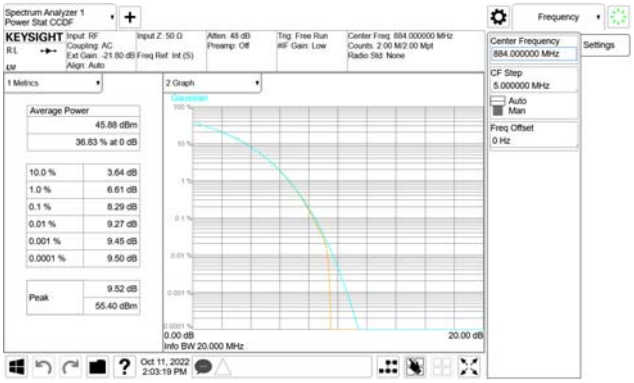
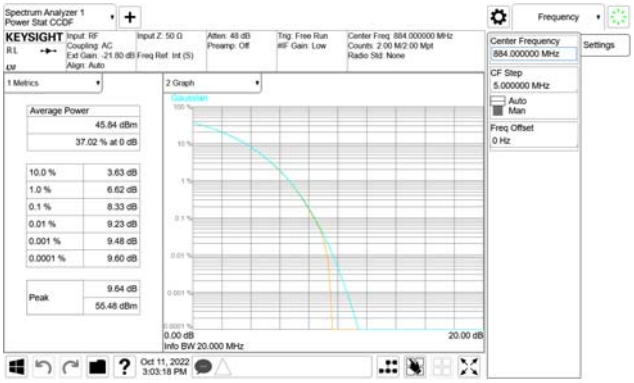
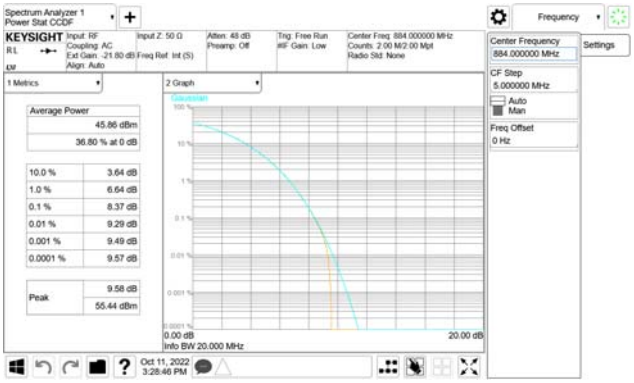
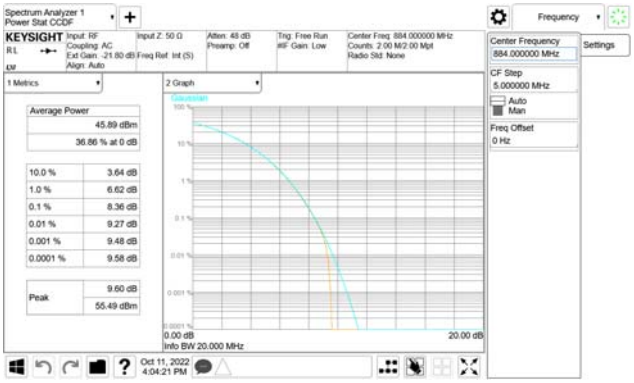
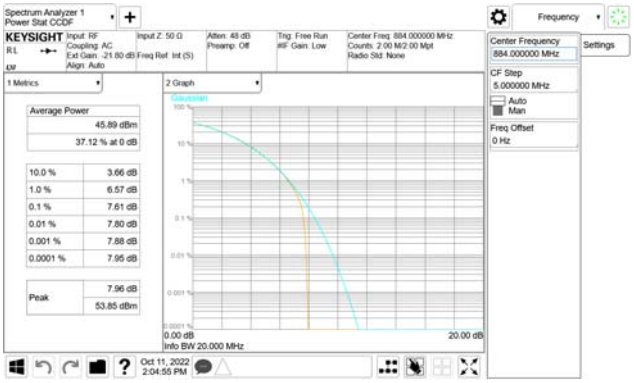
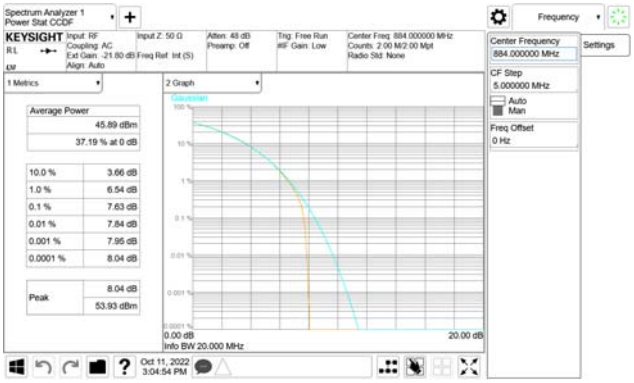
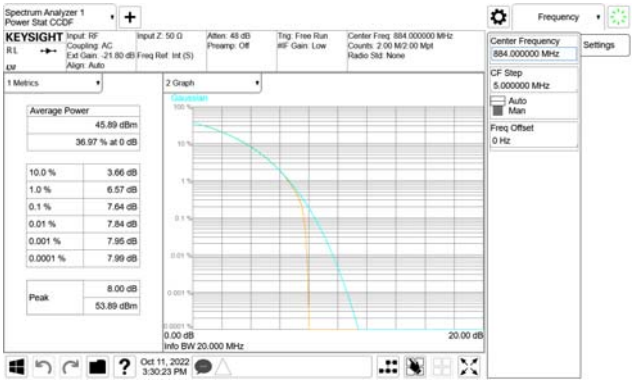
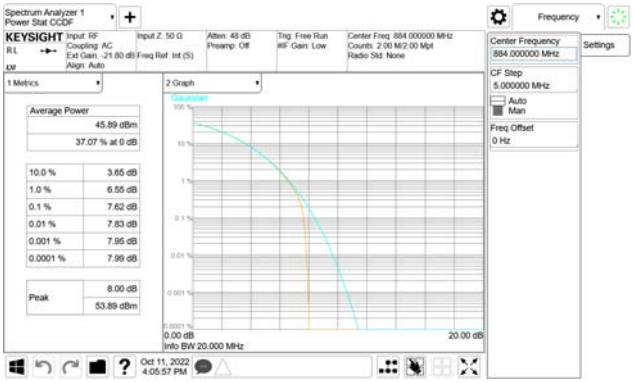
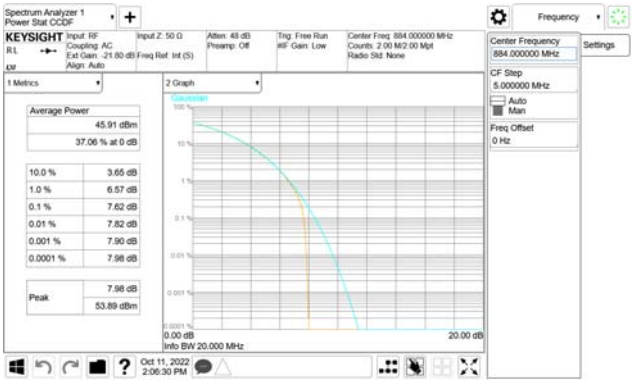
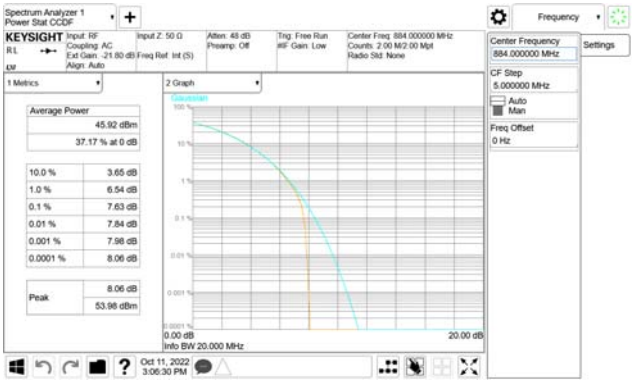
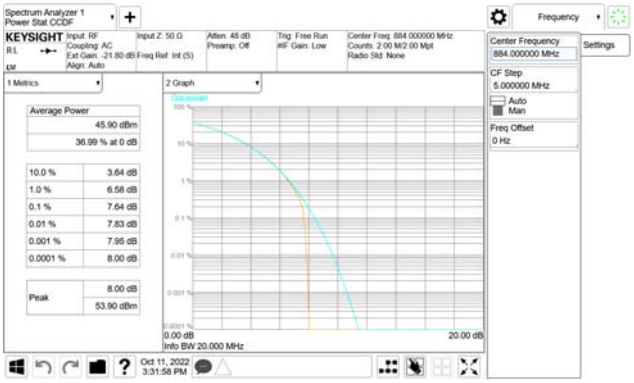
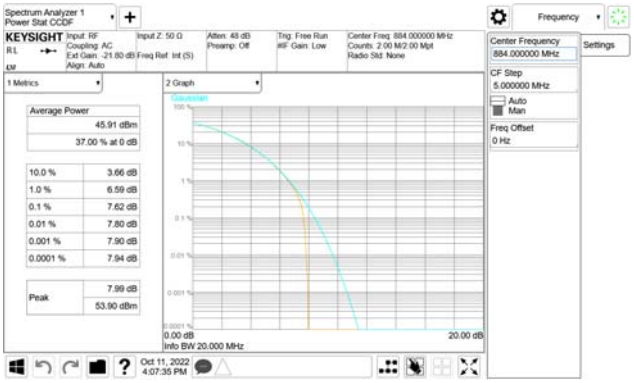
**ANT 2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

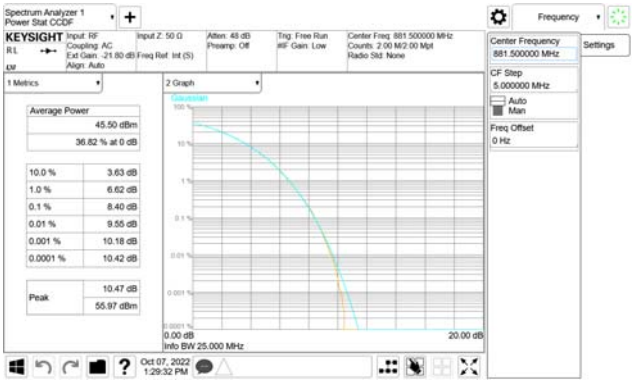
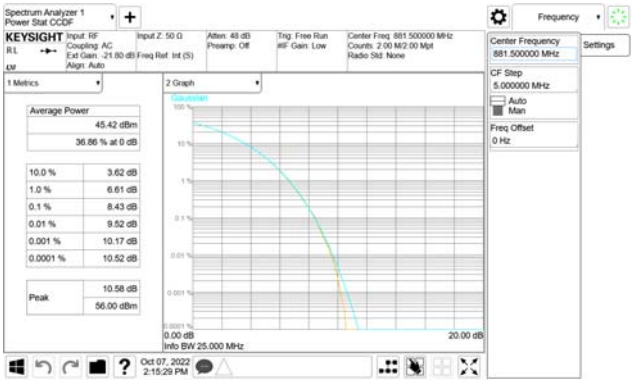
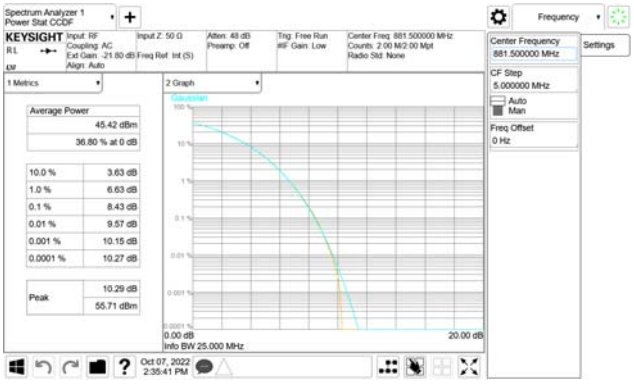
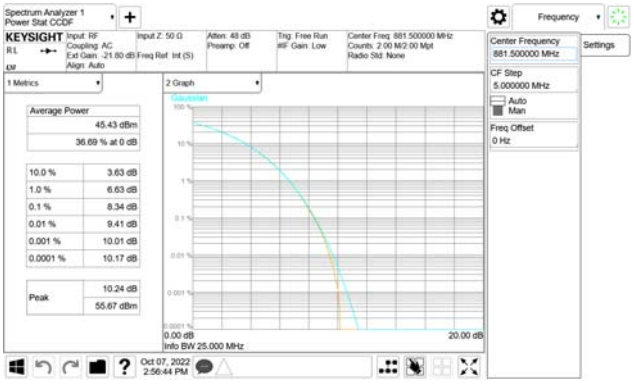
**ANT 3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

