

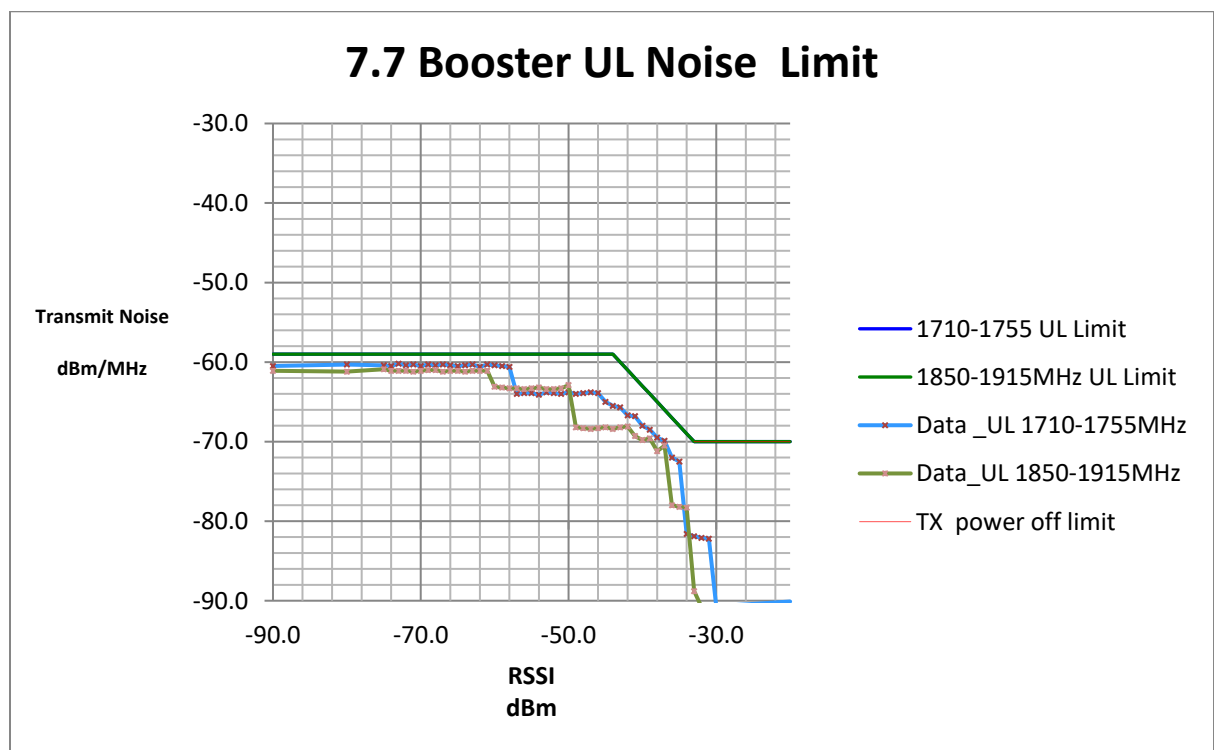
## Summary of Results

### 7.7.1 Maximum transmitter noise power level

- 7.7.1 a-g: Maximum transmitter noise with 50-ohm shielded load

| Maximum Noise Power |                   |               |        |
|---------------------|-------------------|---------------|--------|
| Frequency MHz       | Measured dBm./MHz | Limit dBm/MHz | Margin |
| UL 1710-1755        | -59.7             | -59.0         | -0.7   |
| UL 1850-1915        | -60.8             | -59.0         | -1.8   |
| UL 824-849          | -59.1             | -59.0         | -0.1   |
| UL 698-716          | -59.0             | -59.0         | 0.0    |
| UL 776-787          | -59.8             | -59.0         | -0.8   |
|                     |                   |               |        |
| DL 2110-2155        | -59.0             | -59.0         | 0.0    |
| DL 1930-1995        | -59.5             | -59.0         | -0.5   |
| DL 869-894          | -60.4             | -59.0         | -1.4   |
| DL 728-746          | -59.2             | -59.0         | -0.2   |
| DL 746-757          | -59.1             | -59.0         | -0.1   |

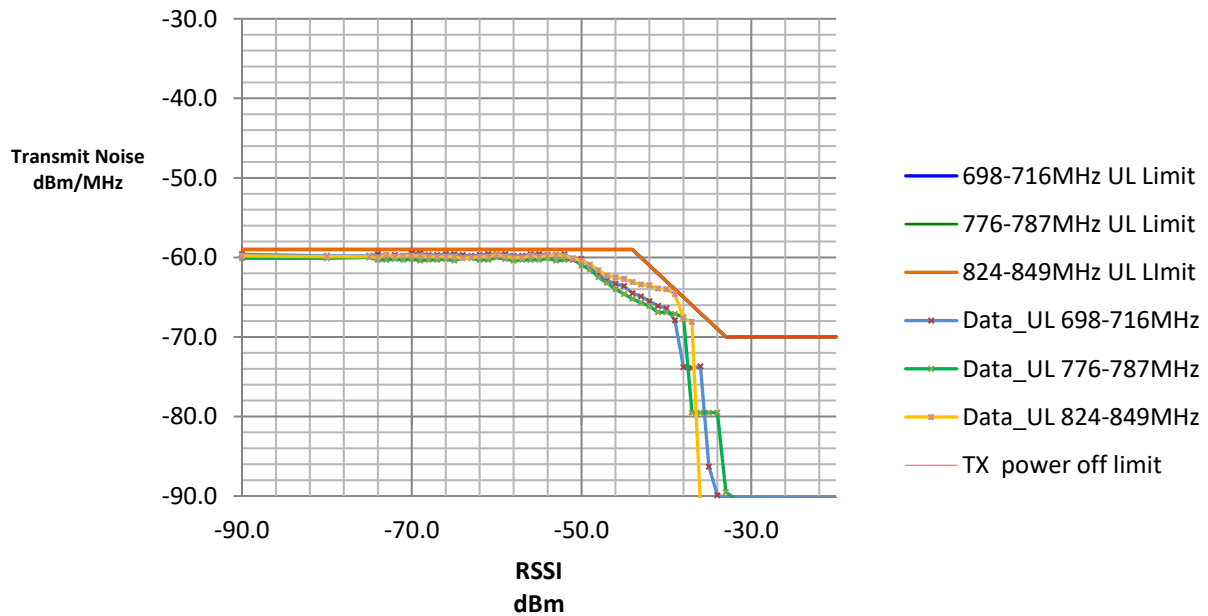
7.7.1 h-n: Maximum transmitter noise when varying the DL signal generator output level with a 4.1MHz AWGN signal



| 1710.0 -1755.0MHz |                                |                   |                            |        |        |
|-------------------|--------------------------------|-------------------|----------------------------|--------|--------|
| RSSI<br>(dBm)     | Measured<br>Noise<br>(dBm/MHz) | Limit             |                            |        | Margin |
|                   |                                | RSSI<br>Dependent | Mobile<br>Booster<br>Limit | TX off |        |
| -80.0             | -60.3                          | -                 | -59.0                      | -      | -1.3   |
| -75.0             | -60.4                          | -                 | -59.0                      | -      | -1.4   |
| -37.0             | -69.9                          | -66.0             | -59.0                      | -      | -3.9   |
| -35.0             | -72.5                          | -68.0             | -59.0                      | -      | -4.5   |
| -32.0             | -82.1                          | -                 | -                          | -70    | -12.1  |
| -31.0             | -82.2                          | -                 | -                          | -70    | -12.2  |

| 1850.0 - 1915.0MHz |                                |                   |                            |        |        |
|--------------------|--------------------------------|-------------------|----------------------------|--------|--------|
| RSSI<br>(dBm)      | Measured<br>Noise<br>(dBm/MHz) | Limit             |                            |        | Margin |
|                    |                                | RSSI<br>Dependent | Mobile<br>Booster<br>Limit | TX off |        |
| -75.0              | -60.9                          | -                 | -59.0                      | -      | -1.9   |
| -69.0              | -61.0                          | -                 | -59.0                      | -      | -2.0   |
| -39.0              | -69.6                          | -64.0             | -59.0                      | -      | -5.6   |
| -37.0              | -70.5                          | -66.0             | -59.0                      | -      | -4.5   |
| -32.0              | -90.8                          | -                 | -                          | -70    | -20.8  |
| -31.0              | -90.7                          | -                 | -                          | -70    | -20.7  |

## 7.7 Booster UL Noise Limit



| 824.0 - 849.0MHz |                          |                |                      |        |        |
|------------------|--------------------------|----------------|----------------------|--------|--------|
| RSSI (dBm)       | Measured Noise (dBm/MHz) | Limit          |                      |        | Margin |
|                  |                          | RSSI Dependent | Mobile Booster Limit | TX off |        |
| -90.0            | -59.8                    | -              | -59.0                | -      | -0.8   |
| -80.0            | -59.9                    | -              | -59.0                | -      | -0.9   |
| -40.0            | -64.0                    | -63.0          | -59.0                | -      | -1.0   |
| -39.0            | -64.6                    | -64.0          | -59.0                | -      | -0.6   |
| -30.0            | -91.4                    | -              | -                    | -70    | -21.4  |
| -20.0            | -91.3                    | -              | -                    | -70    | -21.3  |

| 698.0-716.0MHz |                                |                   |                            |        |        |
|----------------|--------------------------------|-------------------|----------------------------|--------|--------|
| RSSI<br>(dBm)  | Measured<br>Noise<br>(dBm/MHz) | Limit             |                            |        | Margin |
|                |                                | RSSI<br>Dependent | Mobile<br>Booster<br>Limit | TX off |        |
| -70.0          | -59.5                          |                   | -59.0                      |        | -0.5   |
| -69.0          | -59.5                          |                   | -59.0                      |        | -0.5   |
| -40.0          | -66.4                          | -63.0             | -59.0                      |        | -3.4   |
| -39.0          | -67.9                          | -64.0             | -59.0                      |        | -3.9   |
| -32.0          | -90.1                          |                   |                            | -70    | -20.1  |
| -31.0          | -90.1                          |                   |                            | -70    | -20.1  |

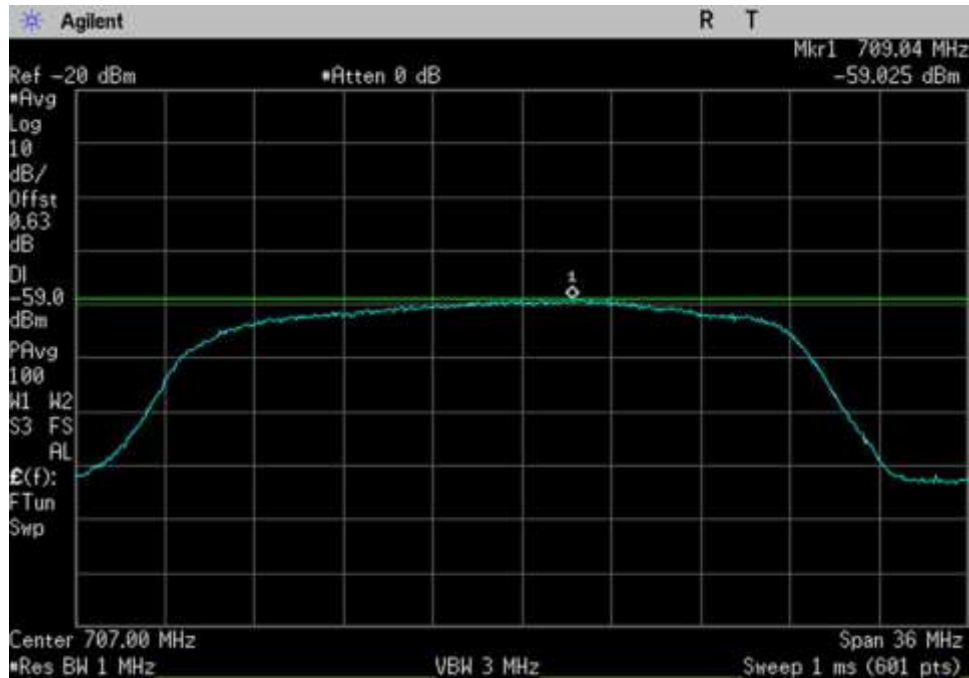
| 776.0 - 787.0MHz |                                |                   |                            |        |        |
|------------------|--------------------------------|-------------------|----------------------------|--------|--------|
| RSSI<br>(dBm)    | Measured<br>Noise<br>(dBm/MHz) | Limit             |                            |        | Margin |
|                  |                                | RSSI<br>Dependent | Mobile<br>Booster<br>Limit | TX off |        |
| -90.0            | -60.1                          |                   | -59.0                      |        | -1.1   |
| -80.0            | -60.1                          |                   | -59.0                      |        | -1.1   |
| -39.0            | -67.1                          | -64.0             | -59.0                      |        | -3.1   |
| -38.0            | -67.5                          | -65.0             | -59.0                      |        | -2.5   |
| -32.0            | -90.3                          |                   |                            | -70    | -20.3  |
| -31.0            | -91.2                          |                   |                            | -70    | -21.2  |

#### 7.7.2 Variable uplink noise timing

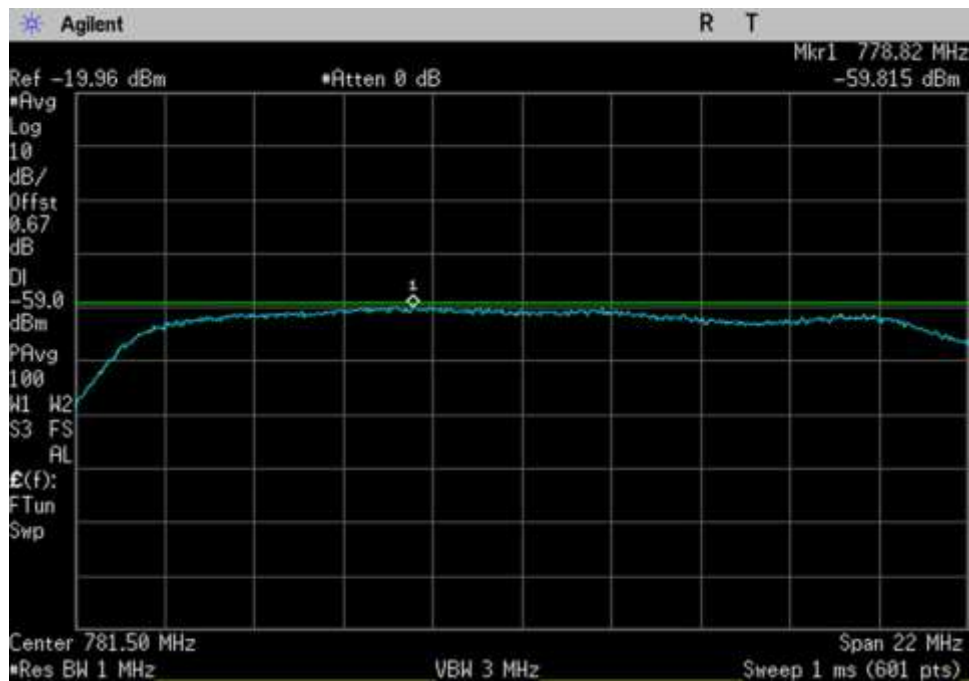
| Uplink Noise timing |                 |              |
|---------------------|-----------------|--------------|
| Frequency<br>MHz    | Measured<br>Sec | Limit<br>sec |
| UL1710-1755         | 0.10            | 1.00         |
| UL1850-1915         | 0.15            | 1.00         |
| UL824-849           | 0.37            | 1.00         |
| UL 698-716          | 0.30            | 1.00         |
| UL776-787           | 0.25            | 1.00         |

## 7.7.1 Maximum Transmitter Noise Power Level

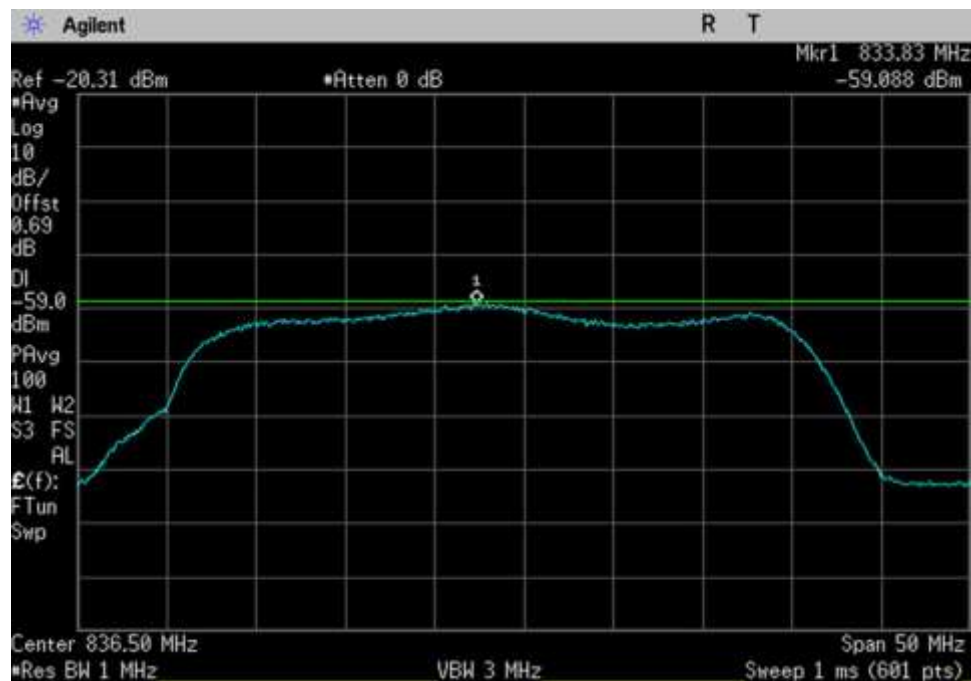
### Plots



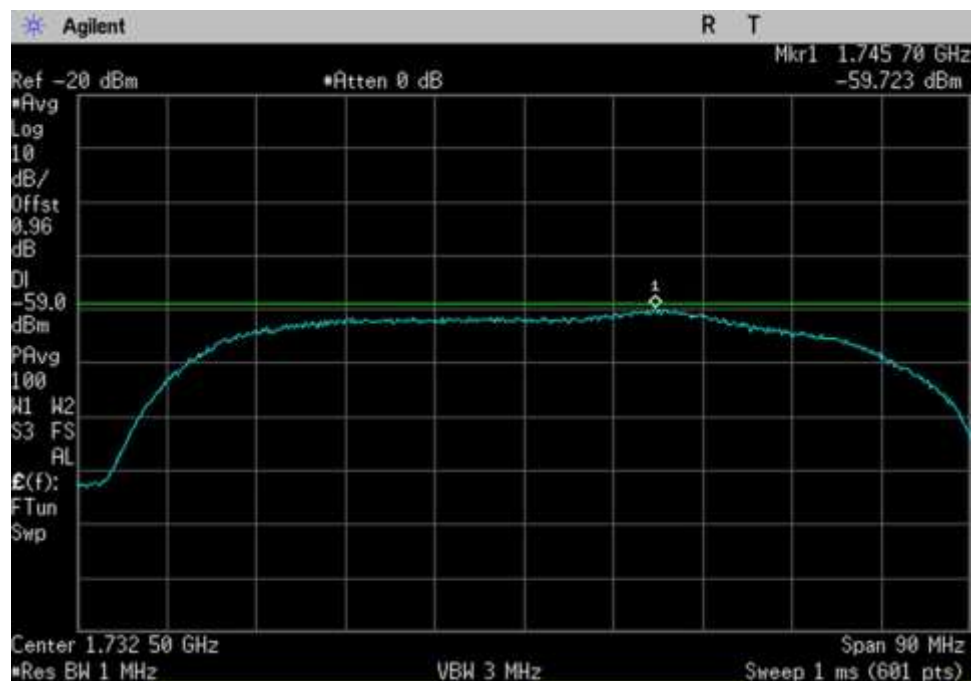
UL\_698-716\_707MHz



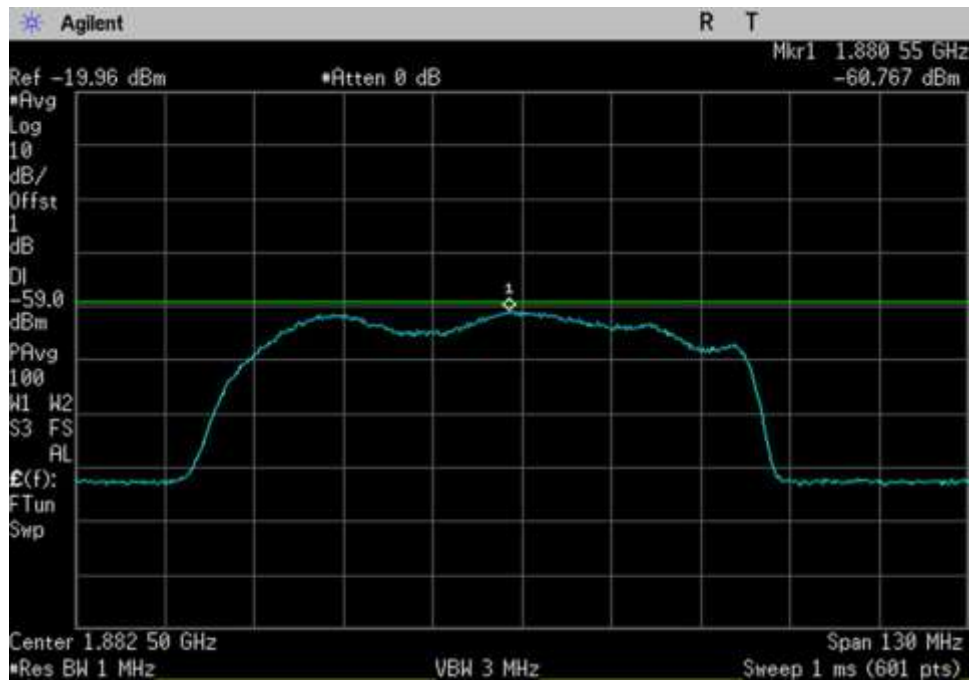
UL\_776-787\_781.5MHz



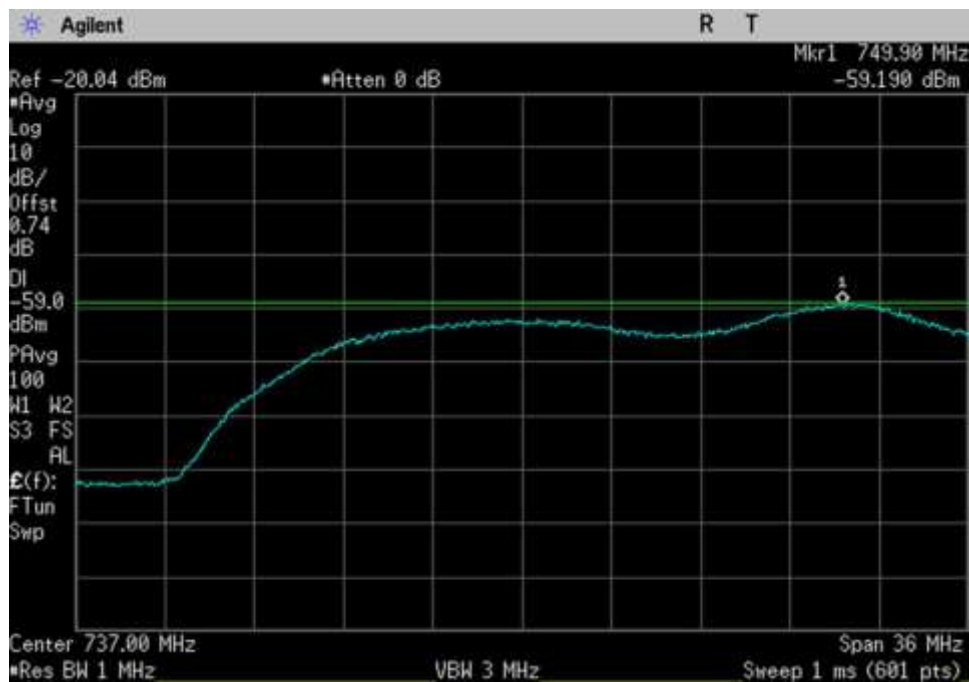
UL\_824-849\_ 836.5MHz



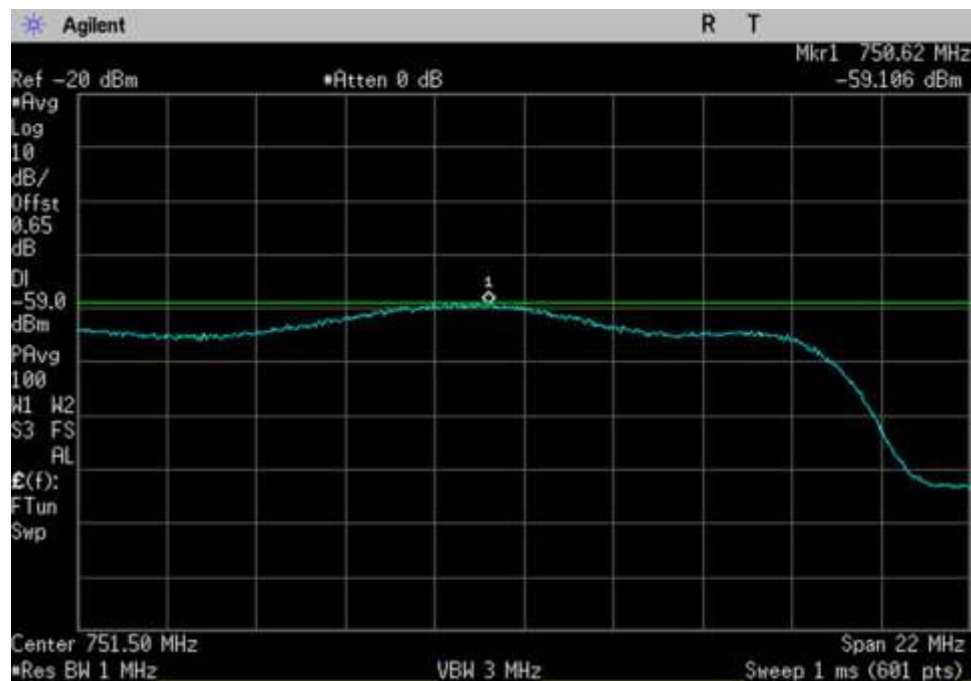
UL\_1710-1755\_ 1732.5MHz



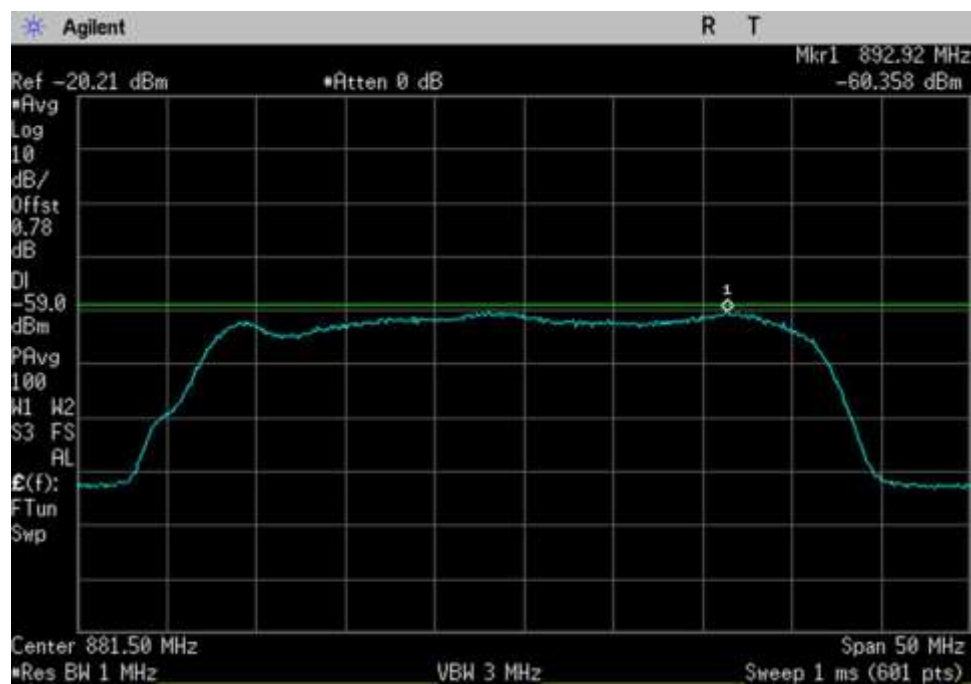
UL\_1850-1915\_ 1882.5MHz



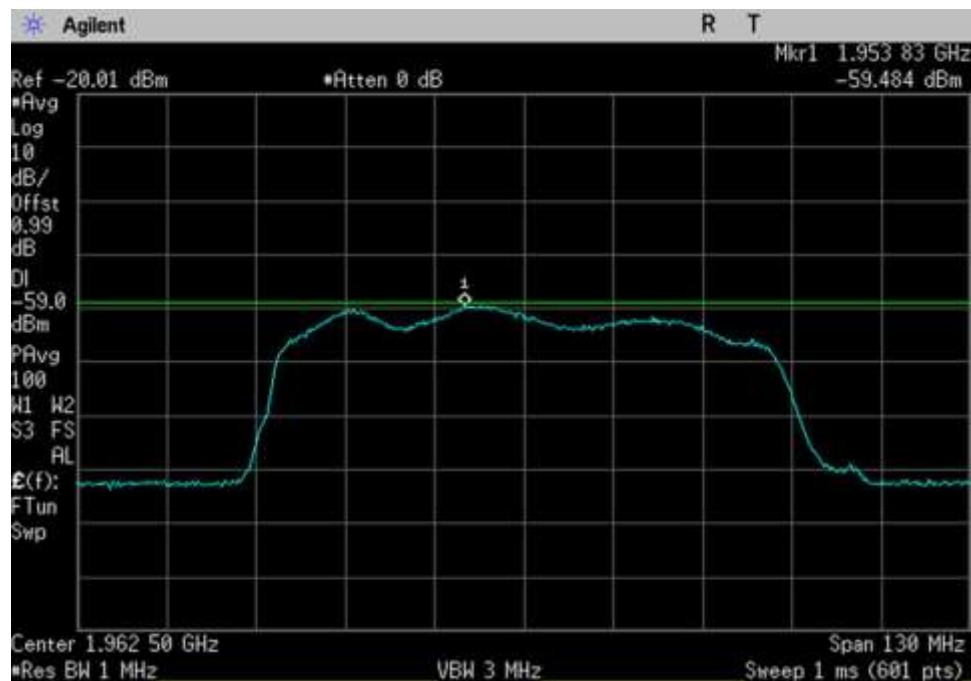
DL\_728-746\_ 737MHz



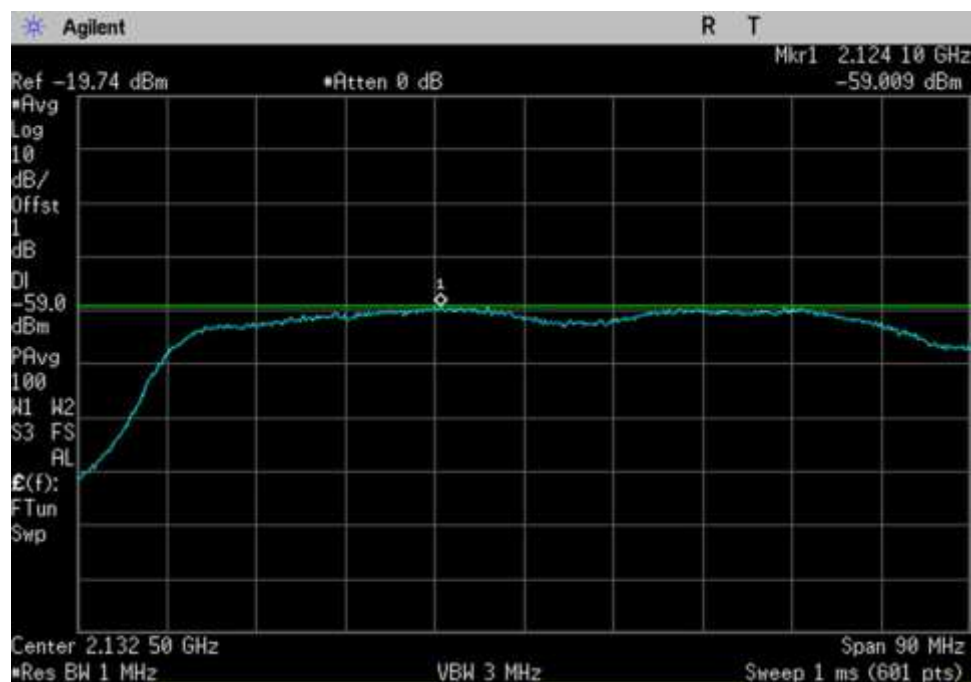
DL\_746-757\_751.5MHz



DL\_869-894\_881.5MHz



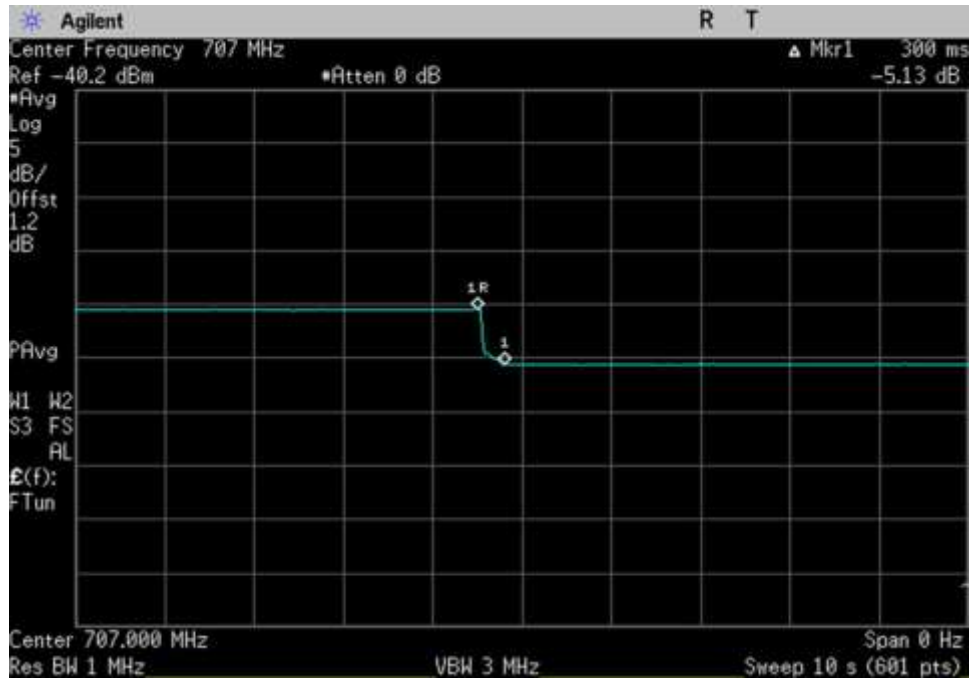
DL\_1930-1995\_ 1962.5MHz



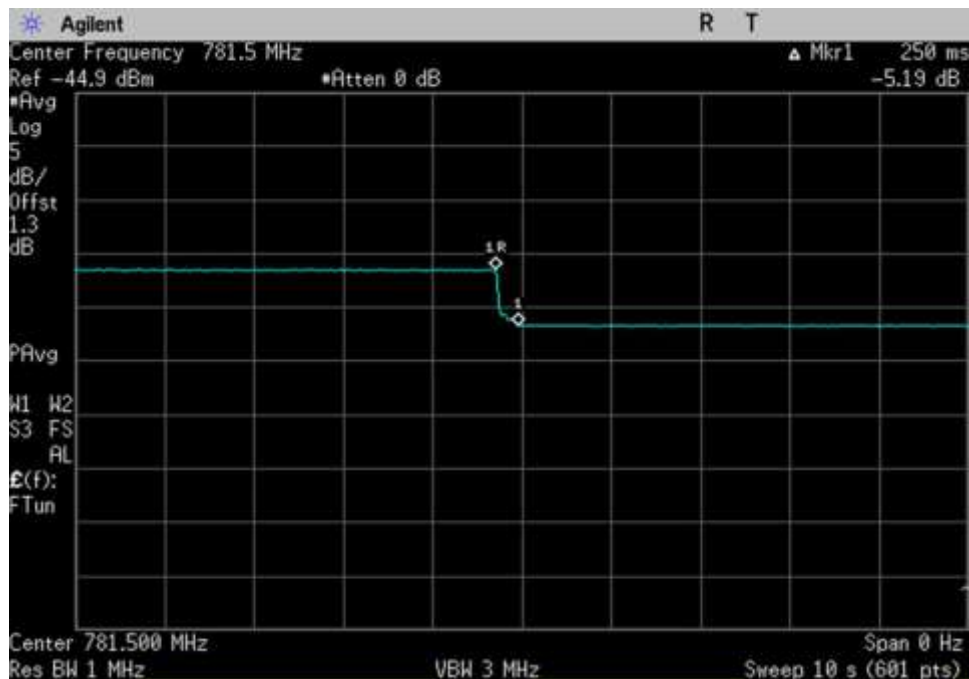
DL\_2110-2155\_ 2132.5MHz

## 7.7.2 Variable UL Noise Timing

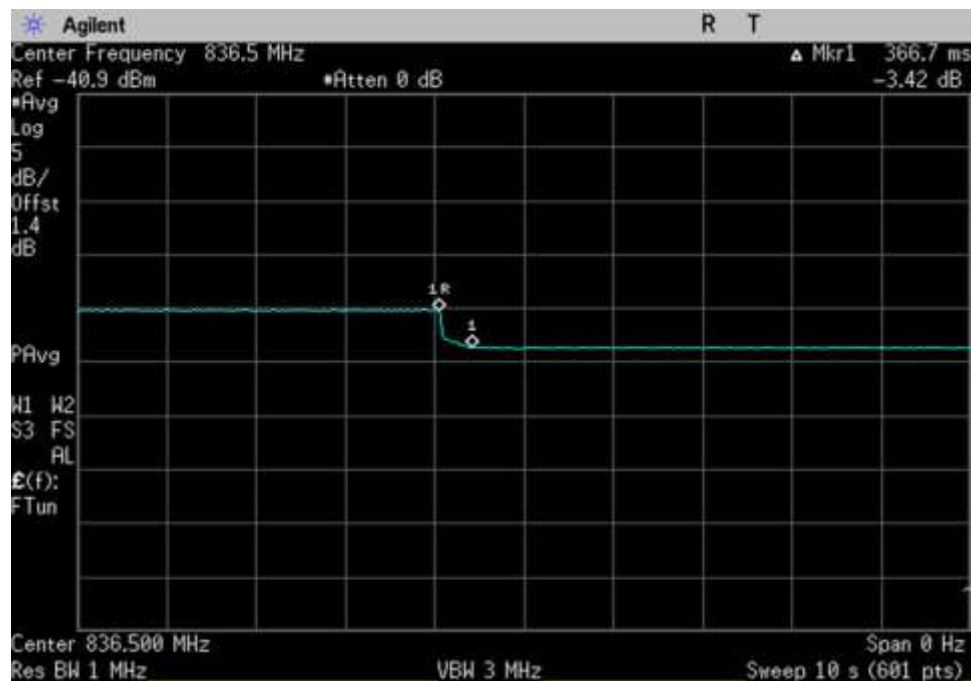
### Plots



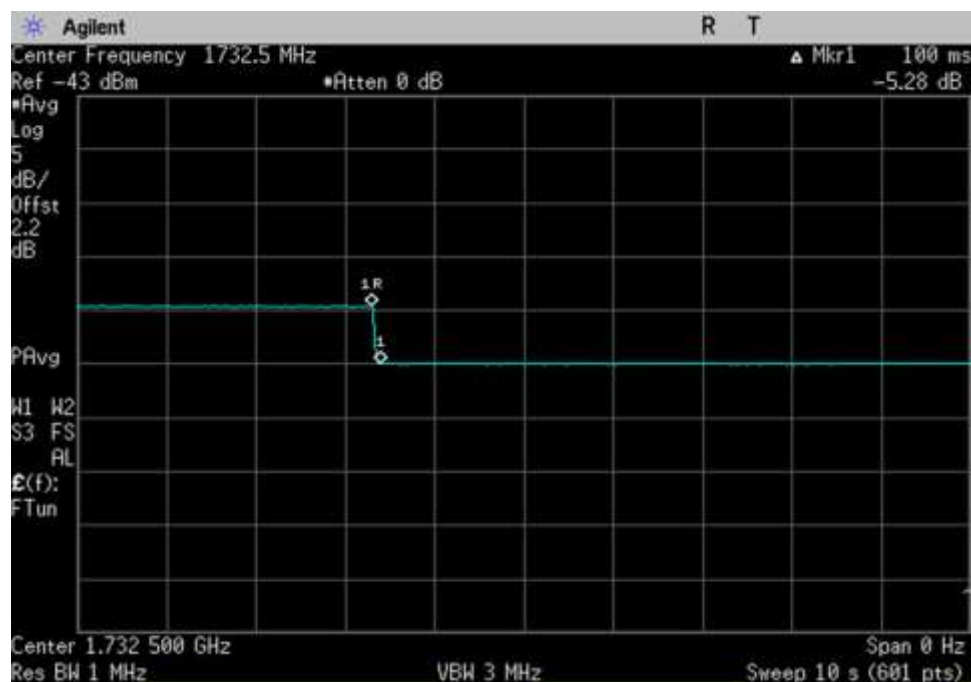
UL\_698-716\_707MHz\_Var



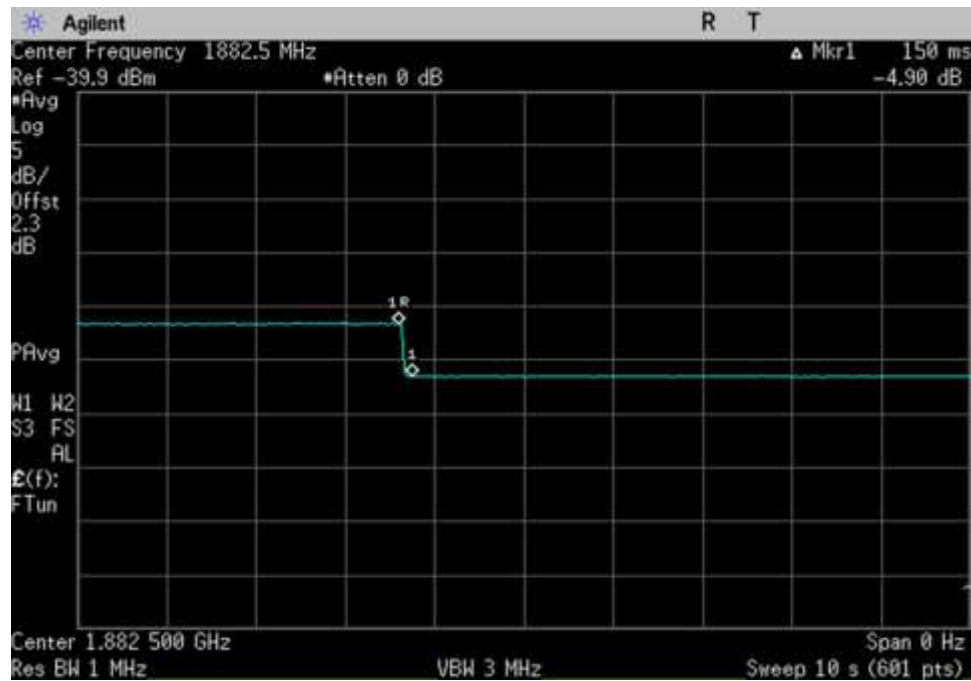
UL\_776-787\_781.5MHz\_Var



UL\_824-849\_ 836.5MHz\_Var



UL\_1710-1755\_ 1732.5MHz\_Var



UL\_1850-1915\_ 1882.5MHz\_Var

## 7.8 Uplink Inactivity

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: Cellphone-Mate, Inc.  
 Specification: **7.8 Uplink Inactivity**  
 Work Order #: **102180** Date: 01/15/2019  
 Test Type: **Conducted Emissions**  
 Tested By: **Hieu Song Nguyenpham**  
 Software: EMITest 5.03.11

#### Equipment Tested:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Support Equipment:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Test Conditions / Notes:

Test environment conditions: Temperature: 20.6°C, 57.2% relative humidity, Pressure: 102.3kPa

#### Test Equipment:

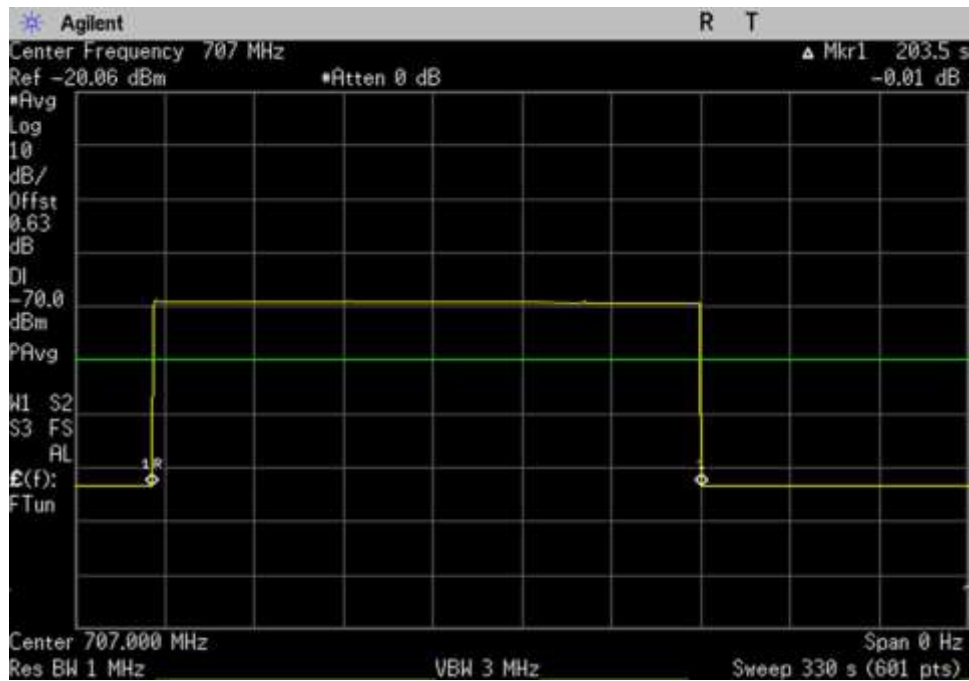
| Asset # | Description       | Manufacturer | Model                    | Calibration Date | Cal Due Date |
|---------|-------------------|--------------|--------------------------|------------------|--------------|
| P07192  | Cable             | Astro        | 32022-29094K-29094K-48TC | 10/9/2017        | 10/9/2019    |
| P07191  | Cable             | Astro        | 32022-29094K-29094K-48TC | 10/30/2017       | 10/30/2019   |
| 03418   | Signal Generator  | Agilent      | E4438C                   | 6/19/2017        | 6/19/2019    |
| 03471   | Spectrum Analyzer | Agilent      | E4440A                   | 1/18/2018        | 1/18/2020    |

