



**FCC CFR47 PART 22 SUBPART H  
AND PART 24 SUBPART E  
CLASS II PERMISSIVE CHANGE  
CERTIFICATION TEST REPORT**

**FOR**

**Express Mini-PCI USB Wireless CDMA Modem Module**

**MODEL NUMBER: MC5720**

**FCC ID: N7N-MC5720**

**REPORT NUMBER: 06U10280-1B**

**ISSUE DATE: MAY 23, 2006**

*Prepared for*  
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**2290 COSMOS CT.**  
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LAB CODE:200065-0

Revision History

| Rev. | Date      | Revisions   | Revised By |
|------|-----------|---|------------|
| --   | 5/16/2006 | Initial Release   | A. Ilarina |
| B    | 5/23/2006 | Revise sections 5.1, 5.2, and 5.6 to clearly reflect equipment. | A. Ilarina |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SIERRA WIRELESS  
2290 COSMOS CT.  
CARLSBAD, CA 92009, USA

**EUT DESCRIPTION:** Express Mini-PCI USB Wireless CDMA Modem Module

**MODEL NUMBER:** MC5720

**SERIAL NUMBER:** 1S666666XX00041

**DATE TESTED:** MAY 10-15, 2006

| APPLICABLE STANDARDS  |                         |
|-----------------------|-------------------------|
| STANDARD              | TEST RESULTS            |
| FCC PART 22 SUBPART H | NO NON-COMPLIANCE NOTED |
| FCC PART 24 SUBPART E | NO NON-COMPLIANCE NOTED |

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:




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ALVIN ILARINA  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

Tested By:




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CHIN PANG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA/EIA 603C (2004), ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 22H and 24E.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                           | UNCERTAINTY    |
|-------------------------------------|----------------|
| Radiated Emission, 30 to 200 MHz    | +/- 3.3 dB     |
| Radiated Emission, 200 to 1000 MHz  | +4.5 / -2.9 dB |
| Radiated Emission, 1000 to 2000 MHz | +4.5 / -2.9 dB |
| Power Line Conducted Emission       | +/- 2.9 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a dual band 800 / 1900MHz Express Mini-PCI USB Wireless CDMA Modem Module, and manufactured by Sierra Wireless, Inc.

### 5.2. CLASS II PERMISSIVE CHANGE DESCRIPTION

Change #1 – To change from a Limited Modular Approval, Mobile Condition to Limited Modular Approval, Portable Condition.

Change #2 – To change antenna from monopole to PIFA>. The PIFA antenna has lower gain compared to the monopole.

Change #3 – To change the co-location condition to co-located with WLAN module FCC ID: PD9LEN3945ABG.

Add ThinkPad Z60 Series (Z61m) with ABS Plastic Frame Laptop.

Add ThinkPad Z60 Series (Z61m) with Metal Frame Laptop.

Add ThinkPad Z60 Series (Z61t) with Aluminum/Titanium Laptop.

Add ThinkPad Z60 Series (Z61t) with Carbon Fiber Frame Laptop.

### 5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

824 to 849 MHz Authorized Band

| Frequency Range<br>(MHz) | Modulation | Conducted<br>Average Power<br>(dBm) | Conducted<br>Average Power<br>(mW) | Conducted<br>Peak Power<br>(dBm) | Conducted<br>Peak Power<br>(mW) |
|--------------------------|------------|-------------------------------------|------------------------------------|----------------------------------|---------------------------------|
| Low CH - 824.7           | 1 x EVDO   | 24.67                               | 293.09                             | 29.04                            | 801.68                          |
| Mid CH - 836.5           |            | 24.5                                | 281.84                             | 28.68                            | 737.90                          |
| High CH - 848.3          |            | 23.89                               | 244.91                             | 28.30                            | 676.08                          |

1850 to 1910 MHz Authorized Band

| Frequency Range<br>(MHz) | Modulation | Conducted<br>Average Power<br>(dBm) | Conducted<br>Average Power<br>(mW) | Conducted<br>Peak Power<br>(dBm) | Conducted<br>Peak Power<br>(mW) |
|--------------------------|------------|-------------------------------------|------------------------------------|----------------------------------|---------------------------------|
| Low CH - 1851.25         | 1 x EVDO   | 23.79                               | 239.33                             | 28.91                            | 778.04                          |
| Mid CH - 1880            |            | 23.08                               | 203.24                             | 28.82                            | 762.08                          |
| High CH - 1908.75        |            | 23.6                                | 229.09                             | 28.25                            | 668.34                          |

NOTE: RBW=VBW=3MHz.

### 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

ThinkPad Z60 Series (Z61m) with ABS Plastic Frame Laptop utilizes an inverted F antenna with a maximum gain of -0.76 dBi for the Cellular Band and 2.74 dBi for the PCS Band.

Add ThinkPad Z60 Series (Z61m) with Metal Frame Laptop utilizes an inverted F antenna with a maximum gain of 0.14 dBi for the Cellular Band and 2.68 dBi for the PCS Band.

The ThinkPad Z60 Series (Z61t) with Aluminum/Titanium Laptop utilizes an inverted F antenna with a maximum gain of 0.26 dBi for the Cellular Band and 0.13 dBi for the PCS Band.

The ThinkPad Z60 Series (Z61t) with Carbon Fiber Frame Laptop utilizes an inverted F antenna with a maximum gain of -.142 dBi for the Cellular Band and 0.30 dBi for the PCS Band.

## 5.5. SOFTWARE AND FIRMWARE

The EUT is linked with Agilent Communication Test Set.

## 5.6. WORST-CASE CONFIGURATION AND MODE

Pre-scan was performed on RF conducted port to determine the worst-case scenario:

| Cellular Band            | Avg. Output Power (dBm)<br>Mid CH | 99% BW (MHz)<br>Mid CH | 26 dB BW (MHz)<br>Mid CH | Band edge (dBm) |                |
|--------------------------|-----------------------------------|------------------------|--------------------------|-----------------|----------------|
|                          |                                   |                        |                          | Low CH          | High CH        |
| 1xRRT RC3, SO2           | 24.38                             | 1.2549                 | 1.394                    | -17.915         | -14.993        |
| 1xRRT RC3, SO32 (+F-SCH) | <b>24.63</b>                      | <b>1.2638</b>          | <b>1.396</b>             | <b>-16.942</b>  | <b>-14.463</b> |
| 1xRRT RC3, SO32 (+SCH)   | 24.58                             | 1.279                  | 1.394                    | -17.511         | -14.684        |
| 1xRRT RC3, SO55          | 24.55                             | 1.2749                 | 1.39                     | -17.216         | -14.97         |
| EVDO                     | 24.50                             | 1.2519                 | 1.39                     | -17.97          | -14.897        |

| PCS Band                 | Avg. Output Power (dBm)<br>Mid CH | 99% BW (MHz)<br>Mid CH | 26 dB BW (MHz)<br>Mid CH | Band edge (dBm) |                |
|--------------------------|-----------------------------------|------------------------|--------------------------|-----------------|----------------|
|                          |                                   |                        |                          | Low CH          | High CH        |
| 1xRRT RC3, SO2           | 24.35                             | 1.253                  | 1.403                    | -35.968         | -33.323        |
| 1xRRT RC3, SO32 (+F-SCH) | <b>24.54</b>                      | <b>1.270</b>           | <b>1.419</b>             | <b>-35.016</b>  | <b>-32.422</b> |
| 1xRRT RC3, SO32 (+SCH)   | 24.51                             | 1.261                  | 1.41                     | -35.869         | -32.894        |
| 1xRRT RC3, SO55          | 24.44                             | 1.263                  | 1.408                    | -35.509         | -32.5          |
| EVDO                     | 23.08                             | 1.253                  | 1.394                    | -36.878         | -33.473        |

Based on the above results from the different modulations, EVDO is determined to be the worst-case scenario for fundamental ERP /EIRP measurement and radiated spurious emissions tests; and 1xRRT RC3, SO32 (+F-SCH) to be the worst-case scenario for RF conducted band-edge and bandwidth tests.

The worst-case channel is determined as the channel with the highest output power. The highest measured output power was at mid channel for both bands.

The laptop used in the final configuration was the ThinkPad Z60 Series (Z61m) with Metal Frame. This worse case was determined by radiation characteristic measurements on each laptop and antenna combination.

