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Test Report

Prepared for: Wilson Electronics, Inc.

Model: 460021

Description: Quint Band Signal Booster

FCC ID: PWO460021

To

FCC Part 20

Date of Issue: December 17, 2014

On the behalf of the applicant: **Wilson Electronics, Inc.**
3301 E Deseret Drive
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Attention of: **Patrick Cook, Sr Research & Development Engineer**
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Project No: p1490002



Mike Graffeo
Project Test Engineer

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	September 25, 2014	Mike Graffeo	Original Document
2.0	November 5, 2014	Mike Graffeo	Added photo for emissions <1GHz. Retested IM to include more points (2 x span/RBW)
3.0	December 17, 2014	Mike Graffeo	Added test data for RSSI-dependent region for variable noise tests.



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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

Sub-part

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: 460021

Description: Quint Band Signal Booster

Firmware: A460021A

Software: 460021A

Serial Number: N/A

Additional Information:

The EUT is a Mobile, 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)					
Uplink	698 - 716	776 - 787	824 - 849	1850 - 1915	1710 – 1755
Downlink	728 - 746	746 - 757	869 - 894	1930 - 1995	2110 - 2155
Modulation Type	LTE		GSM, CDMA, EDGE, HSPA, EVDO, LTE		CDMA, HSPA, LTE, EDGE, EVDO

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

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(c) 27.53(e) 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) Choose: 20.21(e)(8)(i)(C)(2)(iii) (Mobile)	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

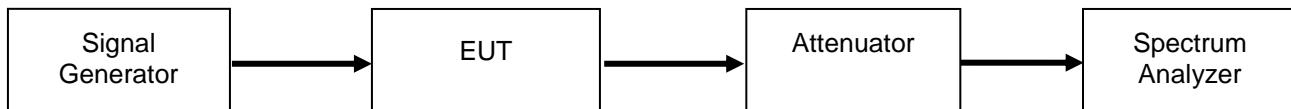
Engineer: Mike Graffeo

Test Date: 9/10/14

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.