## Summary of Results

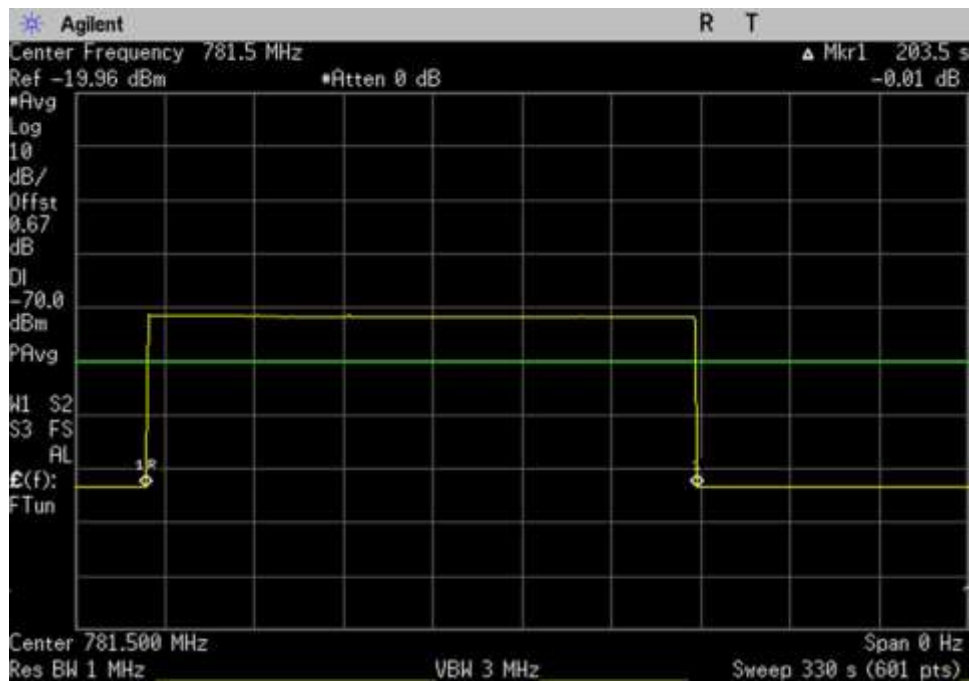
Pass: As demonstrated, when the booster is not serving an active device connection after 5 minutes the uplink noise power does not exceed -70dBm/MHz

| Uplink Inactivity |                 |              |
|-------------------|-----------------|--------------|
| Frequency<br>MHz  | Measured<br>Min | Limit<br>Min |
| UL1710-1755       | 3.4             | 5.0          |
| UL1850-1915       | 3.4             | 5.0          |
| UL824-849         | 3.4             | 5.0          |
| UL 698-716        | 3.4             | 5.0          |
| UL776-787         | 3.4             | 5.0          |

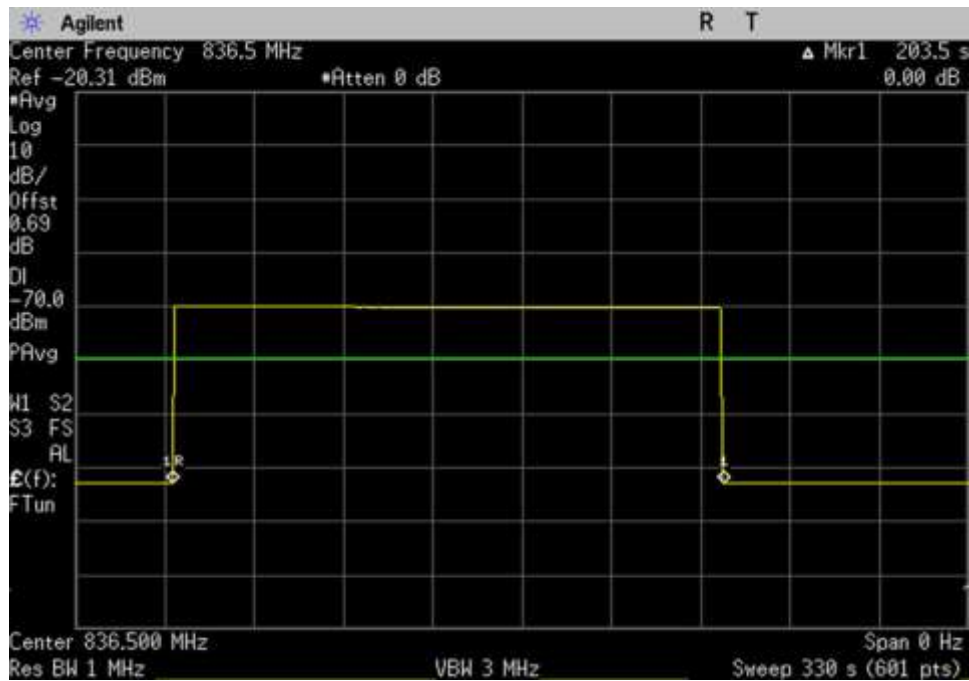
## Plots



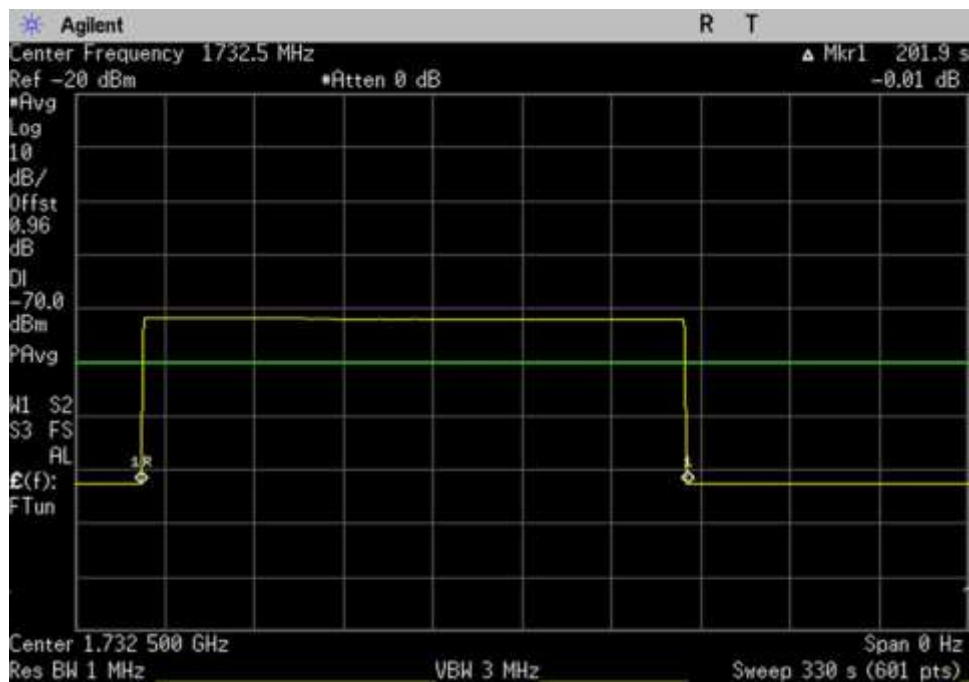
UL\_698-716\_707MHz



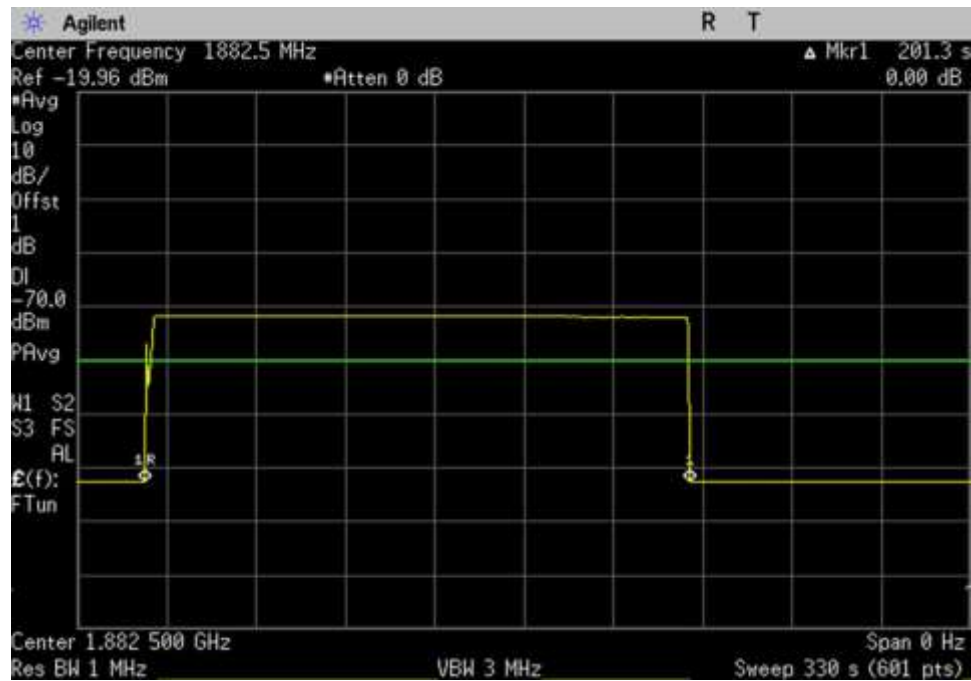
UL\_776-787\_781.5MHz



UL\_824-849\_ 836.5MHz



UL\_1710-1755\_ 1732.5MHz



UL\_1850-1915\_1882.5MHz

## 7.9 Booster Gain Limit

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: Cellphone-Mate, Inc.  
 Specification: **7.9 Variable Booster gain( Max Gain / Variable Uplink Gain Timing)**  
 Work Order #: **102180**  
 Test Type: **Conducted Emissions** Date 01/28/2019 and 01/29/2019  
 Tested By: **Hieu Song Nguyenpham**  
 Software: EMITest 5.03.11

#### Equipment Tested:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Support Equipment:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Test Conditions / Notes:

01/28/2019: Test environment conditions: Temperature: 20.5°C, 38% relative humidity, Pressure: 102.2kPa  
 01/29/2019: Test environment conditions: Temperature: 20.5°C, 43% relative humidity, Pressure: 101.9kPa

Modification #1 was in place during testing.

| Frequency (MHz)   | MSCL (dB) |
|-------------------|-----------|
| PCS(1850-1915)    | 37.8      |
| Cellular(824-849) | 32.5      |
| LTE(698-716)      | 30.6      |
| LTE(776-787)      | 31.5      |
| AWS(1710-1755)    | 37        |

#### Test Equipment:

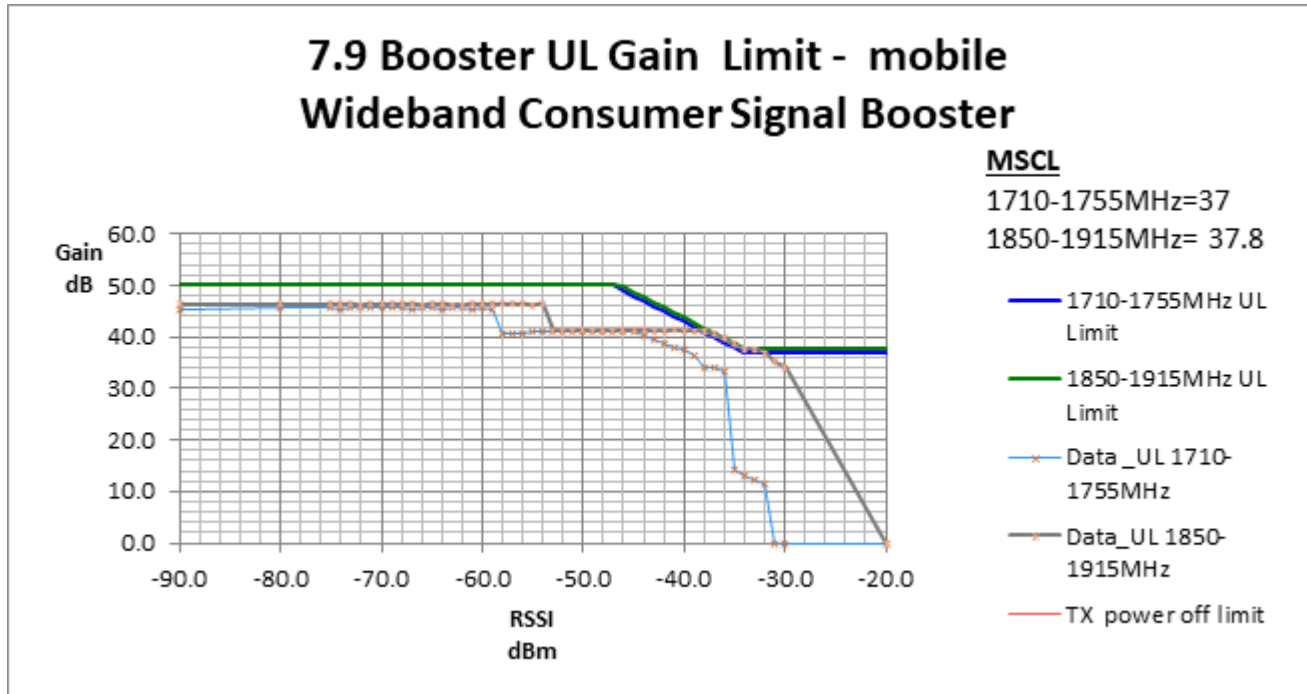
| Asset # | Description                  | Manufacturer           | Model                    | Calibration Date | Cal Due Date |
|---------|------------------------------|------------------------|--------------------------|------------------|--------------|
| P07192  | Cable                        | Astro                  | 32022-29094K-29094K-48TC | 10/9/2017        | 10/9/2019    |
| P07191  | Cable                        | Astro                  | 32022-29094K-29094K-48TC | 10/30/2017       | 10/30/2019   |
| 03418   | Signal Generator             | Agilent                | E4438C                   | 6/19/2017        | 6/19/2019    |
| 03471   | Spectrum Analyzer            | Agilent                | E4440A                   | 1/18/2018        | 1/18/2020    |
| 03360   | Cable                        | Astrolab               | 32022-2-29094-36TC       | 6/25/2018        | 6/25/2020    |
| C00082  | Directional Coupler          | MECA Electronics, Inc. | 722-10-1.500V            | 9/18/2017        | 9/18/2019    |
| C00032  | Arbitrary Waveform Generator | Agilent                | E4433B                   | 3/19/2018        | 3/19/2020    |

## Summary of Results

Pass: As demonstrated, computed gains are within the gain limit. All maximum variable uplink gain timings are within 1 second limit.

### 7.9.1 Maximum Gain

#### 7.9.1 Maximum gain



| 1710.0-1755.0MHz |             |                       |                     |                |                      |        |        |
|------------------|-------------|-----------------------|---------------------|----------------|----------------------|--------|--------|
| RSSI (dBm)       |             |                       |                     | Limit          |                      |        | Margin |
|                  | Input (dBm) | Measured Output (dBm) | Measured Gain (dBm) | RSSI Dependent | Mobile Booster Limit | TX off |        |
| -90.0            | -32.5       | 12.937                | 45.4                | -              | 50.0                 | -      | -4.6   |
| -80.0            | -32.5       | 13.036                | 45.5                | -              | 50.0                 | -      | -4.5   |
| -40.0            | -32.5       | 5.1                   | 37.6                | 43.0           | -                    | -      | -5.4   |
| -39.0            | -32.5       | 3.9                   | 36.4                | 42.0           | -                    | -      | -5.6   |
| -34.0            | -32.5       | -19.4                 | 13.1                | -              | -                    | 37     | -23.9  |
| -33.0            | -32.5       | -20.1                 | 12.4                | -              | -                    | 37     | -24.6  |

| 1850.0-1915.0MHz |                |                             |                        |                   |                            |        |        |
|------------------|----------------|-----------------------------|------------------------|-------------------|----------------------------|--------|--------|
| RSSI<br>(dBm)    |                |                             |                        | Limit             |                            |        | Margin |
|                  | Input<br>(dBm) | Measured<br>Output<br>(dBm) | Measured<br>Gain (dBm) | RSSI<br>Dependent | Mobile<br>Booster<br>Limit | TX off |        |
| -90.0            | -30.8          | 15.6                        | 46.4                   | -                 | 50.0                       | -      | -3.6   |
| -80.0            | -30.8          | 15.6                        | 46.4                   | -                 | 50.0                       | -      | -3.6   |
| -36.0            | -30.8          | 8.9                         | 39.7                   | 39.8              | -                          | -      | -0.1   |
| -35.0            | -30.8          | 7.9                         | 38.7                   | 38.8              | -                          | -      | -0.1   |
| -34.0            | -30.8          | 6.8                         | 37.6                   | -                 | -                          | 37.8   | -0.2   |
| -33.0            | -30.8          | 6.7                         | 37.5                   | -                 | -                          | 37.8   | -0.3   |

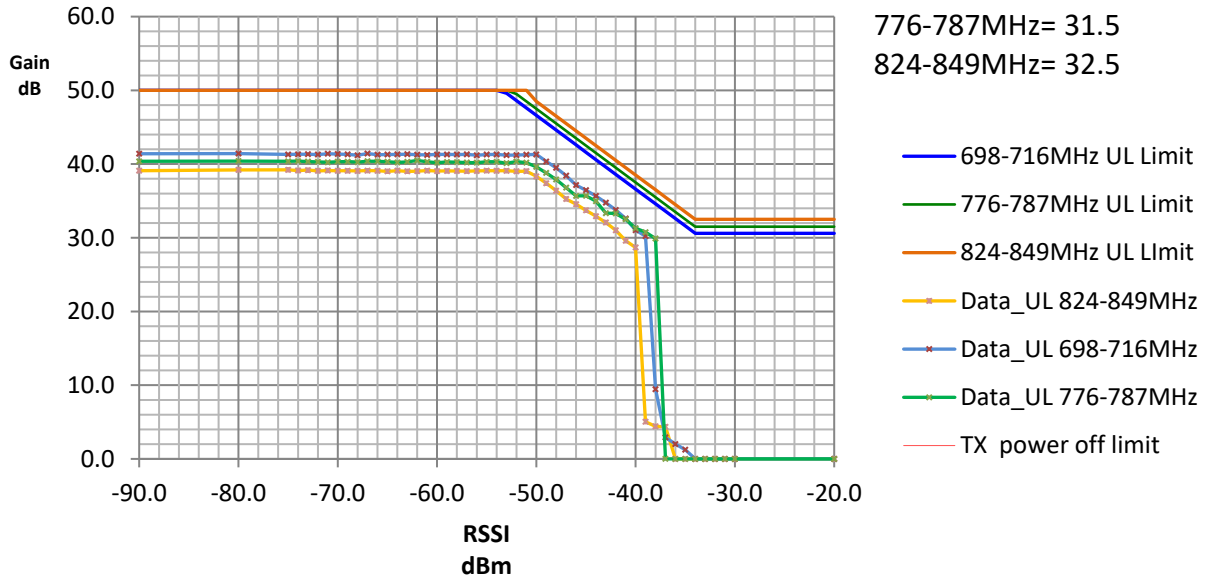
## 7.9 Booster UL Gain Limit - mobile Wideband Consumer Signal Booster

### MSCL

698-716MHz= 30.6

776-787MHz= 31.5

824-849MHz= 32.5



| 824.0-849.0MHz |             |                       |                     |                |                      |        |        |
|----------------|-------------|-----------------------|---------------------|----------------|----------------------|--------|--------|
|                |             |                       |                     | Limit          |                      |        | Margin |
| RSSI (dBm)     | Input (dBm) | Measured Output (dBm) | Measured Gain (dBm) | RSSI Dependent | Mobile Booster Limit | TX off |        |
| -90.0          | -22.5       | 16.6                  | 39.1                | -              | 50.0                 | -      | -10.9  |
| -80.0          | -22.5       | 16.7                  | 39.2                | -              | 50.0                 | -      | -10.8  |
| -41.0          | -22.5       | 7.1                   | 29.6                | 39.5           | -                    | -      | -9.9   |
| -40.0          | -22.5       | 6.2                   | 28.7                | 38.5           | -                    | -      | -9.8   |
| -34.0          | -22.5       | -36.8                 | 0.0                 | -              | -                    | 32.5   | -32.5  |
| -33.0          | -22.5       | -36.8                 | 0.0                 | -              | -                    | 32.5   | -32.5  |

| 698.0-716.0MHz |             |                       |                     |                |                      |        |        |
|----------------|-------------|-----------------------|---------------------|----------------|----------------------|--------|--------|
|                |             |                       |                     | Limit          |                      |        | Margin |
| RSSI (dBm)     | Input (dBm) | Measured Output (dBm) | Measured Gain (dBm) | RSSI Dependent | Mobile Booster Limit | TX off |        |
| -90.0          | -24.5       | 16.9                  | 41.4                | -              | 50.0                 | -      | -8.6   |
| -80.0          | -24.5       | 16.9                  | 41.4                | -              | 50.0                 | -      | -8.6   |
| -43.0          | -24.5       | 10.3                  | 34.8                | 39.6           | -                    | -      | -4.8   |
| -42.0          | -24.5       | 9.3                   | 33.8                | 38.6           | -                    | -      | -4.8   |
| -34.0          | -24.5       | -36.1                 | 0.0                 | -              | -                    | 30.6   | -30.6  |
| -33.0          | -24.5       | -36.1                 | 0.0                 | -              | -                    | 30.6   | -30.6  |

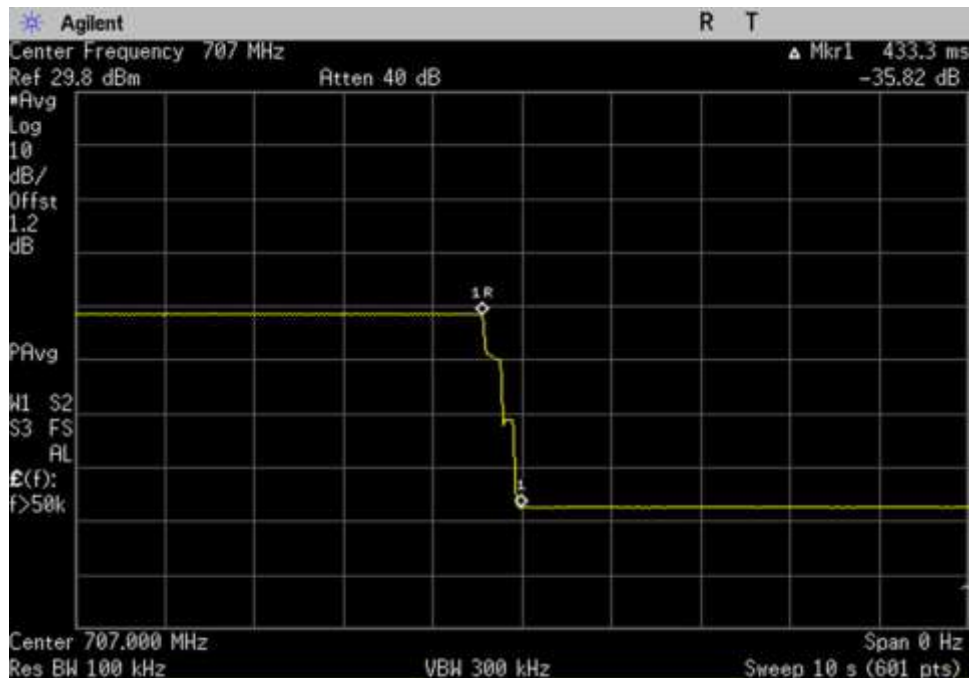
| 776.0-787.0MHz |             |                       |                     |                |                      |        |        |
|----------------|-------------|-----------------------|---------------------|----------------|----------------------|--------|--------|
|                |             |                       |                     | Limit          |                      |        | Margin |
| RSSI (dBm)     | Input (dBm) | Measured Output (dBm) | Measured Gain (dBm) | RSSI Dependent | Mobile Booster Limit | TX off |        |
| -90.0          | -22.5       | 17.9                  | 40.4                | -              | 50.0                 | -      | -9.6   |
| -80.0          | -22.5       | 17.9                  | 40.4                | -              | 50.0                 | -      | -9.6   |
| -39.0          | -22.5       | 8.3                   | 30.8                | 36.5           | -                    | -      | -5.7   |
| -38.0          | -22.5       | 7.4                   | 29.9                | 35.5           | -                    | -      | -5.6   |
| -34.0          | -22.5       | -25.1                 | 0.0                 | -              | -                    | 31.5   | -31.5  |
| -33.0          | -22.5       | -36.9                 | 0.0                 | -              | -                    | 31.5   | -31.5  |

## 7.9.2 Variable uplink Gain Timing

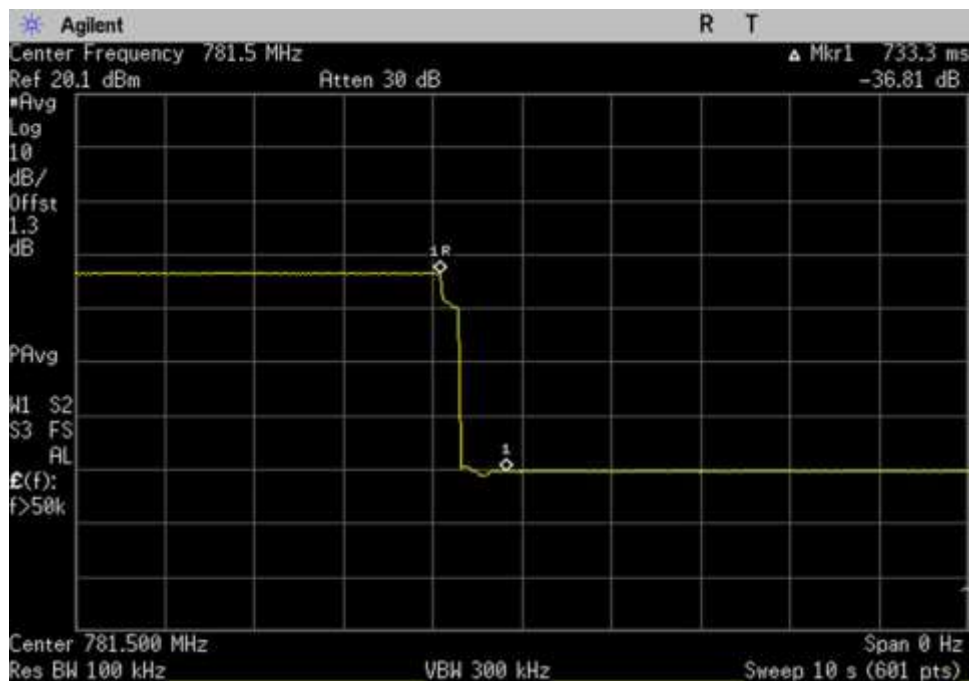
### 7.9.2 Variable uplink gain timing

| Uplink Gain Timing |                |             |
|--------------------|----------------|-------------|
| Frequency (MHz)    | Measured (Sec) | Limit (Sec) |
| UL 1710-1755       | 0.50           | 1.00        |
| UL 1850-1915       | 0.22           | 1.00        |
| UL 824-849         | 0.43           | 1.00        |
| UL 698-716         | 0.43           | 1.00        |
| UL 776-787         | 0.50           | 1.00        |

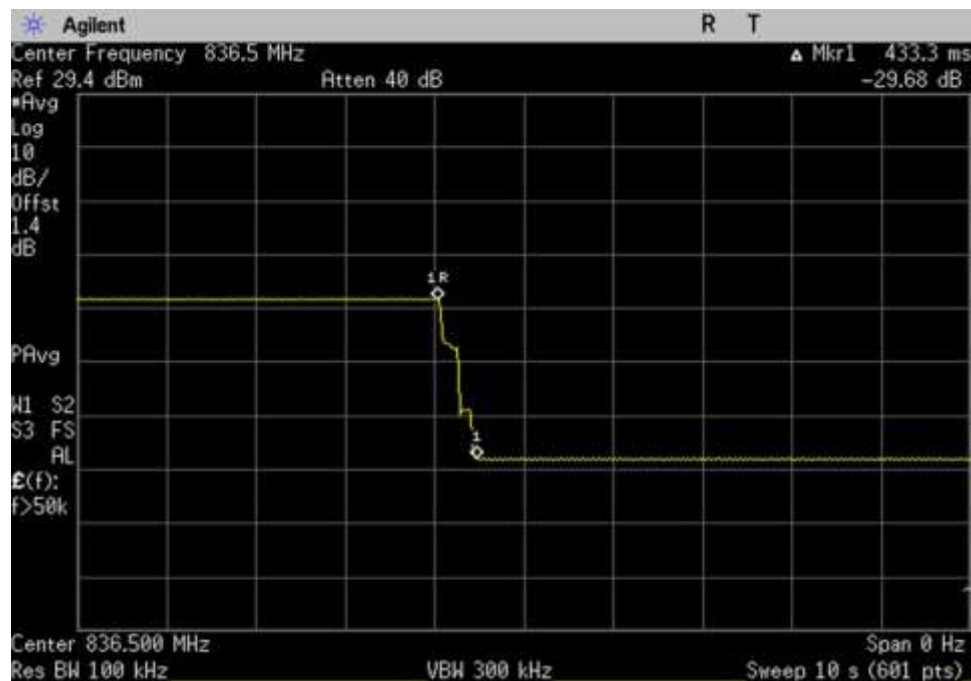
## Plots



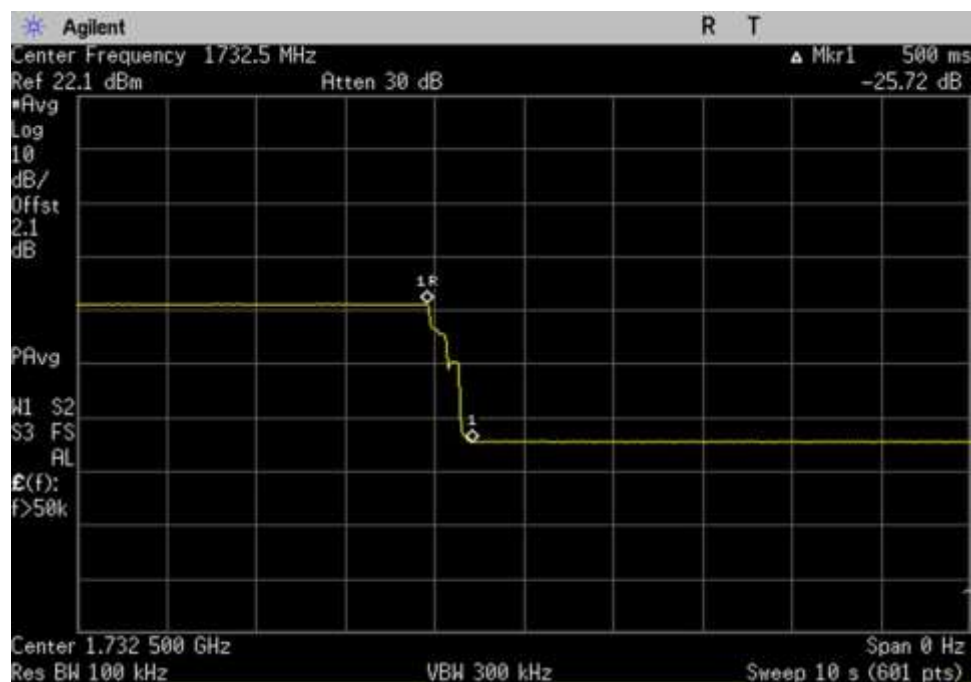
UL\_698-716\_707MHz\_Var



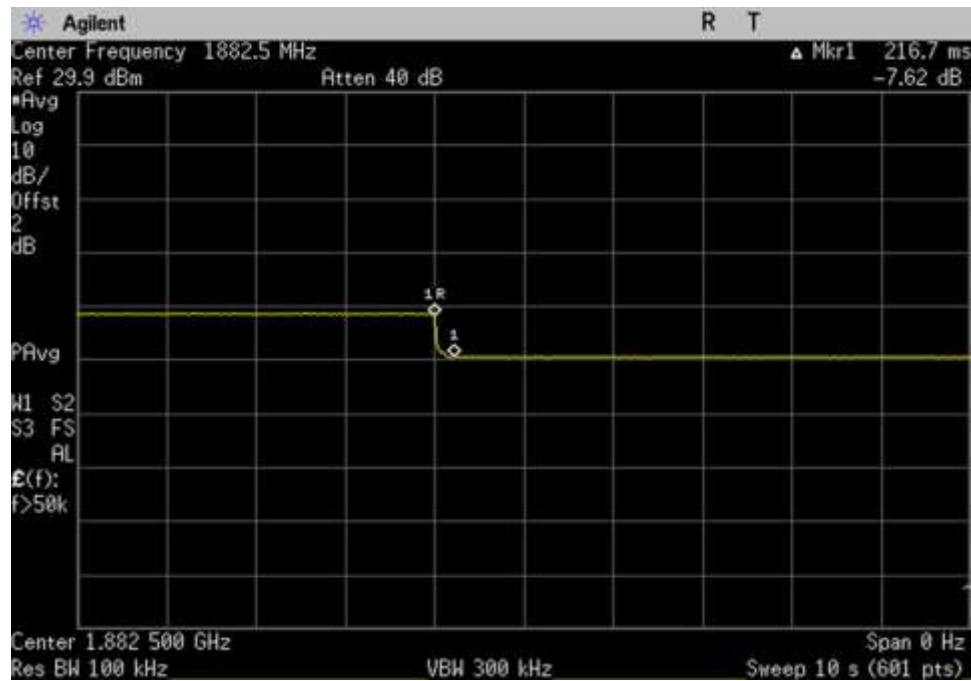
UL\_776-787\_781.5MHz\_Var



UL\_824-849\_ 836.5MHz\_Var



UL\_1710-1755\_ 1732.5MHz\_Var



UL\_1850-1915\_1882.5MHz\_Var

## 7.10 Occupied Band Width

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: Cellphone-Mate, Inc.  
 Specification: **7.10 Occupied Band Width / 47 CFR §2.1049 Occupied Band Width**  
 Work Order #: **102180**  
 Test Type: **Conducted Emissions** Date 01/15/2019  
 Tested By: **Hieu Song Nguyenpham**  
 Software: EMITest 5.03.11

#### Equipment Tested:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Support Equipment:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Test Conditions / Notes:

Test environment conditions: Temperature: 20.6°C, 57.2% relative humidity, Pressure: 102.3kPa

#### Test Equipment:

| Asset # | Description       | Manufacturer | Model                    | Calibration Date | Cal Due Date |
|---------|-------------------|--------------|--------------------------|------------------|--------------|
| P05411  | Attenuator        | Weinschel    | 54A-10                   | 1/19/2018        | 1/19/2020    |
| P07192  | Cable             | Astro        | 32022-29094K-29094K-48TC | 10/9/2017        | 10/9/2019    |
| P07191  | Cable             | Astro        | 32022-29094K-29094K-48TC | 10/30/2017       | 10/30/2019   |
| 03418   | Signal Generator  | Agilent      | E4438C                   | 6/19/2017        | 6/19/2019    |
| 03471   | Spectrum Analyzer | Agilent      | E4440A                   | 1/18/2018        | 1/18/2020    |

## Summary of Results

Pass: As summarized in plots and tables below, the uniformity of the output signal relative to the input signal are practically identical. Therefore, the comparison is within limits.

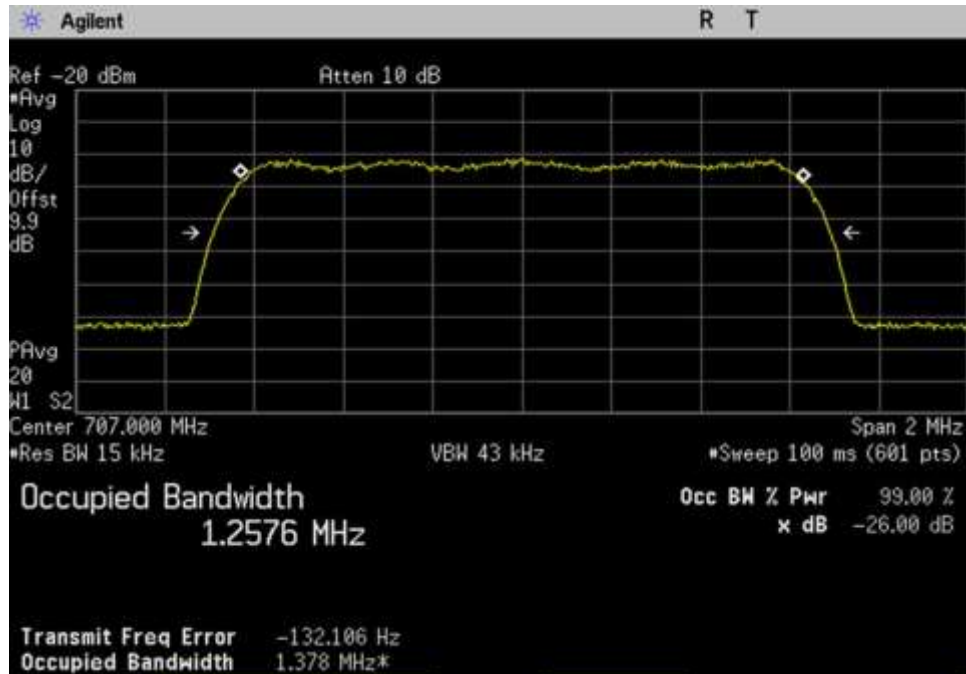
| OBW-Input<br>(Hz) |        |         |         |         |
|-------------------|--------|---------|---------|---------|
| EDGE              | GSM    | CDMA    | AWGN    | LTE     |
| 245231            | 245651 | 1261626 | 4155264 | 4453781 |
| 245498            | 245479 | 1254755 | 4160895 | 4459455 |
| 244683            | 247316 | 1256140 | 4166527 | 4453852 |
| 246657            | 245668 | 1257647 | 4146057 | 4456943 |
| 247432            | 246275 | 1260235 | 4155387 | 4456874 |
| 247299            | 245173 | 1255670 | 4175460 | 4457676 |
| 247632            | 247803 | 1263795 | 4174980 | 4452337 |
| 247984            | 246749 | 1256273 | 4146534 | 4453761 |
| 245669            | 247707 | 1255164 | 4174207 | 4443230 |
| 246380            | 247267 | 1258427 | 4167112 | 4454313 |

| OBW-Output<br>(Hz) |        |         |         |         |
|--------------------|--------|---------|---------|---------|
| EDGE               | GSM    | CDMA    | AWGN    | LTE     |
| 246198             | 245170 | 1249736 | 4184325 | 4447599 |
| 243051             | 246645 | 1259143 | 4140670 | 4446215 |
| 243380             | 245037 | 1259901 | 4148041 | 4435560 |
| 244054             | 246352 | 1255775 | 4147274 | 4444254 |
| 247020             | 244271 | 1259979 | 4142976 | 4448120 |
| 244685             | 245847 | 1256153 | 4185396 | 4451502 |
| 246718             | 246416 | 1253535 | 4162869 | 4458725 |
| 247071             | 245621 | 1256979 | 4173369 | 4461225 |
| 247501             | 246415 | 1251178 | 4148547 | 4451604 |
| 245249             | 245944 | 1260351 | 4125033 | 4429476 |

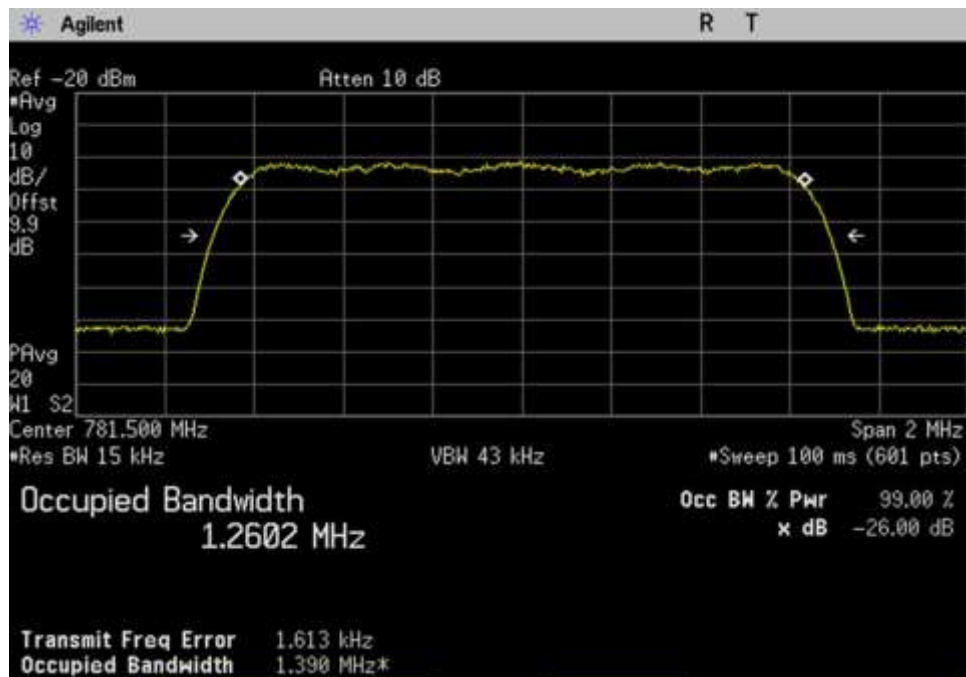
| Max Difference In&Out<br>Occ BW 99% Pwr |       |       |       |       |       |
|-----------------------------------------|-------|-------|-------|-------|-------|
| Frequency Range                         | EDGE  | GSM   | CDMA  | AWGN  | LTE   |
| UL_1710-1755MHz                         | 0.39% | 0.20% | 0.94% | 0.70% | 0.14% |
| UL_1850-1915MHz                         | 1.00% | 0.47% | 0.35% | 0.49% | 0.30% |
| UL_824-849MHz                           | 0.53% | 0.92% | 0.30% | 0.44% | 0.41% |
| UL_698-716MHz                           | 1.06% | 0.28% | 0.15% | 0.03% | 0.28% |
| UL_777-787MHz                           | 0.17% | 0.81% | 0.02% | 0.30% | 0.20% |
| DL_2110-2155MHz                         | 1.06% | 0.27% | 0.04% | 0.24% | 0.14% |
| DL_1930-1995MHz                         | 0.37% | 0.56% | 0.81% | 0.29% | 0.14% |
| DL_869-894MHz                           | 0.37% | 0.46% | 0.06% | 0.65% | 0.17% |
| DL_728-746MHz                           | 0.75% | 0.52% | 0.32% | 0.61% | 0.19% |
| DL_746-756MHz                           | 0.46% | 0.54% | 0.15% | 1.01% | 0.56% |