## 5.7. DESCRIPTION OF TEST SETUP

### **SUPPORT EQUIPMENT**

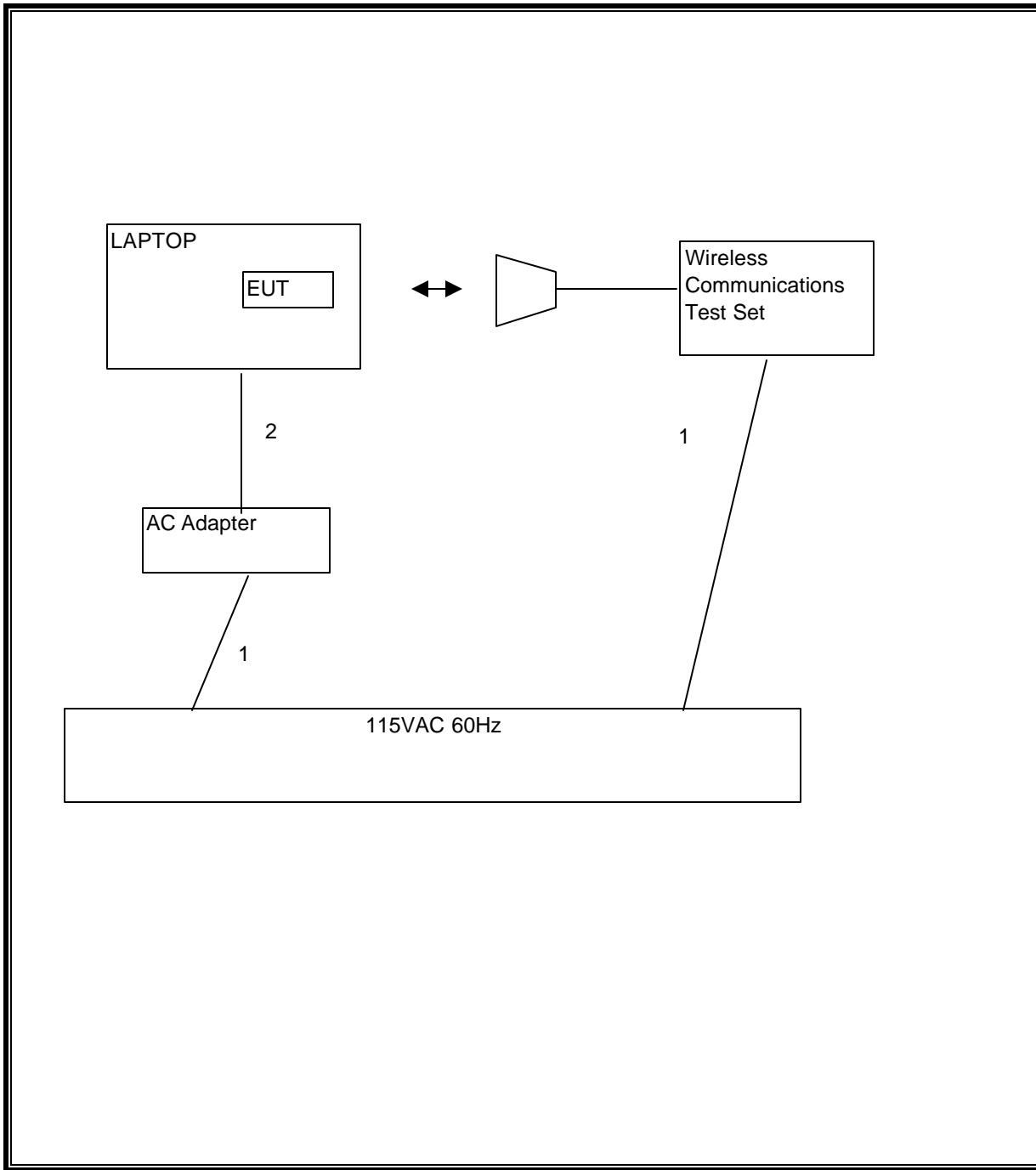
| PERIPHERAL SUPPORT EQUIPMENT LIST |              |               |                 |        |
|-----------------------------------|--------------|---------------|-----------------|--------|
| Description                       | Manufacturer | Model         | Serial Number   | FCC ID |
| Laptop                            | IBM          | ThinkPad Z61m | 1S666666XX00041 | DoC    |
| AC Adapter                        | IBM          | 92P1109       | 550003680H      | DoC    |

### **I/O CABLES**

| I/O CABLE LIST |      |                      |                |             |              |         |
|----------------|------|----------------------|----------------|-------------|--------------|---------|
| Cable No.      | Port | # of Identical Ports | Connector Type | Cable Type  | Cable Length | Remarks |
| 1              | AC   | 1                    | US 115V        | Un-shielded | 2m           | NA      |
| 2              | DC   | 1                    | DC             | Un-shielded | 2m           | NA      |

### **TEST SETUP**

The EUT is installed inside the Laptop during tests. The EUT is linked with Agilent Communication Test Set.

**SETUP DIAGRAM FOR TESTS**

## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST            |                |              |               |           |
|--------------------------------|----------------|--------------|---------------|-----------|
| Description                    | Manufacturer   | Model        | Serial Number | Cal Due   |
| Temperature / Humidity Chamber | Thermotron     | SE 600-10-10 | 8/2/1981      | 6/10/2006 |
| Antenna, Bilog 30 MHz ~ 2 Ghz  | Sunol Sciences | JB1          | A121003       | 9/3/06    |
| Antenna, Horn 1 ~ 18 GHz       | EMCO           | 3115         | 6717          | 4/22/07   |
| EMI Receiver, 9 kHz ~ 2.9 GHz  | Agilent / HP   | 8542E        | 3942A00286    | 2/4/07    |
| RF Filter Section              | Agilent / HP   | 85420E       | 3705A00256    | 2/4/07    |
| Peak Power Meter               | Agilent / HP   | E4416A       | GB41291160    | 12/2/07   |
| Peak / Average Power Sensor    | Agilent        | E9327A       | US40440755    | 12/2/07   |
| Antenna, Horn 1 ~ 18 GHz       | EMCO           | 3115         | 6717          | 4/22/07   |
| Signal Generator 2 -40 GHz     | R & S          | SMP04        | DE 34210      | 6/2/06    |
| Signal Generator 1024 MHz      | R & S          | SMY01        | DE 12311      | 5/11/07   |
| Dipole                         | EMCO           | 3121C-DB2    | 22435         | 5/7/06    |
| 2.7GHz HPF                     | MicroTronic    | HPM13194     | 2             | CNR       |
| 1.5GHz HPF                     | MicroTronic    | HPM13195     | 1             | CNR       |
| Communication Test Set         | Agilent        | E5515C       | 91936         | 4/8/07    |
| Power Splitter                 | HP             | 11667B       | 324           | CNR       |

## 7. LIMITS AND RESULTS

### 7.1. OCCUPIED BANDWIDTH

#### LIMIT

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the -26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal -26 dB bandwidth function is utilized.

#### RESULTS

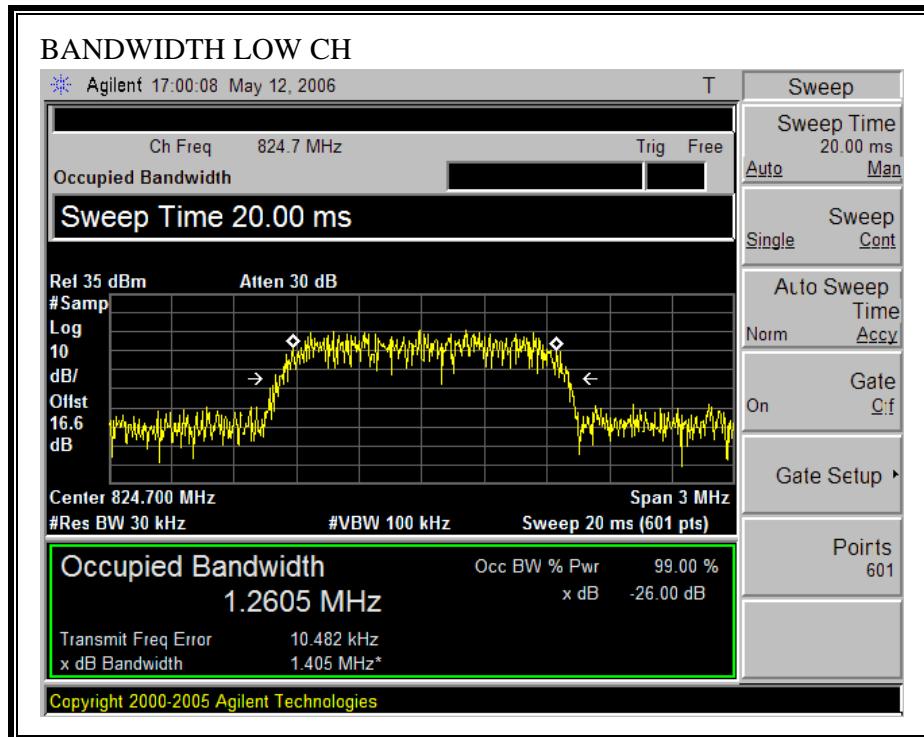
No non-compliance noted:

##### 800MHz CELL CDMA Modulation

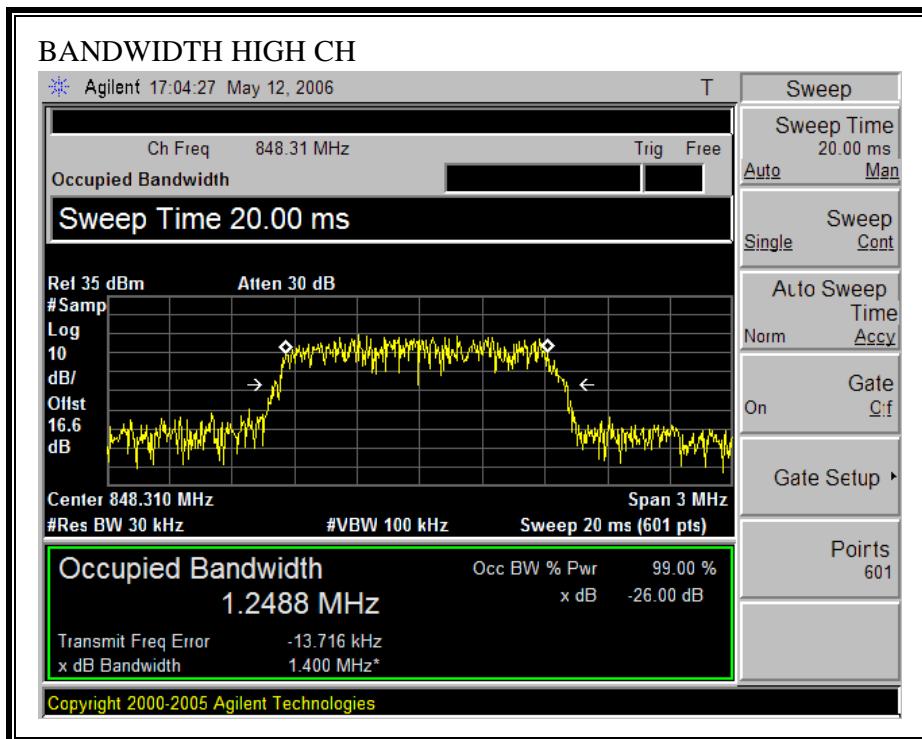
| Channel | Frequency (MHz) | Bandwidth (MHz) |
|---------|-----------------|-----------------|
| Low     | 824.70          | 1.405           |
| Middle  | 836.52          | 1.396           |
| High    | 848.31          | 1.400           |

