

# EMI Test Report

Tested in accordance with  
Federal Communications Commission (FCC)  
Personal Communications Services  
CFR 47, Parts 2, 22 and 24  
and  
Industry Canada, RSS-133 and RSS-128



## Research In Motion Limited

**REPORT NO.:** RIM-0071-0310-01

**PRODUCT MODEL NO:** RAO30GN  
**TYPE NAME:** BlackBerry Wireless Handheld  
**FCC ID:** L6ARAO30GN  
**IC:** 2503A-RAO30GN

**Date:** \_\_\_\_\_ 15 October 2003 \_\_\_\_\_

**Declaration****Statement of Performance:**

The BlackBerry Wireless Handheld, model RAO30GN ASY-06471-002 Rev.1A tested with the following accessories: Travel Charger model number PSM05R-050Q part number ASY-04078-001, Audio Headset part number HDW-03458-001 and USB Data Cable HDW-04162-001 when configured and operated per RIM's operation instructions, performs within the requirements of the test standards.

**Declaration:**

We hereby certify that:

The test data reported herein is an accurate record of the performance of the sample(s) tested.

The test equipment used was suitable for the tests performed and within the manufacturers published specifications and operating parameters.

The test methods were consistent with the methods described in the relevant standards.

**Tested by**

Maurice Battler  
Compliance Specialist

Date: 15 October 2003



Masud S. Attayi, P.Eng.  
Senior Compliance and Certification Engineer

Date: 16 October 2003

**Reviewed and Approved by:**

Paul G. Cardinal, Ph.D.  
Manager, Compliance and Certification

Date: 17 October 2003

## Table of Contents

|  |       |
|--|-------|
| A) Scope .....   | Pg. 3 |
| B) Product Identification .....                        | Pg. 3 |
| C) Support Equipment Used for Testing of the EUT ..... | Pg. 4 |
| D) Test Voltage .....                                  | Pg. 4 |
| E) Test Results Chart .....                            | Pg. 4 |
| F) Modifications to EUT .....                          | Pg. 5 |
| G) Summary of Results .....                            | Pg. 5 |
| H) Compliance Test Equipment Used .....                | Pg. 7 |

Appendix 1 Conducted Emissions Test Data/Plots

Appendix 2 Conducted RF Output Power Test Data

Appendix 3 Frequency Stability Test Data

Appendix 4 Radiated Emissions Test Data

## A) Scope

This report details the results of compliance tests which were performed in accordance to the requirements of:

FCC CFR 47 Part 2, Oct. 1, 2000

FCC CFR 47 Part 22, Subpart H, Cellular Radiotelephone Services, Oct. 1, 2000

FCC CFR 47 Part 24 Subpart E, Broadband PCS, Oct 1. 2000

Industry Canada, RSS-128 Issue 2, Rev 1, Nov. 6/99, 800 MHz Dual-Mode TDMA Cellular Telephones

Industry Canada, RSS-133 Issue 2, Rev. 1 Nov. 6/1999, 2.0 GHz Personal Communications Services

## B) Product Identification

The equipment under test (EUT) was tested at the Research In Motion (RIM) EMI test facility, located at:

305 Phillip Street

Waterloo, Ontario

Canada, N2L 3W8

Phone: 519 888 7465

Fax: 519 888 6906

Web Site: [www.rim.net](http://www.rim.net)

The testing began on May 26, 2003 and completed on October 14, 2003. The sample equipment under test (EUT) included:

- 1a) BlackBerry Wireless Handheld, model number RAO30GN, ASY-06471-002 Rev.1A, RF PCB version 004, PIN 20071150, IMEI 001020.00.043679.0, FCC ID L6ARAO30GN, IC: 2503A-RAO30GN.
- 1b) BlackBerry Wireless Handheld, model number RAO30GN, ASY-06471-002 Rev.1A, RF PCB version 004, PIN 20070300, IMEI 001020.00.0436240.0, FCC ID L6ARAO30GN, IC: 2503A-RAO30GN.
- 1c) BlackBerry Wireless Handheld, model number R6230GN, ASY-06471-001, RF PCB version 004, PIN 20038237, IMEI 001020.00.027868.0, FCC ID L6AR6230GN, IC: 2503A-R6230GN.
- 2) Travel Charger, model number PSM05R-050Q, part number ASY-04078-001 with an output voltage of 5.0 volts dc.
- 3) USB data cable, model number HDW-04162-001, 1.45 metres long.
- 4) Headset, model number HDW-03458-001. The lead length was 1.25 metres long.

The difference between model number RAO30GN and R6230GN is the increase in transmit power in the GSM850 band from 29 dBm to 32 dBm. The transmit power in the PCS band remained the same. The GSM850 band measurements were done on model number RAO30GN and the PCS band measurements were done on model number R6230GN.

The transmit frequency bands for the Handheld are: GSM850 824 to 849 MHz, DCS 1710 to 1785 MHz and PCS 1850 to 1910 MHz. Only the GSM850 band and PCS band emission results are presented here.

**C) Support Equipment Used for the Testing of the EUT**

- 1) Rohde & Schwarz, Universal Radio Communication Tester, model number CMU 200, serial number 100249
- 2) Rohde & Schwarz, Universal Radio Communication Tester, model number CMU 200, serial number 837493/073
- 3) DC Power Supply, H/P, model 6632B, serial number US37472178

**D) Test Voltage**

The ac input voltage was 120 volts, 60 Hz. This configuration was per RIM’s specifications.

**E) Test Results Chart**

| SPECIFICATION                               | Test Type  | MEETS REQUIREMENTS | Performed By    |
|---|--|--------------------|-----------------|
| FCC CFR 47 Part 22, Subpart H<br>IC RSS-128 | Radiated<br>Spurious/harmonic<br>Emissions, ERP                    | Yes                | Masud Attayi    |
| FCC CFR 47 Part 22, Subpart H<br>IC RSS-128 | Conducted Emissions,<br>Occupied Bandwidth,<br>Frequency Stability | Yes                | Maurice Battler |
| FCC CFR 47 Part 24, Subpart E<br>IC RSS-133 | Radiated<br>Spurious/harmonic<br>Emissions, EIRP                   | Yes                | Masud Attayi    |
| FCC CFR 47 Part 24, Subpart E<br>IC RSS-133 | Conducted Emissions,<br>Occupied Bandwidth,<br>Frequency Stability | Yes                | Maurice Battler |

## F) Modifications to EUT

No modifications were required to the EUT.

## G) Summary of Results

- 1) The EUT passed the Conducted Spurious Emissions requirements in the GSM850 band as per 47 CFR 22.917, CFR 22.901(d). The EUT was measured on the low, middle and high channels. The frequency range investigated was from 10 MHz to 10 GHz. See APPENDIX 1 for the test data.
- 2) The EUT passed the Conducted Spurious Emissions requirements in the PCS band as per 47 CFR 2.1057, CFR 24.238 and RSS-133. The EUT was measured on the low, middle and high channels. The frequency range investigated was from 10 MHz to 20 GHz. See APPENDIX 1 for the test data.
- 3) The EUT passed the Occupied Bandwidth and channel mask requirements in the GSM850 band as per 47 CFR 2.202, CFR 22.917 and RSS-128. The channels measured were low, middle and high. See APPENDIX 1 for the test data.
- 4) The EUT passed the Occupied Bandwidth and channel mask requirements in the PCS band as per 47 CFR 2.202, CFR 24.238 and RSS-133. The channels measured were low, middle and high. See APPENDIX 1 for the test data.
- 5) The EUT passed the Conducted RF Output Power requirements for both the GSM850 and PCS bands. The channels measured were low, middle and high. See APPENDIX 2 for the test data.
- 6) The EUT passed the Frequency Stability vs. Temperature and Voltage requirements for GSM850 band as per 22.917 and RSS-128. The maximum frequency error measured was less than 0.1 ppm. The temperature range was from -30°C to +60°C in 10° temperature steps. The EUT was measured on low, middle and high channels at each temperature step. The EUT was measured at low (3.5 volts), nominal (3.8 volts) and high (4.1 volts) dc input voltage at each temperature step and channel at maximum output power. See APPENDIX 3 for the test data.

- 7) The EUT passed the Frequency Stability vs. Temperature and Voltage requirements for the PCS band as per 24.235 and RSS-133. The maximum frequency error measured was less than 0.1 ppm.

The temperature range was from -30°C to +60°C in 10 degree temperature steps. The EUT was measured on low, middle and high channels at each temperature step. The EUT was measured at low (3.5 volts), nominal (3.8 volts) and high (4.1 volts) dc input voltage at each temperature step and channel at maximum output power.

See APPENDIX 3 for the test data.

- 8) The radiated spurious emissions/harmonics and ERP/EIRP were measured for both GSM850 and PCS bands. The results are within the limits. The EUT was placed on a nonconductive wooden table, 80 cm high that was positioned on a remotely rotatable turntable. The test distance used between the EUT and the receiving antenna was three metres. At this point the emissions were maximized by elevating the antenna in the range of 1 to 4 metres. The turntable was rotated to determine the azimuth of the peak emissions. The maximum emissions level was recorded. The measurements were performed in a semi-anechoic chamber. The semi-anechoic chamber FCC registration number is **778487** and the Industry Canada file number is **IC4240**. The EUT was measured on the low, middle and high channels.

The highest ERP in the GSM850 band measured was 29.8 dBm at 848.8 MHz (channel 251).

The highest EIRP in the PCS band measured was 30.6 dBm at 1880.0 MHz (channel 661).

To view the test data see APPENDIX 4.

The radiated carrier harmonics were measured up to the 10<sup>th</sup> harmonic for low, middle and high channels in the GSM850 band and PCS band.

The worst test margin for GSM850 band measured was 22.4 dB below the limit at 1675.2 MHz.

The worst test margin for PCS band measured was 31.6 dB below the limit at 3760.0 MHz.

To view the test data see APPENDIX 4.

### **Sample Calculation:**

Field Strength (dB $\mu$ V/M) is calculated as follows:

$$FS = \text{Measured Level (dB}\mu\text{V)} + \text{A.F. (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp (dB)} + \text{Filter Loss (dB)}$$

### **Measurement Uncertainty $\pm 4.0$ dB**

**H) Compliance Test Equipment Used**

| <u>UNIT</u>                          | <u>MANUFACTURER</u> | <u>MODEL</u> / <u>SERIAL NUMBER</u> | <u>CAL DUE DATE</u><br>(YY MM DD) | <u>USE</u>          |
|--------------------------------------|---------------------|-------------------------------------|-----------------------------------|---------------------|
| Preamplifier system                  | TDK RF Solutions    | PA-02 080010                        | 03-11-06                          | Radiated Emissions  |
| Preamplifier                         | Sonoma              | 310N/11909A 185831                  | 03-11-06                          | Radiated Emissions  |
| EMC Analyzer                         | Agilent             | E7405A US40240226                   | 04-07-31                          | Radiated Emissions  |
| Universal Radio Communication Tester | Rohde & Schwarz     | CMU 200 837493/073                  | 04-04-05                          | Radiated Emissions  |
| Horn Antenna                         | TDK                 | HRN-0118 130092                     | 04-09-16                          | Radiated Emissions  |
| Horn Antenna                         | TDK                 | HRN-0118 030201                     | 03-12-11                          | Radiated Emissions  |
| Hybrid Log Antenna                   | TDK                 | HLP-3003C 017301                    | 03-12-11                          | Radiated Emissions  |
| Dipole Antenna                       | Schwarzbeck         | UHAP 1018                           | 03-11-06                          | Radiated Emissions  |
| Dipole Antenna                       | Schwarzbeck         | UHAP 974                            | 04-09-24                          | Radiated Emissions  |
| Synthesized Sweeper                  | Agilent             | 83630B 3844A00927                   | 04-04-30                          | Radiated Emissions  |
| Universal Radio Communication Tester | Rohde & Schwarz     | CMU 200 100249                      | 04-04-05                          | Conducted Emissions |
| Spectrum Analyzer                    | HP                  | 8563E 3745A08112                    | 04-07-31                          | Conducted Emissions |
| DC Power Supply                      | HP                  | 6632B US37472178                    | 04-08-01                          | Conducted Emissions |
| Temperature Probe                    | Hart Scientific     | 61161-302 21352860                  | 04-09-15                          | Conducted Emissions |
| Power Meter                          | Giga-Tronics        | 8541C 1837762                       | 03-10-30                          | Conducted RF Power  |
| Power Sensor                         | Giga-Tronics        | 80401A 1835838                      | 03-10-30                          | Conducted RF Power  |
| Temperature Probe                    | Hart Scientific     | 61161-302 21352860                  | 04-09-15                          | Conducted Emissions |
| Environmental Chamber                | ESPEC Corp.         | SH-240S1 91005607                   | N/R                               | Conducted Emissions |



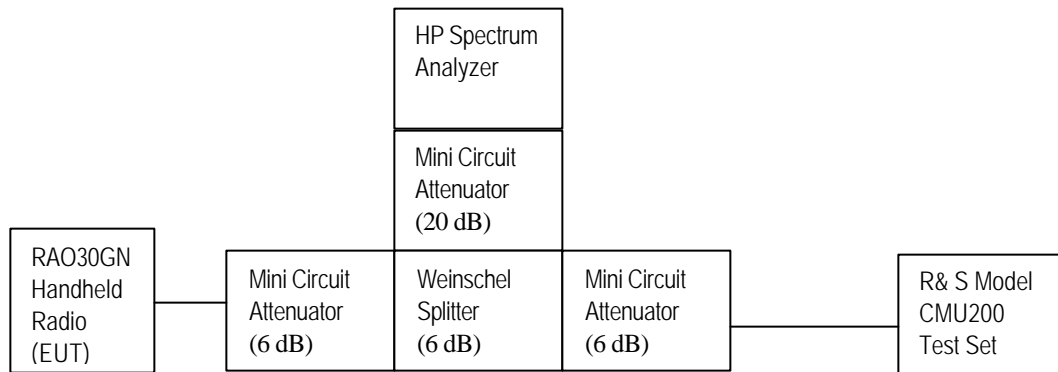
## APPENDIX 1

### CONDUCTED EMISSIONS TEST DATA/PLOTS

Conducted Emission Test Results

This appendix contains measurement data pertaining to conducted spurious emissions, -26 dBc bandwidth, 99% power bandwidth and the channel mask.

