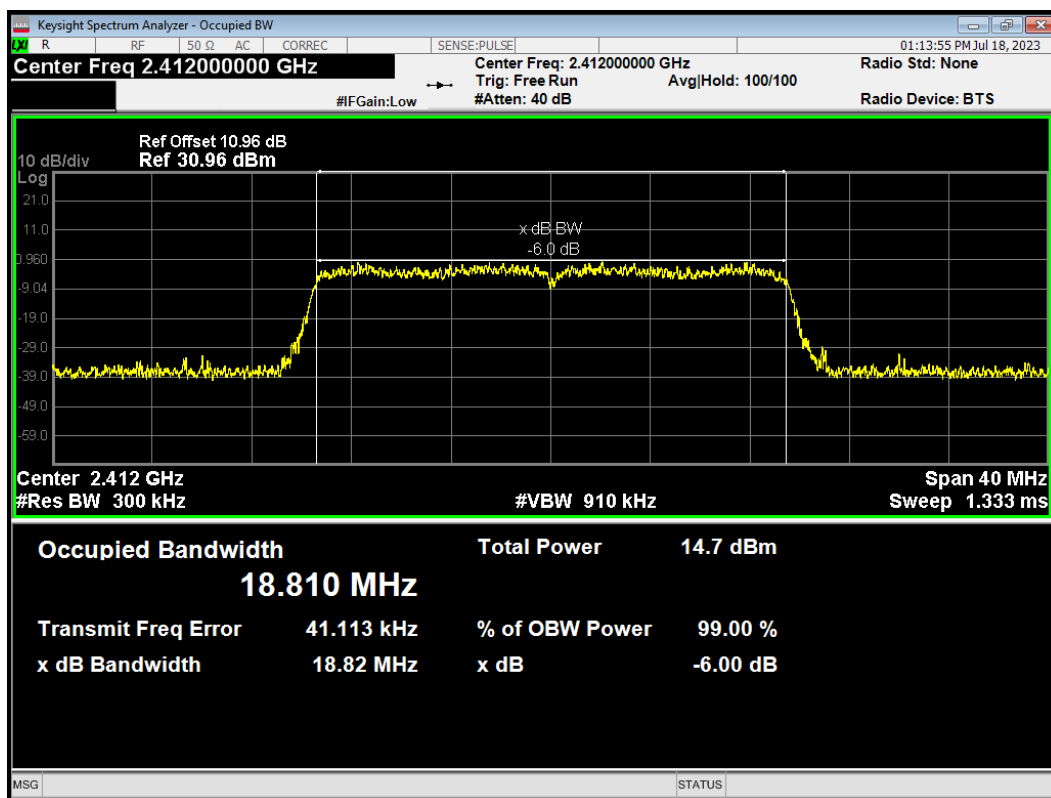


OBW 802.11ax HE40 484-Tones 2452MHz

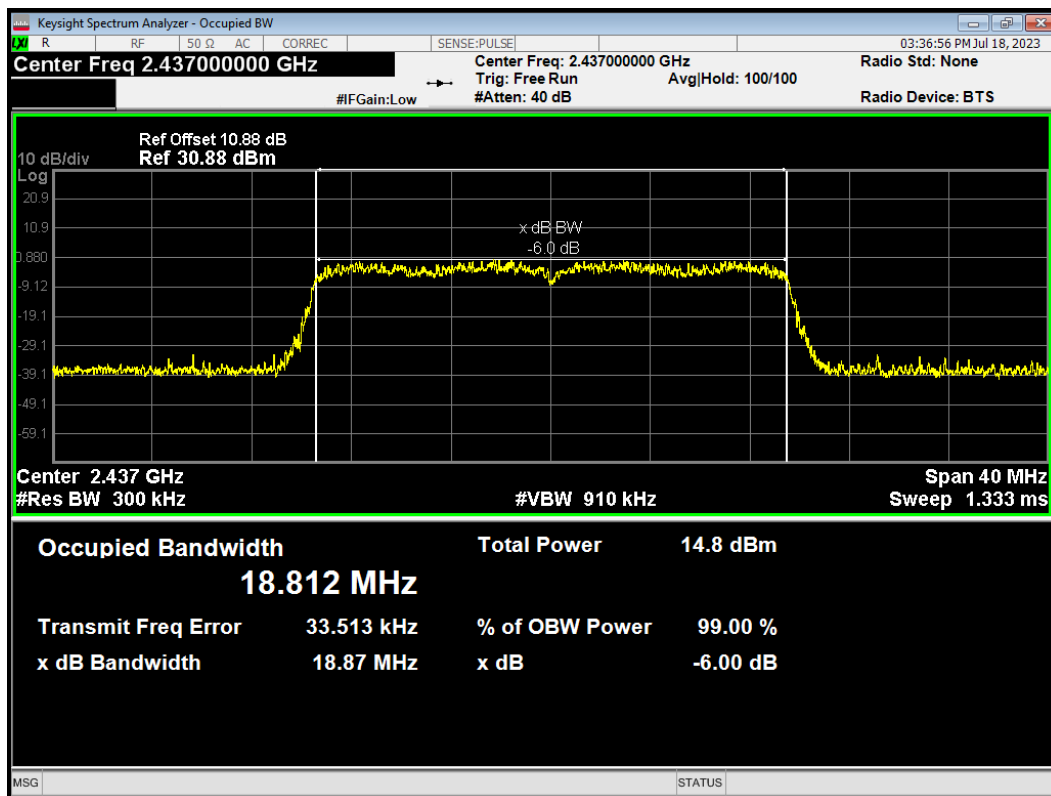


ERSU Mode

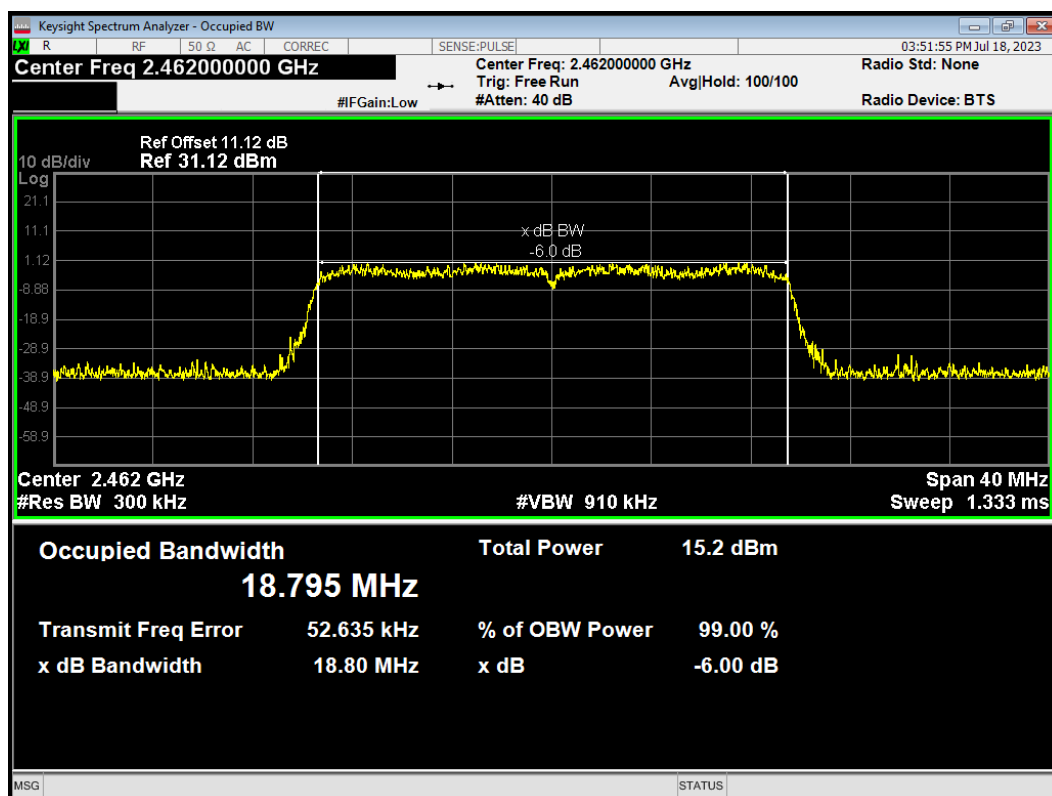
OBW 802.11ax HE20 242-Tones 2412MHz



OBW 802.11ax HE20 242-Tones 2437MHz

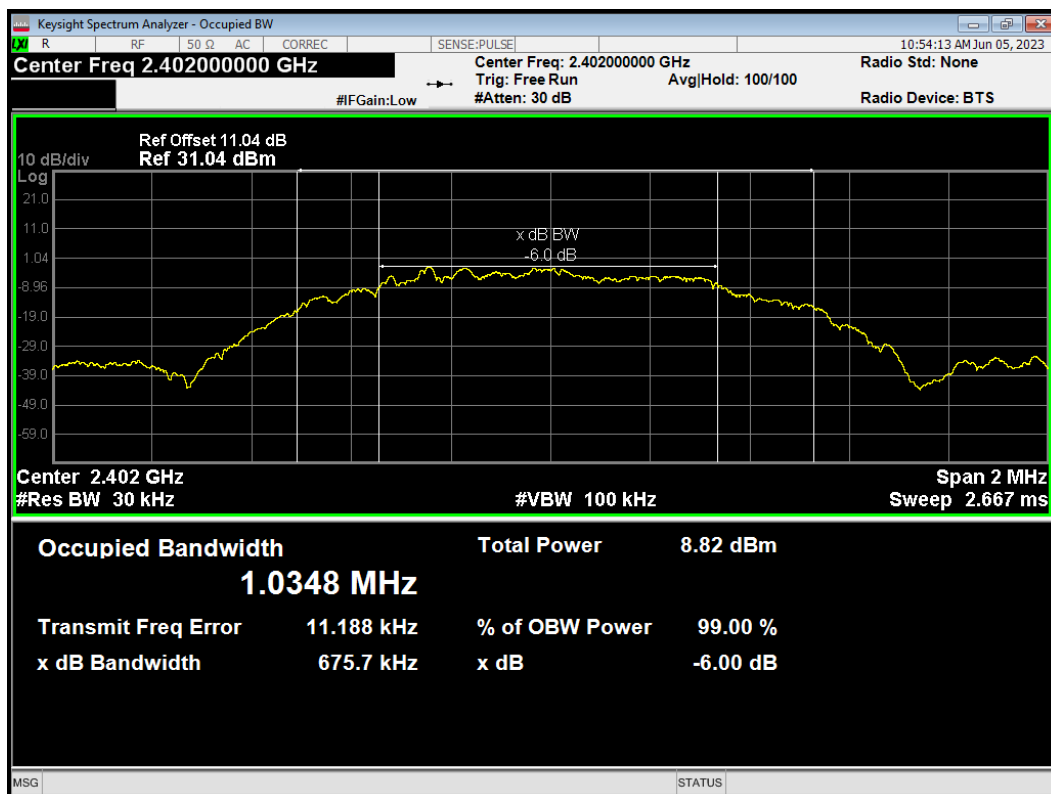


OBW 802.11ax HE20 242-Tones 2462MHz

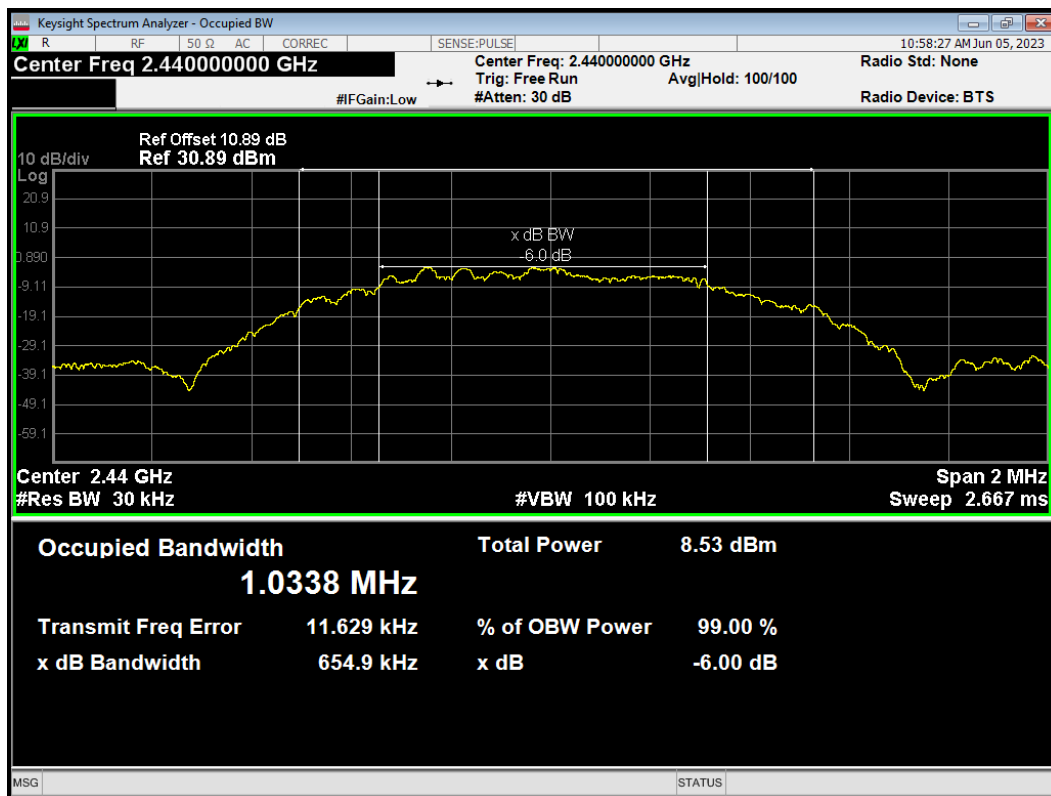


# Bluetooth LE

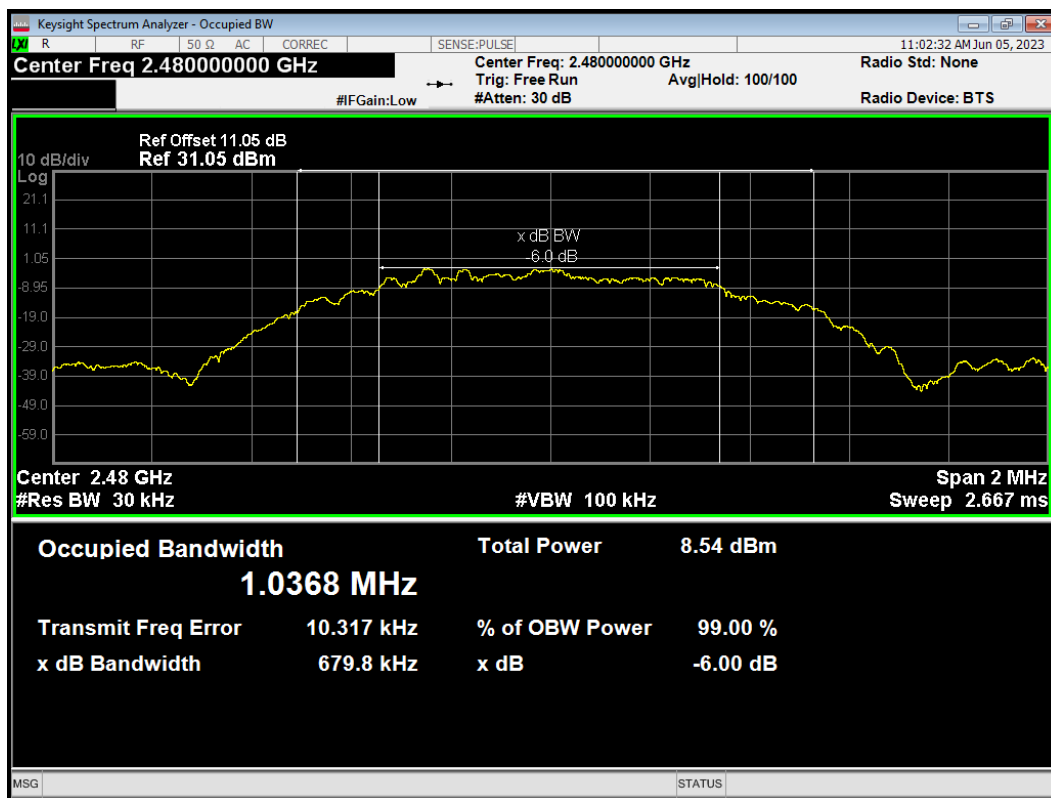
## OBW BLE (1M) 2402MHz



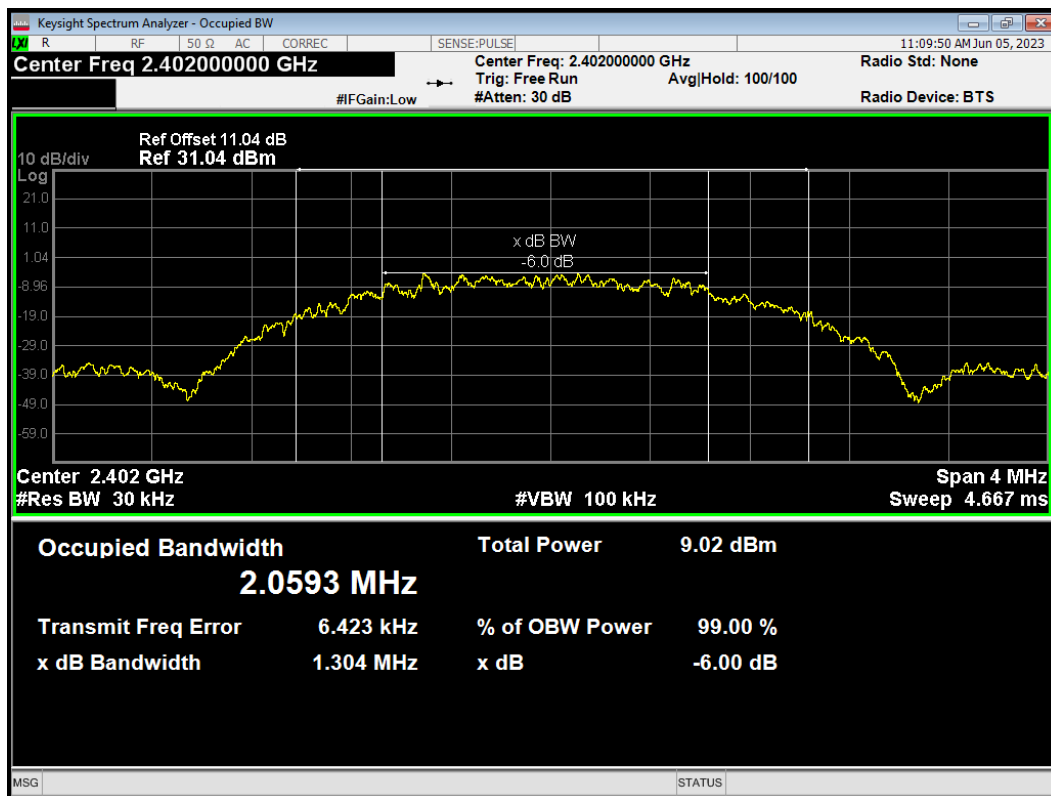
## OBW BLE (1M) 2440MHz



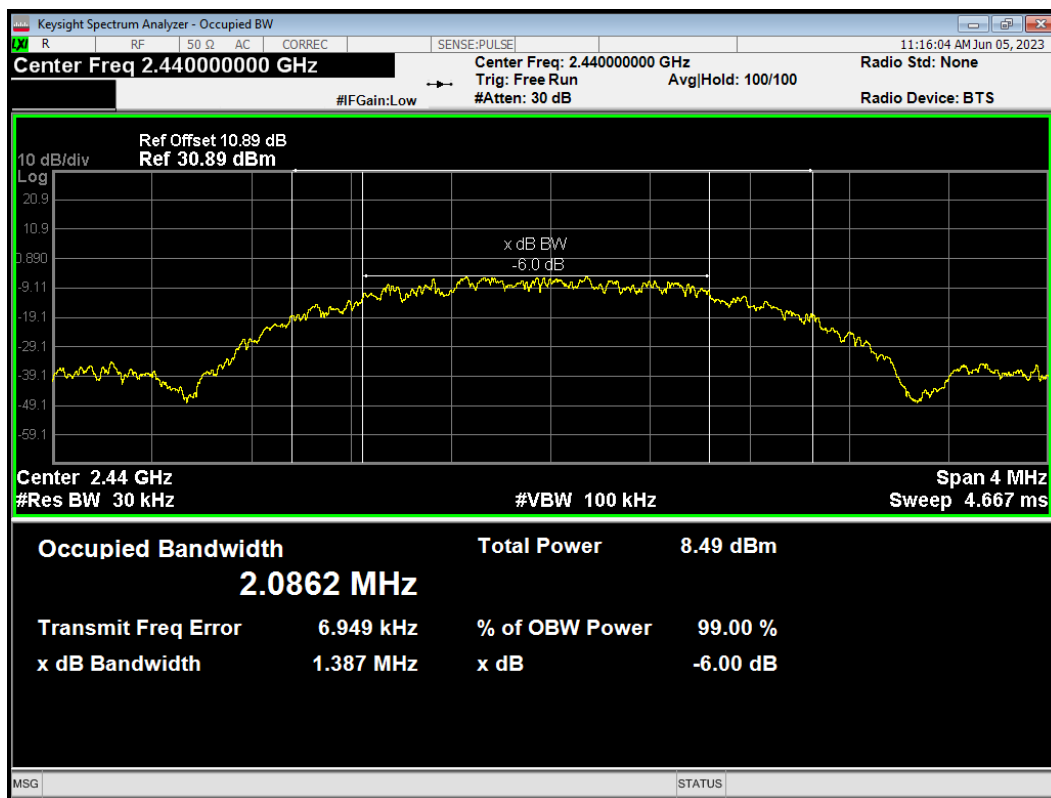
### OBW BLE (1M) 2480MHz



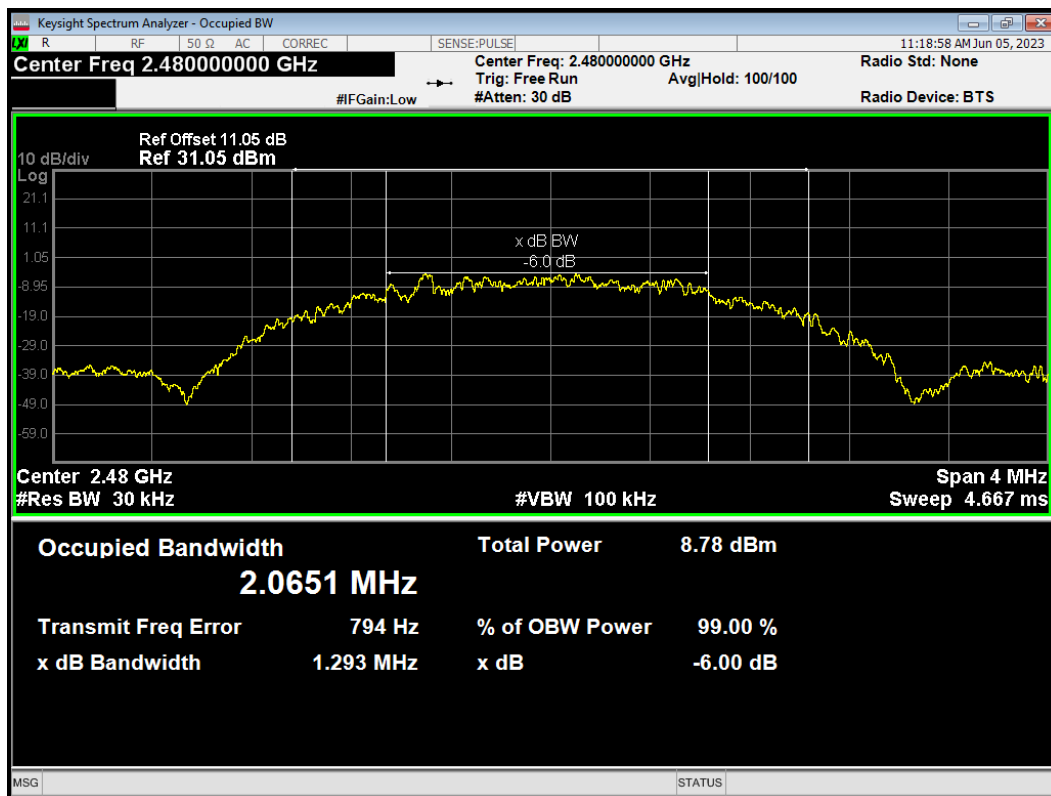
### OBW BLE (2M) 2402MHz



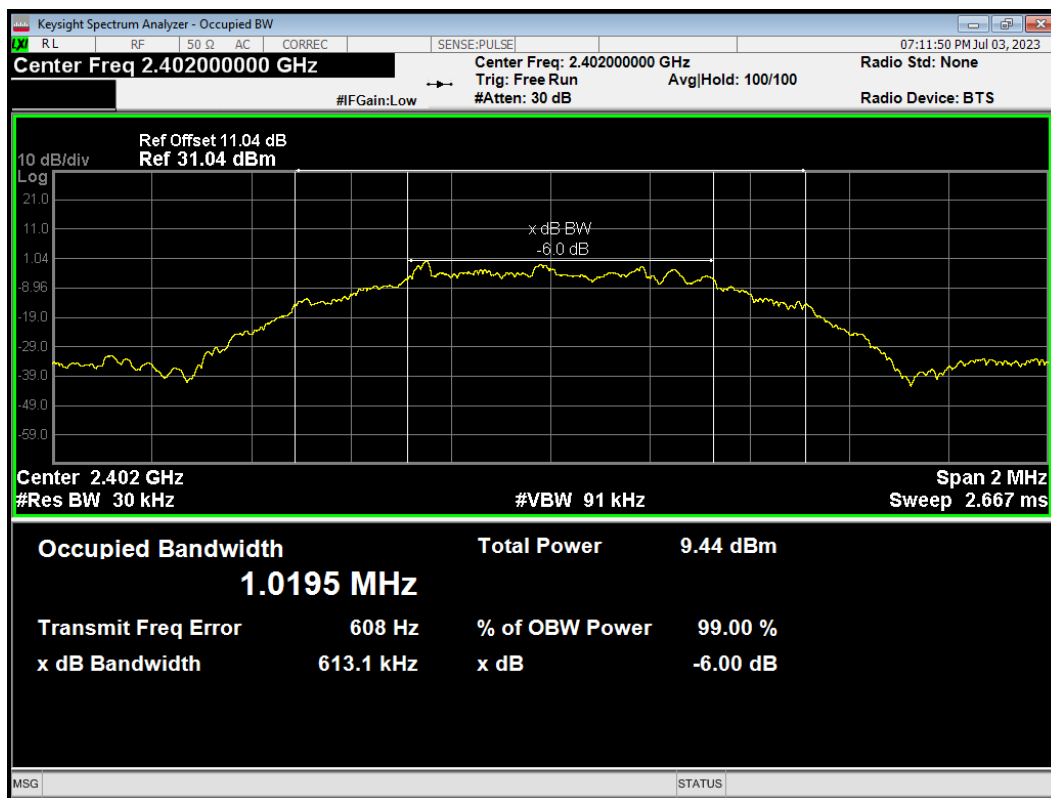
## OBW BLE (2M) 2440MHz



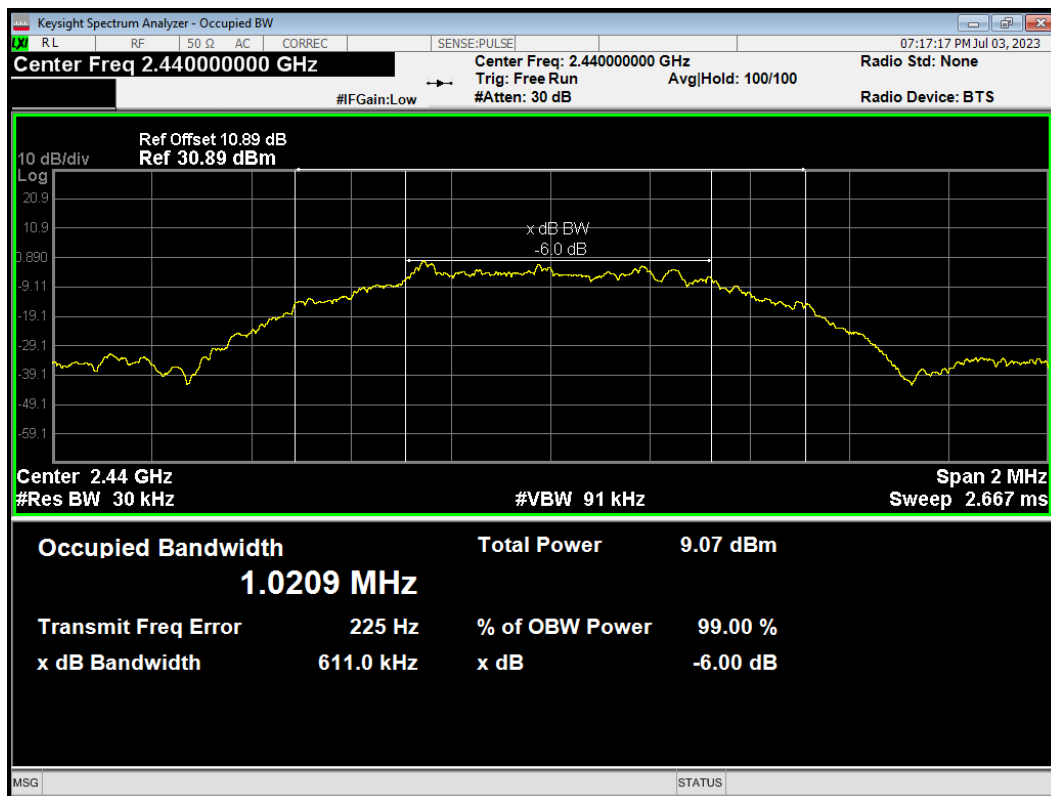
## OBW BLE (2M) 2480MHz



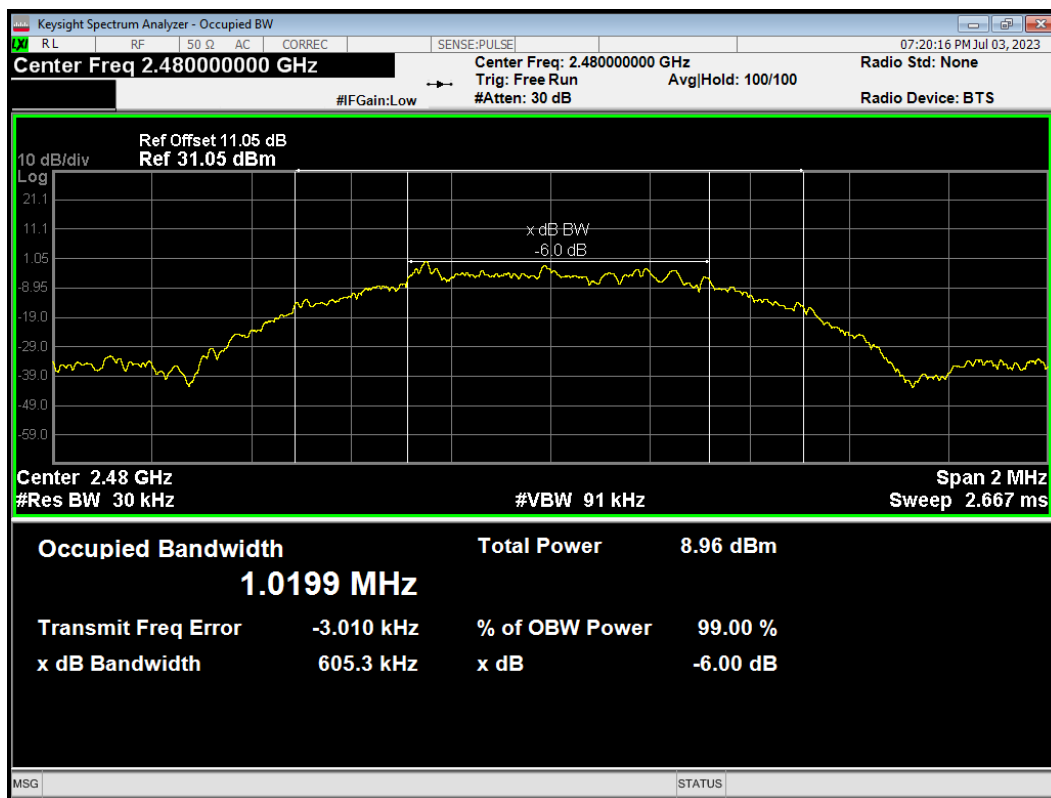
### OBW BLE (S=2) 2402MHz



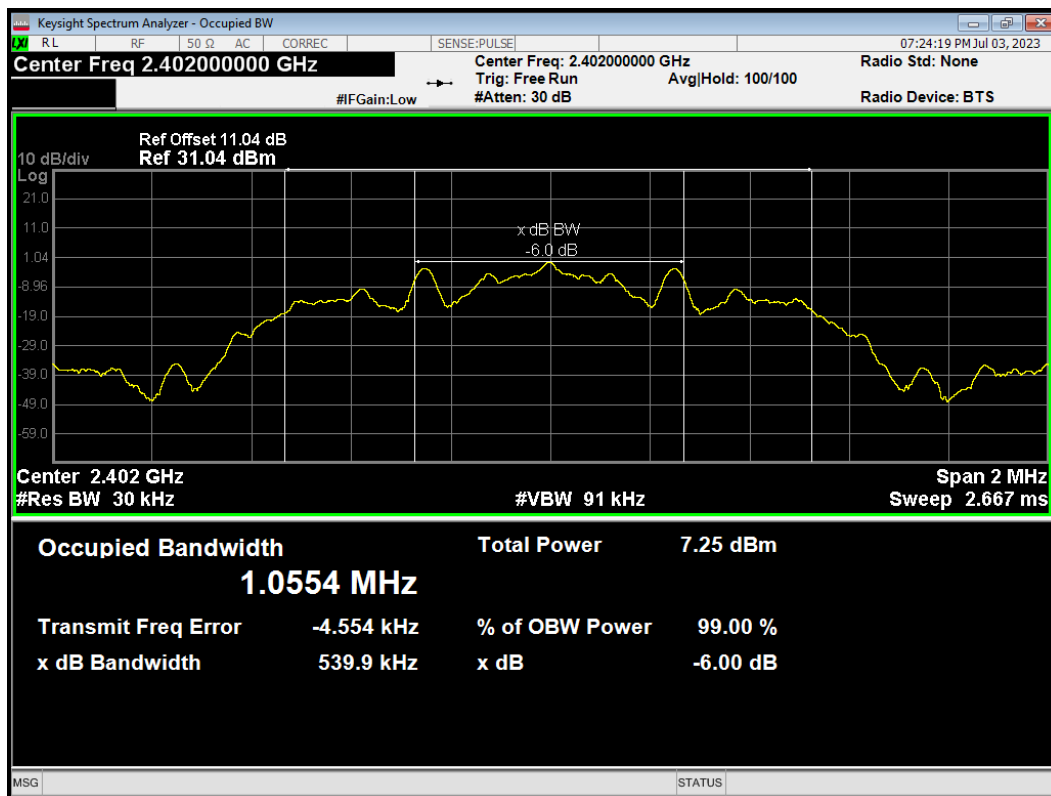
### OBW BLE (S=2) 2440MHz



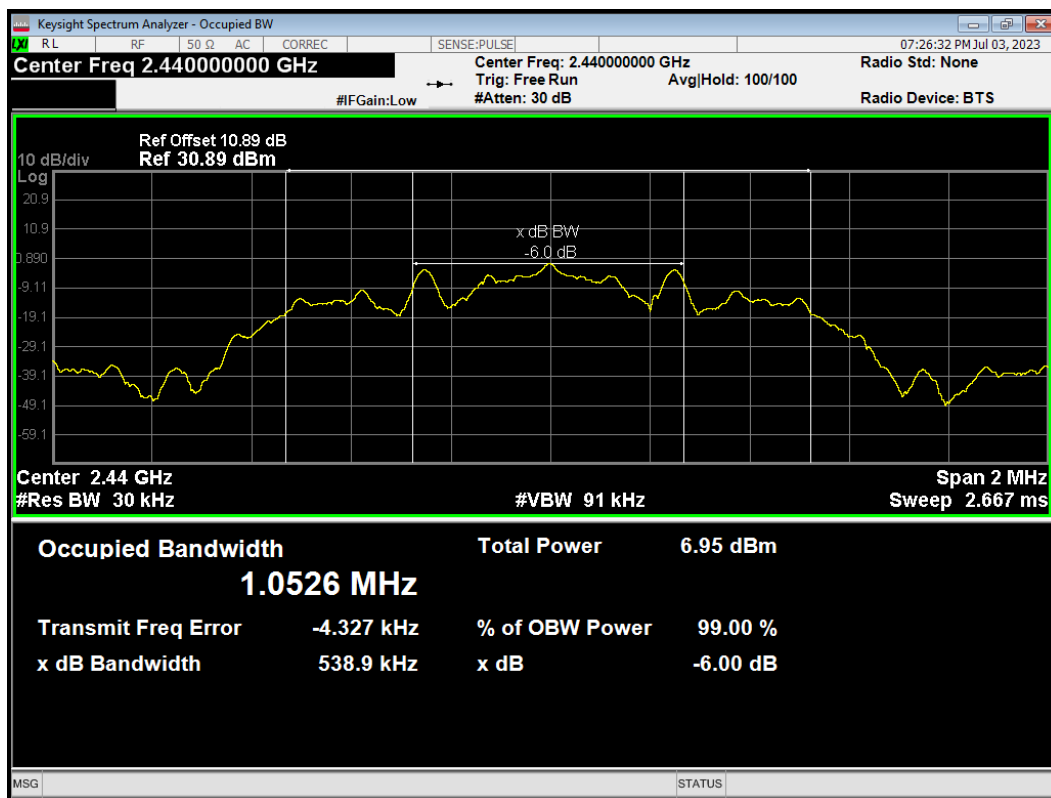
### OBW BLE (S=2) 2480MHz



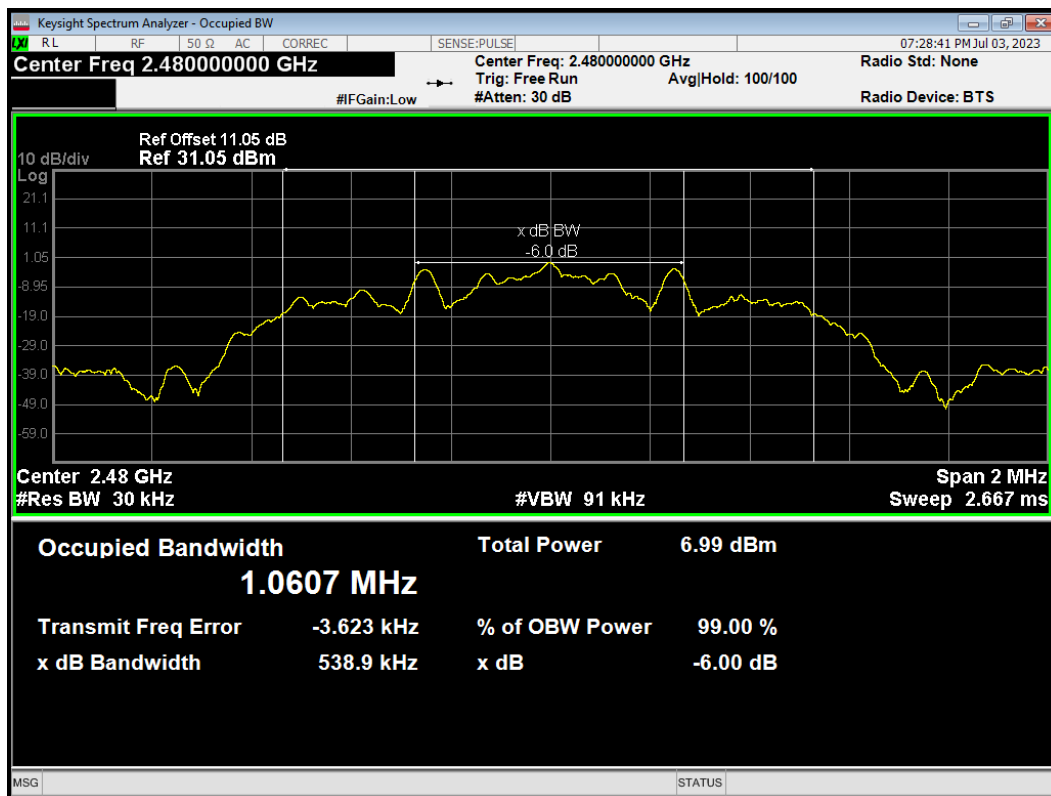
### OBW BLE (S=8) 2402MHz



### OBW BLE (S=8) 2440MHz

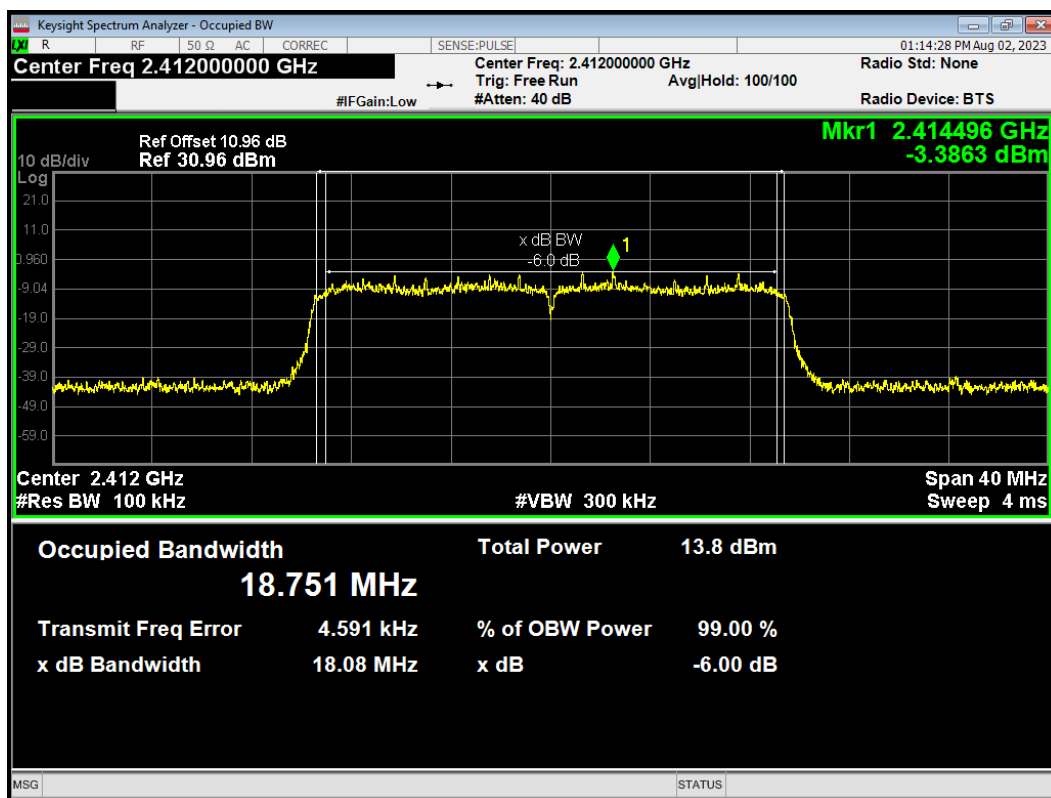


### OBW BLE (S=8) 2480MHz

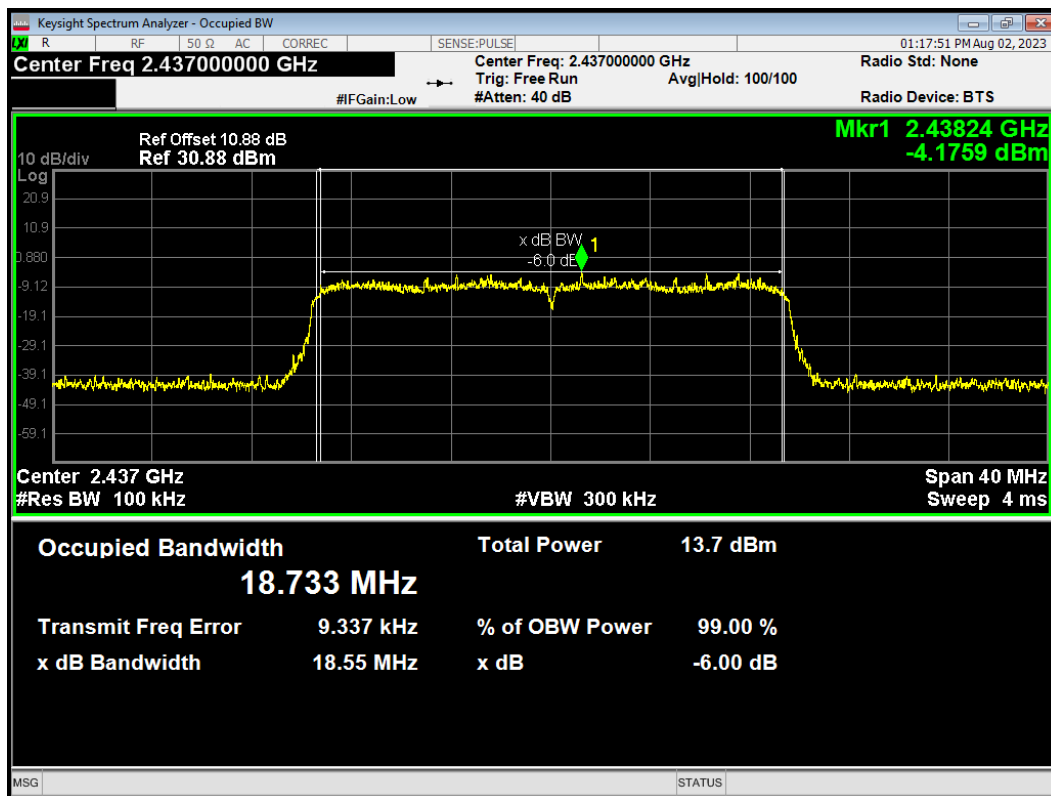


# 6 dB bandwidth

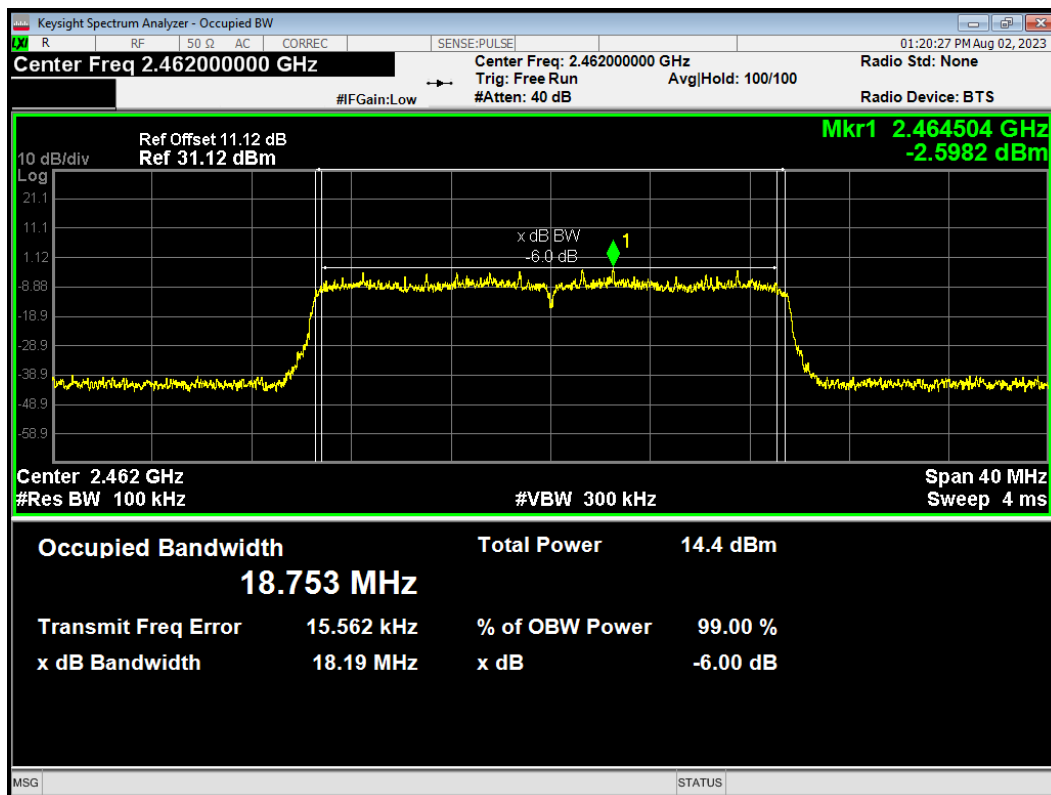
