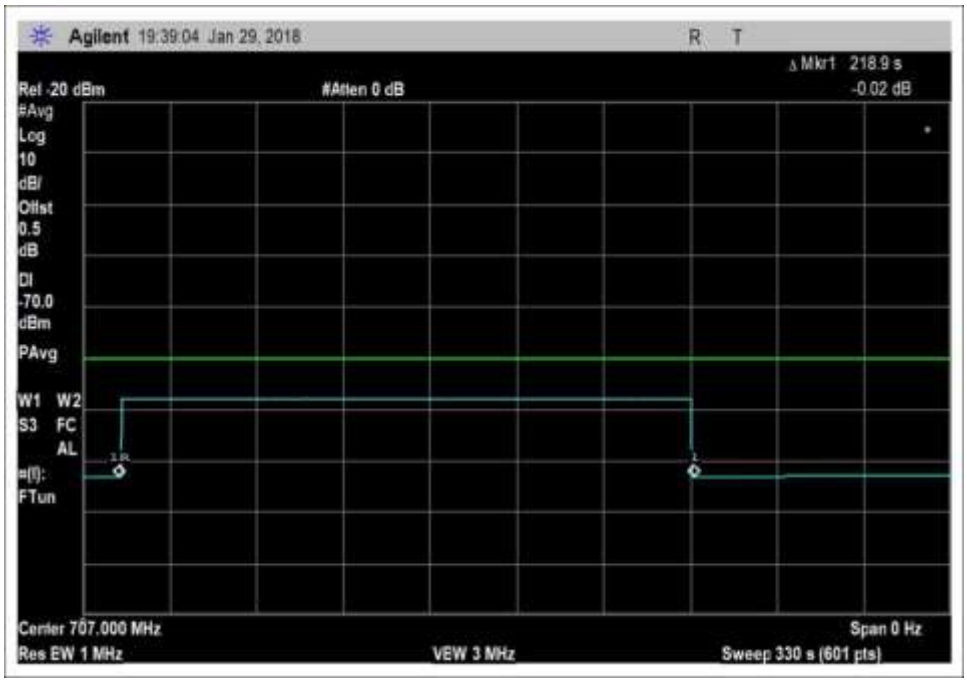
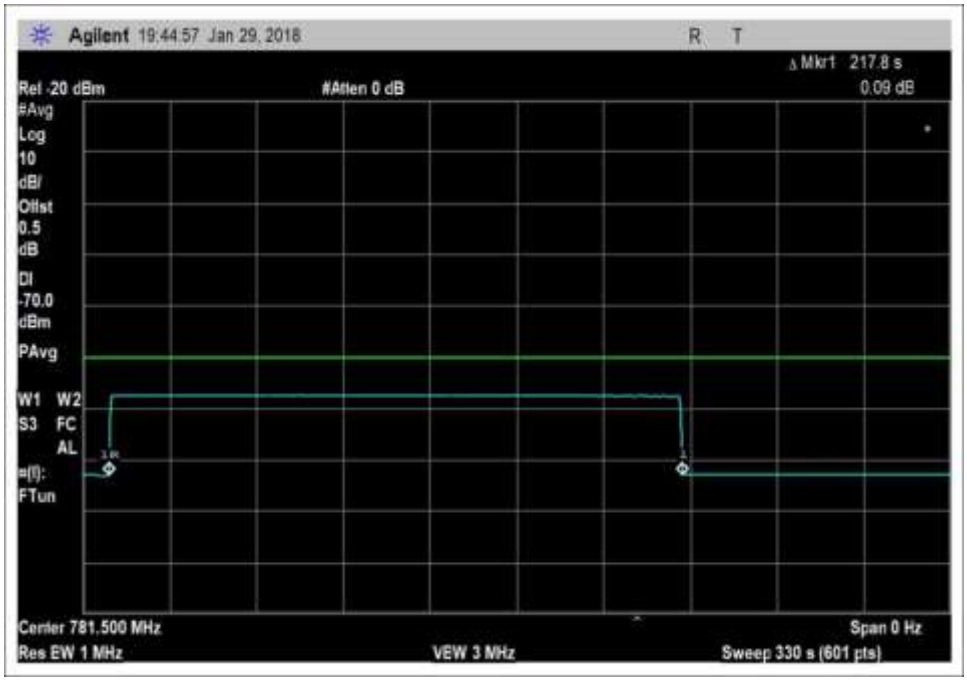
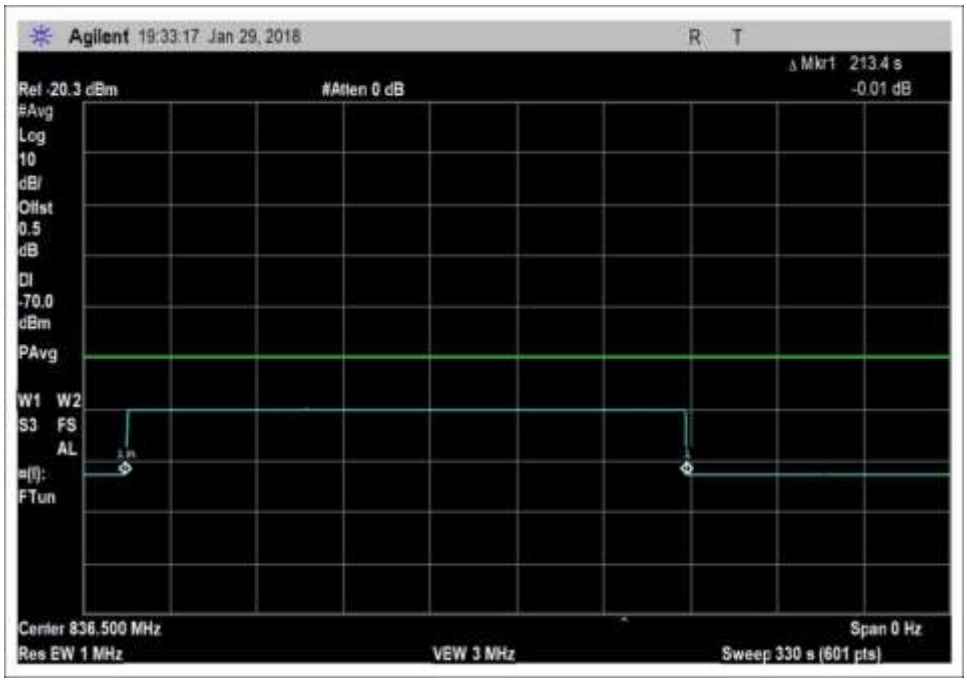
## Plots



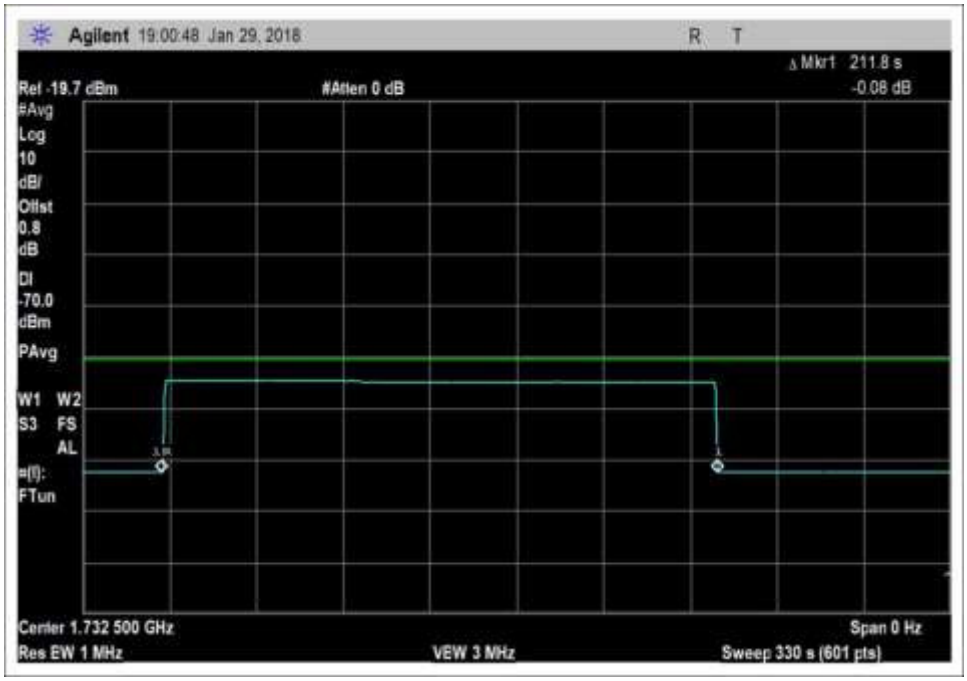

UL 698-716MHz



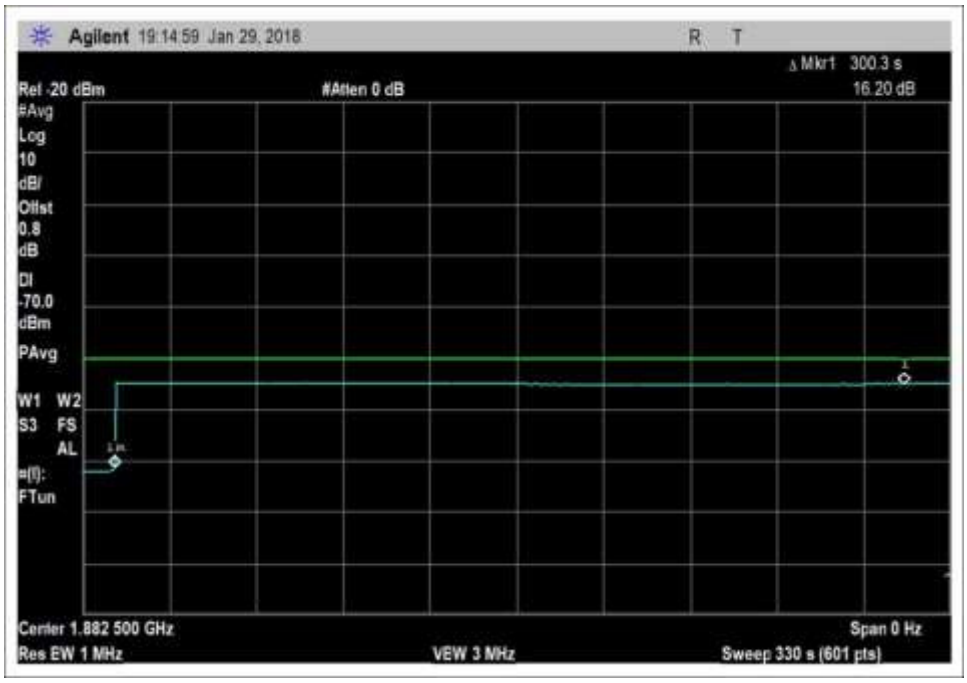

UL_776-787MHz




UL_824-849MHz




UL_1710-1755MHz




UL_1850-1915MHz

# 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 #: | **100826** | Date: | 1/30/2018 |
| Test Type: | **Conducted Emissions** | Time: | 2:26:00 PM |
| Tested By: | E. Wong | Sequence#: | 1 |
| Software: | EMITest 5.03.11 | | 12VDC |

***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: 21°C
Relative Humidity: 41%
Pressure: 100kPa

Manufacturer provided MSCL calculation based on

**Antenna Kitting Information**

| Component | Prod No. Description | Gain/Loss | | | | | Notes |
|---|---|---|---|---|---|---|---|
| | | LTE-A | LTE-V | 800MHz | 1900MHz | 1700MHz\2100MHz | |
| Outdoor Antenna | WPANT10104-S3A（SC325W-WP） | 0.5dBi | 0.5dBi | 2dBi | 2dBi | 3dBi\3dBi | Integrated antenna |
| Indoor Antenna | SC128W | -0.1dBi | -0.1dBi | -0.3dBi | 3dBi | 2.5dBi\3.2dBi | |
| Indoor Cable | SC174-15FT（15Feet） | 3.4dB | 3.4dB | 3.7dB | 6dB | 5.5dB \6.2dB | |

* All equivalent antennas and cables are suitable for use with the EZ CAR (23dB).
As above information. Remark: Lower gain antenna can also be used.

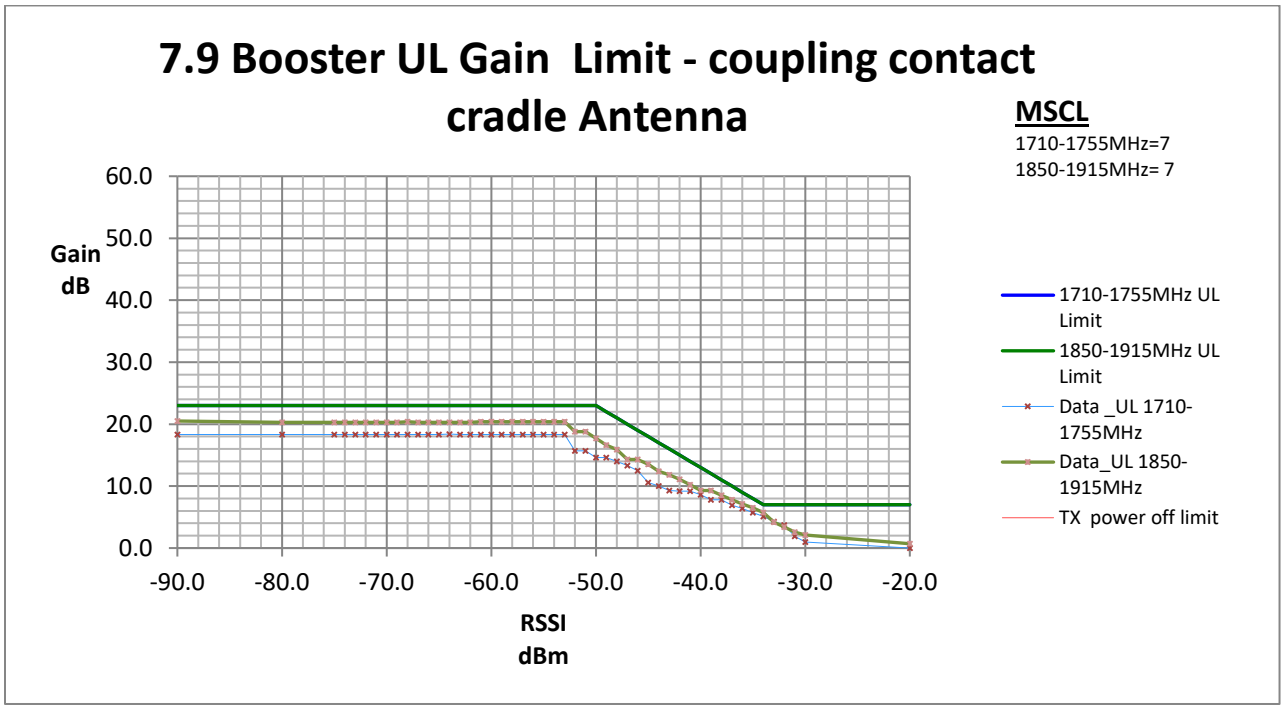
***Test Equipment:***

| Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|
| P05411 | Attenuator | 54A-10 | 1/19/2018 | 1/19/2020 |
| 03470 | Spectrum Analyzer | E4440A | 1/3/2018 | 1/3/2020 |
| P07191 | Cable | 32022-29094K-29094K-48TC | 10/30/2017 | 10/30/2019 |
| P07192 | Cable | 32022-29094K-29094K-48TC | 10/9/2017 | 10/9/2019 |
| C00082 | Directional Coupler | 722-10-1.500V | 9/18/2017 | 9/18/2019 |
| C00032 | Arbitrary Waveform Generator | E4433B | 2/26/2016 | 2/26/2018 |
| 03418 | Signal Generator | E4438C | 6/19/2017 | 6/19/2019 |

## Summary of Results

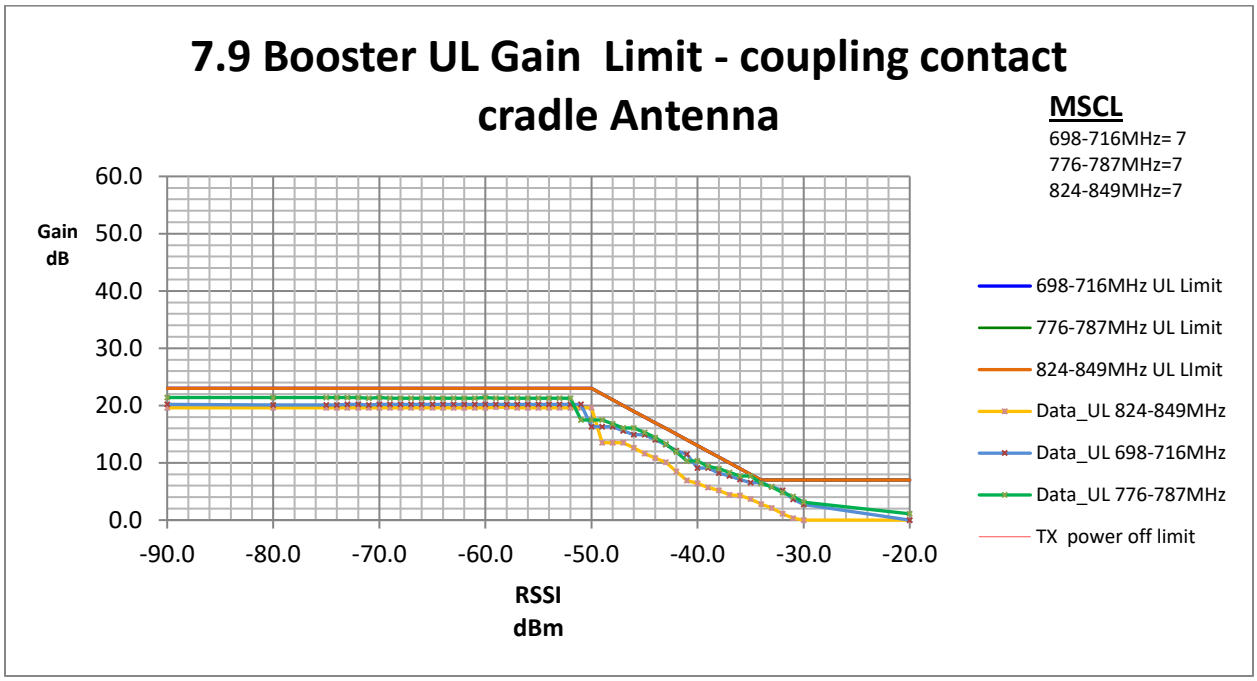
Pass: As demonstrated, computed gains are within the gain limit. All maximum variable uplink gain timings are within 1 second limit.

### 7.9.1 Maximum gain



| 1710.0 - 1755.0 MHz | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Limit | | | Margin |
| RSSI | Input | Measured | Measured | RSSI Dependent | Mobile Booster | TX off | |
| (dBm) | (dBm) | Output (dBm) | Gain (dBm) | | | | |
| -64.0 | -4.2 | 14.2 | 18.4 | - | 23.0 | - | -4.6 |
| -35.0 | -4.2 | 1.5 | 5.7 | 8.0 | - | - | -2.3 |
| -36.0 | -4.2 | 2.2 | 6.4 | 9.0 | - | - | -2.6 |
| -37.0 | -4.2 | 2.7 | 6.9 | 10.0 | - | - | -3.1 |
| -34.0 | -4.2 | 0.9 | 5.1 | 11.0 | - | - | -3.2 |
| -34.0 | -4.2 | 0.9 | 5.1 | - | - | 7 | -1.9 |

| 1850.0 --1915.0MHz | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Limit | | | Margin |
| RSSI | Input | Measured | Measured | RSSI Dependent | Mobile Booster | TX off | |
| (dBm) | (dBm) | Output (dBm) | Gain (dBm) | | | | |
| -90.0 | -2.8 | 17.7 | 20.5 | - | 23 | - | -2.5 |
| -35.0 | -2.8 | 3.7 | 6.5 | 8.0 | - | - | -1.5 |
| -36.0 | -2.8 | 4.3 | 7.1 | 9.0 | - | - | -1.9 |
| -37.0 | -2.8 | 5.0 | 7.8 | 10.0 | - | - | -2.2 |
| -38.0 | -2.8 | 5.7 | 8.5 | 11.0 | - | - | -2.5 |
| -34.0 | -2.8 | 2.9 | 5.7 | - | - | 7 | -1.3 |




| 824.0 - 849.0 MHz | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Limit | | | Margin |
| RSSI | Input | Measured | Measured | RSSI Dependent | Mobile Booster | TX off | |
| (dBm) | (dBm) | Output (dBm) | Gain (dBm) | | | | |
| -59.0 | -3.6 | 16.1 | 19.7 | - | 23 | - | -3.3 |
| -35.0 | -3.6 | 0.1 | 3.7 | 8.0 | - | - | -4.3 |
| -36.0 | -3.6 | 0.7 | 4.3 | 9.0 | - | - | -4.7 |
| -37.0 | -3.6 | 0.8 | 4.4 | 10.0 | - | - | -5.6 |
| -38.0 | -3.6 | 1.6 | 5.2 | 11.0 | - | - | -5.8 |
| -34.0 | -3.6 | -0.8 | 2.8 | - | - | 7 | -4.2 |

| 698.0-716.0MHz | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Limit | | | Margin |
| RSSI | Input | Measured | Measured | RSSI Dependent | Mobile Booster | TX off | |
| (dBm) | (dBm) | Output (dBm) | Gain (dBm) | | | | |
| -90.0 | -4.7 | 15.5 | 20.2 | - | 23 | - | -2.8 |
| -35.0 | -4.7 | 1.8 | 6.5 | 8.0 | - | - | -1.5 |
| -36.0 | -4.7 | 2.4 | 7.1 | 9.0 | - | - | -1.9 |
| -37.0 | -4.7 | 3.0 | 7.7 | 10.0 | - | - | -2.3 |
| -41.0 | -4.7 | 6.8 | 11.5 | 14.0 | - | - | -2.5 |
| -34.0 | -4.7 | 1.9 | 6.6 | - | - | 7 | -0.4 |

| 776.0 -787.0MHz | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Limit | | | Margin |
| RSSI | Input | Measured | Measured | RSSI Dependent | Mobile Booster | TX off | |
| (dBm) | (dBm) | Output (dBm) | Gain (dBm) | | | | |
| -90.0 | -6.2 | 15.2 | 21.4 | - | 23 | - | -1.6 |
| -35.0 | -6.2 | 1.5 | 7.7 | 8.0 | - | - | -0.3 |
| -36.0 | -6.2 | 1.5 | 7.7 | 9.0 | - | - | -1.3 |
| -37.0 | -6.2 | 2.1 | 8.3 | 10.0 | - | - | -1.7 |
| -38.0 | -6.2 | 2.8 | 9.0 | 11.0 | - | - | -2.0 |
| -34.0 | -6.2 | 0.2 | 6.4 | -34.0 | - | 7 | -0.6 |

**7.9.2 Variable uplink gain timing**

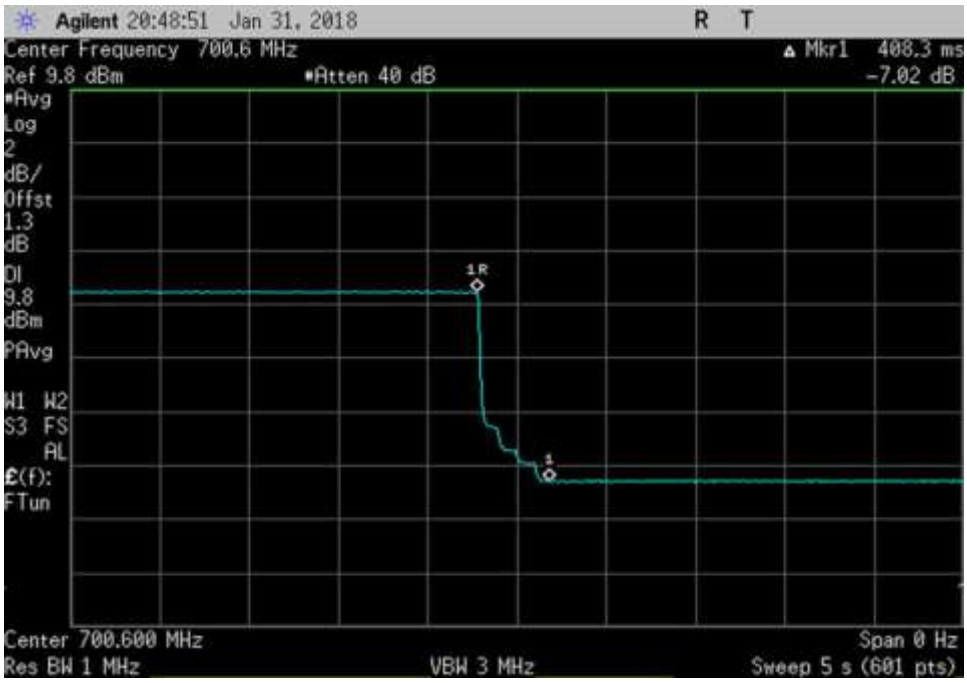
| Uplink Gain Timing | | |
|---|---|---|
| Frequency | Measured | Limit |
| (MHz) | (Sec) | (Sec) |
| UL 1710-1755 | 0.30 | 1 |
| UL 1850-1915 | 0.18 | 1 |
| UL 824-849 | 0.40 | 1 |
| UL 698-716 | 0.41 | 1 |
| UL 776-787 | 0.39 | 1 |

## 7.9.1 Maximum Gain

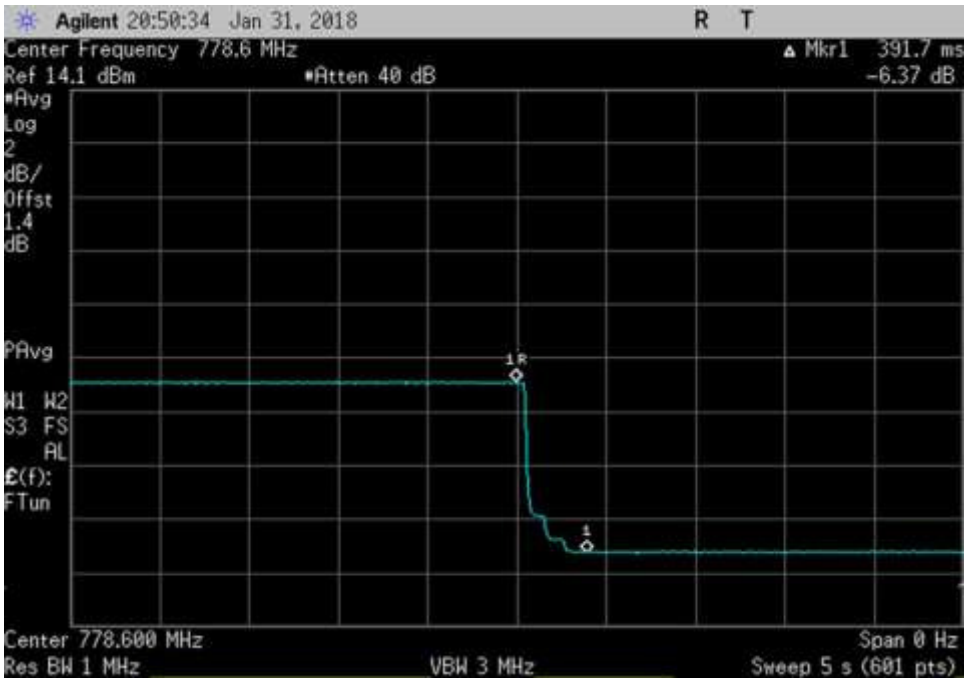
For this subsection, see summary of results of 7.9
7.9.1 Maximum gain

## 7.9.2 Variable uplink Gain Timing

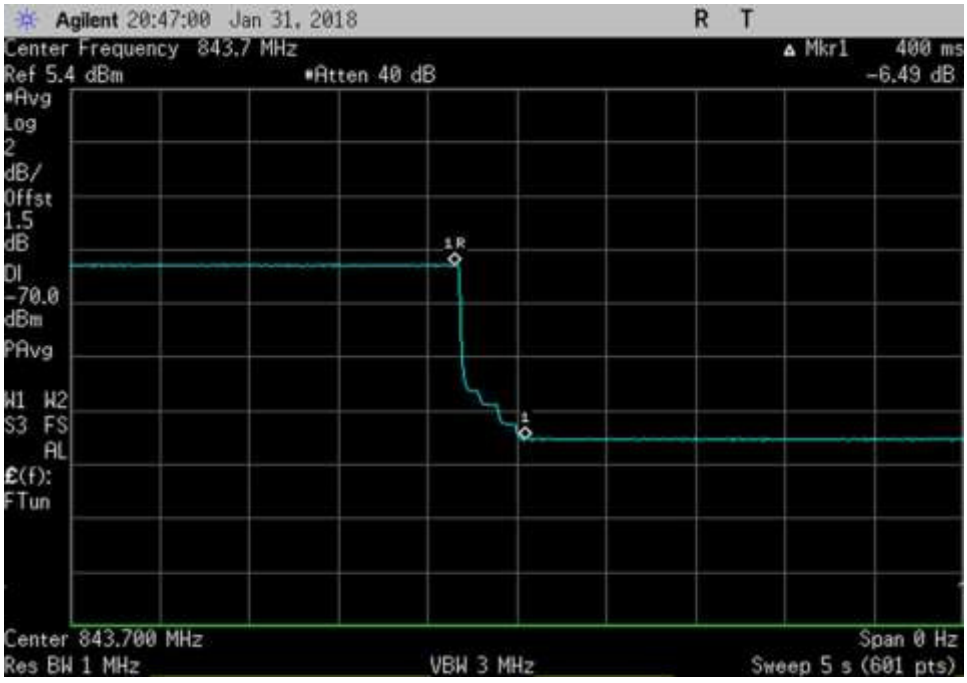
## Plots



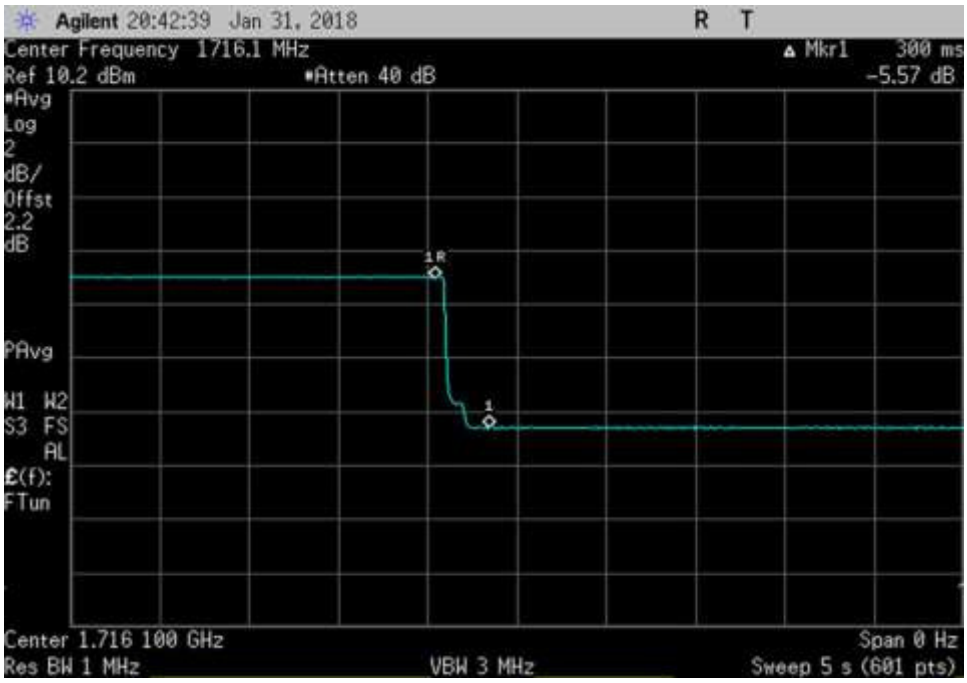

UL_698-716_ 700.6MHz_timing



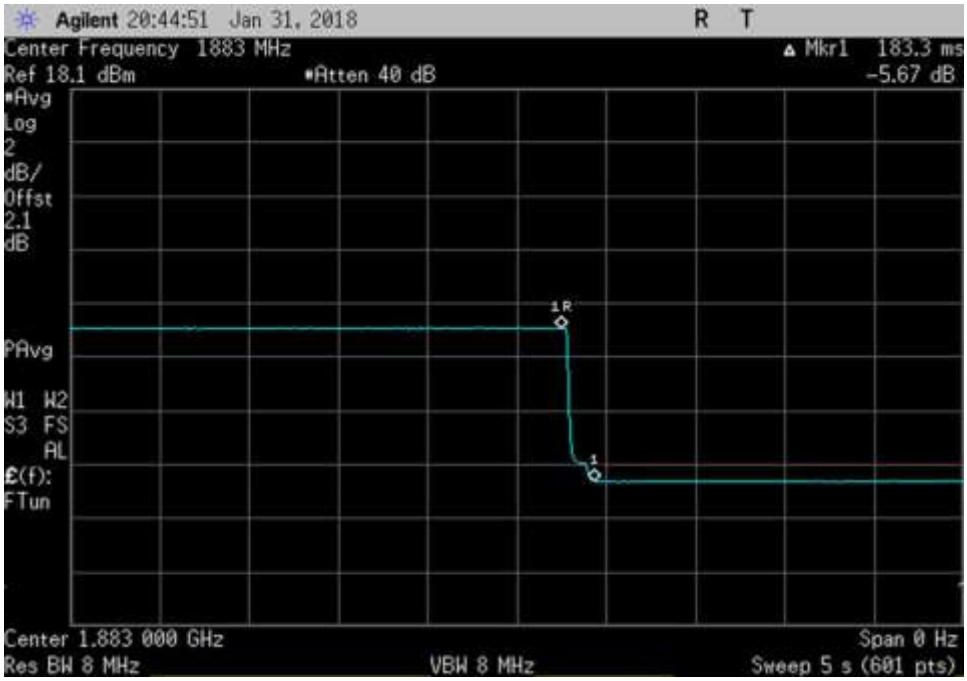

UL_776-787_ 778.6MHz_timing




UL_824-849_ 843.7MHz_timing




UL_1710-1755_ 1716.1MHz_timing




UL_1850-1915_ 1883MHz_timing

# 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** | | |
| Work Order #: | **100826** | Date: | 1/30/2018 |
| Test Type: | **Conducted Emissions** | Time: | 2:26:00 PM |
| Tested By: | E. Wong | Sequence#: | 1 |
| Software: | EMITest 5.03.11 | | 12VDC |

***Equipment Tested:***

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

***Support Equipment:***

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

***Test Equipment:***

| Asset # | Description | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|
| 03470 | Spectrum Analyzer | E4440A | 1/3/2018 | 1/3/2020 |
| P07191 | Cable | 32022-29094K-29094K-48TC | 10/30/2017 | 10/30/2019 |
| P07191 | Cable | 32022-29094K-29094K-48TC | 10/30/2017 | 10/30/2019 |
| 03418 | Signal Generator | E4438C | 6/19/2017 | 6/19/2019 |

