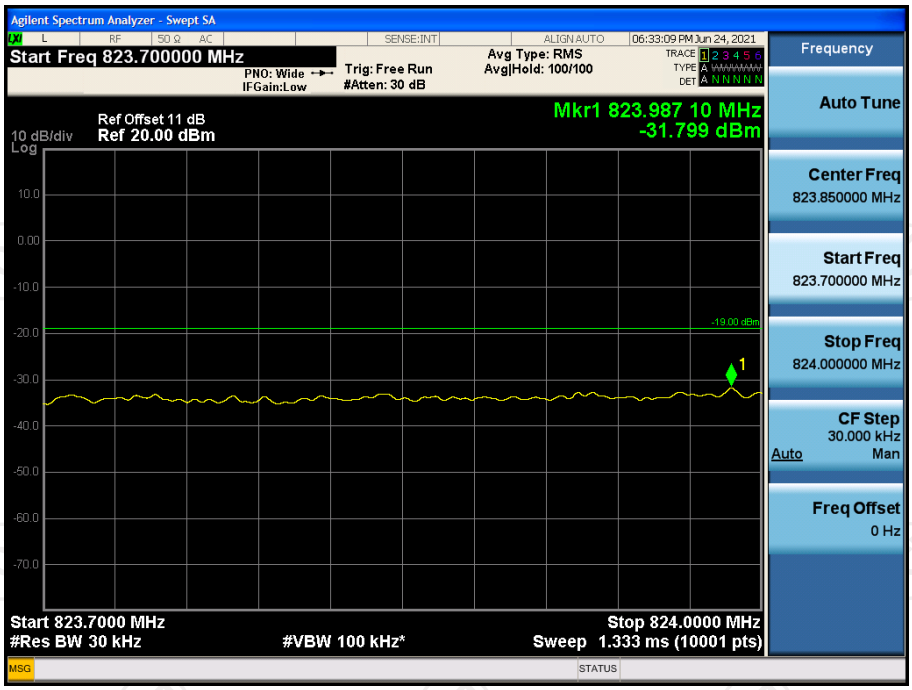
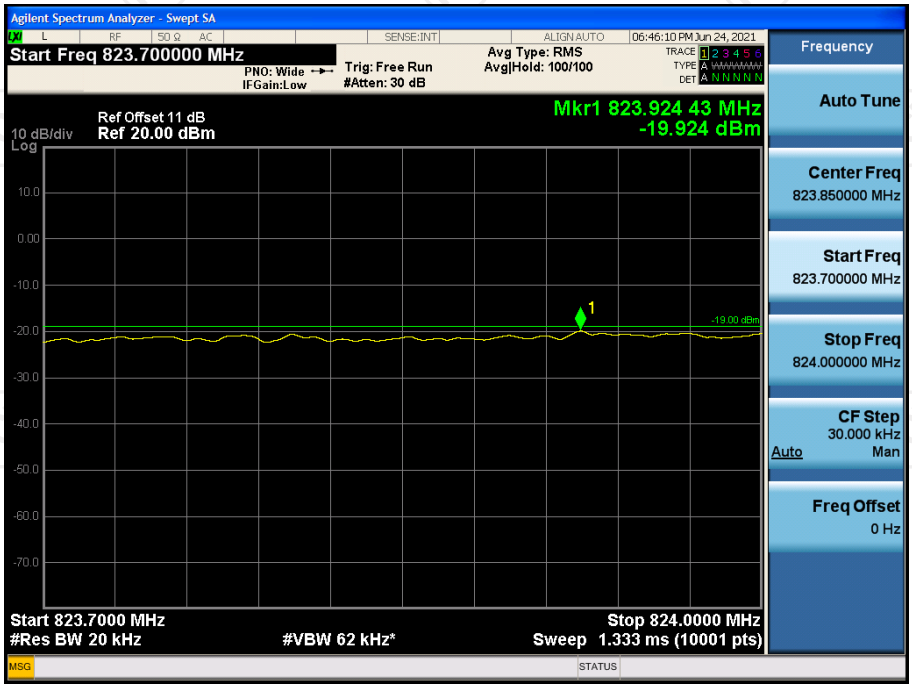
**Cellular GSM UL Right Side Pre AGC**