**Test Setup Diagram**



**Test Equipment List**

| Test Instruments                     | Manufacturer    | Model No.    | Serial No. | Frequency Range  |
|--------------------------------------|-----------------|--------------|------------|------------------|
| Spectrum Analyzer                    | HP              | 8563E        | 374A08112  | 30 Hz – 26.5 GHz |
| Splitter                             | Weinschel       | 1515         | ME092      | DC – 18 GHz      |
| Attenuator                           | Mini Circuit    | MCL BW-S20W2 | --         | DC – 18 GHz      |
| Attenuator                           | Mini Circuit    | MCL BW-S6W2  | --         | DC – 18 GHz      |
| Attenuator                           | Mini Circuit    | MCL BW-S6W2  | --         | DC – 18 GHz      |
| Universal Radio Communication Tester | Rohde & Schwarz | CMU200       | 100249     | --               |

Conducted Emission Test Data Con't

**The conducted spurious emissions** – As per 47 CFR 2.202, 47 CFR 2.1057, 47 CFR 24.238, RSS-133, CFR 22 Subpart H and RSS-128 were measured from 10 MHz to 20 GHz. The EUT has a test margin of greater than 20 dB.

See figures 1 to 12 for the plots of the conducted spurious emissions.

-26 dBc Bandwidth and Occupied Bandwidth (99%)

For each carrier frequency of low, middle and high, the modulation spectrum were measured by both methods of 99% power bandwidth and -26 dBc bandwidth.

The resolution bandwidth required for out-of-band emissions in the 1 MHz bands immediately outside and adjacent to the frequency block, was determined to be at least 1% of the emission bandwidth.

The worst case emission bandwidth for the three GSM850 channels was measured to be 280.0 kHz, and for the three PCS channels was measured to be 272 kHz as shown below, which results in 30 kHz resolution bandwidth.

On any frequency outside the frequency block and outside the adjacent 1 MHz bands, a resolution bandwidth of at least 1 MHz was employed.

***Test Data for GSM850 and PCS selected Frequencies***

| GSM850<br>Frequency (MHz) | -26dBc Bandwidth (kHz) | -99% Occupied Bandwidth (kHz) |
|---------------------------|------------------------|-------------------------------|
| 824.2                     | 272                    | 248.3                         |
| 837.6                     | 267                    | 250.0                         |
| 848.8                     | 280                    | 248.3                         |

| PCS<br>Frequency (MHz) | -26dBc Bandwidth (kHz) | 99% Occupied Bandwidth (kHz) |
|------------------------|------------------------|------------------------------|
| 1850.2                 | 270                    | 246.7                        |
| 1880.0                 | 268                    | 243.3                        |
| 1909.8                 | 272                    | 245.0                        |

***Measurement Plots for GSM850 and PCS***

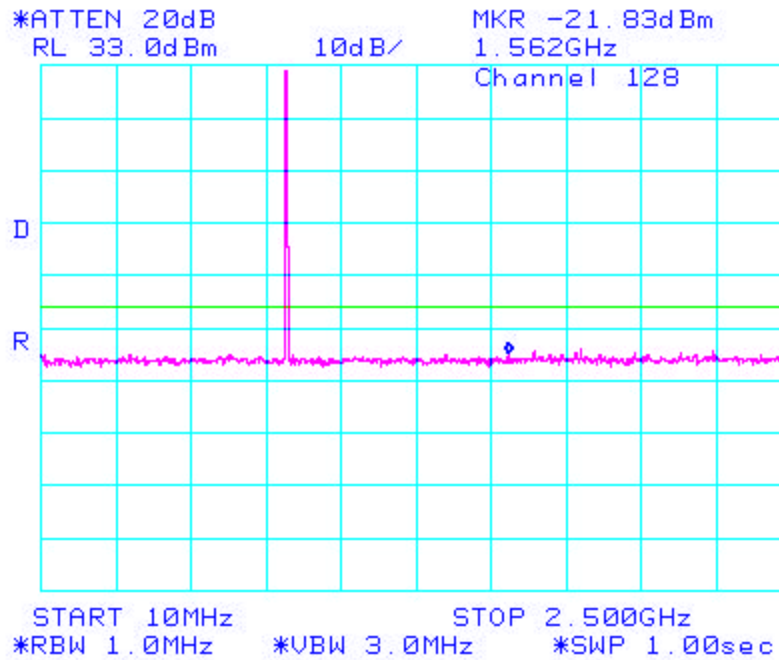
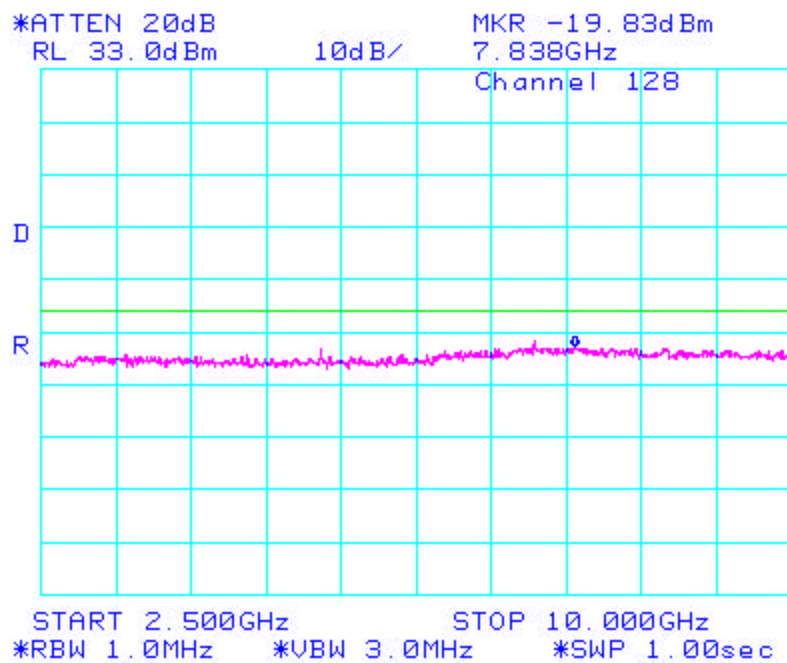
Refer to the following measurement plots for more detail.

See Figures 1 to 12 for plots of the Spurious Emission results

See Figures 13 to 24 for the plots of the -26dBc Bandwidth and 99% Occupied Bandwidth.

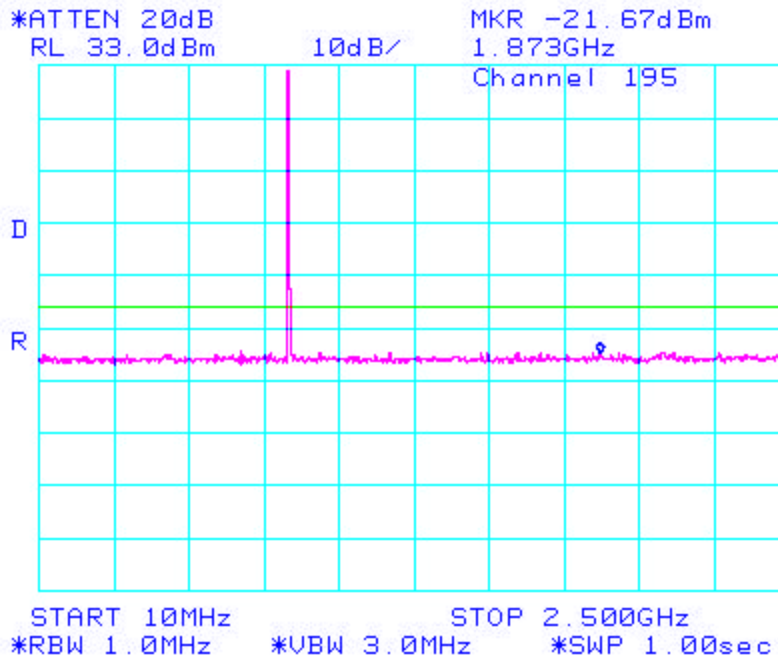
See Figures 25 to 28 for plots of the channel mask results.

The RF power output was at maximum for all the recorded measurements shown below.

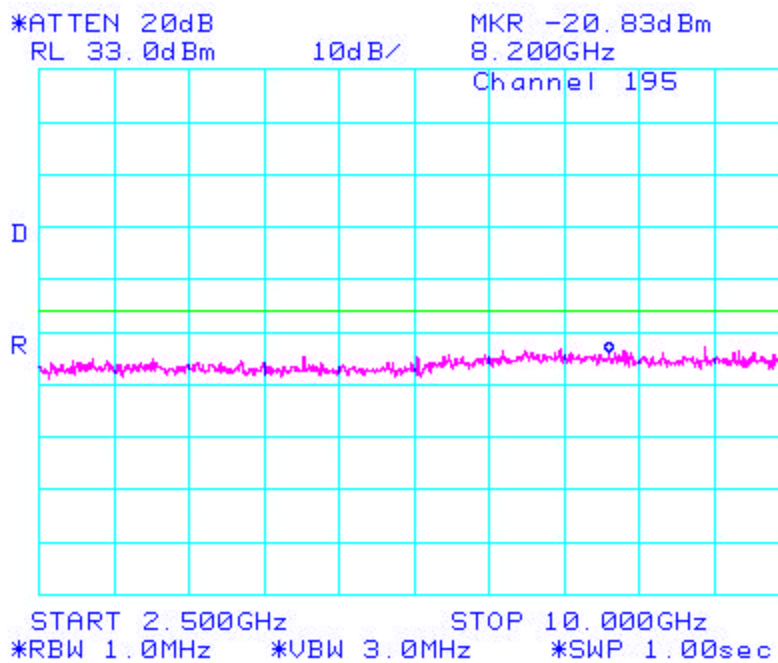
Conducted Emission Test Results con't**Figure 1: GSM 850, Spurious Conducted Emissions, Low channel****Figure 2: GSM 850, Spurious Conducted Emissions, Low channel**

