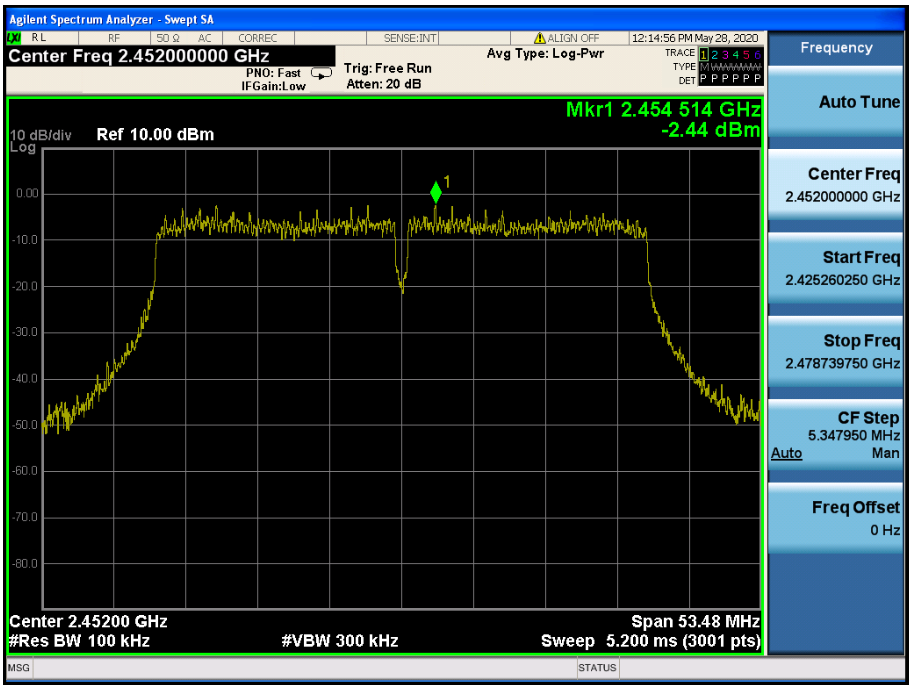
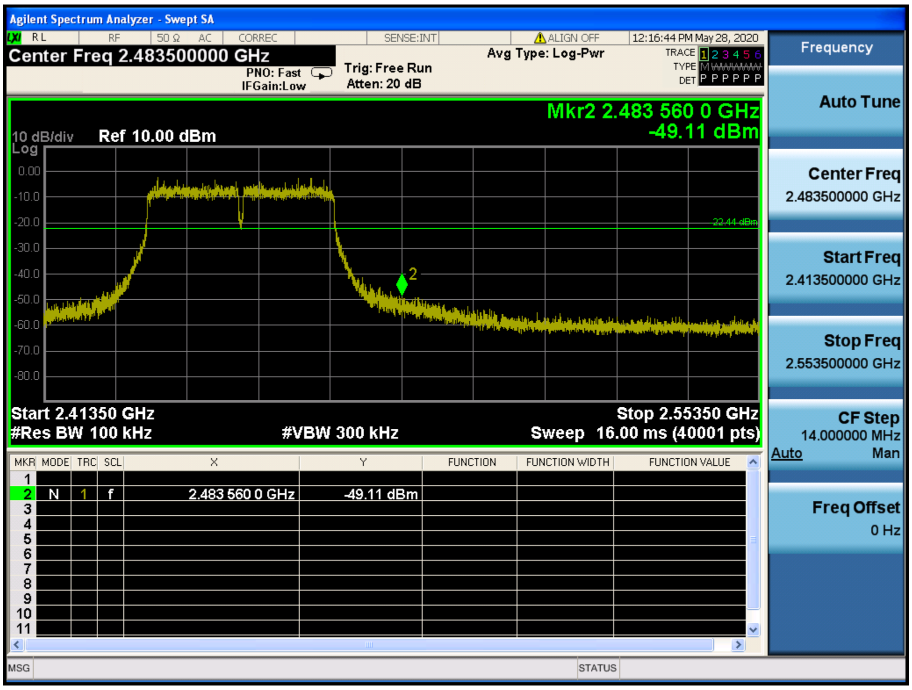
## TM 4 & Highest

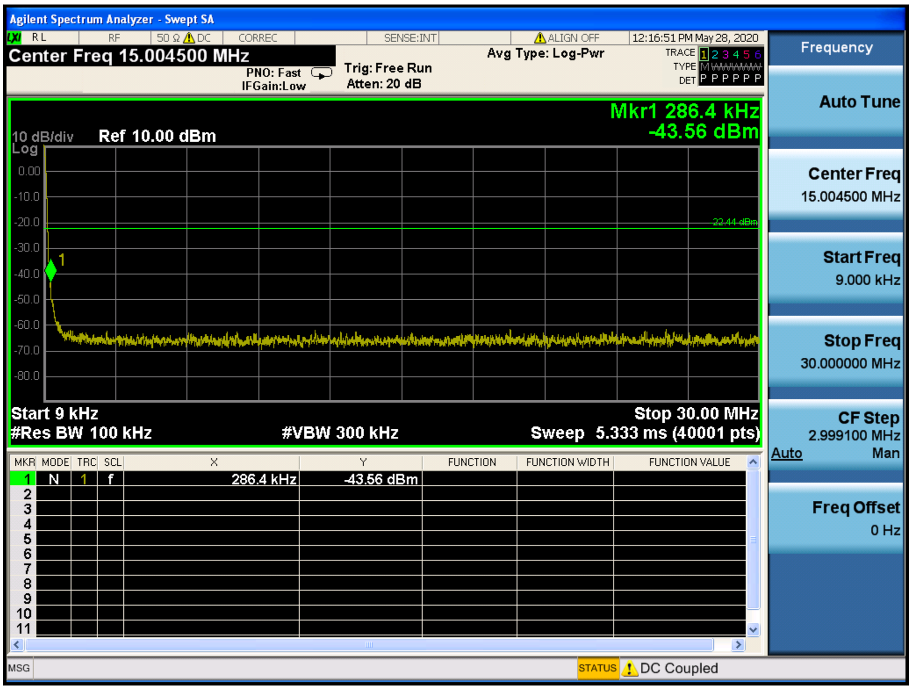
### Reference

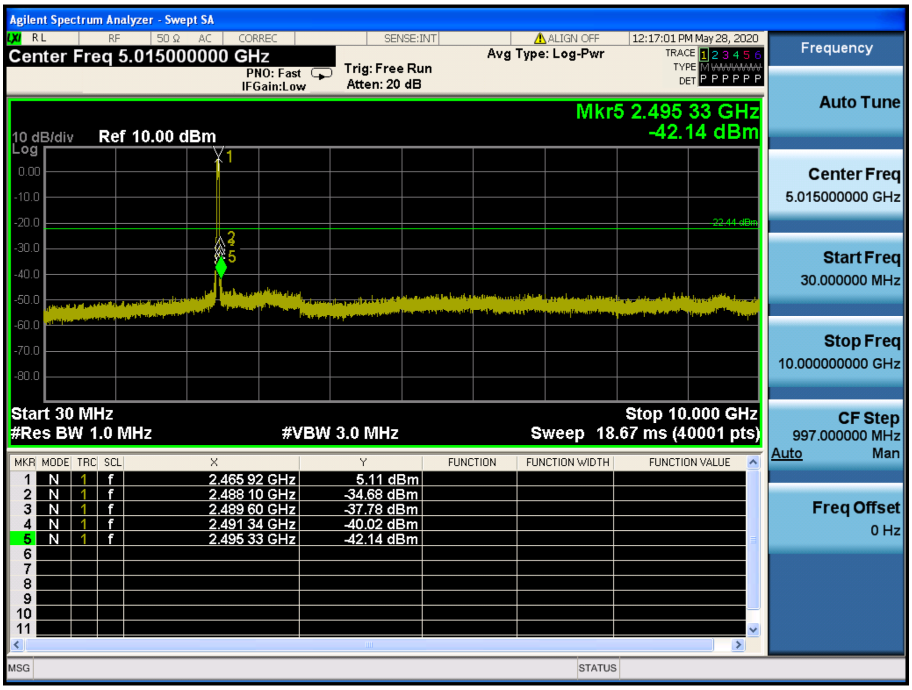



### High Band-edge

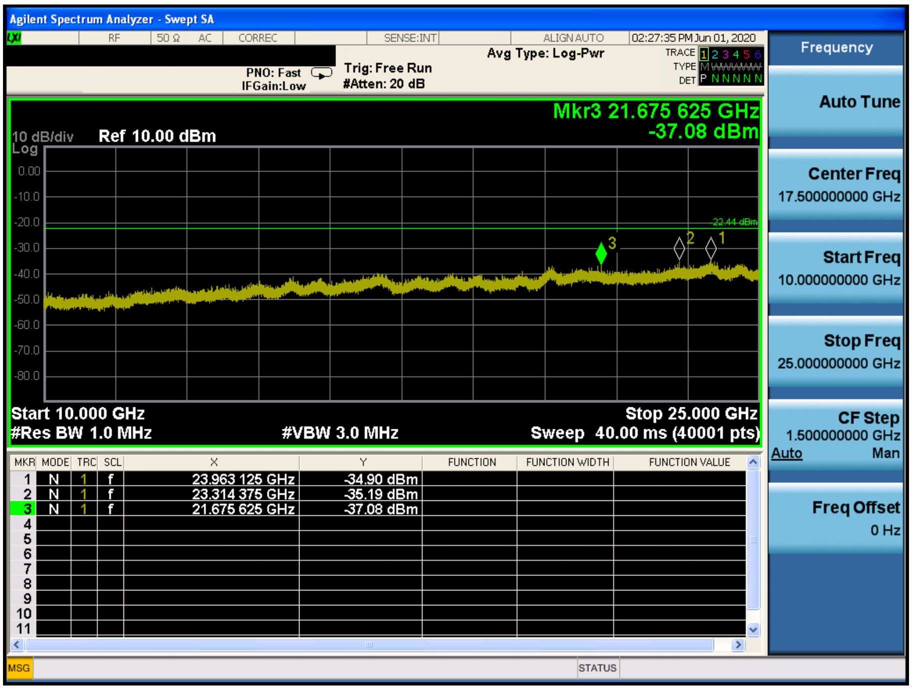


## Conducted Spurious Emissions



## Conducted Spurious Emissions



## 8.5 Radiated spurious emissions

▣ **Test Requirements and limit, §15.247(d), §15.205, §15.209**

In any 100 kHz bandwidth outside the operating frequency band, 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. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed.

▪ **FCC Part 15.209(a) and (b)**

| Frequency (MHz) | Limit (uV/m) | Measurement Distance (meter) |
|---|---|---|
| 0.009 – 0.490 | 2400/F (kHz) | 300 |
| 0.490 – 1.705 | 24000/F (kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 ~ 88 | 100 ** | 3 |
| 88 ~ 216 | 150 ** | 3 |
| 216 ~ 960 | 200 ** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ **FCC Part 15.205 (a):** Only spurious emissions are permitted in any of the frequency bands listed below:

| MHz | MHz | MHz | MHz | GHz | GHz |
|---|---|---|---|---|---|
| 0.009 ~ 0.110 | 8.41425 ~ 8.41475 | 108 ~ 121.94 | 1300 ~ 1427 | 4.5 ~ 5.15 | 14.47 ~ 14.5 |
| 0.495 ~ 0.505 | 12.29 ~ 12.293 | 123 ~ 138 | 1435 ~ 1626.5 | 5.35 ~ 5.46 | 15.35 ~ 16.2 |
| 2.1735 ~ 2.1905 | 12.51975 ~ 12.52025 | 149.9 ~ 150.05 | 1645.5 ~ 1646.5 | 7.25 ~ 7.75 | 17.7 ~ 21.4 |
| 4.125 ~ 4.128 | 12.57675 ~ 12.57725 | 156.52475 ~ | 1660 ~ 1710 | 8.025 ~ 8.5 | 22.01 ~ 23.12 |
| 4.17725 ~ 4.17775 | 13.36 ~ 13.41 | 156.52525 | 1718.8 ~ 1722.2 | 9.0 ~ 9.2 | 23.6 ~ 24.0 |
| 4.20725 ~ 4.20775 | 16.42 ~ 16.423 | 156.7 ~ 156.9 | 2200 ~ 2300 | 9.3 ~ 9.5 | 31.2 ~ 31.8 |
| 6.215 ~ 6.218 | 16.69475 ~ 16.69525 | 162.0125 ~ 167.17 | 2310 ~ 2390 | 10.6 ~ 12.7 | 36.43 ~ 36.5 |
| 6.26775 ~ 6.26825 | 16.80425 ~ 16.80475 | 167.72 ~ 173.2 | 2483.5 ~ 2500 | 13.25 ~ 13.4 | Above 38.6 |
| 6.31175 ~ 6.31225 | 25.5 ~ 25.67 | 240 ~ 285 | 2655 ~ 2900 | | |
| 8.291 ~ 8.294 | 37.5 ~ 38.25 | 322 ~ 335.4 | 3260 ~ 3267 | | |
| 8.362 ~ 8.366 | 73 ~ 74.6 | 399.90 ~ 410 | 3332 ~ 3339 | | |
| 8.37625 ~ 8.38675 | 74.8 ~ 75.2 | 608 ~ 614 | 3345.8 ~ 3358 | | |
| | | 960 ~ 1240 | 3600 ~ 4400 | | |

▪ **FCC Part 15.205(b):** The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector.
Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

## ▣ Test Configuration

Refer to the APPENDIX I.

## ▣ Test Procedure

1. The EUT is placed on a non-conductive table, emission measurements at below 1 GHz, the table height is 80 cm and above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 1 or 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

### - KDB558074 D01v05r02 - Section 8.6
### - ANSI C63.10-2013 – Section 11.12

**Peak Measurement**

RBW = As specified in below table, VBW ≥ 3 x RBW, Sweep = Auto, Detector = Peak, Trace mode = Max Hold until the trace stabilizes.

| Frequency | RBW |
|---|---|
| 9-150 kHz | 200-300 Hz |
| 0.15-30 MHz | 9-10 kHz |
| 30-1000 MHz | 100-120 kHz |
| > 1000 MHz | 1 MHz |

**Average Measurement**

1. RBW = 1 MHz (unless otherwise specified).
2. VBW ≥ 3 x RBW.
3. Detector = RMS (Number of points ≥ 2 x Span / RBW)
4. Averaging type = power. (i.e., RMS)
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.
7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1 / D), where x is the duty cycle.
2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1 / D), where x is the duty cycle.
3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

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**Duty Cycle Correction factor**

| Test Mode | Date rate | $T_{on}$(ms) | $T_{on+off}$ (ms) | D = $T_{on}$ / ($T_{on+off}$) | DCCF(dB) |
|---|---|---|---|---|---|
| TM 1 | 1Mbps | 56.190 | 57.180 | 0.982 7 | 0.08 |
| TM 2 | 6Mbps | 3.897 | 4.899 | 0.795 5 | 0.99 |
| TM 3 | MCS 2 | 2.912 | 3.916 | 0.743 6 | 1.29 |
| TM 4 | MCS 3 | 1.076 | 2.079 | 0.517 6 | 2.86 |

Note1: Where, T= Transmission duration / D= Duty cycle
Note2: Please refer to the appendix II for duty cycle plots.

▣ **Test Results: Comply**

**- Tested Power Supply: DC 12 V**

**Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : *TM 1***

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 386.51 | H | X | PK | 48.39 | 4.79 | N/A | N/A | 53.18 | 74.00 | 20.82 |
| | 2 387.17 | H | X | AV | 39.25 | 4.79 | N/A | N/A | 44.04 | 54.00 | 9.96 |
| | 4 824.23 | V | X | PK | 51.19 | 0.93 | N/A | N/A | 52.12 | 74.00 | 21.88 |
| | 4 823.98 | V | X | AV | 43.55 | 0.93 | N/A | N/A | 44.48 | 54.00 | 9.52 |
| Middle | 4 873.99 | V | X | PK | 51.41 | 1.17 | N/A | N/A | 52.58 | 74.00 | 21.42 |
| | 4 873.90 | V | X | AV | 42.78 | 1.17 | N/A | N/A | 43.95 | 54.00 | 10.05 |
| Highest | 2 484.38 | H | X | PK | 49.07 | 5.26 | N/A | N/A | 54.33 | 74.00 | 19.67 |
| | 2 484.13 | H | X | AV | 38.91 | 5.26 | N/A | N/A | 44.17 | 54.00 | 9.83 |
| | 4 923.49 | V | X | PK | 51.41 | 1.44 | N/A | N/A | 52.85 | 74.00 | 21.15 |
| | 4 924.00 | V | X | AV | 42.30 | 1.45 | N/A | N/A | 43.75 | 54.00 | 10.25 |

**Note.**

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : *TM 2*

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 389.94 | H | X | PK | 52.35 | 4.80 | N/A | N/A | 57.15 | 74.00 | 16.85 |
| | 2 389.72 | H | X | AV | 40.19 | 4.80 | 0.99 | N/A | 45.98 | 54.00 | 8.02 |
| | 4 824.44 | V | X | PK | 49.54 | 0.94 | N/A | N/A | 50.48 | 74.00 | 23.52 |
| | 4 823.60 | V | X | AV | 38.94 | 0.93 | 0.99 | N/A | 40.86 | 54.00 | 13.14 |
| Middle | 4 873.97 | V | X | PK | 49.57 | 1.17 | N/A | N/A | 50.74 | 74.00 | 23.26 |
| | 4 874.34 | V | X | AV | 39.14 | 1.18 | 0.99 | N/A | 41.31 | 54.00 | 12.69 |
| Highest | 2 484.06 | H | X | PK | 54.83 | 5.26 | N/A | N/A | 60.09 | 74.00 | 13.91 |
| | 2 484.10 | H | X | AV | 41.16 | 5.26 | 0.99 | N/A | 47.41 | 54.00 | 6.59 |
| | 4 923.99 | V | X | PK | 49.63 | 1.45 | N/A | N/A | 51.08 | 74.00 | 22.92 |
| | 4 923.77 | V | X | AV | 39.16 | 1.44 | 0.99 | N/A | 41.59 | 54.00 | 12.41 |

**Note.**

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : *TM 3*

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 389.02 | H | X | PK | 50.54 | 4.80 | N/A | N/A | 55.34 | 74.00 | 18.66 |
| | 2 389.33 | H | X | AV | 39.61 | 4.80 | 1.29 | N/A | 45.70 | 54.00 | 8.30 |
| | 4 823.67 | V | X | PK | 49.44 | 0.93 | N/A | N/A | 50.37 | 74.00 | 23.63 |
| | 4 824.30 | V | X | AV | 38.82 | 0.93 | 1.29 | N/A | 41.04 | 54.00 | 12.96 |
| Middle | 4 874.22 | V | X | PK | 49.34 | 1.18 | N/A | N/A | 50.52 | 74.00 | 23.48 |
| | 4 873.66 | V | X | AV | 39.15 | 1.17 | 1.29 | N/A | 41.61 | 54.00 | 12.39 |
| Highest | 2 484.23 | H | X | PK | 50.60 | 5.26 | N/A | N/A | 55.86 | 74.00 | 18.14 |
| | 2 483.61 | H | X | AV | 39.77 | 5.25 | 1.29 | N/A | 46.31 | 54.00 | 7.69 |
| | 4 924.38 | V | X | PK | 50.20 | 1.45 | N/A | N/A | 51.65 | 74.00 | 22.35 |
| | 4 924.00 | V | X | AV | 39.30 | 1.45 | 1.29 | N/A | 42.04 | 54.00 | 11.96 |

**Note.**

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : *TM 4*

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 387.51 | H | X | PK | 55.51 | 4.79 | N/A | N/A | 60.30 | 74.00 | 13.70 |
| | 2 388.43 | H | X | AV | 40.50 | 4.80 | 2.86 | N/A | 48.16 | 54.00 | 5.84 |
| | 4 843.90 | V | X | PK | 49.76 | 1.09 | N/A | N/A | 50.85 | 74.00 | 23.15 |
| | 4 844.33 | V | X | AV | 39.21 | 1.09 | 2.86 | N/A | 43.16 | 54.00 | 10.84 |
| Middle | 4 873.72 | V | X | PK | 49.44 | 1.17 | N/A | N/A | 50.61 | 74.00 | 23.39 |
| | 4 873.66 | V | X | AV | 39.17 | 1.17 | 2.86 | N/A | 43.20 | 54.00 | 10.80 |
| Highest | 2 484.44 | H | X | PK | 55.64 | 5.26 | N/A | N/A | 60.90 | 74.00 | 13.10 |
| | 2 483.86 | H | X | AV | 40.83 | 5.26 | 2.86 | N/A | 48.95 | 54.00 | 5.05 |
| | 4 903.93 | V | X | PK | 49.48 | 1.35 | N/A | N/A | 50.83 | 74.00 | 23.17 |
| | 4 904.37 | V | X | AV | 39.06 | 1.36 | 2.86 | N/A | 43.28 | 54.00 | 10.72 |

**Note.**

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

**- Tested Power Supply: DC 24 V**

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : *TM 1*

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 387.84 | H | X | PK | 49.88 | 4.79 | N/A | N/A | 54.67 | 74.00 | 19.33 |
| | 2 387.51 | H | X | AV | 39.65 | 4.79 | N/A | N/A | 44.44 | 54.00 | 9.56 |
| | 4 823.67 | V | X | PK | 51.30 | 0.93 | N/A | N/A | 52.23 | 74.00 | 21.77 |
| | 4 823.85 | V | X | AV | 43.02 | 0.93 | N/A | N/A | 43.95 | 54.00 | 10.05 |
| Middle | 4 874.21 | V | X | PK | 50.64 | 1.18 | N/A | N/A | 51.82 | 74.00 | 22.18 |
| | 4 874.10 | V | X | AV | 42.76 | 1.18 | N/A | N/A | 43.94 | 54.00 | 10.06 |
| Highest | 2 485.14 | H | X | PK | 49.73 | 5.27 | N/A | N/A | 55.00 | 74.00 | 19.00 |
| | 2 484.35 | H | X | AV | 39.33 | 5.26 | N/A | N/A | 44.59 | 54.00 | 9.41 |
| | 4 924.10 | V | X | PK | 50.62 | 1.45 | N/A | N/A | 52.07 | 74.00 | 21.93 |
| | 4 923.88 | V | X | AV | 41.99 | 1.45 | N/A | N/A | 43.44 | 54.00 | 10.56 |

