FCC ID: PQS-DWM0001

Exhibit 2b

Engineering Report on

Radiated Spurious Emissions (2.1053)

Assessment of Compliance

for

Measurement of Field Strength of Spurious Radiation in accordance with the FCC Rules & Regulations Part 2.1053 and 90

Wireless Modem
DUALWAVE M

Wavenet Technologies Pty Ltd.

February 2002

APREL Project No.:WVTB-Dual Wave M-3861

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APREL Laboratories

Engineering Report

Subject: **Measurement of Field Strength of Spurious Radiation in accordance with the FCC Rules & Regulations Part 2.1053 and 90**

FCC ID: **PPQS-DWM0001**

Equipment: **Wireless Modem attachment for Palm m125/m500/m505/PDA**

Model: **DUALWAVE M**

Client: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Project #: WVTB-Dual Wave M-3861

Prepared By: **APREL Laboratories,**
Regulatory Compliance Division
51 Spectrum Way
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Approved by: _____ Date: Feb. 15, 2002
Jay Sarkar:
Technical Director, Standards & Certification

Submitted by: _____ Date: Feb. 15, 2002
Jay Sarkar:
Technical Director, Standards & Certification

Released by: _____ Date: Feb 15/02.
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FCC ID: **PPQS-DWM0001**
Applicant: Wavenet Technologies Pty Ltd.
Equipment: Wireless Modem attachment for Palm m125/m500/m505/PDA
Model: DUALWAVE M
Standard: FCC Rules and Regulations Part 2.1053 and 90

ENGINEERING SUMMARY

This report contains the results of Field Strength of Spurious Radiation measurement performed on a Wavenet Wireless Modem attachment for Palm m125/m500/m505 or equivalent PDA, model DUALWAVE M in accordance with the FCC Rules and Regulations Part 2.1053 and 90. The measurements were carried out using direct method and substitution method both as radiated. The product was evaluated for spurious radiation when it was set at the highest ERP. DUALWAVE M was tested with Palm m500.

The Wireless Modem is an attachment for a Palm and it can be attached to a PC.

The DUALWAVE M was evaluated in three configurations:

1. Wireless Modem attached to Palm m500
2. Wireless Modem attached to Palm m500 and connected to PC
3. Wireless Modem attached to a PC.

The highest values of Spurious Emissions were obtained in configuration 1, Wireless Modem attached to Palm and placed in vertical position. As such, test data using both methods (direct and substitution) for only configuration 1 is presented. The test data for configurations 1, 2 and 3 are given using substitution method.

The results presented in this report relate only to the sample tested.

Summary of the Results

Test Description	Page No.	Test Set-up Figure No.	Results Summary
Field Strength of Spurious Radiation Ref. Paragraph 2.1053 and 90	8	1	**Passed**

INTRODUCTION

General

This report describes the results of the Field Strength of Spurious Radiation measurement conducted on a Wavenet Wireless Modem attachment for Palm m125/m500/m505/PDA, model DUALWAVE M.

Test Facility

The tests were performed for Wavenet Technologies Pty Ltd. by APREL Laboratories at APREL's EMI facility located in Nepean, Ontario, Canada. The laboratory operates an (3m and 10m) Open Area Test Site (OATS). The measurement facility is calibrated in accordance with ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria per ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. ***APREL's registration number is 90416.***

APREL is accredited by Standard Council of Canada. APREL is also accredited by Industry Canada and recognised by the Federal Communications Commissions (FCC).

Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Parts 2.1053 and the appropriate limits (90).

Personnel: The equipment was tested by Roman Kuleba, EMC Engineer, methodology developed and the report was written by Jayanta (Jay) K. Sarkar, Technical Director, Standards and Certification.

Test Equipment

The test equipment used during the evaluation is listed in Appendix A with calibration due dates.