-6dB Bandwidth 802.11ax(HE20) 2412MHz



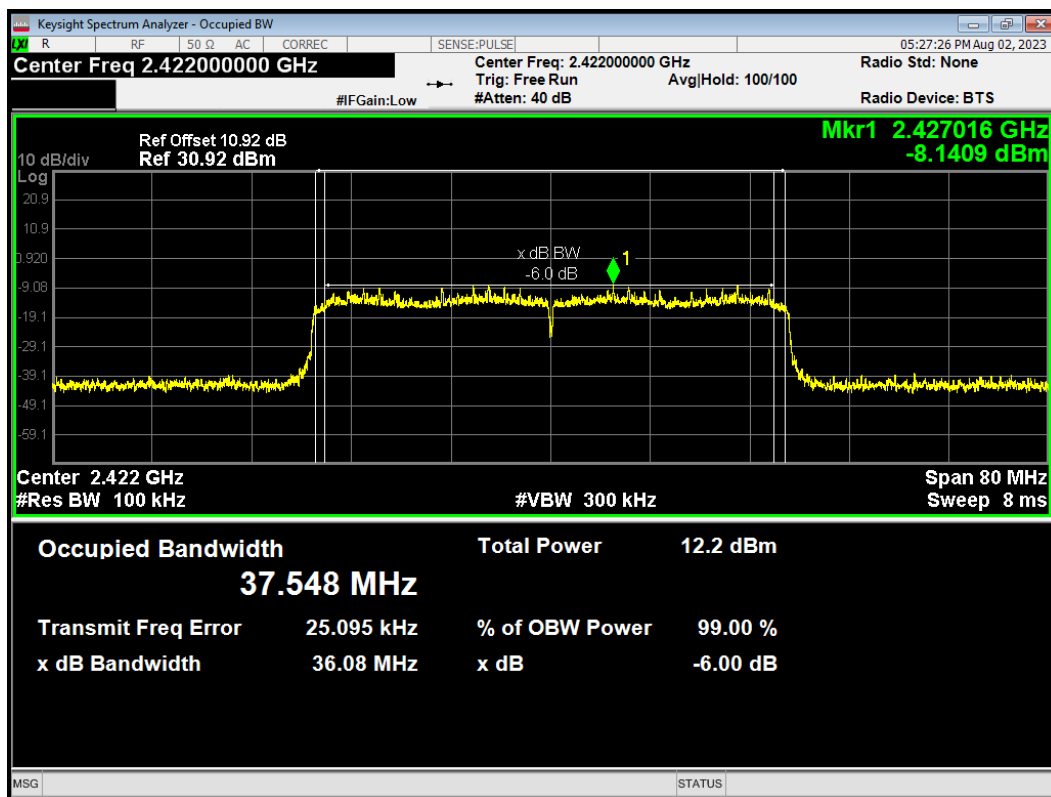
-6dB Bandwidth 802.11ax(HE20) 2437MHz



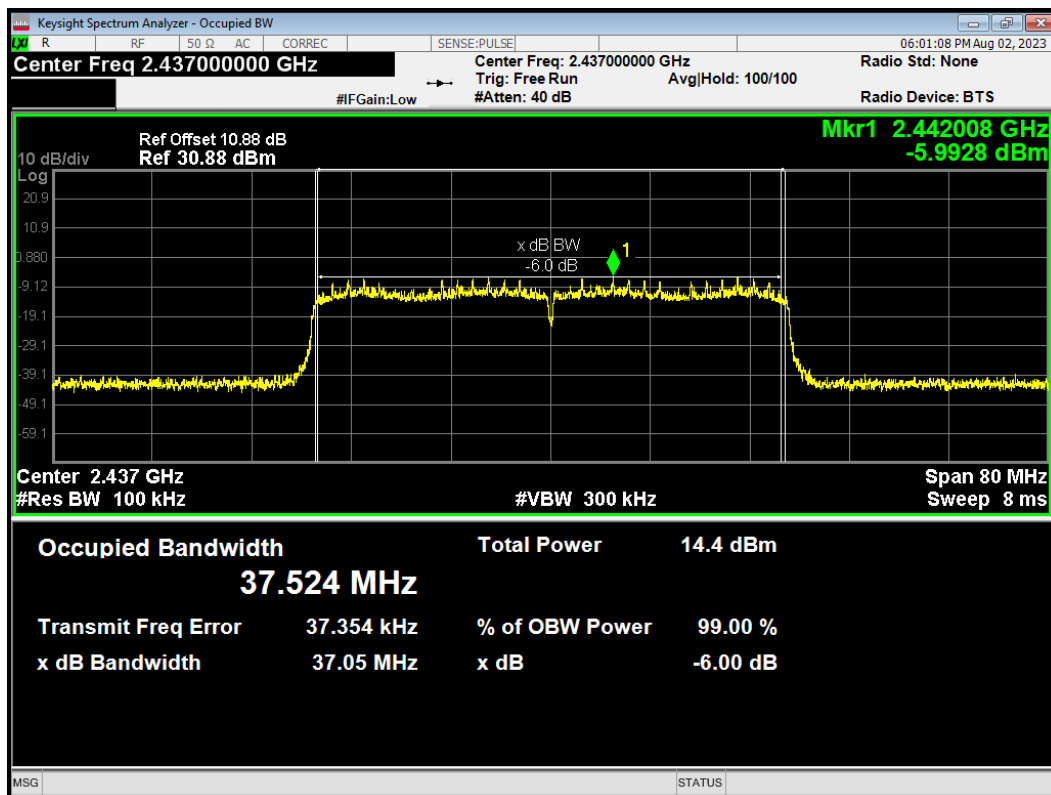
-6dB Bandwidth 802.11ax(HE20) 2462MHz



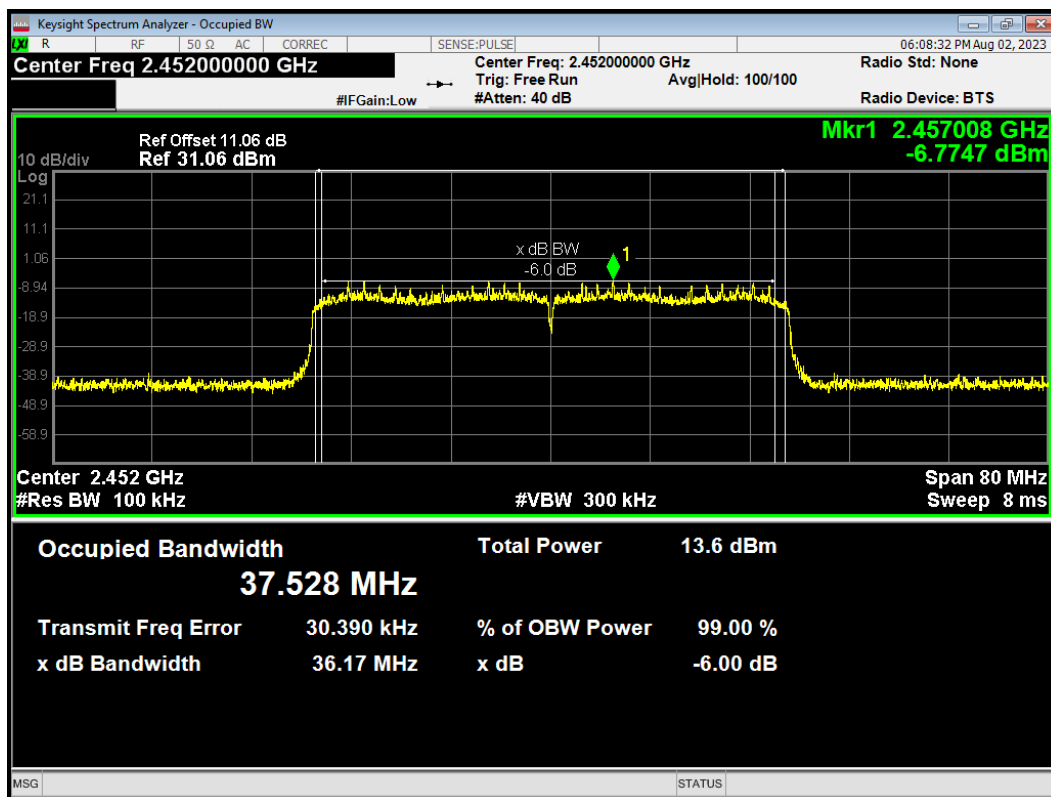
-6dB Bandwidth 802.11ax(HE40) 2422MHz



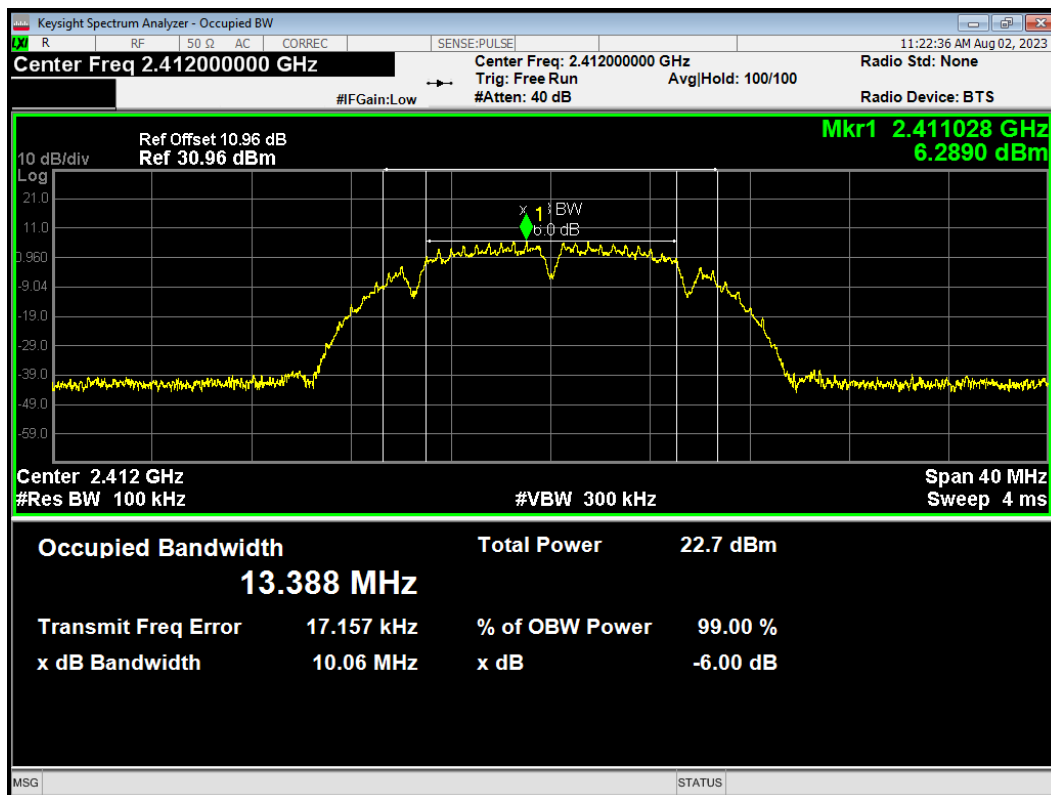
-6dB Bandwidth 802.11ax(HE40) 2437MHz



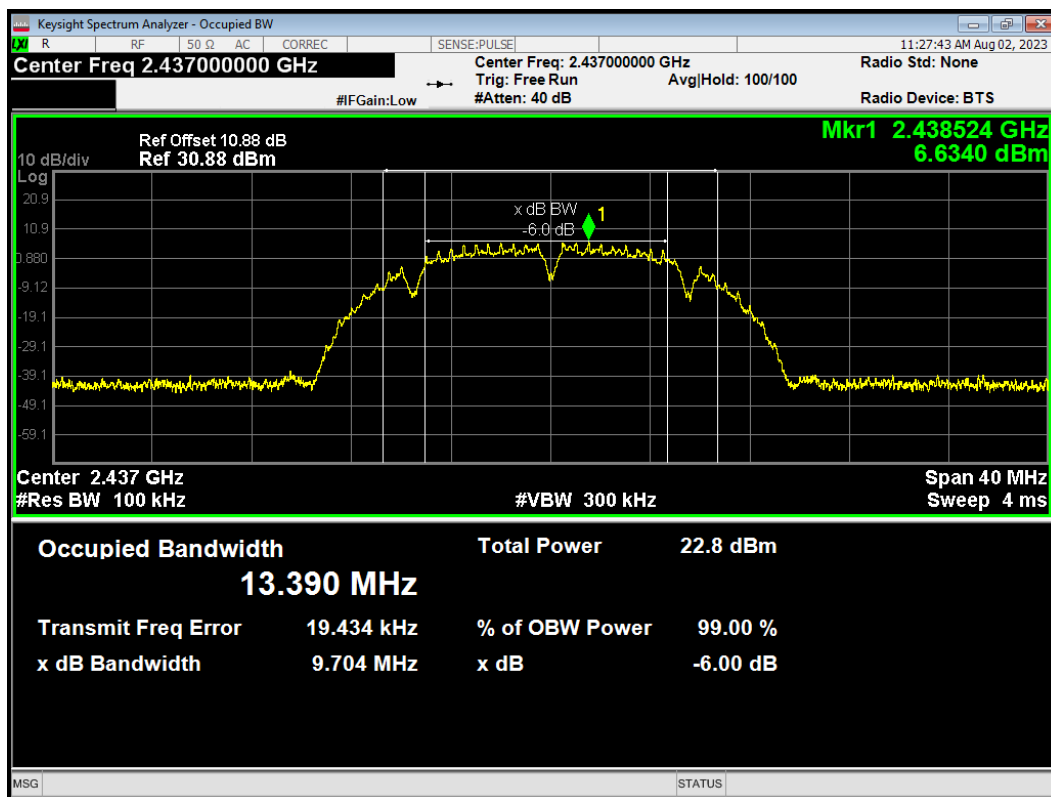
-6dB Bandwidth 802.11ax(HE40) 2452MHz



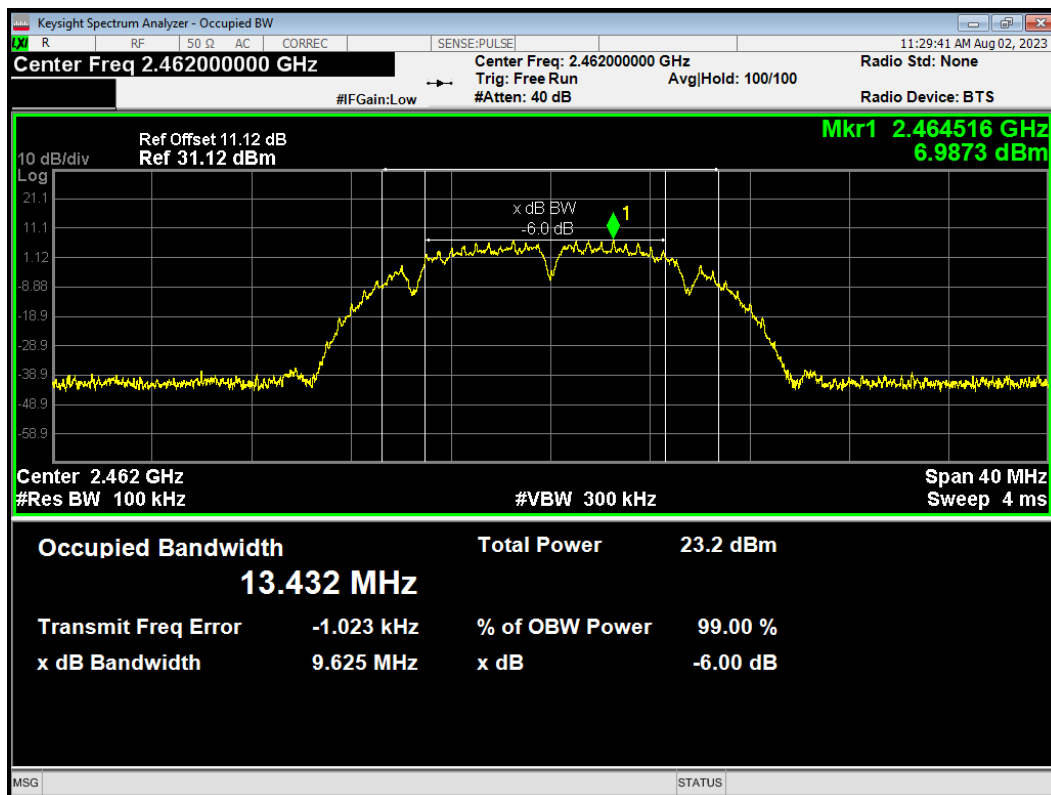
-6dB Bandwidth 802.11b 2412MHz



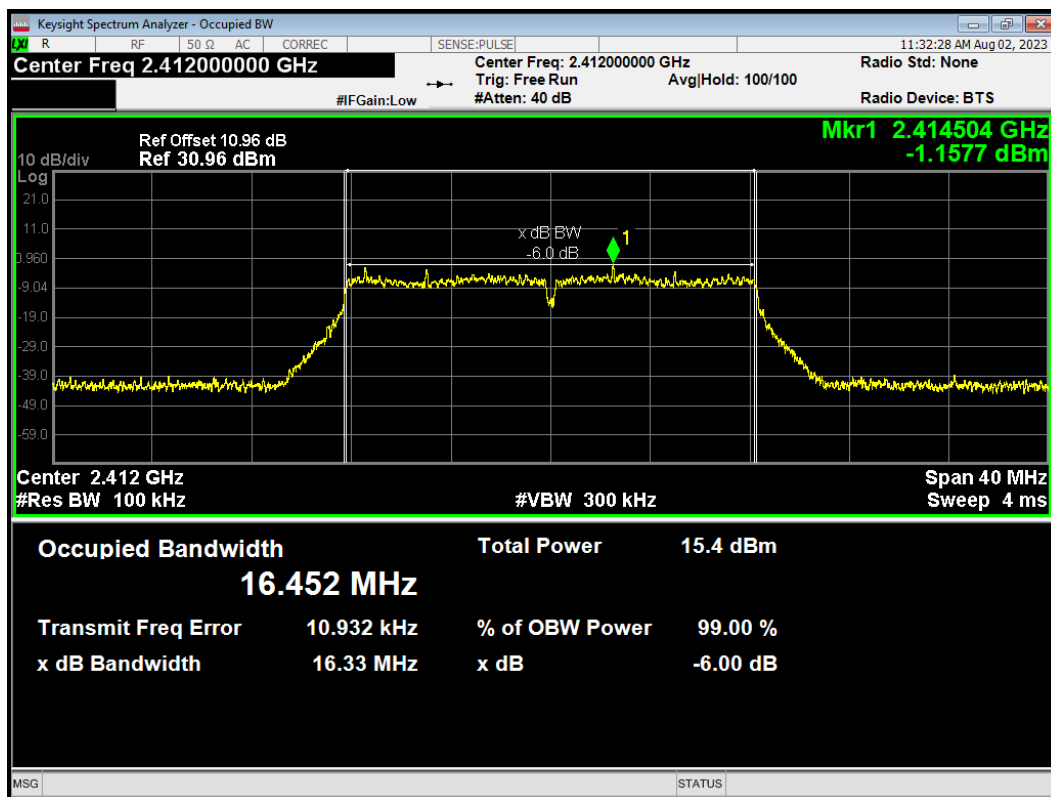
-6dB Bandwidth 802.11b 2437MHz



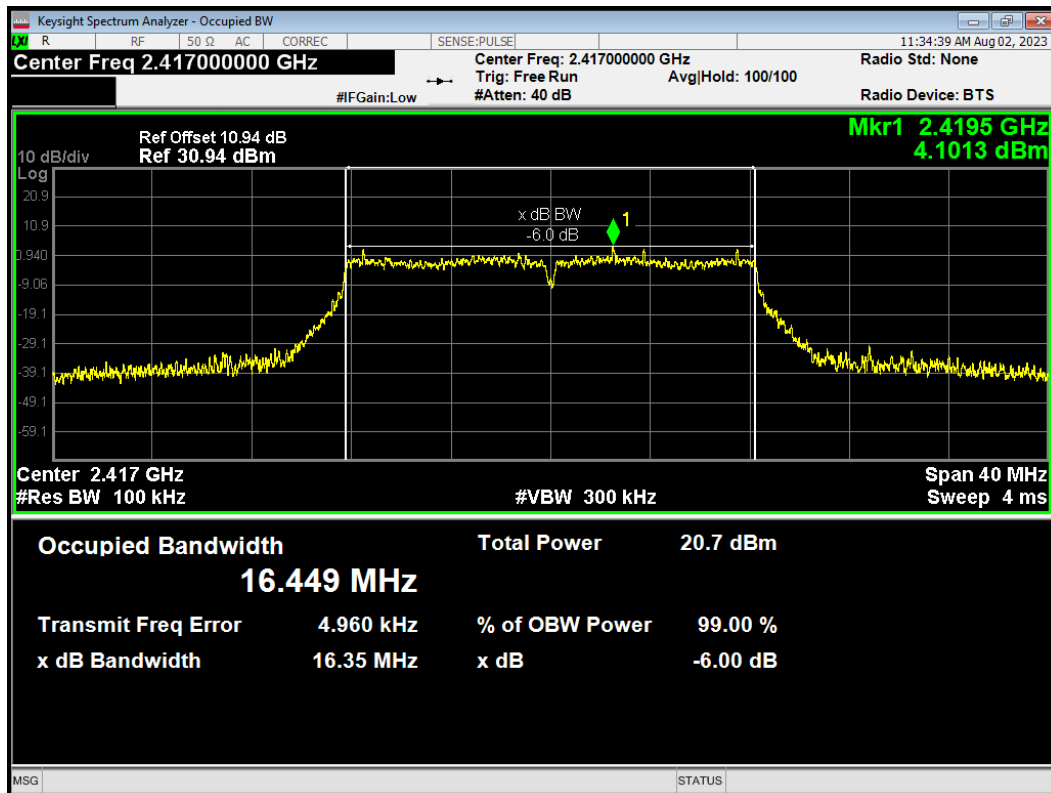
-6dB Bandwidth 802.11b 2462MHz



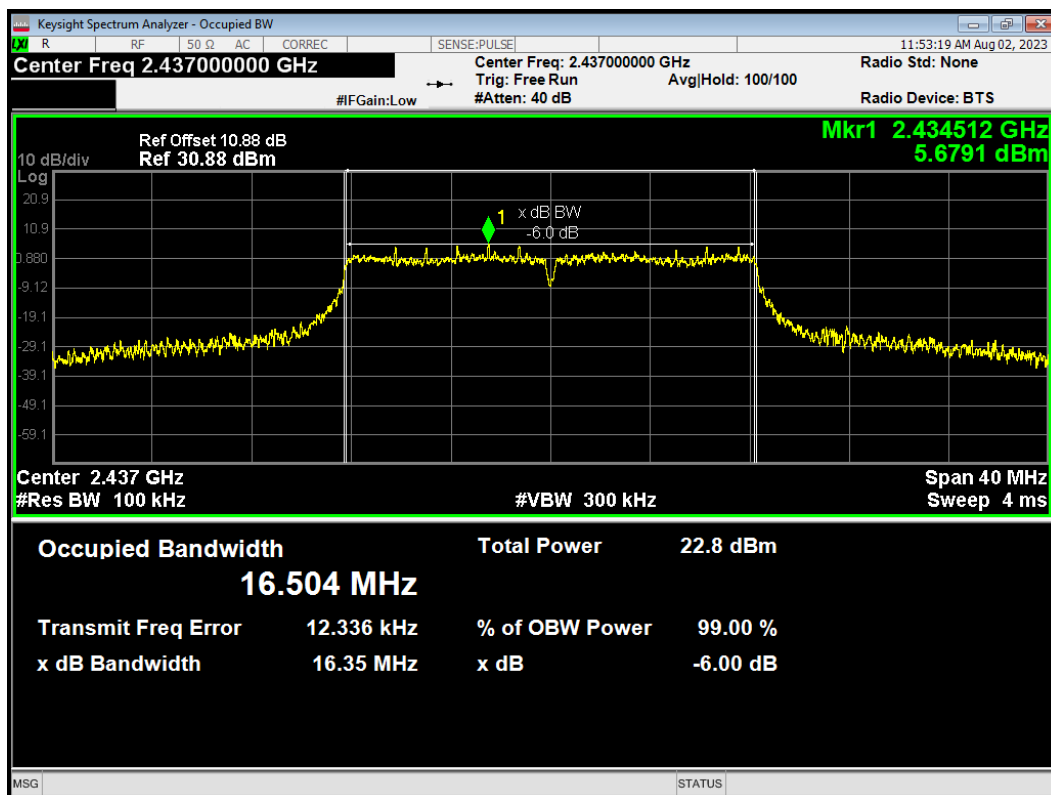
-6dB Bandwidth 802.11g 2412MHz



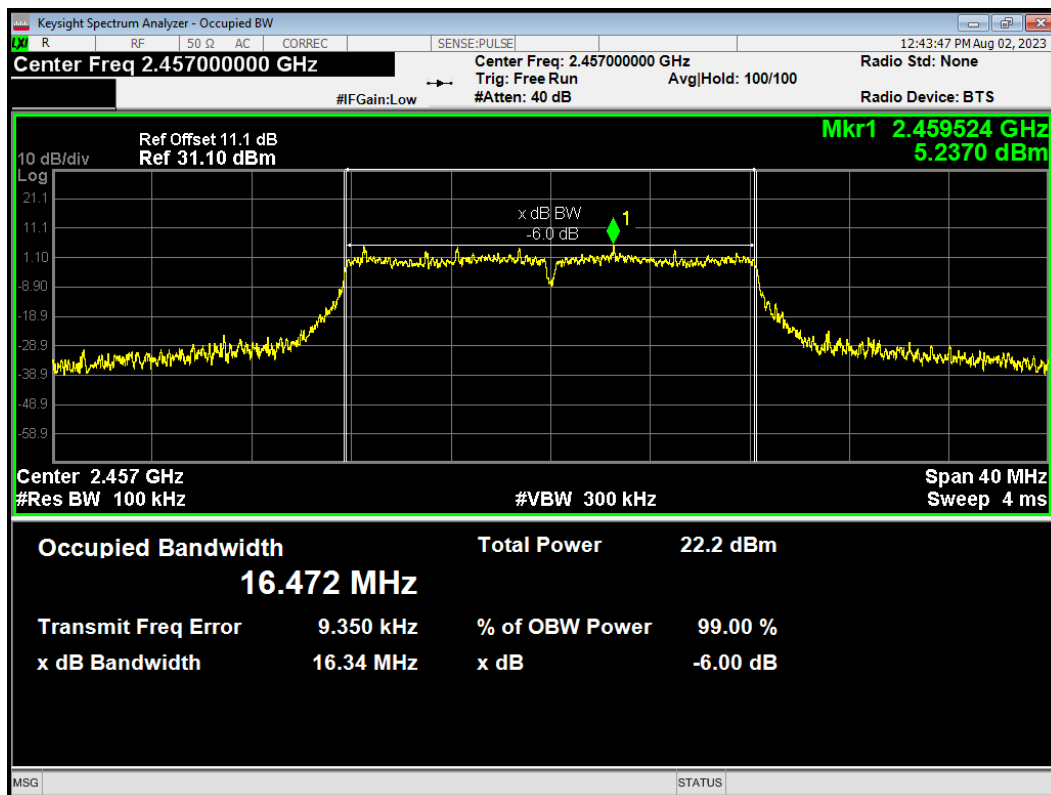
-6dB Bandwidth 802.11g 2417MHz



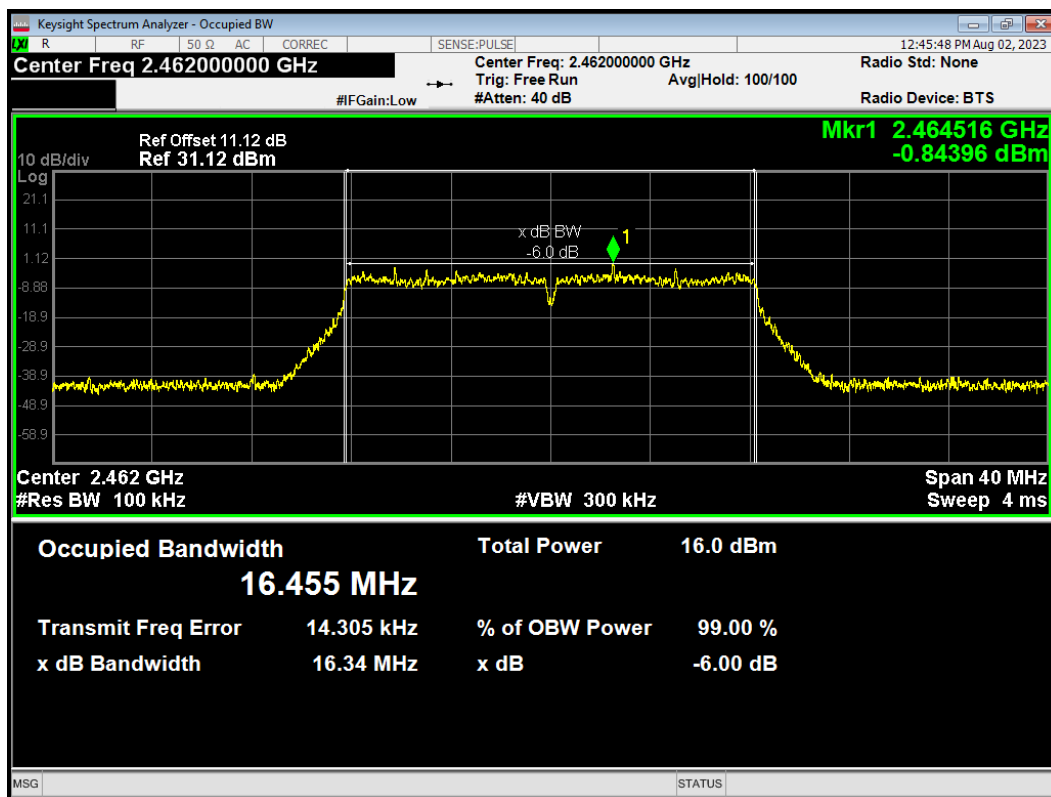
-6dB Bandwidth 802.11g 2437MHz



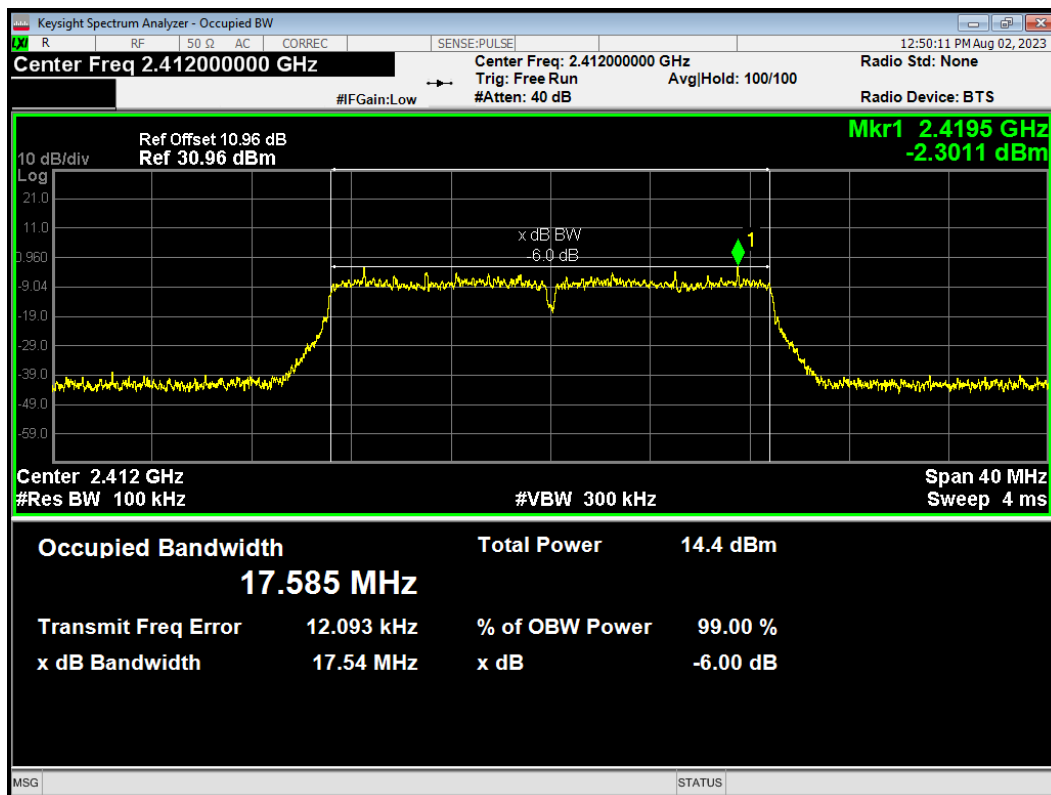
-6dB Bandwidth 802.11g 2457MHz



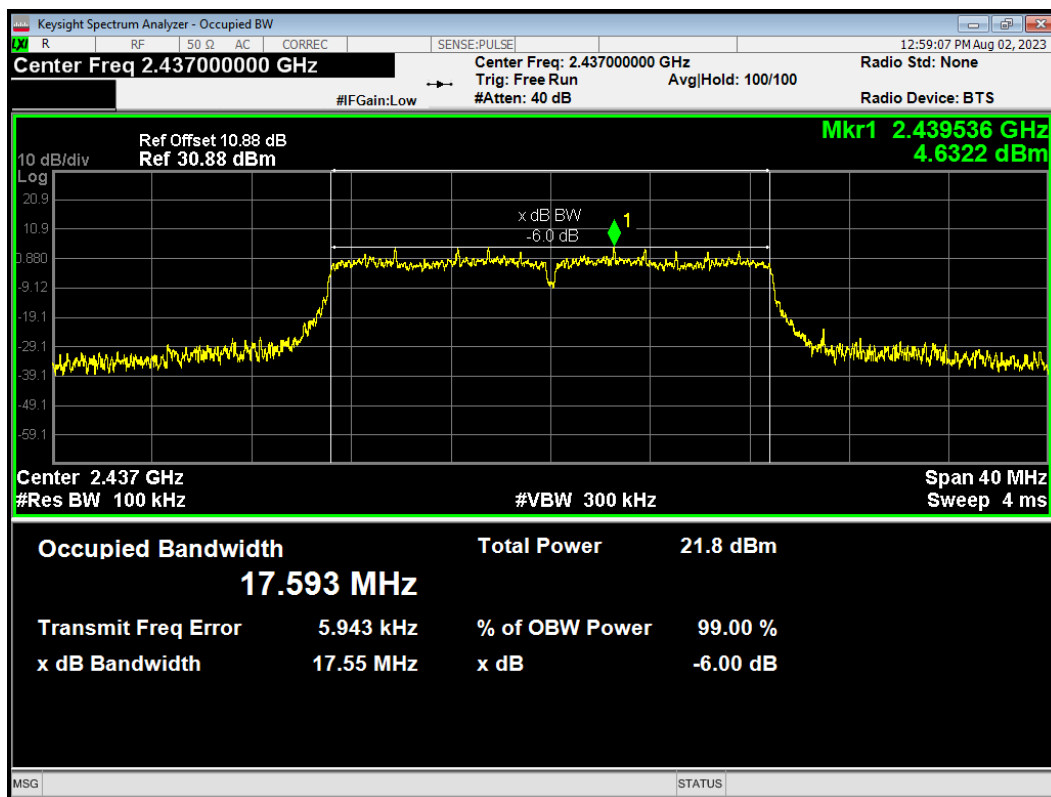
-6dB Bandwidth 802.11g 2462MHz



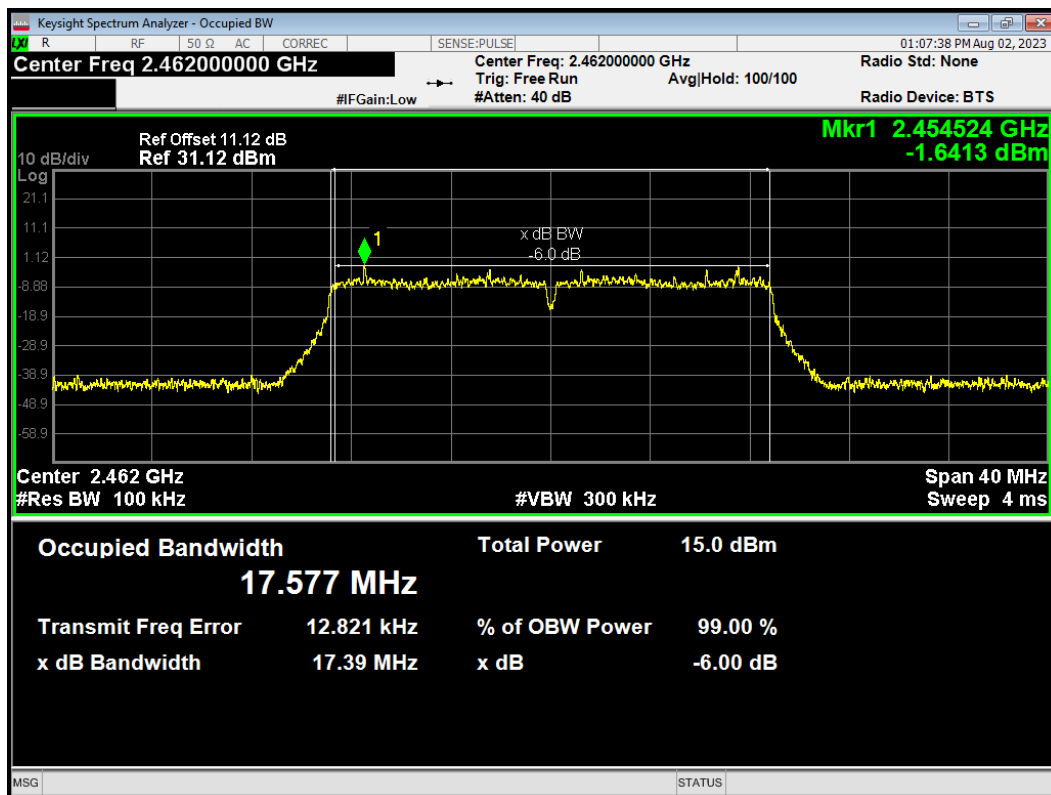
-6dB Bandwidth 802.11n(HT20) 2412MHz



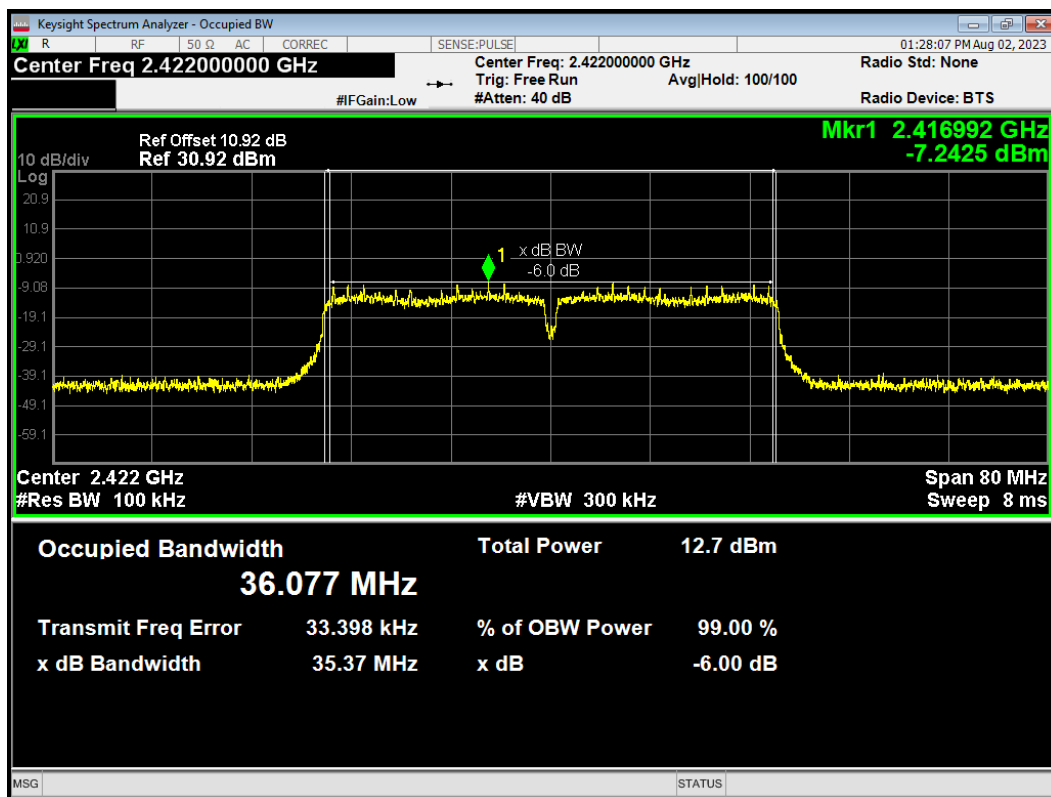
-6dB Bandwidth 802.11n(HT20) 2437MHz