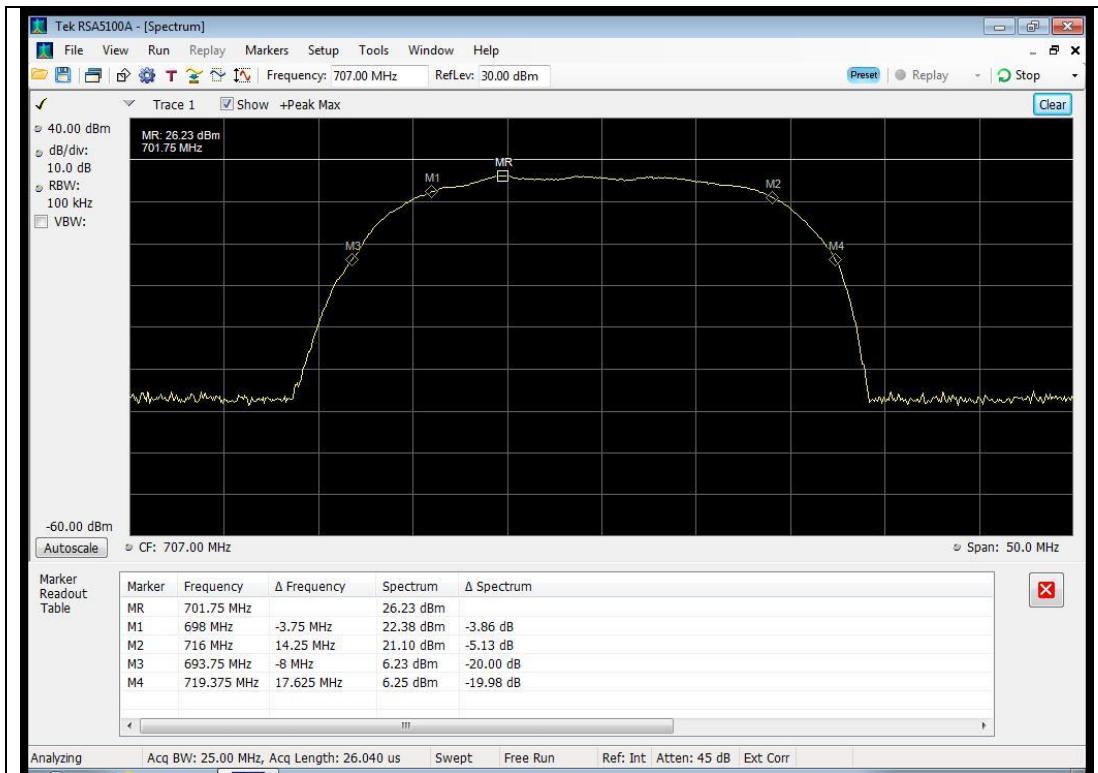
Test Setup



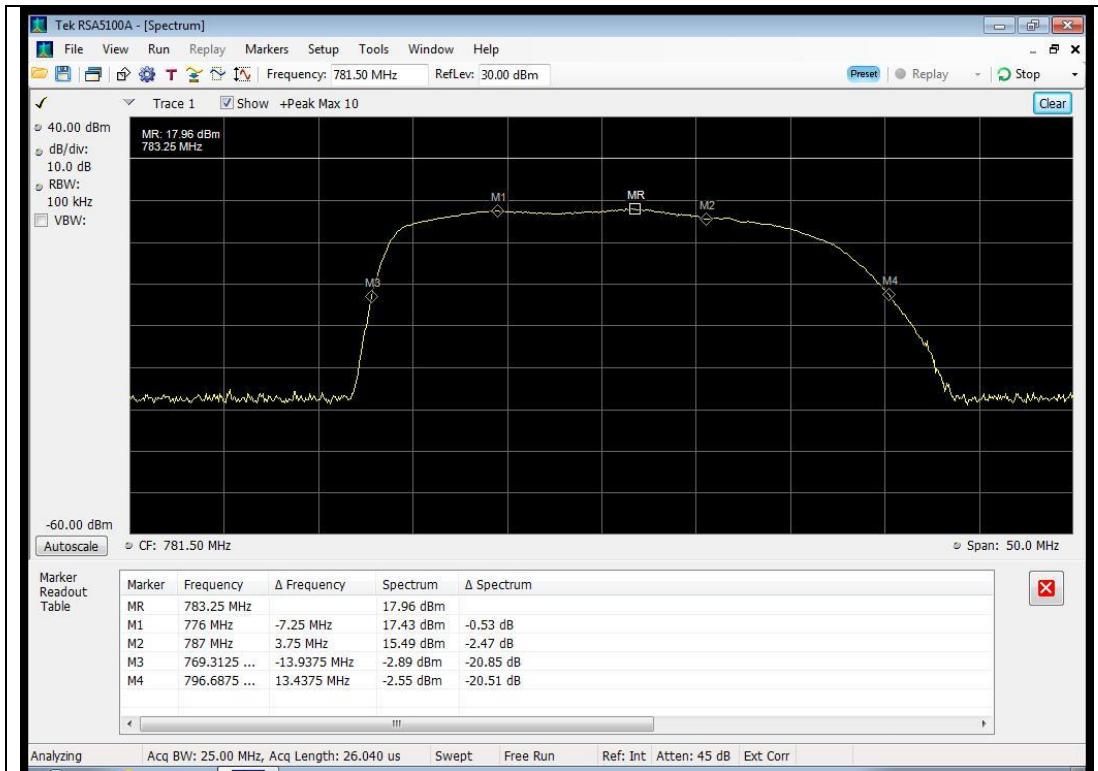


Uplink Test Results

698 - 716 MHz Band

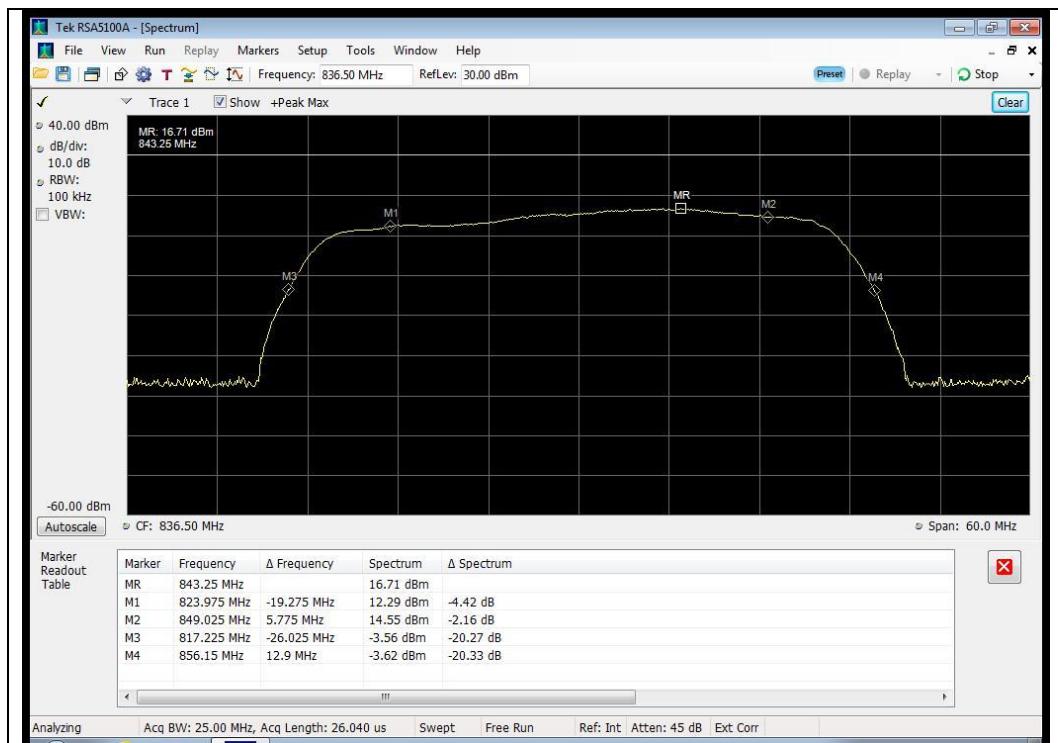


776 - 787 MHz Band

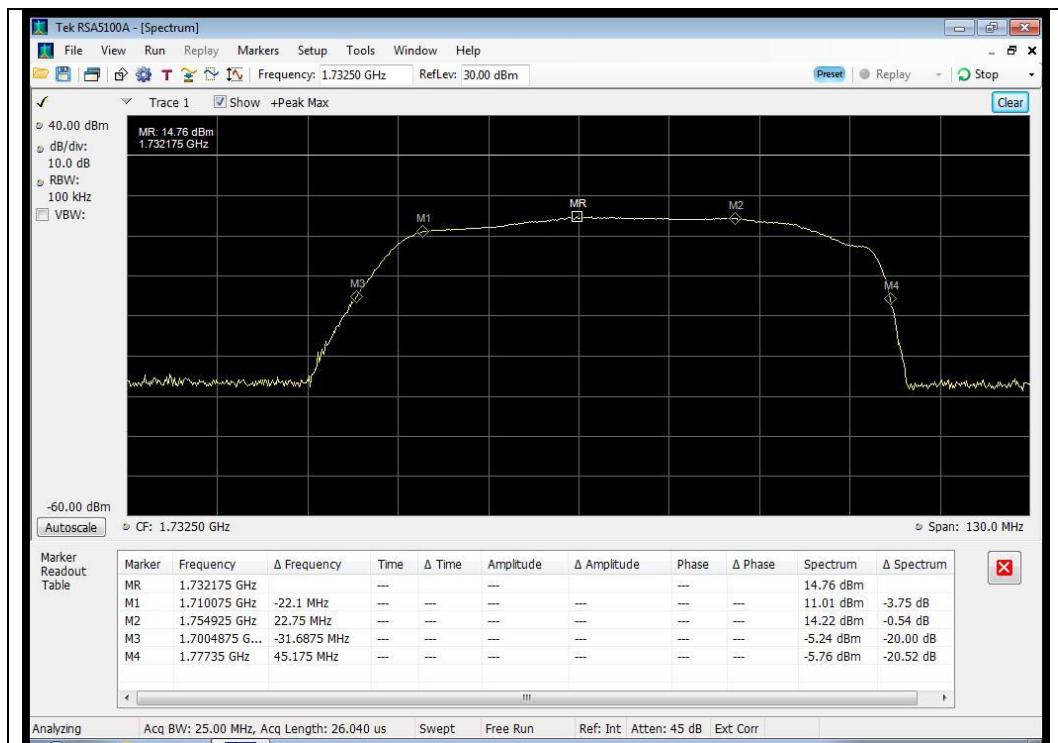




824 - 849 MHz Band

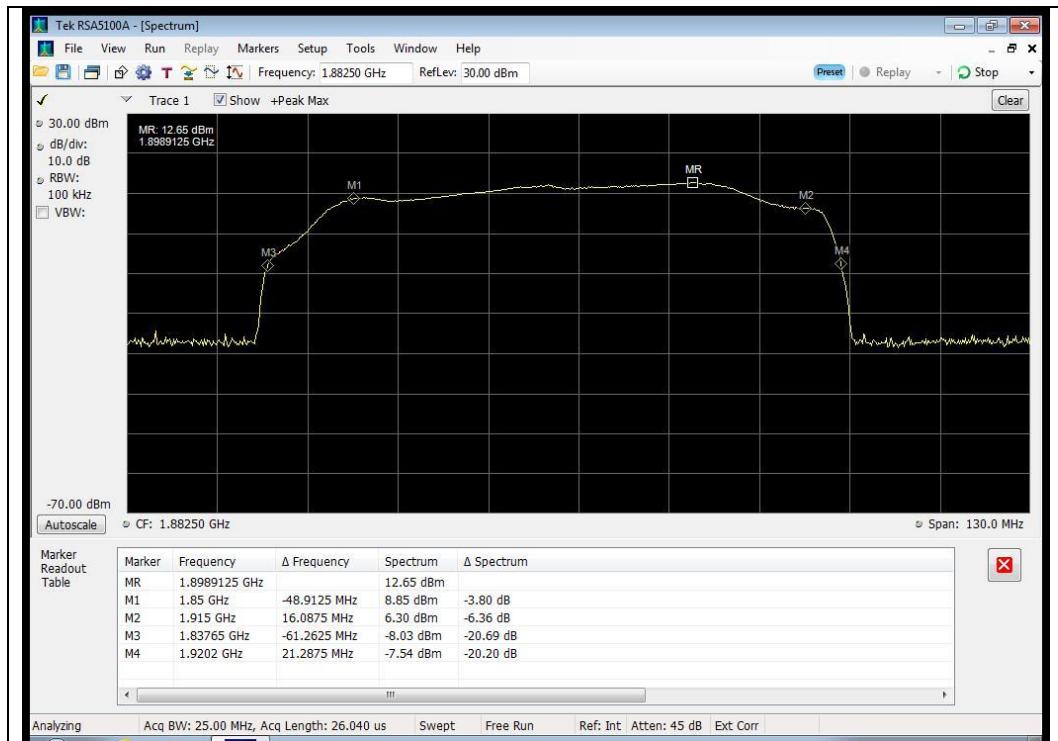


1710 - 1755 MHz Band



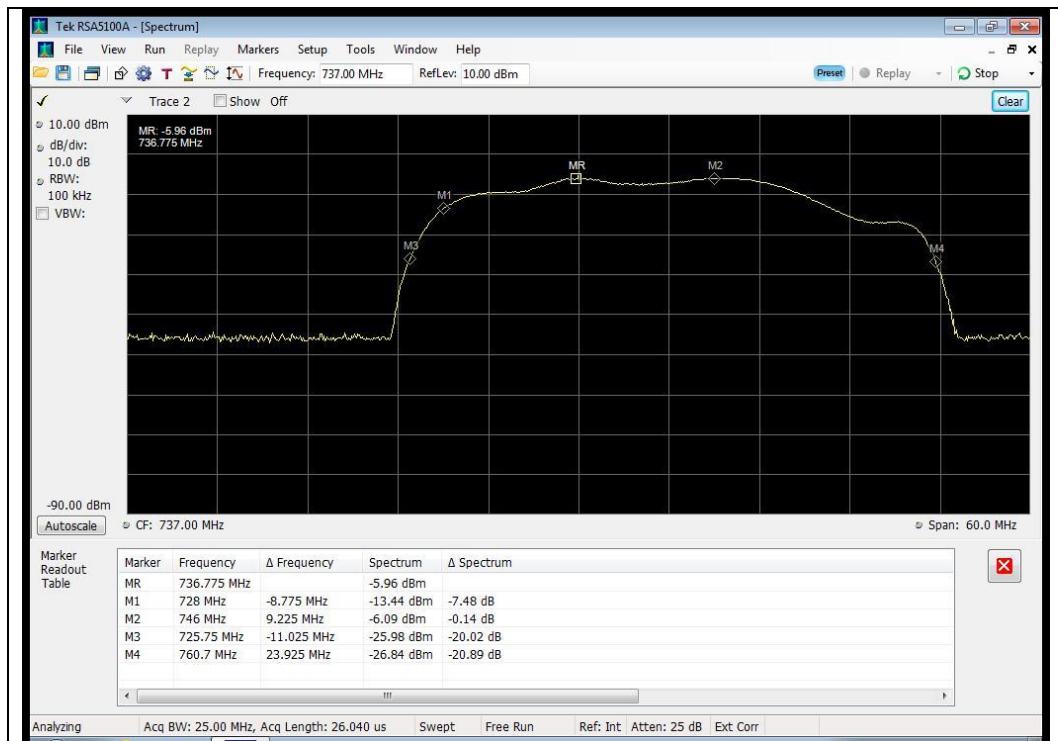


1850 - 1915 MHz Band



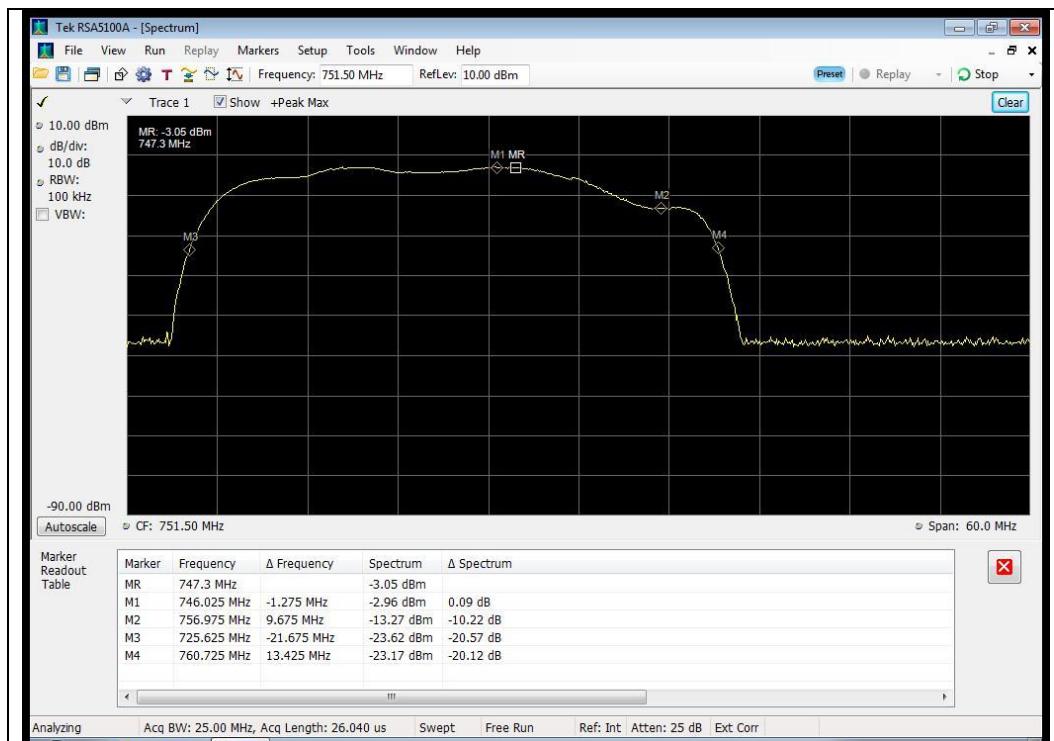
Downlink Test Results

728 - 746 MHz Band

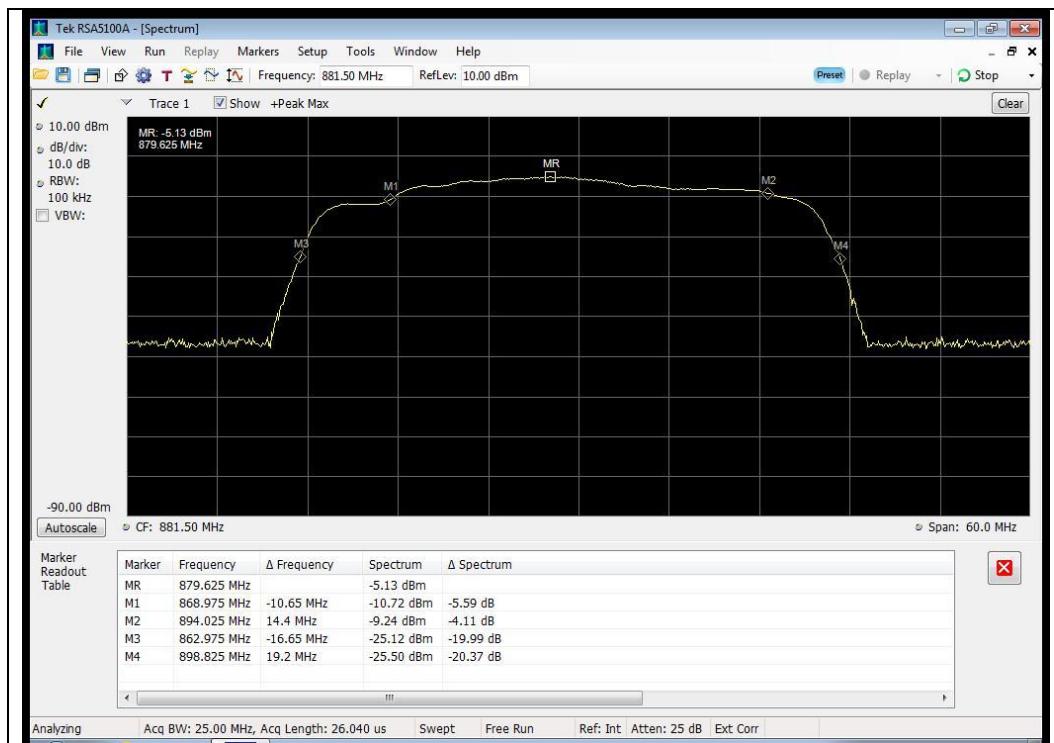




746 - 757 MHz Band

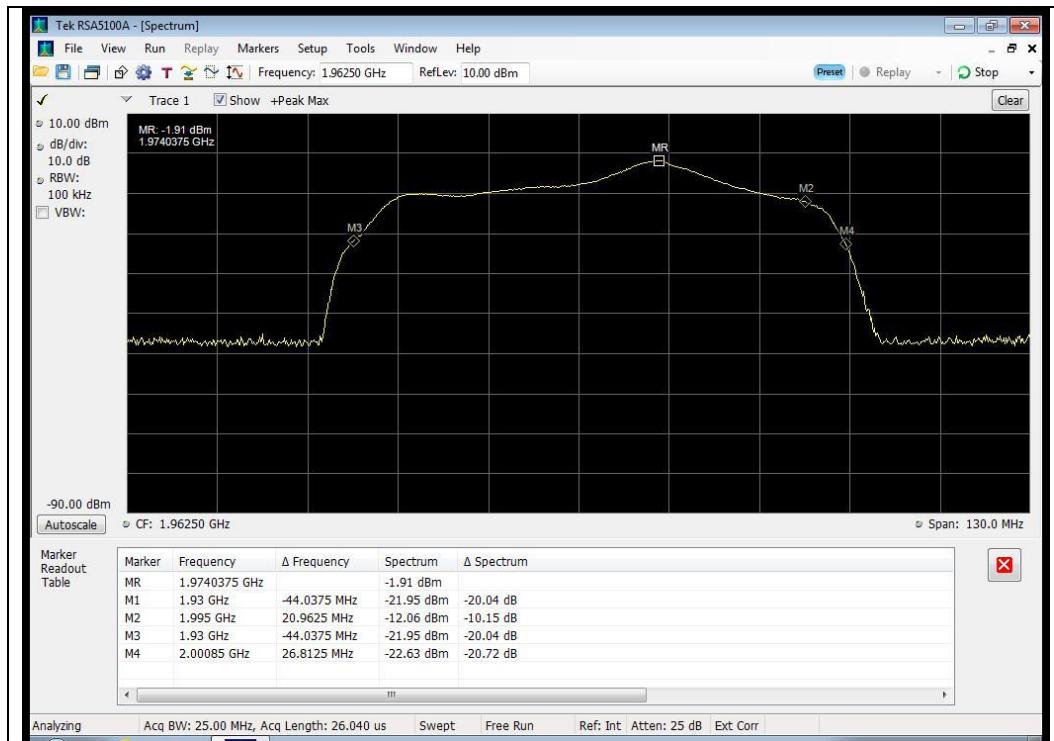


869 - 894 MHz Band

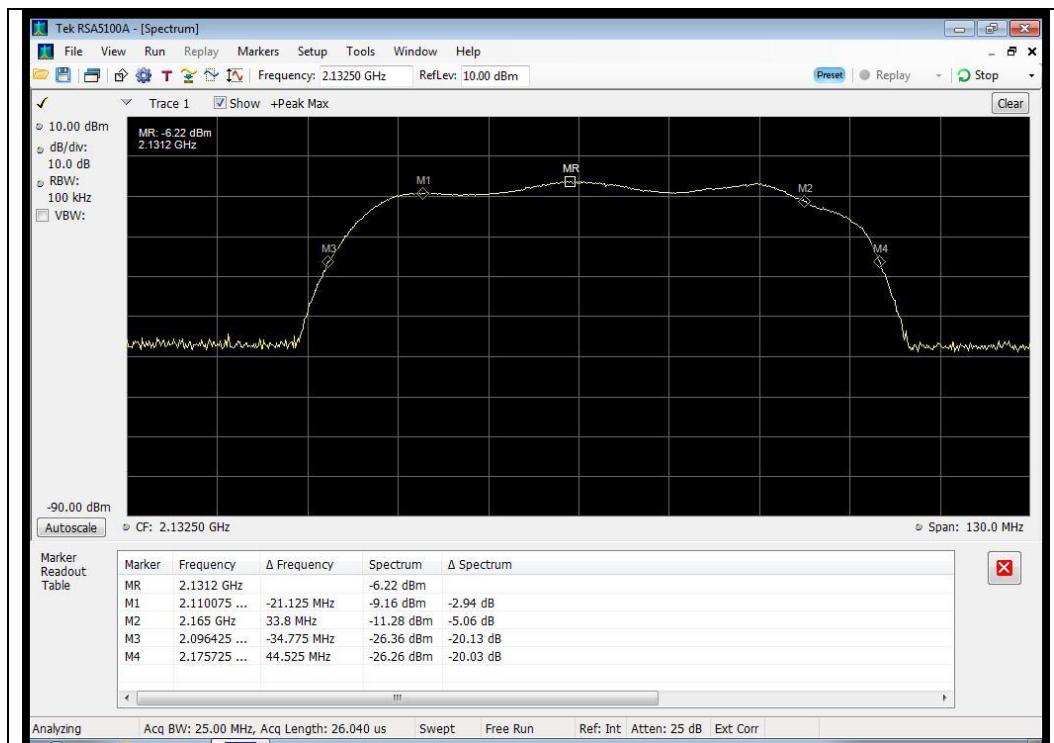




1930 - 1995 MHz Band



2110 - 2155 MHz Band





Maximum Power and Gain

Engineer: Mike Graffeo

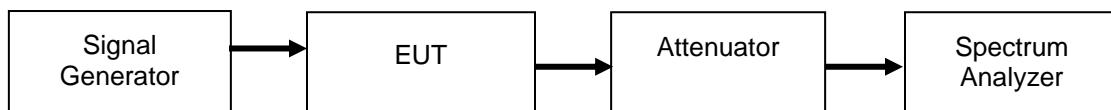
Test Date: 9/25/14

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 Mobile installations the gain is fixed at 50 dB.

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	-20.90	24.84	17	30	Pass
698 - 716 MHz AWGN	-20.60	24.35	17	30	Pass
776 - 787 MHz Pulsed GSM	-22.70	24.35	17	30	Pass
776 - 787 MHz AWGN	-23.10	23.20	17	30	Pass
824 - 849 MHz Pulsed GSM	-21.80	23.40	17	30	Pass
824 - 849 MHz AWGN	-23.20	21.47	17	30	Pass
1710 - 1755 MHz Pulsed GSM	-21.30	21.30	17	30	Pass
1710 - 1755 MHz AWGN	-23.00	20.51	17	30	Pass
1850 - 1915 MHz Pulsed GSM	-19.80	24.43	17	30	Pass
1850 - 1915 MHz AWGN	-21.30	22.40	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	-45.80	2.15	17	Pass
728 - 746 MHz AWGN	-44.50	2.87	17	Pass
746 - 757 MHz Pulsed GSM	-45.30	2.38	17	Pass
746 - 757 MHz AWGN	-44.80	2.79	17	Pass
869 - 894 MHz Pulsed GSM	-47.20	0.04	17	Pass
869 - 894 MHz AWGN	-45.20	2.83	17	Pass
1930 - 1995 MHz Pulsed GSM	-44.90	-0.30	17	Pass
1930 - 1995 MHz AWGN	-43.20	1.92	17	Pass
2110 - 2155 MHz Pulsed GSM	-44.20	1.64	17	Pass
2110 - 2155 MHz AWGN	-44.00	2.00	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	701.75	736.78	45.74	50	48.0	50	2.21	9	-6.79
AWGN	701.75	736.78	44.95	50	47.4	50	2.42	9	-6.58
Pulsed GSM	783.25	748.50	47.05	50	47.7	50	0.63	9	-8.37
AWGN	783.25	748.50	46.30	50	47.6	50	1.29	9	-7.71
Pulsed GSM	843.25	879.63	45.20	50	47.2	50	2.035	9	-6.965
AWGN	843.25	879.63	44.67	50	48.0	50	3.36	9	-5.64
Pulsed GSM	1732.17	2131.20	42.60	50	45.8	50	3.24	9	-5.76
AWGN	1732.17	2131.20	43.51	50	46.0	50	2.49	9	-6.51
Pulsed GSM	1898.91	1974.04	44.23	50	44.6	50	0.37	9	-8.63
AWGN	1898.91	1974.04	43.70	50	45.1	50	1.42	9	-7.58



Intermodulation

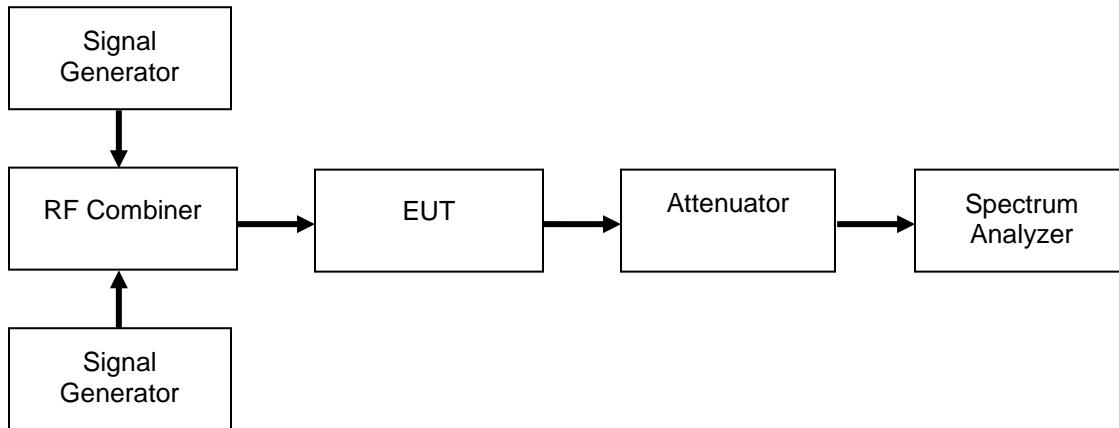
Engineer: Mike Graffeo

Test Date: 9/24/14

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	-20.09	-19	Pass
776 - 787 MHz	-20.60	-19	Pass
824 - 849 MHz	-19.26	-19	Pass
1710 - 1755 MHz	-19.07	-19	Pass
1850 - 1915 MHz	-19.88	-19	Pass

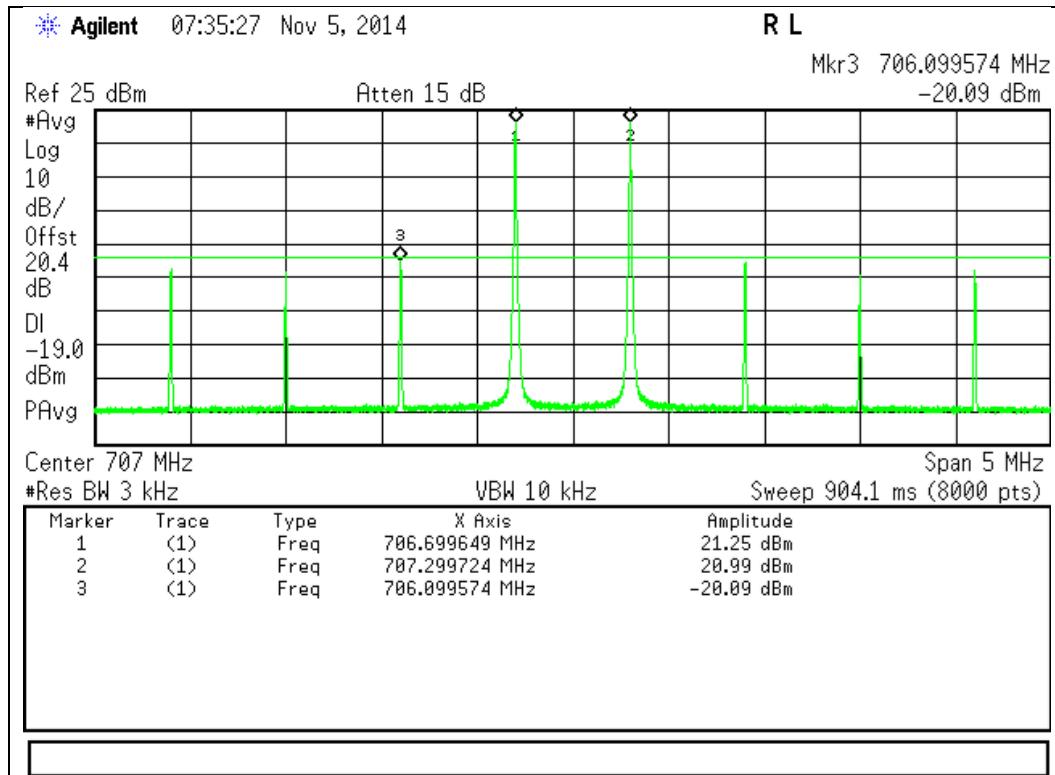
Downlink Test Results

Frequency Band (MHz)	Intermodulation Level (dBm)	Limit (dBm)	Result
728 - 746 MHz	-31.45	-19	Pass
746 - 757 MHz	-29.25	-19	Pass
869 - 894 MHz	-42.01	-19	Pass
1930 - 1995 MHz	-50.16	-19	Pass
2110 - 2155 MHz	-48.61	-19	Pass