Environmental Conditions

Measurements were conducted in open area test site. Temperature: 24°C ± 2,

Relative Humidity: 30 - 50 % , Air Pressure: 101 kPa ± 3.

FCC SUBMISSION INFORMATION

FCC ID:	**PPQS-DWM0001**
Equipment type:	**Wireless Modem attachment for Palm m125/m500/m505/PDA**
Model:	**DUALWAVE M**
For:	Certification
Applicant:	**Wavenet Technologies Pty Ltd.** 140 Burswood Rd Burswood, Perth, WA 6100 AUSTRALIA
Manufacturer:	**Wavenet Technologies Pty Ltd.** 140 Burswood Rd Burswood, Perth, WA 6100 AUSTRALIA
Evaluated by:	**APREL Laboratories** 51 Spectrum Way Nepean, Ontario Canada K2R 1E6

MANUFACTURER'S DATA

FCC ID: **PPQS-DWM0001**

Equipment Type: Wireless Modem attachment for Palm m125/m500/m505/PDA

Model: DUALWAVE M

Reference: FCC Rules and Regulations Parts 2 and Part 90

Manufacturer: Wavenet Technologies Pty Ltd

Power Source: 3.6 (nominal) VDC Battery, Lithium-ion

Development Stage of Unit: Production

GENERAL SPECIFICATIONS

1. Frequency Range: 806.00 to 821.00 MHz (Transmitter)
2. Output Power: 1.622 W (32.1dBm) ERP
3. Emission Designators (See 47 CFR § 2.201 and §2.202): 20K0F1D
4. Antenna Impedance: 50 Ω

Test: **Field Strength of Spurious Radiation**

Ref: FCC Parts 2.1053 and 90.210

Criteria: Emission **Mask G:**

The permitted maximum level of spurious emission is 43 + 10 log (P) dB below the unmodulated carrier power of the transmitter (P).

Set-up: See Figure 1.a

Conditions: Voltage Supply: DC Battery

Equipment: See Appendix A.

Procedure: **A. Direct Method as Radiated (See Section B for Substitution Method).**

The final measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations.
(FCC Registration No.:90416).

The **DUI** was configured to operate at maximum power with appropriate modulation. Special software was employed in order that the transmitter was processing data in a normal manner.

Prior to final measurement in the OATS, preliminary radiated spurious emissions were scanned in a shielded enclosure at a distance of 1 m using biconical, log-periodic and horn antennas in order to determine the characteristic frequencies of the field strength of spurious emissions. Based on this information, measurements were performed in the OATS at these characteristic frequencies using calibrated antennas.

All field strength measurements were made with a spectrum analyser and the appropriate calibrated antenna for the frequency range from 9 kHz up to 10^{th} harmonics of the transmit frequency (see equipment list for the calibrated antenna used). **The Power of the carrier frequency was also measured in the OATS.**