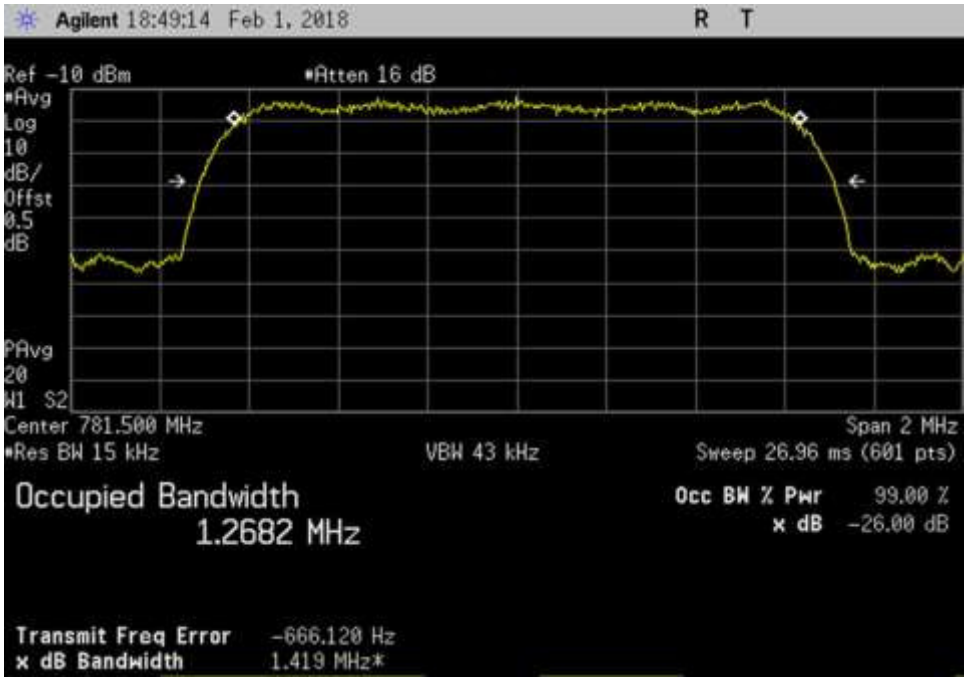
## Summary of Results

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

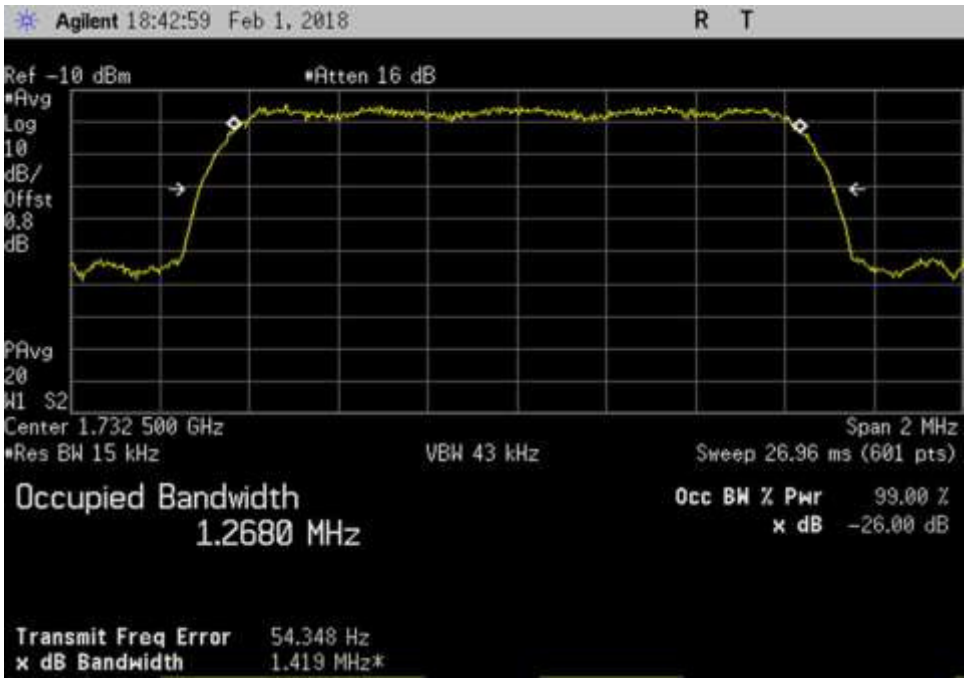
## Plots

**CDMA Input**

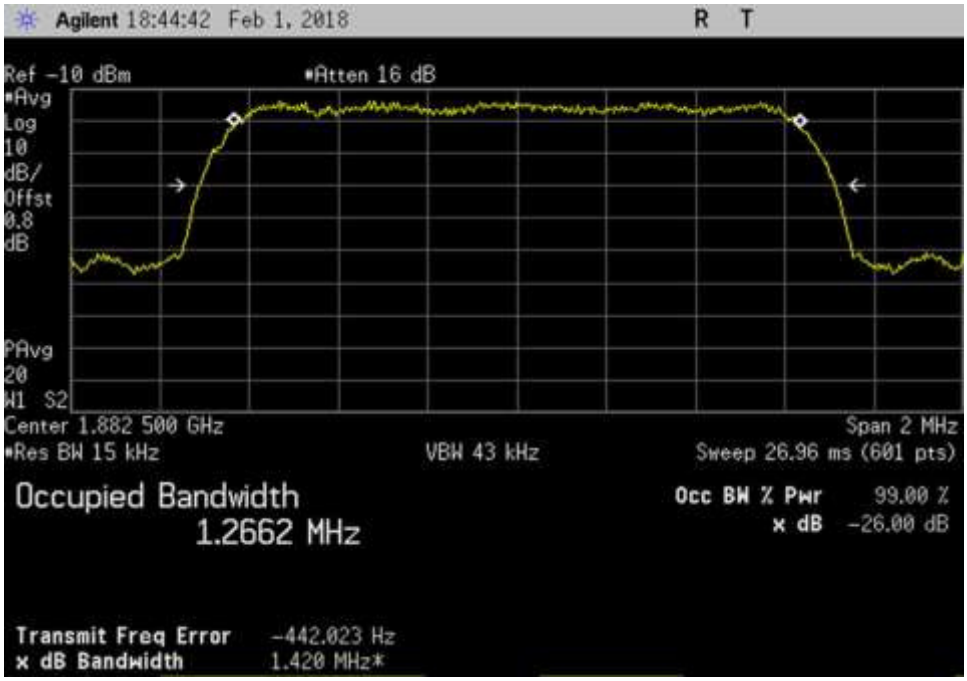

UL_698-716_CDMA_ 707MHz



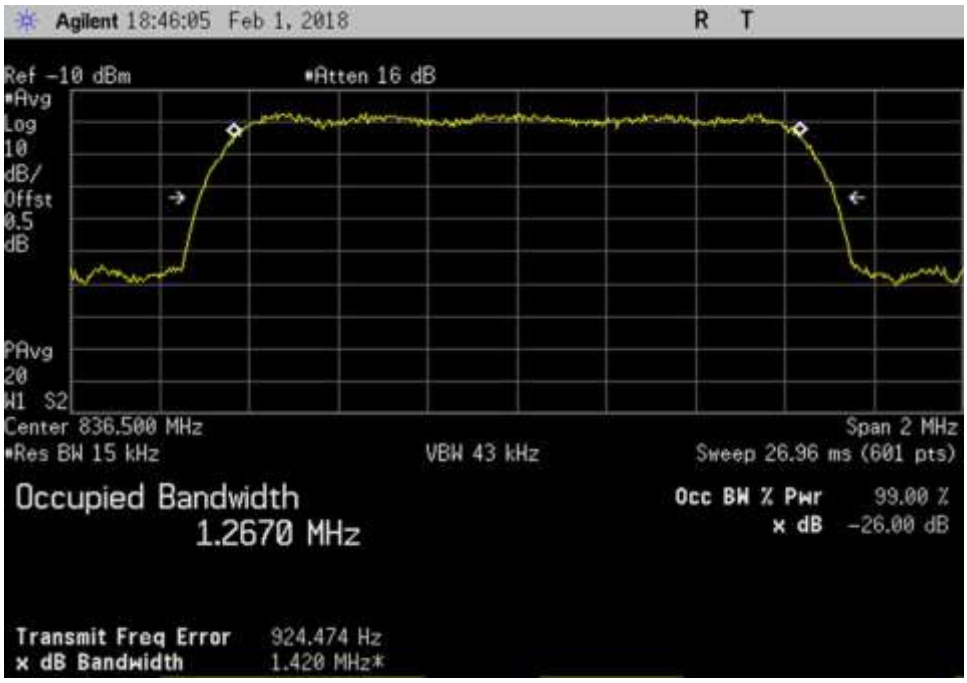

UL_776-787_CDMA_ 781.5MHz



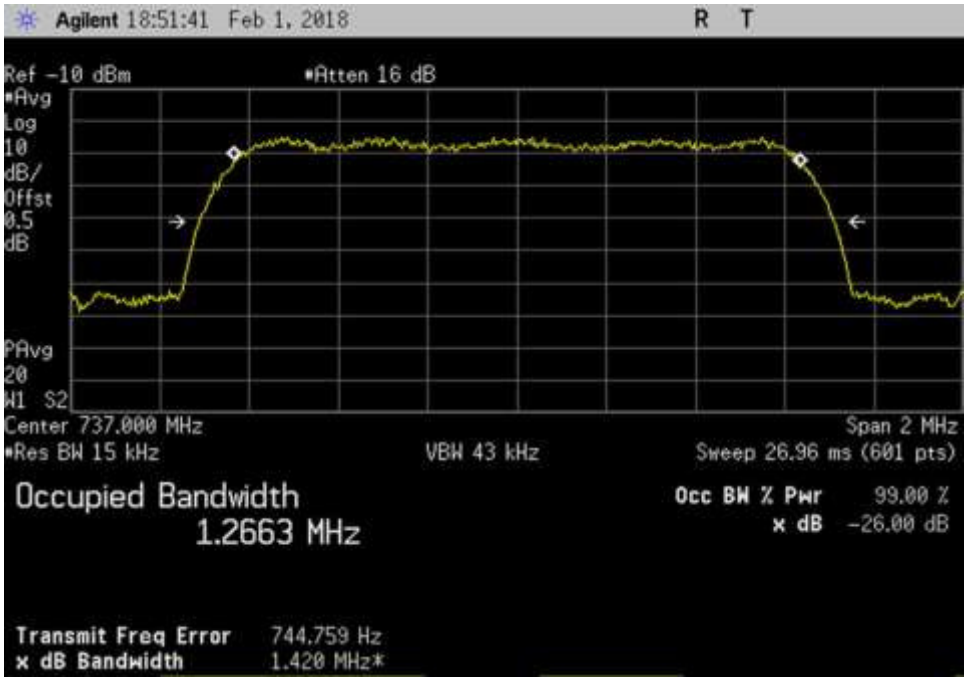

UL_1710-1755_CDMA_ 1732.5MHz



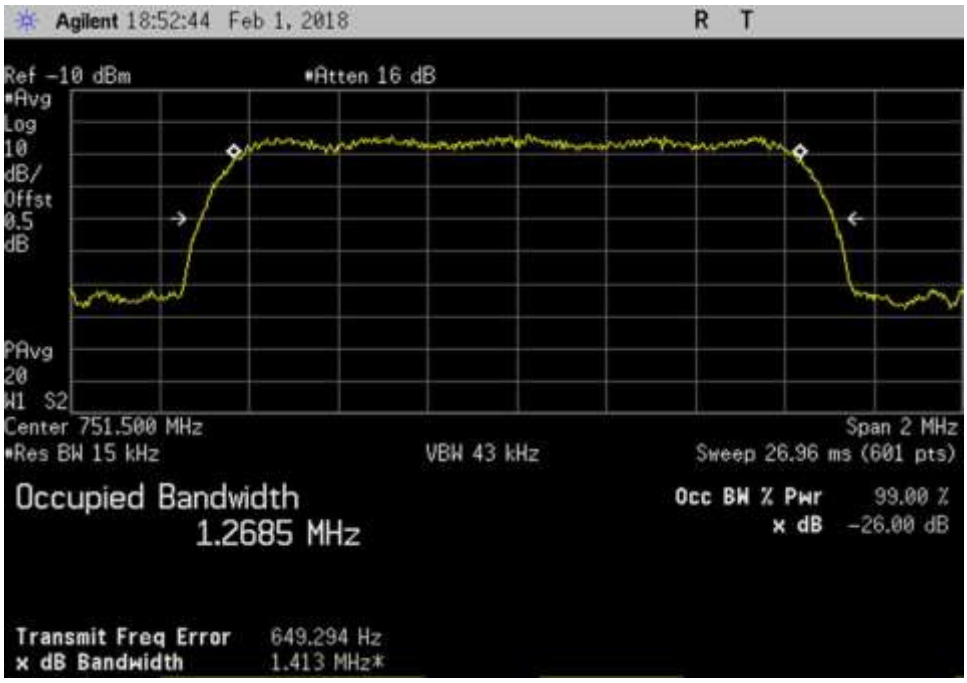

UL_1850-1915_CDMA_ 1882.5MHz



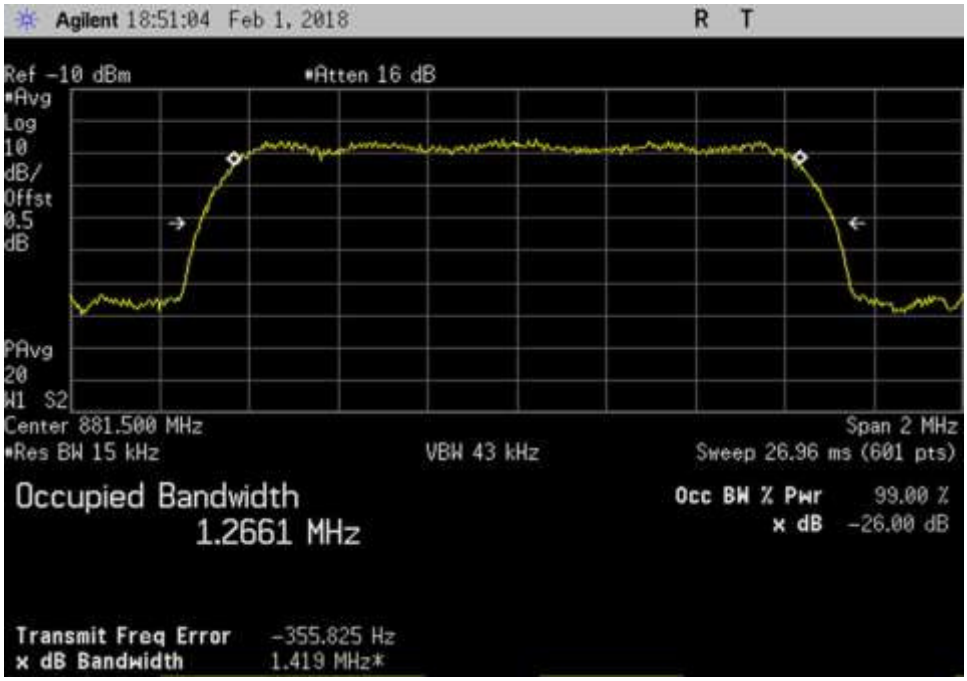

UL_824-849_CDMA_ 836.5MHz



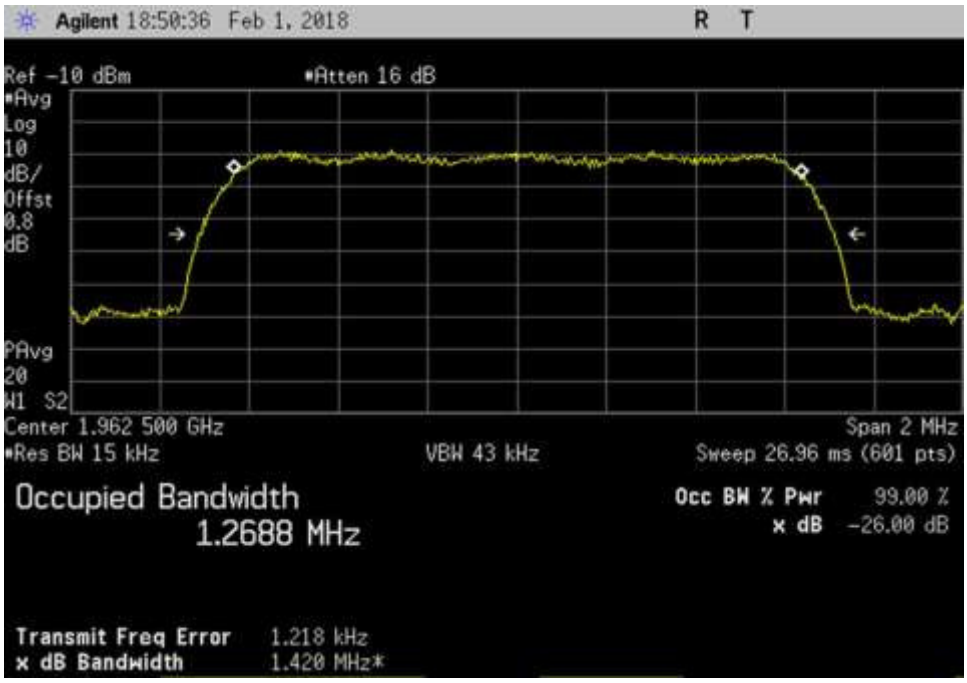

DL_728-746_CDMA_ 737MHz



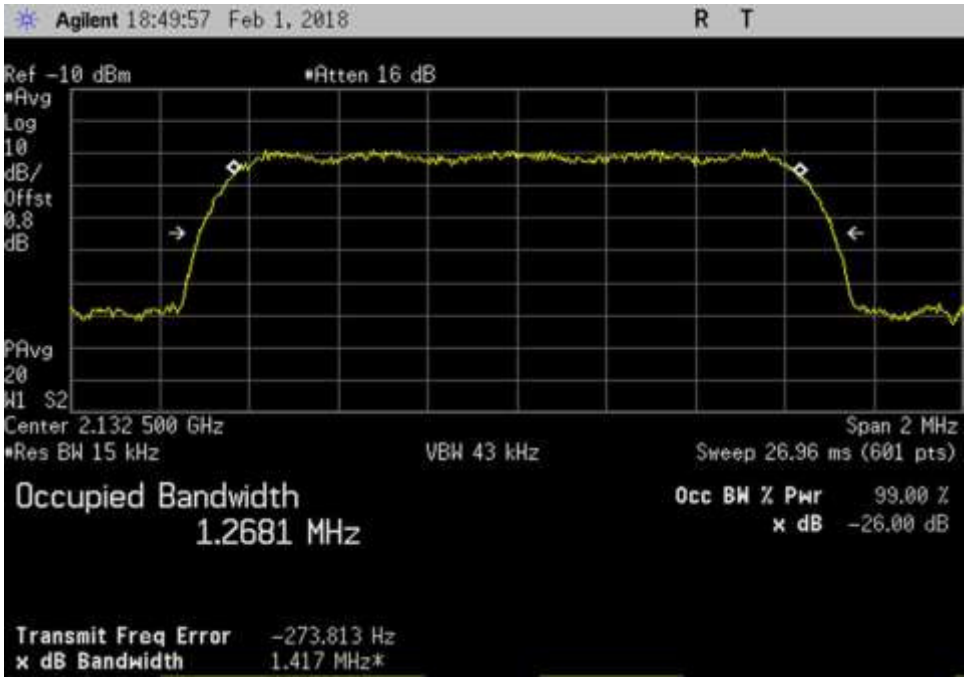

DL_746-757_CDMA_ 751.5MHz




DL_869-894_CDMA_ 881.5MHz

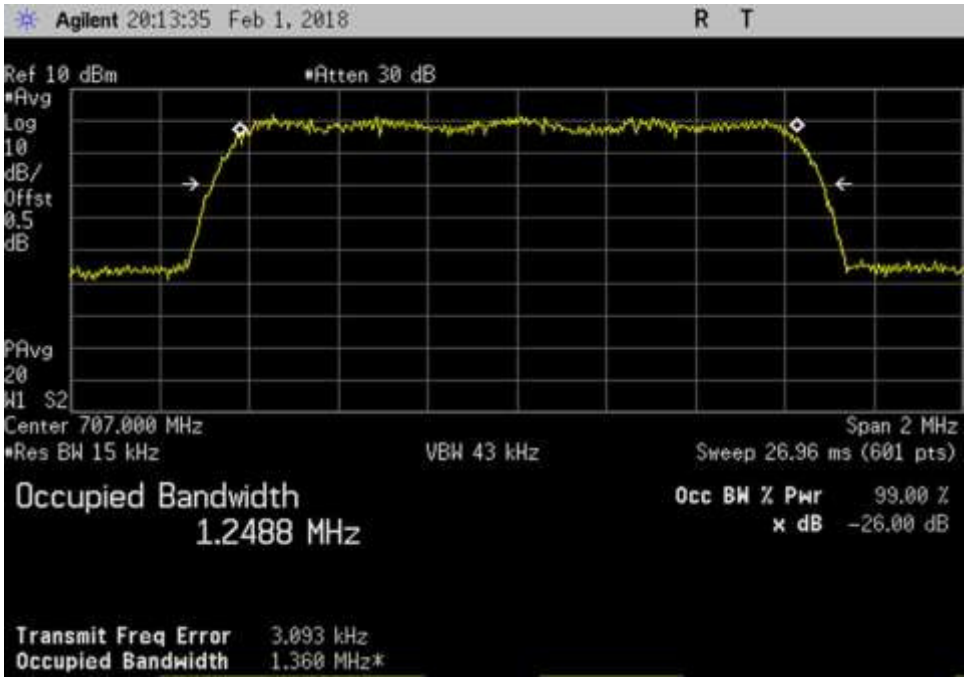



DL_1930-1995_CDMA_ 1962.5MHz

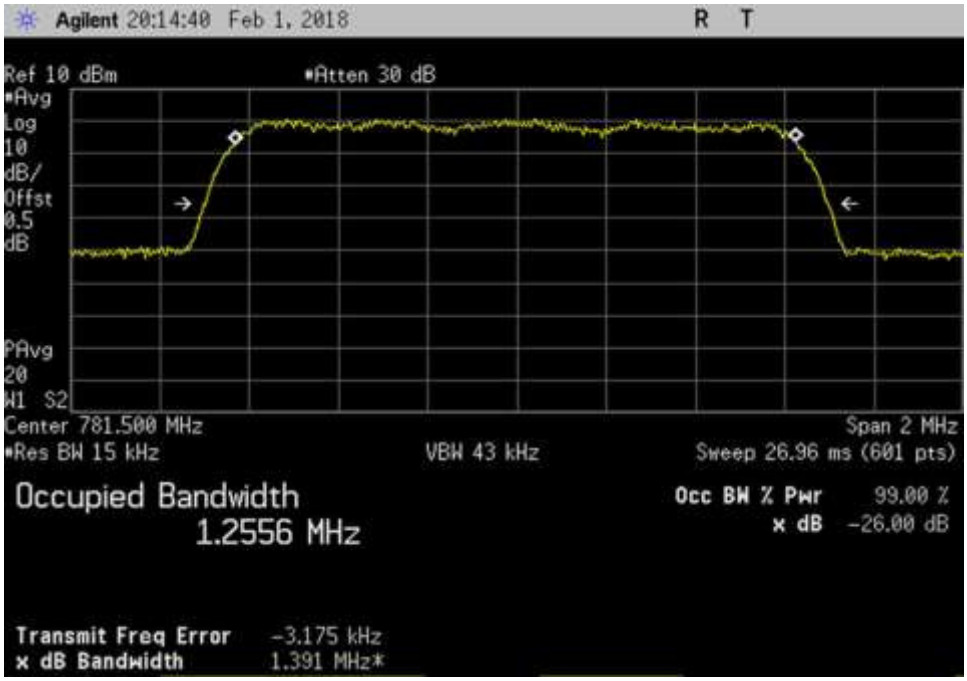



DL_2110-2155_CDMA_ 2132.5MHz

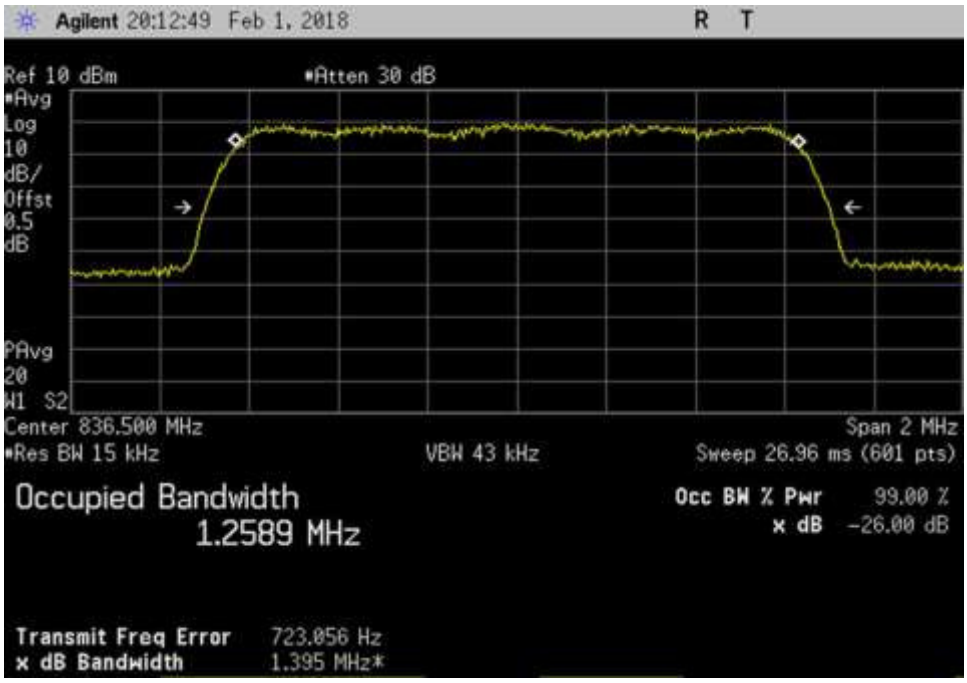
**CDMA Output**



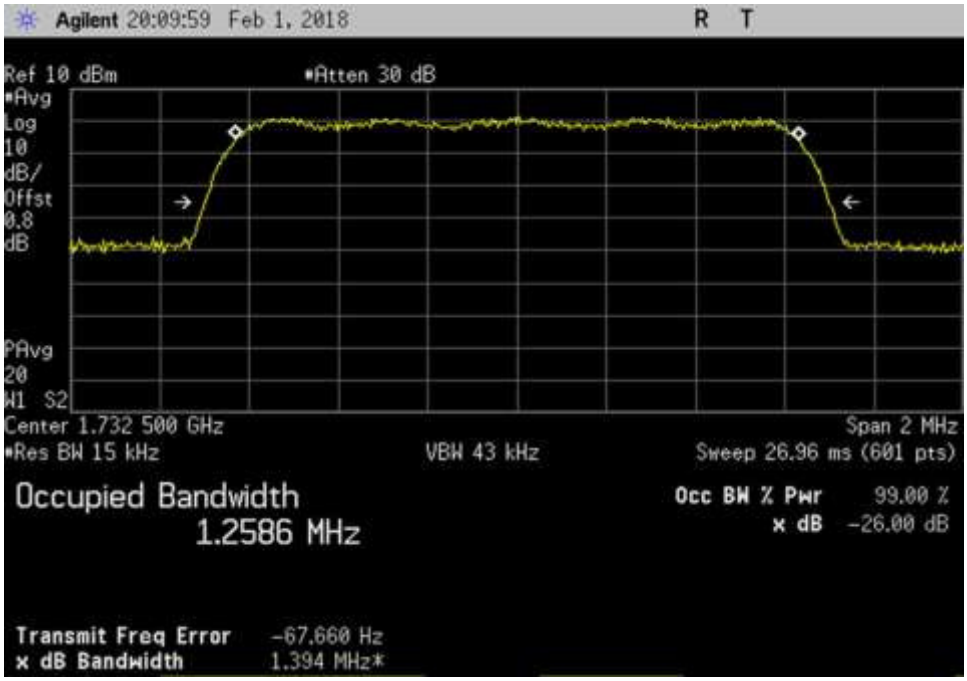

UL_698-716_CDMA_ 707MHz



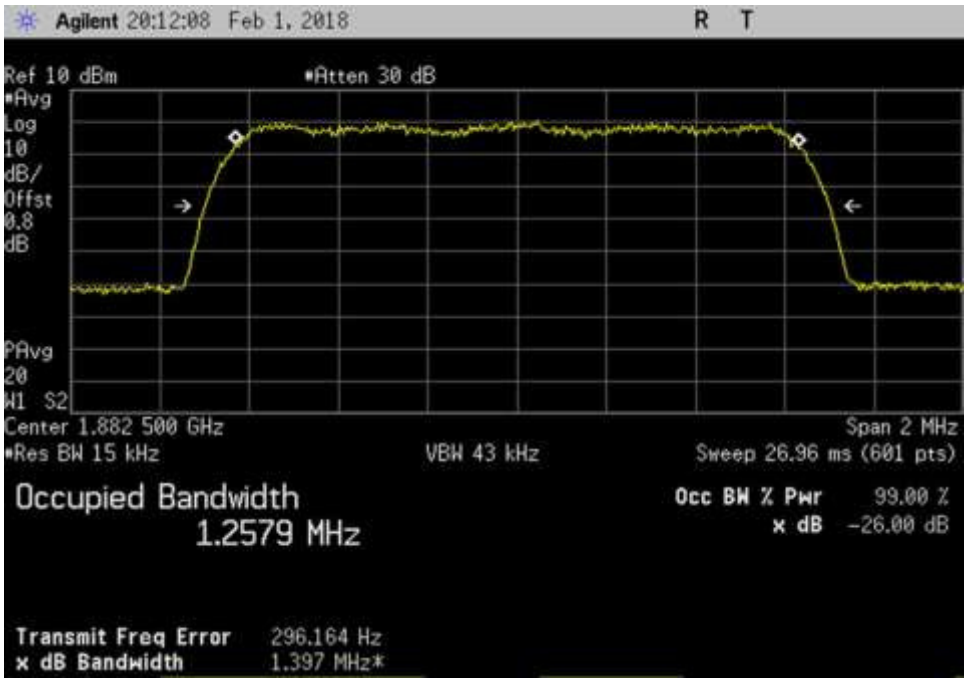

UL_776-787_CDMA_ 781.5MHz



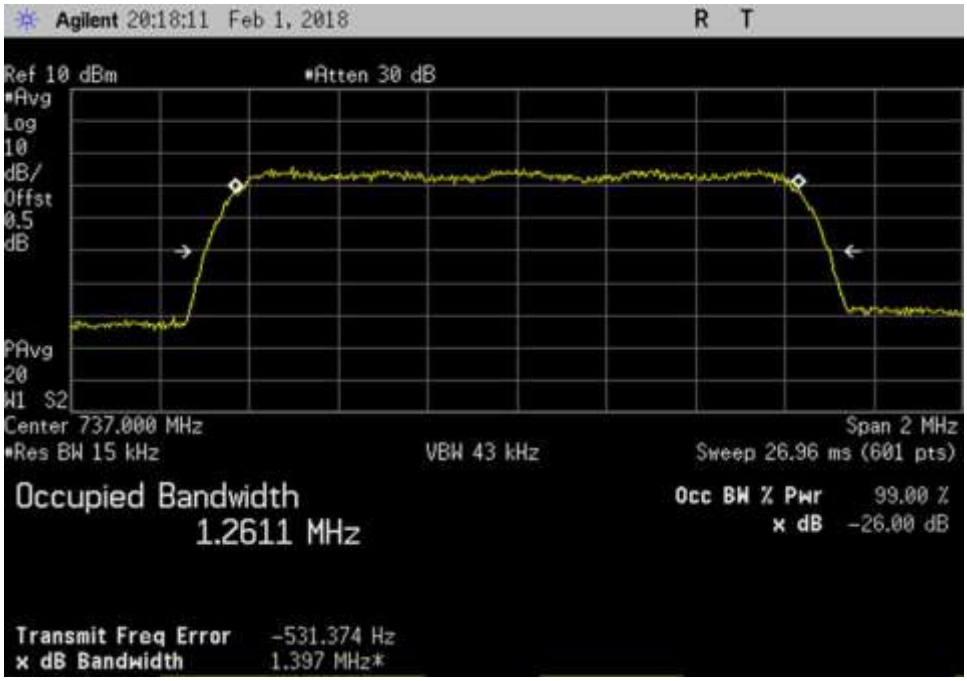

UL_824-849_CDMA_ 836.5MHz



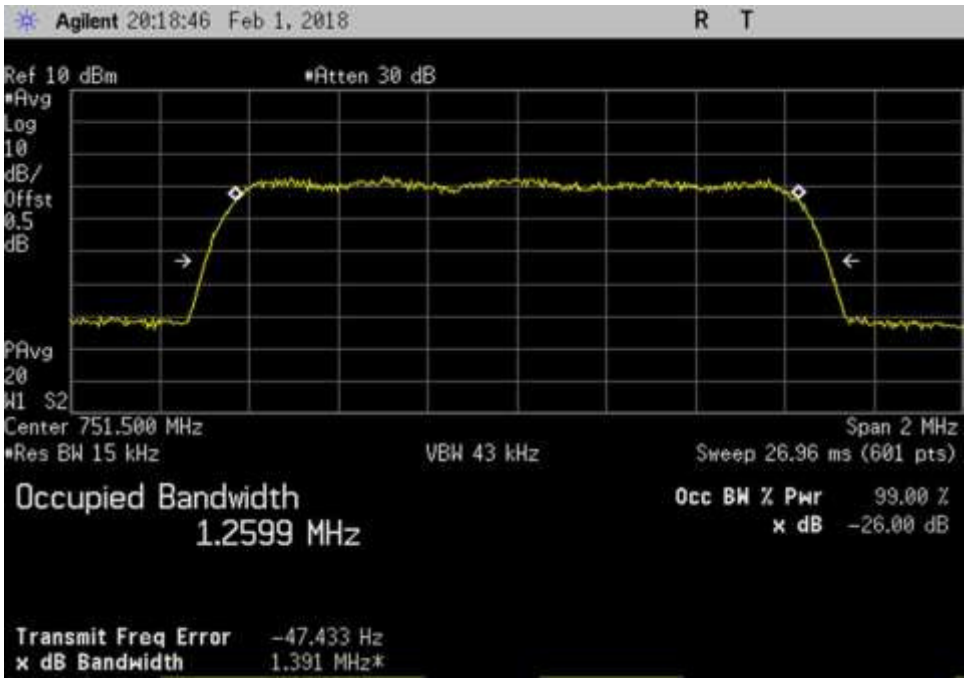

UL_1710-1755_CDMA_ 1732.5MHz



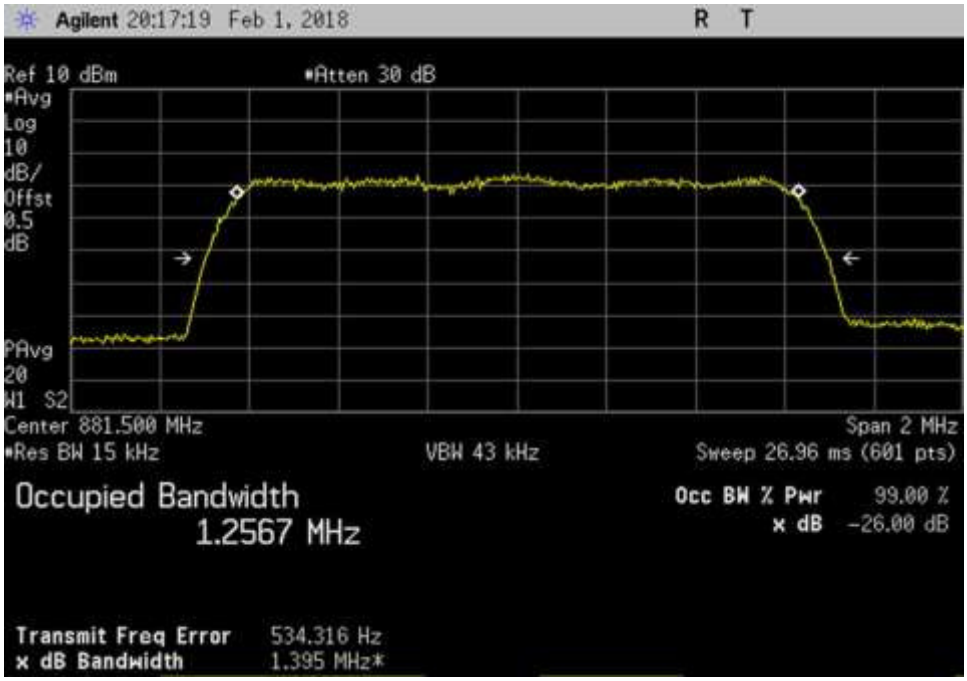

UL_1850-1915_CDMA_ 1882.5MHz



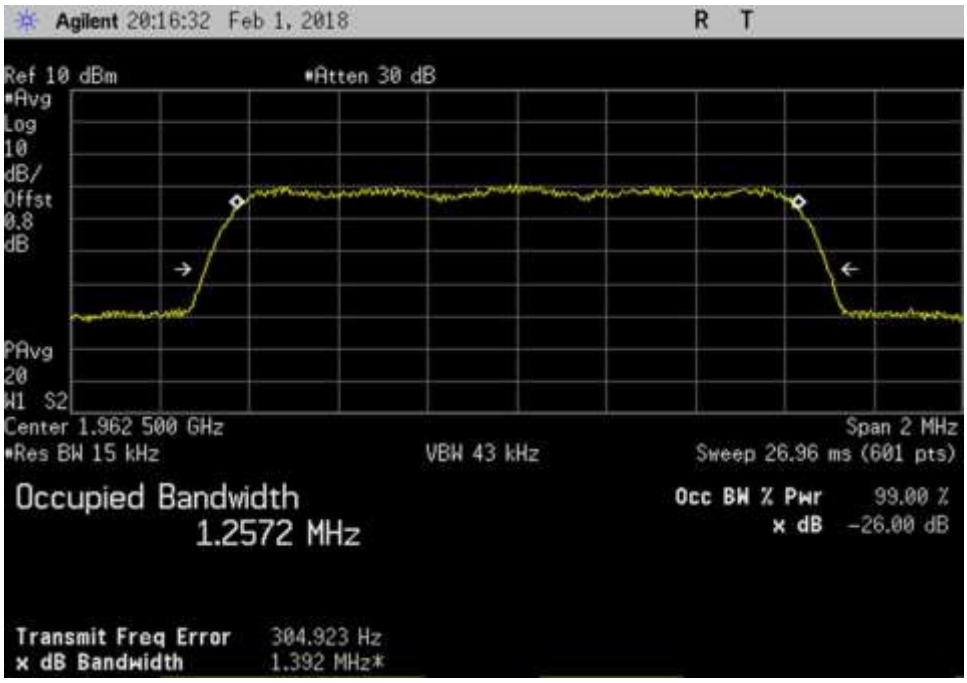

DL_728-746_CDMA_ 737MHz



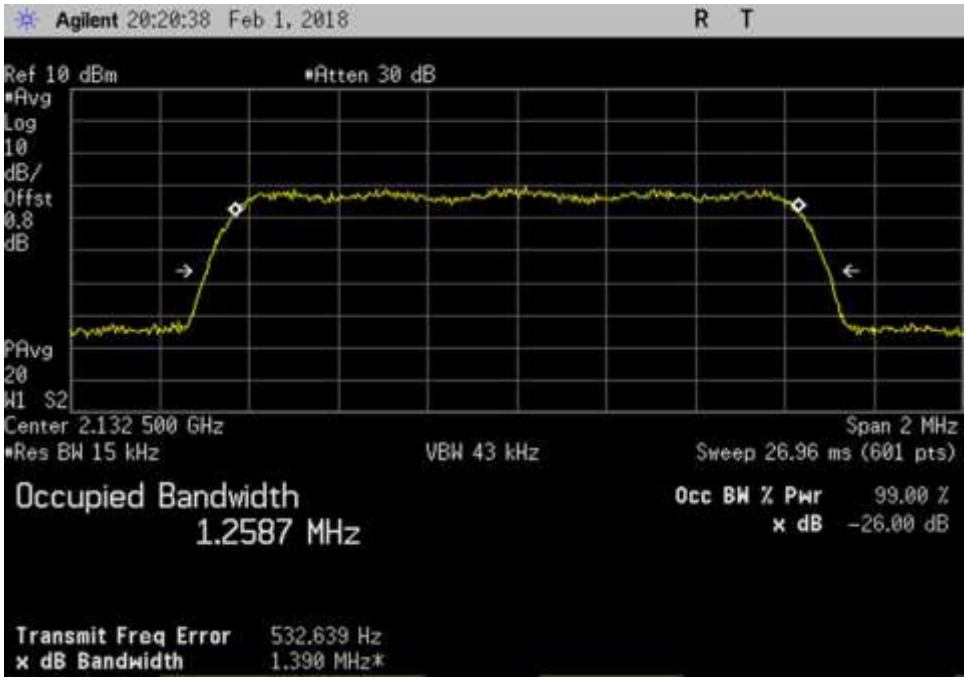

DL_746-757_CDMA_ 751.5MHz




DL_869-894_CDMA_ 881.5MHz

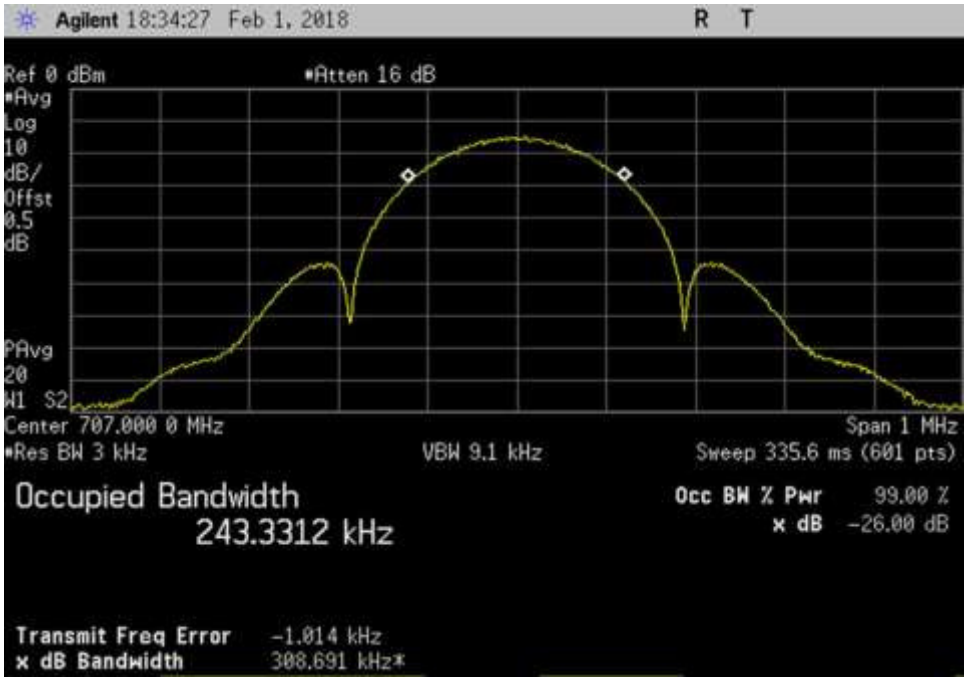



DL_1930-1995_CDMA_ 1962.5MHz

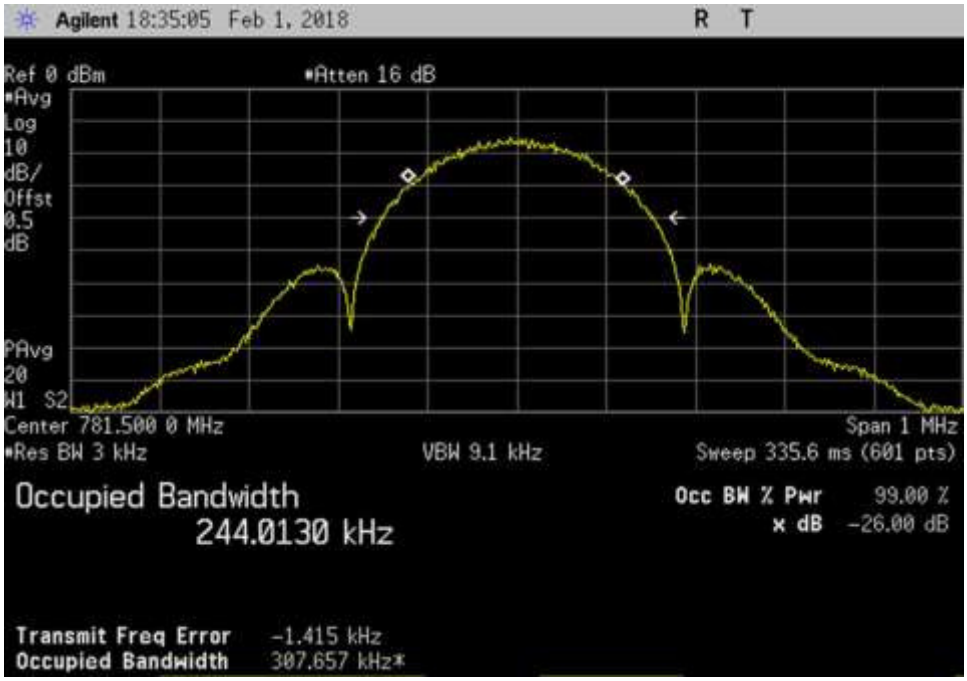



DL_2110-2155_CDMA_ 2132.5MHz

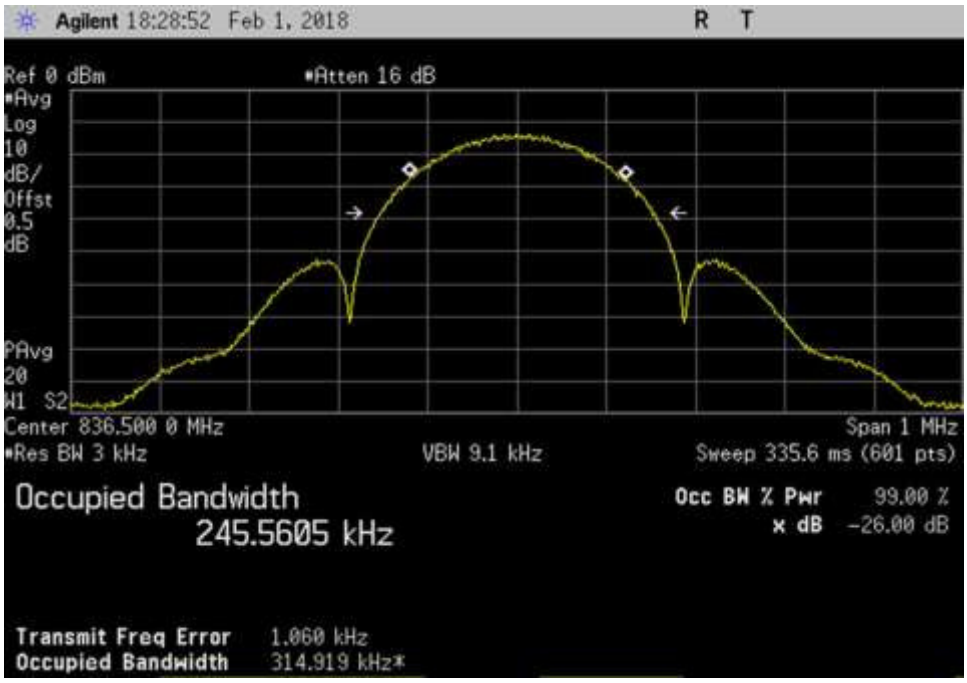
**EDGE Input**



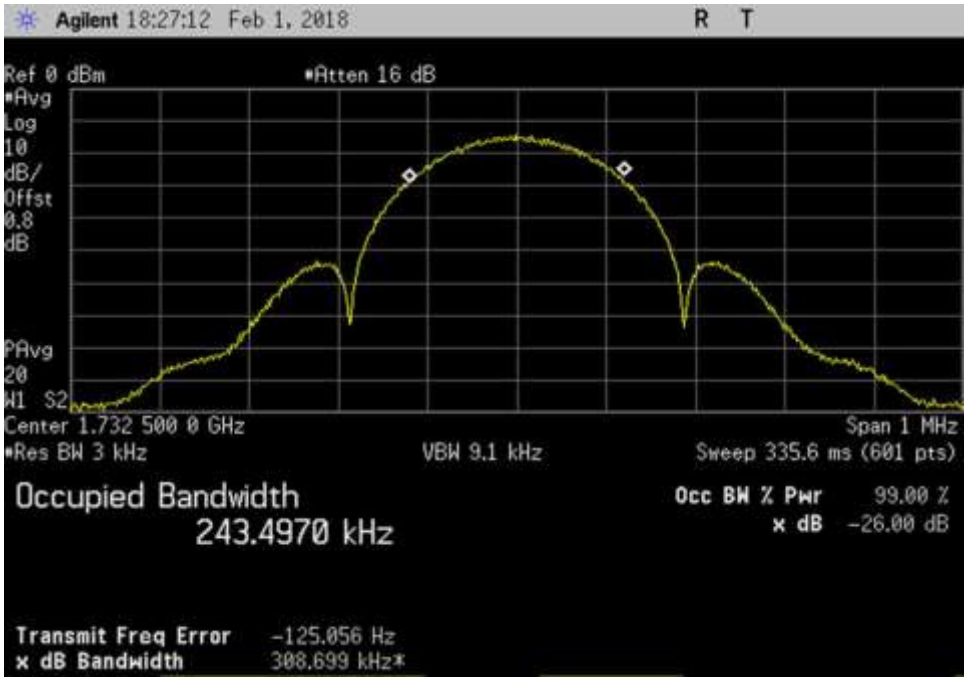

UL_698-716_EDGE_ 707MHz



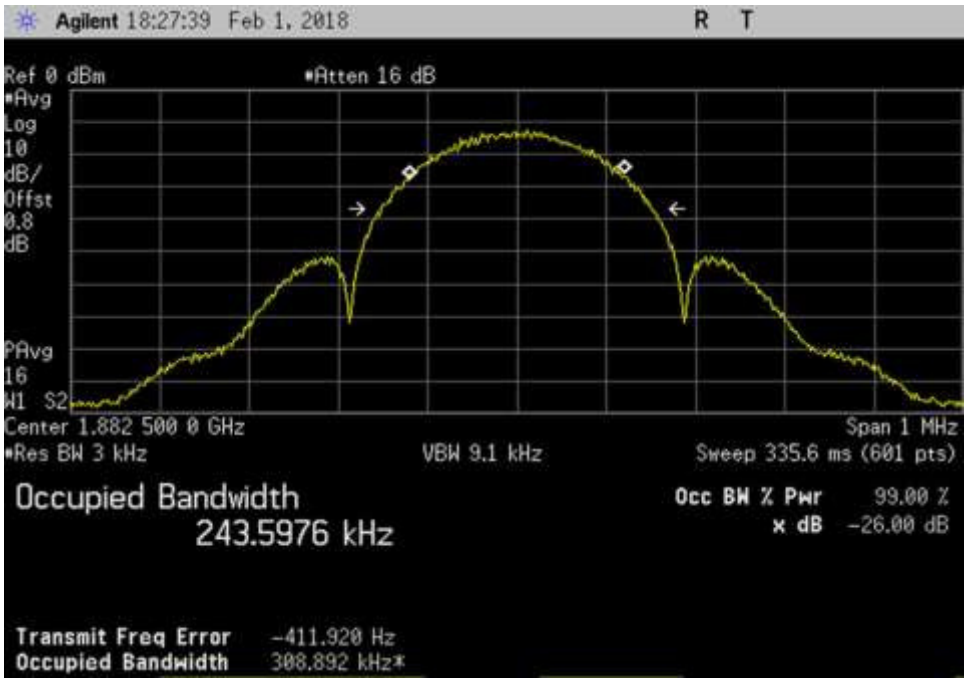

UL_776-787_EDGE_ 781.5MHz