## Plots

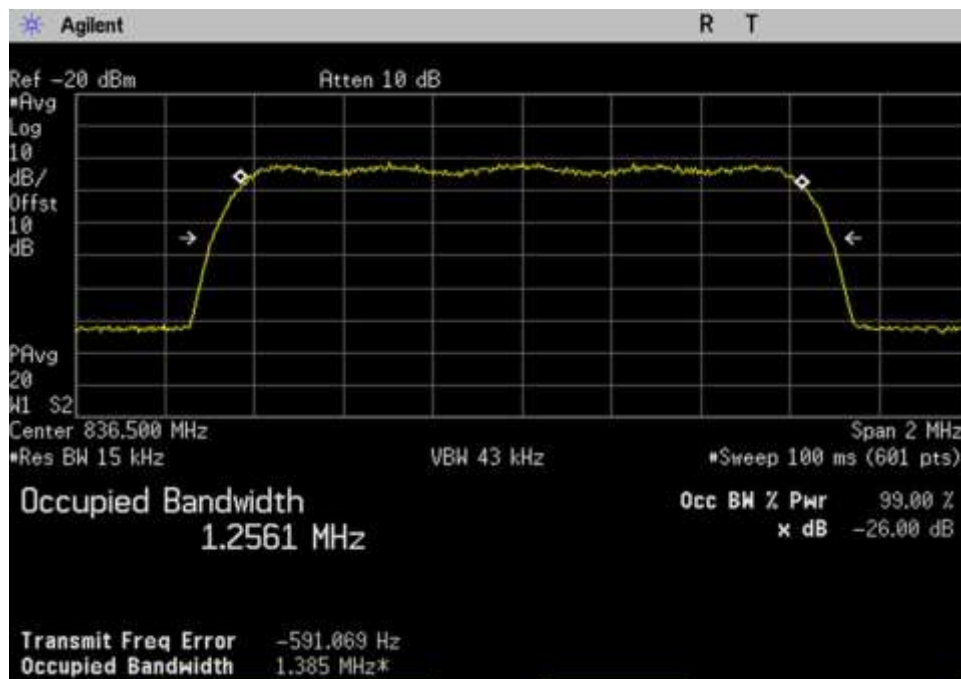
### CDMA Input



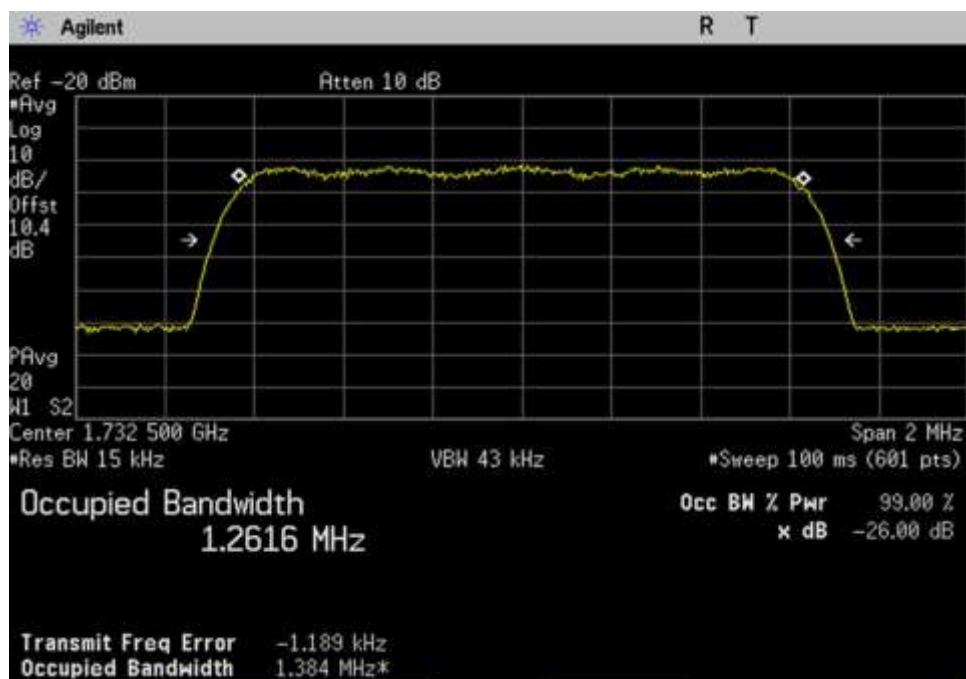
UL\_698-716\_CDMA\_707MHz



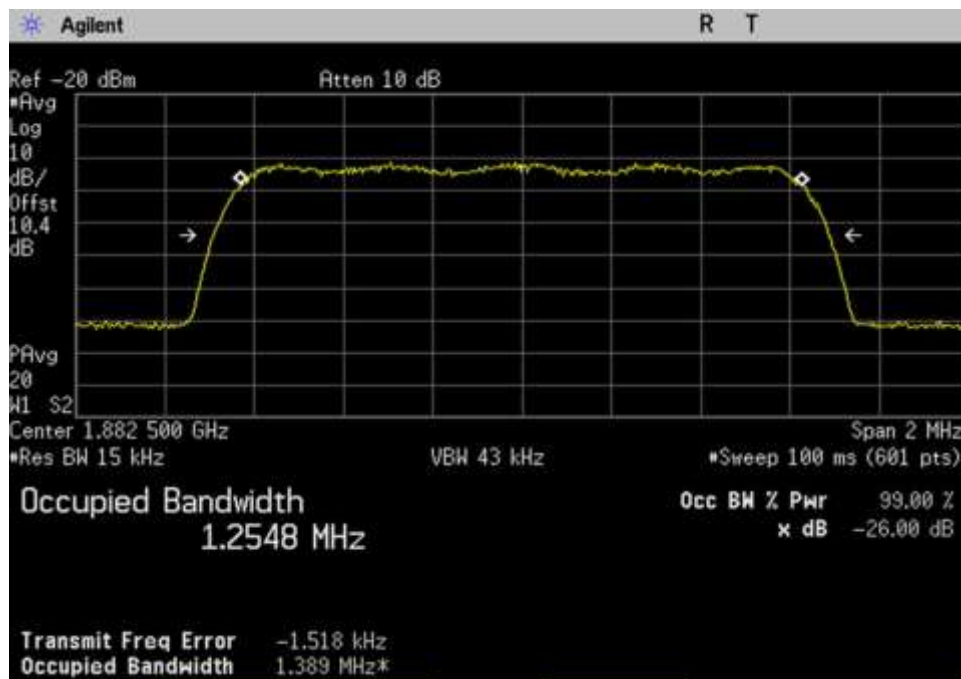
UL\_776-787\_CDMA\_781.5MHz



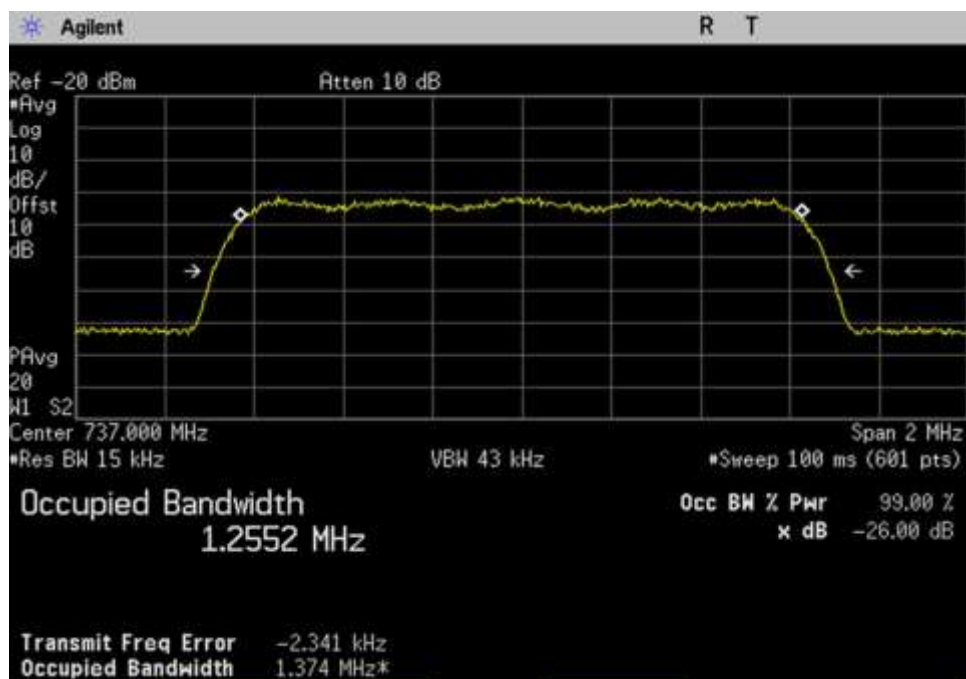
UL\_824-849\_CDMA\_836.5MHz



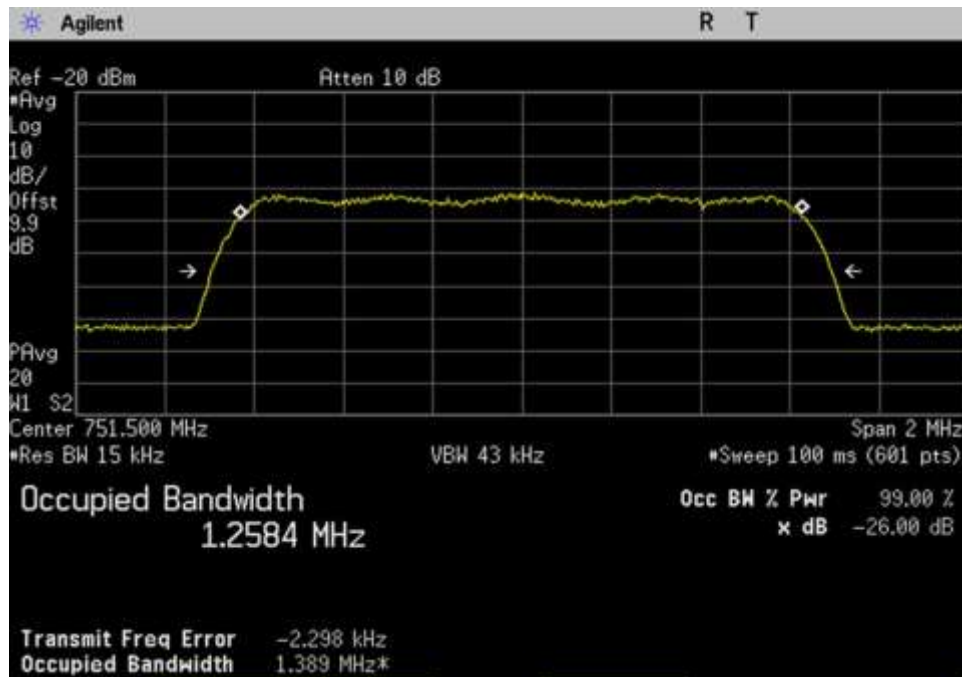
UL\_1710-1755\_CDMA\_1732.5MHz



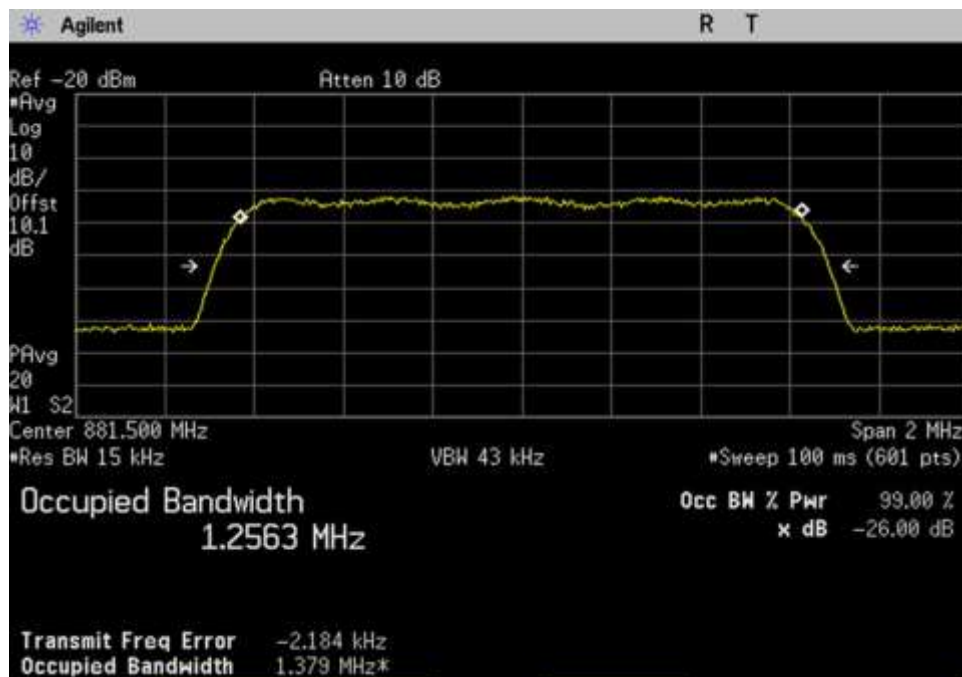
UL\_1850-1915\_CDMA\_1882.5MHz



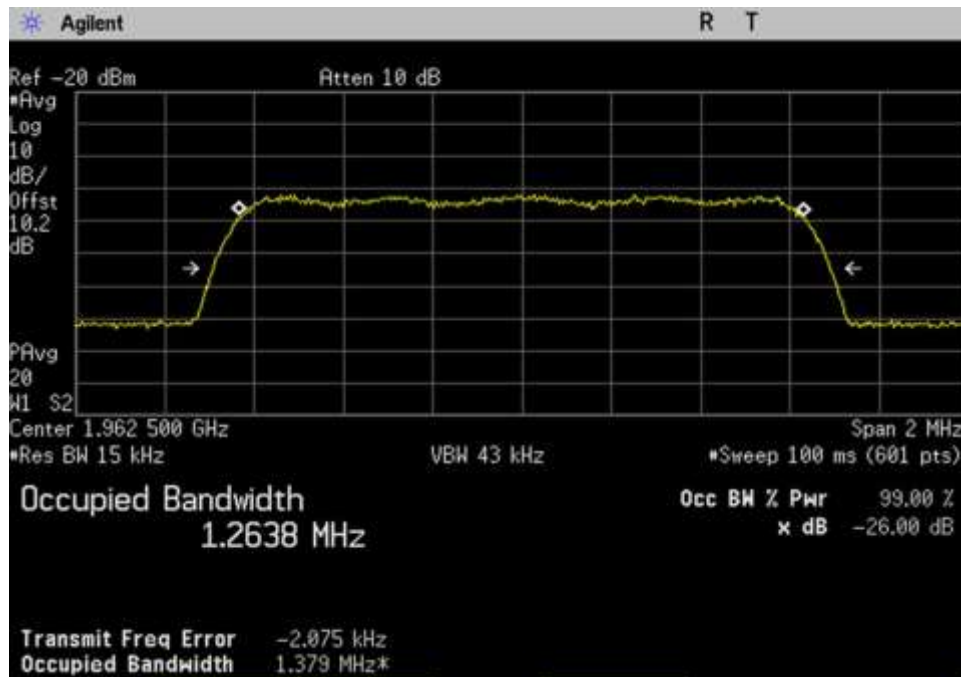
DL\_728-746\_CDMA\_737MHz



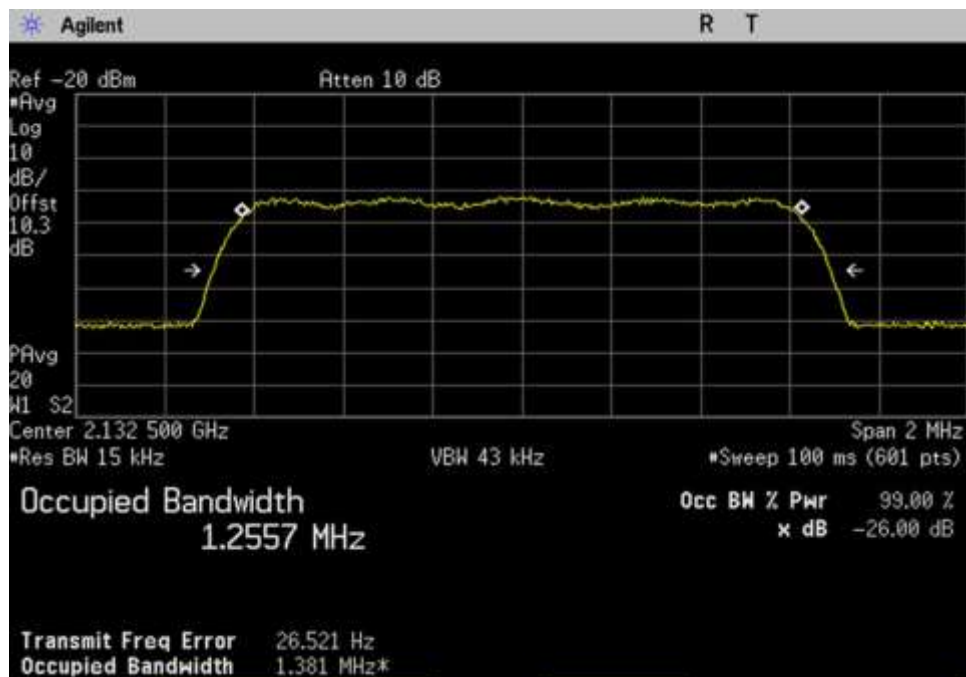
DL\_746-757\_CDMA\_751.5MHz



DL\_869-894\_CDMA\_881.5MHz

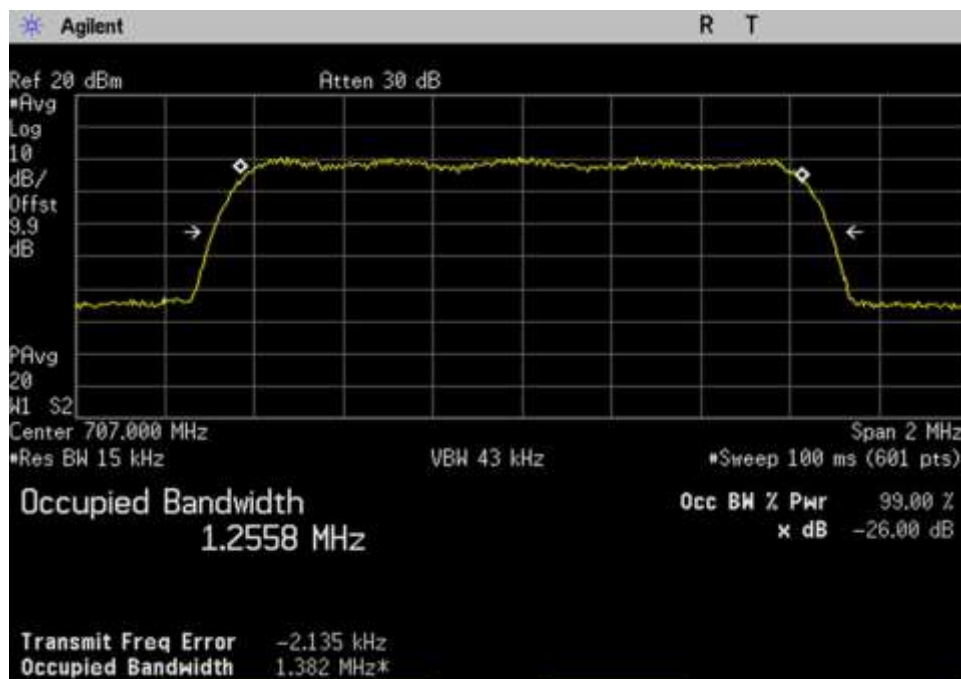


DL\_1930-1995\_CDMA\_1962.5MHz

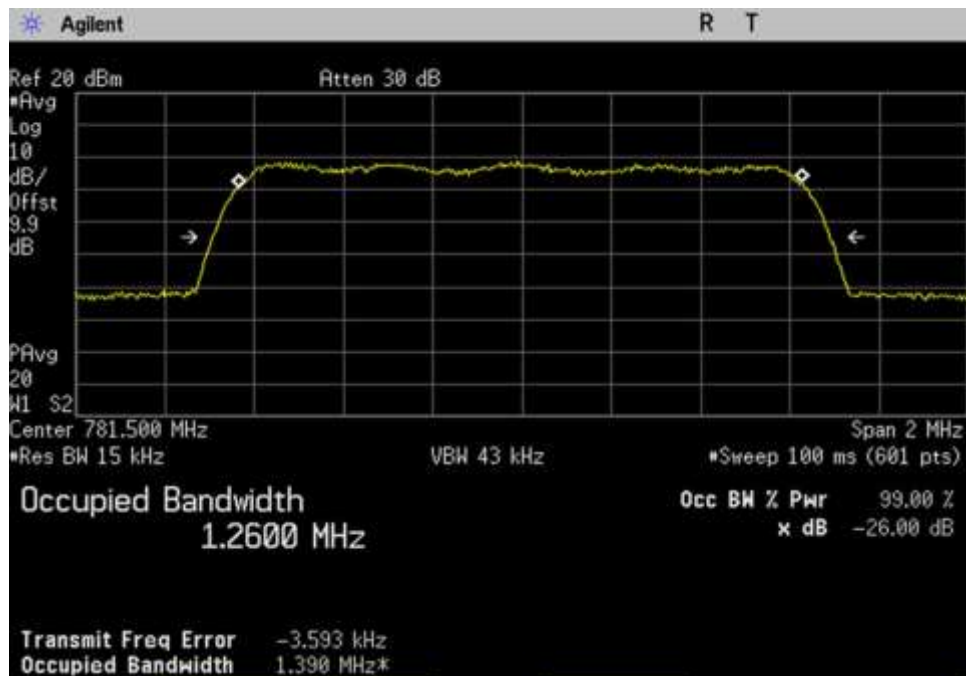


DL\_2110-2155\_CDMA\_2132.5MHz

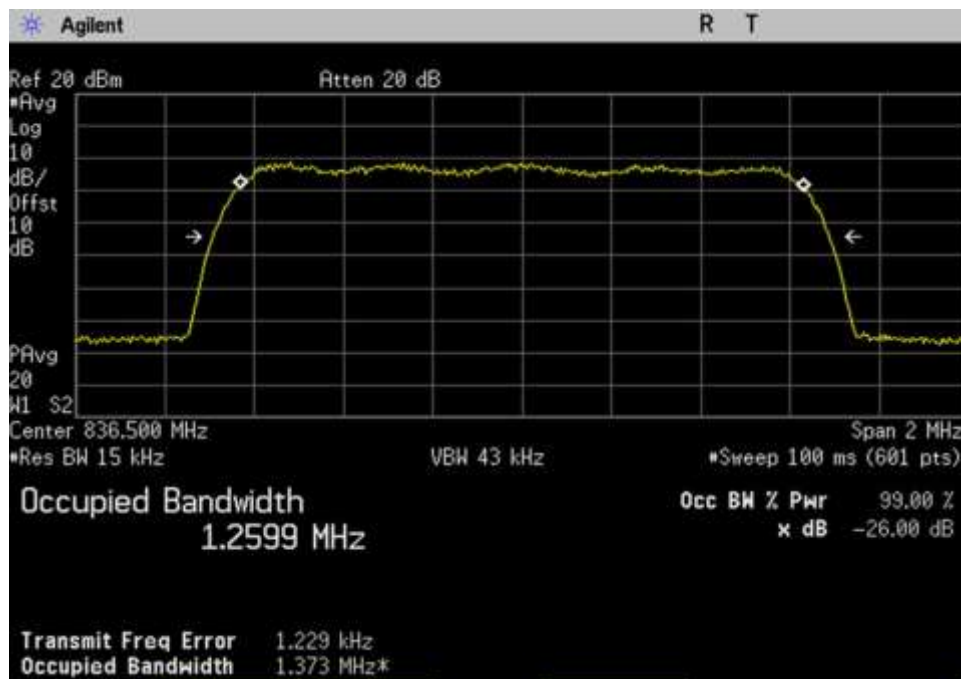
### CDMA Output



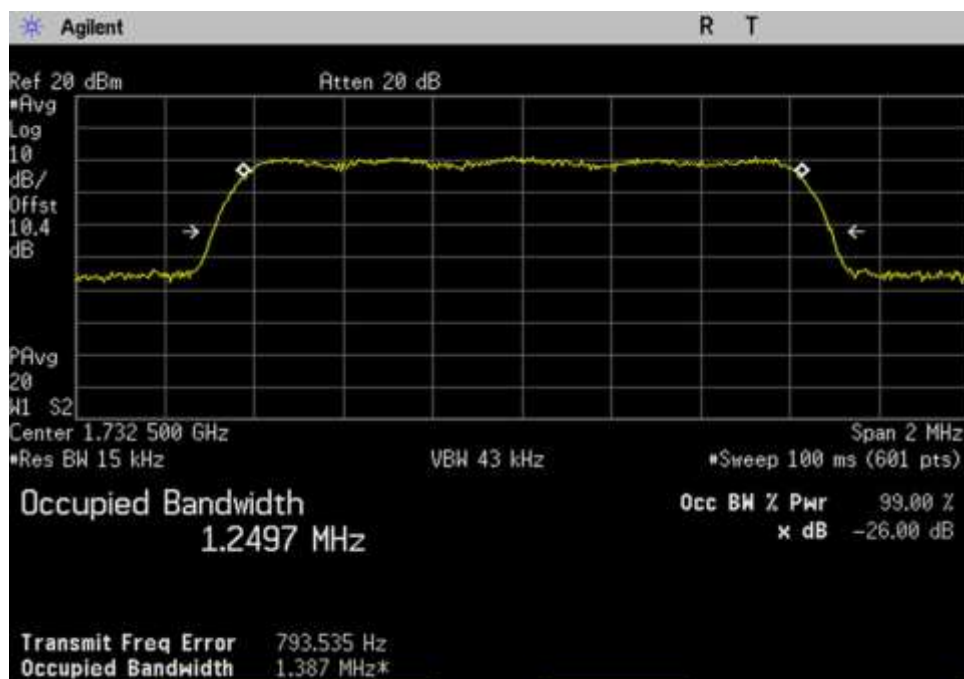
UL\_698-716\_CDMA\_707MHz



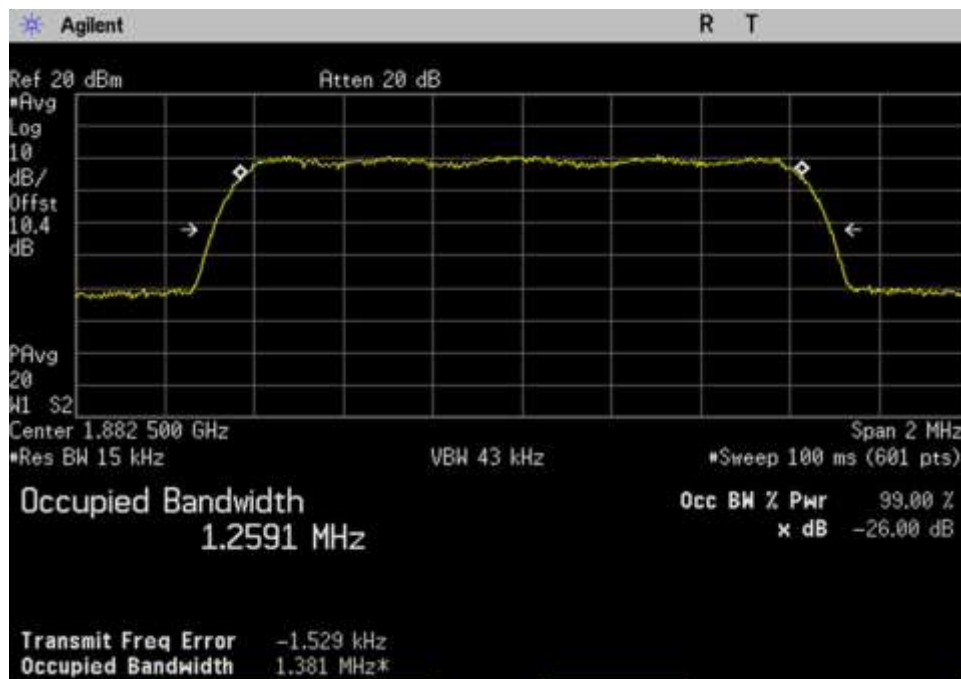
UL\_776-787\_CDMA\_781.5MHz



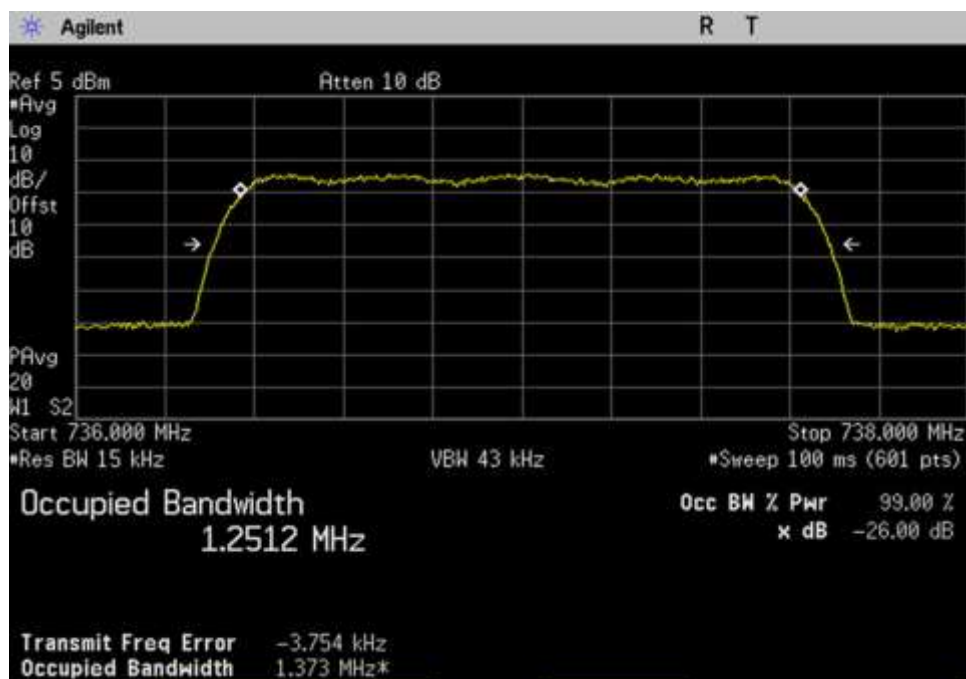
UL\_824-849\_CDMA\_836.5MHz



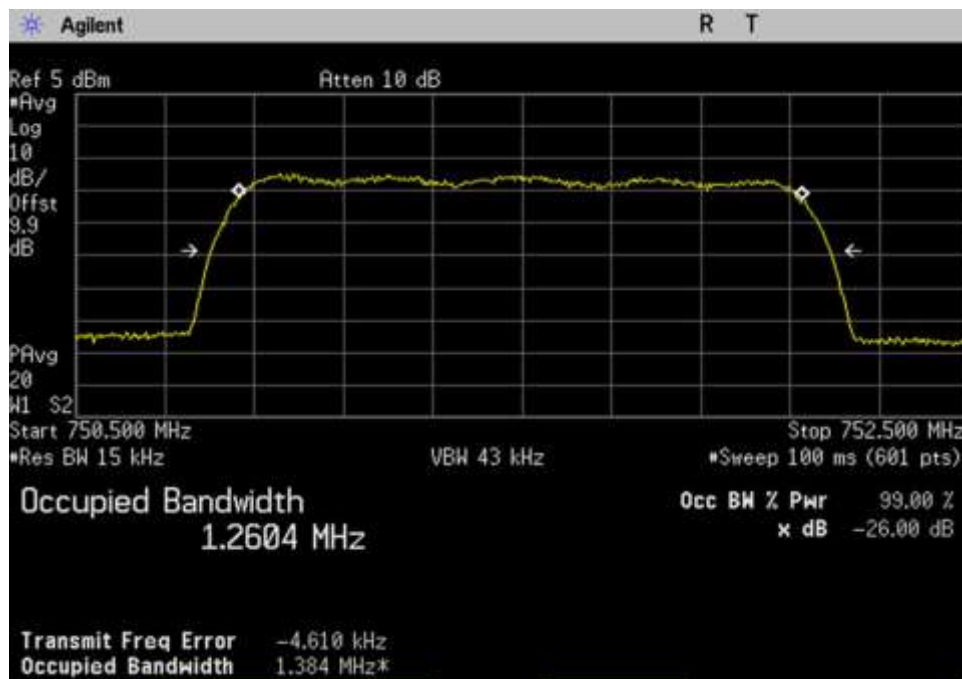
UL\_1710-1755\_CDMA\_1732.5MHz



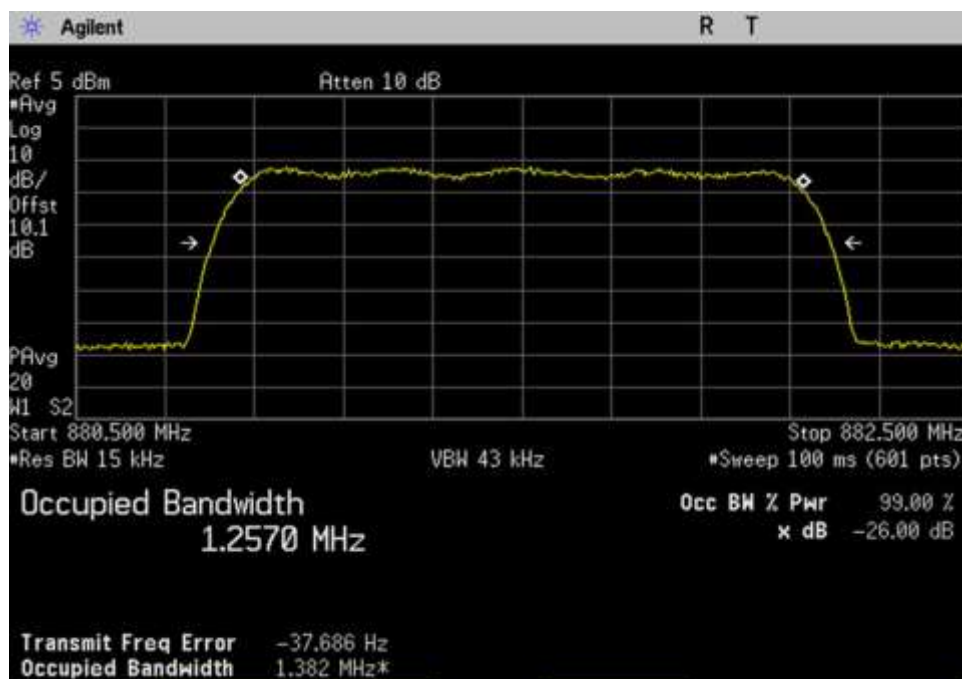
UL\_1850-1915\_CDMA\_1882.5MHz



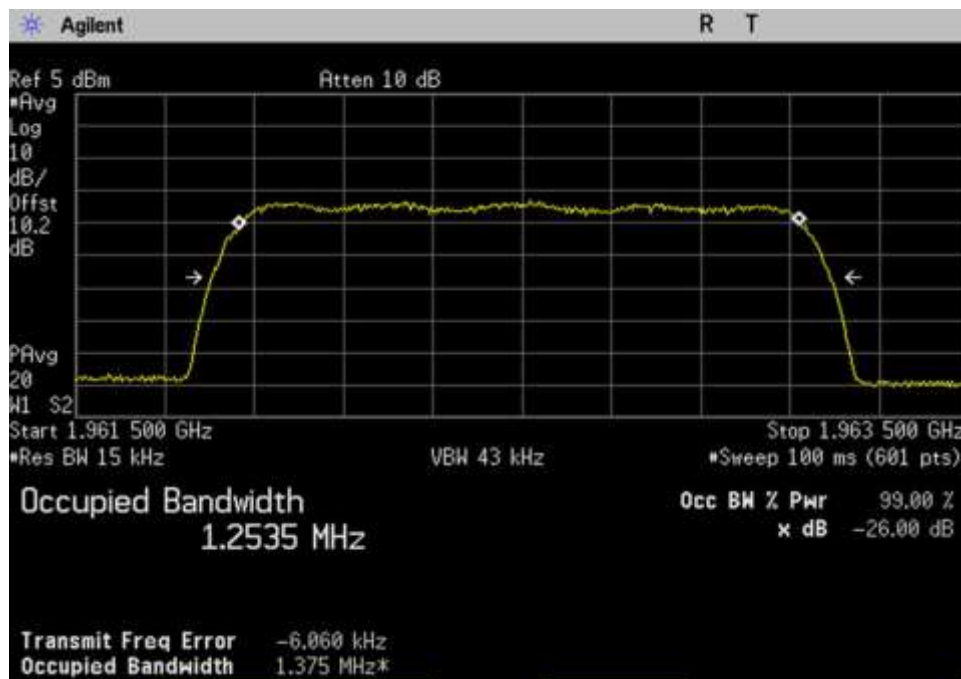
DL\_728-746\_CDMA\_737MHz



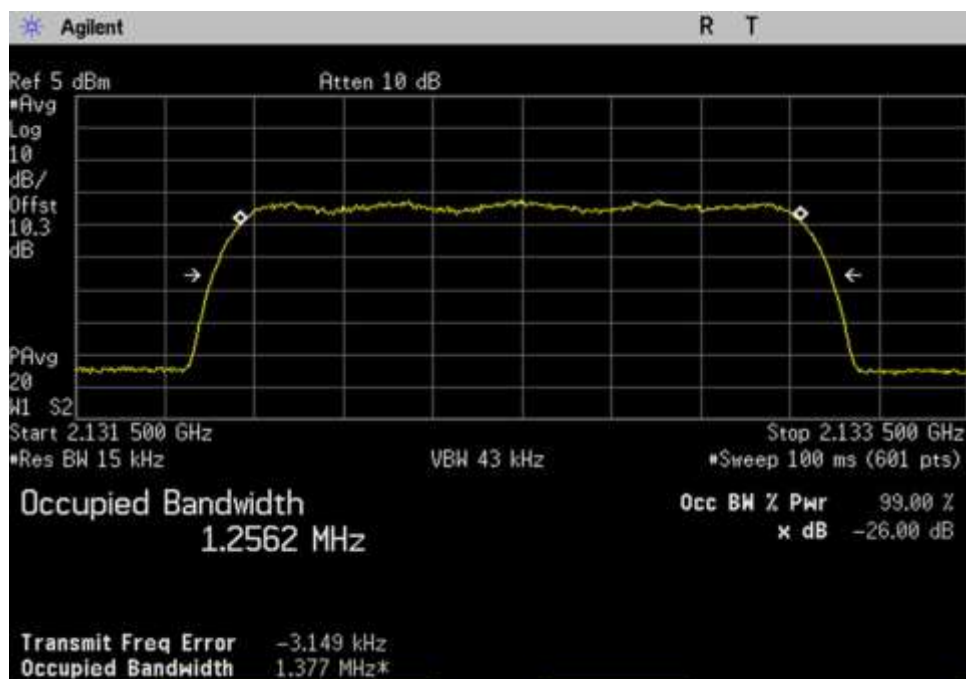
DL\_746-757\_CDMA\_751.5MHz



DL\_869-894\_CDMA\_881.5MHz

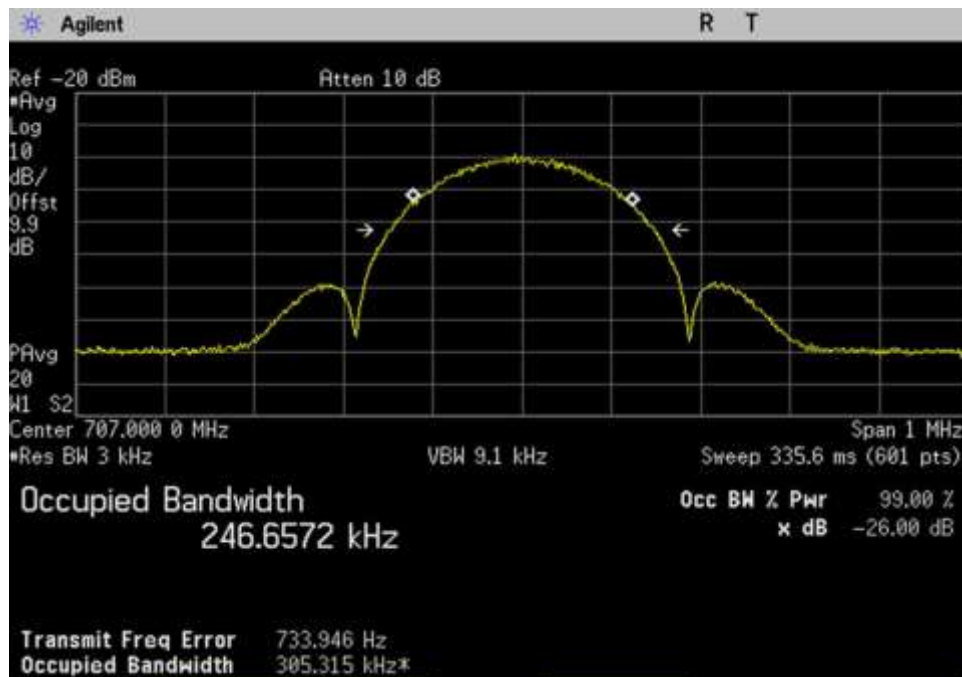


DL\_1930-1995\_CDMA\_1962.5MHz

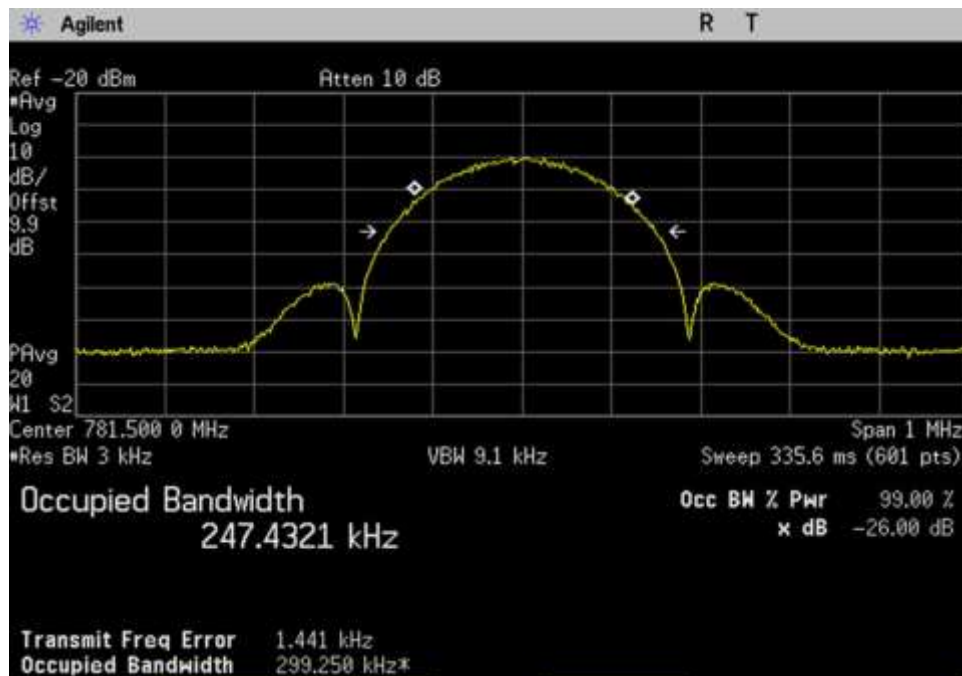


DL\_2110-2155\_CDMA\_2132.5MHz

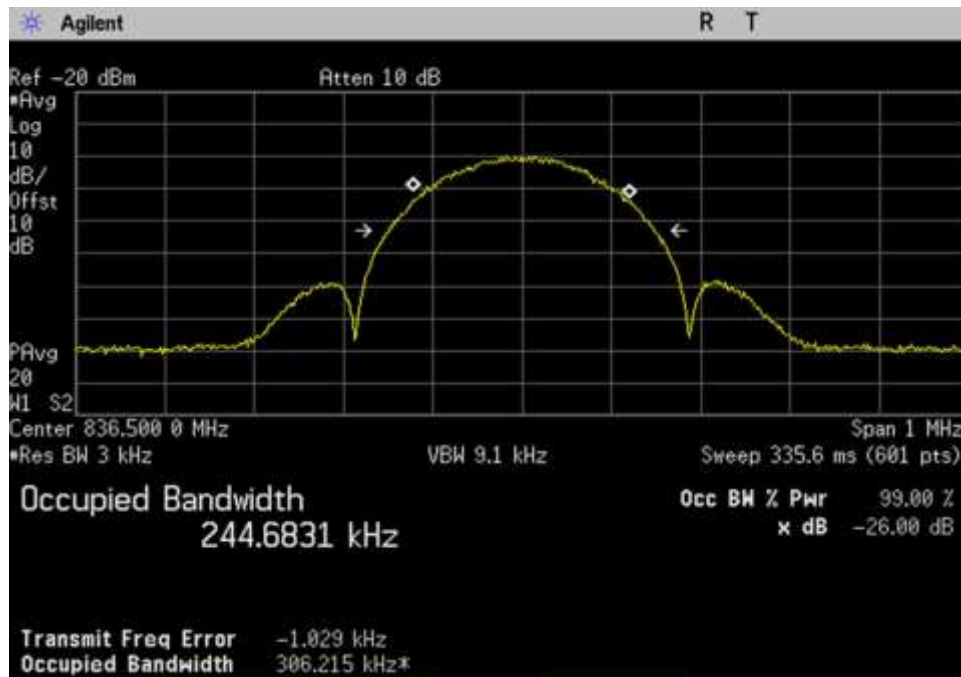
### EDGE Input



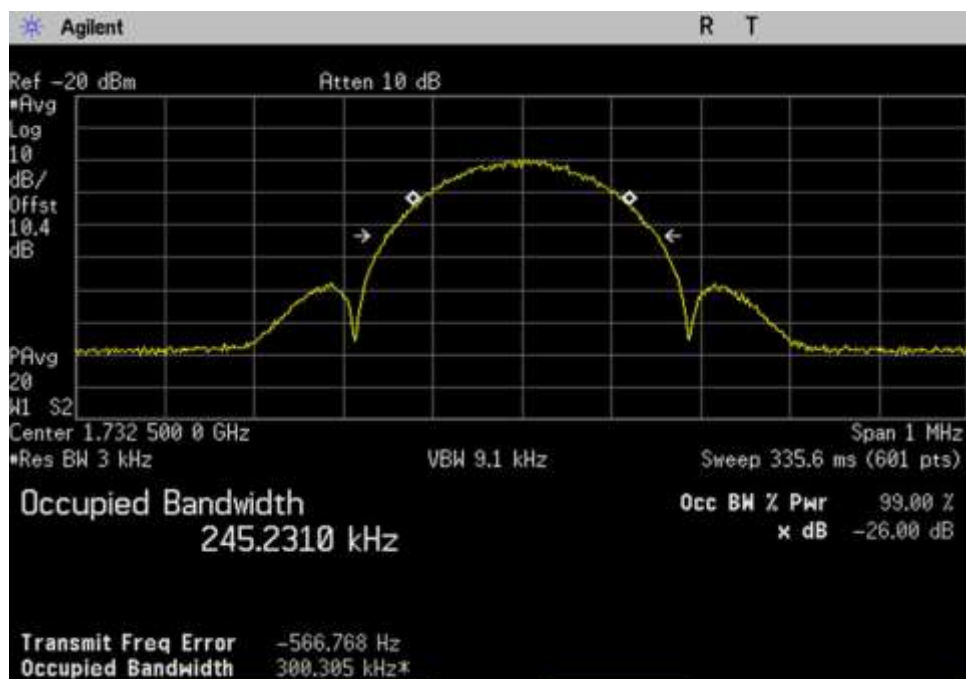
UL\_698-716\_EDGE\_707MHz



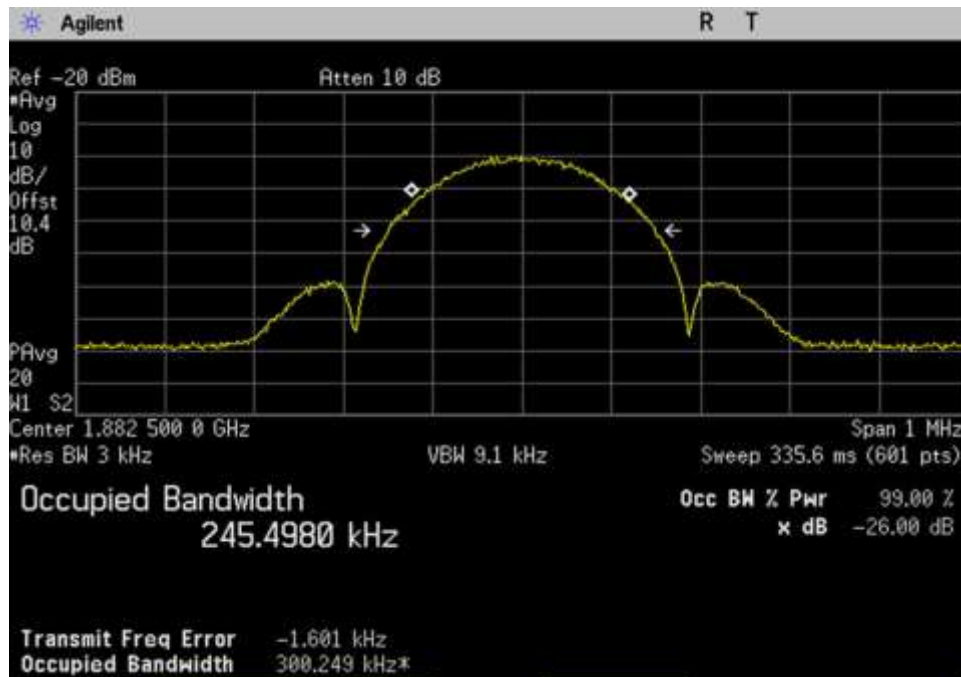
UL\_776-787\_EDGE\_781.5MHz



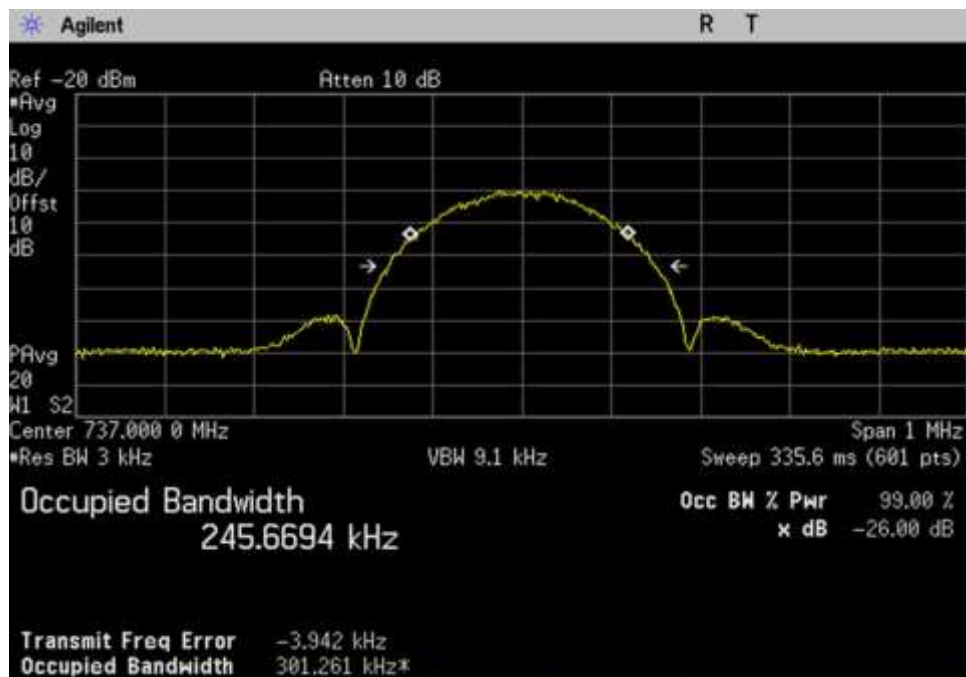
UL\_824-849\_EDGE\_836.5MHz



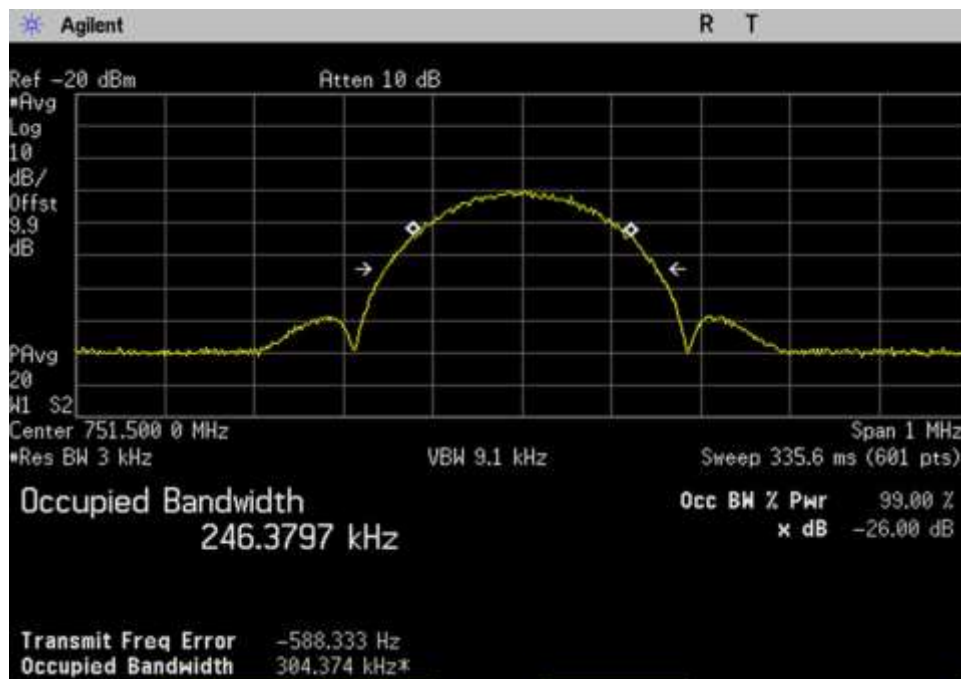
UL\_1710-1755\_EDGE\_1732.5MHz



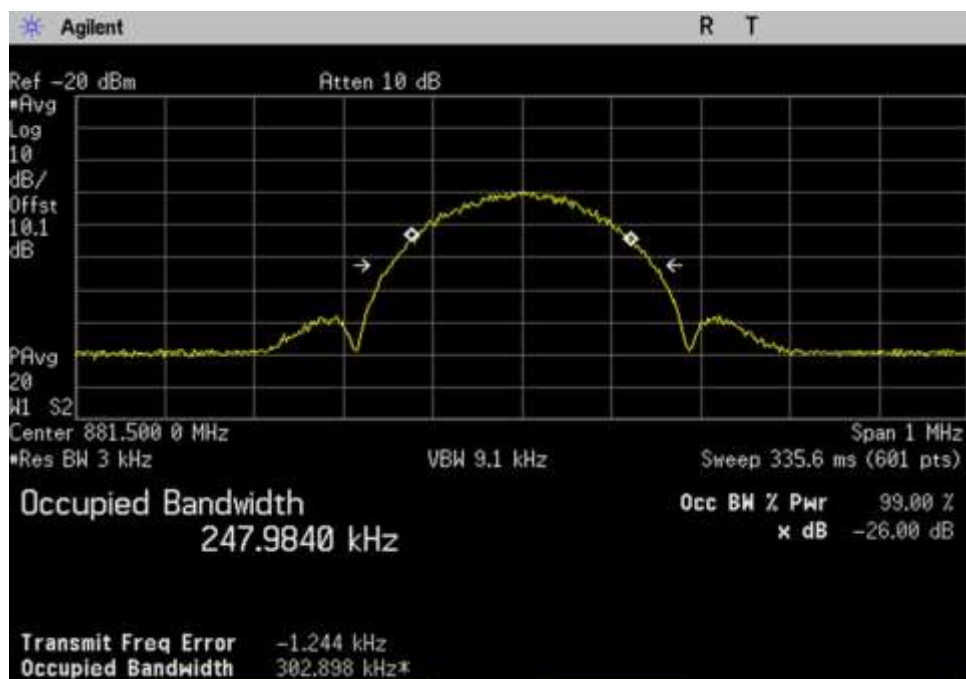
UL\_1850-1915\_EDGE\_1882.5MHz



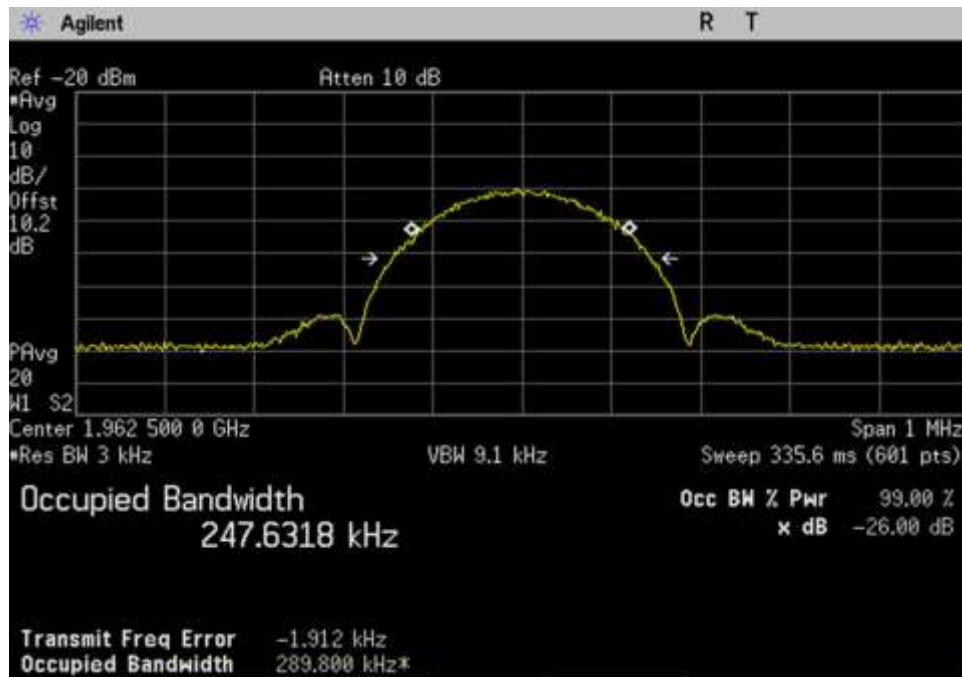
DL\_728-746\_EDGE\_737MHz



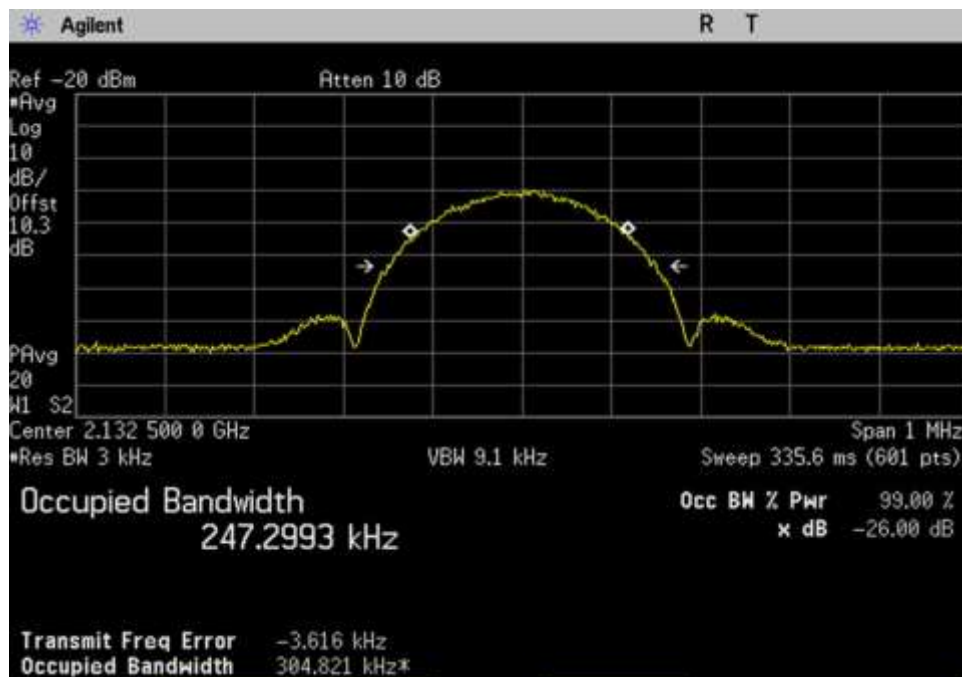
DL\_746-757\_EDGE\_751.5MHz



DL\_869-894\_EDGE\_881.5MHz

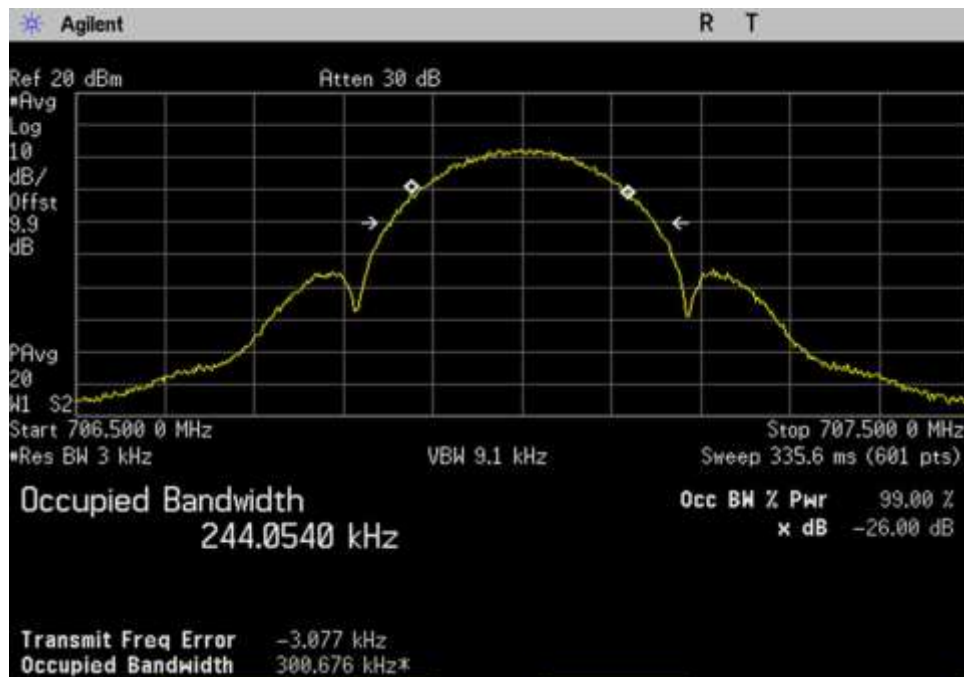


DL\_1930-1995\_EDGE\_1962.5MHz

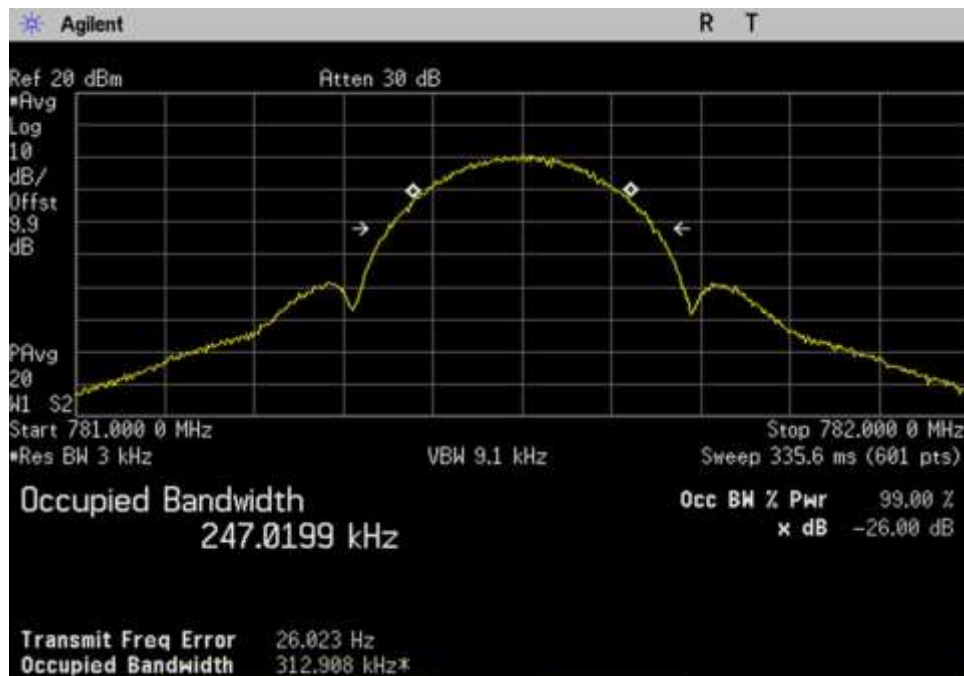


DL\_2110-2155\_EDGE\_2132.5MHz

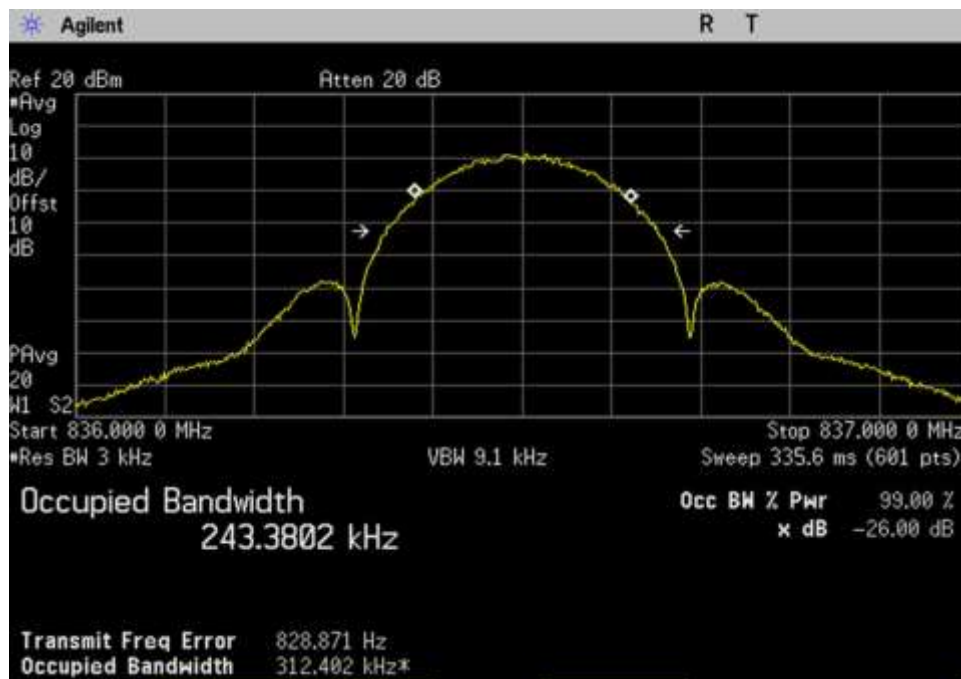
### EDGE Output



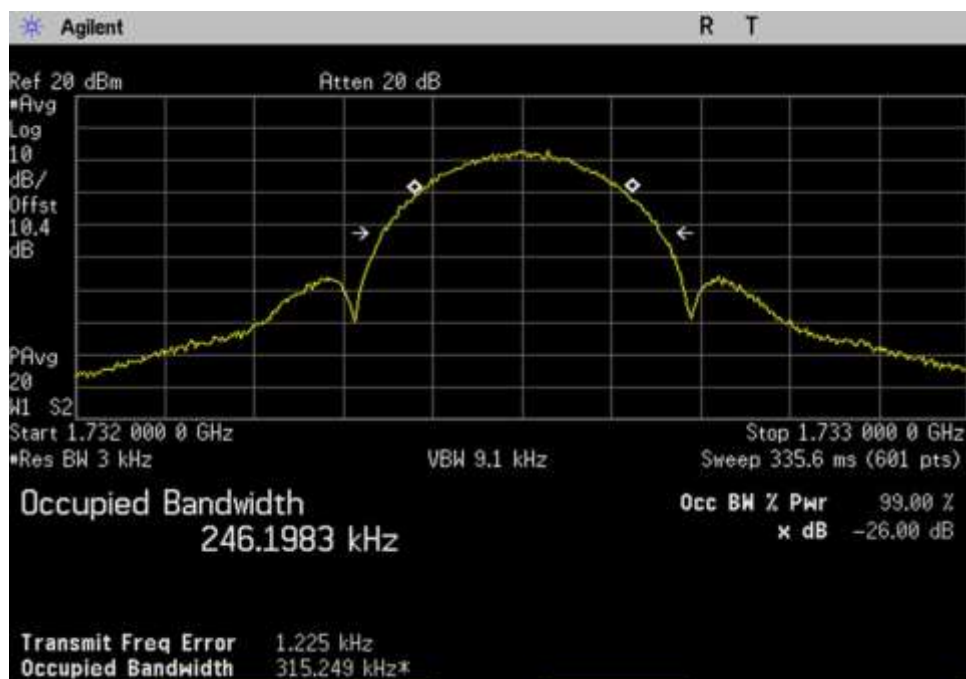
UL\_698-716\_EDGE\_707MHz



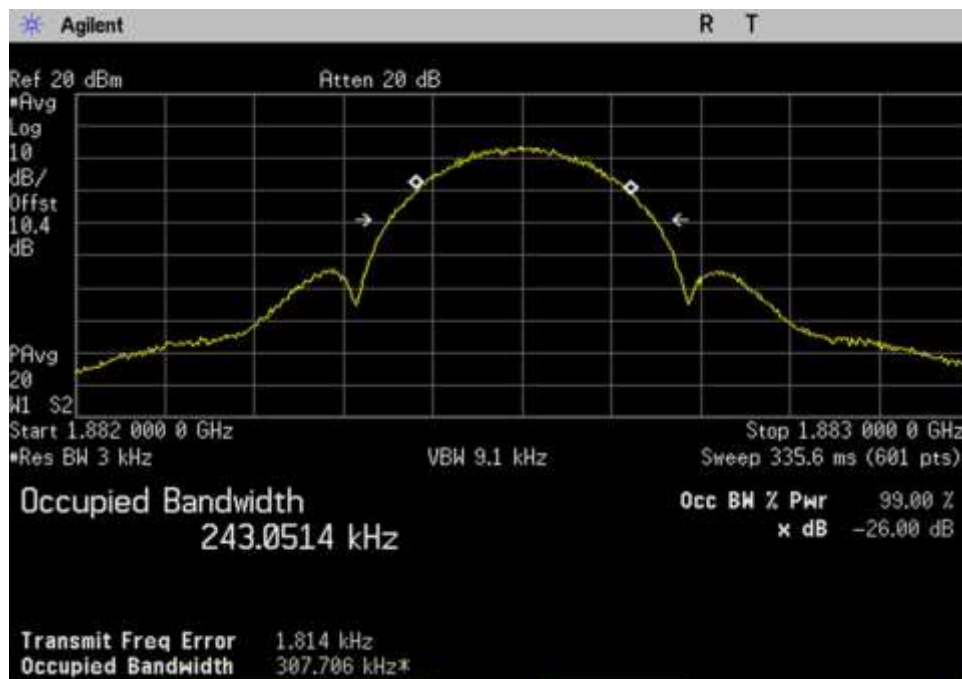
UL\_776-787\_EDGE\_781.5MHz



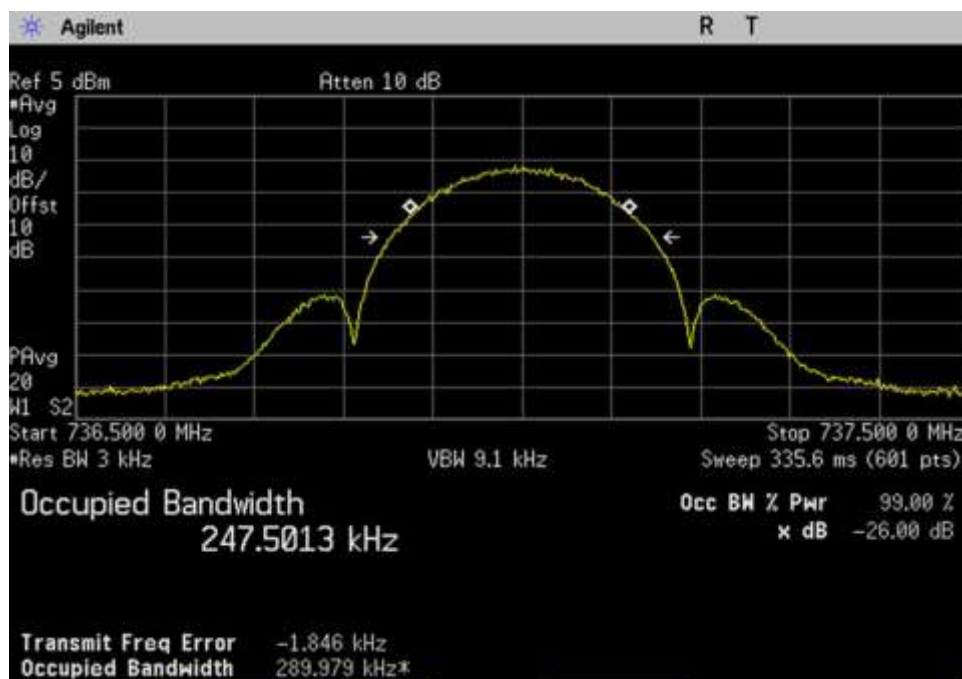
UL\_824-849\_EDGE\_ 836.5MHz



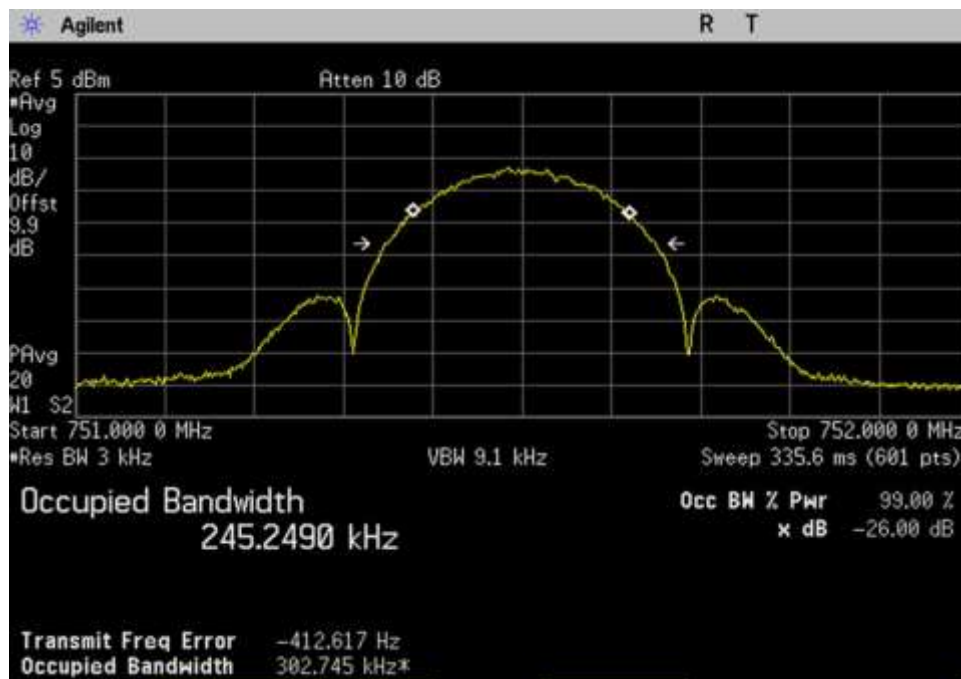
UL\_1710-1755\_EDGE\_ 1732.5MHz



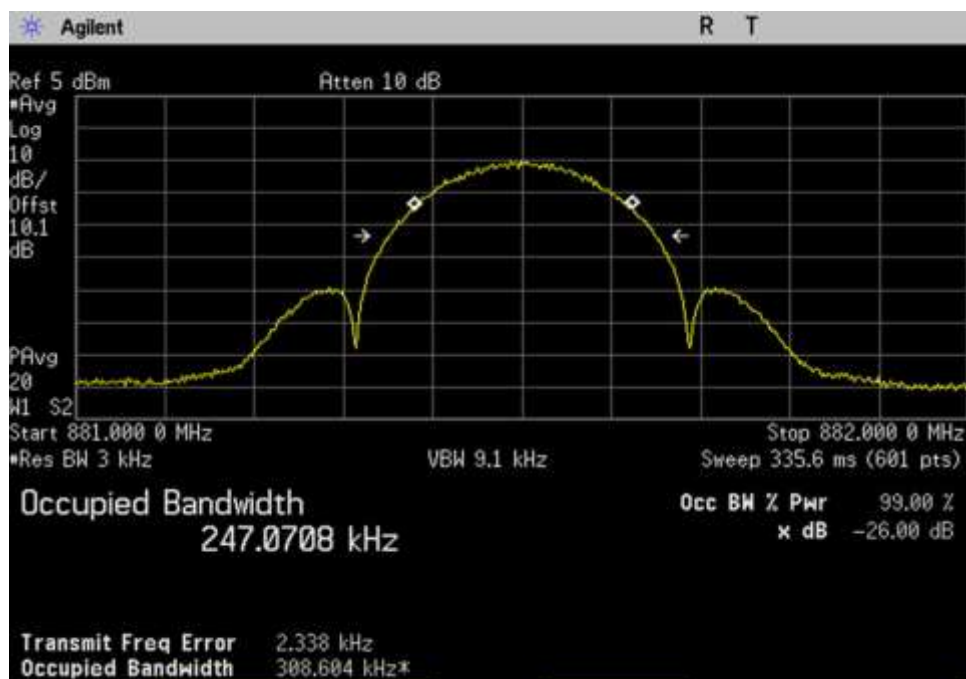
UL\_1850-1915\_EDGE\_1882.5MHz



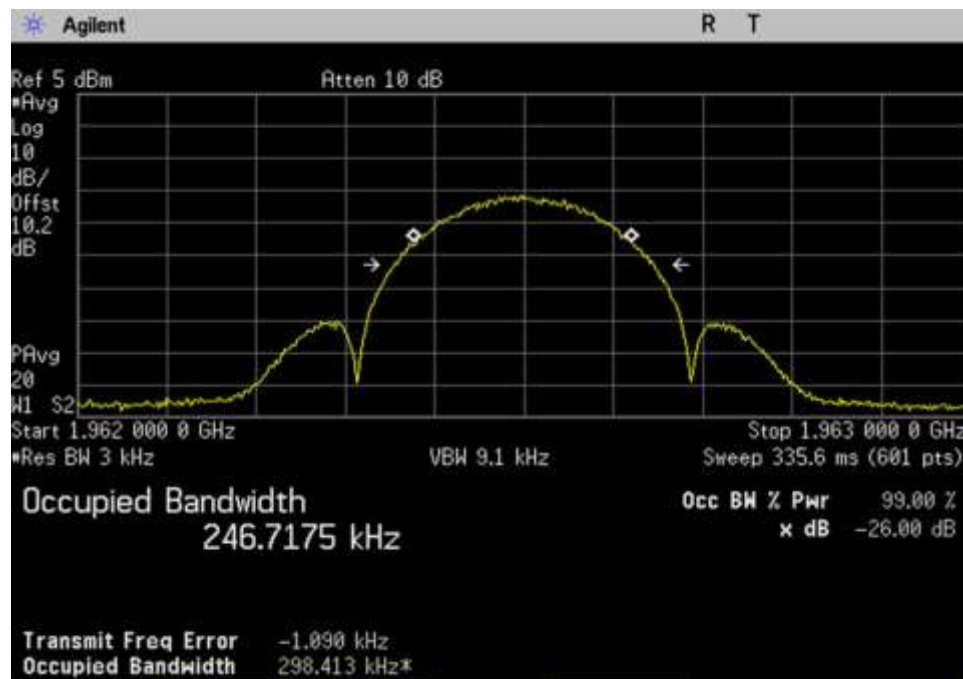
DL\_728-746\_EDGE\_737MHz



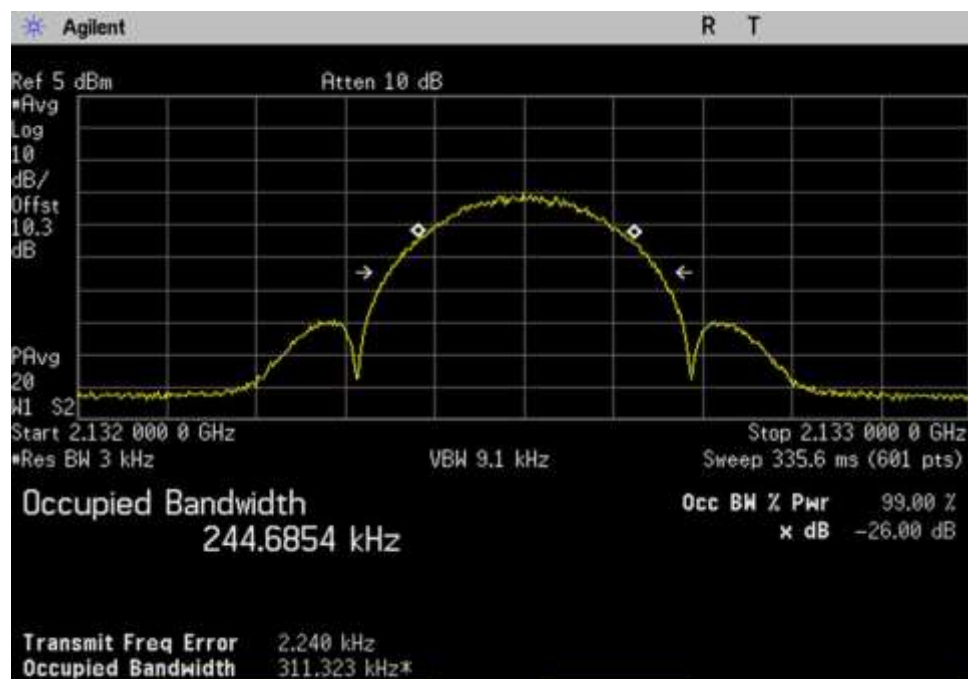
DL\_746-757\_EDGE\_751.5MHz



DL\_869-894\_EDGE\_881.5MHz

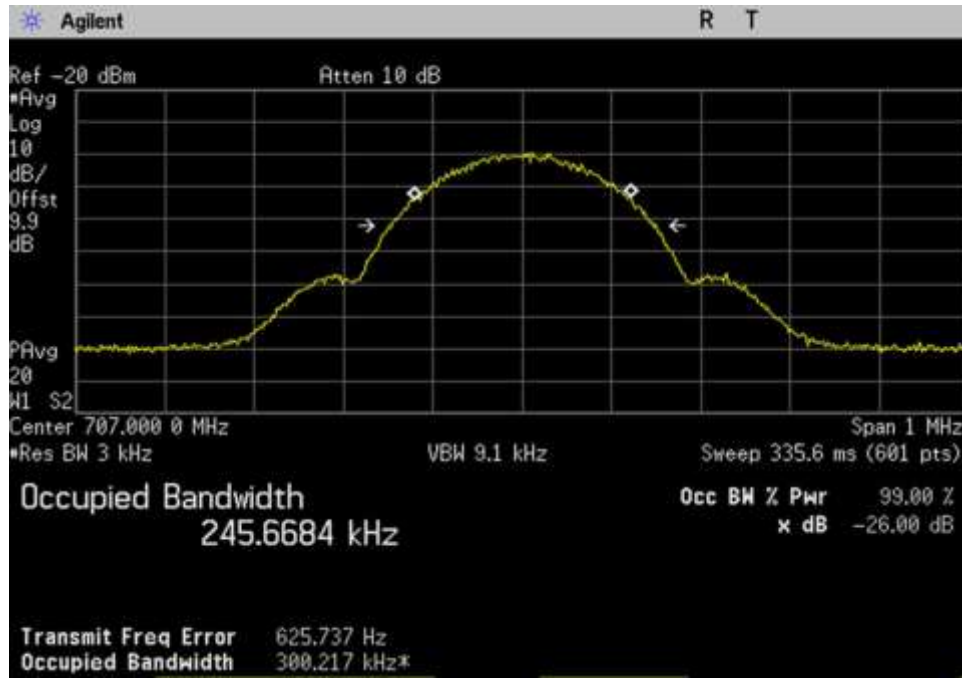


DL\_1930-1995\_EDGE\_1962.5MHz

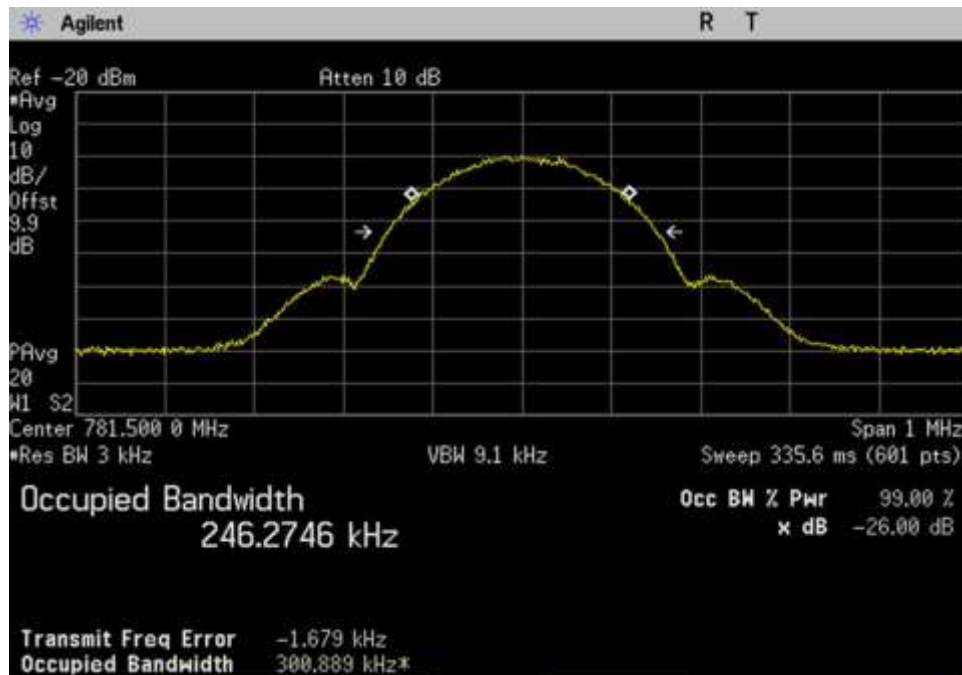


DL\_2110-2155\_EDGE\_2132.5MHz

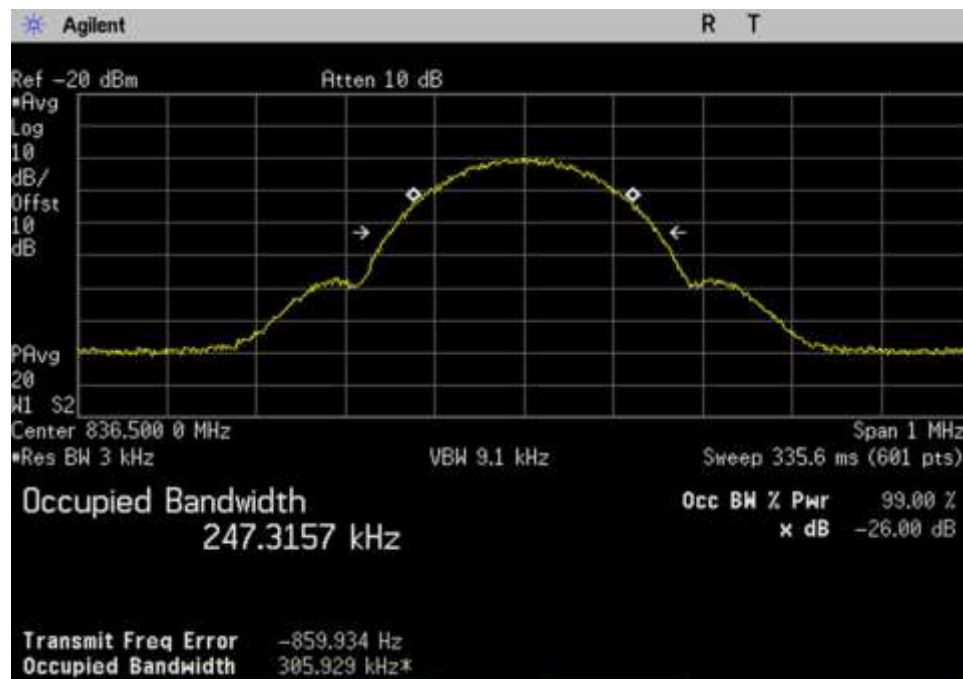
### GSM Input



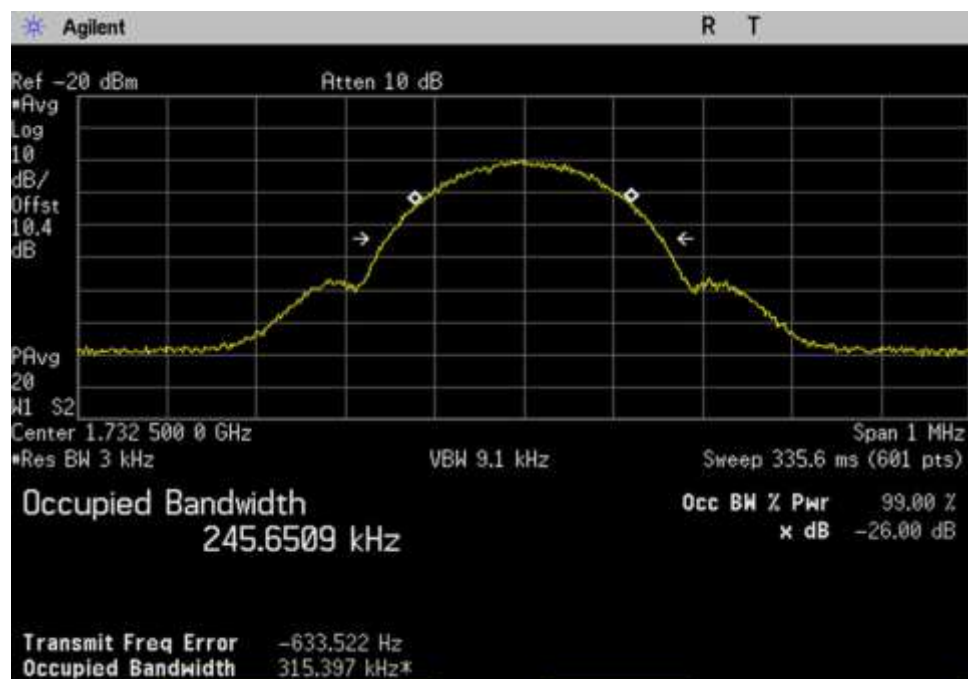
UL\_698-716\_GSM\_707MHz



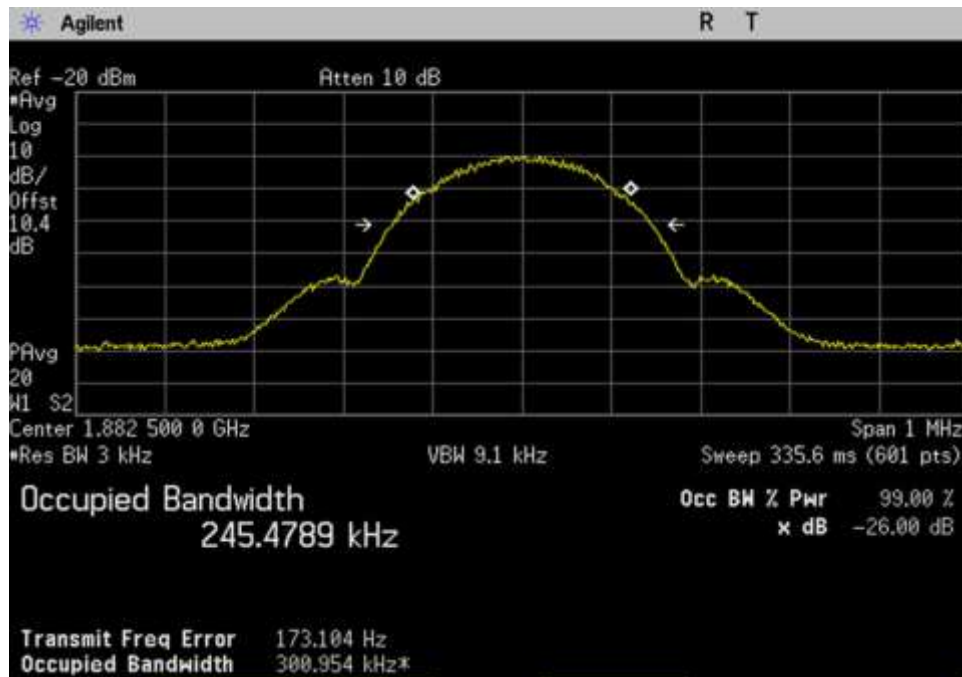
UL\_776-787\_GSM\_781.5MHz



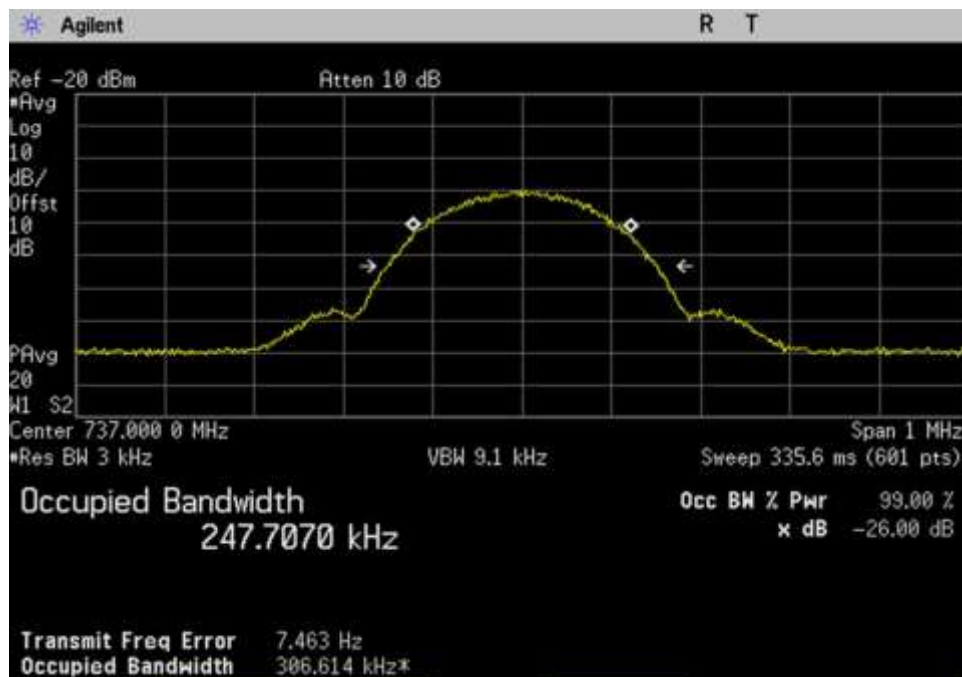
UL\_824-849\_GSM\_836.5MHz



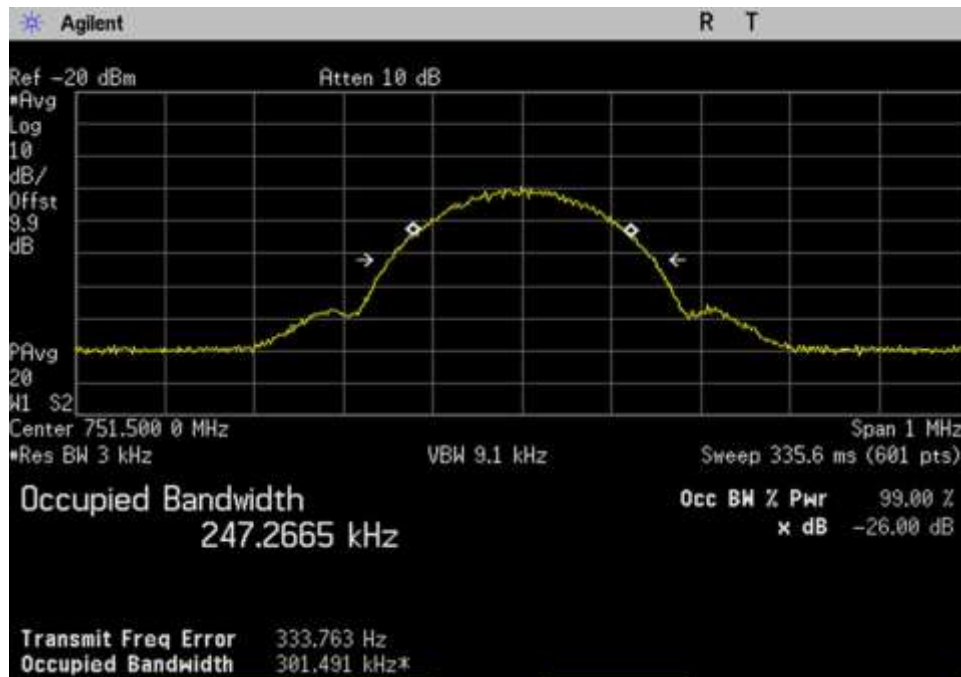
UL\_1710-1755\_GSM\_1732.5MHz



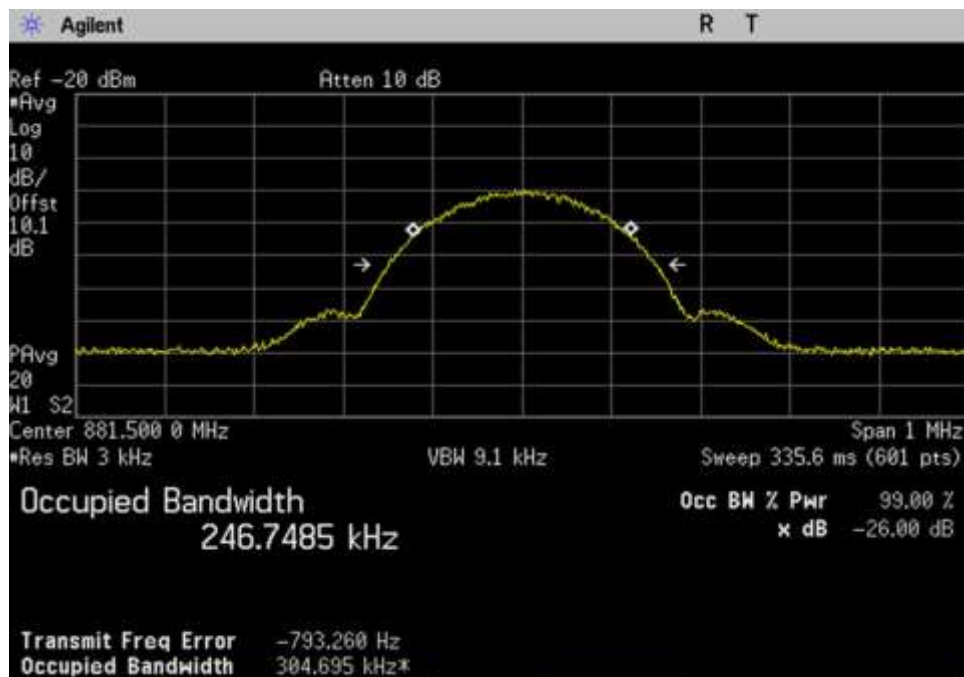
UL\_1850-1915\_GSM\_1882.5MHz