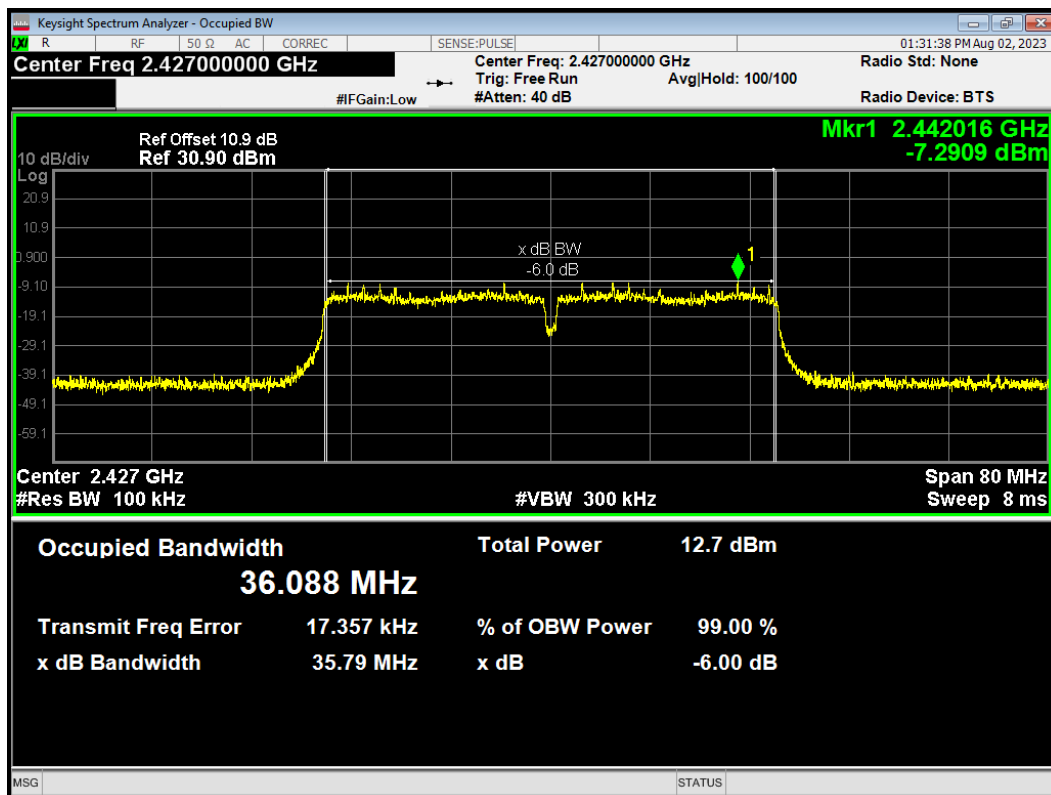
-6dB Bandwidth 802.11n(HT20) 2462MHz



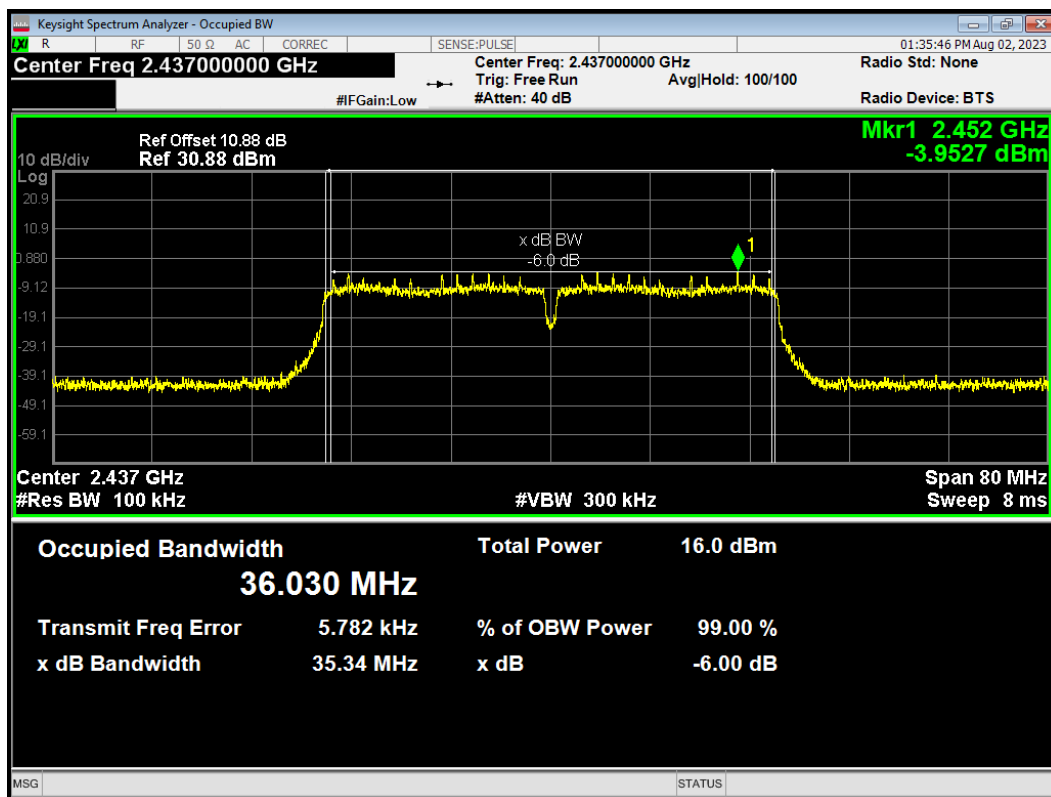
-6dB Bandwidth 802.11n(HT40) 2422MHz



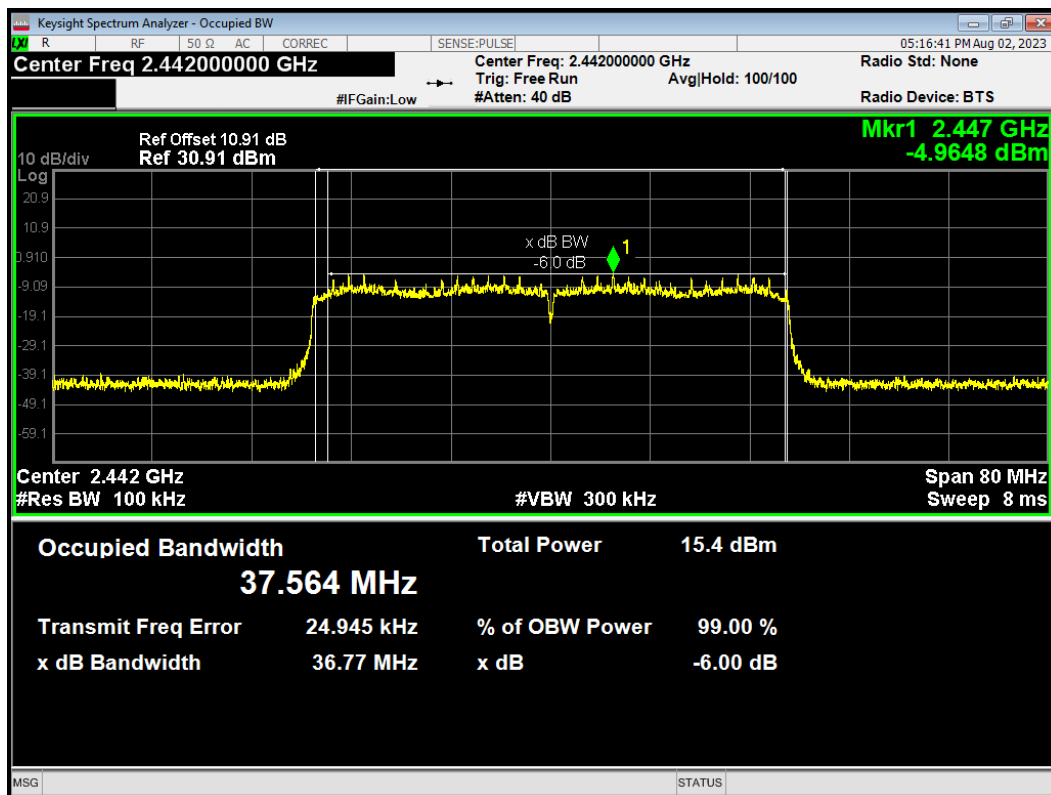
-6dB Bandwidth 802.11n(HT40) 2427MHz



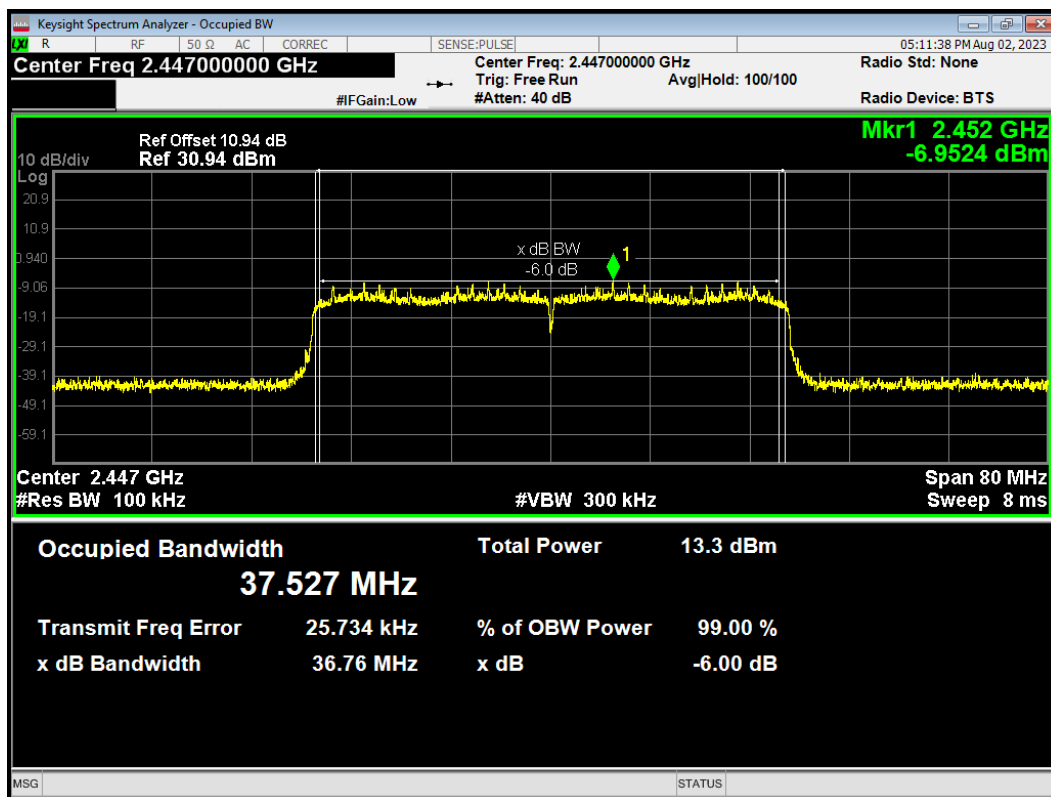
-6dB Bandwidth 802.11n(HT40) 2437MHz



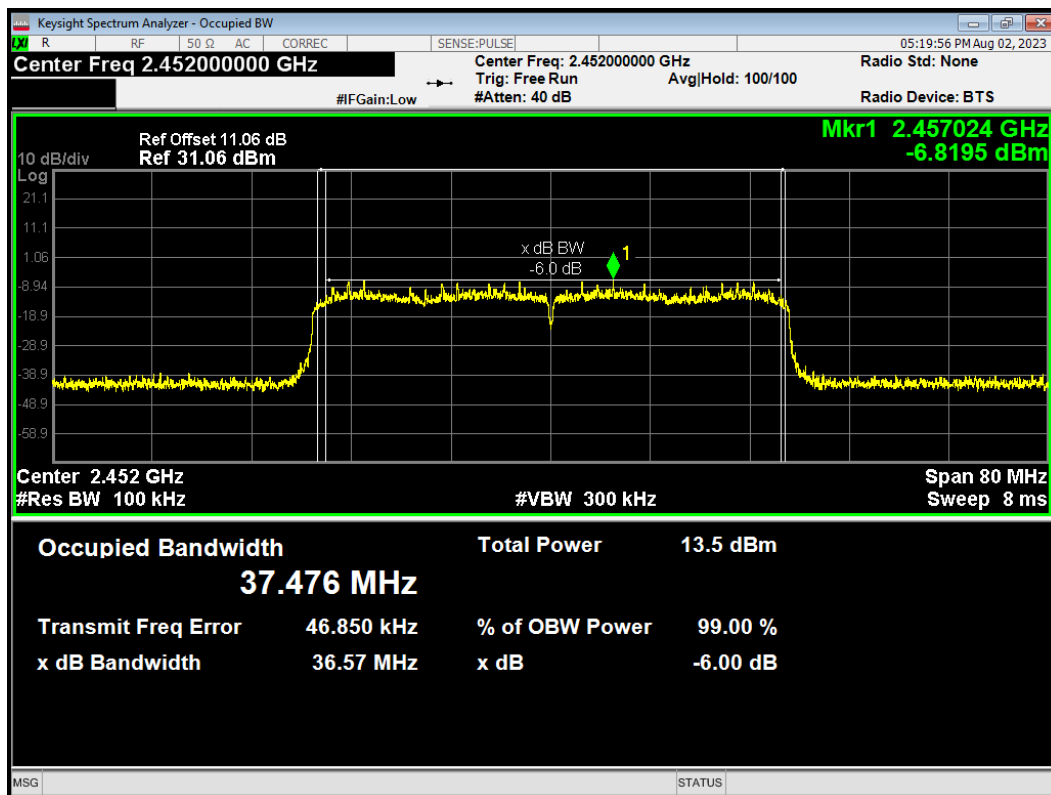
-6dB Bandwidth 802.11n(HT40) 2442MHz



-6dB Bandwidth 802.11n(HT40) 2447MHz

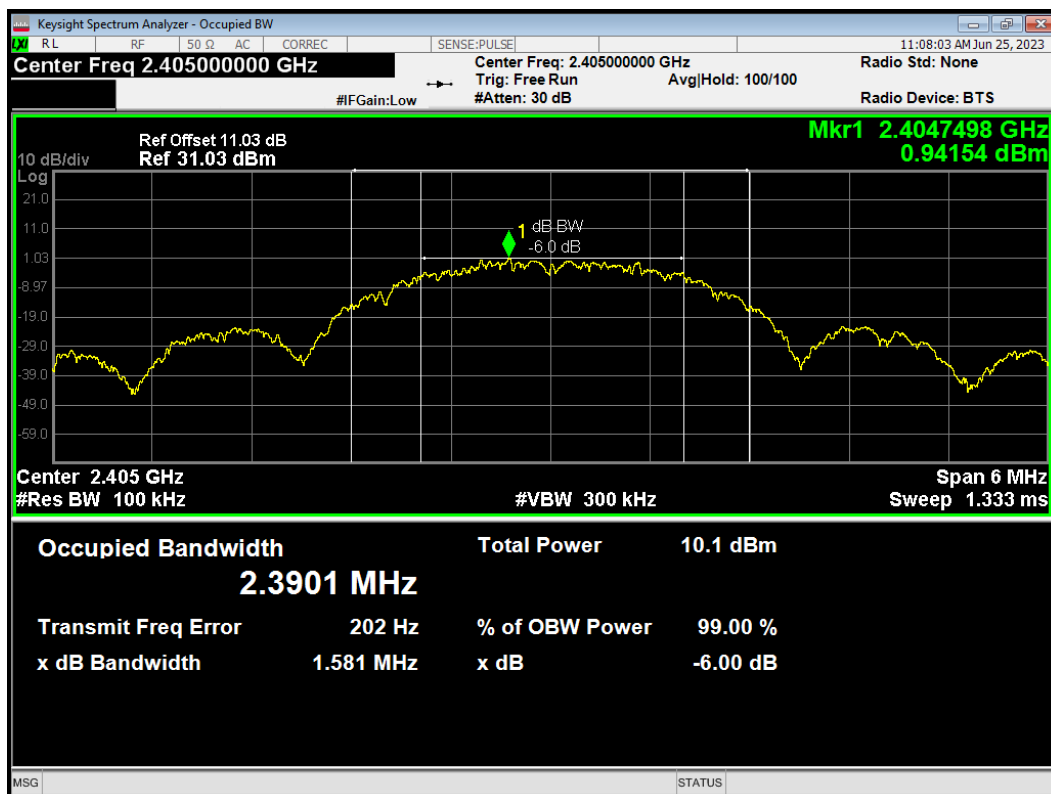


-6dB Bandwidth 802.11n(HT40) 2452MHz

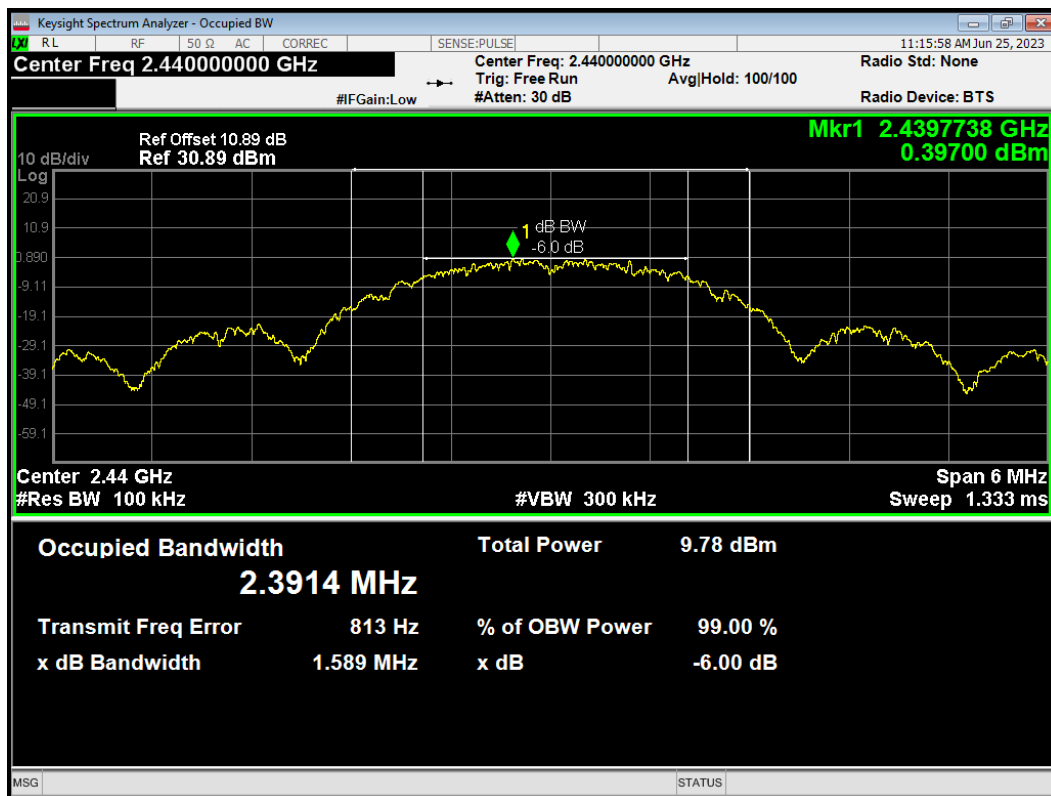


## Thread

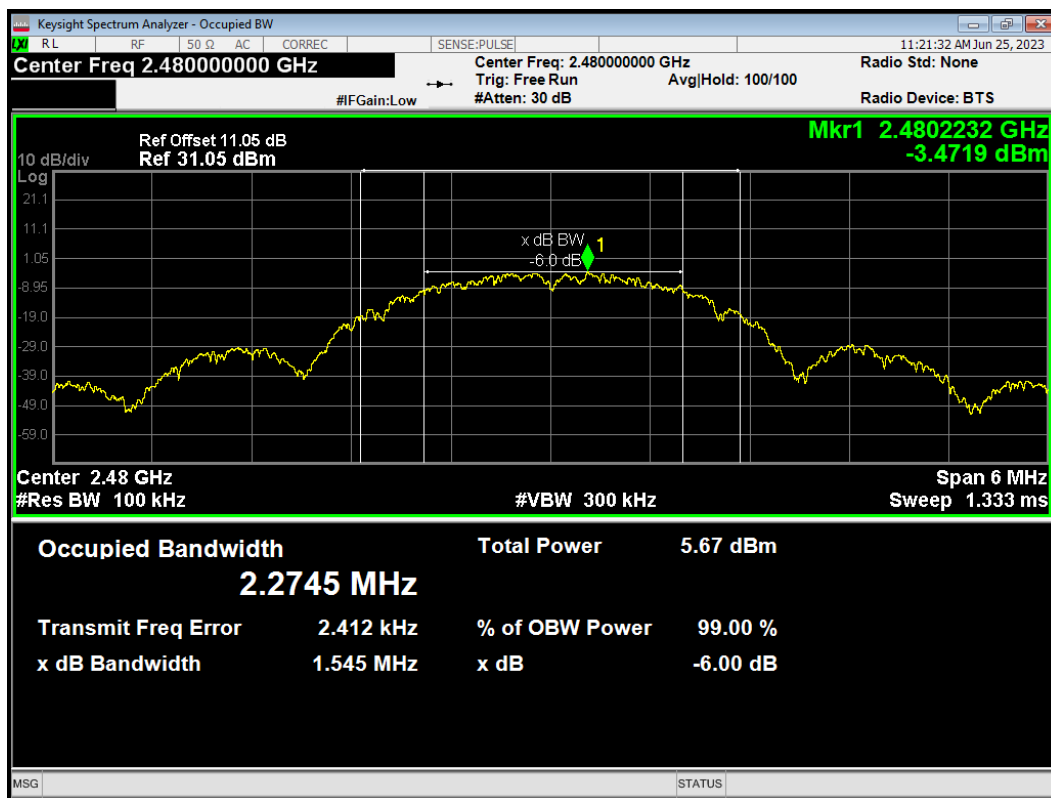
### -6dB Bandwidth thread 2405MHz



### -6dB Bandwidth thread 2440MHz

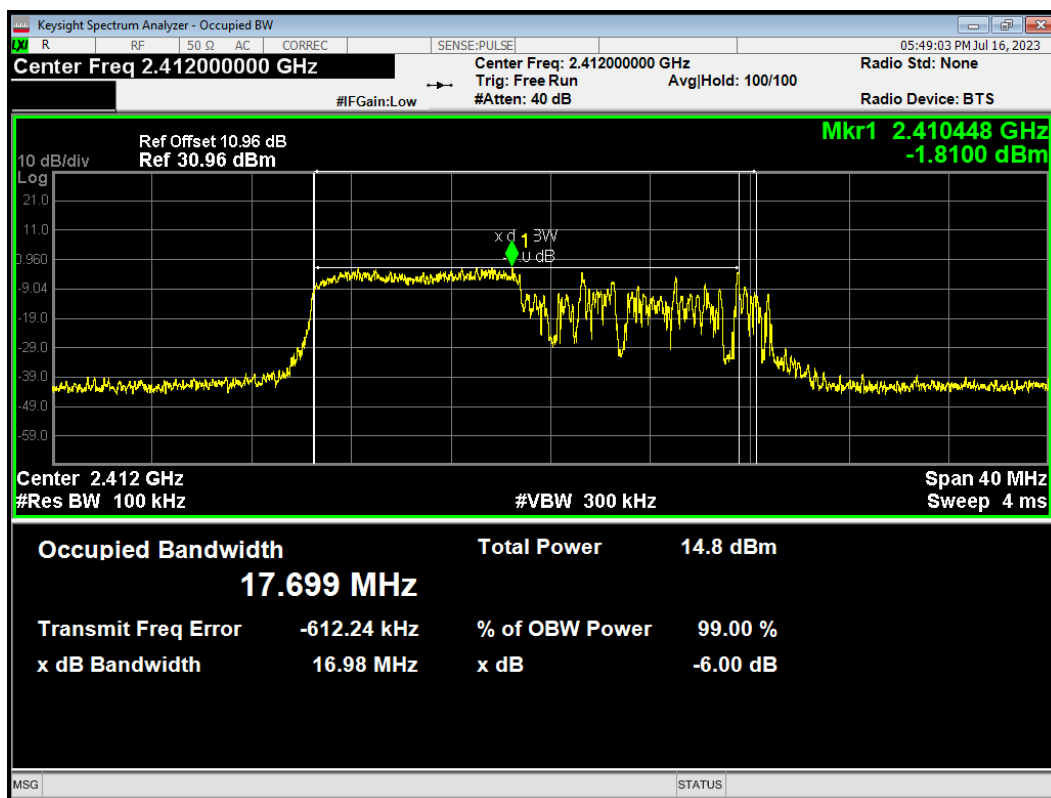


-6dB Bandwidth thread 2480MHz

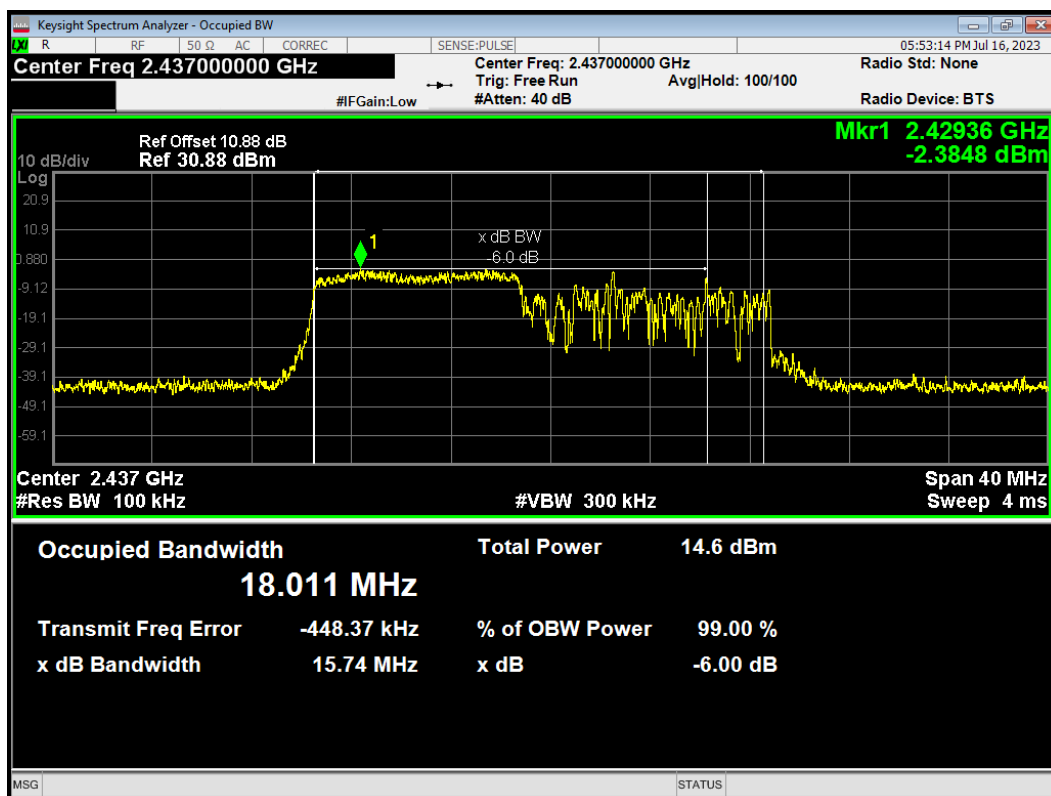


TB Mode

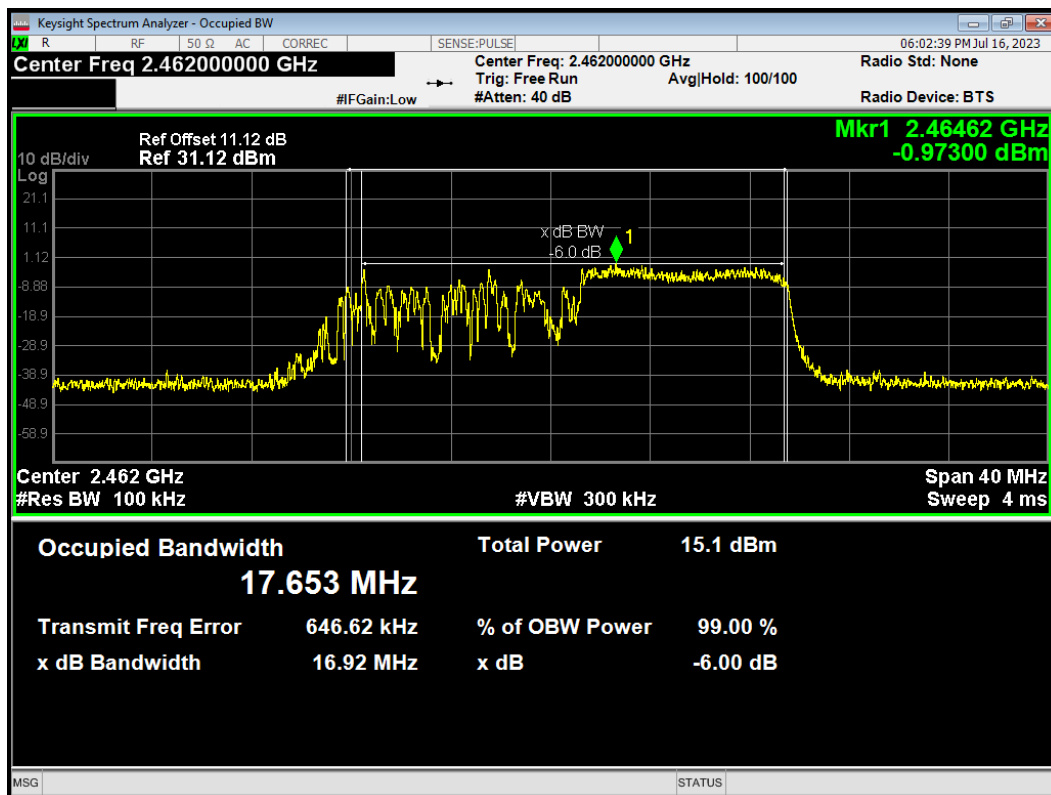
-6dB Bandwidth 802.11ax HE20 106-Tones 2412MHz



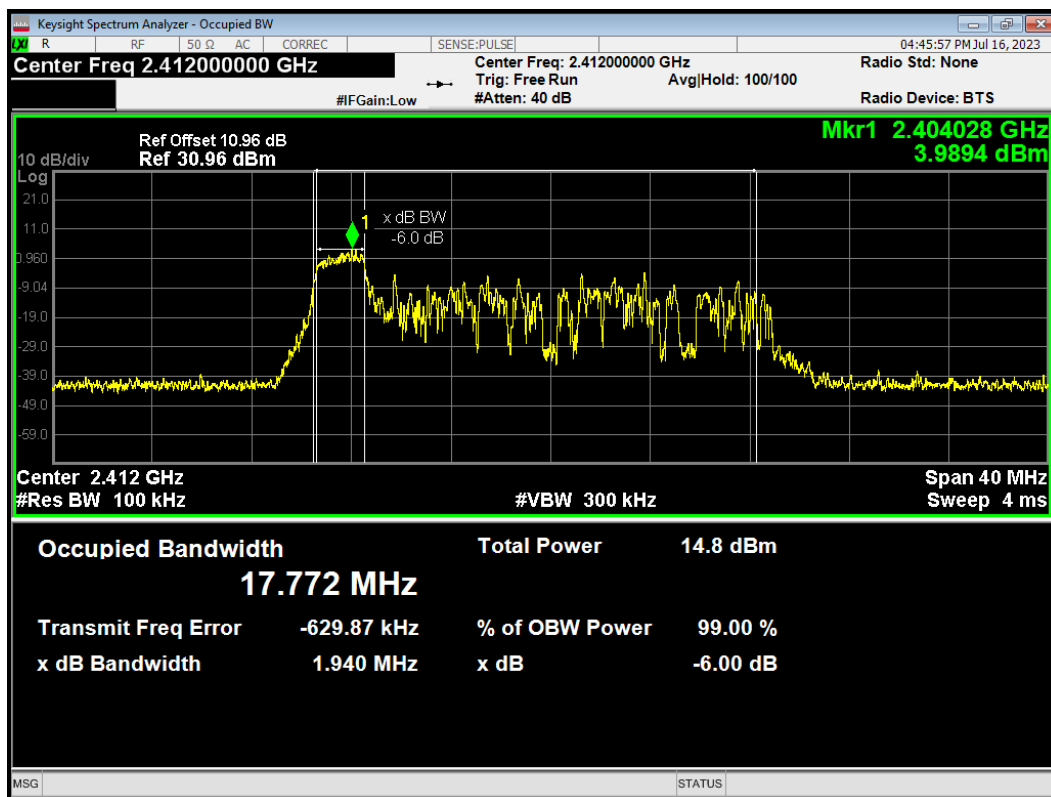
-6dB Bandwidth 802.11ax HE20 106-Tones 2437MHz



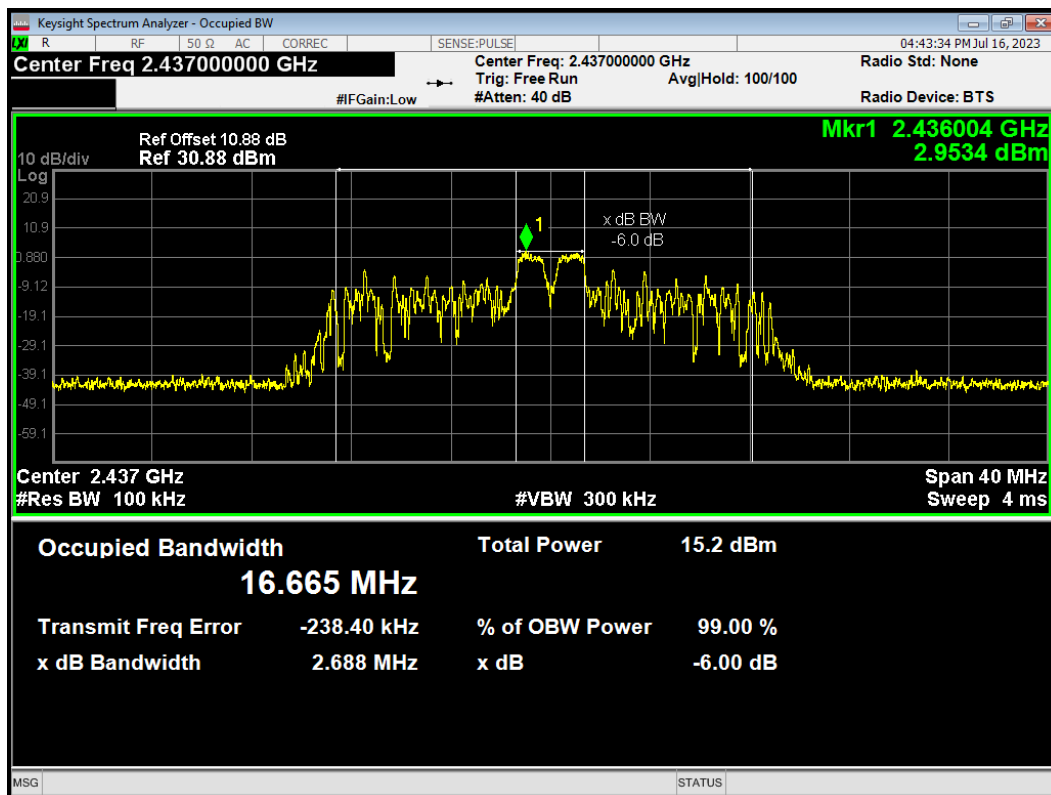
-6dB Bandwidth 802.11ax HE20 106-Tones 2462MHz



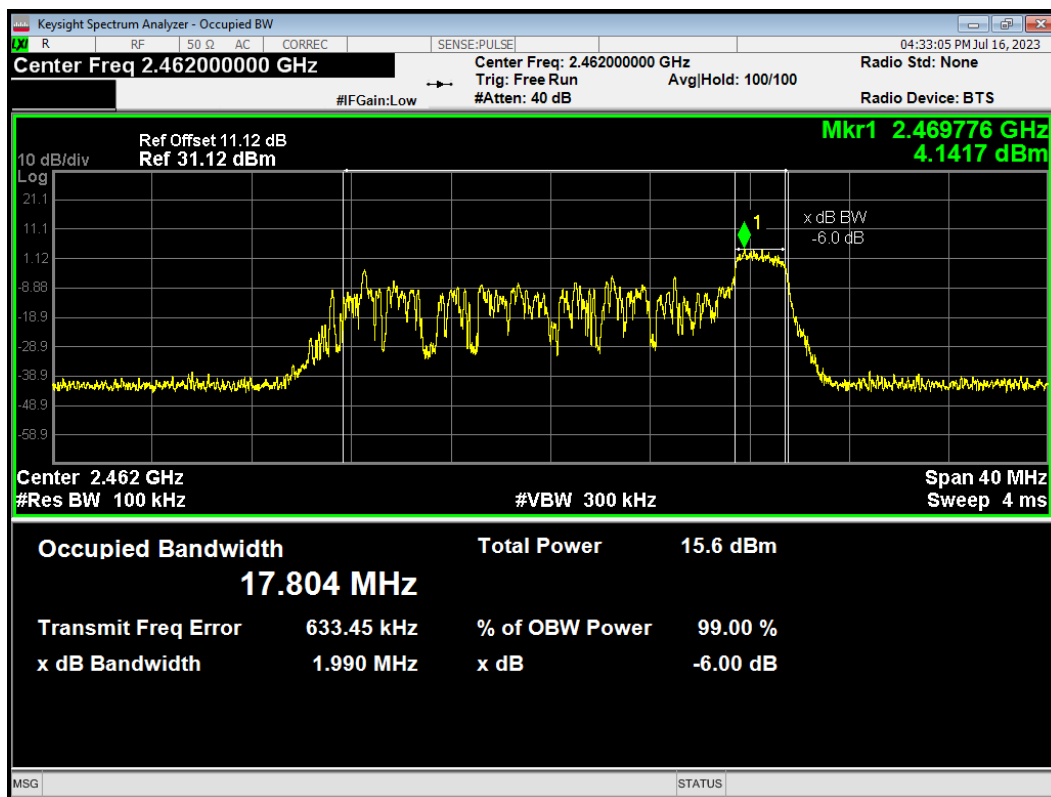
-6dB Bandwidth 802.11ax HE20 26-Tones 2412MHz



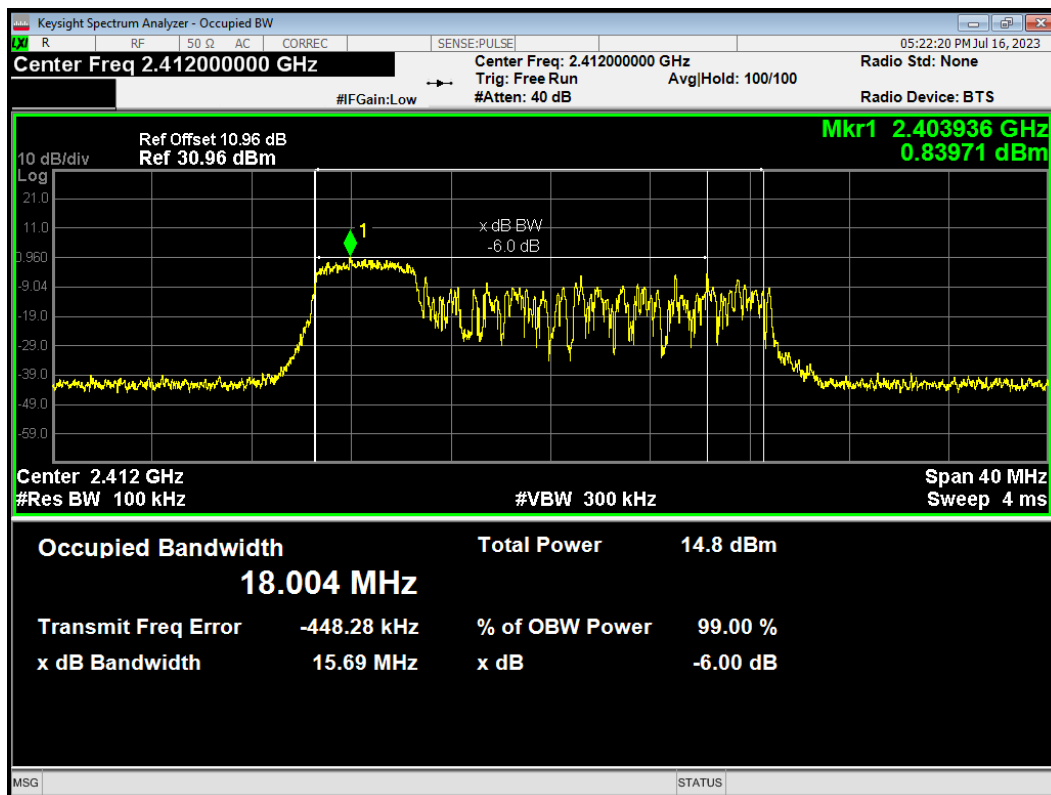
-6dB Bandwidth 802.11ax HE20 26-Tones 2437MHz