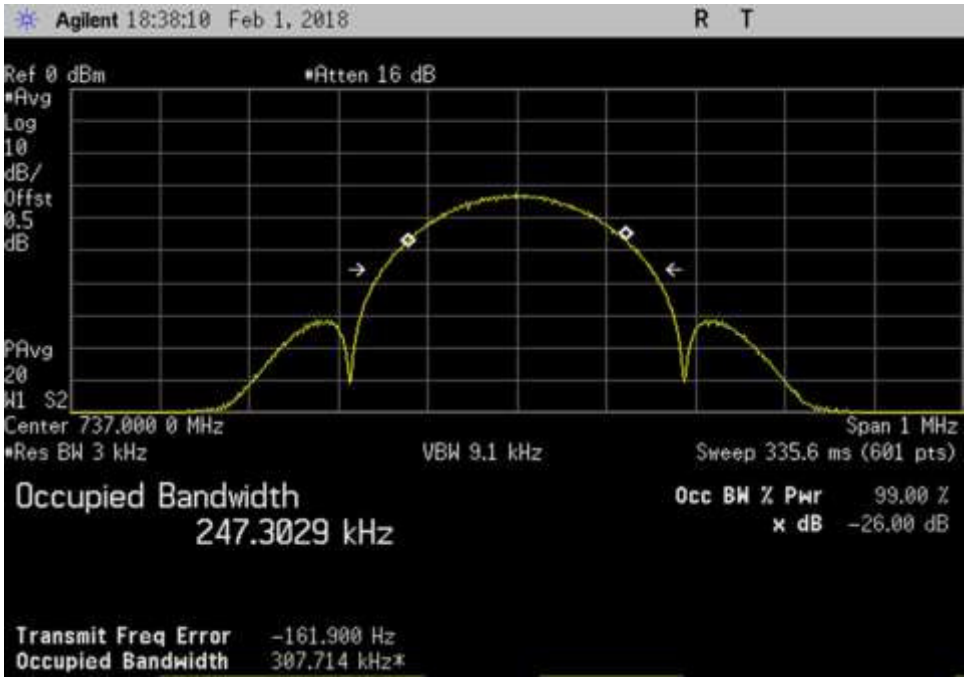

UL_824-849_EDGE_ 836.5MHz



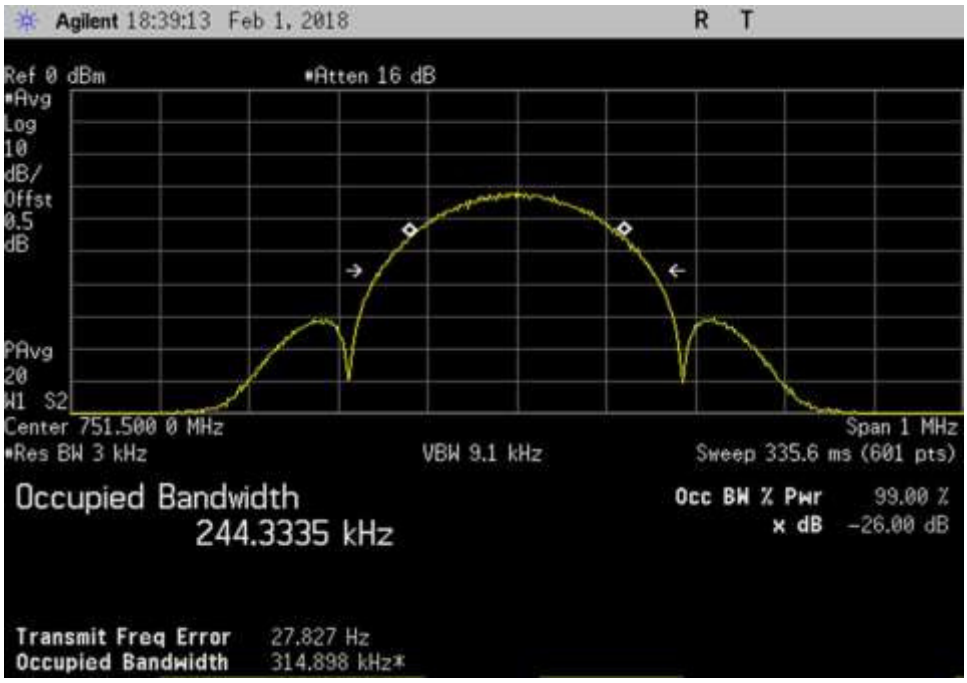

UL_1710-1755_EDGE_ 1732.5MHz



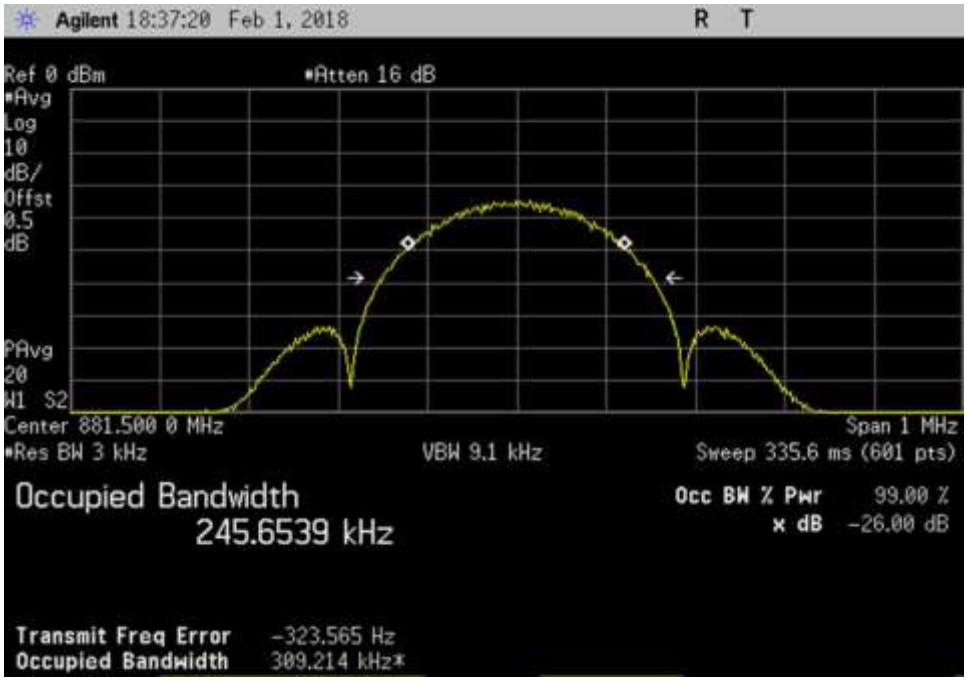

UL_1850-1915_EDGE_ 1882.5MHz



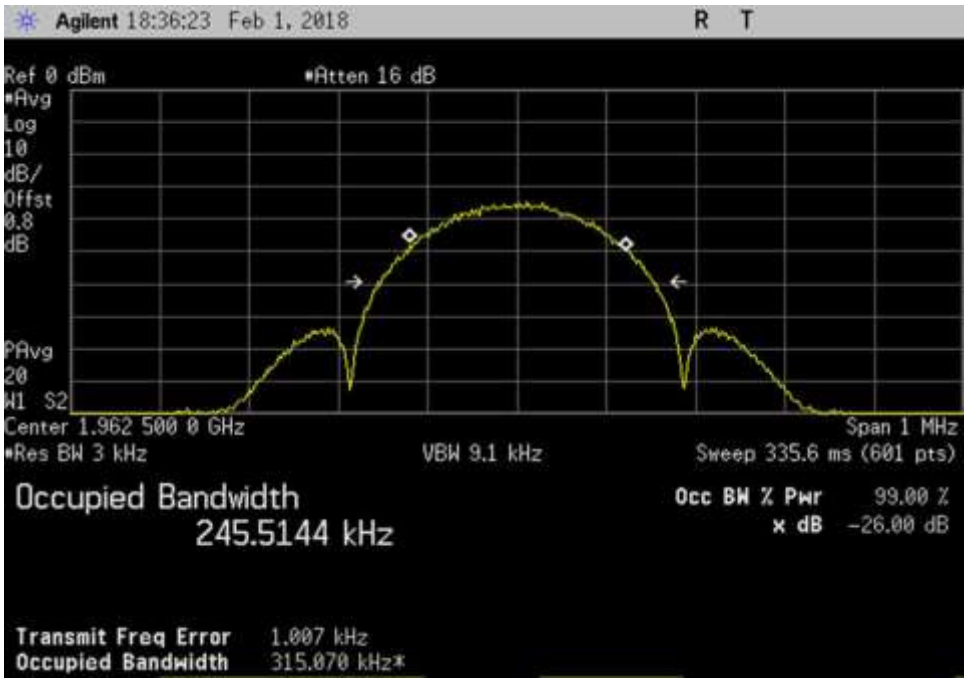

DL_728-746_EDGE_ 737MHz



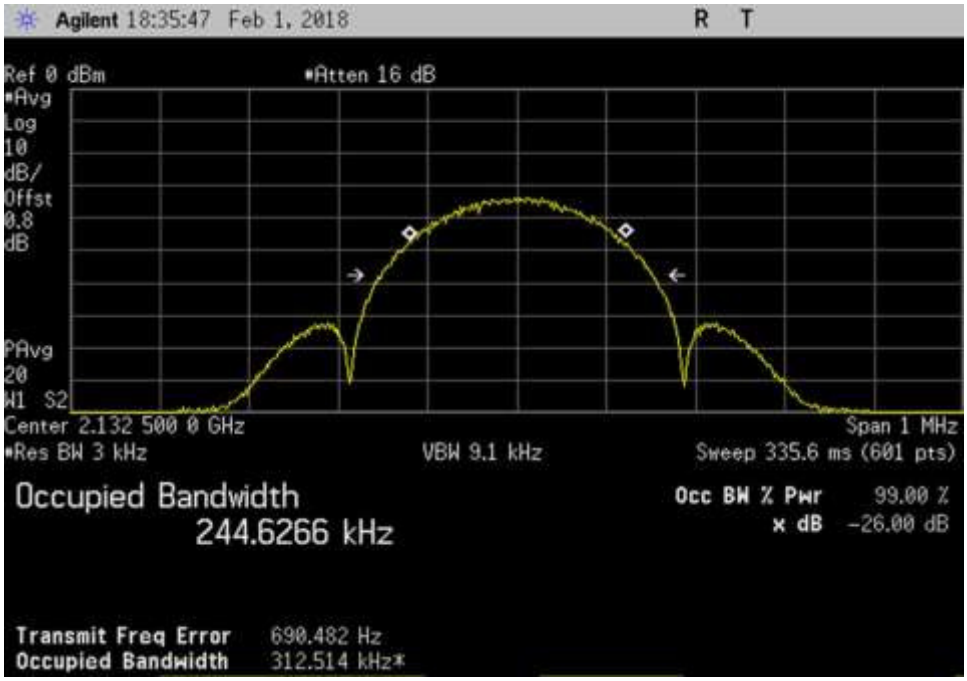

DL_746-757_EDGE_ 751.5MHz




DL_869-894_EDGE_ 881.5MHz

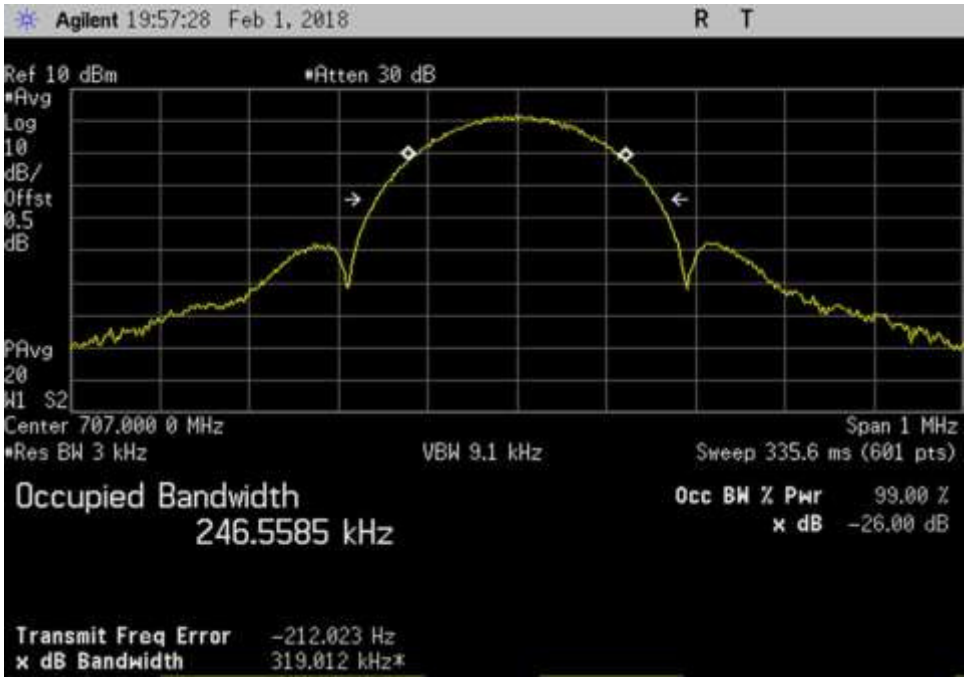



DL_1930-1995_EDGE_ 1962.5MHz

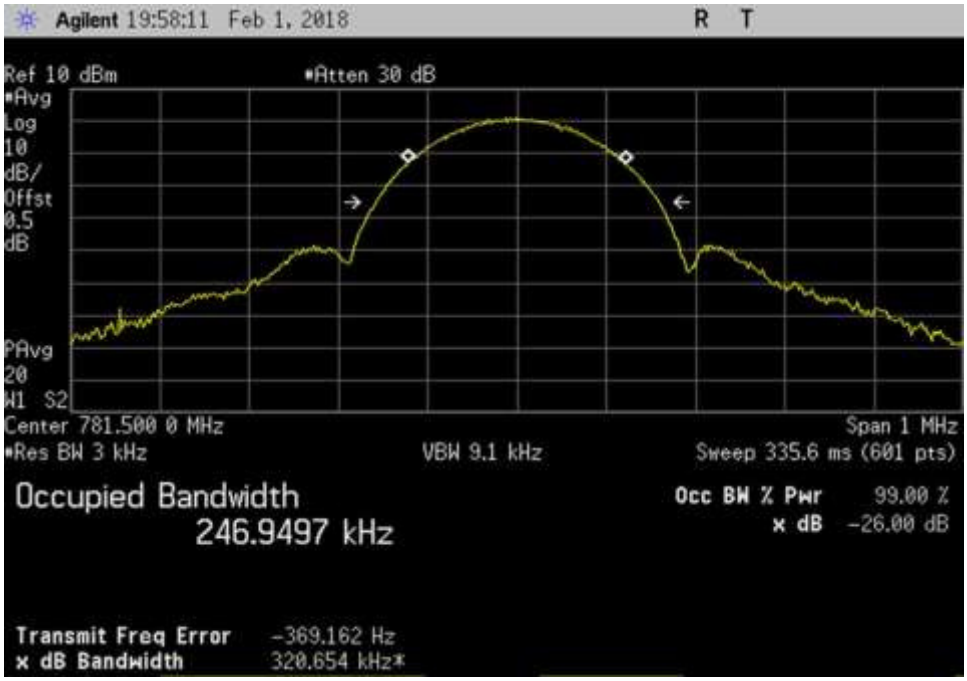



DL_2110-2155_EDGE_ 2132.5MHz

**EDGE Output**

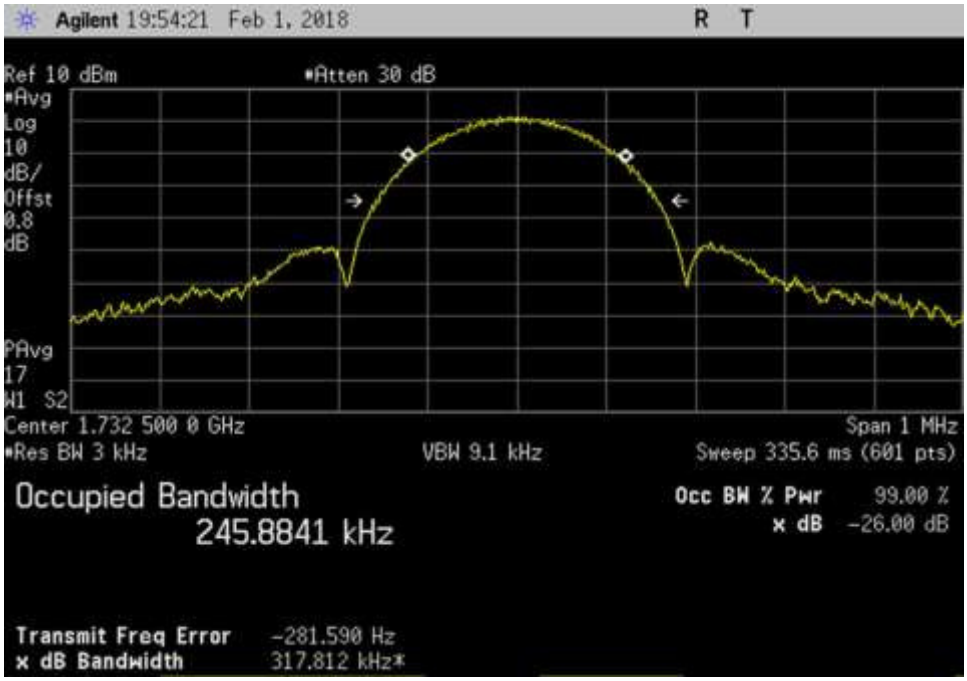



UL_698-716_EDGE_ 707MHz

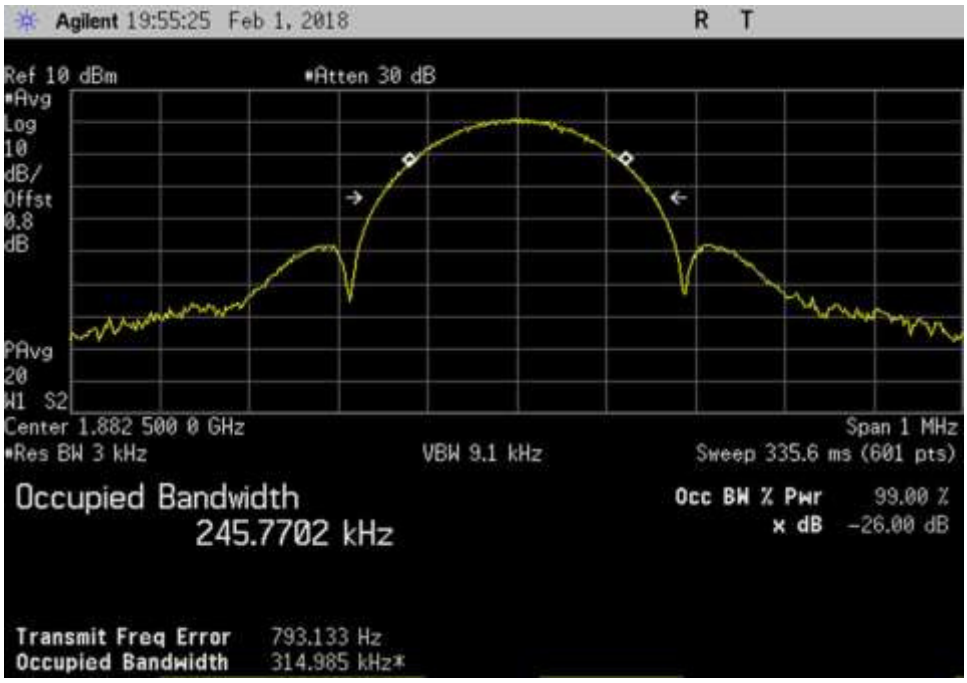



UL_776-787_EDGE_ 781.5MHz

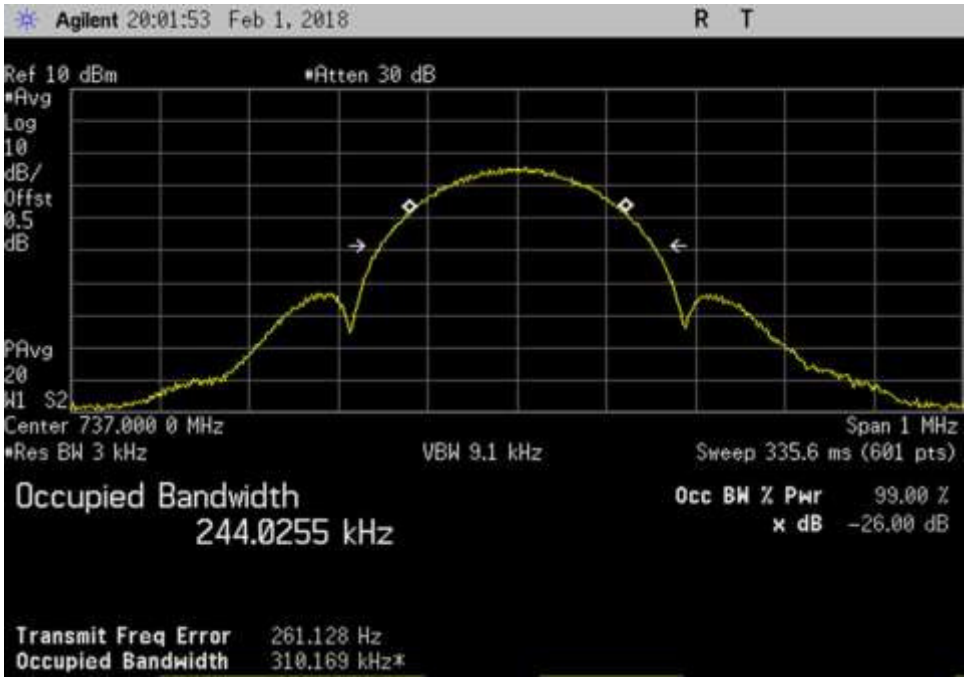

UL_824-849_EDGE_ 836.5MHz



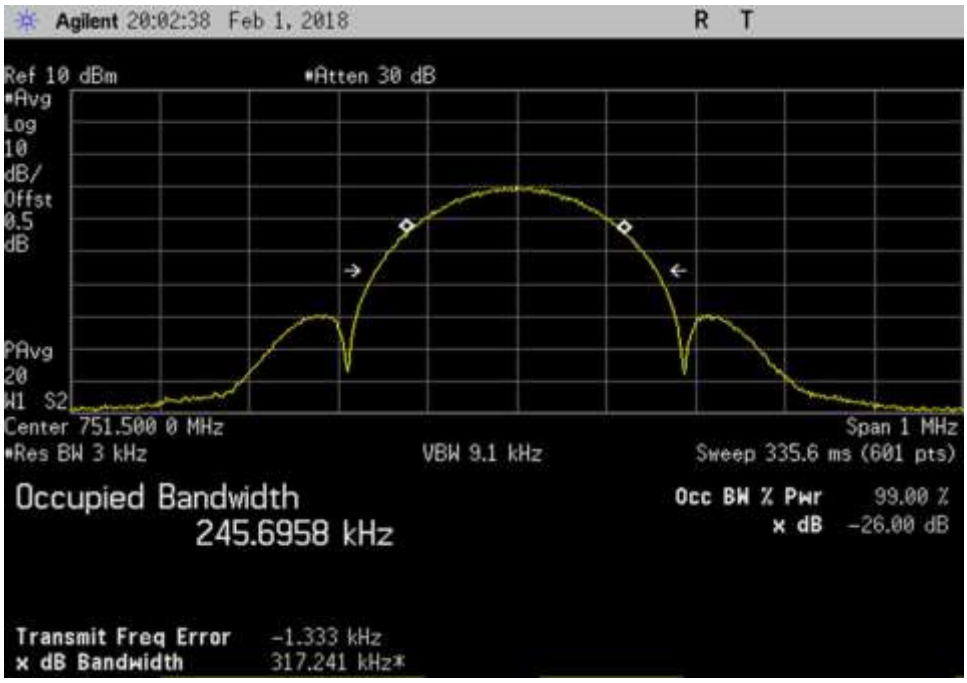

UL_1710-1755_EDGE_ 1732.5MHz



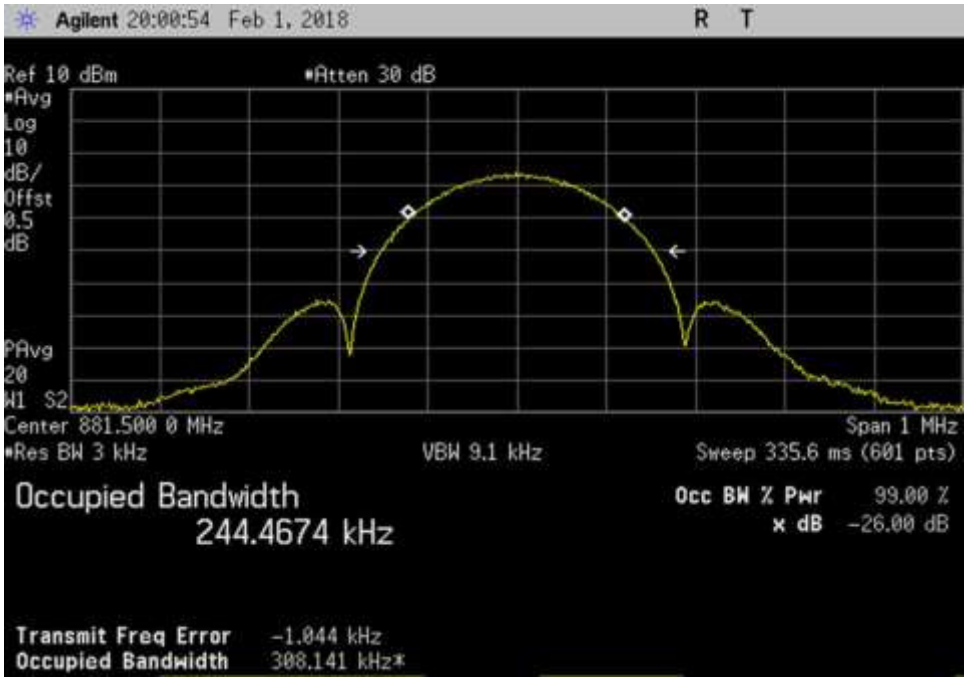

UL_1850-1915_EDGE_ 1882.5MHz



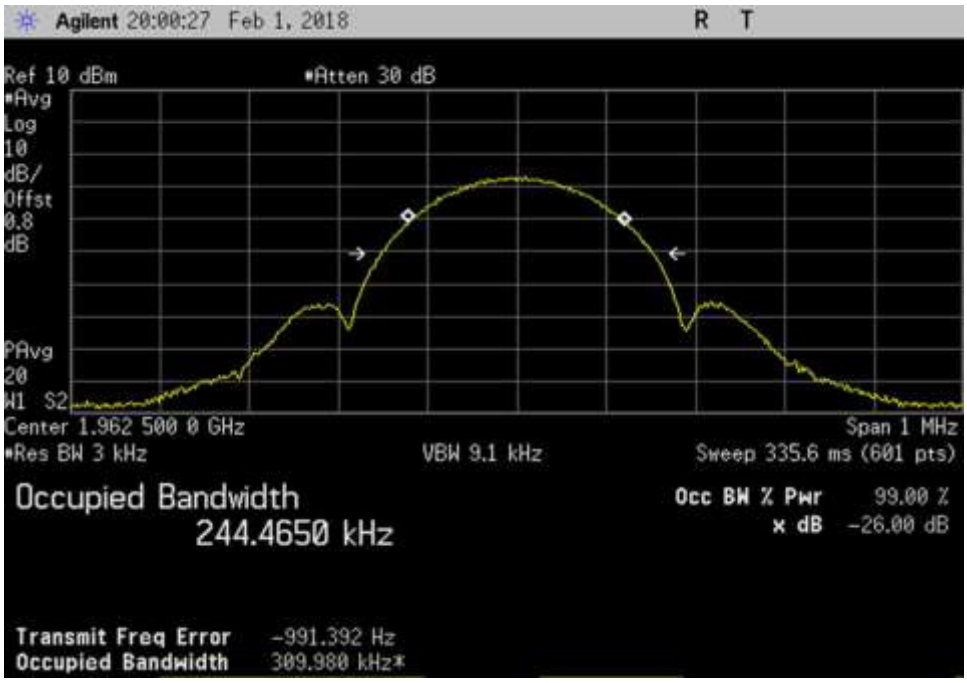

DL_728-746_EDGE_ 737MHz



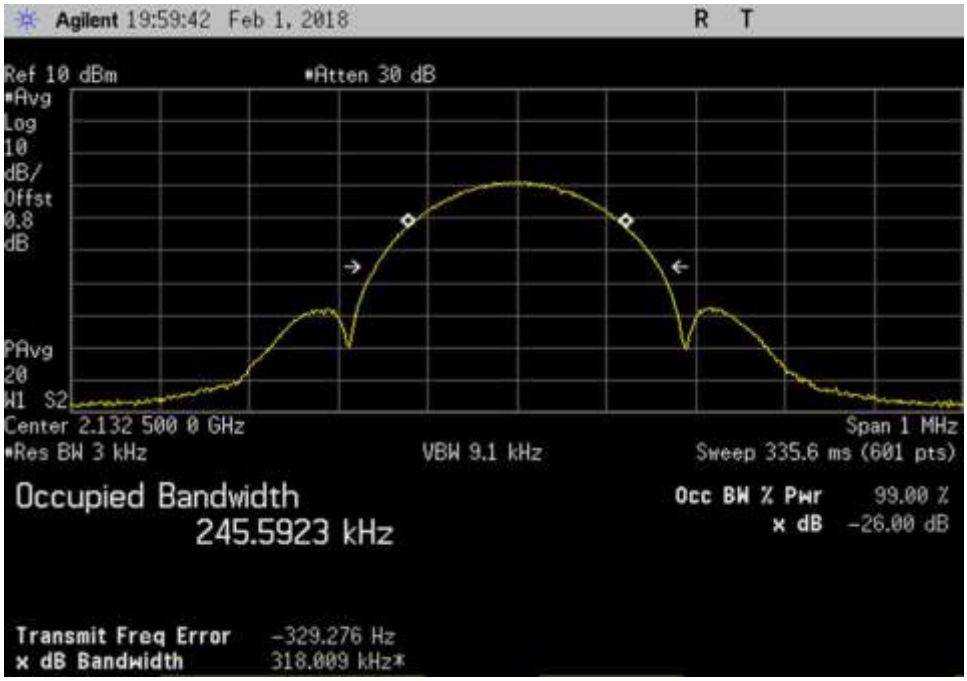

DL_746-757_EDGE_ 751.5MHz




DL_869-894_EDGE_ 881.5MHz

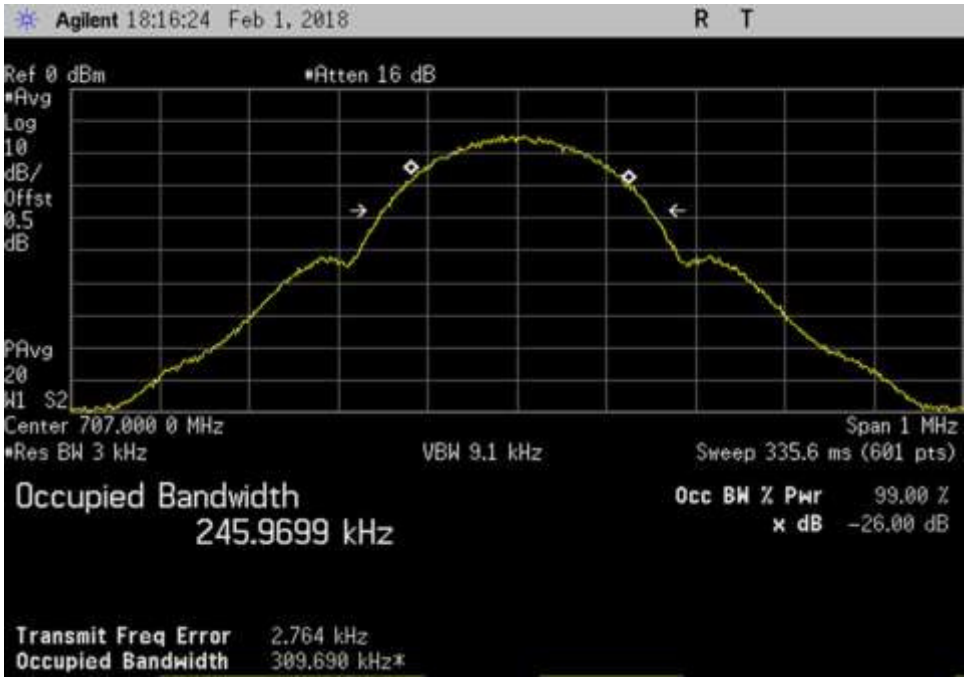



DL_1930-1995_EDGE_ 1962.5MHz

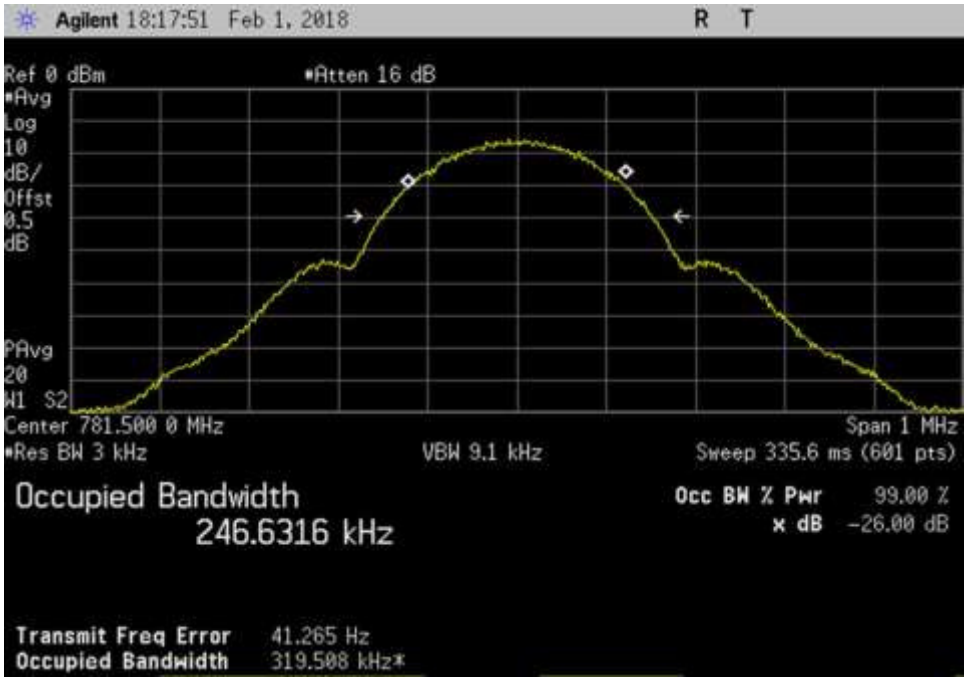



DL_2110-2155_EDGE_ 2132.5MHz

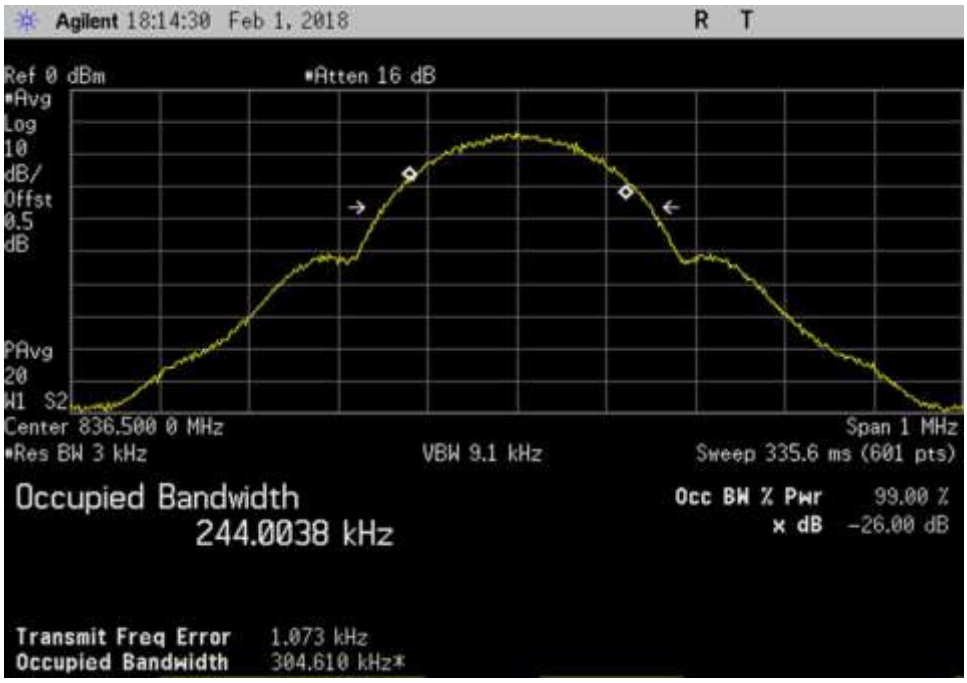
**GSM Input**



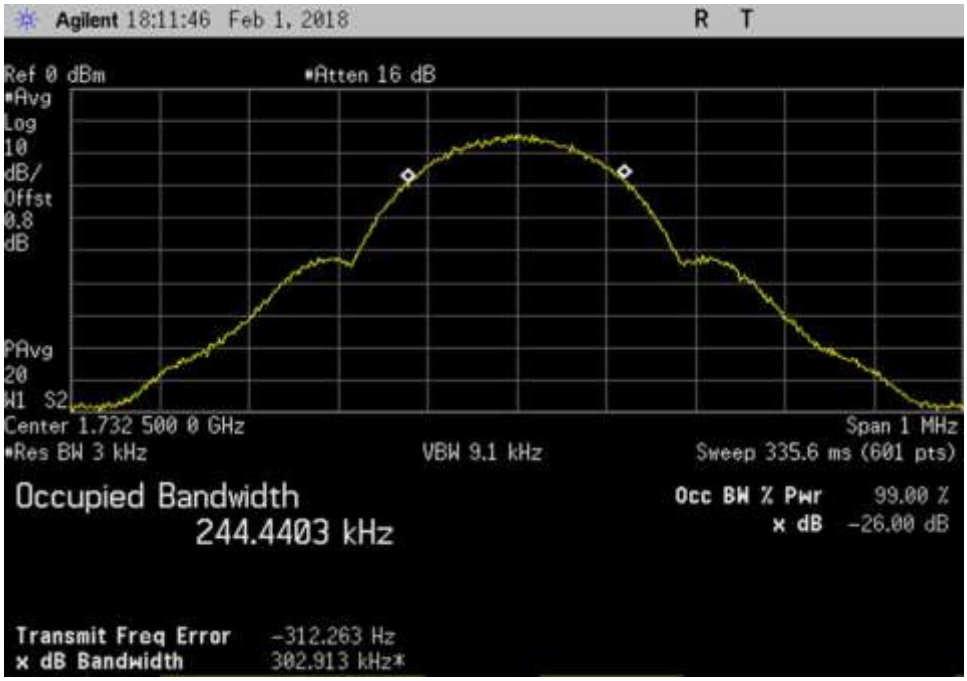

UL_698-716_GSM_ 707MHz



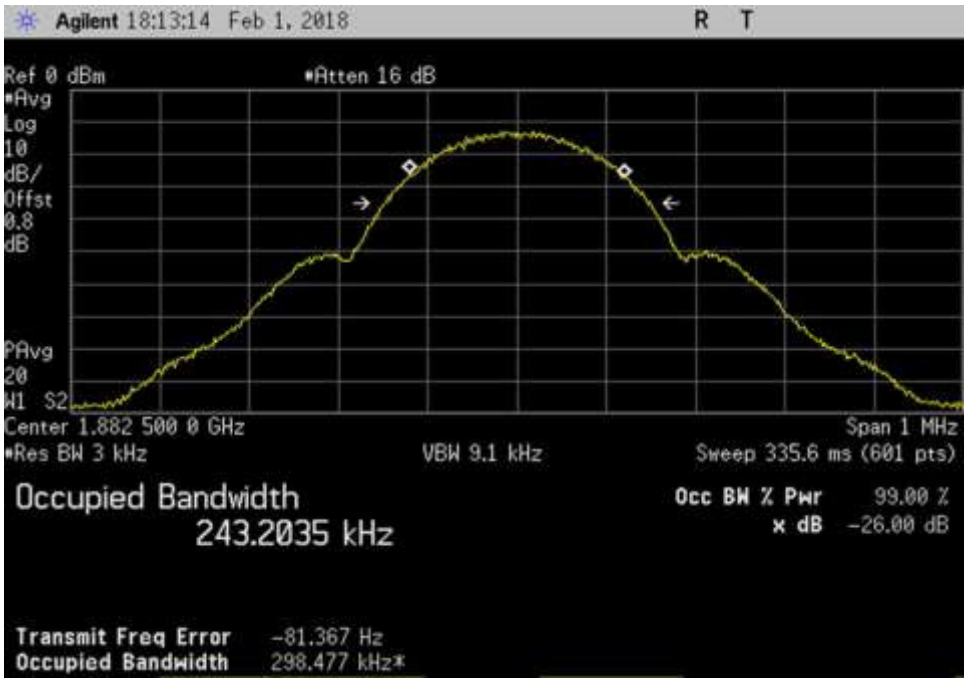

UL_776-787_GSM_ 781.5MHz



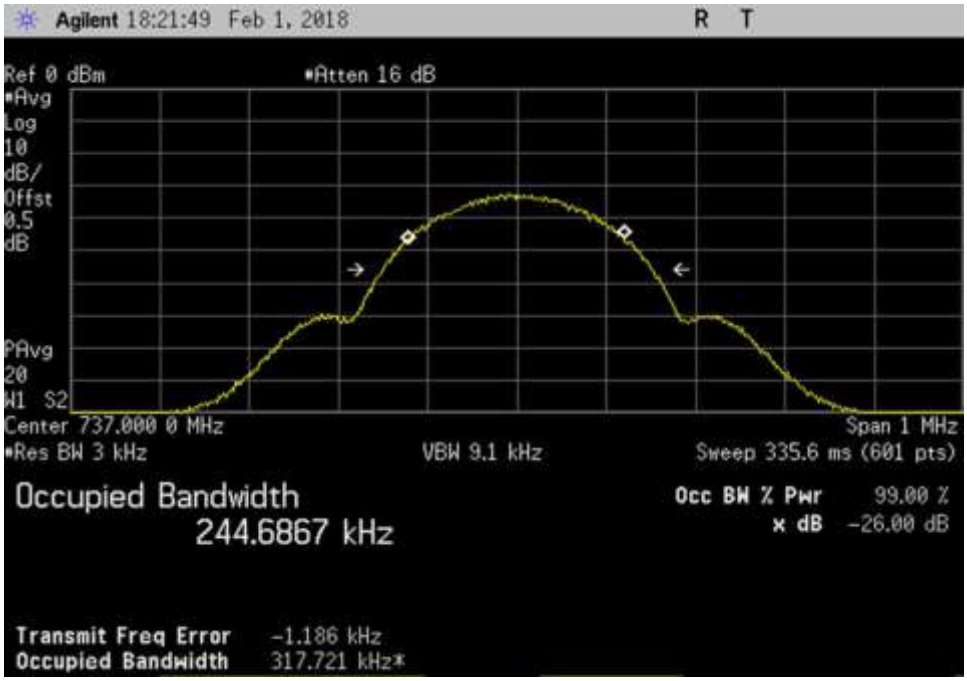

UL_824-849_GSM_ 836.5MHz



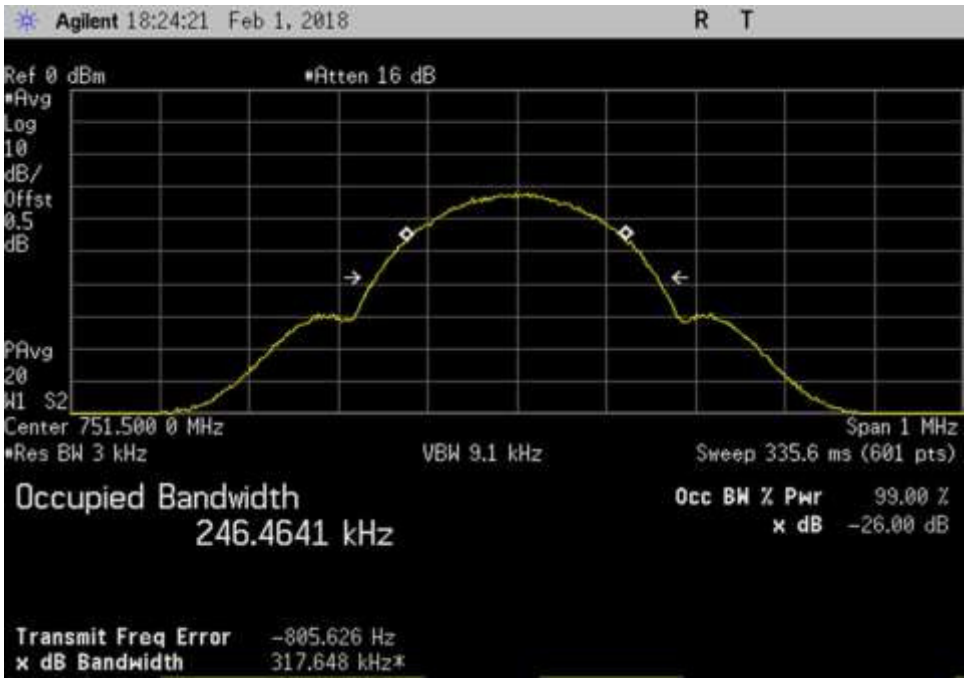

UL_1710-1755_GSM_ 1732.5MHz




UL_1850-1915_GSM_ 1882.5MHz



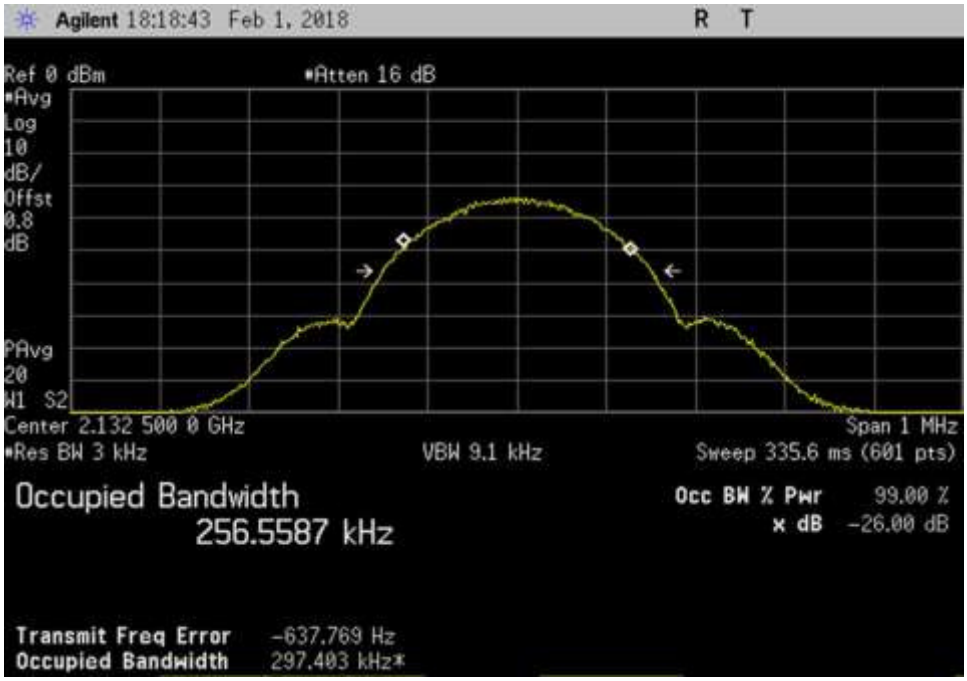

DL_728-746_GSM_ 737MHz




DL_746-757_GSM_ 751.5MHz

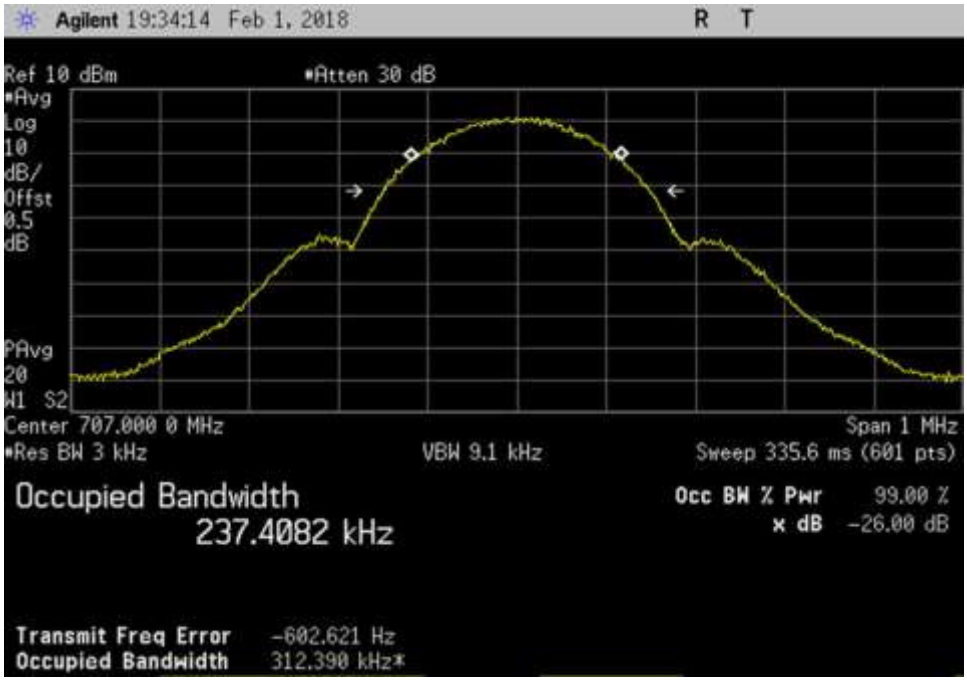

DL_869-894_GSM_ 881.5MHz


