SIERRA WIRELESS

HEART OF THE WIRELESS MACHINE™

# FCC Parts 22 and 24 Test Report

For

800/1800/1900 MHz GSM PC CARD WIRELESS MODEM

## Model: AIRCARD 755

## FCC ID: N7NAC755

**Prepared by**
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**13811 WIRELESS WAY**
**RICHMOND, BC V6V 3A4**
**CANADA**

**Test Date(s): October 2003**

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# 1 Introduction and Purpose

This document provides the FCC test data for the AC755 wireless modem. 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 | DESCRIPTION OF TEST | RESULT | PAGE |
|---|---|---|---|
| 2.1046 | RF Power Output | Complies | 5 |
| 2.1049 | Occupied Bandwidth | Complies | 6 |
| 2.1051, 22.901(d) 22.917, 24.238(a) | Out of Band Emissions at Antenna Terminals | Complies | 14 |
| FCC part 22H/24E | Block Edge Requirements | Complies | 28 |
| 2.1053 | Field Strength of Spurious Radiation | Complies | See CCS Report |
| 2.1055 | Frequency Stability versus Temperature | Complies | 40 |
| 2.1055 | Frequency Stability versus Voltage | Complies | 43 |

The tests described in this report were performed by Mr. Darryl Simpson at:

Sierra Wireless, Inc.
13811 Wireless Way
Richmond, B.C. V6V 3A4
Canada

# 3 Description of Equipment Under Test

The Sierra Wireless Inc. model AirCard 755 is a tri-band PCMCIA card wireless modem operating on the GSM/GPRS network. In the US and Canada, only cellular and PCS bands are used for GSM/GPRS operation, so this test report only contains data for these two bands. The EUT is a production sample and the serial number is S03073100095020.

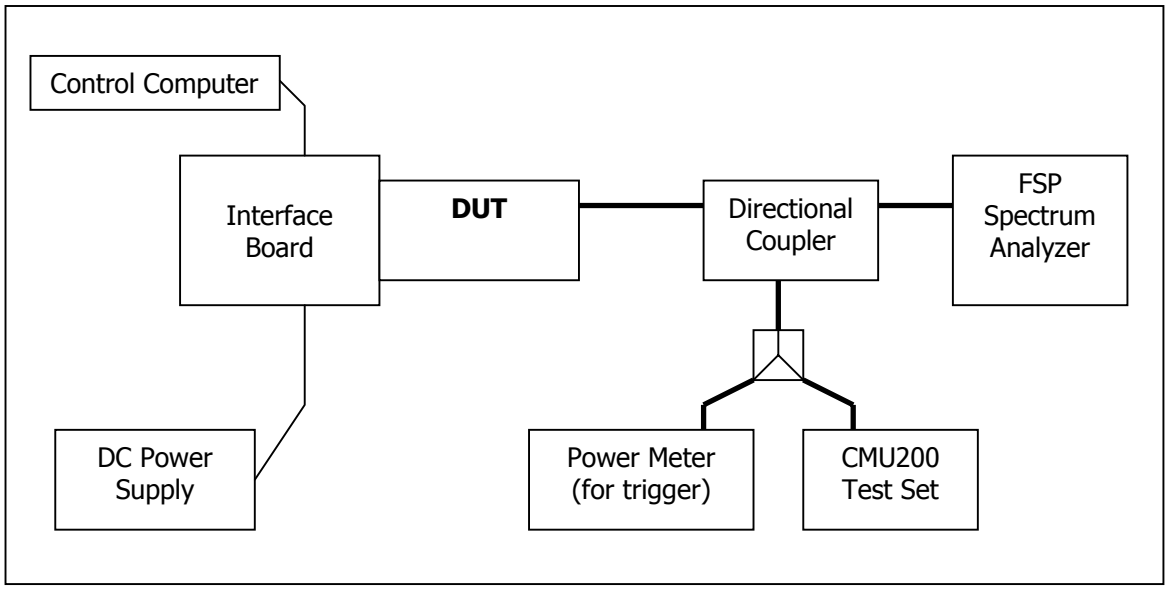
# 4 RF Power Output

FCC 2.1046

## *4.1 Test Procedure*

The transmitter output was connected to a Rohde & Schwarz CMU200 Test Set and configured to operate at maximum power. The power was measured at three equally spaced operating frequencies in each band and the RBW was set at 300 KHz.

**Test Setup**




## *4.2 Test Equipment*

**Instrument List**

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE |
|---|---|---|---|---|
| Control Computer | TC | Generic PC | 100488 | N/A |
| Wireless Test Set | Rohde & Schwarz | CMU200 | 836766/030 | N/A |
| Spectrum Analyzer | Rohde & Schwarz | FSP 30GHz | US41421268 | Sept. 12, 2003 |
| DC Power Supply | HP | E3631A | 100060 | N/A |
| Interface Board | Shop built | Minnow | N/A | N/A |
| Directional Coupler | Pasternack | PE2209-10 | N/A | N/A |

## *4.3 Test Results*

| Mode | Frequency (MHz) | Channel | Peak Power (dBm) |
|---|---|---|---|
| GSM 850 MHz | 824.2 | 128 | 31.5 |
| | 836.6 | 190 | 31.4 |
| | 848.8 | 251 | 31.4 |
| GSM 1900 MHz | 1850.2 | 512 | 28.5 |
| | 1880.0 | 661 | 28.4 |
| | 1909.8 | 810 | 28.5 |

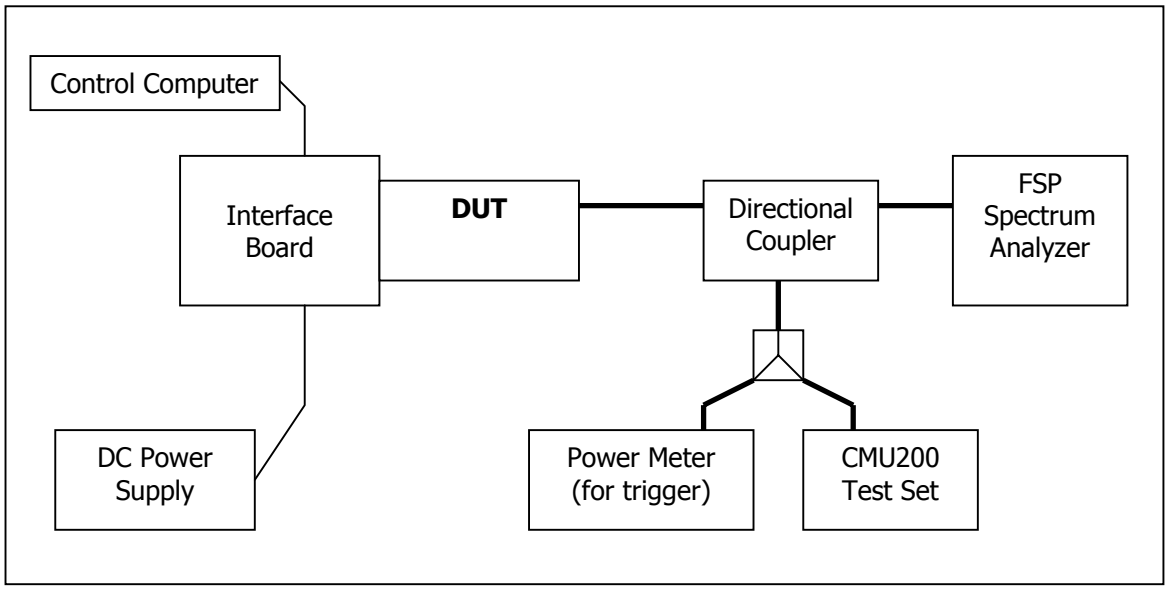
# 5 Occupied Bandwidth

FCC 2.1049

## *5.1 Test Procedure*

The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a spectrum analyzer. The occupied Bandwidth (defined as the 99% Power Bandwidth) was measured with the Spectrum Analyzer at the center frequency of each band.

**Test Setup**




## *5.2 Test Results*

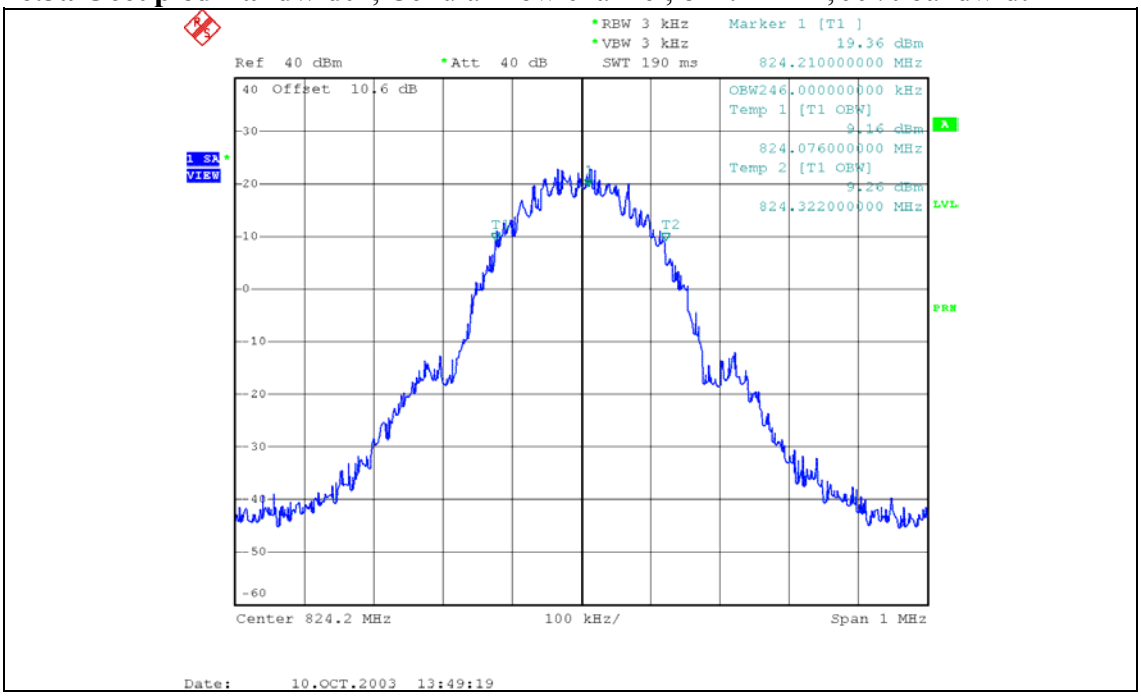
The performance of 800 MHz cellular band is shown in plots 6.3a to 6.3e.
Performance of 1900 MHz PCS band is shown in plots 6.3f to 6.3l.

| Frequency (MHz) | Channel | 99% Occupied Bandwidth | 26dBc Occupied Bandwidth |
|---|---|---|---|

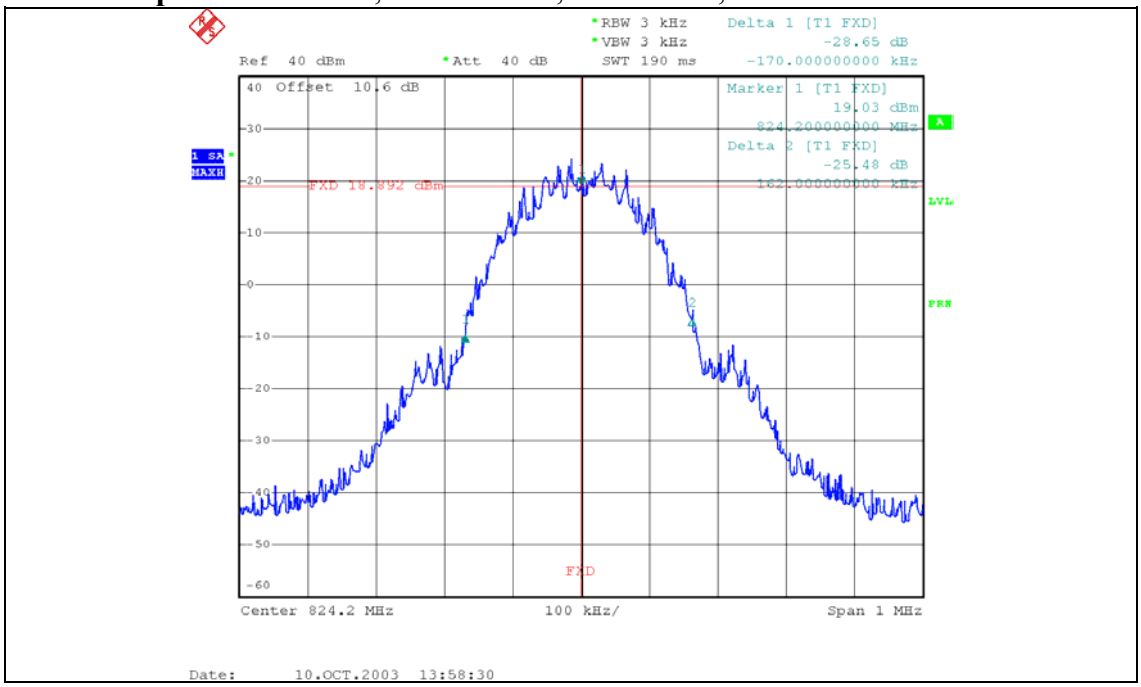
| | | **(kHz)** | **(kHz)** |
|---|---|---|---|
| 824.2 | 128 | 246 | 332 |
| 836.6 | 190 | 246 | 324 |
| 848.8 | 251 | 246 | 326 |
| 1850.2 | 512 | 246 | 324 |
| 1880.0 | 661 | 244 | 328 |
| 1909.8 | 810 | 244 | 316 |

## *5.3 Test Plots*

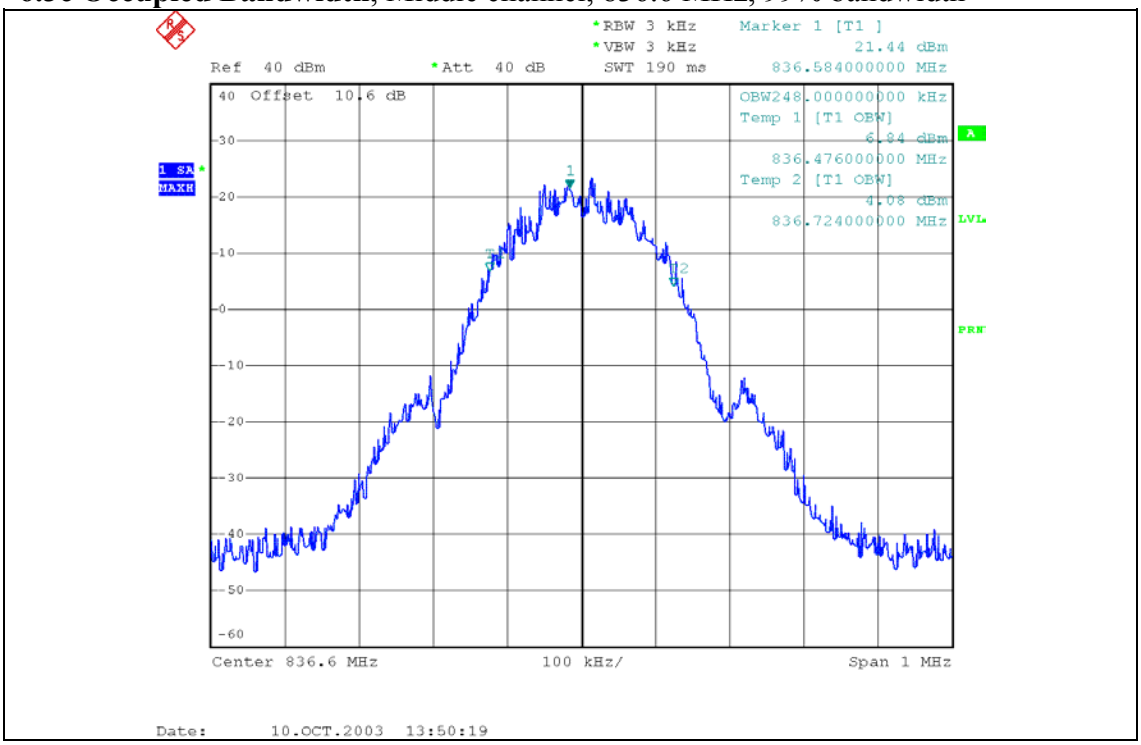
**6.3a Occupied Bandwidth**, Cellular Low channel, 824.2 MHz, 99% bandwidth



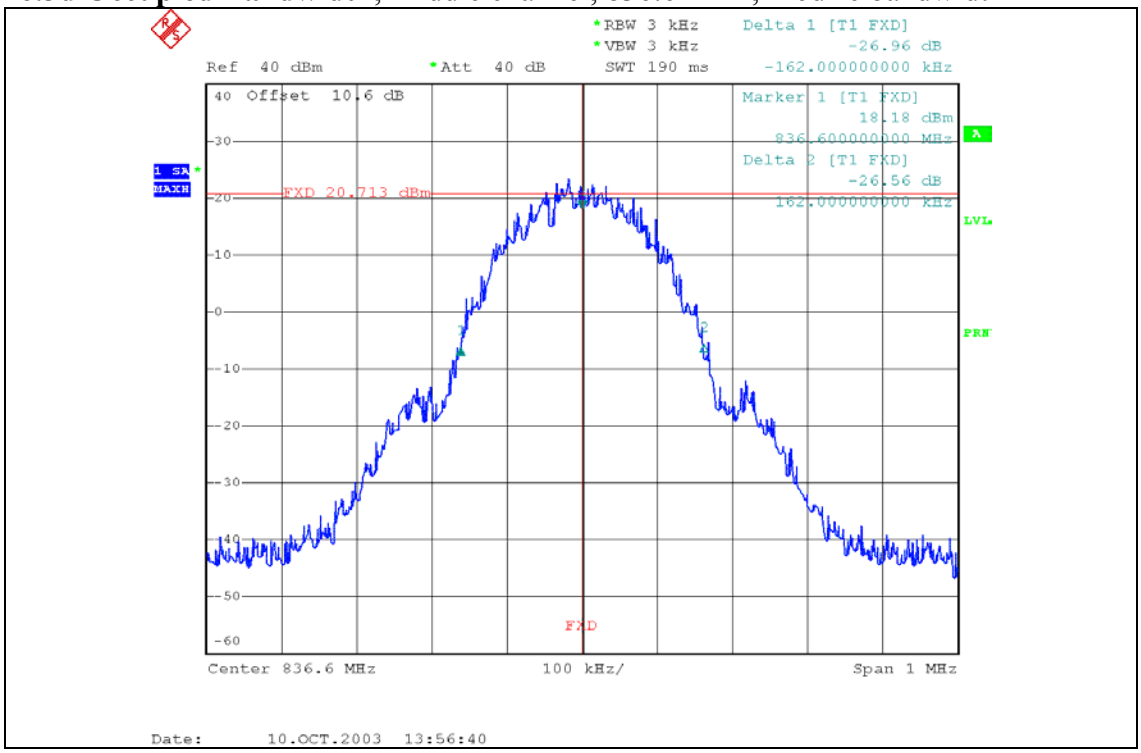

**6.3b Occupied Bandwidth**, Low channel, 824.2 MHz, -26dBc bandwidth



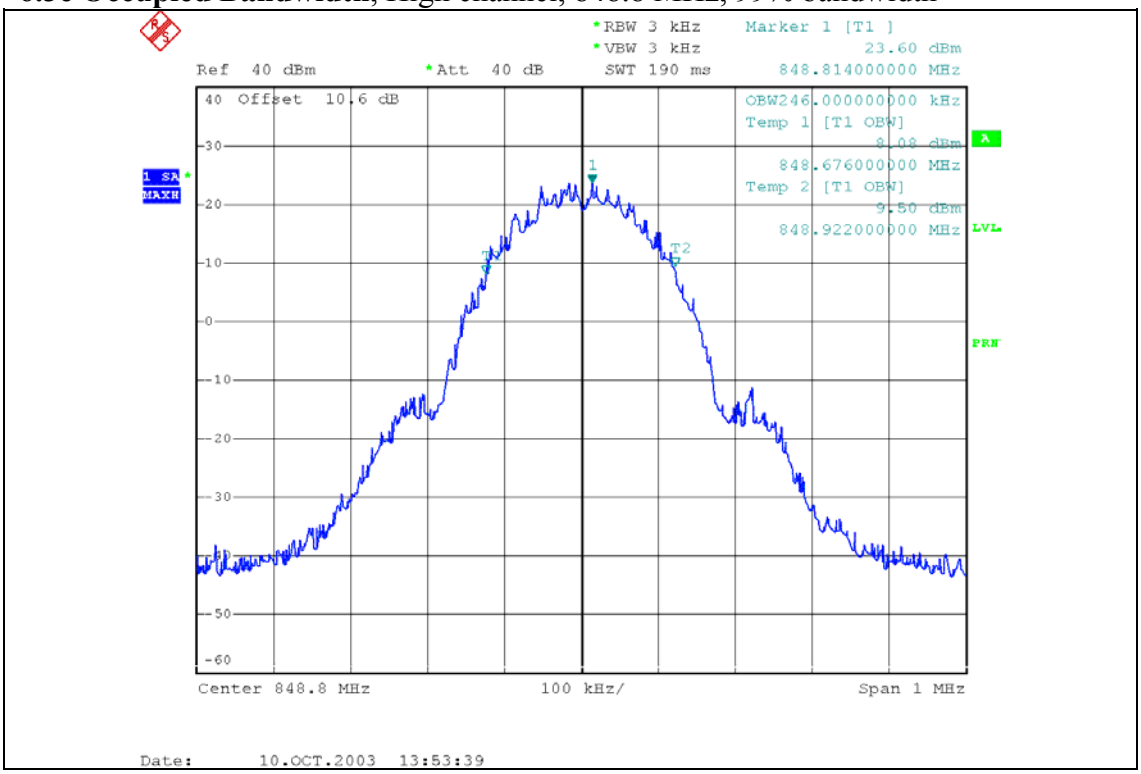
**6.3c Occupied Bandwidth**, Middle channel, 836.6 MHz, 99% bandwidth



