



**SL5011**

Test Report

FOR

FCC and IC Certifications

**IC: 2417C-SL5011  
FCC ID: N7NSL5011**

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# SIERRA WIRELESS, INC.

## 1 Introduction and Purpose

This document provides test data for the SL5011 modem intended for FCC and Industry Canada certifications. The tests included in this report are limited to all conducted tests required. The radiated tests were performed at an external test facility.

## 2 Test Summary

FCC Rule	IC Standards	DESCRIPTION OF TEST	RESULT	PAGE
2.1046	RSS-132, 4.4 Issue 2 RSS-133, 6.4 Issue 5	RF Power Output	Complies	4
2.1049	RSS-Gen, 4.6 Issue 2	Occupied Bandwidth	Complies	6
2.1051, 22.901(d) 22.917, 24.238(a)	RSS-132, 4.5 Issue 2 RSS-133, 6.5 Issue 5	Out of Band Emissions at Antenna Terminals and Block Edge Compliance	Complies	14
2.1053	RSS-132, 4.5 Issue 2 RSS-133, 6.5 Issue 5	Field Strength of Spurious Radiation	Complies	See SGS Report
2.1055	RSS-132, 4.3 Issue 2 RSS-133, 6.3 Issue 5	Frequency Stability versus Temperature	Complies	2727
2.1055	RSS-132, 4.3 Issue 2 RSS-133, 6.3 Issue 5	Frequency Stability versus Voltage	Complies	29

## 3 Description of Equipment under Test

The SL5011 modem, referred to as “EUT” hereafter, is a multi-band wireless modem operating on the CDMA2000/ EVDO networks. EUT support 850MHz and 1900MHz, so this test report only contains data for these two bands (850MHz and 1900MHz).

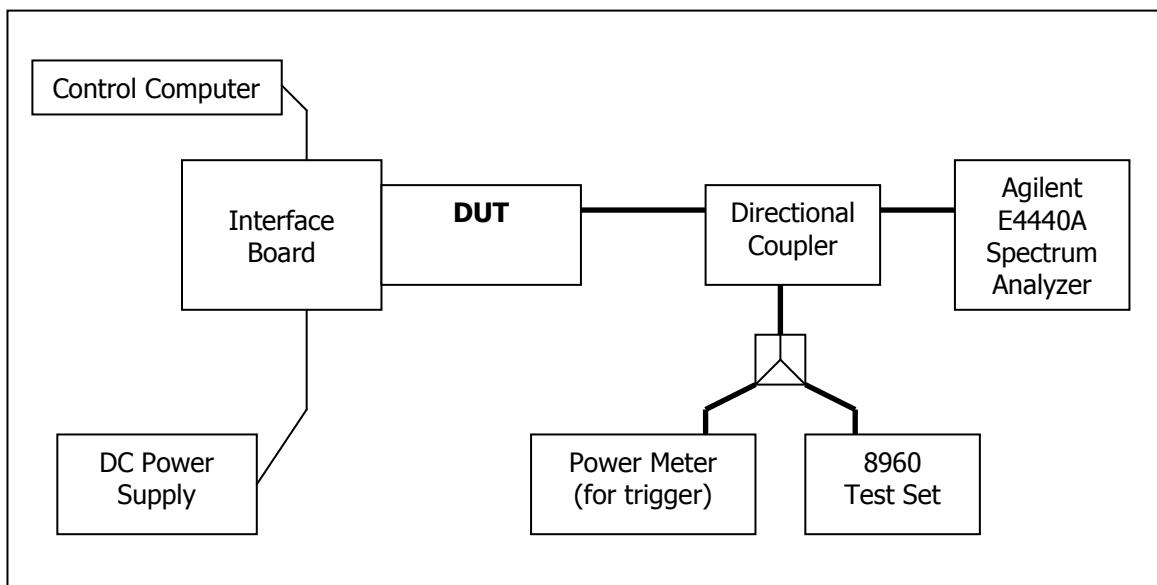
## 4 RF Power Output

### FCC 2.1046

#### 4.1 Test Procedure

The transmitter output was connected to an Agilent 8960 Test Set and configured to operate at maximum power in a call. The power was measured using the spectrum analyzer at three equally spaced operating frequencies for each band. The RBW was set to 1230 KHz for the CDMA2000 and EVDO measurements. The spectrum analyzer was set to measure the RF output power with the cable and coupler losses accounted for.

#### Test Setup



#### 4.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Agilent	8960	MY50260409	2010-09-05
Spectrum Analyzer	Agilent	E4440A	MY48250234	2010-09-22
DC Power Supply	HP	66311B	MY43006721	2010-10-13
Interface Board	Shop built		N/A	N/A
Directional Coupler	Krytar	152010	111269	N/A

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## 4.3 Test Results Cellular band

EUT Mode	Frequency (MHz)	CH	RMS Power (dBm)	Peak Power (dBm)
CDMA 2000	824.70	1013	23.98	28.48
	836.52	384	23.89	28.43
	848.31	777	23.82	28.32
EVDO	824.70	1013	24.24	28.74
	836.52	384	24.05	28.55
	848.31	777	24.09	28.49

## 4.4 Test Results PCS band

EUT Mode	Frequency (MHz)	CH	RMS Power (dBm)	Peak Power (dBm)
CDMA 2000	1851.25	25	24.13	28.63
	1880	600	24.04	28.54
	1908.75	1175	24.09	28.59
EVDO	1851.25	25	24.33	28.53
	1880	600	24.35	28.85
	19.8.75	1175	24.30	28.60

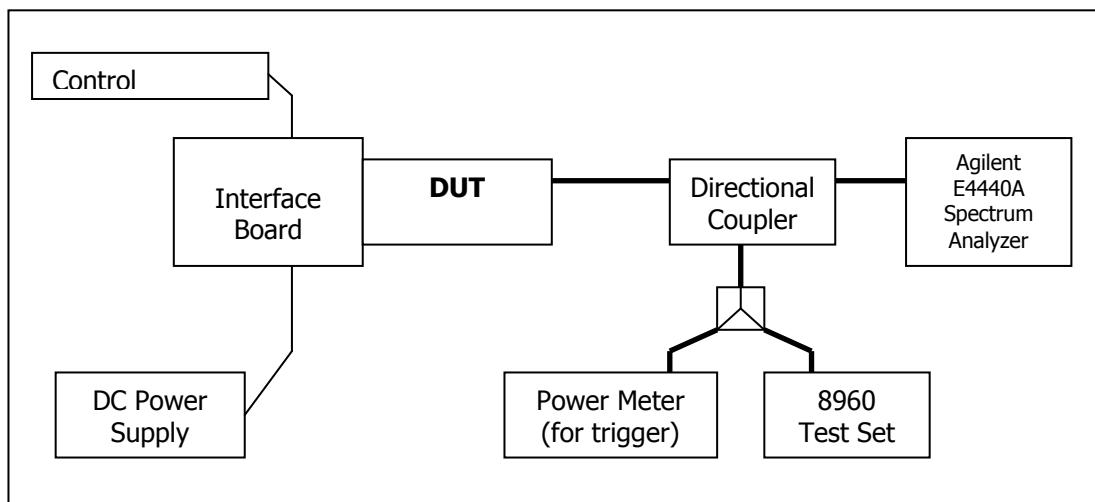
## 5 Occupied Bandwidth

### FCC 2.1049

#### 5.1 Test Procedure

The transmitter output was connected to a spectrum analyzer through a calibrated coaxial cable and a coupler. The occupied bandwidth (defined as the 99% Power Bandwidth) was measured with the spectrum analyzer at low, middle, and high frequencies in each band. The  $-26\text{dB}$  display line was placed on the screen (or 99% bandwidth), the occupied bandwidth is the delta frequency between the two points where the display line intersects the signal trace.

#### Test Setup



#### 5.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Agilent	8960	MY50260409	2010-09-05
Spectrum Analyzer	Agilent	E4440A	MY48250234	2010-09-22
DC Power Supply	HP	66311B	MY43006721	2010-10-13
Interface Board	Shop built		N/A	N/A
Directional Coupler	Krytar	152010	111269	N/A

#### 5.3 Test Results

The performance of the CDMA2000 850 MHz Cellular band is shown in plots 5.3.1 to 5.3.3.

Performance of the CDMA2000 1900 MHz PCS band is shown in plots 5.3.4 to 5.3.6.

Performance of the EVDO 850 Cellular band is shown in plots 5.3.7 to 5.3.9.

Performance of the EVDO 1900 PCS band is shown in plots 5.3.10 to 5.3.12.

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### 5.3.1 CDMA Results

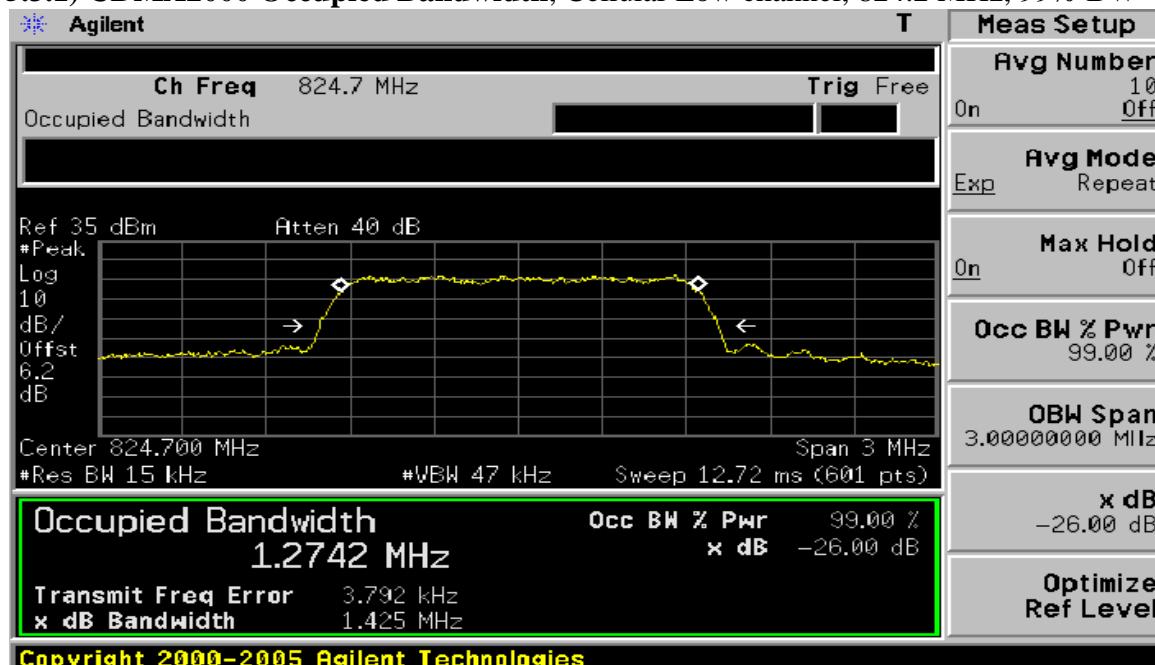
Frequency (MHz)	Channel	99% Occupied Bandwidth (MHz)
824.70	1013	1.2742
836.52	384	1.2781
848.31	777	1.2755
1851.25	25	1.2829
1880.0	600	1.2810
1908.75	1175	1.2817

### 5.3.2 EVDO Results

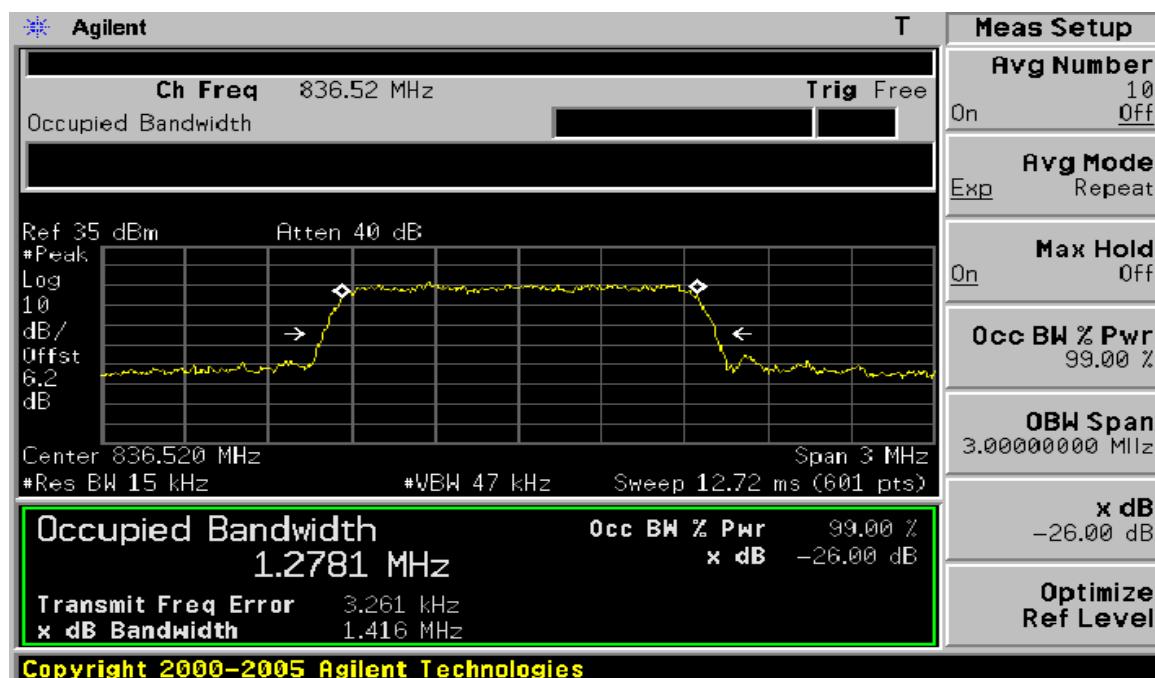
Frequency (MHz)	Channel	99% Occupied Bandwidth (MHz)
824.70	1013	1.2732
836.52	384	1.2729
848.31	777	1.2744
1851.25	25	1.2894
1880.0	600	1.2815
1908.75	1175	1.2860