**Note.**

4. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
5. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
6. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : ***TM 2***

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 388.42 | H | X | PK | 54.07 | 4.80 | N/A | N/A | 58.87 | 74.00 | 15.13 |
| | 2 389.64 | H | X | AV | 40.77 | 4.80 | 0.99 | N/A | 46.56 | 54.00 | 7.44 |
| | 4 824.24 | V | X | PK | 49.68 | 0.93 | N/A | N/A | 50.61 | 74.00 | 23.39 |
| | 4 824.17 | V | X | AV | 39.51 | 0.93 | 0.99 | N/A | 41.43 | 54.00 | 12.57 |
| Middle | 4 873.87 | V | X | PK | 49.84 | 1.17 | N/A | N/A | 51.01 | 74.00 | 22.99 |
| | 4 874.27 | V | X | AV | 39.68 | 1.18 | 0.99 | N/A | 41.85 | 54.00 | 12.15 |
| Highest | 2 483.65 | H | X | PK | 57.62 | 5.25 | N/A | N/A | 62.87 | 74.00 | 11.13 |
| | 2 483.72 | H | X | AV | 41.34 | 5.25 | 0.99 | N/A | 47.58 | 54.00 | 6.42 |
| | 4 923.57 | V | X | PK | 50.29 | 1.44 | N/A | N/A | 51.73 | 74.00 | 22.27 |
| | 4 923.74 | V | X | AV | 39.35 | 1.44 | 0.99 | N/A | 41.78 | 54.00 | 12.22 |

**Note.**

4. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
5. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
6. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : ***TM 3***

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 388.89 | H | X | PK | 50.47 | 4.80 | N/A | N/A | 55.27 | 74.00 | 18.73 |
| | 2 389.40 | H | X | AV | 39.96 | 4.80 | 1.29 | N/A | 46.05 | 54.00 | 7.95 |
| | 4 823.96 | V | X | PK | 49.45 | 0.93 | N/A | N/A | 50.38 | 74.00 | 23.62 |
| | 4 823.74 | V | X | AV | 39.37 | 0.93 | 1.29 | N/A | 41.59 | 54.00 | 12.41 |
| Middle | 4 873.66 | V | X | PK | 49.66 | 1.17 | N/A | N/A | 50.83 | 74.00 | 23.17 |
| | 4 873.89 | V | X | AV | 39.28 | 1.17 | 1.29 | N/A | 41.74 | 54.00 | 12.26 |
| Highest | 2 484.17 | H | X | PK | 51.70 | 5.26 | N/A | N/A | 56.96 | 74.00 | 17.04 |
| | 2 483.89 | H | X | AV | 40.83 | 5.26 | 1.29 | N/A | 47.38 | 54.00 | 6.62 |
| | 4 923.99 | V | X | PK | 51.07 | 1.45 | N/A | N/A | 52.52 | 74.00 | 21.48 |
| | 4 923.78 | V | X | AV | 39.39 | 1.44 | 1.29 | N/A | 42.12 | 54.00 | 11.88 |

**Note.**

4. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
5. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
6. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## Radiated Spurious Emissions data(9 kHz ~ 25 GHz) : ***TM 4***

| Tested Frequency | Frequency (MHz) | ANT Pol | EUT Position (Axis) | Detector Mode | Reading (dBuV) | T.F (dB/m) | DCCF (dB) | DCF (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 2 387.84 | H | X | PK | 56.29 | 4.79 | N/A | N/A | 61.08 | 74.00 | 12.92 |
| | 2 388.92 | H | X | AV | 41.54 | 4.80 | 2.86 | N/A | 49.20 | 54.00 | 4.80 |
| | 4 843.81 | V | X | PK | 49.89 | 1.09 | N/A | N/A | 50.98 | 74.00 | 23.02 |
| | 4 843.95 | V | X | AV | 39.17 | 1.09 | 2.86 | N/A | 43.12 | 54.00 | 10.88 |
| Middle | 4 873.61 | V | X | PK | 49.42 | 1.17 | N/A | N/A | 50.59 | 74.00 | 23.41 |
| | 4 874.00 | V | X | AV | 39.11 | 1.17 | 2.86 | N/A | 43.14 | 54.00 | 10.86 |
| Highest | 2 483.81 | H | X | PK | 55.52 | 5.26 | N/A | N/A | 60.78 | 74.00 | 13.22 |
| | 2 484.31 | H | X | AV | 40.71 | 5.26 | 2.86 | N/A | 48.83 | 54.00 | 5.17 |
| | 4 924.05 | V | X | PK | 49.48 | 1.45 | N/A | N/A | 50.93 | 74.00 | 23.07 |
| | 4 923.64 | V | X | AV | 39.28 | 1.44 | 2.86 | N/A | 43.58 | 54.00 | 10.42 |

**Note.**

1. The radiated emissions were investigated up to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCCF + DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCCF = Duty Cycle Correction Factor, DCF = Distance Correction Factor
3. Information of Distance Factor.
   For finding emissions, the test distance might be reduced from 3m to 1m. In this case, the distance factor(-9.54dB) is applied to the result.
   - Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

## 8.6 Power-line conducted emissions

### ▣ Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15 ~ 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### ▣ Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to the test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

### ▣ Test Results: NA

## 8.7 Occupied Bandwidth

**Test Requirements, RSS-Gen [6.7]**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.

### ▣ TEST CONFIGURATION

Refer to the APPENDIX I.

### ▣ TEST PROCEDURE

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

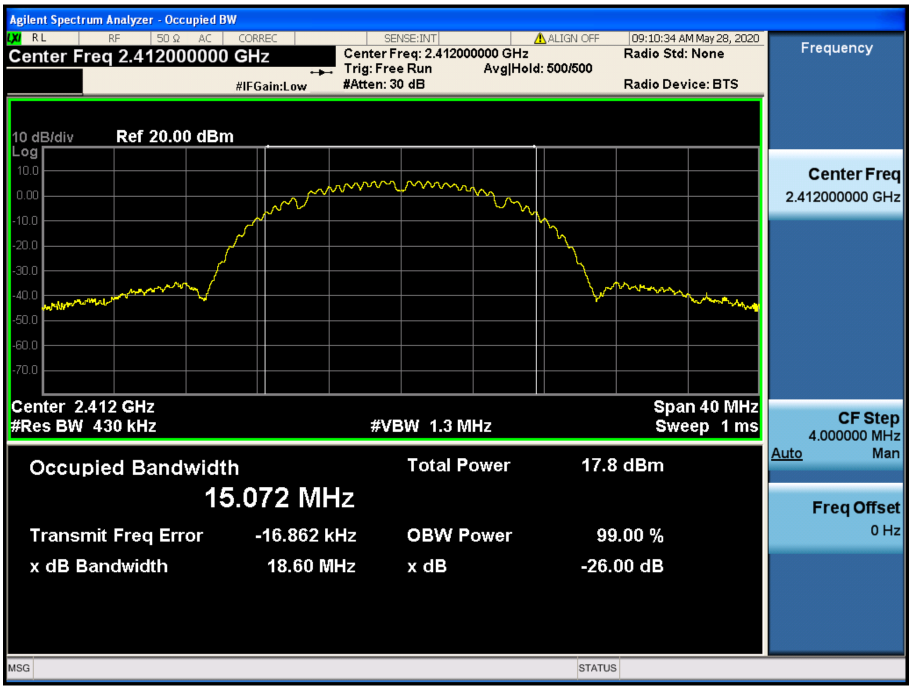
### ▣ TEST RESULTS: Comply

| Test Mode | Frequency | Test Results [MHz] | |
|---|---|---|---|
| | | DC 12 V | DC 24 V |
| TM 1 | Lowest | 15.07 | 15.08 |
| | Middle | 15.11 | 15.11 |
| | Highest | 15.10 | 15.09 |
| TM 2 | Lowest | 16.98 | 17.01 |
| | Middle | 16.97 | 17.06 |
| | Highest | 17.02 | 17.01 |
| TM 3 | Lowest | 17.89 | 17.88 |
| | Middle | 17.86 | 17.90 |
| | Highest | 17.90 | 17.87 |
| TM 4 | Lowest | 36.36 | 36.38 |
| | Middle | 36.35 | 36.37 |
| | Highest | 36.32 | 36.31 |

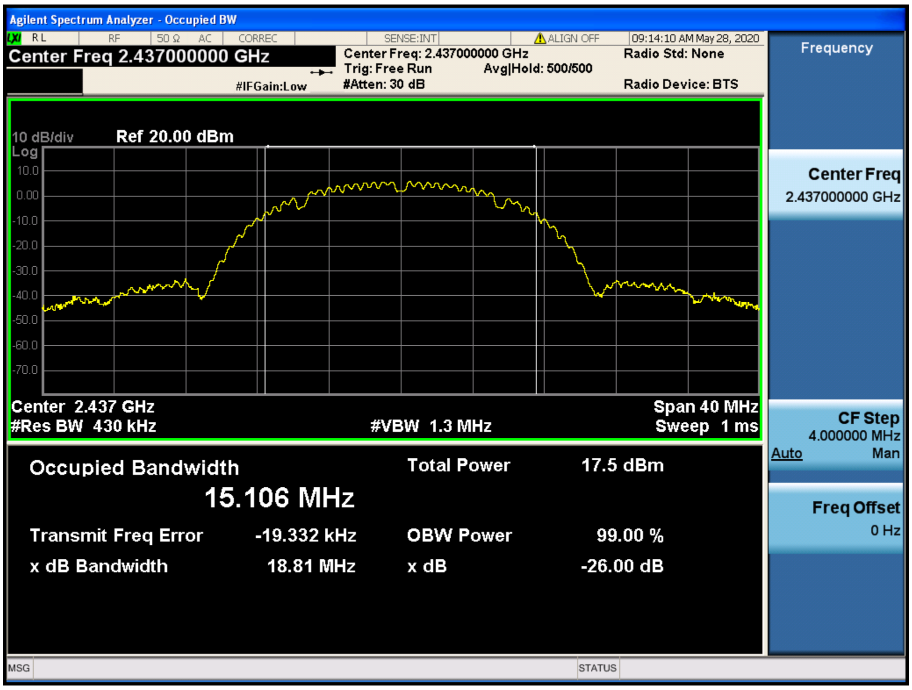
## ▣ RESULT PLOTS

## - Tested Power Supply: DC 12 V

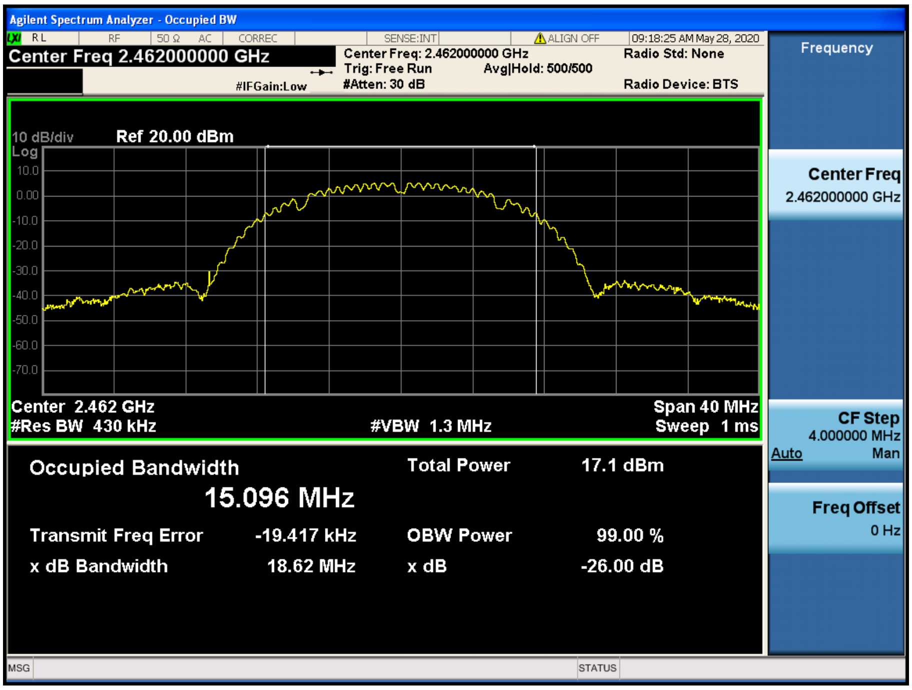
**Occupied Bandwidth** Test Mode: TM 1 & 2412 MHz



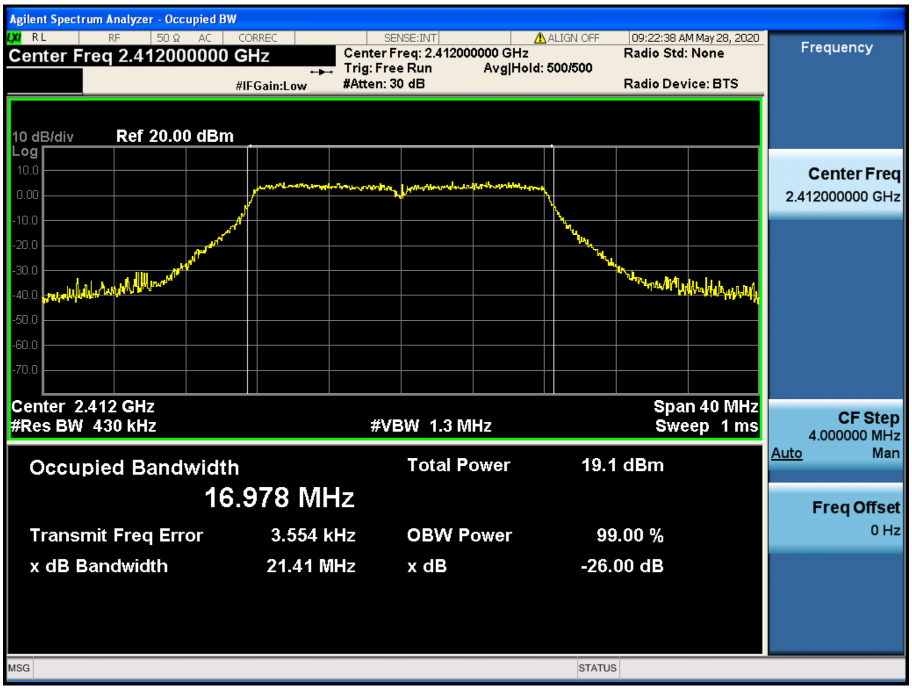

**Occupied Bandwidth** Test Mode: TM 1 & 2437 MHz



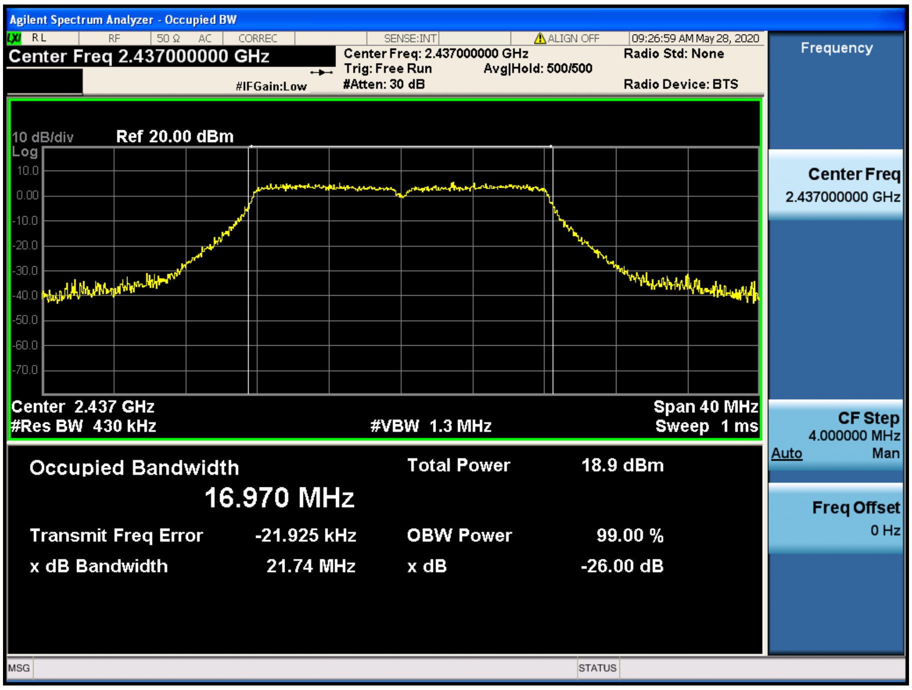
**Occupied Bandwidth** Test Mode: TM 1 & 2462 MHz



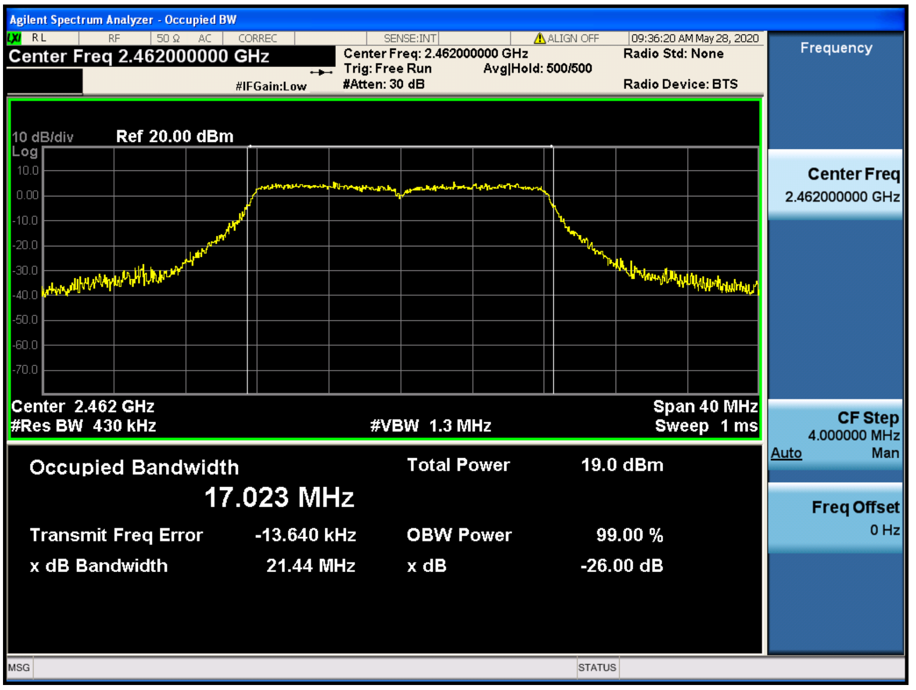
**Occupied Bandwidth** Test Mode: TM 2 & 2412 MHz



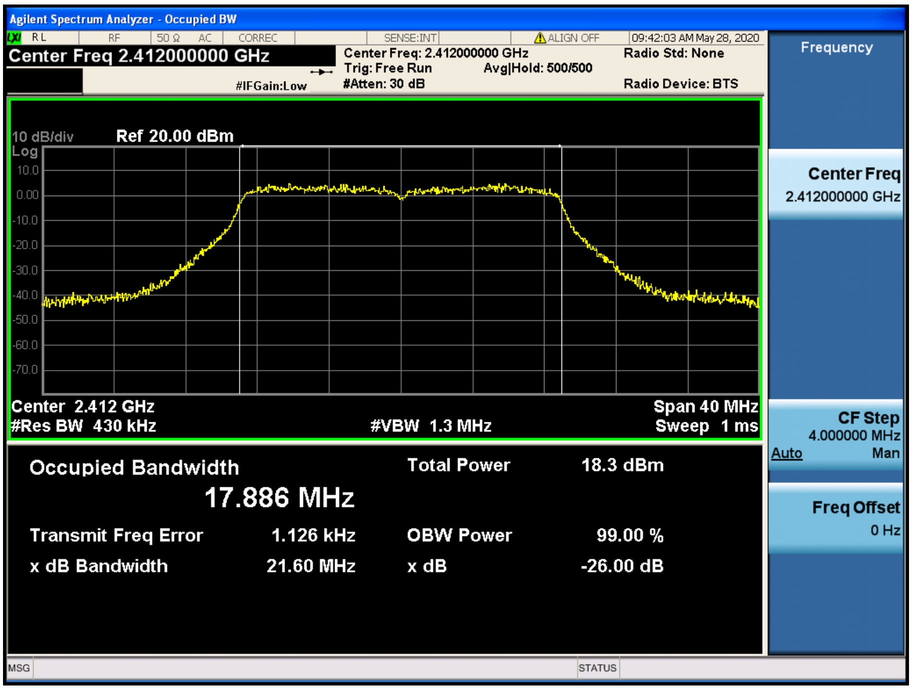

**Occupied Bandwidth** Test Mode: TM 2 & 2437 MHz



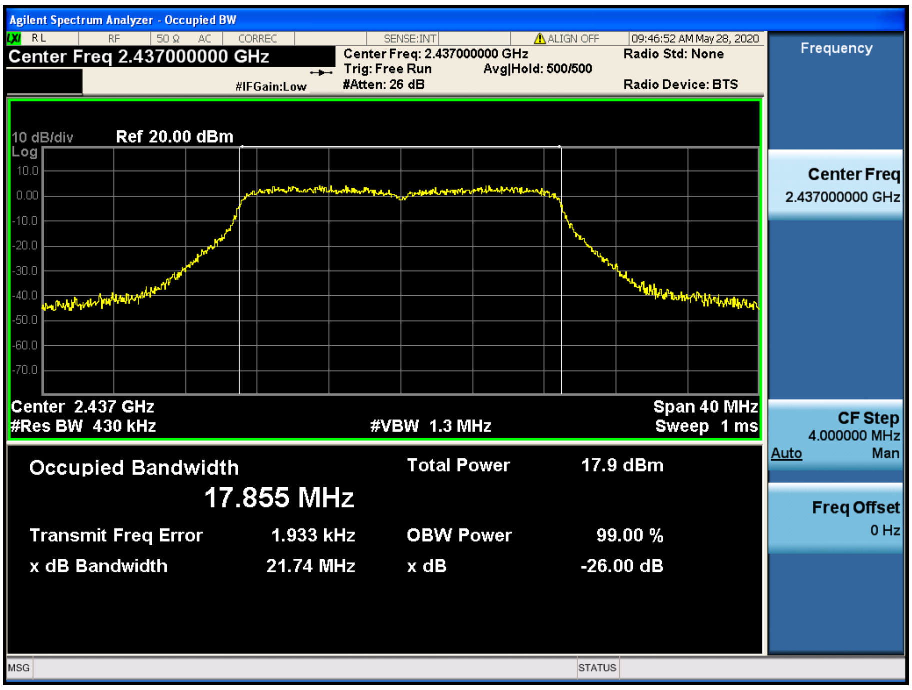
**Occupied Bandwidth** Test Mode: TM 2 & & 2462 MHz