DL_1930-1995_GSM_ 1962.5MHz

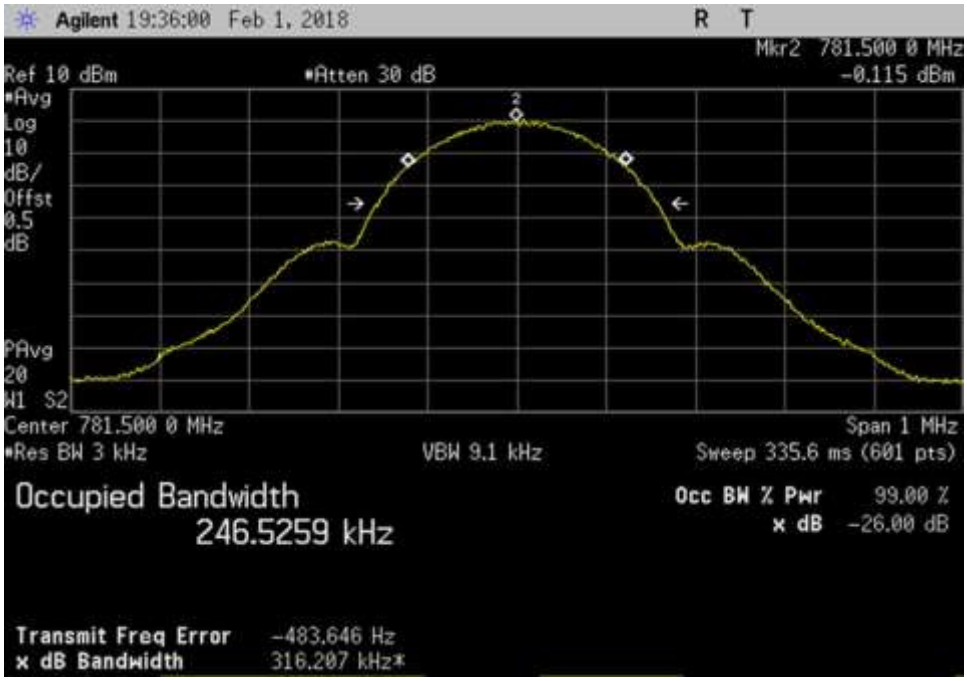



DL_2110-2155_GSM_ 2132.5MHz

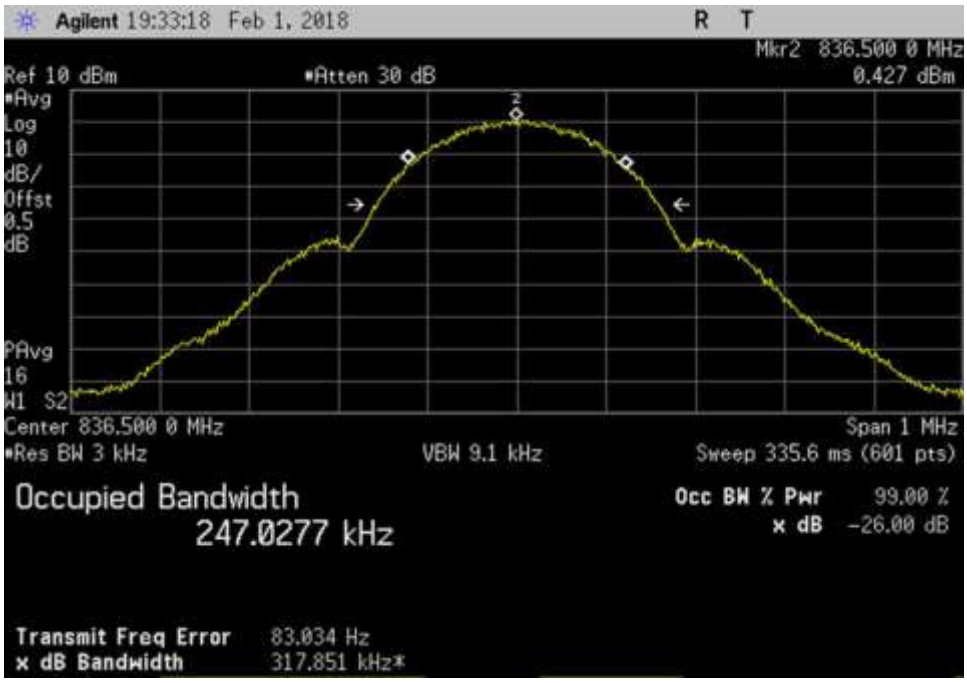
**GSM Output**



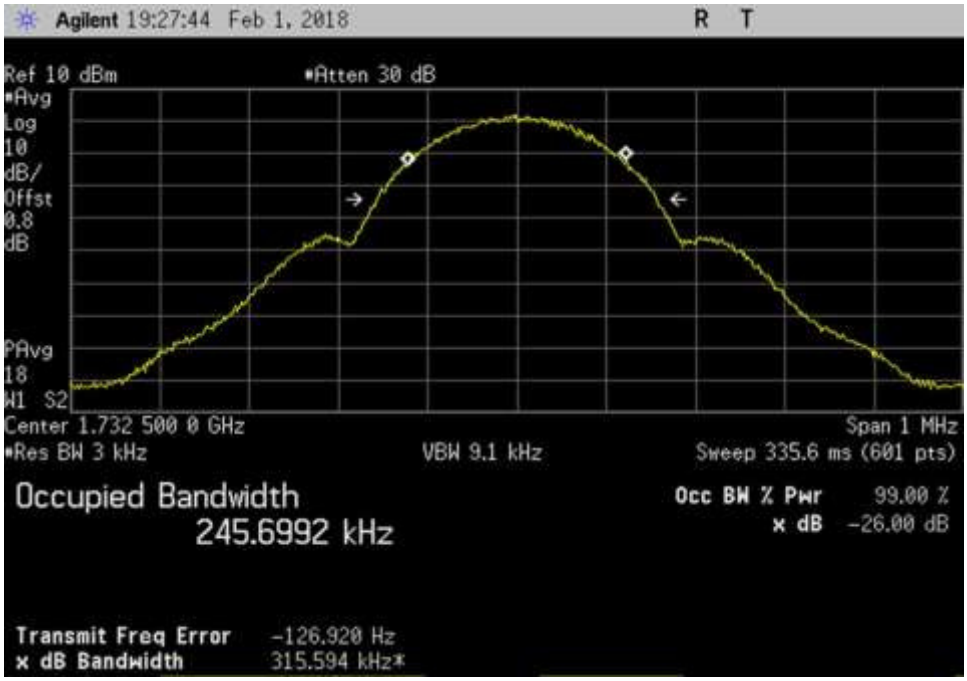

UL_698-716_GSM_ 707MHz




UL_776-787_GSM_ 781.5MHz

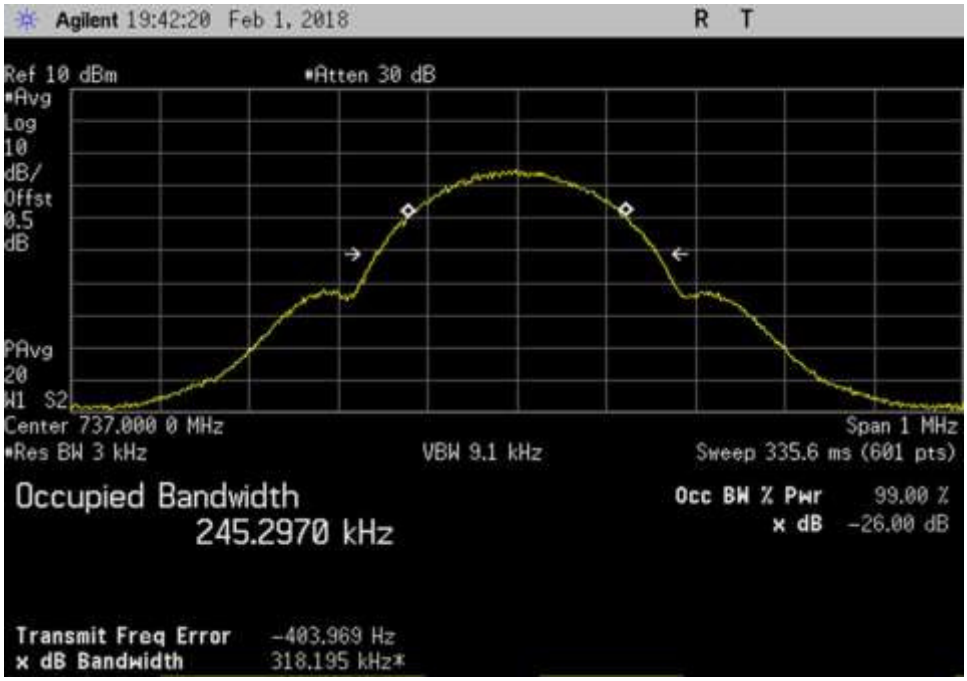



UL_824-849_GSM_ 836.5MHz



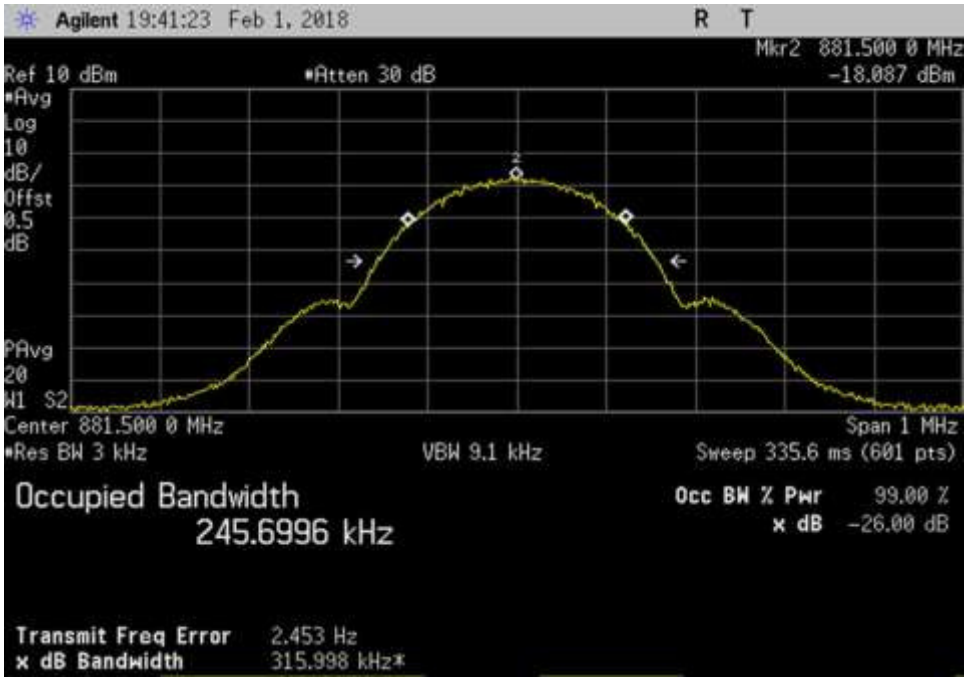

UL_1710-1755_GSM_ 1732.5MHz


UL_1850-1915_GSM_ 1882.5MHz

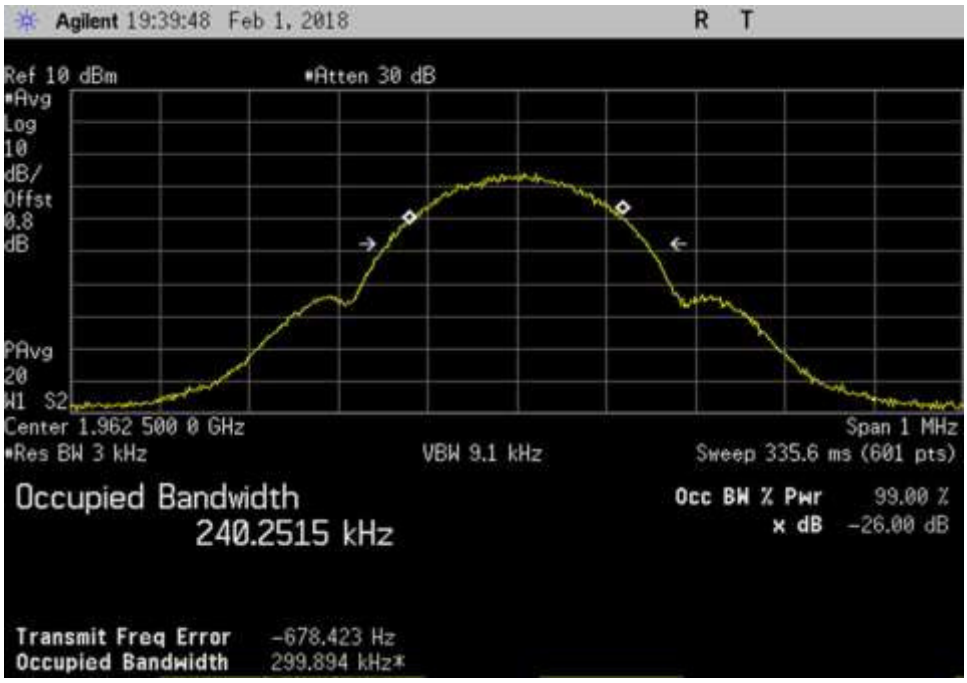



DL_728-746_GSM_ 737MHz

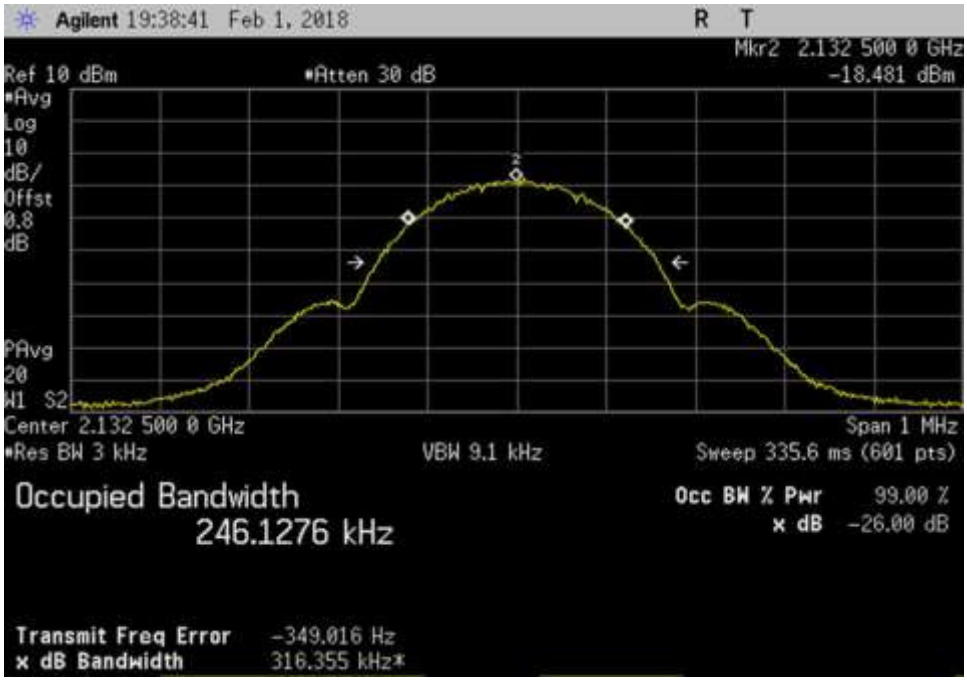

DL_746-757_GSM_ 751.5MHz




DL_869-894_GSM_ 881.5MHz

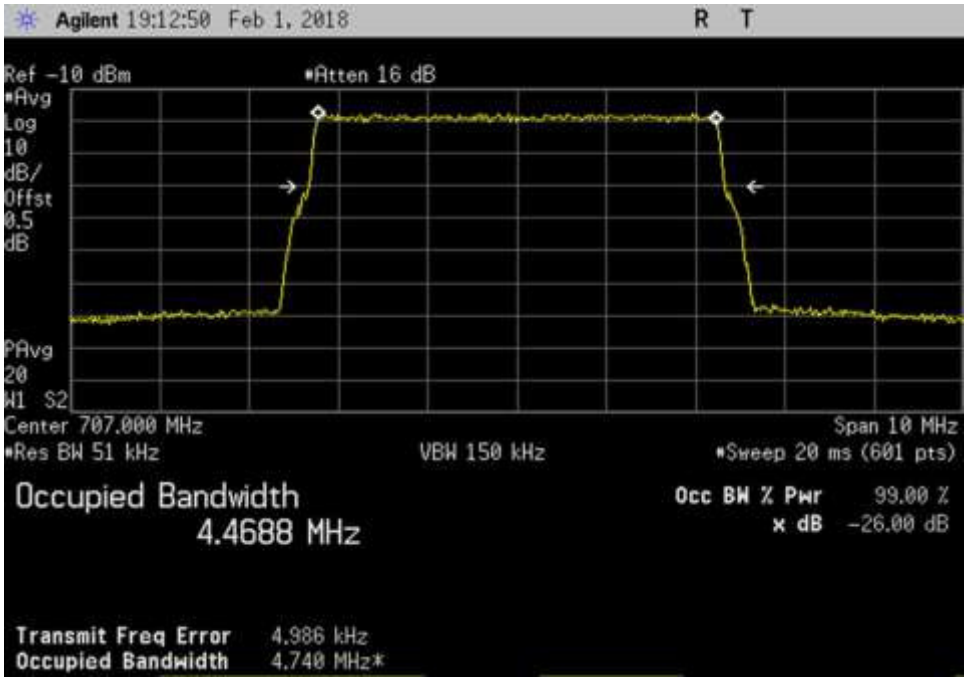



DL_1930-1995_GSM_ 1962.5MHz

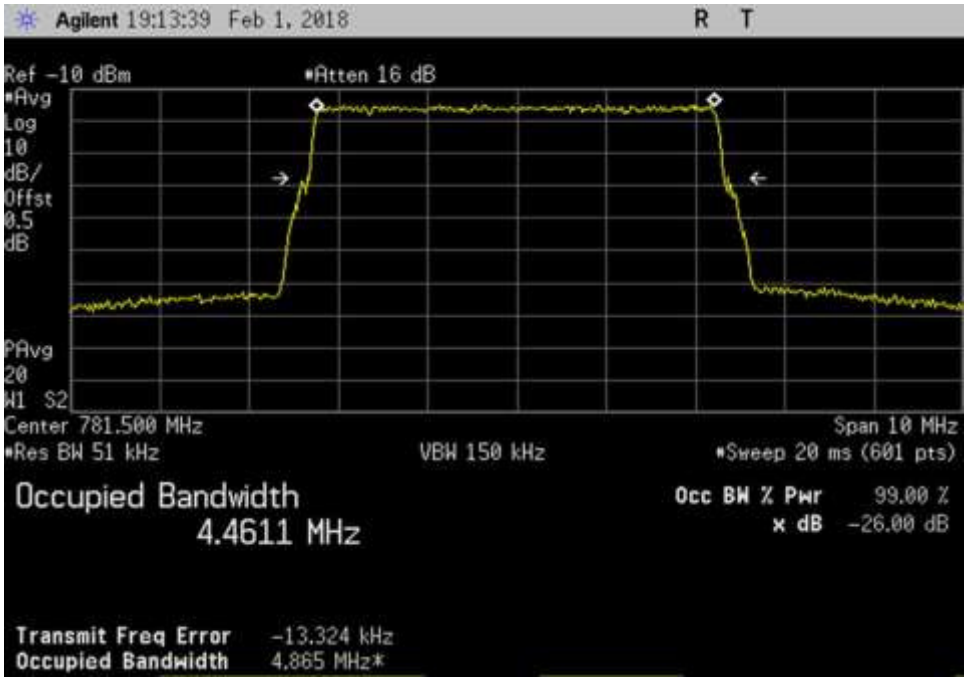



DL_2110-2155_GSM_ 2132.5MHz

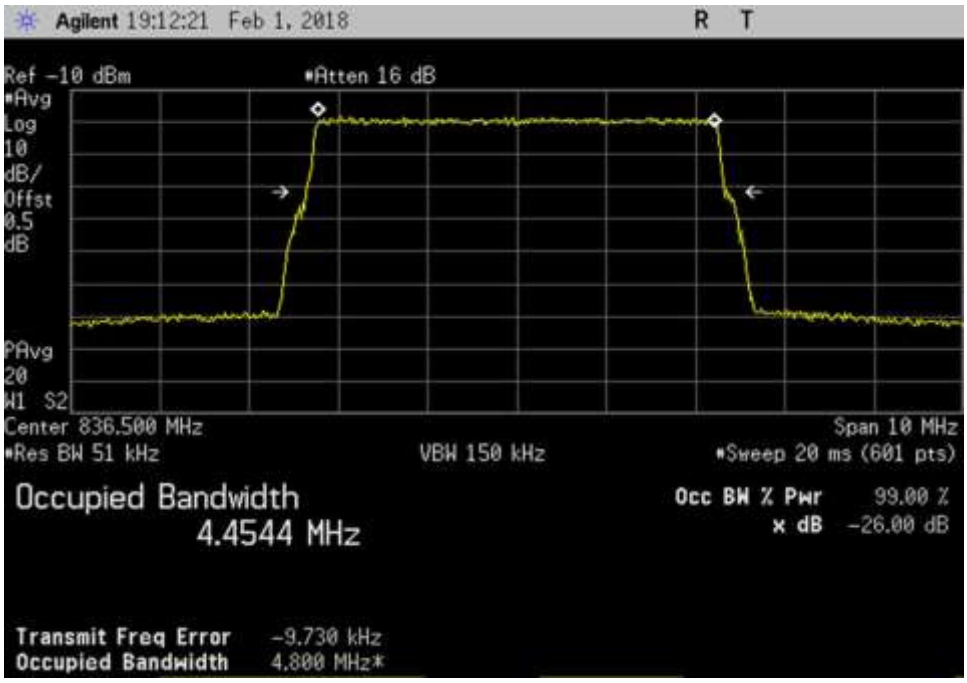
**LTE Input**



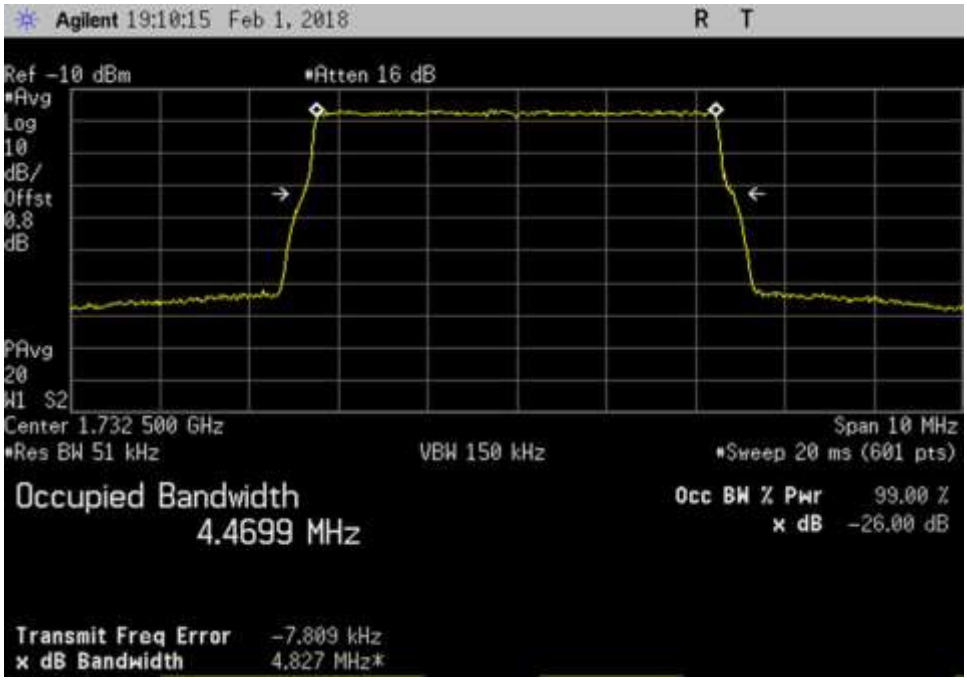

UL_698-716_LTE_ 707MHz



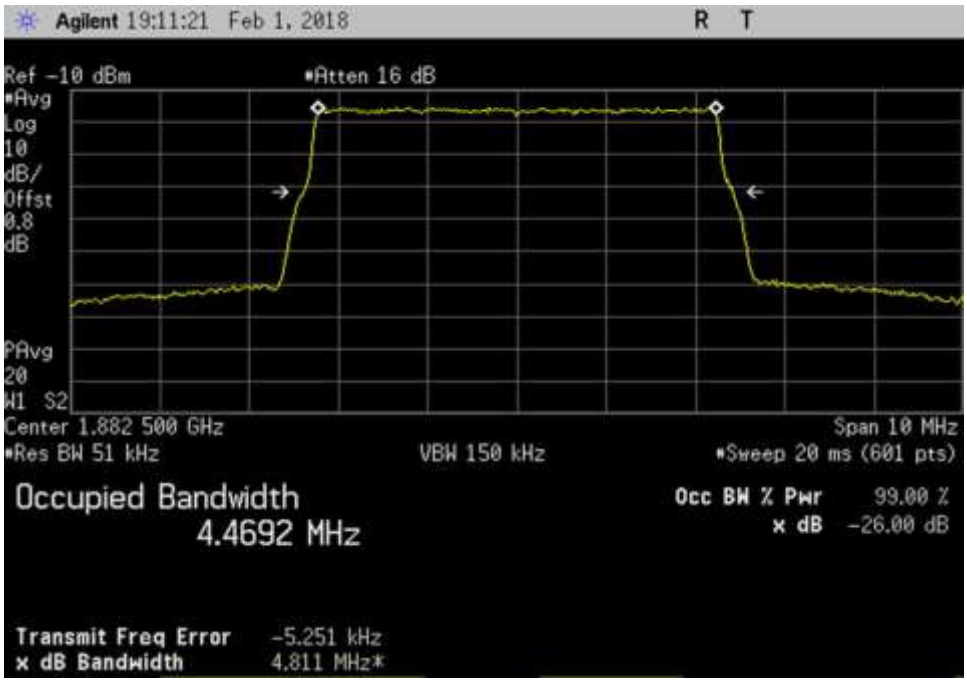

UL_776-787_LTE_ 781.5MHz



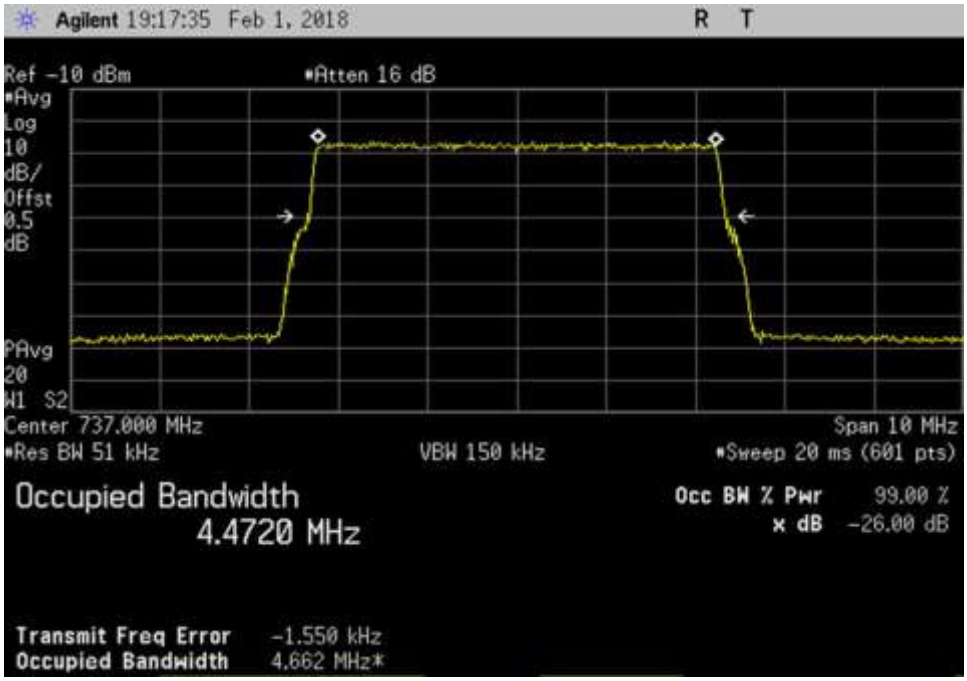

UL_824-849_LTE_ 836.5MHz



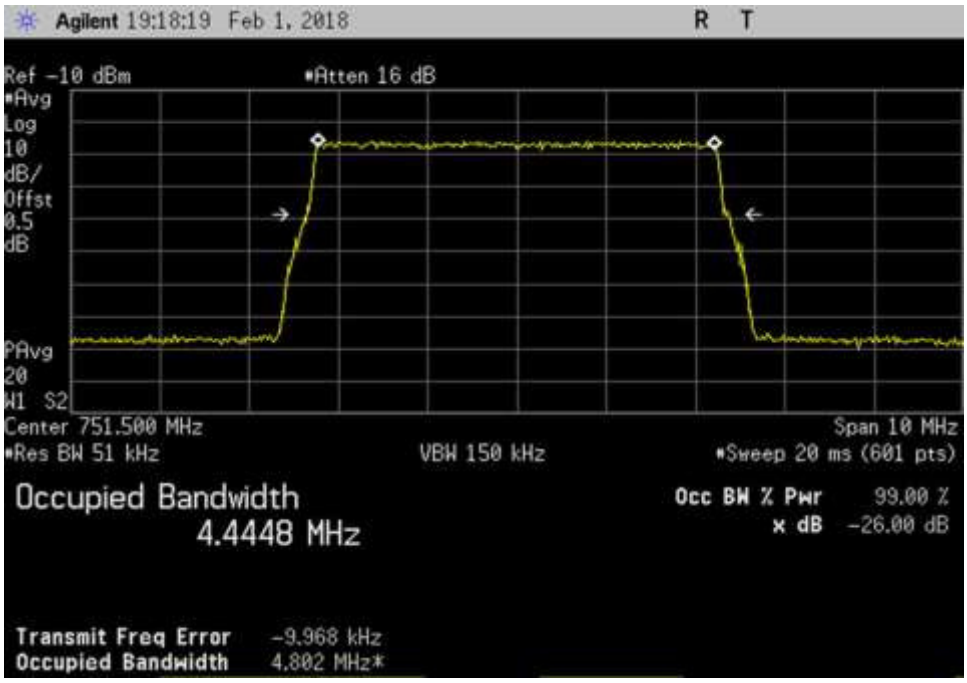

UL_1710-1755_LTE_ 1732.5MHz



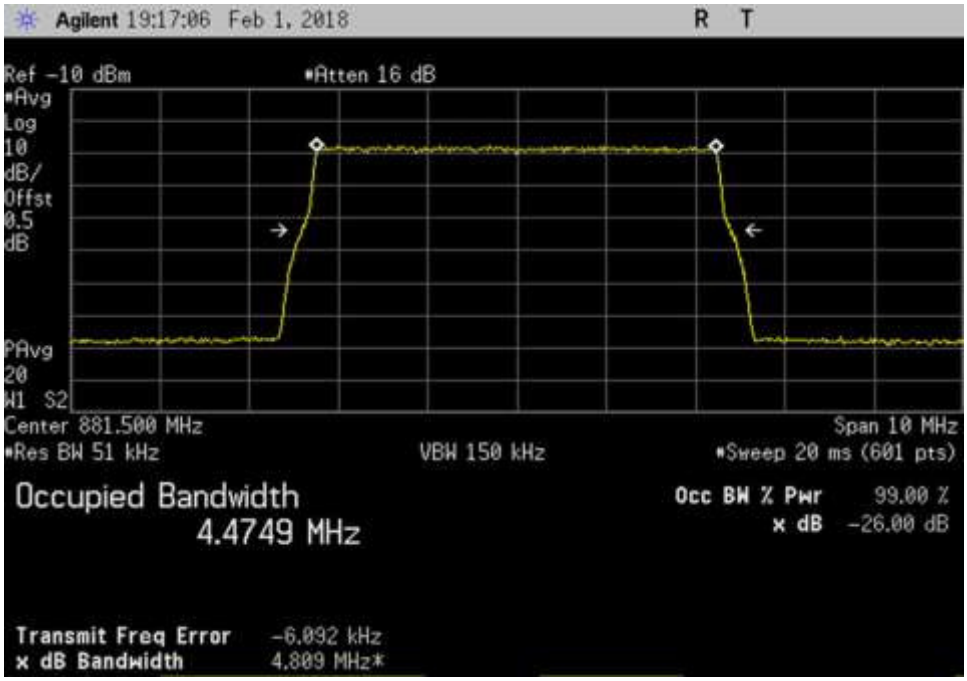

UL_1850-1915_LTE_ 1882.5MHz



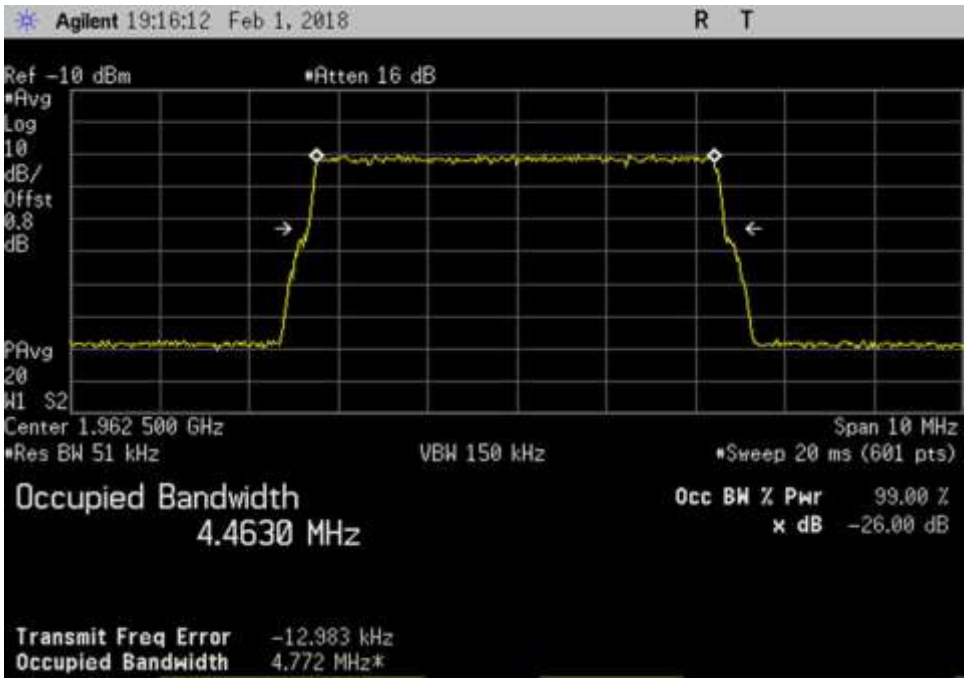

DL_728-746_LTE_ 737MHz



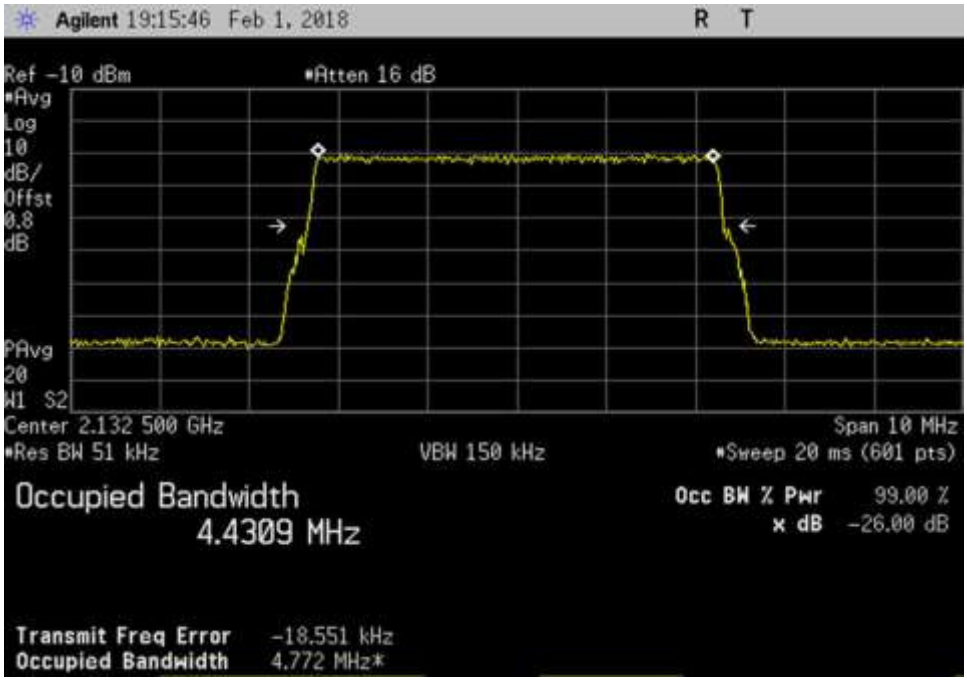

DL_746-757_LTE_ 751.5MHz




DL_869-894_LTE_ 881.5MHz

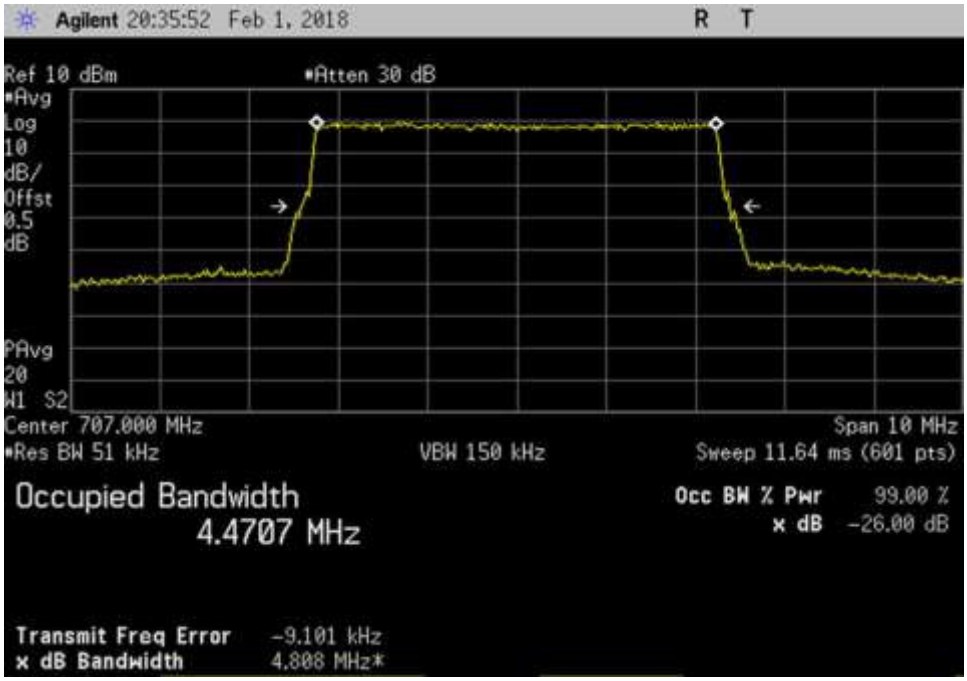



DL_1930-1995_LTE_ 1962.5MHz

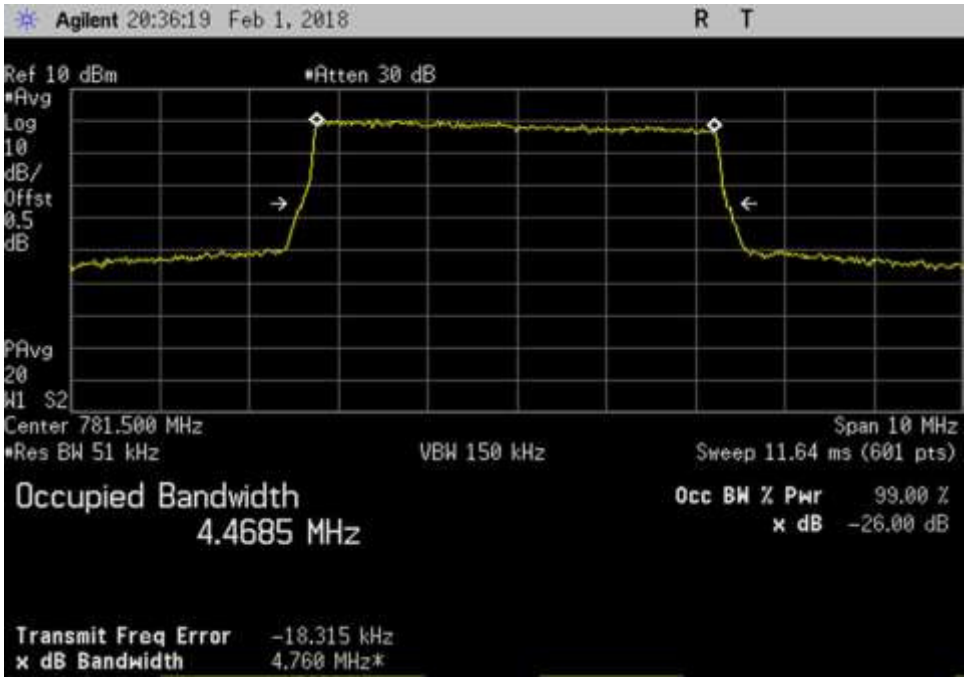



DL_2110-2155_LTE_ 2132.5MHz

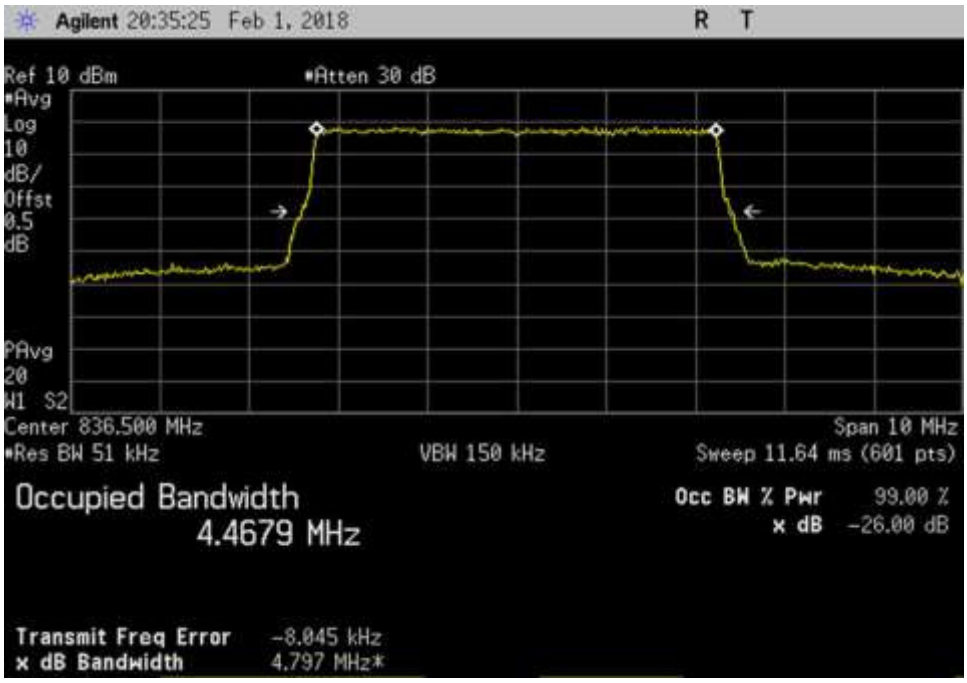
**LTE Output**



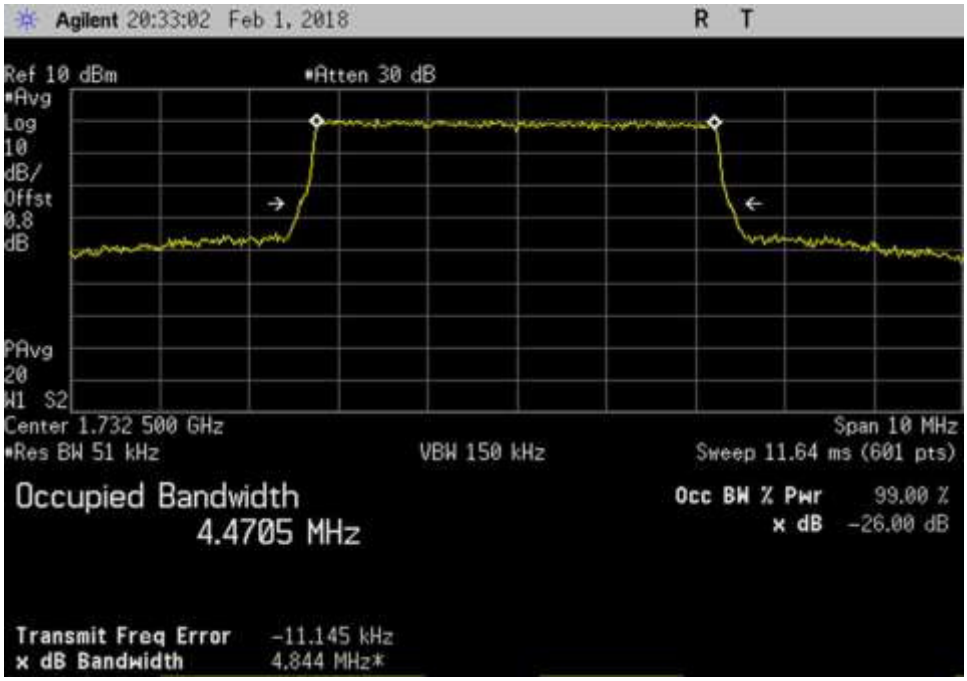

UL_698-716_LTE_ 707MHz



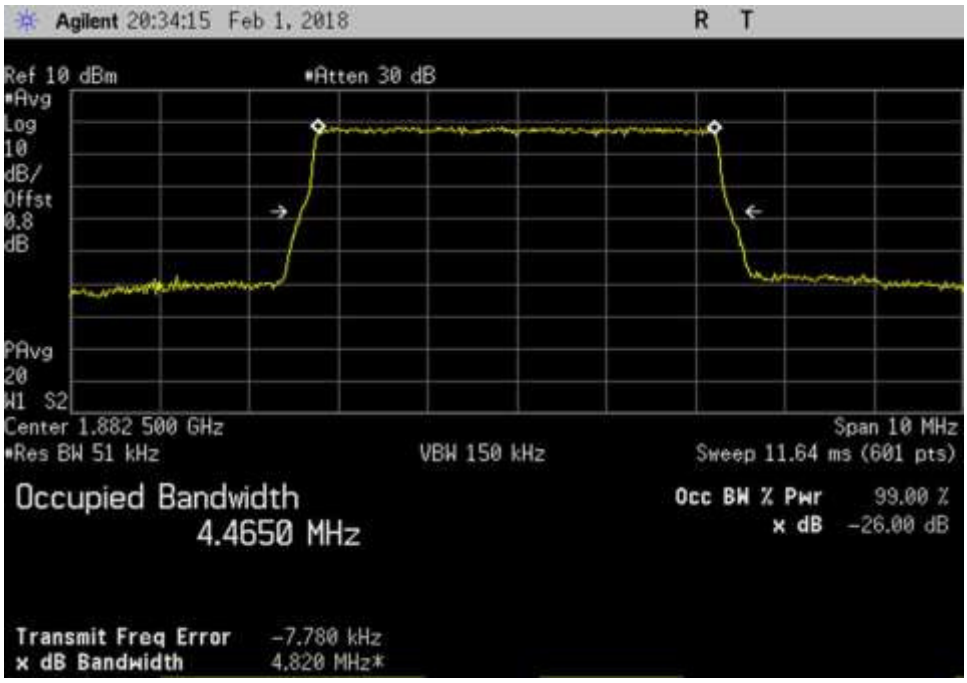

UL_776-787_LTE_ 781.5MHz



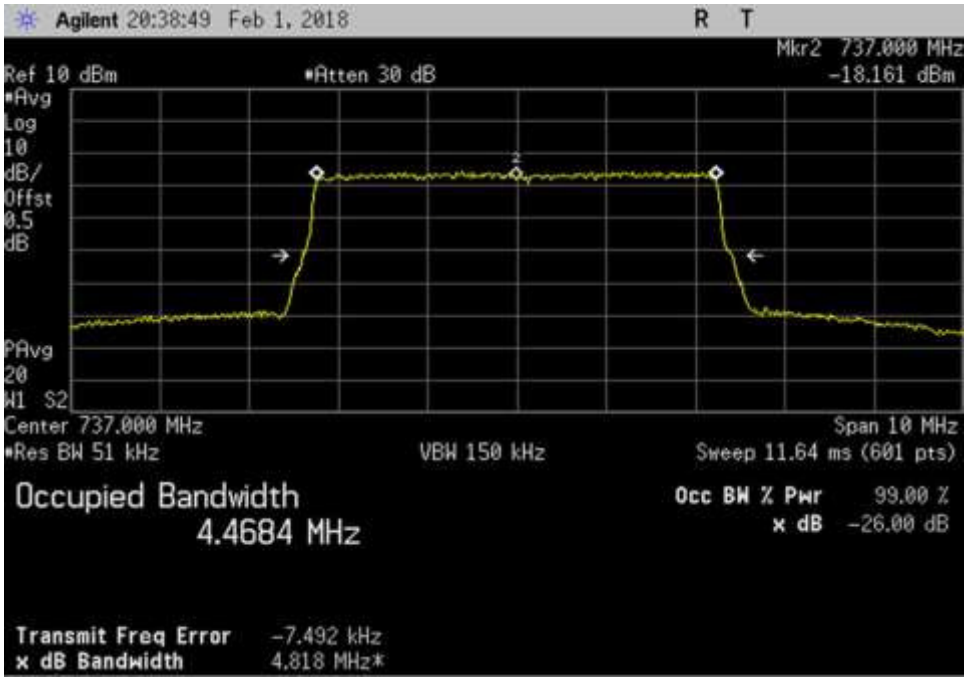

UL_824-849_LTE_ 836.5MHz



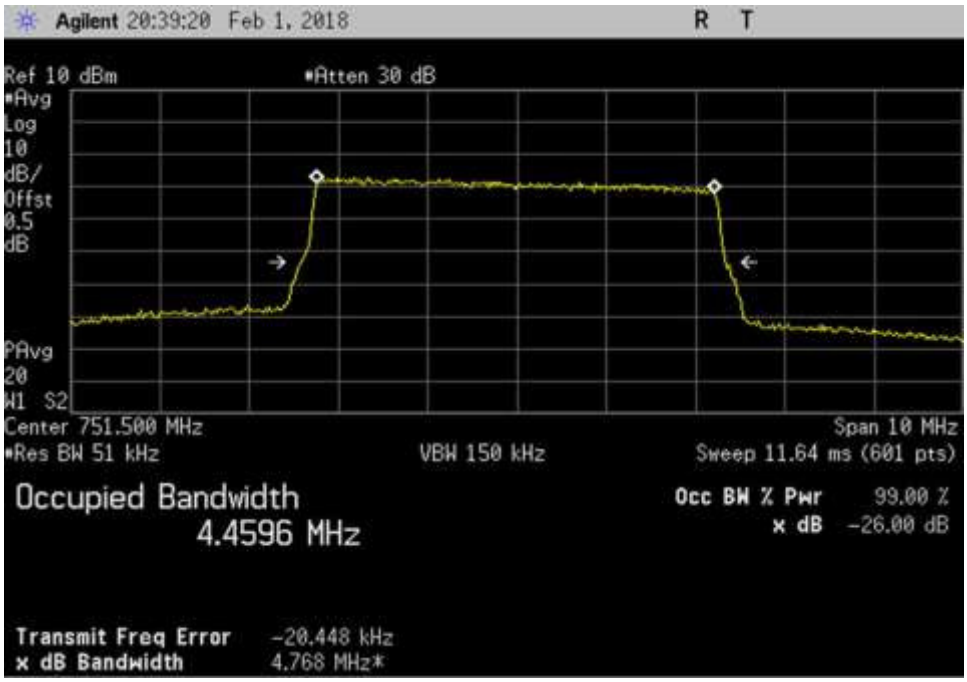

UL_1710-1755_LTE_ 1732.5MHz