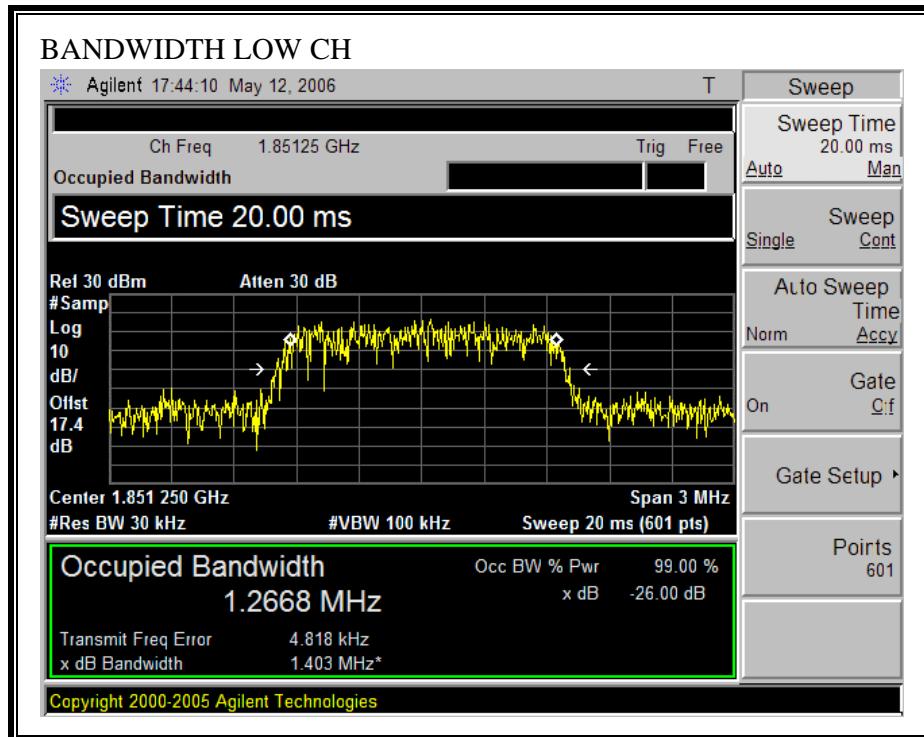
##### 1900MHz PCS Modulation

| Channel | Frequency (MHz) | Bandwidth (MHz) |
|---------|-----------------|-----------------|
| Low     | 1851.25         | 1.403           |
| Middle  | 1880.00         | 1.394           |
| High    | 1908.75         | 1.394           |

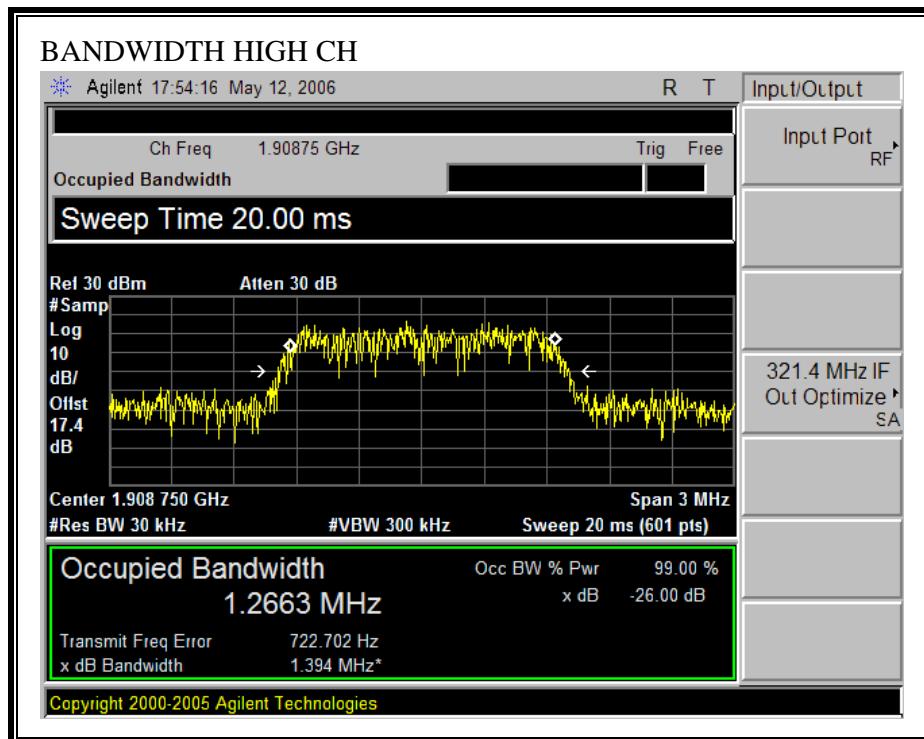
**800MHz CELLULAR 26 dB BANDWIDTH**





**1900MHz PCS 26 dB BANDWIDTH**





## 7.2. RF POWER OUTPUT

### LIMIT

22.913(a) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.  
24.232(b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

### TEST PROCEDURE

ANSI / TIA / EIA 603C Clause 2.2.17

### RESULTS

No non-compliance noted.

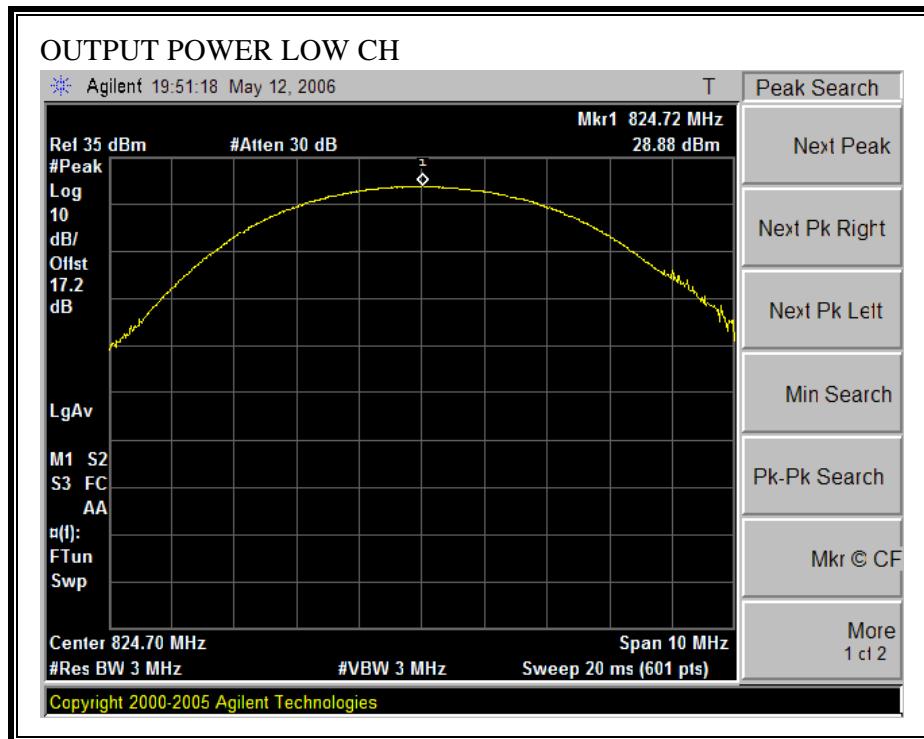
#### 800MHz CELL CDMA Modulation

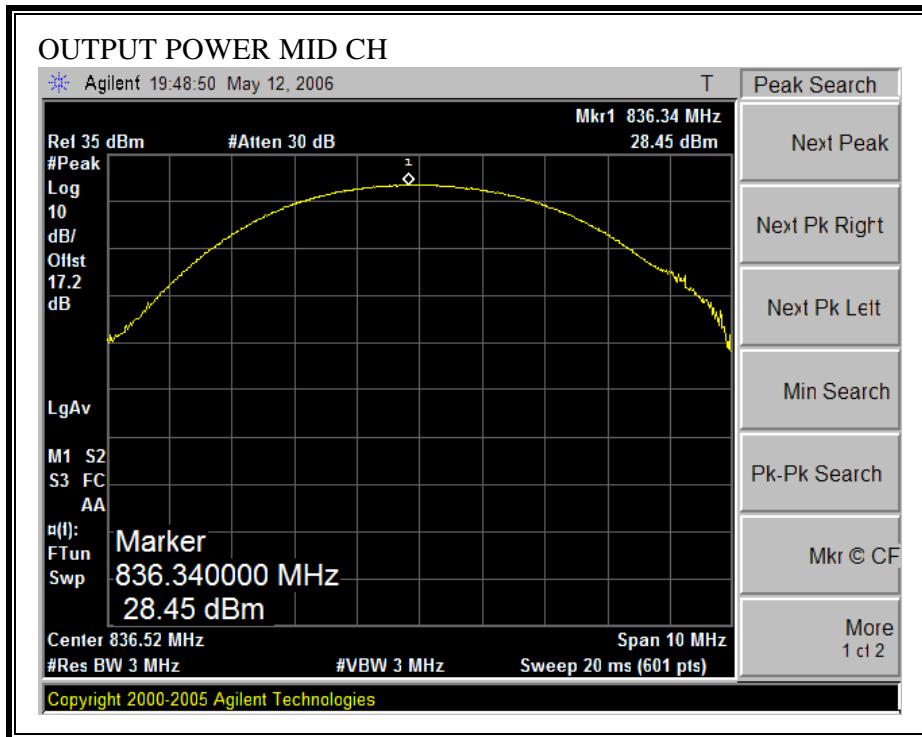
| Channel | Frequency<br>(MHz) | Conducted<br>Peak Power<br>(dBm) | Conducted<br>Peak Power<br>(mW) |
|---------|--------------------|----------------------------------|---------------------------------|
| Low     | 824.7              | 28.88                            | 772.68                          |
| Middle  | 836.5              | 28.45                            | 699.84                          |
| High    | 848.3              | 28.22                            | 663.74                          |