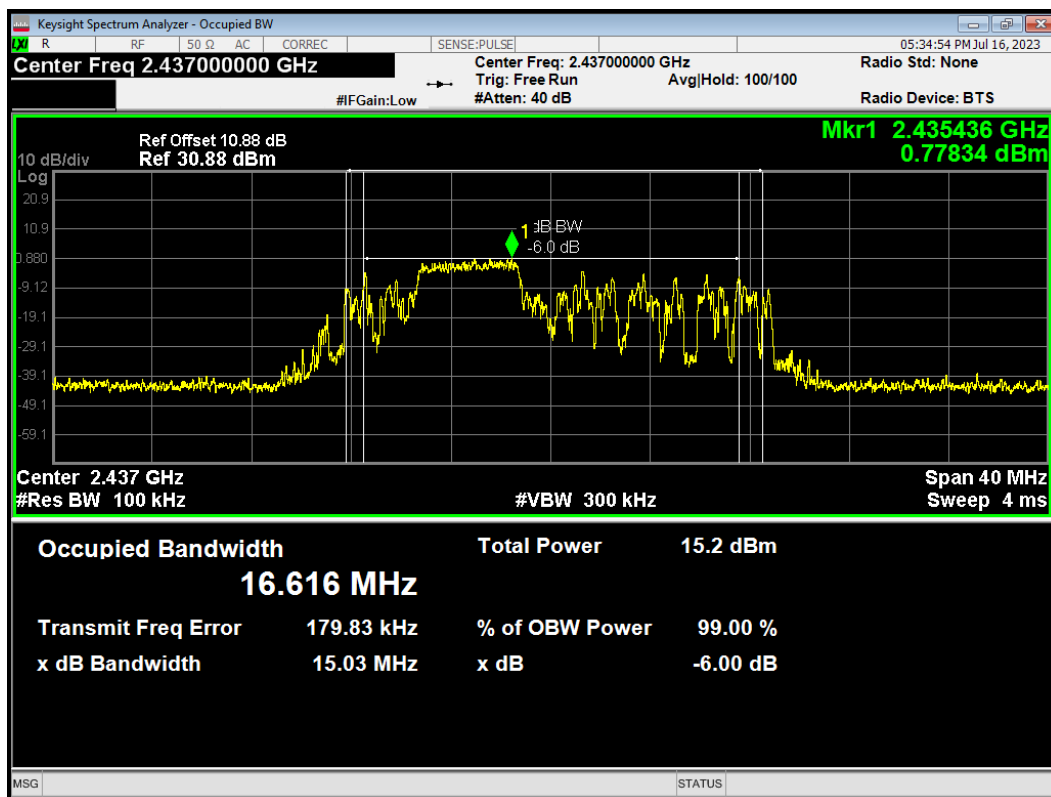
-6dB Bandwidth 802.11ax HE20 26-Tones 2462MHz



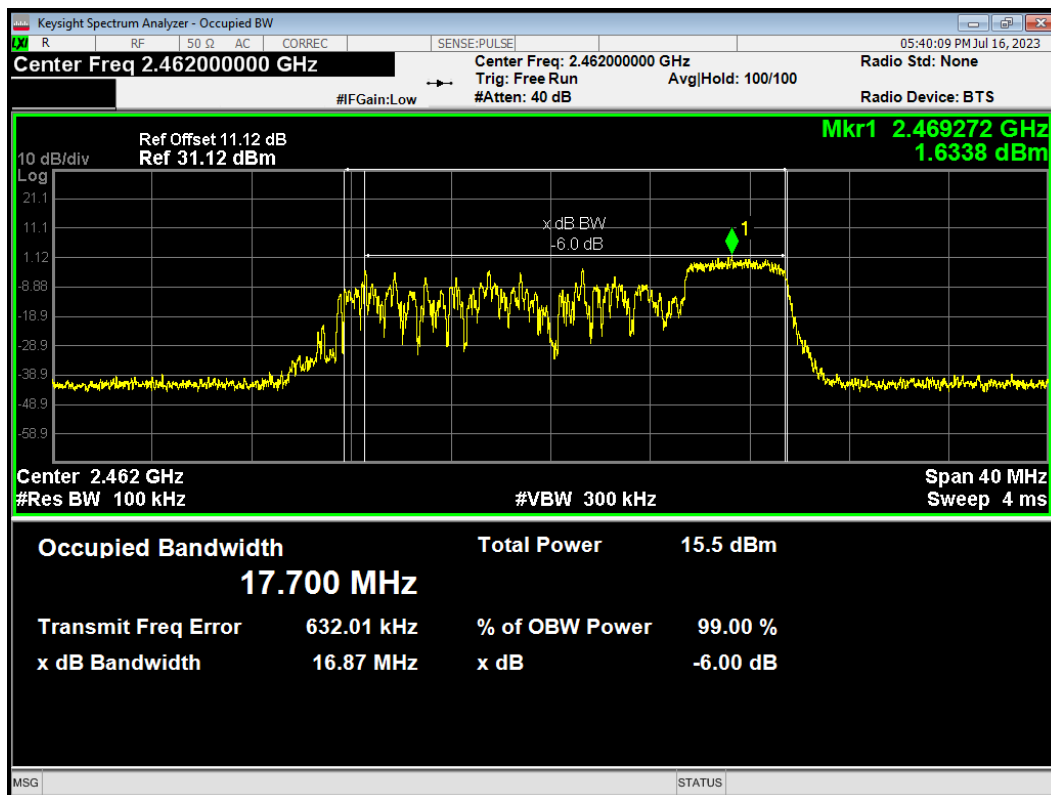
-6dB Bandwidth 802.11ax HE20 52-Tones 2412MHz



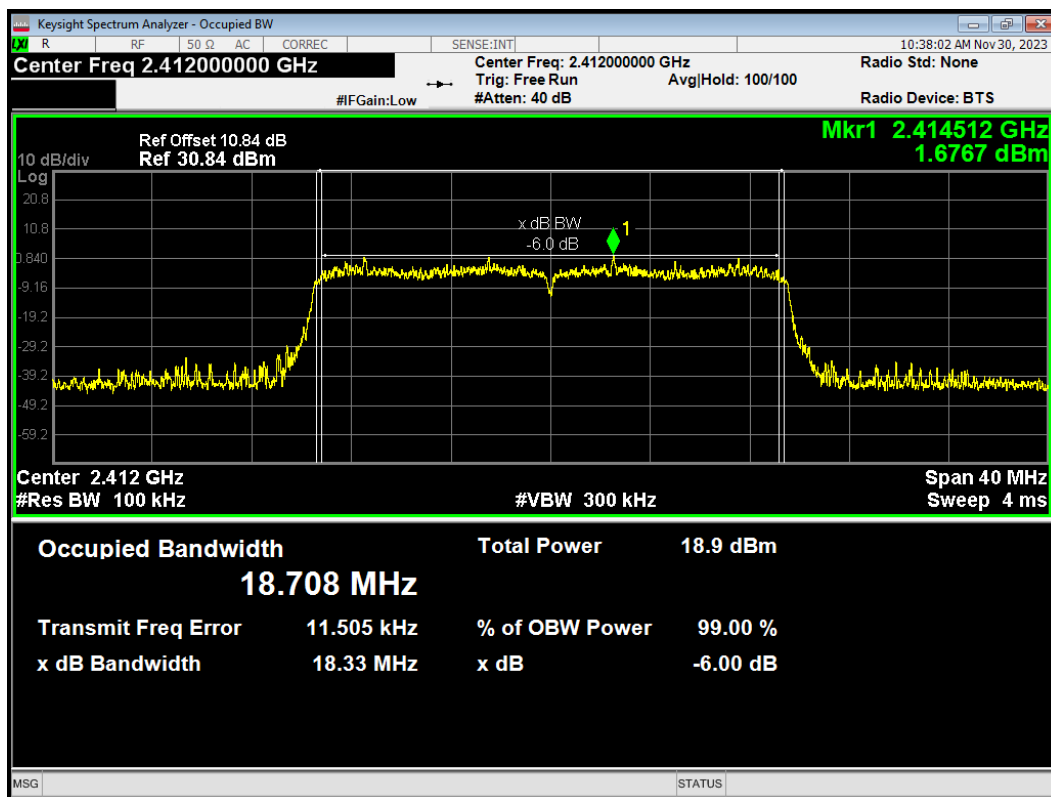
-6dB Bandwidth 802.11ax HE20 52-Tones 2437MHz



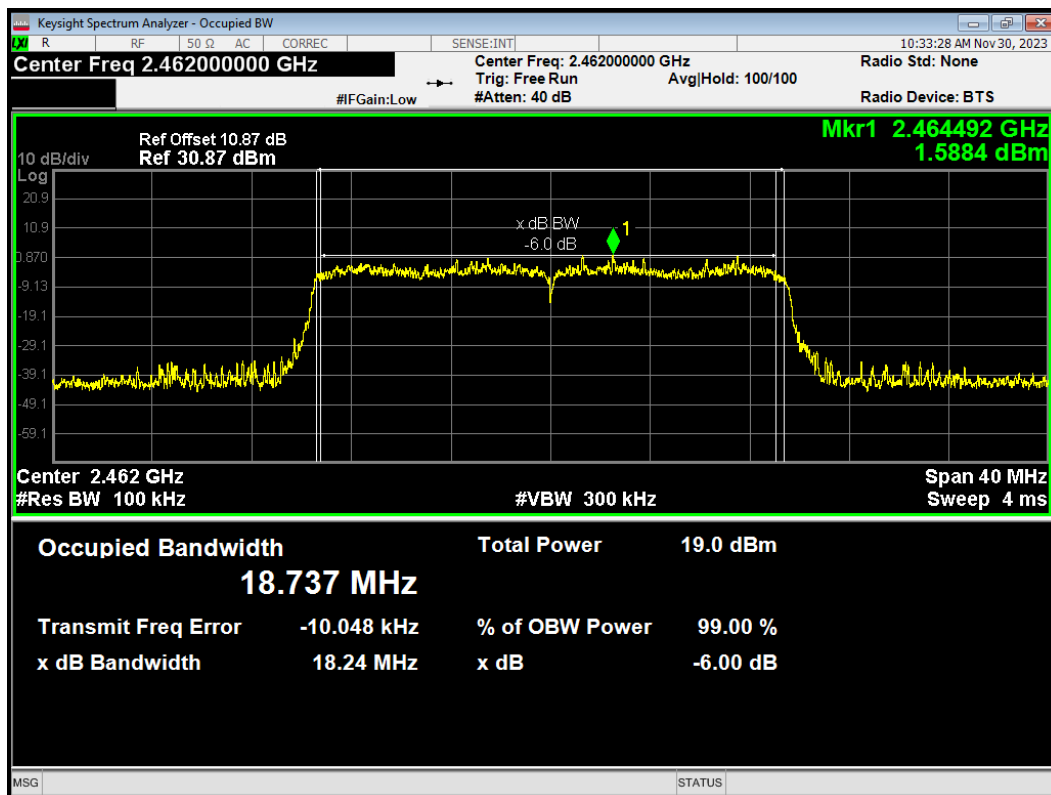
-6dB Bandwidth 802.11ax HE20 52-Tones 2462MHz



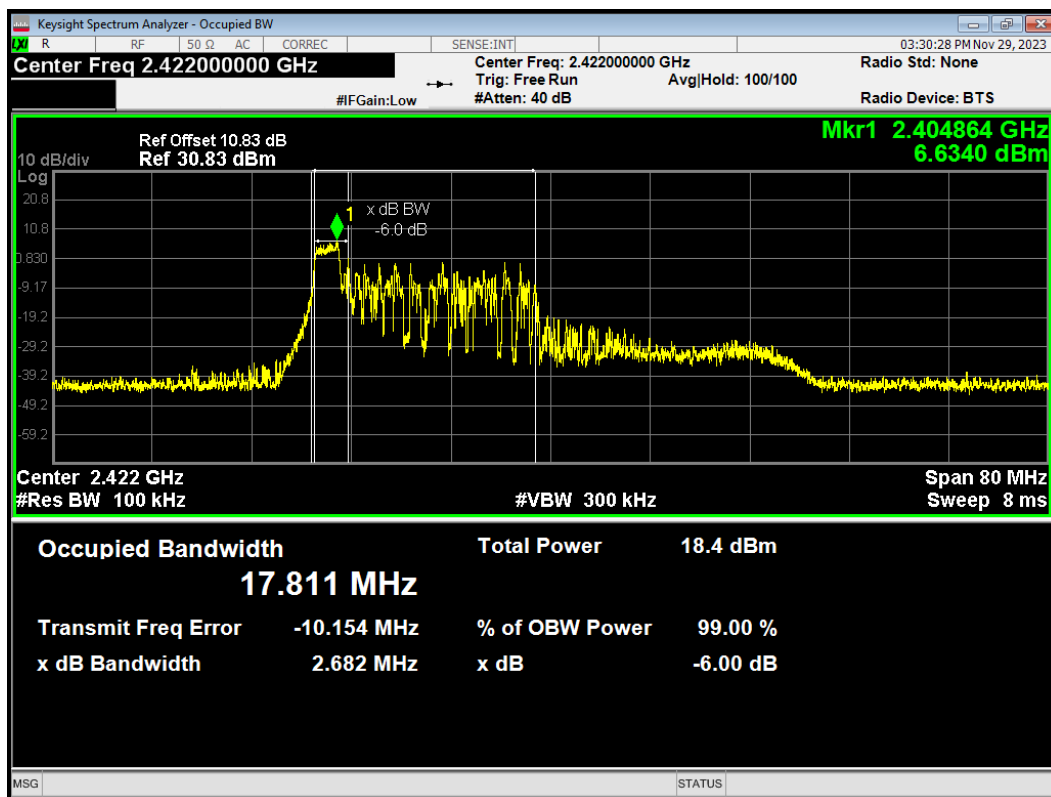
-6dB Bandwidth 802.11ax HE20 242-Tones 2412MHz



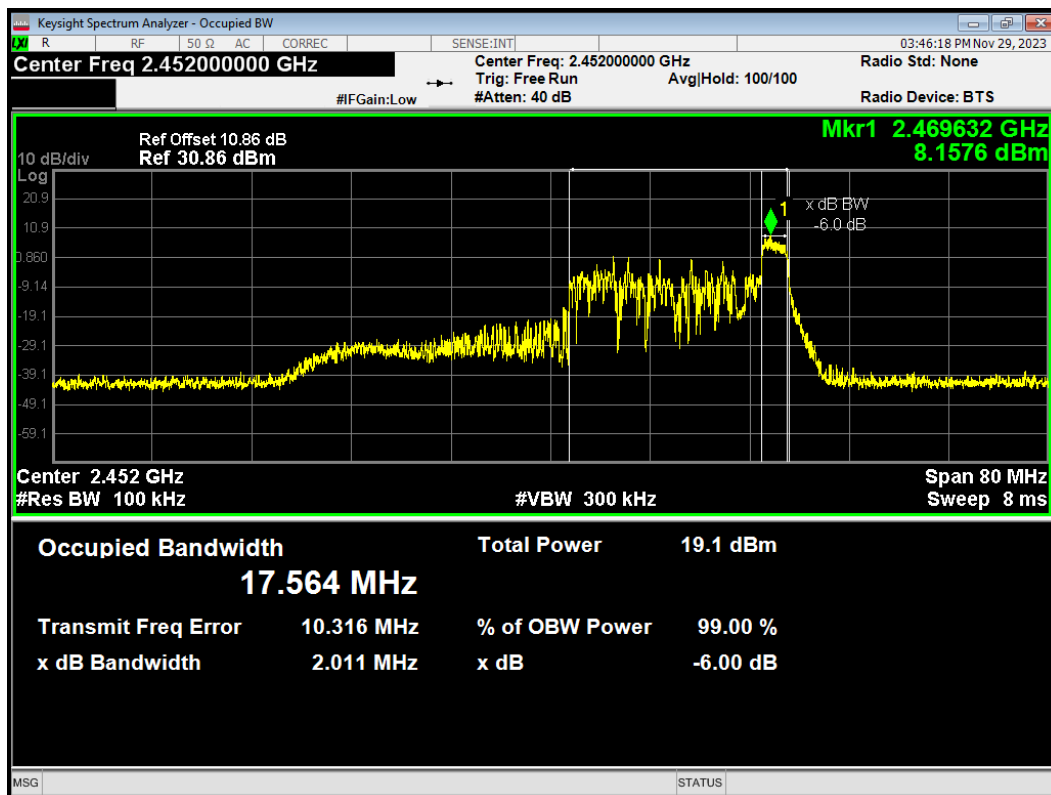
-6dB Bandwidth 802.11ax HE20 242-Tones 2462MHz



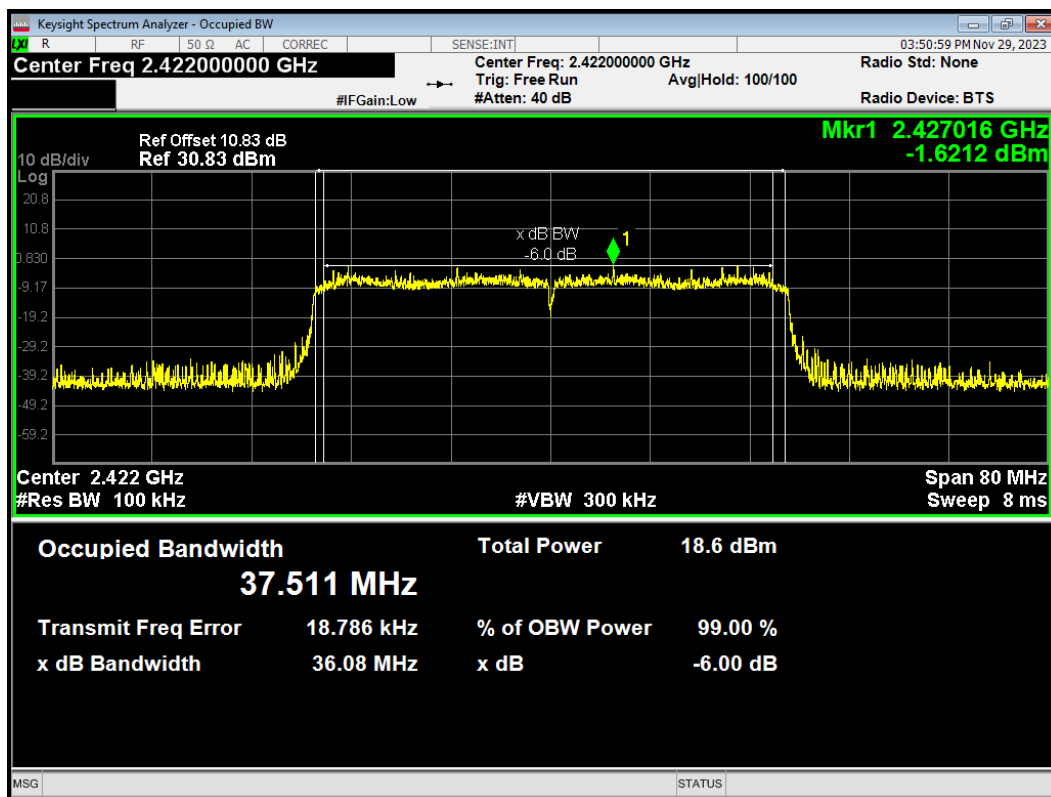
-6dB Bandwidth 802.11ax HE40 26-Tones 2422MHz



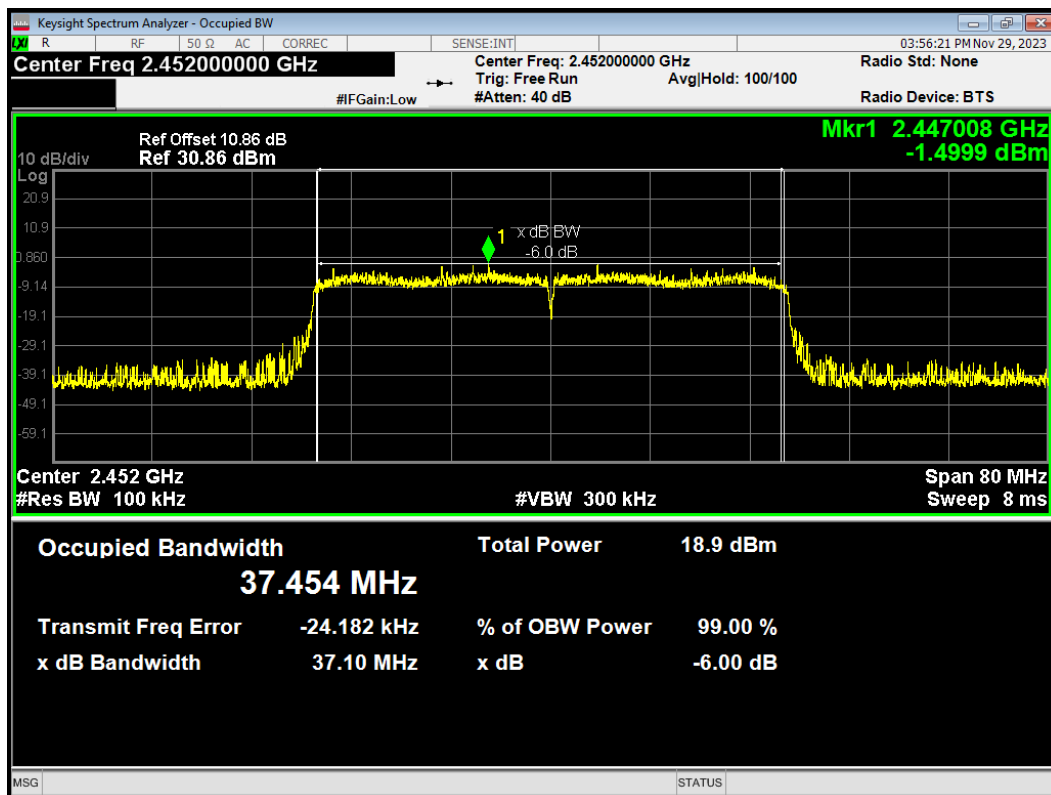
-6dB Bandwidth 802.11ax HE40 26-Tones 2452MHz



-6dB Bandwidth 802.11ax HE40 484-Tones 2422MHz

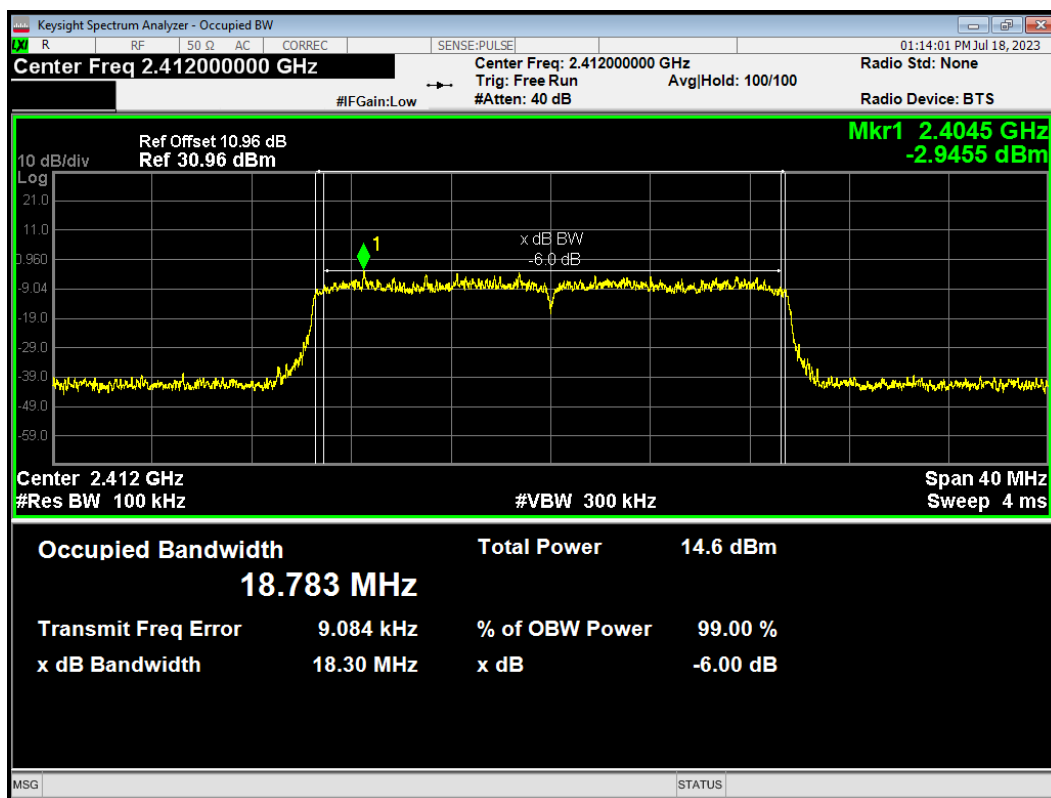


-6dB Bandwidth 802.11ax HE40 484-Tones 2452MHz

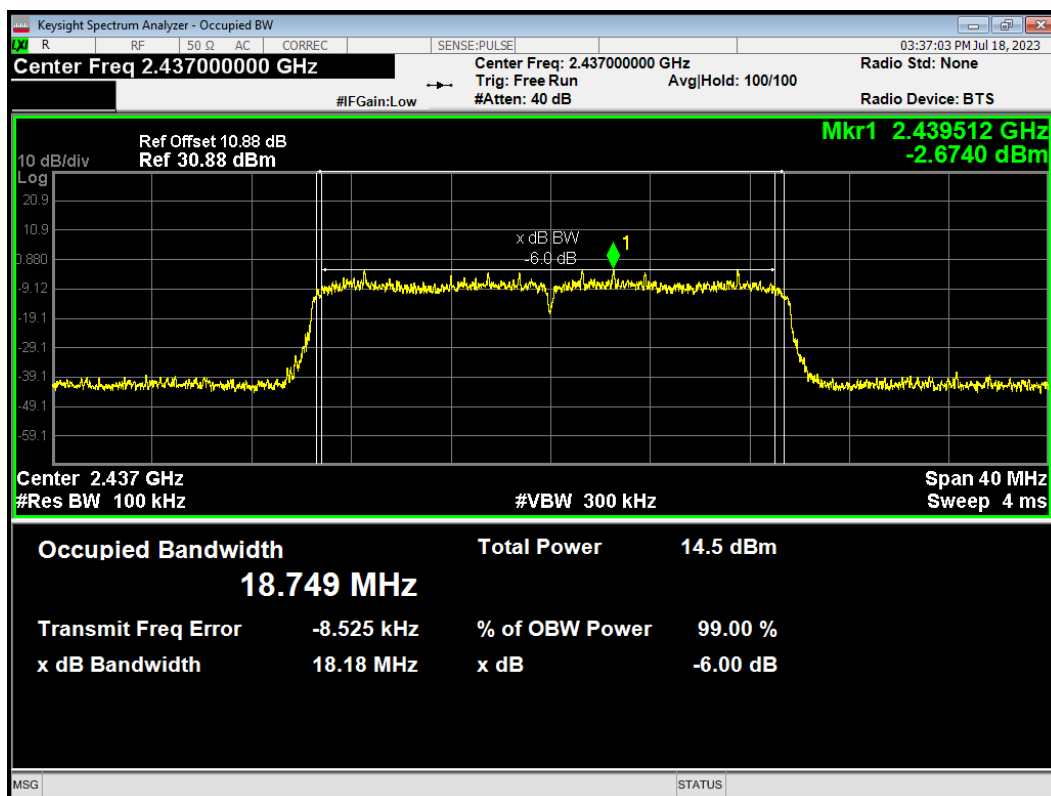


# ERSU Mode

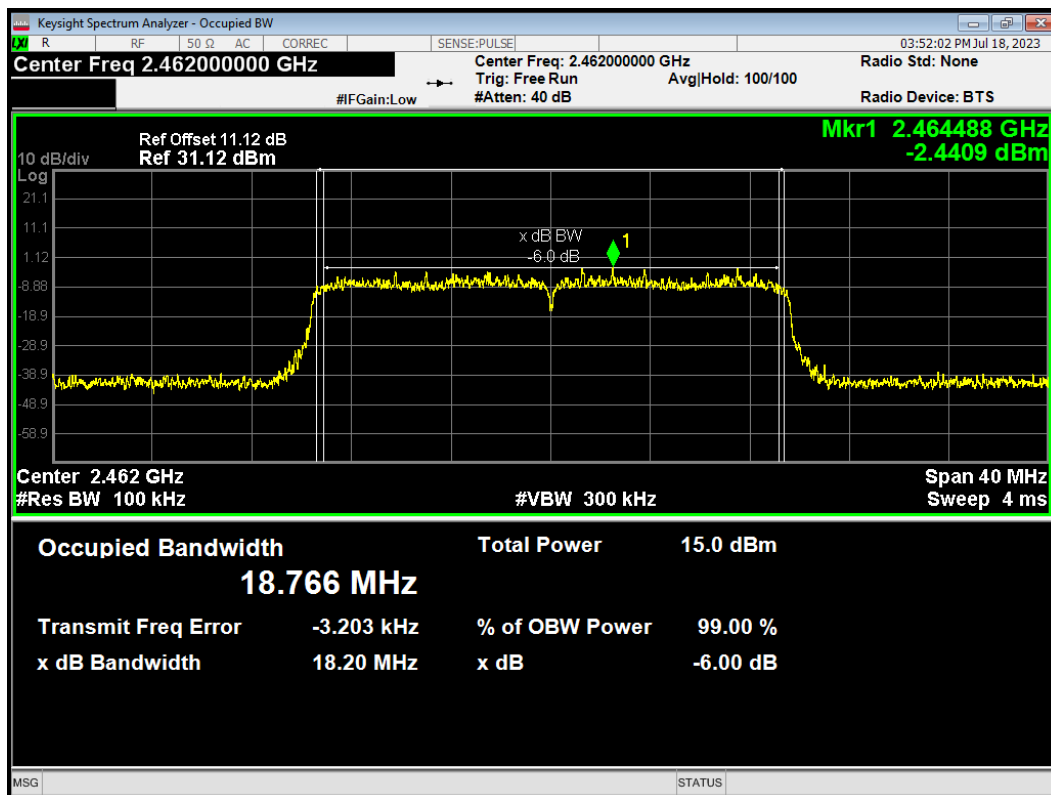
-6dB Bandwidth 802.11ax HE20 242-Tones 2412MHz



