



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

Prepared by
**COMPLIANCE CERTIFICATION SERVICES
561F MONTEREY ROAD
MORGAN HILL, CA 95037, USA
TEL: (408) 463-0885
FAX: (408) 463-0888**

NVLAP[®]
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

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS.....	4
2. TEST METHODOLOGY.....	5
3. FACILITIES AND ACCREDITATION.....	5
4. CALIBRATION AND UNCERTAINTY.....	5
4.1. MEASURING INSTRUMENT CALIBRATION.....	5
4.2. MEASUREMENT UNCERTAINTY.....	5
5. EQUIPMENT UNDER TEST	6
5.1. DESCRIPTION OF EUT.....	6
5.2. CLASS II PERMISSIVE CHANGE DESCRIPTION.....	6
5.3. MAXIMUM OUTPUT POWER.....	7
5.4. DESCRIPTION OF AVAILABLE ANTENNAS	7
5.5. SOFTWARE AND FIRMWARE.....	8
5.6. WORST-CASE CONFIGURATION AND MODE.....	8
5.7. DESCRIPTION OF TEST SETUP.....	9
6. TEST AND MEASUREMENT EQUIPMENT	11
7. LIMITS AND RESULTS.....	12
7.1. OCCUPIED BANDWIDTH.....	12
7.2. RF POWER OUTPUT.....	19
7.3. SPURIOUS EMISSION AT ANTENNA TERMINAL	28
7.4. FIELD STRENGTH OF SPURIOUS RADIATION.....	40
7.5. MAXIMUM PERMISSIBLE EXPOSURE.....	43
7.6. FREQUENCY STABILITY.....	46
8. SETUP PHOTOS.....	49

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: 1S6666666XX00041

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:

Tested By:



ALVIN ILARINA
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

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 (MHz)	Modulation	Conducted Average Power (dBm)	Conducted Average Power (mW)	Conducted Peak Power (dBm)	Conducted Peak Power (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 (MHz)	Modulation	Conducted Average Power (dBm)	Conducted Average Power (mW)	Conducted Peak Power (dBm)	Conducted Peak Power (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)	99% BW (MHz)	26 dB BW (MHz)	Band edge (dBm)	
	Mid CH	Mid CH	Mid CH	Low CH	High CH
1xRRT RC3, SO2	24.38	1.2549	1.394	-17.915	-14.993
1xRRT RC3, SO32 (+F-SCH)	24.63	1.2638	1.396	-16.942	-14.463
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)	99% BW (MHz)	26 dB BW (MHz)	Band edge (dBm)	
	Mid CH	Mid CH	Mid CH	Low CH	High CH
1xRRT RC3, SO2	24.35	1.253	1.403	-35.968	-33.323
1xRRT RC3, SO32 (+F-SCH)	24.54	1.270	1.419	-35.016	-32.422
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	1S6666666XX00041	DoC
AC Adapter	IBM	92P1109	550003680H	DoC

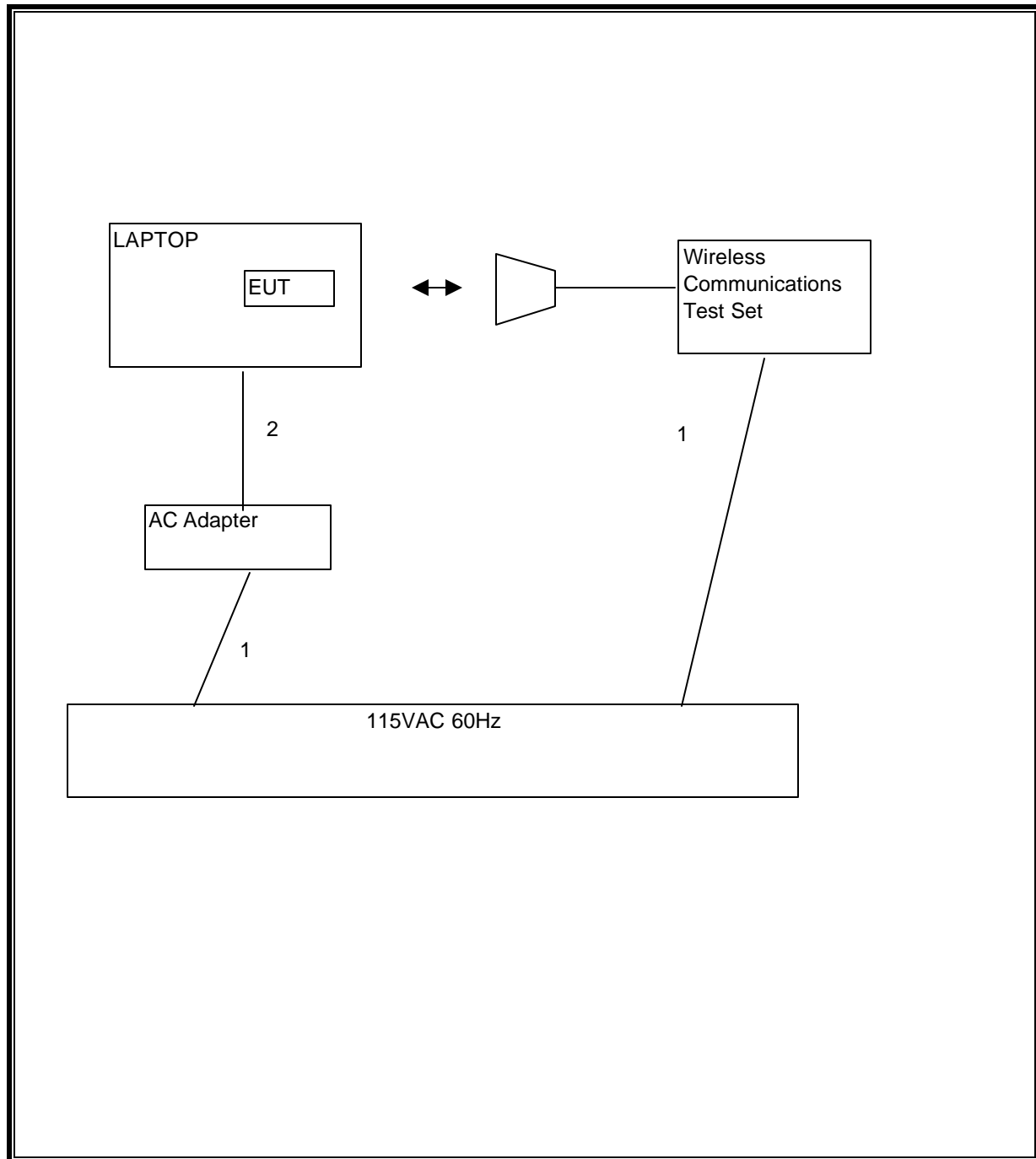
I/O CABLES

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:

