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# Test Report

**Prepared for: Wilson Electronics, Inc.**

**Model: 460004**

**Description: Quint Band In-Building Signal Booster**

**FCC ID: PWO460004**

**To**

**FCC Part 20**

**Date of Issue: September 30, 2014**

| | |
|---|---|
| **On the behalf of the applicant:** | **Wilson Electronics, Inc.**<br>**3301 E Deseret Drive**<br>**St. George, UT 84790** |
| **To the attention of:** | **Patrick Cook, Sr Research & Development Engineer**<br>**Ph: (435) 673-5021**<br>**E-Mail: pcook@infowest.com** |

**Prepared By**
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**Project No: p1350023**

Greg Corbin

**Greg Corbin**
**Project Test Engineer**

## Test Report Revision History

| Revision | Date | Revised By | Reason for Revision |
|---|---|---|---|
| 1.0 | August 8, 2013 | Greg Corbin | Original Document |
| 2.0 | September 4, 2013 | Greg Corbin | Manufacturer modified the EUT noise power.<br>New Noise Power test data was inserted on pages 81 – 83 and associated graphs on pages 84 – 88.<br>Revised references to specifications in the Test Summary Table on page 6 |
| 3.0 | September 19, 2013 | Greg Corbin | Corrected downlink detection time limit on page 129 and the downlink restart time test results units on page 130 , added formulas for calculating limits where required. |
| 4.0 | September 25, 2013 | Greg Corbin | On Rev 3.0, the downlink detection time limit on page 129 did not get updated. Updated downlink detection time limit on page 129. Added a statement clarifying the modulation types and protocols shown in the tables on page 5. |
| 5.0 | October 29, 2013 | Amanda Reed | Incorporated customer requested changes |
| 6.0 | December 19, 2013 | Greg Corbin | Added MSCL to the variable gain tables on page 97.<br>Added OOBE rule sections to the Test Summary table on page 6.<br>Added Spurious Emissions Test data on page 56 and 57 |
| 7.0 | January 9, 2014 | Greg Corbin | Updated Conducted Emissions rule sections in the test summary table on page 6 and 57 to match the eCFR rule sections dated January 7, 2014. |
| 8.0 | January 24, 2014 | Amanda Reed | Corrected Rule Sections per FCC guidance |
| 9.0 | September 29,2014 | Greg Corbin | Corrected RSSI input levels in 829 – 849 Table on page 97, original data was a typo. |

## Table of Contents

**ILAC / A2LA**

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The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

ACCREDITED
TESTING CERT
#2152.01

**FCC OATS Reg, #933597**

**IC Reg. #2044A-1**

**Non-accredited tests contained in this report:**

**N/A**

**Test and Measurement Data**
Subpart
2.1033(c)(14):

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Part 2, Subpart J and the following individual Parts: 20.21 in conjunction with latest version of Draft KDB 935210 D03 Wideband Consumer Signal Booster Measurement Guidance DR04-41516.

**Standard Test Conditions and Engineering Practices**

Except as noted herein, the following conditions and procedures were observed during the testing.

In accordance with ANSI/C63.4-2009, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

| Environmental Conditions | | |
|---|---|---|
| **Temp (ºC)** | **Humidity (%)** | **Pressure (mbar)** |
| 25.5 – 31.4 | 34.7 – 61.9 | 959.2 – 971.7 |

Measurement results, unless otherwise noted, are worst-case measurements.

**EUT Description**

**Model:** 460004

**Description:** Quint Band In-Building Signal Booster

**Firmware:** A460004A

**Software:** 460004A

**Additional Information:**
The EUT is a bi-directional amplifier for the boosting of cellular phone signals and data communication devices. The frequency bands listed in the table below are the bands used by the EUT.

The modulation types and emission designators listed in the tables below represent the modulations that the cell phone providers use for each frequency band. GSK, CDMA, and WCDMA represent all the modulation types (phase and amplitude or a combination thereof) utilized within the industry. EDGE, HSPA, LTE etc. are all protocols or multiplexing techniques using the base modulations.

| Frequency Band (MHz) | | | | | |
|---|---|---|---|---|---|
| **Uplink** | 698 - 716 | 777 - 787 | 824 - 849 | 1850 - 1915 | 1710 - 1755 |
| **Downlink** | 728 - 746 | 746 - 756 | 869 - 894 | 1930 - 1995 | 2110 - 2155 |
| **Modulation Type** | LTE | | GSM, CDMA, EDGE, HSPA. EVDO, LTE | | CDMA, HSPA, LTE, EDGE, EVDO |

| Emission Designators | | | | | |
|---|---|---|---|---|---|
| **CDMA** | **HSPA** | **LTE** | **EVDO** | **EDGE** | **GSM** |
| F9W | F9W | G7D | F9W | G7W | GXW |

**EUT Operation during Tests**
The EUT was in a normal operating condition.

**Test Result Summary**

| Specification | Test Name | Pass, Fail, N/A | Comments |
|---|---|---|---|
| 20.21(e)(3) | Authorized Frequency Band | Pass | |
| 20.21(e)(8)(i)(B)<br>20.21(e)(8)(i)(C)<br>20.21(e)(8)(i)(D) | Maximum Power and Gain | Pass | |
| 20.21(e)(8)(i)(F) | Intermodulation | Pass | |
| 20.21(e)(8)(i)(E) | Out-of-Band Emissions | Pass | |
| 2.1051<br>22.917(a)<br>24.238((a)<br>27.53(c)<br>27.53(e)<br>27.53(f)<br>27.53(g) | Conducted Spurious Emissions | Pass | |
| 20.21(e)(8)(i)(A) | Noise Limits | Pass | |
| 20.21(e)(8)(i)(I) | Uplink Inactivity | Pass | |
| 21(e)(8)(i)(C) | Variable Gain | Pass | |
| 2.1049 | Occupied Bandwidth | Pass | |
| 20.21(e)(8)(ii)(A) | Oscillation Detection | Pass | |
| 2.1053 | Radiated Spurious | Pass | |
| 20.21(e)(8)(i)(B) | Spectrum Block Filtering | N/A | This only applies to devices utilizing spectrum block filtering |

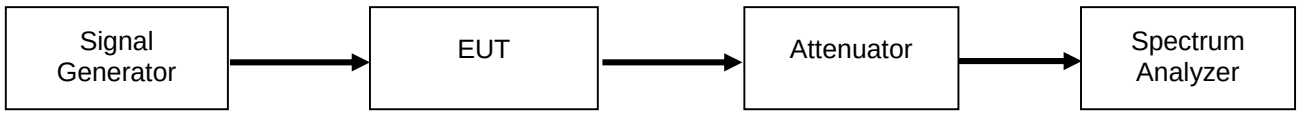
## Authorized Frequency Band

| | | |
|---|---|---|
| **Name of Test:** | Authorized Frequency Band | **Engineer:** Greg Corbin |
| **Test Equipment Utilized:** | SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** 7/15/2013 |

### Test Procedure

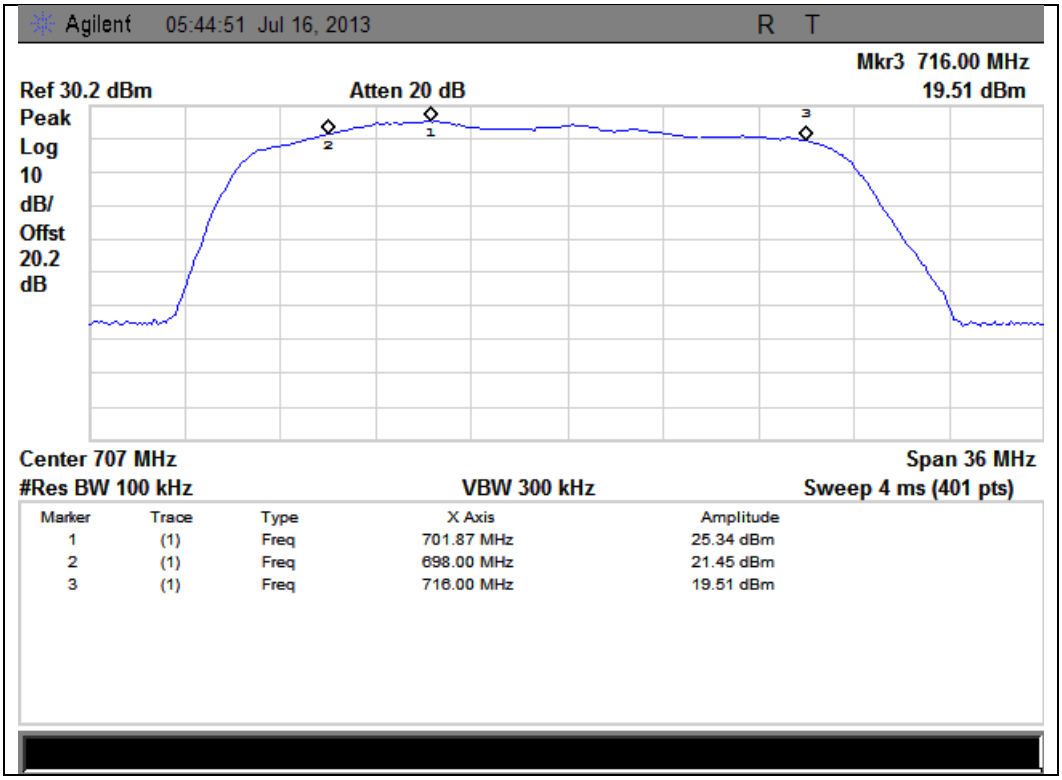
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. A signal generator was utilized to produce a CW input signal tuned to the center channel of the operational band. The RF input level was increased to a point just prior to the AGC being in control of the power. The Signal generator was set to sweep across 2X the operational band of the EUT while the spectrum analyzer was set to MAX HOLD. Two markers were placed at the edges of the operational band and a third marker was placed at the highest point within the band no closer than 2.5 MHz from the band edge.

### Test Setup

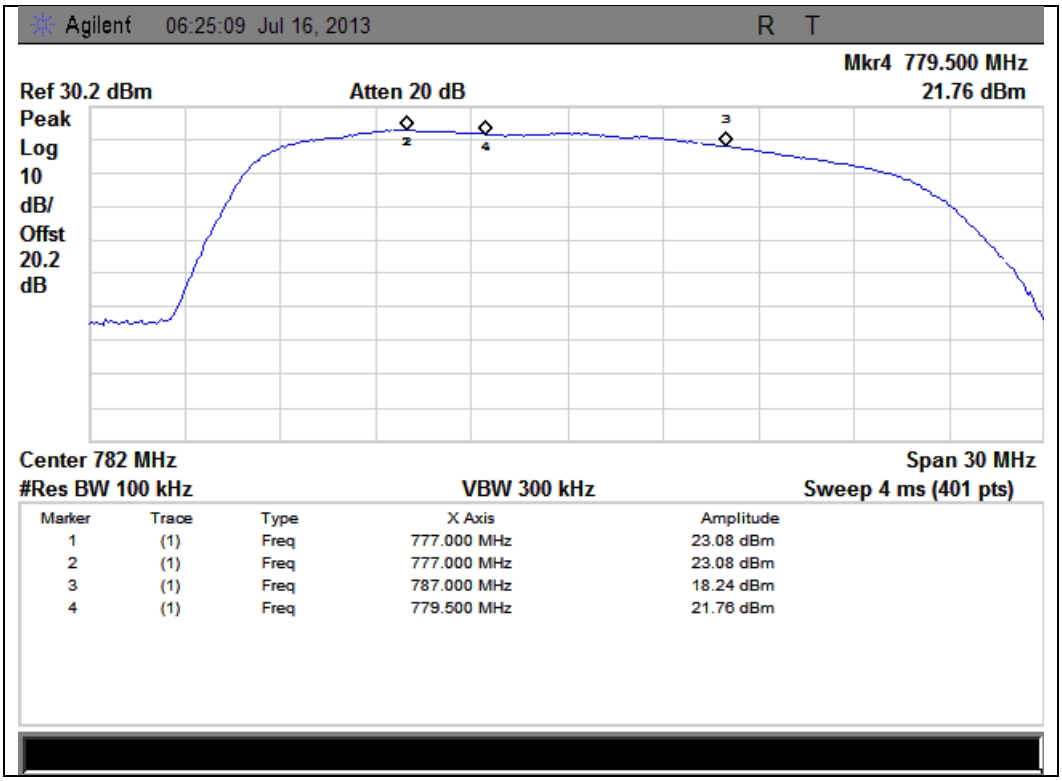


## Uplink Test Results

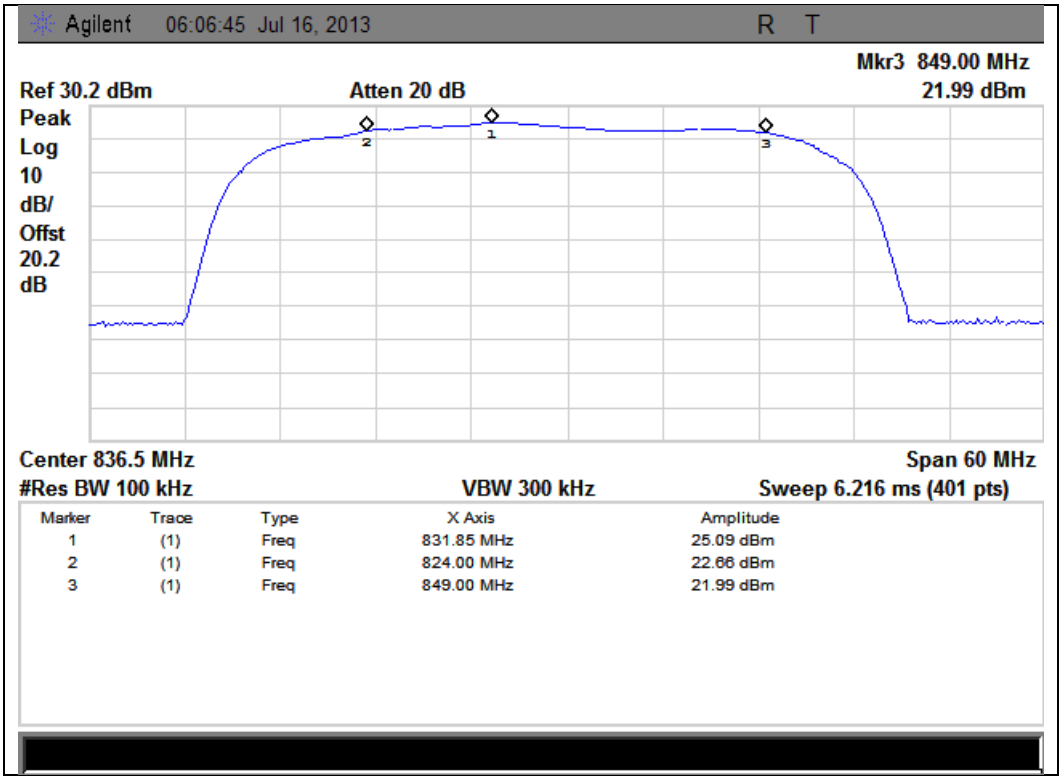
### 698 - 716 MHz Band



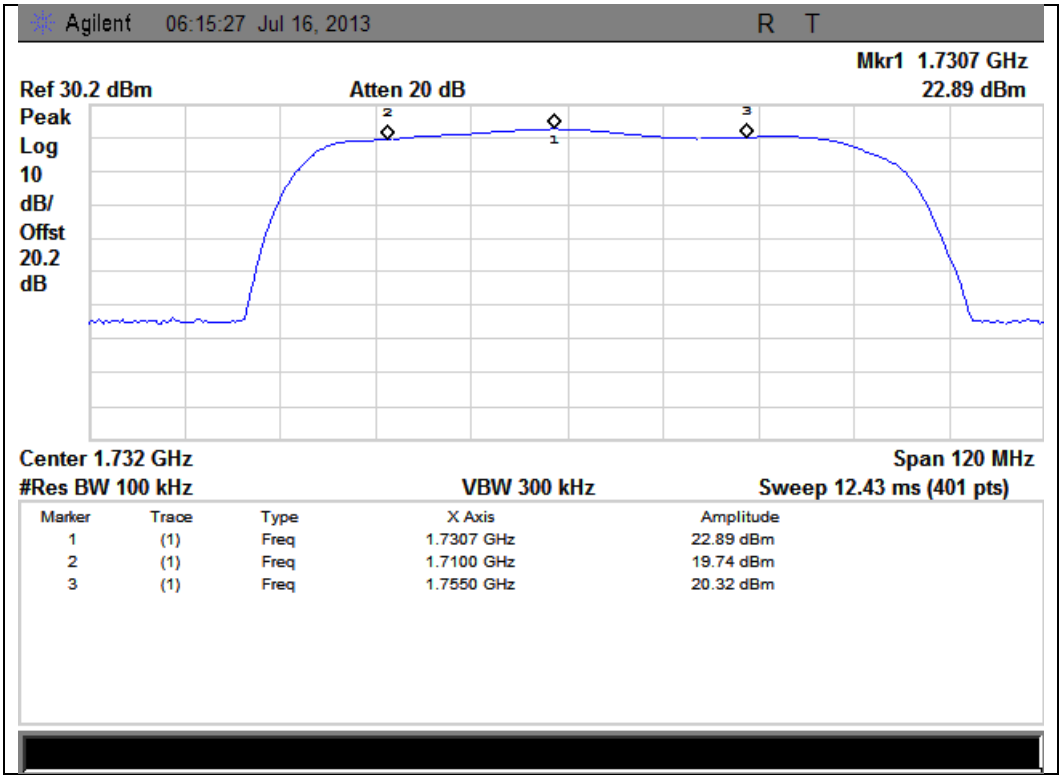

### 777 - 787 MHz Band



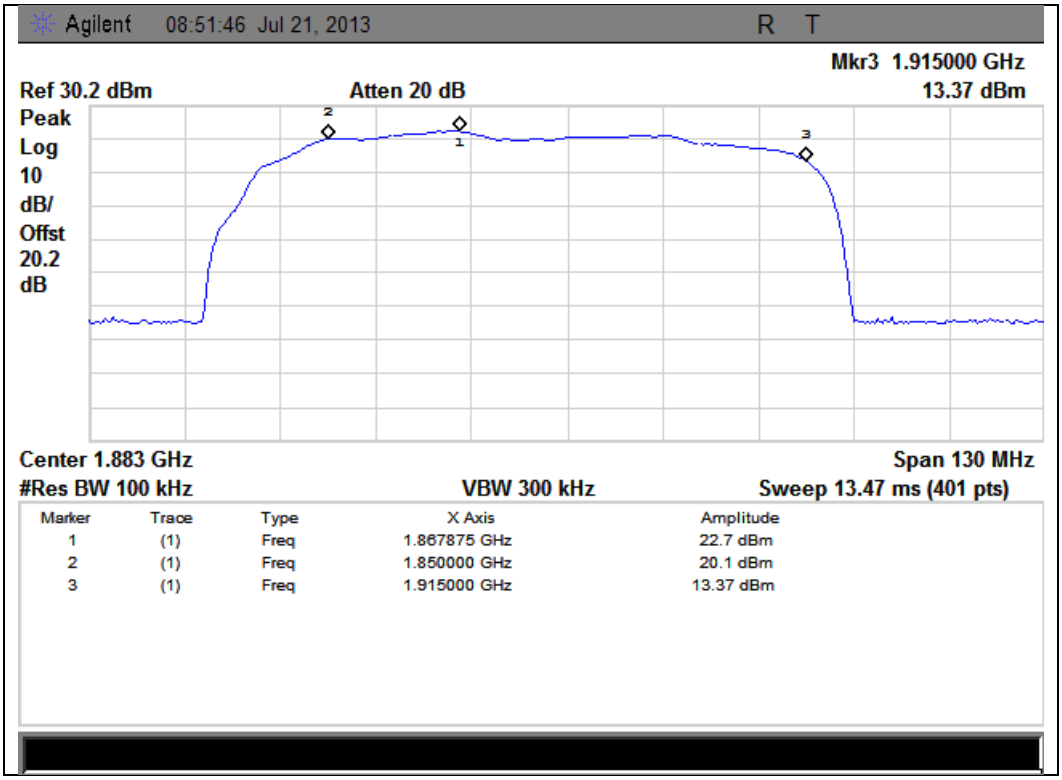
**824 - 849 MHz Band**




**1710 - 1755 MHz Band**

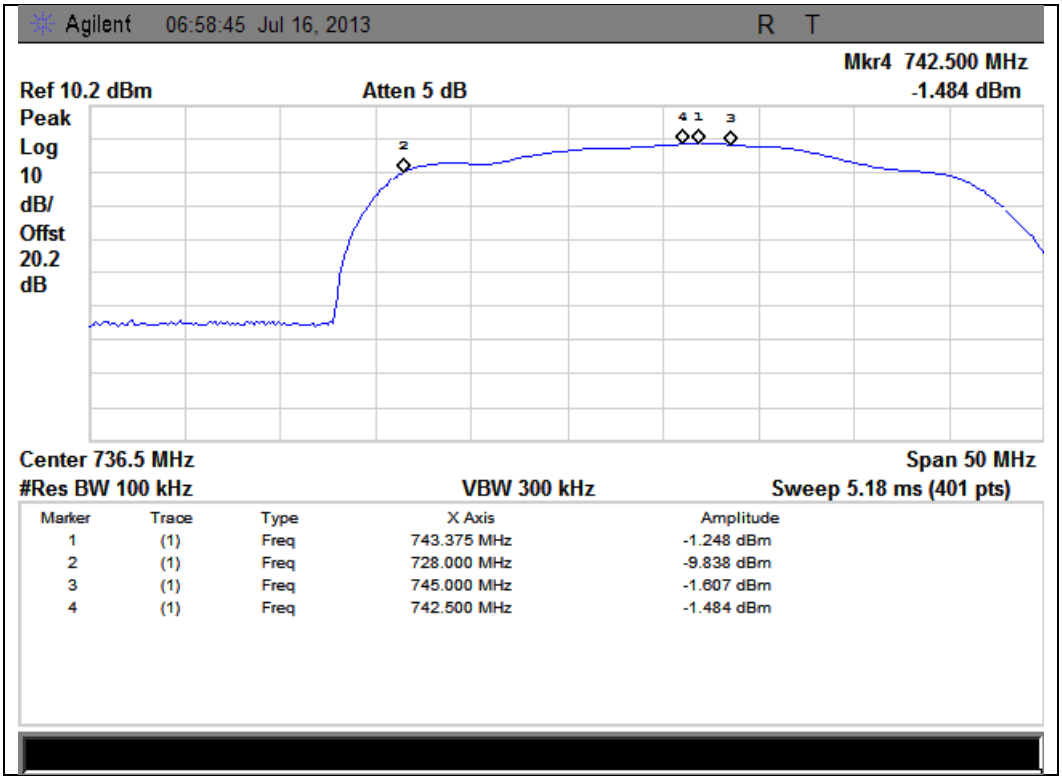


**1850 - 1915 MHz Band**

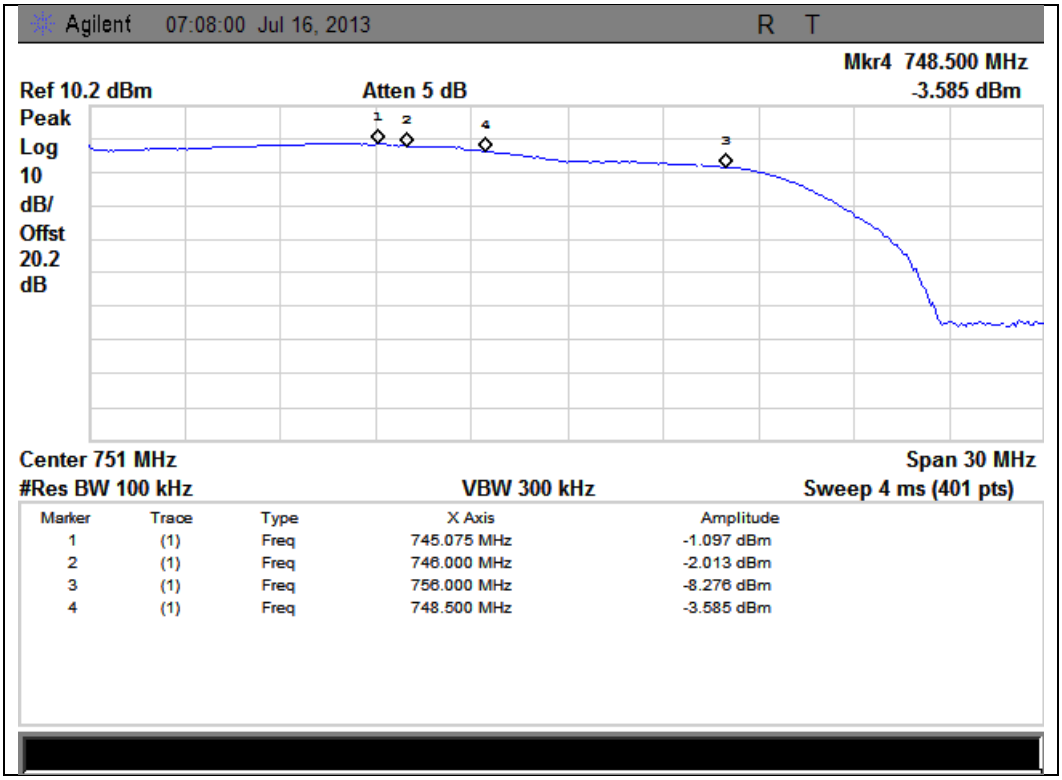



**Downlink Test Results**

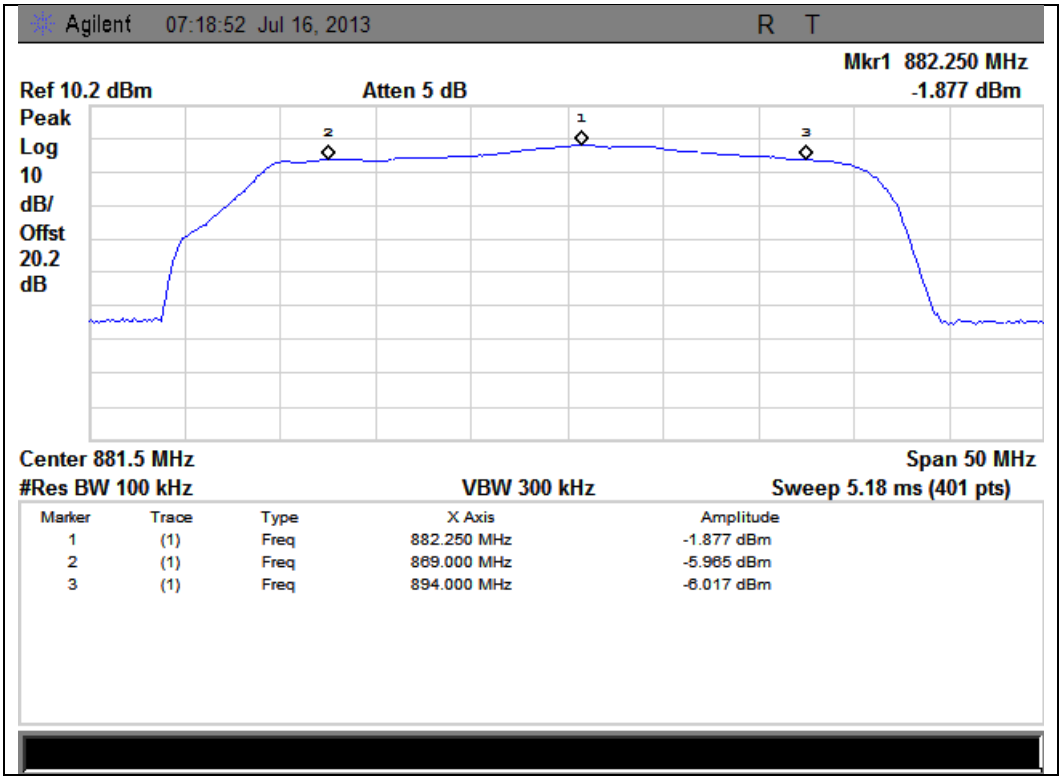
**728 - 746 MHz Band**



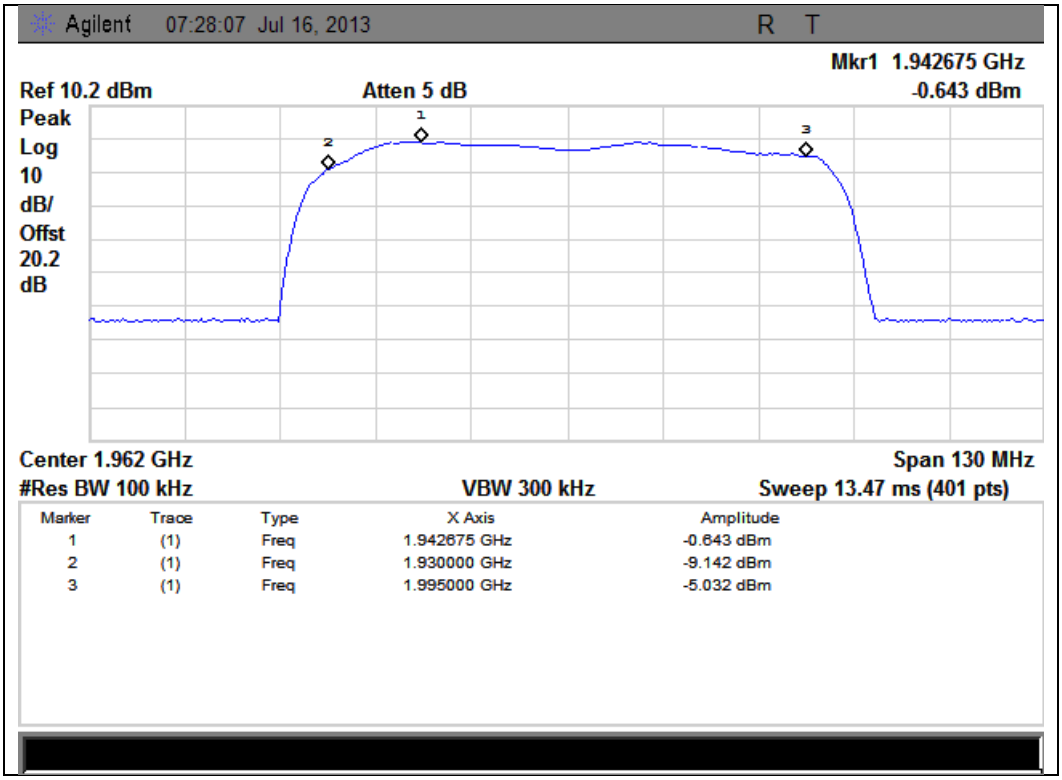
**746 - 756 MHz Band**



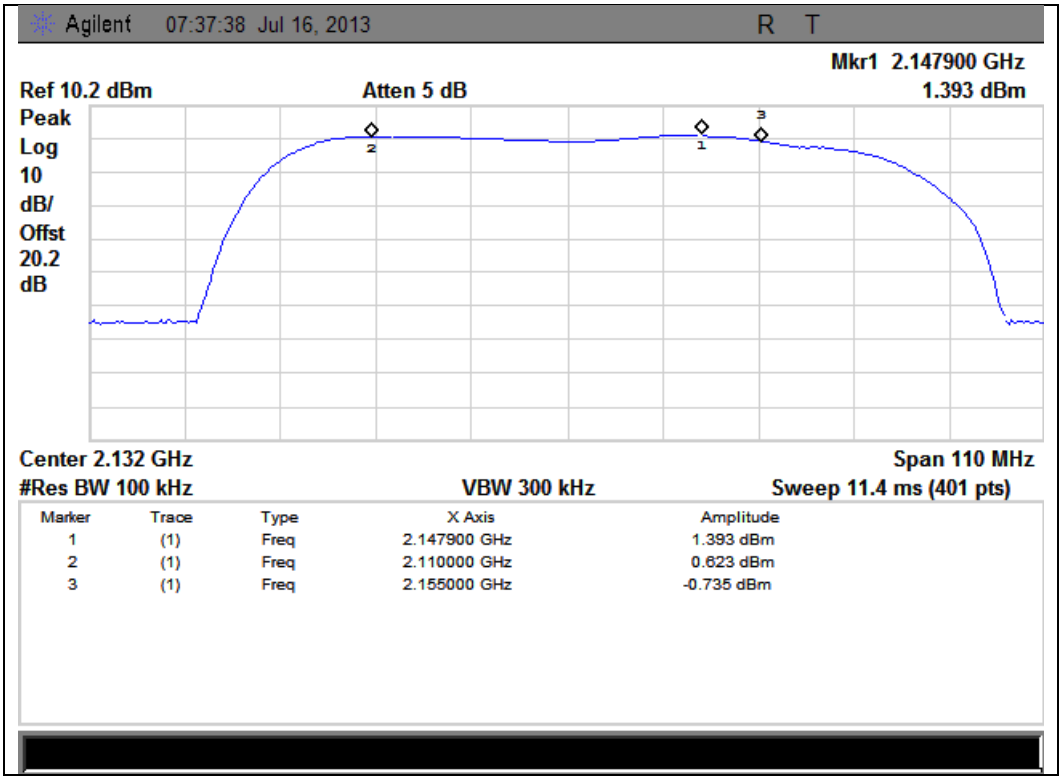

**869 - 894 MHz Band**



**1930 - 1995 MHz Band**




**2110 - 2155 MHz Band**



**Maximum Power and Gain**

| | | | |
|---|---|---|---|
| **Name of Test:** | Maximum Power and Gain | **Engineer:** | Greg Corbin |
| **Test Equipment Utilized:** | SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** | 7/16/2013 |

**Test Procedure**

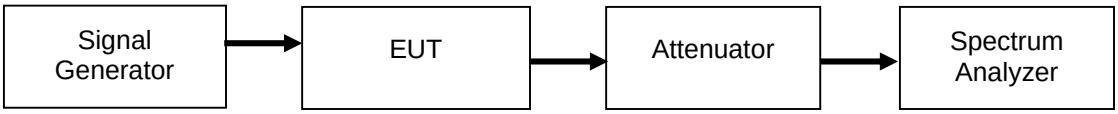
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. The spectrum analyzer and signal generator were tuned to the highest frequency in the band as determined by the Authorized Frequency Band test. The RF input level was increased to a point just prior to the AGC being in control of the power with both a 540 µS 12.5% duty-cycle pulsed CW and 4.1 MHz AWGN modulation. The maximum power was measured and verified to meet the minimum and maximum levels allowed with the maximum gain was computed from these values. The uplink and downlink gain under each condition was verified to be within 9 dB of each other.

The following formulas are used for calculating the limits.
Note – The Downlink gain is calculated based on the paired Uplink center frequency

Maximum Gain Limit (dB) = 6.5 dB + 20Log(Frequency)

Note - Frequency is the uplink mid-band frequency of the supported spectrum bands in MHz

**Test Setup**




**Uplink Power Test Results**

| Frequency Band (MHz) | Input Level (dBm) | Output Power (dBm) | Lower Limit (dBm) | Upper Limit (dBm) | Result |
|---|---|---|---|---|---|
| 698 - 716 MHz Pulsed CW | -38.3 | 23.2 | 17 | 30 | Pass |
| 698 - 716 MHz AWGN | -38.3 | 21.7 | 17 | 30 | Pass |
| 777 - 787 MHz Pulsed CW | -35.7 | 23.8 | 17 | 30 | Pass |
| 777 - 787 MHz AWGN | -35.7 | 21.0 | 17 | 30 | Pass |
| 824 - 849 MHz Pulsed CW | -39.8 | 25.2 | 17 | 30 | Pass |
| 824 - 849 MHz AWGN | -39.8 | 21.8 | 17 | 30 | Pass |
| 1710 - 1755 MHz Pulsed CW | -44.4 | 22.5 | 17 | 30 | Pass |
| 1710 - 1755 MHz AWGN | -44.4 | 20.2 | 17 | 30 | Pass |
| 1850 - 1915 MHz Pulsed CW | -47.8 | 22.1 | 17 | 30 | Pass |
| 1850 - 1915 MHz AWGN | -47.8 | 20.0 | 17 | 30 | Pass |

**Downlink Power Test Results**

| Frequency Band (MHz) | Input Level (dBm) | Output Power (dBm) | Upper Limit (dBm) | Result |
|---|---|---|---|---|
| 728 - 746 MHz Pulsed CW | -63.3 | -1.2 | 17 | Pass |
| 728 - 746 MHz AWGN | -63.3 | -0.4 | 17 | Pass |
| 746 - 756 MHz Pulsed CW | -63.9 | -3.6 | 17 | Pass |
| 746 - 756 MHz AWGN | -63.9 | -2.1 | 17 | Pass |
| 869 - 894 MHz Pulsed CW | -64.6 | -2.4 | 17 | Pass |
| 869 - 894 MHz AWGN | -64.6 | -2.0 | 17 | Pass |
| 1930 - 1995 MHz Pulsed CW | -67.6 | -1.4 | 17 | Pass |
| 1930 - 1995 MHz AWGN | -67.6 | -1.9 | 17 | Pass |
| 2110 - 2155 MHz Pulsed CW | -66.9 | 0.9 | 17 | Pass |
| 2110 - 2155 MHz AWGN | -66.9 | -0.2 | 17 | Pass |

**Uplink and Downlink Gain Test Results**

| Modulation | Uplink Frequency (MHz) | Downlink Frequency (MHz) | Uplink Gain (dB) | Uplink Limit (dB) | Downlink Gain (dB) | Downlink Limit (dB) | Delta (dB) | Limit (dB) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| Pulsed CW | 701.87 | 742.5 | 61.5 | 63.5 | 62.1 | 63.5 | 0.6 | 9 | -8.4 |
| AWGN | 701.87 | 742.5 | 60.0 | 63.5 | 62.9 | 63.5 | 2.9 | 9 | -6.1 |
| Pulsed CW | 779.5 | 748.5 | 59.5 | 64.4 | 60.3 | 64.4 | 0.8 | 9 | -8.2 |
| AWGN | 779.5 | 748.5 | 56.7 | 64.4 | 61.8 | 64.4 | 5.1 | 9 | -3.9 |
| Pulsed CW | 831.85 | 882.25 | 65.0 | 64.9 | 62.2 | 64.9 | 2.8 | 9 | -6.2 |
| AWGN | 831.85 | 882.25 | 61.6 | 64.9 | 62.6 | 64.9 | 1 | 9 | -8 |
| Pulsed CW | 1730.7 | 2147.9 | 66.9 | 71 | 67.8 | 71 | 0.9 | 9 | -8.1 |
| AWGN | 1730.7 | 2147.9 | 64.6 | 71 | 66.7 | 71 | 2.1 | 9 | -6.9 |
| Pulsed CW | 1867.875 | 1942.685 | 69.9 | 72 | 66.2 | 72 | 3.7 | 9 | -5.3 |
| AWGN | 1867.875 | 1942.685 | 67.8 | 72 | 65.7 | 72 | 2.1 | 9 | -6.9 |

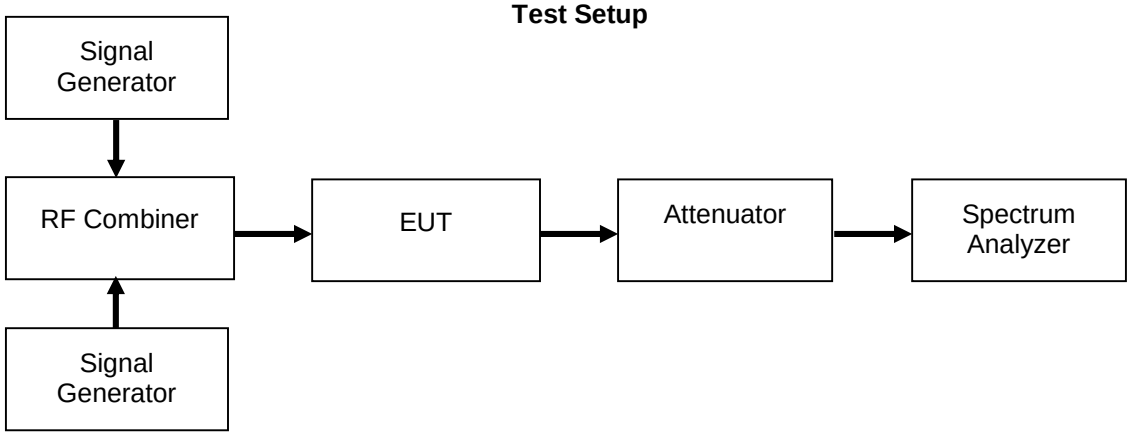
**Intermodulation**

**Name of Test:** Intermodulation
**Engineer:** Greg Corbin
**Test Equipment Utilized:** SMU 200A - S/N:101369
E4407B - S/N:MY41444836
**Test Date:** 7/19/2013

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator. Two signal generators were utilized to produce two CW signals 600 kHz apart and centered in the operational band. Attenuator and cable insertion loss correction factors were input to either the signal generator or the spectrum analyzer as required to ensure accurate measurements were recorded. The input power was set at the maximum allowable power and the intermodulation products were measured to ensure they were less that -19 dBm in a 3 kHz RBW. The uplink and downlink intermodulation products were plotted with the levels being listed in the summary tables.

**Test Setup**




**Uplink Test Results**

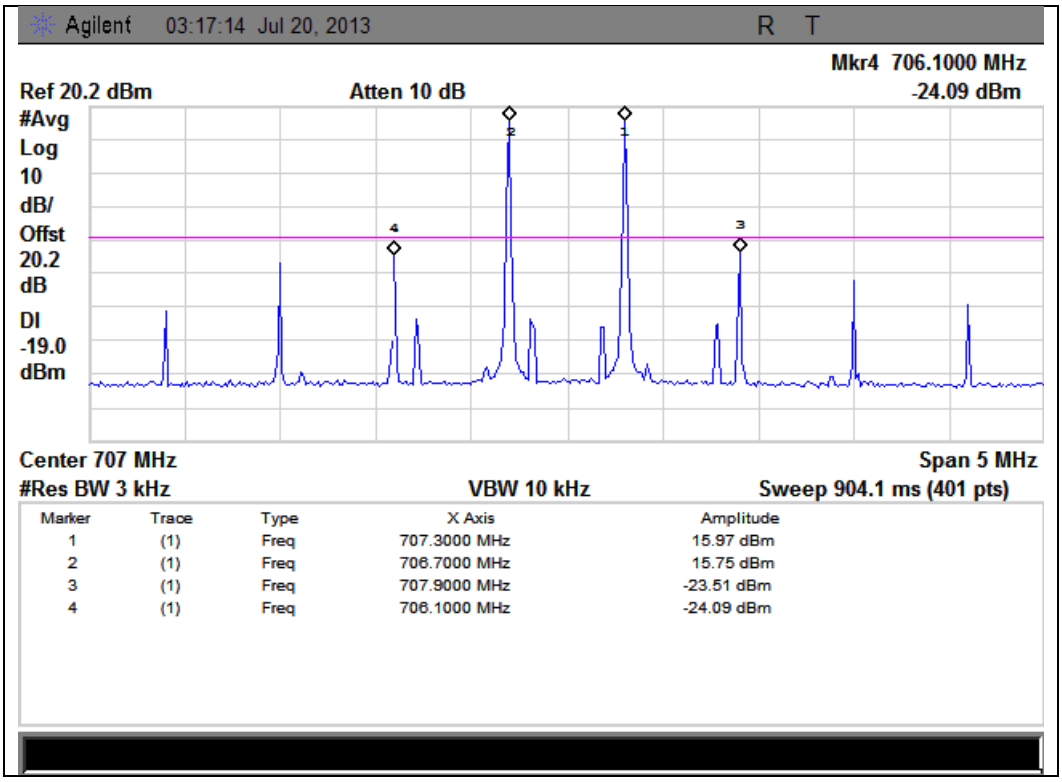
| Frequency Band (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 698 - 716 MHz | -23.5 | -19 | Pass |
| 777 - 787 MHz | -20.4 | -19 | Pass |
| 824 - 849 MHz | -20.9 | -19 | Pass |
| 1710 - 1755 MHz | -22.2 | -19 | Pass |
| 1850 - 1915 MHz | -21.6 | -19 | Pass |

**Downlink Test Results**

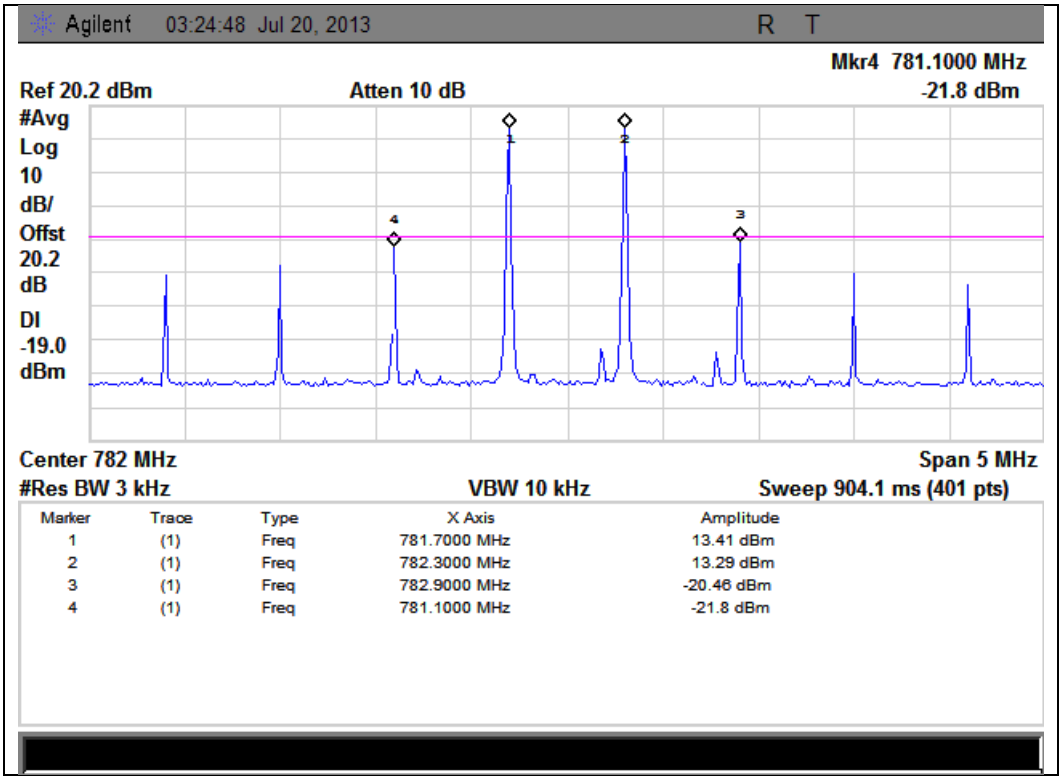
| Frequency Band (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 728 - 746 MHz | -62.8 | -19 | Pass |
| 746 - 756 MHz | -63.4 | -19 | Pass |
| 869 - 894 MHz | -63.9 | -19 | Pass |
| 1930 - 1995 MHz | -63 | -19 | Pass |
| 2110 - 2155 MHz | -61.9 | -19 | Pass |

## Uplink Test Results

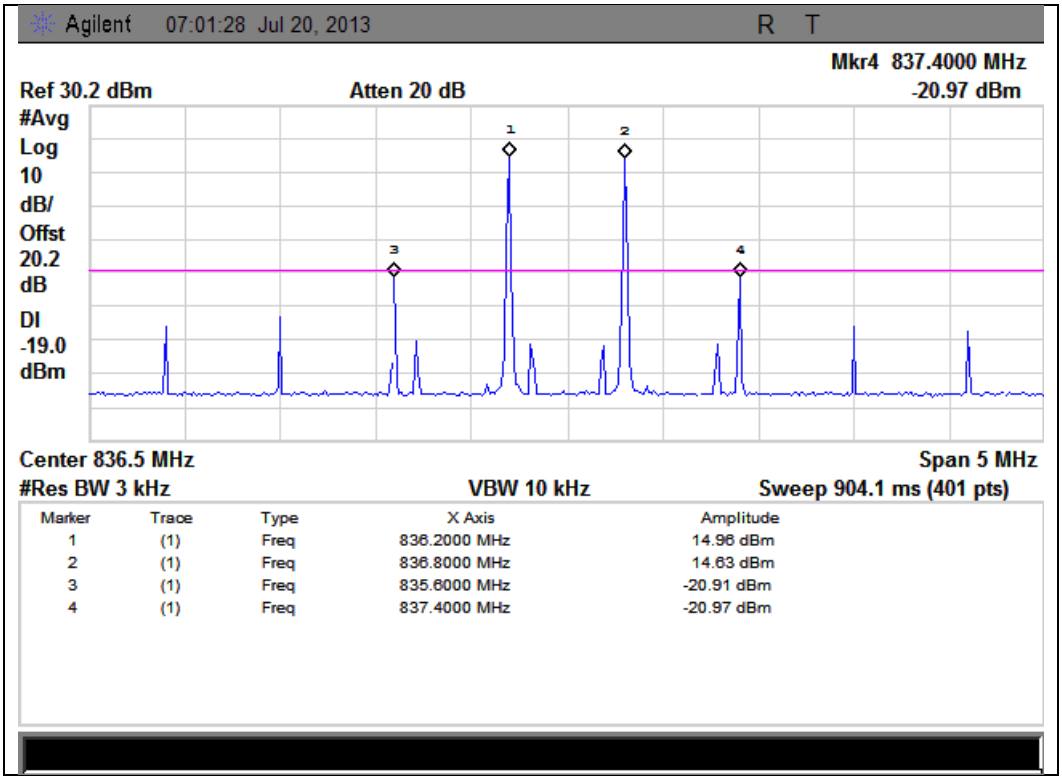
### 698 - 716 MHz Band



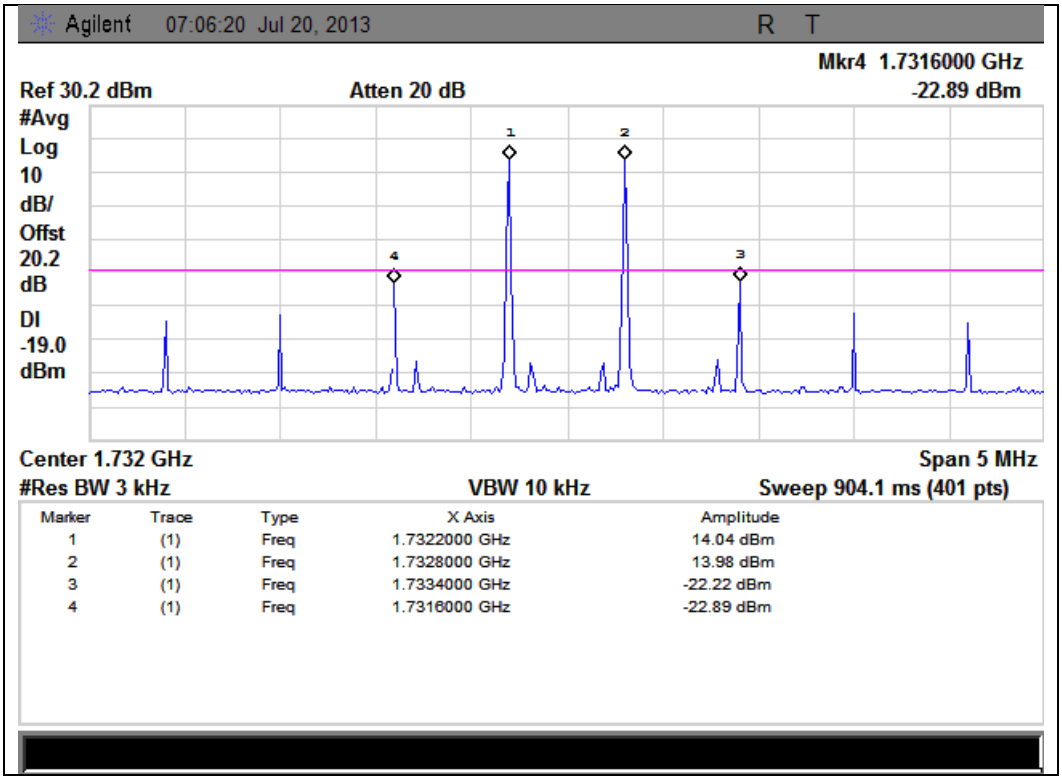

### 777 - 787 MHz Band



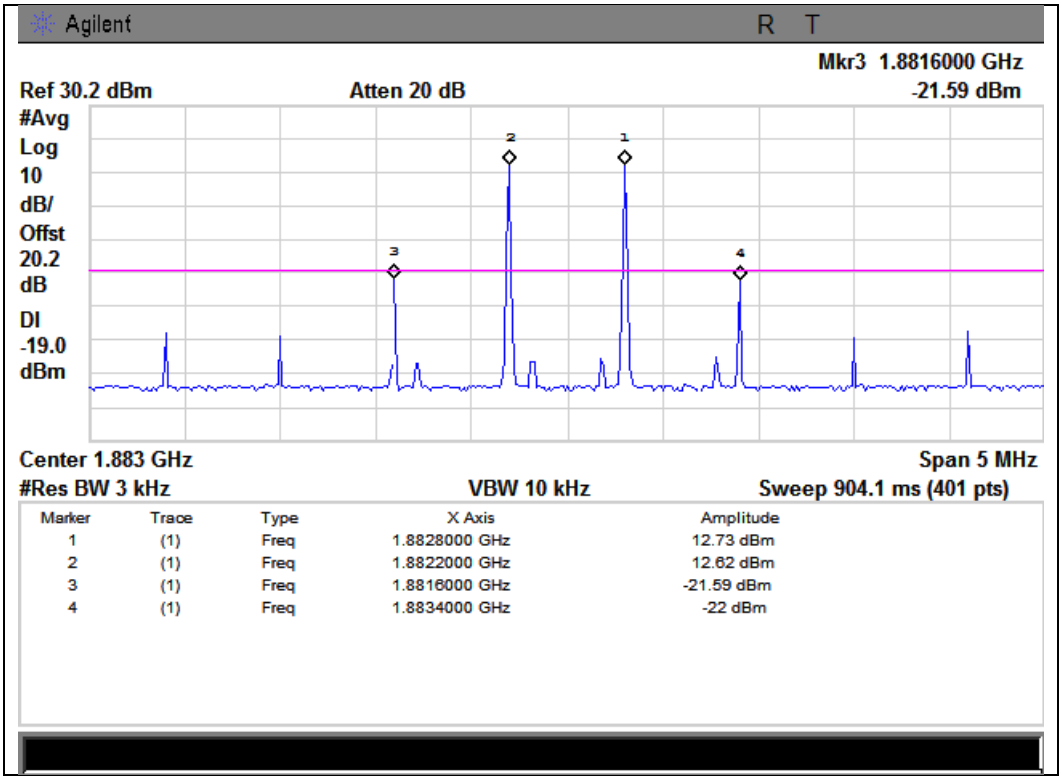
**824 - 849 MHz Band**




**1710 - 1755 MHz Band**

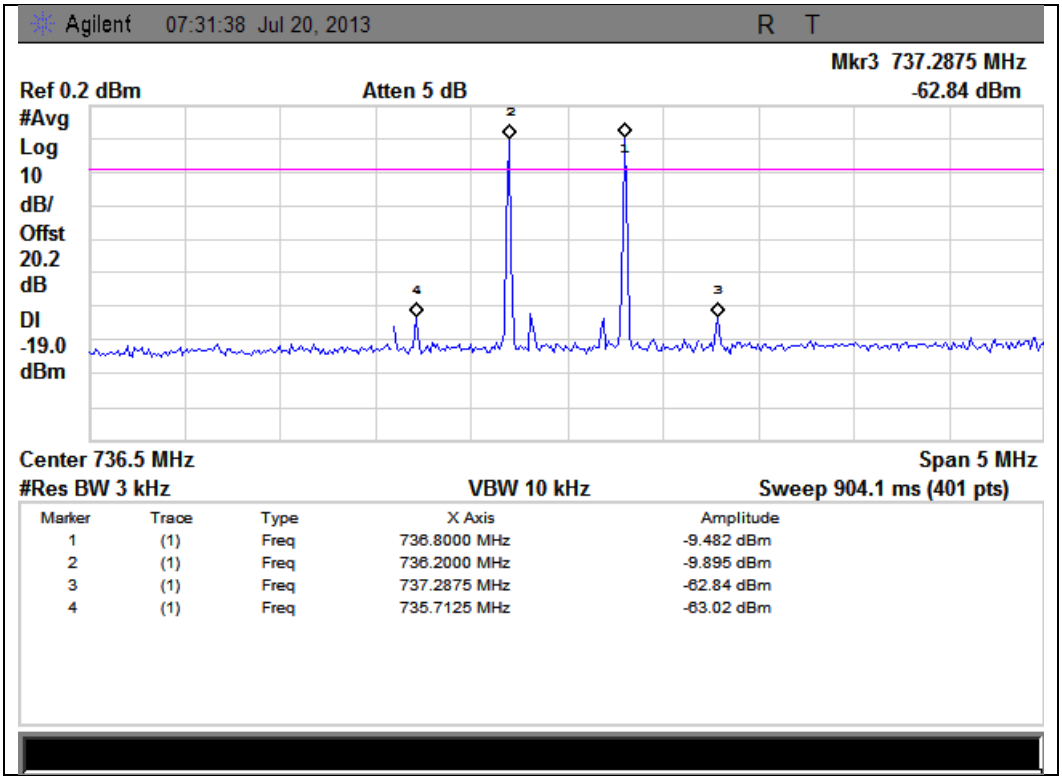


**1850 - 1915 MHz Band**

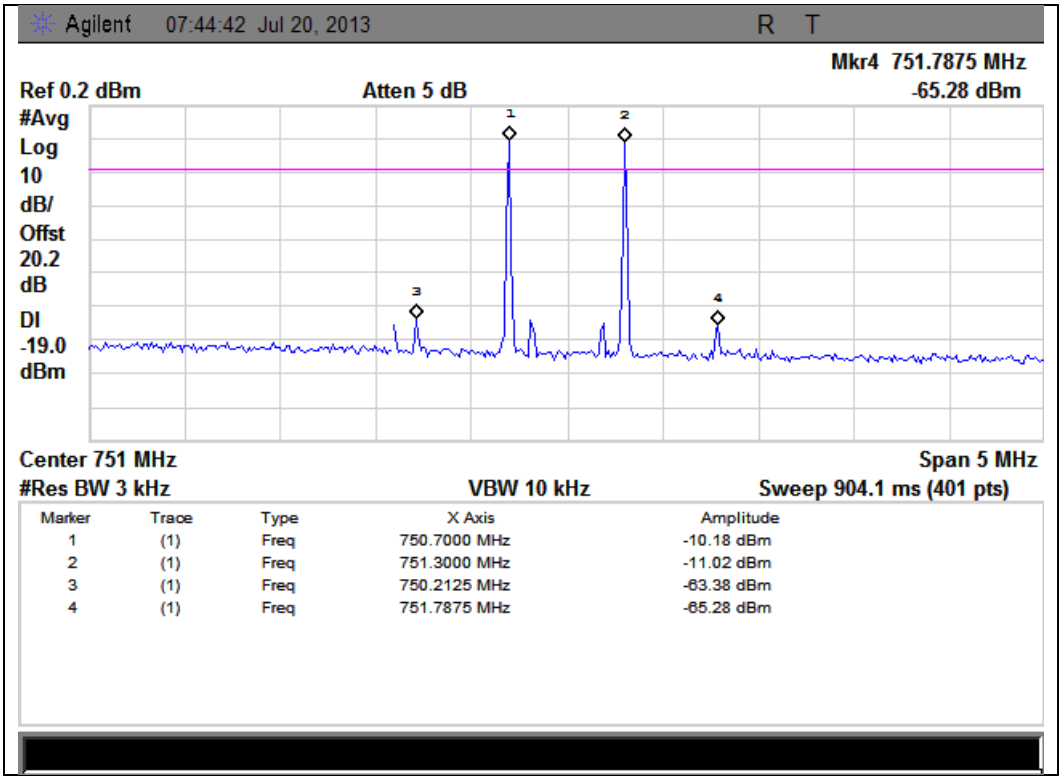



**Downlink Test Results**

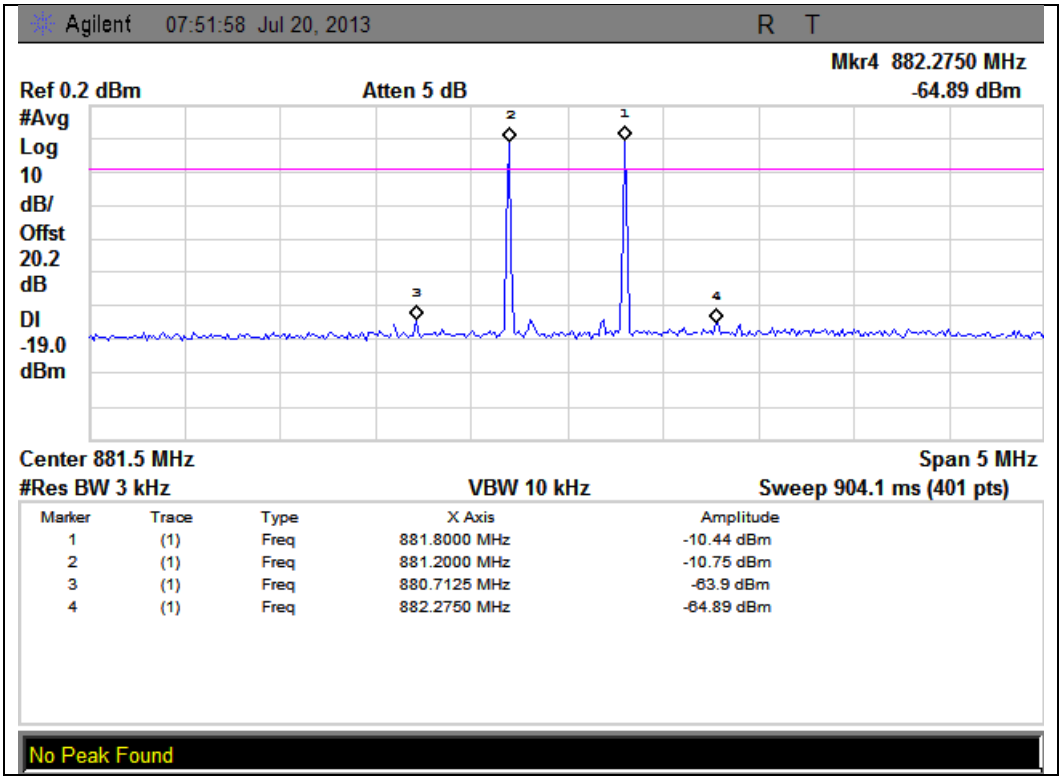
**728 - 746 MHz Band**



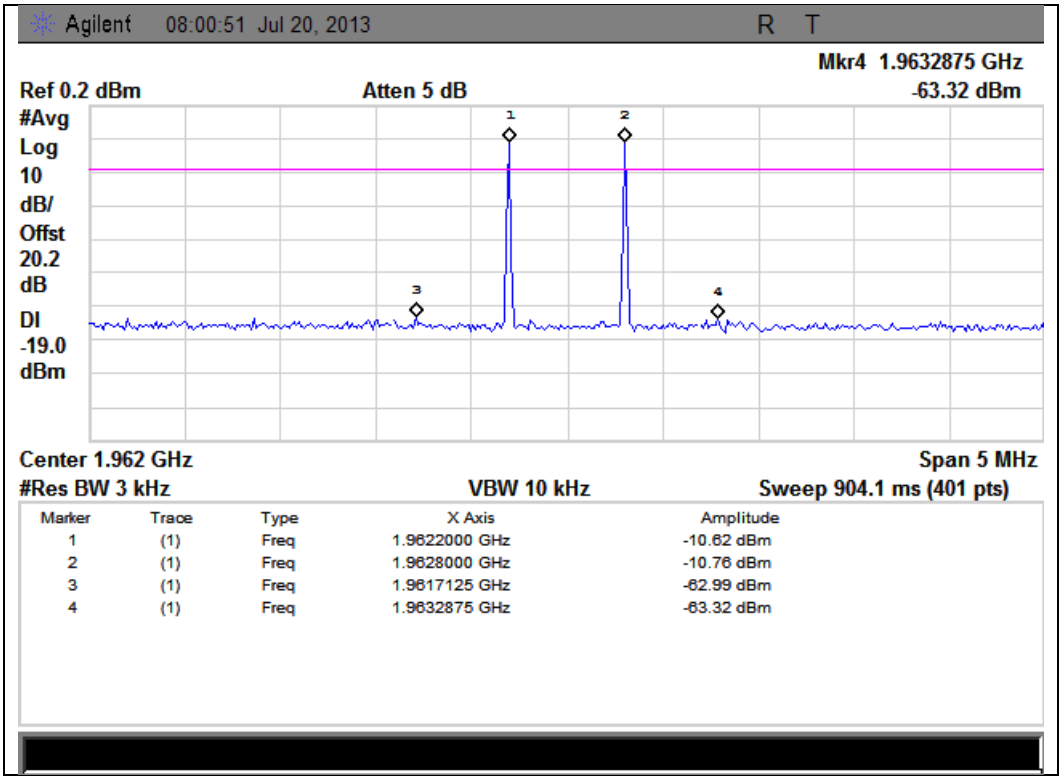
**746 - 756 MHz Band**




**869 - 894 MHz Band**

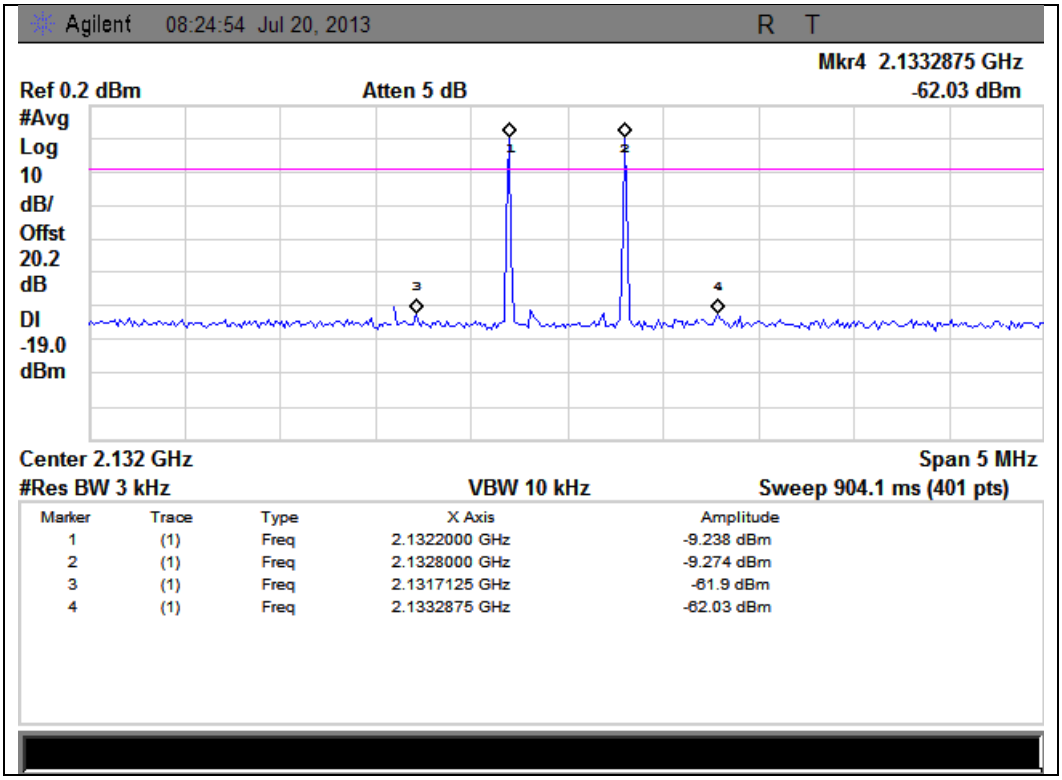


**1930 - 1995 MHz Band**




| Marker | Trace | Type | X Axis | Amplitude |
|---|---|---|---|---|
| 1 | (1) | Freq | 1.9622000 GHz | -10.62 dBm |
| 2 | (1) | Freq | 1.9628000 GHz | -10.76 dBm |
| 3 | (1) | Freq | 1.9617125 GHz | -62.99 dBm |
| 4 | (1) | Freq | 1.9632875 GHz | -63.32 dBm |

**2110 - 2155 MHz Band**




| Marker | Trace | Type | X Axis | Amplitude |
|---|---|---|---|---|
| 1 | (1) | Freq | 2.1322000 GHz | -9.238 dBm |
| 2 | (1) | Freq | 2.1328000 GHz | -9.274 dBm |
| 3 | (1) | Freq | 2.1317125 GHz | -61.9 dBm |
| 4 | (1) | Freq | 2.1332875 GHz | -62.03 dBm |

## Out-of-Band Emissions

| | | |
|---|---|---|
| **Name of Test:** | Out-of-Band Emissions | **Engineer:** Greg Corbin |
| **Test Equipment Utilized:** | SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** 7/22/2013 |

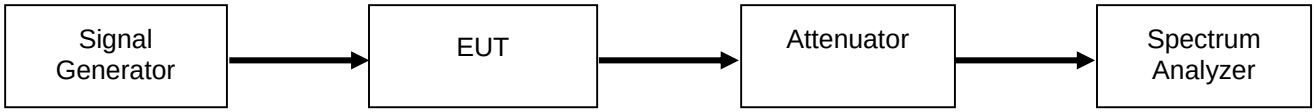
### Test Procedure

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. A signal generator was utilized to produce the following signals; GSM, CDMA, and WCDMA tuned to the lowest allowable upper and lower channel within the EUT operational band for each respective modulation type. The RF input level was increased to a point just prior to the AGC being in control of the power. For each modulation type the Out of Band Emissions was measured ensuring the meet the requirements.

The following formulas are used for calculating the limits

Out-of-Band Emissions Limit = 6+ (43+ 10LogP)

### Test Setup



**GSM Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 698 - 716 | Lower | -20.3 | -19 | Pass |
| 698 - 716 | Upper | -19.8 | -19 | Pass |
| 777 - 787 | Lower | -57.4 | -19 | Pass |
| 777 - 787 | Upper | -20.5 | -19 | Pass |
| 824 - 849 | Lower | -29.9 | -19 | Pass |
| 824 - 849 | Upper | -28.4 | -19 | Pass |
| 1710 - 1755 | Lower | -29.8 | -19 | Pass |
| 1710 - 1755 | Upper | -30.2 | -19 | Pass |
| 1850 - 1915 | Lower | -31.9 | -19 | Pass |
| 1850 - 1915 | Upper | -34.8 | -19 | Pass |

**CDMA Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 698 - 716 | Lower | -42.9 | -19 | Pass |
| 698 - 716 | Upper | -43.6 | -19 | Pass |
| 777 - 787 | Lower | -42.2 | -19 | Pass |
| 777 - 787 | Upper | -40.6 | -19 | Pass |
| 824 - 849 | Lower | -35.4 | -19 | Pass |
| 824 - 849 | Upper | -31.2 | -19 | Pass |
| 1710 - 1755 | Lower | -33.1 | -19 | Pass |
| 1710 - 1755 | Upper | -38.6 | -19 | Pass |
| 1850 - 1915 | Lower | -37.7 | -19 | Pass |
| 1850 - 1915 | Upper | -39.9 | -19 | Pass |

**WCDMA Uplink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 698 - 716 | Lower | -41.1 | -19 | Pass |
| 698 - 716 | Upper | -42.8 | -19 | Pass |
| 777 - 787 | Lower | -45.9 | -19 | Pass |
| 777 - 787 | Upper | -41.8 | -19 | Pass |
| 824 - 849 | Lower | -35.1 | -19 | Pass |
| 824 - 849 | Upper | -31.5 | -19 | Pass |
| 1710 - 1755 | Lower | -33.4 | -19 | Pass |
| 1710 - 1755 | Upper | -35.4 | -19 | Pass |
| 1850 - 1915 | Lower | -35.1 | -19 | Pass |
| 1850 - 1915 | Upper | -37 | -19 | Pass |

**GSM Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 728 – 746 | Lower | -46.5 | -19 | Pass |
| 728 - 746 | Upper | -61.7 | -19 | Pass |
| 746 - 756 | Lower | -42.7 | -19 | Pass |
| 746 - 756 | Upper | -65.9 | -19 | Pass |
| 869 - 894 | Lower | -55.6 | -19 | Pass |
| 869 - 894 | Upper | -56.1 | -19 | Pass |
| 1930 - 1995 | Lower | -56.3 | -19 | Pass |
| 1930 - 1995 | Upper | -55.3 | -19 | Pass |
| 2110 - 2155 | Lower | -51.1 | -19 | Pass |
| 2110 - 2155 | Upper | -53.2 | -19 | Pass |

**CDMA Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 728 – 746 | Lower | -68.1 | -19 | Pass |
| 728 - 746 | Upper | -61.2 | -19 | Pass |
| 746 - 756 | Lower | -67.1 | -19 | Pass |
| 746 - 756 | Upper | -67.1 | -19 | Pass |
| 869 - 894 | Lower | -62.7 | -19 | Pass |
| 869 - 894 | Upper | -62.8 | -19 | Pass |
| 1930 - 1995 | Lower | -65.5 | -19 | Pass |
| 1930 - 1995 | Upper | -61.2 | -19 | Pass |
| 2110 - 2155 | Lower | -58.3 | -19 | Pass |
| 2110 - 2155 | Upper | -58.8 | -19 | Pass |

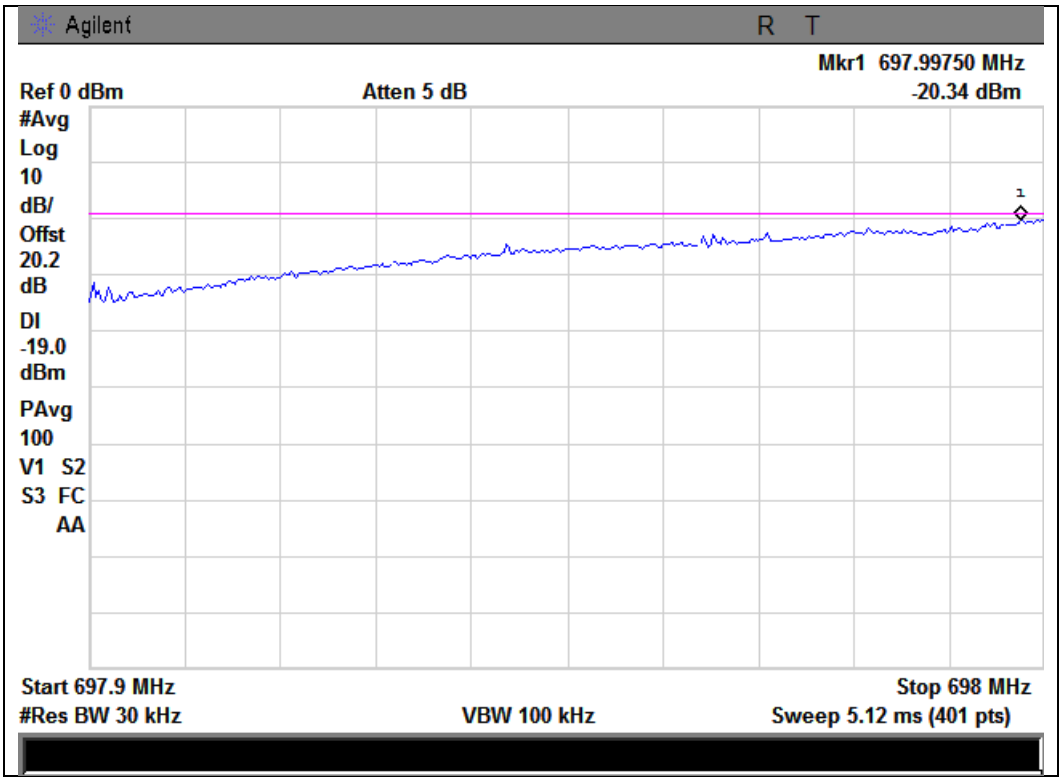
**WCDMA Downlink Test Results**

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 728 - 746 | Lower | -67.5 | -19 | Pass |
| 728 - 746 | Upper | -61.7 | -19 | Pass |
| 746 - 756 | Lower | -61.5 | -19 | Pass |
| 746 - 756 | Upper | -67.4 | -19 | Pass |
| 869 - 894 | Lower | -57.7 | -19 | Pass |
| 869 - 894 | Upper | -57.4 | -19 | Pass |
| 1930 - 1995 | Lower | -60.3 | -19 | Pass |
| 1930 - 1995 | Upper | -56.8 | -19 | Pass |
| 2110 - 2155 | Lower | -53.2 | -19 | Pass |
| 2110 - 2155 | Upper | -53 | -19 | Pass |

