



## **Compliance Testing, LLC**

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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# **Test Report**

Prepared for: Wilson Electronics, Inc.

Model: 460026

Description: Dual Band Fixed Install Signal Booster

FCC ID: PWO460026

To

FCC Part 20

Date of Issue: February 19, 2015

On the behalf of the applicant:

Wilson Electronics, Inc.  
3301 E Deseret Drive  
St. George, UT 84790

To the attention of:

Patrick Cook, Sr Research & Development Engineer  
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Prepared By  
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Project No: p1510001

**Mike Graffeo**  
**Project Test Engineer**

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All results contained herein relate only to the sample tested.



### Test Report Revision History

| Revision | Date    | Revised By   | Reason for Revision     |
|----------|---------|--------------|-------------------------|
| 1.0      | 1/7/15  | Mike Graffeo | Original Document       |
| 2.0      | 2/18/15 | Mike Graffeo | Added EIRP Calculations |
|          |         |              |                         |
|          |         |              |                         |



## Table of Contents

| <b><u>Description</u></b>                          | <b><u>Page</u></b> |
|----------------------------------------------------|--------------------|
| Standard Test Conditions and Engineering Practices | 5                  |
| Test Result Summary                                | 7                  |
| Authorized Frequency Band                          | 8                  |
| Maximum Power and Gain                             | 11                 |
| Intermodulation                                    | 14                 |
| Out-of-Band Emissions                              | 17                 |
| Conducted Spurious Emissions                       | 32                 |
| Noise Limits                                       | 41                 |
| Variable Gain                                      | 47                 |
| Occupied Bandwidth                                 | 50                 |
| Oscillation Detection                              | 63                 |
| Radiated Spurious                                  | 71                 |
| Test Equipment Utilized                            | 73                 |



## ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009).

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**



FCC Site Reg. #349717

IC Site Reg. #2044A-2

**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 KDB 935210.

## 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<br>(°C)             | Humidity<br>(%) | Pressure<br>(mbar) |
| 24.9 – 31.0              | 33.5 – 63.0     | 985.5 - 943.0      |

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

## EUT Description

**Model:** 460026

**Description:** Dual Band Fixed Install Signal Booster

**Firmware:** A46026A

**Software:** 460026A

### Additional Information:

The EUT is a bi-directional amplifier for the boosting of cellular phone signals and data communication devices. The following frequency bands and emission types are utilized and it is considered a direct connect device.

| Frequency Band<br>(MHz) |                                     |                                     |
|-------------------------|-------------------------------------|-------------------------------------|
| <b>Uplink</b>           | 824 - 849                           | 1850 – 1915                         |
| <b>Downlink</b>         | 869 - 894                           | 1930 - 1995                         |
| <b>Modulation Type</b>  | GSM, CDMA, EDGE, HSPA.<br>EVDO, LTE | GSM, CDMA, EDGE, HSPA. EVDO,<br>LTE |

| Emission Designators |             |            |             |             |            |
|----------------------|-------------|------------|-------------|-------------|------------|
| <b>CDMA</b>          | <b>HSPA</b> | <b>LTE</b> | <b>EVDO</b> | <b>EDGE</b> | <b>GSM</b> |
| F9W                  | F9W         | G7D        | F9W         | G7W         | GXW        |

The modulation types and emission designators listed in the tables 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.

## EUT Operation during Tests

The EUT was in a normal operating condition.



**Accessories:**

| Qty | Description          | Manufacturer | Model        | S/N |
|-----|----------------------|--------------|--------------|-----|
| 1   | 50 to 75 ohm adaptor | MiniCircuits | SFMP-5075-3+ | N/A |

**Cables:** None

**Modifications:** None



## 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(f)                                 | Conducted Spurious Emissions | Pass            |                                                                 |
| 20.21(e)(8)(i)(A)<br>20.21(e)(8)(I)                                          | Noise Limits                 | N/A             |                                                                 |
| 20.21(e)(8)(i)(I)                                                            | Uplink Inactivity            | N/A             |                                                                 |
| 20.21(e)(8)(i)(C)(1)<br>20.21(e)(8)(i)(H)<br>20.21(e)(8)(i)(C)(2)(i) (Fixed) | 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:** Mike Graffeo

**Test Equipment Utilized:**

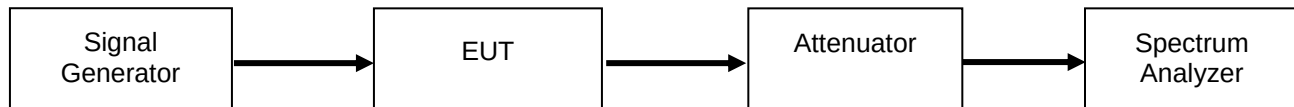
i00379, i00405

**Test Date:** 1/5/15

**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 needed to ensure accurate readings. 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 Plots

### 824 - 849 MHz Band

Agilent 09:08:42 Jan 5, 2015

L



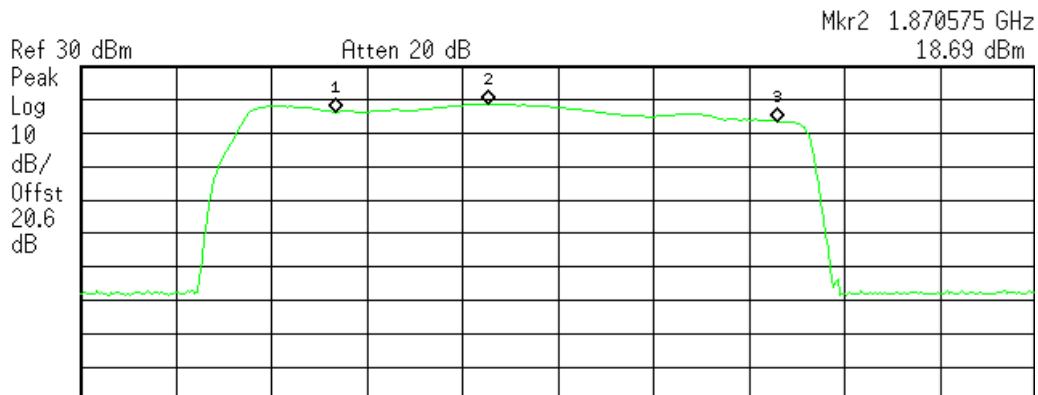
Center 836.5 MHz  
#Res BW 100 kHz  
VBW 300 kHz  
Sweep 5.18 ms (401 pts)  
Span 50 MHz

| Marker | Trace | Type | X Axis      | Amplitude |
|--------|-------|------|-------------|-----------|
| 1      | (1)   | Freq | 824.000 MHz | 18.43 dBm |
| 2      | (1)   | Freq | 833.875 MHz | 19.18 dBm |
| 3      | (1)   | Freq | 849.000 MHz | 16.19 dBm |

### 1850 - 1915 MHz Band

Agilent 09:14:30 Jan 5, 2015

L



Center 1.88 GHz  
#Res BW 100 kHz  
VBW 300 kHz  
Sweep 13.47 ms (401 pts)  
Span 130 MHz

| Marker | Trace | Type | X Axis       | Amplitude |
|--------|-------|------|--------------|-----------|
| 1      | (1)   | Freq | 1.850000 GHz | 16.34 dBm |
| 2      | (1)   | Freq | 1.870575 GHz | 18.69 dBm |
| 3      | (1)   | Freq | 1.910000 GHz | 13.44 dBm |

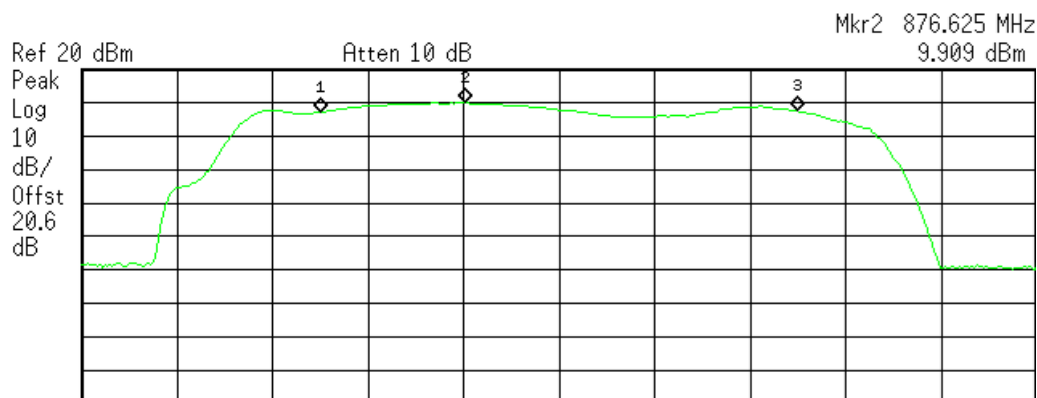


## Downlink Test Plots

### 869 - 894 MHz Band

Agilent 09:21:03 Jan 5, 2015

L



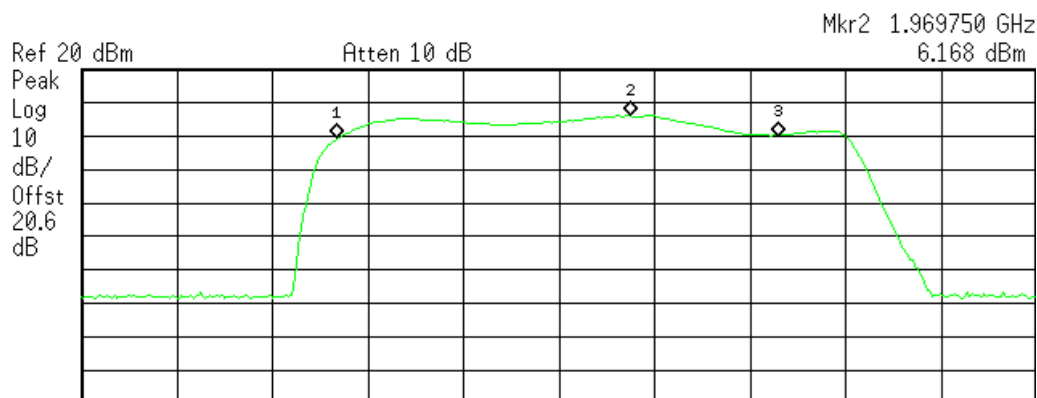
Center 881.5 MHz Span 50 MHz  
#Res BW 100 kHz VBW 300 kHz Sweep 5.18 ms (401 pts)

| Marker | Trace | Type | X Axis      | Amplitude |
|--------|-------|------|-------------|-----------|
| 1      | (1)   | Freq | 869.000 MHz | 7.15 dBm  |
| 2      | (1)   | Freq | 876.625 MHz | 9.909 dBm |
| 3      | (1)   | Freq | 894.000 MHz | 7.387 dBm |

### 1930 - 1995 MHz Band

Agilent 09:38:25 Jan 5, 2015

L



Center 1.96 GHz Span 130 MHz  
#Res BW 100 kHz VBW 300 kHz Sweep 13.47 ms (401 pts)

| Marker | Trace | Type | X Axis       | Amplitude  |
|--------|-------|------|--------------|------------|
| 1      | (1)   | Freq | 1.930000 GHz | -0.483 dBm |
| 2      | (1)   | Freq | 1.969750 GHz | 6.168 dBm  |
| 3      | (1)   | Freq | 1.990000 GHz | 0.105 dBm  |



## Maximum Power and Gain

**Name of Test:** Maximum Power and Gain  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 1/5/15

### Test Procedure

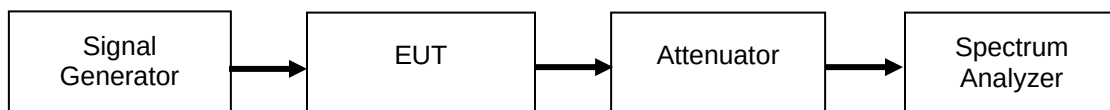
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. The spectrum analyzer and signal generator were tuned to the frequency with the highest power level 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 for both pulsed single time slot GSM modulation 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 being computed from these values. The uplink and downlink gain under each condition were verified to be within 9 dB of each other.

For Fixed installations the following formula was used for calculating the gain limits.

$$\text{Gain Limit (dB)} = 6.5 \text{ dB} + 20\text{Log}(F_{\text{MHz}})$$

$F_{\text{MHz}}$  is the uplink mid-band frequency with the downlink gain limit being equivalent to the paired Uplink band gain limit.

### Test Setup





### Uplink Power Test Results

| Frequency Band (MHz)       | Input Level (dBm) | Output Power (dBm) | Lower Limit (dBm) | Upper Limit (dBm) | Result |
|----------------------------|-------------------|--------------------|-------------------|-------------------|--------|
| 824 - 849 MHz Pulsed GSM   | -36.3             | 24.70              | 17                | 30                | Pass   |
| 824 - 849 MHz AWGN         | -40.3             | 21.29              | 17                | 30                | Pass   |
| 1850 - 1915 MHz Pulsed GSM | -45.2             | 24.78              | 17                | 30                | Pass   |
| 1850 - 1915 MHz AWGN       | -48.4             | 21.44              | 17                | 30                | Pass   |

### Downlink Power Test Results

| Frequency Band (MHz)       | Input Level (dBm) | Output Power (dBm) | Upper Limit (dBm) | Result |
|----------------------------|-------------------|--------------------|-------------------|--------|
| 869 - 894 MHz Pulsed GSM   | -51.7             | 10.17              | 17                | Pass   |
| 869 - 894 MHz AWGN         | -49.5             | 12.26              | 17                | Pass   |
| 1930 - 1995 MHz Pulsed GSM | -61.8             | 6.69               | 17                | Pass   |
| 1930 - 1995 MHz AWGN       | -59.2             | 9.26               | 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  | 833.88                 | 876.6                    | 61.00            | 64.9              | 61.9               | 64.9                | 0.87       | 9          | -8.13       |
| AWGN       | 833.88                 | 876.6                    | 61.59            | 64.9              | 61.8               | 64.9                | 0.17       | 9          | -8.83       |
| Pulsed CW  | 1870.6                 | 1969.7                   | 69.98            | 72                | 68.5               | 72                  | 1.49       | 9          | -7.51       |
| AWGN       | 1870.6                 | 1969.7                   | 69.84            | 72                | 68.5               | 72                  | 1.38       | 9          | -7.62       |



### EIRP Uplink Power Calculations

| Frequency Band (MHz) | Antenna Kit   | EIRP (dBm) | Limit (dBm) | Result |
|----------------------|---------------|------------|-------------|--------|
| 824 - 849            | 311129-400100 | 29.56      | 30.0        | Pass   |
| 1850 - 1915          | 3144473-0640  | 29.52      | 30.0        | Pass   |

### EIRP Downlink Power Calculations

| Frequency Band (MHz) | Antenna Kit | EIRP (dBm) | Limit (dBm) | Result |
|----------------------|-------------|------------|-------------|--------|
| 869 - 894            | 311115-1150 | 2.12       | 30.0        | Pass   |
| 1930 - 1995          | 309900-50N  | 7.49       | 30.0        | Pass   |



## Intermodulation

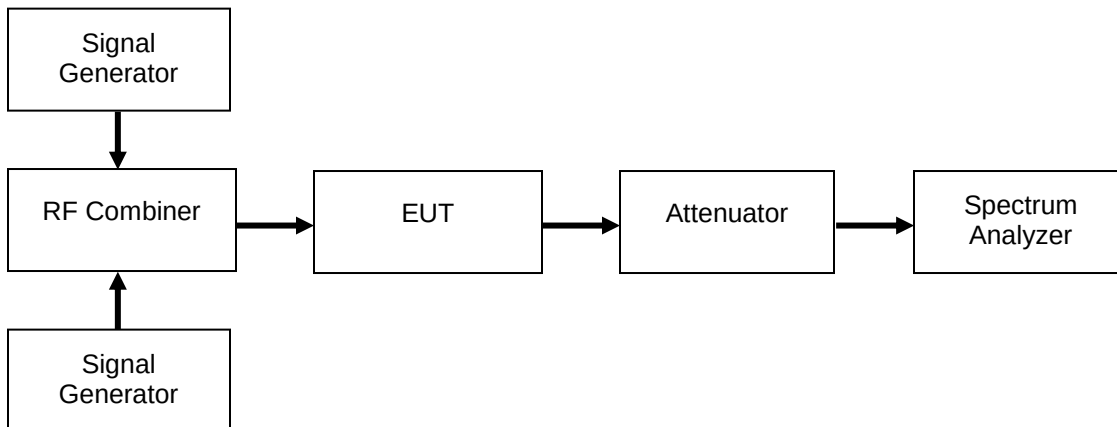
**Name of Test:** Intermodulation  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 1/5/2015

### 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 that 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 than -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 |
|----------------------|-----------------------------|-------------|--------|
| 824 - 849 MHz        | -19.71                      | -19         | Pass   |
| 1850 - 1915 MHz      | -19.95                      | -19         | Pass   |

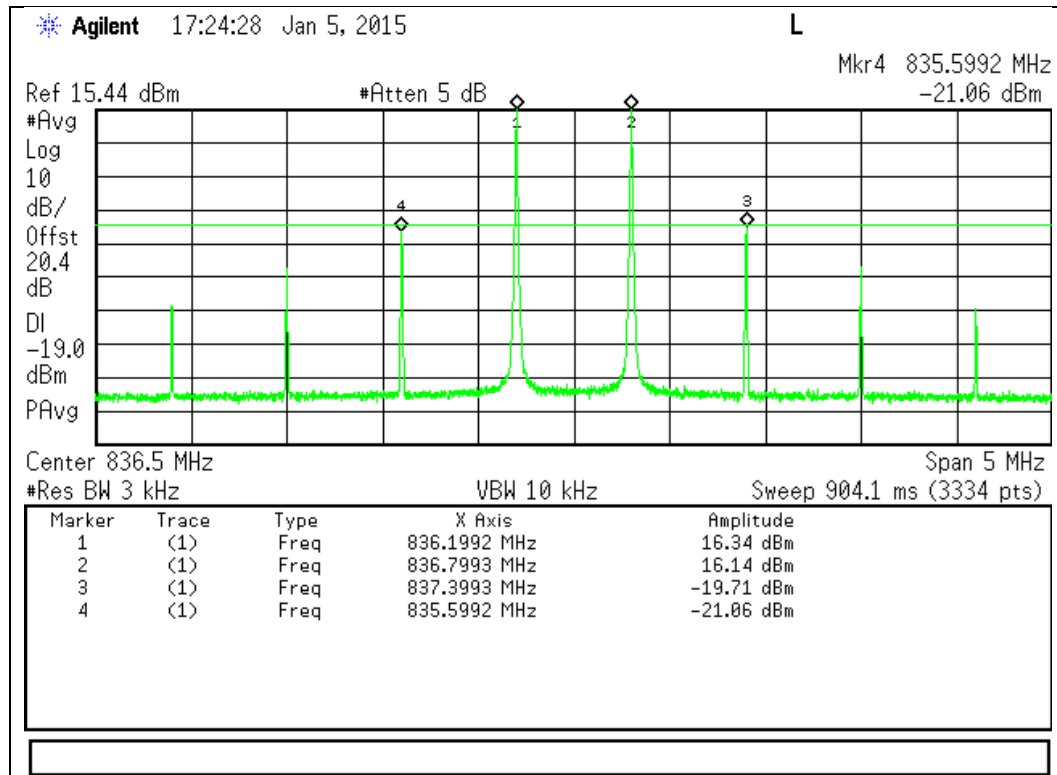
### Downlink Test Results

| Frequency Band (MHz) | Intermodulation Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------------------------|-------------|--------|
| 869 - 894 MHz        | -35.68                      | -19         | Pass   |
| 1930 - 1995 MHz      | -34.80                      | -19         | Pass   |

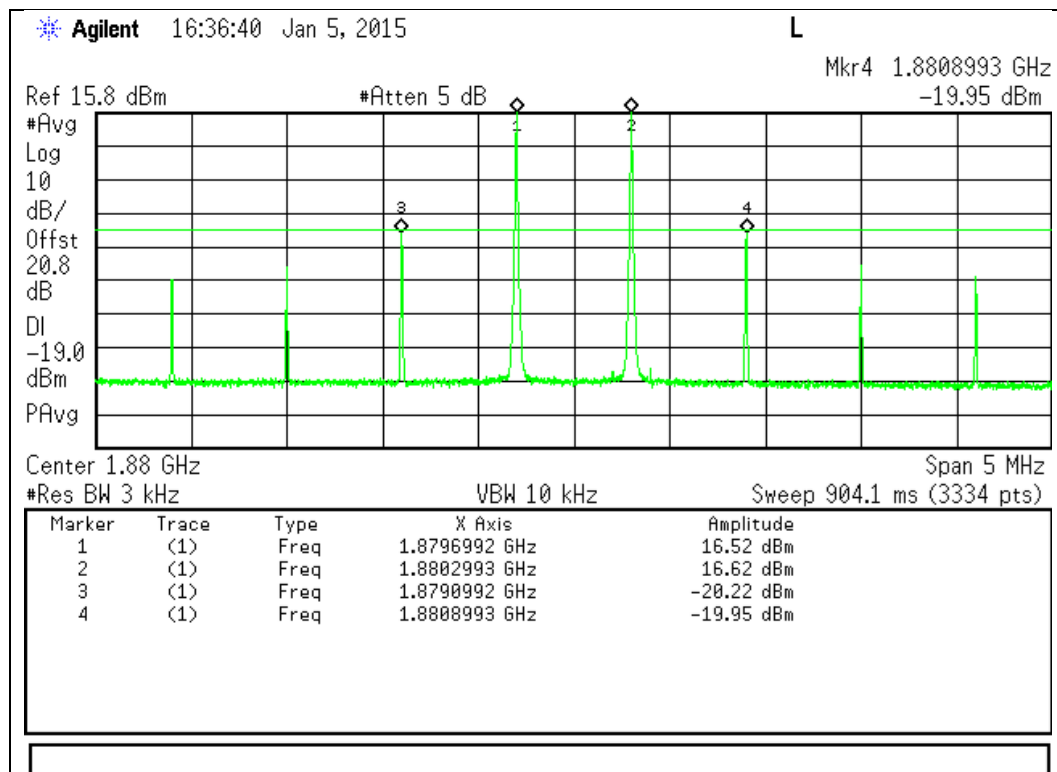


## Uplink Test Results

### 824 - 849 MHz Band



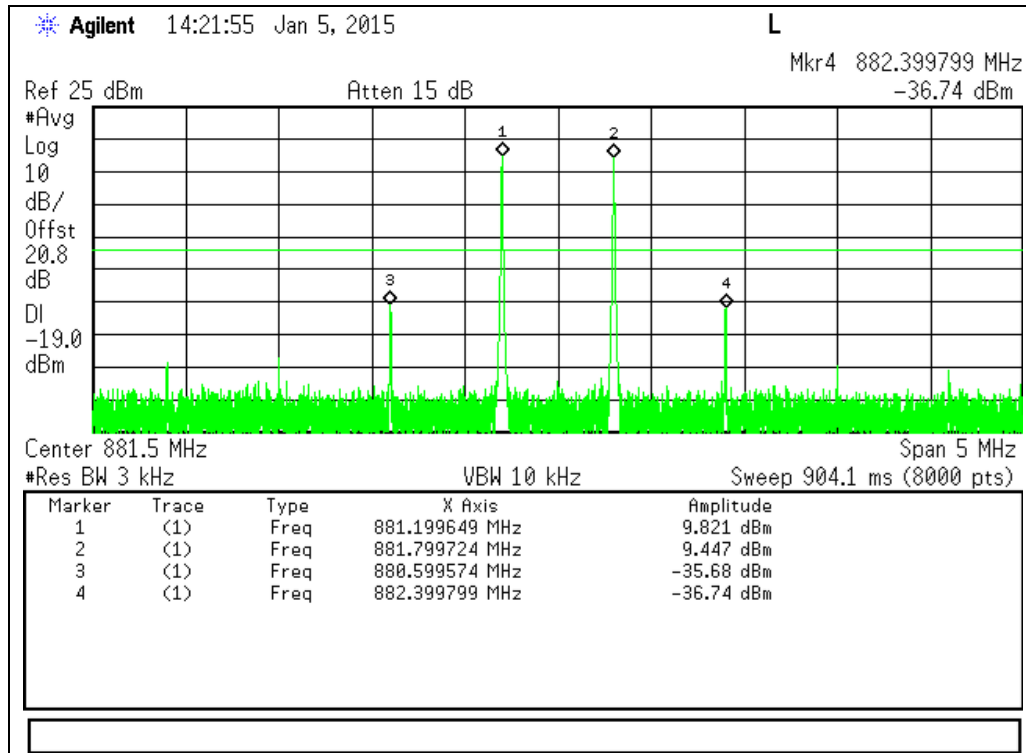
### 1850 - 1915 MHz Band



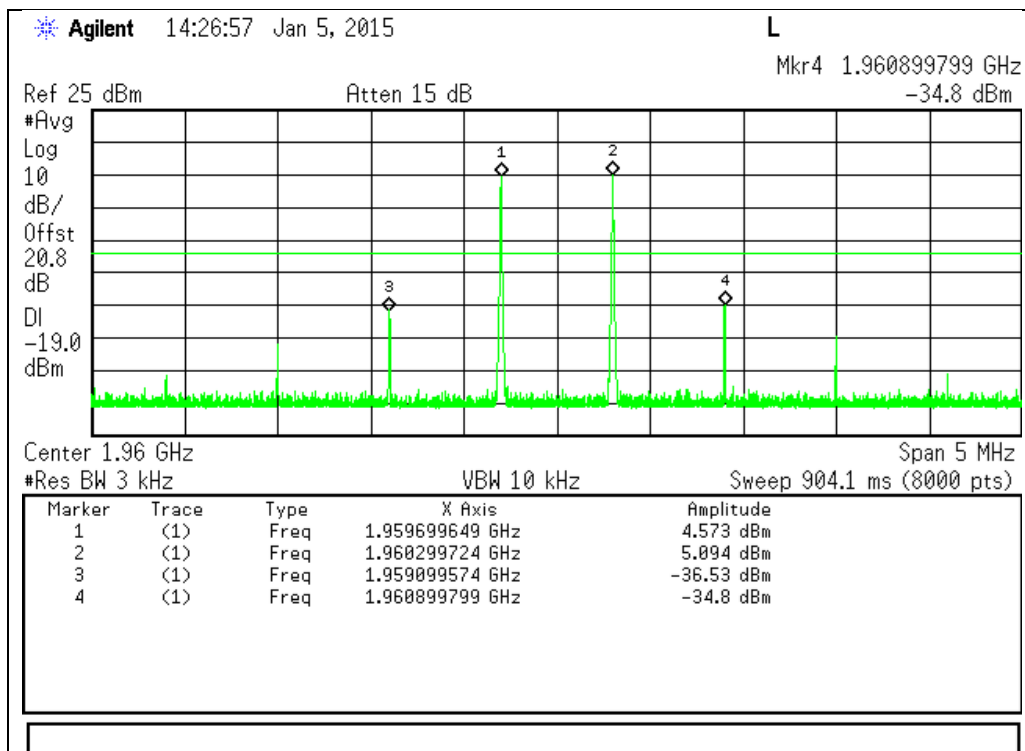


## Downlink Test Results

### 869 - 894 MHz Band



### 1930 - 1995 MHz Band





## Out-of-Band Emissions

**Name of Test:**

Out-of-Band Emissions

**Engineer:** Mike Graffeo

**Test Equipment Utilized:**

i00379, i00405

**Test Date:** 1/6/15

### 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 in order to ensure accurate readings. A signal generator was utilized to produce the following signals: GSM, CDMA, and WCDMA. The signal generator was 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 were measured to ensure they met the limits.