**Cellular GSM UL Right Side Pre AGC+10dB**

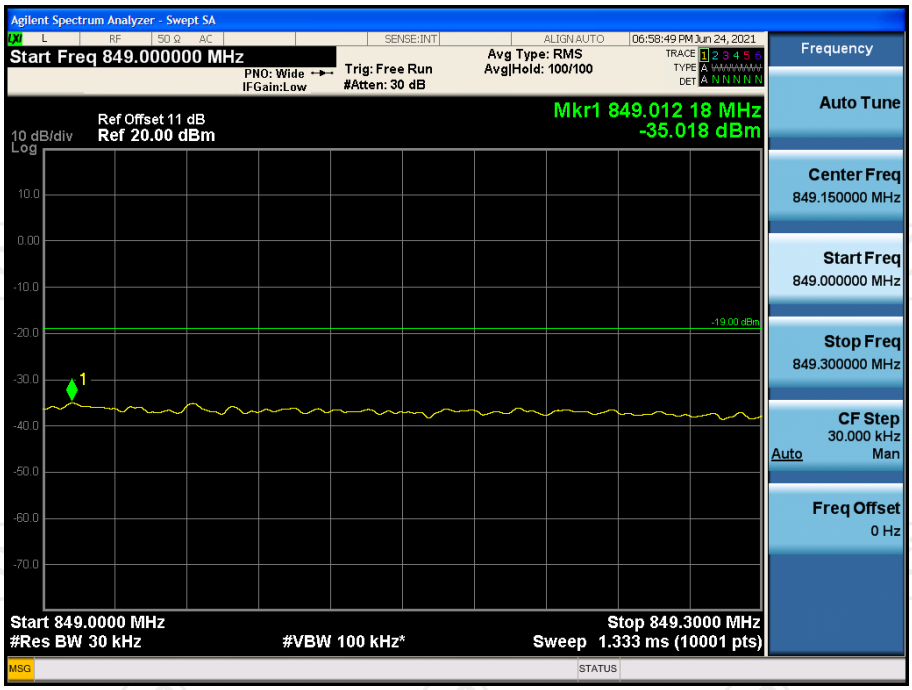
**Cellular CDMA UL Left Side Pre AGC**



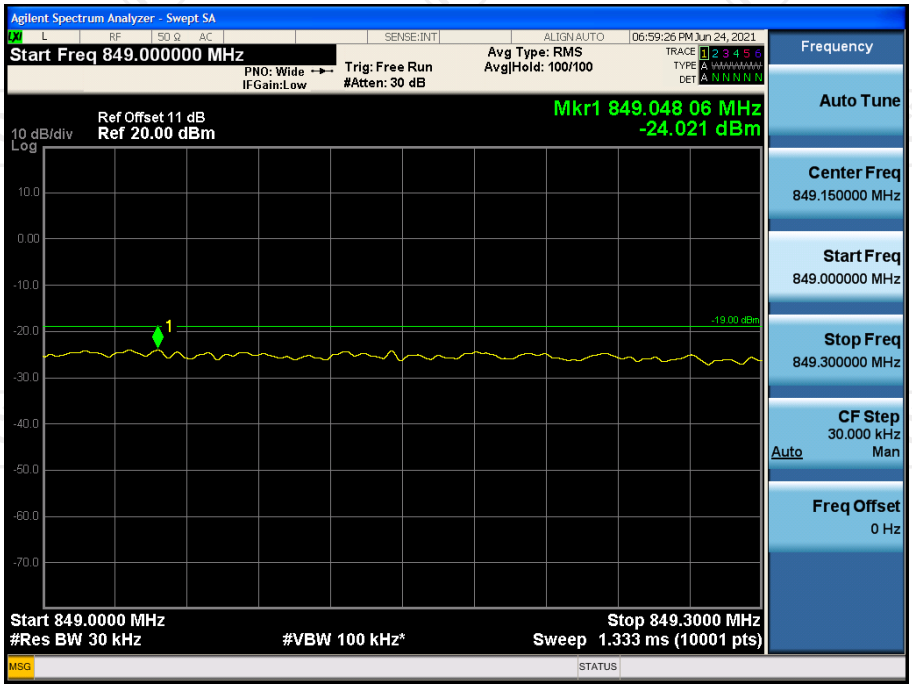

**Cellular CDMA UL Left Side Pre AGC+10dB**



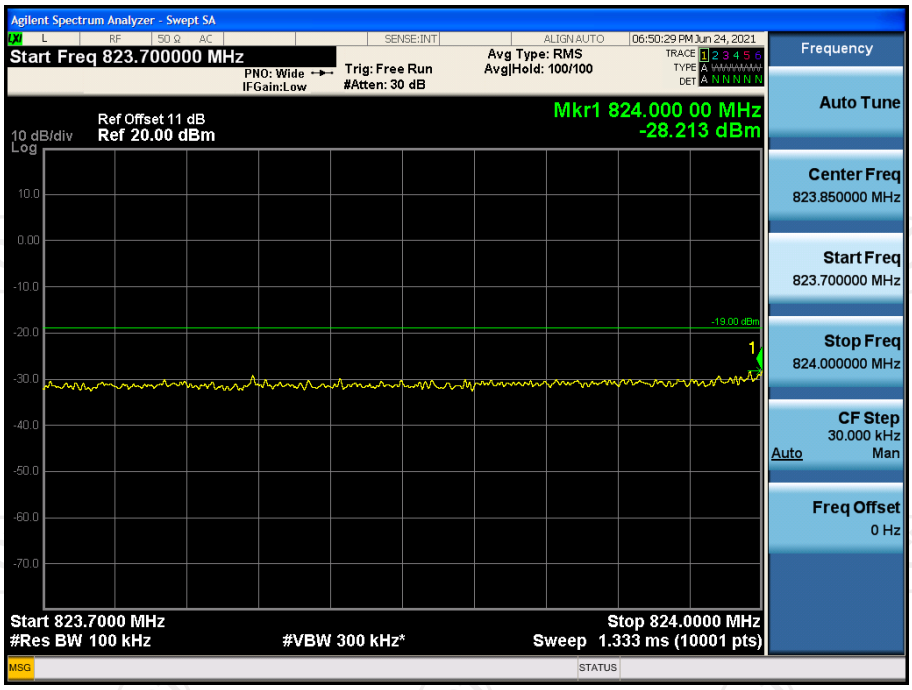
**Cellular CDMA UL Right Side Pre AGC**



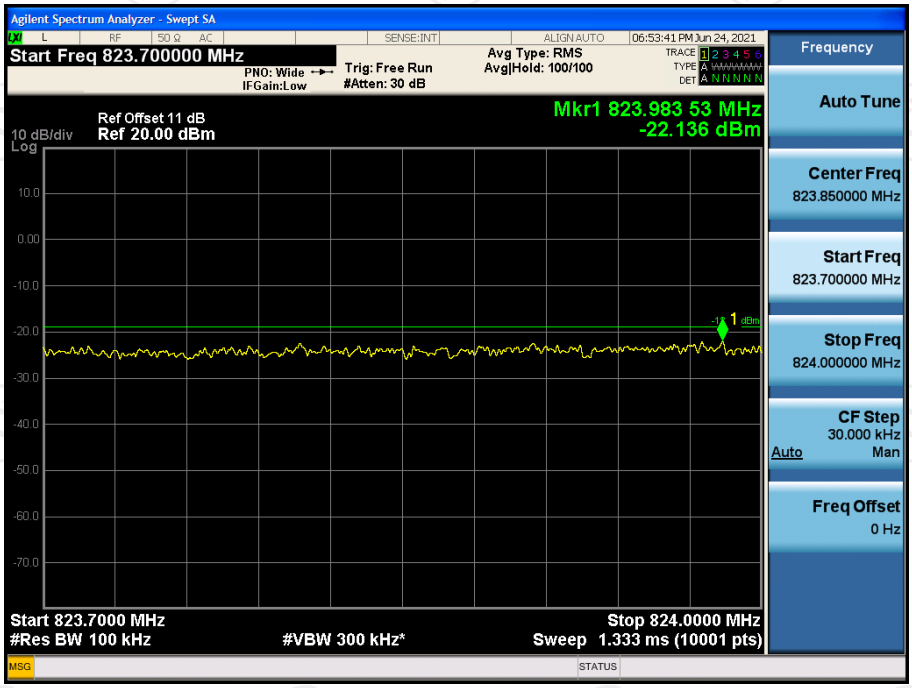

**Cellular CDMA UL Right Side Pre AGC+10dB**



**Cellular LTE UL Left Side Pre AGC**



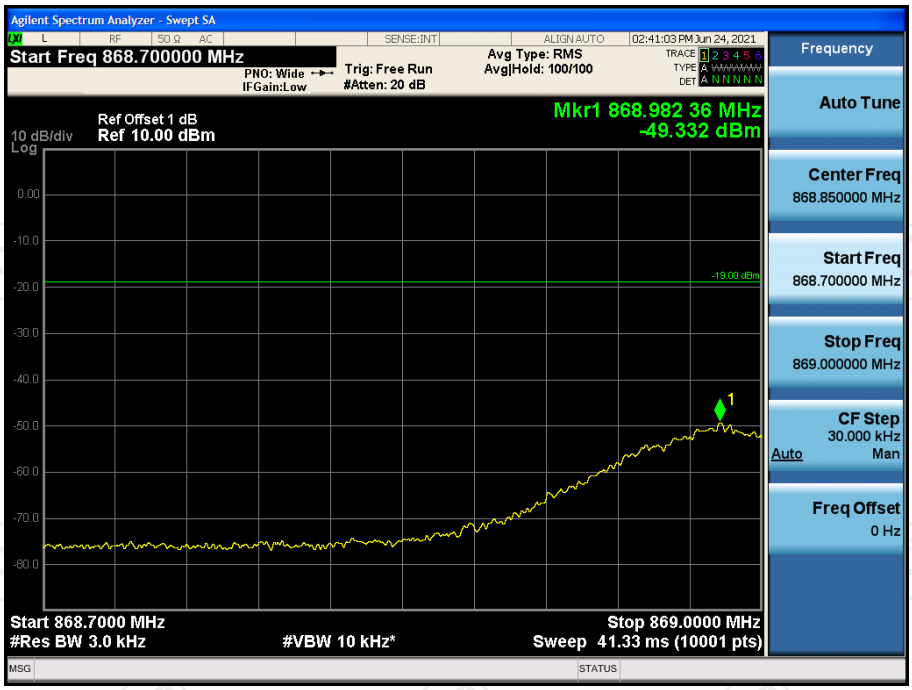

**Cellular LTE UL Left Side Pre AGC+10dB**



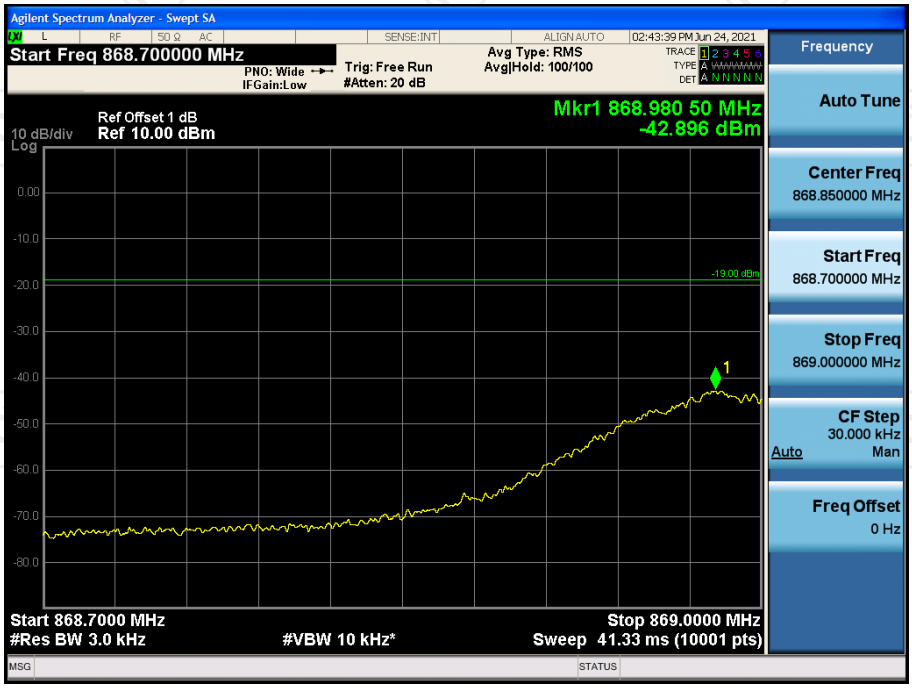
**Cellular LTE UL Right Side Pre AGC**

**Cellular LTE UL Right Side Pre AGC+10dB**

**Cellular GSM DL Left Side Pre AGC**



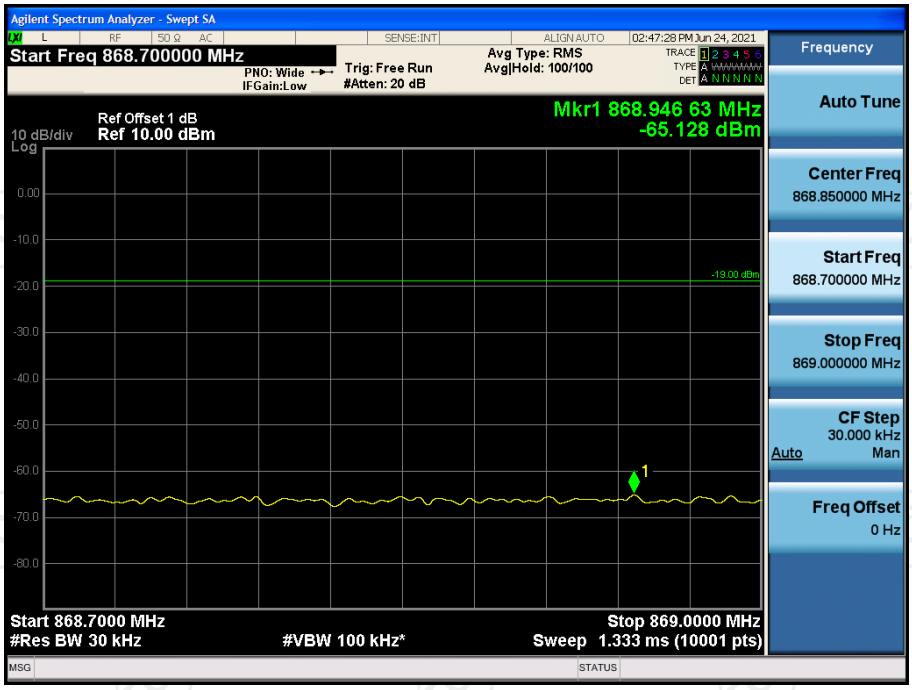

**Cellular GSM DL Left Side Pre AGC+10dB**



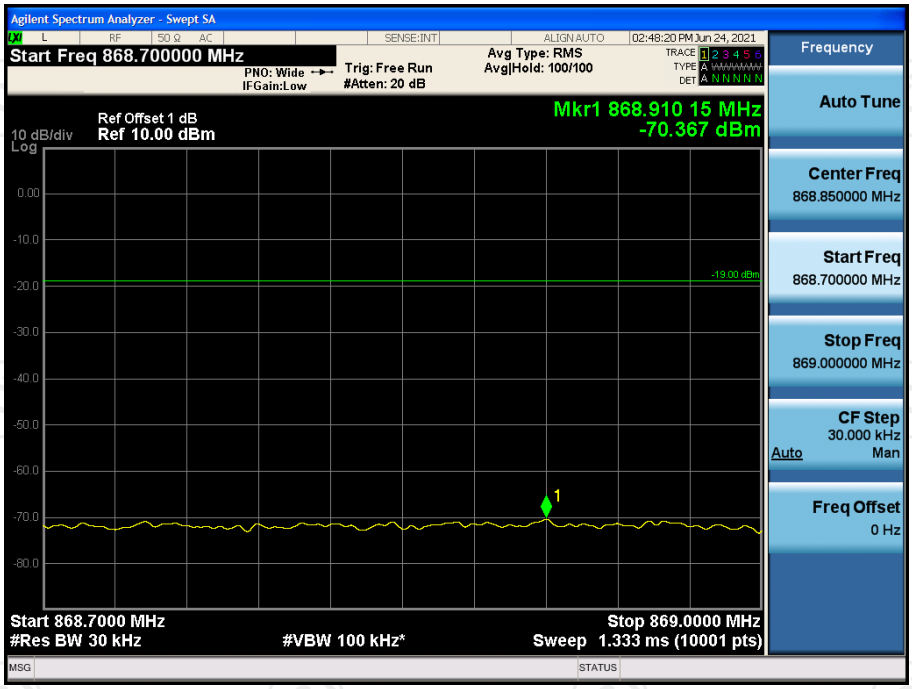
**Cellular GSM DL Right Side Pre AGC**

**Cellular GSM DL Right Side Pre AGC+10dB**

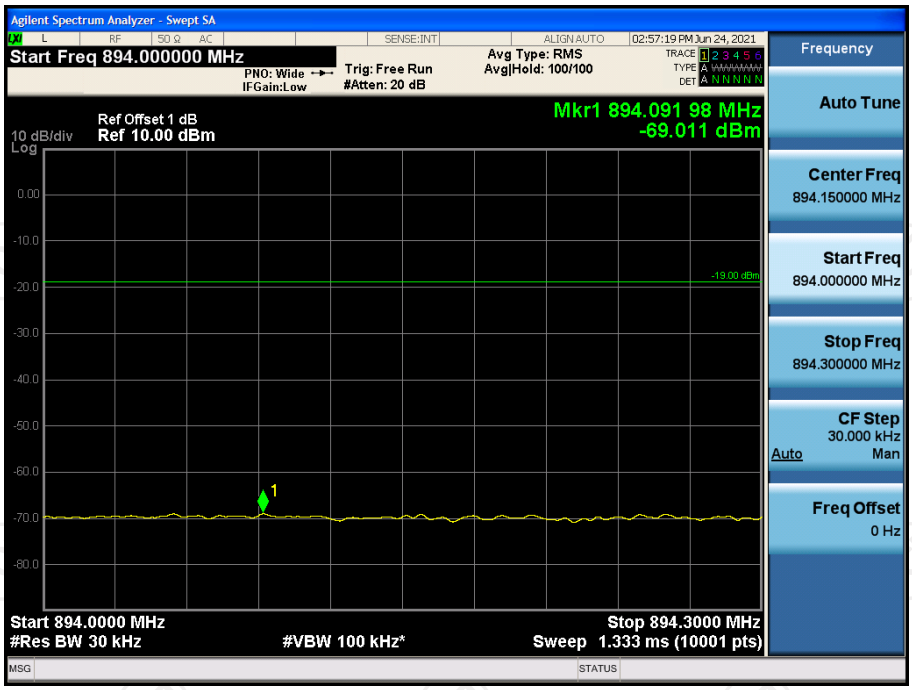
**Cellular CDMA DL Left Side Pre AGC**



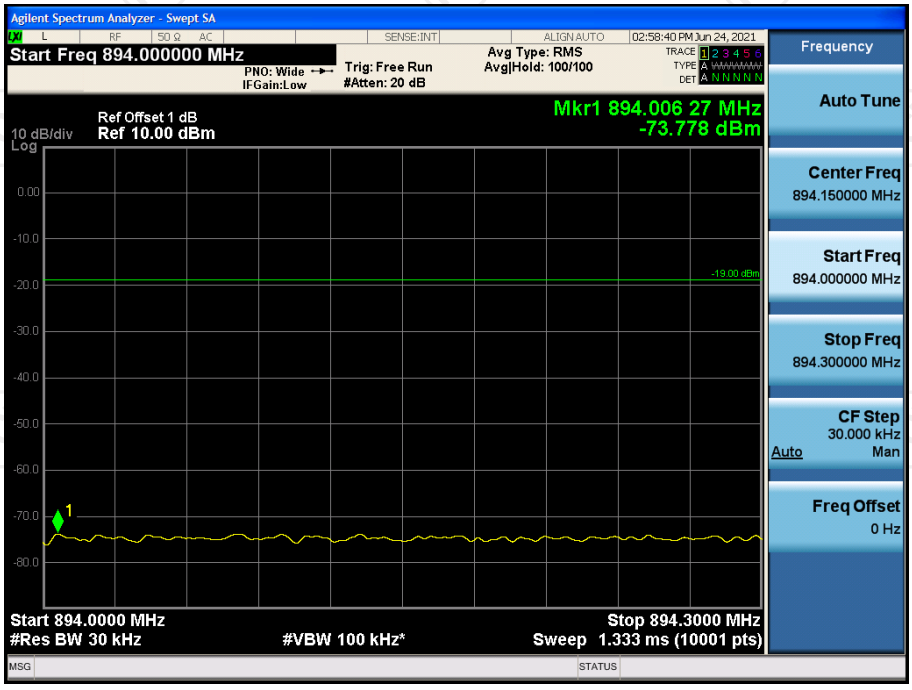

**Cellular CDMA DL Left Side Pre AGC+10dB**



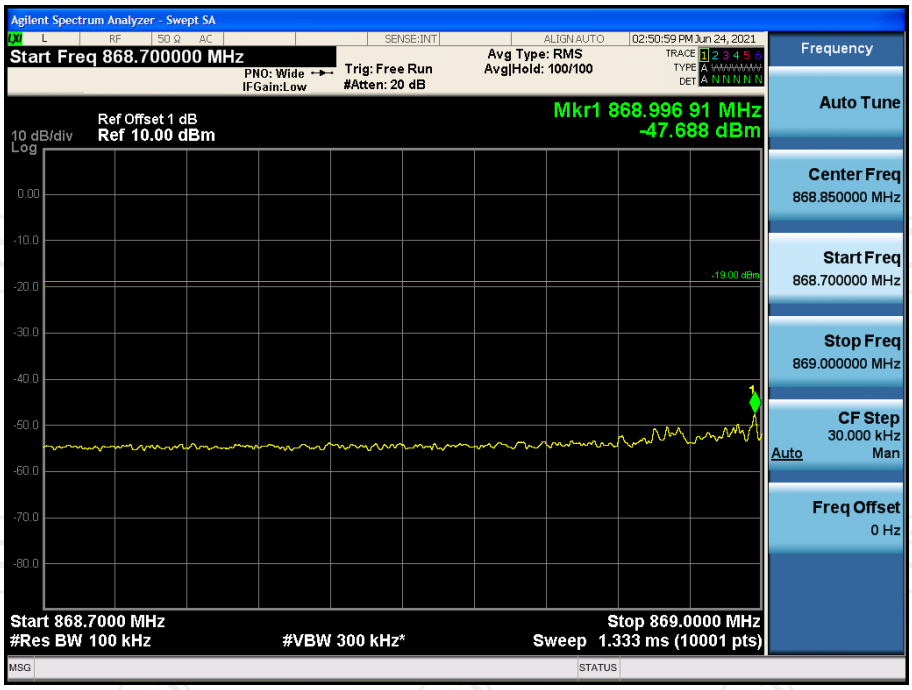
**Cellular CDMA DL Right Side Pre AGC**



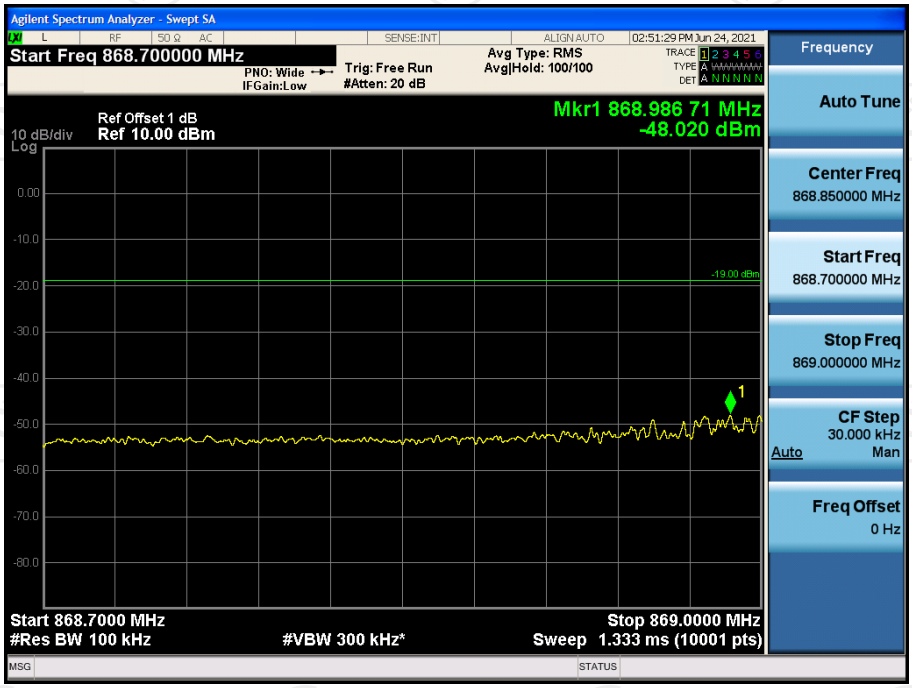

**Cellular CDMA DL Right Side Pre AGC+10dB**



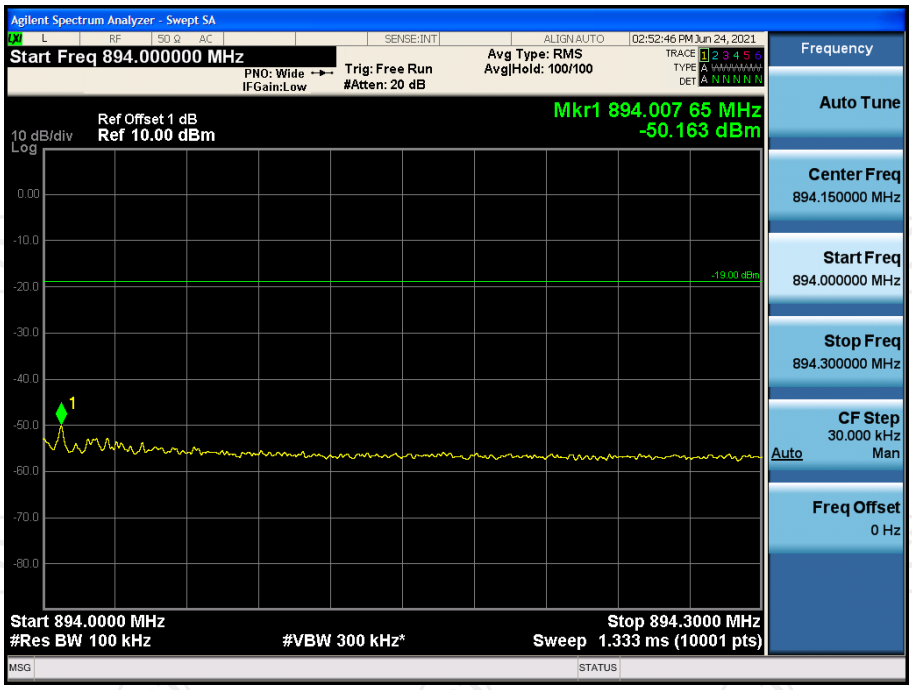
**Cellular LTE DL Left Side Pre AGC**



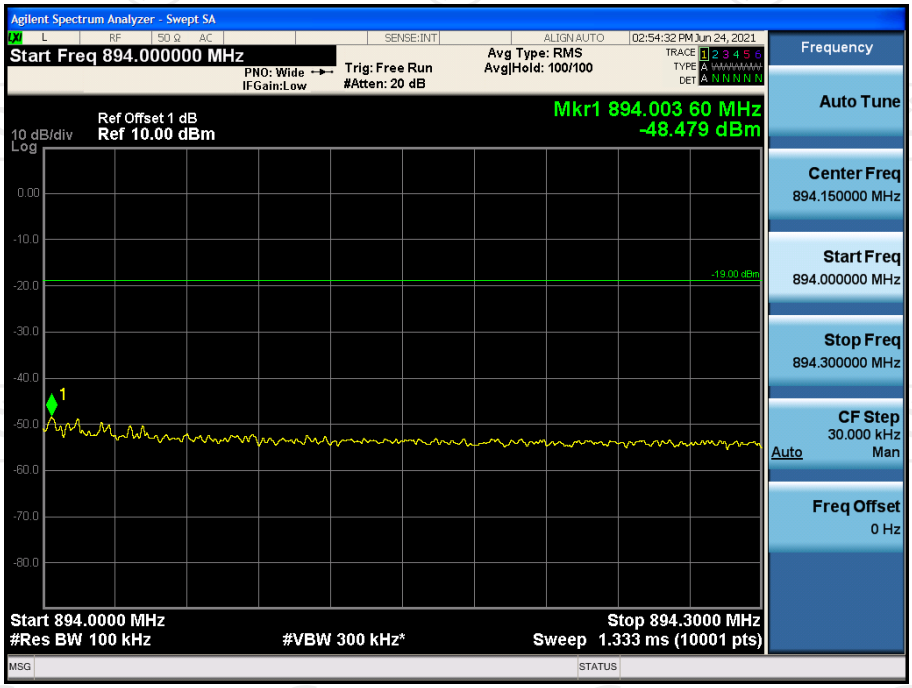

**Cellular LTE DL Left Side Pre AGC+10dB**



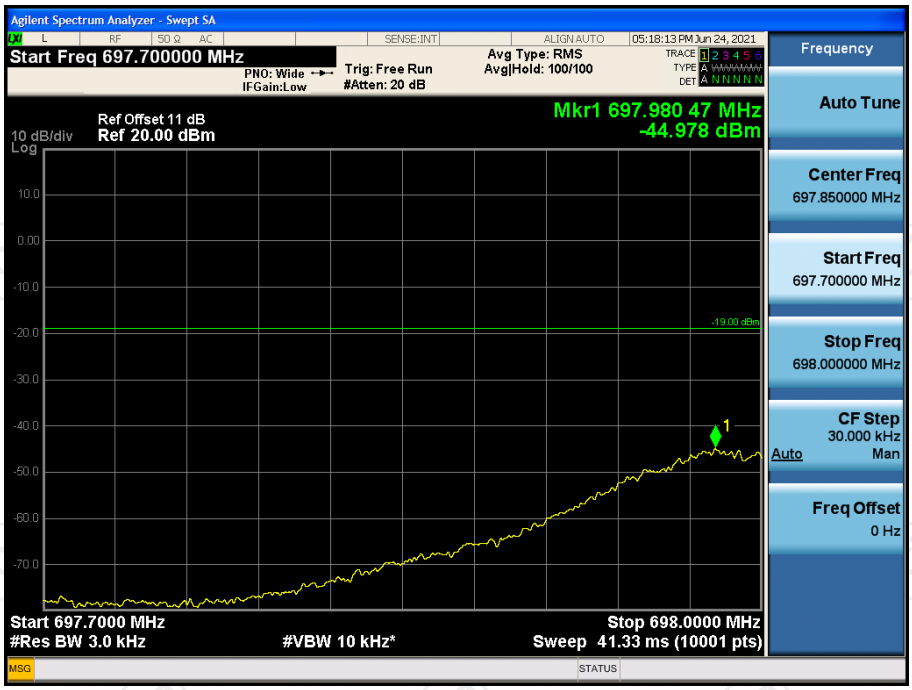
**Cellular LTE DL Right Side Pre AGC**



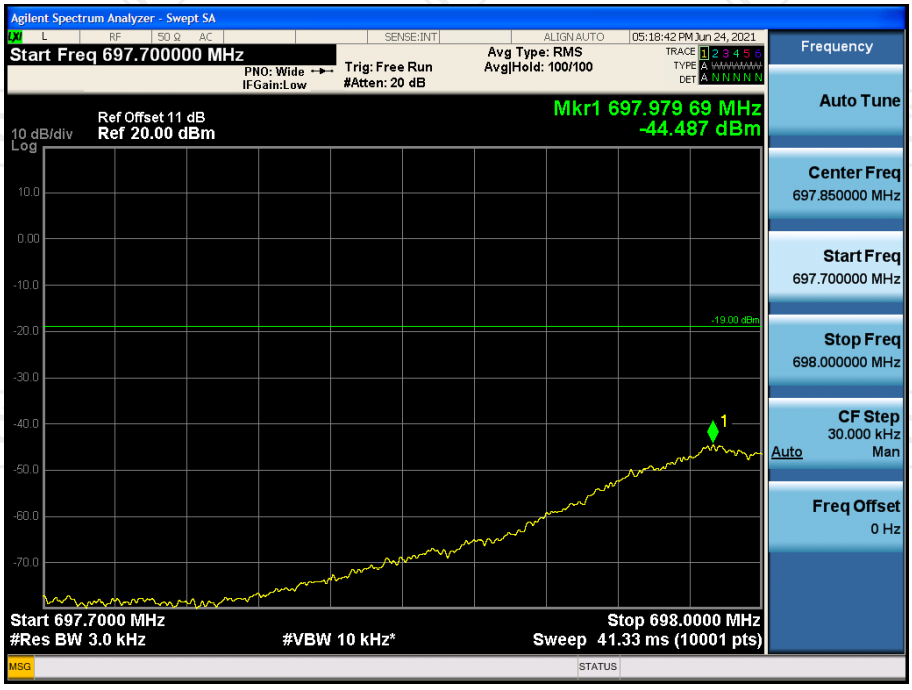

**Cellular LTE DL Right Side Pre AGC+10dB**



**Lower700MHz GSM UL Left Side Pre AGC**



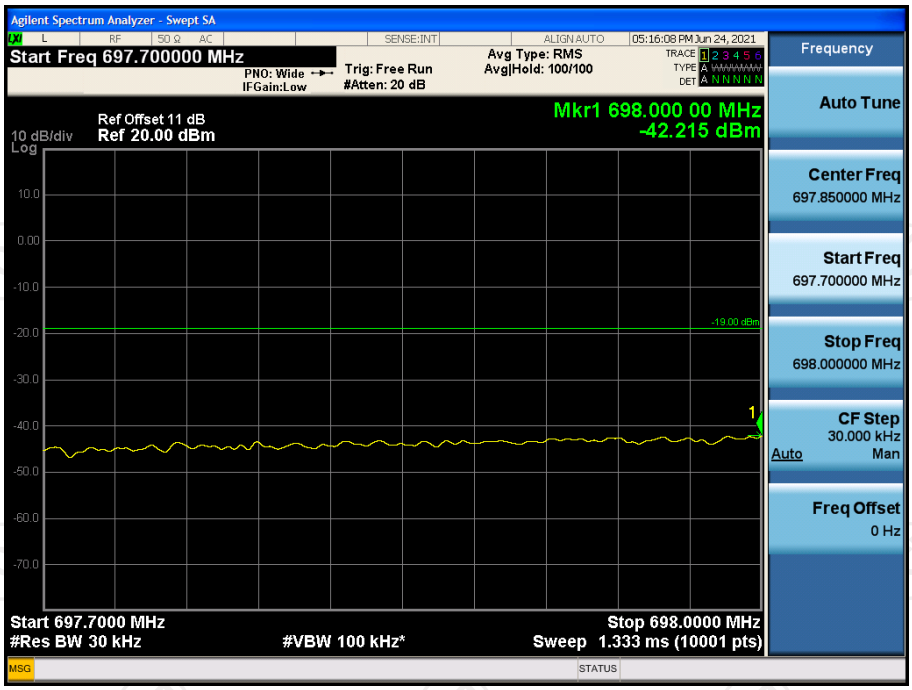

**Lower700MHz GSM UL Left Side Pre AGC+10dB**



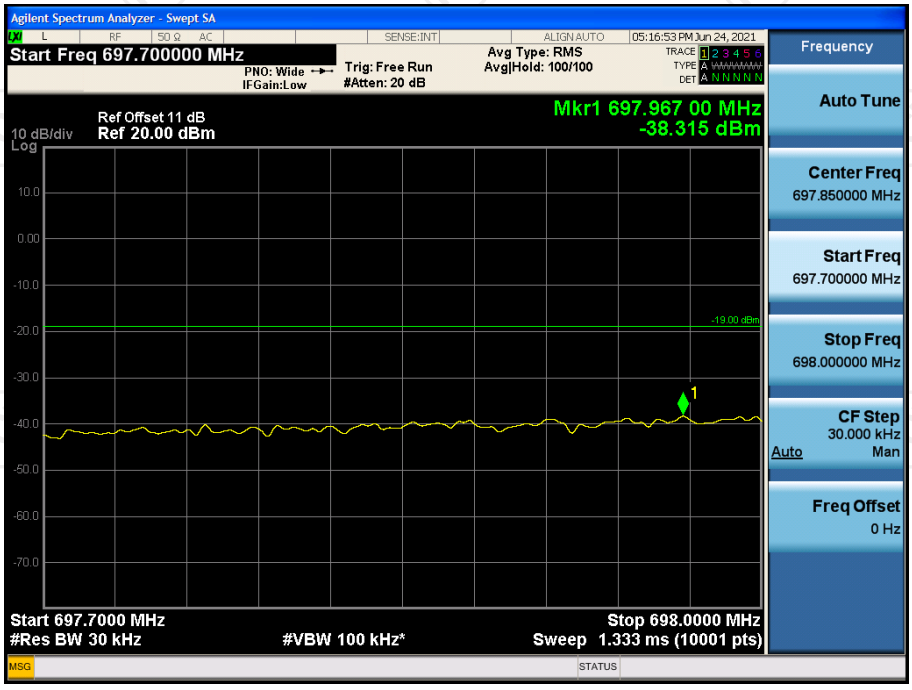
**Lower700MHz GSM UL Right Side Pre AGC**

**Lower700MHz GSM UL Right Side Pre AGC+10dB**

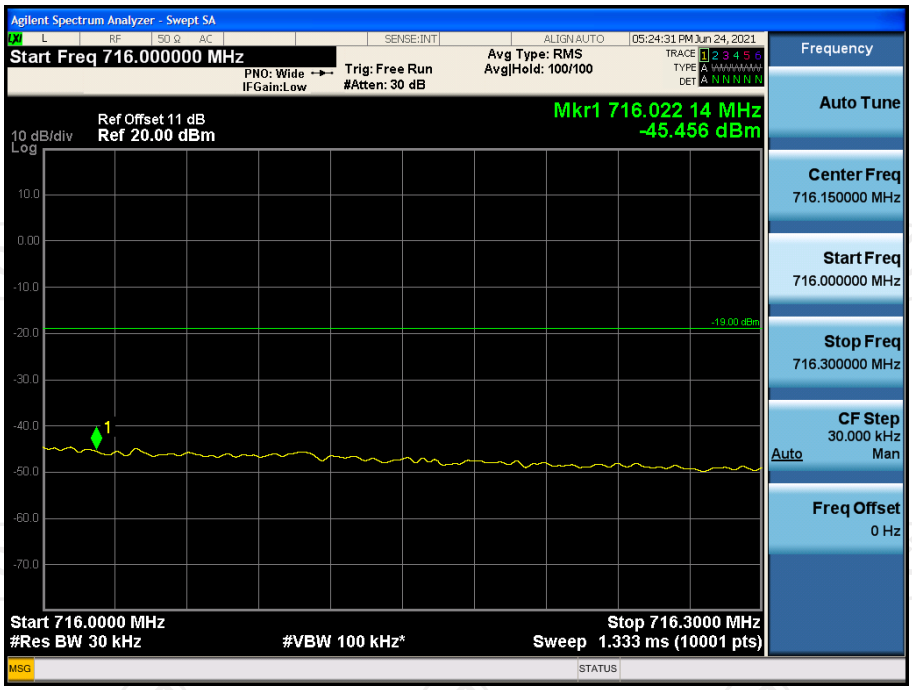
**Lower700MHz CDMA UL Left Side Pre AGC**



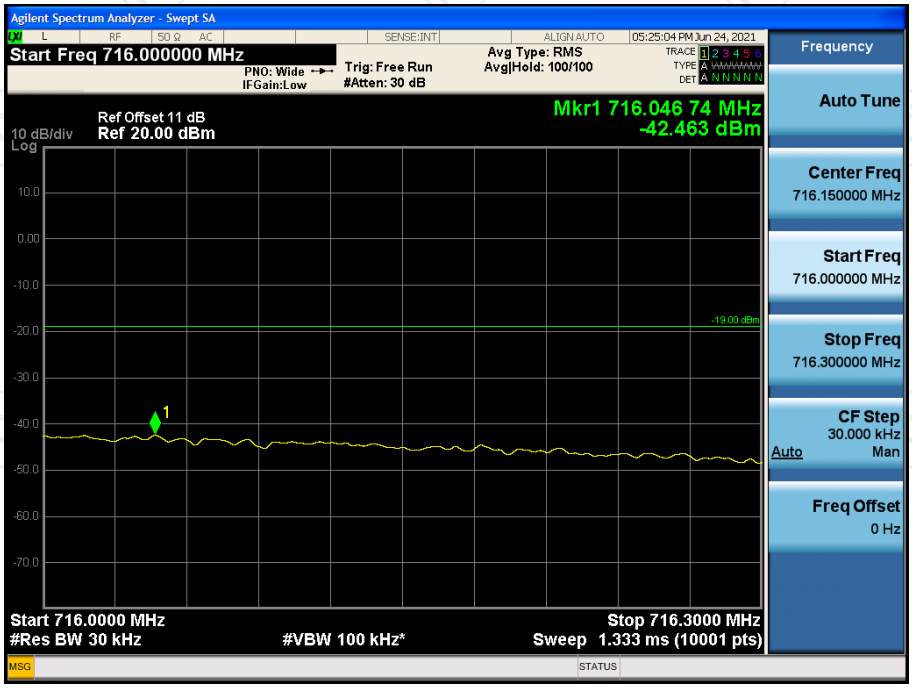

**Lower700MHz CDMA UL Left Side Pre AGC+10dB**



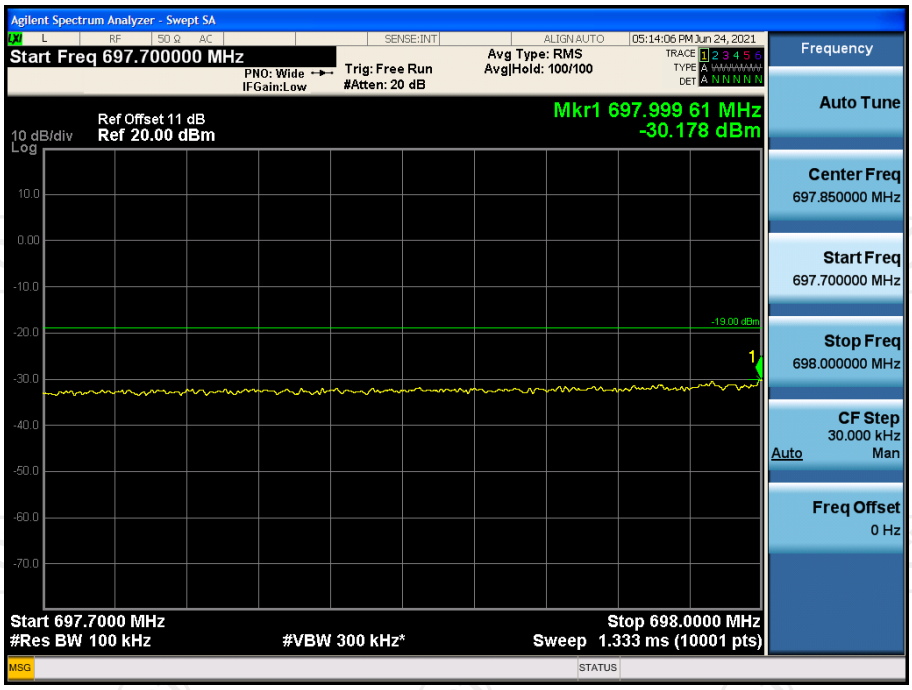
**Lower700MHz CDMA UL Right Side Pre AGC**



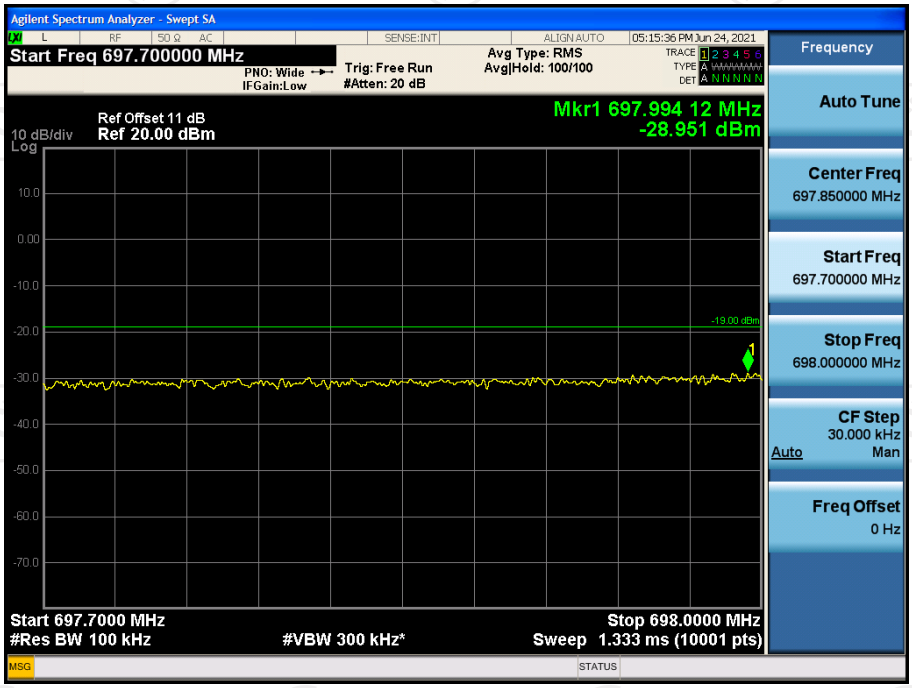

**Lower700MHz CDMA UL Right Side Pre AGC+10dB**



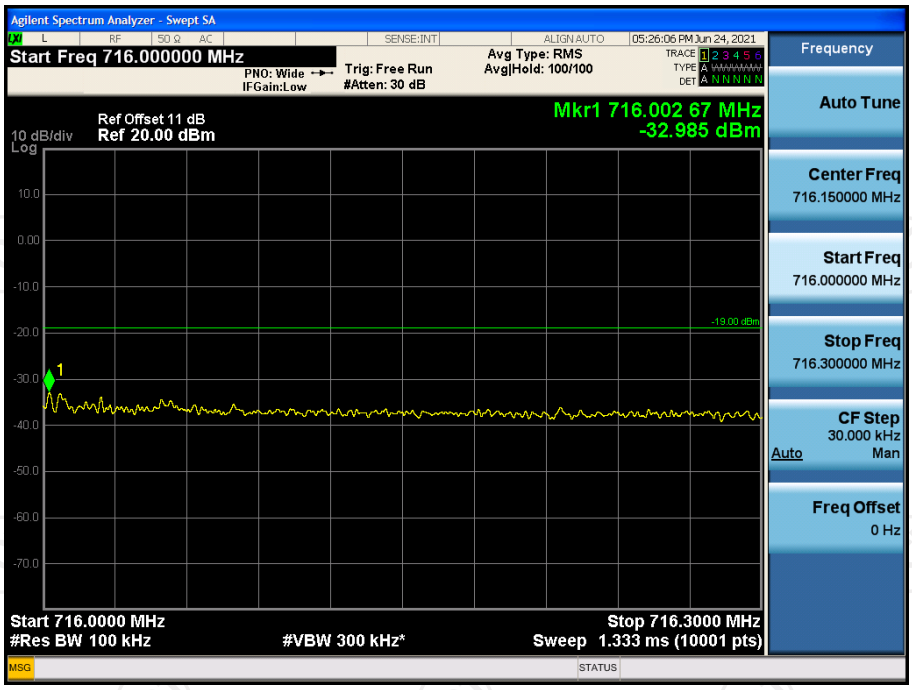
**Lower700MHz LTE UL Left Side Pre AGC**