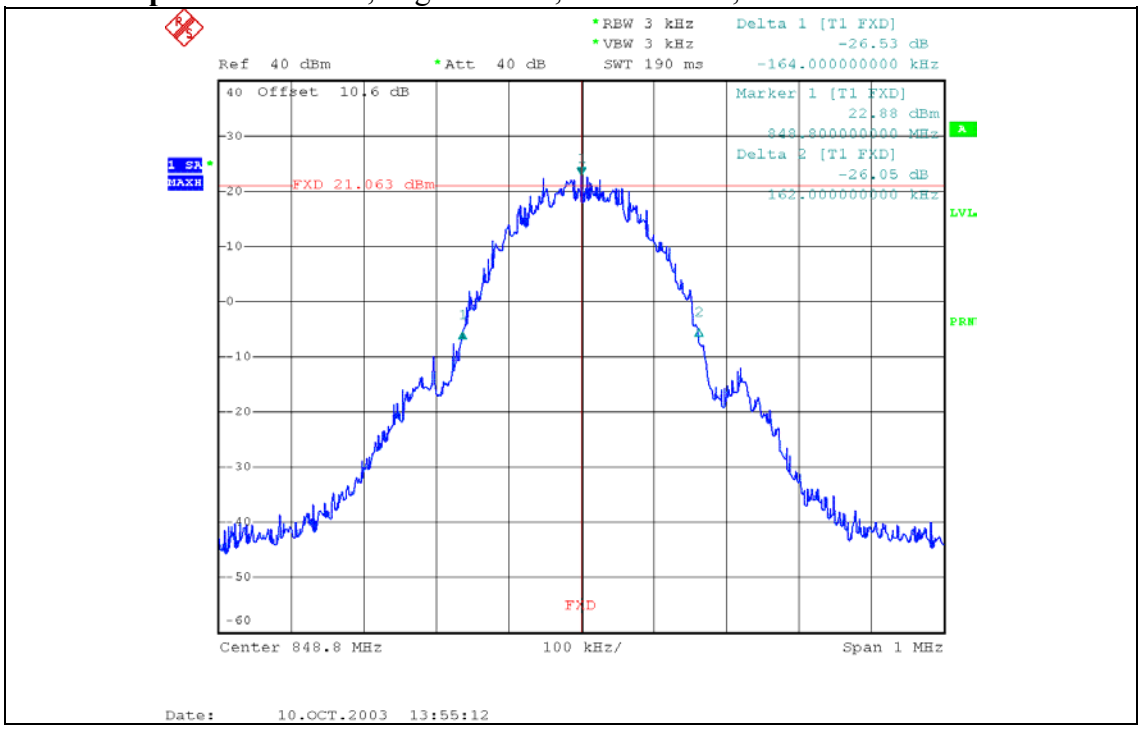

**6.3d Occupied Bandwidth**, Middle channel, 836.6 MHz, -26dBc bandwidth



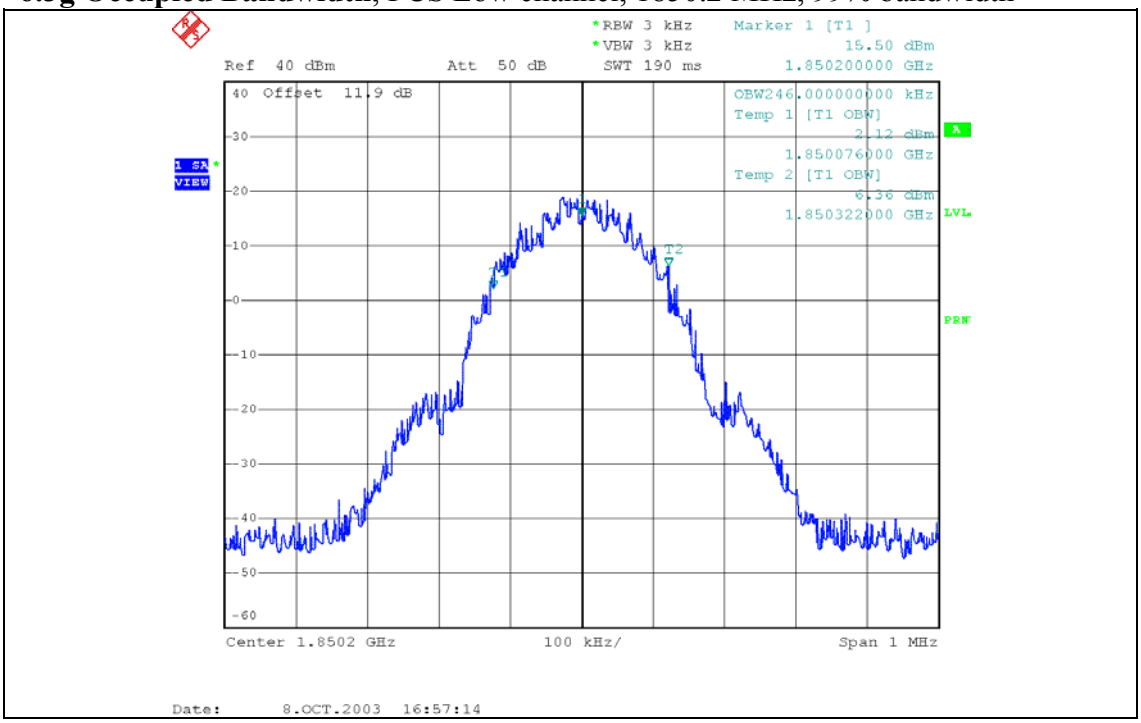
**6.3e Occupied Bandwidth**, High channel, 848.8 MHz, 99% bandwidth



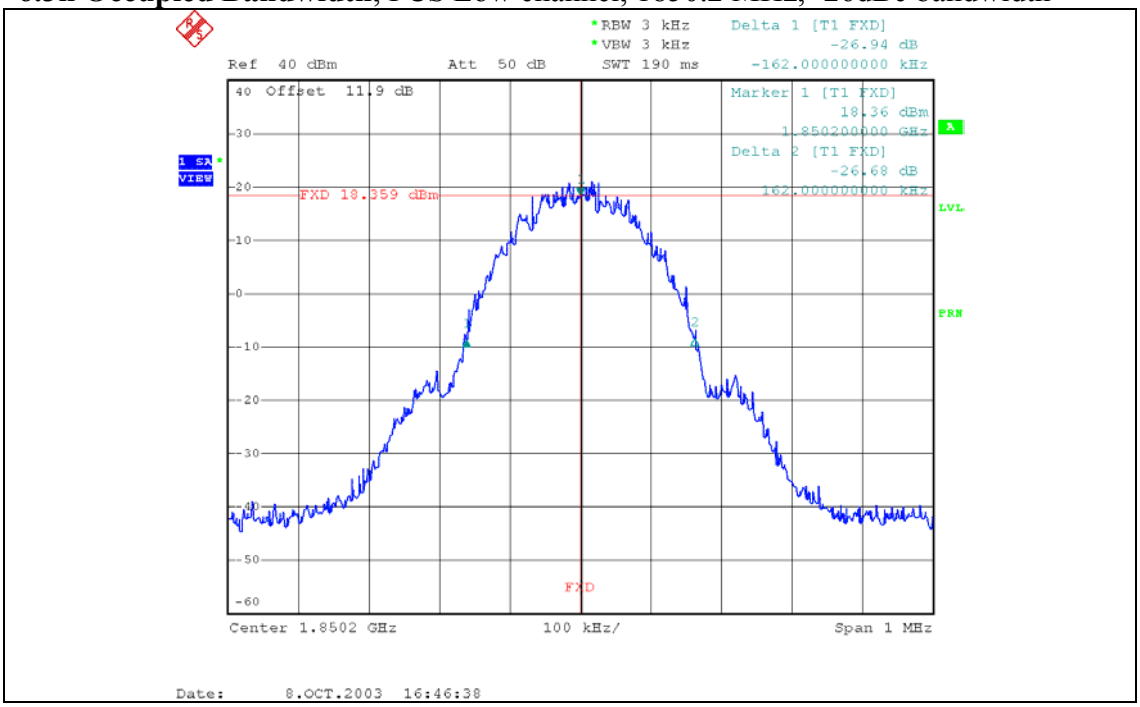

**6.3f Occupied Bandwidth**, High channel, 1909.8 MHz, -26dBc bandwidth



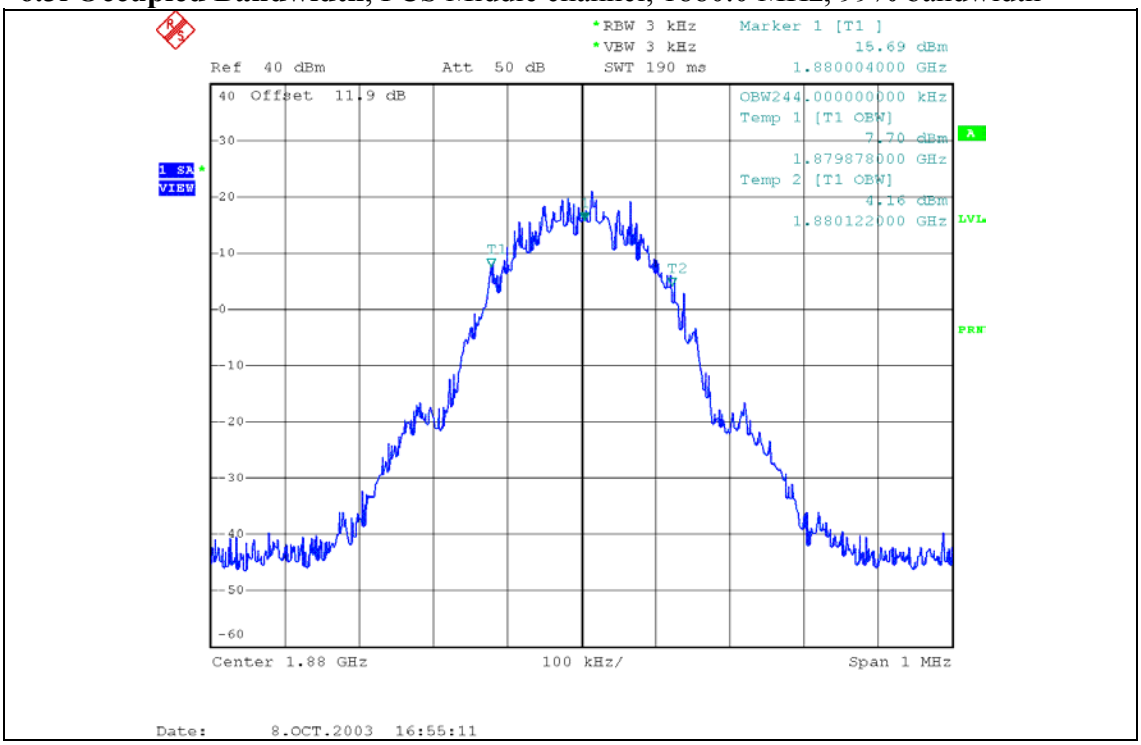
**6.3g Occupied Bandwidth**, PCS Low channel, 1850.2 MHz, 99% bandwidth



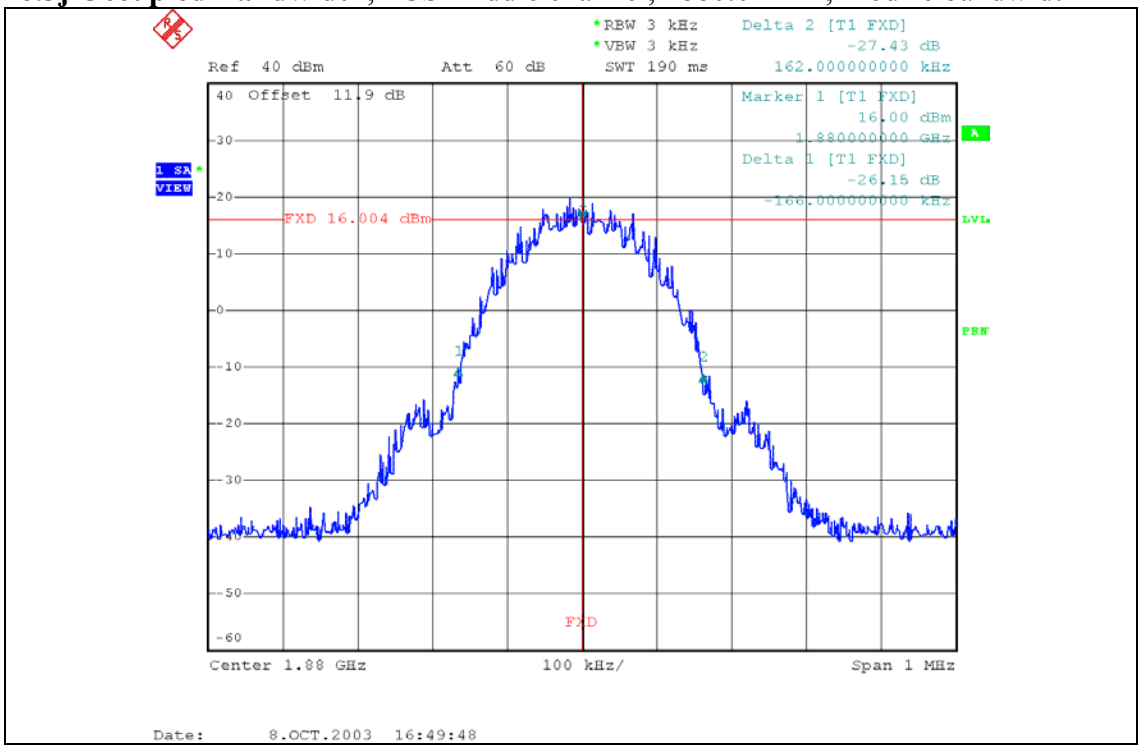

**6.3h Occupied Bandwidth**, PCS Low channel, 1850.2 MHz, -26dBc bandwidth



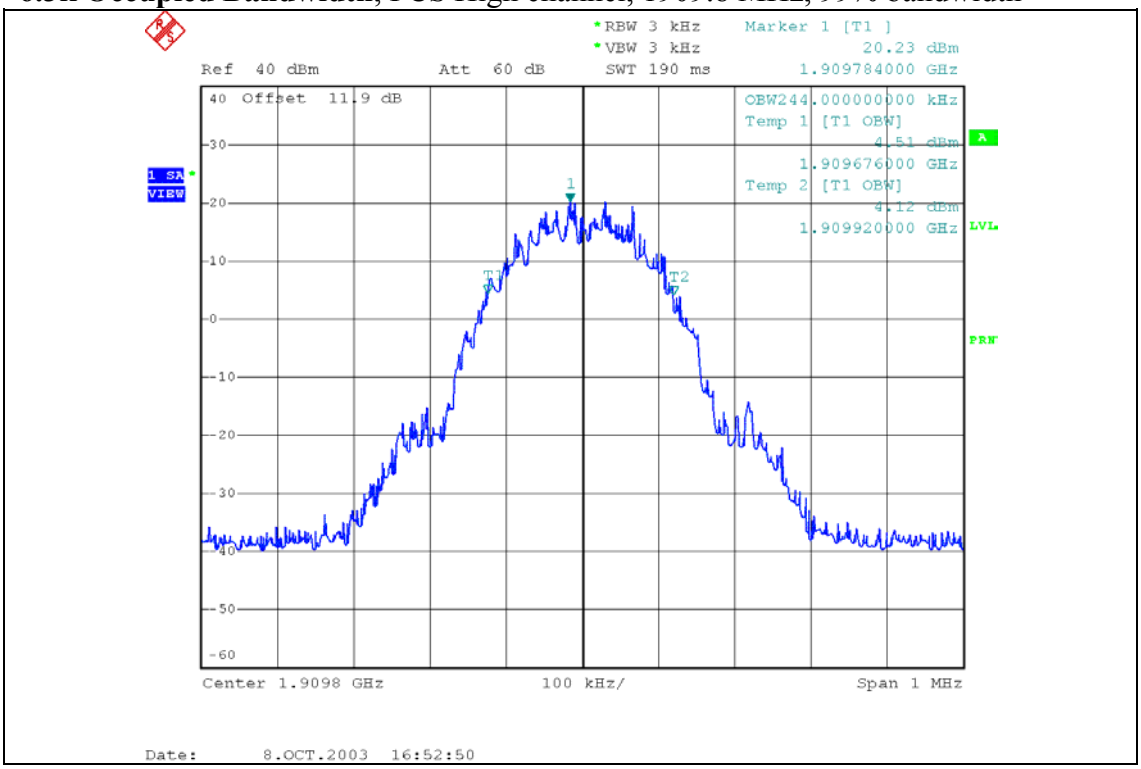
**6.3i Occupied Bandwidth**, PCS Middle channel, 1880.0 MHz, 99% bandwidth



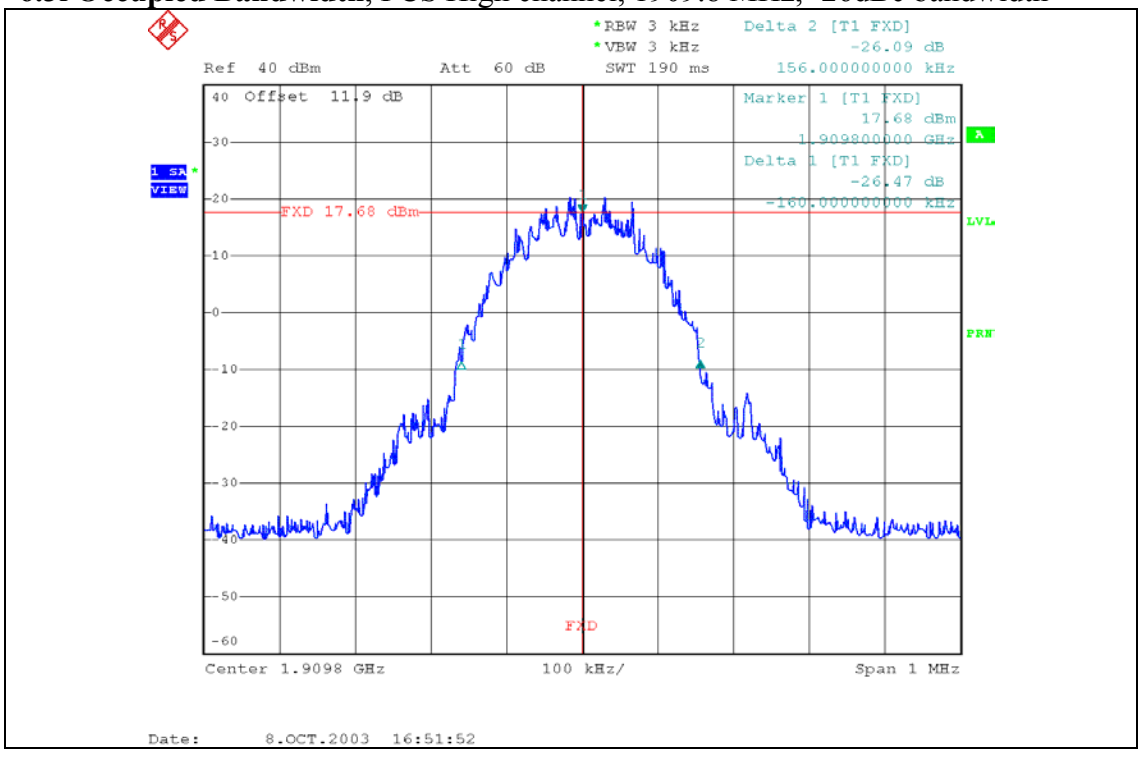

**6.3j Occupied Bandwidth**, PCS Middle channel, 1880.0 MHz, -26dBc bandwidth



**6.3k Occupied Bandwidth**, PCS High channel, 1909.8 MHz, 99% bandwidth




**6.3l Occupied Bandwidth**, PCS High channel, 1909.8 MHz, -26dBc bandwidth



# 6 Out of Band Emissions at Antenna Terminals

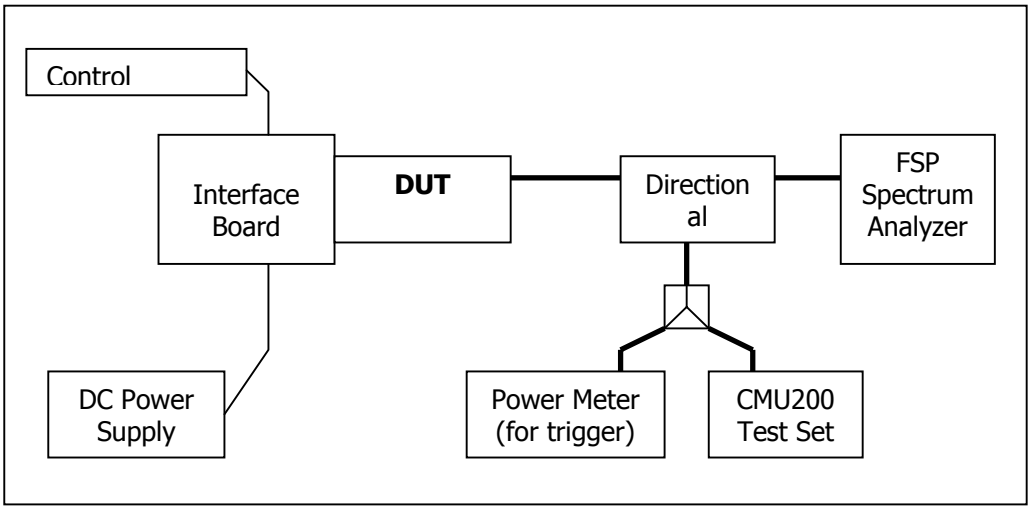
FCC 22.901(d), 22.917, 24.238(a)

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, in this case, -13dBm.

## *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 10th harmonic. The EUT was scanned for spurious emissions from 1MHz to 20GHz with sufficient bandwidth and video resolution. Data plots are included.

**Test Setup**




## *6.2 Test Equipment*

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE |
|---|---|---|---|---|
| Control Computer | TC | Generic PC | 100488 | N/A |
| Wireless Test Set | Rohde & Schwarz | CMU200 | 836766/030 | N/A |
| Spectrum Analyzer | Rohde & Schwarz | FSP 30GHz | US41421268 | Sept. 12, 2003 |
| DC Power Supply | HP | E3631A | 100060 | N/A |
| Interface Board | Shop built | Minnow | N/A | N/A |
| Directional Coupler | Pasternack | PE2209-10 | N/A | N/A |

## *6.3 Test Results*

Refer to the following plots.