The following formula was used for calculating the limits:

$$\text{Limit} = P1 - 6 - (43 + 10\log(P2)) = -19\text{dBm}$$

P1 = power in dBm

P2 = power in Watts

### Test Setup





### GSM Uplink Test Results

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 824 - 849            | Lower     | -38.81               | -19         | Pass   |
| 824 - 849            | Upper     | -39.31               | -19         | Pass   |
| 1850-1915            | Lower     | -37.81               | -19         | Pass   |
| 1850-1915            | Upper     | -63.08               | -19         | Pass   |

### CDMA Uplink Test Results

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 824 - 849            | Lower     | -39.80               | -19         | Pass   |
| 824 - 849            | Upper     | -38.15               | -19         | Pass   |
| 1850-1915            | Lower     | -40.30               | -19         | Pass   |
| 1850-1915            | Upper     | -55.08               | -19         | Pass   |

### WCDMA Uplink Test Results

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 824 - 849            | Lower     | -49.35               | -19         | Pass   |
| 824 - 849            | Upper     | -49.11               | -19         | Pass   |
| 1850-1915            | Lower     | -38.08               | -19         | Pass   |
| 1850-1915            | Upper     | -47.84               | -19         | Pass   |



### GSM Downlink Test Results

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 869 - 894            | Lower     | -47.62               | -19         | Pass   |
| 869 - 894            | Upper     | -44.73               | -19         | Pass   |
| 1930-1995            | Lower     | -51.44               | -19         | Pass   |
| 1930-1995            | Upper     | -51.44               | -19         | Pass   |

### CDMA Downlink Test Results

| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 869 - 894            | Lower     | -54.65               | -19         | Pass   |
| 869 - 894            | Upper     | -54.14               | -19         | Pass   |
| 1930-1995            | Lower     | -55.70               | -19         | Pass   |
| 1930-1995            | Upper     | -55.67               | -19         | Pass   |

### WCDMA Downlink Test Results

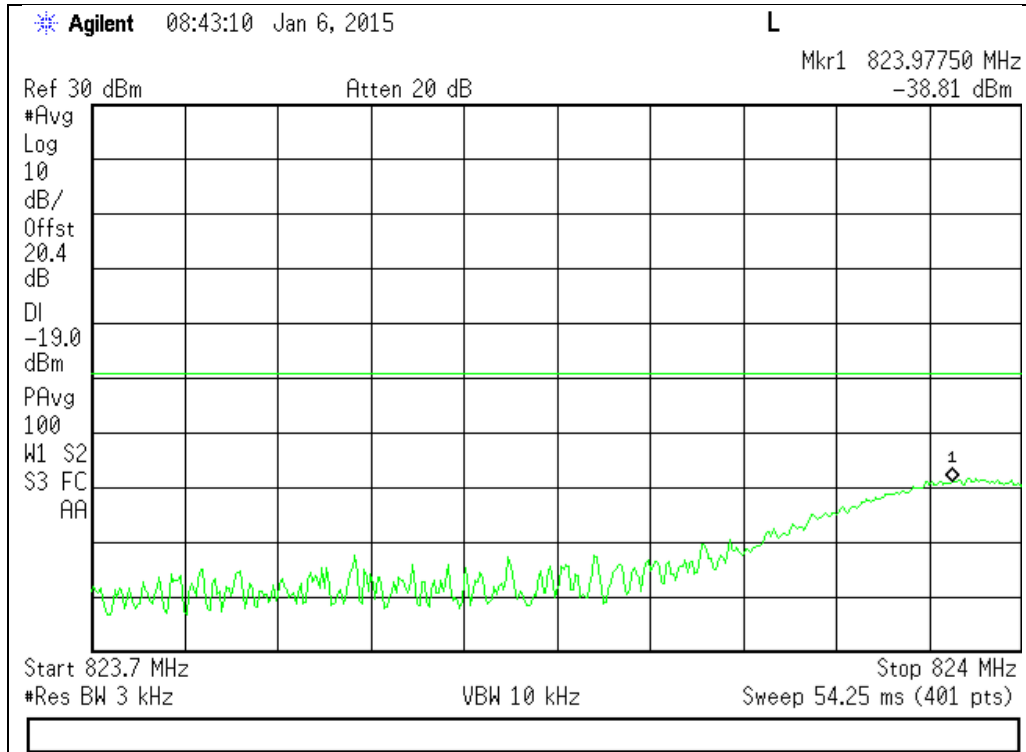
| Frequency Band (MHz) | Band Edge | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|-----------|----------------------|-------------|--------|
| 869 - 894            | Lower     | -48.18               | -19         | Pass   |
| 869 - 894            | Upper     | -45.37               | -19         | Pass   |
| 1930-1995            | Lower     | -47.46               | -19         | Pass   |
| 1930-1995            | Upper     | -48.80               | -19         | Pass   |



