



## **Compliance Testing, LLC**

Previously Flom Test Lab

EMI, EMC, RF Testing Experts Since 1963

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### **Test Report**

**Prepared for: Wireless Extenders**

**Model: ZB570-A**

**Description: Tri-Band Cellular Booster**

**FCC ID: SO4ZB570-TRI-B12**

**To**

**FCC Part 20**

**Date of Issue: August 15, 2014**

**On the behalf of the applicant:**

**Wireless Extenders  
One Meca Way  
Norcorss, GA 30093**

**Attention of:**

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Project No: p1470010**

**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	August 5, 2014	Mike Graffeo	Original Document



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## 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 to the 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 specified 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 (°C)	Humidity (%)	Pressure (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:** ZB570-A

**Description:** Tri-Band Cellular Booster

**Firmware:** N/A

**Software:** N/A

## Additional Information:

The EUT is a fixed installation bi-directional amplifier for the boosting of cellular phone signals and data communication devices. The following frequency bands and emission types are utilized.

Frequency Band (MHz)			
<b>Uplink</b>	698 - 716	824 - 849	1850 - 1910
<b>Downlink</b>	728 - 746	869 - 894	1930 - 1990
<b>Modulation Type</b>	LTE	GSM, CDMA, EDGE, HSPA, EVDO, 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. GSM, 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.



## 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) 20.21(e)(8)(i)(C) 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 22.917(a) 24.238(a) 27.53(f) 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	
20.21(e)(8)(i)(C)(1) 20.21(e)(8)(i)(H) 20.21(e)(8)(i)(C)(2)(i)	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

**Test Equipment Utilized:** i00379 and i00405

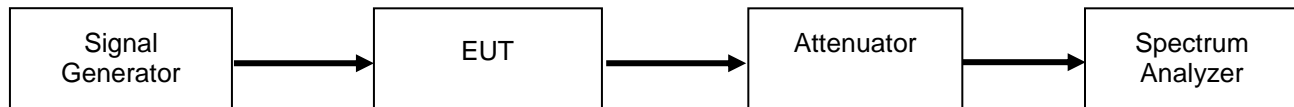
**Engineer:** Mike Graffeo

**Test Date:** 7/29/14

**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.

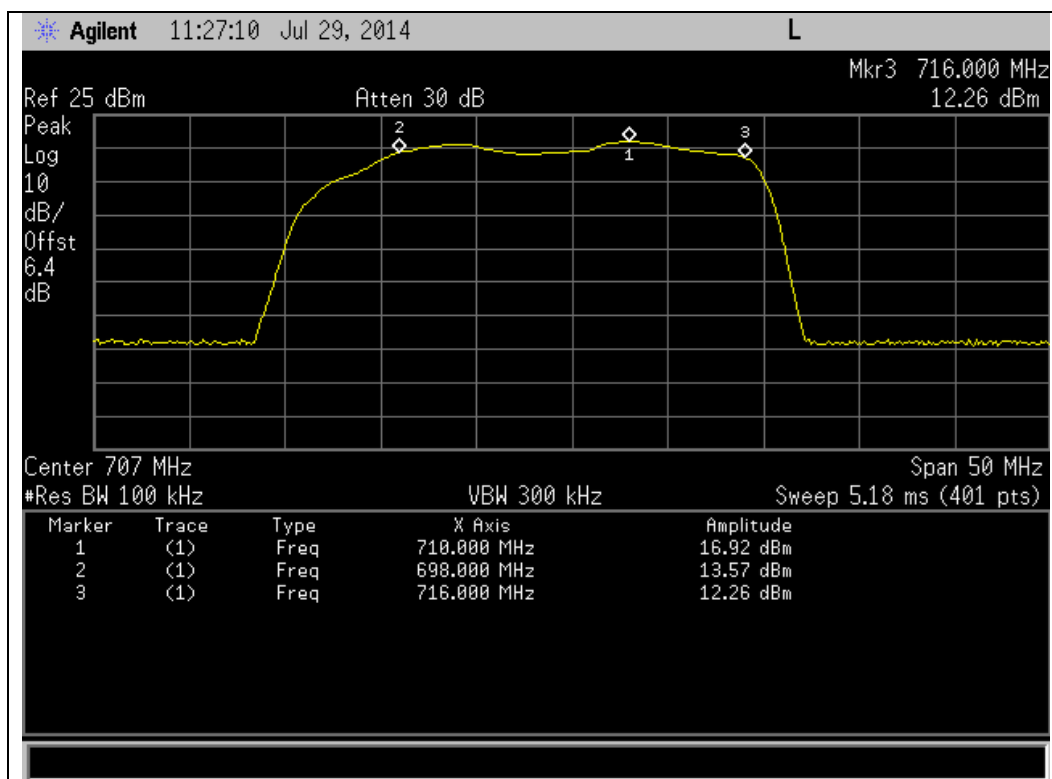
**Test Setup**



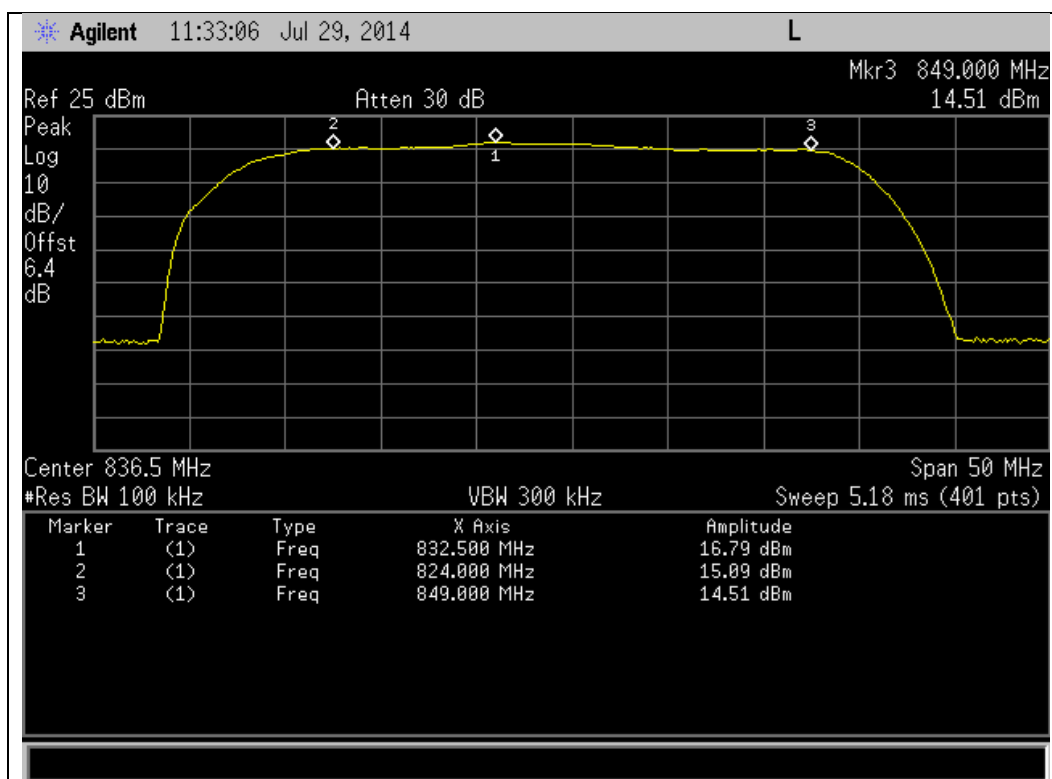


## Uplink Test Results

### 698 - 716 MHz Band



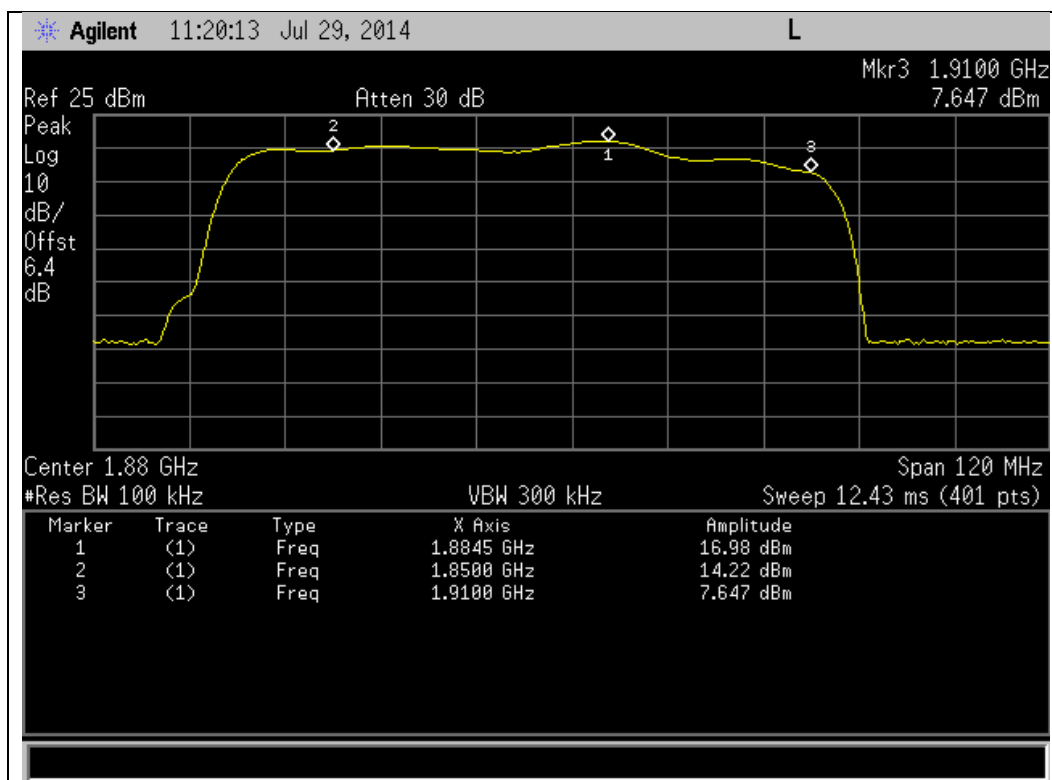
### 824 - 849 MHz Band





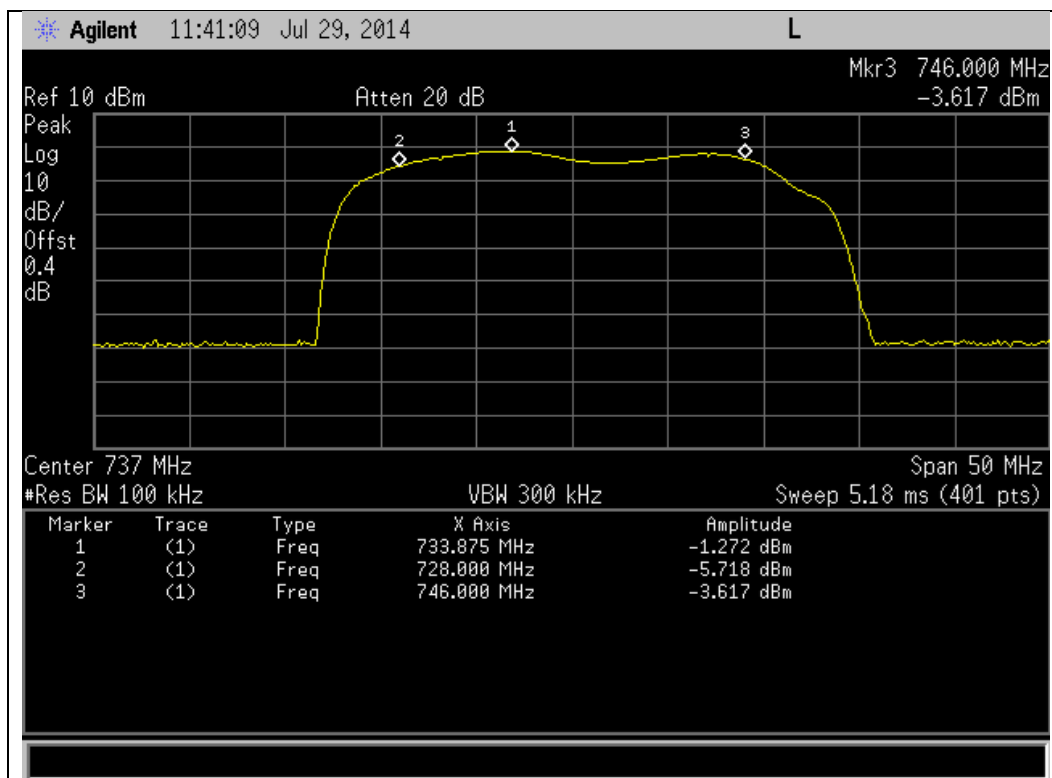


### 1850 - 1910 MHz Band



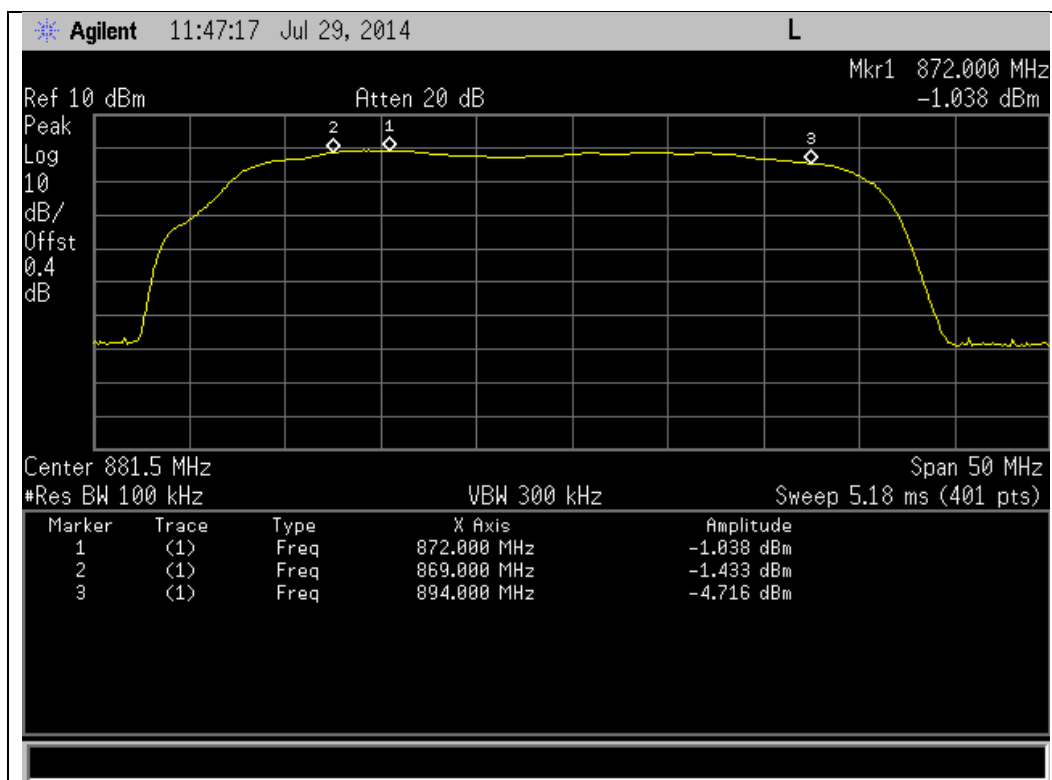
### Downlink Test Results

### 728 - 746 MHz Band

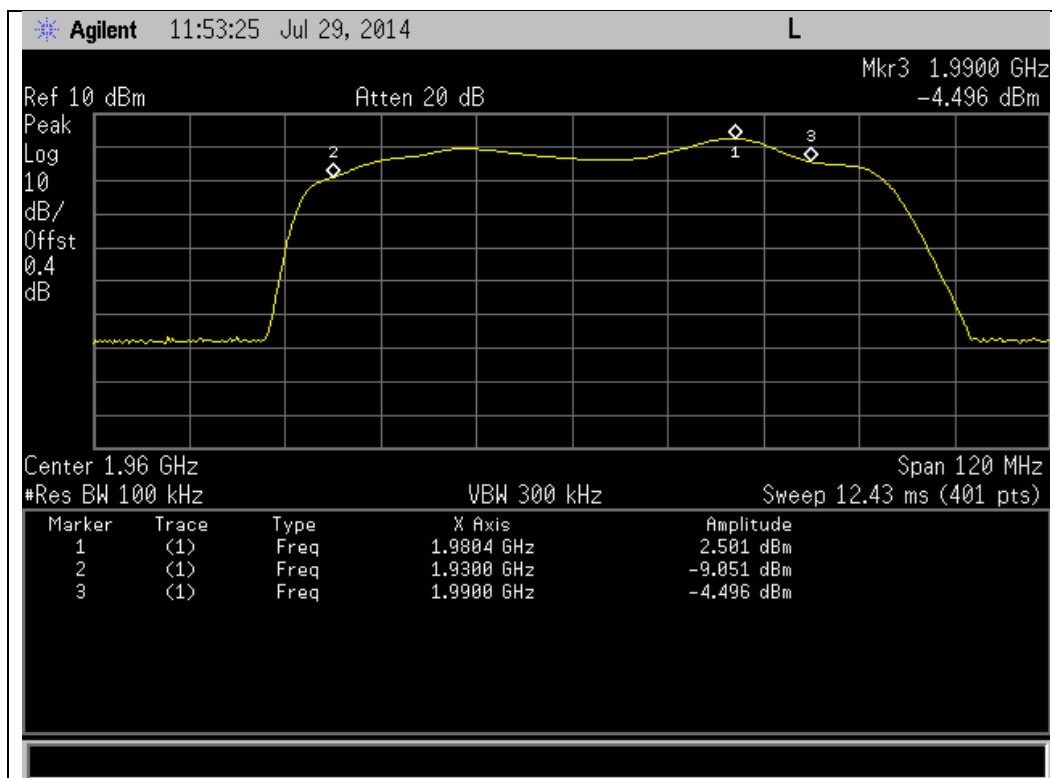




### 869 - 894 MHz Band



### 1930 - 1990 MHz Band





## Maximum Power and Gain

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

**Engineer:** Mike Graffeo  
**Test Date:** 7/29/14

### Test Procedure

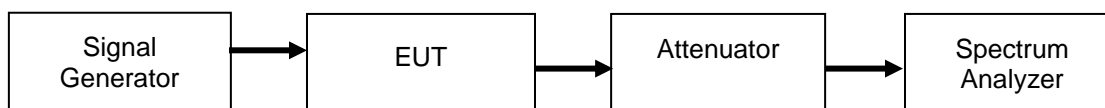
The EUT was connected to a spectrum analyzer through an attenuator with the losses being input into the spectrum analyzer as a combination of reference level offset and correction factor as needed to ensure accurate readings. The spectrum analyzer and signal generator were tuned to the frequency with 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
698 - 716 MHz Pulsed GSM	-40.5	19.77	17	30	Pass
698 - 716 MHz AWGN	-40.8	19.20	17	30	Pass
824 - 849 MHz Pulsed GSM	-41.7	19.32	17	30	Pass
824 - 849 MHz AWGN	-41.9	17.79	17	30	Pass
1850 - 1910 MHz Pulsed GSM	-43.4	22.98	17	30	Pass
1850 - 1910 MHz AWGN	-46.3	19.32	17	30	Pass



### Downlink Power Test Results

Frequency Band (MHz)	Input Level (dBm)	Output Power (dBm)	Upper Limit (dBm)	Result
728 - 746 MHz Pulsed GSM	-61.0	1.69	17	Pass
728 - 746 MHz AWGN	-59.4	3.54	17	Pass
869 - 894 MHz Pulsed GSM	-60.3	1.15	17	Pass
869 - 894 MHz AWGN	-60.7	3.43	17	Pass
1930 - 1990 MHz Pulsed GSM	-66.3	3.71	17	Pass
1930 - 1990 MHz AWGN	-65.7	5.56	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 GSM	710	733.88	60.27	63.5	62.7	63.5	2.42	9	-6.58
AWGN	710	733.88	60.00	63.5	62.9	63.5	2.94	9	-6.06
Pulsed GSM	832.5	872	61.02	64.9	61.5	64.9	0.43	9	-8.57
AWGN	832.5	872	59.69	64.9	64.1	64.9	4.44	9	-4.56
Pulsed GSM	1884.5	1980.4	66.38	72	70.0	72	3.63	9	-5.37
AWGN	1884.5	1980.4	65.62	72	71.3	72	5.64	9	-3.36



## Intermodulation

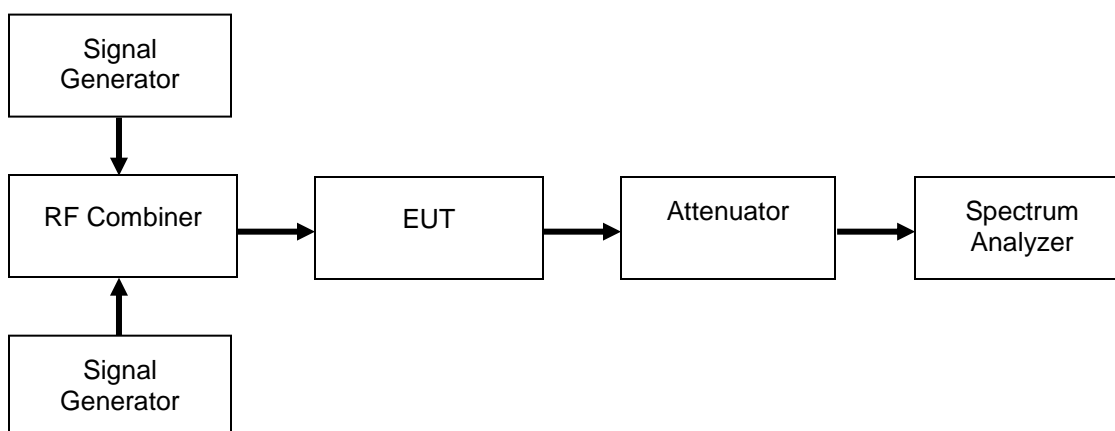
**Name of Test:** Intermodulation  
**Test Equipment Utilized:** i00379 and i00405

**Engineer:** Mike Graffeo  
**Test Date:** 7/30/14

### 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 RMS 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
698 - 716 MHz	-29.32	-19	Pass
824 - 849 MHz	-36.43	-19	Pass
1850 - 1910 MHz	-33.9	-19	Pass

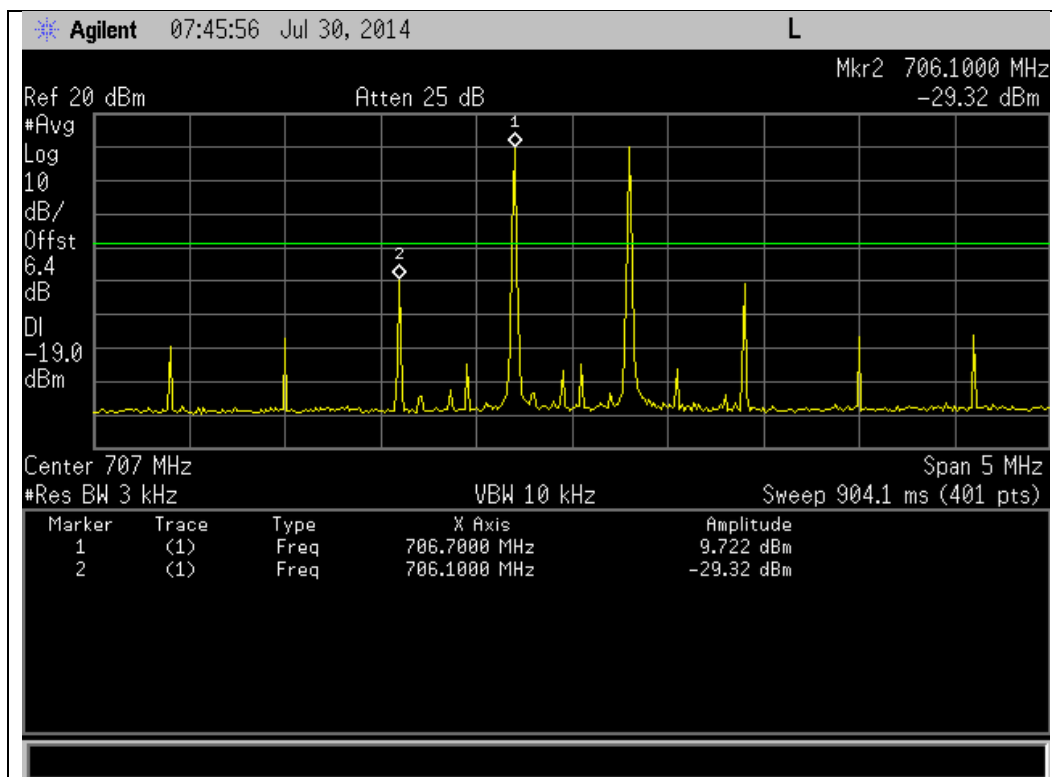
### Downlink Test Results

Frequency Band (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Result
728 - 746 MHz	-43.91	-19	Pass
869 - 894 MHz	-63.79	-19	Pass
1930 - 1990 MHz	-56.61	-19	Pass

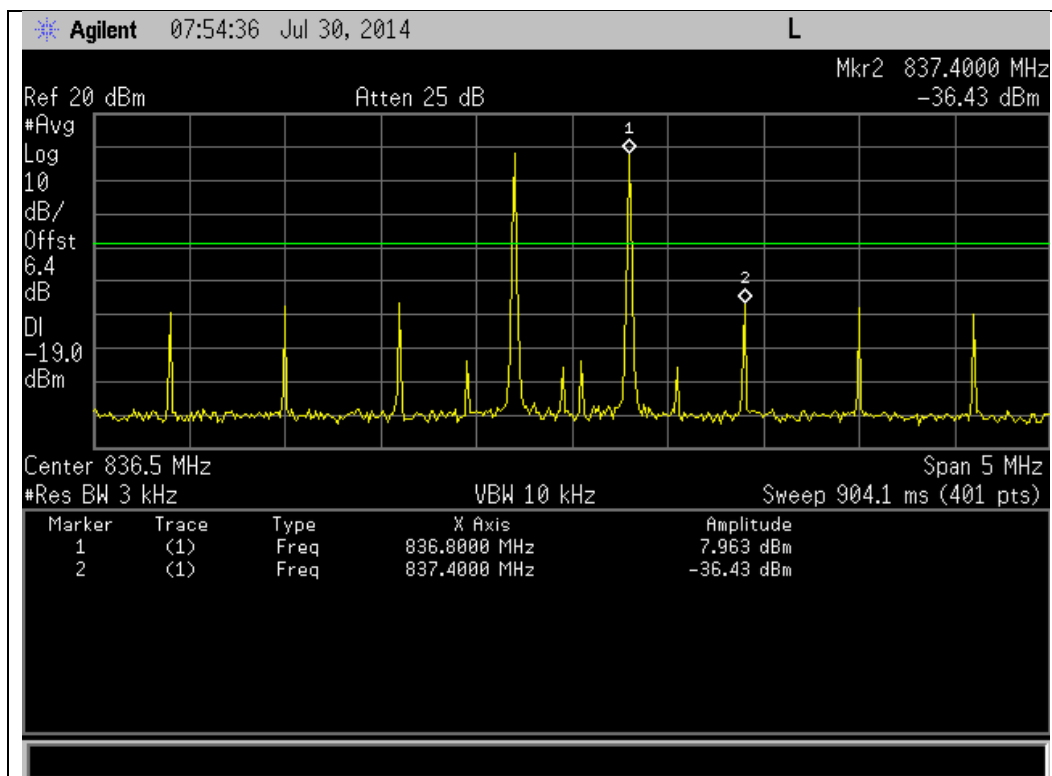


## Uplink Test Results

### 698 - 716 MHz Band

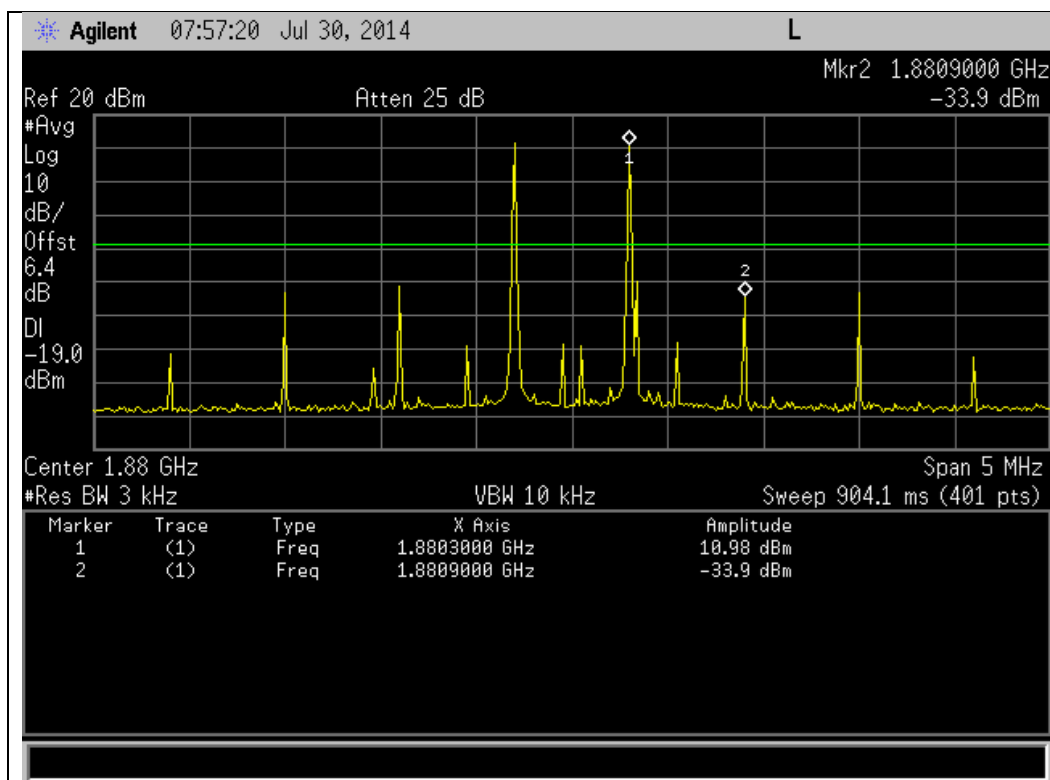


### 824 - 849 MHz Band



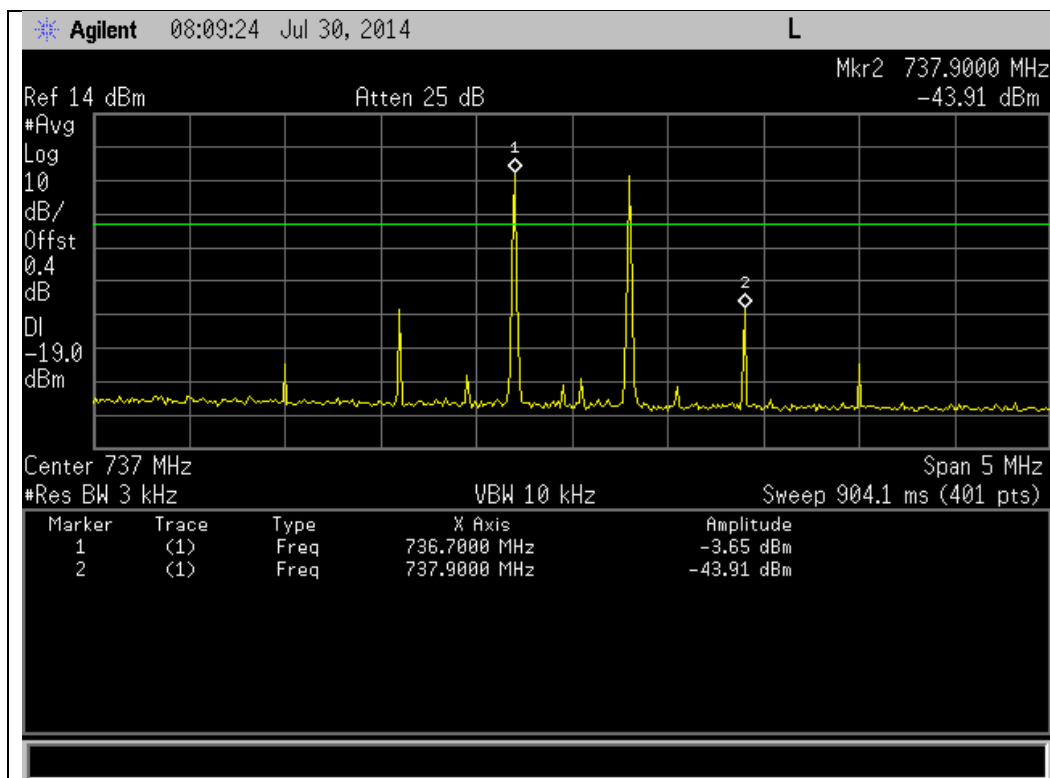


### 1850 - 1910 MHz Band



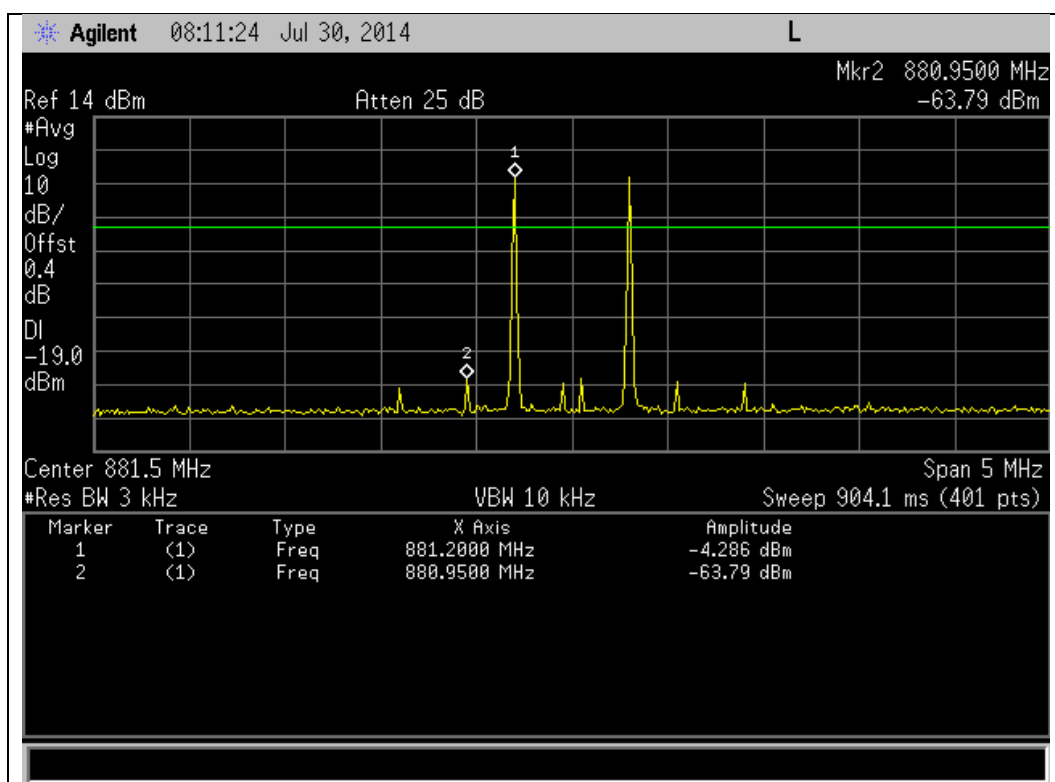
### Downlink Test Results

### 728 - 746 MHz Band

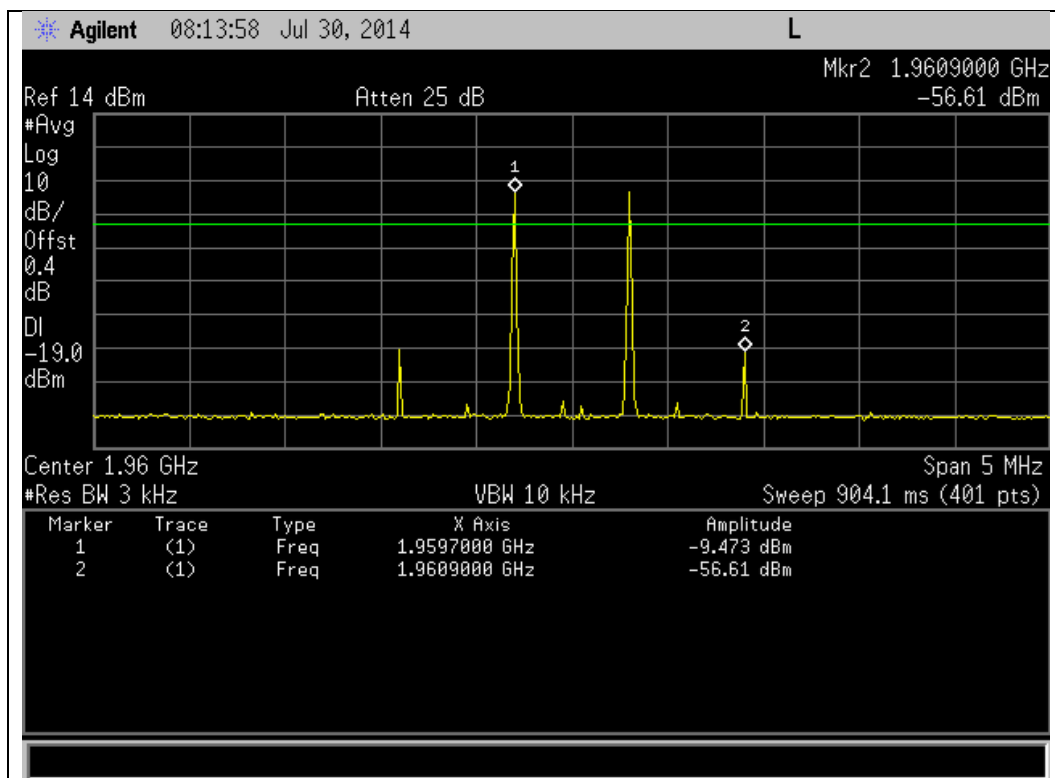




### 869 - 894 MHz Band



### 1930 - 1990 MHz Band







## Out-of-Band Emissions

**Name of Test:**

Out-of-Band Emissions

**Engineer:** Mike Graffeo

**Test Equipment Utilized:**

i00379 and i00405

**Test Date:** 8/1/14

### 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.

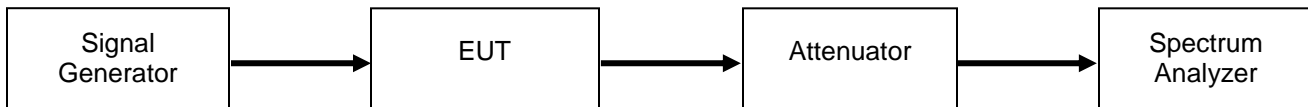
The following formula was used for calculating the limits:

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

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
698 - 716	Lower	-28.09	-19	Pass
698 - 716	Upper	-29.49	-19	Pass
824 - 849	Lower	-37.63	-19	Pass
824 - 849	Upper	-37.81	-19	Pass
1850 - 1910	Lower	-37.52	-19	Pass
1850 - 1910	Upper	-69.72	-19	Pass

### CDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
698 - 716	Lower	-51.27	-19	Pass
698 - 716	Upper	-53.28	-19	Pass
824 - 849	Lower	-41.41	-19	Pass
824 - 849	Upper	-36.53	-19	Pass
1850 - 1910	Lower	-44.13	-19	Pass
1850 - 1910	Upper	-64.98	-19	Pass

### WCDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
698 - 716	Lower	-50.29	-19	Pass
698 - 716	Upper	-56.17	-19	Pass
824 - 849	Lower	-39.59	-19	Pass
824 - 849	Upper	-39.79	-19	Pass
1850 - 1910	Lower	-37.14	-19	Pass
1850 - 1910	Upper	-58.19	-19	Pass



### GSM Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-59.39	-19	Pass
728 - 746	Upper	-57.59	-19	Pass
869 - 894	Lower	-64.86	-19	Pass
869 - 894	Upper	-67.83	-19	Pass
1930 - 1990	Lower	-67.35	-19	Pass
1930 - 1990	Upper	-70.99	-19	Pass

### CDMA Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-66.86	-19	Pass
728 - 746	Upper	-63.58	-19	Pass
869 - 894	Lower	-62.17	-19	Pass
869 - 894	Upper	-64.67	-19	Pass
1930 - 1990	Lower	-62.73	-19	Pass
1930 - 1990	Upper	-60.98	-19	Pass

### WCDMA Downlink Test Results

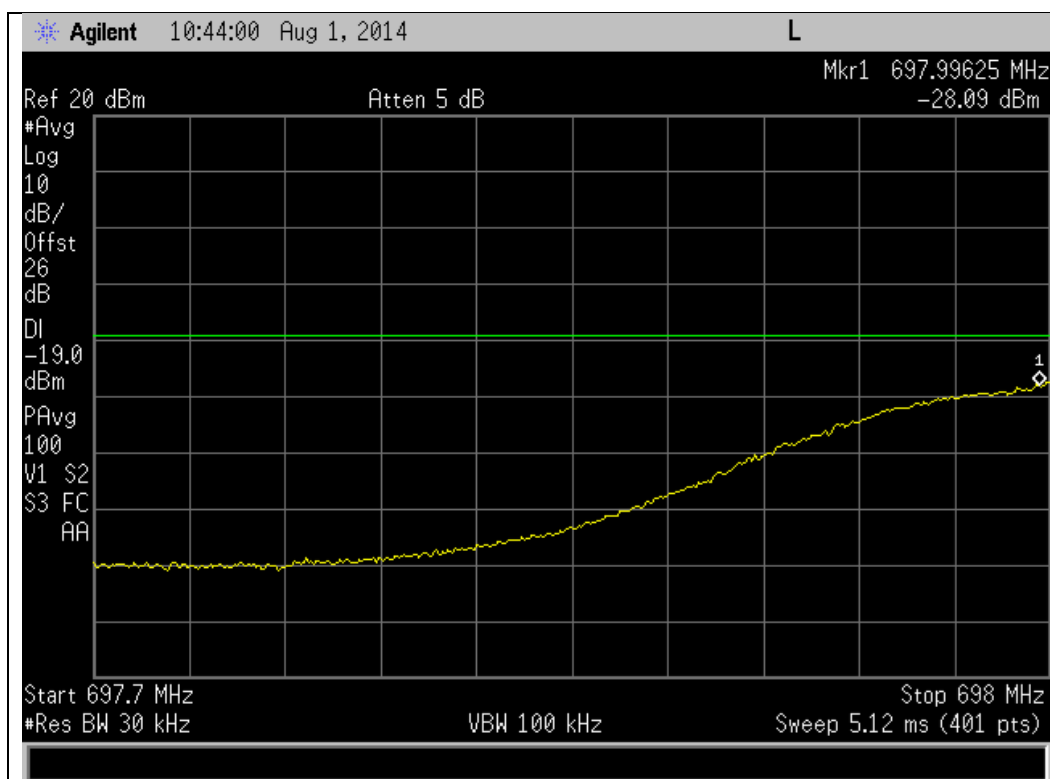
Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-67.08	-19	Pass
728 - 746	Upper	-63.63	-19	Pass
869 - 894	Lower	-57.00	-19	Pass
869 - 894	Upper	-60.28	-19	Pass
1930 - 1990	Lower	-57.88	-19	Pass
1930 - 1990	Upper	-56.37	-19	Pass