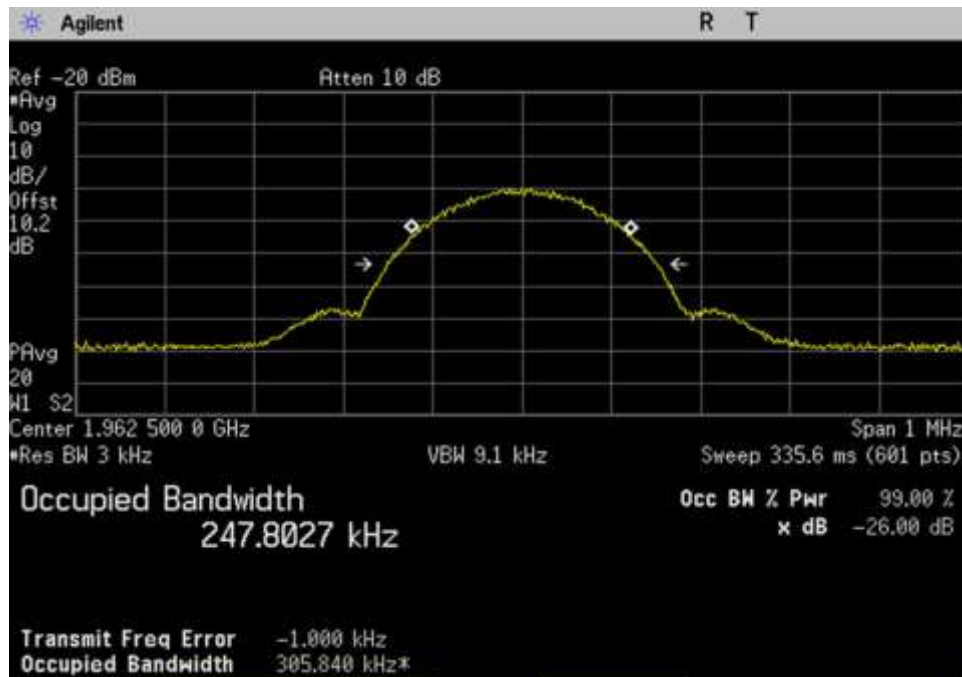
DL\_728-746\_GSM\_737MHz



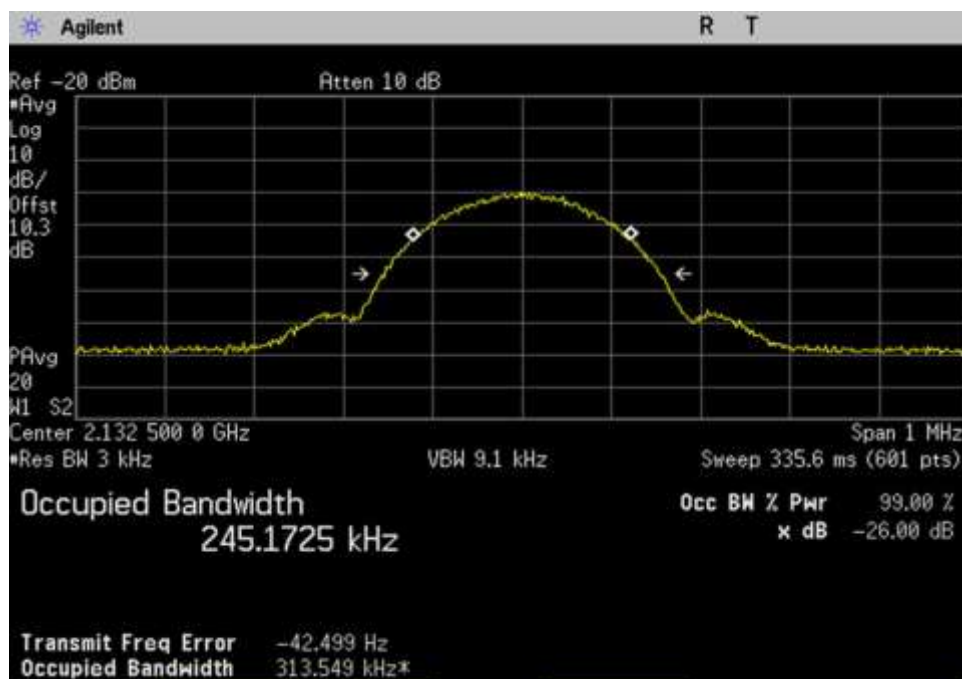
DL\_746-757\_GSM\_751.5MHz



DL\_869-894\_GSM\_881.5MHz

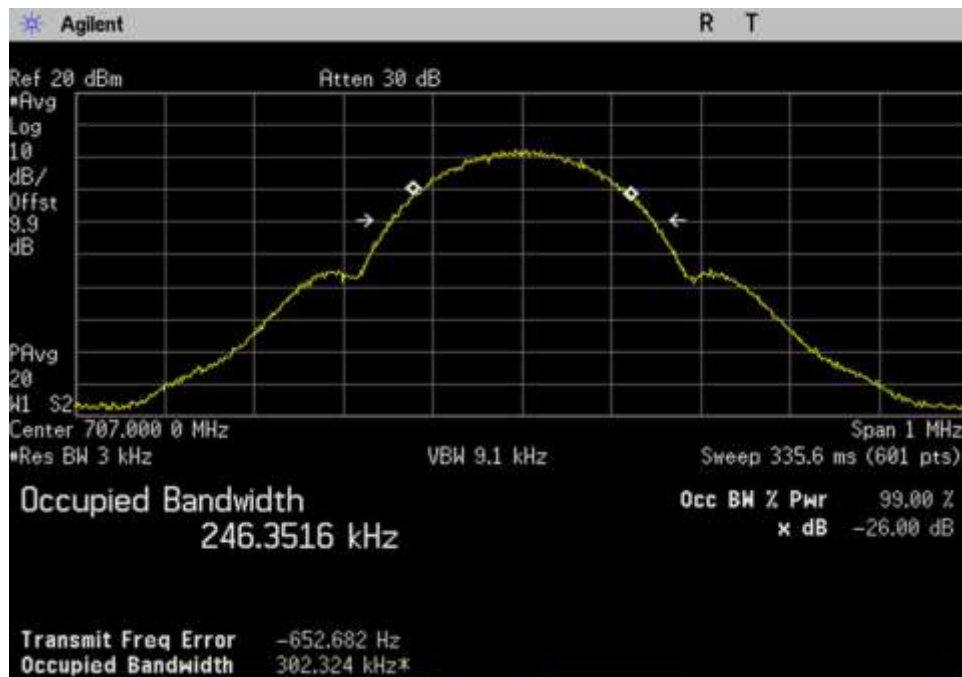


DL\_1930-1995\_GSM\_1962.5MHz

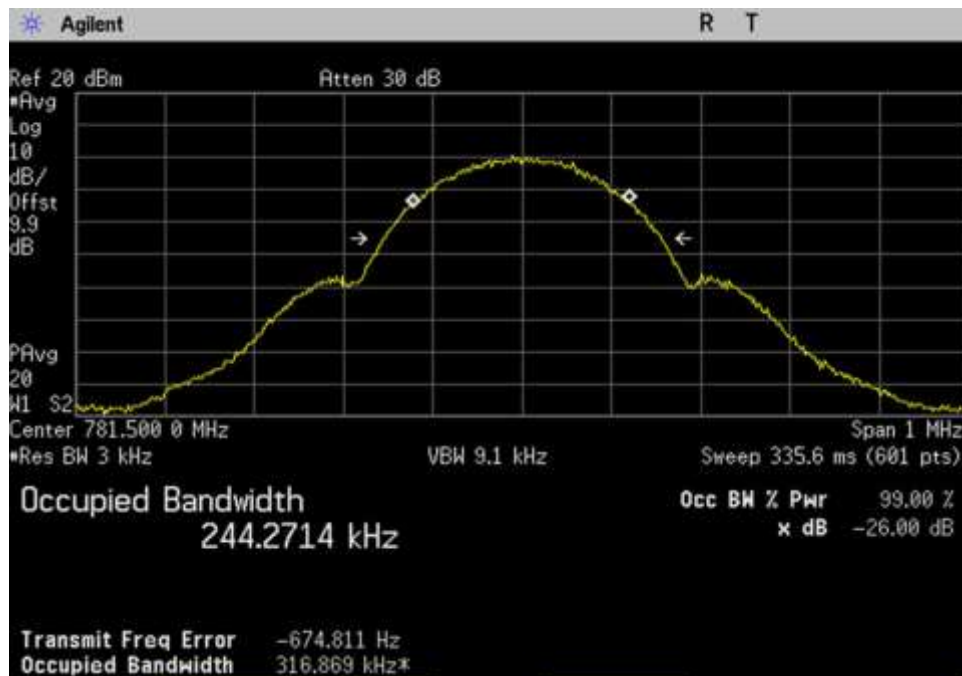


DL\_2110-2155\_GSM\_2132.5MHz

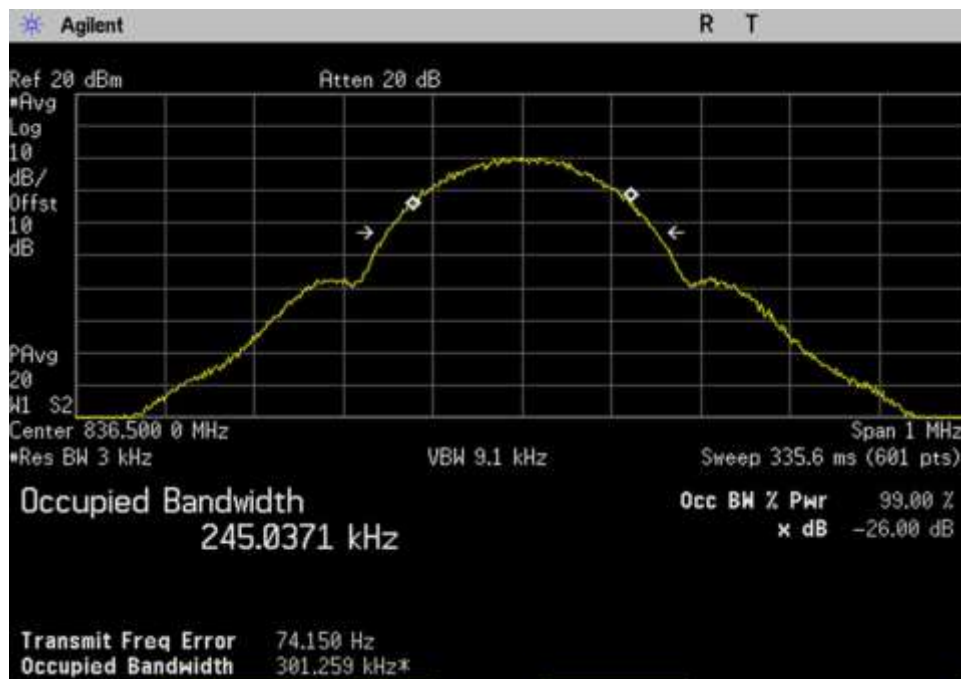
### GSM Output



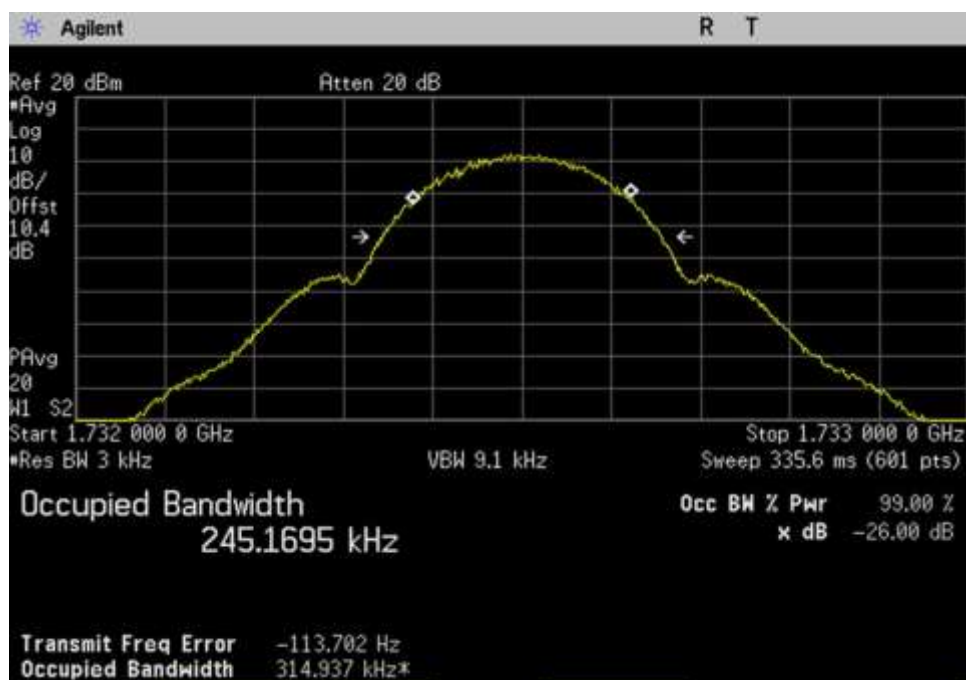
UL\_698-716\_GSM\_707MHz



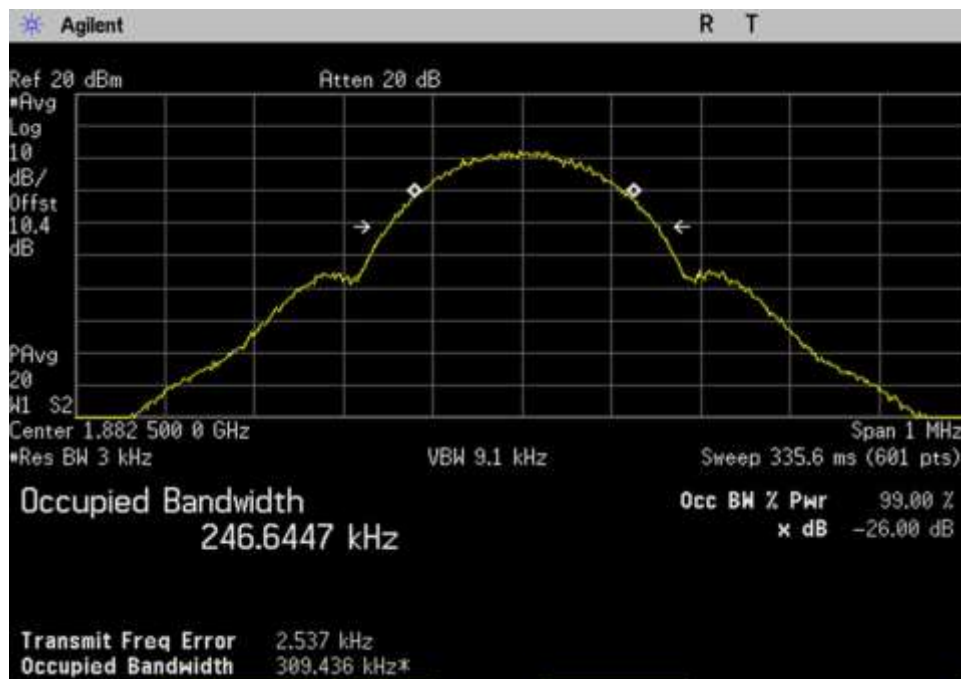
UL\_776-787\_GSM\_781.5MHz



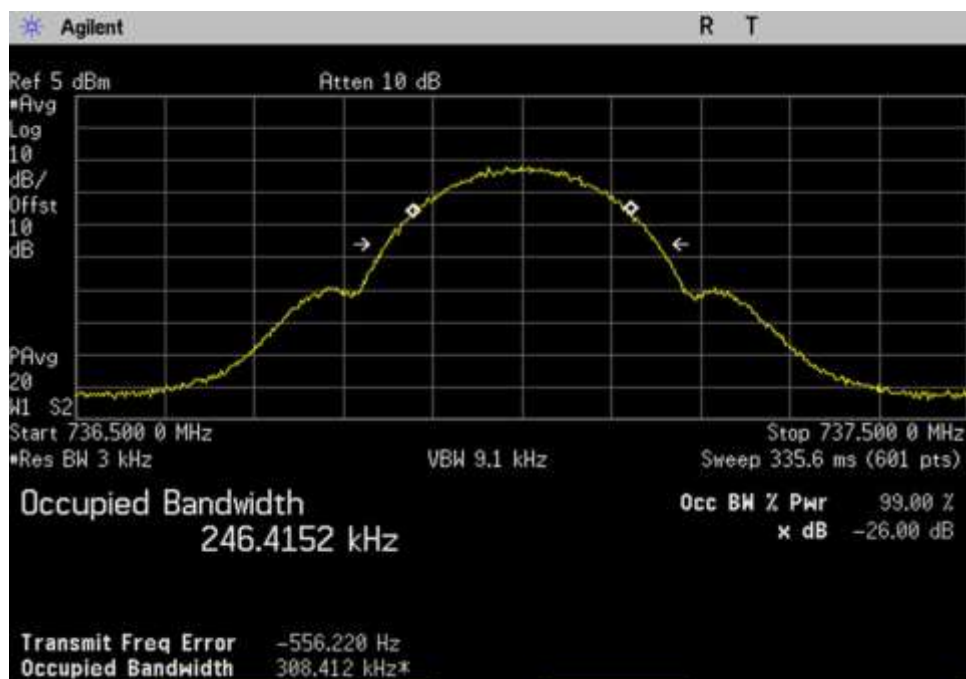
UL\_824-849\_GSM\_836.5MHz



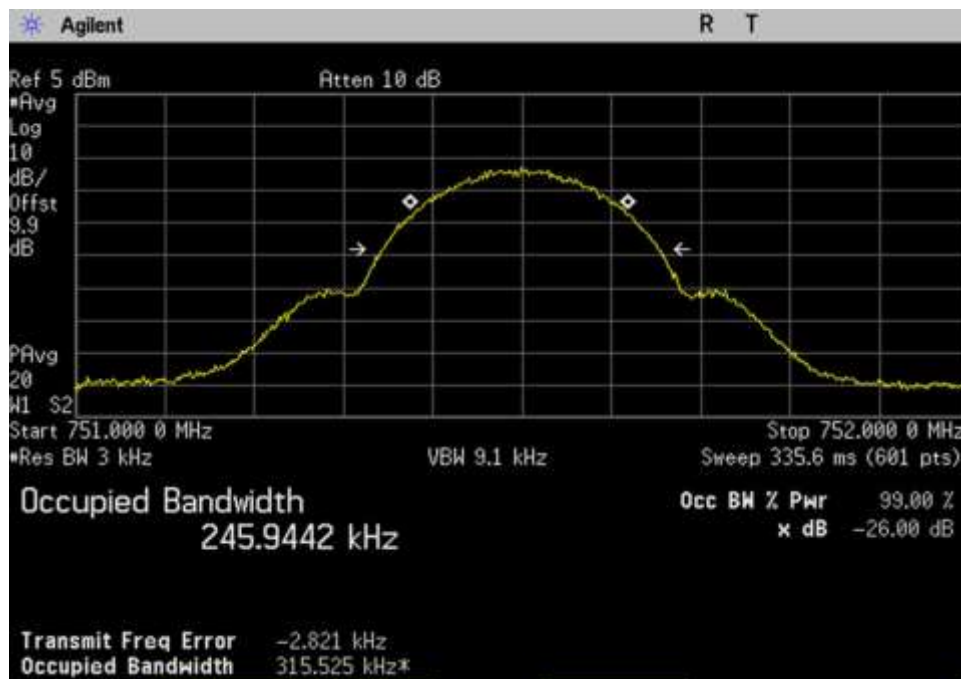
UL\_1710-1755\_GSM\_1732.5MHz



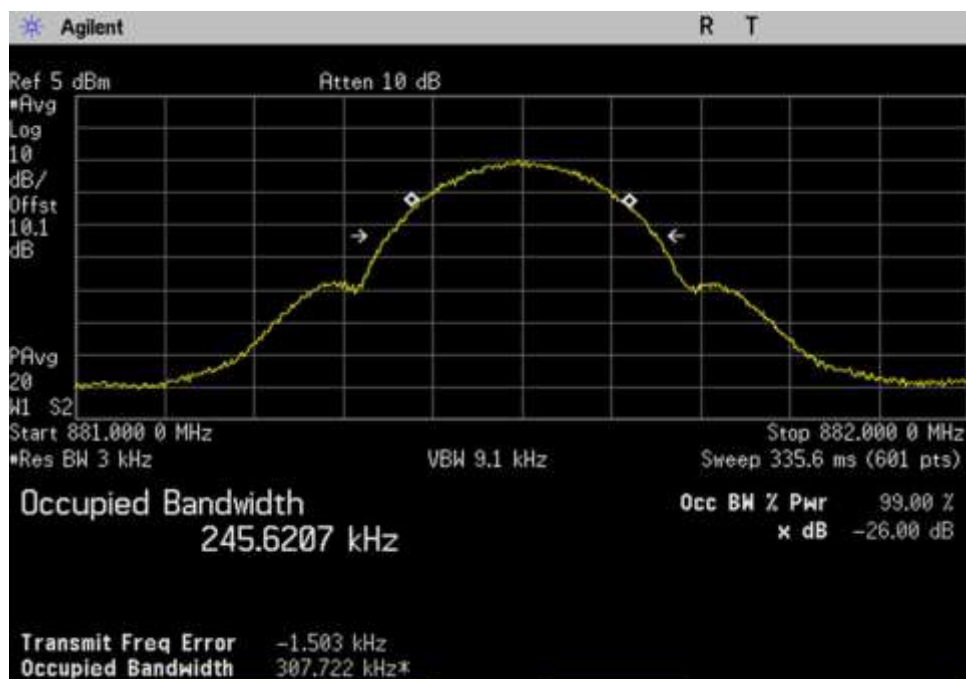
UL\_1850-1915\_GSM\_1882.5MHz



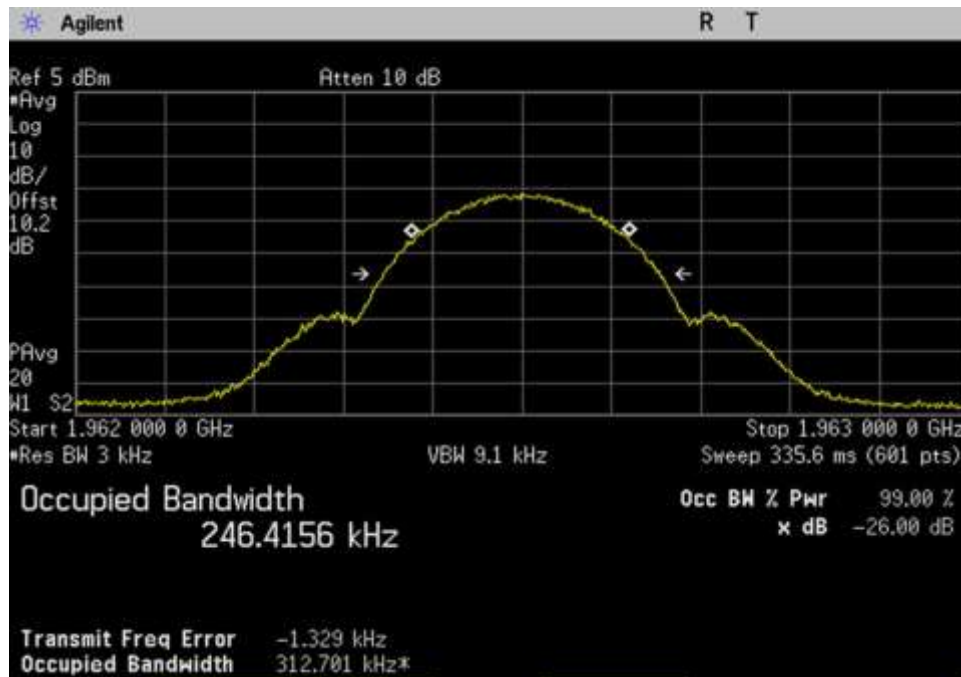
DL\_728-746\_GSM\_737MHz



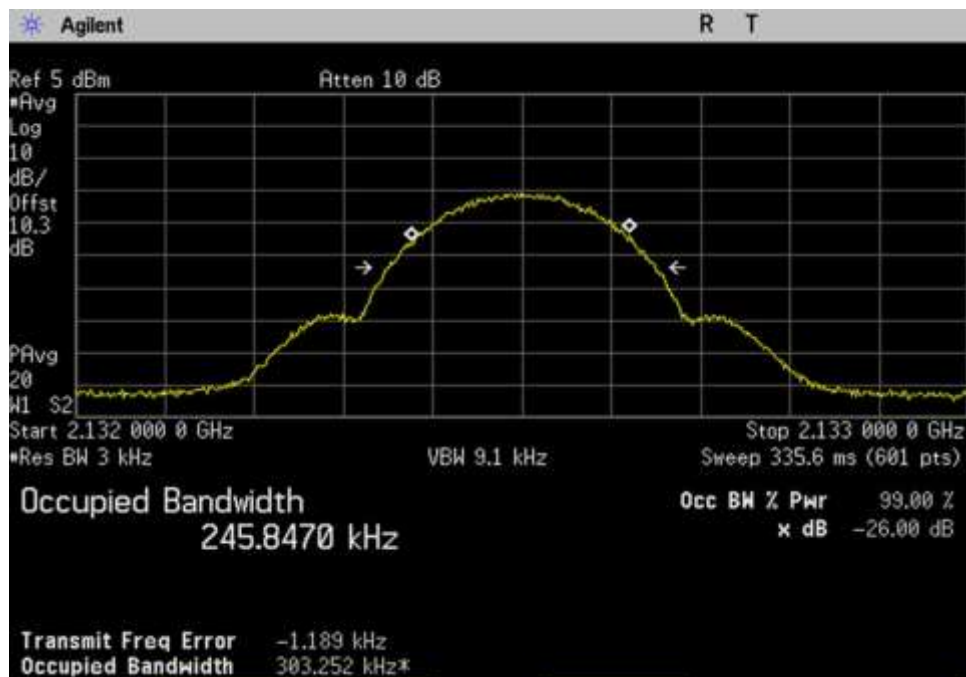
DL\_746-757\_GSM\_751.5MHz



DL\_869-894\_GSM\_881.5MHz

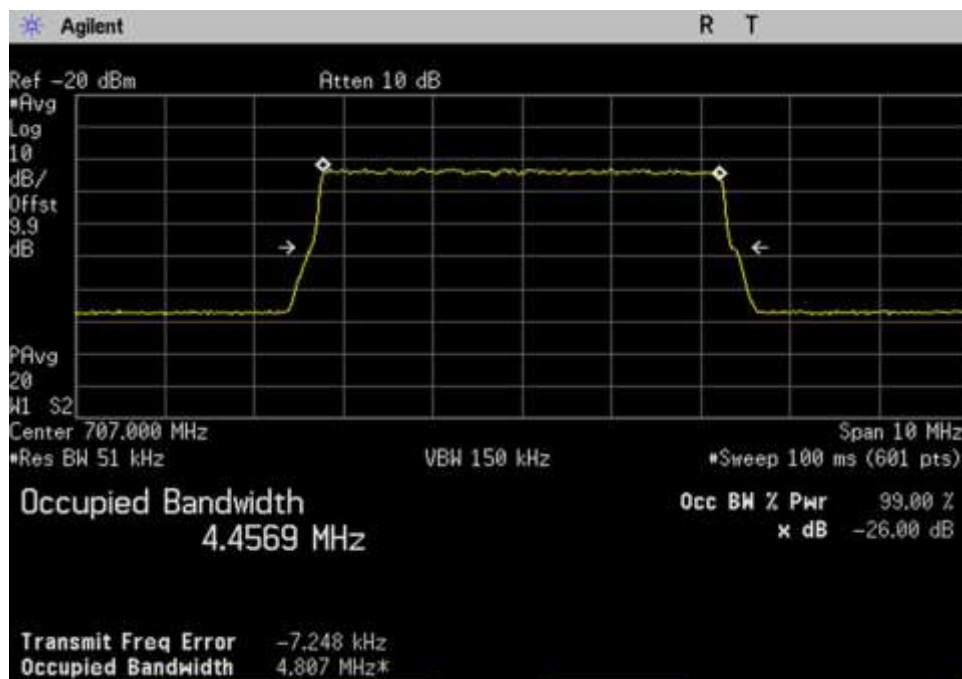


DL\_1930-1995\_GSM\_1962.5MHz

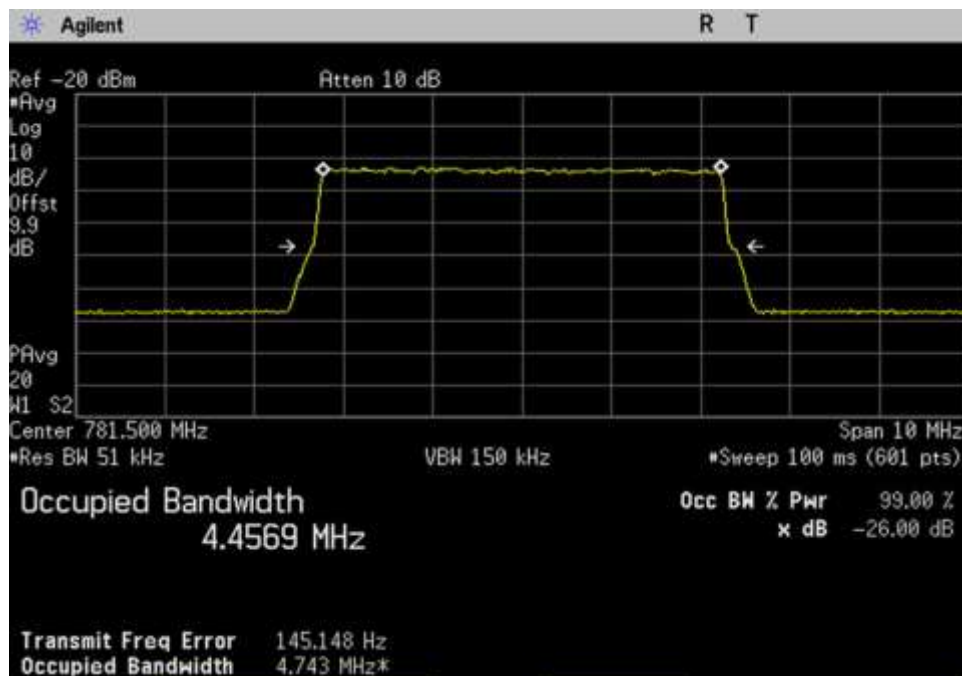


DL\_2110-2155\_GSM\_2132.5MHz

### LTE Input

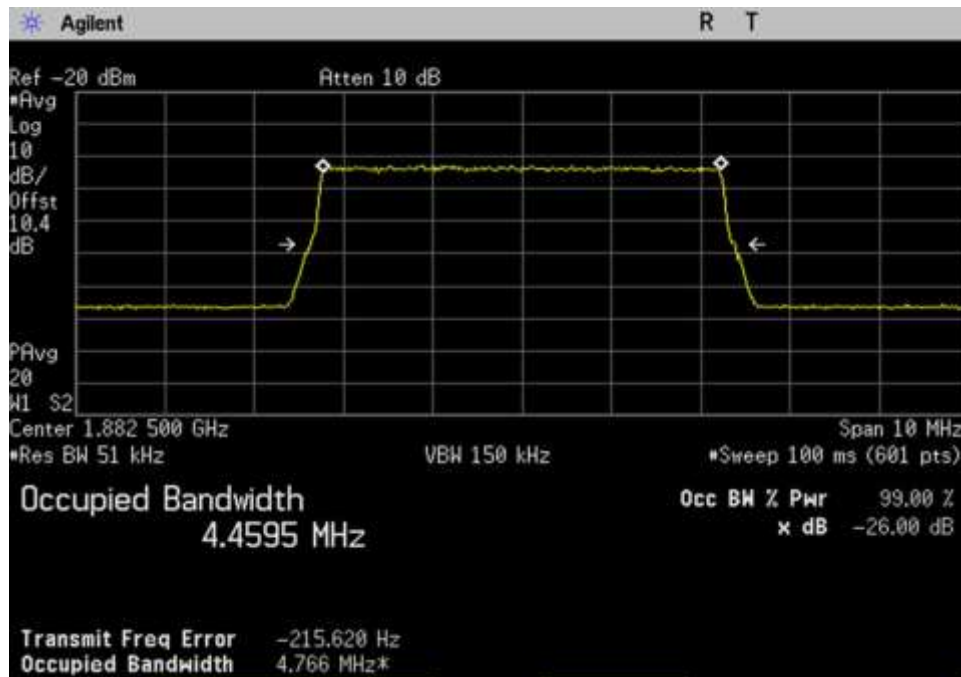


UL\_698-716\_LTE\_ 707MHz

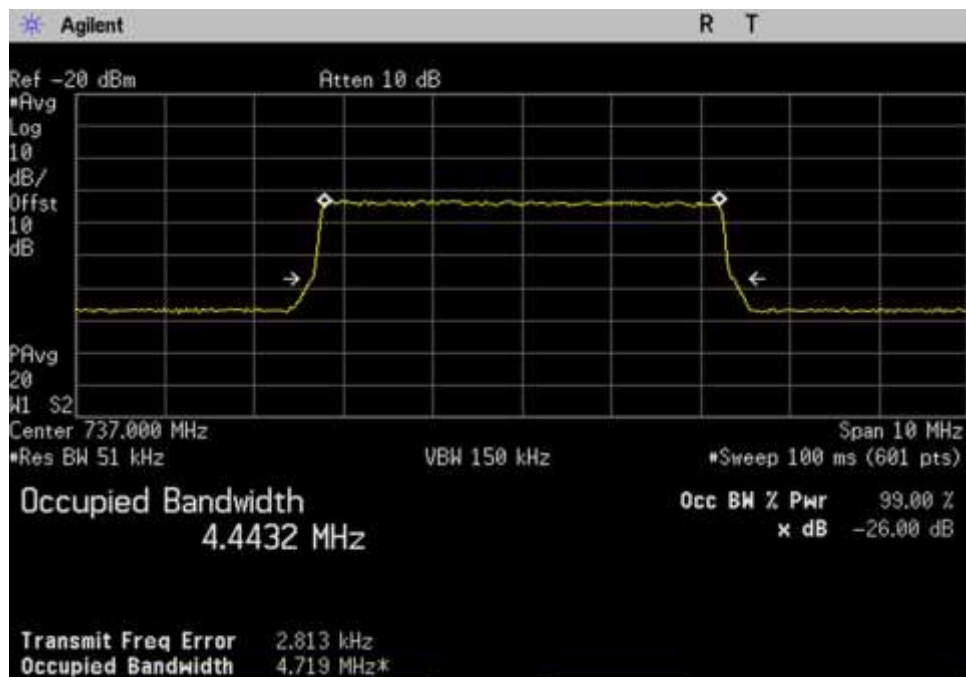


UL\_776-787\_LTE\_ 781.5MHz

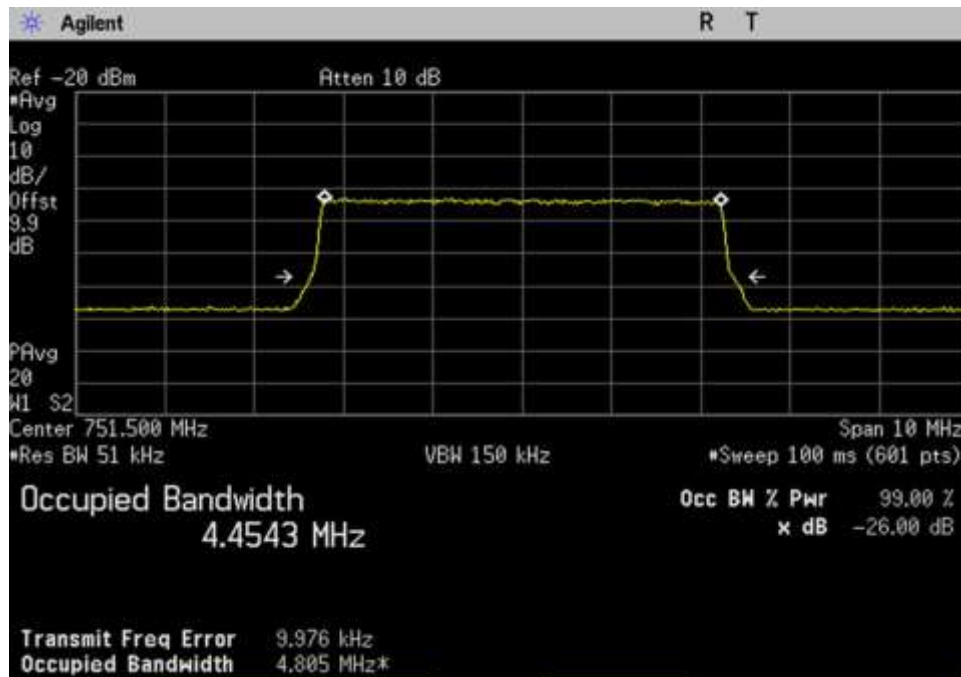




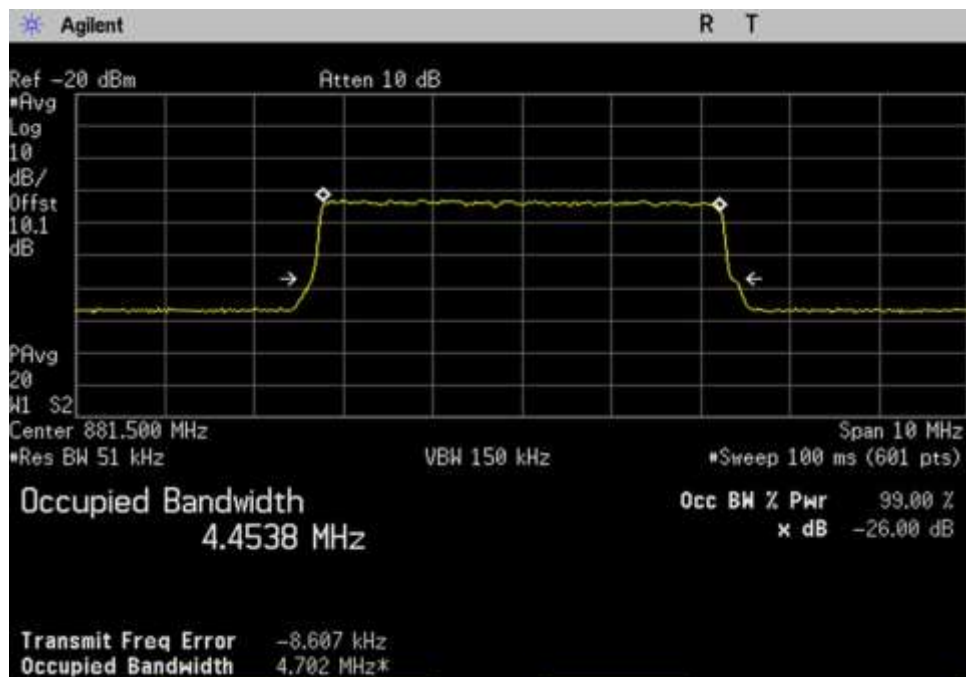
UL\_1850-1915\_LTE\_ 1882.5MHz



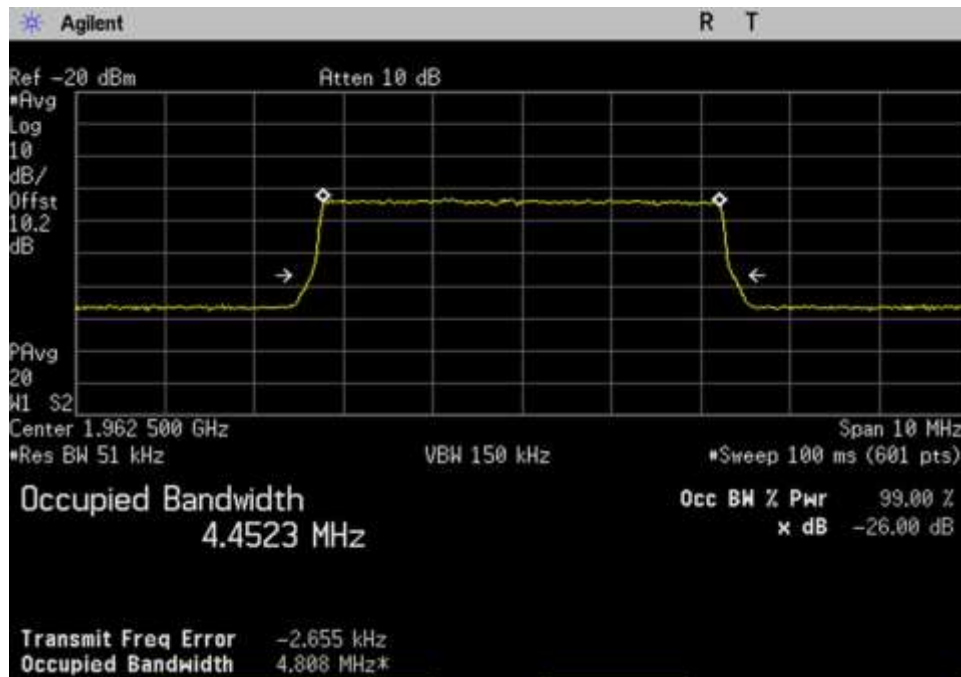
DL\_728-746\_LTE\_ 737MHz



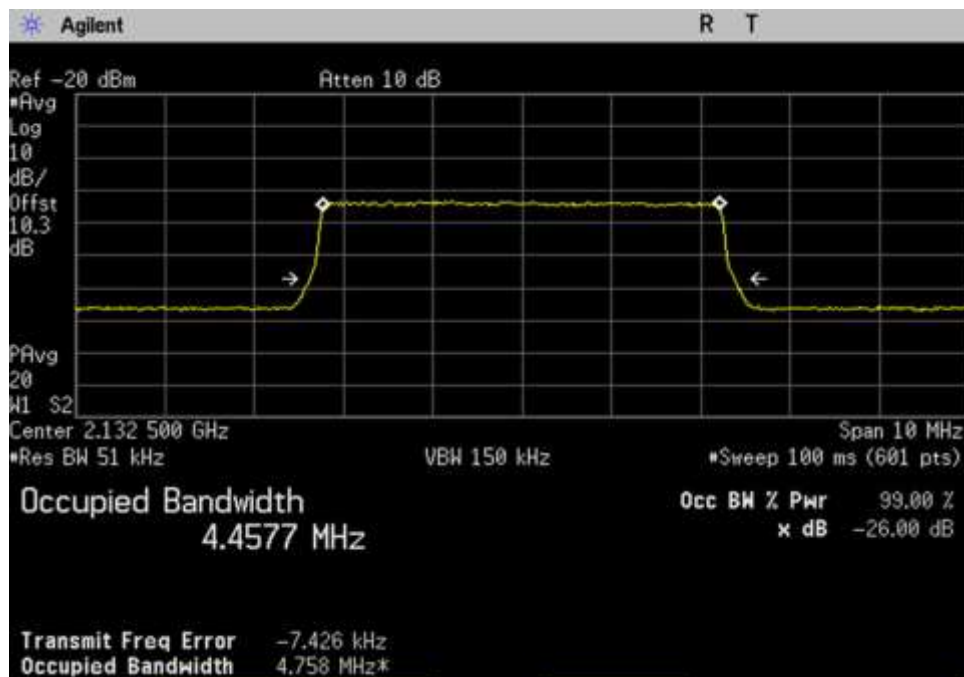
DL\_746-757\_LTE\_751.5MHz



DL\_869-894\_LTE\_881.5MHz

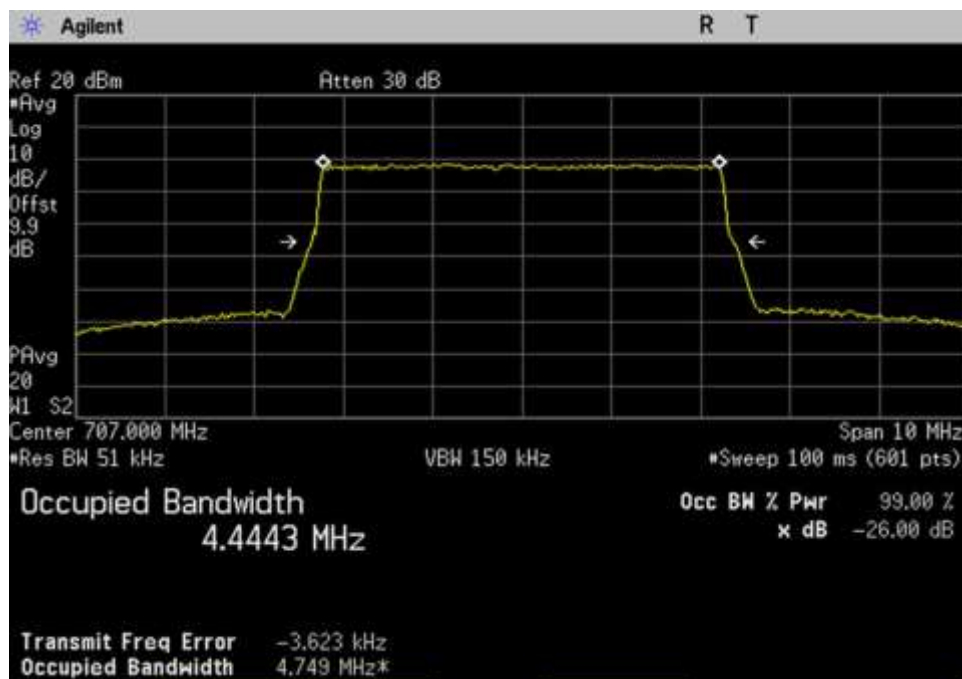


DL\_1930-1995\_LTE\_1962.5MHz

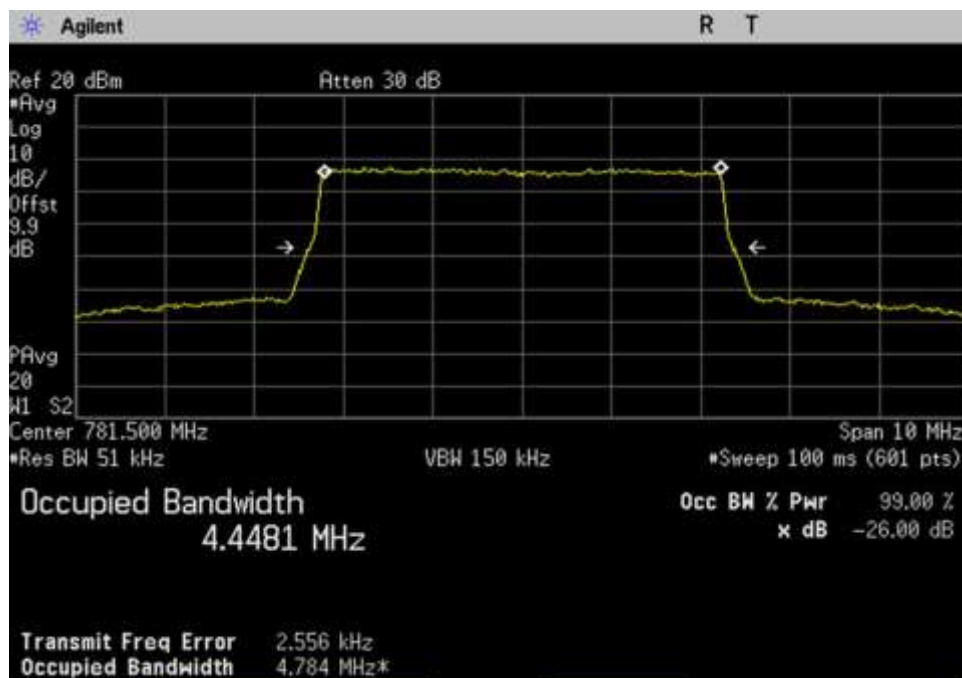


DL\_2110-2155\_LTE\_2132.5MHz

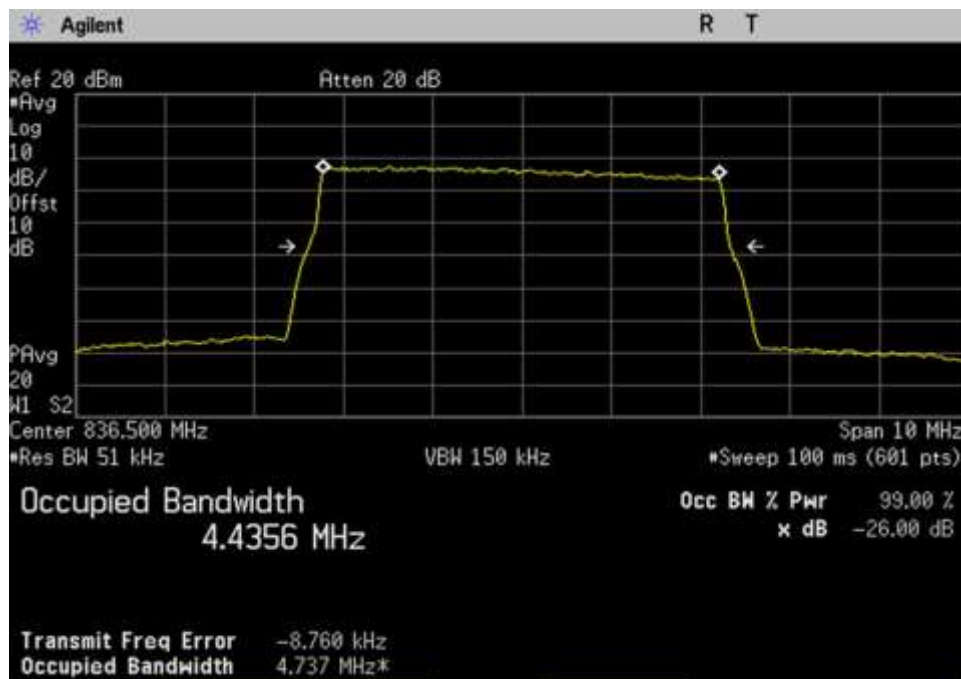
### LTE Output



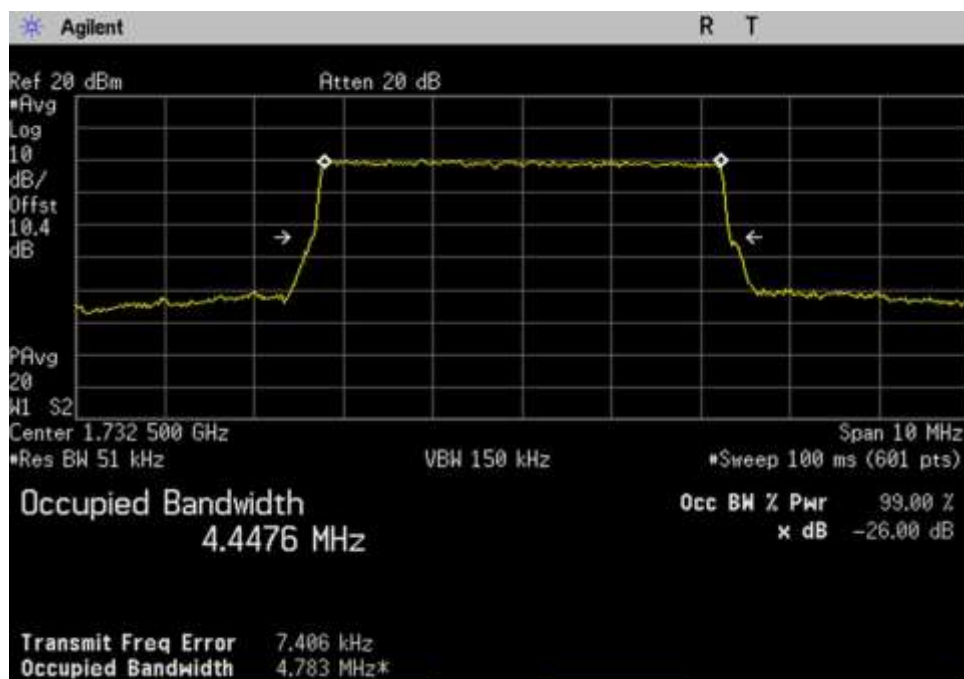
UL\_698-716\_LTE\_ 707MHz



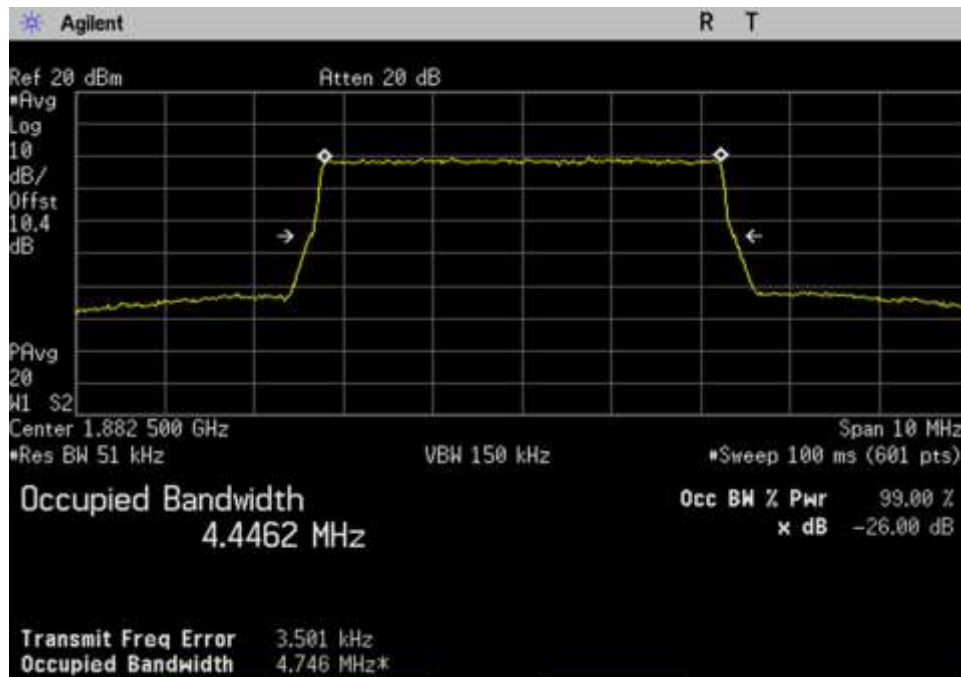
UL\_776-787\_LTE\_ 781.5MHz



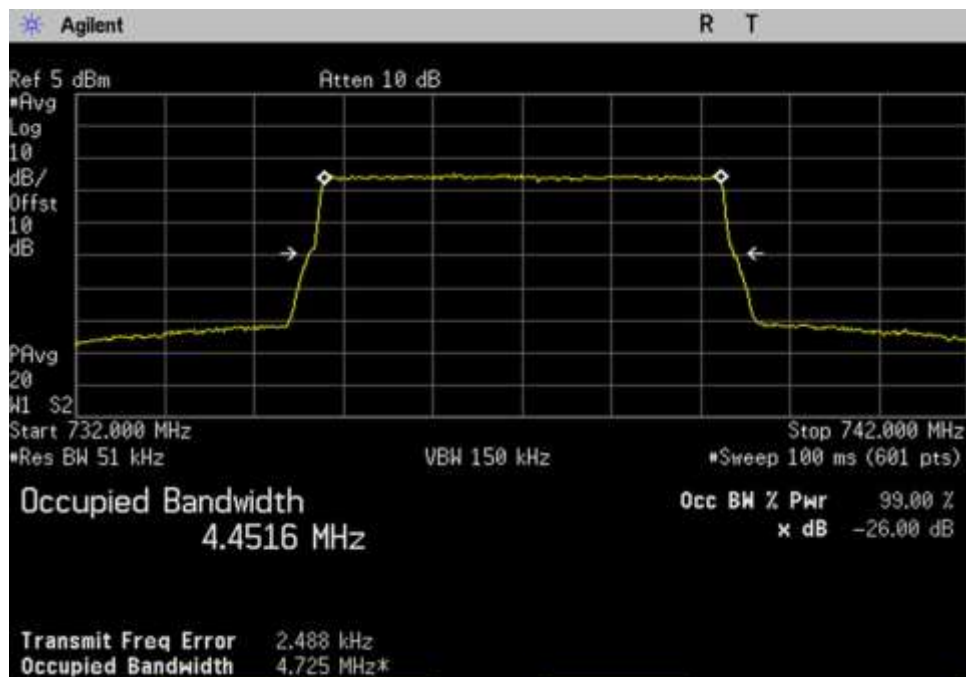
UL\_824-849\_LTE\_836.5MHz



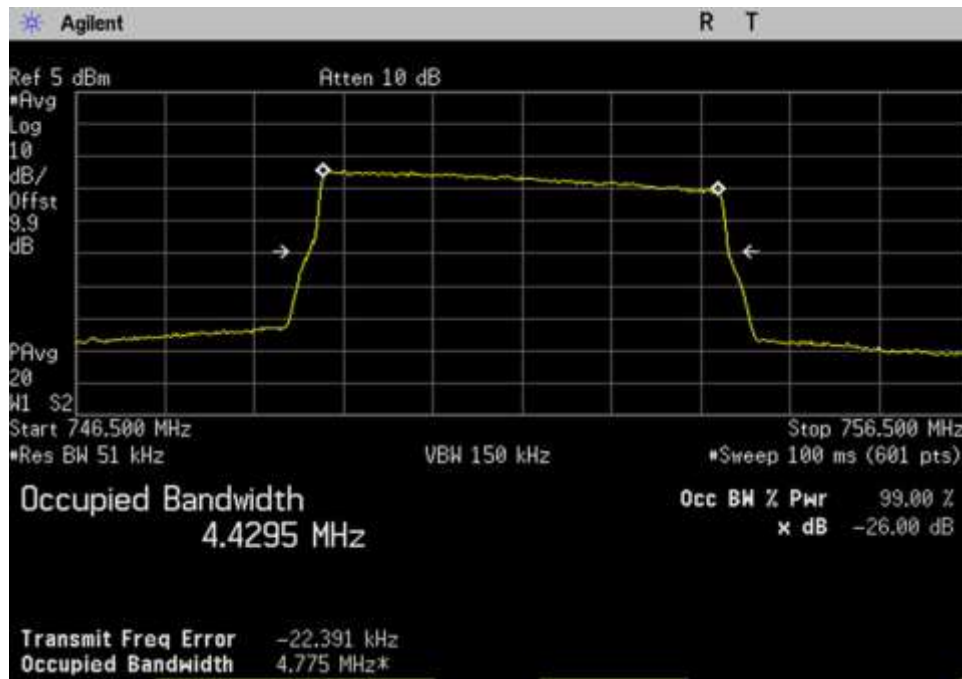
UL\_1710-1755\_LTE\_1732.5MHz



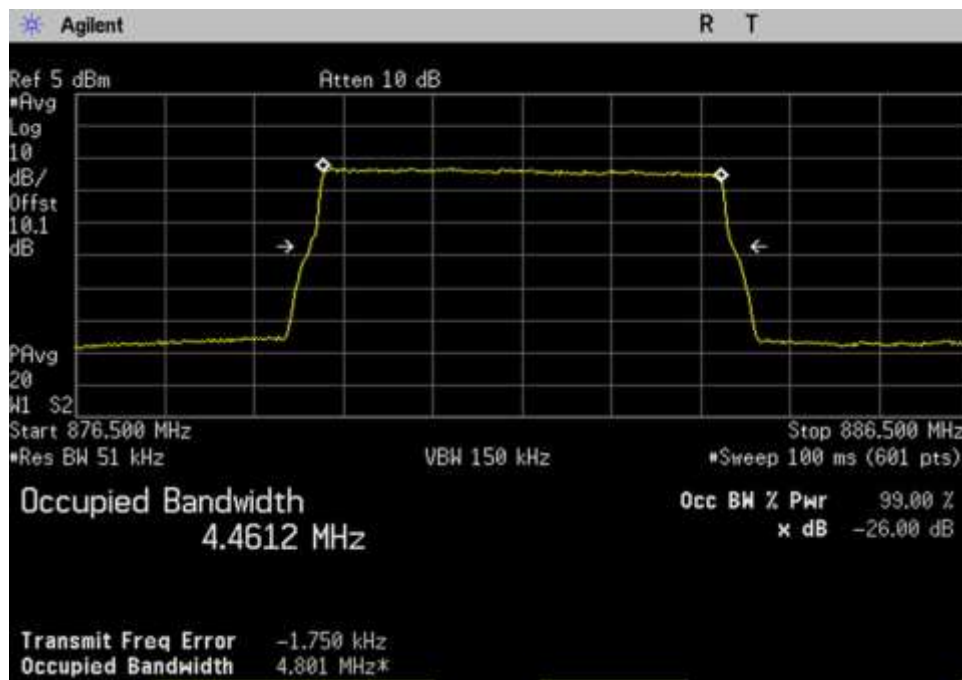
UL\_1850-1915\_LTE\_ 1882.5MHz



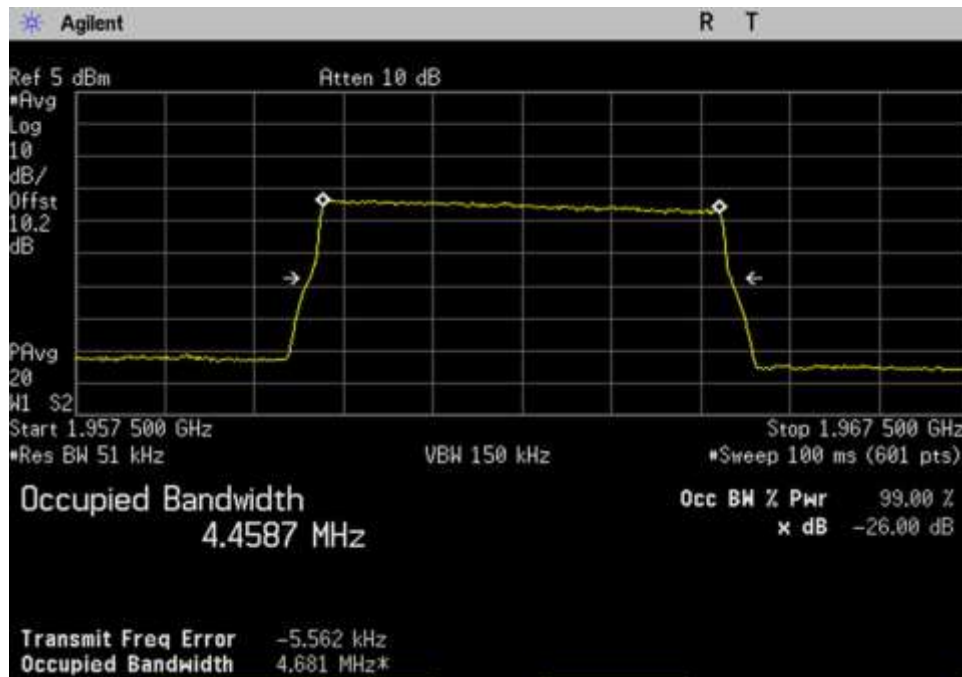
DL\_728-746\_LTE\_ 737MHz



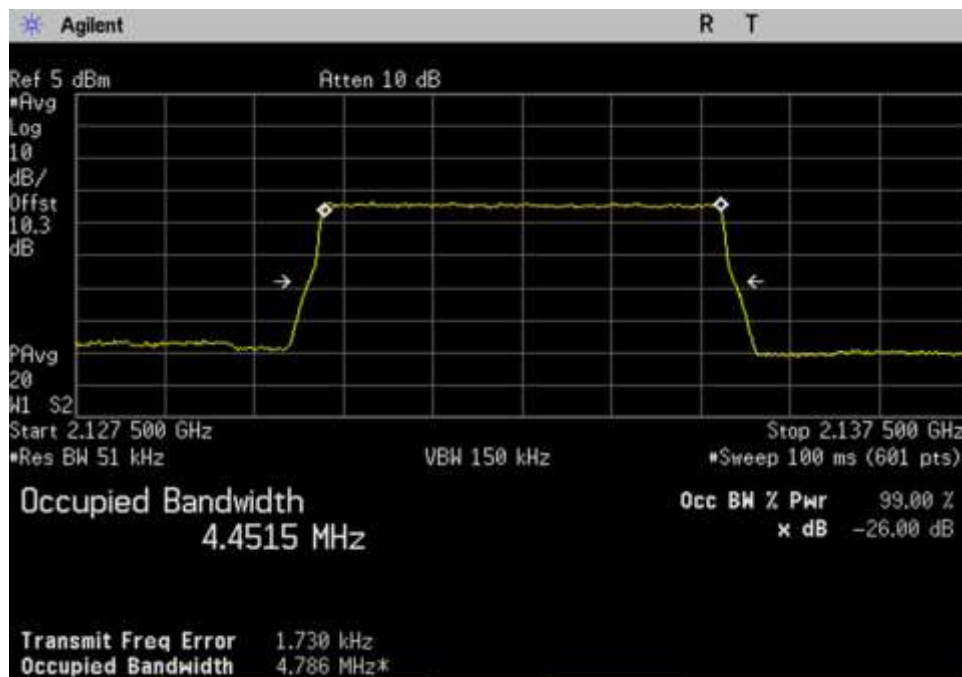
DL\_746-757\_LTE\_751.5MHz



DL\_869-894\_LTE\_881.5MHz

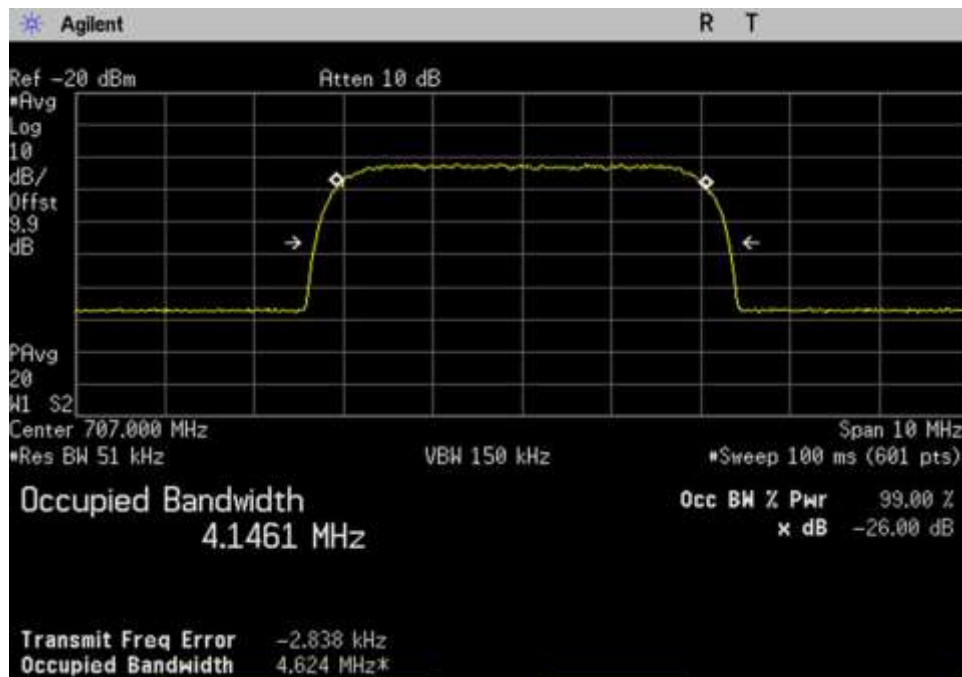


DL\_1930-1995\_LTE\_ 1962.5MHz

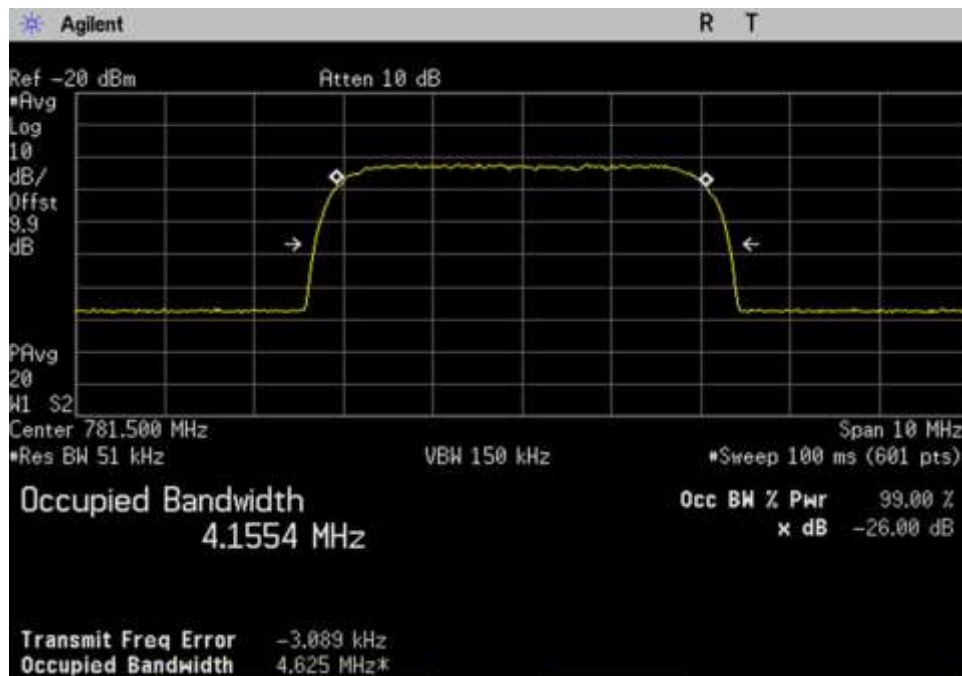


DL\_2110-2155\_LTE\_ 2132.5MHz

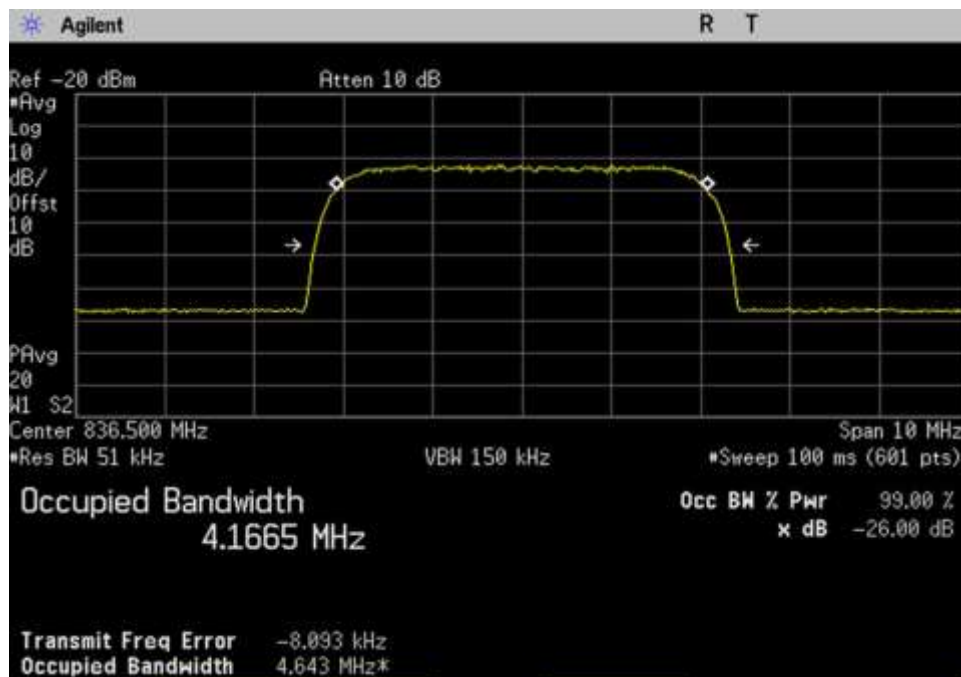
### WCDMA Input



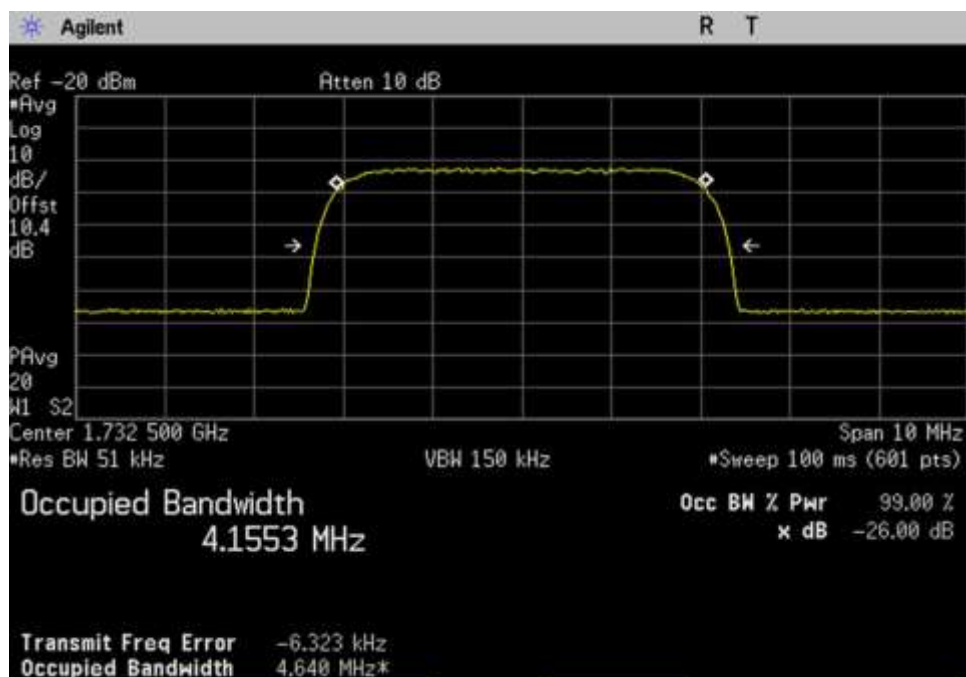
UL\_698-716\_WCDMA\_707MHz



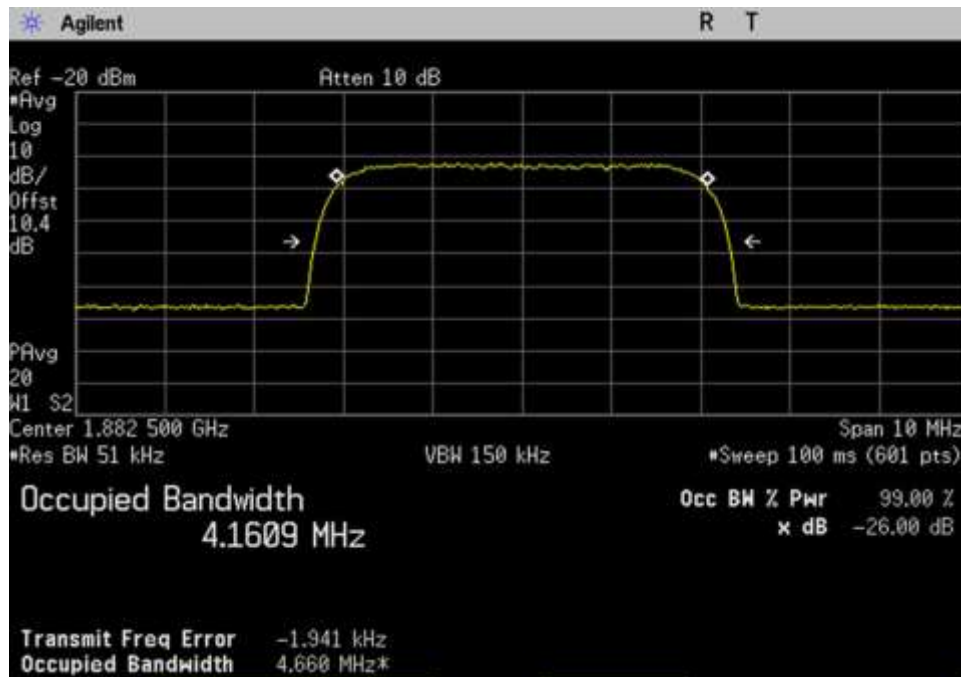
UL\_776-787\_WCDMA\_781.5MHz



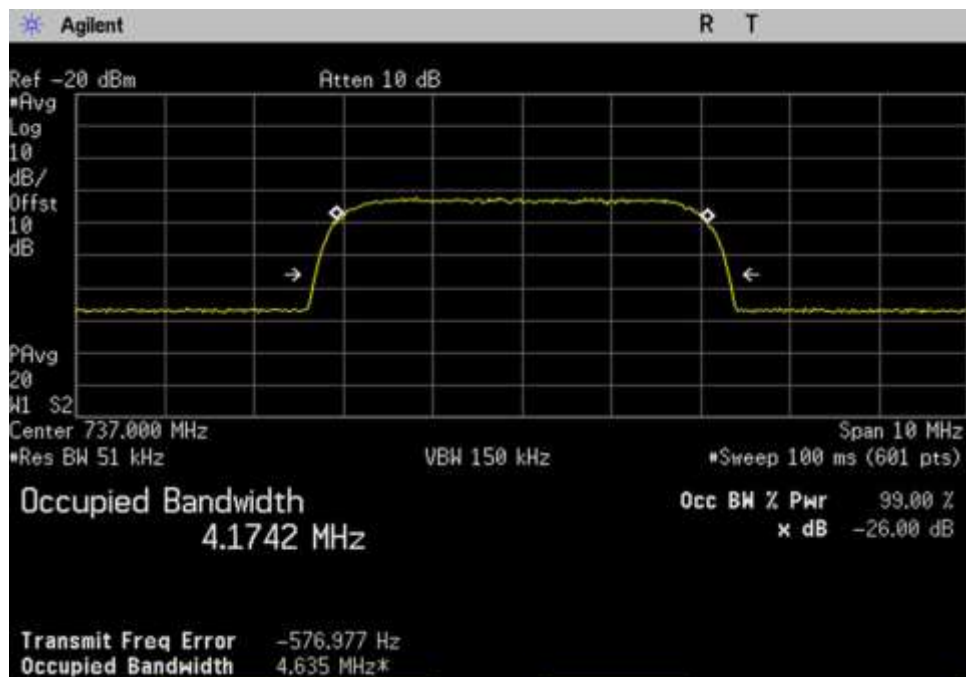
UL\_824-849\_WCDMA\_836.5MHz



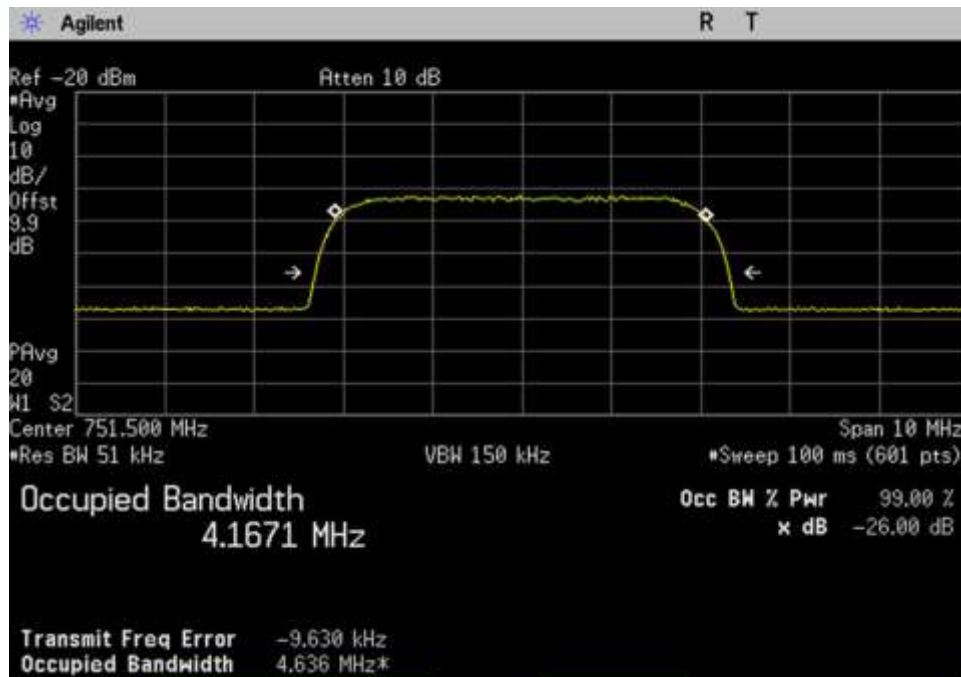
UL\_1710-1755\_WCDMA\_1732.5MHz



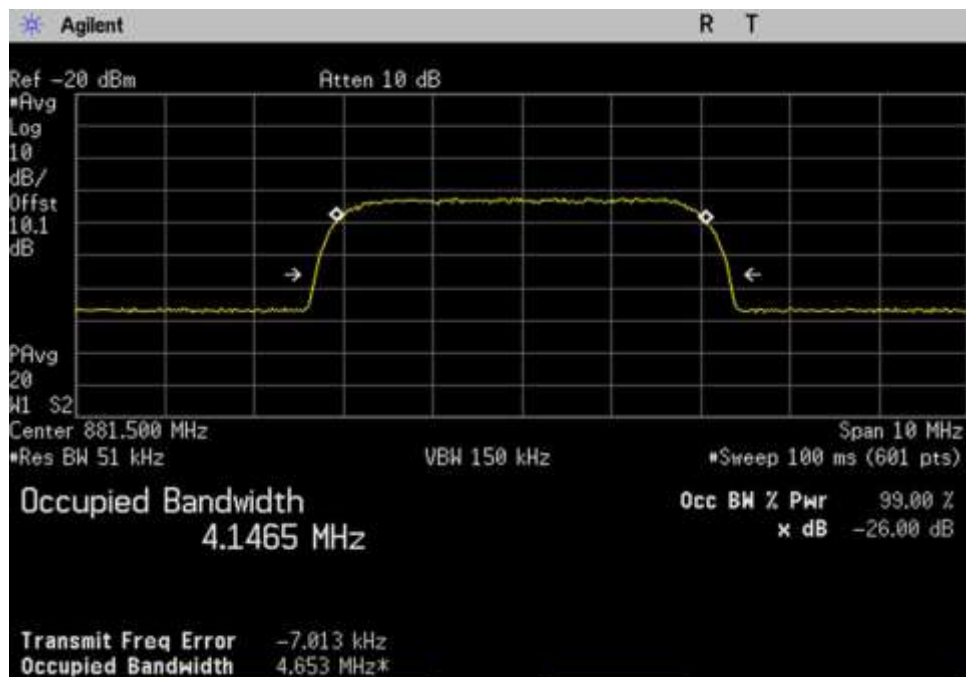
UL\_1850-1915\_WCDMA\_1882.5MHz



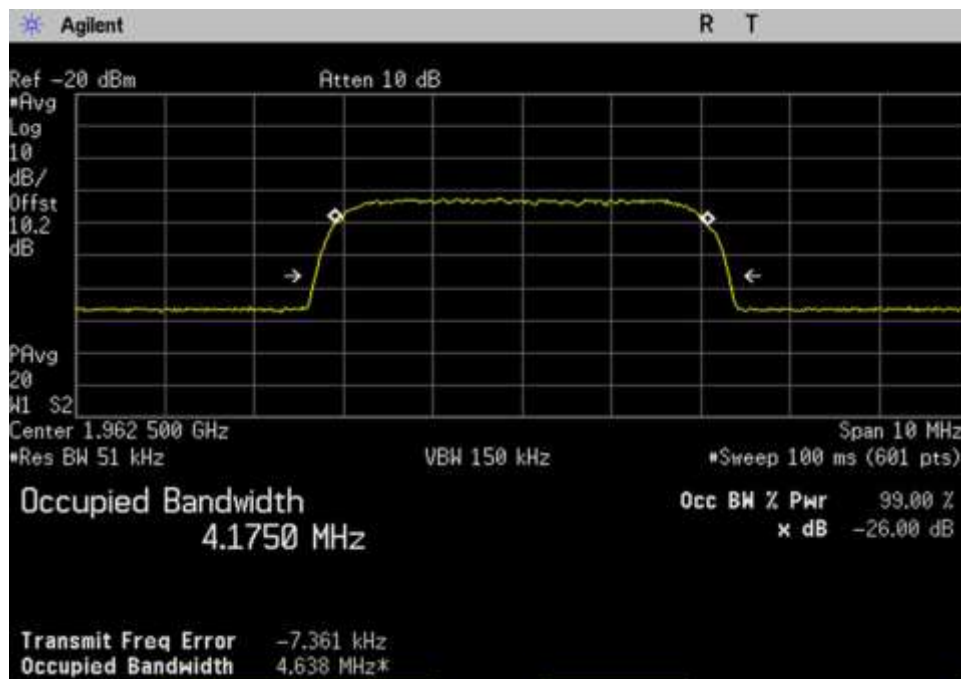
DL\_728-746\_WCDMA\_737MHz



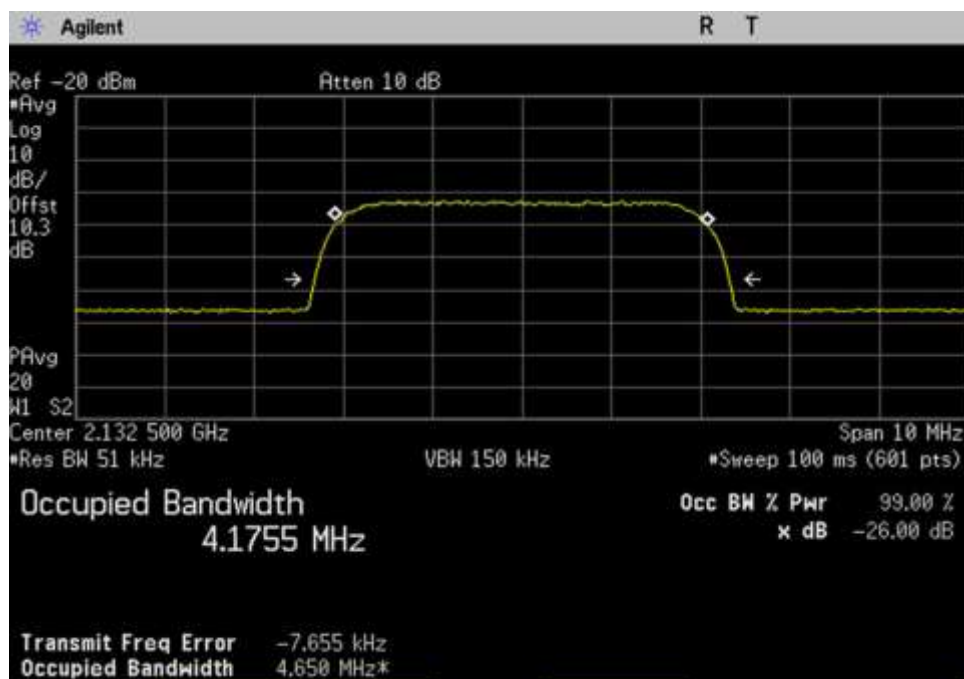
DL\_746-757\_WCDMA\_751.5MHz



DL\_869-894\_WCDMA\_881.5MHz

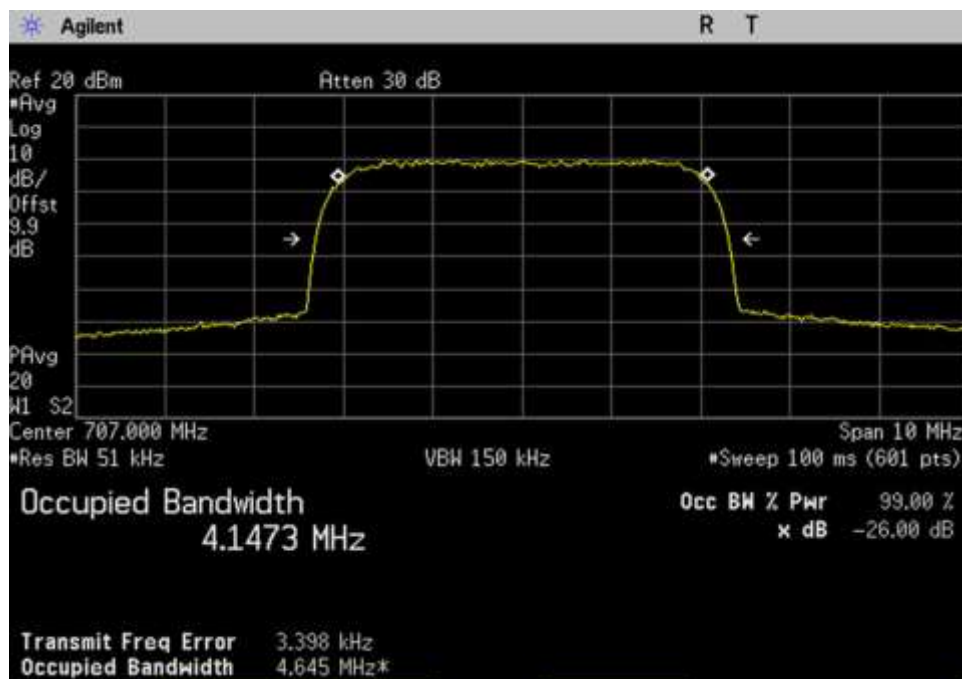


DL\_1930-1995\_WCDMA\_1962.5MHz

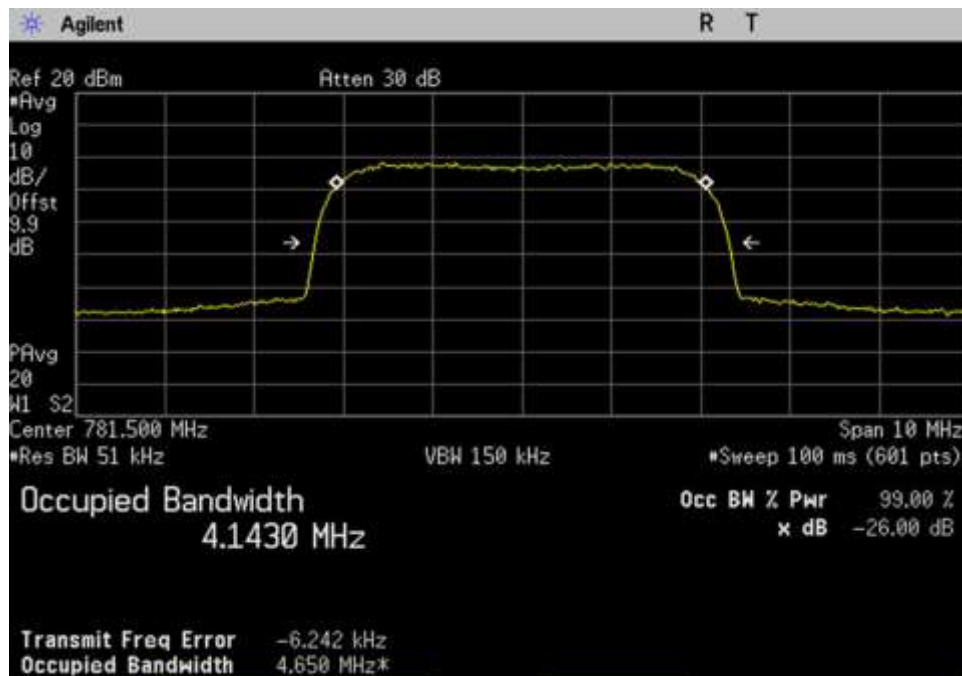


DL\_2110-2155\_WCDMA\_2132.5MHz

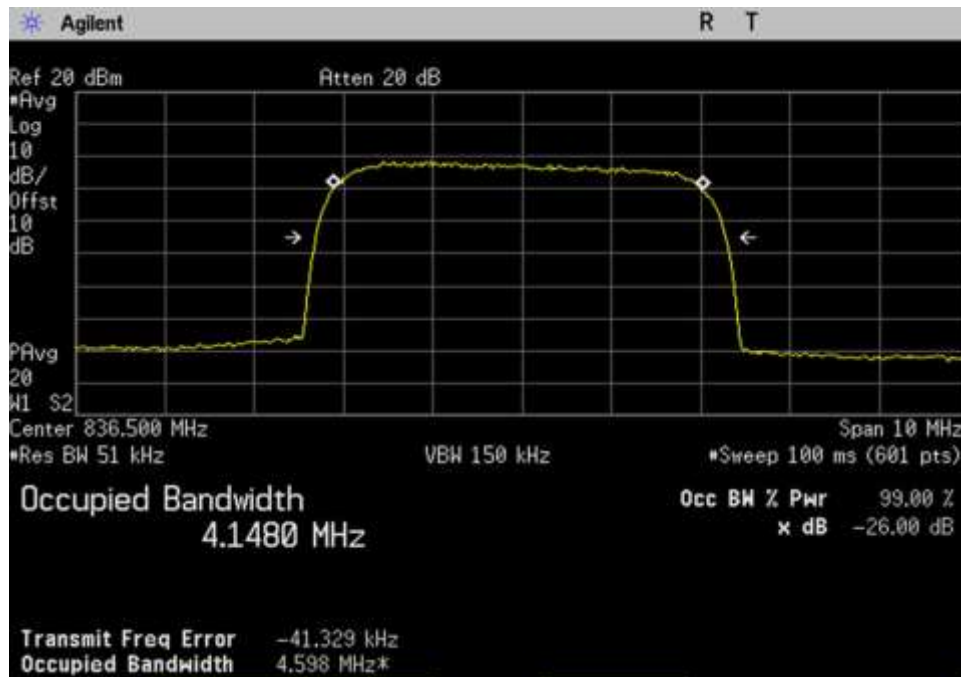
### WCDMA Output



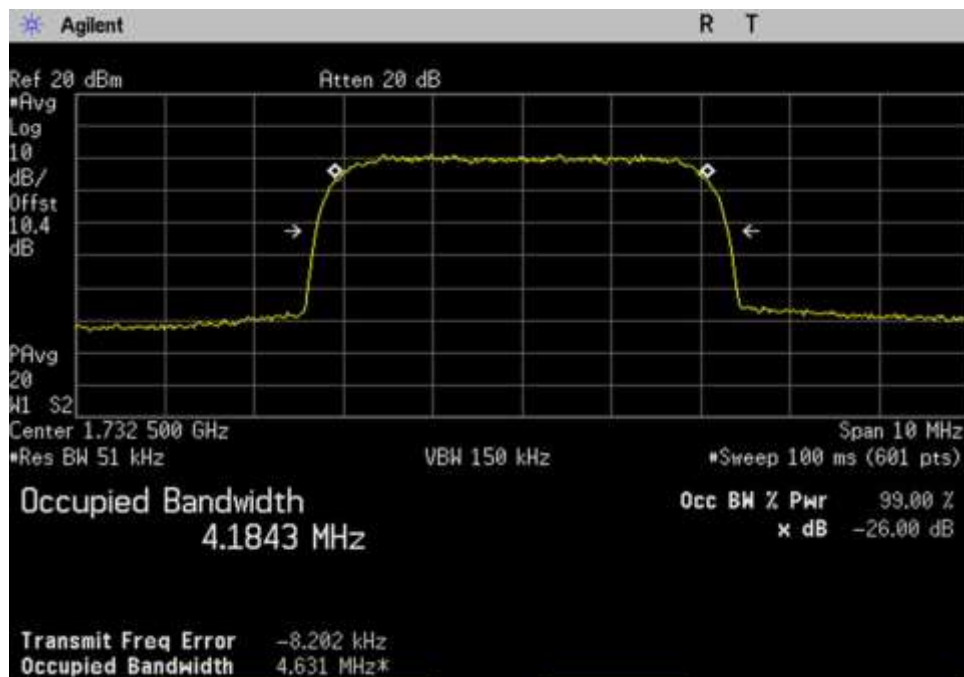
UL\_698-716\_WCDMA\_707MHz



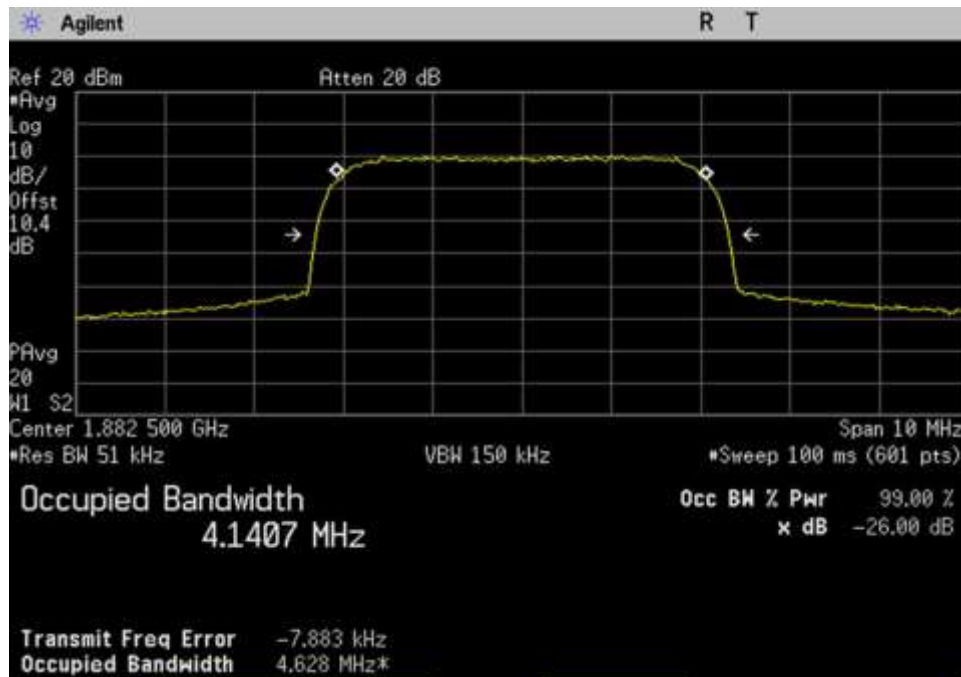
UL\_776-787\_WCDMA\_781.5MHz



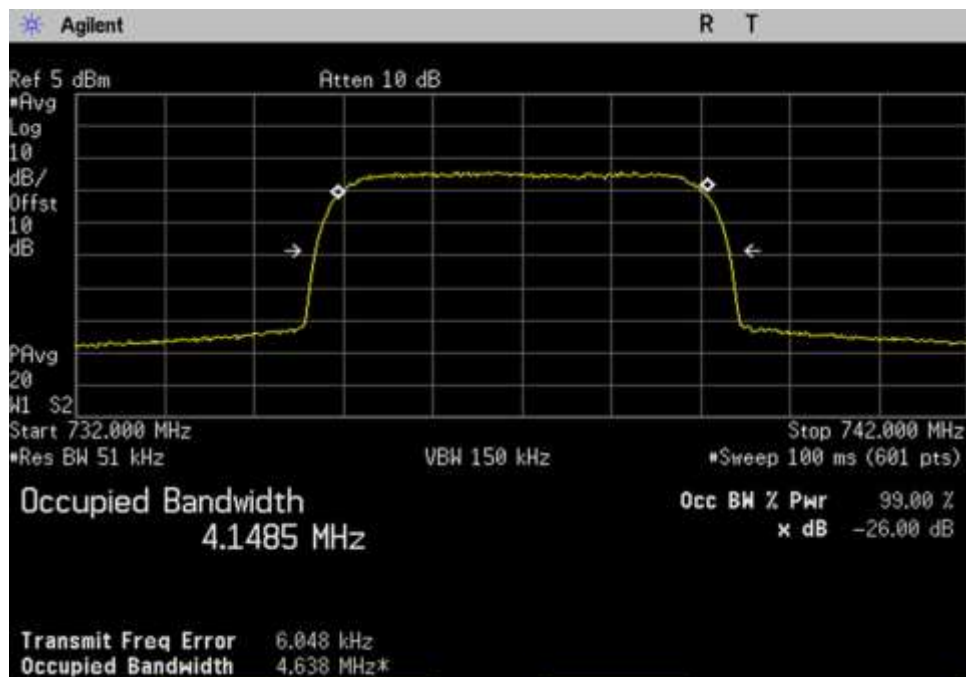
UL\_824-849\_WCDMA\_836.5MHz



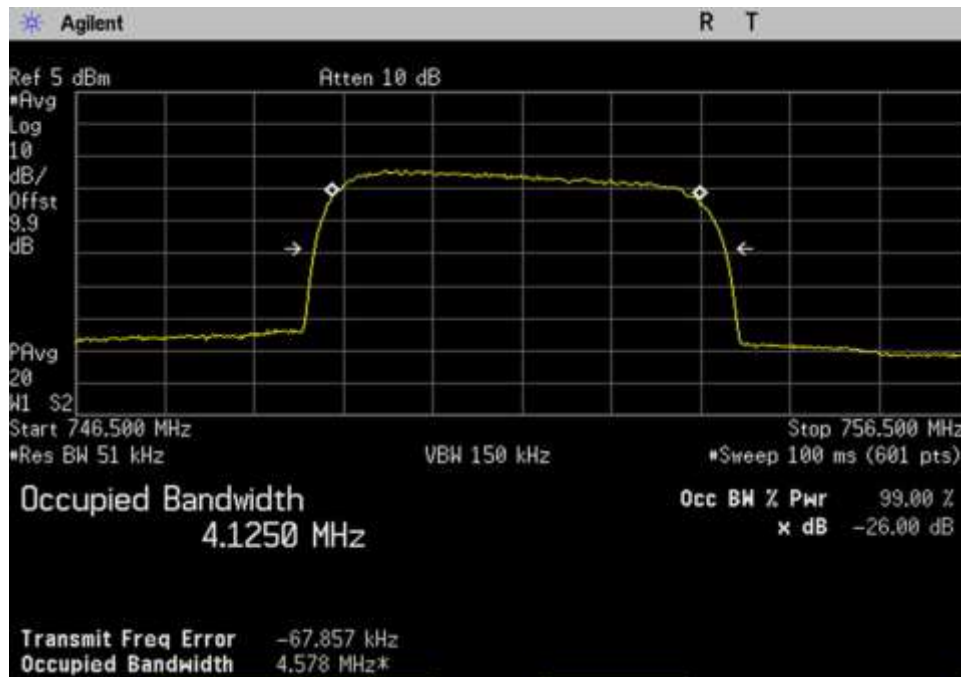