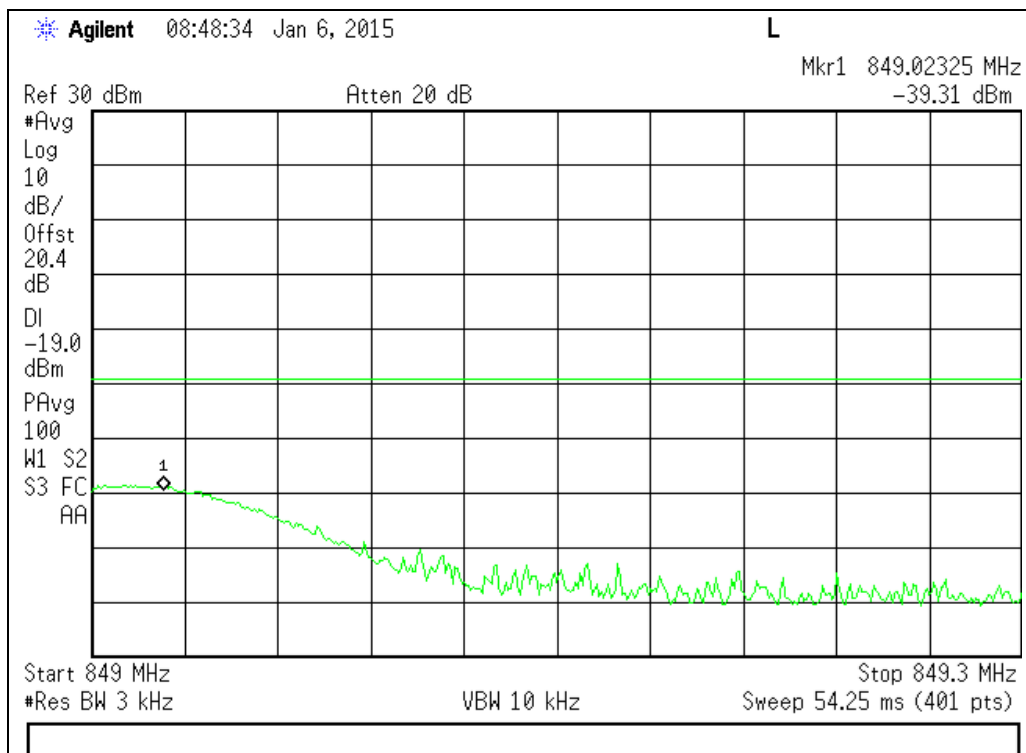
## GSM Uplink Test Plots

824 - 849 MHz Band

Lower Band Edge



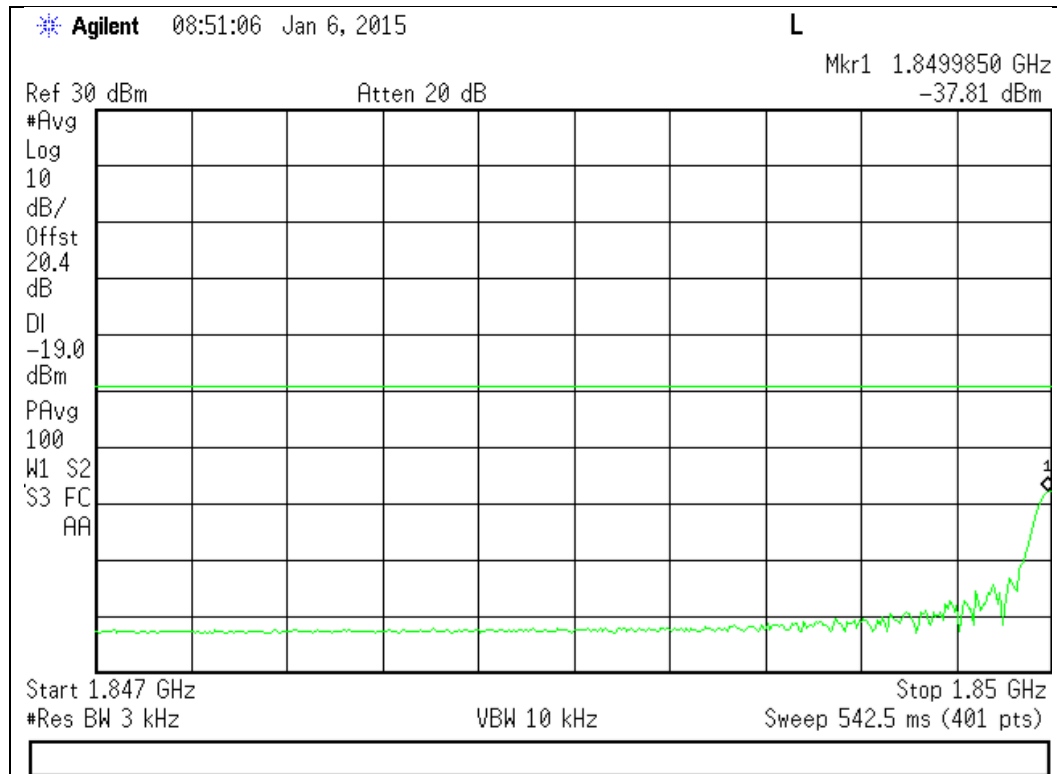
Upper Band Edge



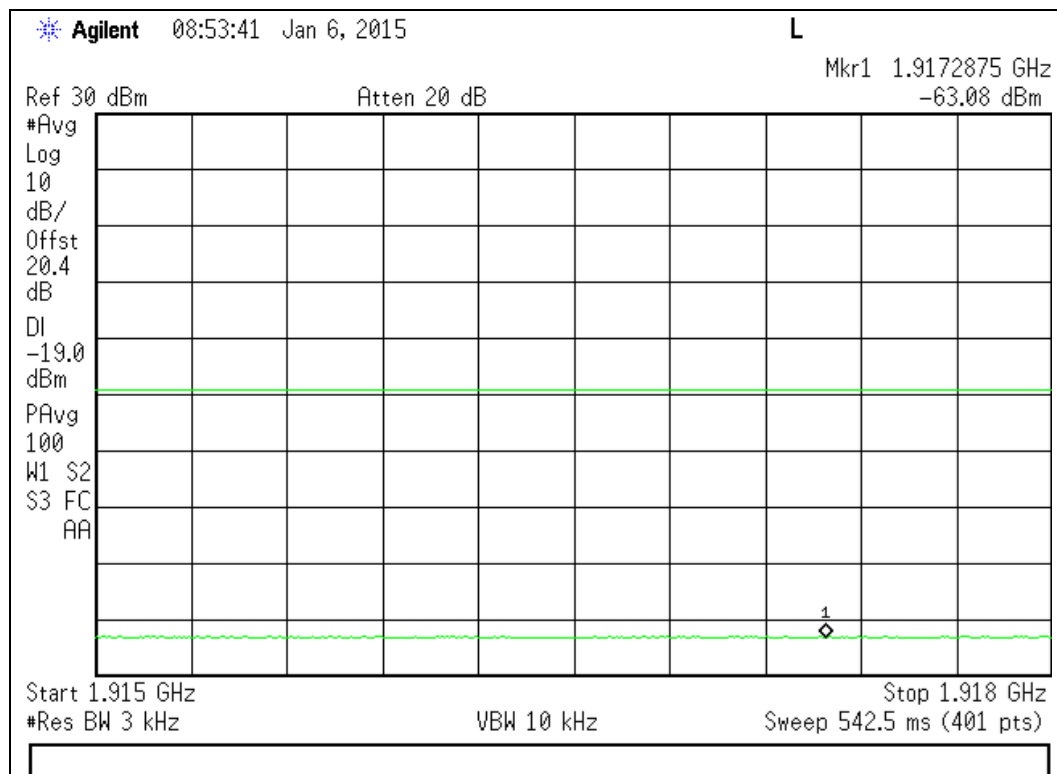


## 1850 - 1915 MHz Band

### Lower Band Edge



### Upper Band Edge

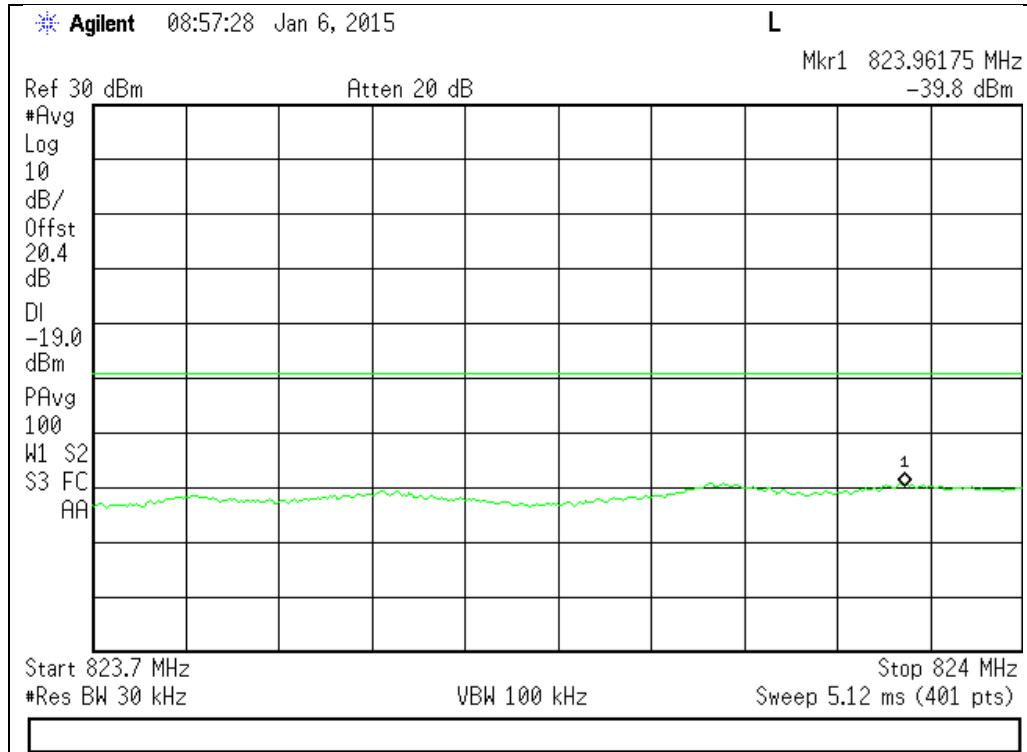




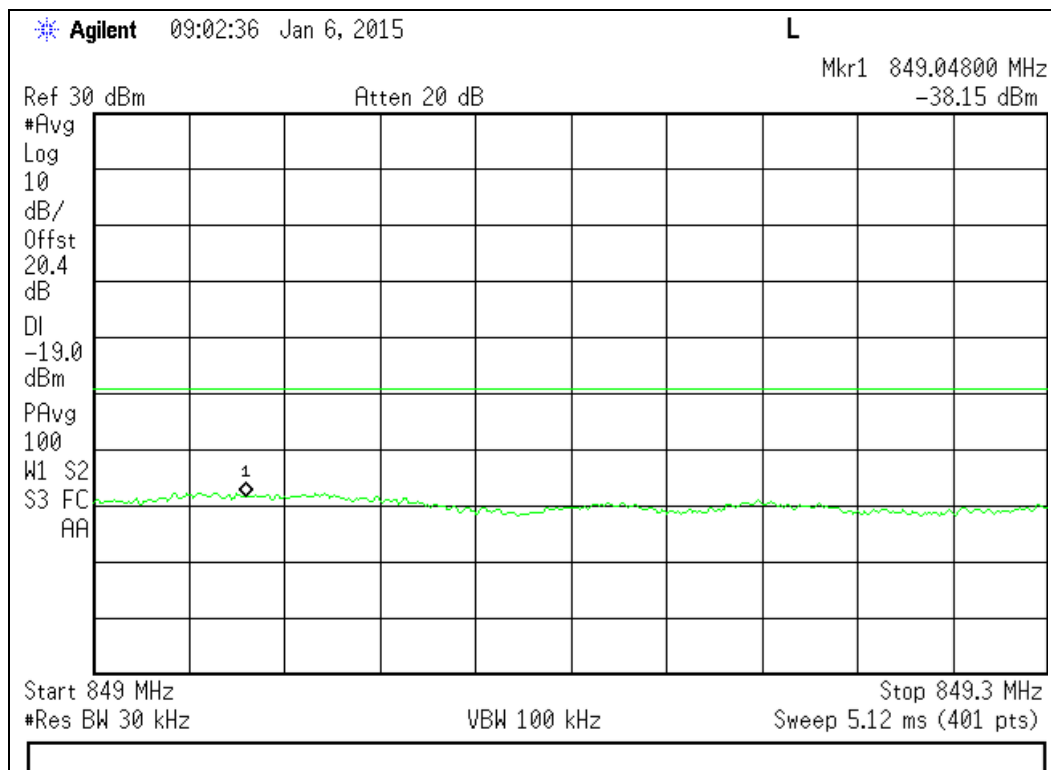
## CDMA Uplink Test Plots

824 - 849 MHz Band

Lower Band Edge



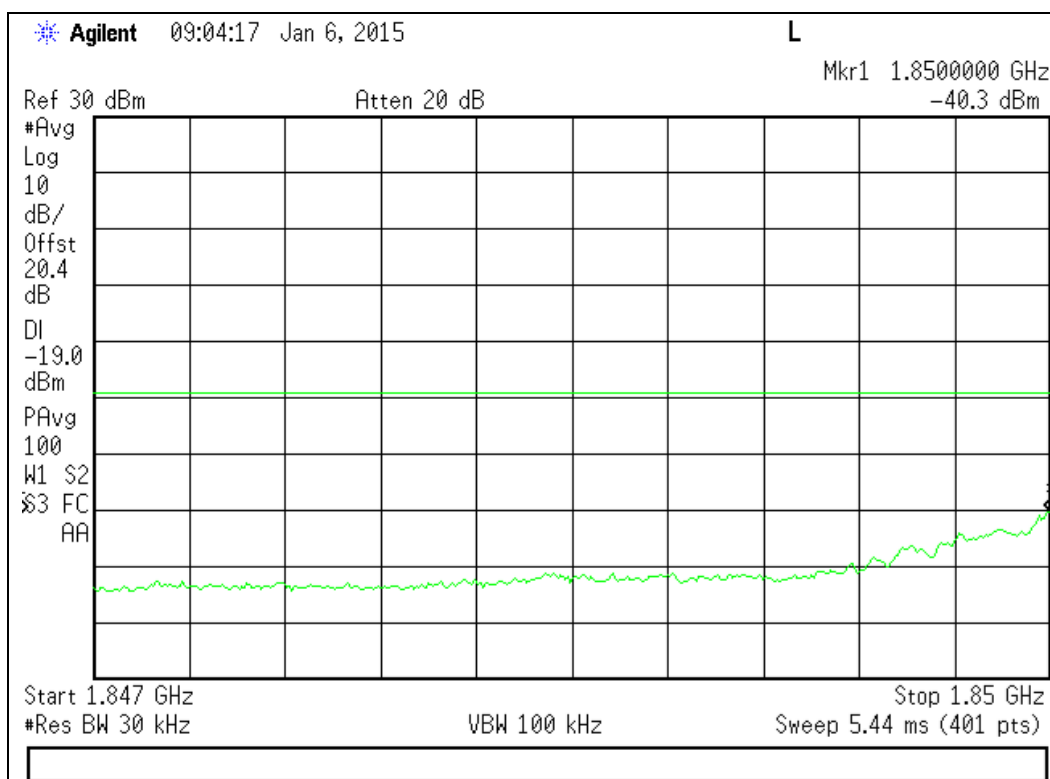
Upper Band Edge



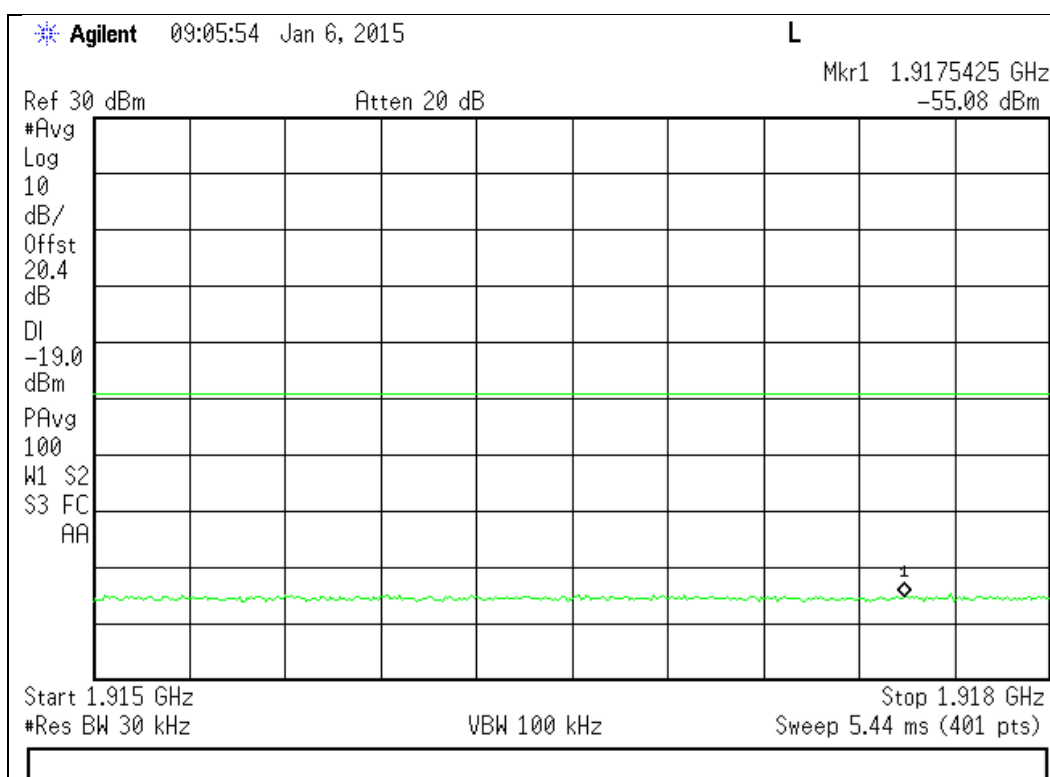


## 1850 - 1915 MHz Band

### Lower Band Edge



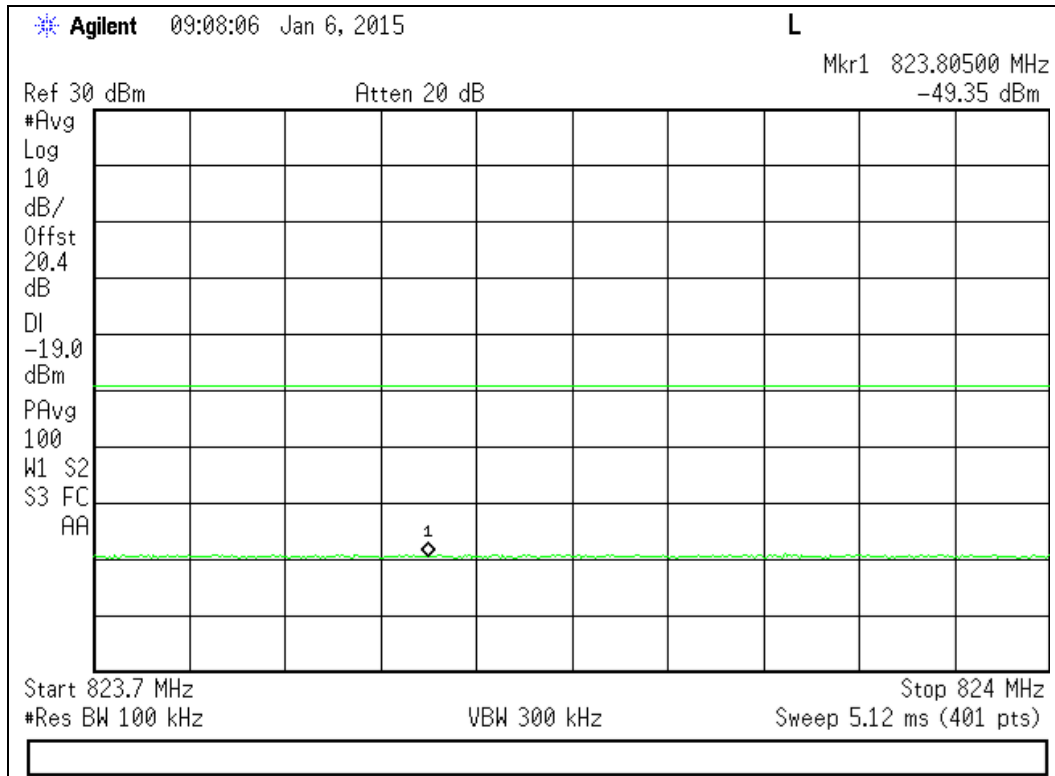
### Upper Band Edge



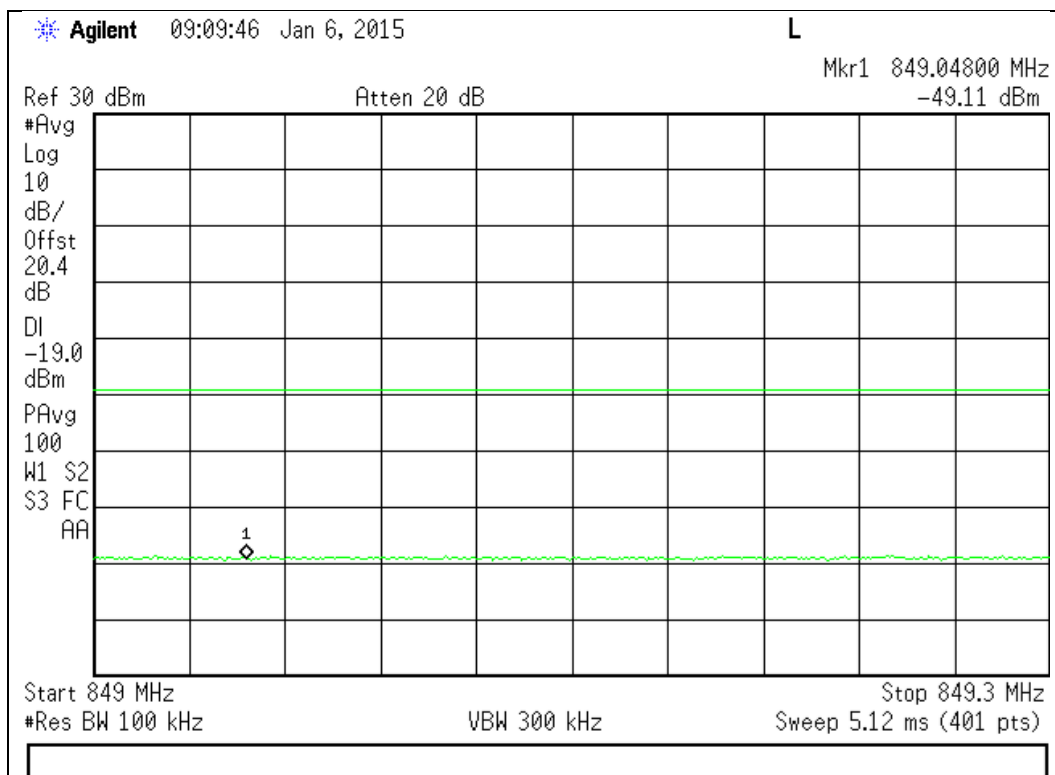


# WCDMA Uplink Test Plots 824 - 849 MHz Band

## Lower Band Edge



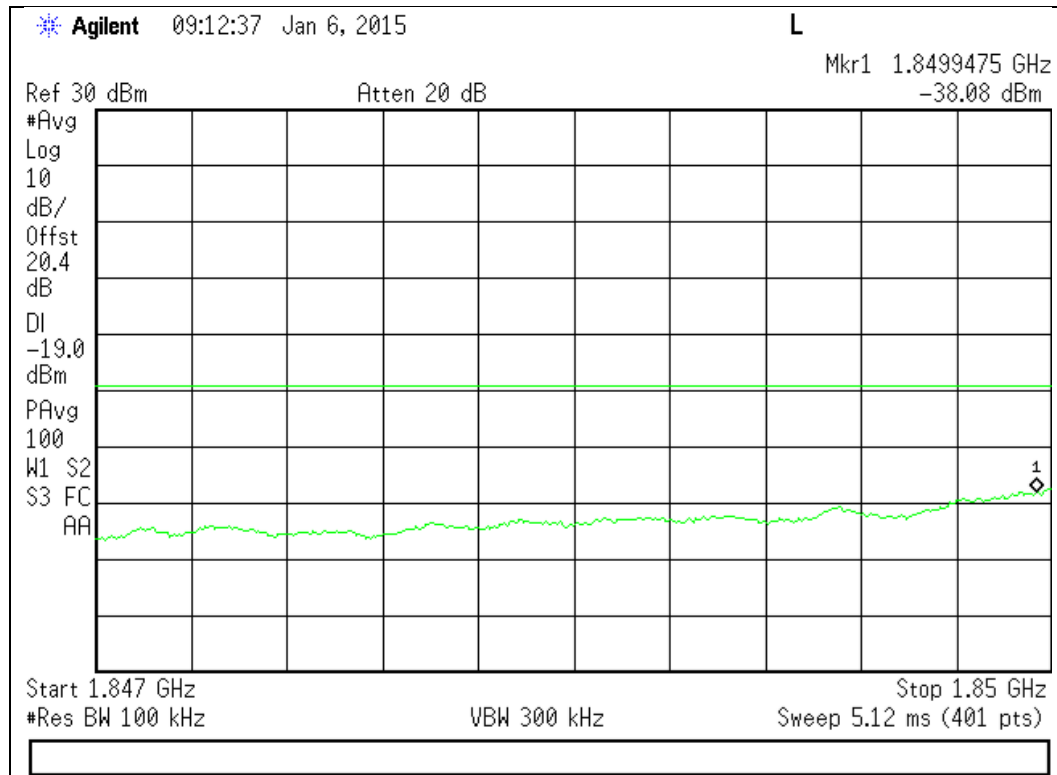
## Upper Band Edge



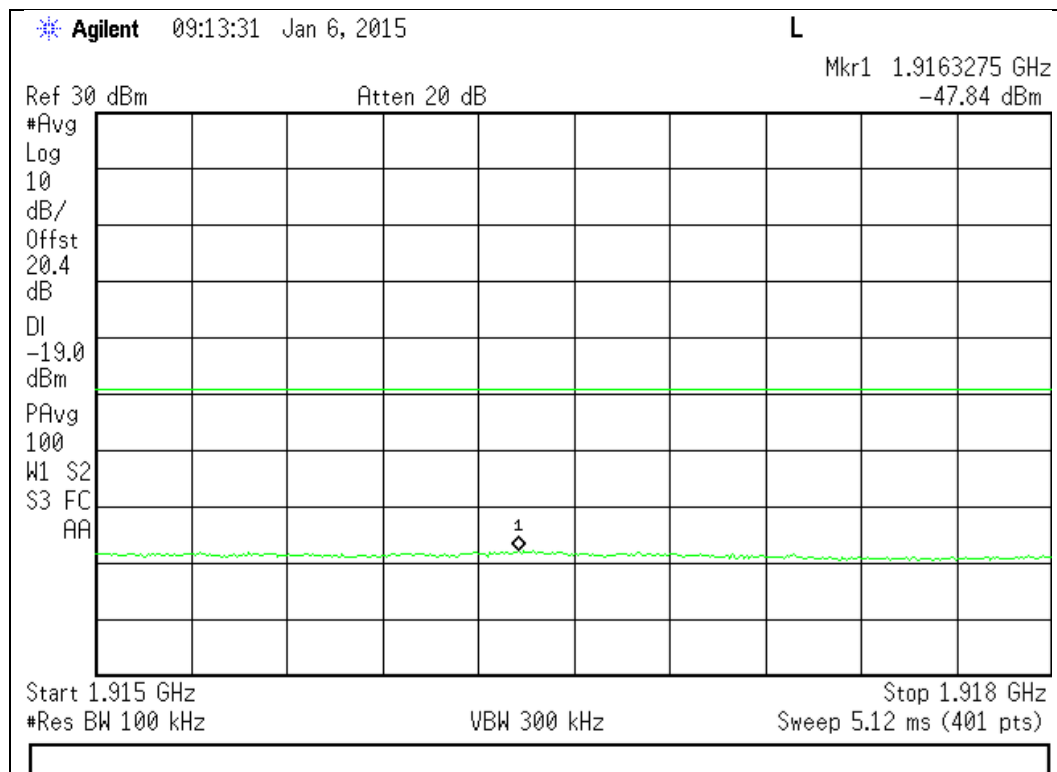


## 1850 - 1915 MHz Band

### Lower Band Edge



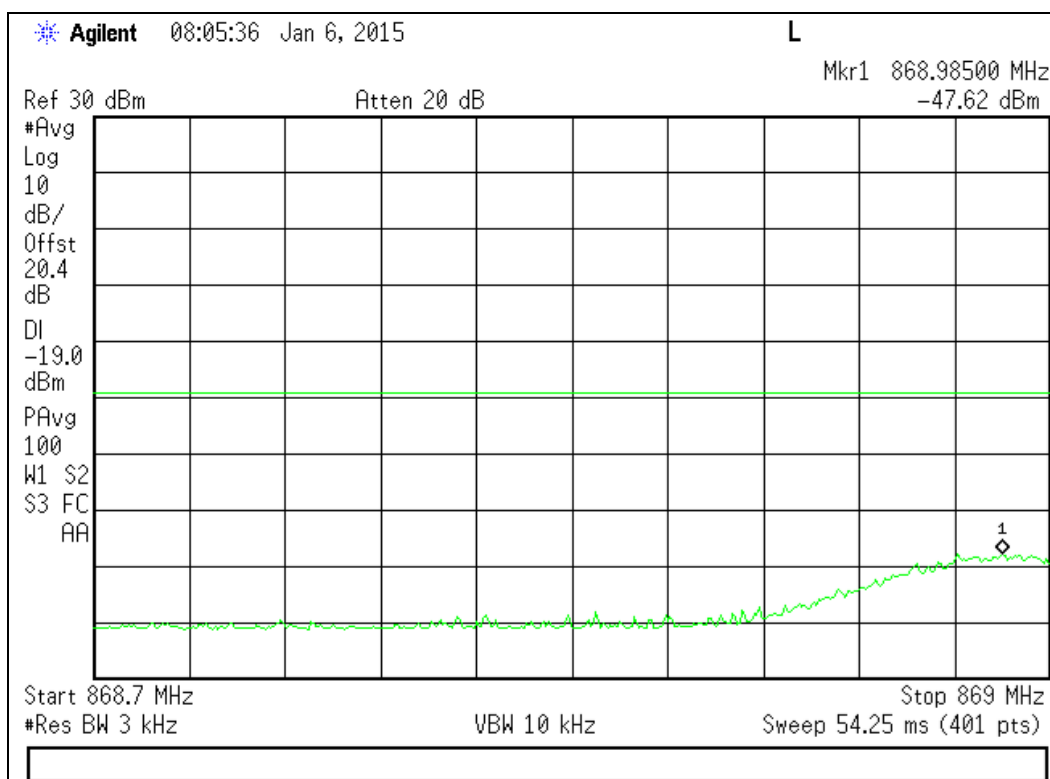
### Upper Band Edge



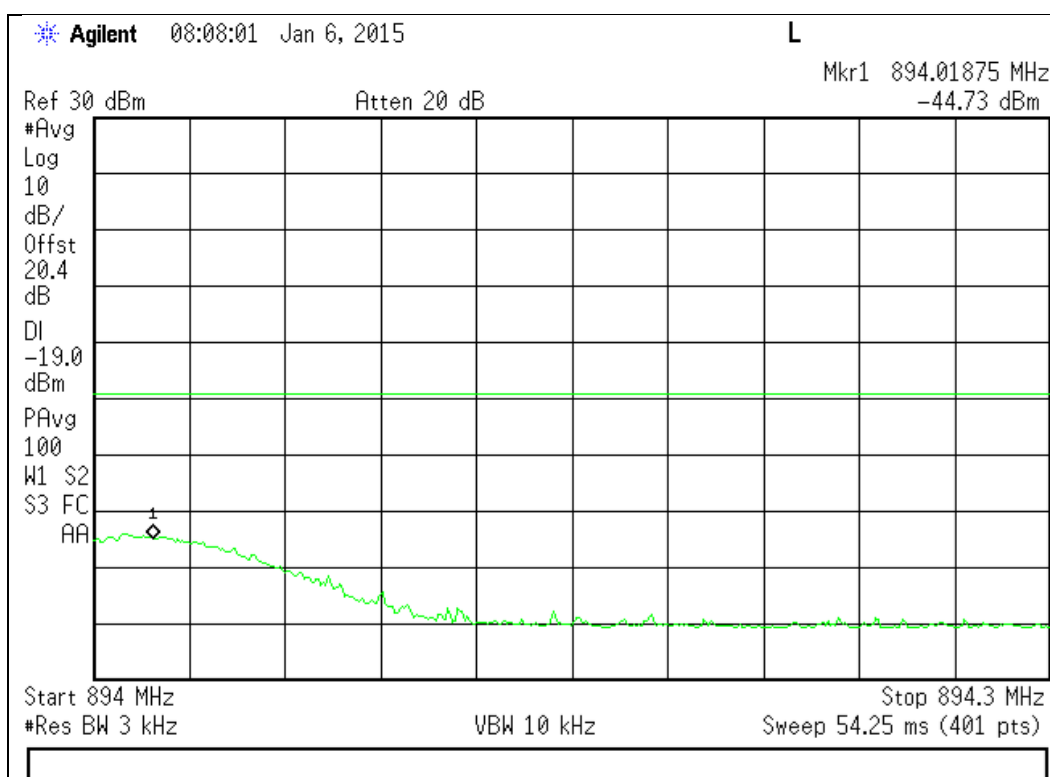


# GSM Downlink Test Plots 869 - 894 MHz Band

## Lower Band Edge



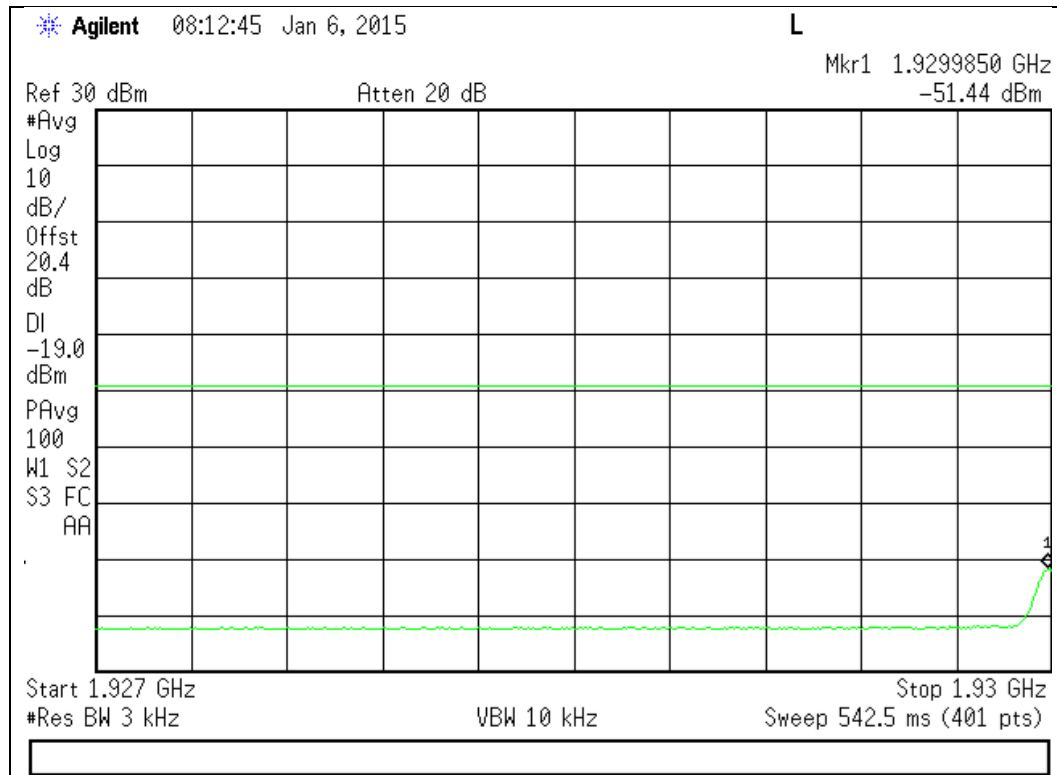
## Upper Band Edge



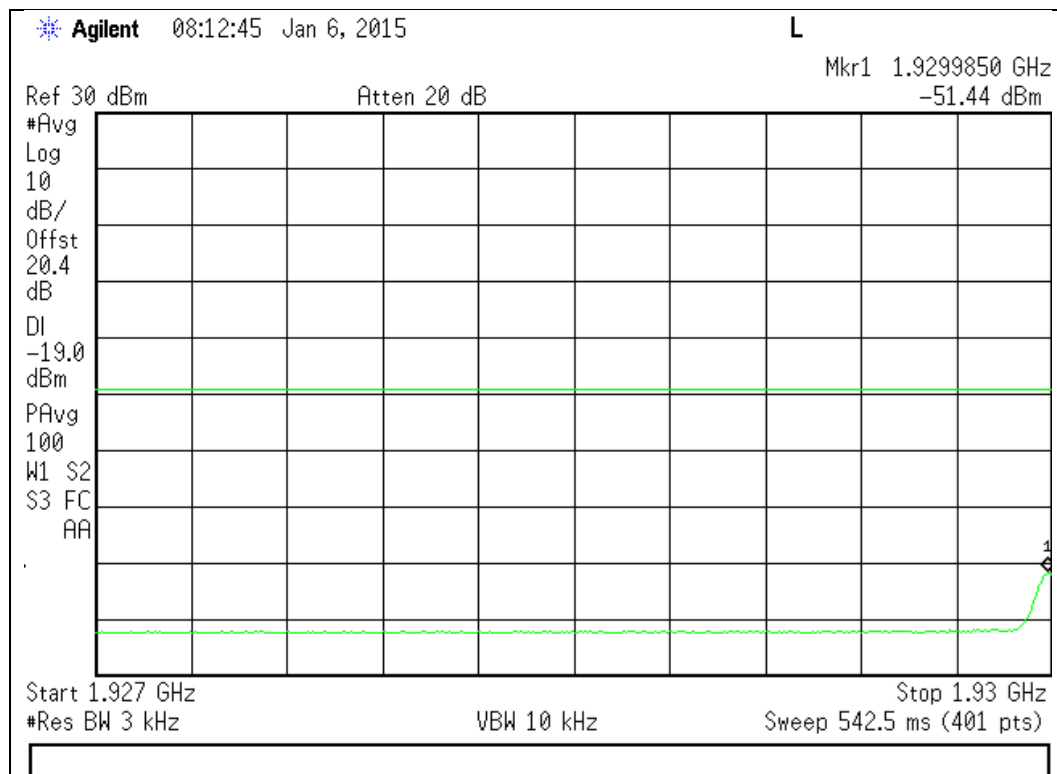


## 1930 - 1995 MHz Band

### Lower Band Edge



### Upper Band Edge

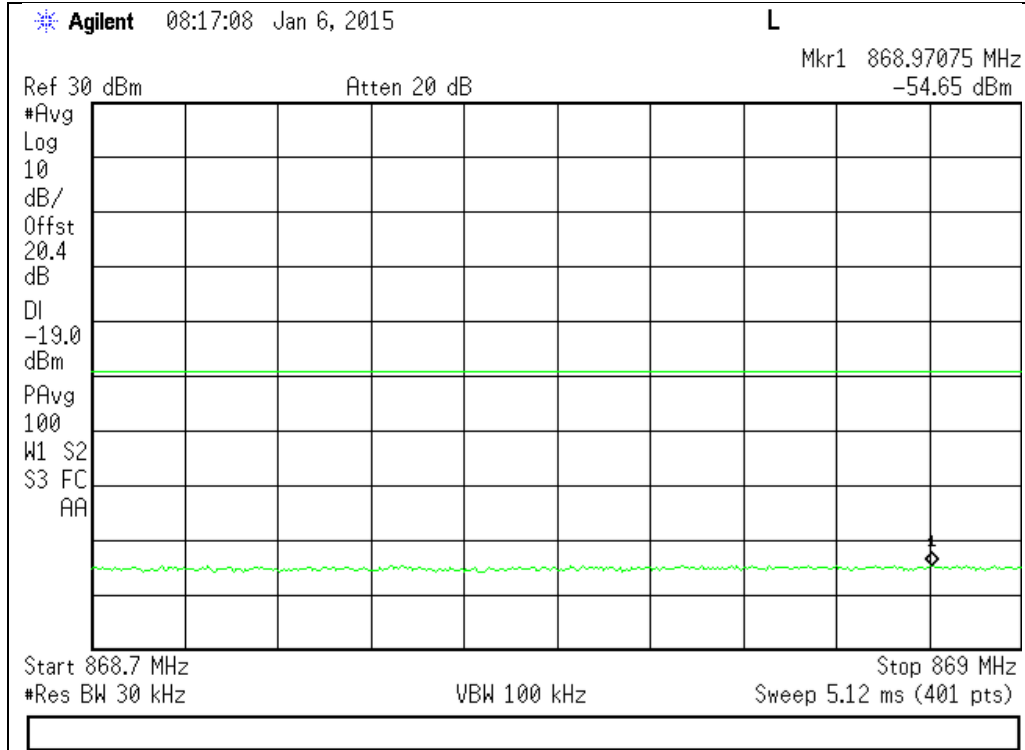




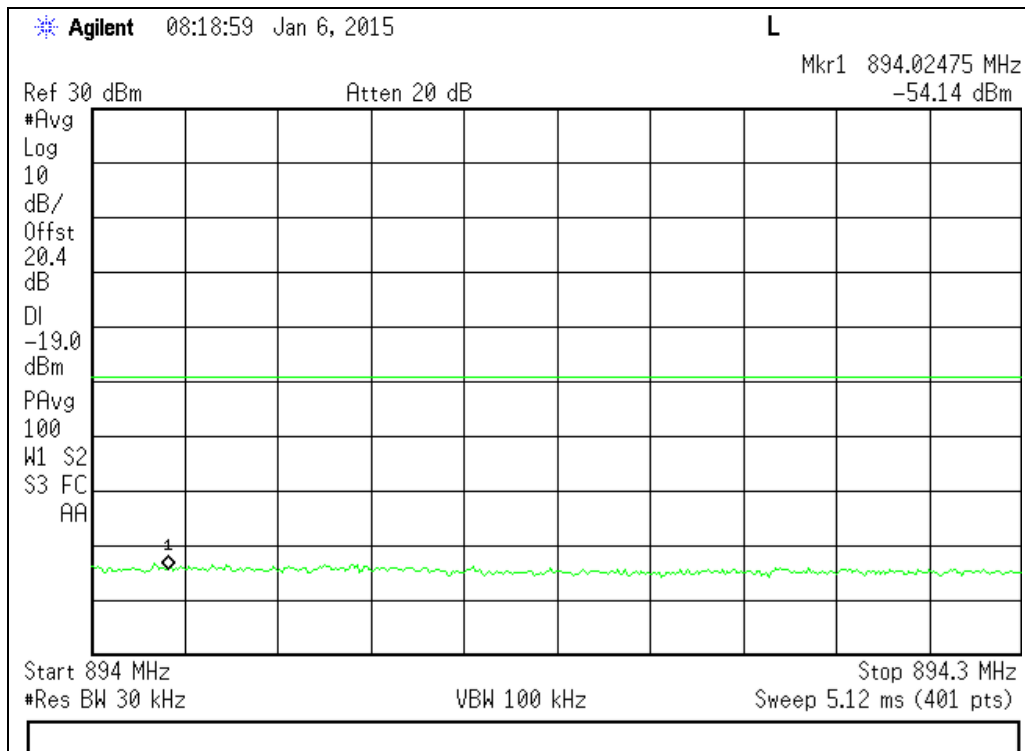
## CDMA Downlink Test Plots

### 869 - 894 MHz Band

#### Lower Band Edge



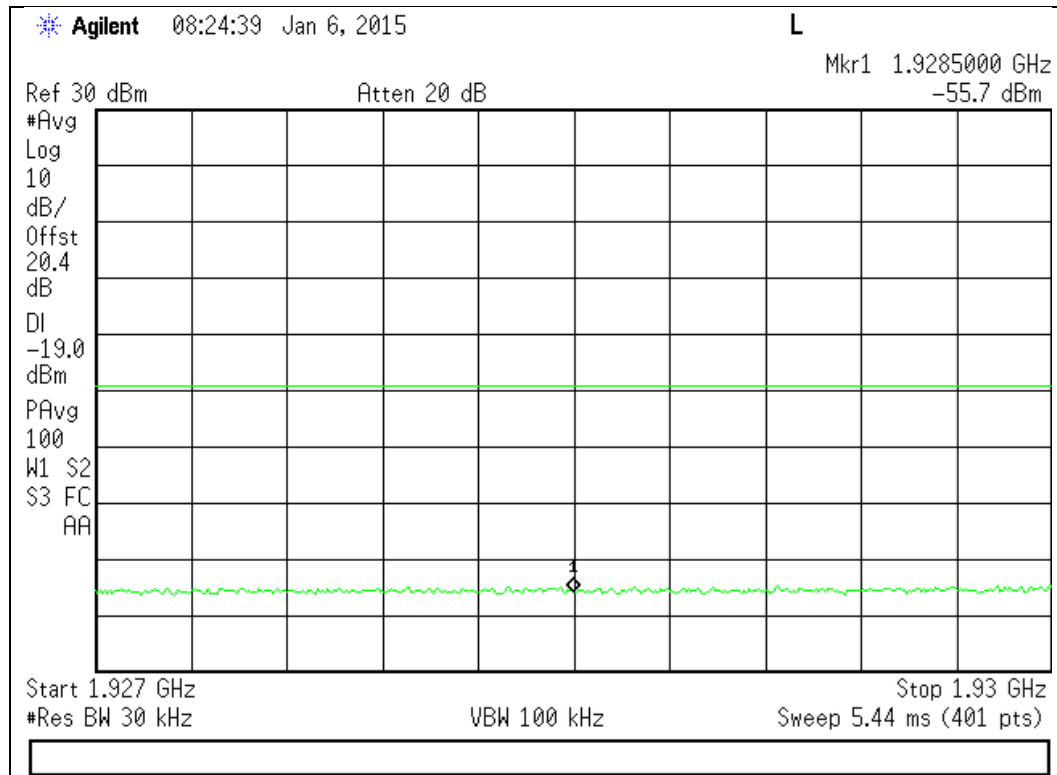
#### Upper Band Edge



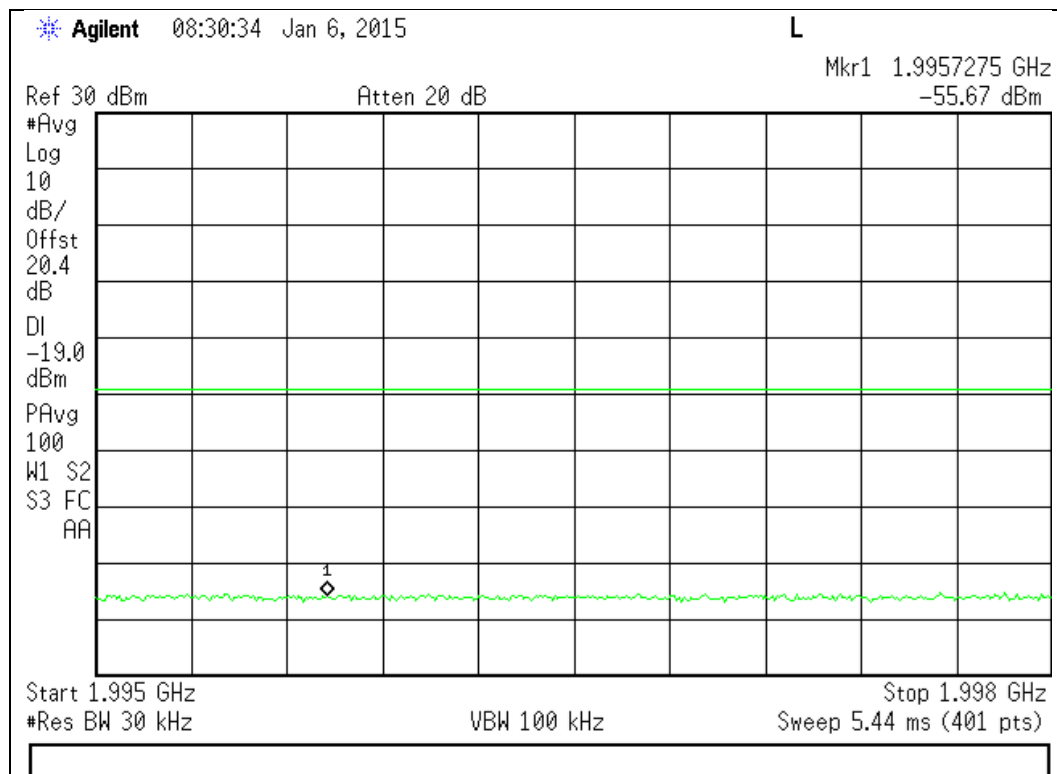


## 1930 - 1995 MHz Band

### Lower Band Edge



### Upper Band Edge

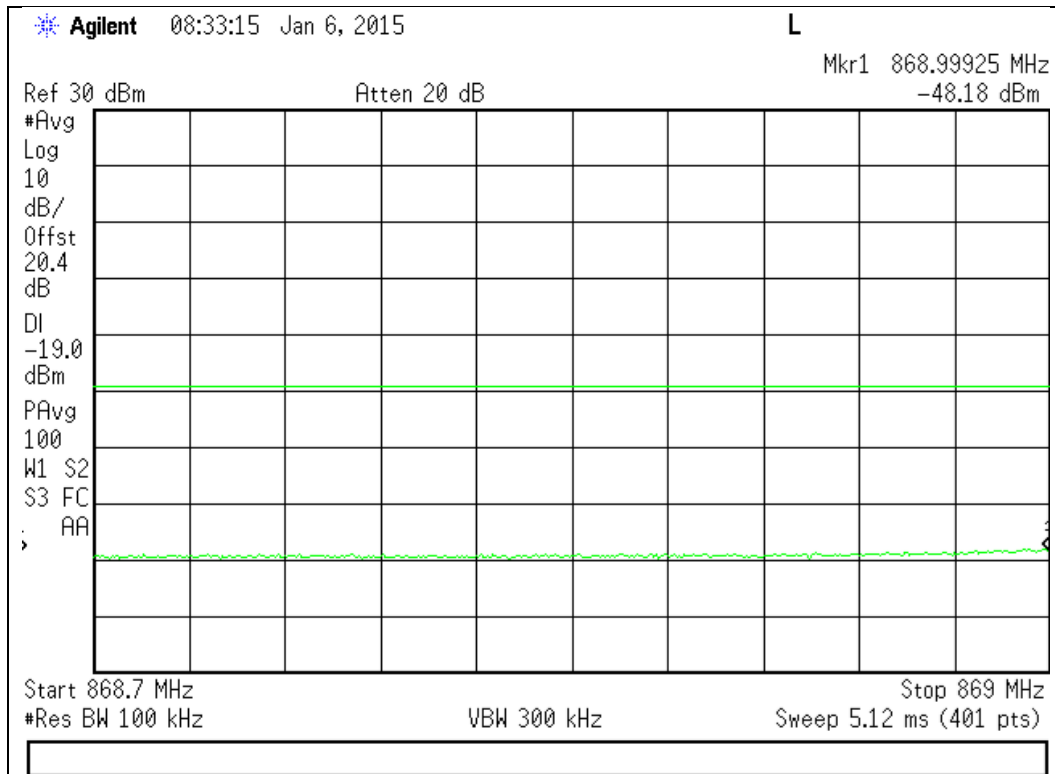




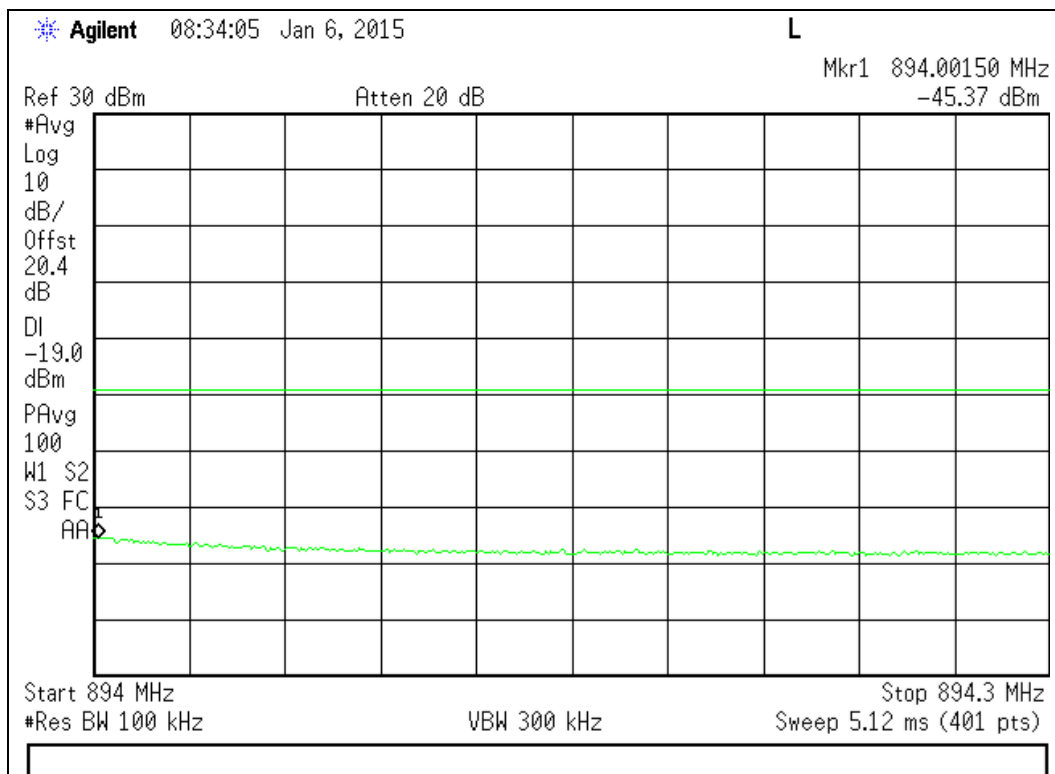
## WCDMA Downlink Test Plots

869 - 894 MHz Band

Lower Band Edge



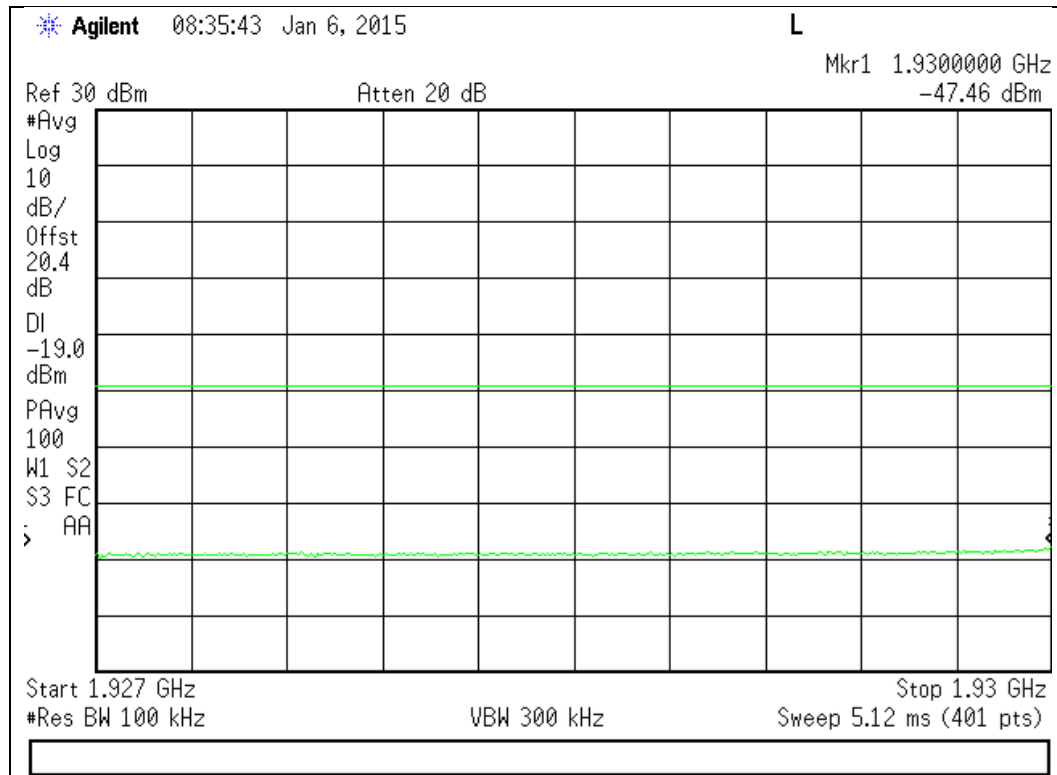
Upper Band Edge



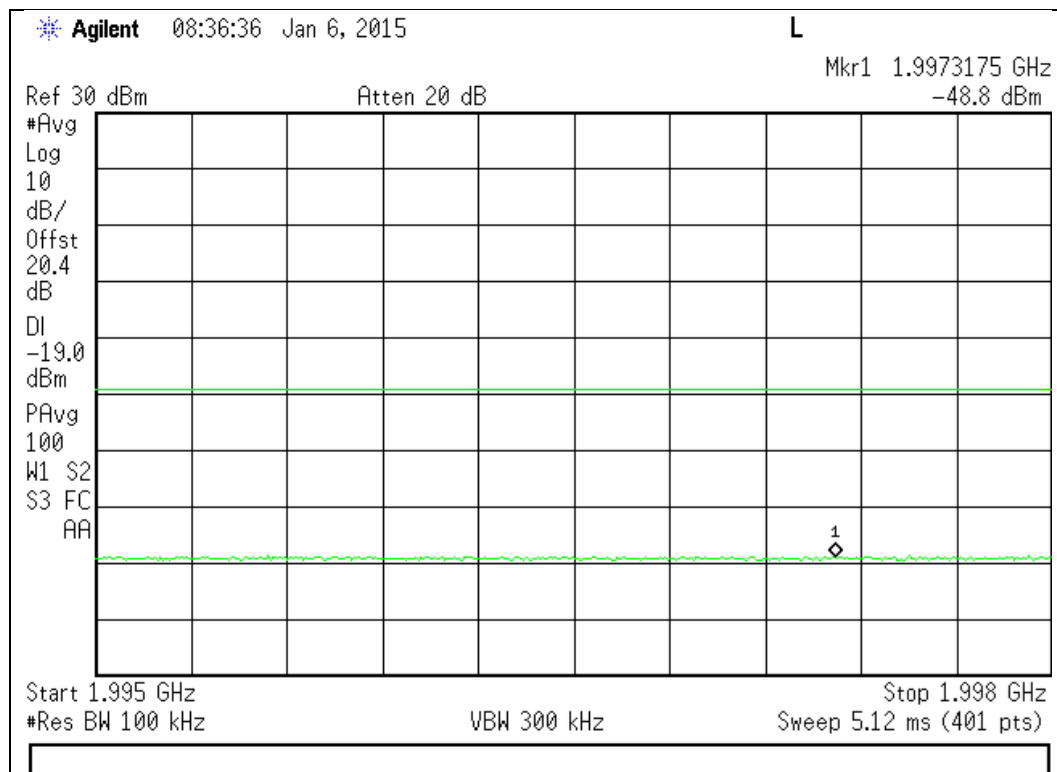


## 1930 - 1995 MHz Band

### Lower Band Edge



### Upper Band Edge





## Conducted Spurious Emissions

**Name of Test:** Conducted Spurious Emissions  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 1/6/15

### 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 needed to ensure accurate readings. 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 were measured per section 7.6(i) of KDB935210. The emissions were plotted and the highest level was recorded in the summary table.