-6dB Bandwidth 802.11ax HE20 242-Tones 2437MHz

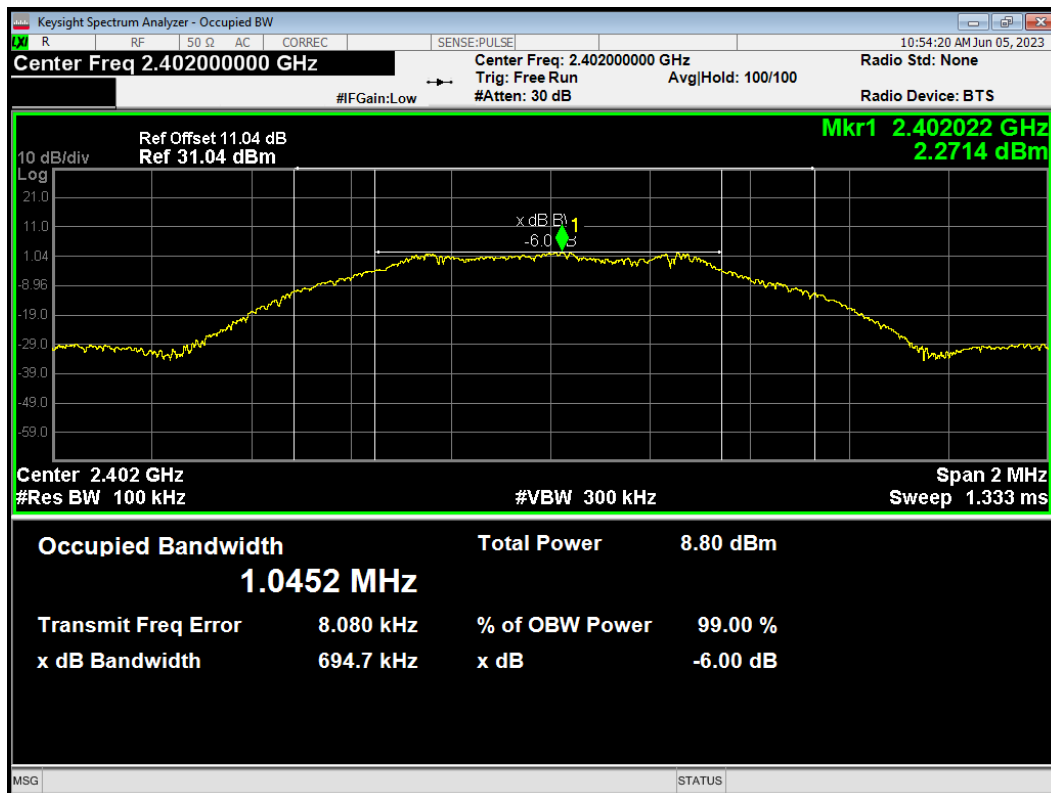


-6dB Bandwidth 802.11ax HE20 242-Tones 2462MHz

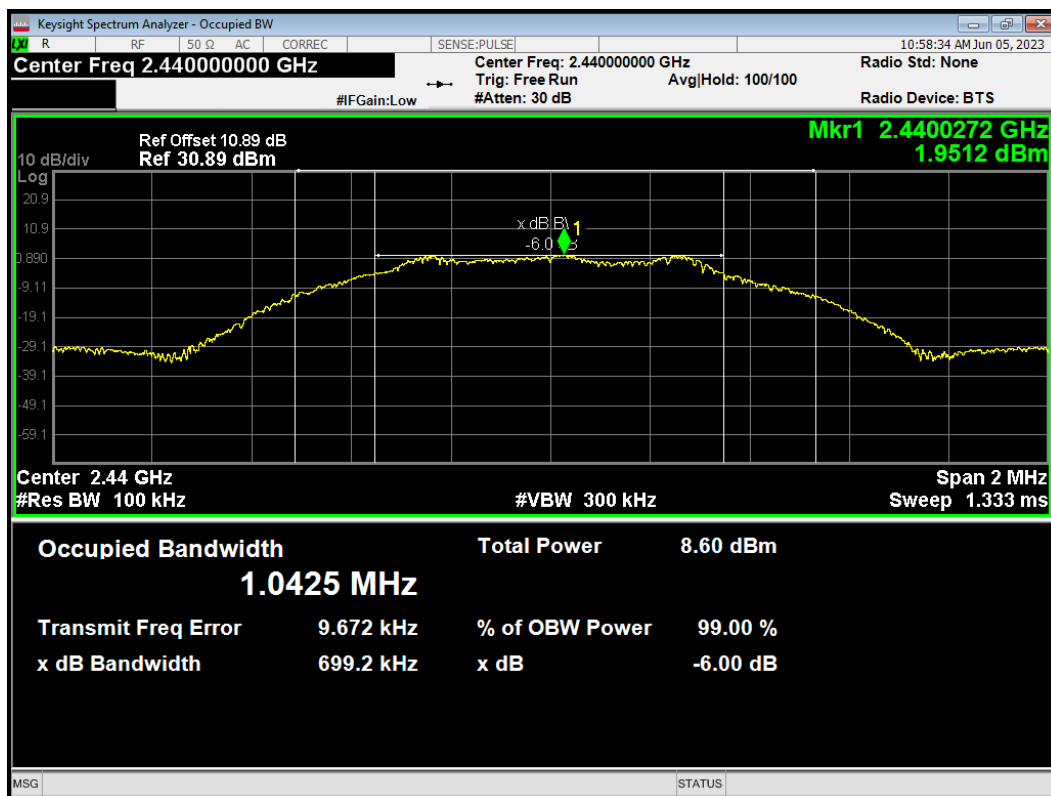


# Bluetooth LE

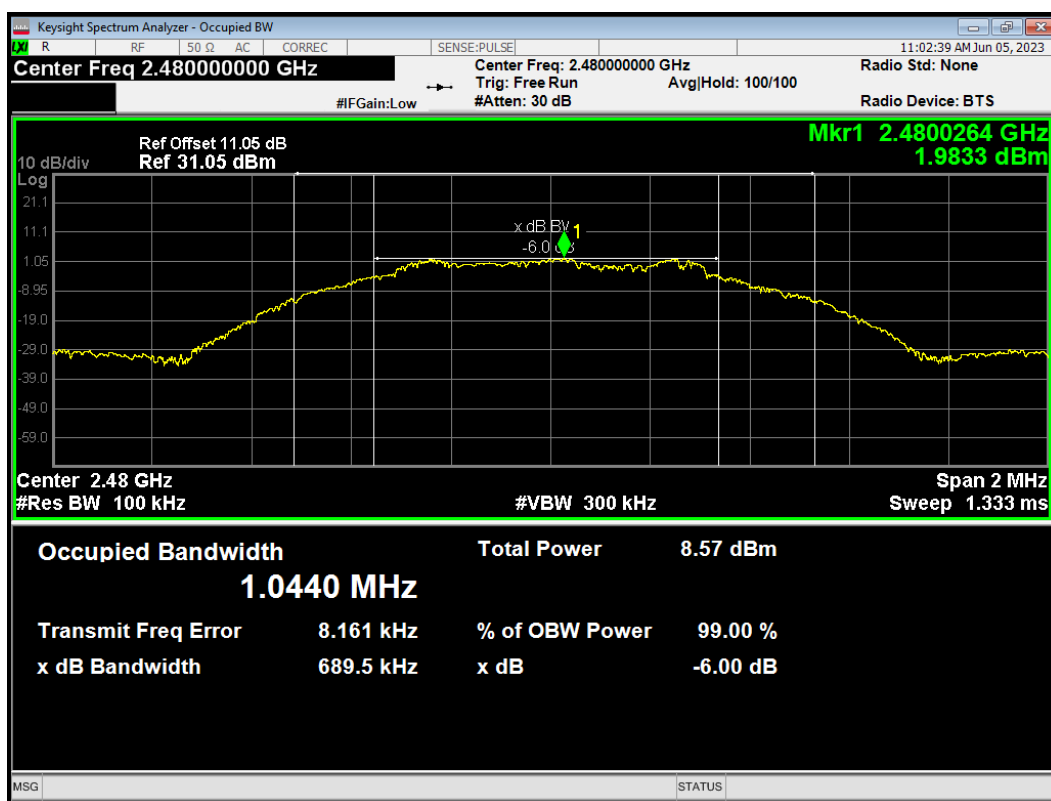
## -6dB Bandwidth BLE (1M) 2402MHz



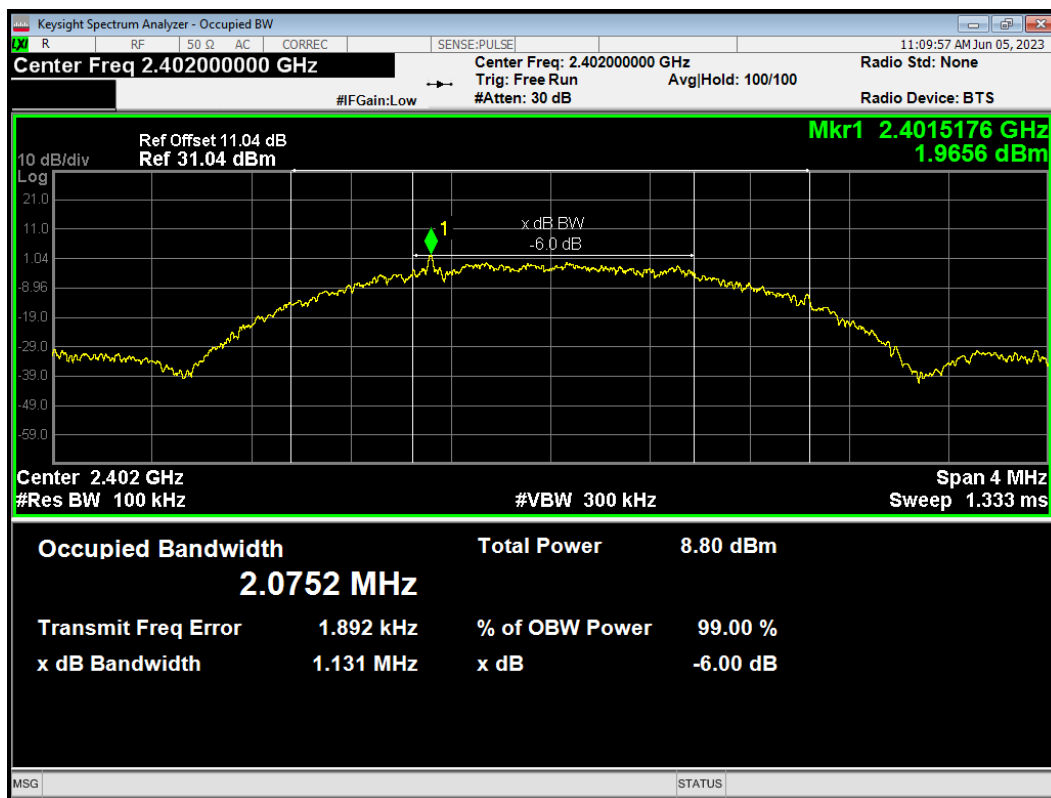
## -6dB Bandwidth BLE (1M) 2440MHz



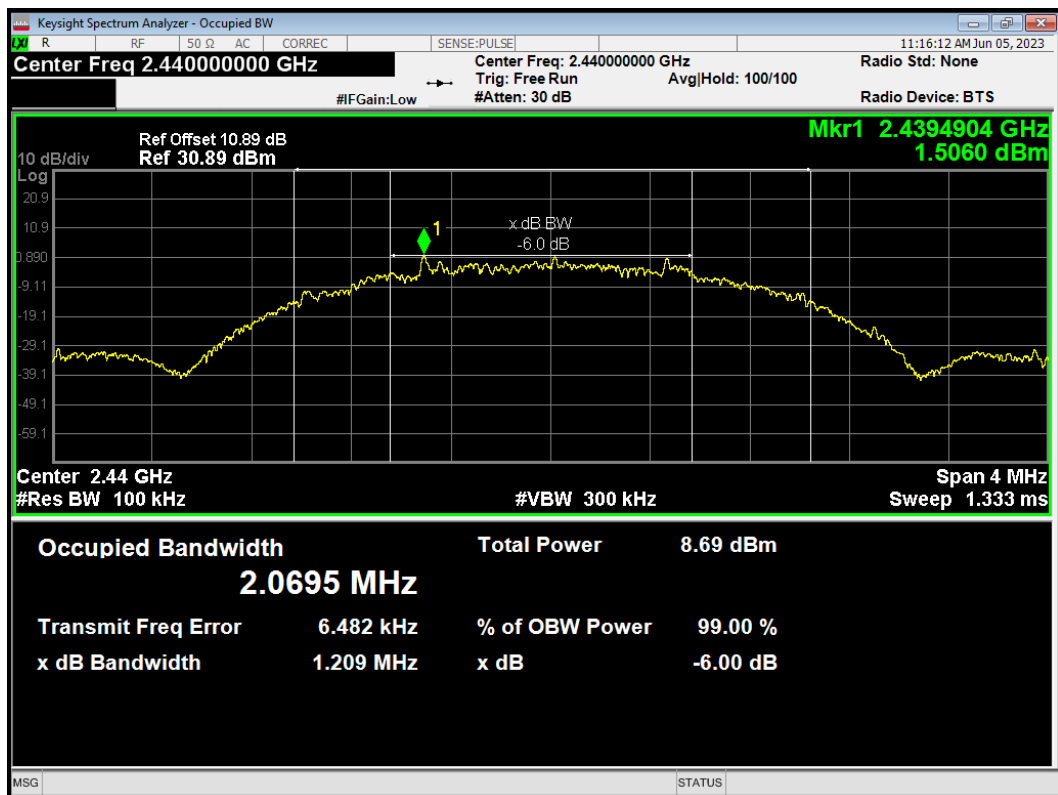
-6dB Bandwidth BLE (1M) 2480MHz



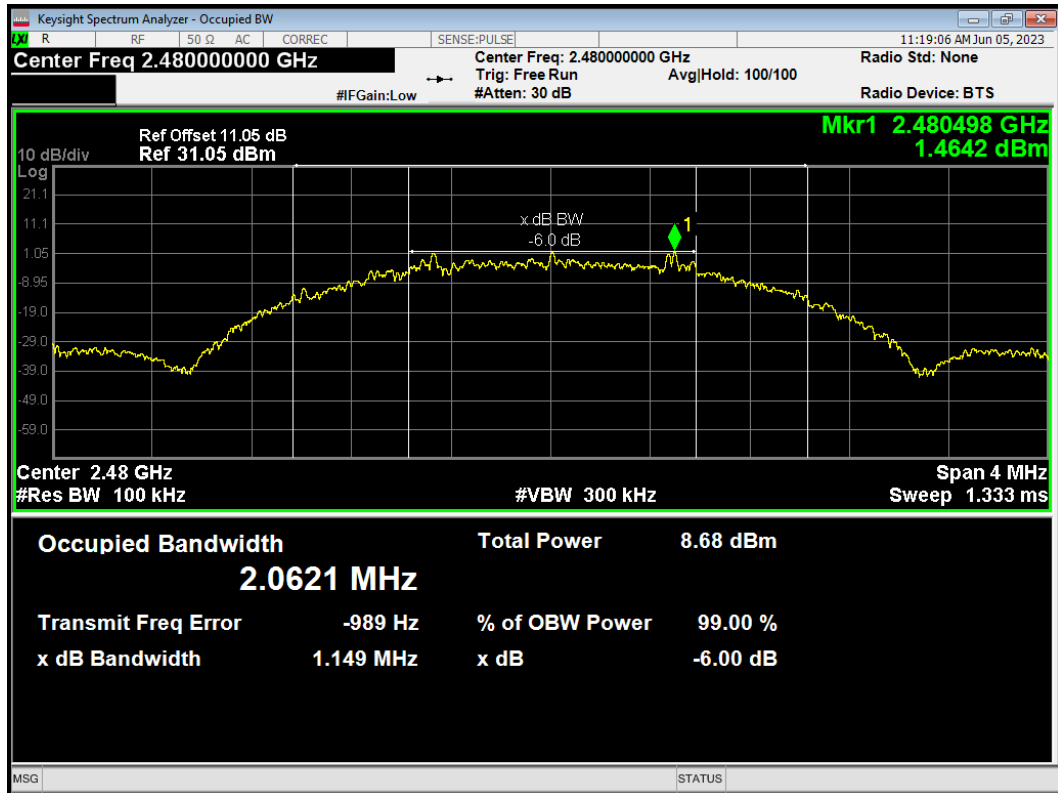
-6dB Bandwidth BLE (2M) 2402MHz



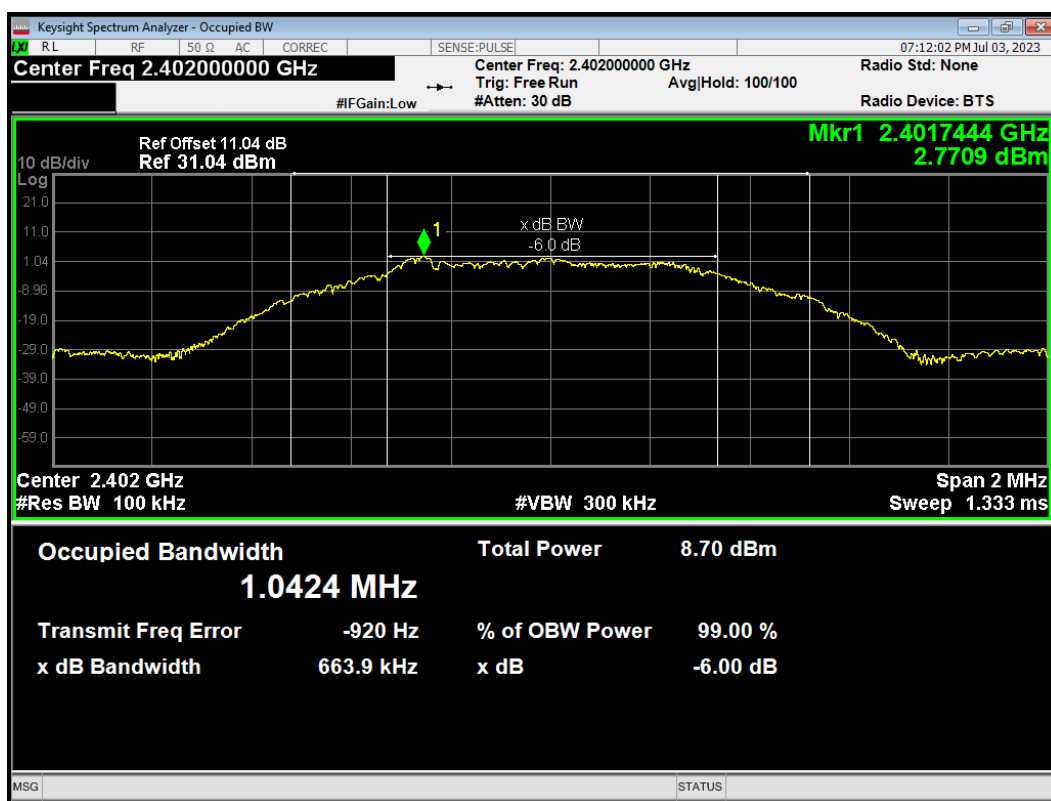
-6dB Bandwidth BLE (2M) 2440MHz



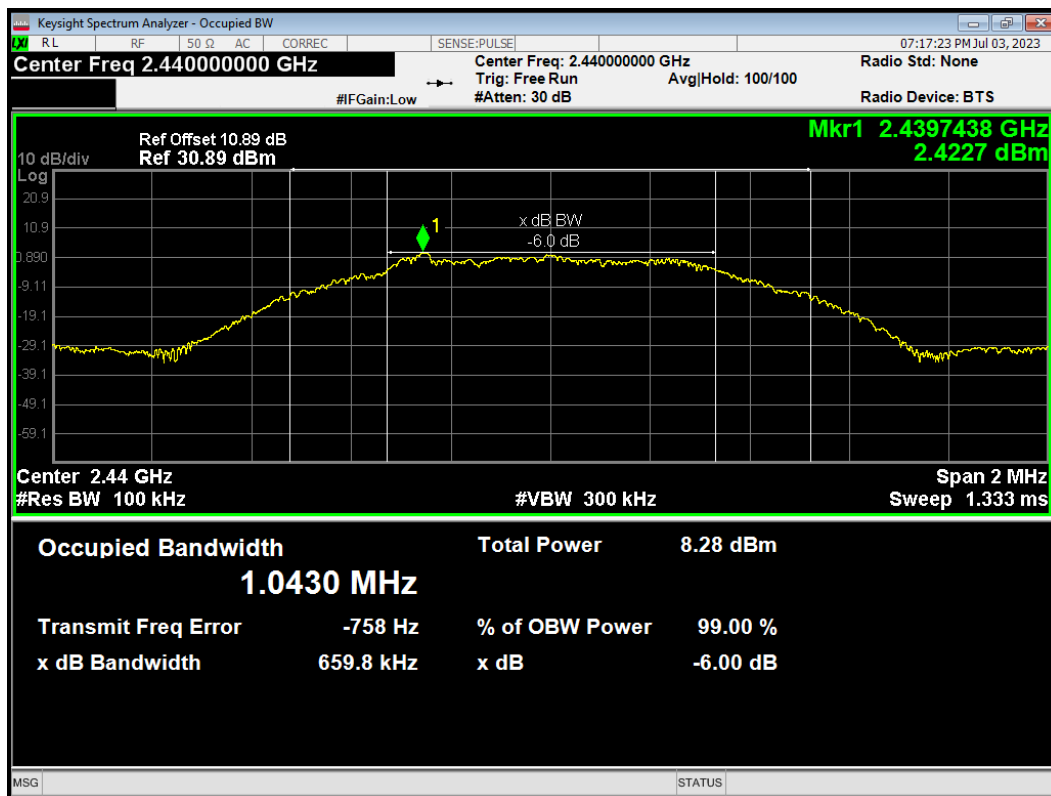
-6dB Bandwidth BLE (2M) 2480MHz



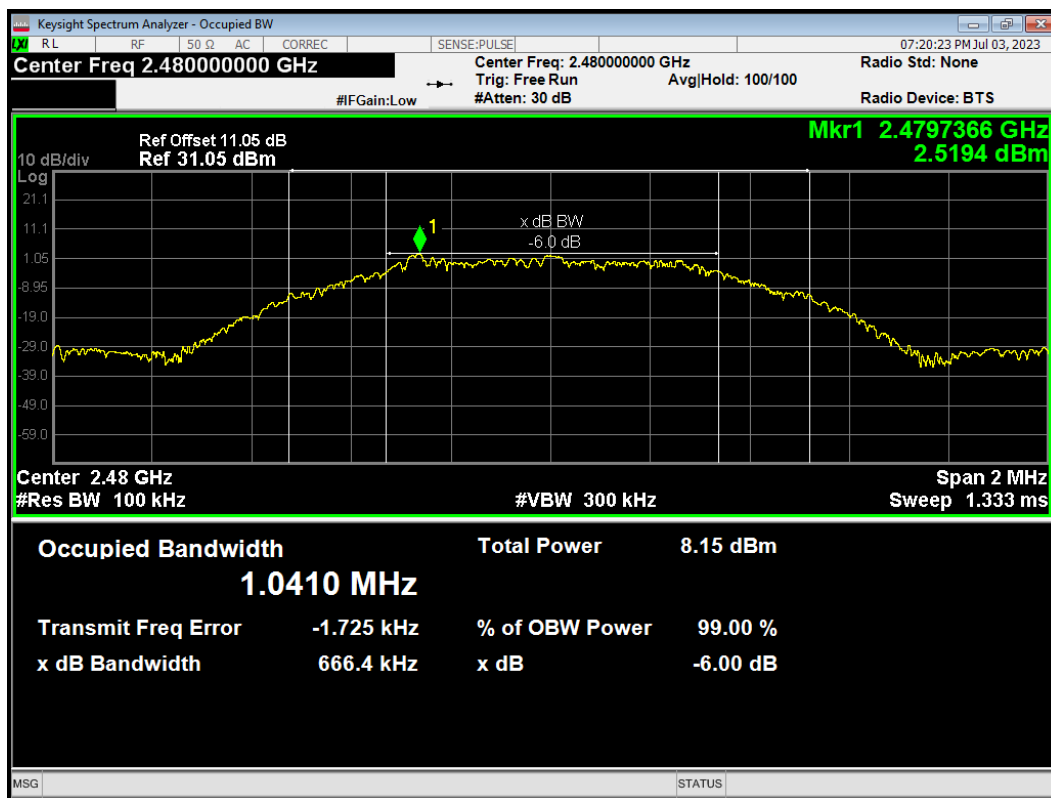
-6dB Bandwidth BLE (S=2) 2402MHz



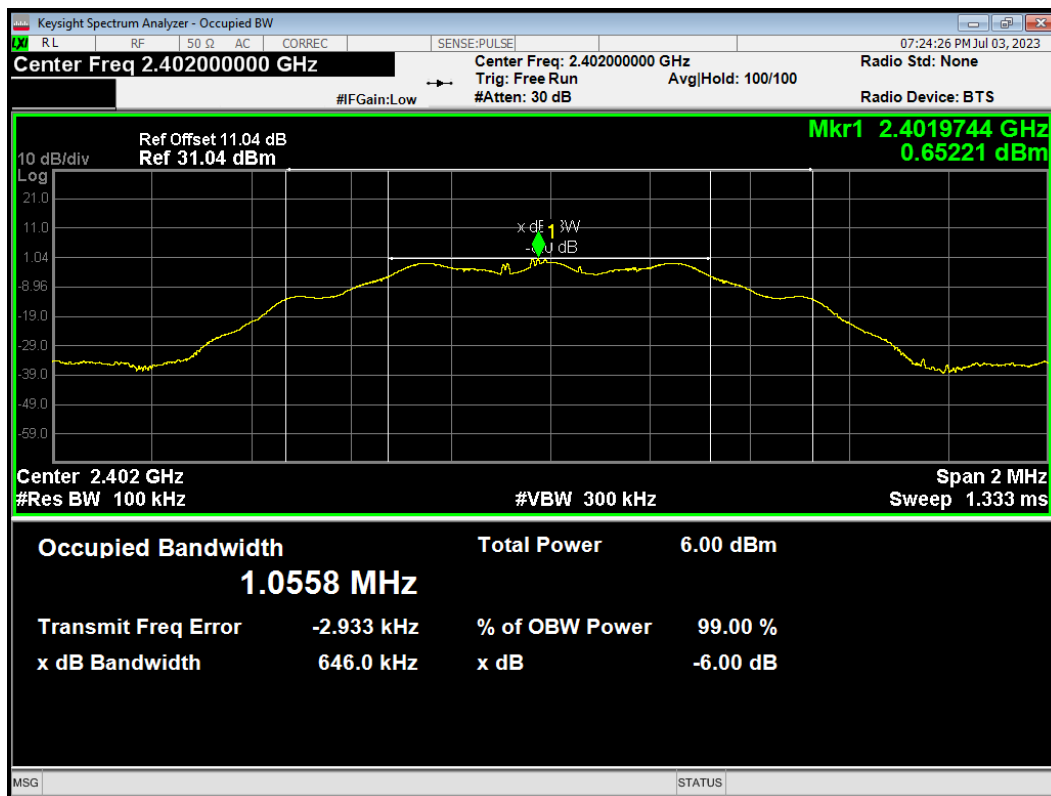
-6dB Bandwidth BLE (S=2) 2440MHz



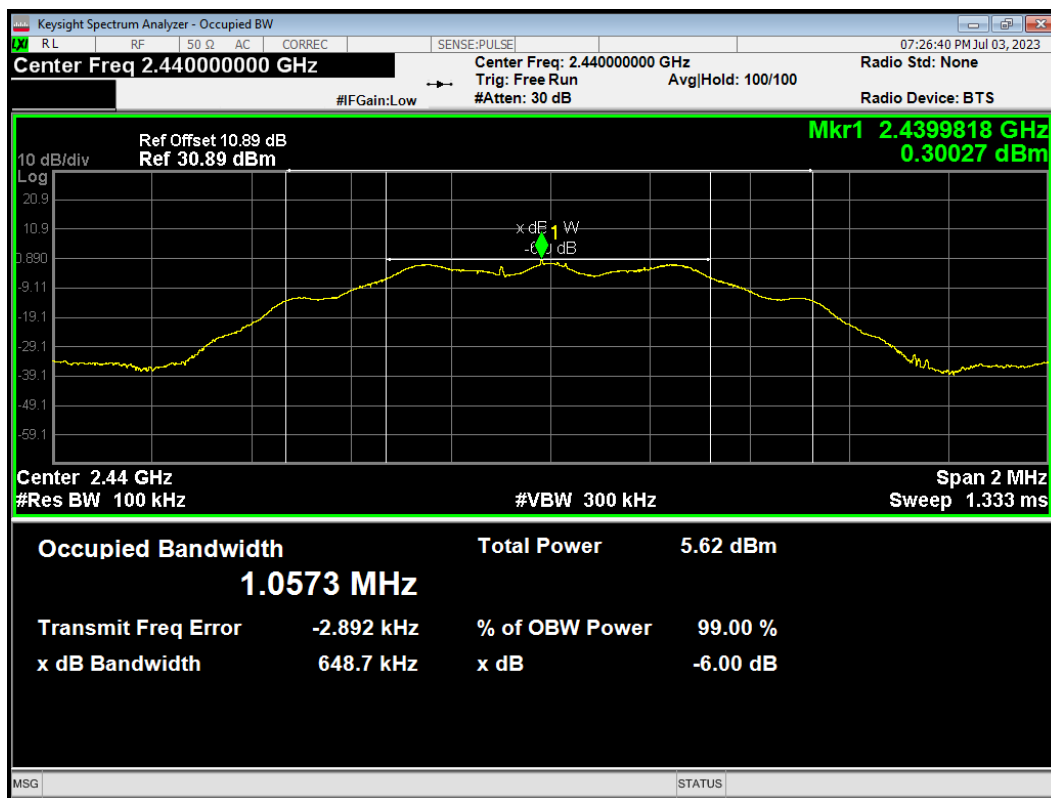
-6dB Bandwidth BLE (S=2) 2480MHz



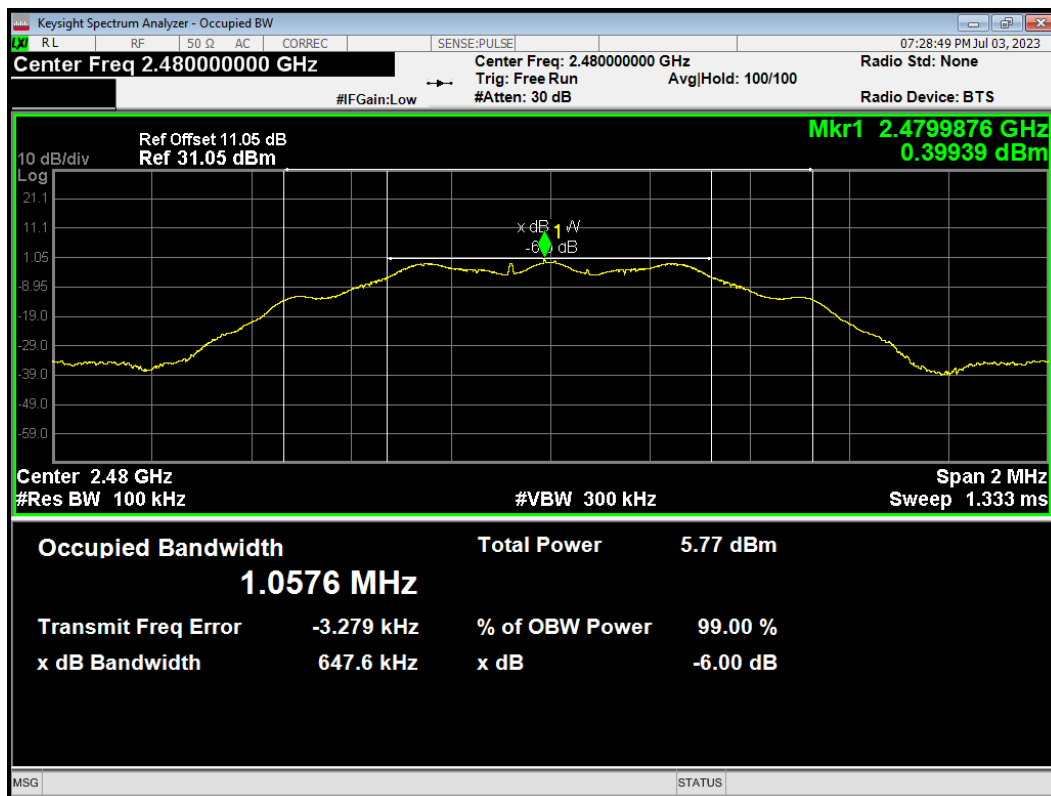
-6dB Bandwidth BLE (S=8) 2402MHz



-6dB Bandwidth BLE (S=8) 2440MHz



-6dB Bandwidth BLE (S=8) 2480MHz



### 5.3. Band Edge

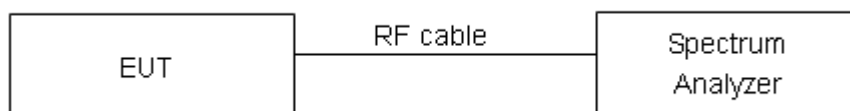
#### Ambient Condition

| Temperature | Relative humidity |
|-------------|-------------------|
| 20°C ~ 25°C | 45% ~ 50%         |

#### Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

#### Test Setup



#### Limits

Rule Part 15.247(d) specifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.” If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.”

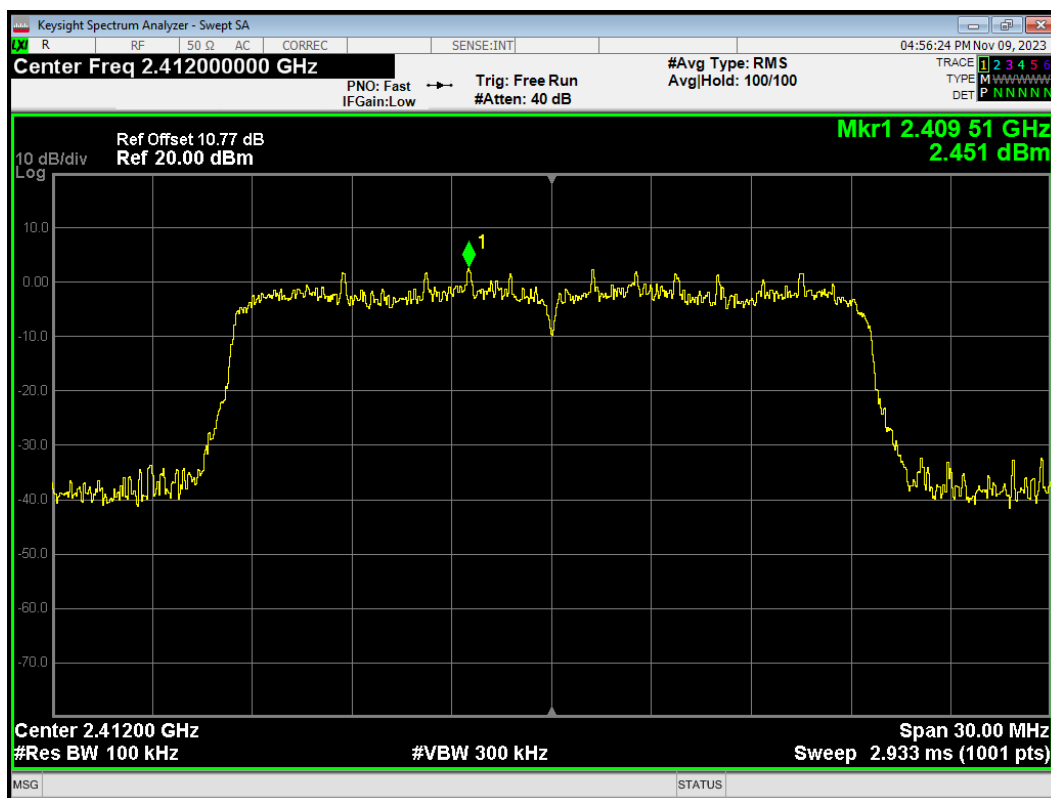
#### Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor  $k = 1.96$ .

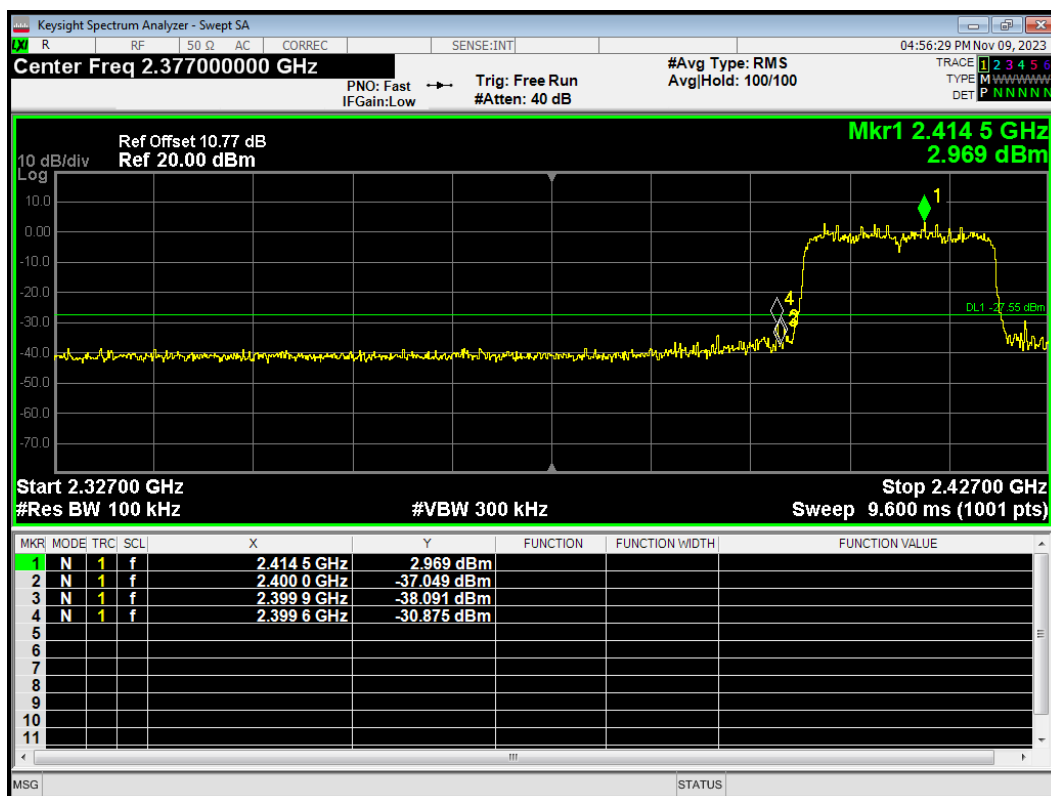
| Frequency | Uncertainty |
|-----------|-------------|
| 2GHz-3GHz | 1.407 dB    |

Test Results: PASS

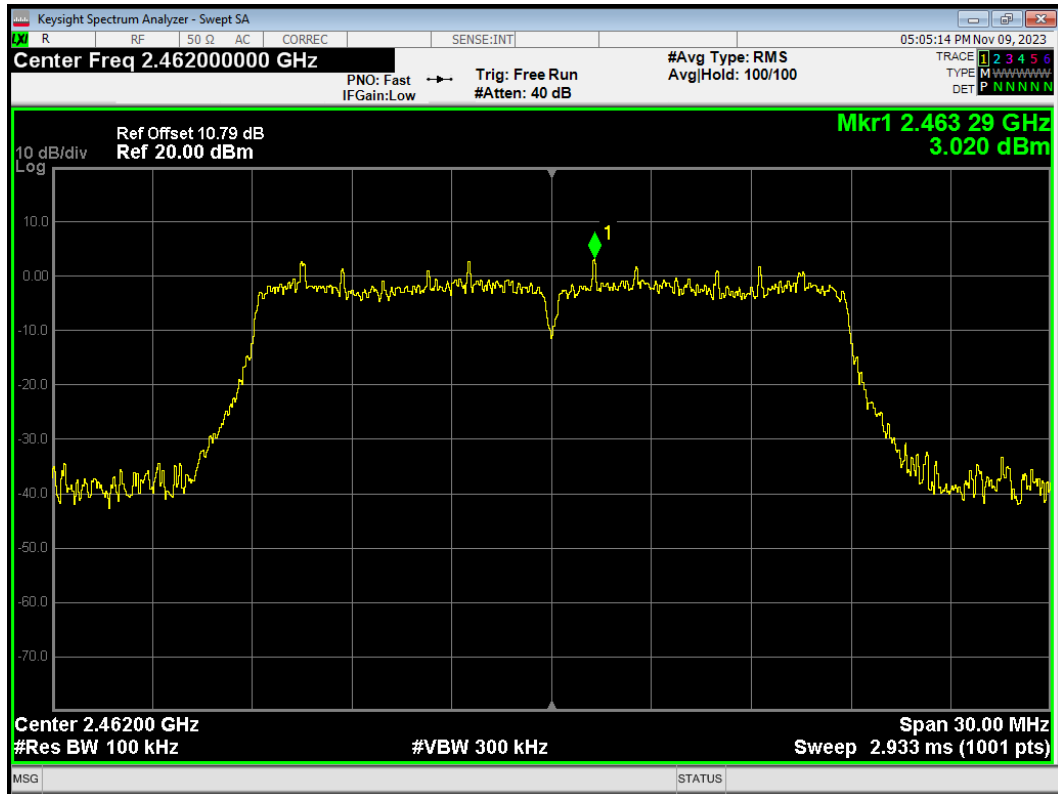
Band Edge 802.11ax(HE20) 2412MHz Ref



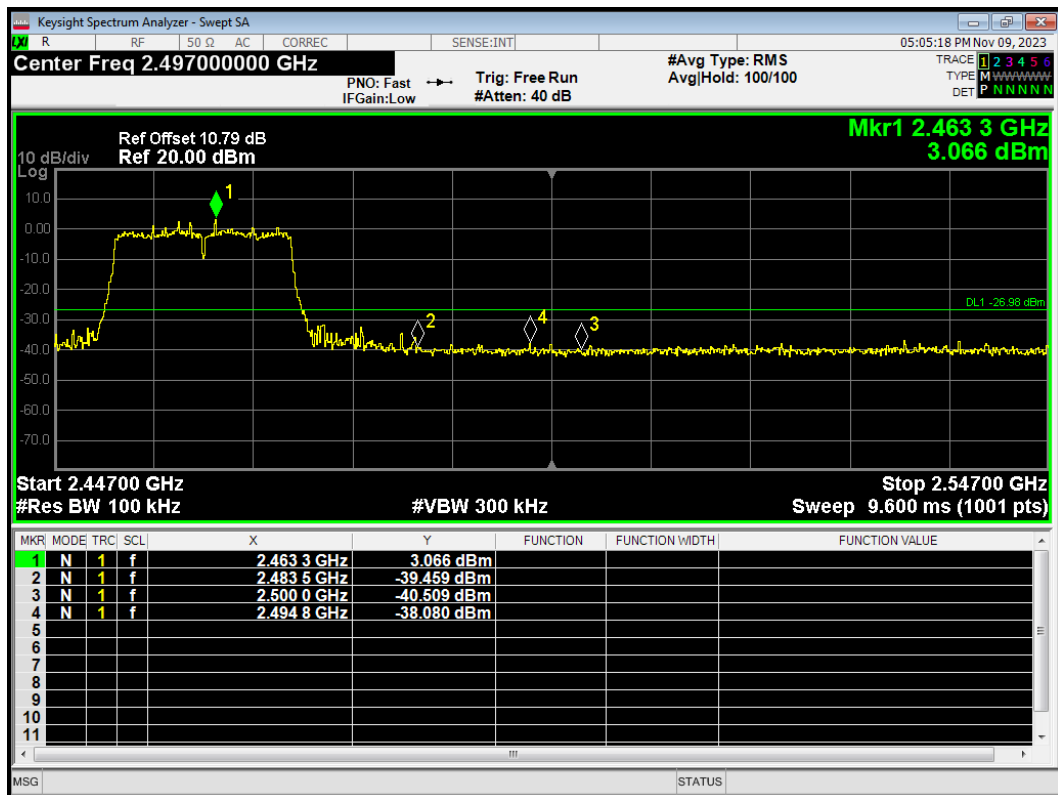
Band Edge 802.11ax(HE20) 2412MHz Emission



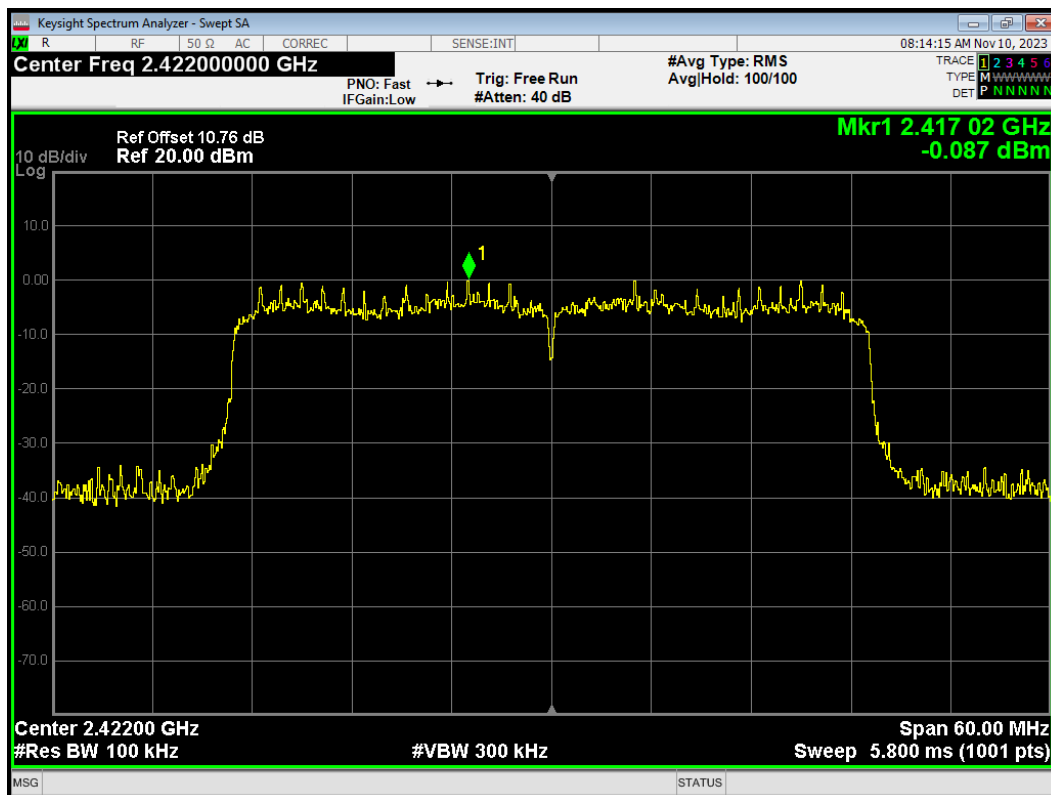
Band Edge 802.11ax(HE20) 2462MHz Ref



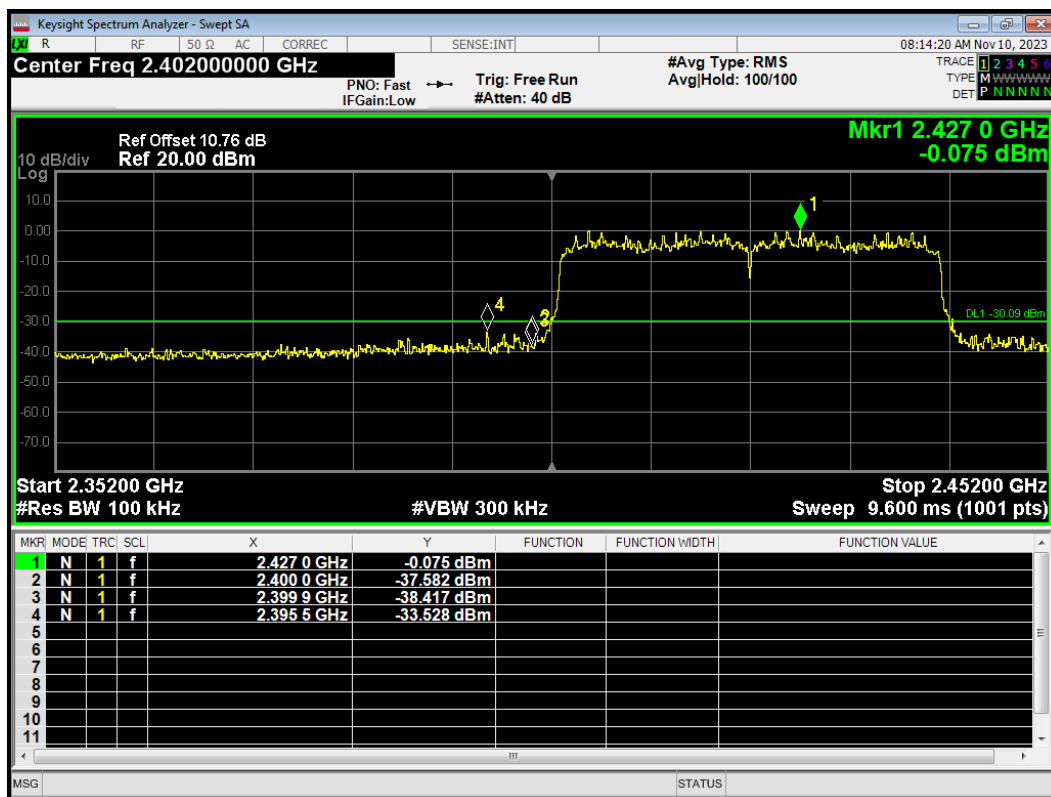
Band Edge 802.11ax(HE20) 2462MHz Emission



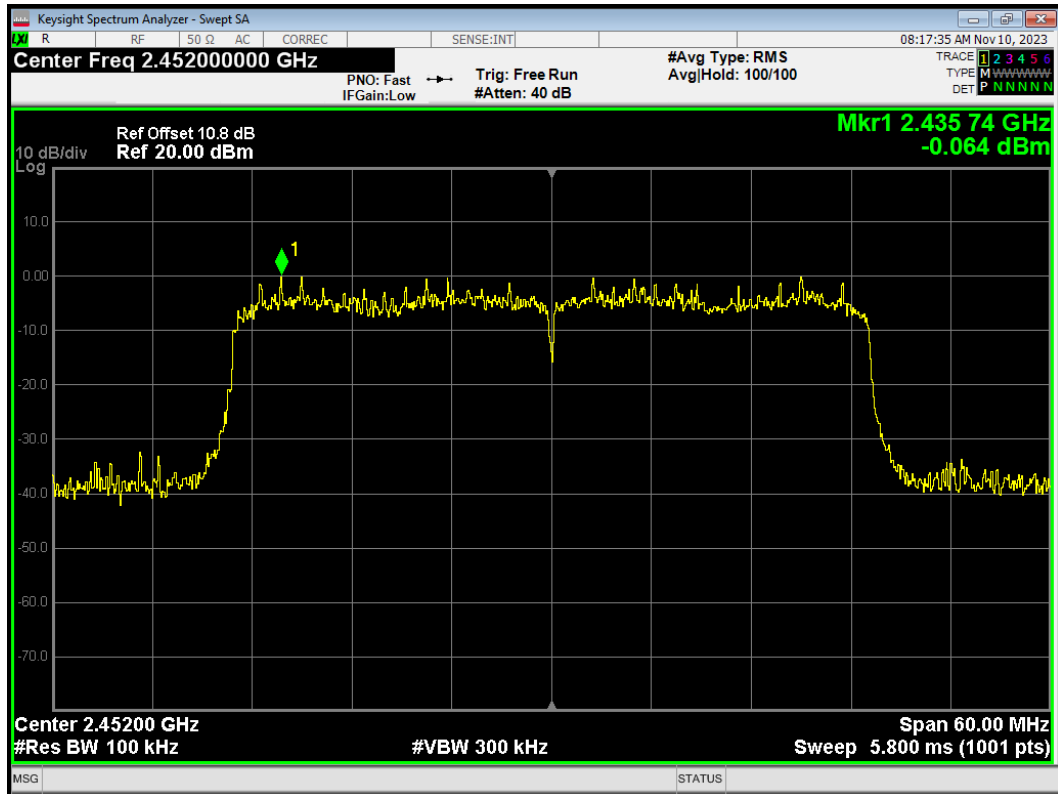
Band Edge 802.11ax(HE40) 2422MHz Ref



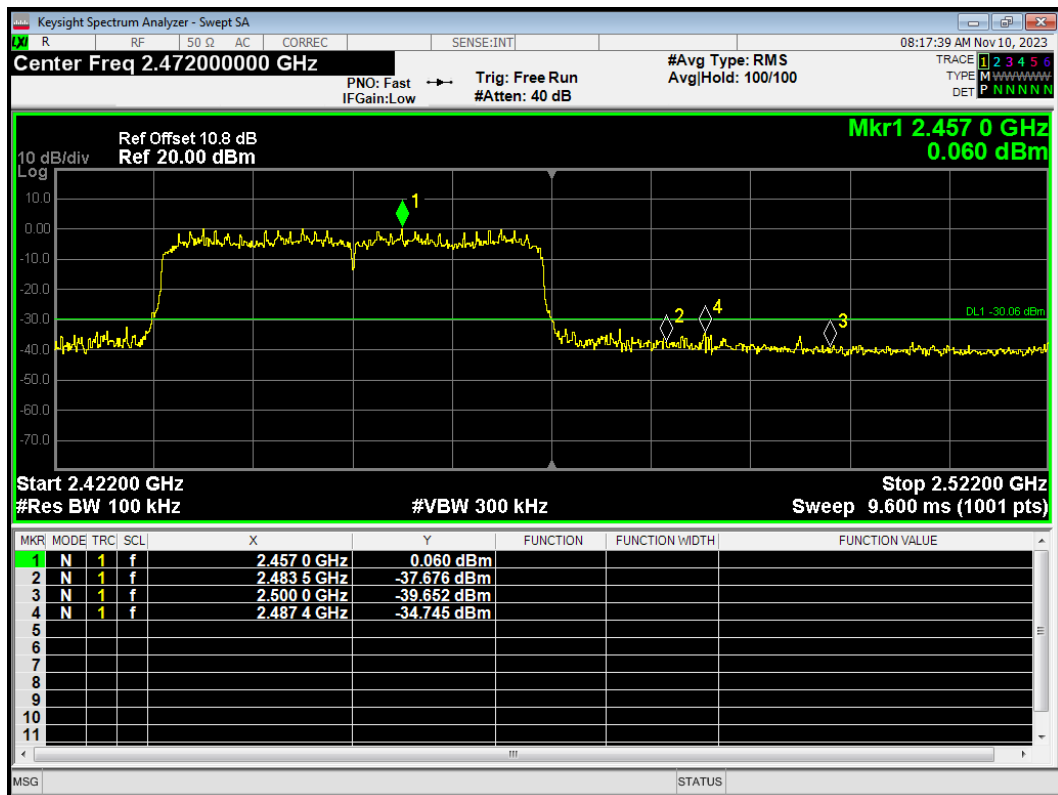
Band Edge 802.11ax(HE40) 2422MHz Emission