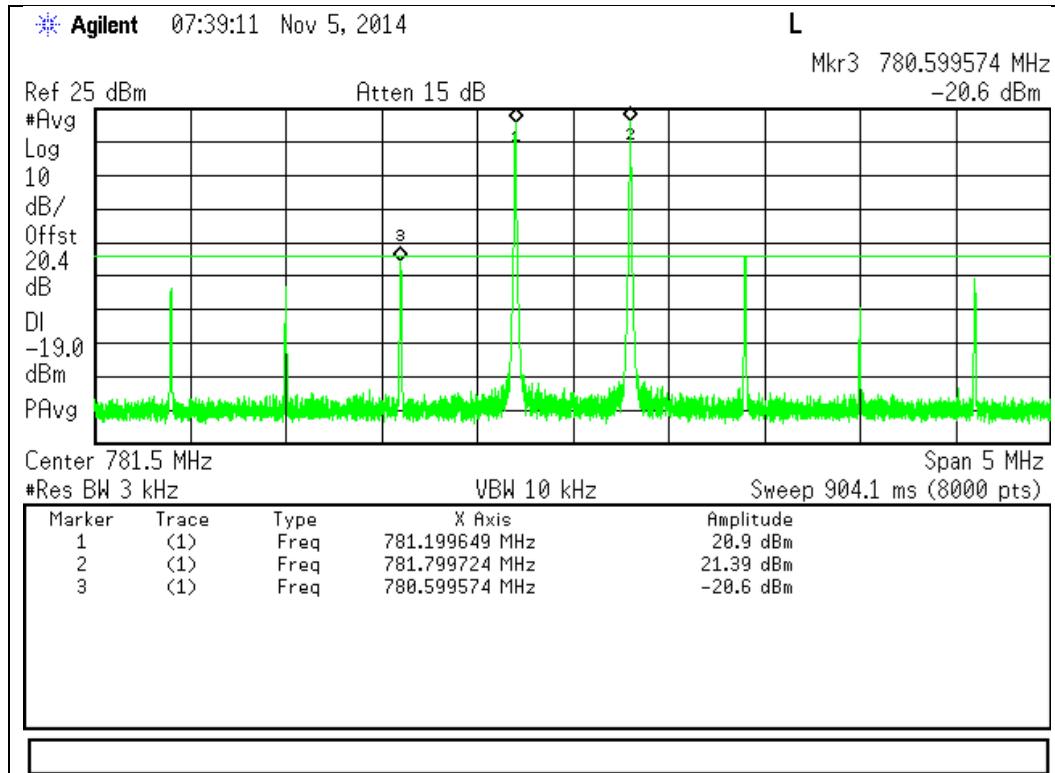


Uplink Test Results

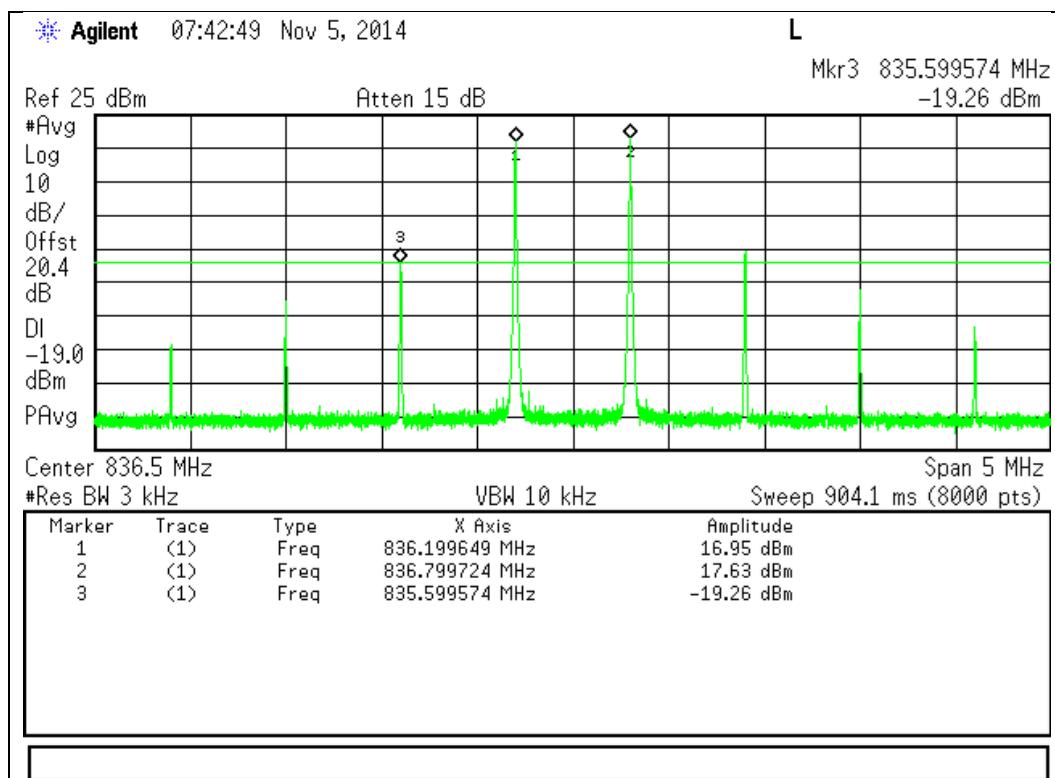
698 - 716 MHz Band



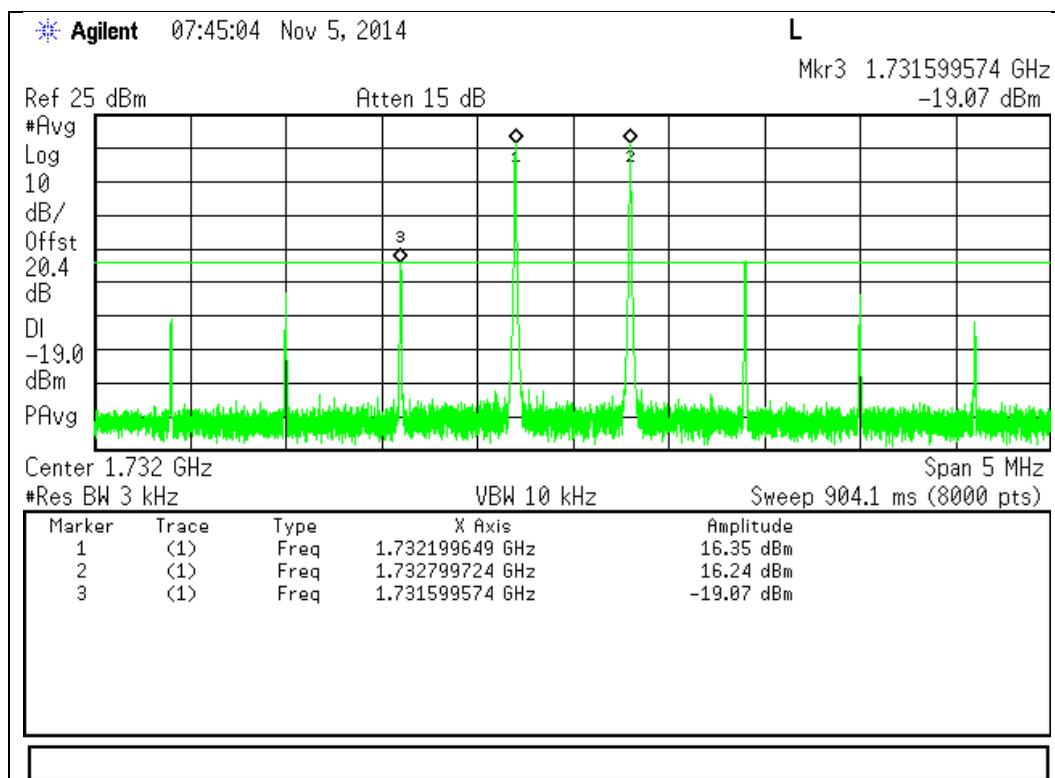
776 - 787 MHz Band



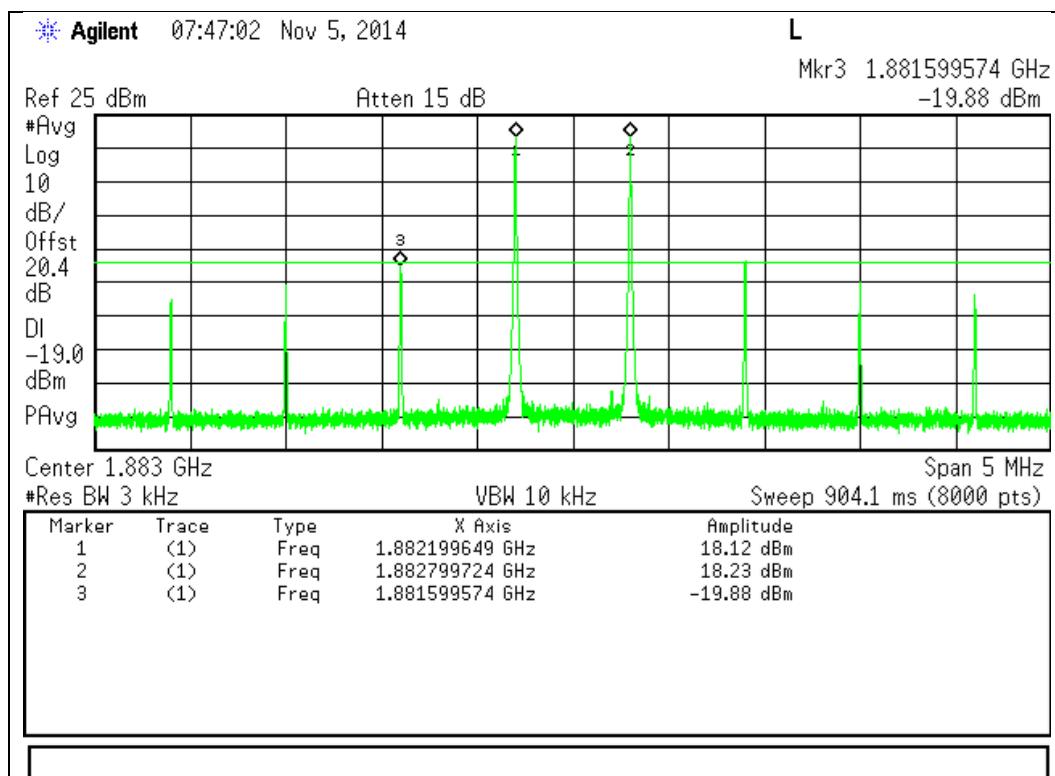
824 - 849 MHz Band



1710 - 1755 MHz Band

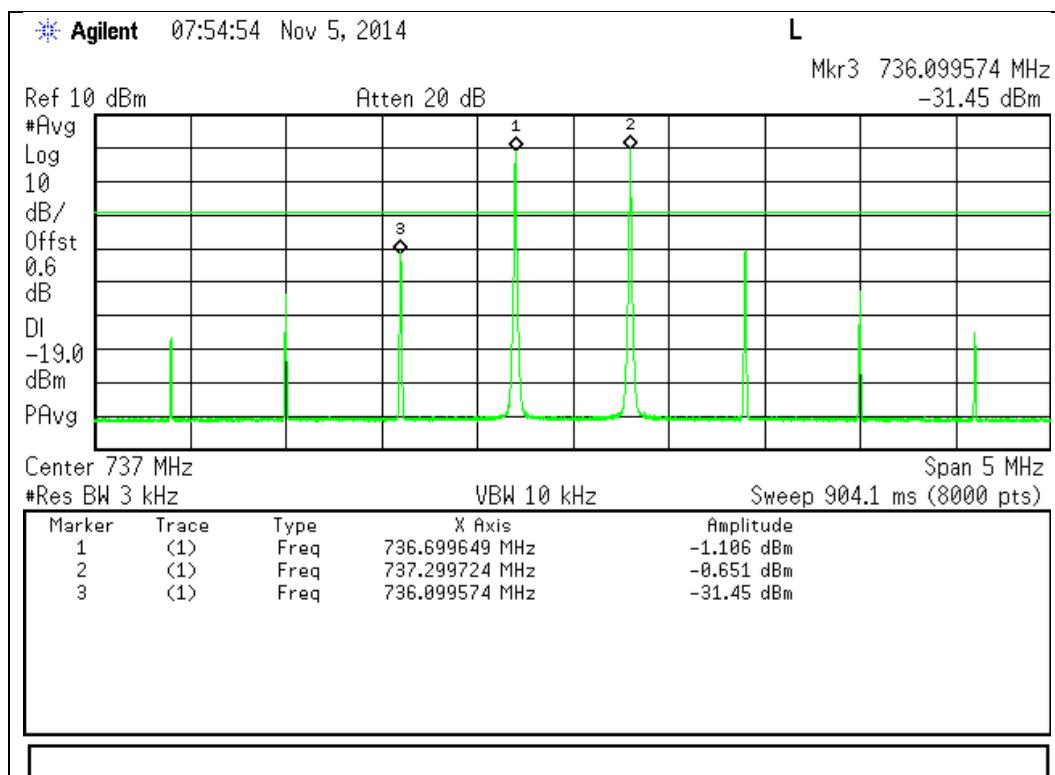


1850 - 1915 MHz Band

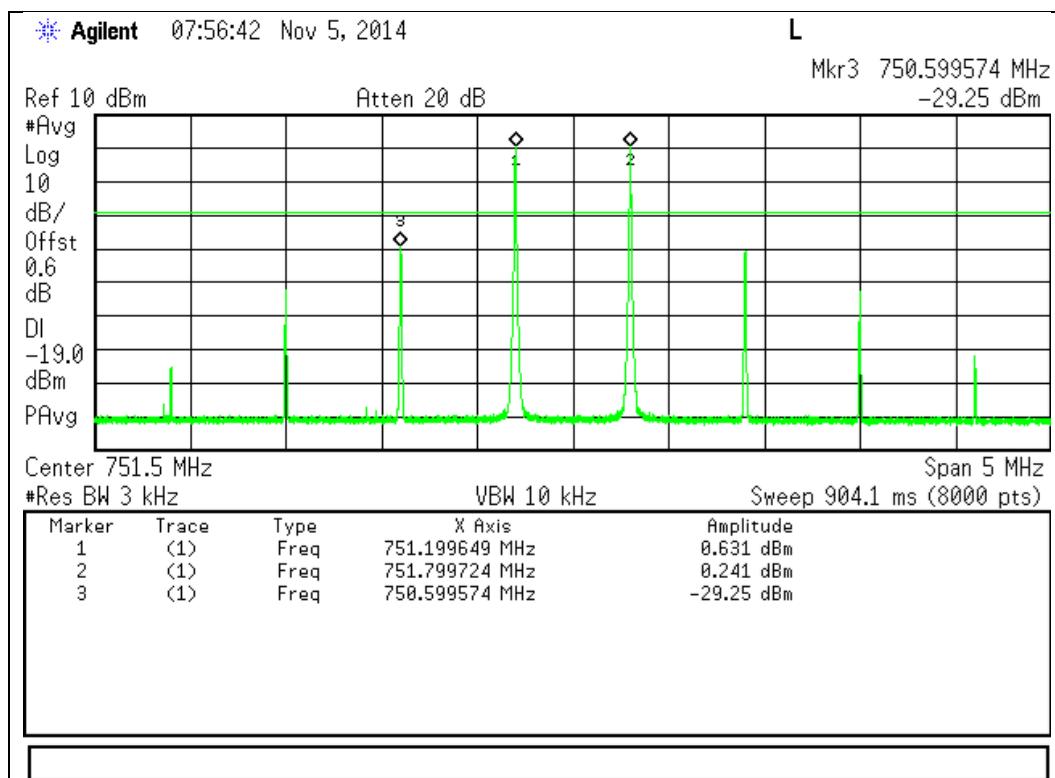


Downlink Test Results

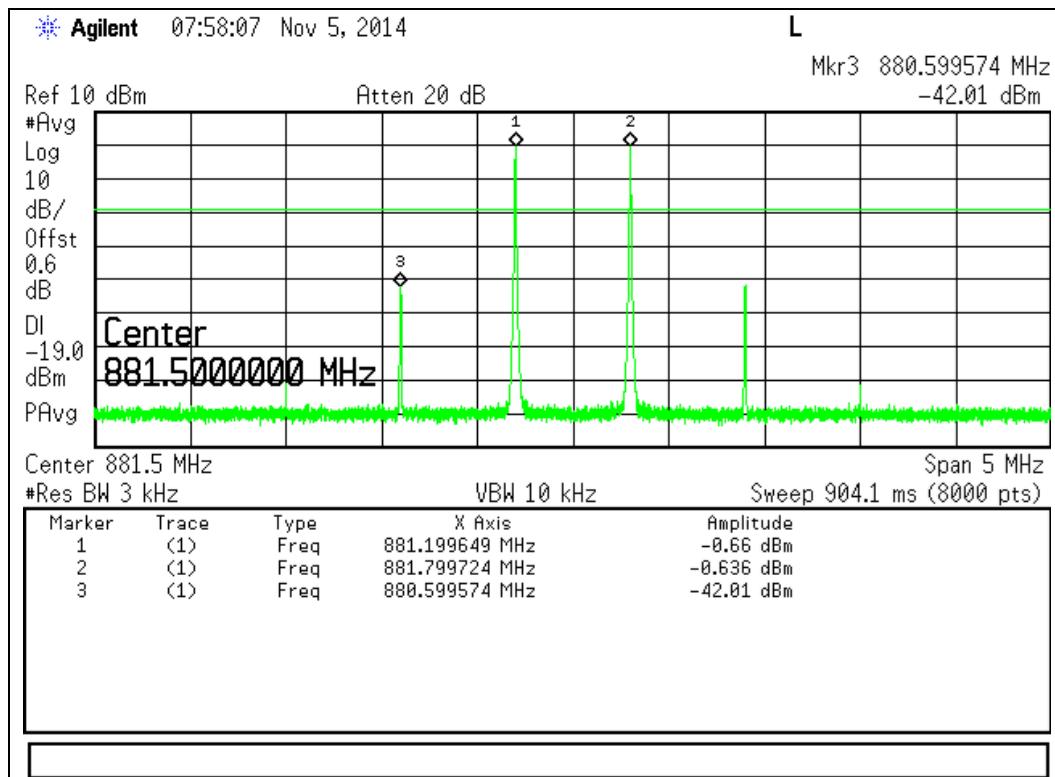
728 - 746 MHz Band



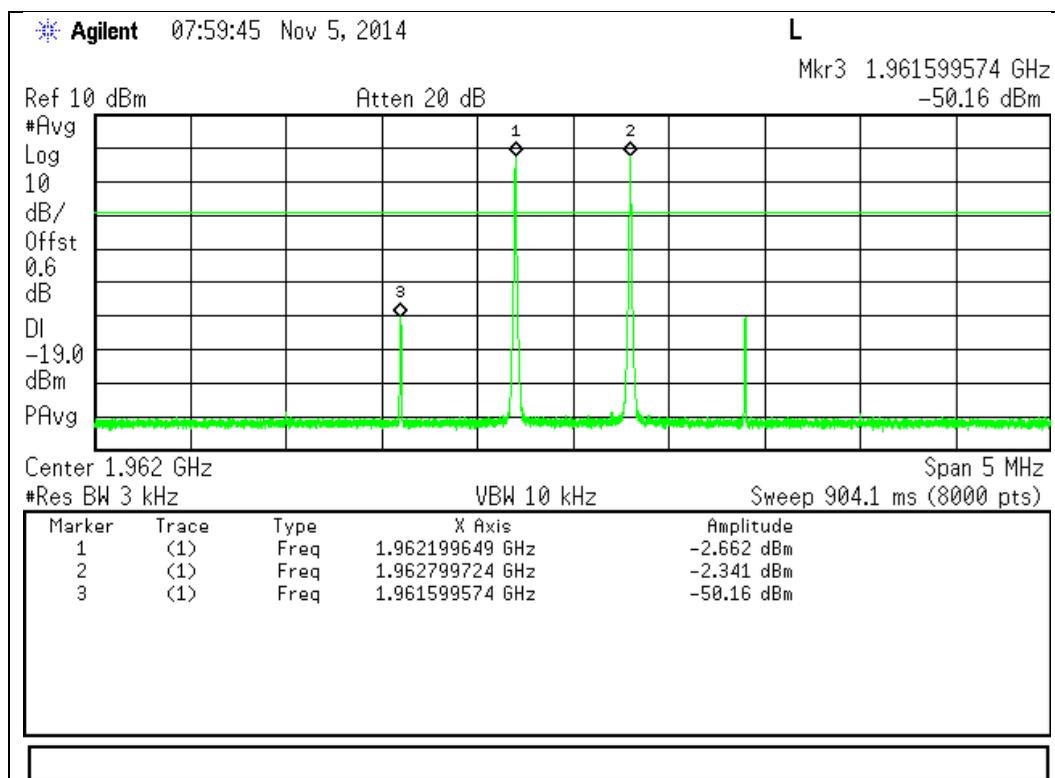
746 - 757 MHz Band



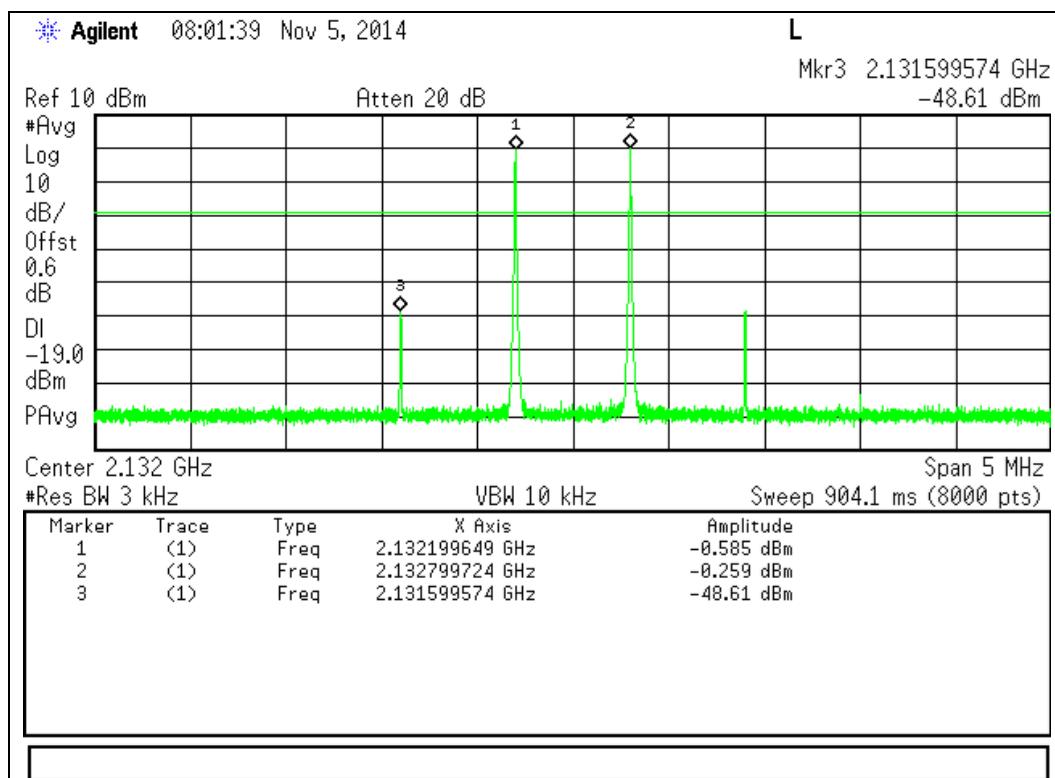
869 - 894 MHz Band



1930 - 1995 MHz Band



2110 - 2155 MHz Band



Out-of-Band Emissions

Engineer: Mike Graffeo

Test Date: 9/26/14

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	-22.27	-19	Pass
698 - 716	Upper	-22.31	-19	Pass
776 - 787	Lower	-22.08	-19	Pass
776 - 787	Upper	-23.13	-19	Pass
824 - 849	Lower	-36.91	-19	Pass
824 - 849	Upper	-35.86	-19	Pass
1710 - 1755	Lower	-38.26	-19	Pass
1710 - 1755	Upper	-35.32	-19	Pass
1850 - 1915	Lower	-36.5	-19	Pass
1850 - 1915	Upper	-35.97	-19	Pass

CDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
698 - 716	Lower	-37.71	-19	Pass
698 - 716	Upper	-33.48	-19	Pass
776 - 787	Lower	-35.19	-19	Pass
776 - 787	Upper	-42.23	-19	Pass
824 - 849	Lower	-37.74	-19	Pass
824 - 849	Upper	-37.00	-19	Pass
1710 - 1755	Lower	-42.46	-19	Pass
1710 - 1755	Upper	-38.35	-19	Pass
1850 - 1915	Lower	-37.67	-19	Pass
1850 - 1915	Upper	-43.36	-19	Pass



WCDMA Uplink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
698 - 716	Lower	-37.43	-19	Pass
698 - 716	Upper	-36.65	-19	Pass
776 - 787	Lower	-36.55	-19	Pass
776 - 787	Upper	-45.41	-19	Pass
824 - 849	Lower	-38.59	-19	Pass
824 - 849	Upper	-36.22	-19	Pass
1710 - 1755	Lower	-36.20	-19	Pass
1710 - 1755	Upper	-32.08	-19	Pass
1850 - 1915	Lower	-36.74	-19	Pass
1850 - 1915	Upper	-35.66	-19	Pass

GSM Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-45.98	-19	Pass
728 - 746	Upper	-38.90	-19	Pass
746 - 757	Lower	-37.81	-19	Pass
746 - 757	Upper	-49.39	-19	Pass
869 - 894	Lower	-56.86	-19	Pass
869 - 894	Upper	-56.22	-19	Pass
1930 - 1995	Lower	-86.28	-19	Pass
1930 - 1995	Upper	-62.91	-19	Pass
2110 - 2155	Lower	-55.28	-19	Pass
2110 - 2155	Upper	-53.52	-19	Pass

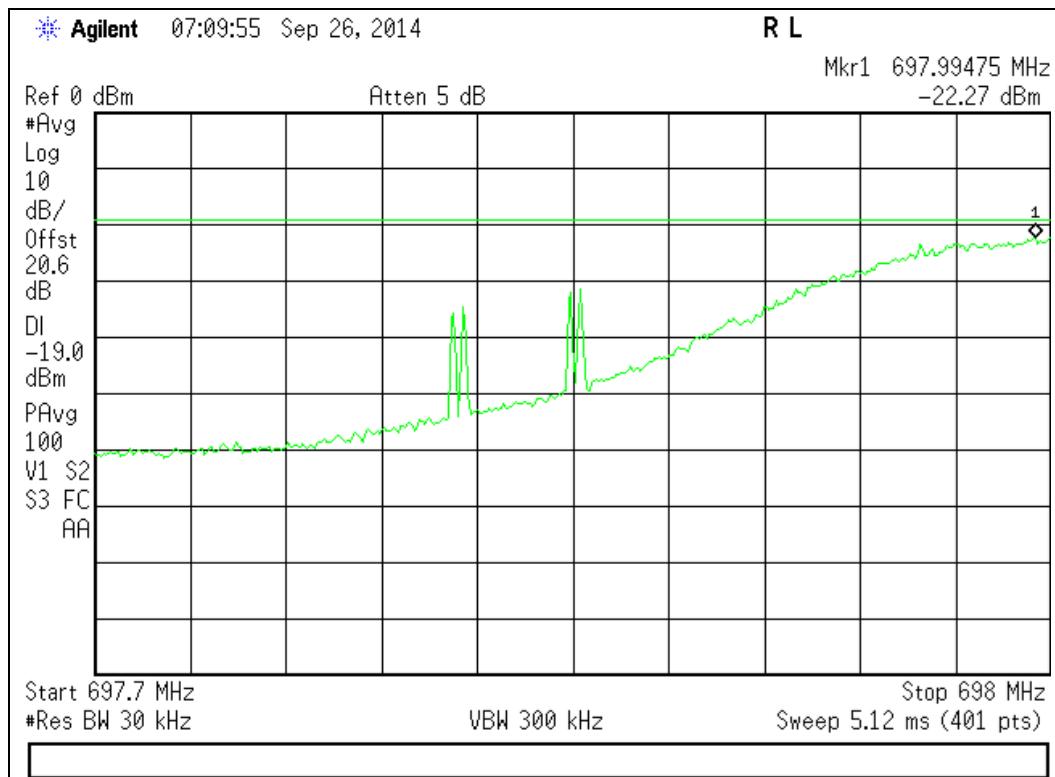
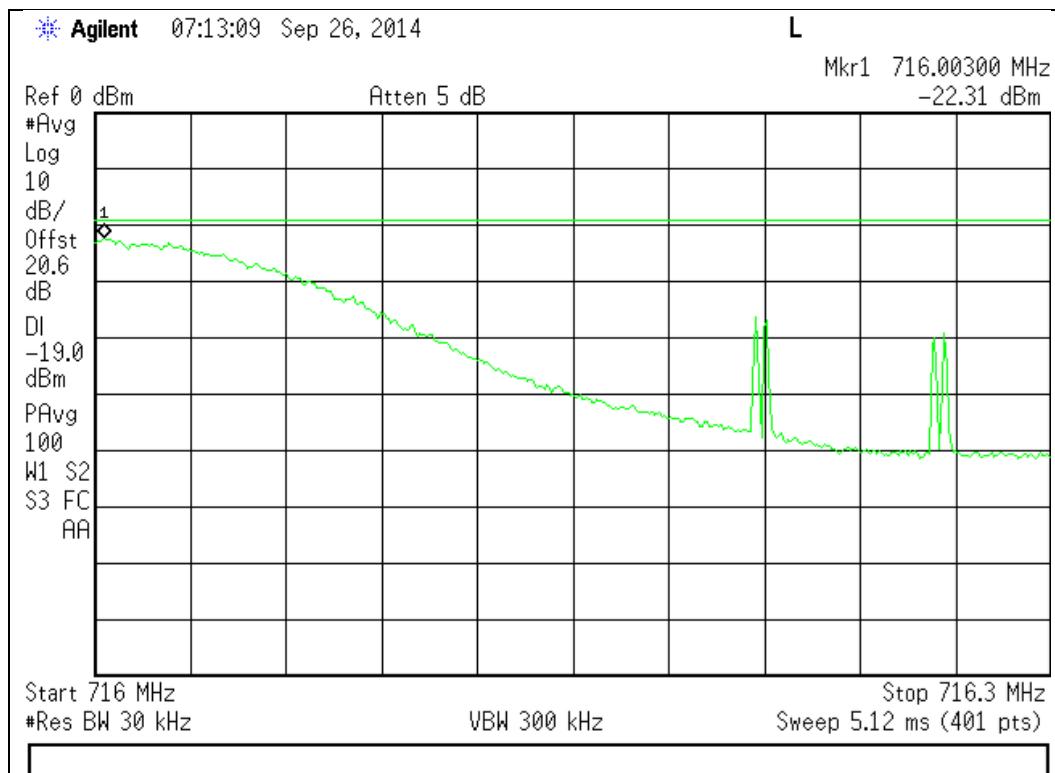


CDMA Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-69.52	-19	Pass
728 - 746	Upper	-54.34	-19	Pass
746 - 757	Lower	-52.14	-19	Pass
746 - 757	Upper	-74.06	-19	Pass
869 - 894	Lower	-70.27	-19	Pass
869 - 894	Upper	-65.61	-19	Pass
1930 - 1995	Lower	-77.50	-19	Pass
1930 - 1995	Upper	-76.75	-19	Pass
2110 - 2155	Lower	-70.11	-19	Pass
2110 - 2155	Upper	-61.45	-19	Pass

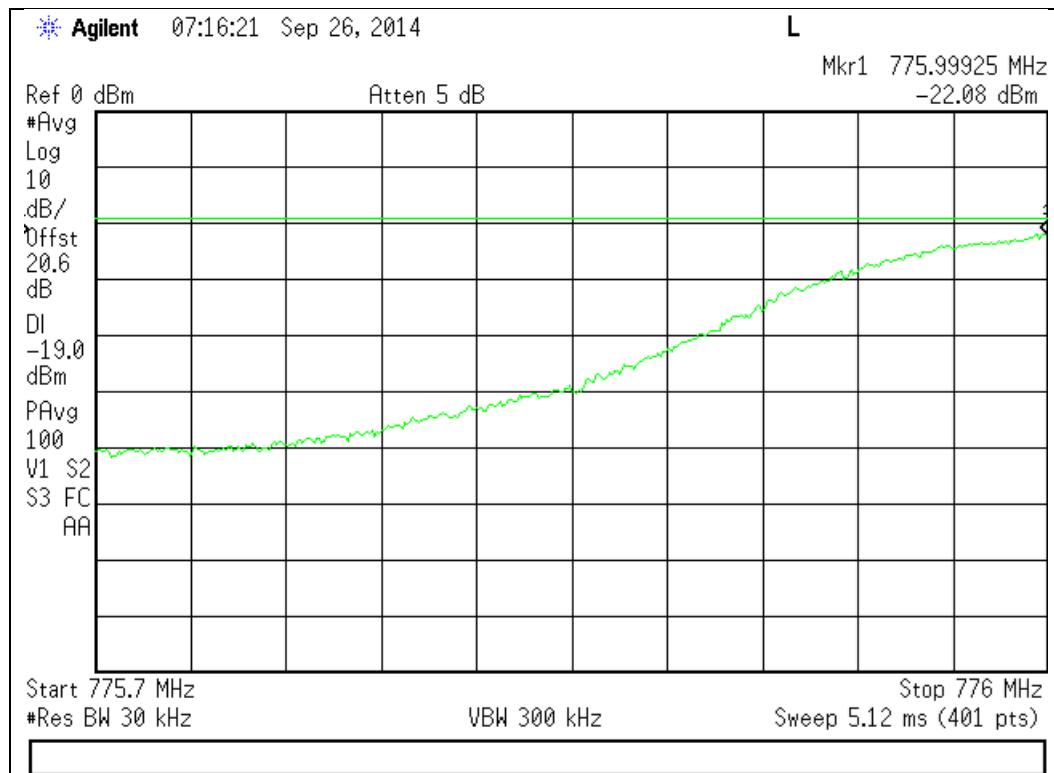
WCDMA Downlink Test Results

Frequency Band (MHz)	Band Edge	Measured Level (dBm)	Limit (dBm)	Result
728 - 746	Lower	-68.09	-19	Pass
728 - 746	Upper	-56.54	-19	Pass
746 - 757	Lower	-53.13	-19	Pass
746 - 757	Upper	-71.58	-19	Pass
869 - 894	Lower	-61.26	-19	Pass
869 - 894	Upper	-59.09	-19	Pass
1930 - 1995	Lower	-71.33	-19	Pass
1930 - 1995	Upper	-65.65	-19	Pass
2110 - 2155	Lower	-62.28	-19	Pass
2110 - 2155	Upper	-56.16	-19	Pass