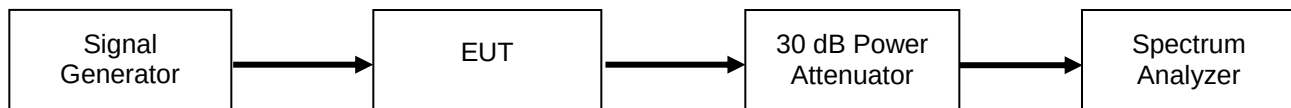
The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit =  $P1 - (43 + 10\log(P2)) = -13 \text{ dBm}$

P1 = power in dBm

P2 = power in Watts

### Test Setup



### Uplink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|--------------------------|----------------------|-------------|--------|
| 824 - 849            | 2986.9                   | -38.94               | -13         | Pass   |
| 1850 - 1915          | 2996                     | -39.97               | -13         | Pass   |

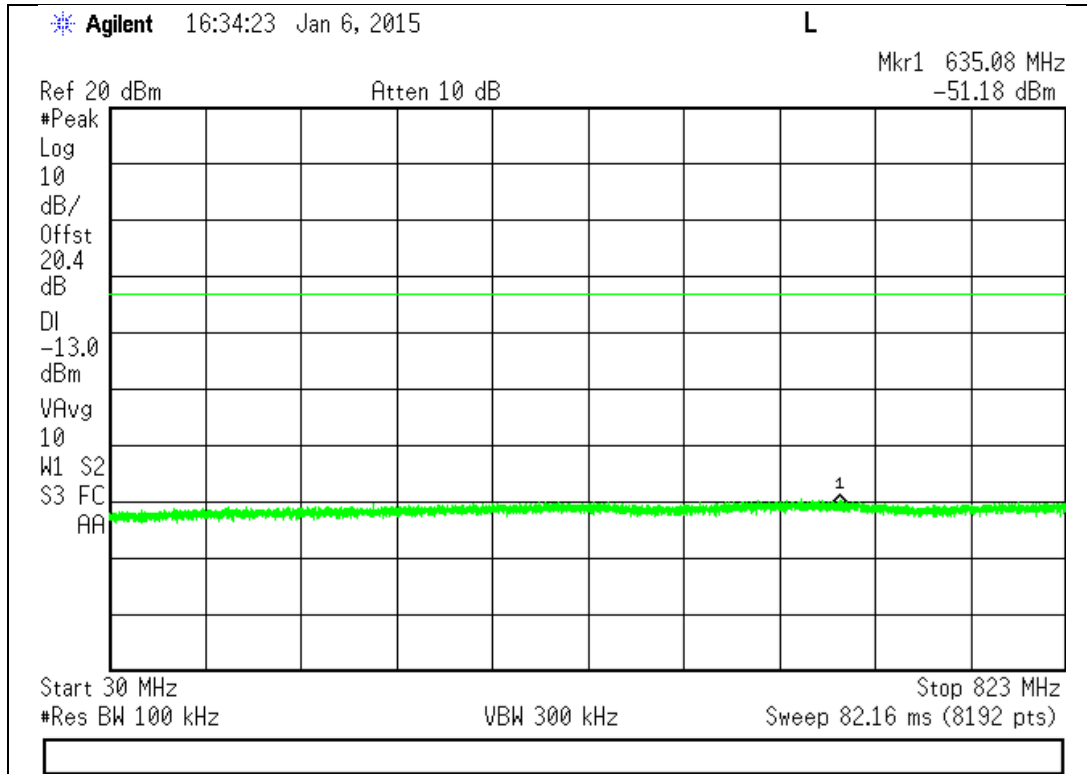
### Downlink Test Results

| Frequency Band (MHz) | Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|----------------------|--------------------------|----------------------|-------------|--------|
| 869 - 894            | 1973.4                   | -34.16               | -13         | Pass   |
| 1930 - 1995          | 2996.5                   | -39.94               | -13         | Pass   |

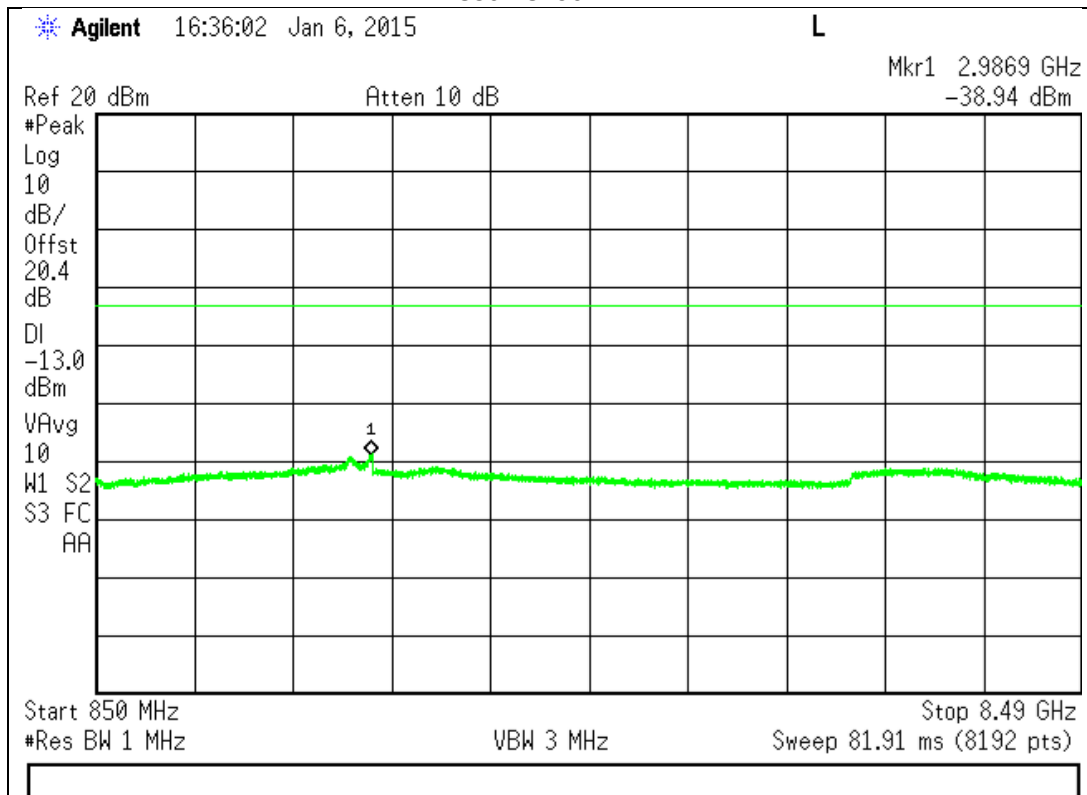


## Uplink Test Plots

### 824 - 849 MHz Band 30 MHz – 823 MHz



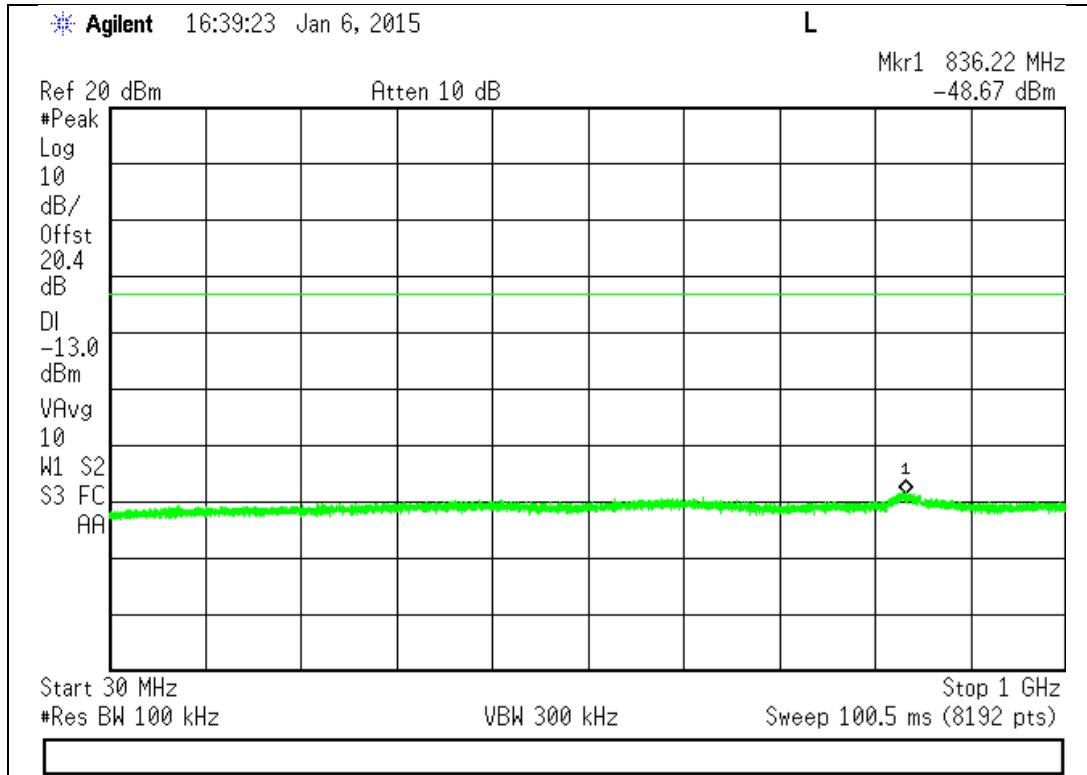
### 850 - 8490 MHz



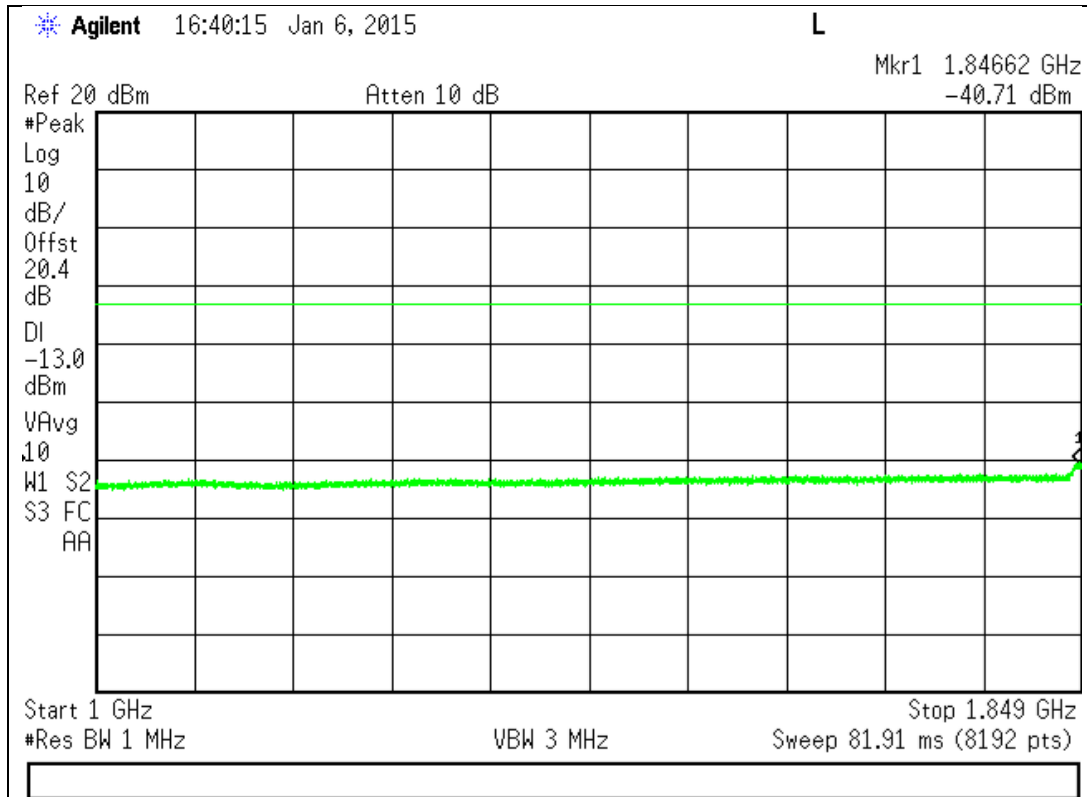


# 1850 - 1915 MHz Band

## 30 MHz – 1000 MHz

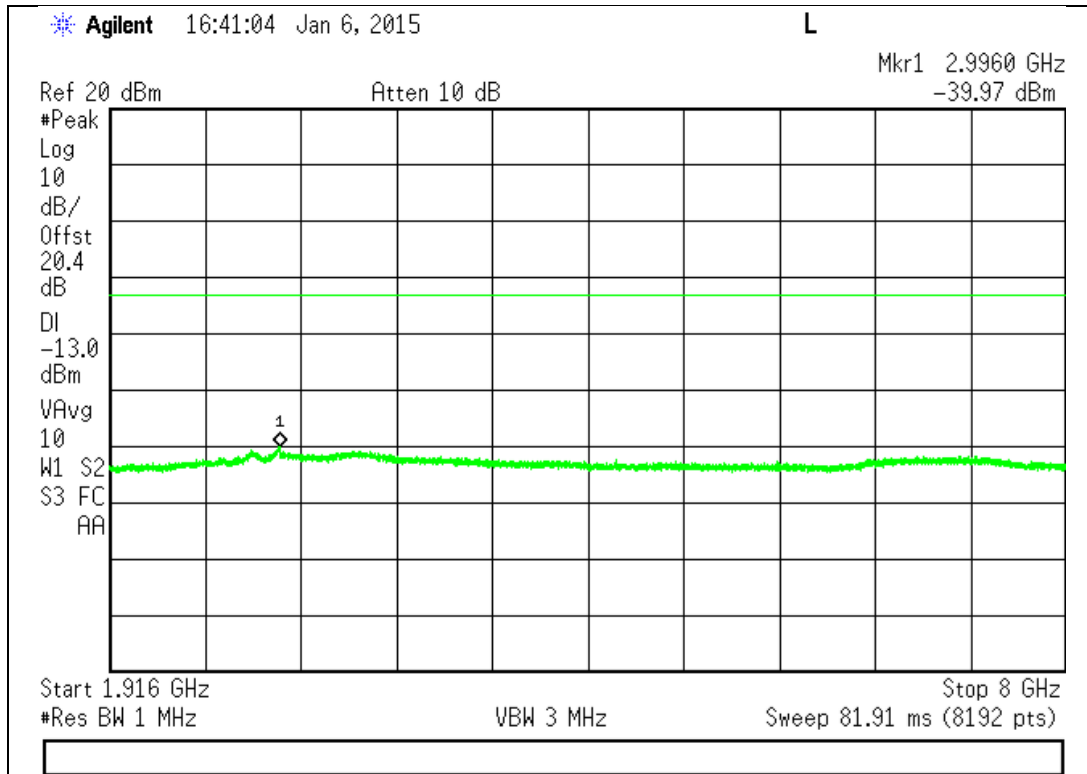


## 1000 – 1849 MHz



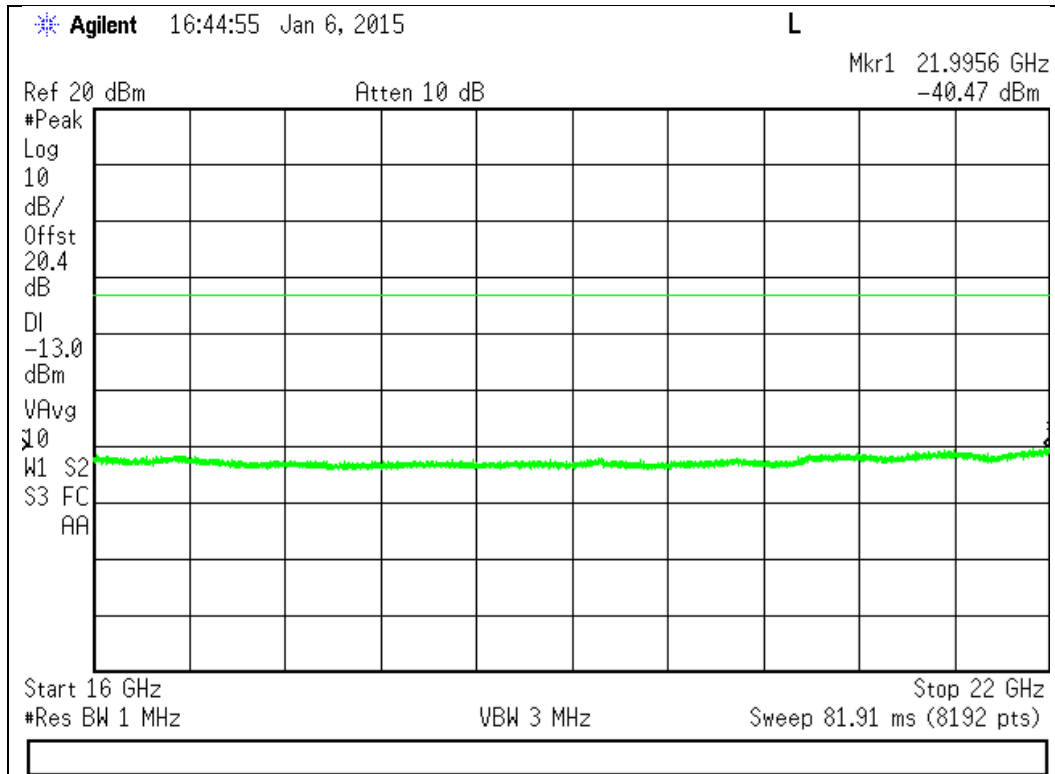


1850 - 1915 MHz Band (cont)  
1916 - 8000 MHz





**1850 - 1915 MHz Band (cont)**  
**16,000 – 22,000 MHz**

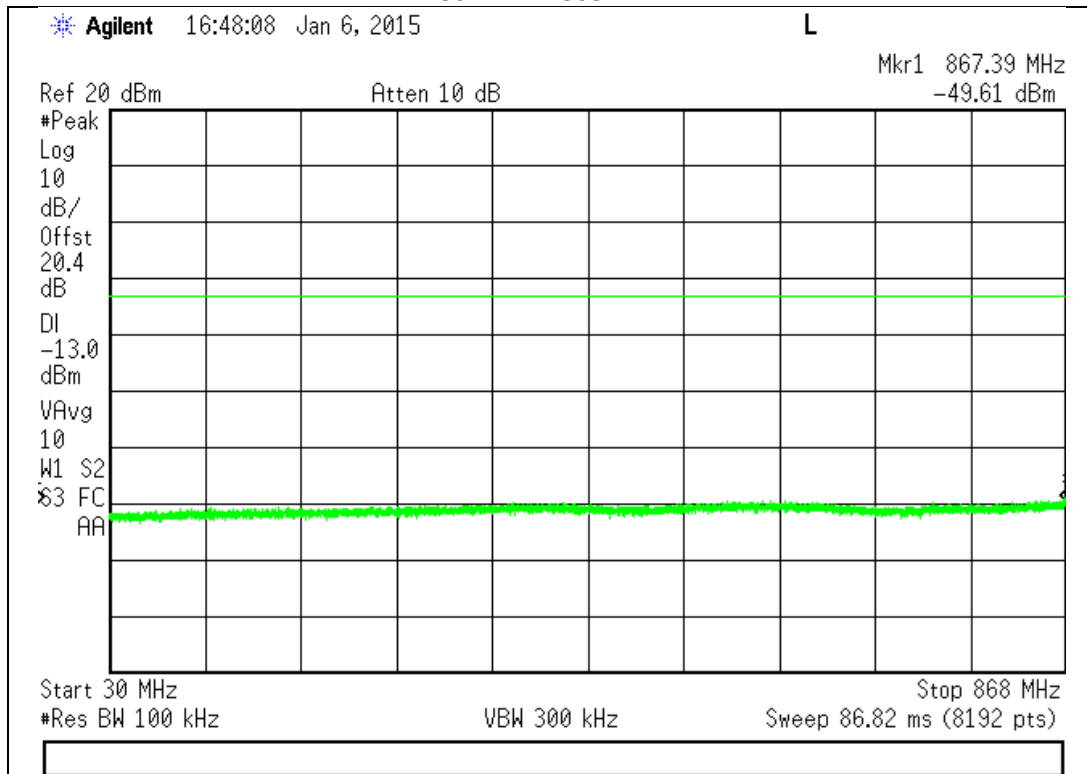




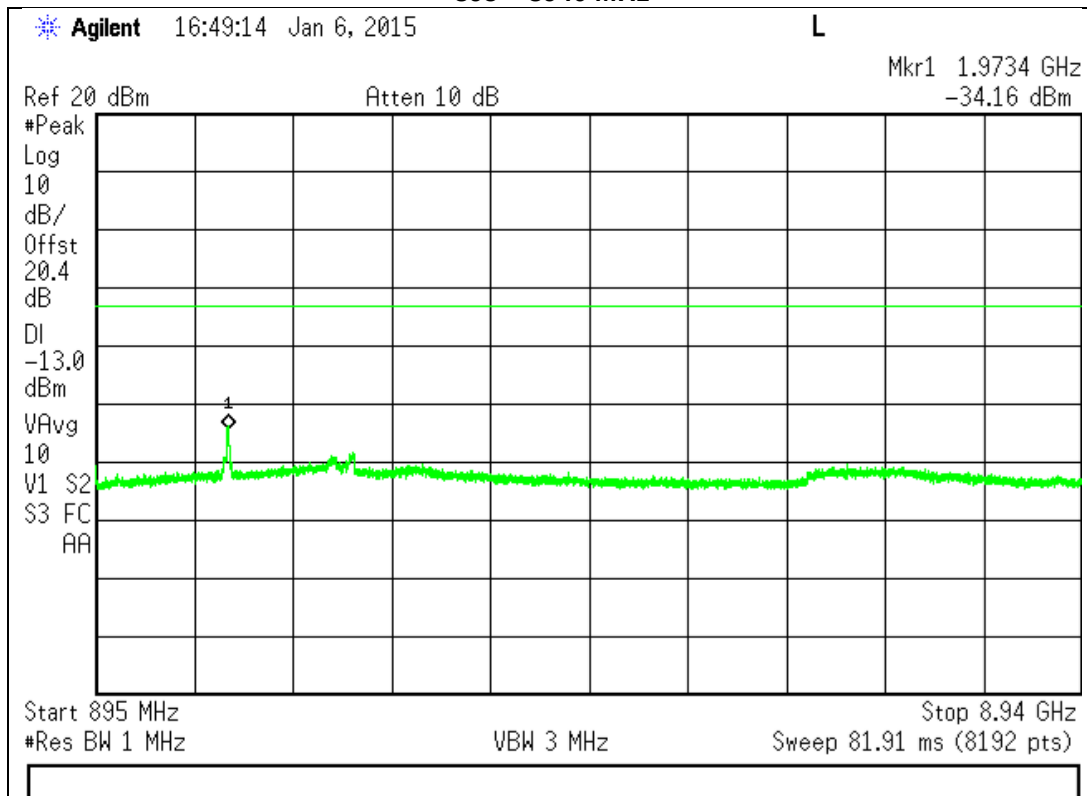
## Downlink Test Plots

### 869 - 894 MHz Band

#### 30 MHz – 868 MHz



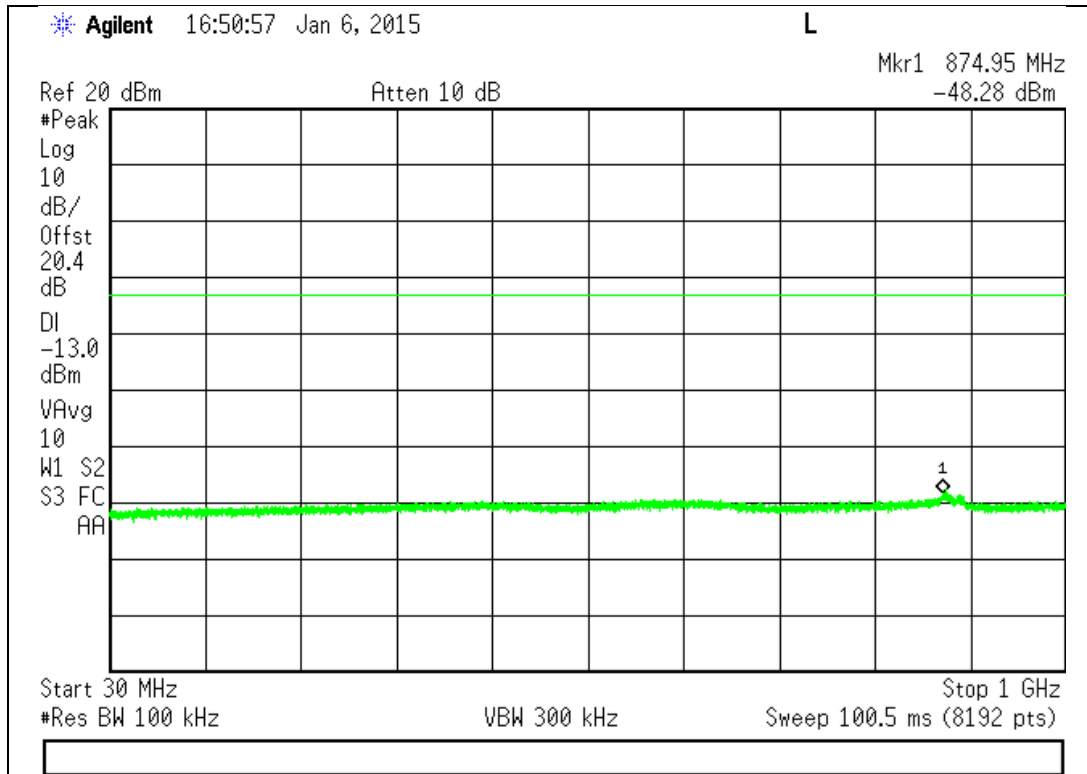
#### 895 – 8940 MHz



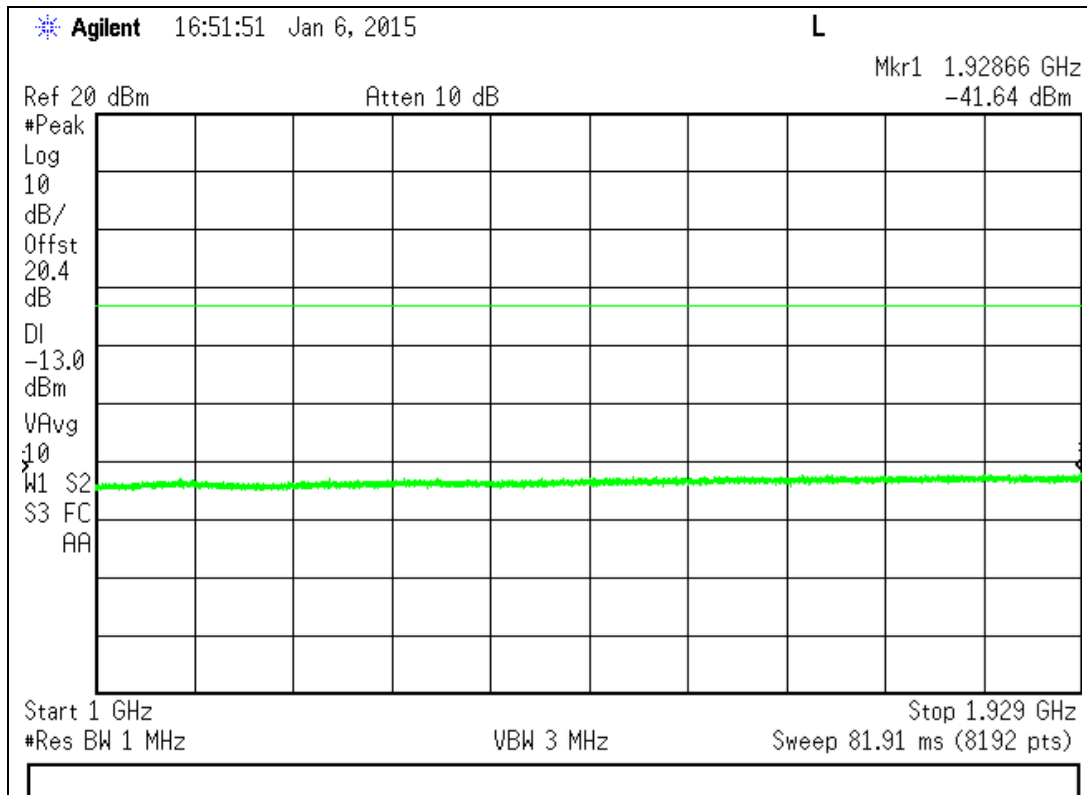


## 1930 - 1995 MHz Band

### 30 MHz – 1000 MHz



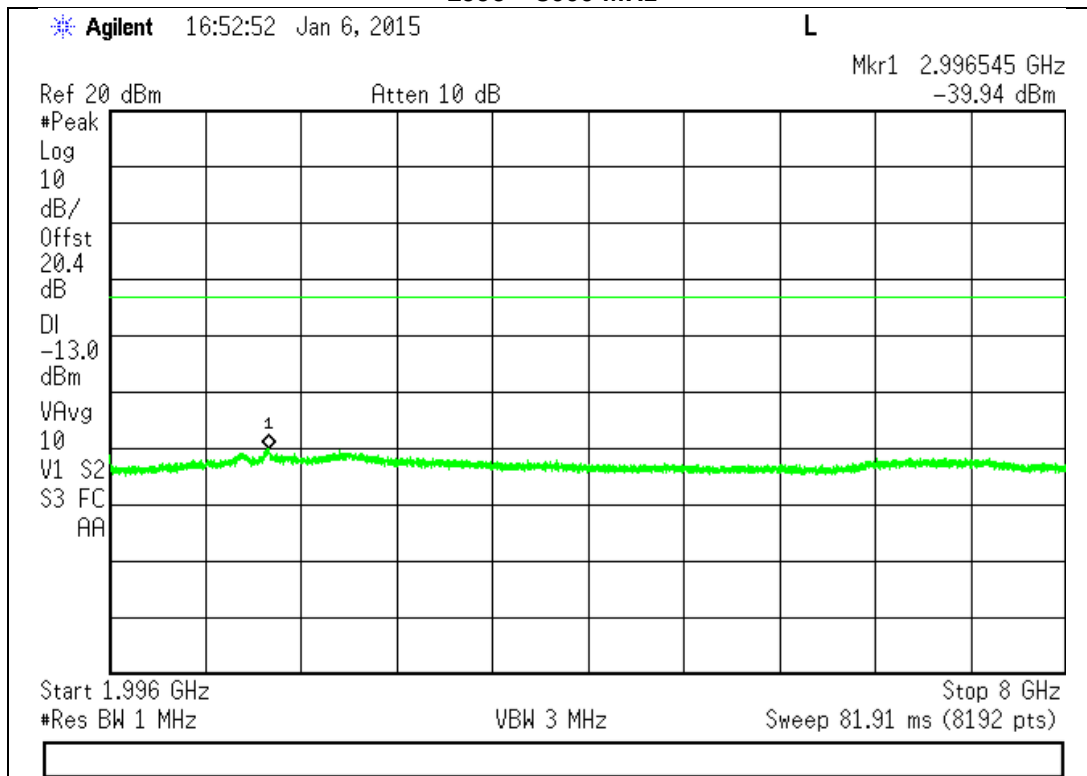
### 1000 – 1929 MHz



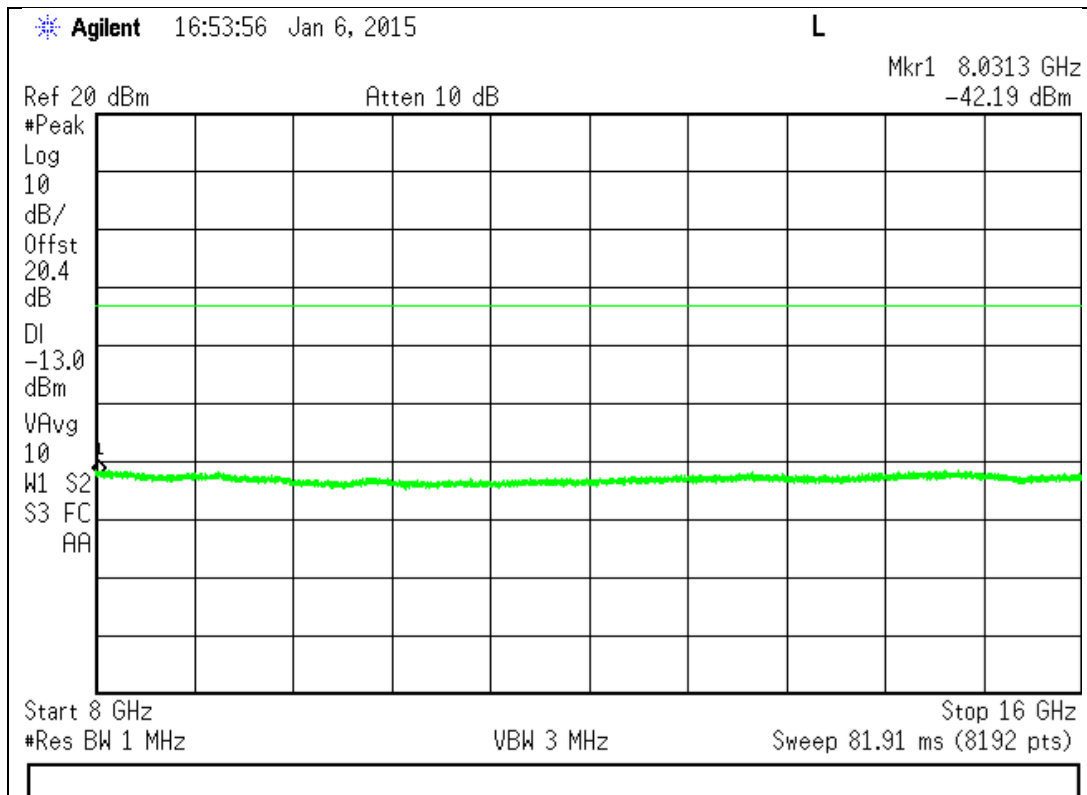


1930 - 1995 MHz Band (cont)

1996 – 8000 MHz



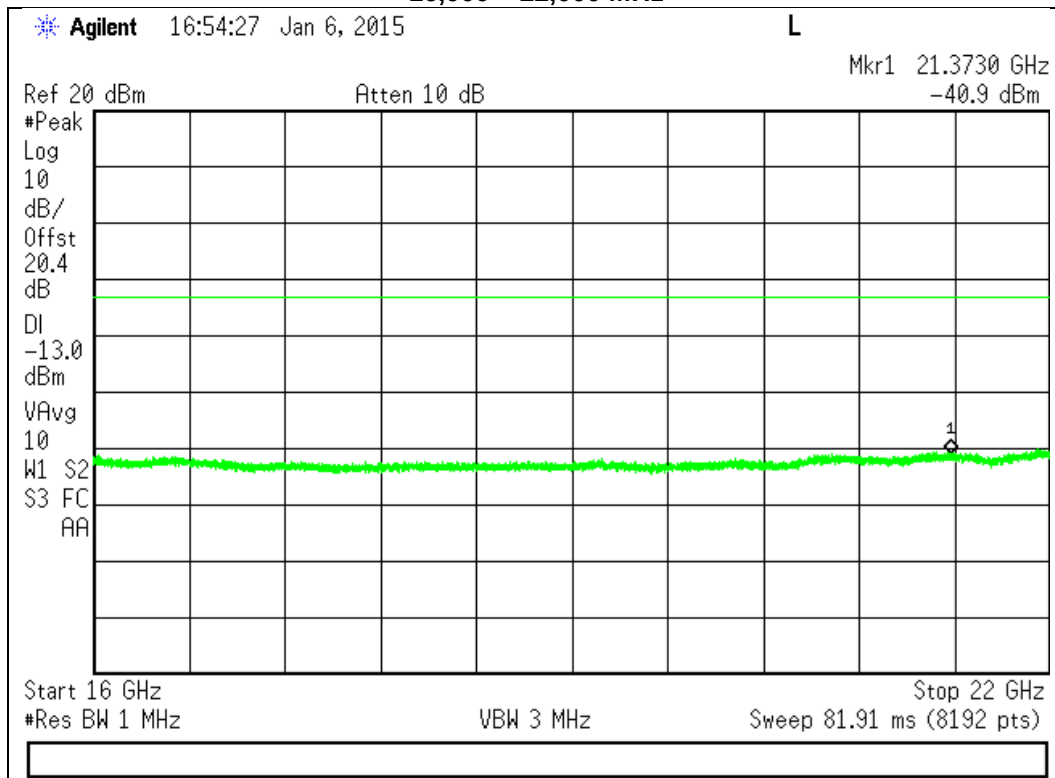
8000 – 16,000 MHz





1930 - 1995 MHz Band (cont)

16,000 – 22,000 MHz





## Noise Limits

**Name of Test:** Noise Limits  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 1/6/15

## 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 that accurate readings were obtained. Two tests were performed: the maximum uplink and downlink noise. 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 power limit is calculated with the center frequency of the associated uplink band.