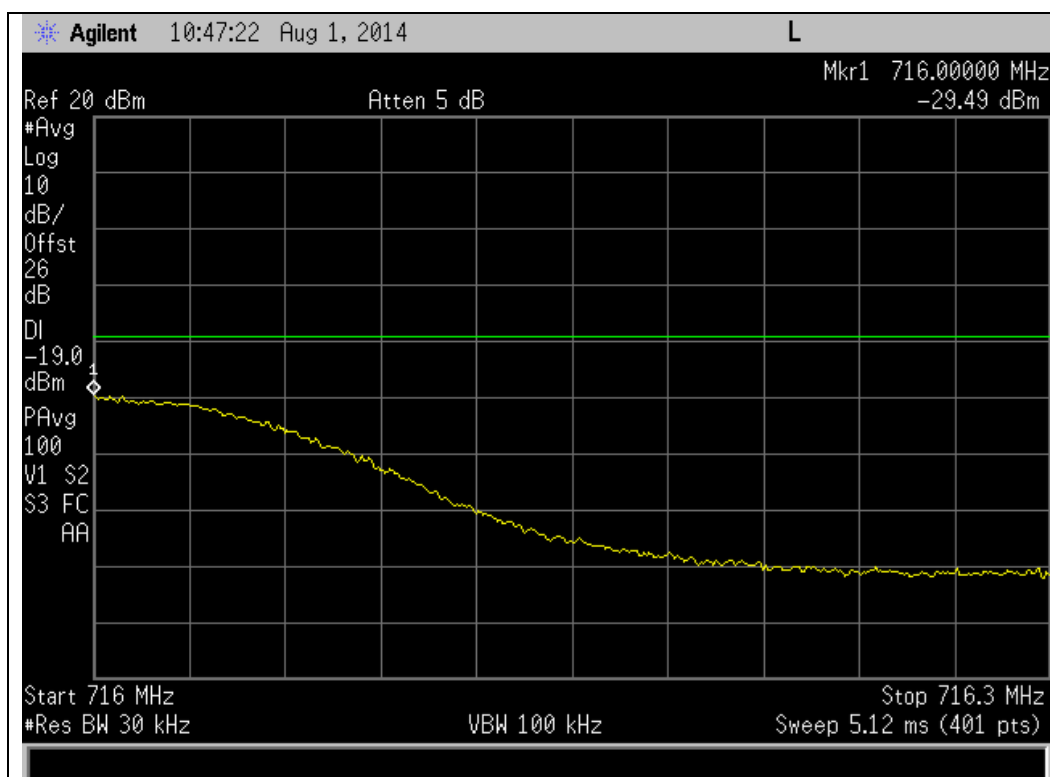
## GSM Uplink Test Plots

698 - 716 MHz Band

Lower Band Edge



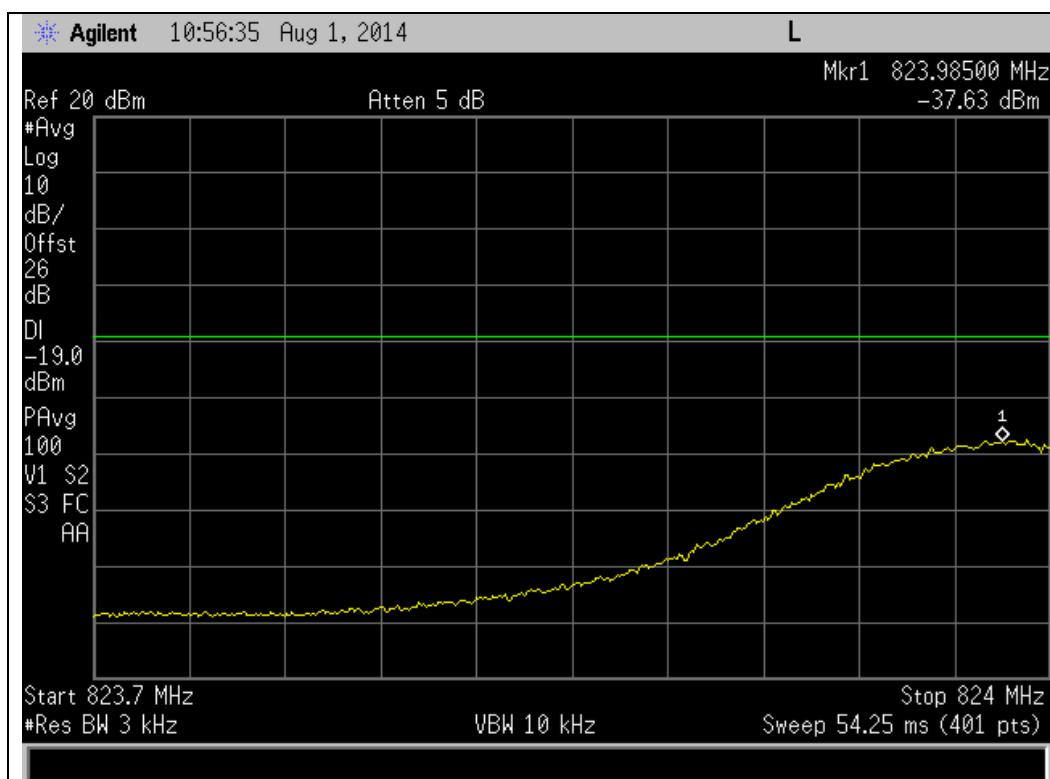
Upper Band Edge



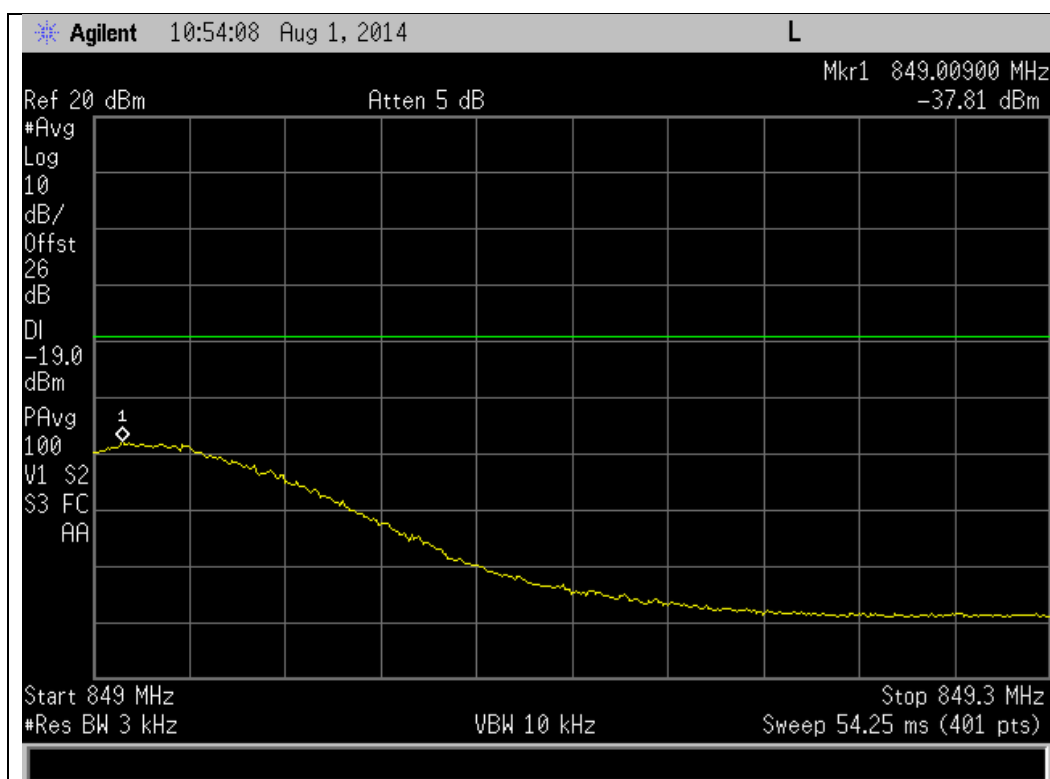


## 824 - 849 MHz Band

### Lower Band Edge



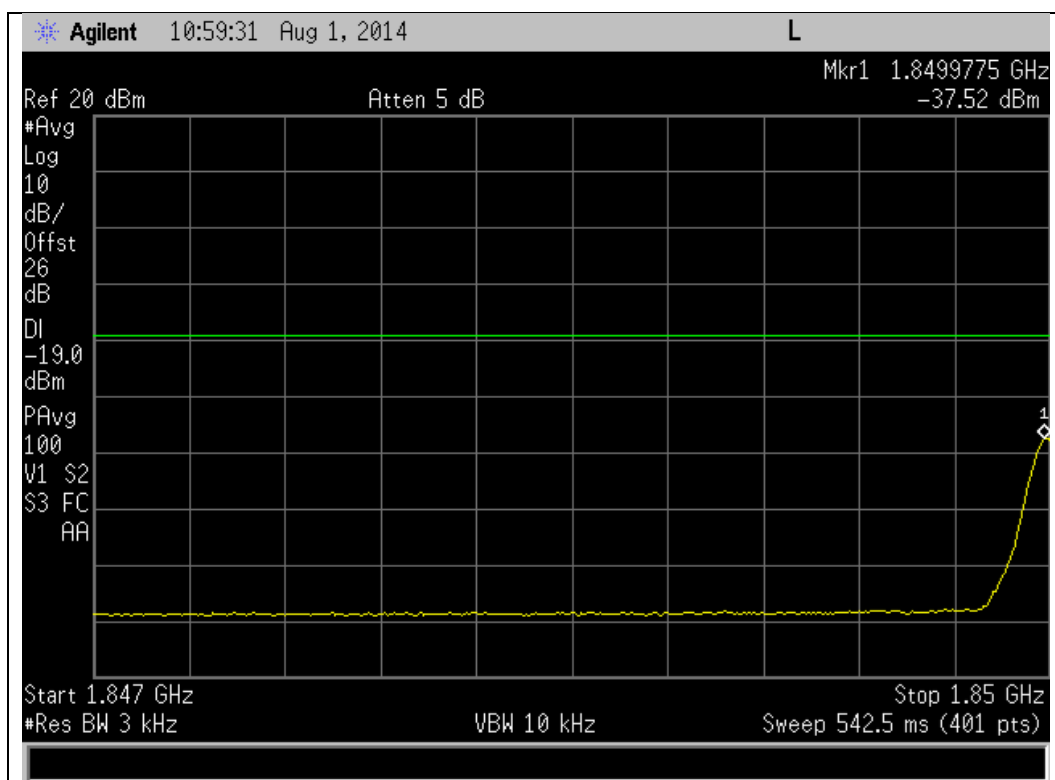
### Upper Band Edge



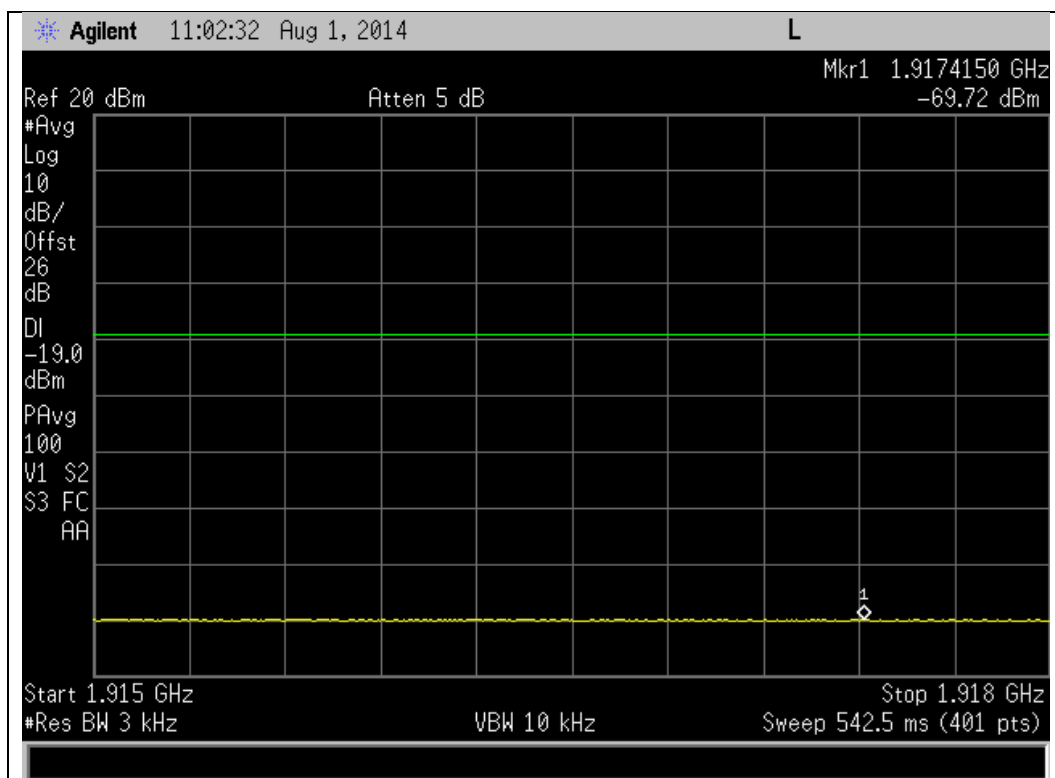


## 1850 - 1910 MHz Band

### Lower Band Edge



### Upper Band Edge

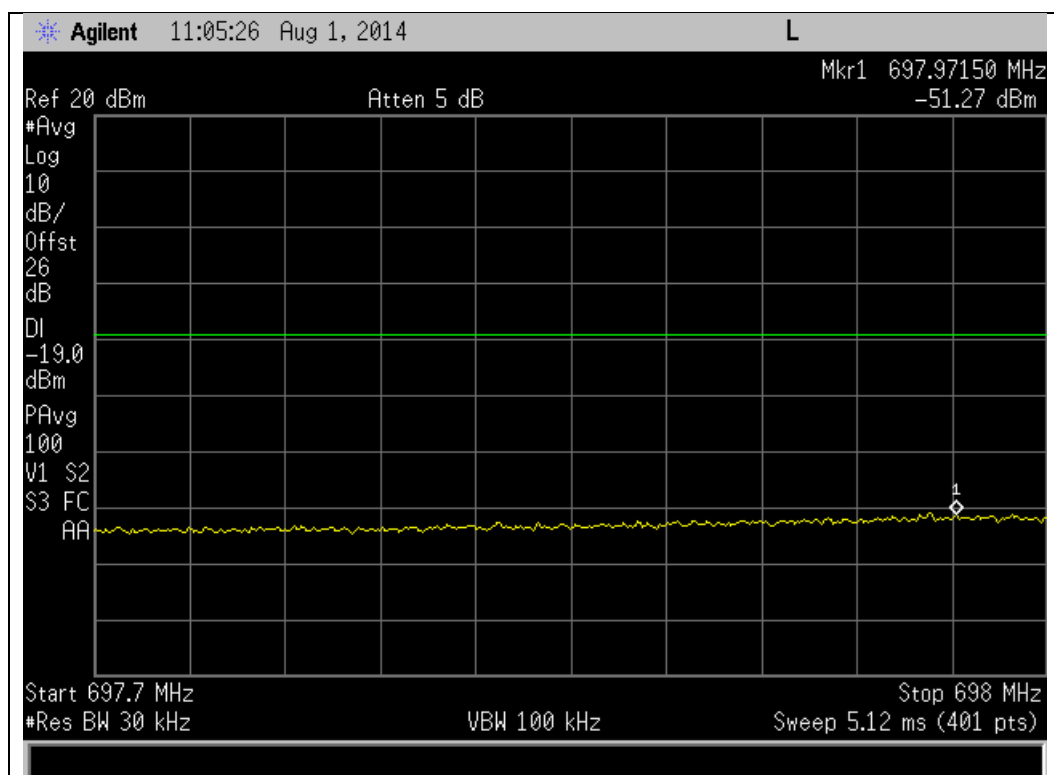




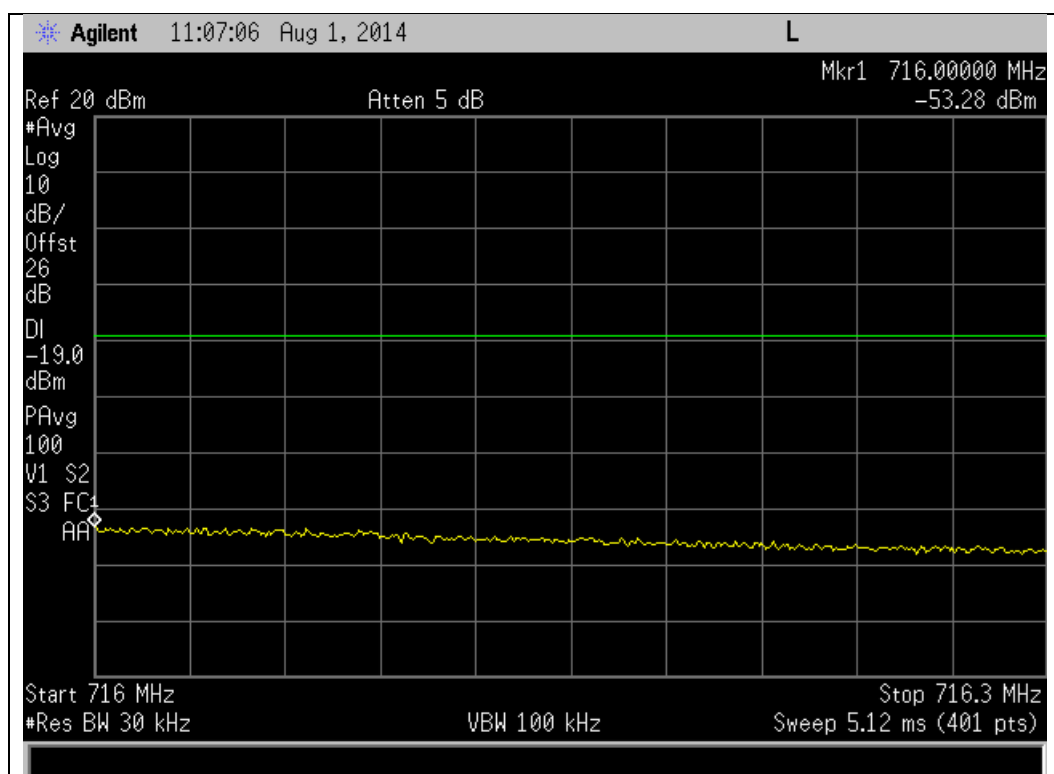
## CDMA Uplink Test Plots

698 - 716 MHz Band

Lower Band Edge



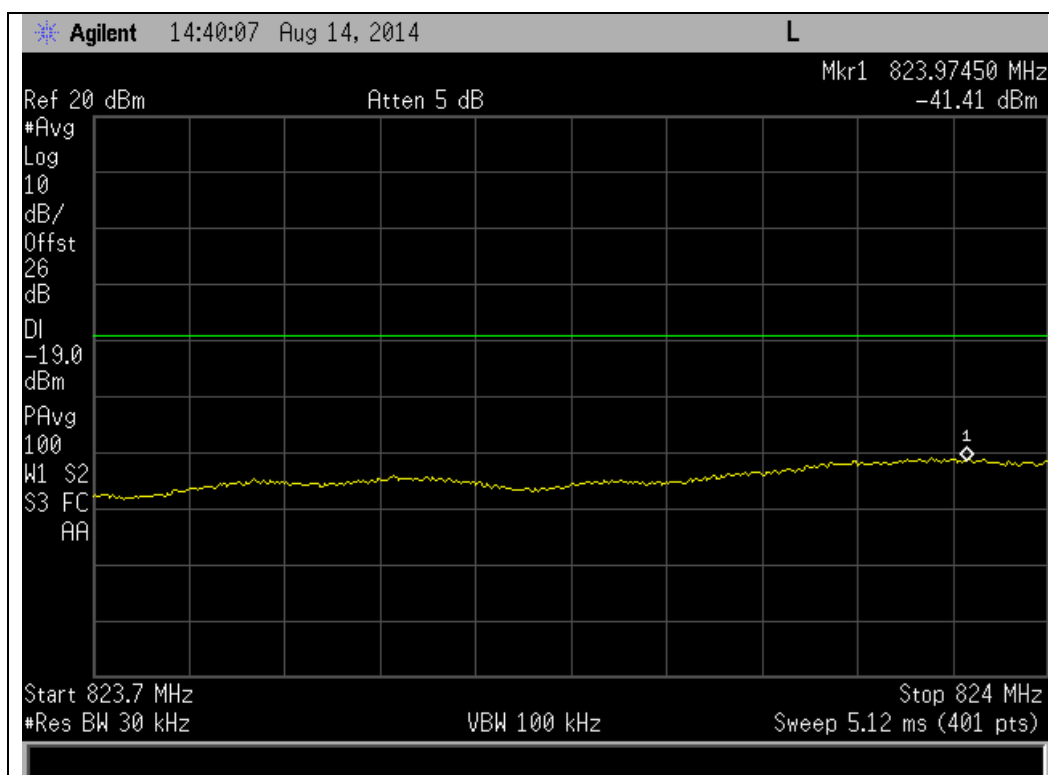
Upper Band Edge



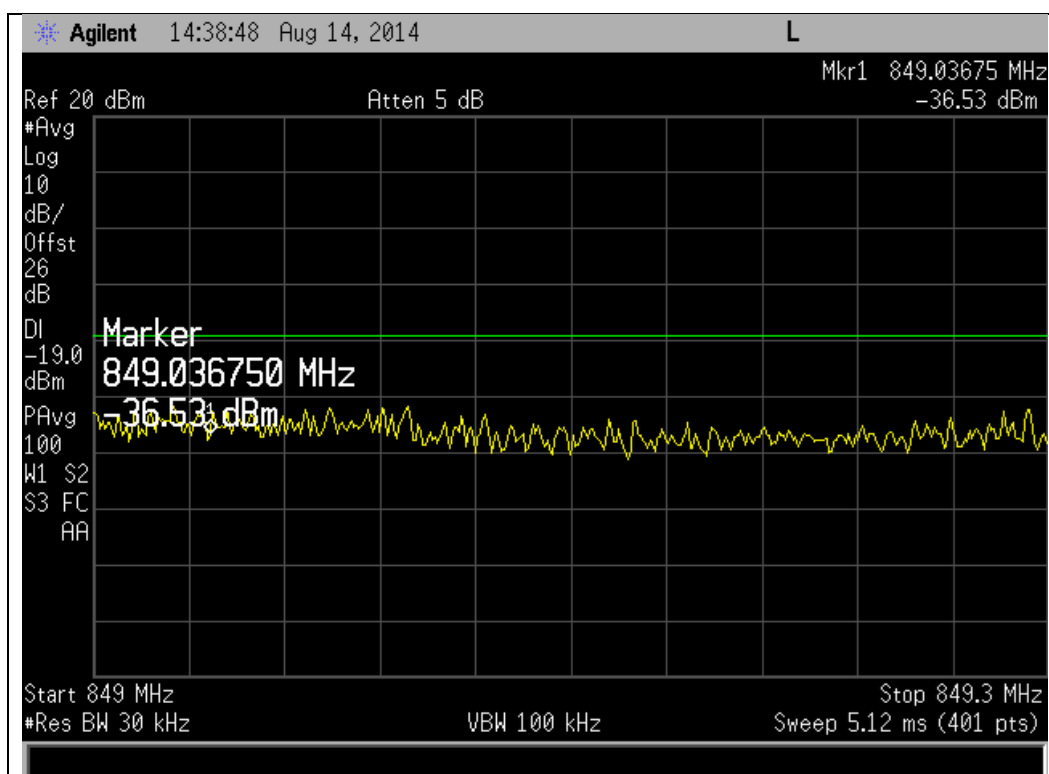


## 824 - 849 MHz Band

### Lower Band Edge



### Upper Band Edge

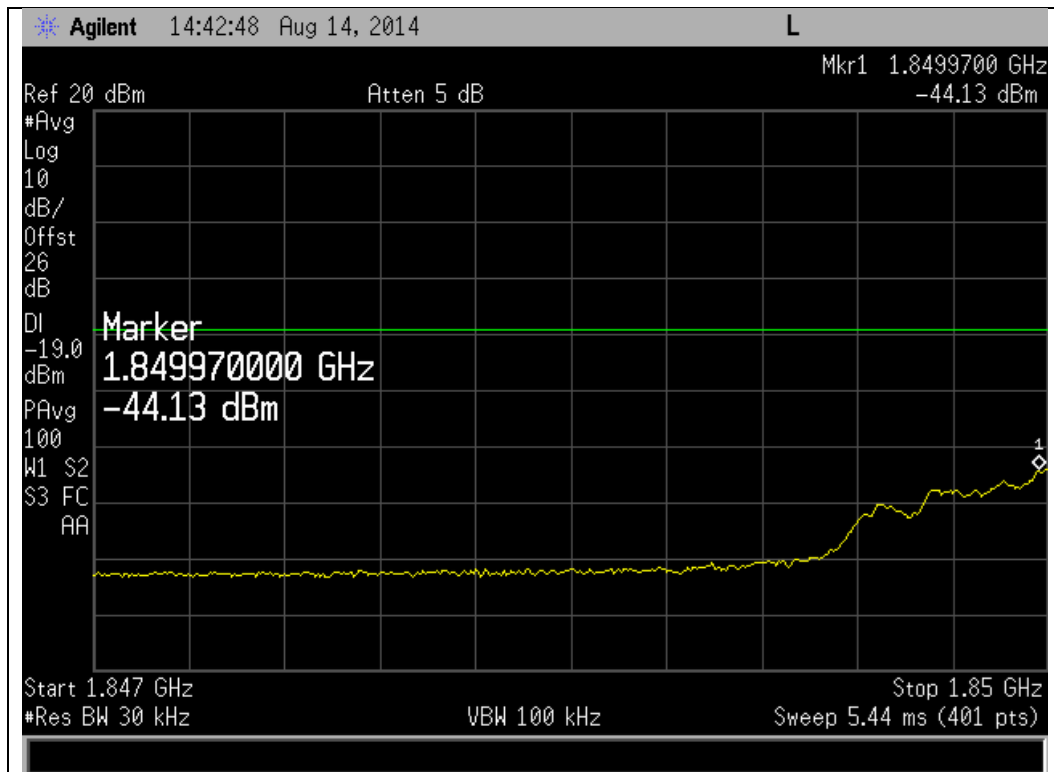




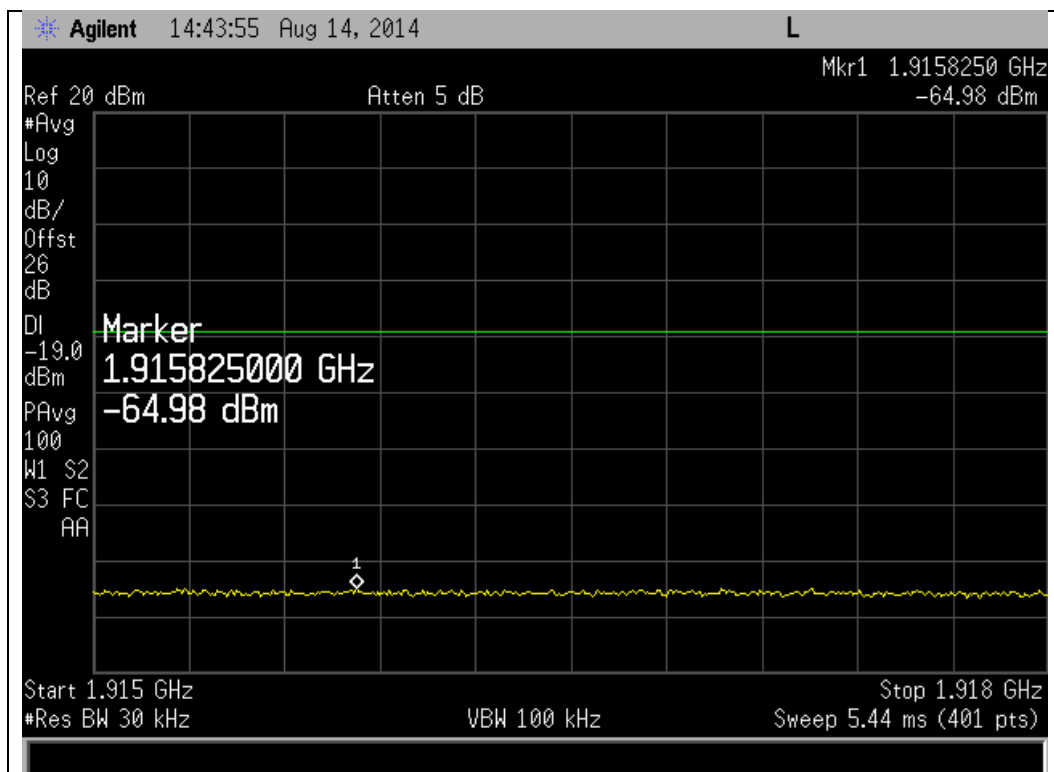


## 1850 - 1910 MHz Band

### Lower Band Edge

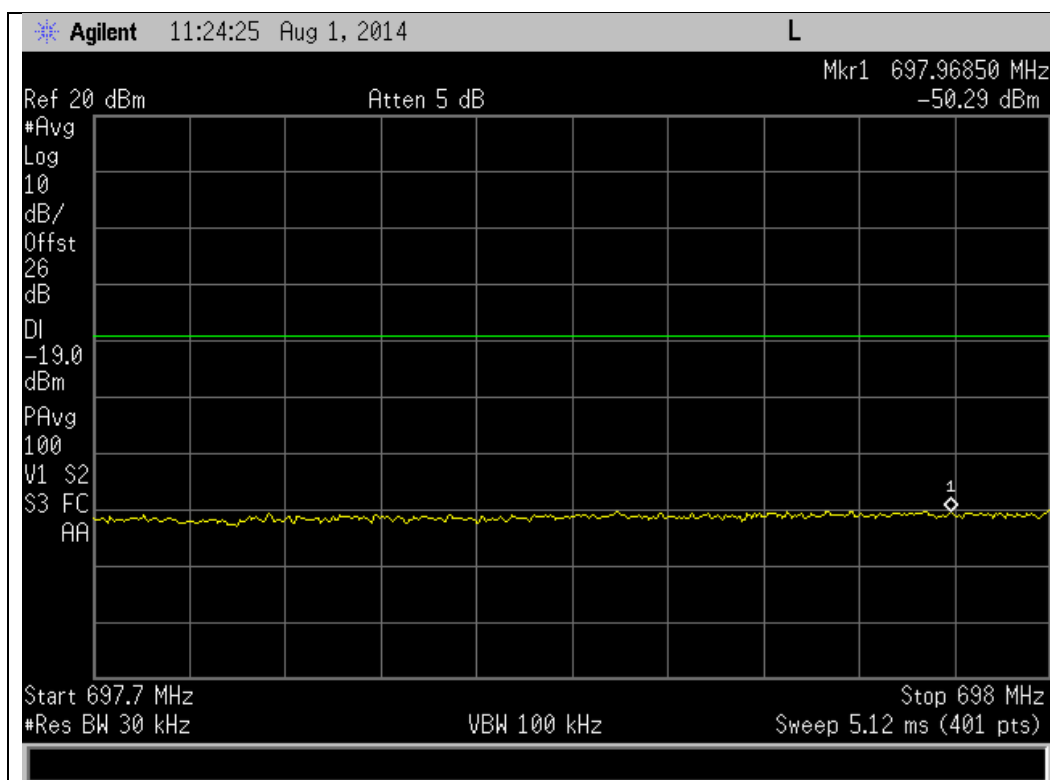


### Upper Band Edge

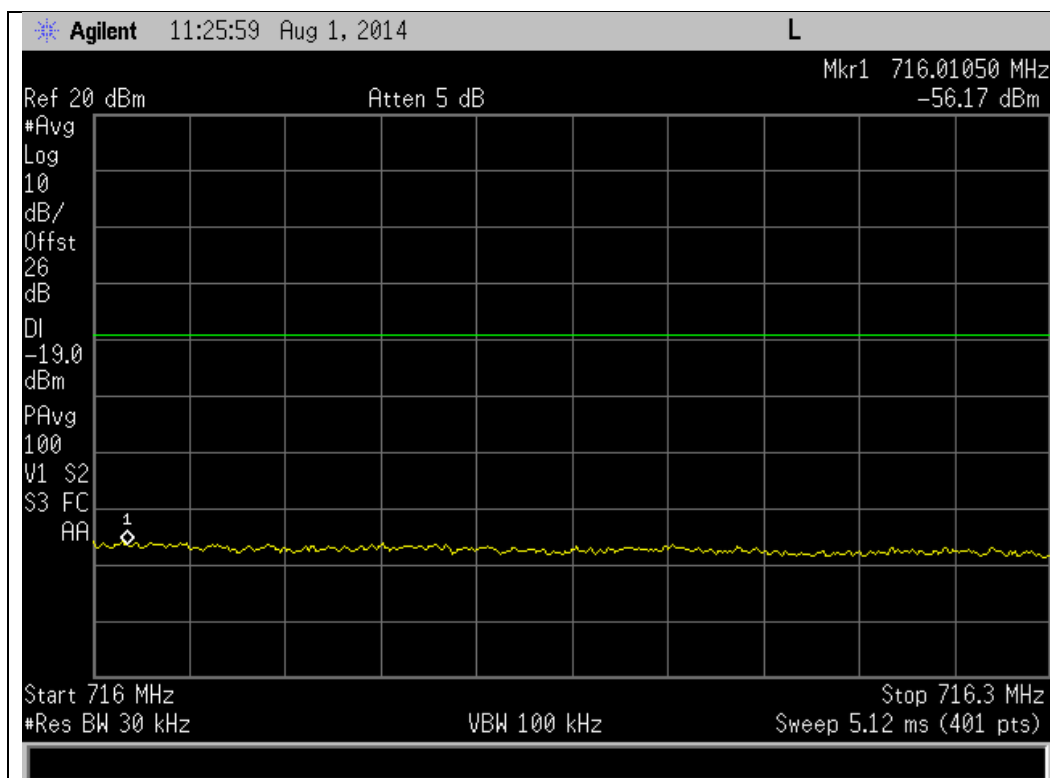




# WCDMA Uplink Test Plots 698 - 716 MHz Band Lower Band Edge



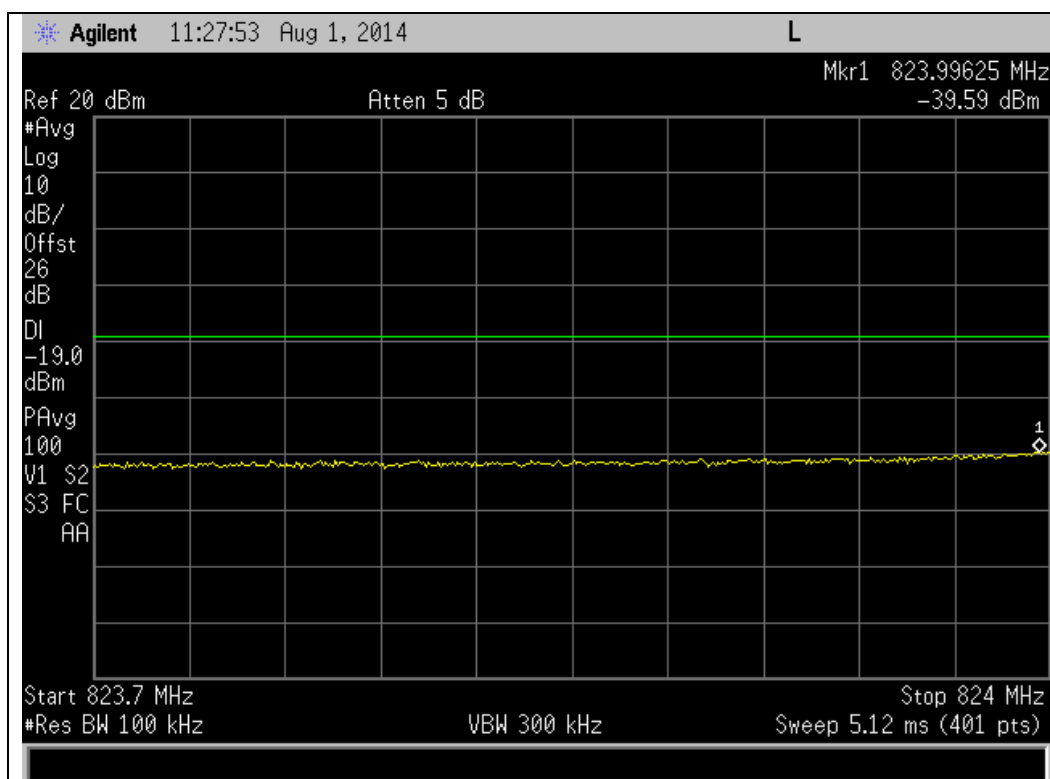
## Upper Band Edge



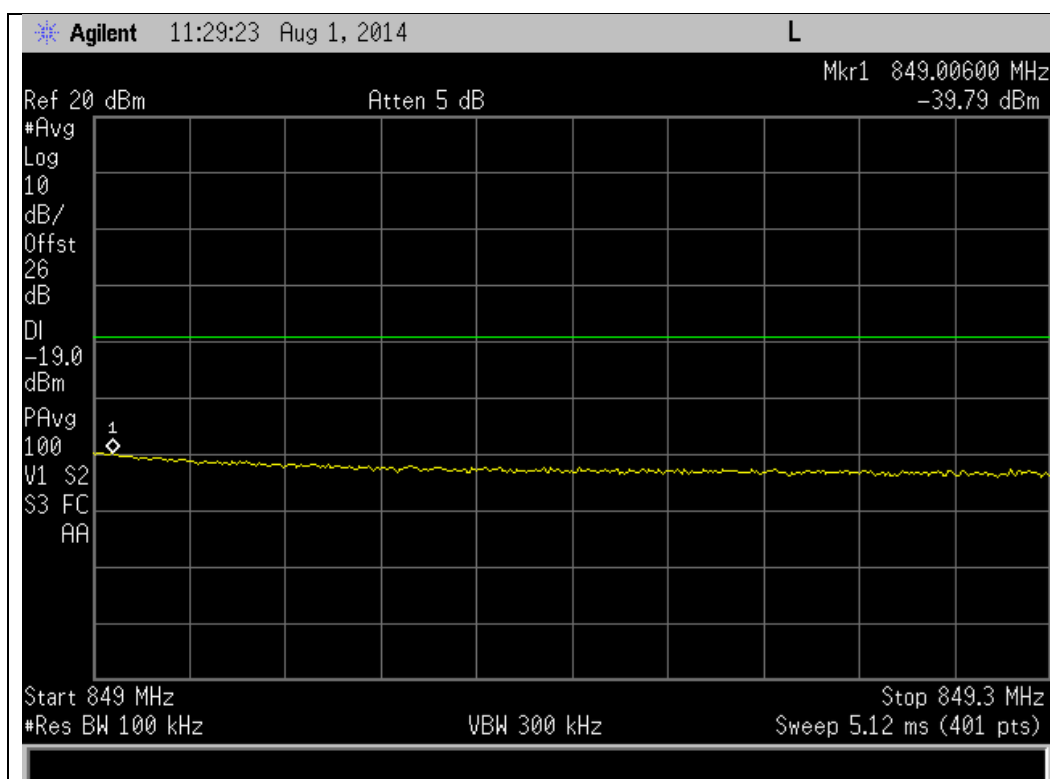


## 824 - 849 MHz

### Lower Band Edge



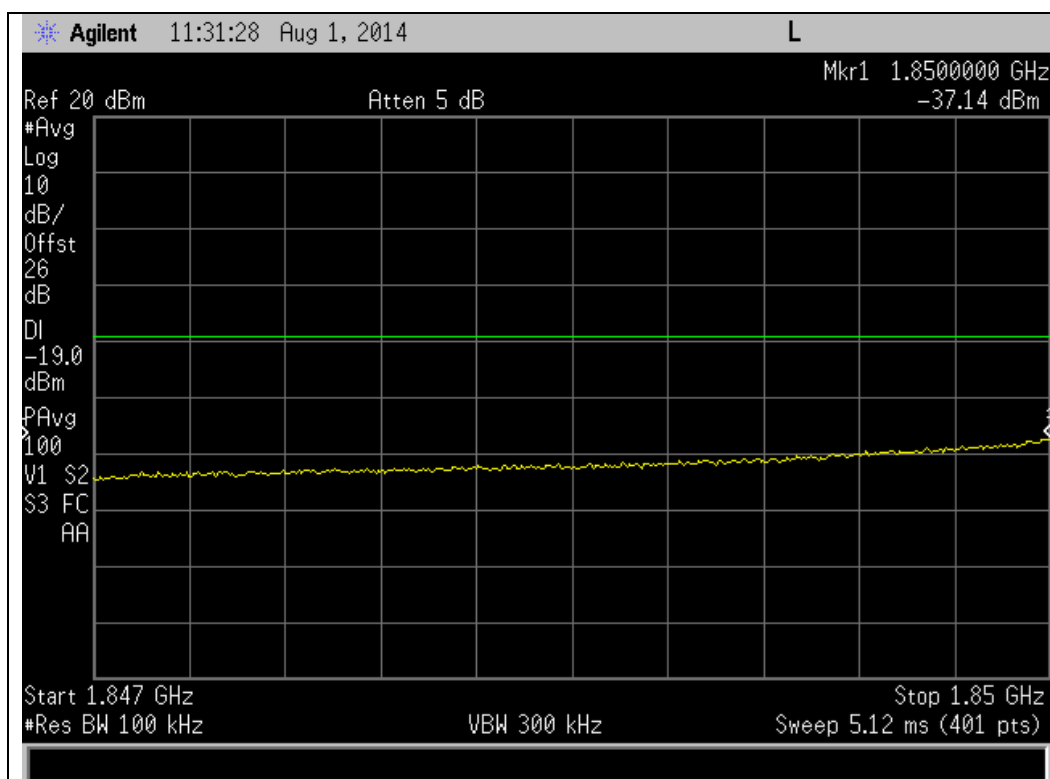
### Upper Band Edge



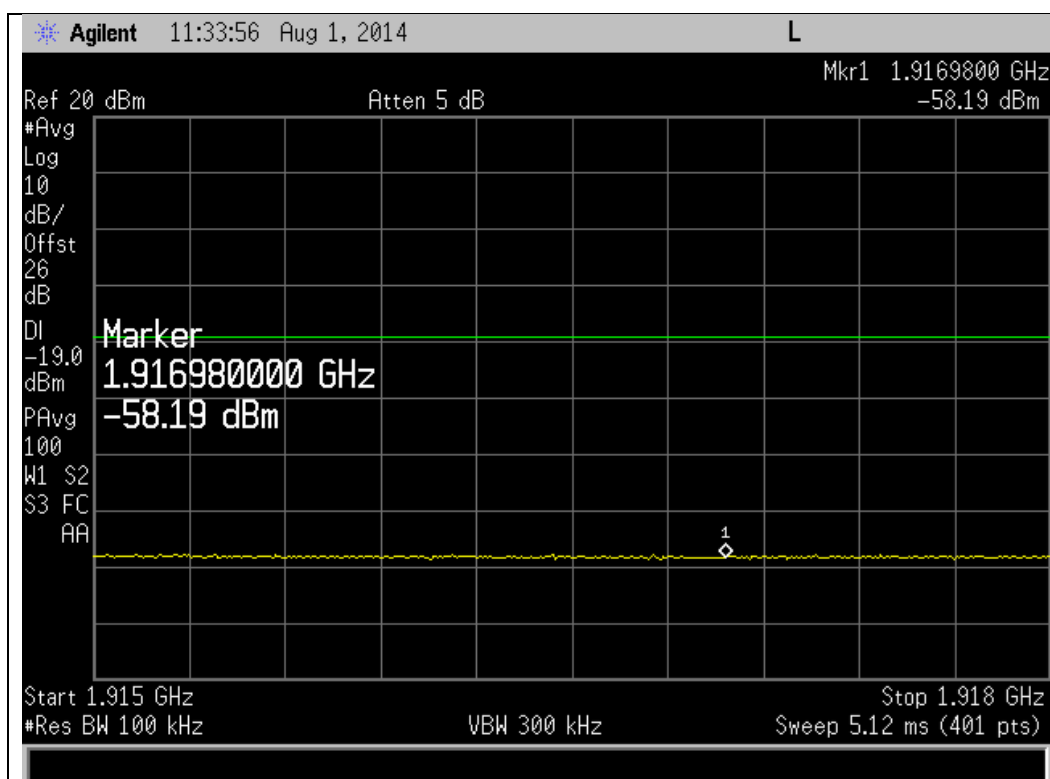


## 1850 - 1910 MHz Band

### Lower Band Edge

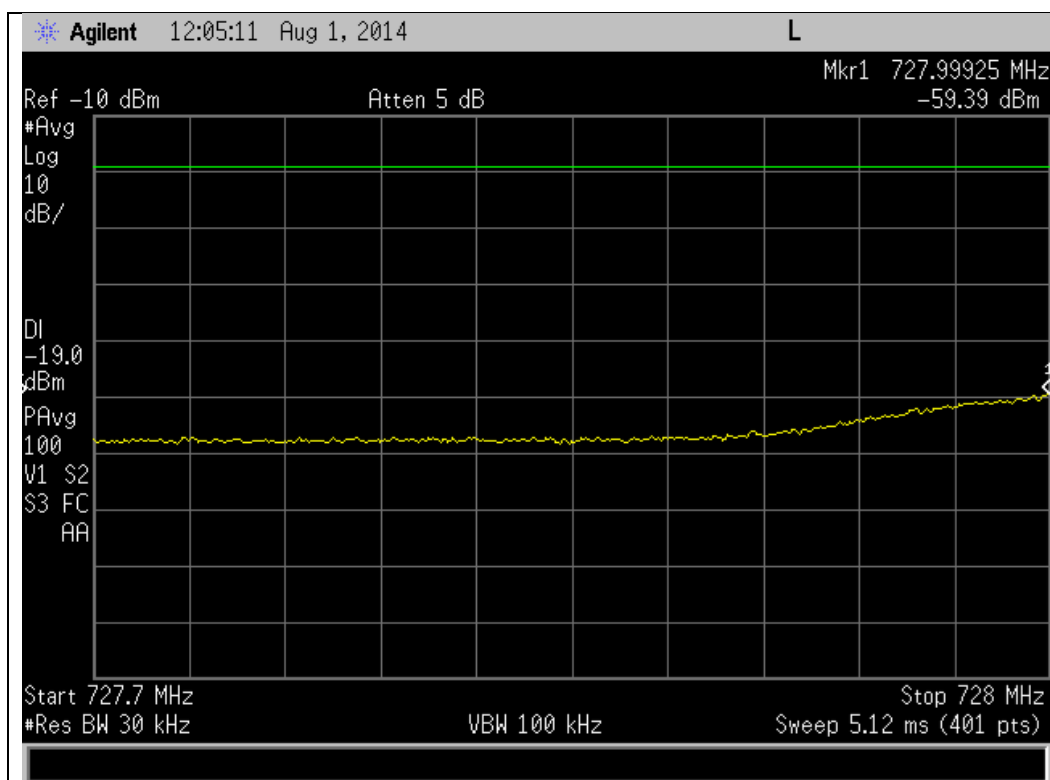


### Upper Band Edge

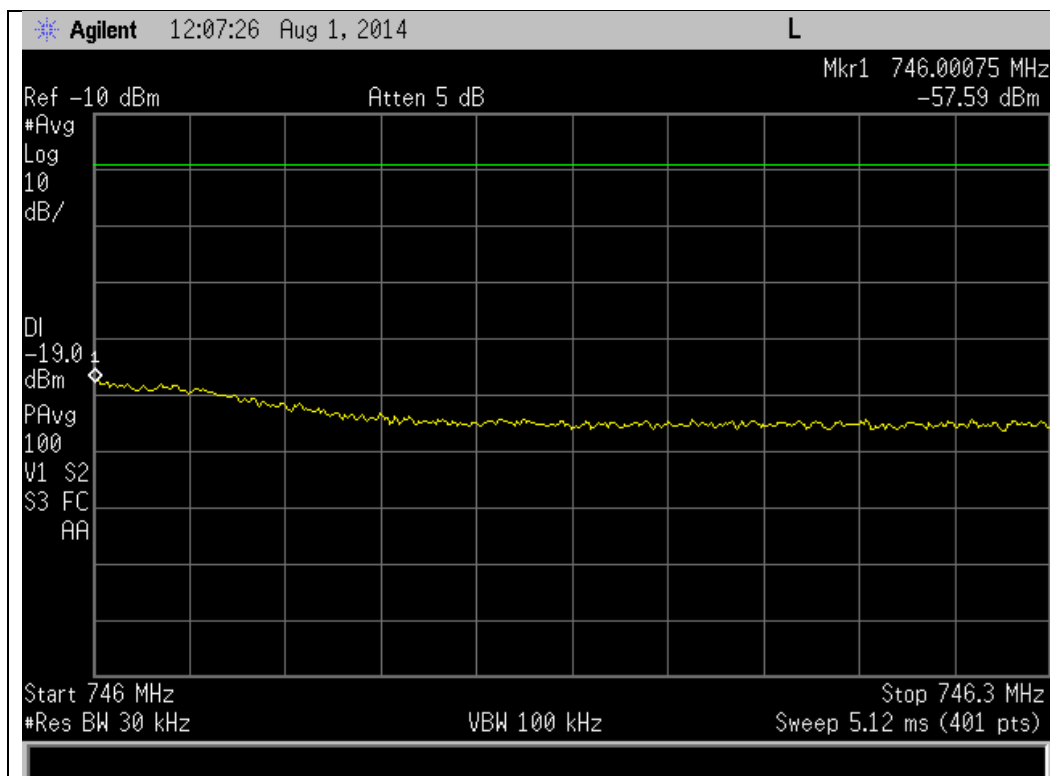




**GSM Downlink Test Plots**  
**728 - 746 MHz Band**  
**Lower Band Edge**



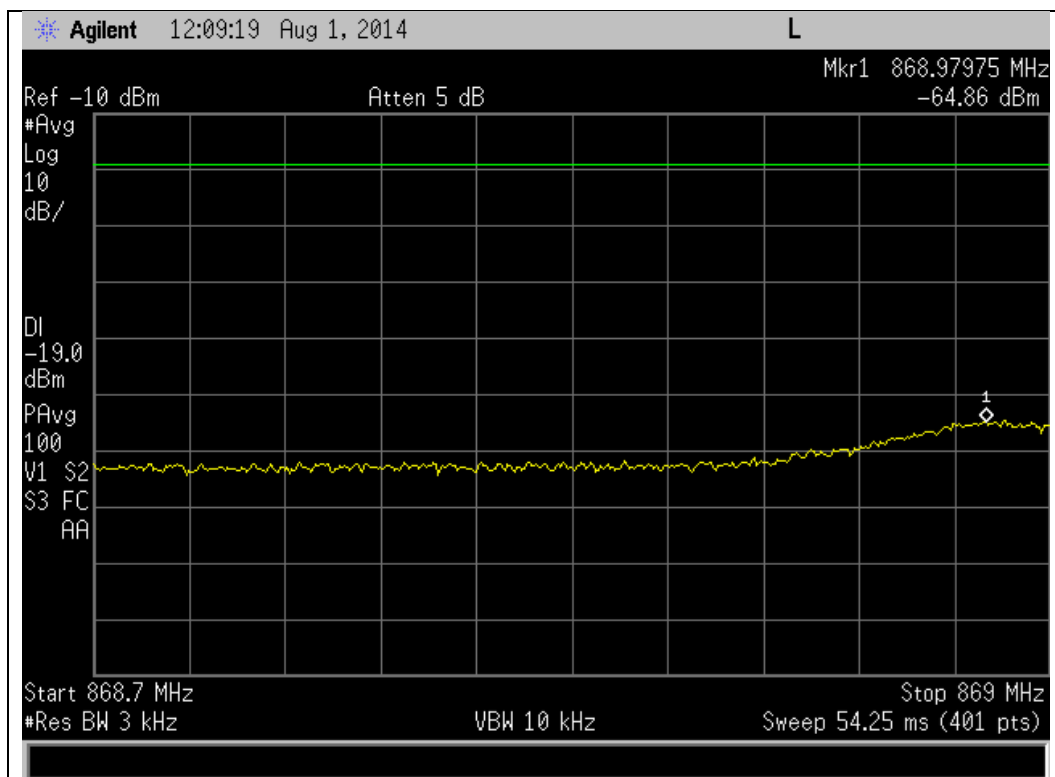
**Upper Band Edge**



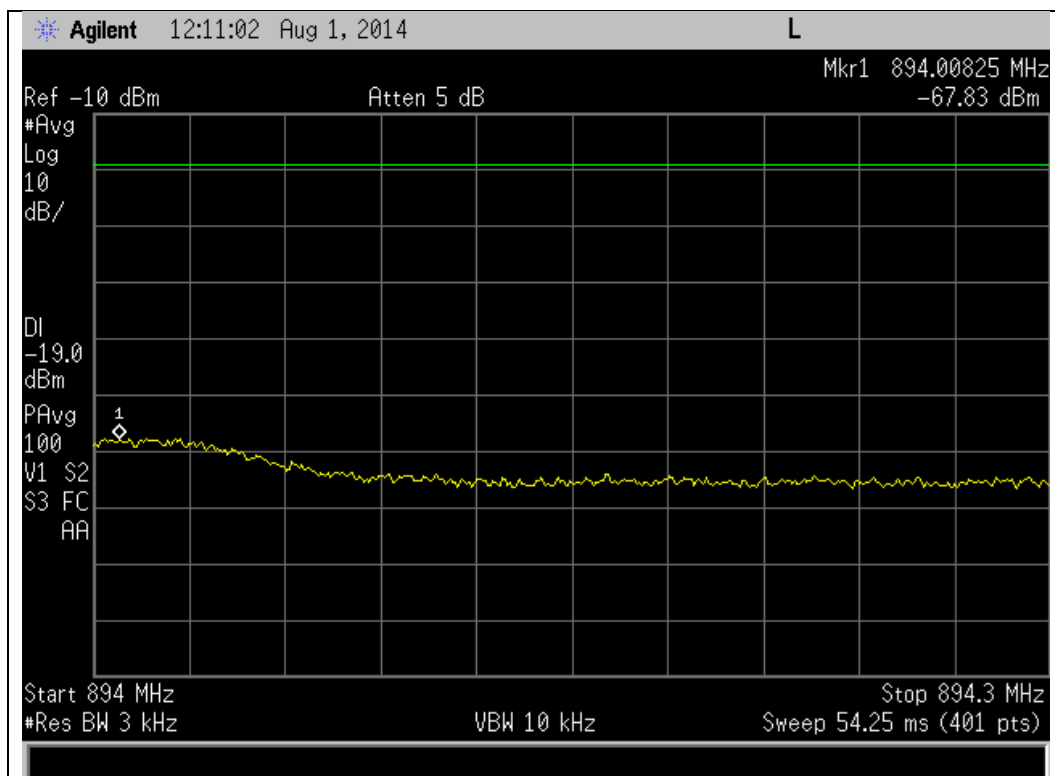