- **Cellular Band**

| Plot Number | Description |
|---|---|
| 7.4a – 7.4c | Low channel, 824.20 MHz |
| 7.4d – 7.4f | Middle Channel, 836.6 MHz |
| 7.4g – 7.4i | High Channel, 848.8 MHz |

- **PCS Band**

| Plot Number | Description |
|---|---|
| 7.4j – 7.4l | Low Channel, 1850.2 MHz |
| 7.4m – 7.4o | Middle Channel, 1880.0 MHz |
| 7.4p – 7.4r | High Channel, 1909.8 MHz |

- **Emissions in Base Station Frequency Range, Cellular band**

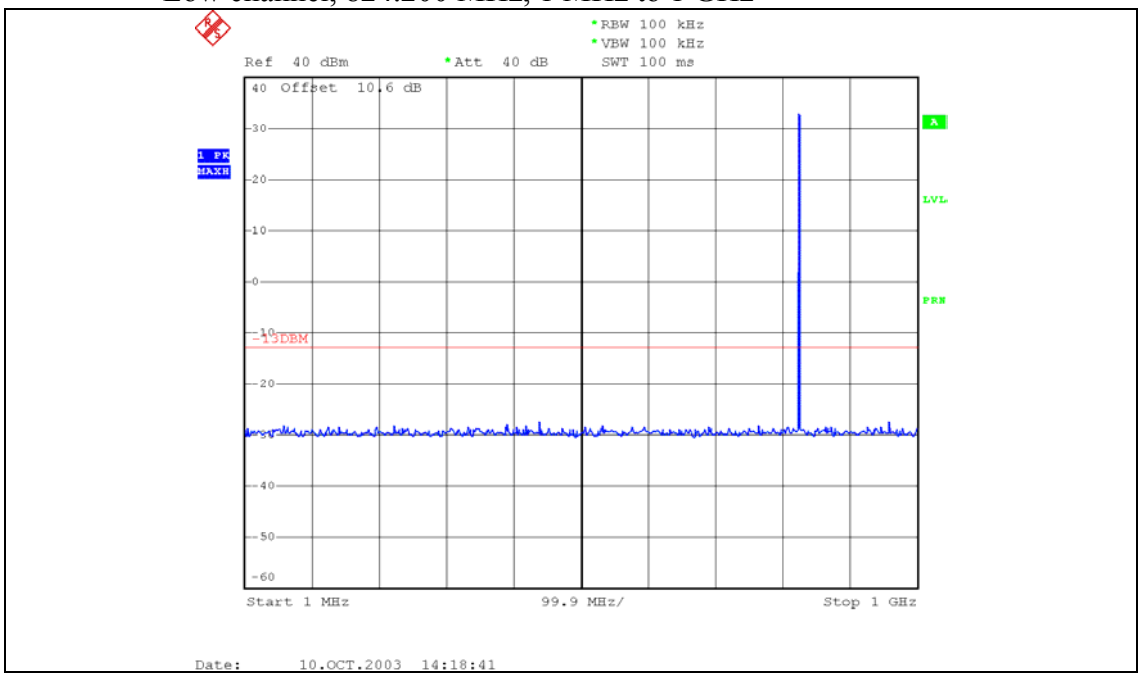
| Plot Number | Description |
|---|---|
| 7.4s | Low channel, 824.20 MHz |
| 7.4t | Middle Channel, 836.6 MHz |
| 7.4u | High Channel, 848.8 MHz |

These plots show that the conducted emission limits requirements are met.

## *6.4 Test Plots*

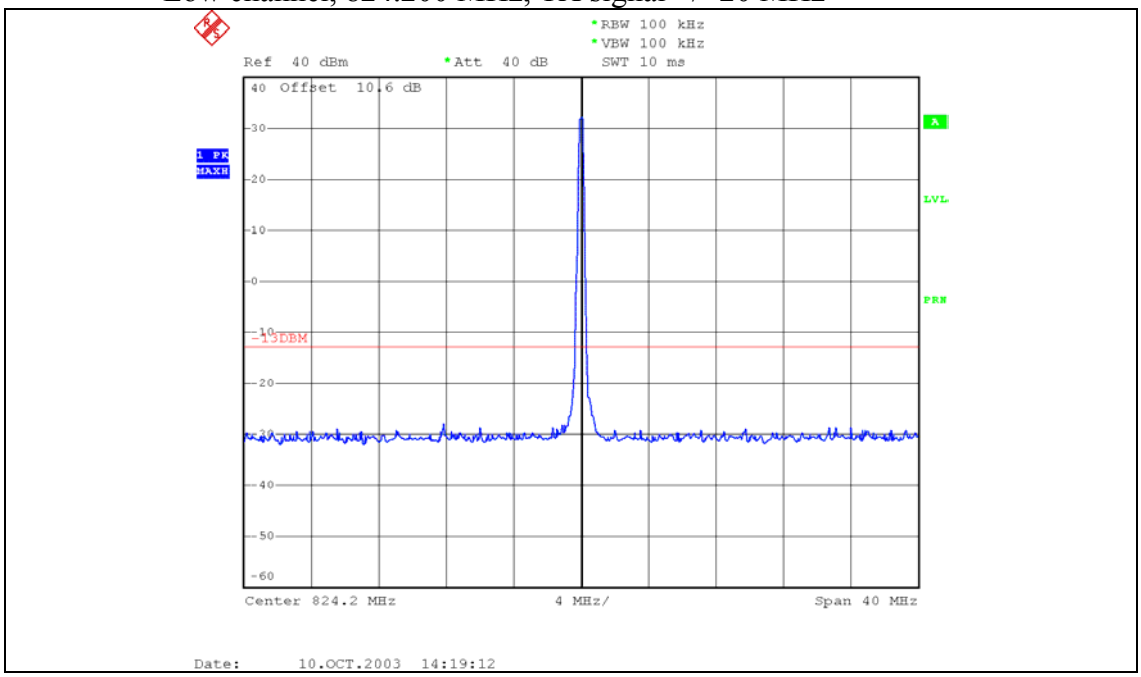
**Plot 7.4a Out of Band Emissions at Antenna Terminals**

Low channel, 824.200 MHz, 1 MHz to 1 GHz




**Plot 7.4b Out of Band Emissions at Antenna Terminals**

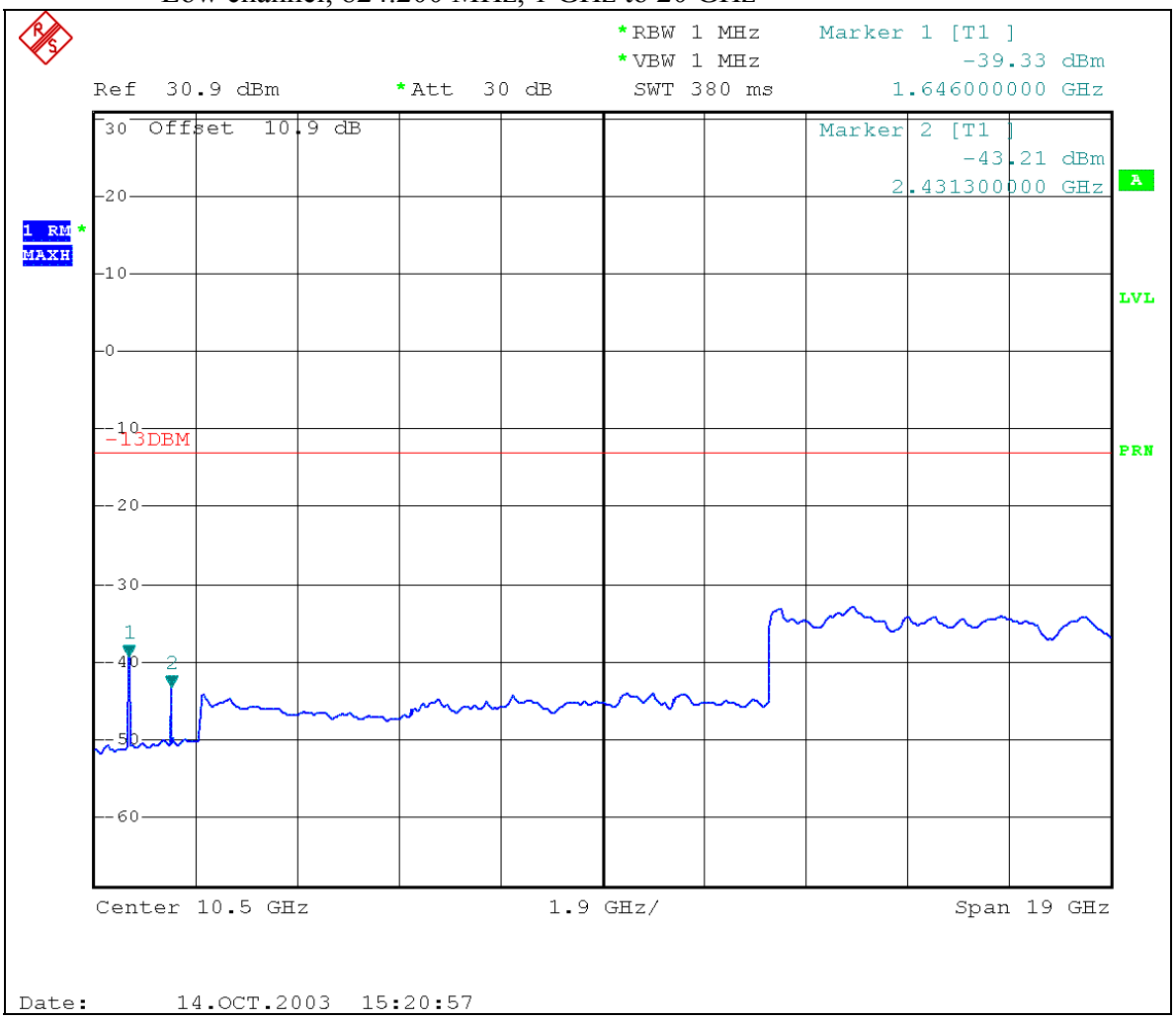
Low channel, 824.200 MHz, TX signal +/- 20 MHz




**Strong emission shown in each case is the carrier signal.**

**Plot 7.4c Out of Band Emissions at Antenna Terminals**

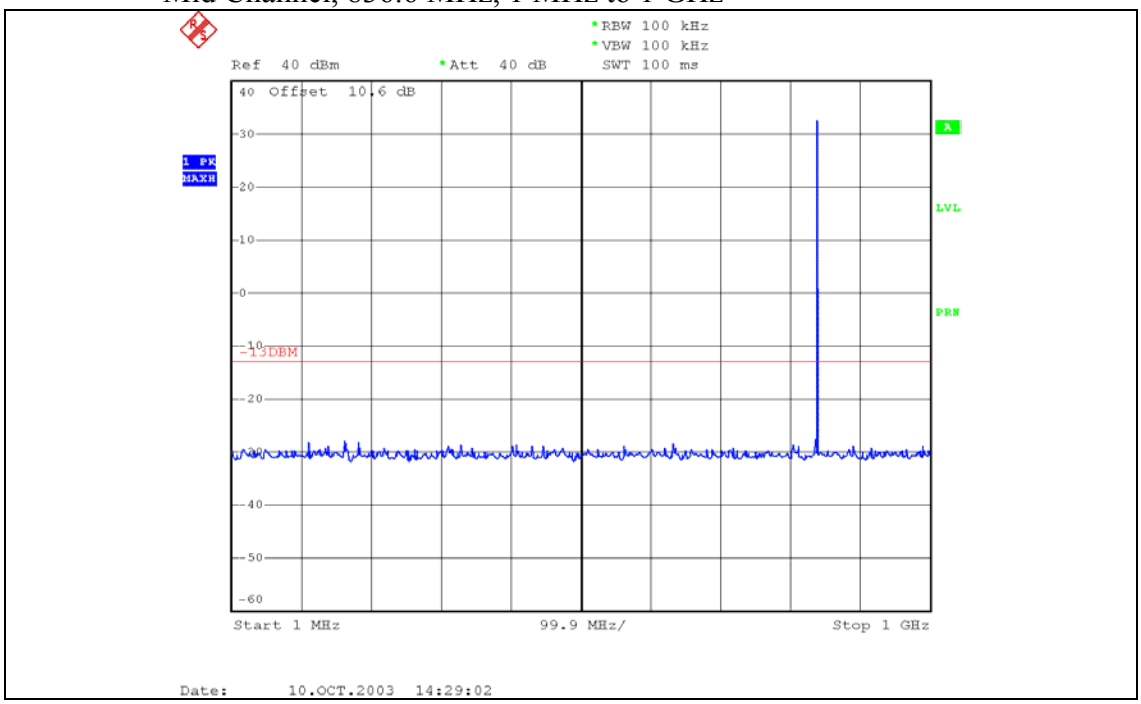
Low channel, 824.200 MHz, 1 GHz to 20 GHz




| Cellular Harmonics for Ch. 128 (824.2 MHz) | Level (dBm) |
|---|---|
| **Second** | **-39 dBm** |
| **Third** | **-42 dBm** |
| **All others** | **< -45dBm up to 13GHz; < -33dBm beyond 13GHz** |

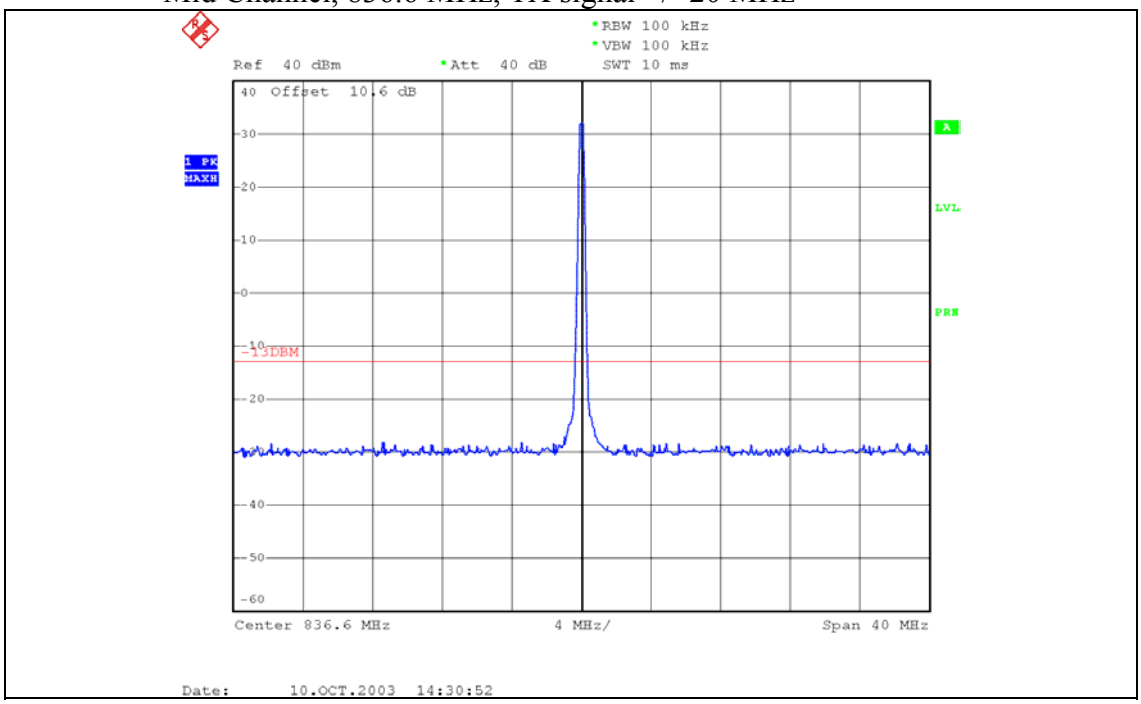
**Plot 7.4d Out of Band Emissions at Antenna Terminals**

Mid Channel, 836.6 MHz, 1 MHz to 1 GHz




**Plot 7.4e Out of Band Emissions at Antenna Terminals**

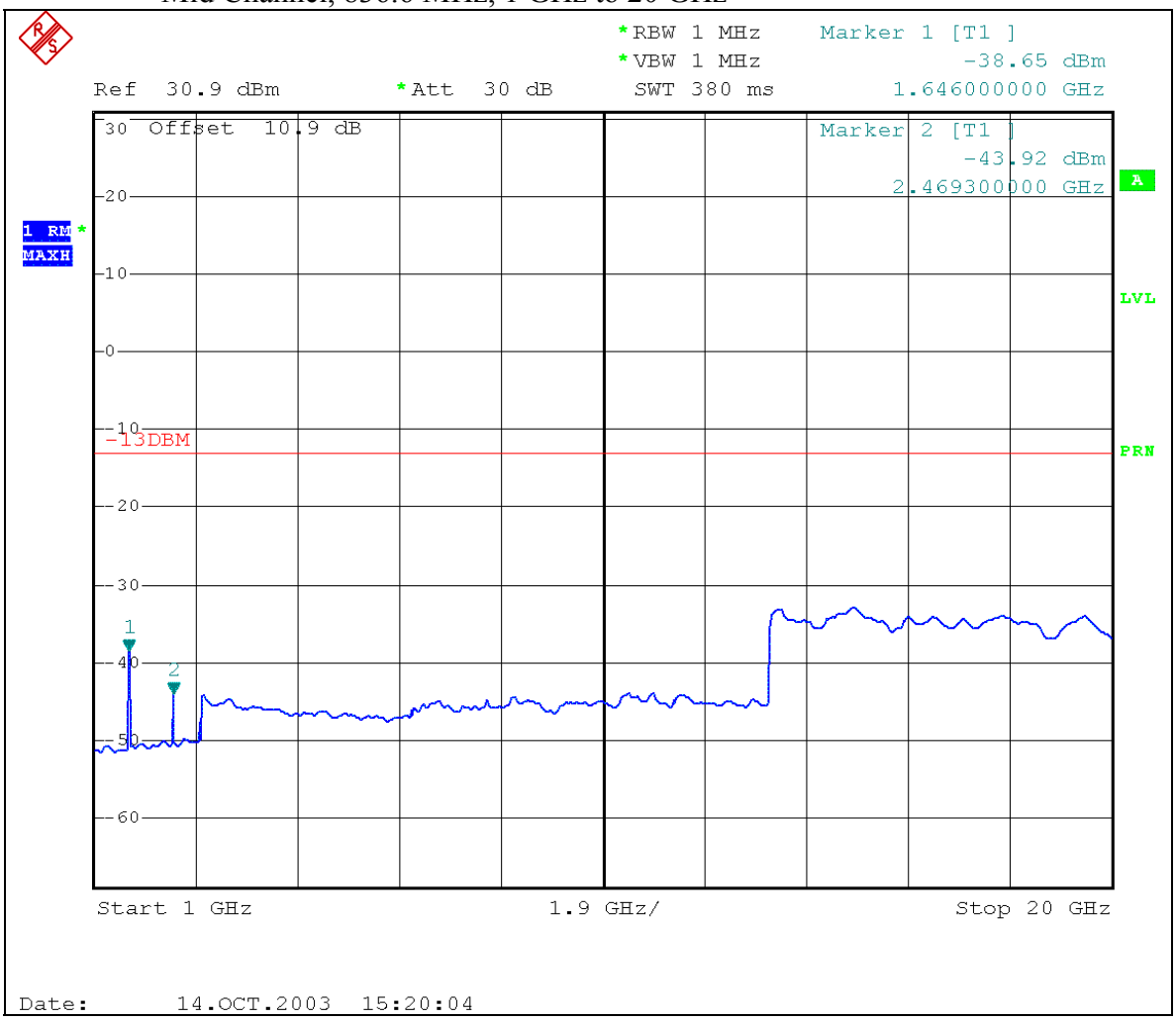
Mid Channel, 836.6 MHz, TX signal +/- 20 MHz




**Strong emission shown in each case is the carrier signal.**

**Plot 7.4f Out of Band Emissions at Antenna Terminals**

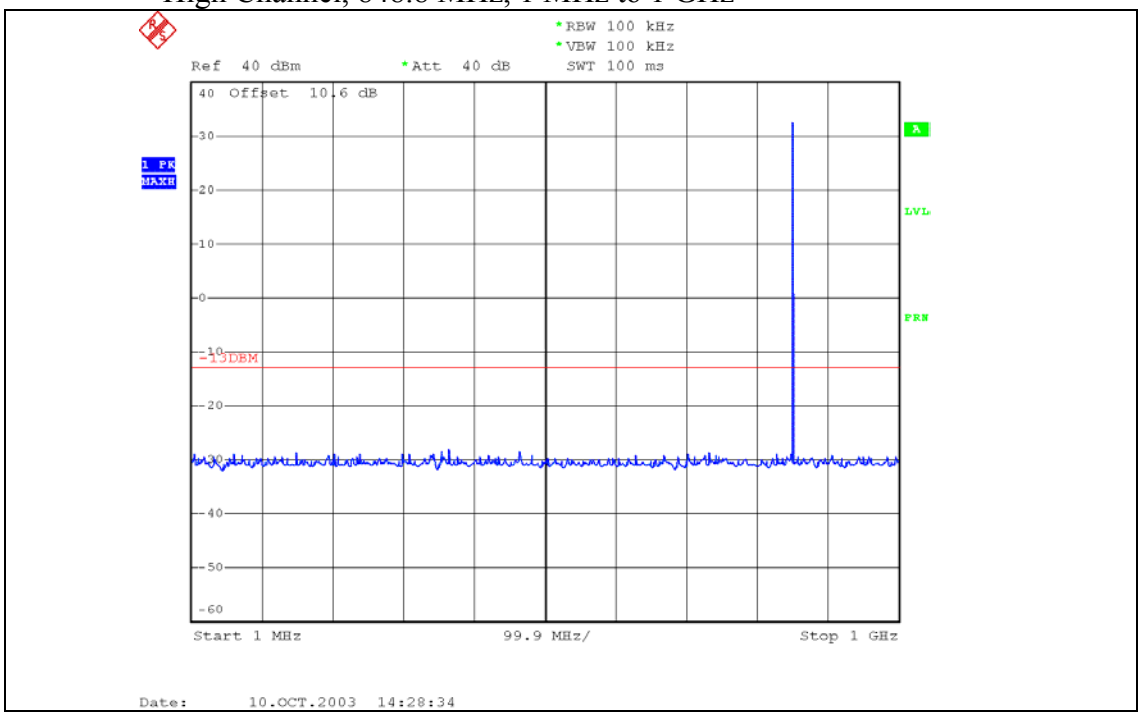
Mid Channel, 836.6 MHz, 1 GHz to 20 GHz




| Cellular Harmonics for Ch. 190 (836.6 MHz) | Level (dBm) |
|---|---|
| Second | -38 dBm |
| Third | -43 dBm |
| All others | < -45dBm up to 13GHz; < -33dBm beyond 13GHz |