Noise Power =  $-102.5 + \text{LOG}_{10}(\text{Band Center Frequency}) * 20$

Variable Noise =  $-103 \text{ dBm/MHz} - \text{RSSI}$

## Test Setup

### Uplink and Downlink Maximum Noise Power





### Maximum Uplink Noise Test Results

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|----------------------|----------------------|-------------|-------------|--------|
| 824 - 849            | -47.19               | -44.05      | -3.1        | Pass   |
| 1850 – 1915          | -38.97               | -37.02      | -2.0        | Pass   |

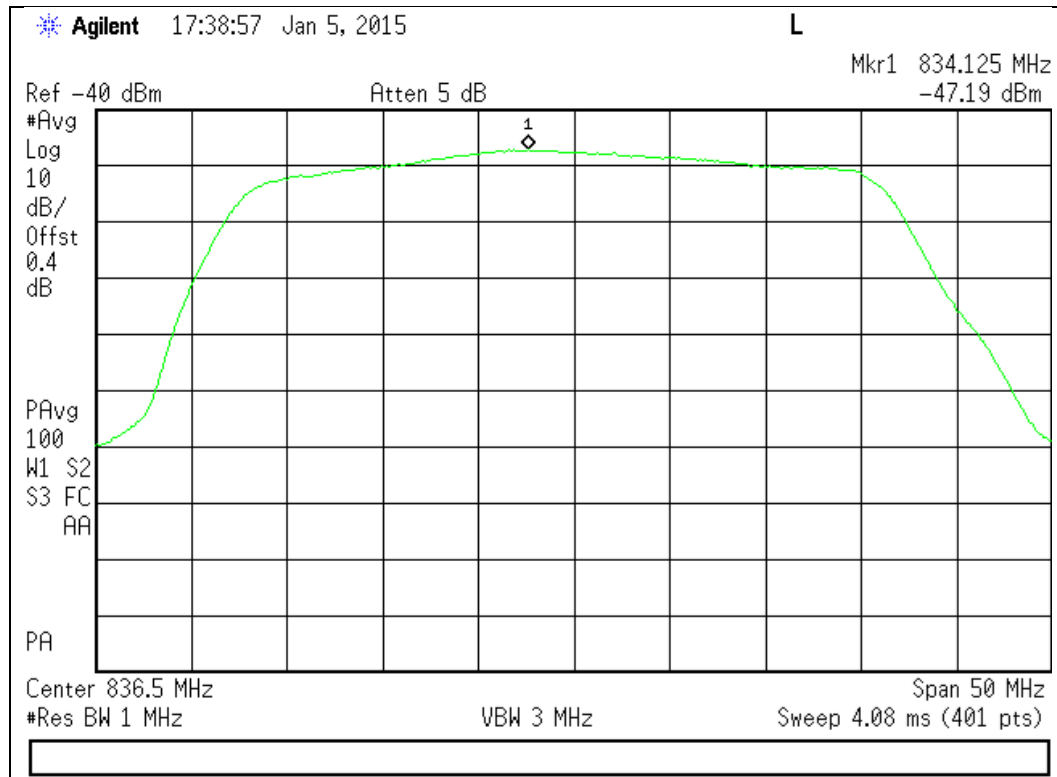
### Maximum Downlink Noise Test Results

| Frequency Band (MHz) | Measured Noise (dBm) | Limit (dBm) | Margin (dB) | Result |
|----------------------|----------------------|-------------|-------------|--------|
| 869 - 894            | -46.18               | -44.1       | -2.1        | Pass   |
| 1930 – 1995          | -39.88               | -37.0       | -2.9        | Pass   |

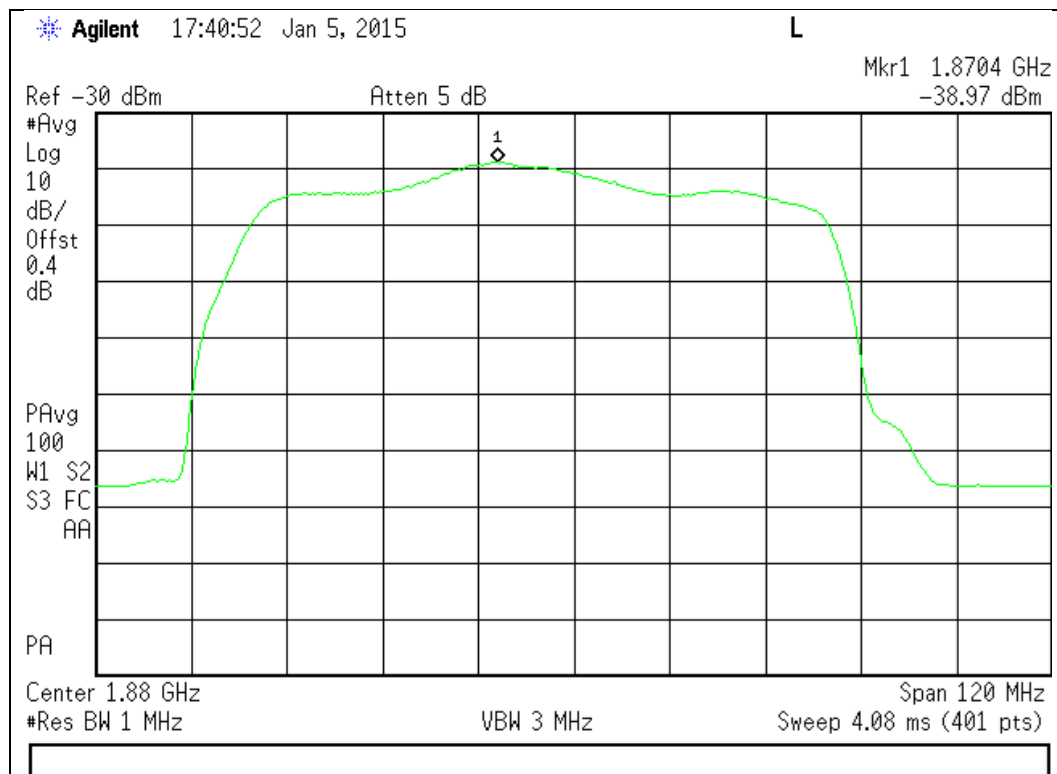


## Maximum Uplink Noise Test Plots

### 824 - 849 MHz Band

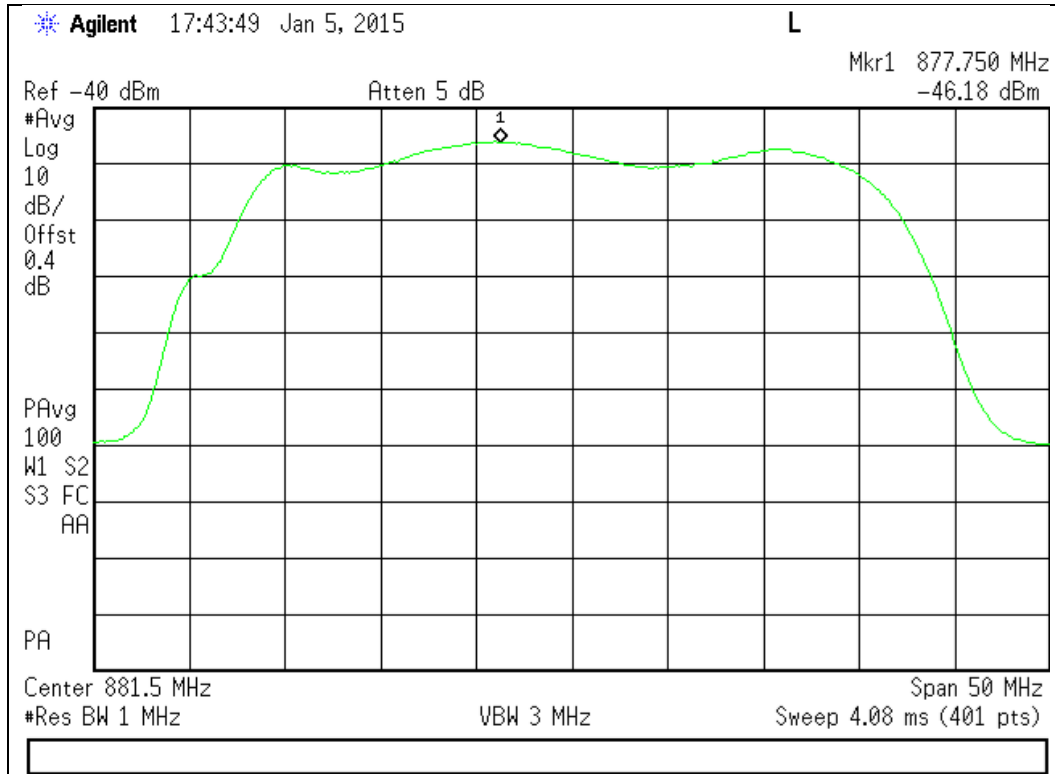


### 1850 - 1915 MHz Band

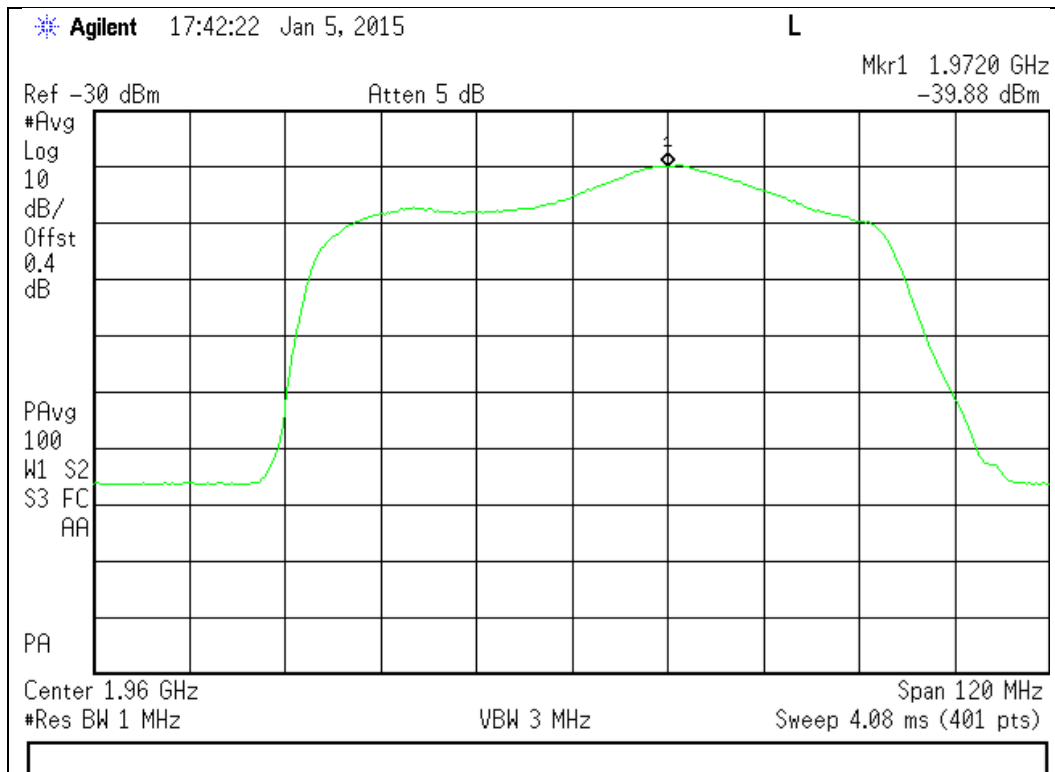




### Maximum Downlink Noise Test Plots 869 – 894 MHz Band



### 1930 - 1995 MHz Band





### Variable Uplink Noise Limit Test Results

#### 824 - 849 MHz

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|------------|-------------------|----------------------|-------------|
| -71.0      | -44.05            | -46.7                | -2.6        |
| -70.0      | -44.05            | -46.7                | -2.6        |
| -69.0      | -44.05            | -46.7                | -2.6        |
| -68.0      | -44.05            | -46.7                | -2.6        |
| -42.0      | -61.00            | -62.8                | -1.8        |
| -41.0      | -62.00            | -63.8                | -1.8        |

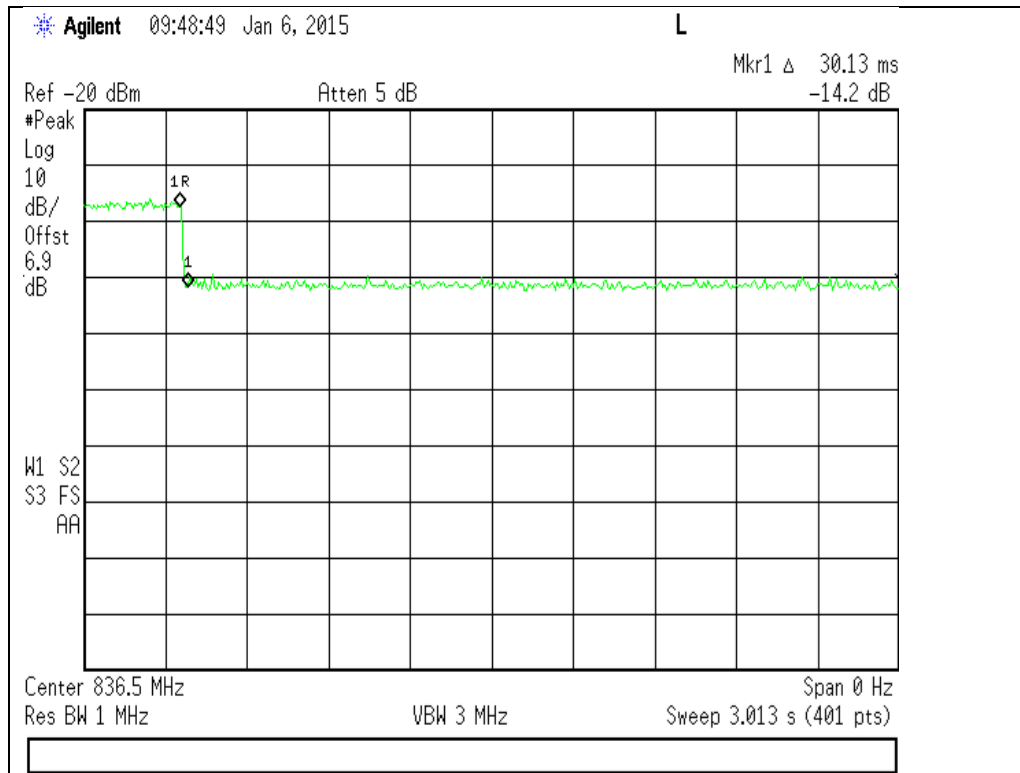
#### 1850 - 1915 MHz

| RSSI (dBm) | Noise Limit (dBm) | Measured Noise (dBm) | Margin (dB) |
|------------|-------------------|----------------------|-------------|
| -71.0      | -37.02            | -38.4                | -1.4        |
| -70.0      | -37.02            | -38.4                | -1.4        |
| -69.0      | -37.02            | -38.4                | -1.4        |
| -68.0      | -37.02            | -38.4                | -1.4        |
| -44.0      | -59.0             | -59.3                | -0.3        |
| -43.0      | -60.0             | -60.3                | -0.3        |

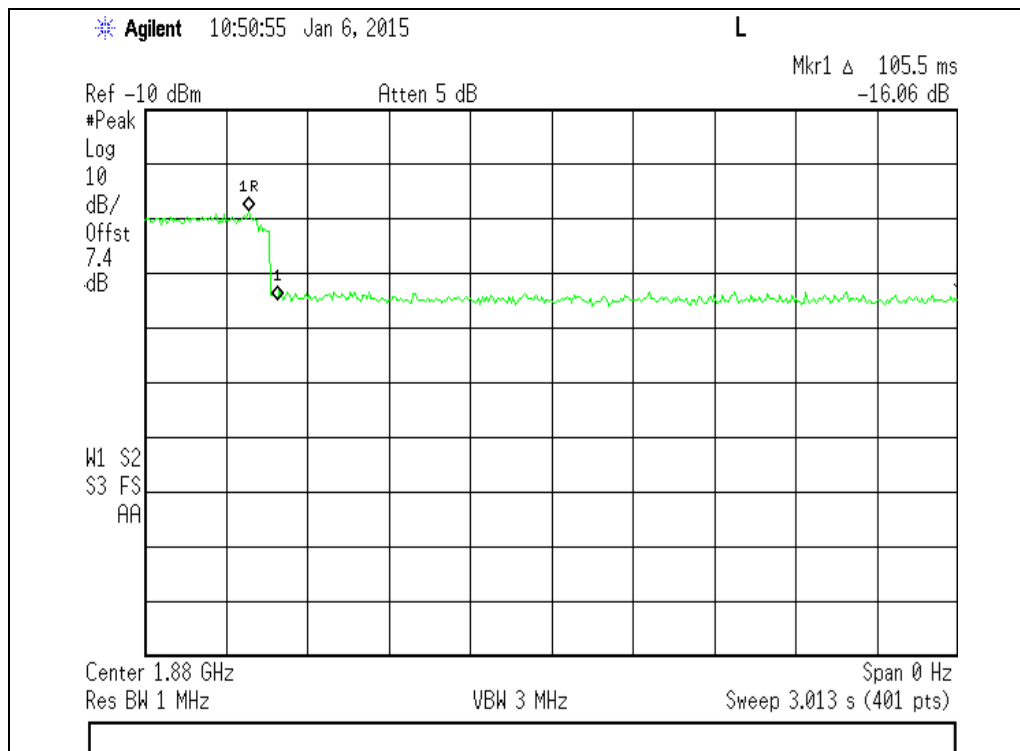


## Uplink Noise Timing Test Plots

### 824 - 849 MHz Band



### 1850 - 1915 MHz Band





## Variable Gain

**Name of Test:** Variable Gain  
**Test Equipment Utilized:** i00379, i00405, i00412

**Engineer:** Mike Graffeo  
**Test Date:** 1/6/15

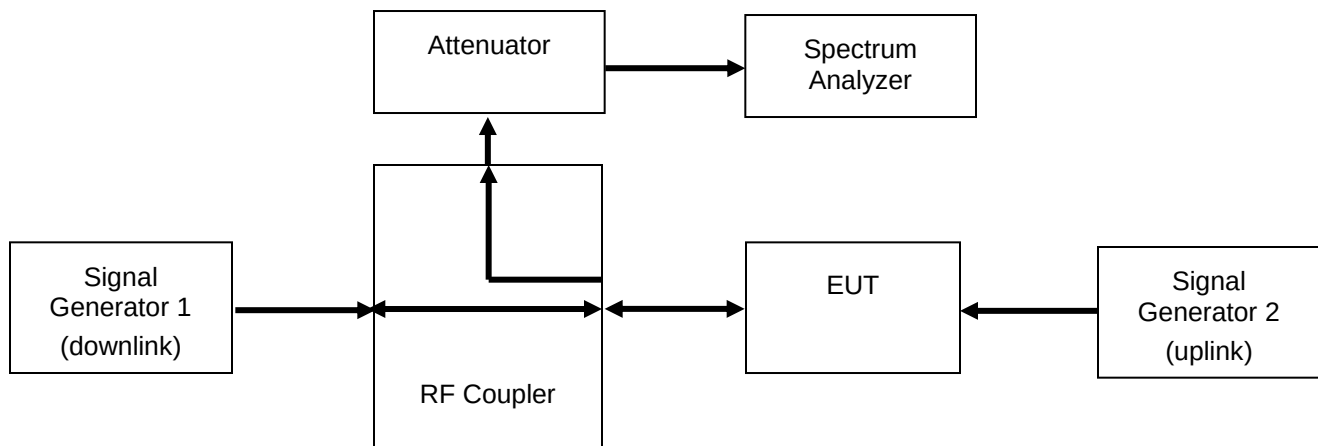
### Test Procedure

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 in order 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:

$$\text{Variable Gain} = -34 \text{ dB} - \text{RSSI} + \text{MSCL}$$

### Test Setup





### Uplink Test Results

#### 824 - 849 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dB) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|------------|-----------|-----------------|-------------|--------------|-----------|-------------|
| -66.0      | 37.04     | 64.90           | -45.3       | 15.6         | 60.9      | -4.0        |
| -65.0      | 37.04     | 64.90           | -45.3       | 15.6         | 60.9      | -4.0        |
| -64.0      | 37.04     | 64.90           | -45.3       | 15.6         | 60.9      | -4.0        |
| -63.0      | 37.04     | 64.90           | -45.3       | 15.6         | 60.9      | -4.0        |
| -44.0      | 37.04     | 47.04           | -45.3       | 1.0          | 46.3      | -0.7        |
| -43.0      | 37.04     | 46.04           | -45.3       | 0.0          | 45.3      | -0.7        |

#### 1850 - 1915 MHz

| RSSI (dBm) | MSCL (dB) | Gain Limit (dB) | P(in) (dBm) | P(out) (dBm) | Gain (dB) | Margin (dB) |
|------------|-----------|-----------------|-------------|--------------|-----------|-------------|
| -71.0      | 38.72     | 72.00           | -53.4       | 14.8         | 68.2      | -3.8        |
| -70.0      | 38.72     | 72.00           | -53.4       | 14.8         | 68.2      | -3.8        |
| -69.0      | 38.72     | 72.00           | -53.4       | 14.8         | 68.2      | -3.8        |
| -68.0      | 38.72     | 72.00           | -53.4       | 14.8         | 68.2      | -3.8        |
| -52.0      | 38.72     | 56.72           | -53.4       | 1.9          | 55.3      | -1.4        |
| -51.0      | 38.72     | 55.72           | -53.4       | 0.9          | 54.3      | -1.4        |

### Variable Uplink Gain Timing Test Results

| Frequency Band (MHz) | Measured Timing (ms) | Limit (ms) | Result |
|----------------------|----------------------|------------|--------|
| 824 - 849            | 131.80               | 3000       | Pass   |
| 1850 - 1915          | 31.00                | 3000       | Pass   |

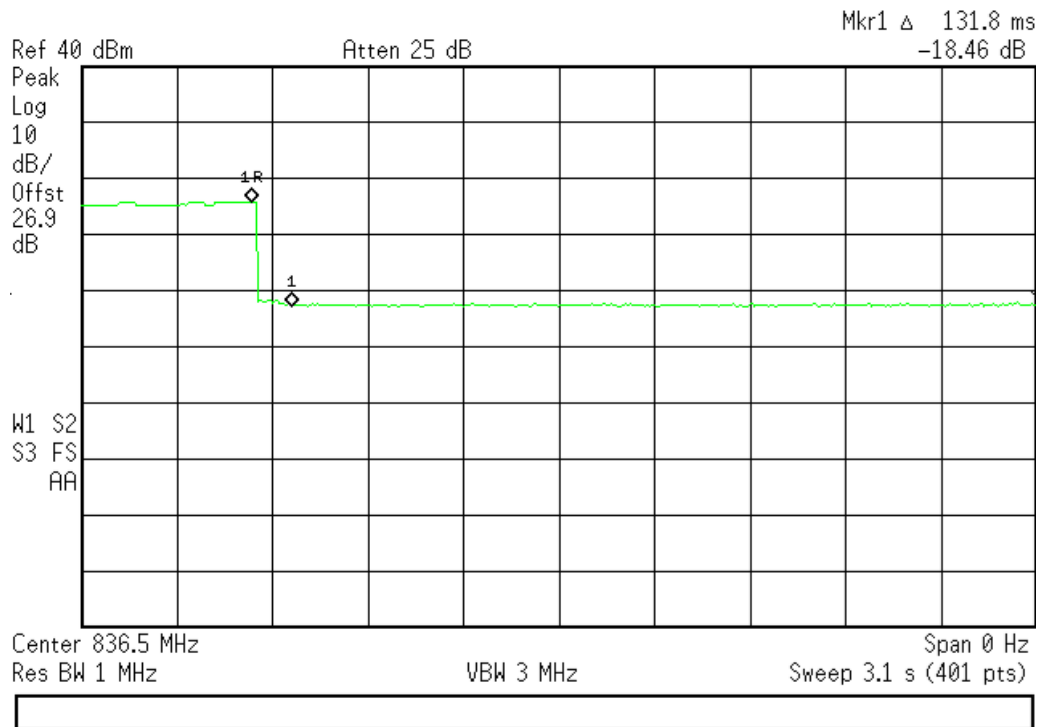


## Variable Uplink Gain Timing

824 - 849 MHz

Agilent 14:33:19 Jan 6, 2015

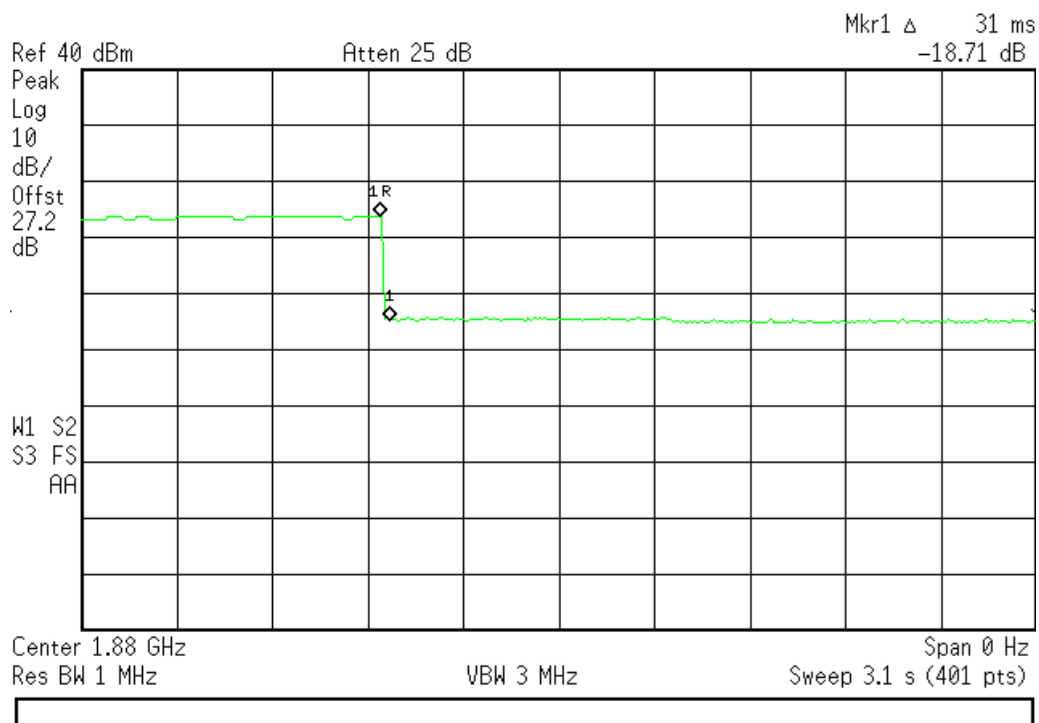
L



1850 - 1915 MHz

Agilent 14:29:49 Jan 6, 2015

L





## Occupied Bandwidth

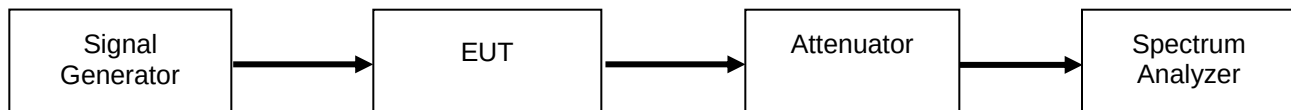
**Name of Test:** Occupied Bandwidth  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 1/6/15

## 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 required to ensure that accurate readings were obtained. A signal generator was utilized to produce the following signals: GSM, CDMA, and WCDMA. The signal generator was tuned to the center channel of each of the EUT operational uplink and downlink bands with the RF level set at 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