UL\_1710-1755\_WCDMA\_1732.5MHz



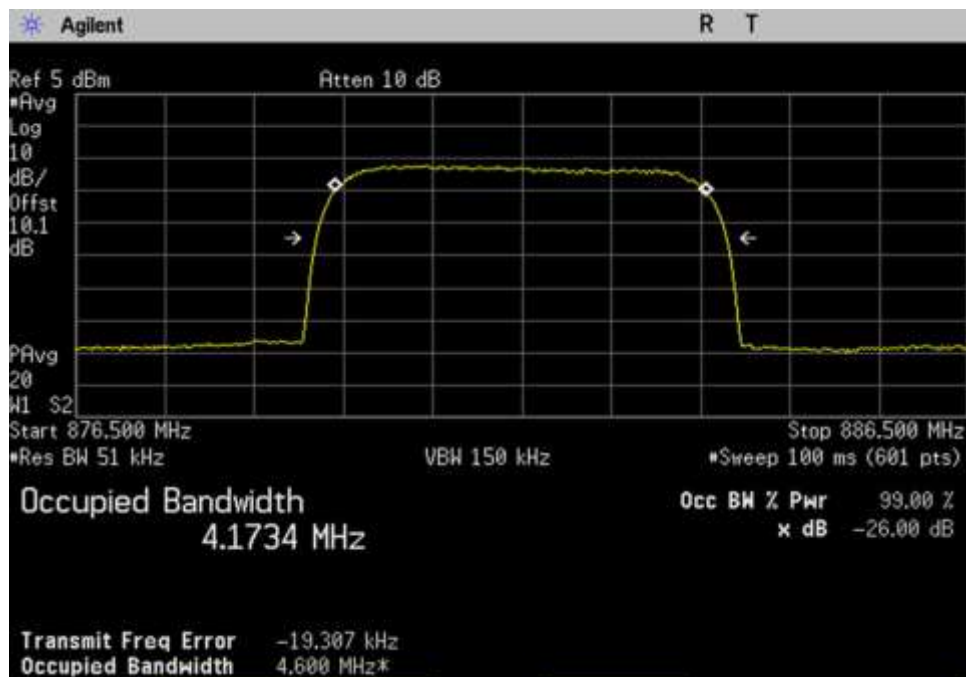
UL\_1850-1915\_WCDMA\_1882.5MHz



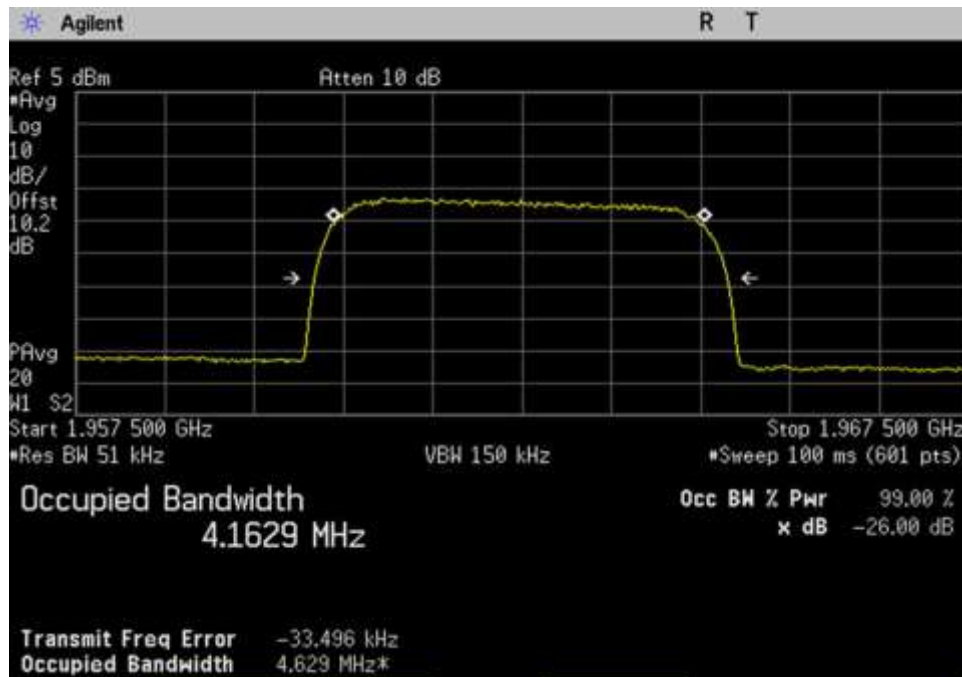
DL\_728-746\_WCDMA\_737MHz



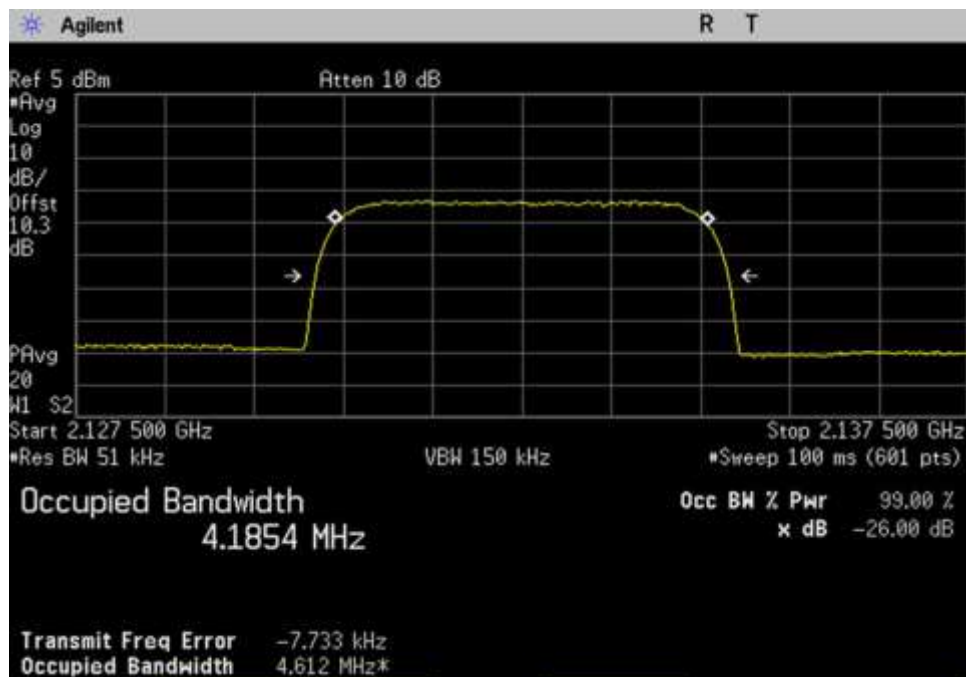
DL\_746-757\_WCDMA\_751.5MHz



DL\_869-894\_WCDMA\_881.5MHz



DL\_1930-1995\_WCDMA\_ 1962.5MHz



DL\_2110-2155\_WCDMA\_ 2132.5MHz

## 7.11 Oscillation Detection

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: Cellphone-Mate, Inc.  
 Specification: **7.11 Anti-Oscillation (Oscillation Restarts / Oscillation mitigation or shutdown)**  
 Work Order #: **102180**  
 Test Type: **Conducted Emissions** Date 01/29/2019  
 Tested By: **Hieu Song Nguyenpham**  
 Software: EMITest 5.03.11

#### Equipment Tested:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Support Equipment:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Test Conditions / Notes:

01/29/219: Test environment conditions: Temperature: 20.5°C, 43% relative humidity, Pressure: 101.9kPa

Modification #1 was in place during testing.

Note: UL1850-1915MHz -AWGNL+5:

- AWGNL denotes a 4.1MHz AWGN signal (99% occupied bandwidth) tuned to the frequency of 2.5 MHz above the lower edge of the operating band 1850-1915MHz

- +5 denotes a variable attenuator adjusted such that the insertion loss for center of band under test (isolation) between the booster's donor and server ports is 5 dB greater than the maximum gain, as recorded in the maximum gain test procedure, for the band under test.

**Test Equipment:**

| Asset # | Description         | Manufacturer           | Model                    | Calibration Date | Cal Due Date |
|---------|---------------------|------------------------|--------------------------|------------------|--------------|
| P07192  | Cable               | Astro                  | 32022-29094K-29094K-48TC | 10/9/2017        | 10/9/2019    |
| P07191  | Cable               | Astro                  | 32022-29094K-29094K-48TC | 10/30/2017       | 10/30/2019   |
| 03418   | Signal Generator    | Agilent                | E4438C                   | 6/19/2017        | 6/19/2019    |
| 03470   | Spectrum Analyzer   | Agilent                | E4440A                   | 1/3/2018         | 1/3/2020     |
| P06904  | Cable               | Astrolab               | 32022-29094K-29094K-36TC | 1/4/2018         | 1/4/2020     |
| C00082  | Directional Coupler | MECA Electronics, Inc. | 722-10-1.500V            | 9/18/2017        | 9/18/2019    |
| 03412   | Band Pass Filter    | Pasternack             | PE8705                   | 8/16/2017        | 8/16/2019    |
| 03413   | Band Pass Filter    | Pasternack             | PE8706                   | 8/16/2017        | 8/16/2019    |
| 03414   | Band Pass Filter    | Pasternack             | PE8707                   | 8/16/2017        | 8/16/2019    |
| 03415   | Band Pass Filter    | Pasternack             | PE8708                   | 8/16/2017        | 8/16/2019    |
| 03447   | Band Pass Filter    | Pasternack             | PE8710                   | 8/16/2017        | 8/16/2019    |
| 03448   | Band Pass Filter    | Pasternack             | PE8711                   | 8/16/2017        | 8/16/2019    |
| 03446   | Band Pass Filter    | K & L                  | 4FV50-707/H18-O/O        | 8/16/2017        | 8/16/2019    |
| 03467   | High Pass Filter    | K & L                  | 4FV50-731/H30-O/O        | 8/16/2017        | 8/16/2019    |