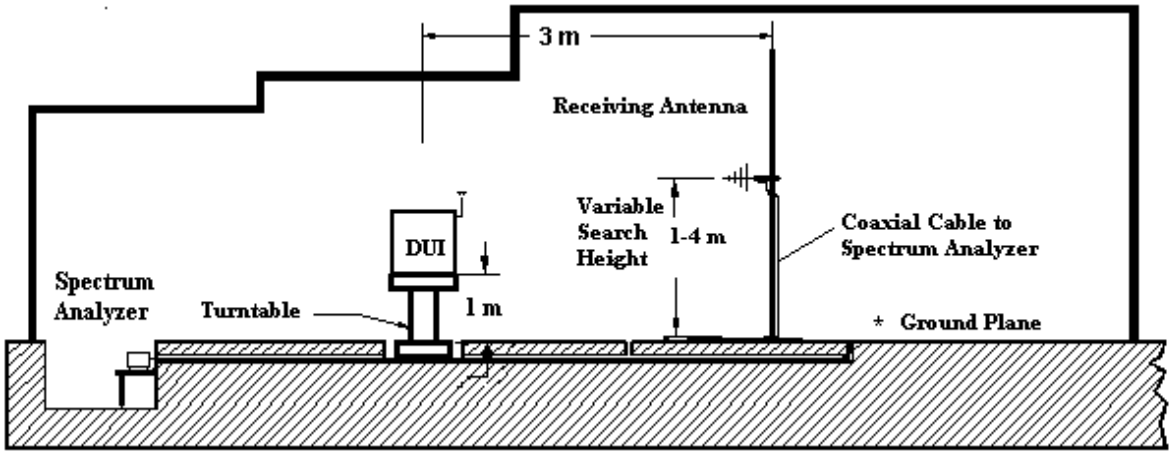


Figure 1.a Test set up for the Field Strength of Spurious Radiation Measurement in OATS (Not to scale)

Fig. 1.b APREL's OATS (Open Area Test Site)

The equipment under test was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer. For each identified frequency, the received signal was maximised by the positioning of the turntable and the height of the antenna. The process was repeated for both horizontal and vertical polarisation.

Information submitted includes the relative radiated power of each spurious emissions with reference to the calculated limit per 90.210 assuming all emissions are radiated from half-wave dipole antenna.

Measurements given in the spurious emissions test result tables contain: analyzer reading, correction factor, and final reading. The final field strength level are derived from the analyzer measurement and the correction factor (antenna factor and cable loss) as shown in the following example:

Sample Calculation for direct method

A. Spectrum analyzer reading

At 1630.00 MHz, a spurious level of 38.9 dBµV @ 3 meters is measured.

B. Correction factor (antenna factor and cable loss)

Cable loss: 2.5 dB
Antenna Factor: 27.1 dB
Total Correction Factor: 2.5 + 27.1 = 29.6 dB/m

C. Final reading (Field Strength of spurious emission):

C = A + B
C = 38.9 dBµV + 29.6 dB
C = 68.5 dBµV/m @ 3 meters

D. The criteria level.

The field intensity, which would be produced by the transmitter carrier operating into a half-wave dipole antenna (gain of 1.64), at a distance of 3 m, was calculated using the following formula:

Field Strength of Unmodulated Carrier (dBµV/m) = $10 \log_{10} (P_t G/4\pi r^2)$ + 146 dB

Where:

Pt is transmitter carrier power, unmodulated = 1.622 W (ERP)
G is gain, 1.64
R is distance, 3 meters

Limit/criteria (D) = Field strength of carrier – (43 + 10·$\log_{10}$ ERP)

D = 132.0 dBµV/m – (43 + 10·$\log_{10}$ 1.622)
D = 86.9 dBµV/m at 3 meters
Criteria (reference level) at 3 meters from 1.622 Watt (ERP) into a half-wave dipole antenna is 86.9 dBmV/m for direct method.

E = Margin (spurious emission below the reference level)

E = D – C
E = 86.9 dBµV/m–68.5 dBµV/m
E = 18.4 dBµV/m (direct method)

B: Substitution Method (Radiated)

The DUALWAVE M was also tested for spurious radiated emissions using the substitution method with a procedure similar to that used in the ERP measurement and described in the ERP measurement portion of the Test Report. A set of three reference dipoles, a horn antenna and a signal generator to duplicate the signal were used. Signals radiated from the DUALWAVE M on the fundamental frequency as well as second and third harmonic were evaluated by comparing to the signals transmitted from the reference dipoles. The antennas used for the first three harmonics were a set of three dipoles, l = 18.5 cm (first harmonic/fundamental), l = 9.2 cm (second harmonic), and l = 6.0 cm (third harmonic). For testing the higher frequencies, fourth to 8th harmonics, a calibrated horn antenna with known gain was used as a replacement source of radiation thus substituting the DUALWAVE M. The duplicated reading (taken in dBm) was then referenced to the dipole.