## 5.4 Test Plots

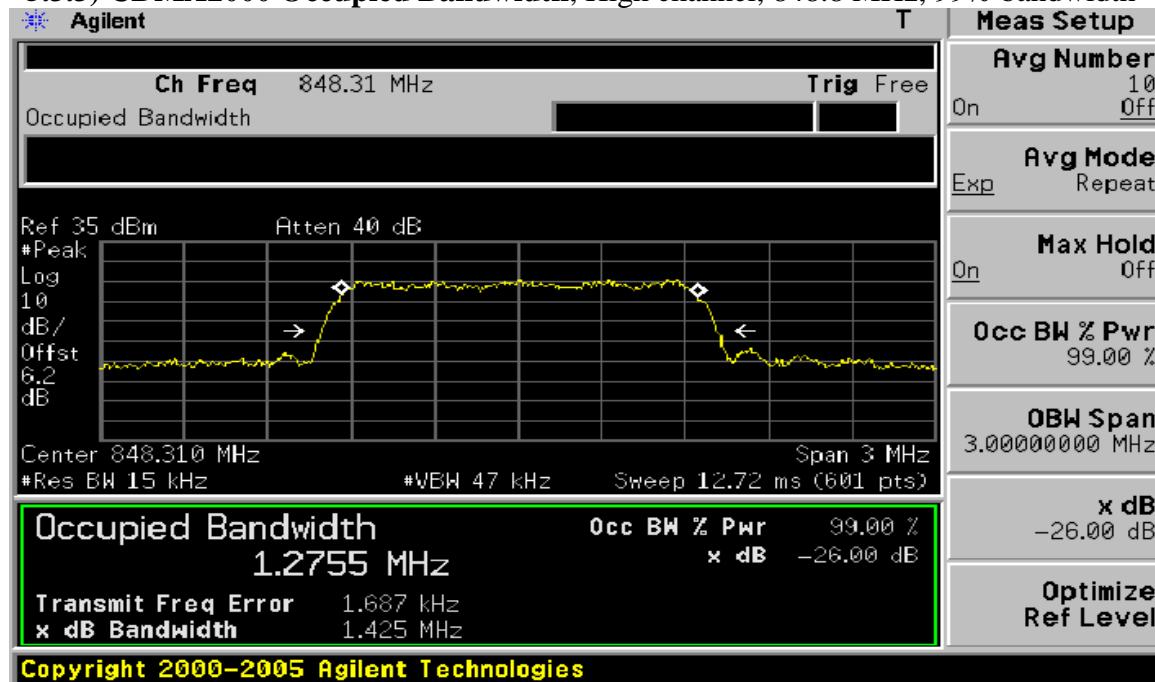
### 5.3.1) CDMA2000 Occupied Bandwidth, Cellular Low channel, 824.2 MHz, 99% BW



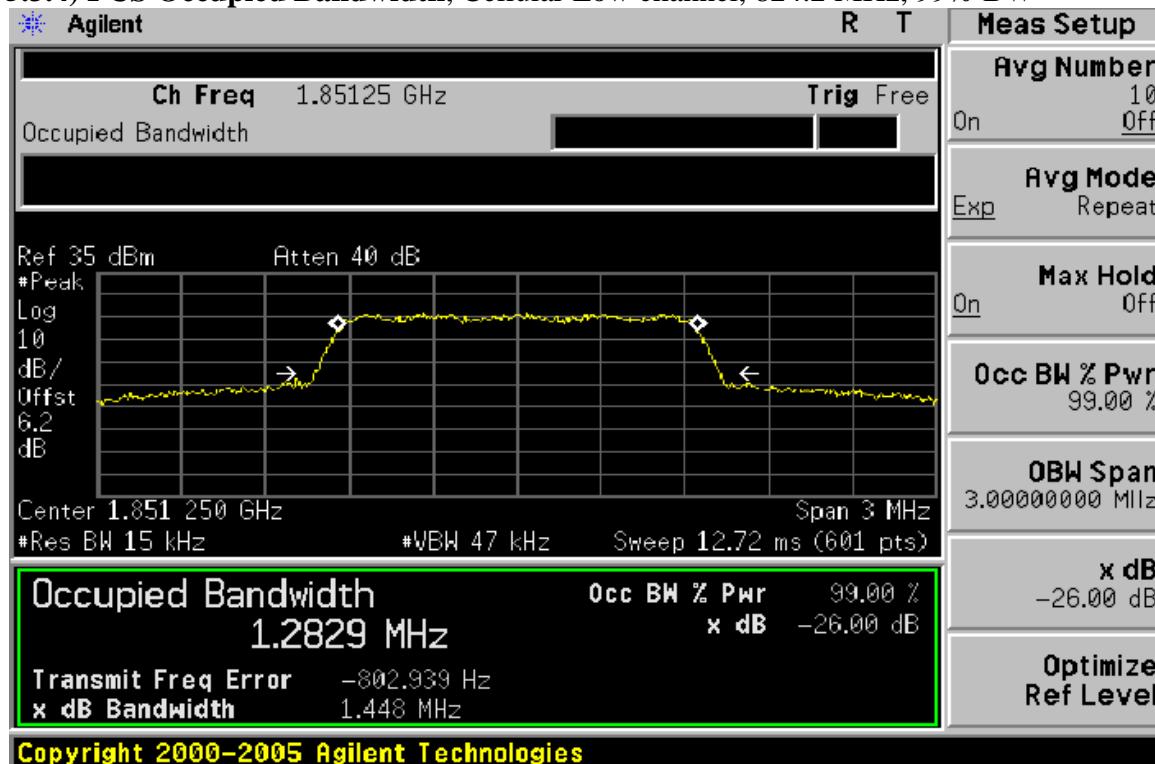
### 5.3.2) CDMA2000 Occupied Bandwidth, Middle channel, 836.6 MHz, 99% bandwidth



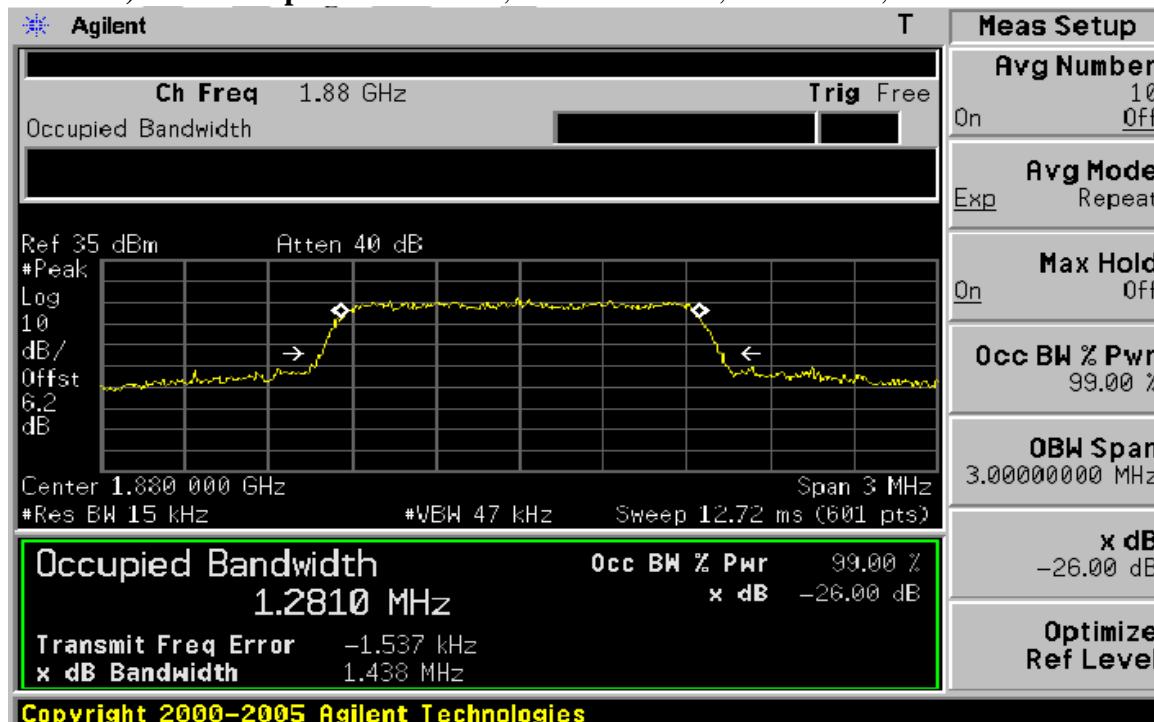
## 5.3.3) CDMA2000 Occupied Bandwidth, High channel, 848.8 MHz, 99% bandwidth



## 5.3.4) PCS Occupied Bandwidth, Cellular Low channel, 824.2 MHz, 99% BW



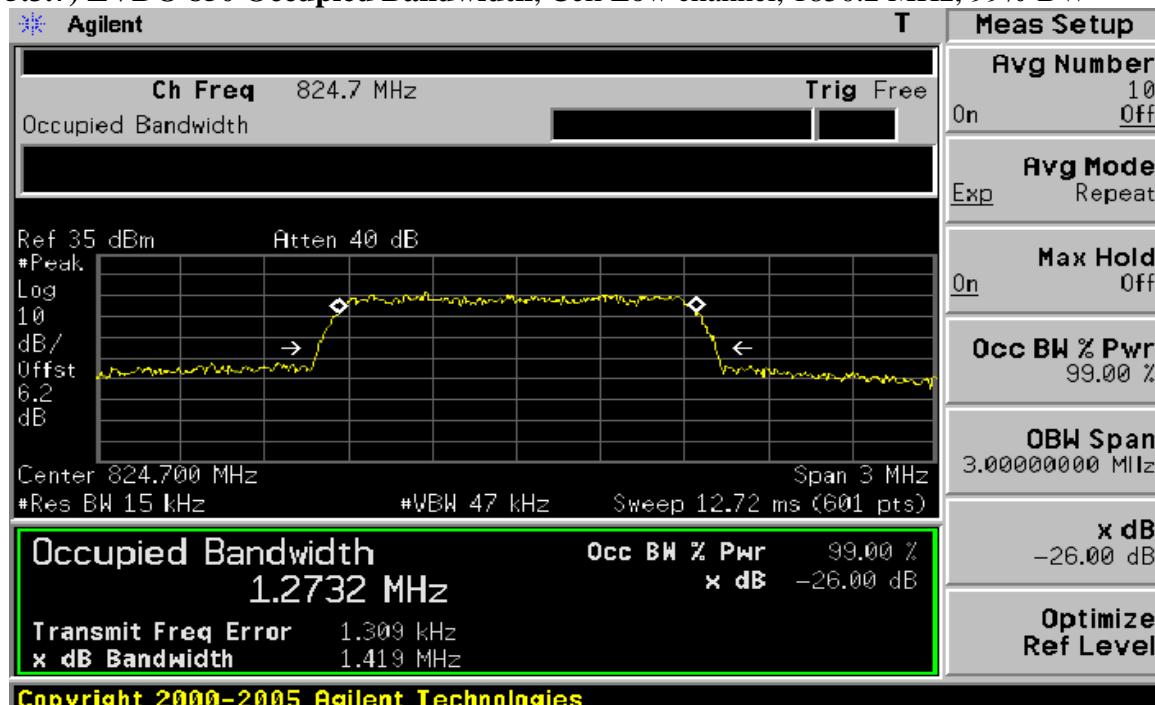
## 5.3.5) PCS Occupied Bandwidth, Middle channel, 836.6 MHz, 99% bandwidth