Conducted Emission Test Results Con't

**Figure 3: GSM 850, Spurious Conducted Emissions, Middle Channel**

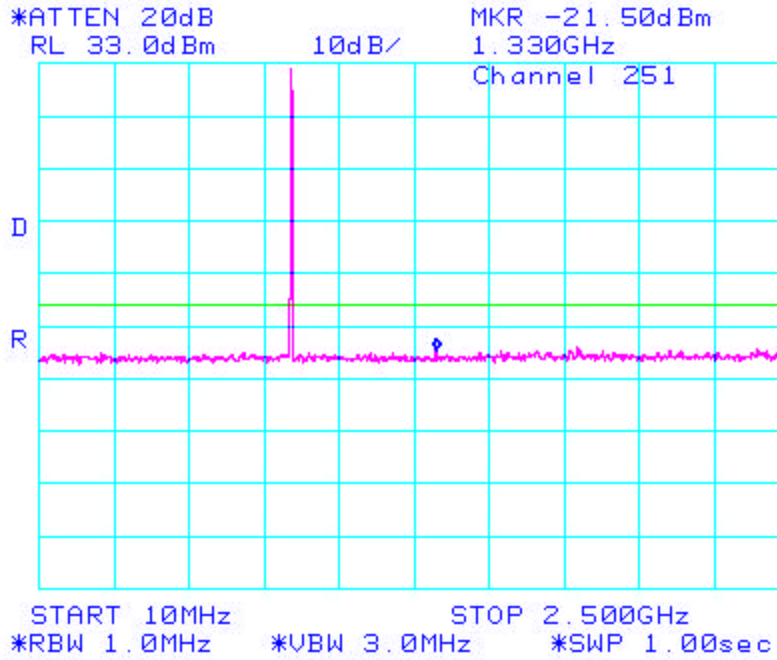


**Figure 4: GSM 850, Spurious Conducted Emissions, Middle Channel**

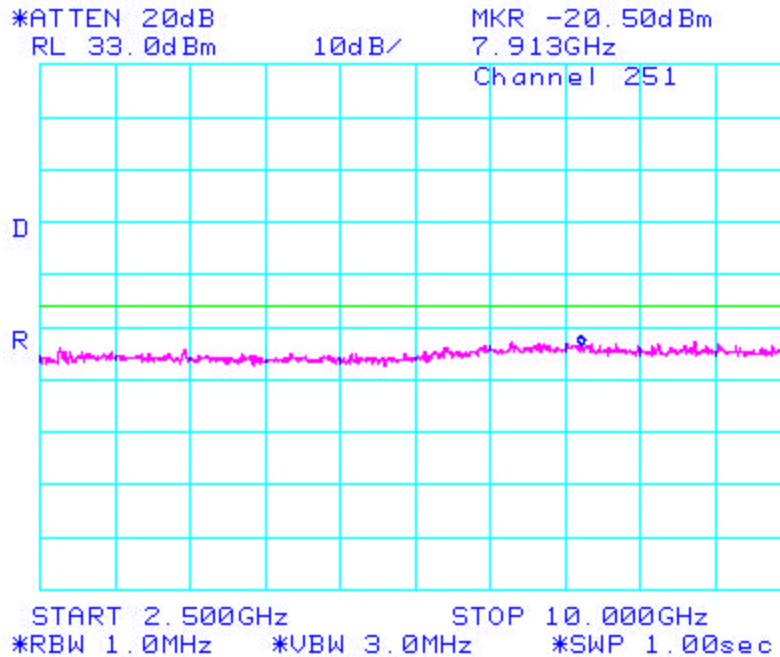


Conducted Emission Test Results Con't

**Figure 5: GSM 850, Spurious Conducted Emissions, High Channel**

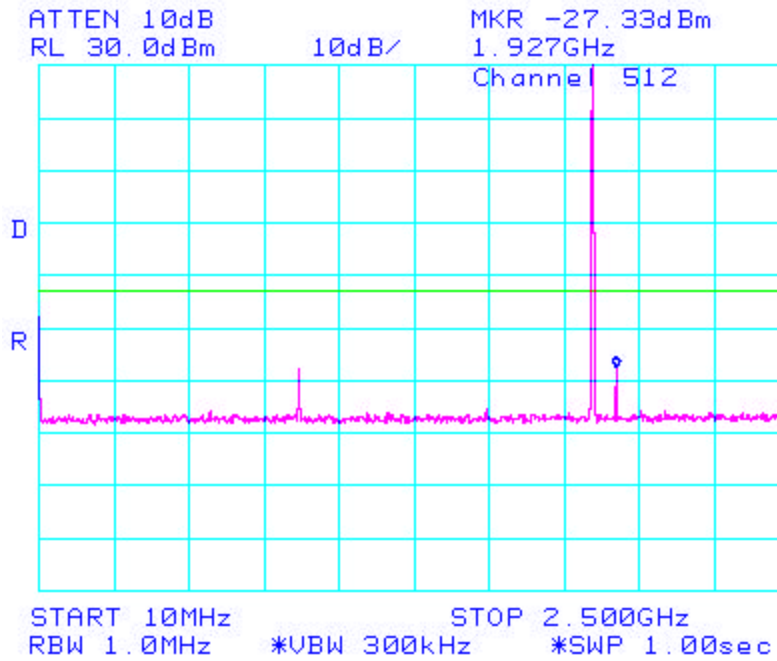


**Figure 6: GSM 850, Spurious Conducted Emissions, High Channel**

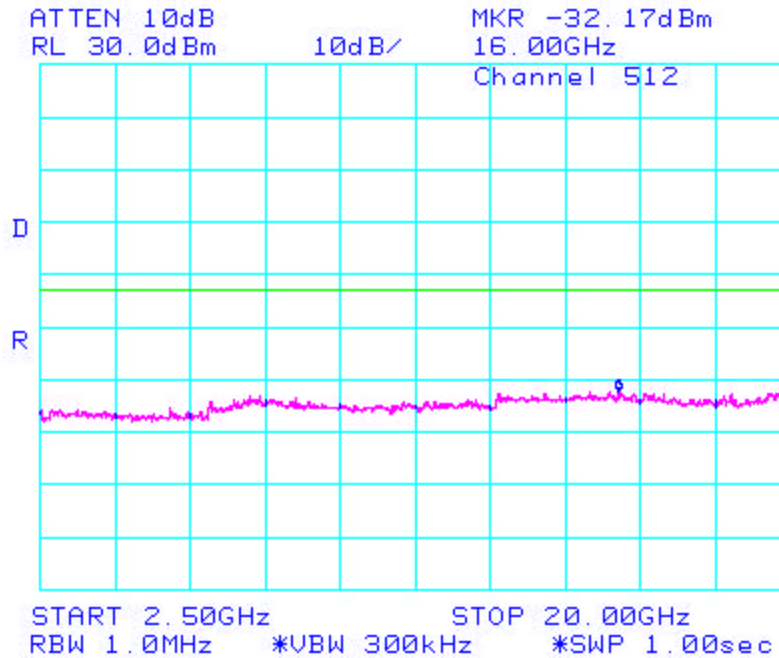


### Conducted Emission Test Results Con't

**Figure 7: PCS, Spurious Conducted Emissions, Low Channel**

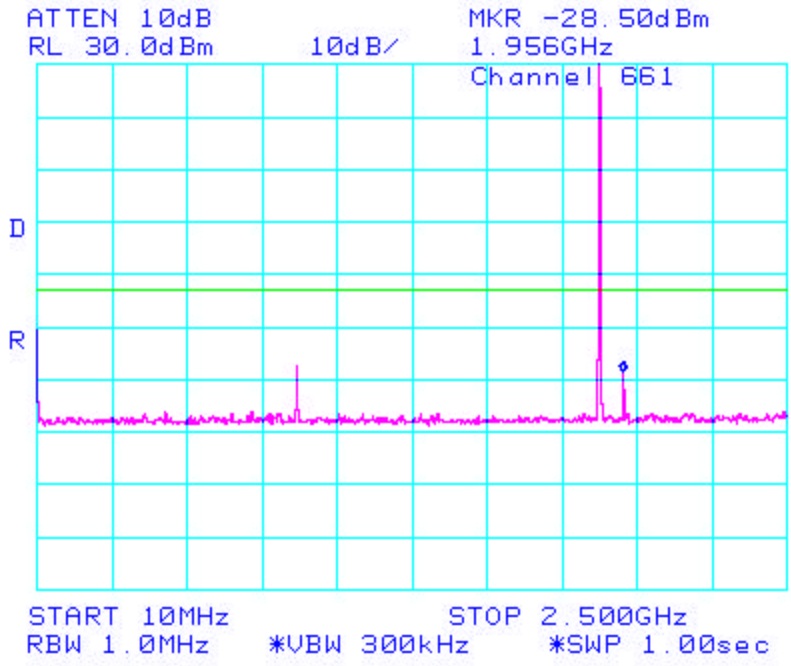


**Figure 8: PCS, Spurious Conducted Emissions, Low Channel**

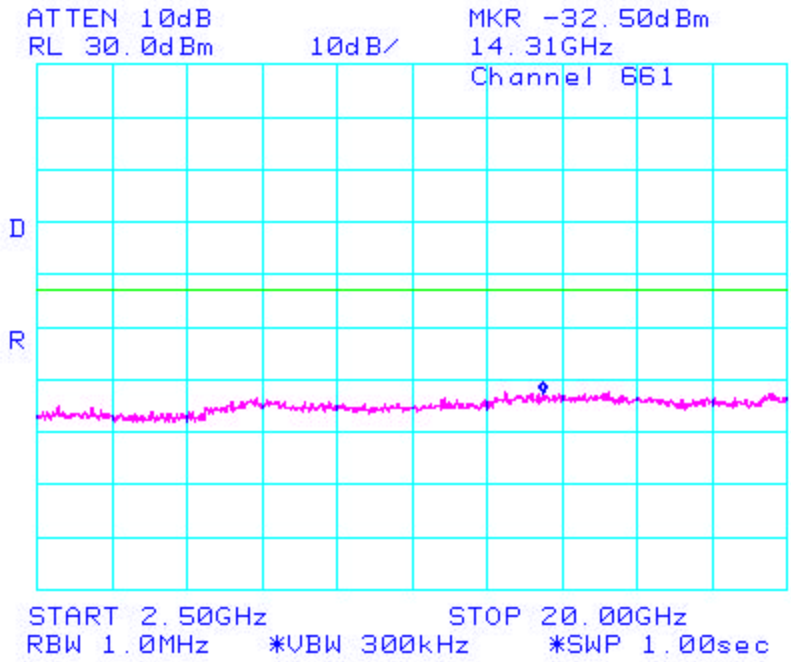


Conducted Emission Test Results Con't

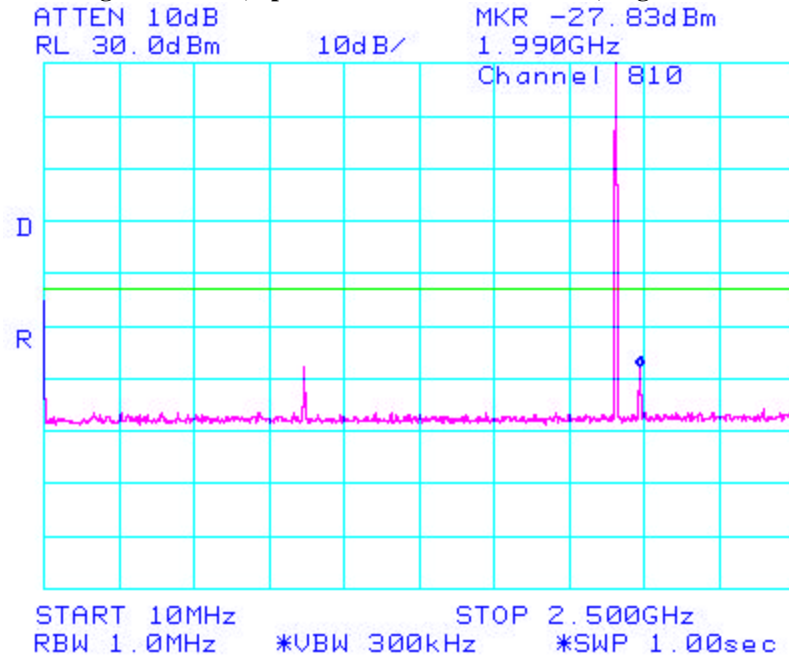
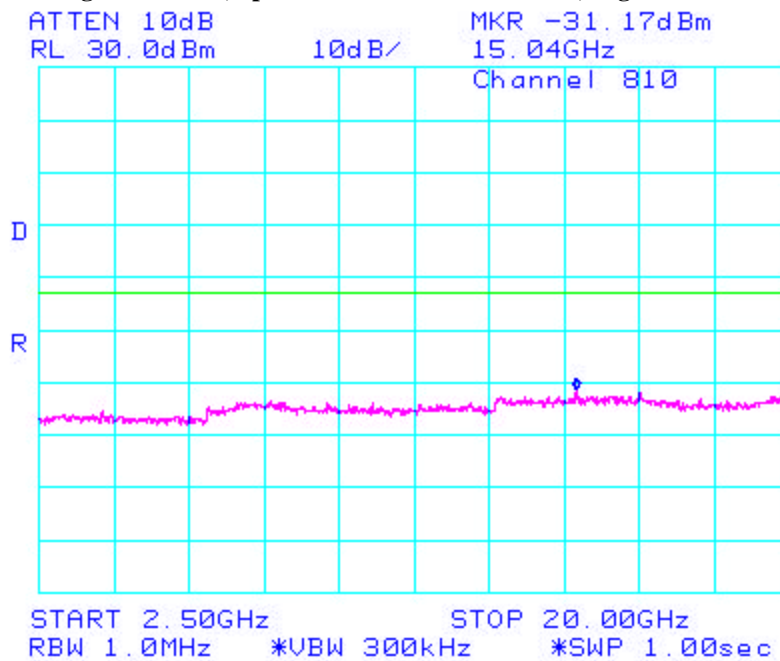
**Figure 9: PCS, Spurious Conducted Emissions, Middle Channel**

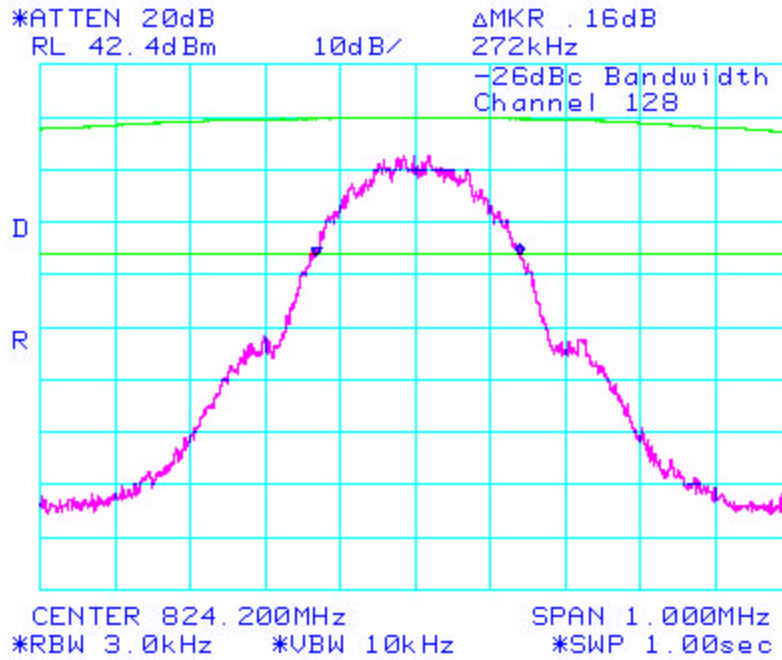
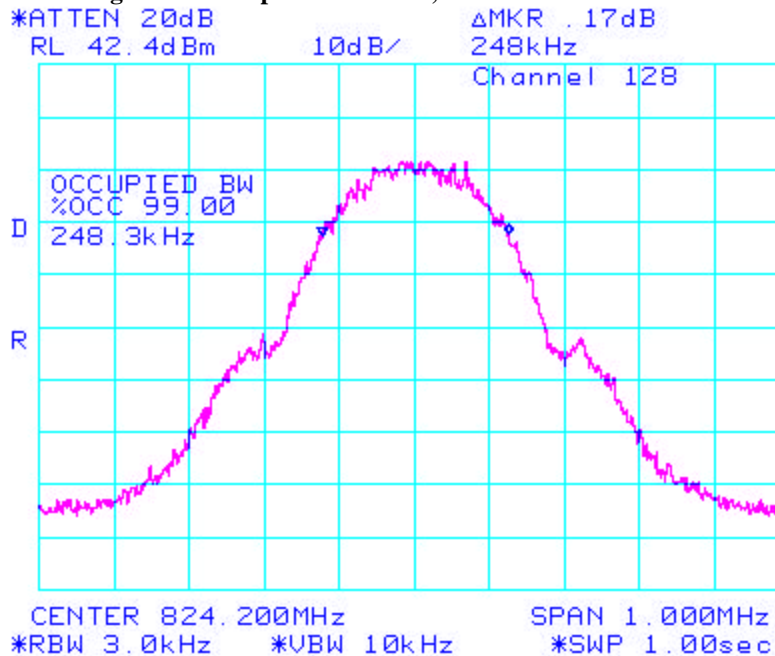


**Figure 10: PCS, Spurious Conducted Emissions, Middle Channel**



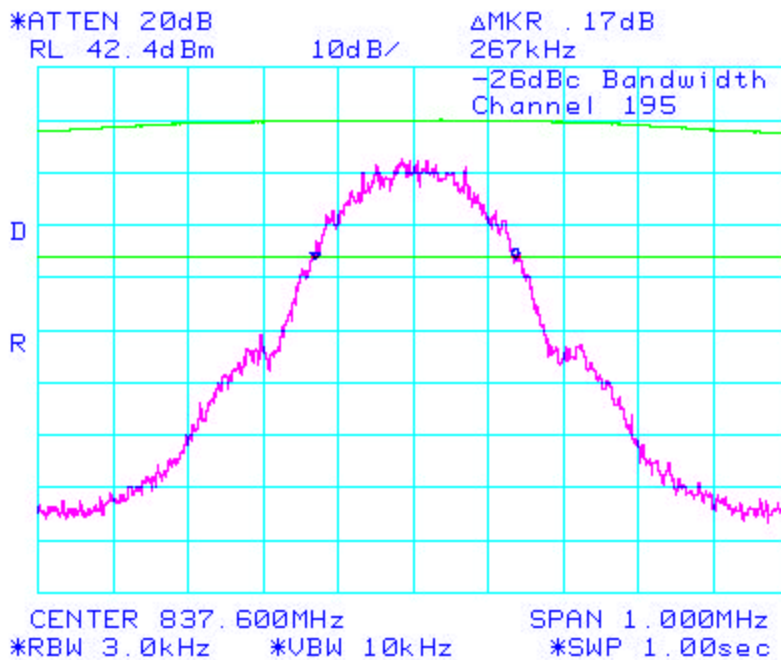


Conducted Emission Test Results Con't**Figure 11: PCS, Spurious Conducted Emissions, High Channel****Figure 12: PCS, Spurious Conducted Emissions, High Channel**