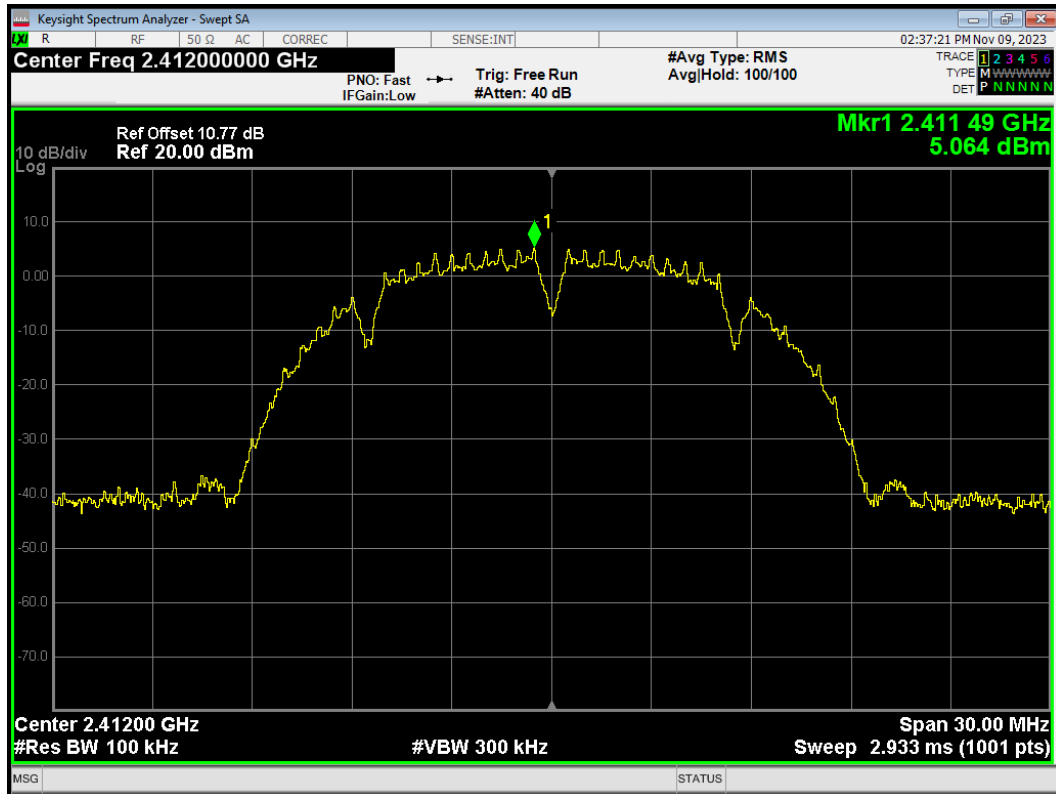
Band Edge 802.11ax(HE40) 2452MHz Ref



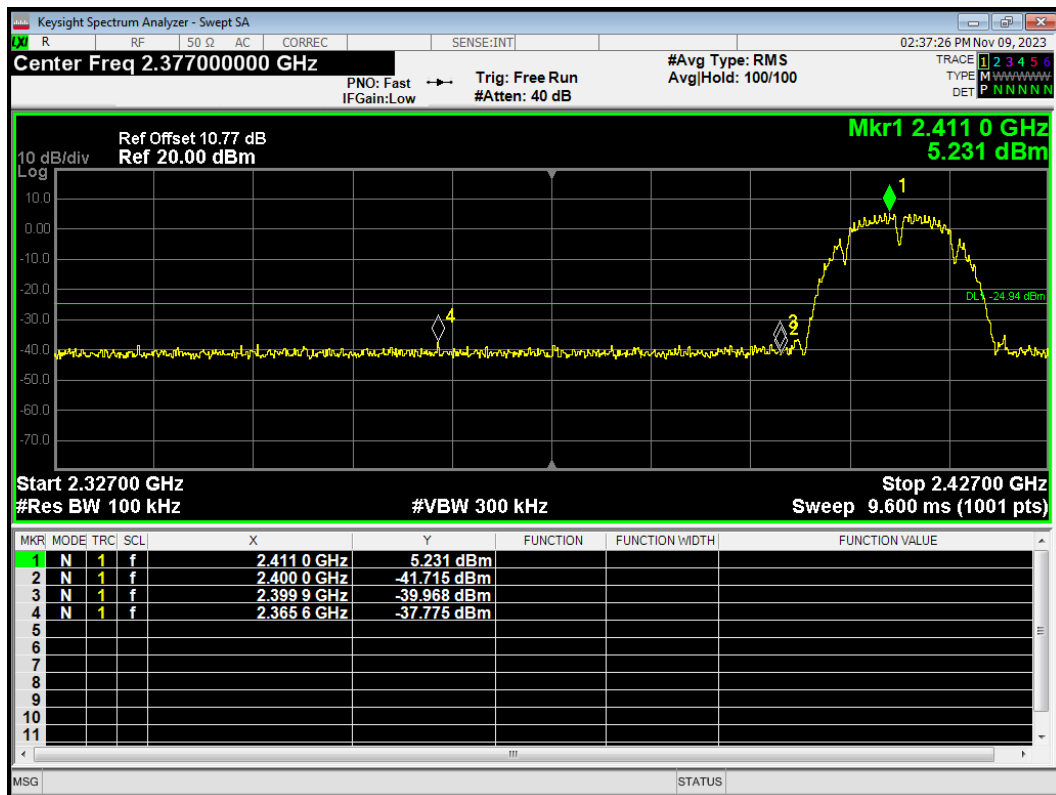
Band Edge 802.11ax(HE40) 2452MHz Emission



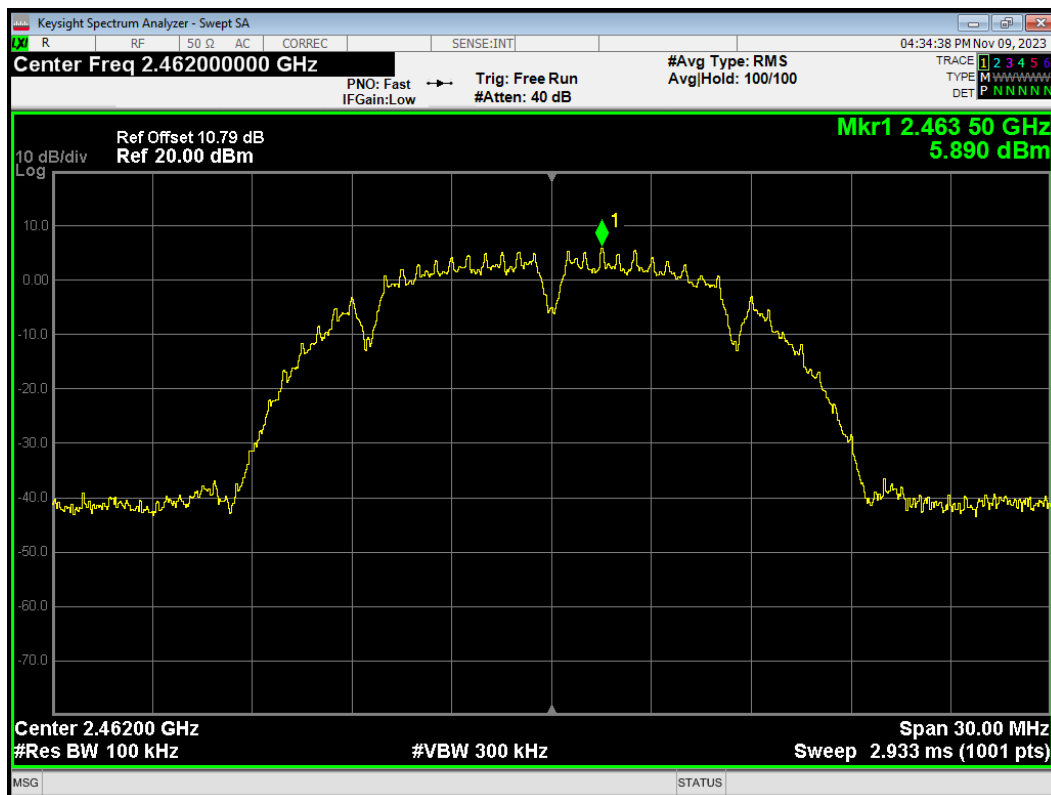
Band Edge 802.11b 2412MHz Ref



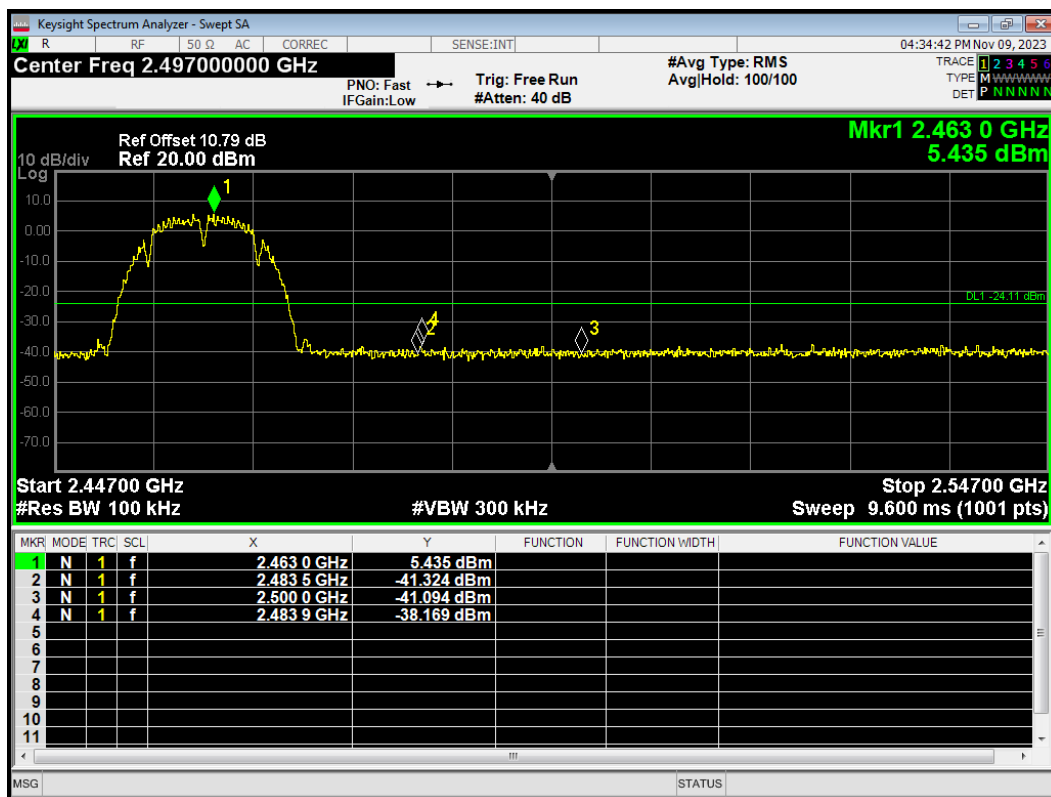
Band Edge 802.11b 2412MHz Emission



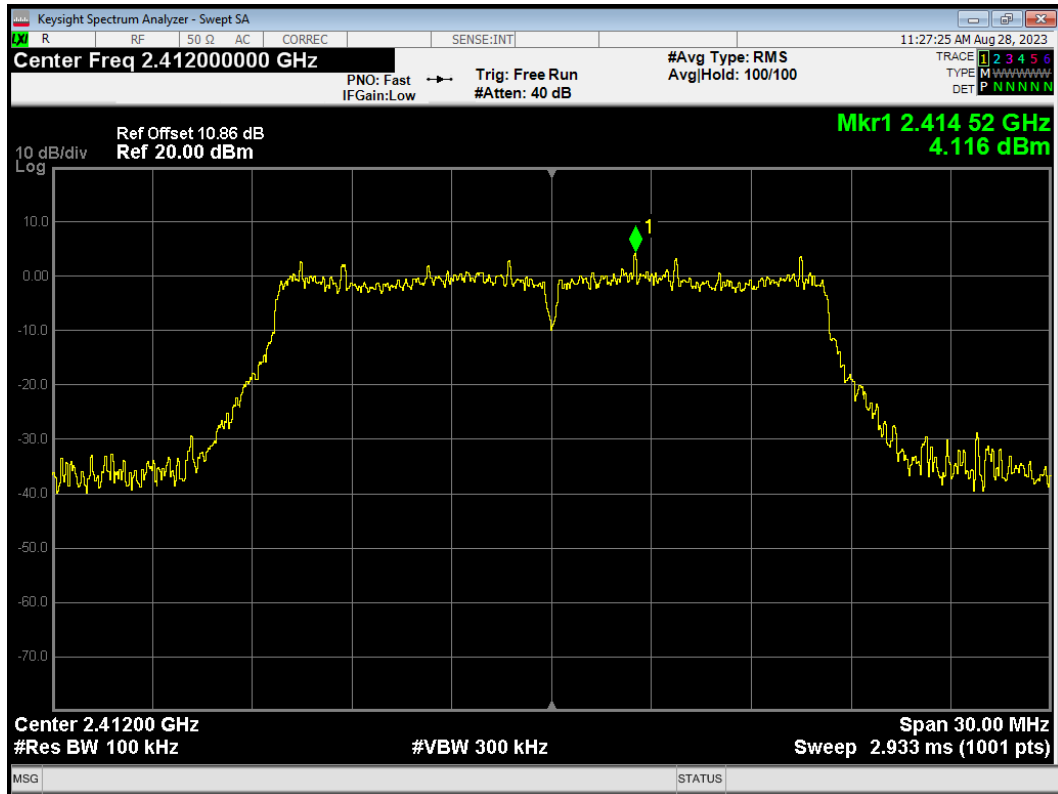
Band Edge 802.11b 2462MHz Ref



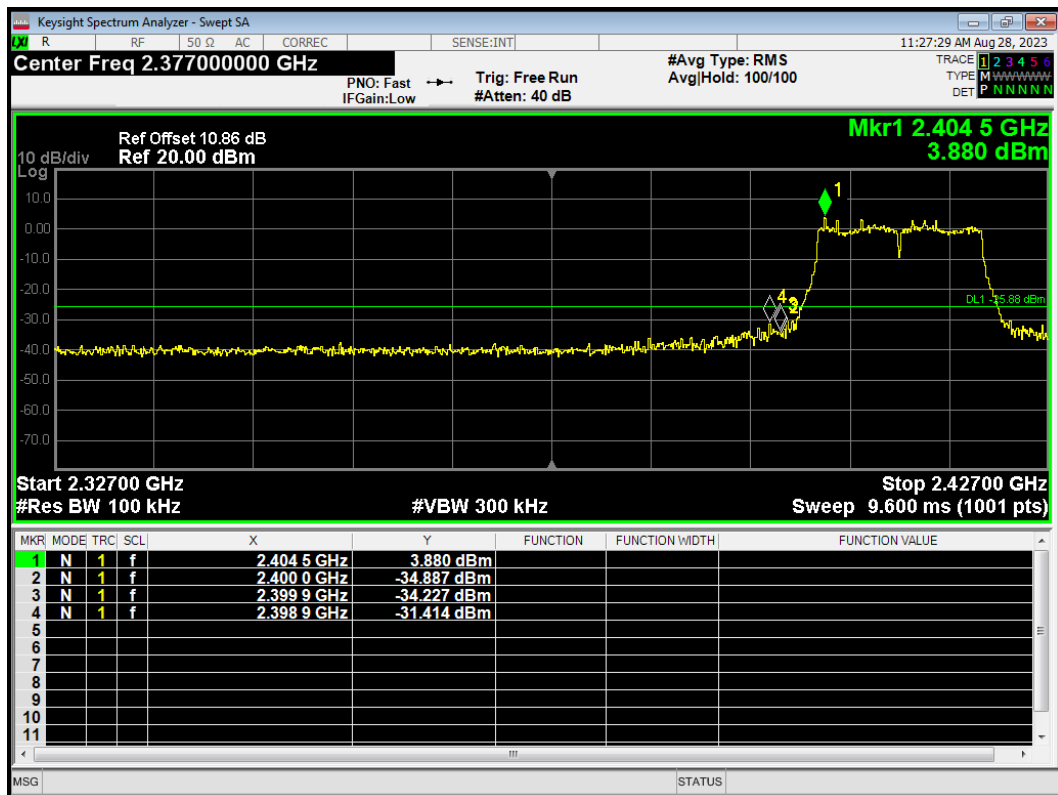
Band Edge 802.11b 2462MHz Emission



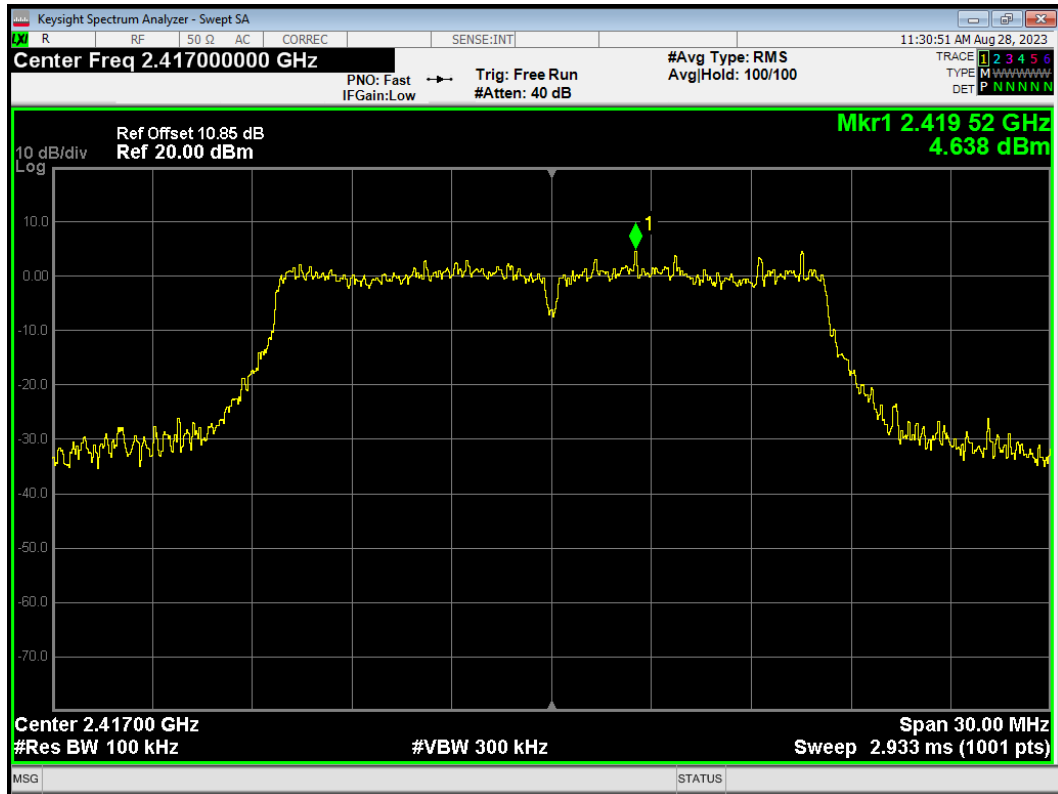
Band Edge 802.11g 2412MHz Ref



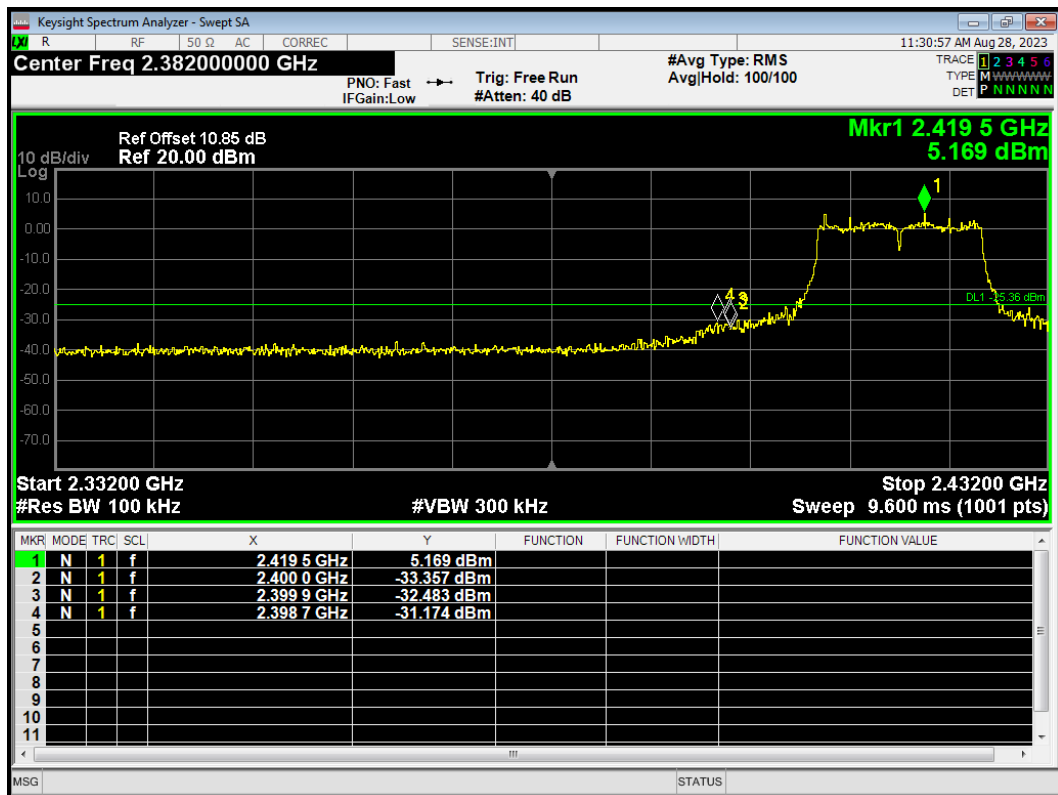
Band Edge 802.11g 2412MHz Emission



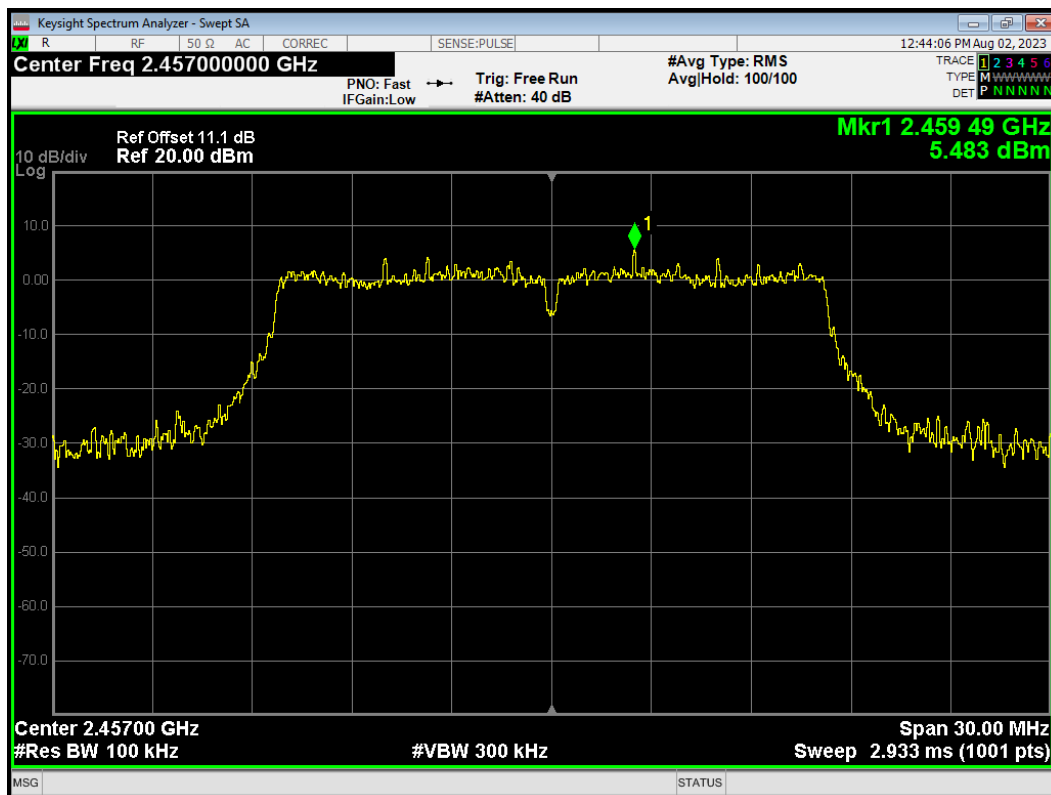
Band Edge 802.11g 2417MHz Ref



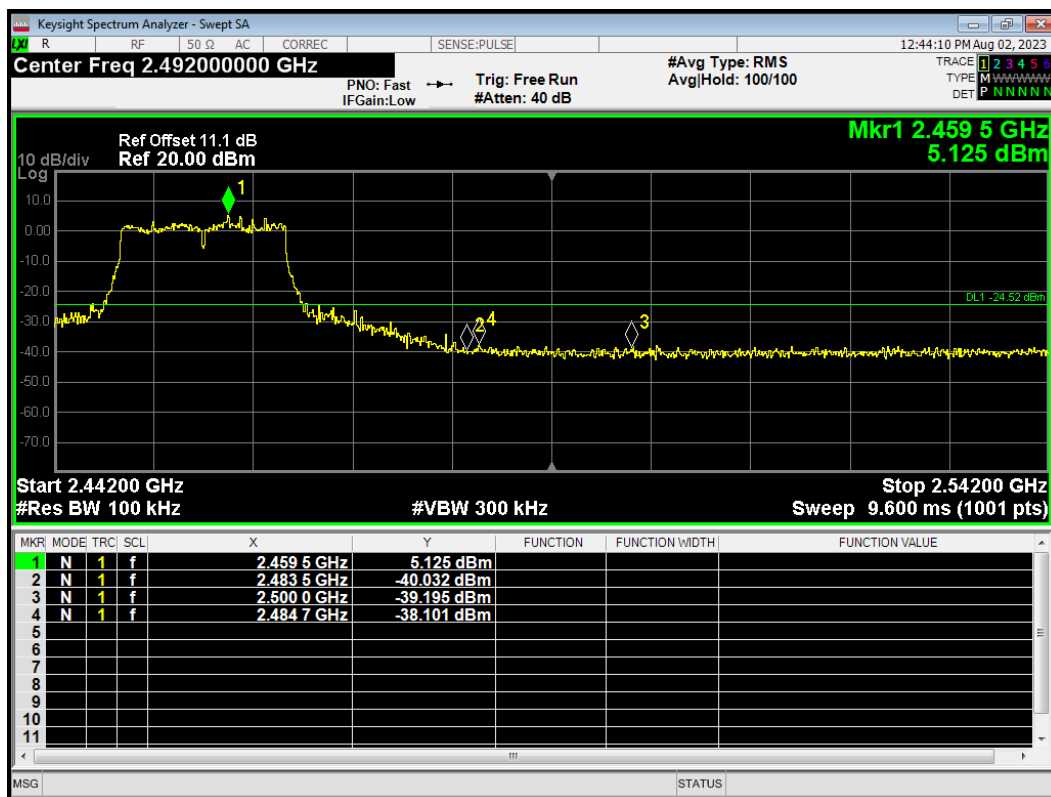
Band Edge 802.11g 2417MHz Emission



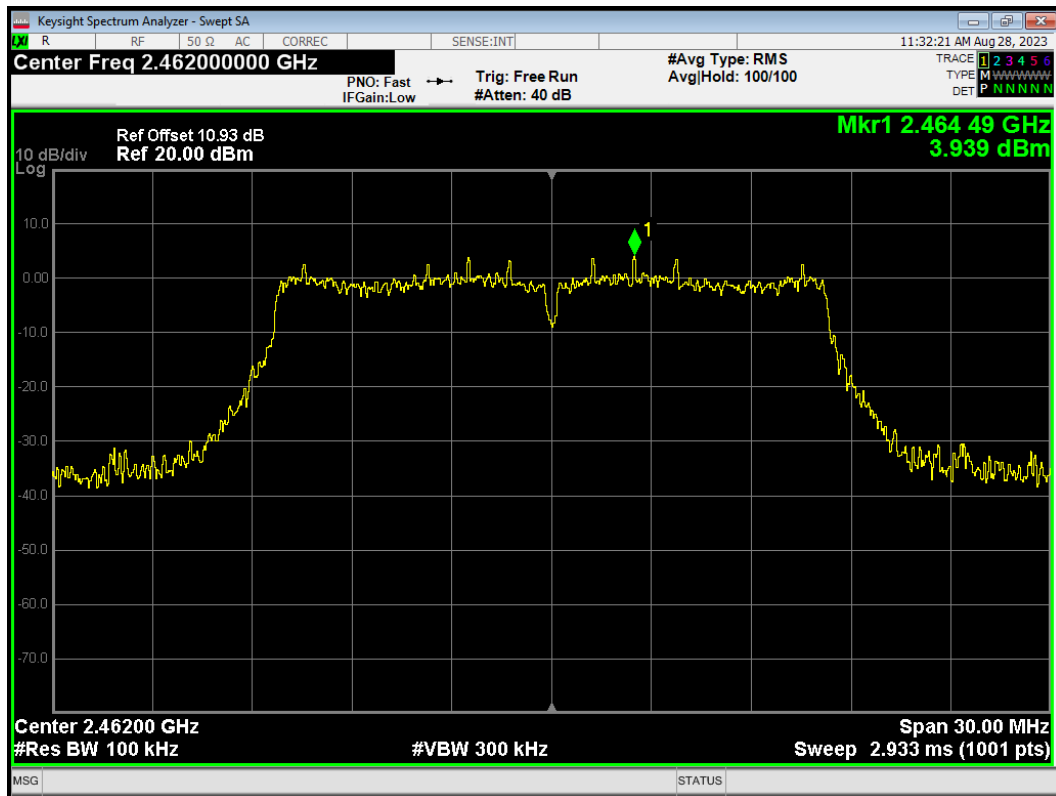
Band Edge 802.11g 2457MHz Ref



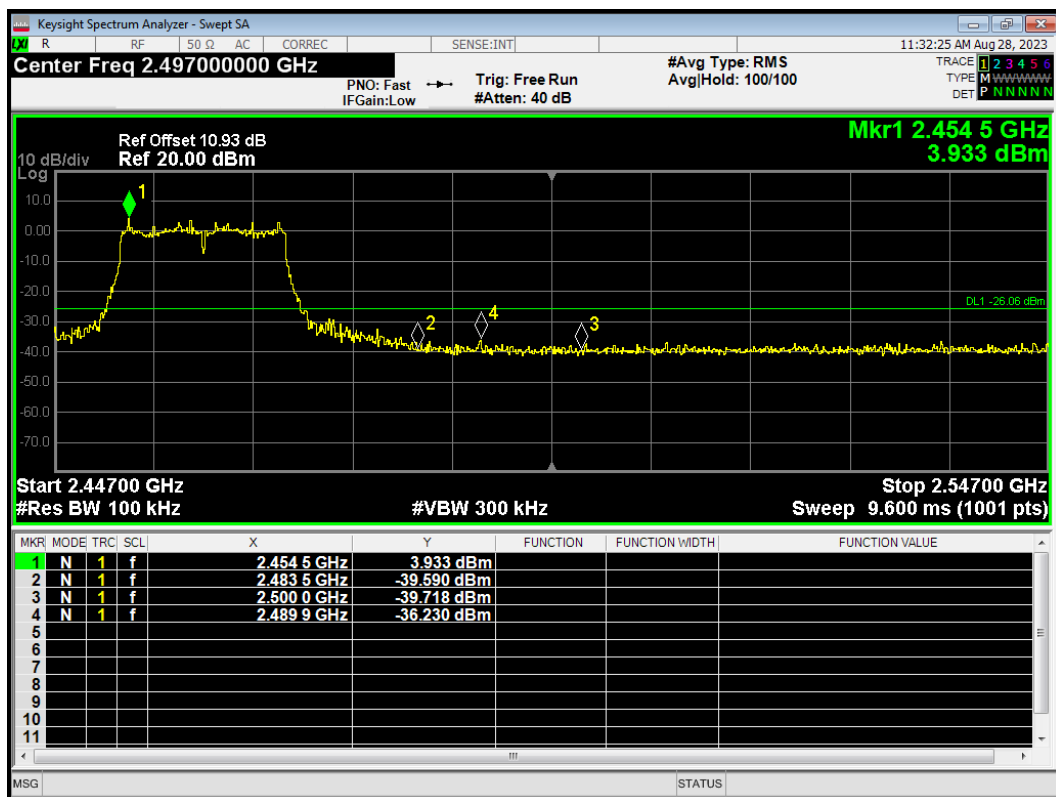
Band Edge 802.11g 2457MHz Emission



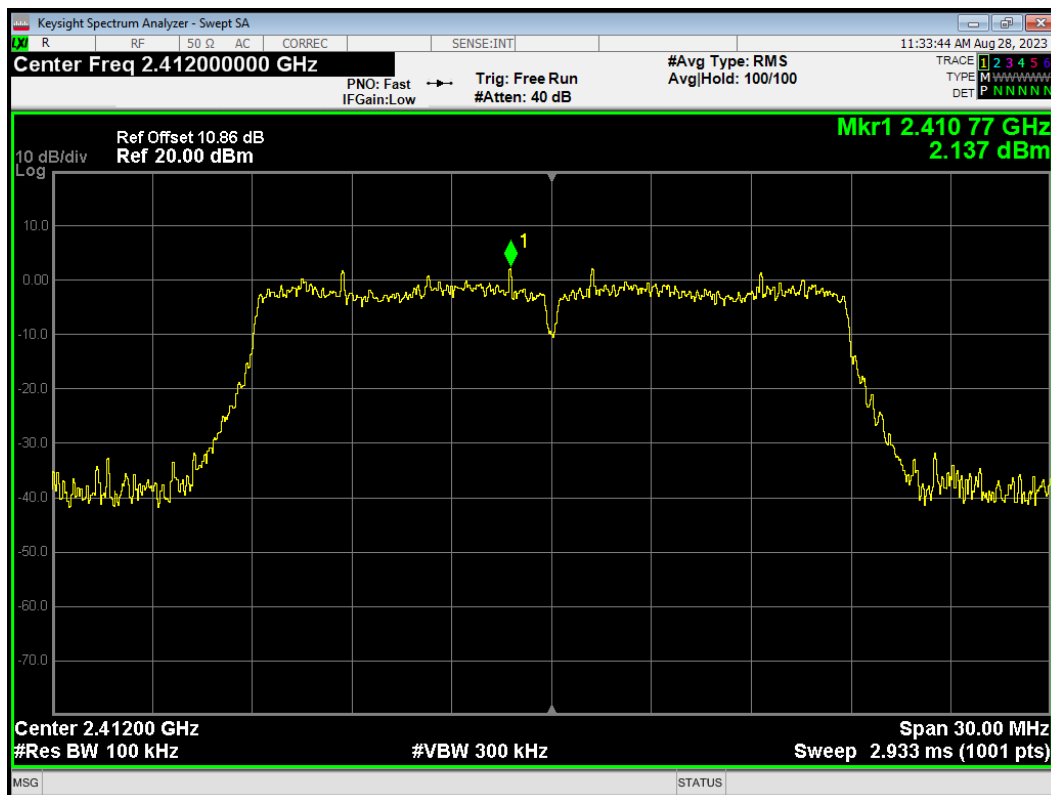
Band Edge 802.11g 2462MHz Ref



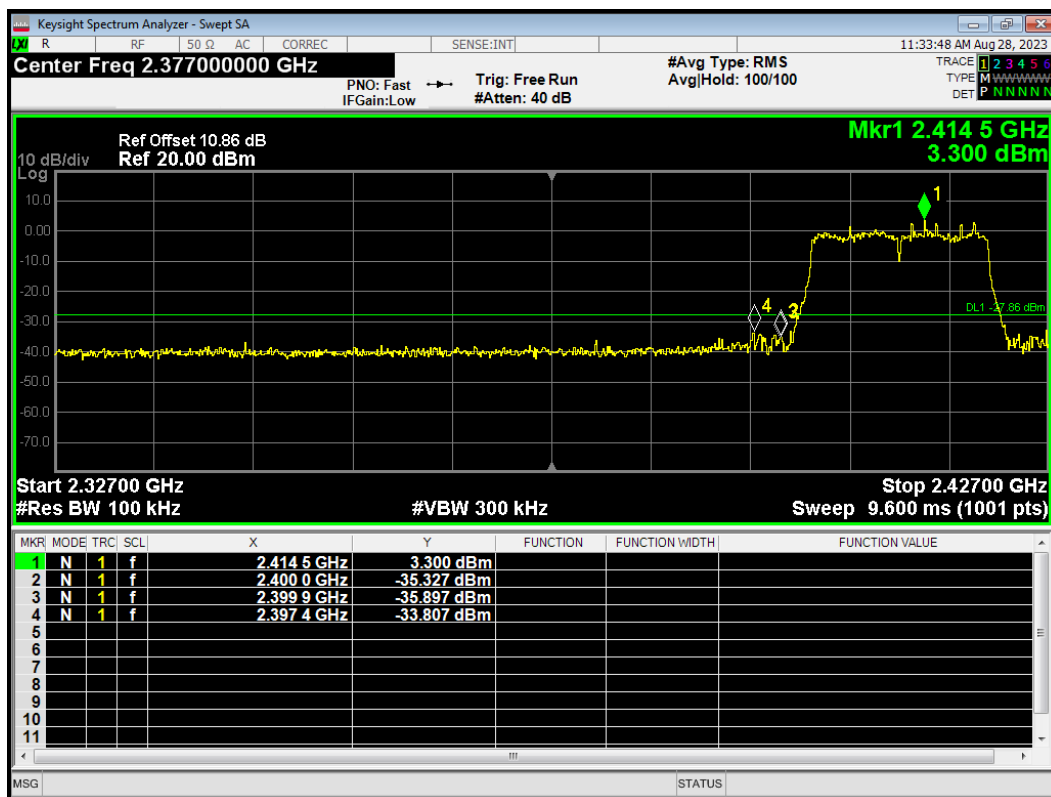
Band Edge 802.11g 2462MHz Emission



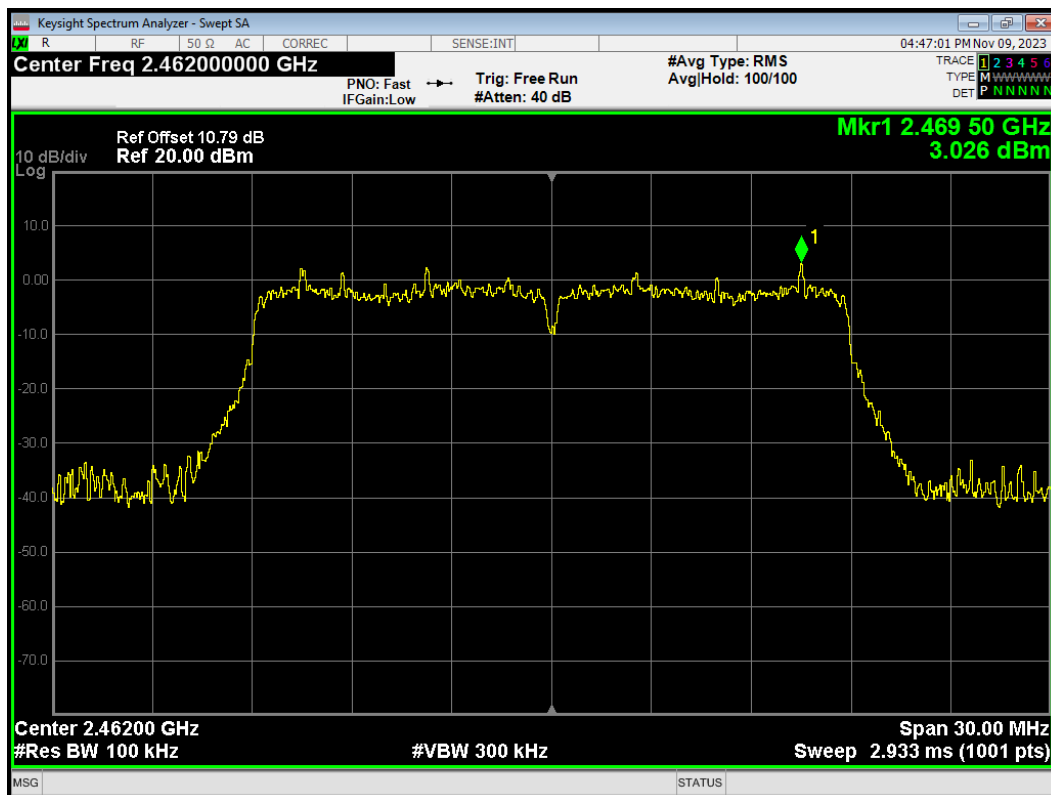
Band Edge 802.11n(HT20) 2412MHz Ref



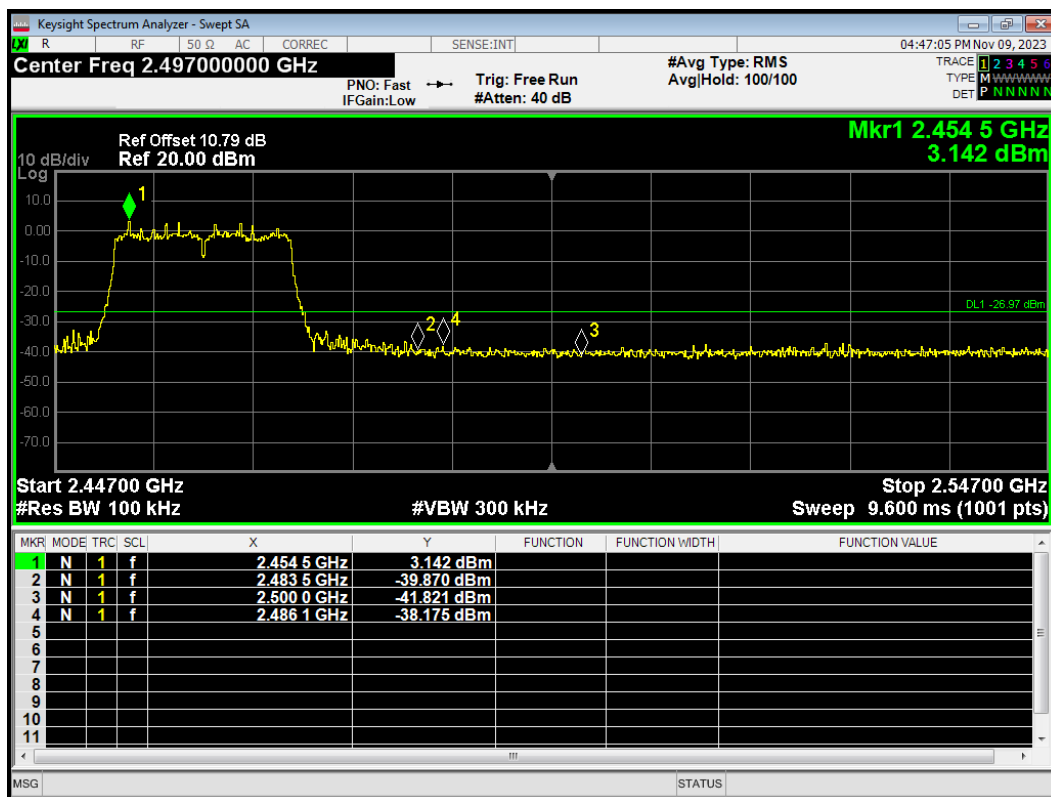
Band Edge 802.11n(HT20) 2412MHz Emission



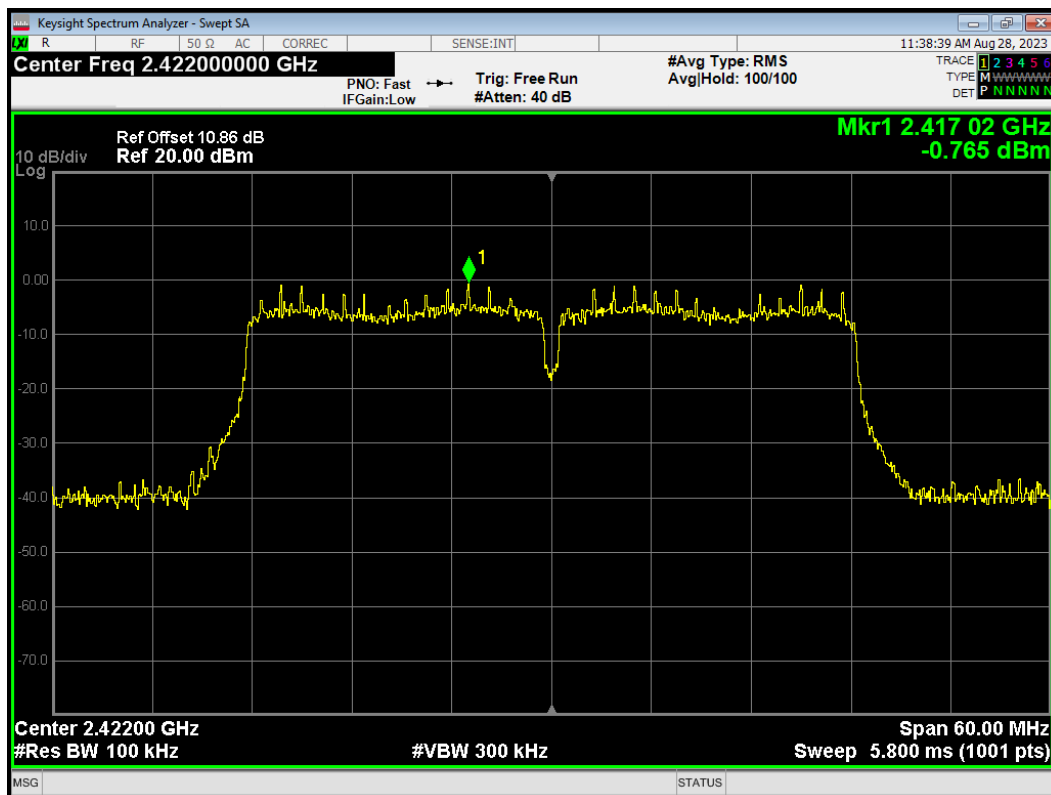
Band Edge 802.11n(HT20) 2462MHz Ref



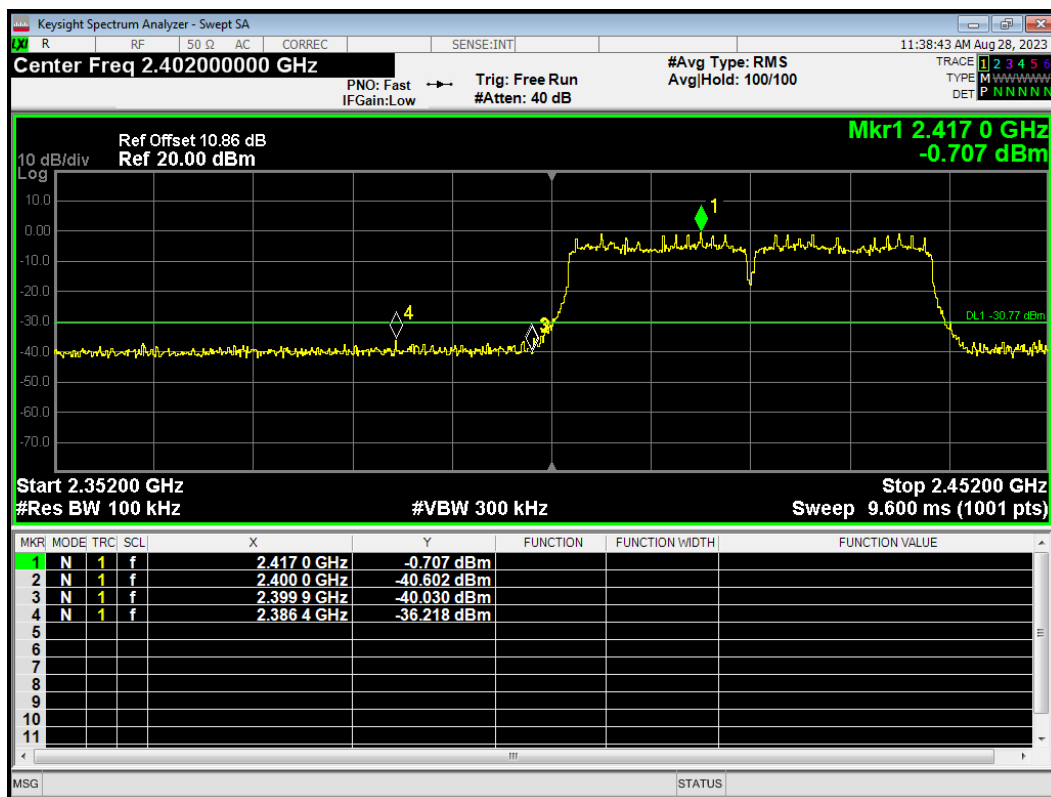
Band Edge 802.11n(HT20) 2462MHz Emission