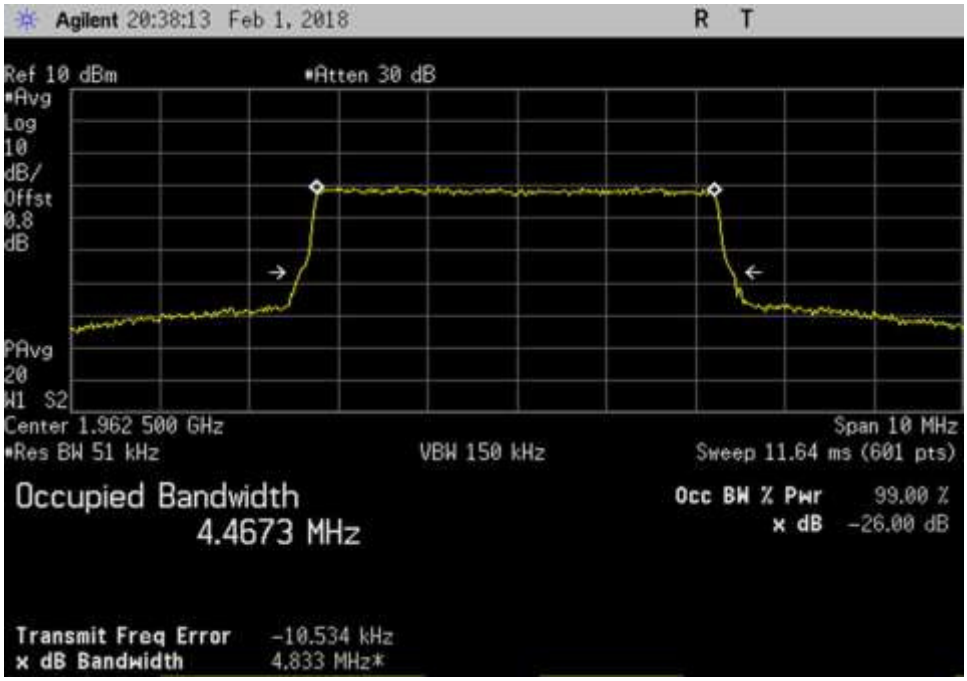

UL_1850-1915_LTE_ 1882.5MHz



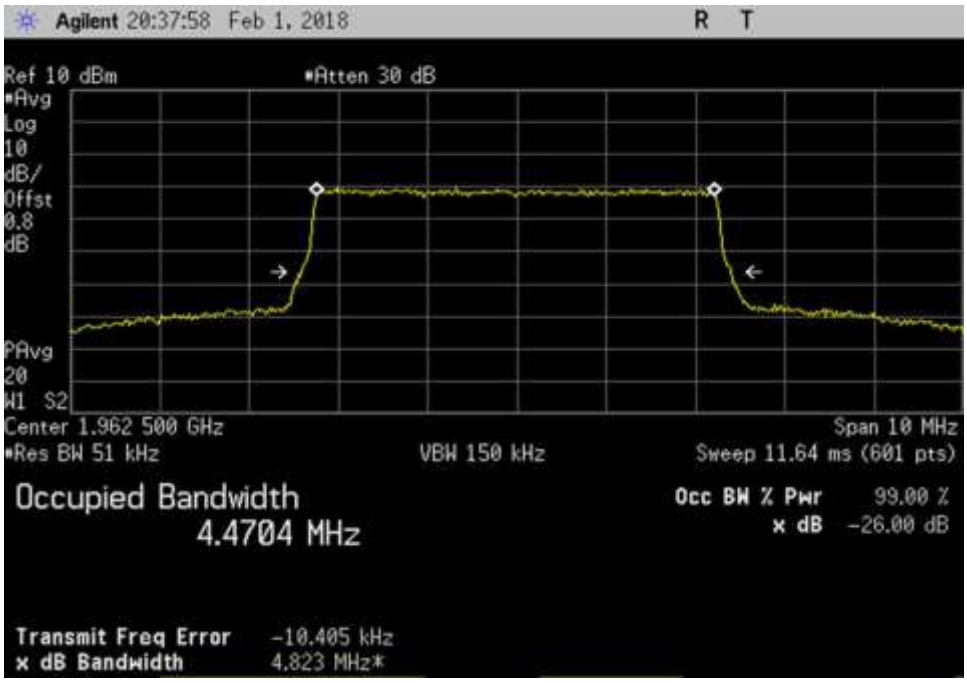

DL_728-746_LTE_ 737MHz



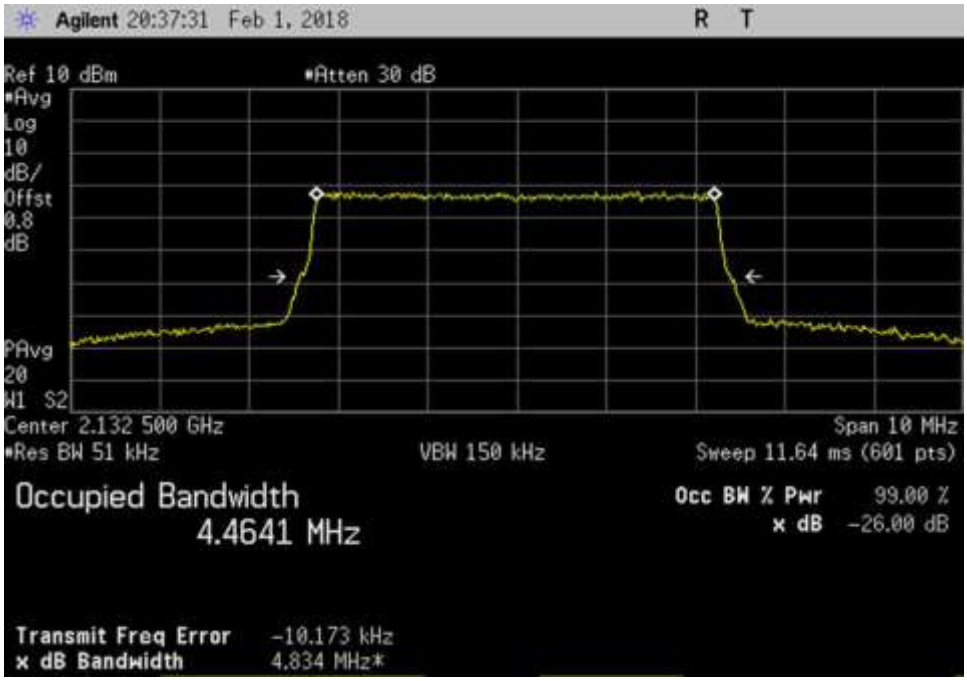

DL_746-757_LTE_ 751.5MHz




DL_869-894_LTE_ 1962.5MHz

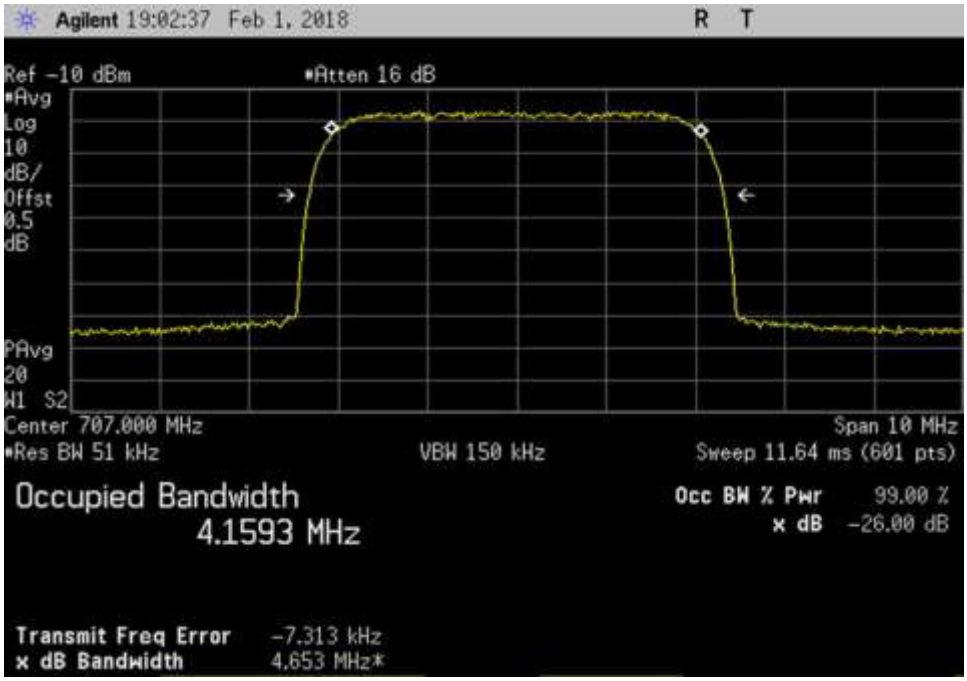



DL_1930-1995_LTE_ 1962.5MHz

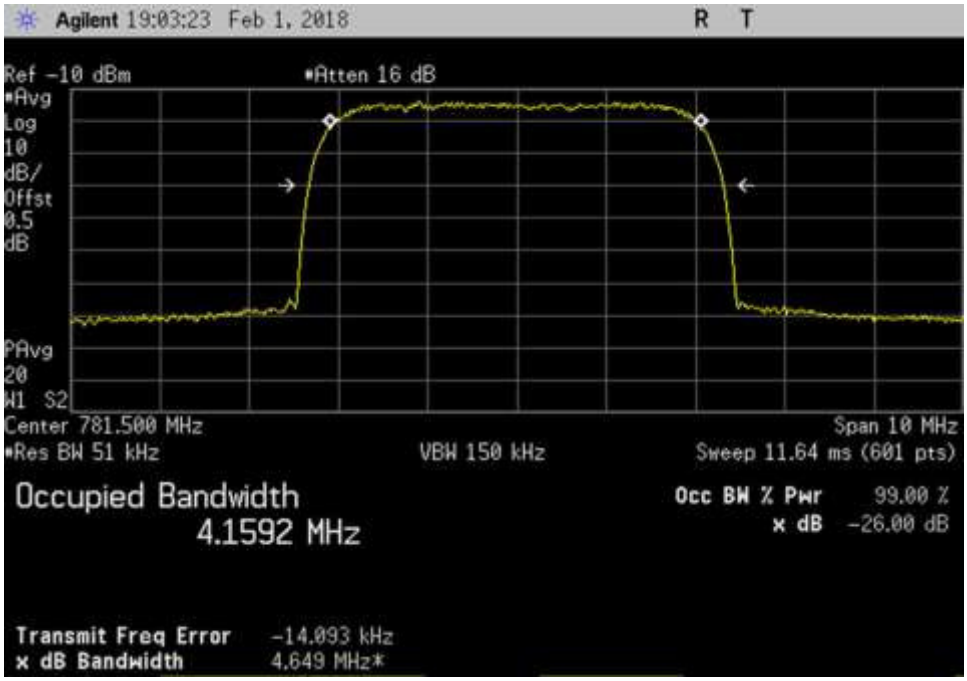



DL_2110-2155_LTE_ 2132.5MHz

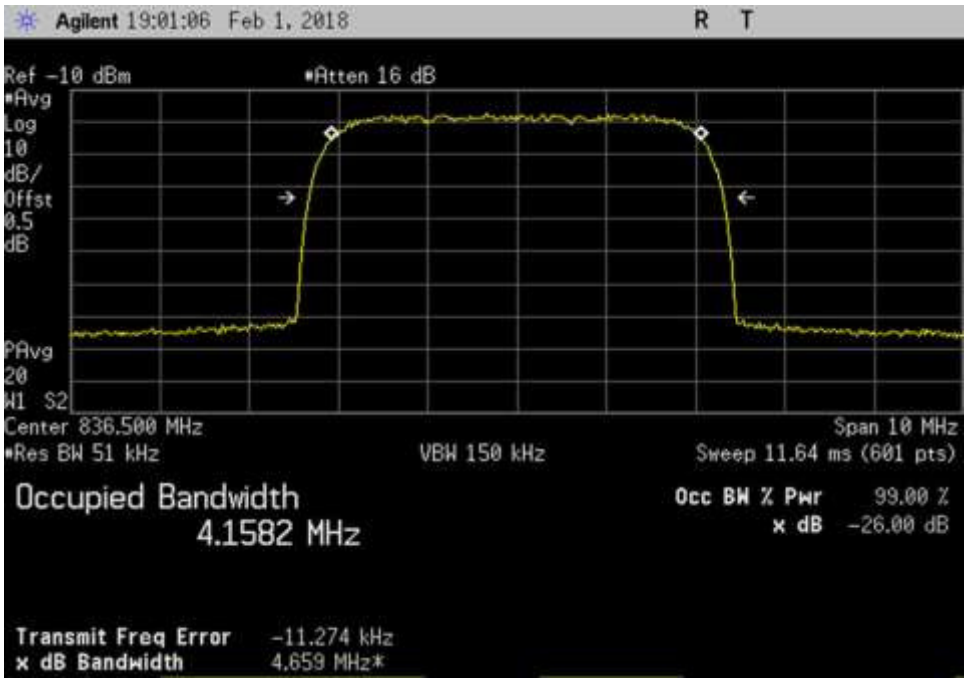
**WCDMA Input**



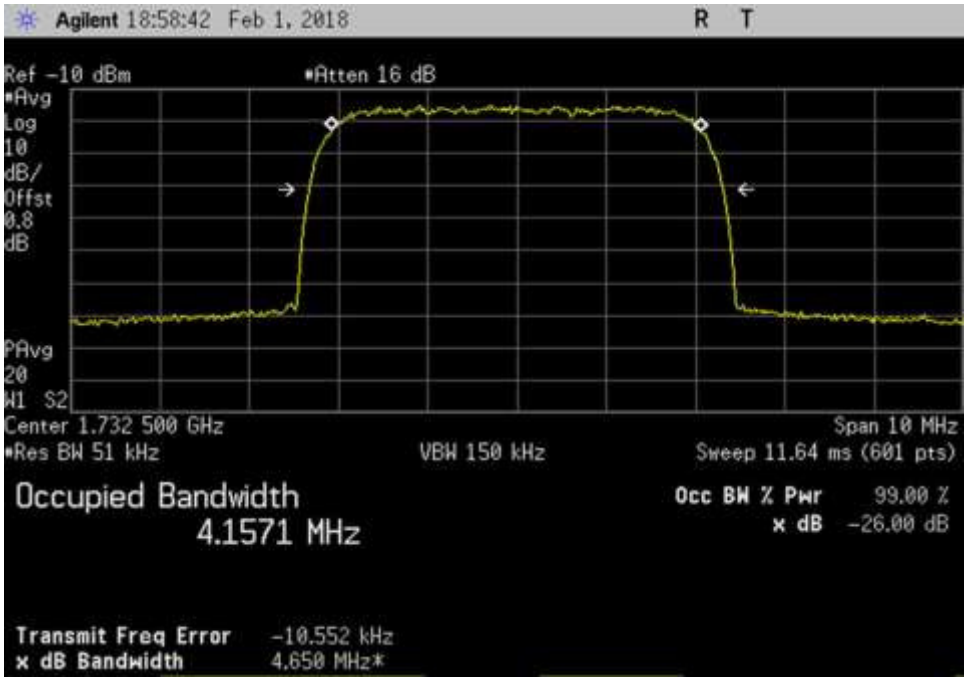

UL_698-716_WCDMA_ 707MHz



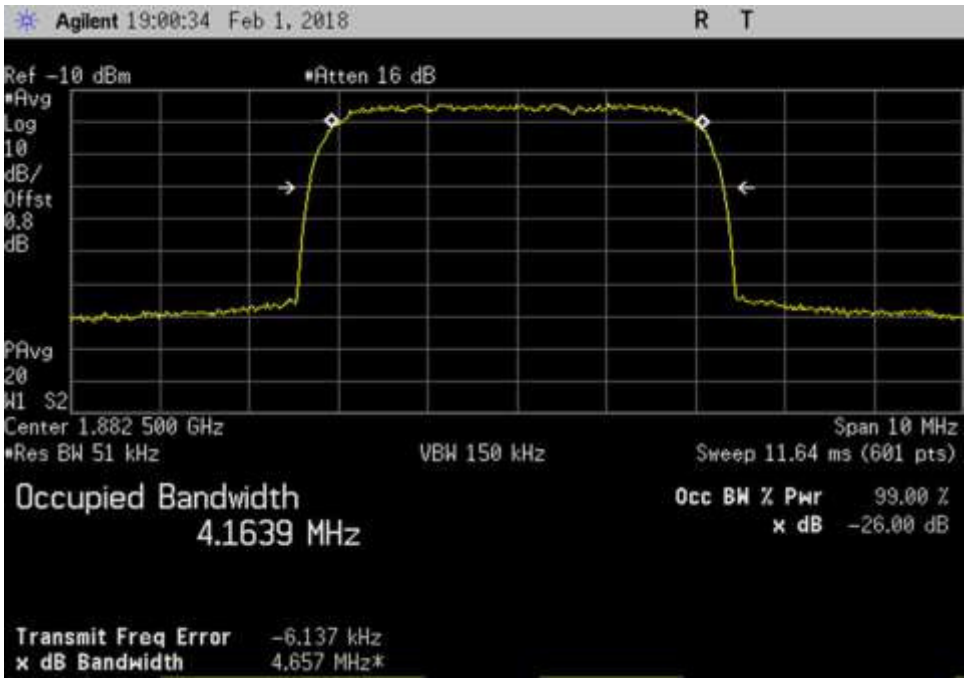

UL_776-787_WCDMA_ 781.5MHz



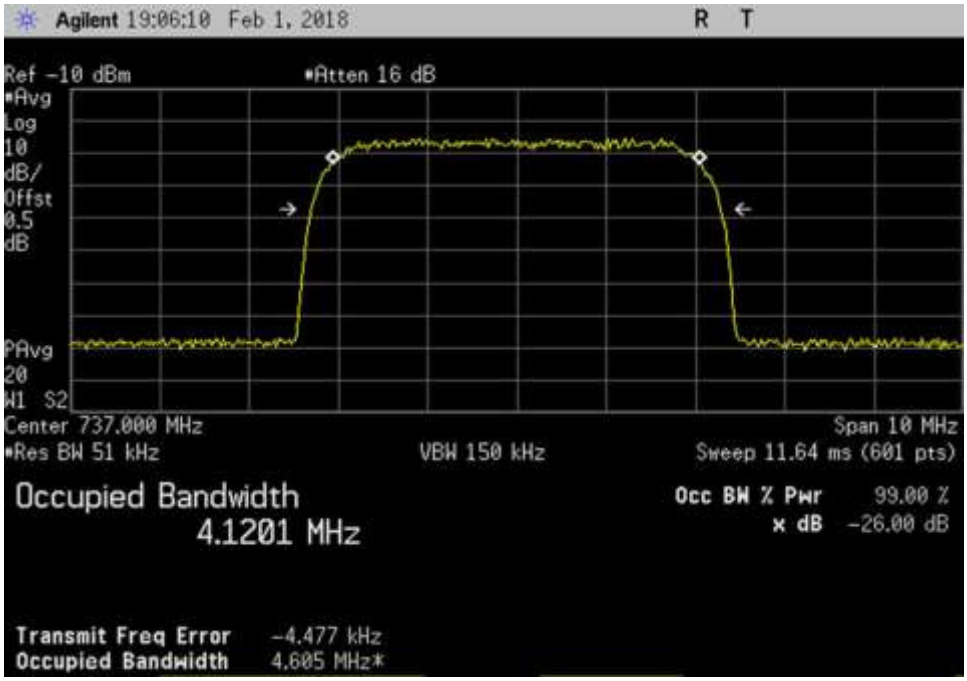

UL_824-849_WCDMA_ 836.5MHz



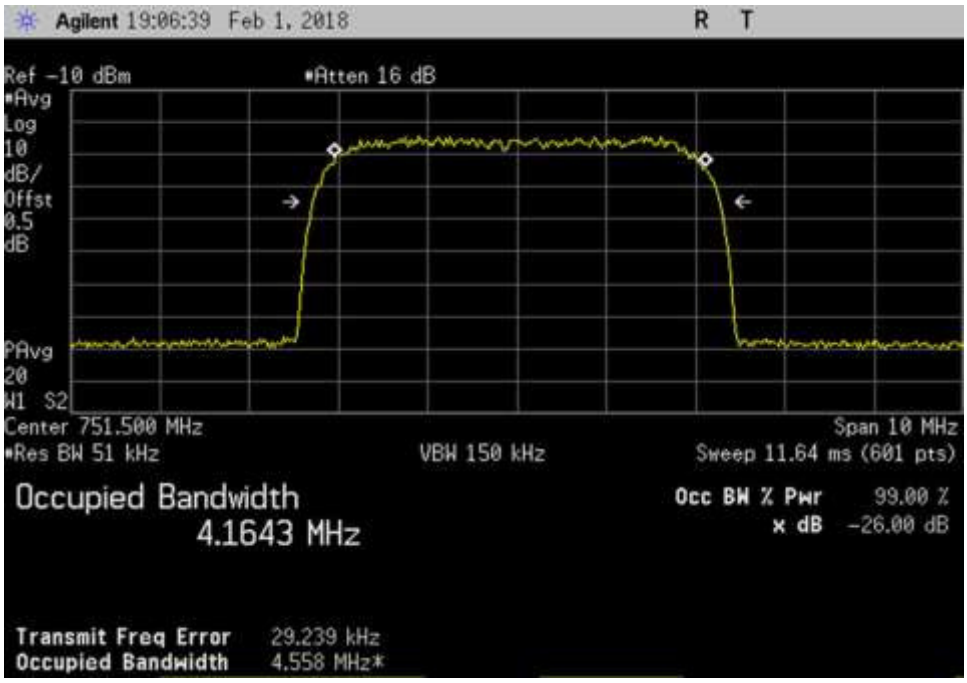

UL_1710-1755_WCDMA_ 1732.5MHz



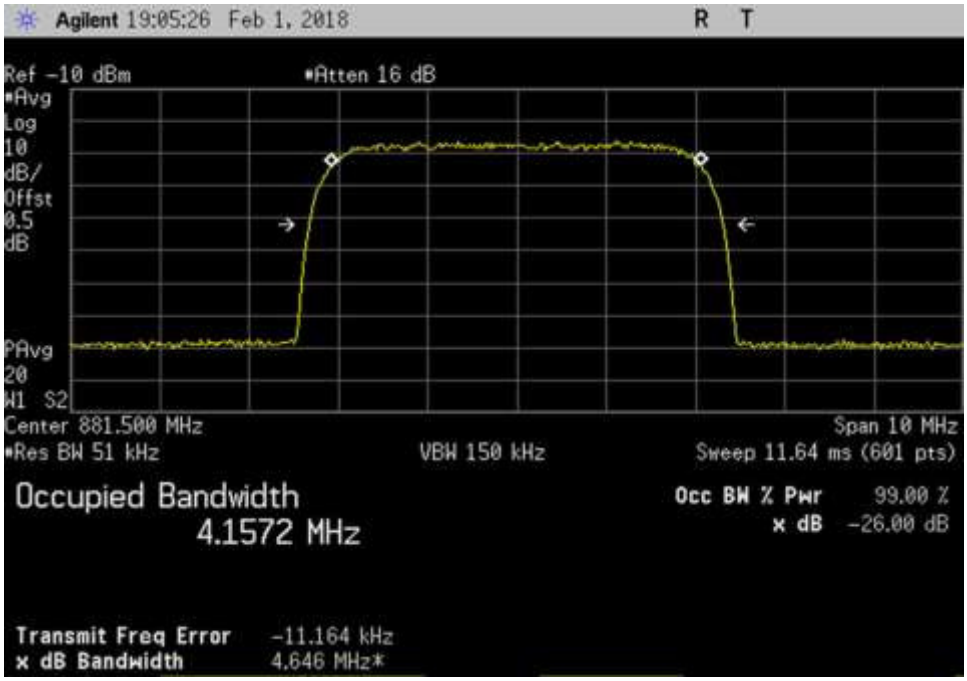

UL_1850-1915_WCDMA_ 1882.5MHz



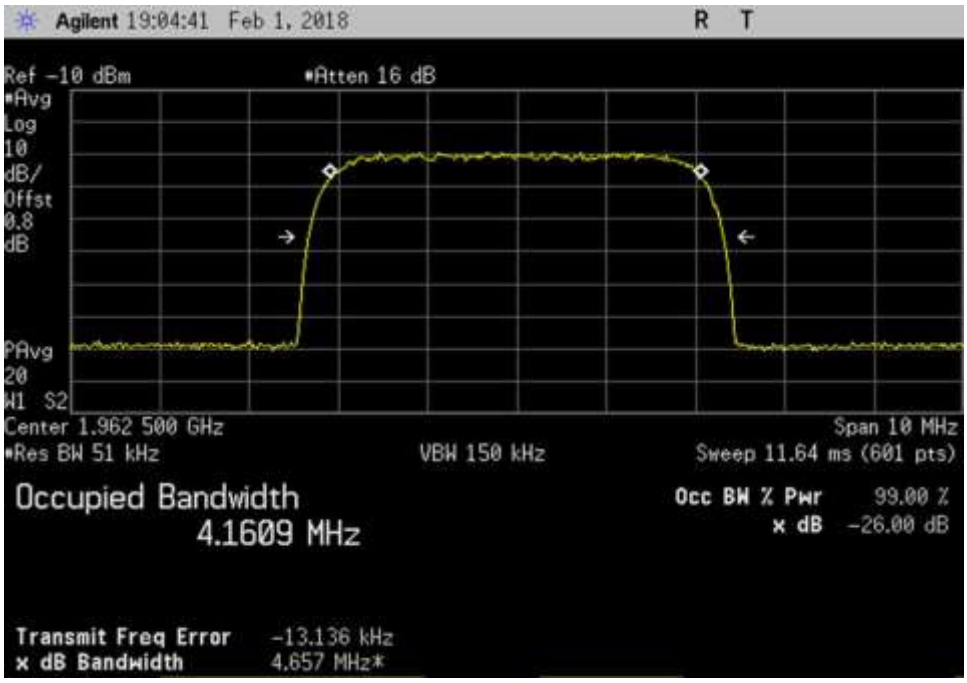

DL_728-746_WCDMA_ 737MHz



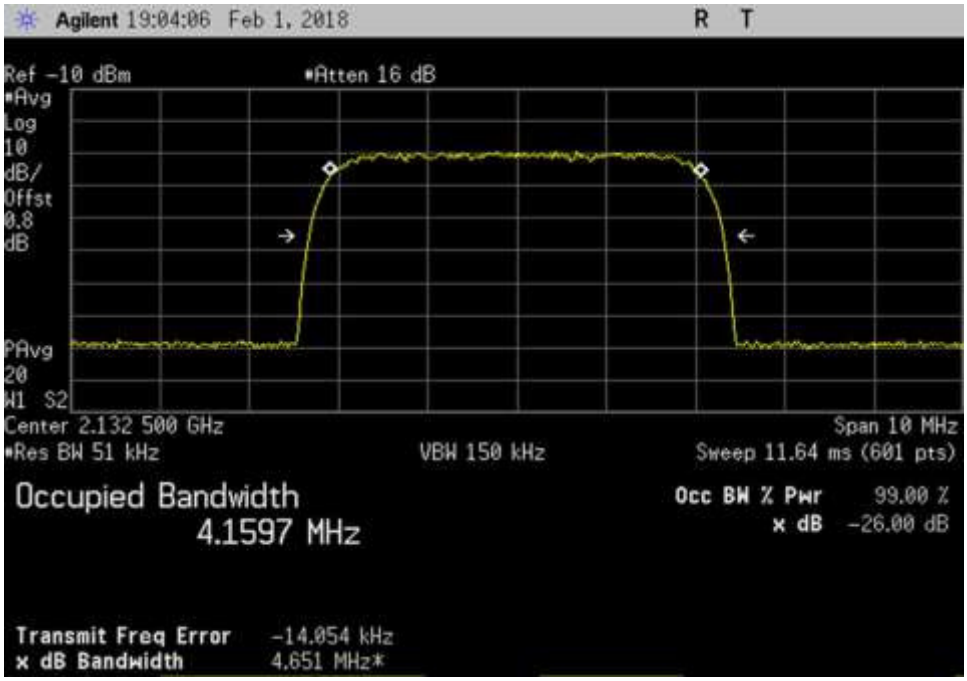

DL_746-757_WCDMA_ 751.5MHz




DL_869-894_WCDMA_ 881.5MHz

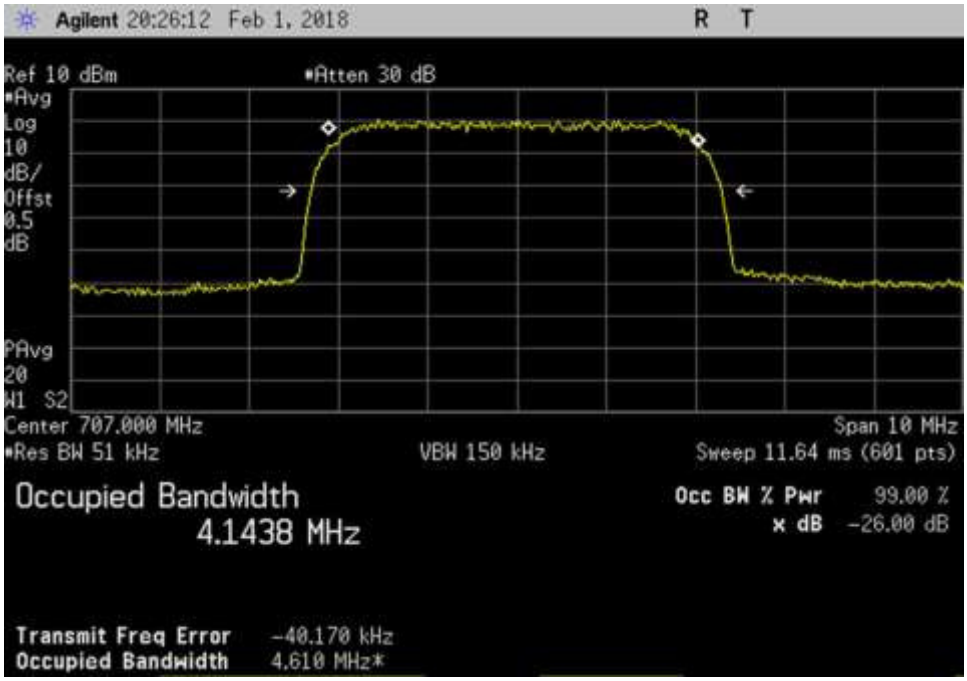



DL_1930-1995_WCDMA_ 1962.5MHz

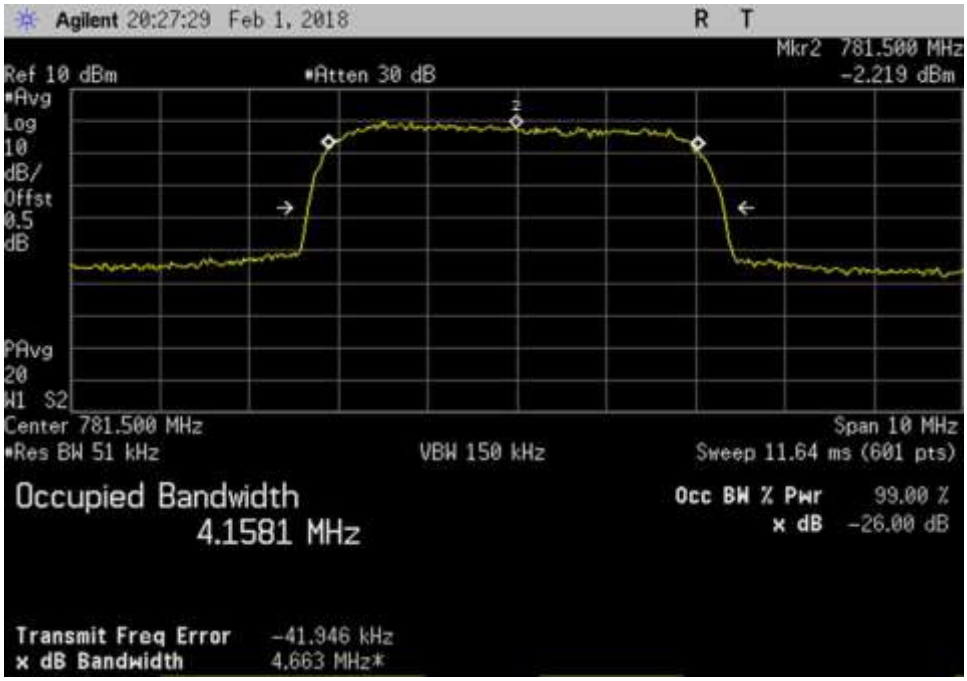



DL_2110-2155_WCDMA_ 2132.5MHz

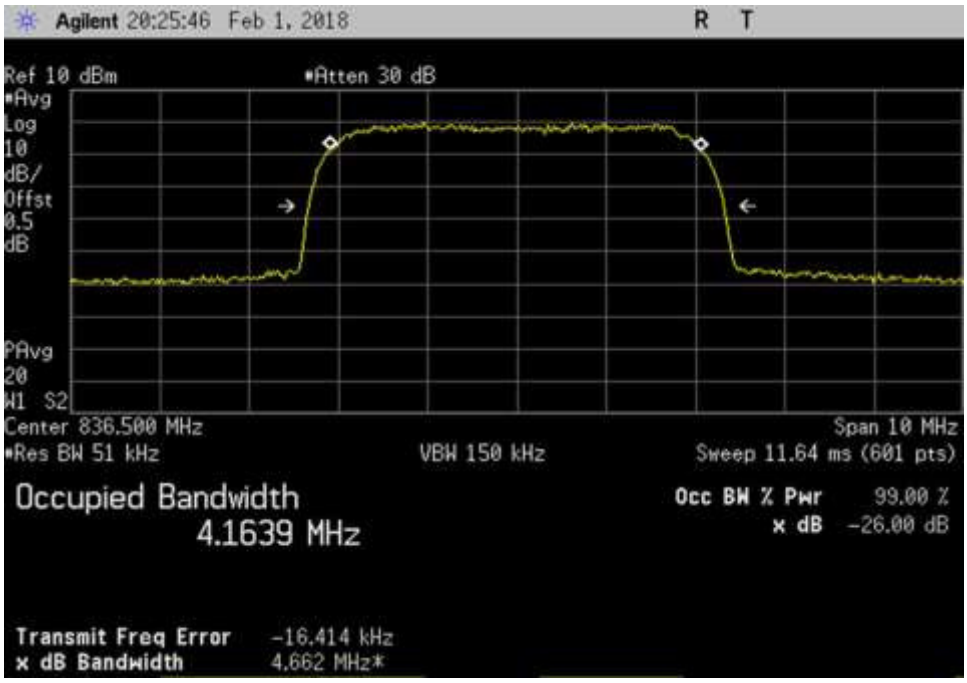
**WCDMA Output**



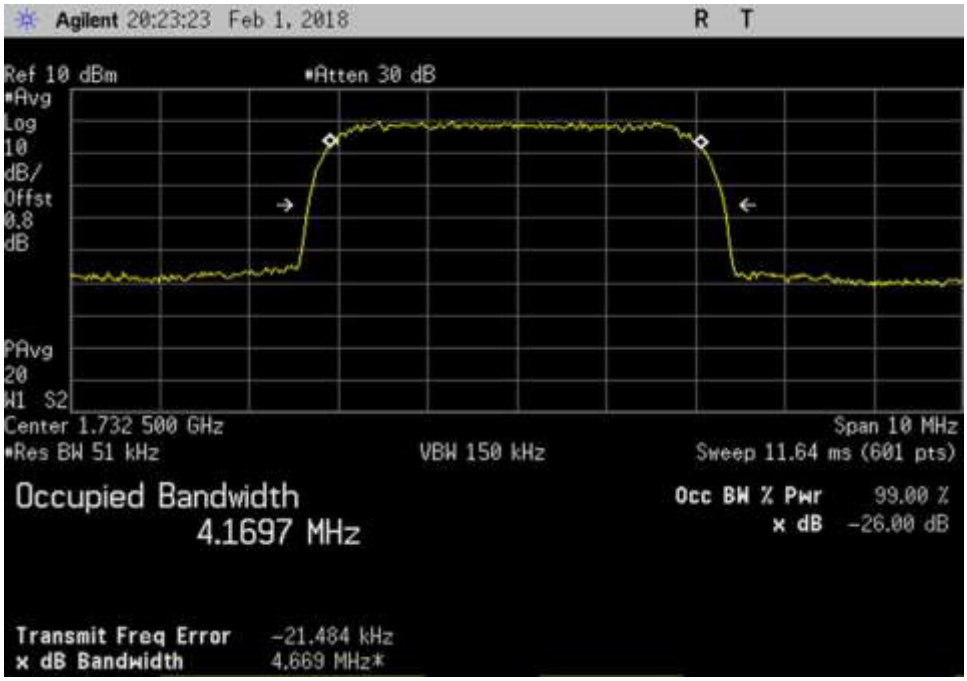

UL_698-716_WCDMA_ 707MHz



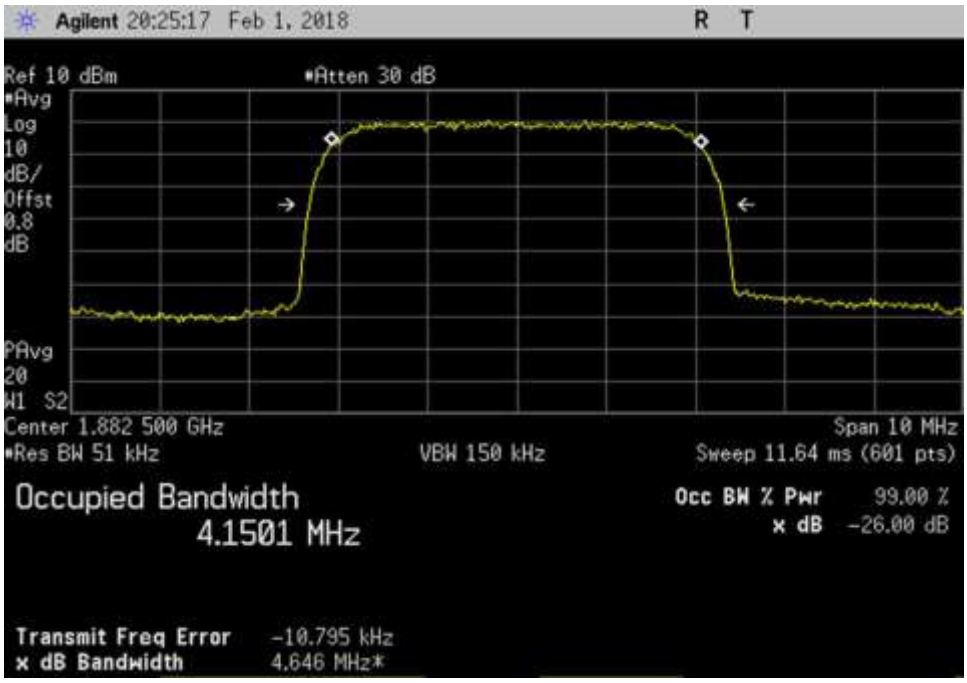

UL_776-787_WCDMA_ 781.5MHz



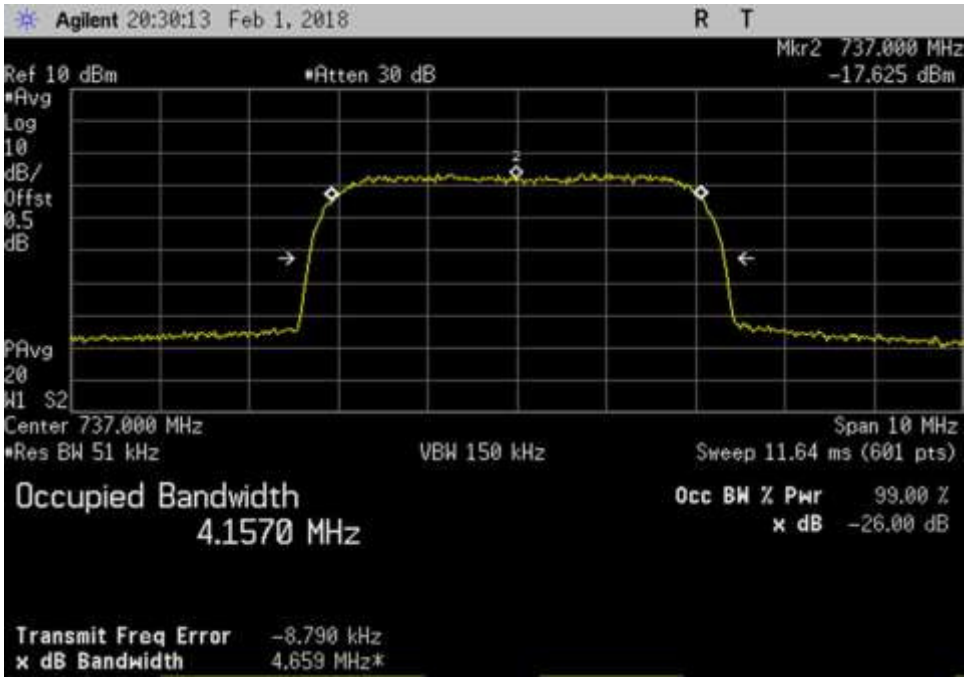

UL_824-849_WCDMA_ 836.5MHz



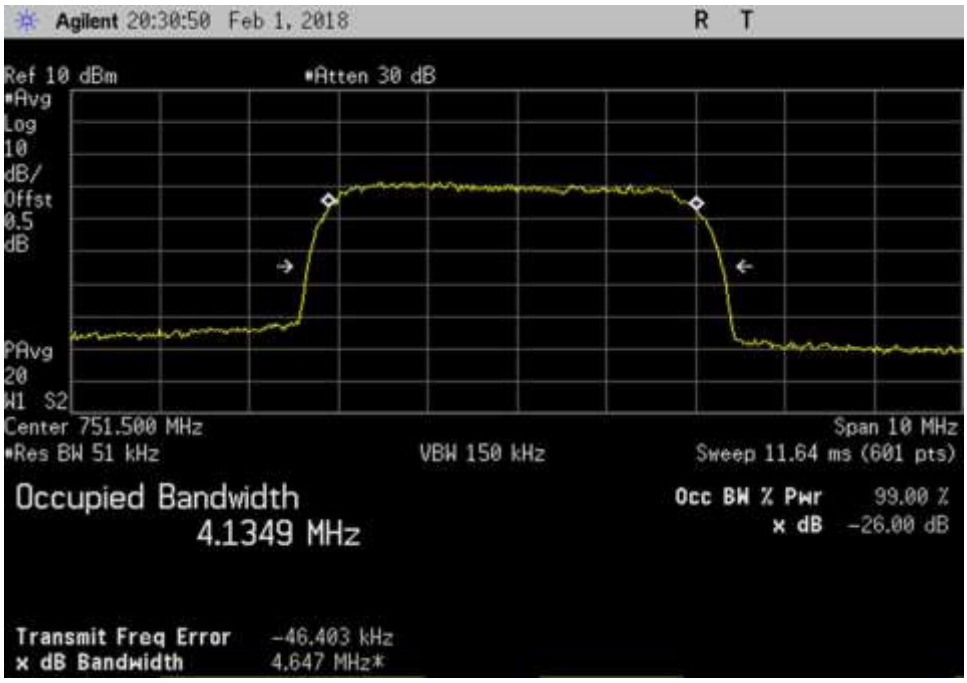

UL_1710-1755_WCDMA_ 1732.5MHz



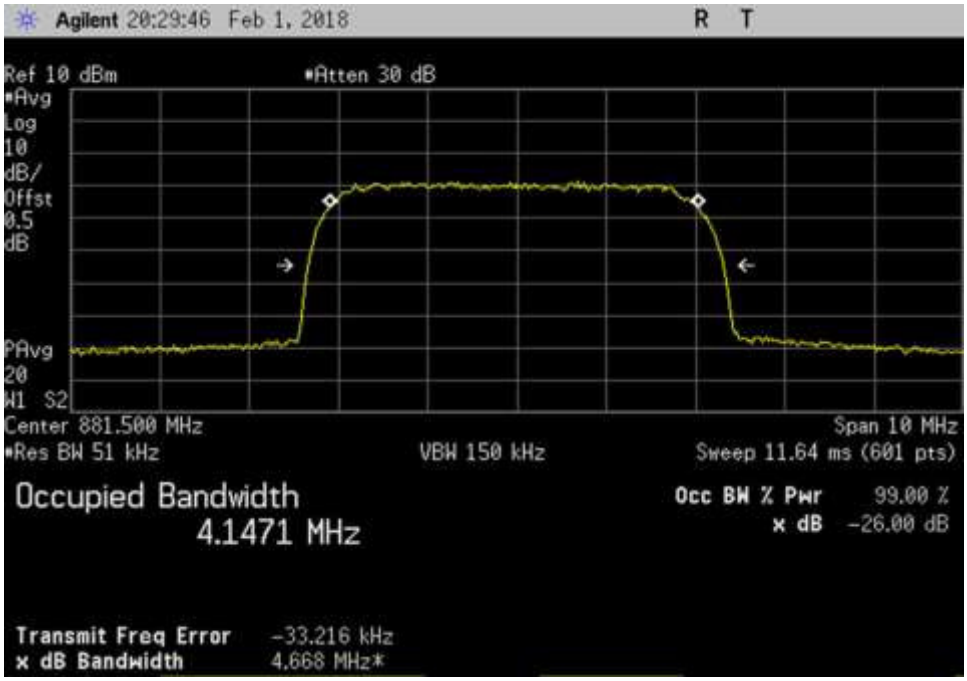

UL_1850-1915_WCDMA_ 1882.5MHz



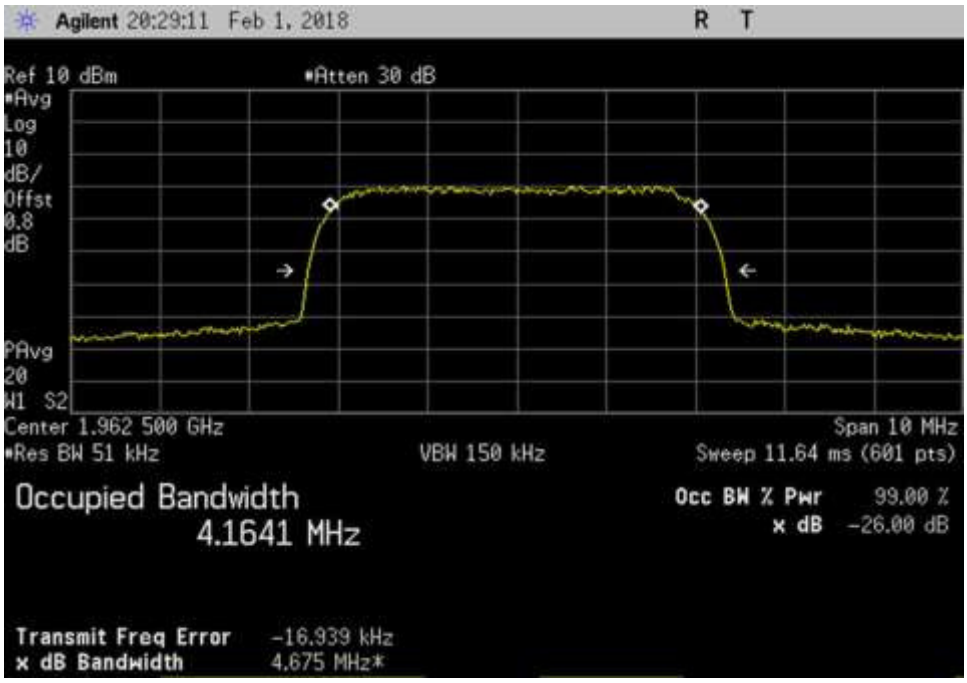

DL_728-746_WCDMA_ 737MHz



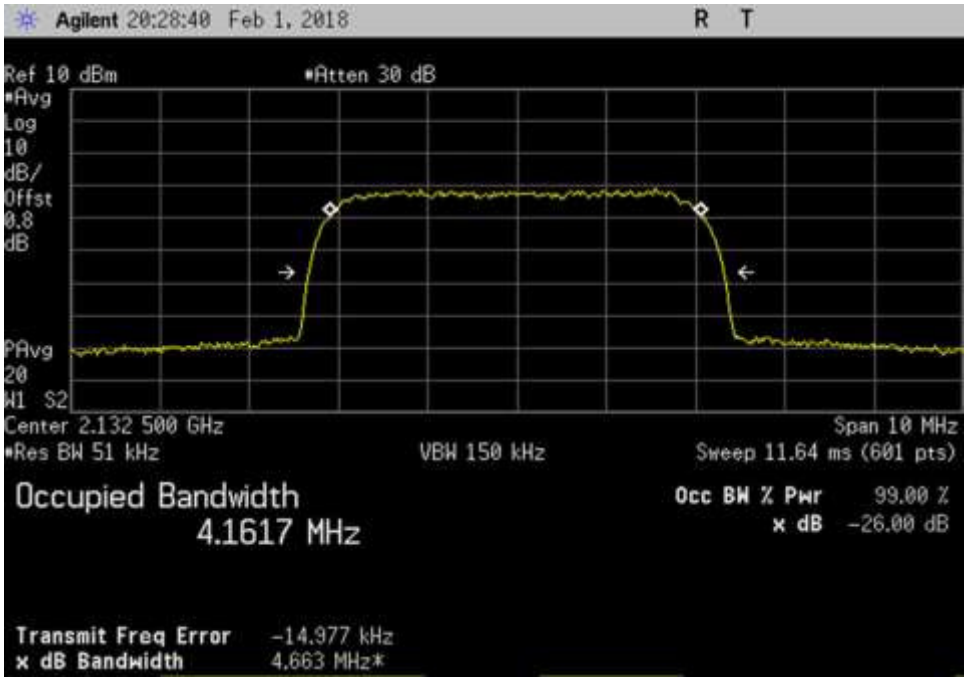

DL_746-757_WCDMA_ 751.5MHz




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 #: | **100826** | Date: | 2/1/2018 |