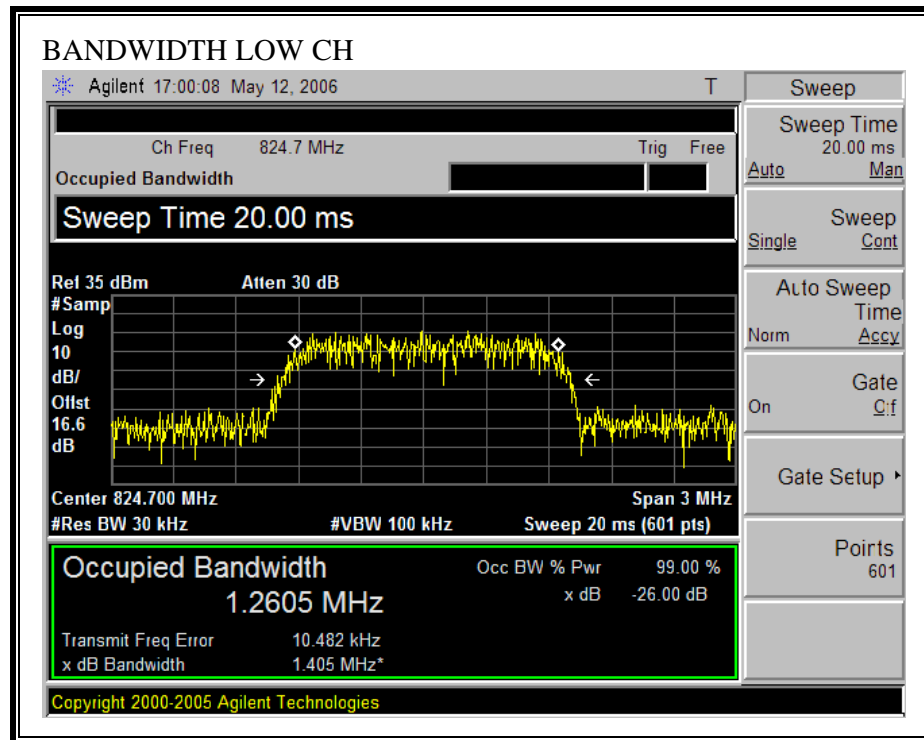
800MHz CELL CDMA Modulation

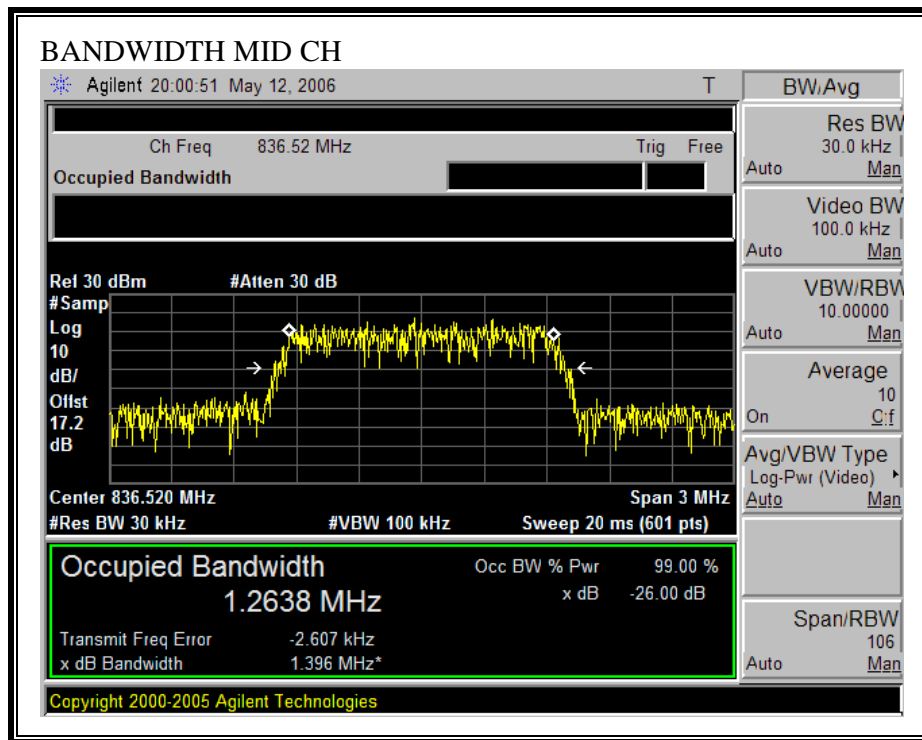
Channel	Frequency (MHz)	Bandwidth (MHz)
Low	824.70	1.405
Middle	836.52	1.396
High	848.31	1.400