## 869 - 894 MHz Band

### Lower Band Edge



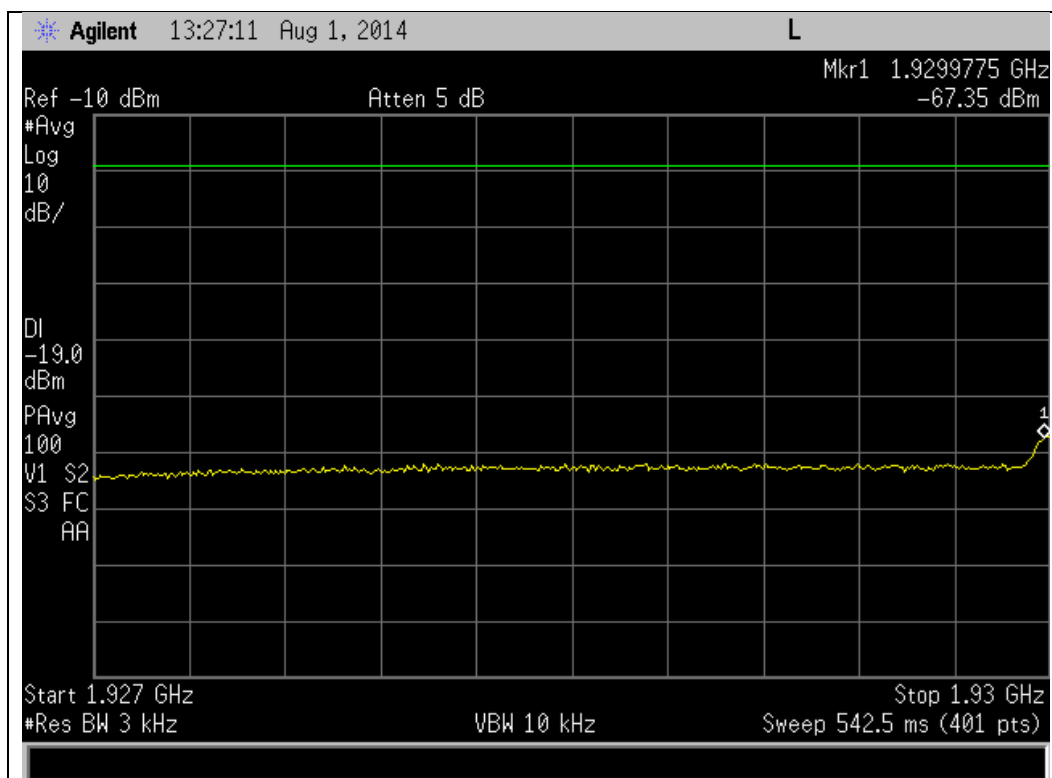
### Upper Band Edge



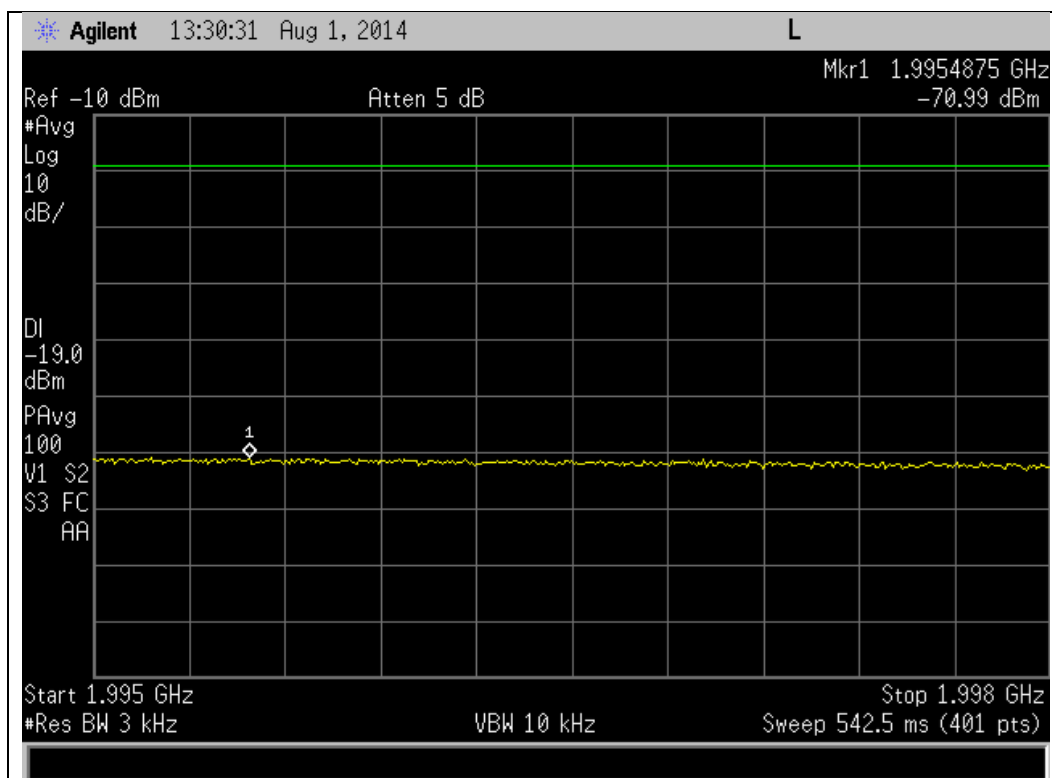


## 1930 - 1990 MHz Band

### Lower Band Edge



### Upper Band Edge

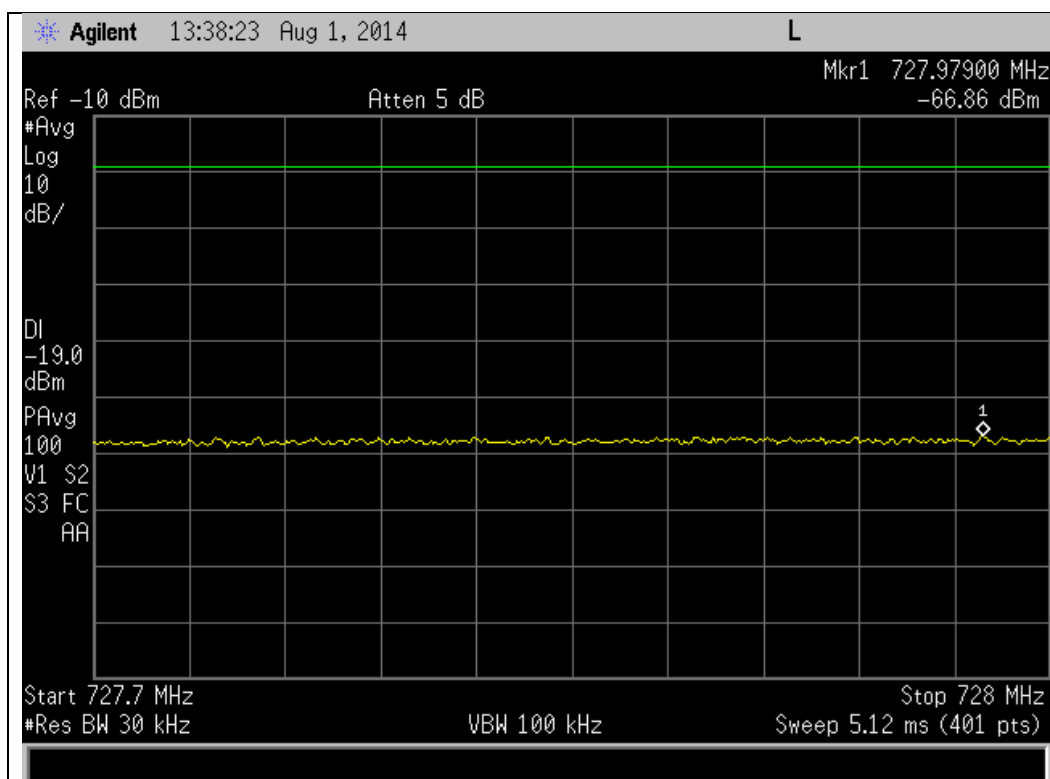




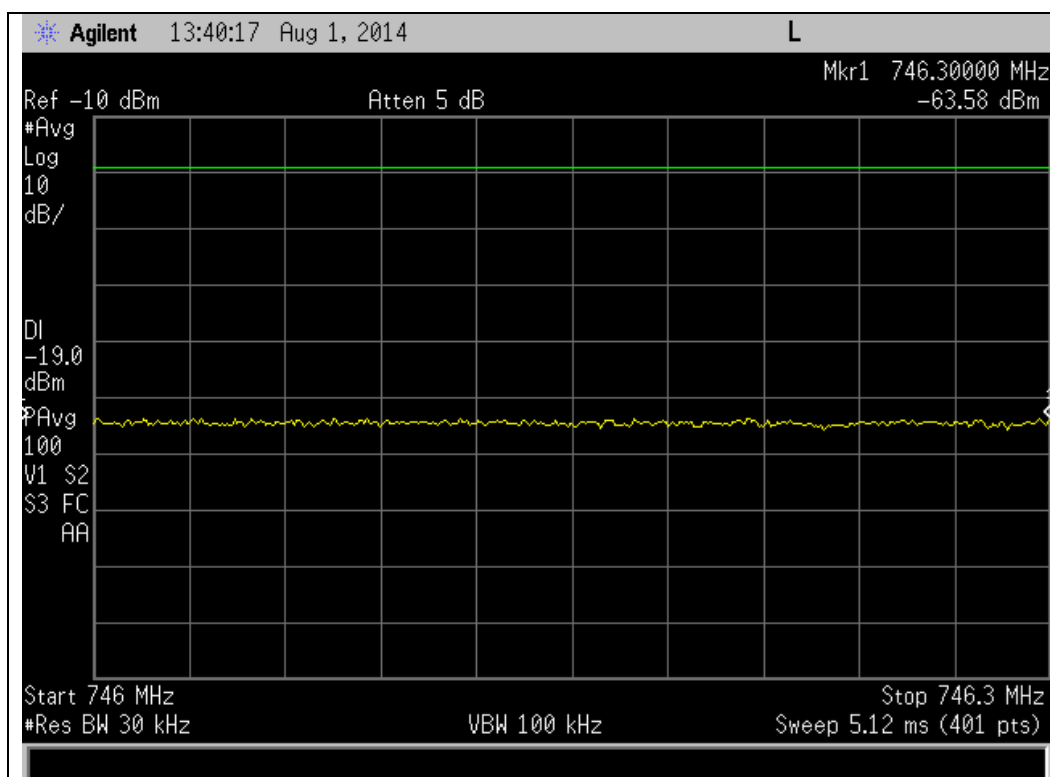
## CDMA Downlink Test Plots

728 - 746 MHz Band

Lower Band Edge



Upper Band Edge

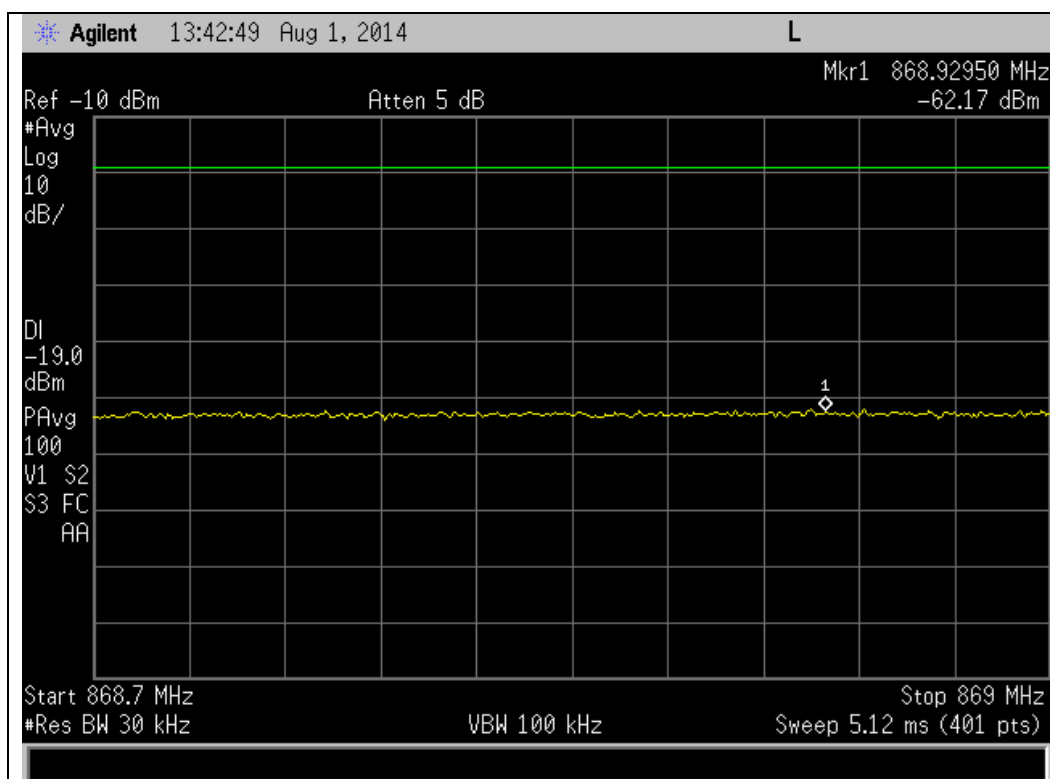




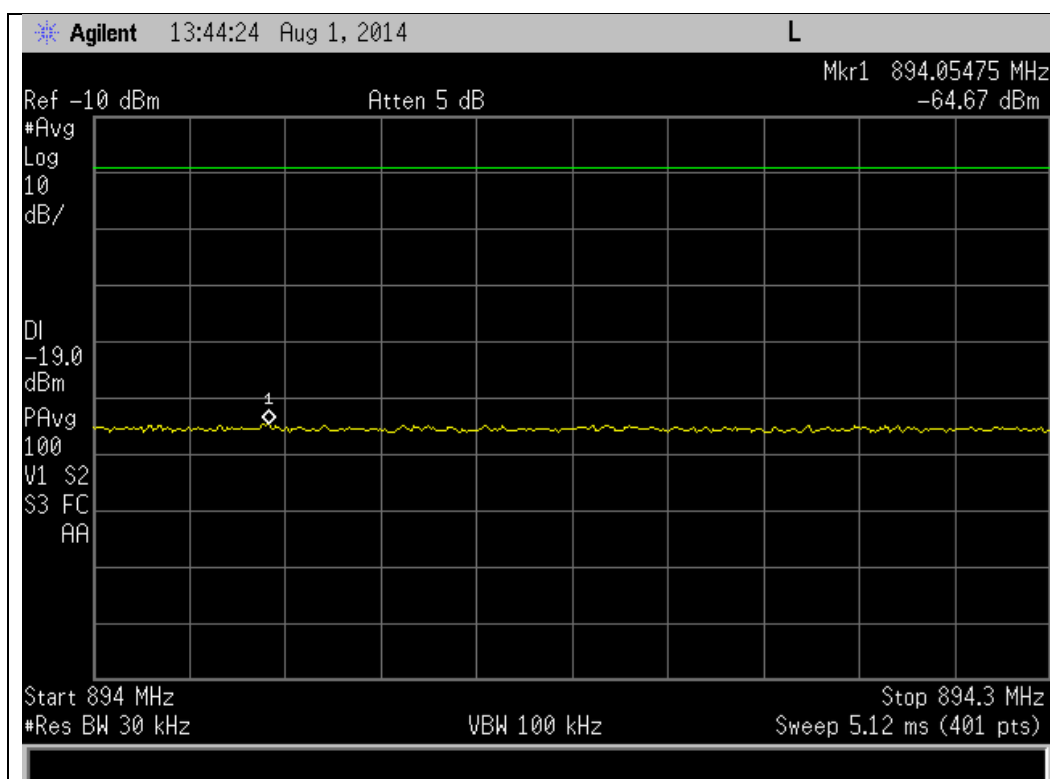


## 869 - 894 MHz Band

### Lower Band Edge



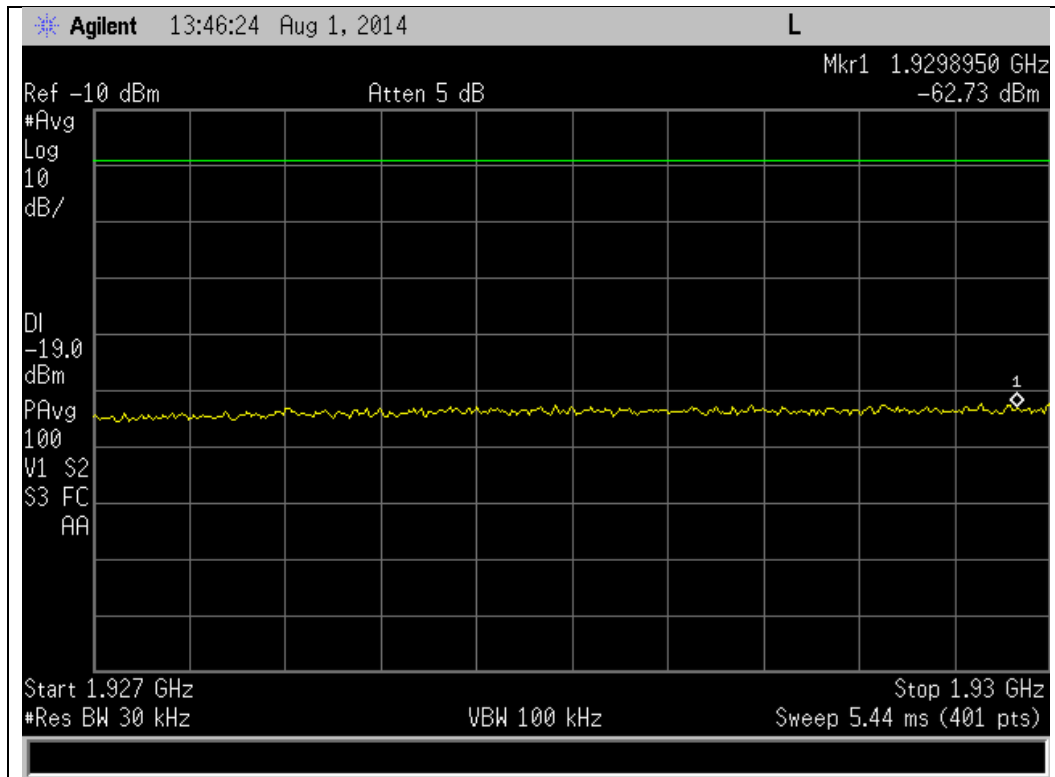
### Upper Band Edge



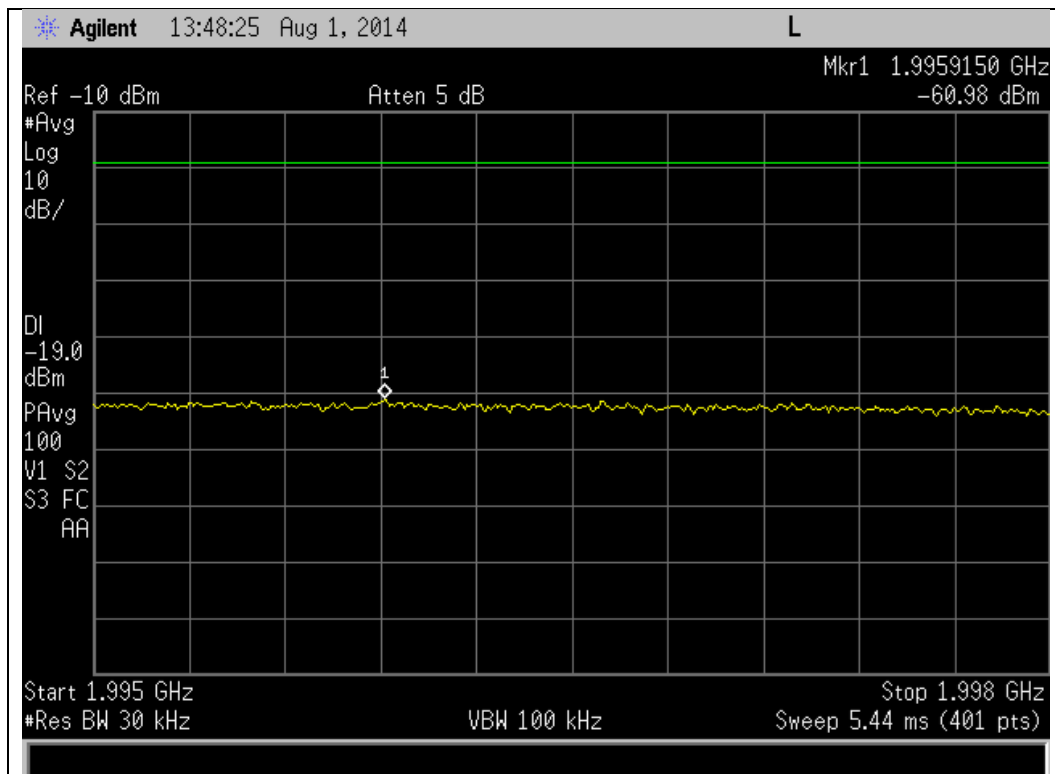


## 1930 - 1990 MHz Band

### Lower Band Edge



### Upper Band Edge

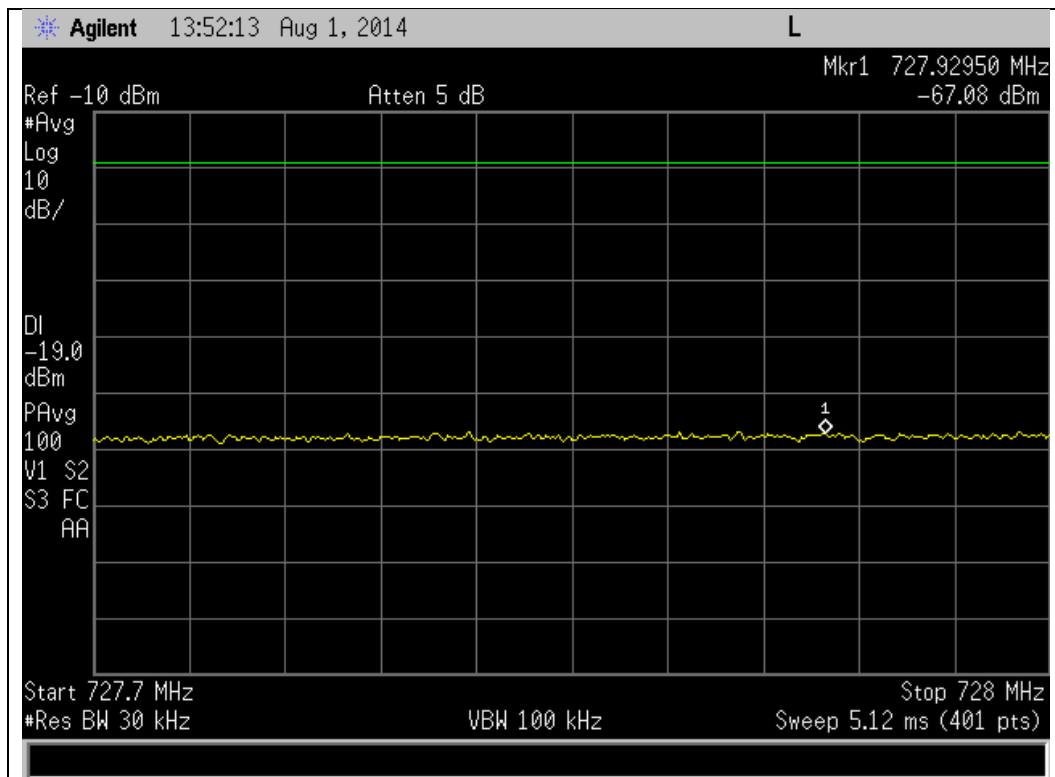




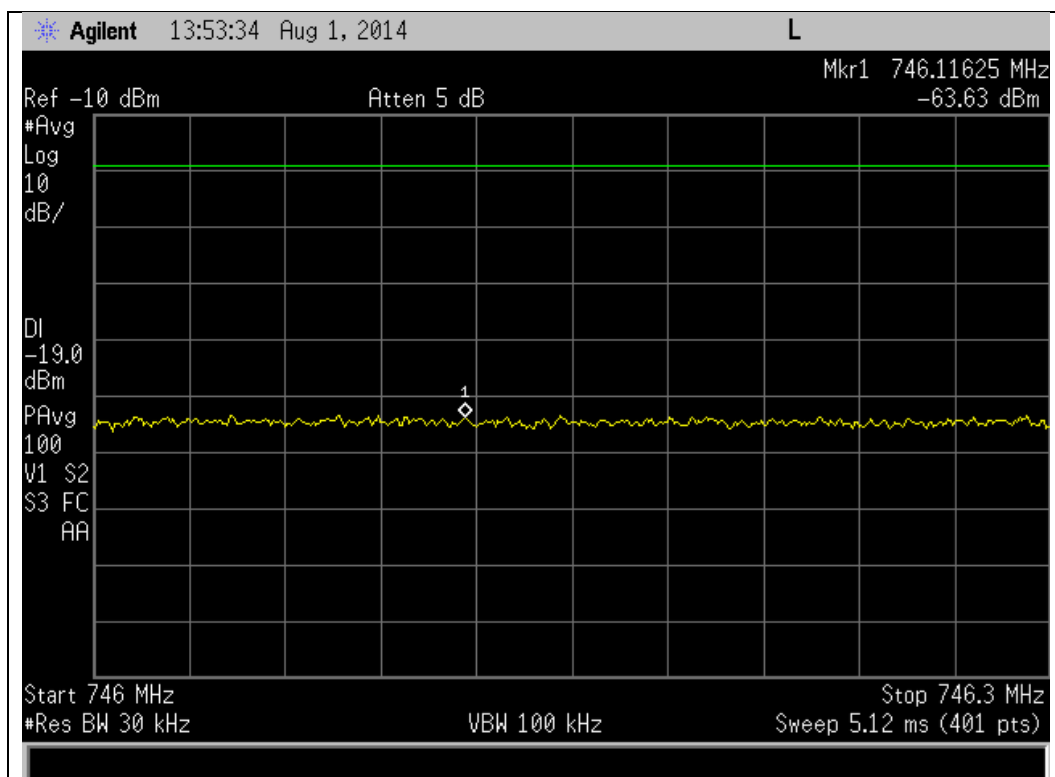
## WCDMA Downlink Test Plots

728 - 746 MHz Band

Lower Band Edge



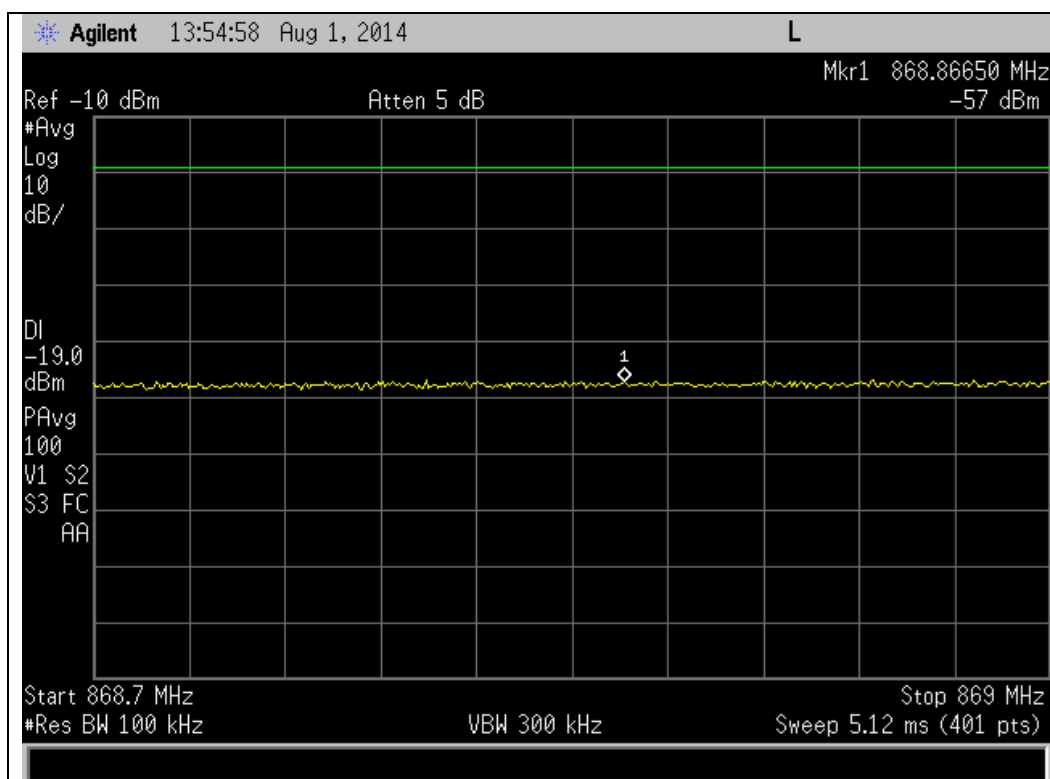
Upper Band Edge



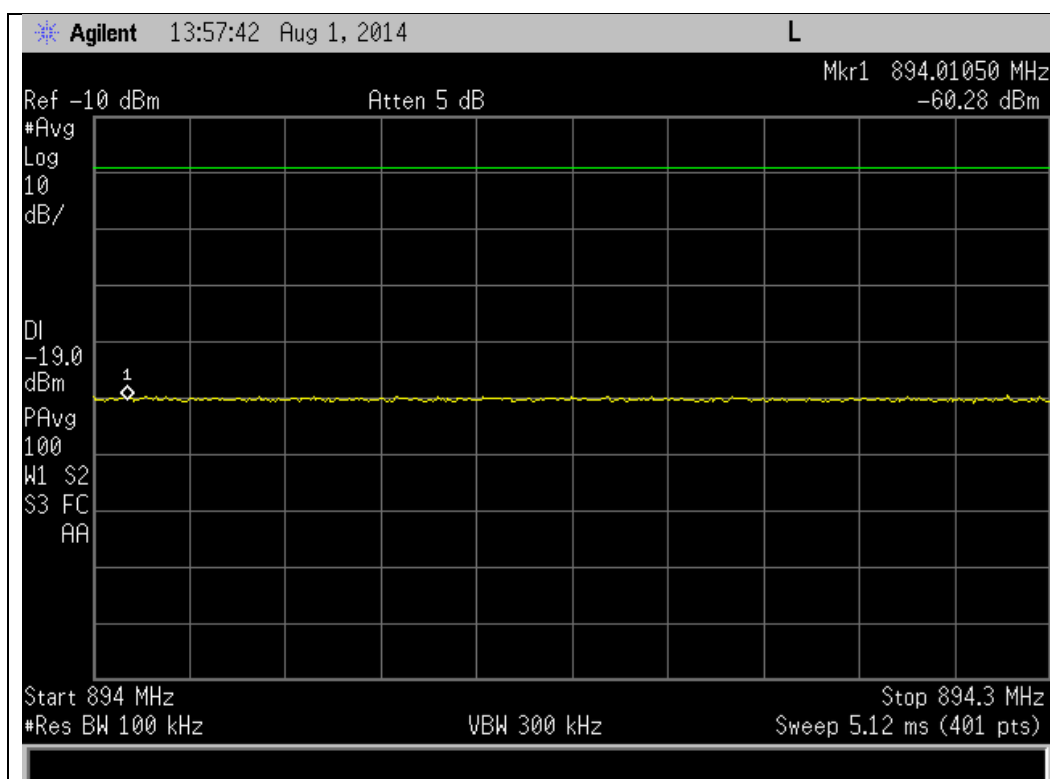


## 869 - 894 MHz Band

### Lower Band Edge



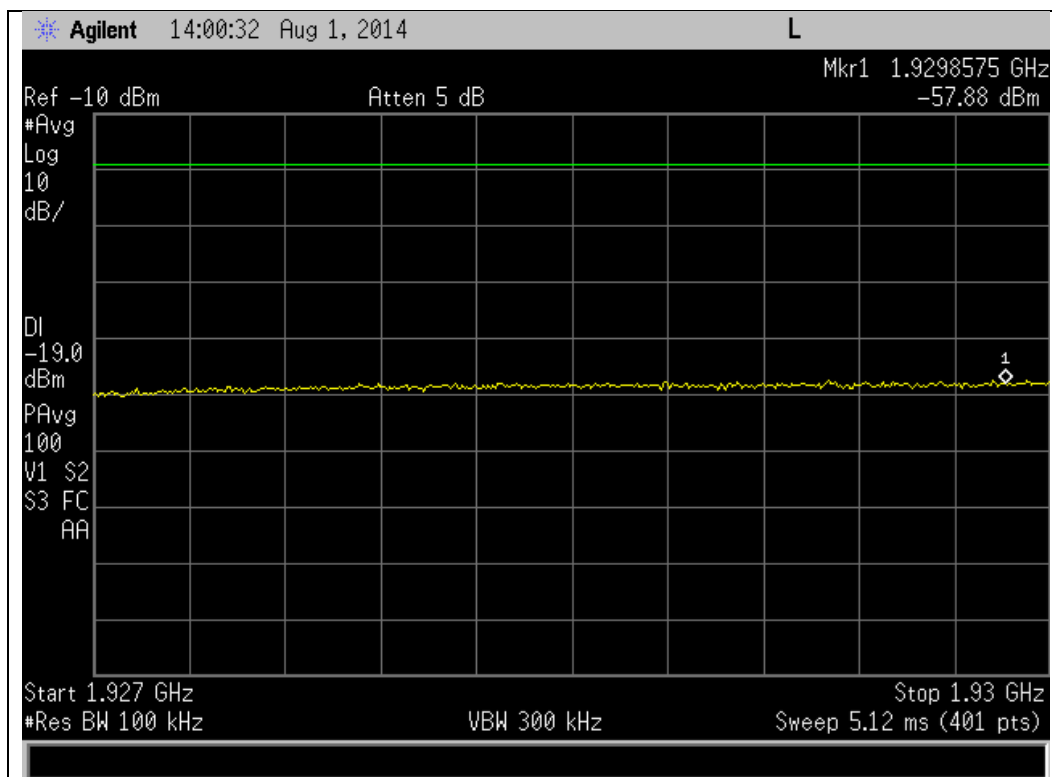
### Upper Band Edge



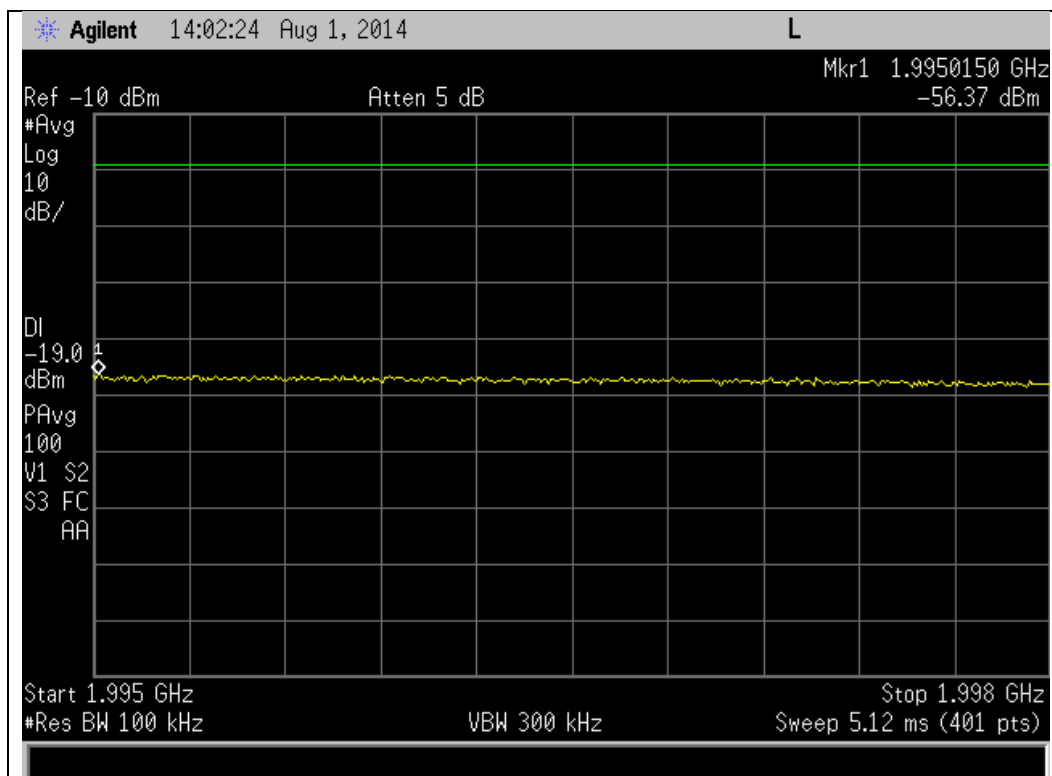


## 1930 - 1990 MHz Band

### Lower Band Edge



### Upper Band Edge





## Conducted Spurious Emissions

**Name of Test:** Conducted Spurious Emissions

**Engineer:** Mike Graffeo

**Test Equipment Utilized:** i00379 and i00405

**Test Date:** 8/1/14

### 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 9 kHz to 10 times the highest tunable frequency for each operational band were 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.

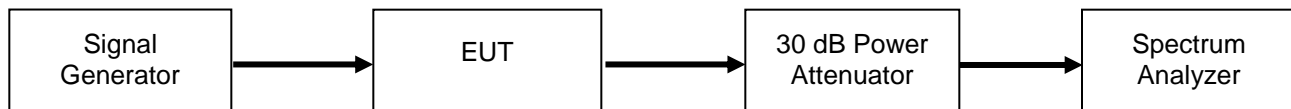
The following formulas are used for calculating the limits.