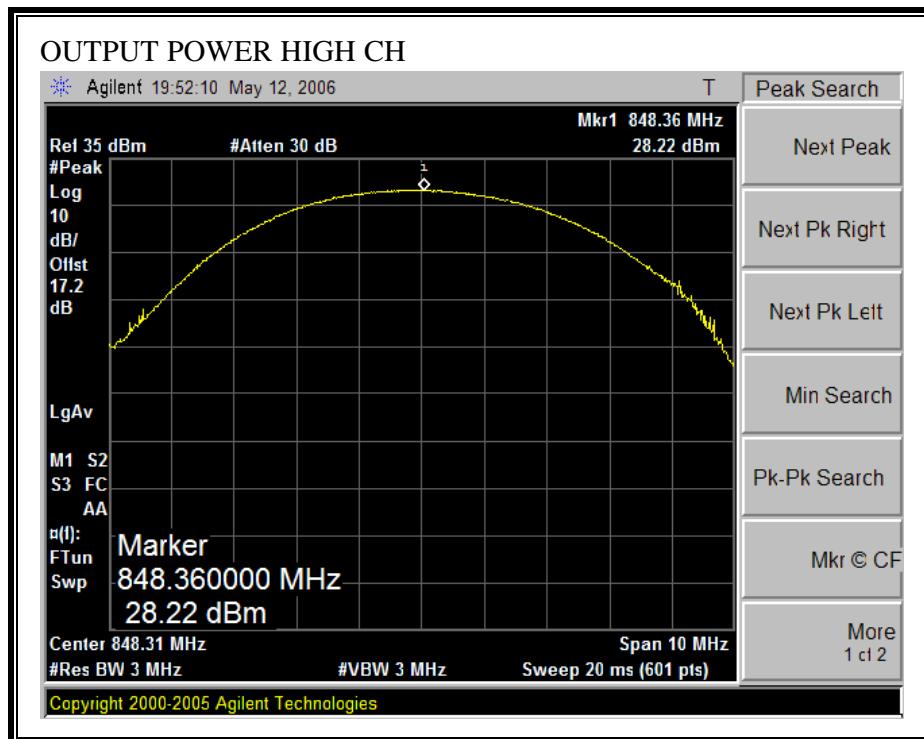
#### 1900MHz PCS Modulation

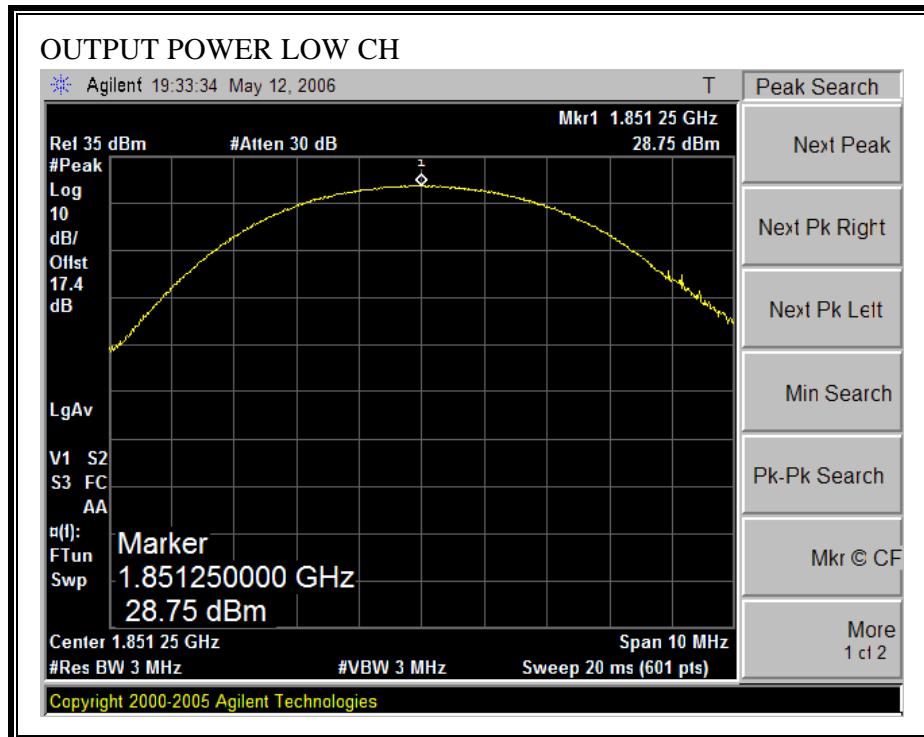
| Channel | Frequency<br>(MHz) | Conducted<br>Peak Power<br>(dBm) | Conducted<br>Peak Power<br>(mW) |
|---------|--------------------|----------------------------------|---------------------------------|
| Low     | 1851.25            | 28.75                            | 749.89                          |
| Middle  | 1880.00            | 28.80                            | 758.58                          |
| High    | 1908.75            | 28.20                            | 660.69                          |

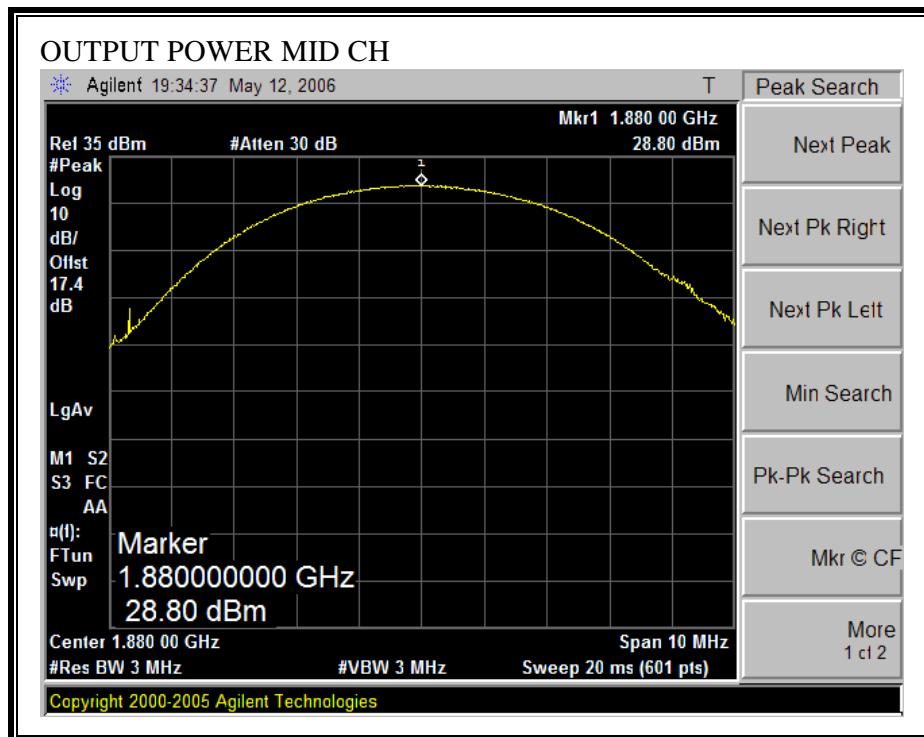
**NOTE: RBW=VBW=3MHz**

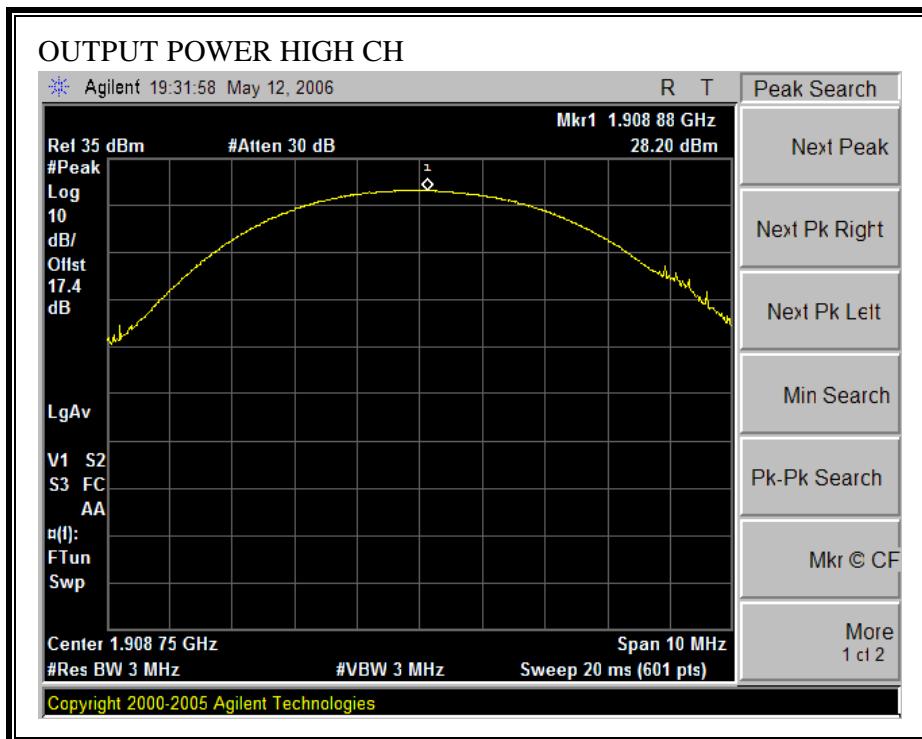
**800MHz CELLULAR (RF CONDUCTED OUTPUT POWER)**





**1900MHz PCS (RF CONDUCTED OUTPUT POWER)**





**Cellular Output Power (ERP)**

| f<br>MHz            | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBd) | ERP<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) | Notes |
|---------------------|------------------------|--------------------|---------------------|------------|---------------|--------------|----------------|----------------|-------|
| <b>Low Channel</b>  |                        |                    |                     |            |               |              |                |                |       |
| 824.7               | 100.2                  | V                  | 25.8                | 0.5        | 0.0           | 25.3         | 38.5           | -13.2          |       |
| 824.7               | 96.8                   | H                  | 22.5                | 0.5        | 0.0           | 22.0         | 38.5           | -16.4          |       |
| <b>Mid Channel</b>  |                        |                    |                     |            |               |              |                |                |       |
| 836.5               | 99.8                   | V                  | 25.2                | 0.6        | 0.0           | 24.6         | 38.5           | -13.8          |       |
| 836.5               | 96.5                   | H                  | 22.0                | 0.6        | 0.0           | 21.4         | 38.5           | -17.0          |       |
| <b>High Channel</b> |                        |                    |                     |            |               |              |                |                |       |
| 848.3               | 100.4                  | V                  | 25.8                | 0.7        | 0.0           | 25.1         | 38.5           | -13.3          |       |
| 848.3               | 97.0                   | H                  | 22.4                | 0.7        | 0.0           | 21.7         | 38.5           | -16.7          |       |

NOTE: EUT tested at worst antenna position with 0dBi reference dipole antenna, RBW=VBW=3MHz

**PCS Output Power (EIRP)**

| f<br>GHz            | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBi) | EIRP<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) | Notes |
|---------------------|------------------------|--------------------|---------------------|------------|---------------|---------------|----------------|----------------|-------|
| <b>Low Channel</b>  |                        |                    |                     |            |               |               |                |                |       |
| 1.850               | 92.7                   | V                  | 18.7                | 0.9        | 8.3           | 26.1          | 33.0           | -6.9           |       |
| 1.850               | 90.5                   | H                  | 14.5                | 0.9        | 8.3           | 21.9          | 33.0           | -11.1          |       |
| <b>Mid Channel</b>  |                        |                    |                     |            |               |               |                |                |       |
| 1.880               | 91.0                   | V                  | 17.9                | 0.9        | 8.3           | 25.3          | 33.0           | -7.7           |       |
| 1.880               | 90.3                   | H                  | 15.5                | 0.9        | 8.3           | 22.9          | 33.0           | -10.1          |       |
| <b>High Channel</b> |                        |                    |                     |            |               |               |                |                |       |
| 1.910               | 90.6                   | V                  | 17.3                | 0.9        | 8.4           | 24.8          | 33.0           | -8.2           |       |
| 1.910               | 89.0                   | H                  | 13.9                | 0.9        | 8.4           | 21.4          | 33.0           | -11.6          |       |