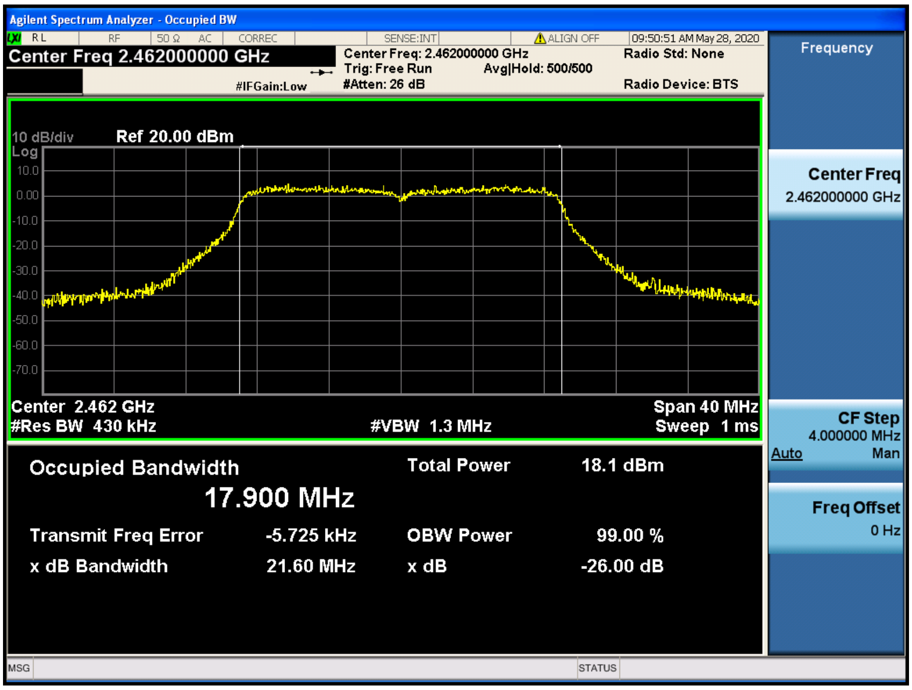
**Occupied Bandwidth** Test Mode: TM 3 & 2412 MHz



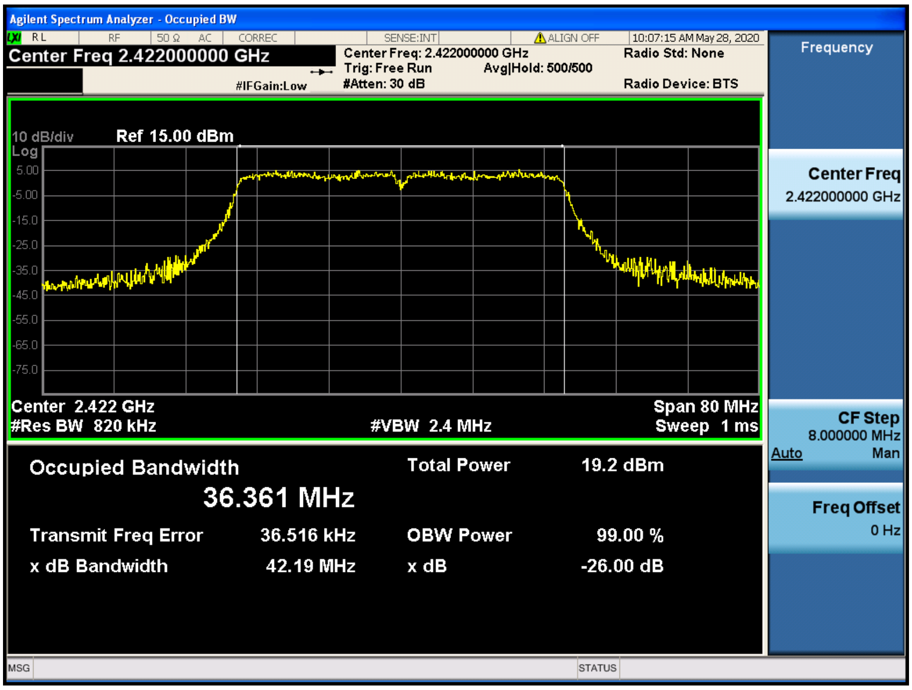

**Occupied Bandwidth** Test Mode: TM 3 & 2437 MHz



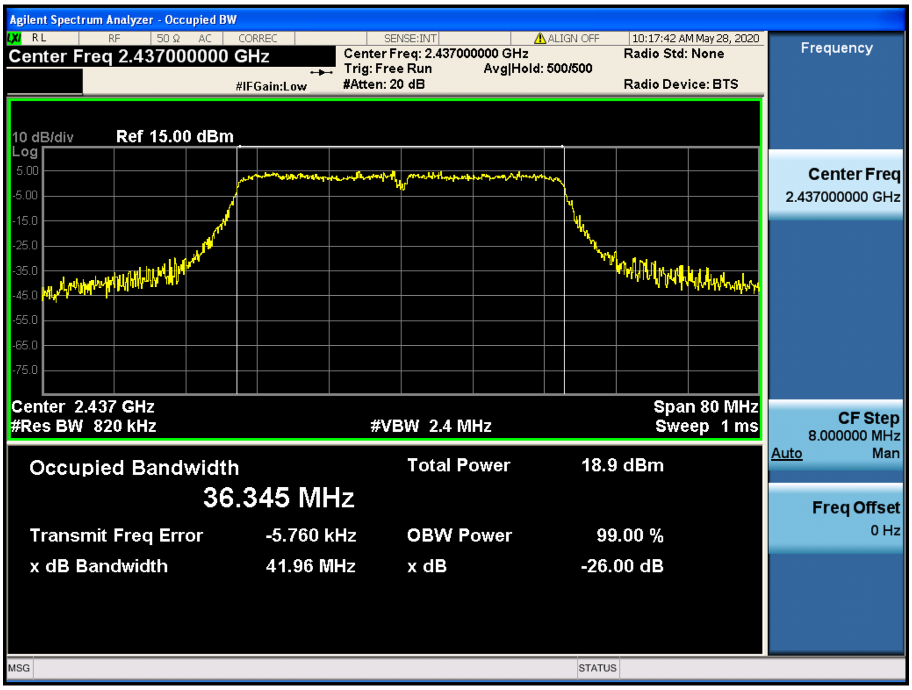
**Occupied Bandwidth** Test Mode: TM 3 & 2462 MHz



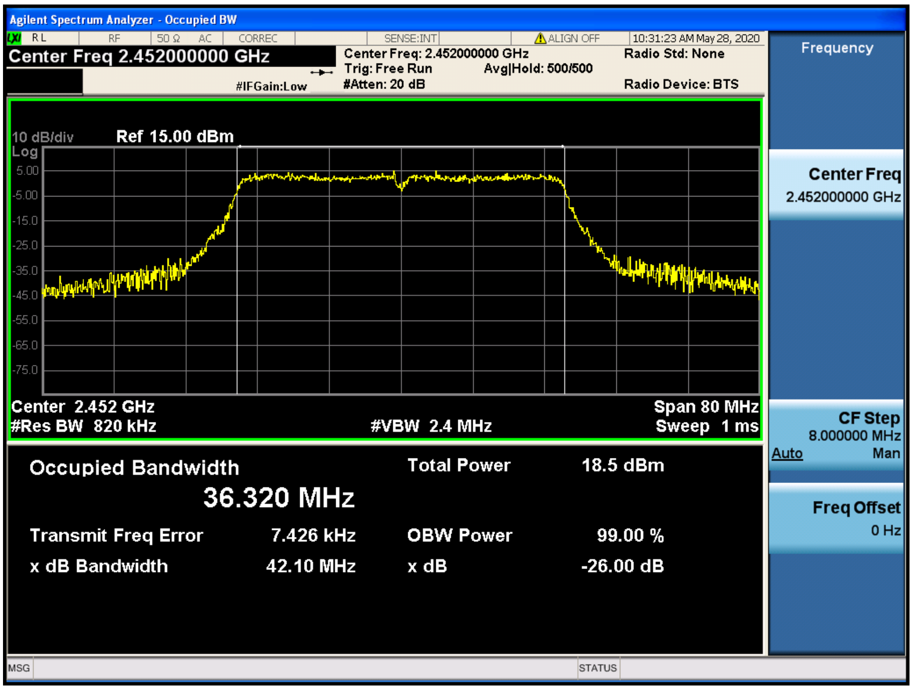
**Occupied Bandwidth** Test Mode: TM 4 & 2422 MHz




**Occupied Bandwidth** Test Mode: TM 4 & 2437 MHz

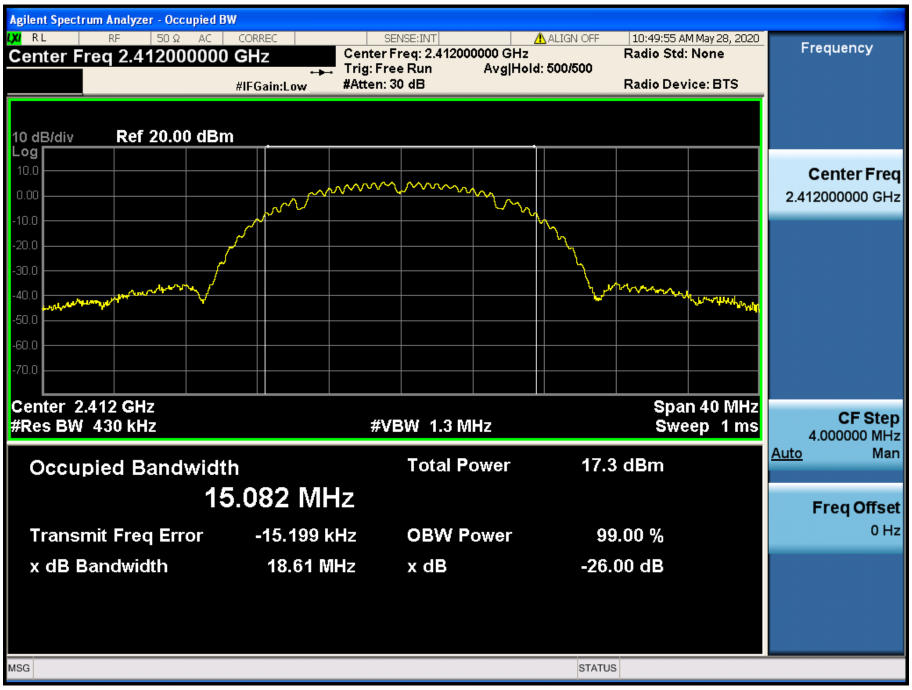


**Occupied Bandwidth** Test Mode: TM 4 & 2452 MHz

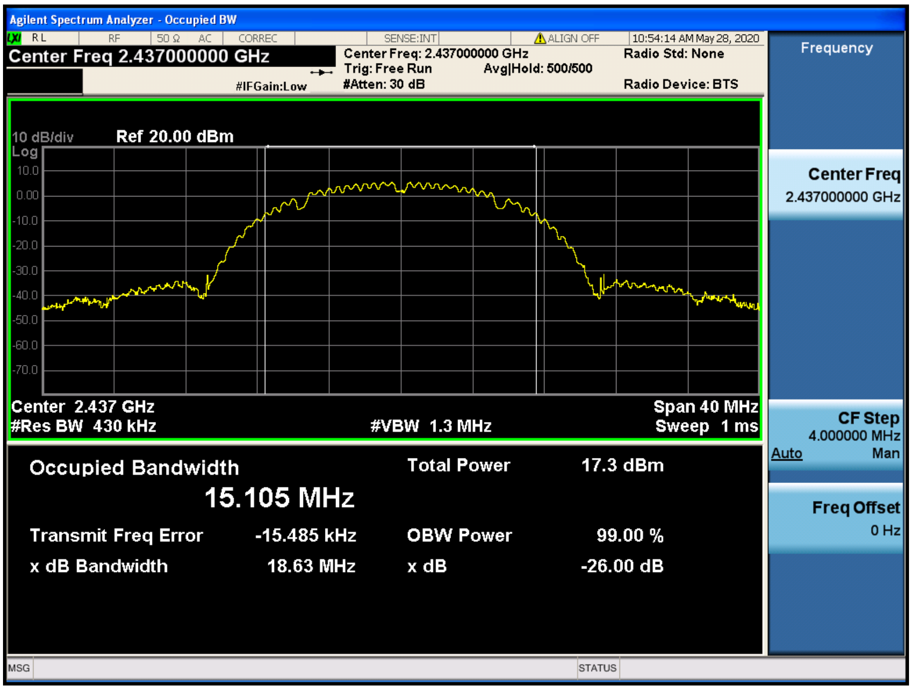


## - Tested Power Supply: DC 24 V

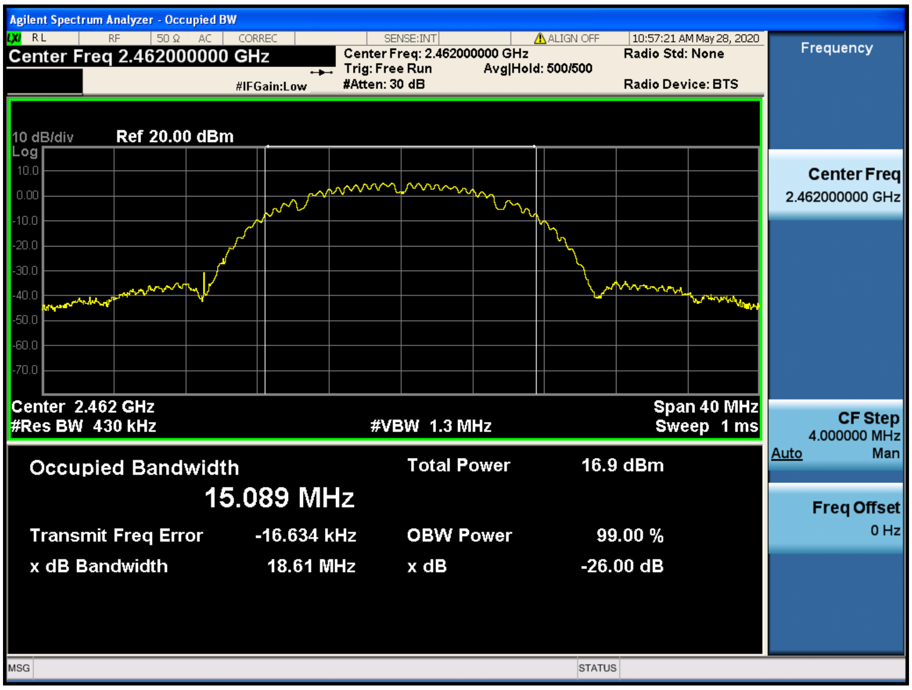
**Occupied Bandwidth** Test Mode: TM 1 & 2412 MHz



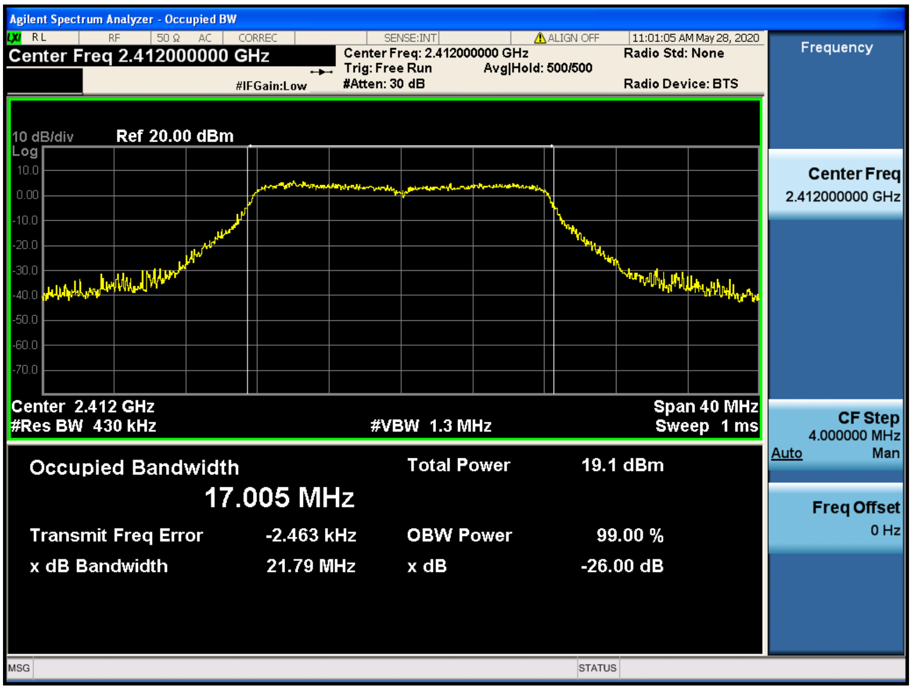

**Occupied Bandwidth** Test Mode: TM 1 & 2437 MHz



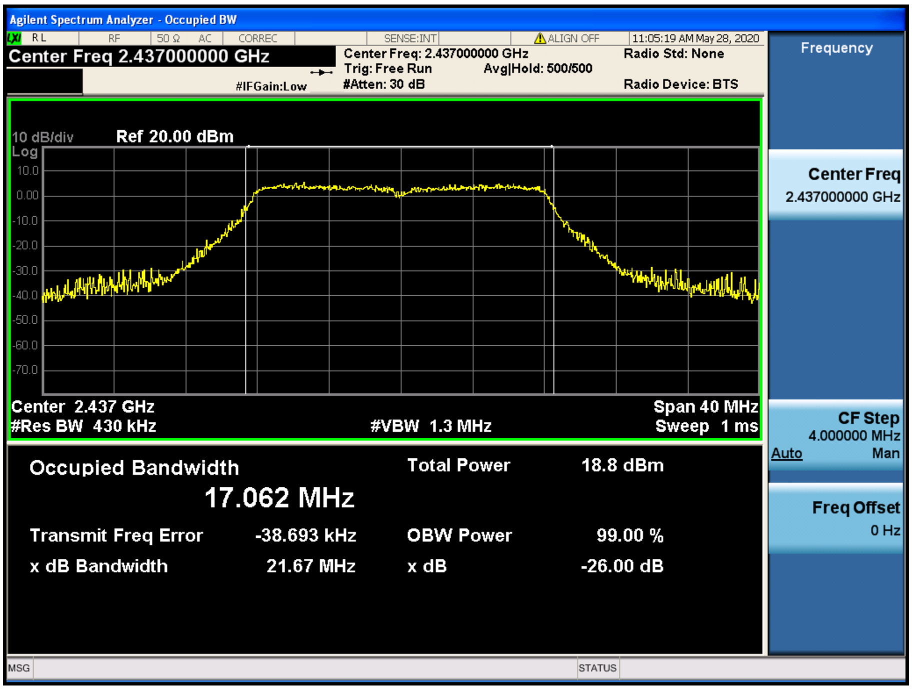
**Occupied Bandwidth** Test Mode: TM 1 & 2462 MHz



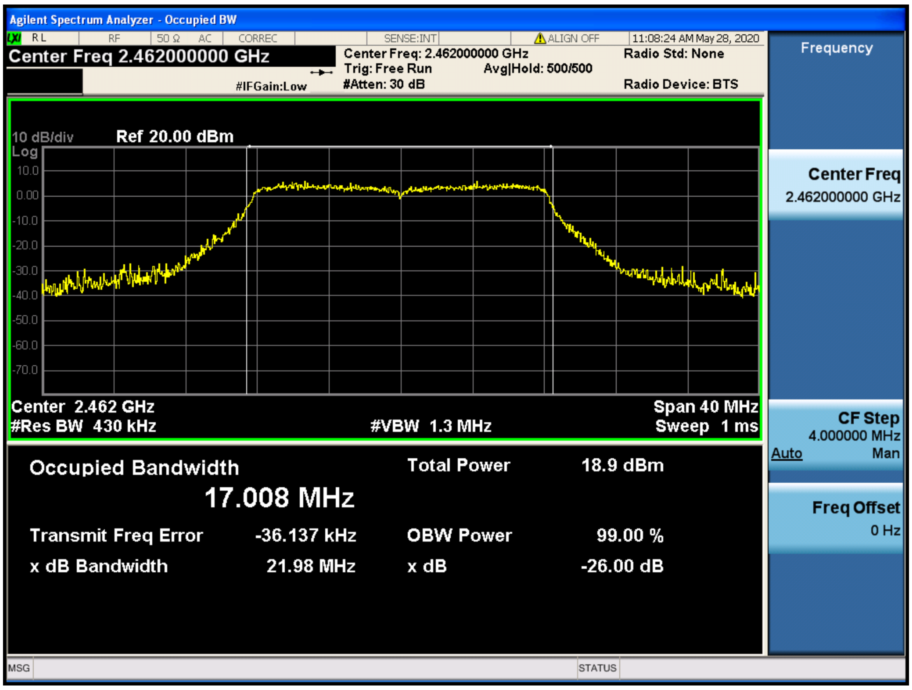
**Occupied Bandwidth** Test Mode: TM 2 & 2412 MHz