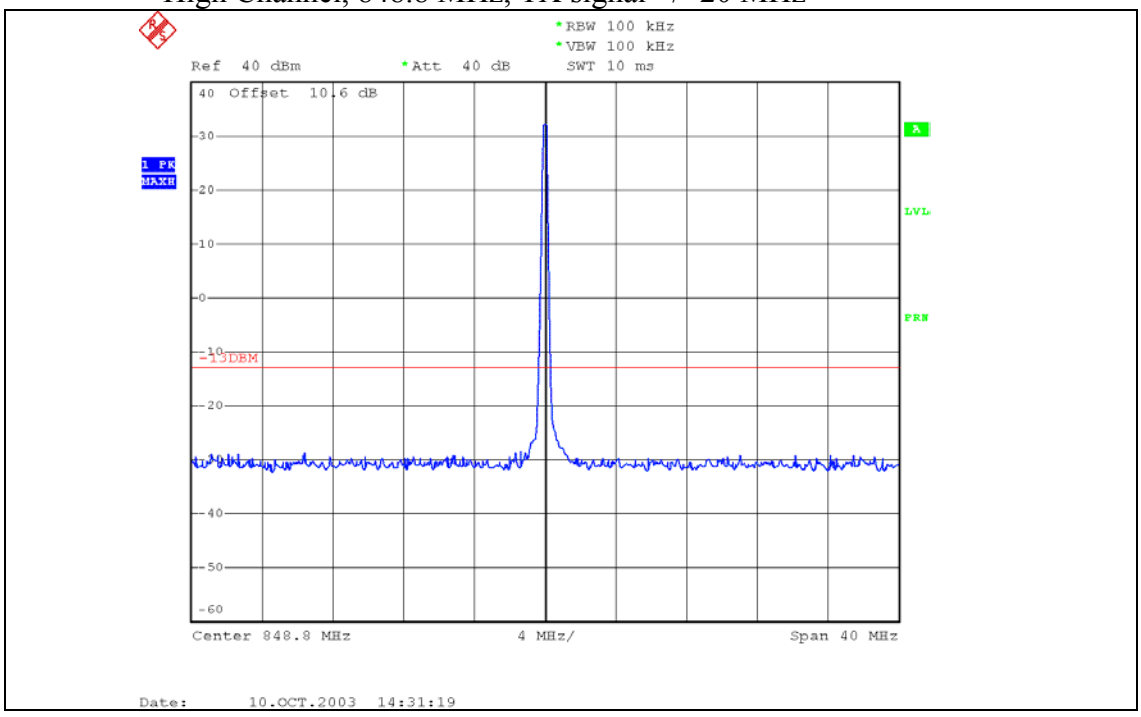
**Plot 7.4g Out of Band Emissions at Antenna Terminals**

High Channel, 848.8 MHz, 1 MHz to 1 GHz




**Plot 7.4h Out of Band Emissions at Antenna Terminals**

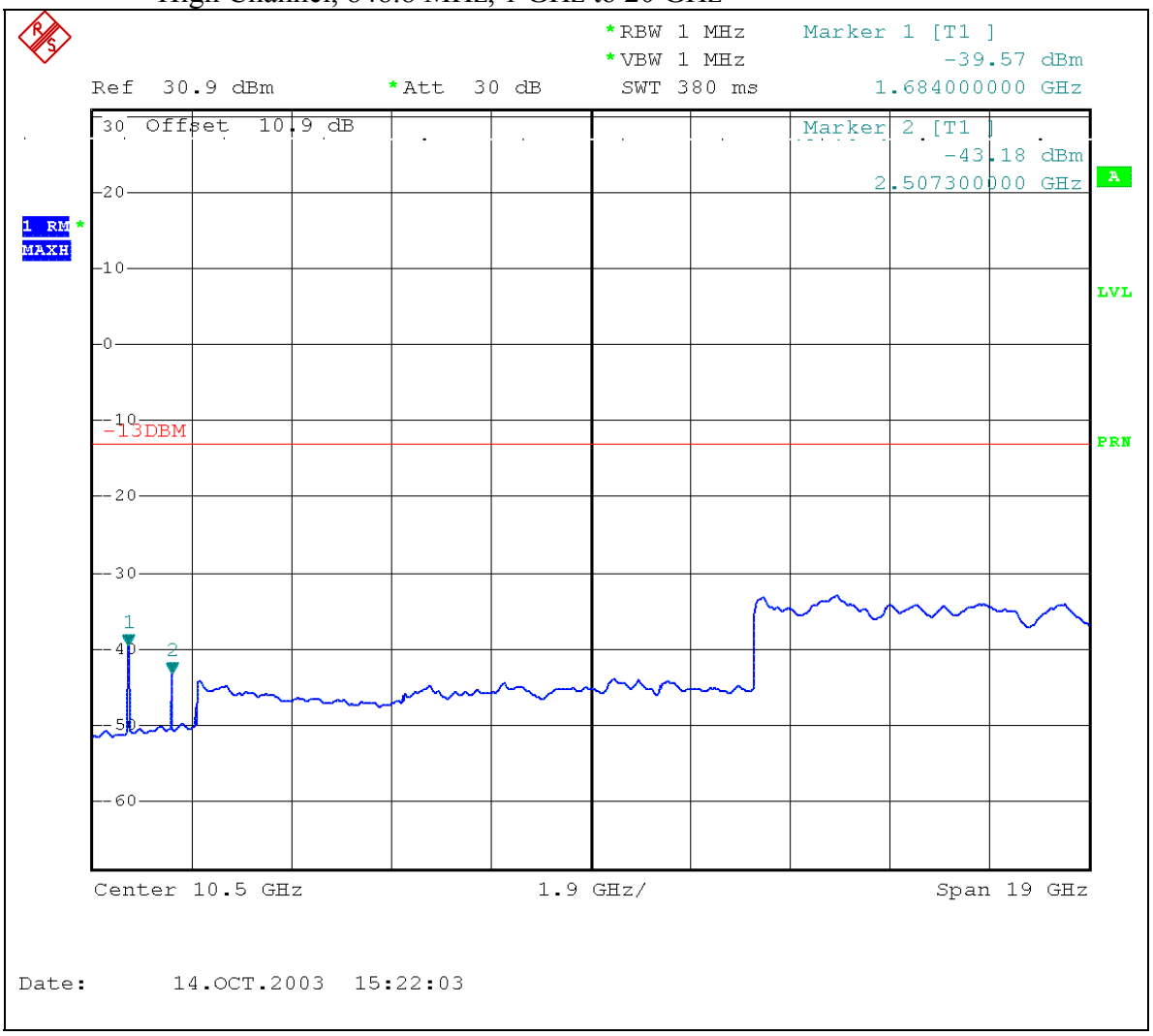
High Channel, 848.8 MHz, TX signal +/- 20 MHz




**Strong emission shown in each case is the carrier signal.**

**Plot 7.4i Out of Band Emissions at Antenna Terminals**

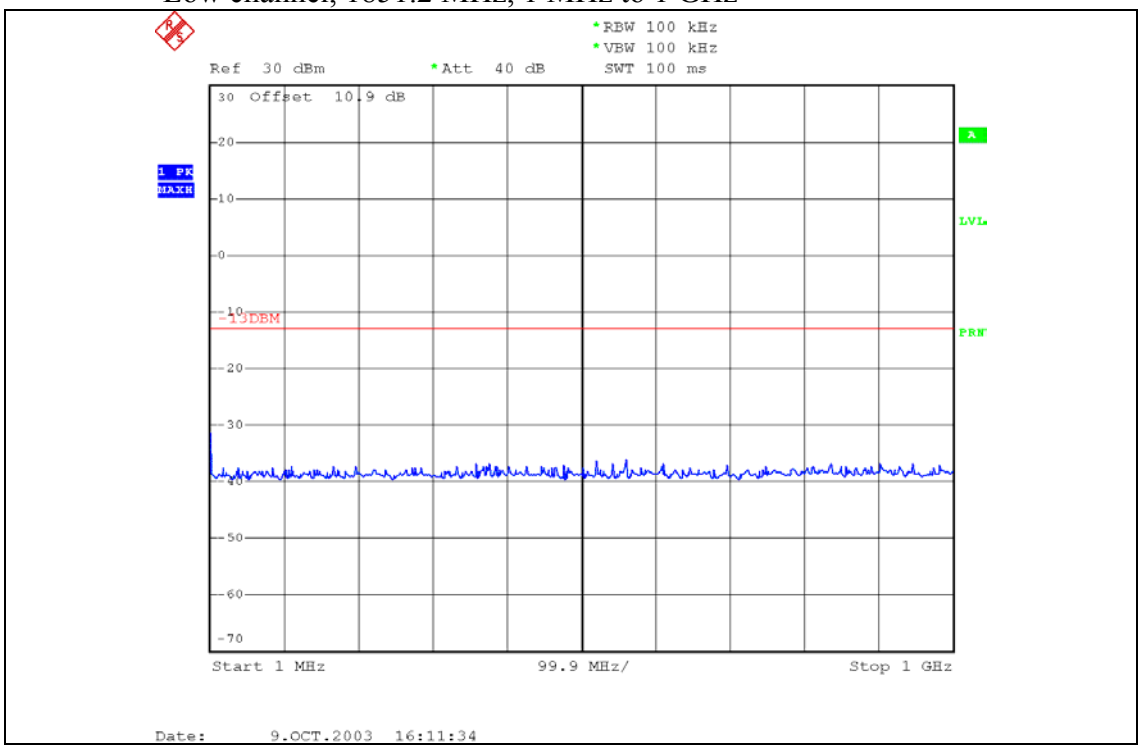
High Channel, 848.8 MHz, 1 GHz to 20 GHz




| Cellular Harmonics for Ch. 251 (848.8 MHz) | Level (dBm) |
|---|---|
| Second | -39 dBm |
| Third | -43 dBm |
| All others | < -45dBm up to 13GHz; < -33dBm beyond 13GHz |

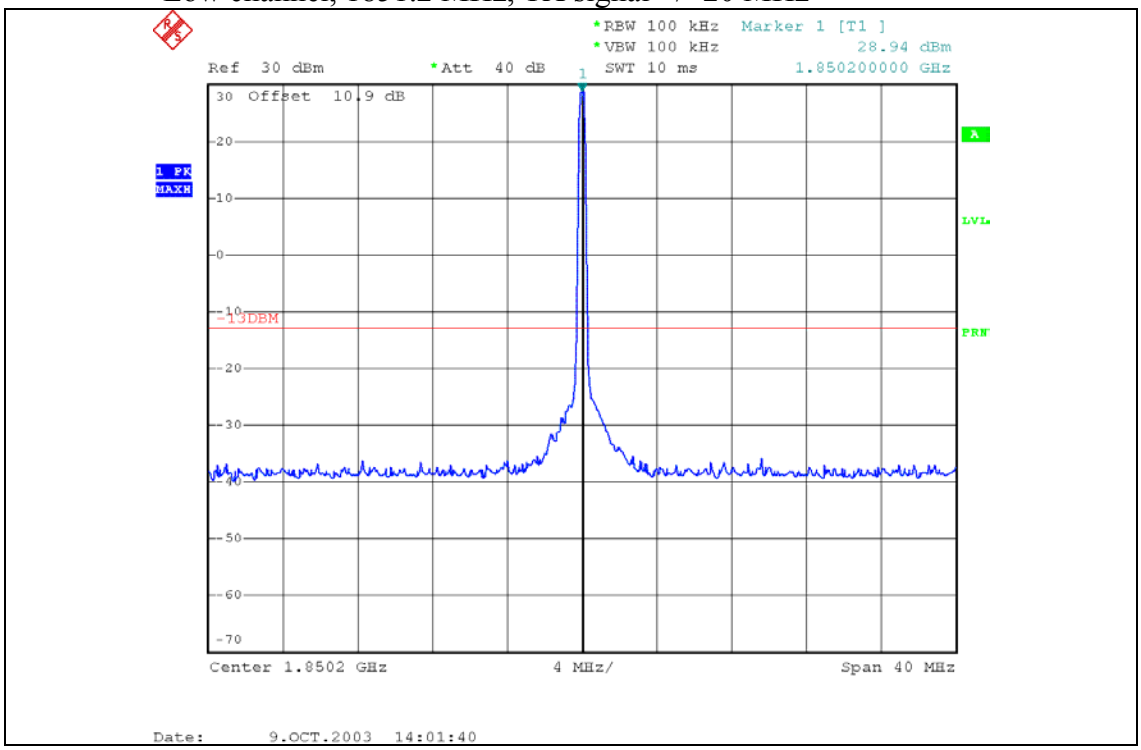
**Plot 7.4j Out of Band Emissions at Antenna Terminals**

Low channel, 1851.2 MHz, 1 MHz to 1 GHz



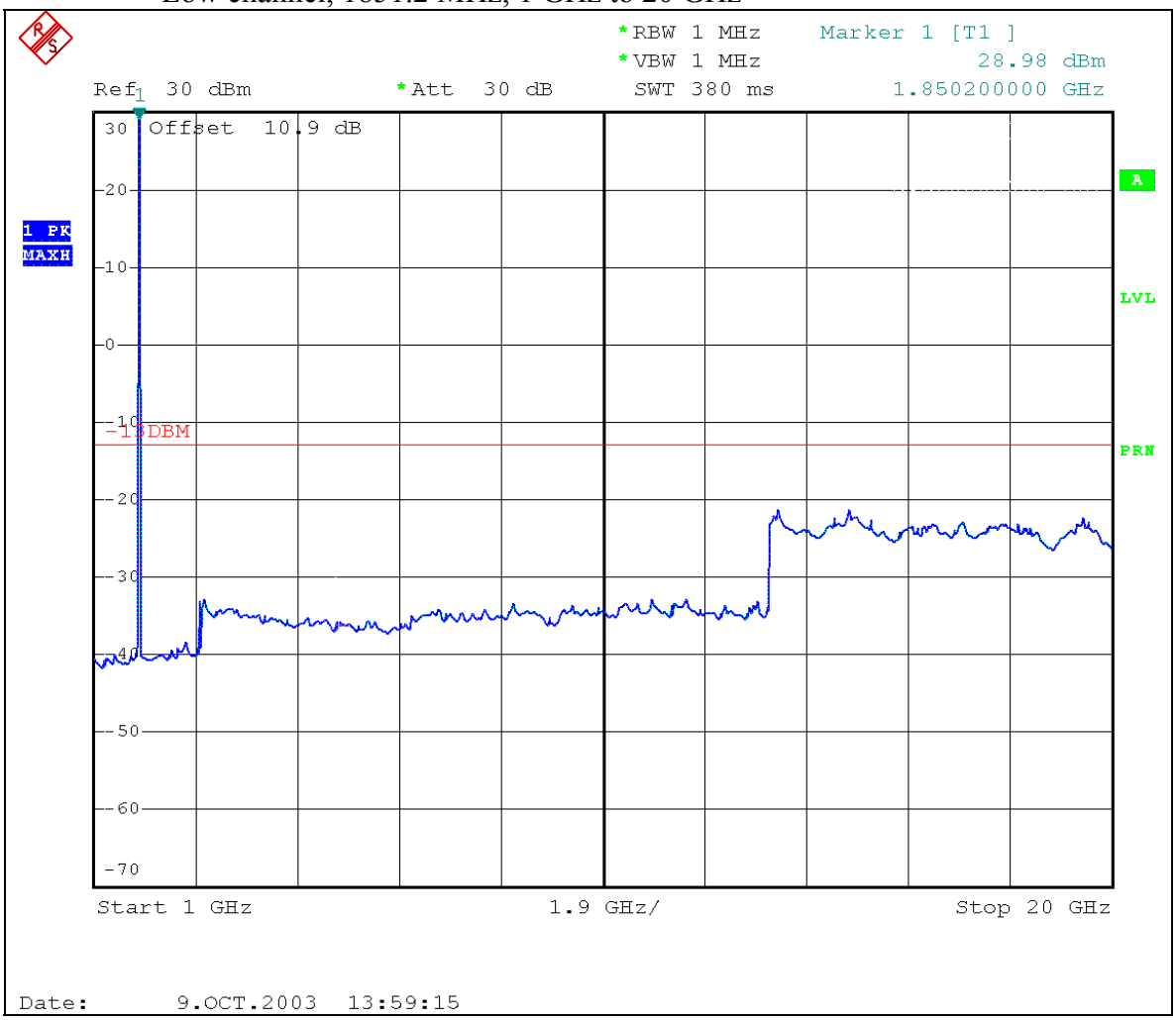

**Plot 7.4k Out of Band Emissions at Antenna Terminals**

Low channel, 1851.2 MHz, TX signal +/- 20 MHz



**Plot 7.4l Out of Band Emissions at Antenna Terminals**

Low channel, 1851.2 MHz, 1 GHz to 20 GHz

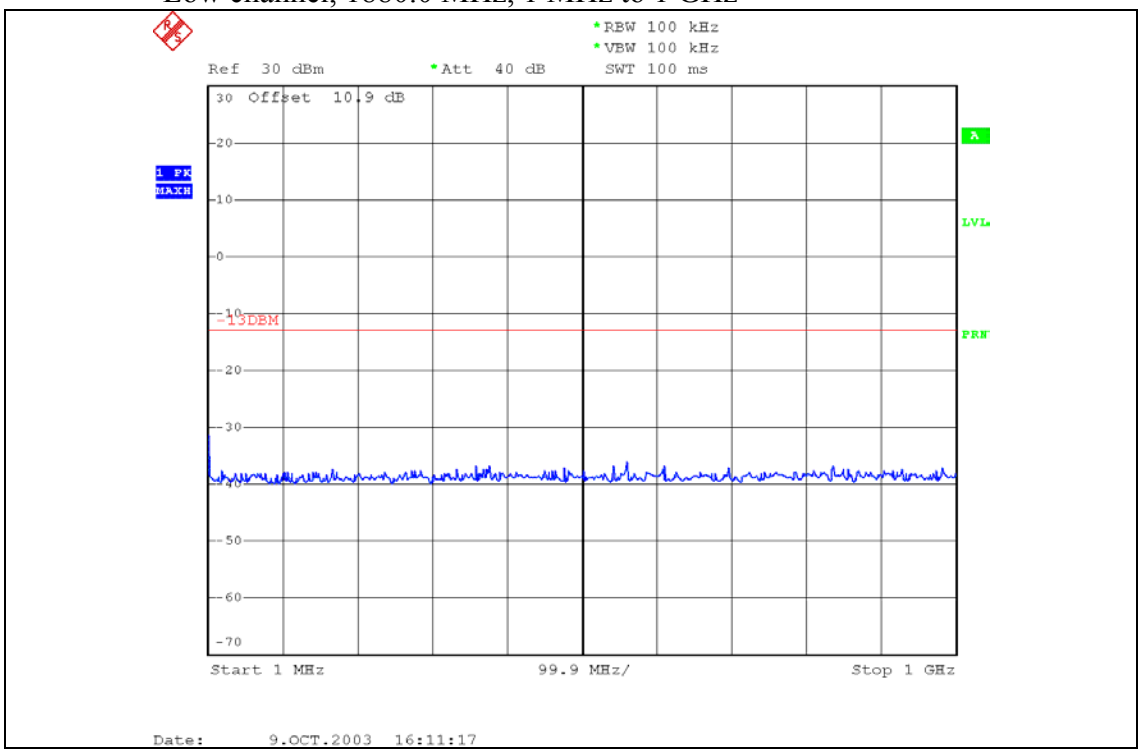



**Strong emission shown is the carrier signal.**

| PCS Harmonics for Ch. 512 (1850.2 MHz) | Level (dBm) |
|---|---|
| **Second** | **-41 dBm** |
| **Third** | **-37 dBm** |
| **All others** | **< -50dBm** |

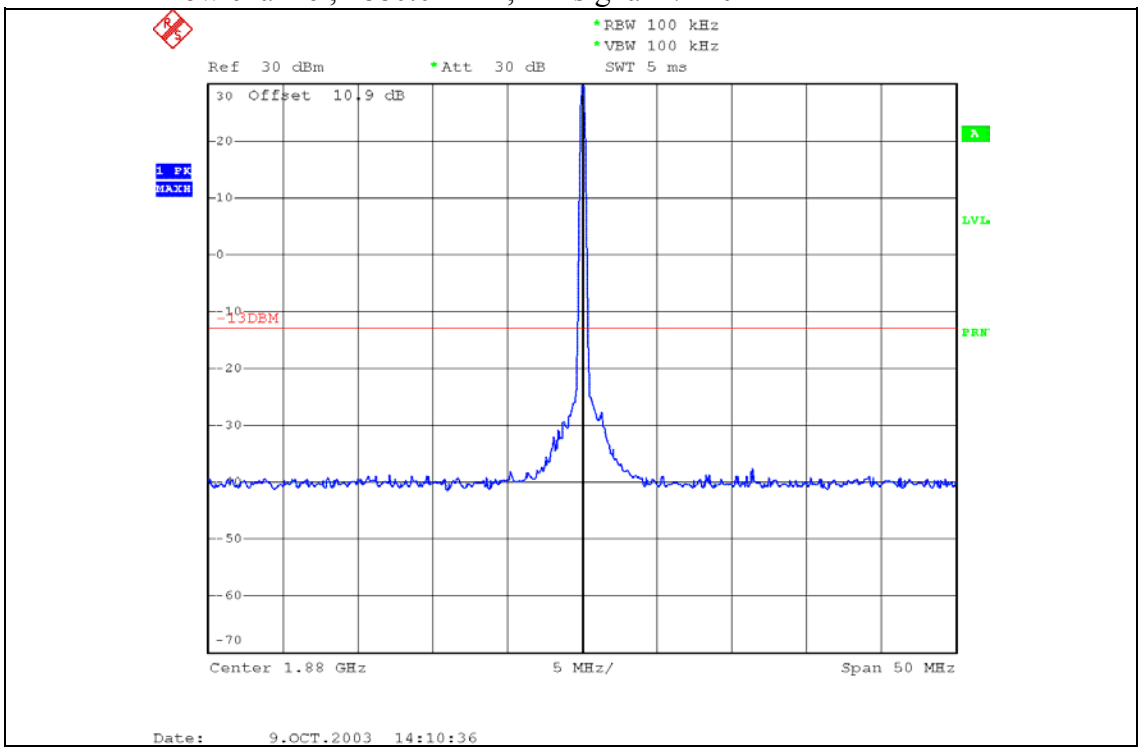
**Plot 7.4m Out of Band Emissions at Antenna Terminals**