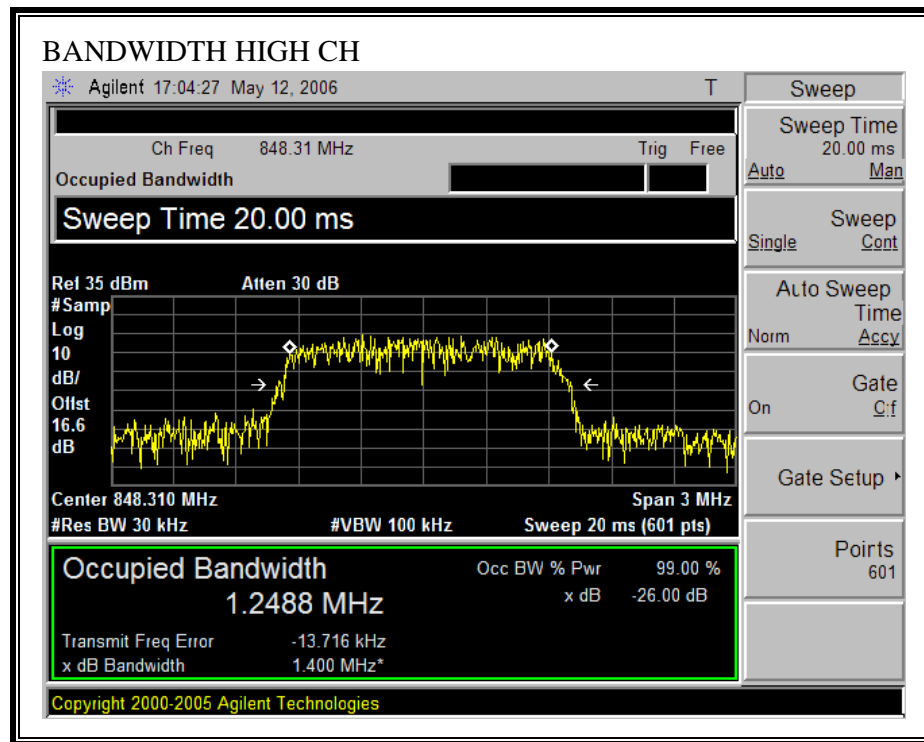
1900MHz PCS Modulation

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

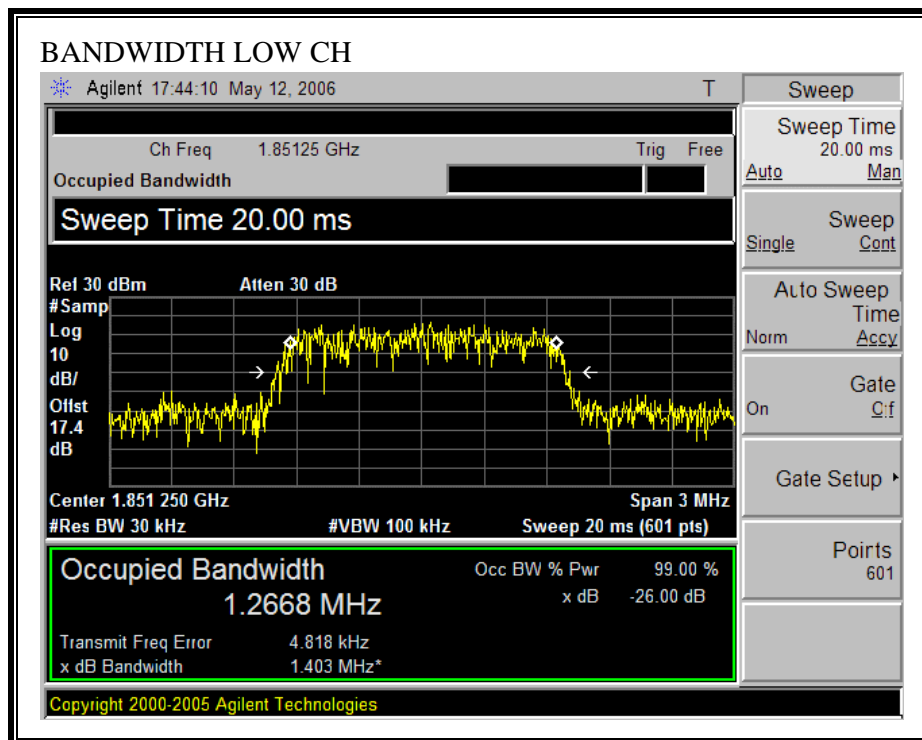
800MHz CELLULAR 26 dB BANDWIDTH

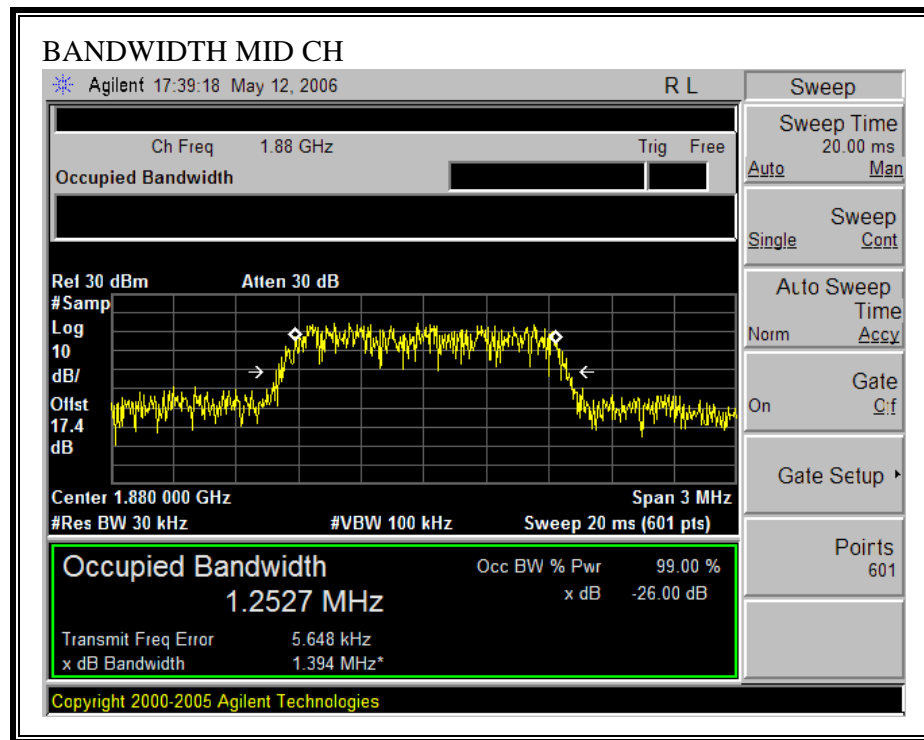


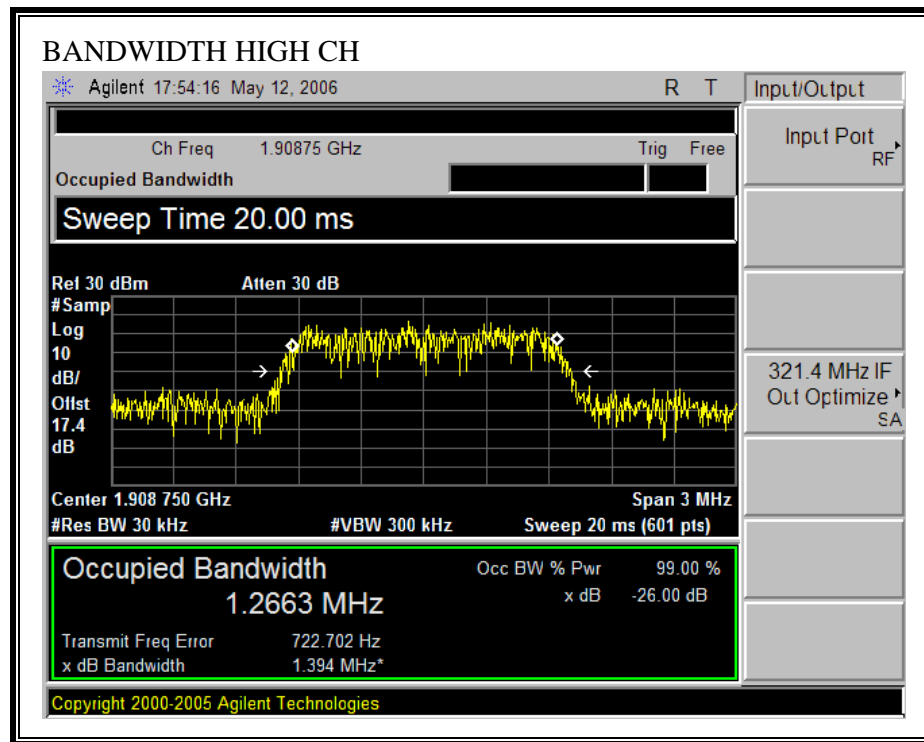




1900MHz PCS 26 dB BANDWIDTH







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

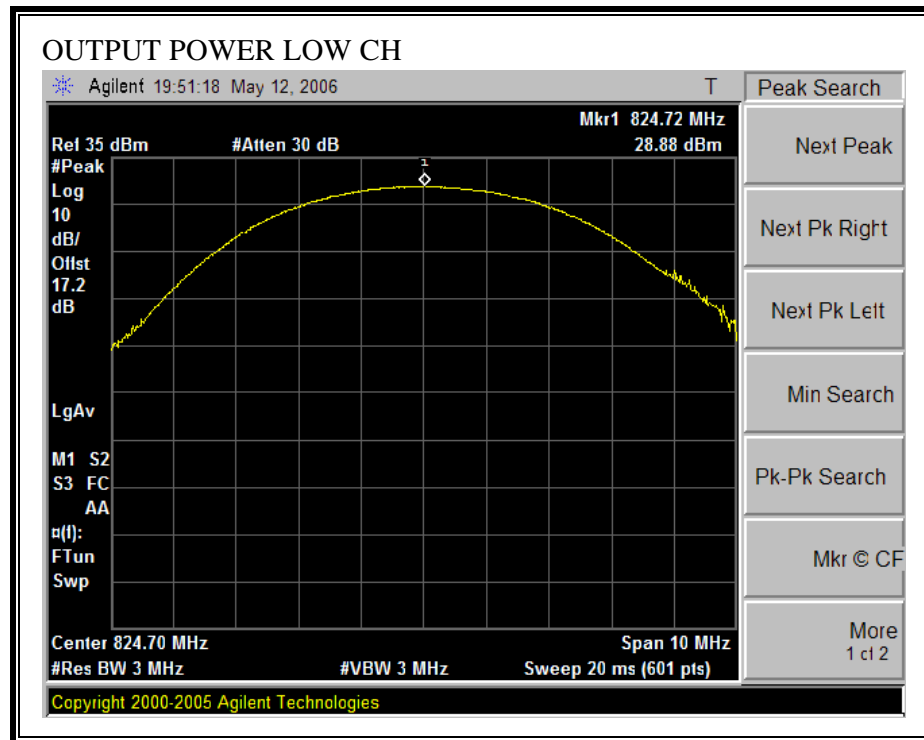
Channel	Frequency (MHz)	Conducted Peak Power (dBm)	Conducted Peak Power (mW)
Low	824.7	28.88	772.68
Middle	836.5	28.45	699.84
High	848.3	28.22	663.74