Criteria: The criteria level using substitution method was calculated to be –13.0 dBm.
This level was obtained by using the following expression:

$$\mathbf{Criteria_{Limit\,(dBm)} = ERP_{Carrier\,(dBm)} - [43 + 10 * \log_{10} ERP_{(W)}]}$$

Example: $\mathbf{Criteria}_{Limit(dBm)} = 32.1\ dBm - [43 + 10 * \log_{10}(1.622\ W)]$
$\mathbf{Criteria}_{Limit(dBm)} = 32.1\ dBm - (43 + 2.1)\ dB = -13.0\ dBm$

Results: **Passed . See Tables 1 and 2 for direct method**
See Tables 2 and 3 for substitution method

Table 1
Field Strength of Spurious Radiation
Antenna Polarization: **Vertical**
Resolution Bandwidth:
10 kHz (below 1 GHz)
100 kHz (above 1 GHz)
Direct Method as Radiated
Wireless modem attached to Palm (Configuration 1)

Frequency (MHz)	Measured Level (dBμV) "A"	Correction Factor (dB/m) "B"	Field Strength (dBμV/m) "C"	Criteria Level (dBμV/m) "D"	Margin (dB) "E"
Low Channel - Transmitting Frequency: 806.00 MHz					
806.00	107.0	25.0	132.0	-	-
1612.00	39.0	29.5	68.5	86.9	18.4
2418.00	30.4	32.2	62.6	86.9	24.3
3224.00	14.6 noise floor	35.1	49.7	86.9	37.2
Medium Channel - Transmitting Frequency: 815.00 MHz					
815.00	106.2	25.1	131.3	-	-
1630.00	38.9	29.6	68.5	86.9	18.4
2445.00	27.6	32.3	59.9	86.9	27.0
3260.00	14.6 noise floor	35.2	49.8	86.9	37.1
High Channel - Transmitting Frequency: 821.00 MHz					
821.00	106.3	25.1	131.4	-	-
1642.00	39.1	29.6	68.7	86.9	18.2
2463.00	29.1	32.4	61.5	86.9	25.4
3284.00	14.6 noise floor	35.3	49.9	86.9	37.0

C = a+b, e = d-c

Test performed by: Kulekha Rowan Date: February 2002

Table 2
Field Strength of Spurious Radiation
Antenna Polarization: **Horizontal**
Resolution Bandwidth:
10 kHz (below 1 GHz)
100 kHz (above 1 GHz)
Direct Method as Radiated
Wireless modem attached to Palm (Configuration 1)

Frequency (MHz)	Measured Level (dBμV) "A"	Correction Factor (dB/m) "B"	Field Strength (dBμV/m) "C"	Criteria Level (dBμV/m) "D"	Margin (dB) "E"
Low Channel - Transmitting Frequency: 806.00 MHz					
806.00	99.1	25.0	124.1	-	-
1612.00	27.0	29.5	56.5	86.9	30.4
2418.00	22.0	32.2	54.2	86.9	32.7
3224.00	14.6 noise floor	35.1	49.7	86.9	37.2
Medium Channel - Transmitting Frequency: 815.00 MHz					
815.00	99.3	25.1	124.4	-	-
1630.00	25.0	29.6	54.6	86.9	32.3
2445.00	15.4	32.3	47.7	86.9	39.2
3260.00	14.6 noise floor	35.2	49.8	86.9	37.1
High Channel - Transmitting Frequency: 821.00 MHz					
821.00	92.3	25.1	117.4	-	-
1642.00	25.1	29.6	54.7	86.9	32.2
2463.00	15.4	32.4	47.8	86.9	39.1
3284.00	14.6 noise floor	35.3	49.9	86.9	37.0

C = a+b, e = d-c

Test performed by: Kuldeep Rohan Date: February 2002

Table 3
Field Strength of Spurious Radiation
Antenna Polarization: **Vertical**
Substitution Method as Radiated
Wireless Modem attached to Palm (Configuration 1)