Low channel, 1880.0 MHz, 1 MHz to 1 GHz



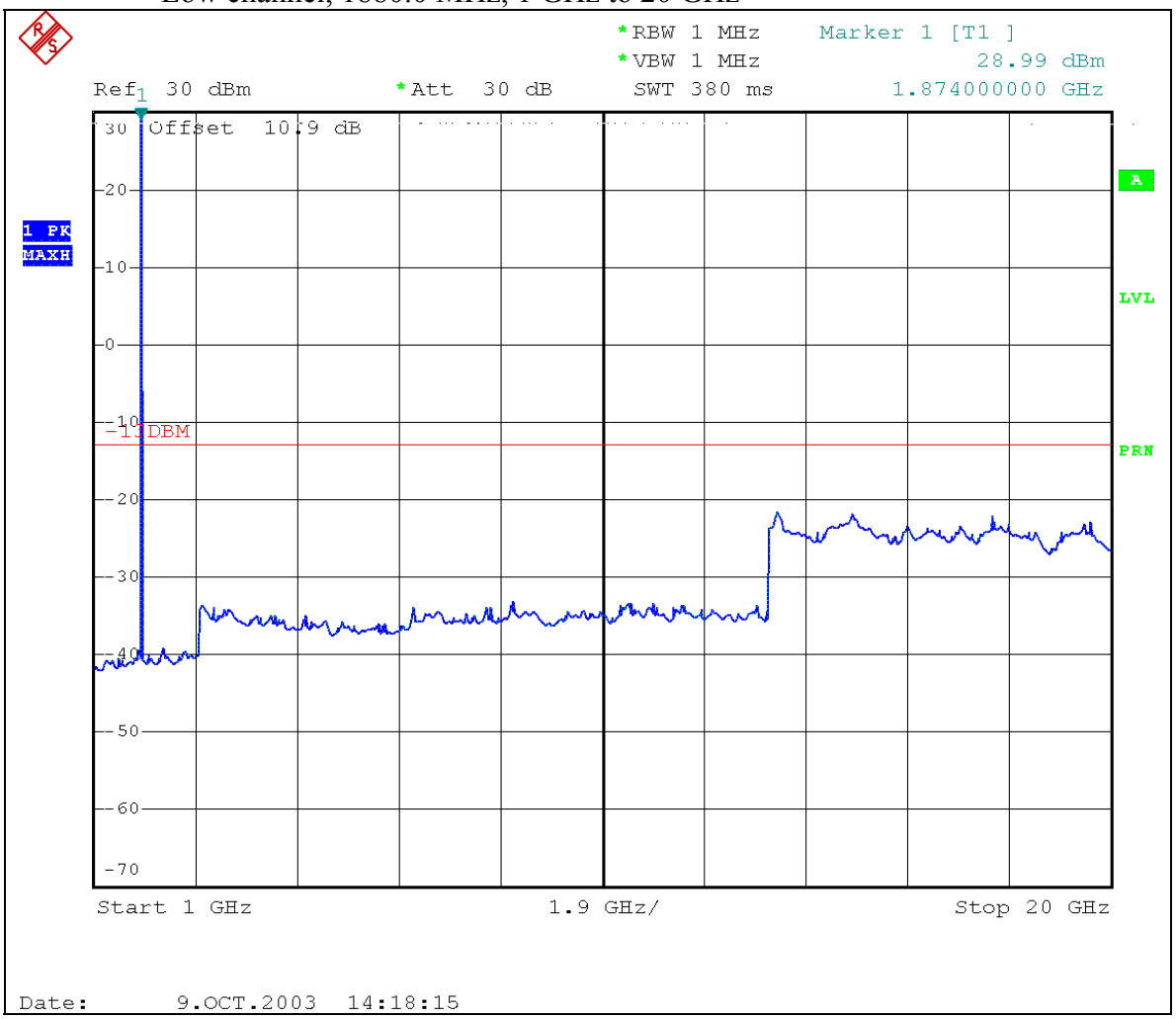

**Plot 7.4n Out of Band Emissions at Antenna Terminals**

Low channel, 1880.0 MHz, TX signal +/- 20 MHz



**Plot 7.4o Out of Band Emissions at Antenna Terminals**

Low channel, 1880.0 MHz, 1 GHz to 20 GHz

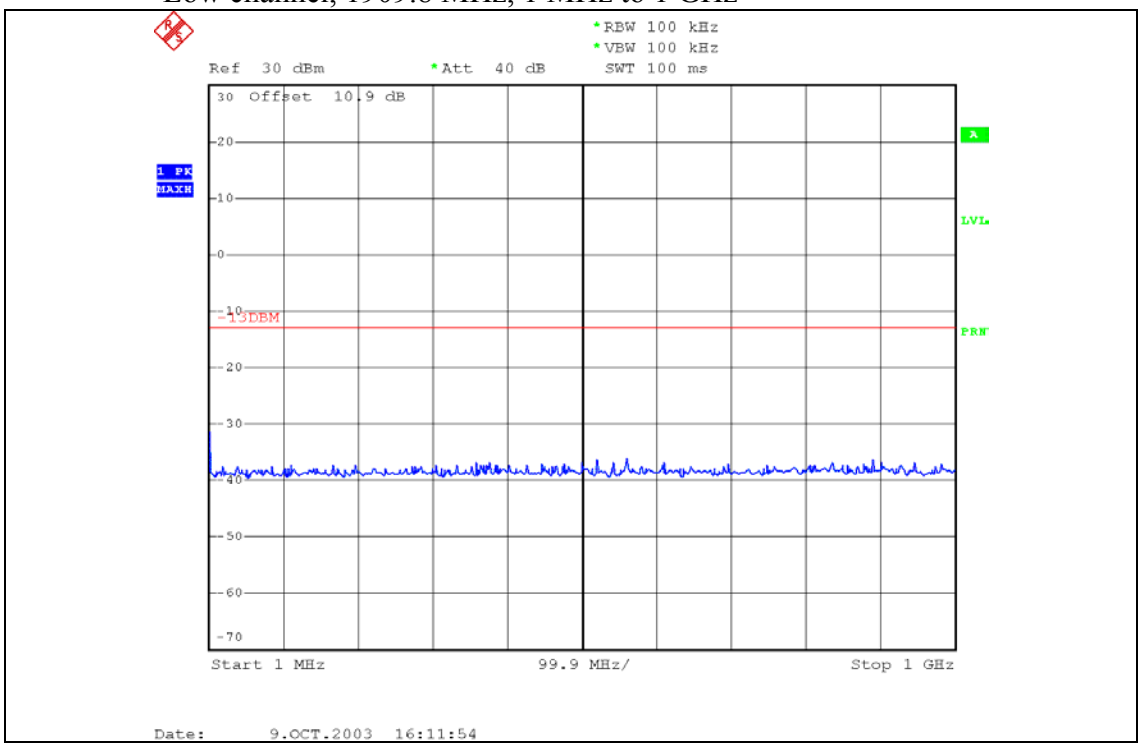



**Strong emission shown is the carrier signal.**

| PCS Harmonics for Ch. 661 (1880.0 MHz) | Level (dBm) |
|---|---|
| **Second** | **-43 dBm** |
| **Third** | **-38 dBm** |
| **All others** | **< -50dBm** |

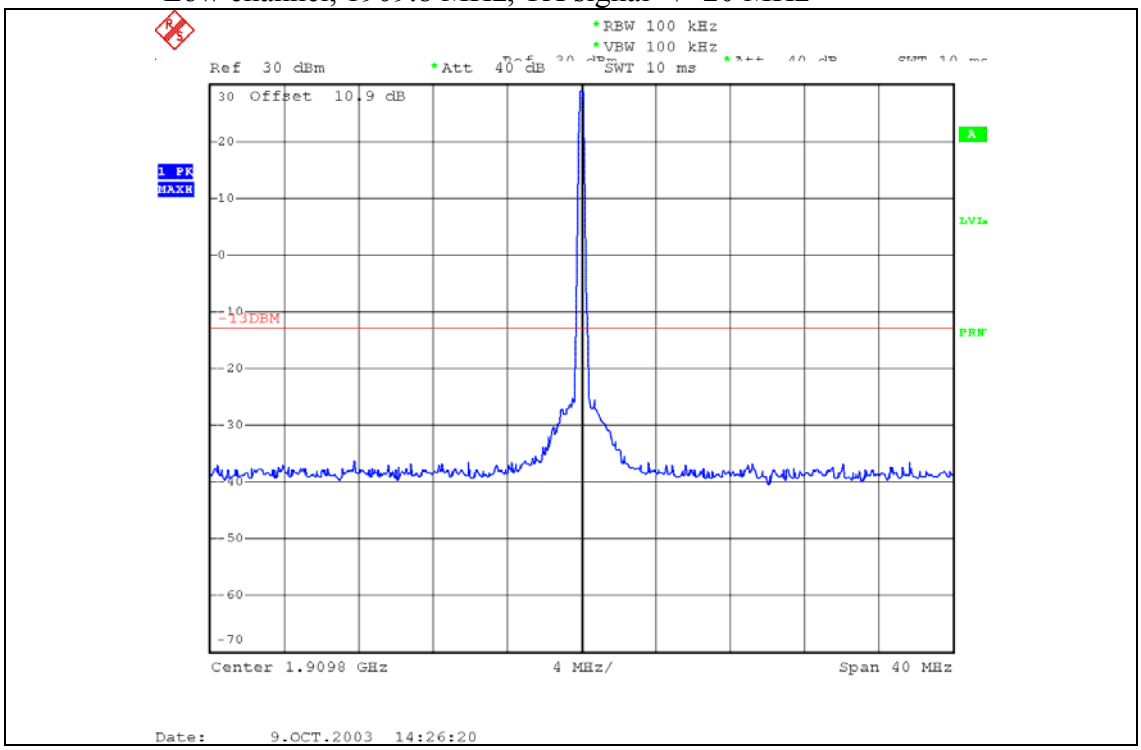
**Plot 7.4p Out of Band Emissions at Antenna Terminals**

Low channel, 1909.8 MHz, 1 MHz to 1 GHz



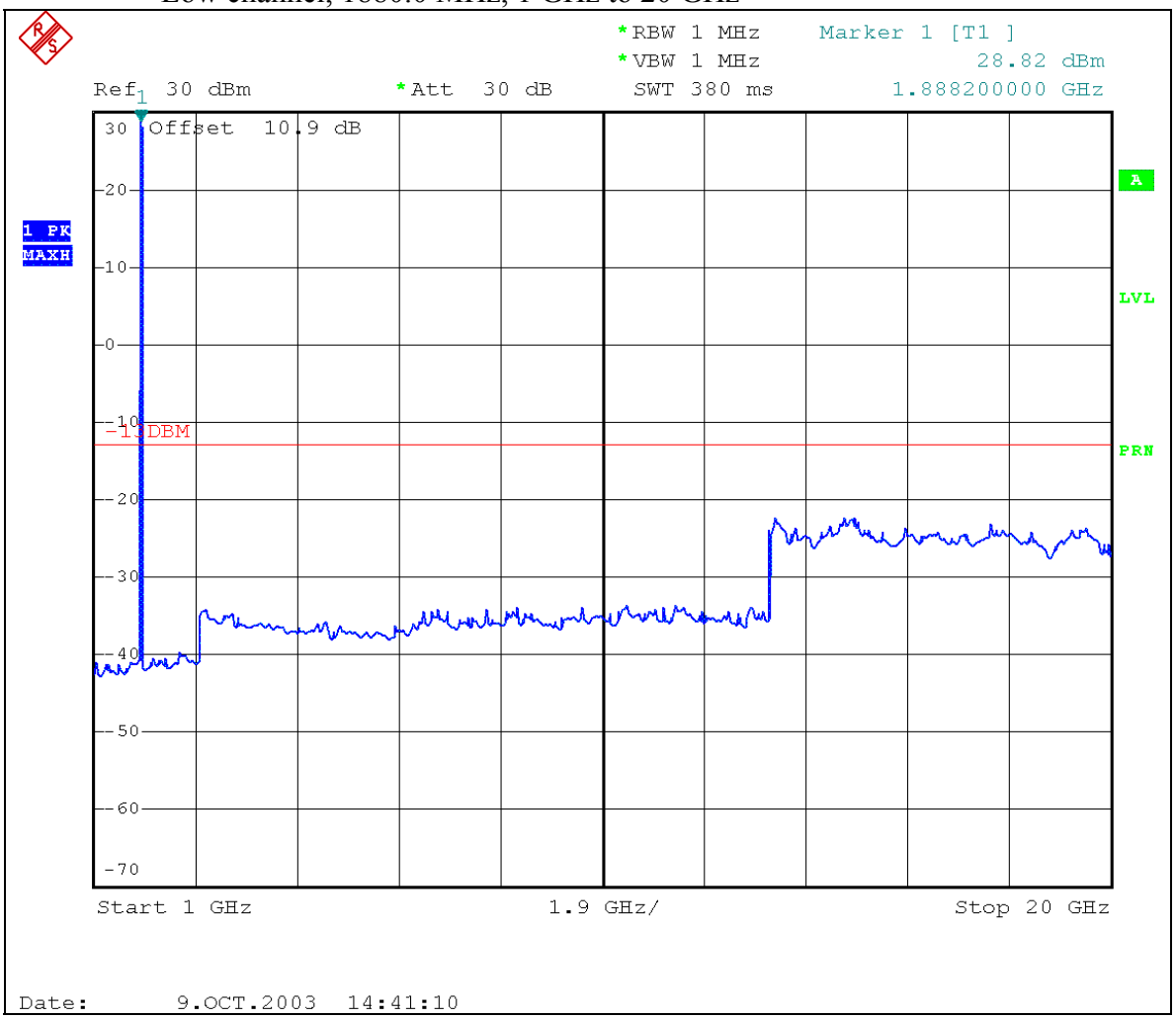

**Plot 7.4q Out of Band Emissions at Antenna Terminals**

Low channel, 1909.8 MHz, TX signal +/- 20 MHz



**Plot 7.4r Out of Band Emissions at Antenna Terminals**

Low channel, 1880.0 MHz, 1 GHz to 20 GHz




**Strong emission shown is the carrier signal.**

| PCS Harmonics for Ch. 810 (1909.8 MHz) | Level (dBm) |
|---|---|
| **Second** | **-43 dBm** |
| **Third** | **-38 dBm** |
| **All others** | **< -50dBm** |

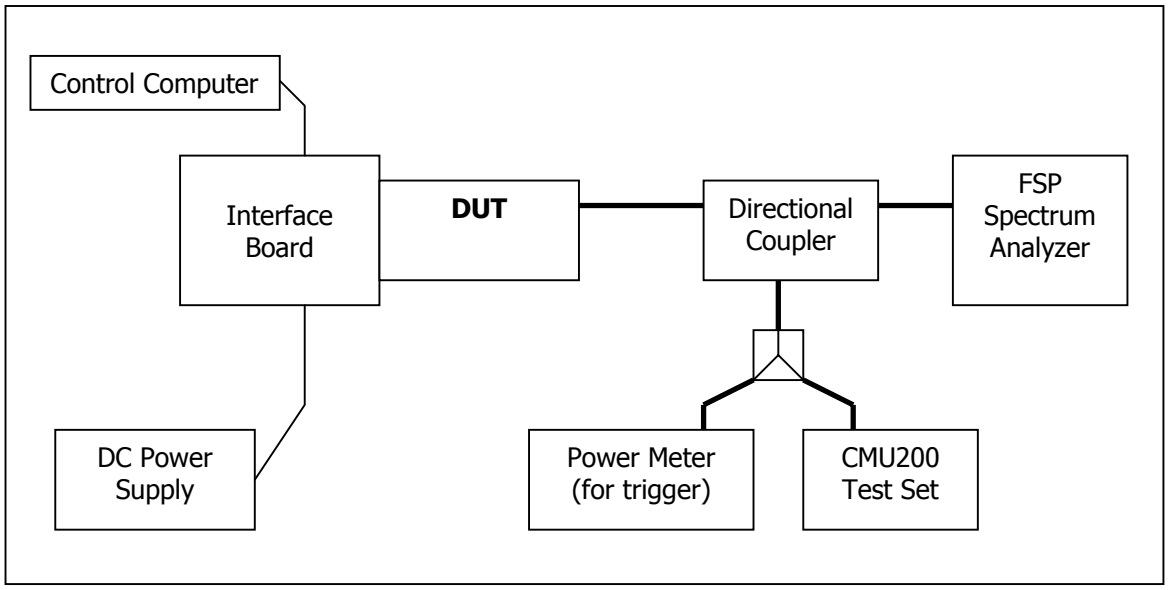
# 7 Block Edge Compliance

FCC part 22H/24E

## *7.1 Test Procedure*

The transmitter output was connected to a Rohde & Schwarz CMU200 Test Set 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**



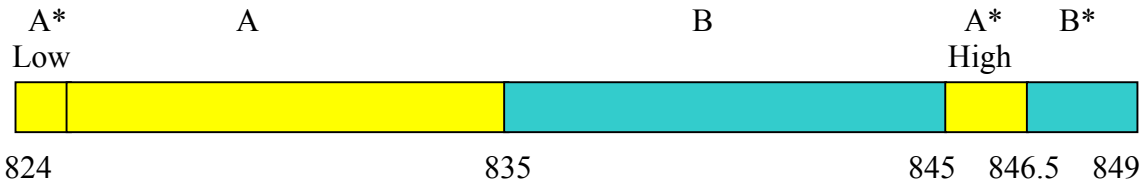

## *7.2 Test Equipment*

**Instrument List**

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE |
|---|---|---|---|---|
| Control Computer | TC | Generic PC | 100488 | N/A |
| Wireless Test Set | Rohde & Schwarz | CMU200 | 836766/030 | N/A |
| Spectrum Analyzer | Rohde & Schwarz | FSP 30GHz | US41421268 | Sept. 12, 2003 |
| DC Power Supply | HP | E3631A | 100060 | N/A |
| Interface Board | Shop built | Minnow | N/A | N/A |
| Directional Coupler | Pasternack | PE2209-10 | N/A | N/A |

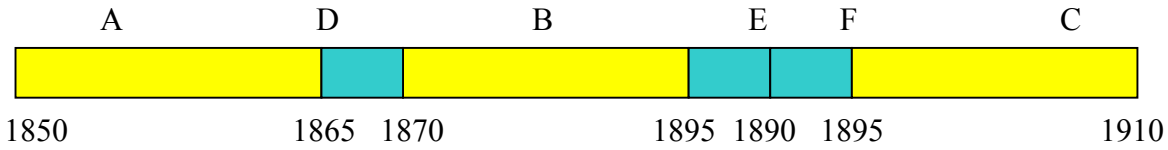
### *7.3 Test Results*

Cellular Mobile Station Block Requirements




| Block Number | Frequency Boundaries (MHz) | Channels Tested | Corresponding Plots | Result |
|---|---|---|---|---|
| 1 | Below 824 MHz, above 835 MHz | 128, 181 | 8.4a, 8.4b | Complies |
| 2 | Below 835 MHz, above 845 MHz | 183, 231 | 8.4c, 8.4d | Complies |
| 3 | Below 845 MHz, above 846.5 MHz | 233, 238 | 8.4e, 8.4f | Complies |
| 4 | Below 846.5 MHz, above 849 MHz | 241, 251 | 8.4g, 8.4h | Complies |

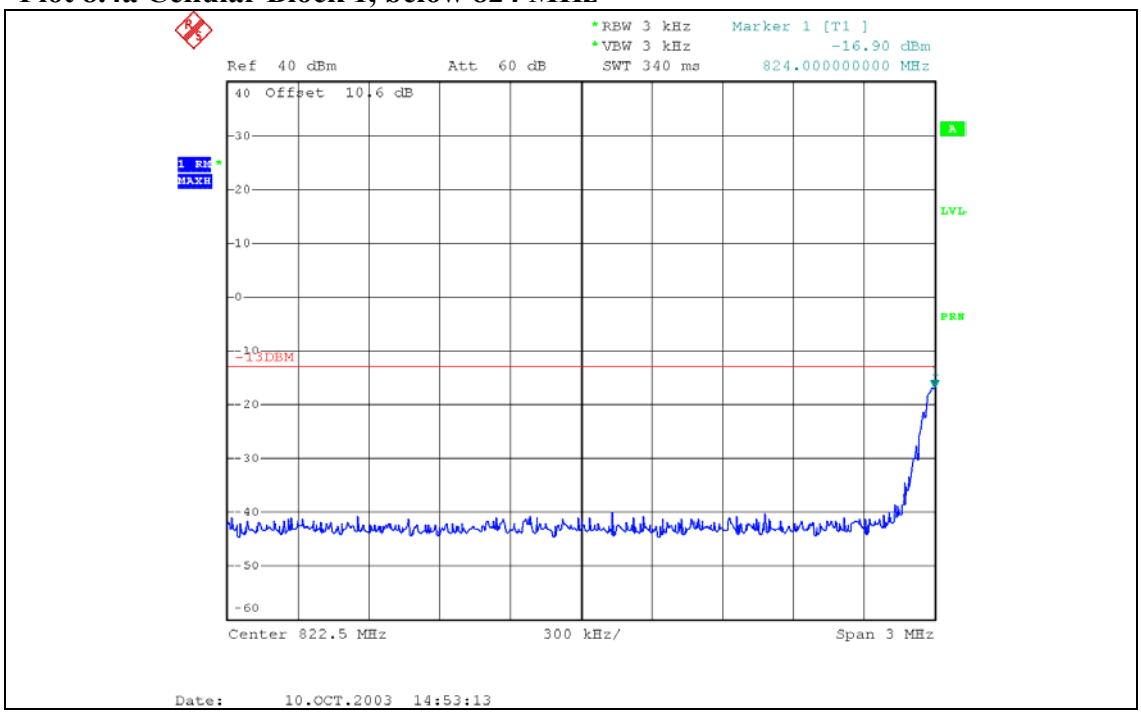
PCS Mobile Station Block Requirements



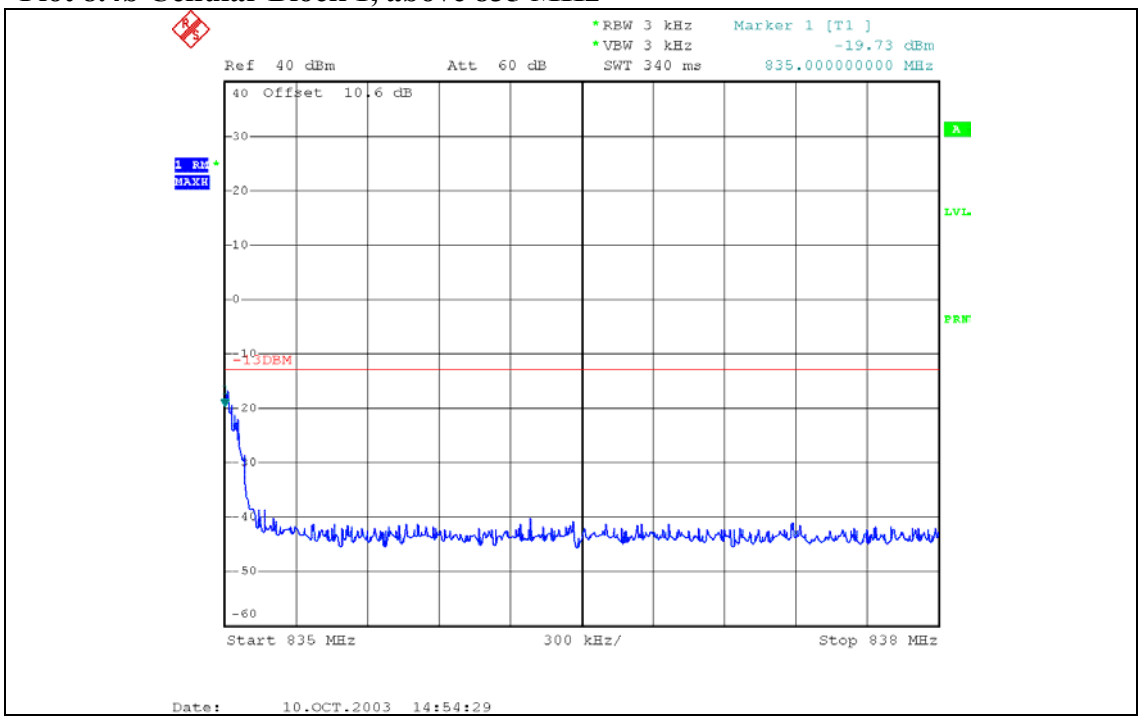

| Block Number | Frequency Boundaries (MHz) | Channels Tested | Corresponding Plots | Result |
|---|---|---|---|---|
| 1 | Below 1850 MHz, above 1865 MHz | 512, 585 | 8.4i, 8.4j | Complies |
| 2 | Below 1865 MHz, above 1870 MHz | 587, 610 | 8.4k, 8.4l | Complies |
| 3 | Below 1870 MHz, above 1885 MHz | 612, 685 | 8.4m, 8.4n | Complies |
| 4 | Below 1885 MHz, above 1890 MHz | 687, 710 | 8.4o, 8.4p | Complies |
| 5 | Below 1890 MHz, above 1895 MHz | 712, 735 | 8.4q, 8.4r | Complies |
| 6 | Below 1895 MHz, above 1910 MHz | 737, 810 | 8.4s, 8.4t | Complies |