| 03468   | High Pass Filter    | K & L                  | 4CS10-781.5/E12.2-O/O    | 8/16/2017        | 8/16/2019    |
| 03469   | High Pass Filter    | K & L                  | 4CS10-751.5/E12-O/O      | 8/16/2017        | 8/16/2019    |
| 02475   | Attenuator          | HP                     | 8494B                    | 6/8/2017         | 6/8/2019     |
| 03429   | Attenuator          | HP                     | 8496B                    | 11/8/2017        | 11/8/2019    |

## Summary of Results

Pass: All oscillations detections and mitigations occur within 0.3 seconds in uplink bands, within 1 second in the downlink bands and the noise level is below the -70dBm/MHz limit.

### 7.11.2 Oscillation restart tests

| Oscillation detection |              |           |                | Time Between restart |                    | Number of restart |       |
|-----------------------|--------------|-----------|----------------|----------------------|--------------------|-------------------|-------|
| Frequency MHz         | Measured Sec | Limit Sec | Peak Level dBm | Measured Sec         | Limit At least sec | Measured          | Limit |
| UL1710-1755           | 0.183        | 0.3       | 23.7           | 69                   | 60                 | 3                 | 5     |
| UL1850-1915           | 0.192        | 0.3       | 24.6           | 68                   | 60                 | 3                 | 5     |
| UL824-894             | 0.150        | 0.3       | 28.9           | 69                   | 60                 | 3                 | 5     |
| UL 698-716            | 0.216        | 0.3       | 29.8           | 66                   | 60                 | 3                 | 5     |
| UL776-787             | 0.150        | 0.3       | 30.2           | 65                   | 60                 | 3                 | 5     |
|                       |              |           |                |                      |                    |                   |       |
| DL2110-2155           | 0.167        | 1.0       | 26.8           | 68                   | 60                 | 3                 | 5     |
| DL1930-1995           | 0.216        | 1.0       | 25.5           | 70                   | 60                 | 4                 | 5     |
| DL869-894             | 0.167        | 1.0       | 13.0           | 69                   | 60                 | 3                 | 5     |
| DL:728-746            | 0.217        | 1.0       | 13.1           | 66                   | 60                 | 3                 | 5     |
| DL 746-757            | 0.183        | 1.0       | 14.5           | 70                   | 60                 | 3                 | 5     |

The booster continues to mitigate at least 1 minute before restarting. The plots demonstrate after 1 restart (the limit is 5 restart), the booster does not resume operation until manually reset.

### 7.11.3 Test procedure for measuring oscillation mitigation or shutdown

|                       | UL 1710-1755        | UL1850-1915         | UL 824-894          | UL 698-716          | UL 776-787          |          |
|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------|
| Max Gain Isolation dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Limit dB |
| +5dB                  | 8.5                 | 10.2                | (12.4) *            | 9.5                 | 8.2                 | 12.0     |