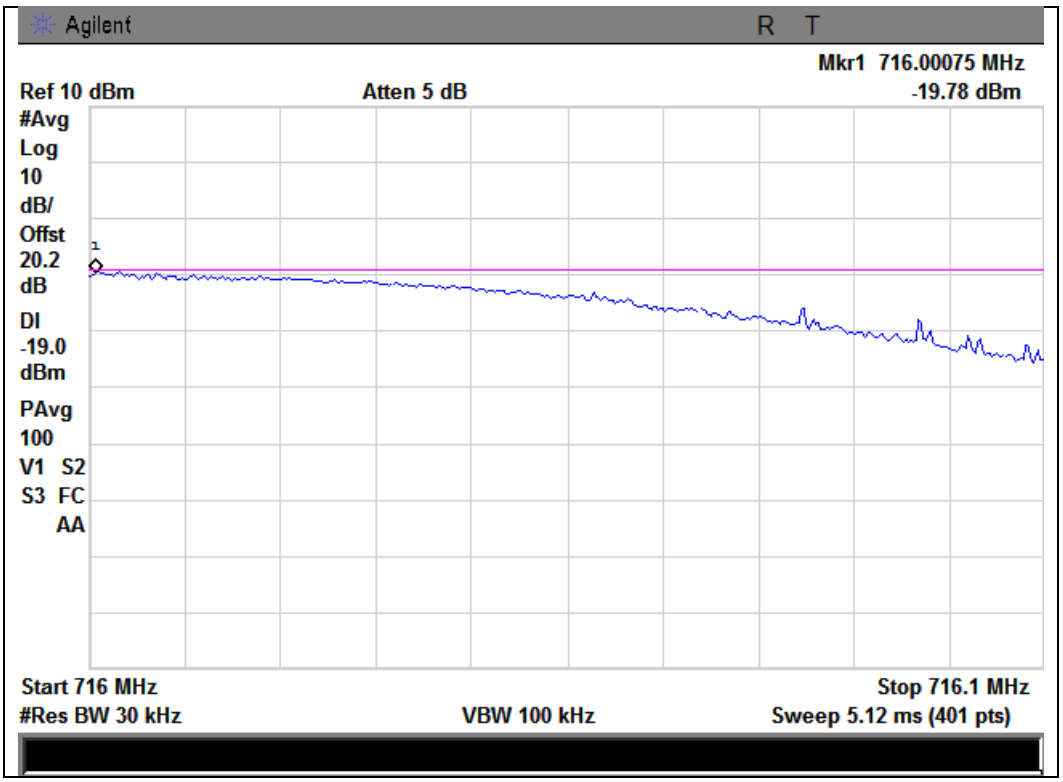
## GSM Uplink Test Plots

### 698 - 716 MHz Band

### Lower Band Edge

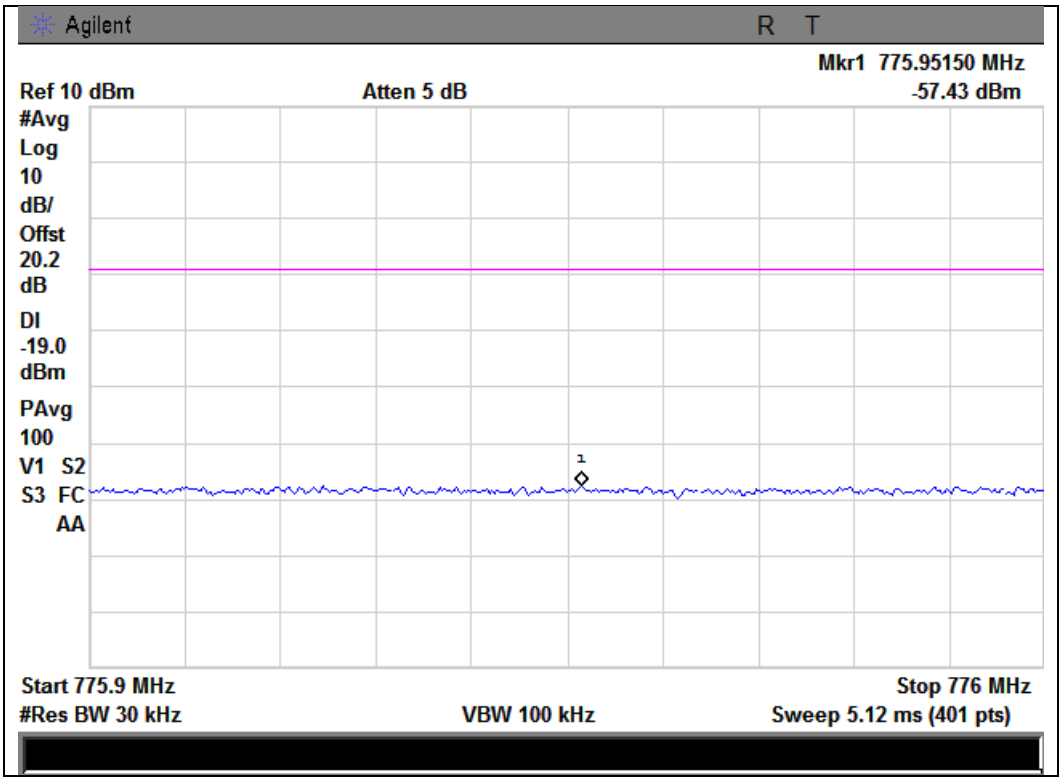



### Upper Band Edge

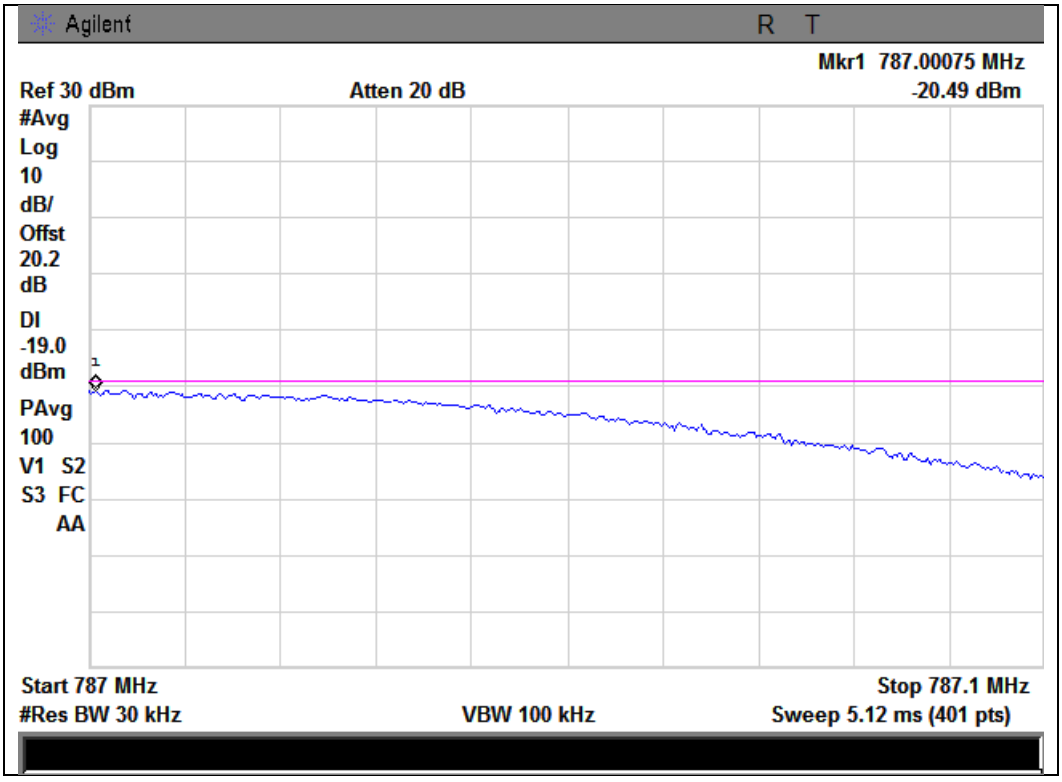


## 777 - 787 MHz Band

### Lower Band Edge

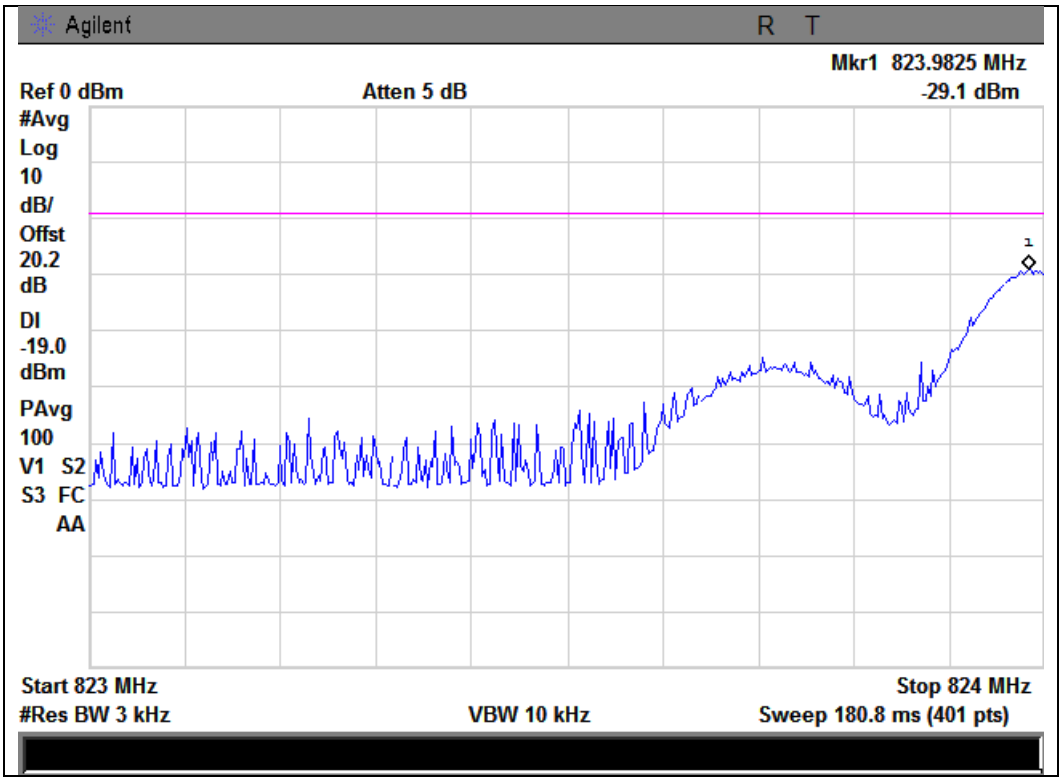



### Upper Band Edge

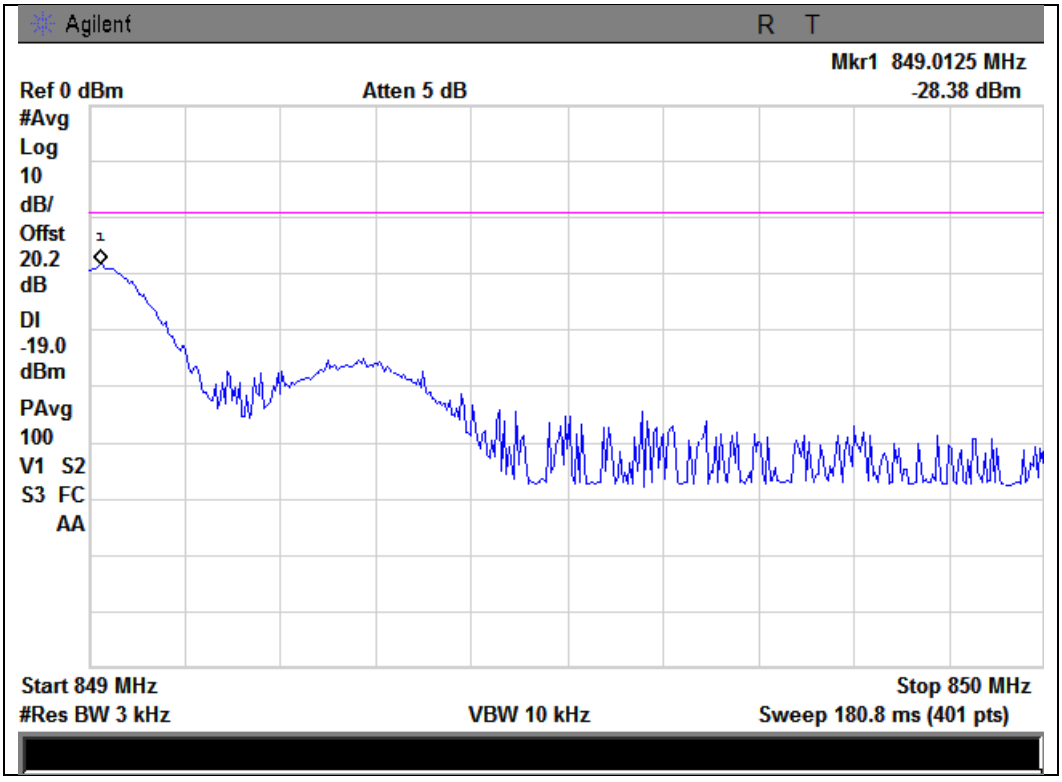


## 824 - 849 MHz Band

### Lower Band Edge

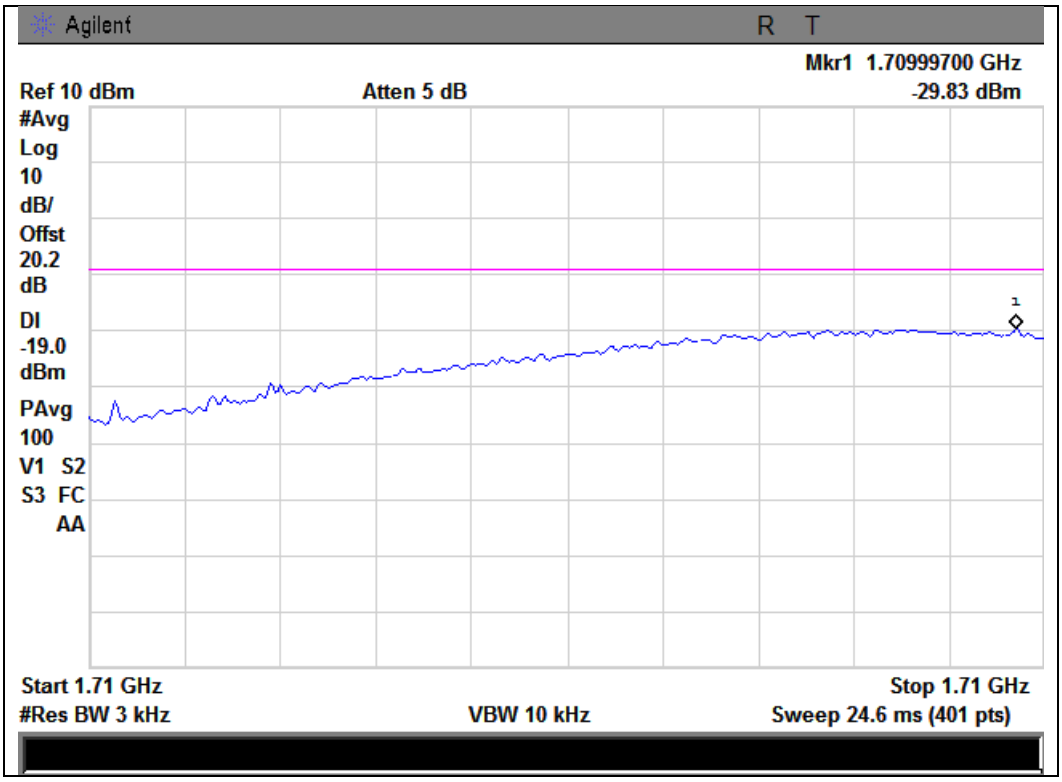



### Upper Band Edge

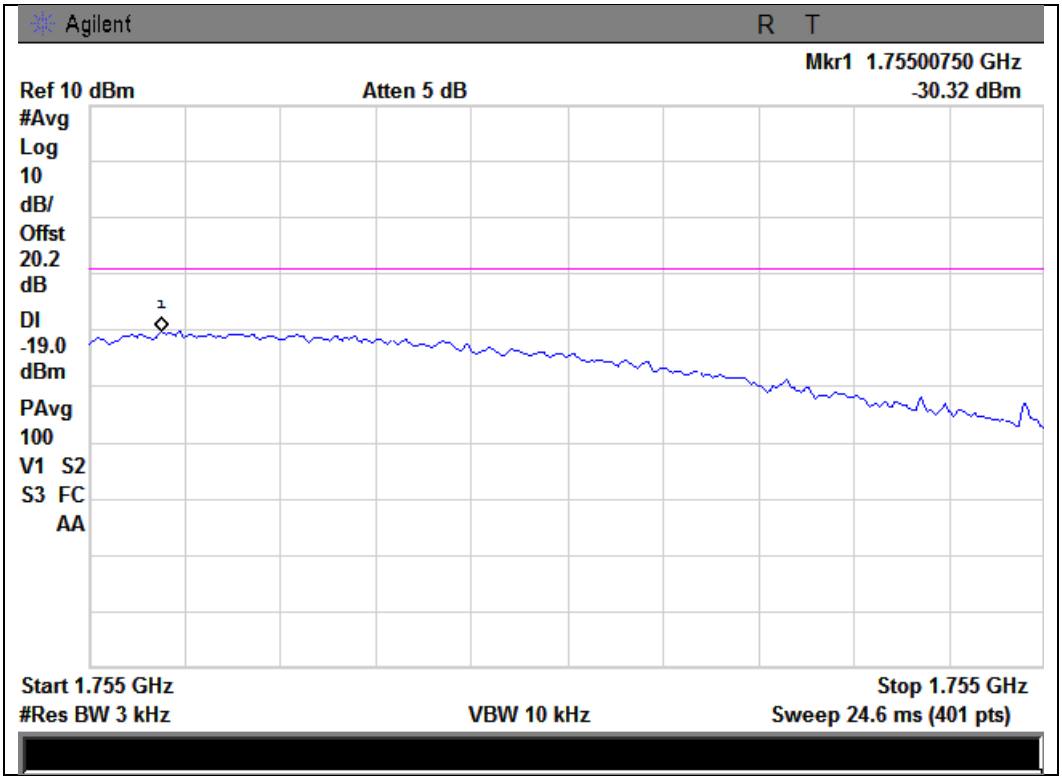


## 1710 - 1755 MHz Band

### Lower Band Edge

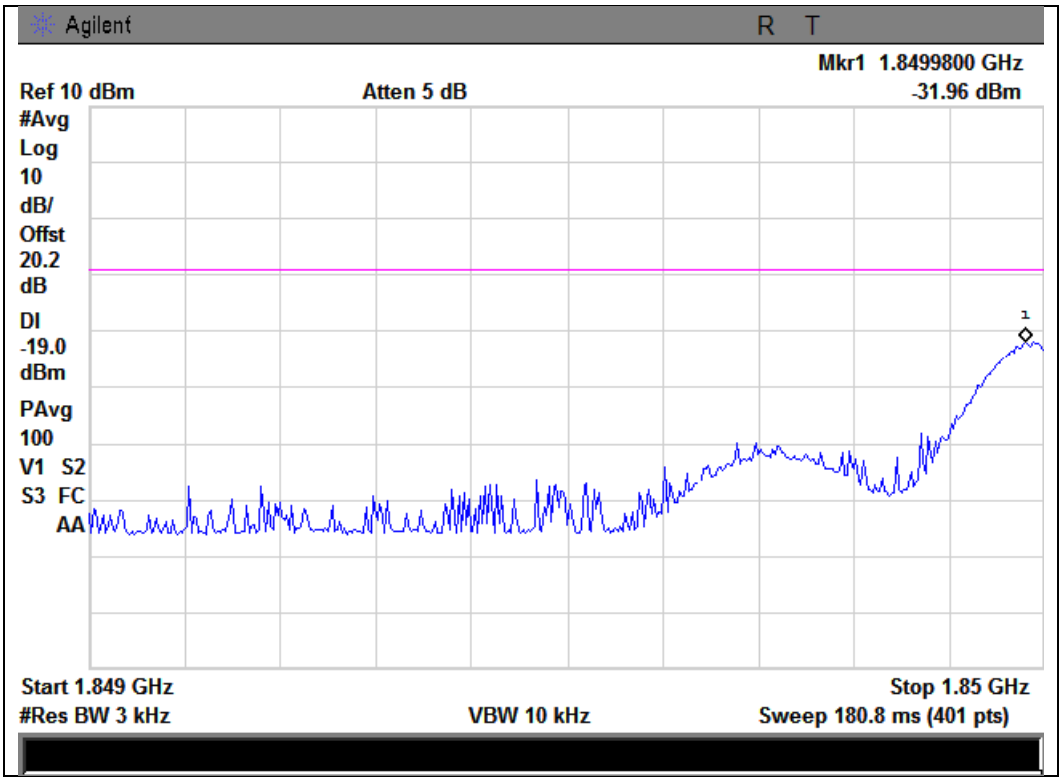



### Upper Band Edge

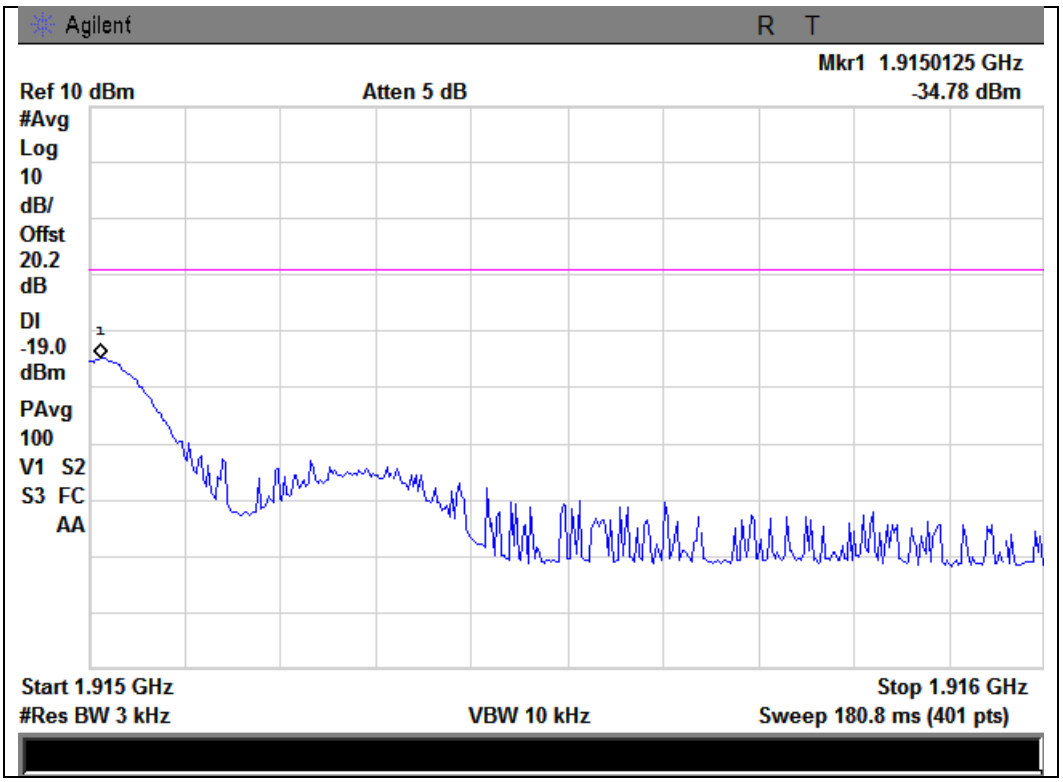


## 1850 - 1915 MHz Band

### Lower Band Edge



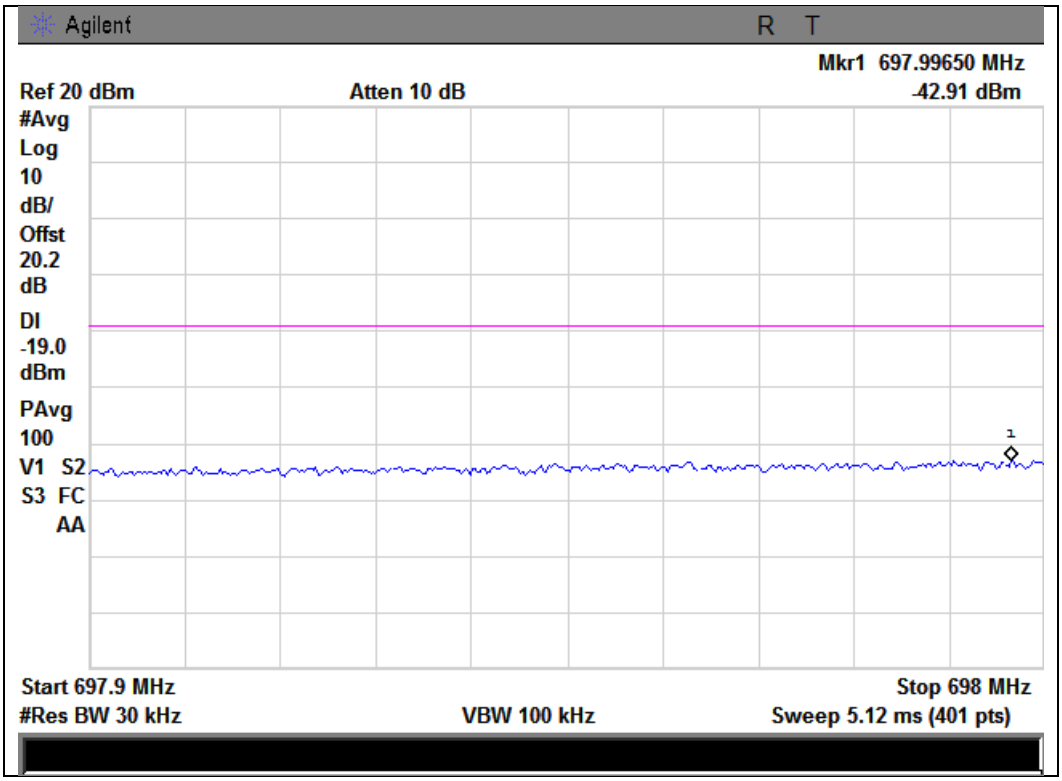

### Upper Band Edge



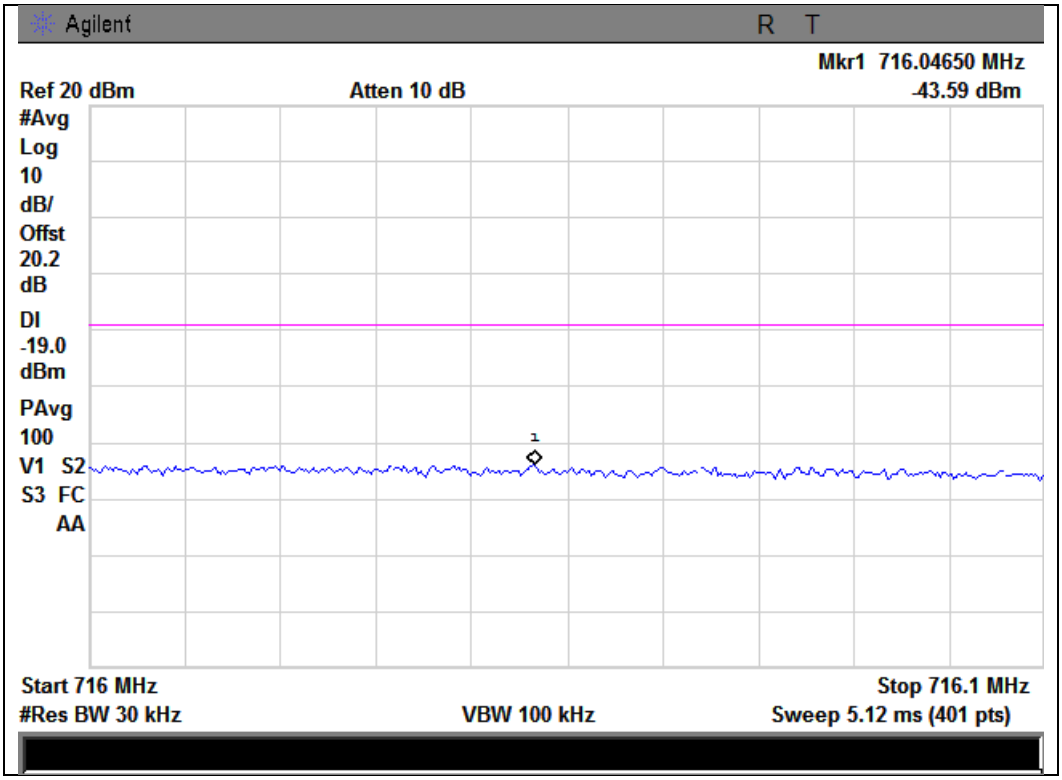
## CDMA Uplink Test Plots

### 698 - 716 MHz Band

### Lower Band Edge

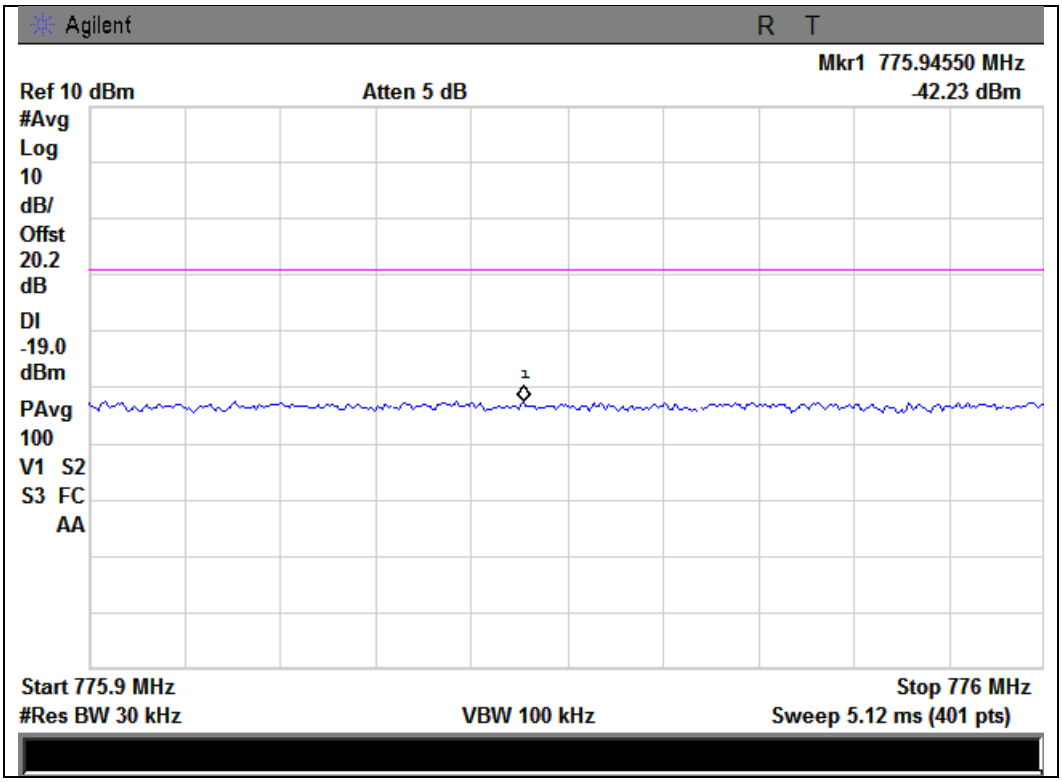



### Upper Band Edge

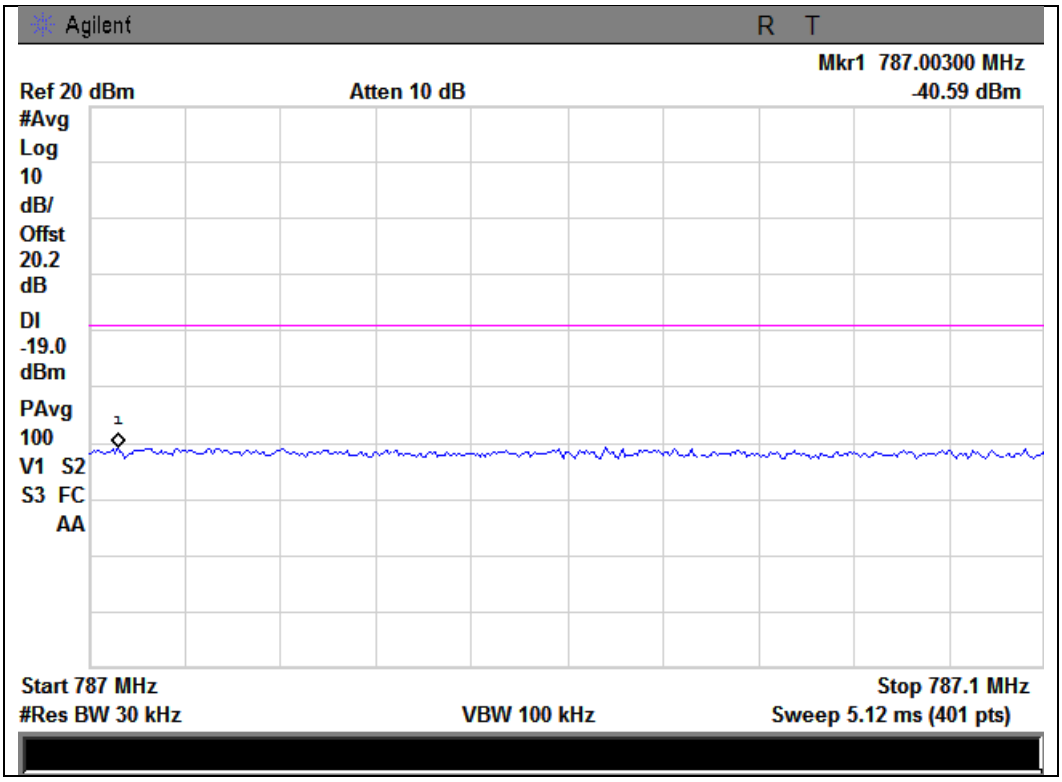


## 777 - 787 MHz Band

### Lower Band Edge

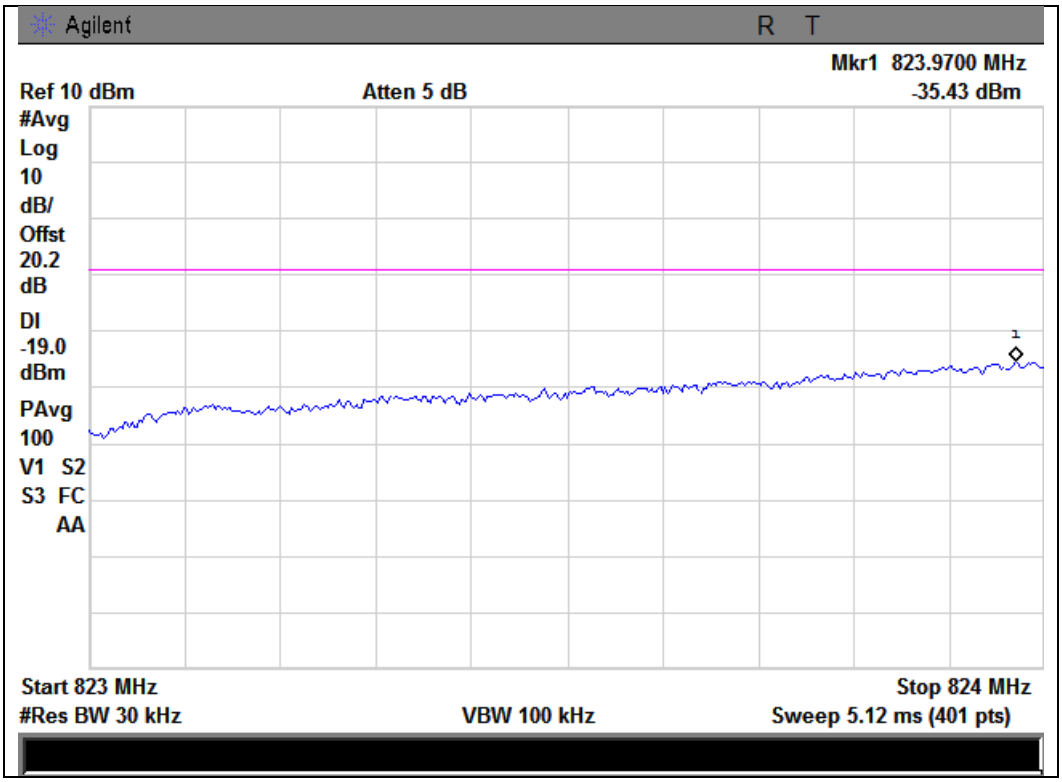



### Upper Band Edge

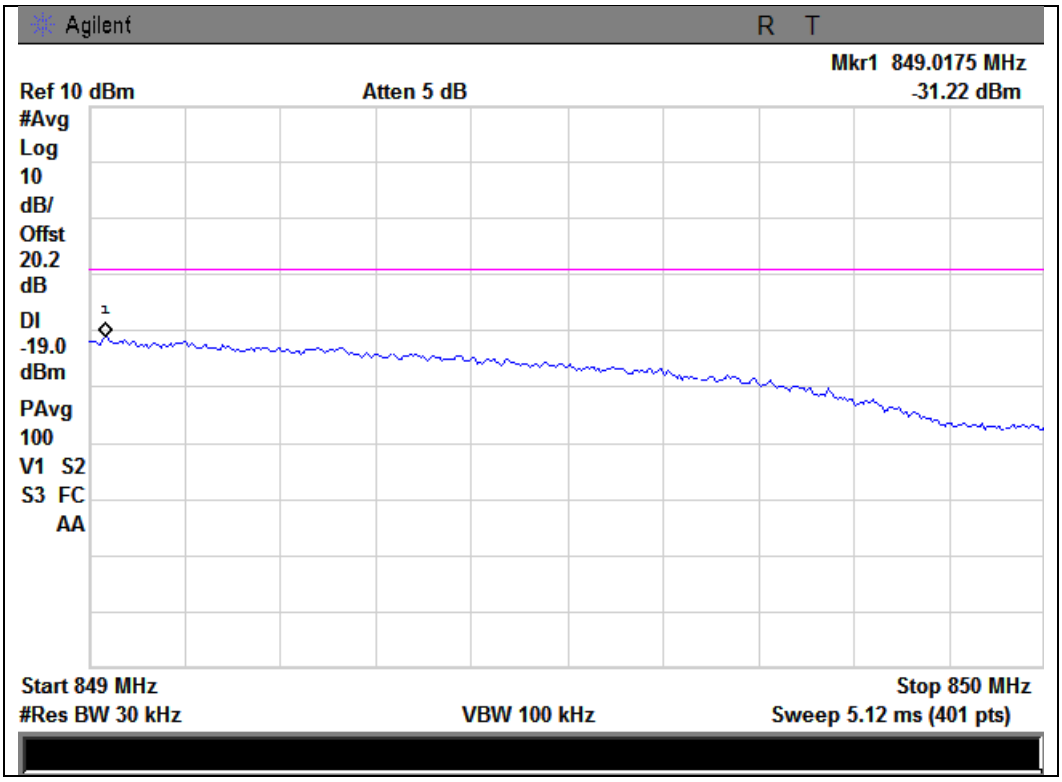


## 824 - 849 MHz Band

### Lower Band Edge

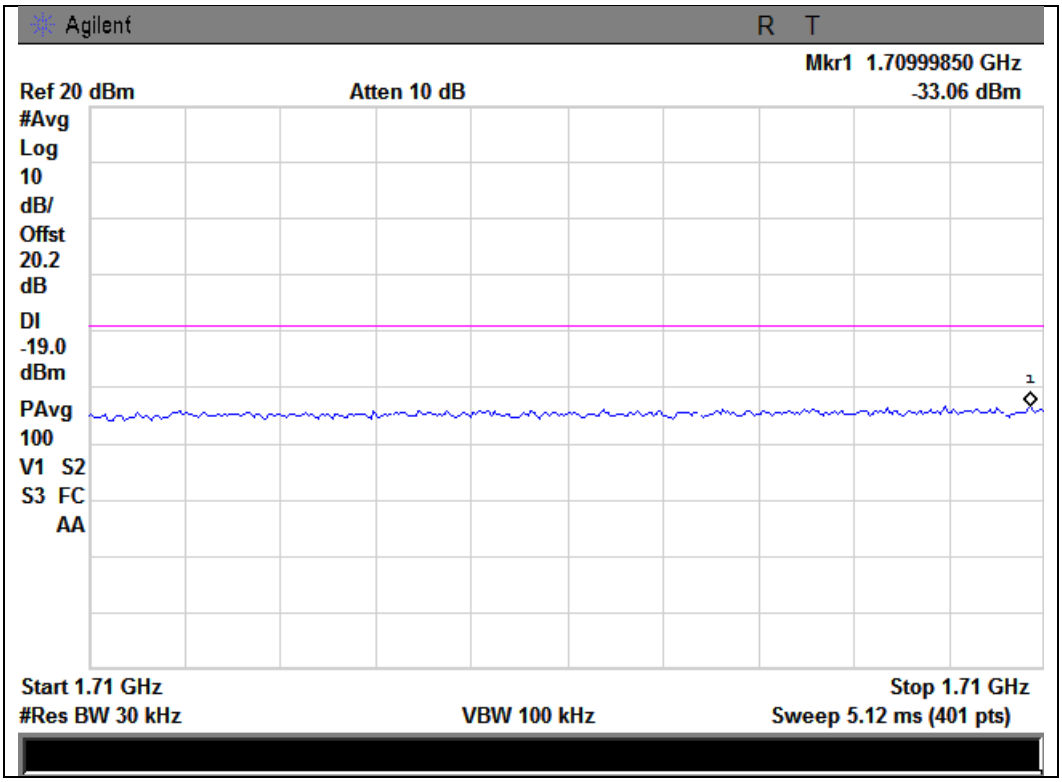



### Upper Band Edge

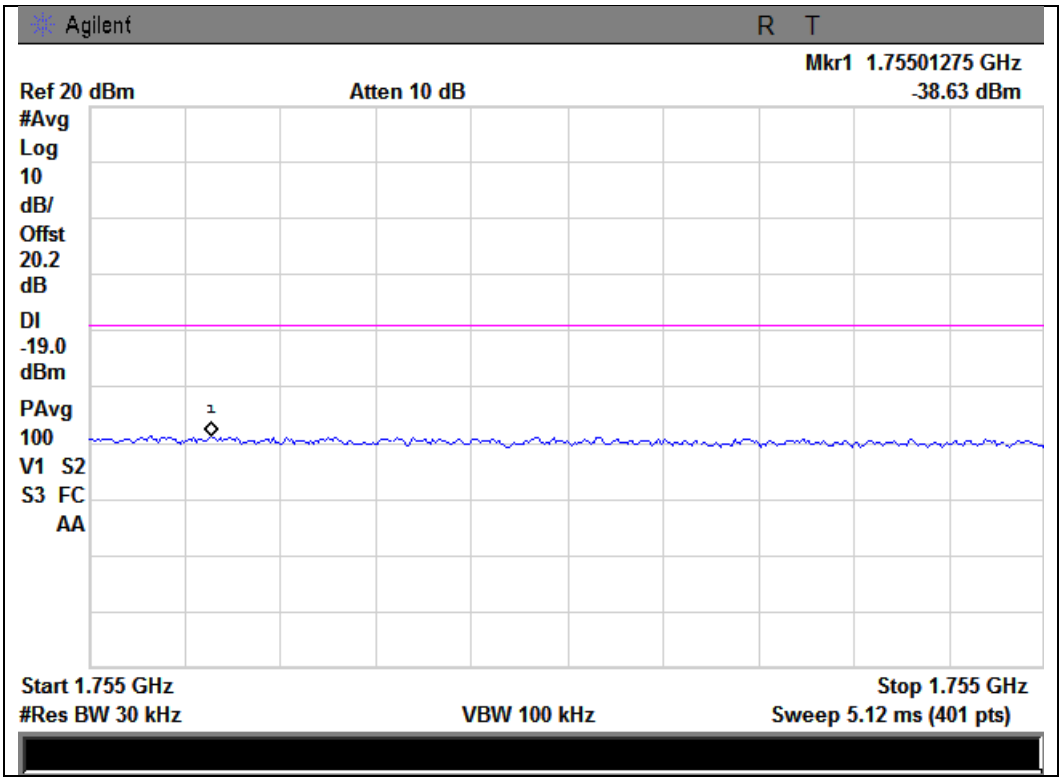


**1710 - 1755 MHz Band**

**Lower Band Edge**

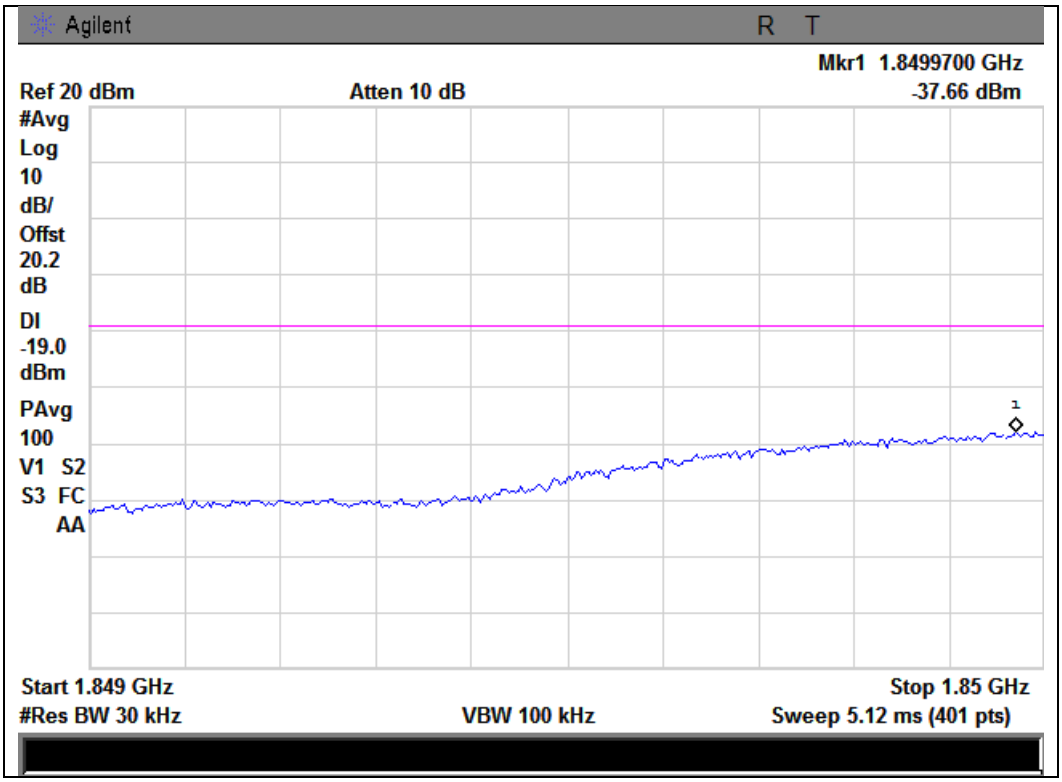



**Upper Band Edge**

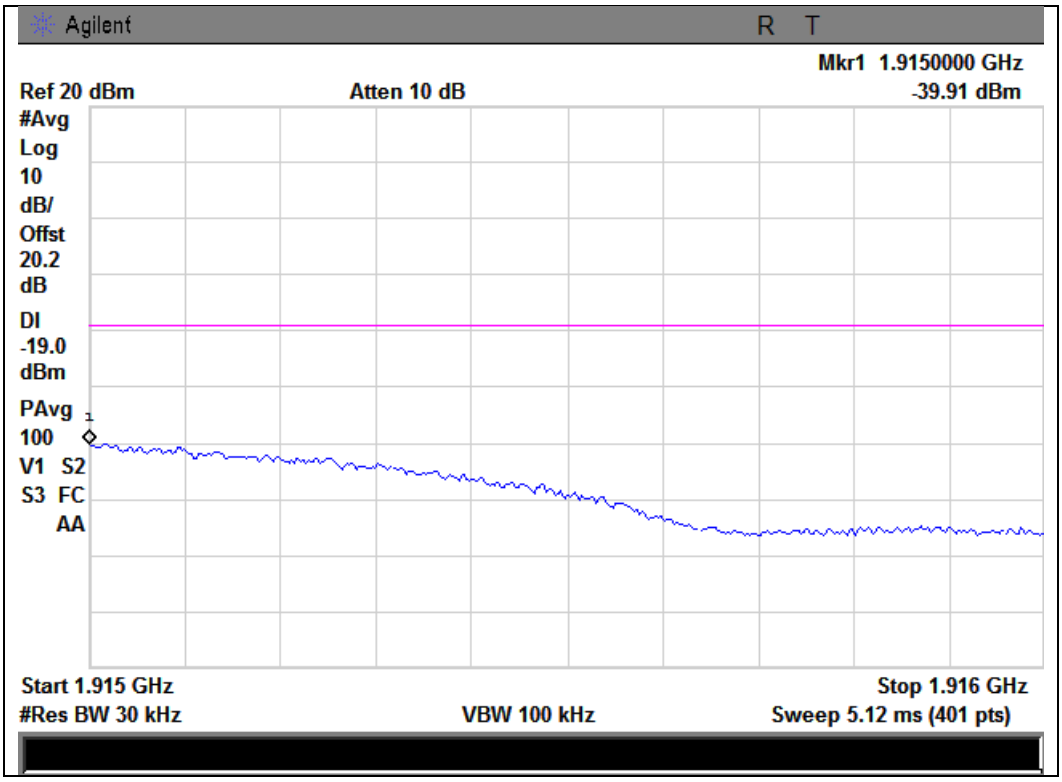


**1850 - 1915 MHz Band**

**Lower Band Edge**



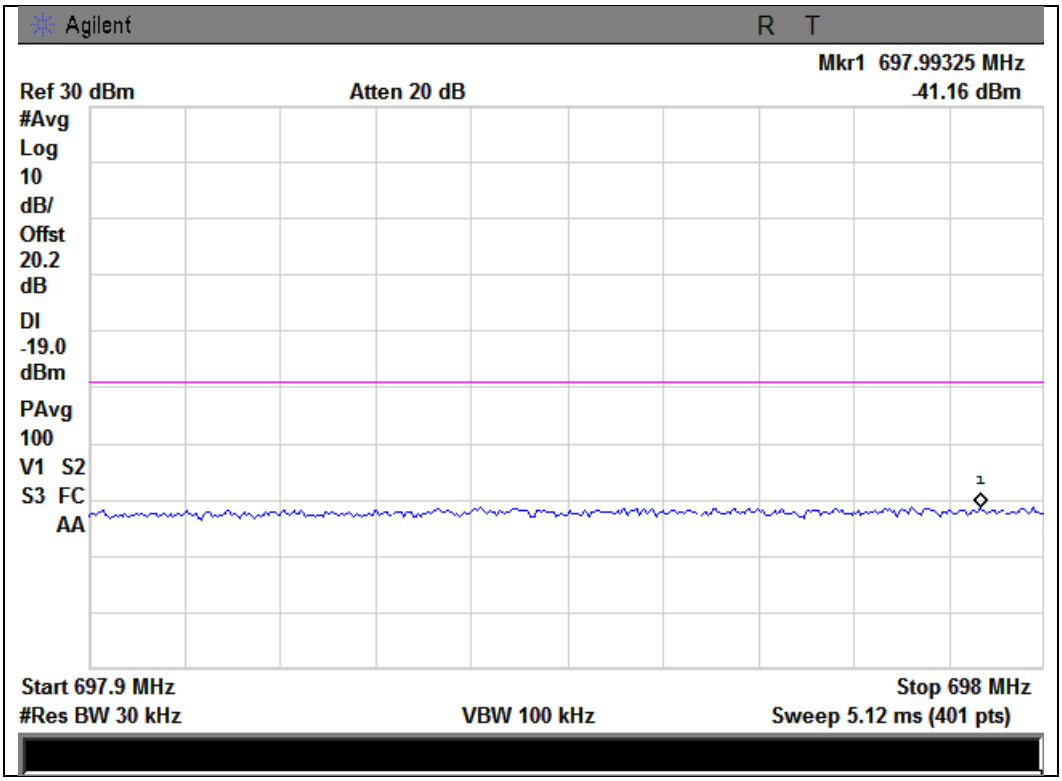

**Upper Band Edge**



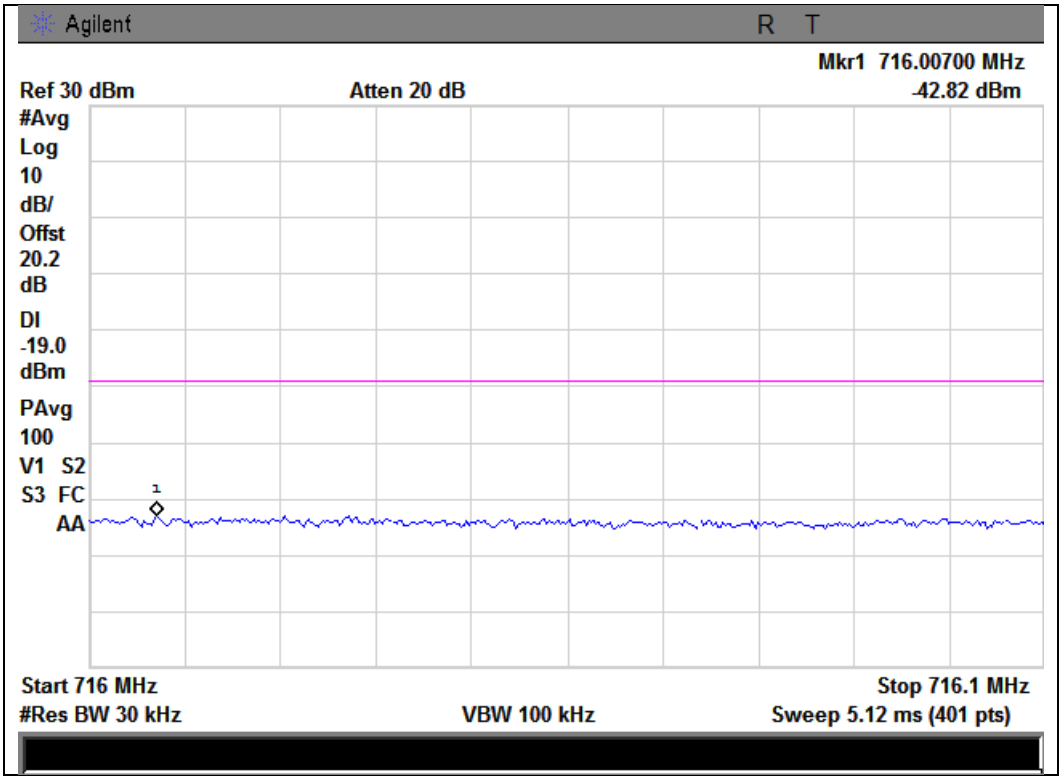
## WCDMA Uplink Test Plots

### 698 - 716 MHz Band

### Lower Band Edge

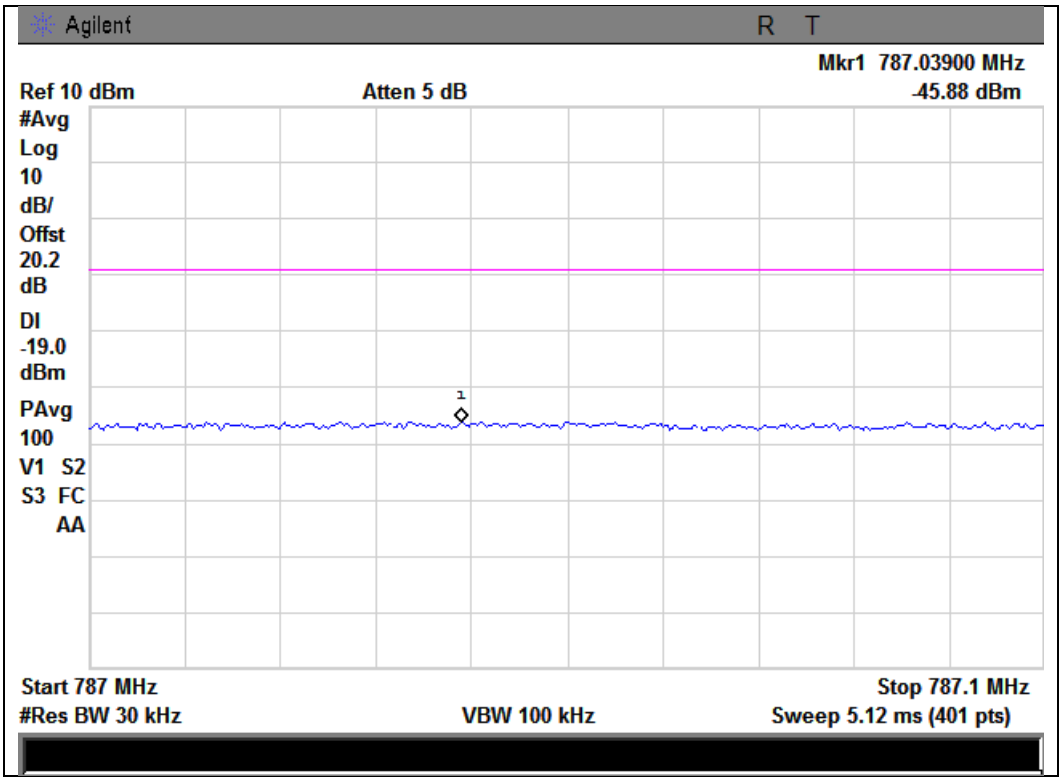



### Upper Band Edge

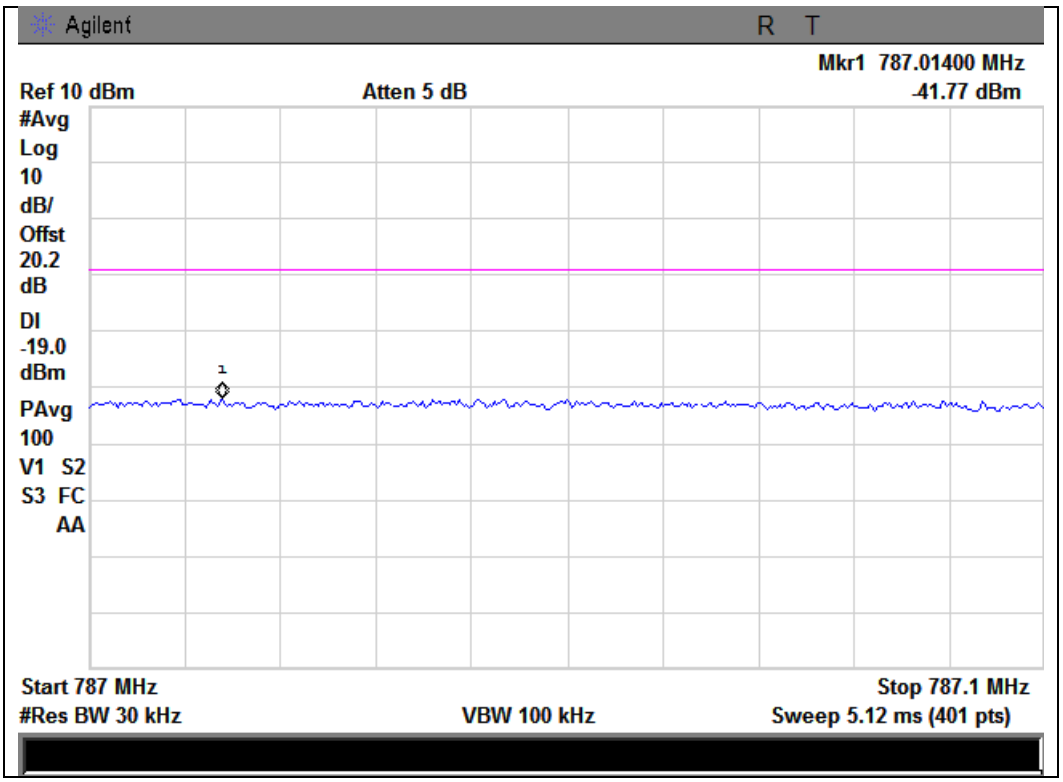


## 777 - 787 MHz Band

### Lower Band Edge

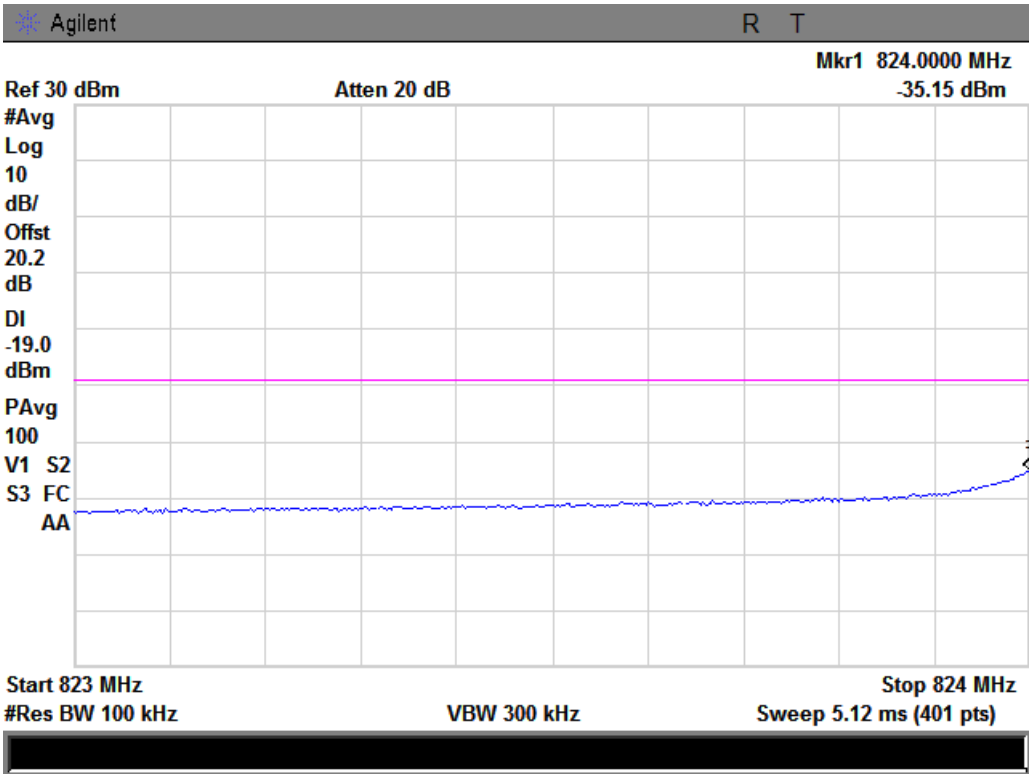



### Upper Band Edge

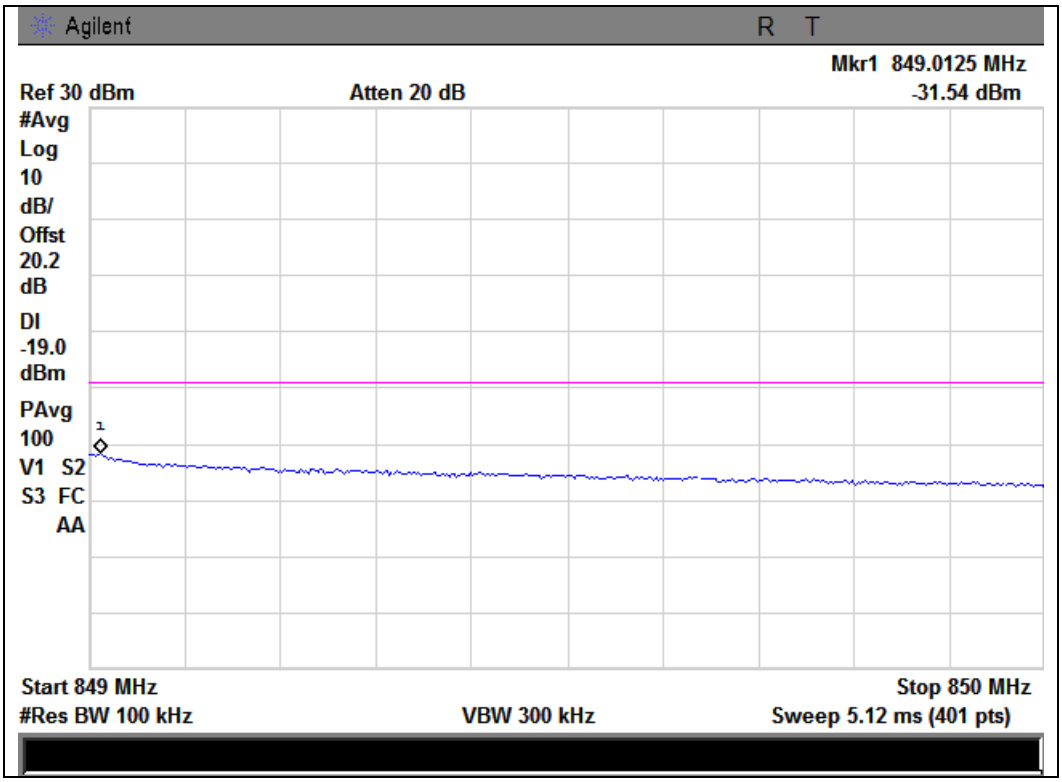


## 824 - 849 MHz Band

### Lower Band Edge

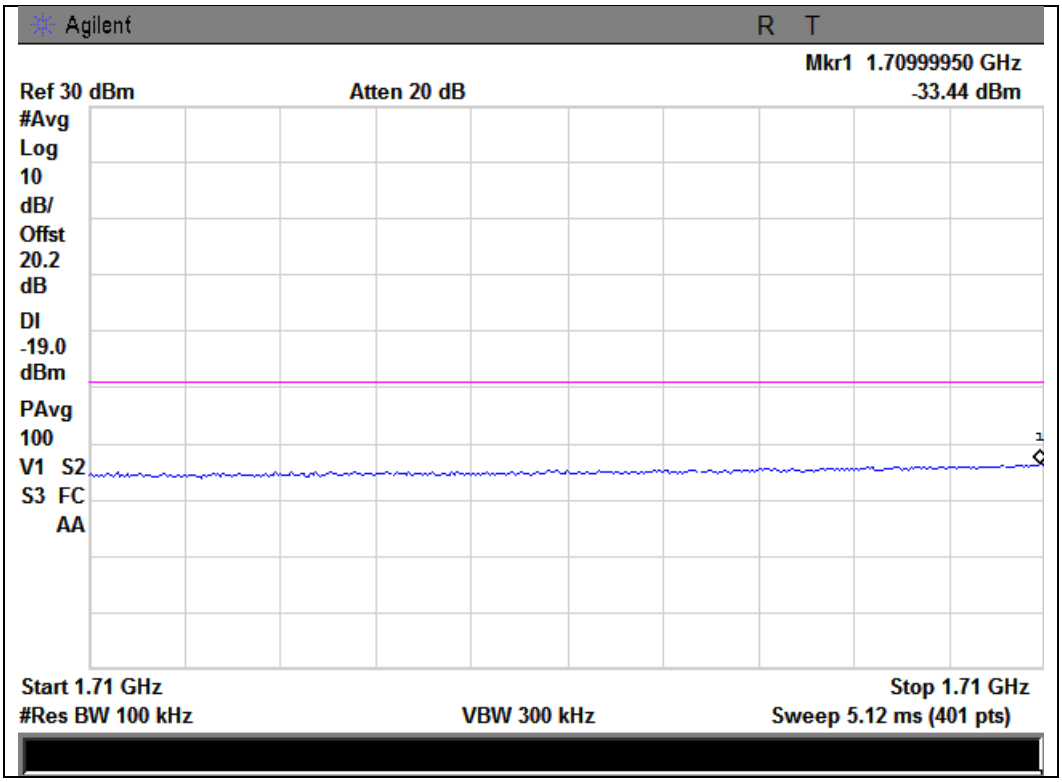



### Upper Band Edge

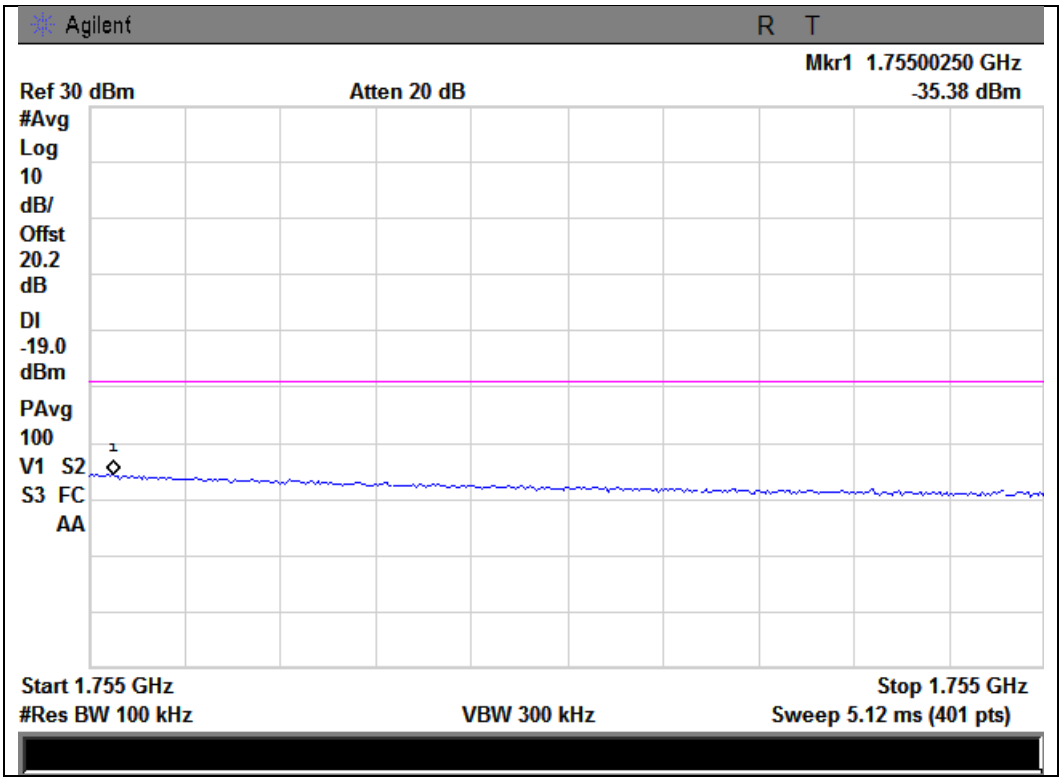


**1710 - 1755 MHz Band**

**Lower Band Edge**

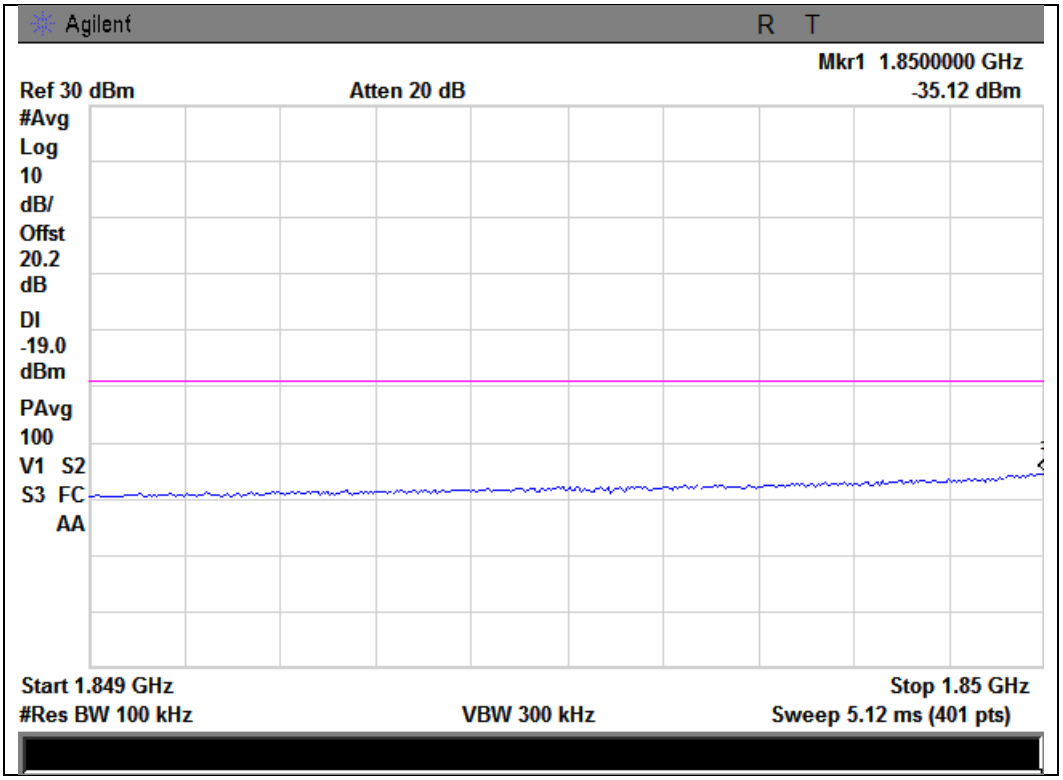



**Upper Band Edge**

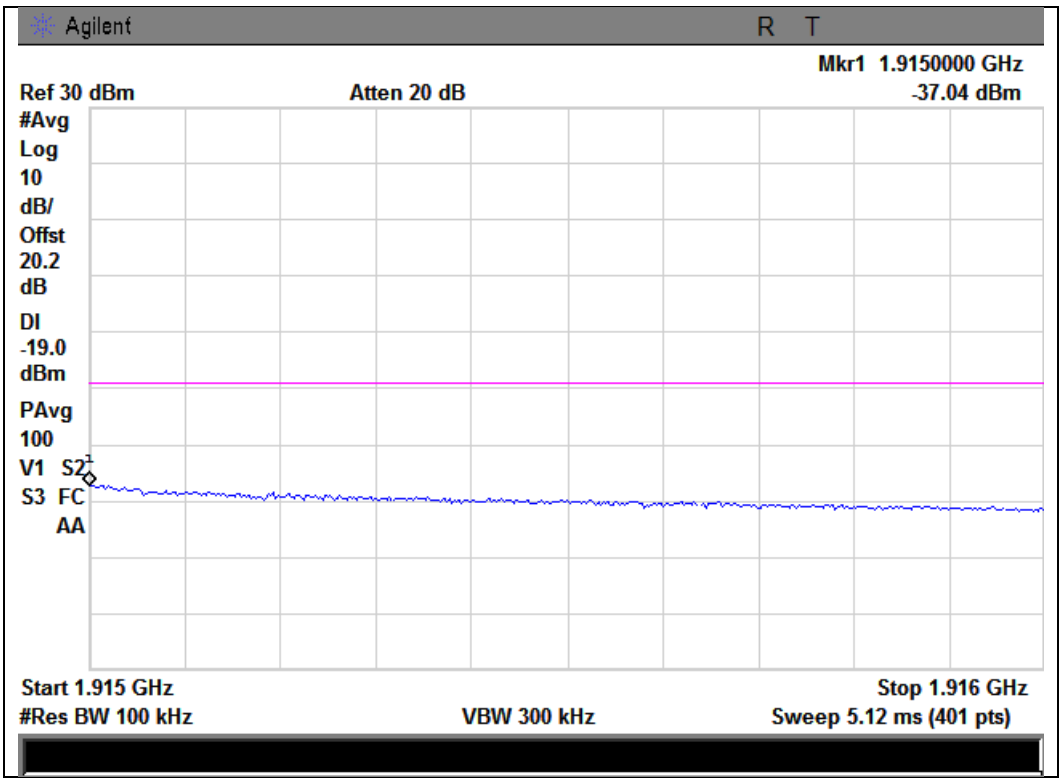


## 1850 - 1915 MHz Band

### Lower Band Edge



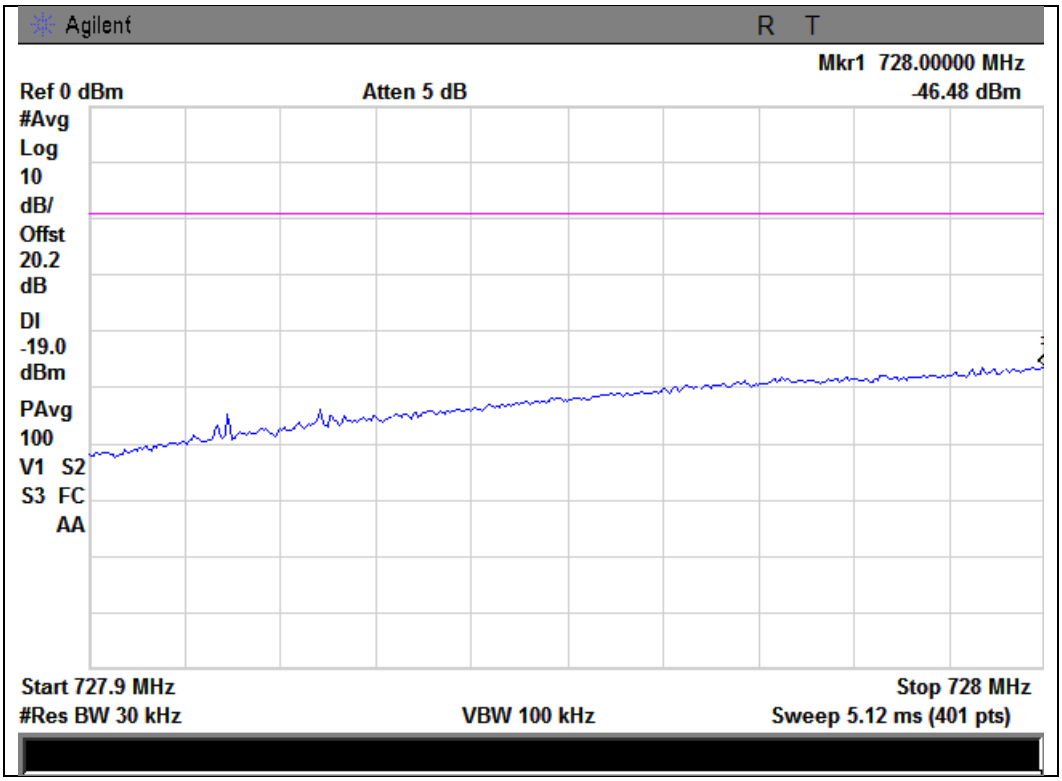

### Upper Band Edge



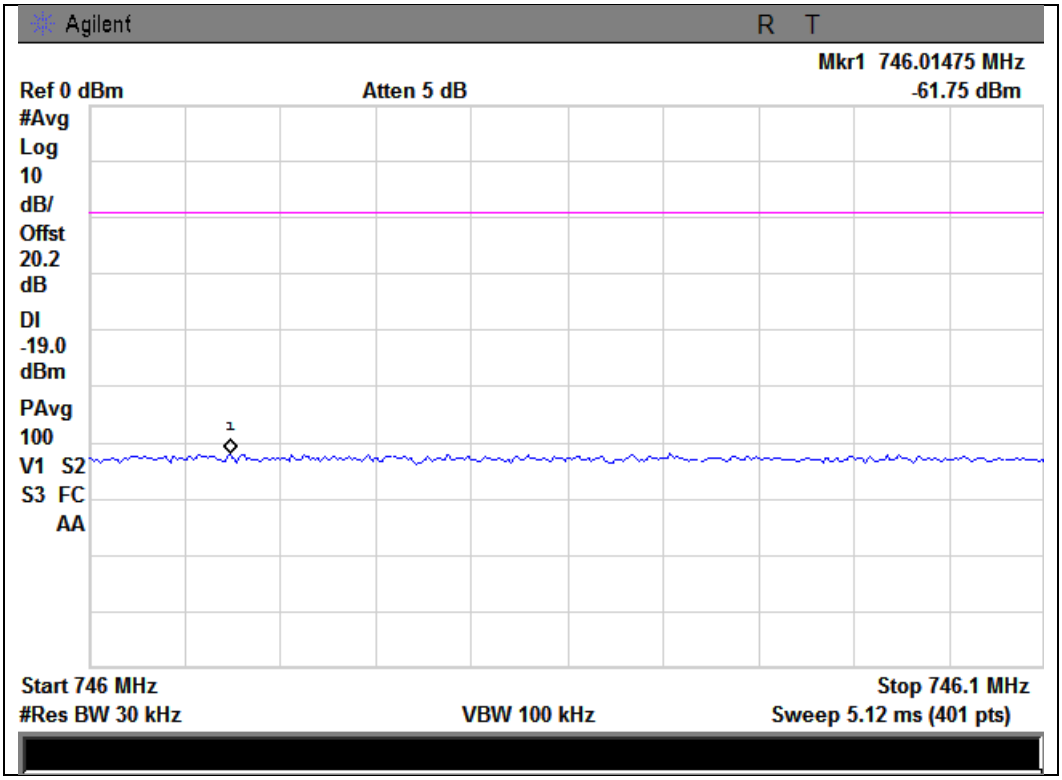
## GSM Downlink Test Plots

## 728 - 746 MHz Band

### Lower Band Edge

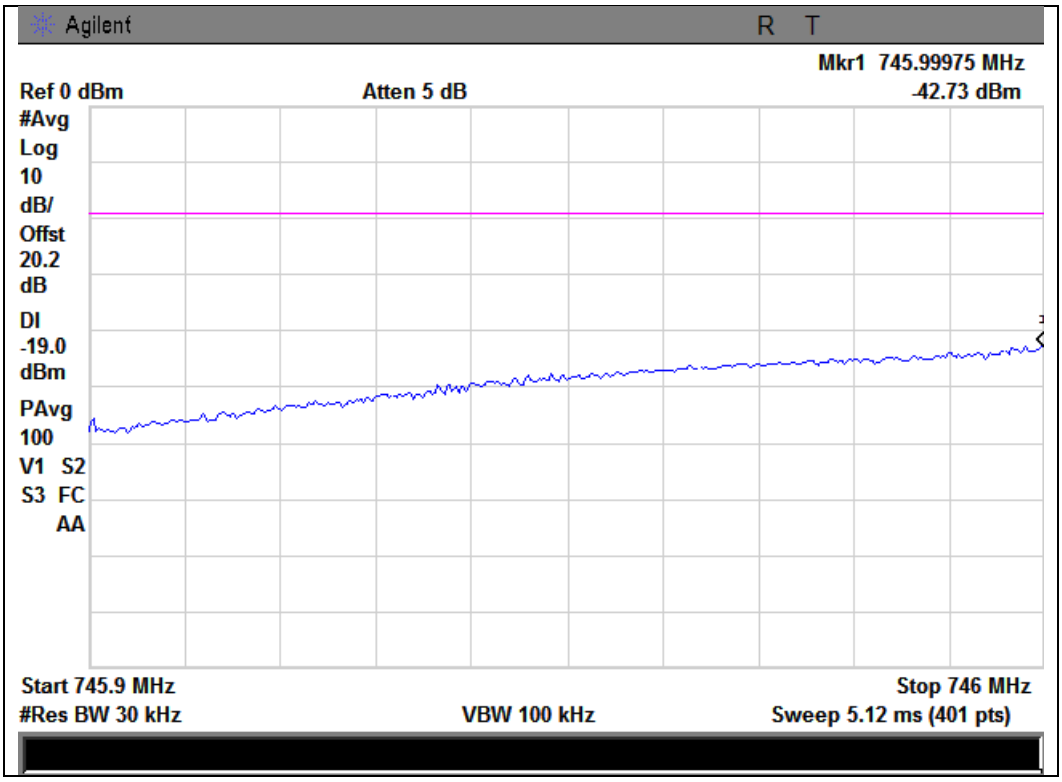



### Upper Band Edge

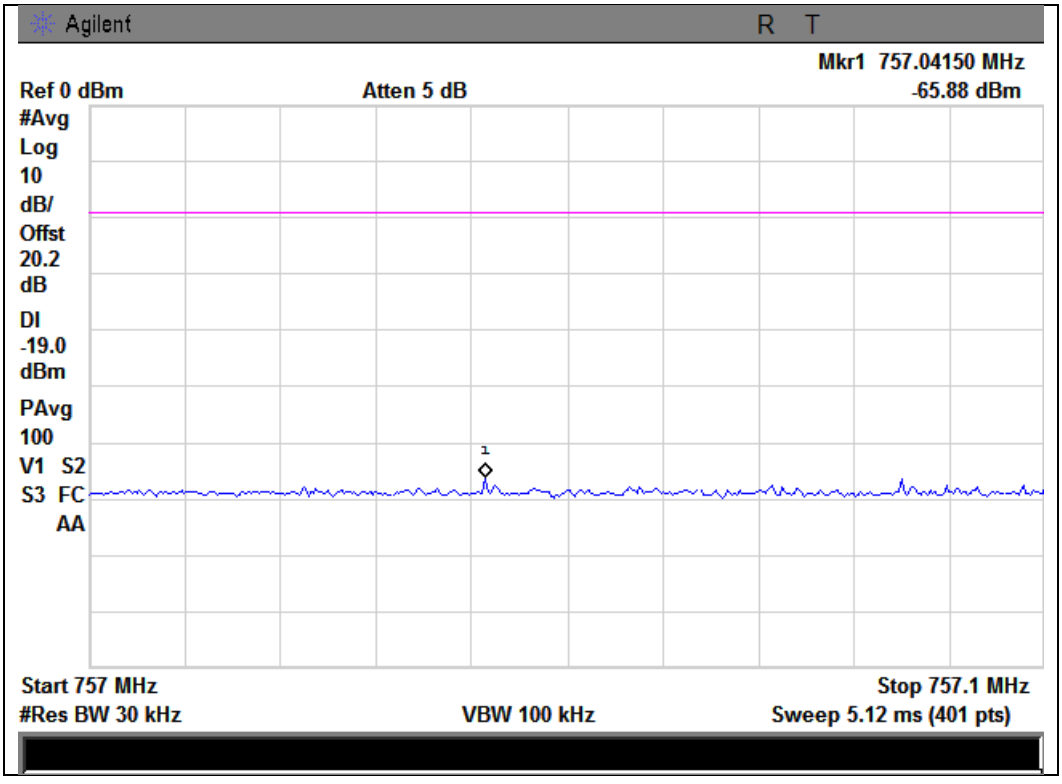


## 746 - 756 MHz Band

### Lower Band Edge

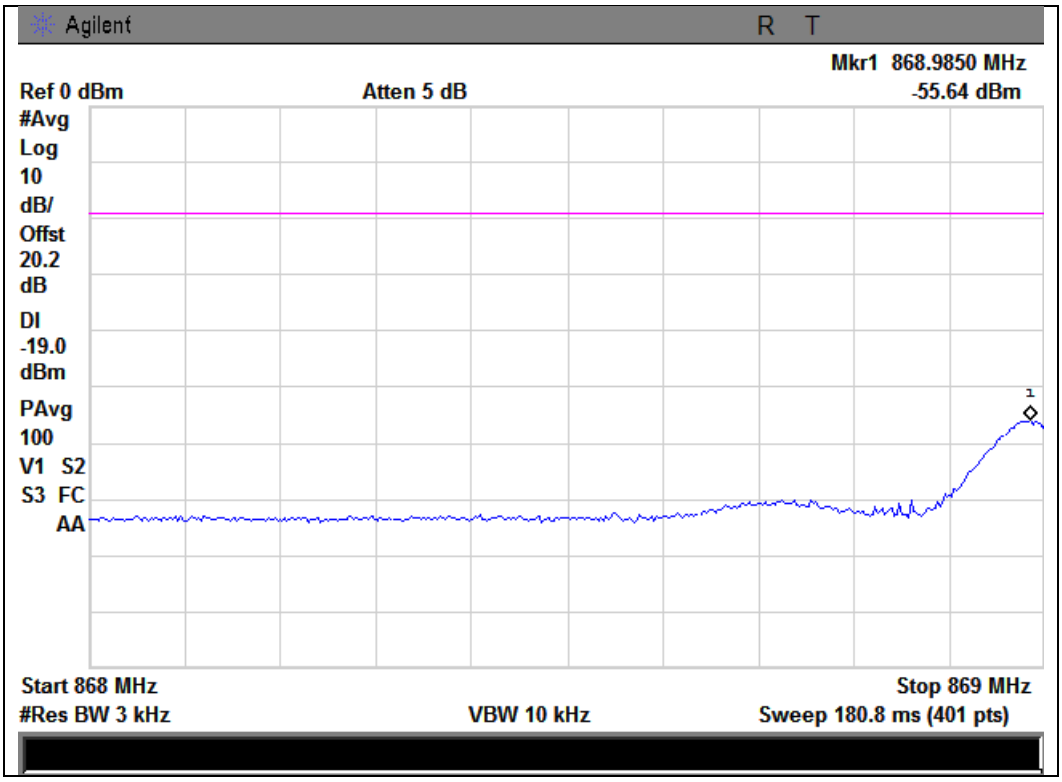



### Upper Band Edge

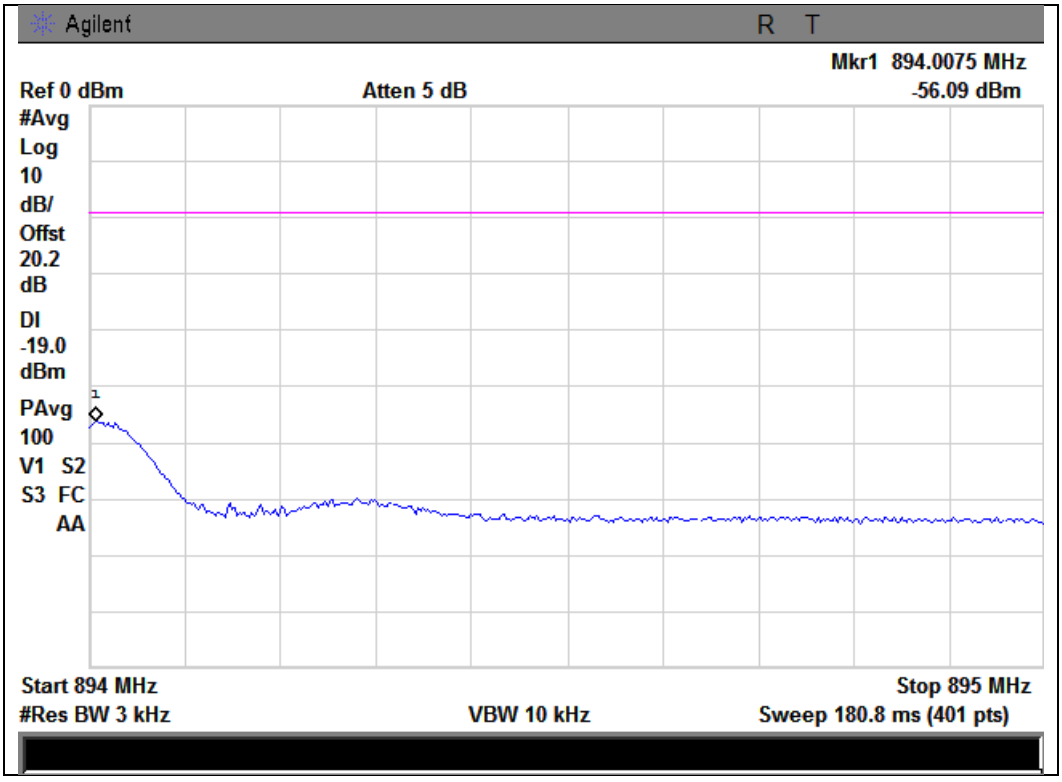


## 869 - 894 MHz Band

### Lower Band Edge

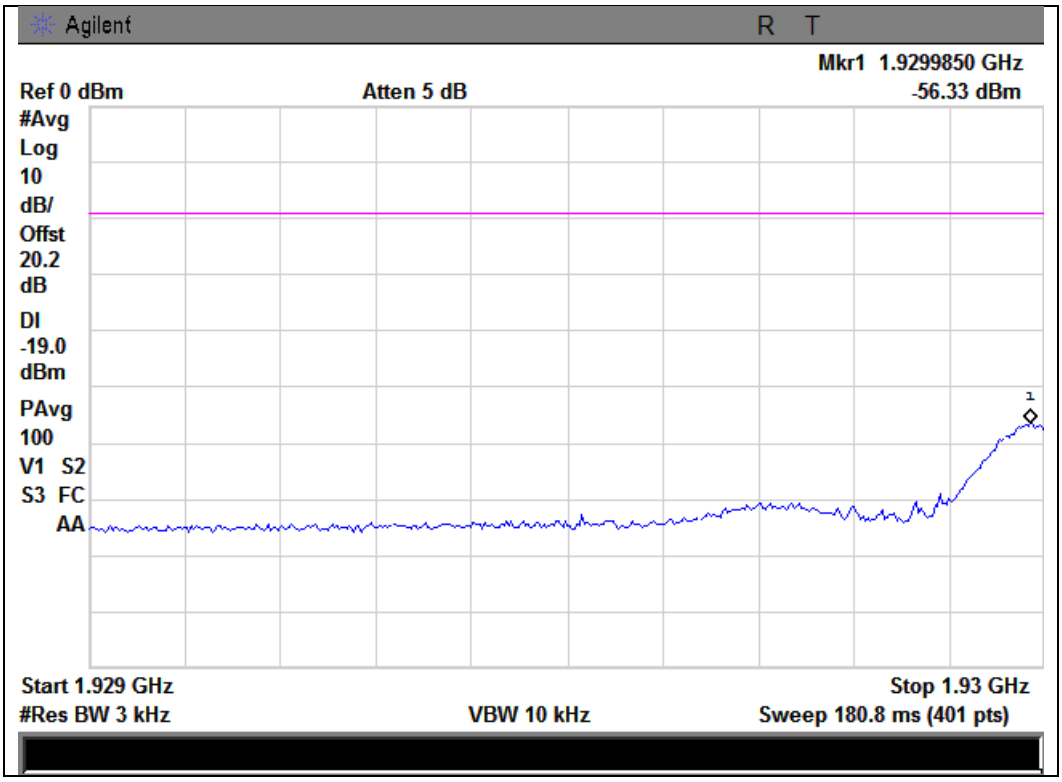



### Upper Band Edge

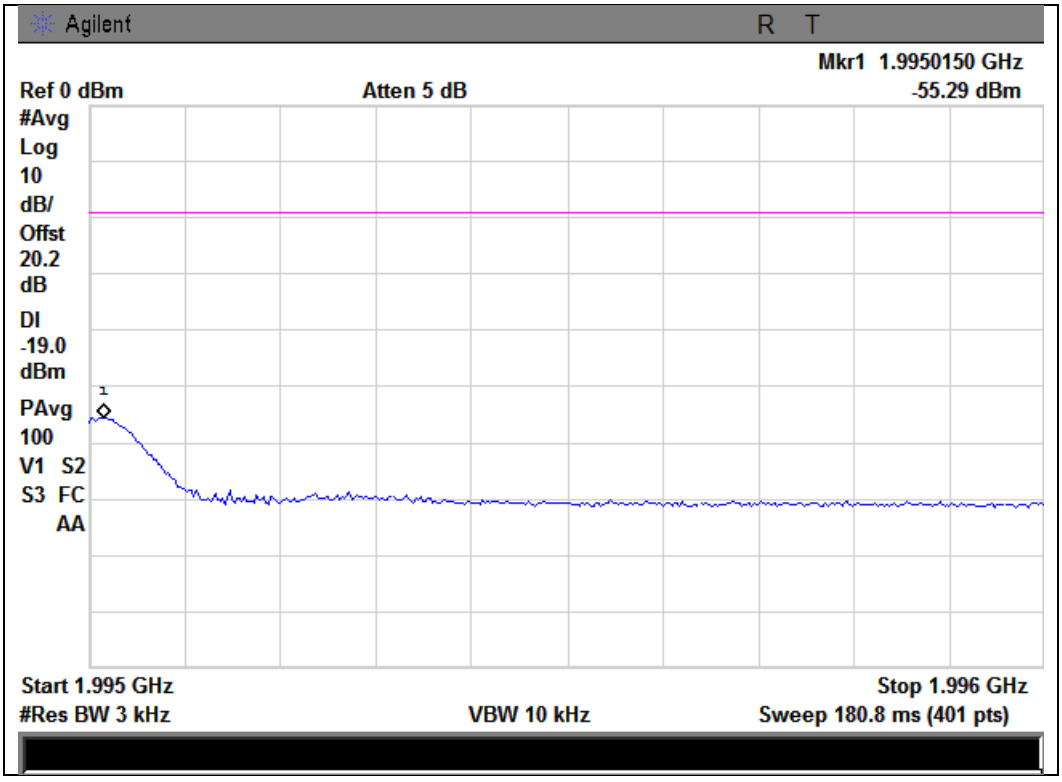


## 1930 - 1995 MHz Band

### Lower Band Edge

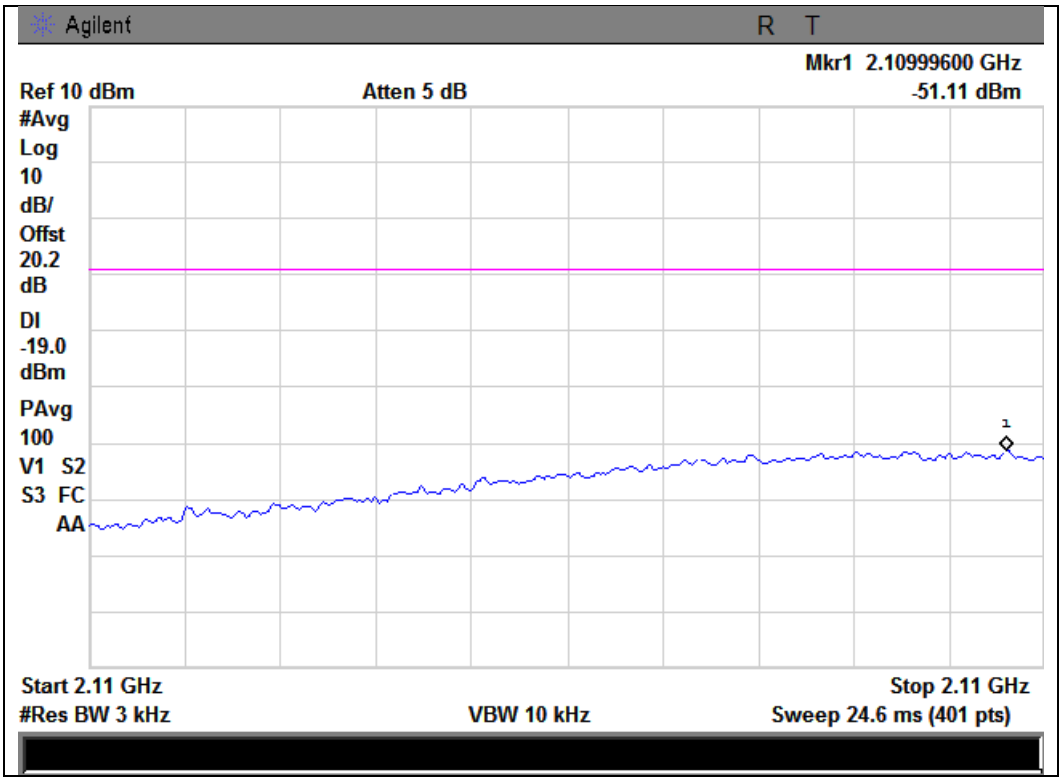



### Upper Band Edge

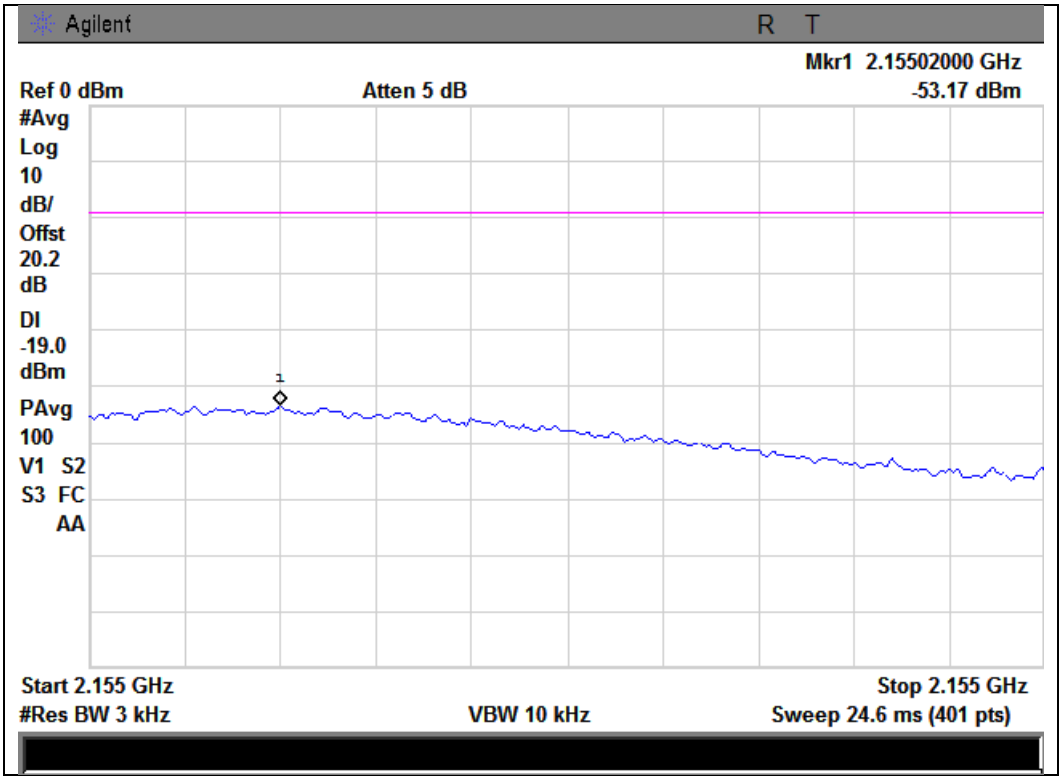


## 2110 - 2155 MHz Band

### Lower Band Edge



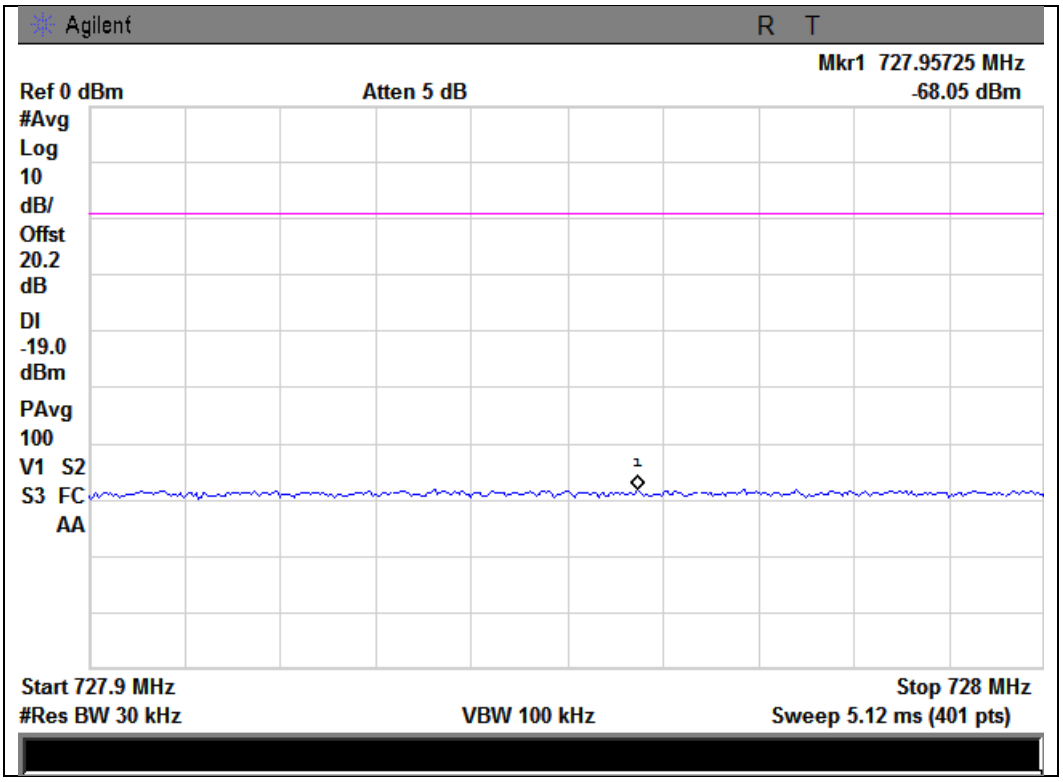

### Upper Band Edge



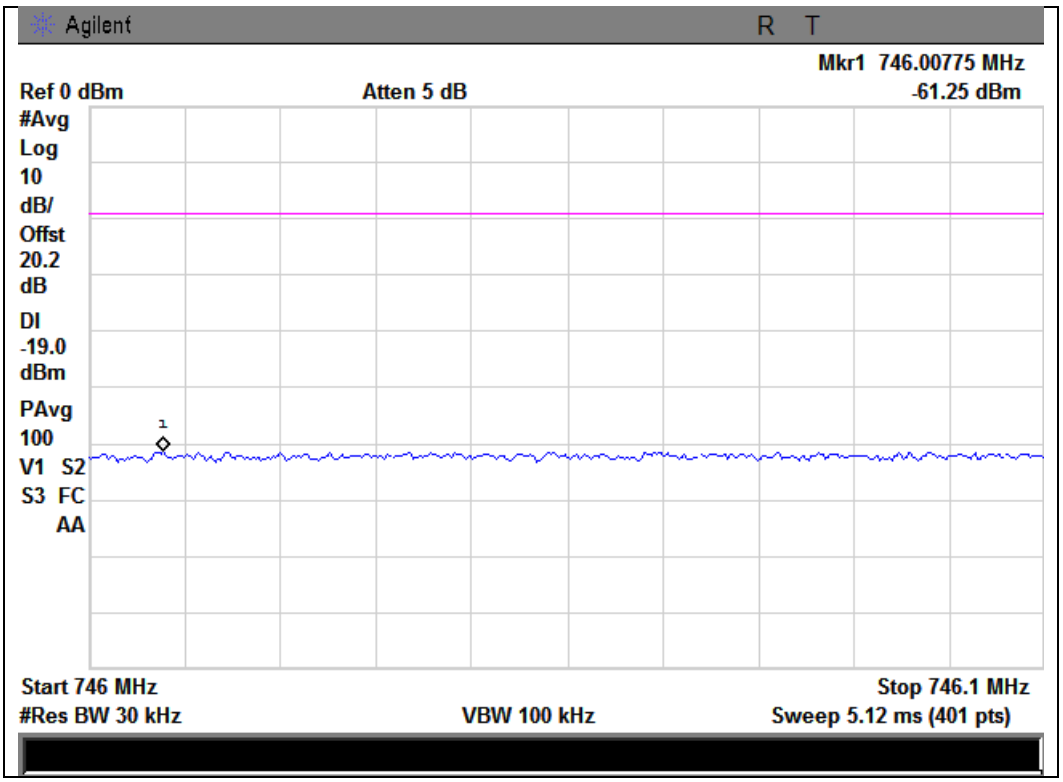
## CDMA Downlink Test Plots

## 728 - 746 MHz Band

### Lower Band Edge

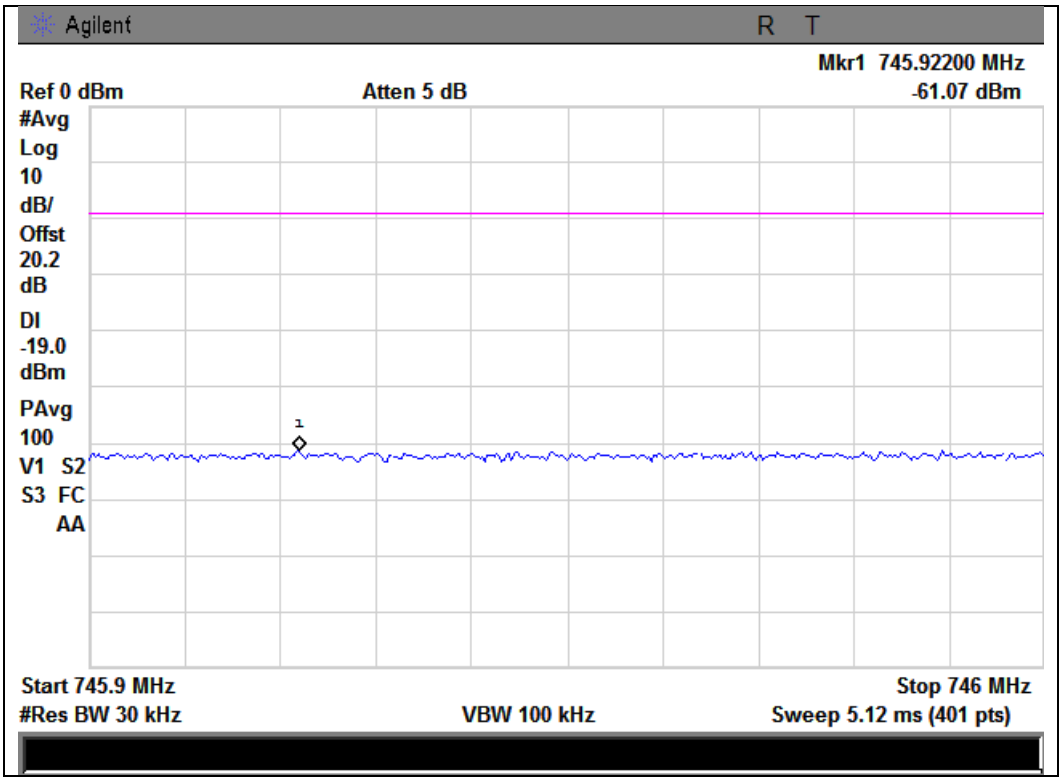



### Upper Band Edge

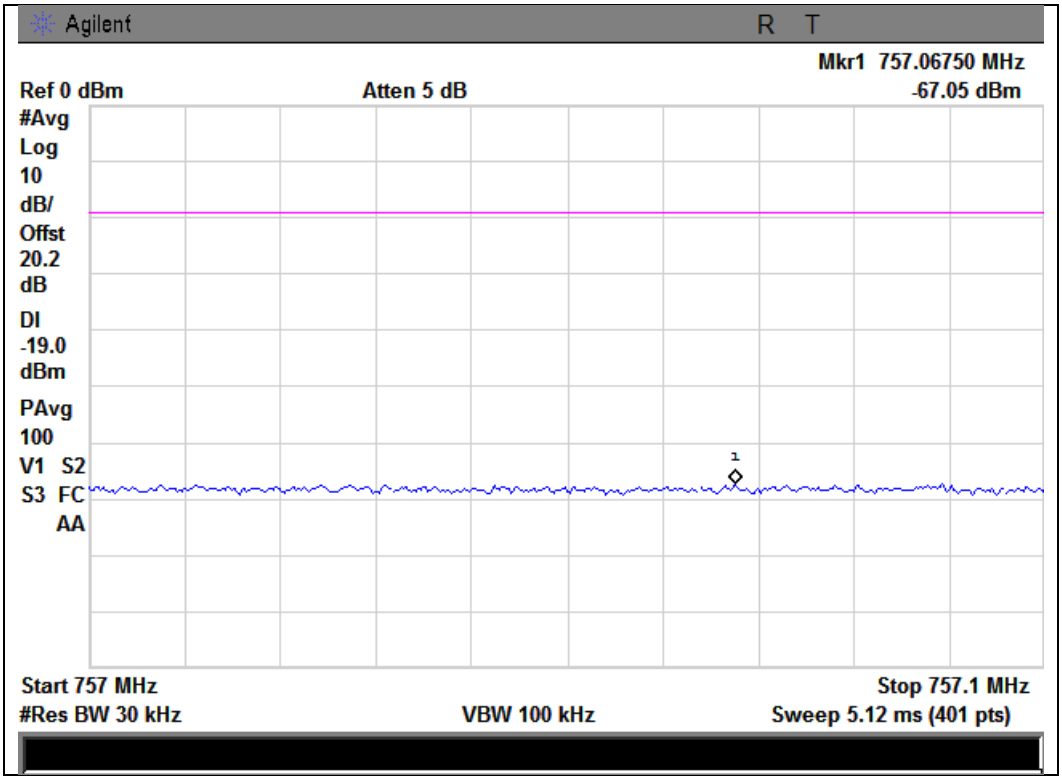


## 746 - 756 MHz Band

### Lower Band Edge

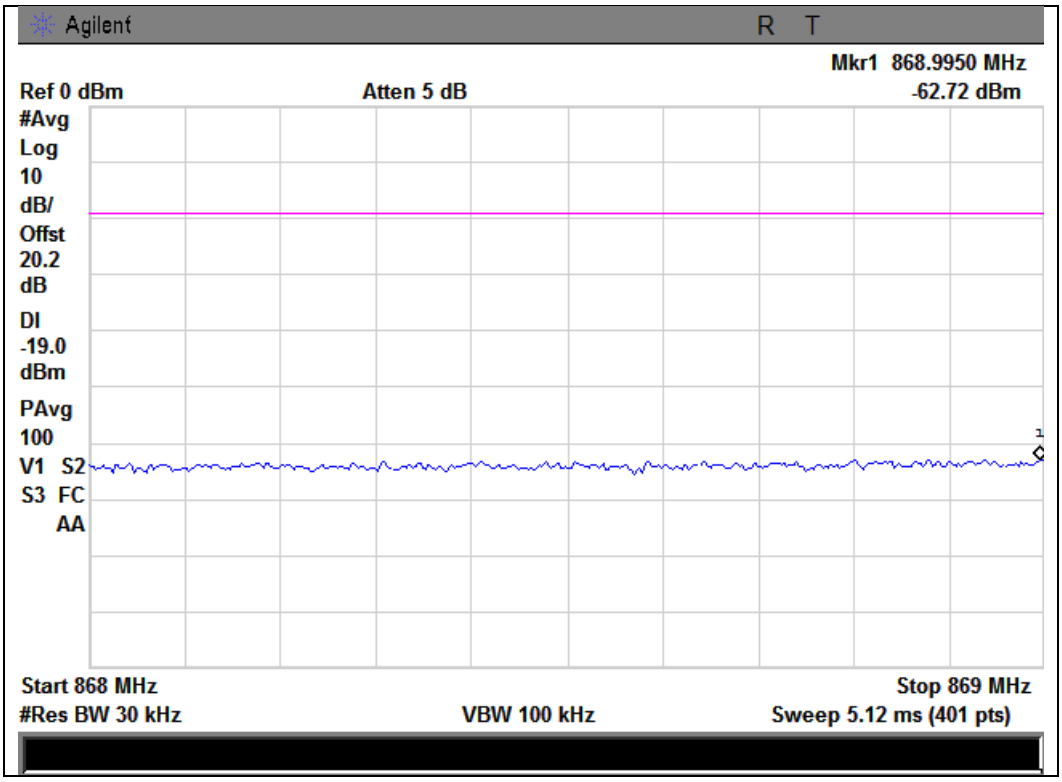



### Upper Band Edge

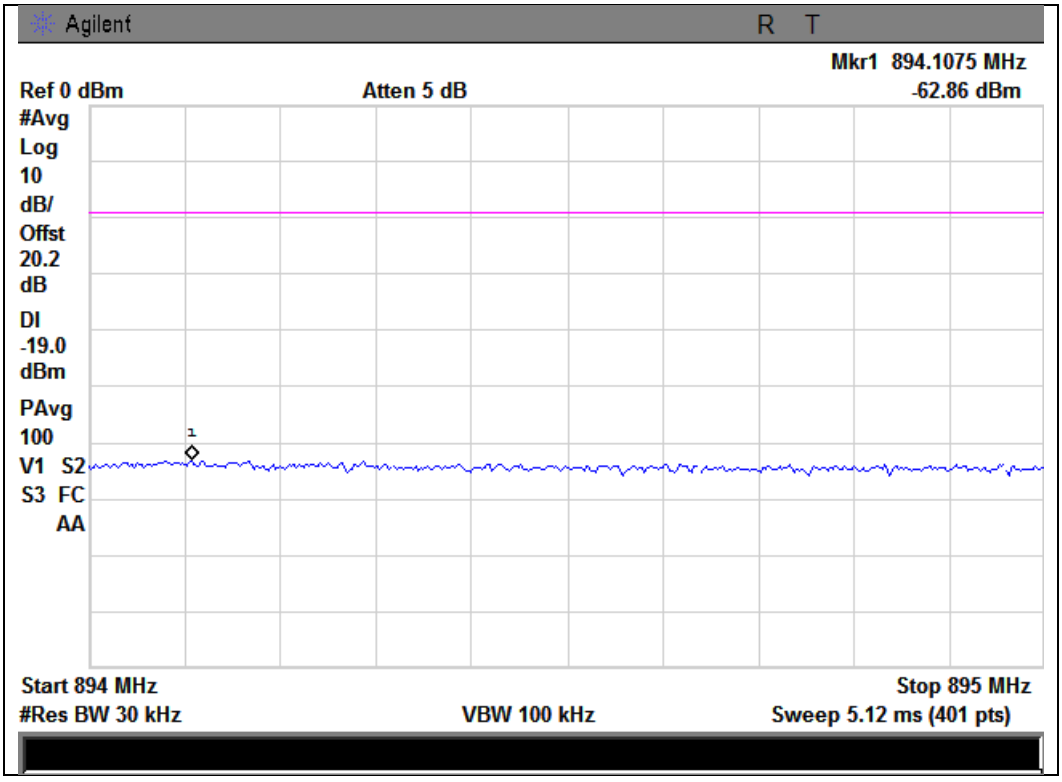


## 869 - 894 MHz Band

### Lower Band Edge

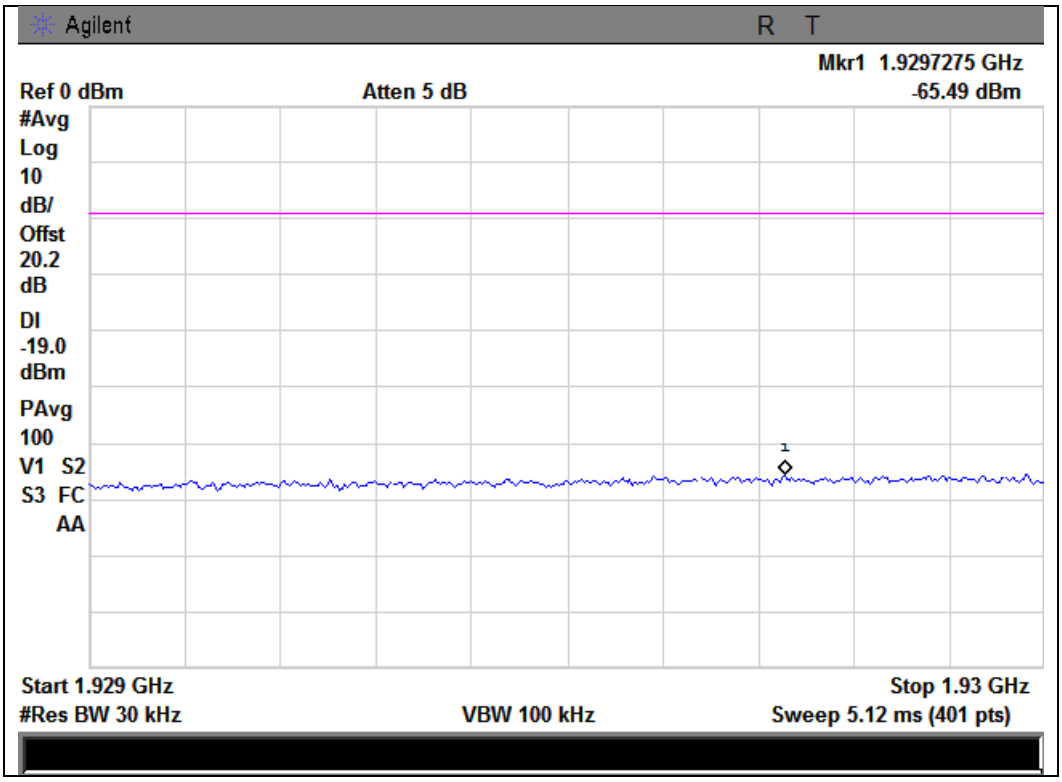



### Upper Band Edge

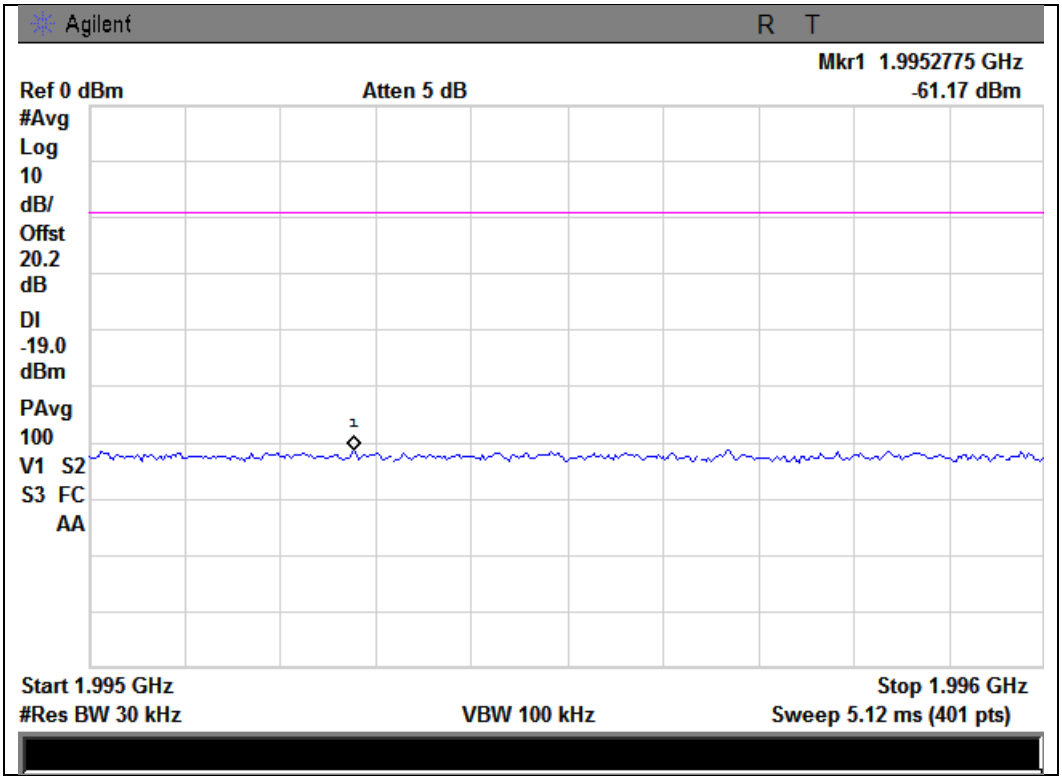


## 1930 - 1995 MHz Band

### Lower Band Edge

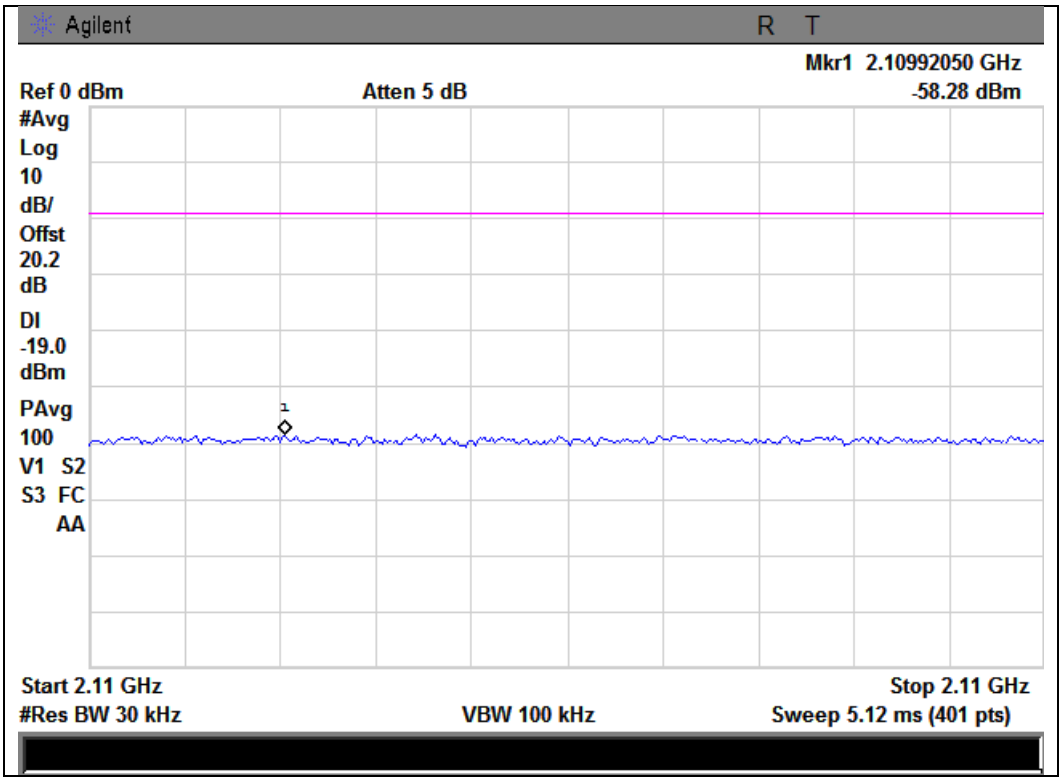



### Upper Band Edge

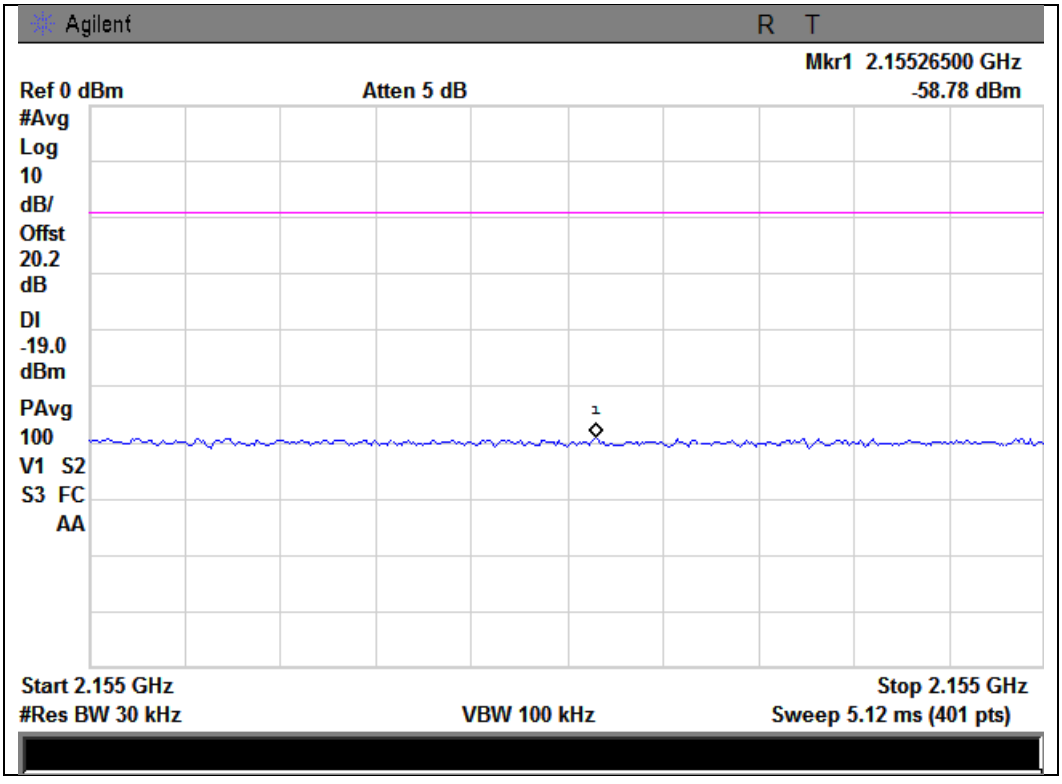


## 2110 - 2155 MHz Band

### Lower Band Edge



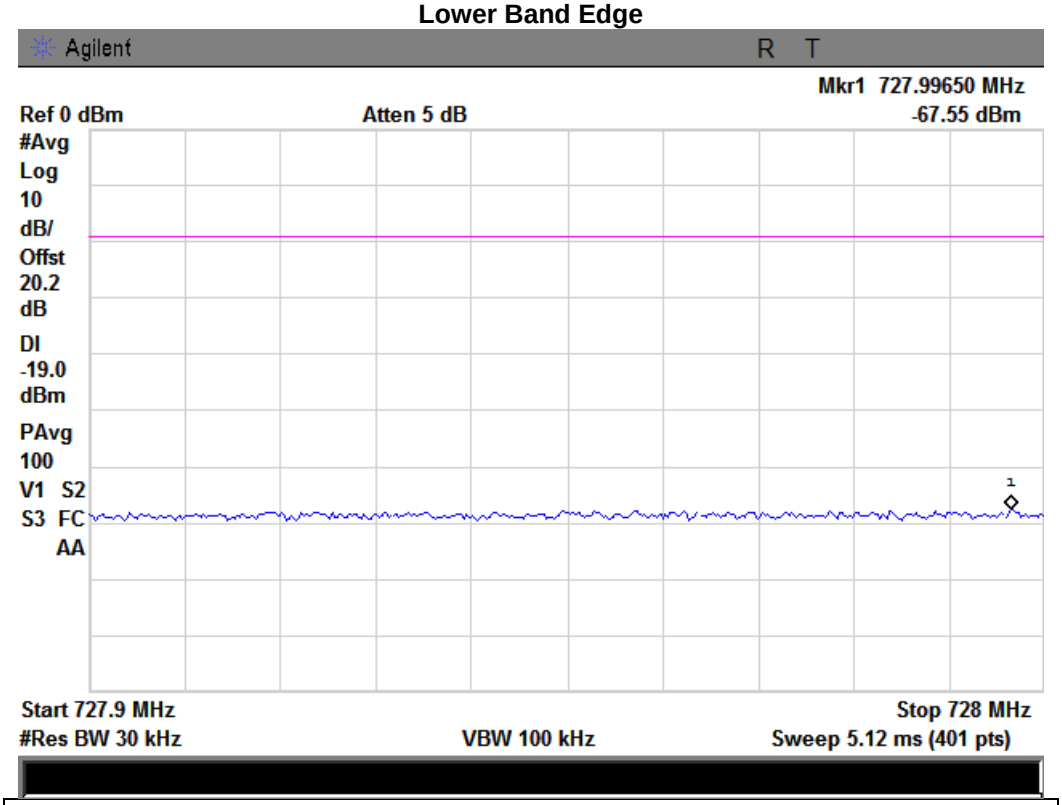

### Upper Band Edge



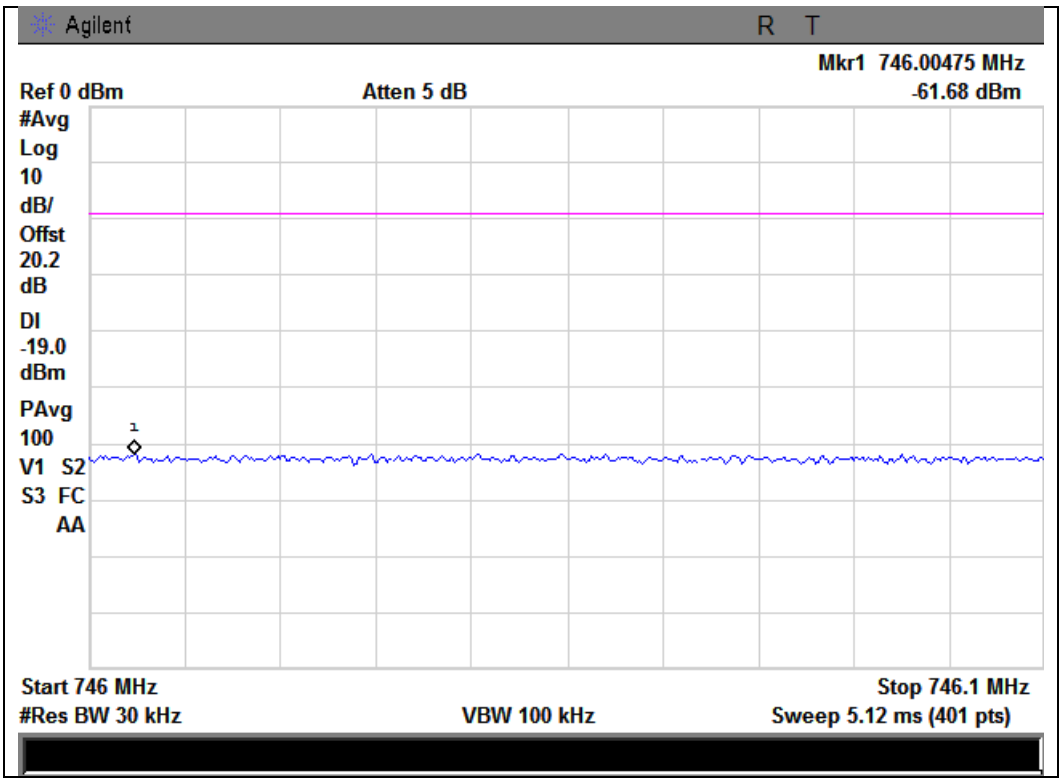
## WCDMA Downlink Test Plots

## 728 - 746 MHz Band

### Lower Band Edge

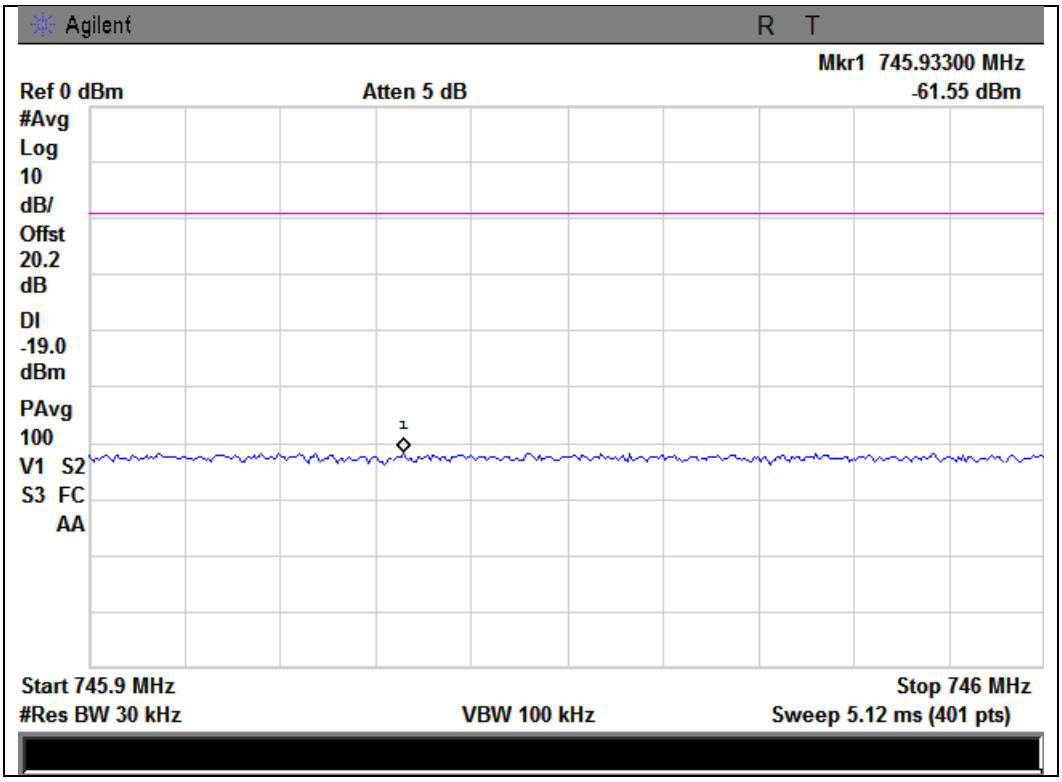



### Upper Band Edge

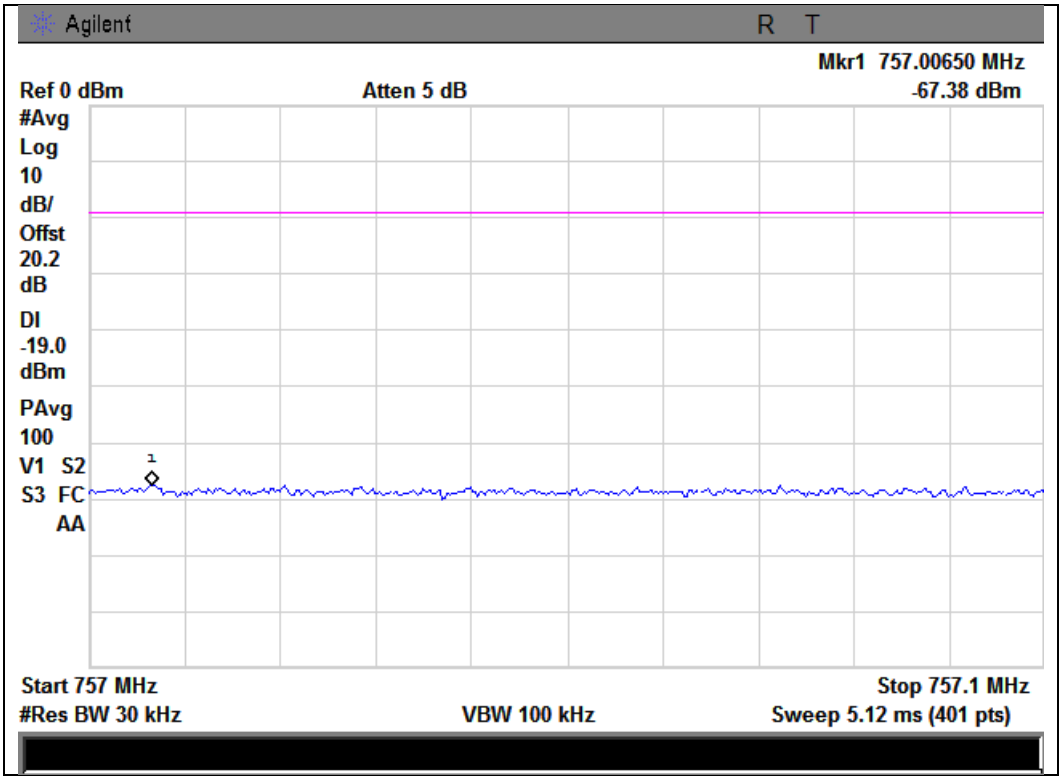


## 746 - 756 MHz Band

### Lower Band Edge

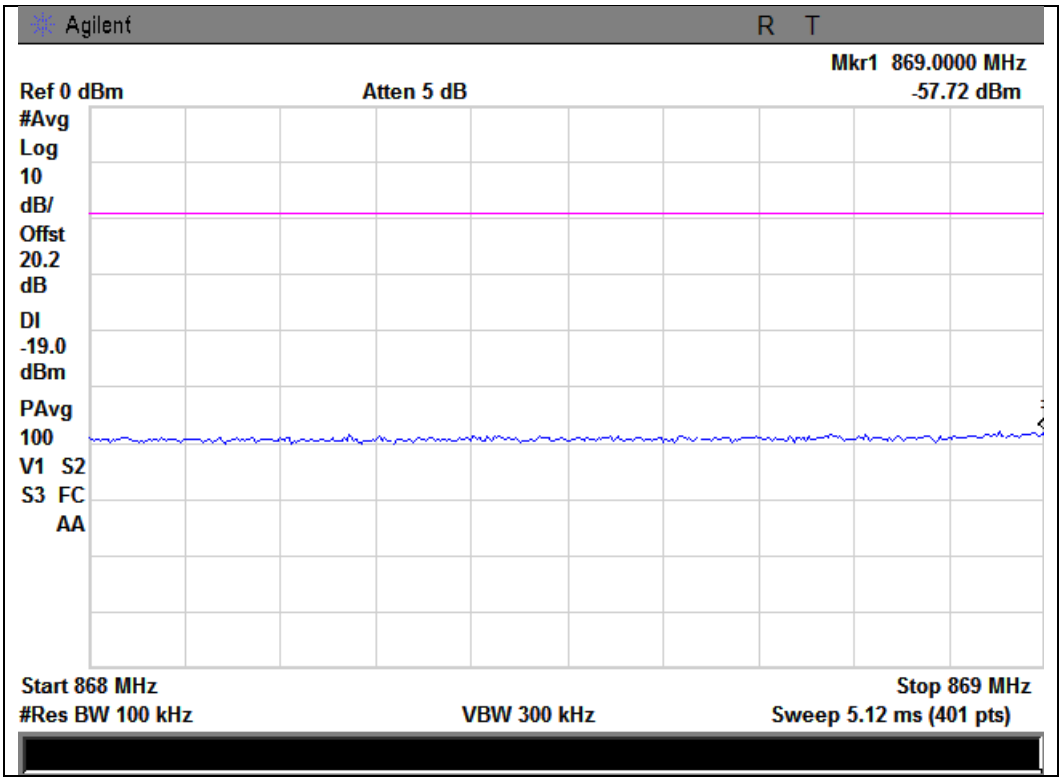



### Upper Band Edge

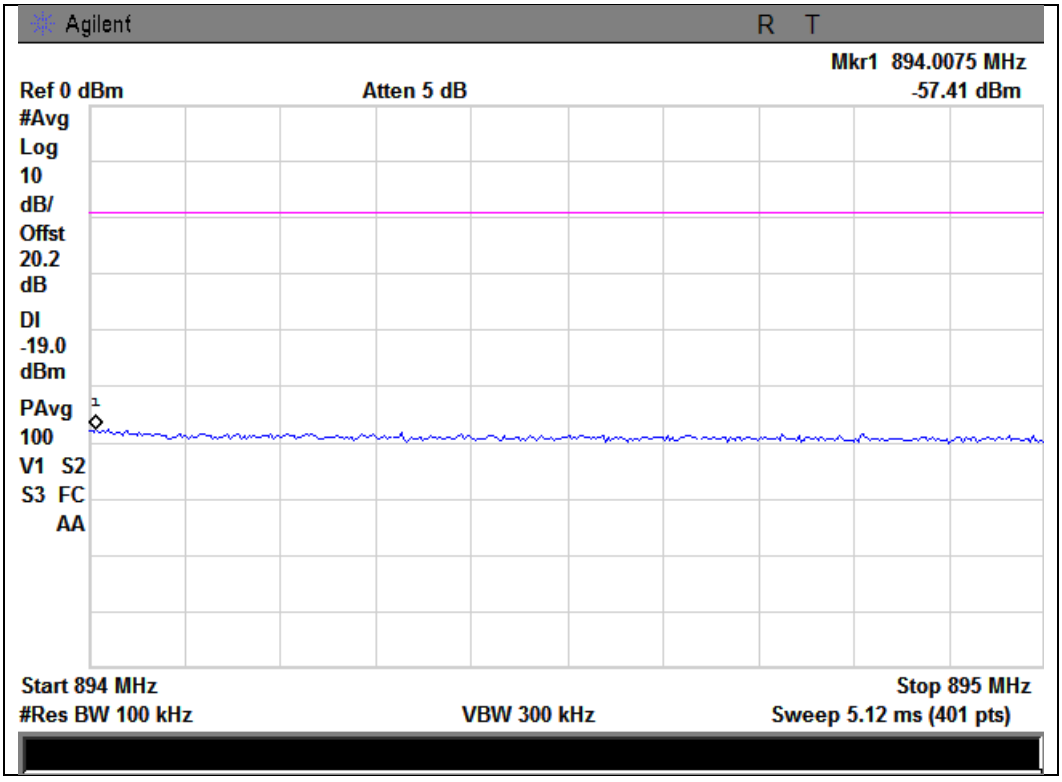


## 869 - 894 MHz Band

### Lower Band Edge

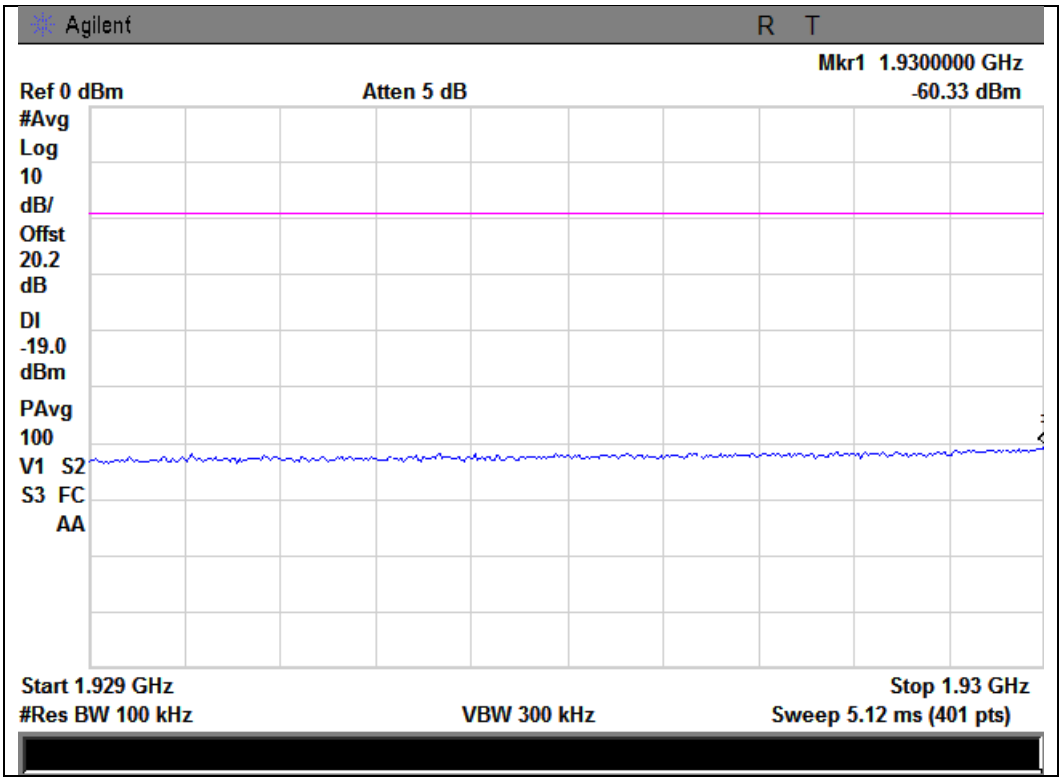



### Upper Band Edge

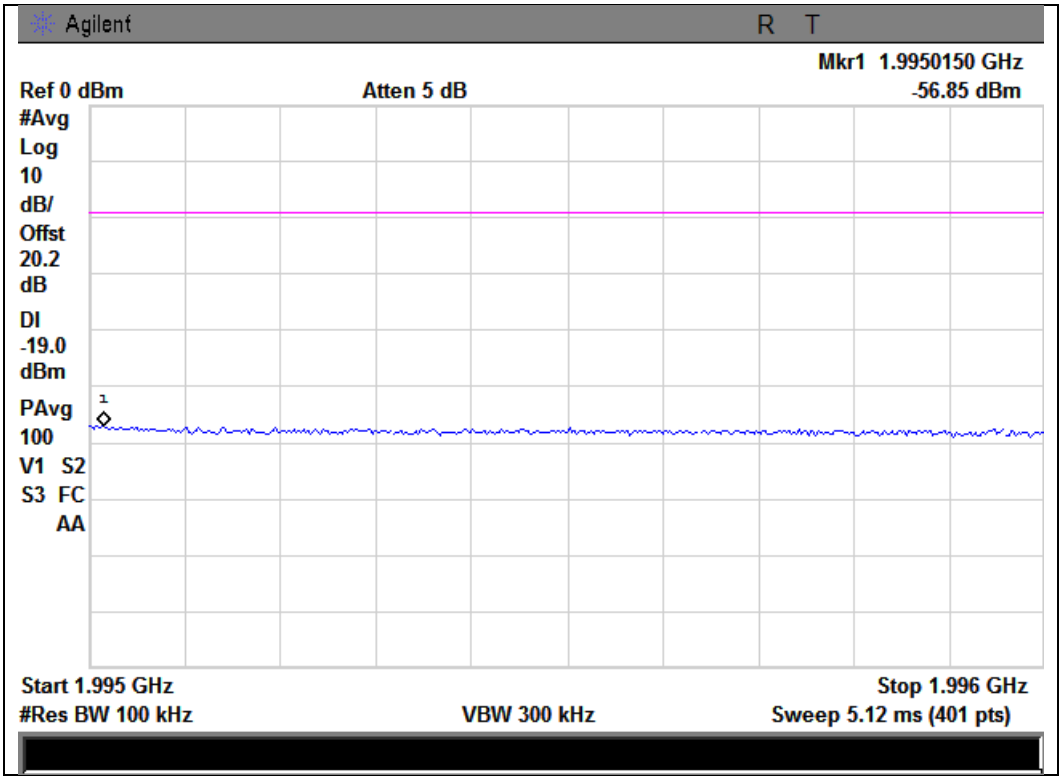


## 1930 - 1995 MHz Band

### Lower Band Edge

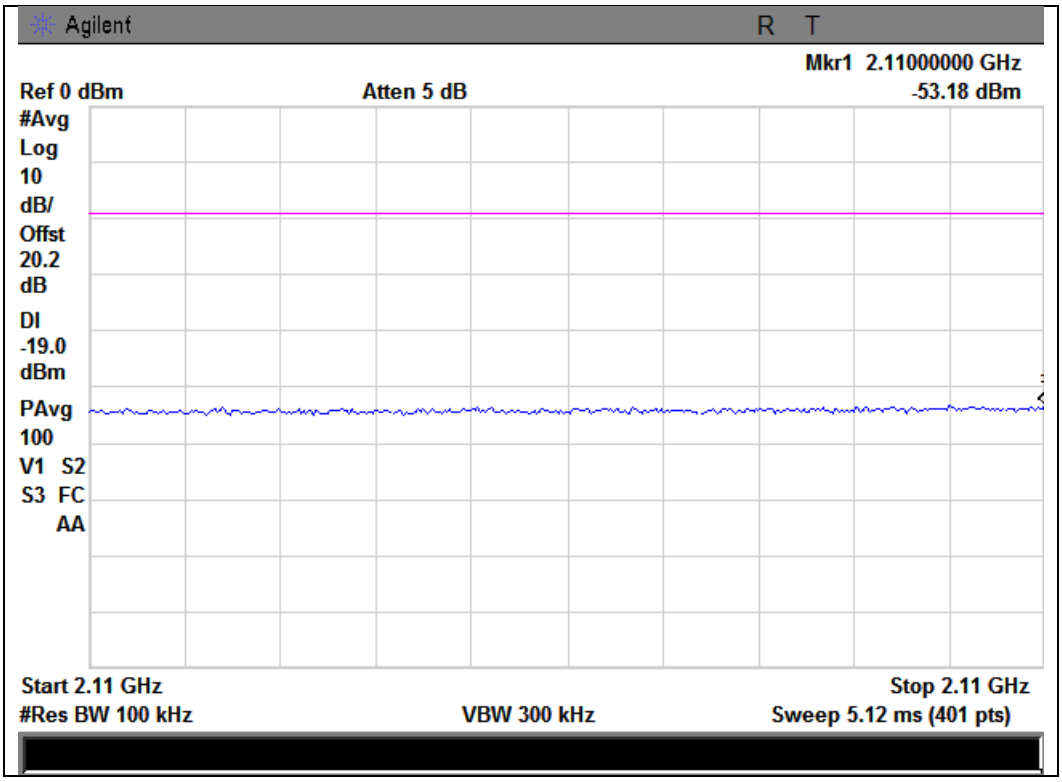



### Upper Band Edge

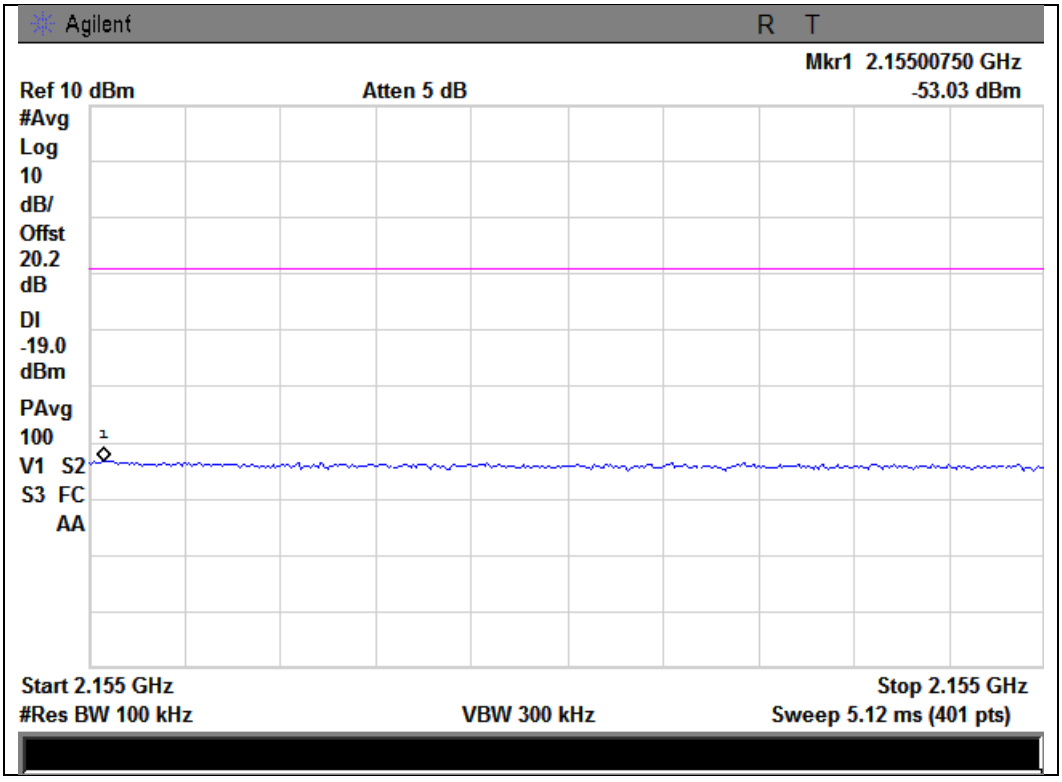