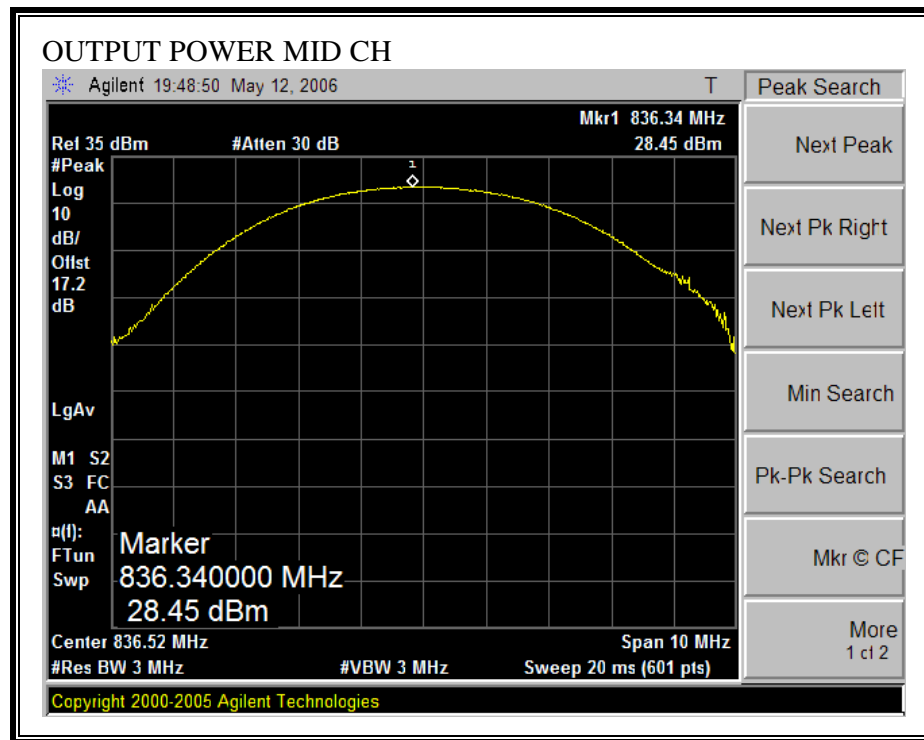
1900MHz PCS Modulation

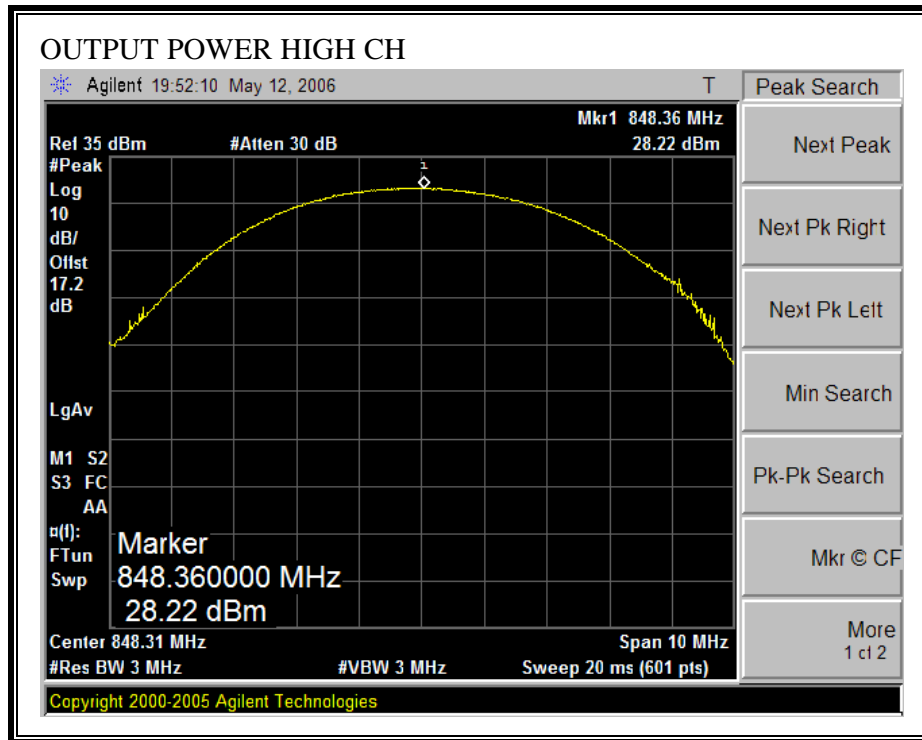
Channel	Frequency (MHz)	Conducted Peak Power (dBm)	Conducted Peak Power (mW)
Low	1851.25	28.75	749.89
Middle	1880.00	28.80	758.58
High	1908.75	28.20	660.69

NOTE: RBW=VBW=3MHz

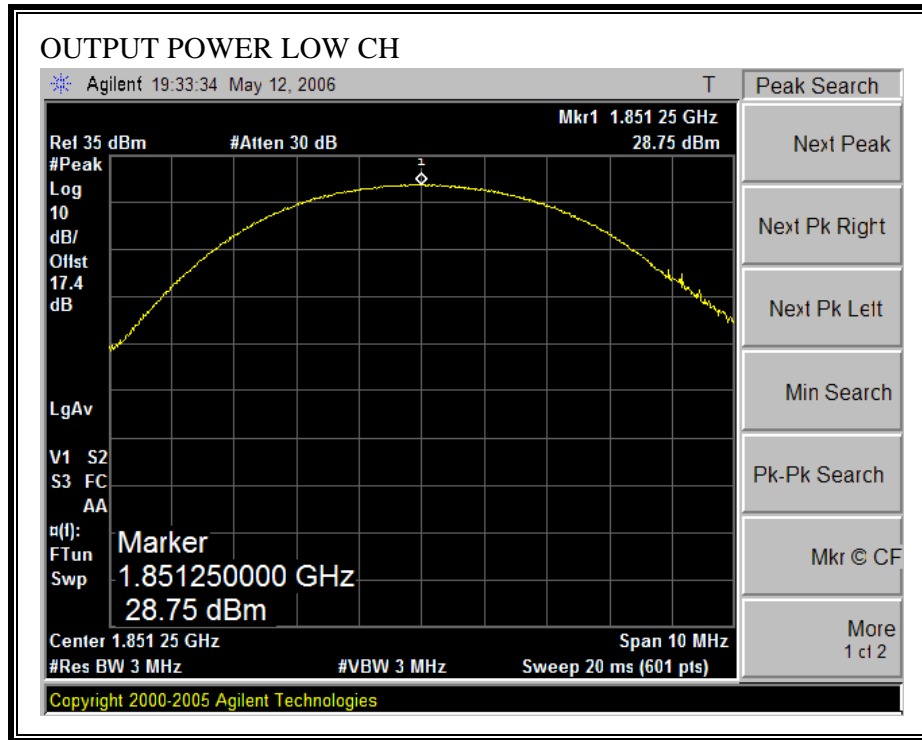
800MHz CELLULAR (RF CONDUCTED OUTPUT POWER)

