

**FCC ID: PQSWAVENET-DUAL-V**

**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

**PDA Wireless Modem attachment for Palm V/V<sub>x</sub>  
DWV 100D**

Wavenet Technologies Pty Ltd.



June 2001

APREL Project No.:WVTB-Dual Wave V-3279

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## Engineering Report

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

**FCC ID:** PQSWAVENET-DUAL-V

**Equipment:** PDA Wireless Modem attachment for Palm V/Vx

**Model:** DWV 100D

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

**Project #:** WWTB-Dual Wave V-3729

**Prepared By:** APREL Laboratories,  
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51 Spectrum Way  
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**Approved by:**  Date: June 25, 2001  
**Jay Sarkar:**  
Technical Director, Standards & Certification

**Submitted by:**  Date: June 25, 2001  
**Jay Sarkar:**  
Technical Director, Standards & Certification

**Released by:**  Date: June 25/01  
**Dr. Jack J. Wojcik, P.Eng.**



**FCC ID:** PQSWAVENET-DUAL-V  
**Applicant:** Wavenet Technologies Pty Ltd.  
**Equipment:** PDA Wireless Modem attachment for Palm V/V<sub>x</sub>  
**Model:** DWV 100D  
**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 PDA Wireless Modem attachment for Palm V/V<sub>x</sub>, model DWV 100D 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 maximum power level.

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

The DWV 100D was evaluated in three configurations:

1. PDA Wireless Modem attached to Palm V
2. PDA Wireless Modem attached to Palm V and connected to PC
3. PDA Wireless Modem (cradle only) connected to PC.

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

## INTRODUCTION

### General

This report describes the results of the Field Strength of Spurious Radiation measurement conducted on a Wavenet PDA Wireless Modem attachment for Palm V/Vx, model DWV 100D.

### 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).

### 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:** PQSWAVENET-DUAL-V

Equipment type: **PDA Wireless Modem attachment for Palm V/Vx**

Model: **DWV 100D**

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

<b>FCC ID:</b>	<b>PQSWAVENET-DUAL-V</b>
<b>Equipment Type:</b>	PDA Wireless Modem attachment for Palm V/V <sub>x</sub>
<b>Model:</b>	DWV 100D
<b>Reference:</b>	FCC Rules and Regulations Parts 2 and Part 90
<b>Manufacturer:</b>	Wavenet Technologies Pty Ltd
<b>Power Source:</b>	3.6 (nominal) VDC Battery, Lithium-ion
<b>Development Stage of Unit:</b>	Production

## GENERAL SPECIFICATIONS

1. Frequency Range: 806.00 to 821.00 MHz (Transmitter)
2. Output Power: 1.862 W (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.

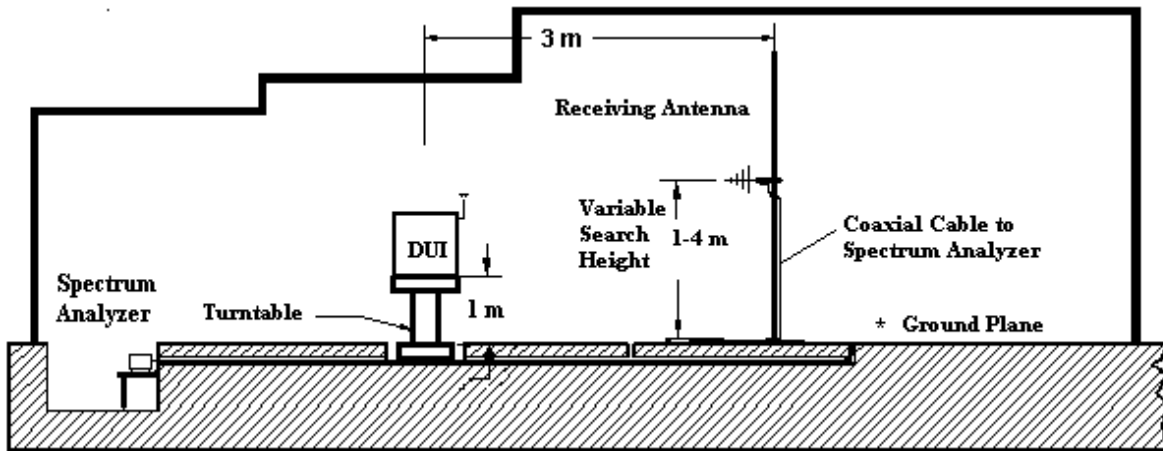
**Procedure:** **A. Direct Method as Radiated (See Section B for Substitution Method).**

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<sup>th</sup> 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 87.2 dB $\mu$ V/m 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 45.1 dB $\mu$ V @ 3 meters is measured.