## 2110 - 2155 MHz Band

### Lower Band Edge




### Upper Band Edge



**Conducted Spurious Emissions**

**Name of Test:** Conducted Spurious Emissions
**Engineer:** Greg Corbin
**Test Equipment Utilized:** SMU 200A - S/N:101369
E4407B - S/N:MY41444836
**Test Date:** 7/22/2013

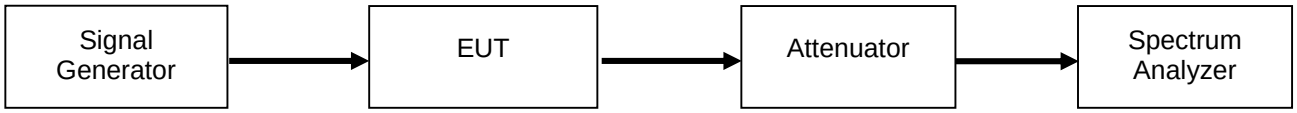
## Test Procedure

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. A signal generator was utilized to produce a 4.1 MHz AWGN signal operating at the maximum allowable power. The conducted spurious emissions from 30 MHz to 10 times the highest tunable frequency for each operational band was measured excluding the band defined by the Out of band emissions test. The emissions were plotted and the highest level was recorded in the summary table.

The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit = 43+ 10Log(P)dB

## Test Setup




## Uplink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 698 - 716 | 697.81 | -31.6 | -13 | Pass |
| 777 - 787 | 775.71 | -41.7 | -13 | Pass |
| 824 - 849 | 1.8918 | -36.5 | -13 | Pass |
| 1710 - 1755 | 1.8678 | -34.7 | -13 | Pass |
| 1850 - 1915 | 3.7647 | -33.4 | -13 | Pass |

## Downlink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|
| 728 - 746 | 1.9772 | -37.9 | -13 | Pass |
| 746 - 756 | 1.9757 | -37.5 | -13 | Pass |
| 869 - 894 | 1.978 | -37.2 | -13 | Pass |
| 1930 - 1995 | 2.1309 | -39 | -13 | Pass |
| 2110 - 2155 | 1.979 | -35.8 | -13 | Pass |

For the 746 – 758 downlink and 776 – 788 Uplink bands of operation, the following additional spurious emissions requirements apply.

**27.53(c)**
*For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:*

> *(3)On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;*

To show compliance with 27.53 (c)(3) rule section, the limit would be -46 dBm in a 6.25 kHz bandwidth, based on the maximum output power of +23.8 dBm (page 13 of the test report) and using the formula 76 + 10 log (P) dB.

The graphs on page 70 of the test report for the 746 – 758 MHz band and page 58 for the 776 – 788 MHz band show the noise floor to be < -50 dBm in a 1 MHz bandwidth.

The original data was recorded in a 1 MHz RBW, since the limit is referenced to a 6.25 kHz BW the measured value has the following bandwidth correction factor added to it.

BW correction Factor = 10Log B1/B2
BW correction Factor =10Log 6.25 / 1000 = 22.0 dB

Final Value (dBm) = conducted measurement +BW correction factor

**777 – 787 MHz Uplink Band**

| Spurious Frequency Range (MHz) | Measured Value (dB) | Bandwidth Correction Factor (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 763 – 775 | -56 | -22.0 | -76 | -46 | -30 |
| 793 – 805 | -56 | -22.0 | -76 | -46 | -30 |

**746 - 756 MHz Downlink Band**

| Spurious Frequency Range (MHz) | Measured Value (dB) | Bandwidth Correction Factor (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| 763 – 775 | -56 | -22.0 | -76 | -46 | -30 |
| 793 – 805 | -56 | -22.0 | -76 | -46 | -30 |

**27.53(e)**
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. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

To show compliance with 27.53(e) rule section, the Limit is -70dBW/MHz equivalent EIRP for wideband signals which is -40 dBm/MHz.

The final value for the spurious emissions in the 1559 – 1610 MHz band is calculated using the data provided from the test report and antenna kitting document. ,
Data:

- Conducted measurement = Measured value (-57 dBm in a 1 MHz BW) from the Conducted Spurious Emissions graphs in the test report on page 58,
- The final gain/loss (+4.2 dB) from the antenna kitting document) for the 777 – 787 band.
- The original data was recorded in a 1 MHz RBW, since the limit for narrowband emissions is referenced to (< 700Hz BW) , the measured value has the following bandwidth correction factor added to it.
  BW correction Factor = 10Log B1/B2
  BW correction Factor =10Log 700 / 1,000,000 = 31.5 dB

Final Value (dBm) = conducted measurement +BW correction factor + final gain/loss from Antenna Kitting document

The Limit for discreet (narrowband) emissions is -80dBW (-50 dBm) in 700 MHz BW.

**777 – 787 MHz Uplink Band**

| Spurious Frequency Range (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Gain/Loss from Antenna Kitting Information (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 1559 – 1610 (Narrowband) | -57 | -31.5 | 4.2 | --84.3 | -50 | -34.3 |
| 1559 – 1610 (Wideband) | -57 | 0 | 4.2 | -52.8 | -40 | -12.8 |

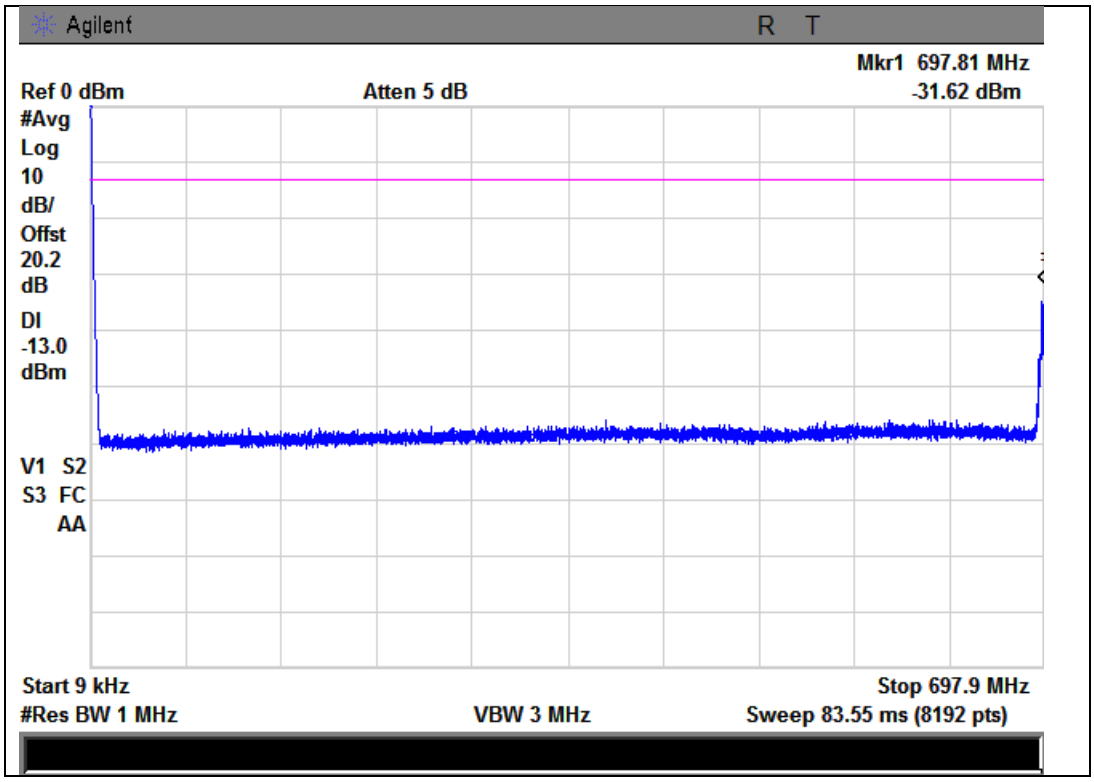
**746 - 756 MHz Downlink Band**

| Spurious Frequency Range (MHz) | Measured Value (dBm) | Bandwidth Correction Factor (dB) | Gain/Loss from Antenna Kitting information (dB) | Final Value (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| 1559 – 1610 (Narrowband) | -57 | -31.5 | 2.1 | -86.4 | -50 | -36.4 |
| 1559 – 1610 (Wideband) | -57 | 0 | 2.1 | -54.9 | -40 | -14.9 |