Frequency	ERP_V	Limit	Margin
MHz	dBm	dBm	dB
Low Channel - Transmitting Frequency: 806.00 MHz			
806.00	32.1	-	-
1612.00	-32.8	-13.0	19.8
2418.00	-38.9	-13.0	25.9
3224.00	-53.6	-13.0	40.6
Medium Channel - Transmitting Frequency: 815.00 MHz			
815.00	31.3	-	-
1630.00	-32.6	-13.0	19.6
2445.00	-41.8	-13.0	28.8
3260.00	-53.6	-13.0	40.6
High Channel - Transmitting Frequency: 821.00 MHz			
821.00	31.6	-	-
1642.00	-32.3	-13.0	19.3
2463.00	-40.1	-13.0	27.1
3284.00	-53.5	-13.0	40.5

Test performed by: Kin Che Robinson Date: February, 2002

Table 4
Field Strength of Spurious Radiation
Antenna Polarization: **Horizontal**
Substitution Method as Radiated
Wireless Modem attached to Palm (Configuration 1)

Frequency	ERP_H	Limit	Margin
MHz	dBm	dBm	dB
Low Channel - Transmitting Frequency: 806.00 MHz			
806.00	24.2	-	-
1612.00	-44.7	-13.0	31.7
2418.00	-47.4	-13.0	34.4
3224.00	-53.6	-13.0	40.6
Medium Channel - Transmitting Frequency: 815.00 MHz			
815.00	24.5	-	-
1630.00	-46.5	-13.0	33.5
2445.00	-54.3	-13.0	41.3
3260.00	-53.6	-13.0	40.6
High Channel - Transmitting Frequency: 821.00 MHz			
821.00	17.5	-	-
1642.00	-46.4	-13.0	33.4
2463.00	-54.0	-13.0	41.0
3284.00	-53.5	-13.0	40.5

Test performed by: Kelsea Rollins Date: February 2002

Table 5
Field Strength of Spurious Radiation
Transmitter Frequency: 815.00 MHz
Antenna Polarization: **Vertical**
Substitution Method as Radiated
Wireless Modem attached to Palm and connected to PC (Configuration 2)

Frequency	ERP_V	Limit	Margin
MHz	dBm	dBm	dB
815.00	30.2	-	-
1630.00	-32.8	-13.0	19.8
2445.00	-37.9	-13.0	24.9
3260.00	-49.2	-13.0	36.2

Table 6
Field Strength of Spurious Radiation
Transmitter Frequency: 815.00 MHz
Antenna Polarization: **Horizontal**
Substitution Method as Radiated
Wireless Modem attached to Palm and connected to PC (Configuration 2)

f	ERP_H	Limit	Margin
MHz	dBm	dBm	dB
815.00	29.0	-	-
1630.00	-36.5	-13.0	23.5
2445.00	-45.1	-13.0	32.1
3260.00	-49.2	-13.0	36.2

Test performed by: Kristen Johnson Date: February 2002

Table 7
Field Strength of Spurious Radiation
Transmitter Frequency: 815.00 MHz
Antenna Polarization: **Vertical**
Substitution Method as Radiated
Wireless Modem only connected to PC (Configuration 3)

Frequency	ERP_V	Limit	Margin
MHz	dBm	dBm	dB
815.00	29.2	-	-
1630.00	-35.1	-13.0	22.1
2445.00	-39.3	-13.0	26.3
3260.00	-49.2	-13.0	36.2

Table 8
Field Strength of Spurious Radiation
Transmitter Frequency: 815.00 MHz
Antenna Polarization: **Horizontal**
Substitution Method as Radiated
Wireless Modem only connected to PC (Configuration 3)

f	ERP_H	Limit	Margin
MHz	dBm	dBm	dB
815.00	27.7	-	-
1630.00	-36.1	-13.0	23.1
2445.00	-46.1	-13.0	33.1
3260.00	-49.2	-13.0	36.2