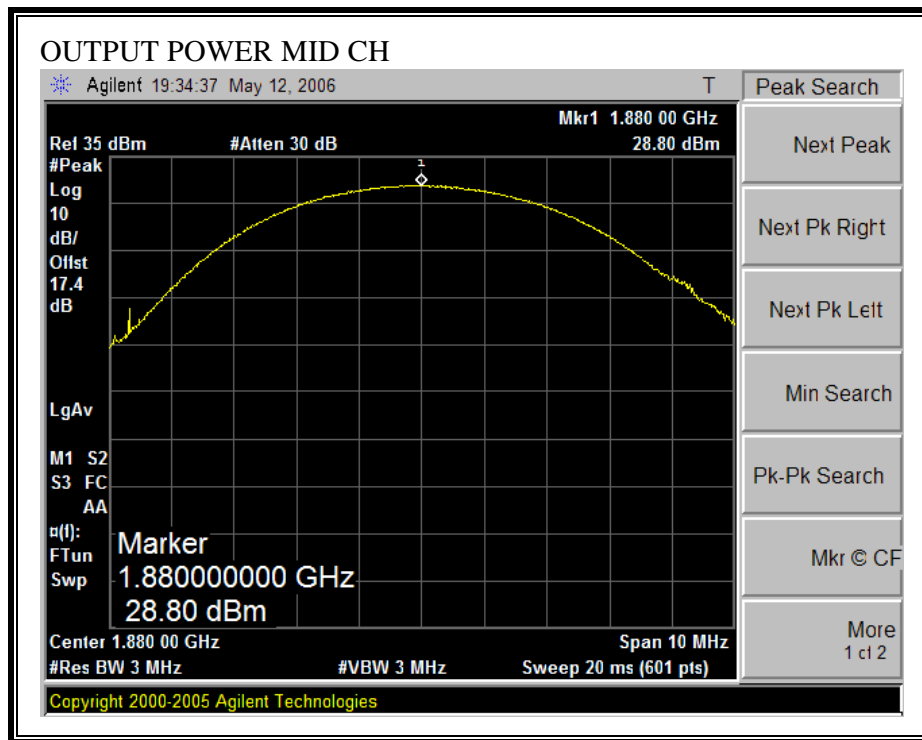


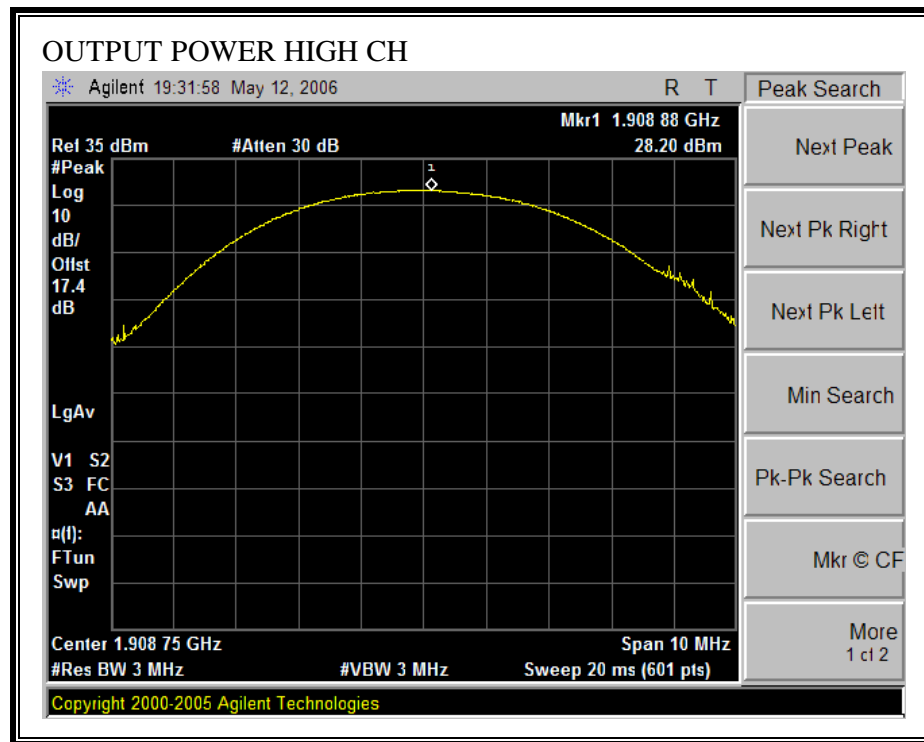




1900MHz PCS (RF CONDUCTED OUTPUT POWER)







Cellular Output Power (ERP)

f MHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Channel									
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	
Mid Channel									
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	
High Channel									
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 GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Channel									
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	
Mid Channel									
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	
High Channel									
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.

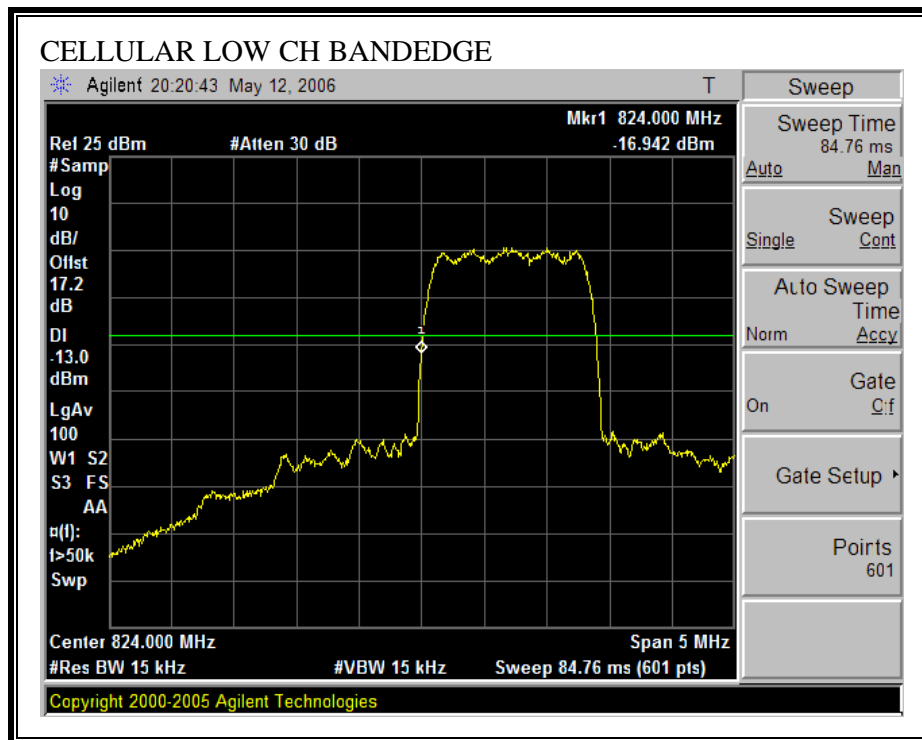
TEST PROCEDURE

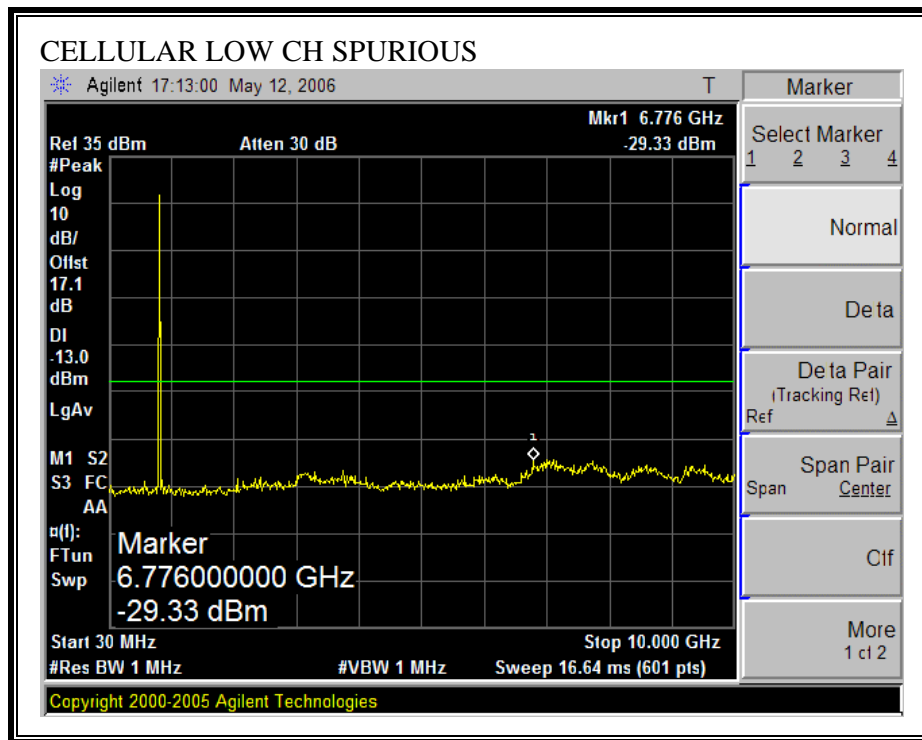
ANSI / TIA / EIA 603C Clause 2.2.12, FCC 22.917 (h), & FCC 24.238 (b)