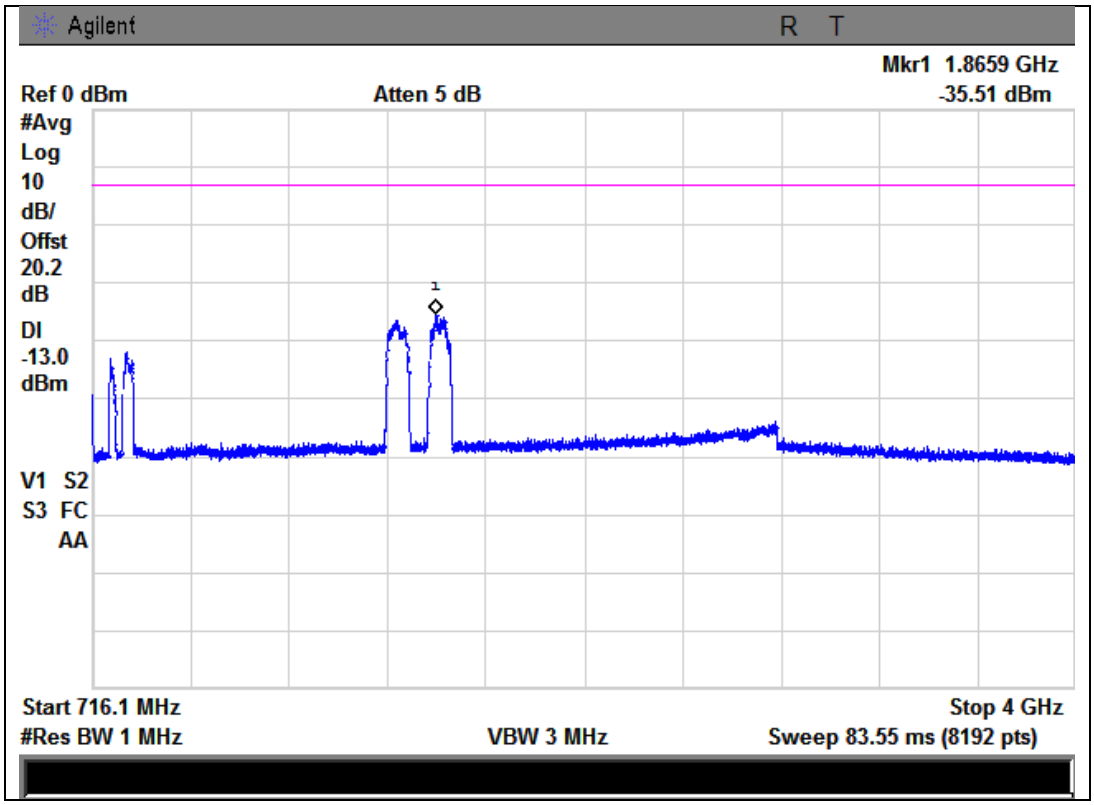
## Uplink Test Plots

### 698 - 716 MHz Band

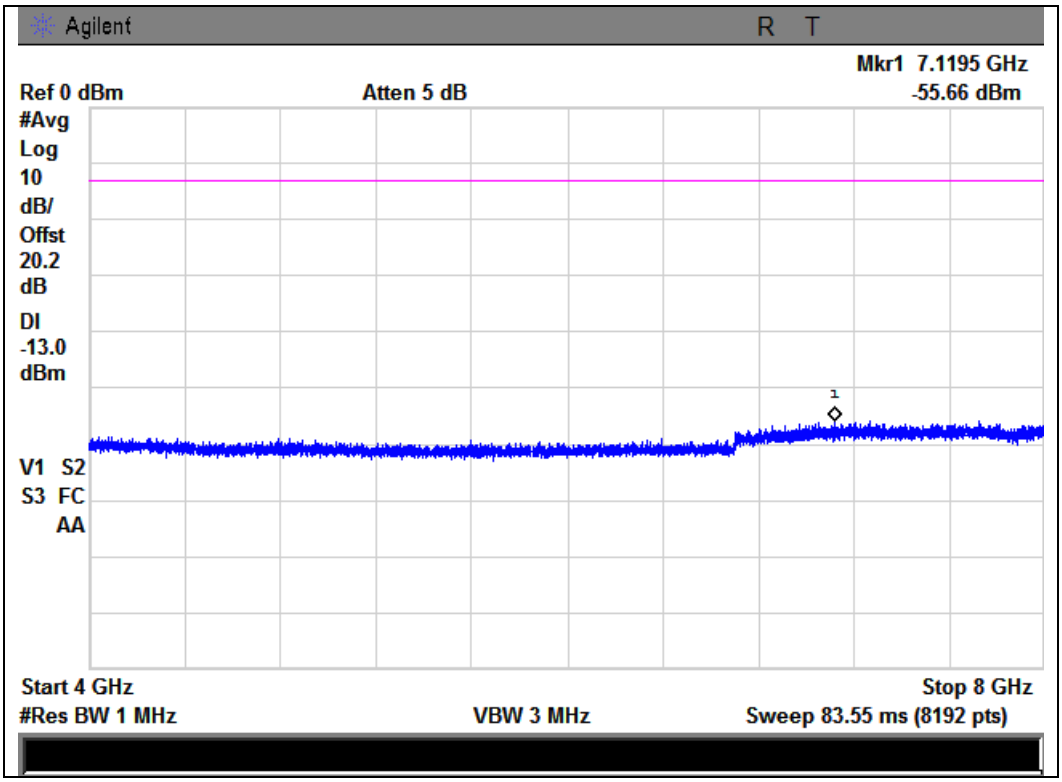
**9 kHz – 697.9 MHz**




**716.1 – 4000 MHz**

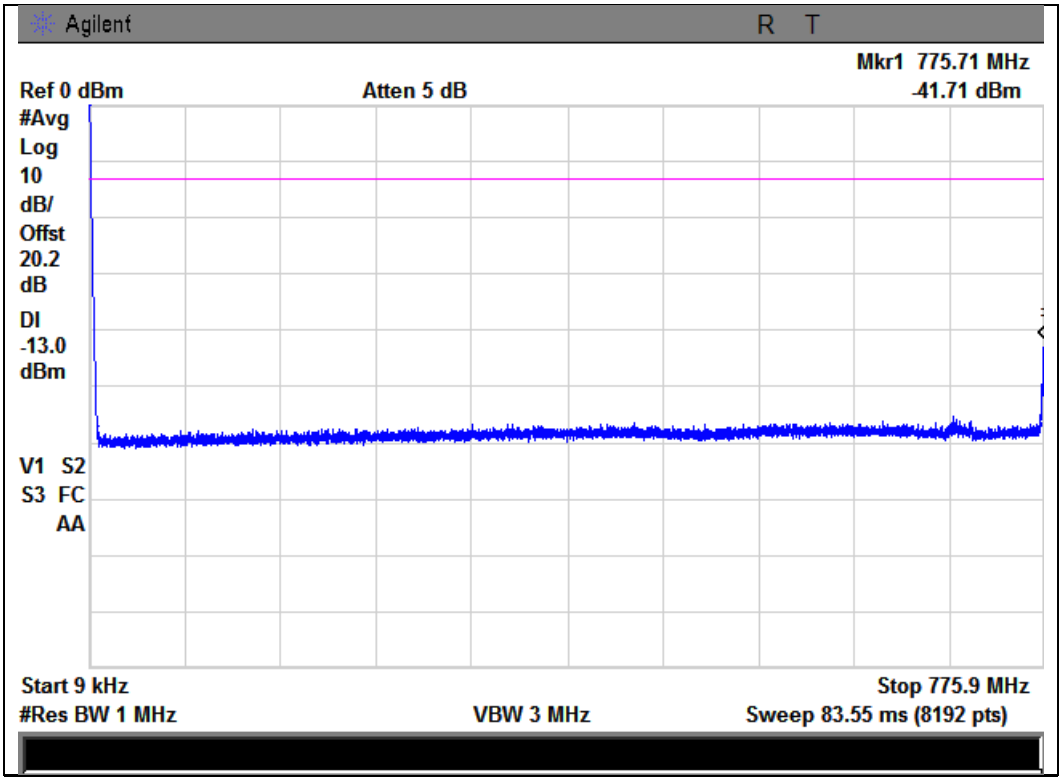


**4000 – 8000 MHz**

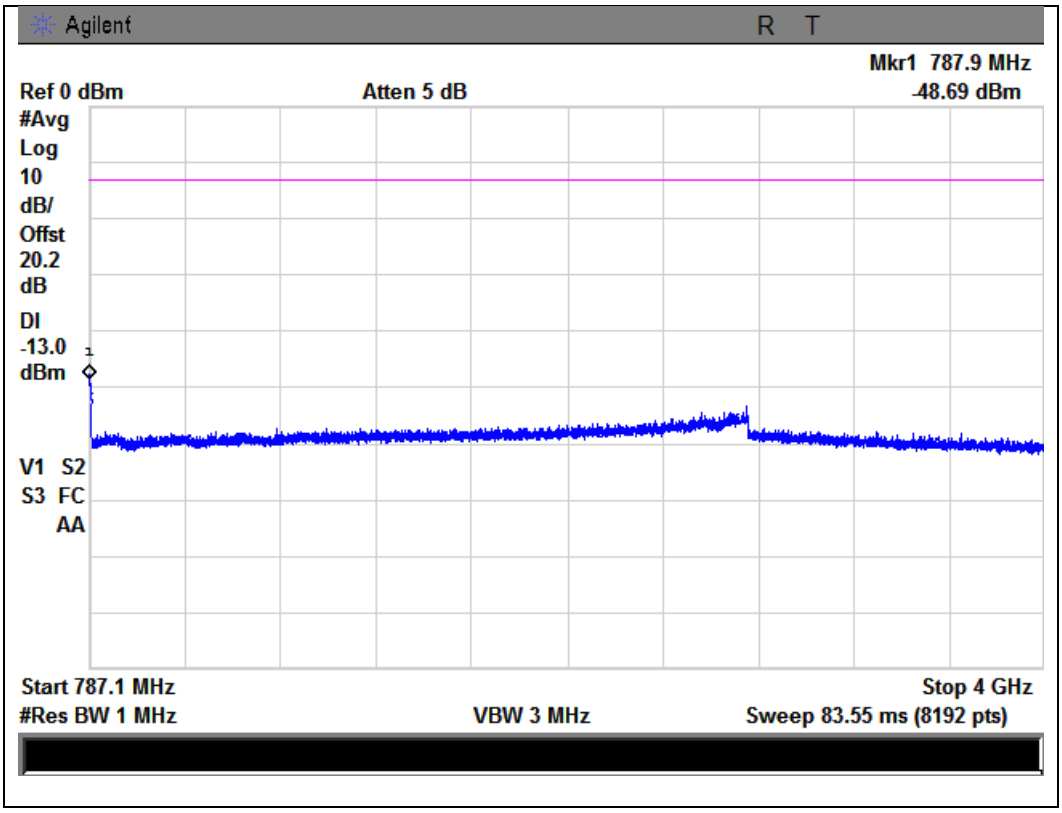


## 777 - 787 MHz Band

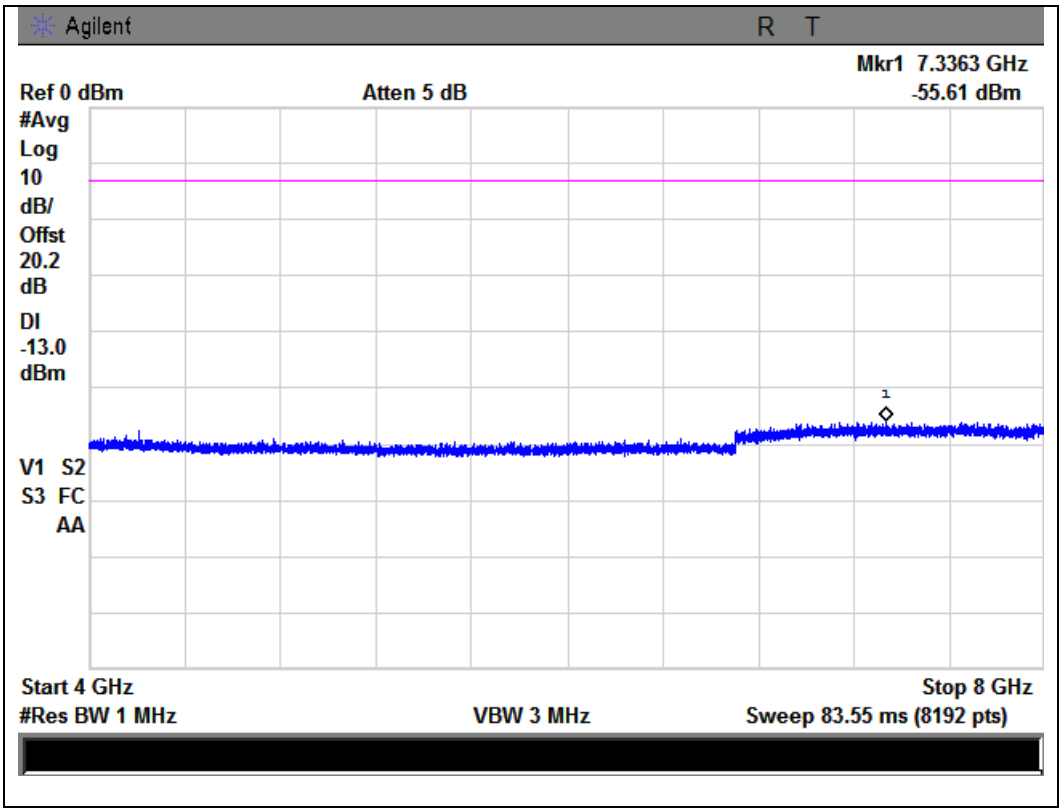
### 9 kHz – 775.9 MHz




### 787.1 – 4000 MHz

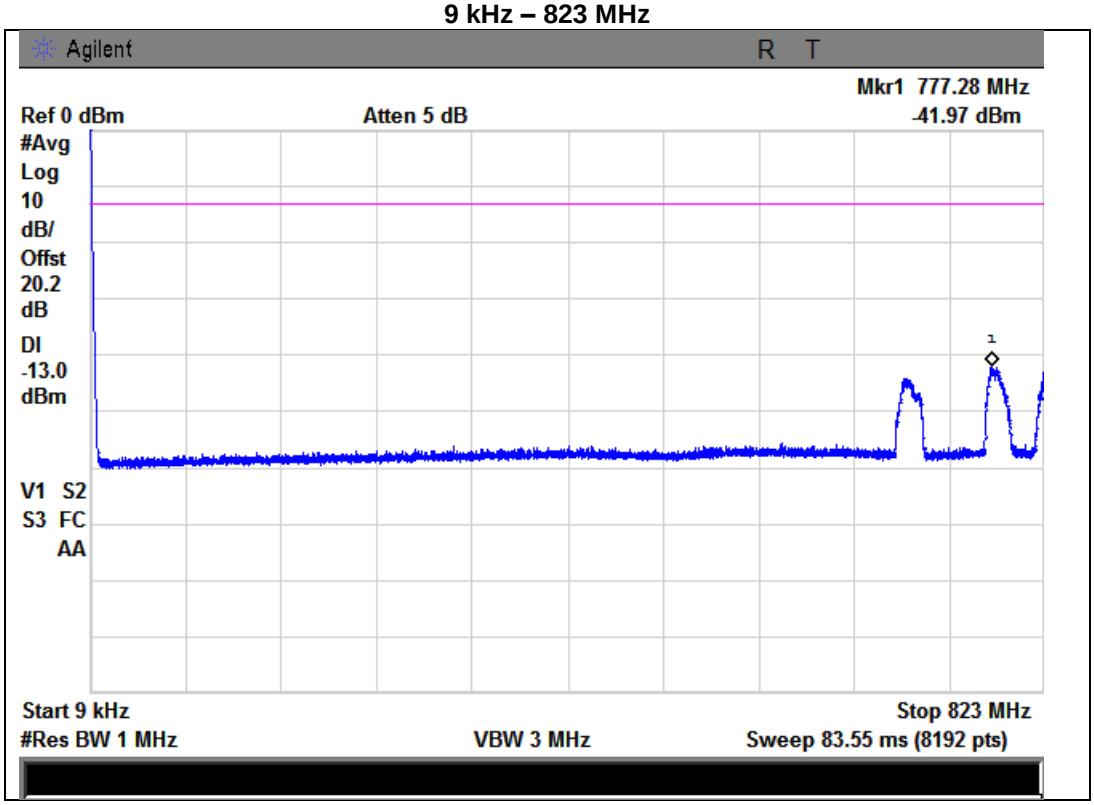


**4000 – 8000 MHz**

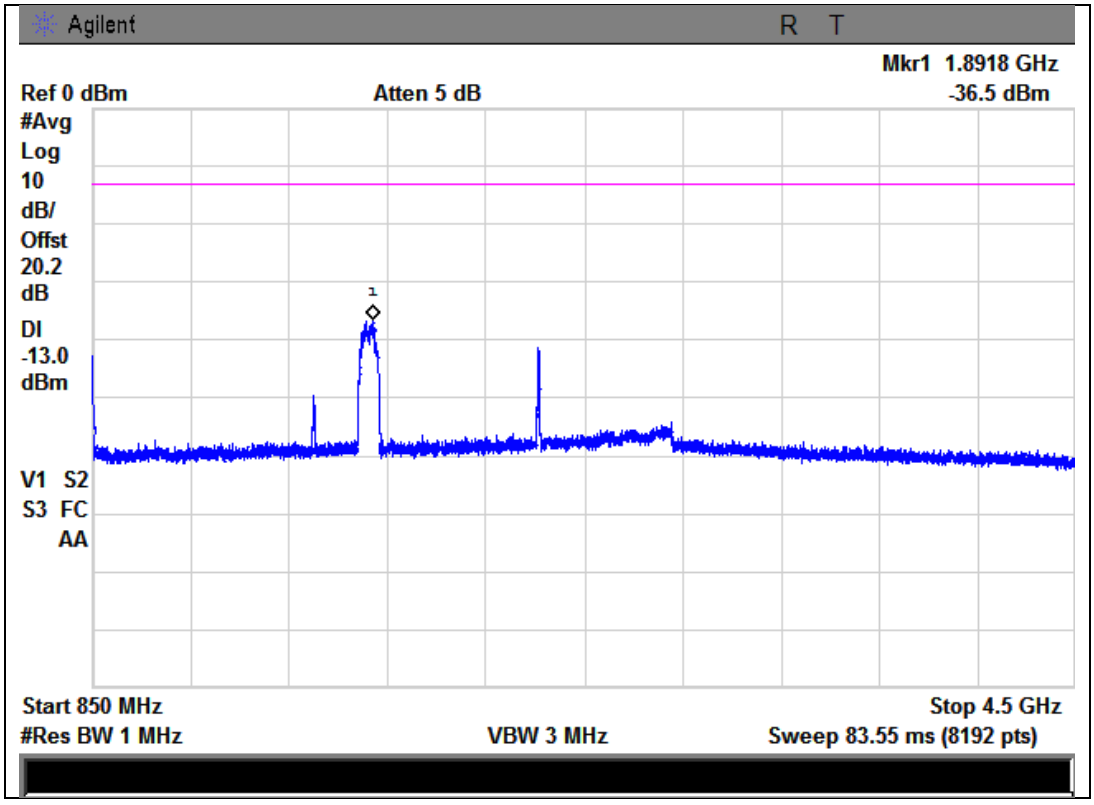


**824 - 849 MHz Band**

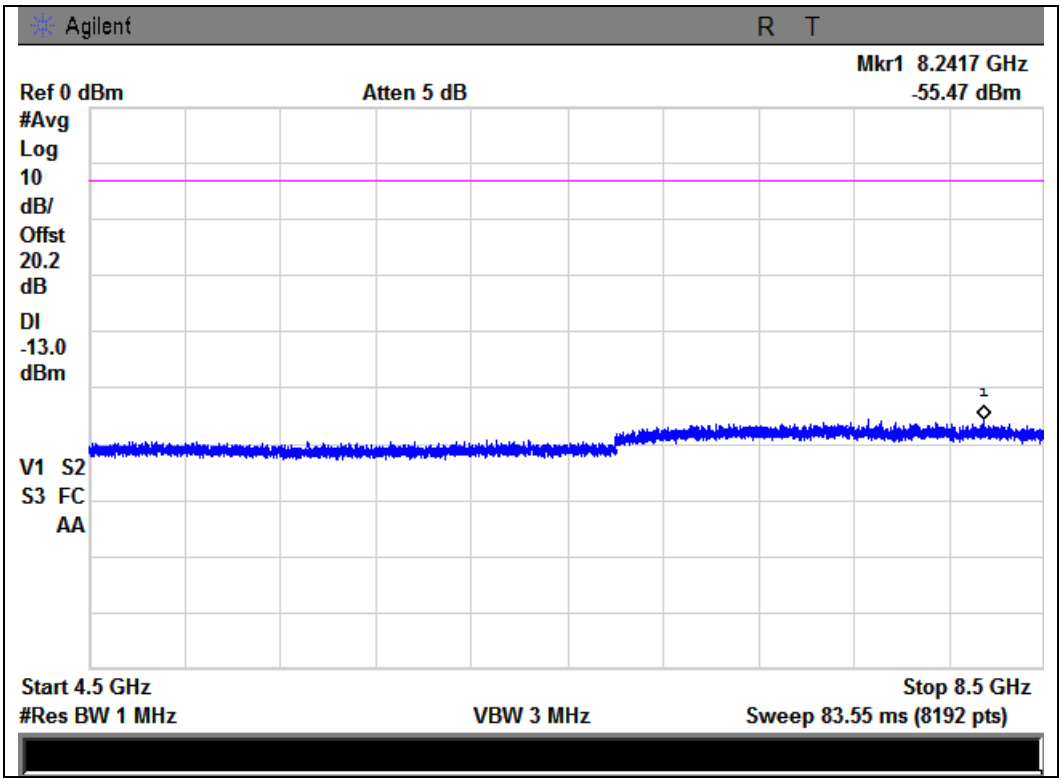
**9 kHz – 823 MHz**




**850 - 4500 MHz**

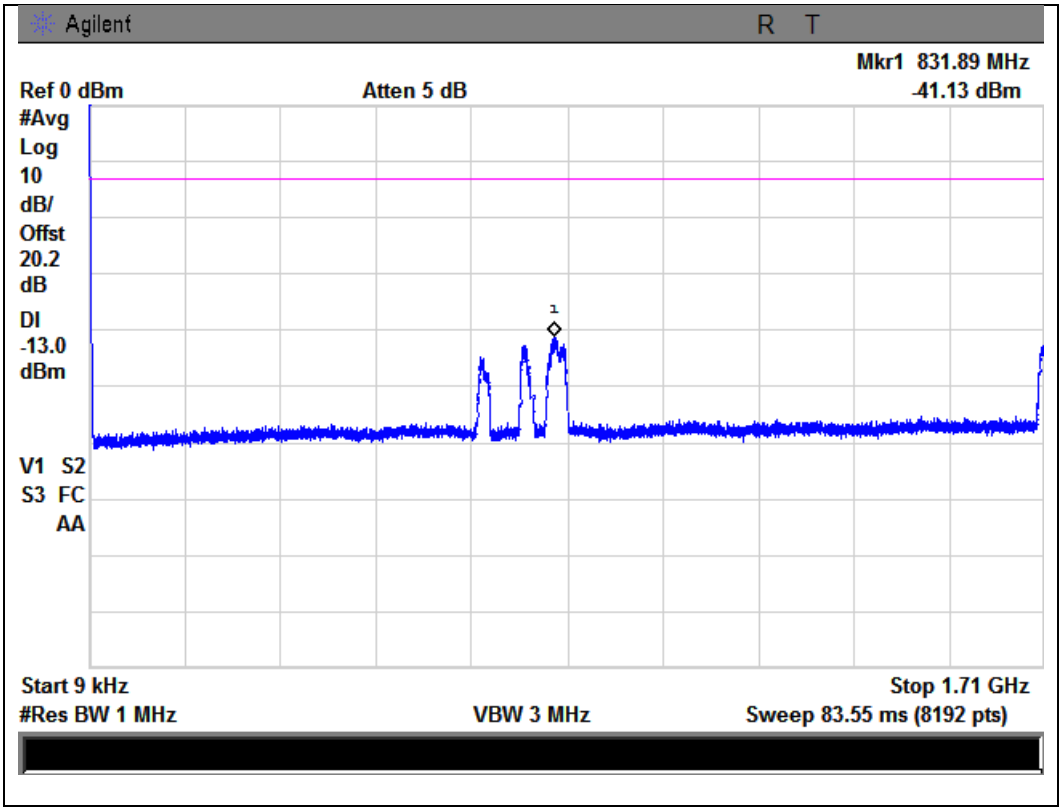


**4500 – 8500 MHz**

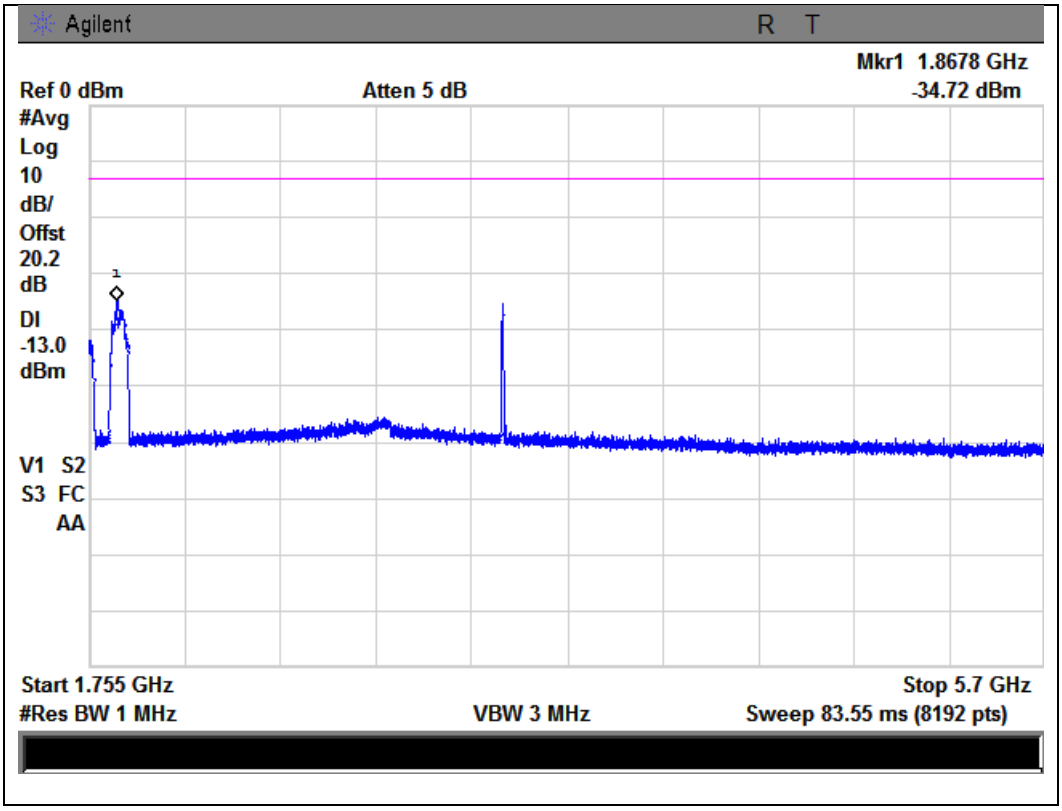


## 1710 - 1755 MHz Band

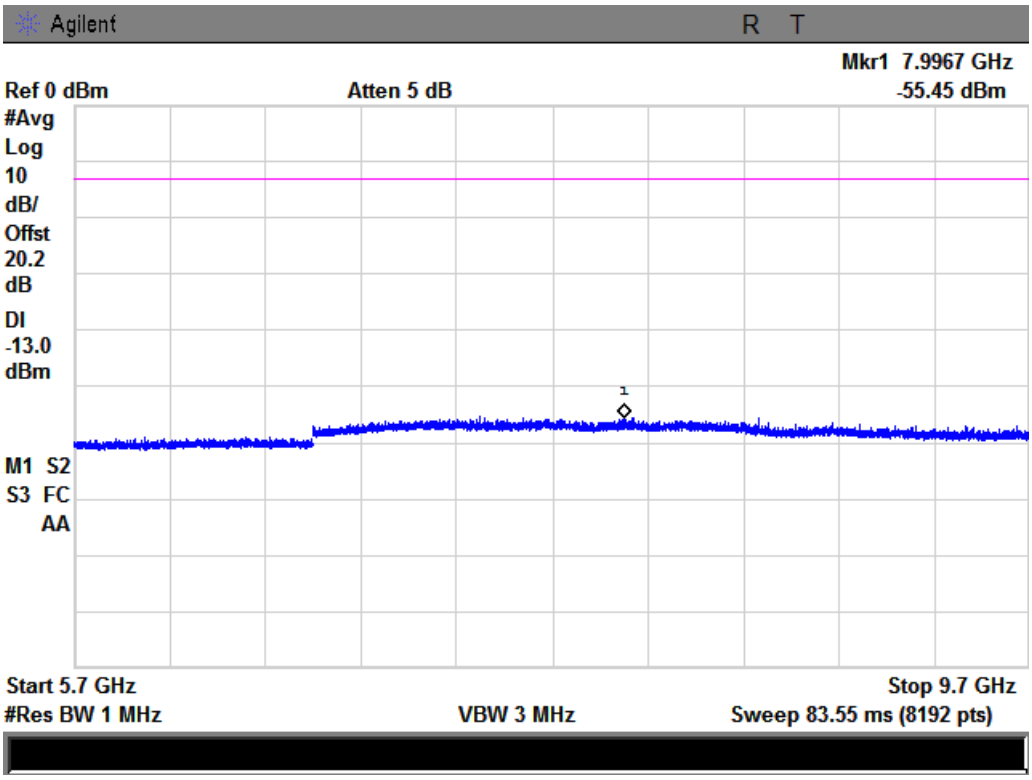
### 9 kHz – 1710 MHz



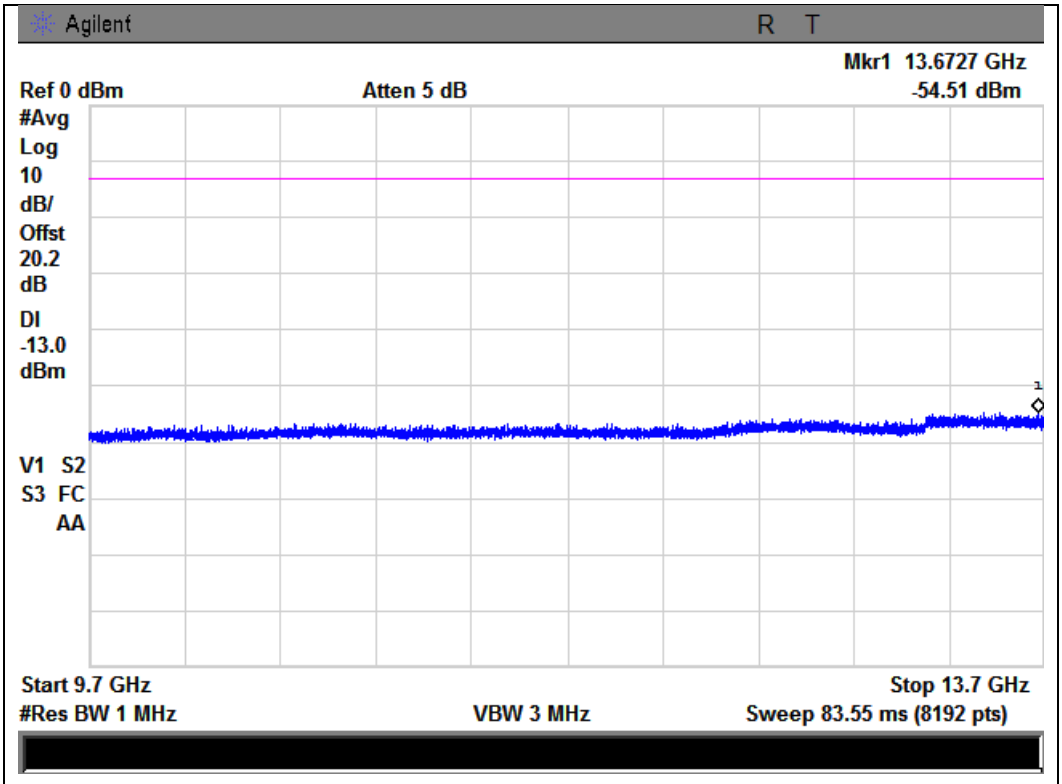

### 1755 – 5700 MHz



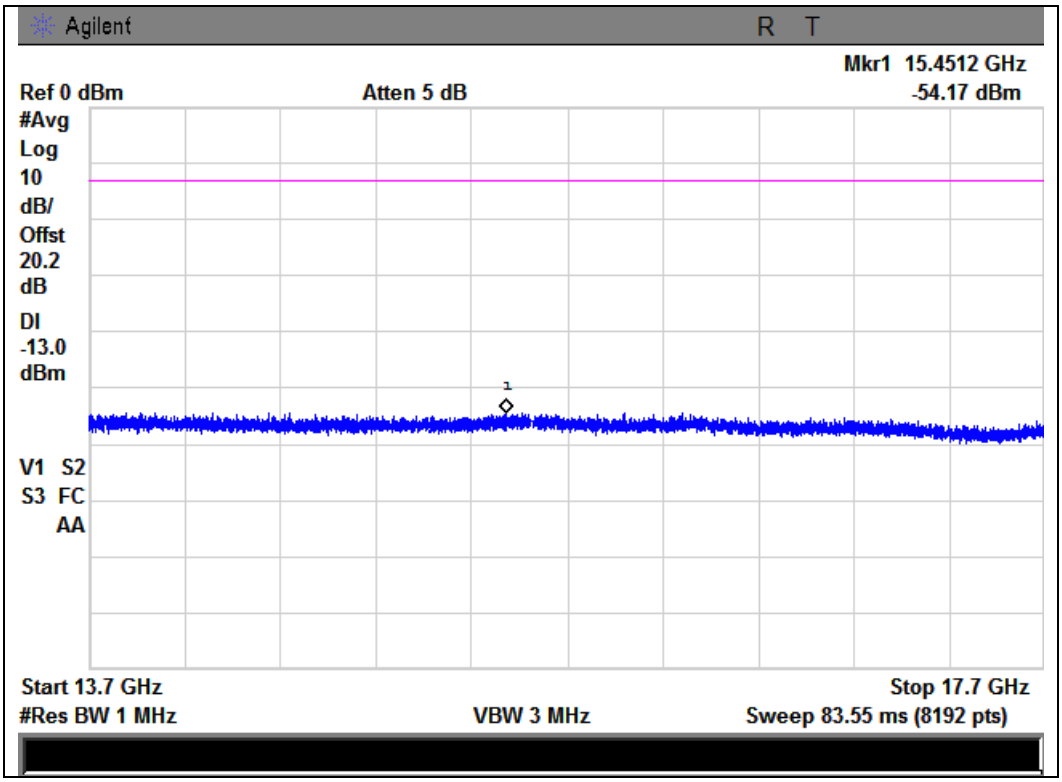
**5700 - 9700 MHz**




**9700 - 13700**

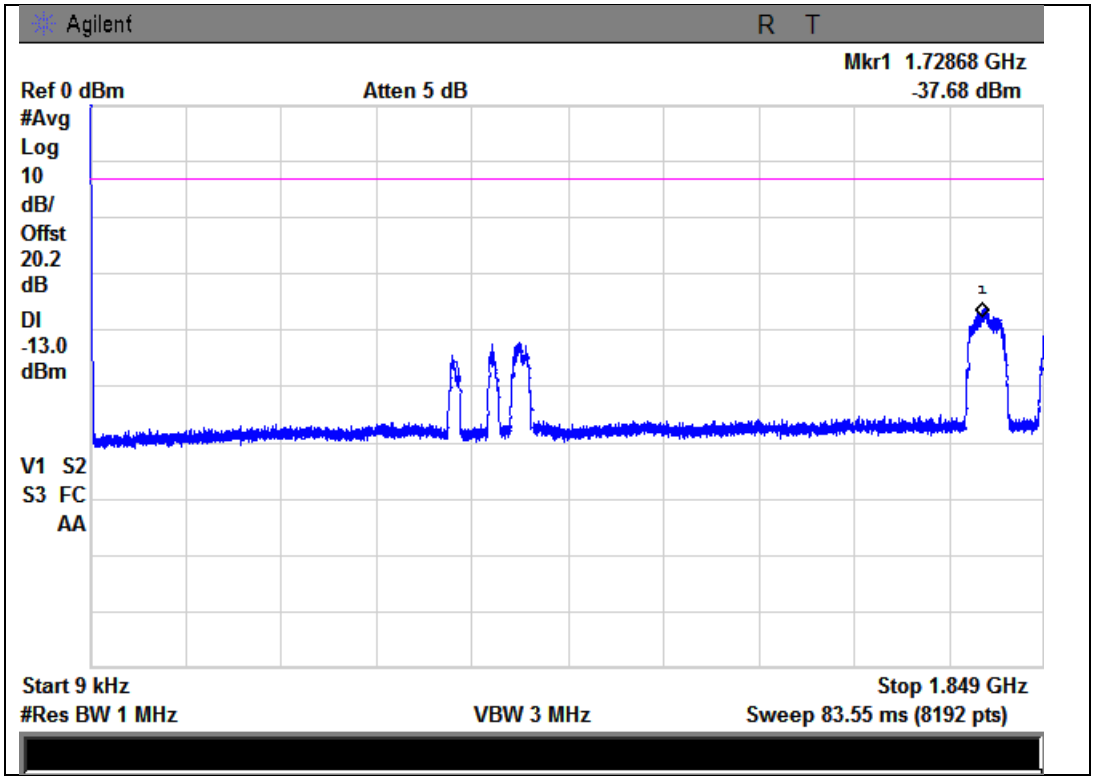


**13700 – 17700**

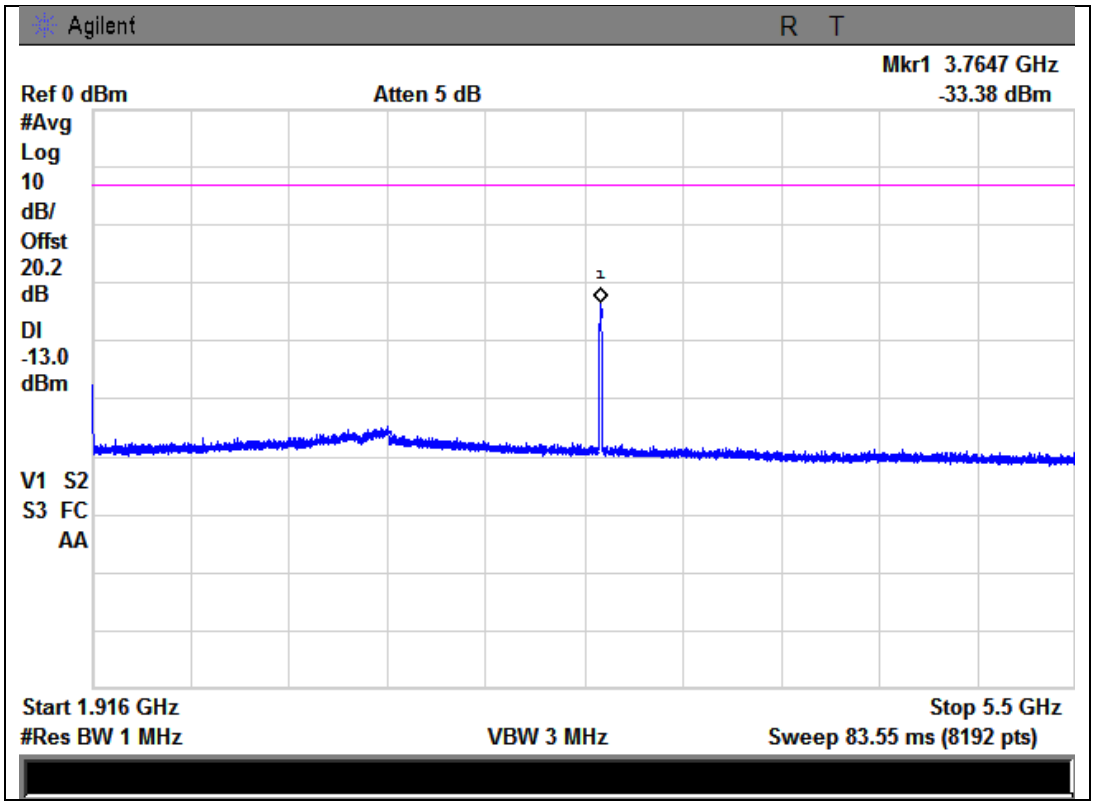

Agilent
R T
Mkr1 15.4512 GHz
Ref 0 dBm
Atten 5 dB
-54.17 dBm
#Avg
Log
10
dB/
Offst
20.2
dB
Dl
-13.0
dBm
V1 S2
S3 FC
AA
Start 13.7 GHz
Stop 17.7 GHz
#Res BW 1 MHz
VBW 3 MHz
Sweep 83.55 ms (8192 pts)