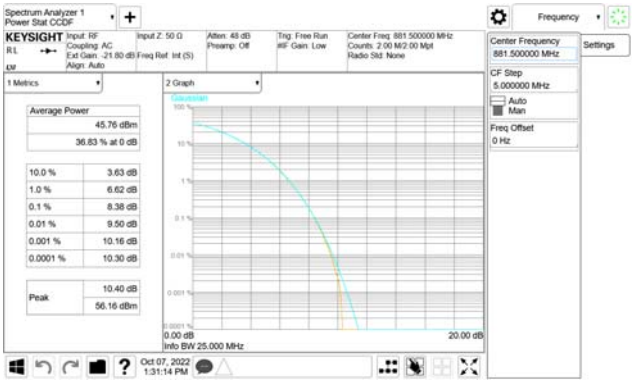
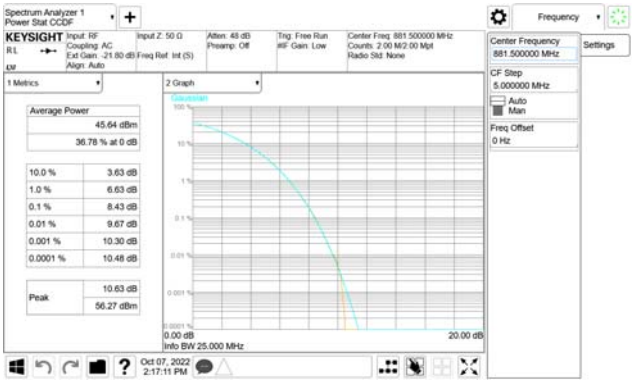
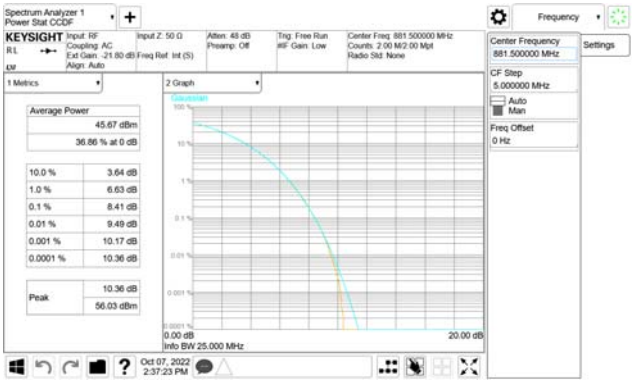
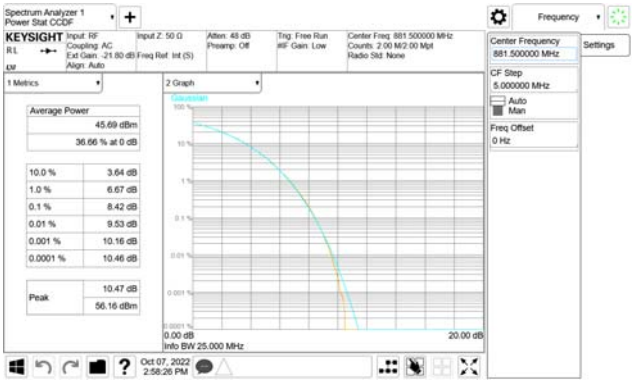
**ANT 4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

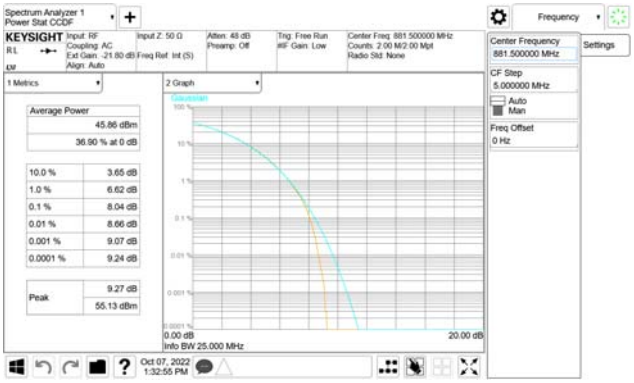
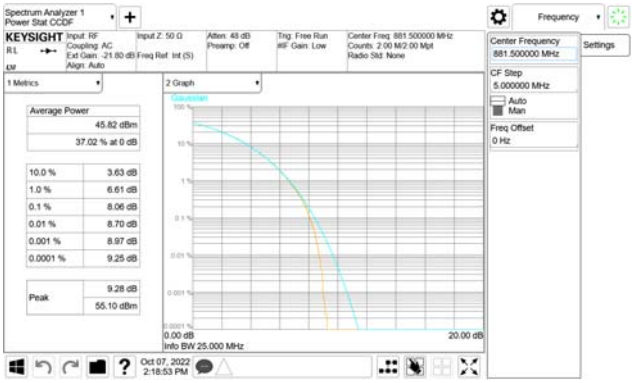
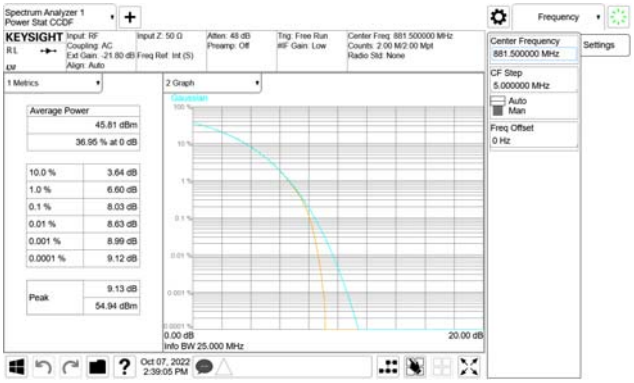
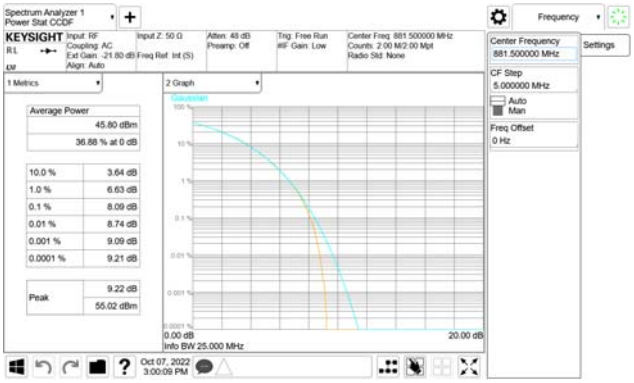
**LTE, Multi carrier 5 MHz + 20 MHz, Middle Channel**
**ANT 1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

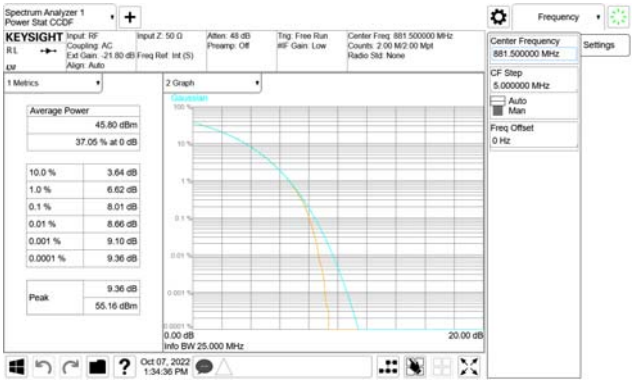
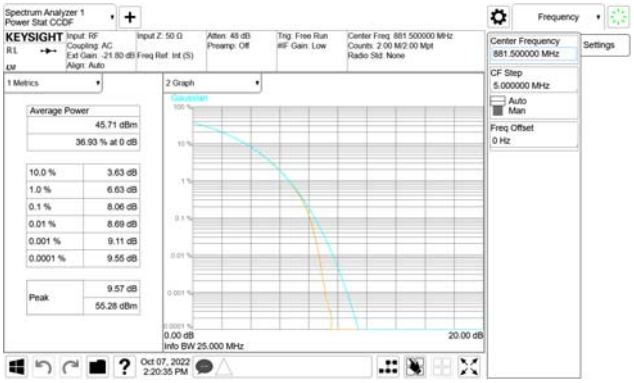
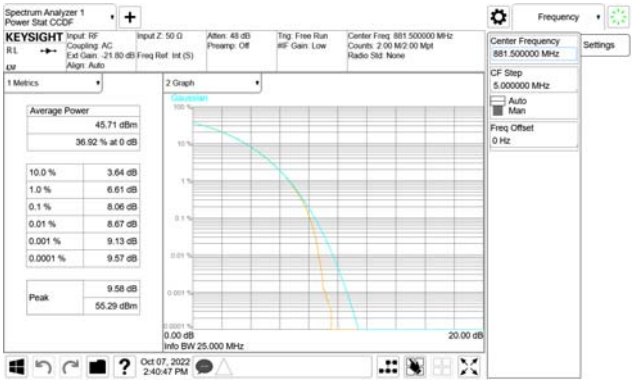
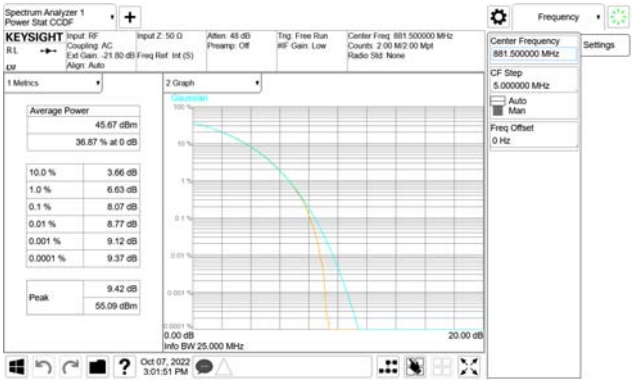
**ANT 2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT 3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT 4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