| Test Type: | **Conducted Emissions** | Time: | 8:27:00 AM |
| Tested By: | E. Wong | Sequence#: | 1 |
| Software: | EMITest 5.03.11 | | 12VDC |

***Equipment Tested:***

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

***Support Equipment:***

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

***Test Conditions / Notes:***

Note:
- +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 | Model | Calibration Date | Cal Due Date |
|---|---|---|---|---|
| 03470 | Spectrum Analyzer | E4440A | 1/3/2018 | 1/3/2020 |
| P07191 | Cable | 32022-29094K-29094K-48TC | 10/30/2017 | 10/30/2019 |
| P07191 | Cable | 32022-29094K-29094K-48TC | 10/30/2017 | 10/30/2019 |
| 03418 | Signal Generator | E4438C | 6/19/2017 | 6/19/2019 |
| C00082 | Directional Coupler | 722-10-1.500V | 9/18/2017 | 9/18/2019 |
| 03412 | Band Pass Filter | PE8705 | 8/16/2017 | 8/16/2019 |
| 03413 | Band Pass Filter | PE8706 | 8/16/2017 | 8/16/2019 |
| 03414 | Band Pass Filter | PE8707 | 8/16/2017 | 8/16/2019 |
| 03415 | Band Pass Filter | PE8708 | 8/16/2017 | 8/16/2019 |
| 03447 | Band Pass Filter | PE8710 | 8/16/2017 | 8/16/2019 |
| 03448 | Band Pass Filter | PE8711 | 8/16/2017 | 8/16/2019 |
| 03446 | Band Pass Filter | 4FV50-707/H18-O/O | 8/16/2017 | 8/16/2019 |
| 03467 | Band Pass Filter | 4FV50-731/H30-O/O | 8/16/2017 | 8/16/2019 |
| 03468 | Band Pass Filter | 4CS10-781.5/E12.2-O/O | 8/16/2017 | 8/16/2019 |
| 03469 | Band Pass Filter | 4CS10-751.5/E12-O/O | 8/16/2017 | 8/16/2019 |
| 02475 | Attenuator | 8494B | 6/8/2017 | 6/8/2019 |
| 03429 | Attenuator | 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 | 0.191 | 0.3 | 23.3 | 74 | 60 | 2 | 5 |
| UL1850-1915 | 0.116 | 0.3 | 24.9 | 74 | 60 | 2 | 5 |
| UL824-894 | 0.133 | 0.3 | 26.2 | 73 | 60 | 2 | 5 |