Test performed by: K. Celia Roman Date: February 2002

APPENDIX A
List of Test Equipment

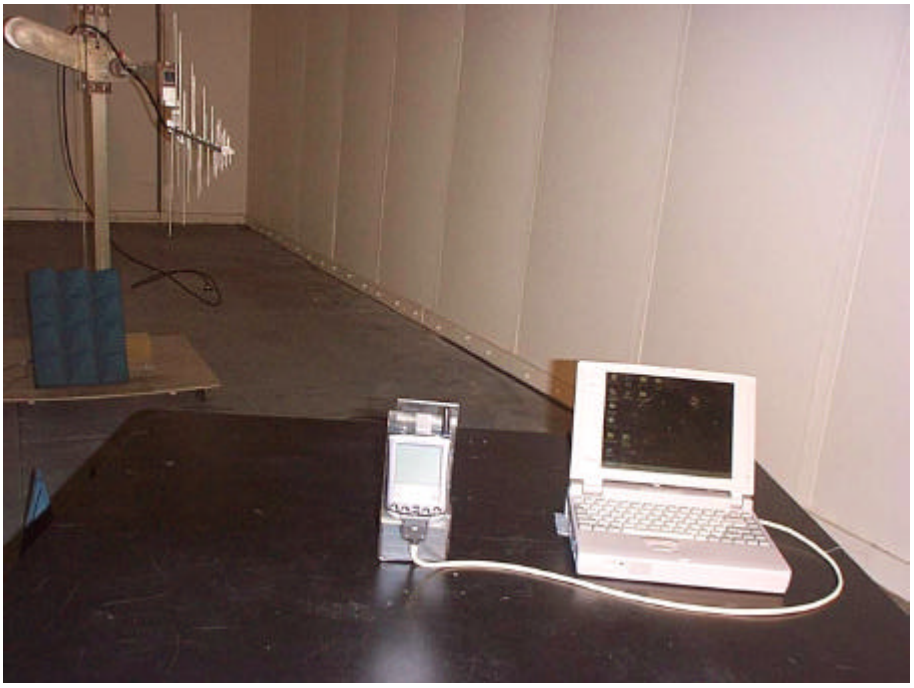
List of Equipment

Description	Range	Manufacturer	Model #	APREL Asset #	Cal. Due Date
Spectrum Analyzer	9 kHz - 3 GHz	Anritsu	MS2661C	301330	Dec 10, 2002
Spectrum Analyzer	9 kHz - 30 GHz	Anritsu	MS2667C	301436	Nov 3, 2002
RF Signal Generator	10 MHz – 26.5 GHz	Hewlett Packard	HP 8340 B	100955	Oct 5, 2002
Amplifier (LNA)	30-1000 MHz	APREL Inc.	APRLNA-001	301415	June 20, 2002
Attenuator	20 dB	Pasternack	PE 7002-20	301370	May 18, 2002
Notch Filter	DC - 6 GHz	APREL Inc.	NFLT-835	301470	CBT
RF Power Meter	10 MHz - 18 GHz	Rohde & Schwarz	NRVS	100851	July 21, 2002
Biconical Antenna	20 MHz - 200 MHz	Eaton	94455-1	100890	July 21, 2002
Log - Periodic Antenna	200 MHz -1.0 GHz	Eaton	ALP-1	100761	July 21, 2002
Horn Antenna	1 – 18 GHz	APREL Inc.	AA – 118	100400	March 12, 2002
Anechoic Shielded Room	10 kHz - 10 GHz	APREL Inc.	_	301329	N/A
Reference Half -wave Dipole Antenna	815.00 MHz	APREL Inc.	_	_	N/A
Reference Half -wave Dipole Antenna	1630.00 MHz	APREL Inc.	_	_	N/A
Reference Half -wave Dipole Antenna	2500.00 MHz	APREL Inc.	_	_	N/A
OATS	30 MHz – 1 GHz	APREL Inc.	3 m & 10 m	N/A	N/A
Mast with the Controller	1 m – 4 m	EMCO	1051 – 12	100507	N/A
Turntable with the Controller	0° - 360°	EMCO	1060 – 1.241	100506	N/A