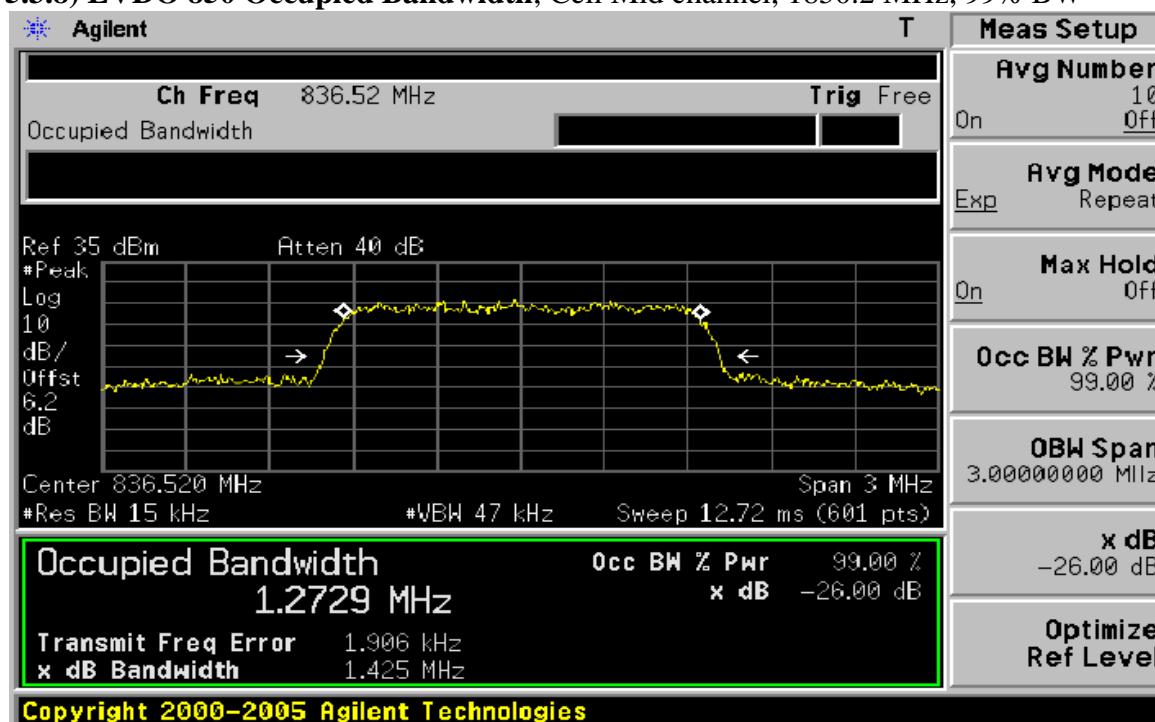
## 5.3.6) PCS Occupied Bandwidth, High channel, 848.8 MHz, 99% bandwidth



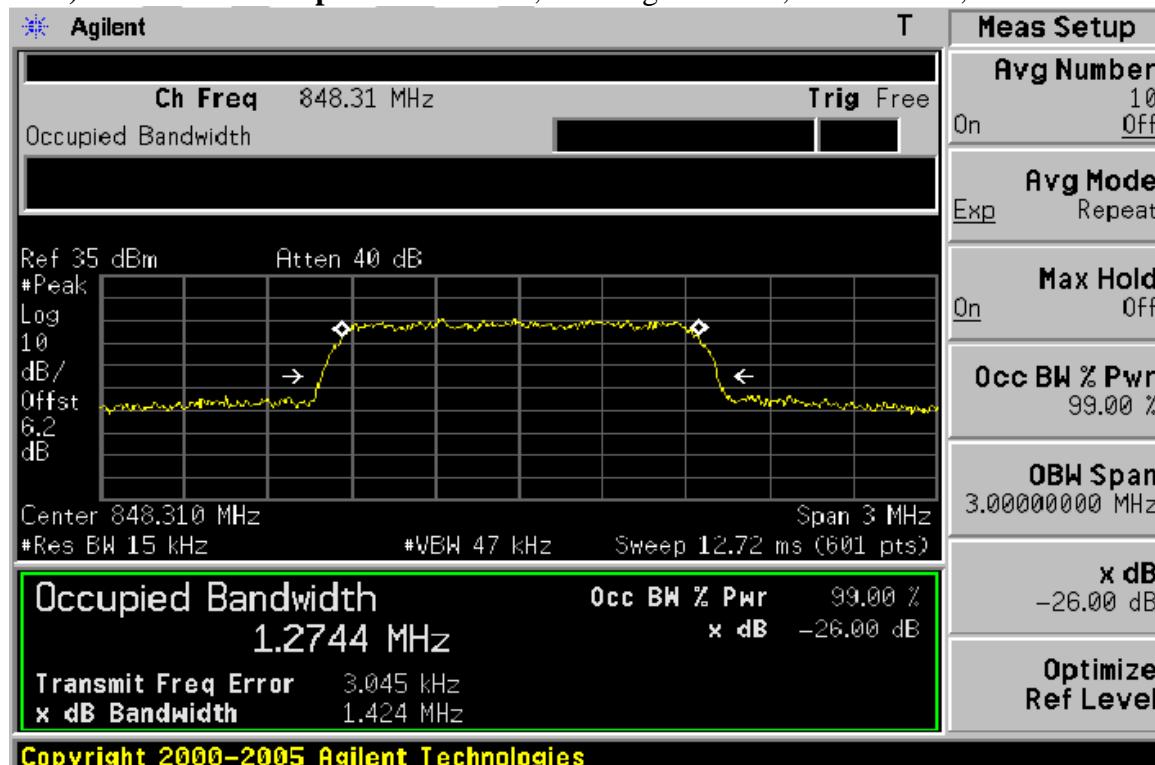
## 5.3.7) EVDO 850 Occupied Bandwidth, Cell Low channel, 1850.2 MHz, 99% BW



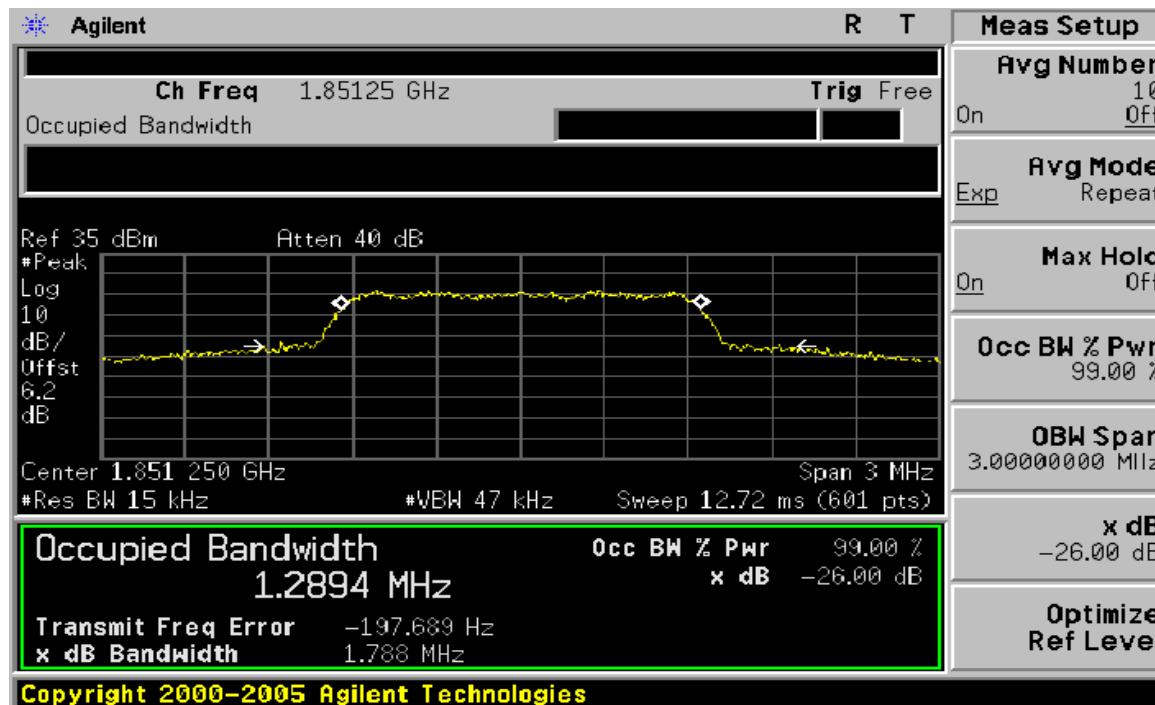
## 5.3.8) EVDO 850 Occupied Bandwidth, Cell Mid channel, 1850.2 MHz, 99% BW



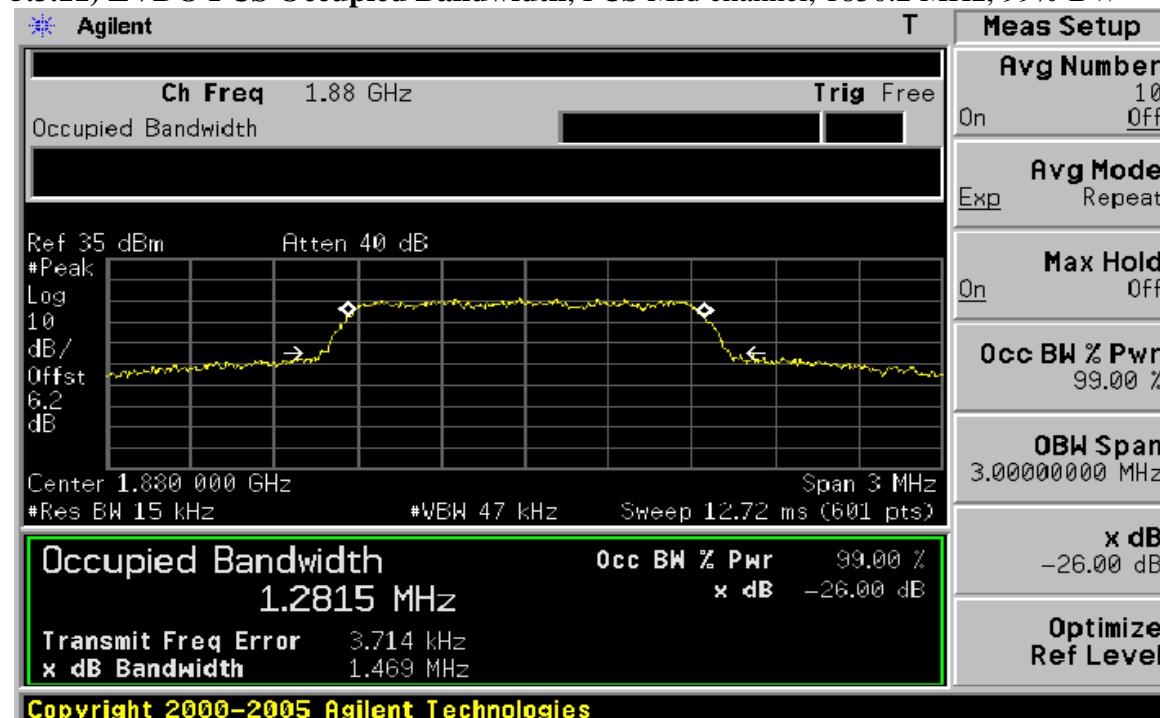
## 5.3.9) EVDO 850 Occupied Bandwidth, Cell High channel, 1850.2 MHz, 99% BW



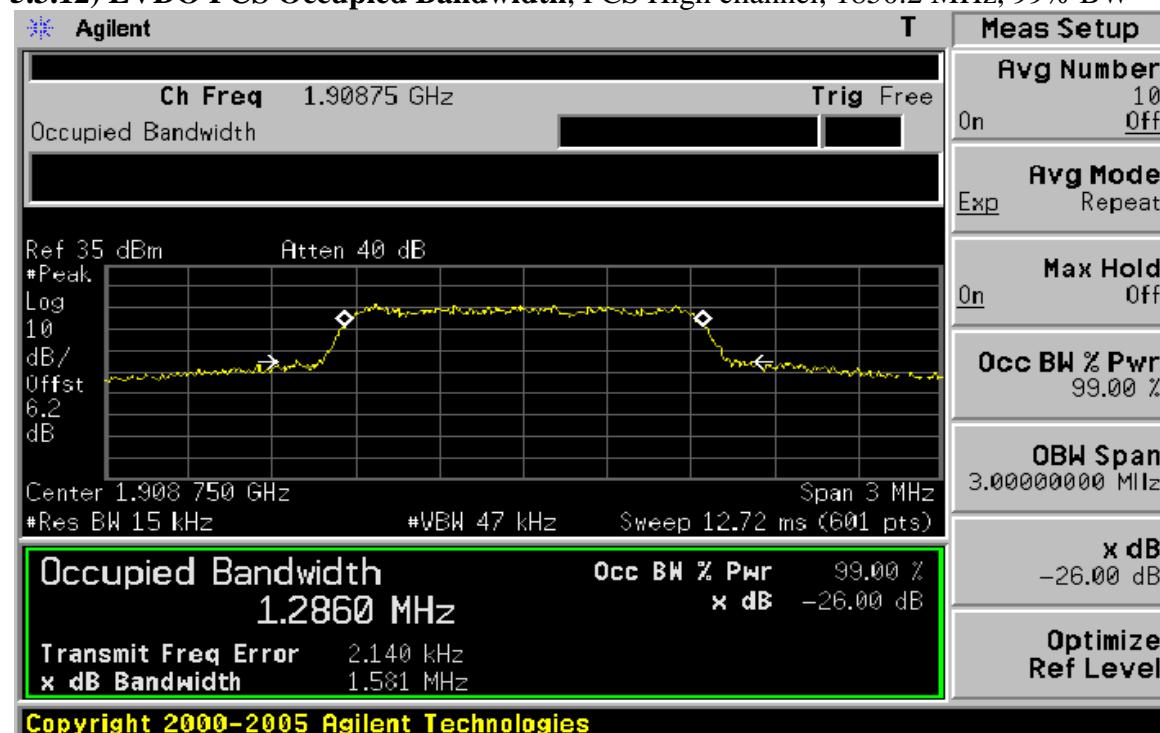
## 5.3.10) EVDO PCS Occupied Bandwidth, PCS Low channel, 1850.2 MHz, 99% BW