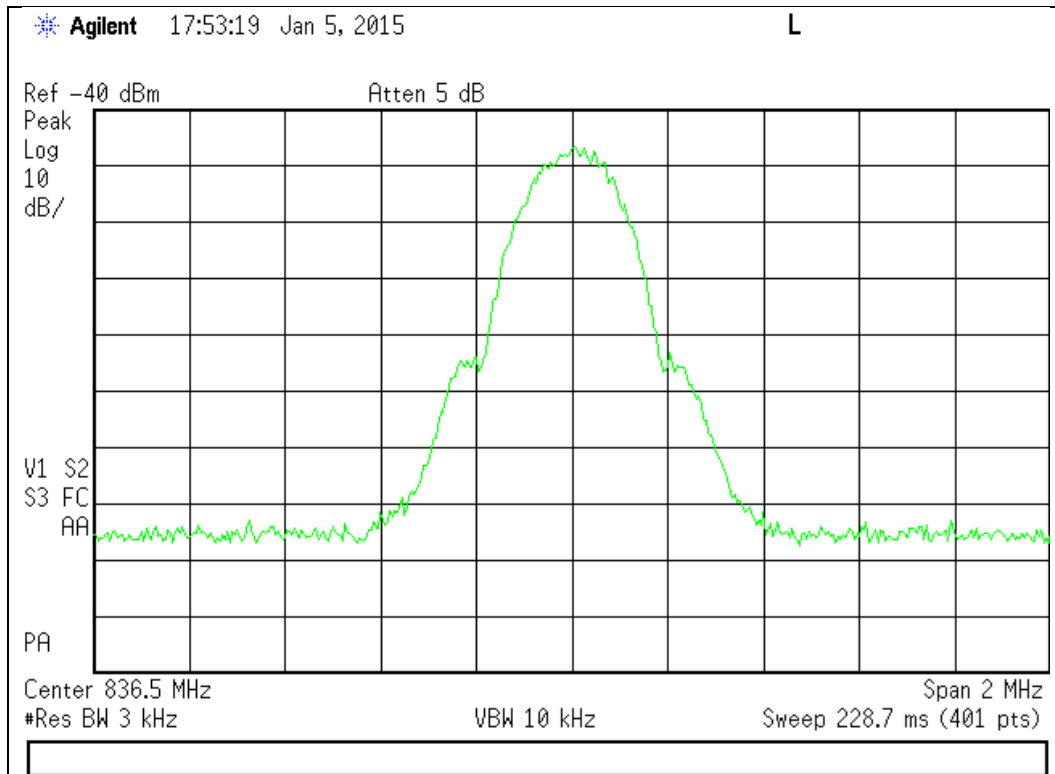




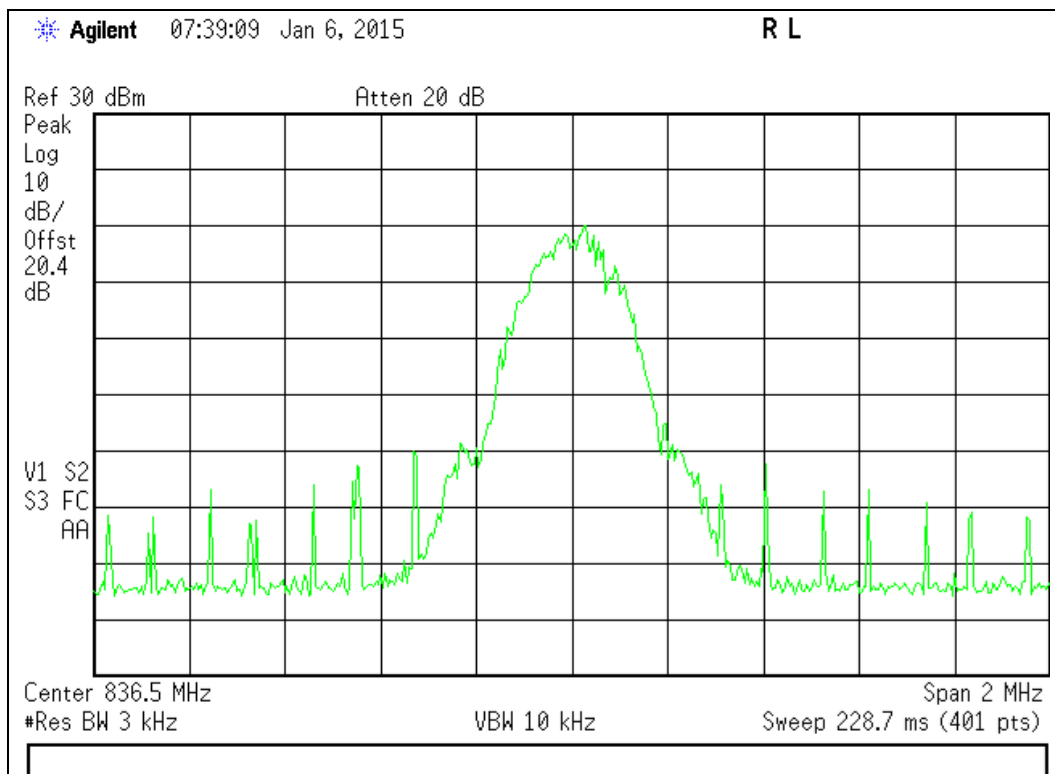
## GSM Uplink Test Plots

824 - 849 MHz Band

Input



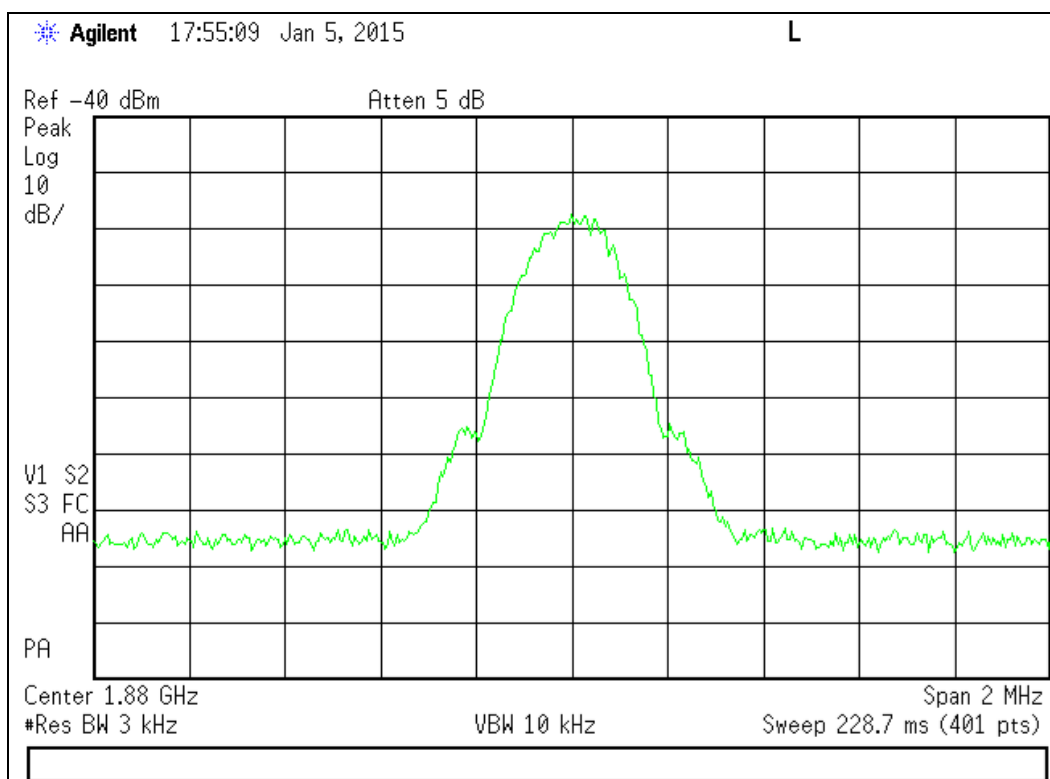
Output



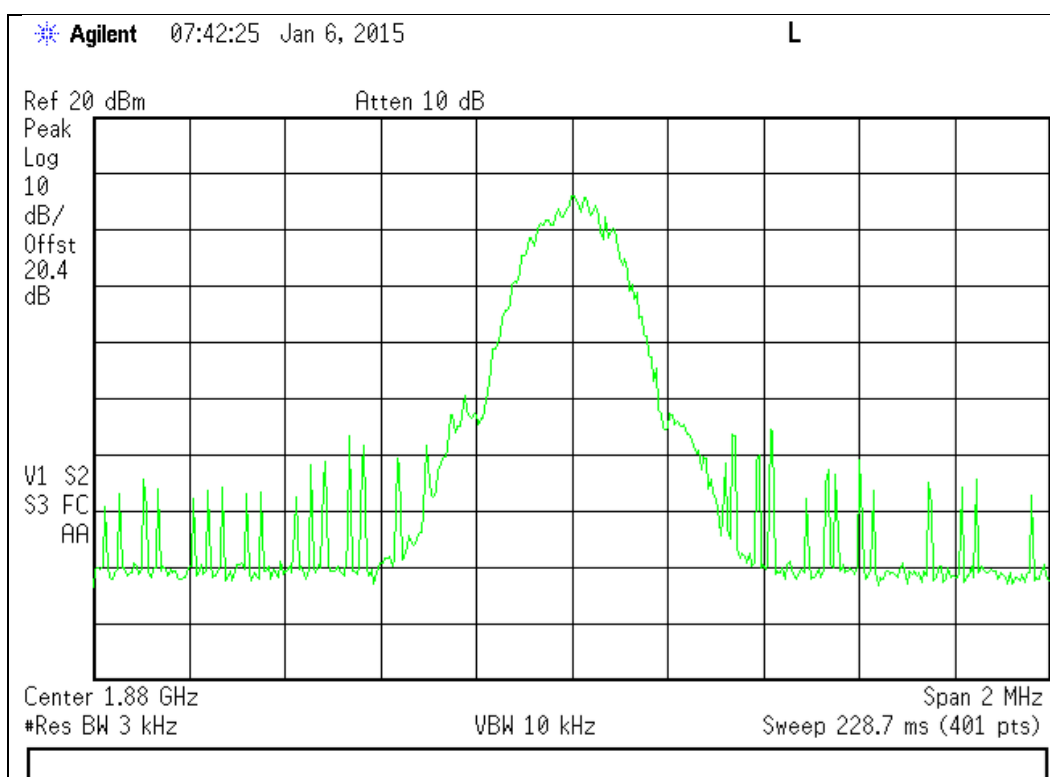


## 1850 - 1915 MHz Band

### Input



### Output

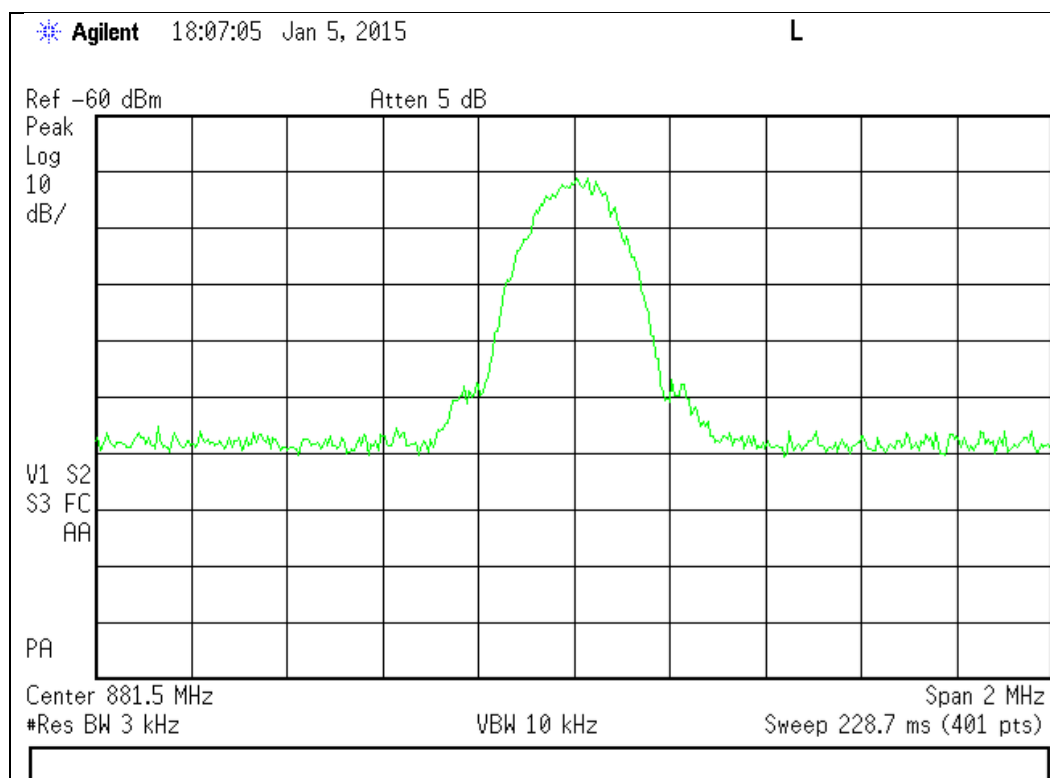




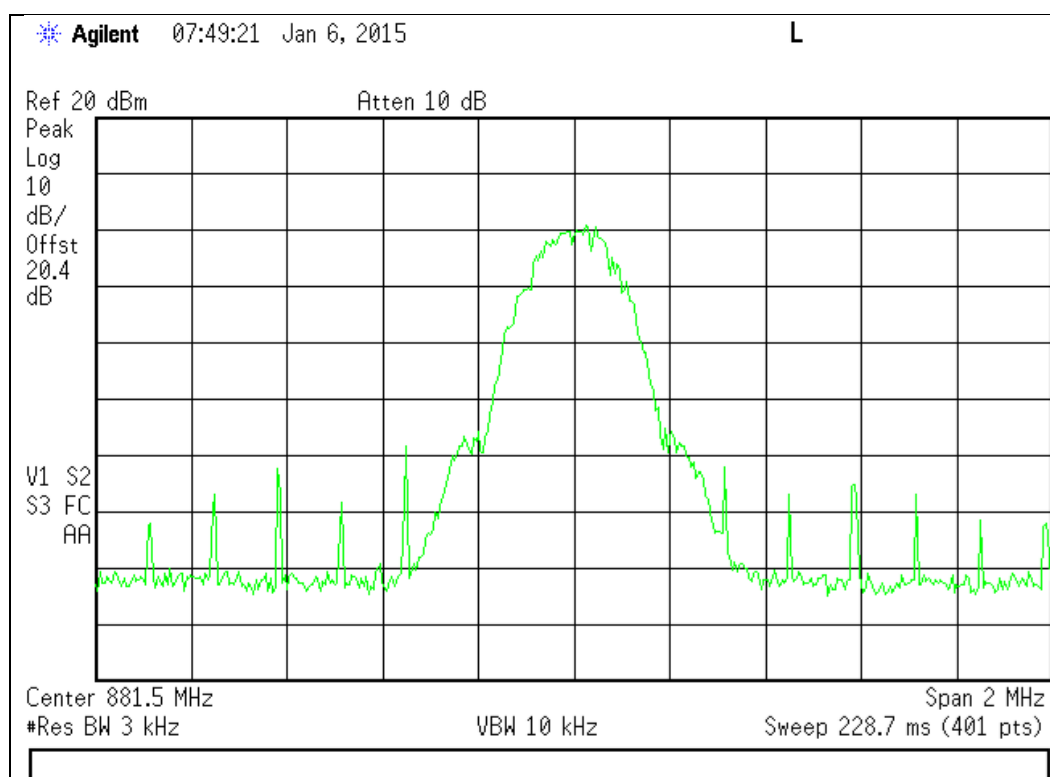
## GSM Downlink Test Plots

869 - 894 MHz Band

### Input



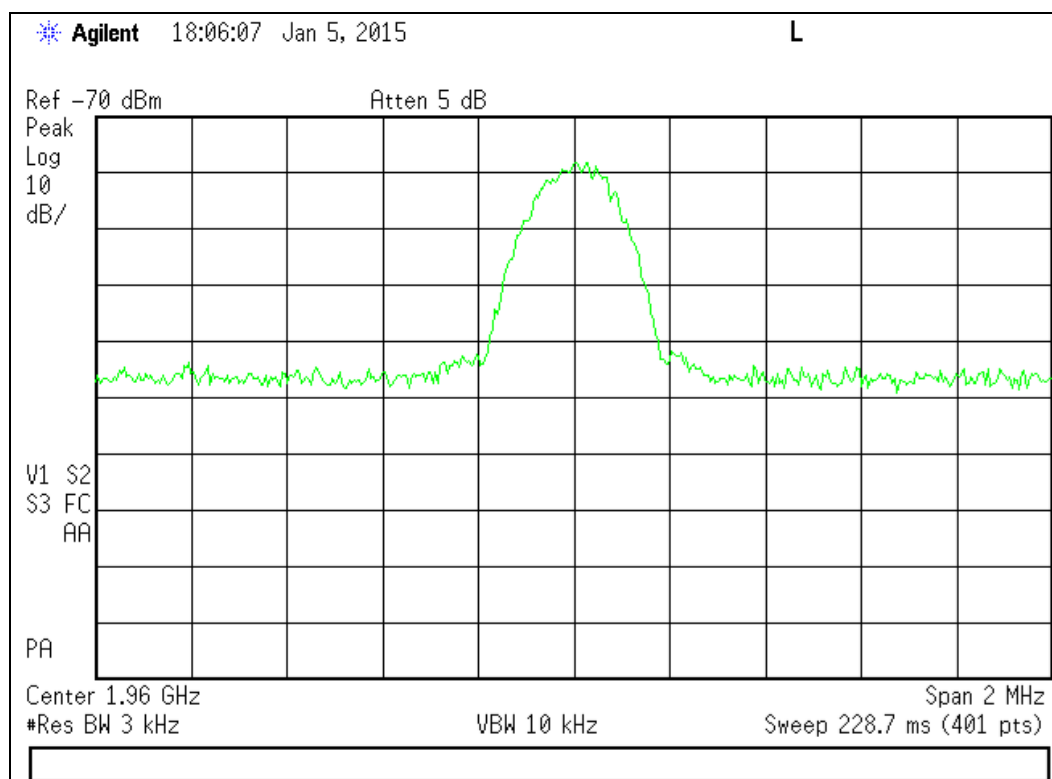
### Output



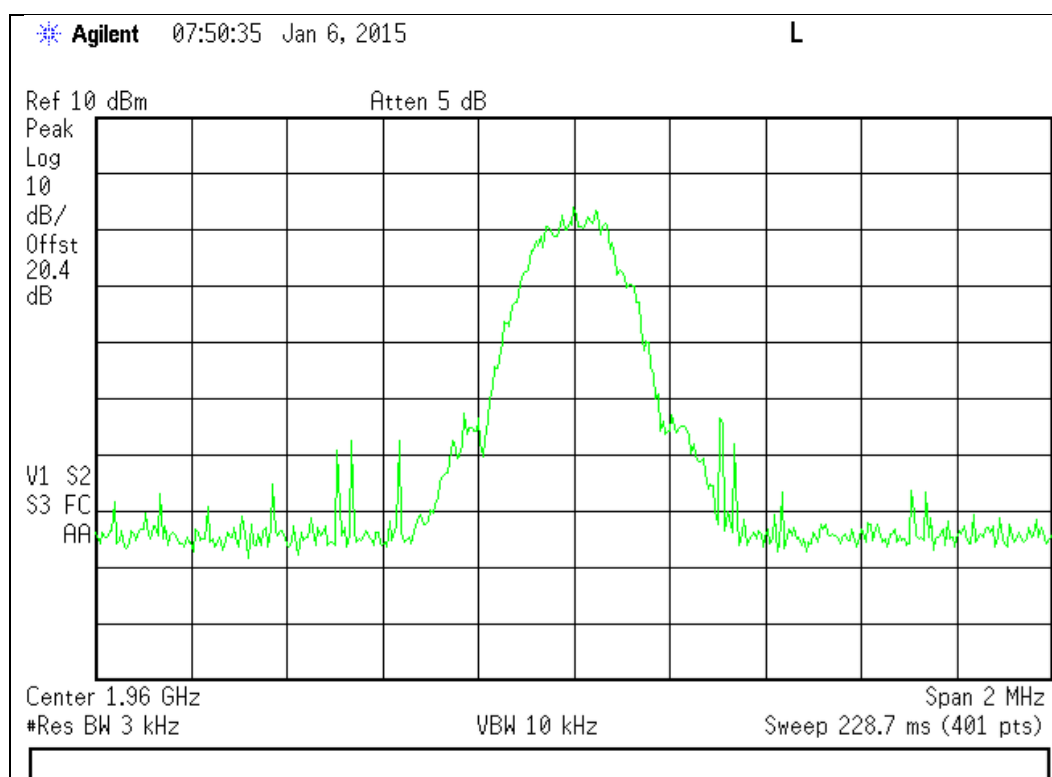


## 1930 - 1995 MHz Band

### Input



### Output

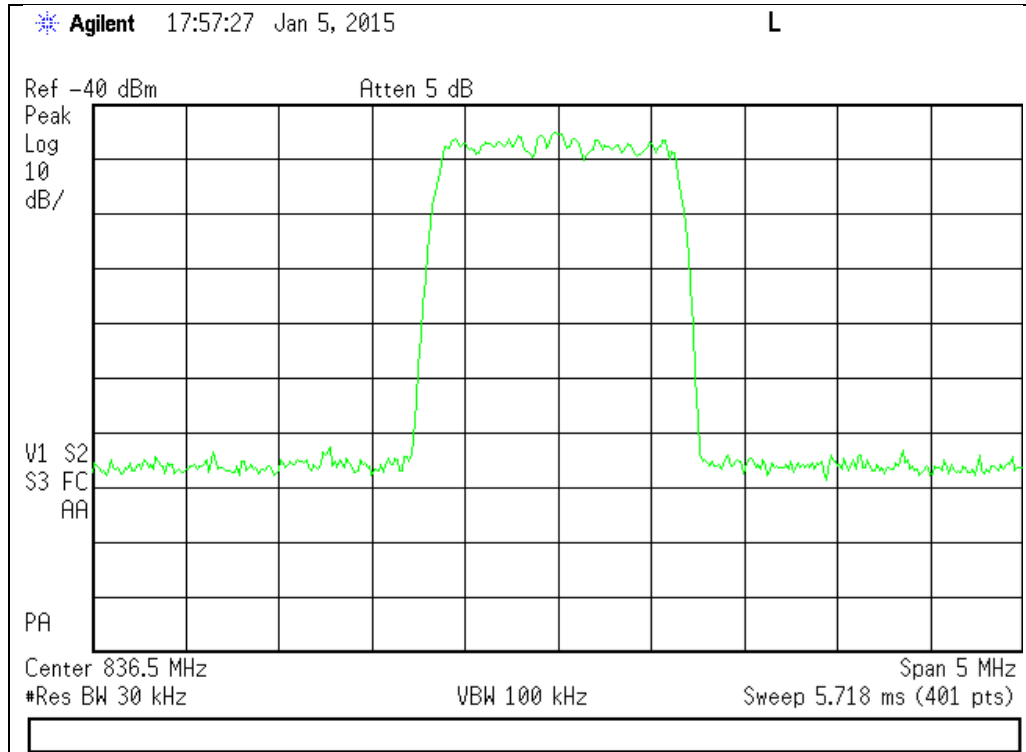




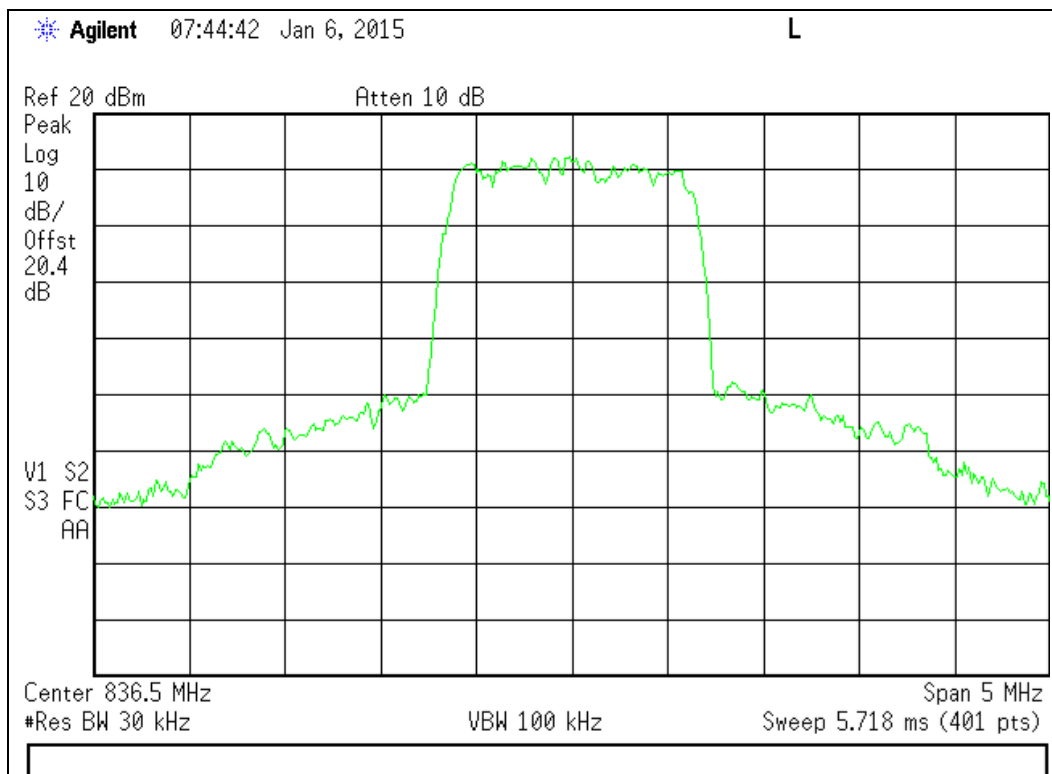
## CDMA Uplink Test Plots

### 824-849 MHz Band

#### Input



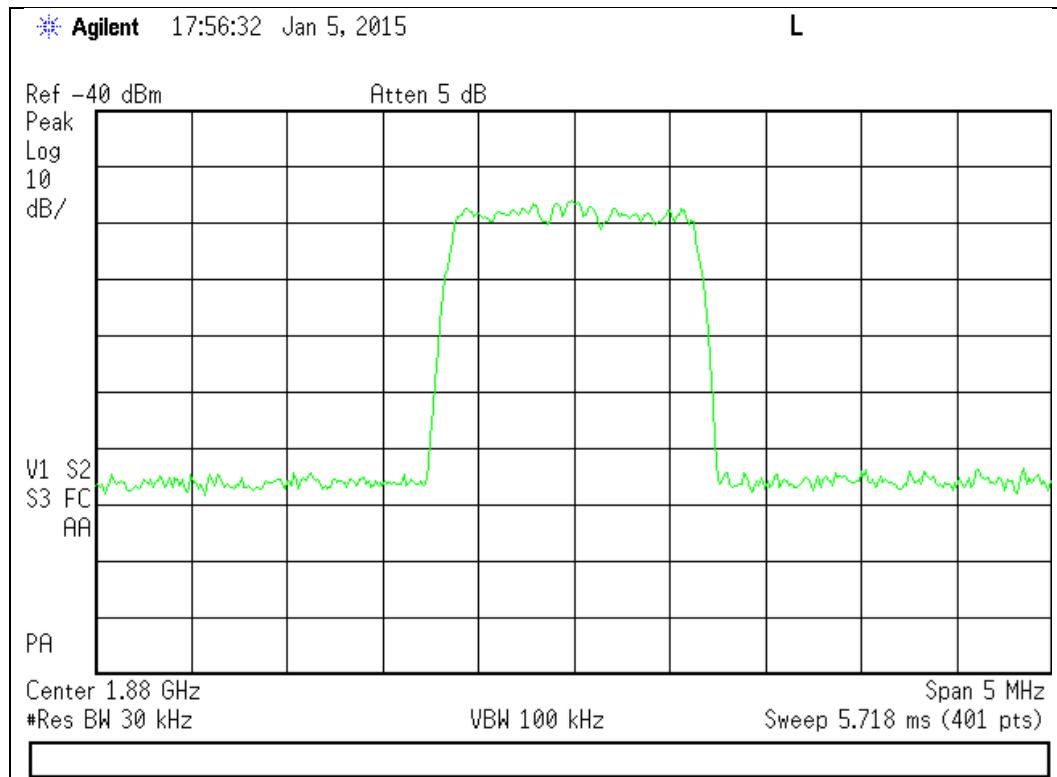
#### Output



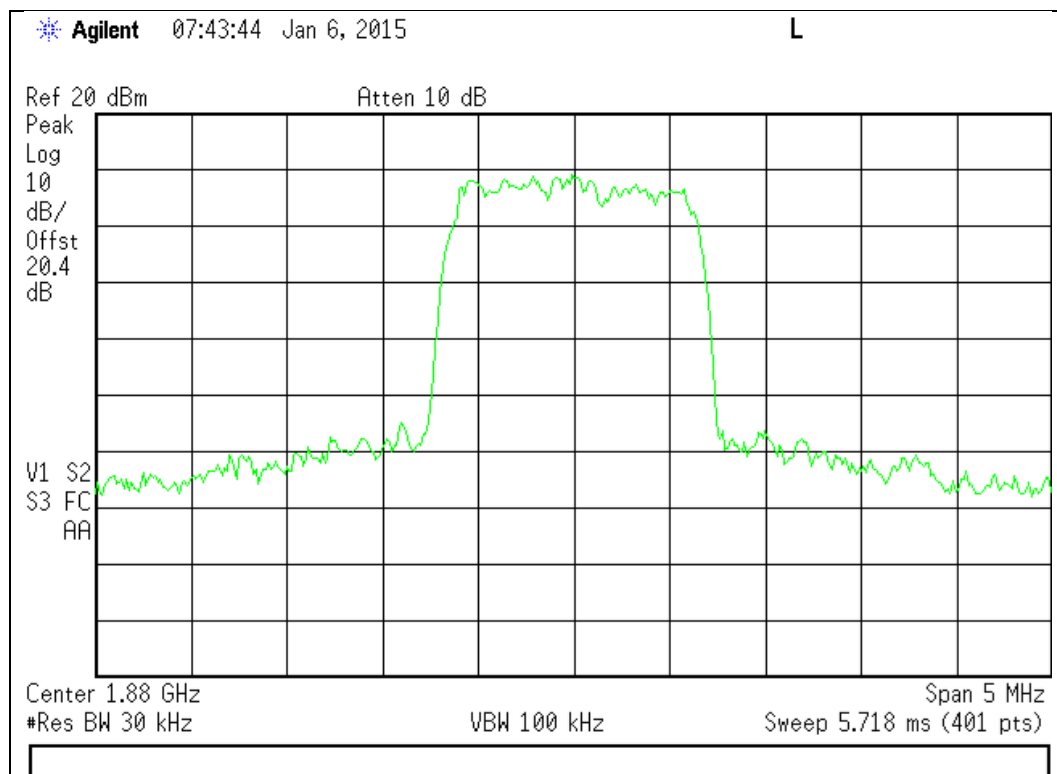


## 1850 - 1915 MHz Band

### Input



### Output

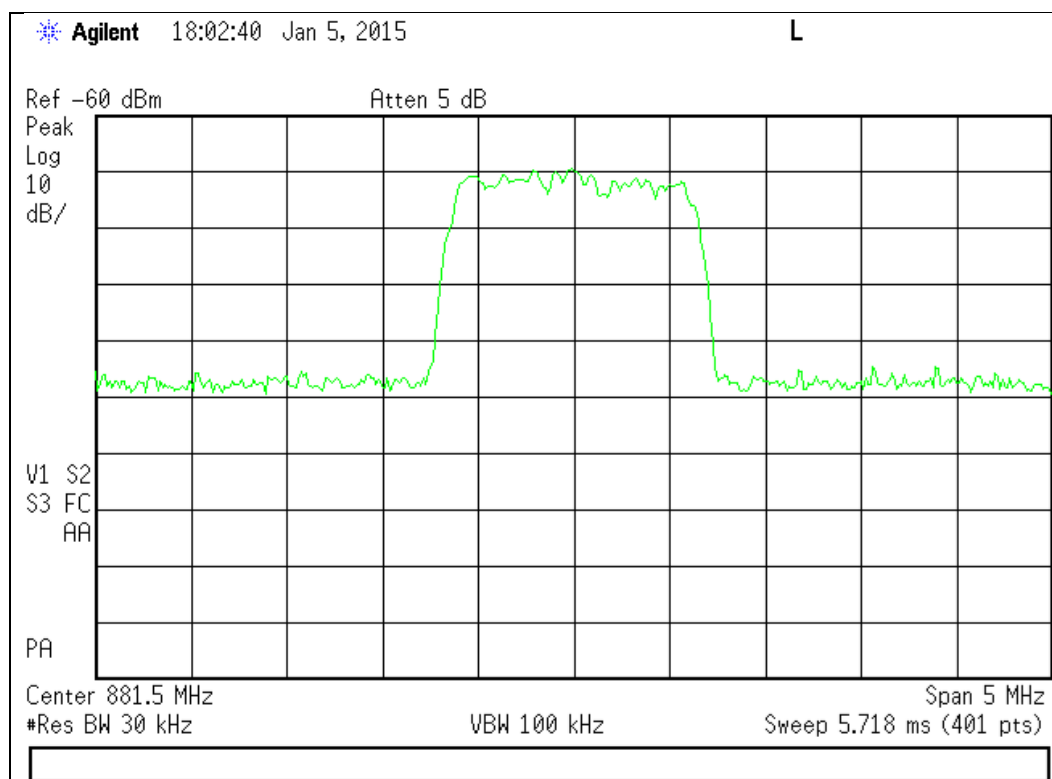




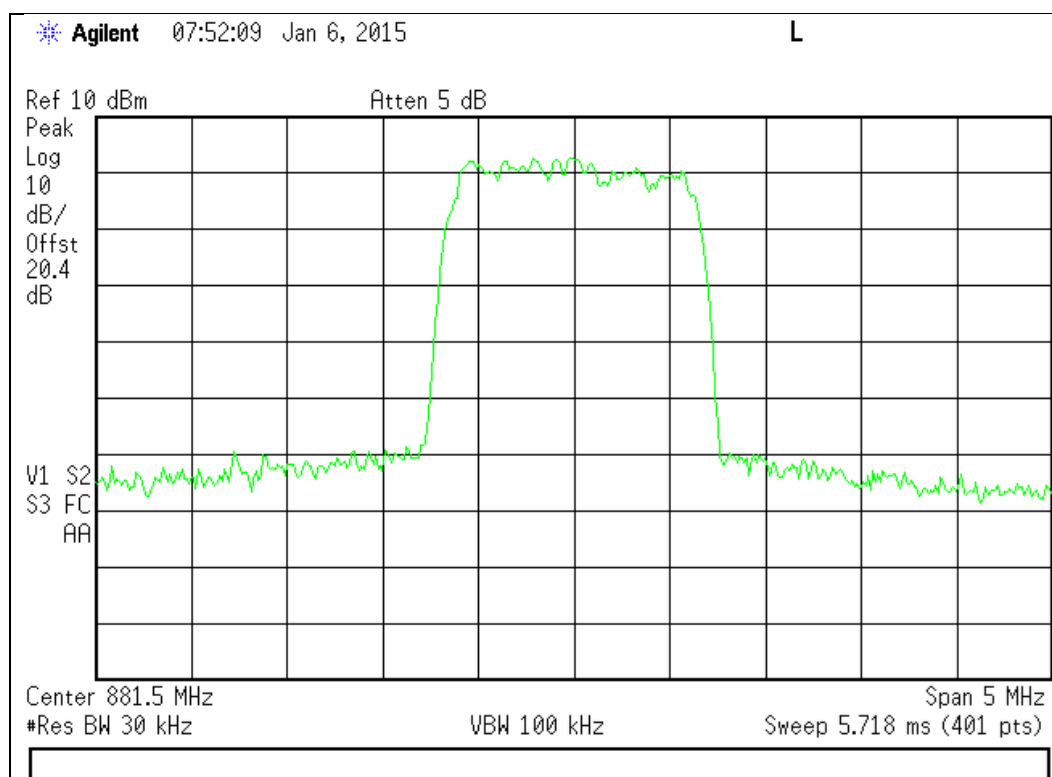
## CDMA Downlink Test Plots

869 - 894 MHz Band

Input



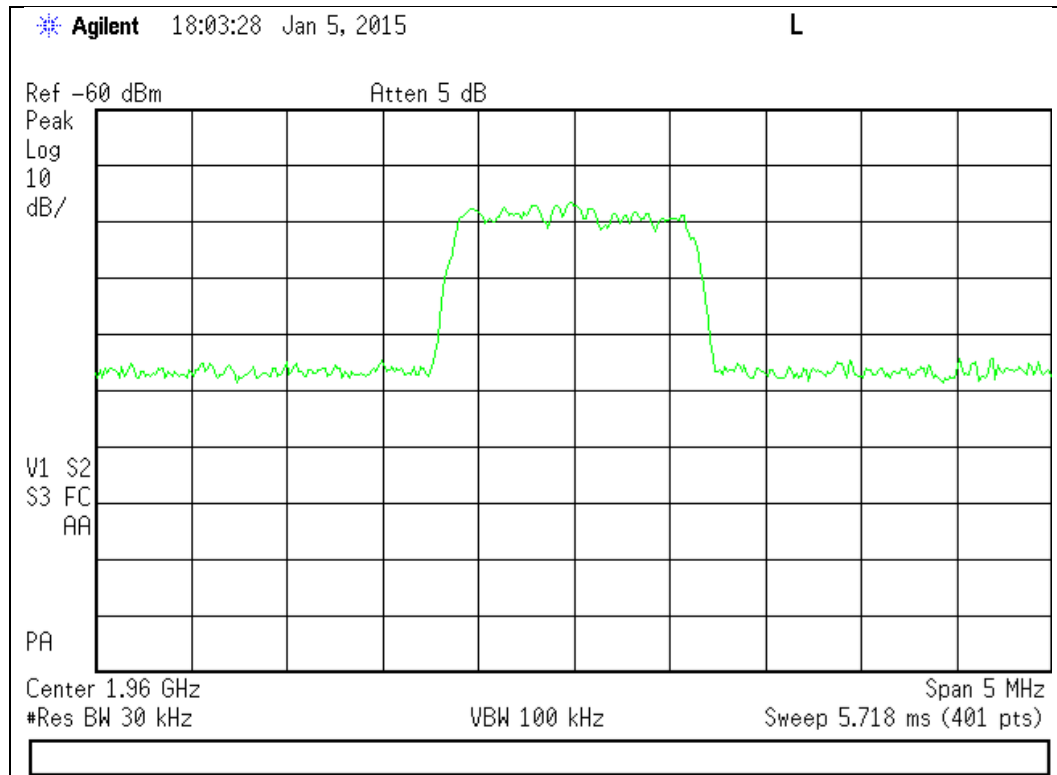
Output



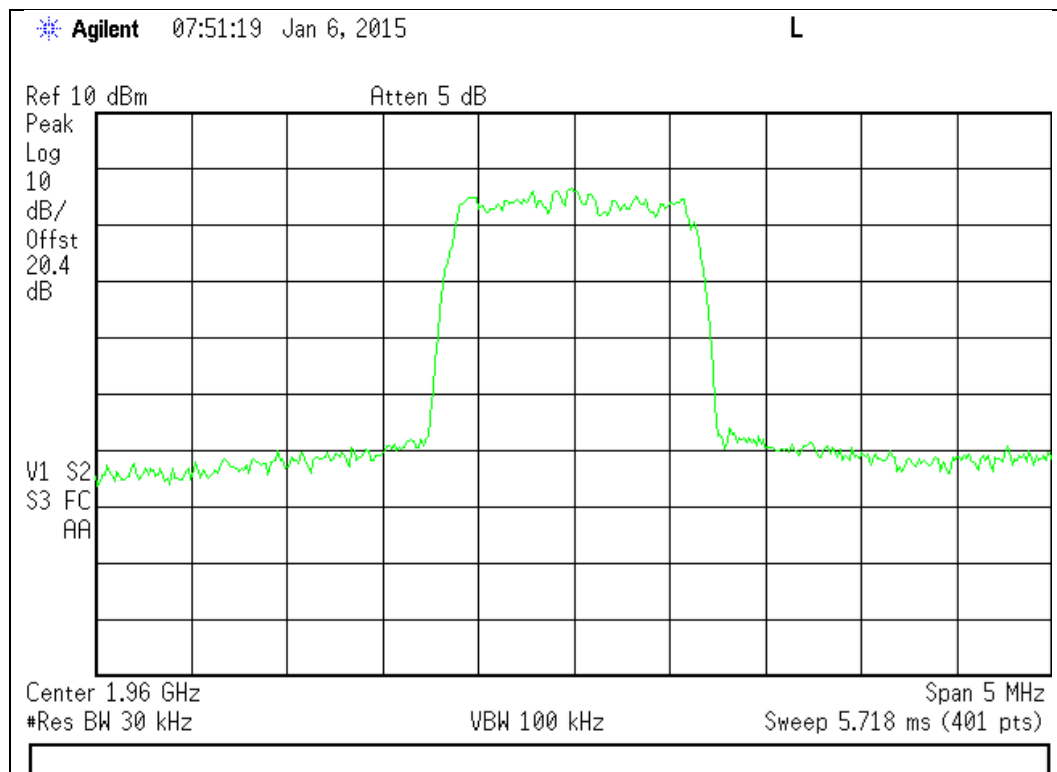


## 1930 - 1995 MHz Band

### Input



### Output

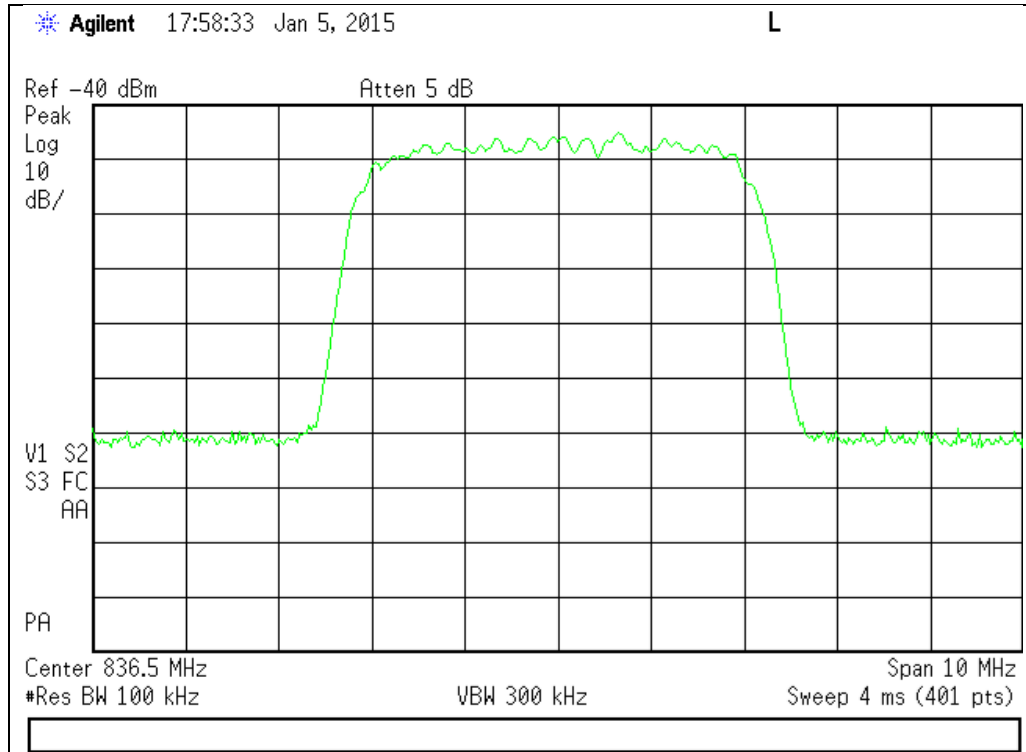




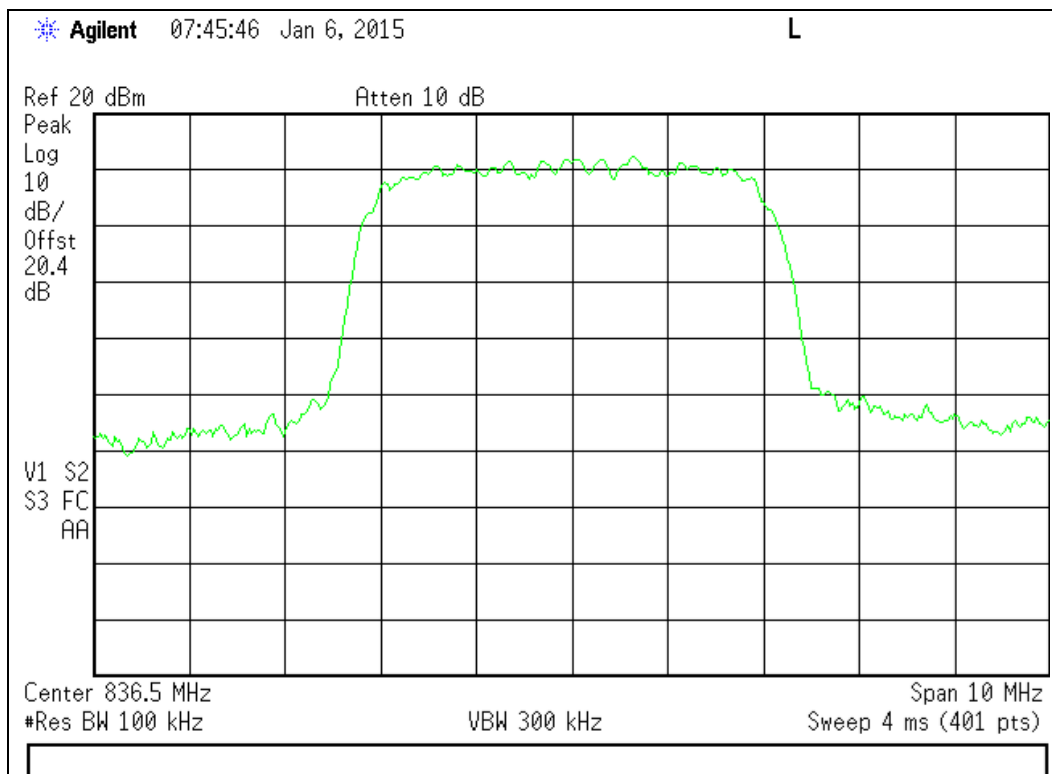
## WCDMA Uplink Test Plots

824 – 849 MHz Band

### Input



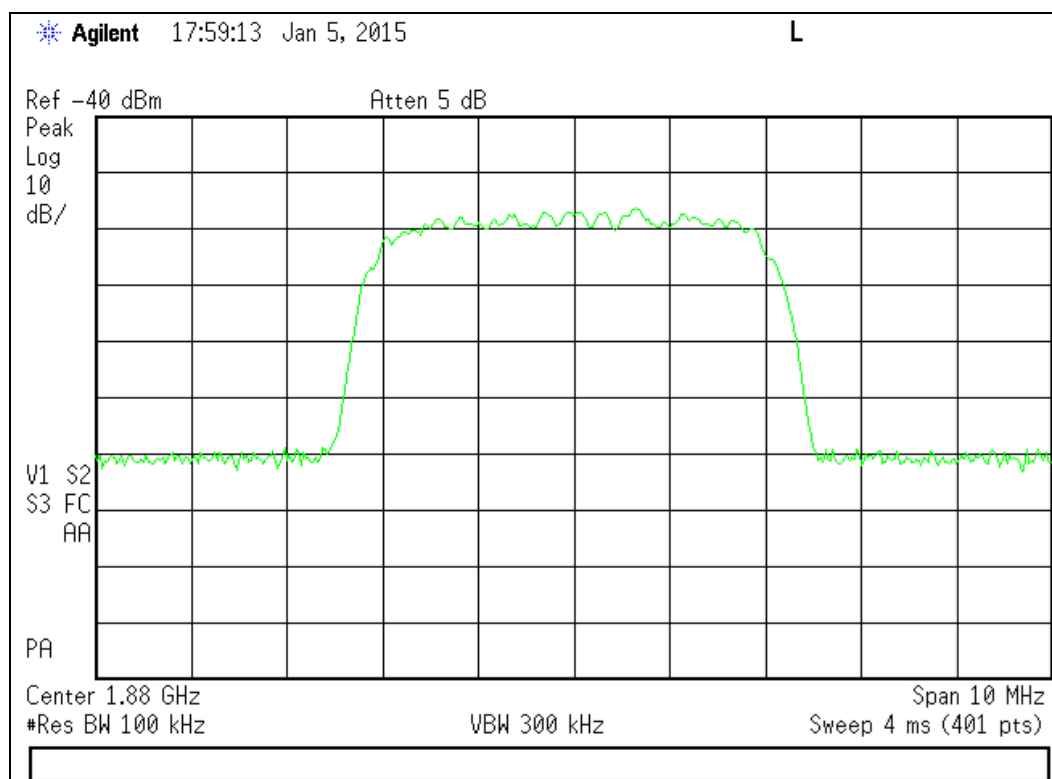
### Output



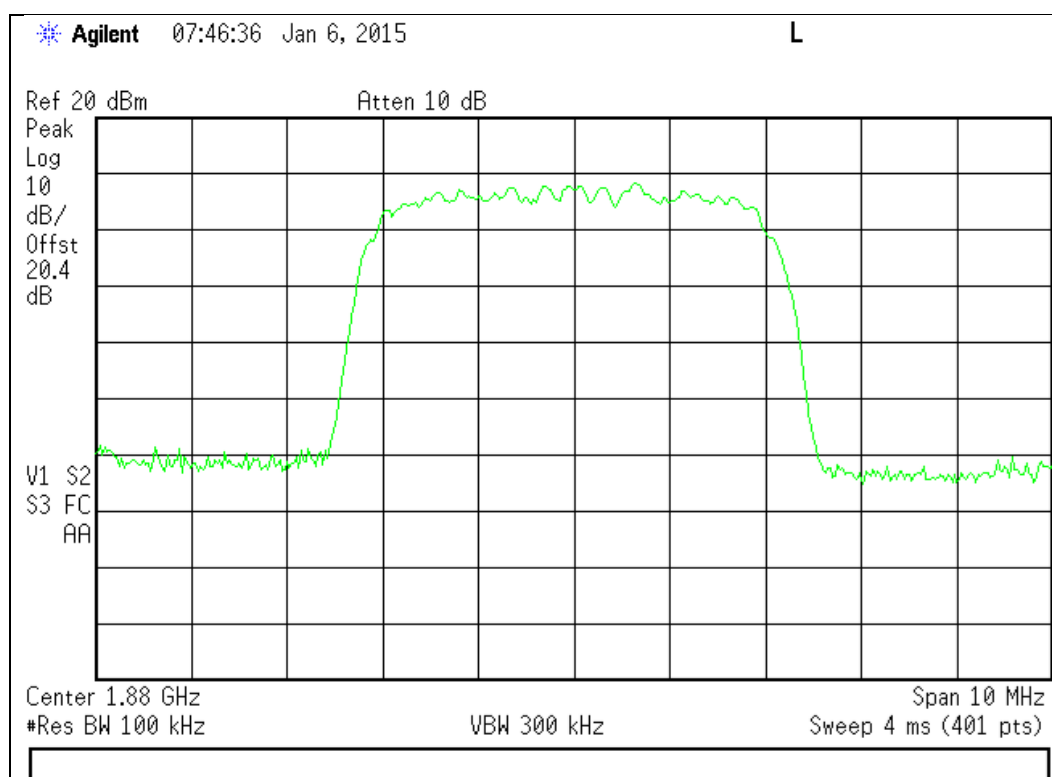


## 1850 - 1915 MHz Band

### Input



### Output

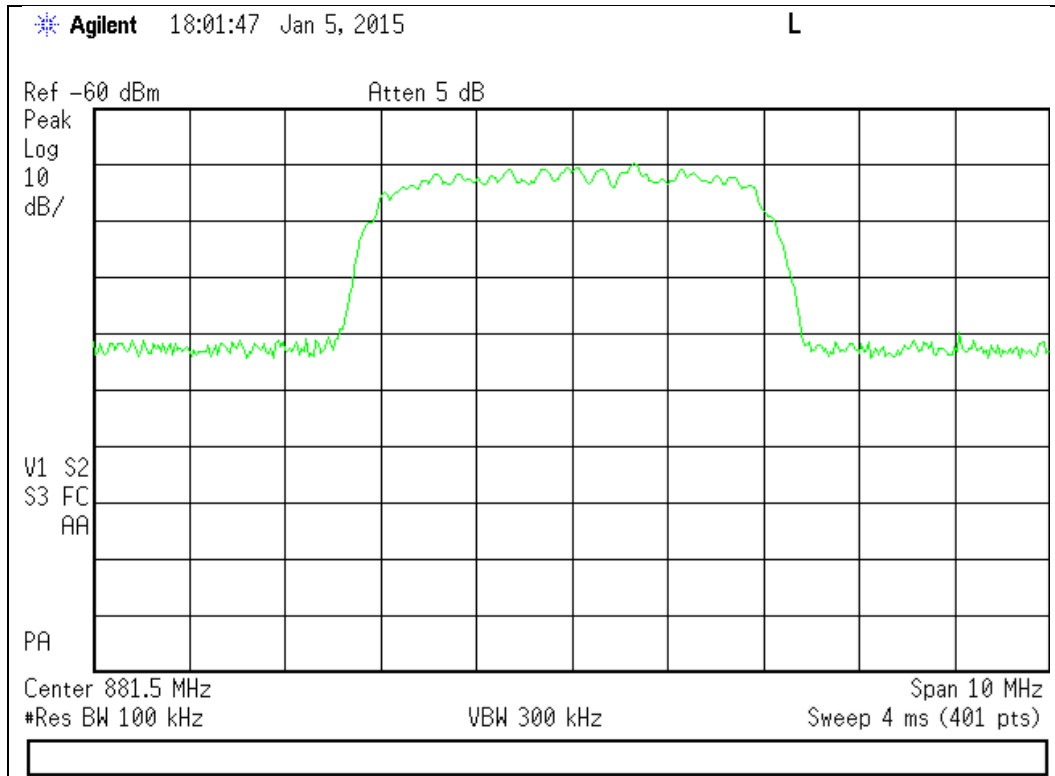




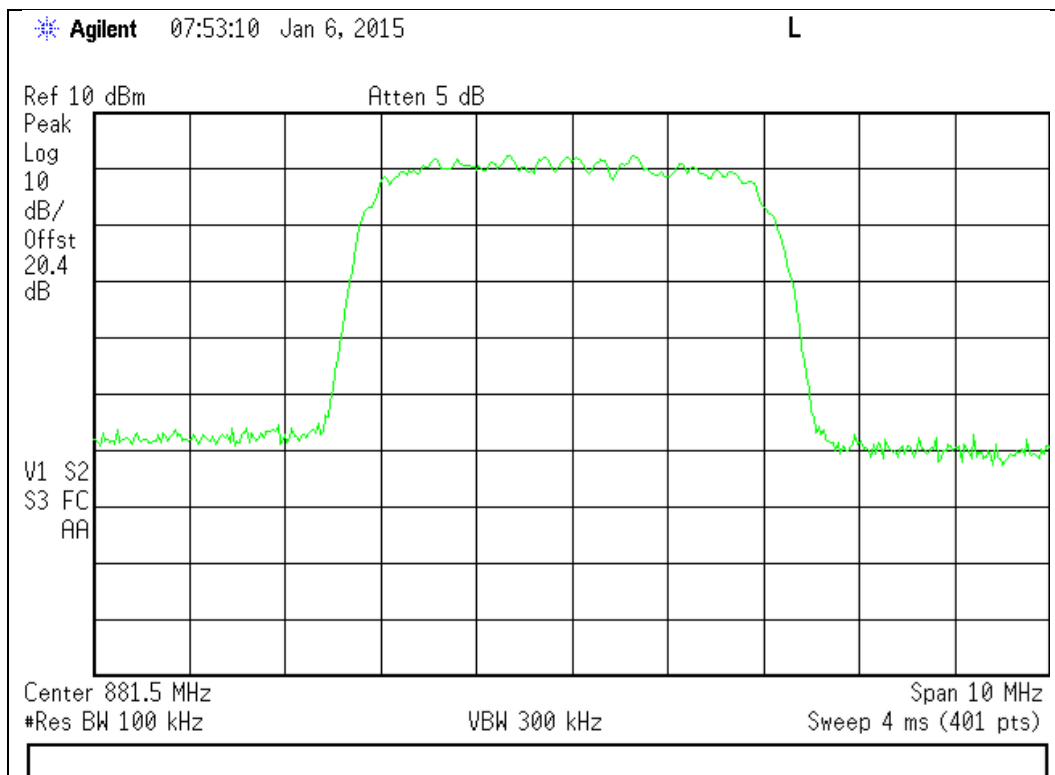
## WCDMA Downlink Test Plots

869 - 894 MHz Band

Input



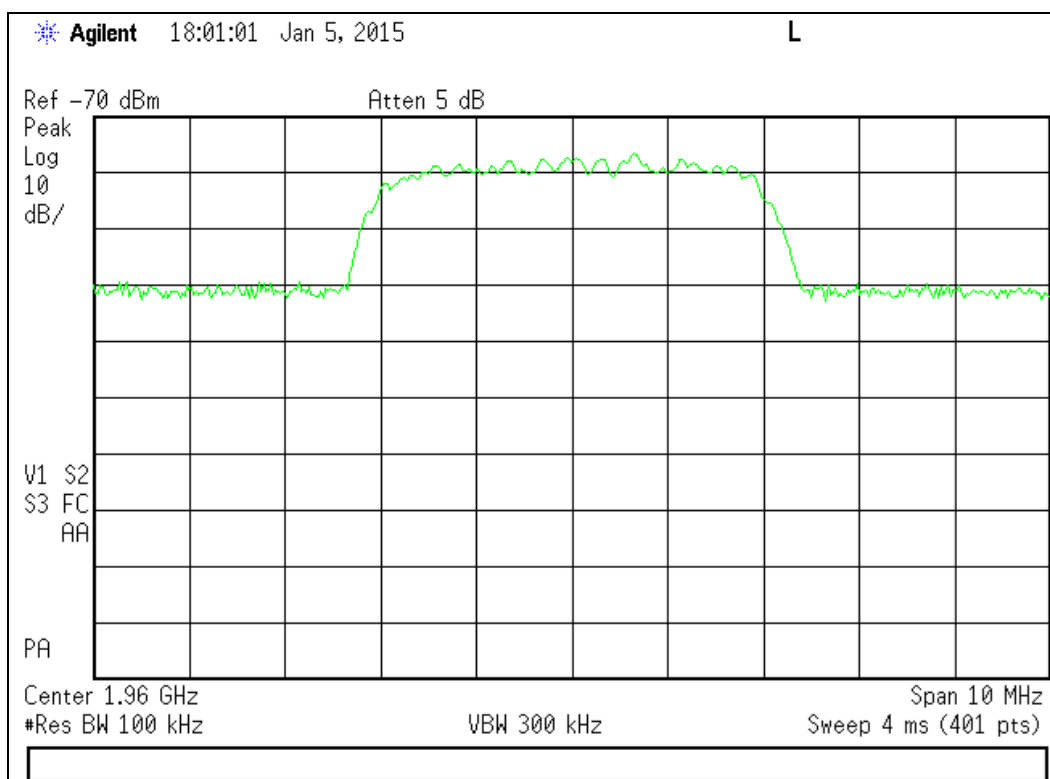
Output



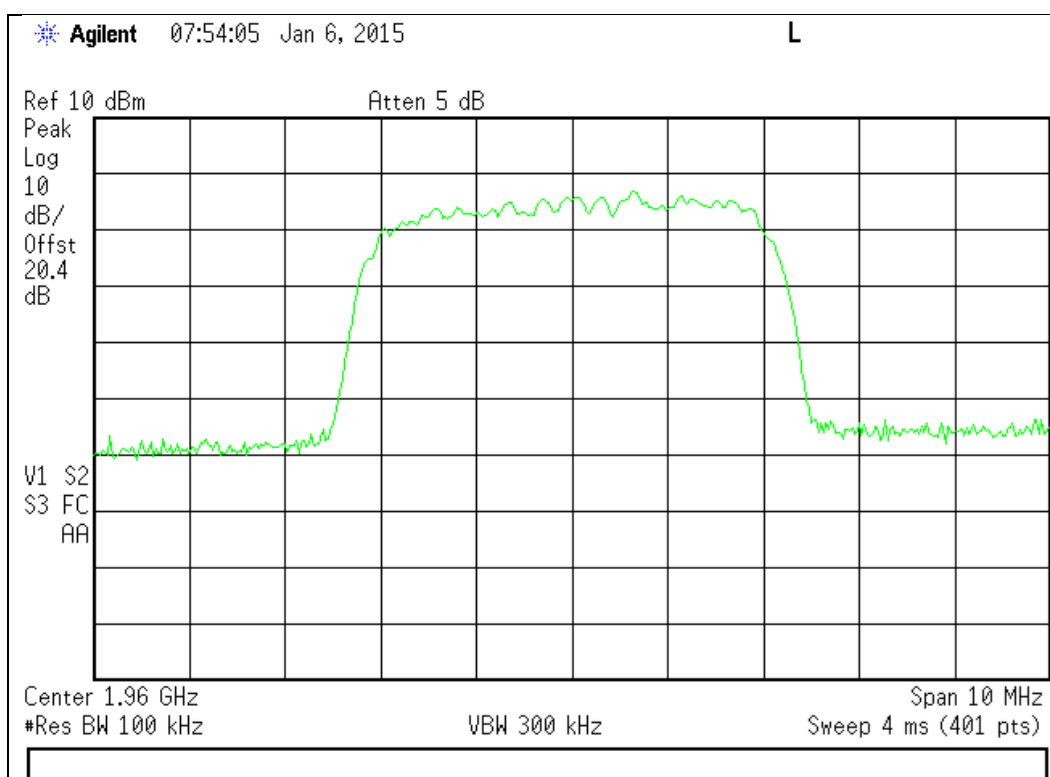


## 1930 - 1995 MHz Band

### Input



### Output





## Oscillation Detection

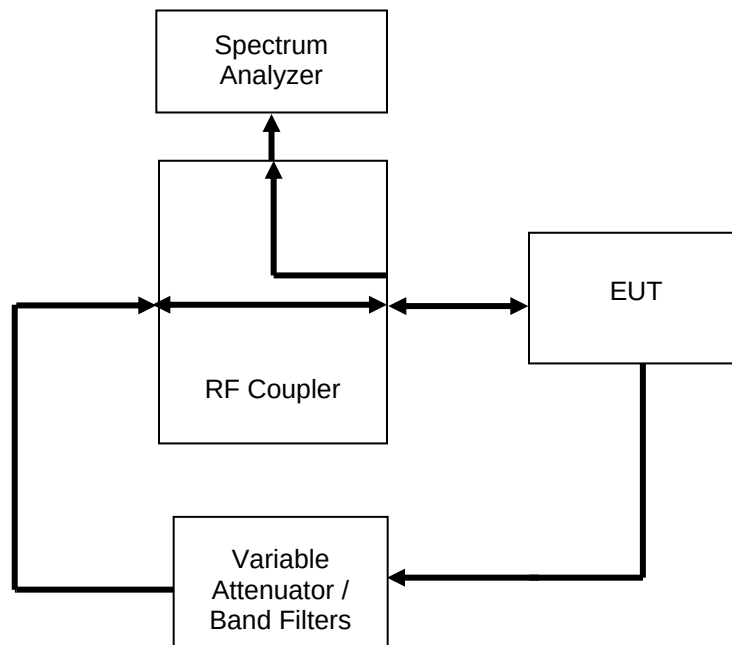