## *7.4 Test Plots*

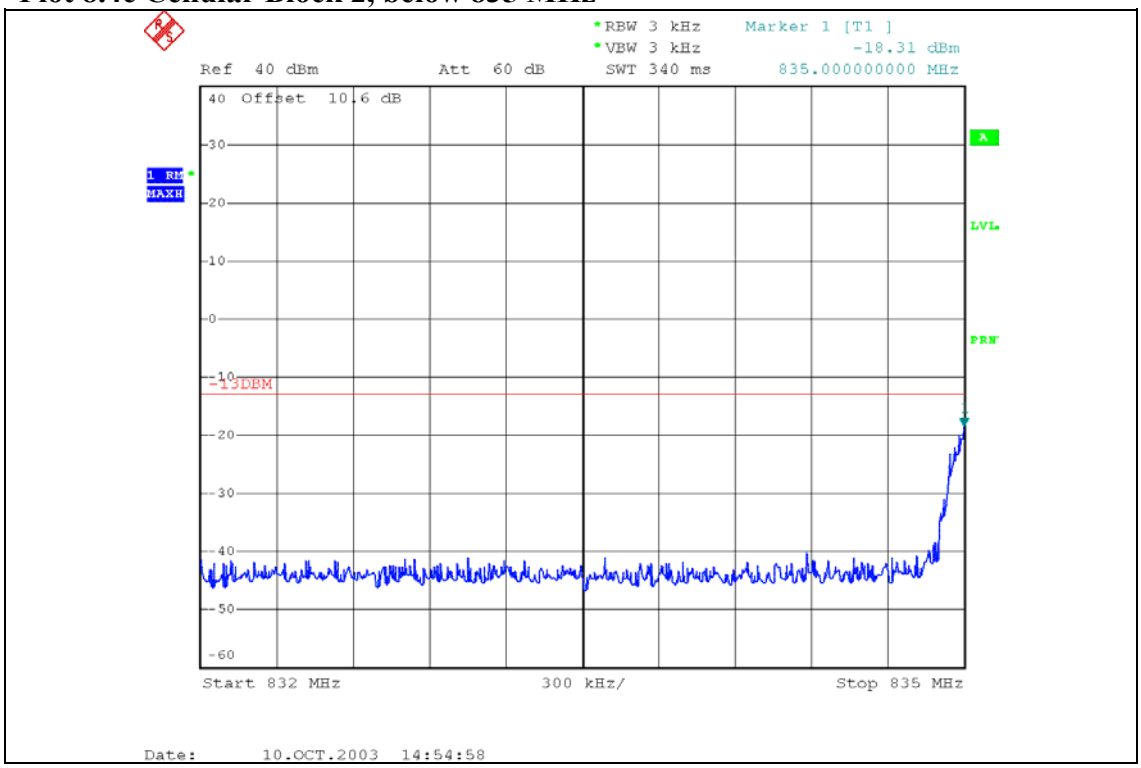
**Plot 8.4a Cellular Block 1, below 824 MHz**



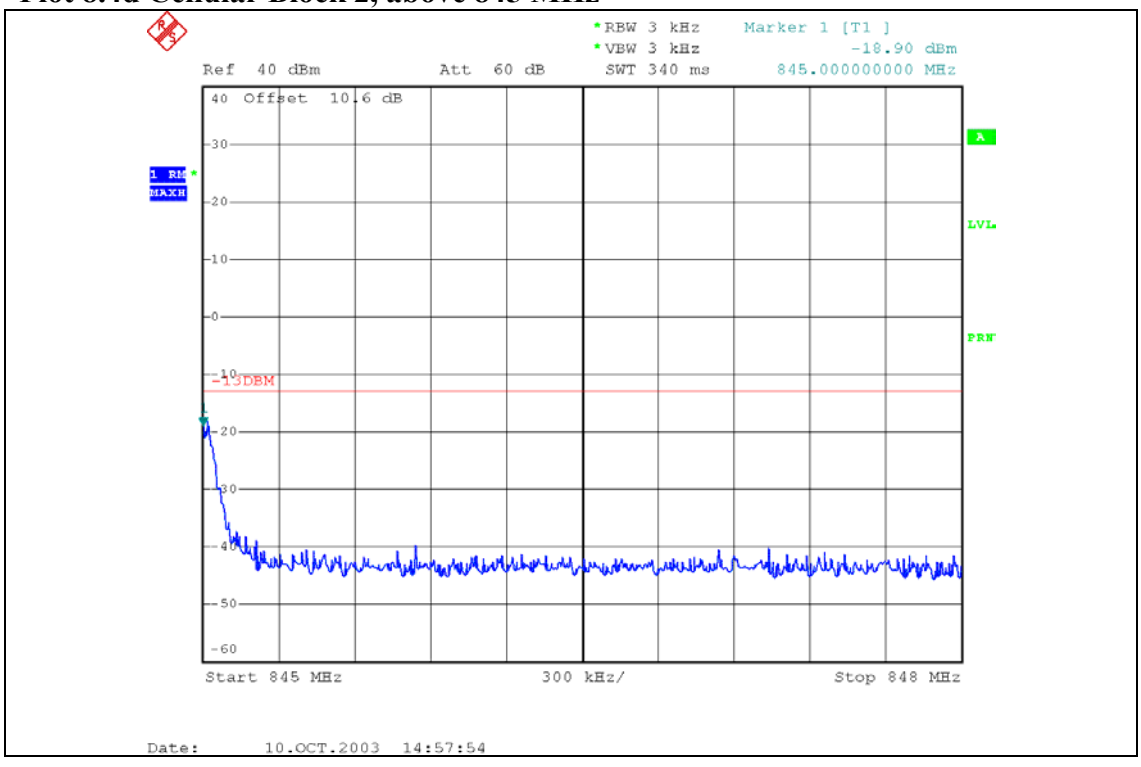

**Plot 8.4b Cellular Block 1, above 835 MHz**



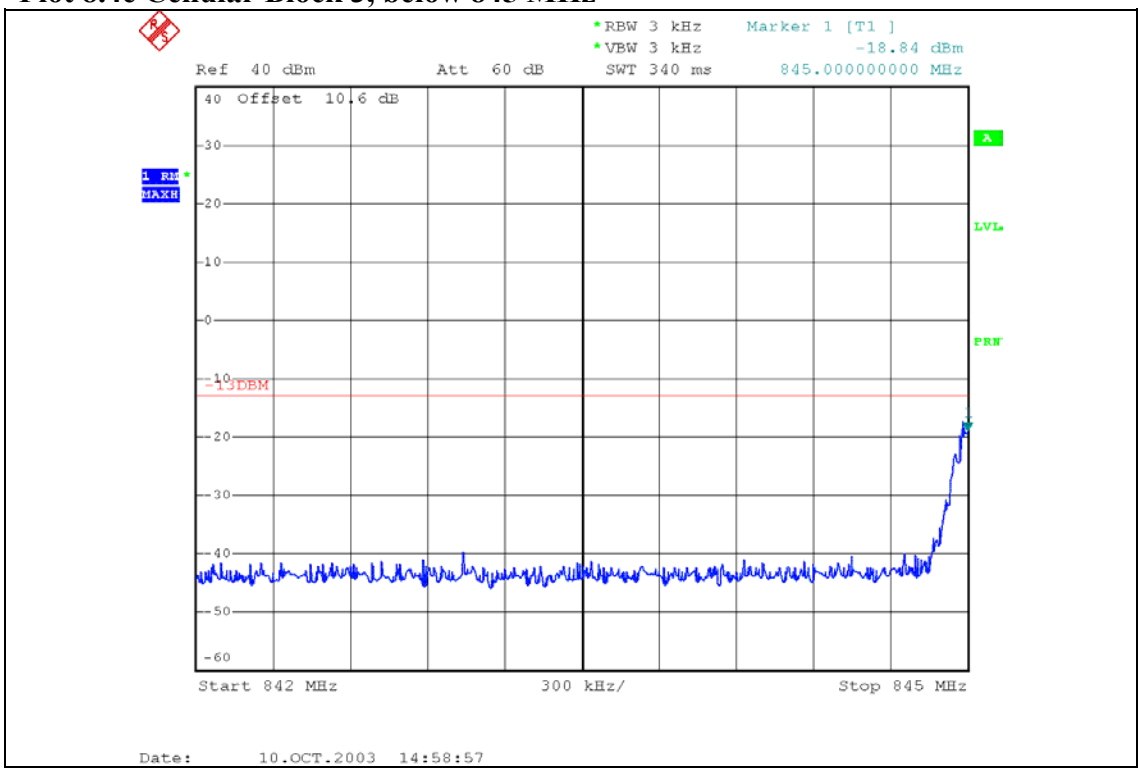
**Plot 8.4c Cellular Block 2, below 835 MHz**



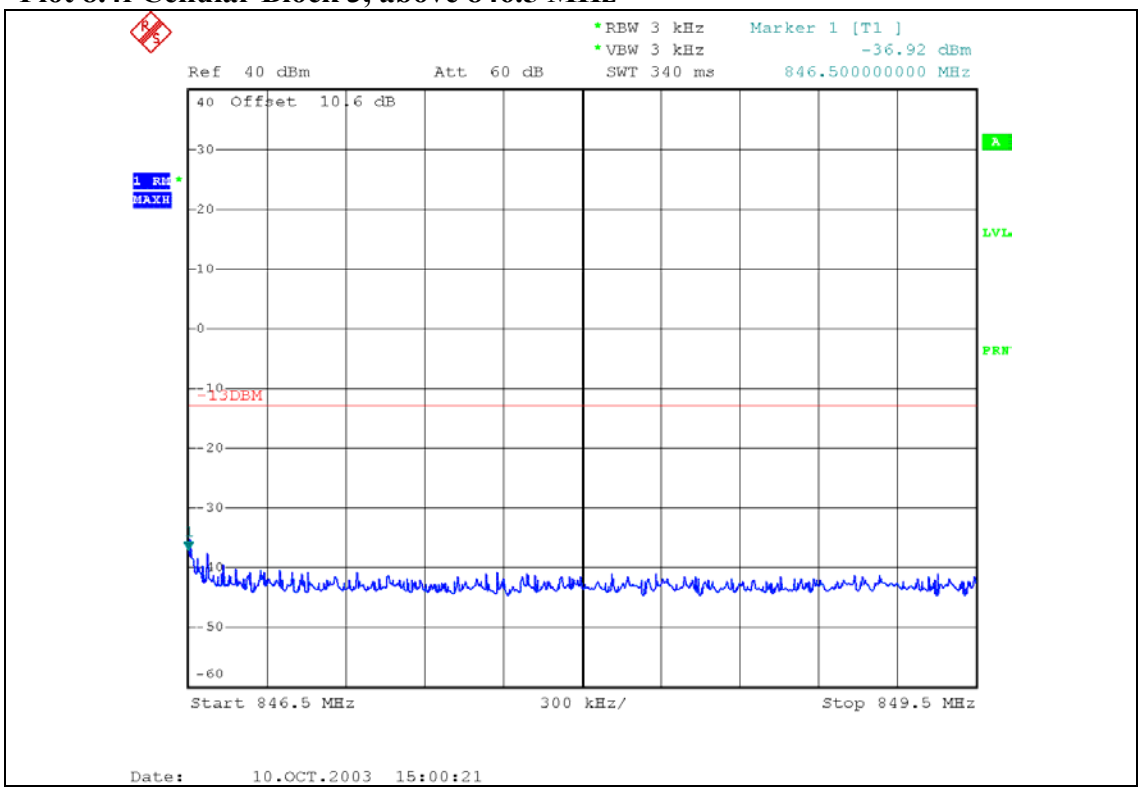

**Plot 8.4d Cellular Block 2, above 845 MHz**



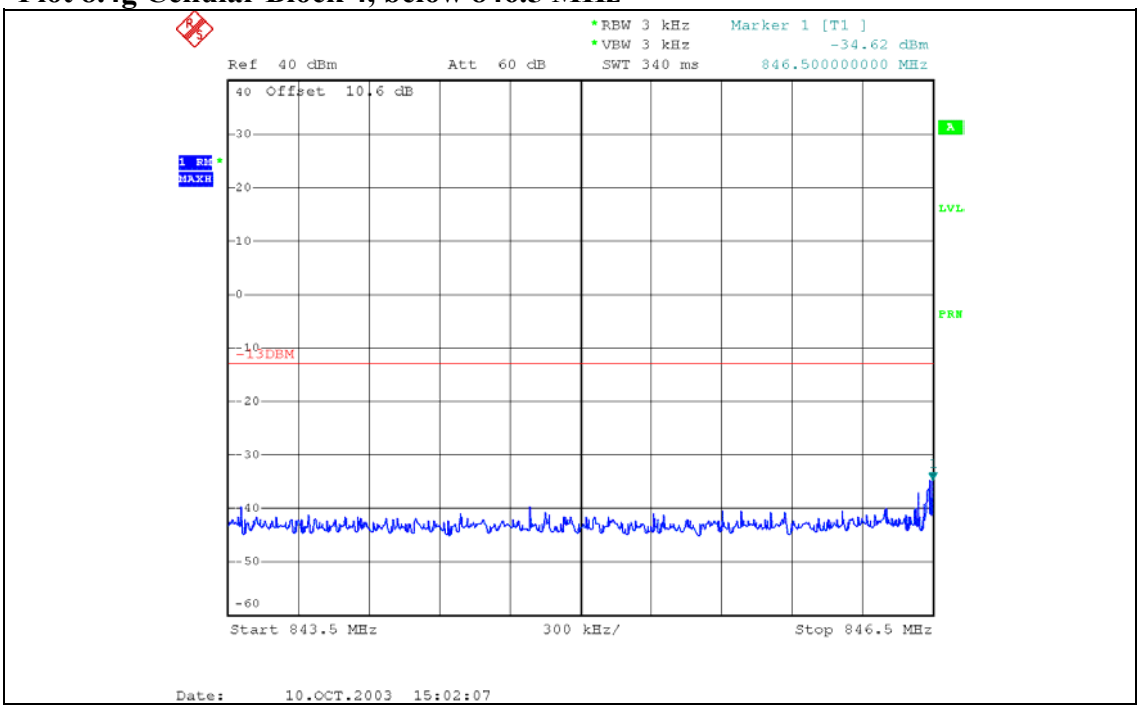
**Plot 8.4e Cellular Block 3, below 845 MHz**



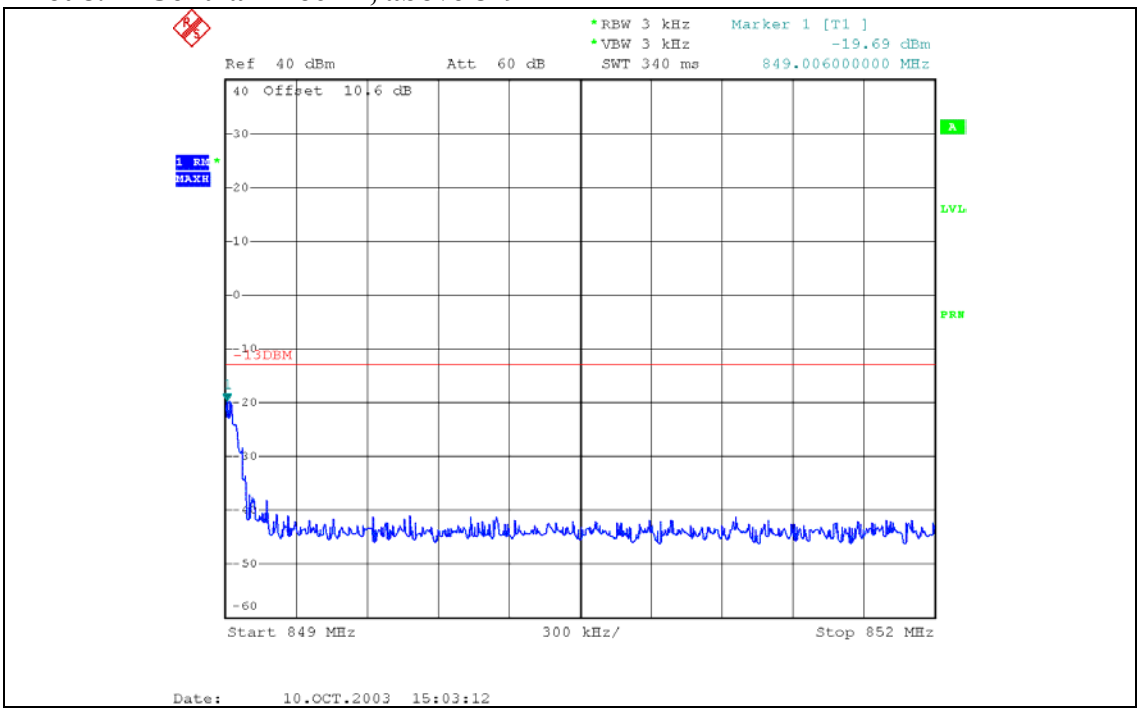

**Plot 8.4f Cellular Block 3, above 846.5 MHz**



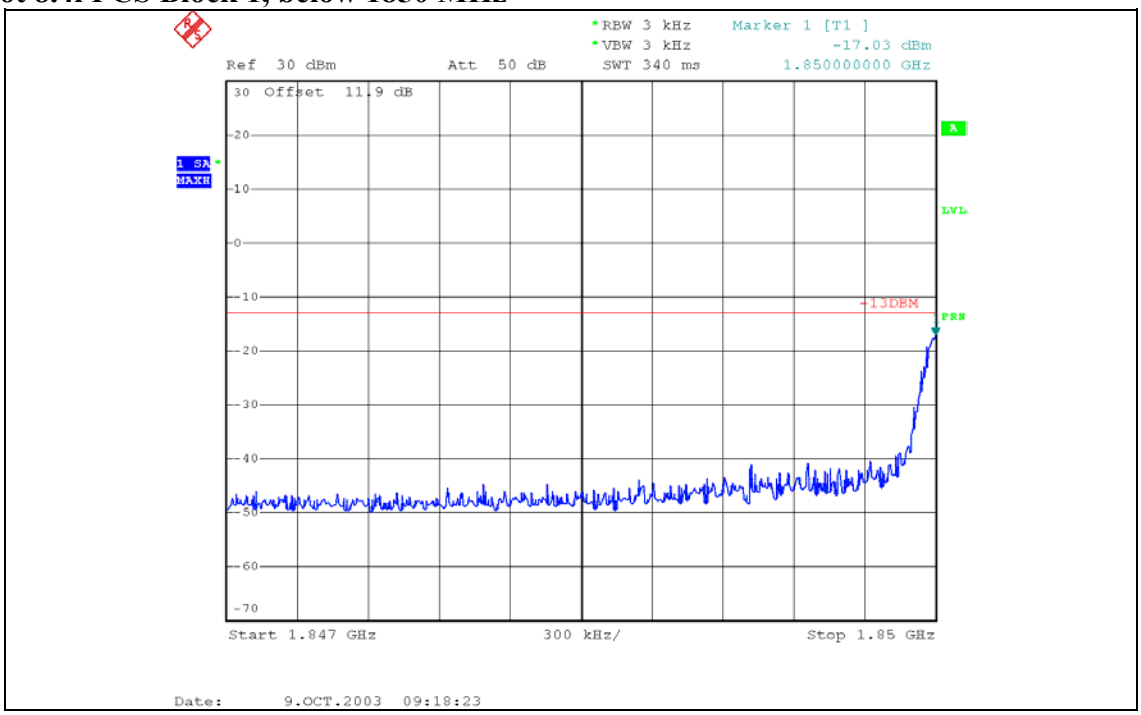
**Plot 8.4g Cellular Block 4, below 846.5 MHz**