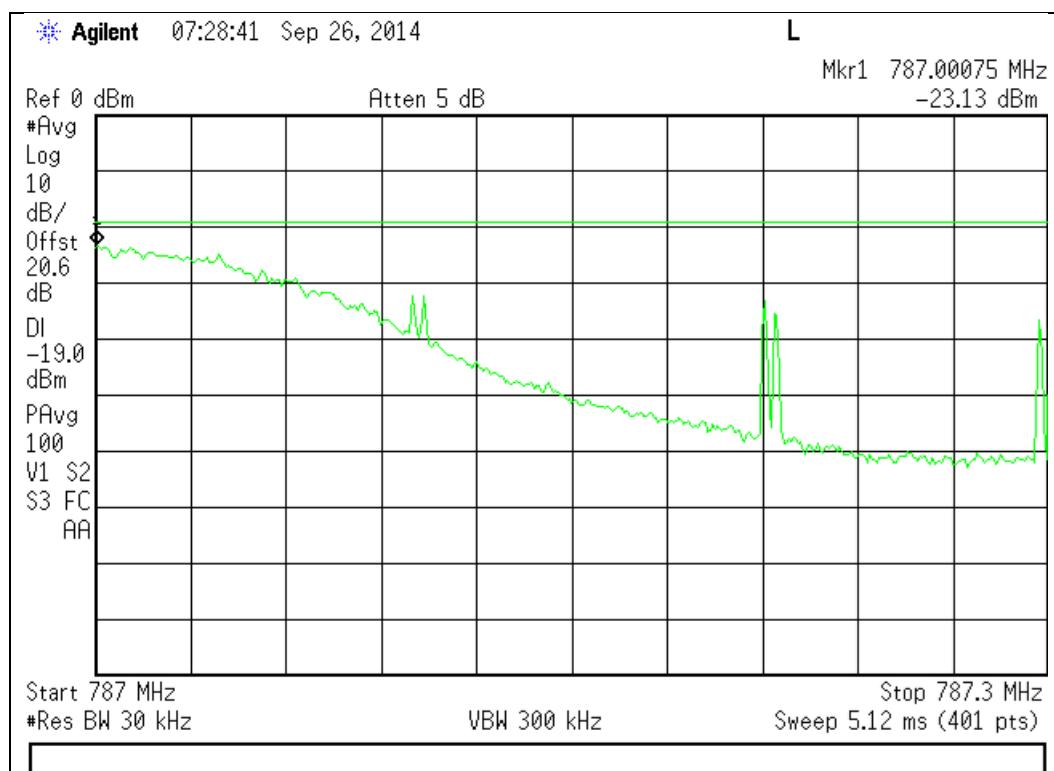
GSM Uplink Test Plots**698 - 716 MHz Band****Lower Band Edge****Upper Band Edge**

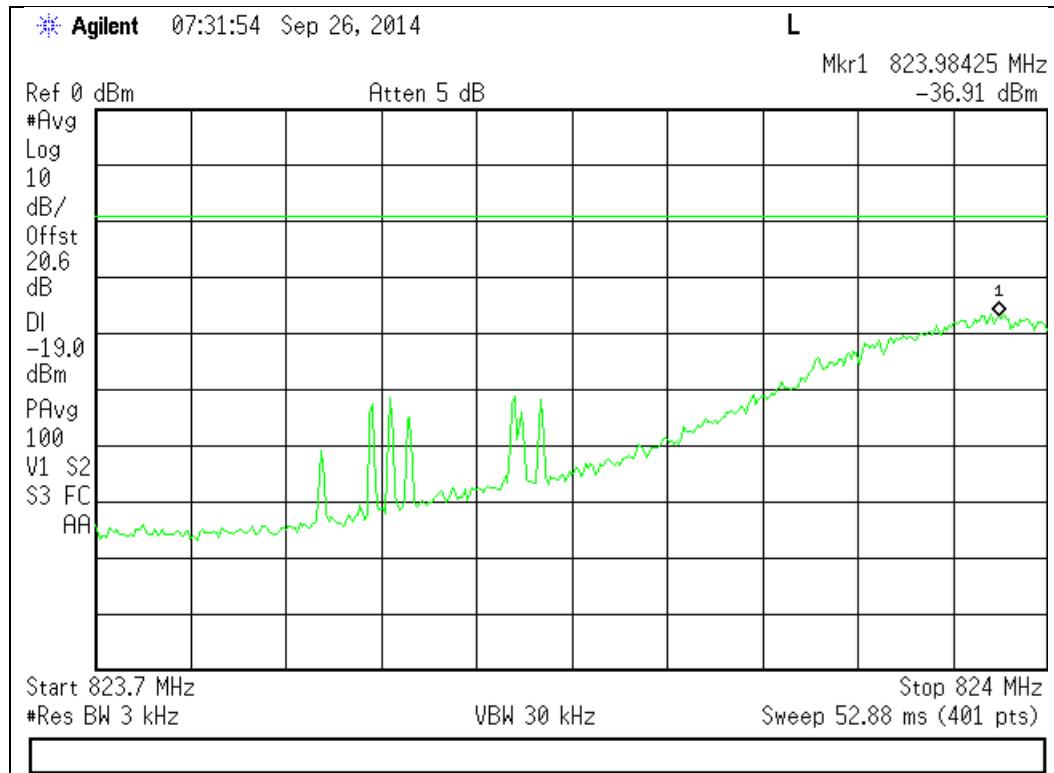
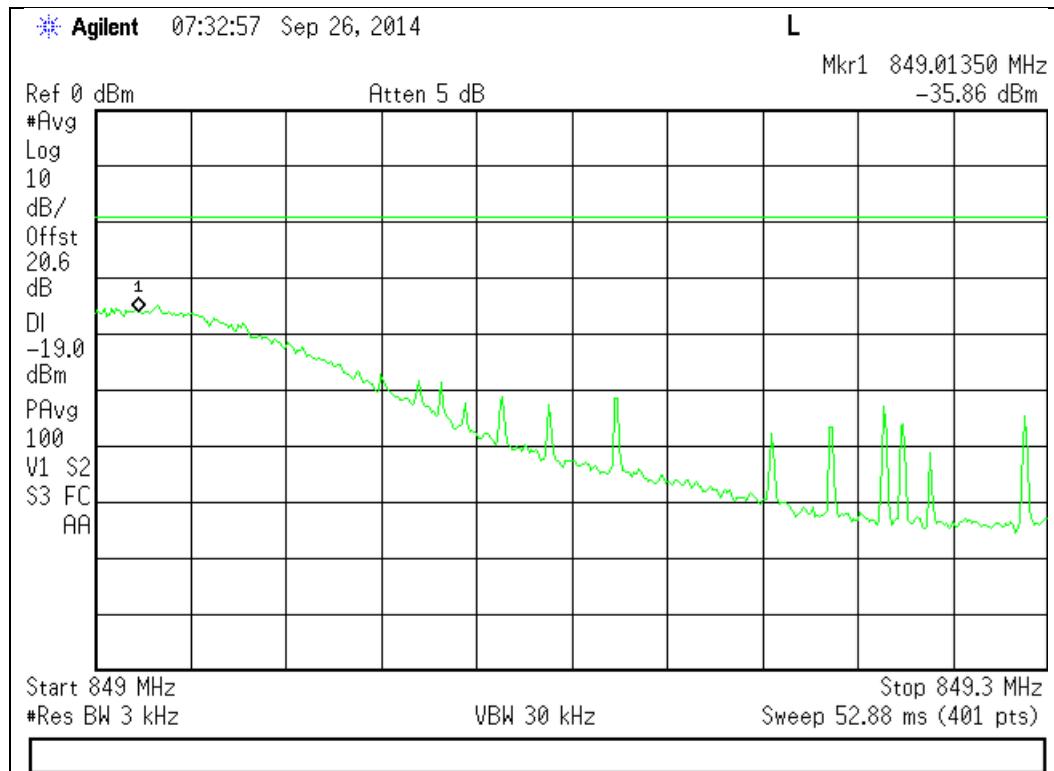
776 - 787 MHz Band

Lower Band Edge



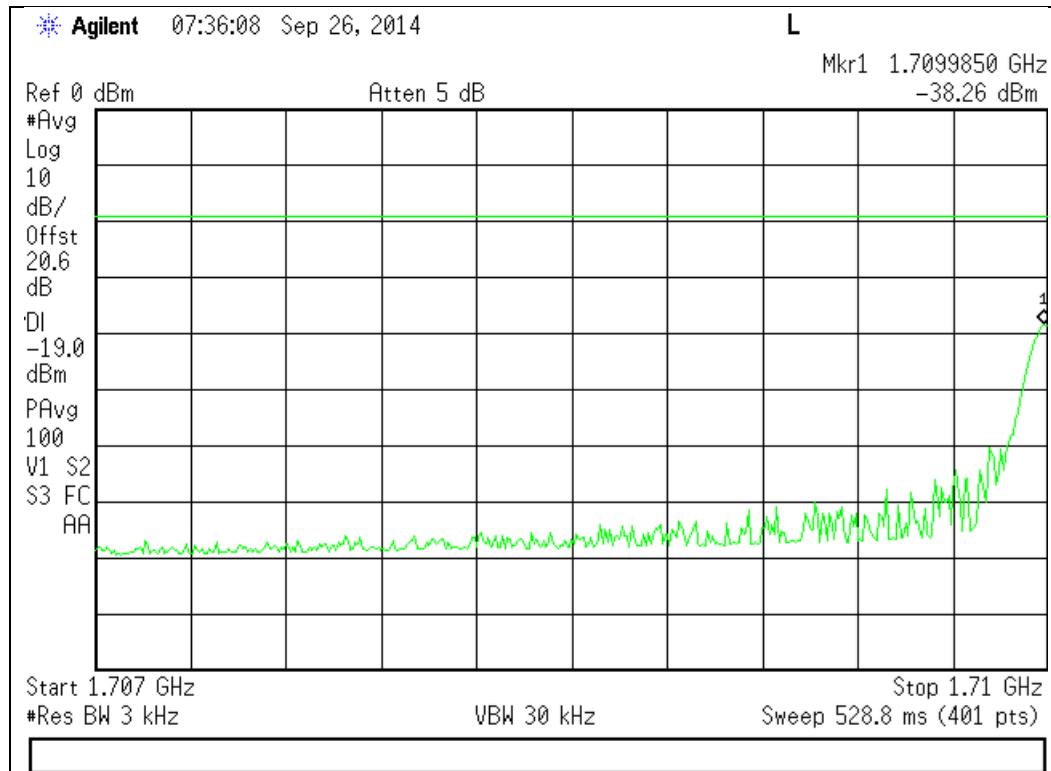
Upper Band Edge



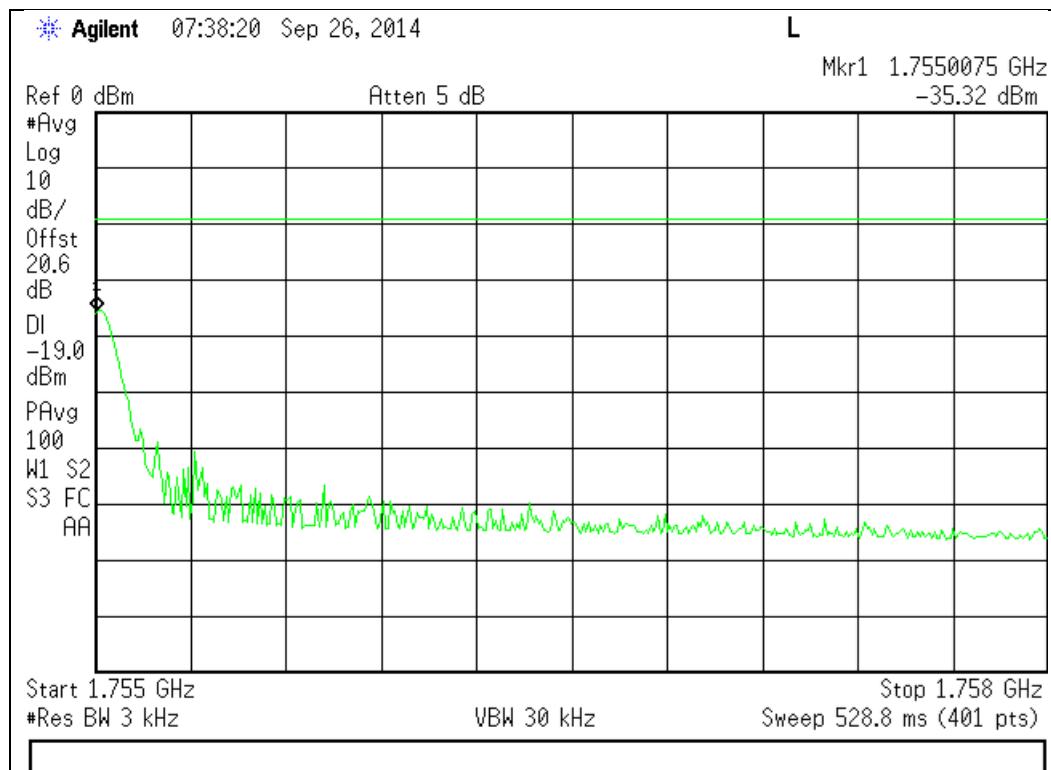
824 - 849 MHz Band**Lower Band Edge****Upper Band Edge**