## 5.3.11) EVDO PCS Occupied Bandwidth, PCS Mid channel, 1850.2 MHz, 99% BW



## 5.3.12) EVDO PCS Occupied Bandwidth, PCS High channel, 1850.2 MHz, 99% BW



## 6 Out of Band Emissions at Antenna Terminals

FCC 22.901(d), 22.917, 24.238(a)

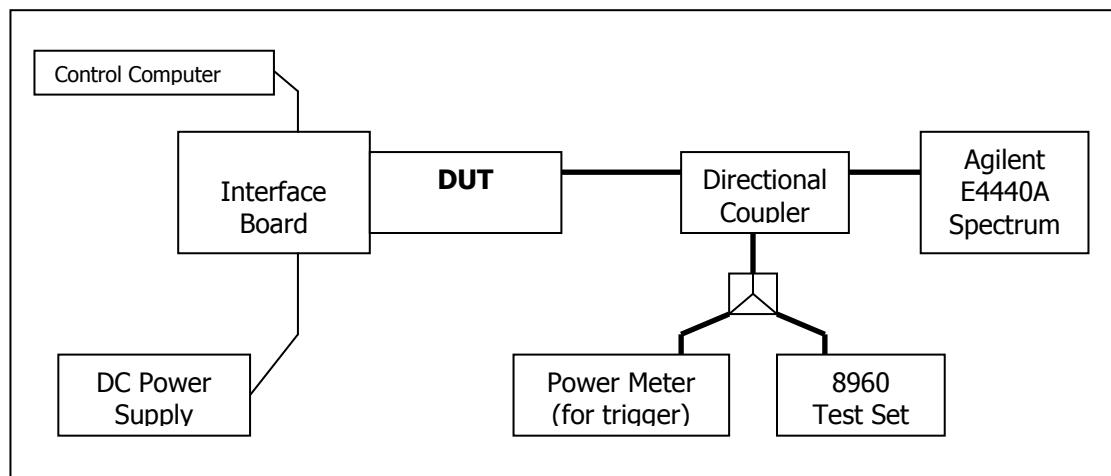
### Out of Band Emissions:

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by at least  $(43 + 10 \log P)$  dB. The out of band emission limit translates to a worst case absolute limit of -13dBm in this case.

### **6.1 Test Procedure**

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band emissions, if any, up to 10<sup>th</sup> harmonic. The EUT was scanned for spurious emissions from 30MHz to 20GHz with sufficient bandwidth and video resolution. Data plots are included. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were captured.

### Test Setup



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## 6.2 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Agilent	8960	MY50260409	2010-09-05
Spectrum Analyzer	Agilent	E4440A	MY48250234	2010-09-22
DC Power Supply	HP	66311B	MY43006721	2010-10-13
Interface Board	Shop built		N/A	N/A
Directional Coupler	Krytar	152010	111269	N/A
Control Computer	TC	Generic PC	100488	N/A

## 6.3 Test Results

Refer to the following plots.

- CDMA Cellular Band

Plot Number	Description
6.4.1	CDMA2000 Mode, Low channel, 824.70 MHz
6.4.2	CDMA2000 Mode, Middle Channel, 836.52 MHz
6.4.3	CDMA2000 Mode, High Channel, 848.31 MHz

- CDMA PCS Band

Plot Number	Description
6.4.4	CDMA2000 Mode, Low Channel, 1851.25 MHz
6.4.5	CDMA2000 Mode, Middle Channel, 1880.0 MHz
6.4.6	CDMA2000 Mode, High Channel, 1908.75MHz

- EVDO Cellular Band

Plot Number	Description
6.4.7	EVDO Mode, Low Channel, 824.70 MHz
6.4.8	EVDO Mode, Middle Channel, 836.52 MHz
6.4.9	EVDO Mode, High Channel, 846.31 MHz

- EVDO PCS Band

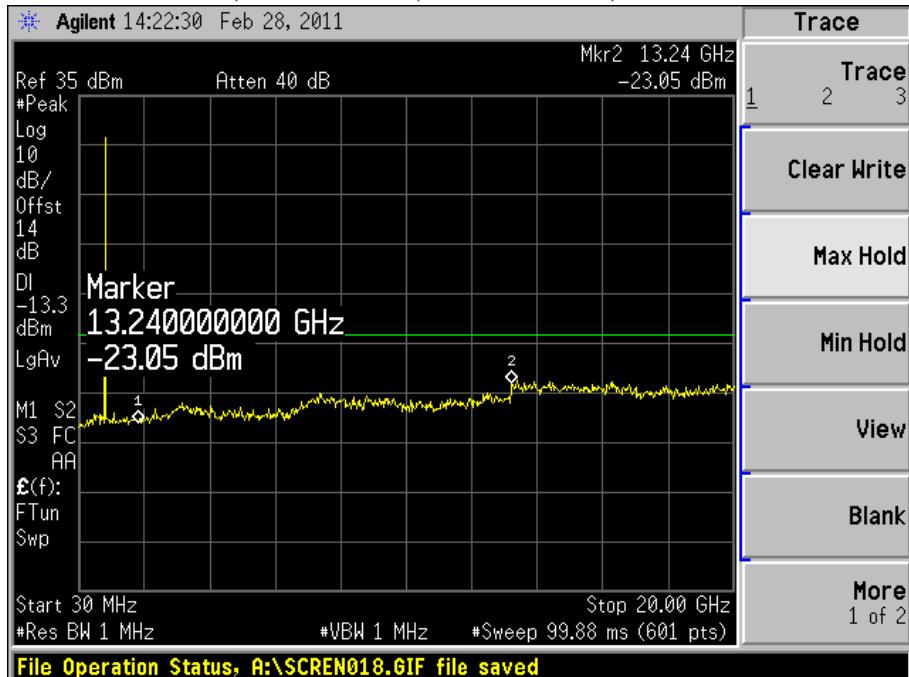
Plot Number	Description
6.4.10	EVDO Mode, Low Channel, 1851.25MHz
6.4.11	EVDO Mode, Middle Channel, 1880.0 MHz
6.4.12	EVDO Mode, High Channel, 1908.75 MHz

The plots below show that the conducted emission limits requirements are met.

## 6.4 Test Plots

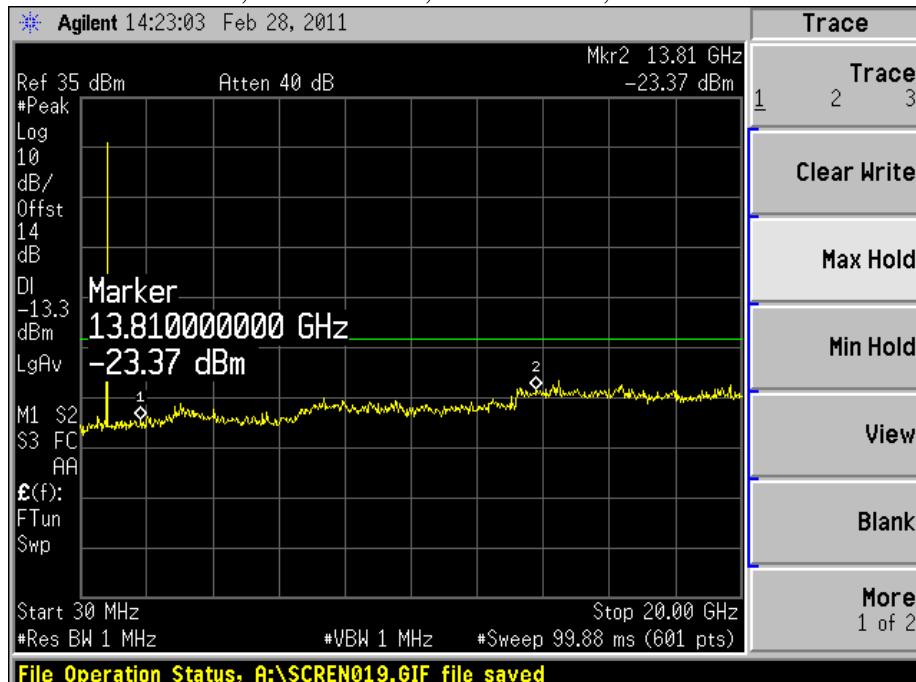
### Plot 6.4.1) Out of Band Emissions at Antenna Terminals

CDMA2000, Low channel, 824.700 MHz, 30 MHz to 20 GHz



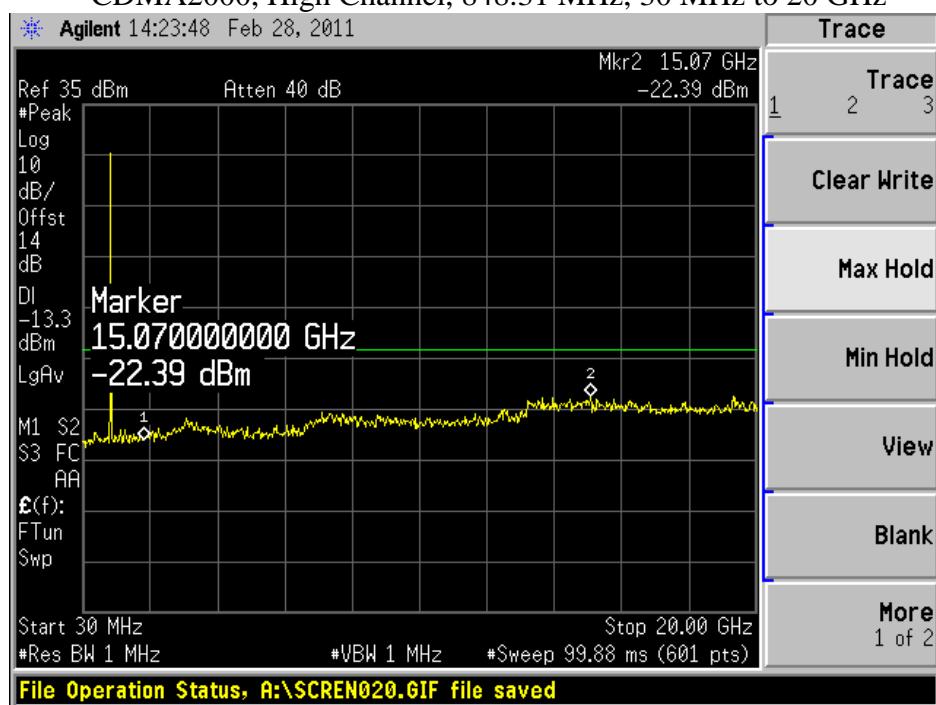
### Plot 6.4.2) Out of Band Emissions at Antenna Terminals