| UL 698-716 | 0.133 | 0.3 | 25.0 | 71 | 60 | 2 | 5 |
| UL776-787 | 0.0916 | 0.3 | 26.9 | 70 | 60 | 2 | 5 |
| | | | | | | | |
| DL2110-2155 | 0.100 | 1.0 | 18.3 | 72 | 60 | 2 | 5 |
| DL1930-1995 | 0.116 | 1.0 | 15.0 | 72 | 60 | 2 | 5 |
| DL869-894 | 0.141 | 1.0 | 17.8 | 69 | 60 | 2 | 5 |
| DL:728-746 | 0.166 | 1.0 | 23.0 | 68 | 60 | 2 | 5 |
| DL 746-757 | 0.200 | 1.0 | 22.6 | 70 | 60 | 2 | 5 |

The booster continues to mitigate at least 1 minute before restarting. The plots demonstrate after **2** 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 | 9.0 | 9.0 | 6.0 | 5.0 | 5.0 | 12.0 |
| +4dB | 10.0 | 10.0 | 9.0 | 7.0 | 6.0 | 12.0 |
| +3dB | 13.0 | 10.2 | 10.0 | 8.0 | 8.0 | 12.0 |
| +2dB | 12.3* | 13.0* | 14.0* | 9.0 | 7.0 | 12.0 |
| +1dB | 17.0* | 17.0* | 18.0* | 11.0 | 11.0 | 12.0 |
| 0dB | 18.0* | 22.0* | 24.0* | 16.0* | 9.0 | 12.0 |
| -1dB | 25.0* | 36.0* | 93.0* | ** | ** | 12.0 |
| -2dB | ** | ** | ** | ** | ** | 12.0 |
| -3dB | ** | ** | ** | ** | ** | 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 | 2.0 | 4.0 | 3.0 | 9.0 | 6.0 | 12.0 |
| +4dB | 6.0 | 5.0 | 3.0 | 10.0 | 8.0 | 12.0 |
| +3dB | 10.0 | 6.0 | 4.0 | 10.0 | 10.0 | 12.0 |
| +2dB | 10.6 | 6.0 | 5.0 | 12.0* | 12.0* | 12.0 |
| +1dB | 16.0* | 8.0 | 8.0 | 16.0* | 15.0* | 12.0 |
| 0dB | ** | 11.0 | 11.0 | 20.0* | 19.0* | 12.0 |
| -1dB | ** | 16.0* | ** | ** | 25.0* | 12.0 |
| -2dB | ** | 27.0* | ** | ** | ** | 12.0 |
| -3dB | ** | ** | ** | ** | ** | 12.0 |
| -4dB | ** | ** | ** | ** | ** | 12.0 |
| -5dB | ** | ** | ** | ** | ** | 12.0 |

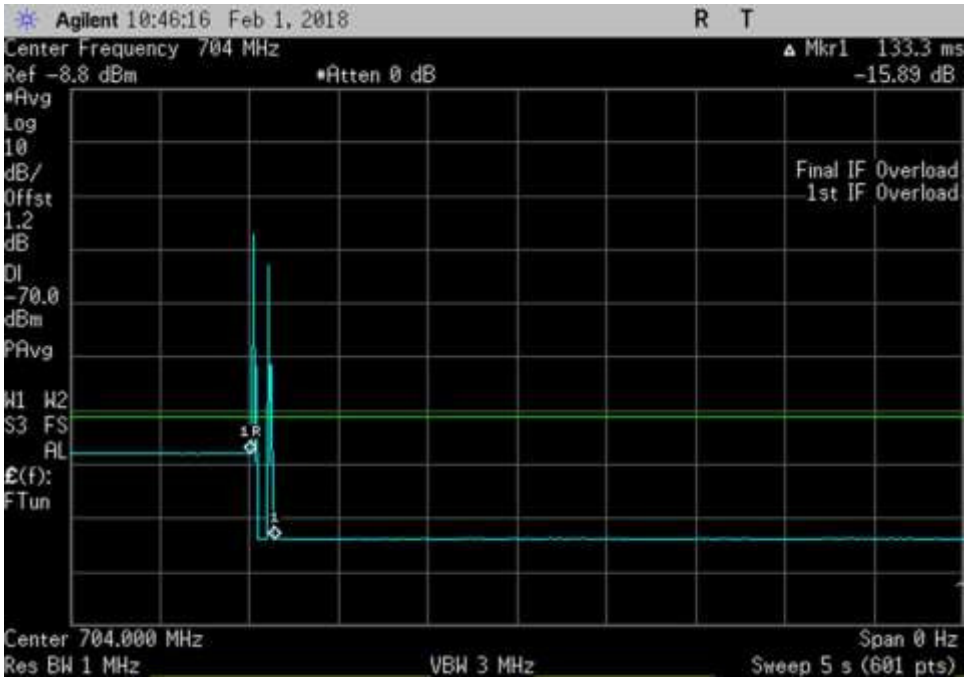
Note:

* 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 **66** seconds for the Uplink bands and 61 seconds for the Downlink bands.

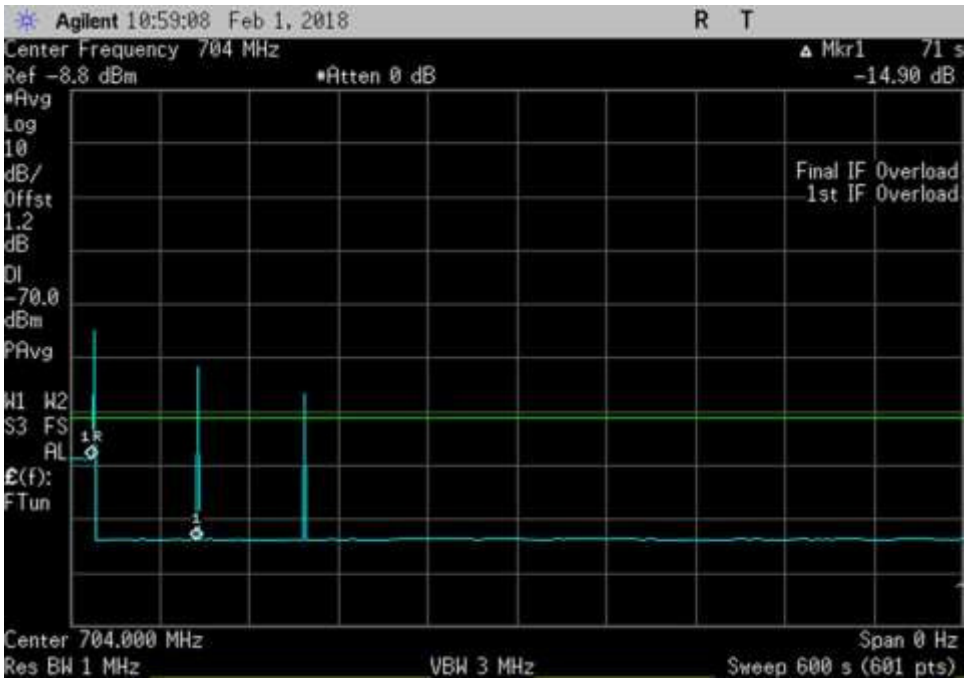
** The device shuts down immediately.