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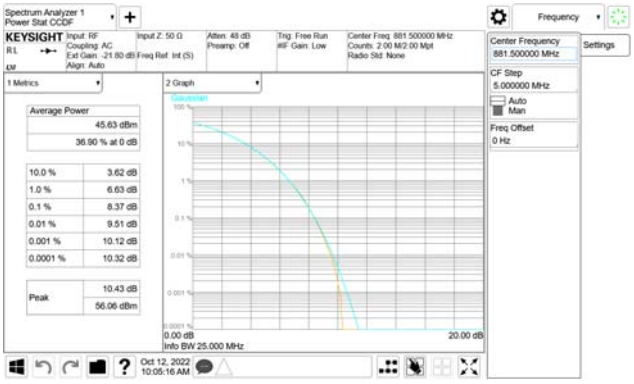
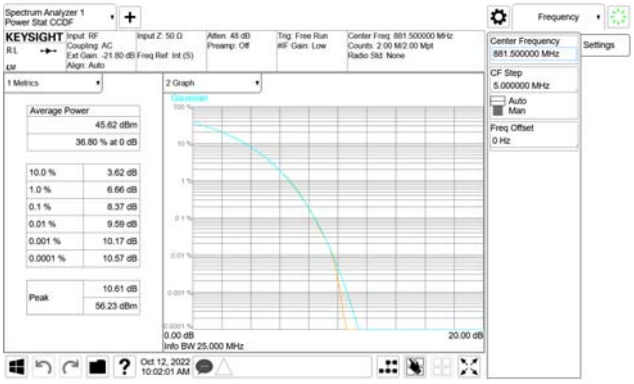
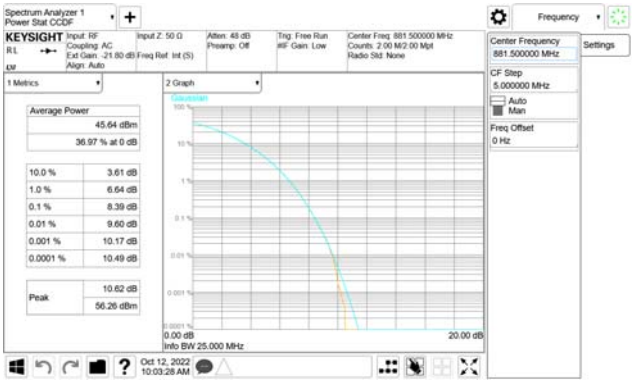
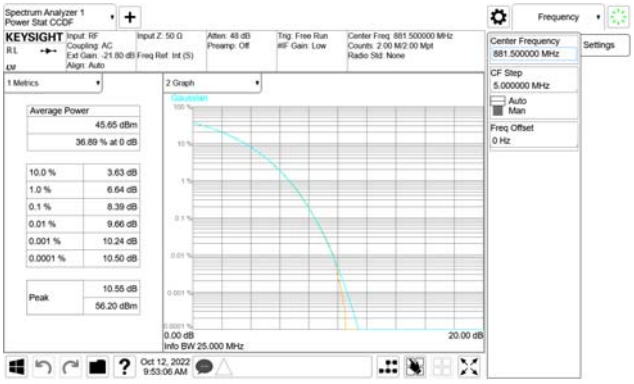
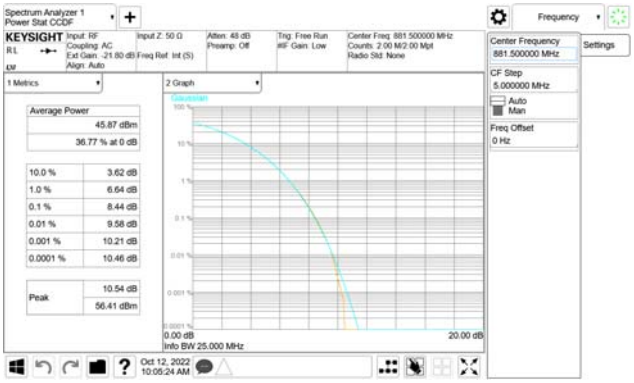
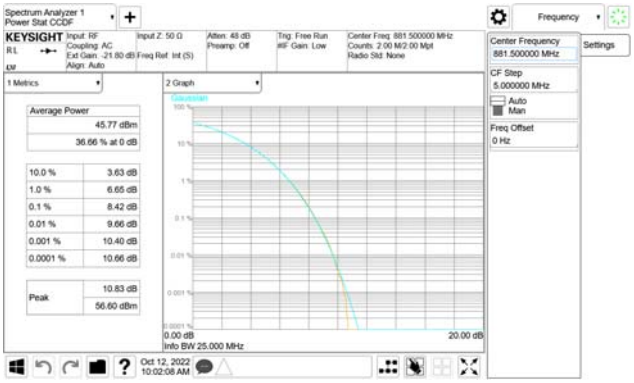
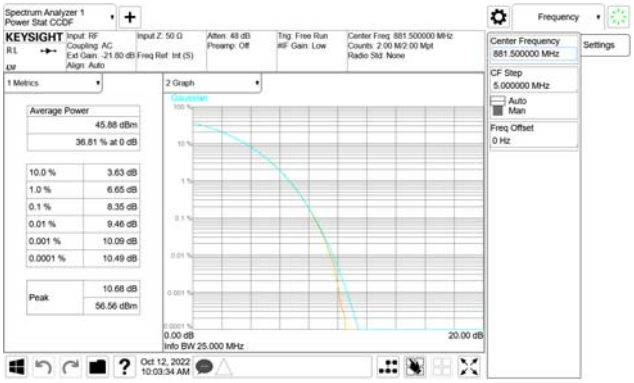
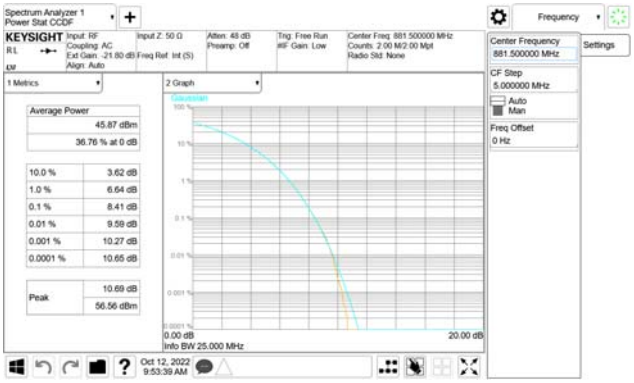
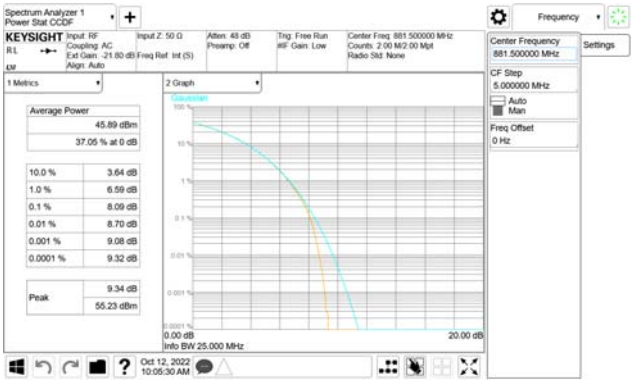
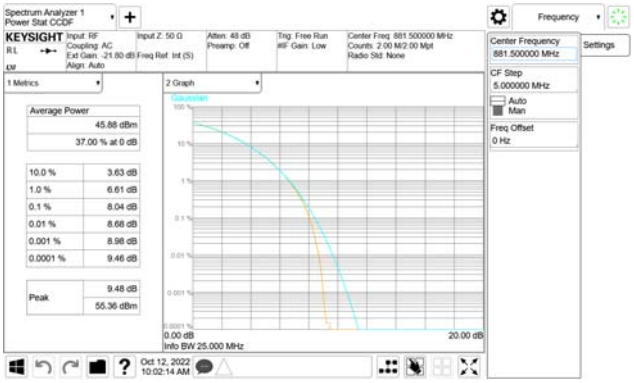
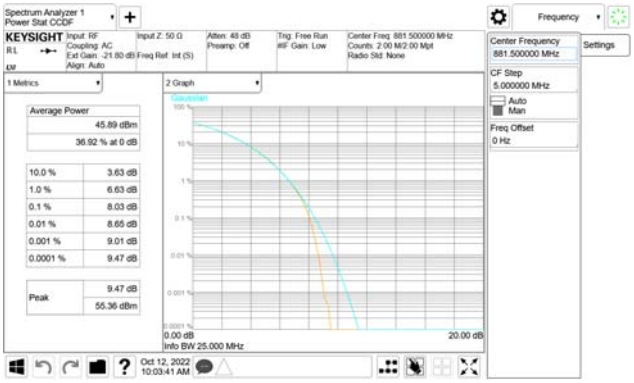
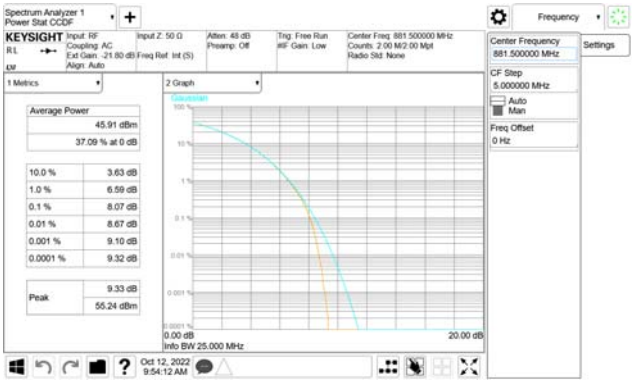
**5G NR, Multi carrier 5 MHz + 20 MHz, Middle Channel**
**ANT 1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

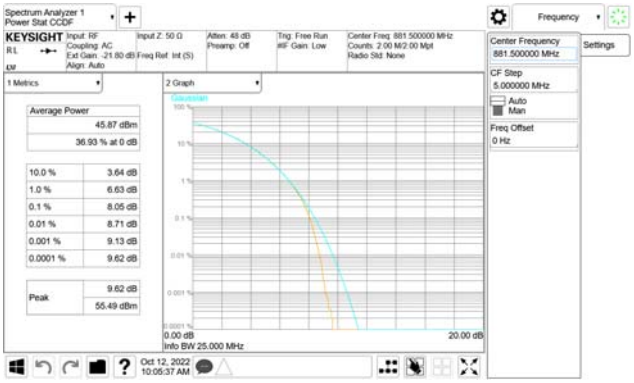
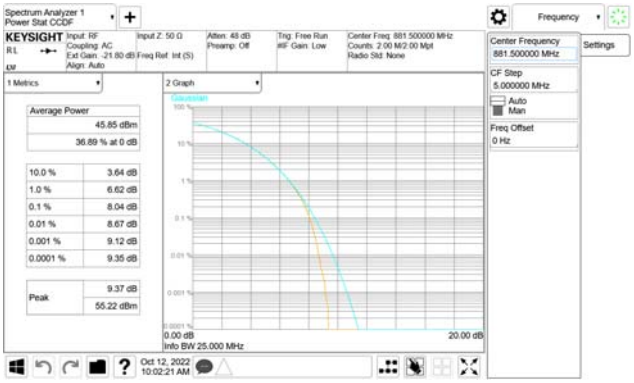
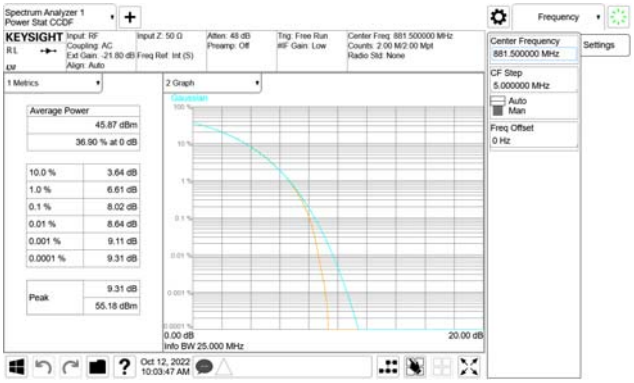
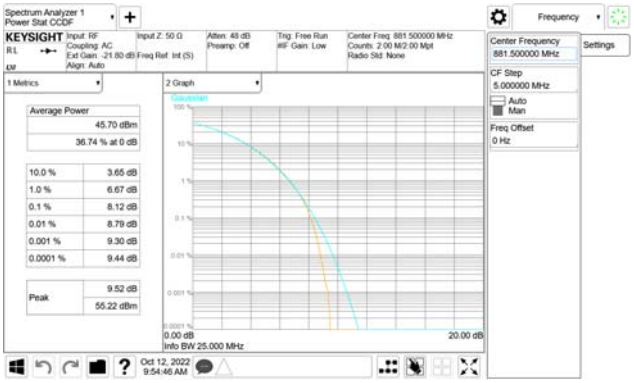
**ANT 2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT 3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT 4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

# 6. Occupied Bandwidth

**Test Requirements :**

**§ 2.1049 Measurements required : Occupied bandwidth**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049(a) through (i) as applicable.