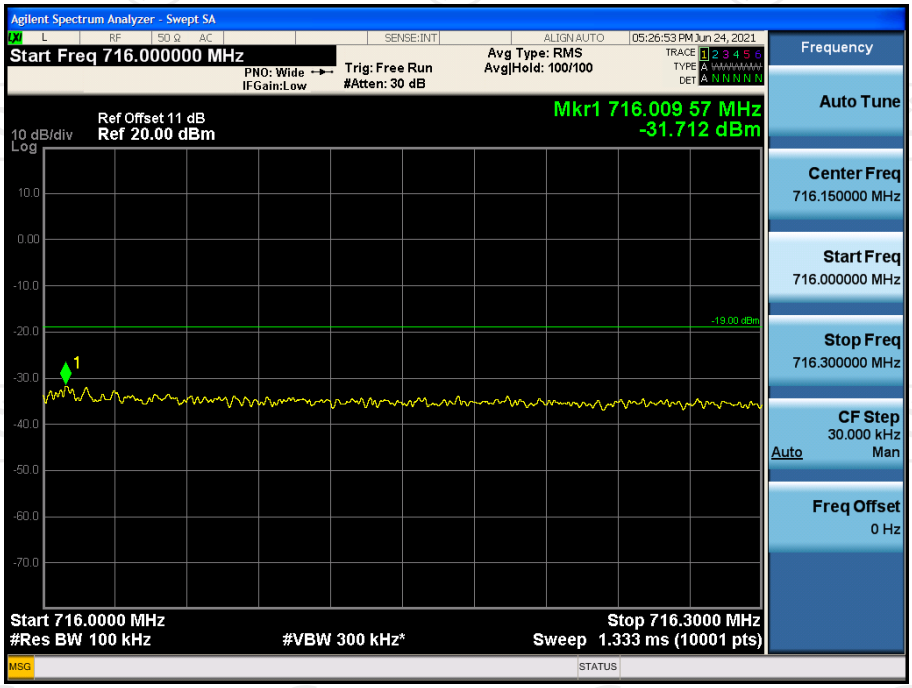

**Lower700MHz LTE UL Left Side Pre AGC+10dB**



**Lower700MHz LTE UL Right Side Pre AGC**




**Lower700MHz LTE UL Right Side Pre AGC+10dB**

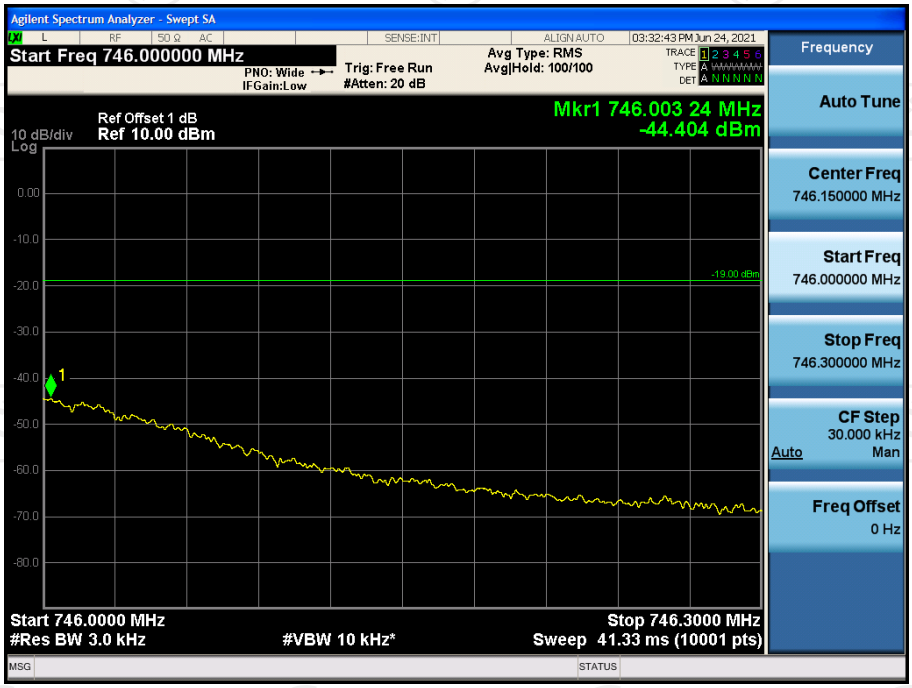


**Lower700MHz GSM DL Left Side Pre AGC**

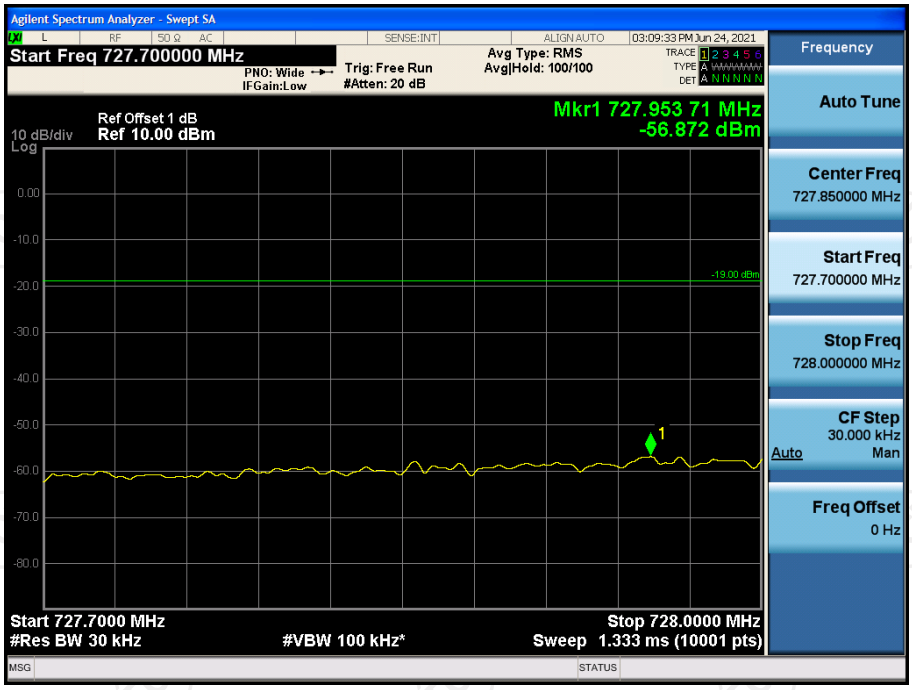
**Lower700MHz GSM DL Left Side Pre AGC+10dB**

**Lower700MHz GSM DL Right Side Pre AGC**

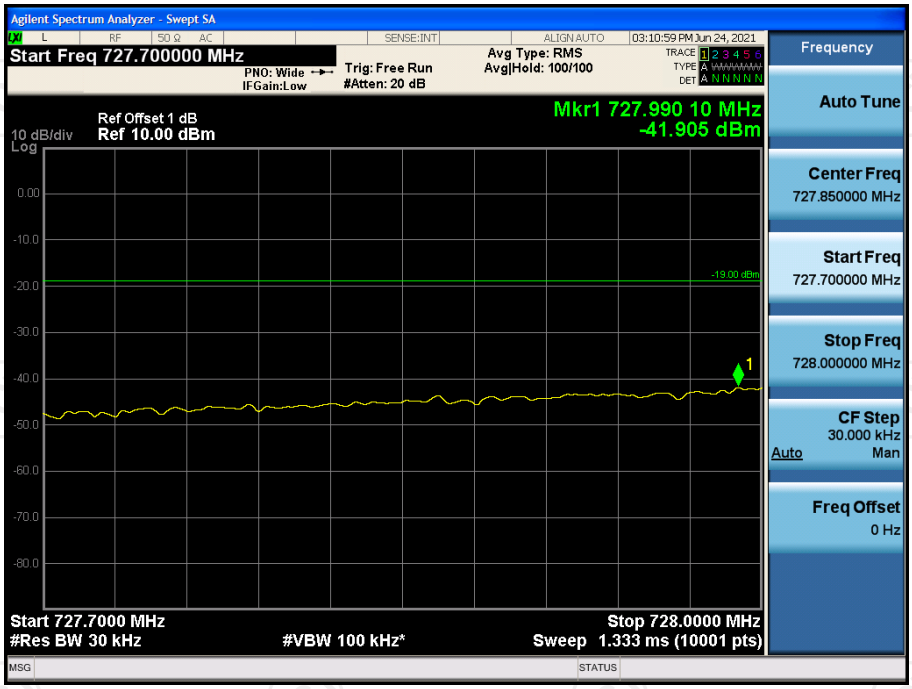
**Lower700MHz GSM DL Right Side Pre AGC+10dB**



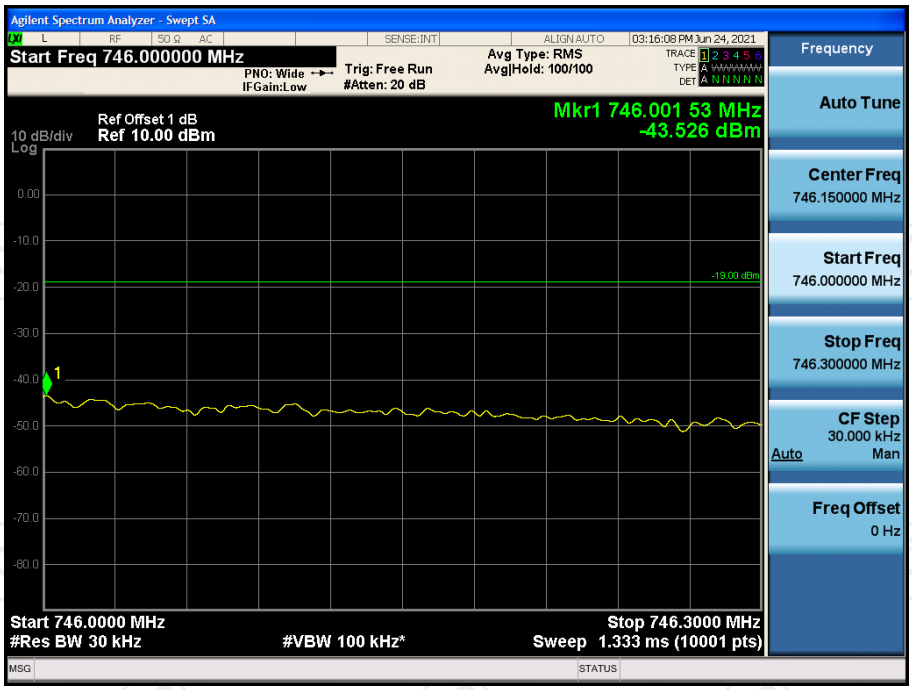
**Lower700MHz CDMA DL Left Side Pre AGC**



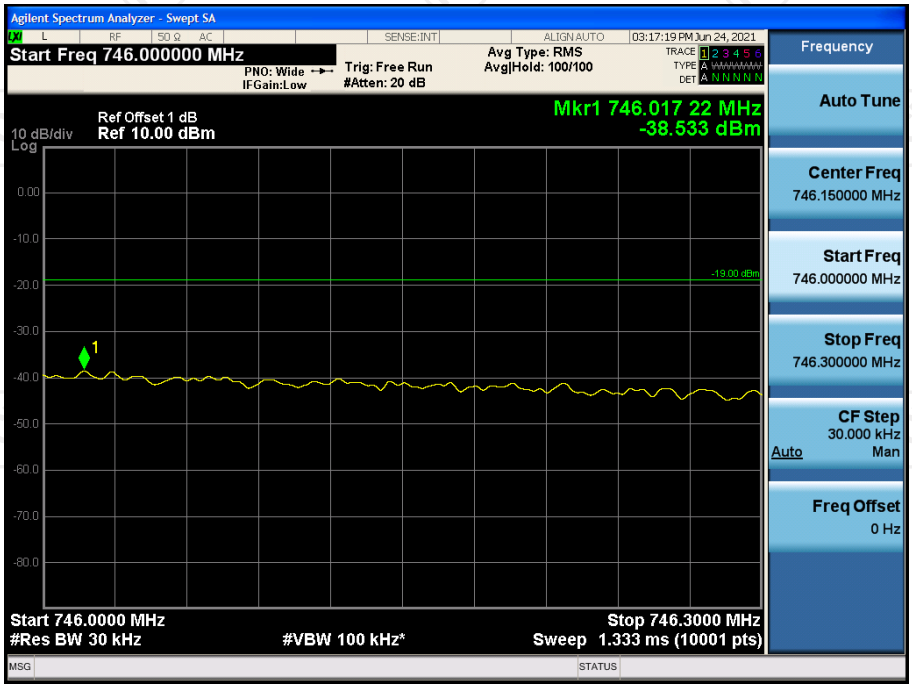

**Lower700MHz CDMA DL Left Side Pre AGC+10dB**



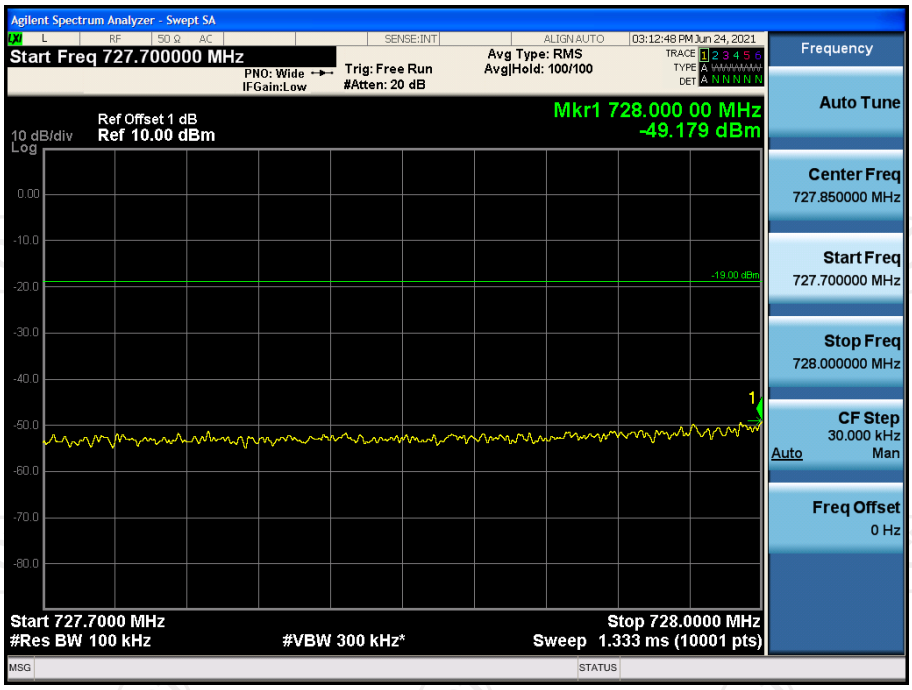
**Lower700MHz CDMA DL Right Side Pre AGC**



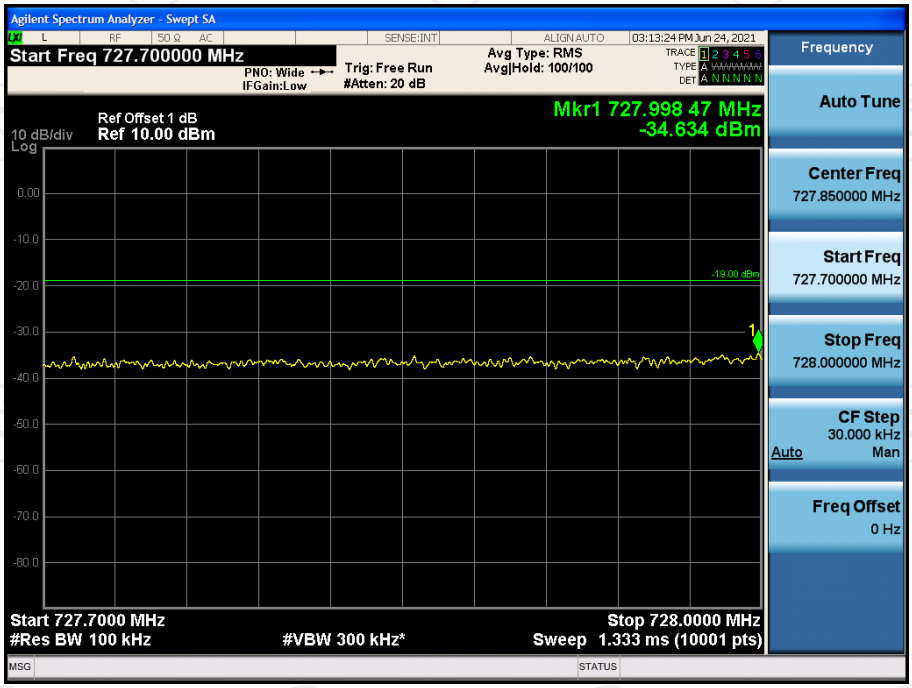

**Lower700MHz CDMA DL Right Side Pre AGC+10dB**



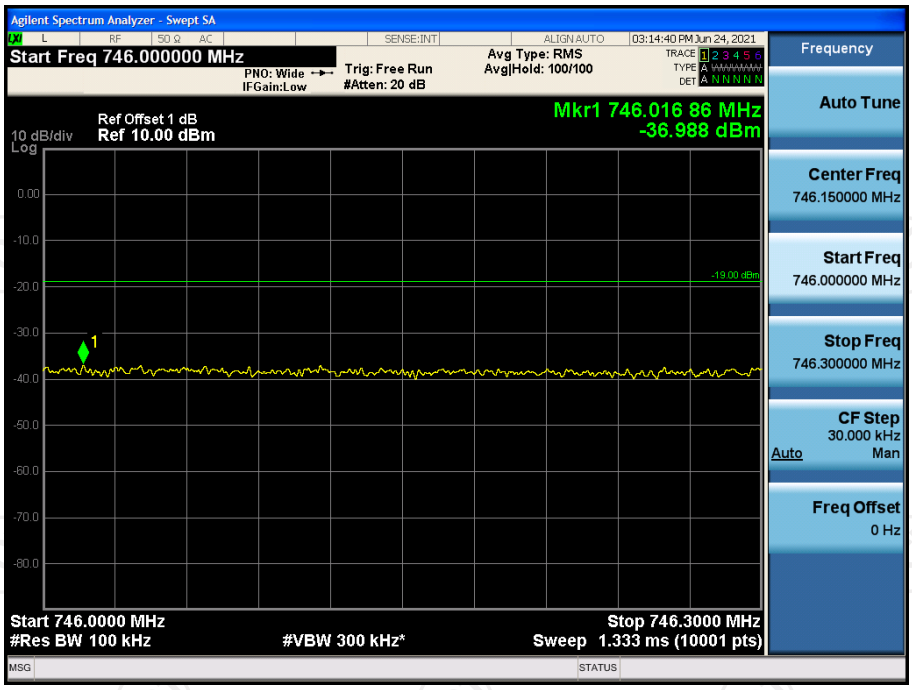
**Lower700MHz LTE DL Left Side Pre AGC**



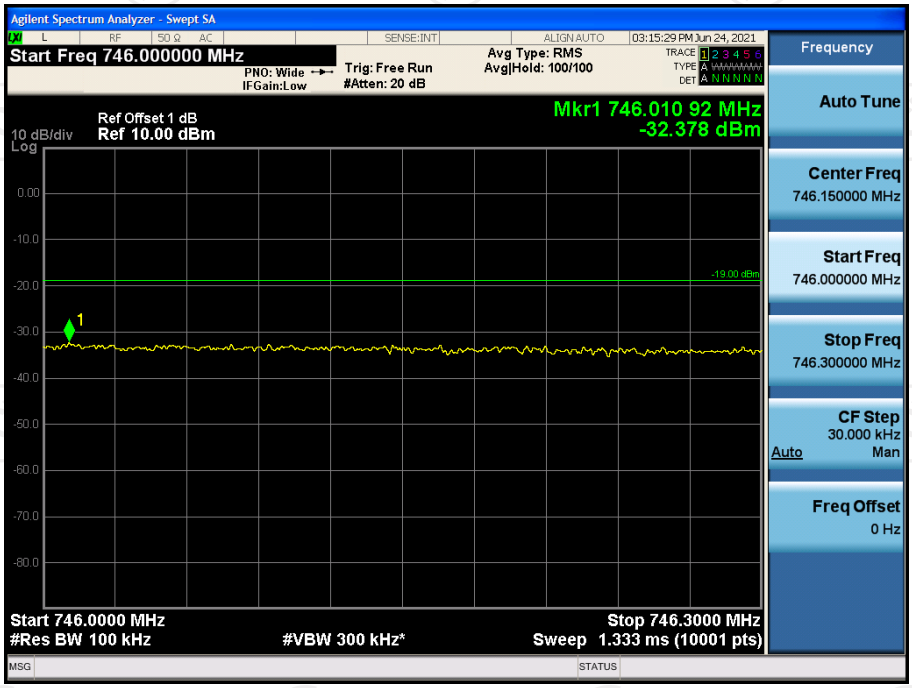

**Lower700MHz LTE DL Left Side Pre AGC+10dB**



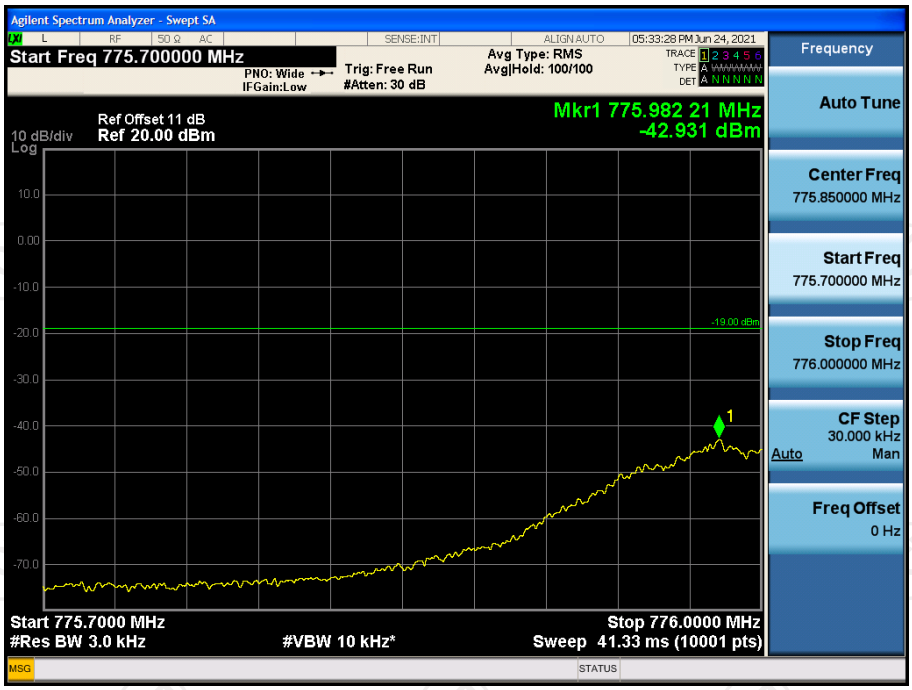
**Lower700MHz LTE DL Right Side Pre AGC**