CDMA2000, Mid Channel, 836.52 MHz, 30 MHz to 20 GHz

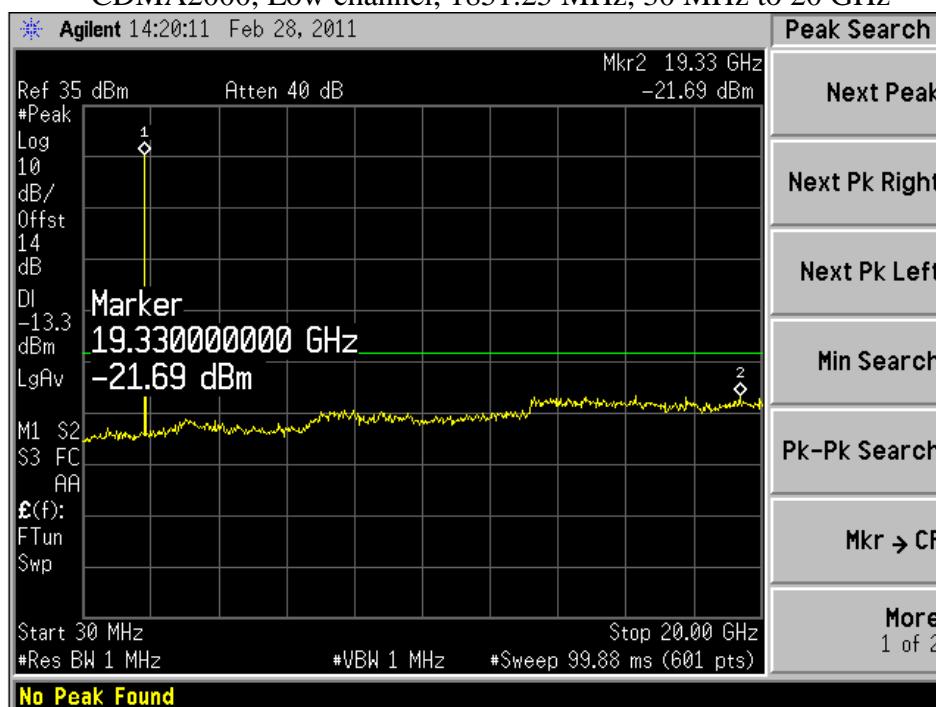


**Plot 6.4.3) Out of Band Emissions at Antenna Terminals**

CDMA2000, High Channel, 848.31 MHz, 30 MHz to 20 GHz

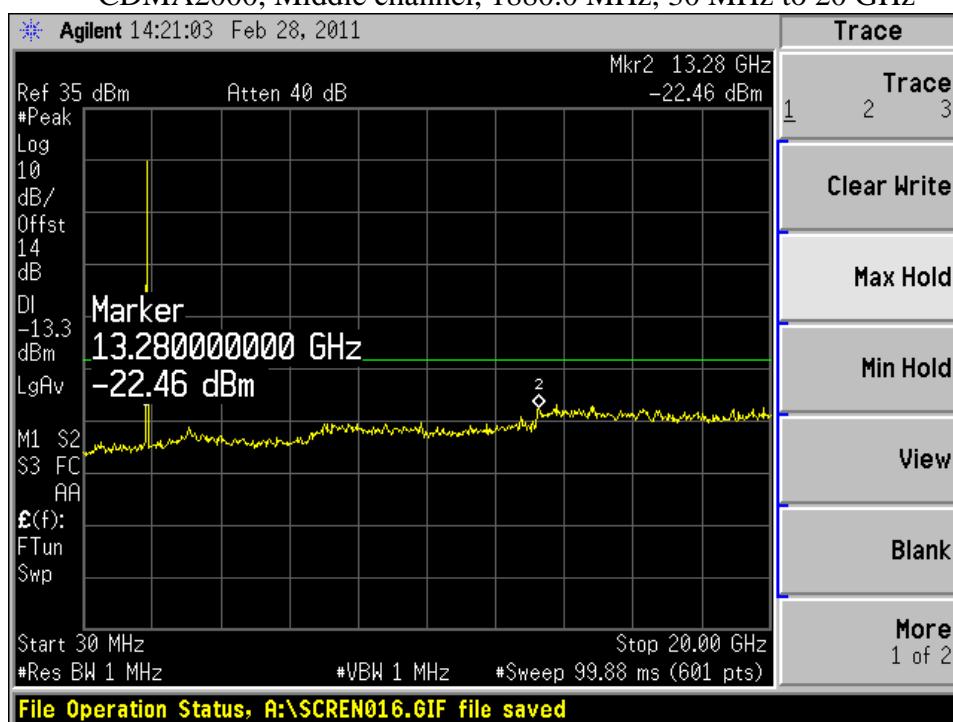
**Plot 6.4.4) Out of Band Emissions at Antenna Terminals**

CDMA2000, Low channel, 1851.25 MHz, 30 MHz to 20 GHz

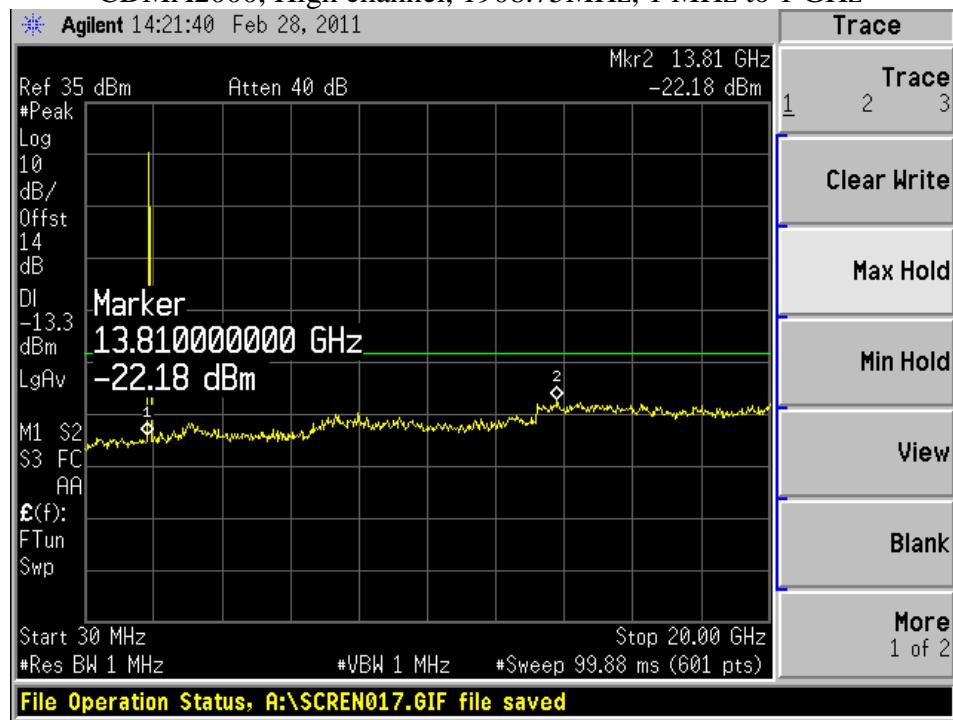


**Plot 6.4.5) Out of Band Emissions at Antenna Terminals**

CDMA2000, Middle channel, 1880.0 MHz, 30 MHz to 20 GHz

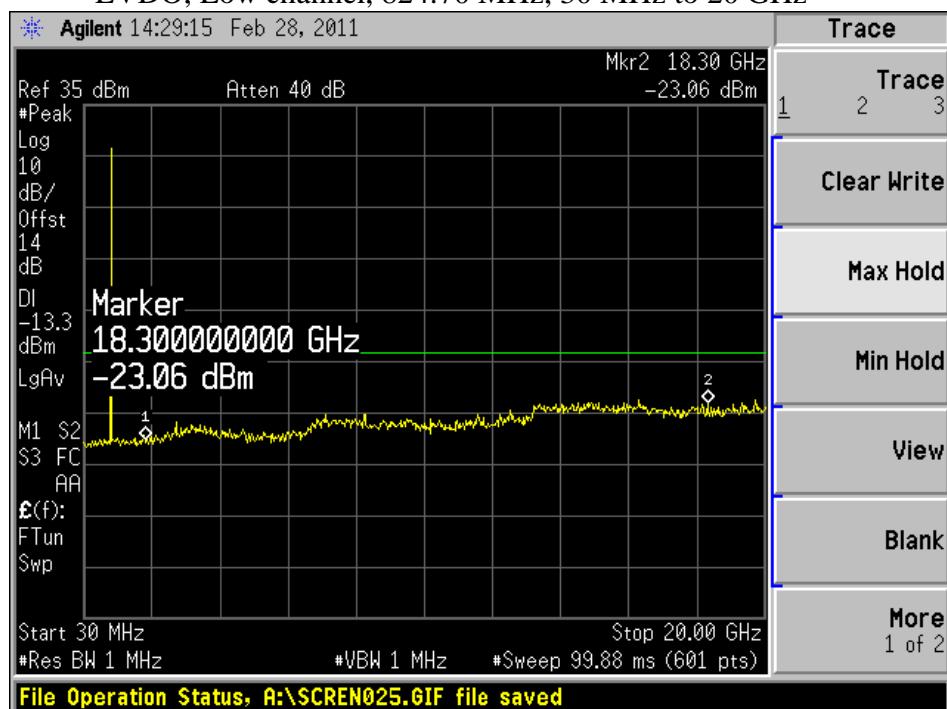
**Plot 6.4.6) Out of Band Emissions at Antenna Terminals**

CDMA2000, High channel, 1908.75MHz, 1 MHz to 1 GHz

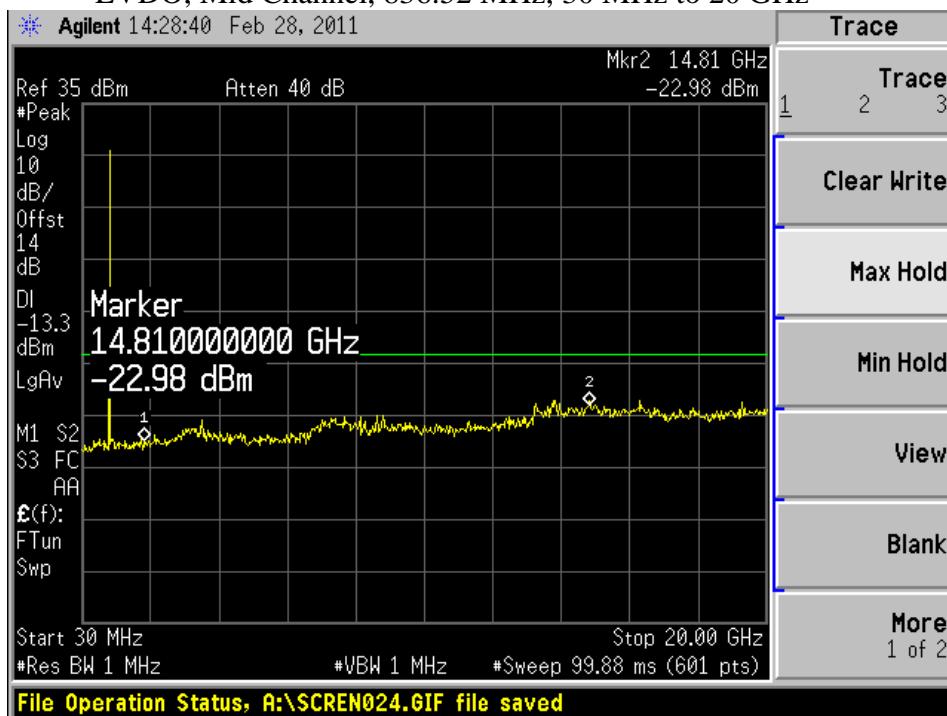


**Plot 6.4.7) Out of Band Emissions at Antenna Terminals**

EVDO, Low channel, 824.70 MHz, 30 MHz to 20 GHz

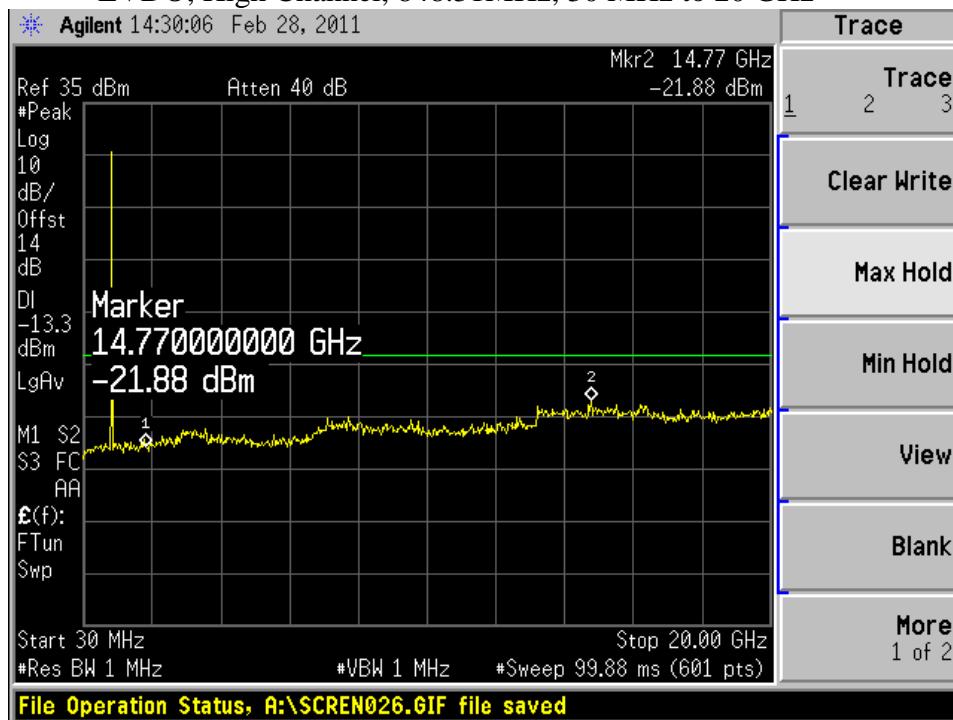
**Plot 6.4.8) Out of Band Emissions at Antenna Terminals**