1710 - 1755 MHz Band

Lower Band Edge



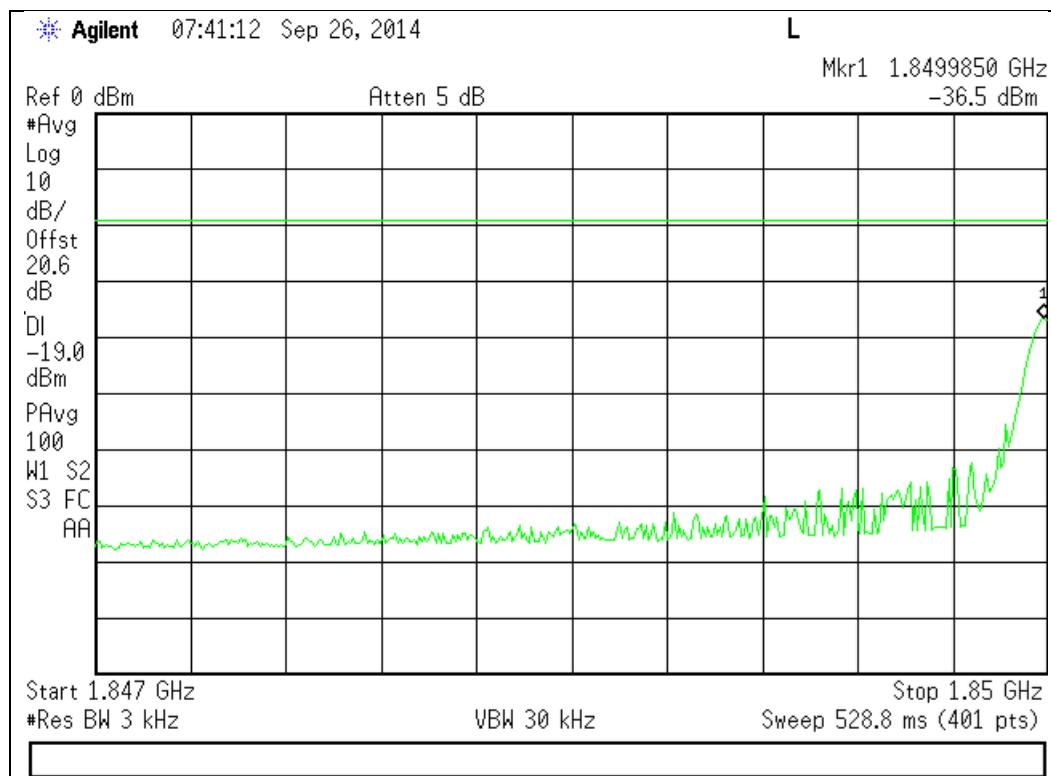
Upper Band Edge



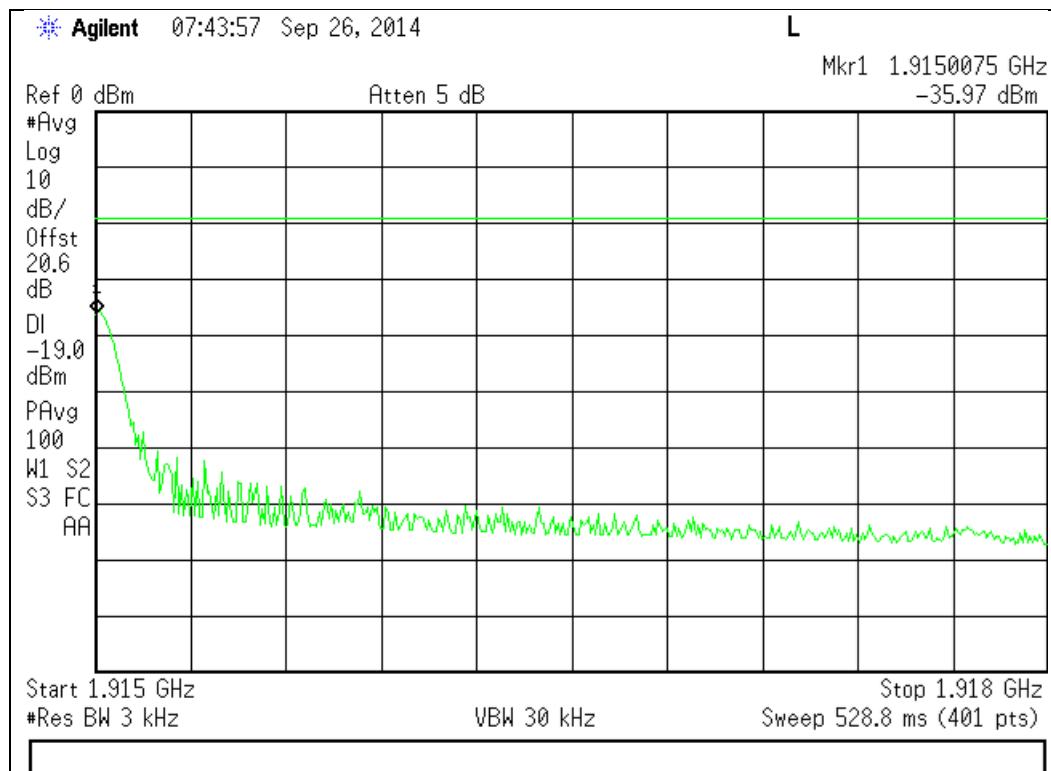


1850 - 1915 MHz Band

Lower Band Edge



Upper Band Edge

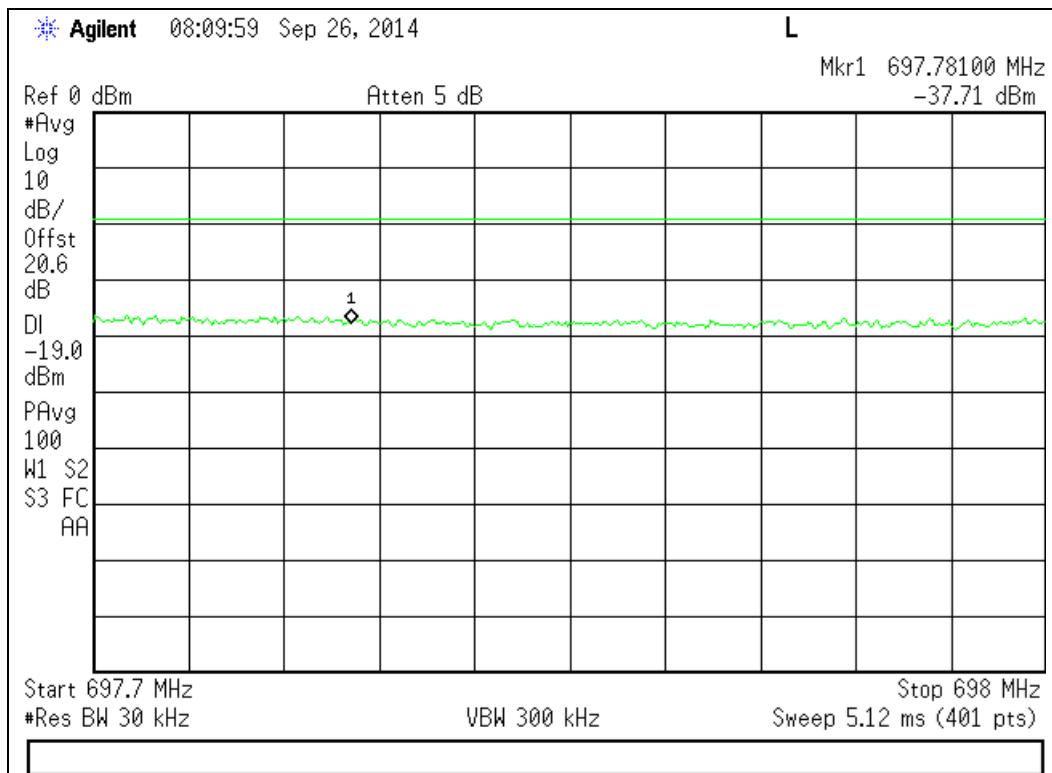




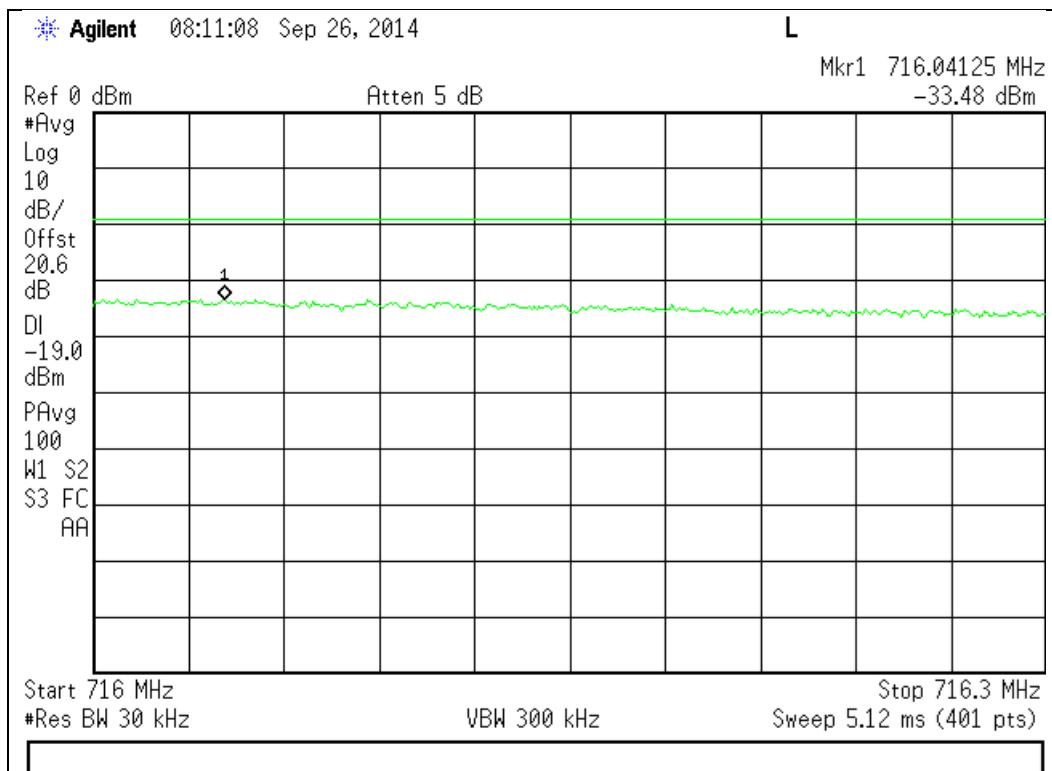
CDMA Uplink Test Plots

698 - 716 MHz Band

Lower Band Edge



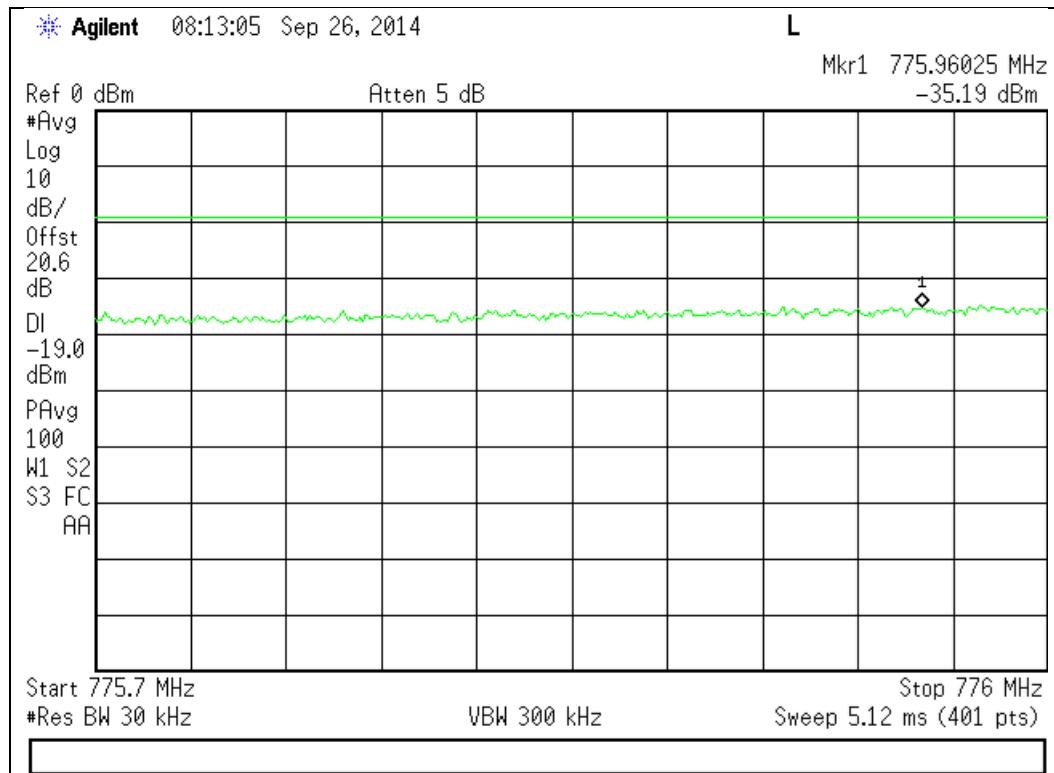
Upper Band Edge



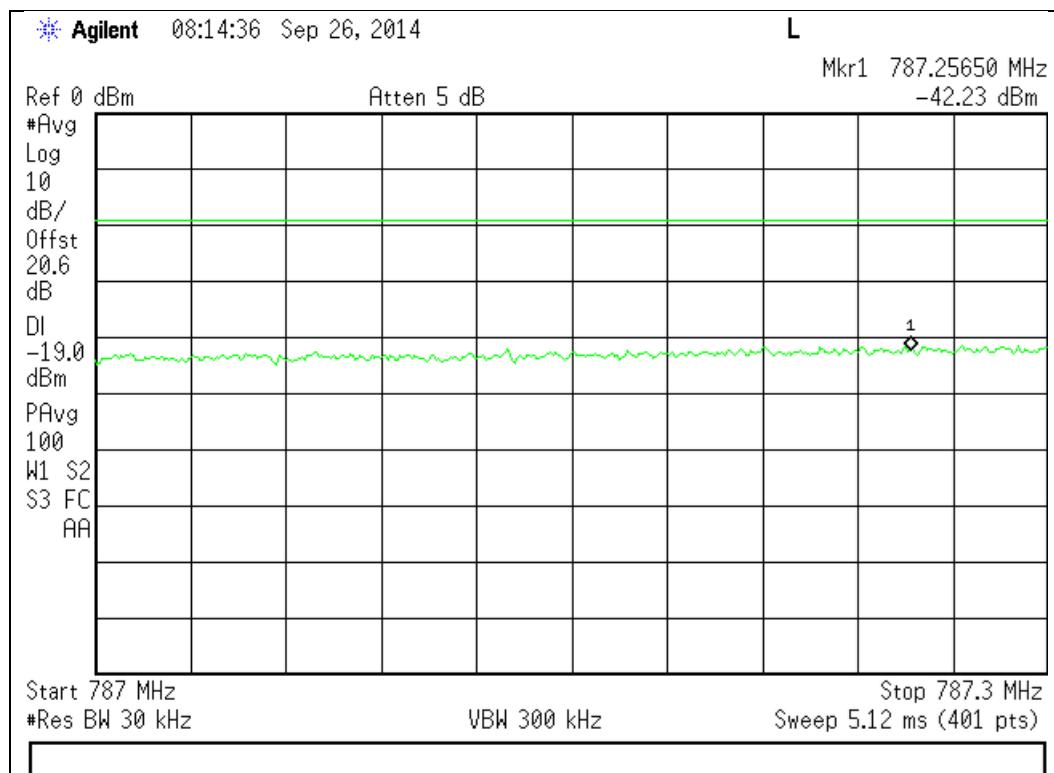


776 - 787 MHz Band

Lower Band Edge



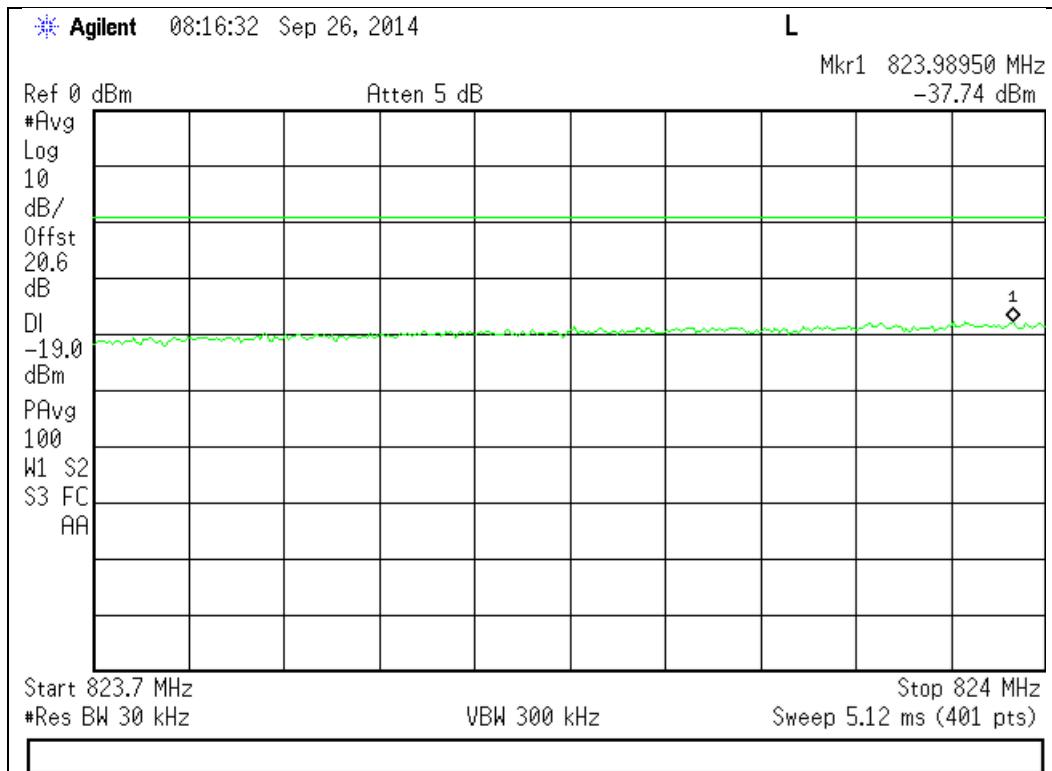
Upper Band Edge



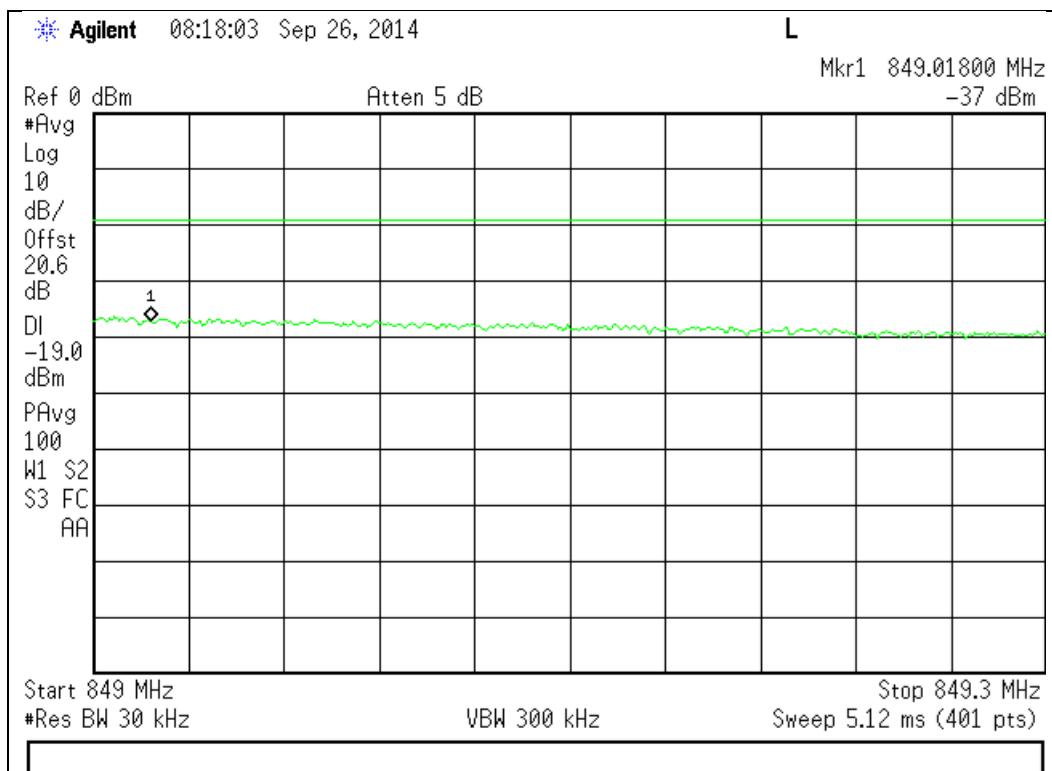


824 - 849 MHz Band

Lower Band Edge

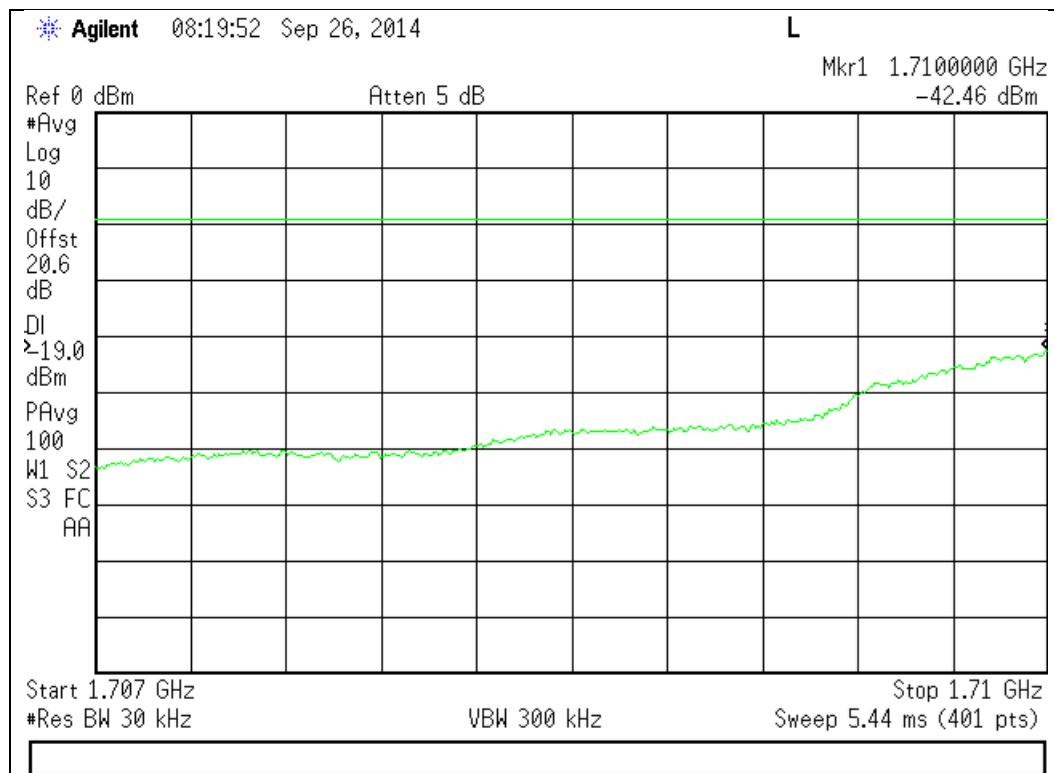


Upper Band Edge

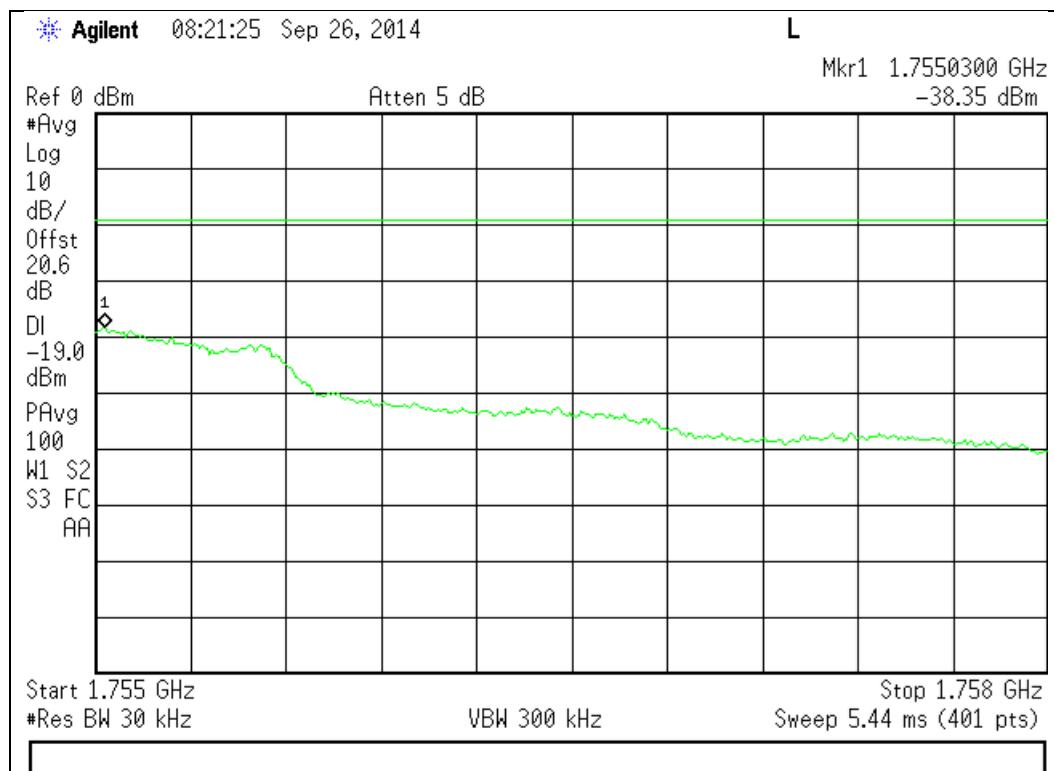


1710 - 1755 MHz Band

Lower Band Edge