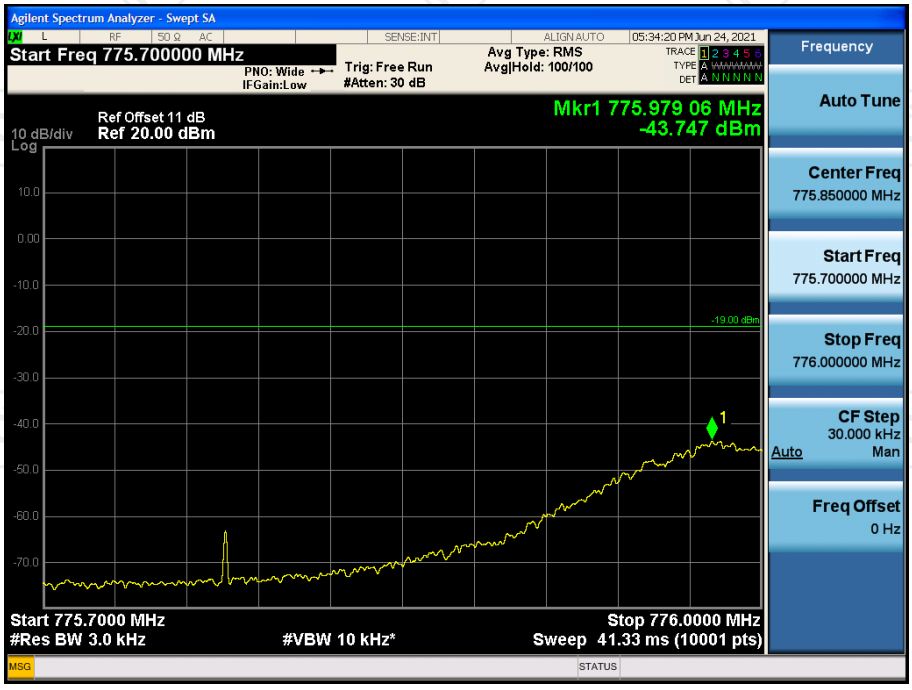

**Lower700MHz LTE DL Right Side Pre AGC+10dB**



**Upper700MHz GSM UL Left Side Pre AGC**



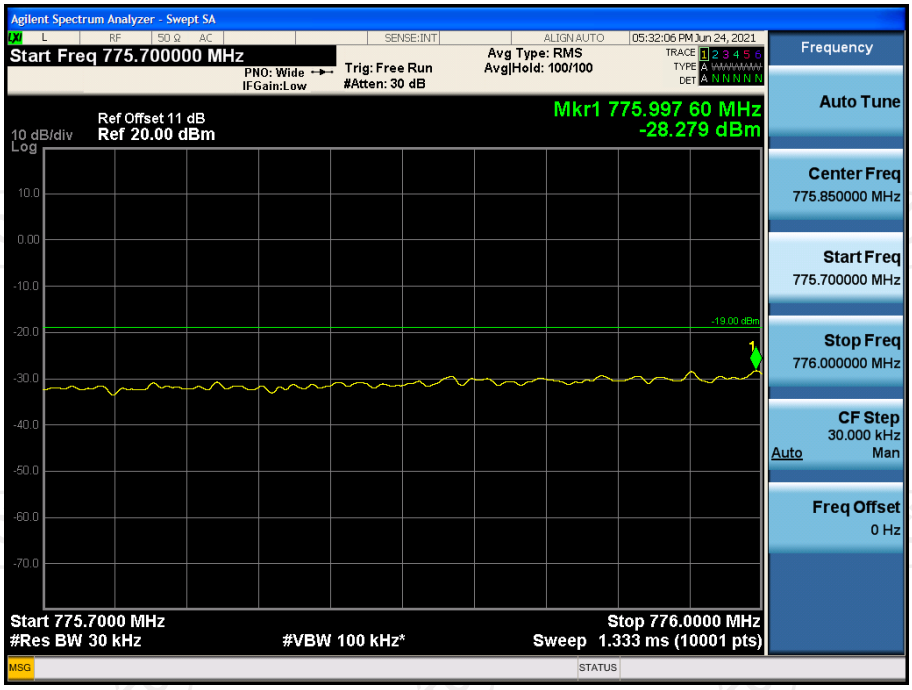

**Upper700MHz GSM UL Left Side Pre AGC+10dB**



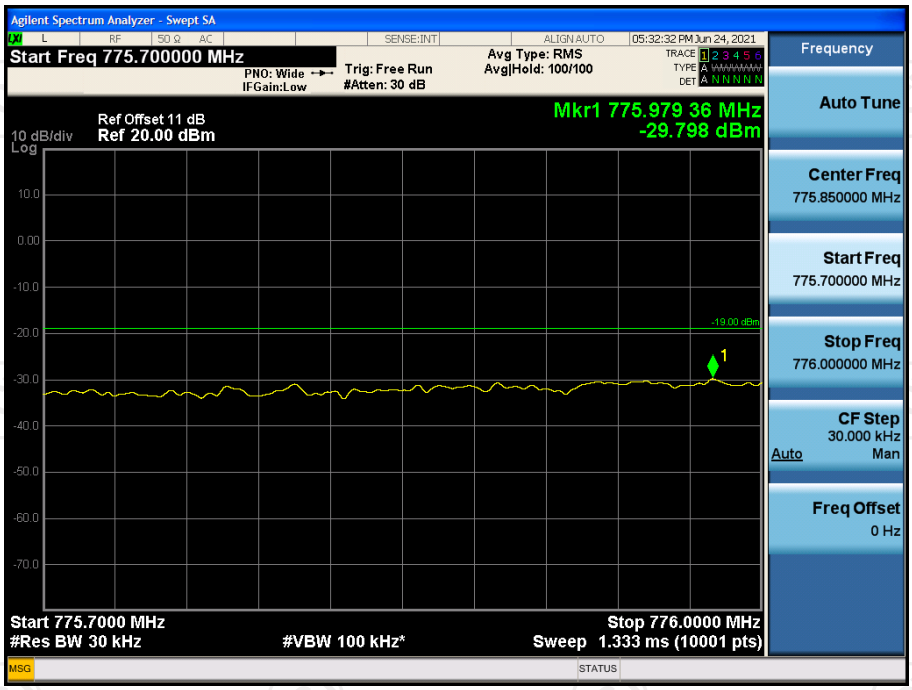
**Upper700MHz GSM UL Right Side Pre AGC**

**Upper700MHz GSM UL Right Side Pre AGC+10dB**

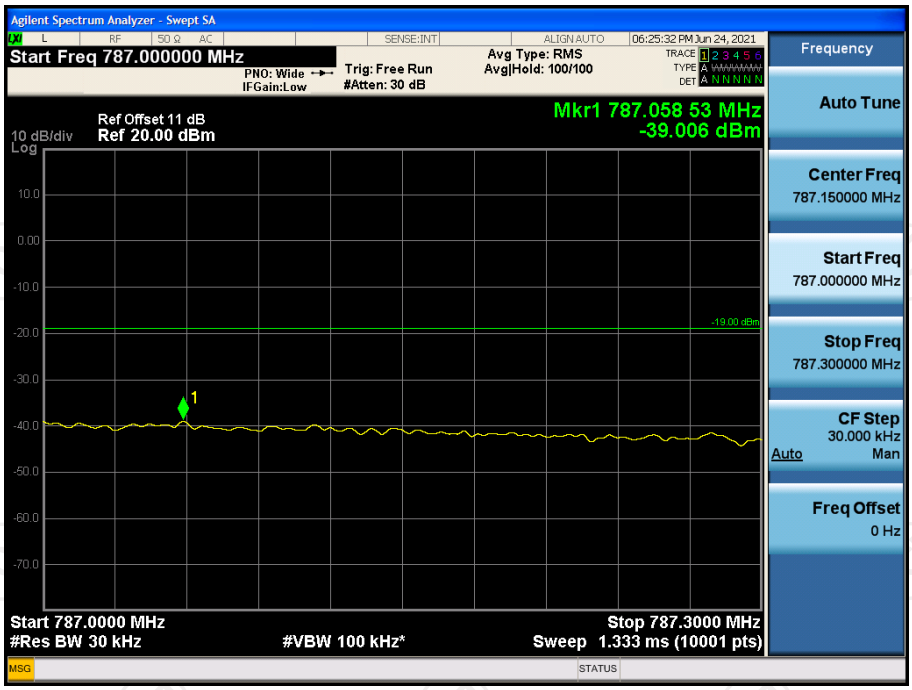
**Upper700MHz CDMA UL Left Side Pre AGC**



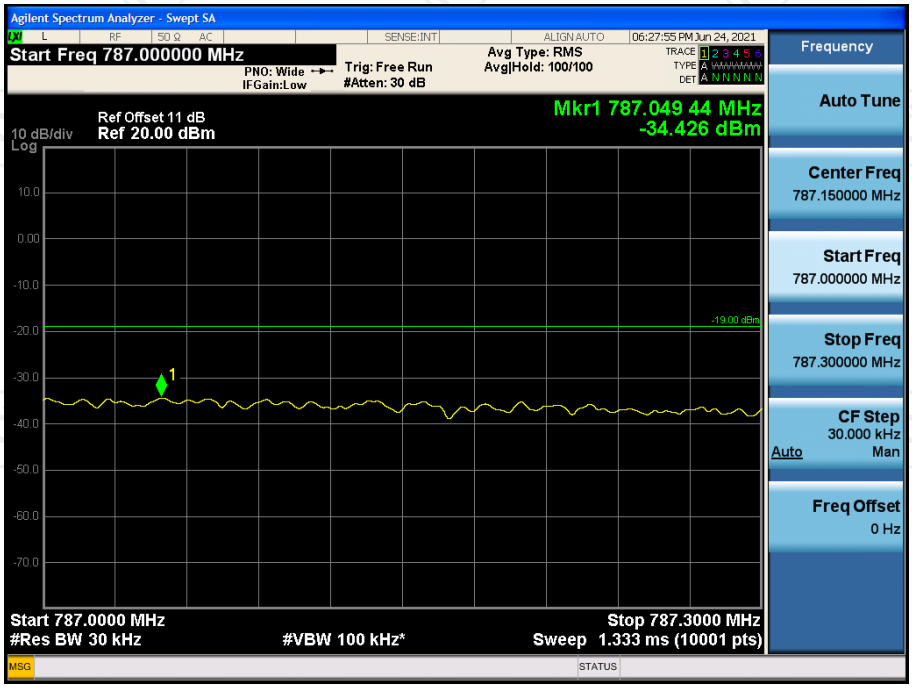

**Upper700MHz CDMA UL Left Side Pre AGC+10dB**



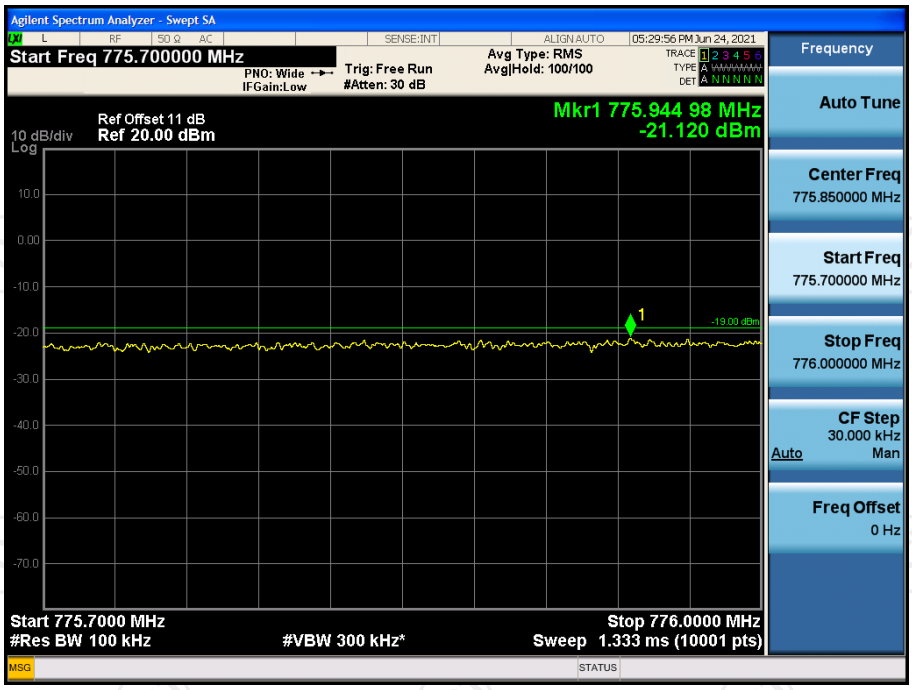
**Upper700MHz CDMA UL Right Side Pre AGC**



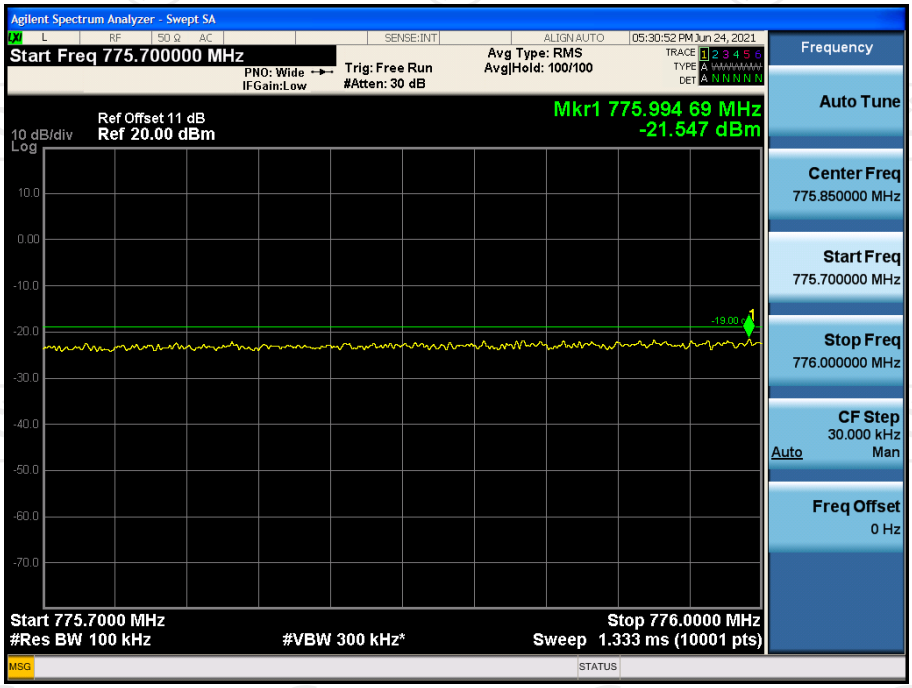

**Upper700MHz CDMA UL Right Side Pre AGC+10dB**



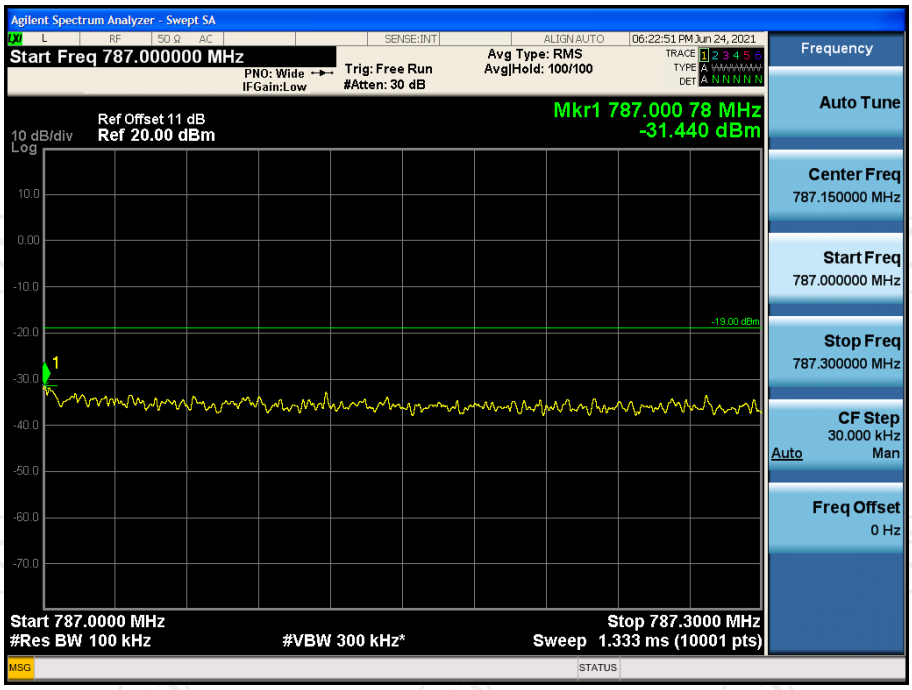
**Upper700MHz LTE UL Left Side Pre AGC**



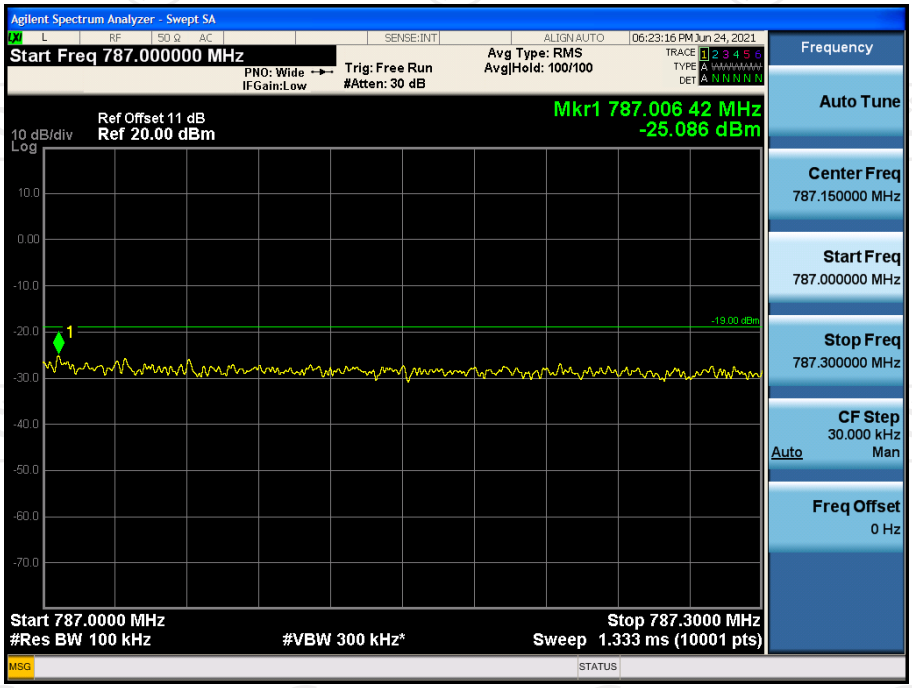

**Upper700MHz LTE UL Left Side Pre AGC+10dB**



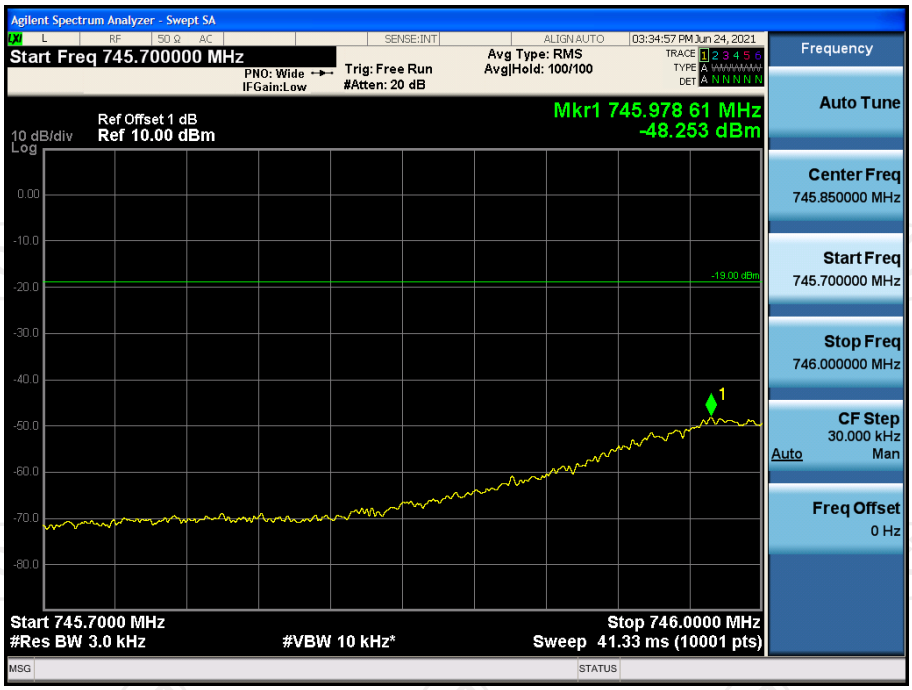
**Upper700MHz LTE UL Right Side Pre AGC**




**Upper700MHz LTE UL Right Side Pre AGC+10dB**



**Upper700MHz GSM DL Left Side Pre AGC**

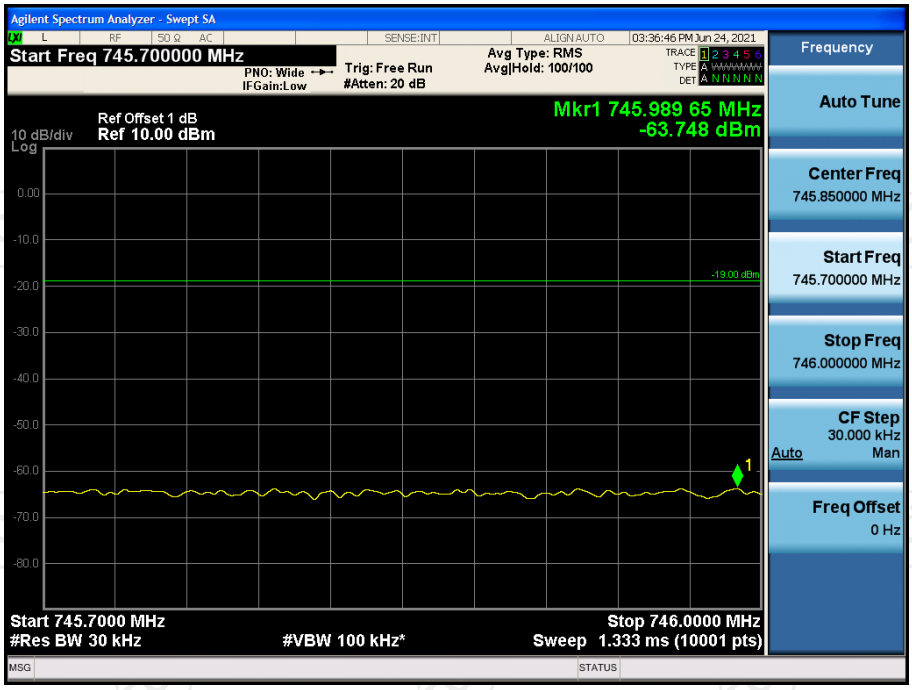



**Upper700MHz GSM DL Left Side Pre AGC+10dB**

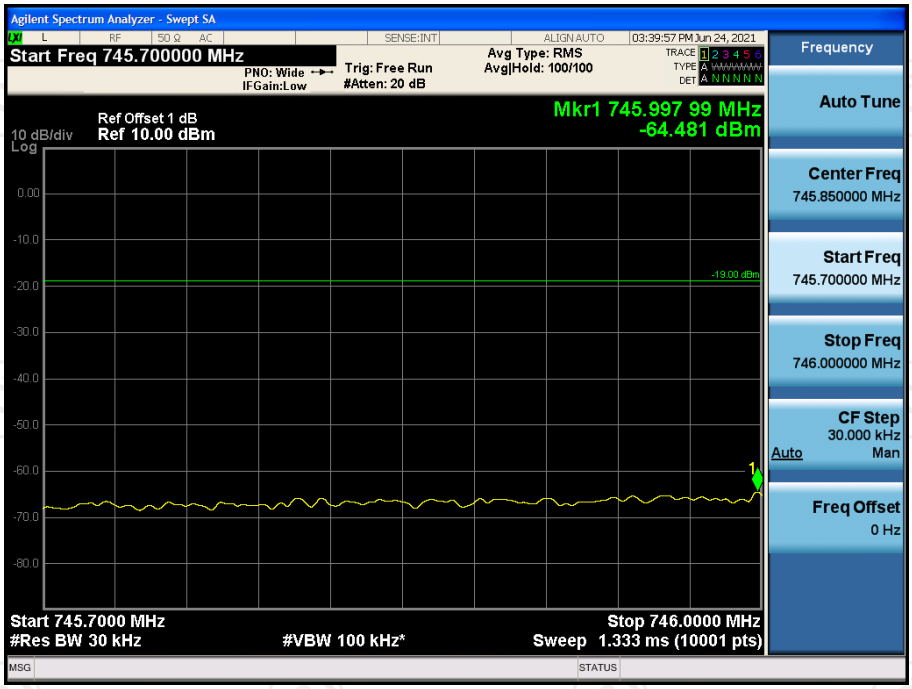
**Upper700MHz GSM DL Right Side Pre AGC**