**Test Procedures :**

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation. The EUT was connected to a spectrum analyzer enabled with an occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels. The occupied bandwidth was measured using the built in occupied bandwidth function of the spectrum analyzer. It was set to measure the bandwidth where 99% of the signal power was contained. The analyzer automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT.

The measurement is performed in according with Section 5.4.4 of ANSI C63.26.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 x OBW is sufficient).
b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1 % to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 x RBW.
c) Set the reference level ofthe instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

   NOTE-Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.
e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% ofthe total is reached and record that fî-equency As the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.
f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

**Test Results : Occupied Bandwidth**

**Test Data : Single carrier**

**[LTE_Bandwidth 20 MHz]**

| Channel | Antenna port | OBW [MHz] | | | |
|---|---|---|---|---|---|
| | | Modulation Type | | | |
| | | QPSK | 16QAM | 64QAM | 256QAM |
| Low | 1 | 17.89 | 17.93 | 17.92 | 17.91 |
| | 2 | 17.90 | 17.92 | 17.90 | 17.91 |
| | 3 | 17.93 | 17.91 | 17.92 | 17.91 |
| | 4 | 17.89 | 17.94 | 17.91 | 17.89 |
| Middle | 1 | 17.88 | 17.93 | 17.91 | 17.87 |
| | 2 | 17.93 | 17.91 | 17.90 | 17.87 |
| | 3 | 17.88 | 17.93 | 17.90 | 17.92 |
| | 4 | 17.89 | 17.95 | 17.92 | 17.91 |
| High | 1 | 17.88 | 17.95 | 17.94 | 17.90 |
| | 2 | 17.89 | 17.90 | 17.93 | 17.92 |
| | 3 | 17.88 | 17.95 | 17.92 | 17.90 |
| | 4 | 17.89 | 17.93 | 17.91 | 17.92 |

**[5G NR_Bandwidth 20 MHz]**

| Channel | Antenna port | OBW [MHz] | | | |
|---|---|---|---|---|---|
| | | Modulation Type | | | |
| | | QPSK | 16QAM | 64QAM | 256QAM |
| Low | 1 | 18.92 | 18.95 | 18.95 | 18.91 |
| | 2 | 18.92 | 18.98 | 18.93 | 18.92 |
| | 3 | 18.93 | 18.95 | 18.92 | 18.97 |
| | 4 | 18.92 | 18.98 | 18.96 | 18.97 |
| Middle | 1 | 18.93 | 18.99 | 18.94 | 18.92 |
| | 2 | 18.89 | 18.99 | 18.94 | 18.95 |
| | 3 | 18.92 | 19.01 | 18.94 | 18.98 |
| | 4 | 18.90 | 19.00 | 18.93 | 18.95 |
| High | 1 | 18.95 | 18.99 | 18.95 | 18.96 |
| | 2 | 18.93 | 18.95 | 18.91 | 18.97 |
| | 3 | 18.92 | 19.00 | 18.91 | 18.96 |
| | 4 | 18.95 | 18.99 | 18.94 | 18.97 |

**Test Data : Multi carrier**

**[LTE_Bandwidth 5 MHz + 20 MHz]**

| Channel | Antenna port | OBW [MHz] | | | |
|---|---|---|---|---|---|
| | | Modulation Type | | | |
| | | QPSK | 16QAM | 64QAM | 256QAM |
| Middle | 1 | 23.59 | 23.60 | 23.56 | 23.64 |
| | 2 | 23.55 | 23.57 | 23.56 | 23.63 |
| | 3 | 23.58 | 23.59 | 23.57 | 23.63 |
| | 4 | 23.55 | 23.60 | 23.54 | 23.58 |

**[5G NR_Bandwidth 5 MHz + 20 MHz]**

| Channel | Antenna port | OBW [MHz] | | | |
|---|---|---|---|---|---|
| | | Modulation Type | | | |
| | | QPSK | 16QAM | 64QAM | 256QAM |
| Middle | 1 | 24.06 | 24.19 | 24.07 | 24.10 |
| | 2 | 24.08 | 24.12 | 24.08 | 24.08 |
| | 3 | 24.05 | 24.10 | 24.09 | 24.08 |
| | 4 | 24.07 | 24.17 | 24.06 | 24.10 |

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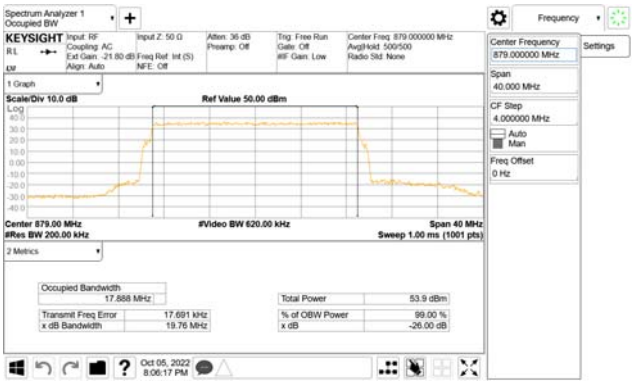
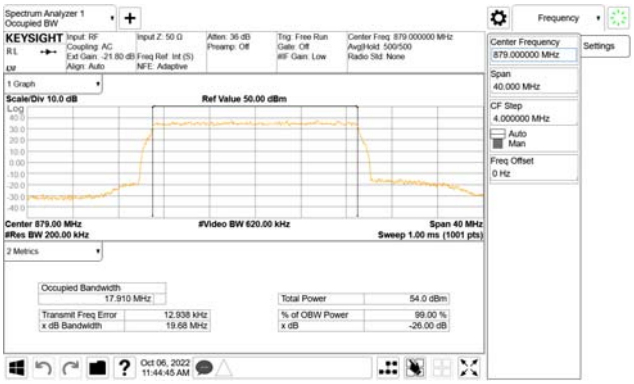
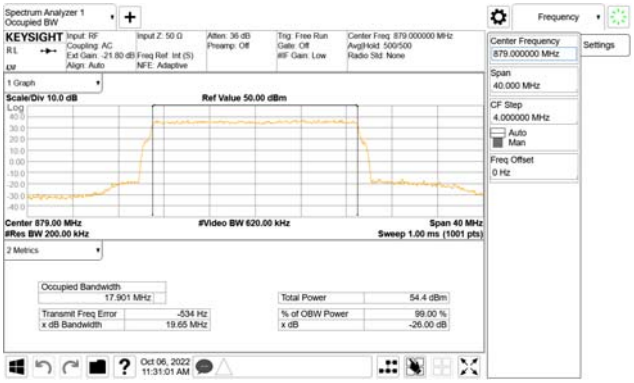
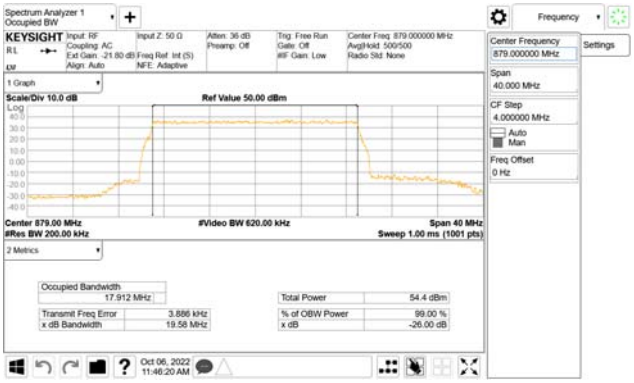
## Test Plot at Occupied Bandwidth

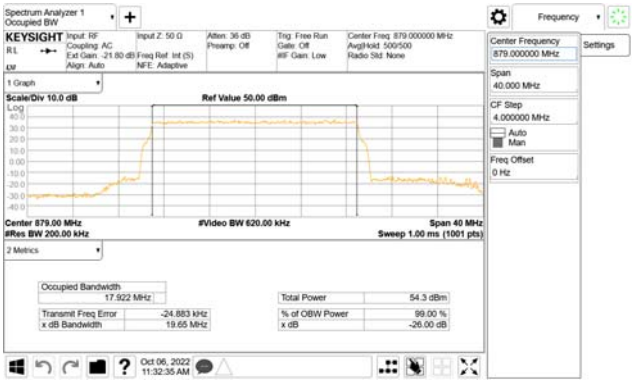
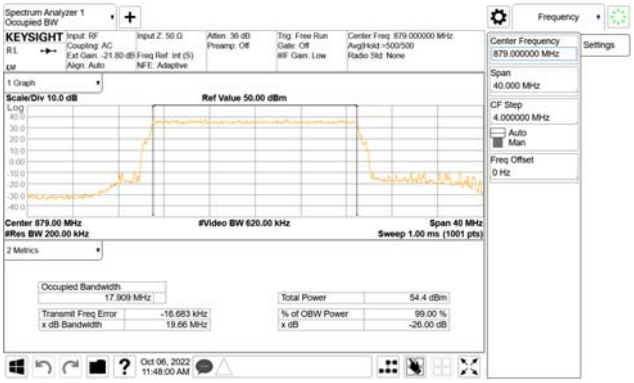
### LTE, Single carrier 20 MHz, Low Channel
### ANT1

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

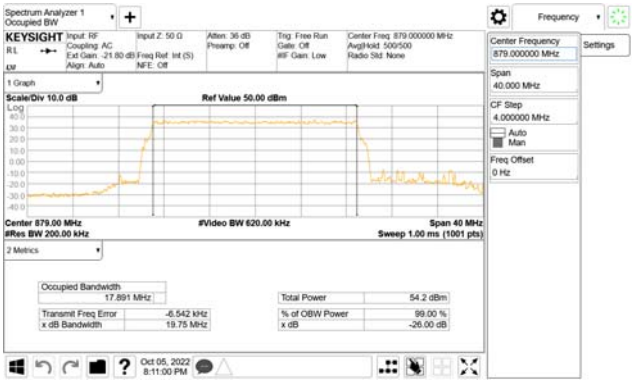
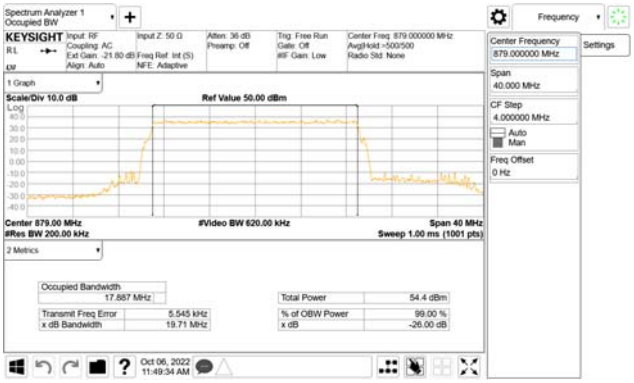
**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