### 7.3. SPURIOUS EMISSION AT ANTENNA TERMINAL

#### LIMIT

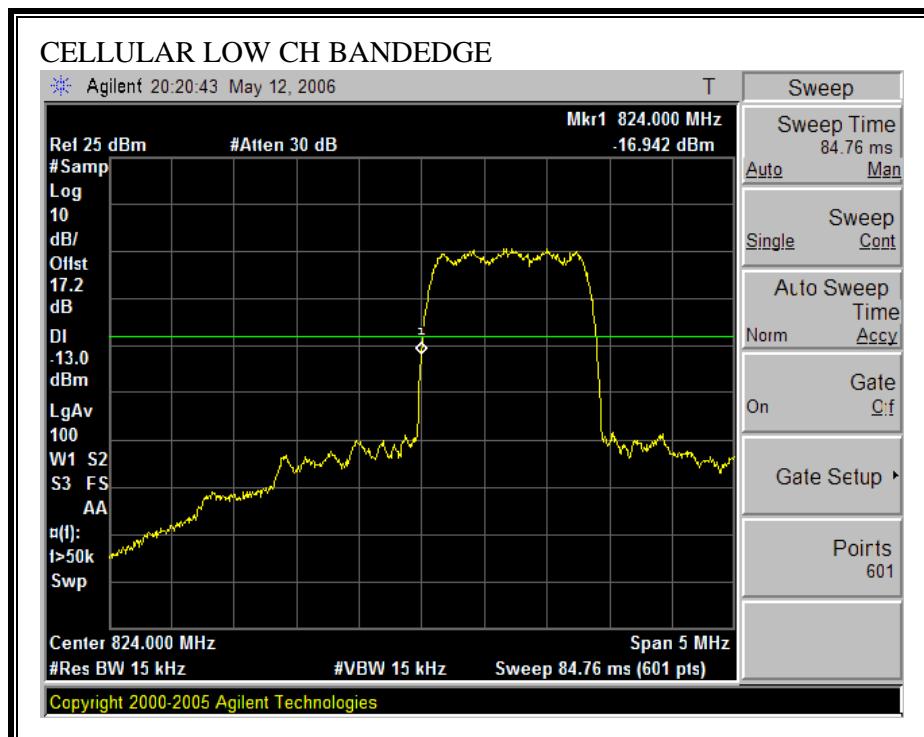
§22.917 (e) and §24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

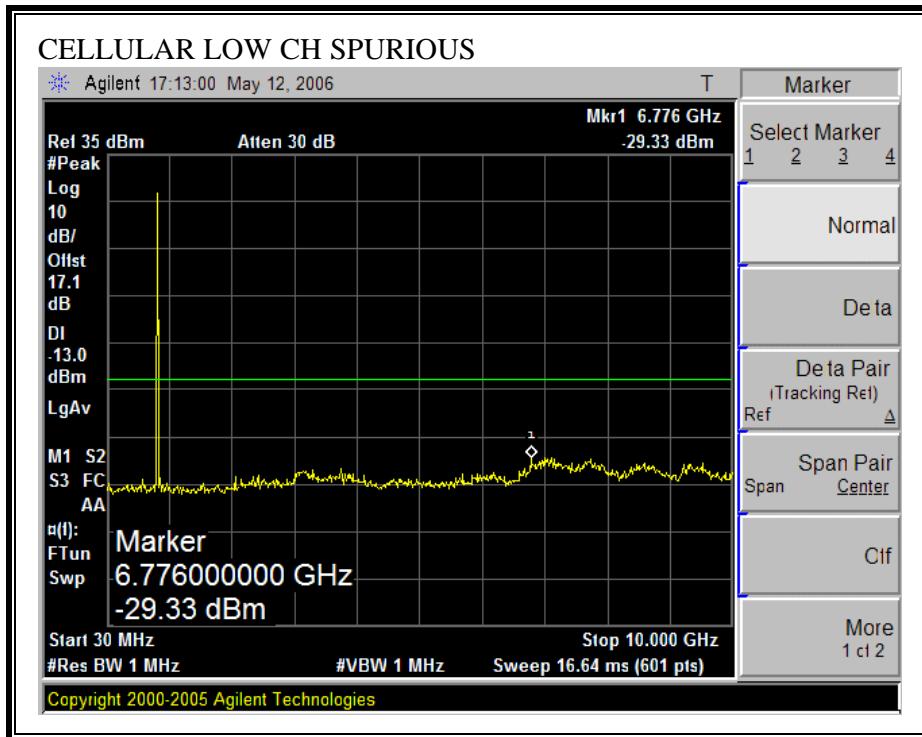
#### TEST PROCEDURE

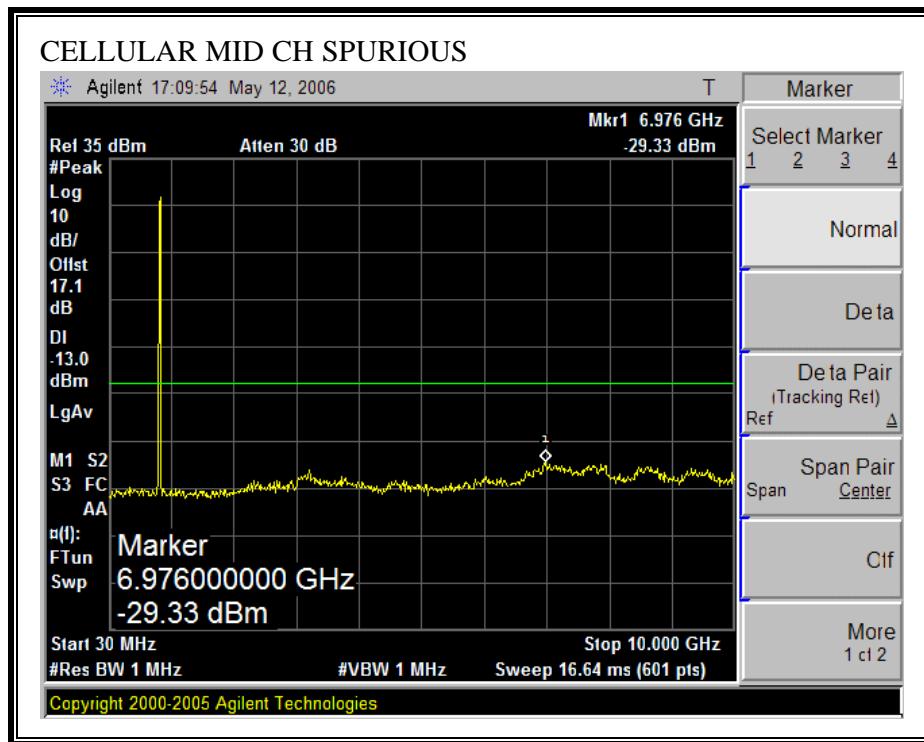
ANSI / TIA / EIA 603C Clause 2.2.12, FCC 22.917 (h), & FCC 24.238 (b)