| +4dB                  | 9.6                 | 11.6                | (13.9) *            | 11.5                | 10.1                | 12.0     |
| +3dB                  | 10.5                | (12.7) *            | (16.5) *            | (13.5)*             | 11.6                | 12.0     |
| +2dB                  | (12.1) *            | (14.6) *            | (19.7) *            | (15.5)*             | (13.8)*             | 12.0     |
| +1dB                  | (13.6) *            | (17.3) *            | (23.6) *            | (18.4)*             | (15.8)*             | 12.0     |
| 0dB                   | (15.2) *            | (21.8) *            | (40.2) *            | (22.4)*             | (20.9)*             | 12.0     |
| -1dB                  | (18.1) *            | (33.2) *            | **                  | (33.1)*             | **                  | 12.0     |
| -2dB                  | (24.3) *            | **                  | **                  | **                  | **                  | 12.0     |
| -3dB                  | (42.1) *            | **                  | **                  | **                  | **                  | 12.0     |
| -4dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |
| -5dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |

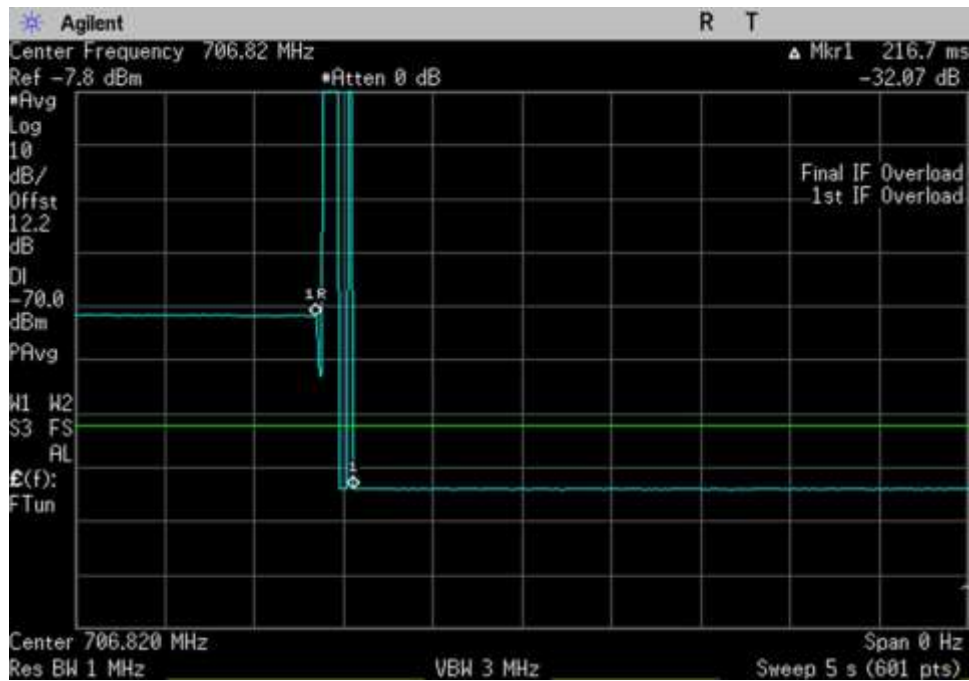
|                       | DL 2110-2155        | DL 1930-1995        | DL 869-894          | DL 728-746          | DL 746-775          |          |
|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------|
| Max Gain Isolation dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Pk-Pk Difference dB | Limit dB |
| +5dB                  | 11                  | 10.3                | 10.9                | (12.6)*             | 8.3                 | 12.0     |
| +4dB                  | (13.5) *            | 11.7                | (12.5)*             | (14.9)*             | 10.4                | 12.0     |
| +3dB                  | (14.5) *            | (14.1) *            | (14.1)*             | (17.0)*             | 11.4                | 12.0     |
| +2dB                  | (16.8) *            | (17.2) *            | (16.1)*             | (21.3)*             | (14.3)*             | 12.0     |
| +1dB                  | (21.6) *            | (19.8) *            | (19.4)*             | (26.6)*             | (16.7)*             | 12.0     |
| 0dB                   | (26.7) *            | (28.1) *            | (26.3)*             | (70.4)*             | (22.1)*             | 12.0     |
| -1dB                  | (51.6) *            | **                  | **                  | **                  | (36.1)*             | 12.0     |
| -2dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |
| -3dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |
| -4dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |
| -5dB                  | **                  | **                  | **                  | **                  | **                  | 12.0     |

Note:

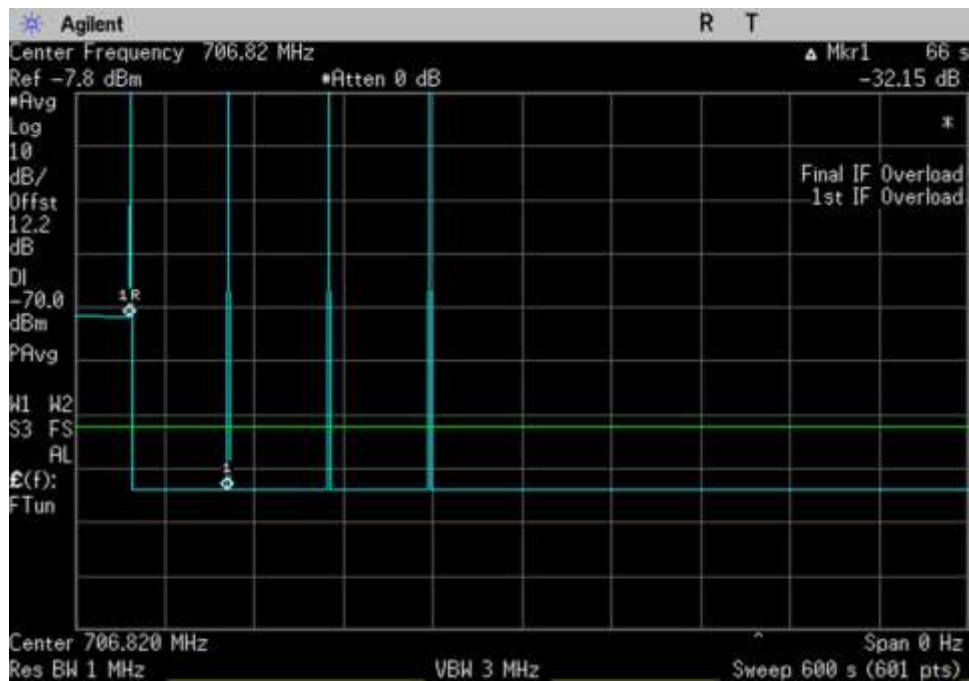
\* The measured difference exceeds the limit for a period of less than 300 second before device mitigates or shuts down. The maximum recorded time prior to shutdown was 194 seconds for the Uplink bands and 99 seconds for the Downlink bands.

\*\* The device shuts down immediately.

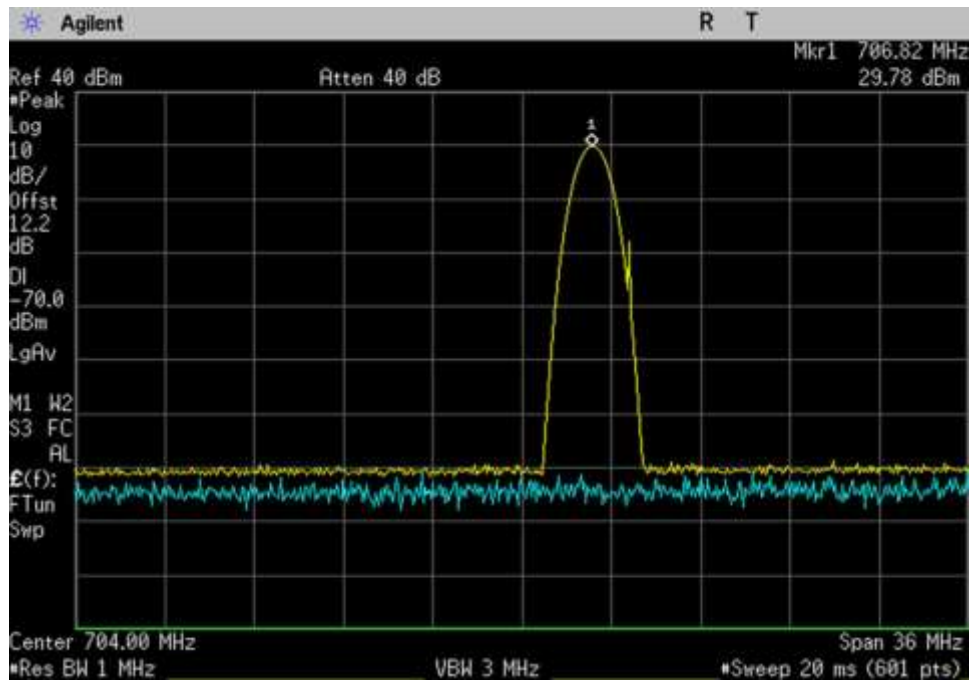
Plot(s)