EVDO, Mid Channel, 836.52 MHz, 30 MHz to 20 GHz

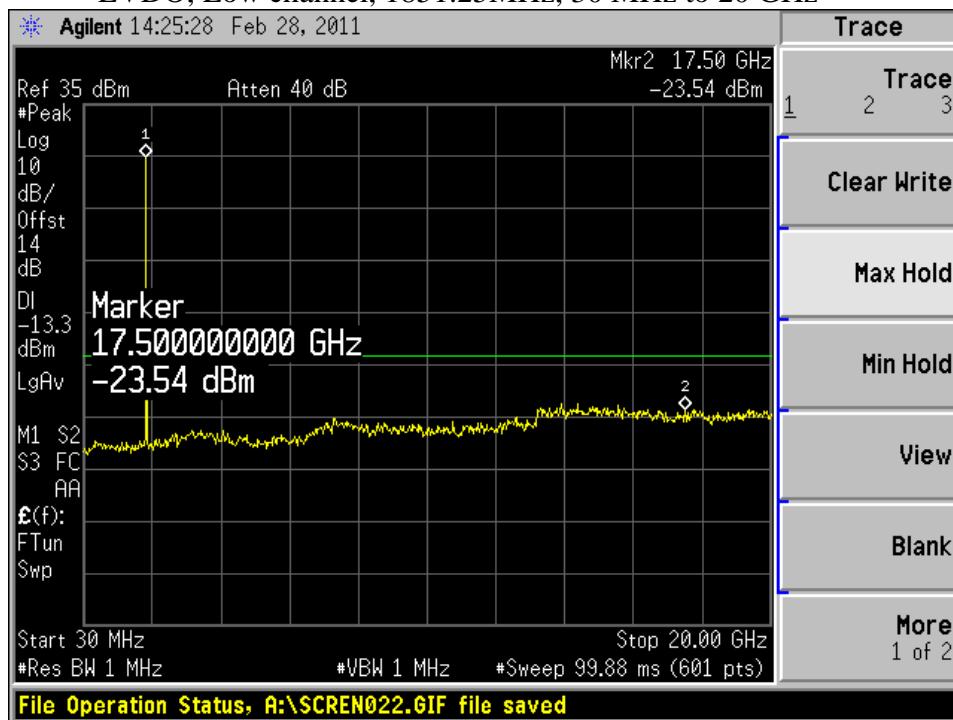


**Plot 6.4.9) Out of Band Emissions at Antenna Terminals**

EVDO, High Channel, 848.31MHz, 30 MHz to 20 GHz

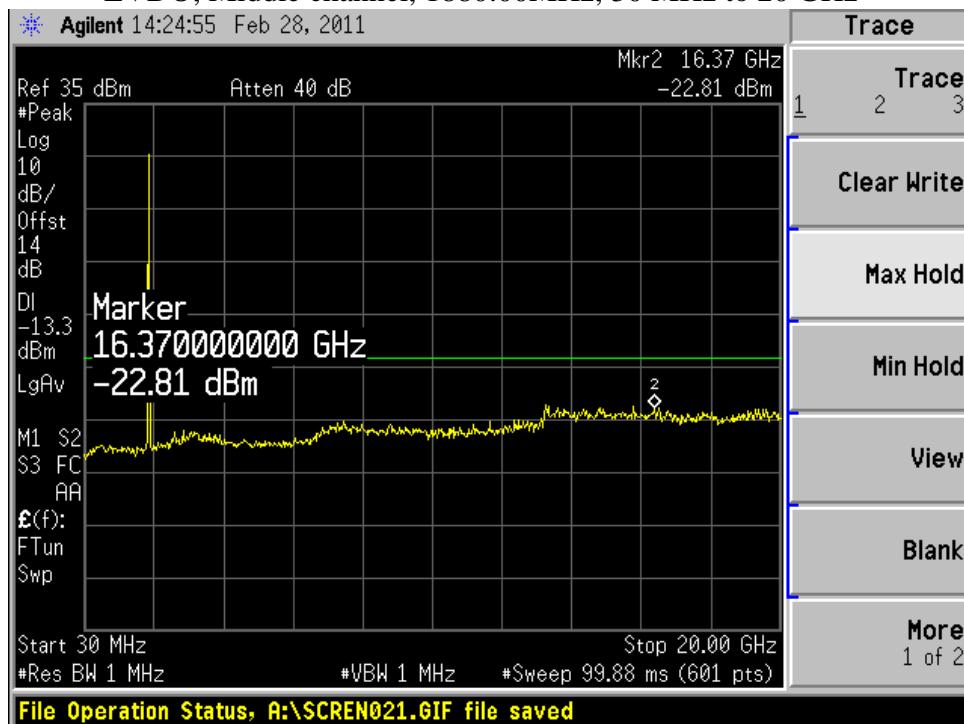
**Plot 6.4.10) Out of Band Emissions at Antenna Terminals**

EVDO, Low channel, 1851.25MHz, 30 MHz to 20 GHz

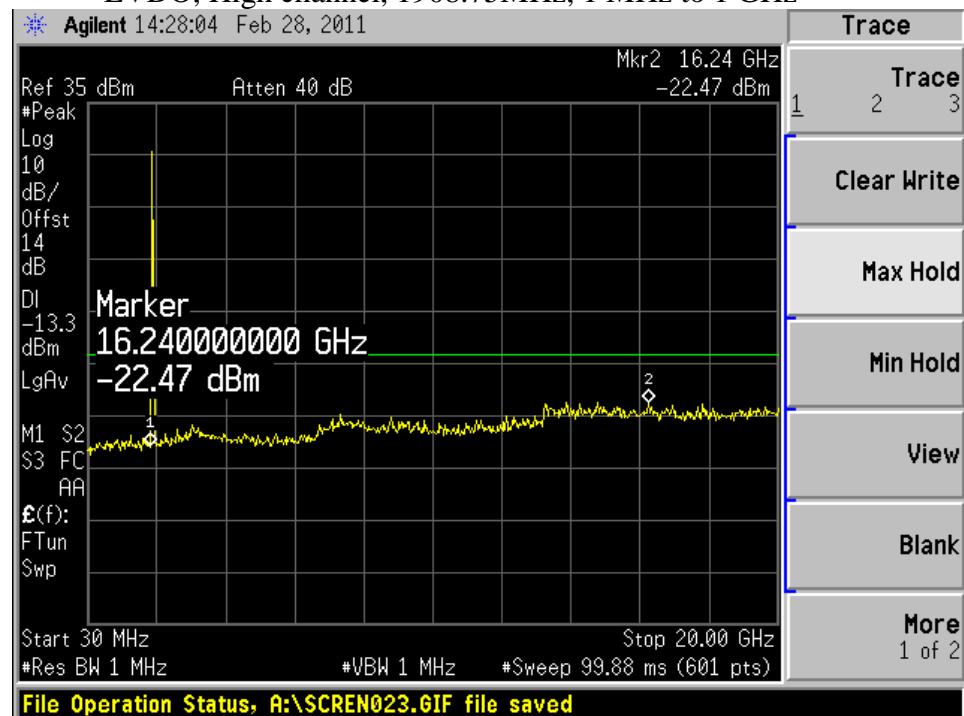


**Plot 6.4.11) Out of Band Emissions at Antenna Terminals**

EVDO, Middle channel, 1880.00MHz, 30 MHz to 20 GHz

**Plot 6.4.12) Out of Band Emissions at Antenna Terminals**

EVDO, High channel, 1908.75MHz, 1 MHz to 1 GHz



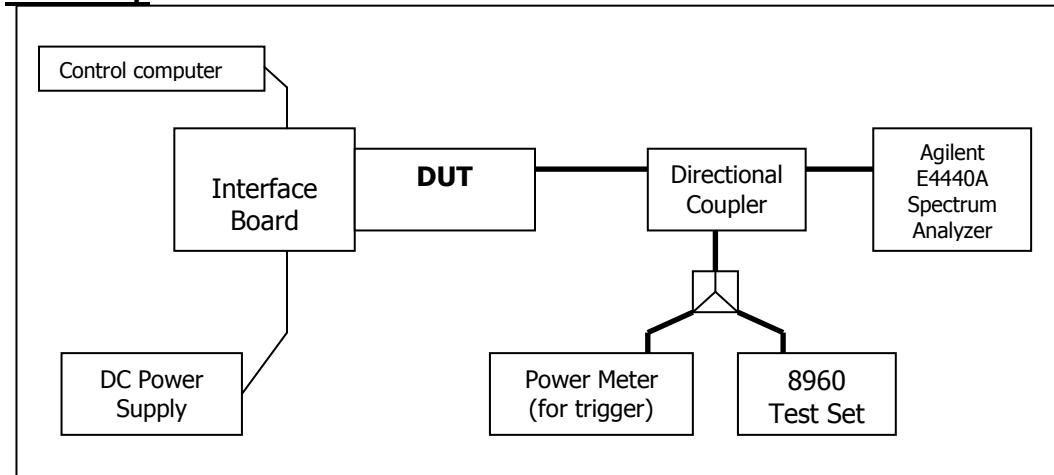
## 7 Block Edge Compliance

### FCC Part 22H/24E

#### 7.1 Test Procedure

The transmitter output was connected to a Rohde & Schwarz CMU200 Test Set, through a coaxial RF cable and a directional coupler, and configured to operate at maximum power. The block edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

#### Test Setup



#### 7.2 Test Equipment

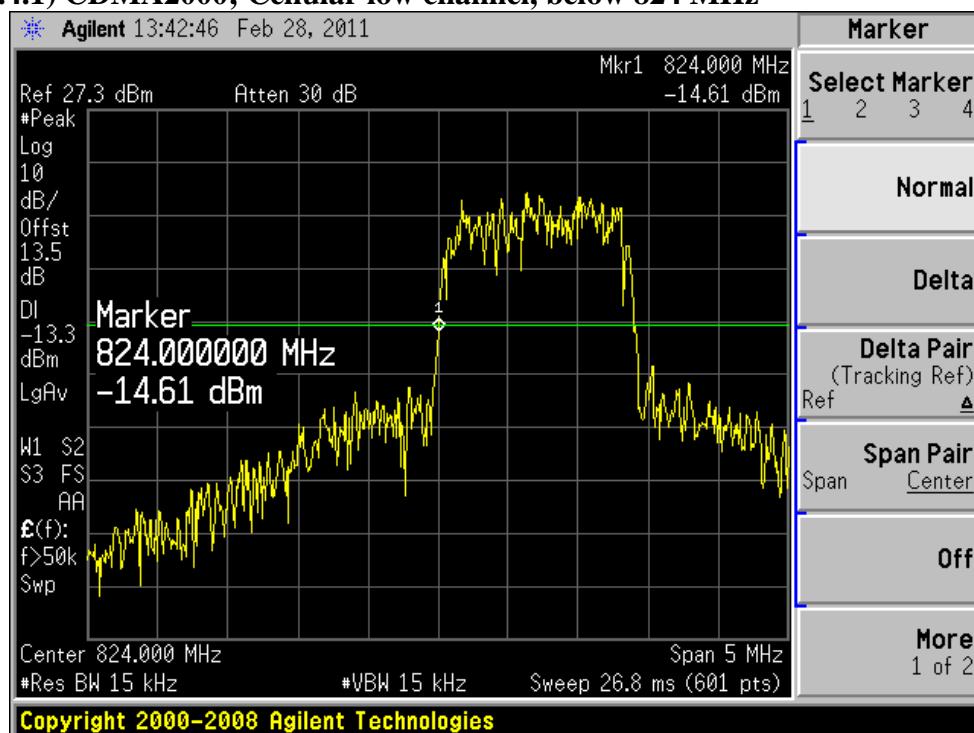
EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Agilent	8960	MY50260409	2010-09-05
Spectrum Analyzer	Agilent	E4440A	MY48250234	2010-09-22
DC Power Supply	HP	66311B	MY43006721	2010-10-13
Interface Board	Shop built		N/A	N/A
Directional Coupler	Krytar	152010	111269	N/A