B. Correction factor (antenna factor and cable loss)

Cable loss: 0.9 dB

Antenna Factor: 22.0 dB

Total Correction Factor:  $0.9 + 22.0 = 22.9$  dB/m

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

$$C = A + B$$

$$C = 45.1 \text{ dB}\mu\text{V} + 22.9 \text{ dB}$$

$$C = 68.0 \text{ dB}\mu\text{V/m @ 3 meters}$$

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:

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

Pt is transmitter carrier power, unmodulated

G is gain, 1.64

R is distance, 3 meters

Criteria (reference) level at 3 meters from 1.862 Watt (ERP) into half-wave dipole antenna is 87.2 dBμV/m.

E = Margin (spurious emission below the reference level)

$$E = D - C$$

$$E = 87.2 \text{ dB}\mu\text{V}/\text{m} - 68.0 \text{ dB}\mu\text{V}/\text{m}$$

$$E = 19.2 \text{ dB}\mu\text{V}/\text{m}$$

### **B: Substitution Method (Radiated)**

The DWV 100D 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 DWV 100D on the fundamental frequency as well as second and third harmonic were evaluated by comparing to the signals transmitted from the reference dipoles. The antenna used for the first three harmonics were a set of three dipoles, 1 = 18.5 cm (first harmonic/fundamental), 1 = 9.2 cm (second harmonic), and 1 = 6.0 cm (third harmonic). For testing the higher frequencies, fourth to 8<sup>th</sup> harmonics, a calibrated horn antenna with known gain was used as a replacement source of radiation thus substituting the DWV 100D. 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:

$$\text{ERP}_{\text{Limit (dBm)}} = \text{ERP}_{\text{Carrier (dBm)}} - [43 + 10 \cdot \log_{10} \text{ERP}_{\text{(w)}}]$$

Example:  $\text{ERP}_{\text{Limit(dBm)}} = 32.6 \text{ dBm} - [43 + 10 \cdot \log_{10}(1.820 \text{ W})]$   
 $\text{ERP}_{\text{Limit(dBm)}} = 32.6 \text{ dBm} - (43 + 2.6) \text{ dB} = -13.0 \text{ dBm}$

**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  
Transmitter Frequency: 815.00 MHz  
Antenna Polarization: Vertical  
Resolution Bandwidth:  
10 kHz (below 1 GHz)  
100 kHz (above 1 GHz)  
**Direct Method as Radiated**  
Palm V attached to PDA Modem (Configuration I)

Frequency (MHz)	Measured Level (dBµV)	Correction Factor (dB/m)	Field Strength (dBµV/m)	Criteria Level (dBµV/m)	Margin (dB)
	"A"	"B"	"C"	"D"	"E"
815.00 Carrier	112.5	20.4	132.9		
1630.00 2 <sup>nd</sup> harmonic	45.1	22.9	68.0	87.2	19.2
2445.00 3 <sup>rd</sup> harmonic	37.4	26.7	64.1	87.2	23.1
3260.00 4 <sup>th</sup> harmonic	25.8 noise floor	29.0	54.8	87.2	32.4
4075.00 5 <sup>th</sup> harmonic	38.4	32.2	70.6	87.2	16.6
4890.00 6 <sup>th</sup> harmonic	30.0	35.1	65.1	87.2	22.1
5705.00 7 <sup>th</sup> harmonic	31.9	38.0	69.9	87.2	17.3
6520.00 8 <sup>th</sup> harmonic	22.2 noise floor	36.8	59.0	87.2	28.2

Test performed by: Kirlela Polunin

Date: June, 2001

**Table 2**  
 Field Strength of Spurious Radiation  
 Transmitter Frequency: 815.00 MHz  
 Antenna Polarization: **Horizontal**  
**Resolution Bandwidth:**  
 10 kHz (below 1 GHz)  
 100 kHz (above 1 GHz)  
**Direct Method as Radiated**  
 Palm V attached to PDA Modem(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"
815.00 Carrier	107.7	20.4	134.1		
1630.00 2 <sup>nd</sup> harmonic	37.8	22.9	66.7	87.2	20.5
2445.00 3 <sup>rd</sup> harmonic	28.6	26.7	61.3	87.2	25.9
3260.00 4 <sup>th</sup> harmonic	32.8	29.0	67.8	87.2	19.4
4075.00 5 <sup>th</sup> harmonic	30.6	32.2	68.8	87.2	18.4
4890.00 6 <sup>th</sup> harmonic	27.0	35.1	68.1	87.2	19.1
5705.00 7 <sup>th</sup> harmonic	25.5	38.0	69.5	87.2	17.7
6520.00 8 <sup>th</sup> harmonic	23.7 noise floor	36.8	66.5	87.2	20.7