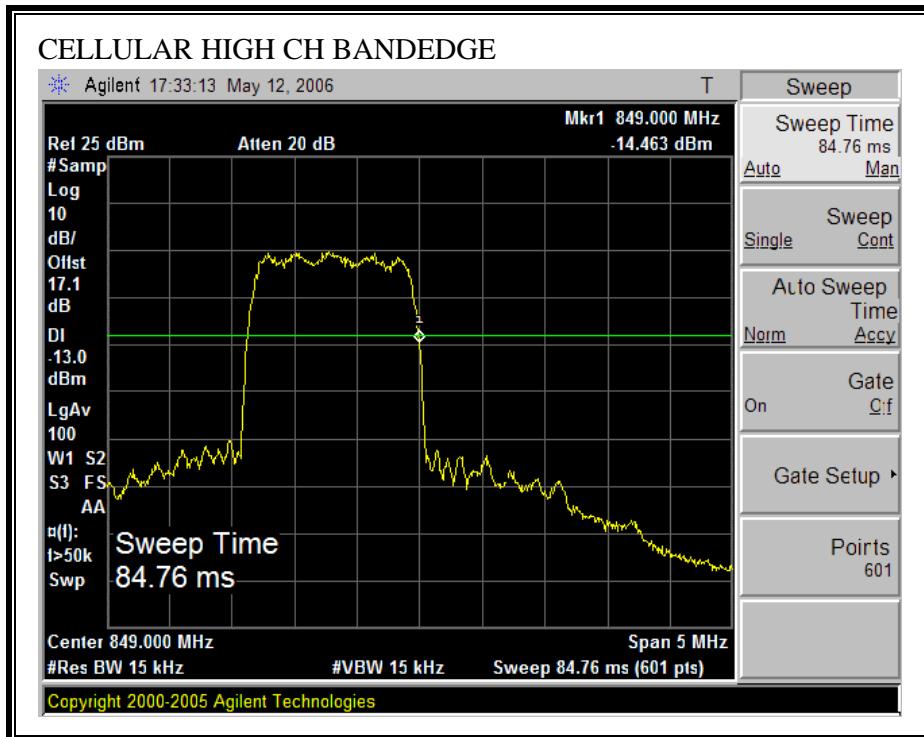
#### RESULTS

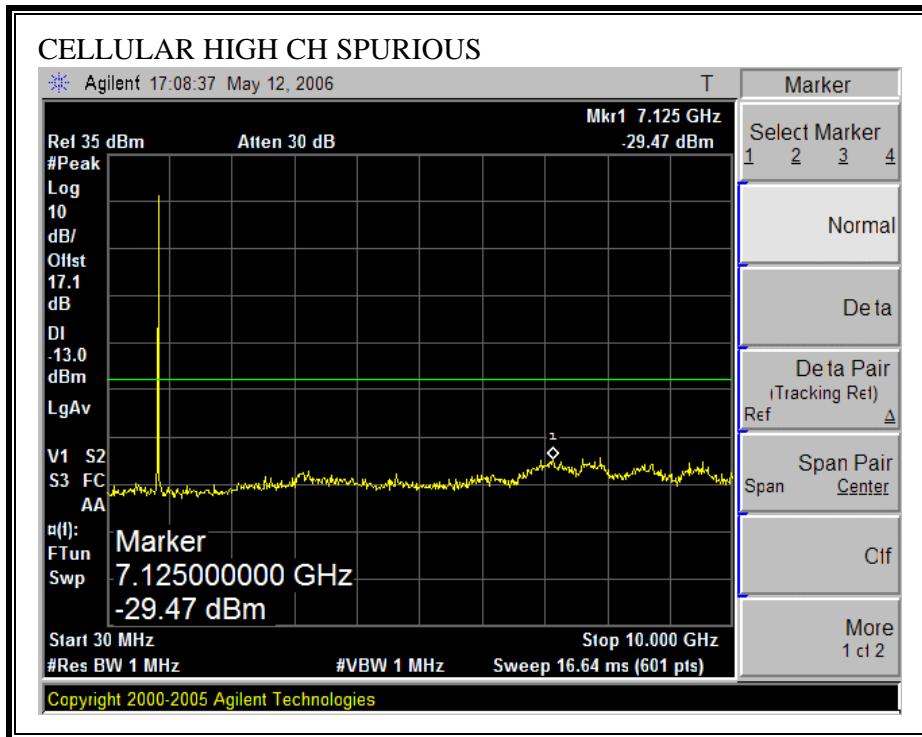
No non-compliance noted.