## 1850 - 1915 MHz Band

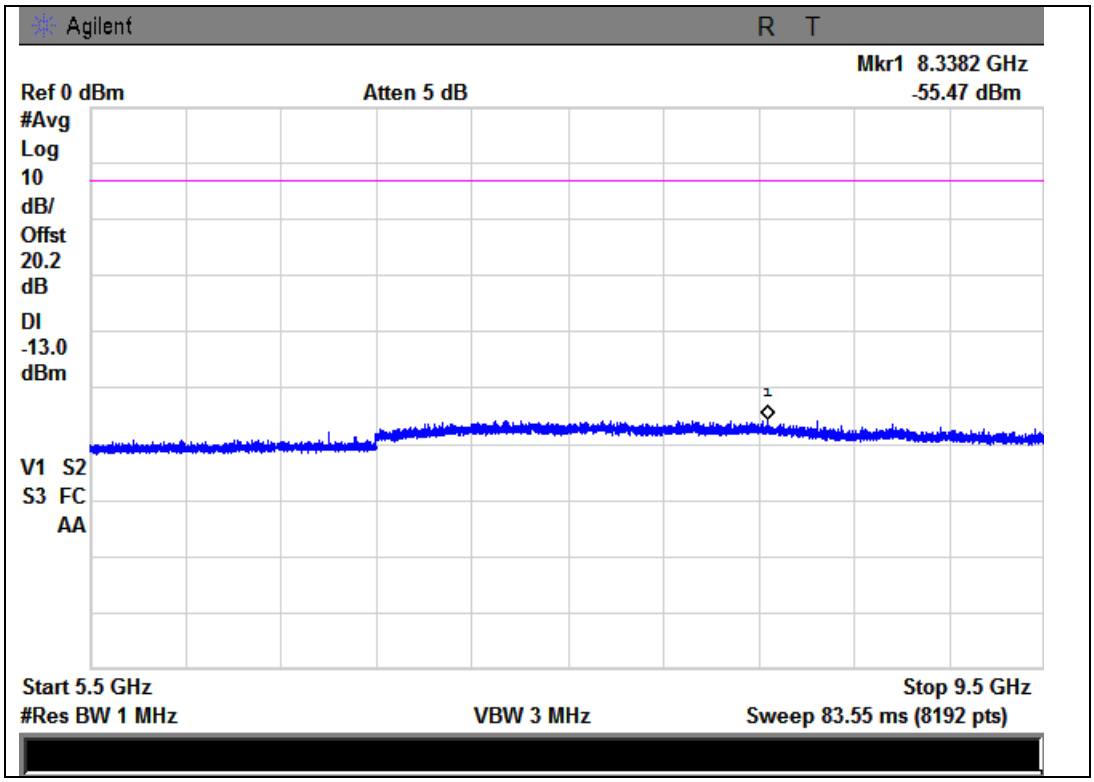
### 9 kHz – 1849 MHz



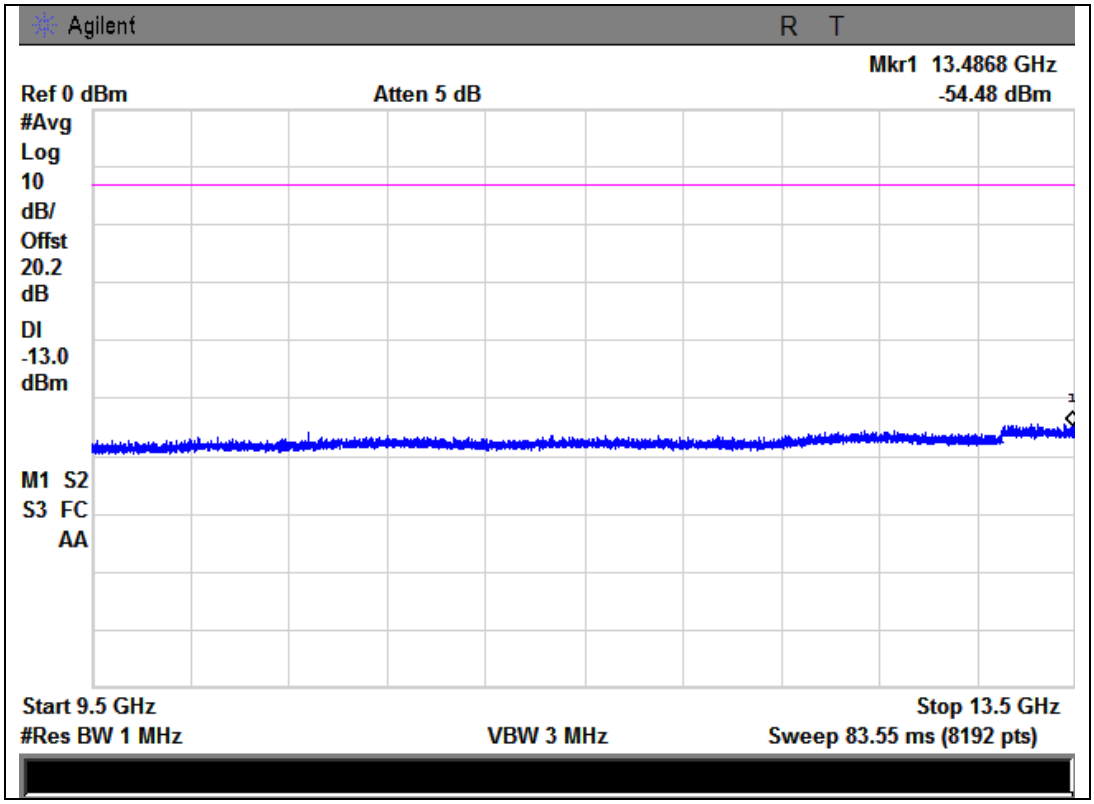

### 1916 – 5500 MHz



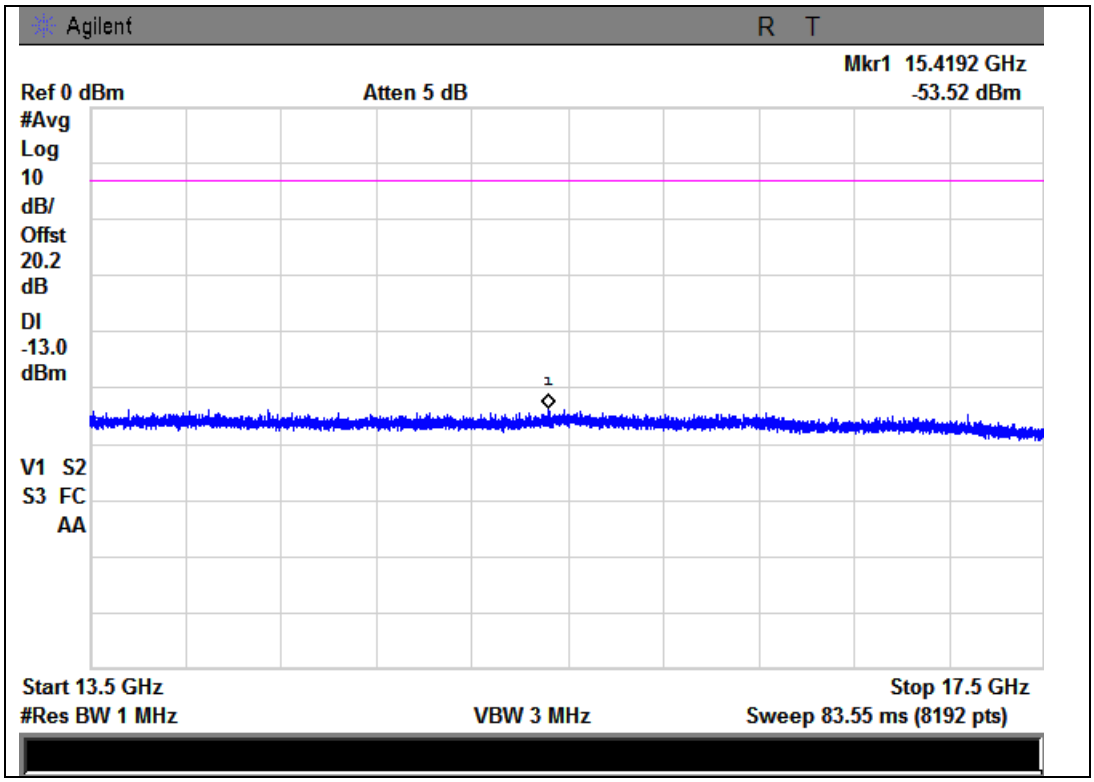
**5500 – 9500 MHz**



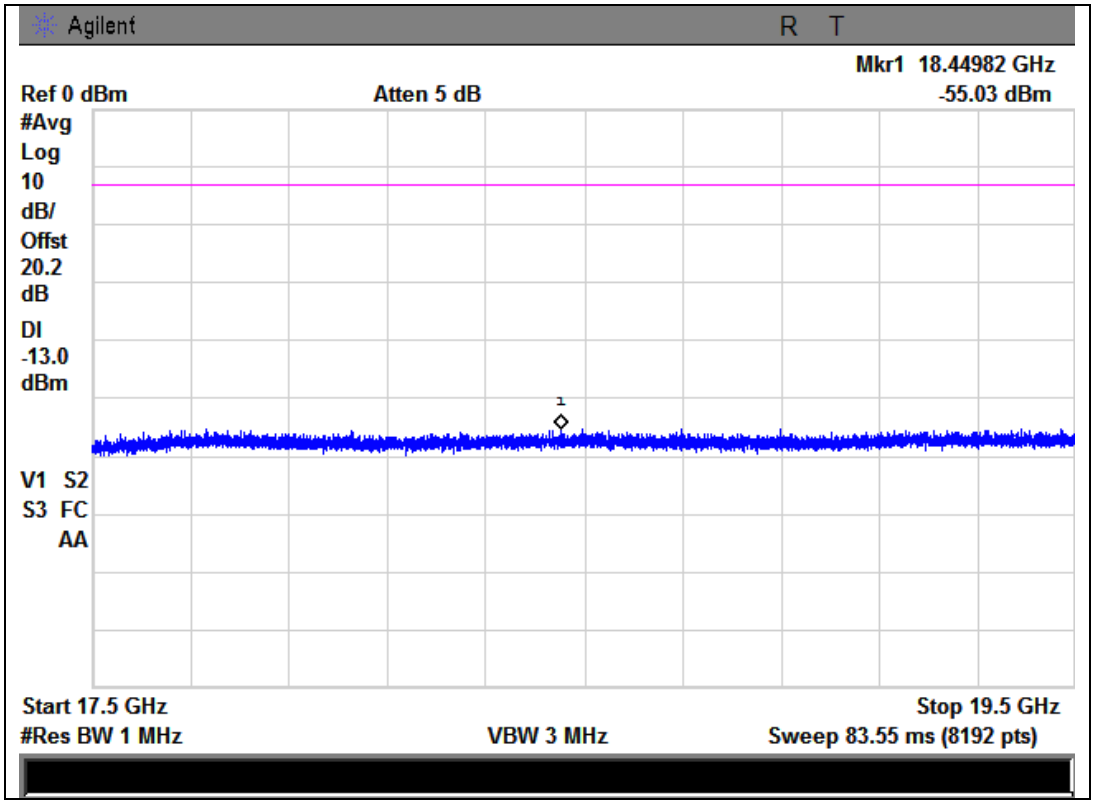

**9500 - 13500**



**13500 - 17500**



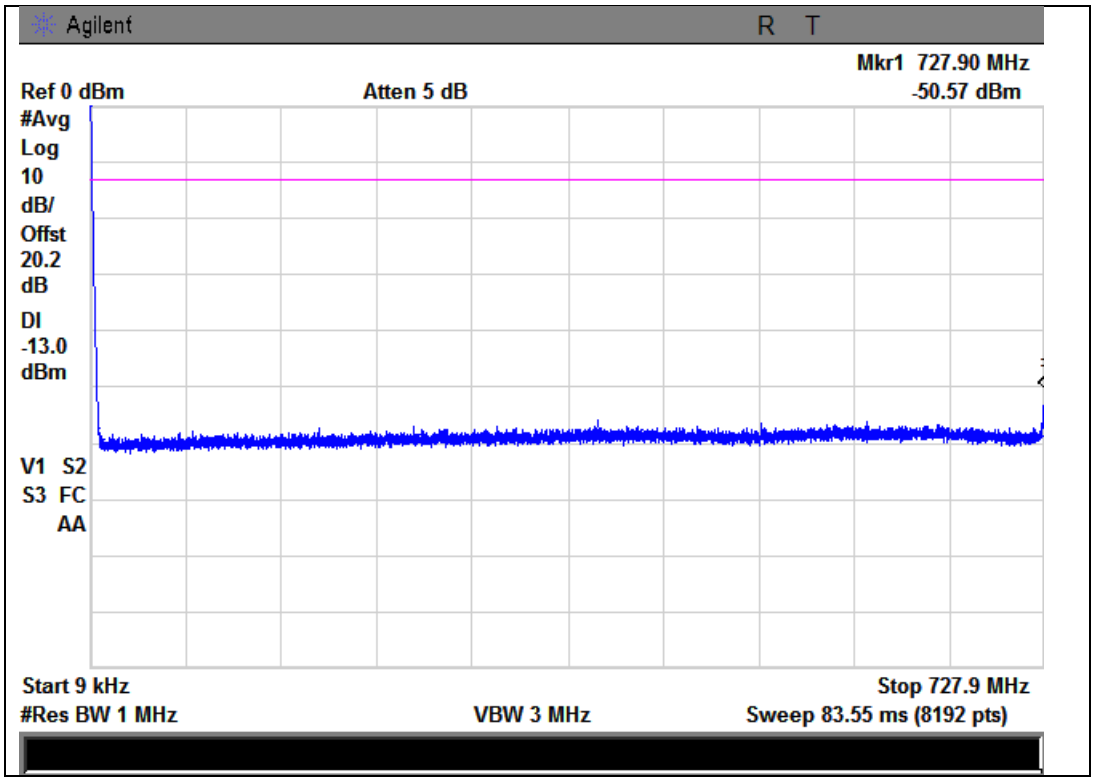

**17500 - 19500**



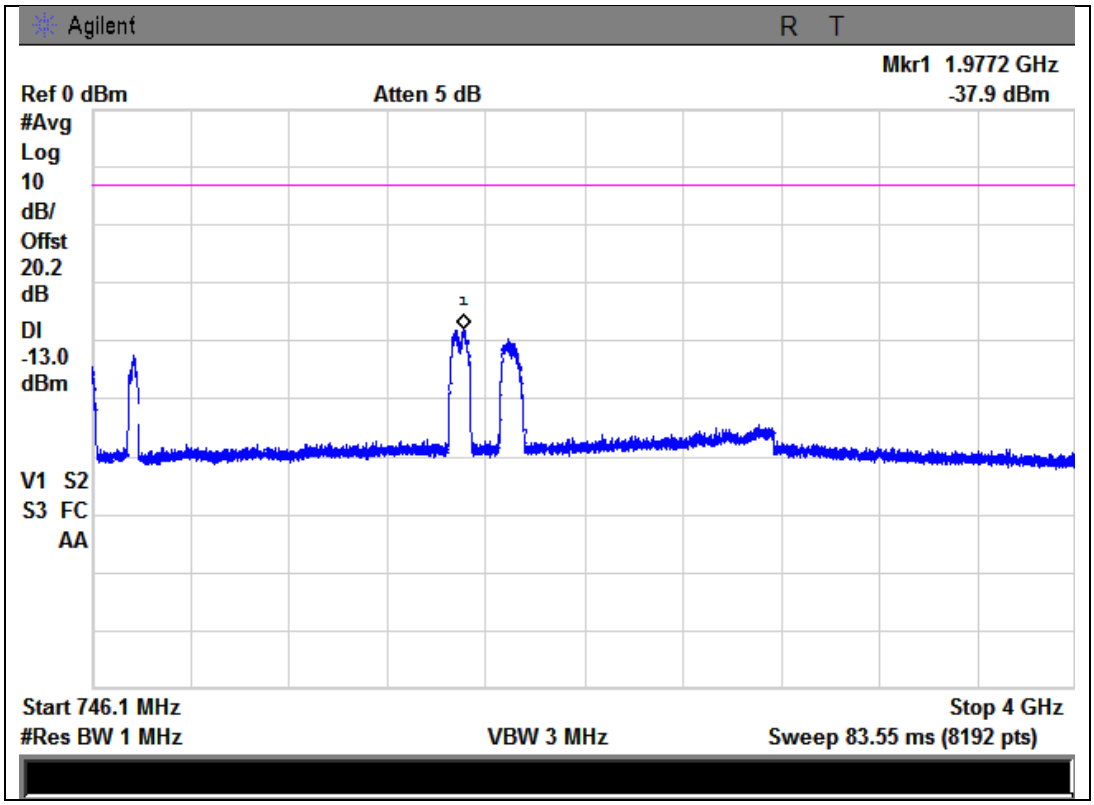
## Downlink Test Plots

### 728 - 746 MHz Band

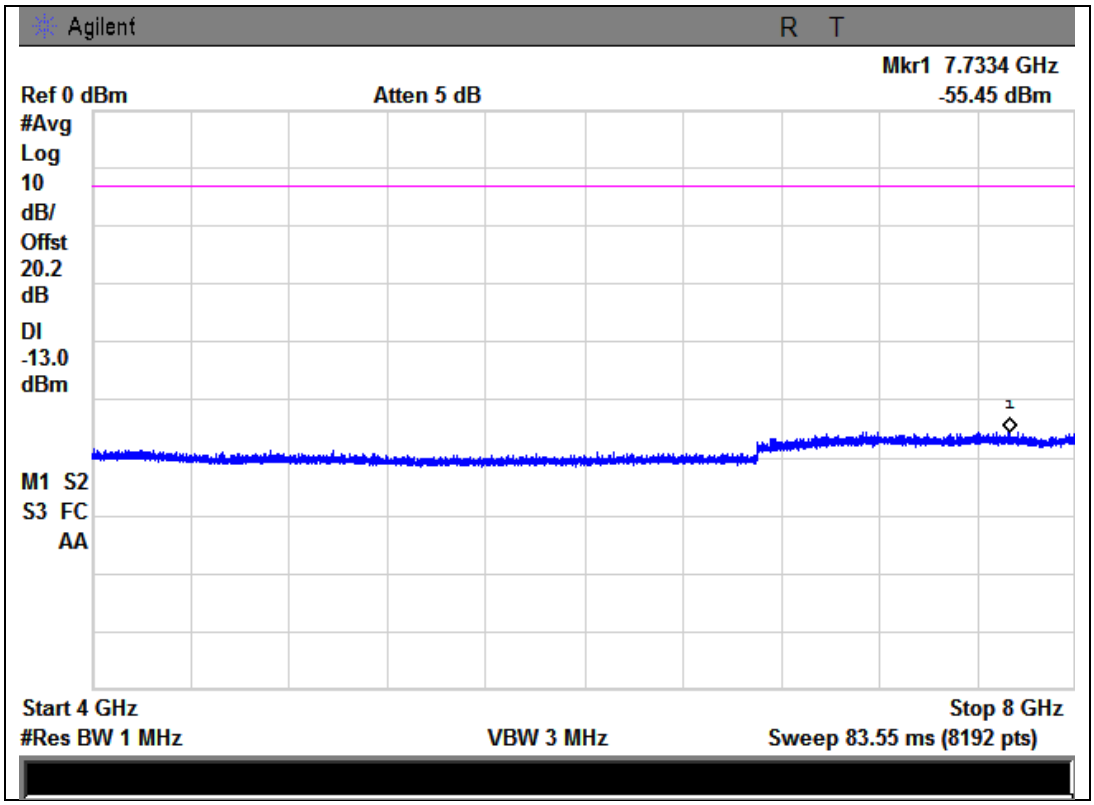
**9 kHz – 727.9 MHz**




**746.1 – 4000 MHz**

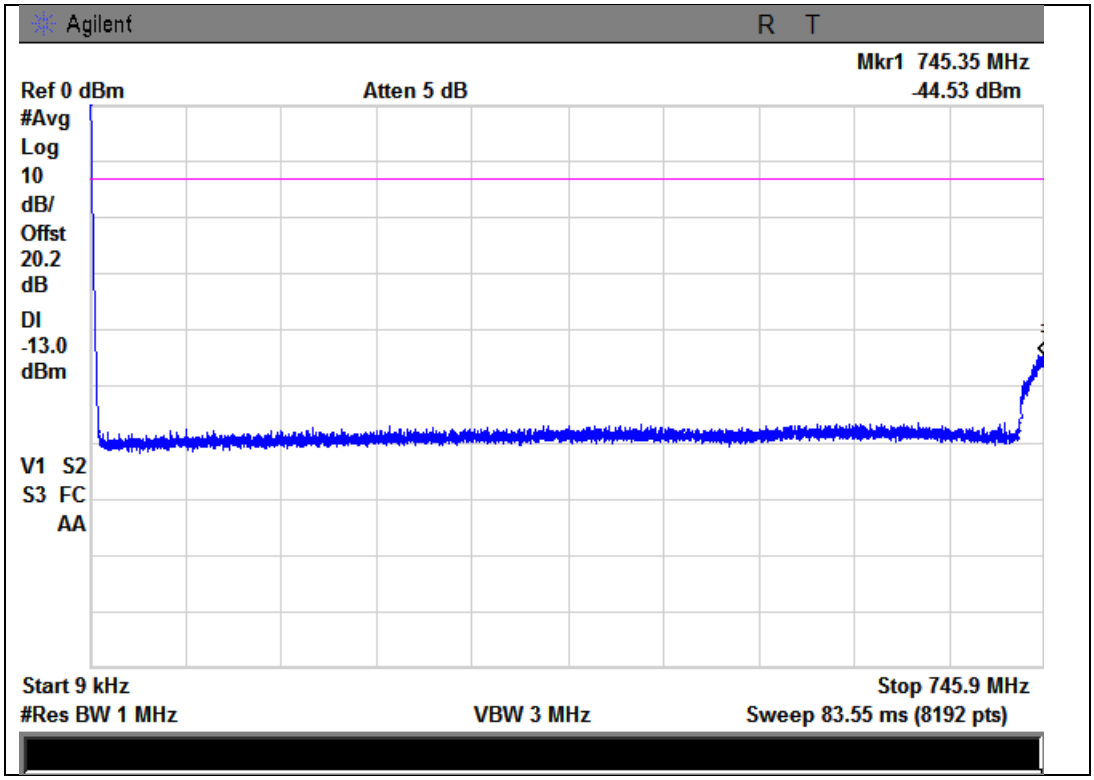


**4000 – 8000 MHz**

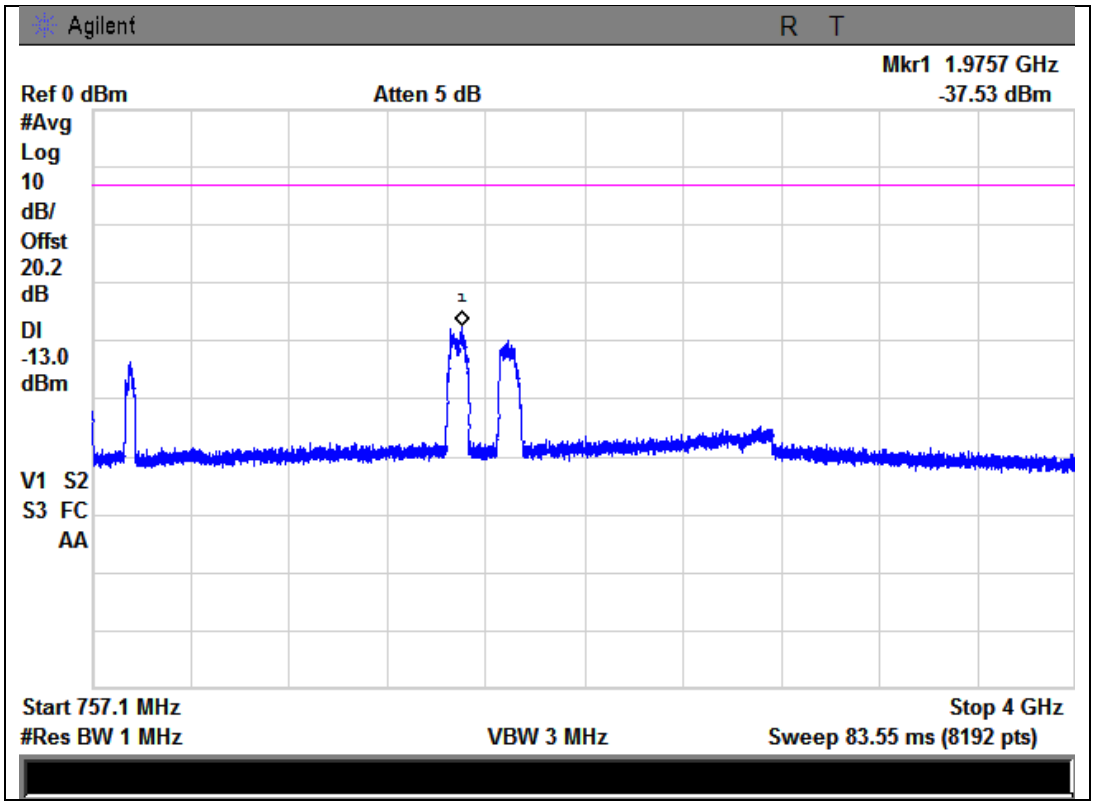


**746 - 756 MHz Band**

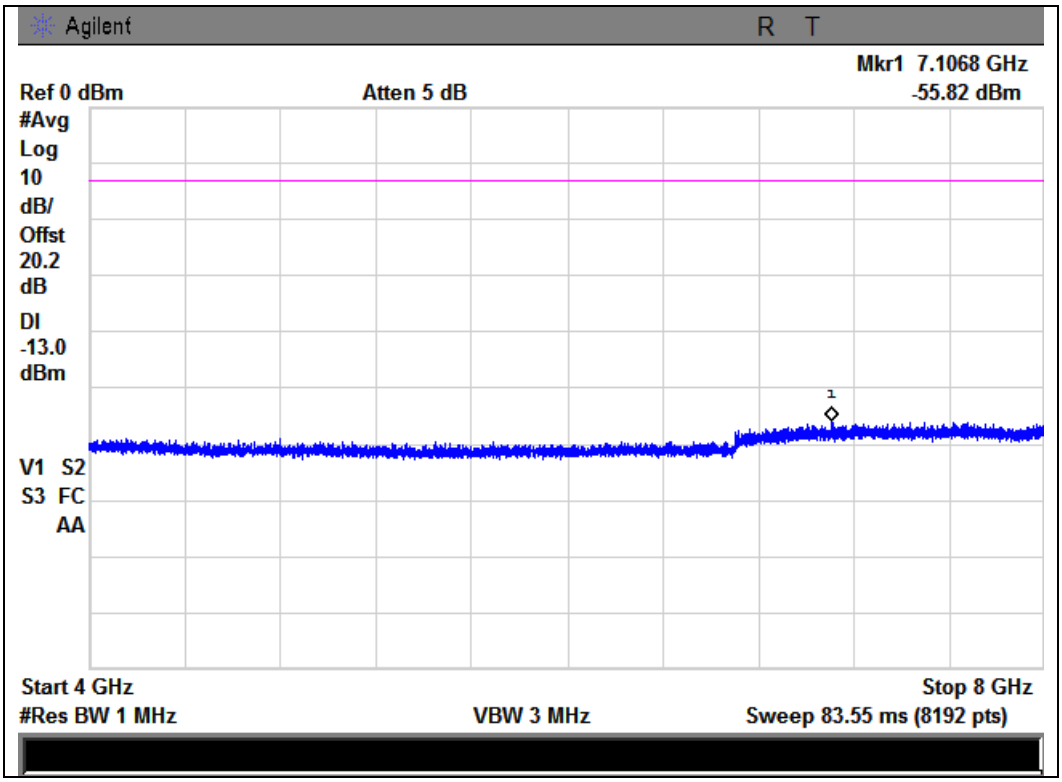
**9 kHz – 745.9 MHz**




**757.1 – 4000 MHz**

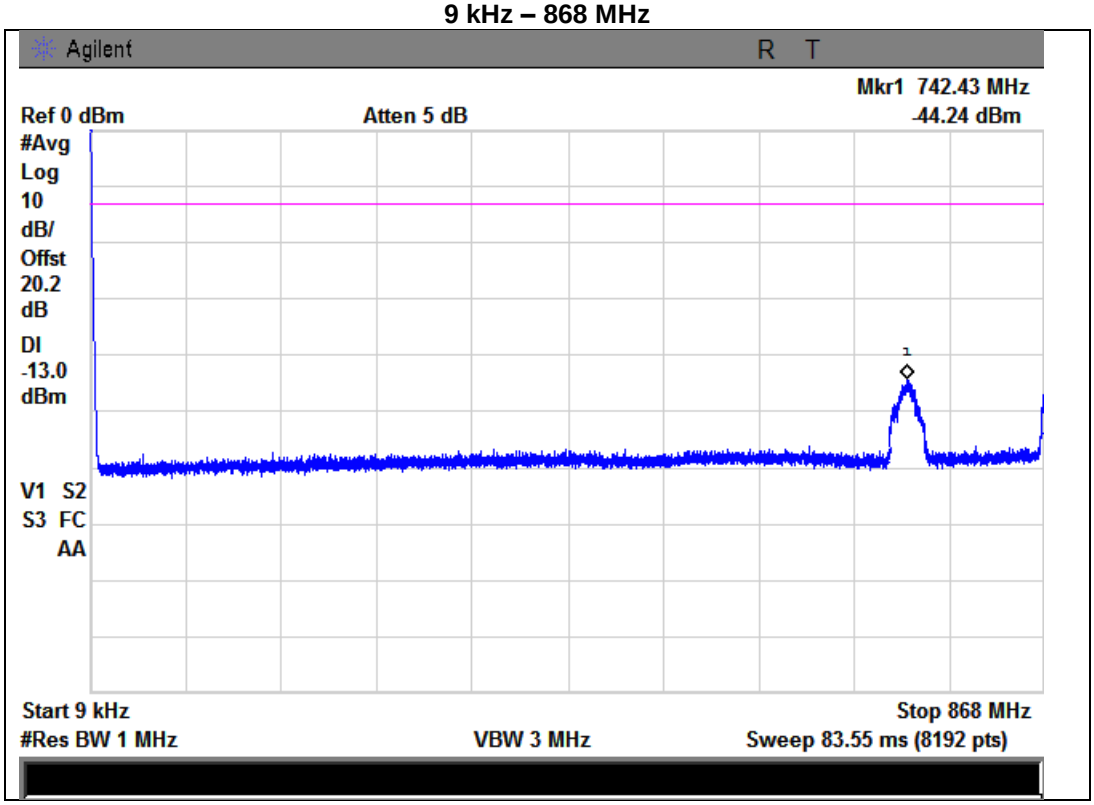


**4000 – 8000 MHz**

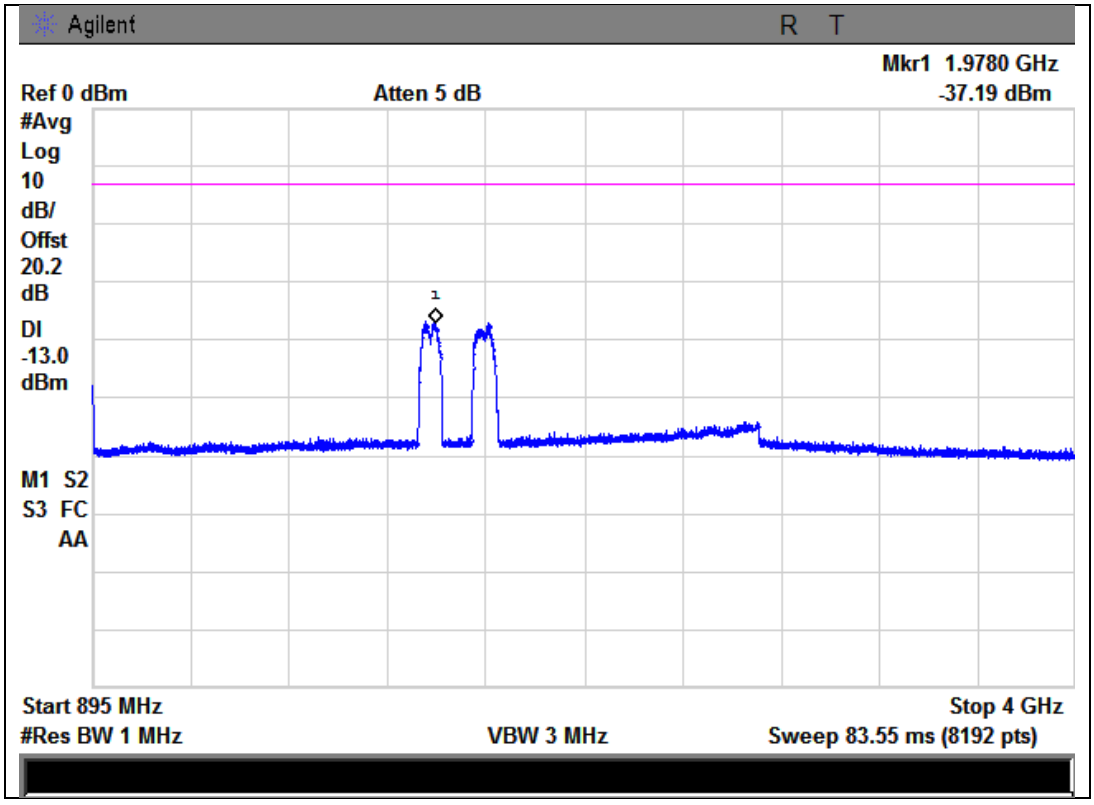


**869 - 894 MHz Band**

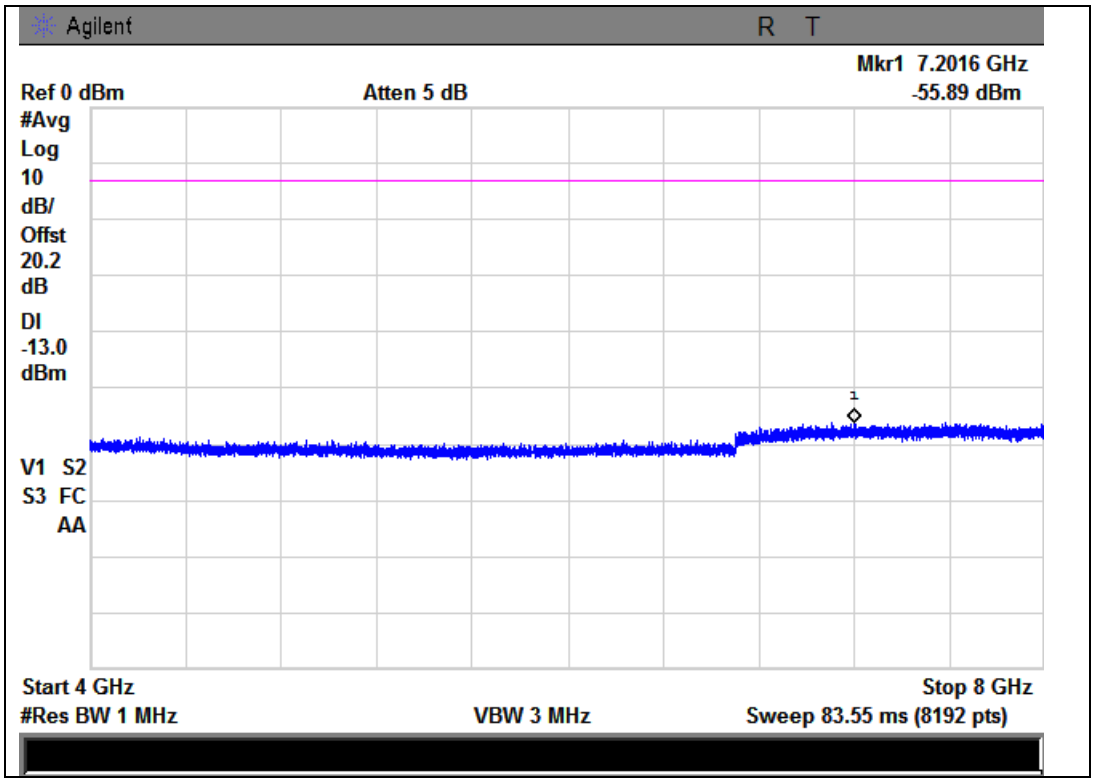
**9 kHz – 868 MHz**



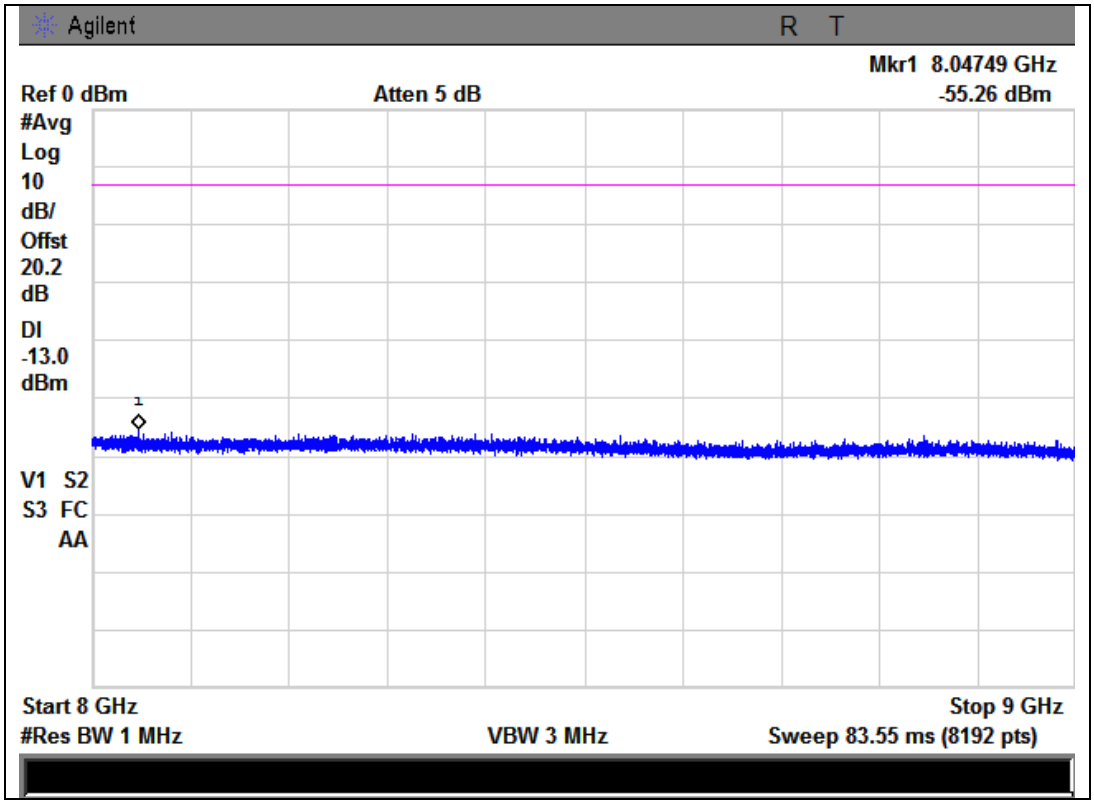

**895 – 4000 MHz**



**4000 – 8000 MHz**

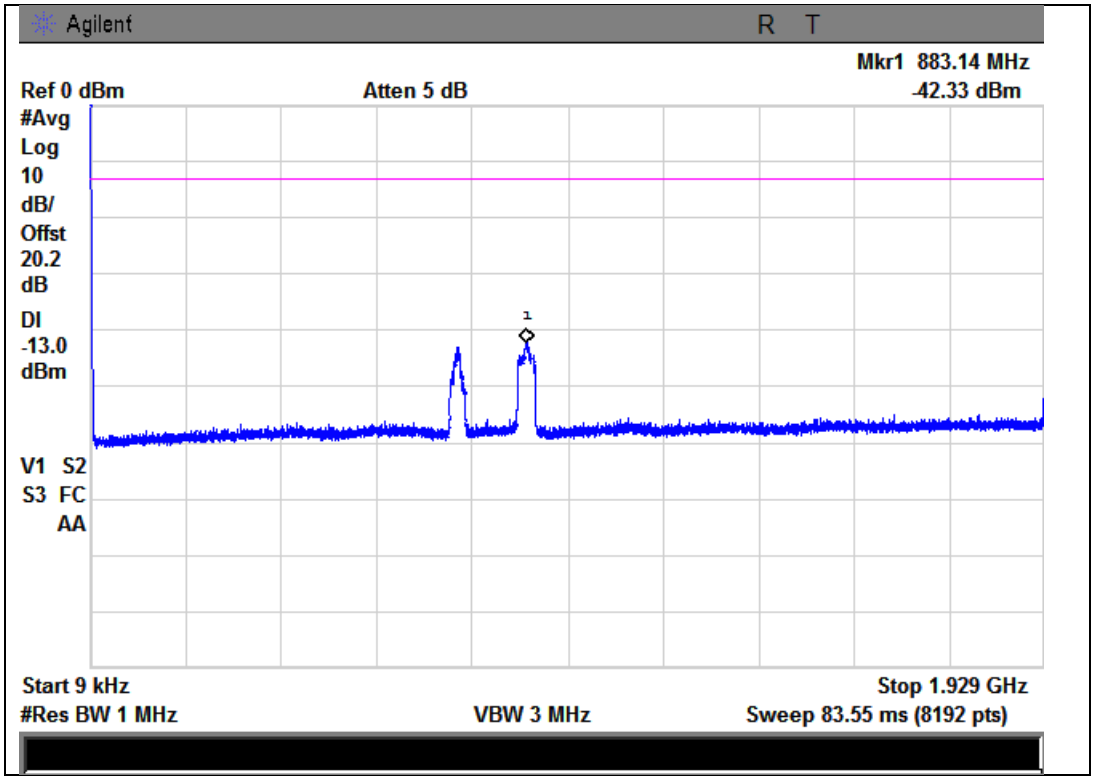



**8000 – 9000 MHz**

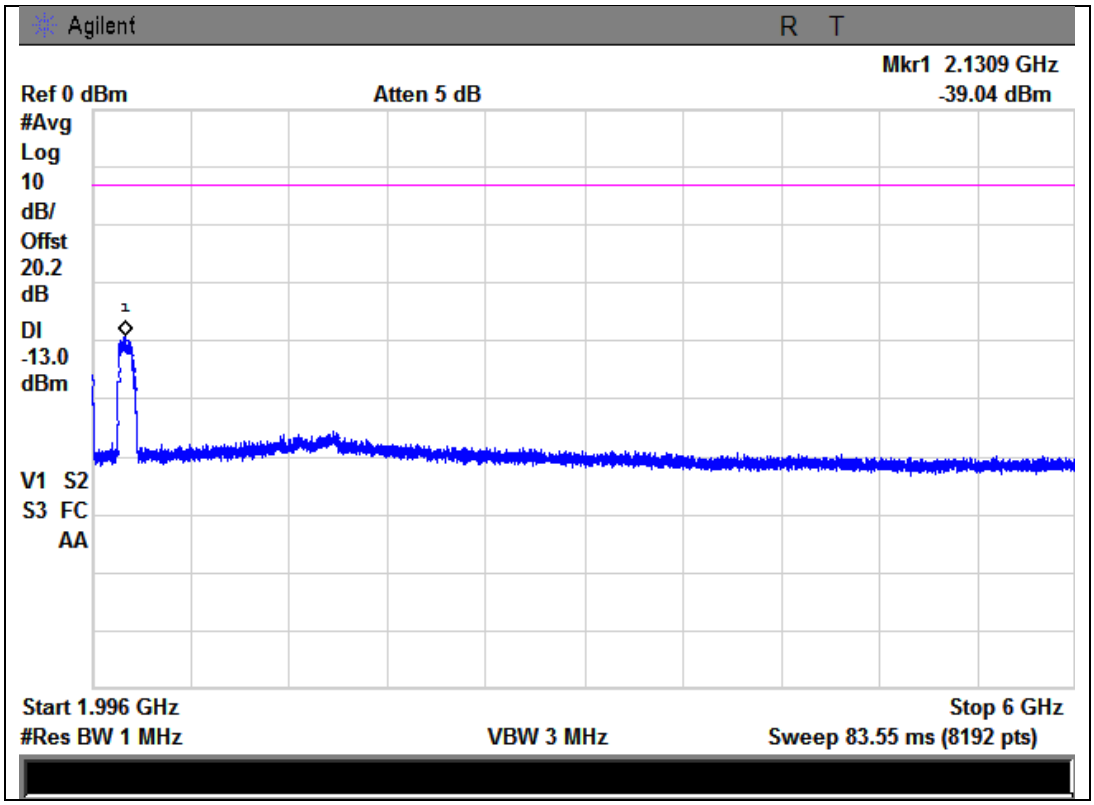


## 1930 - 1995 MHz Band

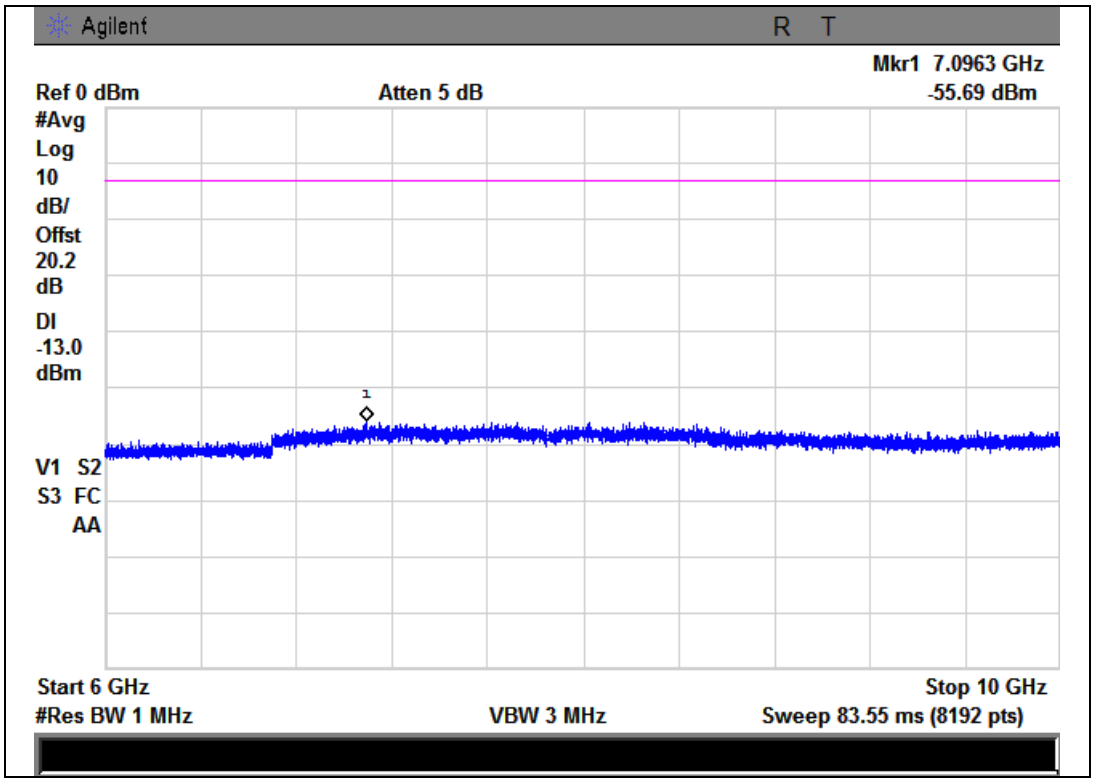
### 9 kHz – 1929 MHz



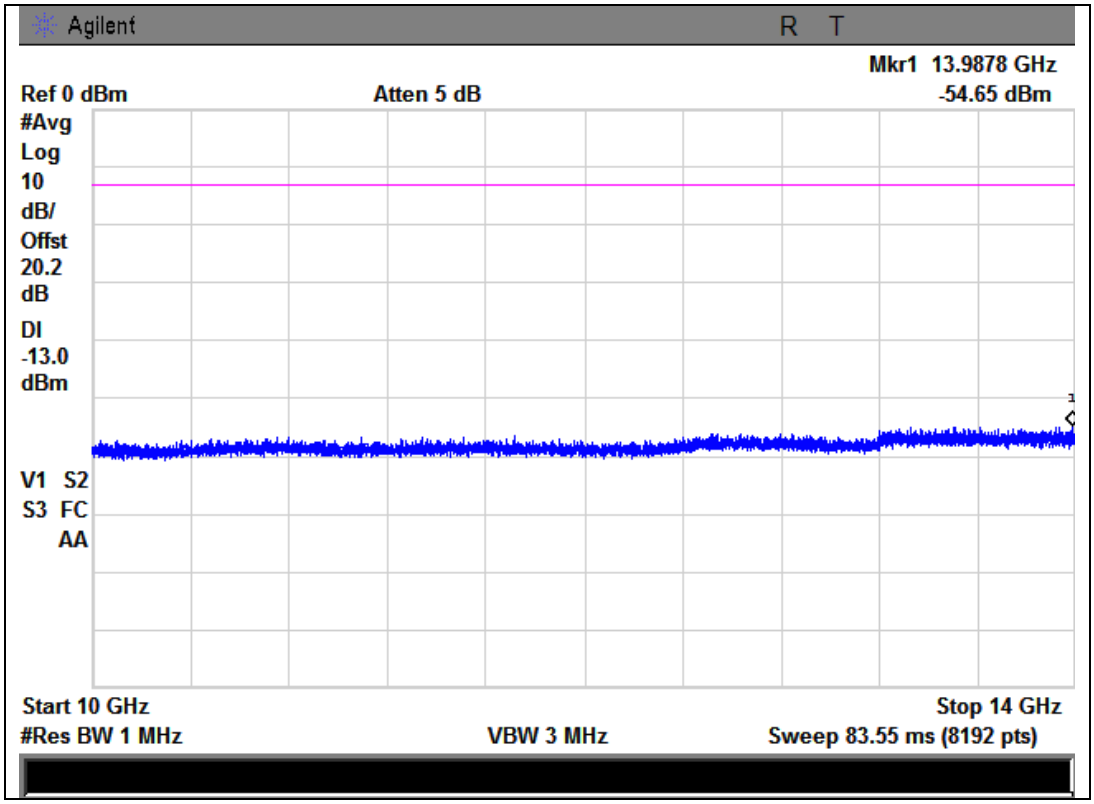

### 1996 – 6000 MHz



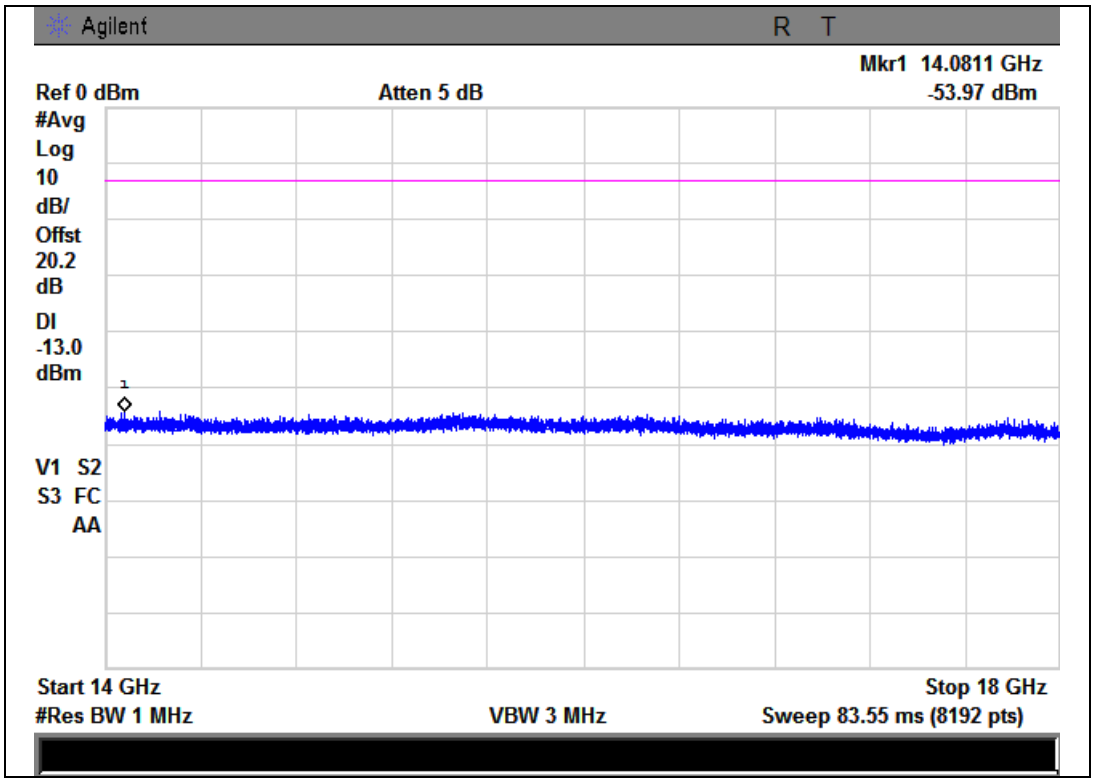
**6000 – 10000 MHz**



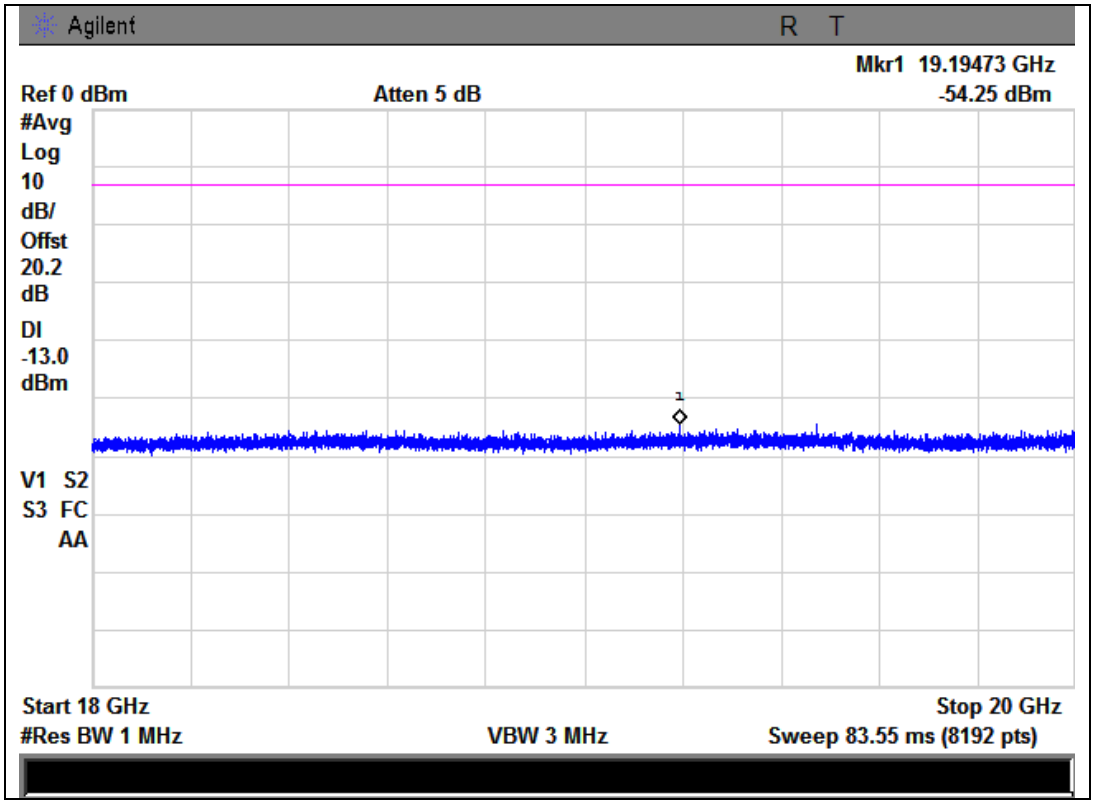

**10000 – 14000 MHz**



**14000 – 18000 MHz**

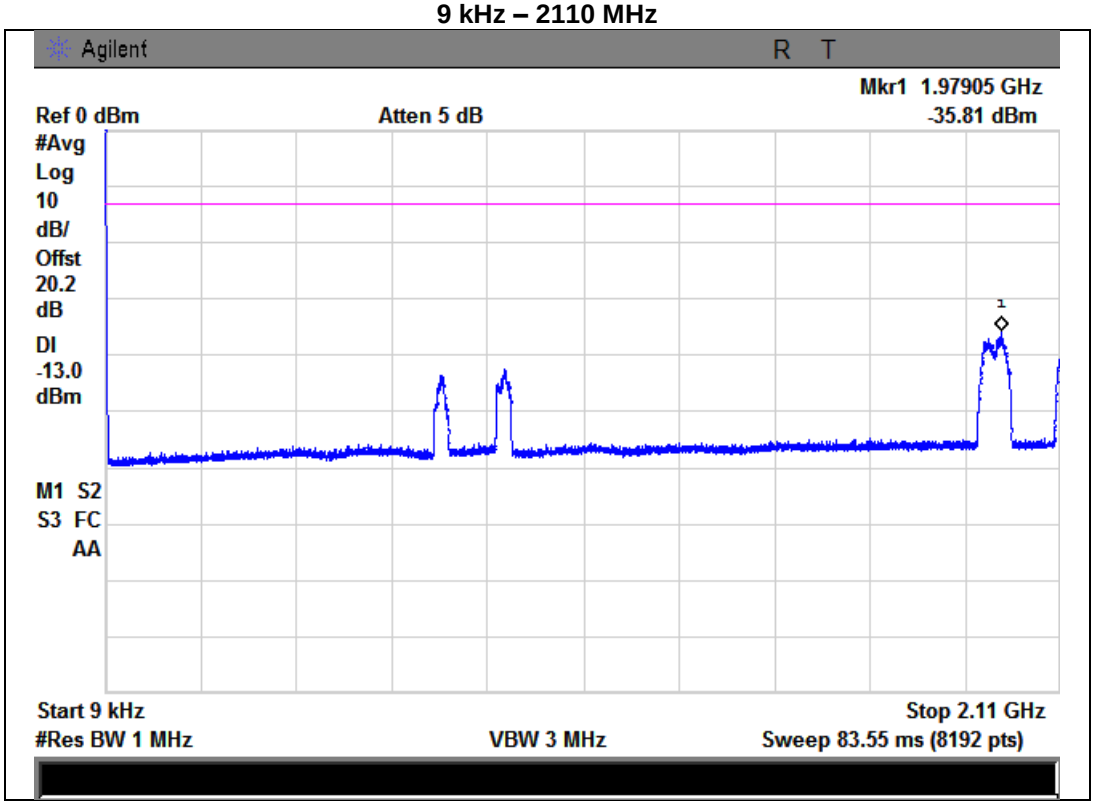



**18000 – 20000 MHz**

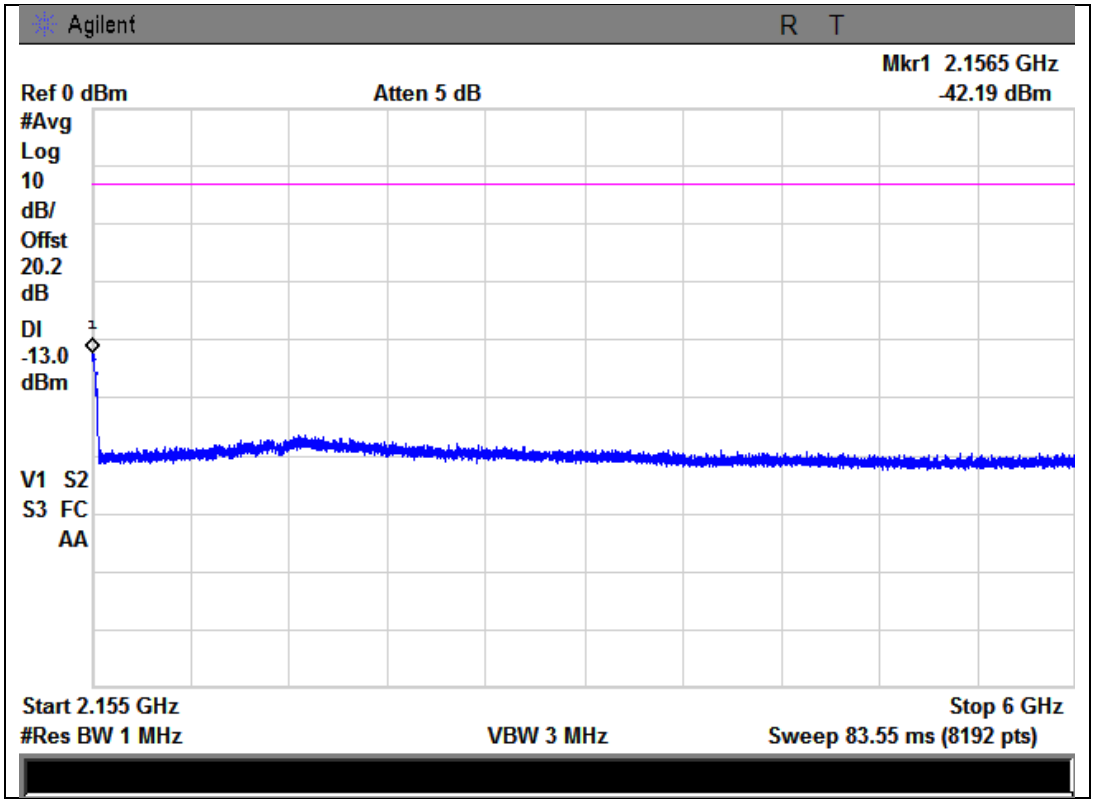


## 2110 - 2155 MHz Band

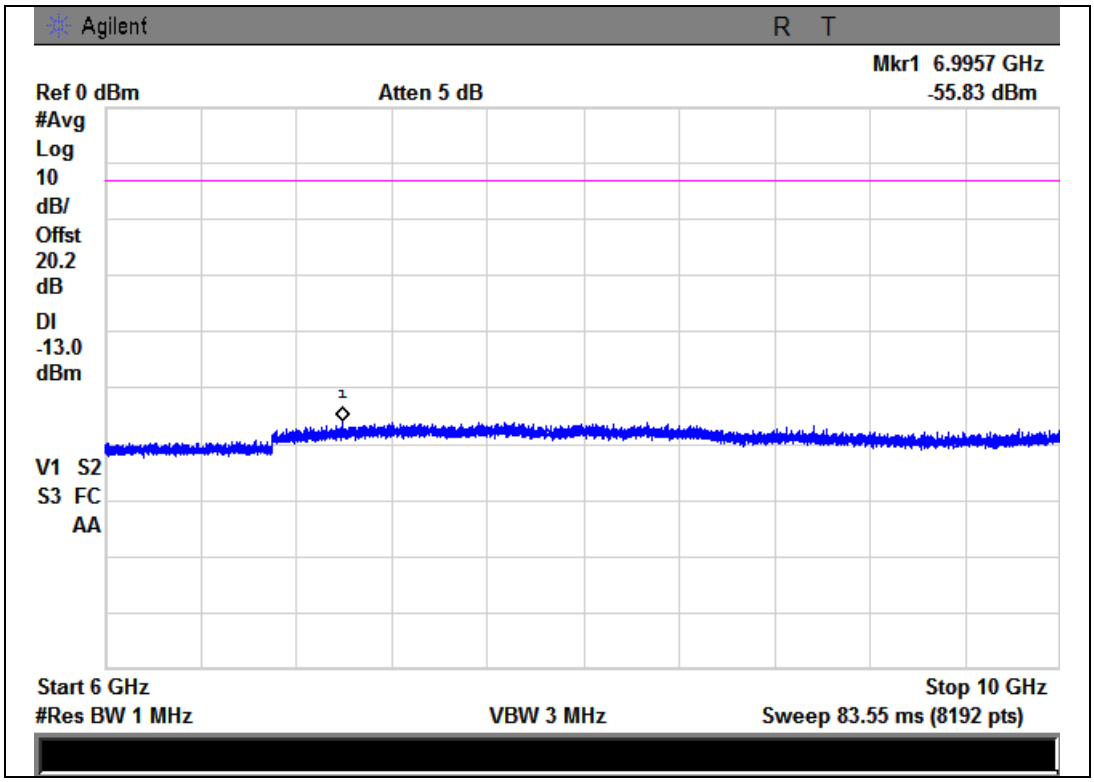
### 9 kHz – 2110 MHz



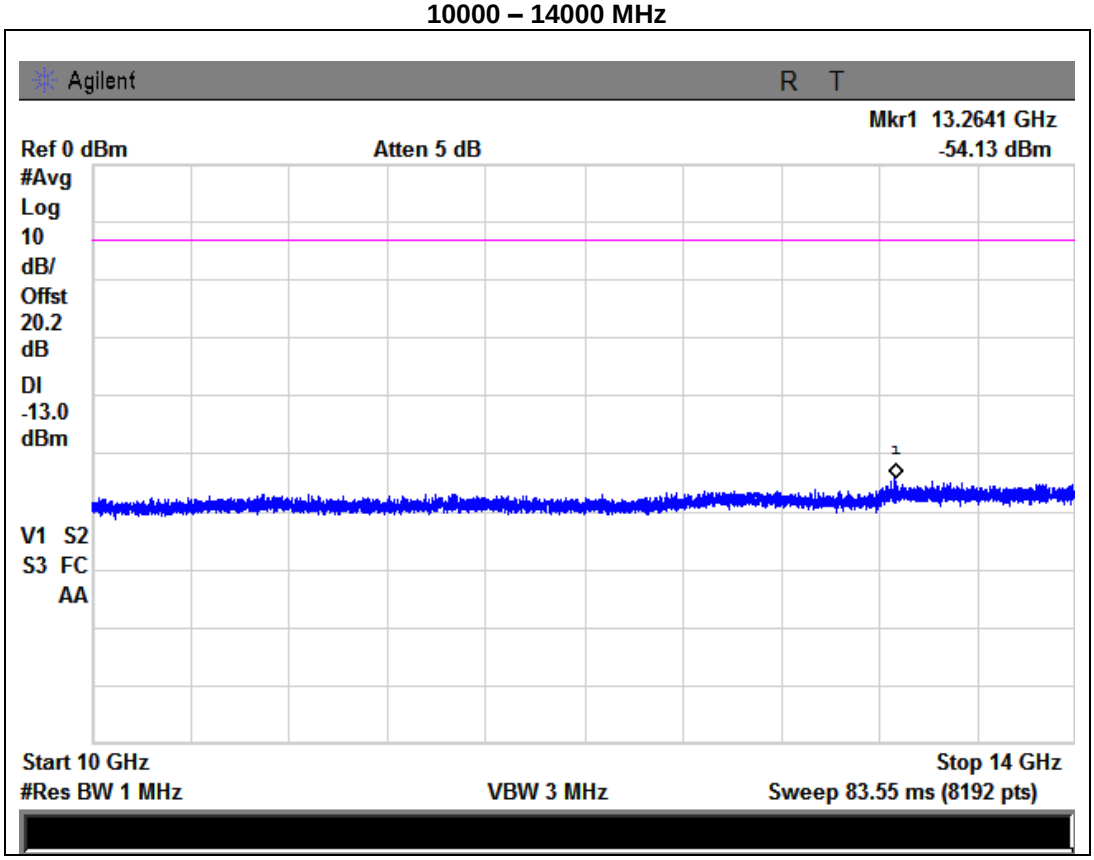

### 2155 – 6000 MHz



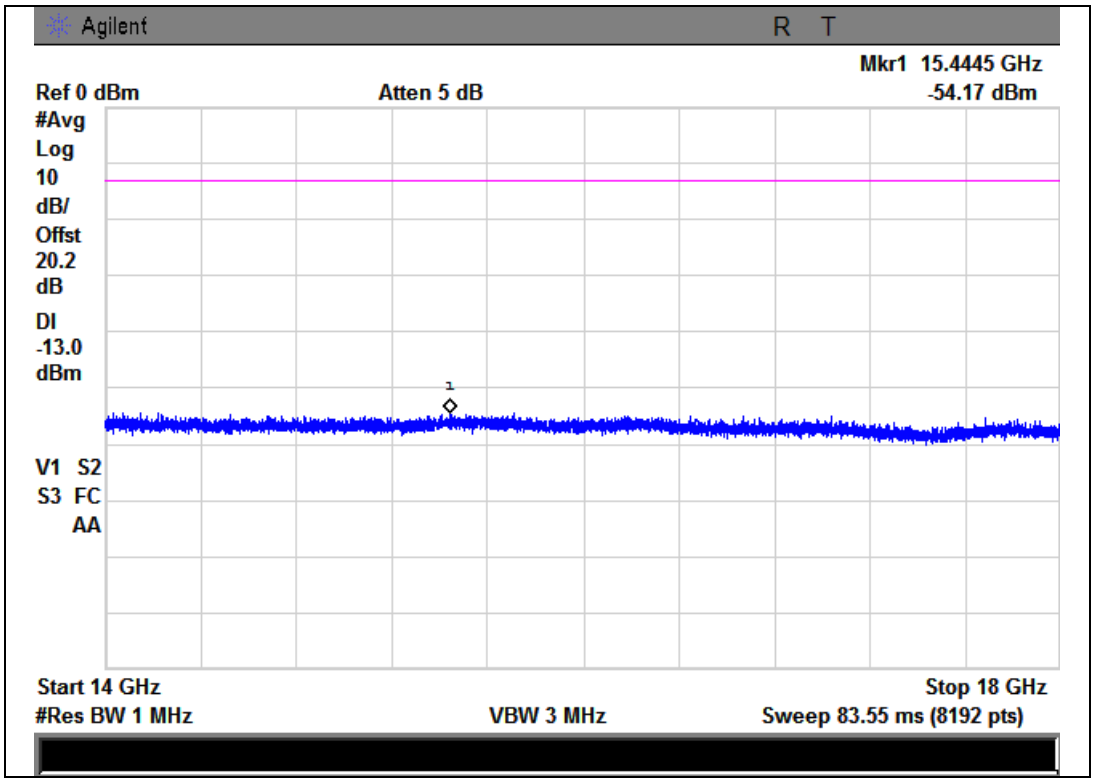
**6000 – 10000 MHz**



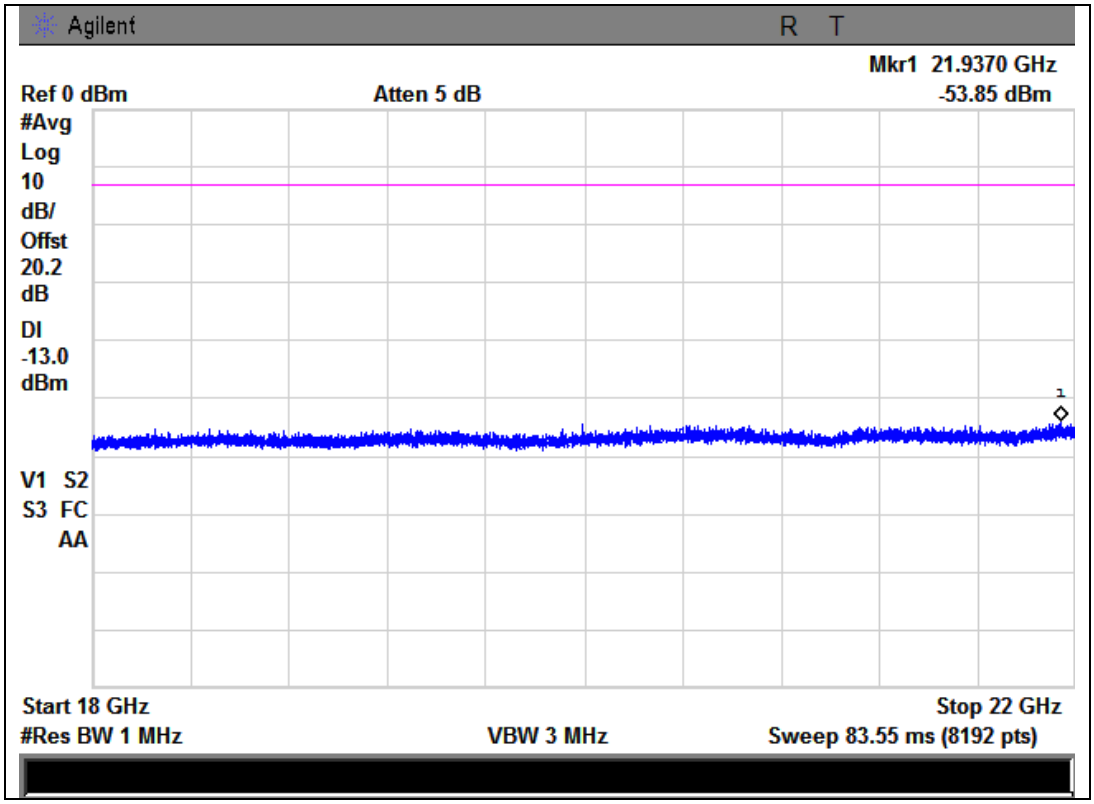

**10000 – 14000 MHz**



**14000 – 18000 MHz**




**18000 – 22000 MHz**



**Noise Limits**

| | | |
|---|---|---|
| **Name of Test:** | Noise Limits | **Engineer:** Greg Corbin |
| **Test Equipment Utilized:** | i00413, SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** 7/29/2013 |

**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. A series of three tests are performed to measure the maximum uplink and downlink noise and the variable noise for the uplink and downlink in the presence of a downlink signal. The detailed procedures from KDB 935210 D03 Wideband Consumer Signal Booster Measurement Guidance DR04-41516c were followed.

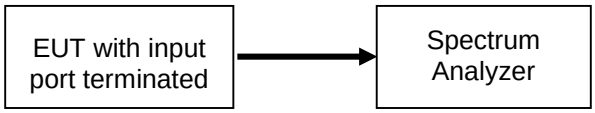
The following formulas are used for calculating the limits. Note – Downlink noise is calculated with the CF of the associated uplink band.

Noise Power =-102.5+LOG10(Band Center Frequency)*20

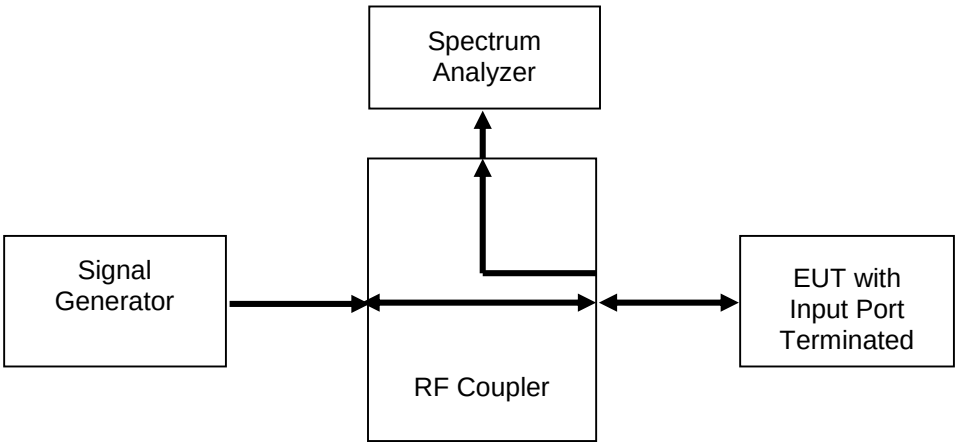
Variable Noise =-103 dBm/MHz-RSSI

**Test Setup**

**Maximum Noise Power**




**Variable Uplink Noise Power and Timing**




**Variable Downlink Noise Power and Timing**

**Maximum Uplink Noise Test Results**

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 698 - 716 | -49.5 | -45.5 | -4.0 | Pass |
| 777 - 787 | -48.1 | -44.6 | -3.5 | Pass |
| 824 - 849 | -47.7 | -44.1 | -3.6 | Pass |
| 1710 - 1755 | -41 | -37.7 | -3.3 | Pass |
| 1850 - 1915 | -39.8 | -37.0 | -2.8 | Pass |

**Maximum Downlink Noise Test Results**

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|---|---|---|---|---|
| 728 - 746 | -48.9 | -45.5 | -3.4 | Pass |
| 746 - 756 | -49.2 | -44.6 | -4.6 | Pass |
| 869 - 894 | -47.6 | -44.1 | -3.5 | Pass |
| 1930 - 1995 | -41.3 | -37.0 | -4.3 | Pass |
| 2110 - 2155 | -41.5 | -37.7 | -3.8 | Pass |

**Uplink Noise Timing Test Results**

| Frequency Band (MHz) | Measured Timing (Seconds) | Limit (Seconds) | Result |
|---|---|---|---|
| 698 - 716 | 0.48 | 3.0 | Pass |
| 777 - 787 | 0.38 | 3.0 | Pass |
| 824 - 849 | 0.30 | 3.0 | Pass |
| 1710 - 1755 | 0.40 | 3.0 | Pass |
| 1850 - 1915 | 0.45 | 3.0 | Pass |

## Variable Uplink Noise Limit Test Results

**698 - 716 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -73.0 | -45.5 | -49.8 | -4.3 |
| -72.0 | -45.5 | -49.8 | -4.3 |
| -71.0 | -45.5 | -49.8 | -4.3 |
| -70.0 | -45.5 | -49.8 | -4.3 |
| -53.0 | -50.0 | -55.5 | -5.5 |
| -46.0 | -57.0 | -62.2 | -5.2 |

**777 - 787 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -43.0 | -60.0 | -62.8 | -2.8 |
| -42.0 | -61.0 | -63.7 | -2.7 |
| -41.0 | -62.0 | -64.4 | -2.4 |
| -40.0 | -63.0 | -65.4 | -2.4 |
| -39.0 | -64.0 | -66.2 | -2.2 |
| -38.0 | -65.0 | -67.1 | -2.1 |

**824 - 849 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -66.0 | -44.0 | -47.8 | -3.8 |
| -65.0 | -44.0 | -47.9 | -3.9 |
| -64.0 | -44.0 | -47.8 | -3.8 |
| -63.0 | -44.0 | -47.9 | -3.9 |
| -62.0 | -44.0 | -48.5 | -4.5 |
| -61.0 | -44.0 | -49.5 | -5.5 |

**1710 - 1755 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -54.0 | -49.0 | -51.4 | -2.4 |
| -48.0 | -55.0 | -57.4 | -2.4 |
| -47.0 | -56.0 | -58.3 | -2.3 |
| -46.0 | -57.0 | -59.3 | -2.3 |
| -45.0 | -58.0 | -60.4 | -2.4 |
| -44.0 | -59.0 | -61.3 | -2.3 |

**1850 - 1915 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -47.0 | -56.0 | -58.3 | -2.3 |
| -46.0 | -57.0 | -59.5 | -2.5 |
| -45.0 | -58.0 | -60.3 | -2.3 |
| -44.0 | -59.0 | -61.4 | -2.4 |
| -43.0 | -60.0 | -62.5 | -2.5 |
| -42.0 | -61.0 | -63.2 | -2.2 |

## Variable Downlink Noise Limit Test Results

**728 - 746 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -66.0 | -45.5 | -47.7 | -2.2 |
| -65.0 | -45.5 | -47.6 | -2.1 |
| -64.0 | -45.5 | -47.7 | -2.2 |
| -63.0 | -45.5 | -47.7 | -2.2 |
| -62.0 | -45.5 | -48.1 | -2.6 |
| -61.0 | -45.5 | -49.4 | -3.9 |

**746 - 756 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -83.0 | -44.6 | -48.5 | -3.9 |
| -82.0 | -44.6 | -48.5 | -3.9 |
| -81.0 | -44.6 | -48.5 | -3.9 |
| -63.0 | -44.6 | -48.5 | -3.9 |
| -44.0 | -59.0 | -63.4 | -4.4 |
| -40.0 | -63.0 | -67.1 | -4.1 |

**869 - 894 MHz**

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -81.0 | -44.0 | -47.2 | -3.2 |
| -69.0 | -44.0 | -47.2 | -3.2 |
| -68.0 | -44.0 | -47.3 | -3.3 |
| -67.0 | -44.0 | -47.3 | -3.3 |
| -66.0 | -44.0 | -48.0 | -4.0 |
| -65.0 | -44.0 | -48.9 | -4.9 |

**1930 - 1995 MHz**

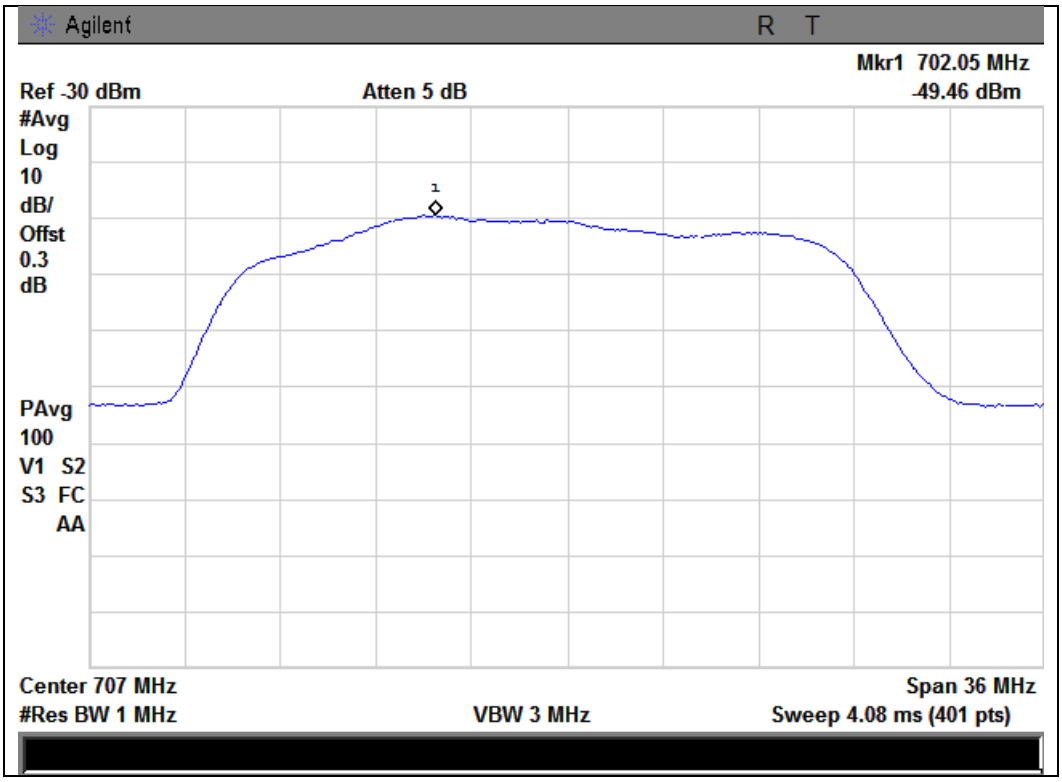
| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -82.0 | -37.0 | -40.5 | -3.5 |
| -81.0 | -37.0 | -40.5 | -3.5 |
| -70.0 | -37.0 | -40.4 | -3.4 |
| -69.0 | -37.0 | -40.4 | -3.4 |
| -68.0 | -37.0 | -40.9 | -3.9 |
| -44.0 | -59.0 | -63.4 | -4.4 |

**2110 - 2155 MHz**

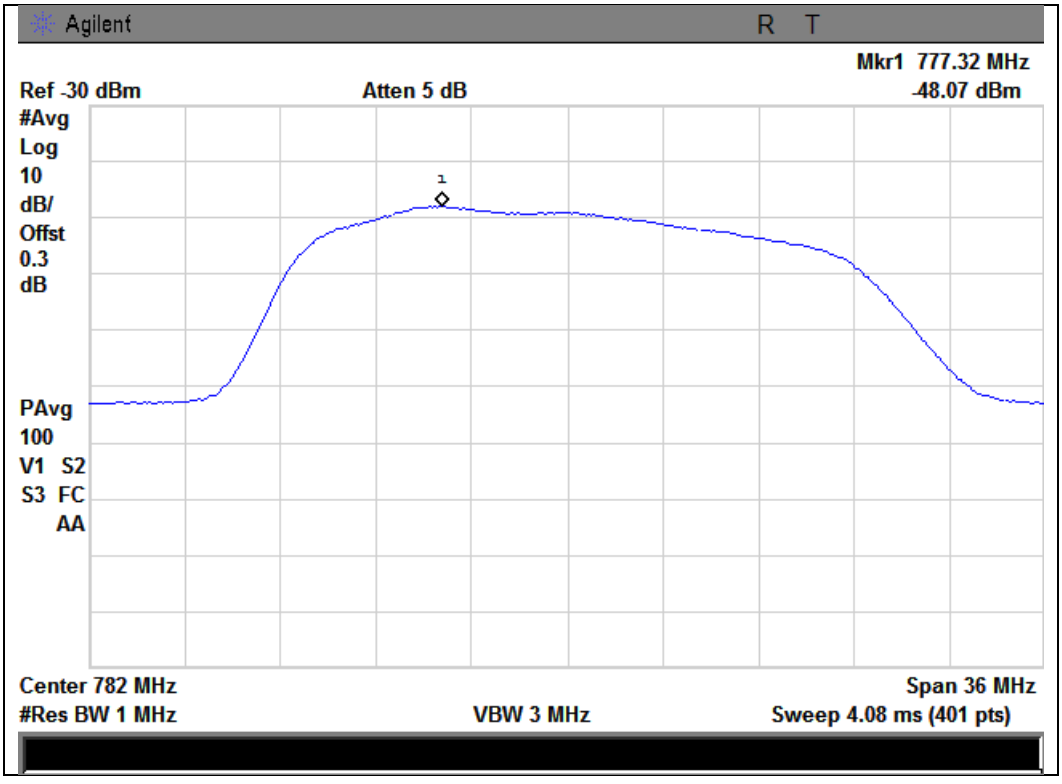
| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|---|---|---|---|
| -75.0 | -37.7 | -40.6 | -2.9 |
| -74.0 | -37.7 | -40.3 | -2.6 |
| -73.0 | -37.7 | -40.5 | -2.8 |
| -72.0 | -37.7 | -40.6 | -2.9 |
| -70.0 | -37.7 | -42.5 | -4.8 |
| -69.0 | -37.7 | -43.3 | -5.6 |

## Maximum Uplink Noise Test Plots

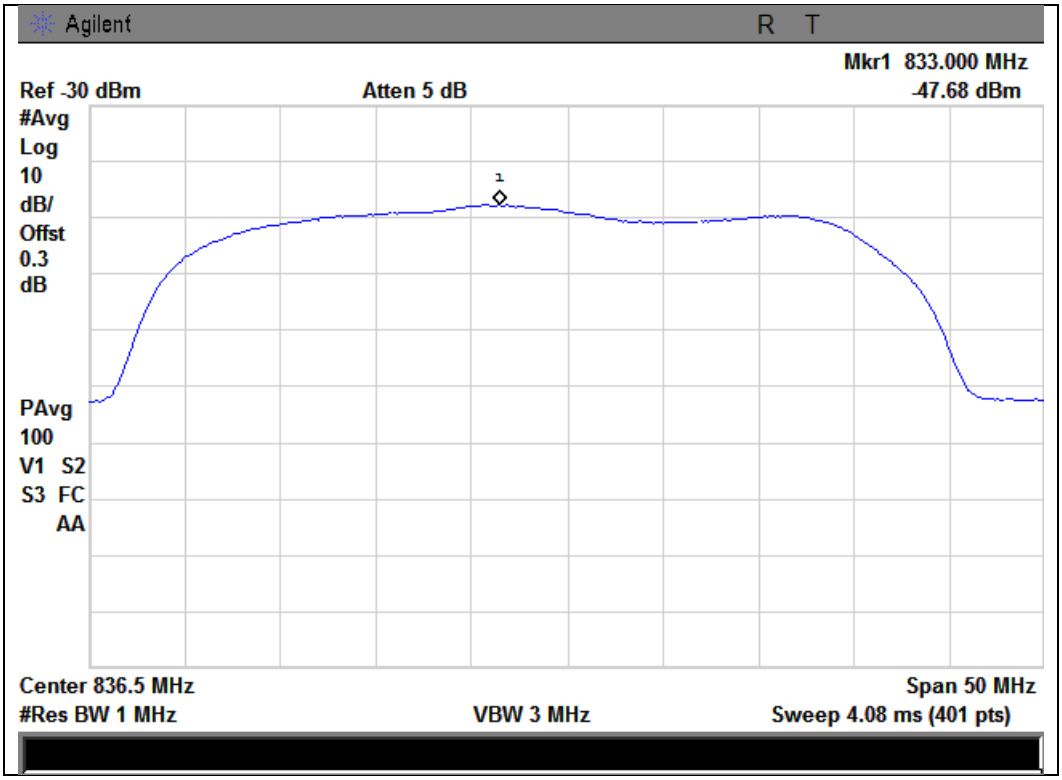
### 698 - 716 MHz Band



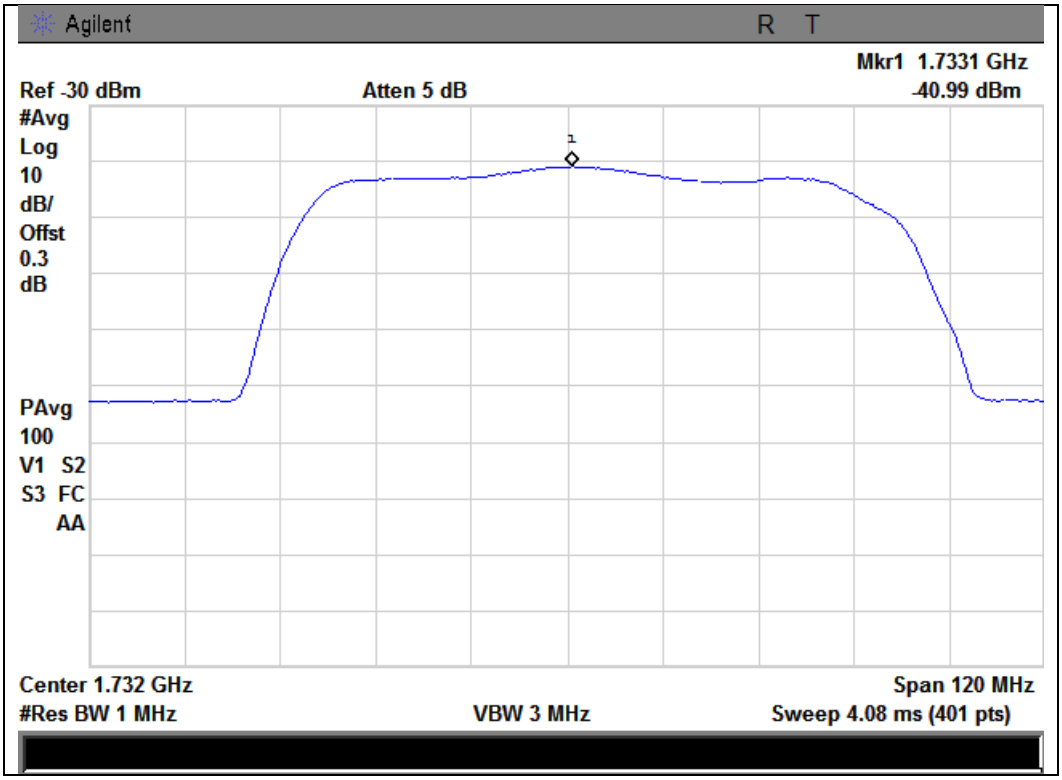

### 777 - 787 MHz Band



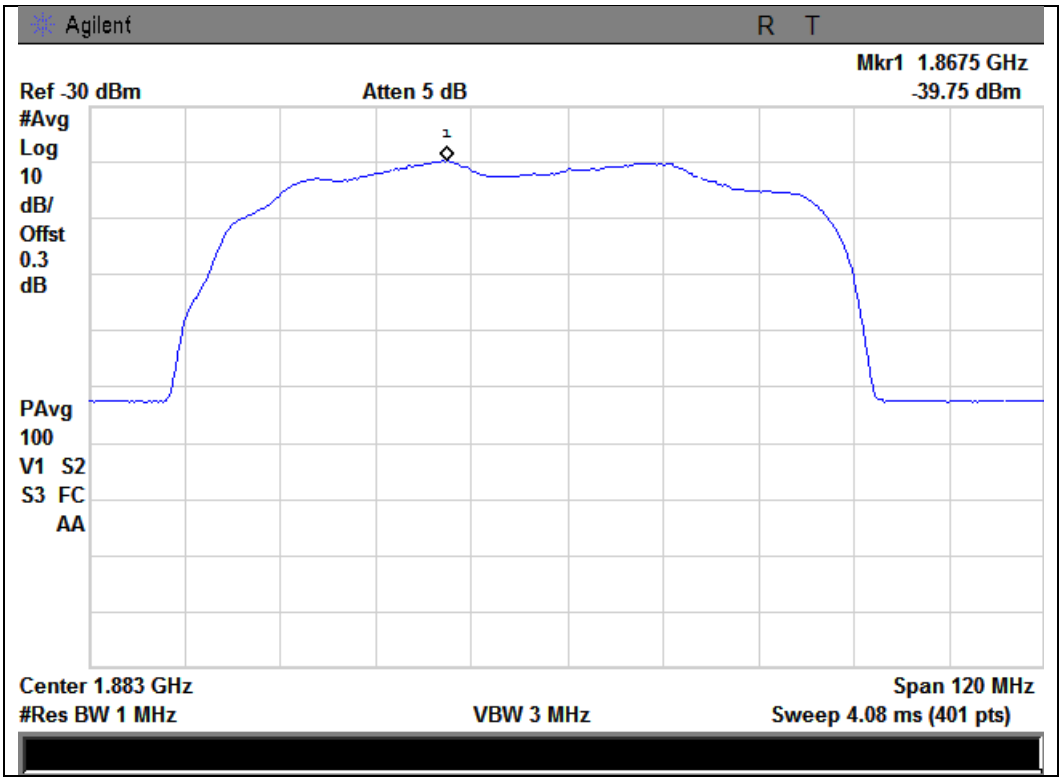
**824 - 849 MHz Band**




**1710 - 1755 MHz Band**

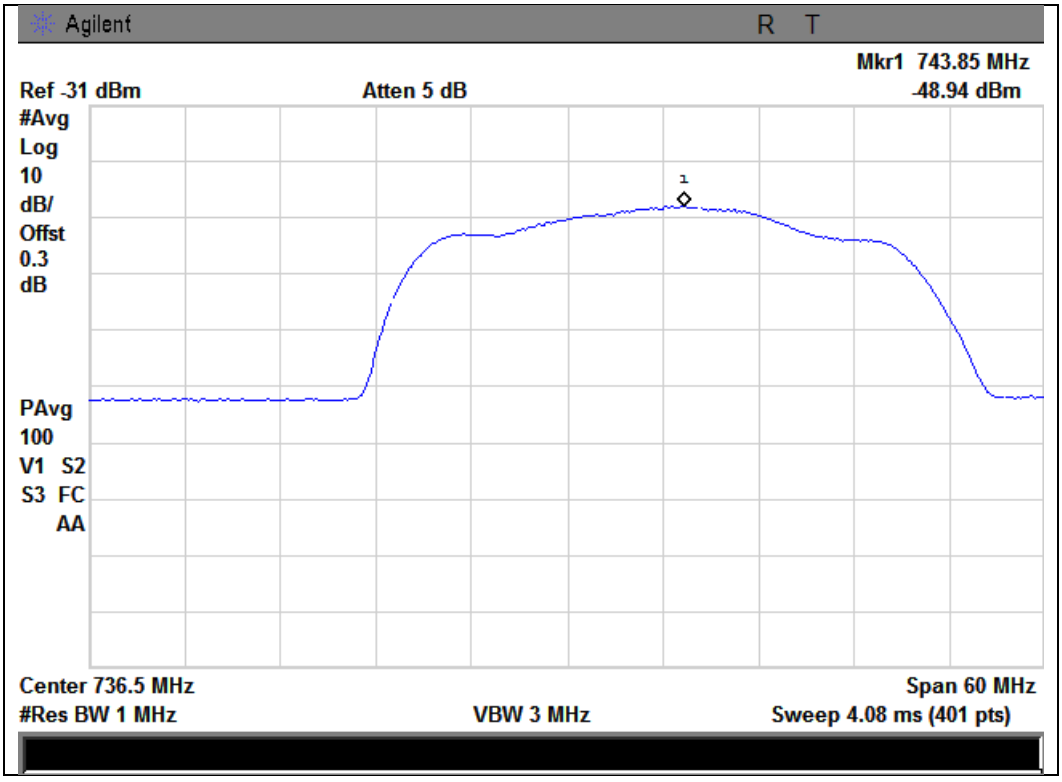


**1850 - 1915 MHz Band**

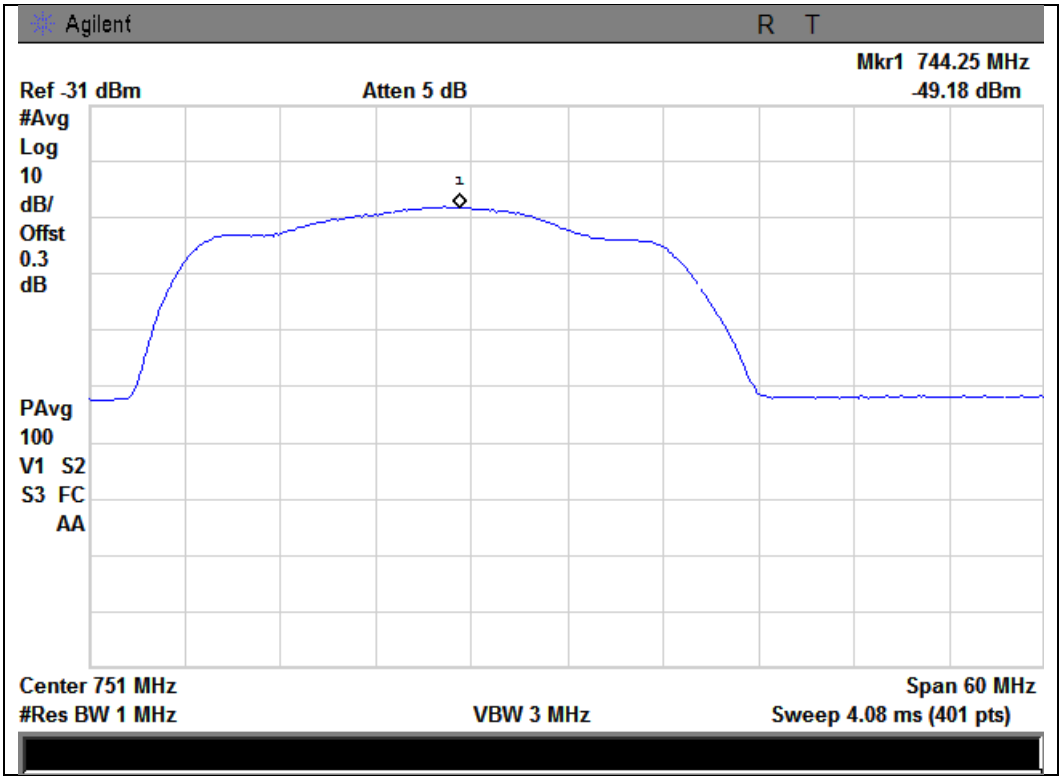



**Maximum Downlink Noise Test Plots**

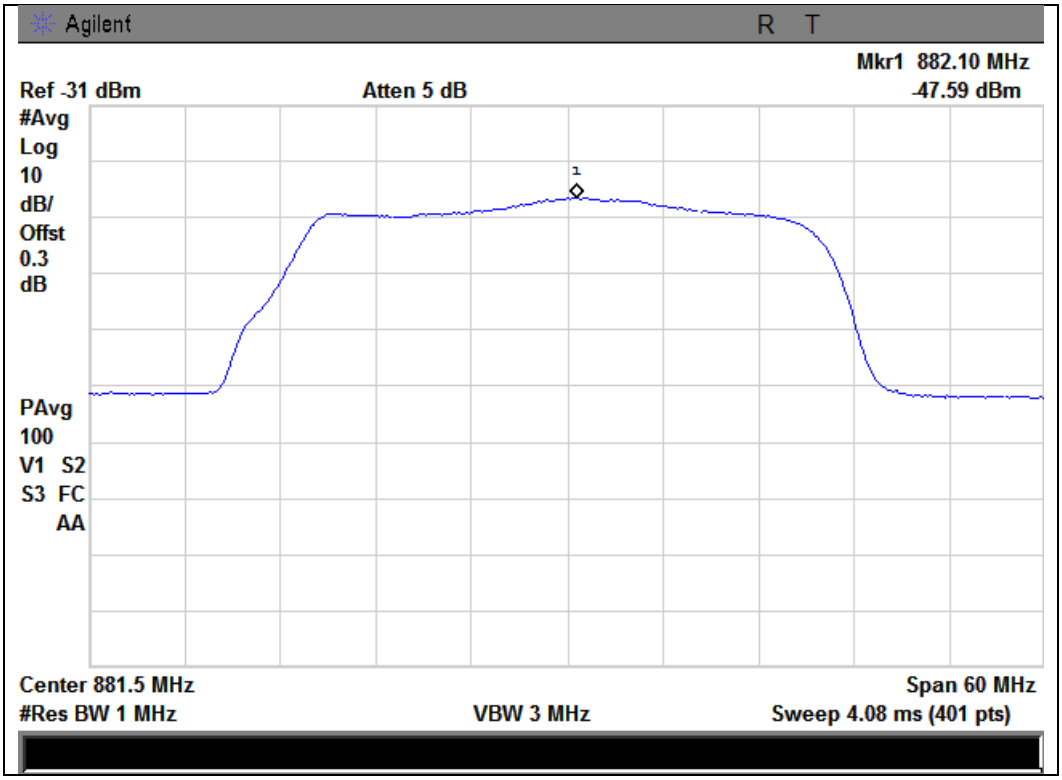
**728 - 746 MHz Band**



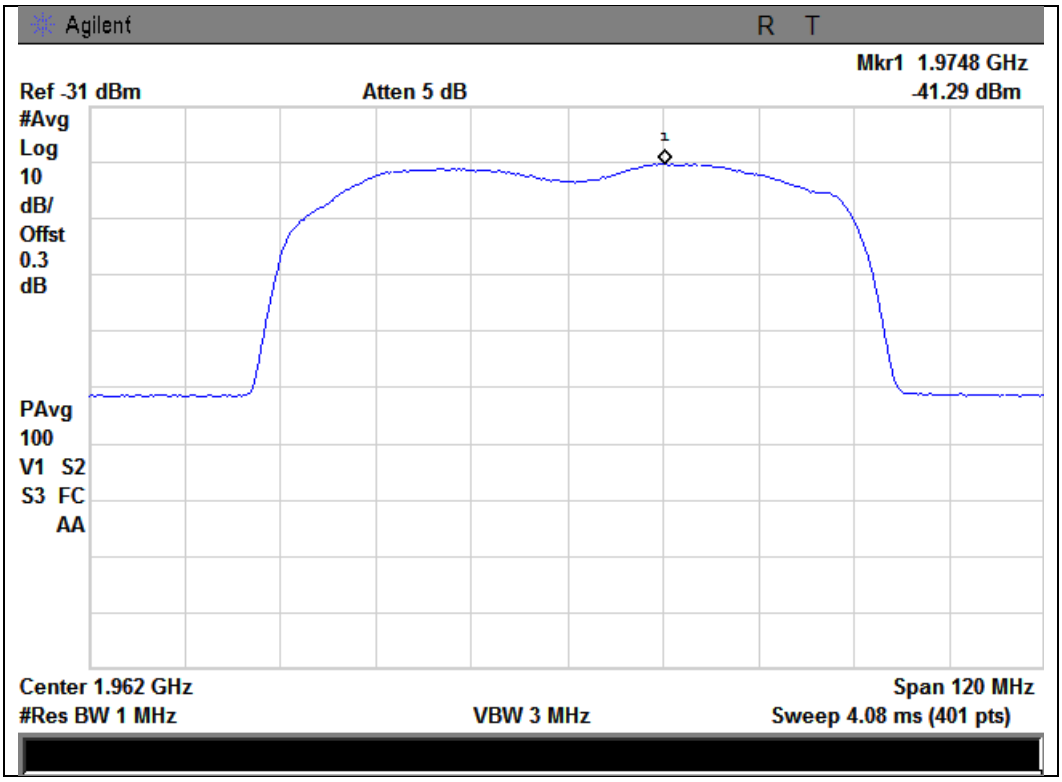
**746 - 756 MHz Band**



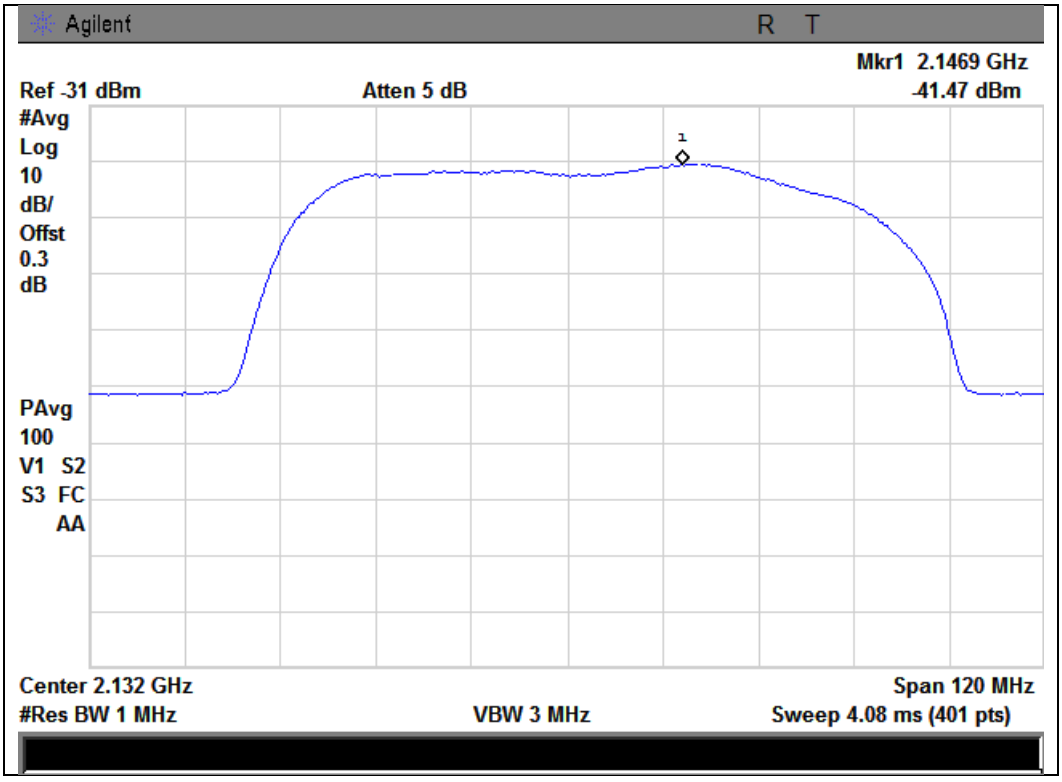

**869 - 894 MHz Band**



**1930 - 1995 MHz Band**

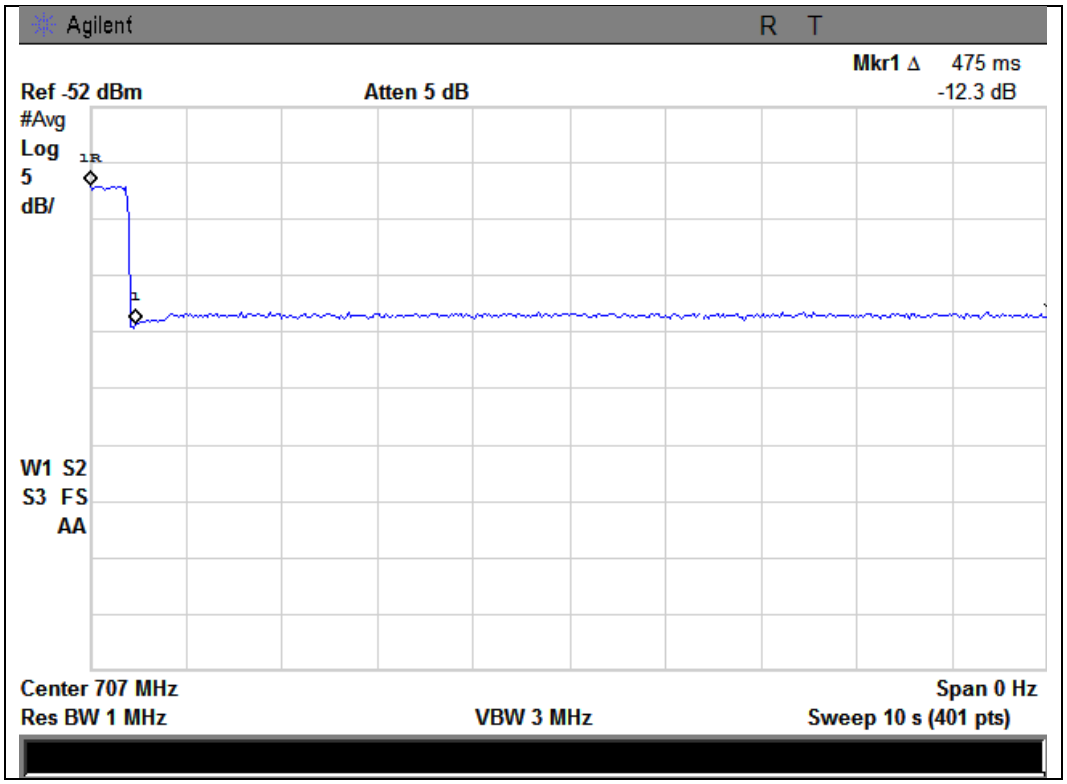



**2110 - 2155 MHz Band**

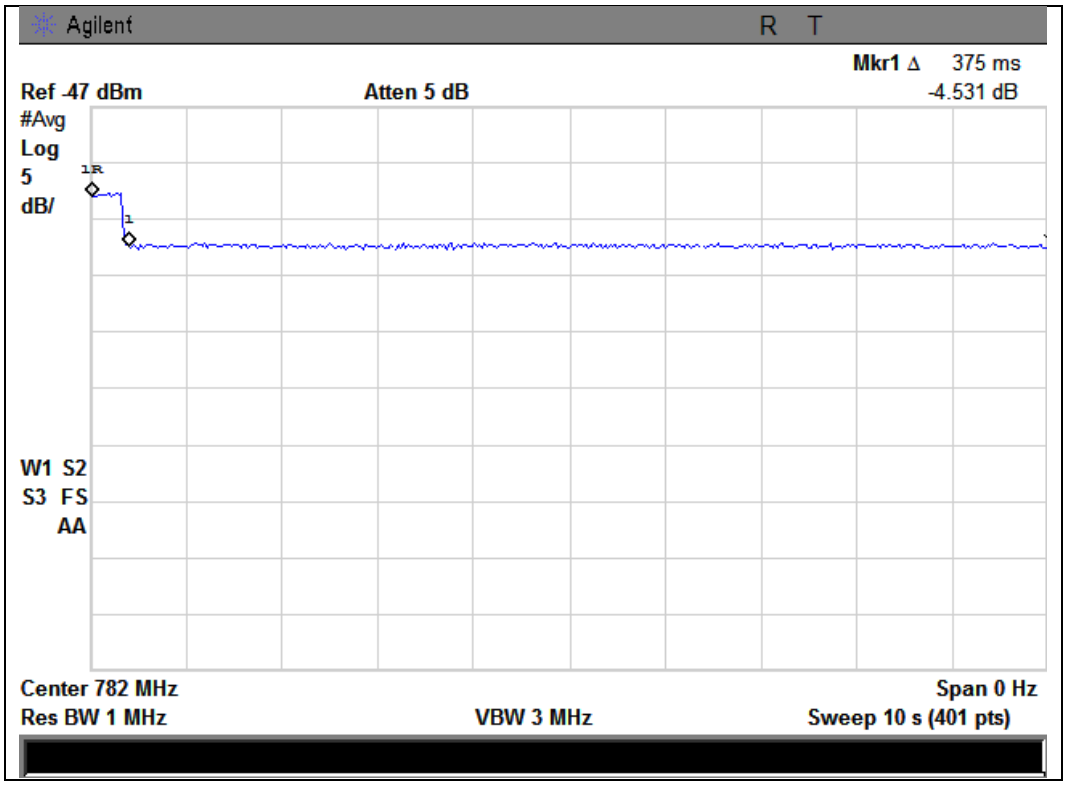


## Uplink Noise Timing Test Plots

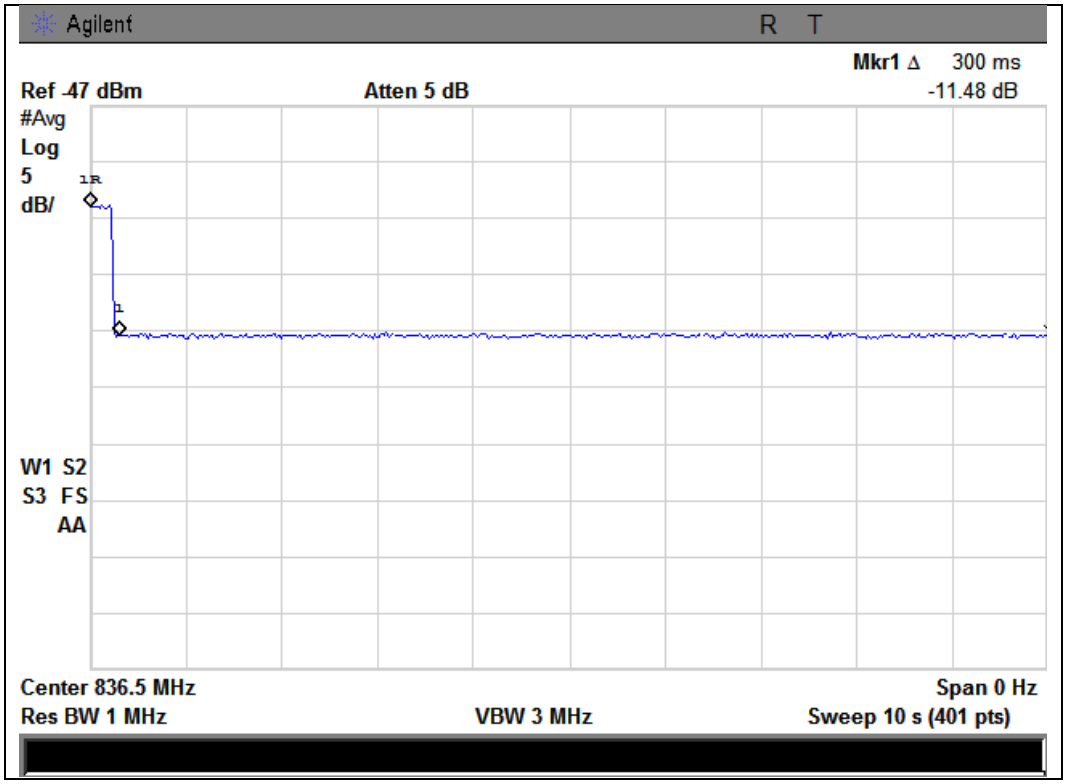
### 698 - 716 MHz Band



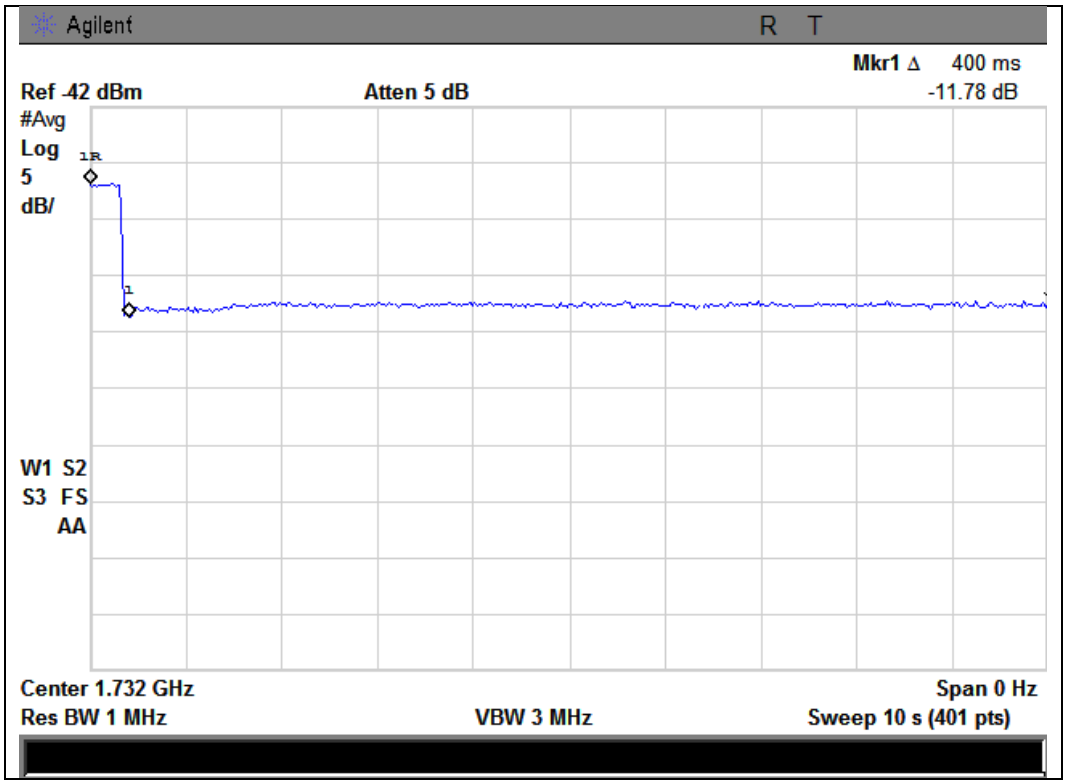

### 777 - 787 MHz Band



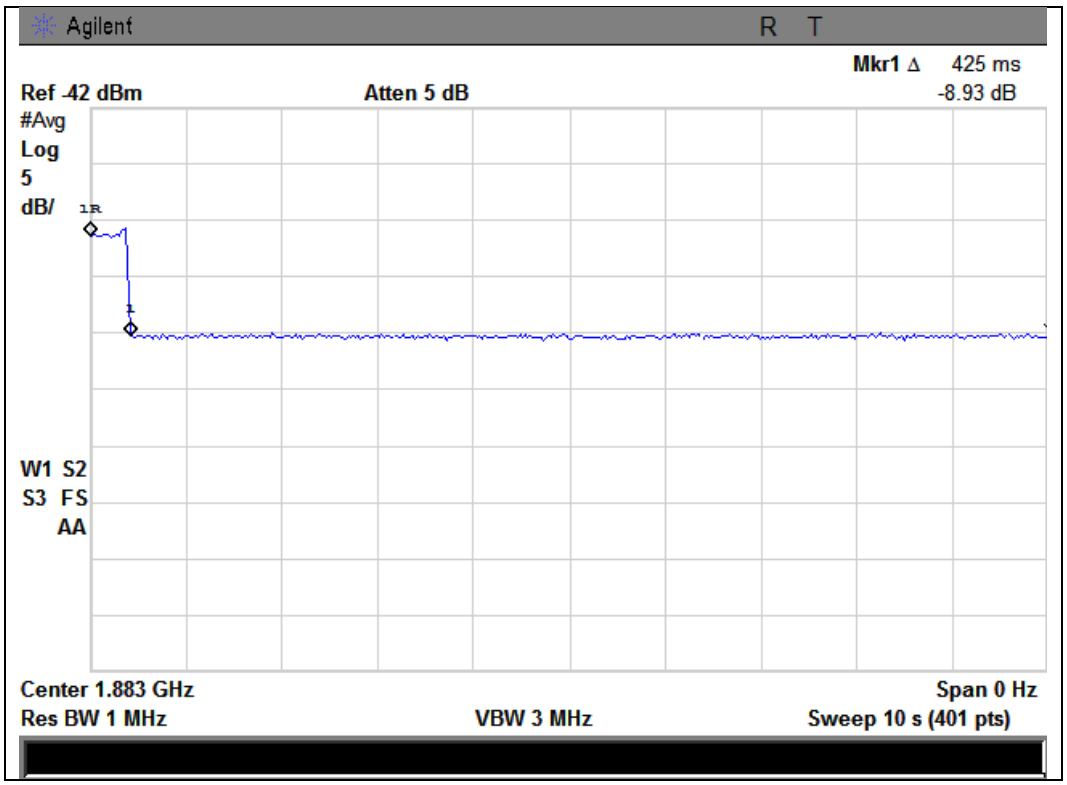
**824 - 849 MHz Band**




**1710 - 1755 MHz Band**



**1850 - 1915 MHz Band**



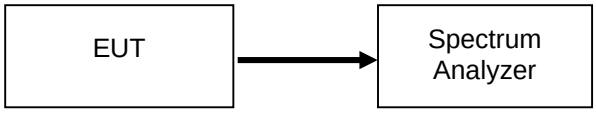
**Uplink Inactivity**

| | | | |
|---|---|---|---|
| **Name of Test:** | Uplink Inactivity | **Engineer:** | Greg Corbin |
| **Test Equipment Utilized:** | E4407B - S/N:MY41444836 | **Test Date:** | 7/23/2013 |

**Test Procedure**

The EUT was connected directly to a spectrum analyzer set to operate in the center of the EUT operational uplink and downlink bands. The span was set to 0 Hz with a sweep time of 330 seconds and MAX HOLD operation. The EUT was powered on and the time for the uplink to return to an inactive state was measured using the DELTA MARKER method was utilized to ensure it was less than 300 seconds. The noise level after the return to an inactive state was less than 70 dBm/MHz.

**Test Setup**

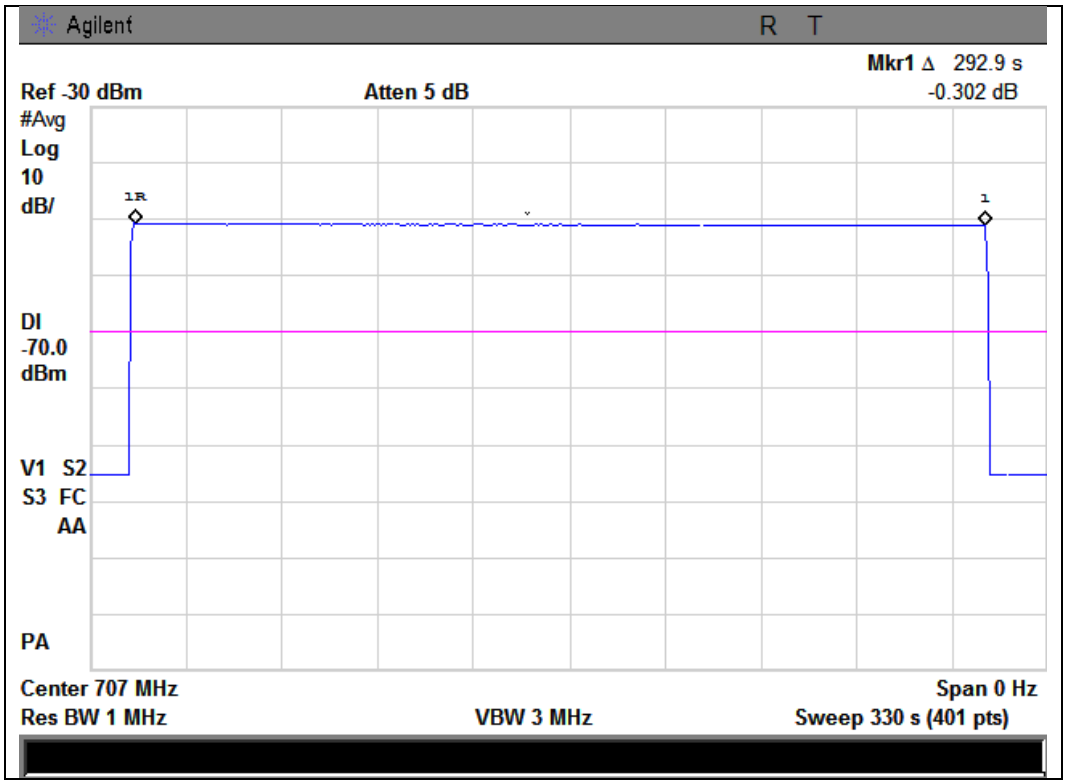



**Uplink Test Results**

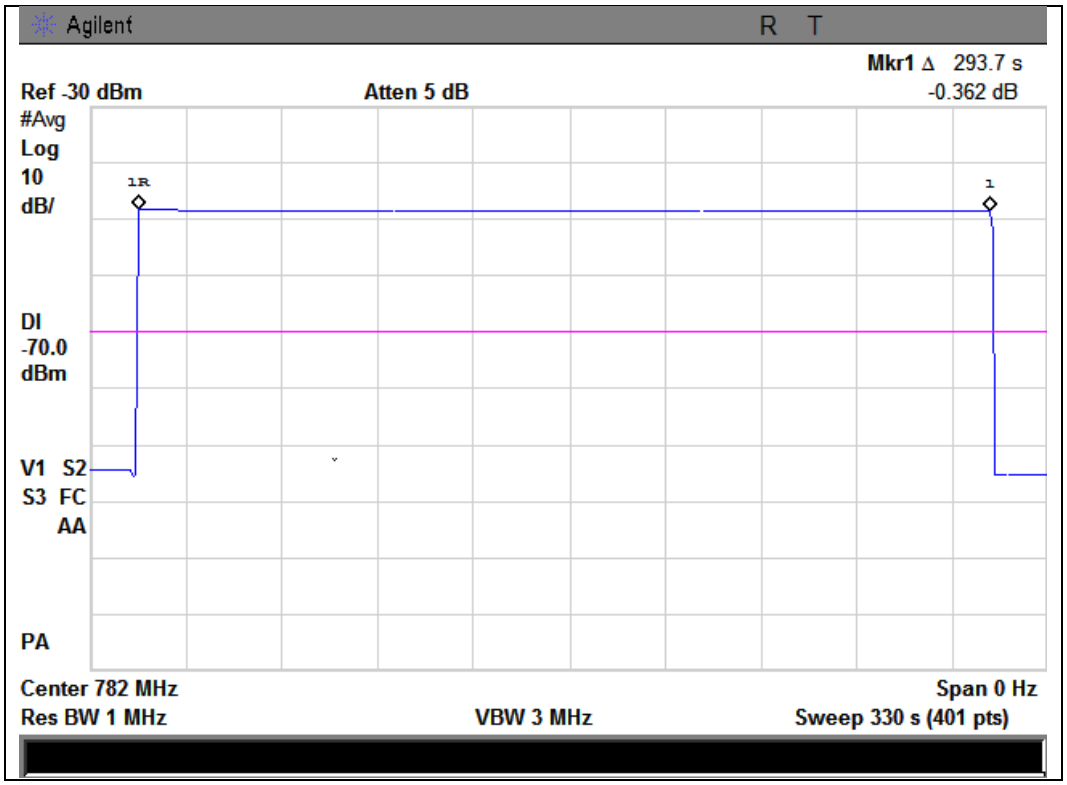
| Frequency Band (MHz) | Measured Time (Seconds) | Limit (Seconds) | Result |
|---|---|---|---|
| 698 - 716 | 292.9 | 300 | Pass |
| 777 - 787 | 293.7 | 300 | Pass |
| 824 - 849 | 292.9 | 300 | Pass |
| 1710 - 1755 | 292.9 | 300 | Pass |
| 1850 - 1915 | 292.9 | 300 | Pass |

## Uplink Inactivity Test Results

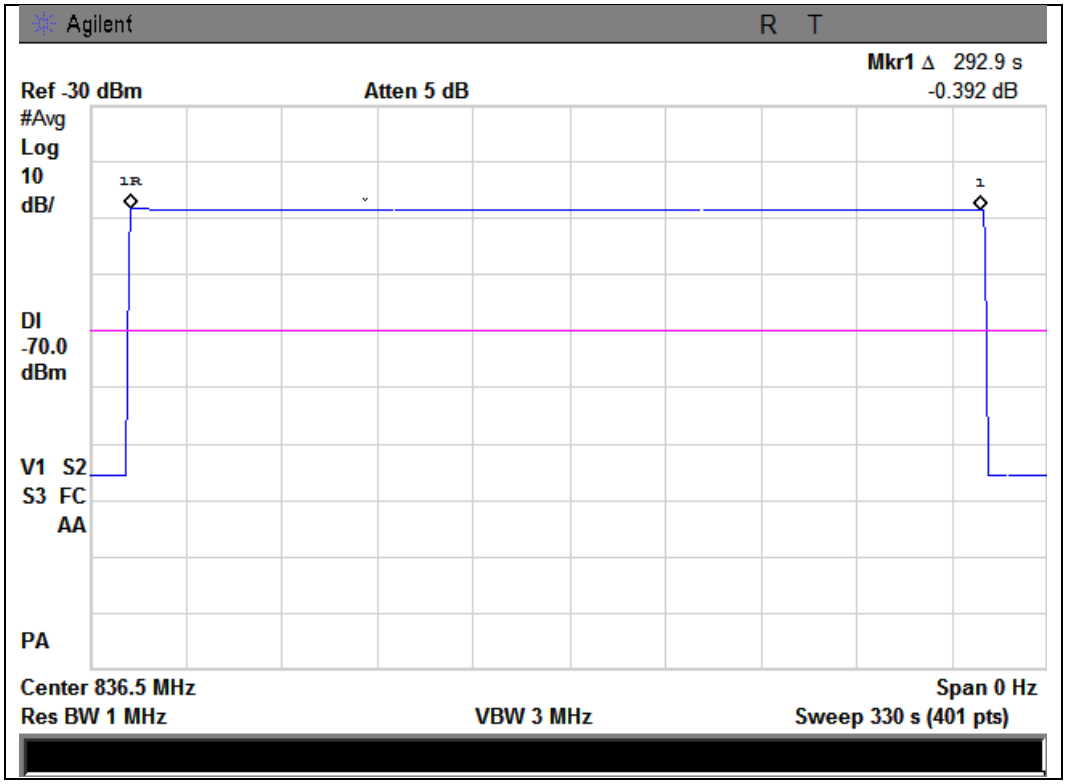
### 698 - 716 MHz



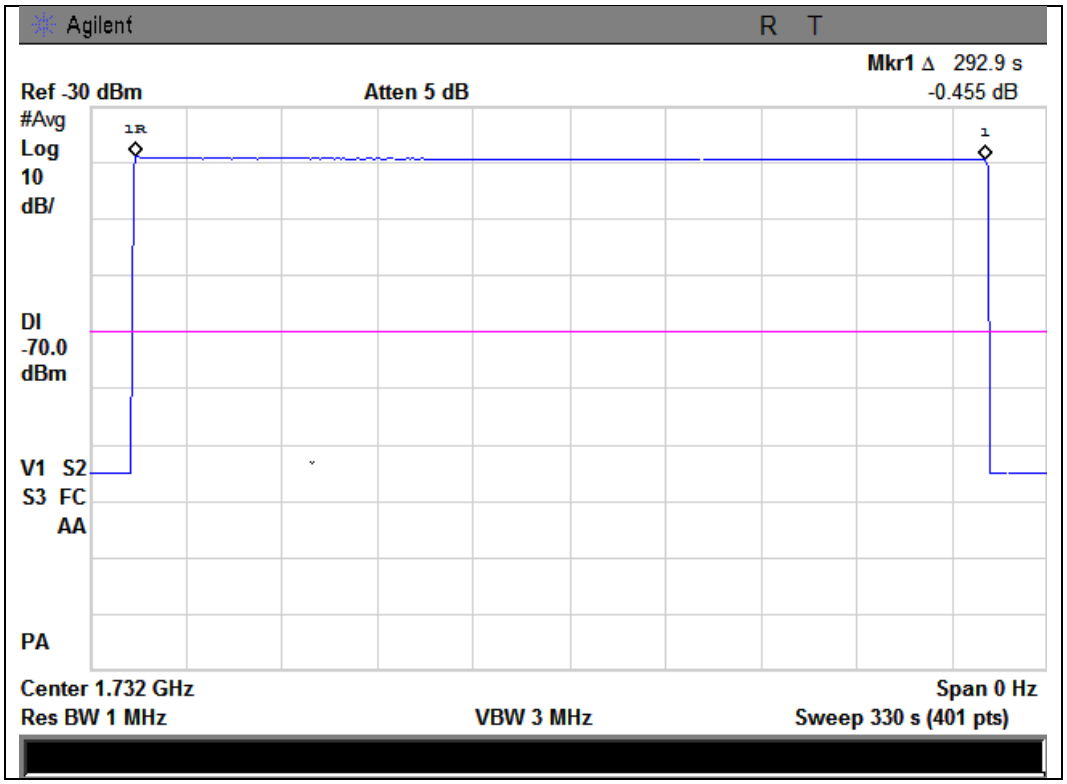

### 777 - 787 MHz



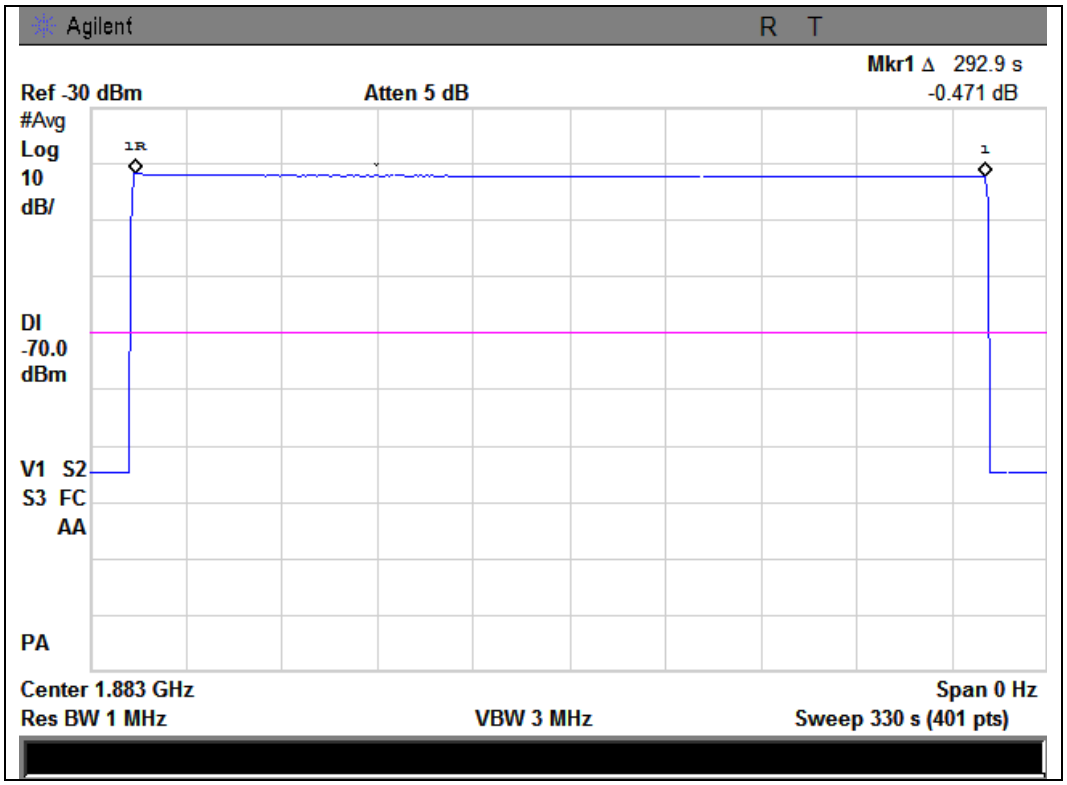
**824 - 849 MHz**




**1710 - 1755 MHz**



**1850 - 1915 MHz**



**Variable Gain**

| | | |
|---|---|---|
| **Name of Test:** | Variable Gain | **Engineer:** Greg Corbin |
| **Test Equipment Utilized:** | i00413, SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** 8/2/2013 |

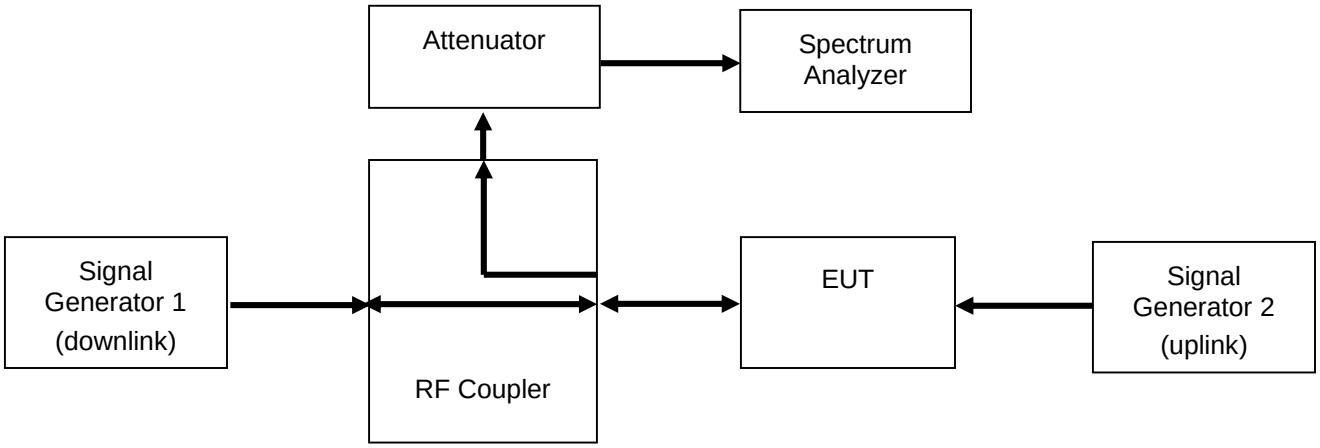
**Test Procedure**

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. The uplink gain in the presence of a downlink signal was measured for each operational uplink band using the detailed procedures from KDB 935210 D03 Wideband Consumer Signal Booster Measurement Guidance DR04-41516.