Conducted Spurious Emissions Limit =  $P1 - (43 + 10\log(P2)) = -13$  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
698 - 716	1882.8	-36.59	-13	Pass
824 - 849	1884.4	-37.36	-13	Pass
1850 - 1910	1843.7	-40.49	-13	Pass

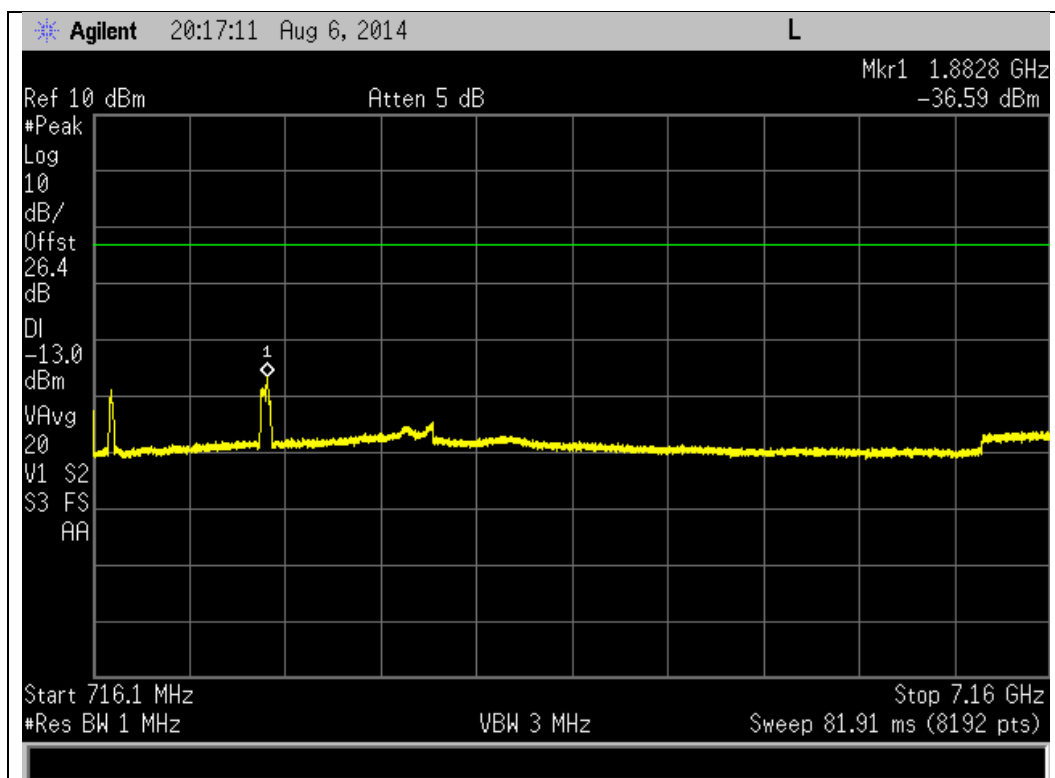
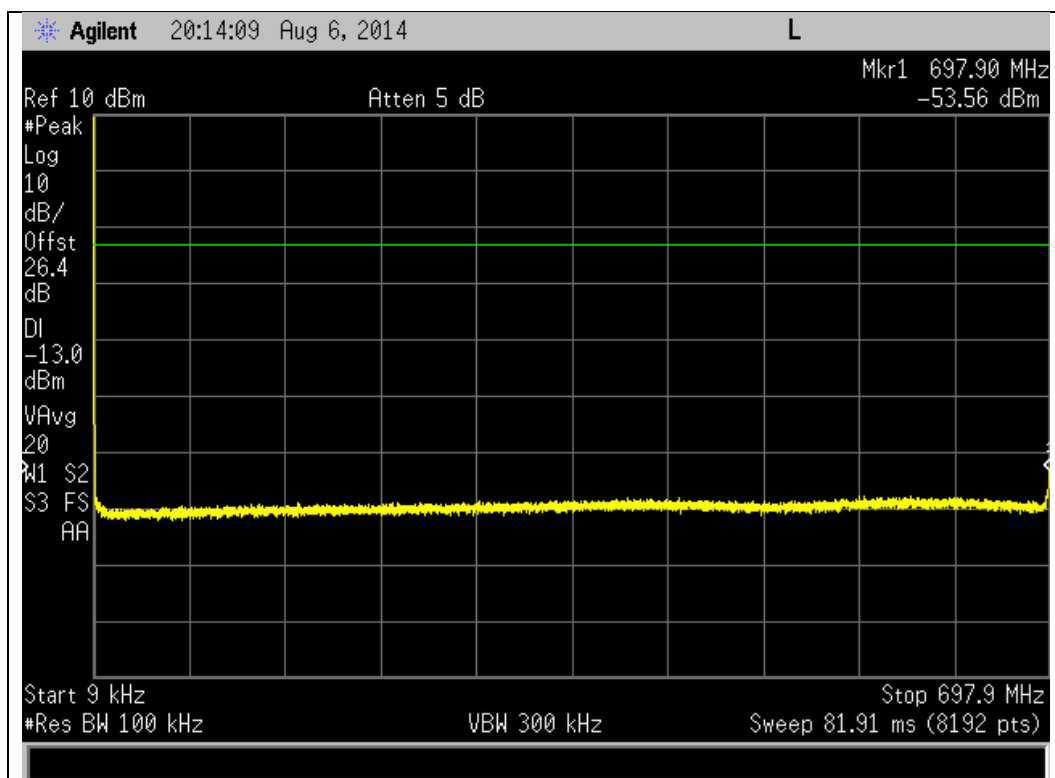
### Downlink Test Results

Frequency Band (MHz)	Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	1981.3	-32.41	-13	Pass
869 - 894	1984.4	-33.80	-13	Pass
1930 - 1990	1996.0	-41.48	-13	Pass



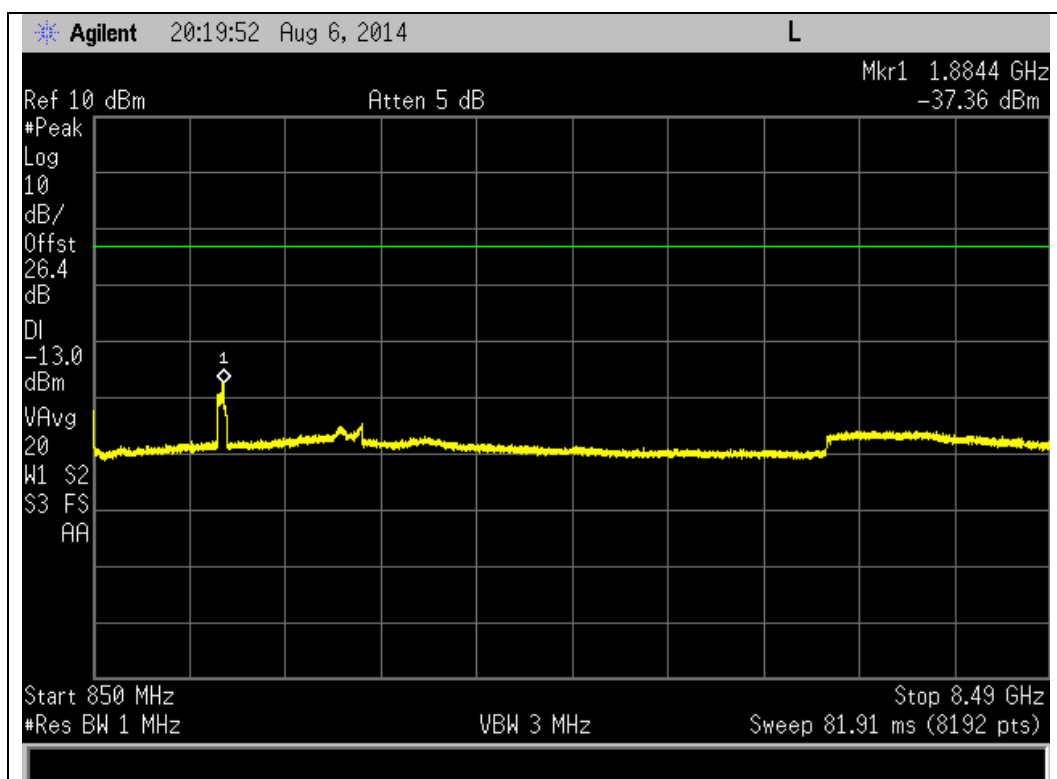
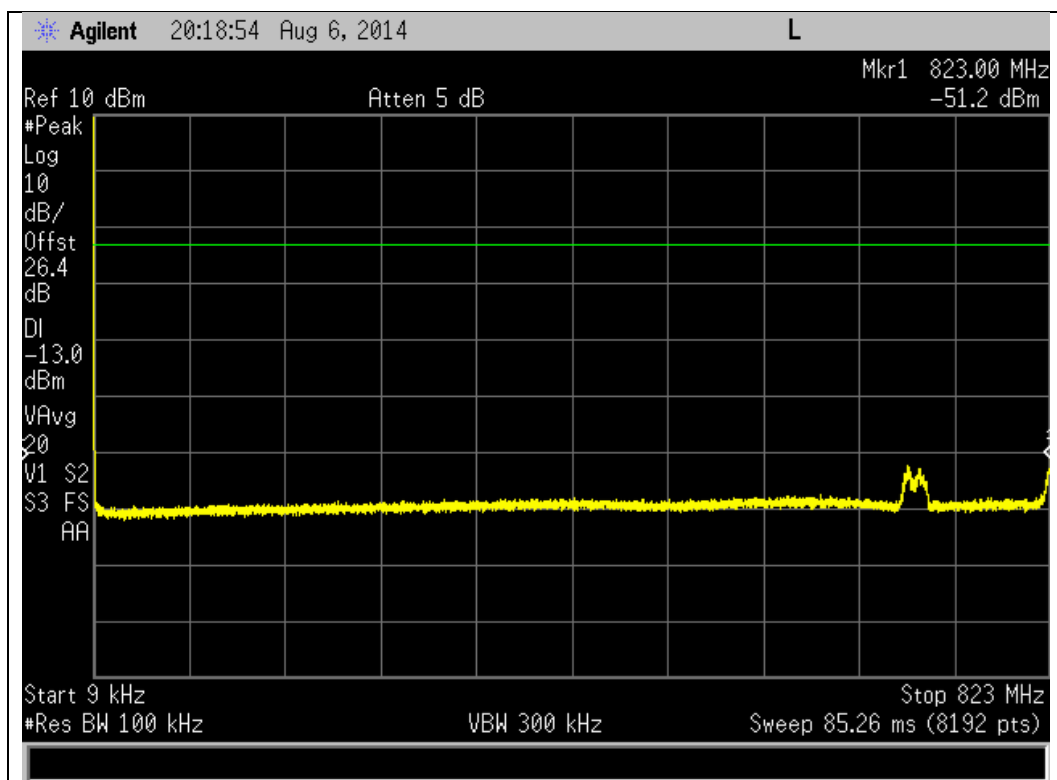
## Uplink Test Plots

### 698 - 716 MHz Band





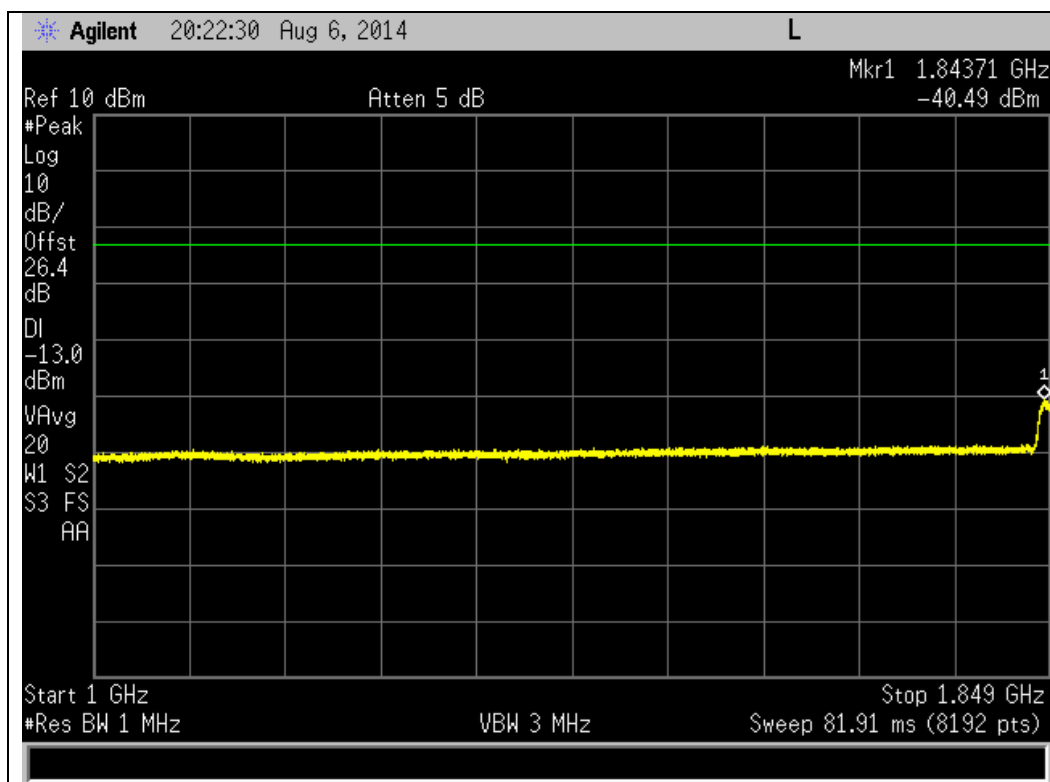
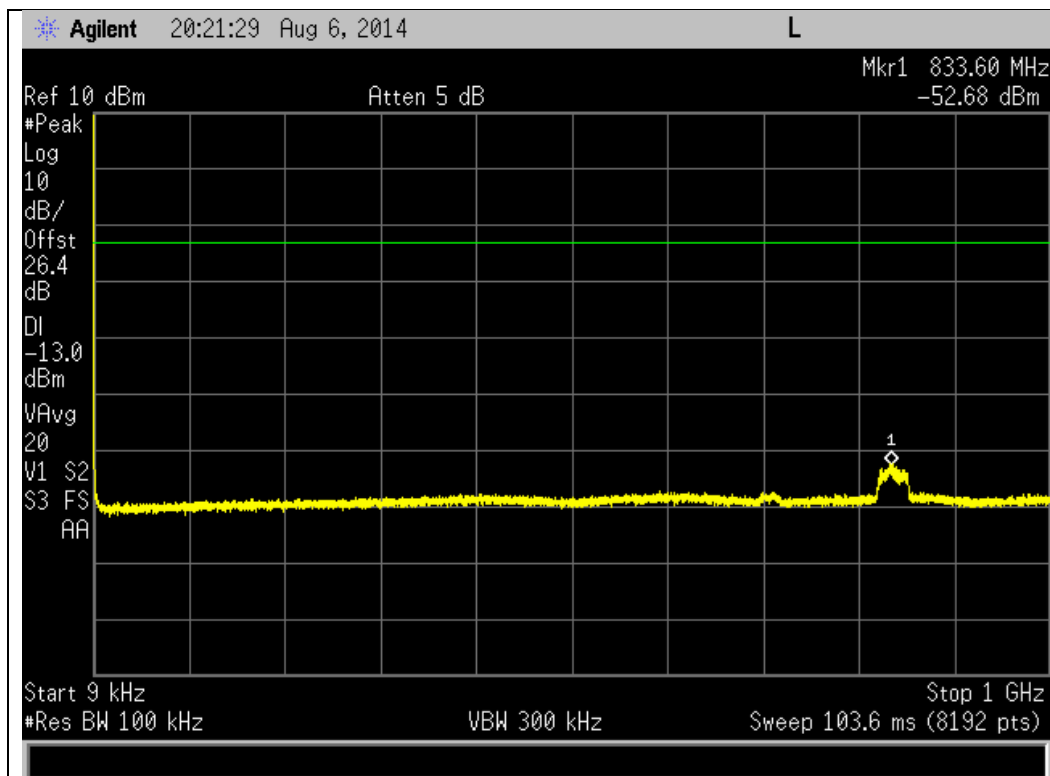
## 824 - 849 MHz Band





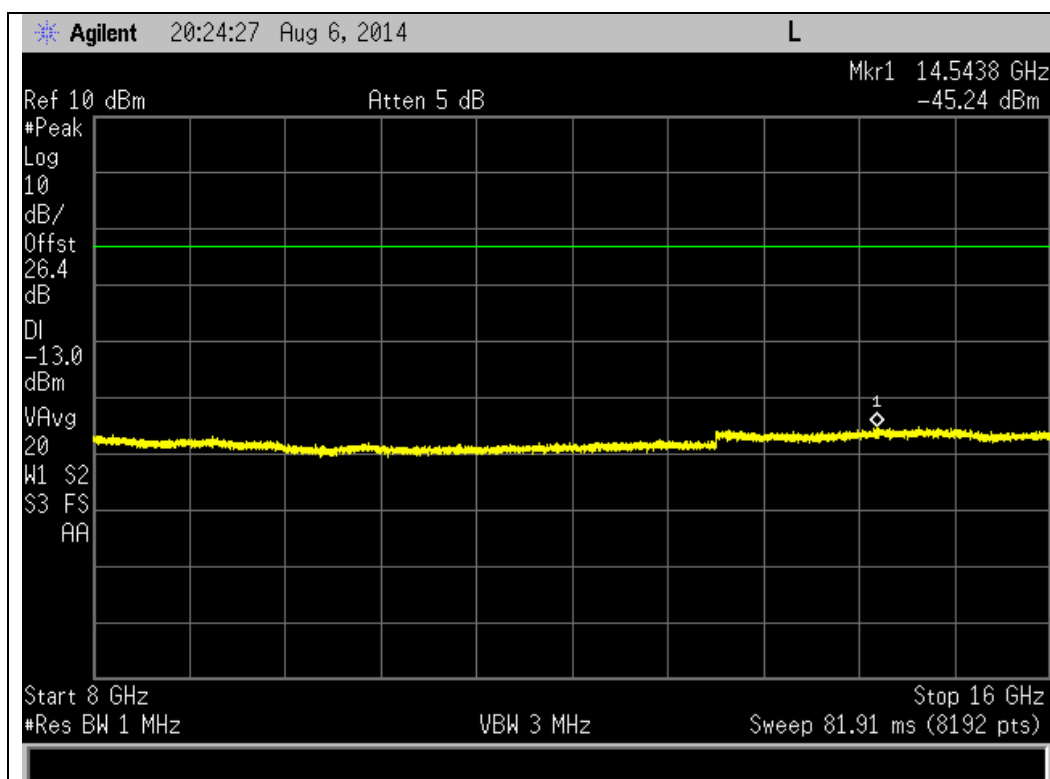
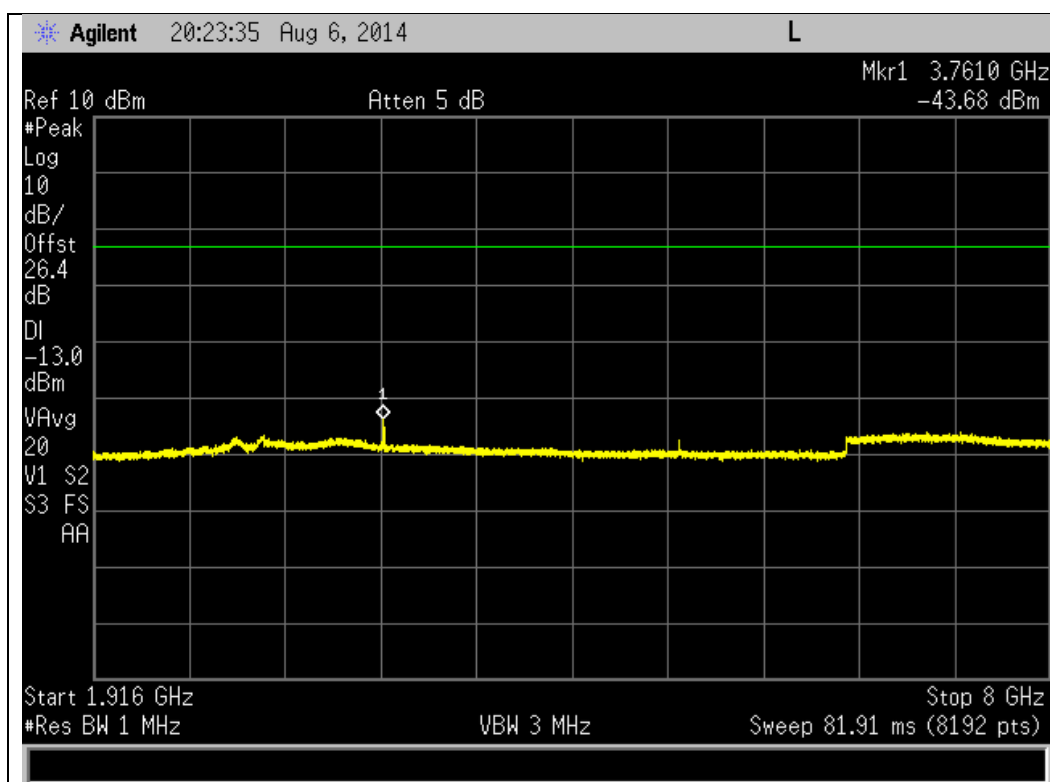


# 1850 - 1910 MHz Band



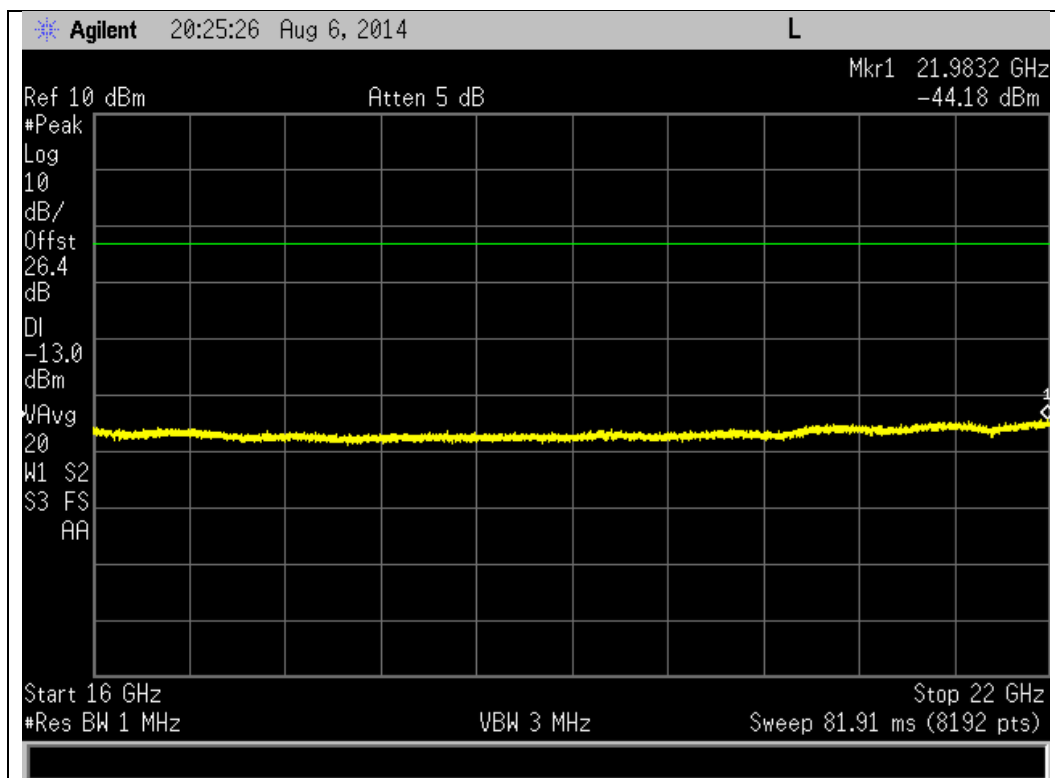


# 1850 - 1910 MHz Band (cont)





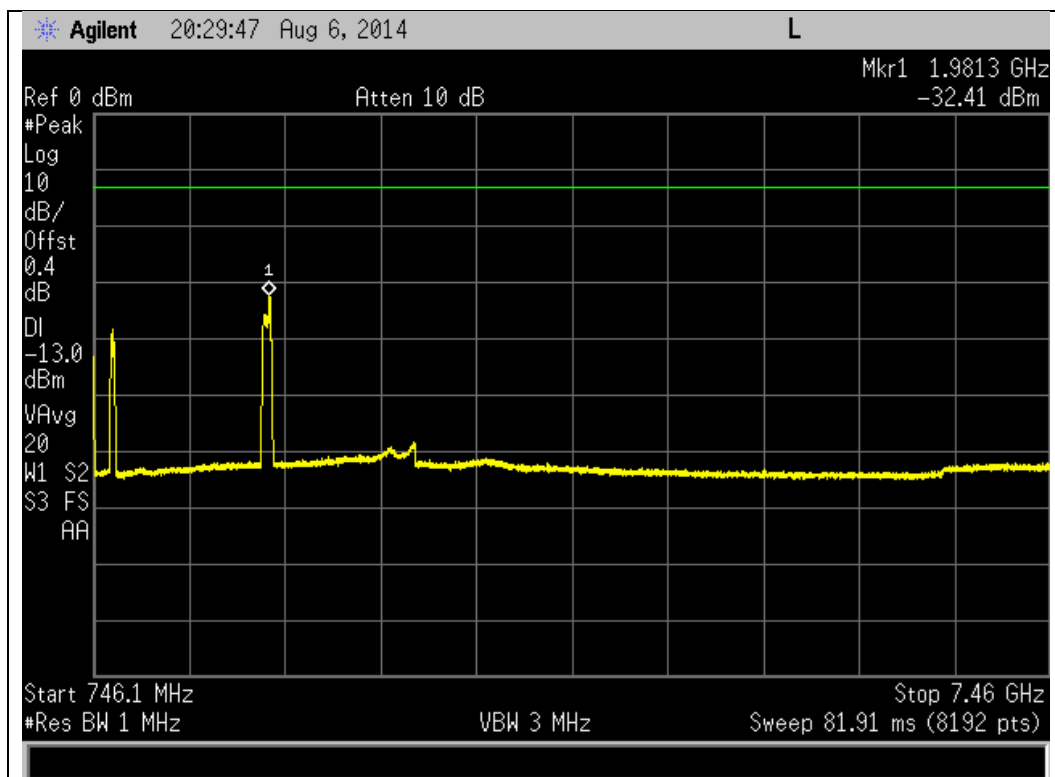
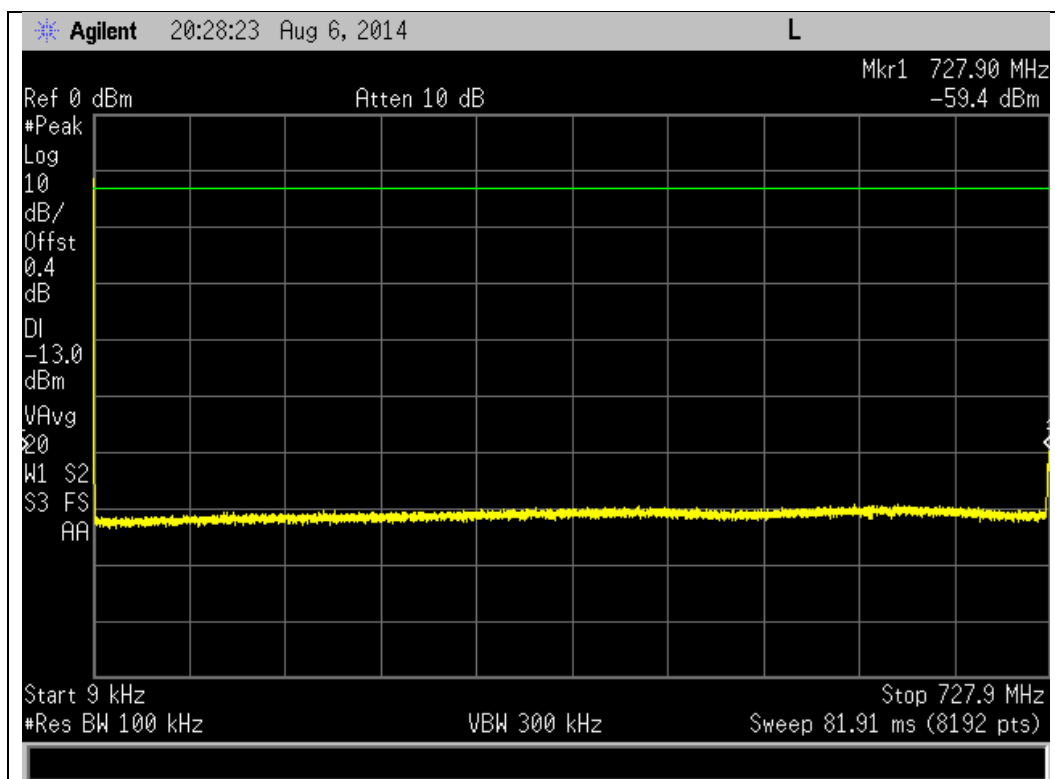
### 1850 - 1910 MHz Band (cont)





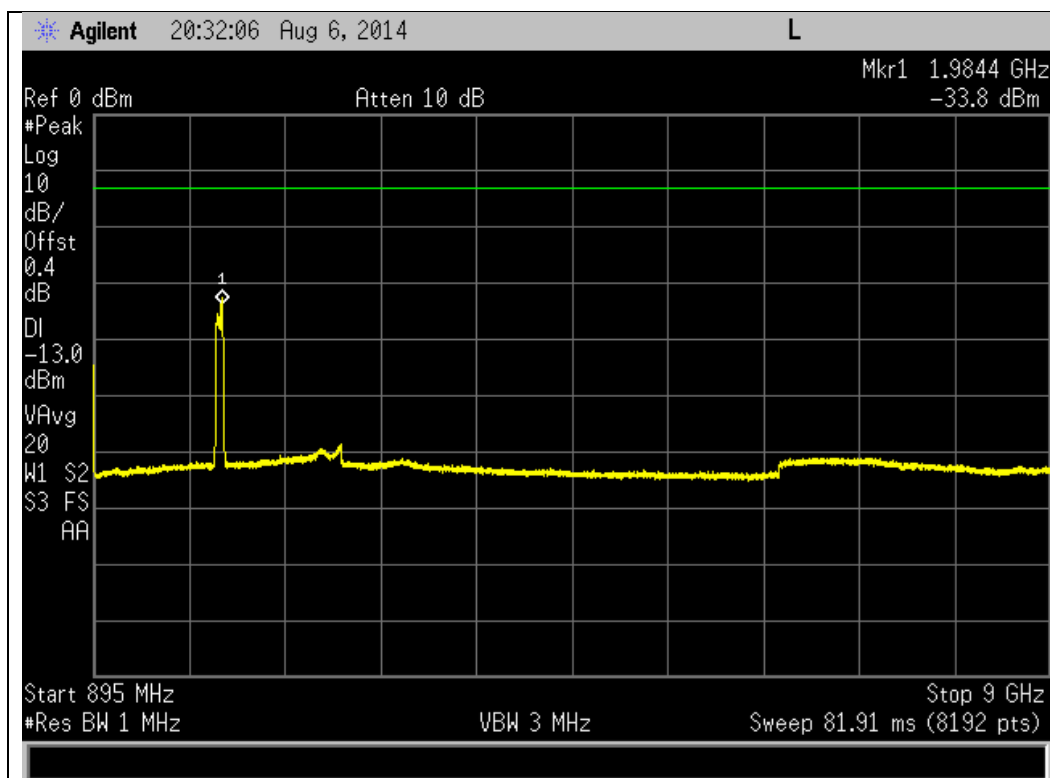
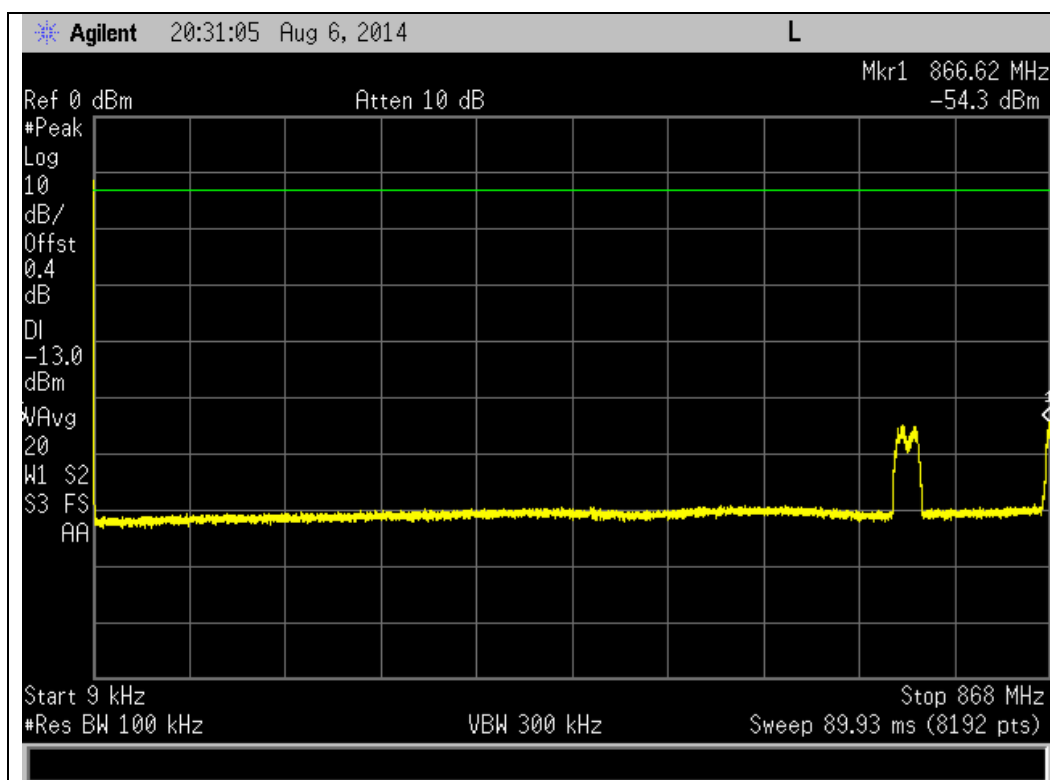
## Downlink Test Plots

### 728 - 746 MHz Band



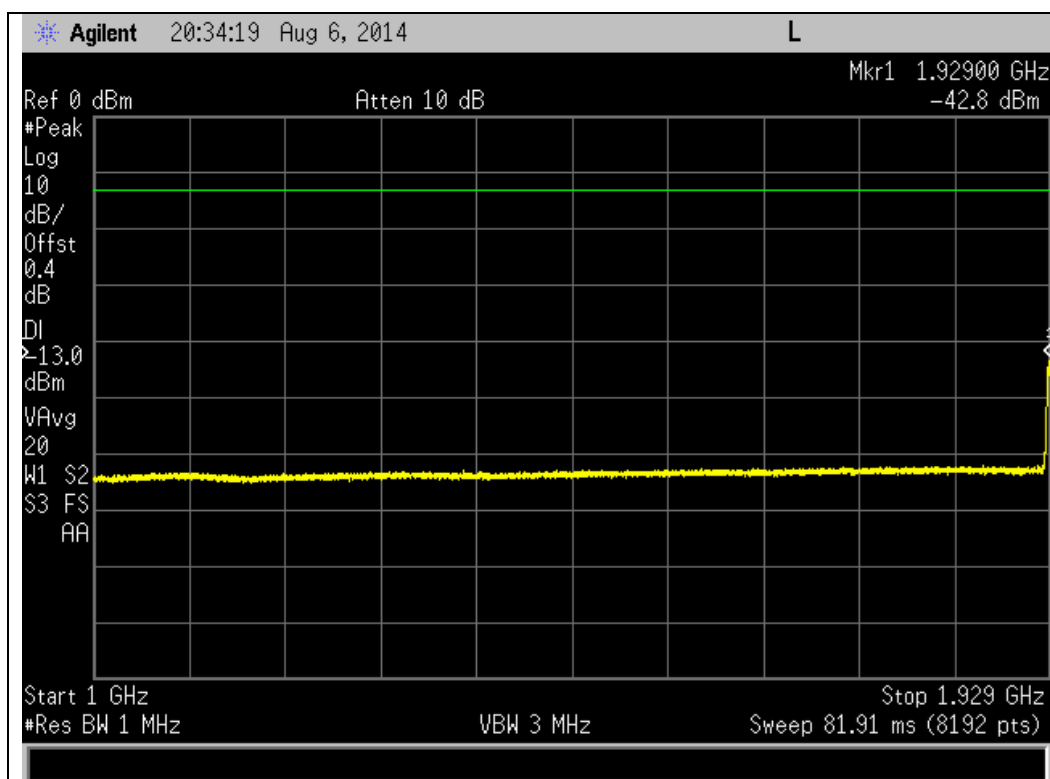
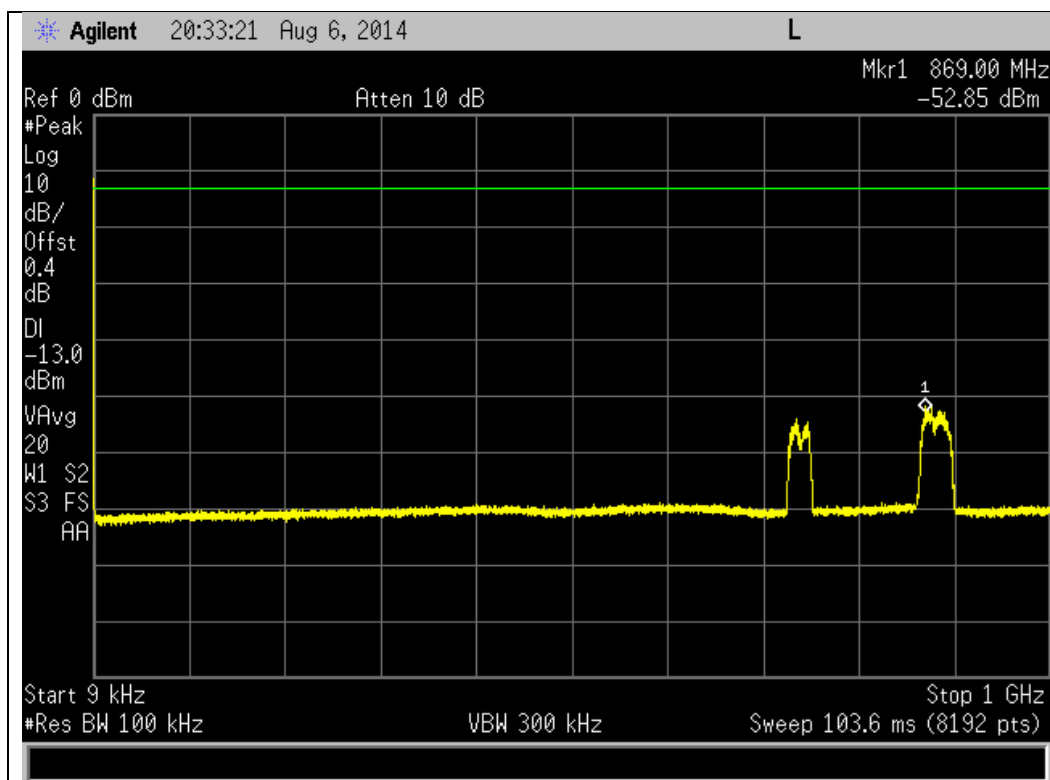


### 869 - 894 MHz Band



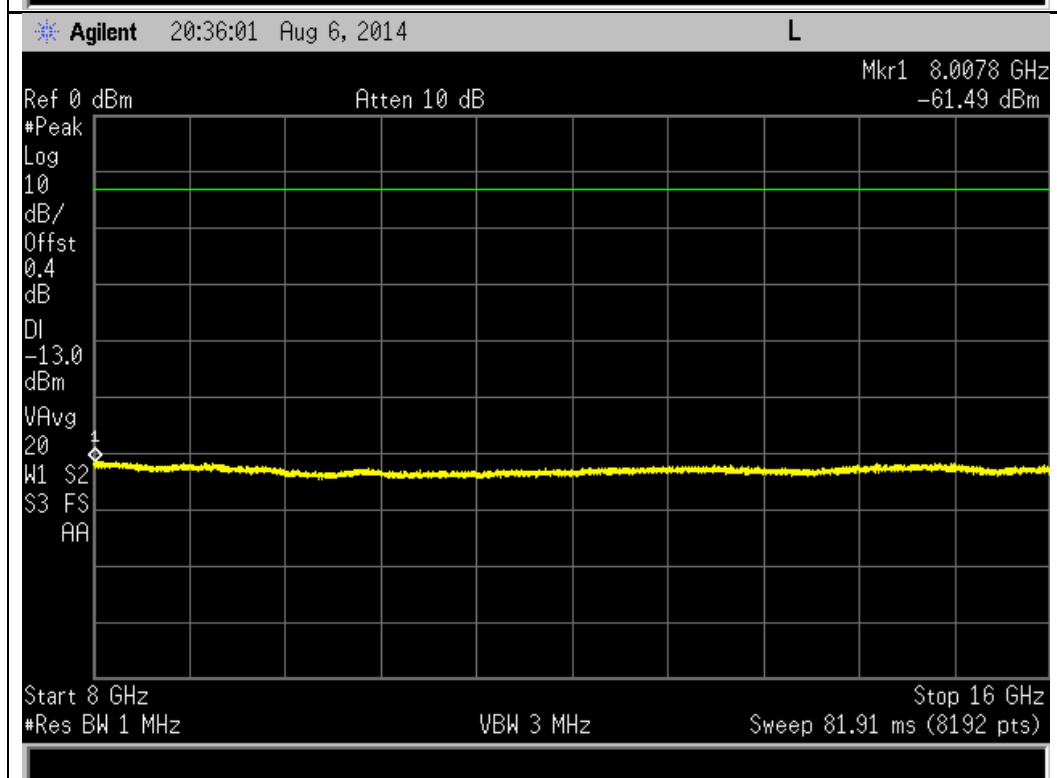
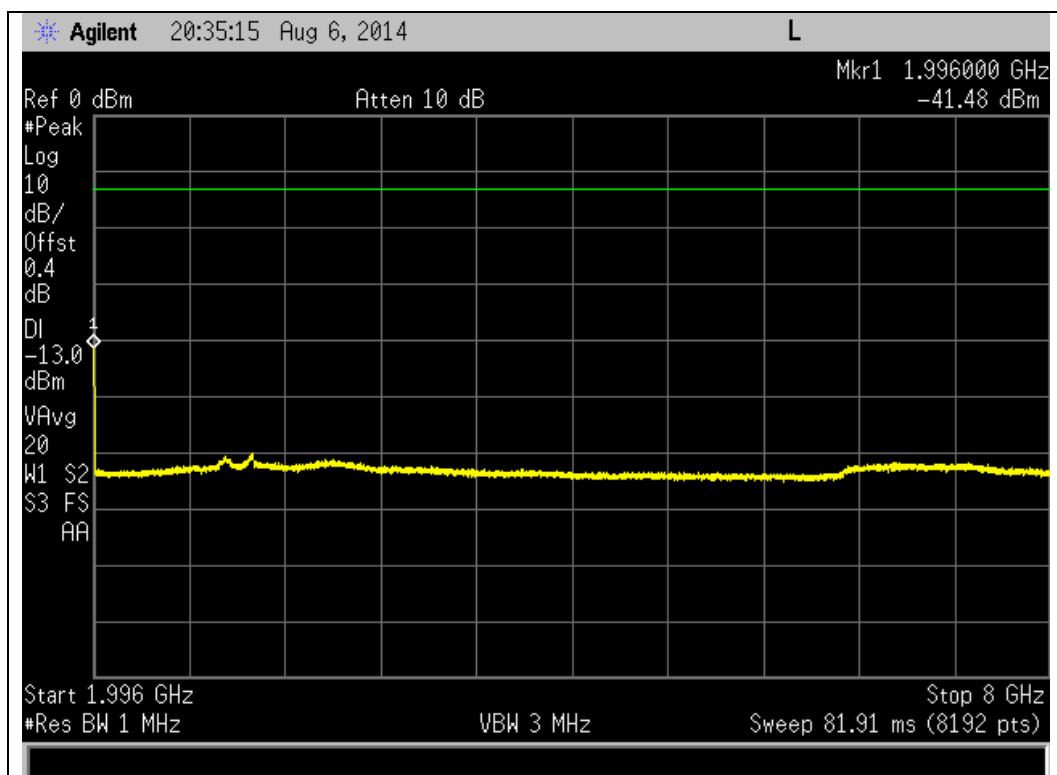