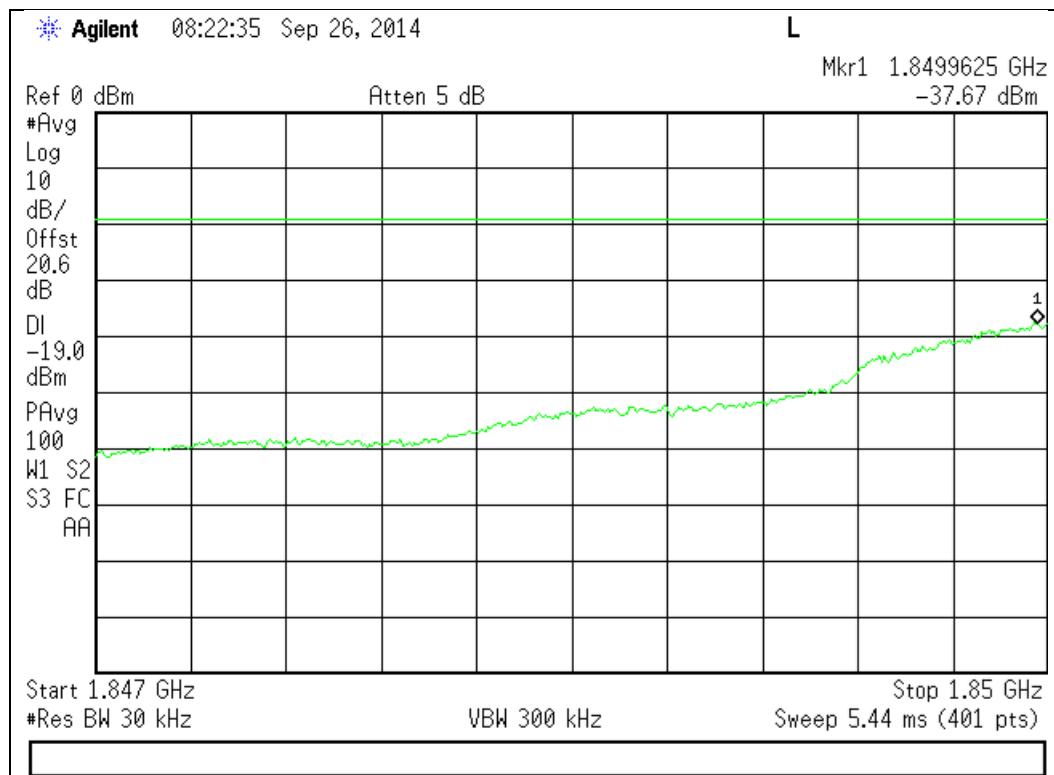
Upper Band Edge



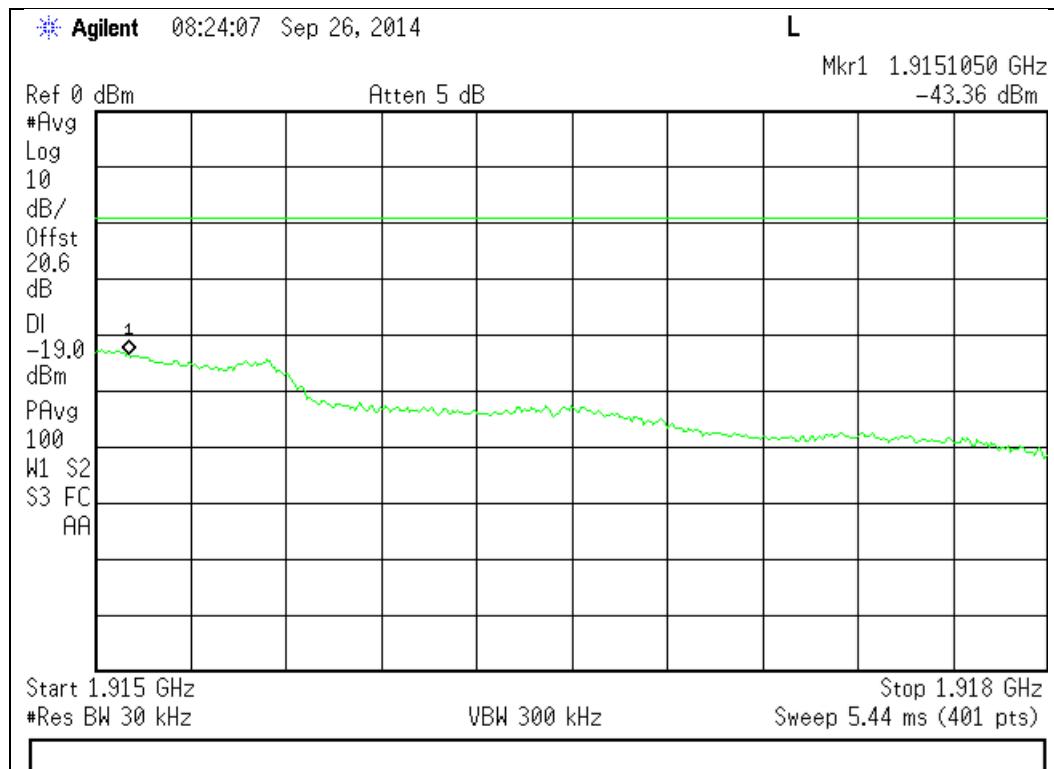


1850 - 1915 MHz Band

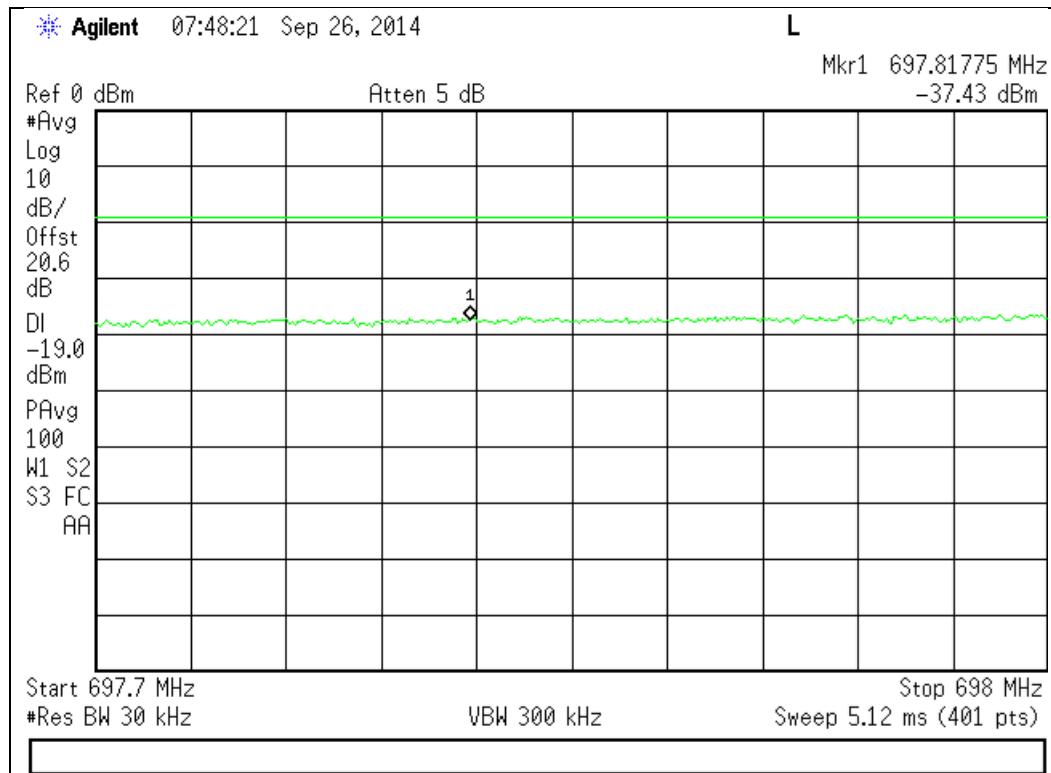
Lower Band Edge



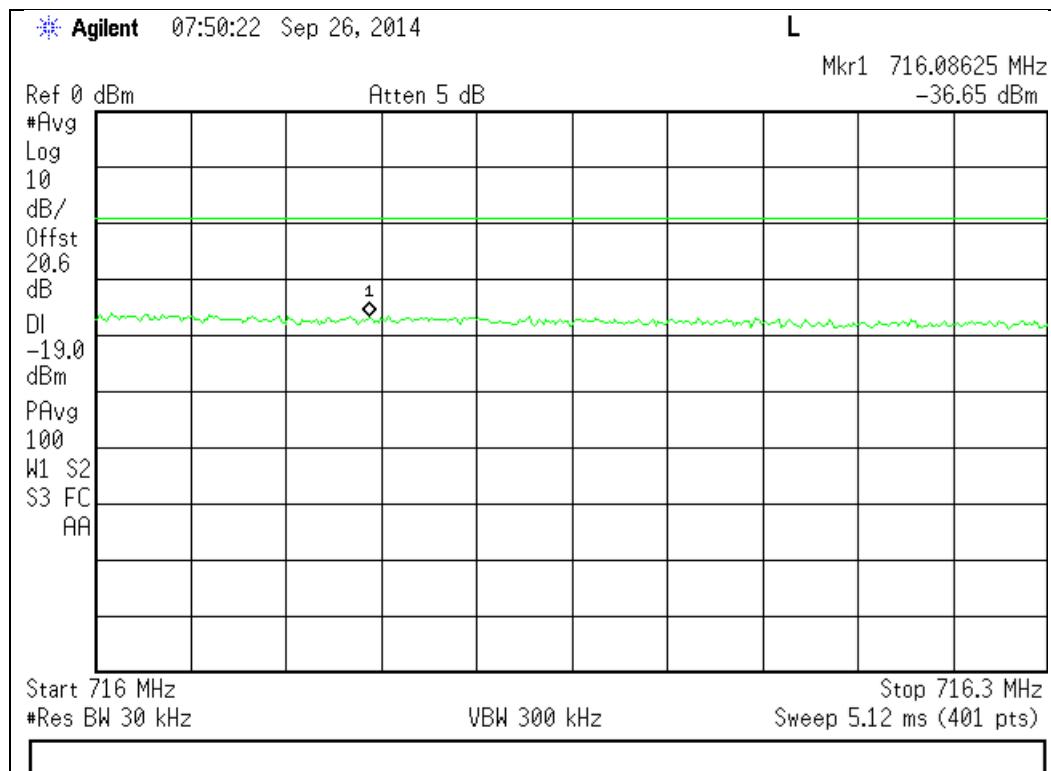
Upper Band Edge



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



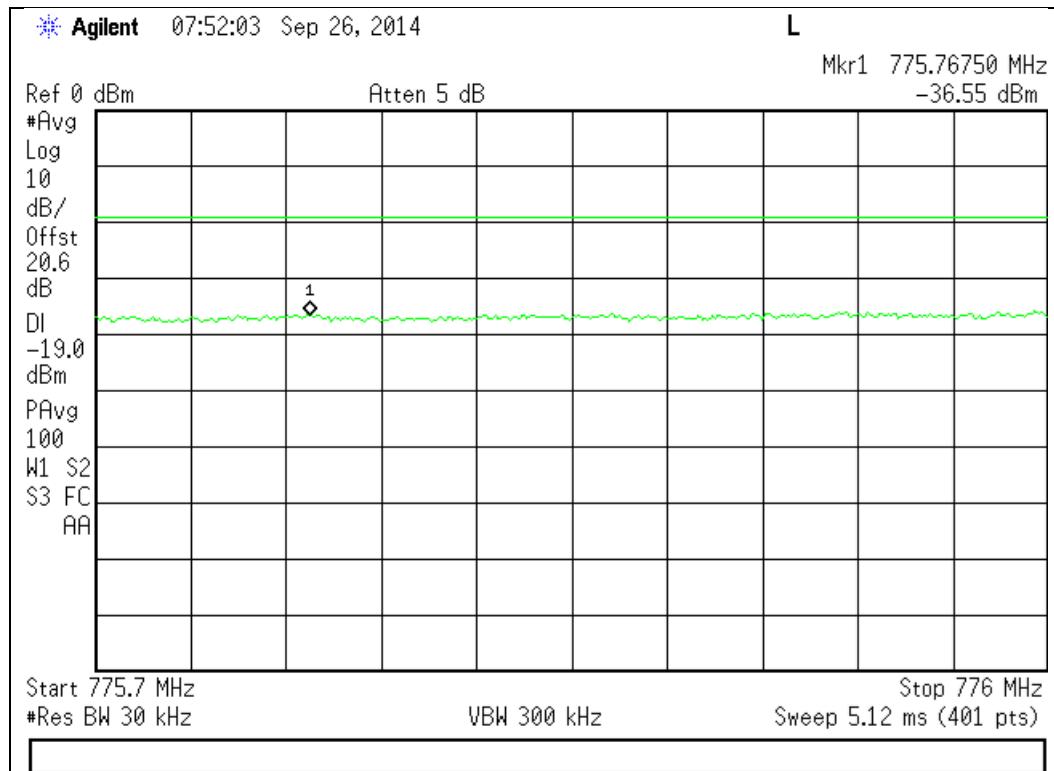
Upper Band Edge



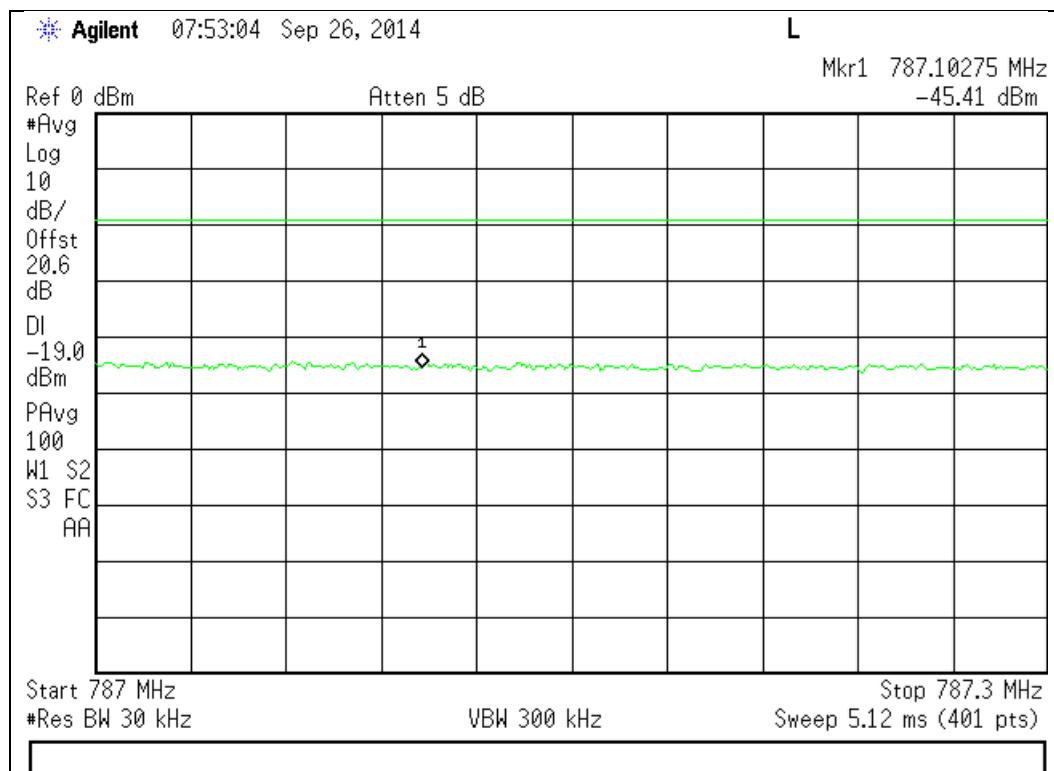


776 - 787 MHz Band

Lower Band Edge



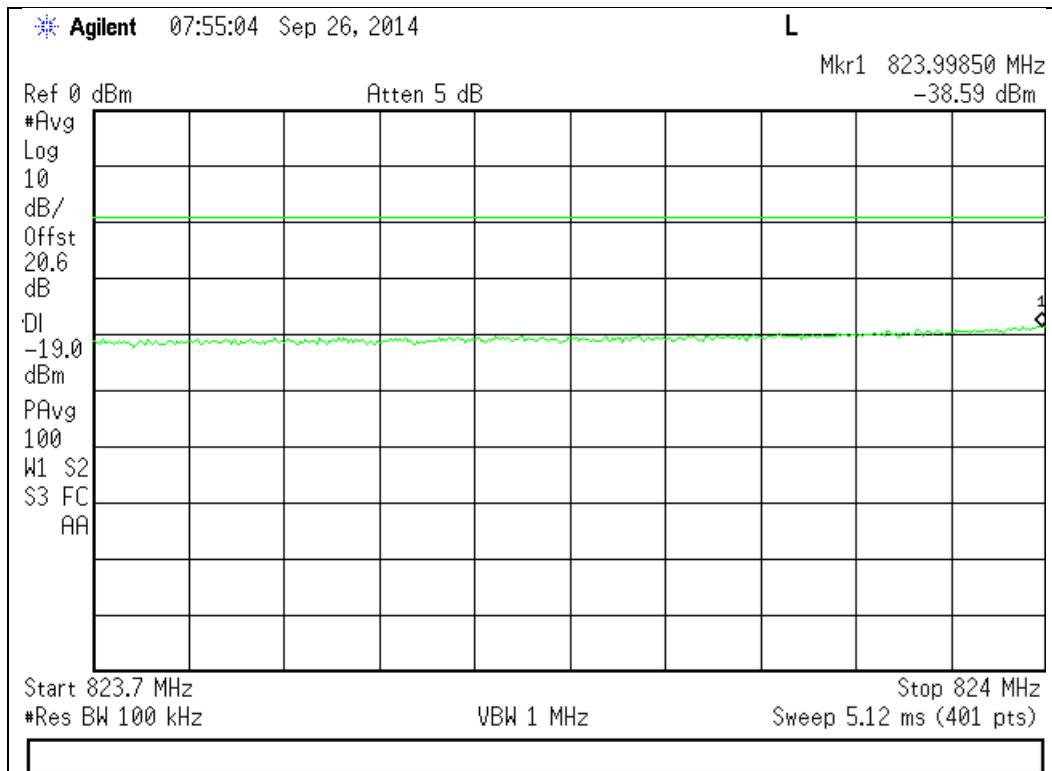
Upper Band Edge



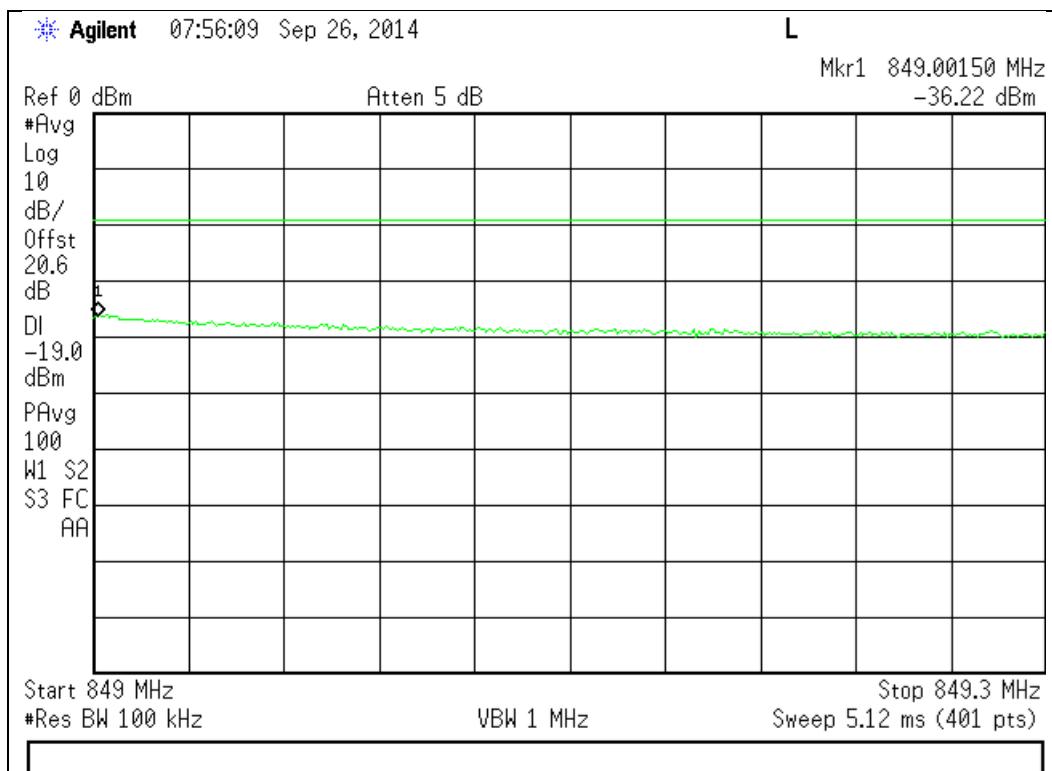


824 - 849 MHz Band

Lower Band Edge



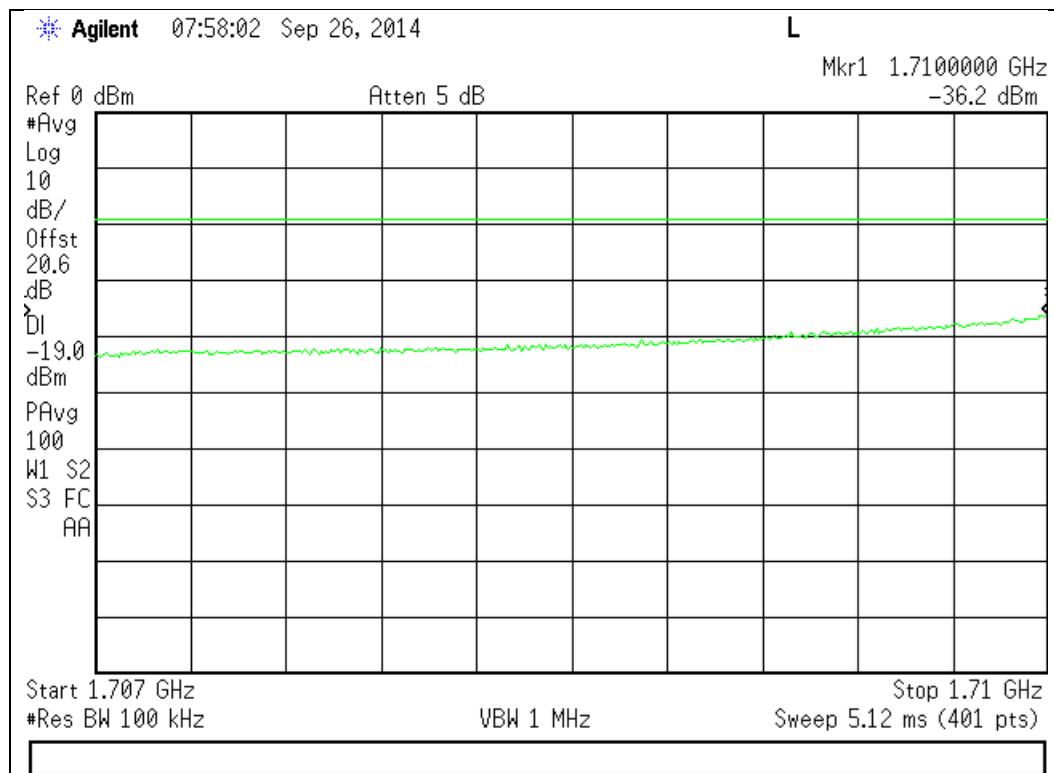
Upper Band Edge



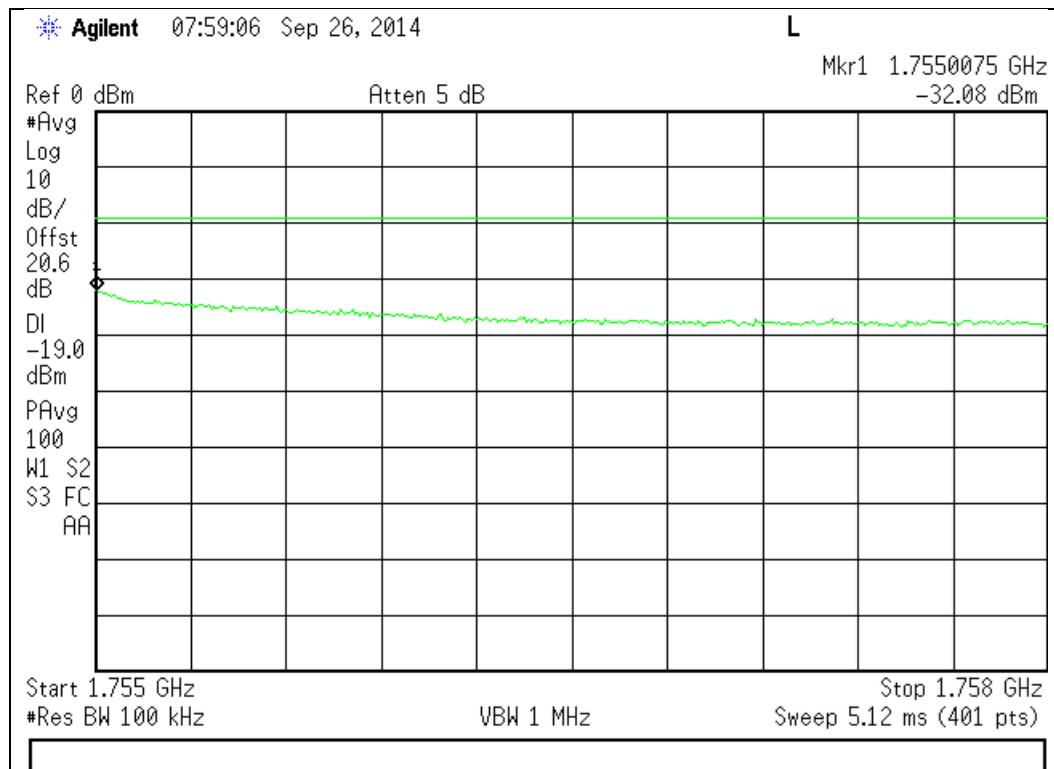


1710 - 1755 MHz Band

Lower Band Edge



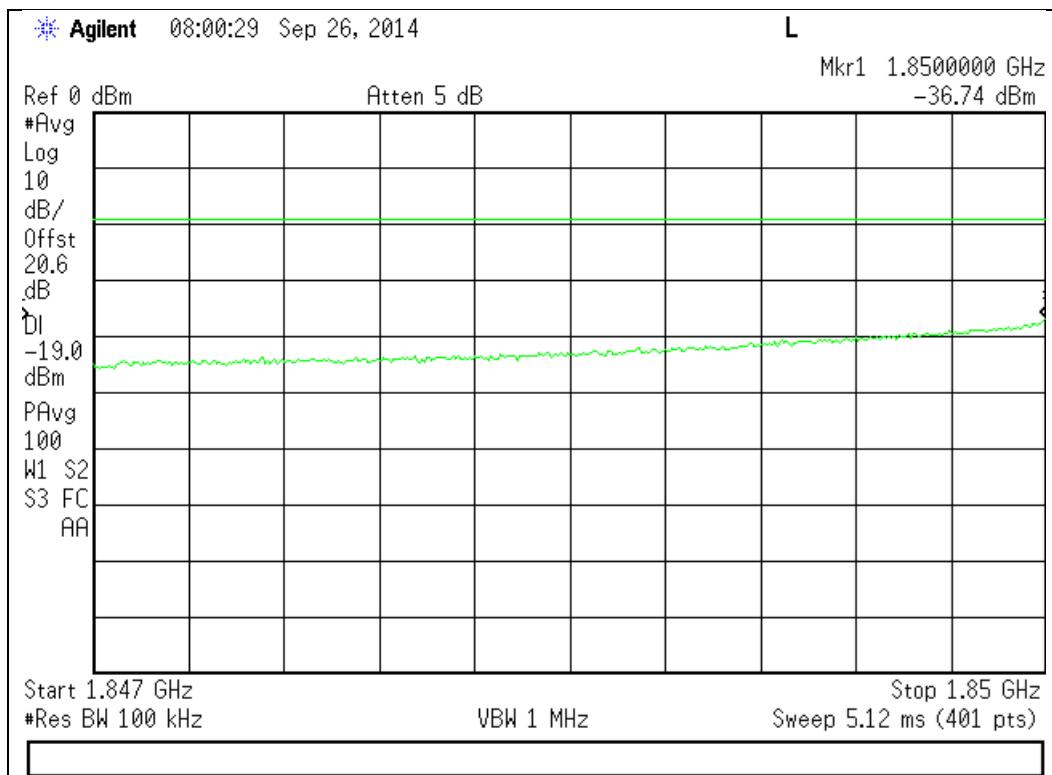