## 7.11.2 Oscillation Restart Tests

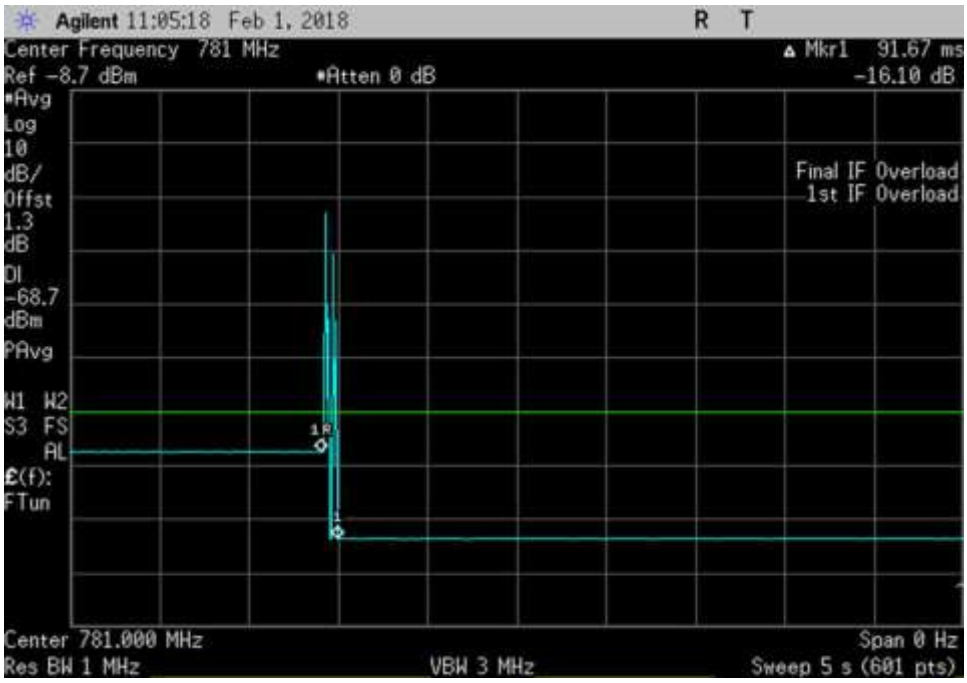
**Plots**



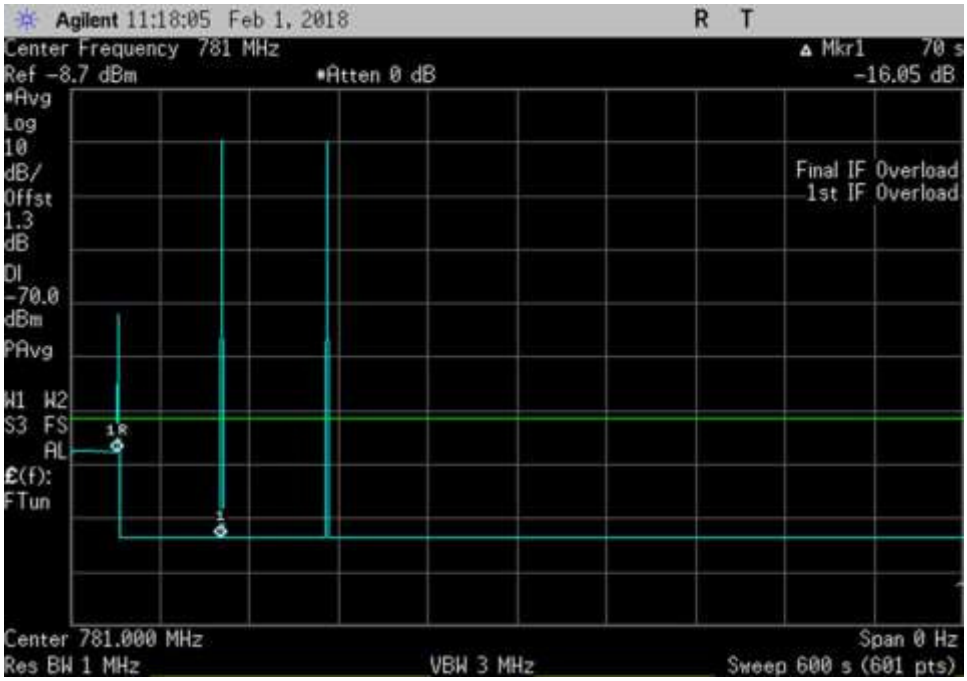

UL__698-716_ 704MHz



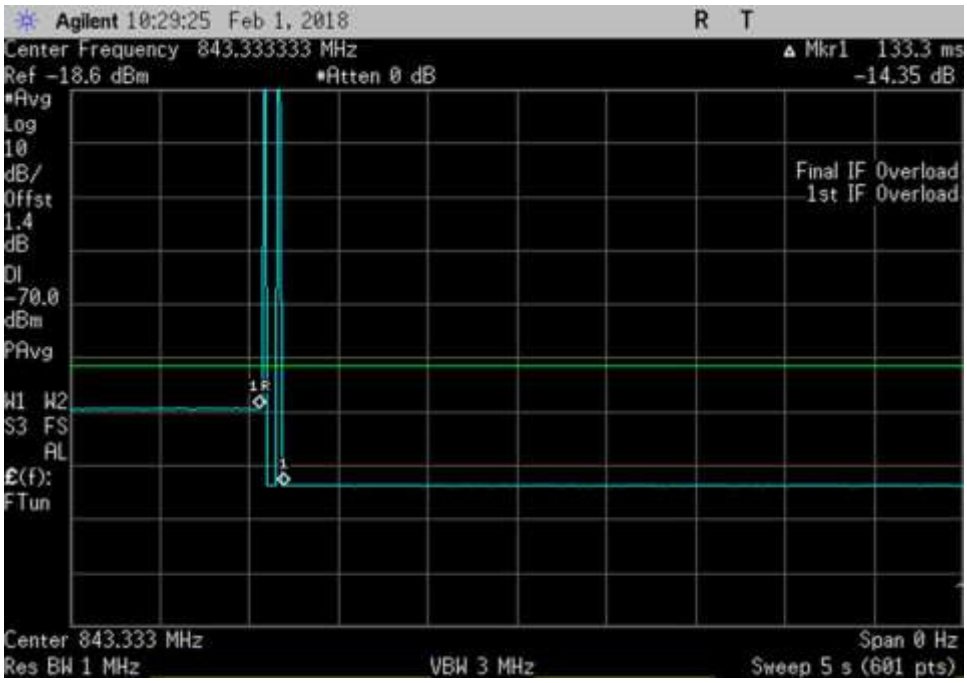

UL_698-716_600sec_ 704MHz



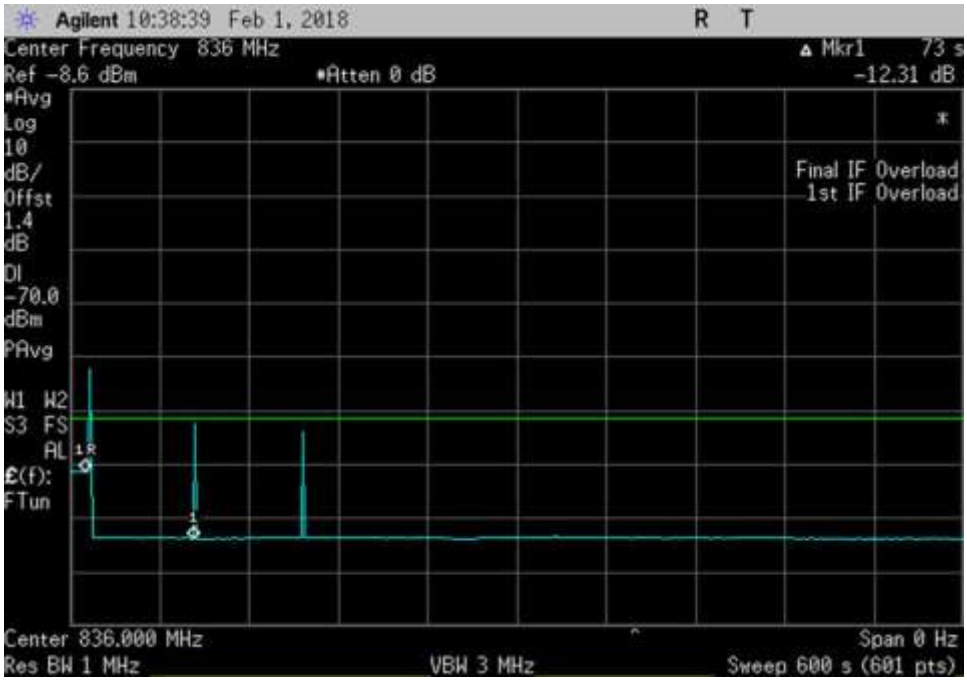

UL_776-787_ 781MHz



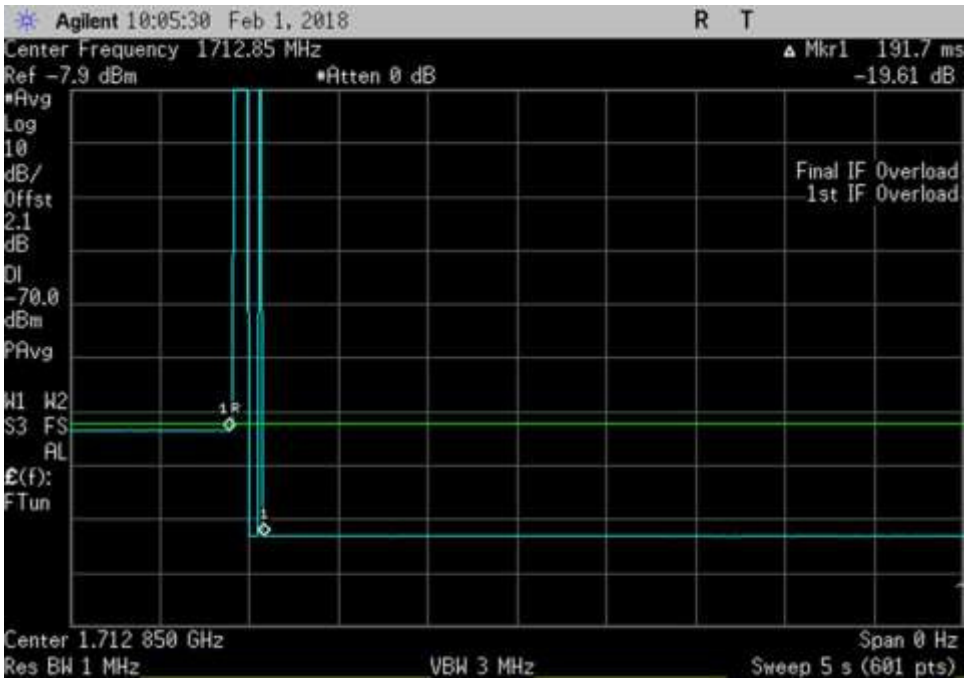

UL_776-787_600sec_ 781MHz



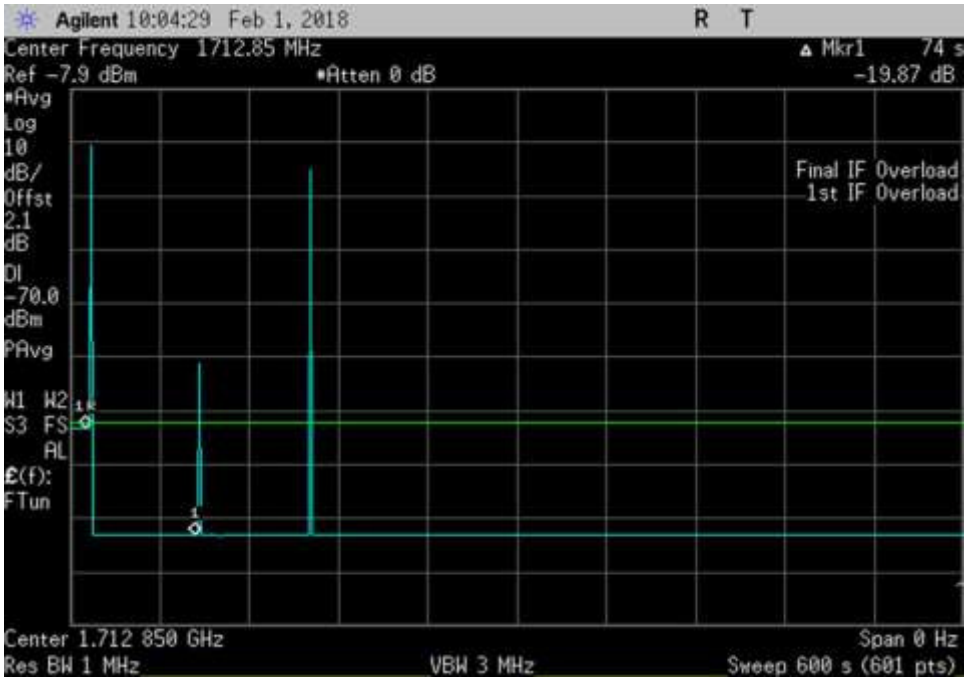

UL_824-849_ 843.33MHz



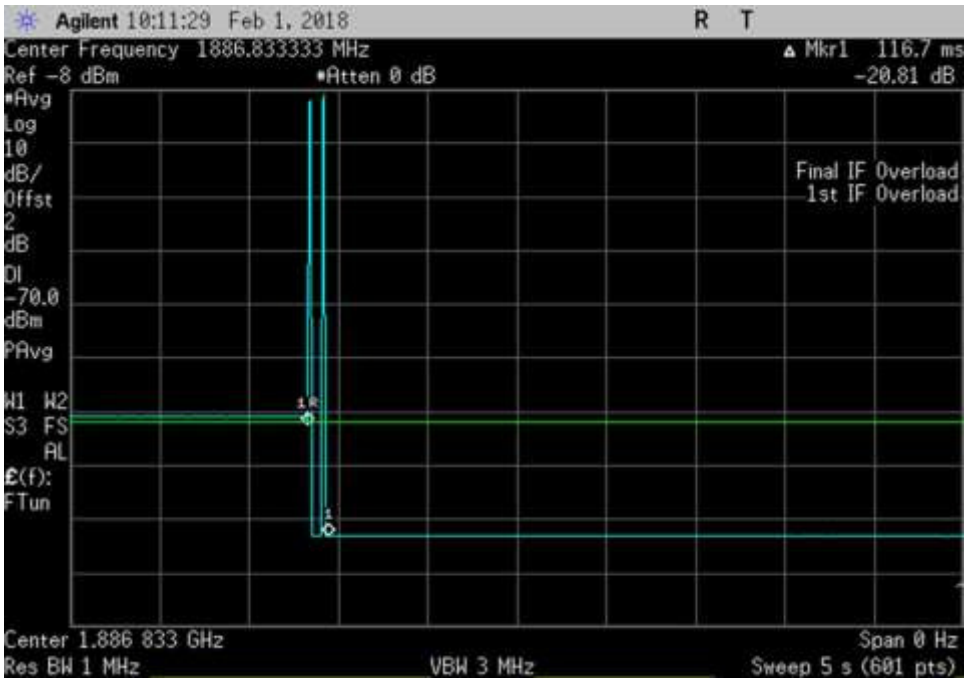

UL_824-849_600sec_ 836MHz



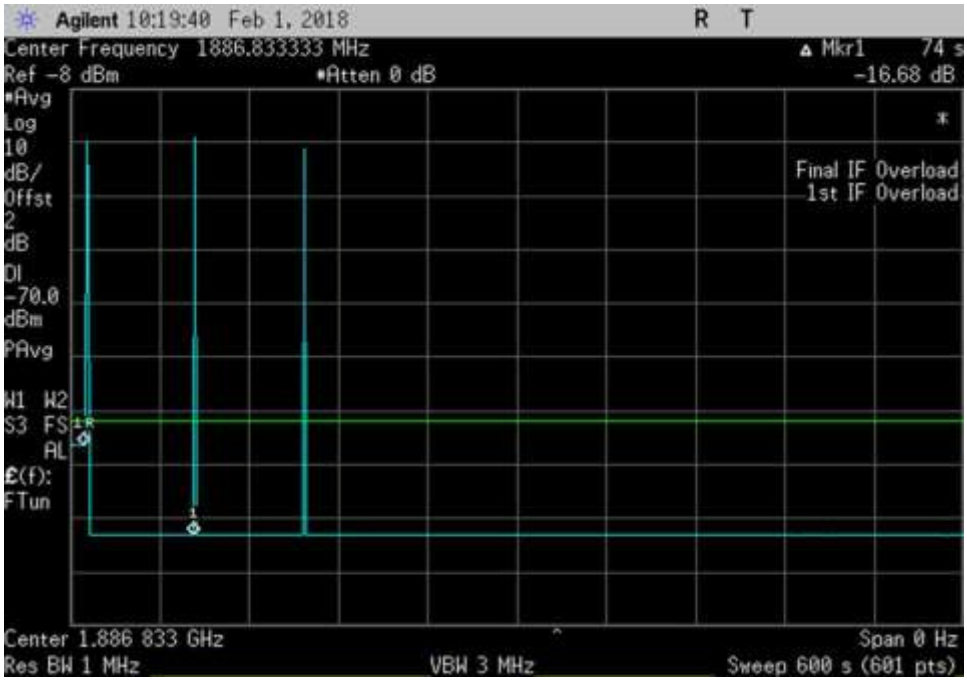

UL_1710-1755_ 1712.85MHz



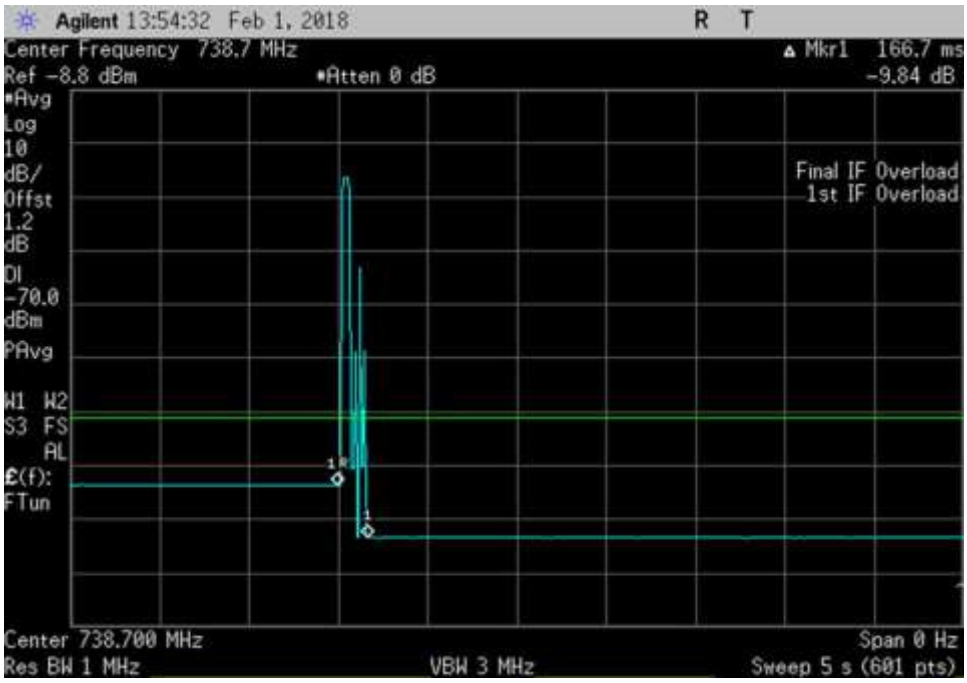

UL_1710-1755_600sec_ 1712.85MHz



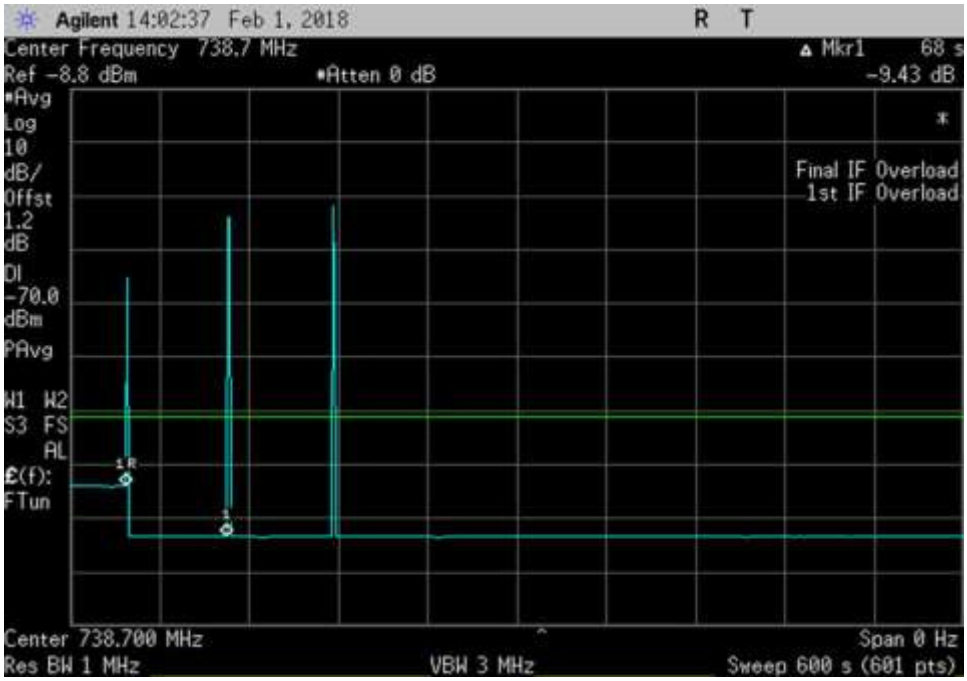

UL_1850-1915_ 1886.8MHz



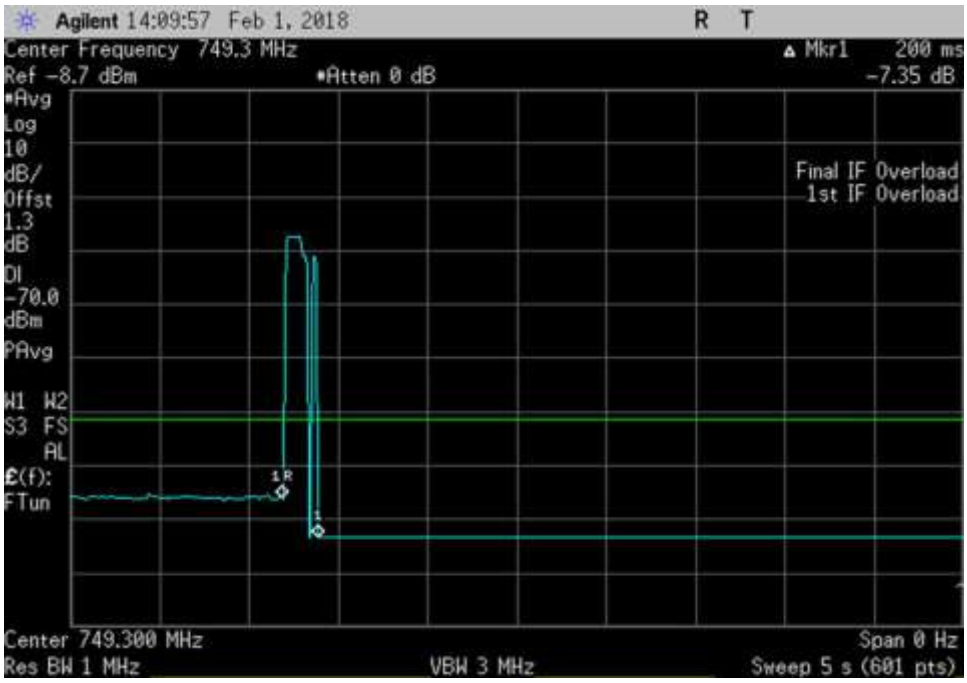

UL_1850-1915_600sec_ 1886.83MHz



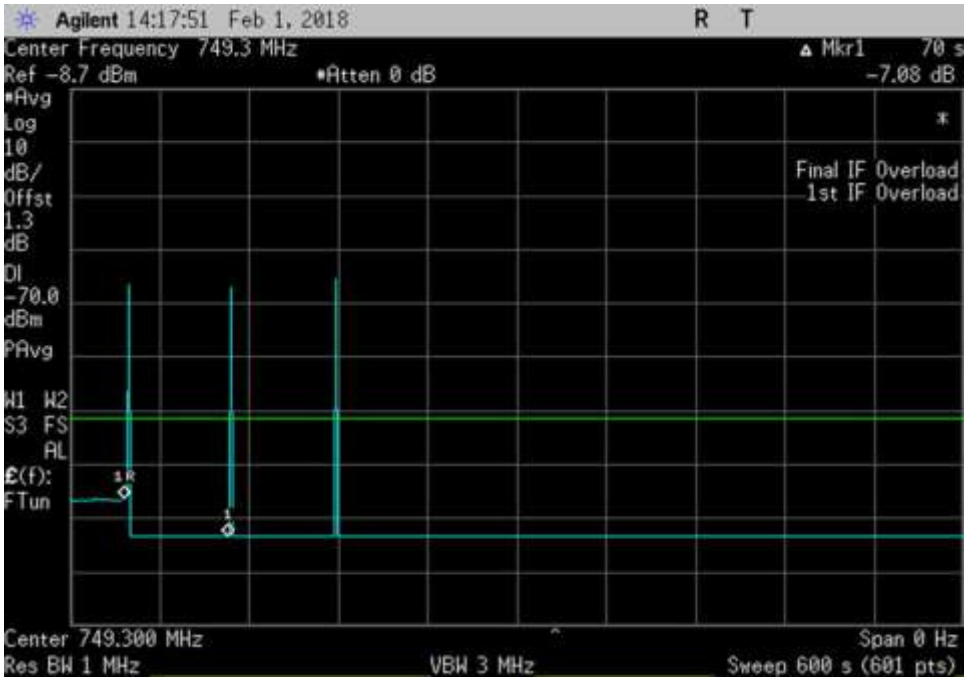

DL_728-746_ 738.7MHz



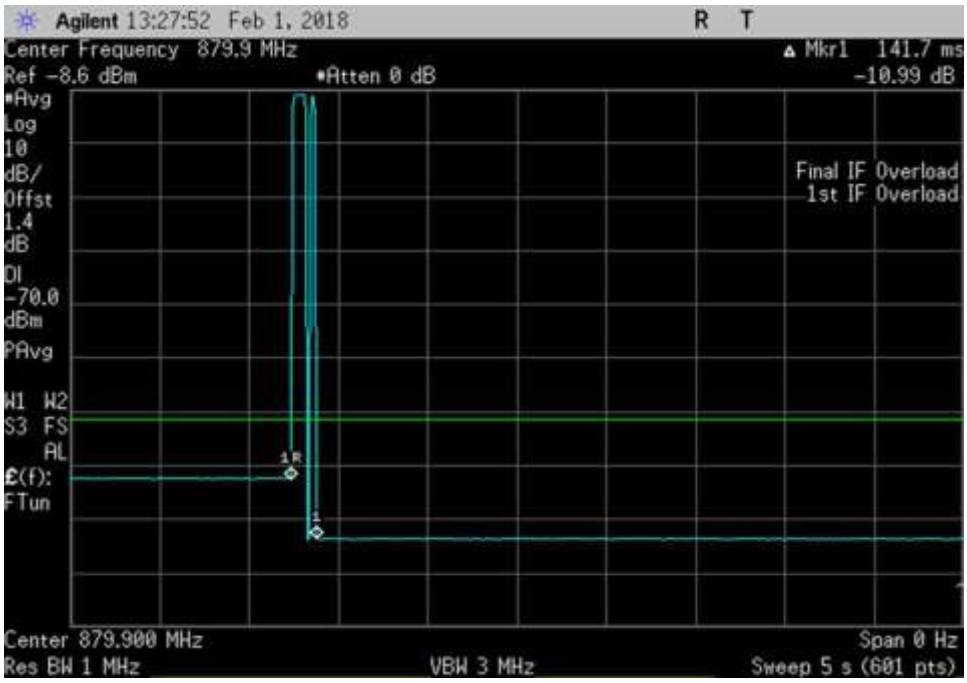

DL_728-746_600sec_ 738.7MHz



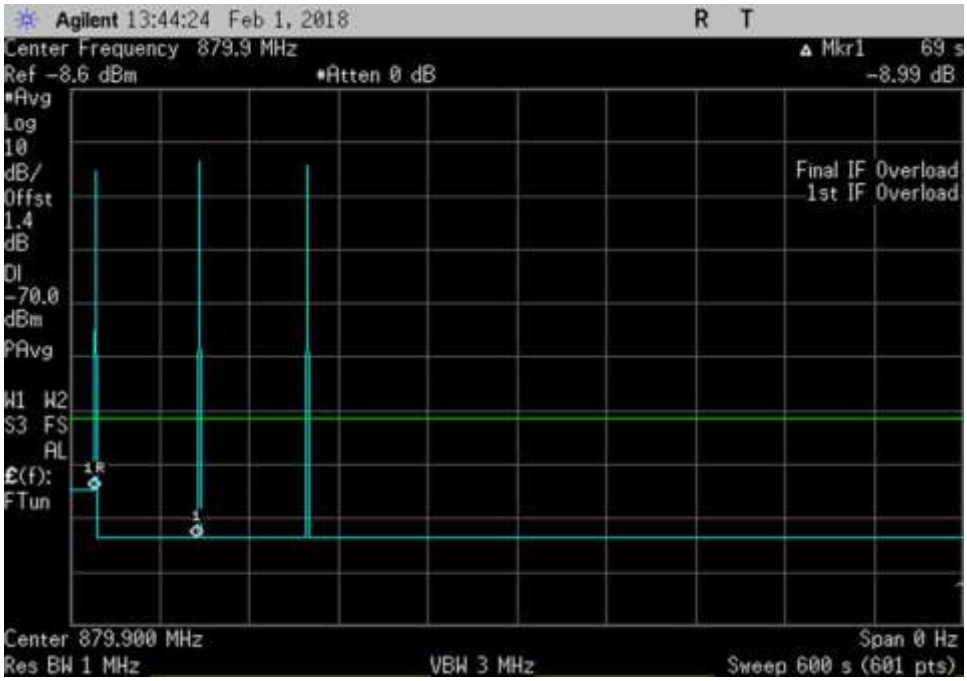

DL_746-757_ 749.3MHz



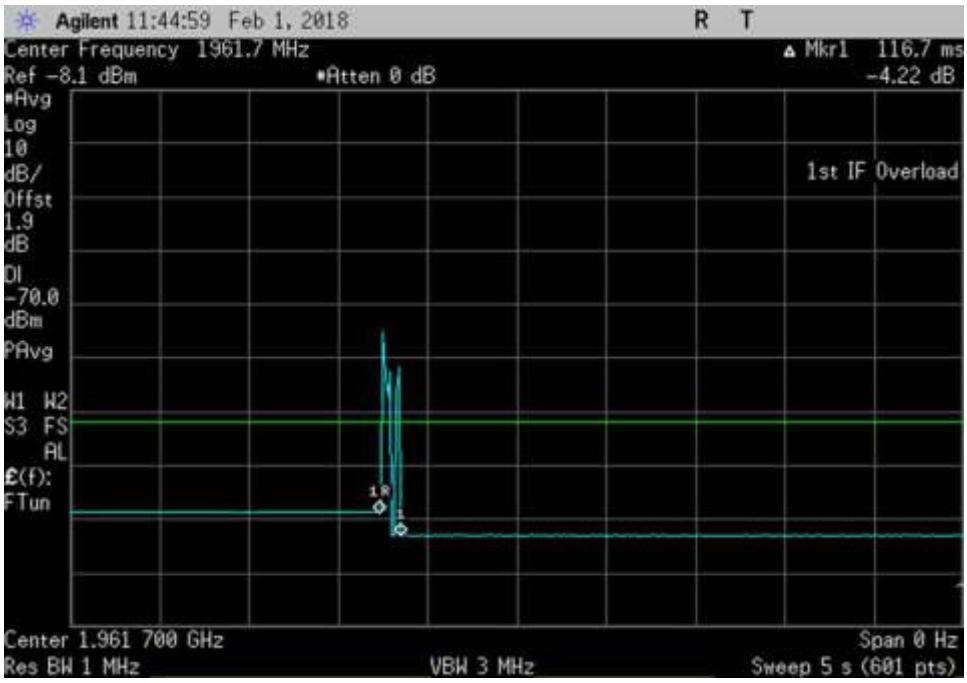

DL_746-757_600sec_ 749.3MHz



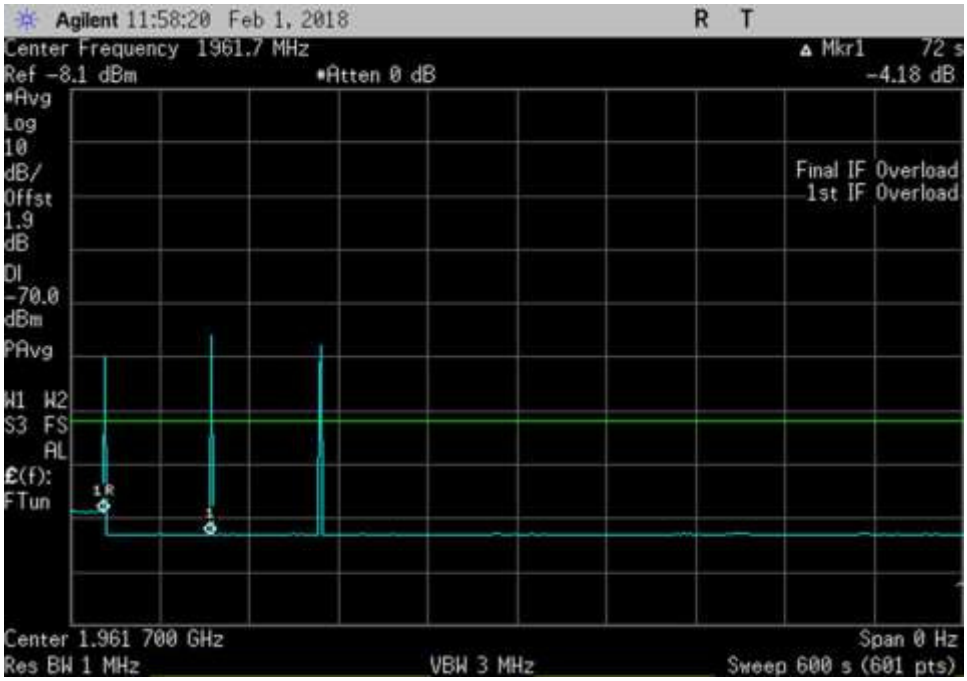

DL_869-894_ 879.9MHz



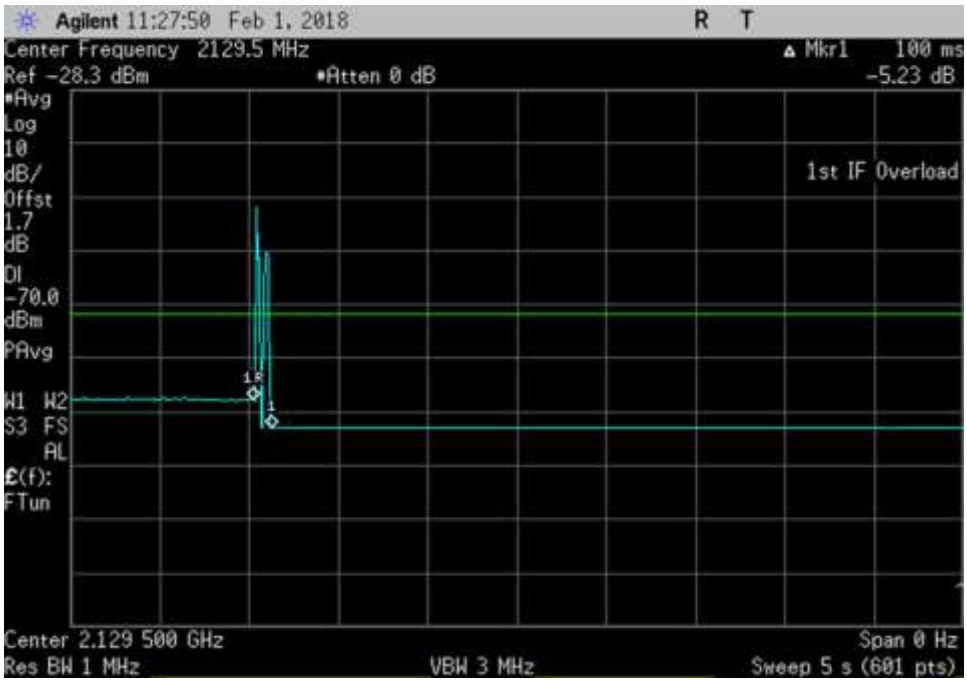

DL_869-894_600sec_ 879.9MHz



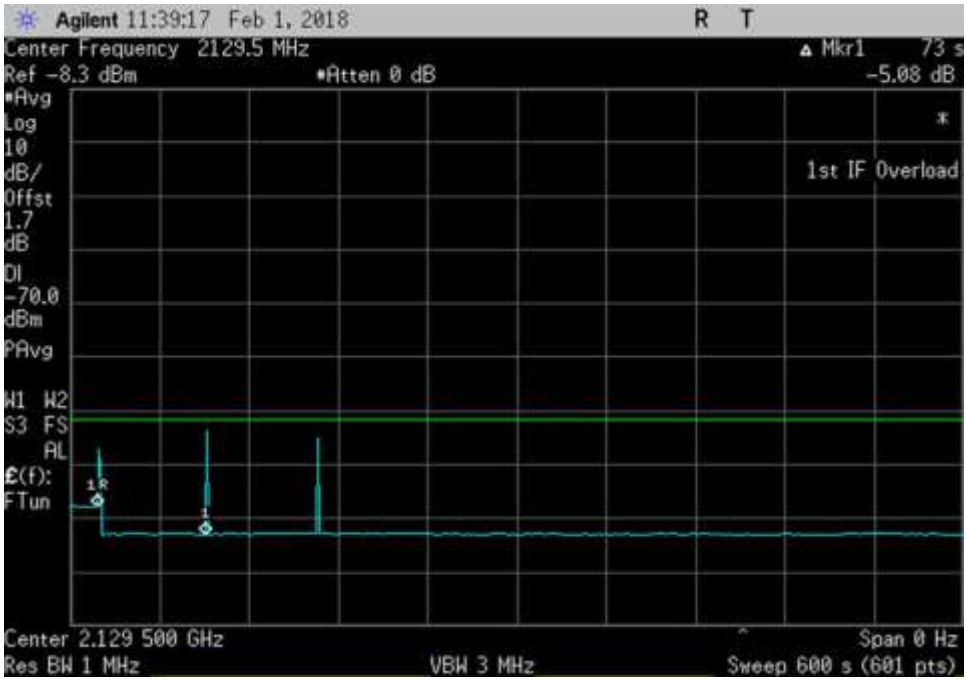

DL_1930-1995_ 1961.7MHz




DL_1930-1995_600sec_ 1961.7MHz




DL_2110-2155_ 2129.5MHz




DL_2110-2155_600sec_ 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: | **Radiated Emissions** | | |
| Work Order #: | **100826** | Date: | 02/08/2018 |
| Tested By: | Hieu Song Nguyenpham | | |
| Software: | EMITest 5.03.11 | | 12VDC |

***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: 23.5°C
Relative Humidity: 45%
Pressure: 101.6 kPa

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.

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 | Manufacturer | Model | Cal Date | Cal Due |
|---|---|---|---|---|---|
| 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 |
| P06909 | Attenuator | Pasternack | PE7083 | 12/20/2017 | 12/20/2019 |

| Test Equipment | | | | | |
|---|---|---|---|---|---|
| **Asset#** | **Description** | **Manufacturer** | **Model** | **Cal Date** | **Cal Due** |
| 01996 | Biconilog Antenna | Chase | CBL6111C | 11/1/2016 | 11/1/2018 |
| P06049 | Attenuator | Pasternack | PE7002-6 | 5/9/2016 | 5/9/2018 |
| P00880 | Cable | Pasternack | RG214U | 5/10/2016 | 5/10/2018 |
| P01187 | Cable | Andrews | CNT-195 | 8/8/2016 | 8/8/2018 |
| 00971A | Preamp | HP | 8447D | 1/8/2018 | 1/8/2020 |
| 02870 | Spectrum Analyzer | Agilent | E4440A | 3/31/2016 | 3/31/2018 |
| 02113 | Horn Antenna | EMC Test Systems | 3115 | 2/6/2017 | 2/6/2019 |
| 03607 | Preamp | Miteq | AMF-7D-00101800-30-10P | 6/6/2017 | 6/6/2019 |
| P01210 | Cable | Andrews | FSJ1P-50A-4A | 1/16/2017 | 1/16/2019 |
| 03362 | Cable | Astrolab | 32022-2-29094-48TC | 1/10/2017 | 1/10/2019 |
| 03302 | Cable | Astrolab | 32026-29094K-29094K-72TC | 1/29/2016 | 1/29/2018 |
| P06138 | Cable | Astrolab | 32022-29094K-29094K-72TC | 3/27/2017 | 3/27/2019 |
| P00928 | Cable | various | various | 1/15/2018 | 1/15/2020 |
| P06126 | Cable | Astrolab | 32022-29094K-29094K-168TC | 3/27/2017 | 3/27/2019 |
| 02693 | Active Horn Antenna | Miteq | AMFW-5F-12001800-20-10P | 5/11/2017 | 5/11/2019 |
| 02694 | Horn Antenna | Miteq | AMFW-5F-18002650-20-10P | 5/11/2017 | 5/11/2019 |
| 02695 | Active Horn Antenna | Miteq | AMFW-5F-260400-33-8P | 5/11/2017 | 5/11/2019 |
| P00929 | Cable | various | various | 1/15/2018 | 1/15/2020 |
| 00432 | Loop Antenna | EMCO | 6502 | 5/30/2017 | 5/30/2019 |

## 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 $P_{t\ at\ 3\ meter}$ dB
Limit line (dBuV) = $E_{dBuv}$ - 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 /$m^2$
Pt = 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 m**
10 Log $P_t$ = 20 Log E (V/m) + 20 Log 3 – 10 Log 30
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 (uV/m) –120***

10 Log $P_t$ = 20 Log E (uV/m) - 120 - 5.23

10 Log $P_t$ = 20 Log E (uV/m) –125.23

Limit line (dBuV) at 3 meter = $E_{dBuv}$ – Attenuation

= $E_{dBuv}$ - ( 43+10 Log $P_{t\ at\ 3\ meter}$ )

= $E_{dBuv}$ - 43 - 10 Log $P_{t\ at\ 3\ meter}$

= $E_{dBuv}$ - 43 – (20 Log E (uV/m) –125.23)

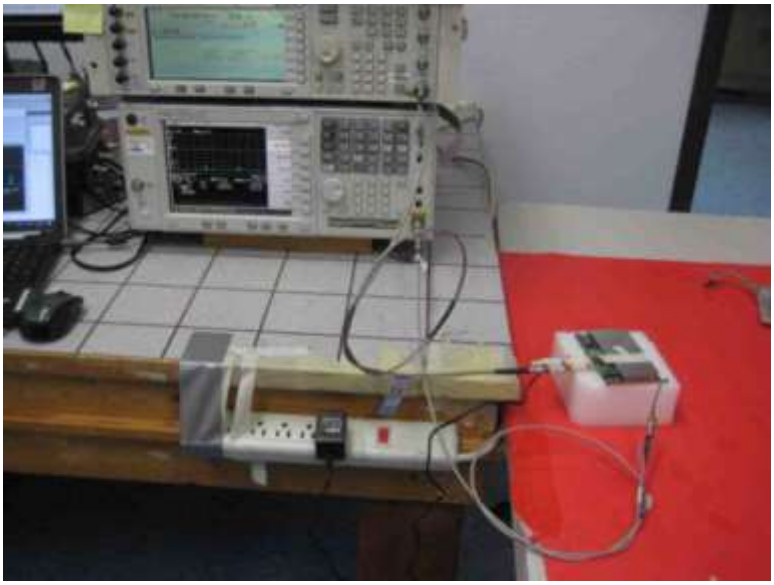
= $E_{dBuv}$ - 43 - 20 Log E (uV/m) + 125.23

= $E_{dBuv}$ - 20 Log E (uV/m) + 82.23

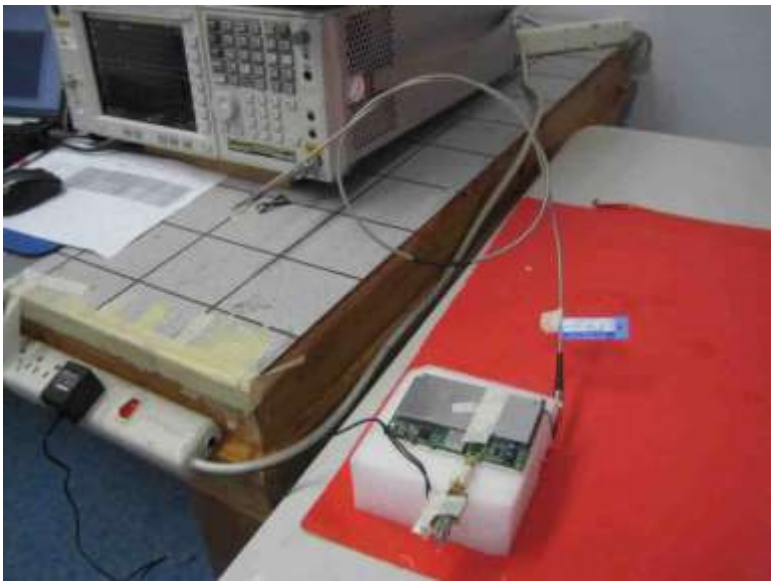
***Since 20 Log E (uV/m) = E in dBuV/m*** = ~~$E_{dBuv}$~~ - ~~$E_{dBuv}$~~ + 82.23

Radiated Emission limit 3 meter = 82.23 dBuV at any power level measured in dBuV

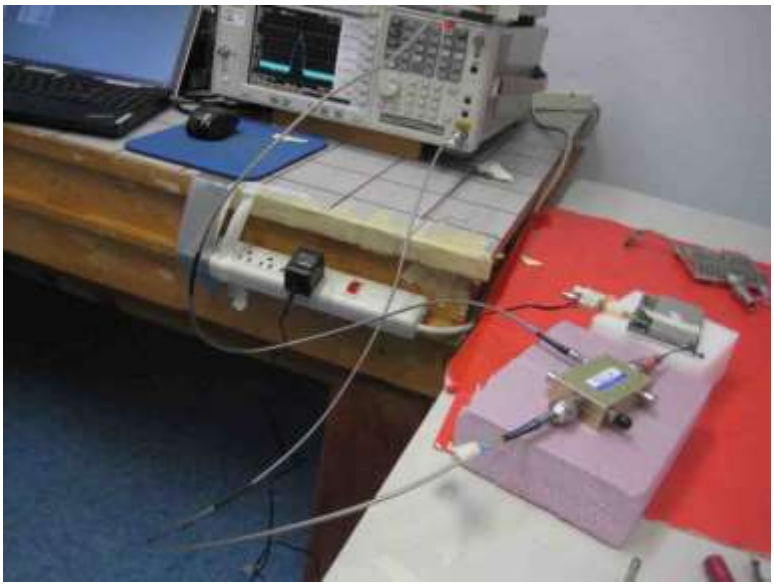
# EXHIBIT A: TEST SETUP PHOTOS



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

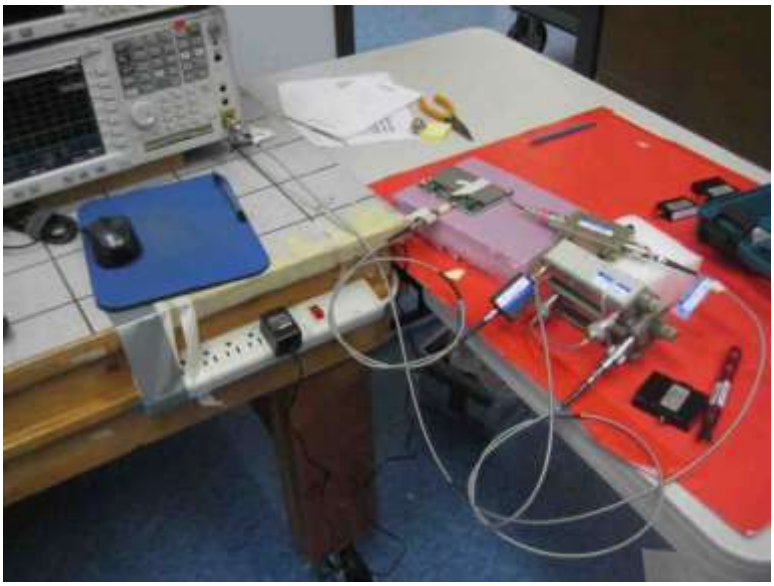


Section 7.7 and 7.8 Uplink Inactive Max Noise

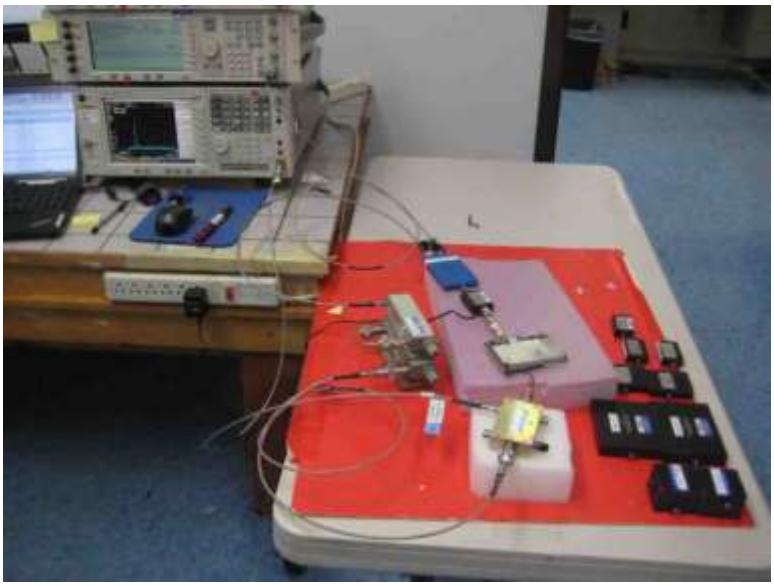


Section 7.7 Variable Noise Timing

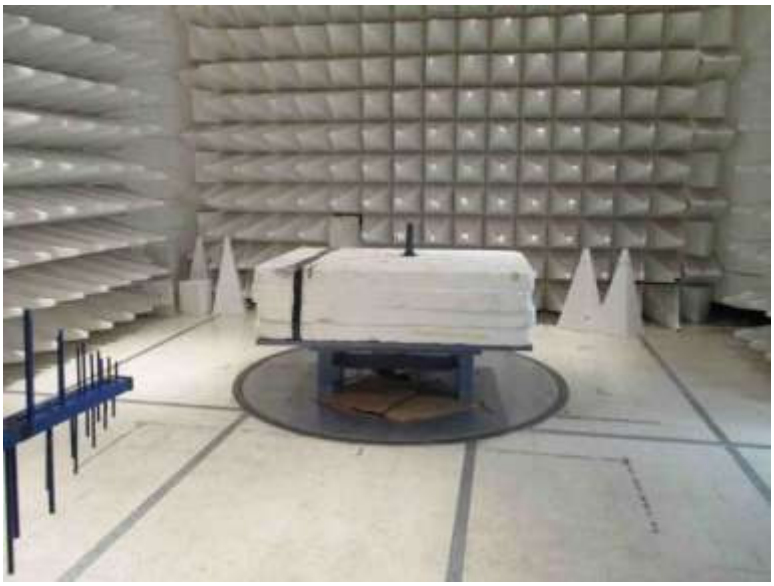
Section 7.9



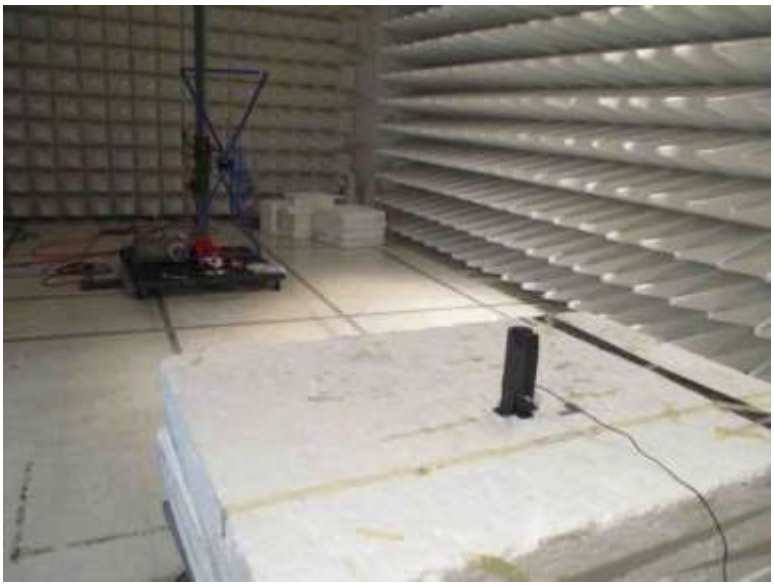
Section 7.11.2



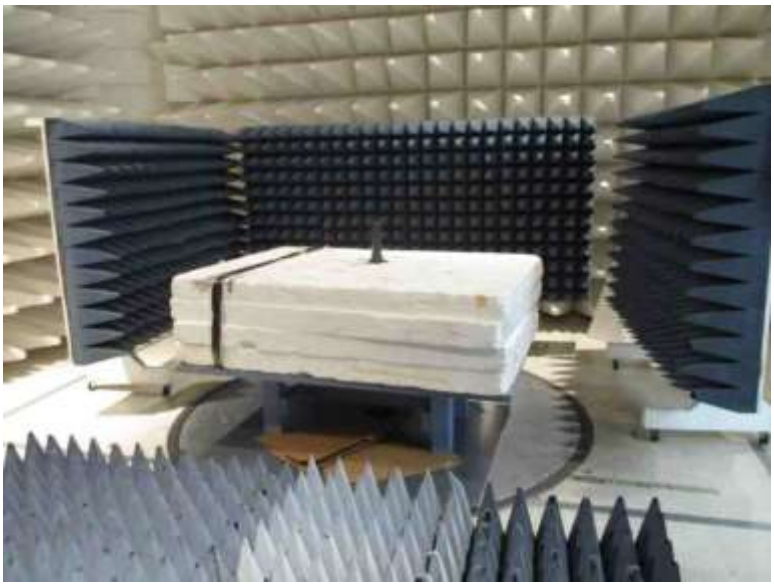
Section 7.11.3



Section 7.12, Below 1GHz



Section 7.12, Below 1GHz



Section 7.12 Above 1GHz

Section 7.12 Above 1GHz

# 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 dBµV/m, the spectrum analyzer reading in dBµV 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 | (dBµV) |
| + | Antenna Factor | (dB/m) |
| + | Cable Loss | (dB) |
| - | Distance Correction | (dB) |
| - | Preamplifier Gain | (dB) |
| = | Corrected Reading | (dBµV/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.