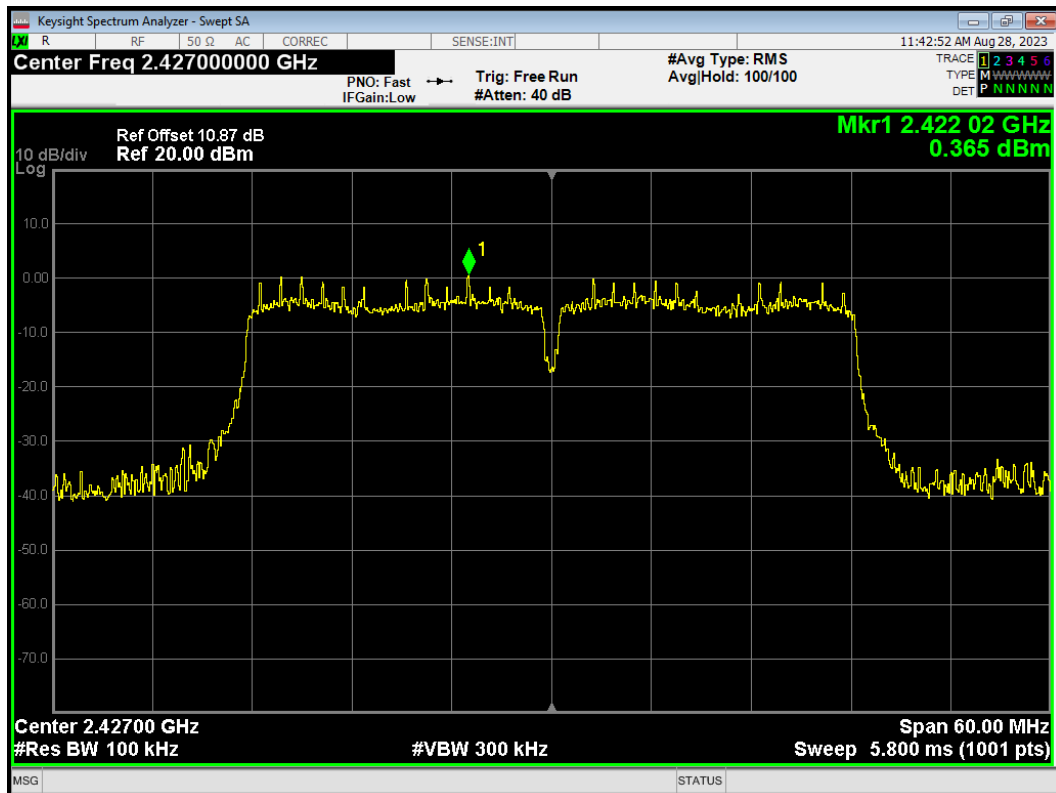
Band Edge 802.11n(HT40) 2422MHz Ref



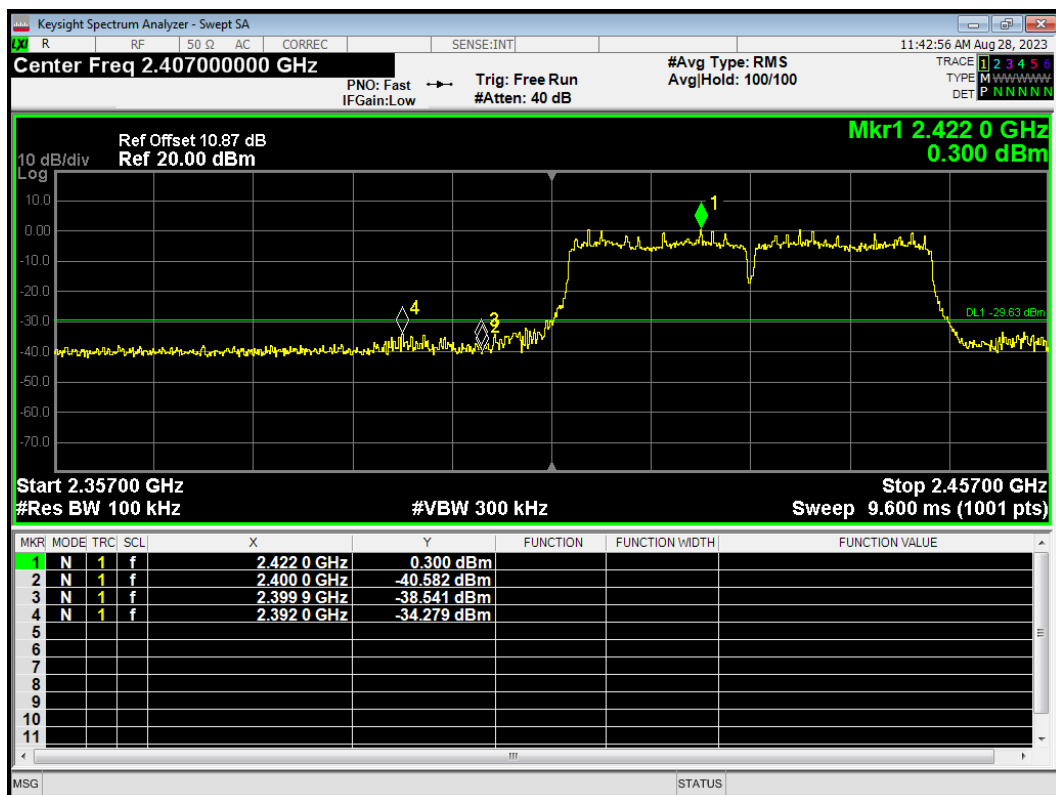
Band Edge 802.11n(HT40) 2422MHz Emission



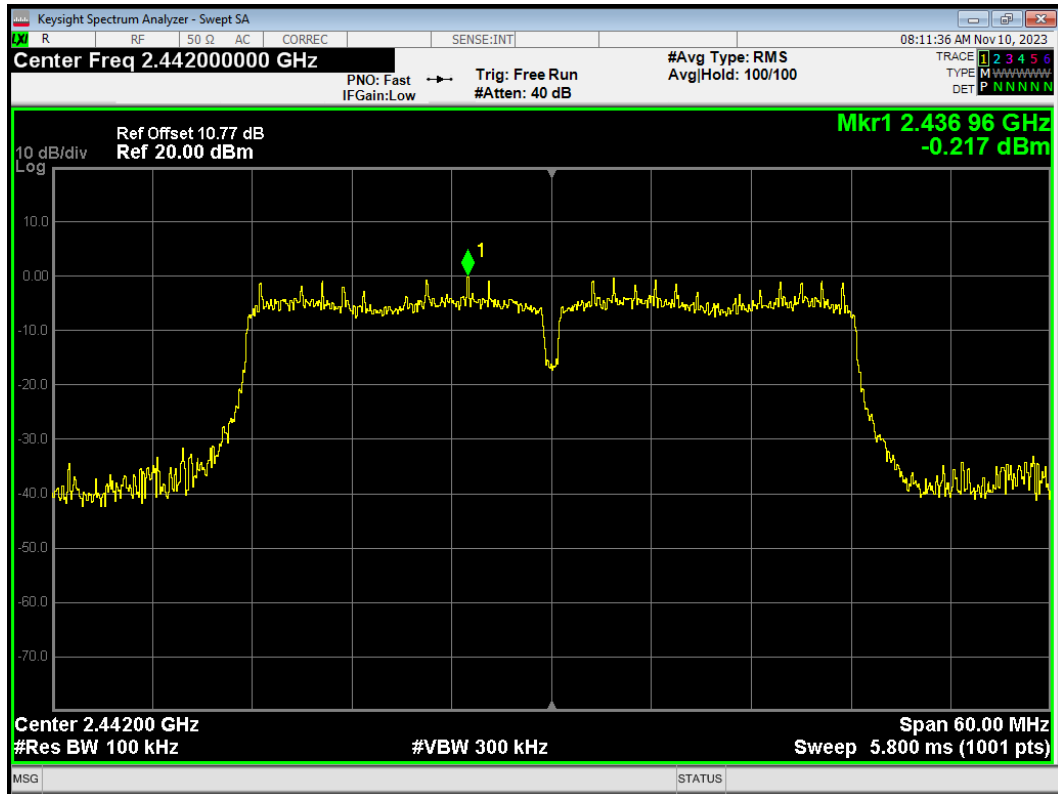
Band Edge 802.11n(HT40) 2427MHz Ref



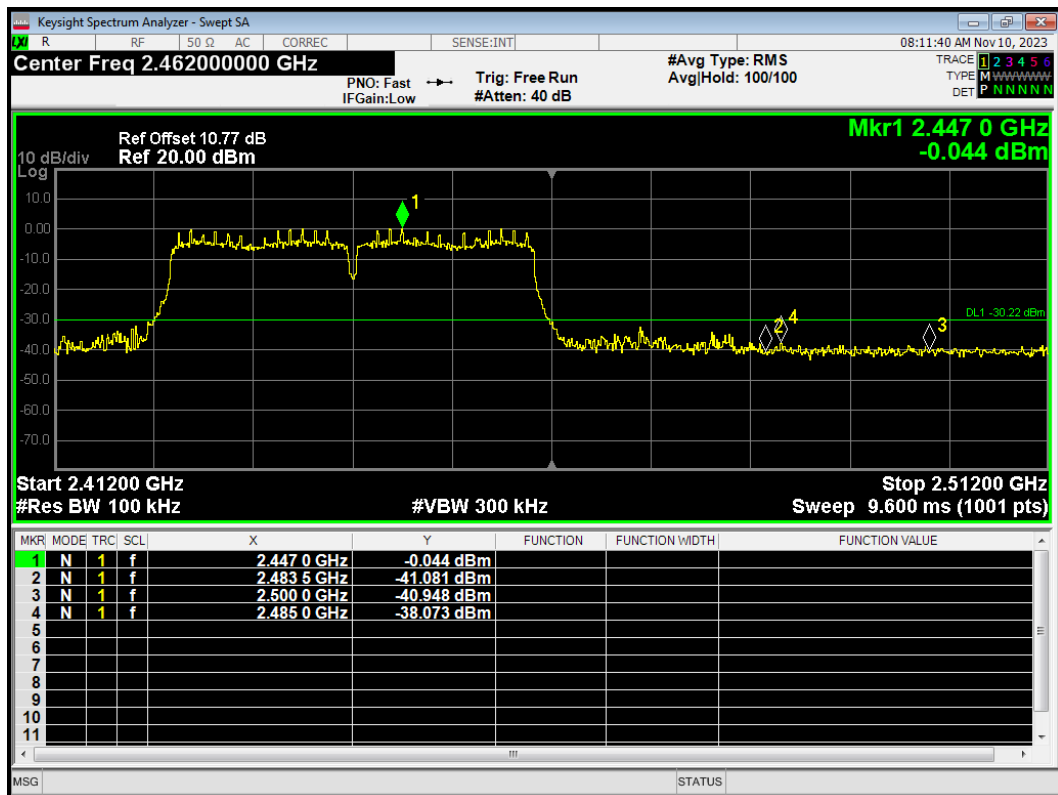
Band Edge 802.11n(HT40) 2427MHz Emission



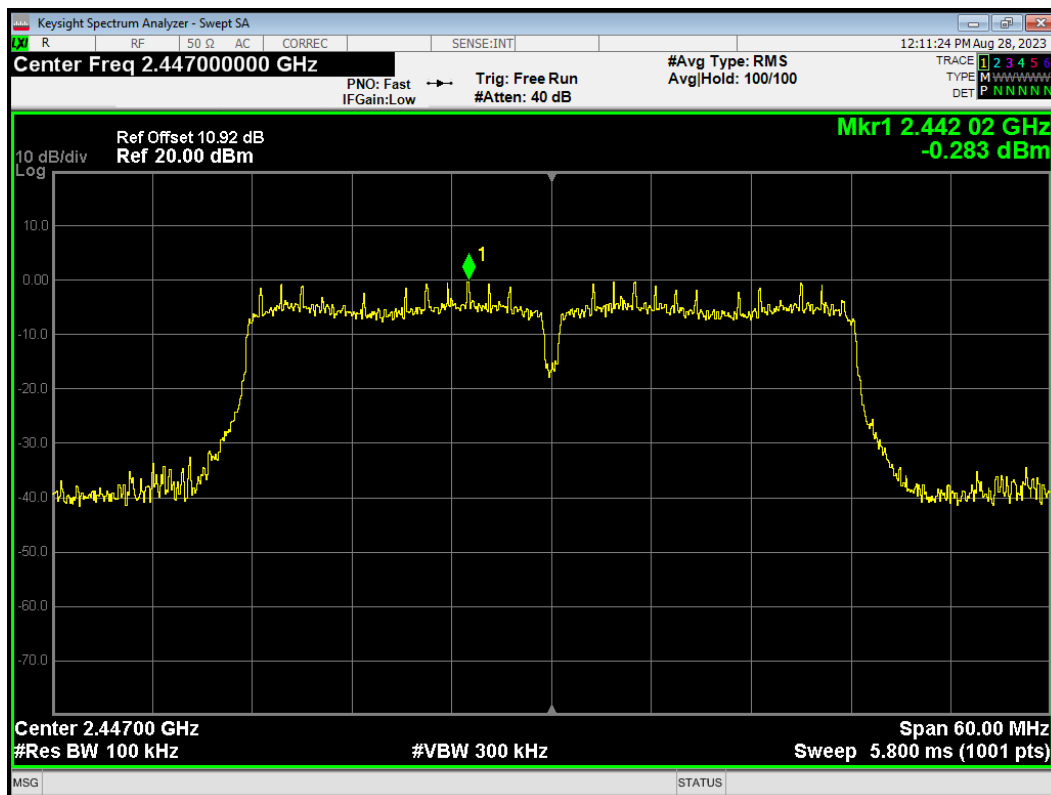
Band Edge 802.11n(HT40) 2442MHz Ref



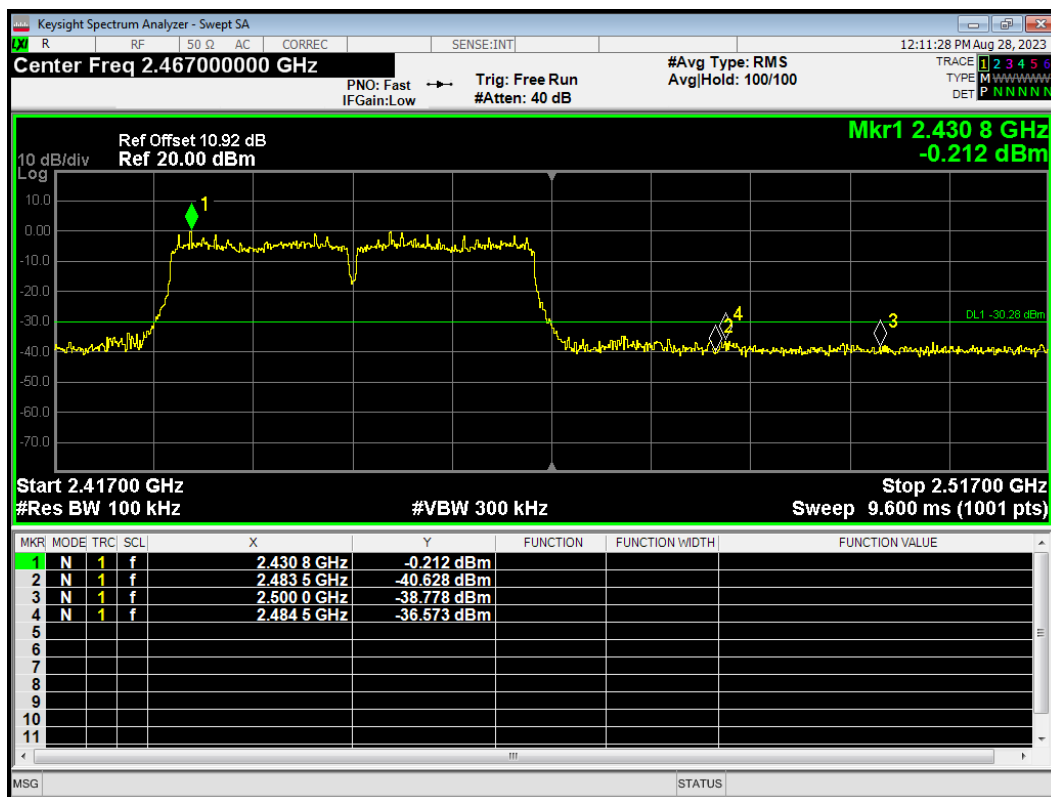
Band Edge 802.11n(HT40) 2442MHz Emission



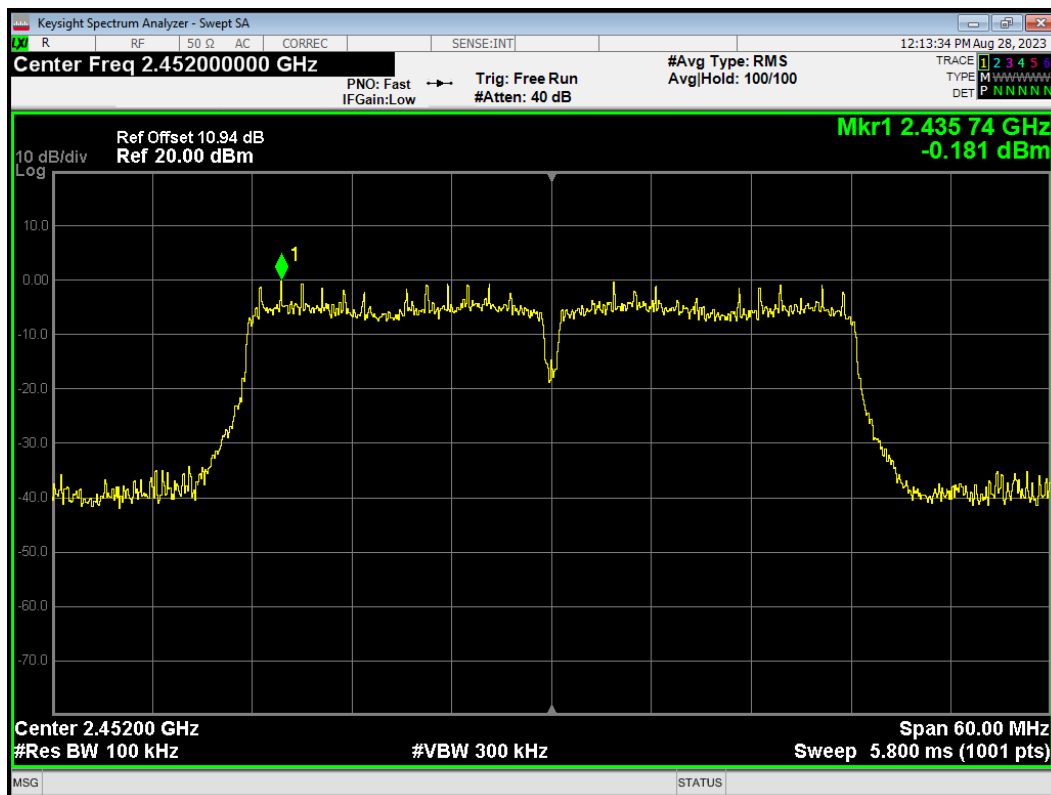
Band Edge 802.11n(HT40) 2447MHz Ref



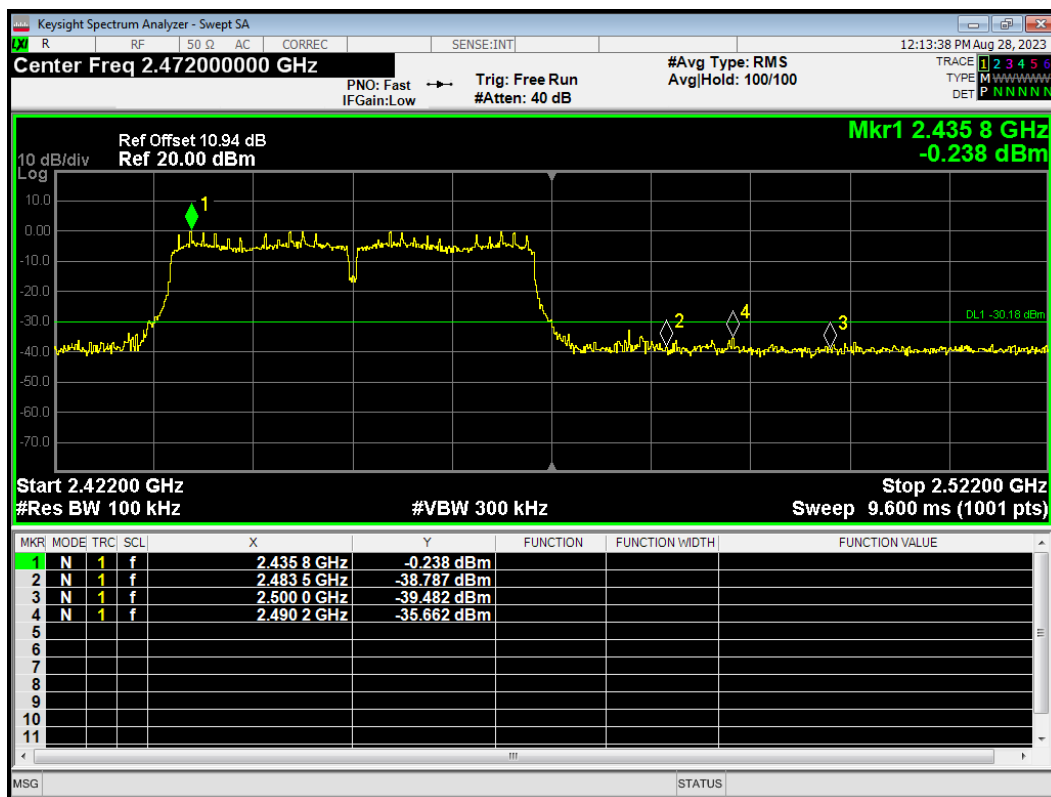
Band Edge 802.11n(HT40) 2447MHz Emission



Band Edge 802.11n(HT40) 2452MHz Ref

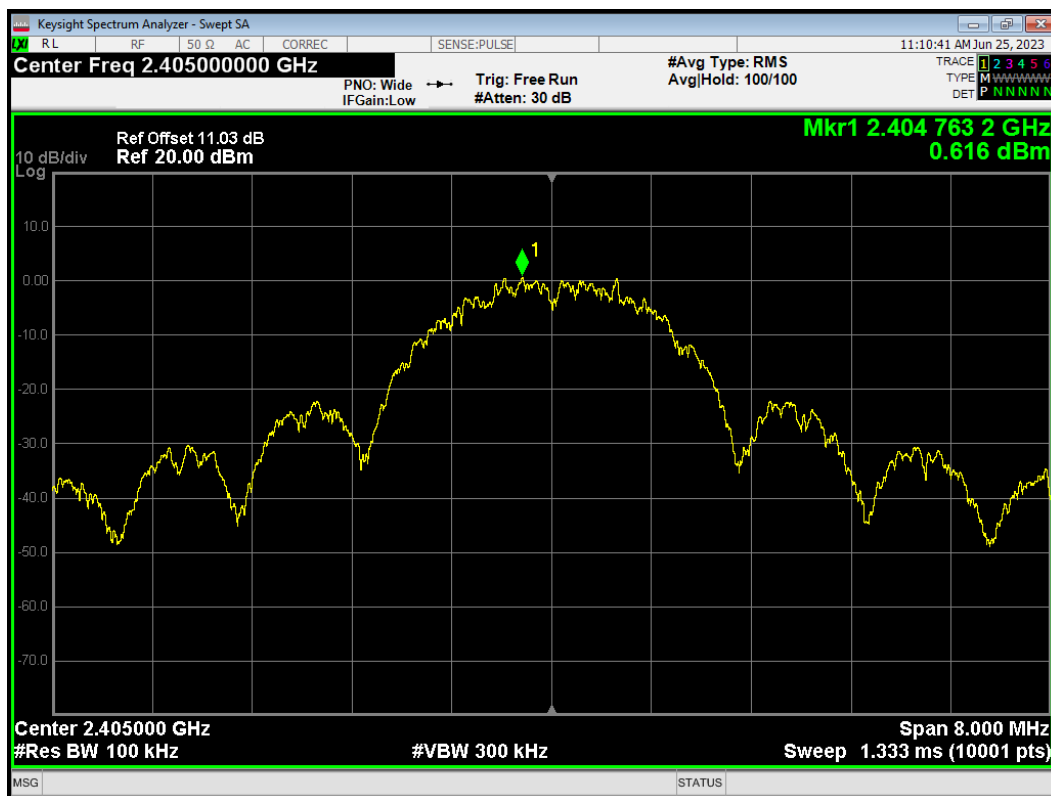


Band Edge 802.11n(HT40) 2452MHz Emission

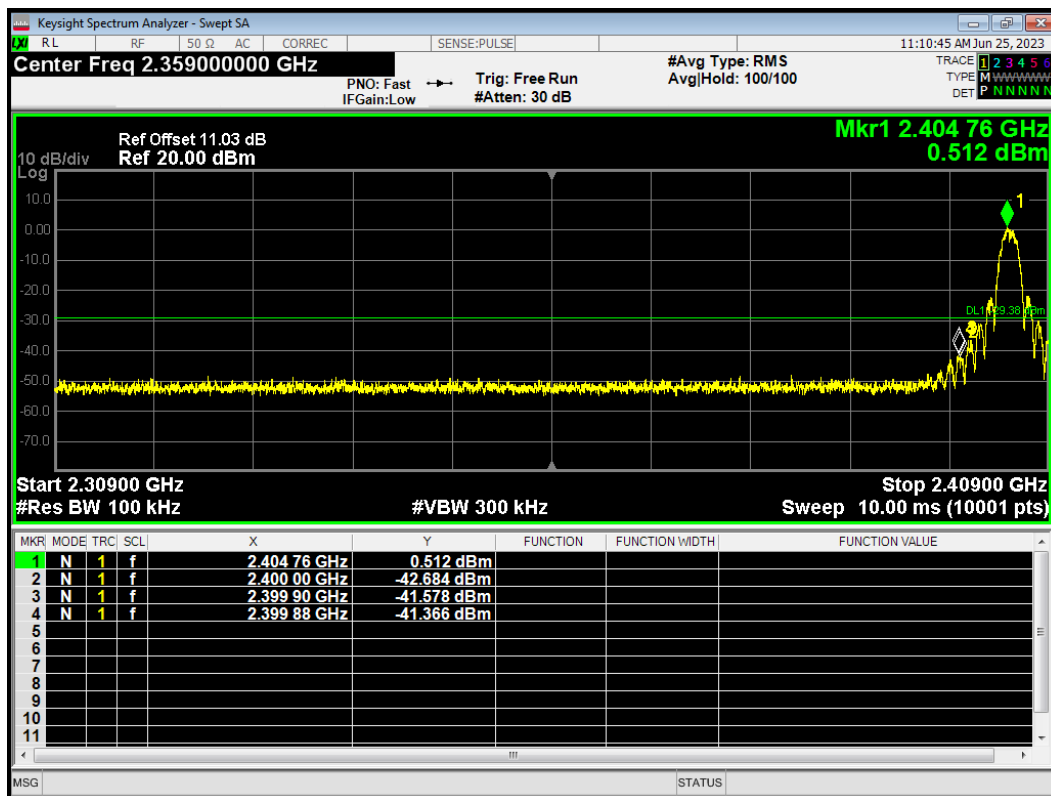


# Thread

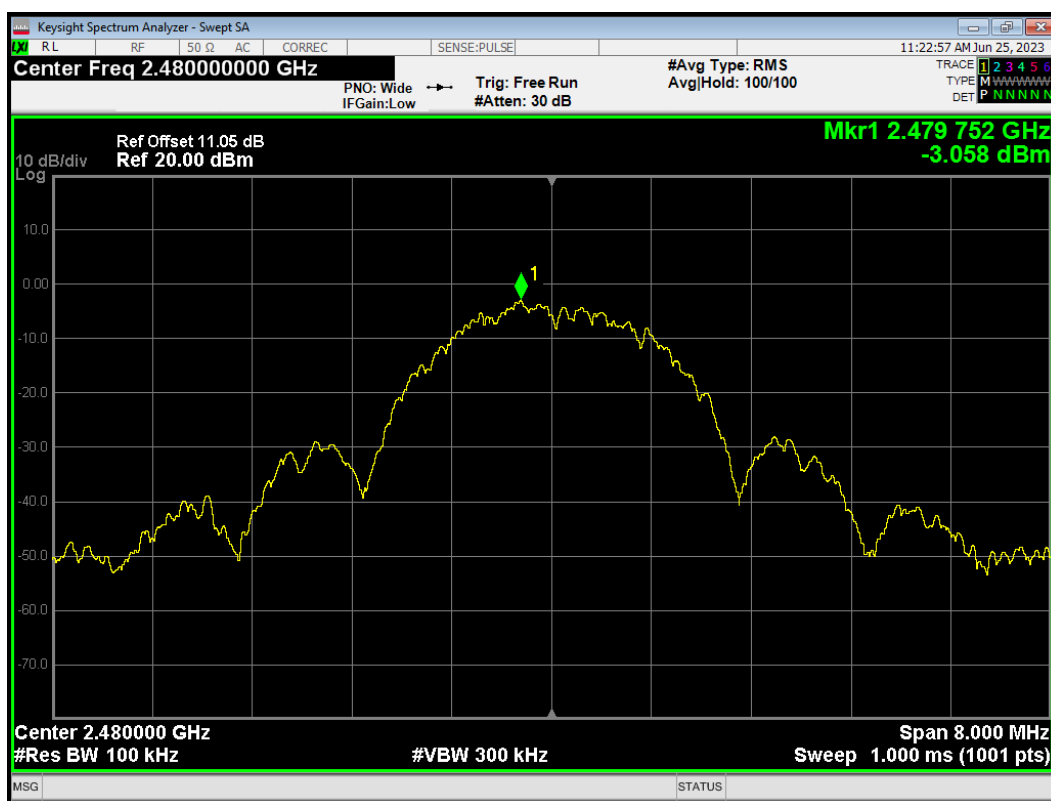
## Band Edge thread 2405MHz Ref



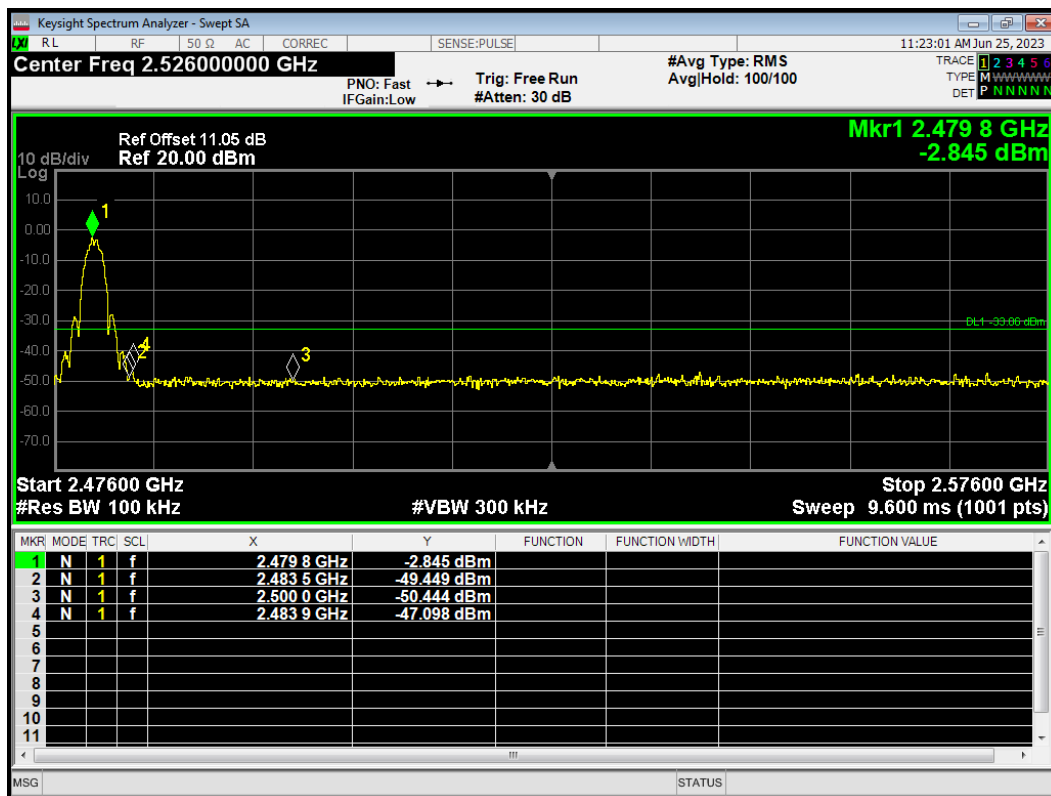
## Band Edge thread 2405MHz Emission



### Band Edge thread 2480MHz Ref

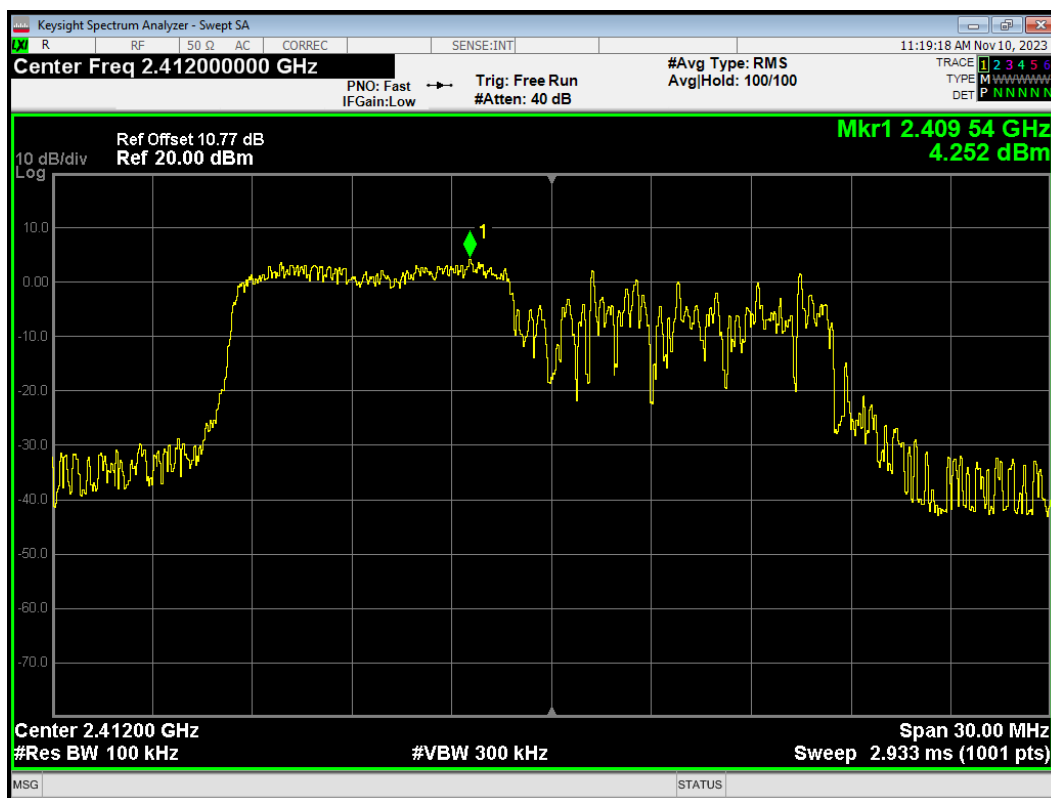


### Band Edge thread 2480MHz Emission

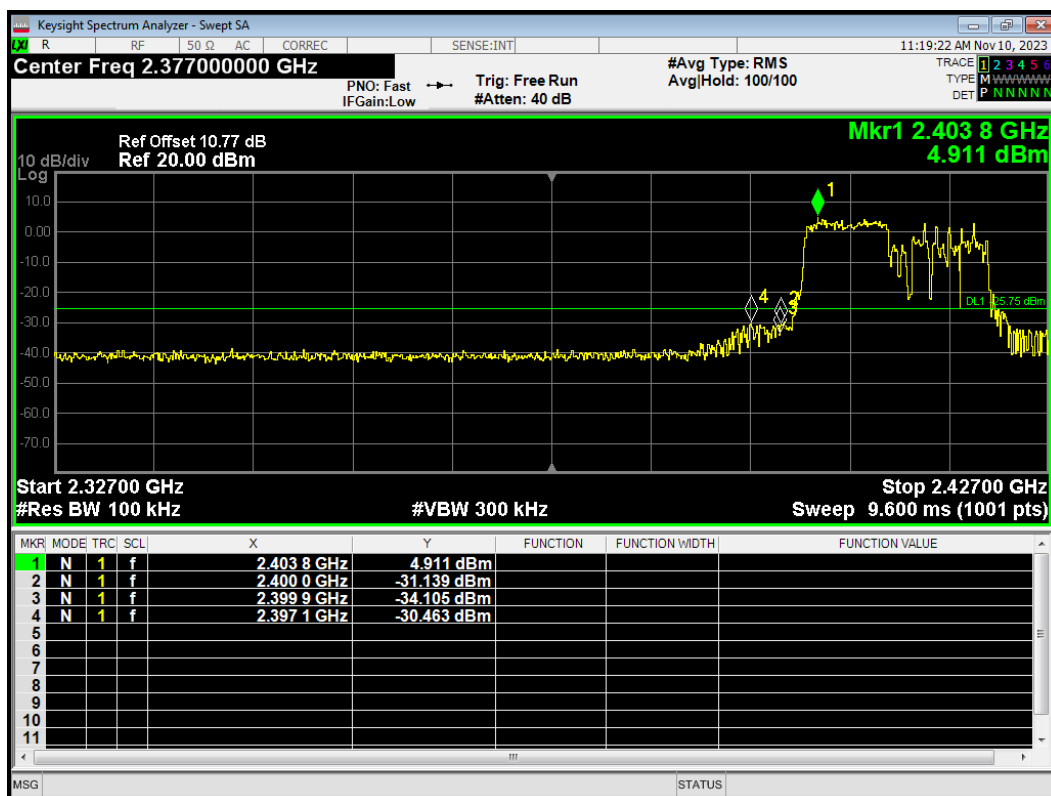


TB Mode

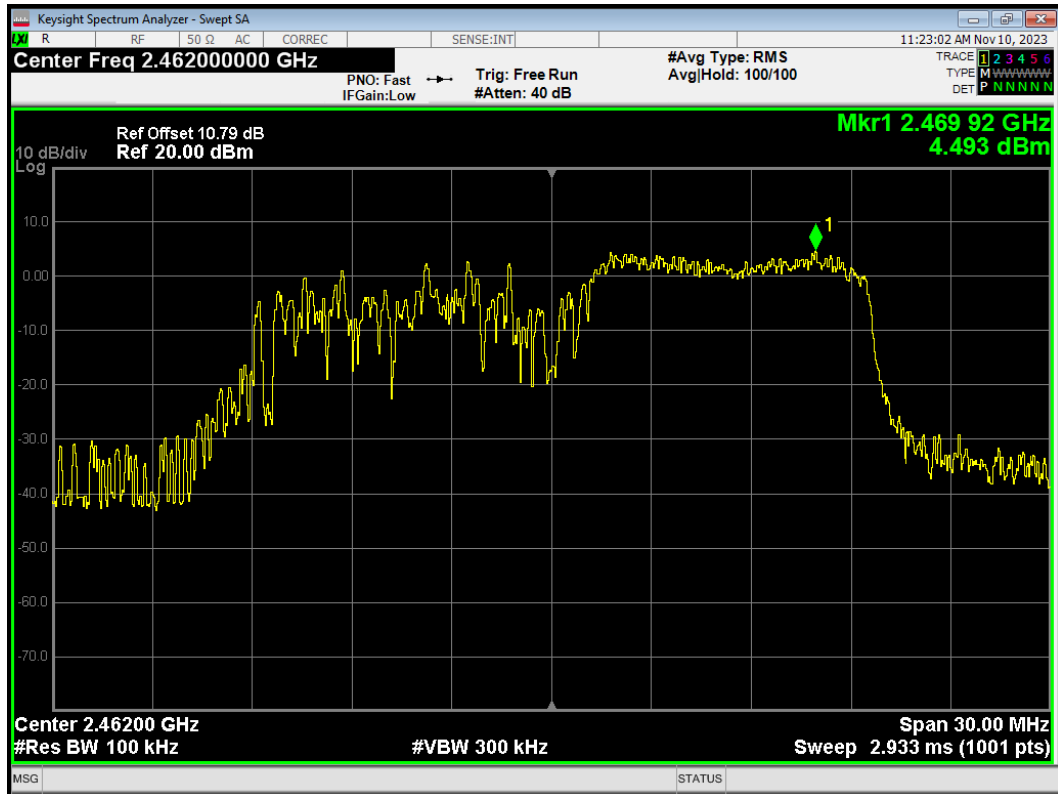
Band Edge 802.11ax HE20 106-Tones 2412MHz Ref