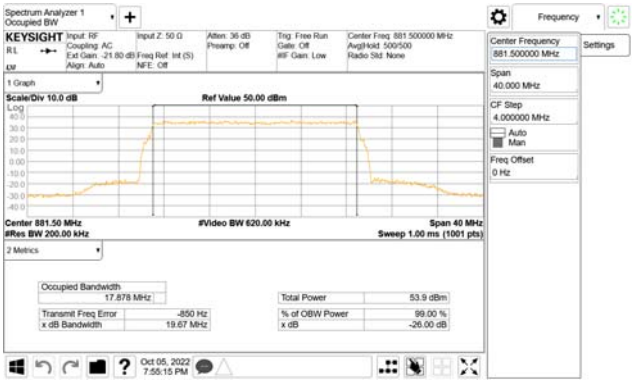
**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

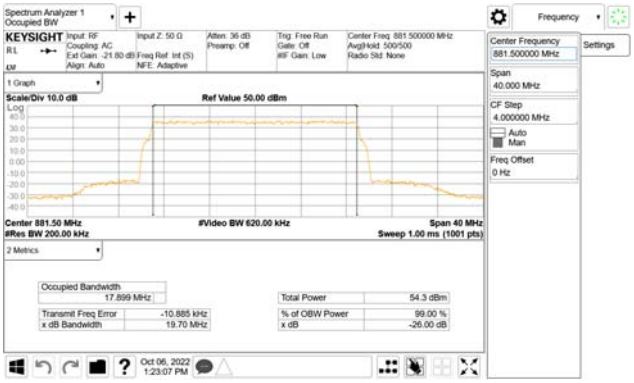
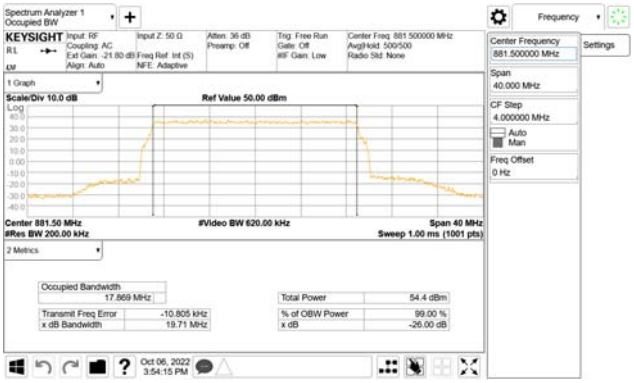
**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

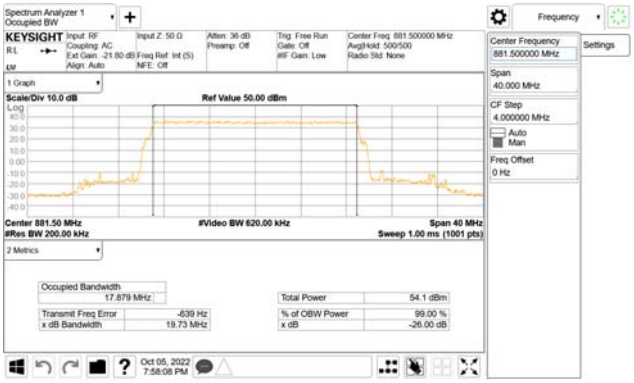
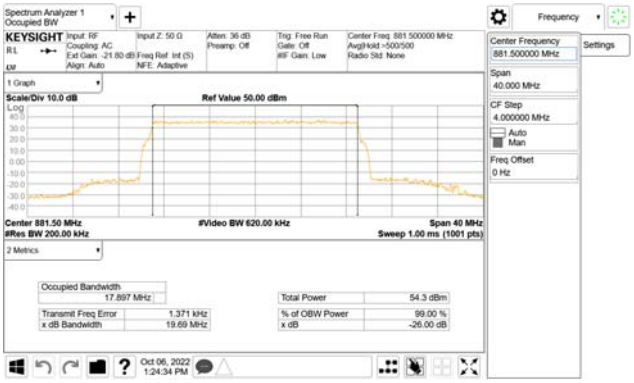
**LTE, Single carrier 20 MHz, Middle Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

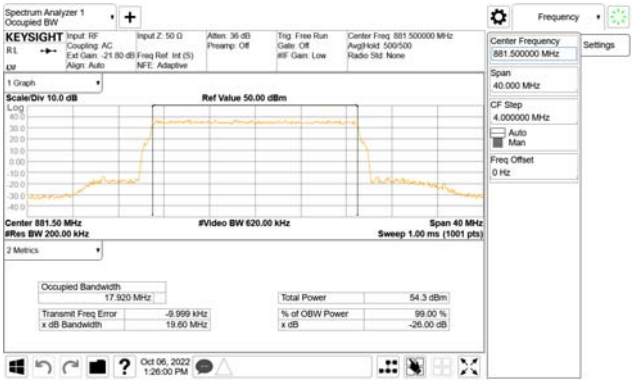
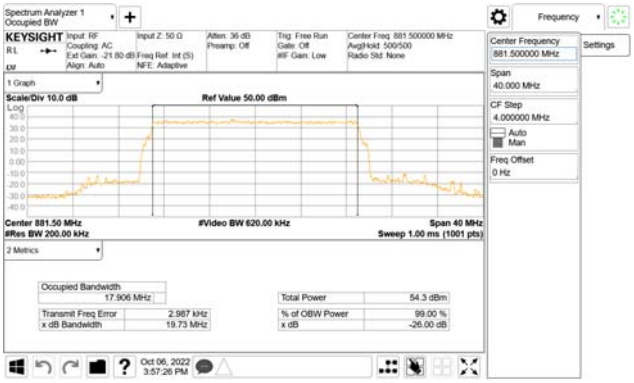
**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

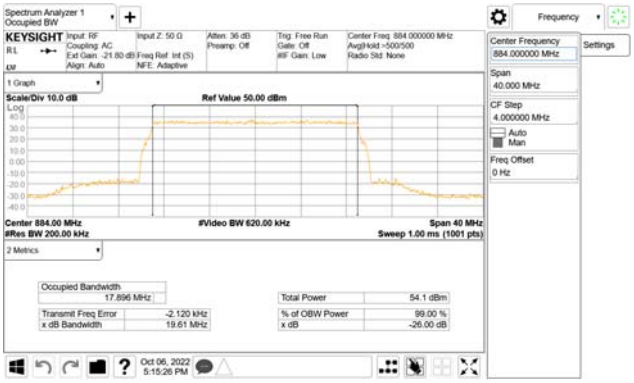
**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

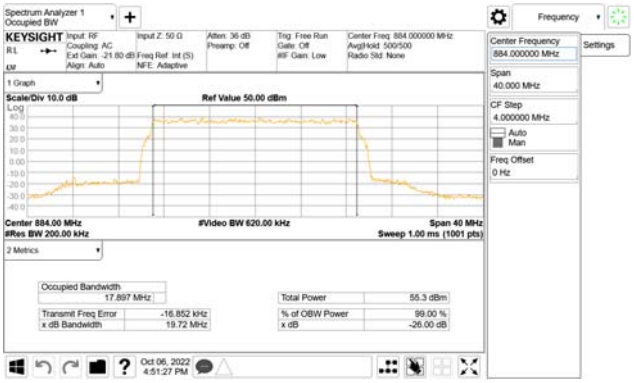
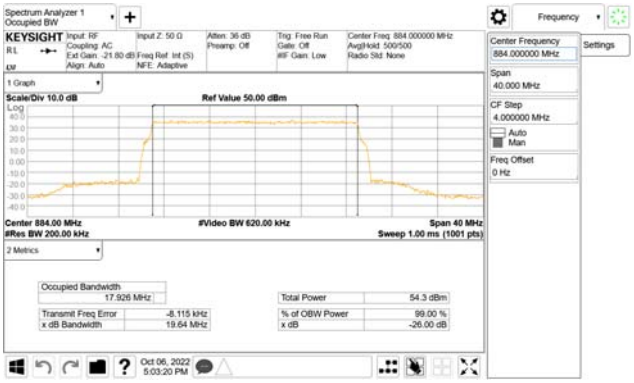
**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

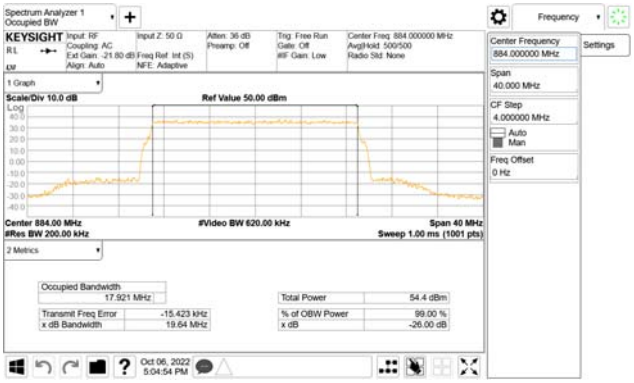
**LTE, Single carrier 20 MHz, High Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**5G NR, Single carrier 20 MHz, Low Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

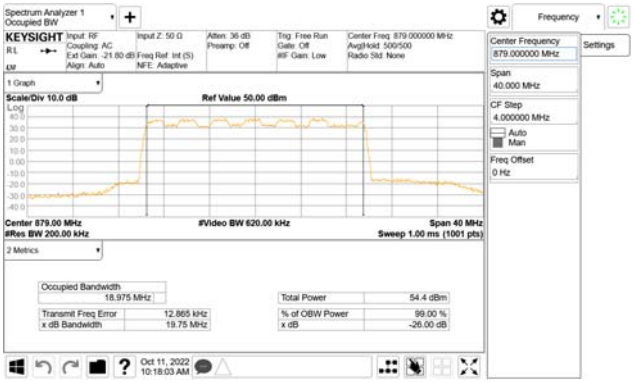
**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

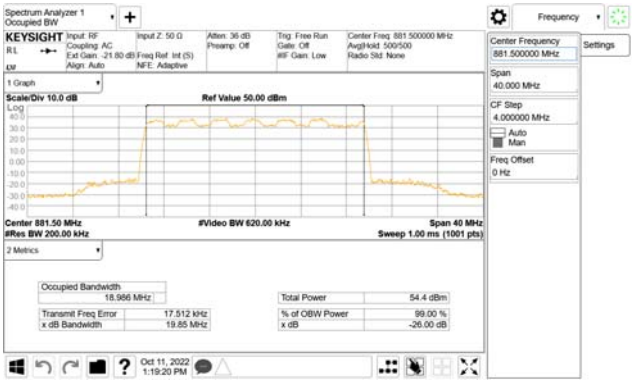
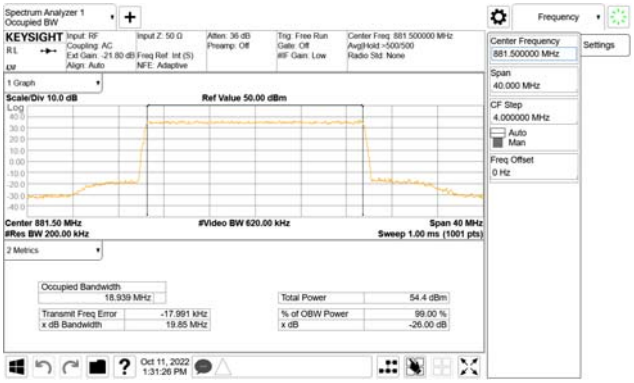
**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