**Upper700MHz GSM DL Right Side Pre AGC+10dB**

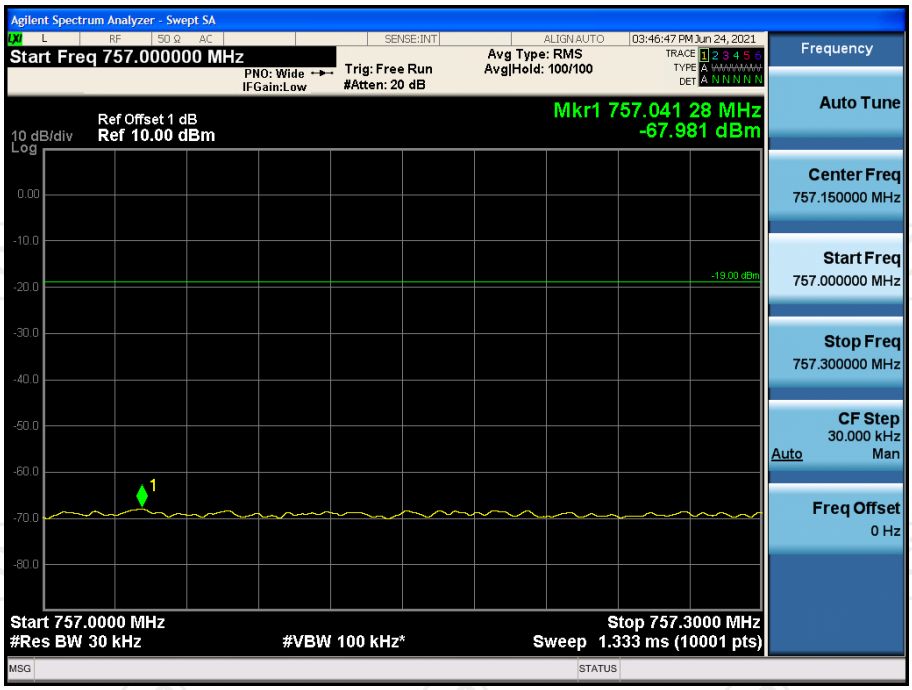
**Upper700MHz CDMA DL Left Side Pre AGC**



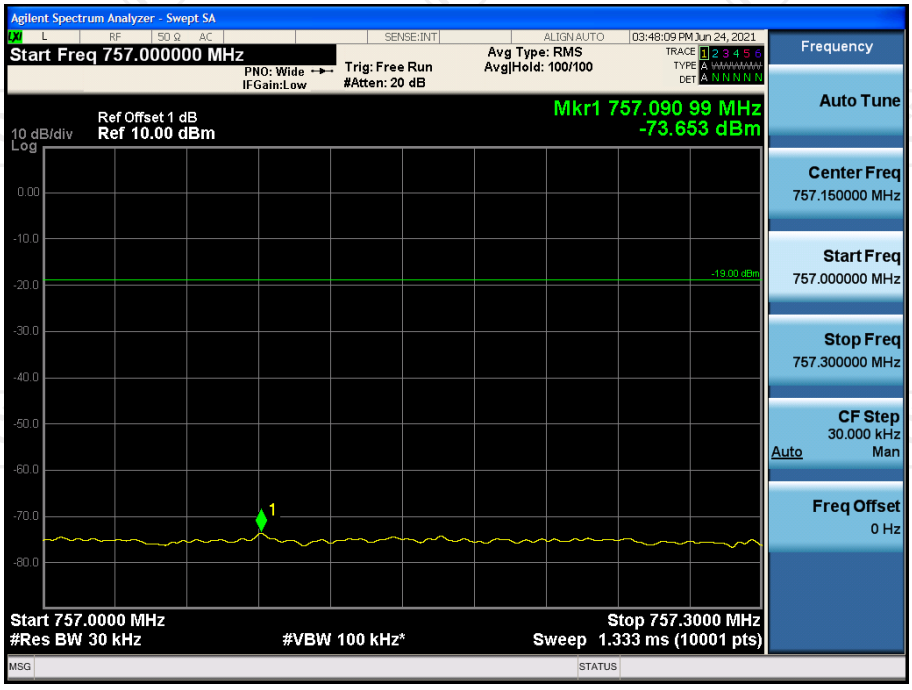

**Upper700MHz CDMA DL Left Side Pre AGC+10dB**



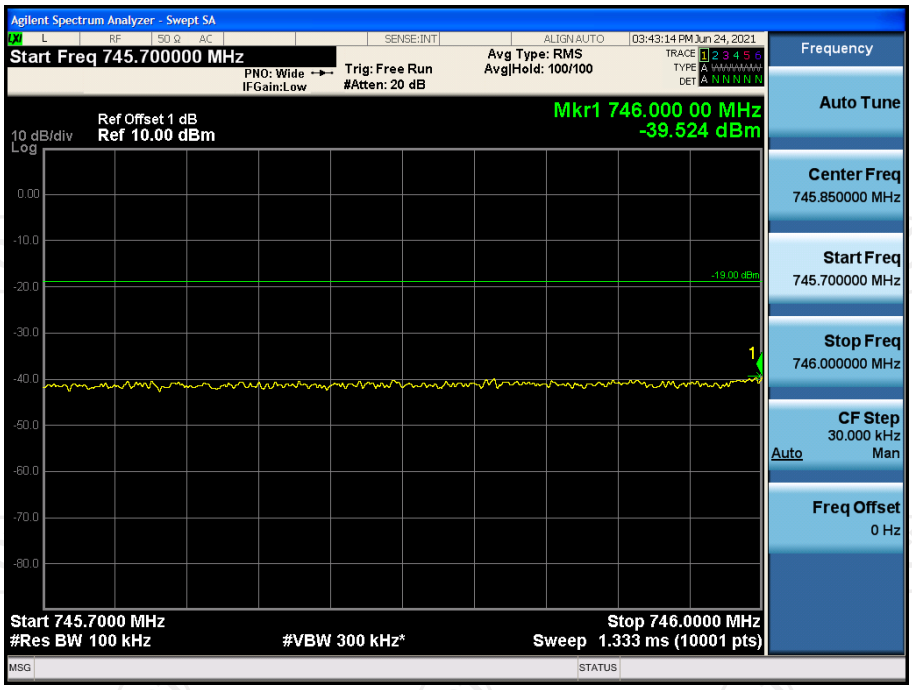
**Upper700MHz CDMA DL Right Side Pre AGC**



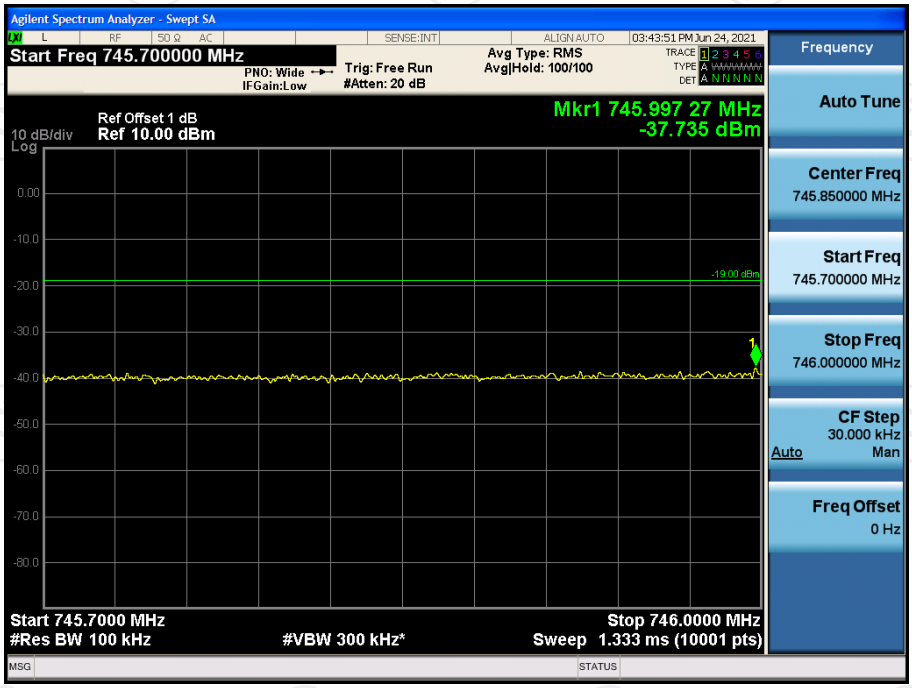

**Upper700MHz CDMA DL Right Side Pre AGC+10dB**



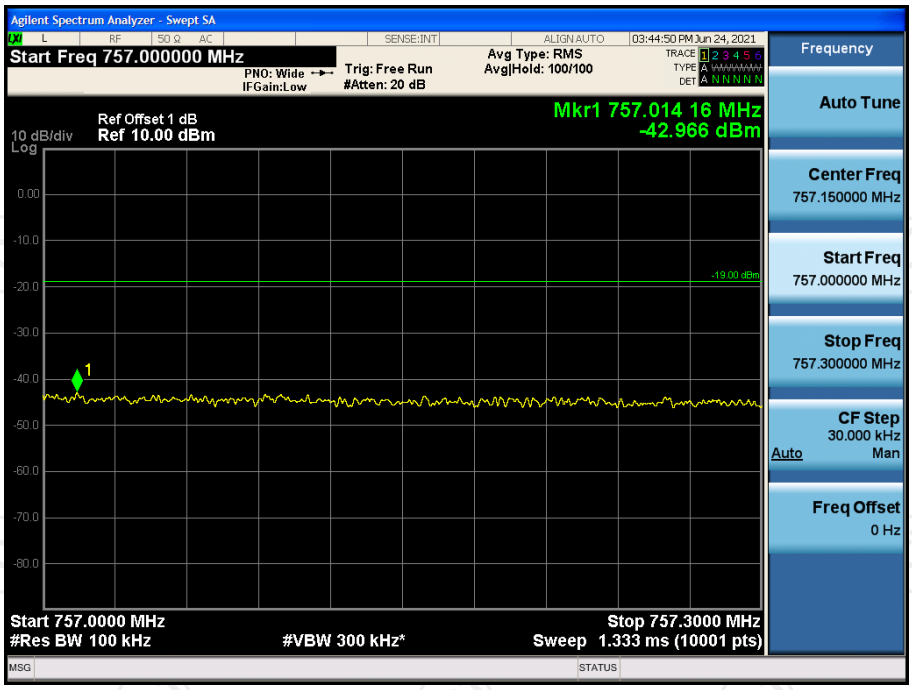
**Upper700MHz LTE DL Left Side Pre AGC**



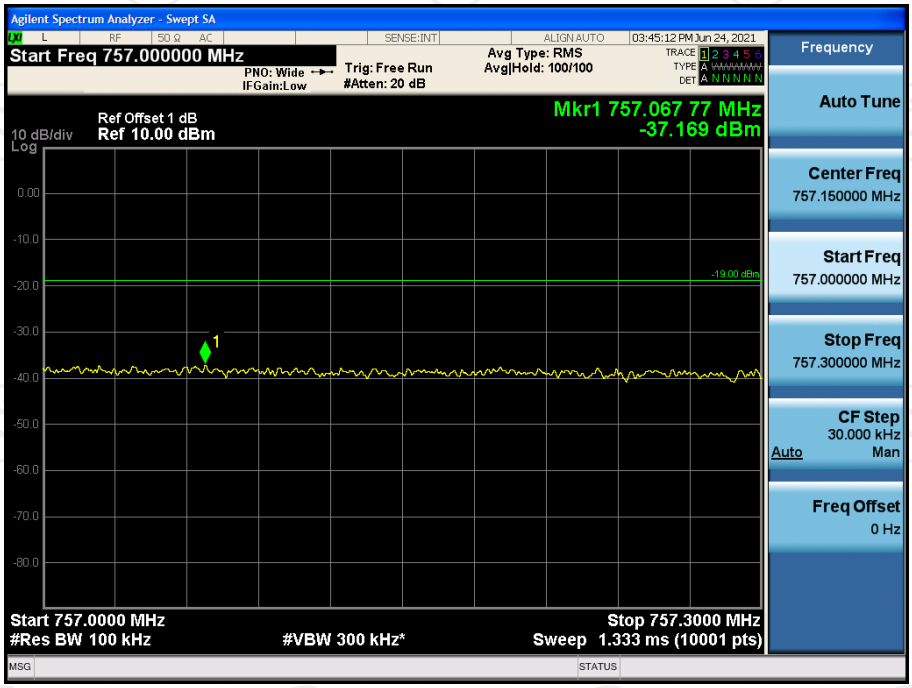

**Upper700MHz LTE DL Left Side Pre AGC+10dB**



**Upper700MHz LTE DL Right Side Pre AGC**

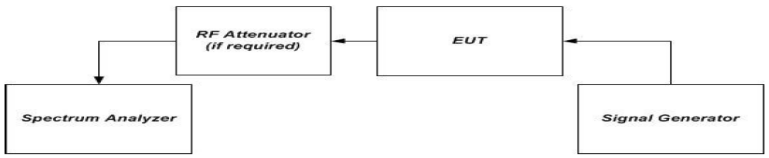



**Upper700MHz LTE DL Right Side Pre AGC+10dB**



## 5.5. Conducted Spurious Emission

### 5.5.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part2 Section 1051; FCC Rules Part 27 Subpart C, Section 27.53 |
| **Test Method:** | KDB 935210 D03 Signal Booster Measurements v04r04 |
| **Limit:** | -13 dBm |
| **Test Setup:** |  |
| **Test Procedure:** | a) Connect the EUT to the test equipment as shown in Set-Up. Begin with the uplink output connected to the spectrum analyzer.<br>b) Configure the signal generator for AWGN with a 99% occupied bandwidth of 4.1 MHz operation with a center frequency corresponding to the center of the CMRS band under test.<br>c) Set the signal generator amplitude to the level determined in the power measurement procedure in Maximum power.<br>d) Turn on the signal generator RF output and measure the spurious emission power levels with an appropriate measurement instrument as follows.<br>e) Set RBW = measurement bandwidth specified in the applicable rule section for the operational frequency band under consideration (see Annex A for relevant cross-references). Note that many of the individual rule sections permit the use of a narrower RBW (typically ≥ 1% of the emission bandwidth) to enhance measurement accuracy, but the result must then be integrated over the specified measurement bandwidth.<br>f) Set VBW = 3 X RBW.<br>g) Select the power averaging (RMS) detector. (See above note regarding the use of a peak detector for preliminary measurements.)<br>h) Sweep time = auto-couple.<br>i) Set the analyzer start frequency to the lowest radio frequency signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. Note that the number of measurement points in each sweep must be ≥ (2 X span/RBW) which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the spectrum analyzer. Trace average at least 10 traces in power averaging (i.e., RMS) mode.<br>j) Use the peak marker function to identify the highest amplitude level over each measured frequency range Record the frequency and amplitude and capture a Test Plots for inclusion in the test report.<br>k) Reset the analyzer start frequency to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the analyzer stop frequency to 10 times the highest frequency of the fundamental emission. Note that the number of measurement points in each sweep must be ≥ (2 X span/RBW) which may require that the measurement range defined by the start and stop frequencies above be subdivided, depending on the available number of measurement points provided by the |

| | |
|---|---|
| | spectrum analyzer.<br>l) Use the peak marker function to identify the highest amplitude level over each of the measured frequency ranges. Record the frequency and amplitude and capture a Test Plots for inclusion in the test report.<br>m) Repeat steps b) through l) for each supported frequency band of operation. |
| **Test Result:** | PASS |

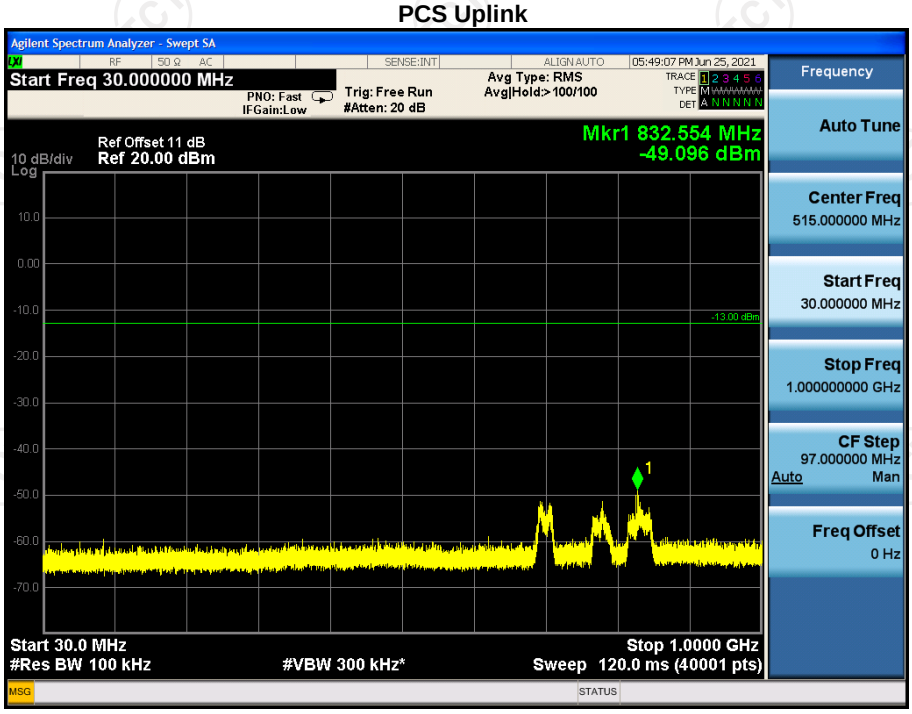
### 5.5.2. Test Instruments

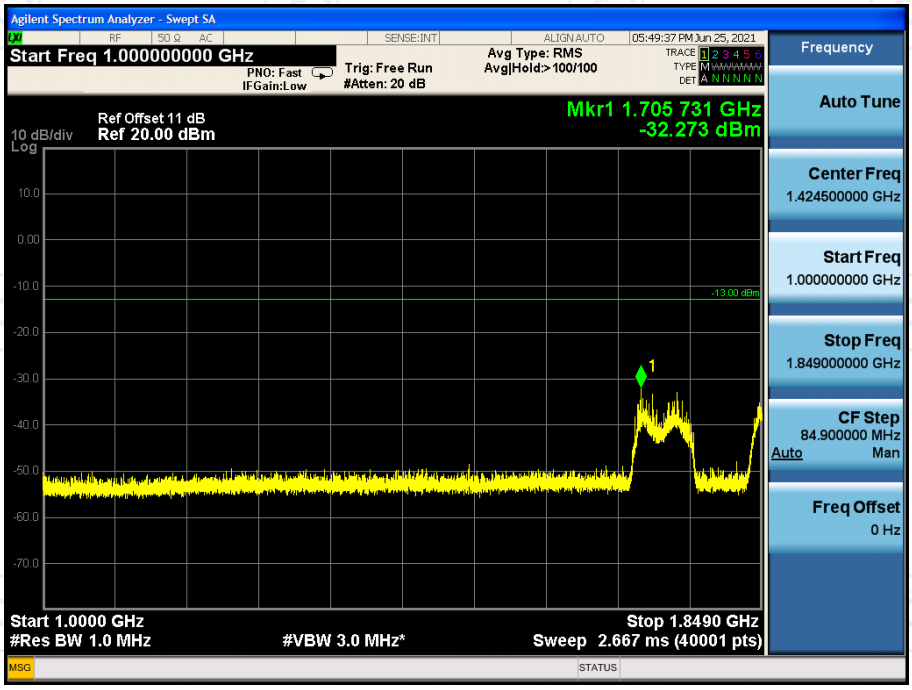
| Equipment | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| Signal Generator | Agilent | N5182A | MY47070282 | Sep. 03, 2020 | Sep. 02, 2021 |
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 12, 2020 | Sep. 11, 2021 |
| Attenuator | 50FP-006-H3 | JFW | 907763 | Sep. 12, 2020 | Sep. 11, 2021 |