#### 7.3 Test Results

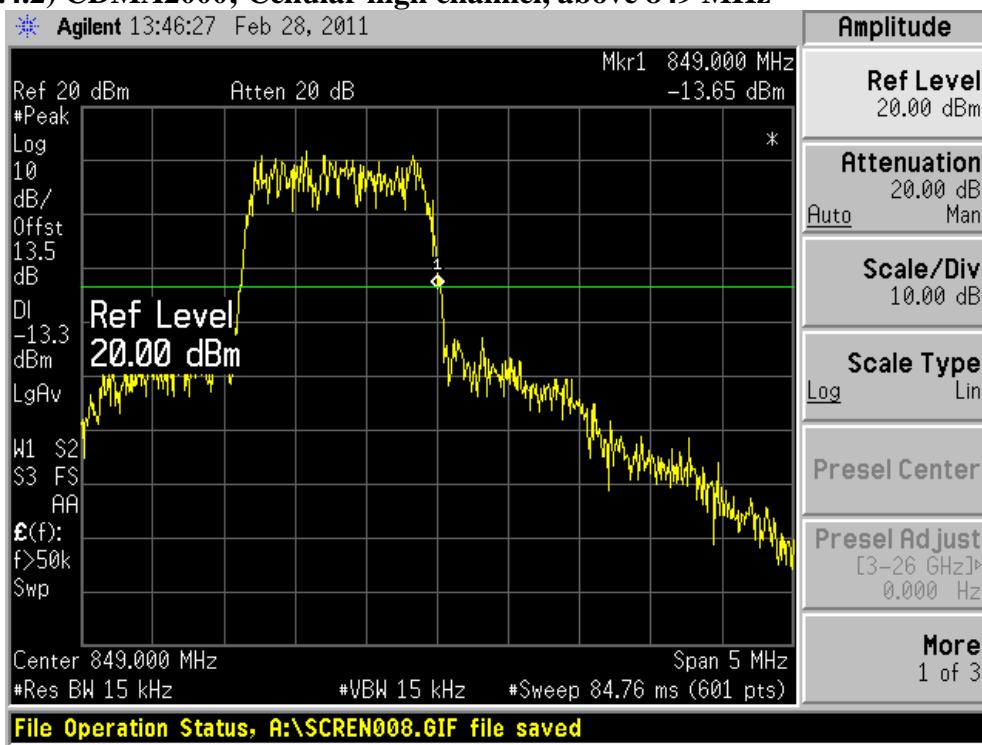
Block Test	Frequency Boundaries (MHz)	Channels Tested	Corresponding Plots	Result
1	CDMA2000: Below 824 MHz, above 849 MHz	1013, 777	7.4.1, 7.4.2	Complies
2	CDMA2000: Below 1850MHz, above 1910MHz	25, 1175	7.4.3, 7.4.4	Complies
Block Test	Frequency Boundaries (MHz)	Channels Tested	Corresponding Plots	Result
1	EVDO: Below 824MHz, above 849MHz	1013, 777	7.4.5, 7.4.6	Complies
2	EVDO: Below 1850MHz, above 1910MHz	25, 1175	7.4.7, 7.4.8	Complies

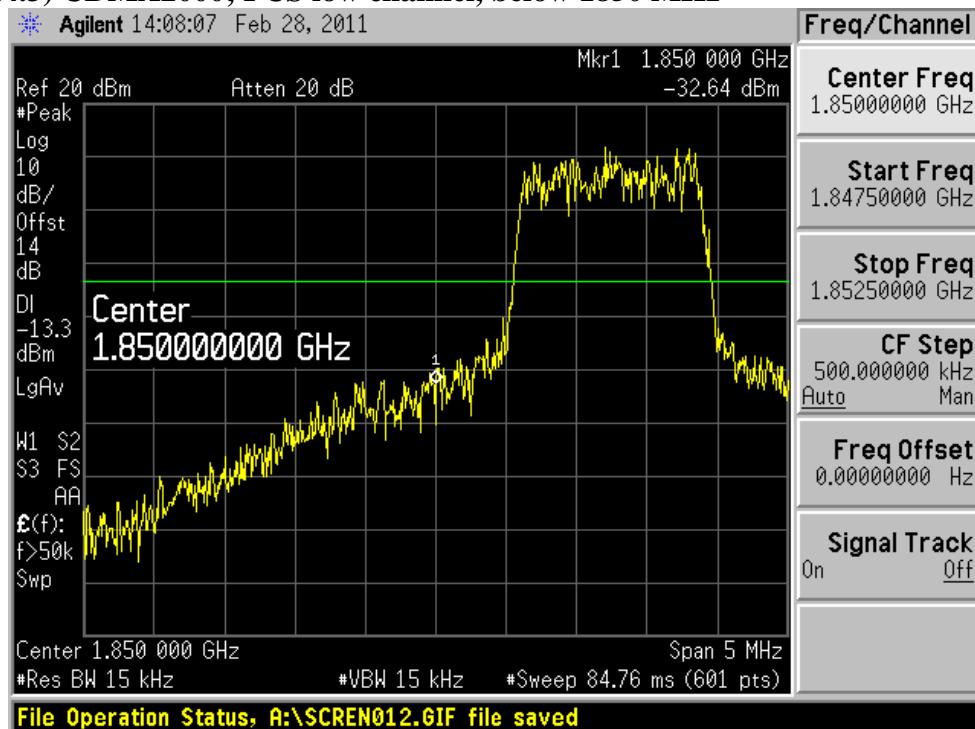
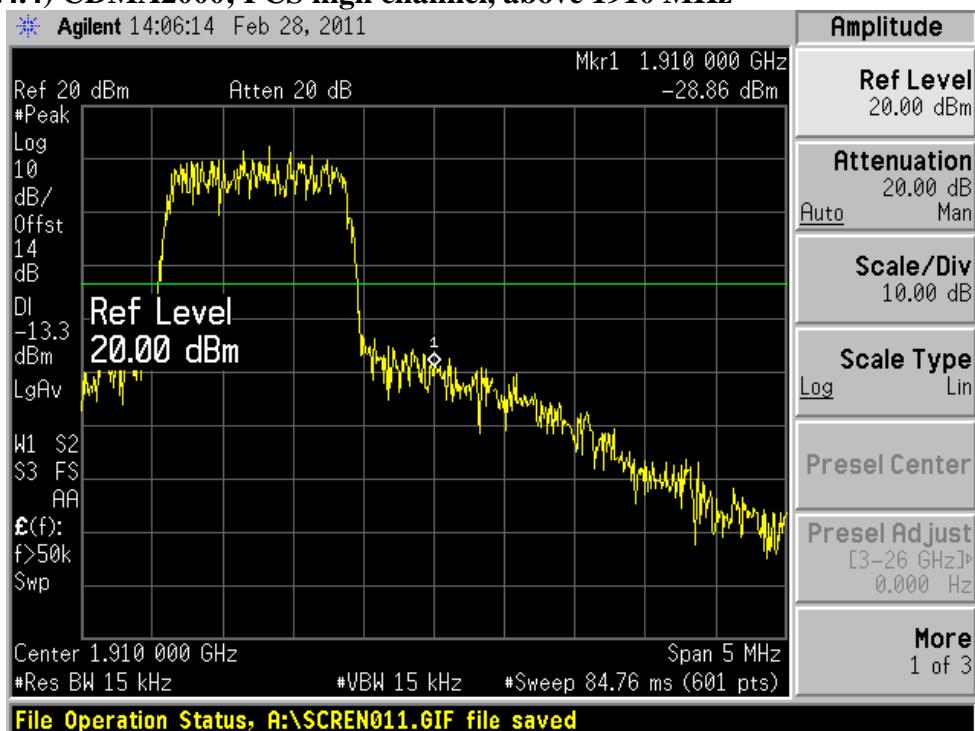
## 7.4 Test Plots

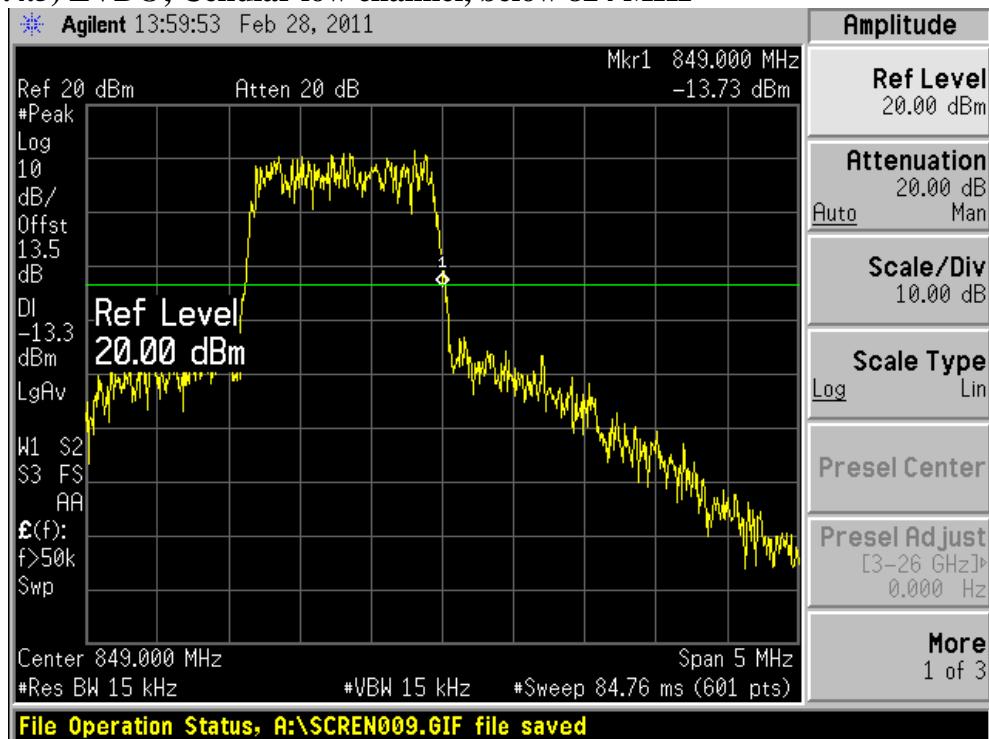
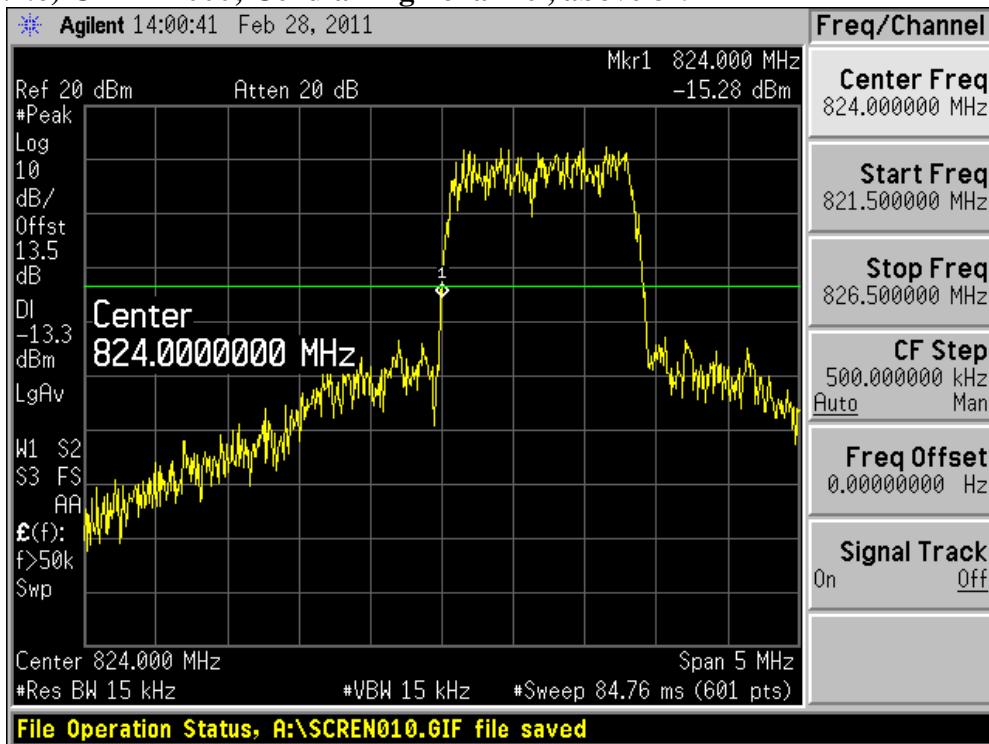
### Plot 7.4.1) CDMA2000; Cellular low channel, below 824 MHz