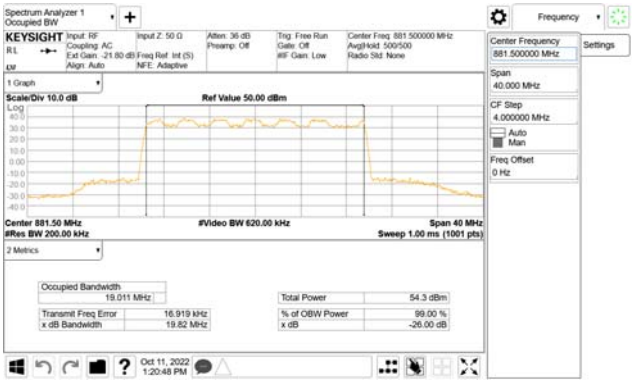
**5G NR, Single carrier 20 MHz, Middle Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

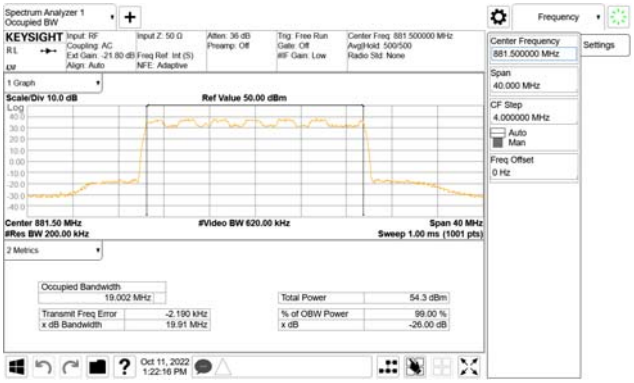
**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

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**5G NR, Single carrier 20 MHz, High Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**LTE, Multi carrier 5 MHz + 20 MHz, Middle Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**5G NR, Multi carrier 5 MHz + 20 MHz, Middle Channel**
**ANT1**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT2**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT3**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

**ANT4**

| QPSK | 16QAM |
|---|---|
|  |  |
| **64QAM** | **256QAM** |
|  |  |

# 7. Spurious Emission at Antenna Terminal

**§ 2.1051 Measurements required: Spurious emissions at antenna terminals.**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**§ 22.917 Emission limitations for cellular equipment.**

The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

(1) In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy, provided that the measured power is integrated over the full required reference bandwidth (i.e., 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(2) In the spectrum above 1 GHz, instrumentation should employ a reference bandwidth of 1 MHz.

(c) Alternative out of band emission limit. Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

**Test Procedures :**

The measurement is performed in according with Section 5.7.4 of ANSI C63.26.

a) Set the spectrum analyzer stalt frequency to the lowest frequency generated by the EUT, without going below 9 kHz, and the stop frequency to the lower frequency covered by the measurements previously performed in 5.7.3. As an alternative, the stop frequency can be set to the value specified in 5. 1.1, depending on the EUT operating range, if the resulting plot can clearly demonstrate compliance for all frequencies not addressed by the out-of-band emissions measurements performed as per 5.7.3.

b) When using an average power (rms) detector, ensure that the number of points in the sweep ≥ 2 x (span / RBW). This may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the spectrum analyzer capabilities. This requirement does not apply to peak-detected power measurements. When average power is specified by the applicable regulation, a peak-detector can be utilized for preliminary measurements to accommodate wider frequency spans. Any emissions found in the preliminary measurement to exceed the applicable limit(s) shall be further examined using a power averaging (rms) detector with the minimum number of measurement points as defined above.

c) The sweep time should be set to auto-couple for performing peak-detector measurements. For measurements that use a power averaging (rms) detector, the sweep time shall be set as described for out-of-band emissions measurements in item d) of 5.7.3.

d) Identify and measure the highest spurious emission levels in each frequency range. It is not necessary to re-measure the out-of-band emissions as a part of this test. Record the frequencies and amplitudes corresponding to the measured emissions and capture the data plots.

e) Repeat step b) through step d) for the upper spurious emission frequency range if not already captured by a wide span measurement performed as per the alternative provided in step a). The upper frequency for this measurement is defined in 5.1.1 as a function of the EUT operating range.

f) Compare the results with the corresponding limit in the applicable regulation.

g) The test report shall include the data plots ofthe measuring instrument display and the measured data.

**Notes :**

1. Due to 64 x 64 MIMO operation, limit is **-19.02 dBm** (-13 dBm - 10*Log(4)) per KDB Publication 662911 D01 Multiple Transmitter Output v02r01.
2. In 9 kHz - 150 kHz and 150 kHz - 30 MHz bands, RBW was reduced to 1% and 10% of the reference bandwidth for measuring unwanted emission level(typically, 100 kHz if the authorized frequency band is below 1 GHz) and power was integrated.

   i.e.: 9 kHz - 150 kHz (**-39.02 dBm** = -19.02 dBm – 10log(100 kHz/1 kHz))

   150 kHz - 30 MHz (**-29.02 dBm** = -19.02 dBm – 10log(100 kHz/10 kHz))
3. All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its at maximum power, and at the appropriate frequencies.

   All modulation types were investigated to determine the worst case configuration.

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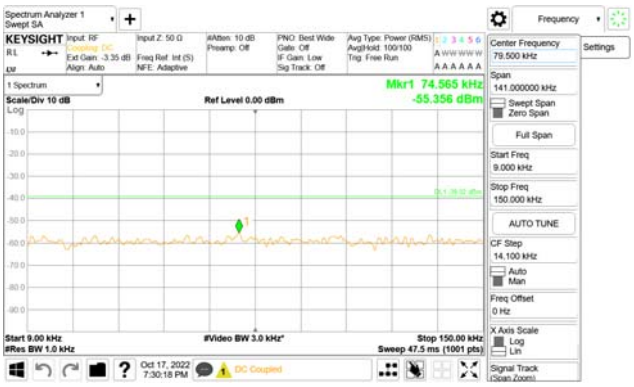
**Test Results : Spurious Emission at Antenna Terminal**

**Test Data : Single carrier**

**Test plot at Spurious Emission at Antenna Terminal**

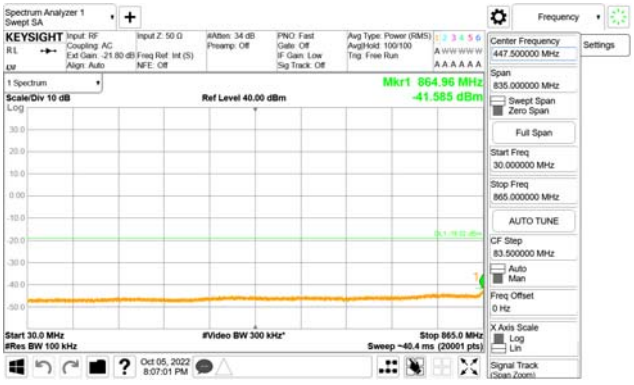
**LTE, Single carrier 20 MHz, Low Channel, QPSK**
**ANT1**

9 kHz - 150 kHz

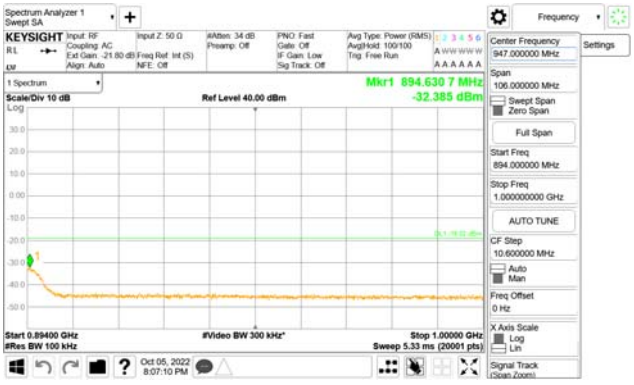



150 kHz - 30 MHz

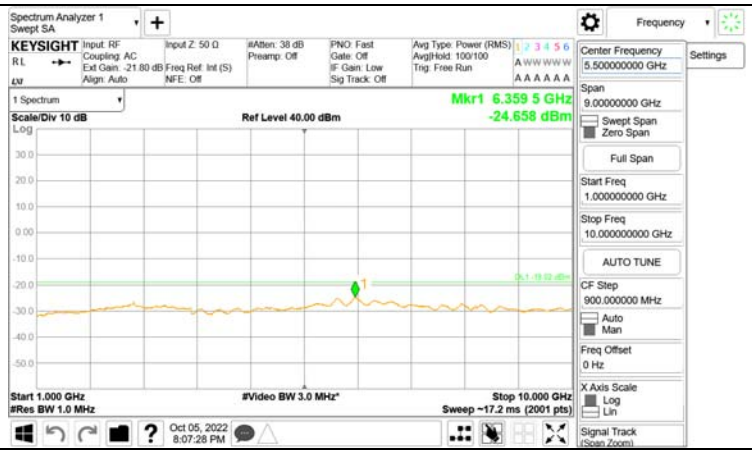

30 MHz - 865 MHz



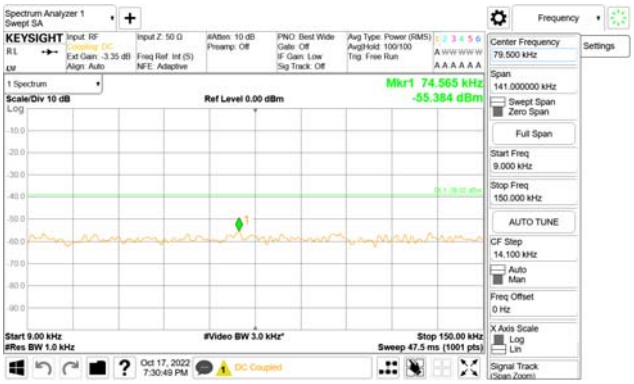
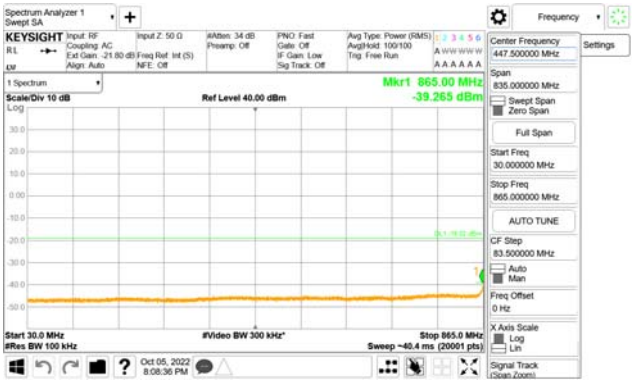
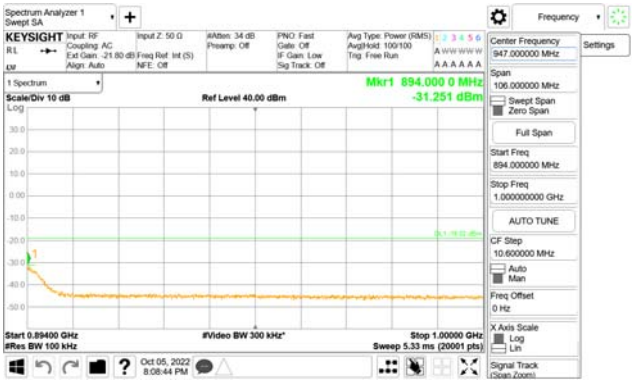
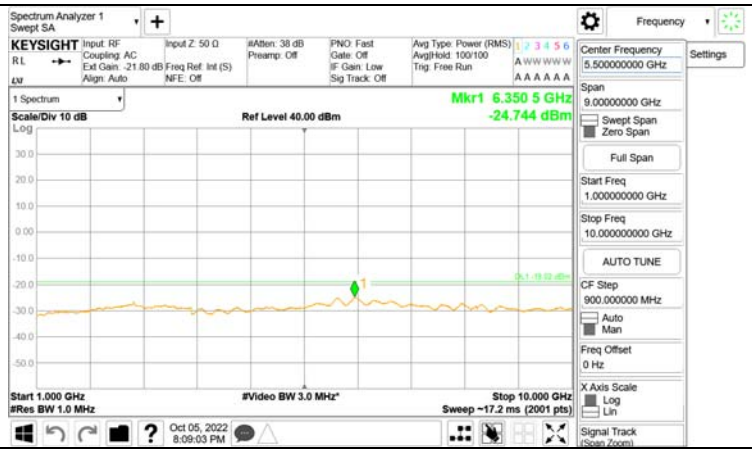