Upper Band Edge



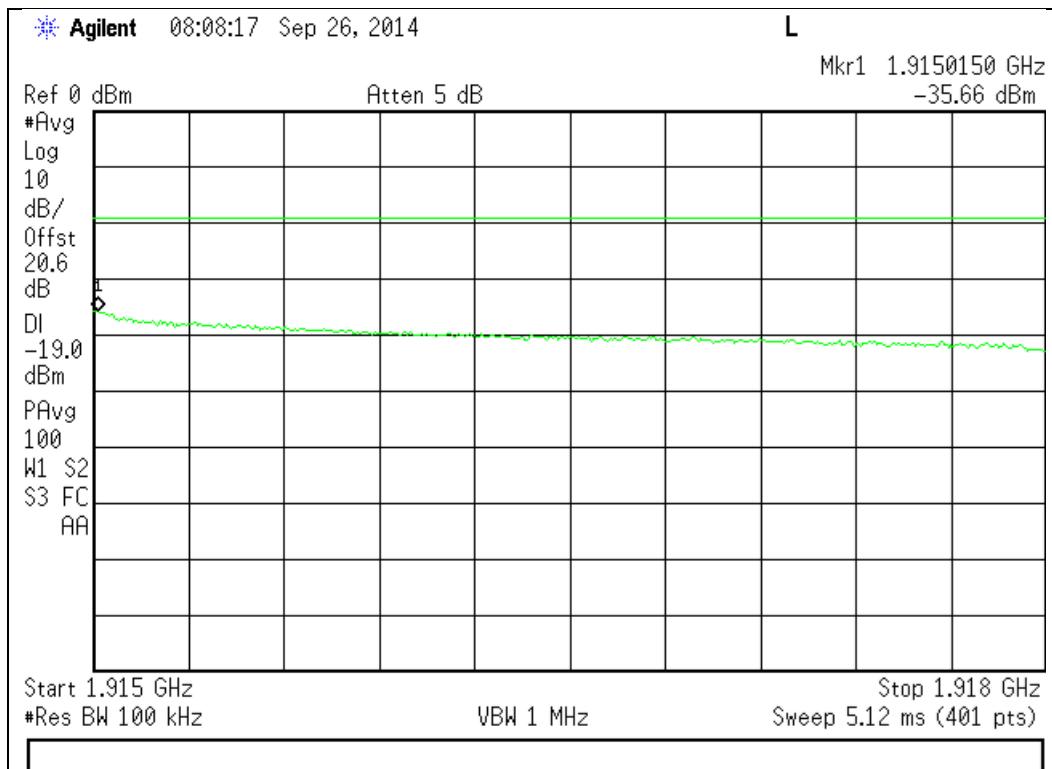


1850 - 1915 MHz Band

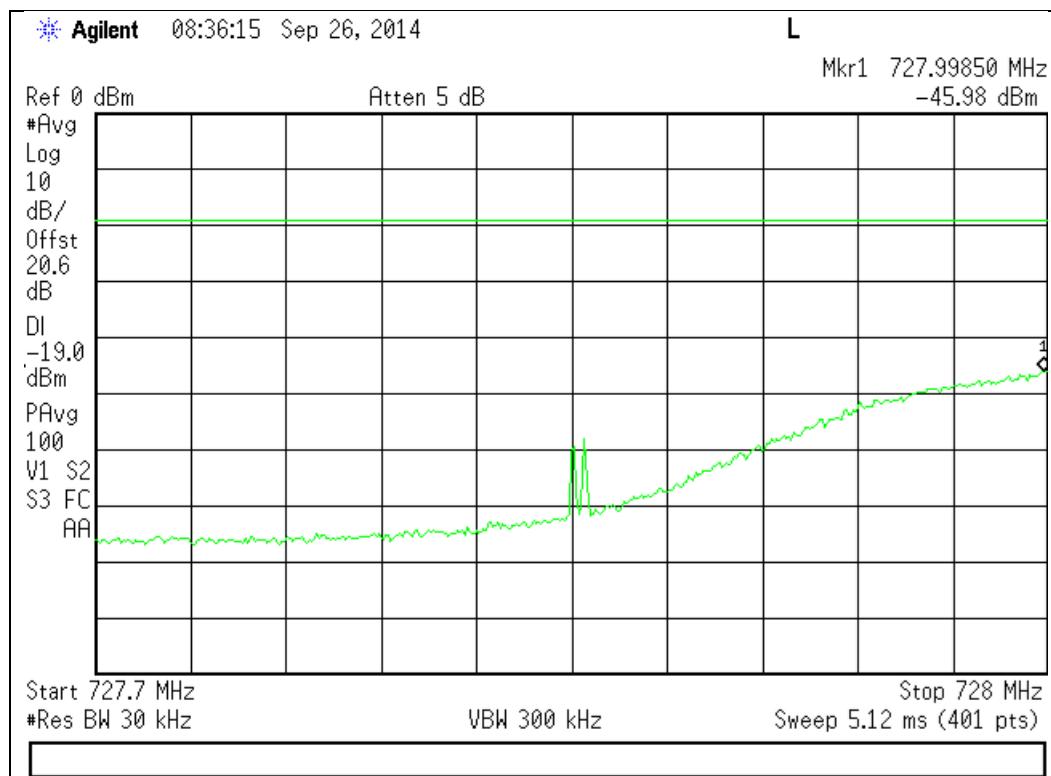
Lower Band Edge



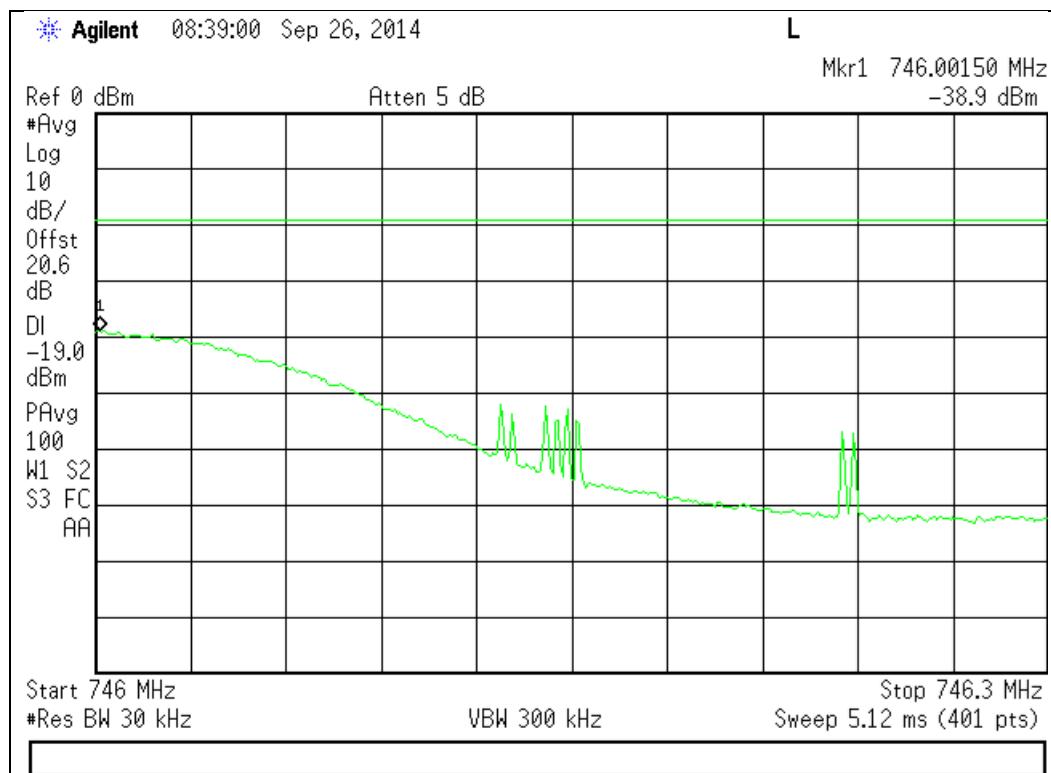
Upper Band Edge



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

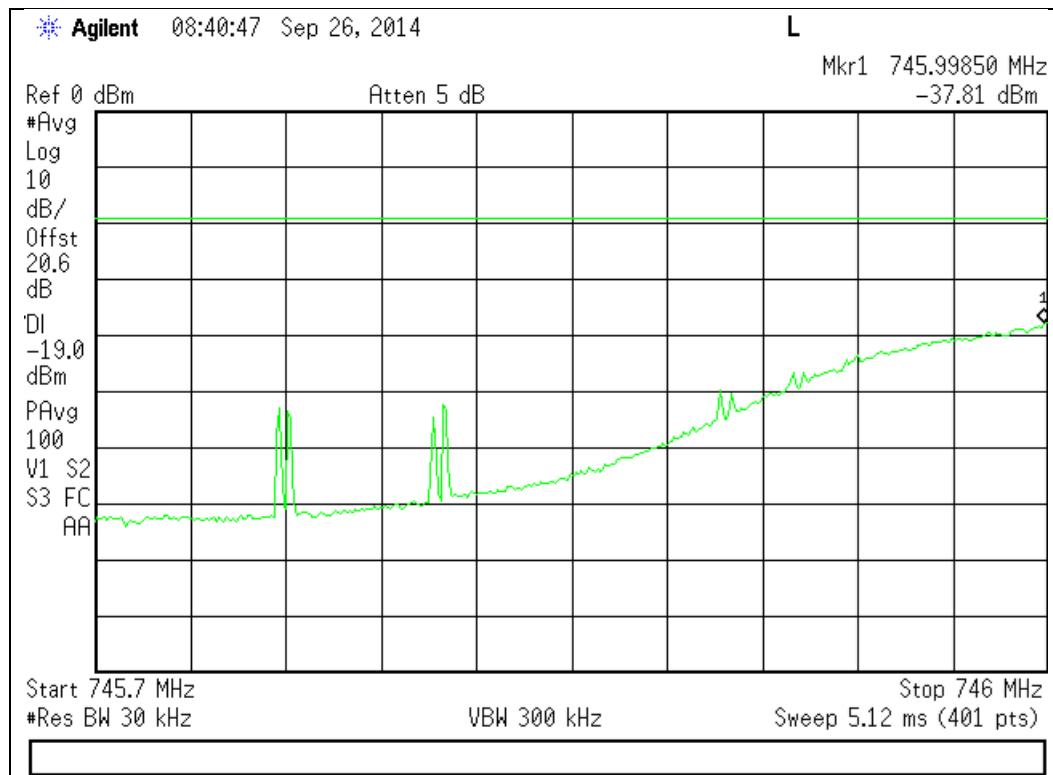


Upper Band Edge

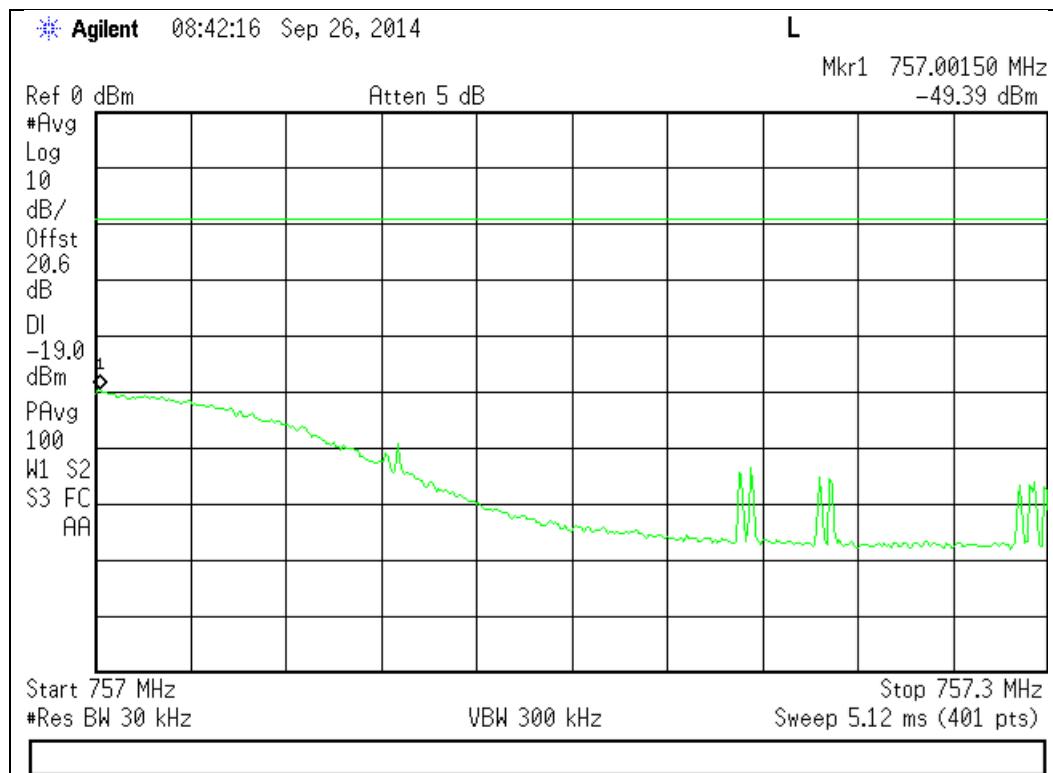


746 - 757 MHz Band

Lower Band Edge



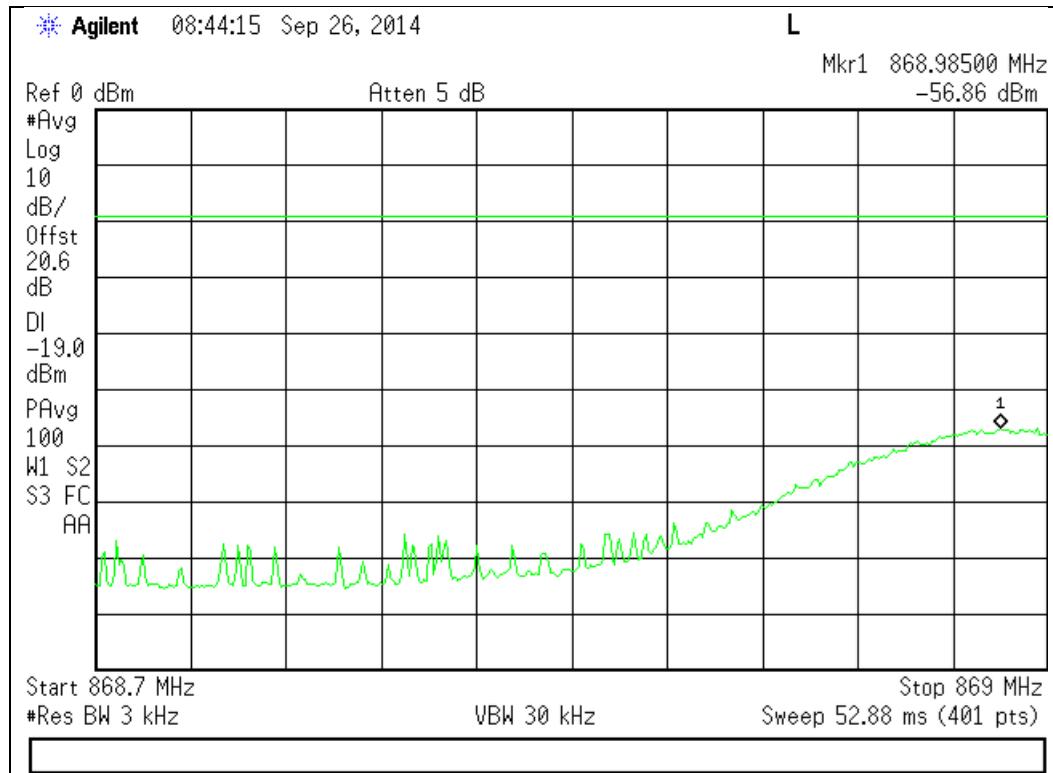
Upper Band Edge



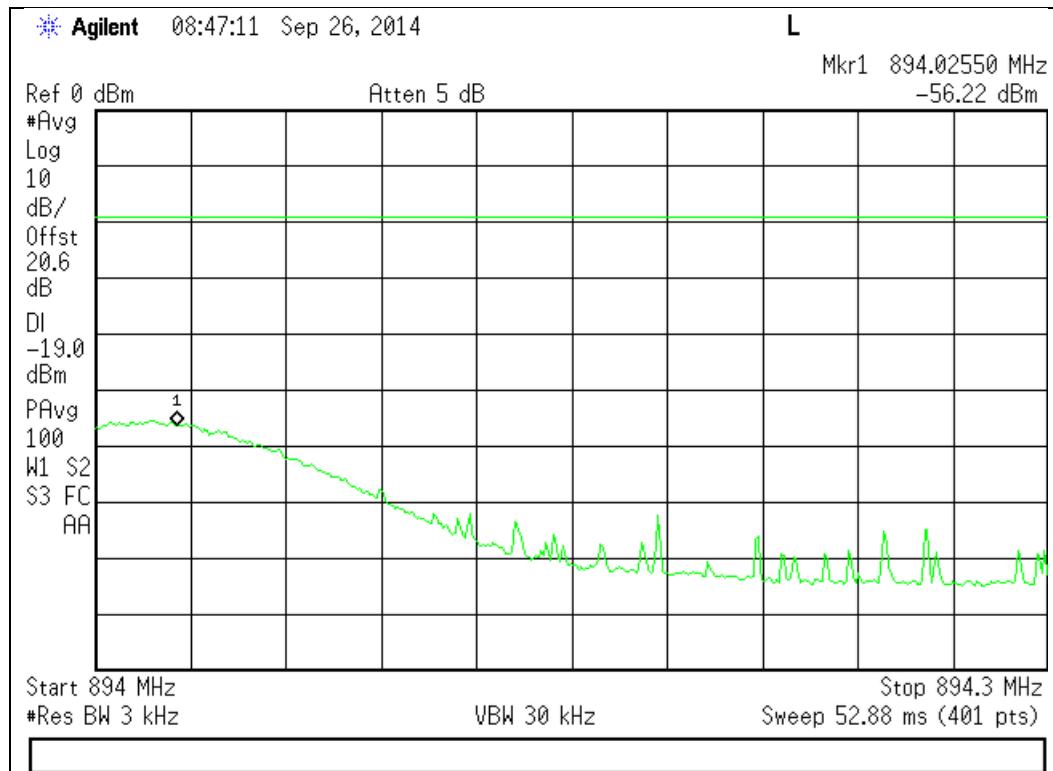


869 - 894 MHz Band

Lower Band Edge



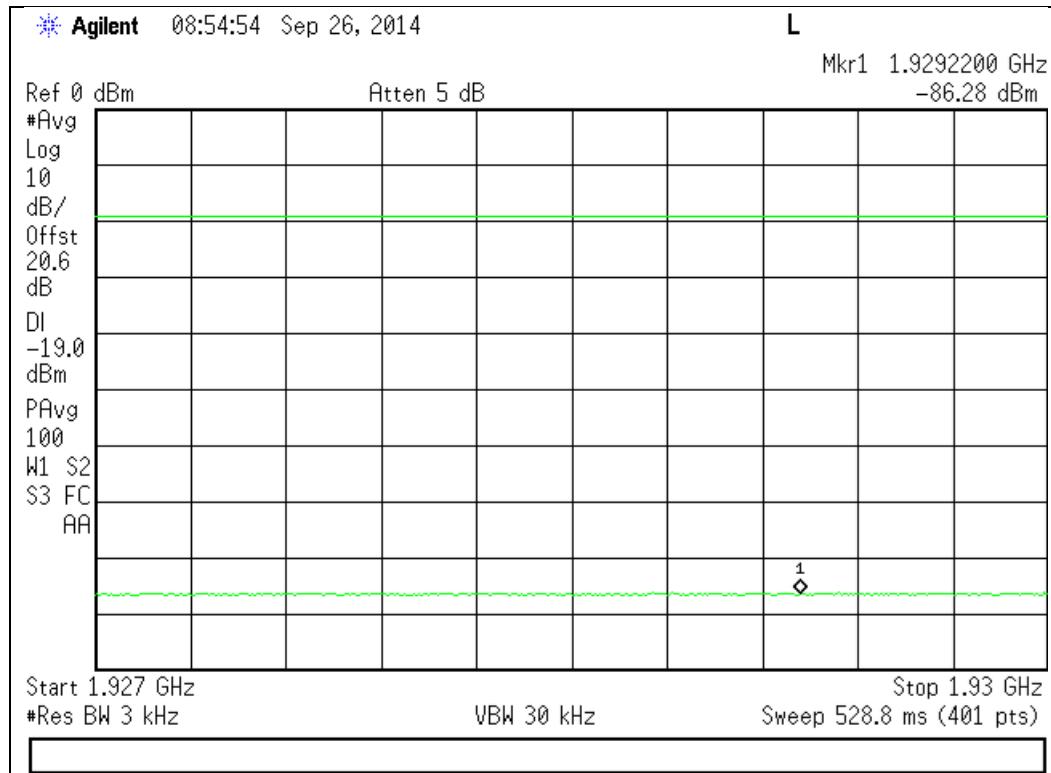
Upper Band Edge



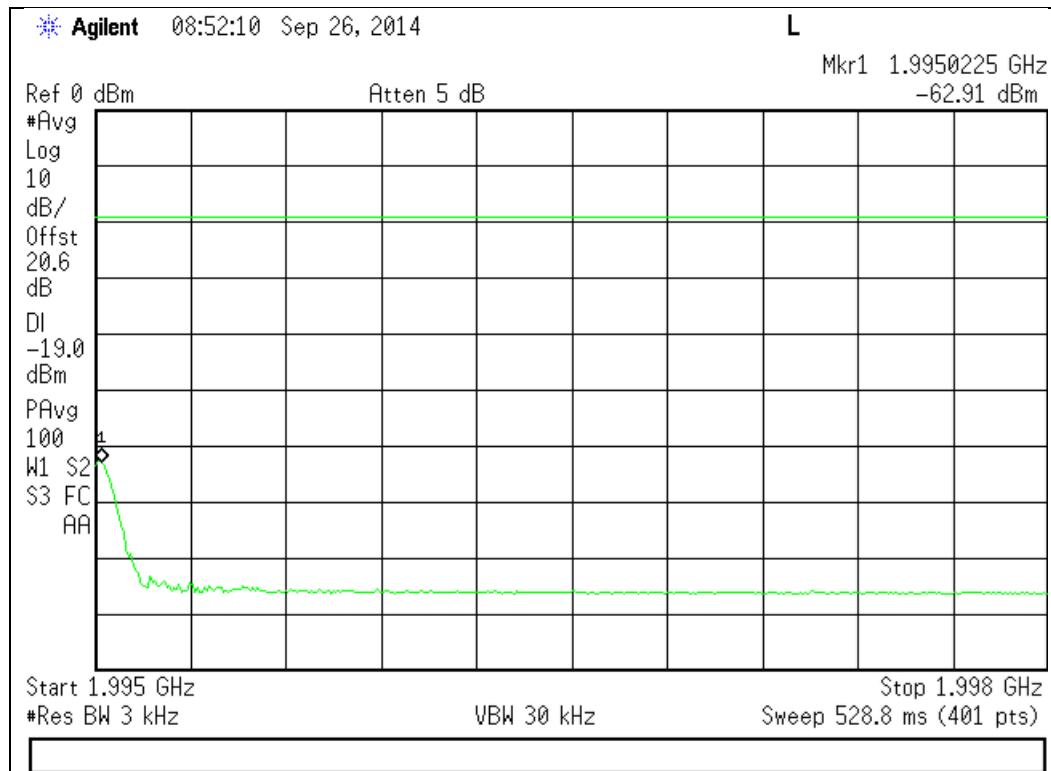


1930 - 1995 MHz Band

Lower Band Edge

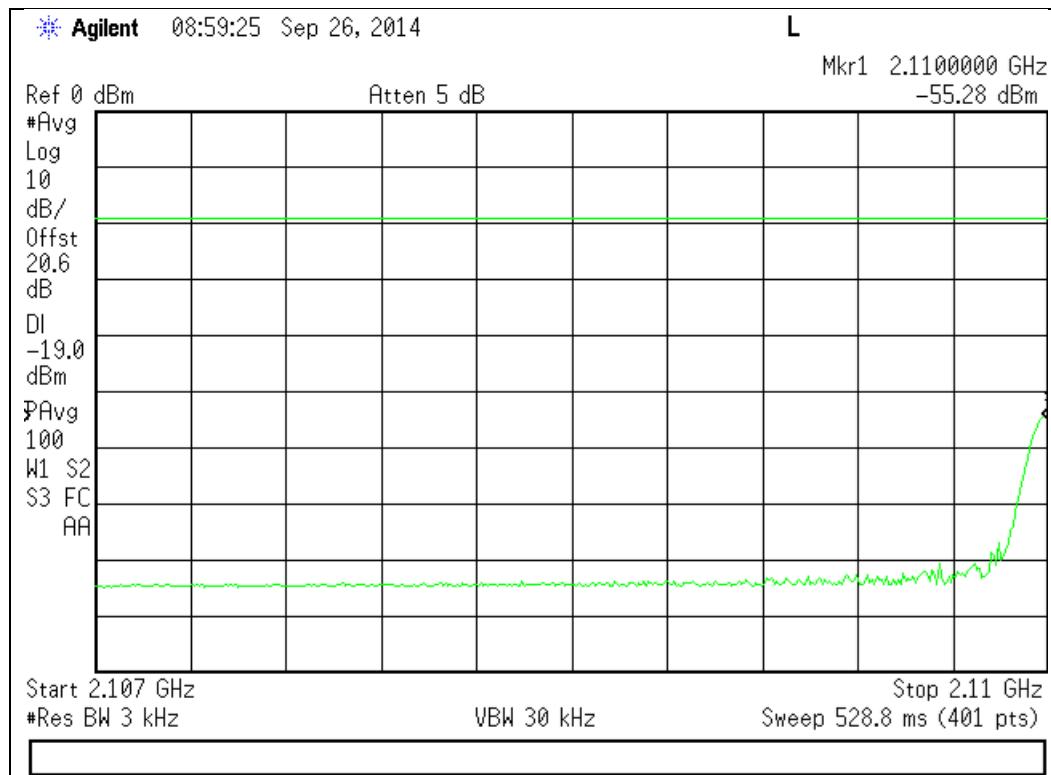


Upper Band Edge

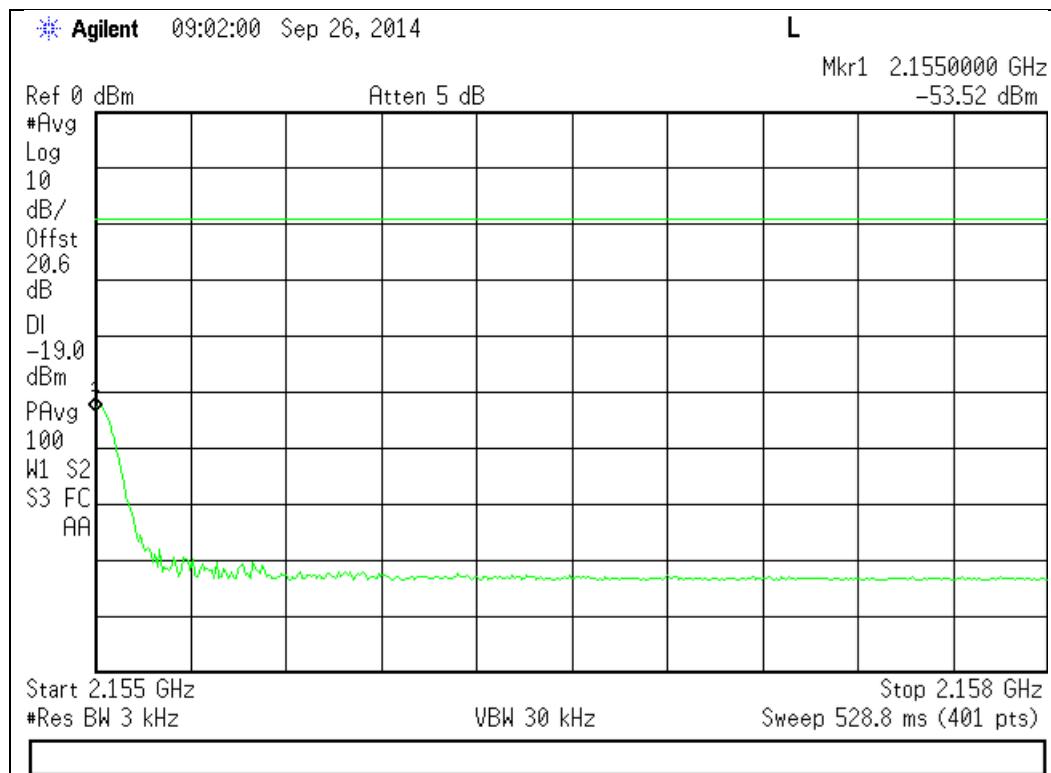