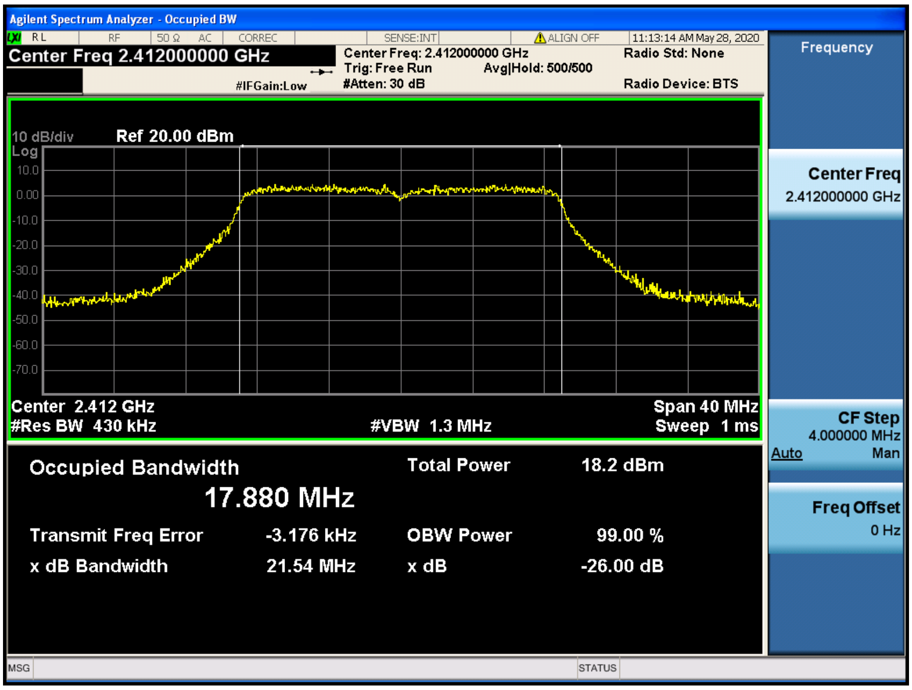

**Occupied Bandwidth** Test Mode: TM 2 & 2437 MHz



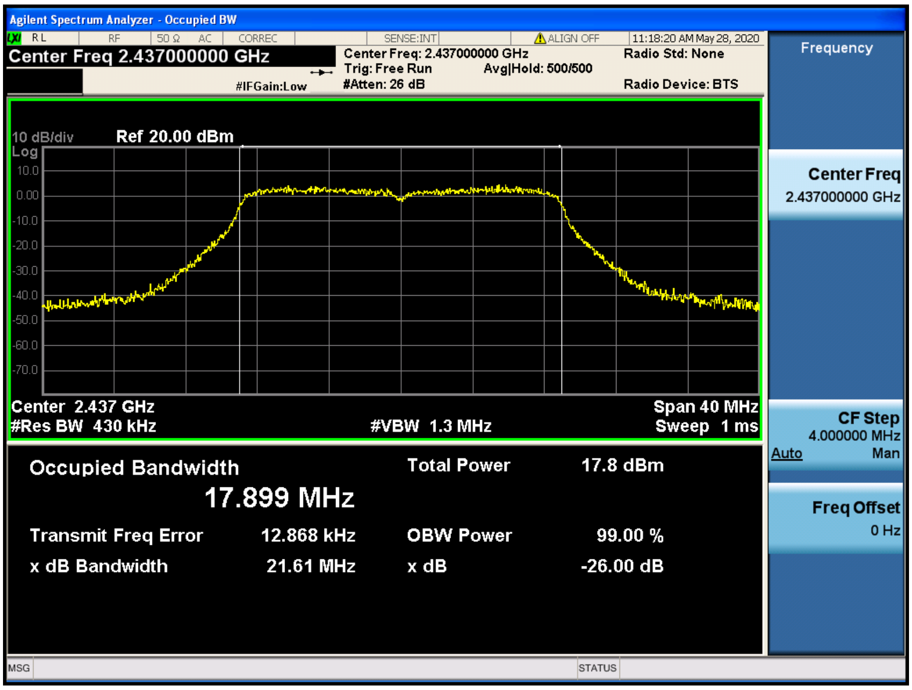
**Occupied Bandwidth** Test Mode: TM 2 & & 2462 MHz



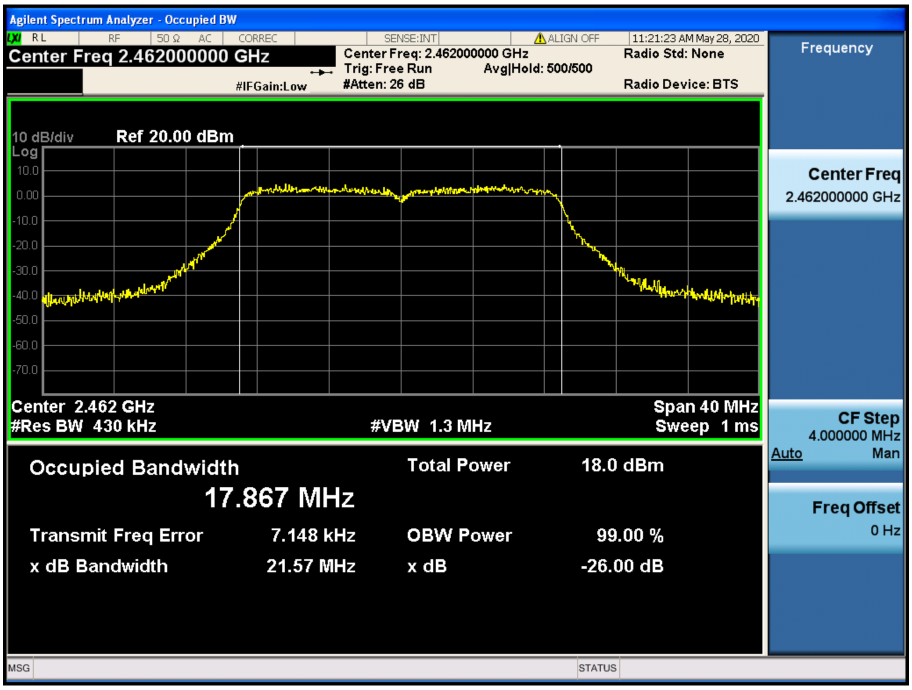
**Occupied Bandwidth** Test Mode: TM 3 & 2412 MHz



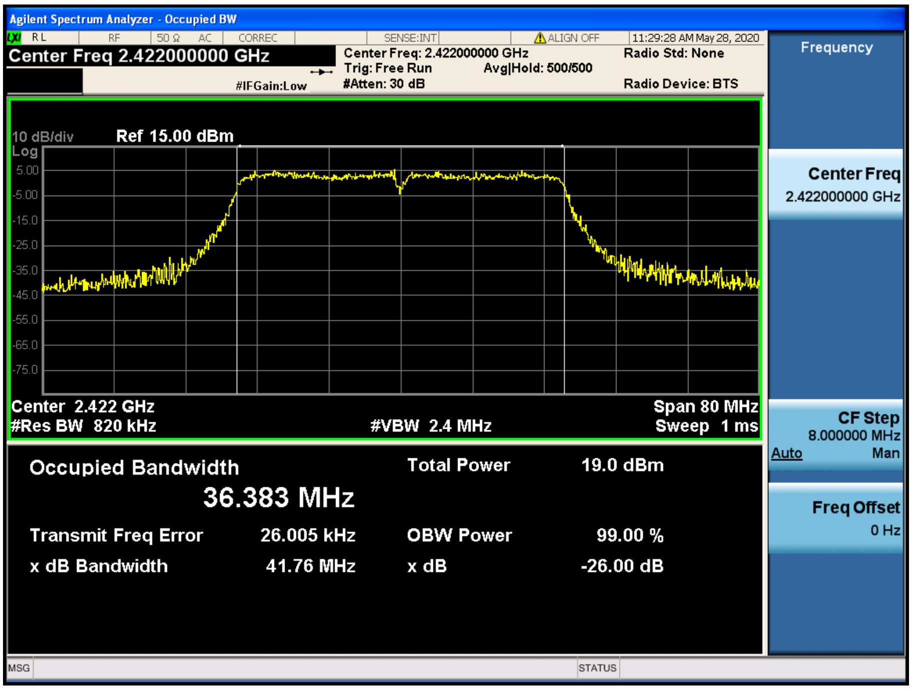

**Occupied Bandwidth** Test Mode: TM 3 & 2437 MHz



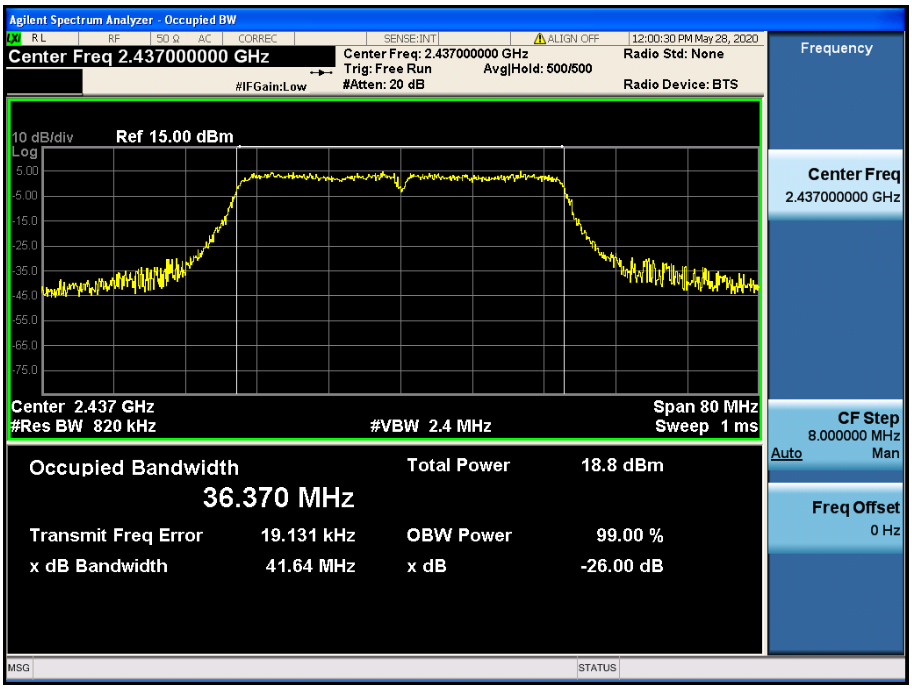
**Occupied Bandwidth** Test Mode: TM 3 & 2462 MHz



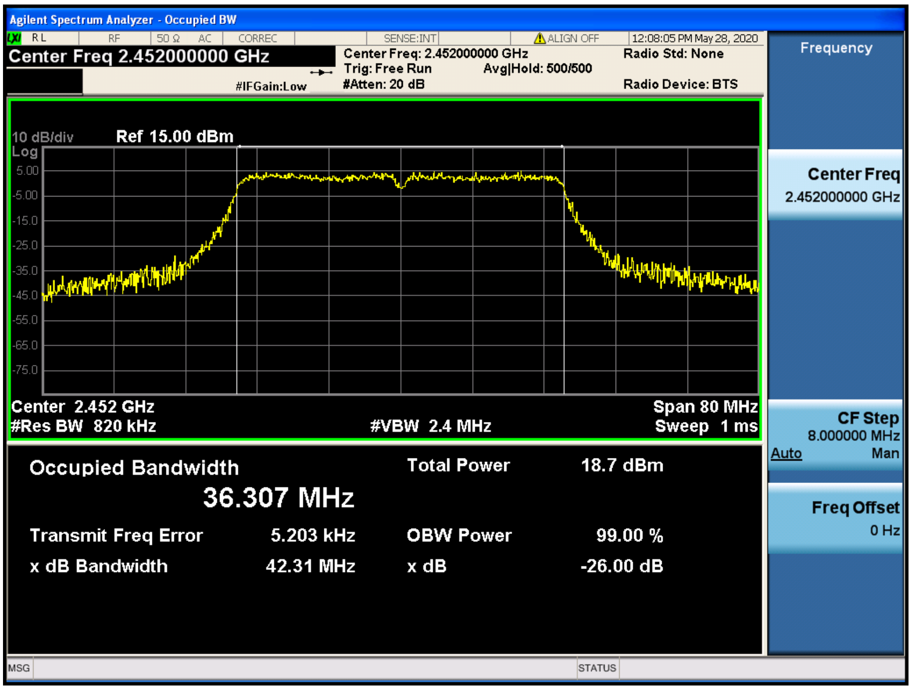
**Occupied Bandwidth** Test Mode: TM 4 & 2422 MHz




**Occupied Bandwidth** Test Mode: TM 4 & 2437 MHz



**Occupied Bandwidth** Test Mode: TM 4 & 2452 MHz



# 9. LIST OF TEST EQUIPMENT

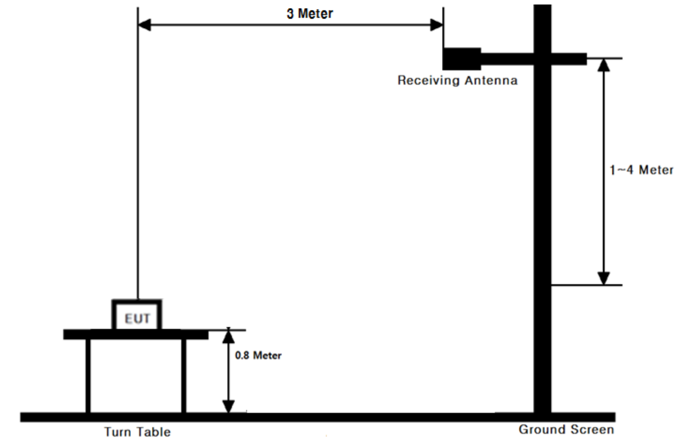
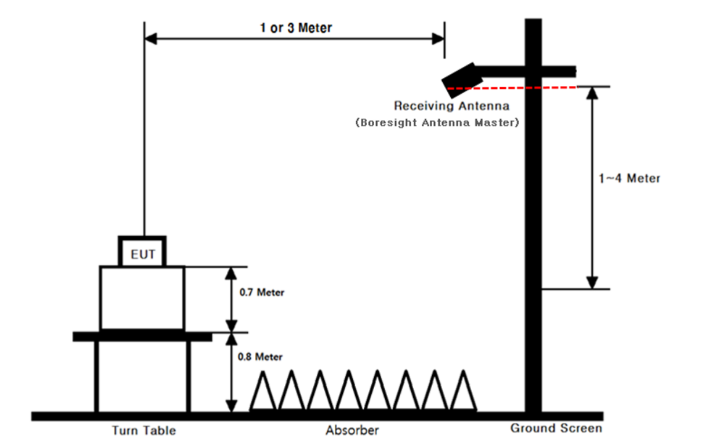
| Type | Manufacturer | Model | Cal.Date (yy/mm/dd) | Next.Cal.Date (yy/mm/dd) | S/N |
|---|---|---|---|---|---|
| Spectrum Analyzer | Agilent Technologies | N9020A | 20/02/26 | 21/02/26 | MY46471251 |
| Spectrum Analyzer | Agilent Technologies | N9020A | 19/12/16 | 20/12/16 | MY48011700 |
| Spectrum Analyzer | Agilent Technologies | N9020A | 19/12/16 | 20/12/16 | MY48010133 |
| DC Power Supply | Agilent Technologies | 66332A | 19/12/16 | 20/12/16 | US37476998 |
| DC Power Supply | SM techno | SDP30-5D | 19/06/24 | 20/06/24 | 305DMG305 |
| DC Power Supply | Agilent Technologies | 6654A | 19/06/27 | 20/06/27 | MY40002935 |
| Multimeter | FLUKE | 17B | 19/12/16 | 20/12/16 | 26030065WS |
| Signal Generator | Rohde Schwarz | SMBV100A | 19/12/16 | 20/12/16 | 255571 |
| Signal Generator | ANRITSU | MG3695C | 19/12/16 | 20/12/16 | 173501 |
| Thermohygrometer | BODYCOM | BJ5478 | 19/12/18 | 20/12/18 | 120612-1 |
| Thermohygrometer | BODYCOM | BJ5478 | 19/12/18 | 20/12/18 | 120612-2 |
| Thermohygrometer | BODYCOM | BJ5478 | 19/06/25 | 20/06/25 | N/A |
| Loop Antenna | Schwarzbeck | FMZB1513 | 20/02/19 | 22/02/19 | 1513-128 |
| BILOG ANTENNA | Schwarzbeck | VULB 9160 | 19/04/23 | 21/04/23 | 9160-3362 |
| Horn Antenna | ETS-Lindgren | 3115 | 20/01/30 | 22/01/30 | 6419 |
| Horn Antenna | A.H.Systems Inc. | SAS-574 | 19/07/03 | 21/07/03 | 155 |
| PreAmplifier | tsj | MLA-0118-B01-40 | 19/12/16 | 20/12/16 | 1852267 |
| PreAmplifier | tsj | MLA-1840-J02-45 | 19/06/27 | 20/06/27 | 16966-10728 |
| PreAmplifier | H.P | 8447D | 19/12/16 | 20/12/16 | 2944A07774 |
| High Pass Filter | Wainwright Instruments | WHKX12-935-1000-15000-40SS | 19/06/26 | 20/06/26 | 8 |
| High Pass Filter | Wainwright Instruments | WHKX10-2838-3300-18000-60SS | 19/06/26 | 20/06/26 | 1 |
| High Pass Filter | Wainwright Instruments | WHNX8.0/26.5-6SS | 19/06/27 | 20/06/27 | 3 |
| Attenuator | Hefei Shunze | SS5T2.92-10-40 | 19/06/27 | 20/06/27 | 16012202 |
| Attenuator | SRTechnology | F01-B0606-01 | 19/06/27 | 20/06/27 | 13092403 |
| Attenuator | Aeroflex/Weinschel | 56-3 | 19/06/27 | 20/06/27 | Y2370 |
| Attenuator | SMAJK | SMAJK-2-3 | 19/06/27 | 20/06/27 | 2 |
| Attenuator | SMAJK | SMAJK-50-10 | 19/06/25 | 20/06/25 | 15081903 |
| Power Meter & Wide Bandwidth Sensor | Anritsu | ML2496A MA2411B | 19/12/16 | 20/12/16 | 1338004 1306053 |
| EMI Receiver | ROHDE&SCHWARZ | ESW44 | 19/07/30 | 20/07/30 | 101645 |
| Cable | Junkosha | MWX241 | 20/01/13 | 21/01/13 | G-04 |
| Cable | Junkosha | MWX241 | 20/01/13 | 21/01/13 | G-07 |
| Cable | DT&C | Cable | 20/01/13 | 21/01/13 | G-13 |
| Cable | DT&C | Cable | 20/01/13 | 21/01/13 | G-14 |
| Cable | HUBER+SUHNER | SUCOFLEX 104 | 20/01/13 | 21/01/13 | G-15 |
| Cable | Radiall | TESTPRO3 | 20/01/16 | 21/01/16 | M-01 |
| Cable | Junkosha | MWX315 | 20/01/16 | 21/01/16 | M-05 |
| Cable | Junkosha | MWX221 | 20/01/16 | 21/01/16 | M-06 |
| Cable | Radiall | TESTPRO3 | 20/01/16 | 21/01/16 | RF-92 |
| Test Software | tsj | Radiated Emission Measurement | N/A | N/A | Version 2.00.0177 |

Note 1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017
Note 2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

# APPENDIX I

## Test set up diagrams

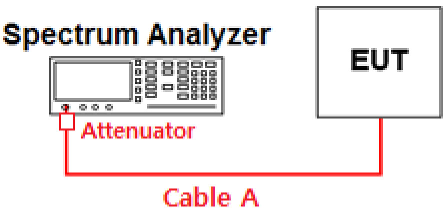
### ▪ Radiated Measurement

| Below 1GHz | Above 1GHz |
| --- | --- |
|  |  |





### ▪ Conducted Measurement




**Path loss information**

| Frequency (GHz) | Path Loss (dB) | Frequency (GHz) | Path Loss (dB) |
| --- | --- | --- | --- |
| 0.03 | 9.63 | 15 | 11.10 |
| 1 | 9.91 | 20 | 12.53 |
| 2.412 & 2.437 & 2.462 | 10.56 | 25 | 13.01 |
| 5 | 10.72 | - | - |
| 10 | 10.82 | - | - |

Note 1: The path loss from EUT to Spectrum analyzer was measured and used for test.
Path loss (S/A's correction factor) = Cable A + Attenuator