Test performed by: *Ku Chua Poon*

Date: *June, 2001*

**Table 3**  
Field Strength of Spurious Radiation  
Transmitter Frequency: 815.00 MHz  
Antenna Polarization: **Vertical**  
**Substitution Method as Radiated**  
Palm V attached to PDA Modem(Configuration 1)

Frequency MHz	ERP <sub>V</sub> dBm	Limit dBm	Margin dB
1630.00	-33.2	-13.0	20.2
2445.00	-37.8	-13.0	24.8
3260.00	-46.4 noise floor	-13.0	33.4
4075.00	-32.0	-13.0	19.0
4890.00	-34.6	-13.0	21.6
5705.00	-31.2	-13.0	18.2
6520.00	-41.1 noise floor	-13.0	28.1

**Table 4**  
Field Strength of Spurious Radiation  
Transmitter Frequency: 815.00 MHz  
Antenna Polarization: **Horizontal**  
**Substitution Method as Radiated**  
Palm V attached to PDA Modem(Configuration 1)

f MHz	ERP <sub>H</sub> dBm	Limit dBm	Margin dB
1630.00	-38.0	-13.0	25.0
2445.00	-45.2	-13.0	32.2
3260.00	-38.3	-13.0	25.3
4075.00	-35.5	-13.0	22.5
4890.00	-42.0	-13.0	29.0
5705.00	-34.8	-13.0	21.8
6520.00	-38.9 noise floor	-13.0	25.9

Test performed by: *K. Cele Polina* Date: *June, 2001*

**Table 5**

Field Strength of Spurious Radiation  
 Transmitter Frequency: 815.00 MHz  
 Antenna Polarization: **Vertical**  
**Substitution Method as Radiated**

Palm V attached to PDA Modem and connected to PC (Configuration 2)

Frequency MHz	ERP <sub>V</sub> dBm	Limit dBm	Margin dB
1630.00	-33.4	-13.0	20.4
2445.00	-37.3	-13.0	24.3
3260.00	-46.6	-13.0	33.6
4075.00	-30.8	-13.0	17.8
4890.00	-36.3	-13.0	23.3
5705.00	-31.5	-13.0	18.5
6520.00	-42.4	-13.0	29.4

**Table 6**

Field Strength of Spurious Radiation  
 Transmitter Frequency: 815.00 MHz  
 Antenna Polarization: **Horizontal**  
**Substitution Method as Radiated**

Palm V attached to PDA Modem and connected to PC (Configuration 2)

f MHz	ERP <sub>H</sub> dBm	Limit dBm	Margin dB
1630.00	-40.7	-13.0	27.7
2445.00	-46.1	-13.0	33.1
3260.00	-39.6	-13.0	26.6
4075.00	-38.6	-13.0	25.6
4890.00	-39.3	-13.0	26.3
5705.00	-37.9	-13.0	24.9
6520.00	-40.9	-13.0	27.9

Test performed by: *Lin Eba Polina*

Date: *June, 2001*



**Table 7**

Field Strength of Spurious Radiation

Transmitter Frequency: 815.00 MHz

Antenna Polarization: **Vertical**

**Substitution Method as Radiated**

Modem (cradle) only connected to PC (Configuration 3)

Frequency MHz	ERP <sub>v</sub> dBm	Limit dBm	Margin dB
1630.00	-37.9	-13.0	24.9
2445.00	-41.9	-13.0	28.9
3260.00	-47.3	-13.0	34.3
4075.00	-35.7	-13.0	22.7
4890.00	-41.3	-13.0	28.3
5705.00	-34.9	-13.0	21.9
6520.00	-47.5	-13.0	34.5

**Table 8**

Field Strength of Spurious Radiation

Transmitter Frequency: 815.00 MHz

Antenna Polarization: **Horizontal**

**Substitution Method as Radiated**

Modem (cradle) only connected to PC (Configuration 3)

f MHz	ERP <sub>H</sub> dBm	Limit dBm	Margin dB
1630.00	-44.4	-13.0	31.4
2445.00	-52.0	-13.0	39.0
3260.00	-44.9	-13.0	31.9
4075.00	-42.2	-13.0	29.2
4890.00	-43.5	-13.0	30.5
5705.00	-42.6	-13.0	29.6
6520.00	-46.5	-13.0	33.5