# 1930 - 1990 MHz Band



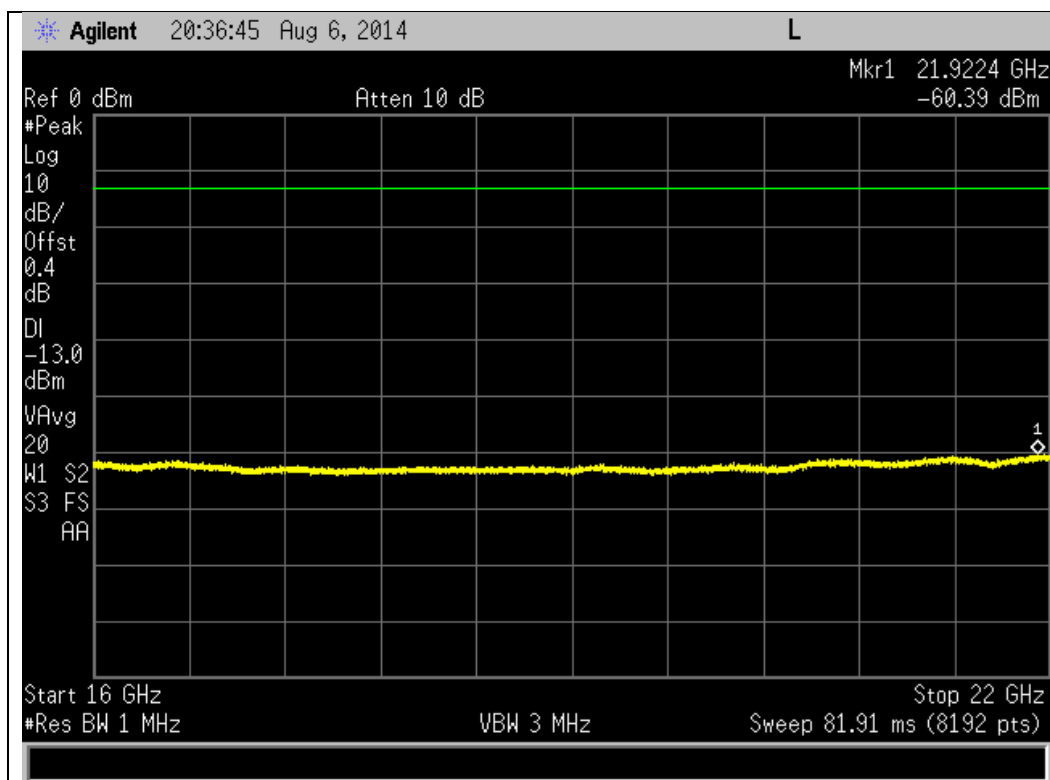


# 1930 - 1990 MHz Band (cont)





### 1930 - 1990 MHz Band (cont)







## Noise Limits

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

**Engineer:** Mike Graffeo  
**Test Date:** 7/29/14

## 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. A series of three tests were performed: the maximum uplink and downlink noise, the variable noise for the uplink and downlink in the presence of a downlink signal, and the variable uplink noise timing. 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 =  $-102.5 + \text{LOG}_{10}(\text{Band Center Frequency}) * 20$

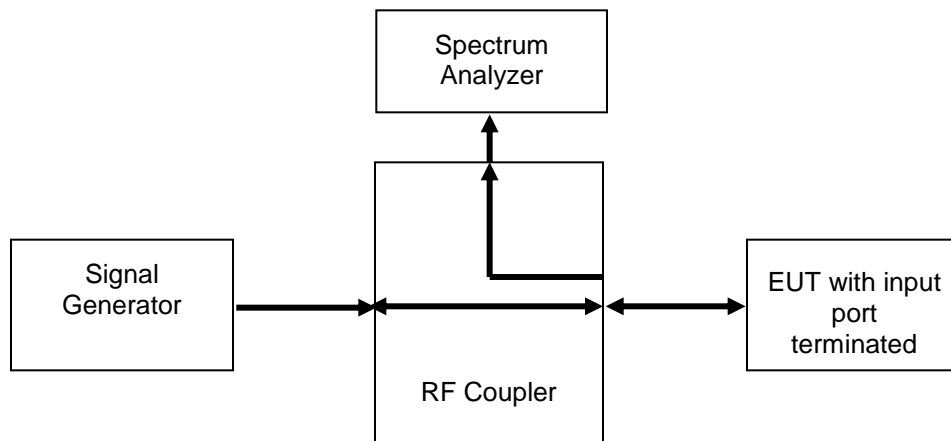
Variable Noise =  $-103 \text{ dBm/MHz-RSSI}$

## 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	-45.89	-45.5	-0.4	Pass
824 - 849	-45.64	-44.1	-1.5	Pass
1850 - 1910	-43.93	-37.0	-6.9	Pass

### Maximum Downlink Noise Test Results

Frequency Band (MHz)	Measured Noise (dBm)	Limit (dBm)	Margin (dB)	Result
728 - 746	-46.2	-45.5	-0.7	Pass
869 - 894	-45.01	-44.1	-0.9	Pass
1930 - 1990	-37.88	-37.0	-0.9	Pass

### Uplink Noise Timing Test Results

Frequency Band (MHz)	Measured Timing (mS)	Limit (mS)	Result
698 - 716	122.70	3000	Pass
824 - 849	49.09	3000	Pass
1850 - 1910	49.09	3000	Pass



## Variable Uplink Noise Limit Test Results

### 698 - 716 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-58.0	-45.5	-50.0	-4.5
-57.0	-46.0	-50.0	-4.0
-56.0	-47.0	-51.0	-4.0
-55.0	-48.0	-52.0	-4.0
-59.0	-45.5	-49.5	-4.0
-69.0	-45.5	-48.5	-3.0

### 824 - 849 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-55.0	-48.0	-54.2	-6.2
-54.0	-49.0	-55.2	-6.2
-46.0	-57.0	-63.2	-6.2
-52.0	-51.0	-57.0	-6.0
-60.0	-44.0	-50.0	-6.0
-45.0	-58.0	-63.2	-5.2

### 1850 - 1910 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-45.0	-58.0	-66	-8.0
-44.0	-59.0	-67	-8.0
-43.0	-60.0	-67	-7.0
-42.0	-61.0	-67	-6.0
-41.0	-62.0	-67	-5.0
-40.0	-63.0	-67	-4.0



## Variable Downlink Noise Limit Test Results

### 728 - 746 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-55.0	-48.0	-50.0	-2.0
-54.0	-49.0	-51.0	-2.0
-53.0	-50.0	-52.0	-2.0
-52.0	-51.0	-53.0	-2.0
-51.0	-52.0	-54.0	-2.0
-58.0	-45.5	-47.0	-1.5

### 869 - 894 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-48.0	-55.0	-57.5	-2.5
-45.0	-58.0	-60.2	-2.2
-49.0	-54.0	-56.0	-2.0
-44.0	-59.0	-61.0	-2.0
-43.0	-60.0	-61.2	-1.2
-42.0	-61.0	-62.0	-1.0

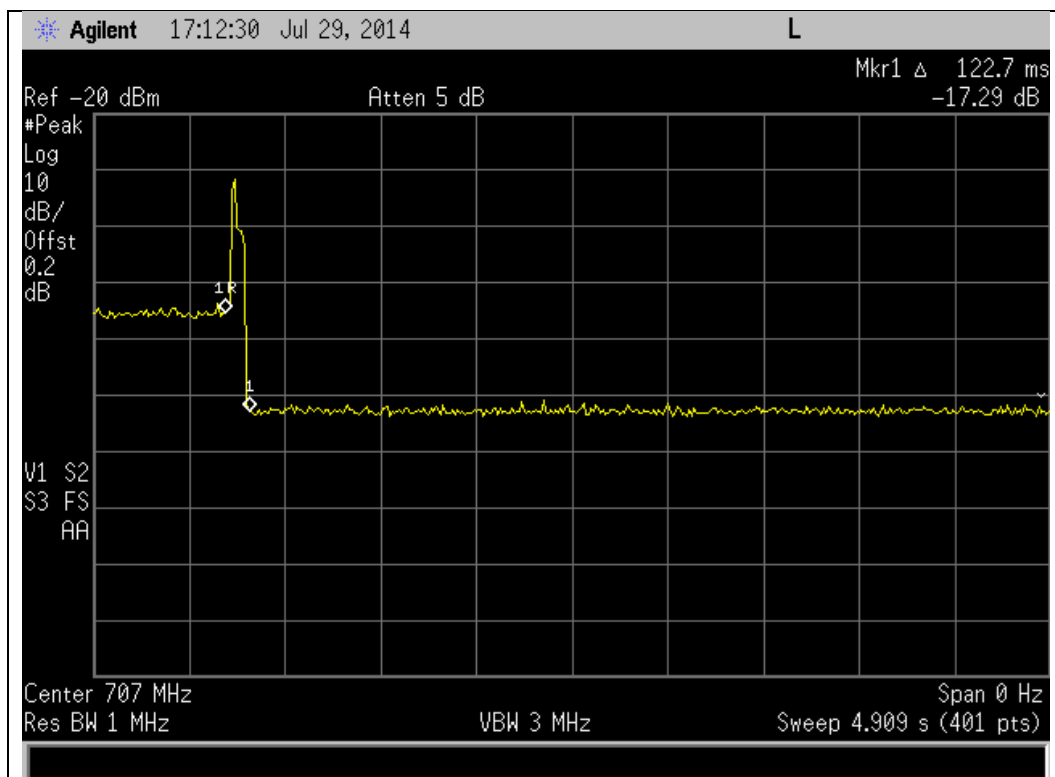
### 1930 - 1990 MHz

RSSI (dBm)	Noise Limit (dBm)	Measured Noise (dBm)	Margin (dB)
-46.0	-57.0	-59.3	-2.3
-48.0	-55.0	-57.2	-2.2
-49.0	-54.0	-56.0	-2.0
-47.0	-56.0	-58.0	-2.0
-44.0	-59.0	-60.9	-1.9
-62.0	-41.0	-42.0	-1.0

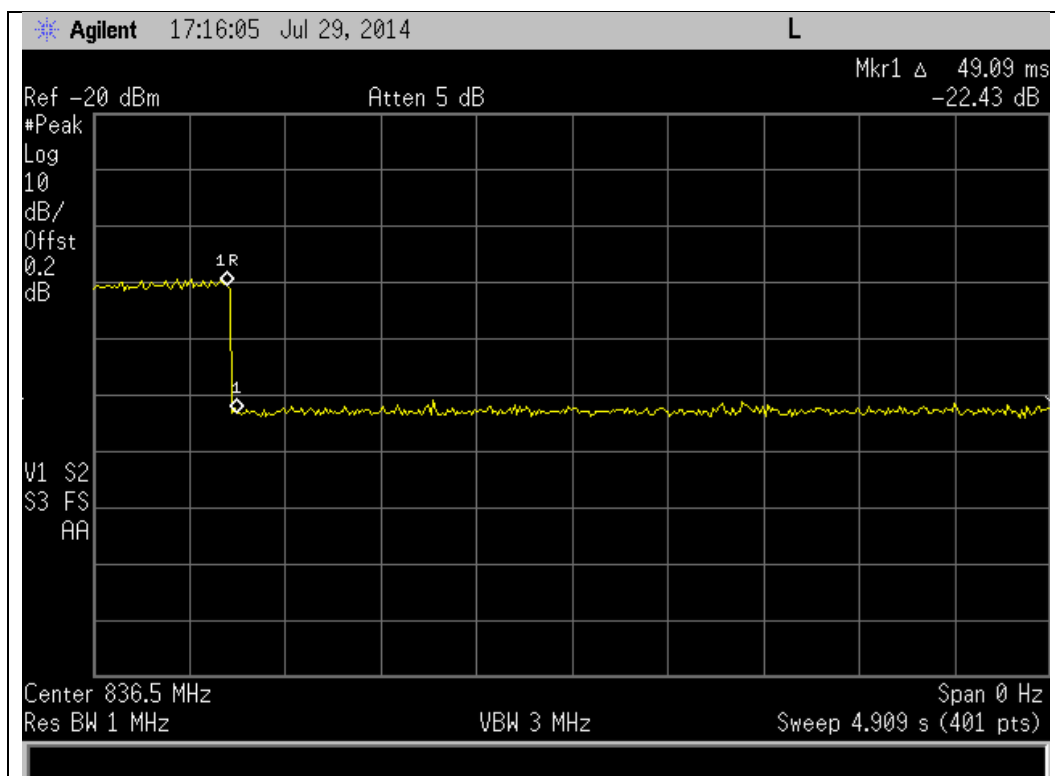


## Uplink Noise Test Plots

### 698 - 716 MHz Band

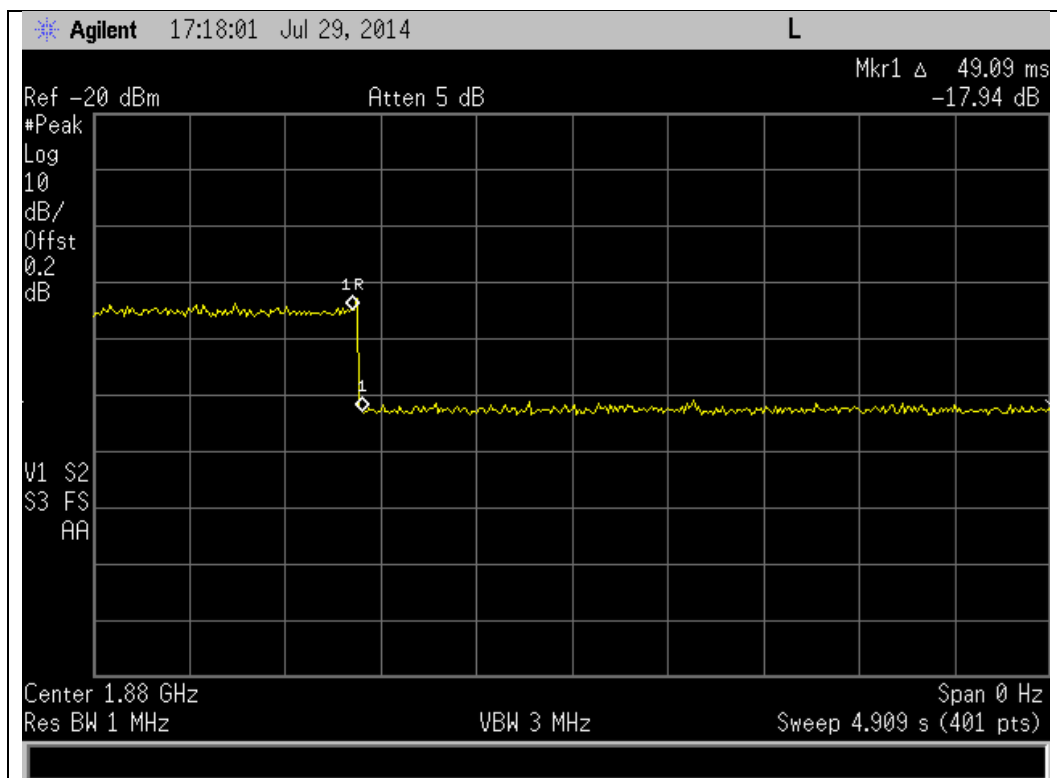


### 824 - 849 MHz Band





# 1850 - 1910 MHz Band





## Uplink Inactivity

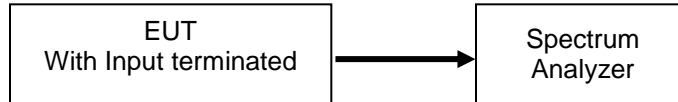
**Name of Test:** Uplink Inactivity  
**Test Equipment Utilized:** i00379

**Engineer:** Mike Graffeo  
**Test Date:** 7/31/14

### 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 to ensure that it was less than 300 seconds. The noise level after the return to an inactive state was less than -70 dBm/MHz.

### Test Setup



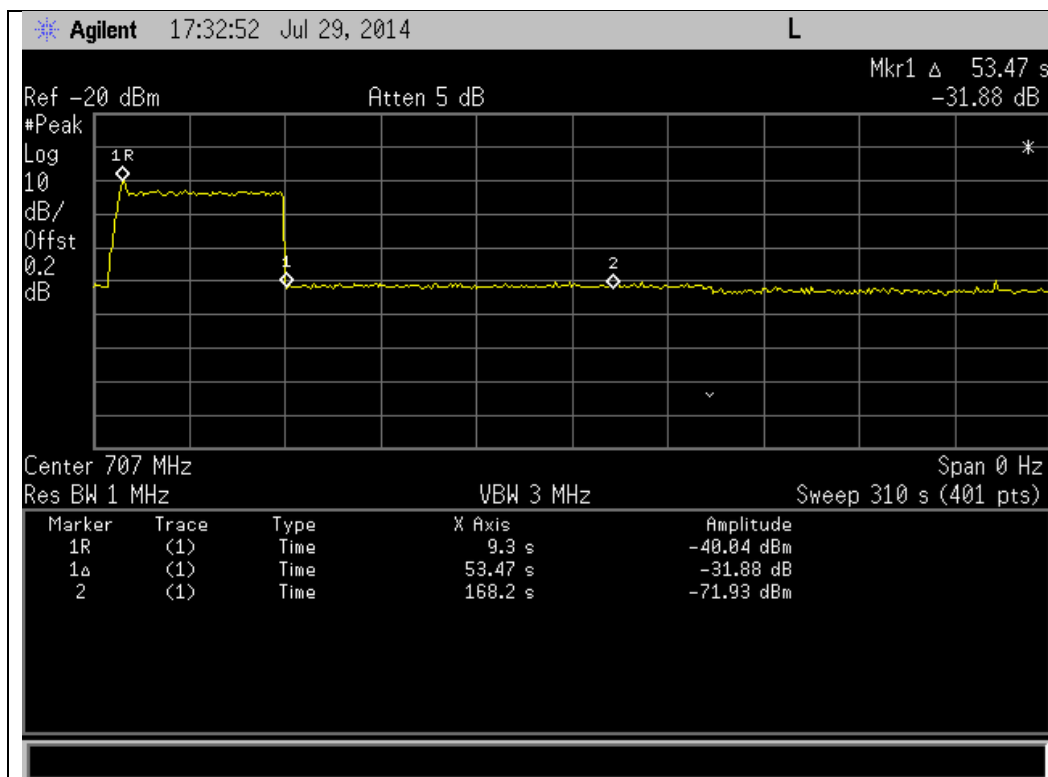
### Uplink Test Results

Frequency Band (MHz)	Measured Time (Seconds)	Limit (Seconds)	Result
698 - 716	53.47	300	Pass
824 - 849	51.15	300	Pass
1850 - 1910	51.15	300	Pass

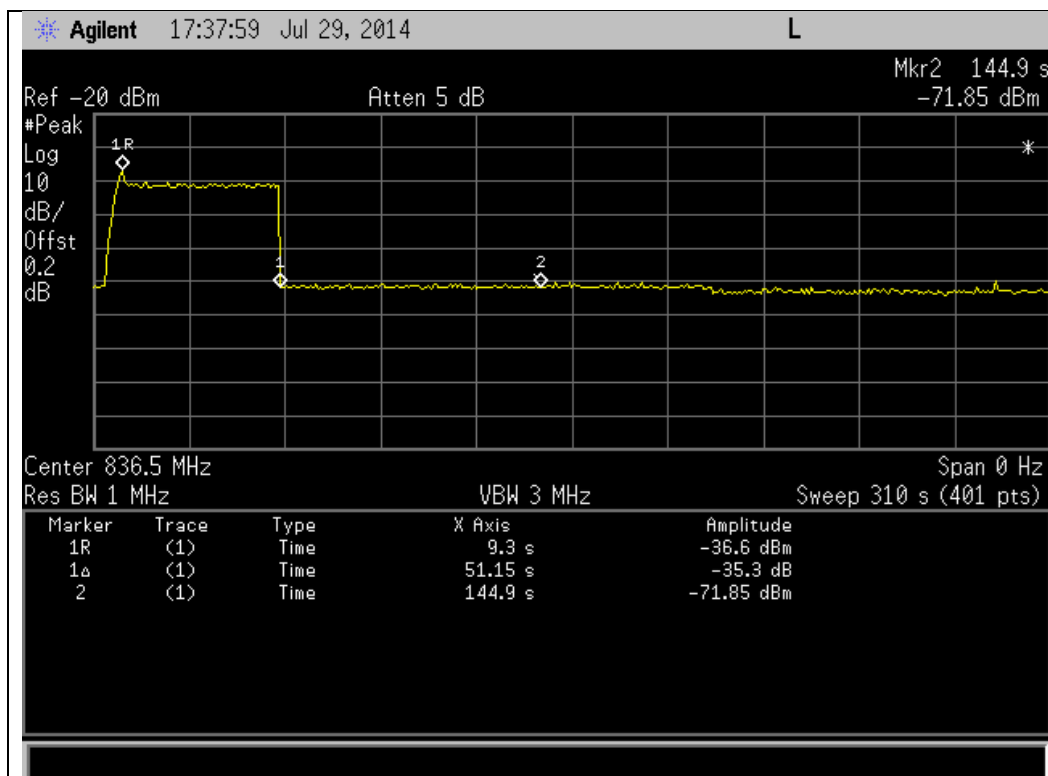


## Uplink Inactivity Test Results

698 - 716 MHz



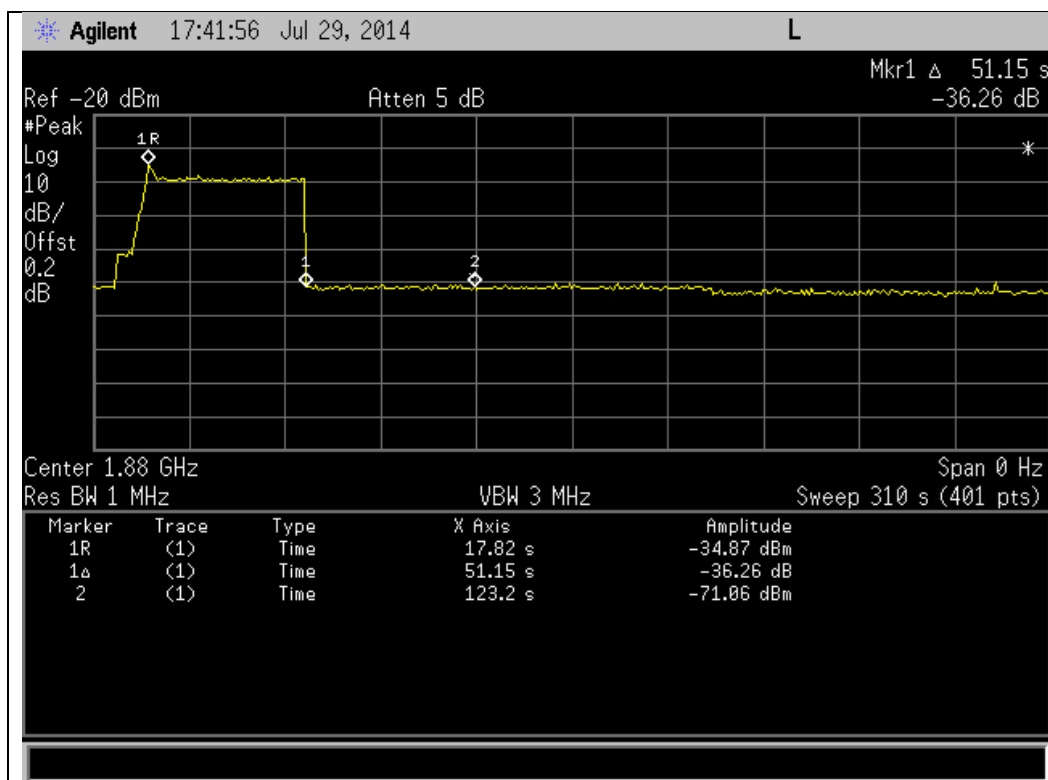
824 - 849 MHz







# 1850 - 1910 MHz





## Variable Gain

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

**Engineer:** Mike Graffeo  
**Test Date:** 7/31/14

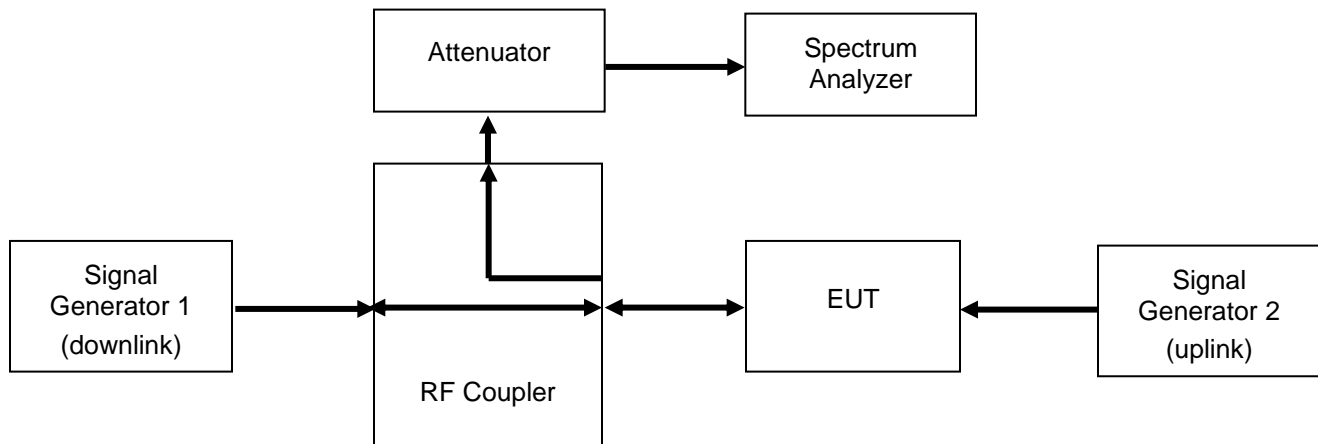
### Test Procedure

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

### 698 - 716 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-59	36.0	61.0	-45.8	8.0	53.8	-7.2
-58	36.0	60.0	-45.8	7.0	52.8	-7.2
-57	36.0	59.0	-45.8	6.0	51.8	-7.2
-56	36.0	58.0	-45.8	5.0	50.8	-7.2
-55	36.0	57.0	-45.8	4.0	49.8	-7.2
-54	36.0	56.0	-45.8	3.0	48.8	-7.2

### 824 - 849 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-60	36.0	62.0	-46.9	12.5	59.4	-2.6
-59	36.0	61.0	-46.9	11.5	58.4	-2.6
-58	36.0	60.0	-46.9	10.5	57.4	-2.6
-57	36.0	59.0	-46.9	9.5	56.4	-2.6
-56	36.0	58.0	-46.9	8.5	55.4	-2.6
-55	36.0	57.0	-46.9	7.5	54.4	-2.6

### 1850 - 1910 MHz

RSSI (dBm)	MSCL (dB)	Gain Limit (dBm)	P(in) (dBm)	P(out) (dBm)	Gain (dB)	Margin (dB)
-58	39.0	63.0	-51.3	1.0	52.3	-10.7
-59	39.0	64.0	-51.3	2.3	53.6	-10.4
-62	39.0	67.0	-51.3	5.5	56.8	-10.2
-61	39.0	66.0	-51.3	4.5	55.8	-10.2
-60	39.0	65.0	-51.3	3.5	54.8	-10.2
-63	39.0	68.0	-51.3	6.6	57.9	-10.1

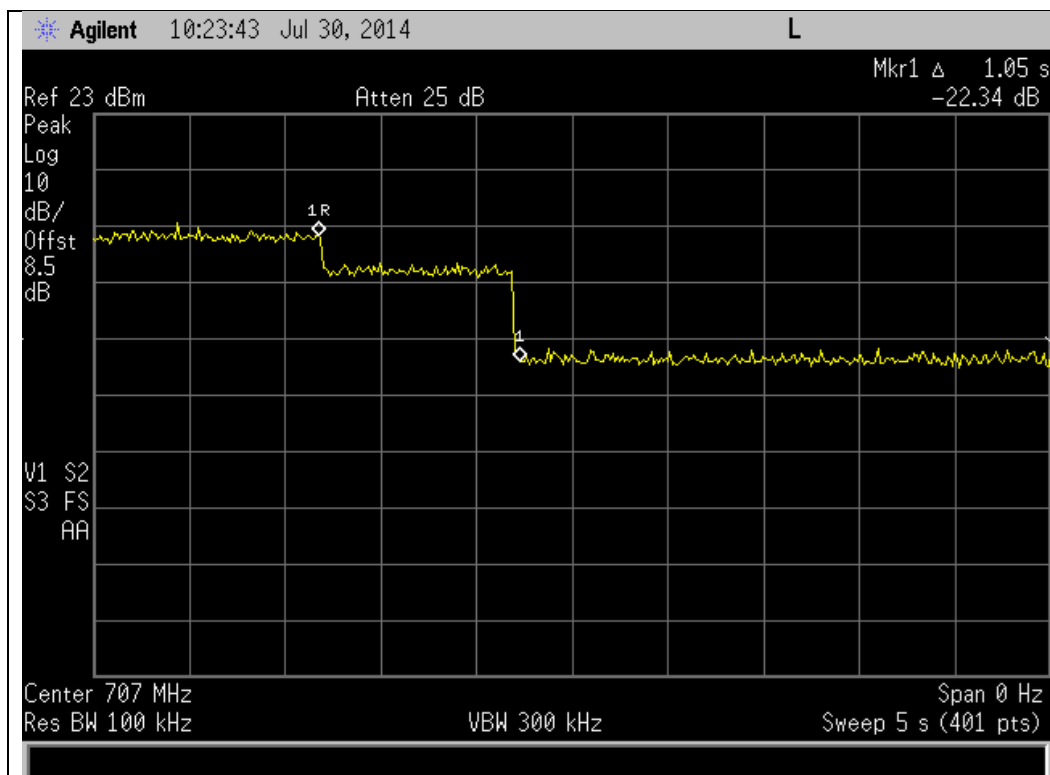
## Uplink Gain Timing Test Results

Frequency Band (MHz)	Measured Timing (Seconds)	Limit (Seconds)	Result
704 - 716	1.05	3.0	Pass
824 - 849	1.01	3.0	Pass
1850 - 1910	0.04	3.0	Pass

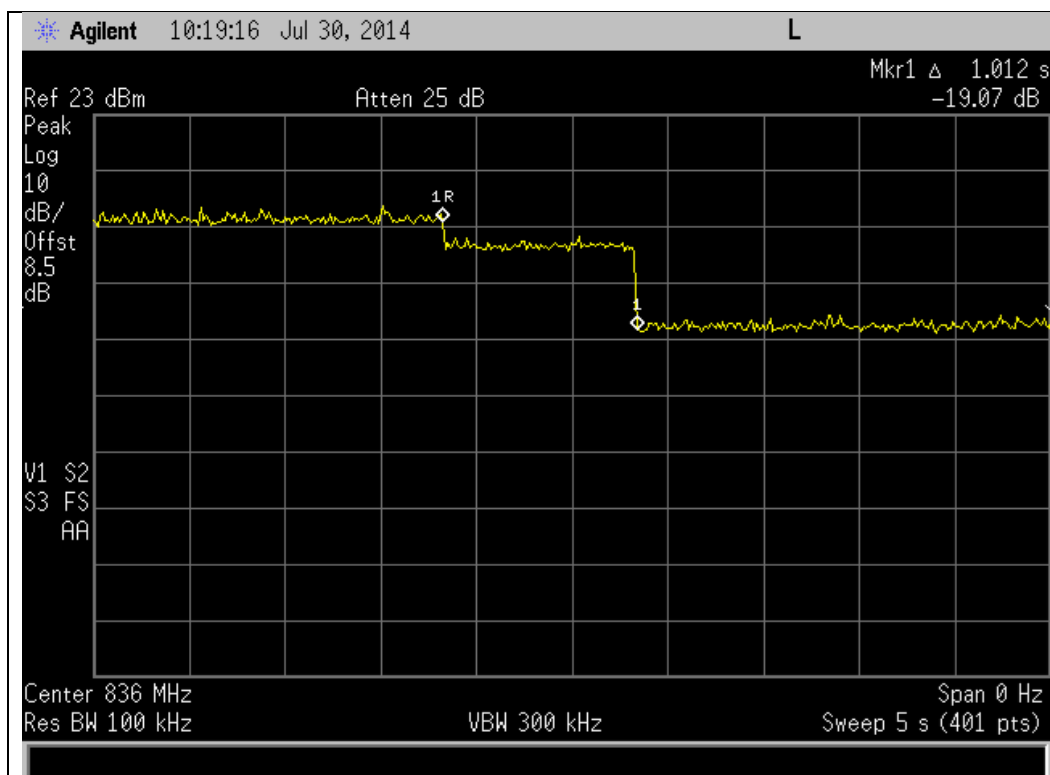


## Variable Gain Timing Test Plots

### 698 - 716 MHz Band

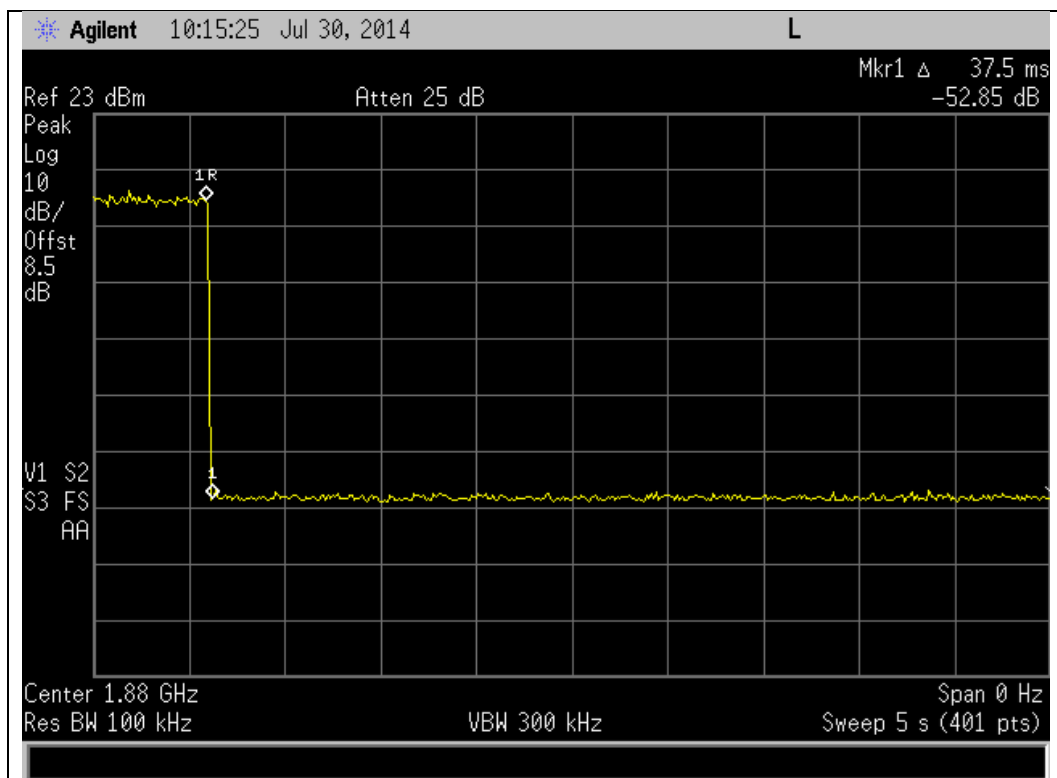


### 824 - 849 MHz Band





# 1850 - 1910 MHz Band





## Occupied Bandwidth

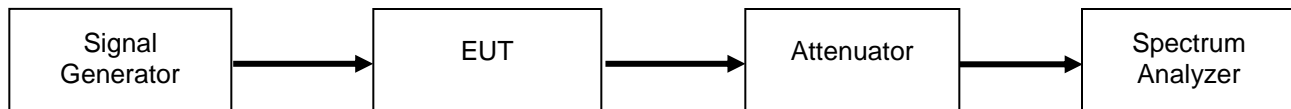
**Name of Test:** Occupied Bandwidth  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 8/4/14