# APPENDIX II

## Duty cycle plots

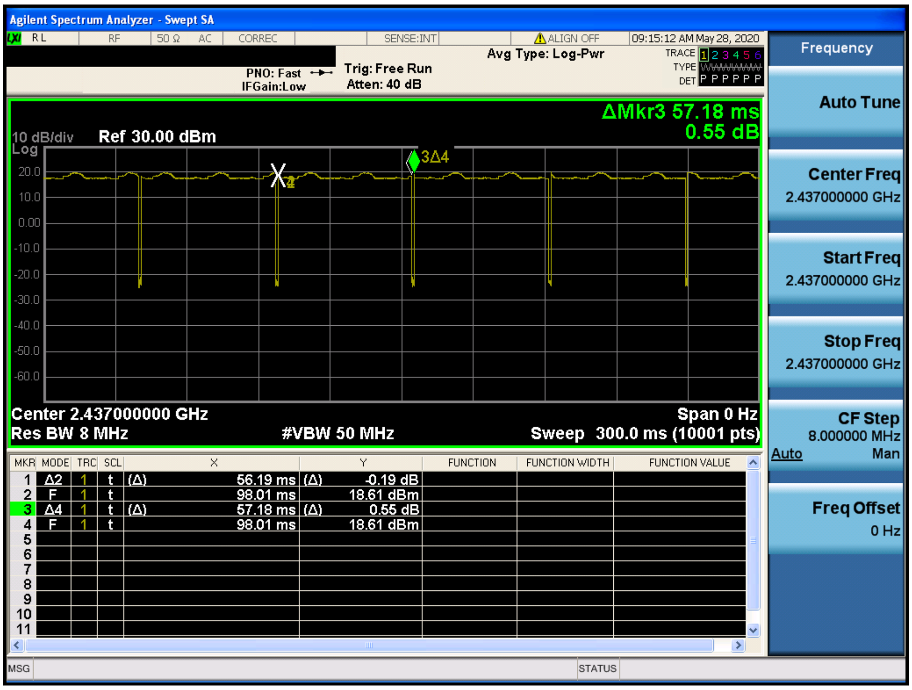
### ▪ Test Procedure

**Duty Cycle** was measured using **section 6.0 b) of KDB558074 D01V05R02 :**

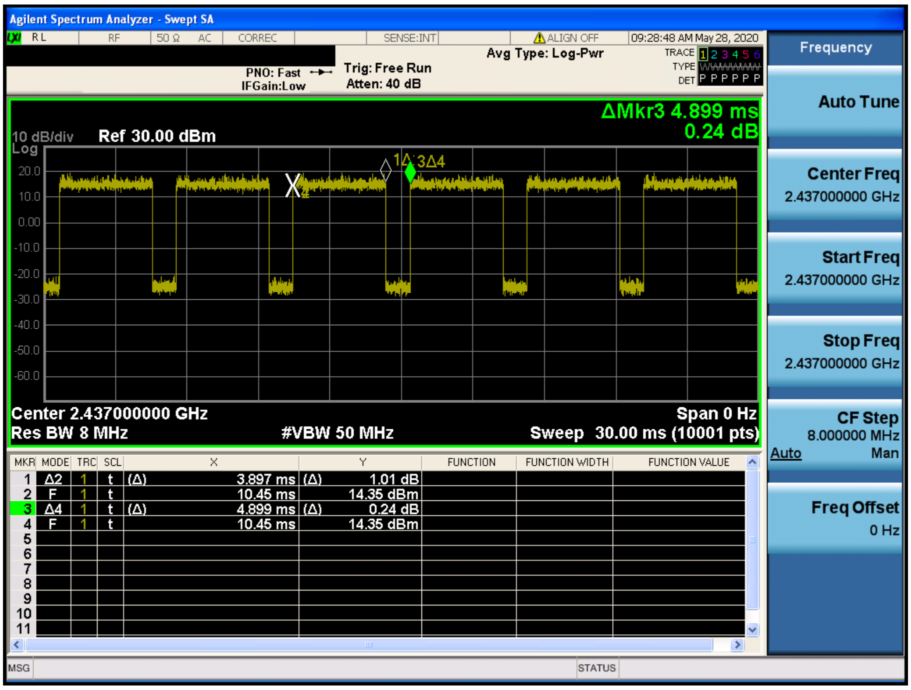
The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

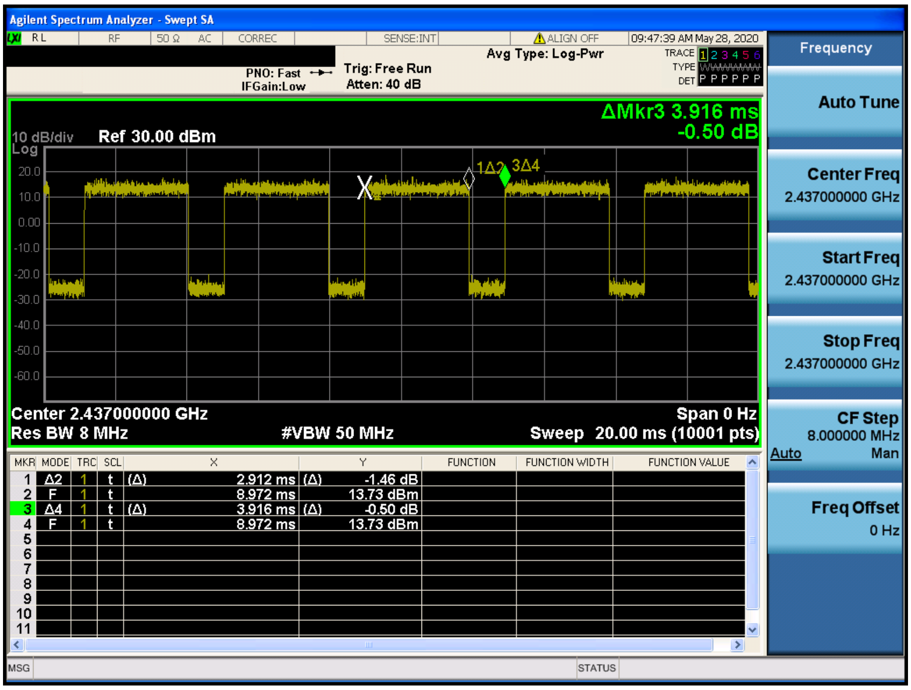
**Duty Cycle** TM 1 & Middle



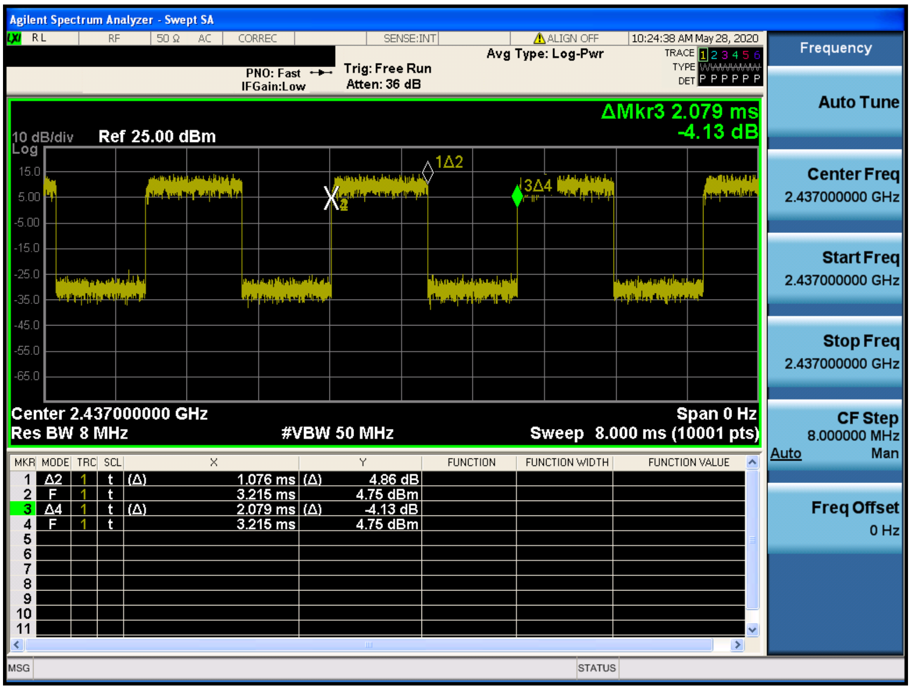
**Duty Cycle** TM 2 & Middle




**Duty Cycle** TM 3 & Middle



**Duty Cycle** TM 4 & Middle

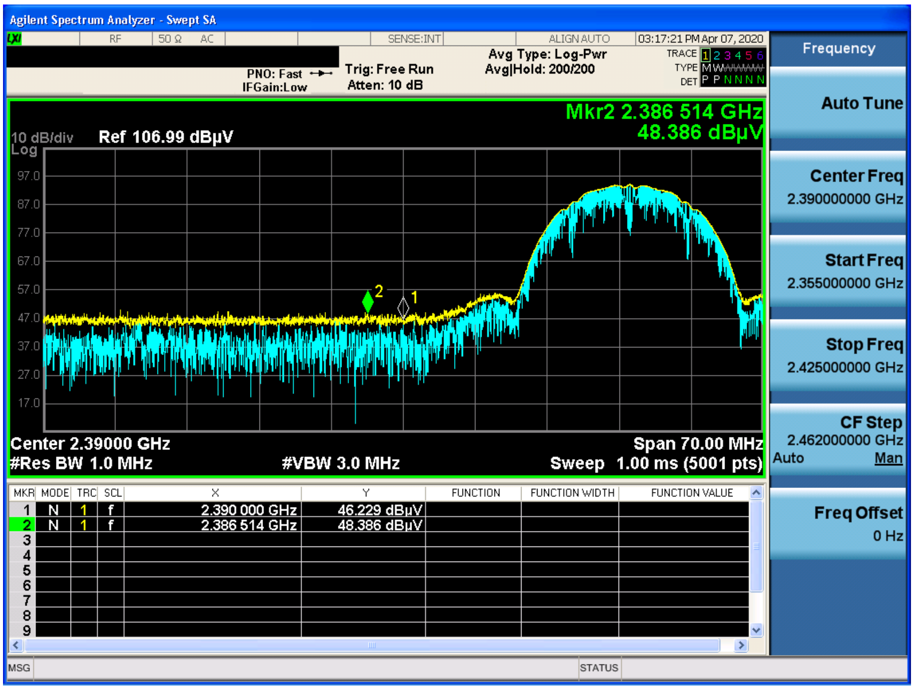


# APPENDIX III

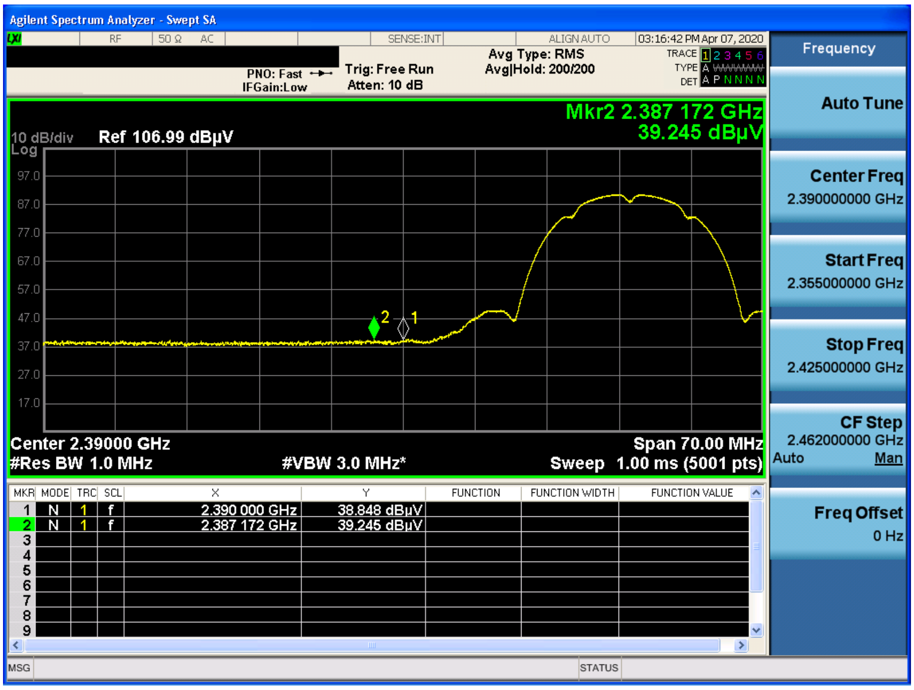
## Unwanted Emissions (Radiated) Test Plot

### - Tested Power Supply: DC 12 V

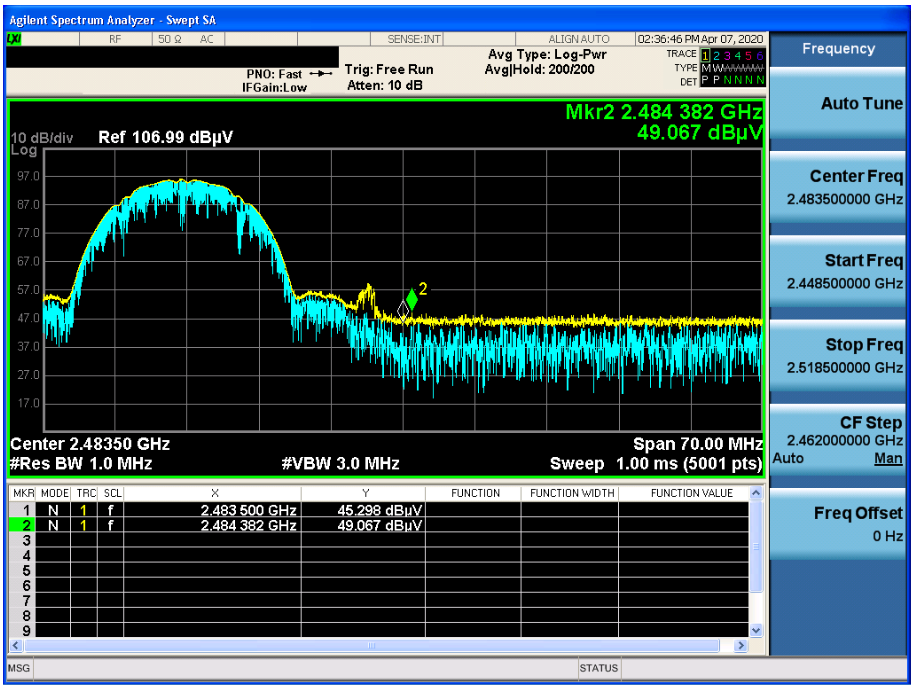
**TM 1 & Lowest & X axis & Hor** **Detector Mode : PK**




**TM 1 & Lowest & X axis & Hor** **Detector Mode : AV**

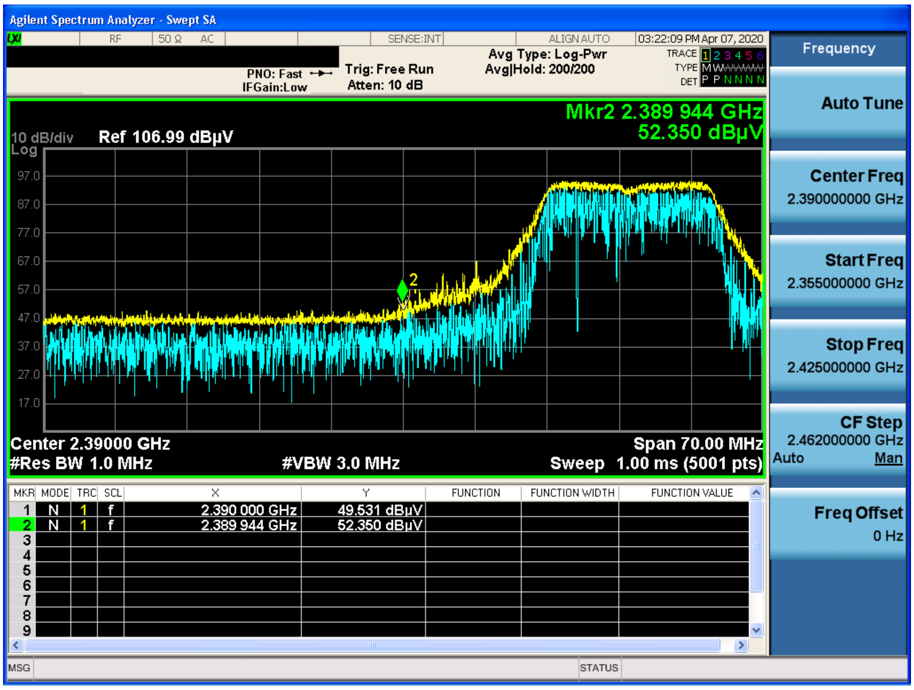


**TM 1 & Highest & X axis & Hor** **Detector Mode : PK**

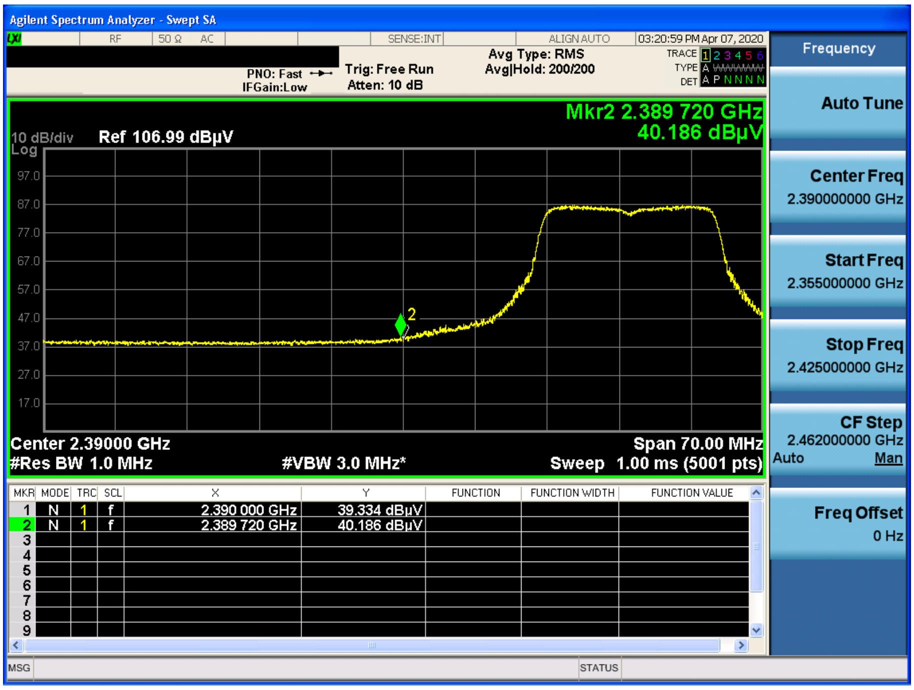



**TM 1 & Highest & X axis & Hor** **Detector Mode : AV**

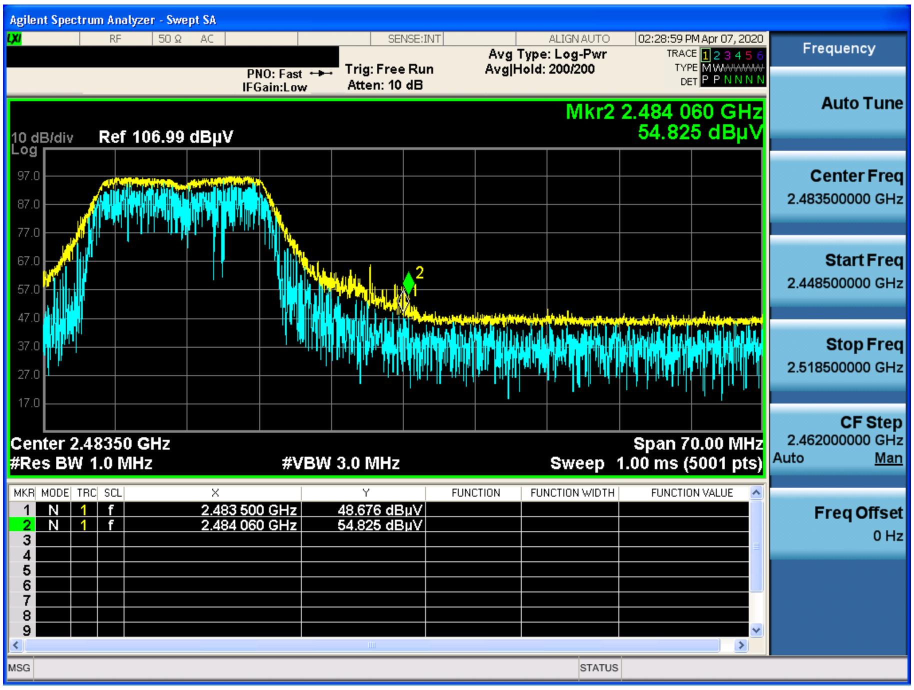
**TM 2 & Lowest & X axis & Hor** **Detector Mode : PK**