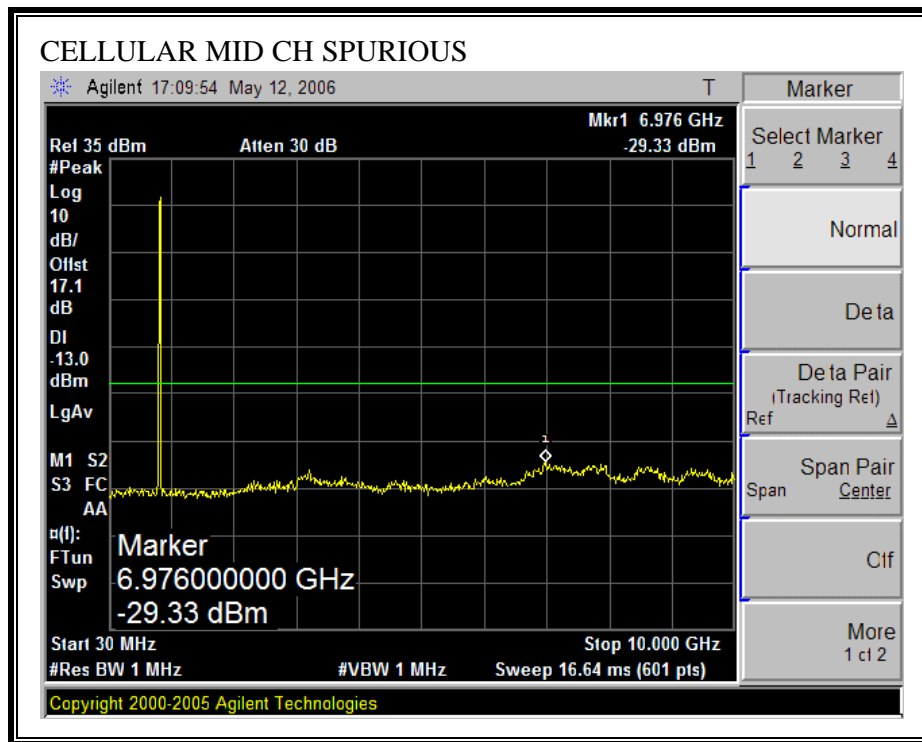
RESULTS

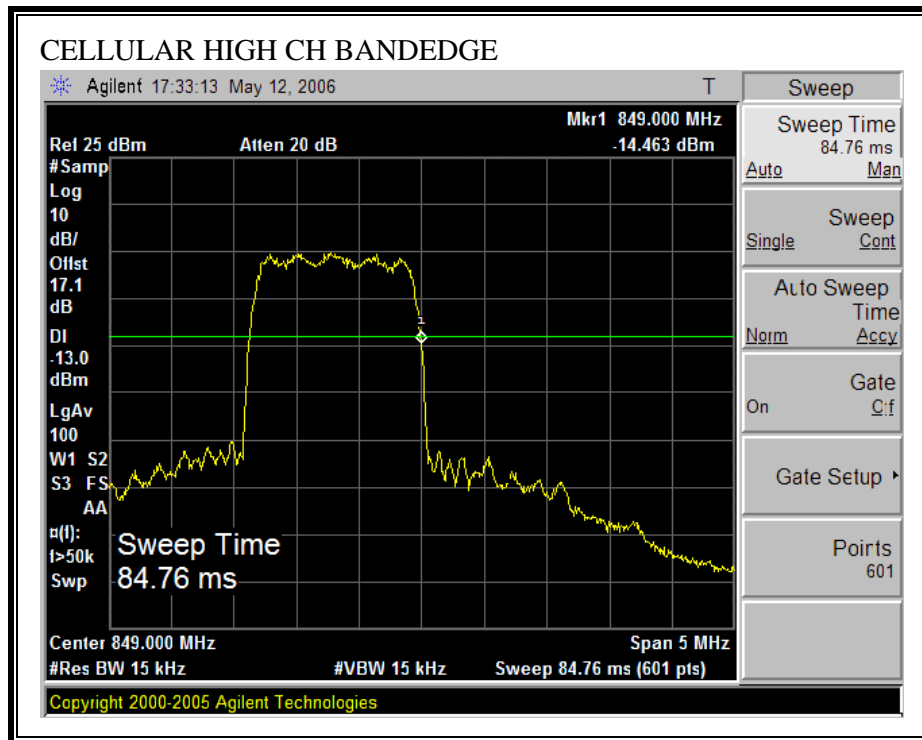
No non-compliance noted.