## 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

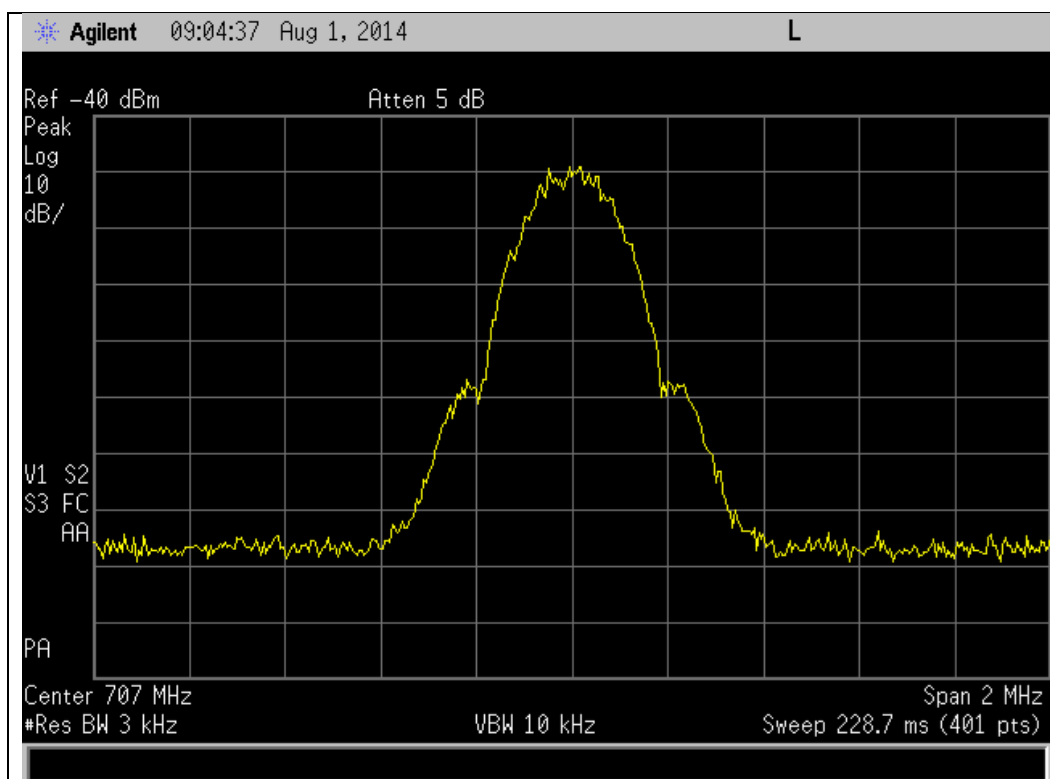




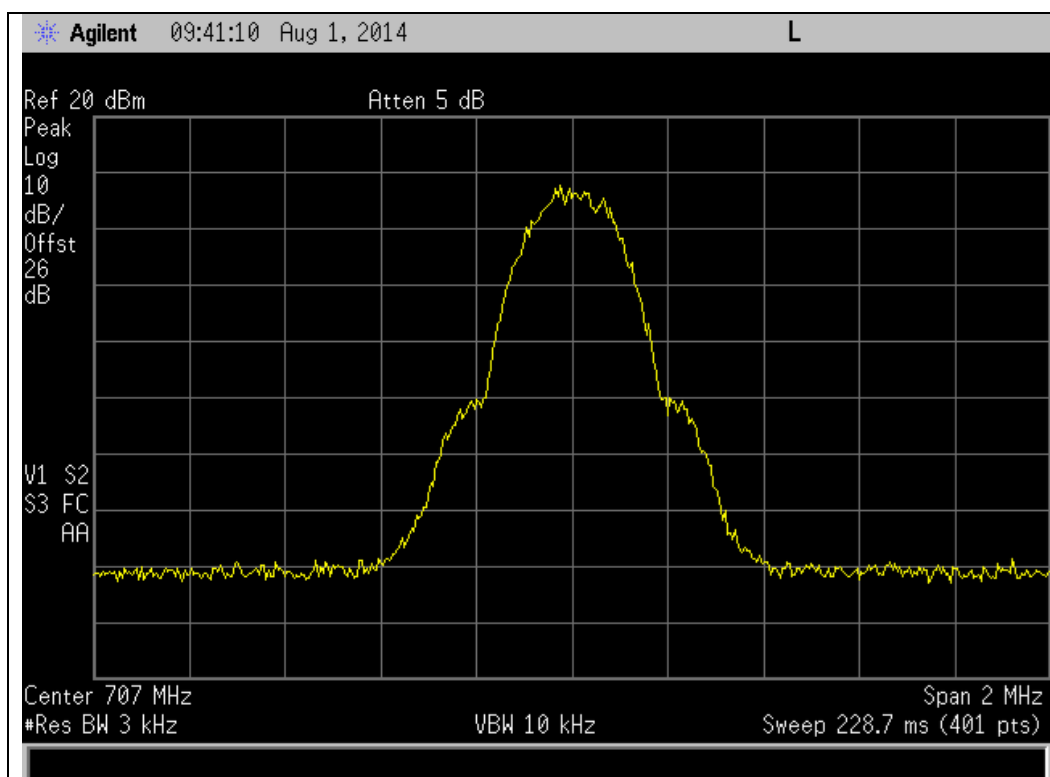
## GSM Uplink Test Plots

698 - 716 MHz Band

Input



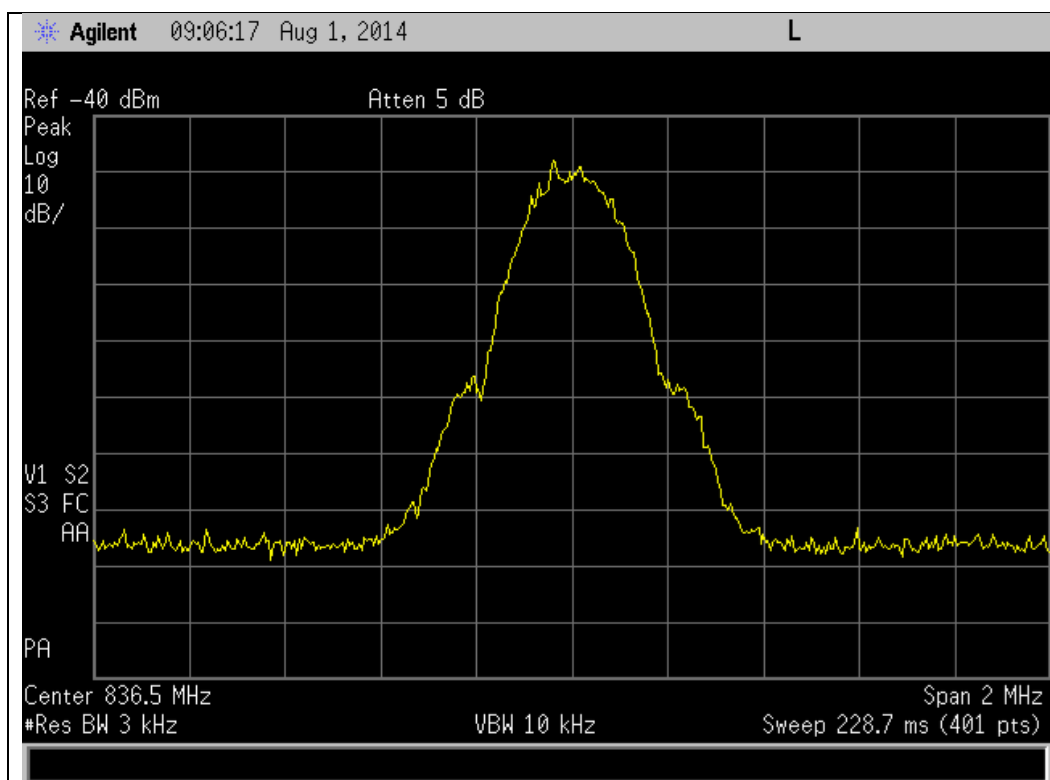
Output



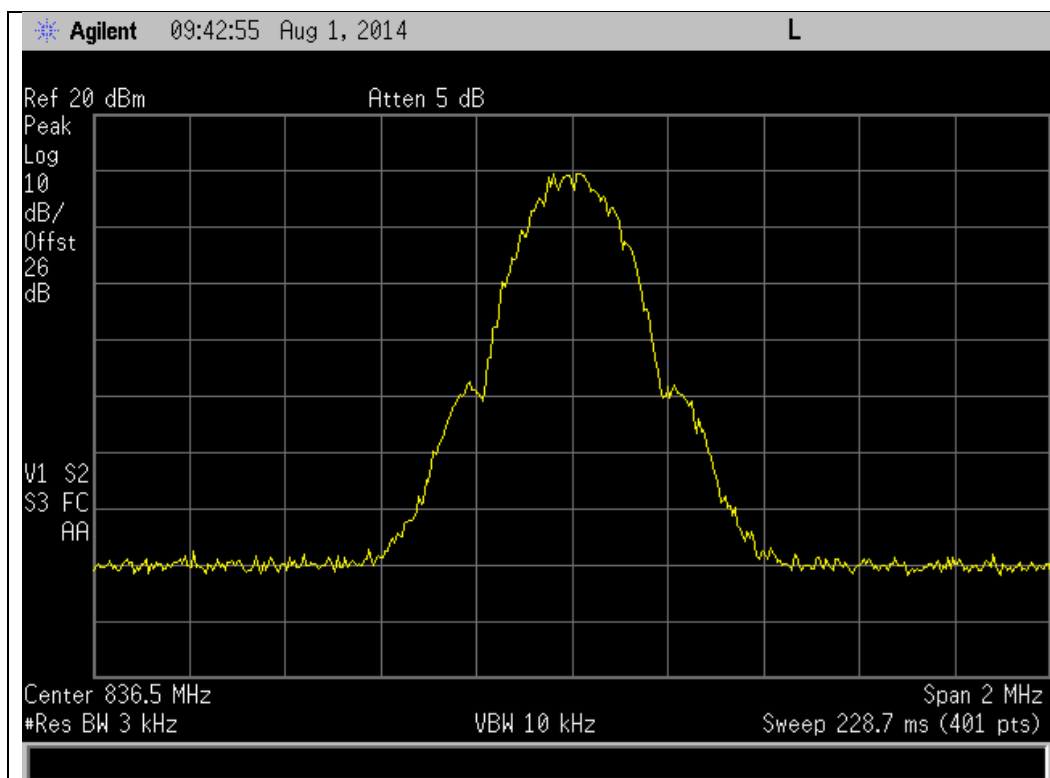


## 824 - 849 MHz Band

### Input



### Output

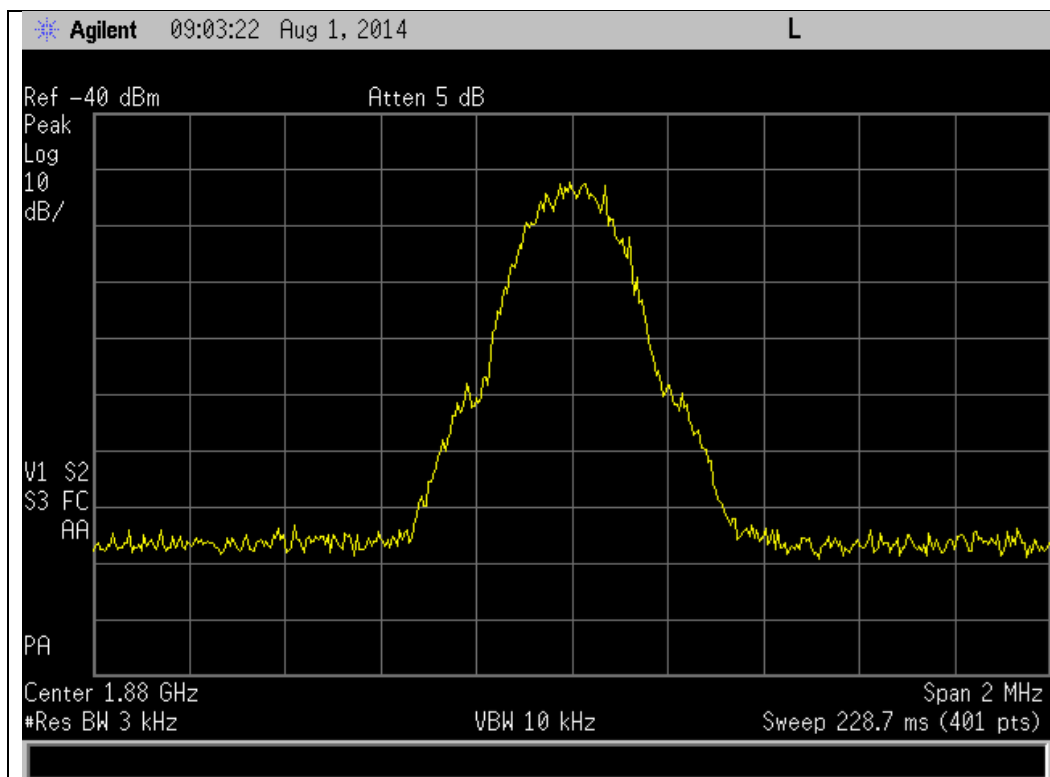




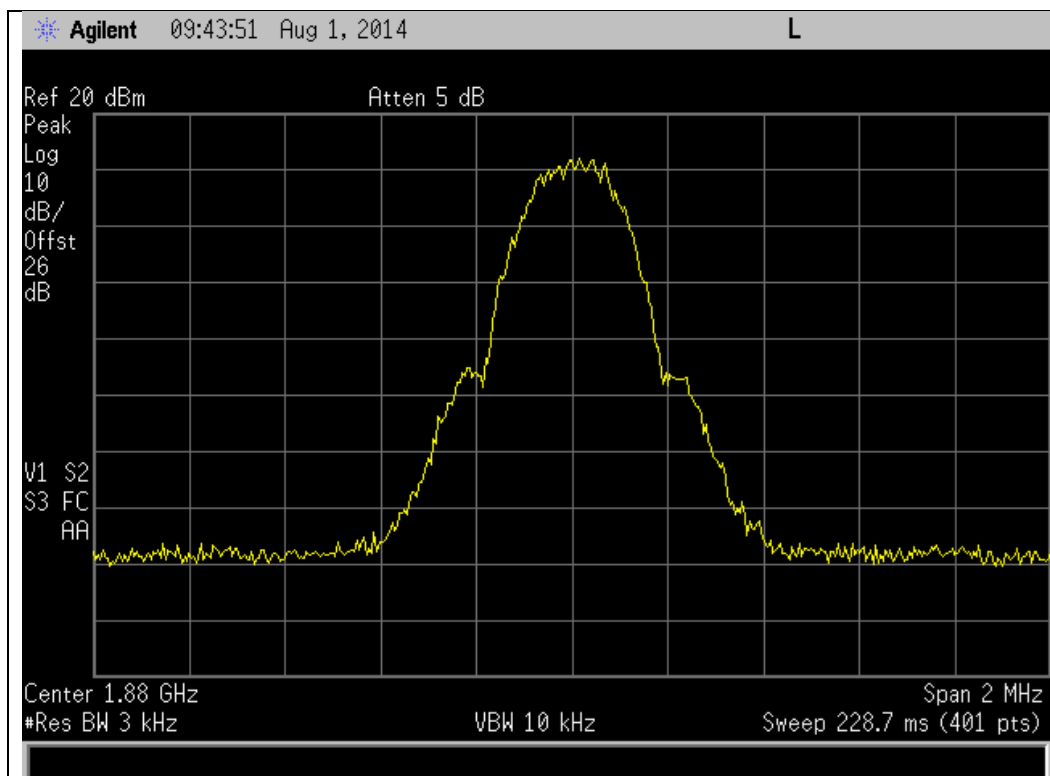


## 1850 - 1910 MHz Band

### Input



### Output

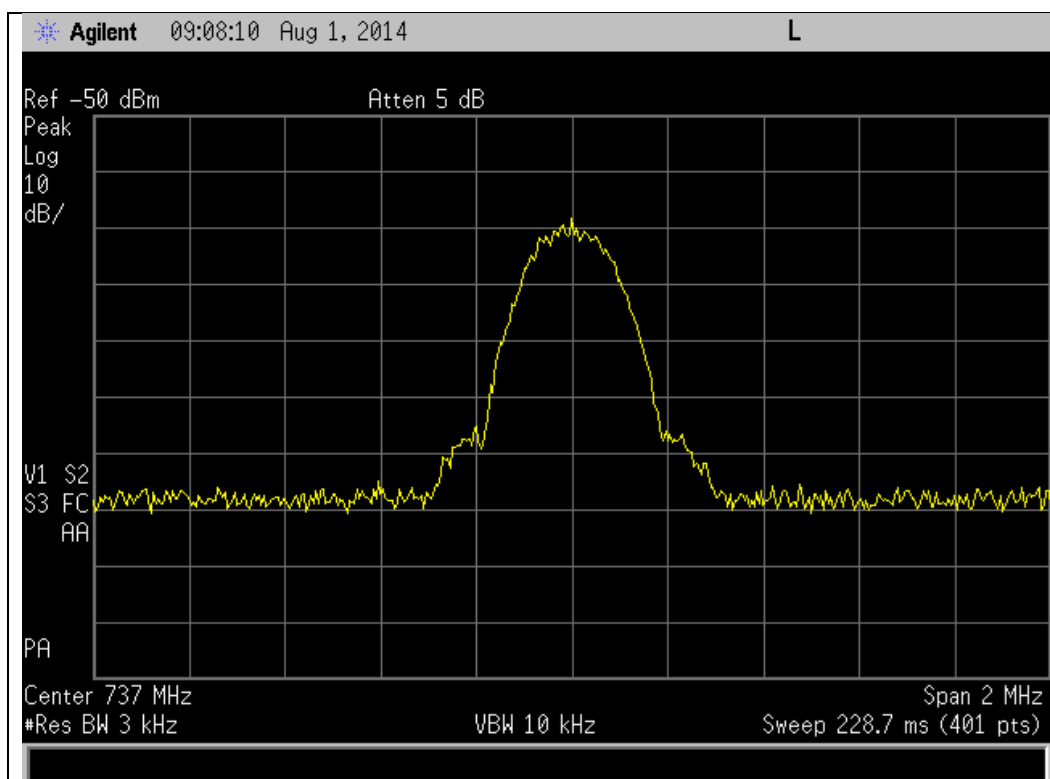




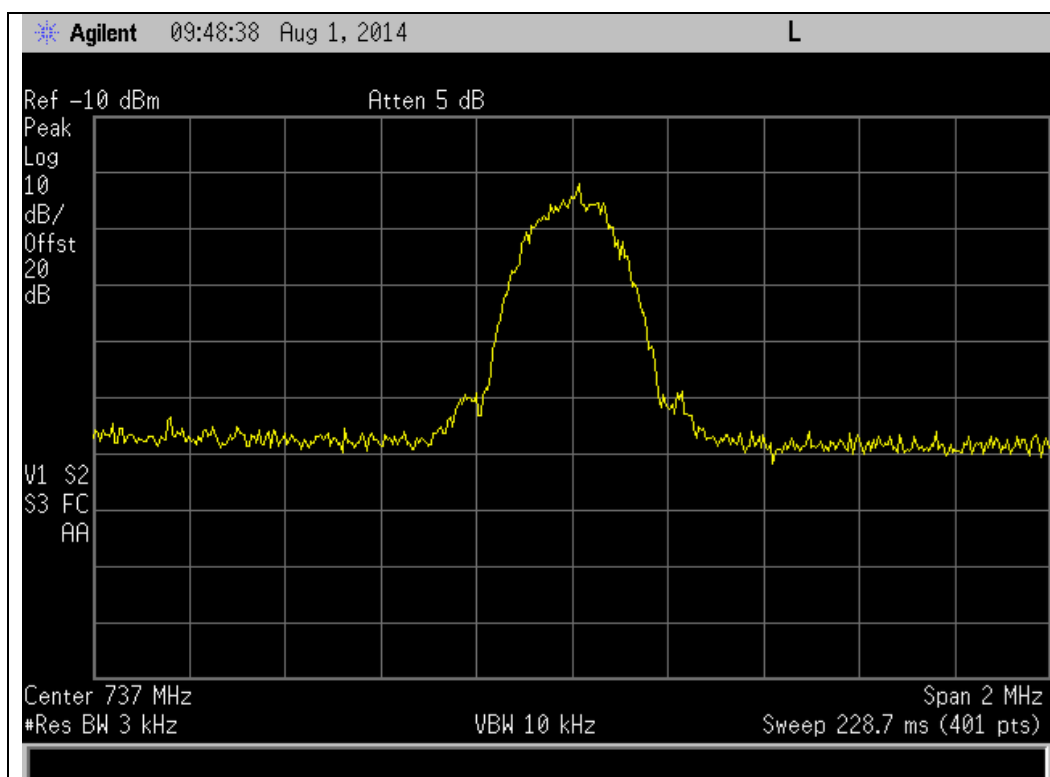
## GSM Downlink Test Plots

728 - 746 MHz Band

Input



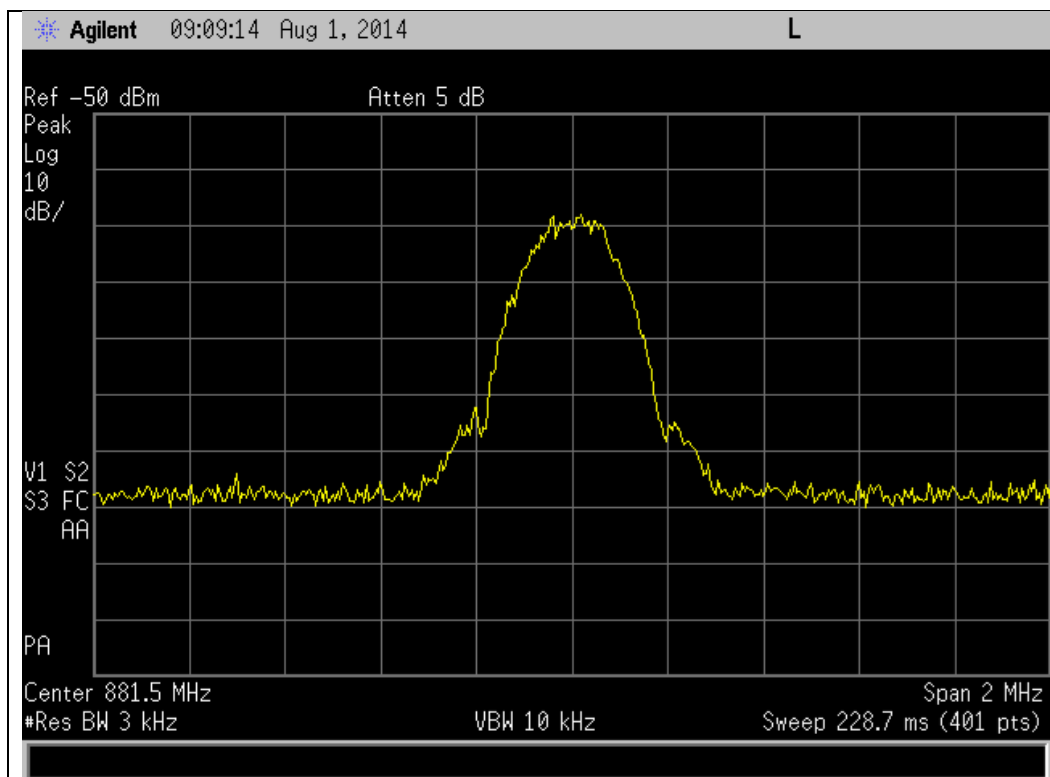
Output



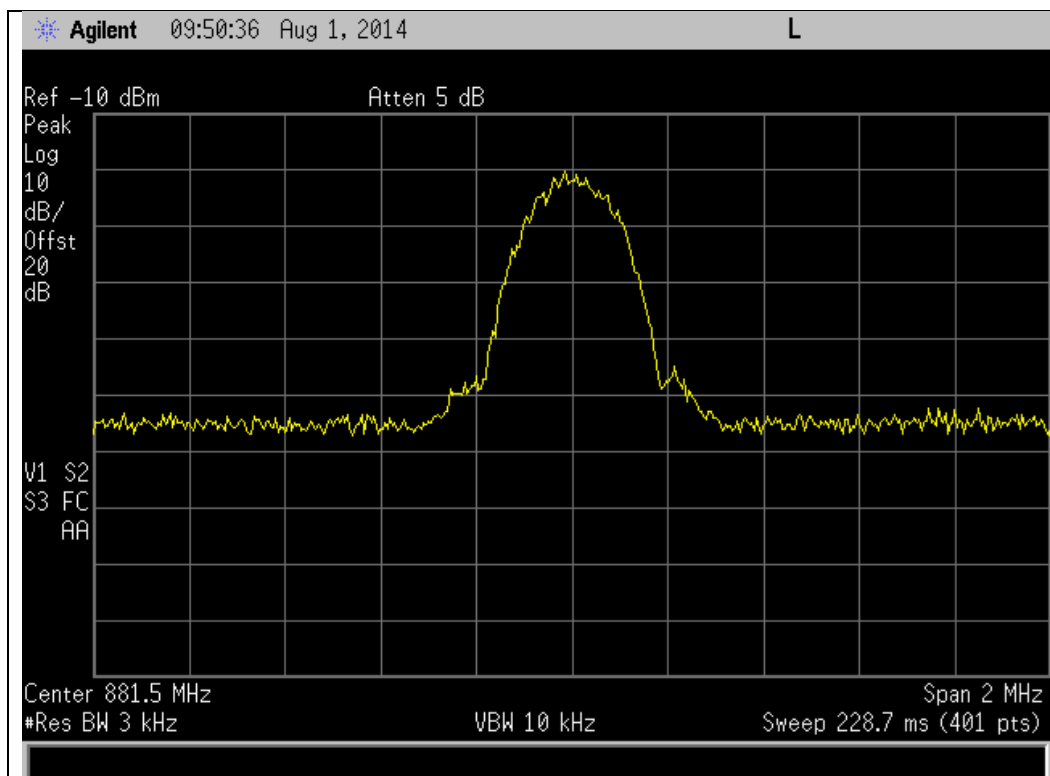


## 869 - 894 MHz Band

### Input



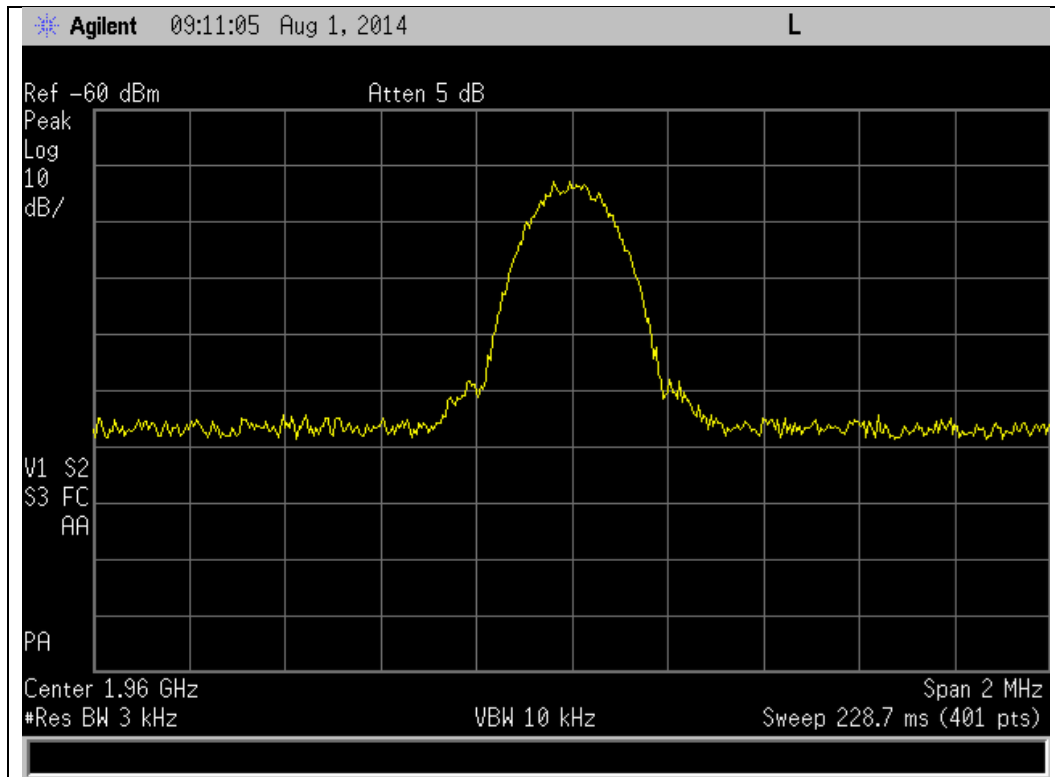
### Output



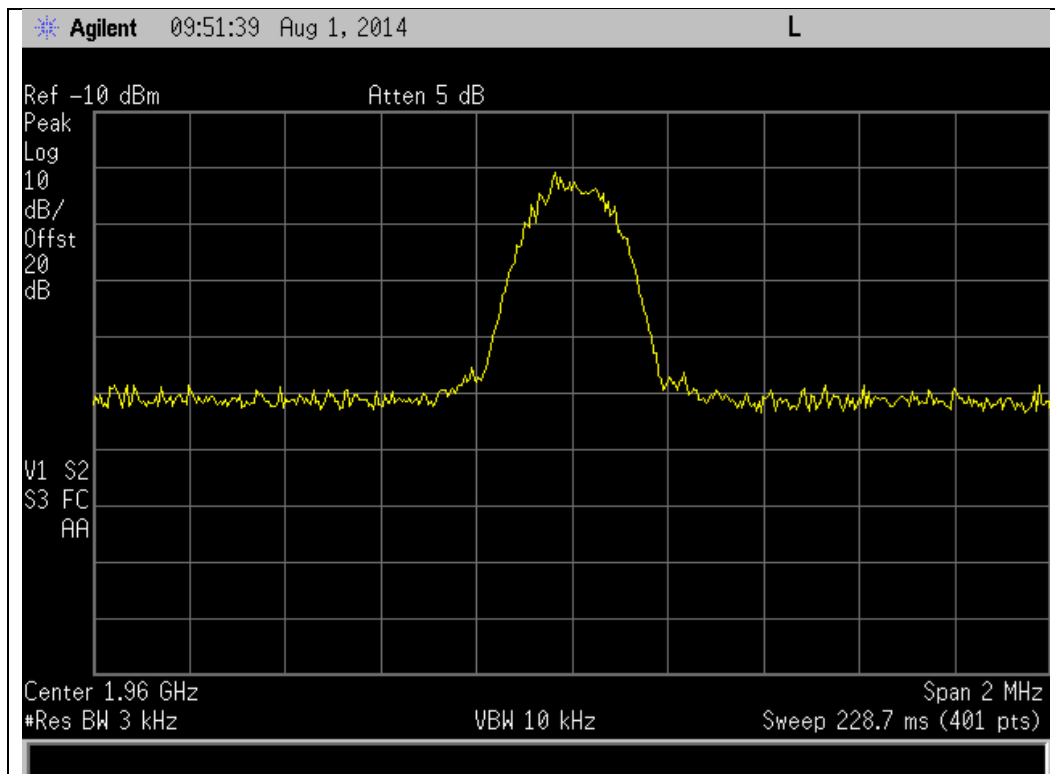


## 1930 - 1990 MHz Band

### Input



### Output

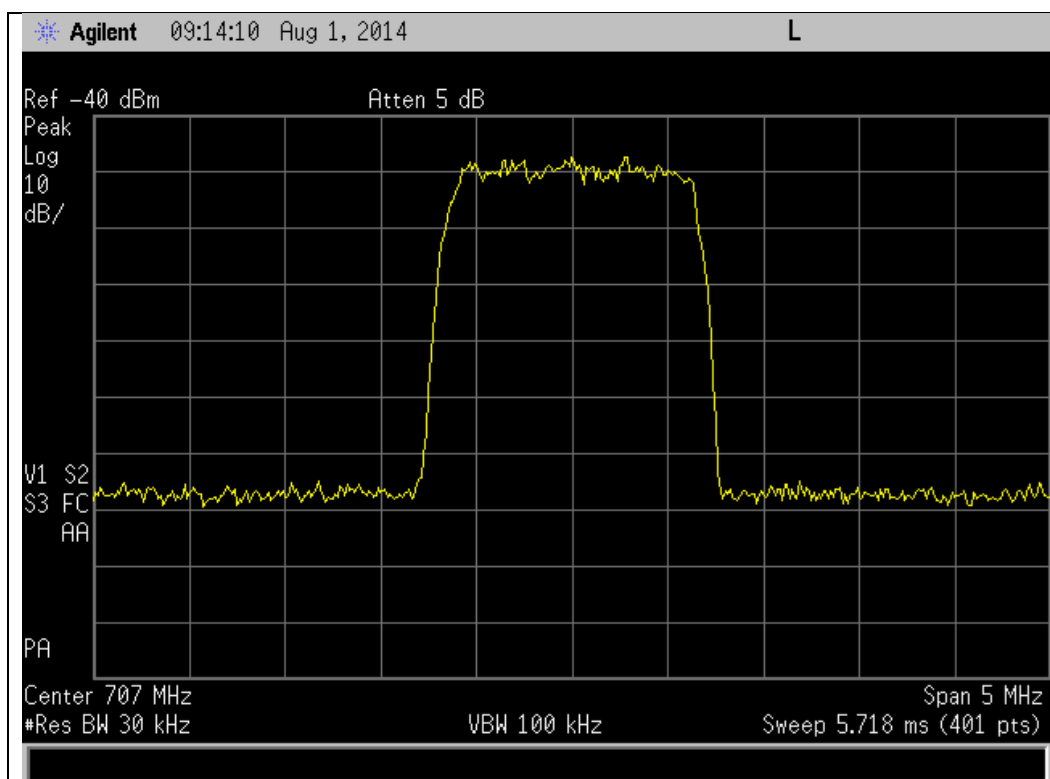




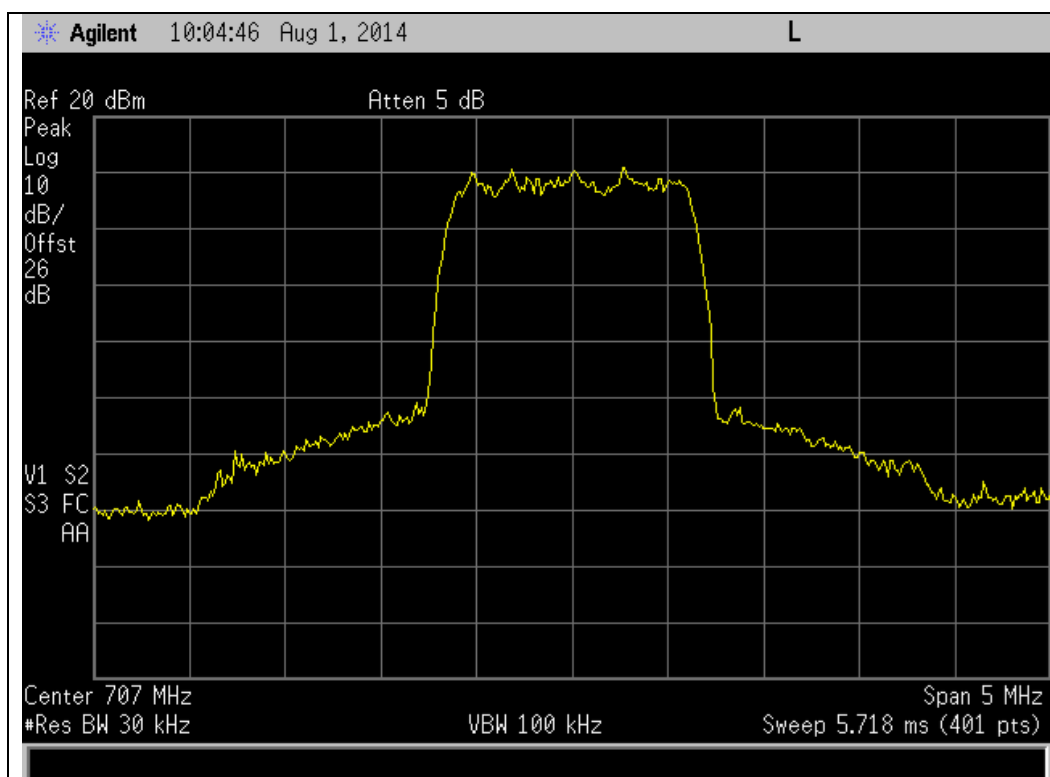
## CDMA Uplink Test Plots

698 - 716 MHz Band

Input



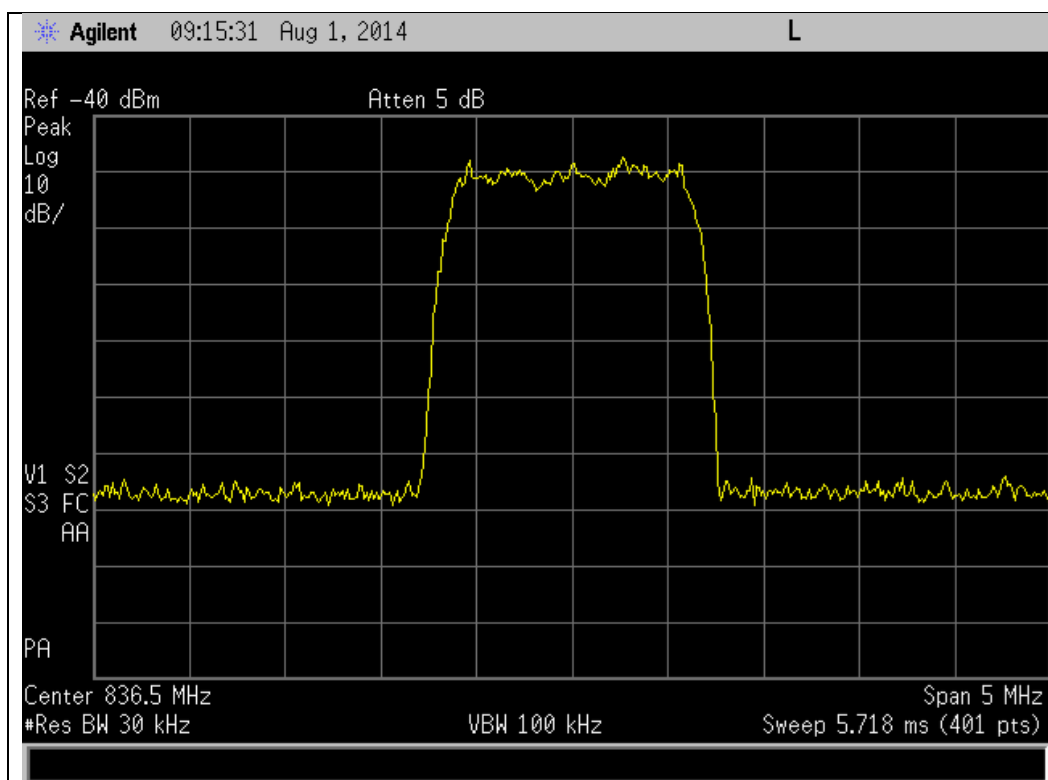
Output



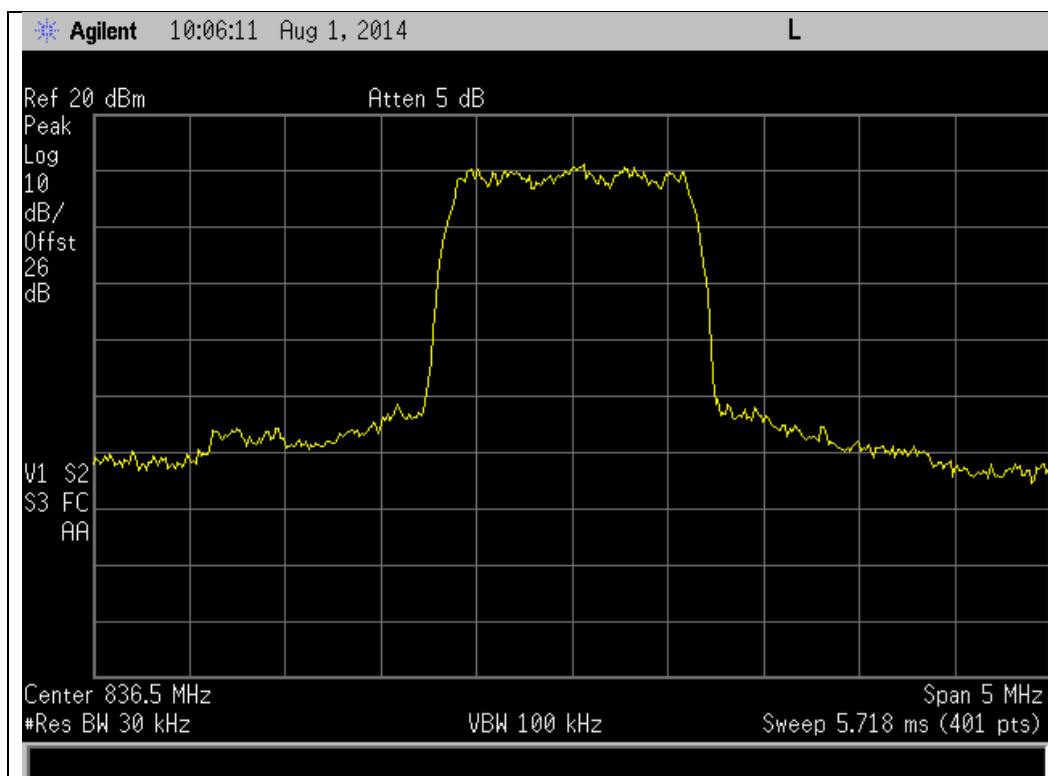


## 824 - 849 MHz Band

### Input



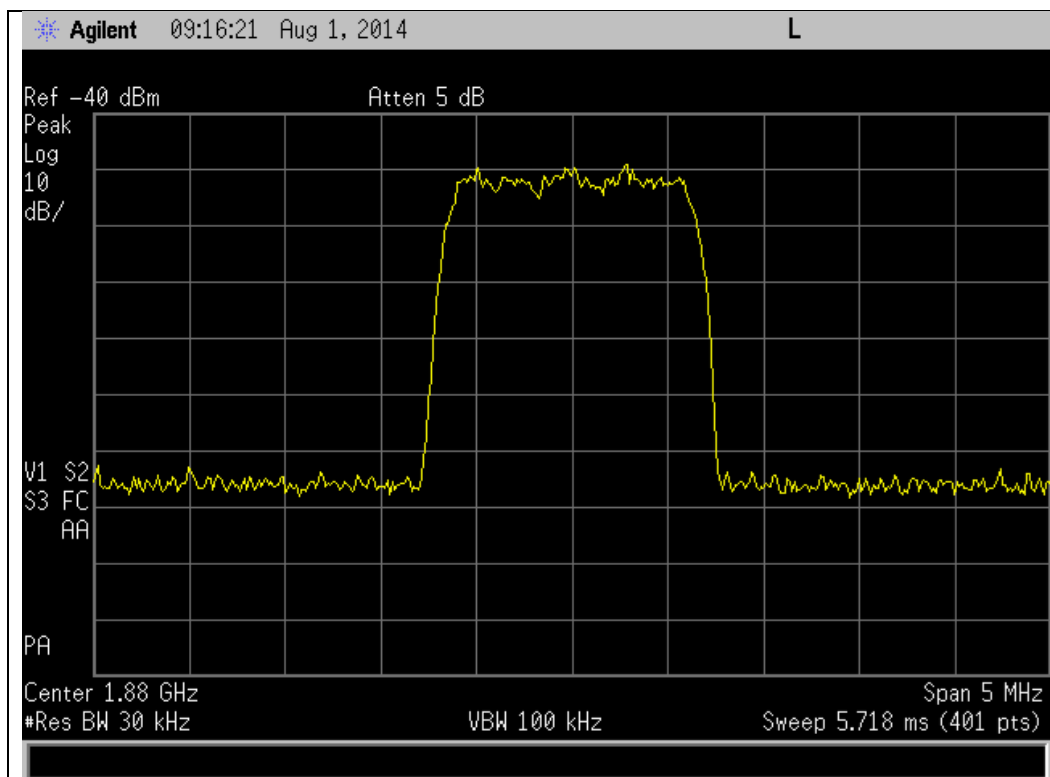
### Output



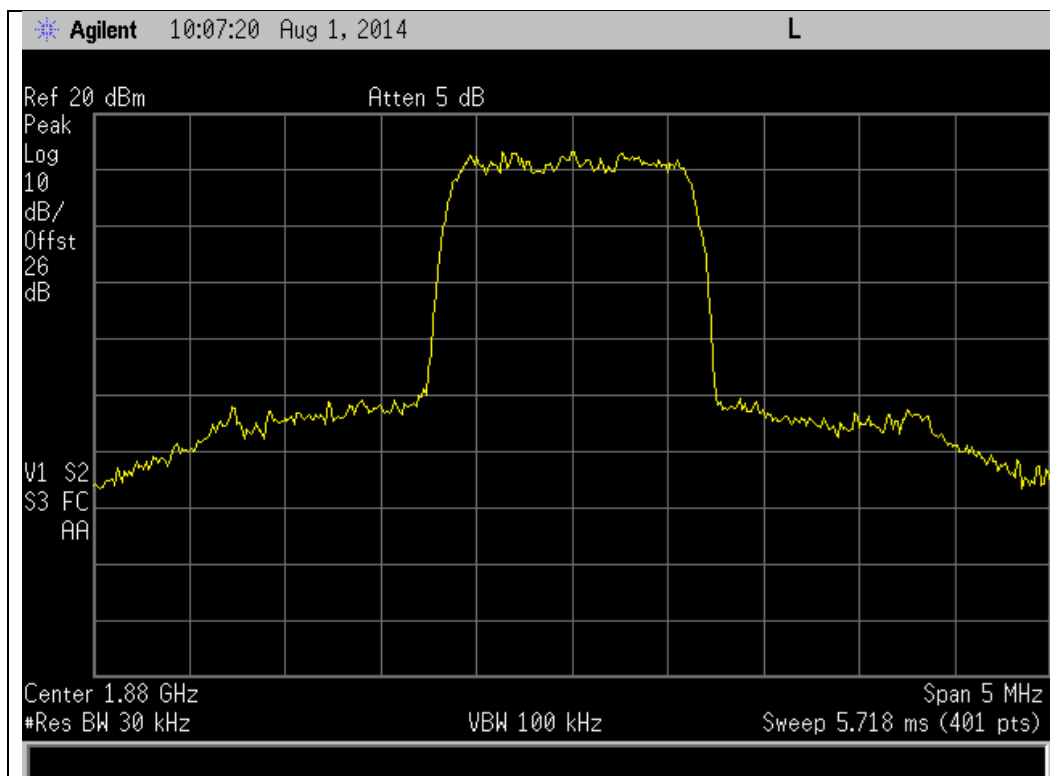


## 1850 - 1910 MHz Band

### Input



### Output

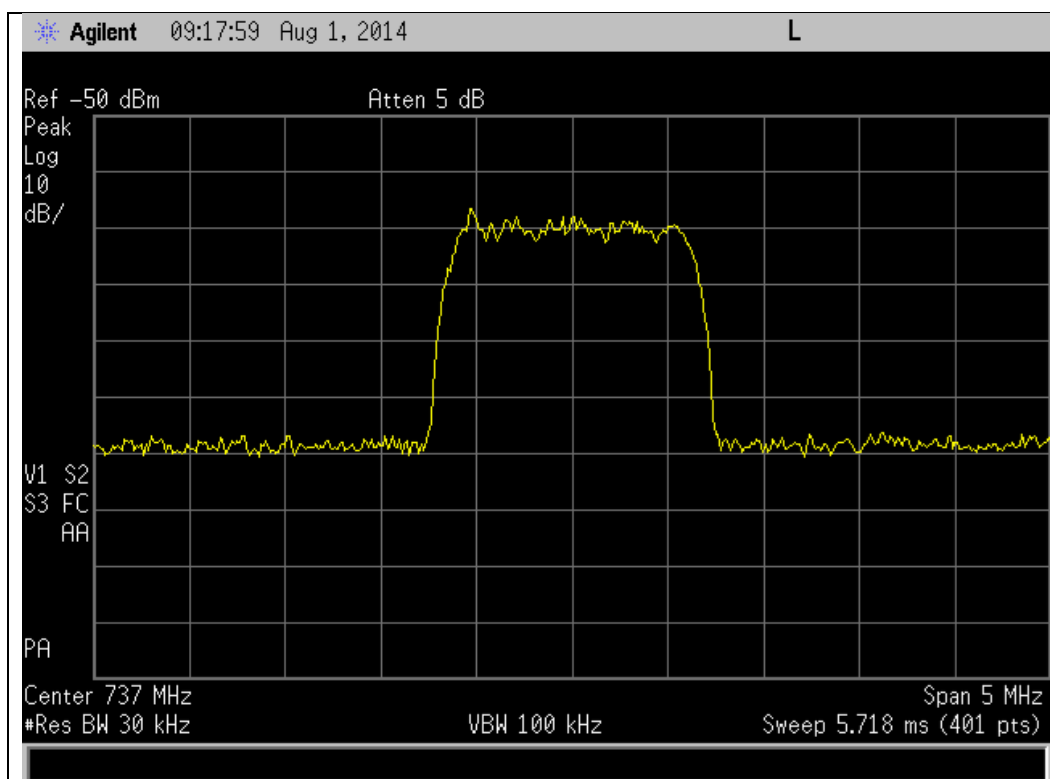




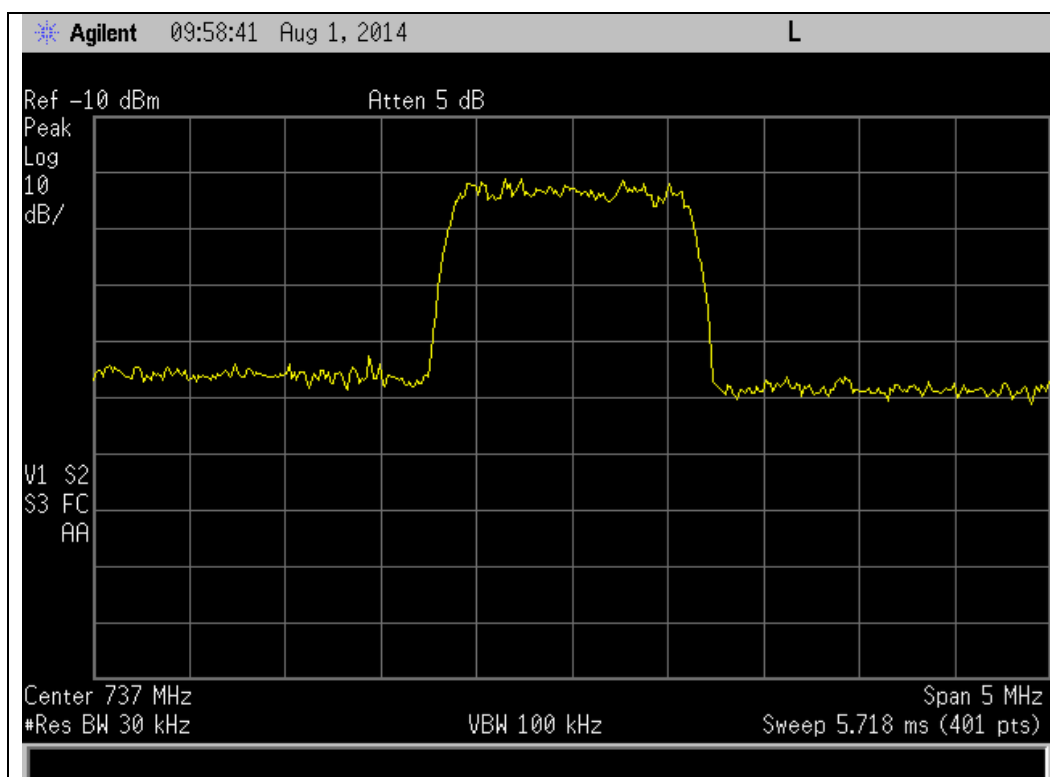
## CDMA Downlink Test Plots

728 - 746 MHz Band

Input



Output

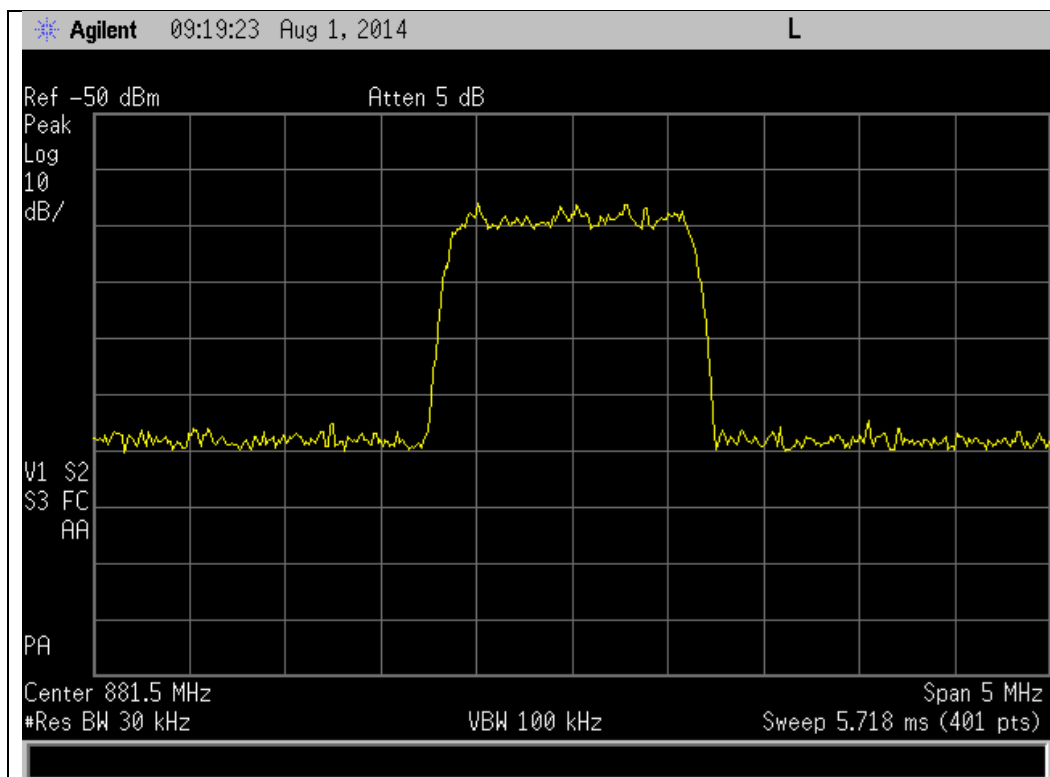




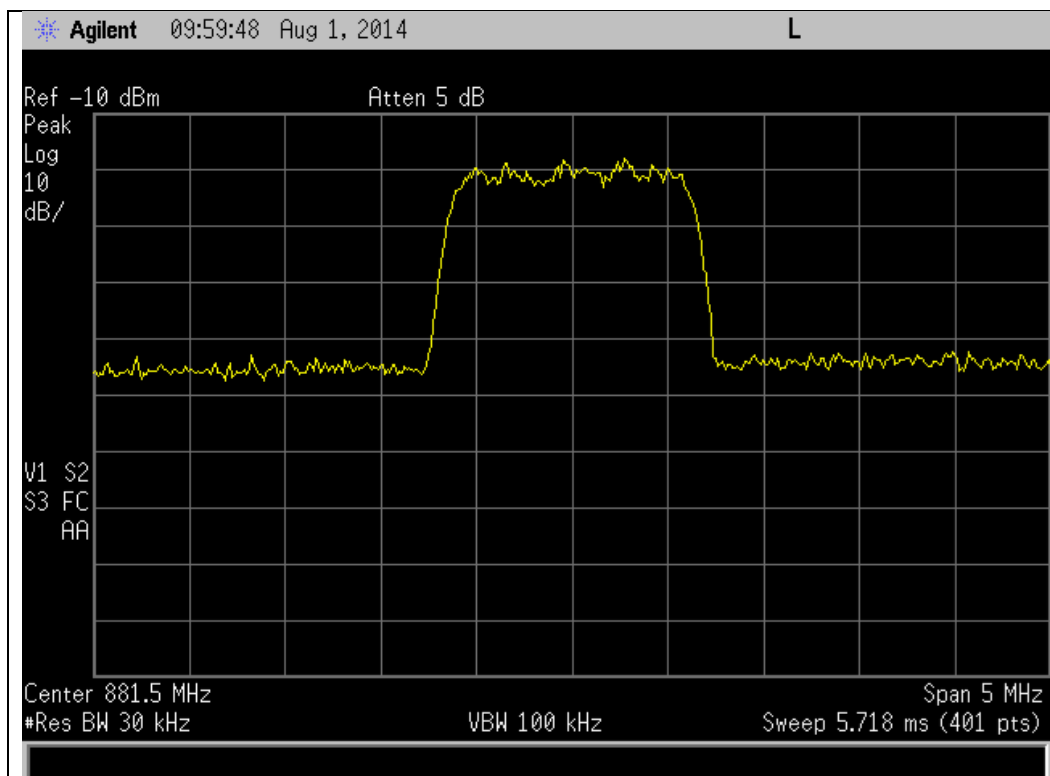


## 869 - 894 MHz Band

### Input



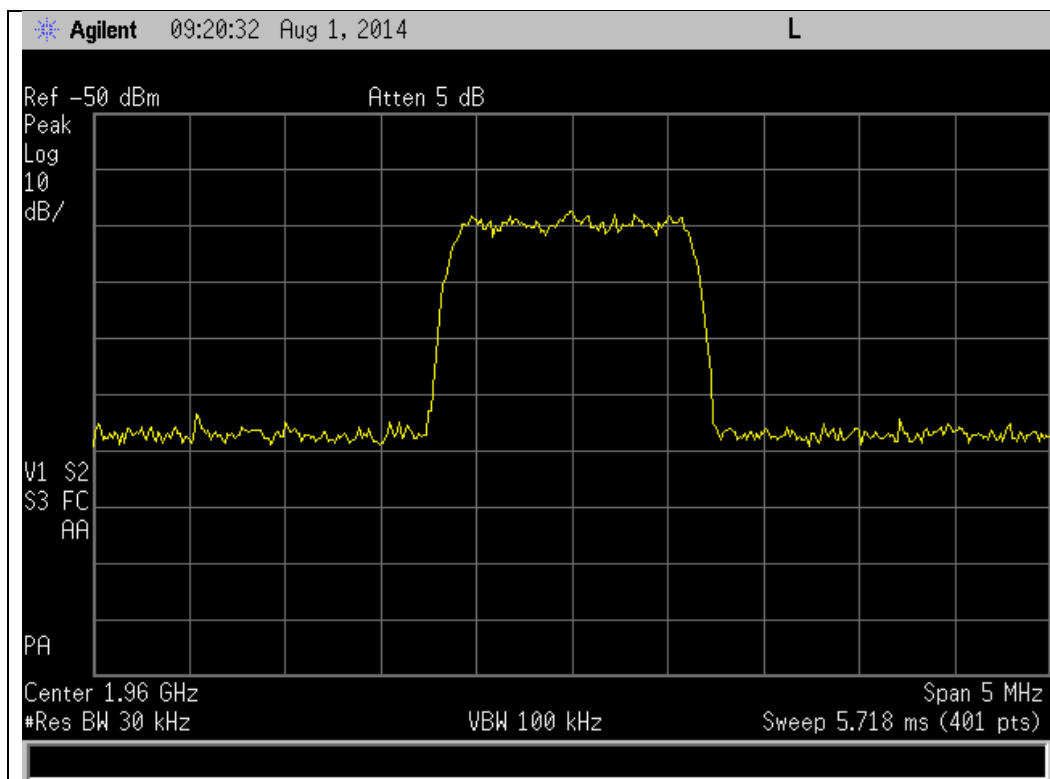
### Output



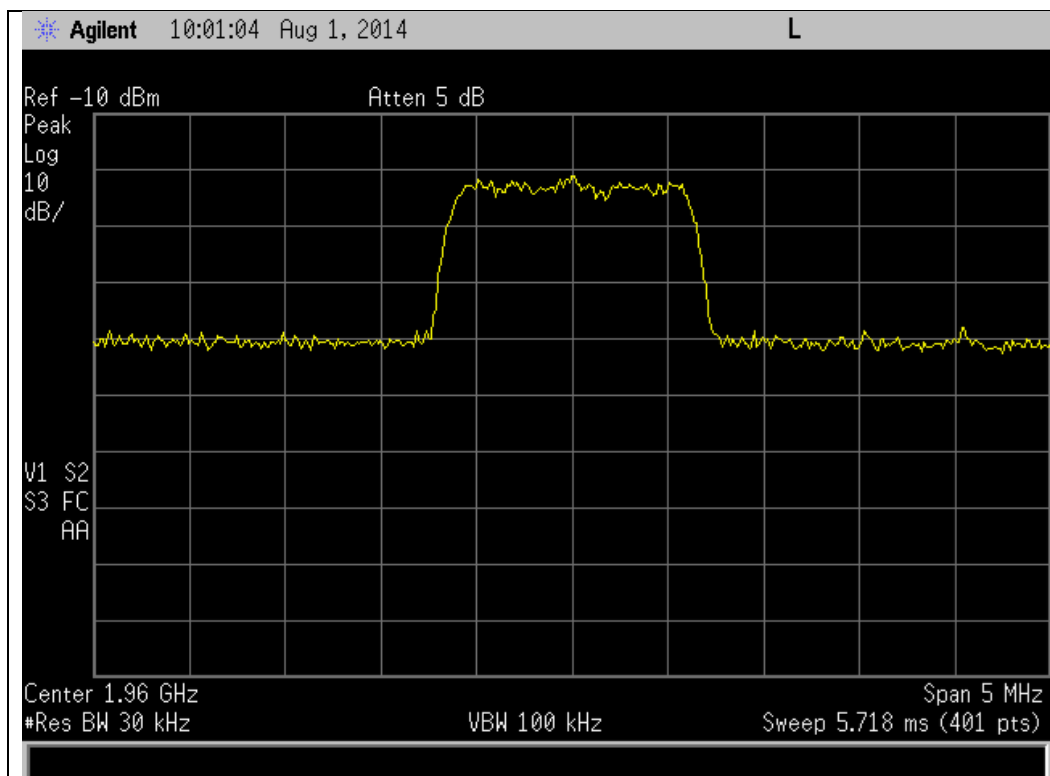


## 1930 - 1990 MHz Band

### Input



### Output

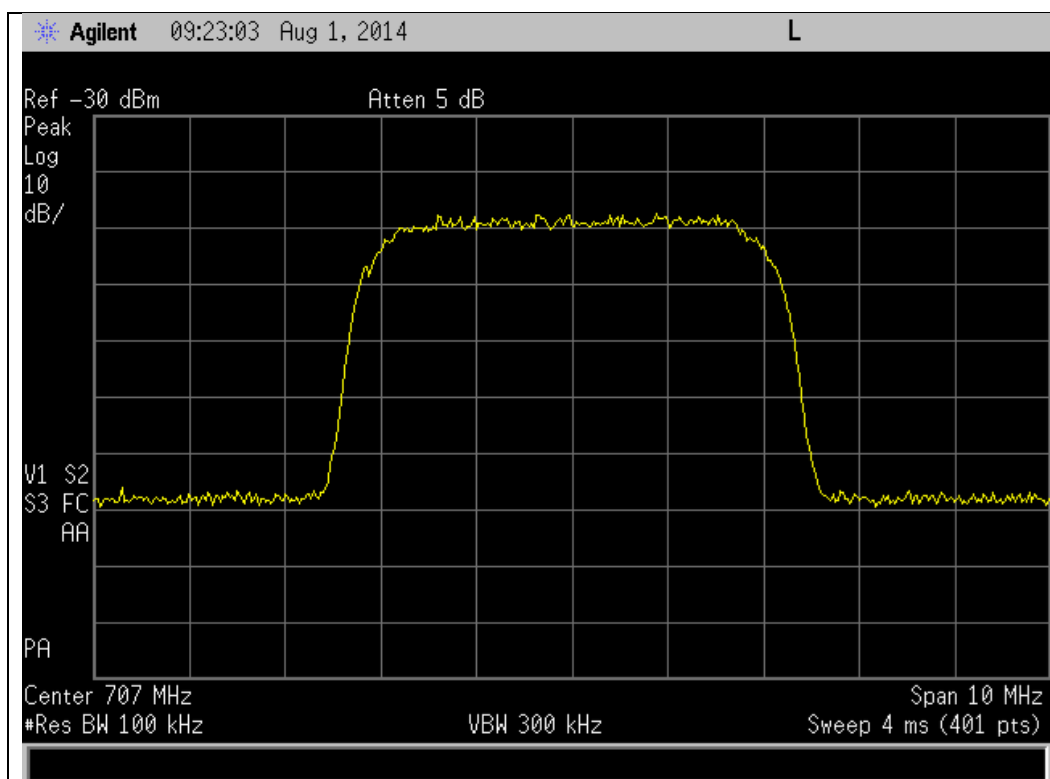




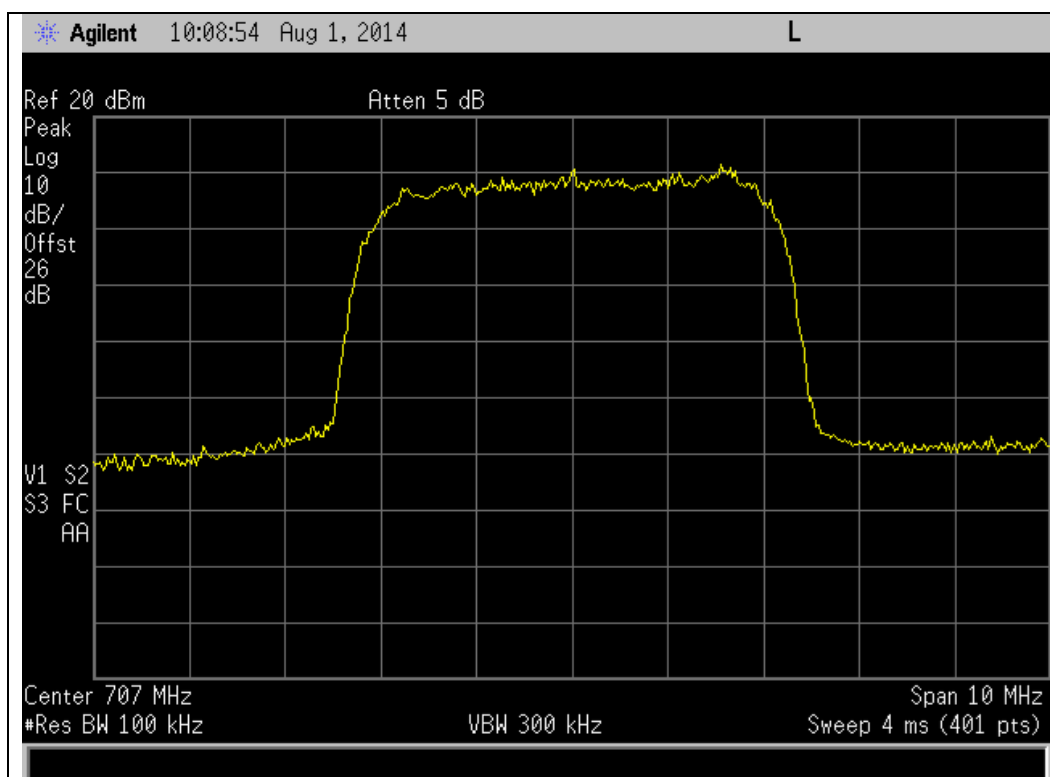
## WCDMA Uplink Test Plots

698 - 716 MHz Band