Test performed by: *Kulcha Polman* Date: *June, 2001*

# APPENDIX A

## List of Test Equipment

### List of Equipment

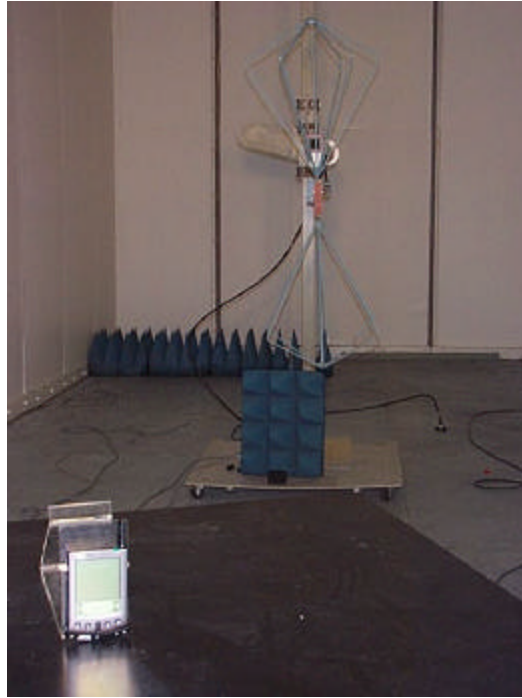
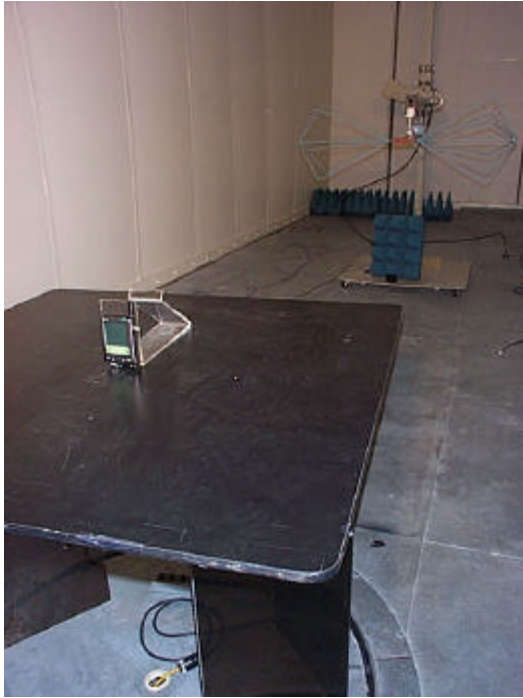
Description	Range	Manufacturer	Model #	APREL Asset #	Cal. Due Date
Spectrum Analyzer	9 kHz - 3 GHz	Anritsu	MS2661C	301330	Dec 10, 2001
Spectrum Analyzer	9 kHz - 30 GHz	Anritsu	MS2667C	301436	Nov 3, 2001
RF Signal Generator	10 MHz – 26.5 GHz	Hewlett Packard	HP 8340 B	100955	Oct 5, 2001
Amplifier (LNA)	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, 2001
Biconical Antenna	20 MHz - 200 MHz	Eaton	94455-1	100890	July 21, 2001
Log - Periodic Antenna	200 MHz -1.0 GHz	Eaton	ALP-1	100761	July 21, 2001
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**