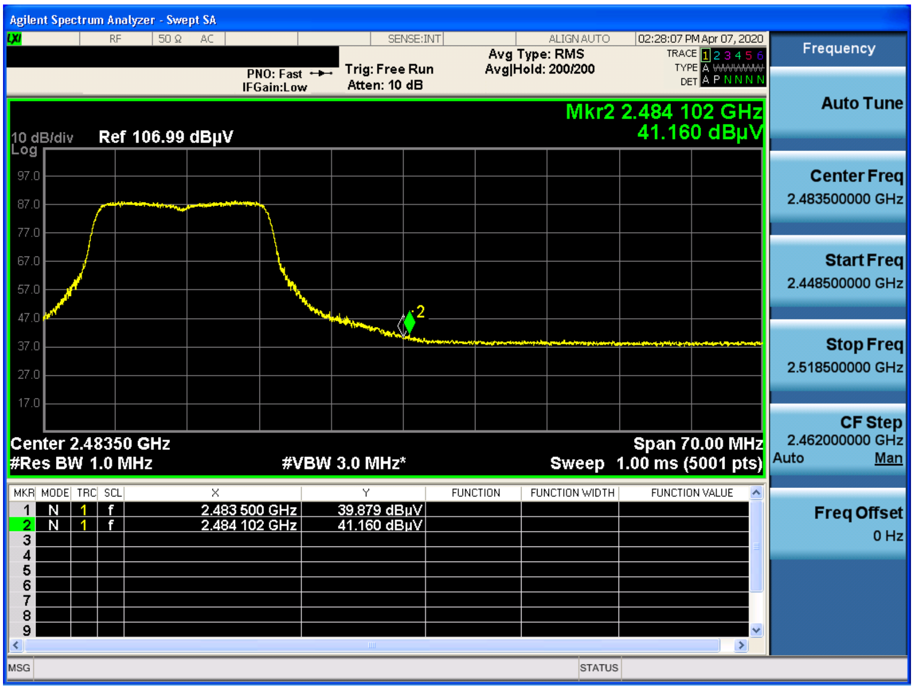

**TM 2 & Lowest & X axis & Hor** **Detector Mode : AV**



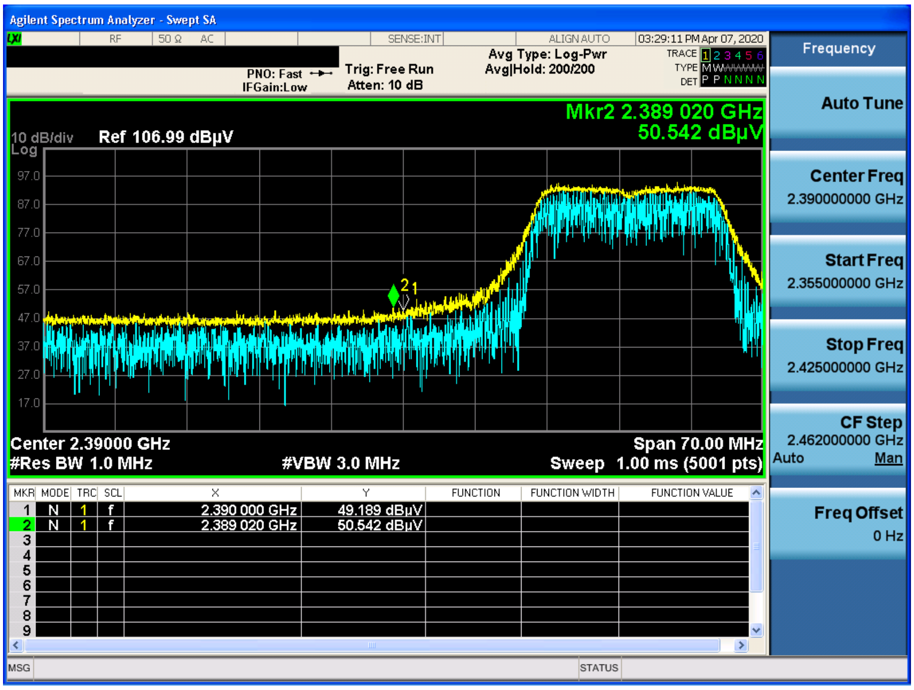
**TM 2 & Highest & X axis & Hor** **Detector Mode : PK**



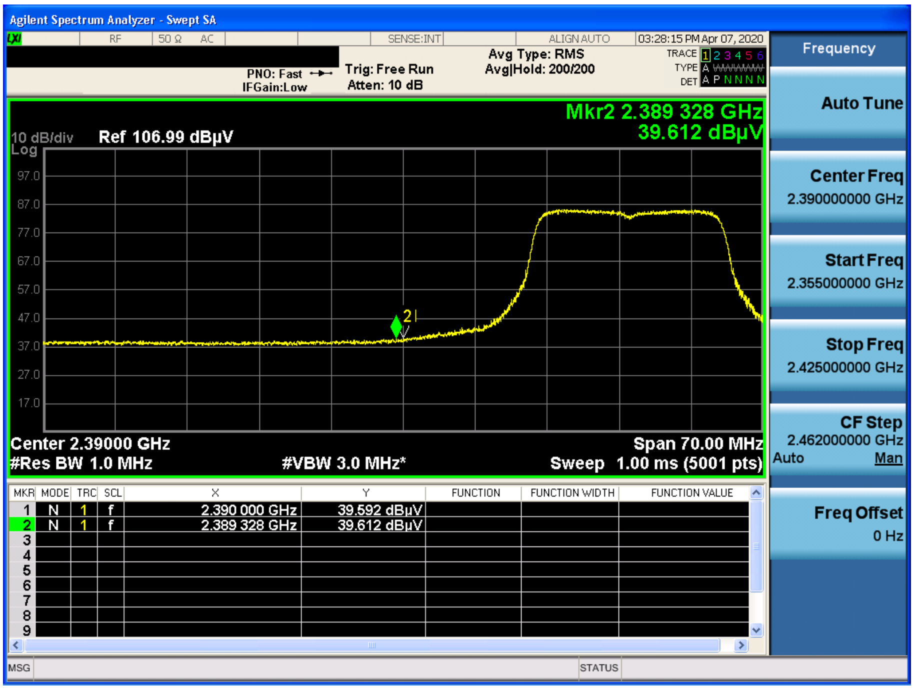

**TM 2 & Highest & X axis & Hor** **Detector Mode : AV**



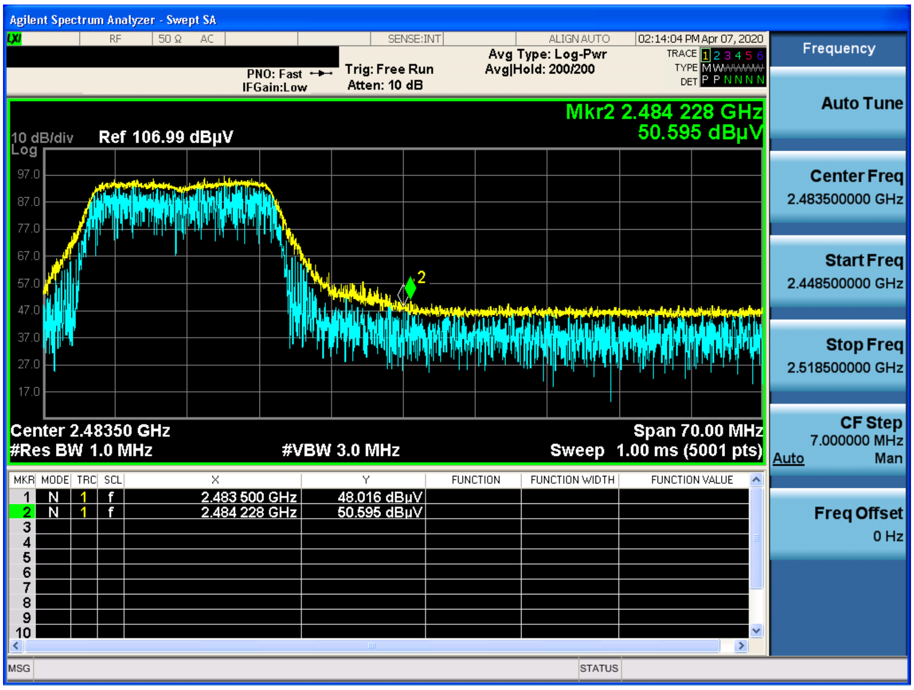
**TM 3 & Lowest & X axis & Hor** **Detector Mode : PK**



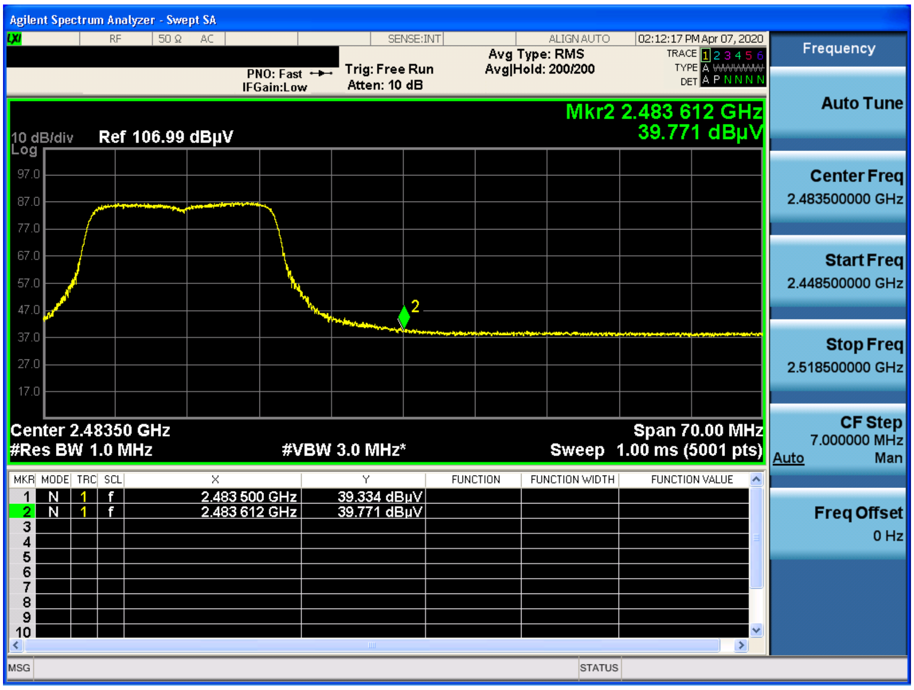

**TM 3 & Lowest & X axis & Hor** **Detector Mode : AV**



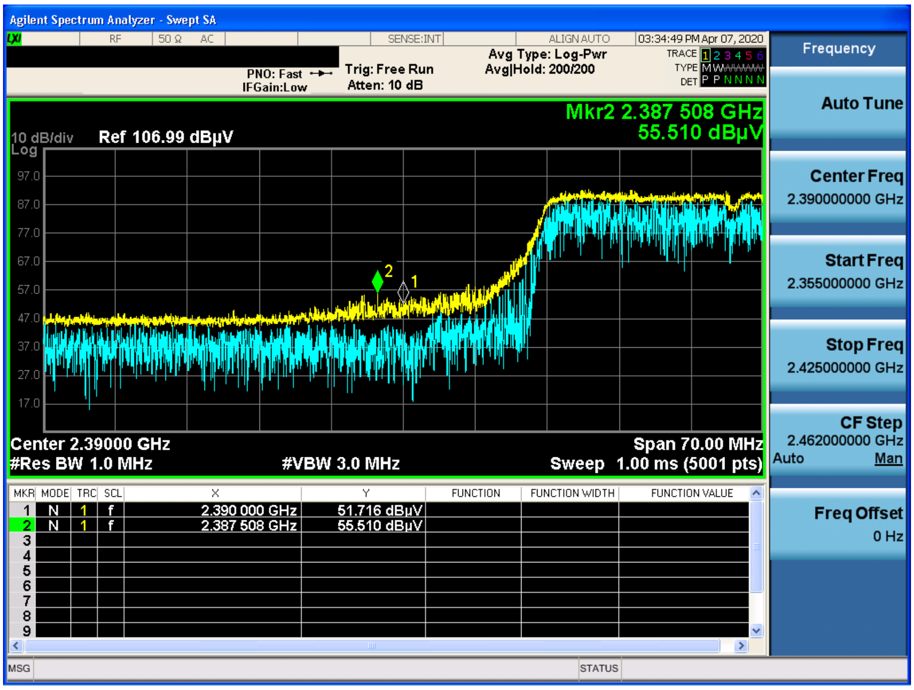
**TM 3 & Highest & X axis & Hor** **Detector Mode : PK**



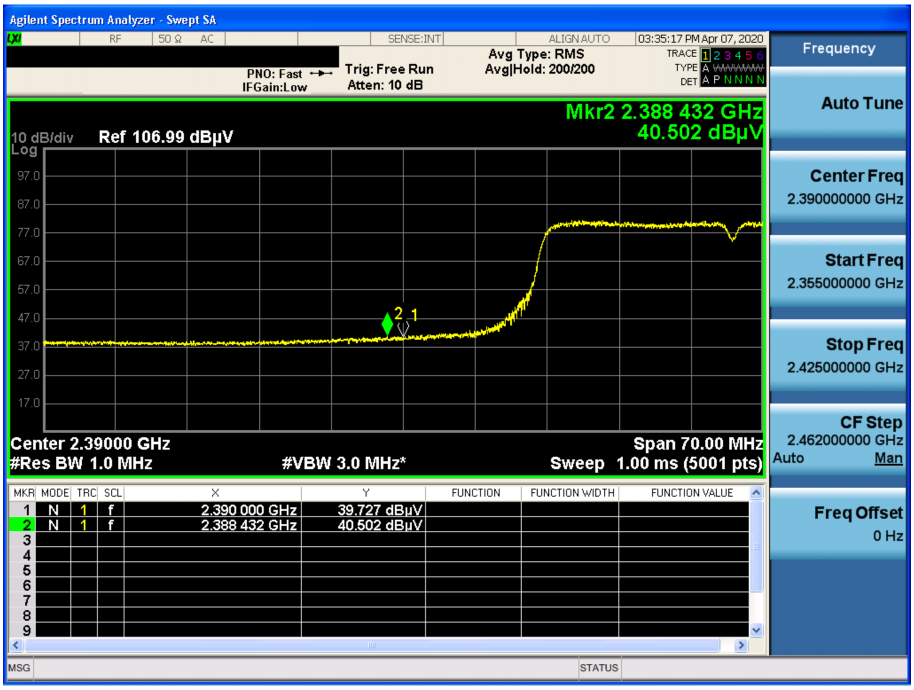

**TM 3 & Highest & X axis & Hor** **Detector Mode : AV**



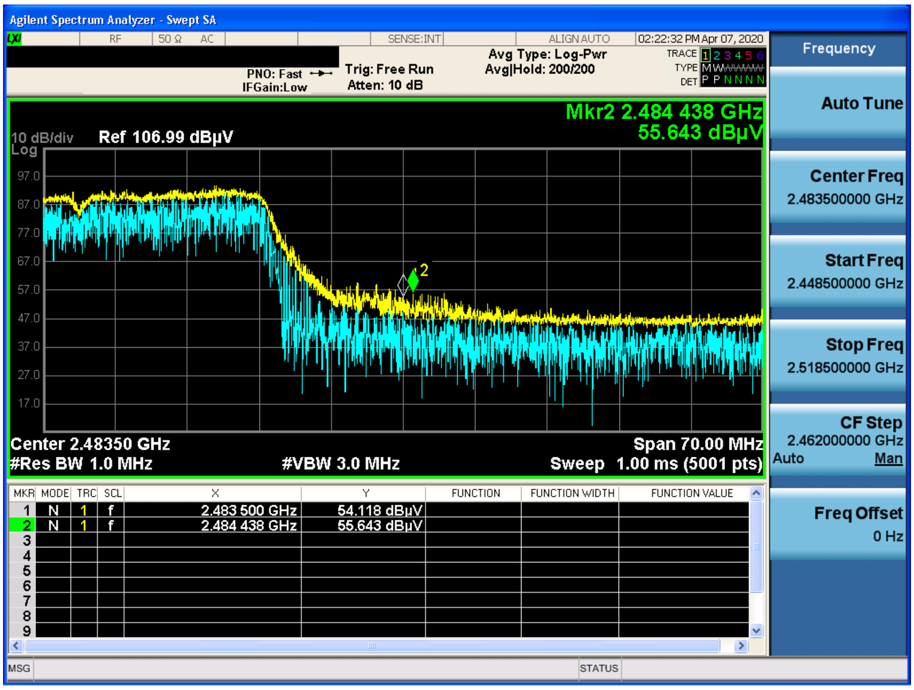
**TM 4 & Lowest & X axis & Hor** **Detector Mode : PK**



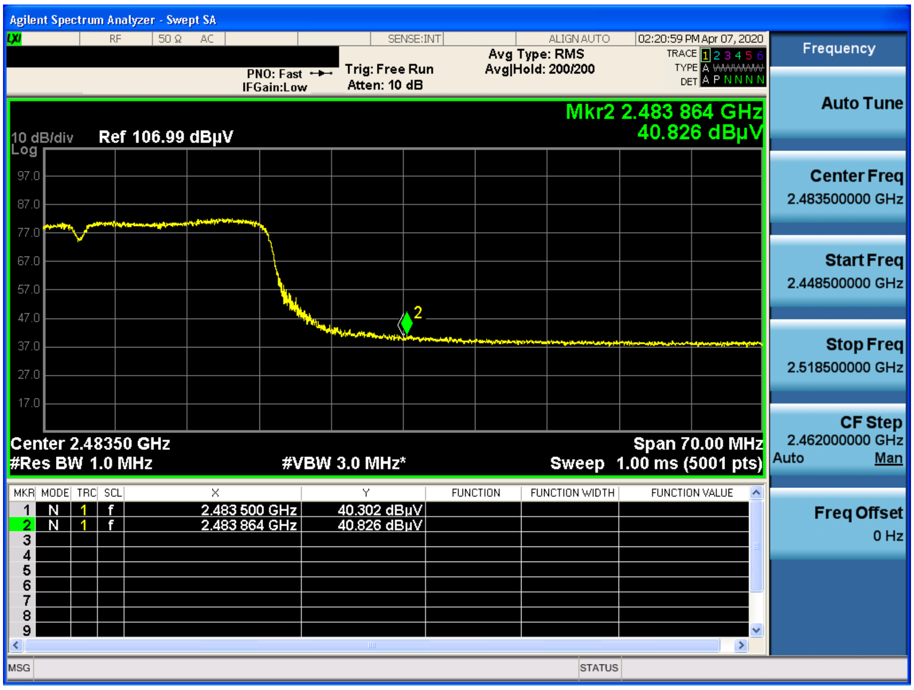

**TM 4 & Lowest & X axis & Hor** **Detector Mode : AV**



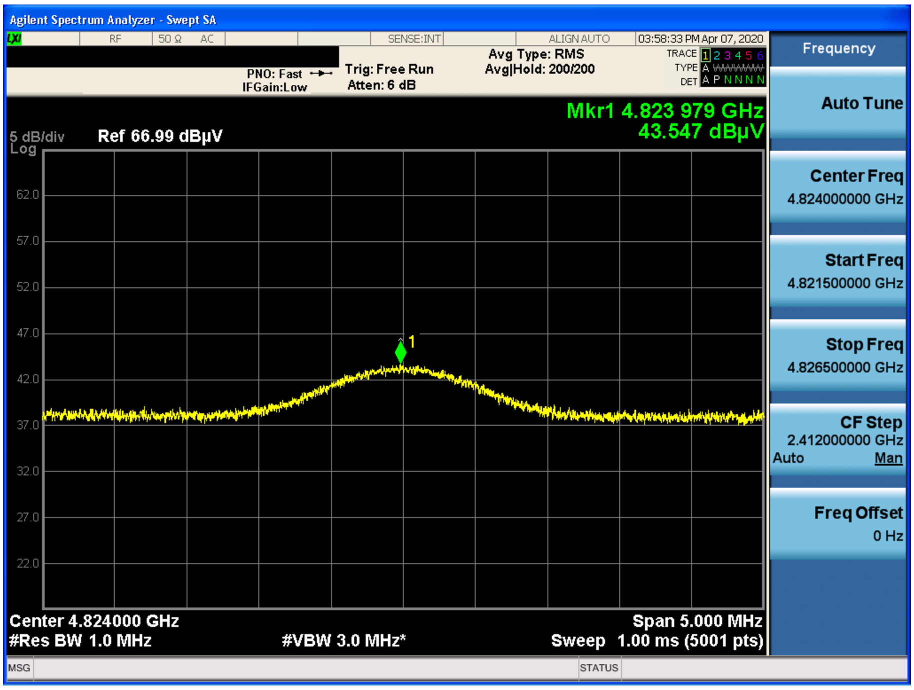
**TM 4 & Highest & X axis & Hor** **Detector Mode : PK**



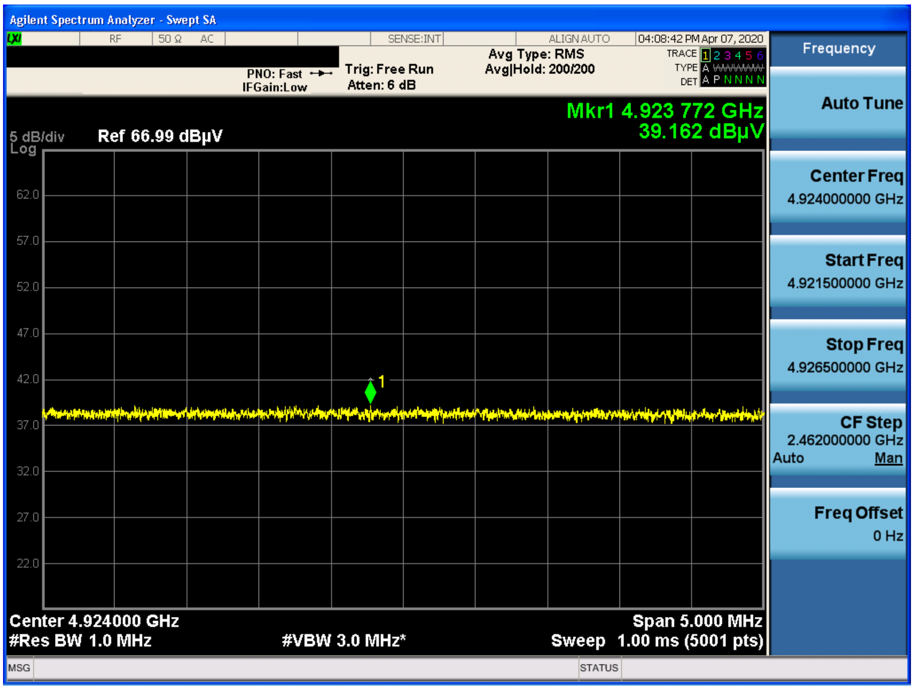

**TM 4 & Highest & X axis & Hor** **Detector Mode : AV**



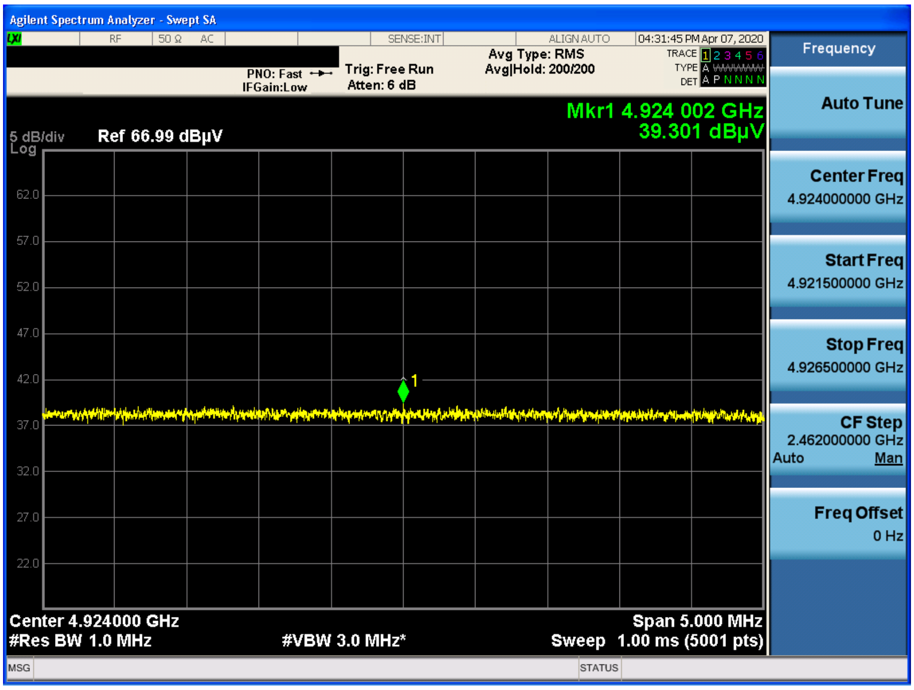
**TM 1 & Lowest & X axis & Ver** **Detector Mode : AV**