2110 - 2155 MHz Band

Lower Band Edge



Upper Band Edge

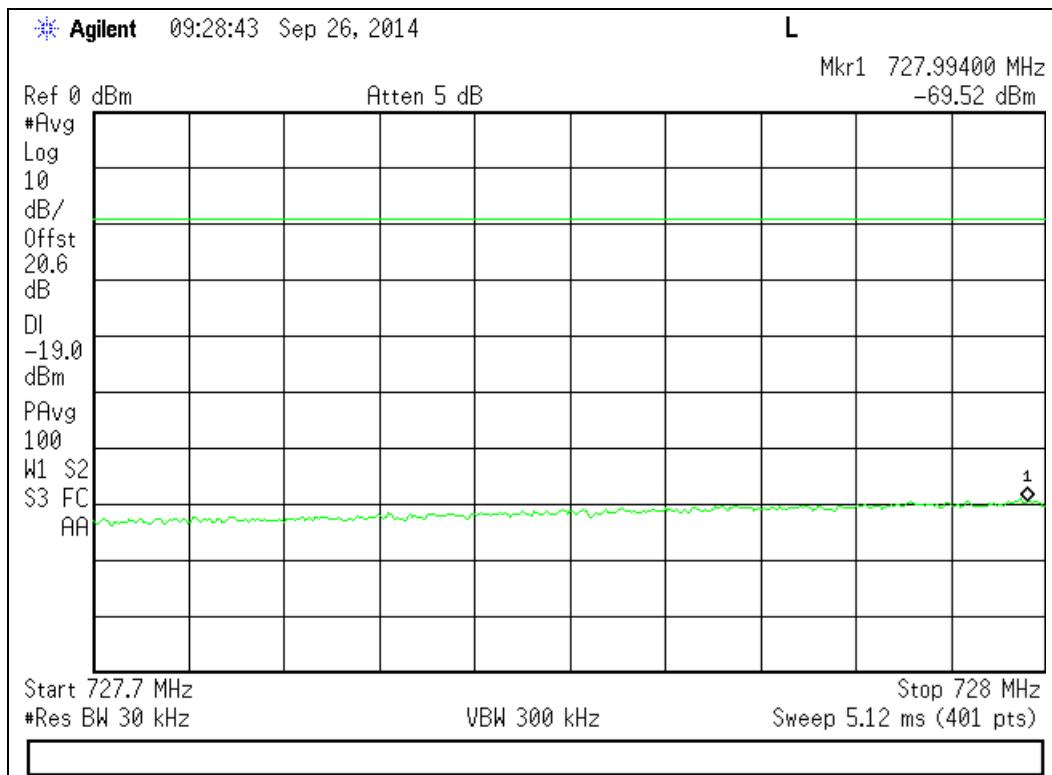




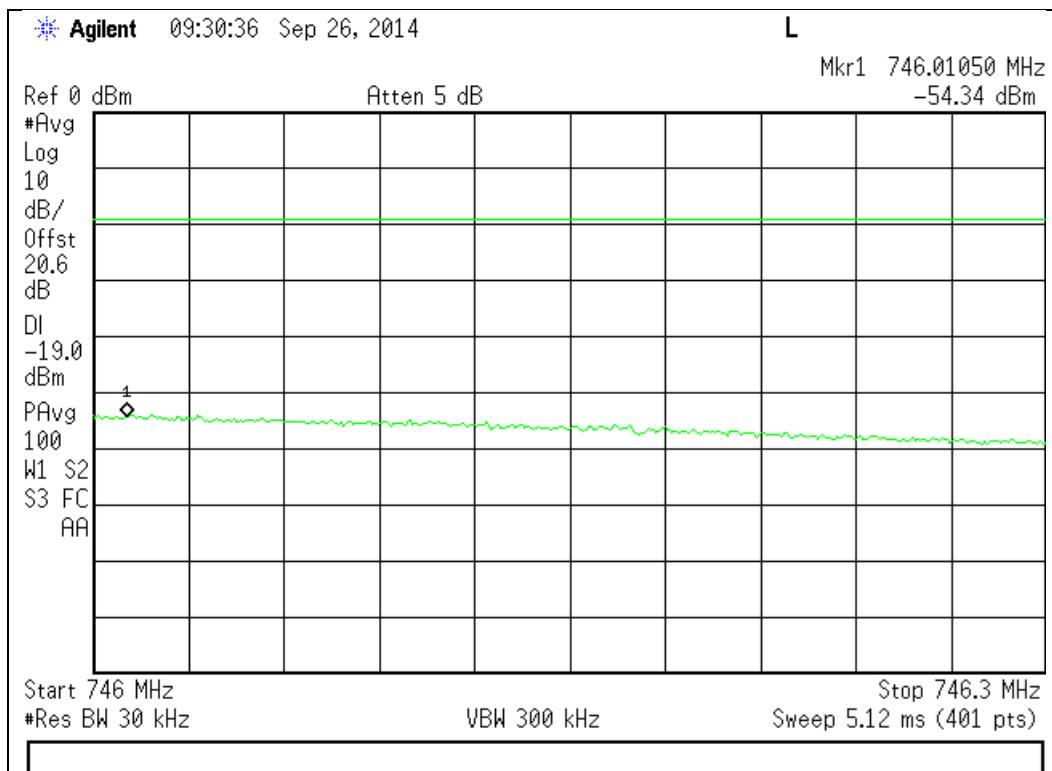
CDMA Downlink Test Plots

728 - 746 MHz Band

Lower Band Edge



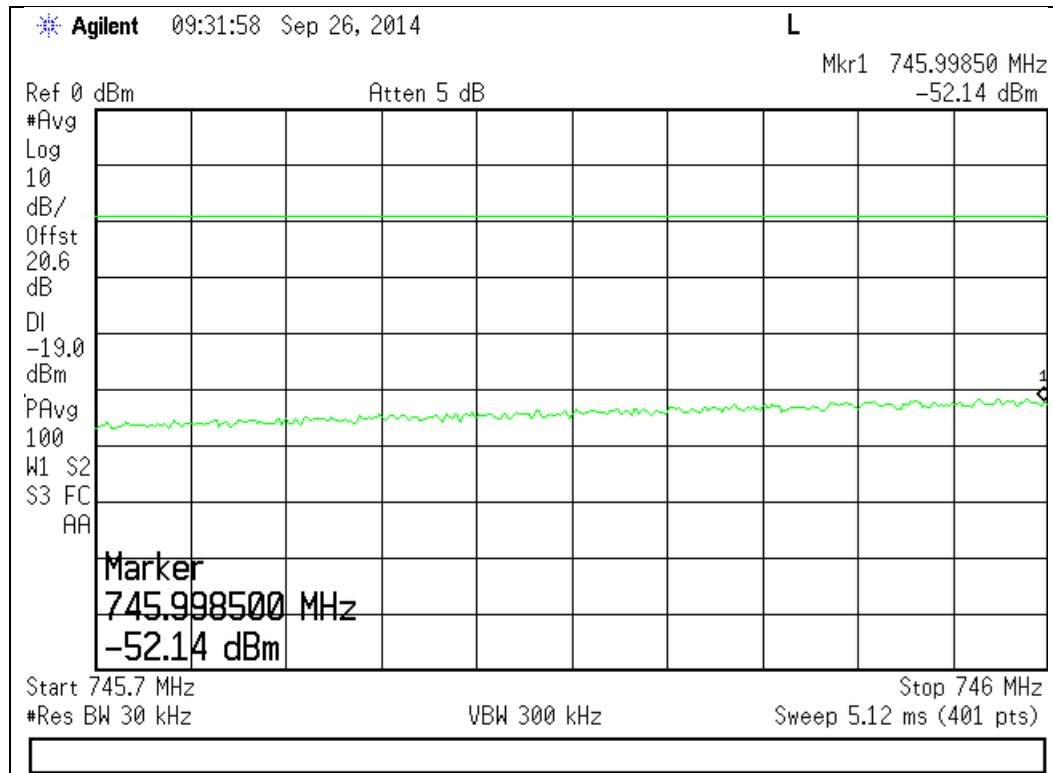
Upper Band Edge



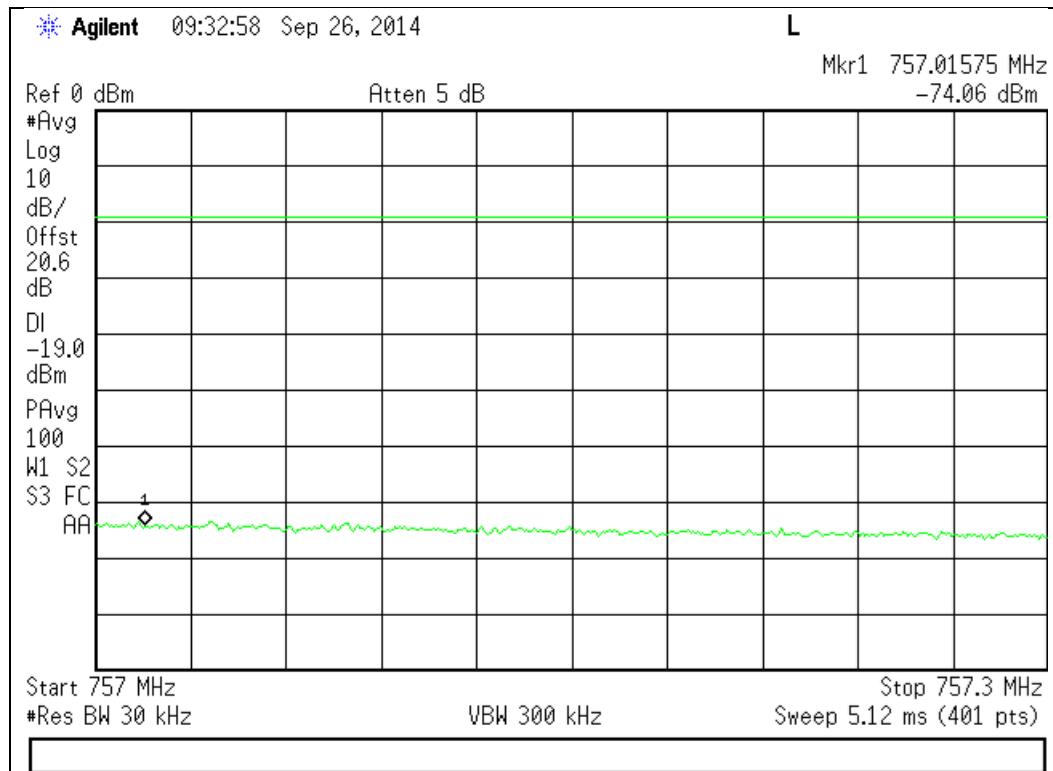


746 - 757 MHz Band

Lower Band Edge

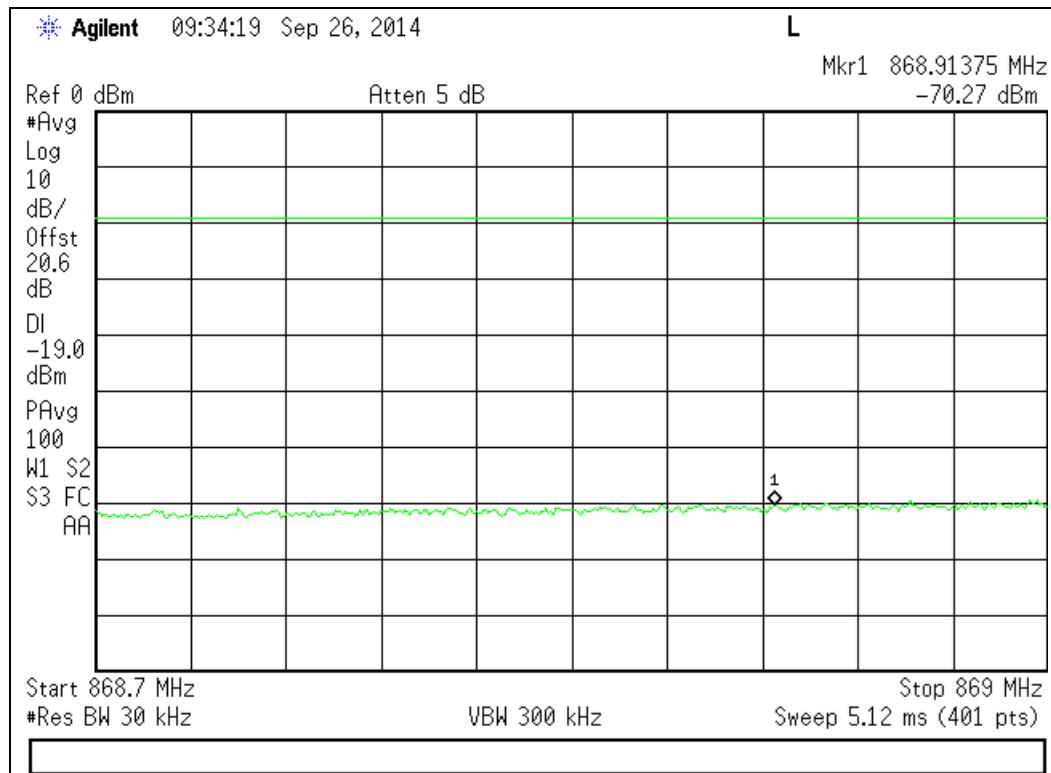


Upper Band Edge

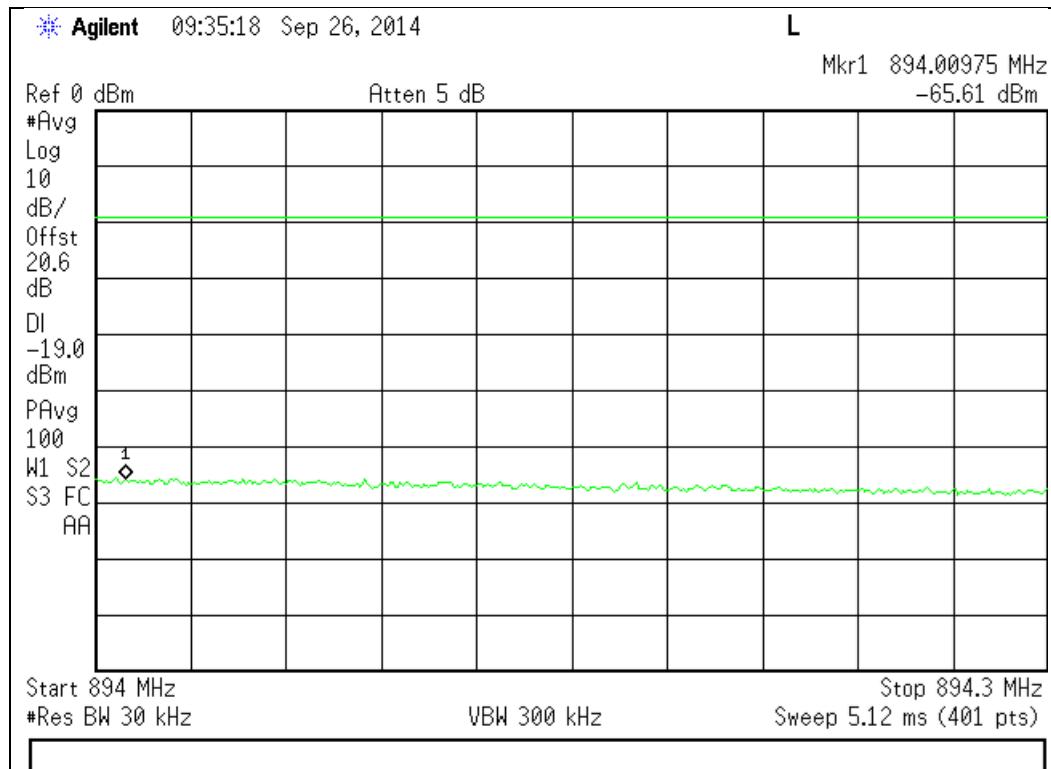


869 - 894 MHz Band

Lower Band Edge



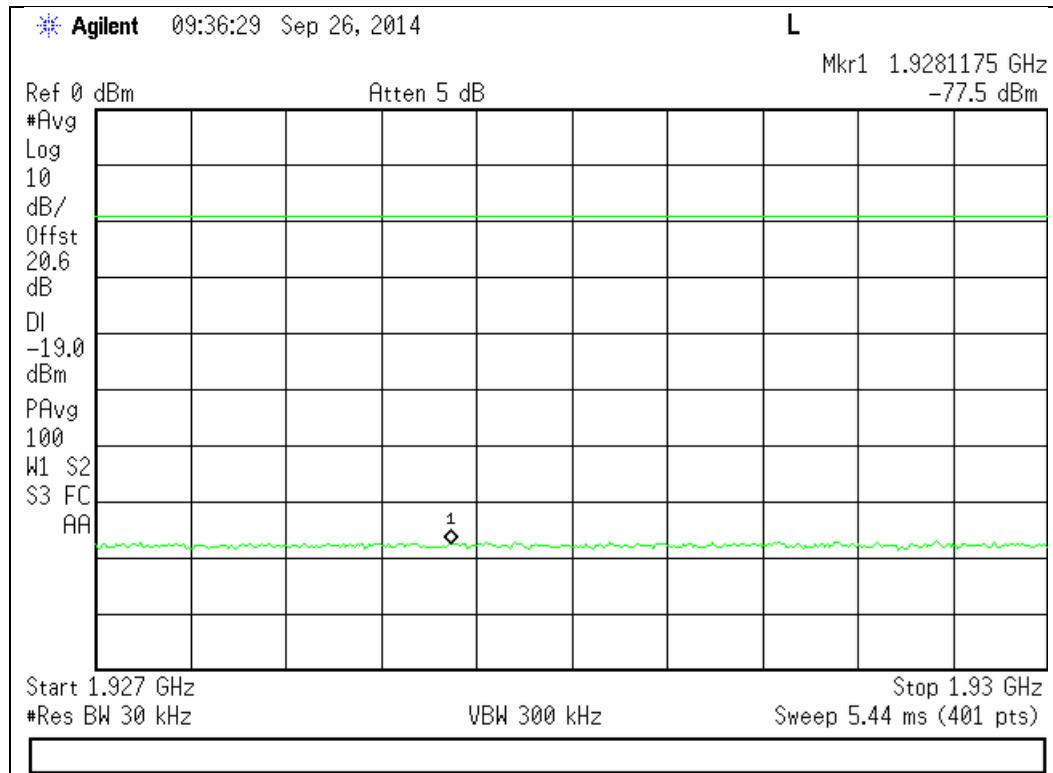
Upper Band Edge



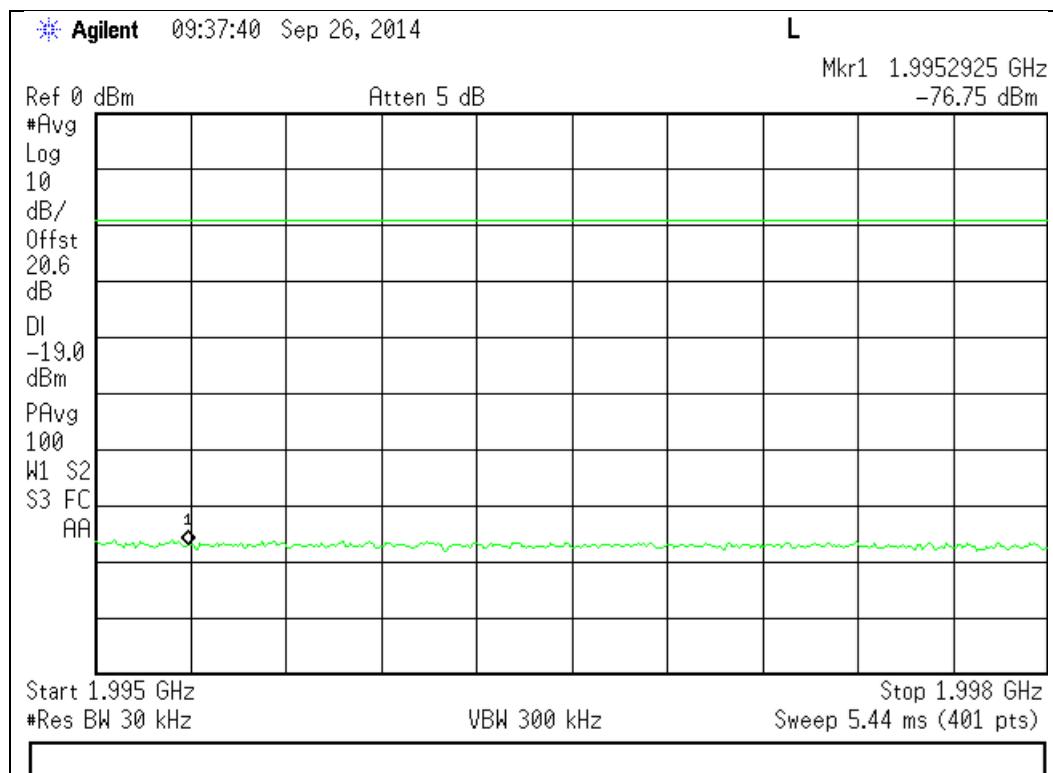


1930 - 1995 MHz Band

Lower Band Edge

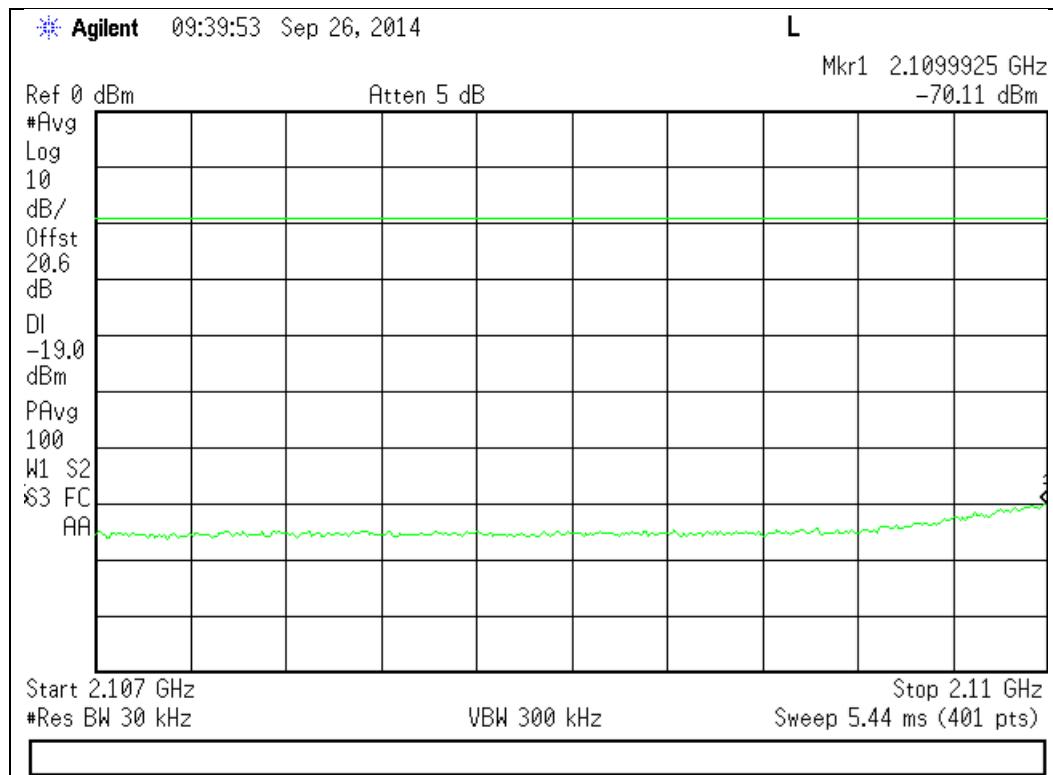


Upper Band Edge



2110 - 2155 MHz Band

Lower Band Edge



Upper Band Edge