Input



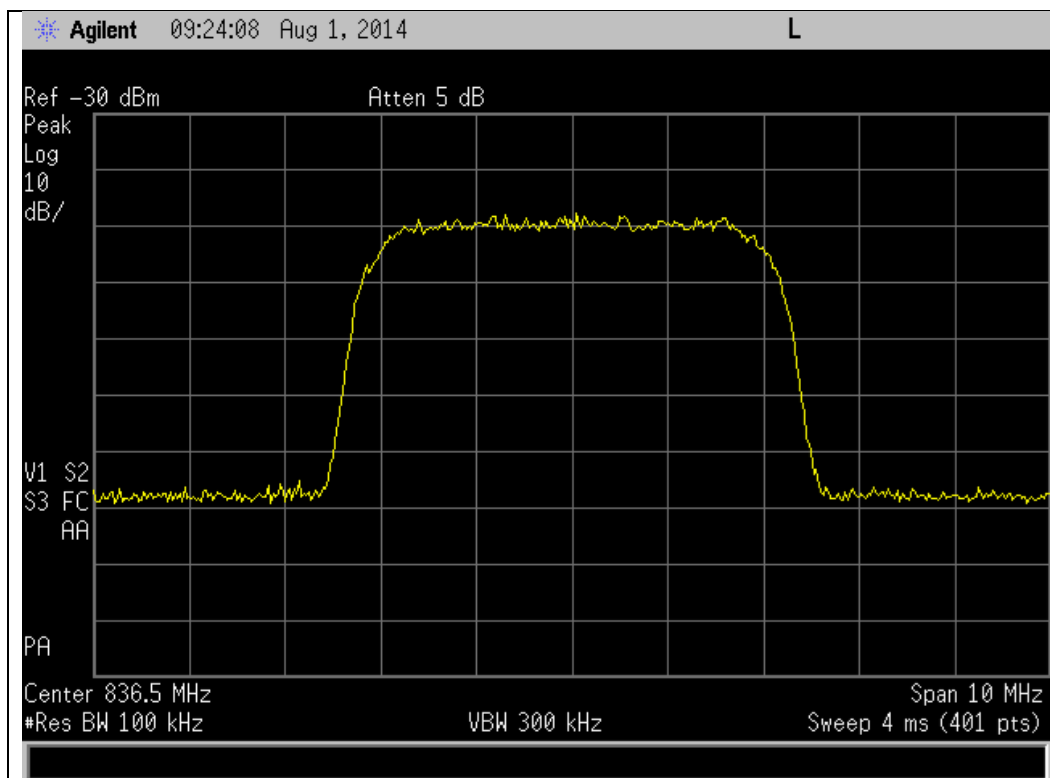
Output



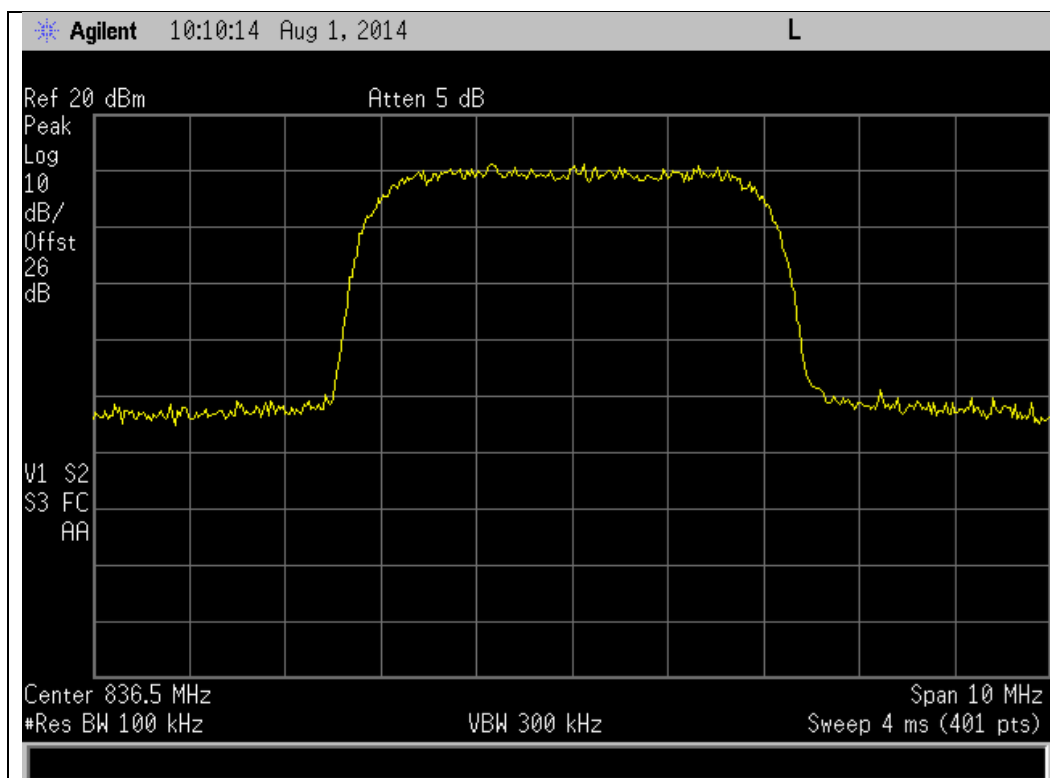


## 824 - 849 MHz Band

### Input



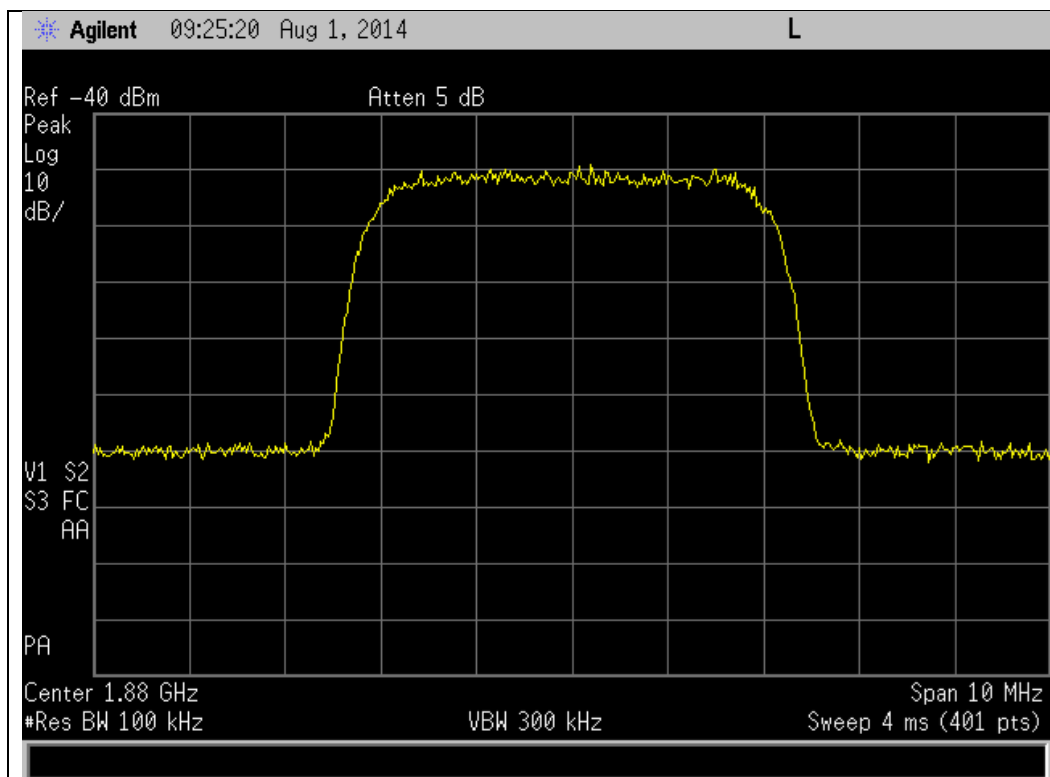
### Output



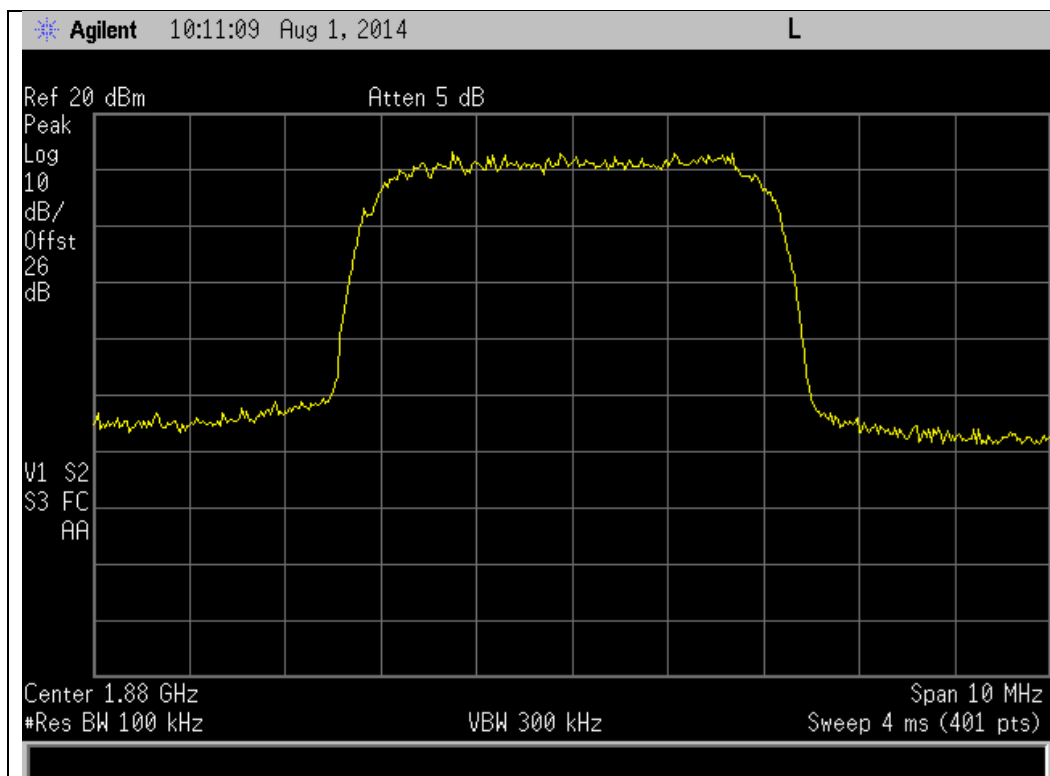


## 1850 - 1910 MHz Band

### Input



### Output

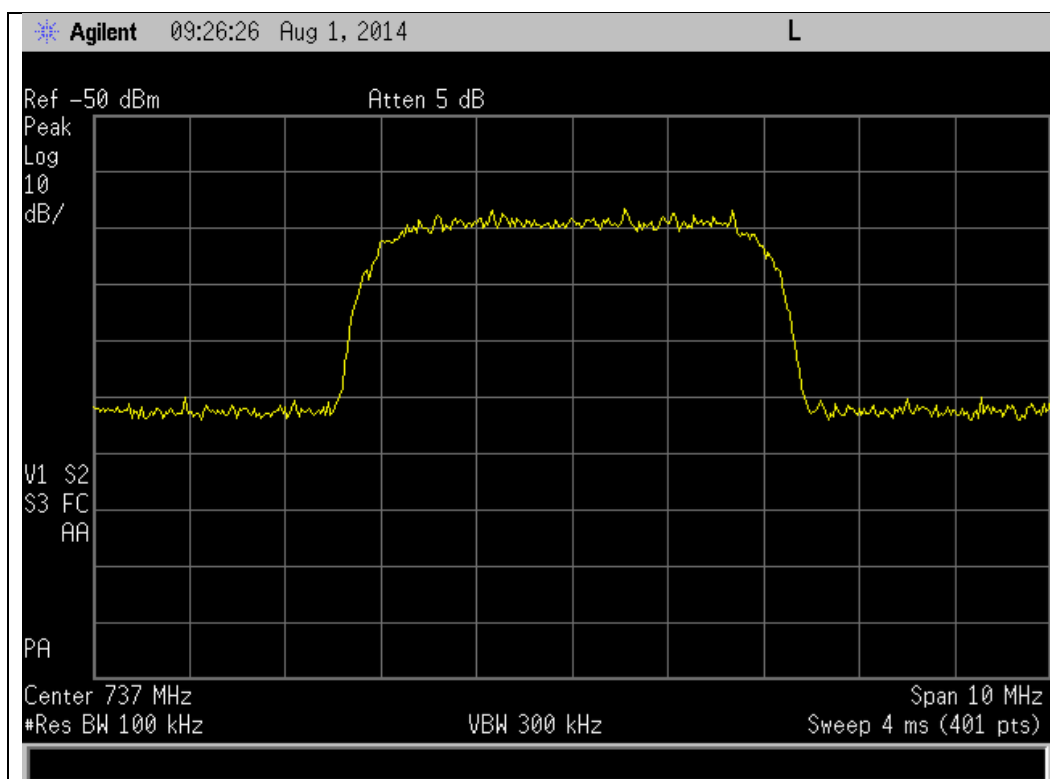




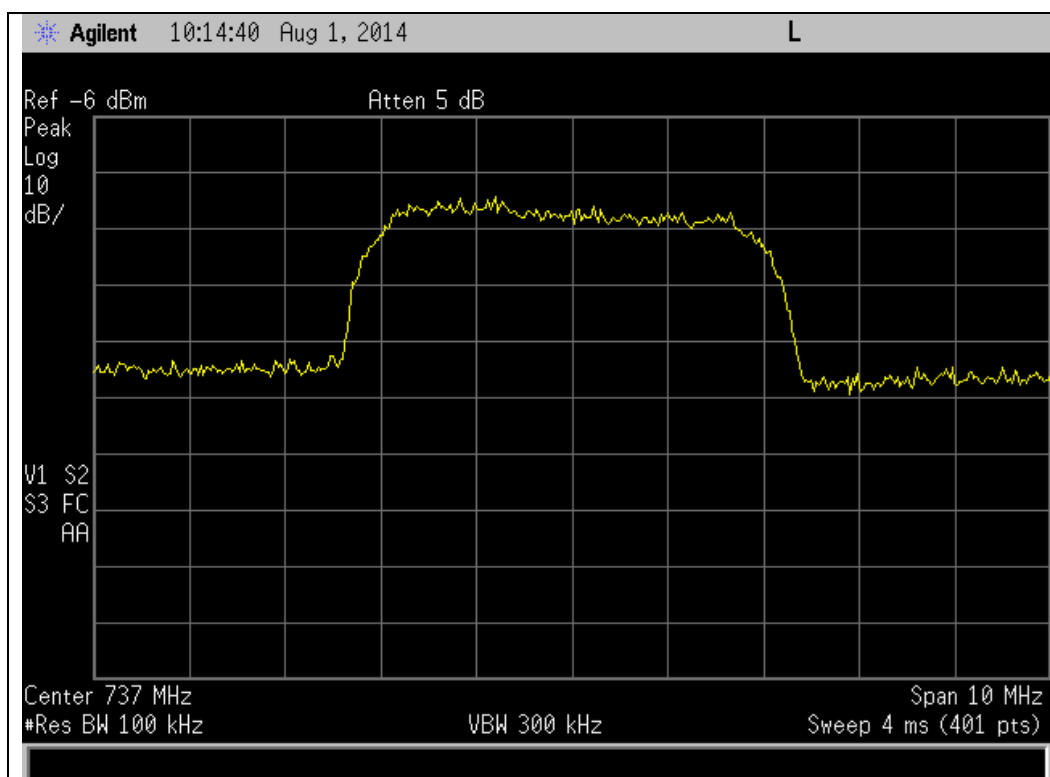
## WCDMA Downlink Test Plots

### 728 - 746 MHz Band

#### Input



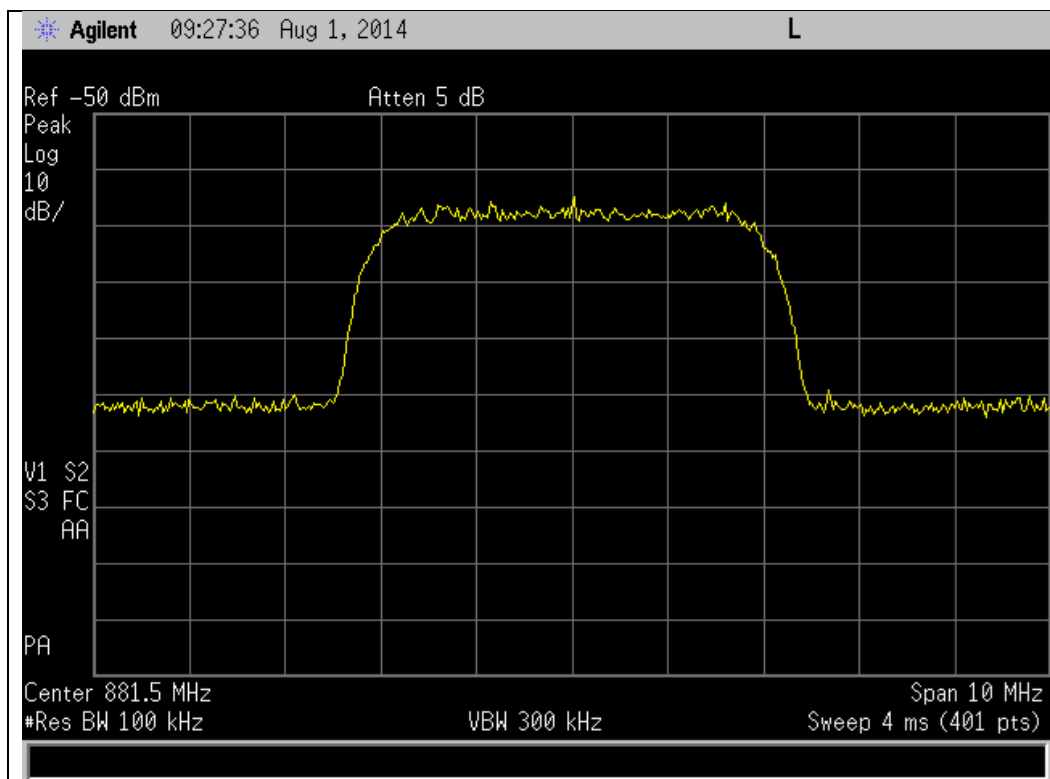
#### Output



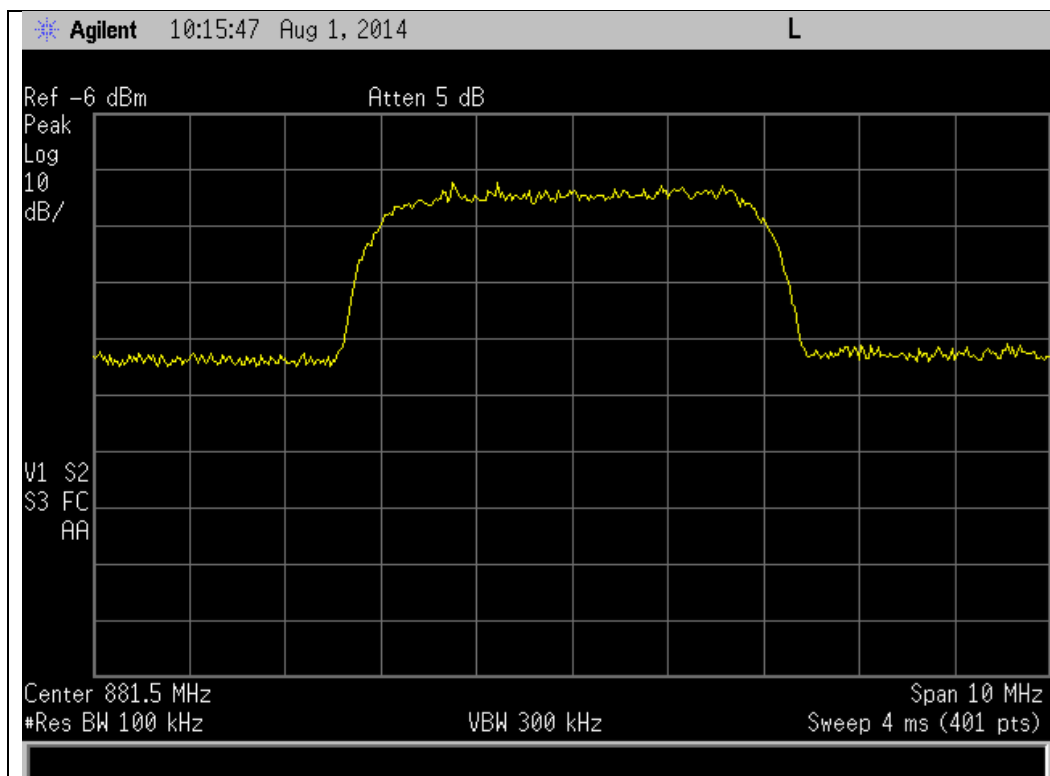


## 869 - 894 MHz Band

### Input



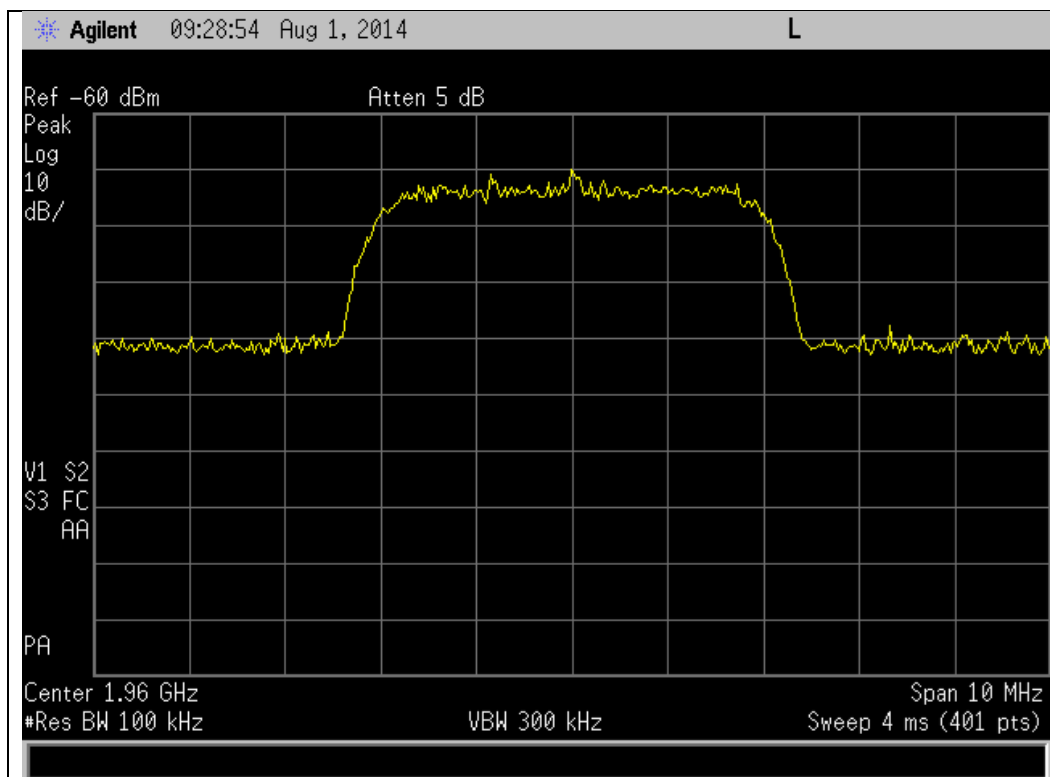
### Output



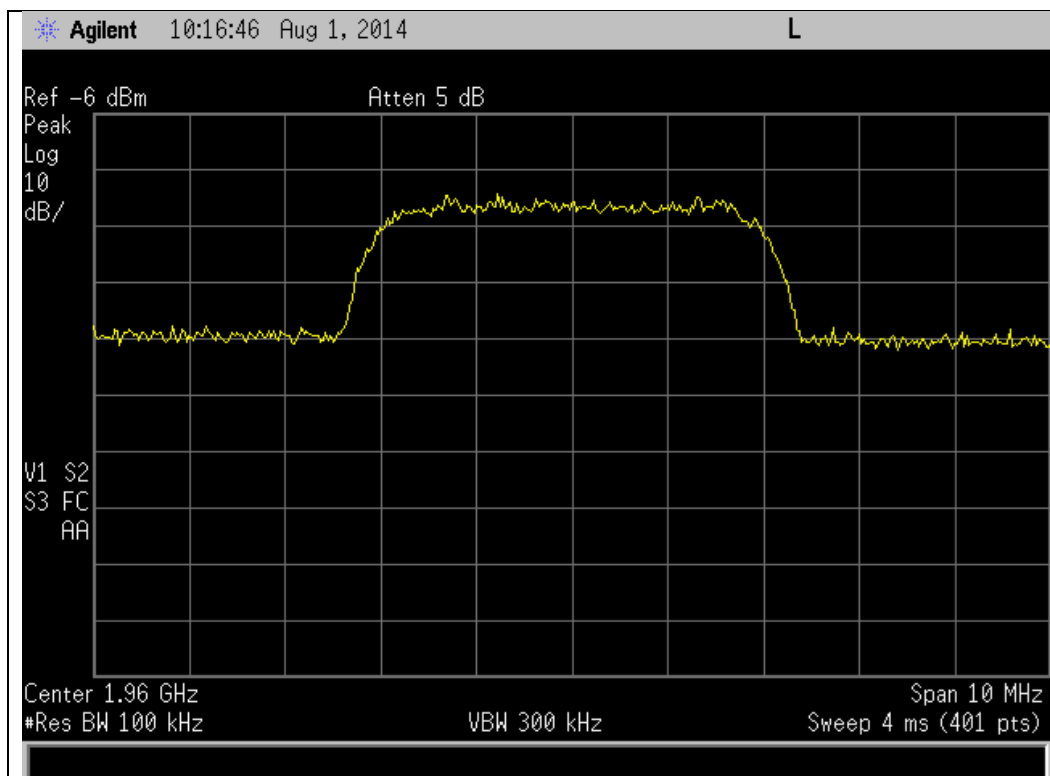


## 1930 - 1990 MHz Band

### Input



### Output







## Oscillation Detection

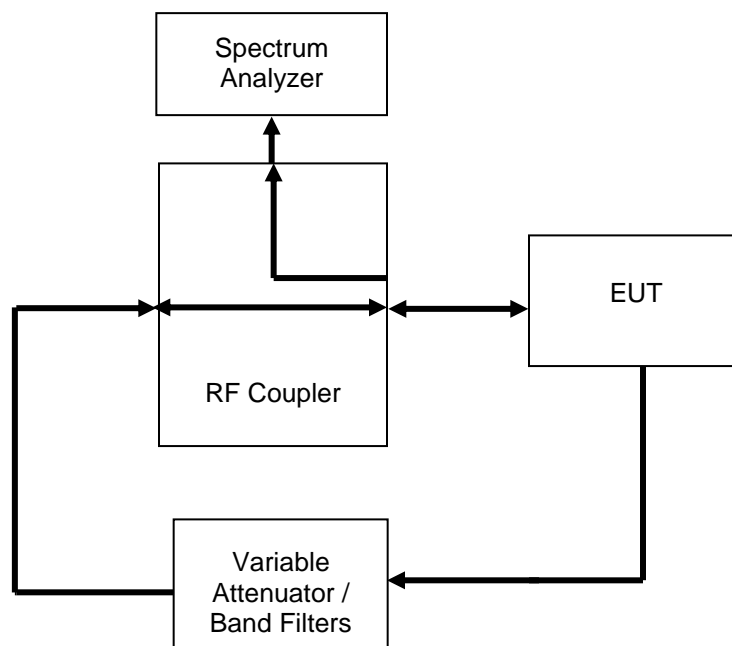
**Name of Test:** Oscillation Detection  
**Test Equipment Utilized:** i00379, i00405

**Engineer:** Mike Graffeo  
**Test Date:** 7/30/14

### 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	110.70	300	Pass
824 - 849	27.00	300	Pass
1850 - 1910	144.00	300	Pass

#### Downlink Detection Time Test Results

Frequency Band (MHz)	Measured Time (mS)	Limit (mS)	Result
728 - 746	30.60	1000	Pass
869 - 894	29.70	1000	Pass
1930 - 1990	59.40	1000	Pass

#### Uplink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
698 - 716	65.28	≥60	Pass
824 - 849	64.58	≥60	Pass
1850 - 1910	65.10	≥60	Pass

#### Downlink Restart Time Test Results

Frequency Band (MHz)	Measured Time (S)	Limit (S)	Result
728 - 746	64.05	≥60	Pass
869 - 894	64.75	≥60	Pass
1930 - 1990	65.10	≥60	Pass

#### Uplink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
698 - 716	5	≤5	Pass
824 - 849	5	≤5	Pass
1850 - 1910	5	≤5	Pass

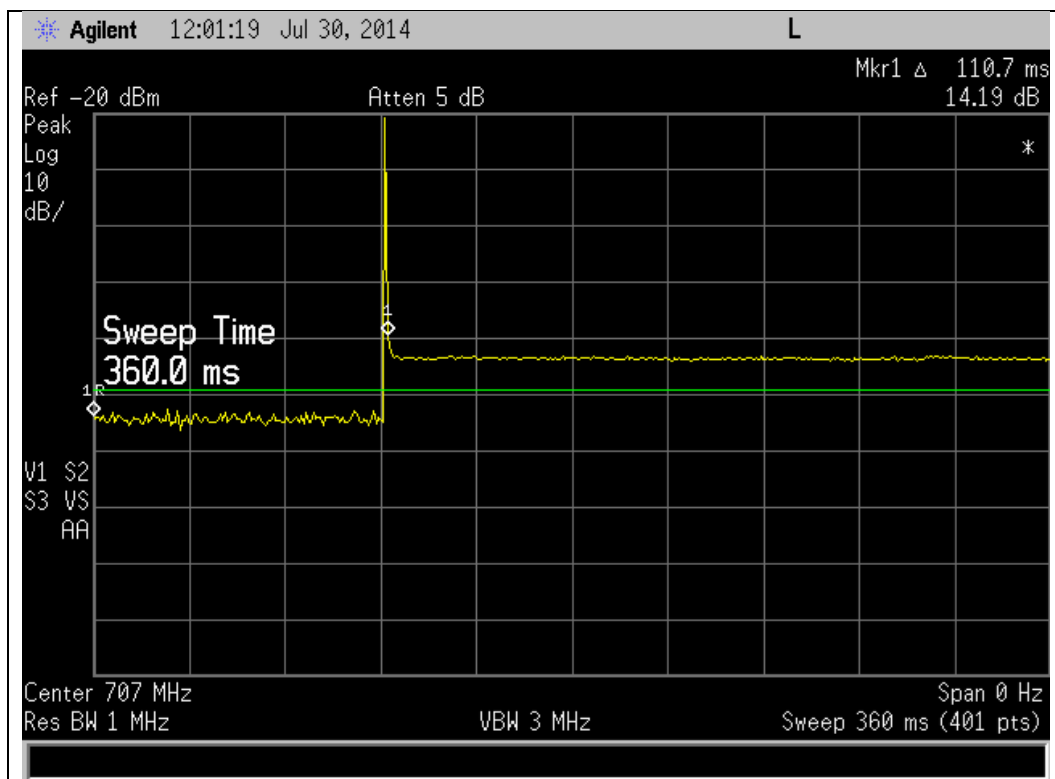
#### Downlink Restart Count Test Results

Frequency Band (MHz)	Restarts	Limit	Result
728 - 746	5	≤5	Pass
869 - 894	5	≤5	Pass
1930 - 1990	5	≤5	Pass