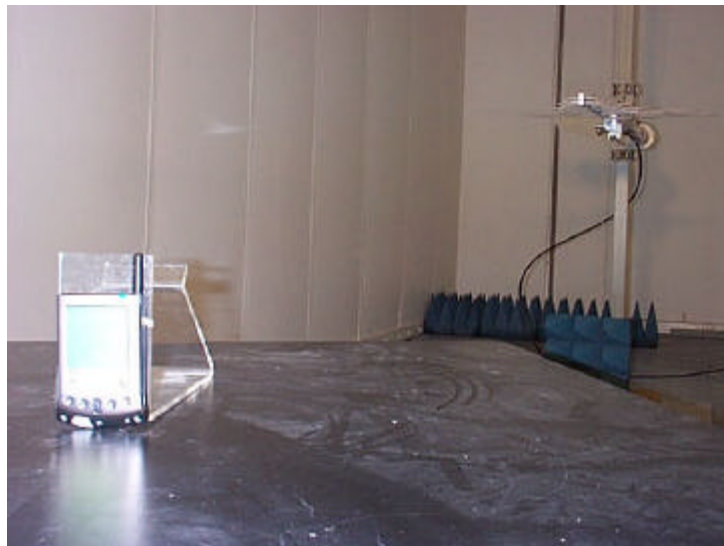
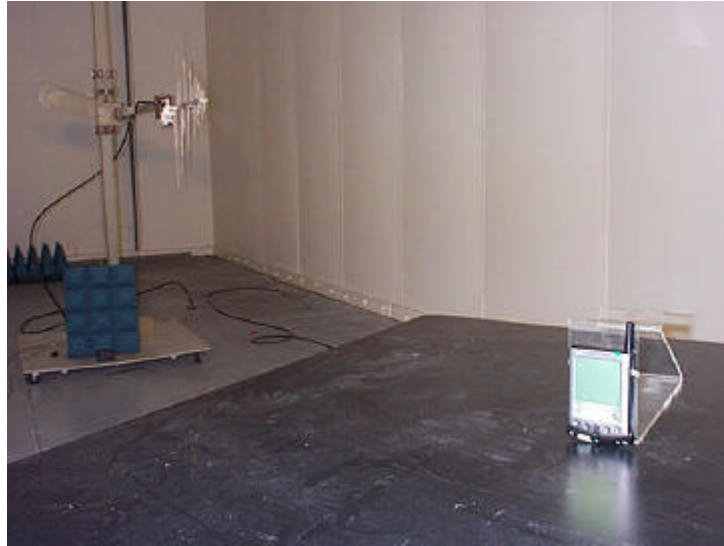
# **PHOTOGRAPHS**



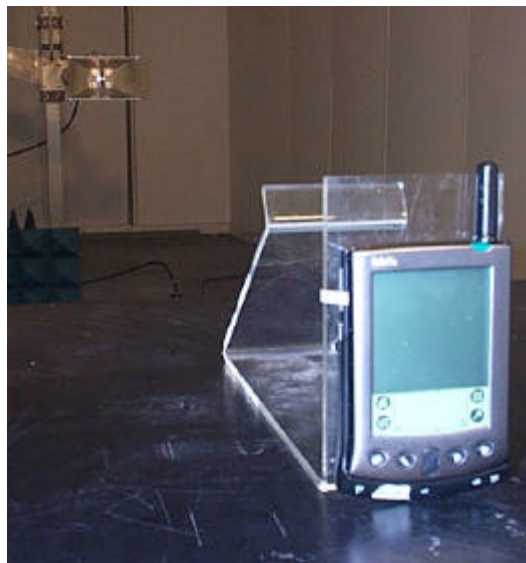
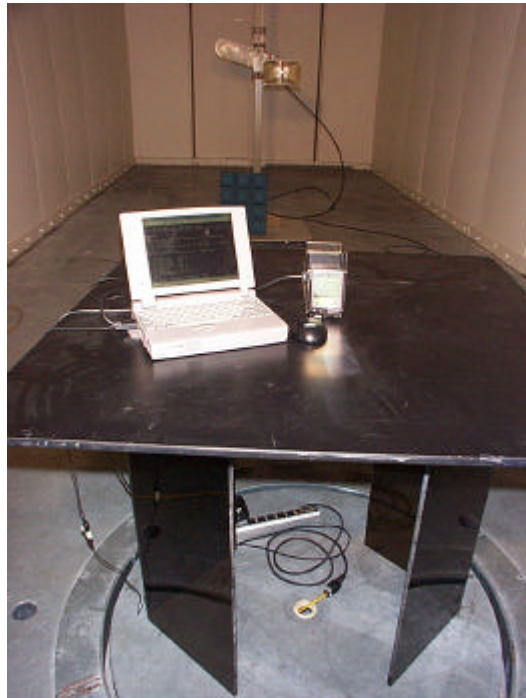
**Wavenet DWV 100D PDA Wireless modem**



**Palm V and WaveNet DWV 100D PDA Wireless modem  
Testing for Spurious Emissions from Transmitter  
Frequency Range: 30 MHz – 200 MHz**



**Palm V and WaveNet DWV 100D PDA Wireless modem  
Testing for Spurious Emissions from Transmitter  
Frequency Range: 200 MHz – 1 GHz**



**Palm V and Wavenet DWV 100D PDA Wireless Modem  
tested for Spurious Emissions from Transmitter  
in three different configurations  
Frequency Range: 1 GHz – 18 GHz**