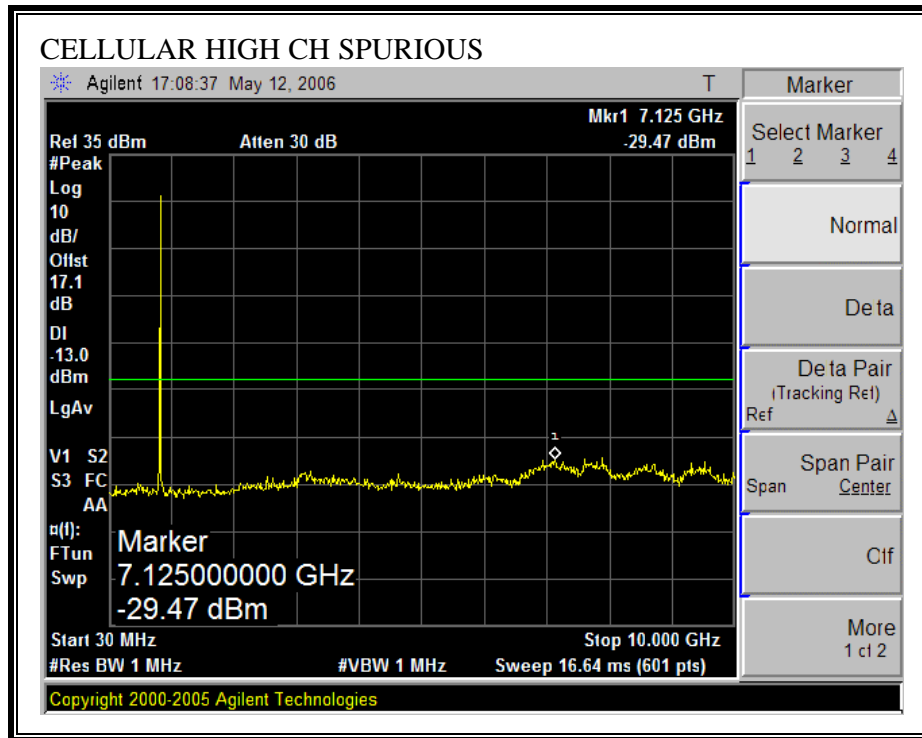
800MHz CELLULAR



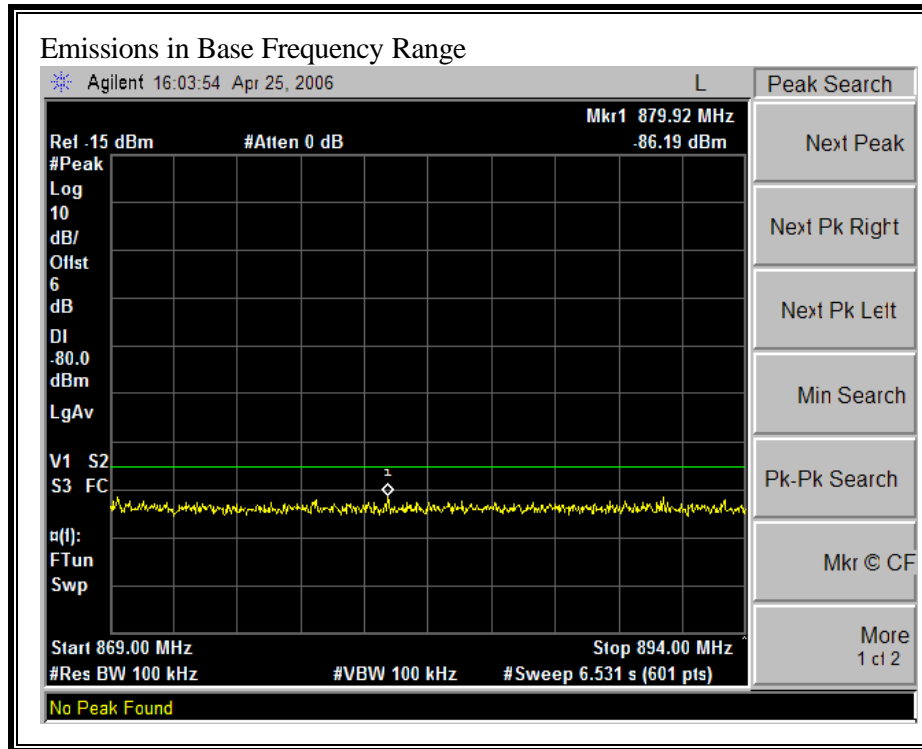




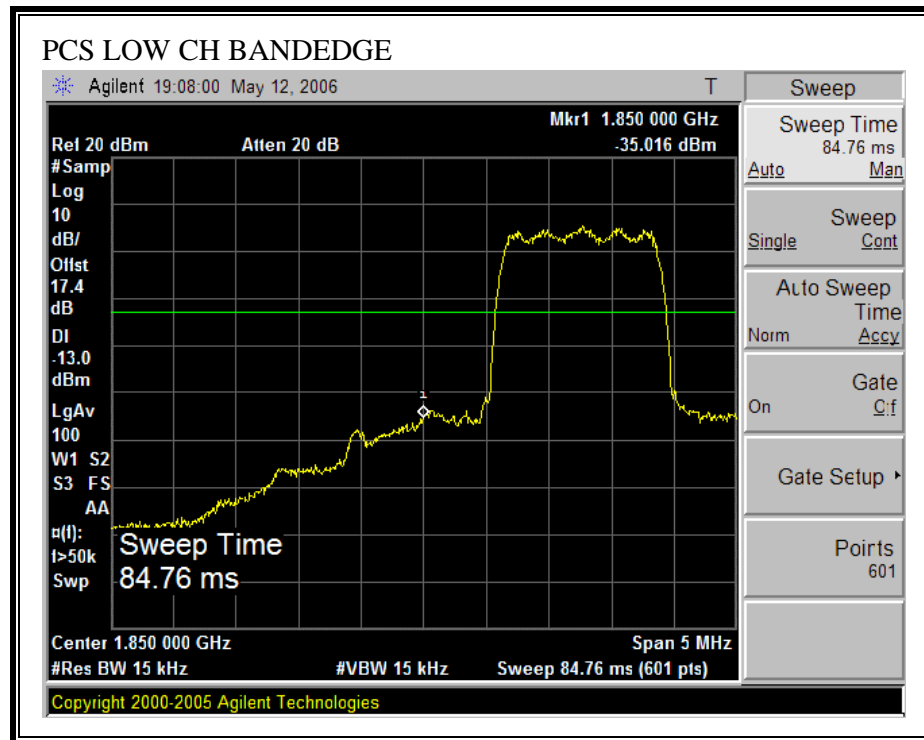


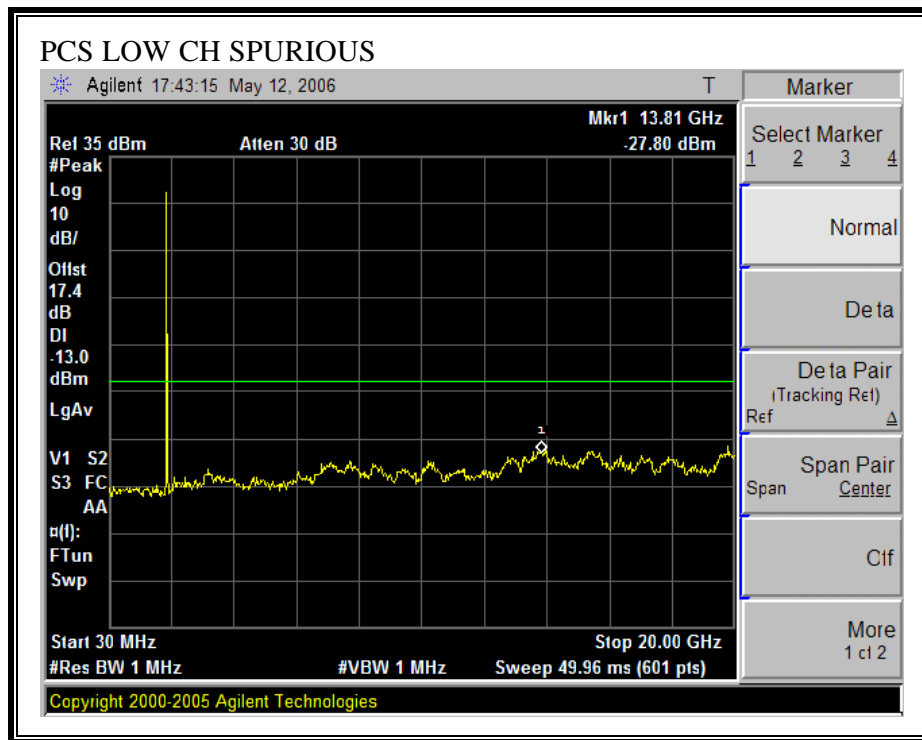


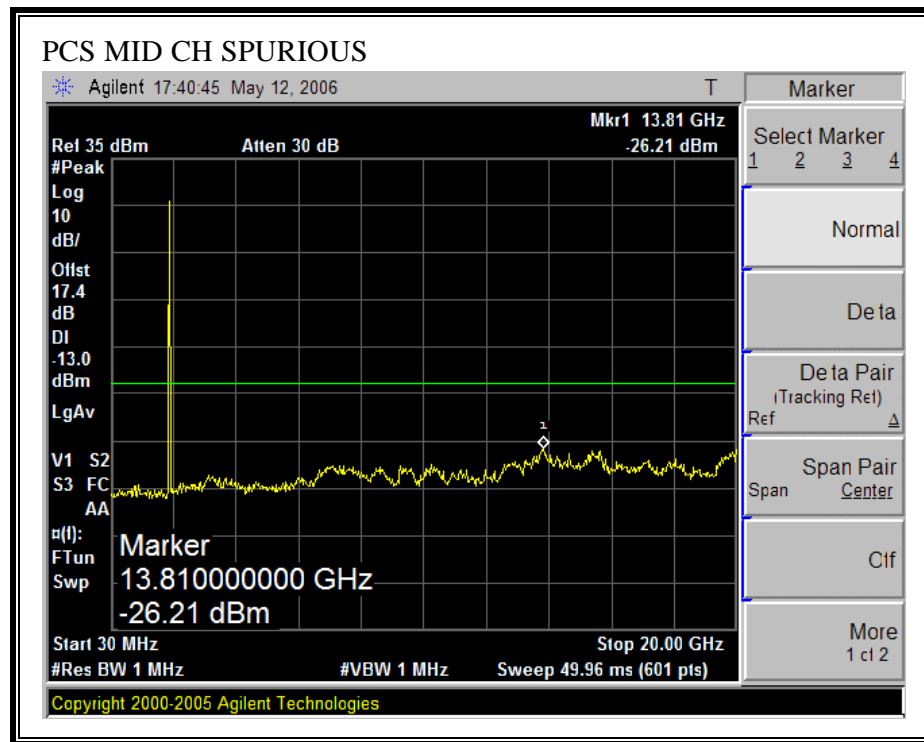
800MHz Cellular Mobile Emissions in Base Frequency Range

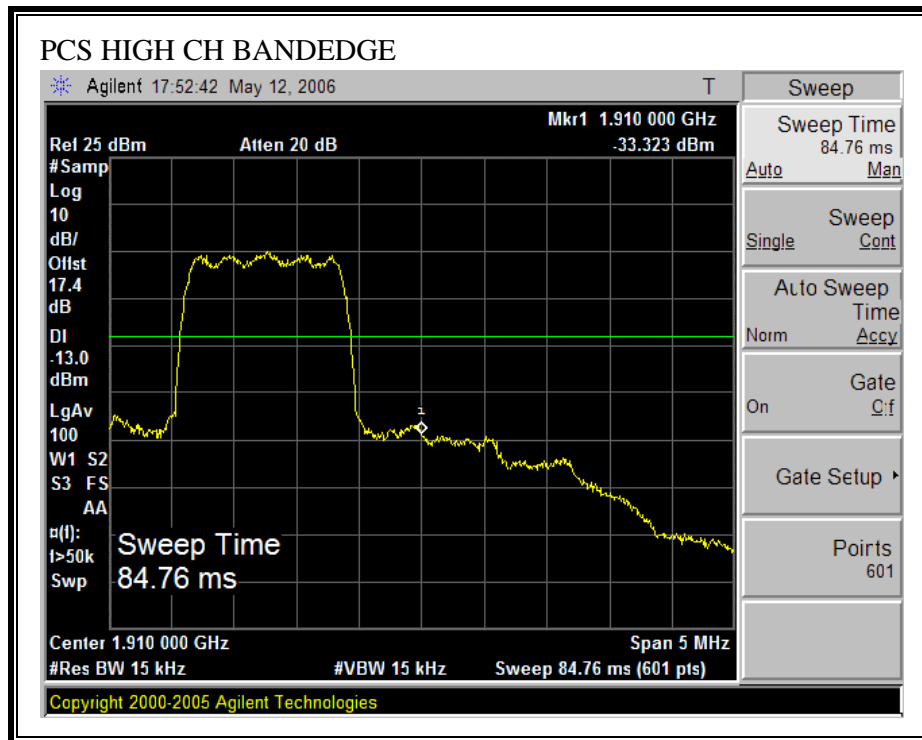


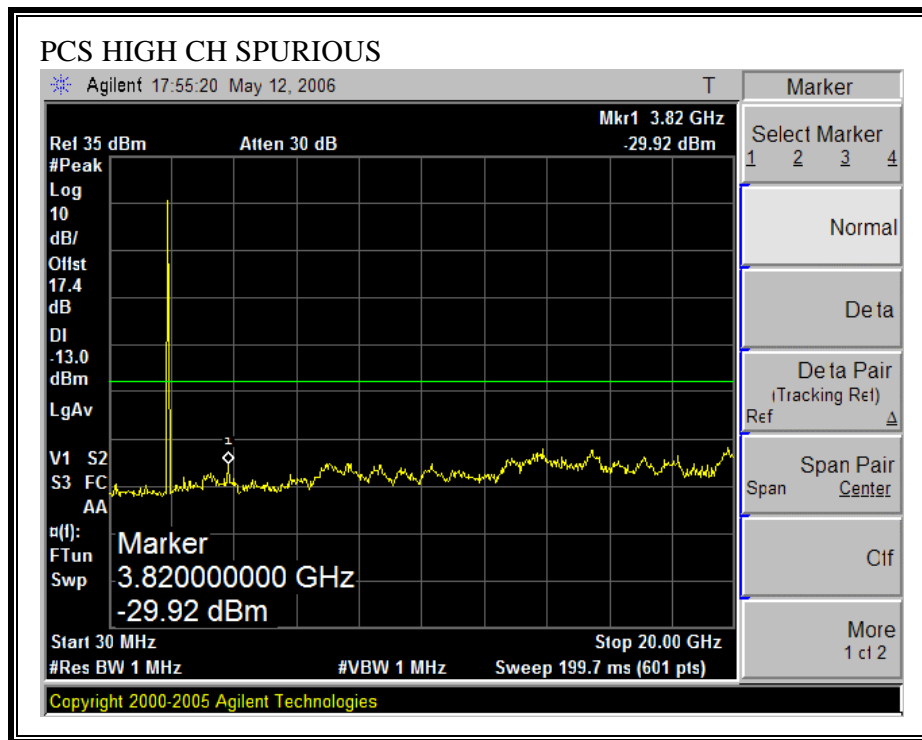
1900MHZ PCS











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 & Harmonic (ERP)

Cellular Harmonic Substitution Measurement									
Compliance Certification Services, Morgan Hill Immunity Chamber									
Company: Sierra Wireless Inc.									
Project #: 06U10280									
Date: 5/14/2006									
Test Engineer: Chin Pang									
Configuration: EUT Only									
Mode: CDMA 1xRTT RC3									
Test Equipment:									
Receiving: Horn T59, Pre-amp T34, Chin SMA Cables 2 & 12 ft (Setup this one for testing EUT)									
Substitution: Horn T60, 6ft SMA Cable Warehouse S/N: 208947 002									
f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Channel (824.73MHz)									
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	
Mid Channel (836.52MHz)									
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	-52.5	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	
High Channel (848.31MHz)									
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 Compliance Certification Services, Morgan Hill Immunity Chamber Company: Sierra Wireless Inc. Project #: 06U10282 Date: 5/14/2006 Test Engineer: Chin Pang Configuration: EUT Only Mode: CDMA 1xRTT Test Equipment: Receiving: Horn T59, Pre-amp T34, and Chin SMA Cables 2 & 12 ft (Setup this one for testing EUT) Substitution: Horn T60, and 6ft SMA Cable Warehouse S/N: 208947 002									
f GHz	SA reading (dBuV/m)	Ant. Pol. (H/V)	SG reading (dBm)	CL (dB)	Gain (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Notes
Low Channel (1851.25MHz)									
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	
Mid Channel (1880MHz)									
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	-35.5	-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	
High Channel (1908.75MHz)									
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 ²)	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 ²)	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 ²)	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 ²)	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/cm²

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/cm²

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

LIMITS

From §1.1310 Table 1 (B), $S = 1.0 \text{ mW/cm}^2$

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/cm²)
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				
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
3.60	20	835.825250	0	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				
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	20	835.825250	0	2.5
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 (Vdc)	Environment 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
3.60	20	1879.309077	0	2.5
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 (Vdc)	Environment Temperature (°C)	Frequency Deviation Measured with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.60	20	1879.309077	0	2.5
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