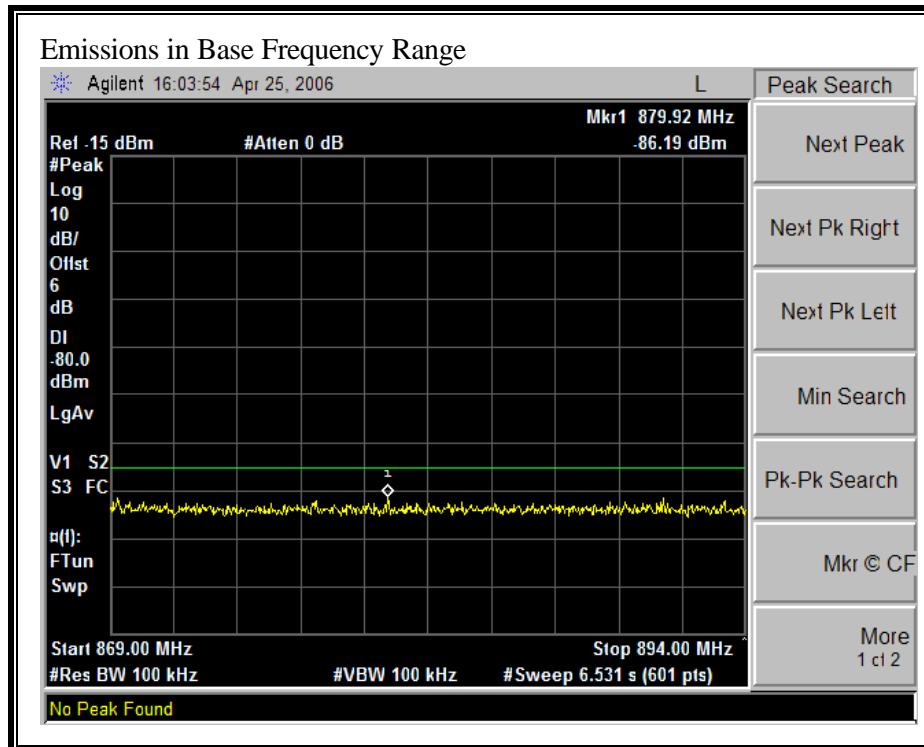
**800MHz CELLULAR**

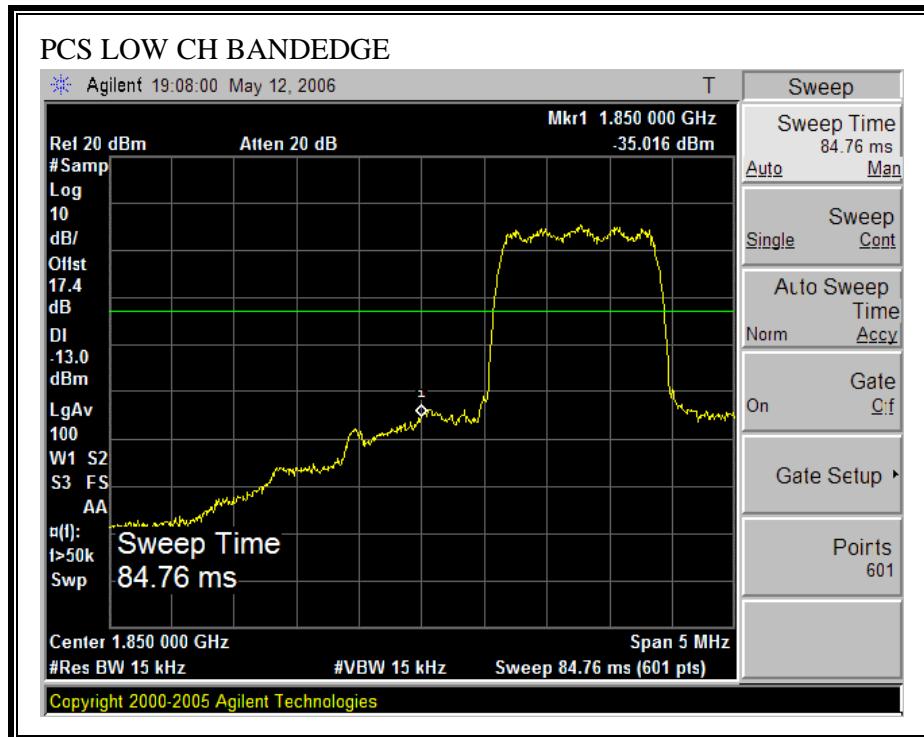


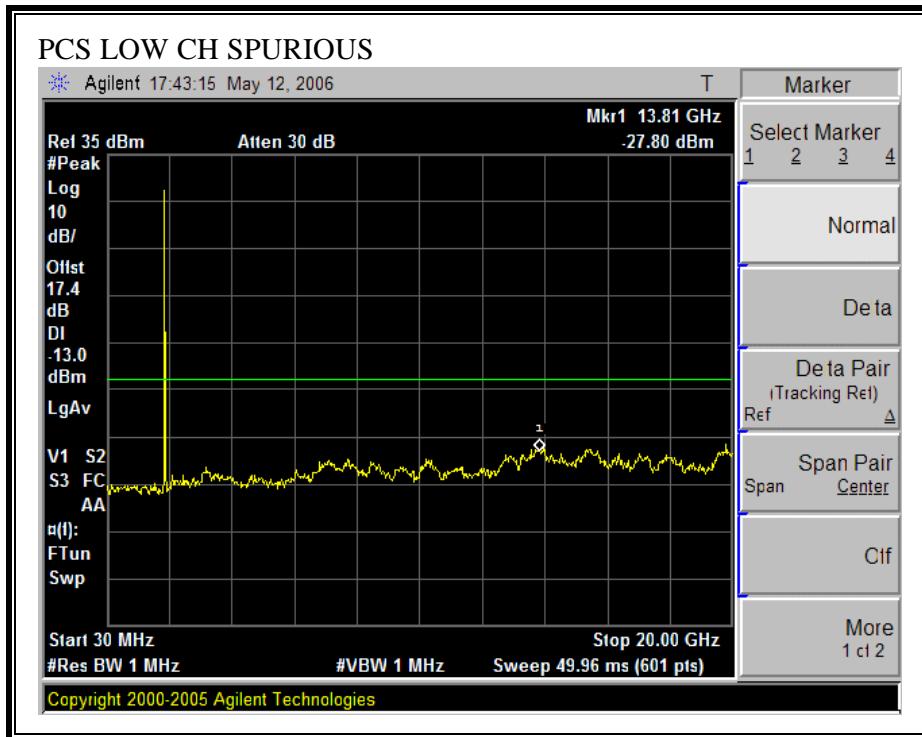


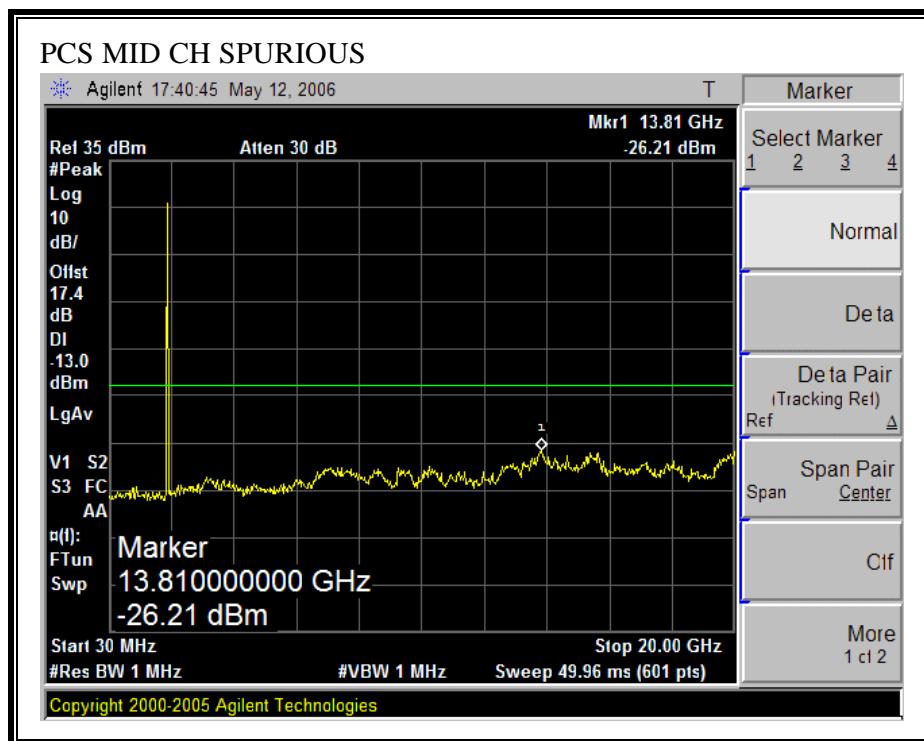


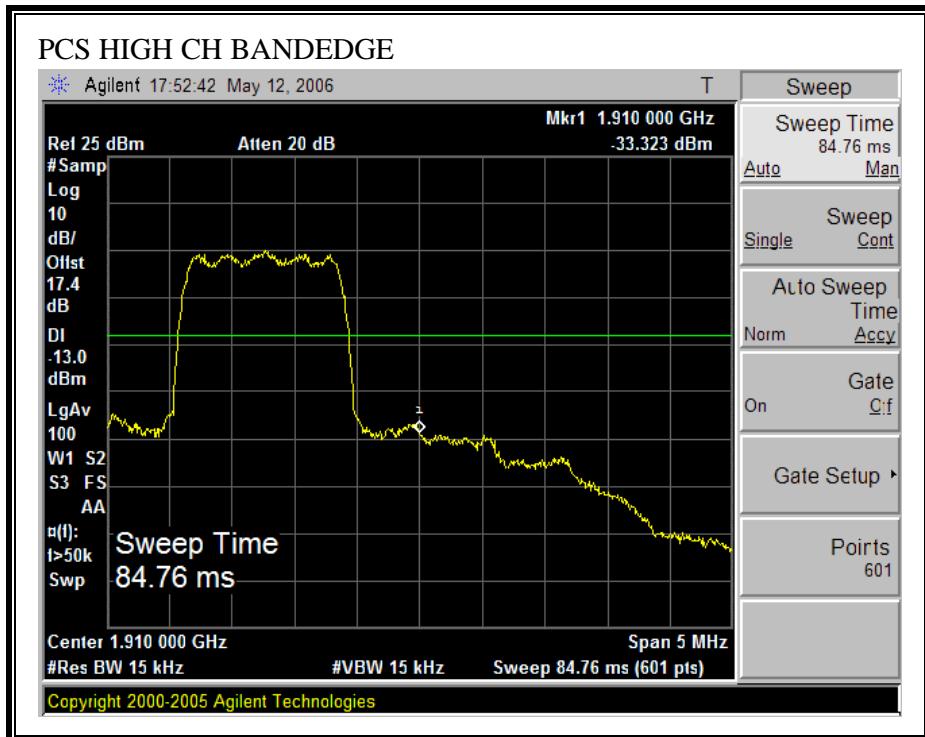


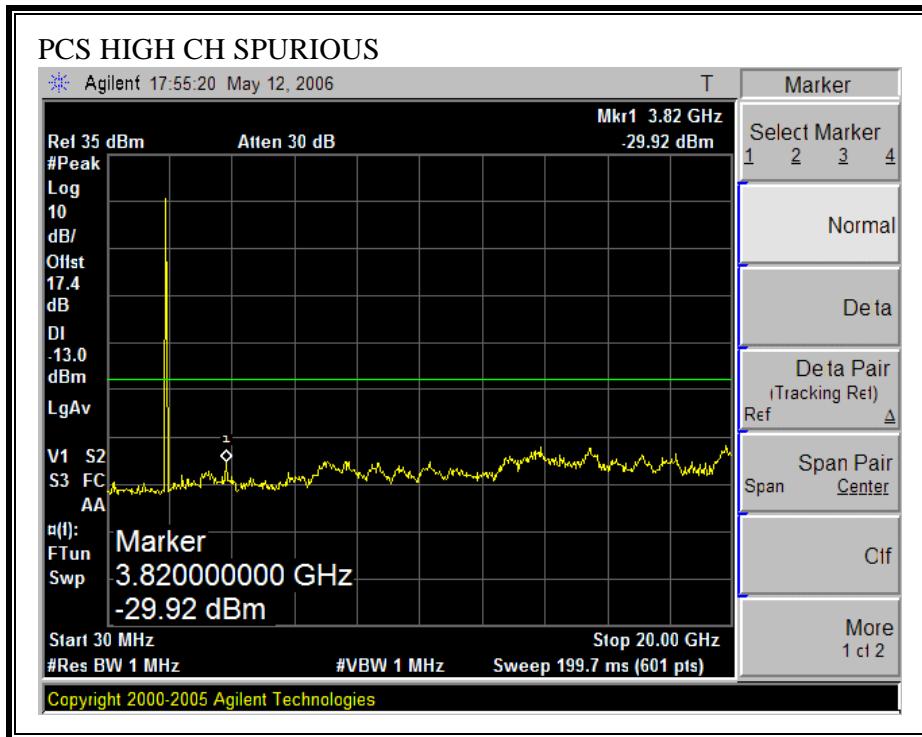
**800MHz Cellular Mobile Emissions in Base Frequency Range**

**1900MHZ PCS**









**7.4.****FIELD STRENGTH OF SPURIOUS RADIATION****LIMIT**

§22.917 (e) and §24.238 (a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log (P)$  dB.

**TEST PROCEDURE**

ANSI / TIA / EIA 603C Clause 2.2.12, FCC 22.917 (h), & FCC 24.238 (b)

**RESULTS**

No non-compliance noted.

Note: No emissions were found within 30-1000MHz of 20dB below the system noise.

## 800MHz Band CDMA Spurious &amp; Harmonic (ERP)

| Cellular Harmonic Substitution Measurement<br>Compliance Certification Services, Morgan Hill Immunity Chamber   |                        |                    |                     |            |               |              |                |                |       |
|---|------------------------|--------------------|---------------------|------------|---------------|--------------|----------------|----------------|-------|
| <b>Company:</b> Sierra Wireless Inc.<br><b>Project #:</b> 06U10280<br><b>Date:</b> 5/14/2006<br><b>Test Engineer:</b> Chin Pang<br><b>Configuration:</b> EUT Only<br><b>Mode:</b> CDMA 1xRTT RC3        |                        |                    |                     |            |               |              |                |                |       |
| <b>Test Equipment:</b><br><b>Receiving:</b> Horn T59, Pre-amp T34, Chin SMA Cables 2 & 12 ft (Setup this one for testing EUT)<br><b>Substitution:</b> Horn T60, 6ft SMA Cable Warehouse S/N: 208947 002 |                        |                    |                     |            |               |              |                |                |       |
| f<br>GHz  | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBd) | ERP<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) | Notes |
| <b>Low Channel (824.7MHz)</b>   |                        |                    |                     |            |               |              |                |                |       |
| 1.649   | 55.7                   | V                  | -57.6               | 0.8        | 4.9           | -53.5        | -13.0          | -40.5          |       |
| 2.474   | 51.5                   | V                  | -58.9               | 1.0        | 7.1           | -52.7        | -13.0          | -39.7          |       |
| 3.299   | 50.0                   | V                  | -55.5               | 1.2        | 7.3           | -49.4        | -13.0          | -36.4          |       |
| 4.124   | 45.8                   | V                  | -59.7               | 1.3        | 7.8           | -53.2        | -13.0          | -40.2          |       |
| 1.649   | 53.2                   | H                  | -61.1               | 0.8        | 4.9           | -57.0        | -13.0          | -44.0          |       |
| 2.474   | 54.5                   | H                  | -56.2               | 1.0        | 7.1           | -50.0        | -13.0          | -37.0          |       |
| 3.299   | 59.7                   | H                  | -47.7               | 1.2        | 7.3           | -41.6        | -13.0          | -28.6          |       |
| 4.124   | 46.3                   | H                  | -59.4               | 1.3        | 7.8           | -53.0        | -13.0          | -40.0          |       |
| <b>Mid Channel (830.52MHz)</b>  |                        |                    |                     |            |               |              |                |                |       |
| 1.673   | 54.6                   | V                  | -58.5               | 0.8        | 5.0           | -54.3        | -13.0          | -41.3          |       |
| 2.510   | 57.3                   | V                  | -52.1               | 1.0        | 7.1           | -46.0        | -13.0          | -33.0          |       |
| 3.346   | 51.0                   | V                  | -55.8               | 1.2        | 7.3           | -49.6        | -13.0          | -36.6          |       |
| 4.183   | 47.6                   | V                  | -57.9               | 1.4        | 7.9           | -51.4        | -13.0          | -38.4          |       |
| 1.673   | 56.0                   | H                  | -58.2               | 0.8        | 5.0           | -54.0        | -13.0          | -41.0          |       |
| 2.510   | 58.5                   | H                  | -52.8               | 1.0        | 7.1           | -46.4        | -13.0          | -33.4          |       |
| 3.346   | 47.6                   | H                  | -60.0               | 1.2        | 7.3           | -53.8        | -13.0          | -40.8          |       |
| 4.183   | 45.3                   | H                  | -60.2               | 1.4        | 7.9           | -53.7        | -13.0          | -40.7          |       |
| <b>High Channel (848.31MHz)</b>   |                        |                    |                     |            |               |              |                |                |       |
| 1.697   | 56.0                   | V                  | -56.9               | 0.8        | 5.1           | -52.6        | -13.0          | -39.6          |       |
| 2.545   | 53.6                   | V                  | -55.2               | 1.0        | 7.1           | -49.0        | -13.0          | -36.0          |       |
| 3.393   | 52.0                   | V                  | -54.5               | 1.2        | 7.4           | -48.3        | -13.0          | -35.3          |       |
| 4.242   | 47.7                   | V                  | -58.2               | 1.4        | 8.0           | -51.6        | -13.0          | -38.6          |       |
| 1.697   | 54.8                   | H                  | -58.9               | 0.8        | 5.1           | -54.6        | -13.0          | -41.6          |       |
| 2.545   | 56.6                   | H                  | -54.7               | 1.0        | 7.1           | -48.6        | -13.0          | -35.6          |       |
| 3.393   | 49.8                   | H                  | -57.8               | 1.2        | 7.4           | -51.6        | -13.0          | -38.6          |       |
| 4.242   | 46.0                   | H                  | -59.3               | 1.4        | 8.0           | -52.7        | -13.0          | -39.7          |       |
| Note: No other emissions were detected above the system noise floor.  |                        |                    |                     |            |               |              |                |                |       |