894 MHz - 1 GHz



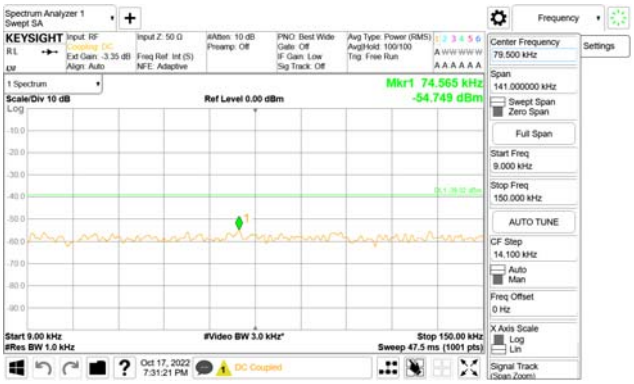
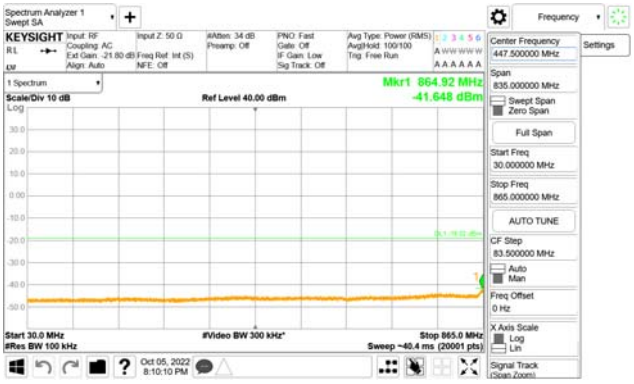
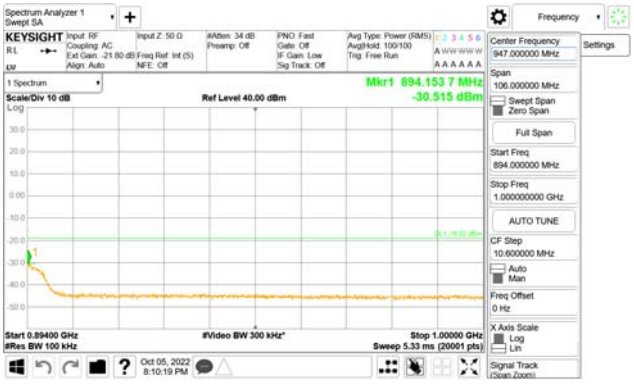
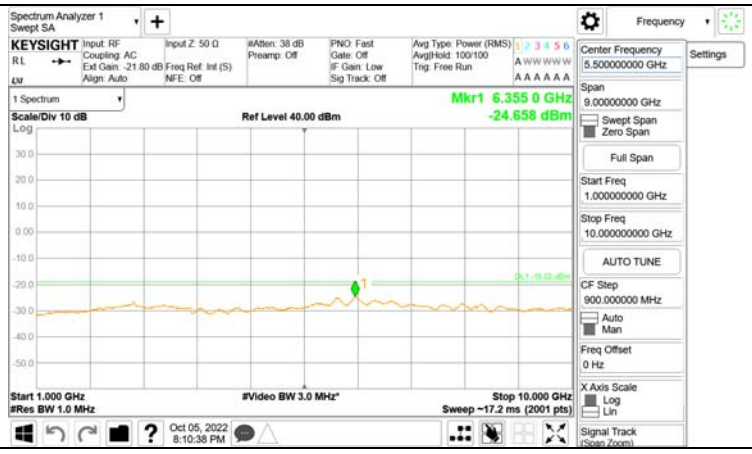

1 GHz - 10 GHz



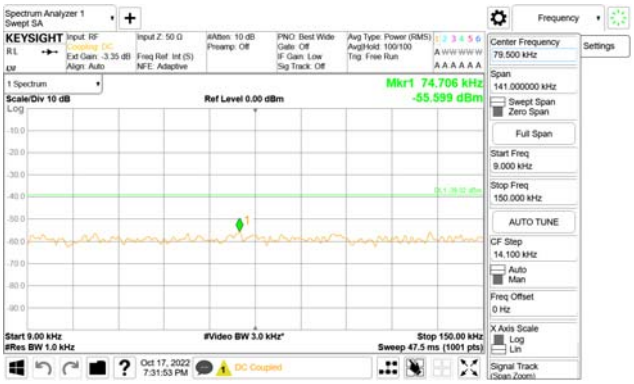
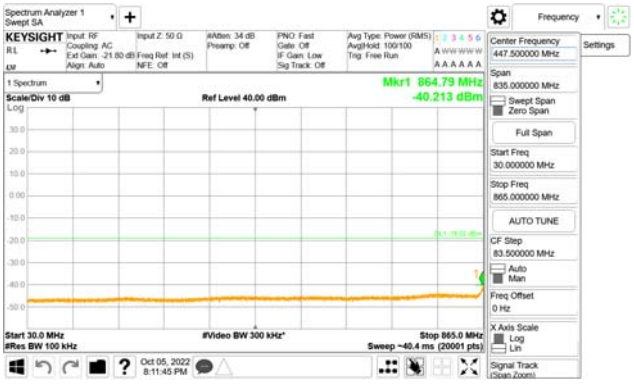
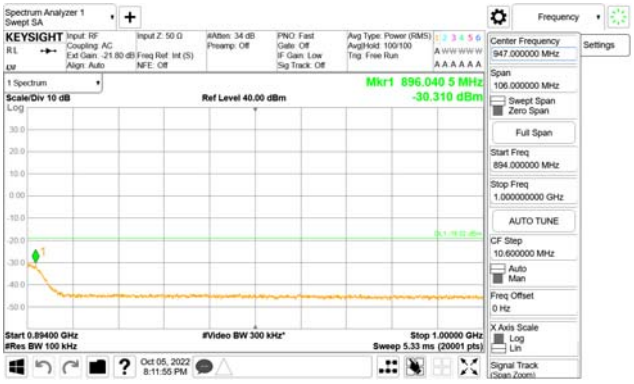
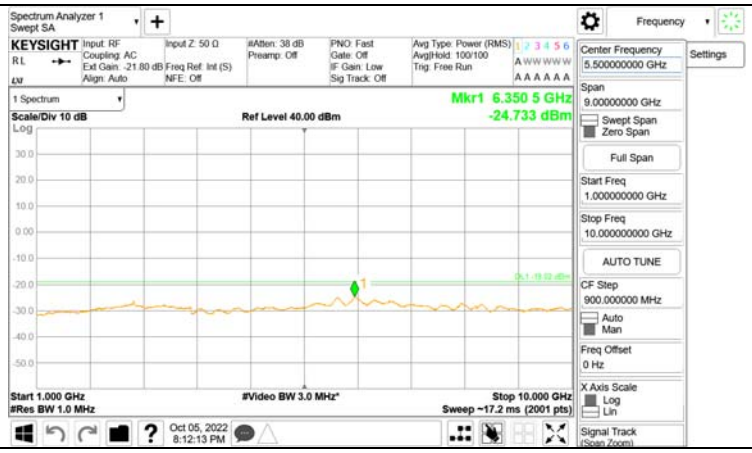
**ANT2**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 865 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |

**ANT3**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 865 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |

**ANT4**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 865 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |

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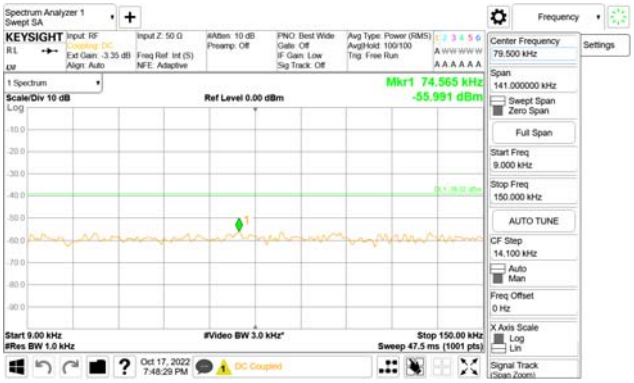
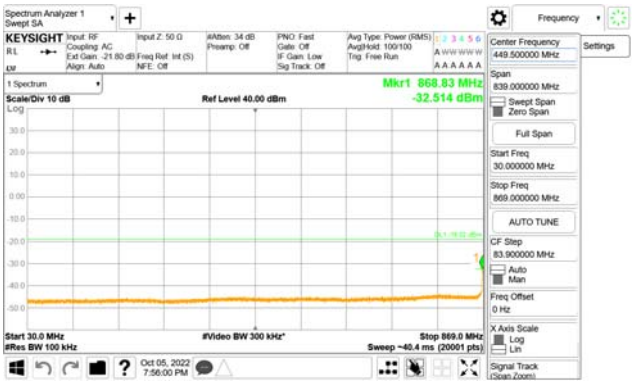
**LTE, Single carrier 20 MHz, Middle Channel, QPSK**
**ANT1**