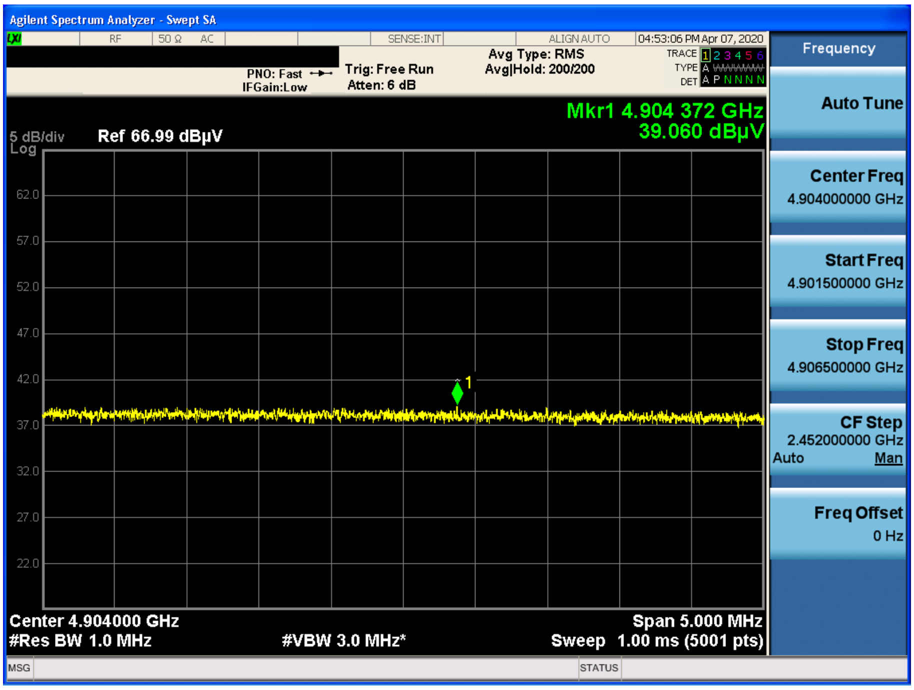

**TM 2 & Highest & X axis & Ver** **Detector Mode : AV**



TM 3 & Highest & X axis & Ver Detector Mode : AV

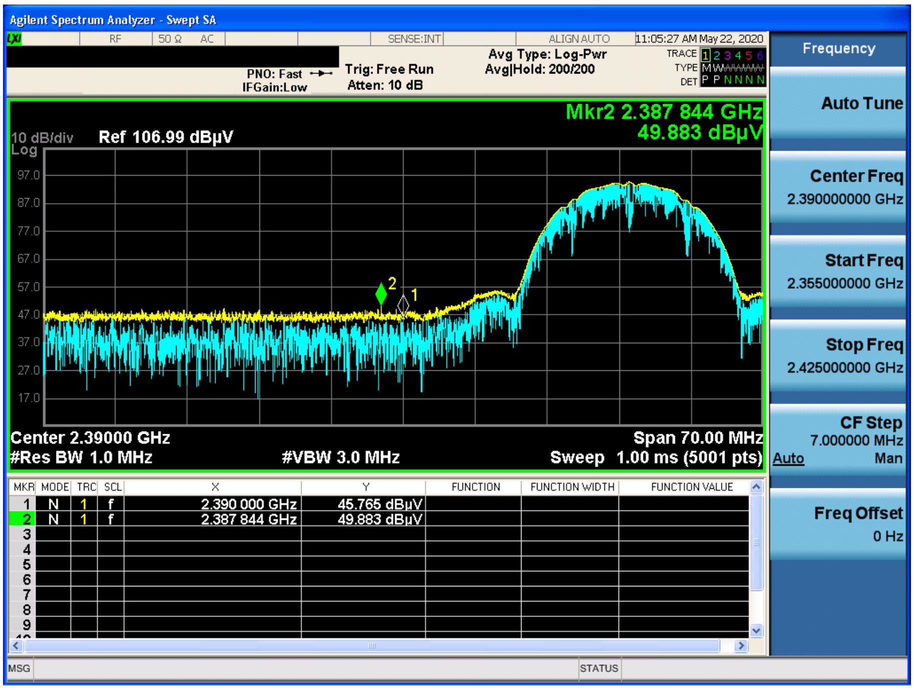



TM 4 & Highest & X axis & Ver Detector Mode : AV

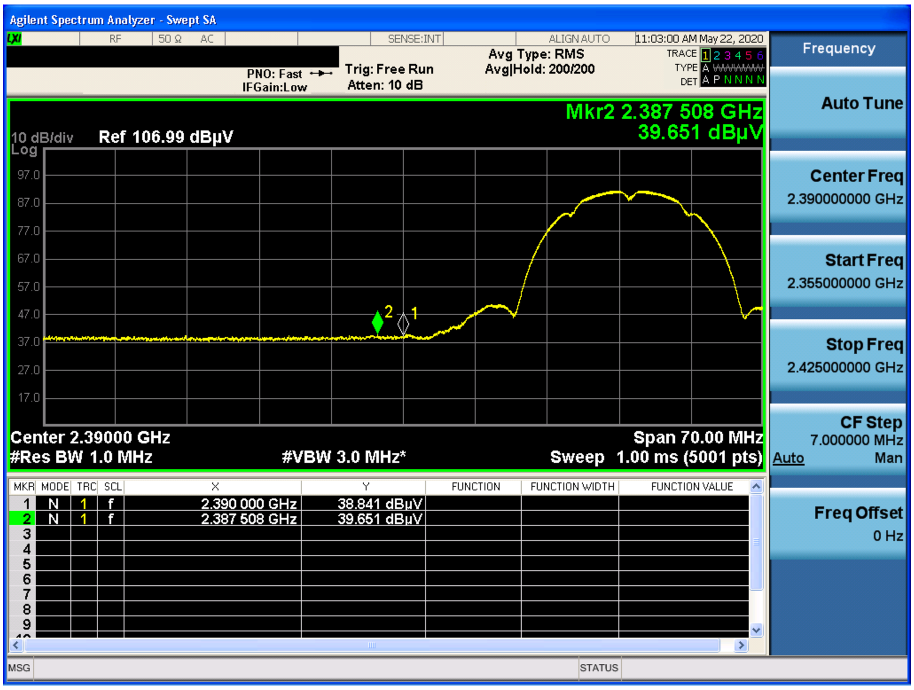


## - Tested Power Supply: DC 24 V

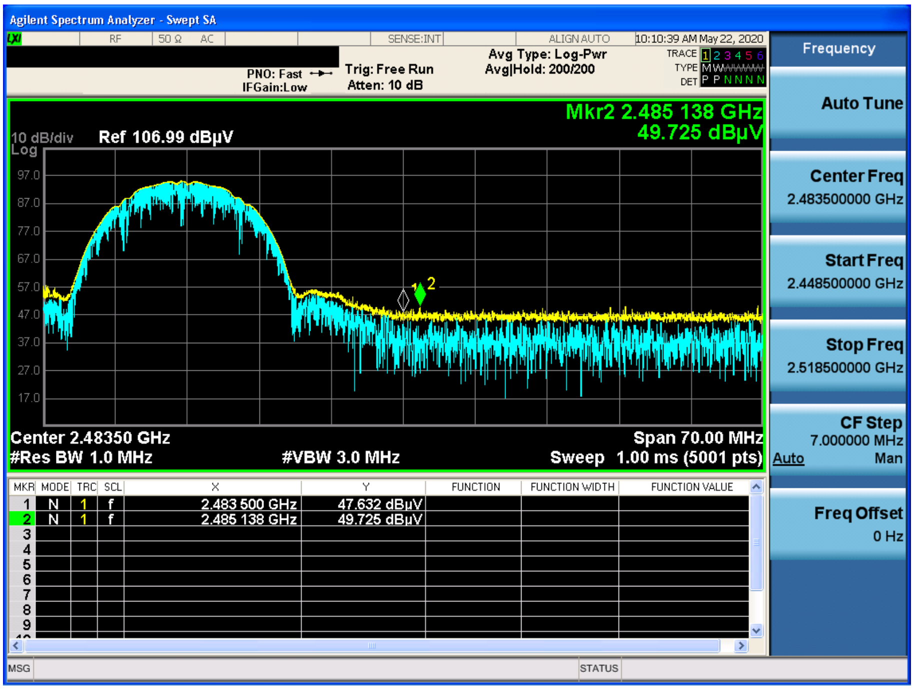
**TM 1 & Lowest & X axis & Hor** **Detector Mode : PK**



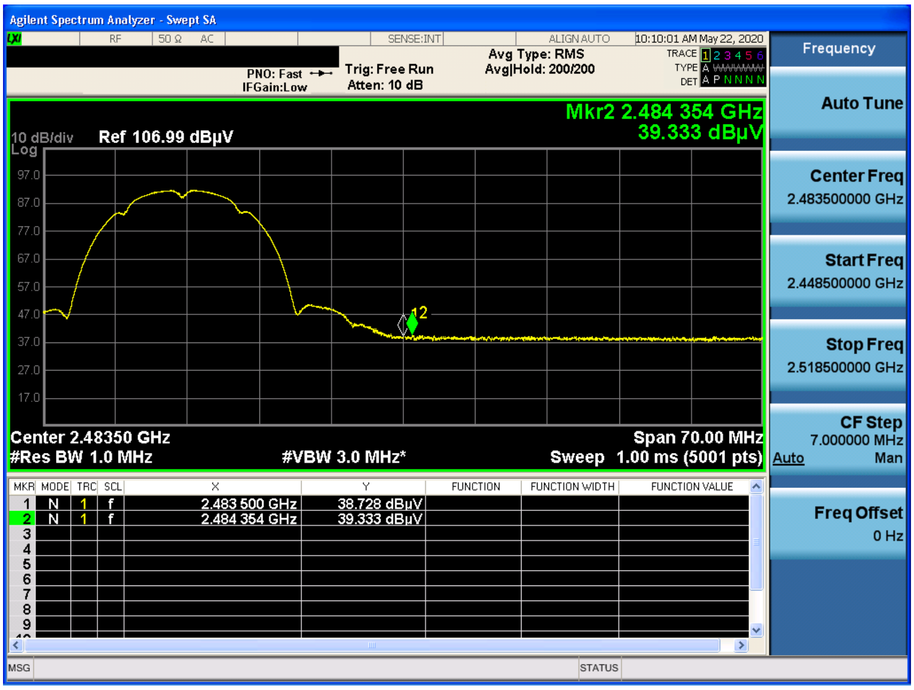

**TM 1 & Lowest & X axis & Hor** **Detector Mode : AV**



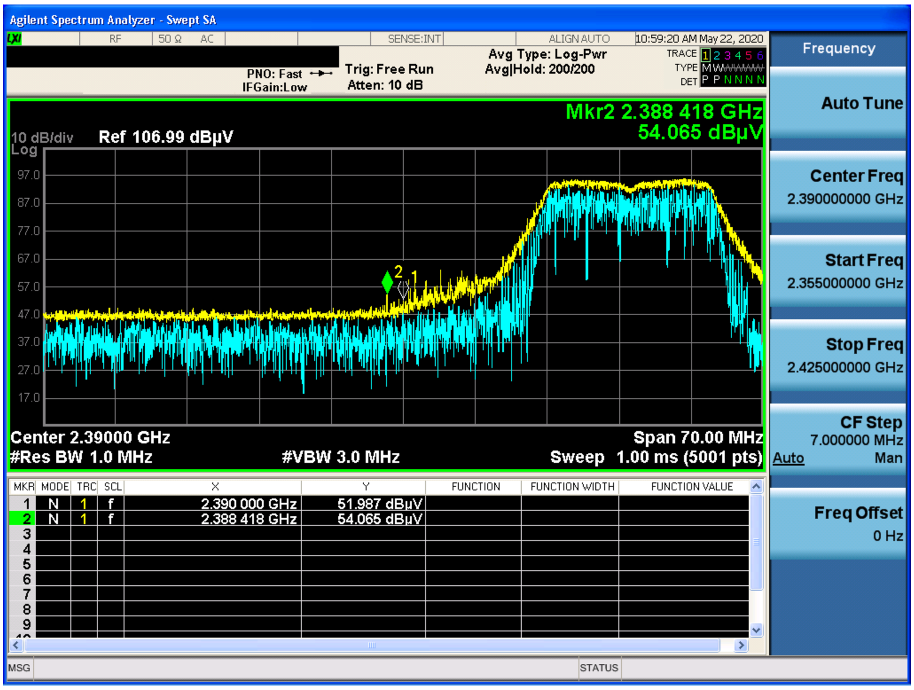
**TM 1 & Highest & X axis & Hor** **Detector Mode : PK**



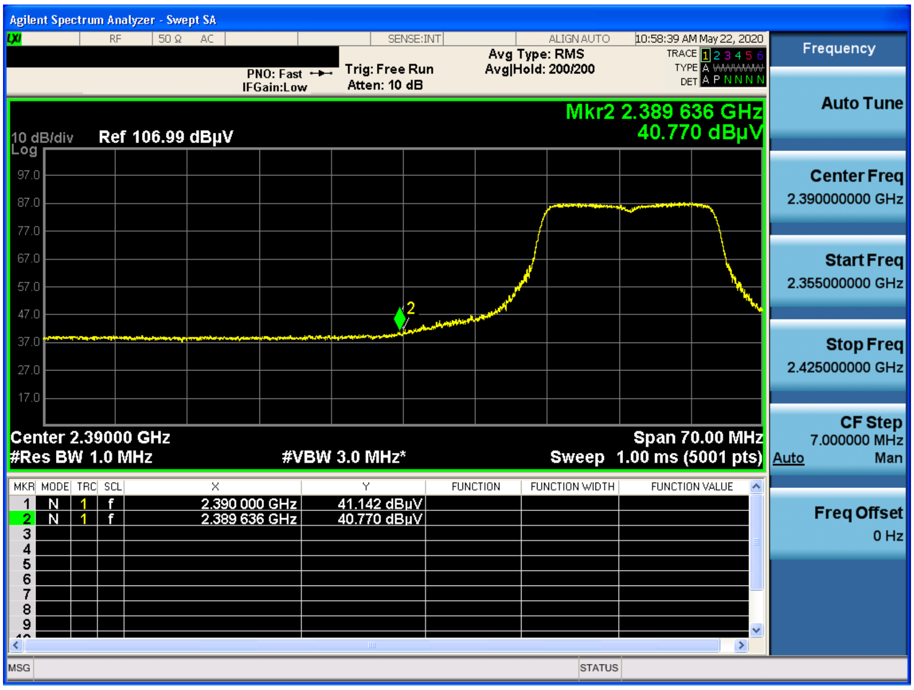

**TM 1 & Highest & X axis & Hor** **Detector Mode : AV**



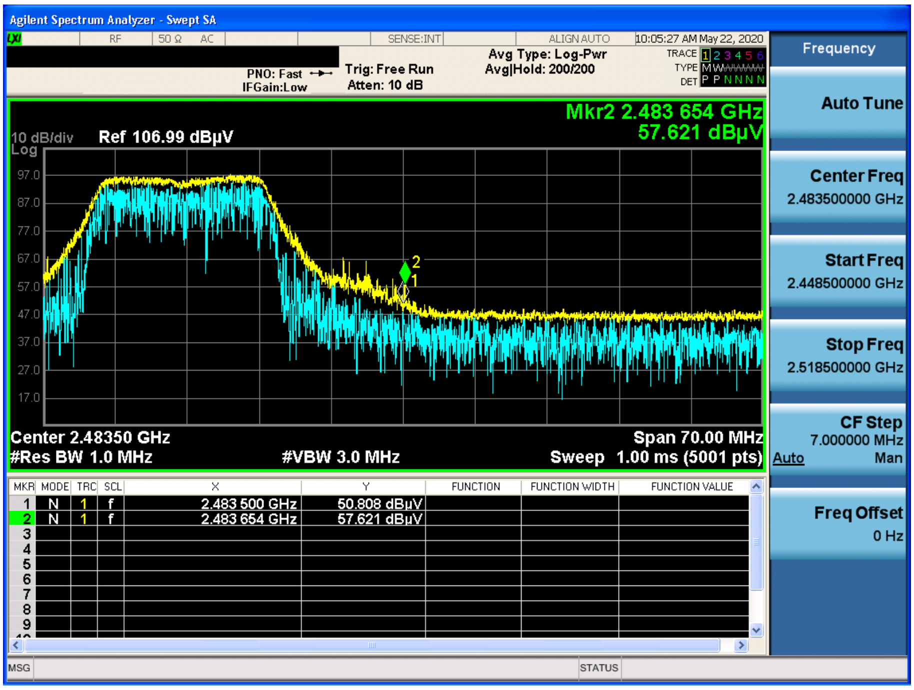
**TM 2 & Lowest & X axis & Hor** **Detector Mode : PK**



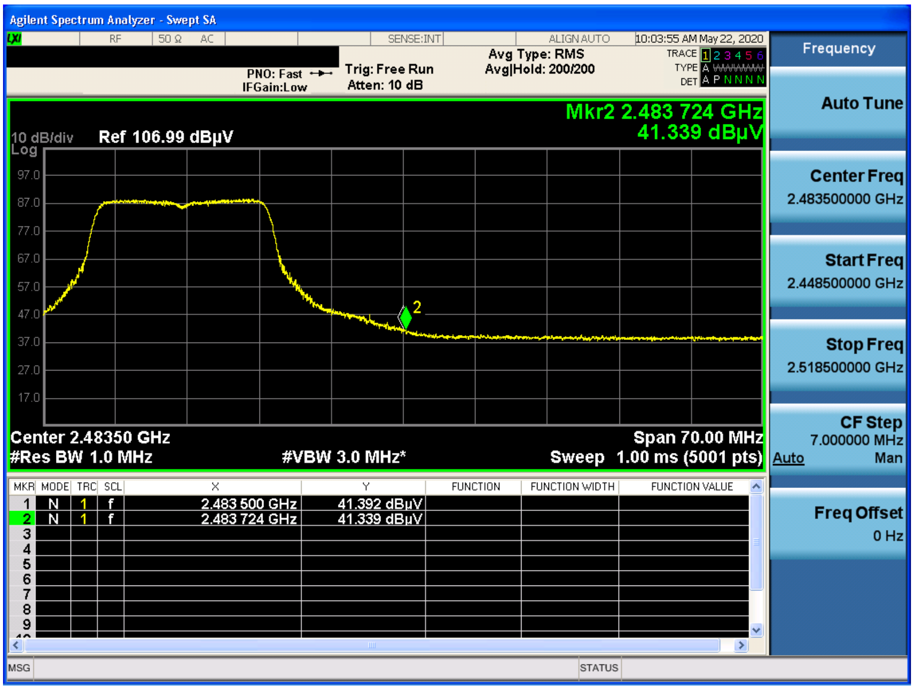

**TM 2 & Lowest & X axis & Hor** **Detector Mode : AV**



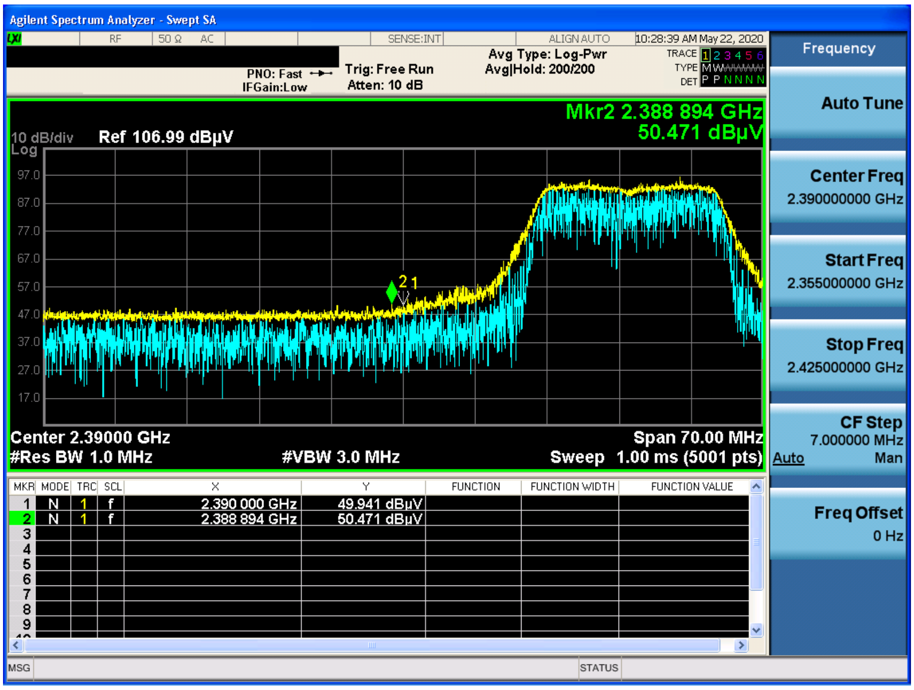
**TM 2 & Highest & X axis & Hor** **Detector Mode : PK**