PCS Spurious & Harmonic (EIRP):

| PCS Harmonic Substitution Measurement<br>Compliance Certification Services, Morgan Hill Immunity Chamber |                        |                    |                     |            |               |               |                |                |       |
|--|------------------------|--------------------|---------------------|------------|---------------|---------------|----------------|----------------|-------|
| f<br>GHz   | SA reading<br>(dBuV/m) | Ant. Pol.<br>(H/V) | SG reading<br>(dBm) | CL<br>(dB) | Gain<br>(dBi) | EIRP<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) | Notes |
| <b>Low Channel (1851.25MHz)</b>  |                        |                    |                     |            |               |               |                |                |       |
| 3.703  | 58.8                   | V                  | -46.3               | 1.2        | 9.7           | -37.8         | -13.0          | 24.8           |       |
| 5.554  | 61.4                   | V                  | -41.1               | 1.6        | 11.0          | -31.7         | -13.0          | 18.7           |       |
| 7.405  | 51.0                   | V                  | -48.6               | 1.9        | 12.0          | -38.5         | -13.0          | 25.5           |       |
| 3.703  | 54.6                   | H                  | -51.9               | 1.2        | 9.7           | -43.5         | -13.0          | 30.5           |       |
| 5.554  | 58.3                   | H                  | -43.7               | 1.6        | 11.0          | -34.3         | -13.0          | 21.3           |       |
| 7.405  | 52.0                   | H                  | -46.7               | 1.9        | 12.0          | -36.6         | -13.0          | 23.6           |       |
| <b>Mid Channel (1880MHz)</b>   |                        |                    |                     |            |               |               |                |                |       |
| 3.760  | 56.0                   | V                  | -48.5               | 1.3        | 9.7           | -40.1         | -13.0          | 27.1           |       |
| 5.640  | 58.3                   | V                  | -44.5               | 1.7        | 11.2          | -35.0         | -13.0          | 22.0           |       |
| 7.520  | 54.8                   | V                  | -45.6               | 1.9        | 12.0          | -38.8         | -13.0          | 22.5           |       |
| 3.760  | 54.0                   | H                  | -52.1               | 1.3        | 9.7           | -43.6         | -13.0          | 30.6           |       |
| 5.640  | 55.5                   | H                  | -46.4               | 1.7        | 11.2          | -36.9         | -13.0          | 23.9           |       |
| 7.520  | 53.8                   | H                  | -45.3               | 1.9        | 12.0          | -35.2         | -13.0          | 22.2           |       |
| <b>High Channel (1908.75MHz)</b>   |                        |                    |                     |            |               |               |                |                |       |
| 3.818  | 53.2                   | V                  | -51.0               | 1.3        | 9.7           | -42.6         | -13.0          | 29.6           |       |
| 5.726  | 62.7                   | V                  | -39.8               | 1.7        | 11.3          | -30.2         | -13.0          | 17.2           |       |
| 7.635  | 56.5                   | V                  | -43.5               | 1.9        | 12.0          | -33.3         | -13.0          | 20.3           |       |
| 3.818  | 54.0                   | H                  | -51.4               | 1.3        | 9.7           | -42.9         | -13.0          | 29.9           |       |
| 5.726  | 55.0                   | H                  | -47.2               | 1.7        | 11.3          | -37.6         | -13.0          | 24.6           |       |
| 7.635  | 51.5                   | H                  | -47.4               | 1.9        | 12.0          | -37.3         | -13.0          | 24.3           |       |

Note: No other emissions were detected above the system noise floor.

## 7.5. MAXIMUM PERMISSIBLE EXPOSURE

### LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range (MHz)                                   | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| (A) Limits for Occupational/Controlled Exposures        |                               |                               |                                     |                          |
| 0.3–3.0 .....   | 614                           | 1.63                          | *(100)                              | 6                        |
| 3.0–30 .....  | 1842/f                        | 4.89/f                        | *(900/f <sup>2</sup> )              | 6                        |
| 30–300 .....  | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300–1500 .....  | .....                         | .....                         | f/300                               | 6                        |
| 1500–100,000 .....                                      | .....                         | .....                         | 5                                   | 6                        |
| (B) Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
| 0.3–1.34 .....  | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34–30 .....   | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

| Frequency range (MHz) | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|-----------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| 30–300 .....          | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300–1500 .....        | .....                         | .....                         | f/1500                              | 30                       |
| 1500–100,000 .....    | .....                         | .....                         | 1.0                                 | 30                       |

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

**CALCULATIONS**

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$$d = \sqrt{(30 * P * G) / (3770 * S)}$$

Changing to units of Power to mW and Distance to cm, using:

$$P (\text{mW}) = P (\text{W}) / 1000 \text{ and}$$

$$d (\text{cm}) = 100 * d (\text{m})$$

yields

$$d = 100 * \sqrt{(30 * (P / 1000) * G) / (3770 * S)}$$

$$d = 0.282 * \sqrt{(P * G / S)}$$

where

d = distance in cm

P = Power in mW

G = Numeric antenna gain

S = Power Density in mW/cm<sup>2</sup>

Substituting the logarithmic form of power and gain using:

$$P (\text{mW}) = 10^{(P (\text{dBm}) / 10)} \text{ and}$$

$$G (\text{numeric}) = 10^{(G (\text{dBi}) / 10)}$$

yields

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S} \quad \text{Equation (1)}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

Equation (1) and the measured peak power is used to calculate the MPE distance.

**LIMITS**

From §1.1310 Table 1 (B), S = 1.0 mW/cm<sup>2</sup>

**RESULTS**

No non-compliance noted: (MPE distance equals 20 cm)

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

| Mode           | MPE Distance (cm) | Output Power (dBm) | Antenna Gain (dBi) | Power Density (mW/cm <sup>2</sup> ) |
|----------------|-------------------|--------------------|--------------------|-------------------------------------|
| 800MHz Celllar | 20.0              | 28.88              | 5.10               | 0.497                               |
| 1900 MHz PCS   | 20.0              | 28.80              | 4.15               | 0.392                               |

## 7.6. FREQUENCY STABILITY

### LIMIT

§22.355 Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C-1 of this section.

For Mobile devices operating in the 824 to 849 MHz band at a power level less than or equal to 3 Watts, the limit specified in Table C-1 is +/- 2.5 ppm.

§24.235 The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

### TEST PROCEDURE

ANSI / TIA / EIA 603C Clause 2.3.1 and 2.3.2

### RESULTS

No non-compliance noted.

800MHz CELLULAR – MID CHANNEL

| Reference Frequency: Cellular Mid Channel 835.843716MHz @ 20*C<br>Limit: to stay +- 2.5 ppm = 2089.563 Hz |                              |   |             |             |
|---|------------------------------|---|-------------|-------------|
| Power Supply (Vdc)  | Environment Temperature (*C) | Frequency Deviation Measured with Time Elapse |             |             |
|   |                              | (MHz)   | Delta (ppm) | Limit (ppm) |
| 3.60  | 50                           | 835.825028                                    | 0.266       | 2.5         |
| 3.60  | 40                           | 835.825215                                    | 0.042       | 2.5         |
| 3.60  | 30                           | 835.825092                                    | 0.189       | 2.5         |
| <b>3.60</b>   | <b>20</b>                    | <b>835.825250</b>                             | <b>0</b>    | 2.5         |
| 3.60  | 10                           | 835.825005                                    | 0.293       | 2.5         |
| 3.60  | 0                            | 835.824988                                    | 0.313       | 2.5         |
| 3.60  | -10                          | 835.825202                                    | 0.057       | 2.5         |
| 3.60  | -20                          | 835.825239                                    | 0.013       | 2.5         |
| 3.60  | -30                          | 835.825322                                    | -0.086      | 2.5         |

| Reference Frequency: Cellular Mid Channel 835.839966MHz @ 20*C<br>Limit: to stay +- 2.5 ppm = 2089.563 Hz |                              |   |             |             |
|---|------------------------------|---|-------------|-------------|
| Power Supply (Vdc)  | Environment Temperature (*C) | Frequency Deviation Measured with Time Elapse |             |             |
|   |                              | (MHz)   | Delta (ppm) | Limit (ppm) |
| <b>3.60</b>   | <b>20</b>                    | <b>835.825250</b>                             | <b>0</b>    | <b>2.5</b>  |
| 3.4 (end point)   | 20                           | 835.825056                                    | 0.232       | 2.5         |
| 3.5   | 20                           | 835.825226                                    | 0.029       | 2.5         |
| 4.14  | 20                           | 835.825330                                    | -0.096      | 2.5         |

**1900MHz PCS – MID CHANNEL**

| Reference Frequency: PCS Mid Channel 1880.000030MHz @ 20°C      |                                 |   |             |             |
|---|---------------------------------|---|-------------|-------------|
| Limit: within the authorized block or +/- 2.5 ppm = 4698.273 Hz |                                 |   |             |             |
| Power Supply<br>(Vdc)   | Environment<br>Temperature (°C) | Frequency Deviation Measured with Time Elapse |             |             |
|   |                                 | (MHz)   | Delta (ppm) | Limit (ppm) |
| 3.60  | 50                              | 1879.309303                                   | -0.120      | 2.5         |
| 3.60  | 40                              | 1879.308929                                   | 0.079       | 2.5         |
| 3.60  | 30                              | 1879.309022                                   | 0.029       | 2.5         |
| <b>3.60</b>   | <b>20</b>                       | <b>1879.309077</b>                            | <b>0</b>    | <b>2.5</b>  |
| 3.60  | 10                              | 1879.309913                                   | -0.445      | 2.5         |
| 3.60  | 0                               | 1879.309036                                   | 0.022       | 2.5         |
| 3.60  | -10                             | 1879.309152                                   | -0.040      | 2.5         |
| 3.60  | -20                             | 1879.309199                                   | -0.065      | 2.5         |
| 3.60  | -30                             | 1879.309214                                   | -0.073      | 2.5         |

| Reference Frequency: PCS Mid Channel 1880.000030MHz @ 20°C      |                                 |   |             |             |
|---|---------------------------------|---|-------------|-------------|
| Limit: within the authorized block or +/- 2.5 ppm = 4698.273 Hz |                                 |   |             |             |
| Power Supply<br>(Vdc)   | Environment<br>Temperature (°C) | Frequency Deviation Measured with Time Elapse |             |             |
|   |                                 | (MHz)   | Delta (ppm) | Limit (ppm) |
| <b>3.60</b>   | <b>20</b>                       | <b>1879.309077</b>                            | <b>0</b>    | <b>2.5</b>  |
| 3.4 (end point)   | 20                              | 1879.308066                                   | 0.538       | 2.5         |
| 3.5   | 20                              | 1879.309123                                   | -0.024      | 2.5         |
| 4.14  | 20                              | 1879.309737                                   | -0.351      | 2.5         |