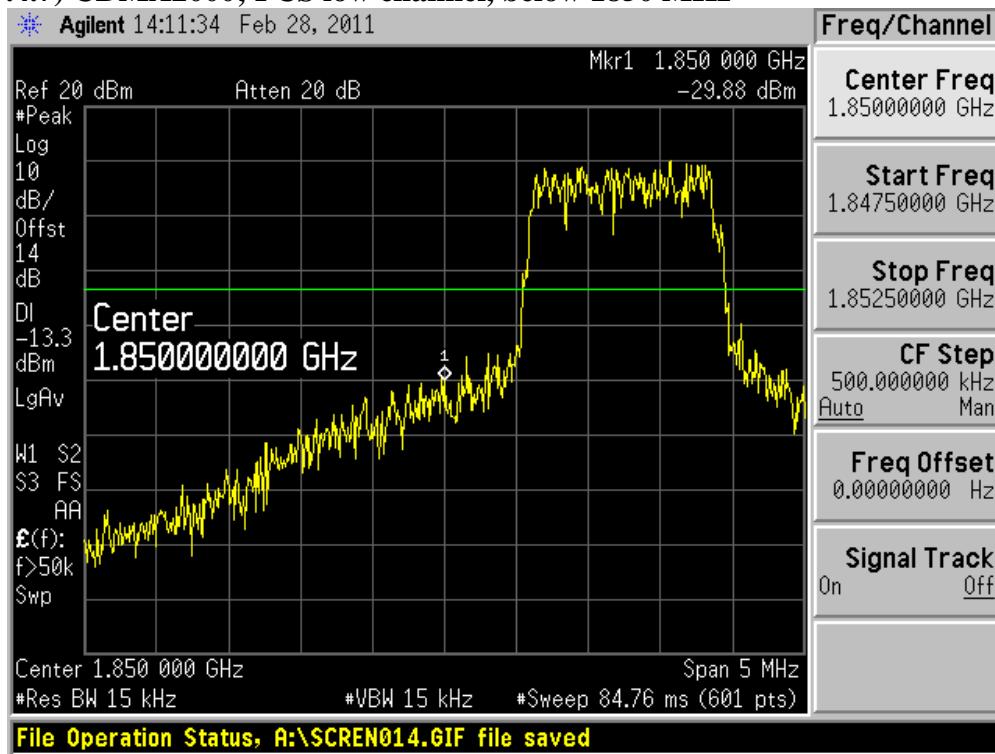
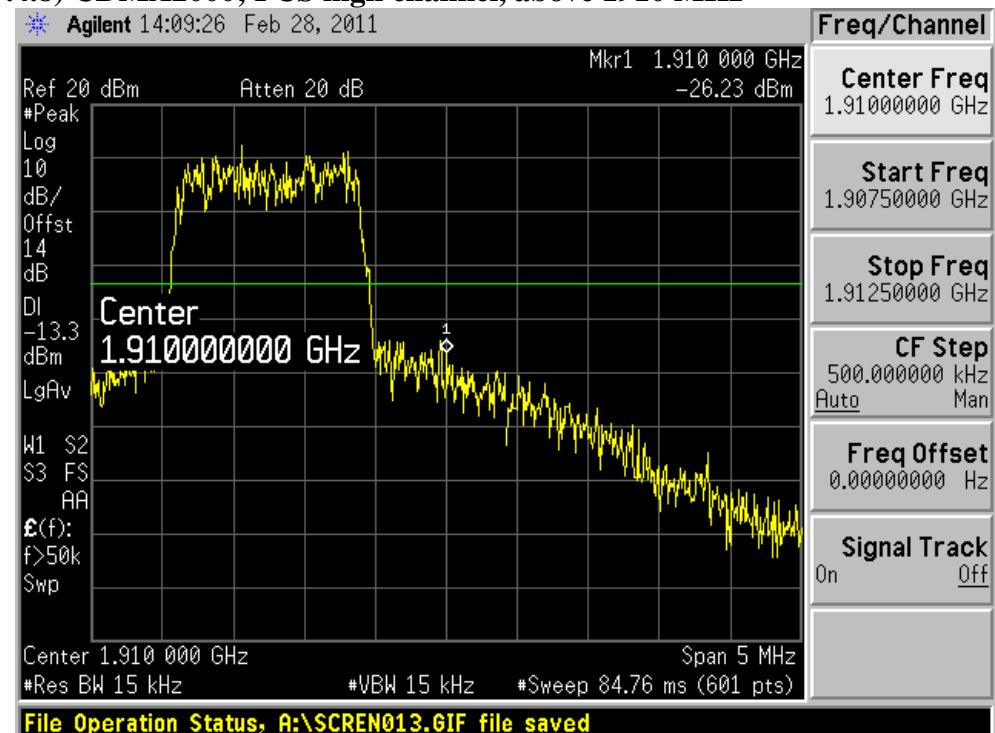


### Plot 7.4.2) CDMA2000; Cellular high channel, above 849 MHz



**Plot 7.4.3) CDMA2000; PCS low channel, below 1850 MHz****Plot 7.4.4) CDMA2000; PCS high channel, above 1910 MHz**

**Plot 7.4.5) EVDO; Cellular low channel, below 824 MHz****Plot 7.4.6) CDMA2000; Cellular high channel, above 849 MHz**

**Plot 7.4.7) CDMA2000; PCS low channel, below 1850 MHz****Plot 7.4.8) CDMA2000; PCS high channel, above 1910 MHz**

## 8 Frequency Stability versus Temperature

FCC 2.1055, FCC 22.355, FCC 24.235

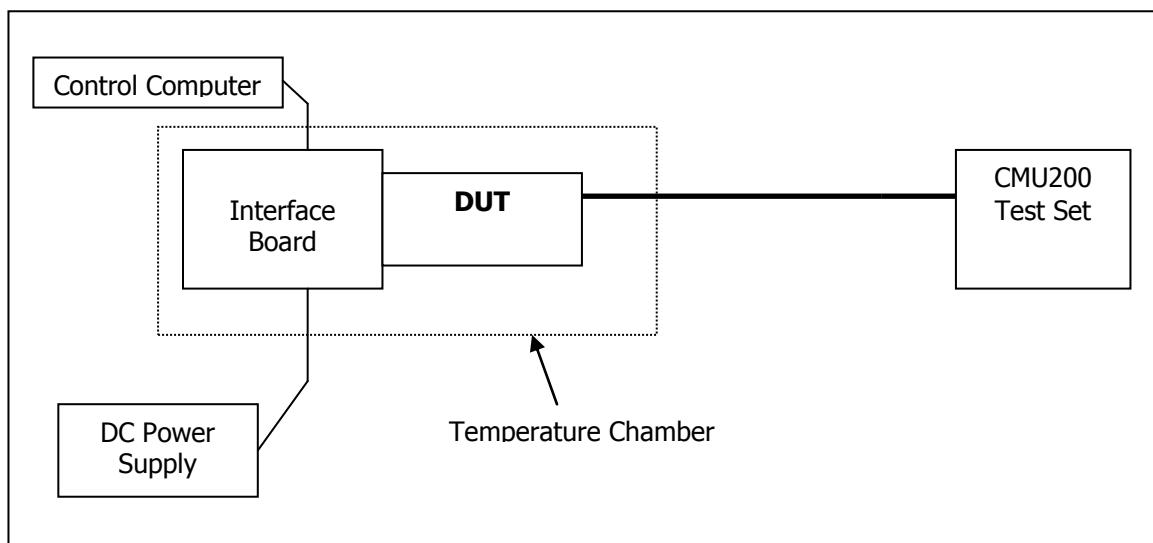
### 8.1 Summary of Results

The EUT's Frequency Stability versus temperature meets the requirements of less than 2.5ppm when temperature varies from -30°C to +50°C.

### 8.2 Test Procedure

The EUT was placed inside a temperature chamber. The temperature was set to -30°C and maintained to stabilize. After sufficient soak time, the transmitting frequency error was measured. The temperature was then increased by 10 degrees, maintained to stabilize, and the measurement was repeated. This procedure was repeated until +50°C is reached. Frequency metering included internal averaging of the 8960 to stabilize the reading. Reference power supply voltage for these tests is 3.8 volts.

### Test Setup



### 8.3 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110520	November 17, 2008
Spectrum Analyzer	Rohde & Schwarz	FSP	100714	November 15, 2008
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

## 8.4 Test Results

### 8.4.1 CDMA2000 Frequency Error over Temperature

Temp (°C)	Cellular Band: 824MHz to 849MHz		PCS Band: 1850MHz to 1910MHz	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
-30	-15.10	-0.0180	-30.38	-0.0363
-20	16.10	0.0192	7.97	0.0095
-10	12.50	0.0149	-16.66	-0.0199
0	-1.16	-0.0014	1.26	0.0015
10	2.97	0.0036	3.26	0.0039
20	-21.10	-0.0252	1.00	0.0012
30	-5.10	-0.0061	-18.66	-0.0223
40	-26.50	-0.0317	-14.82	-0.0177
50	-29.10	-0.0348	-40.16	-0.0480

### 8.4.2 EVDO Frequency Error over Temperature

Temp (°C)	Cellular Band: 824MHz to 849MHz		PCS Band: 1850MHz to 1910MHz	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
-30	-4.39	-0.0052	-5.14	-0.0027
-20	-2.64	-0.0032	-5.91	-0.0031
-10	-1.95	-0.0023	-9.54	-0.0051
0	-8.77	-0.0105	-13.05	-0.0069
10	-3.98	-0.0048	-18.36	-0.0098
20	-5.59	-0.0067	-7.71	-0.0041
30	0.85	0.0010	-7.22	-0.0038
40	-1.30	-0.0016	1.14	0.0006
50	-6.29	-0.0075	-9.86	-0.0052

## 9 Frequency Stability versus Voltage

FCC 2.1055, FCC 22.355, FCC 24.235

### 9.1 Summary of Results

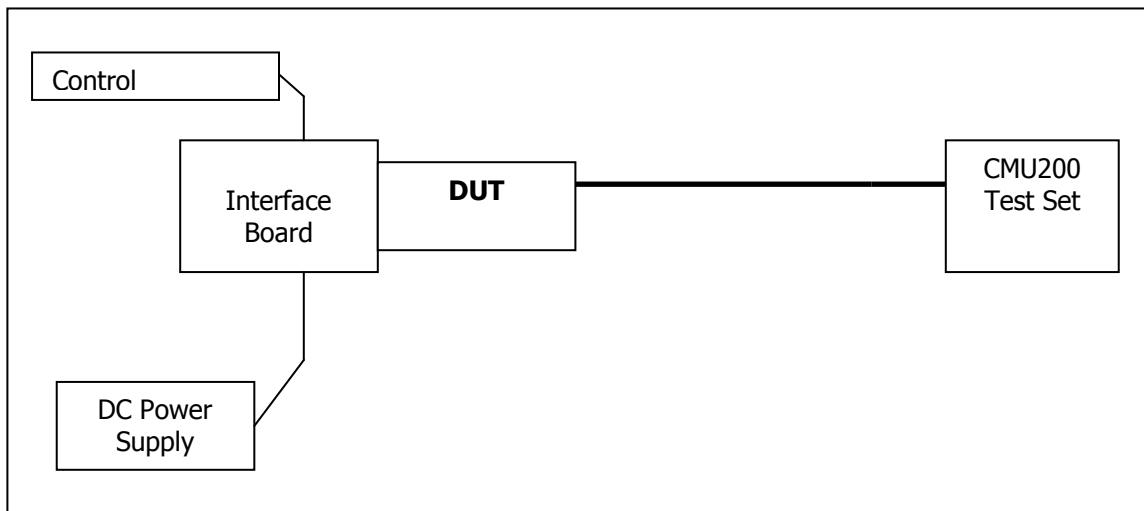
The EUT is specified to operate with a supply voltage varying between 3.3VDC and 4.3VDC, having a nominal voltage of 3.6 VDC. It meets the frequency stability limit of less than 2.5ppm when supply voltage varies within the specified limits. Operation above or below these voltage limits is prohibited by firmware in order to prevent improper operation.

### 9.2 Test Procedure

The EUT was connected to a DC Power Supply and a UMTS test set (CMU 200) with frequency error measurement capability. The power supply output was adjusted to the test voltage as measured at the input terminals to the device while transmitting. A voltmeter was used to confirm the terminal voltage. The peak frequency error is recorded (worst case). The test voltages are 3.3 volts to 4.3 volts.

**NOTE: Below 3.3V and above 4.3V, the device stops transmitting.**

### Test Setup



### 9.3 Test Equipment

EQUIPMENT	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DATE
Control Computer	TC	Generic PC	100488	N/A
Wireless Test Set	Rohde & Schwarz	CMU200	110520	November 17, 2008
Spectrum Analyzer	Rohde & Schwarz	FSP	100714	November 15, 2008
DC Power Supply	HP	6632A	3530A	N/A
Interface Board	Shop built	ATEMux	N/A	N/A
Directional Coupler	Pasternack	PE2209-10	N/A	N/A

## 9.4 *Test Results*

### 9.4.1 *CDMA2000 Frequency Error over Voltage*

Voltage (V)	Cellular Band: 824MHz to 848MHz		PCS Band: 1850MHz to 1910MHz	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
3.3	-193.00	-0.2307	-153.29	-0.1832
3.6	-30.06	-0.0359	-28.31	-0.0338
4.3	0.71	0.0008	-12.69	0.0152

### 9.4.2 *EVDO Frequency Error over Voltage*

Voltage (V)	Cellular Band: 824MHz to 848MHz		PCS Band: 1850MHz to 1910MHz	
	Offset (Hz)	Offset (ppm)	Offset (Hz)	Offset (ppm)
3.3	-0.23	-0.0003	-16.48	-0.0088
3.6	-2.69	-0.0032	-20.95	-0.0111
4.3	1.34	0.0007	1.75	0.0009