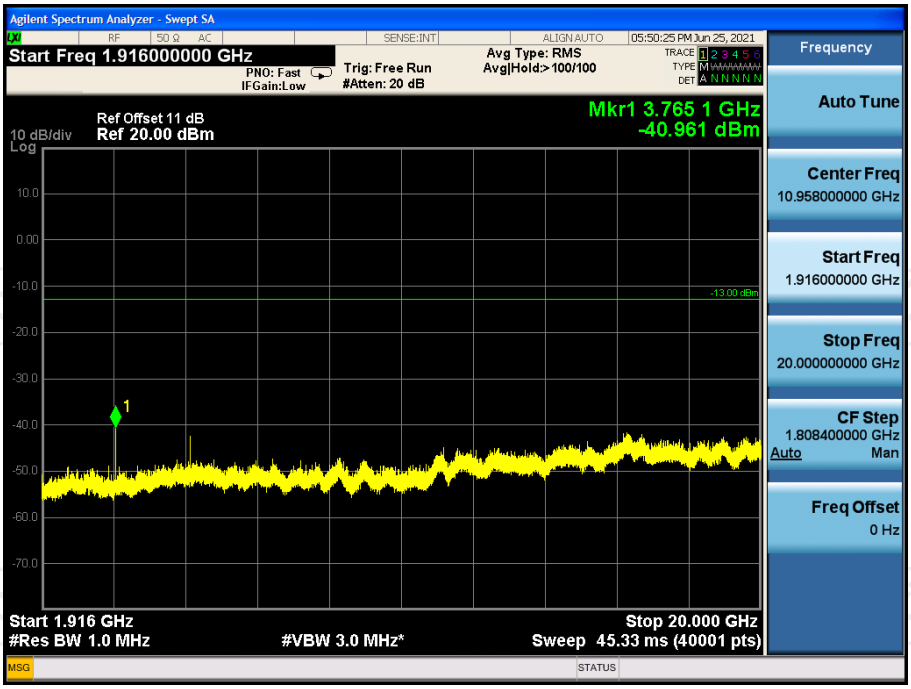
### 5.5.3. Test data

**Test Plots**

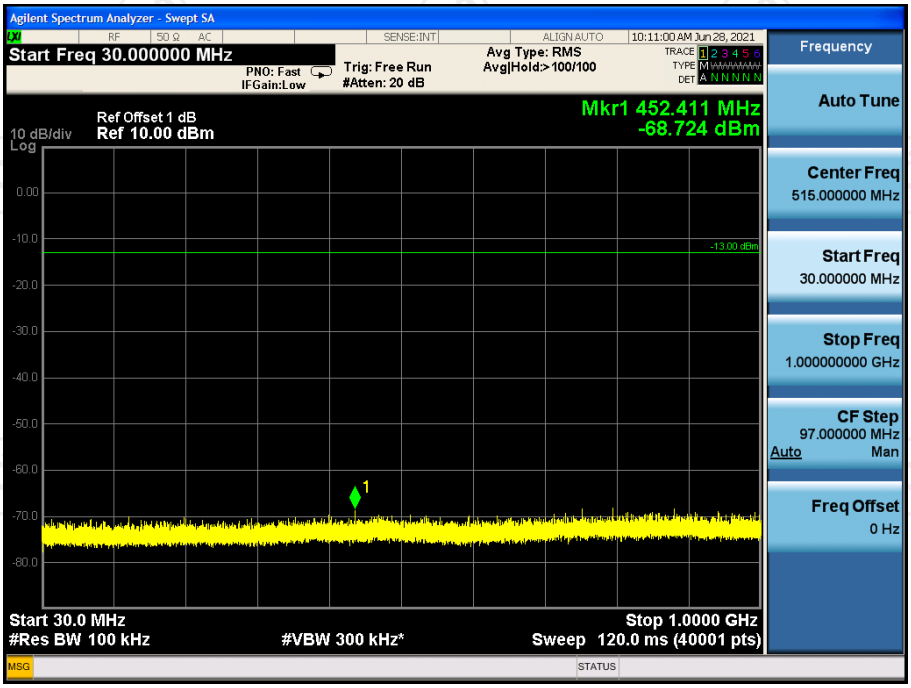
**PCS Uplink**

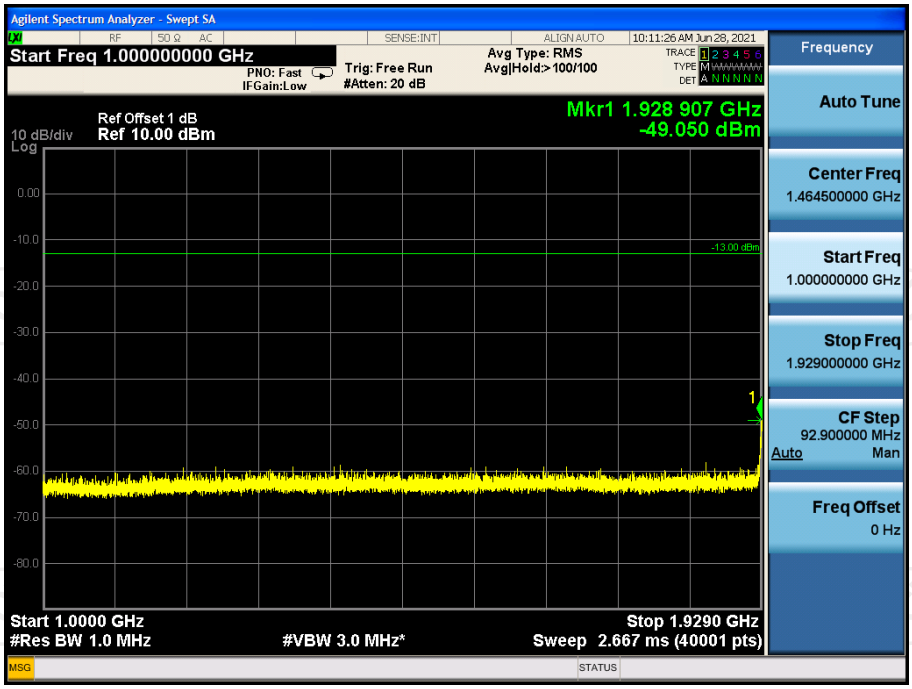


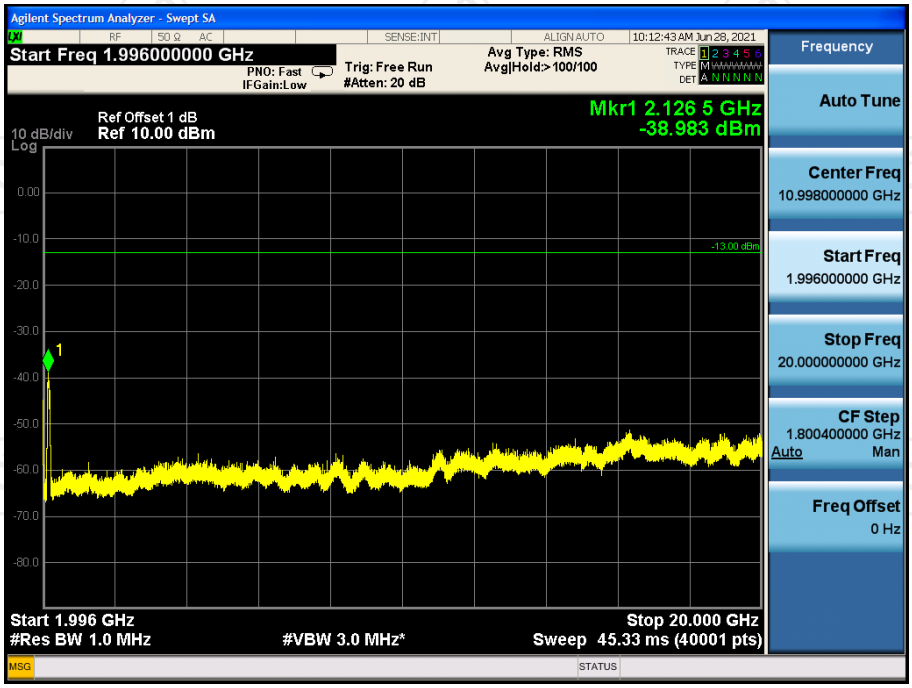






**PCS Downlink**

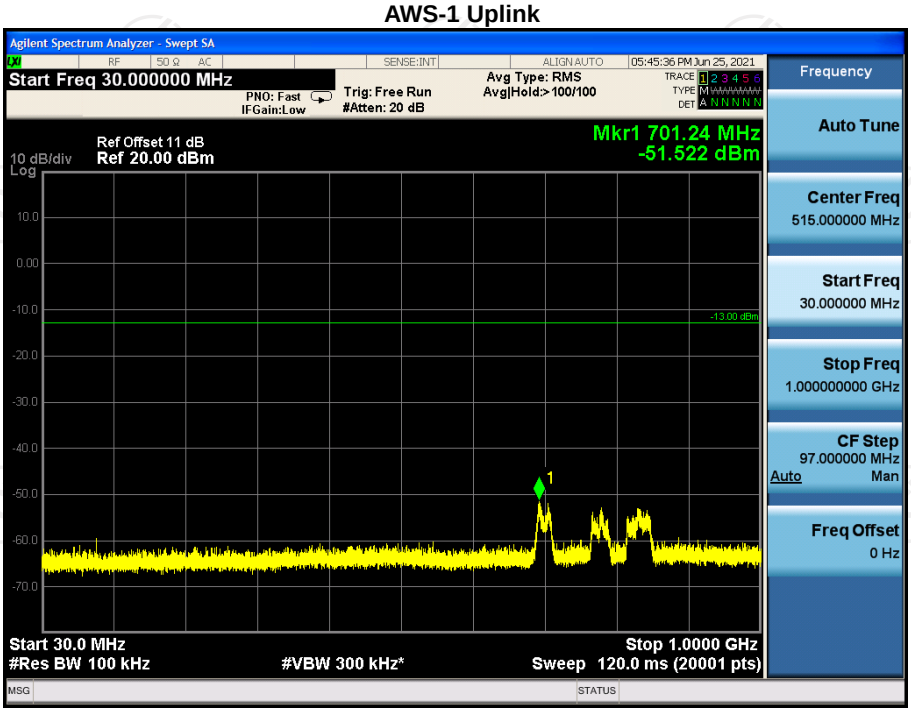


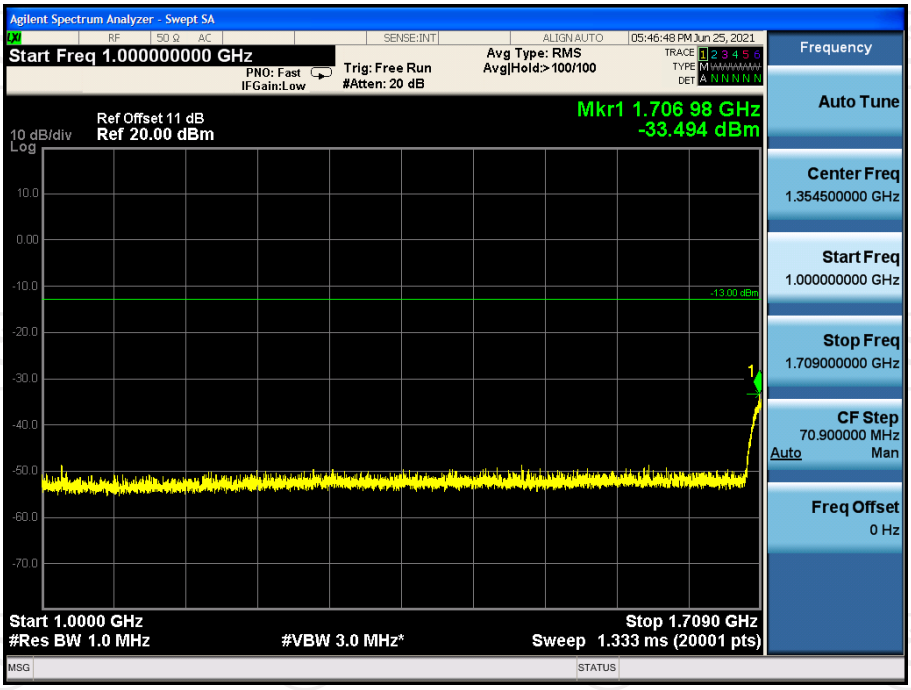

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:11:26 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 1.928 907 GHz
-49.050 dBm
-13.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 1.9290 GHz
Sweep 2.667 ms (40001 pts)
Frequency
Auto Tune
Center Freq
1.464500000 GHz
Start Freq
1.000000000 GHz
Stop Freq
1.929000000 GHz
CF Step
92.900000 MHz
Auto
Man
Freq Offset
0 Hz

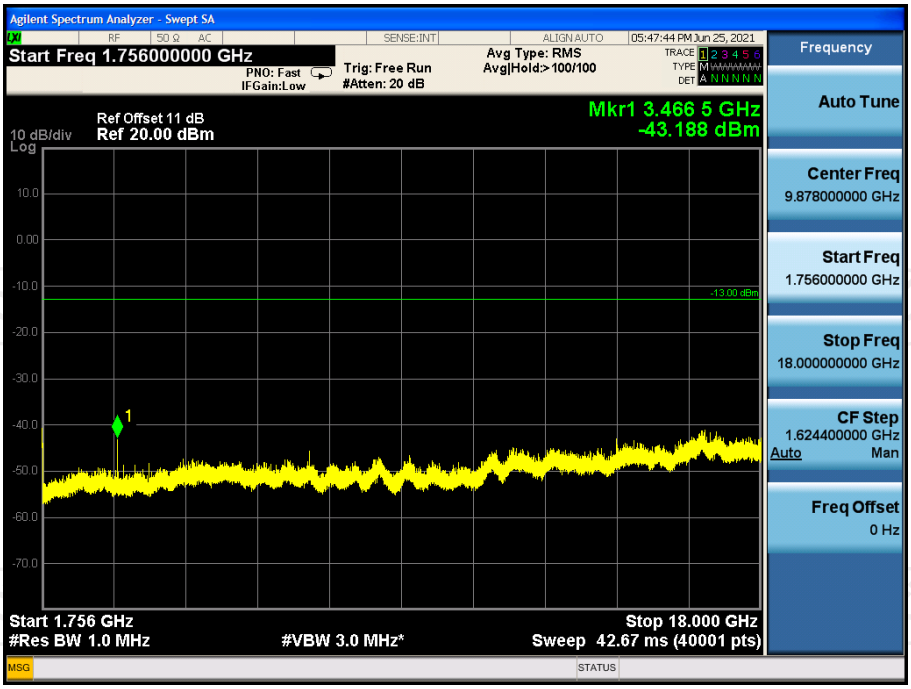

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.996000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:12:43 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 2.126 5 GHz
-38.983 dBm
-13.00 dBm
Start 1.996 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 20.000 GHz
Sweep 45.33 ms (40001 pts)
Frequency
Auto Tune
Center Freq
10.998000000 GHz
Start Freq
1.996000000 GHz
Stop Freq
20.000000000 GHz
CF Step
1.800400000 GHz
Auto
Man
Freq Offset
0 Hz

## Test Plots

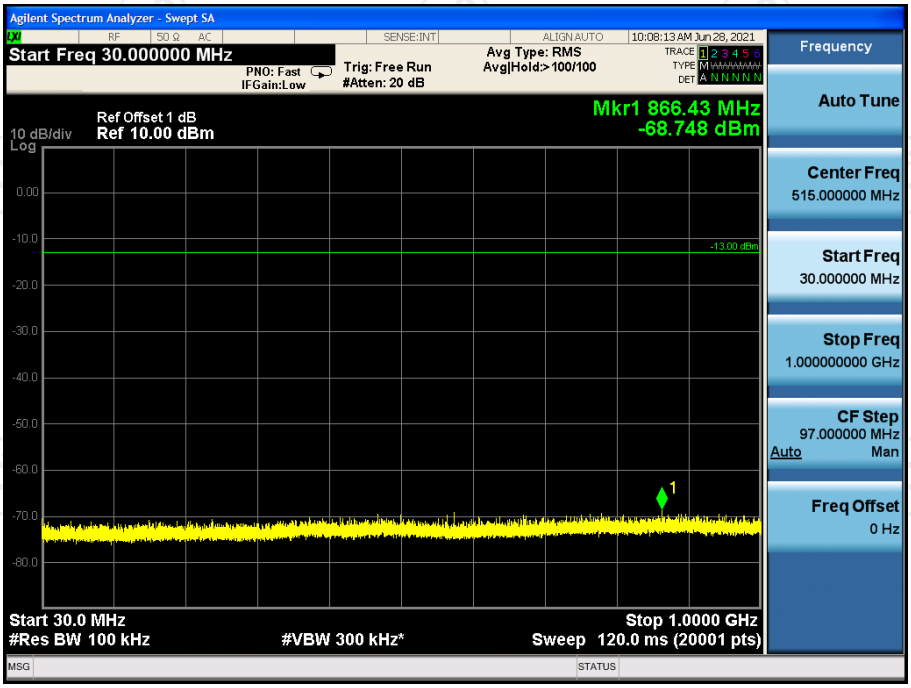
### AWS-1 Uplink

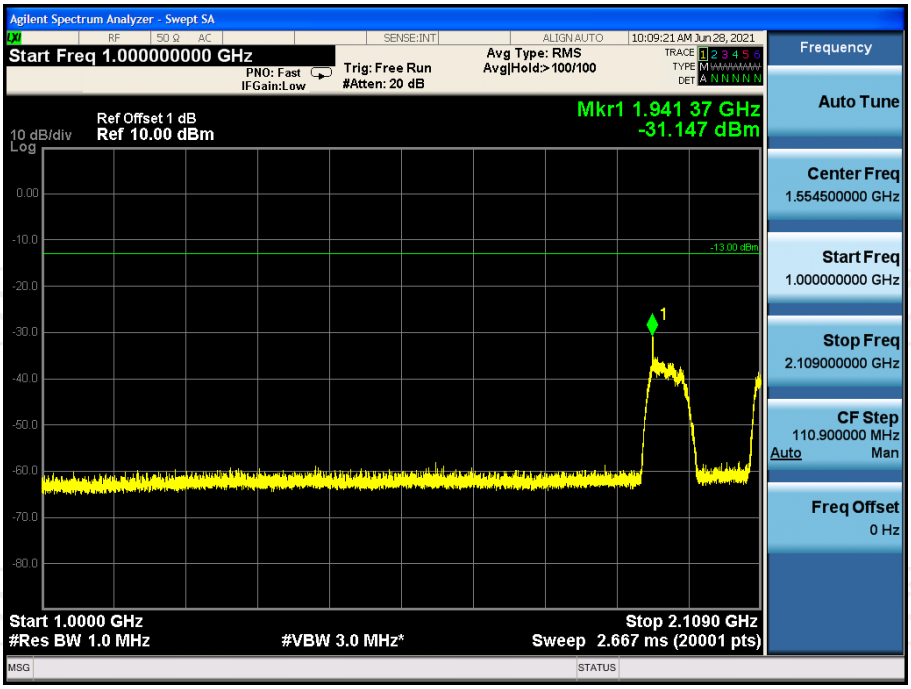


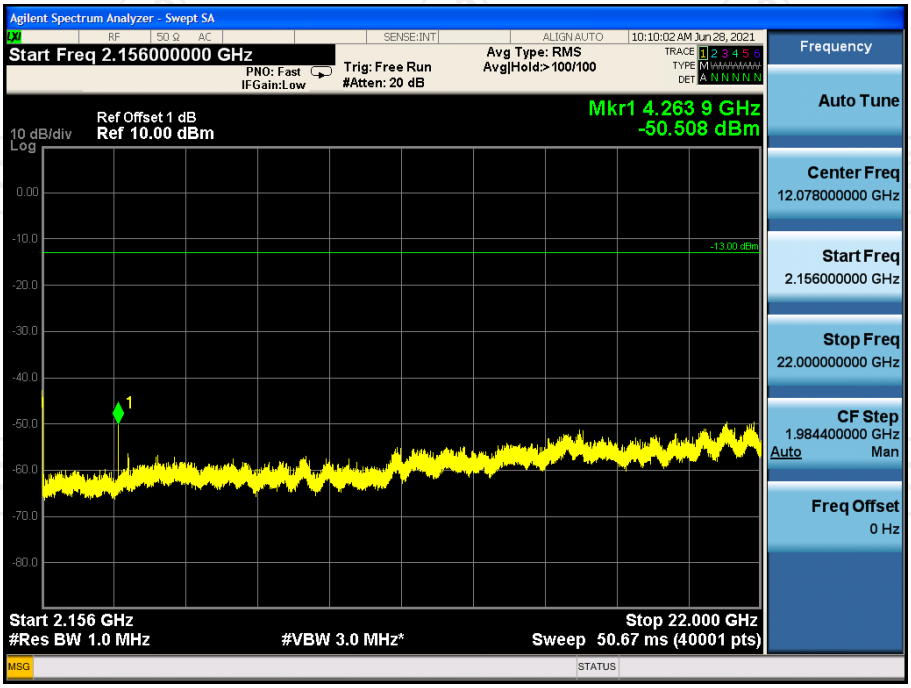






**AWS-1 Downlink**

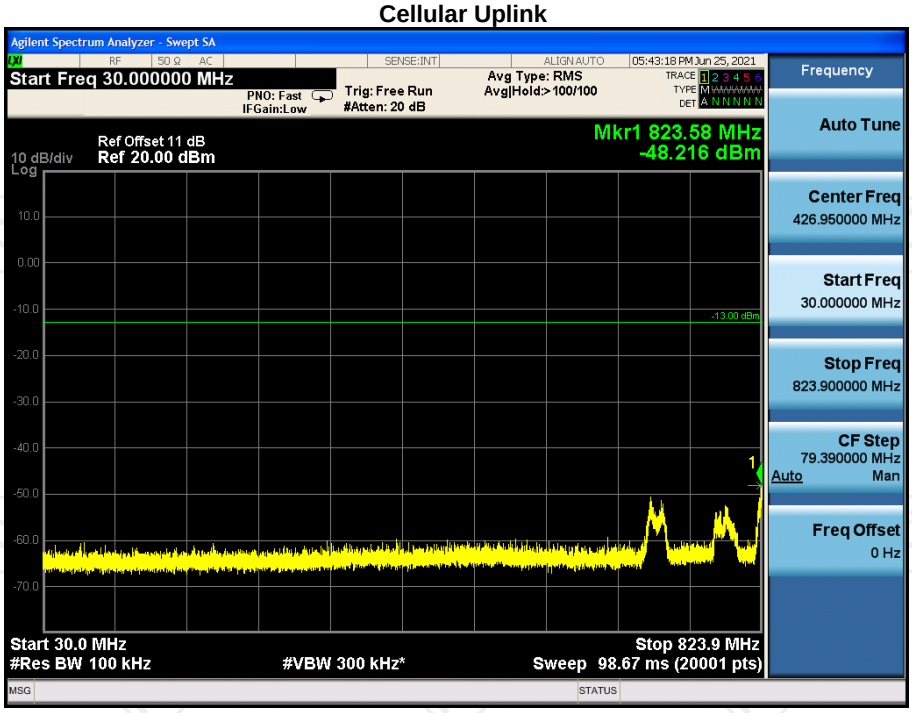


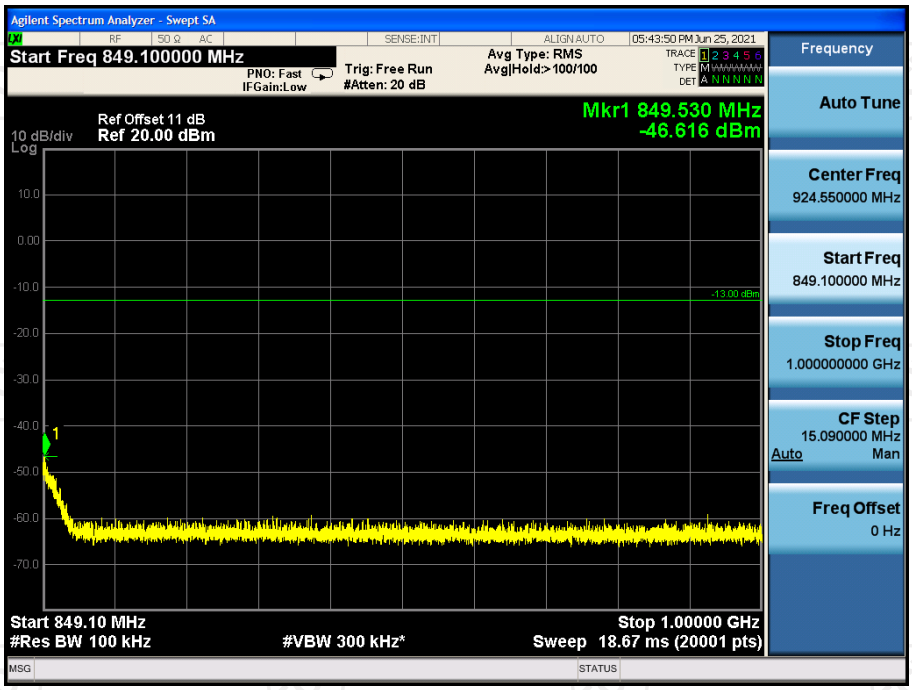

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:09:21 AM Jun 28, 2021
Mkr1 1.941 37 GHz
-31.147 dBm
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
-13.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.1090 GHz
Sweep 2.667 ms (20001 pts)
Frequency
Auto Tune
Center Freq
1.554500000 GHz
Start Freq
1.000000000 GHz
Stop Freq
2.109000000 GHz
CF Step
110.900000 MHz
Auto
Man
Freq Offset
0 Hz

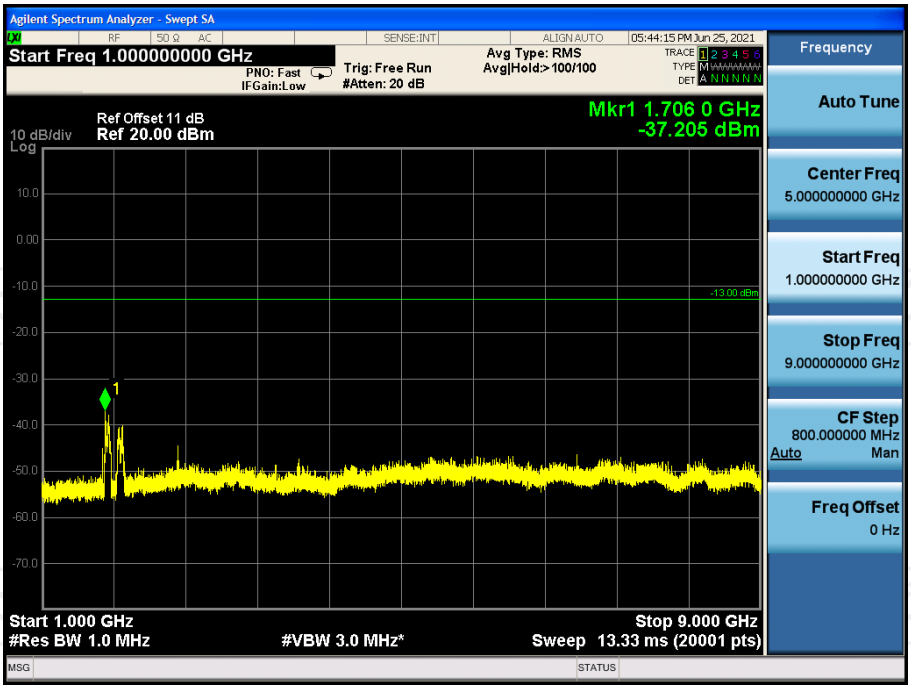

Agilent Spectrum Analyzer - Swept SA
Start Freq 2.156000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:10:02 AM Jun 28, 2021
Mkr1 4.263 9 GHz
-50.508 dBm
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
-13.00 dBm
Start 2.156 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 22.000 GHz
Sweep 50.67 ms (40001 pts)
Frequency
Auto Tune
Center Freq
12.078000000 GHz
Start Freq
2.156000000 GHz
Stop Freq
22.000000000 GHz
CF Step
1.984400000 GHz
Auto
Man
Freq Offset
0 Hz