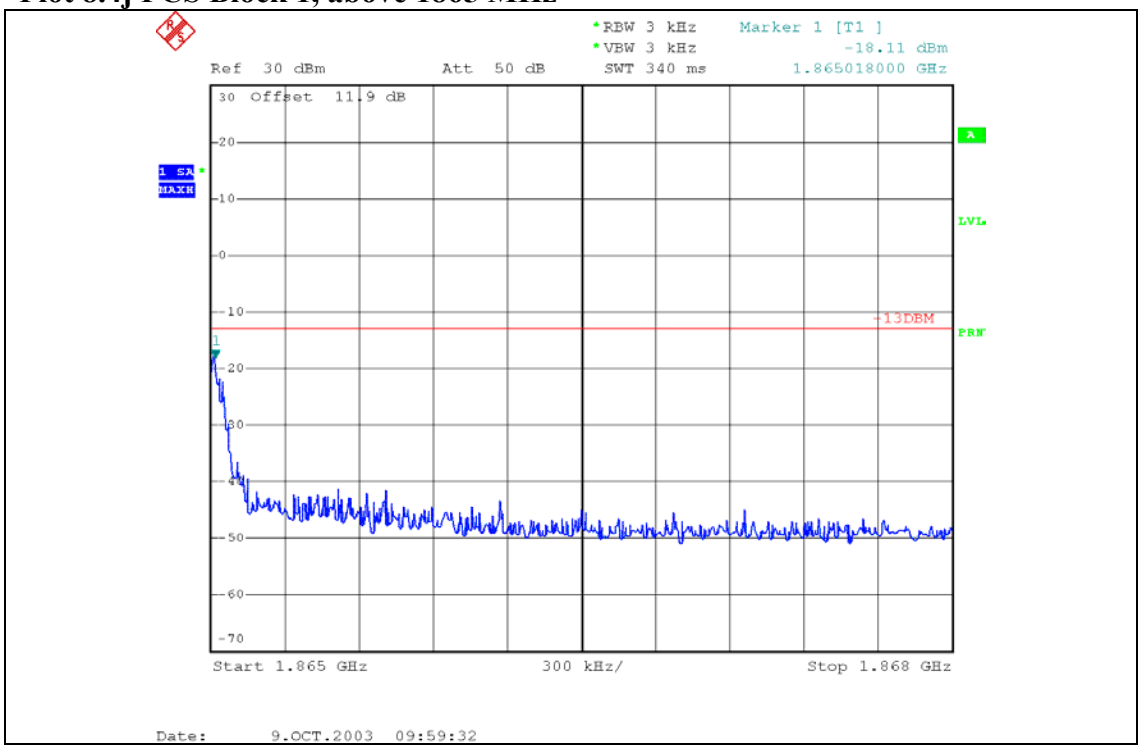

**Plot 8.4h Cellular Block 4, above 849 MHz**



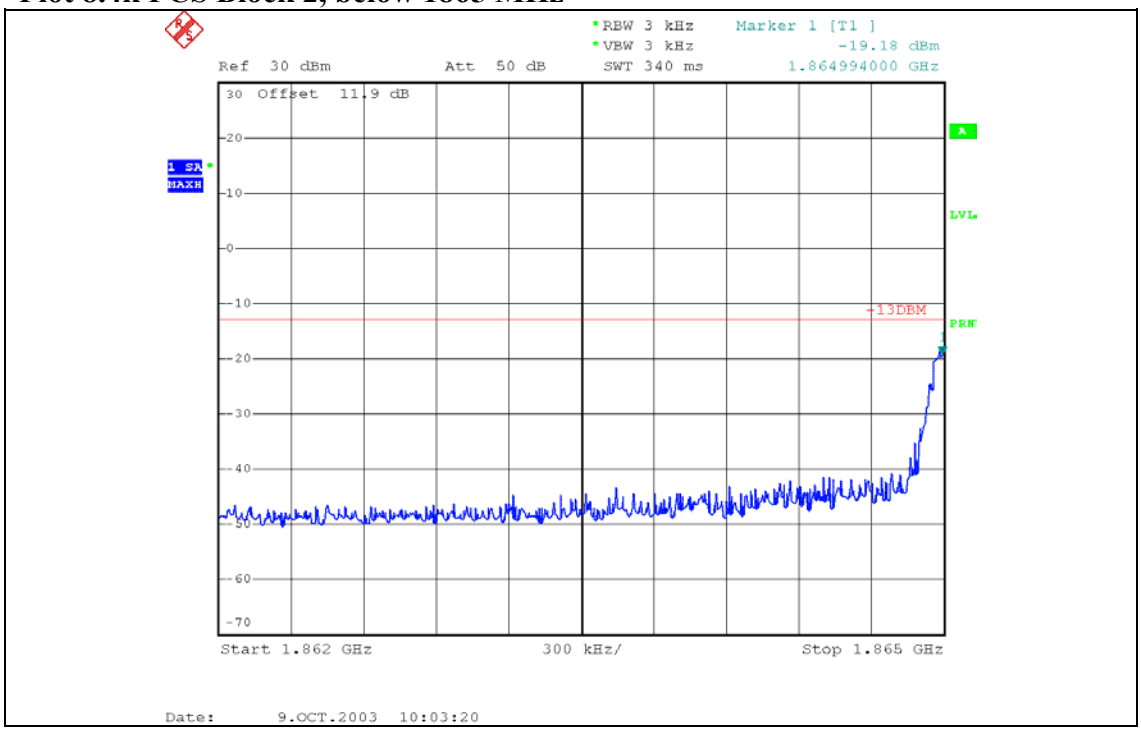
**Plot 8.4i PCS Block 1, below 1850 MHz**



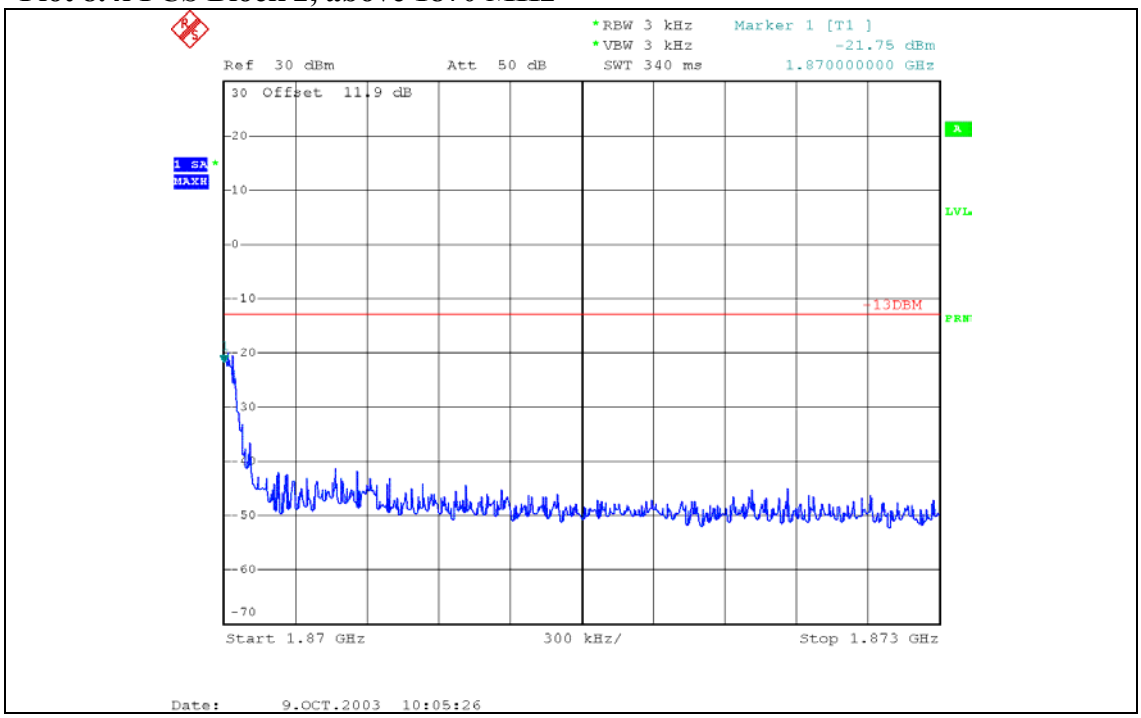

**Plot 8.4j PCS Block 1, above 1865 MHz**



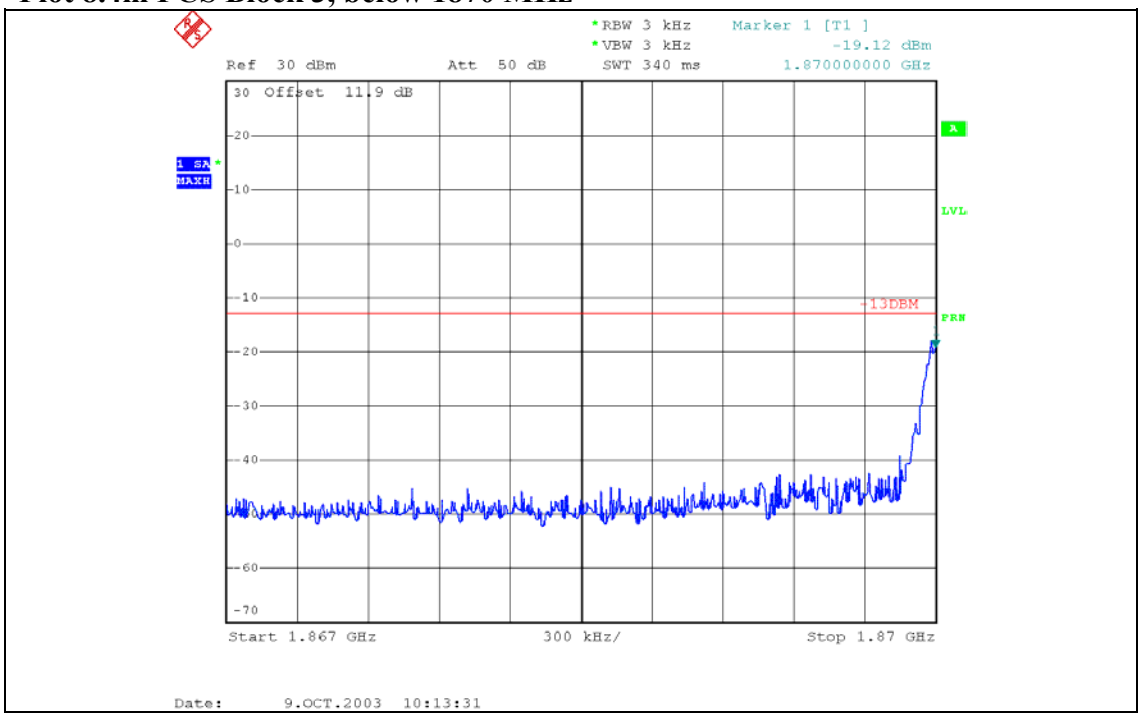
**Plot 8.4k PCS Block 2, below 1865 MHz**



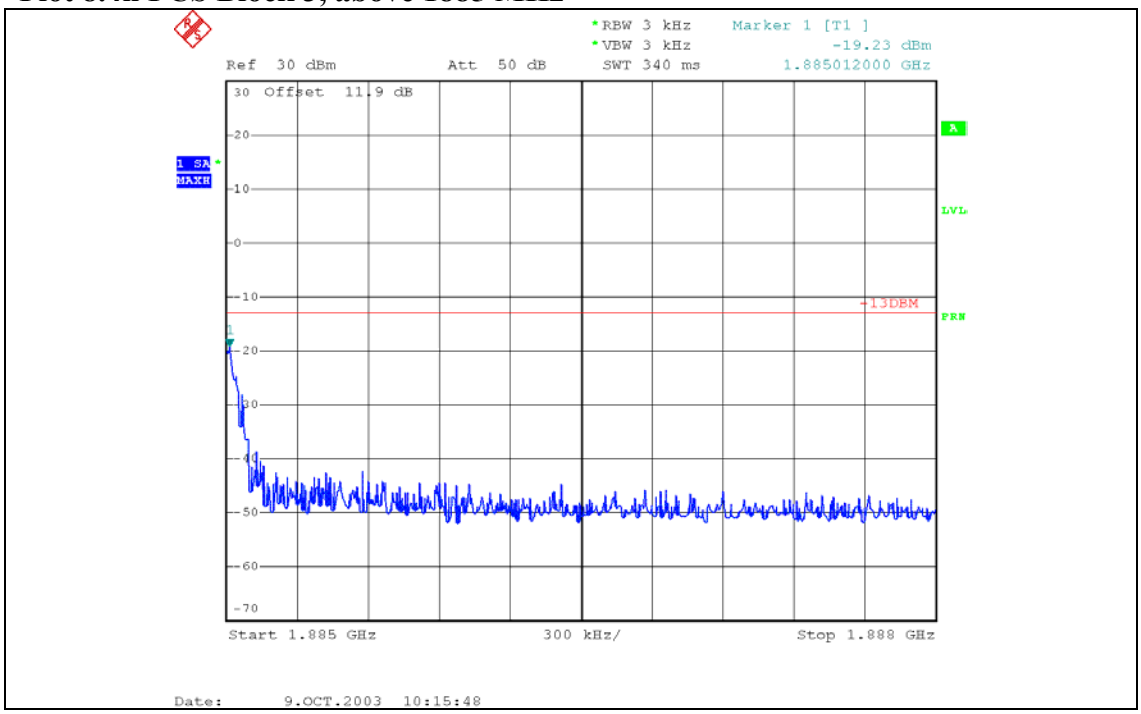

**Plot 8.4l PCS Block 2, above 1870 MHz**



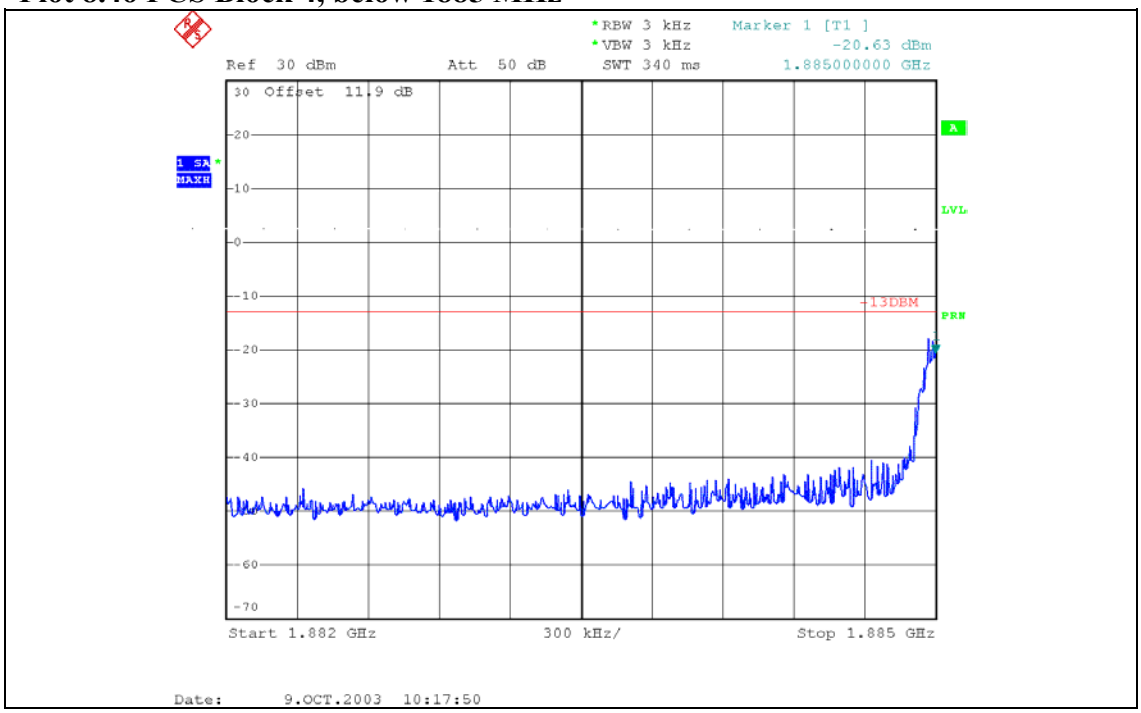
**Plot 8.4m PCS Block 3, below 1870 MHz**



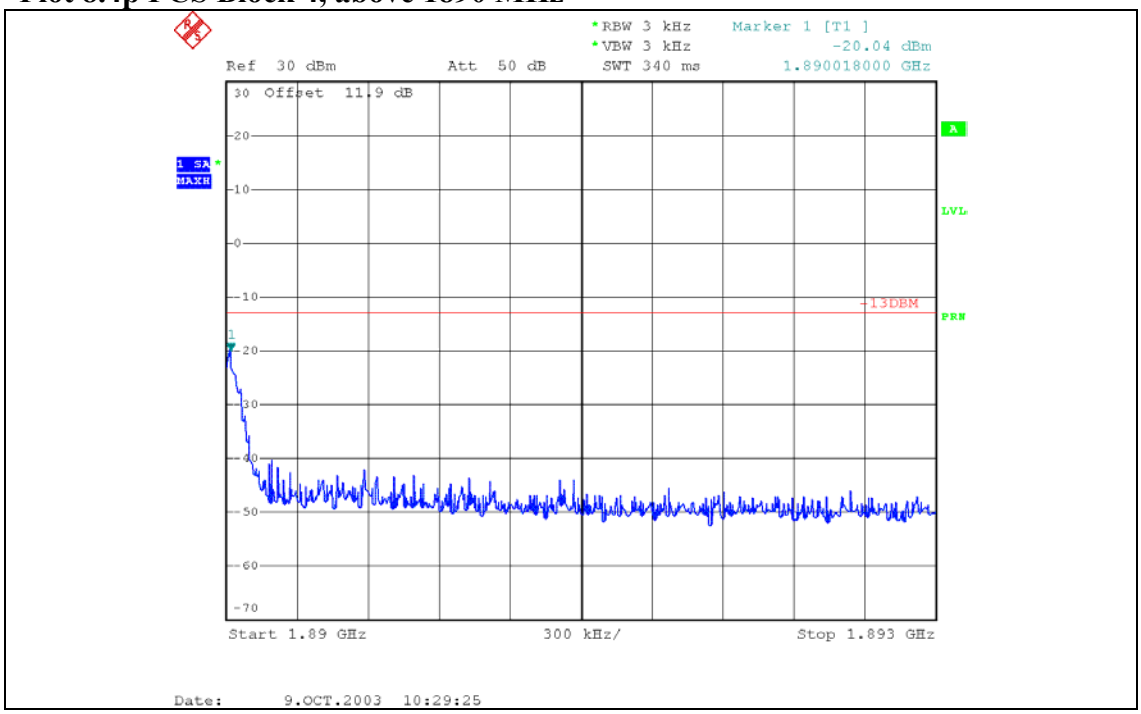

**Plot 8.4n PCS Block 3, above 1885 MHz**



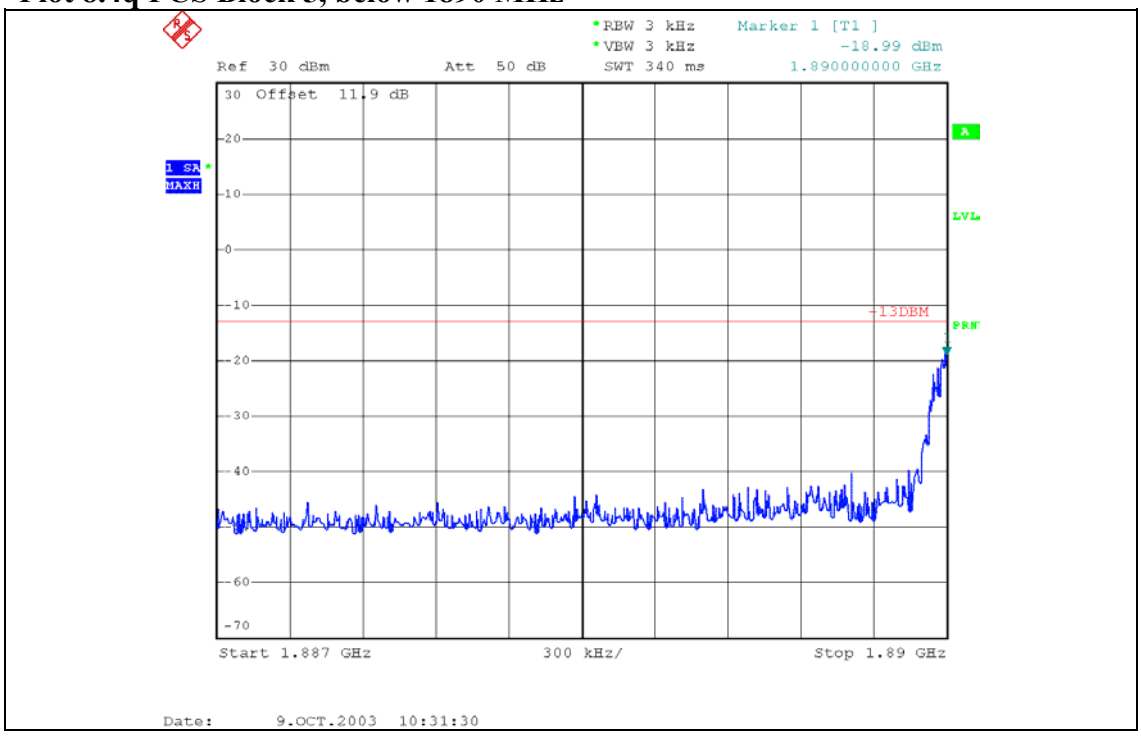
**Plot 8.4o PCS Block 4, below 1885 MHz**



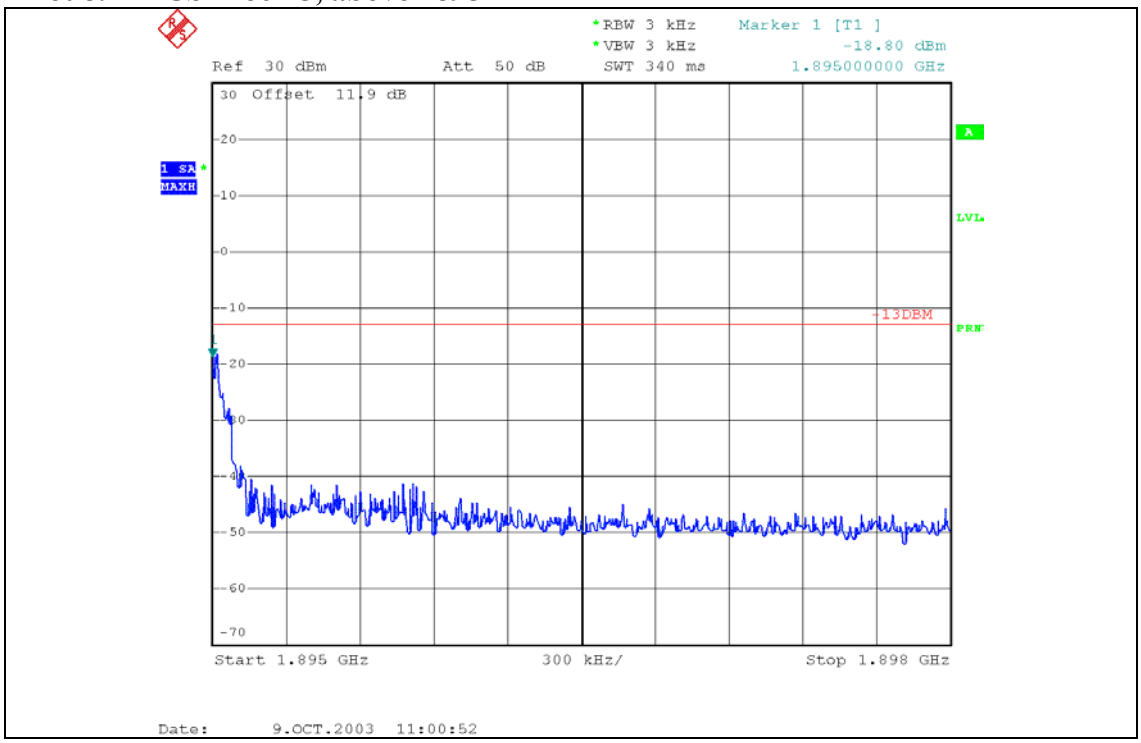

**Plot 8.4p PCS Block 4, above 1890 MHz**



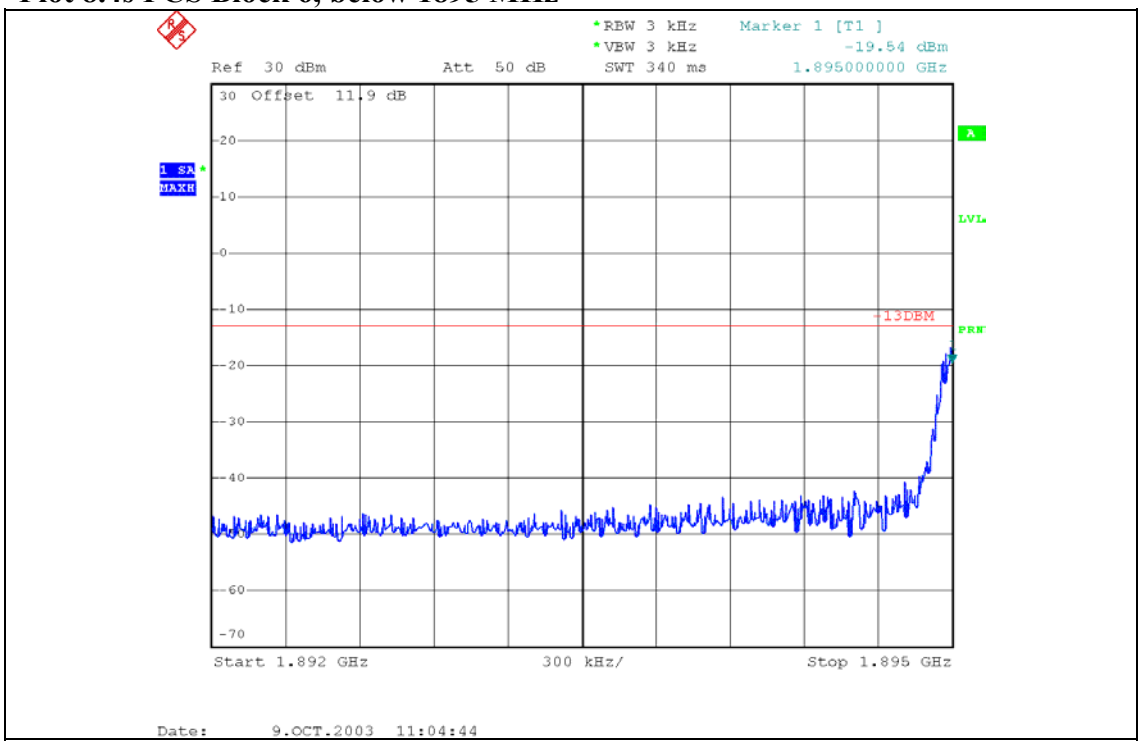
**Plot 8.4q PCS Block 5, below 1890 MHz**