**Name of Test:** Oscillation Detection  
**Test Equipment Utilized:** i00379, i00405, i00412

**Engineer:** Mike Graffeo  
**Test Date:** 1/6/15

### 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 |
|----------------------|--------------------|------------|--------|
| 824 - 849            | 51.3               | 300        | Pass   |
| 1850 - 1915          | 63.9               | 300        | Pass   |

**Downlink Detection Time Test Results**

| Frequency Band (MHz) | Measured Time (mS) | Limit (mS) | Result |
|----------------------|--------------------|------------|--------|
| 869 - 894            | 52.25              | 1000       | Pass   |
| 1930 - 1995          | 41.25              | 1000       | Pass   |

**Uplink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|----------------------|-------------------|-----------|--------|
| 824 - 849            | 70.20             | ≥60       | Pass   |
| 1850 - 1915          | 69.97             | ≥60       | Pass   |

**Downlink Restart Time Test Results**

| Frequency Band (MHz) | Measured Time (S) | Limit (S) | Result |
|----------------------|-------------------|-----------|--------|
| 869 - 894            | 69.80             | ≥60       | Pass   |
| 1930 - 1995          | 69.80             | ≥60       | Pass   |

**Uplink Restart Count Test Results**

| Frequency Band (MHz) | Restarts | Limit | Result |
|----------------------|----------|-------|--------|
| 824 - 849            | 2        | ≤5    | Pass   |
| 1850 - 1915          | 2        | ≤5    | Pass   |

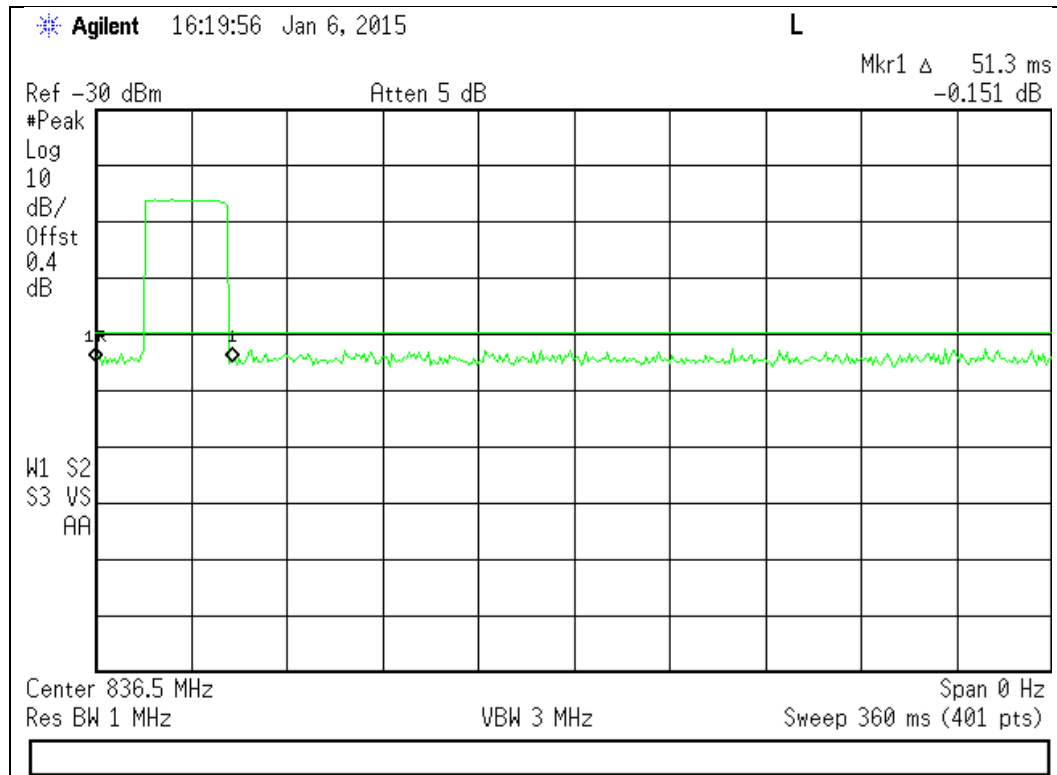
**Downlink Restart Count Test Results**

| Frequency Band (MHz) | Restarts | Limit | Result |
|----------------------|----------|-------|--------|
| 869 - 894            | 3        | ≤5    | Pass   |
| 1930 - 1995          | 2        | ≤5    | Pass   |