## Test Plots

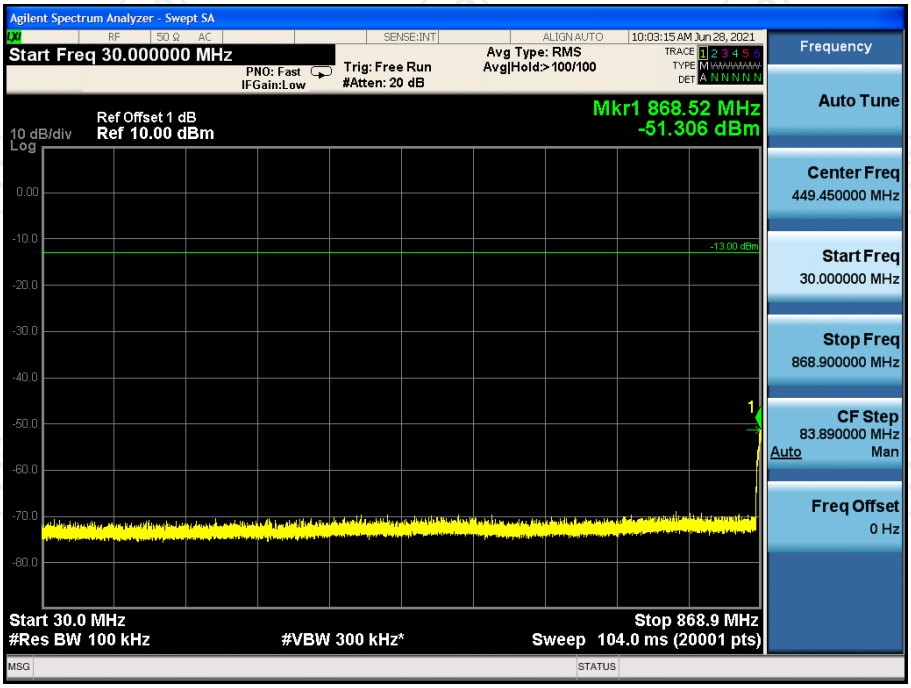
### Cellular Uplink

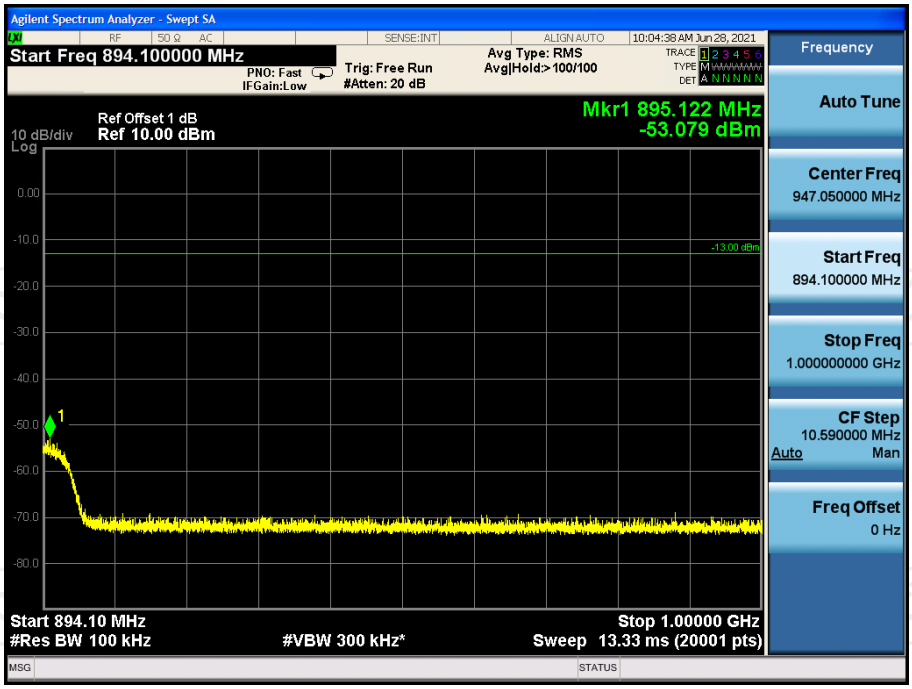


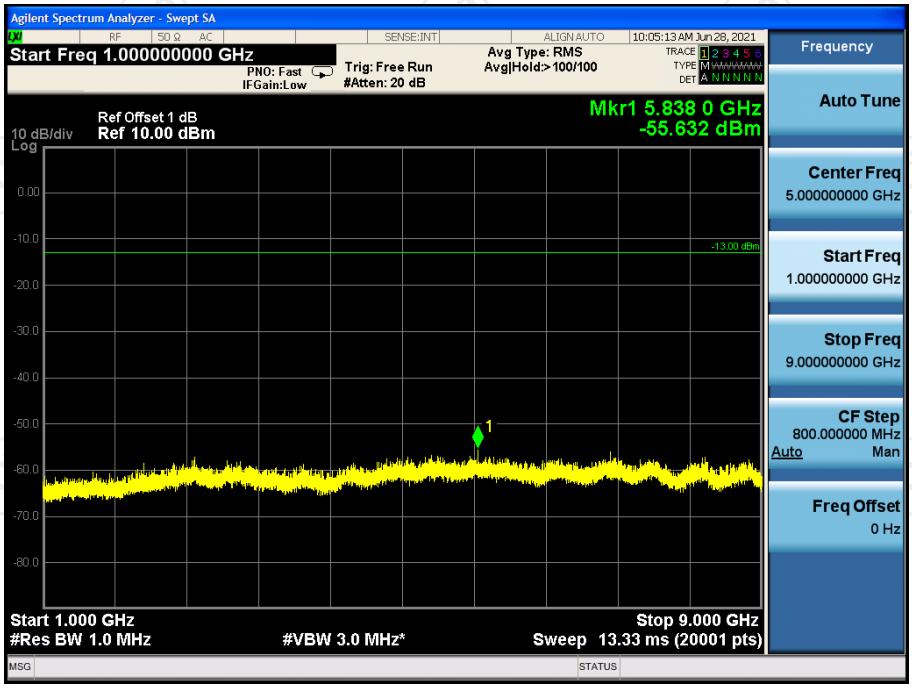






**Cellular Downlink**

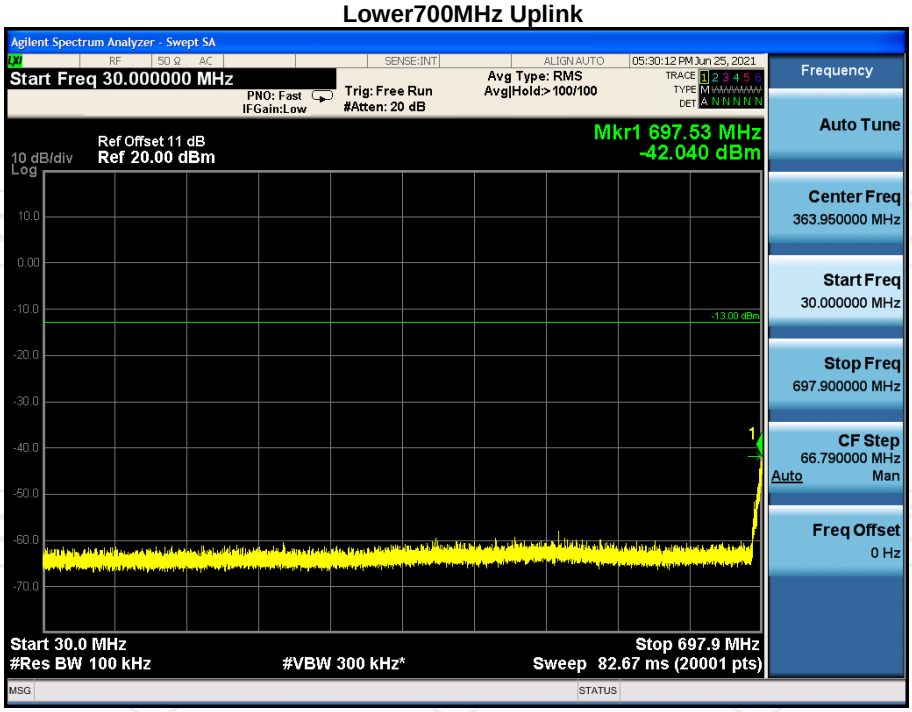


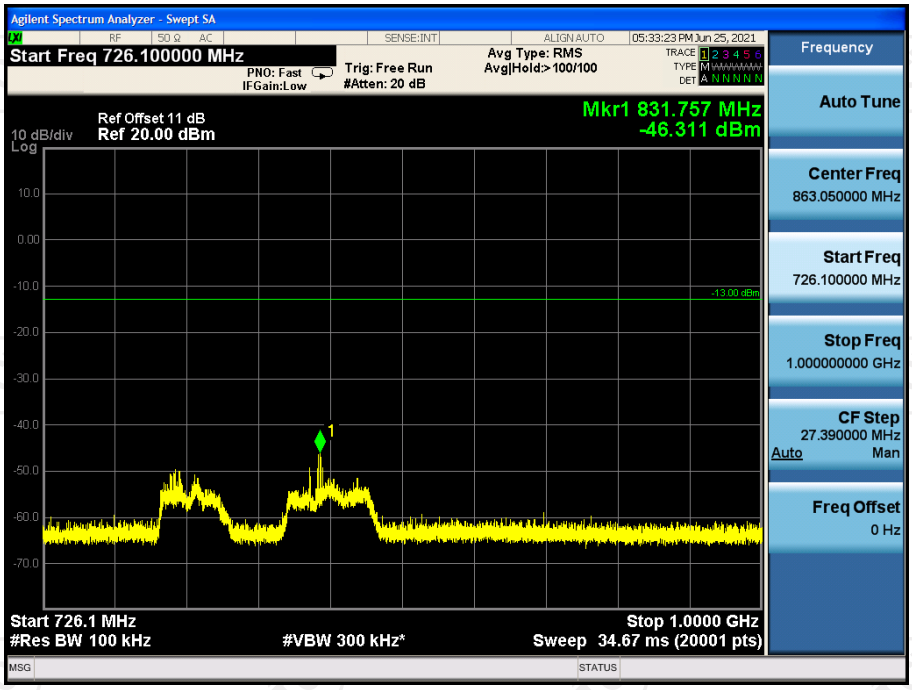

Agilent Spectrum Analyzer - Swept SA
Start Freq 894.100000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:04:38 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 895.122 MHz
-53.079 dBm
-13.00 dBm
Start 894.10 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.00000 GHz
Sweep 13.33 ms (20001 pts)
Frequency
Auto Tune
Center Freq
947.050000 MHz
Start Freq
894.100000 MHz
Stop Freq
1.000000000 GHz
CF Step
10.590000 MHz
Auto
Man
Freq Offset
0 Hz

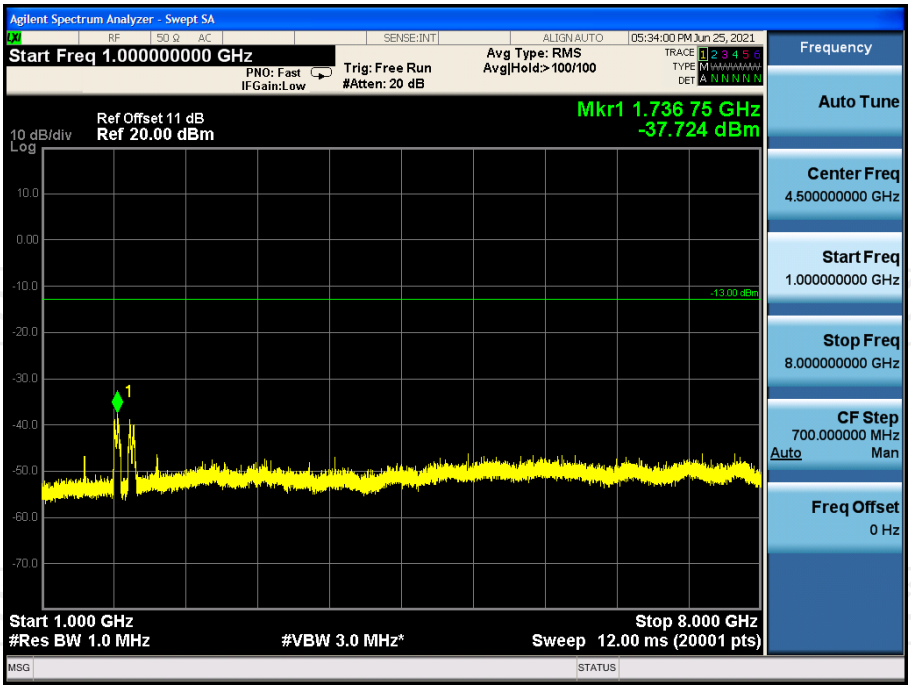

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
10:05:13 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 5.838 0 GHz
-55.632 dBm
-13.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 9.000 GHz
Sweep 13.33 ms (20001 pts)
Frequency
Auto Tune
Center Freq
5.000000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
9.000000000 GHz
CF Step
800.000000 MHz
Auto
Man
Freq Offset
0 Hz

## Test Plots

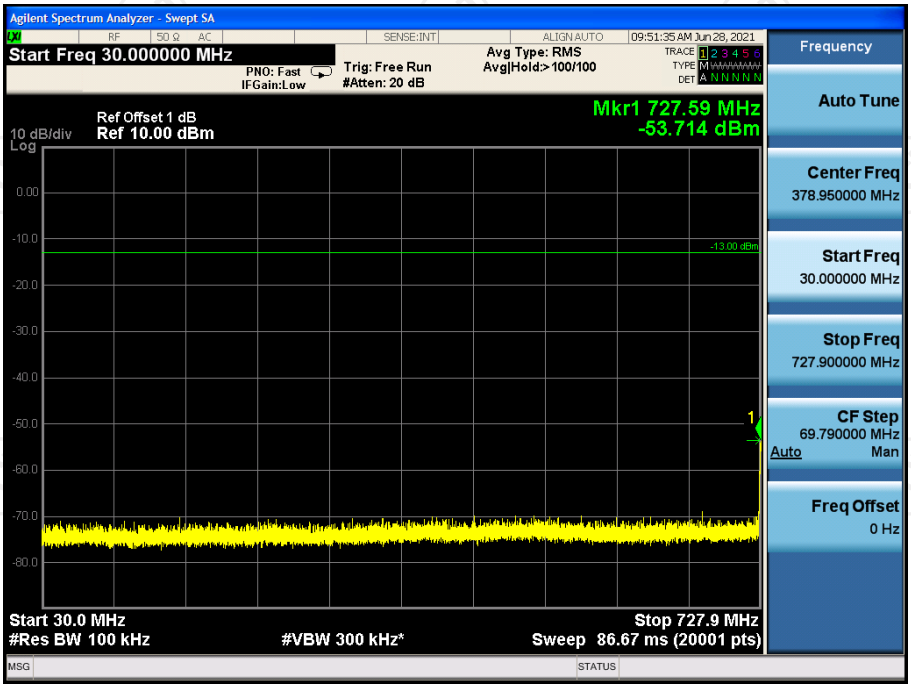
### Lower700MHz Uplink

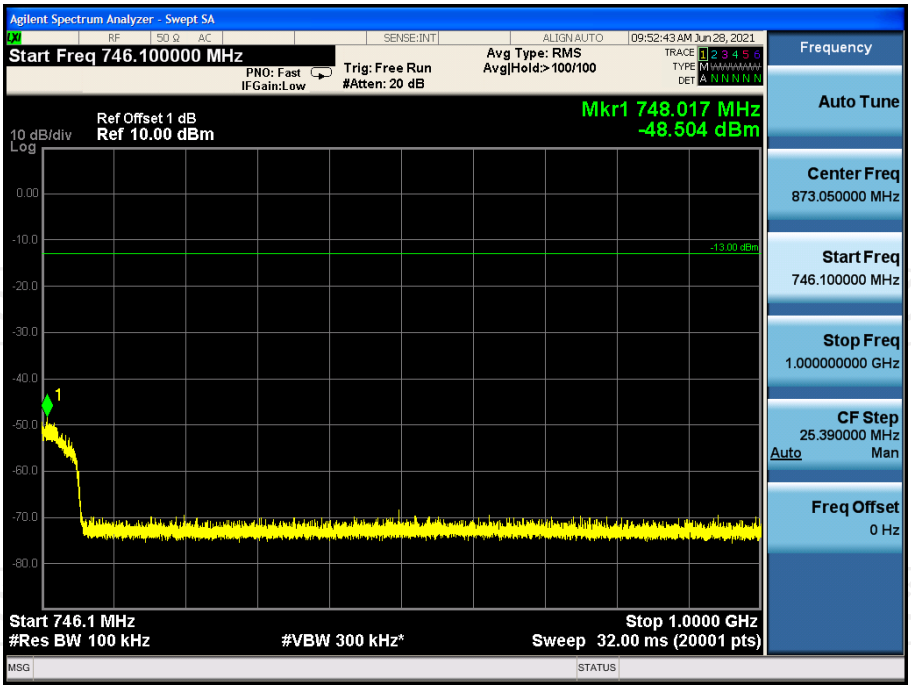


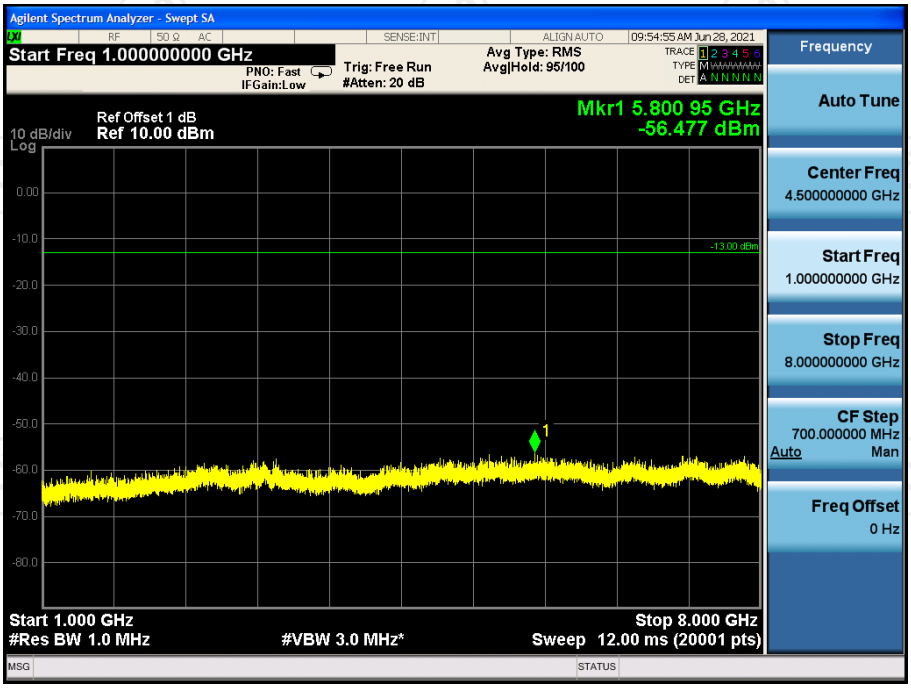






**Lower700MHz Downlink**

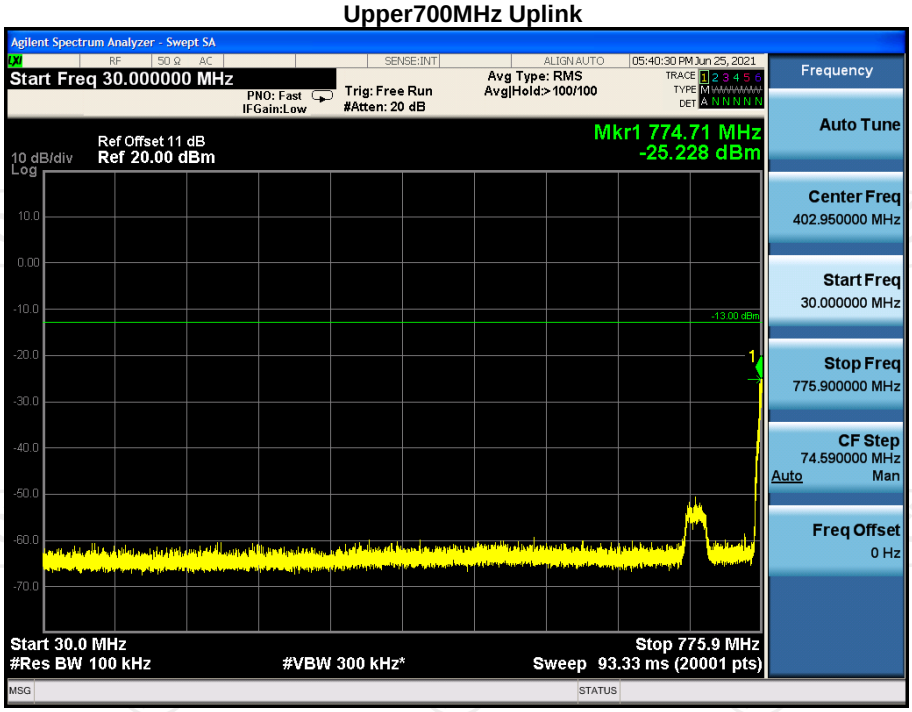


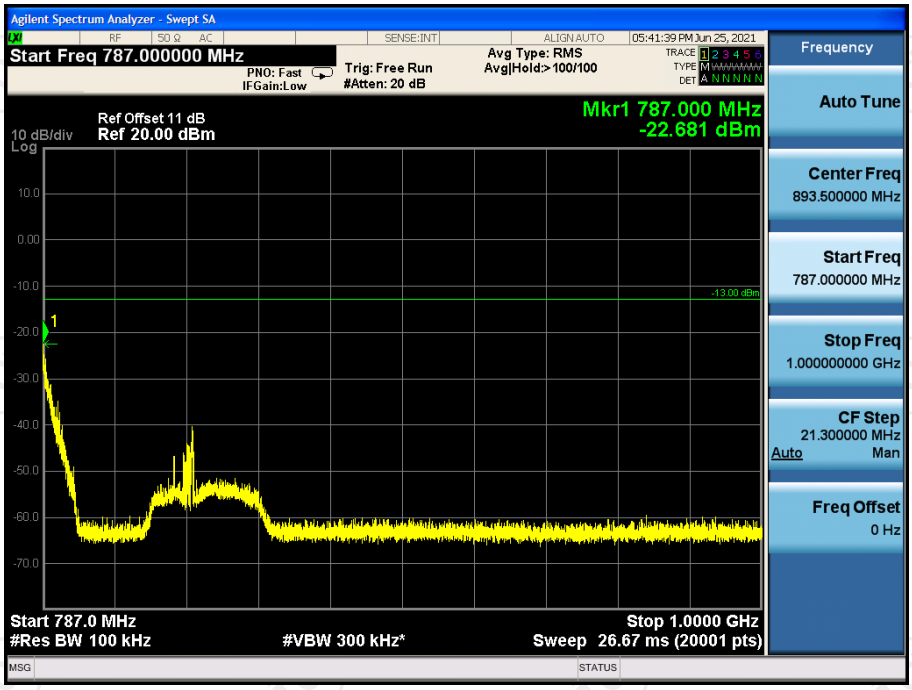

Agilent Spectrum Analyzer - Swept SA
Start Freq 746.100000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
09:52:43 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 748.017 MHz
-48.504 dBm
-13.00 dBm
Start 746.1 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 32.00 ms (20001 pts)
Frequency
Auto Tune
Center Freq
873.050000 MHz
Start Freq
746.100000 MHz
Stop Freq
1.000000000 GHz
CF Step
25.390000 MHz
Auto
Man
Freq Offset
0 Hz

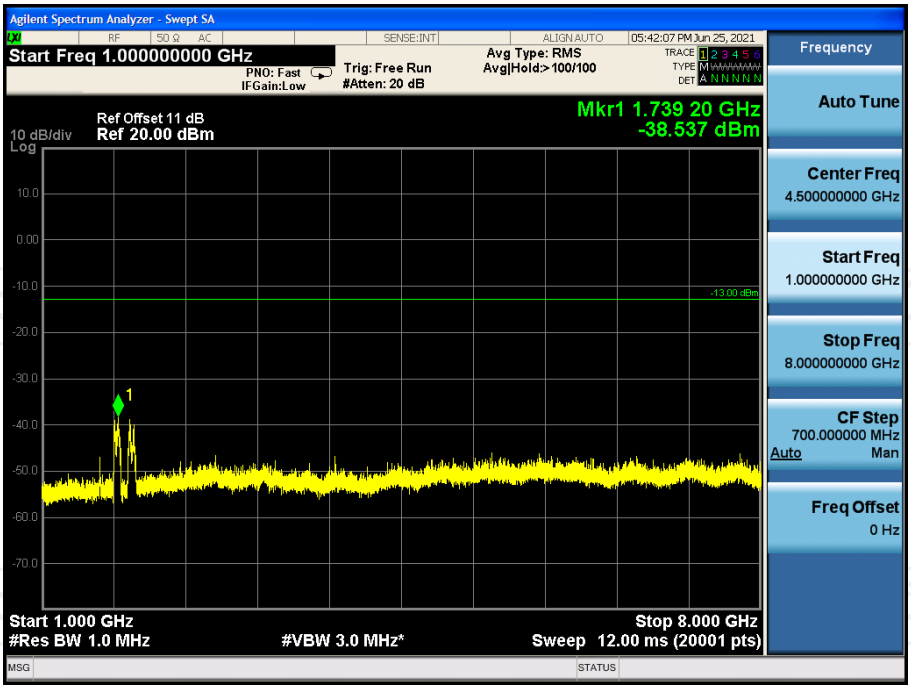

Agilent Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 95/100
09:54:55 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 5.800 95 GHz
-56.477 dBm
-13.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 8.000 GHz
Sweep 12.00 ms (20001 pts)
Frequency
Auto Tune
Center Freq
4.500000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
8.000000000 GHz
CF Step
700.000000 MHz
Auto
Man
Freq Offset
0 Hz