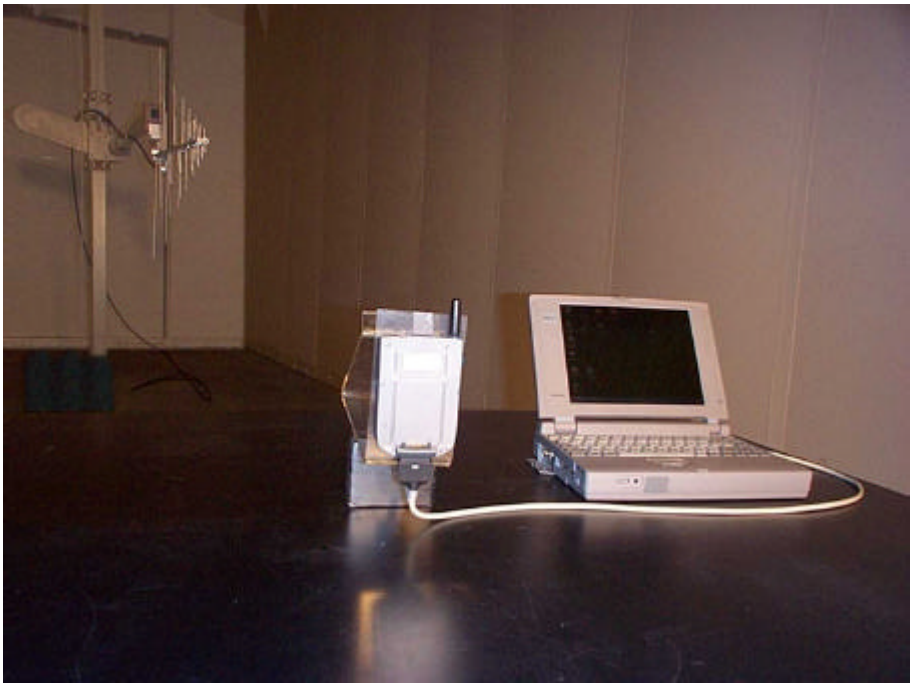
APPENDIX B
PHOTOGRAPHS

Wavenet DUALWAVE M Wireless modem and Palm

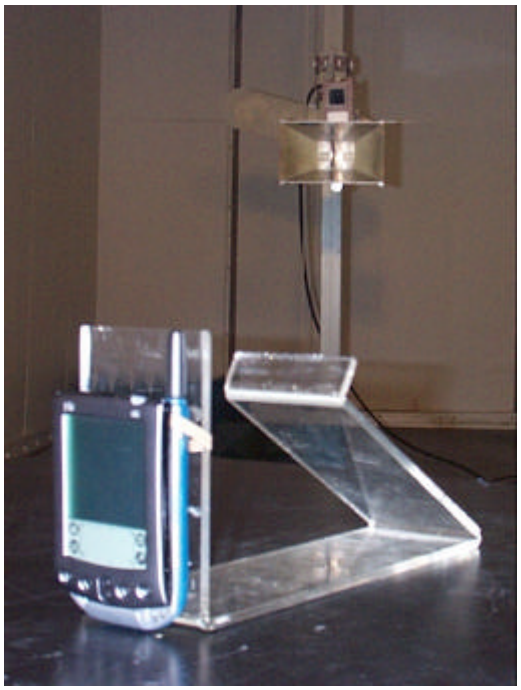
Palm and WaveNet DUALWAVE M Wireless modem
Testing for Spurious Emissions from Transmitter
Frequency Range: 30 MHz – 200 MHz