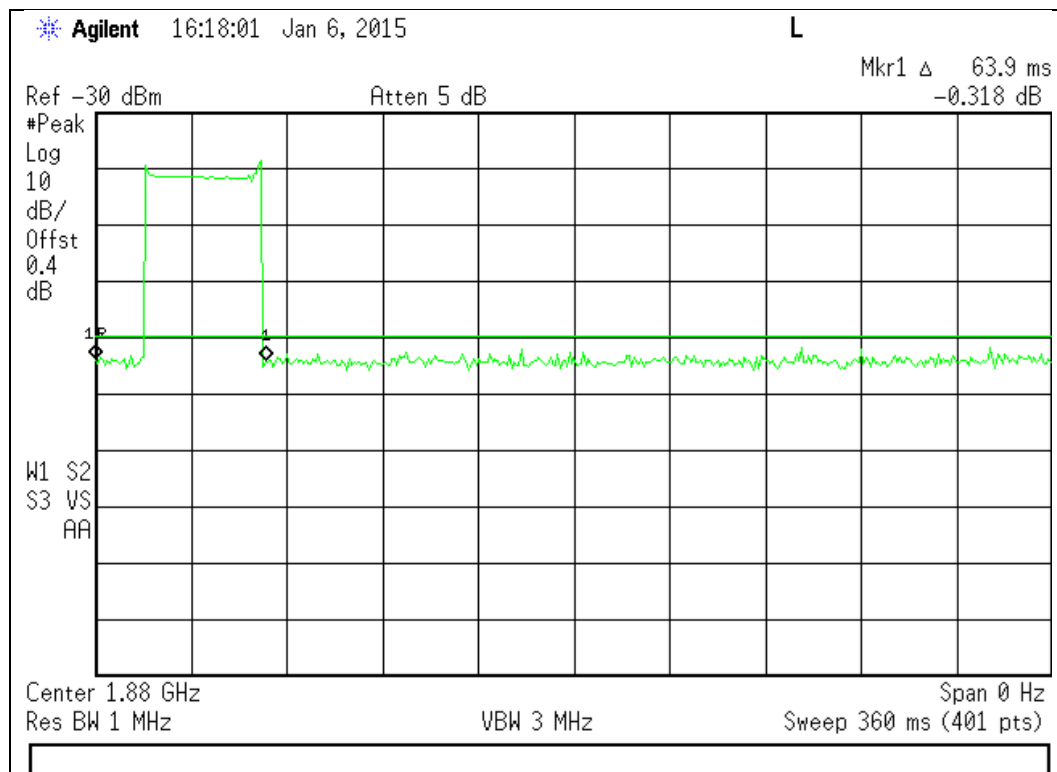


## Uplink Detection Time Test Results

### 824 - 849 MHz Band

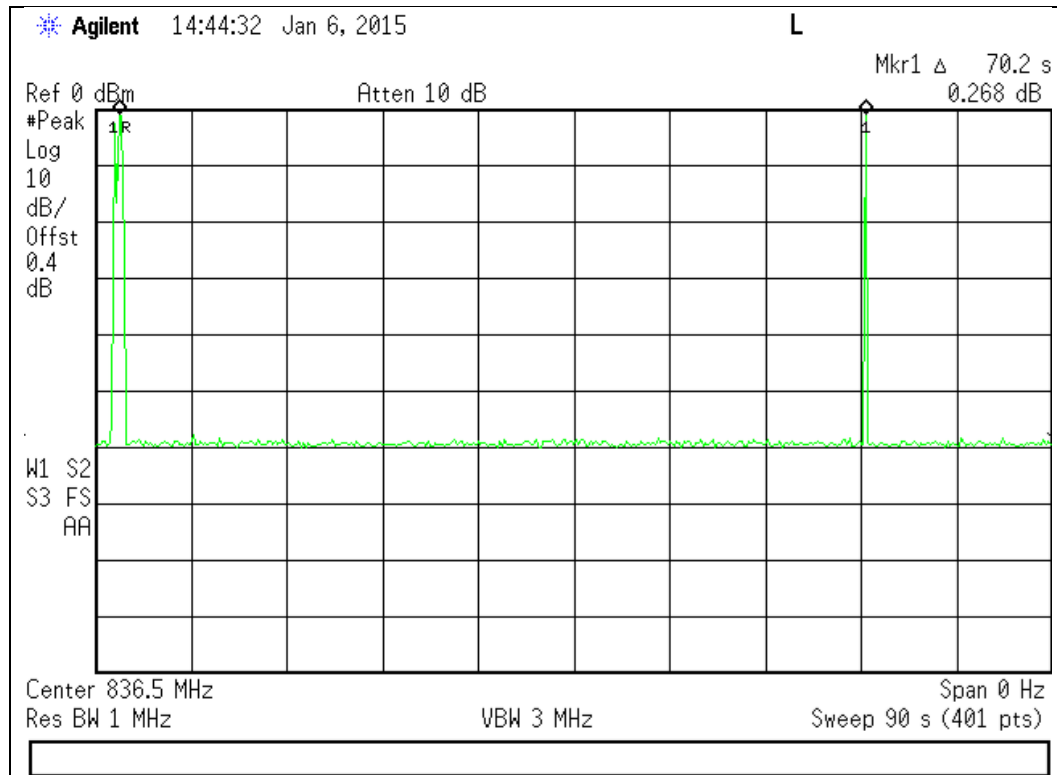


### 1850 - 1915 MHz Band

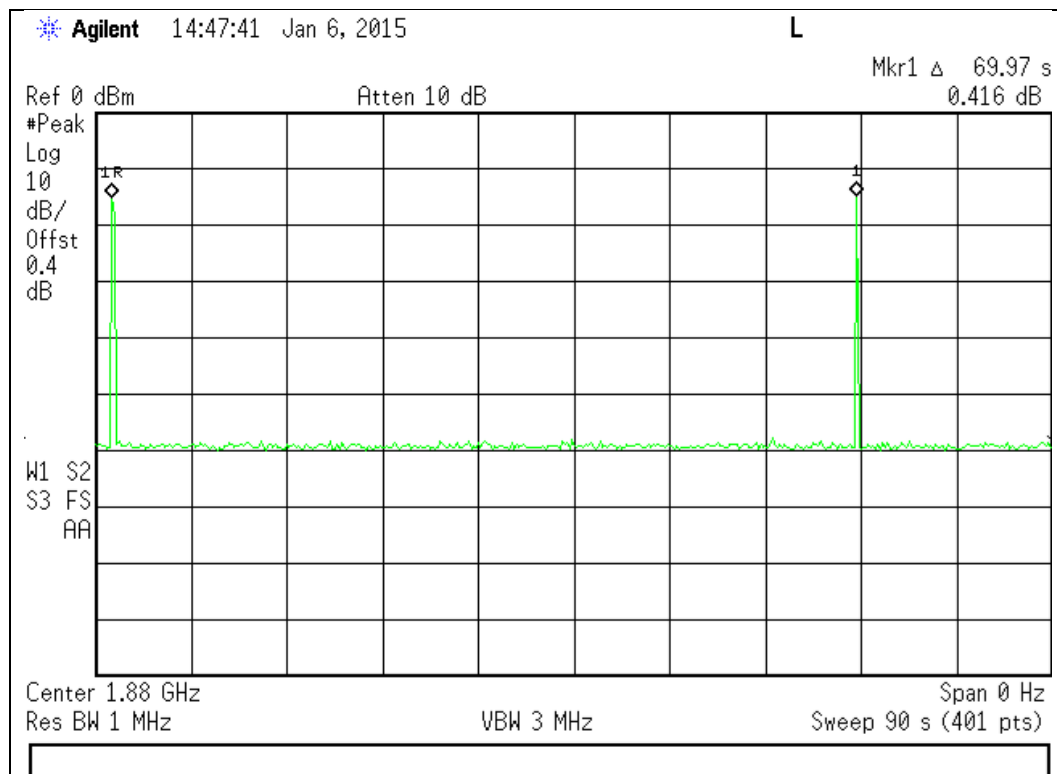




### Uplink Restart Time Test Results 824 - 849 MHz Band

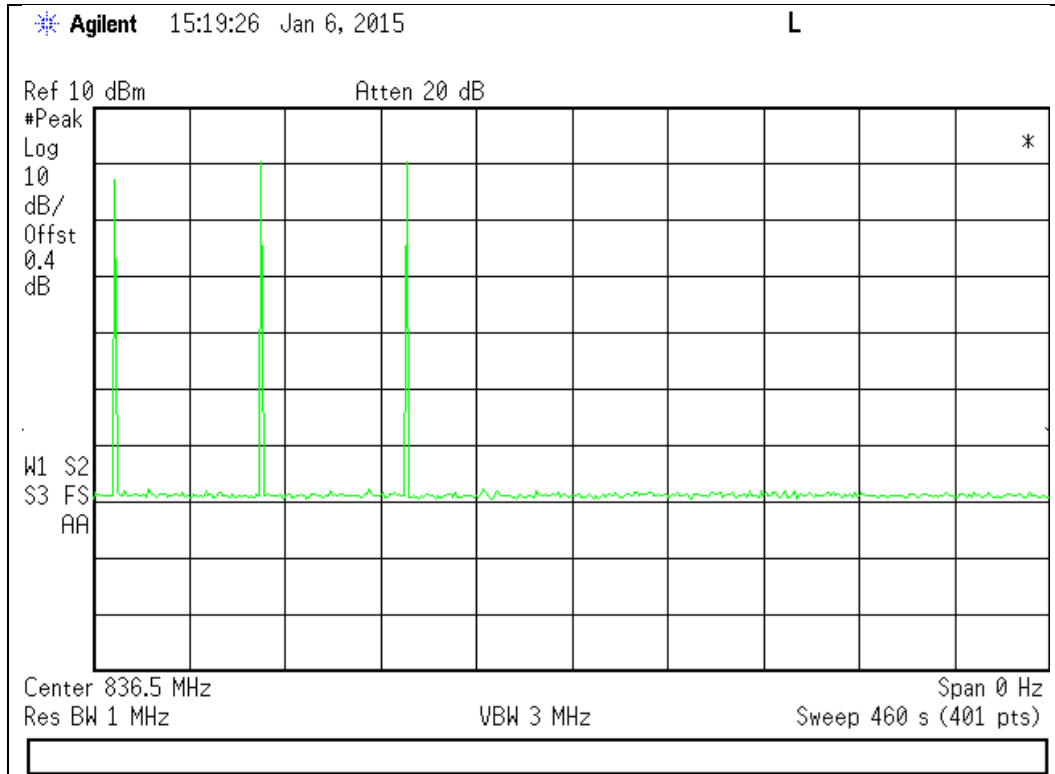


### 1850 - 1915 MHz Band

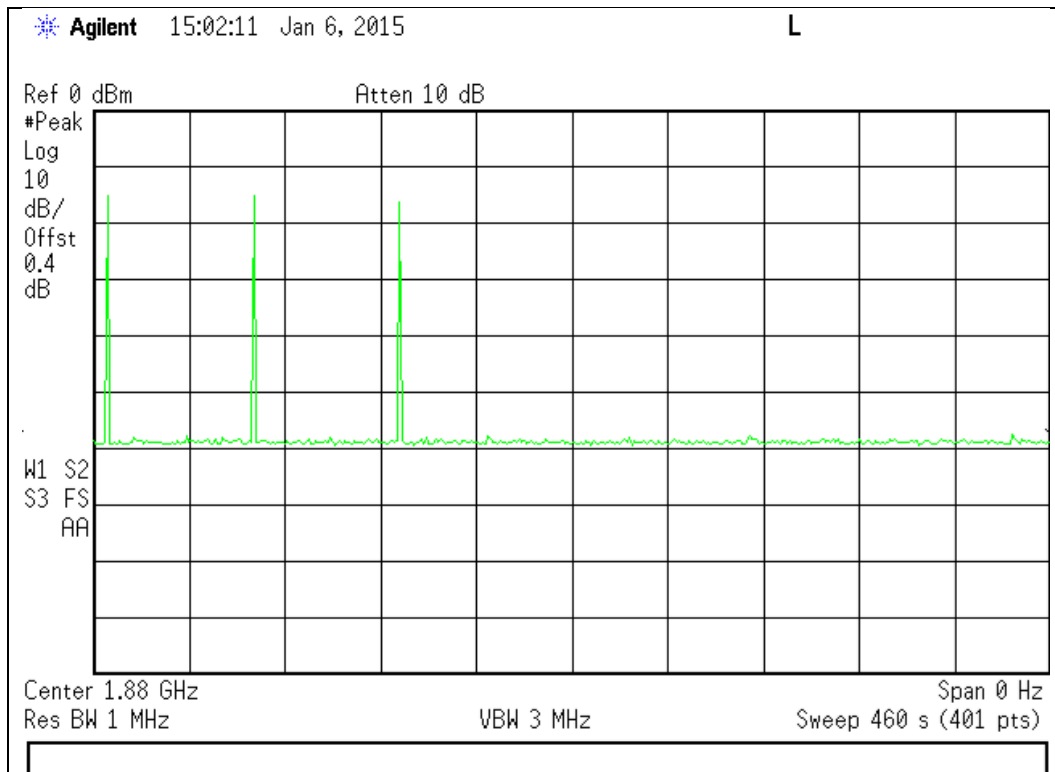




### Uplink Restart Count Test Results 824 - 849 MHz Band



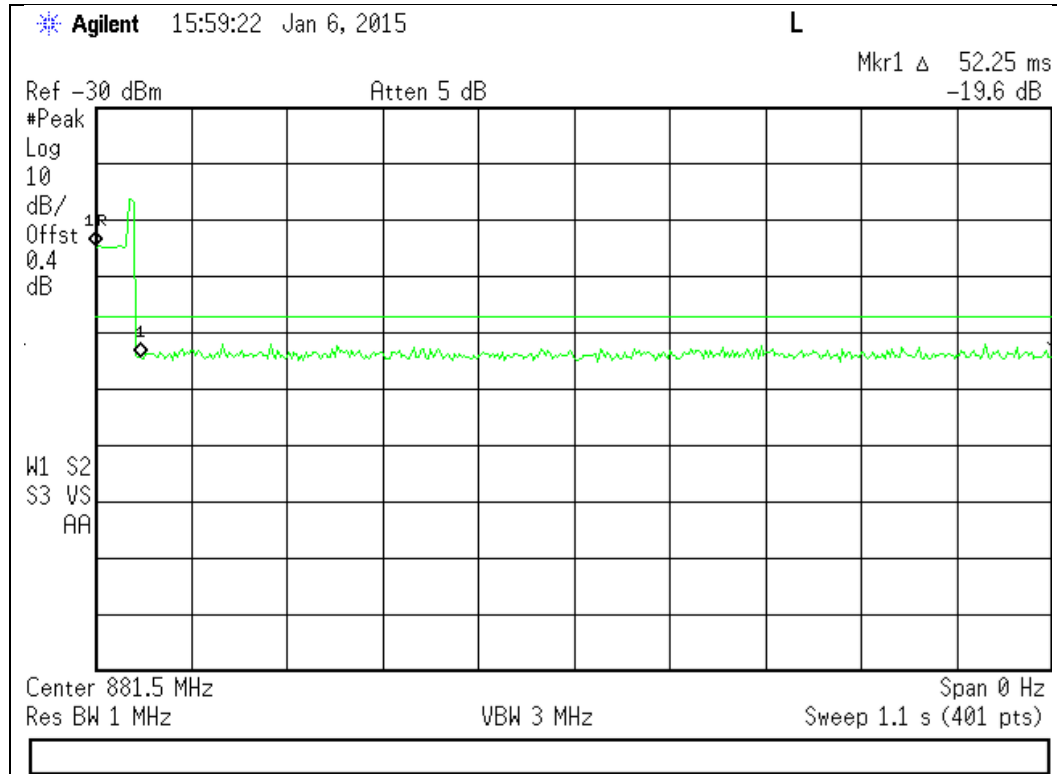
### 1850 - 1915 MHz Band



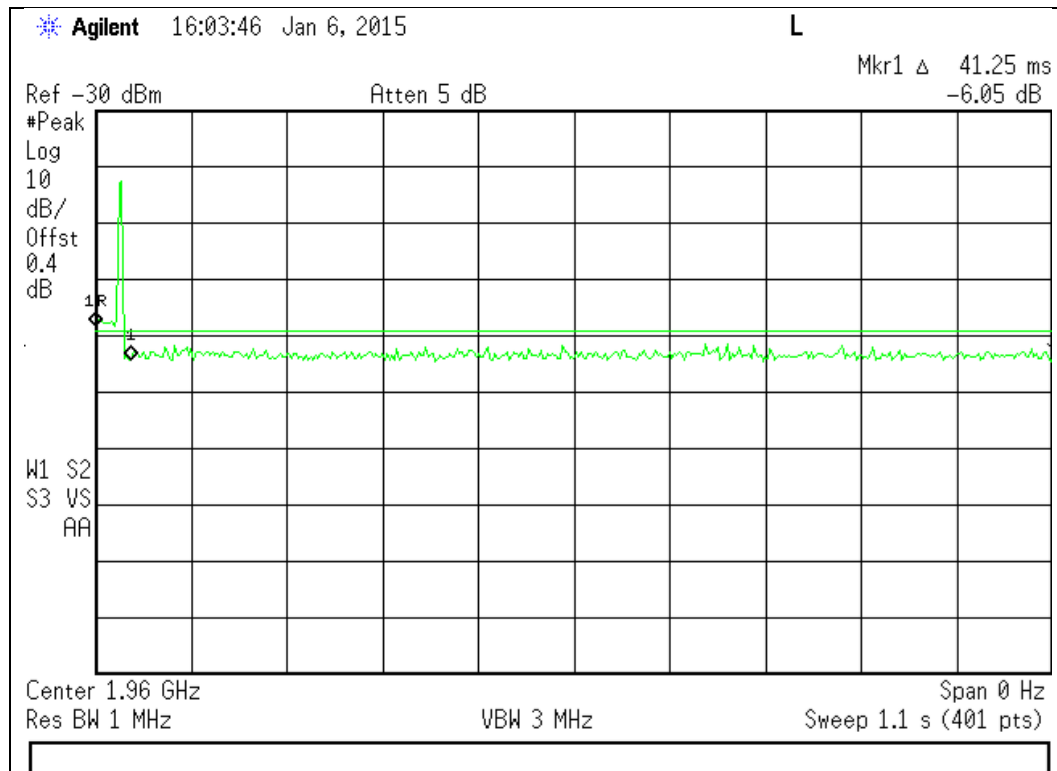


## Downlink Detection Time Test Results

### 869 - 894 MHz Band



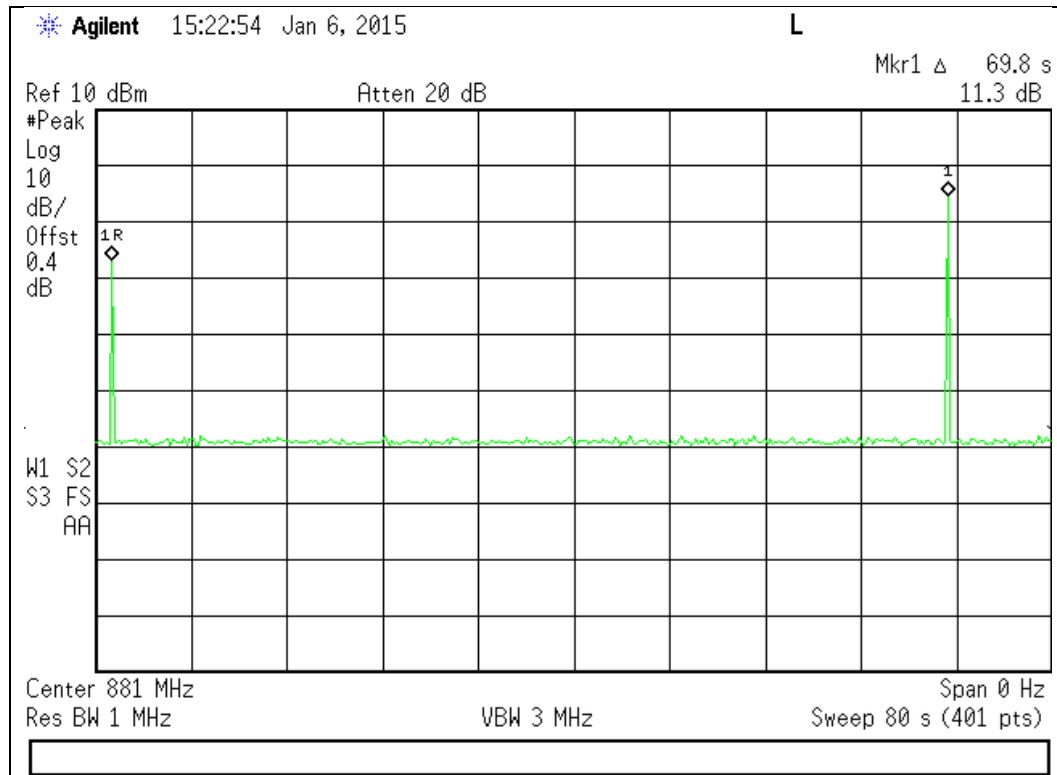
### 1930 - 1995 MHz Band



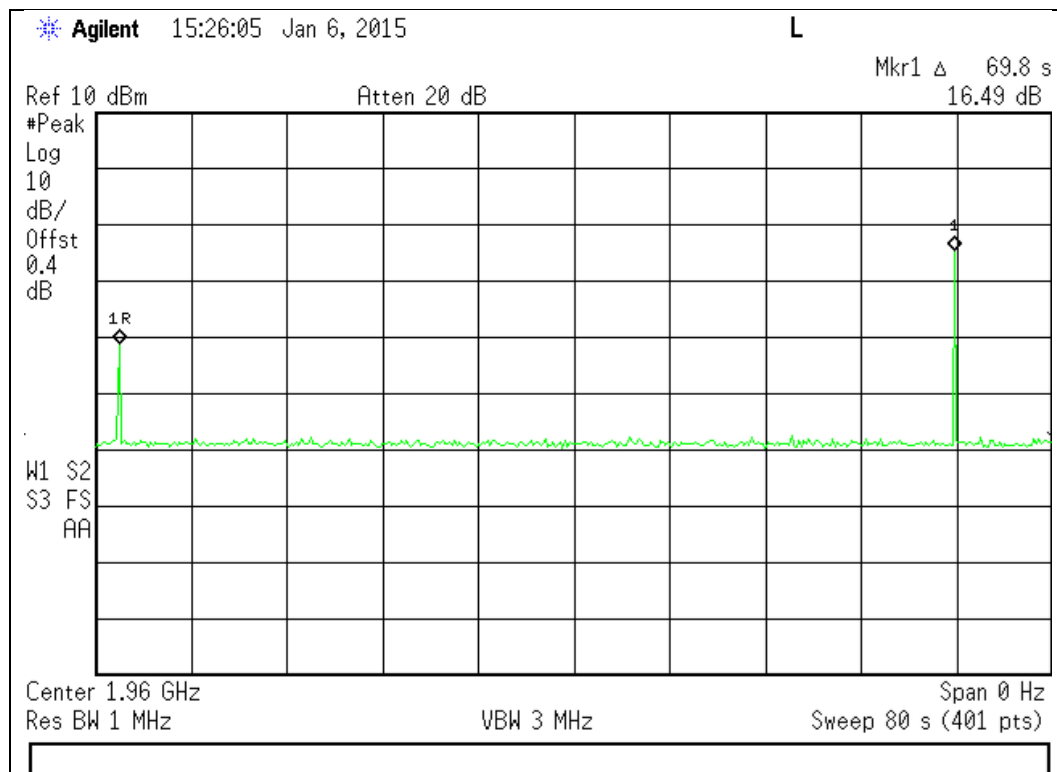


## Downlink Restart Time Test Results

### 869 - 894 MHz Band



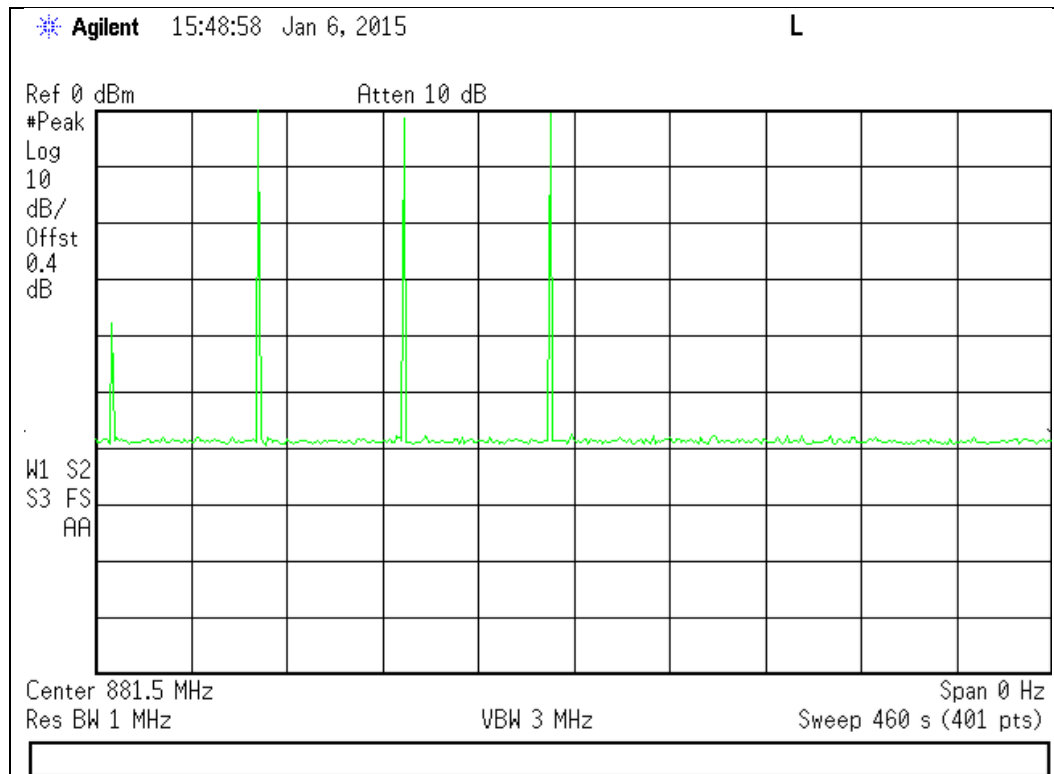
### 1930 - 1995 MHz Band



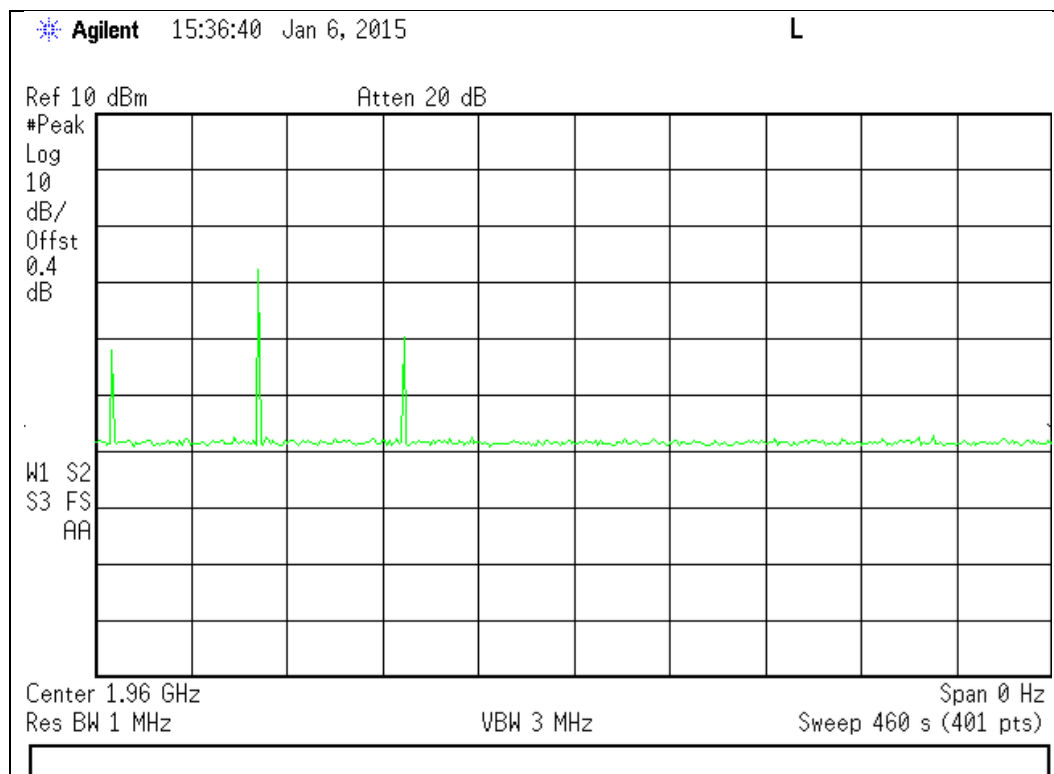


## Downlink Restart Count Test Results

### 869 - 894 MHz Band



### 1930 - 1995 MHz Band





## Radiated Spurious

**Name of Test:**

Radiated Spurious

**Engineer:** Mike Graffeo

**Test Equipment Utilized:** i00334, i00103, i00379, i00405

**Test Date:** 1/7/15

### Test Procedure

The EUT was tested in a semi-anechoic chamber with the turntable 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 antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that 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.

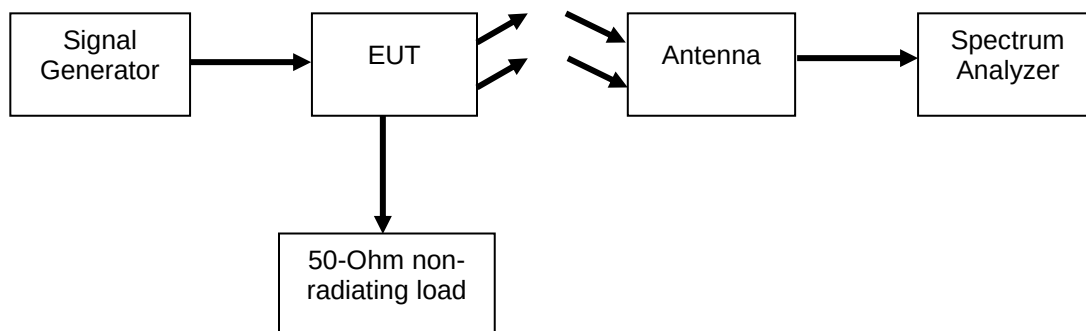
The following formula was used for calculating the limits:

Radiated Spurious Emissions Limit =  $P1 - (43 + 10\log(P2)) = -13\text{dBm}$

P1 = power in dBm

P2 = power in Watts

### Test Setup





### Uplink Test Results

#### 824 - 849 MHz Band 836.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|--------------------------|----------------------|-------------|--------|
| 1673                     | -54.89               | -13         | Pass   |
| 2509.6                   | -49.17               | -13         | Pass   |
| 3346                     | -47.66               | -13         | Pass   |

#### 1850 - 1915 MHz Band 1880 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|--------------------------|----------------------|-------------|--------|
| 3760                     | -42.18               | -13         | Pass   |
| 5640                     | -40.38               | -13         | Pass   |
| 7520                     | -34.72               | -13         | Pass   |

### Downlink Test Results

#### 869 - 894 MHz Band 881.5 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|--------------------------|----------------------|-------------|--------|
| 1763                     | -55.34               | -13         | Pass   |
| 2644.5                   | -47.56               | -13         | Pass   |
| 3526                     | -44.62               | -13         | Pass   |

#### 1930 - 1995 MHz Band 1960 MHz Tuned Frequency

| Measured Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Result |
|--------------------------|----------------------|-------------|--------|
| 3920                     | -42.54               | -13         | Pass   |
| 5880                     | -40.51               | -13         | Pass   |
| 7840                     | -31.13               | -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 #     | CT Asset # | Last Cal Date       | Cal Due Date |
|------------------------|-----------------|-------------|------------|---------------------|--------------|
| * Horn Antenna         | EMCO            | 3115        | i00103     | 12/11/12            | 12/11/14     |
| Bi-Log Antenna         | Schaffner       | CBL 6111D   | i00349     | 10/8/13             | 10/8/15      |
| Humidity / Temp Meter  | Newport         | IBTHX-W-5   | i00282     | 3/24/14             | 3/24/15      |
| Voltmeter              | Fluke           | 75III       | i00320     | 3/24/14             | 3/24/15      |
| EMI Analyzer           | Agilent         | E7405A      | i00379     | 1/14/14             | 1/14/15      |
| Non-radiating load     | Termaline       | 8201        | i00334     | Verified on: 1/5/15 |              |
| Power Supply (for EUT) | HP              | 6654A       | i00350     | Verified on: 1/5/15 |              |
| * Signal Generator     | Rohde & Schwarz | SMU200A     | i00405     | 12/11/13            | 12/11/14     |
| RF Directional Coupler | Meca            | CS06-1.500V | i00412     | Verified on: 1/5/15 |              |

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.

\* Lab manager has granted a 30 day calibration extension on this equipment.

END OF TEST REPORT