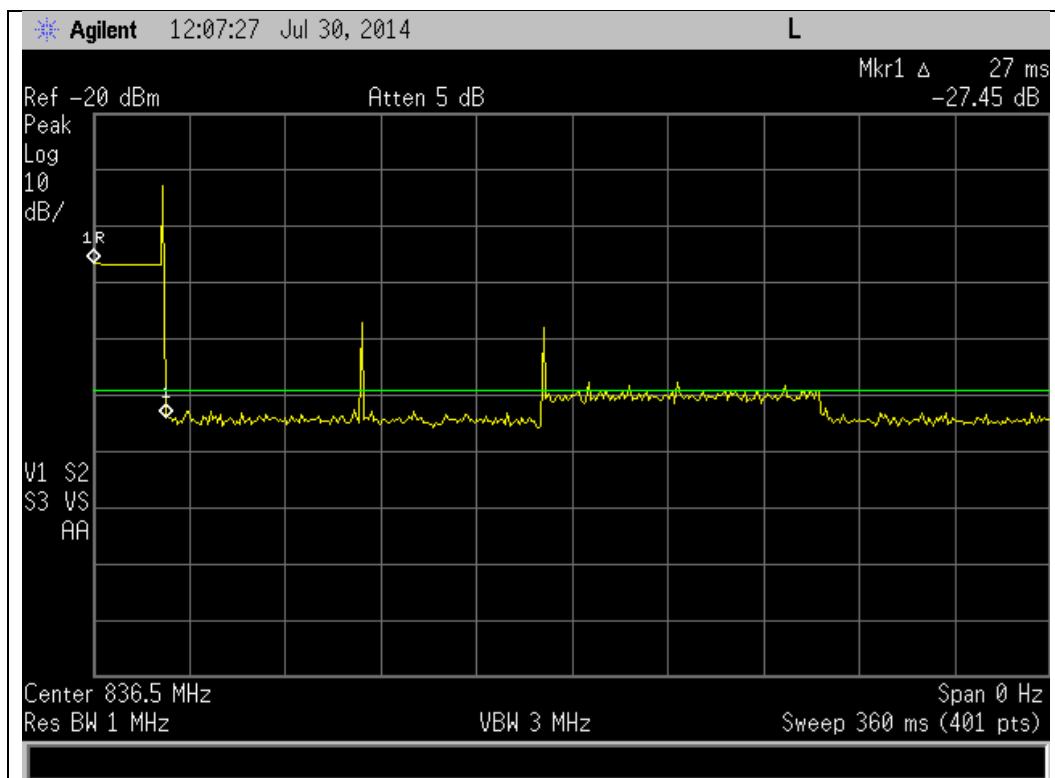


## Uplink Detection Time Test Results

### 698 - 716 MHz Band

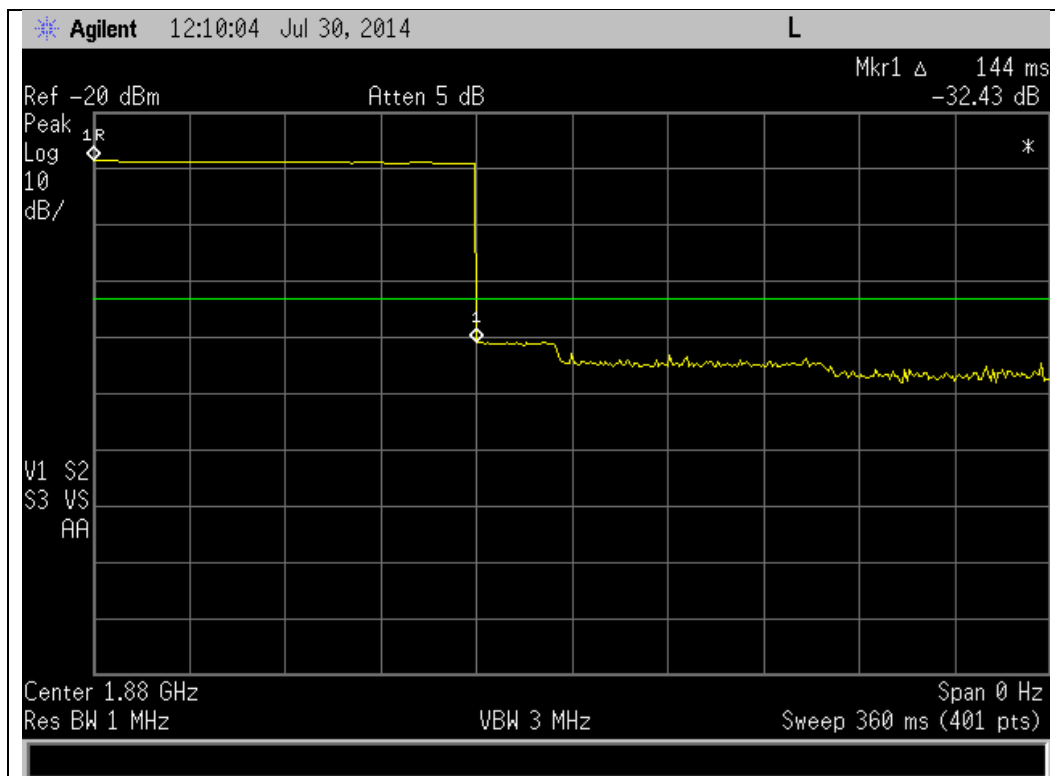


### 824 - 849 MHz Band



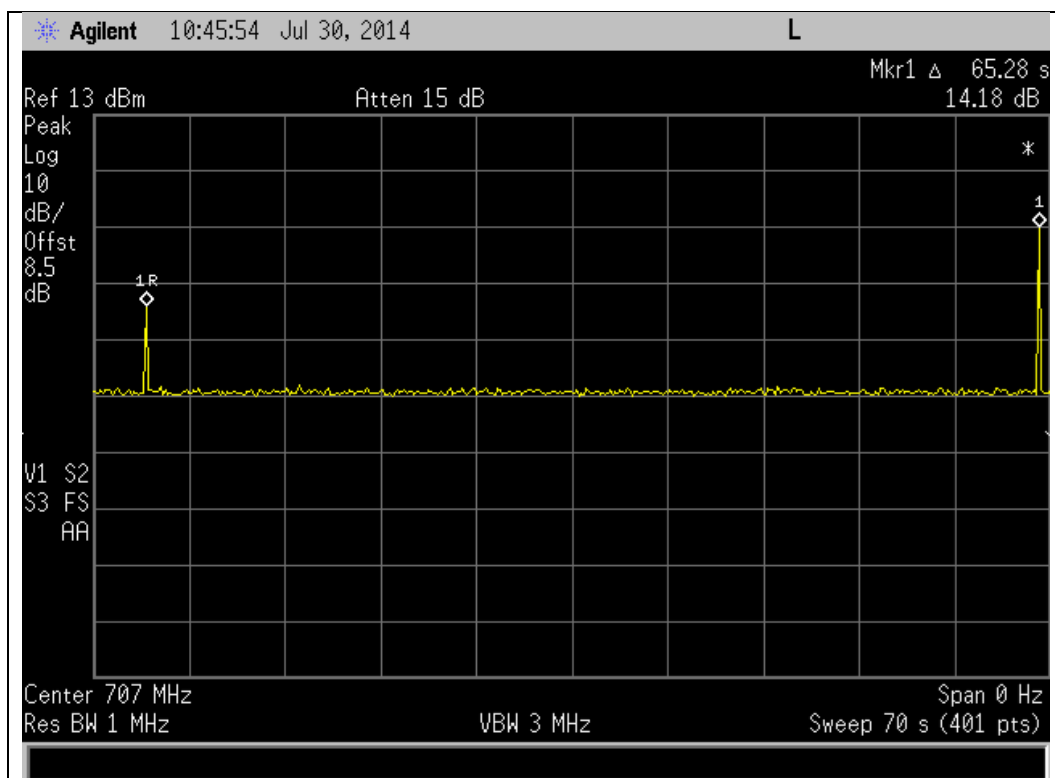


### 1850 - 1910 MHz Band



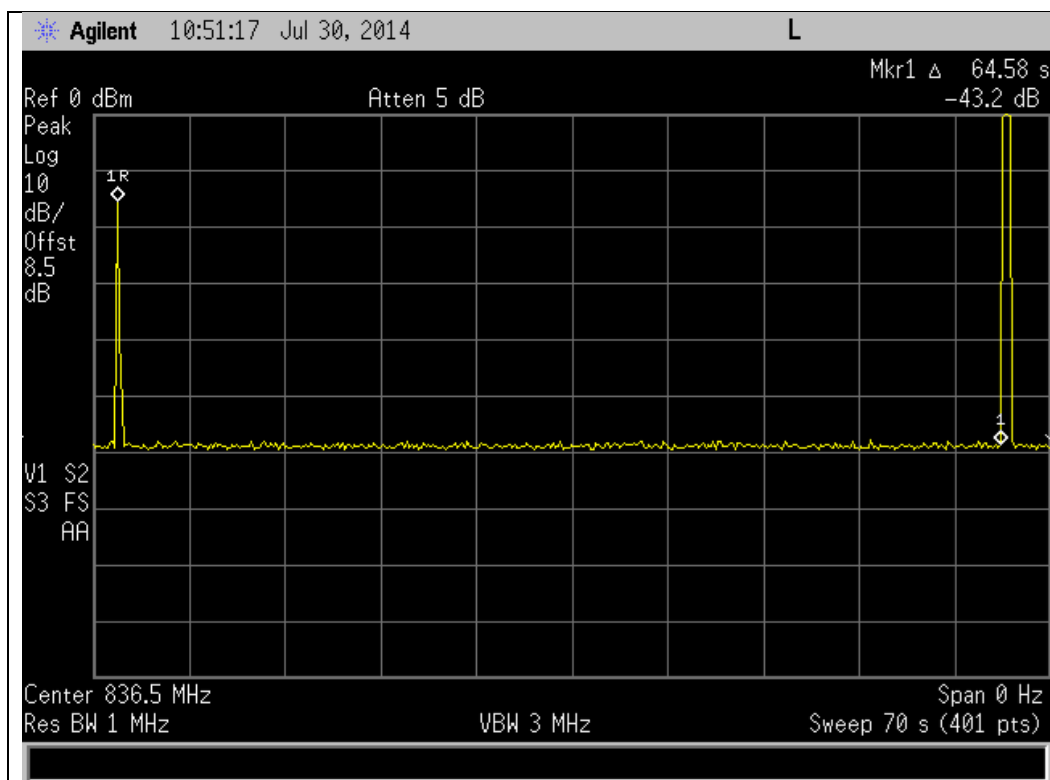
### Uplink Restart Time Test Results

### 698 - 716 MHz Band

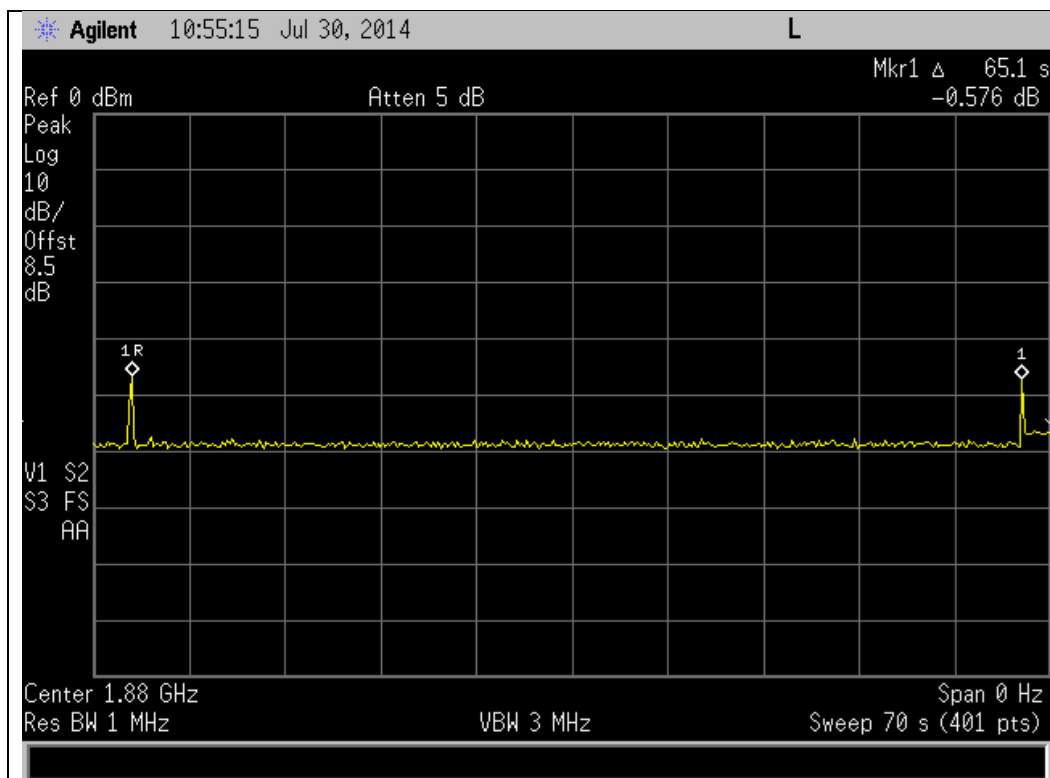




### 824 - 849 MHz Band



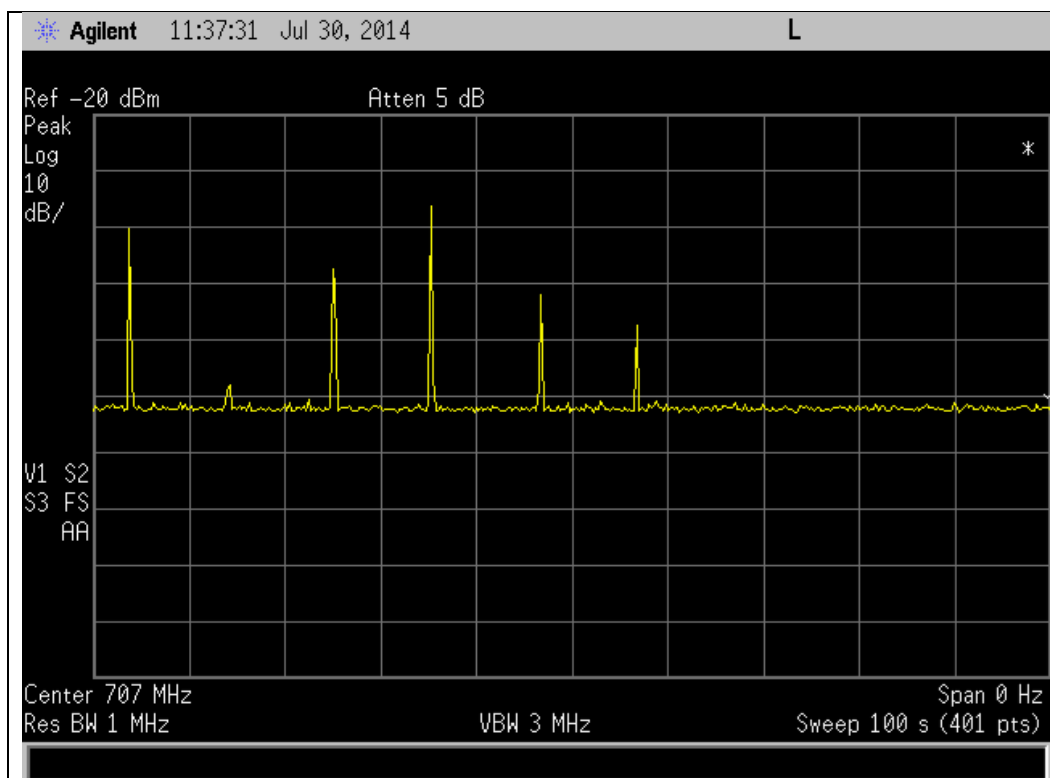
### 1850 - 1910 MHz Band



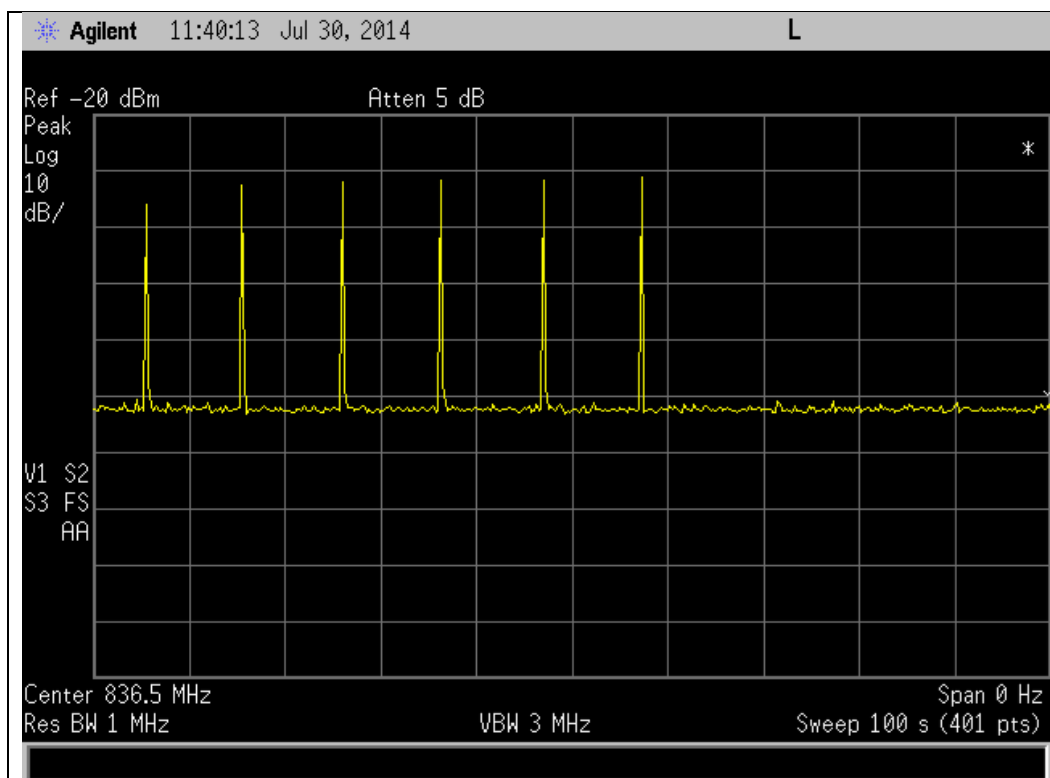


## Uplink Restart Count Test Results

### 698 - 716 MHz Band

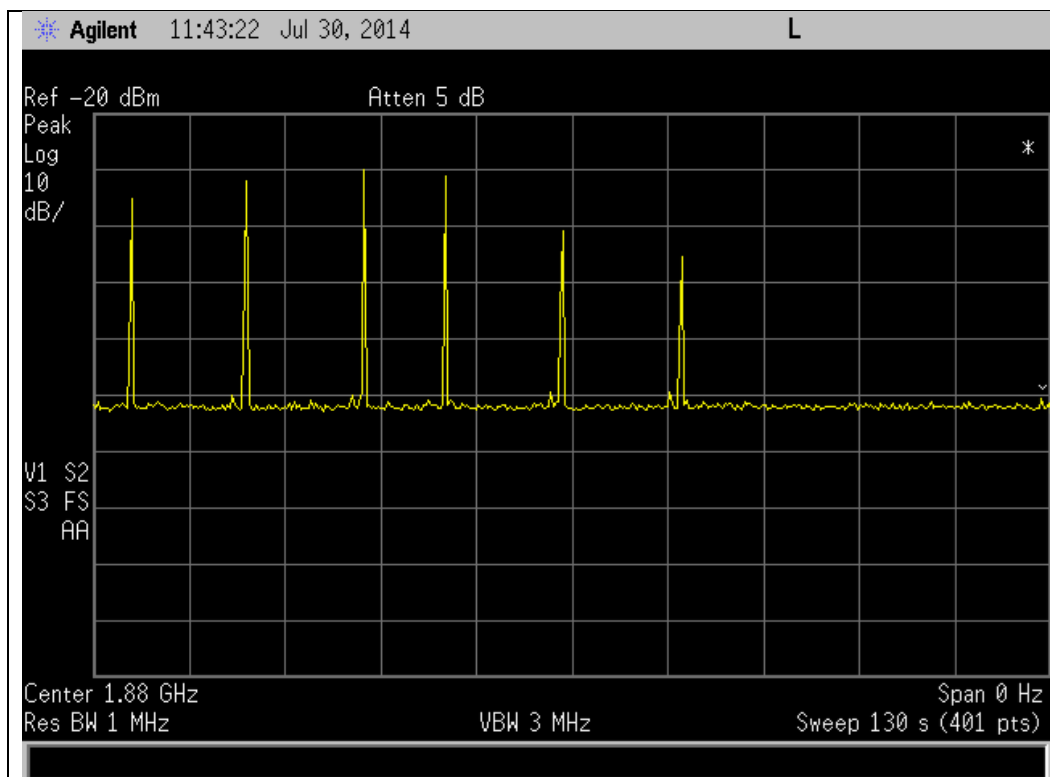


### 824 - 849 MHz Band



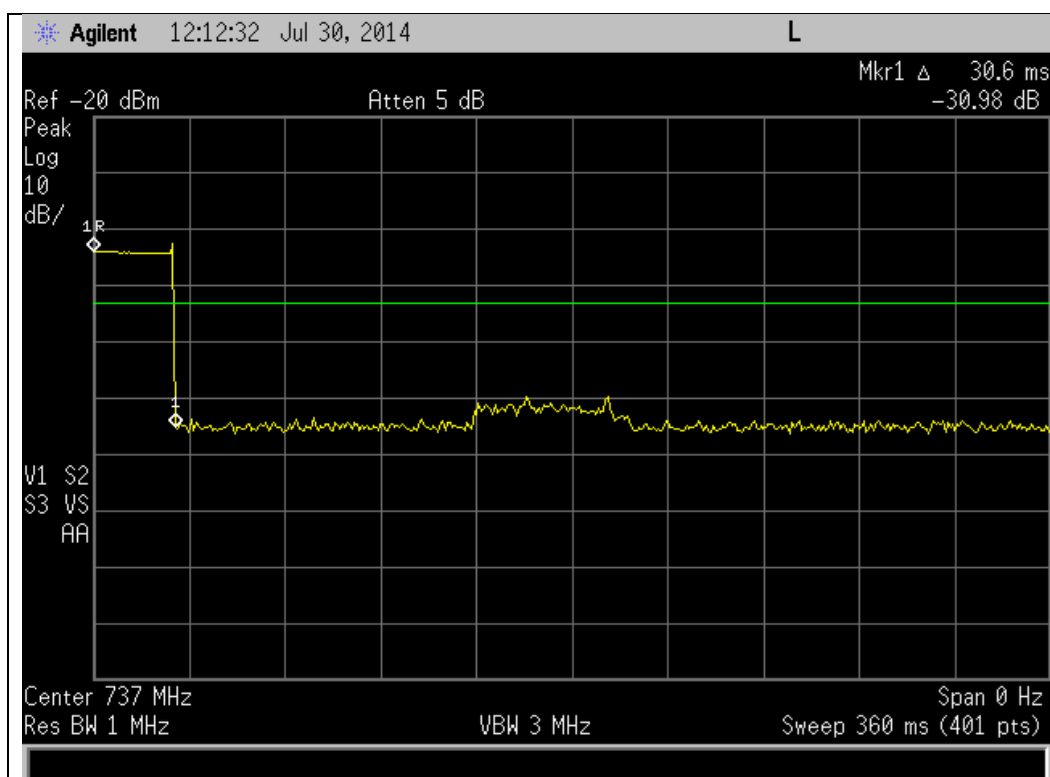


### 1850 - 1910 MHz Band



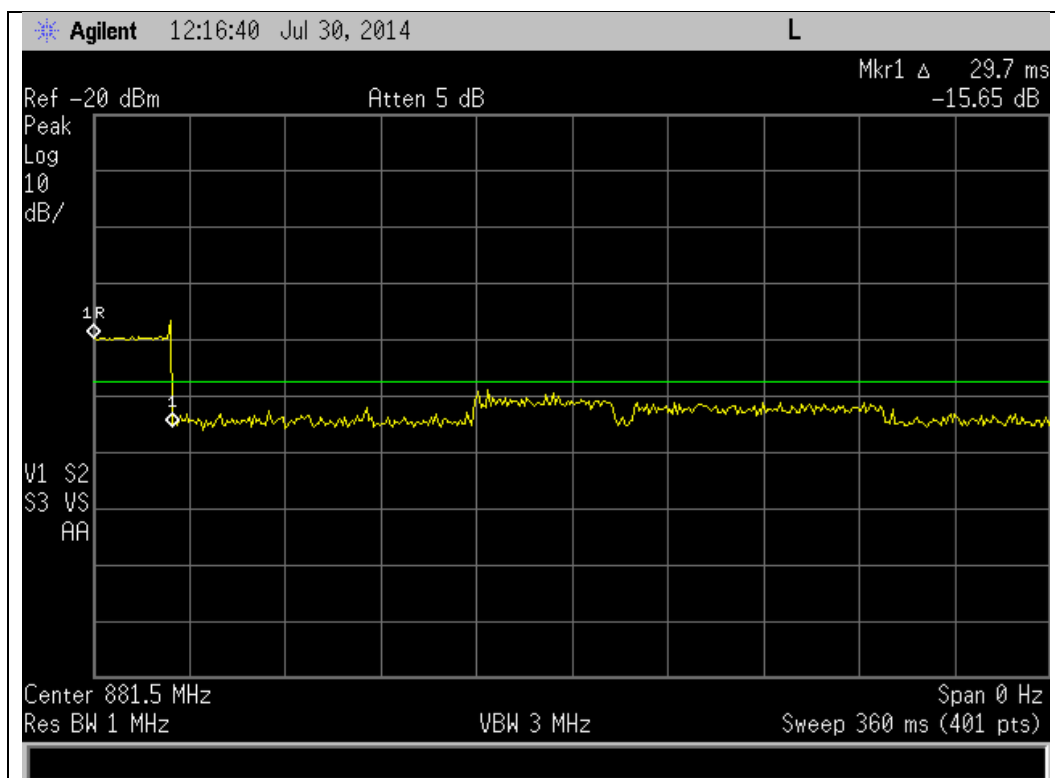
### Downlink Detection Time Test Results

### 728 - 746 MHz Band

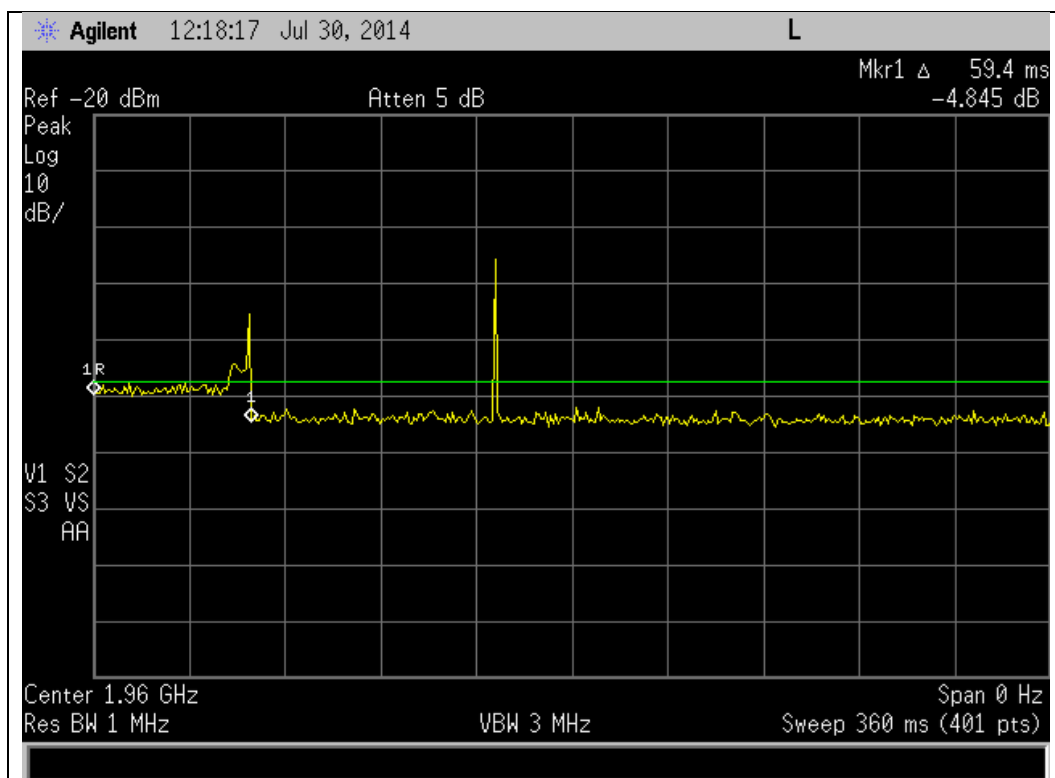




### 869 - 894 MHz Band



### 1930 - 1990 MHz Band

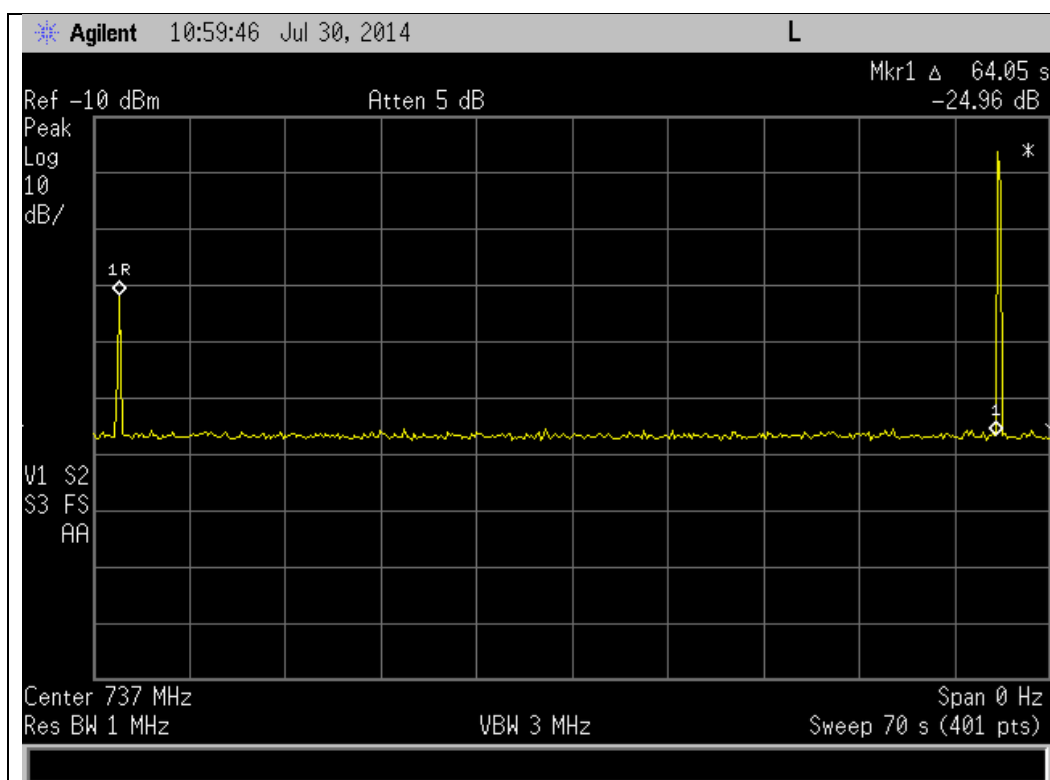




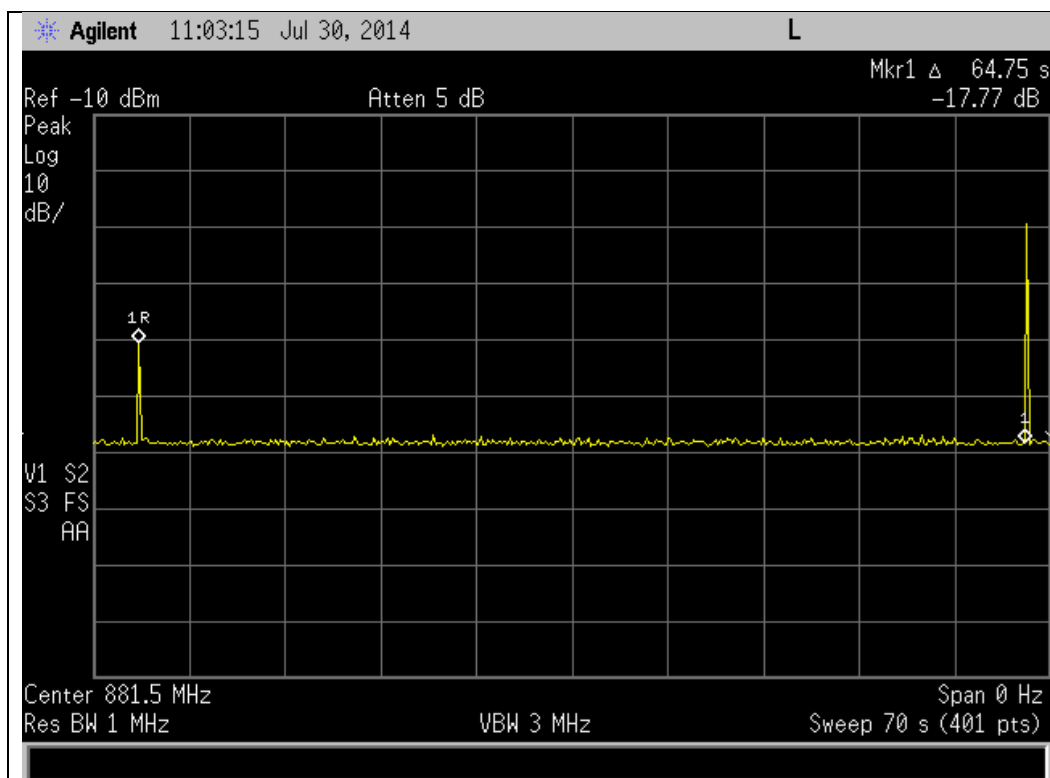


## Downlink Restart Time Test Results

### 728 - 746 MHz Band

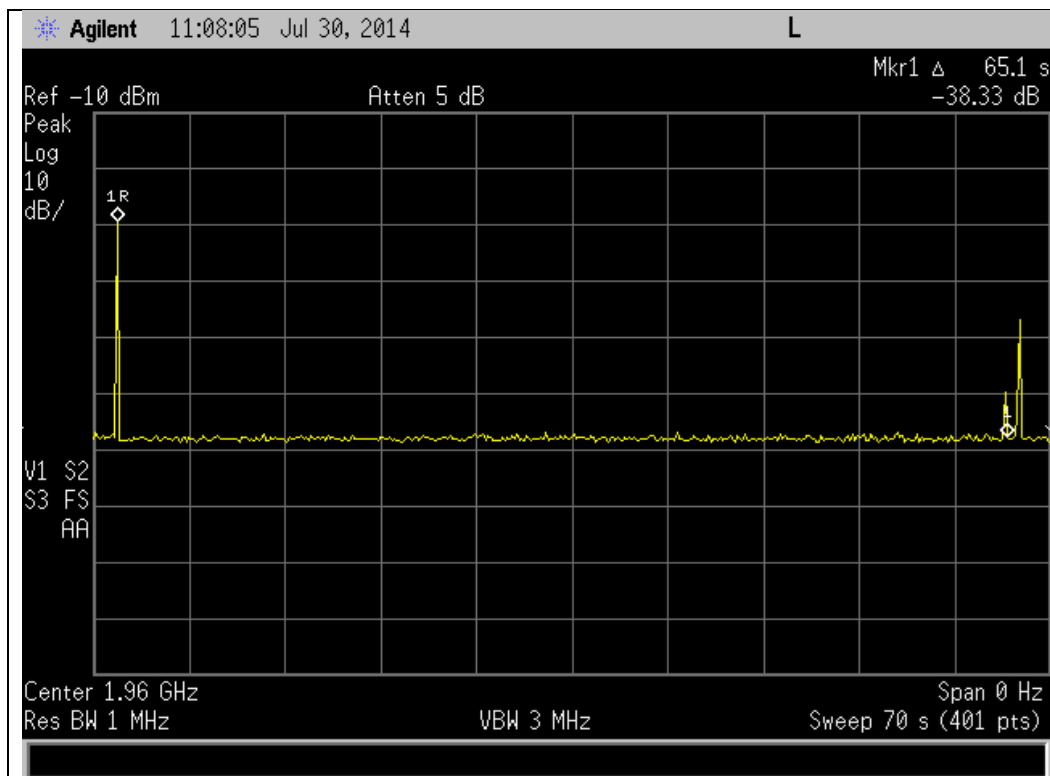


### 869 - 894 MHz Band



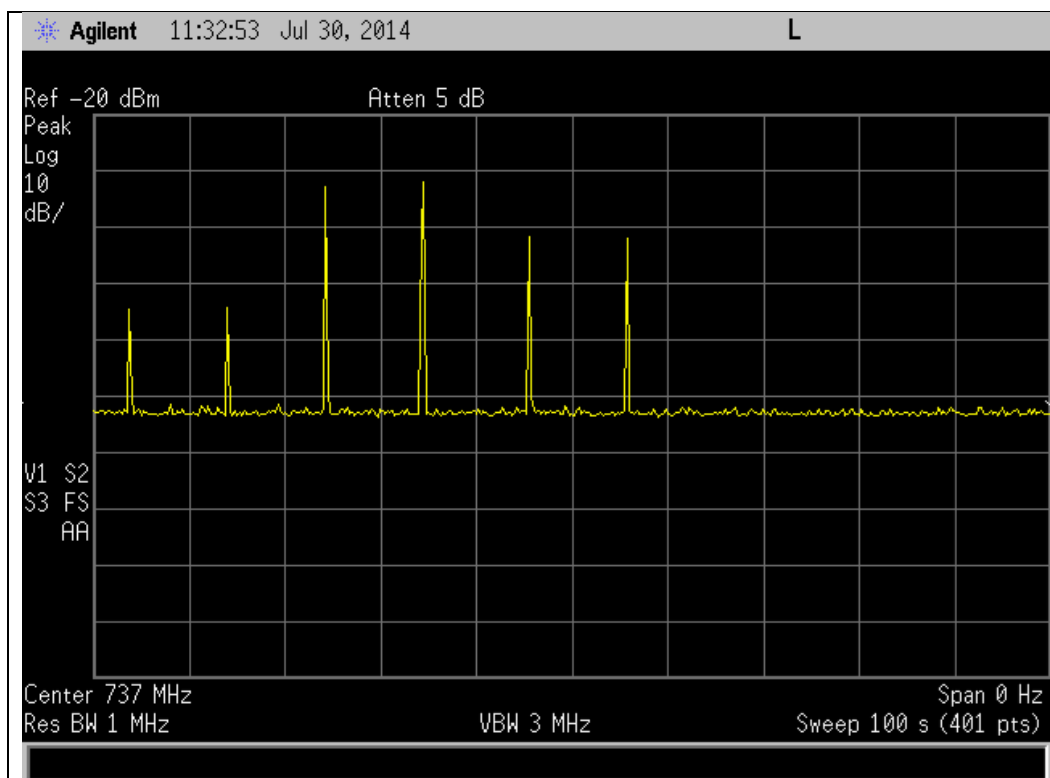


### 1930 - 1990 MHz Band



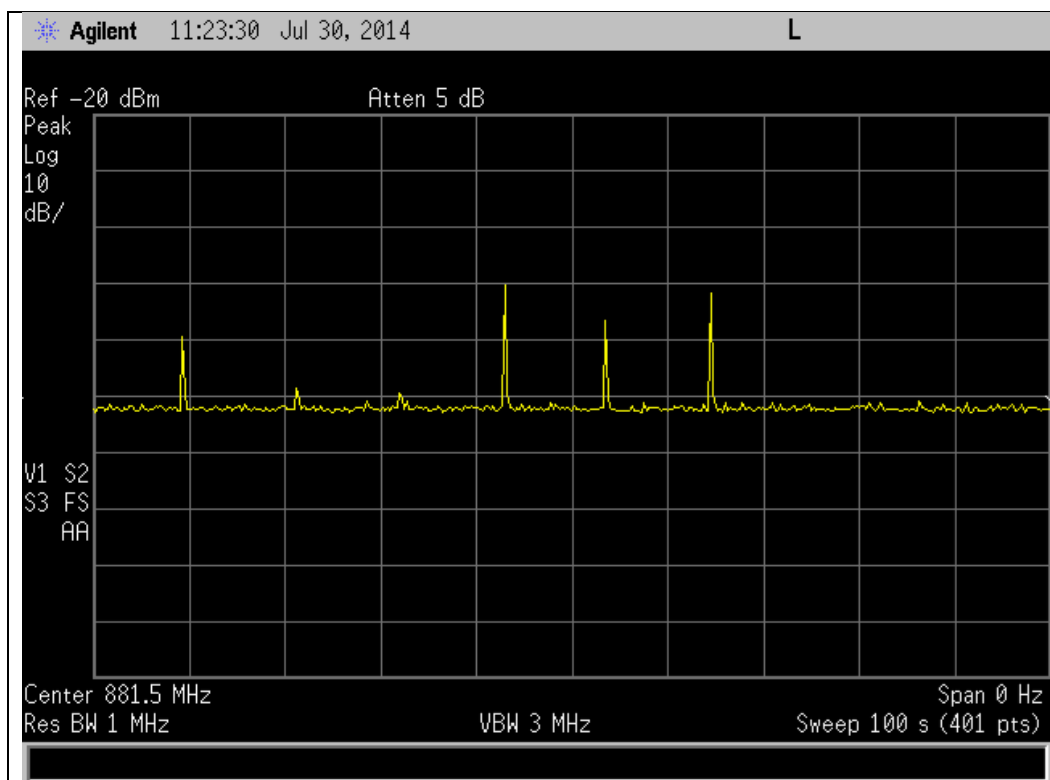
### Downlink Restart Count Test Results

### 728 - 746 MHz Band

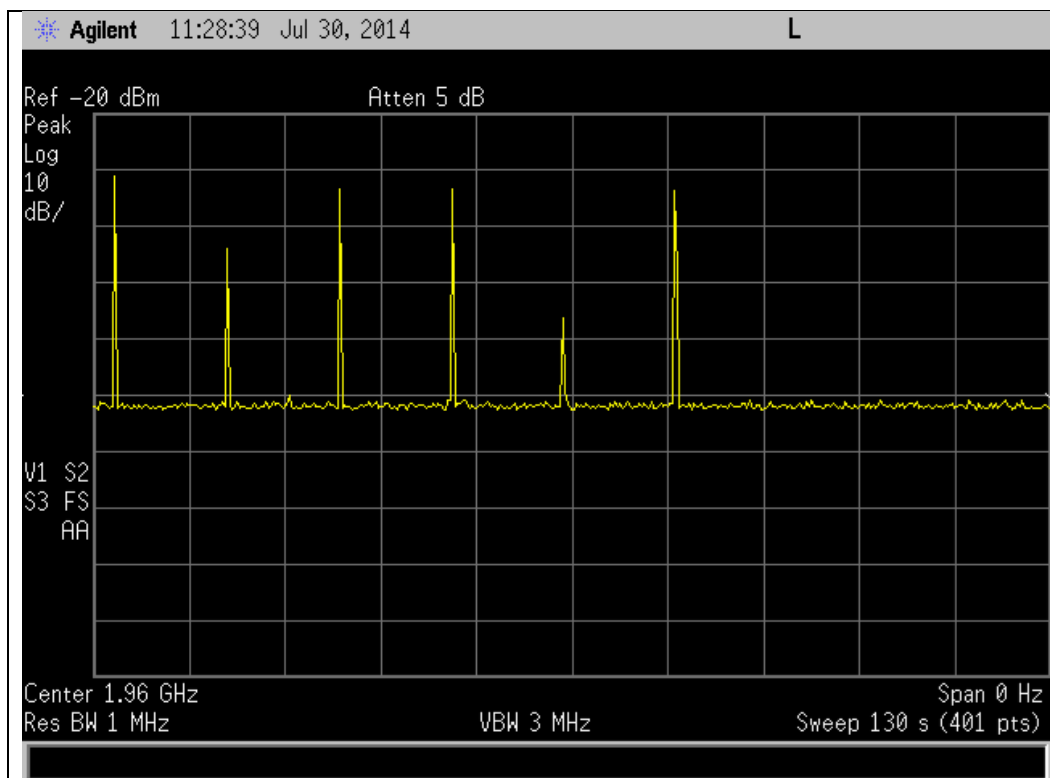




### 869 - 894 MHz Band



### 1930 - 1990 MHz Band





## Radiated Spurious

**Name of Test:** Radiated Spurious  
**Test Equipment Utilized:** i00405, i00103, i00379

**Engineer:** Mike Graffeo  
**Test Date:** 8/4/2014

### 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.

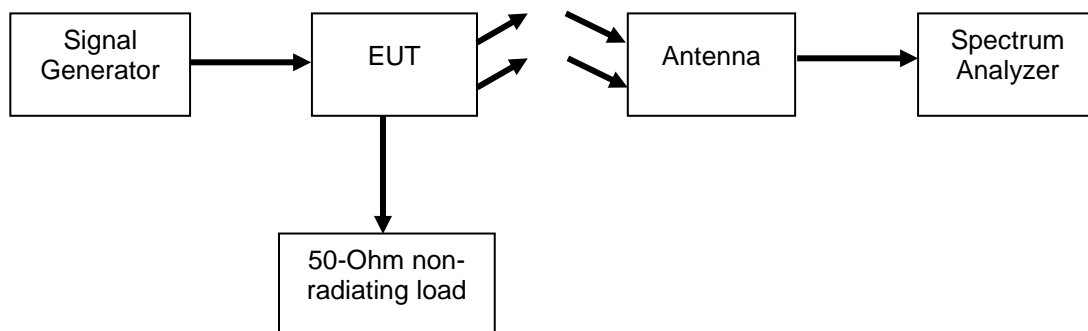
The following formula was used for calculating the limits:

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

### 698 - 716 MHz Band 707 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1414	-47.44	-13	Pass
2121	-39.76	-13	Pass
2828	-35.29	-13	Pass

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

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1673	-53.75	-13	Pass
2509.5	-48.67	-13	Pass
3346	-45.33	-13	Pass

### 1850 - 1910 MHz Band 1880 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
3760	-45.22	-13	Pass
5640	-40.23	-13	Pass
7520	-36.86	-13	Pass



## Downlink Test Results

### 728 - 746 MHz Band 737 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1474	-54.53	-13	Pass
2211	-44.90	-13	Pass
2948	-41.57	-13	Pass

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

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
1763	-52.03	-13	Pass
2644.5	-46.70	-13	Pass
3526	-44.57	-13	Pass

### 1930 - 1990 MHz Band 1960 MHz Tuned Frequency

Measured Frequency (MHz)	Measured Level (dBm)	Limit (dBm)	Result
3920	-46.33	-13	Pass
5880	-38.71	-13	Pass
7840	-35.98	-13	Pass

No other emissions were detected. All emissions were lower than -13 dBm.



### 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
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
Signal Generator	Rohde & Schwarz	SMU200A	i00405	12/11/13	12/11/14
RF Directional Coupler	Meca	CS06-1.500V	i00412	Verified on: 1/16/14	

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