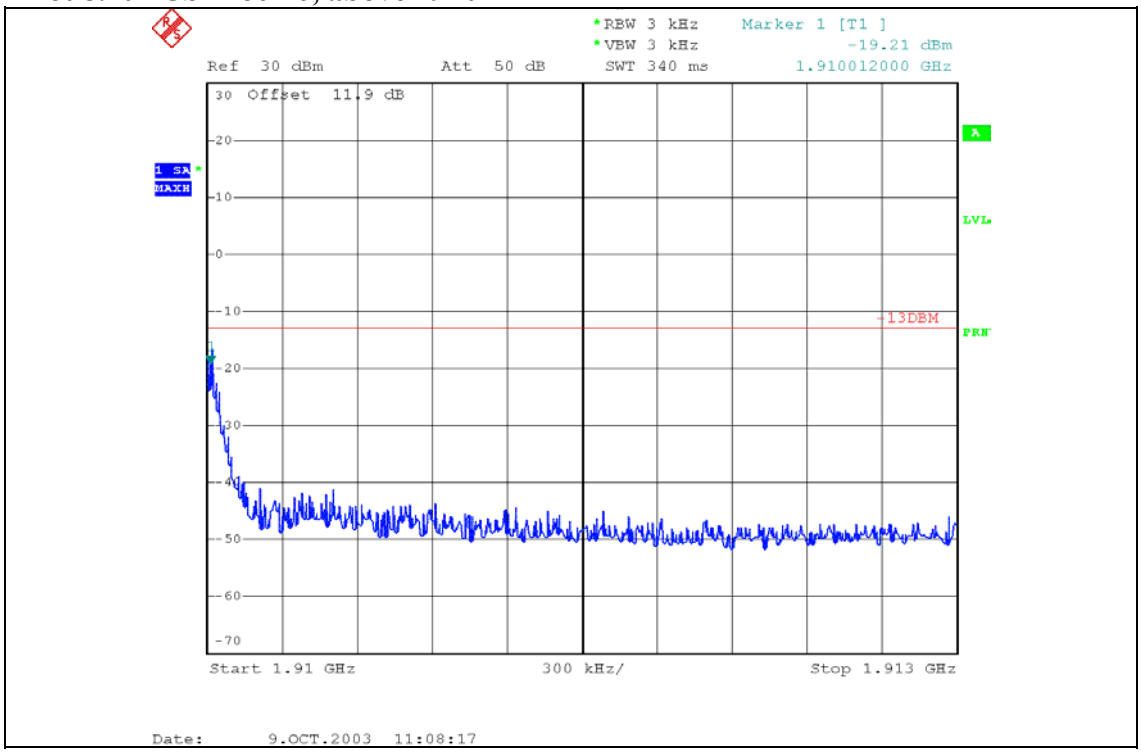

**Plot 8.4r PCS Block 5, above 1895 MHz**



**Plot 8.4s PCS Block 6, below 1895 MHz**




**Plot 8.4t PCS Block 6, above 1910 MHz**



# 8 Frequency Stability Versus Temperature

FCC 2.1055

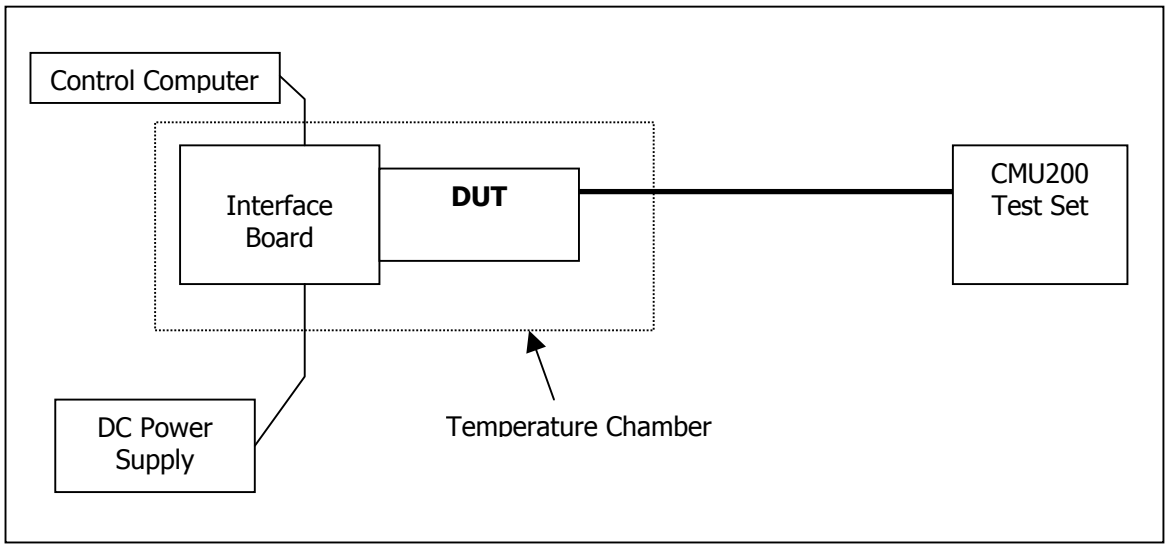
## *8.1 Summary of Results*

The AC755 Frequency Stability versus temperature meets the requirement of being within ±0.1ppm of the received base station frequency.

## *8.2 Test Procedure*

The AC755 was placed inside the temperature chamber. The transmitting frequency error is measured at 25 degrees C, then the temperature is set to +60 degrees C and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is decreased by 10 degrees, allowed to stabilize and soak, then the measurement is repeated. This is repeated until -20 degrees C is completed. The process is then repeated back up to +60 degrees C. Frequency metering included internal averaging of the CMU200 to stabilize the reading. Reference power supply voltage for these tests is 5.0 volts.

**Test Setup**

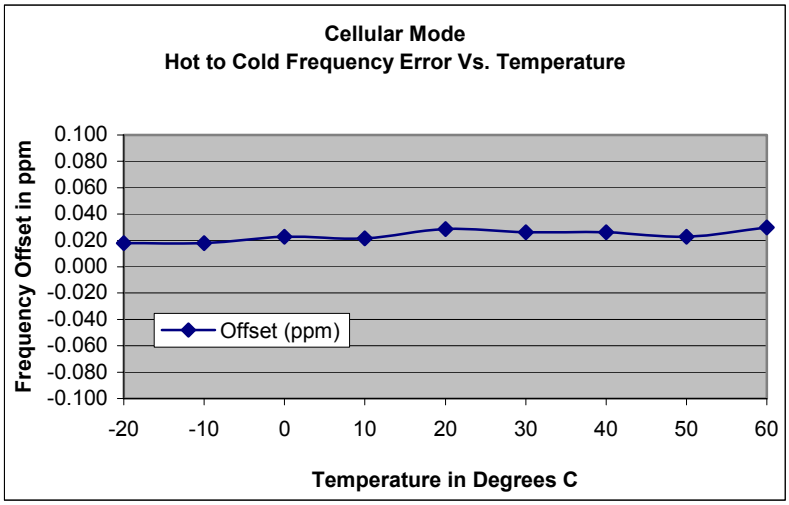


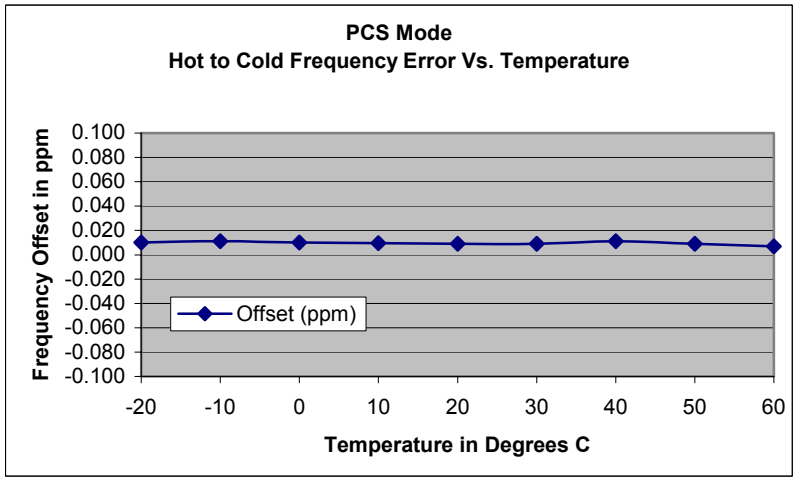

## *8.3 Test Equipment*

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE |
|---|---|---|---|---|
| Control Computer | TC | Generic PC | 100488 | N/A |
| Wireless Test Set | Rohde & Schwarz | CMU200 | 836766/030 | N/A |
| Spectrum Analyzer | Rohde & Schwarz | FSP 30GHz | US41421268 | Sept. 12, 2003 |
| DC Power Supply | HP | E3631A | 100060 | N/A |
| Interface Board | Shop built | Minnow | N/A | N/A |

### *8.4 Test Results*

High to Low Temperature Frequency Error

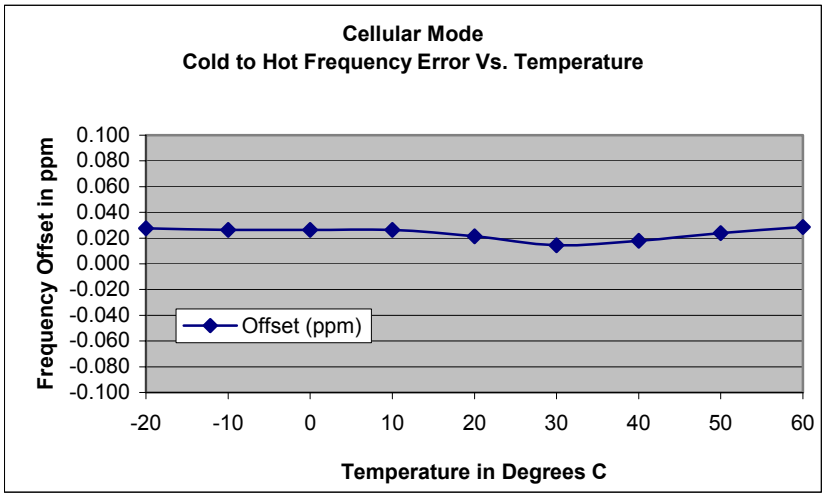


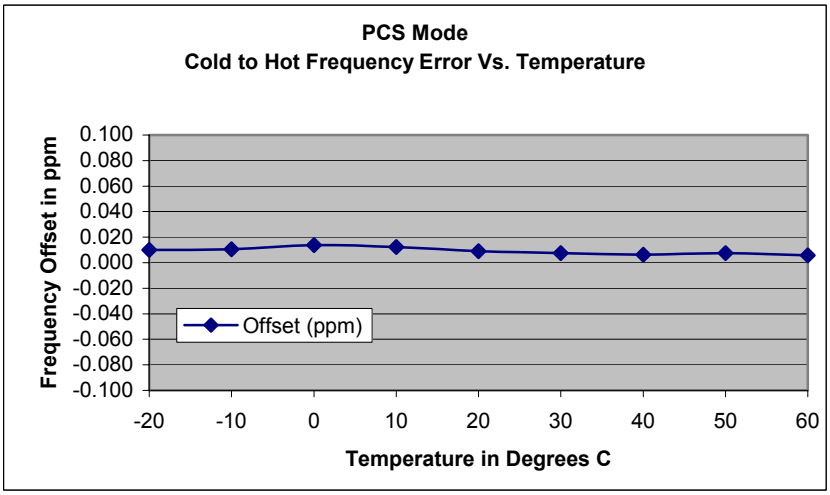




High to Low Temperature Tabular Readings

| | Cellular Mode | | PCS Mode | |
|---|---|---|---|---|
| Temp (C) | Offset (Hz) | Offset (ppm) | Offset (Hz) | Offset (ppm) |
| 60 | 25 | 0.030 | 13 | 0.007 |
| 50 | 19 | 0.023 | 17 | 0.009 |
| 40 | 22 | 0.026 | 21 | 0.011 |
| 30 | 22 | 0.026 | 17 | 0.009 |
| 20 | 24 | 0.029 | 17 | 0.009 |
| 10 | 18 | 0.022 | 18 | 0.010 |
| 0 | 19 | 0.023 | 19 | 0.010 |
| -10 | 15 | 0.018 | 21 | 0.011 |
| -20 | 15 | 0.018 | 19 | 0.010 |

Low to High Temperature Frequency Error




Low to High Temperature Tabular Readings

| | Cellular Mode | | PCS Mode | |
|---|---|---|---|---|
| Temp (C) | Offset (Hz) | Offset (ppm) | Offset (Hz) | Offset (ppm) |
| -20 | 23 | 0.027 | 19 | 0.010 |
| -10 | 22 | 0.026 | 20 | 0.011 |
| 0 | 22 | 0.026 | 26 | 0.014 |
| 10 | 22 | 0.026 | 23 | 0.012 |
| 20 | 18 | 0.022 | 17 | 0.009 |
| 30 | 12 | 0.014 | 14 | 0.007 |
| 40 | 15 | 0.018 | 12 | 0.006 |
| 50 | 20 | 0.024 | 14 | 0.007 |
| 60 | 24 | 0.029 | 11 | 0.006 |

# 9 Frequency Stability Versus Voltage

FCC 2.1055

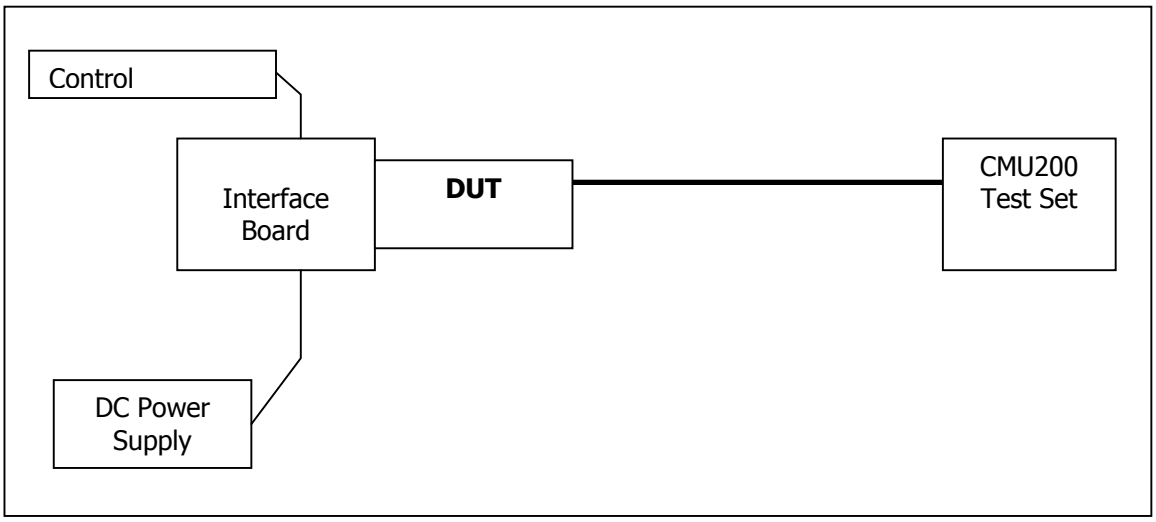
## *9.1 Summary of Results*

The unit meets the limit of less than 0.1ppm of frequency offset from center for 85% and 115% of the supply voltage for 5.0 volts.

## *9.2 Test Procedure*

The AC755 was connected to a DC Power Supply and a GSM test set (CMU 200) with frequency error measurement capability. The power supply output is adjusted to the test voltage as measured at the input terminals to the module while transmitting. A voltmeter was used to confirm the terminal voltage.
The test voltages are 4.25 volts to 5.75 volts.

**Test Setup**

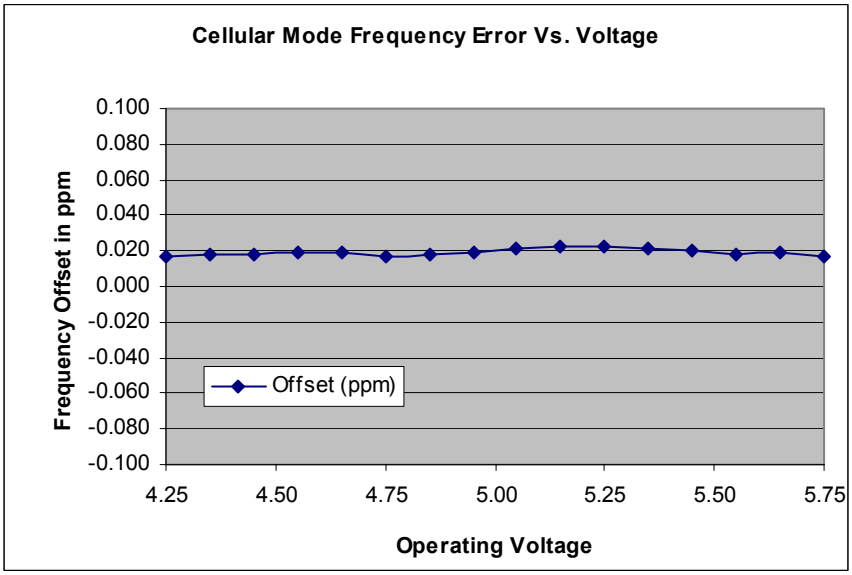


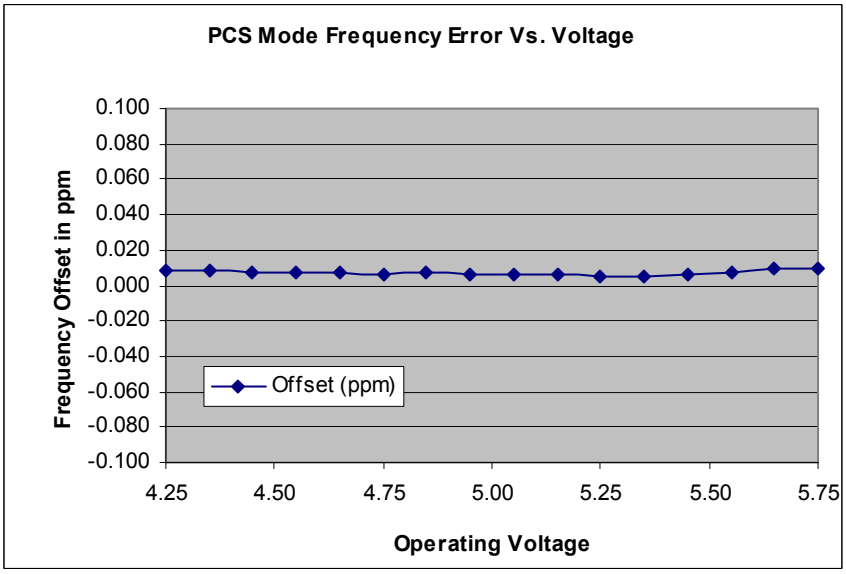

## *9.3 Test Equipment*

| EQUIPMENT | MANUFACTURER | MODEL NO. | SERIAL NO. | CAL. DATE |
|---|---|---|---|---|
| Control Computer | TC | Generic PC | 100488 | N/A |
| Wireless Test Set | Rohde & Schwarz | CMU200 | 836766/030 | N/A |
| Spectrum Analyzer | Rohde & Schwarz | FSP 30GHz | US41421268 | Sept. 12, 2003 |
| DC Power Supply | HP | E3631A | 100060 | N/A |
| Interface Board | Shop built | Minnow | N/A | N/A |

### *9.4 Test Results*

85% to 115% of 5 Volts Frequency Error



85% to 115% of 5 Volts Frequency Error, Tabular Data

| | Cellular Mode | | PCS Mode | |
|---|---|---|---|---|
| Supply (V) | Offset (Hz) | Offset (ppm) | Offset (Hz) | Offset (ppm) |
| 4.25 | 14 | 0.017 | 15 | 0.008 |
| 4.35 | 15 | 0.018 | 15 | 0.008 |
| 4.45 | 15 | 0.018 | 14 | 0.007 |
| 4.55 | 16 | 0.019 | 14 | 0.007 |
| 4.65 | 16 | 0.019 | 13 | 0.007 |
| 4.75 | 14 | 0.017 | 11 | 0.006 |
| 4.85 | 15 | 0.018 | 13 | 0.007 |
| 4.95 | 16 | 0.019 | 11 | 0.006 |
| 5.05 | 18 | 0.022 | 11 | 0.006 |
| 5.15 | 19 | 0.023 | 12 | 0.006 |
| 5.25 | 19 | 0.023 | 9 | 0.005 |
| 5.35 | 18 | 0.022 | 9 | 0.005 |
| 5.45 | 17 | 0.020 | 12 | 0.006 |
| 5.55 | 15 | 0.018 | 14 | 0.007 |
| 5.65 | 16 | 0.019 | 17 | 0.009 |
| 5.75 | 14 | 0.017 | 17 | 0.009 |