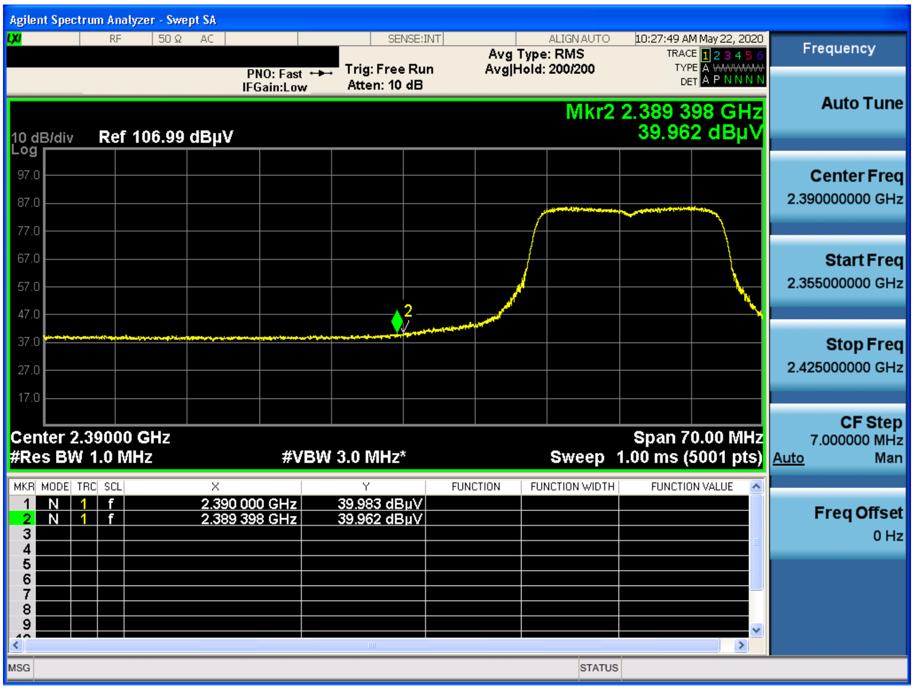

**TM 2 & Highest & X axis & Hor** **Detector Mode : AV**



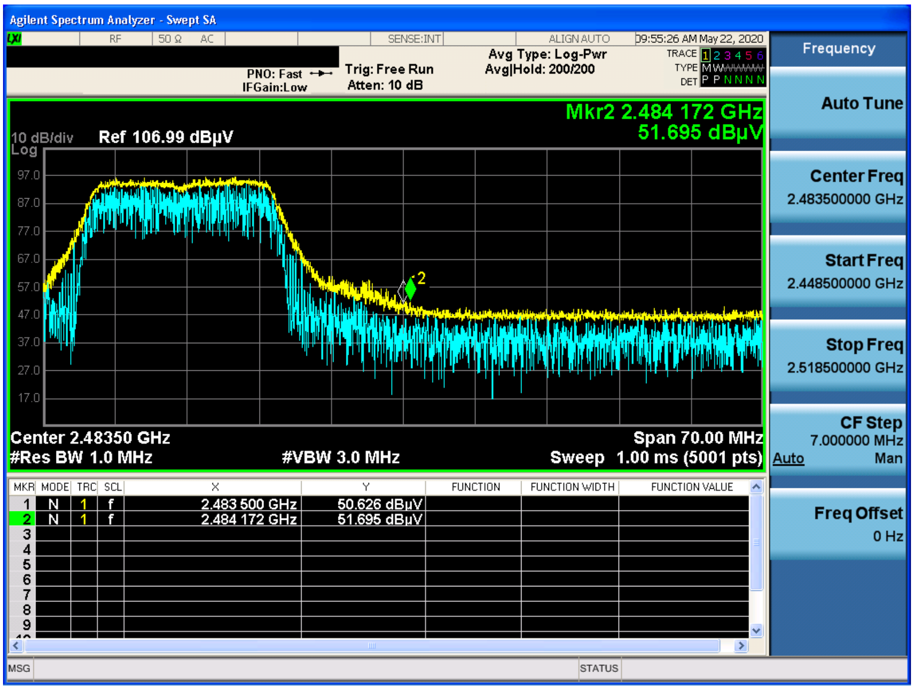
**TM 3 & Lowest & X axis & Hor** **Detector Mode : PK**



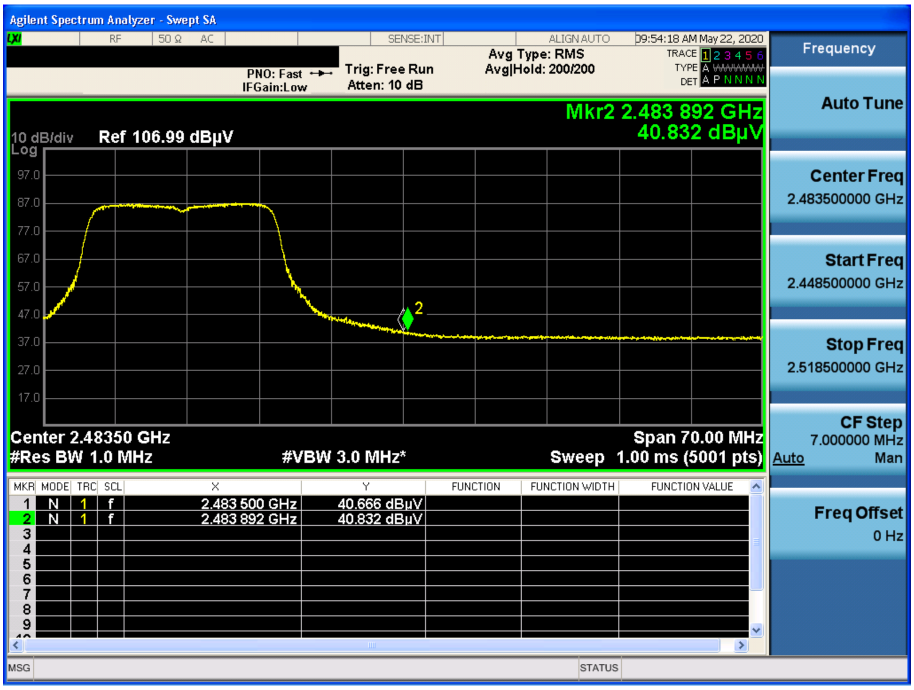

**TM 3 & Lowest & X axis & Hor** **Detector Mode : AV**



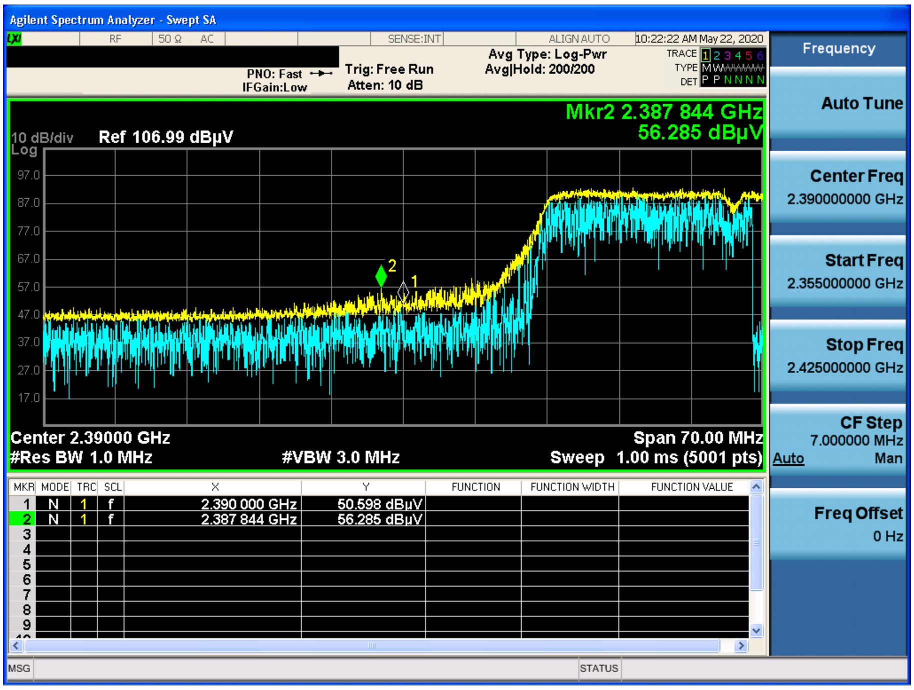
**TM 3 & Highest & X axis & Hor** **Detector Mode : PK**



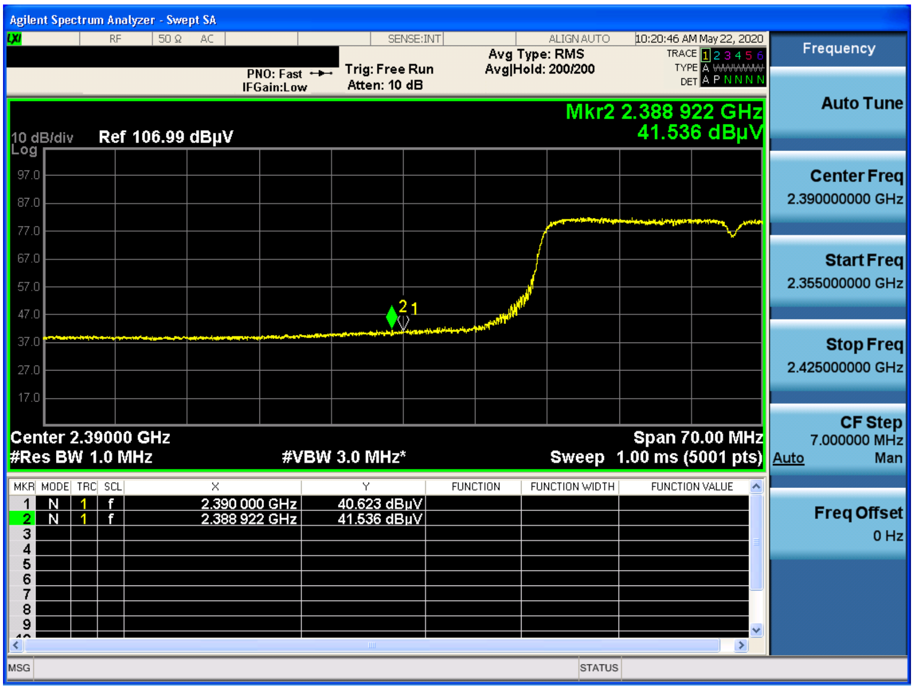

**TM 3 & Highest & X axis & Hor** **Detector Mode : AV**



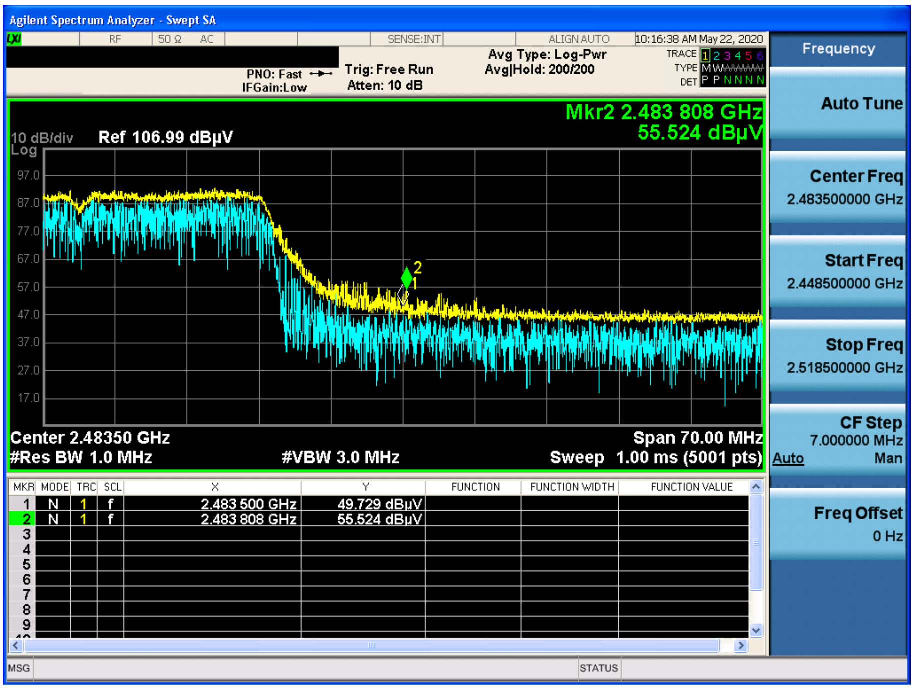
**TM 4 & Lowest & X axis & Hor** **Detector Mode : PK**



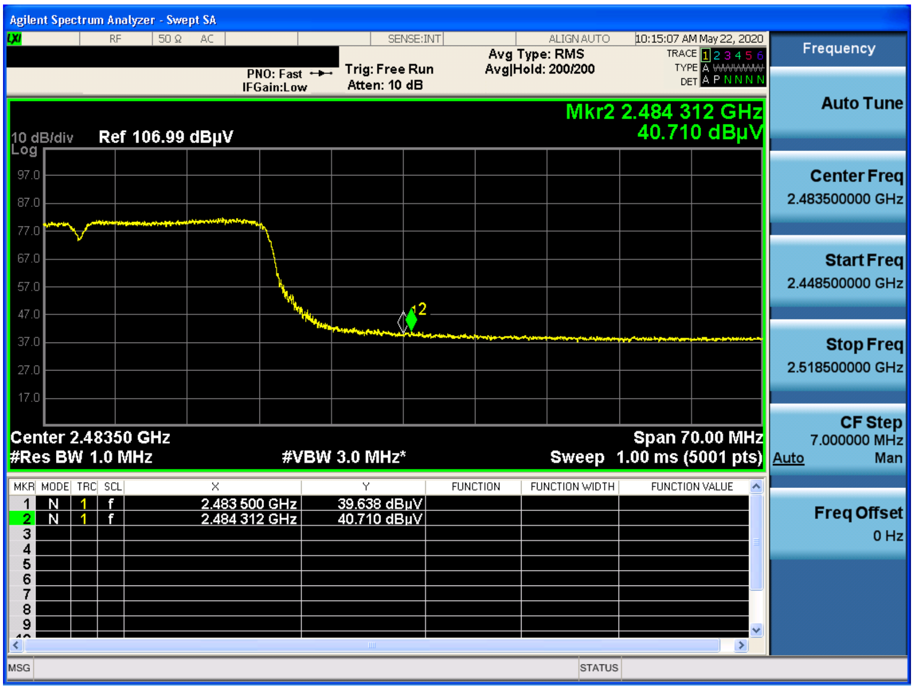

**TM 4 & Lowest & X axis & Hor** **Detector Mode : AV**



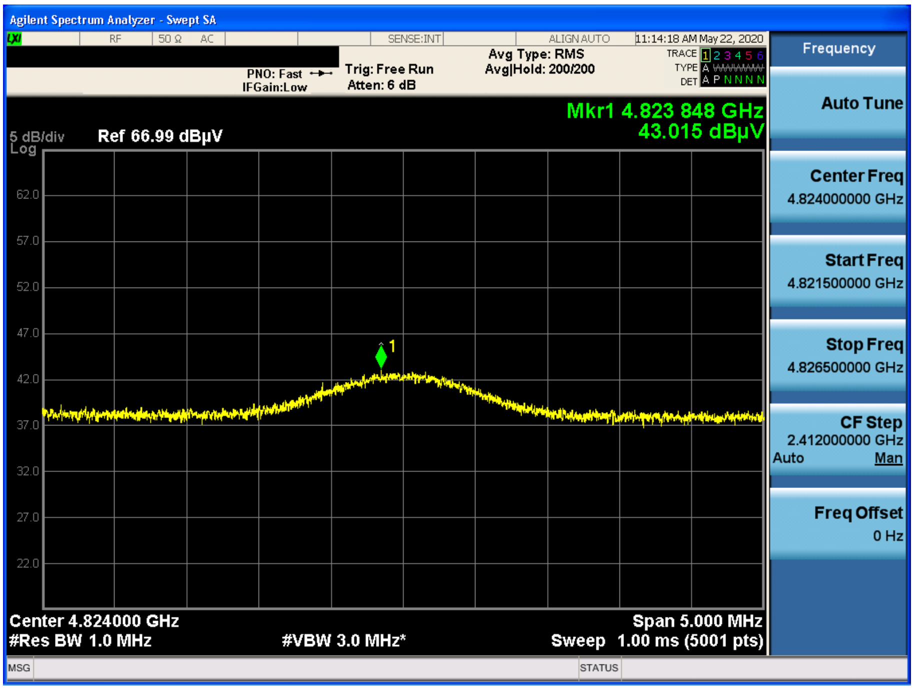
**TM 4 & Highest & X axis & Hor** **Detector Mode : PK**



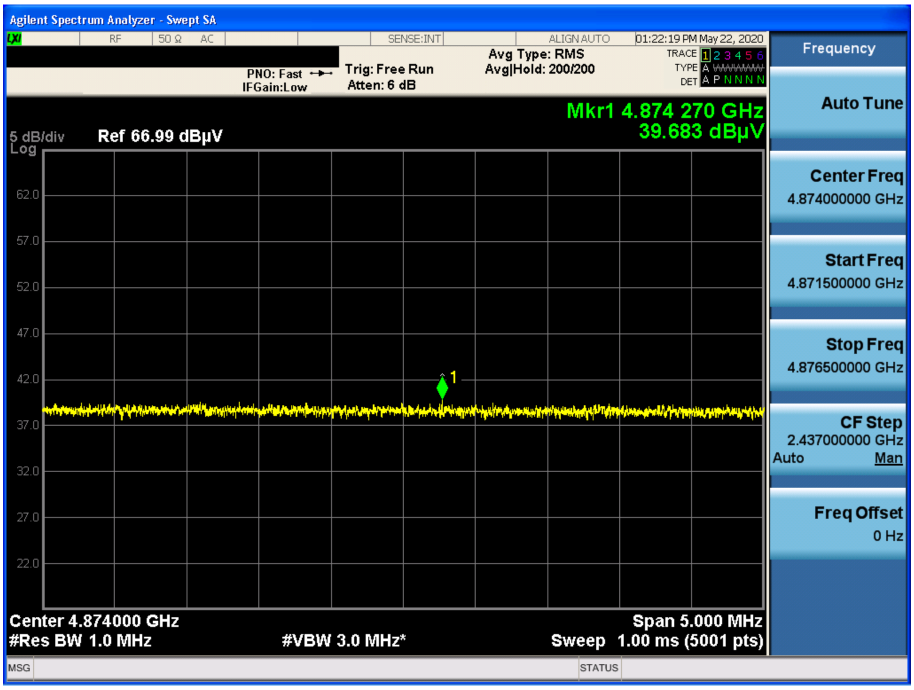

**TM 4 & Highest & X axis & Hor** **Detector Mode : AV**



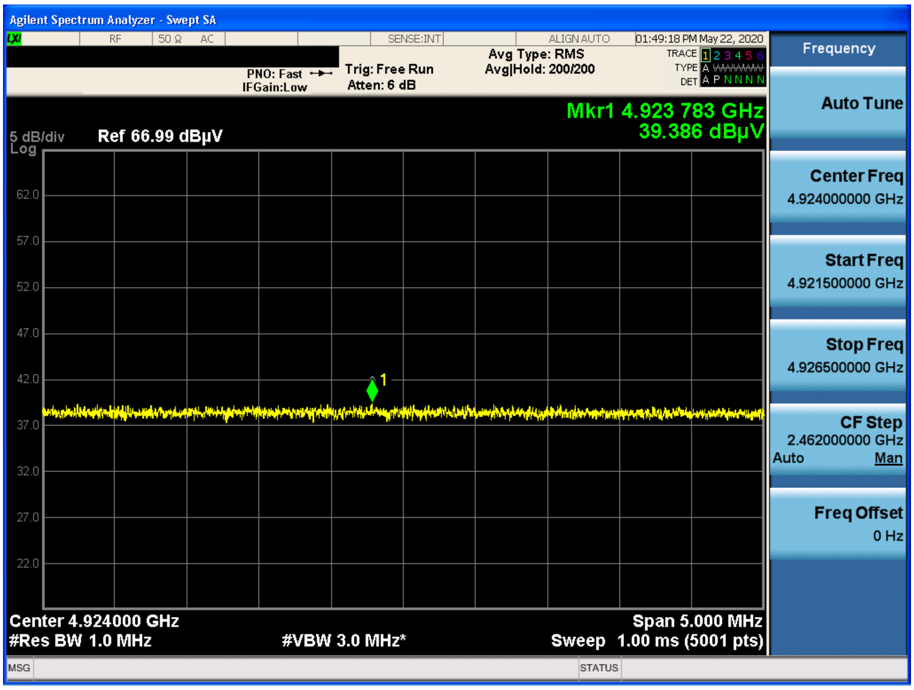
**TM 1 & Lowest & X axis & Ver** **Detector Mode : AV**




**TM 2 & Middle & X axis & Ver** **Detector Mode : AV**



**TM 3 & Highest & X axis & Ver** **Detector Mode : AV**




**TM 4 & Highest & X axis & Ver** **Detector Mode : AV**