The following formula is used for calculating the limits.

Variable Gain = -34 dB - RSSI +MSCL

**Test Setup**



## Uplink Test Results

### 698 - 716 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -60.0 | 34.9 | 60.9 | -43.3 | 16.8 | 60.1 | -0.8 |
| -59.0 | 34.9 | 59.9 | -43.3 | 15.6 | 58.9 | -1.0 |
| -43.0 | 34.9 | 43.9 | -43.3 | -0.4 | 42.9 | -1.0 |
| -42.0 | 34.9 | 42.9 | -43.3 | -1.5 | 41.8 | -1.1 |
| -41.0 | 34.9 | 41.9 | -43.3 | -2.5 | 40.8 | -1.1 |
| -40.0 | 34.9 | 40.9 | -43.3 | -3.5 | 39.8 | -1.1 |

### 777 - 787 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -37 | 35.8 | 38.8 | -40.7 | -2.1 | 38.6 | -0.2 |
| -53 | 35.8 | 54.8 | -40.7 | 13.8 | 54.5 | -0.3 |
| -51 | 35.8 | 52.8 | -40.7 | 11.8 | 52.5 | -0.3 |
| -48.0 | 35.8 | 49.8 | -40.7 | 8.8 | 49.5 | -0.3 |
| -47.0 | 35.8 | 48.8 | -40.7 | 7.8 | 48.5 | -0.3 |
| -46.0 | 35.8 | 47.8 | -40.7 | 6.8 | 47.5 | -0.3 |

### 824 - 849 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -74.0 | 36.2 | 65.0 | -44.8 | 19.2 | 64.0 | -1.0 |
| -73.0 | 36.2 | 65.0 | -44.8 | 19.2 | 64.0 | -1.0 |
| -72.0 | 36.2 | 65.0 | -44.8 | 19.2 | 64.0 | -1.0 |
| -71.0 | 36.2 | 65.0 | -44.8 | 19.2 | 64.0 | -1.0 |
| -61.0 | 36.2 | 63.2 | -44.8 | 16.9 | 61.7 | -1.5 |
| -60.0 | 36.2 | 62.2 | -44.8 | 15.9 | 60.7 | -1.5 |

### 1710 - 1755 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -53 | 40.5 | 59.5 | -49.4 | 6.3 | 55.7 | -3.8 |
| -51 | 40.5 | 57.5 | -49.4 | 4.3 | 53.7 | -3.8 |
| -66 | 40.5 | 71.0 | -49.4 | 17.7 | 67.1 | -3.9 |
| -54 | 40.5 | 60.5 | -49.4 | 7.2 | 56.6 | -3.9 |
| -52 | 40.5 | 58.5 | -49.4 | 5.2 | 54.6 | -3.9 |
| -43 | 40.5 | 49.5 | -49.4 | -3.8 | 45.6 | -3.9 |

### 1850 - 1915 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dBm) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|---|---|---|---|---|---|---|
| -71 | 41.2 | 72.0 | -52.8 | 16.2 | 69.0 | -3.0 |
| -70 | 41.2 | 72.0 | -52.8 | 16.2 | 69.0 | -3.0 |
| -67 | 41.2 | 72.0 | -52.8 | 16.1 | 68.9 | -3.1 |
| -66 | 41.2 | 72.0 | -52.8 | 16.1 | 68.9 | -3.1 |
| -49 | 41.2 | 56.2 | -52.8 | -0.5 | 52.3 | -3.9 |
| -43 | 41.2 | 50.2 | -52.8 | -6.5 | 46.3 | -3.9 |

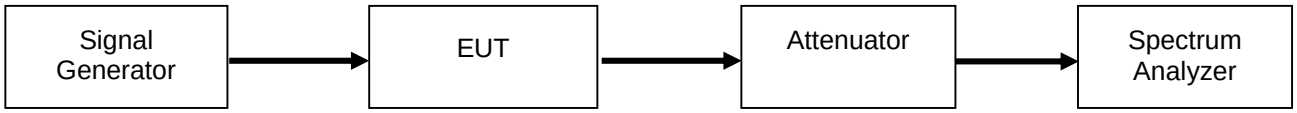
## Occupied Bandwidth

| | | |
|---|---|---|
| **Name of Test:** | Occupied Bandwidth | **Engineer:** Greg Corbin |
| **Test Equipment Utilized:** | SMU 200A - S/N:101369<br>E4407B - S/N:MY41444836 | **Test Date:** 7/22/2013 |

### Test Procedure

The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as necessary to ensure accurate readings were obtained. A signal generator was utilized to produce the following signals; GSM, CDMA, and WCDMA tuned to the center channel of each the EUT operational uplink and downlink band with the RF level set a point just prior to the AGC being in control of the power. For each modulation type the input and output signal was measured and plotted to ensure that the signals were similar.