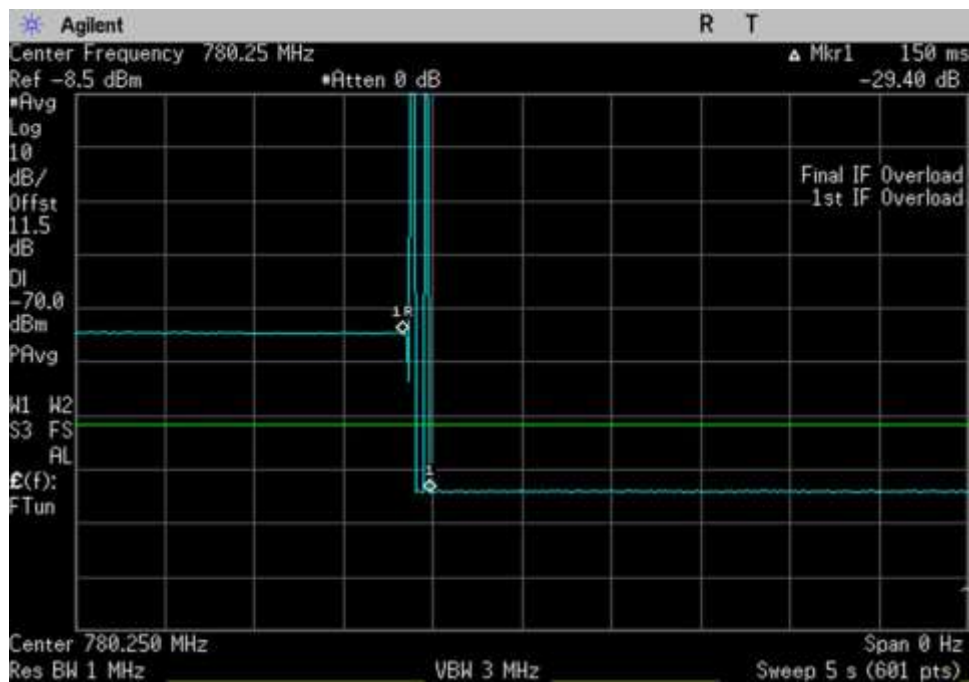
UL\_698-716\_706.82MHz



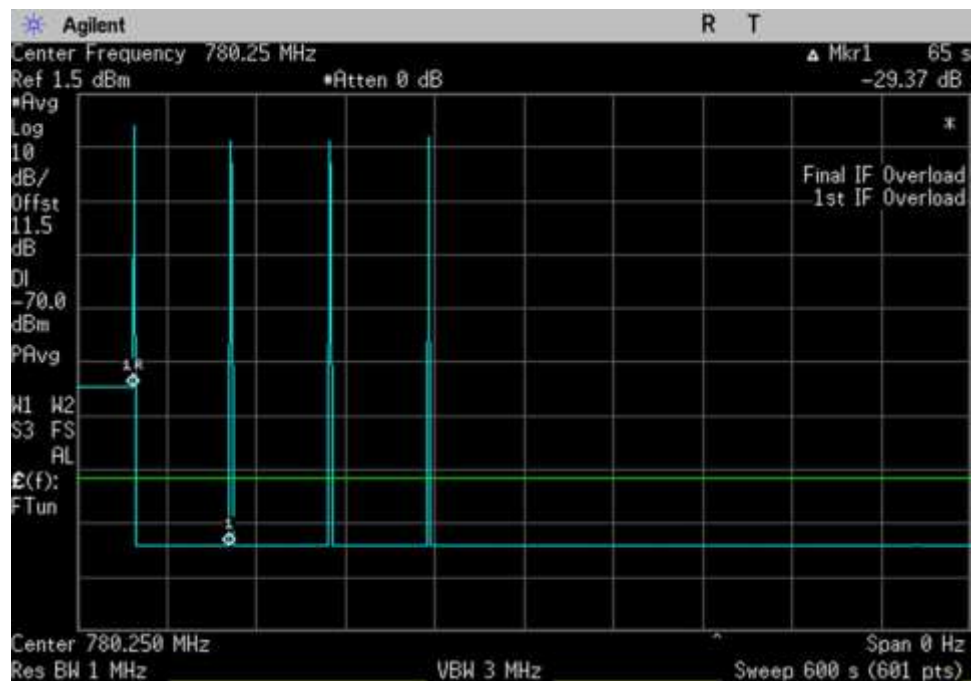
UL\_698-716\_600sec\_706.82MHz



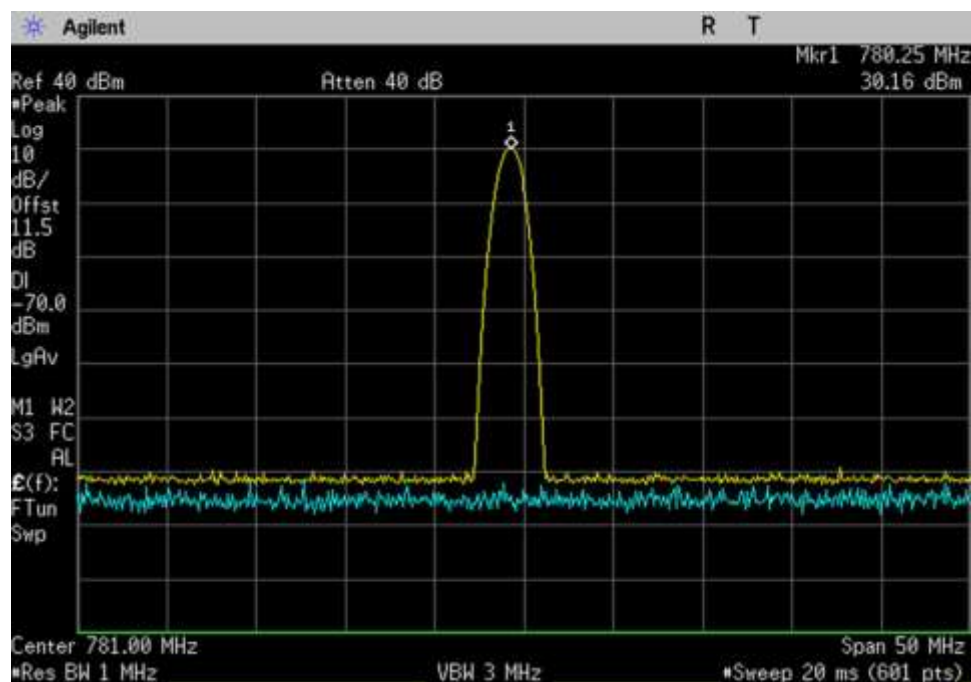
UL\_698-716\_Pk\_704MHz



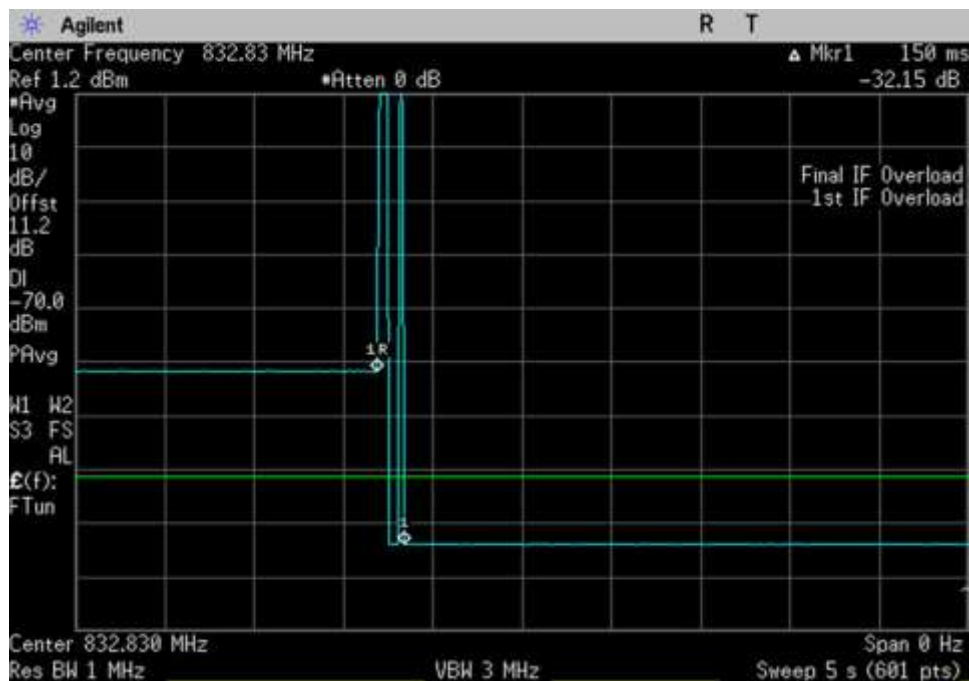
UL\_776-787\_780.25MHz



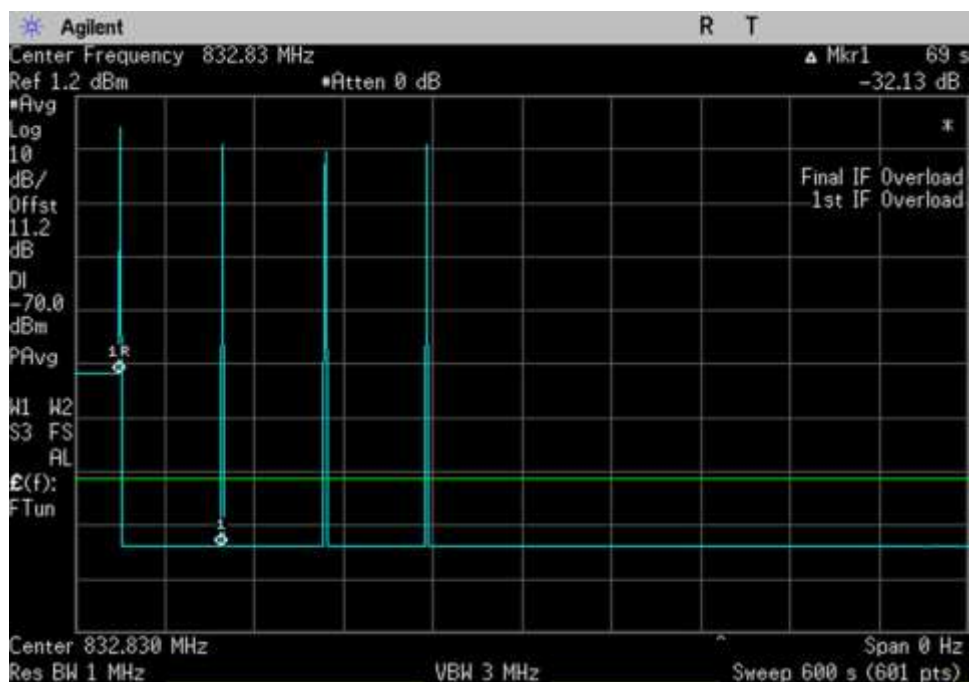
UL\_776-787\_600sec\_780.25MHz



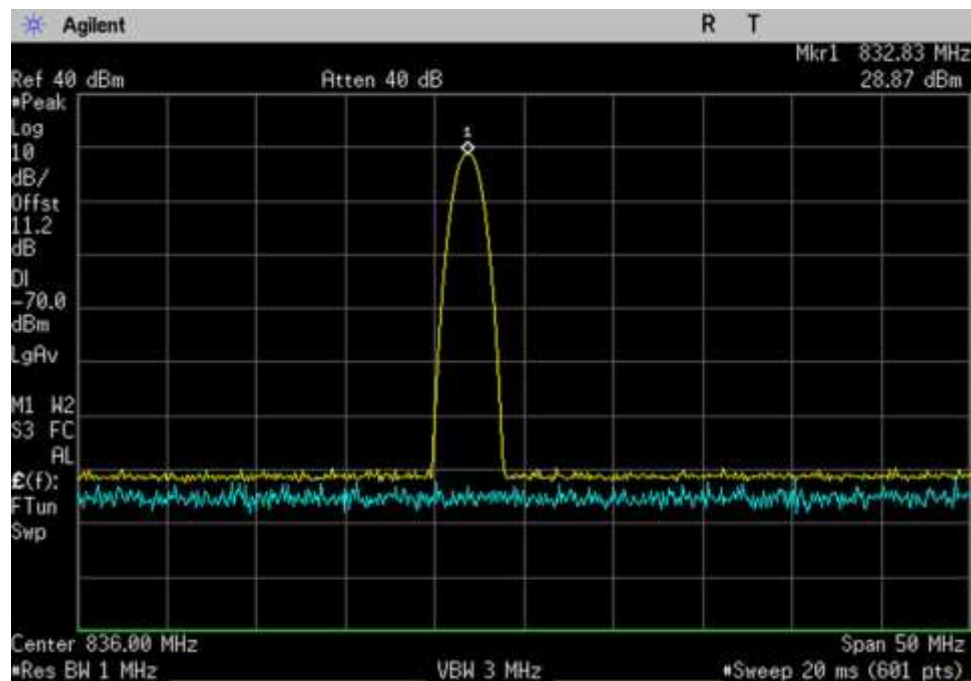
UL\_776-787\_Pk\_781MHz



UL\_824-849\_ 832.83MHz



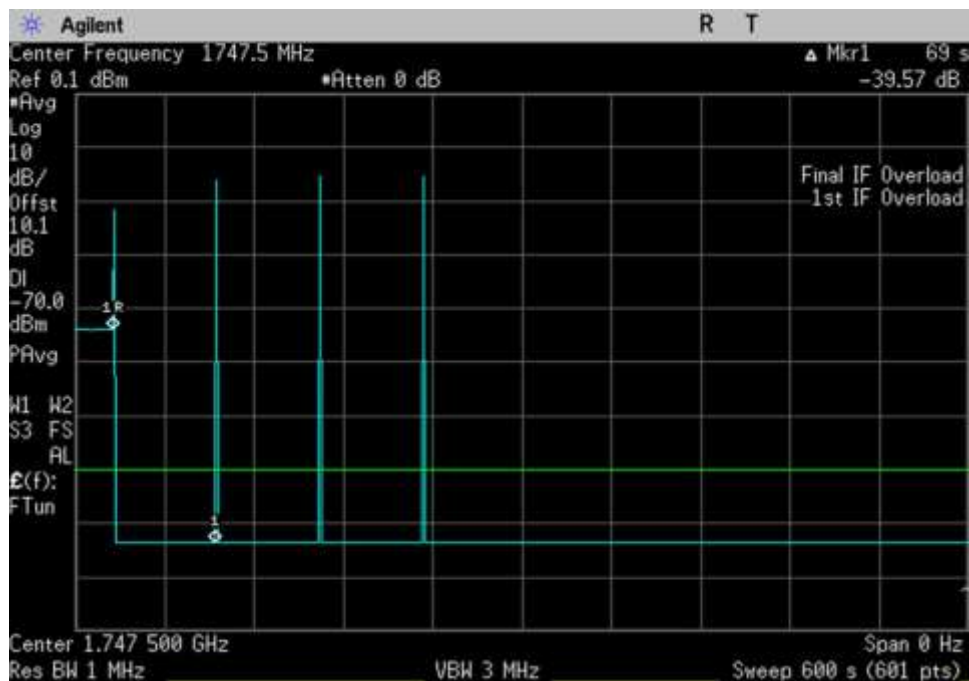
UL\_824-849\_600sec\_ 832.83MHz



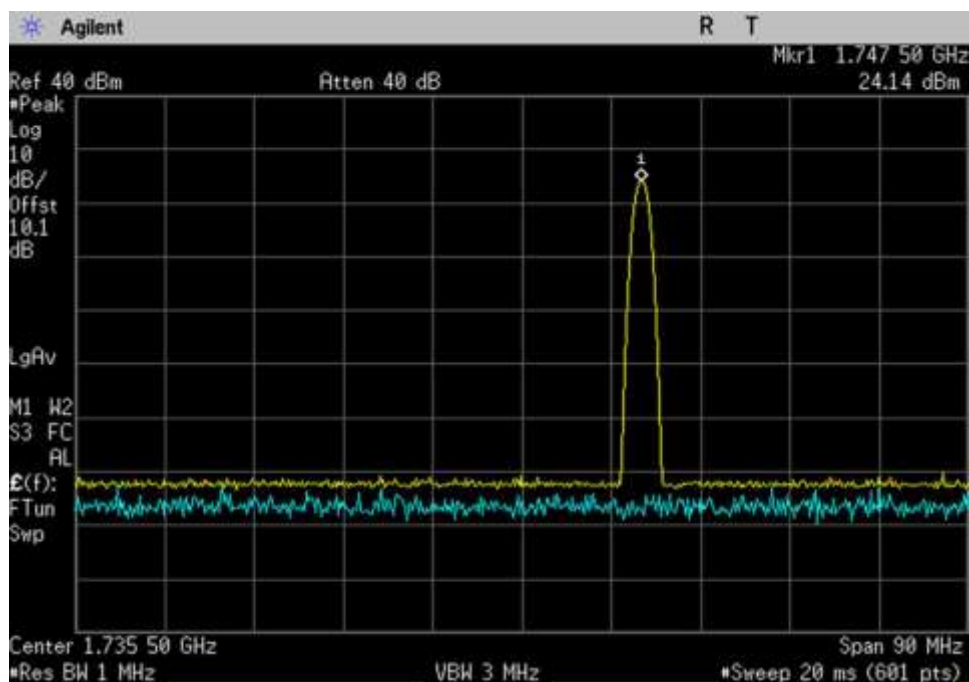
UL\_824-849\_Pk\_ 836MHz



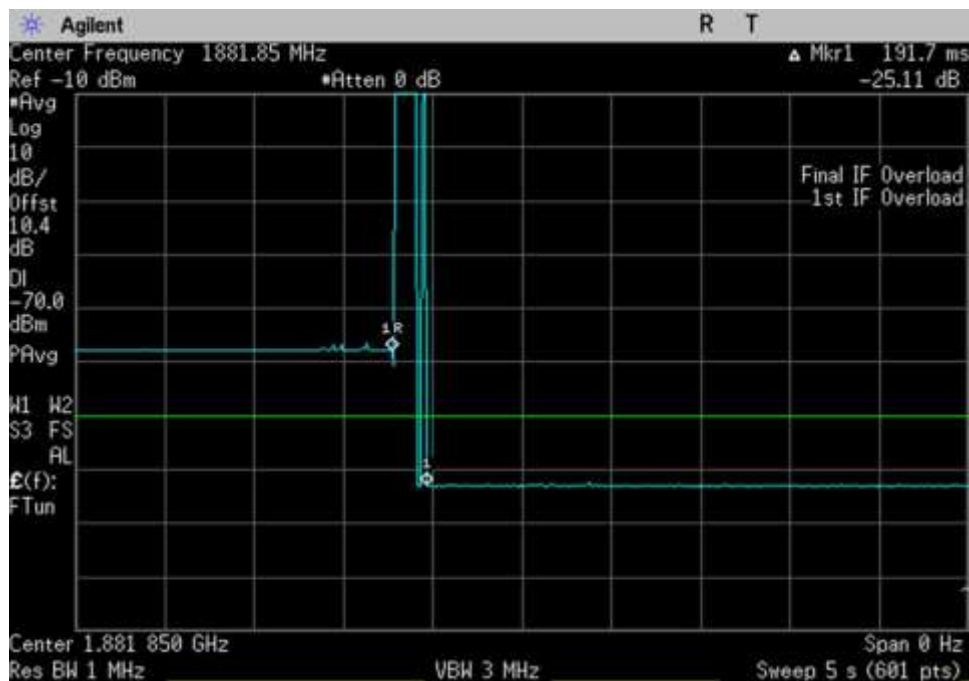
UL\_1710-1755\_ 1747.5MHz



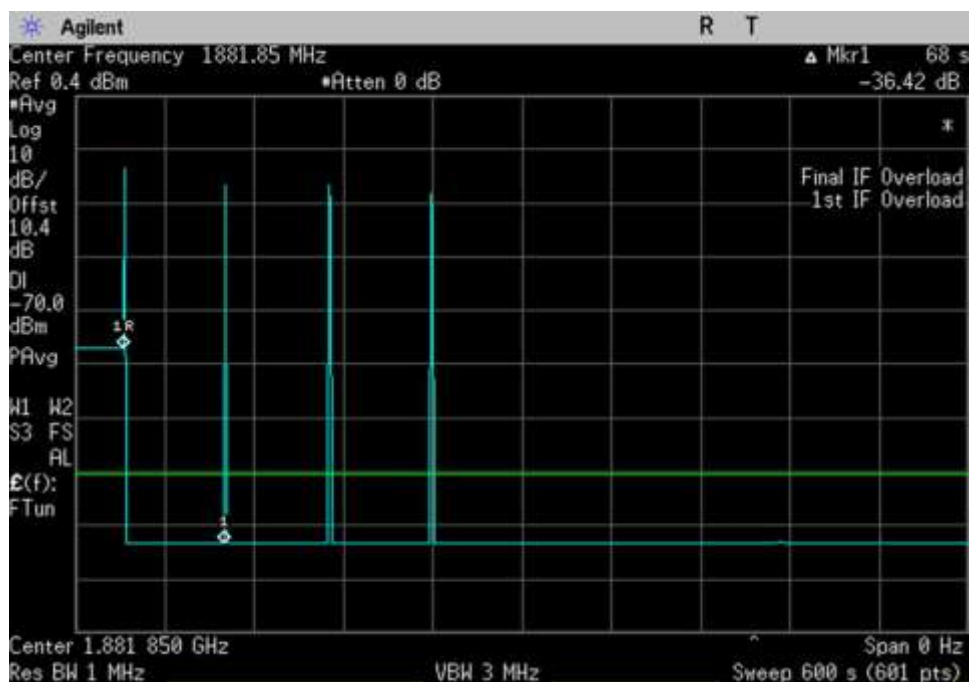
UL\_1710-1755\_600sec\_1747.5MHz



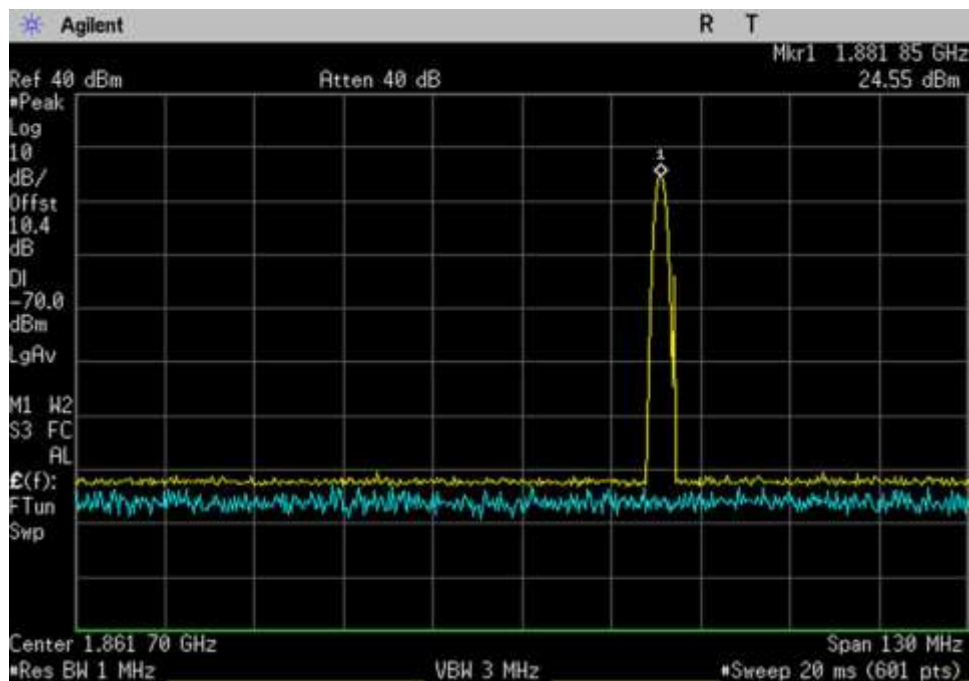
UL\_1710-1755\_Pk\_1735.5MHz



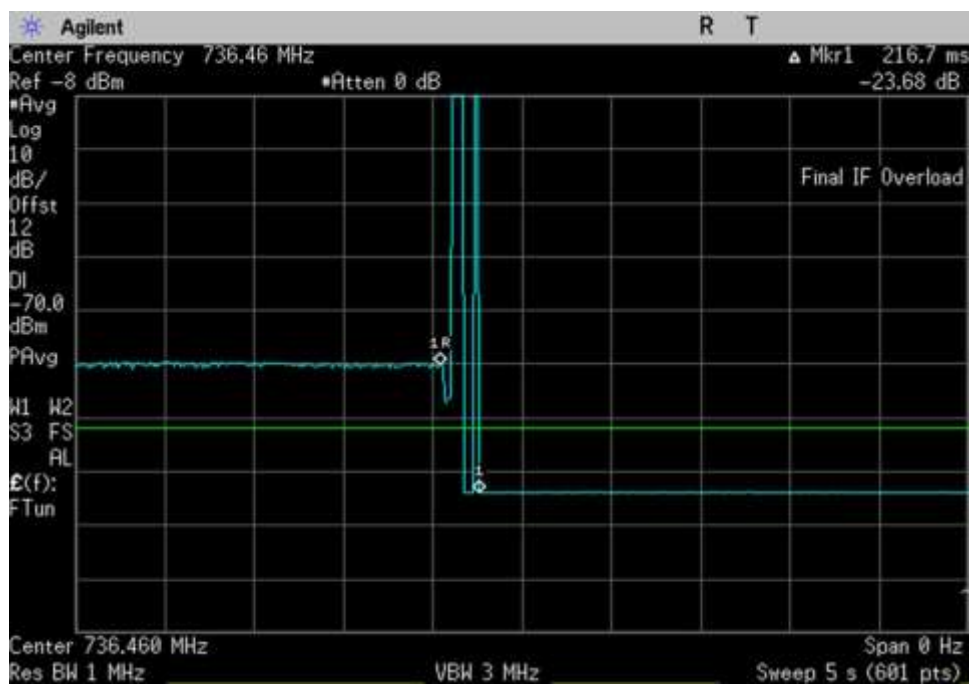
UL\_1850-1915\_ 1881.85MHz



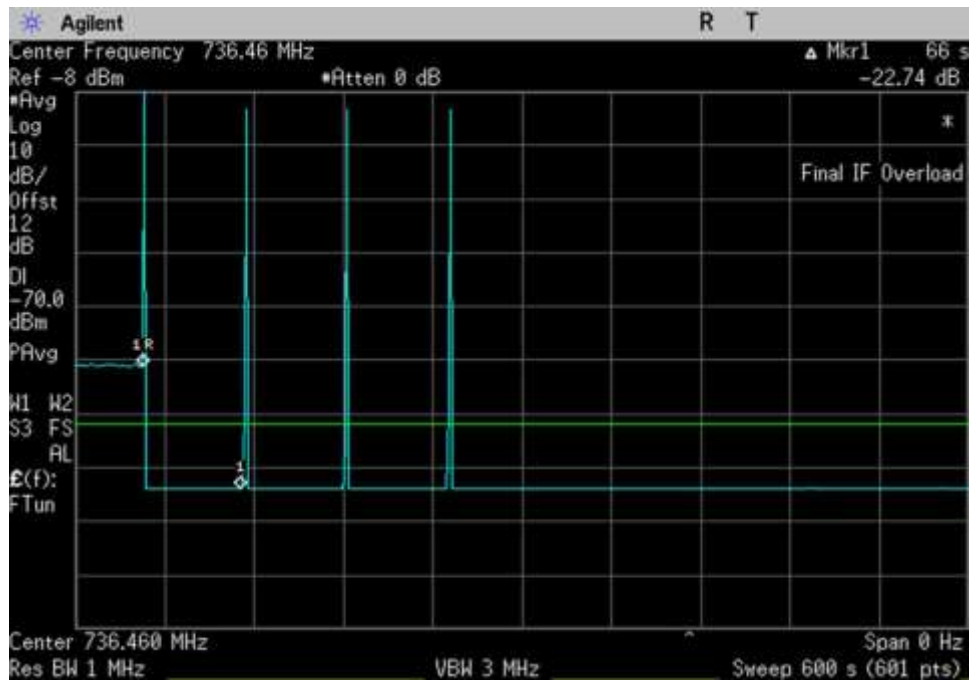
UL\_1850-1915\_600sec\_ 1881.85MHz



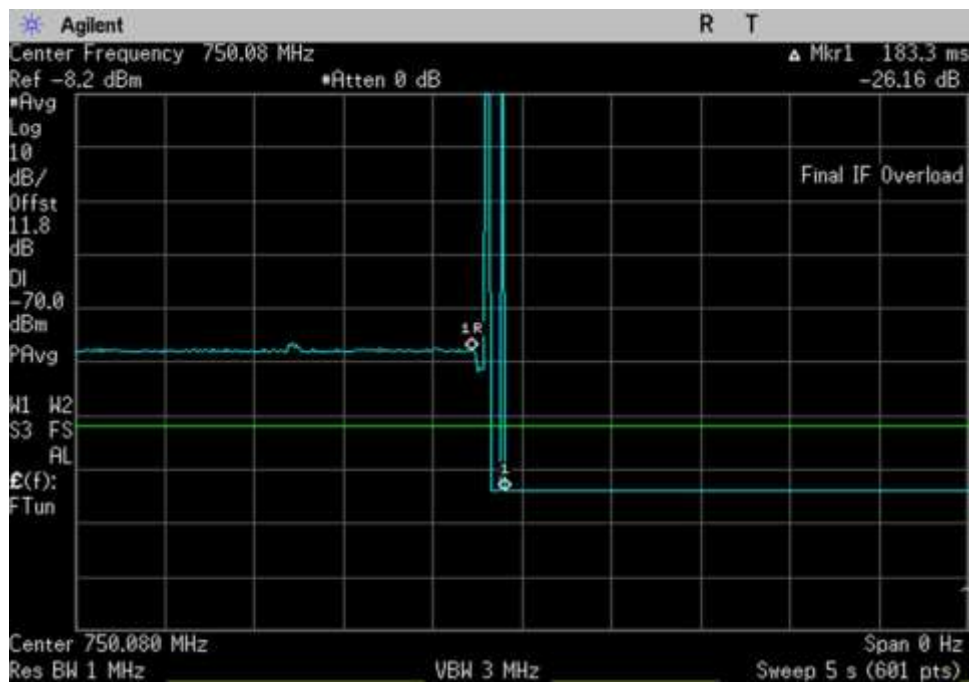
UL\_1850-1915\_Pk\_ 1861.7MHz



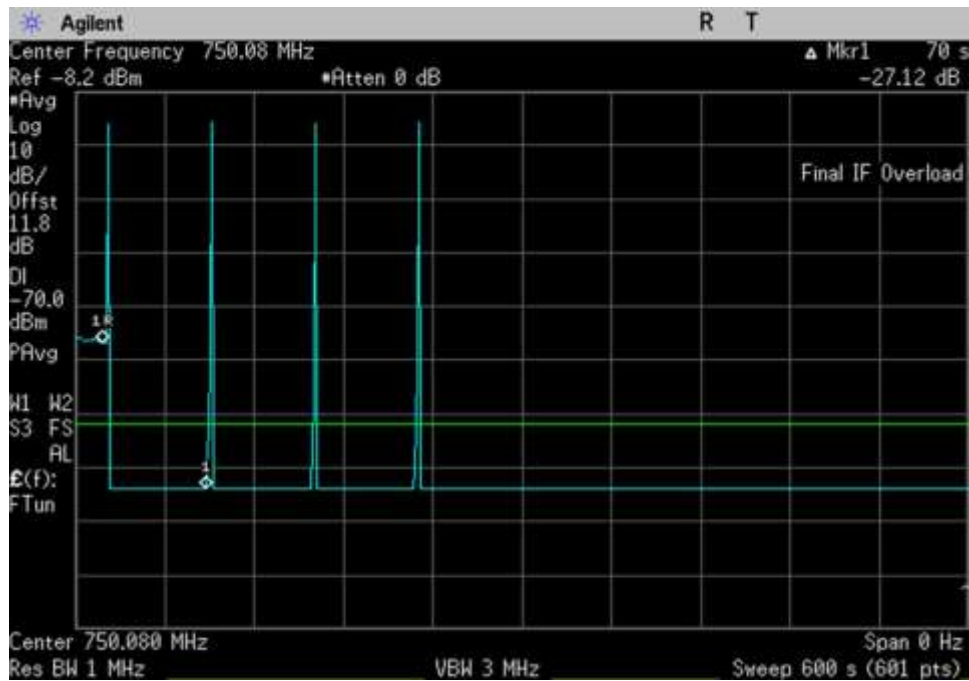
DL\_728-746\_ 736.46MHz



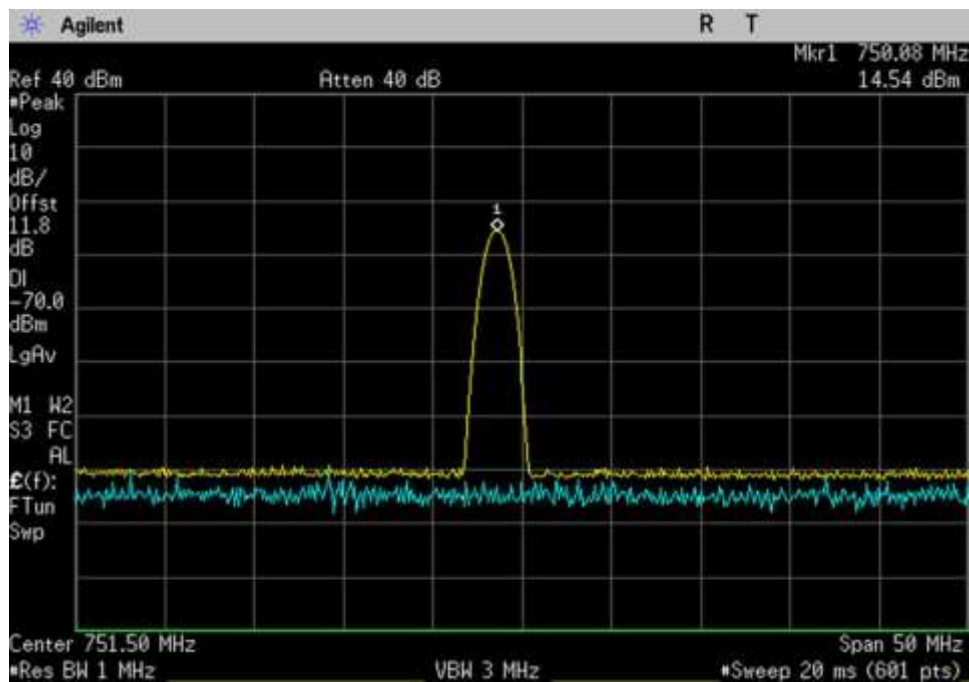
DL\_728-746\_600sec\_736.46MHz



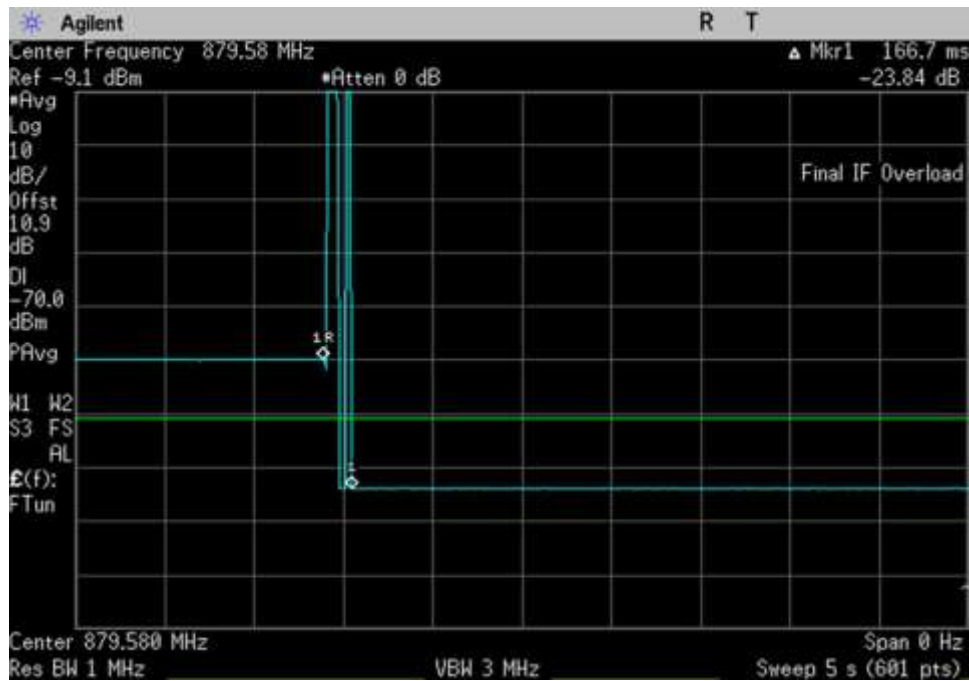
DL\_746-757\_750.08MHz



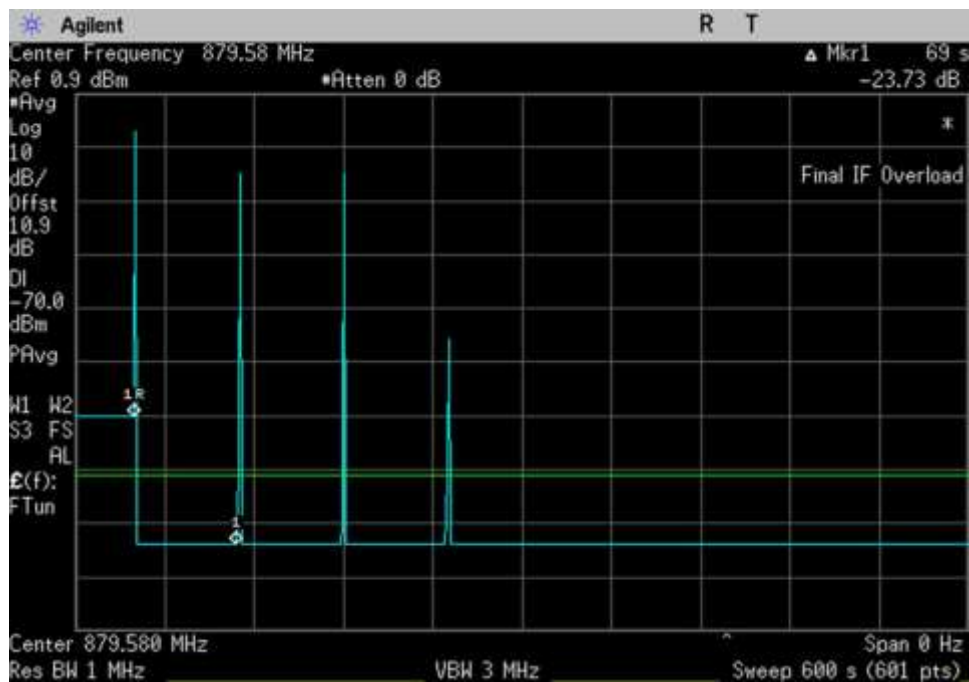
DL\_746-757\_600sec\_750.08MHz



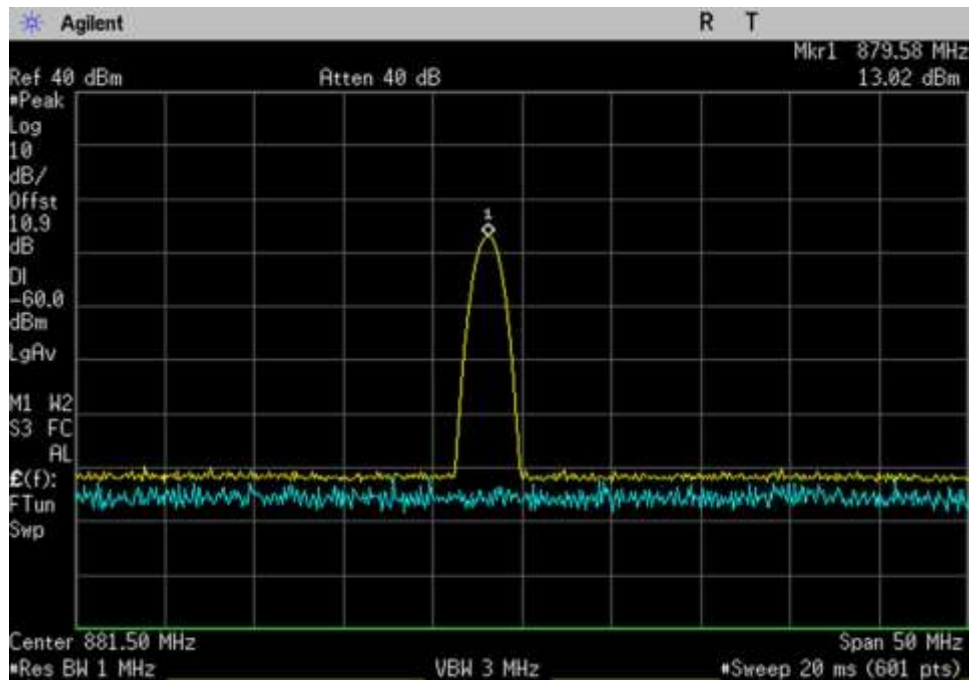
DL\_746-757\_Pk\_751.5MHz



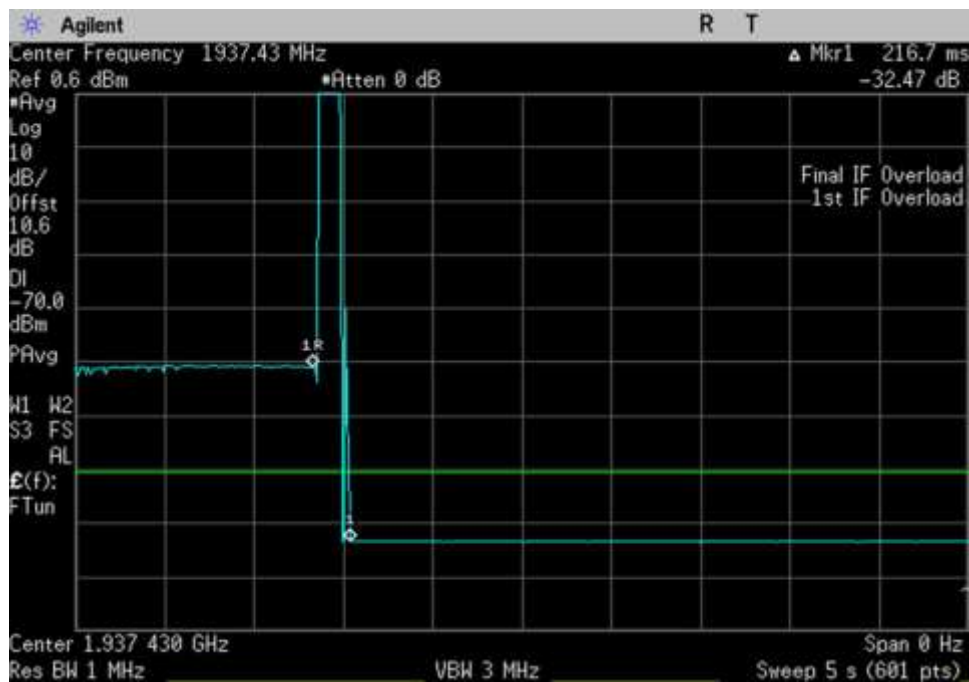
DL\_869-894MHz\_ 879.58MHz



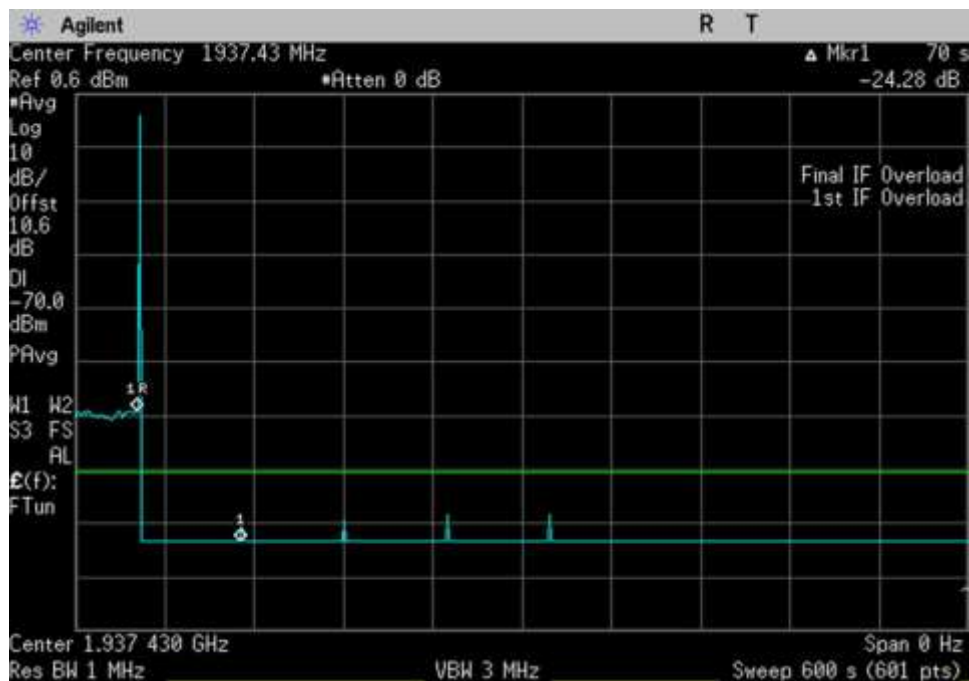
DL\_869-894MHz\_600sec\_ 879.58MHz



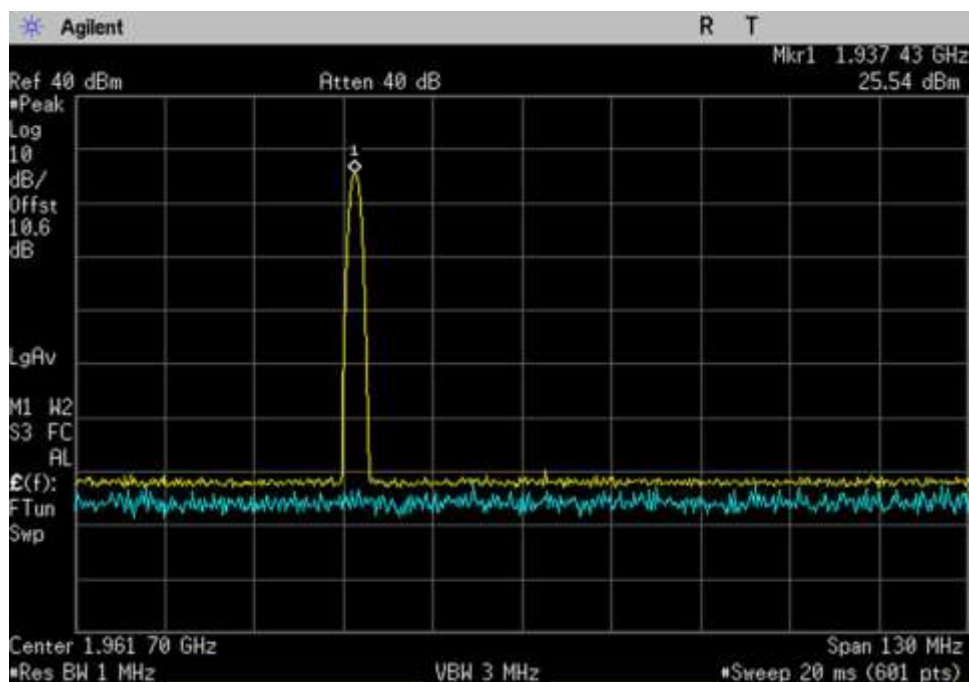
DL\_869-894MHz\_Pk\_ 881.5MHz



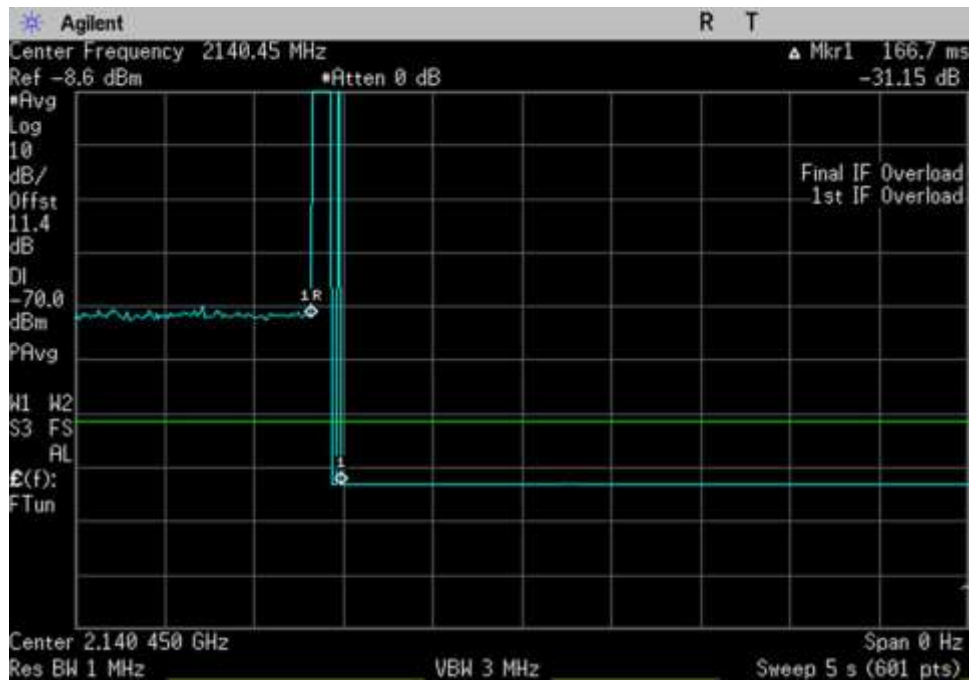
DL\_1930-1995\_ 1937.43MHz



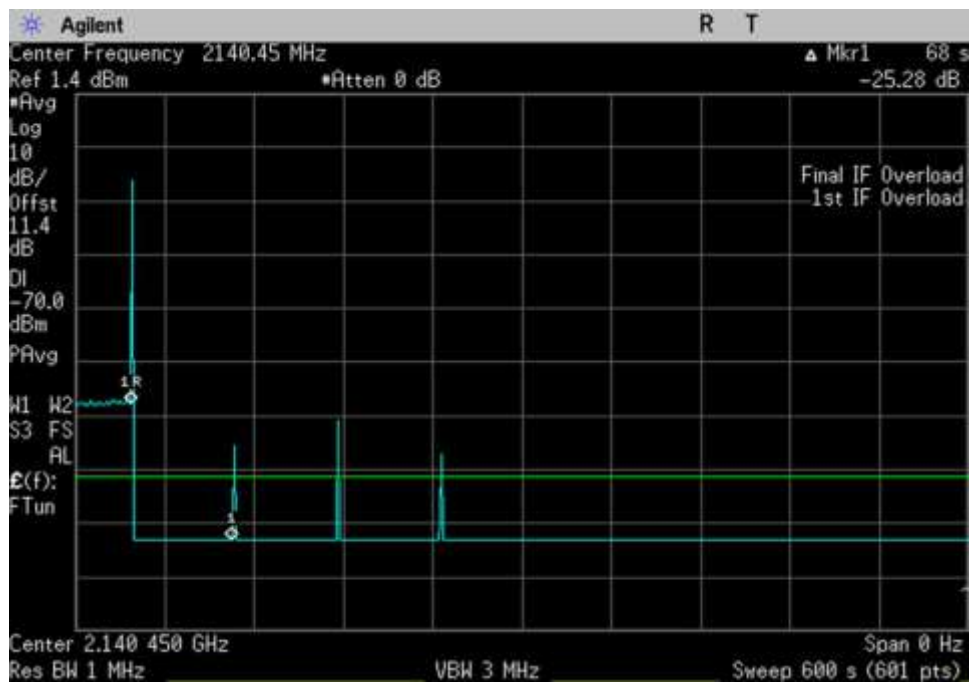
DL\_1930-1995\_600sec\_1937.43MHz



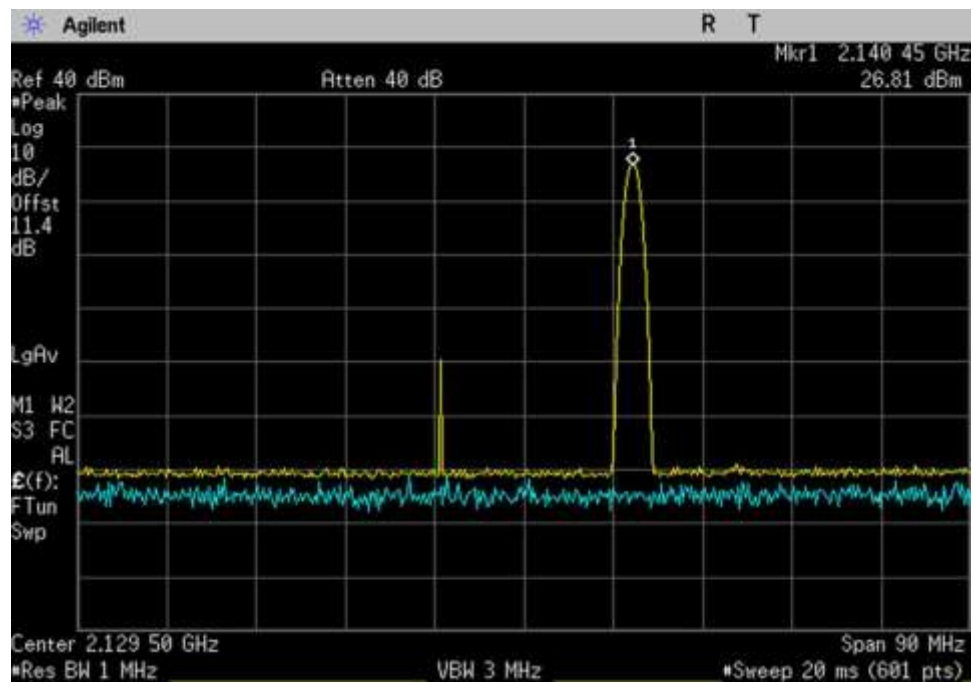
DL\_1930-1995\_Pk\_1961.7MHz



DL\_2110-2155\_ 2140.45MHz



DL\_2110-2155\_600sec\_ 2140.45MHz



DL\_2110-2155\_Pk\_ 2129.5MHz

## 7.12 Radiated Spurious Emissions

### Test Conditions / Setup

Test Location: CKC Laboratories, Inc. • 1120 Fulton Place • Fremont, CA 94539 • (510) 249-1170  
 Customer: Cellphone-Mate, Inc.  
 Specification: **7.12 Radiated Spurious Emissions**

Work Order #: **102180** Date: 01/29/2019  
 Test Type: **Radiated Emissions**  
 Tested By: **Hieu Song Nguyenpham**  
 Software: EMITest 5.03.11

#### Equipment Tested:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Support Equipment:

| Device          | Manufacturer | Model # | S/N |
|-----------------|--------------|---------|-----|
| Configuration 1 |              |         |     |

#### Test Conditions / Notes:

Test environment conditions: Temperature: 20.5°C, 43% relative humidity, Pressure: 101.9kPa

Modification #1 was in place during testing.

Frequency range of measurement = 9 kHz- 22 GHz.

9 kHz - 150 kHz -> RBW=200 Hz VBW=200 Hz

150 kHz - 30 MHz -> RBW=9 kHz VBW=9 kHz

30 MHz - 1000MHz -> RBW=120 kHz VBW=120 kHz

1000 MHz-22000MHz -> RBW=1 MHz VBW=1 MHz

Note:

**No spurious emissions were found within 20dB of the limit line.**

Emissions in the band 1559-1610 MHz were investigated and these were not found within 20dB of the limit line.

27.53(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

**Test Equipment:**

| Asset #  | Description                                | Model                           | Calibration Date              | Cal Due Date |
|----------|--------------------------------------------|---------------------------------|-------------------------------|--------------|
| AN03471  | Spectrum Analyzer                          | E4440A                          | 1/18/2018                     | 1/18/2020    |
| 00852    | Biconilog Antenna                          | Schaffner                       | CBL 6111C                     | 5/1/2018     |
| ANP06049 | Attenuator                                 | PE7002-6                        | 5/14/2018                     | 5/14/2020    |
| ANP06691 | Cable                                      | PE3062-180                      | 5/14/2018                     | 5/14/2020    |
| ANP00880 | Cable                                      | RG214U                          | 5/14/2018                     | 5/14/2020    |
| P07508   | Preamp                                     | Sonoma                          | 310N                          | 10/15/2018   |
| ANP01187 | Cable                                      | CNT-195                         | 8/8/2016                      | 8/8/2018     |
| AN02157  | Horn Antenna-<br>ANSI C63.5                | 3115                            | 2/6/2017                      | 2/6/2019     |
| AN03302  | Cable                                      | 32026-29094K-<br>29094K-72TC    | 1/15/2018                     | 1/15/2020    |
| ANP01210 | Cable                                      | FSJ1P-50A-4A                    | 1/16/2017                     | 1/16/2019    |
| ANP06903 | Cable                                      | 32022-29094K-<br>29094K-36TC    | 1/4/2018                      | 1/4/2020     |
| AN02693  | Active Horn<br>Antenna-ANSI<br>C63.5 3m    | AMFW-5F-<br>12001800-20-<br>10P | 5/11/2017                     | 5/11/2019    |
| AN02694  | Horn Antenna-<br>ANSI C63.5<br>Calibration | AMFW-5F-<br>18002650-20-<br>10P | 5/11/2017                     | 5/11/2019    |
| AN00266  | Loop Antenna                               | 6502                            | 6/1/2018                      | 6/1/2020     |
| AN03607  | Preamp                                     | AMF-7D-<br>00101800-30-<br>10P  | 6/6/2017                      | 6/6/2019     |
| P06126   | Cable                                      | Astrolab                        | 32022-29094K-<br>29094K-168TC | 3/27/2017    |
| P06899   | Cable                                      | Astrolab                        | 32022-29094K-<br>29094K-72TC  | 1/4/2018     |

### Summary of Results

Pass: All Radiated Spurious Emissions were found with more than 20dB margin of the limit line.

**Frequency Range of measurement 9kHz → 22GHz**

### LIMIT LINE FOR SPURIOUS RADIATED EMISSION

**REQUIRED ATTENUATION = 43+10 LOG P (DB)**  
**FOR RADIATED SPURIOUS EMISSION MEASURED AT 3 METER TEST DISTANCE,**

Required attenuation = 43+10 Log  $P_{t \text{ at 3 meter}}$  dB  
 Limit line (dBuV) =  $E_{dBuV} - \text{Attenuation}$

$E_{dBuV}$  = Measured field strength at 3 meter in dBuV/m

#### Power Density (Isotropic)

$$P_D = \frac{P_t}{4\pi r^2}$$

$P_D$  = Power Density in Watts /m<sup>2</sup>

$P_t$  = Average Transmit Power

$r$  = Test distance

#### Field Intensity E (V/m)

$$E = \sqrt{P_D \times 377}$$

$$E = \frac{\sqrt{P_t \times 377}}{4\pi r^2}$$

$$E = \sqrt{\frac{P_t \times 30}{r^2}}$$

$$P_t = \left( \frac{E^2 \times r^2}{30} \right)$$

$$10 \log P_t = 10 \log E^2 (V/m) + 10 \log r^2 - 10 \log 30$$

$$10 \log P_t = 20 \log E (V/m) + 20 \log r - 10 \log 30$$

At 3 meter,  $r = 3 \text{ m}$

$$10 \log P_t = 20 \log E (V/m) + 20 \log 3 - 10 \log 30$$

$$\mathbf{10 \log P_t = 20 \log E (V/m) + 9.54 - 14.77}$$

$$10 \log P_t = 20 \log E (V/m) - 5.23$$

**Since  $20 \log E (V/m) = 20 \log E (\mu V/m) - 120$**

$$10 \log P_t = 20 \log E (\mu V/m) - 120 - 5.23$$

$$10 \log P_t = 20 \log E (\mu V/m) - 125.23$$

$$\begin{aligned} \text{Limit line (dBuV) at 3 meter} &= E_{dBuV} - \text{Attenuation} \\ &= E_{dBuV} - (43 + 10 \log P_{t \text{ at 3 meter}}) \\ &= E_{dBuV} - 43 - 10 \log P_{t \text{ at 3 meter}} \\ &= E_{dBuV} - 43 - (20 \log E (\mu V/m) - 125.23) \\ &= E_{dBuV} - 43 - 20 \log E (\mu V/m) + 125.23 \\ &= E_{dBuV} - 20 \log E (\mu V/m) + 82.23 \end{aligned}$$

$$\text{Since } 20 \log E (\mu V/m) = E \text{ in dBuV/m} = E_{dBuV} - E_{dBuV} + 82.23$$

$$\text{Radiated Emission limit 3 meter} = 82.23 \text{ dBuV at any power level measured in dBuV}$$

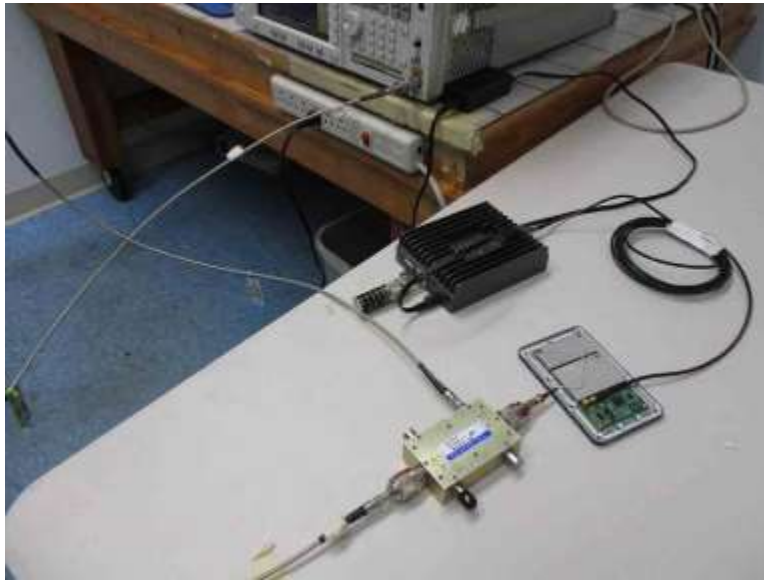
## EXHIBIT A: TEST SETUP PHOTOS



Section 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, and 7.10 Test Setup



Section 7.7 Max Noise, 7.8 Test Setup



Section 7.7 Var Noise Test Setup



Section 7.9 Test Setup



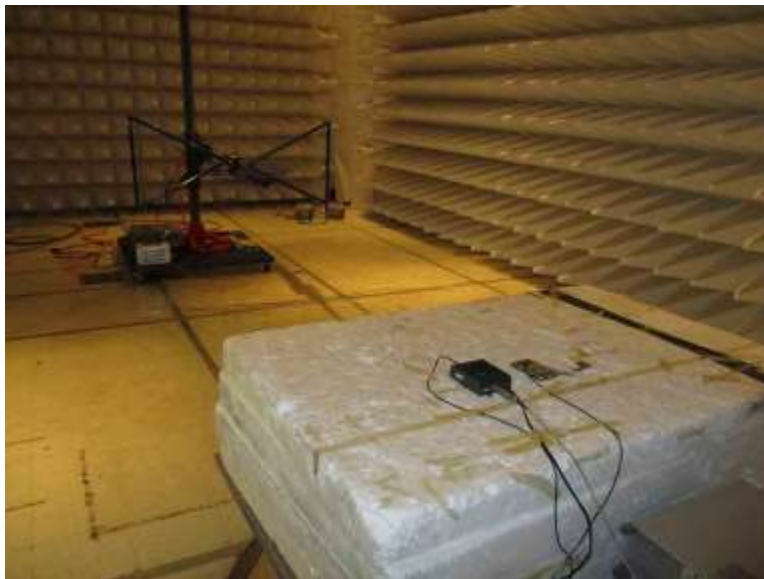
Section 7.11.2 Test Setup



Section 7.11.3 Test Setup



Section 7.12, Below 1GHz Test Setup



Section 7.12, Below 1GHz Test Setup



Section 7.12, Above 1GHz Cone placement Test Setup



Section 7.12, Above 1GHz Cone placement Test Setup

## SUPPLEMENTAL INFORMATION

### Measurement Uncertainty

| Uncertainty Value | Parameter                 |
|-------------------|---------------------------|
| 4.73 dB           | Radiated Emissions        |
| 3.34 dB           | Mains Conducted Emissions |
| 3.30 dB           | Disturbance Power         |

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ . Compliance is deemed to occur provided measurements are below the specified limits.

### Emissions Test Details

#### TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

#### CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in  $\text{dB}\mu\text{V}/\text{m}$ , the spectrum analyzer reading in  $\text{dB}\mu\text{V}$  was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

| SAMPLE CALCULATIONS |                     |                                     |
|---------------------|---------------------|-------------------------------------|
|                     | Meter reading       | ( $\text{dB}\mu\text{V}$ )          |
| +                   | Antenna Factor      | ( $\text{dB}/\text{m}$ )            |
| +                   | Cable Loss          | ( $\text{dB}$ )                     |
| -                   | Distance Correction | ( $\text{dB}$ )                     |
| -                   | Preamplifier Gain   | ( $\text{dB}$ )                     |
| =                   | Corrected Reading   | ( $\text{dB}\mu\text{V}/\text{m}$ ) |

## TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

| MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE |                     |                  |                   |
|------------------------------------------------------------|---------------------|------------------|-------------------|
| TEST                                                       | BEGINNING FREQUENCY | ENDING FREQUENCY | BANDWIDTH SETTING |
| CONDUCTED EMISSIONS                                        | 150 kHz             | 30 MHz           | 9 kHz             |
| RADIATED EMISSIONS                                         | 9 kHz               | 150 kHz          | 200 Hz            |
| RADIATED EMISSIONS                                         | 150 kHz             | 30 MHz           | 9 kHz             |
| RADIATED EMISSIONS                                         | 30 MHz              | 1000 MHz         | 120 kHz           |
| RADIATED EMISSIONS                                         | 1000 MHz            | >1 GHz           | 1 MHz             |

## SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

### Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

### Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

### Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.