## Test Plots

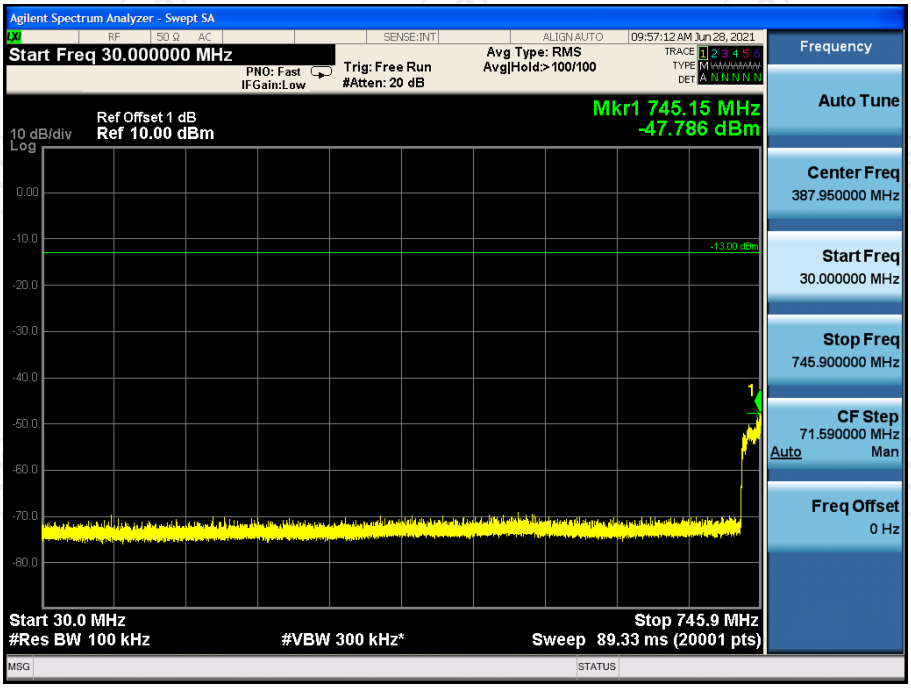
### Upper700MHz Uplink

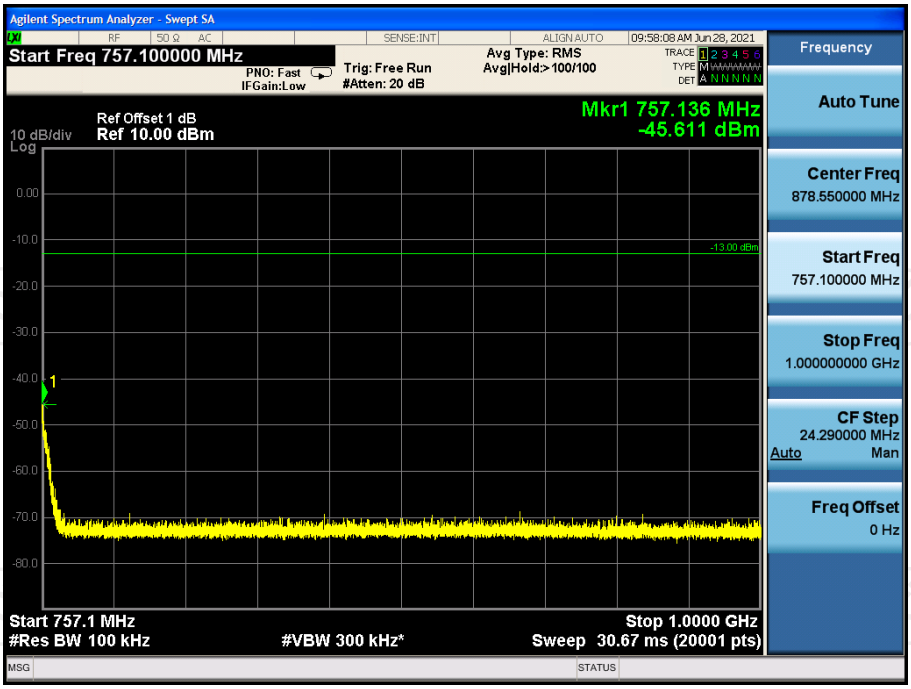


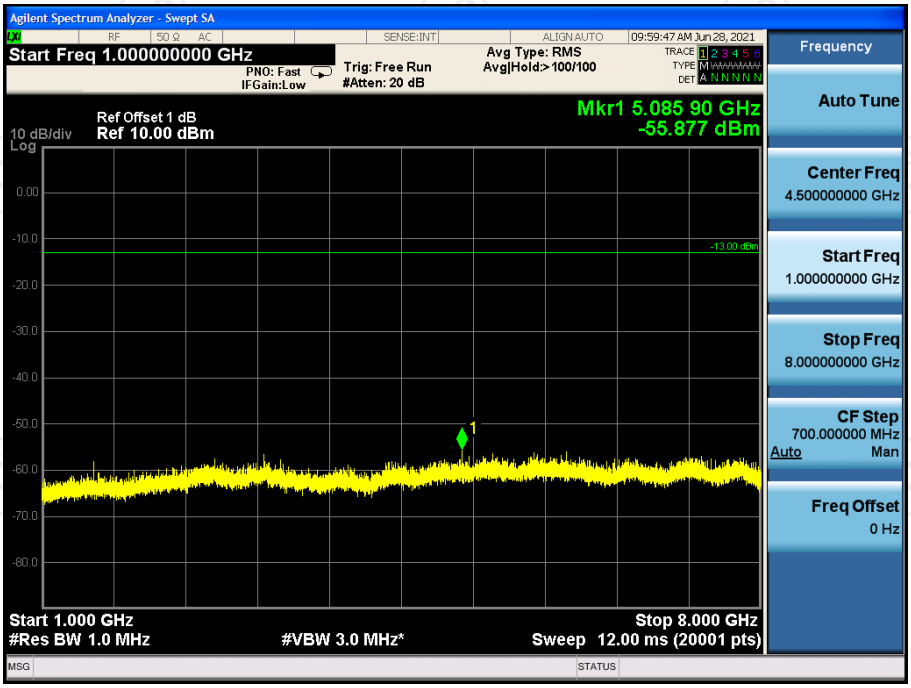






**Upper700MHz Downlink**

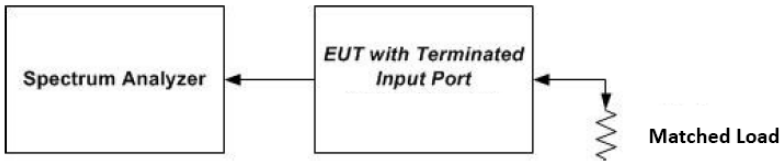
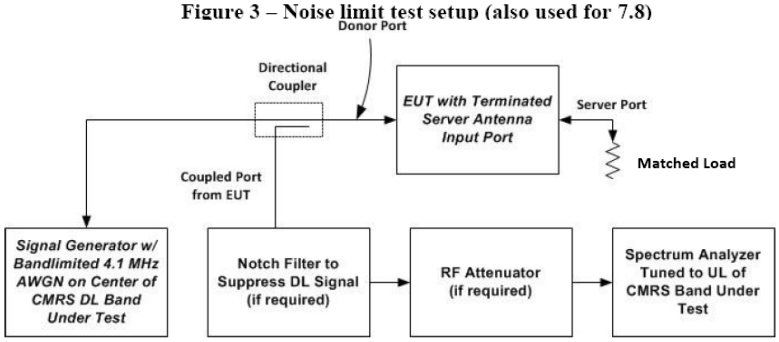



Agilent Spectrum Analyzer - Swept SA
Start Freq 757.100000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
09:58:08 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 757.136 MHz
-45.611 dBm
-13.00 dBm
Start 757.1 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 30.67 ms (20001 pts)
Frequency
Auto Tune
Center Freq
878.550000 MHz
Start Freq
757.100000 MHz
Stop Freq
1.000000000 GHz
CF Step
24.290000 MHz
Auto
Man
Freq Offset
0 Hz


Agilent Spectrum Analyzer - Swept SA
Start Freq 1.000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
09:59:47 AM Jun 28, 2021
Ref Offset 1 dB
10 dB/div
Ref 10.00 dBm
Log
Mkr1 5.085 90 GHz
-55.877 dBm
-13.00 dBm
Start 1.000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 8.000 GHz
Sweep 12.00 ms (20001 pts)
Frequency
Auto Tune
Center Freq
4.500000000 GHz
Start Freq
1.000000000 GHz
Stop Freq
8.000000000 GHz
CF Step
700.000000 MHz
Auto
Man
Freq Offset
0 Hz

## 5.6. Noise Limits

### 5.6.1. Test Specification

| | |
|---|---|
| **Test Requirement:** | FCC Part20 Section 20.21(e)(8)(i)(A); 20.21(e)(8)(i)(H) |
| **Test Method:** | KDB935210 D03 Signal Booster Measurements v04r04 |
| **Limit:** | not exceed −103 dBm/MHz—RSSI.<br>not exceed −102.5 dBm/MHz + 20 log (F), where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz. |
| **Test Setup:** |  <br>Figure 3 – Noise limit test setup (also used for 7.8)<br>  <br>Figure 4 – Test setup for uplink noise power measurement in the presence of a downlink signal |
| **Test Procedure:** | a) Connect the EUT to the test equipment as shown in Figure 3. Begin with the uplink output (donor) port connected to the spectrum analyzer. When measuring downlink noise, connect the downlink output (server) port to the spectrum analyzer.<br>b) Set the spectrum analyzer RBW to 1 MHz with the VBW ≥ 3 . RBW.<br>c) Select the power averaging (rms) detector and trace average over at least 100 traces.<br>d) Set the center frequency of the spectrum analyzer to the center of the CMRS band under test with the span ≥ 2 . the CMRS band.<br>e) Measure the maximum transmitter noise power level.<br>f) Save the spectrum analyzer Test Plots as necessary for inclusion in the final test report.<br>g) Repeat 7.7b) to 7.7f) for all operational uplink and downlink bands.<br>h) Connect the EUT to the test equipment as shown in Figure 4 for uplink noise power measurement in the presence a downlink signal. Affirm the coupled path of the RF coupler is connected to the spectrum analyzer.<br>i) Configure the signal generator for AWGN operation with a 99% OBW of 4.1 MHz.<br>j) Set the spectrum analyzer RBW for 1 MHz, VBW ≥ 3 . RBW, with a power averaging (rms) detector with at least 100 trace averages.<br>k) Set the center frequency of the spectrum analyzer to the center of |

| | |
|---|---|
| | the CMRS band under test, with the span ≥ 2 □ the CMRS band. This shall include all spectrum blocks in the particular CMRS band under test (see Appendix A).<br>l) For uplink noise measurements, set the spectrum analyzer center frequency for the uplink band under test, and tune the signal generator to the center of the paired downlink band.<br>m) Measure the maximum transmitter noise power level while varying the downlink signal generator output level from −90 dBm to −20 dBm, as measured at the input port (i.e., downlink signal level at the booster donor port node of Figure 4), in 1 dB steps inside the RSSI-dependent region, and in 10 dB steps outside the RSSI-dependent region. Report the six values closest to the limit, with at least two points within the RSSI-dependent region of the limit. See Appendix D for noise limits graphs.<br>n) Repeat 7.7.1h) through 7.7.1m) for all operational uplink bands.<br>**Variable uplink noise timing**<br>Variable uplink noise timing is to be measured as follows, using the test setup shown in Figure 4.<br>a) Set the spectrum analyzer to the uplink frequency to be measured.<br>b) Set the span to 0 Hz, with a sweep time of 10 seconds.<br>c) Set the power level of signal generator to the lowest level of the RSSI-dependent noise [see 7.7.1m)].<br>d) Select MAX HOLD and increase the power level of signal generator by 10 dB for mobile boosters, and 20 dB for fixed boosters.<br>e) Confirm that the uplink noise decreases to the specified level within 1 second for mobile devices, and within 3 seconds for fixed devices.12<br>f) Repeat 7.7.2a) to 7.7.2e) for all operational uplink bands.<br>g) Include Test Plotss and summary table in test report. |
| **Test Result:** | PASS |

### 5.6.2. Test Instruments

| Equipment | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due |
|---|---|---|---|---|---|
| Signal Generator | Agilent | N5182A | MY47070282 | Sep. 03, 2020 | Sep. 02, 2021 |
| Spectrum Analyzer | Agilent | N9020A | MY49100619 | Sep. 12, 2020 | Sep. 11, 2021 |
| RF Combiner | SUNVNDN | SUD-CS 0800 | 16230009 | Sep. 12, 2020 | Sep. 11, 2021 |
| Attenuator | 50FP-006-H3 | JFW | 907763 | Sep. 12, 2020 | Sep. 11, 2021 |

### 5.6.3. Test Data

| Max Noise Power | | | |
|---|---|---|---|
| Frequency Band (MHz) | Measured dBm/MHz | Limit dBm/MHz | Result (dB) |
| PCS Uplink | -47.05 | -37.02 | PASS |
| AWS-1 Uplink | -45.04 | -37.73 | PASS |
| Cellular Uplink | -51.12 | -44.05 | PASS |
| Lower700MHz Uplink | -49.62 | -45.51 | PASS |
| Upper700MHz Uplink | -51.11 | -44.64 | PASS |
| PCS Downlink | -45.18 | -37.02 | PASS |
| AWS-1 Downlink | -47.00 | -37.73 | PASS |
| Cellular Downlink | -47.24 | -44.05 | PASS |
| Lower700MHz Downlink | -48.30 | -45.51 | PASS |
| Upper700MHz Downlink | -48.27 | -44.64 | PASS |

**Note:** Fixed booster maximum noise power shall not exceed –102.5 dBm/MHz + 20 log (F), where Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz.

| Variable Uplink Noise | | | | |
|---|---|---|---|---|
| Operation Bands | RSSI dBm | Measured dBm/MHz | Limit dBm/MHz | Results |
| PCS | -80 | -48.02 | -37.02 | PASS |
| | -75 | -48.10 | -37.02 | PASS |
| | -72 | -51.14 | -37.02 | PASS |
| | -63 | -51.58 | -40.00 | PASS |
| | -58 | -53.28 | -45.00 | PASS |
| | -56 | -54.83 | -47.00 | PASS |
| AWS-1 | -80 | -45.78 | -37.73 | PASS |
| | -75 | -46.30 | -37.73 | PASS |
| | -71 | -48.90 | -37.73 | PASS |
| | -68 | -50.72 | -37.73 | PASS |
| | -64 | -52.35 | -39.00 | PASS |
| | -58 | -53.60 | -45.00 | PASS |
| Cellular | -80 | -51.59 | -44.05 | PASS |
| | -70 | -51.62 | -44.05 | PASS |

| | | | | |
|---|---|---|---|---|
| | -69 | -54.57 | -44.05 | PASS |
| | -64 | -57.40 | -44.05 | PASS |
| | -62 | -58.52 | -44.05 | PASS |
| | -56 | -59.98 | -47.00 | PASS |
| Lower700MHz | -80 | -49.56 | -45.51 | PASS |
| | -73 | -59.61 | -45.51 | PASS |
| | -68 | -52.65 | -45.51 | PASS |
| | -63 | -55.31 | -45.51 | PASS |
| | -57 | -57.17 | -46.00 | PASS |
| | -51 | -57.95 | -52.00 | PASS |
| Upper700MHz | -80 | -51.14 | -44.64 | PASS |
| | -70 | -51.66 | -44.64 | PASS |
| | -67 | -53.60 | -44.64 | PASS |
| | -62 | -56.40 | -44.64 | PASS |
| | -57 | -58.18 | -46.00 | PASS |
| | -53 | -59.03 | -50.00 | PASS |

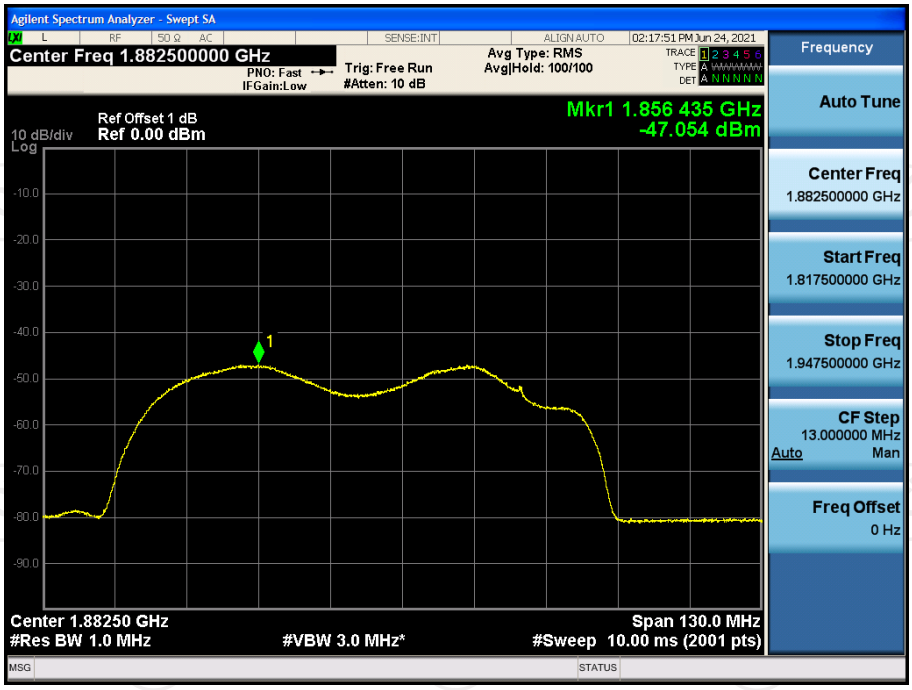
**Note:** According to the KDB 935210 D03 Signal Booster Measurements v04r04 APPENDIX D, when outside of RSSI Dependent limit (20.21.e.8.1.A.1),fixed booster maximum noise power shall not exceed −102.5 dBm/MHz + 20 log (F).RSSI limit not exceed −103 dBm/MHz-RSSI.

**Variable Uplink Noise Timing**

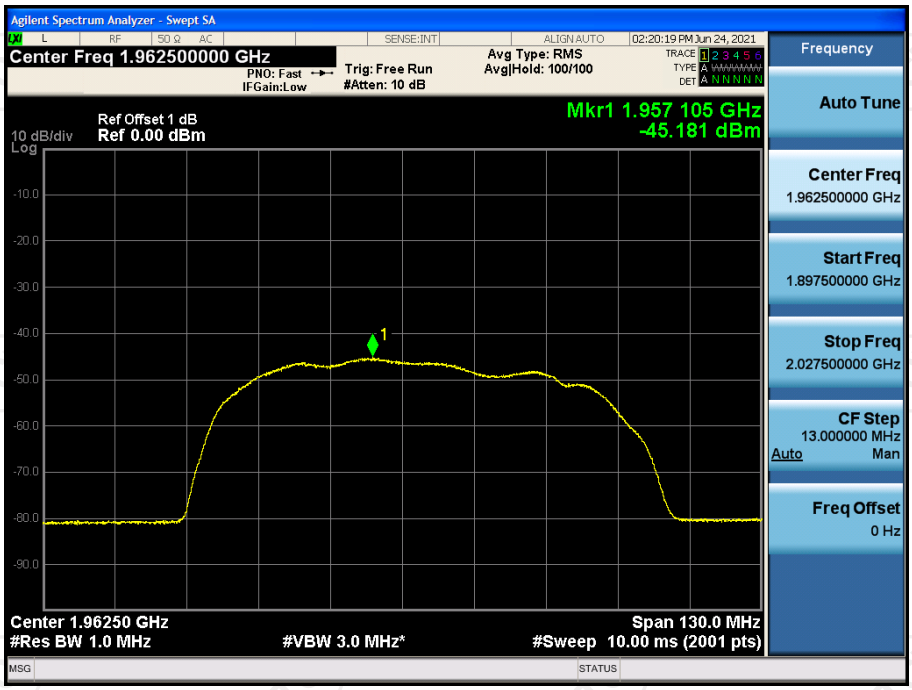
| Operation Bands | Measured Sec | Limit Sec | Results |
|---|---|---|---|
| PCS | 0.04 | 3 | PASS |
| AWS-1 | 0.04 | 3 | PASS |
| Cellular | 0.02 | 3 | PASS |
| Lower700MHz | 0.03 | 3 | PASS |
| Upper700MHz | 0.05 | 3 | PASS |

## Test Plots

PCS

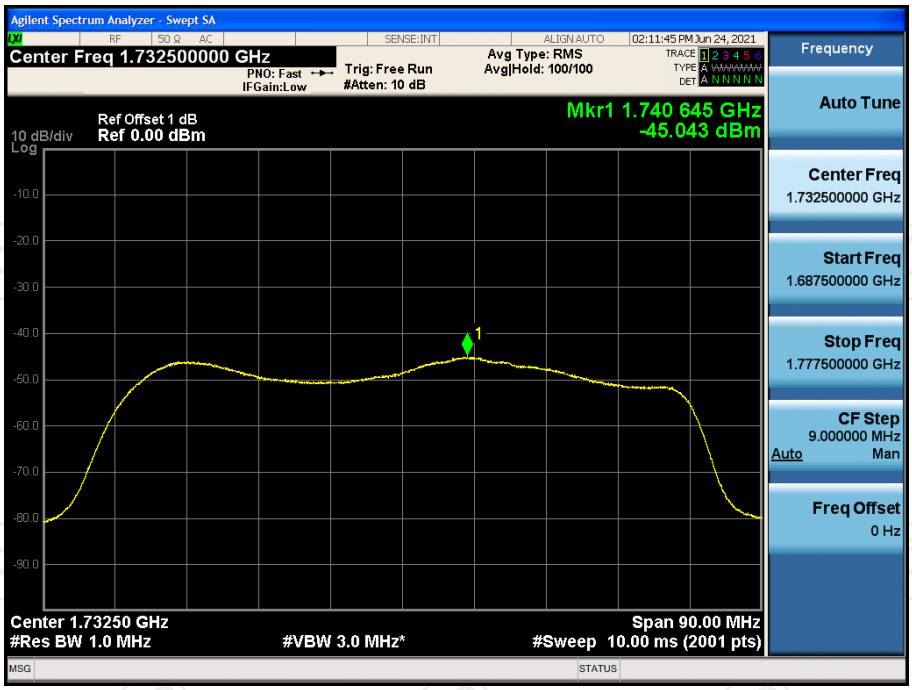



**Uplink Noise**

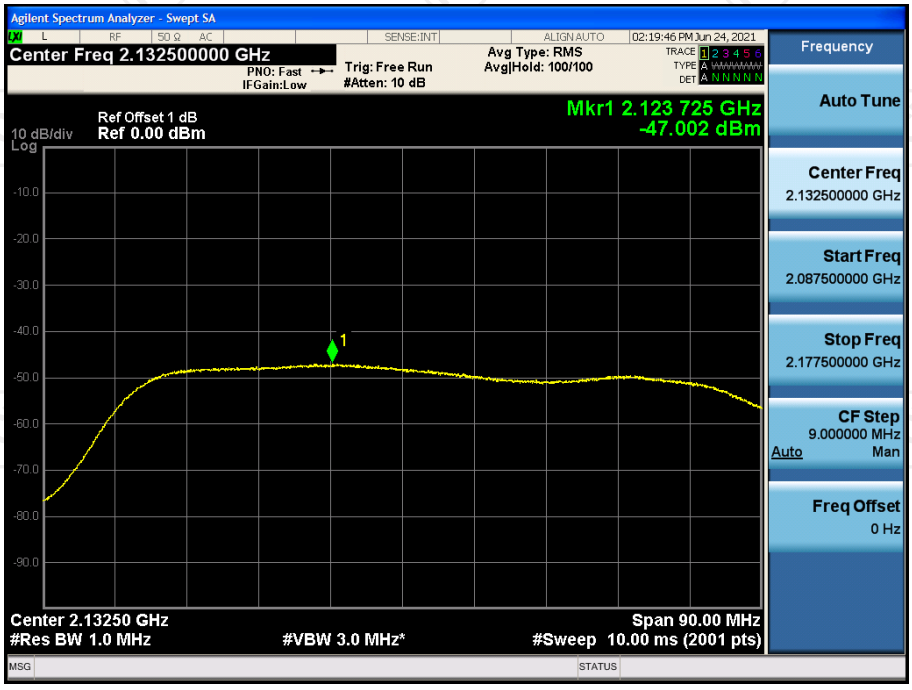



**Downlink Noise**

AWS-1

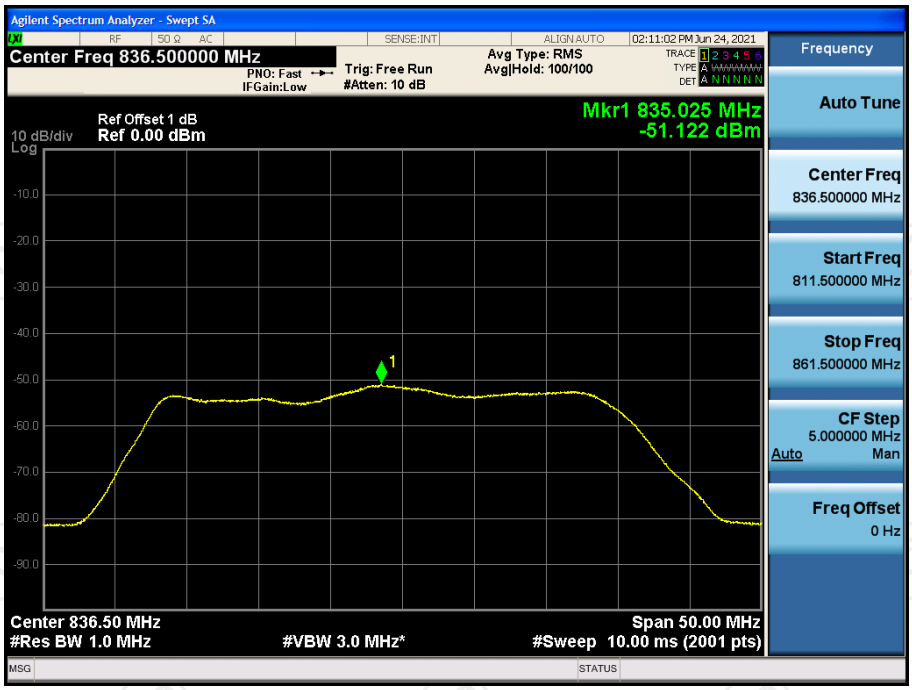



**Uplink Noise**




**Downlink Noise**

Cellular




**Uplink Noise**

**Downlink Noise**