9 kHz - 150 kHz

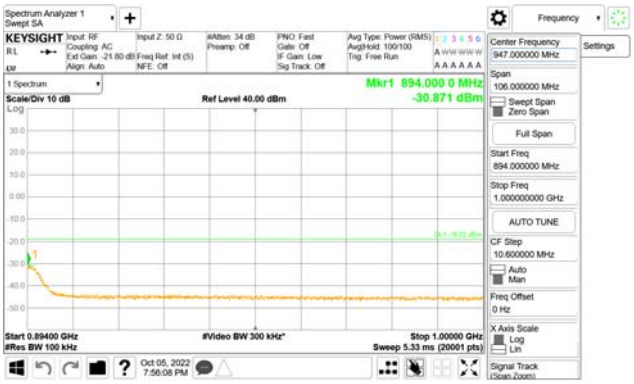



150 kHz - 30 MHz

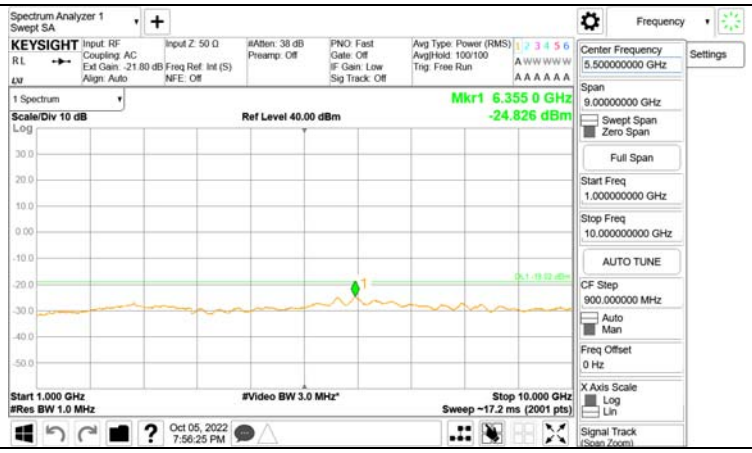

30 MHz - 869 MHz



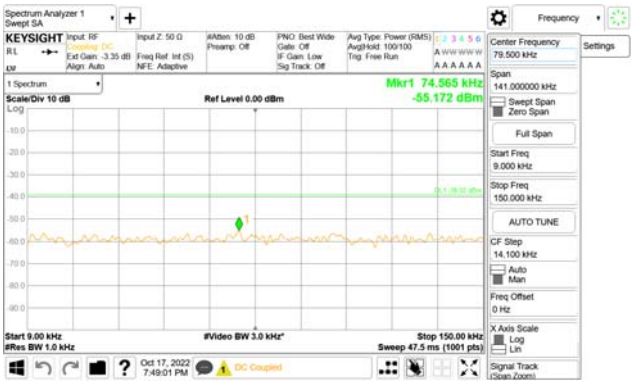
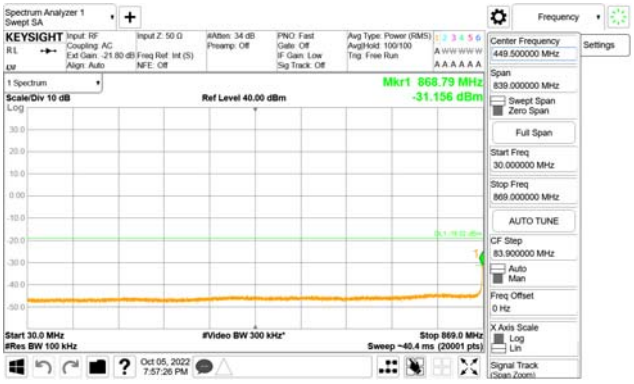
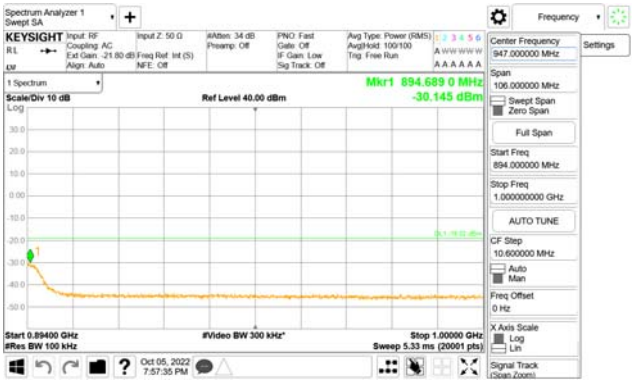
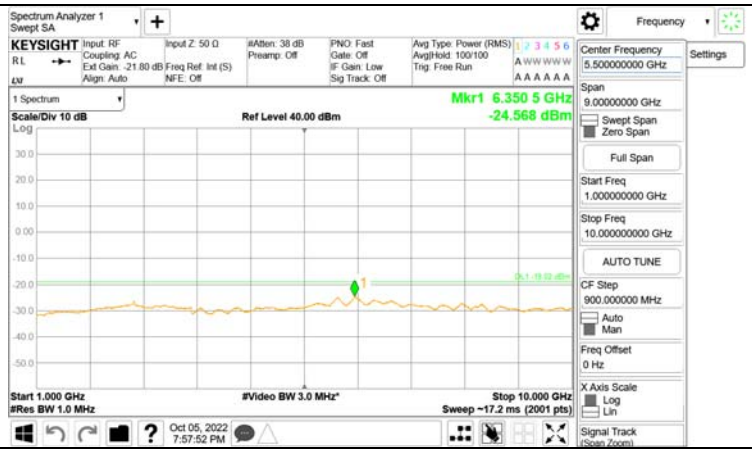

894 MHz - 1 GHz



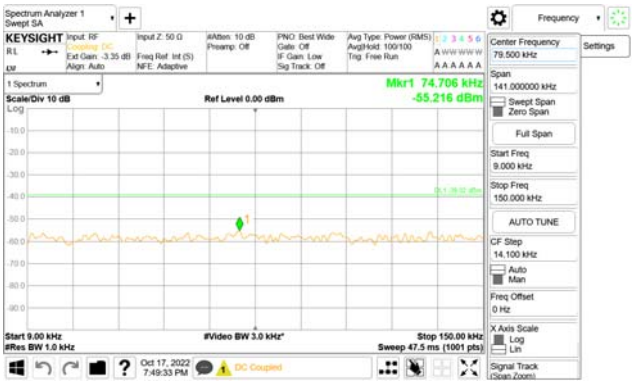
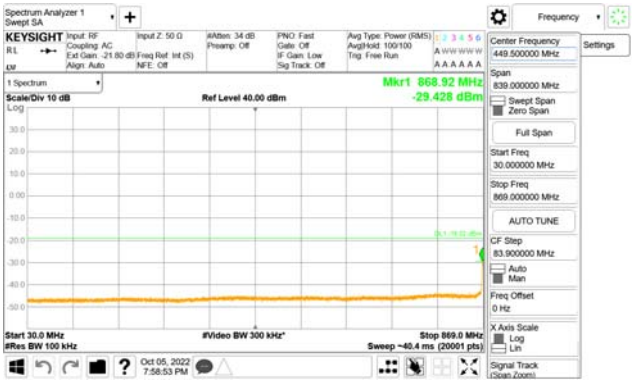
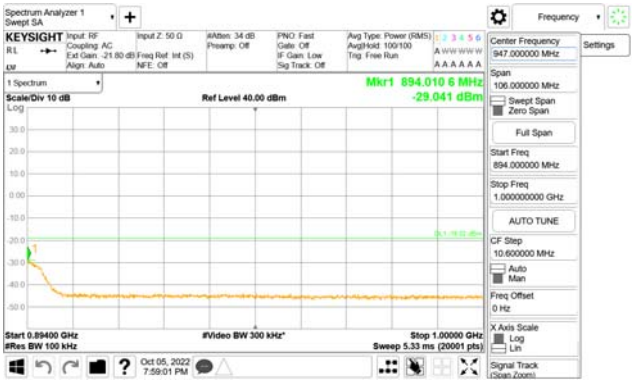
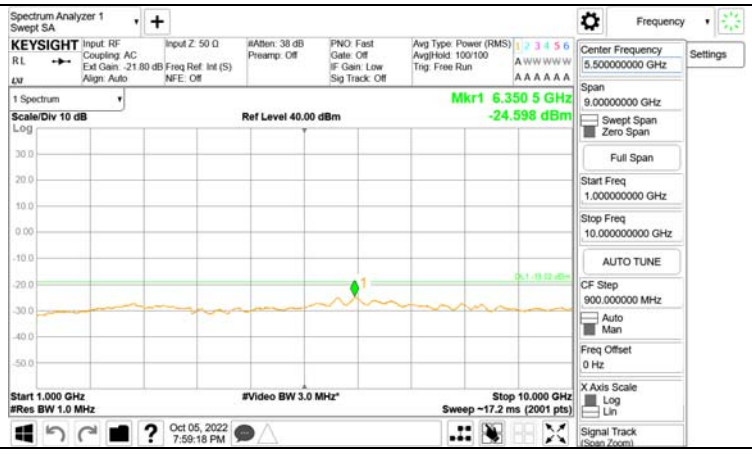

1 GHz - 10 GHz



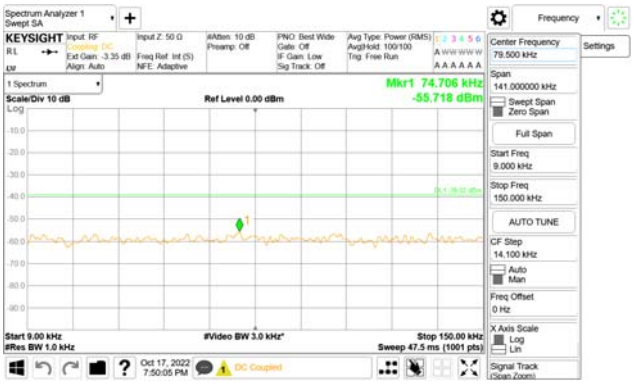
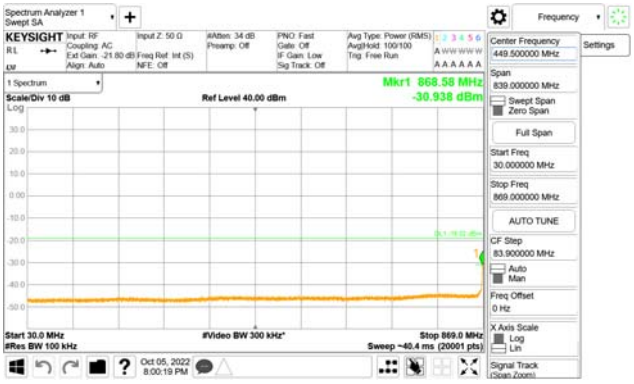
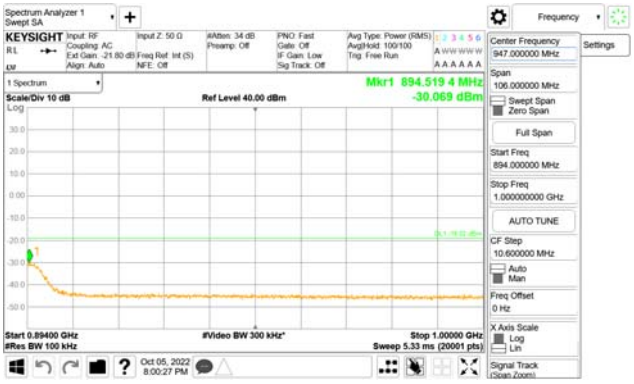
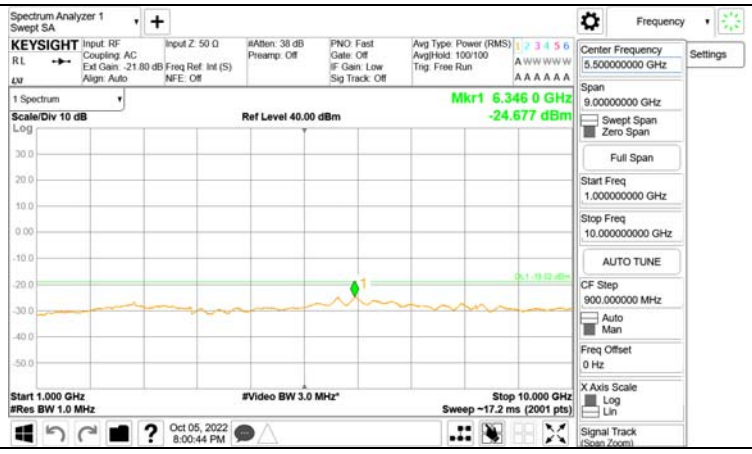
**ANT2**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 869 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |

**ANT3**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 869 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |

**ANT4**

| 9 kHz - 150 kHz | 150 kHz - 30 MHz |
|---|---|
|  |  |
| **30 MHz - 869 MHz** | **894 MHz - 1 GHz** |
|  |  |
| **1 GHz - 10 GHz** | |
|  | |