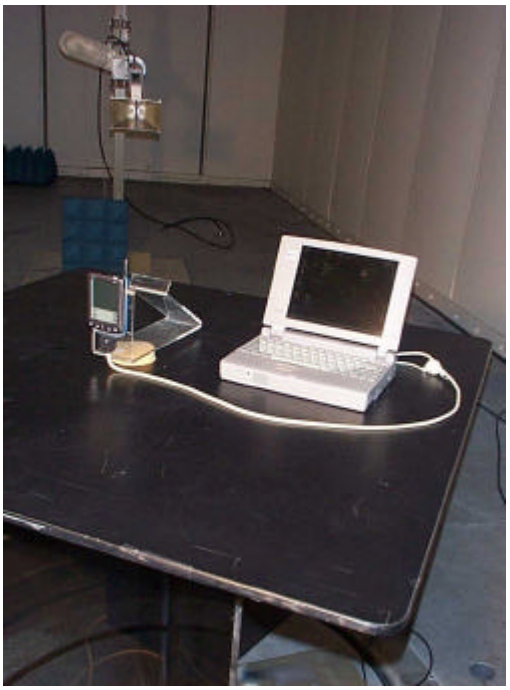


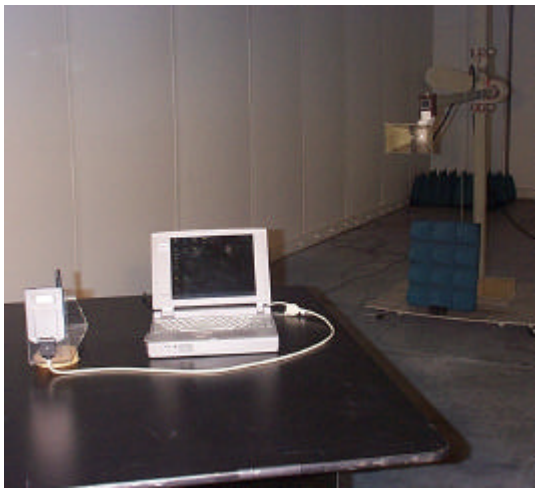
Palm and WaveNet DUALWAVE M Wireless modem connected to PC
Testing for Spurious Emissions from Transmitter
Frequency Range: 200 MHz – 1 GHz

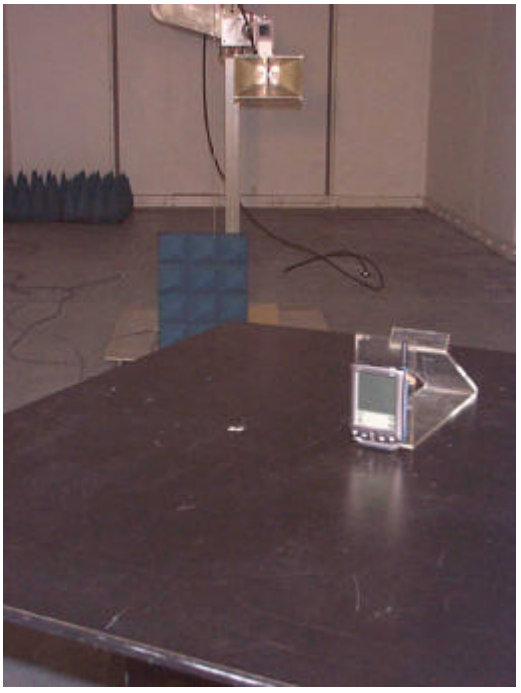


Wavenet DUALWAVE M wireless modem (without palm)
Communicating with PC
Testing for Spurious Emissions from Transmitter
Frequency Range: 200 MHz – 1 GHz









Palm and Wavenet DUALWAVE M Wireless Modem
tested for Spurious Emissions from Transmitter
in three different configurations
Frequency Range: 1 GHz – 18 GHz