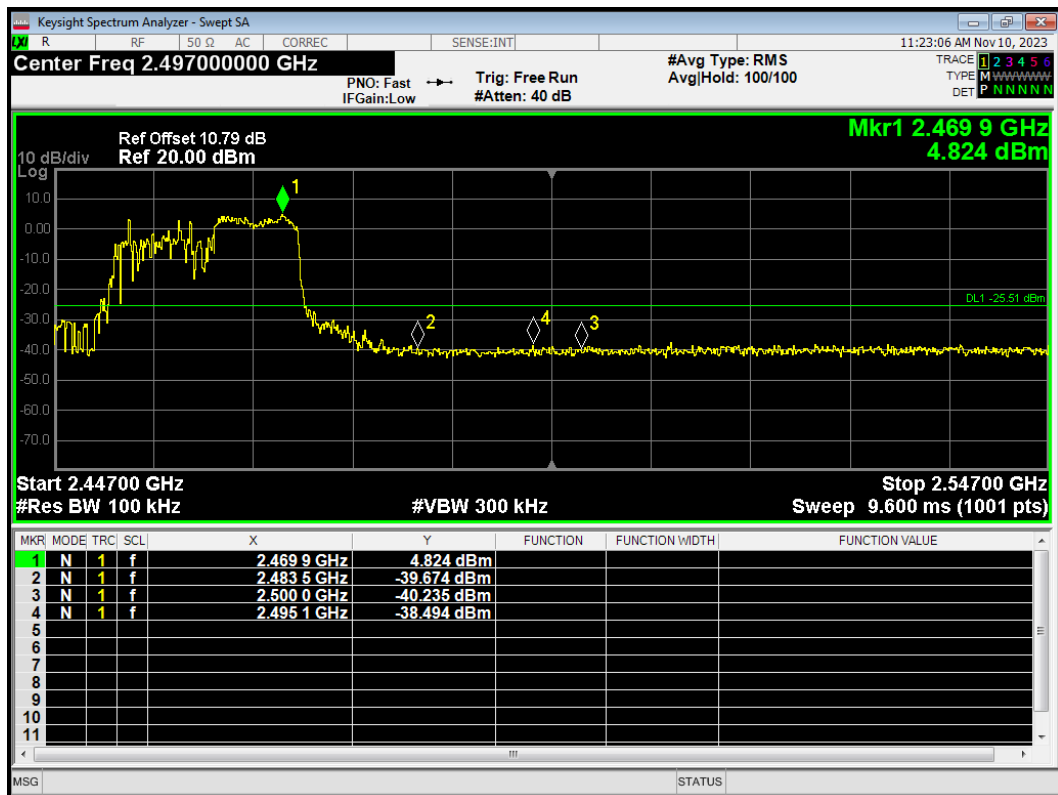
Band Edge 802.11ax HE20 106-Tones 2412MHz Emission



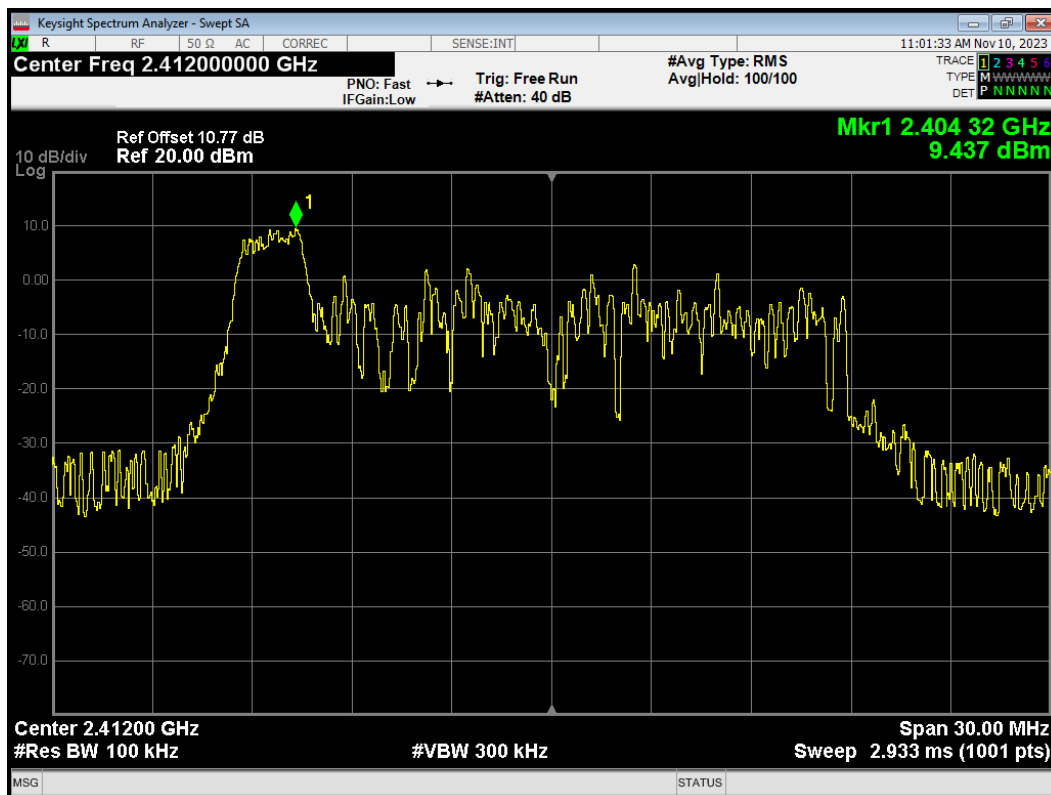
Band Edge 802.11ax HE20 106-Tones 2462MHz Ref



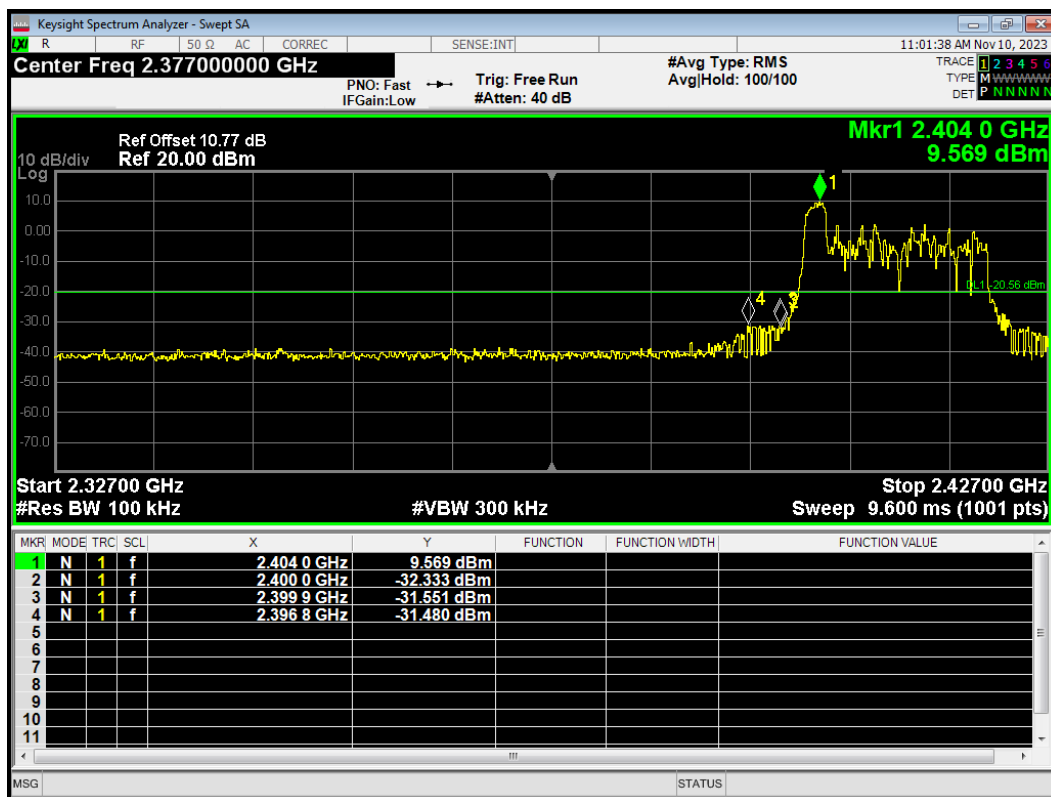
Band Edge 802.11ax HE20 106-Tones 2462MHz Emission



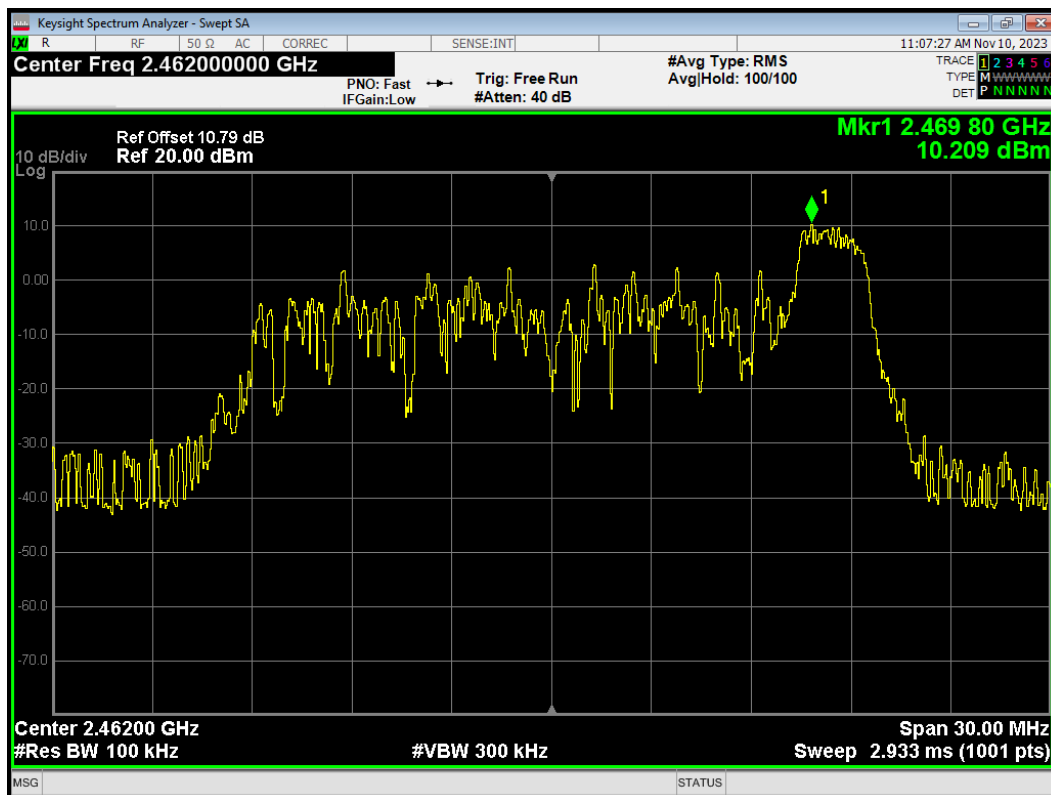
Band Edge 802.11ax HE20 26-Tones 2412MHz Ref



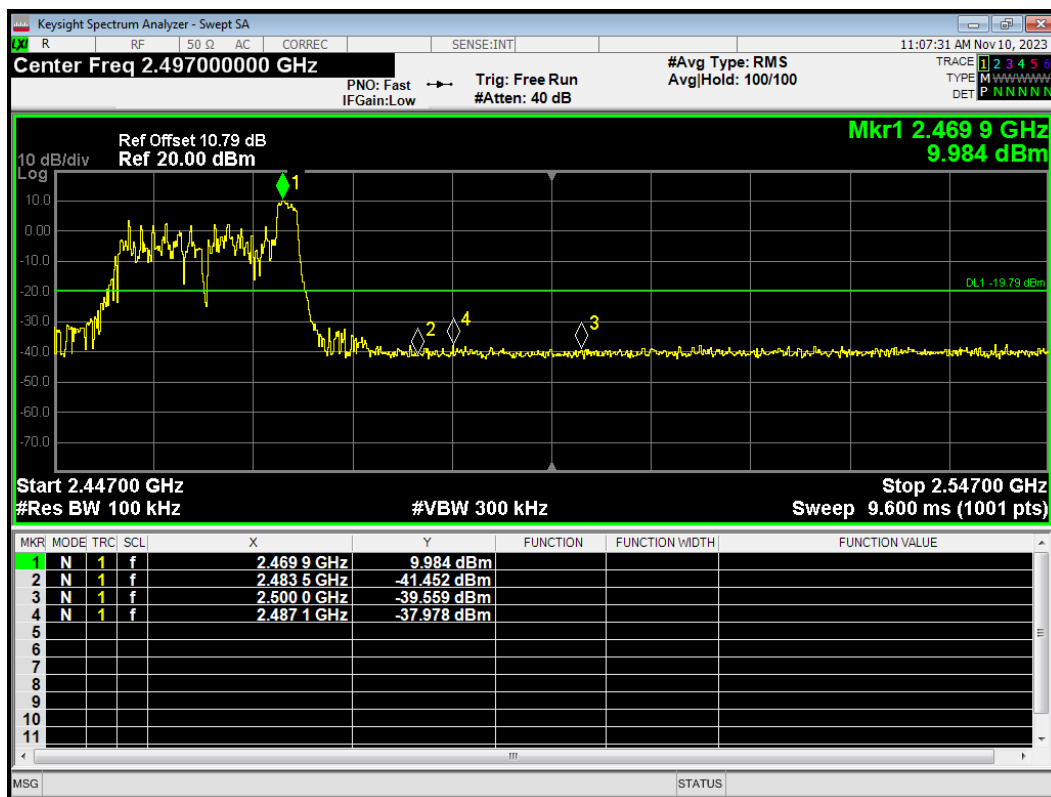
Band Edge 802.11ax HE20 26-Tones 2412MHz Emission



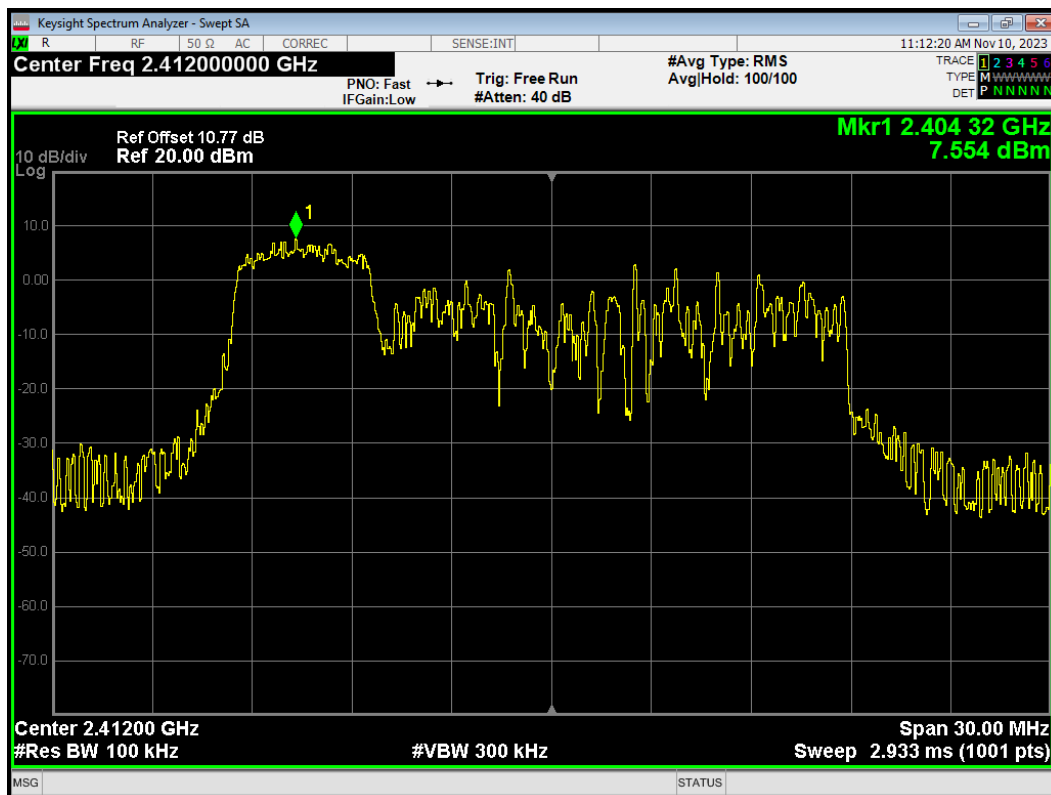
Band Edge 802.11ax HE20 26-Tones 2462MHz Ref



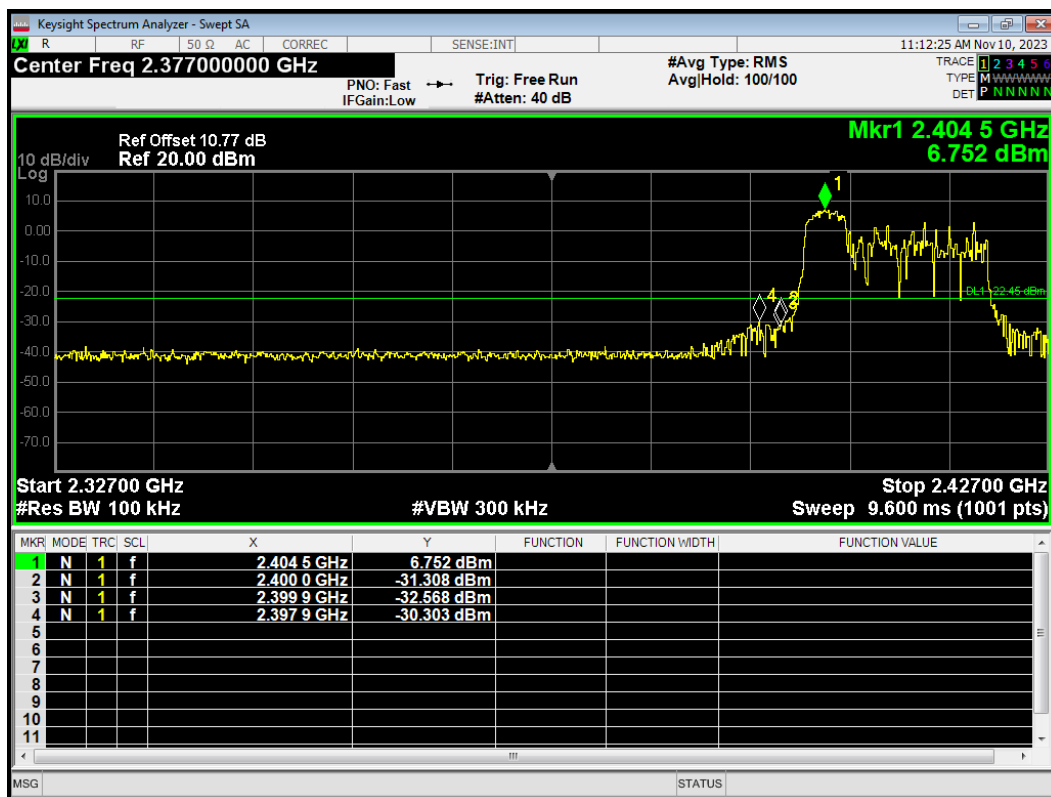
Band Edge 802.11ax HE20 26-Tones 2462MHz Emission



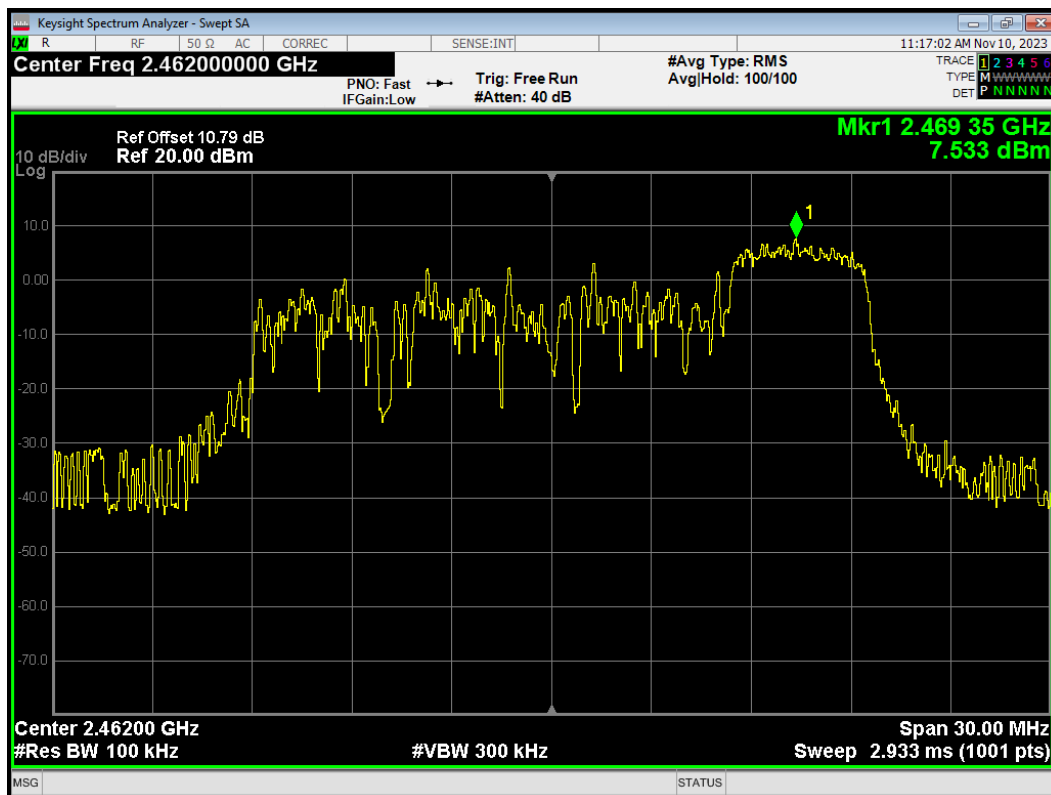
Band Edge 802.11ax HE20 52-Tones 2412MHz Ref



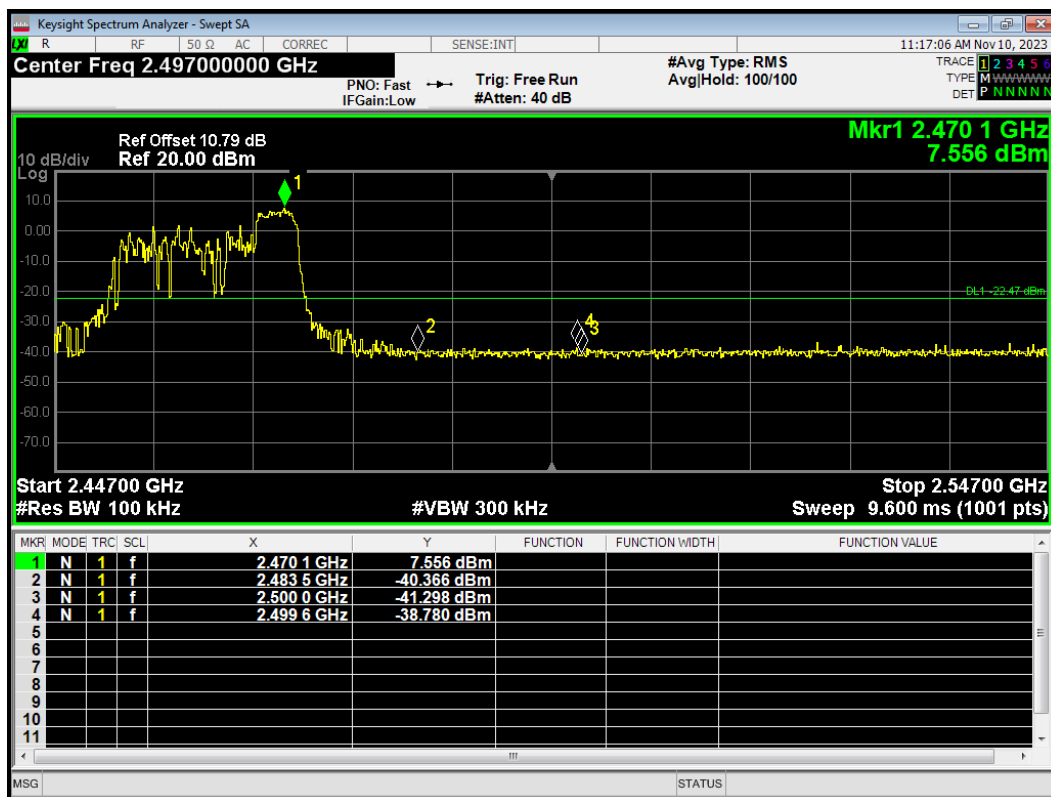
Band Edge 802.11ax HE20 52-Tones 2412MHz Emission



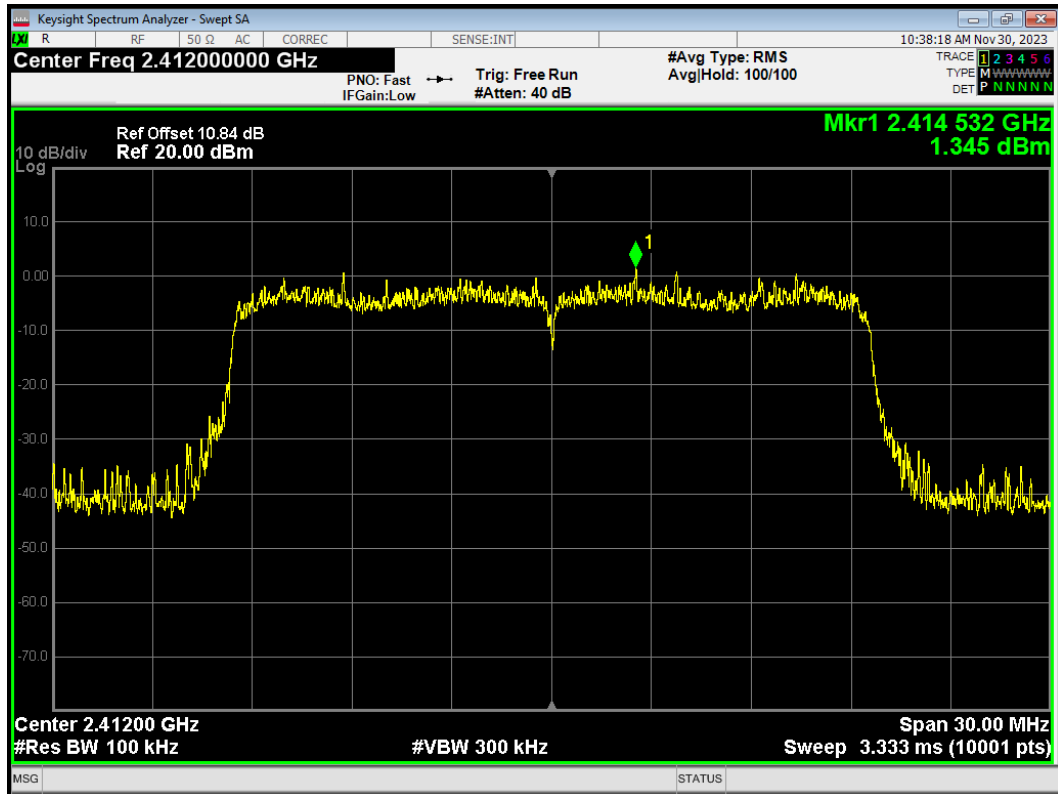
Band Edge 802.11ax HE20 52-Tones 2462MHz Ref



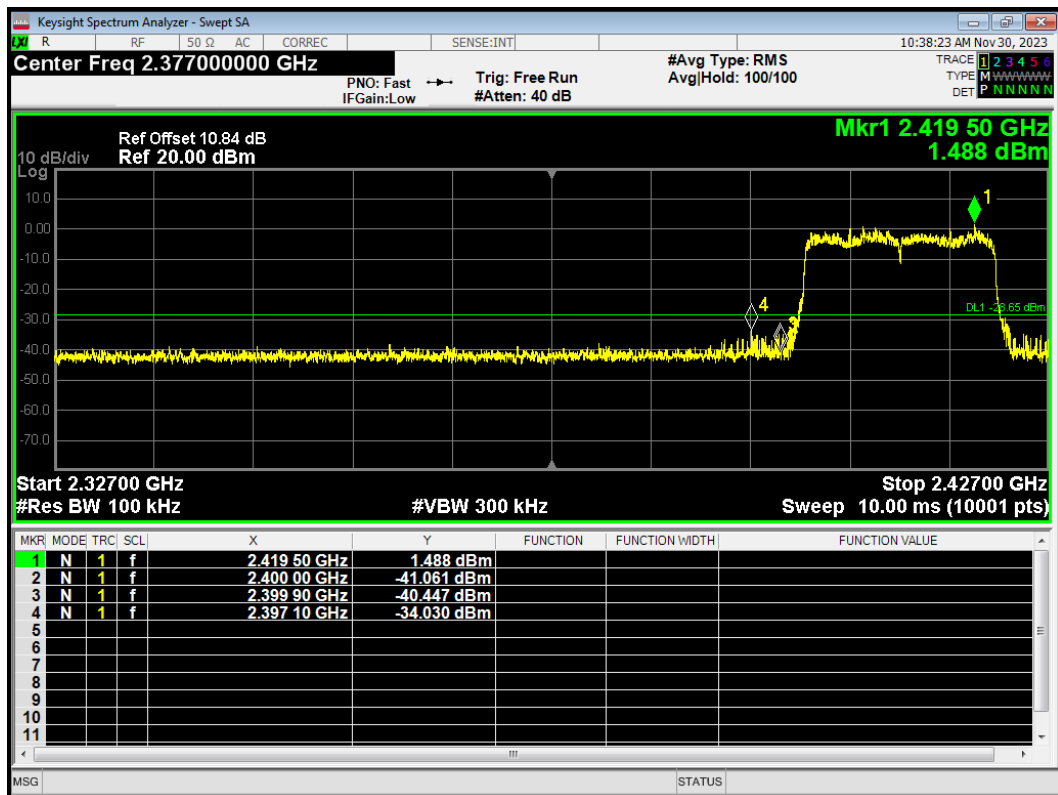
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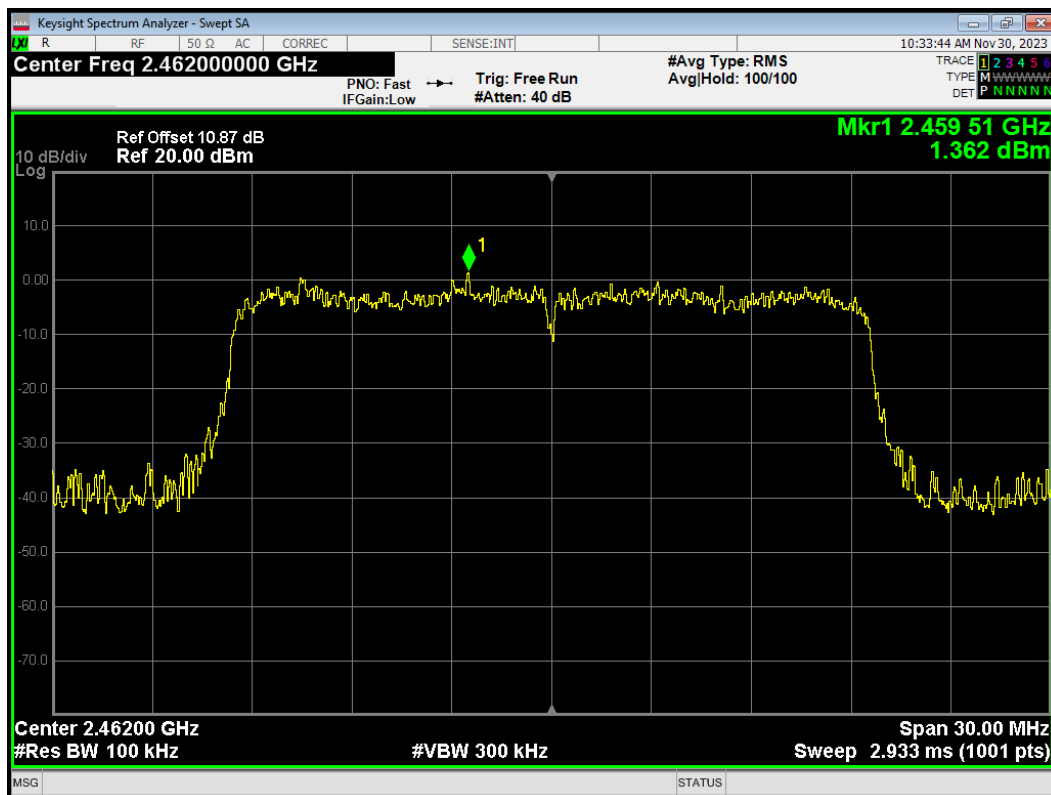
Band Edge 802.11ax HE20 242-Tones 2412MHz Ref



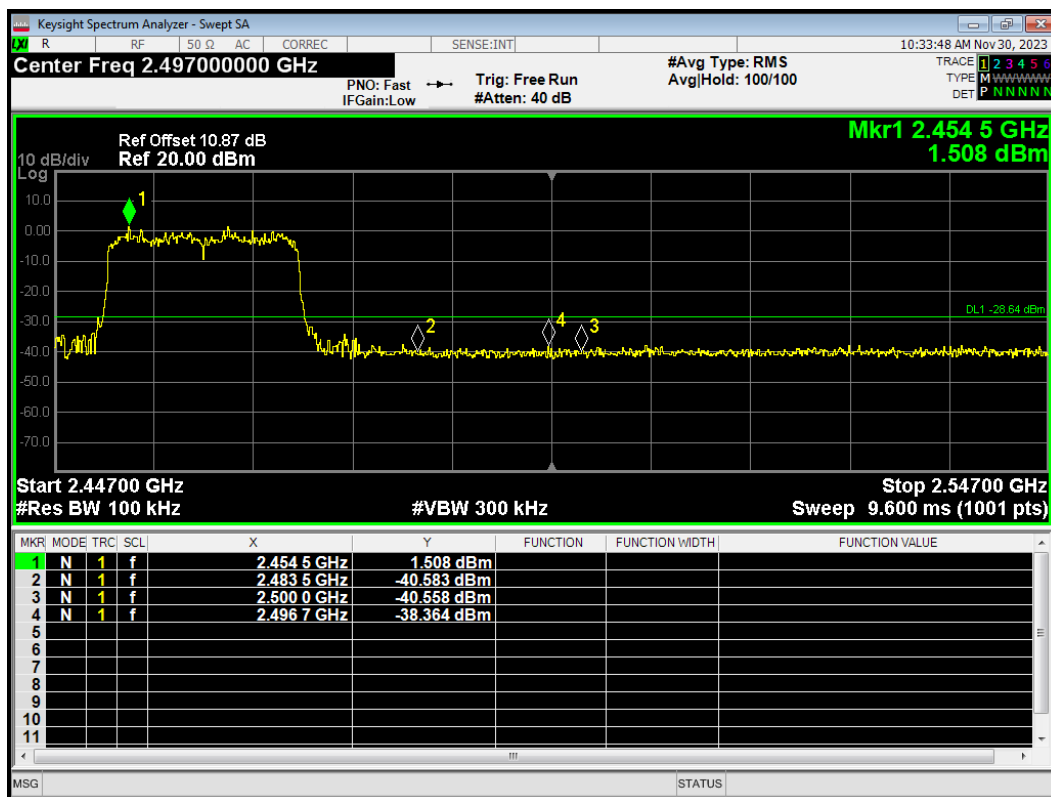
Band Edge 802.11ax HE20 242-Tones 2412MHz Emission



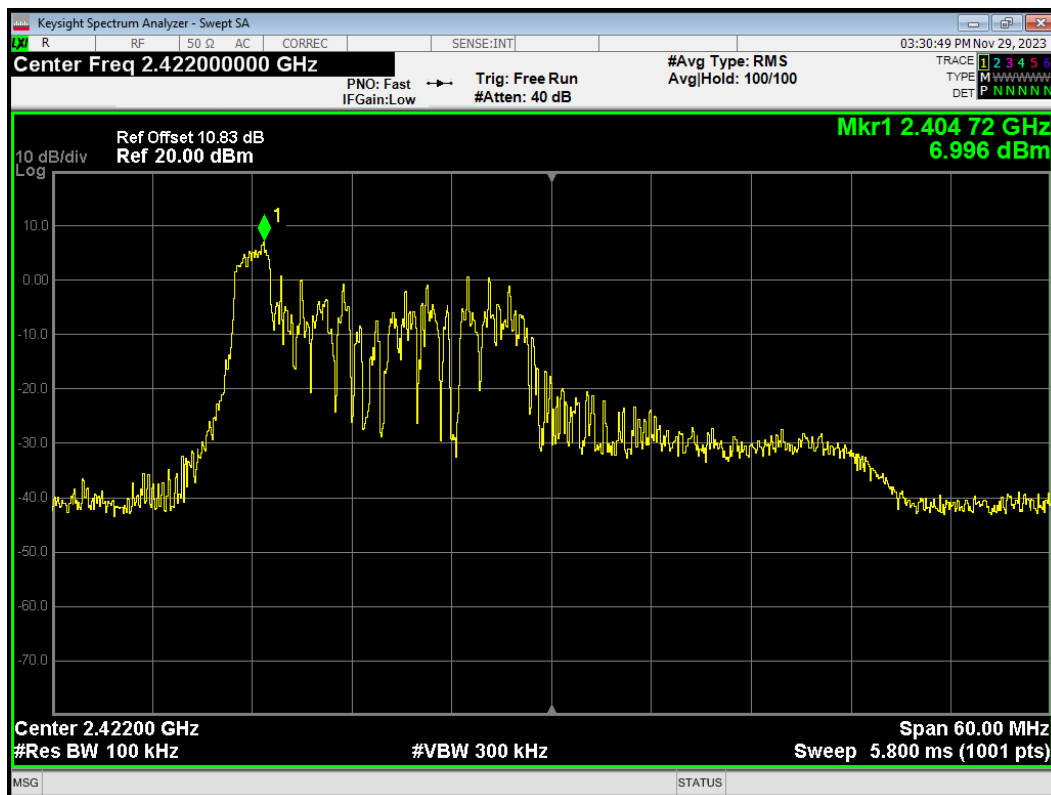
Band Edge 802.11ax HE20 242-Tones 2462MHz Ref



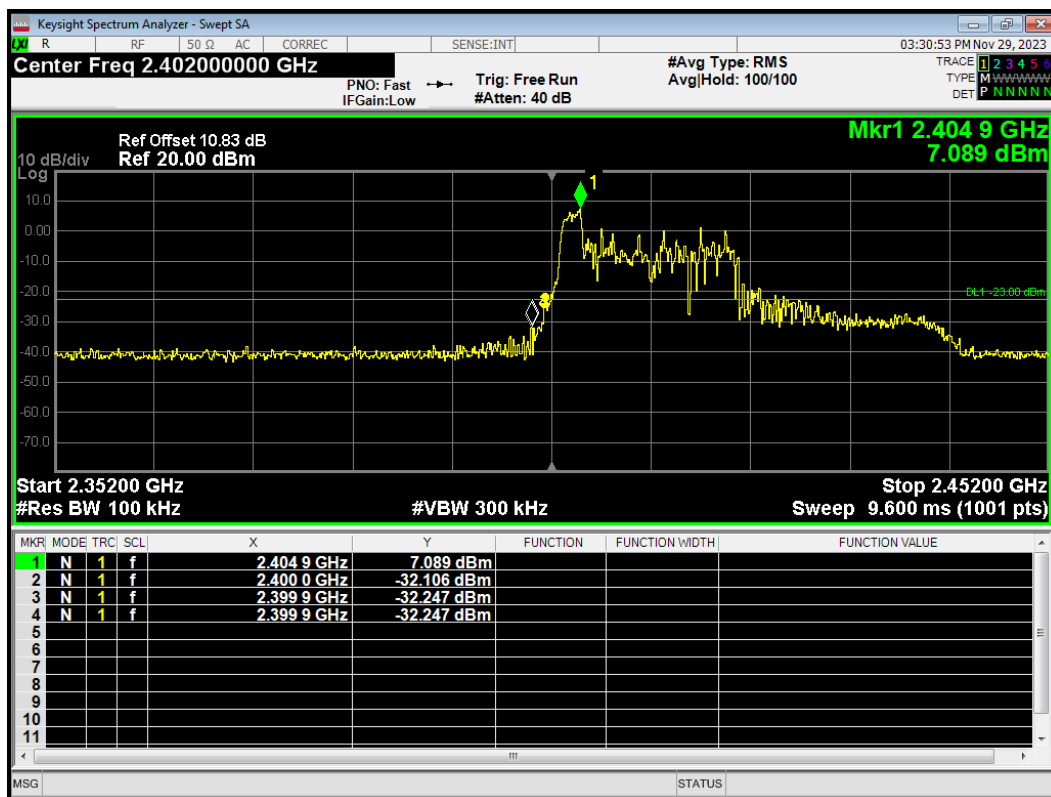
Band Edge 802.11ax HE20 242-Tones 2462MHz Emission



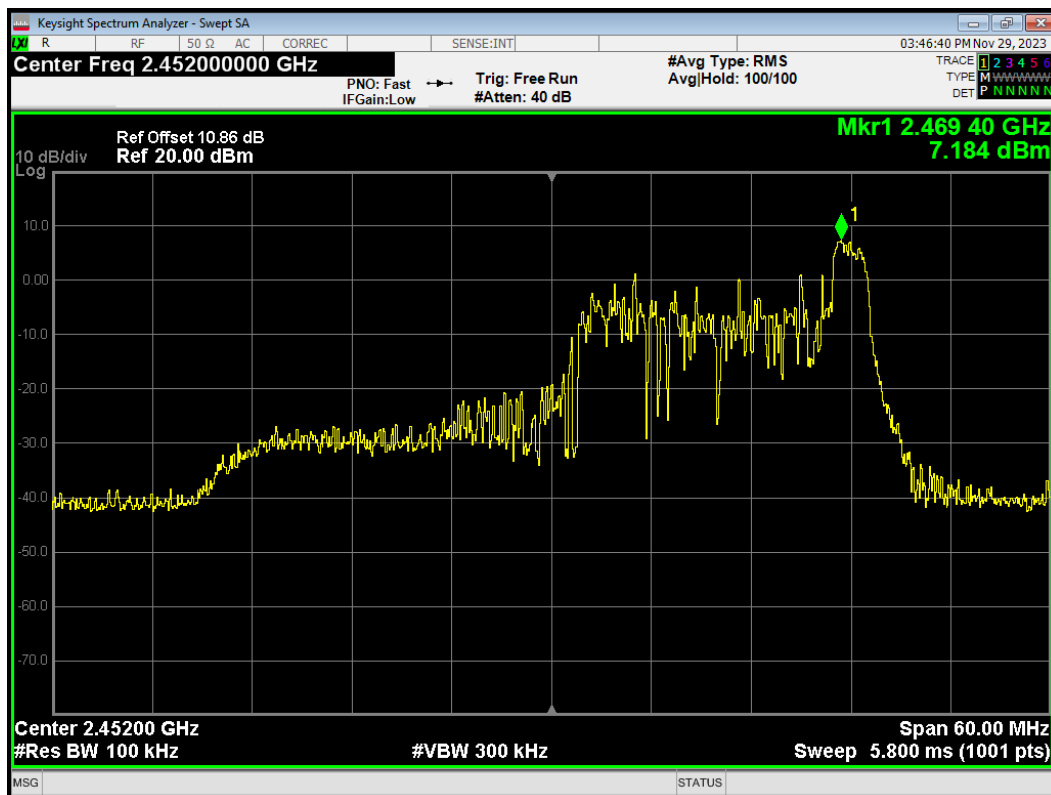
Band Edge 802.11ax HE40 26-Tones 2422MHz Ref



Band Edge 802.11ax HE40 26-Tones 2422MHz Emission



Band Edge 802.11ax HE40 26-Tones 2452MHz Ref



Band Edge 802.11ax HE40 26-Tones 2452MHz Emission