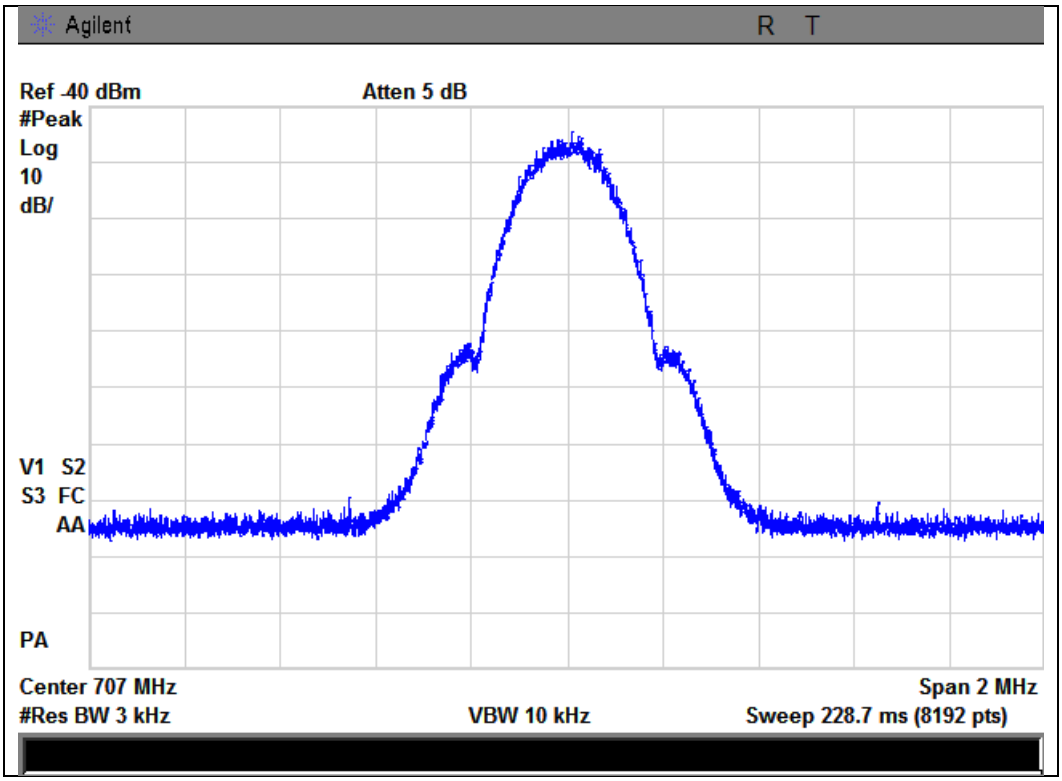
### Test Setup



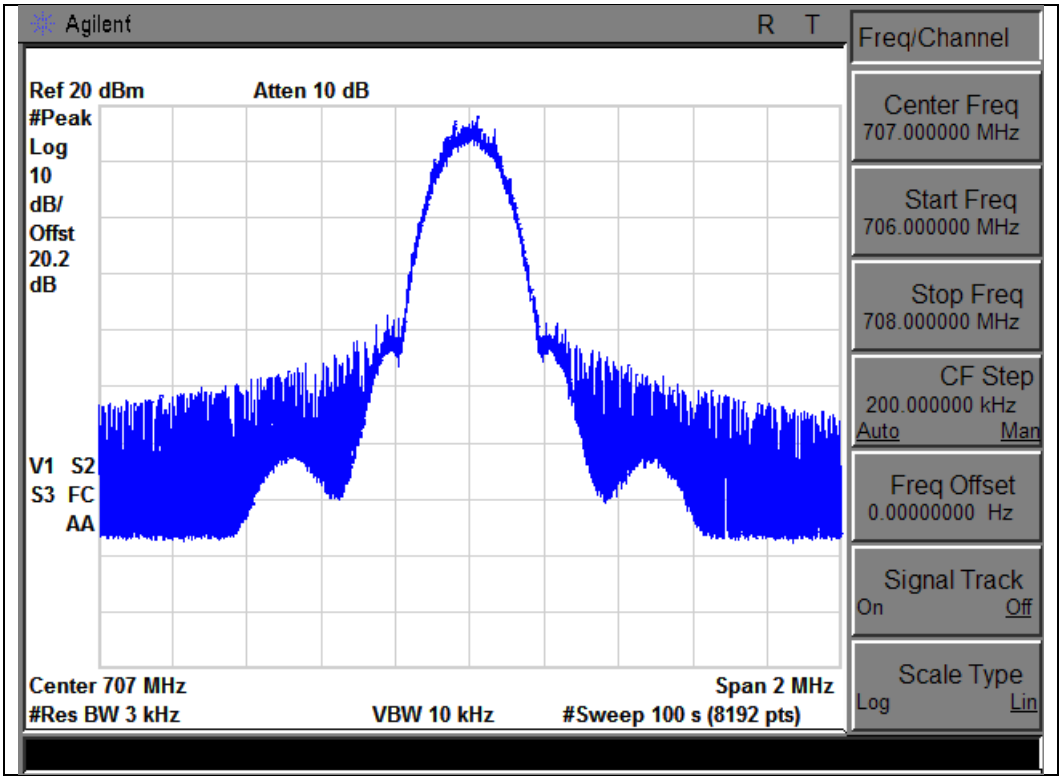
## GSM Uplink Test Plots

## 698 - 716 MHz Band

### Input

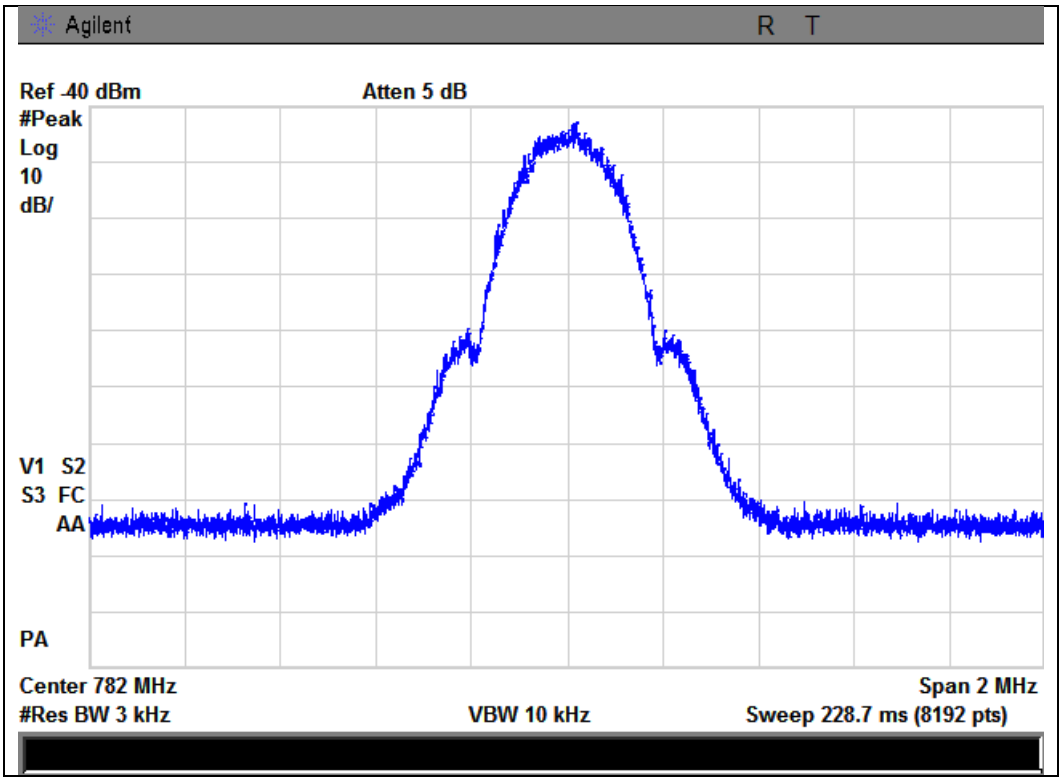



### Output

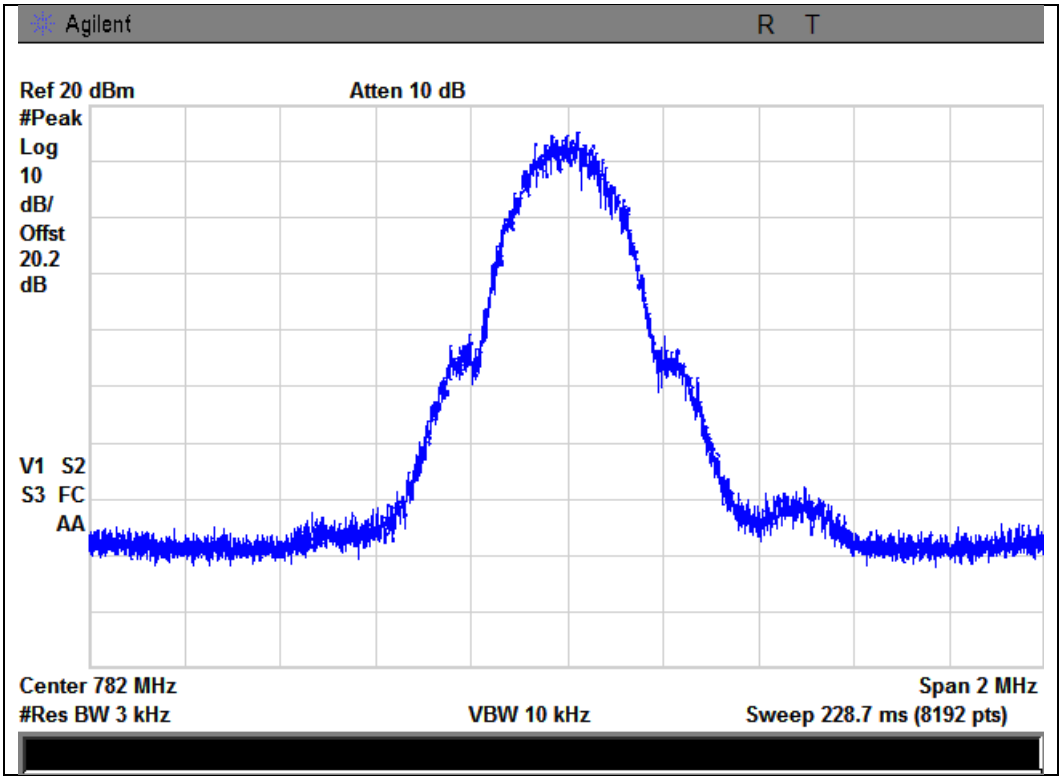


## 777 - 787 MHz Band

### Input

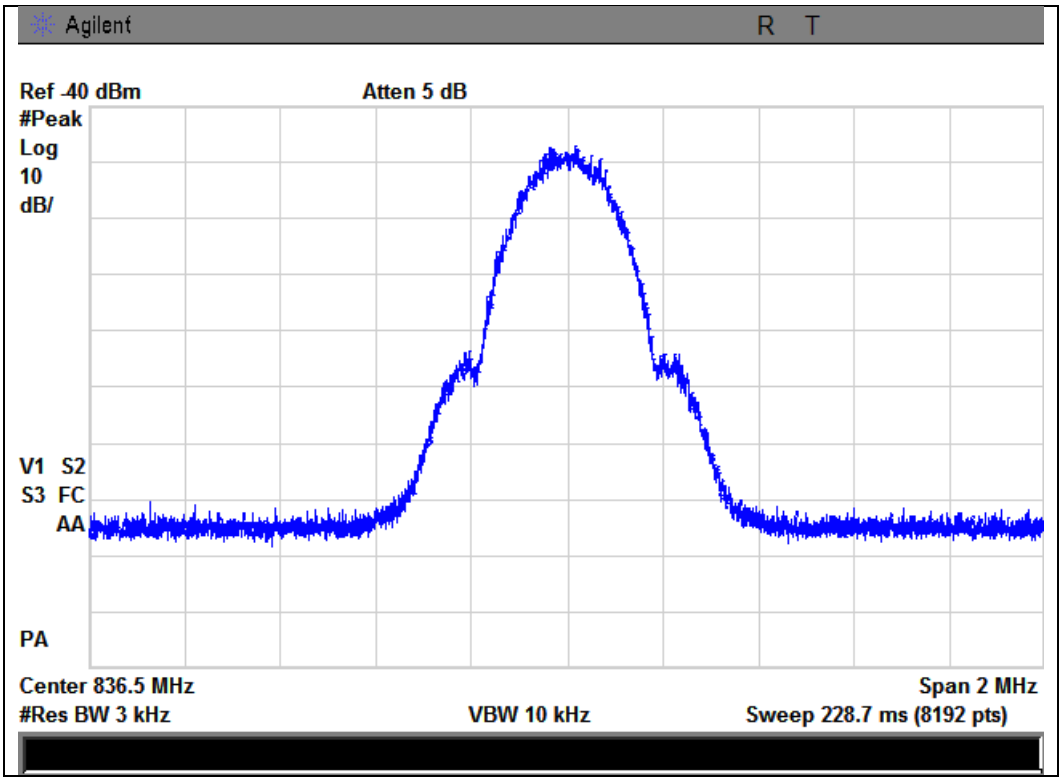



### Output

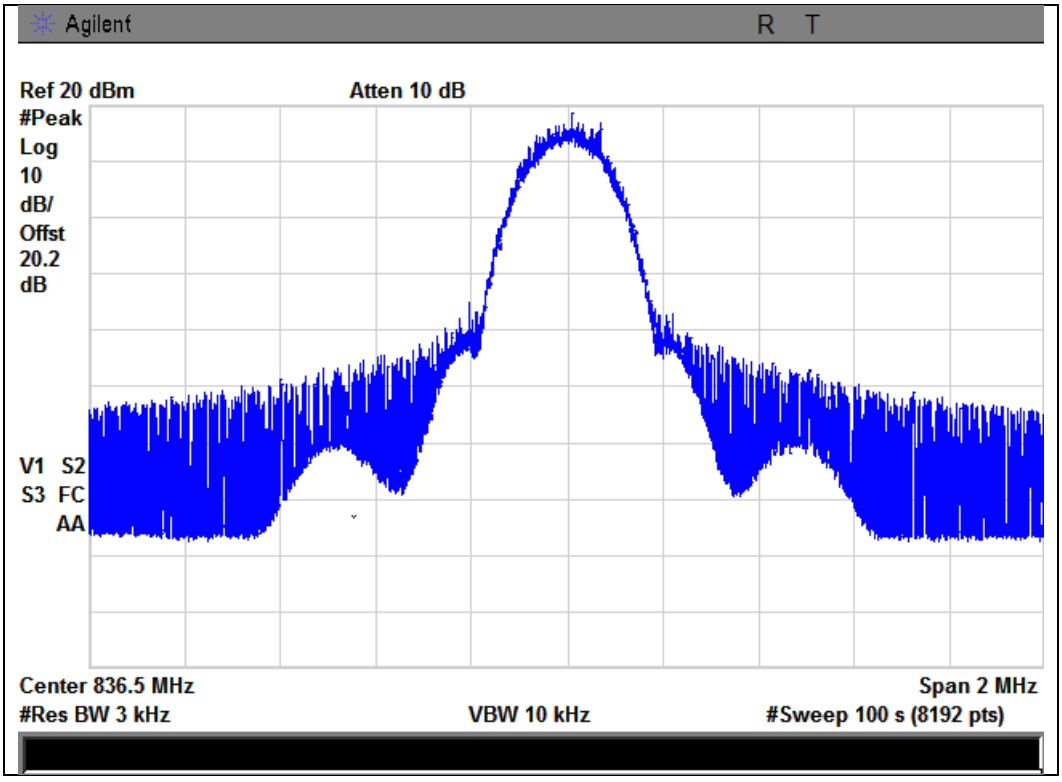


**824 - 849 MHz Band**

**Input**

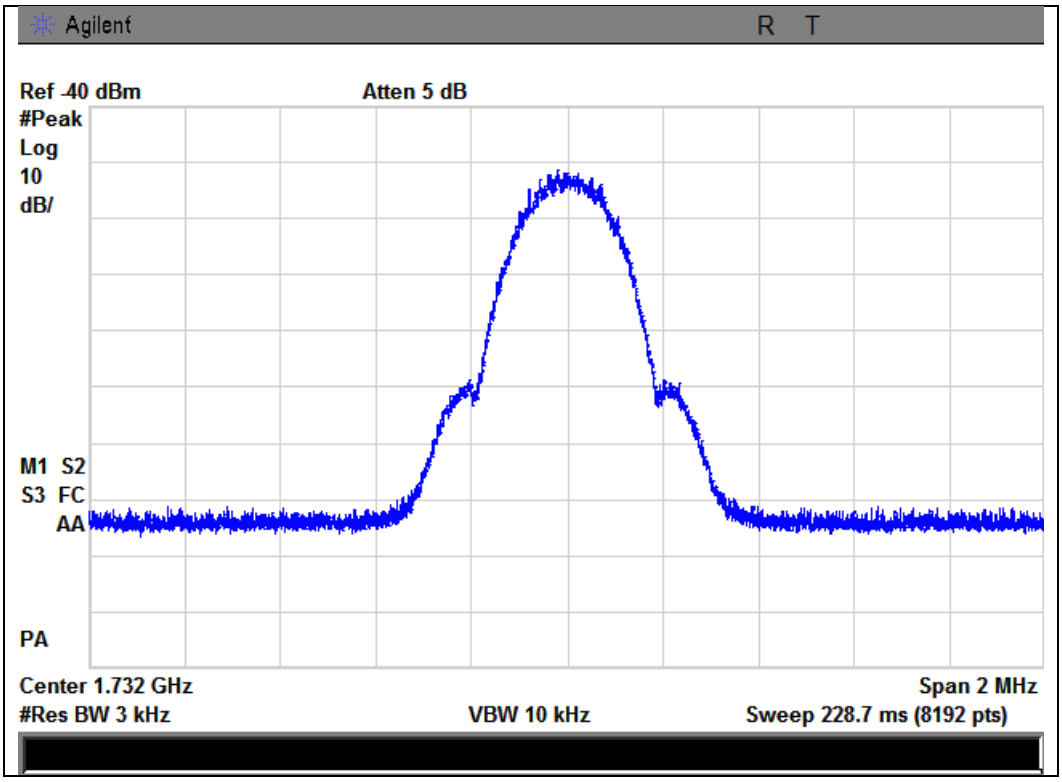



**Output**

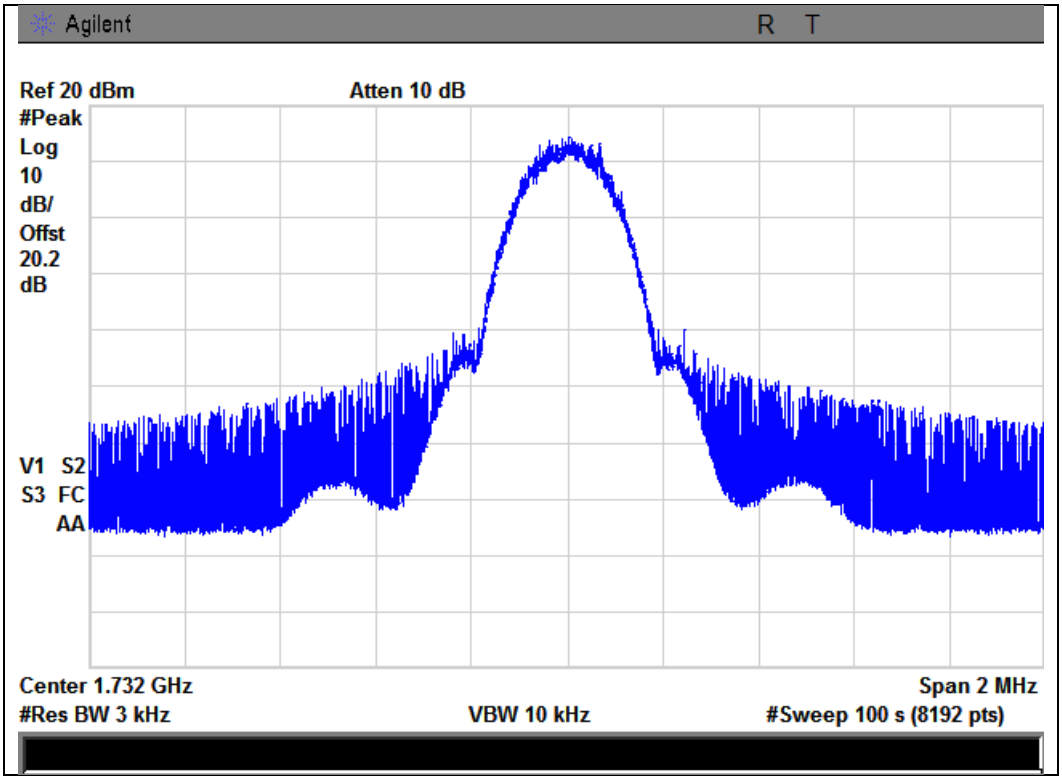


**1710 - 1755 MHz Band**

**Input**

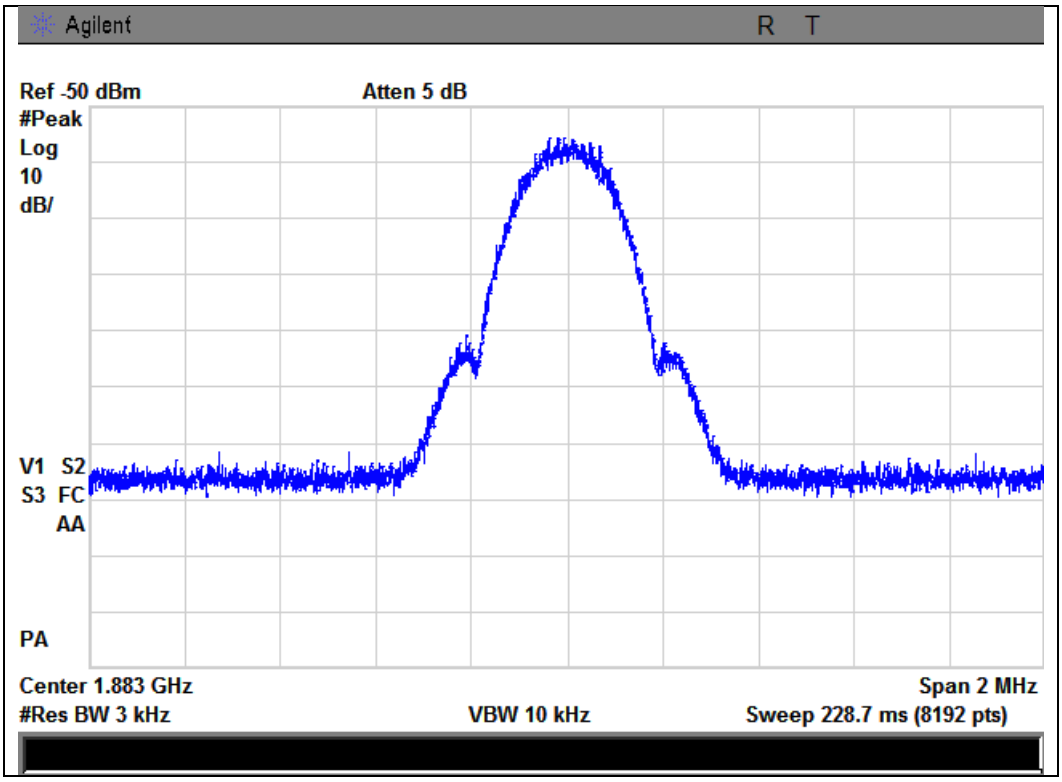



**Output**

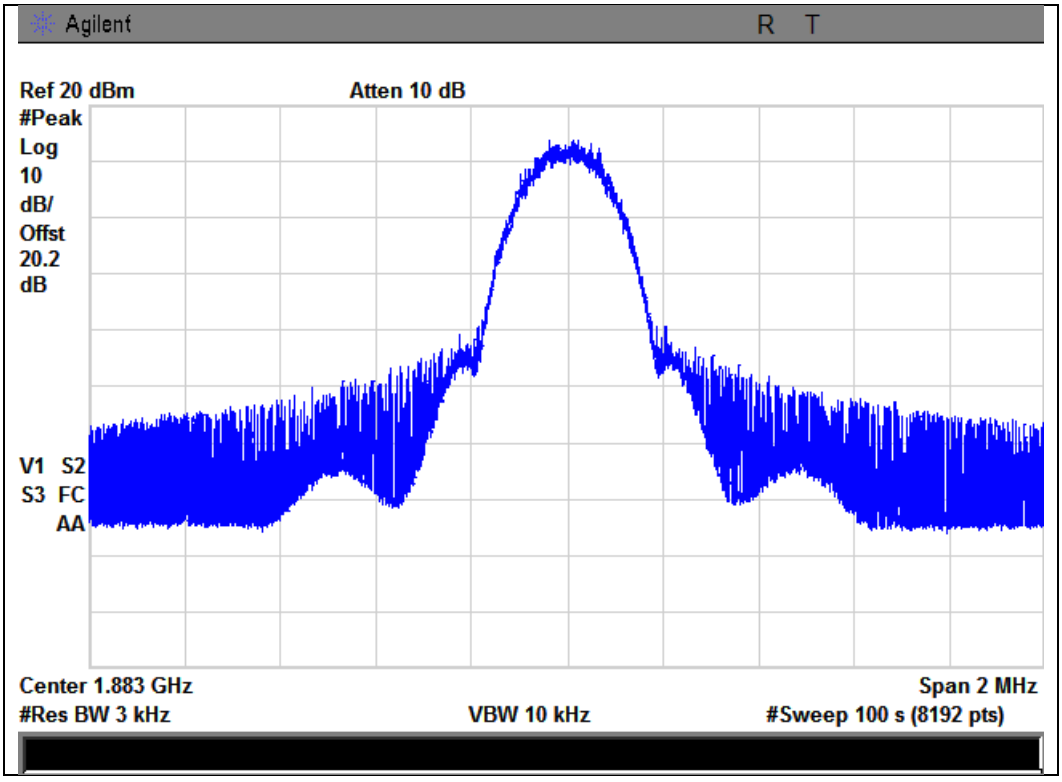


**1850 - 1915 MHz Band**

**Input**



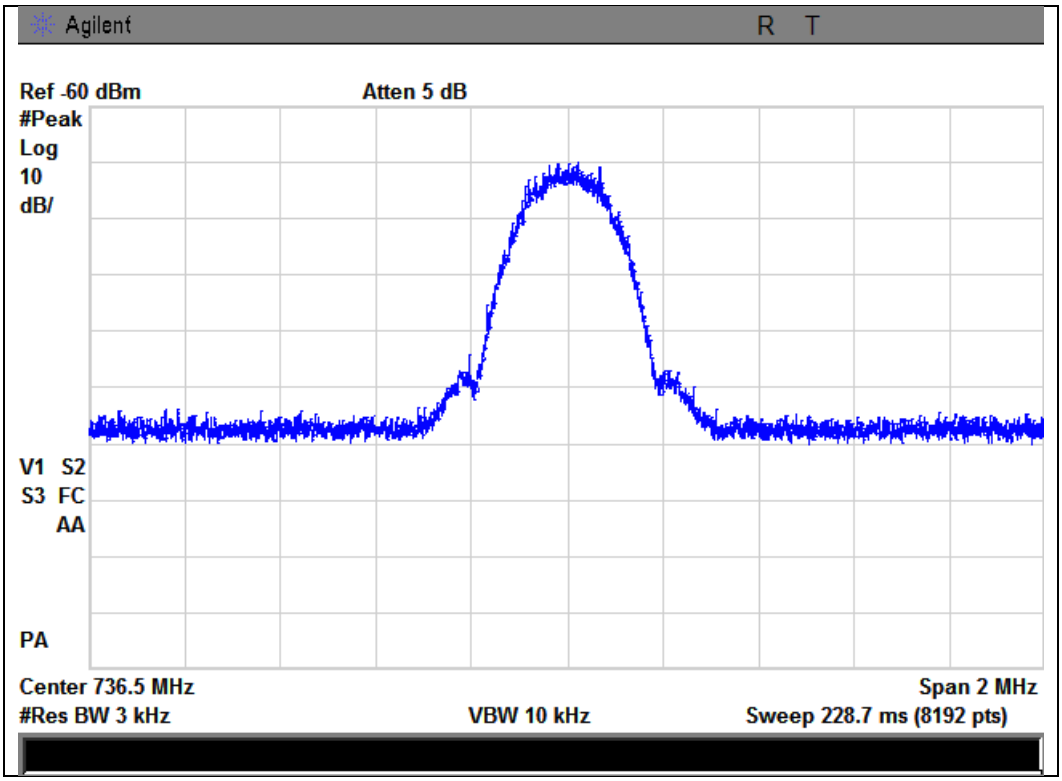

**Output**



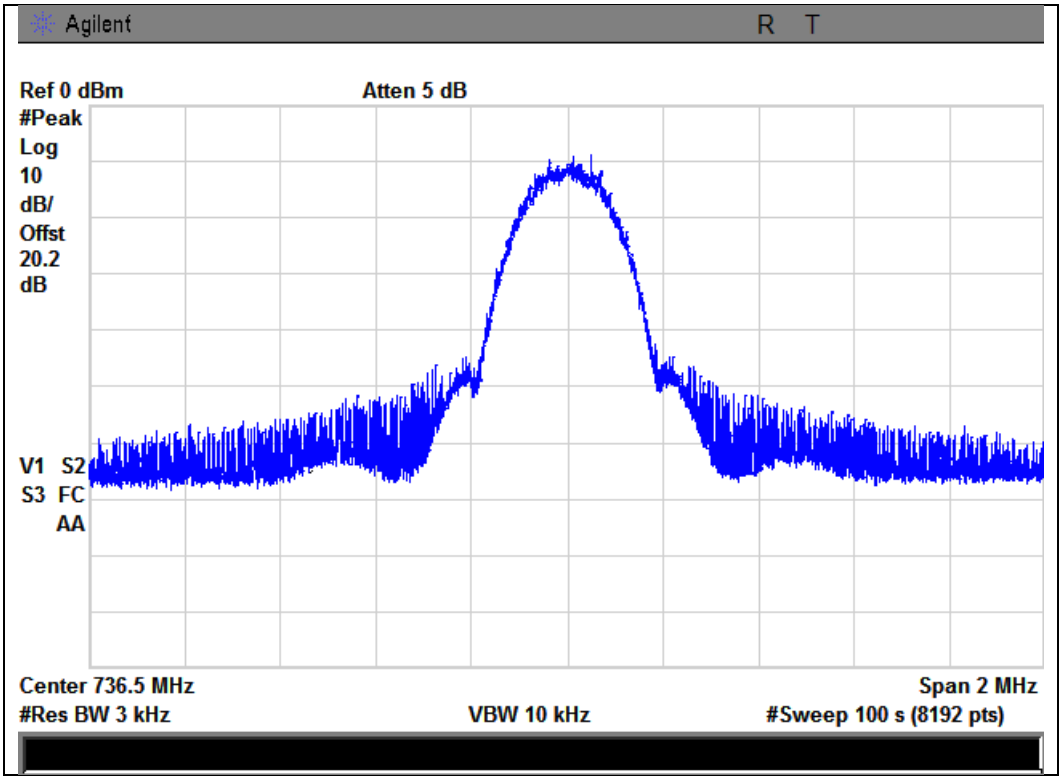
## GSM Downlink Test Plots

## 728 - 746 MHz Band

### Input

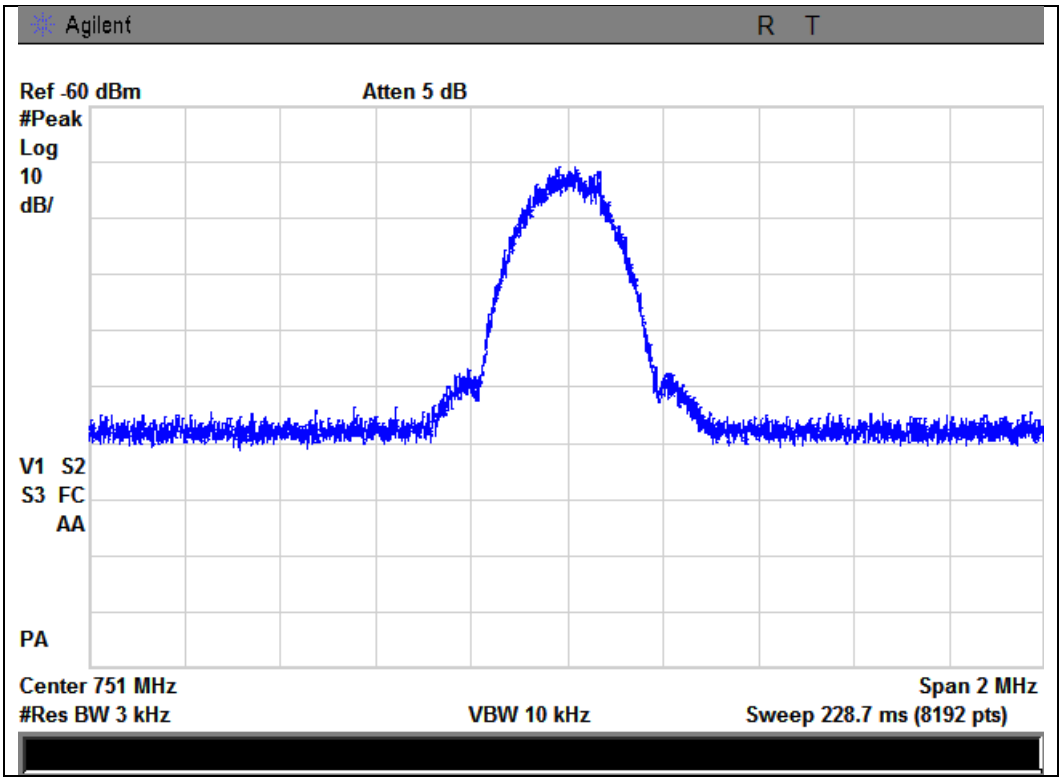



### Output

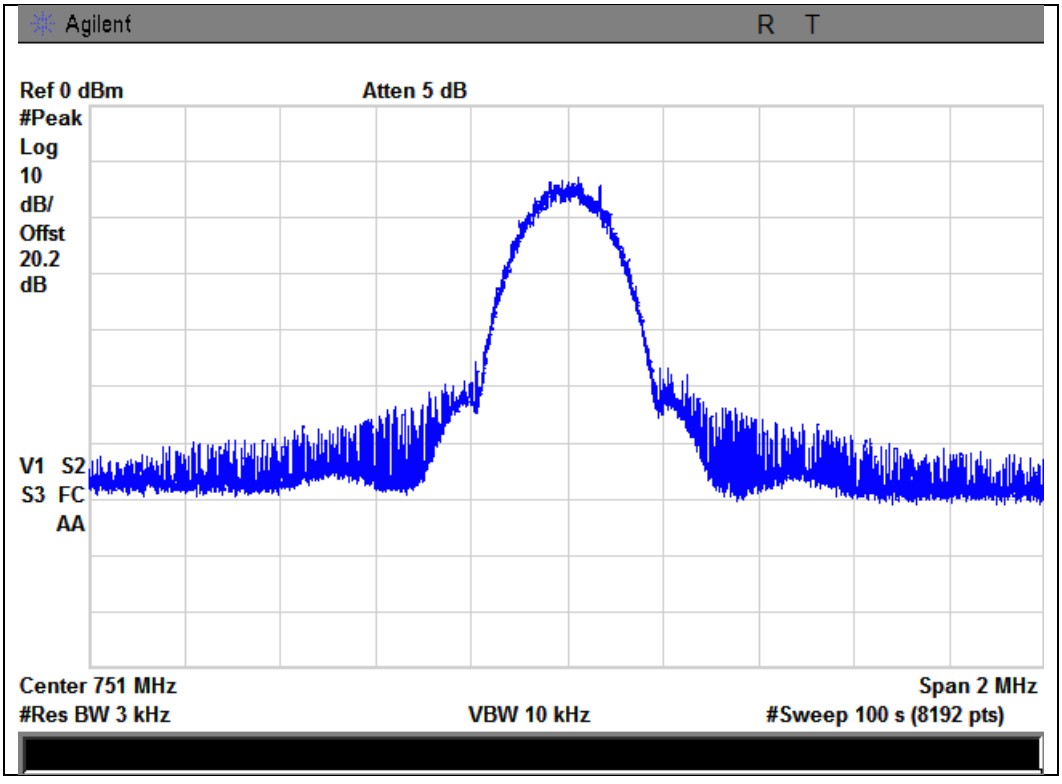


**746 - 756 MHz Band**

**Input**

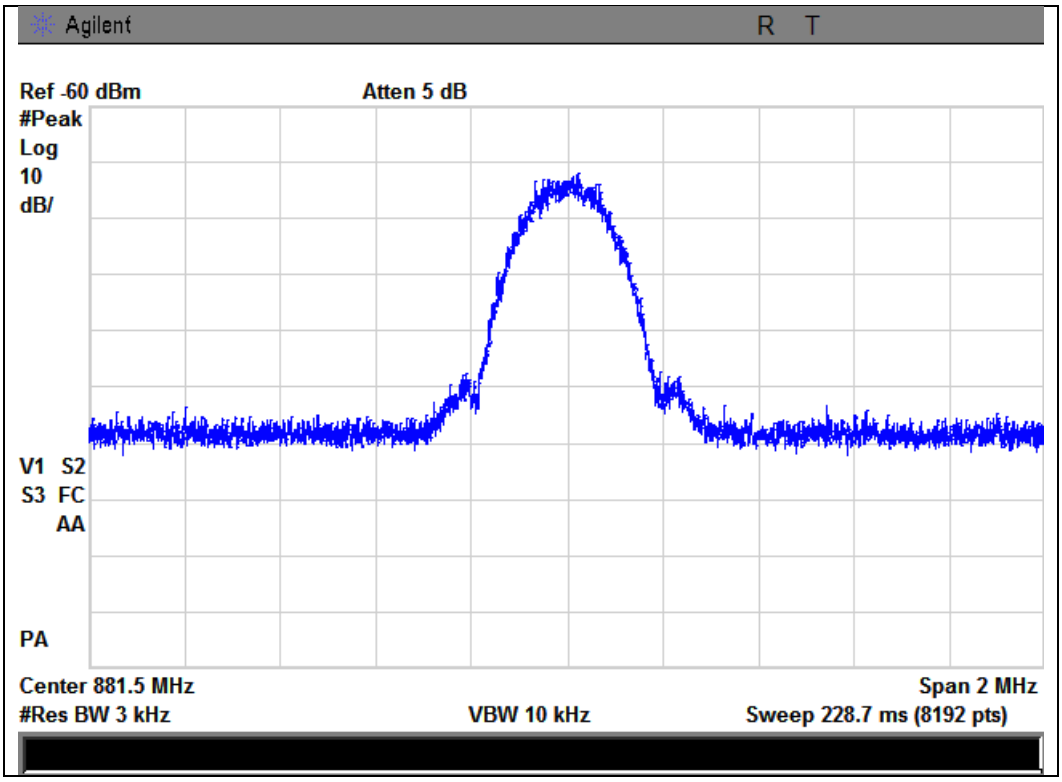



**Output**

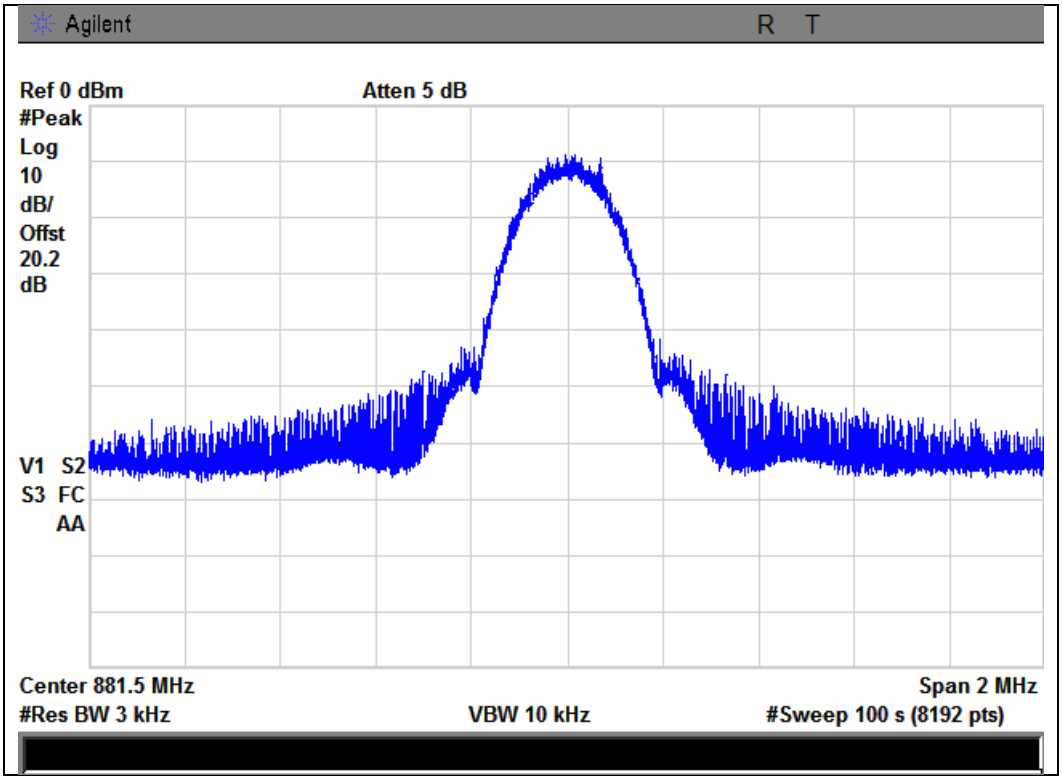


## 869 - 894 MHz Band

### Input

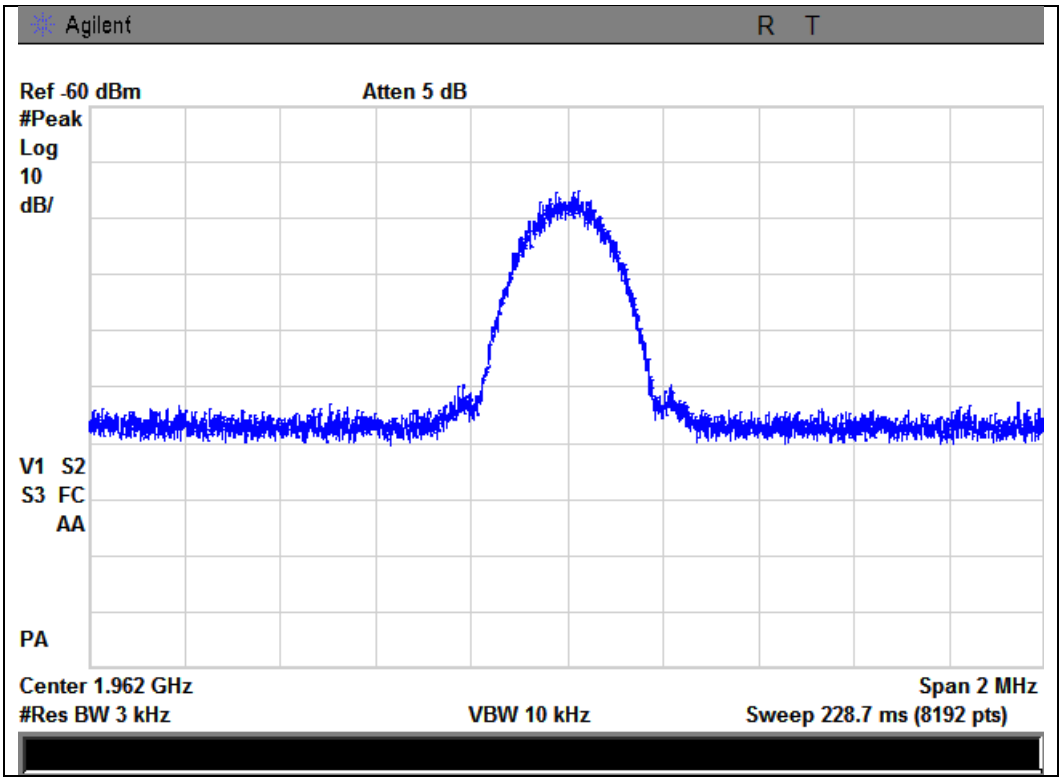



### Output

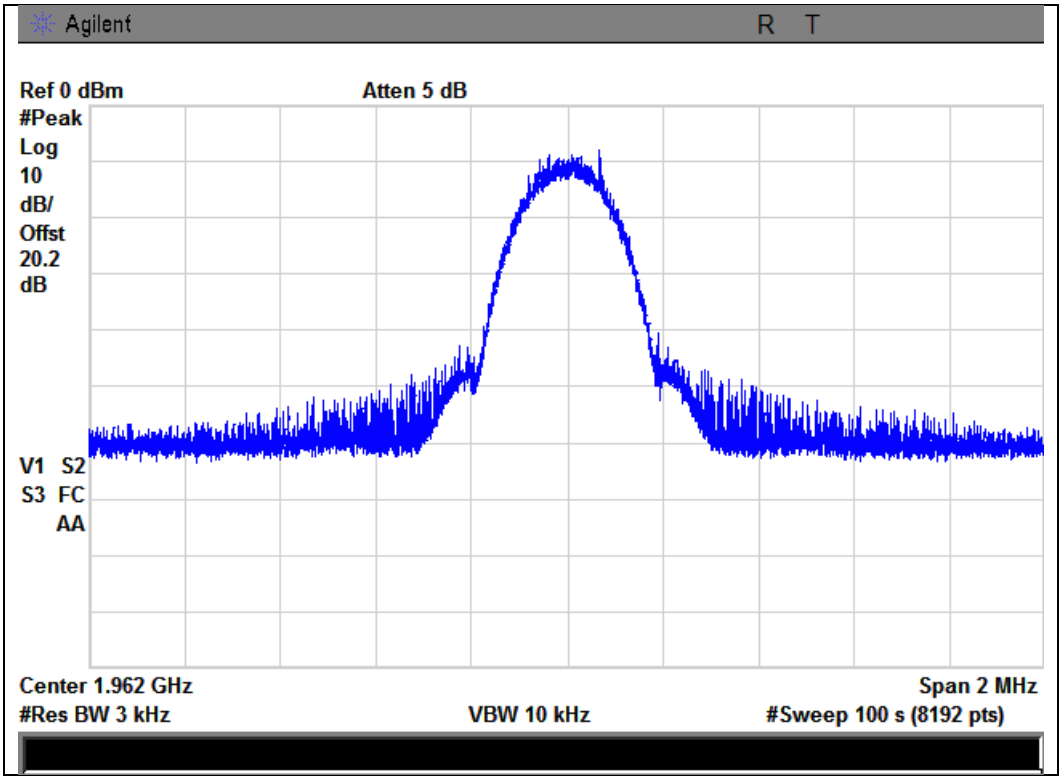


## 1930 - 1995 MHz Band

### Input

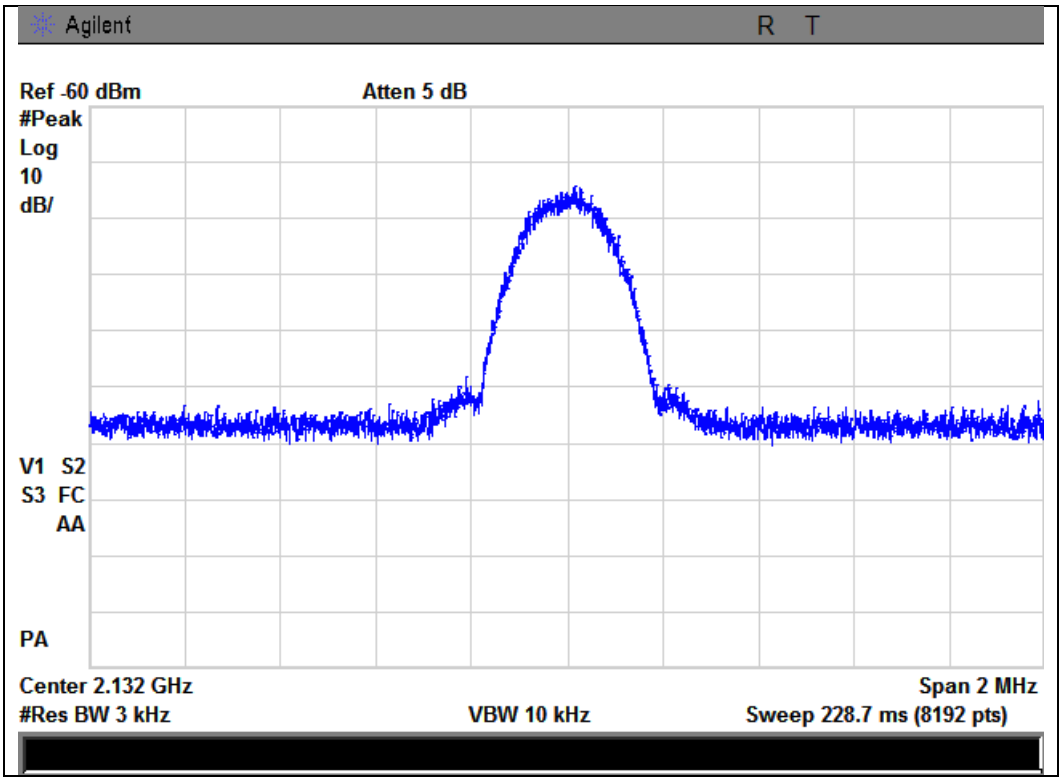



### Output

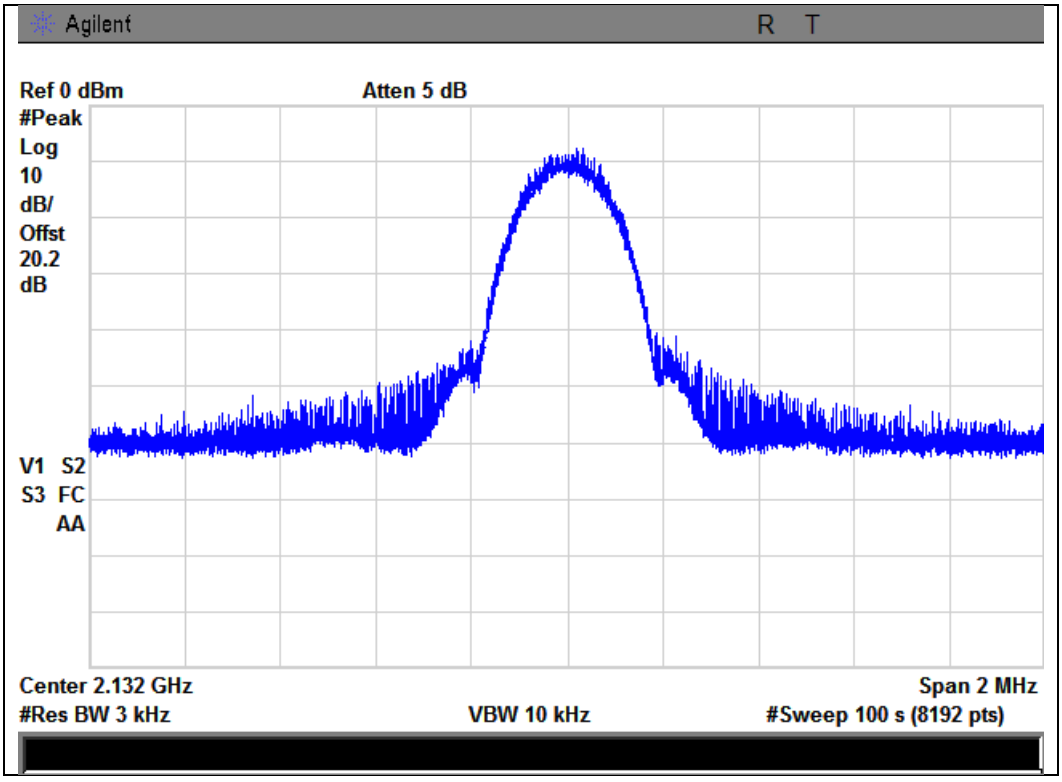


## 2110 - 2155 MHz Band

### Input



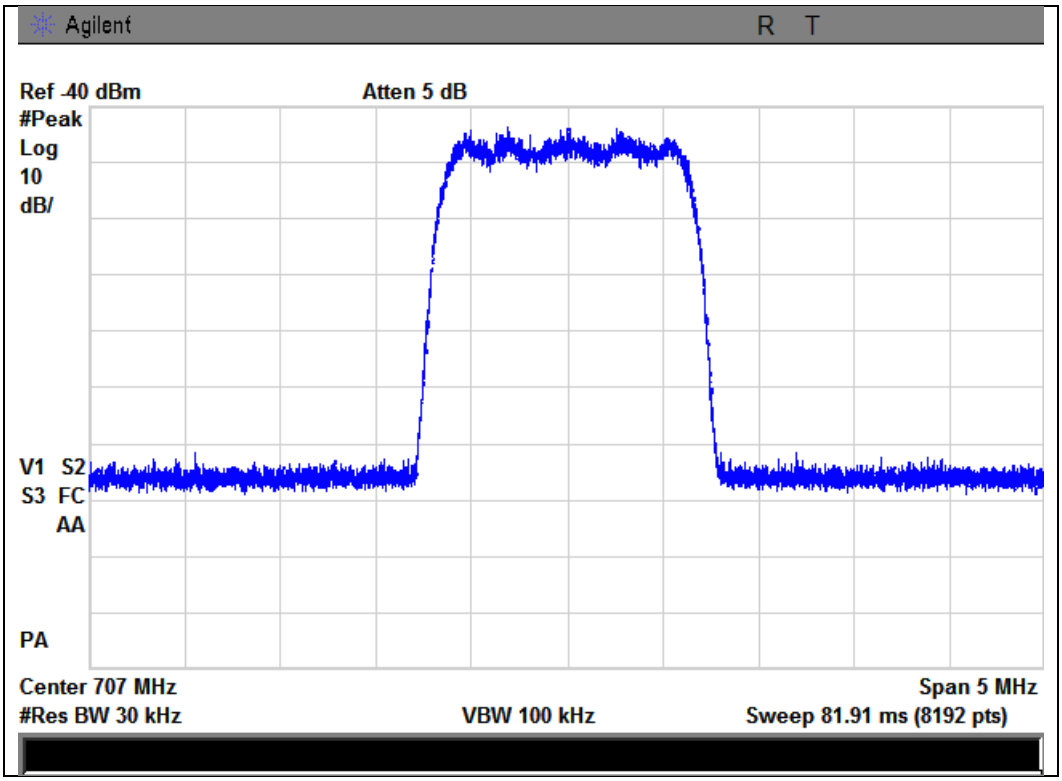

### Output



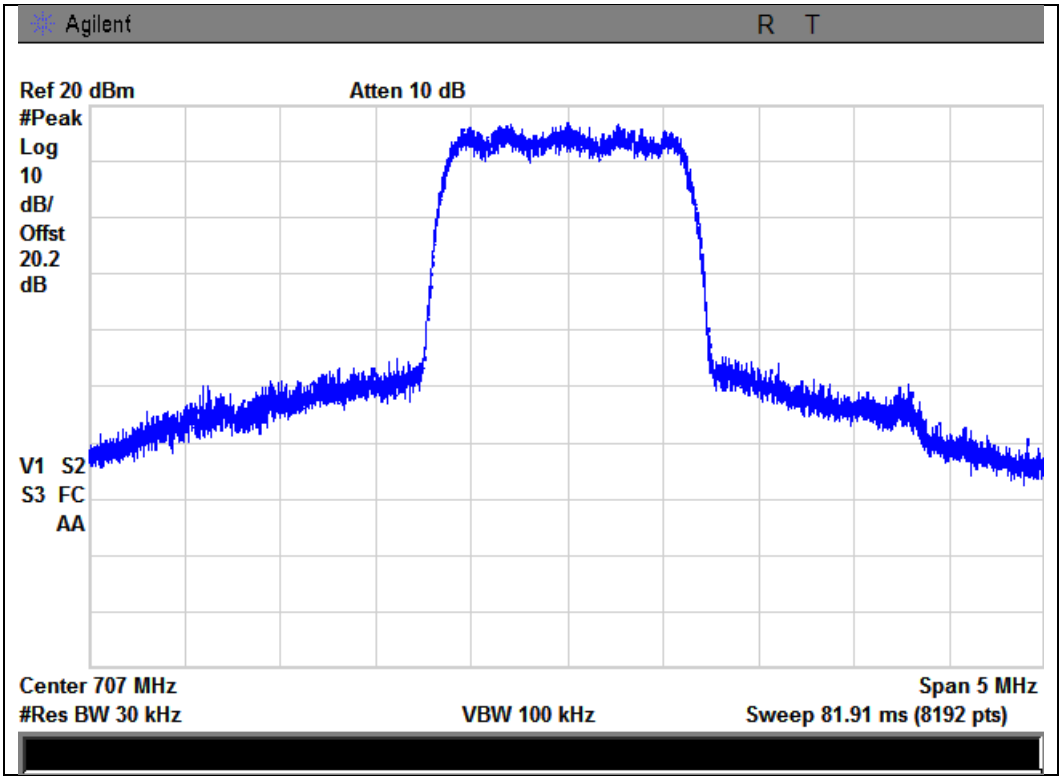
## CDMA Uplink Test Plots

## 698 - 716 MHz Band

### Input

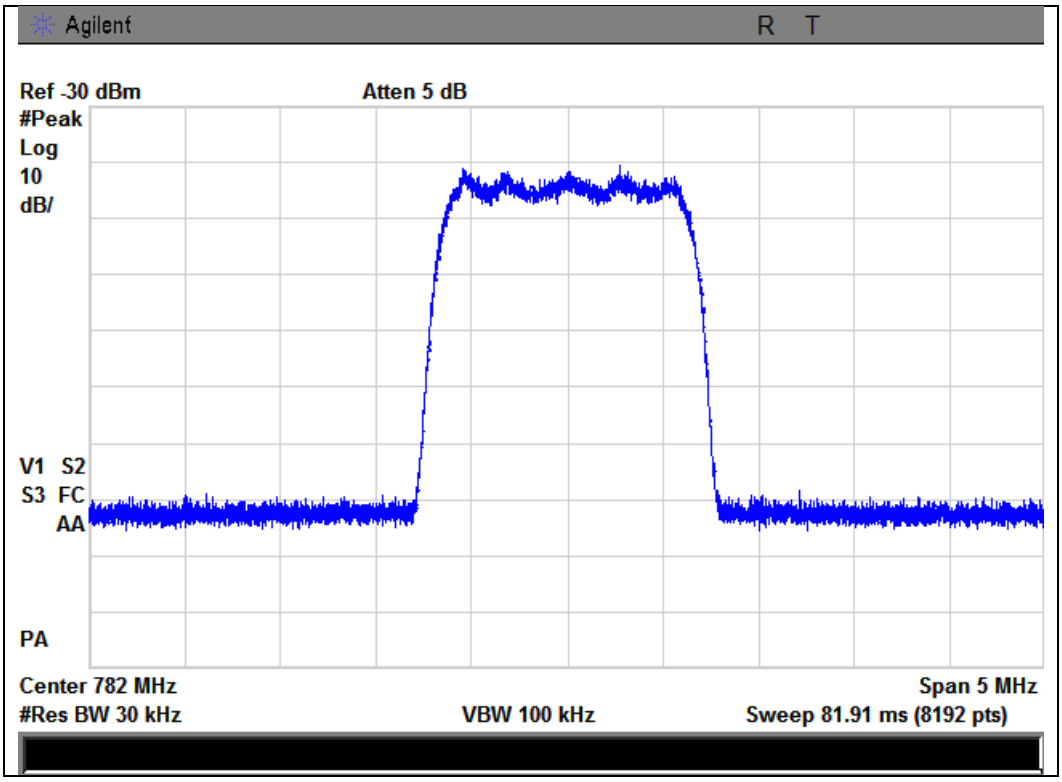



### Output

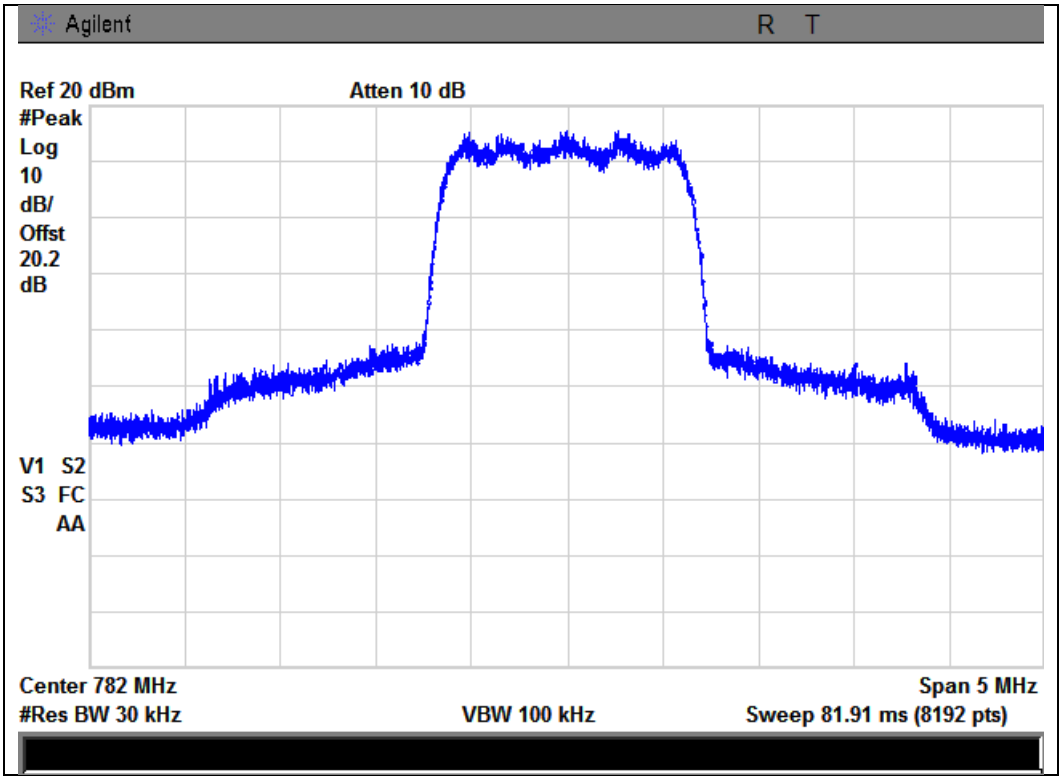


## 777 - 787 MHz Band

### Input

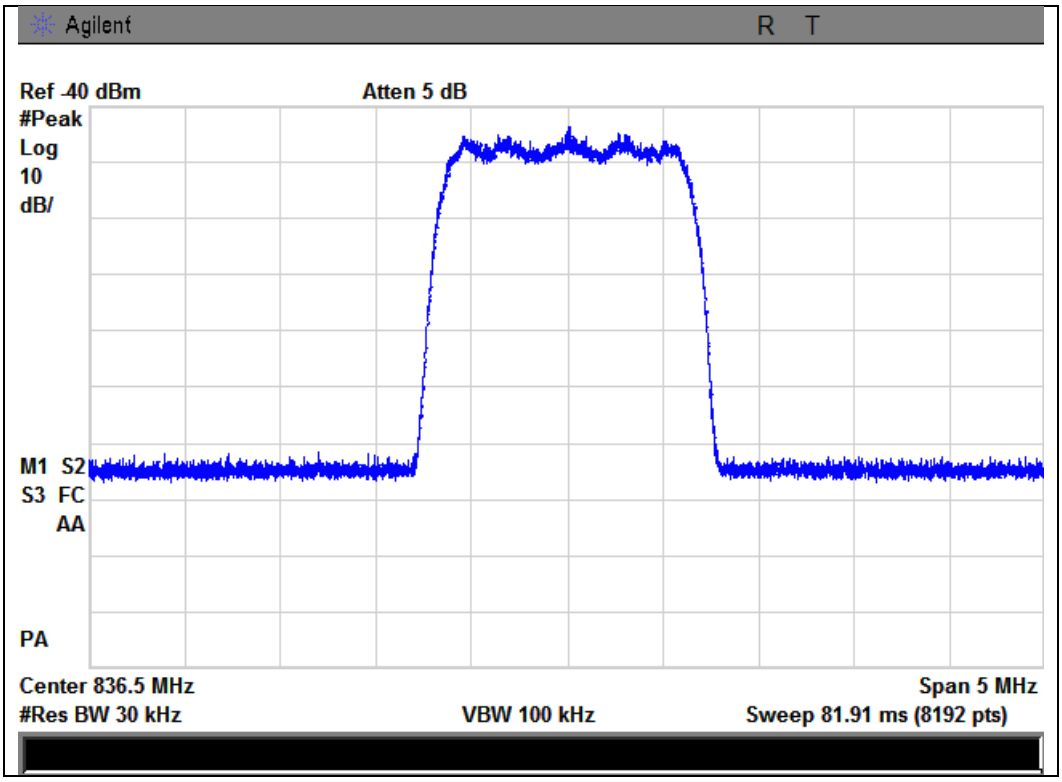



### Output

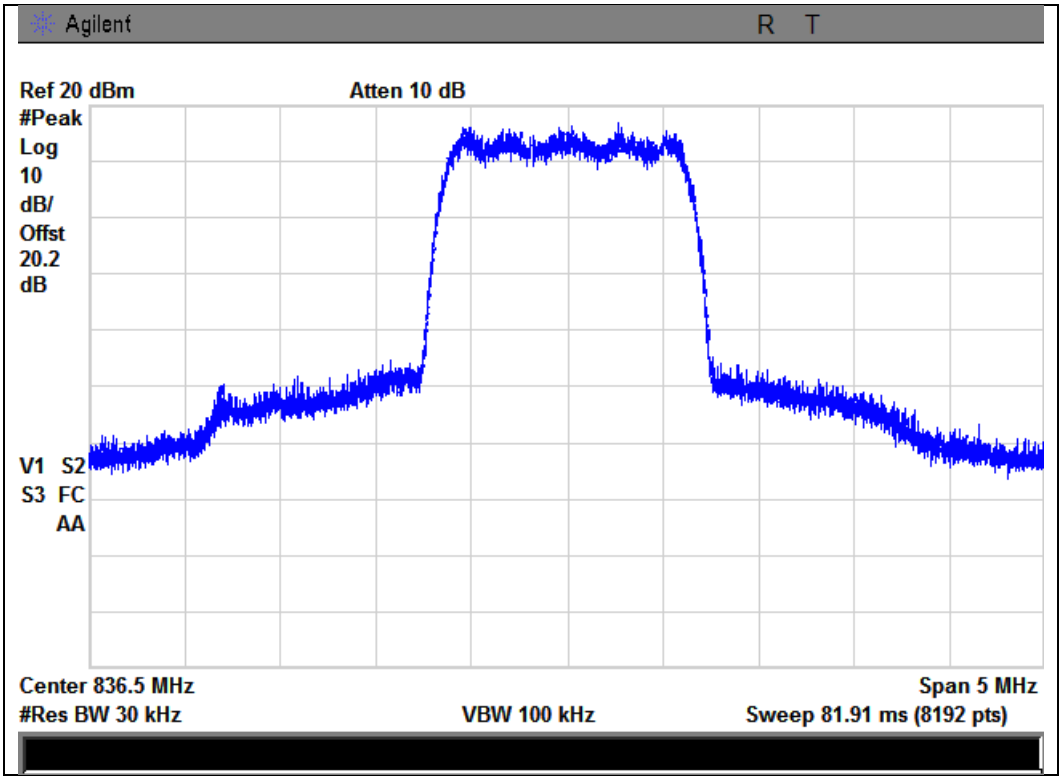


**824 - 849 MHz Band**

**Input**

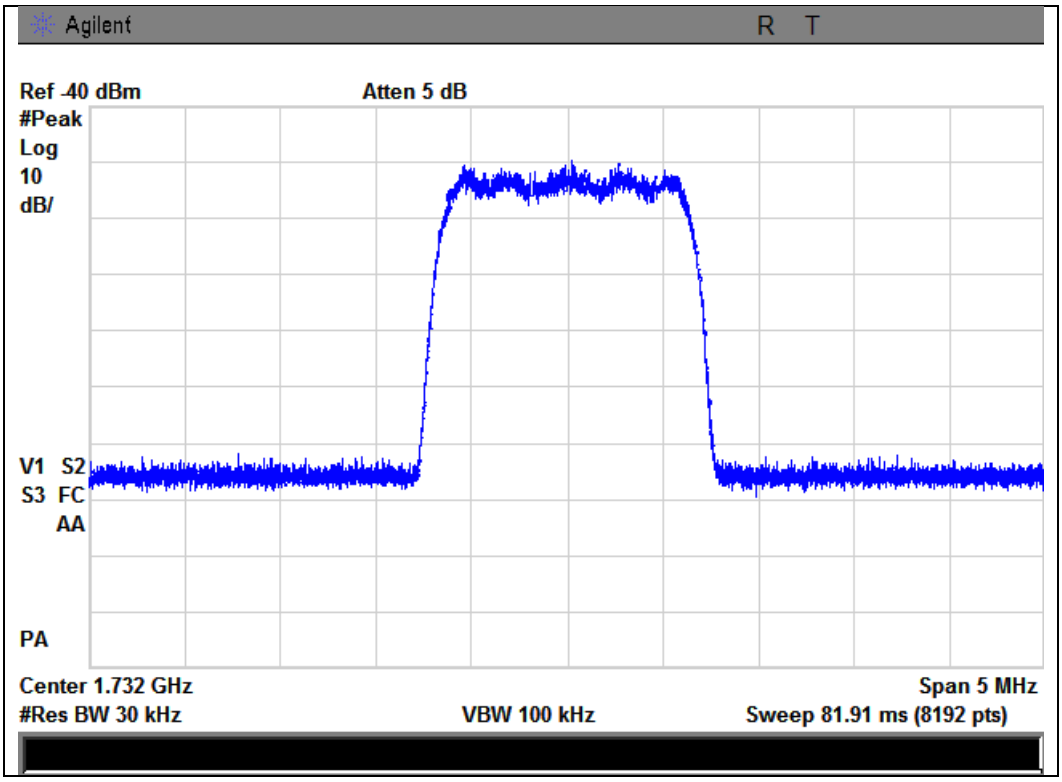



**Output**

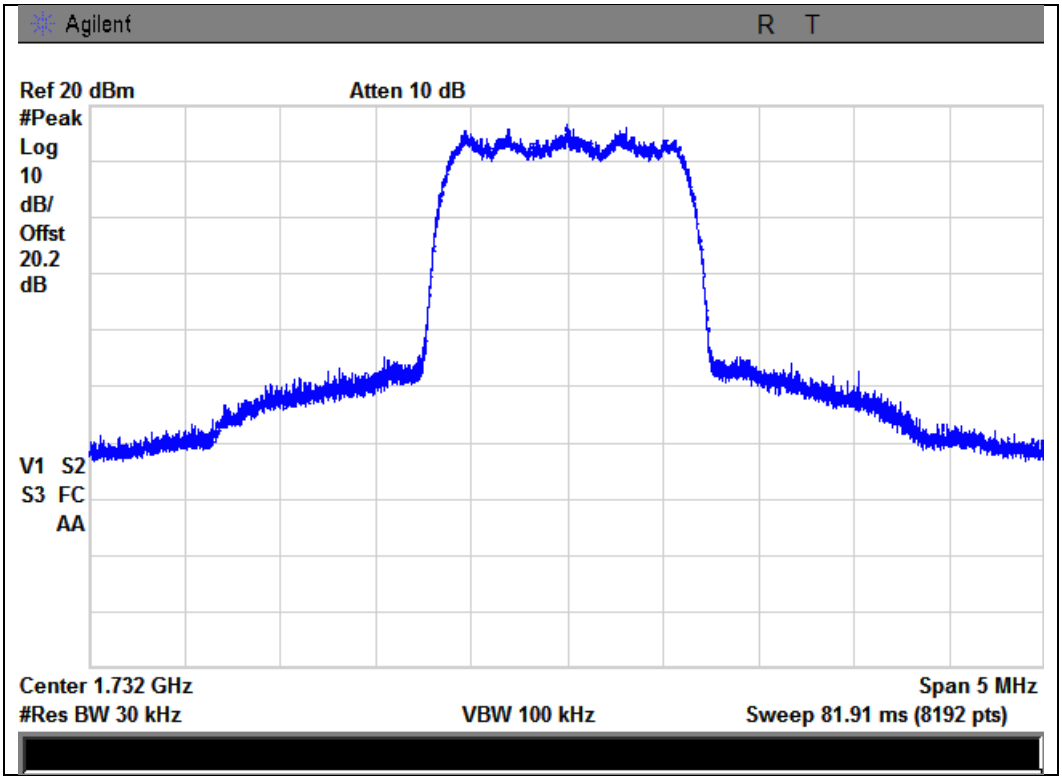


## 1710 - 1755 MHz Band

### Input

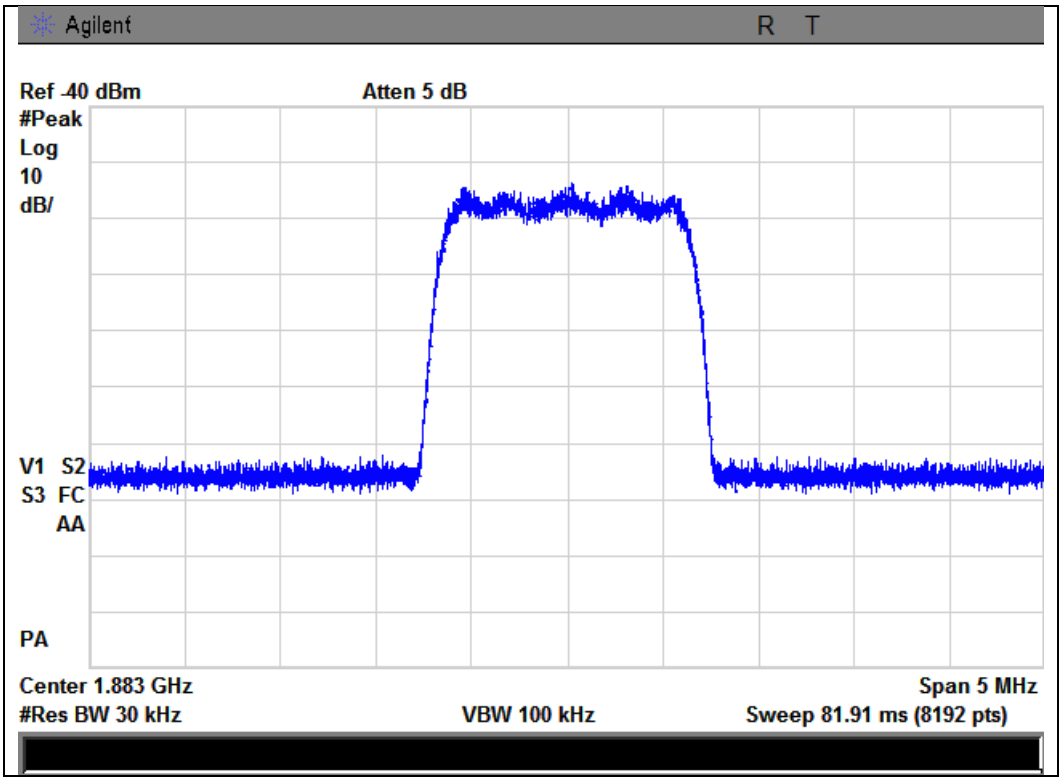



### Output

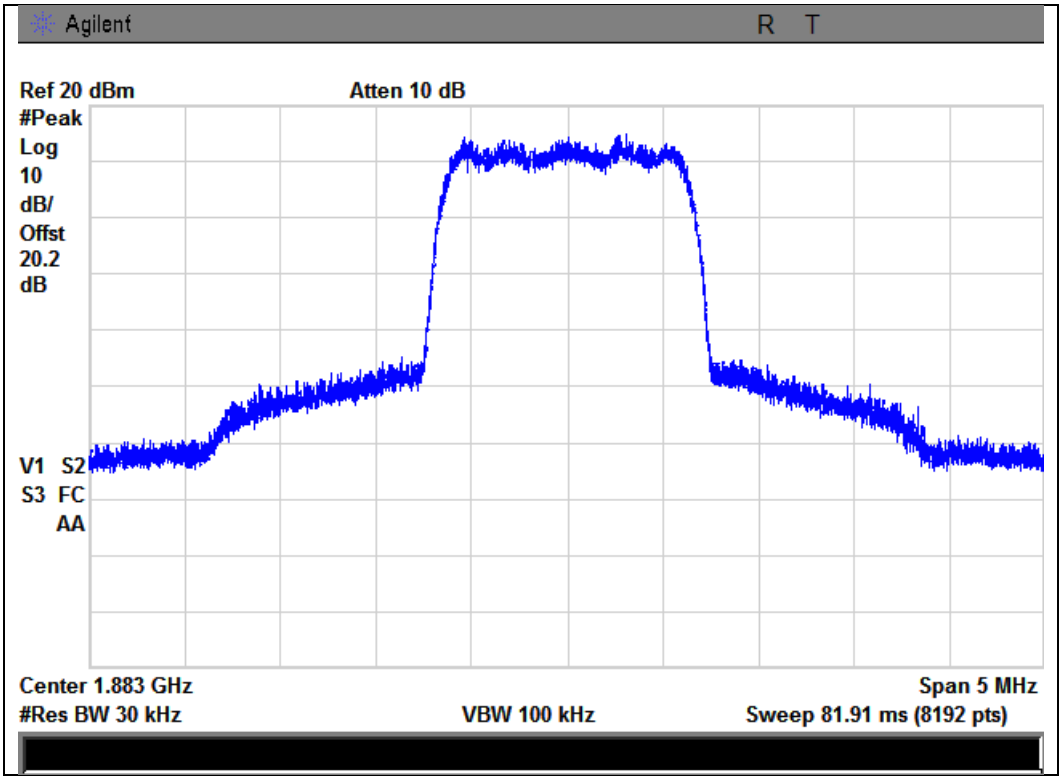


## 1850 - 1915 MHz Band

### Input



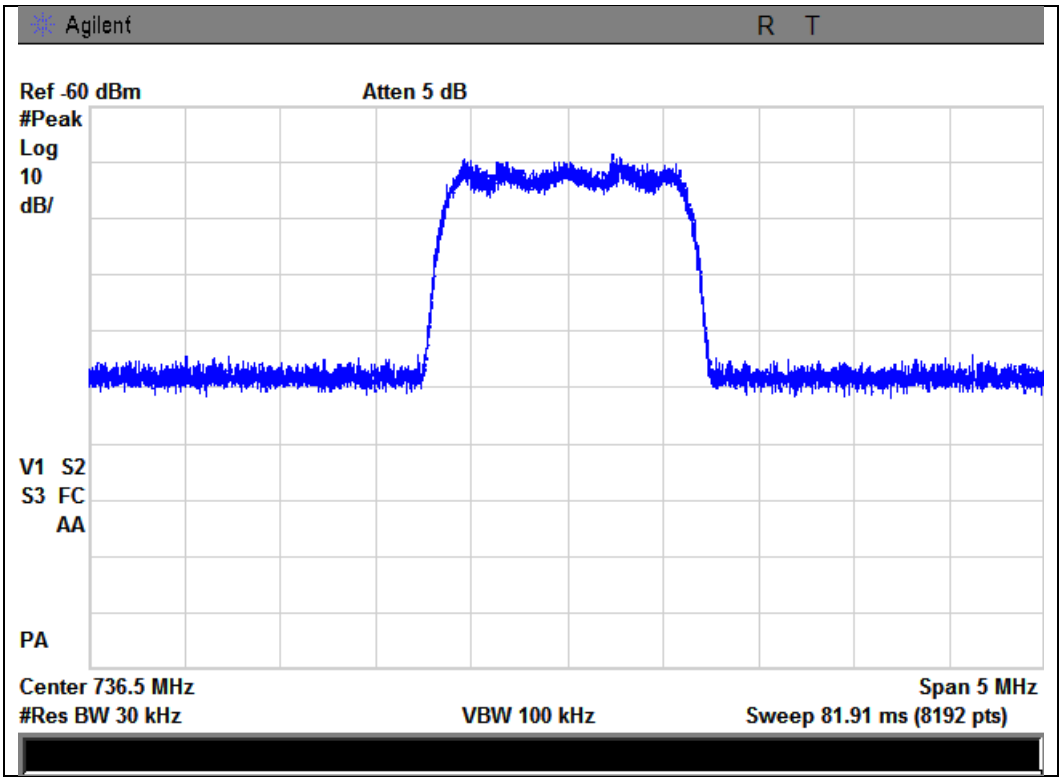

### Output



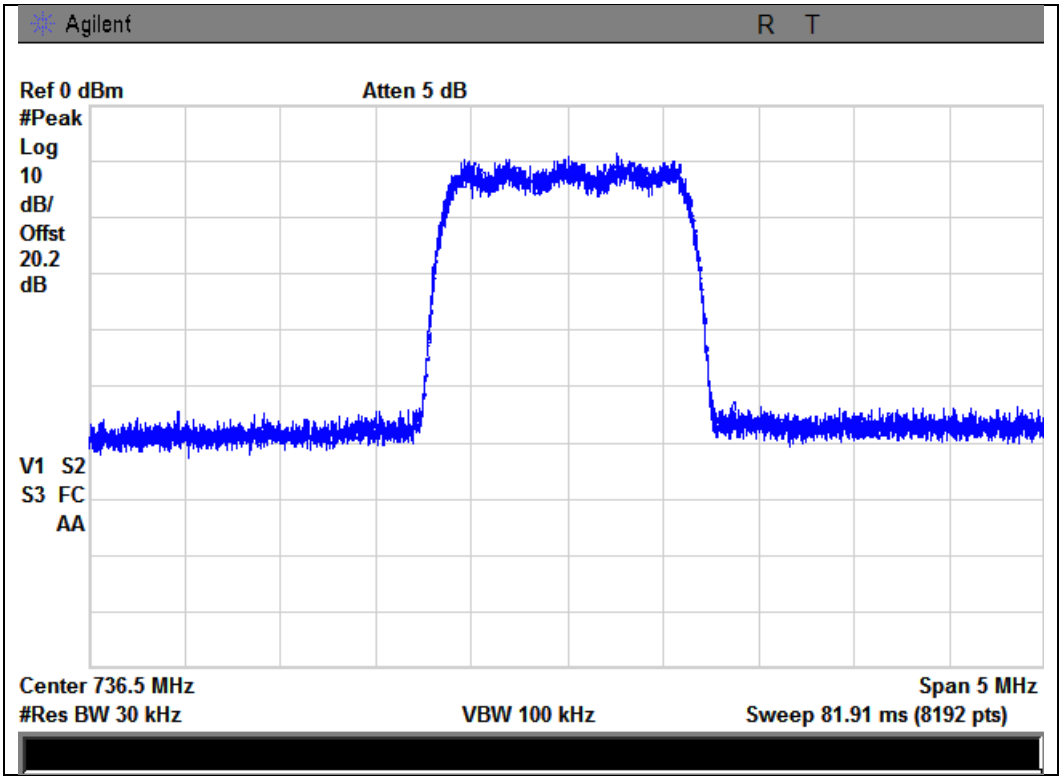
## CDMA Downlink Test Plots

## 728 - 746 MHz Band

### Input

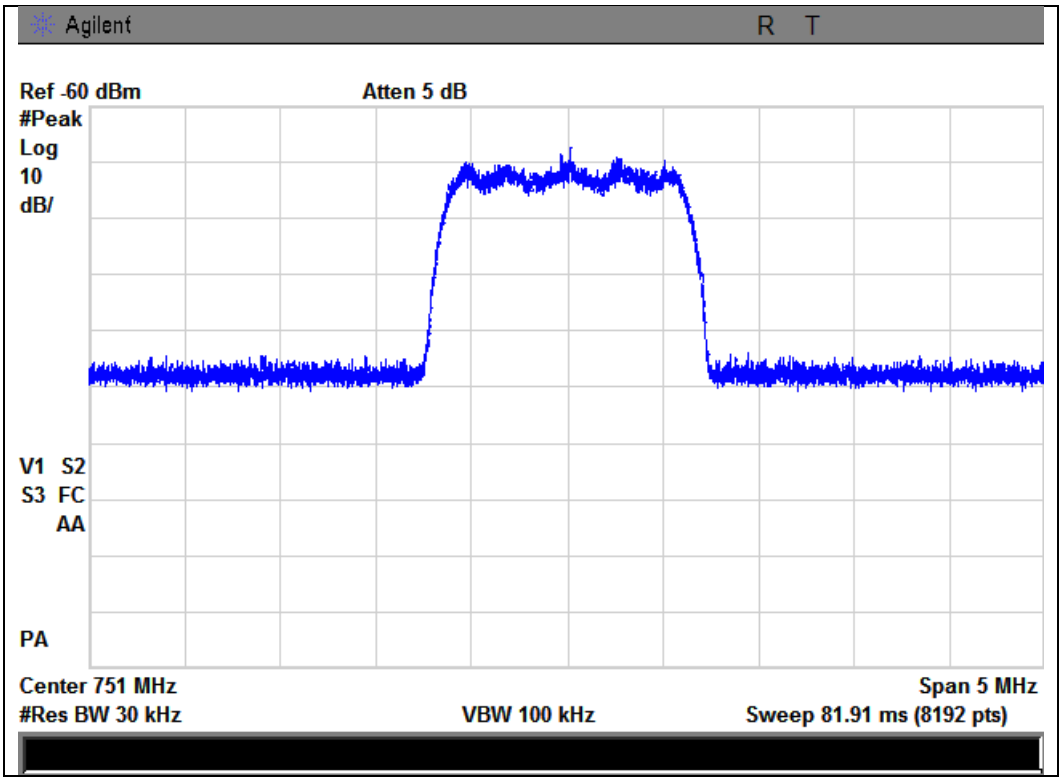



### Output

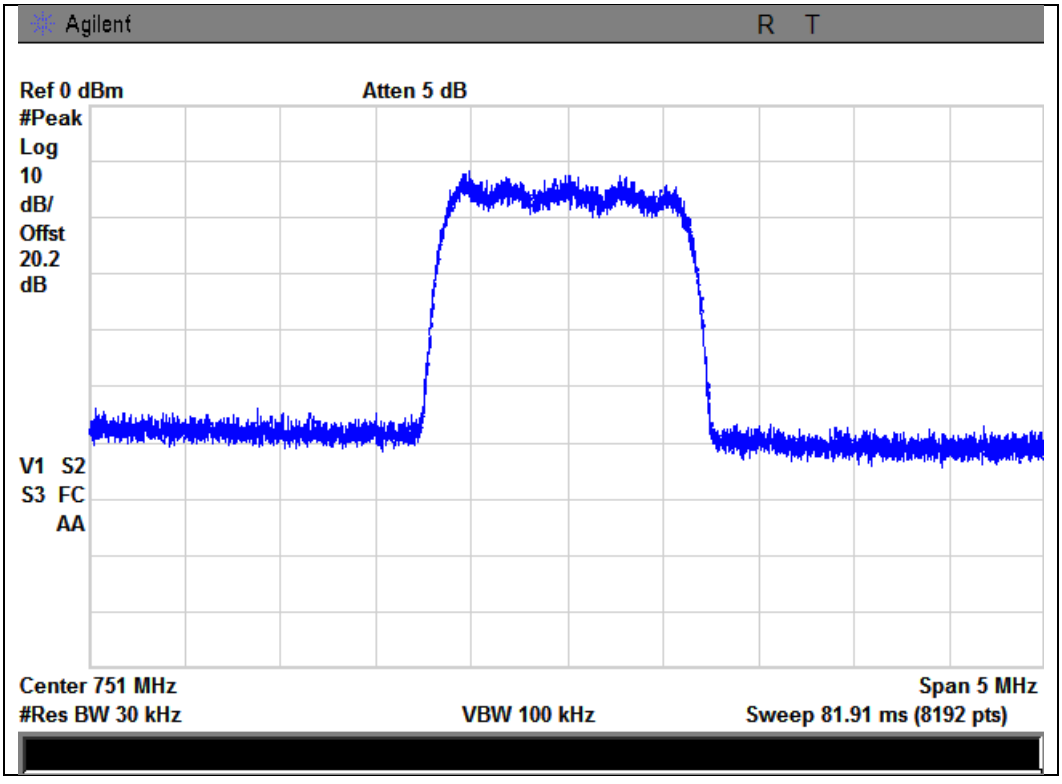


**746 - 756 MHz Band**

**Input**

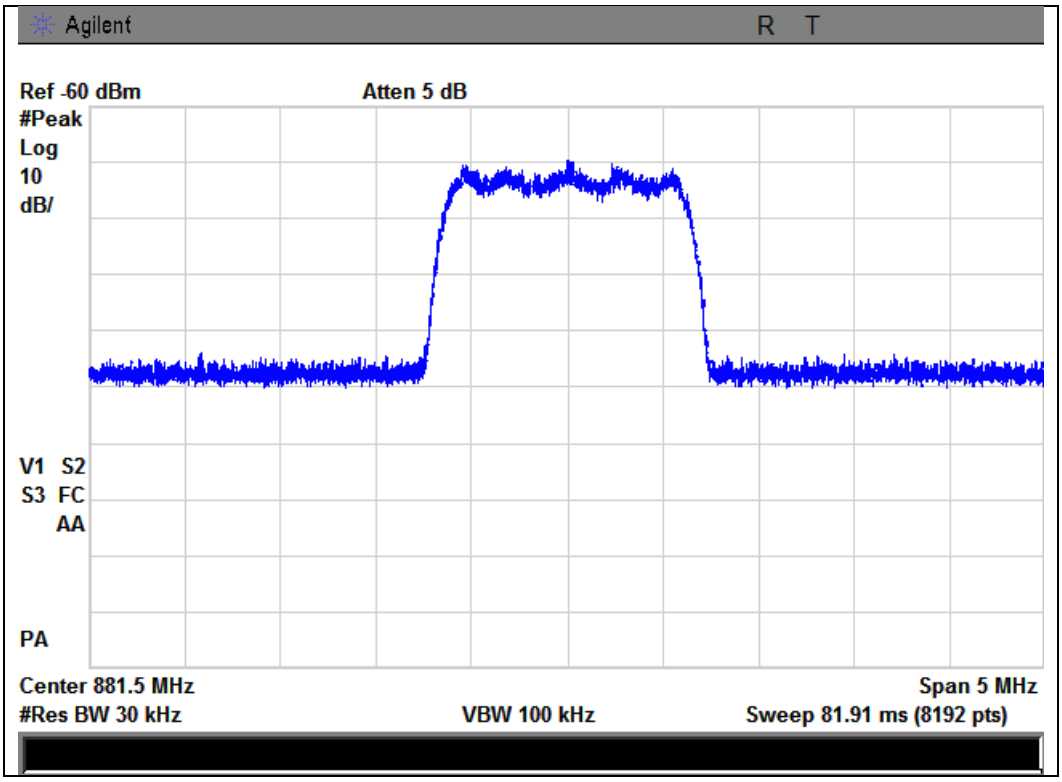



**Output**

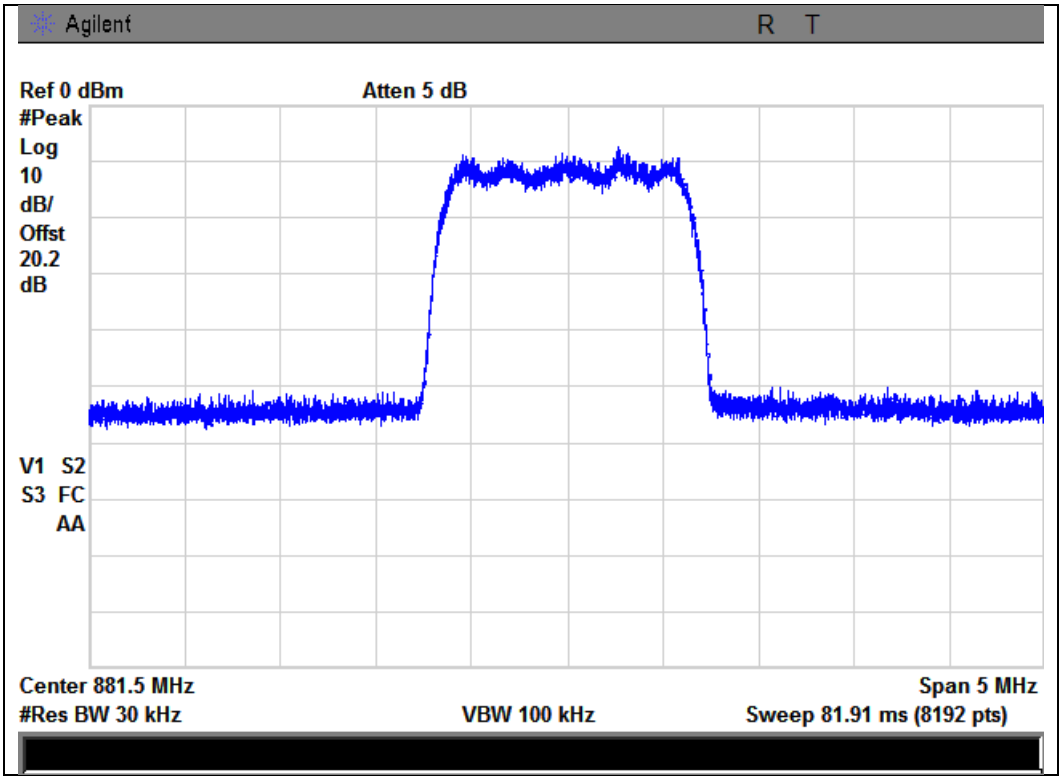


**869 - 894 MHz Band**

**Input**

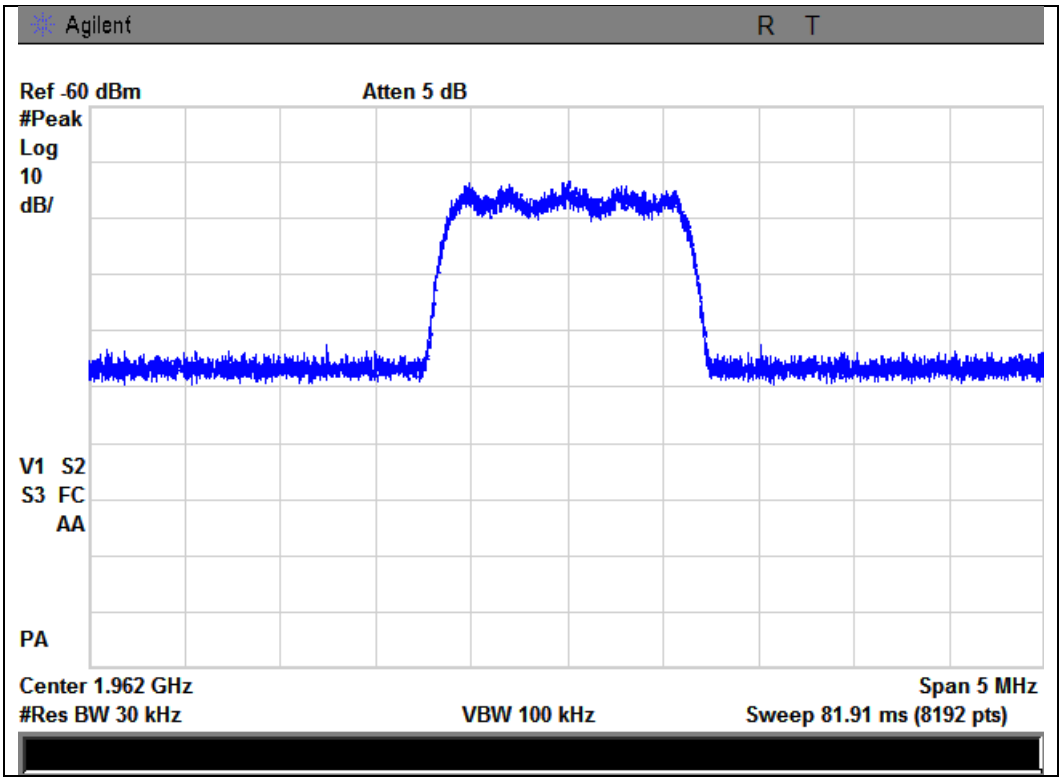



**Output**

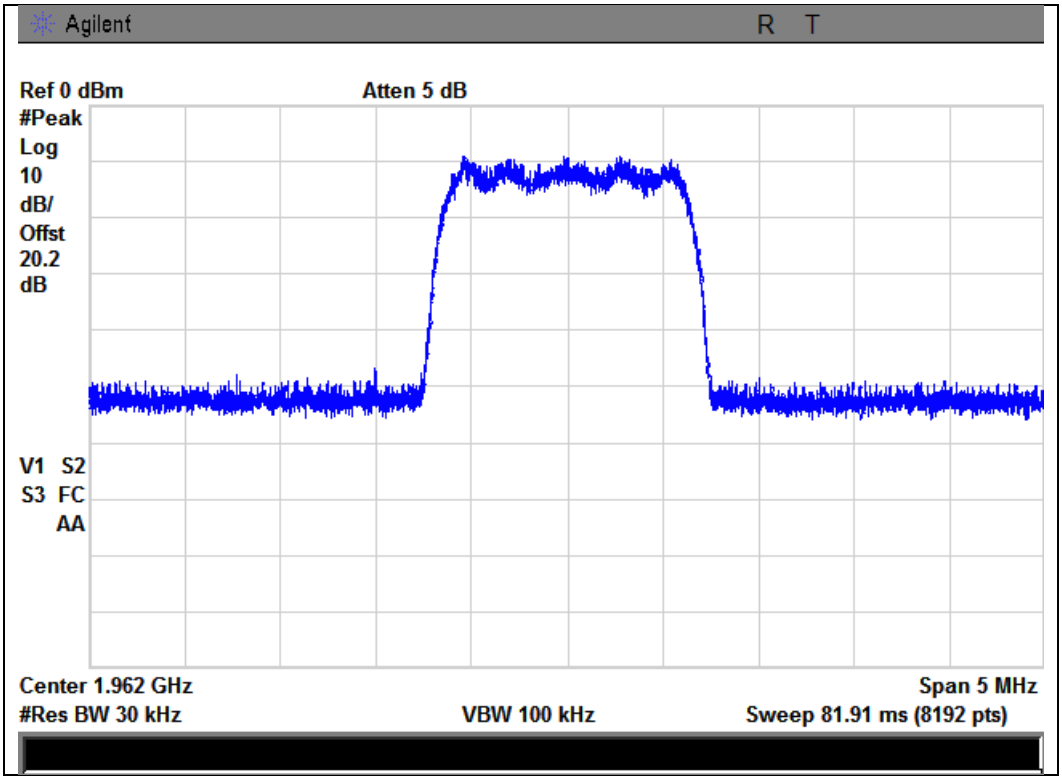


**1930 - 1995 MHz Band**

**Input**

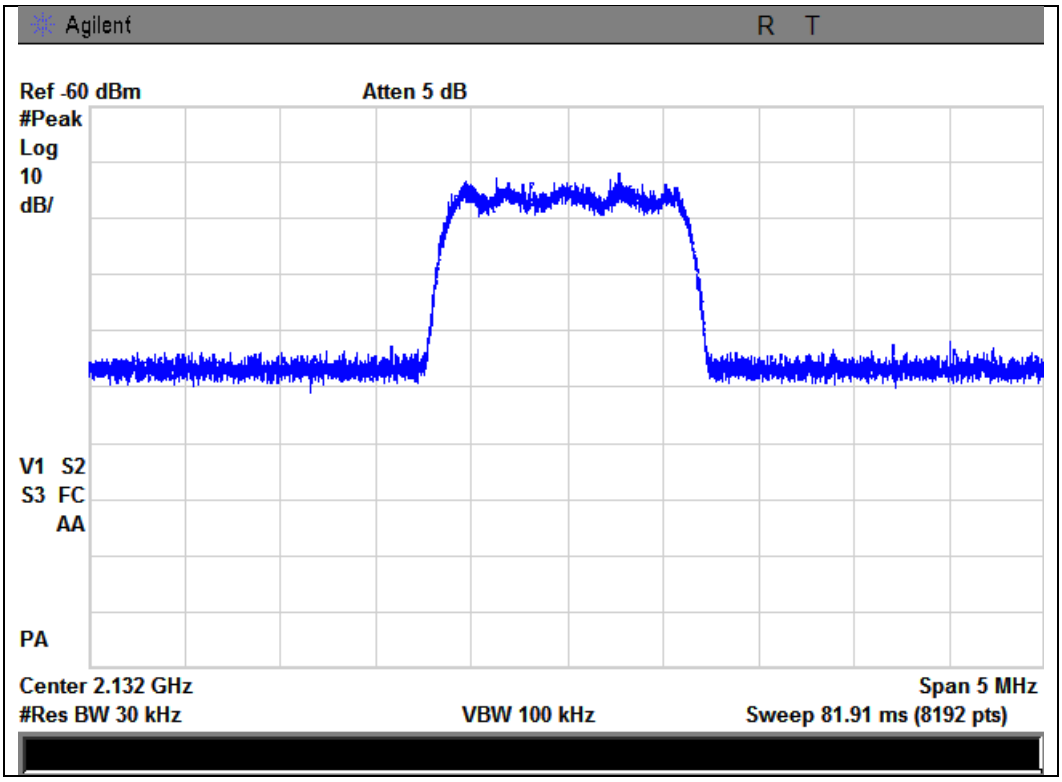



**Output**

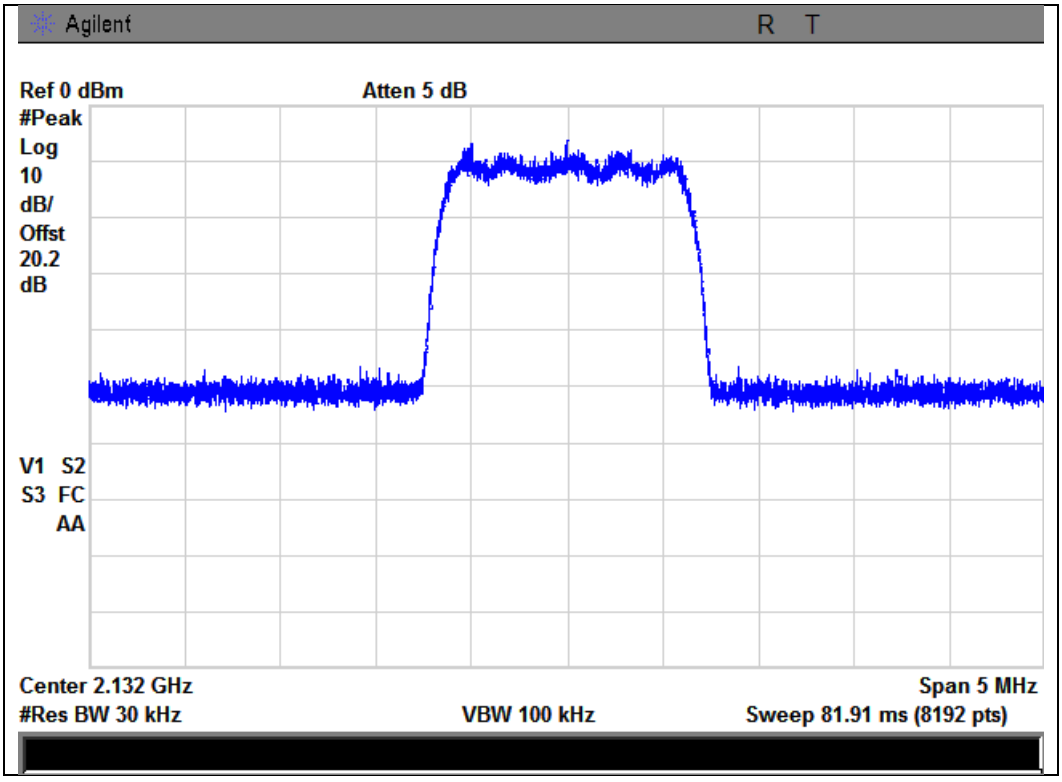


## 2110 - 2155 MHz Band

### Input



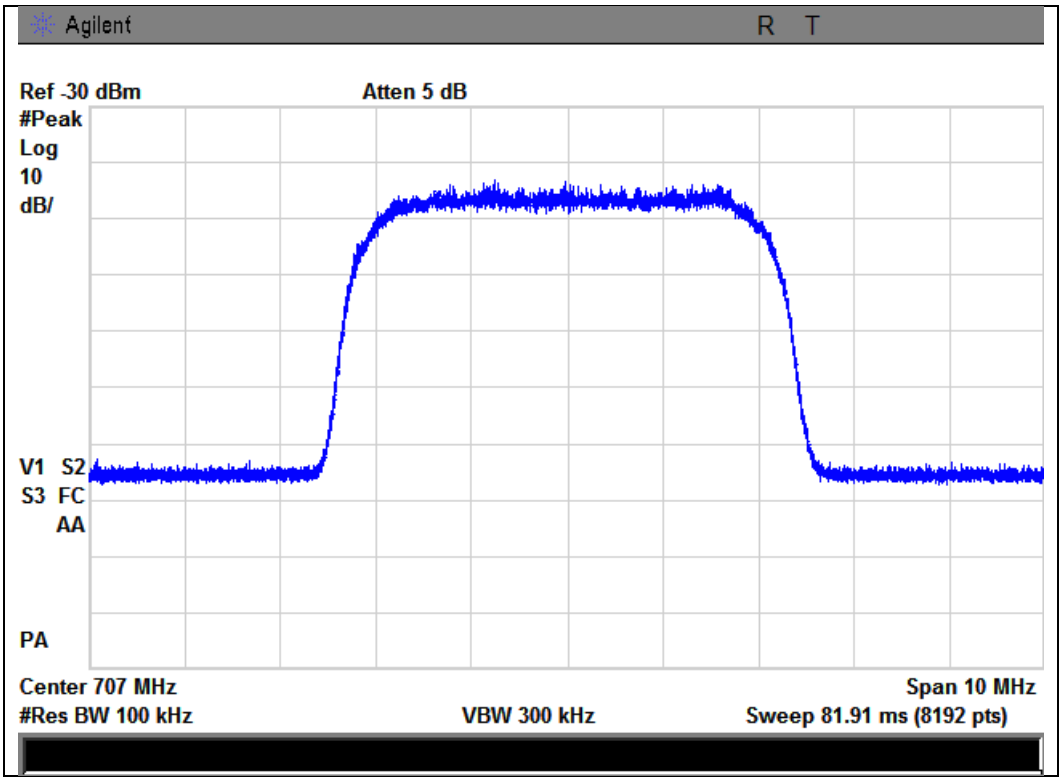

### Output



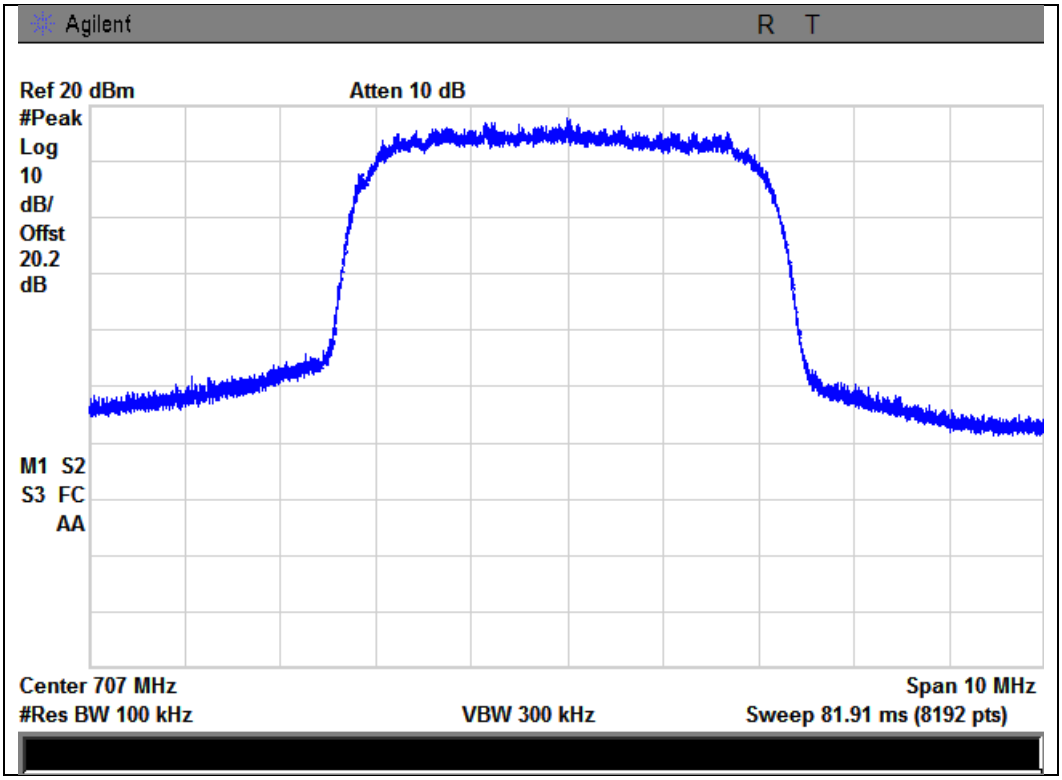
## WCDMA Uplink Test Plots

## 698 - 716 MHz Band

### Input

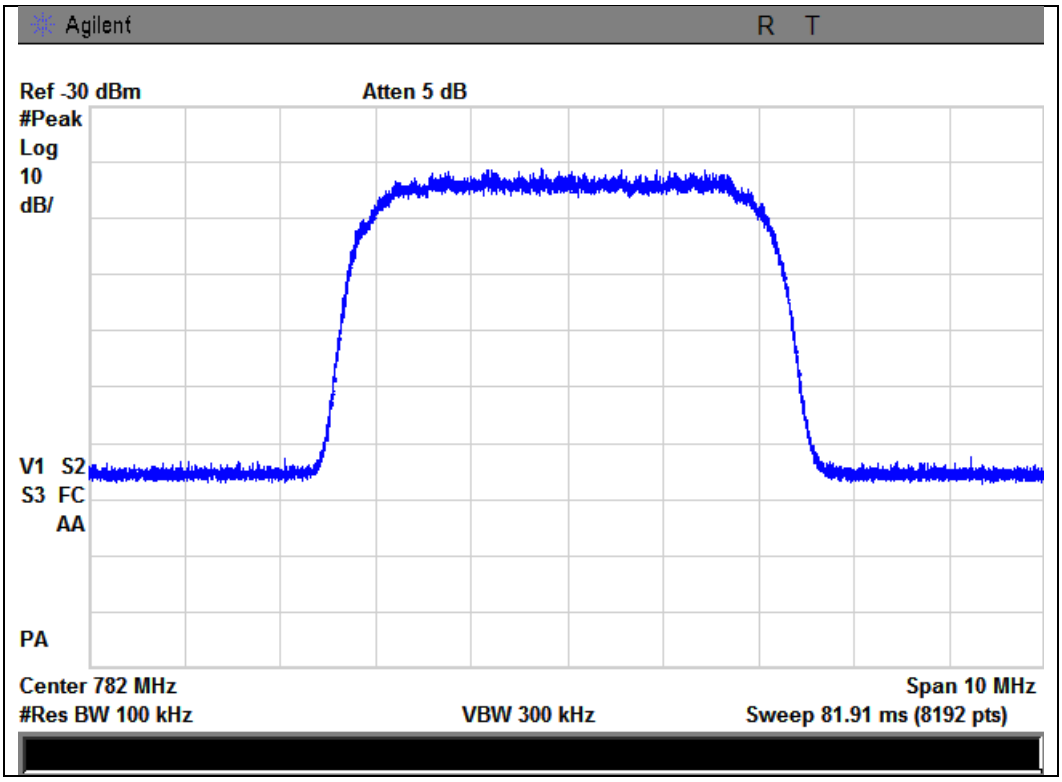



### Output

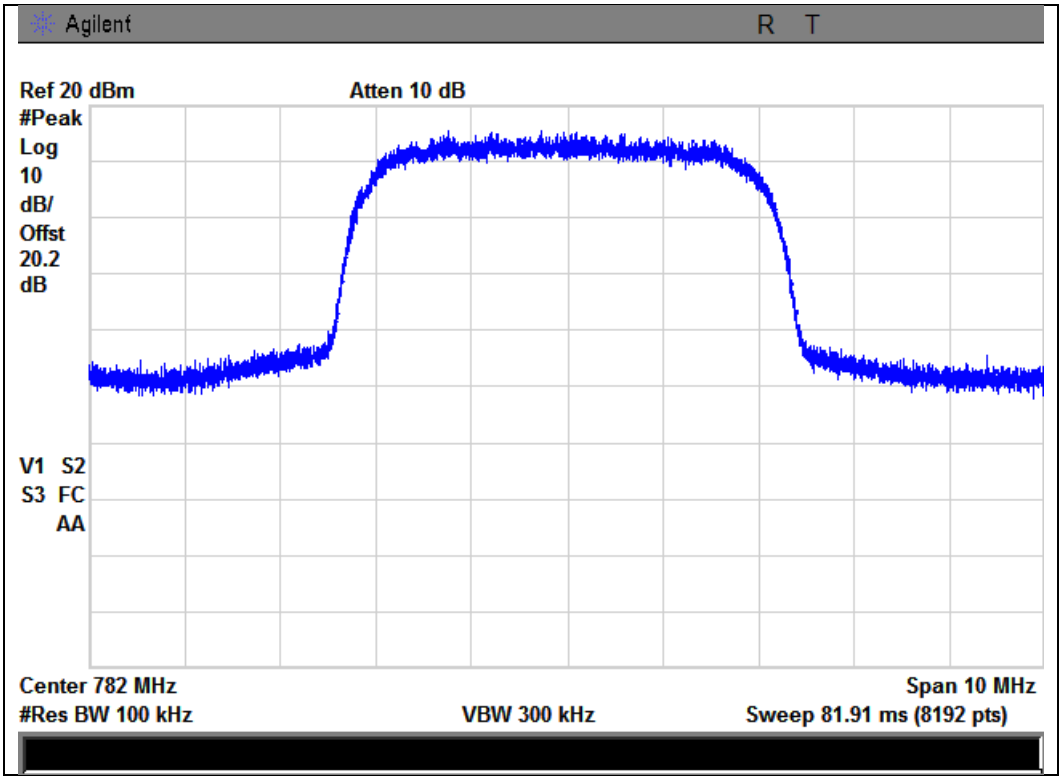


**777 - 787 MHz Band**

**Input**

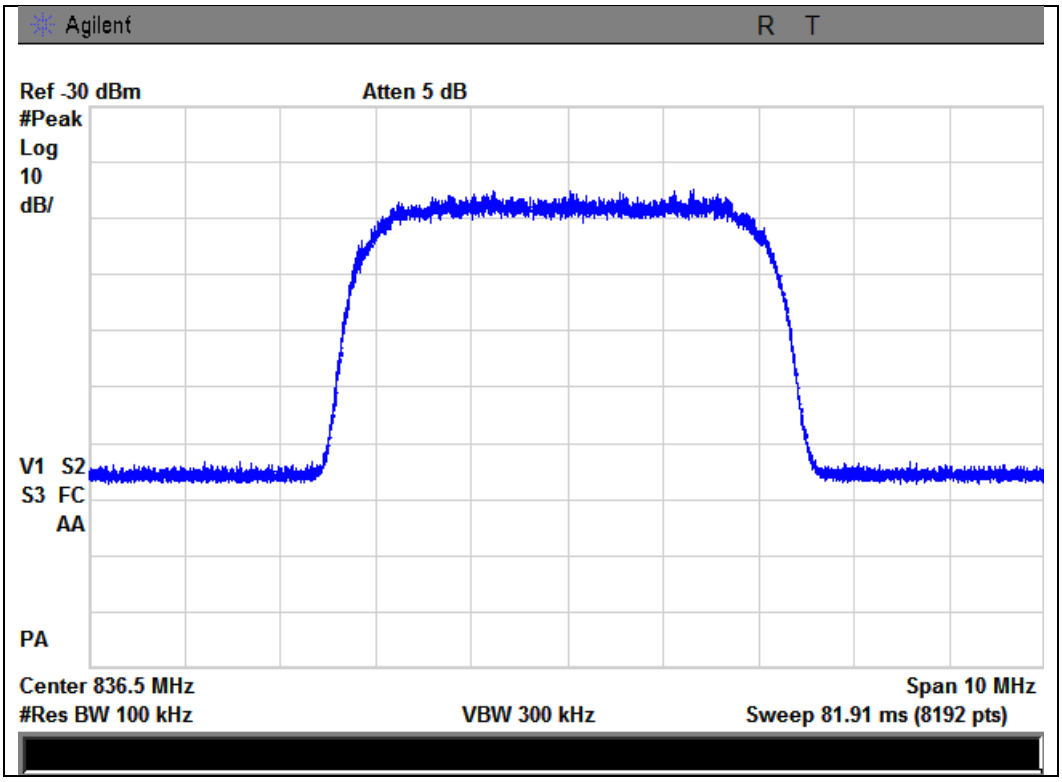



**Output**

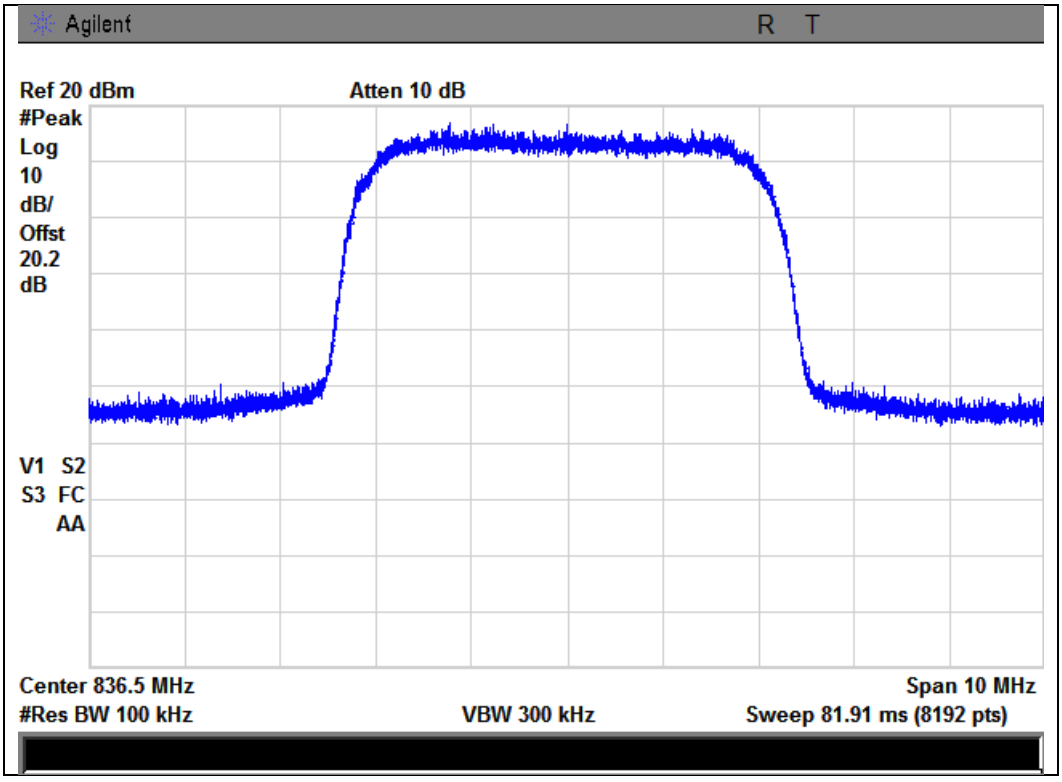


## 824 - 849 MHz Band

### Input

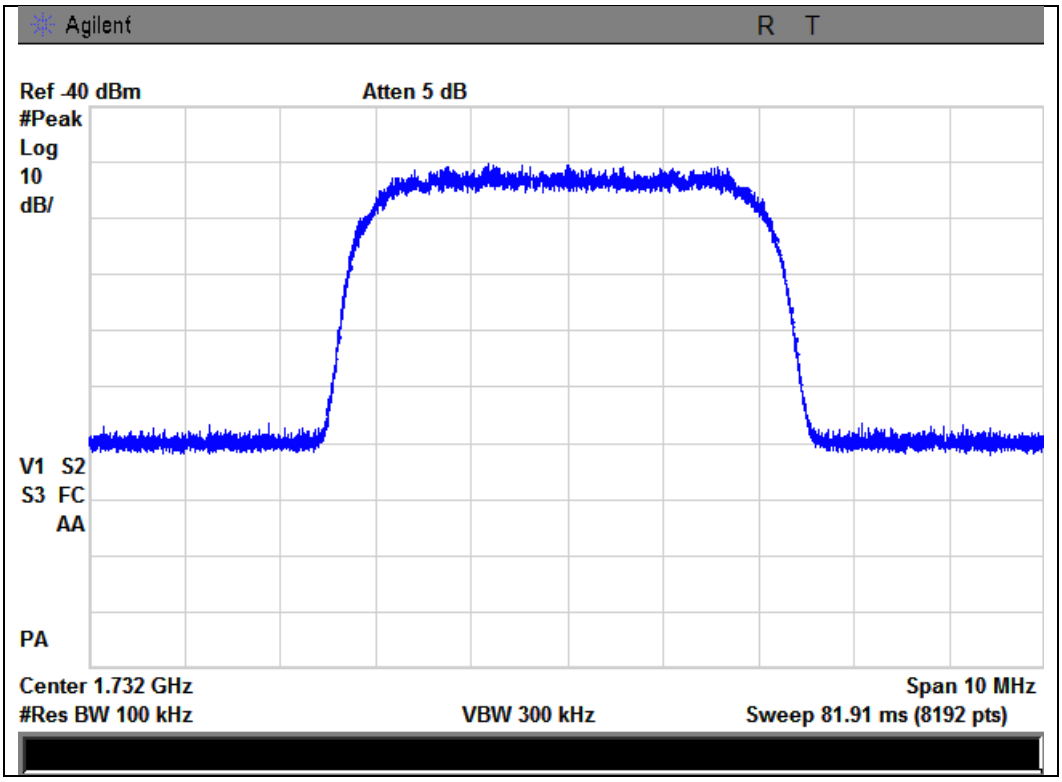



### Output

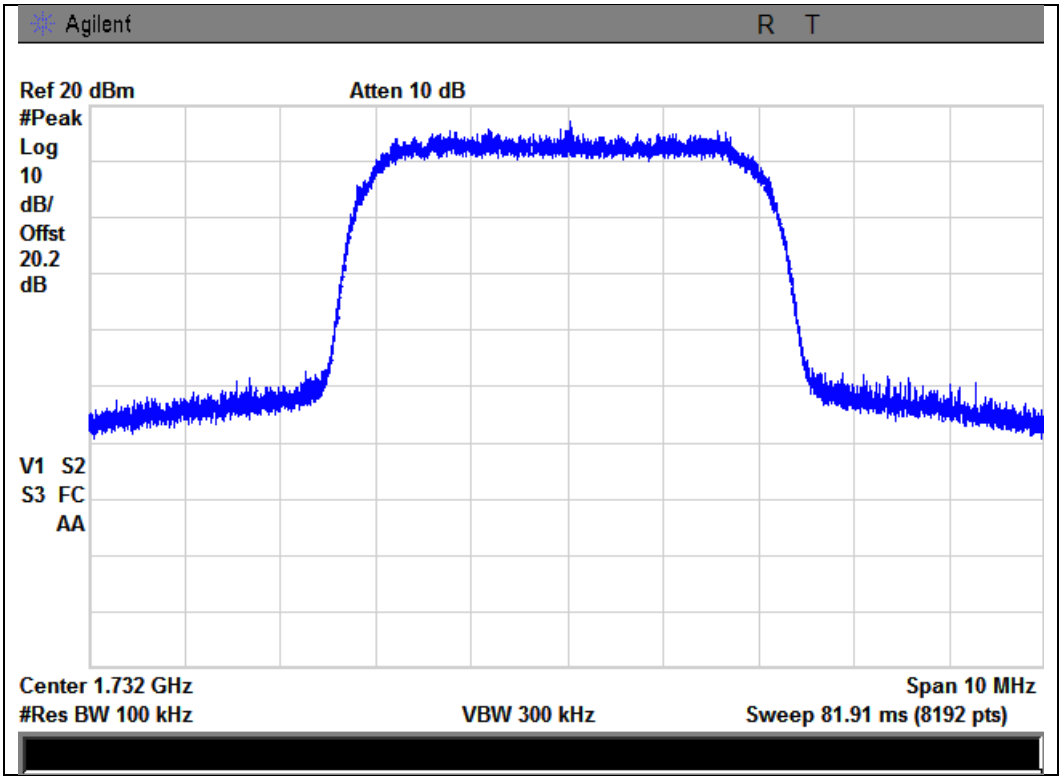


**1710 - 1755 MHz Band**

**Input**

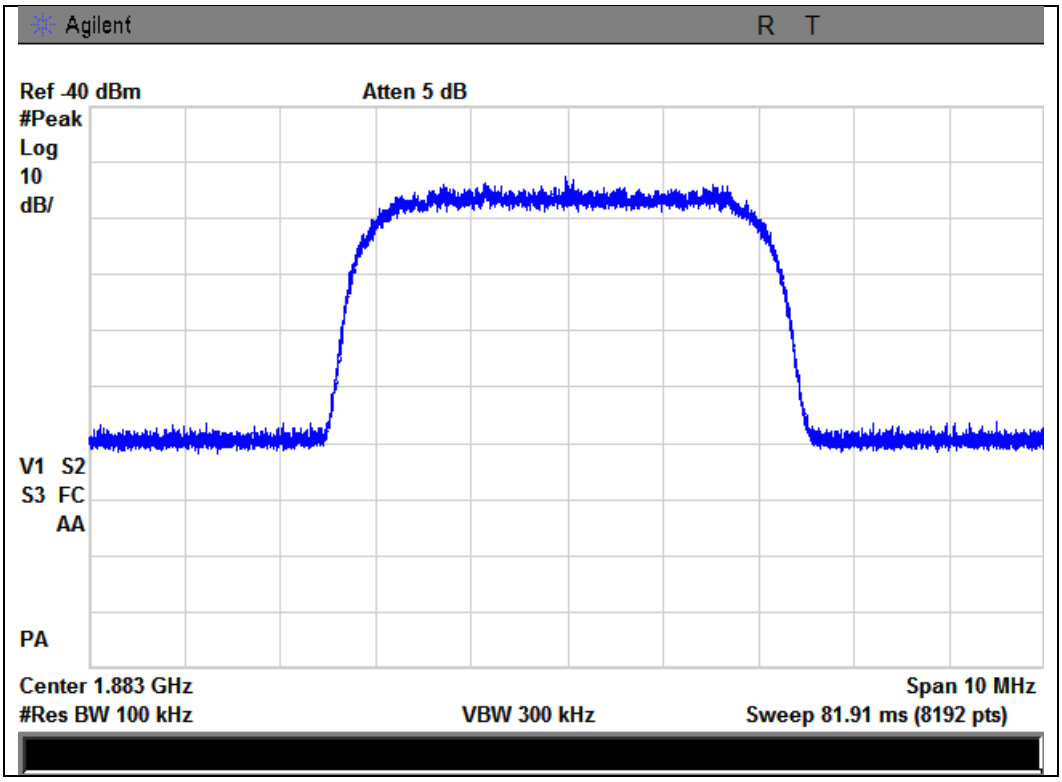



**Output**

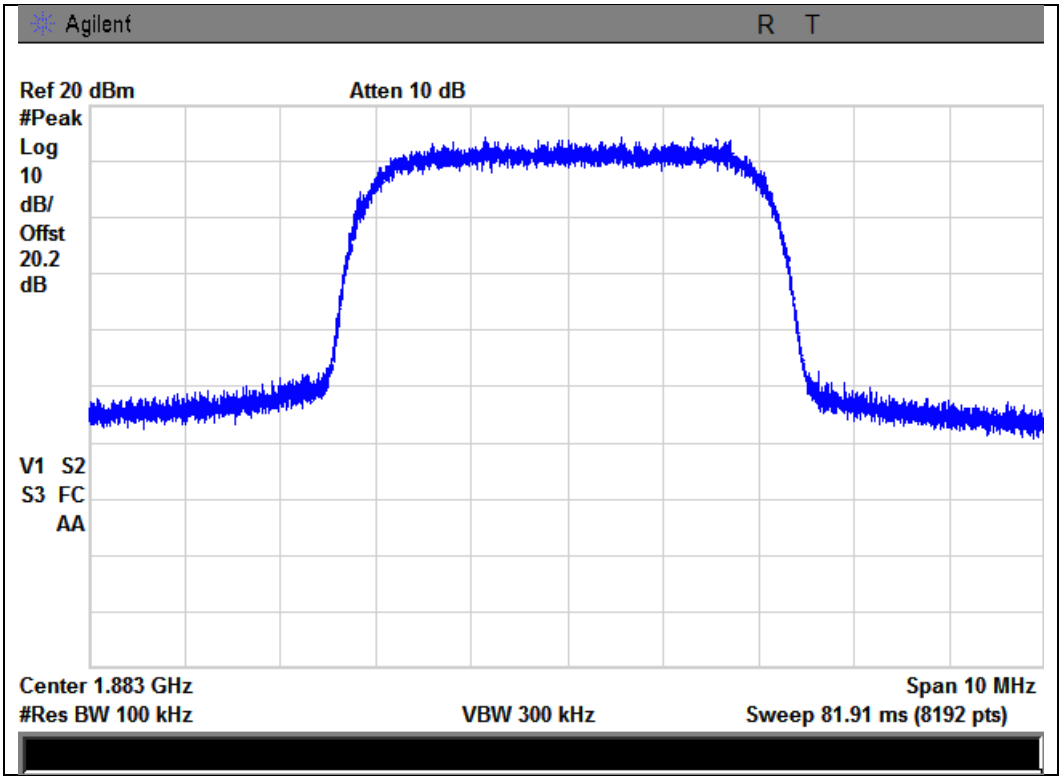


**1850 - 1915 MHz Band**

**Input**



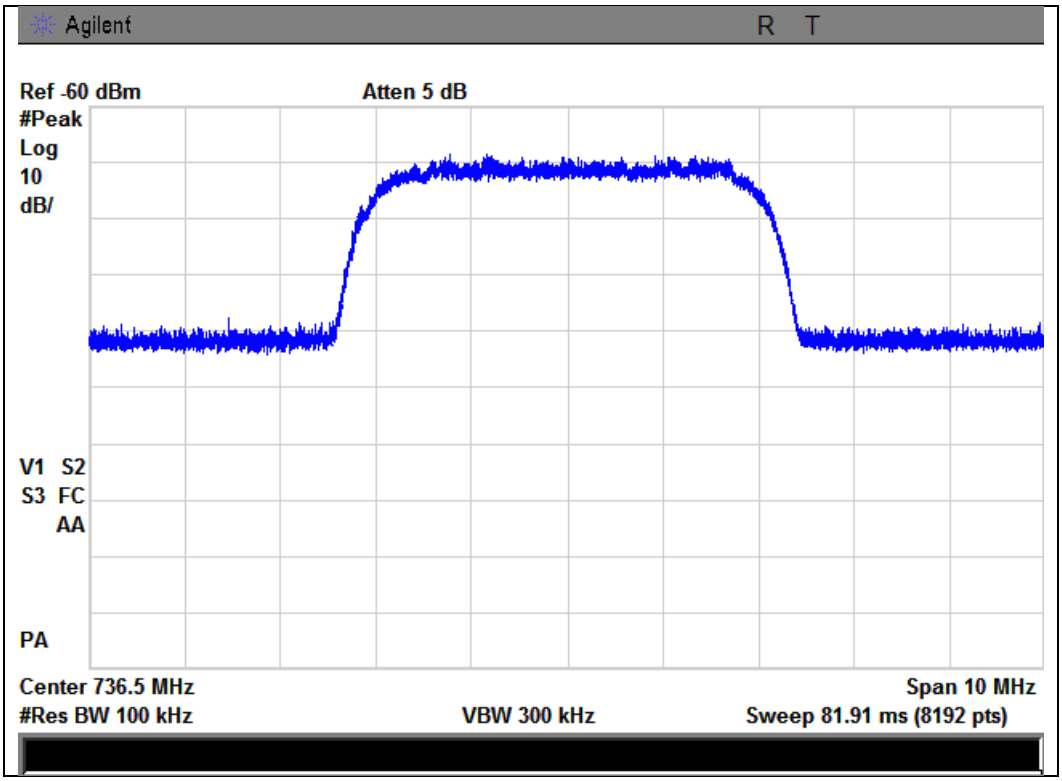

**Output**



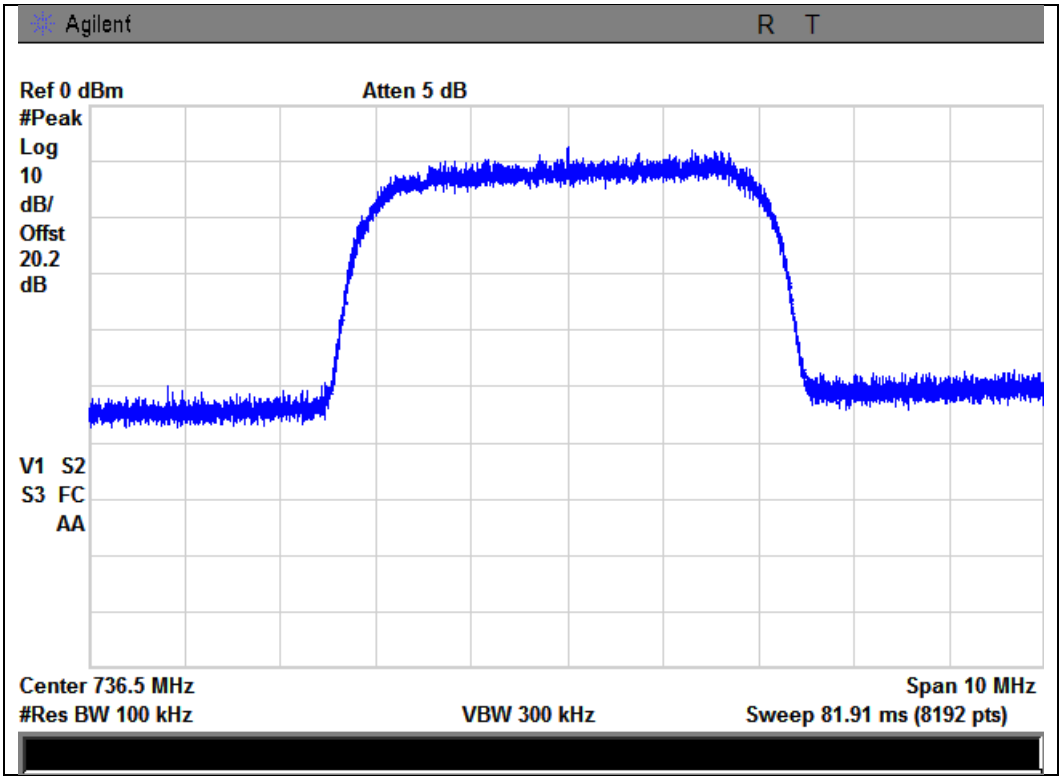
## WCDMA Downlink Test Plots

## 728 - 746 MHz Band

### Input

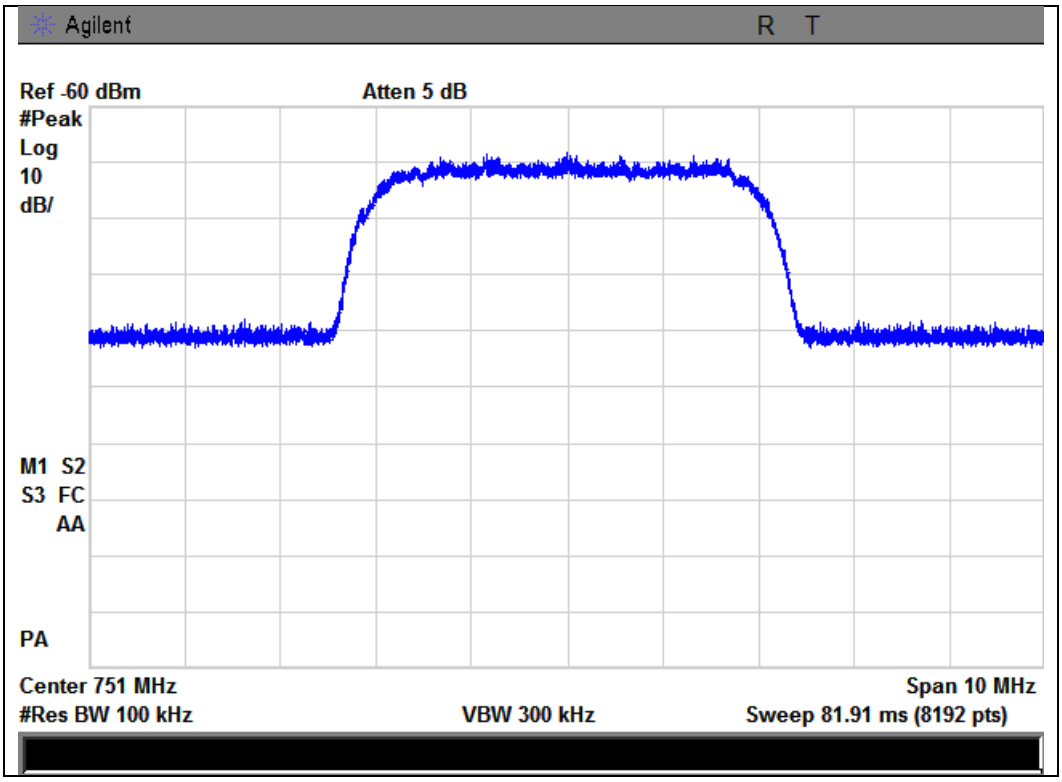



### Output

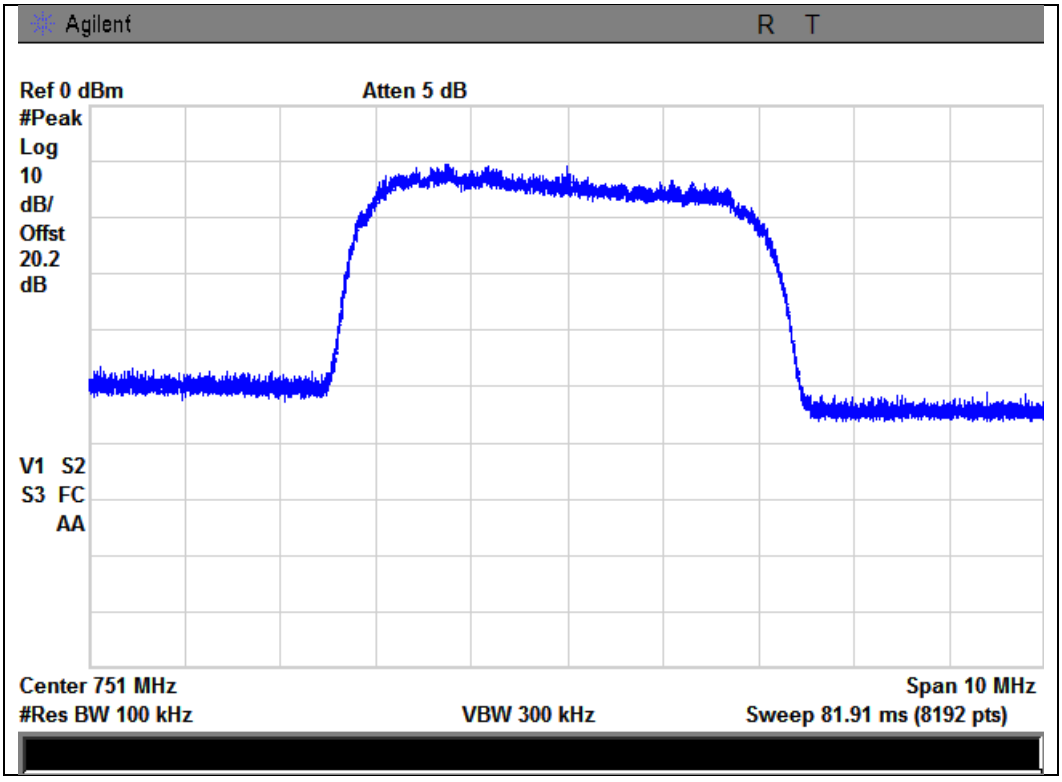


**746 - 756 MHz Band**

**Input**

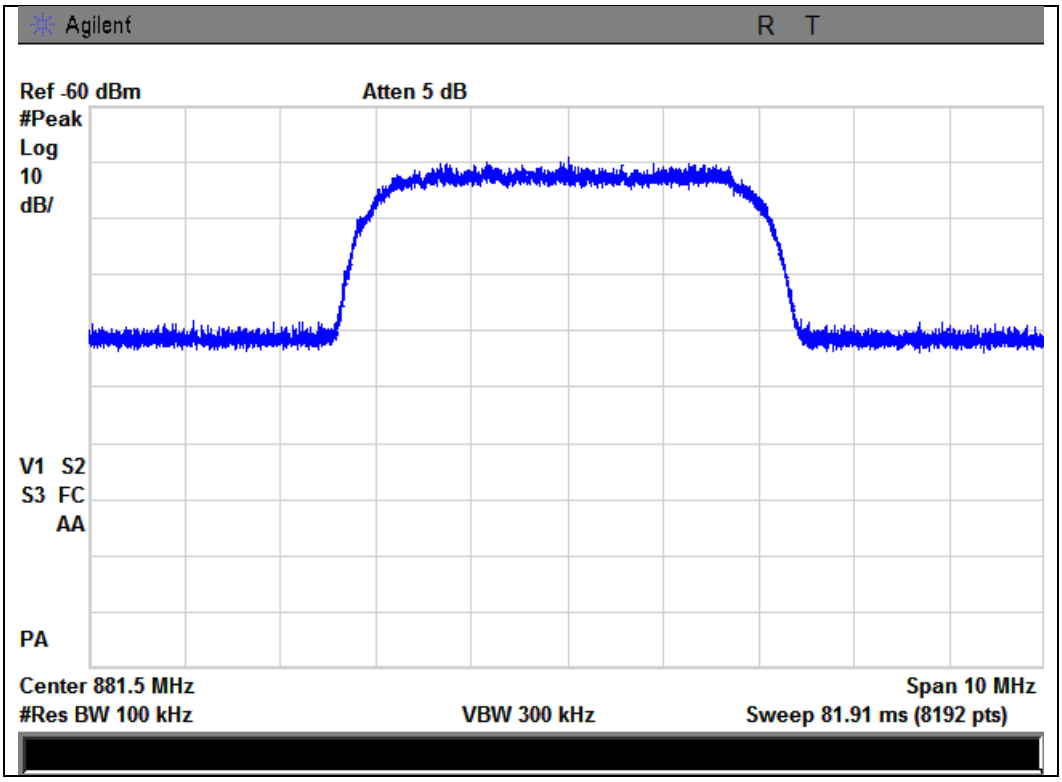



**Output**

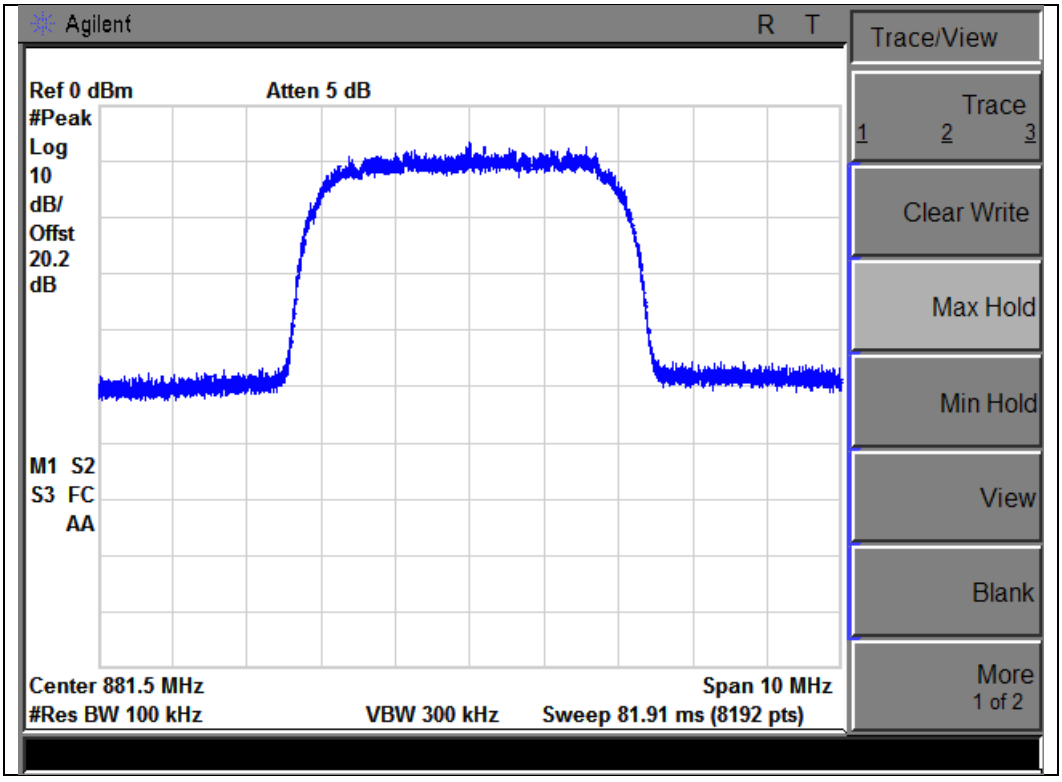


**869 - 894 MHz Band**

**Input**

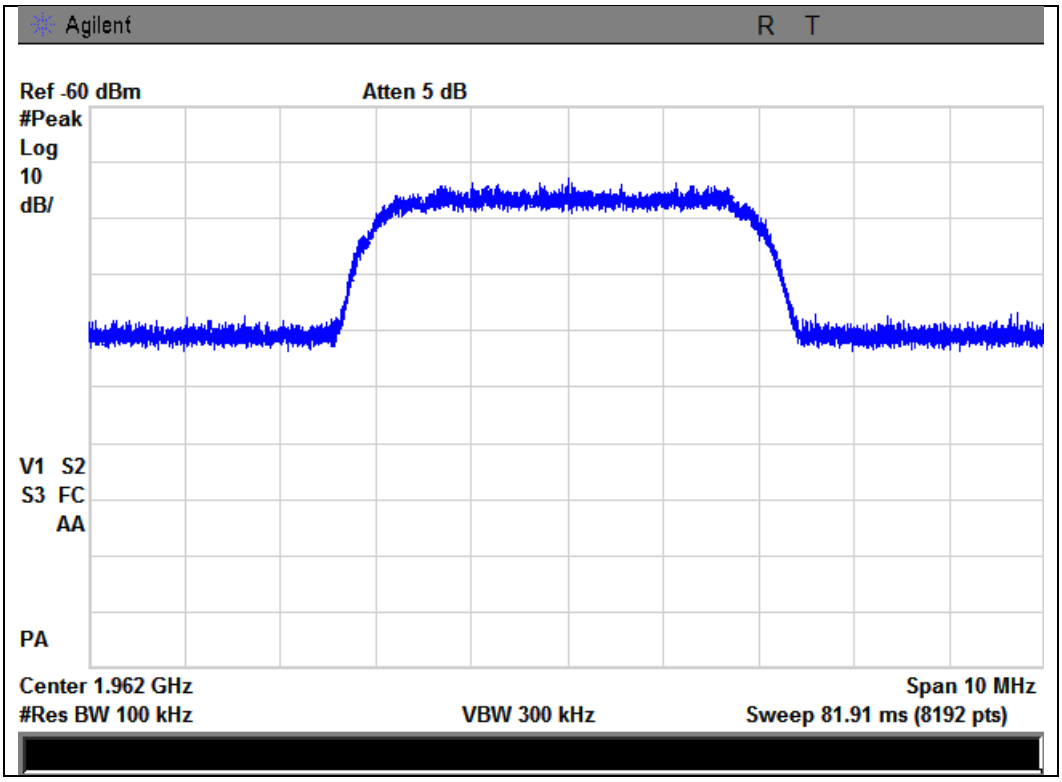



**Output**

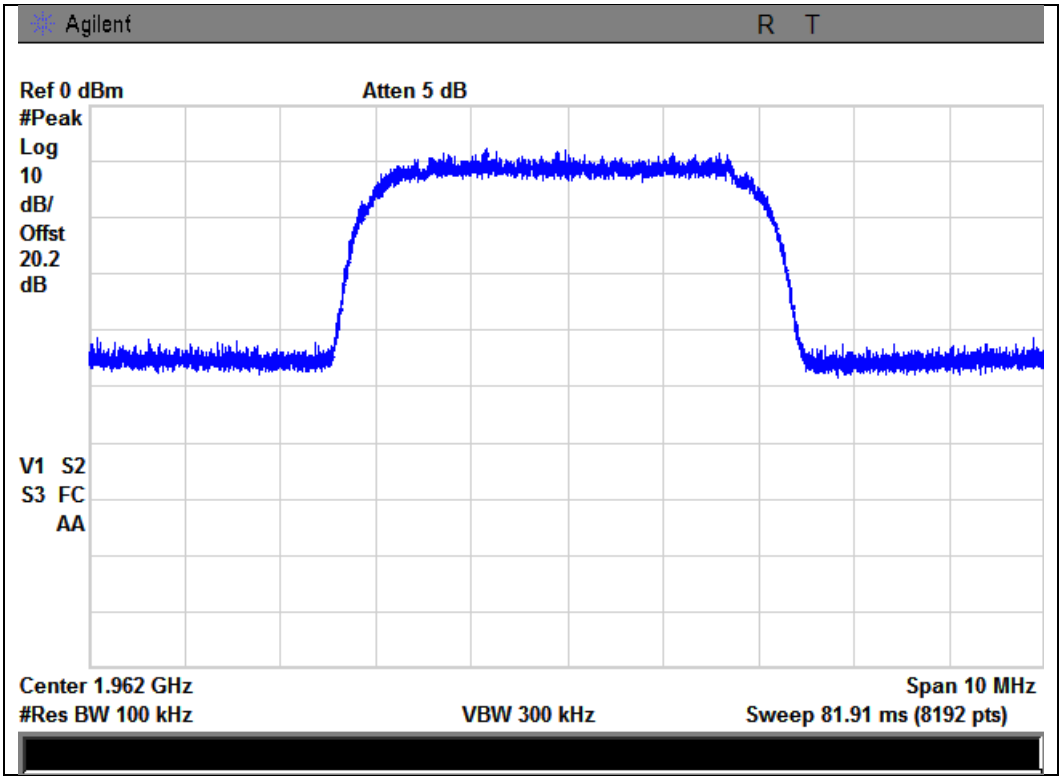


**1930 - 1995 MHz Band**

**Input**

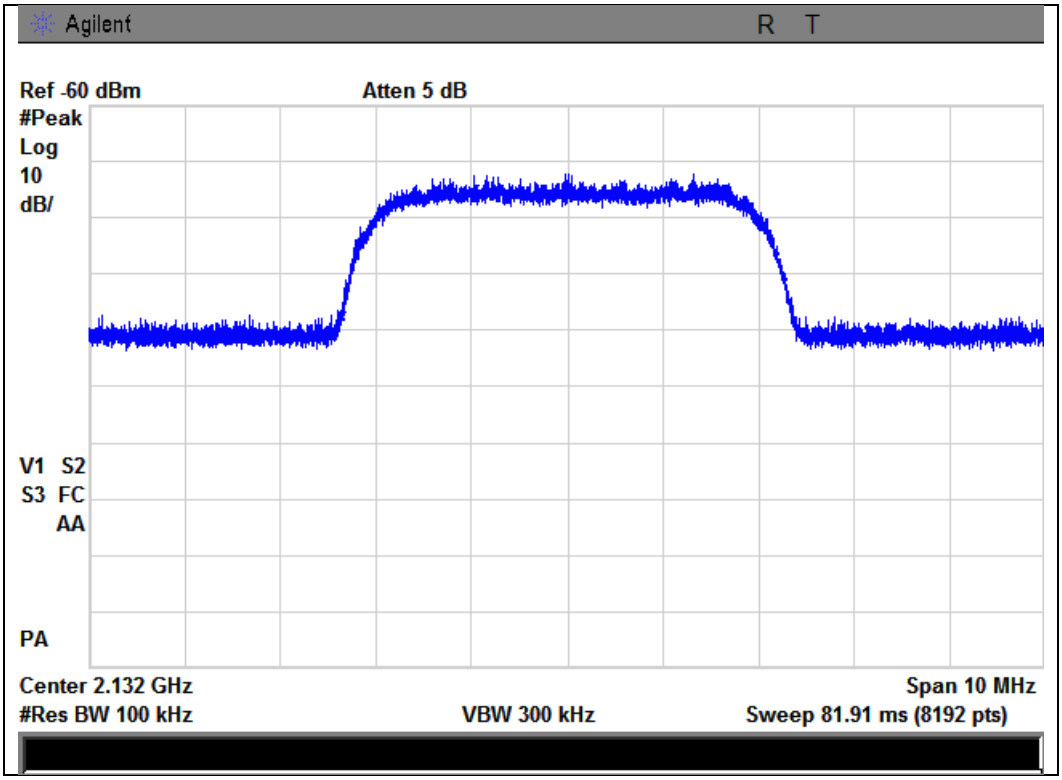



**Output**

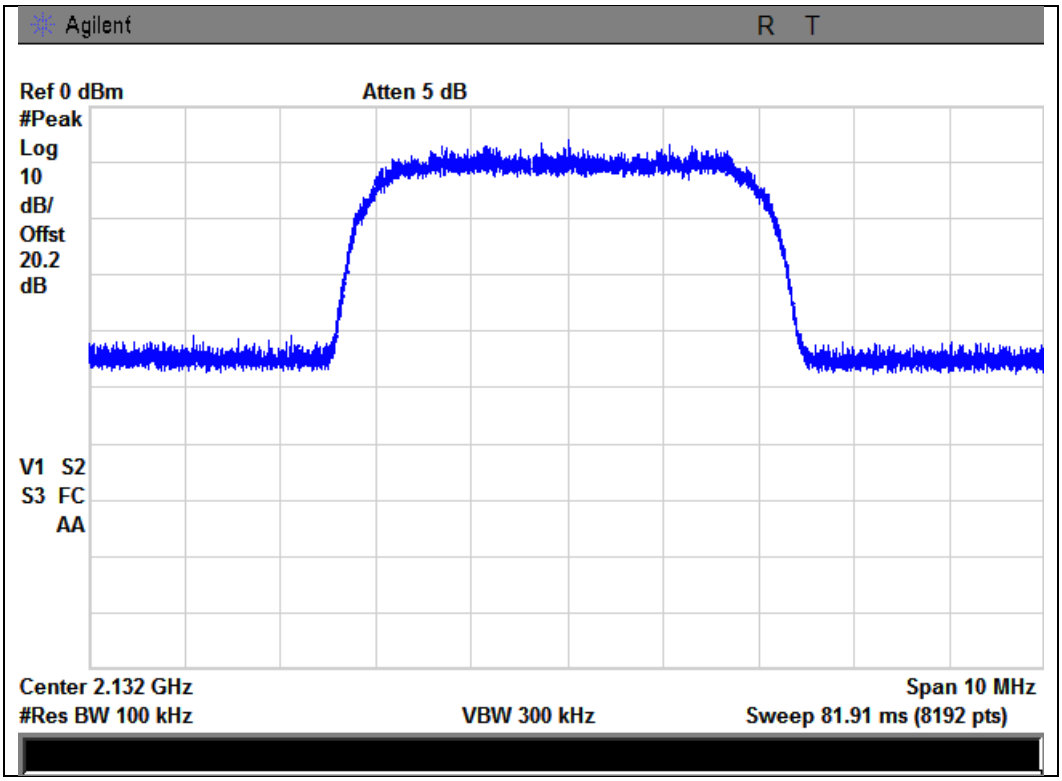


## 2110 - 2155 MHz Band

### Input




### Output



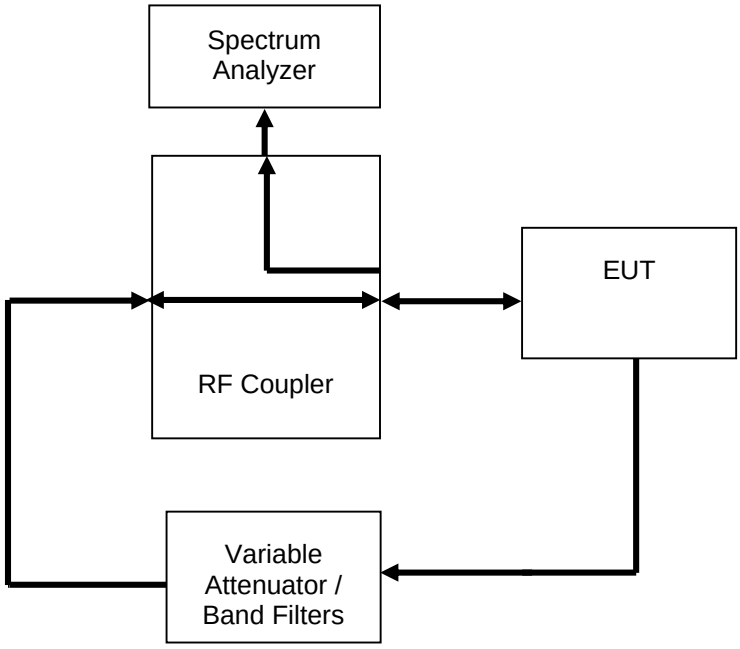
## Oscillation Detection

**Name of Test:** Oscillation Detection
**Engineer:** Greg Corbin
**Test Equipment Utilized:** i00413, E4407B - S/N:MY41444836
**Test Date:** 8/14/2013

### Test Procedure

The EUT was connected to a spectrum analyzer set for 0 Hz operation. The EUT uplink and downlink were fed back upon each other through a selectable band pass filter and variable attenuator. The EUT uplink and downlink were tested to ensure that the presence of oscillation was detected and that the EUT output turned off within 300 mS for the Uplink and 1 second for the Downlink and remained off for 1 minute. A EUT with test software was utilized to ensure that the EUT only had a maximum of 5 attempts at restart from oscillation before permanently shutting off.