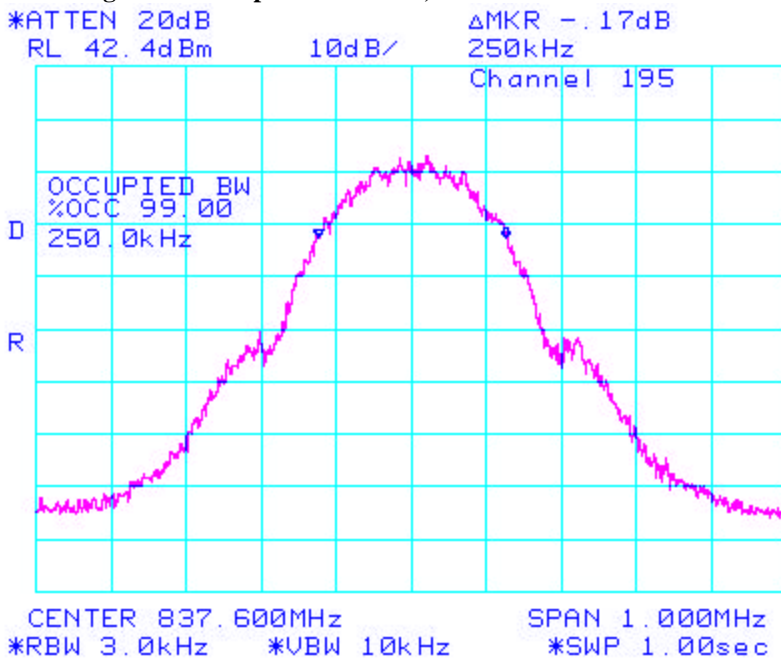
Conducted Emission Test Results Con't**Figure 13: -26dBc bandwidth, GSM 850 Low Channel****Figure 14: Occupied Bandwidth, GSM 850 Low Channel**

Conducted Emission Test Results Con't

**Figure 15: -26dBc bandwidth, GSM 850 Middle Channel**



**Figure 16: Occupied Bandwidth, GSM 850 Middle Channel**



Report No. RIM-0071-0310-01

Test Date: Test Date: May 26 to October 14, 2003

Conducted Emission Test Results Con't

Figure 17: -26dBc bandwidth, GSM 850 High Channel

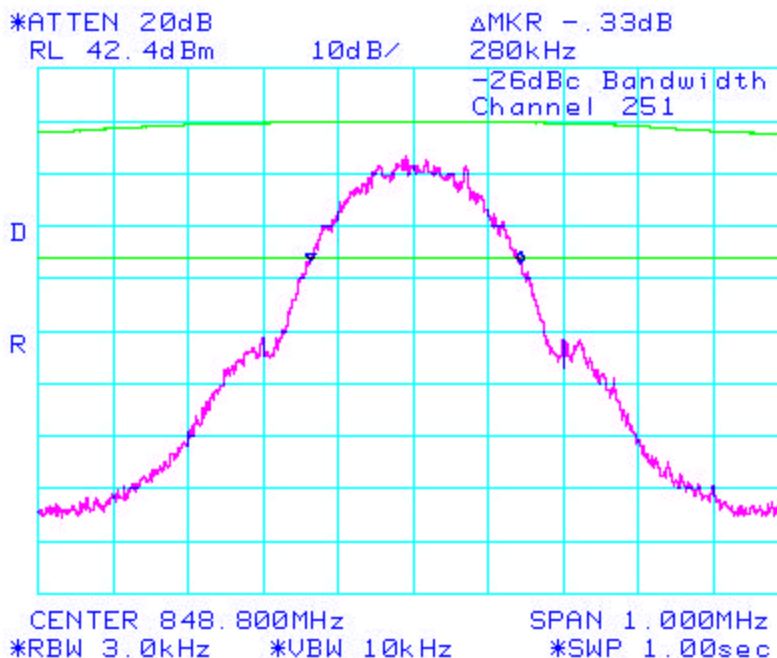
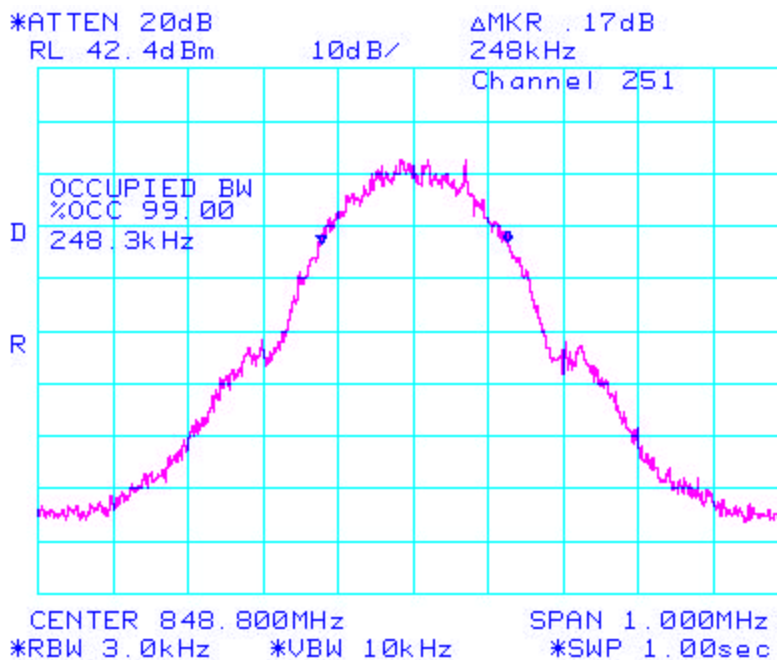
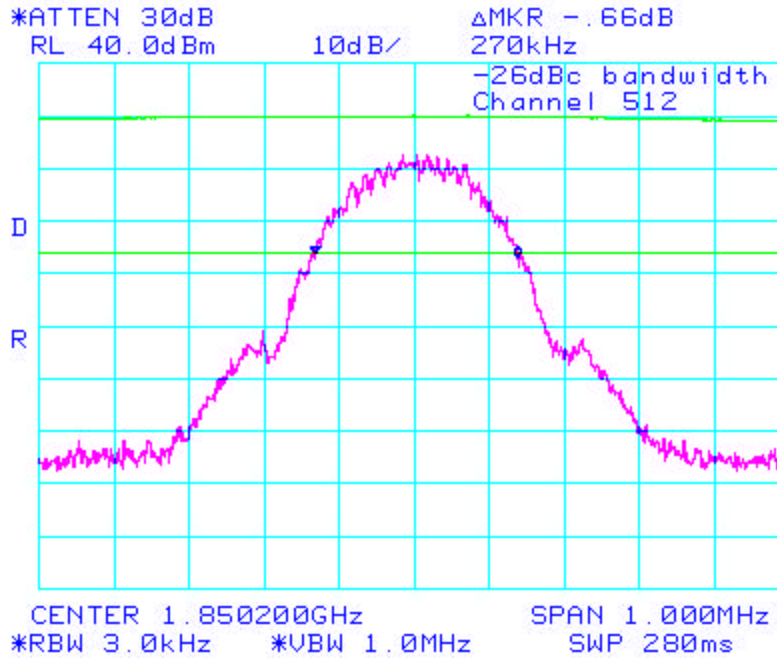
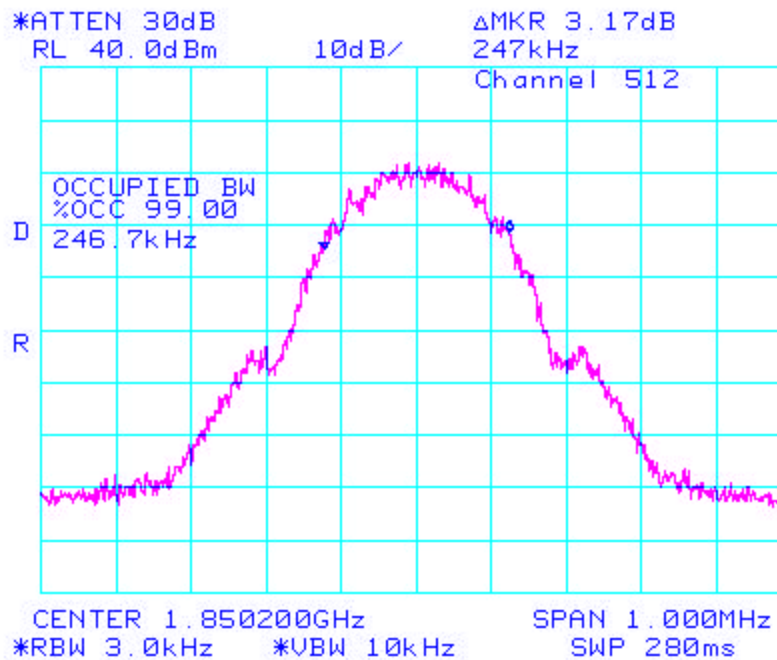


Figure 18: Occupied Bandwidth, GSM 850 High Channel



### Conducted Emission Test Results Con't

**Figure 19: -26dBc bandwidth, PCS Low Channel**

**Figure 20: Occupied Bandwidth, PCS Low Channel**


Conducted Emission Test Results Con't

Figure 21: -26dBc bandwidth, PCS Middle Channel

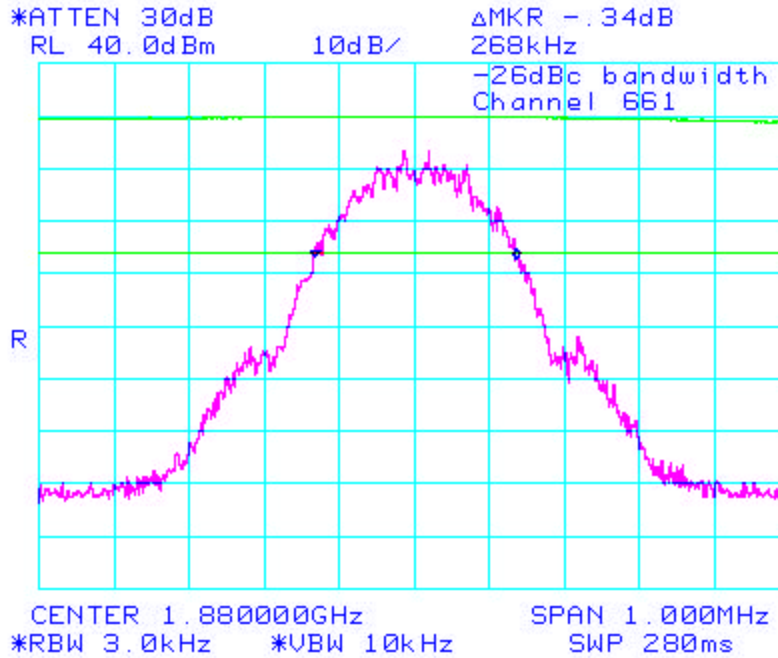
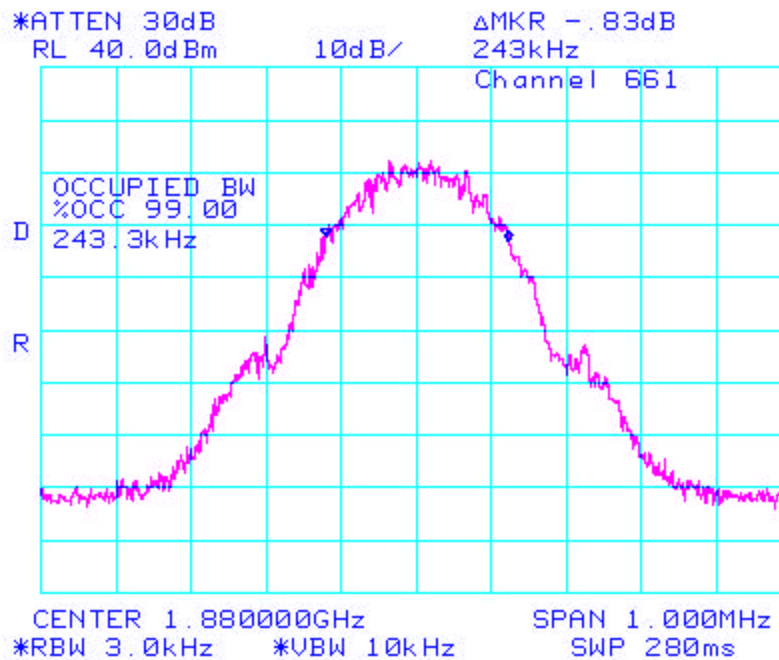
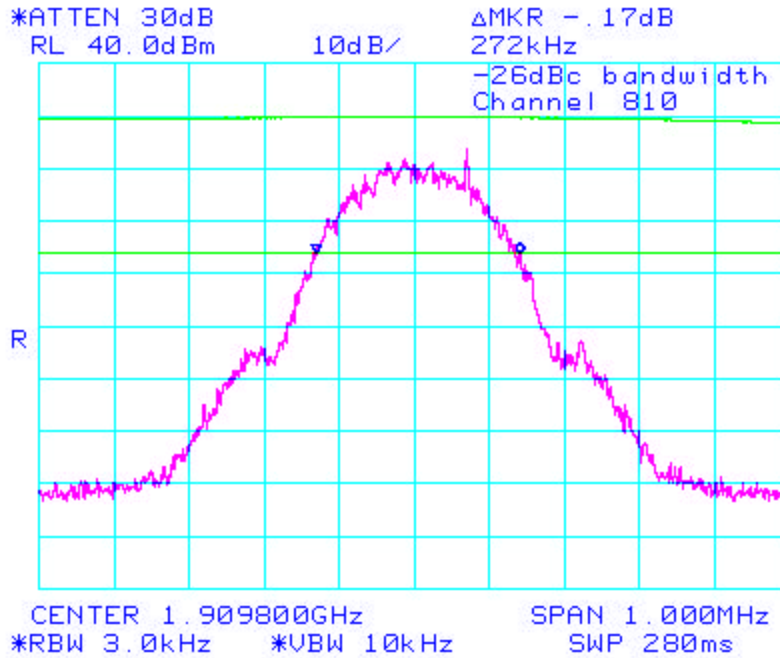
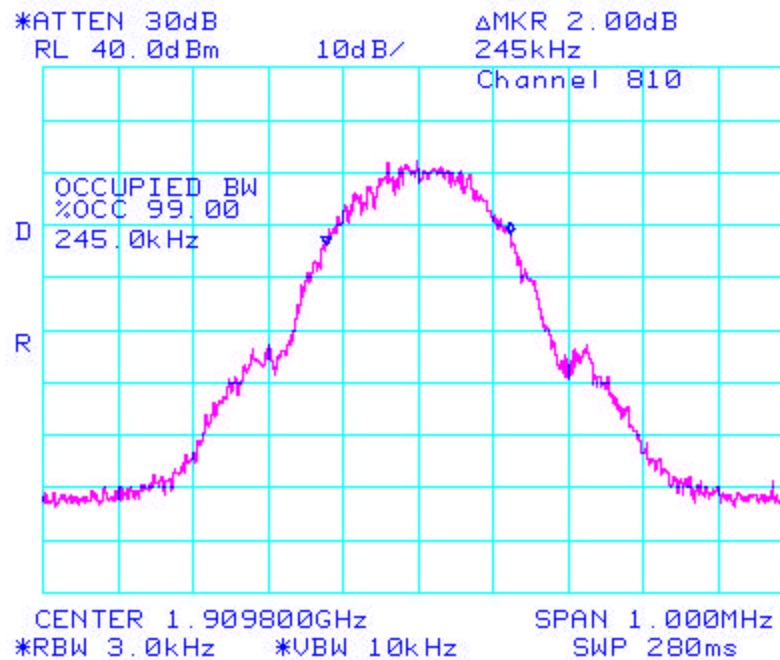
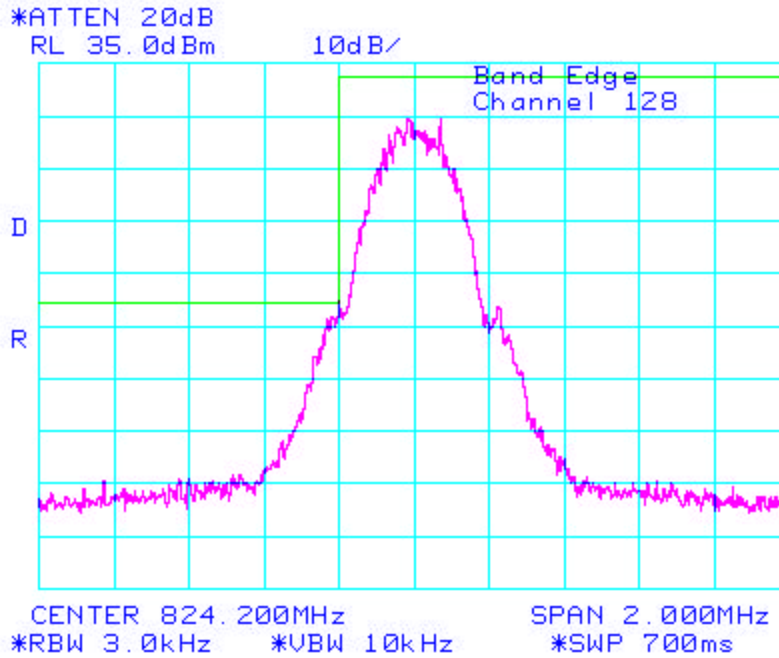
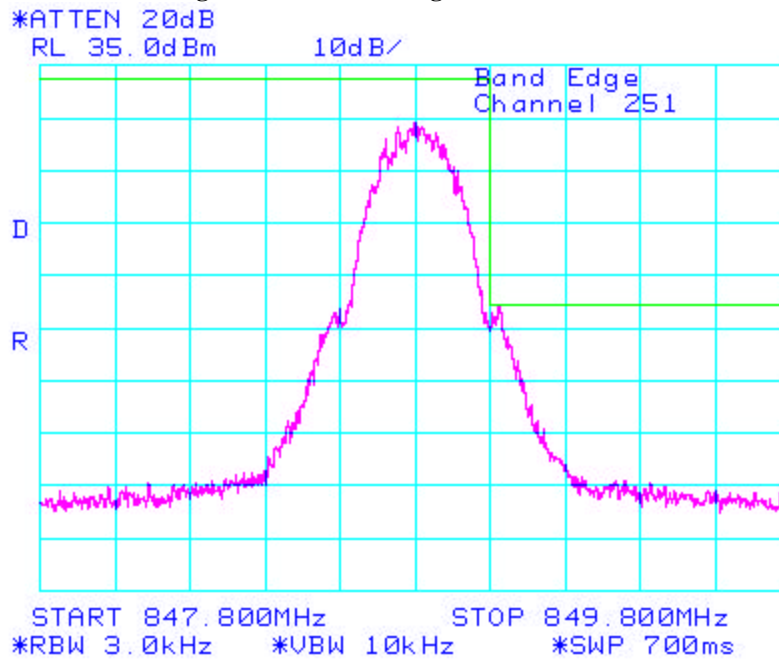


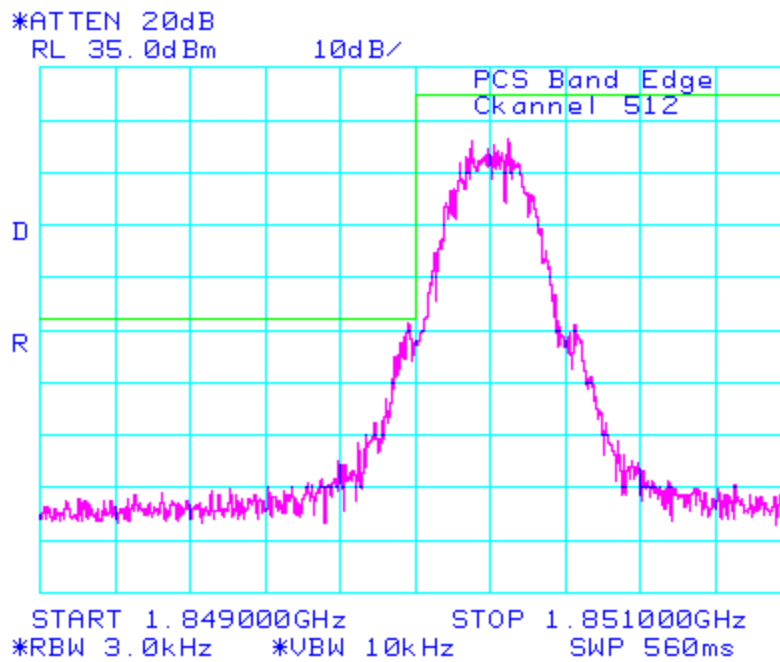
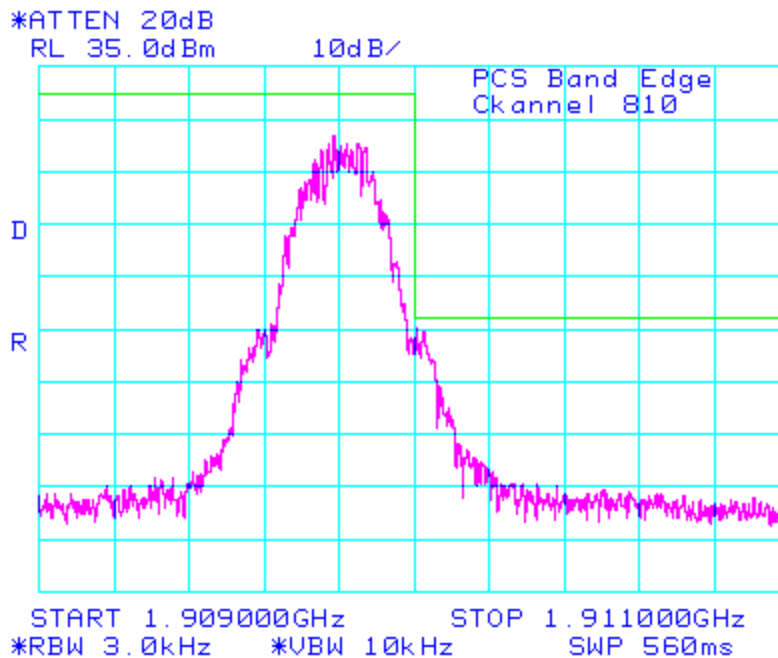
Figure 22: Occupied Bandwidth, PCS Middle Channel



Conducted Emission Test Results Con't**Figure 23: -26dBc bandwidth, PCS High Channel****Figure 24: Occupied Bandwidth, PCS High Channel**

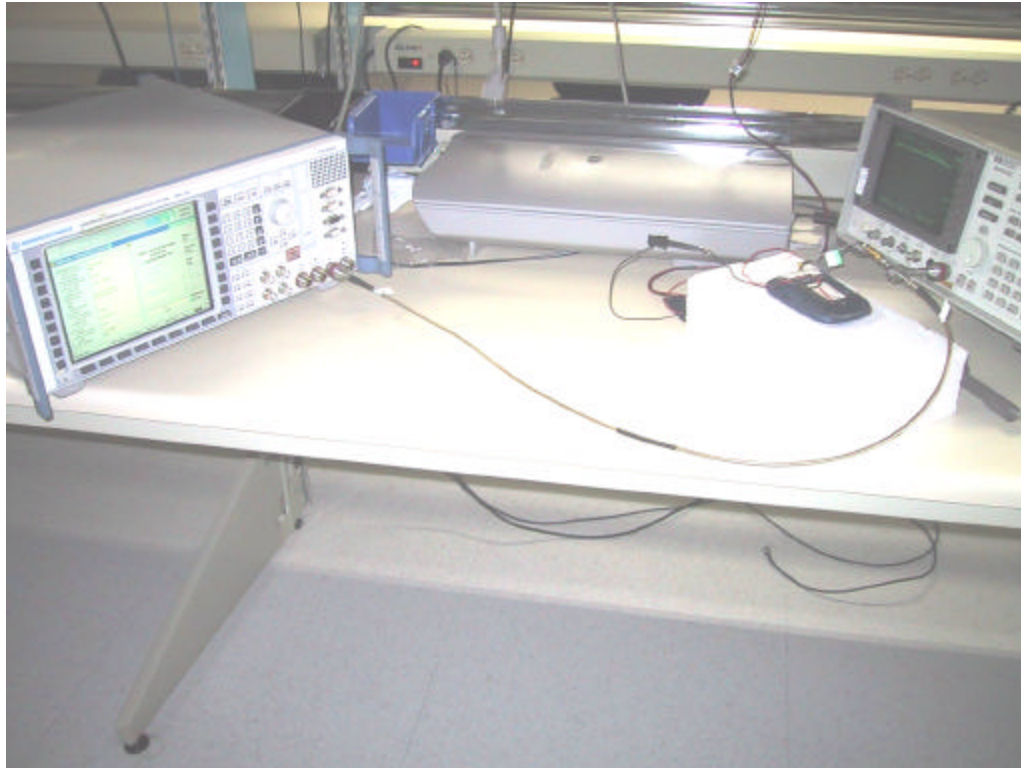
Conducted Emission Test Results Con't**Figure 25: GSM 850, Low Channel Mask****Figure 26: GSM 850 High Channel Mask**



Conducted Emission Test Results Con't**Figure27: PCS, Low Channel Mask****Figure28: PCS, High Channel Mask**

Conducted Emission Test-Setup Photo

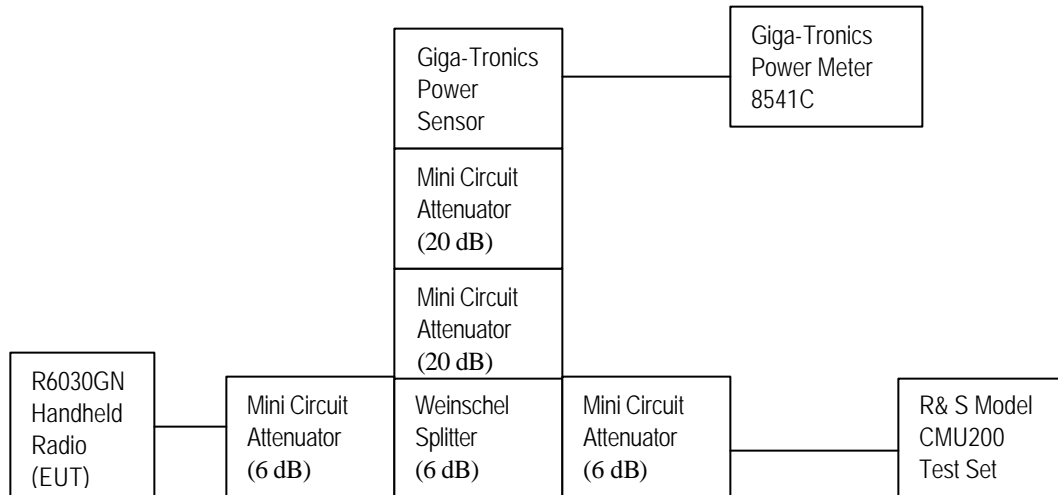
FCC CFR 47 Part 24, Subpart E, RSS-133



## APPENDIX 2

### CONDUCTED RF OUTPUT POWER TEST DATA

Conducted RF Output Power Test Data



**Test Equipment List**

| Test Instruments                     | Manufacturer    | Model No.    | Serial No. | Frequency Range |
|--------------------------------------|-----------------|--------------|------------|-----------------|
| Power Sensor                         | Giga-Tronics    | 80401A       | 1835838    | .01 – 18 GHz    |
| Power Meter                          | Giga-Tronics    | 8541C        | 1837762    | .01 – 18 GHz    |
| Splitter                             | Weinschel       | 1515         | ME092      | DC – 18 GHz     |
| Attenuator                           | Mini Circuit    | MCL BW-S20W2 | --         | DC – 18 GHz     |
| Attenuator                           | Mini Circuit    | MCL BW-S20W2 | --         | DC – 18 GHz     |
| Attenuator                           | Mini Circuit    | MCL BW-S6W2  | --         | DC – 18 GHz     |
| Attenuator                           | Mini Circuit    | MCL BW-S6W2  | --         | DC – 18 GHz     |
| Universal Radio Communication Tester | Rohde & Schwarz | CMU200       | 100249     | --              |

**Power Output for GSM850 and PCS**

At three transmit frequencies the maximum radio output power level was measured using the Power Meter. The calibrated insertion loss measured for the attenuator and cable assembly was added to the power measurements which produced the following results.

***Test Data***

Peak nominal output power is 32 dBm for GSM850 and 30 dBm for PCS.

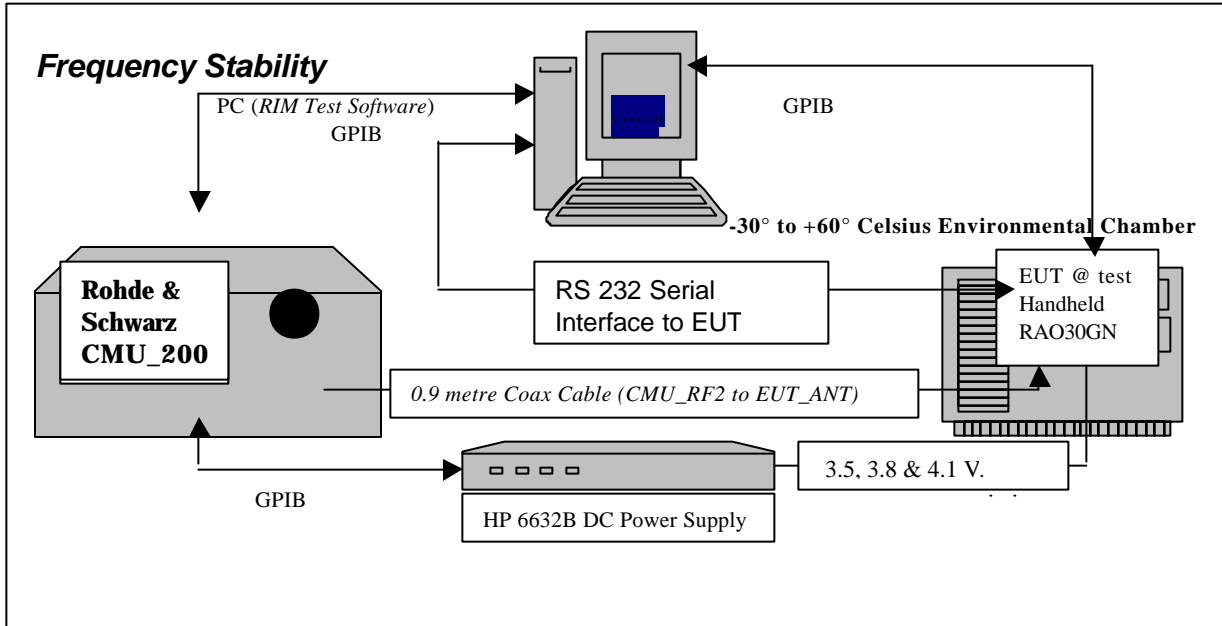
| Channel | GSM850 Frequency (MHz) | Measured Peak Conducted Power (dBm) | Total Correction Factor (dB) | Corrected Peak Conducted Power (dBm) |
|---------|------------------------|-------------------------------------|------------------------------|--------------------------------------|
| 128     | 824.2                  | -20.3                               | 52.4                         | 32.1                                 |
| 195     | 837.6                  | -20.4                               | 52.4                         | 32.0                                 |
| 251     | 848.8                  | -20.5                               | 52.4                         | 31.9                                 |

| Channel | PCS Frequency (MHz) | Measured Peak Conducted Power (dBm) | Total Correction Factor (dB) | Corrected Peak Conducted Power (dBm) |
|---------|---------------------|-------------------------------------|------------------------------|--------------------------------------|
| 512     | 1850.2              | -22.2                               | 52.6                         | 30.4                                 |
| 661     | 1880.0              | -22.2                               | 52.6                         | 30.4                                 |
| 810     | 1909.8              | -22.2                               | 52.6                         | 30.4                                 |

## APPENDIX 3

### FREQUENCY STABILITY TEST DATA

Frequency Stability Test Data



| <i>SYSTEM</i>                                | <i>Model</i> | <i>Serial Number</i> | <i>Calibration Due Date.</i> |
|--|--------------|----------------------|------------------------------|
| R & S Universal Radio Communication Test Set | CMU200       | 100249               | 04-April-2004                |
| HP System DC Power Supply                    | 6632B        | US37472178           | 01-Aug-2004                  |
| Network Analyzer                             | HP 8753D     | 3410A07083           | 31-July-2004                 |
| Calibration Kit                              | HP85033C     | 2920A02997           | 20-Aug-2004                  |
| Espec Environmental Chamber                  | SH240S1      | 91005607             | N/A                          |
| Hart Temperature Probe                       | 61161-302    | 21352860             | 15-Sept-2004                 |

CFR 47 Chapter 1 - Federal Communications Commission Rules

Part 2 Required Measurements

2.995 Frequency Stability - Procedures

(a,b) Frequency Stability - Temperature Variation

(d) Frequency Stability - Voltage Variation

**24.235** *Frequency Stability.*

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

The RAO30GN handheld, (referred as EUT herein and after) transmitted frequencies are less than 0.1 ppm of the received frequency from the Rhode & Schwarz CMU 200 Universal Radio Communication Test Set. *The EUT meets the requirements as stated in CFR 47 chapter 1, Section 24.235, RSS-133, CFR 47 chapter 1, Section 22.917 and RSS-128 Frequency Stability.*

Frequency Stability measurement devices were configured as presented in the block diagram recording frequency, power, data, temperatures, and stepped voltages controlled via a GPIB interface linked to the Environmental chamber, a DC power supply, and the Communications Test Set. A 1.9-meter coax cable was calibrated to characterize the insertion loss for the transmitted frequencies between the RF input/output of the CMU 200 and the EUT antenna port; located inside the environmental chamber.

Calibration for the Cable Loss was performed in the RF Laboratory on 30 May 2003.

Procedure:

Full\_ Two port Calibration of 8720D using the 85033D was completed.

The cable assembly from the RF input to the RF output was measured at the following Frequencies:

| PCS Frequency (MHz) | Cable loss (dB) | GSM 850 Frequency (MHz) | Cable loss (dB) |
|---------------------|-----------------|-------------------------|-----------------|
| 1850.2              | 2.67            | 824.2                   | 1.80            |
| 1880.0              | 2.67            | 836.4                   | 1.80            |
| 1909.8              | 2.67            | 848.6                   | 1.80            |

Procedure:

The EUT was placed in the Temperature chamber and connected to CMU 200 outside as shown in the figure above. Dry air was pumped inside the temperature chamber to maintain a backpressure during the test. The EUT was kept in the off condition at all times except when the measurements were to be made.

The chamber was switched on and the temperature was set to -30°C.

After the chamber stabilized at -30 °C there was a soak period of one hour to alleviate moisture in the chamber, the EUT voltage was enabled.

The system software recorded the frequency, power, and associated measurements.

A Computer system controlled the automated software. This application was given the command of activating all machines intrinsic to the temperature and voltage tests controlling the CMU 200 via the GPIB Bus. The Environmental Chamber was instructed through an RS-232 serial line. The EUT dialogue was passed through a serial connection.

The EUT repetitively transmitted 100 bursts for each set of programmed parameters recording temperature, voltage settings, and systematically selected frequencies. The power supply was cycled from minimum voltage 3.5 volts, to 3.8 volts to 4.1 volts nominal voltage.

The frequency error was measured at a maximum output power and recorded by the automated system test software.



The EUT output power and frequency was measured at 3.5 volts, 3.8 volts and 4.1 volts. The transmit frequency was varied in 3 steps consisting of 824.2, 836.4, and 848.6 MHz for the GSM850 band and 1850.2, 1880.0 and 1909.8 MHz for the PCS band. This frequency was recorded in MHz and deviation from nominal, in Parts Per Million.

After the initial one-hour soak at the beginning of the start of the measurement tests, a period of thirty minutes soak was initialized between each ascending temperature step, before proceeding to the next measurement test cycle.

#### PROCEDURE:

The test system software for commencing the Frequency Stability Tests carried through the following cycle.

1. Switch on the HP 6632B power supply; CMU 200 Communications test Set, and Environmental Chamber.
2. Start test program
3. Set the Temperature to  $-30$  degrees Celsius and maintain a period of one- hour soak time, with the EUT supply voltage disabled.
4. Set power supply voltage to 3.5 Volts.
5. Set up CMU 200 Radio Communication Tester.
6. Command the CMU 200 to switch to the low channel.
7. Enable the voltage to the EUT, and connect a link to the CMU 200 test set.
8. EUT is commanded to Transmit 100 Bursts.
9. Software logs the following data from the CMU 200, power supply and temperature chamber: Traffic Channel Number, Traffic Channel Frequency, Power Level, Chamber Temperature, Supply Voltage, Power, Frequency Error.
10. The CMU 200 commands the EUT to change frequency to the middle channel and high channel and repeats steps 7 to 9.
11. Repeat steps 5 to 10 changing the supply voltage to 3.8 Volts
12. Increase temperature by  $10^{\circ}\text{C}$  and soak for 1/2 hour.
13. Repeat steps 4 - 12 for temperatures  $-30$  degrees to  $60$  degrees Celsius.
14. Repeat steps 5 to 10 changing the supply voltage to 4.1 Volts

Procedure 5 to 10 was repeated at room temperature ( $20^{\circ}\text{C}$ ) with the power supply voltage set to 3.5, 3.8 and 4.1 Volts.

The maximum frequency error in the GSM850 band measured was  $-0.0970$  PPM.

The maximum frequency error in the PCS band measured was  $-0.0503$  PPM.

GSM 850 Channel results: channels 128, 189 and 250 @ 20°C maximum transmitted power

| <i>Traffic Channel Number</i> | <i>GSM 850 Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|--------------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                          | 3.5                    | 20                           | -42.42                      | -0.0515    |
| 189                           | 836.4                          | 3.5                    | 20                           | -27.96                      | -0.0334    |
| 250                           | 848.6                          | 3.5                    | 20                           | -39.97                      | -0.0471    |

| <i>Traffic Channel Number</i> | <i>GSM 850 Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|--------------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                          | 3.8                    | 20                           | -44.23                      | -0.0537    |
| 189                           | 836.4                          | 3.8                    | 20                           | -23.31                      | -0.0279    |
| 250                           | 848.6                          | 3.8                    | 20                           | -45.46                      | -0.0536    |

| <i>Traffic Channel Number</i> | <i>GSM 850 Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|--------------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                          | 4.1                    | 20                           | -51.59                      | -0.0626    |
| 189                           | 836.4                          | 4.1                    | 20                           | -22.99                      | -0.0275    |
| 250                           | 848.6                          | 4.1                    | 20                           | -30.93                      | -0.0364    |

PCS Channel results: channels 512, 661, & 810 @ 20°C maximum transmitted power

| <i>Traffic Channel Number</i> | <i>PCS Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|----------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                     | 3.5                    | 20                           | 35.51                       | 0.0192     |
| 661                           | 1880.0                     | 3.5                    | 20                           | 41.91                       | 0.0223     |
| 810                           | 1909.8                     | 3.5                    | 20                           | 41.65                       | 0.0218     |

| <i>Traffic Channel Number</i> | <i>PCS Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|----------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                     | 3.8                    | 20                           | 33.96                       | 0.0184     |
| 661                           | 1880.0                     | 3.8                    | 20                           | 42.04                       | 0.0224     |
| 810                           | 1909.8                     | 3.8                    | 20                           | 42.36                       | 0.0222     |

| <i>Traffic Channel Number</i> | <i>PCS Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|----------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                     | 4.1                    | 20                           | 36.87                       | 0.0199     |
| 661                           | 1880.0                     | 4.1                    | 20                           | 37.77                       | 0.0201     |
| 810                           | 1909.8                     | 4.1                    | 20                           | 40.49                       | 0.0212     |

GSM850 Results: channel 128 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                  | 3.5                    | -30                          | -41.58                      | -0.0504    |
| 128                           | 824.2                  | 3.5                    | -20                          | -54.11                      | -0.0657    |
| 128                           | 824.2                  | 3.5                    | -10                          | -79.94                      | -0.0970    |
| 128                           | 824.2                  | 3.5                    | 0                            | -56.18                      | -0.0682    |
| 128                           | 824.2                  | 3.5                    | 10                           | -37.77                      | -0.0458    |
| 128                           | 824.2                  | 3.5                    | 20                           | -42.42                      | -0.0515    |
| 128                           | 824.2                  | 3.5                    | 30                           | -48.95                      | -0.0594    |
| 128                           | 824.2                  | 3.5                    | 40                           | -63.93                      | -0.0776    |
| 128                           | 824.2                  | 3.5                    | 50                           | -26.93                      | -0.0327    |
| 128                           | 824.2                  | 3.5                    | 60                           | -40.62                      | -0.0493    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                  | 3.8                    | -30                          | -51.66                      | -0.0627    |
| 128                           | 824.2                  | 3.8                    | -20                          | -54.69                      | -0.0664    |
| 128                           | 824.2                  | 3.8                    | -10                          | -76.45                      | -0.0928    |
| 128                           | 824.2                  | 3.8                    | 0                            | -63.22                      | -0.0767    |
| 128                           | 824.2                  | 3.8                    | 10                           | -34.42                      | -0.0418    |
| 128                           | 824.2                  | 3.8                    | 20                           | -44.23                      | -0.0537    |
| 128                           | 824.2                  | 3.8                    | 30                           | -41.00                      | -0.0497    |
| 128                           | 824.2                  | 3.8                    | 40                           | -49.72                      | -0.0603    |
| 128                           | 824.2                  | 3.8                    | 50                           | -27.89                      | -0.0338    |
| 128                           | 824.2                  | 3.8                    | 60                           | -32.16                      | -0.0390    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 128                           | 824.2                  | 4.1                    | -30                          | -50.75                      | -0.0616    |
| 128                           | 824.2                  | 4.1                    | -20                          | -51.72                      | -0.0628    |
| 128                           | 824.2                  | 4.1                    | -10                          | -71.55                      | -0.0868    |
| 128                           | 824.2                  | 4.1                    | 0                            | -59.08                      | -0.0717    |
| 128                           | 824.2                  | 4.1                    | 10                           | -32.48                      | -0.0394    |
| 128                           | 824.2                  | 4.1                    | 20                           | -51.59                      | -0.0626    |
| 128                           | 824.2                  | 4.1                    | 30                           | -39.65                      | -0.0481    |
| 128                           | 824.2                  | 4.1                    | 40                           | -56.44                      | -0.0685    |
| 128                           | 824.2                  | 4.1                    | 50                           | -27.77                      | -0.0337    |
| 128                           | 824.2                  | 4.1                    | 60                           | -36.68                      | -0.0445    |

GSM850 Results: channel 189 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 189                           | 836.4                  | 3.5                    | -30                          | -71.42                      | -0.0854    |
| 189                           | 836.4                  | 3.5                    | -20                          | -25.83                      | -0.0309    |
| 189                           | 836.4                  | 3.5                    | -10                          | -54.43                      | -0.0651    |
| 189                           | 836.4                  | 3.5                    | 0                            | -56.11                      | -0.0671    |
| 189                           | 836.4                  | 3.5                    | 10                           | -27.83                      | -0.0333    |
| 189                           | 836.4                  | 3.5                    | 20                           | -27.96                      | -0.0334    |
| 189                           | 836.4                  | 3.5                    | 30                           | -22.41                      | -0.0268    |
| 189                           | 836.4                  | 3.5                    | 40                           | -45.91                      | -0.0549    |
| 189                           | 836.4                  | 3.5                    | 50                           | -31.38                      | -0.0375    |
| 189                           | 836.4                  | 3.5                    | 60                           | -39.32                      | -0.0470    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 189                           | 836.4                  | 3.8                    | -30                          | -65.09                      | -0.0778    |
| 189                           | 836.4                  | 3.8                    | -20                          | -28.80                      | -0.0344    |
| 189                           | 836.4                  | 3.8                    | -10                          | -61.08                      | -0.0730    |
| 189                           | 836.4                  | 3.8                    | 0                            | -46.17                      | -0.0552    |
| 189                           | 836.4                  | 3.8                    | 10                           | -22.34                      | -0.0267    |
| 189                           | 836.4                  | 3.8                    | 20                           | -23.31                      | -0.0279    |
| 189                           | 836.4                  | 3.8                    | 30                           | -23.18                      | -0.0277    |
| 189                           | 836.4                  | 3.8                    | 40                           | -51.53                      | -0.0616    |
| 189                           | 836.4                  | 3.8                    | 50                           | -27.12                      | -0.0324    |
| 189                           | 836.4                  | 3.8                    | 60                           | -37.84                      | -0.0452    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 189                           | 836.4                  | 4.1                    | -30                          | -56.95                      | -0.0681    |
| 189                           | 836.4                  | 4.1                    | -20                          | -26.67                      | -0.0319    |
| 189                           | 836.4                  | 4.1                    | -10                          | -55.53                      | -0.0664    |
| 189                           | 836.4                  | 4.1                    | 0                            | -48.30                      | -0.0577    |
| 189                           | 836.4                  | 4.1                    | 10                           | -23.57                      | -0.0282    |
| 189                           | 836.4                  | 4.1                    | 20                           | -22.99                      | -0.0275    |
| 189                           | 836.4                  | 4.1                    | 30                           | -27.96                      | -0.0334    |
| 189                           | 836.4                  | 4.1                    | 40                           | -52.43                      | -0.0627    |
| 189                           | 836.4                  | 4.1                    | 50                           | -24.92                      | -0.0298    |
| 189                           | 836.4                  | 4.1                    | 60                           | -42.29                      | -0.0506    |

GSM850 Results: channel 250 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 250                           | 848.6                  | 3.5                    | -30                          | -44.23                      | -0.0521    |
| 250                           | 848.6                  | 3.5                    | -20                          | -66.06                      | -0.0778    |
| 250                           | 848.6                  | 3.5                    | -10                          | -43.07                      | -0.0508    |
| 250                           | 848.6                  | 3.5                    | 0                            | -28.73                      | -0.0339    |
| 250                           | 848.6                  | 3.5                    | 10                           | -33.84                      | -0.0399    |
| 250                           | 848.6                  | 3.5                    | 20                           | -39.97                      | -0.0471    |
| 250                           | 848.6                  | 3.5                    | 30                           | -22.60                      | -0.0266    |
| 250                           | 848.6                  | 3.5                    | 40                           | -52.56                      | -0.0619    |
| 250                           | 848.6                  | 3.5                    | 50                           | -30.28                      | -0.0357    |
| 250                           | 848.6                  | 3.5                    | 60                           | -31.25                      | -0.0368    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 250                           | 848.6                  | 3.8                    | -30                          | -50.30                      | -0.0593    |
| 250                           | 848.6                  | 3.8                    | -20                          | -58.05                      | -0.0684    |
| 250                           | 848.6                  | 3.8                    | -10                          | -51.01                      | -0.0601    |
| 250                           | 848.6                  | 3.8                    | 0                            | -16.47                      | -0.0194    |
| 250                           | 848.6                  | 3.8                    | 10                           | -36.61                      | -0.0431    |
| 250                           | 848.6                  | 3.8                    | 20                           | -45.46                      | -0.0536    |
| 250                           | 848.6                  | 3.8                    | 30                           | -28.41                      | -0.0335    |
| 250                           | 848.6                  | 3.8                    | 40                           | -56.63                      | -0.0667    |
| 250                           | 848.6                  | 3.8                    | 50                           | -31.96                      | -0.0377    |
| 250                           | 848.6                  | 3.8                    | 60                           | -37.06                      | -0.0437    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 250                           | 848.6                  | 4.1                    | -30                          | -43.78                      | -0.0516    |
| 250                           | 848.6                  | 4.1                    | -20                          | -62.18                      | -0.0733    |
| 250                           | 848.6                  | 4.1                    | -10                          | -44.23                      | -0.0521    |
| 250                           | 848.6                  | 4.1                    | 0                            | -17.76                      | -0.0209    |
| 250                           | 848.6                  | 4.1                    | 10                           | -32.29                      | -0.0381    |
| 250                           | 848.6                  | 4.1                    | 20                           | -30.93                      | -0.0364    |
| 250                           | 848.6                  | 4.1                    | 30                           | -30.41                      | -0.0358    |
| 250                           | 848.6                  | 4.1                    | 40                           | -42.62                      | -0.0502    |
| 250                           | 848.6                  | 4.1                    | 50                           | -26.02                      | -0.0307    |
| 250                           | 848.6                  | 4.1                    | 60                           | -31.32                      | -0.0369    |

PCS 1900 Results: channel 512 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                 | 3.5                    | -30                          | 39.32                       | 0.0213     |
| 512                           | 1850.2                 | 3.5                    | -20                          | 30.15                       | 0.0163     |
| 512                           | 1850.2                 | 3.5                    | -10                          | 25.83                       | 0.0140     |
| 512                           | 1850.2                 | 3.5                    | 0                            | 30.15                       | 0.0163     |
| 512                           | 1850.2                 | 3.5                    | 10                           | 31.06                       | 0.0168     |
| 512                           | 1850.2                 | 3.5                    | 20                           | 35.51                       | 0.0192     |
| 512                           | 1850.2                 | 3.5                    | 30                           | 24.47                       | 0.0132     |
| 512                           | 1850.2                 | 3.5                    | 40                           | -71.80                      | -0.0388    |
| 512                           | 1850.2                 | 3.5                    | 50                           | 23.50                       | 0.0127     |
| 512                           | 1850.2                 | 3.5                    | 60                           | -53.40                      | -0.0289    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                 | 3.8                    | -30                          | 32.48                       | 0.0176     |
| 512                           | 1850.2                 | 3.8                    | -20                          | 37.84                       | 0.0205     |
| 512                           | 1850.2                 | 3.8                    | -10                          | 39.13                       | 0.0211     |
| 512                           | 1850.2                 | 3.8                    | 0                            | 22.54                       | 0.0122     |
| 512                           | 1850.2                 | 3.8                    | 10                           | 43.59                       | 0.0236     |
| 512                           | 1850.2                 | 3.8                    | 20                           | 33.96                       | 0.0184     |
| 512                           | 1850.2                 | 3.8                    | 30                           | 20.47                       | 0.0111     |
| 512                           | 1850.2                 | 3.8                    | 40                           | -92.98                      | -0.0503    |
| 512                           | 1850.2                 | 3.8                    | 50                           | -17.69                      | -0.0096    |
| 512                           | 1850.2                 | 3.8                    | 60                           | -58.63                      | -0.0317    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 512                           | 1850.2                 | 4.1                    | -30                          | -24.28                      | -0.0131    |
| 512                           | 1850.2                 | 4.1                    | -20                          | 36.87                       | 0.0199     |
| 512                           | 1850.2                 | 4.1                    | -10                          | 39.91                       | 0.0216     |
| 512                           | 1850.2                 | 4.1                    | 0                            | 27.89                       | 0.0151     |
| 512                           | 1850.2                 | 4.1                    | 10                           | 27.25                       | 0.0147     |
| 512                           | 1850.2                 | 4.1                    | 20                           | 34.87                       | 0.0188     |
| 512                           | 1850.2                 | 4.1                    | 30                           | 28.28                       | 0.0153     |
| 512                           | 1850.2                 | 4.1                    | 40                           | -88.14                      | -0.0476    |
| 512                           | 1850.2                 | 4.1                    | 50                           | 18.27                       | 0.0099     |
| 512                           | 1850.2                 | 4.1                    | 60                           | -52.88                      | -0.0286    |

PCS 1900 Results: channel 661 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 661                           | 1880.0                 | 3.5                    | -30                          | 33.19                       | 0.0177     |
| 661                           | 1880.0                 | 3.5                    | -20                          | 55.92                       | 0.0297     |
| 661                           | 1880.0                 | 3.5                    | -10                          | 45.59                       | 0.0243     |
| 661                           | 1880.0                 | 3.5                    | 0                            | 40.03                       | 0.0213     |
| 661                           | 1880.0                 | 3.5                    | 10                           | 34.74                       | 0.0185     |
| 661                           | 1880.0                 | 3.5                    | 20                           | 41.91                       | 0.0223     |
| 661                           | 1880.0                 | 3.5                    | 30                           | 16.66                       | 0.0089     |
| 661                           | 1880.0                 | 3.5                    | 40                           | -86.01                      | -0.0458    |
| 661                           | 1880.0                 | 3.5                    | 50                           | 21.24                       | 0.0113     |
| 661                           | 1880.0                 | 3.5                    | 60                           | -51.79                      | -0.0275    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 661                           | 1880.0                 | 3.8                    | -30                          | 28.86                       | 0.0154     |
| 661                           | 1880.0                 | 3.8                    | -20                          | 50.11                       | 0.0278     |
| 661                           | 1880.0                 | 3.8                    | -10                          | 52.24                       | 0.0154     |
| 661                           | 1880.0                 | 3.8                    | 0                            | 36.81                       | 0.0267     |
| 661                           | 1880.0                 | 3.8                    | 10                           | 51.98                       | 0.0276     |
| 661                           | 1880.0                 | 3.8                    | 20                           | 42.04                       | 0.0224     |
| 661                           | 1880.0                 | 3.8                    | 30                           | 21.11                       | 0.0112     |
| 661                           | 1880.0                 | 3.8                    | 40                           | -75.87                      | -0.0404    |
| 661                           | 1880.0                 | 3.8                    | 50                           | 27.70                       | 0.0147     |
| 661                           | 1880.0                 | 3.8                    | 60                           | -55.08                      | -0.0293    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 661                           | 1880.0                 | 4.1                    | -30                          | 29.77                       | 0.0158     |
| 661                           | 1880.0                 | 4.1                    | -20                          | 45.07                       | 0.0240     |
| 661                           | 1880.0                 | 4.1                    | -10                          | 49.40                       | 0.0263     |
| 661                           | 1880.0                 | 4.1                    | 0                            | 39.13                       | 0.0208     |
| 661                           | 1880.0                 | 4.1                    | 10                           | 42.29                       | 0.0225     |
| 661                           | 1880.0                 | 4.1                    | 20                           | 37.77                       | 0.0201     |
| 661                           | 1880.0                 | 4.1                    | 30                           | 31.38                       | 0.0167     |
| 661                           | 1880.0                 | 4.1                    | 40                           | -78.33                      | -0.0417    |
| 661                           | 1880.0                 | 4.1                    | 50                           | 24.92                       | 0.0133     |
| 661                           | 1880.0                 | 4.1                    | 60                           | 43.20                       | 0.0230     |

PCS 1900 Results: channel 810 @ maximum transmitted power

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 810                           | 1909.8                 | 3.5                    | -30                          | 46.04                       | 0.0241     |
| 810                           | 1909.8                 | 3.5                    | -20                          | 61.54                       | 0.0322     |
| 810                           | 1909.8                 | 3.5                    | -10                          | 61.54                       | 0.0322     |
| 810                           | 1909.8                 | 3.5                    | 0                            | 42.75                       | 0.0224     |
| 810                           | 1909.8                 | 3.5                    | 10                           | 32.87                       | 0.0172     |
| 810                           | 1909.8                 | 3.5                    | 20                           | 41.65                       | 0.0218     |
| 810                           | 1909.8                 | 3.5                    | 30                           | 21.44                       | 0.0112     |
| 810                           | 1909.8                 | 3.5                    | 40                           | -66.19                      | -0.0347    |
| 810                           | 1909.8                 | 3.5                    | 50                           | 25.76                       | 0.0135     |
| 810                           | 1909.8                 | 3.5                    | 60                           | -52.56                      | -0.0275    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 810                           | 1909.8                 | 3.8                    | -30                          | 24.41                       | 0.0128     |
| 810                           | 1909.8                 | 3.8                    | -20                          | 69.22                       | 0.0362     |
| 810                           | 1909.8                 | 3.8                    | -10                          | 51.46                       | 0.0269     |
| 810                           | 1909.8                 | 3.8                    | 0                            | 49.78                       | 0.0261     |
| 810                           | 1909.8                 | 3.8                    | 10                           | 52.11                       | 0.0273     |
| 810                           | 1909.8                 | 3.8                    | 20                           | 42.36                       | 0.0222     |
| 810                           | 1909.8                 | 3.8                    | 30                           | 22.21                       | 0.0116     |
| 810                           | 1909.8                 | 3.8                    | 40                           | -78.20                      | -0.0409    |
| 810                           | 1909.8                 | 3.8                    | 50                           | 36.48                       | 0.0191     |
| 810                           | 1909.8                 | 3.8                    | 60                           | -49.85                      | -0.0261    |

| <i>Traffic Channel Number</i> | <i>Frequency (MHz)</i> | <i>Voltage (Volts)</i> | <i>Temperature (Celsius)</i> | <i>Frequency Error (Hz)</i> | <i>PPM</i> |
|-------------------------------|------------------------|------------------------|------------------------------|-----------------------------|------------|
| 810                           | 1909.8                 | 4.1                    | -30                          | 19.05                       | 0.0100     |
| 810                           | 1909.8                 | 4.1                    | -20                          | 47.01                       | 0.0246     |
| 810                           | 1909.8                 | 4.1                    | -10                          | 49.72                       | 0.0260     |
| 810                           | 1909.8                 | 4.1                    | 0                            | 53.53                       | 0.0280     |
| 810                           | 1909.8                 | 4.1                    | 10                           | 39.97                       | 0.0209     |
| 810                           | 1909.8                 | 4.1                    | 20                           | 40.49                       | 0.0212     |
| 810                           | 1909.8                 | 4.1                    | 30                           | 35.39                       | 0.0185     |
| 810                           | 1909.8                 | 4.1                    | 40                           | -73.74                      | -0.0386    |
| 810                           | 1909.8                 | 4.1                    | 50                           | 23.83                       | 0.0125     |
| 810                           | 1909.8                 | 4.1                    | 60                           | -41.97                      | -0.0220    |



## APPENDIX 4

### RADIATED EMISSIONS TEST DATA

Radiated Emissions Test Data Results

Test distance is 3.0 metres

| EUT                              |     |                    |      | Rx Antenna |      | Spectrum Analyzer |                        | Substitution Method |                  |   |
|----------------------------------|-----|--------------------|------|------------|------|-------------------|------------------------|---------------------|------------------|---|
| Type                             | Ch  | Frequency<br>(MHz) | Band | Type       | Pol. | Reading<br>(dBuV) | Max<br>(V,H)<br>(dBuV) | Pol.<br>Tx-Rx       | Reading<br>(dBm) | Corrected Reading<br>(relative to dipole) |
| <b>GSM850 Band (ERP)</b>         |     |                    |      |            |      |                   |                        |                     |                  |   |
| Handheld Standalone, on its side |     |                    |      |            |      |                   |                        |                     |                  |   |
| F0                               | 128 | 824.20             | 850  | Dipole     | V    | 74.6              | 86.9                   | V-V                 | 12.7             | 28.7                                      |
| F0                               | 128 | 824.20             | 850  | Dipole     | H    | 86.9              |                        | H-H                 | 10.7             |   |
| F0                               | 195 | 837.60             | 850  | Dipole     | V    | 75.7              | 87.1                   | V-V                 | 13.1             | 29.1                                      |
| F0                               | 195 | 837.60             | 850  | Dipole     | H    | 87.1              |                        | H-H                 | 11.1             |   |
| F0                               | 251 | 848.80             | 850  | Dipole     | V    | 75.7              | 88.3                   | V-V                 | 13.8             | 29.8                                      |
| F0                               | 251 | 848.80             | 850  | Dipole     | H    | 88.3              |                        | H-H                 | 12.3             |   |

Radiated Emissions Test Data Results con't

Test distance is 3.0 metres

| EUT   |     |                    |      | Rx Antenna |      | Spectrum Analyzer |                        | Substitution Method |                  |   |       |                          |
|---|-----|--------------------|------|------------|------|-------------------|------------------------|---------------------|------------------|---|-------|--------------------------|
| Type  | Ch  | Frequency<br>(MHz) | Band | Type       | Pol. | Reading<br>(dBuV) | Max<br>(V,H)<br>(dBuV) | Pol.<br>Tx-Rx       | Reading<br>(dBm) | Corrected<br>Reading<br>(relative to<br>dipole) | Limit | Diff to<br>Limit<br>(dB) |
| <b>GSM850 Band (Harmonics)</b>  |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| Handheld Standalone, upright position   |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| <b>Low Channel – 824.2 MHz</b>  |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| 2 <sup>nd</sup>   | 128 | 1648.40            | 850  | Horn       | V    | 63.1              | 63.1                   | V-V                 | -40.7            | -37.4   | -13   | -24.4                    |
| 2 <sup>nd</sup>   | 128 | 1648.40            | 850  | Horn       | H    | 63.0              |                        | H-H                 | -40.2            |   |       |                          |
| The harmonics were investigated up to the 10 <sup>th</sup> harmonic.<br>Emissions above the 2 <sup>nd</sup> harmonic were in the noise floor (NF) |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| <b>Middle Channel – 837.6 MHz</b>   |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| 2 <sup>nd</sup>   | 195 | 1675.2             | 850  | Horn       | V    | 64.4              | 64.4                   | V-V                 | -35.4            |   | -13   | -22.4                    |
| 2 <sup>nd</sup>   | 195 | 1675.2             | 850  | Horn       | H    | 58.6              |                        | H-H                 | -38.2            |   |       |                          |
| The harmonics were investigated up to the 10 <sup>th</sup> harmonic.<br>Emissions above the 2 <sup>nd</sup> harmonic were in the NF               |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| <b>High Channel – 848.8 MHz</b>   |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |
| 2 <sup>nd</sup>   | 251 | 1697.60            | 850  | Horn       | V    | 63.0              | 63.0                   | V-V                 | -39.9            | -36.6   | -13   | -23.6                    |
| 2 <sup>nd</sup>   | 251 | 1697.60            | 850  | Horn       | H    | 57.2              |                        | H-H                 | -39.4            |   |       |                          |
| The harmonics were investigated up to the 10 <sup>th</sup> harmonic.<br>Emissions above the 2 <sup>nd</sup> harmonic were in the NF               |     |                    |      |            |      |                   |                        |                     |                  |   |       |                          |

Radiated Emissions Test Data Results con't

Test distance is 3.0 metres

| EUT  |     |                 |      | Receive Antenna |      | Spectrum Analyzer |                          |           | Substitution Method |  |      |       |                    |
|--|-----|-----------------|------|-----------------|------|-------------------|--------------------------|-----------|---------------------|--|------|-------|--------------------|
| Type   | Ch  | Frequency (MHz) | Band | Type            | Pol. | Reading (dBuV)    | Corrected Reading (dBuV) | Max (V,H) | Reading (dBm)       | Corrected Reading (relative to dipole) | Pol. | Limit | Diff to Limit (dB) |
| <b>PCS Band (EIRP)</b>                                       |     |                 |      |                 |      |                   |                          |           |                     |  |      |       |                    |
| Handheld Standalone, upright position                        |     |                 |      |                 |      |                   |                          |           |                     |  |      |       |                    |
| FO   | 512 | 1850.2          | 1900 | Horn            | V    | 92.9              | 92.9                     | 92.9      | 9.6                 | 28.88                                  | VV   | 33    | -4.12              |
| FO   | 512 | 1850.2          | 1900 | Horn            | H    | 87.5              | 87.5                     |           | 10.6                |  | HH   |       |                    |
| FO   | 661 | 1880.0          | 1900 | Horn            | V    | 92.1              | 92.1                     | 92.1      | 10.8                | 29.88                                  | VV   | 33    | -3.12              |
| FO   | 661 | 1880.0          | 1900 | Horn            | H    | 85.5              | 85.5                     |           | 11.6                |  | HH   |       |                    |
| FO   | 810 | 1909.8          | 1900 | Horn            | V    | 90.8              | 90.8                     | 90.8      | 8.6                 | 27.78                                  | VV   | 33    | -5.22              |
| FO   | 810 | 1909.8          | 1900 | Horn            | H    | 86.6              | 86.6                     |           | 9.5                 |  | HH   |       |                    |
| Handheld in upright position with Headset                    |     |                 |      |                 |      |                   |                          |           |                     |  |      |       |                    |
| FO   | 512 | 1850.2          | 1900 | Horn            | V    | 92.9              | 92.9                     | 92.9      | 9.6                 | 28.88                                  | VV   | 33    | -4.12              |
| FO   | 512 | 1850.2          | 1900 | Horn            | H    | 87.7              | 87.7                     |           | 10.6                |  | HH   |       |                    |
| FO   | 661 | 1880.0          | 1900 | Horn            | V    | 92.1              | 92.1                     | 92.1      | 10.8                | 29.88                                  | VV   | 33    | -3.12              |
| FO   | 661 | 1880.0          | 1900 | Horn            | H    | 86.1              | 86.1                     |           | 11.6                |  | HH   |       |                    |
| FO   | 810 | 1909.8          | 1900 | Horn            | V    | 91.2              | 91.2                     | 91.2      | 9.0                 | 28.18                                  | VV   | 33    | -4.82              |
| FO   | 810 | 1909.8          | 1900 | Horn            | H    | 86.8              | 86.8                     |           | 9.9                 |  | HH   |       |                    |
| Handheld in upright position with Travel Charger and Headset |     |                 |      |                 |      |                   |                          |           |                     |  |      |       |                    |
| FO   | 512 | 1850.2          | 1900 | Horn            | V    | 92.1              | 92.1                     | 92.1      | 8.8                 | 28.08                                  | VV   | 33    | -4.92              |
| FO   | 512 | 1850.2          | 1900 | Horn            | H    | 87.4              | 87.4                     |           | 9.8                 |  | HH   |       |                    |
| FO   | 661 | 1880.0          | 1900 | Horn            | V    | 92.8              | 92.8                     | 92.8      | 11.5                | 30.58                                  | VV   | 33    | -2.42              |
| FO   | 661 | 1880.0          | 1900 | Horn            | H    | 86.6              | 86.6                     |           | 12.3                |  | HH   |       |                    |
| FO   | 810 | 1909.8          | 1900 | Horn            | V    | 91.9              | 91.9                     | 91.9      | 9.7                 | 28.88                                  | VV   | 33    | -4.12              |
| FO   | 810 | 1909.8          | 1900 | Horn            | H    | 84.5              | 84.5                     |           | 10.6                |  | HH   |       |                    |

Radiated Emissions Test Data Results con't

Test distance is 3.0 metres

| EUT   |     |                 |      | Receive Antenna |      | Spectrum Analyzer |                          |           | Substitution Method |  |      |       |                    |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
|---|-----|-----------------|------|-----------------|------|-------------------|--------------------------|-----------|---------------------|--|------|-------|--------------------|-----------------|-----|--------|------|------|---|------|------|------|-------|-------|----|-----|-------|-----------------|-----|--------|------|------|---|------|------|--|-------|--|----|--|--|-----------------|-----|--------|------|------|---|------|------|------|-------|-------|----|-----|-------|-----------------|-----|--------|------|------|---|------|------|--|-------|--|----|--|--|-----------------|-----|--------|------|------|---|------|------|------|-------|-------|----|-----|-------|-----------------|-----|--------|------|------|---|------|------|--|-------|--|----|--|--|
| Type  | Ch  | Frequency (MHz) | Band | Type            | Pol. | Reading (dBuV)    | Corrected Reading (dBuV) | Max (V,H) | Reading (dBm)       | Corrected Reading (relative to dipole) | Pol. | Limit | Diff to Limit (dB) |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| <p><b>PCS Band (Harmonics)</b><br/>Handheld in upright position connected to Travel Charger and Headset.</p> <p><b>Low Channel</b></p> <table border="1"> <tr> <td>2<sup>nd</sup></td> <td>512</td> <td>3700.4</td> <td>1900</td> <td>Horn</td> <td>V</td> <td>35.5</td> <td>35.5</td> <td>37.4</td> <td>-49.4</td> <td>-45.8</td> <td>VV</td> <td>-13</td> <td>-32.8</td> </tr> <tr> <td>2<sup>nd</sup></td> <td>512</td> <td>3700.4</td> <td>1900</td> <td>Horn</td> <td>H</td> <td>37.4</td> <td>37.4</td> <td></td> <td>-49.5</td> <td></td> <td>HH</td> <td></td> <td></td> </tr> </table> <p>The harmonics were investigated up to the 10<sup>th</sup> harmonic.<br/>Emissions above the 2<sup>nd</sup> harmonic were in the NF</p> <p><b>Middle Channel</b></p> <table border="1"> <tr> <td>2<sup>nd</sup></td> <td>661</td> <td>3760.0</td> <td>1900</td> <td>Horn</td> <td>V</td> <td>34.9</td> <td>34.9</td> <td>36.4</td> <td>-48.2</td> <td>-44.6</td> <td>VV</td> <td>-13</td> <td>-31.6</td> </tr> <tr> <td>2<sup>nd</sup></td> <td>661</td> <td>3760.0</td> <td>1900</td> <td>Horn</td> <td>H</td> <td>36.4</td> <td>36.4</td> <td></td> <td>-49.2</td> <td></td> <td>HH</td> <td></td> <td></td> </tr> </table> <p>The harmonics were investigated up to the 10<sup>th</sup> harmonic.<br/>Emissions above the 2<sup>nd</sup> harmonic were in the NF</p> <p><b>High Channel</b></p> <table border="1"> <tr> <td>2<sup>nd</sup></td> <td>881</td> <td>3819.6</td> <td>1900</td> <td>Horn</td> <td>V</td> <td>34.8</td> <td>34.8</td> <td>36.6</td> <td>-48.8</td> <td>-45.2</td> <td>VV</td> <td>-13</td> <td>-32.2</td> </tr> <tr> <td>2<sup>nd</sup></td> <td>881</td> <td>3819.6</td> <td>1900</td> <td>Horn</td> <td>H</td> <td>36.6</td> <td>36.6</td> <td></td> <td>-51.8</td> <td></td> <td>HH</td> <td></td> <td></td> </tr> </table> <p>The harmonics were investigated up to the 10<sup>th</sup> harmonic.<br/>Emissions above the 2<sup>nd</sup> harmonic were in the NF</p> |     |                 |      |                 |      |                   |                          |           |                     |  |      |       |                    | 2 <sup>nd</sup> | 512 | 3700.4 | 1900 | Horn | V | 35.5 | 35.5 | 37.4 | -49.4 | -45.8 | VV | -13 | -32.8 | 2 <sup>nd</sup> | 512 | 3700.4 | 1900 | Horn | H | 37.4 | 37.4 |  | -49.5 |  | HH |  |  | 2 <sup>nd</sup> | 661 | 3760.0 | 1900 | Horn | V | 34.9 | 34.9 | 36.4 | -48.2 | -44.6 | VV | -13 | -31.6 | 2 <sup>nd</sup> | 661 | 3760.0 | 1900 | Horn | H | 36.4 | 36.4 |  | -49.2 |  | HH |  |  | 2 <sup>nd</sup> | 881 | 3819.6 | 1900 | Horn | V | 34.8 | 34.8 | 36.6 | -48.8 | -45.2 | VV | -13 | -32.2 | 2 <sup>nd</sup> | 881 | 3819.6 | 1900 | Horn | H | 36.6 | 36.6 |  | -51.8 |  | HH |  |  |
| 2 <sup>nd</sup>   | 512 | 3700.4          | 1900 | Horn            | V    | 35.5              | 35.5                     | 37.4      | -49.4               | -45.8                                  | VV   | -13   | -32.8              |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| 2 <sup>nd</sup>   | 512 | 3700.4          | 1900 | Horn            | H    | 37.4              | 37.4                     |           | -49.5               |  | HH   |       |                    |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| 2 <sup>nd</sup>   | 661 | 3760.0          | 1900 | Horn            | V    | 34.9              | 34.9                     | 36.4      | -48.2               | -44.6                                  | VV   | -13   | -31.6              |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| 2 <sup>nd</sup>   | 661 | 3760.0          | 1900 | Horn            | H    | 36.4              | 36.4                     |           | -49.2               |  | HH   |       |                    |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| 2 <sup>nd</sup>   | 881 | 3819.6          | 1900 | Horn            | V    | 34.8              | 34.8                     | 36.6      | -48.8               | -45.2                                  | VV   | -13   | -32.2              |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |
| 2 <sup>nd</sup>   | 881 | 3819.6          | 1900 | Horn            | H    | 36.6              | 36.6                     |           | -51.8               |  | HH   |       |                    |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |                 |     |        |      |      |   |      |      |      |       |       |    |     |       |                 |     |        |      |      |   |      |      |  |       |  |    |  |  |

Radiated Emissions Test Photos con't**Radiated Emissions at 3.0 metres**