### Test Setup




**Uplink Detection Time Test Results**

| Frequency Band (MHz) | Measured Time (mS) | Limit (mS) | Result |
|---|---|---|---|
| 698 - 716 | 66.1 | 300 | Pass |
| 777 - 787 | 57.5 | 300 | Pass |
| 824 - 849 | 70.1 | 300 | Pass |
| 1710 - 1755 | 37.5 | 300 | Pass |
| 1850 - 1915 | 95 | 300 | Pass |

**Downlink Detection Time Test Results**

| Frequency Band (MHz) | Measured Time (mS) | Limit (mS) | Result |
|---|---|---|---|
| 728 - 746 | 40 | 1000 | Pass |
| 746 - 756 | 52.5 | 1000 | Pass |
| 869 - 894 | 57.5 | 1000 | Pass |
| 1930 - 1995 | 75 | 1000 | Pass |
| 2110 - 2155 | 45 | 1000 | Pass |

**Uplink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|---|---|---|---|
| 698 - 716 | 70.7 | ≥60 | Pass |
| 777 - 787 | 70.7 | ≥60 | Pass |
| 824 - 849 | 70.2 | ≥60 | Pass |
| 1710 - 1755 | 71 | ≥60 | Pass |
| 1850 - 1915 | 71 | ≥60 | Pass |

**Downlink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|---|---|---|---|
| 728 - 746 | 70 | ≥60 | Pass |
| 746 - 756 | 70.2 | ≥60 | Pass |
| 869 - 894 | 70.5 | ≥60 | Pass |
| 1930 - 1995 | 70 | ≥60 | Pass |
| 2110 - 2155 | 70.2 | ≥60 | Pass |

**Uplink Restart Count Test Results**

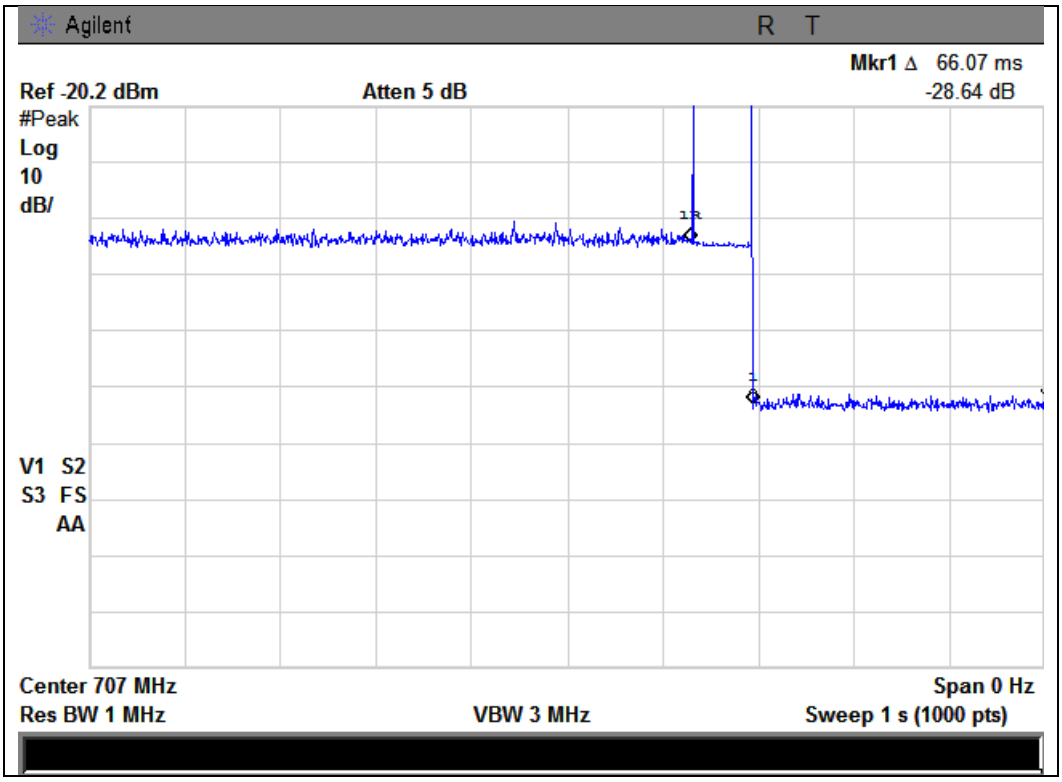
| Frequency Band (MHz) | Restarts | Limit | Result |
|---|---|---|---|
| 698 - 716 | 4 | ≤5 | Pass |
| 777 - 787 | 4 | ≤5 | Pass |
| 824 - 849 | 4 | ≤5 | Pass |
| 1710 - 1755 | 4 | ≤5 | Pass |
| 1850 - 1915 | 4 | ≤5 | Pass |

**Downlink Restart Count Test Results**

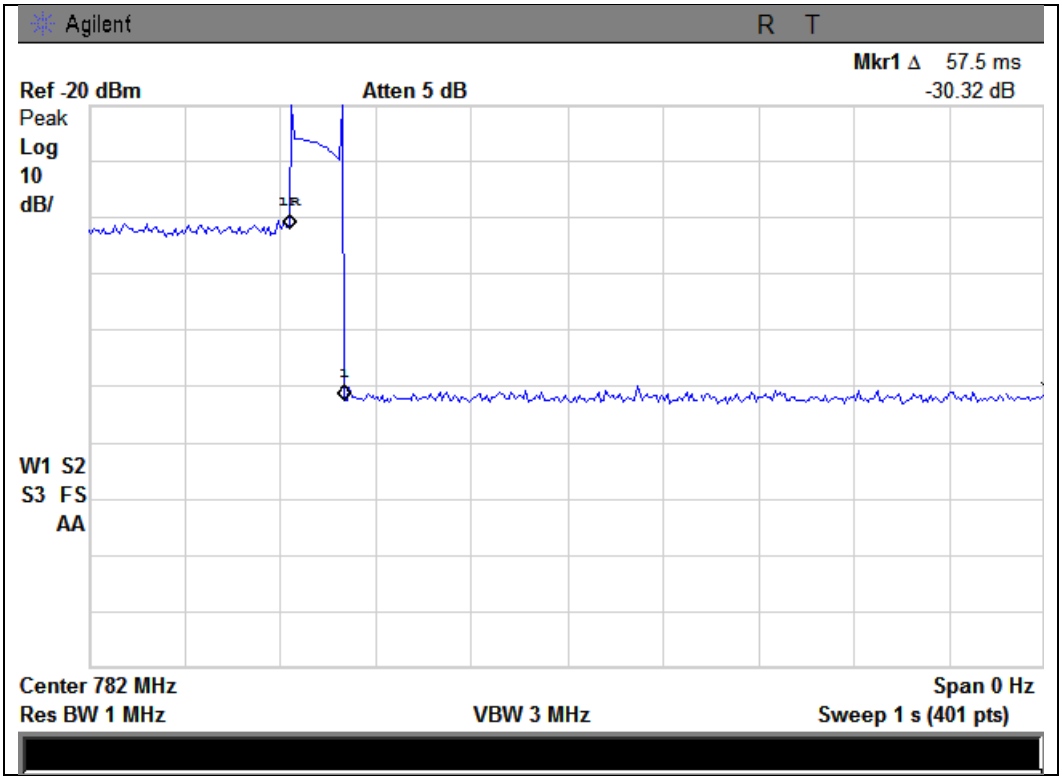
| Frequency Band (MHz) | Restarts | Limit | Result |
|---|---|---|---|
| 728 - 746 | 4 | ≤5 | Pass |
| 746 - 756 | 4 | ≤5 | Pass |
| 869 - 894 | 4 | ≤5 | Pass |
| 1930 - 1995 | 4 | ≤5 | Pass |
| 2110 - 2155 | 4 | ≤5 | Pass |

## Uplink Detection Time Test Results

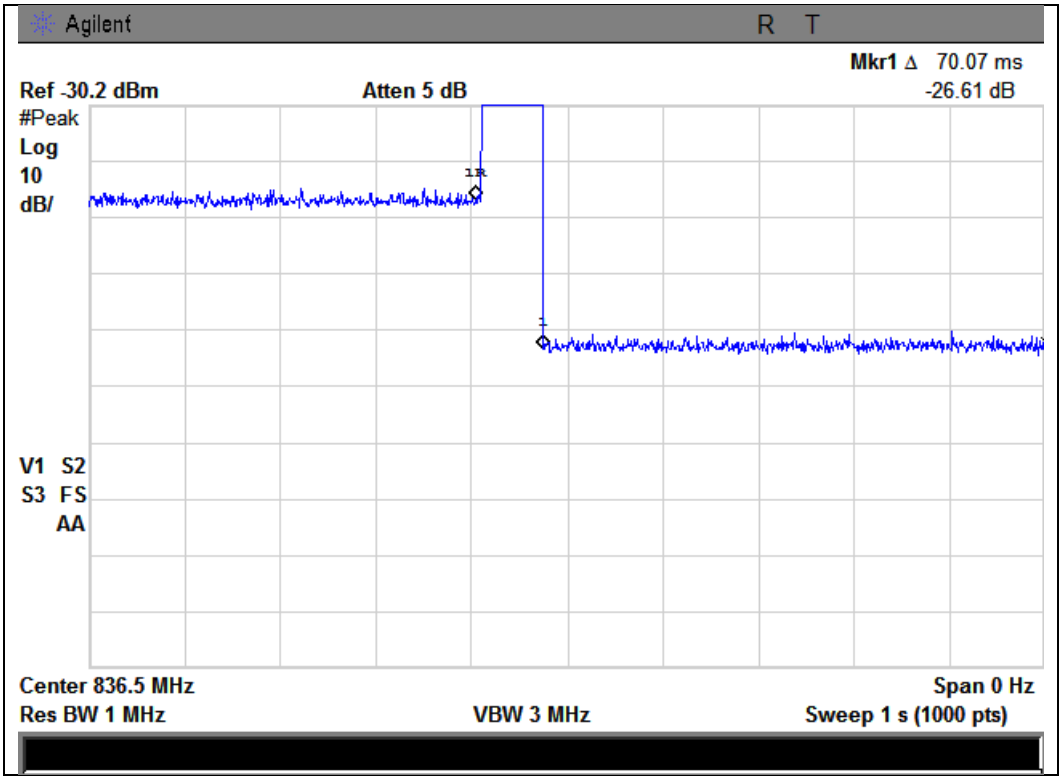
### 698 - 716 MHz Band



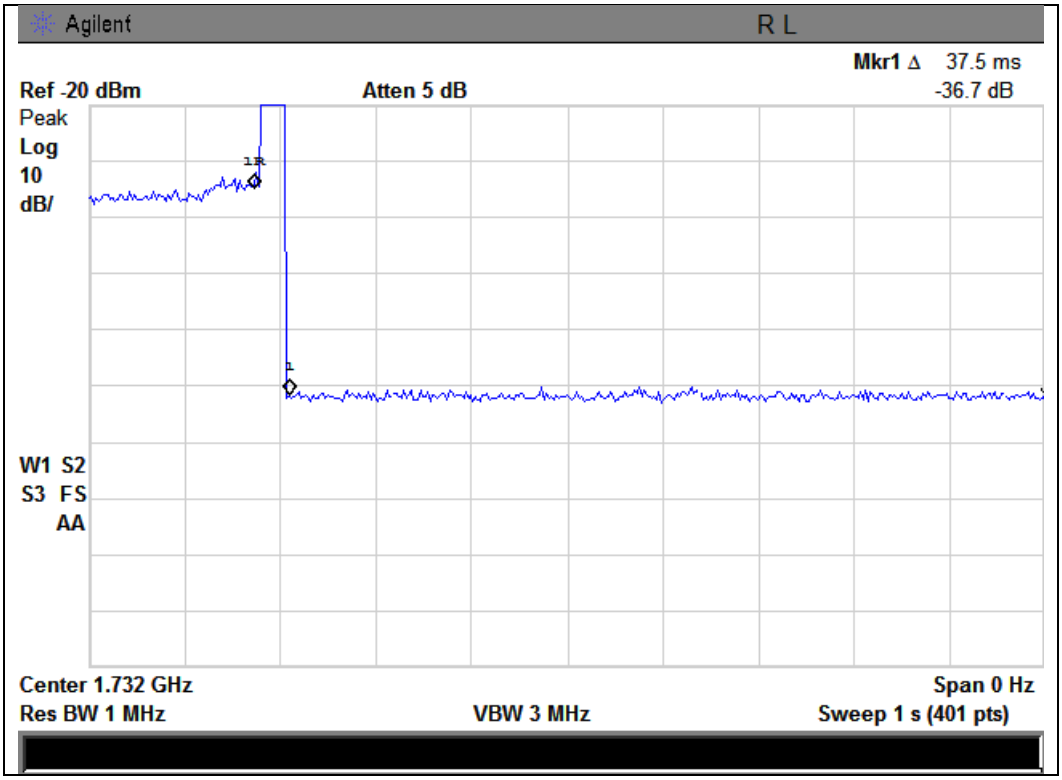

### 777 - 787 MHz Band



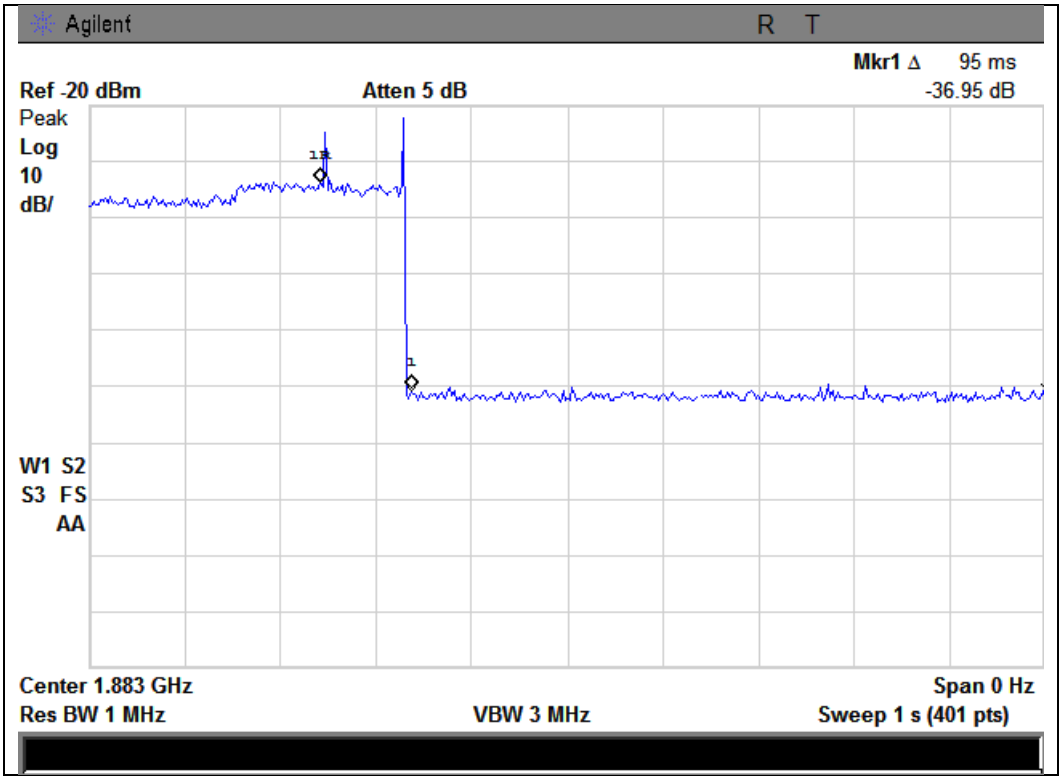
**824 - 849 MHz Band**




**1710 - 1755 MHz Band**

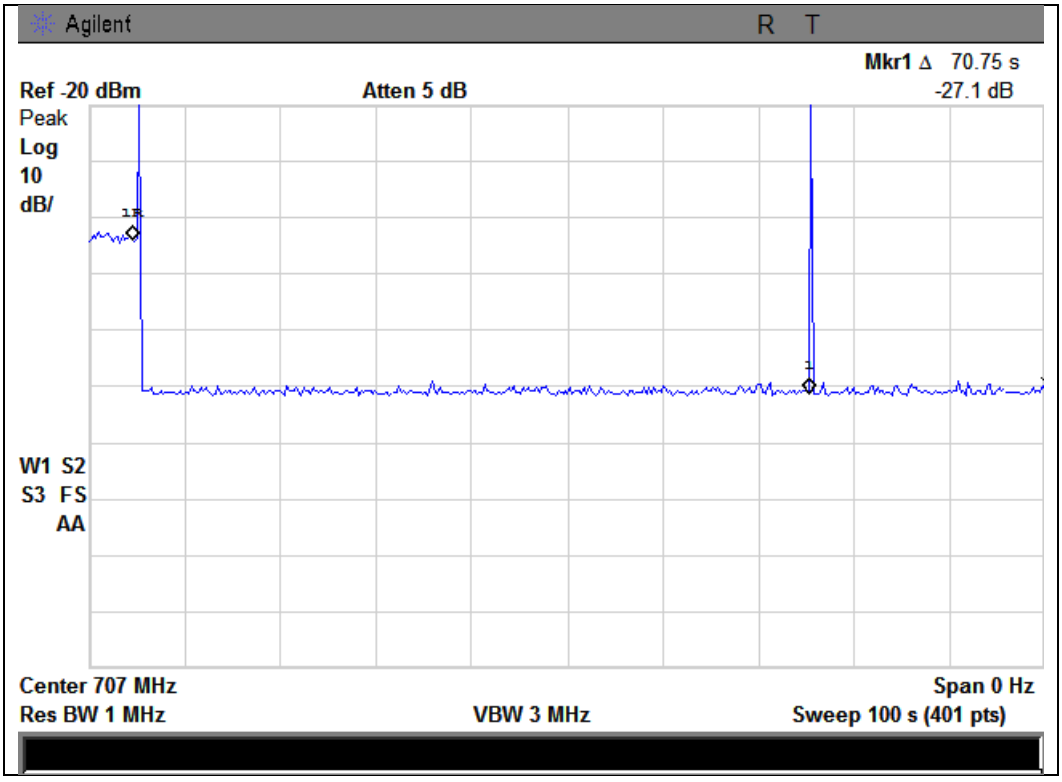


**1850 - 1915 MHz Band**

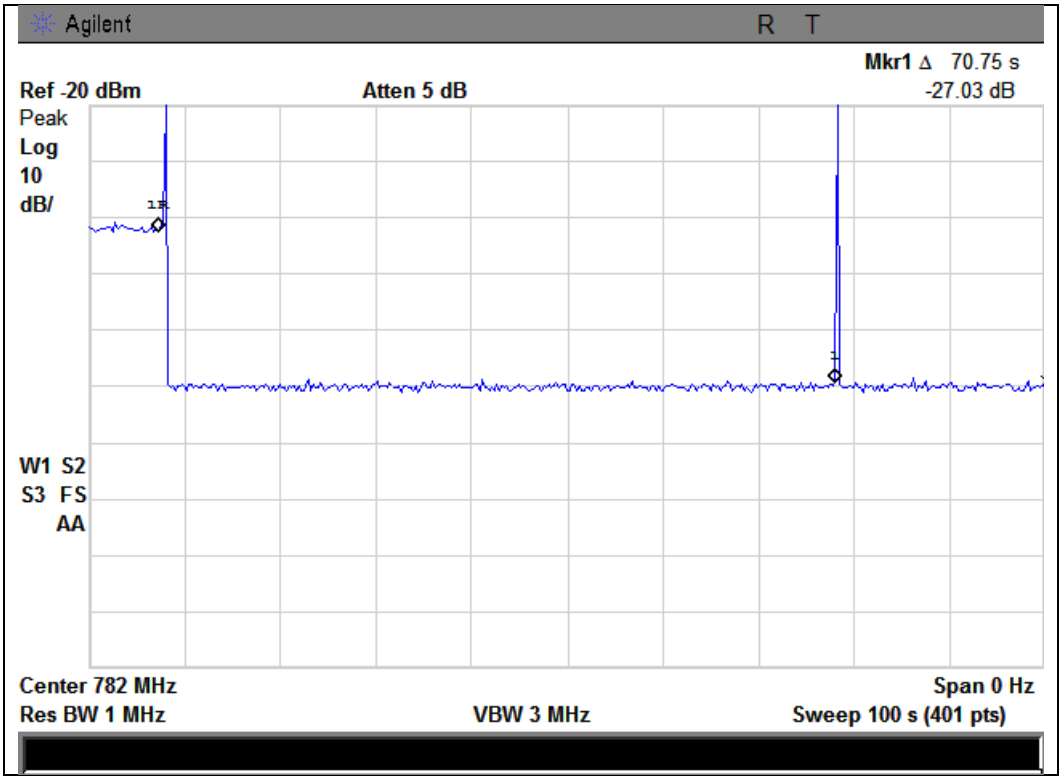



**Uplink Restart Time Test Results**

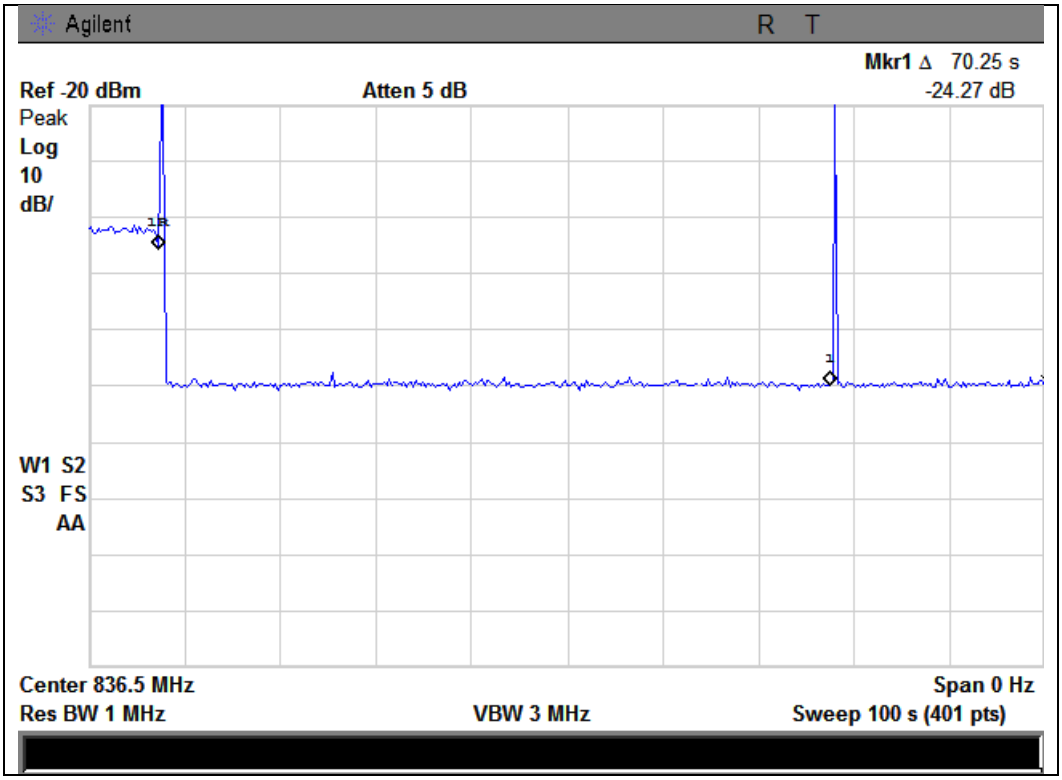
**698 - 716 MHz Band**



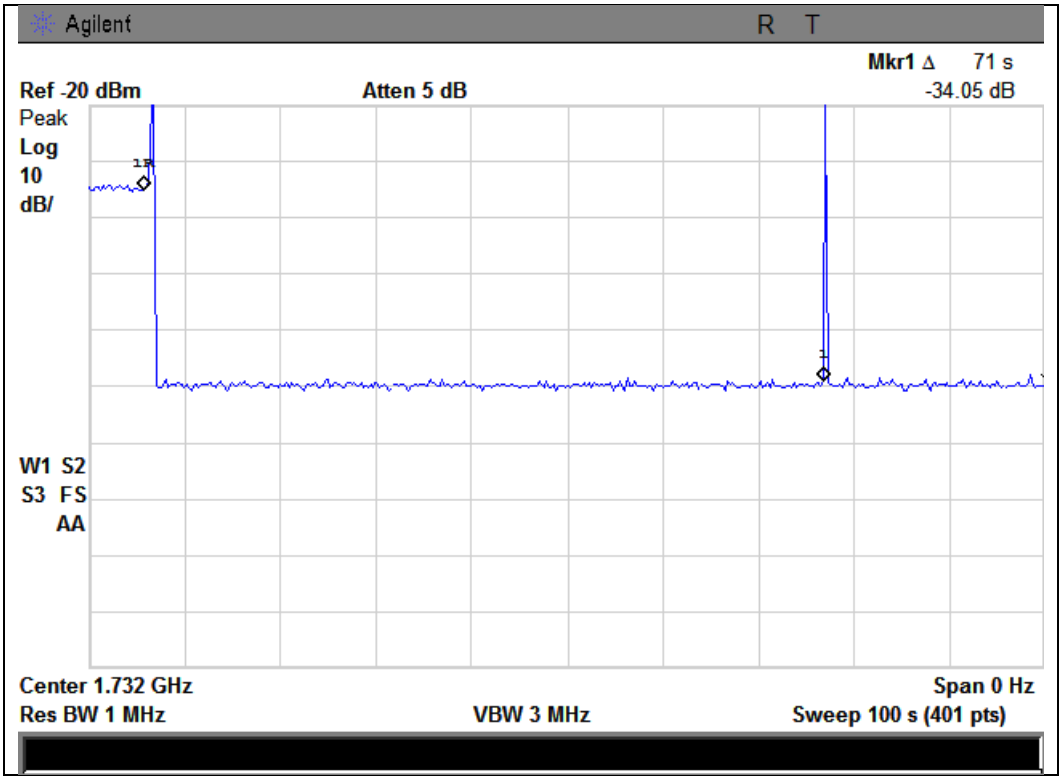
**777 - 787 MHz Band**



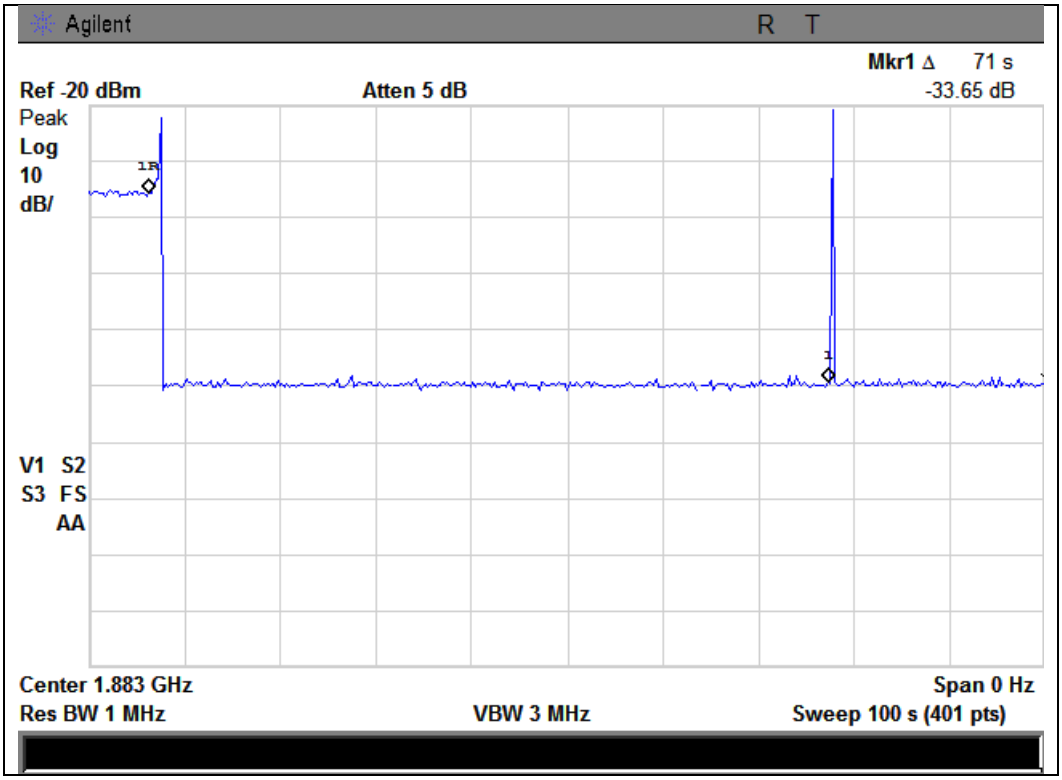

**824 - 849 MHz Band**



**1710 - 1755 MHz Band**

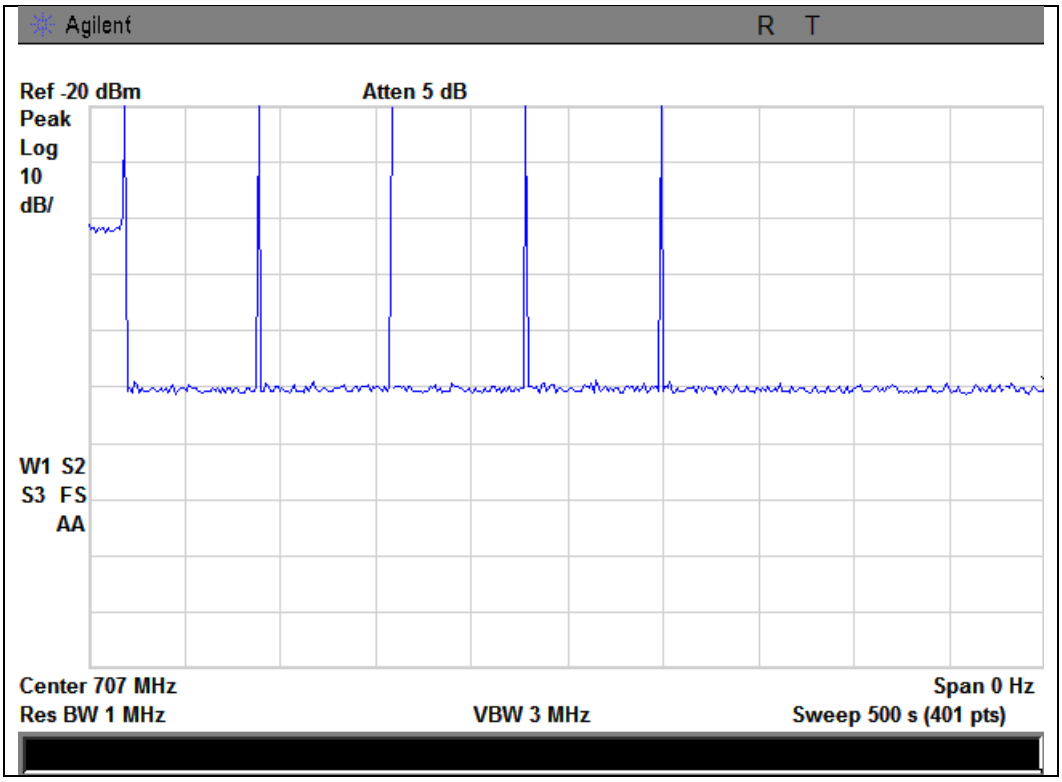



**1850 - 1915 MHz Band**

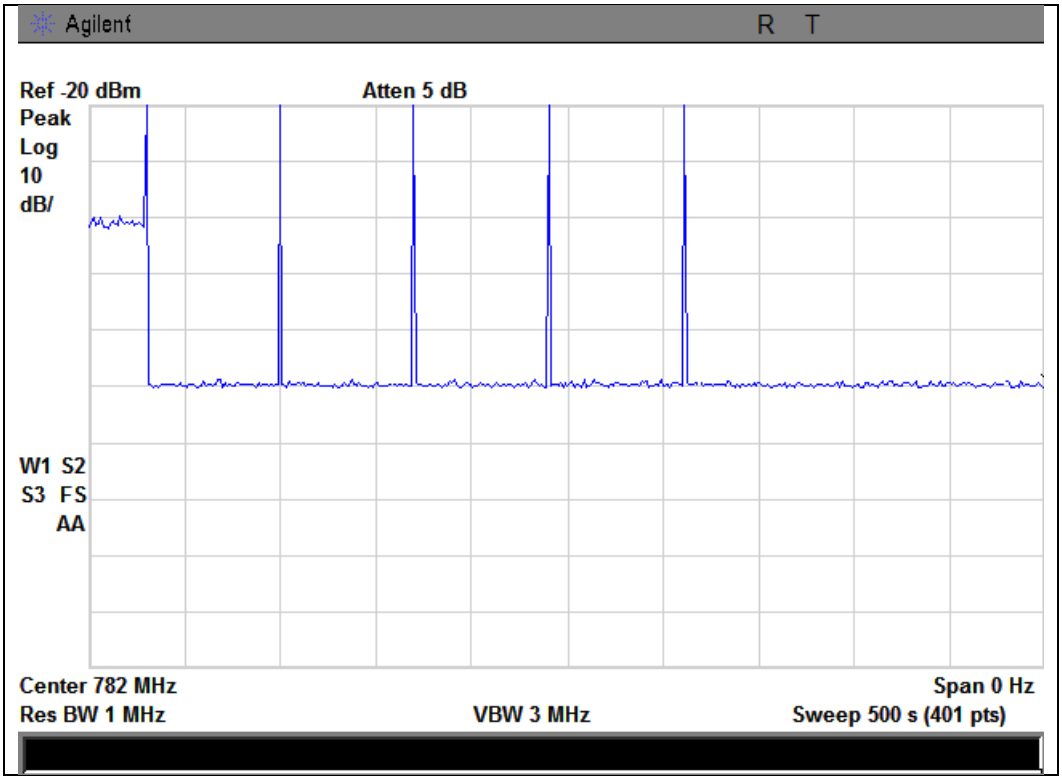


## Uplink Restart Count Test Results

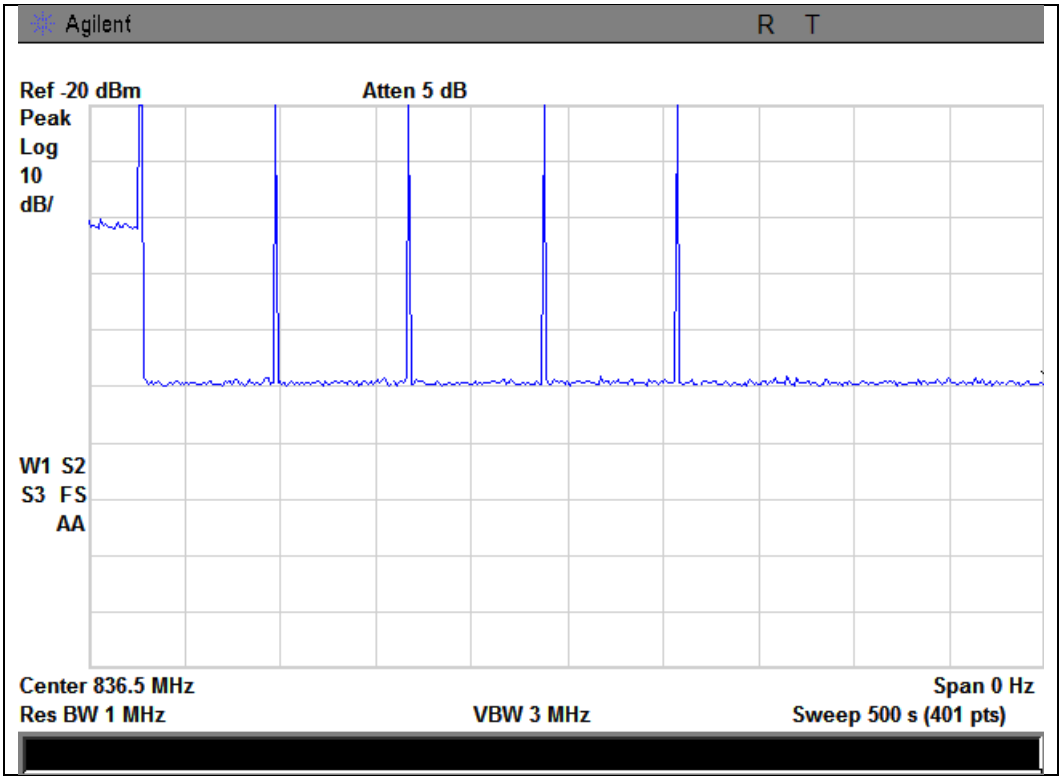
### 698 - 716 MHz Band



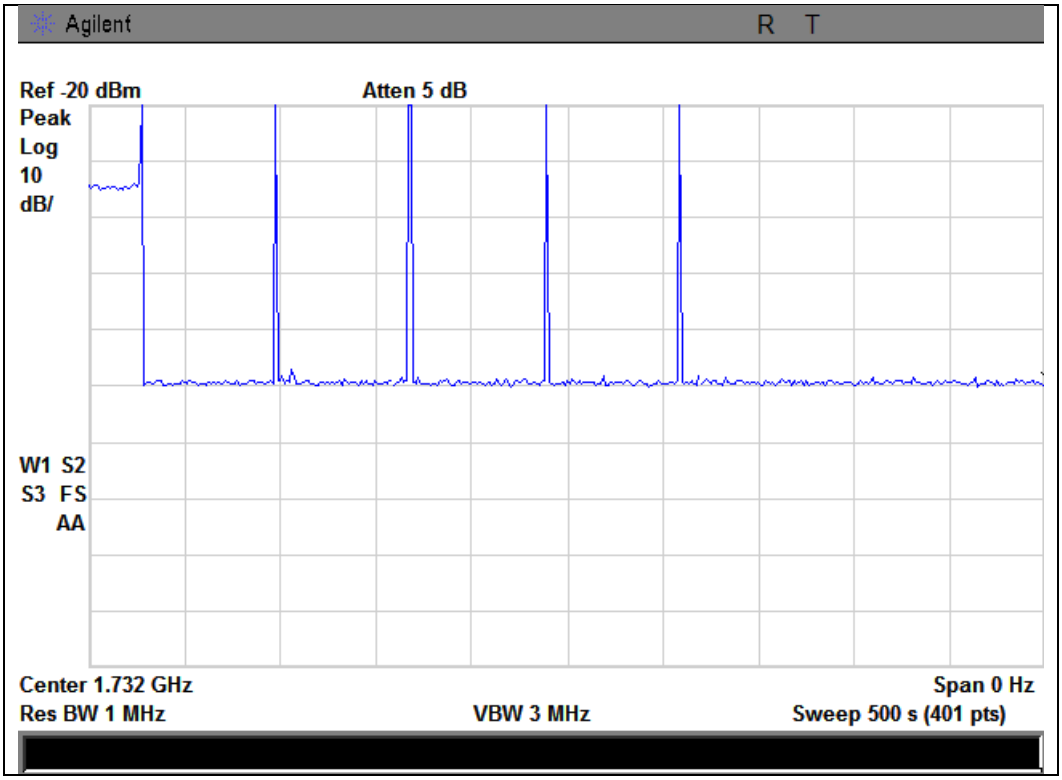

### 777 - 787 MHz Band



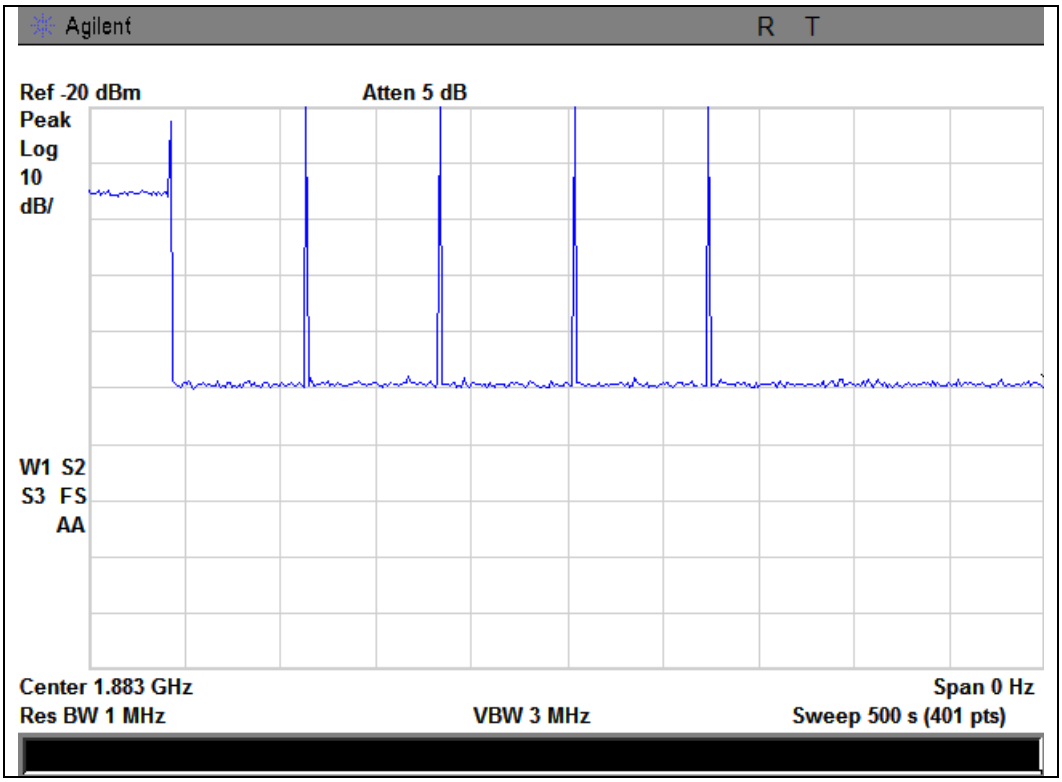
**824 - 849 MHz Band**



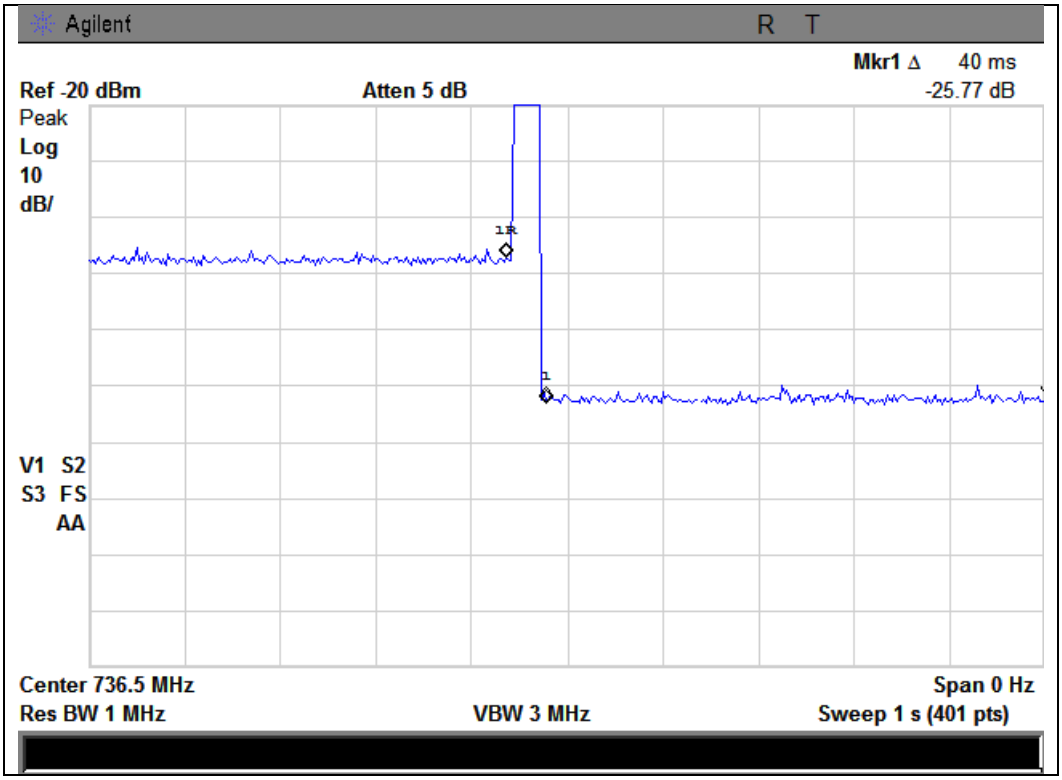

**1710 - 1755 MHz Band**



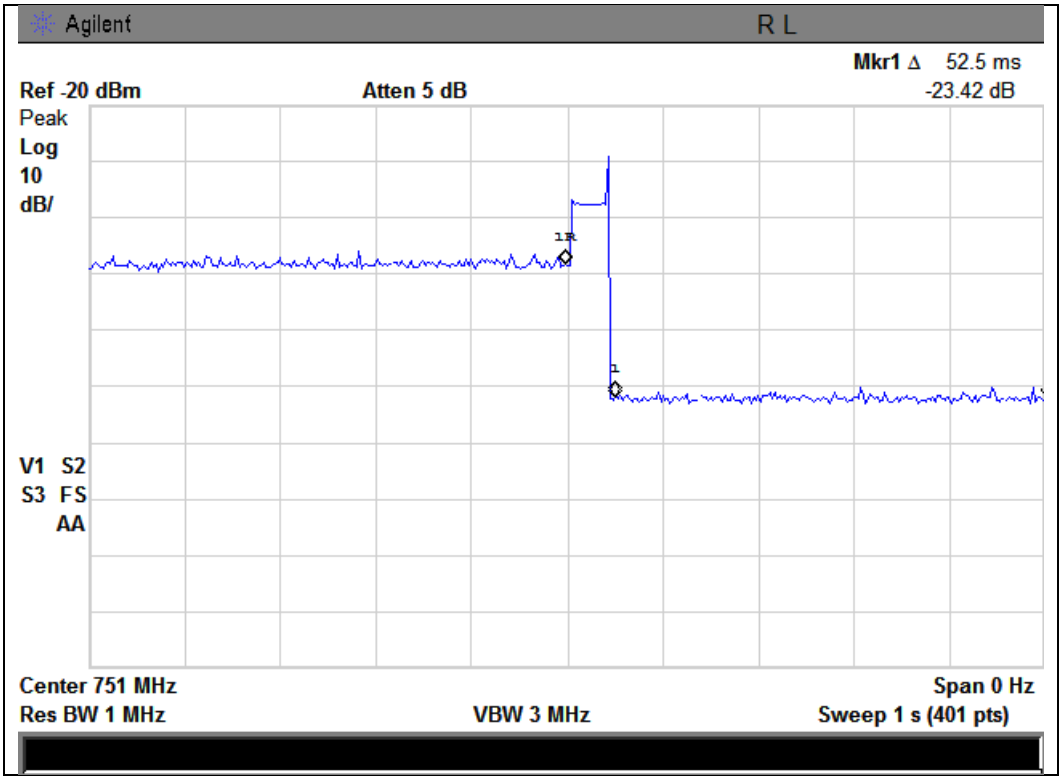
**1850 - 1915 MHz Band**



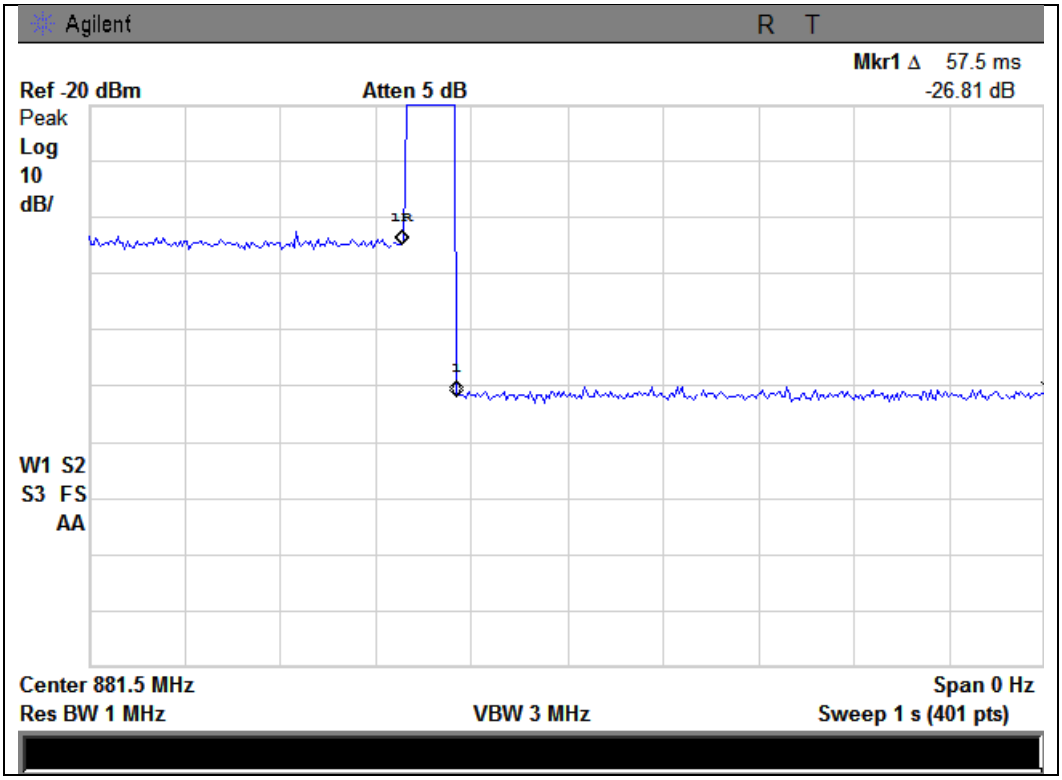

**Downlink Detection Time Test Results**
**728 - 746 MHz Band**



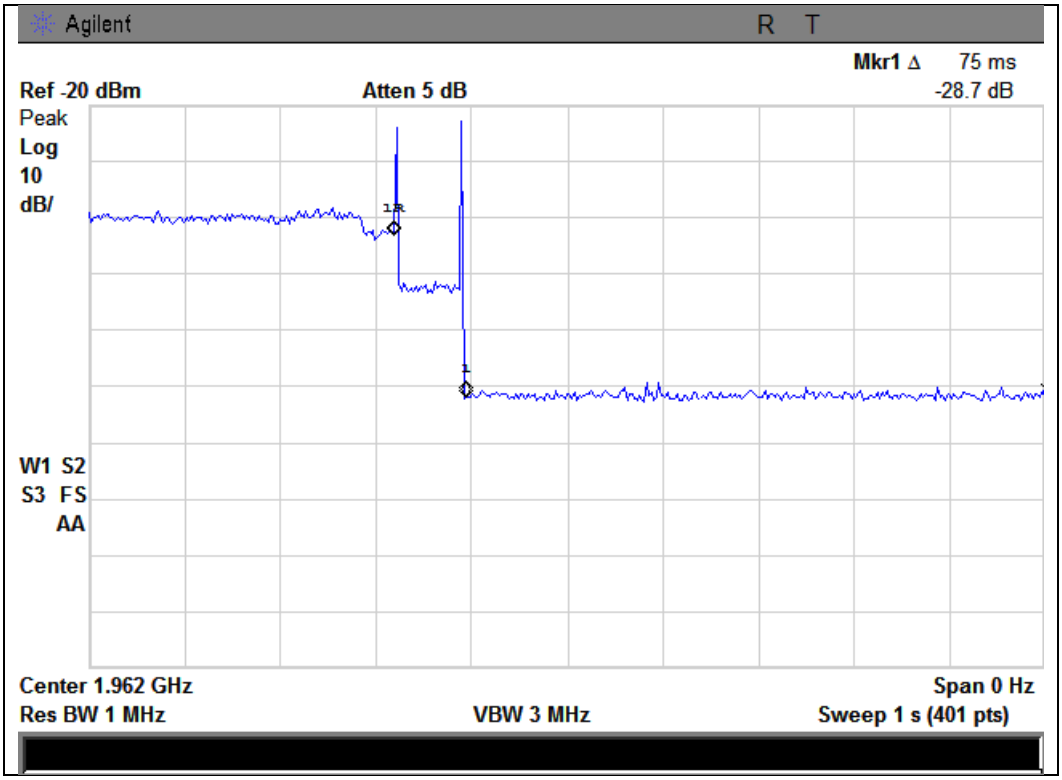
**746 - 756 MHz Band**



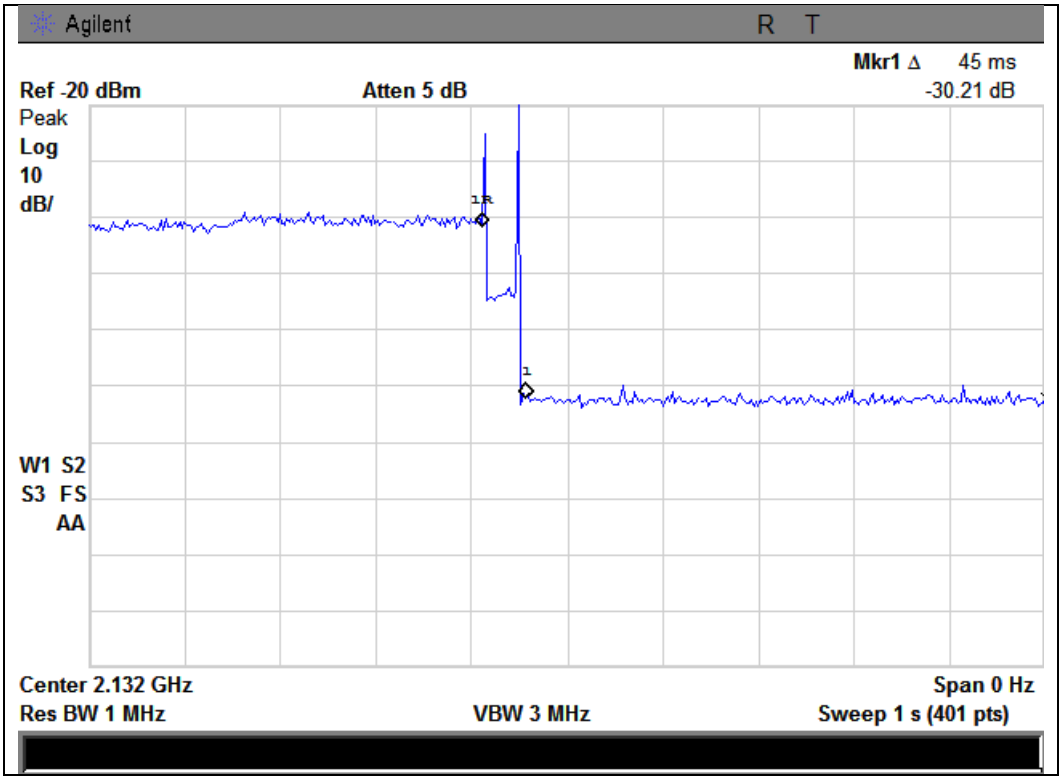

**869 - 894 MHz Band**



**1930 - 1995 MHz Band**

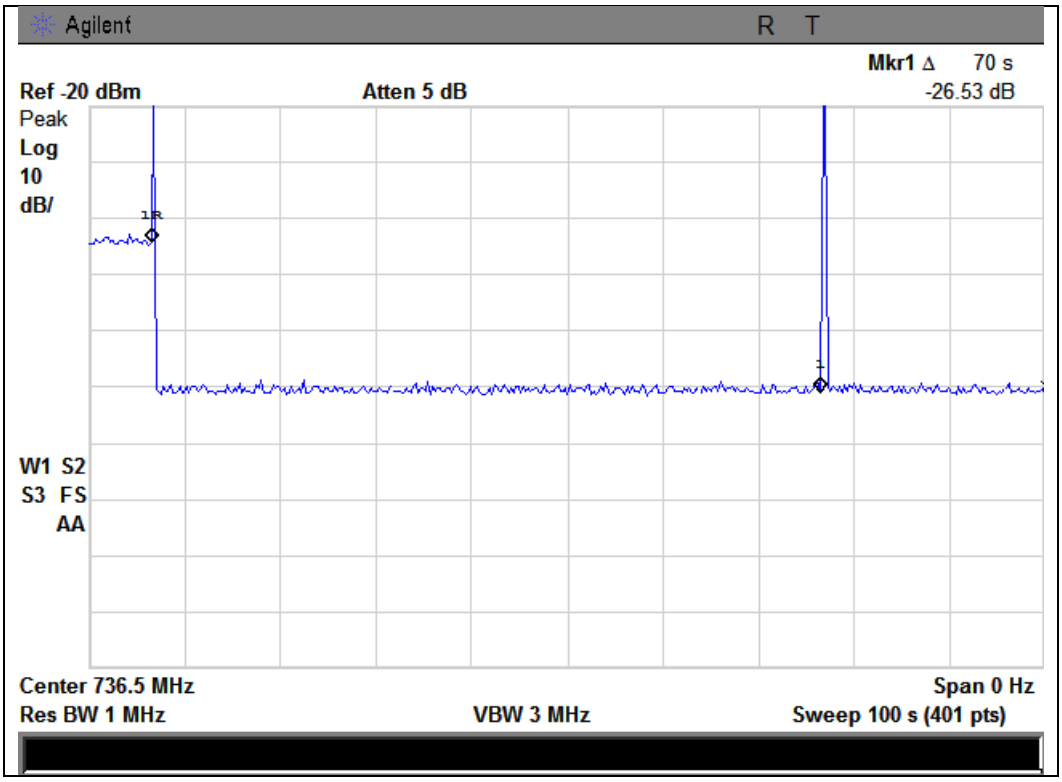



**2110 - 2155 MHz Band**

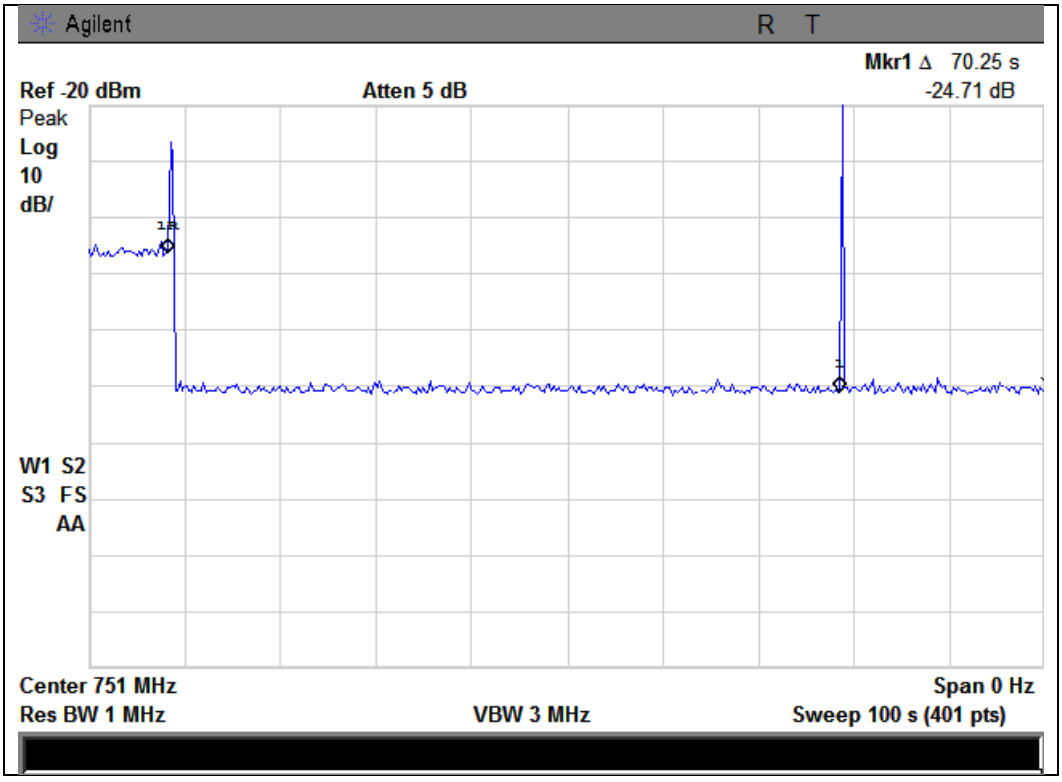


## Downlink Restart Time Test Results

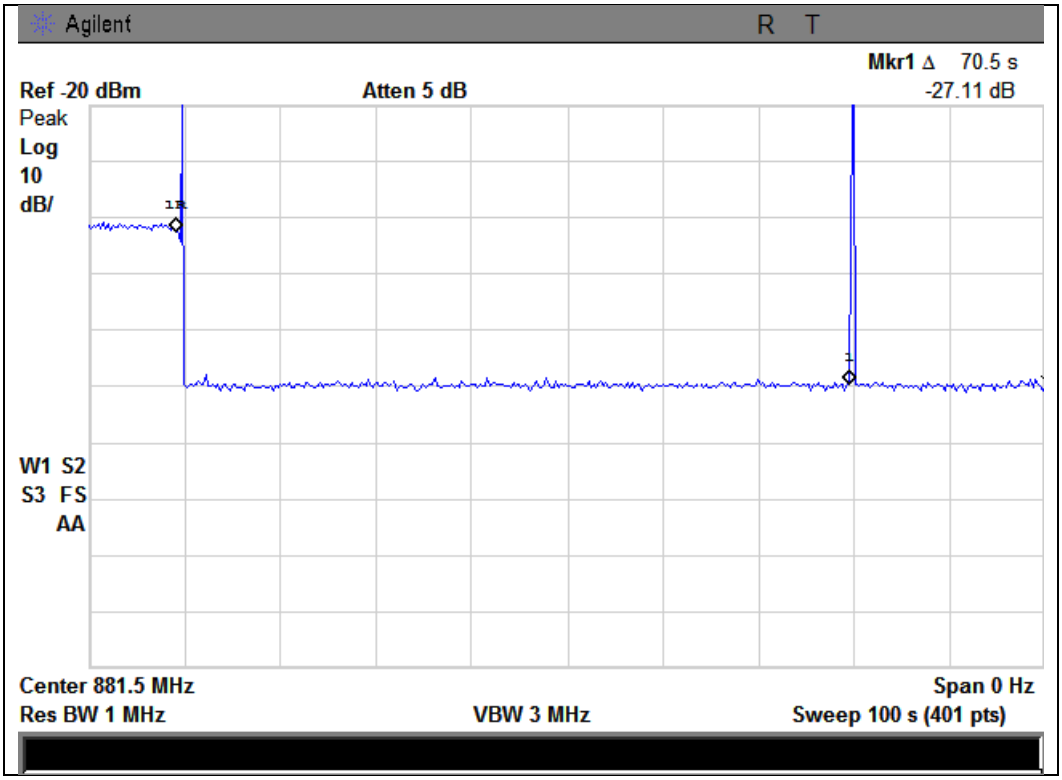
### 728 - 746 MHz Band



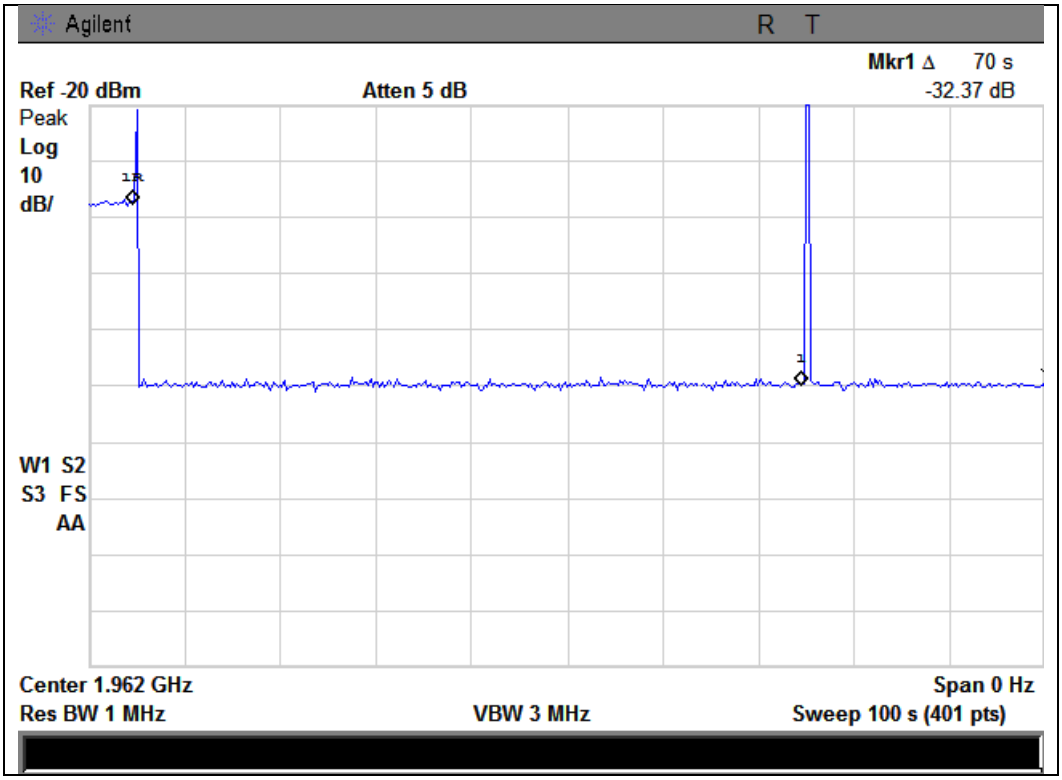

### 746 - 756 MHz Band



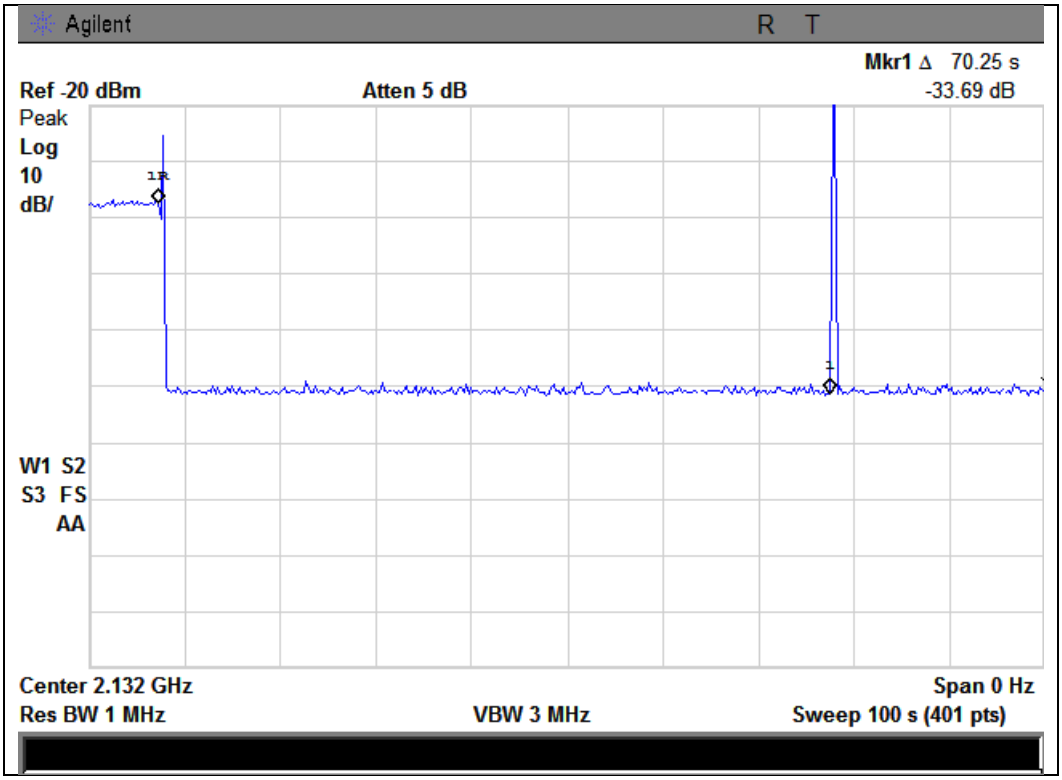
**869 - 894 MHz Band**




**1930 - 1995 MHz Band**

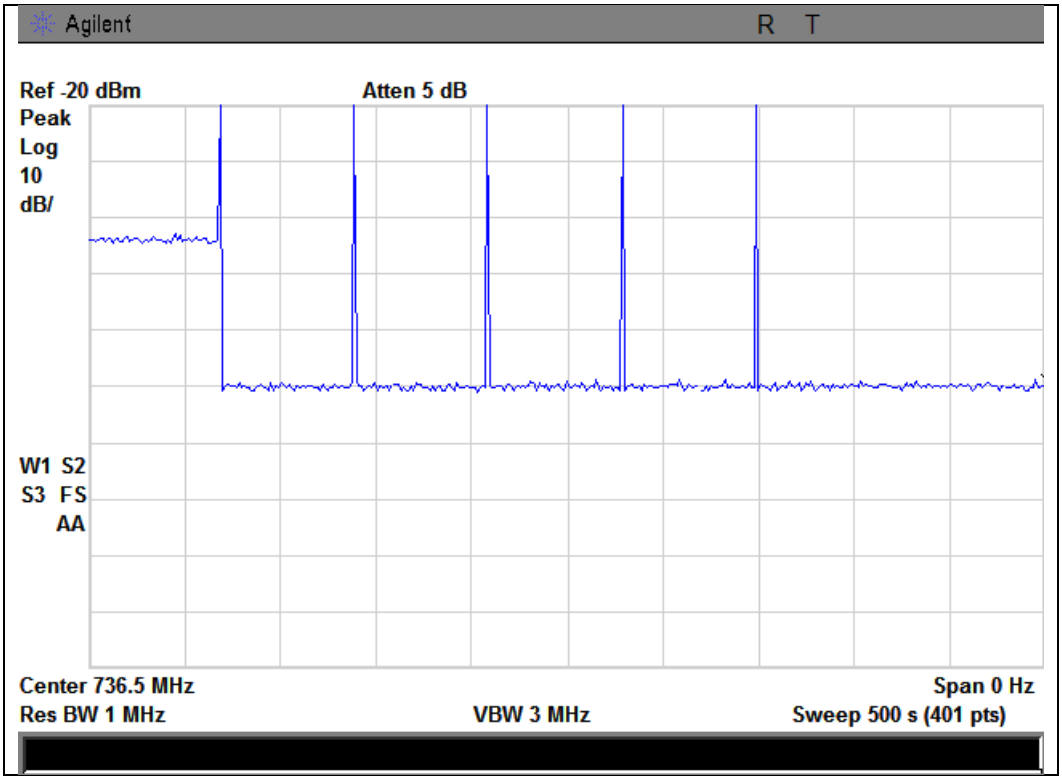


**2110 - 2155 MHz Band**

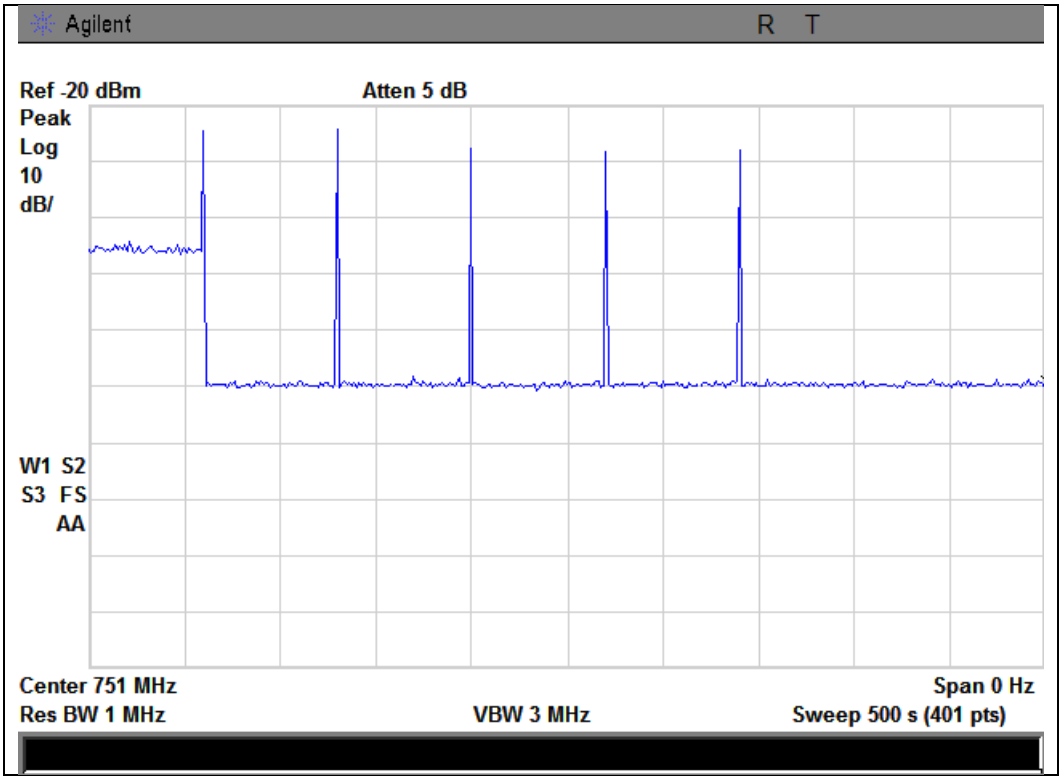



**Downlink Restart Count Test Results**

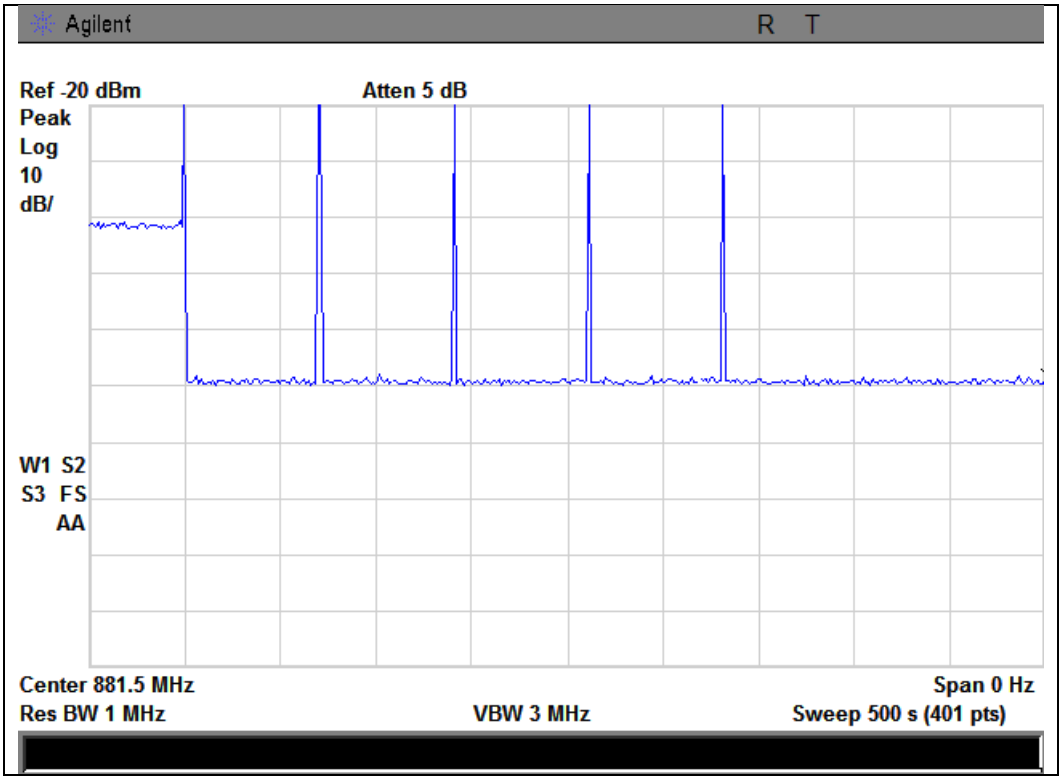
**728 - 746 MHz Band**



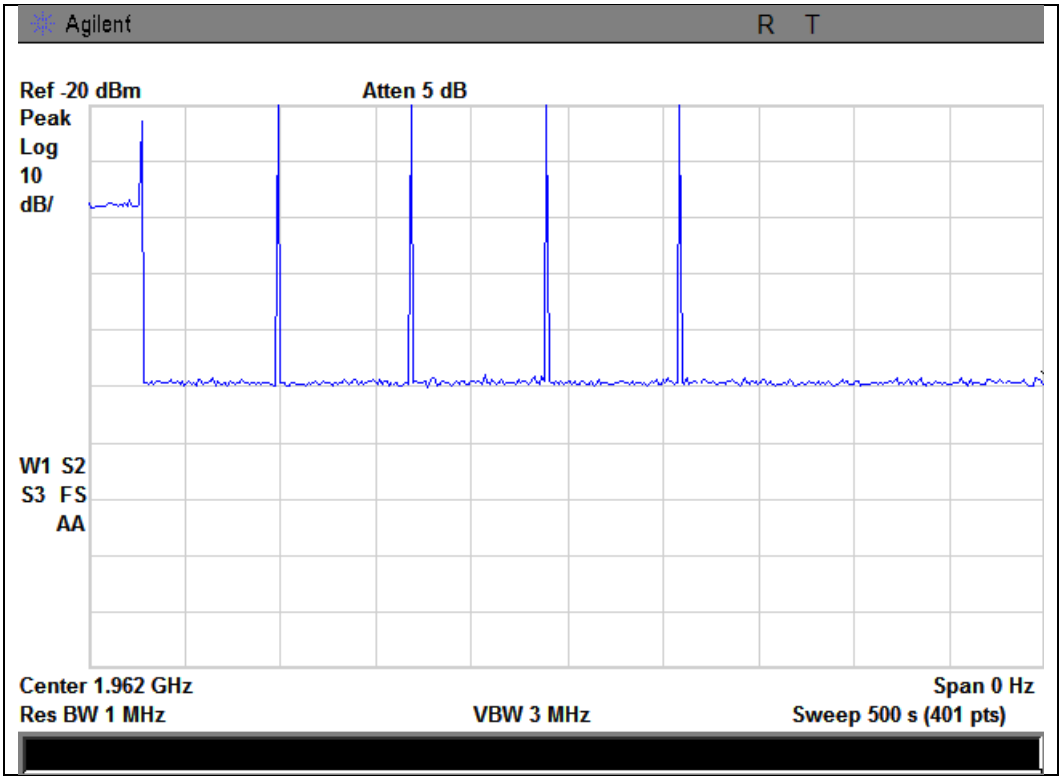
**746 - 756 MHz Band**



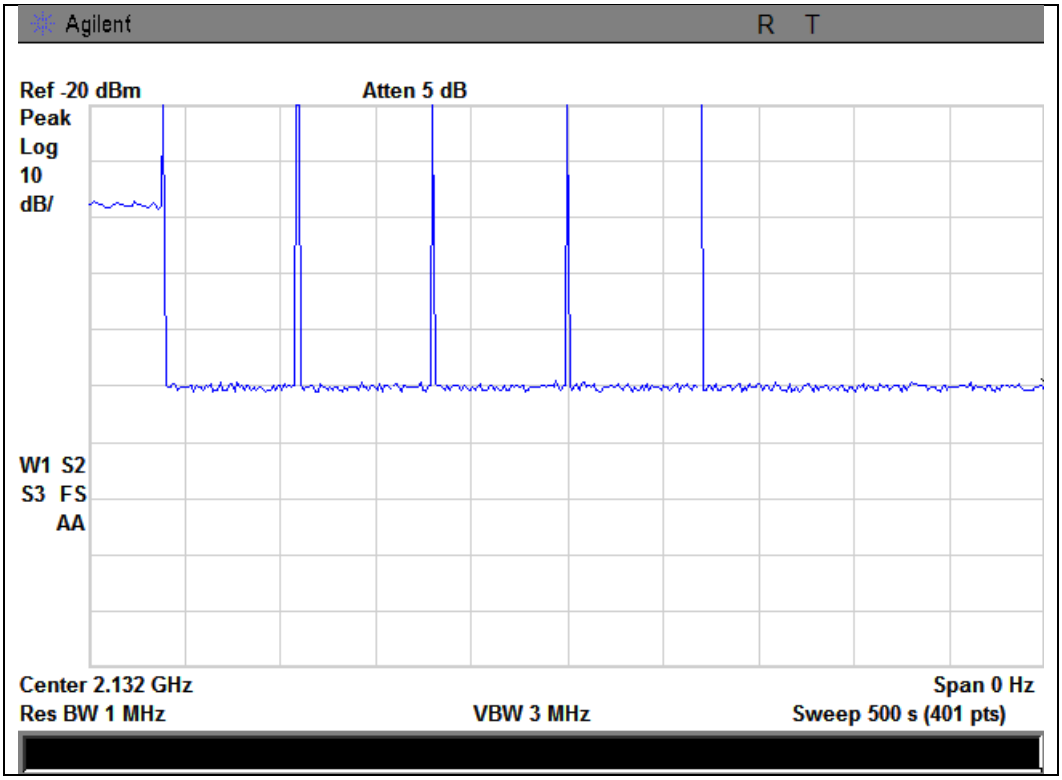

**869 - 894 MHz Band**



**1930 - 1995 MHz Band**




**2110 - 2155 MHz Band**



**Radiated Spurious**

| | | | |
|---|---|---|---|
| **Name of Test:** | Radiated Spurious | **Engineer:** | Greg Corbin |
| **Test Equipment Utilized:** | i00103, i00334, i00348, i00379 | **Test Date:** | 8/15/2013 |

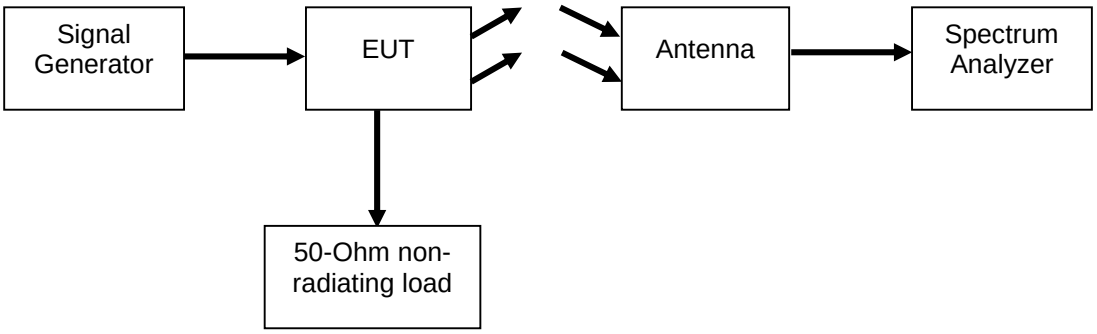
**Test Procedure**

The EUT was tested in an Open Area Test Site (OATS) set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antennas in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal centered in each operational uplink and downlink band. The EUT output was terminated into a 50 Ohm non-radiating load.

The following formulas are used for calculating the limits.

Radiated Spurious Emissions Limit = 43+ 10Log(P)dB

**Test Setup**



## Uplink Test Results

### 698 - 716 MHz Band_707 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1414 | -42.5 | -13 | Pass |
| 2121 | -39.6 | -13 | Pass |
| 2828 | -36 | -13 | Pass |

### 777 - 787 MHz Band_782 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1563 | -44.2 | -13 | Pass |
| 2344.5 | -40.4 | -13 | Pass |
| 3126 | -36.3 | -13 | Pass |

### 824 - 849 MHz Band_836.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1672 | -44.6 | -13 | Pass |
| 2508 | -37.6 | -13 | Pass |
| 3344 | -33.1 | -13 | Pass |

### 1710 - 1755 MHz Band_1732.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 3484 | -32.5 | -13 | Pass |
| 5226 | -32.2 | -13 | Pass |
| 6968 | -25.0 | -13 | Pass |

### 1850 - 1915 MHz Band 1882.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 3760 | -33.1 | -13 | Pass |
| 5640 | -30.5 | -13 | Pass |
| 7520 | -23.3 | -13 | Pass |

## Downlink Test Results

### 728 - 746 MHz Band_736.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1474 | -44.0 | -13 | Pass |
| 2211 | -41 | -13 | Pass |
| 2948 | -36.0 | -13 | Pass |

### 746 - 756 MHz Band_751 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1503 | -44.2 | -13 | Pass |
| 2254.5 | -38.4 | -13 | Pass |
| 3006 | -35.0 | -13 | Pass |

### 869 - 894 MHz Band_881.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 1763 | -42.2 | -13 | Pass |
| 2644.5 | -37.4 | -13 | Pass |
| 3526 | -33.8 | -13 | Pass |

### 1930 - 1995 MHz Band_1962.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 3920 | -34.4 | -13 | Pass |
| 5880 | -30.8 | -13 | Pass |
| 7840 | -22.6 | -13 | Pass |

### 2110 - 2155 MHz Band_2132.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|---|---|---|---|
| 4265 | -33.5 | -13 | Pass |
| 6397.5 | -29.6 | -13 | Pass |
| 8530 | -21.3 | -13 | Pass |

No other emissions were detected. All emissions were lower than –13 dBm.
All emissions were system noise floor.

**Test Equipment Utilized**

| Description | Manufacturer | Model Number | CT Asset # | Last Cal Date | Cal Due Date |
|---|---|---|---|---|---|
| Horn Antenna | EMCO | 3115 | i00103 | 12/11/12 | 12/11/14 |
| Humidity / Temp Meter | Newport | IBTHX-W-5 | i00282 | 12/4/12 | 12/4/13 |
| Voltmeter | Fluke | 75III | i00320 | 2/1/13 | 2/1/14 |
| Non-radiating load | Termaline | 8201 | i00334 | Verified on: 8/15/13 | |
| Vector Signal Generator | Agilent | E4438C | i00348 | 1/4/13 | 1/4/14 |
| EMI Analyzer | Agilent | E7405A | i00379 | 11/21/12 | 11/21/13 |
| Tunable Band Pass Filter | Wilson Electronics | Variable attenuator / Bandpass Filter Switch Assembly | i00411 | Verified on: 8/14/13 | |
| RF Directional Coupler | Meca | CS06-1.500V | i00413 | Verified on: 7/29/2013 | |
| Signal Generator | Rohde & Schwarz | SMU200A | S/N:101369 | 6/24/13 | 6/24/16 |
| Spectrum Analyzer | Agilent | E4407B | S/N: MY41444836 | 6/21/13 | 6/21/14 |

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT