

Exhibit 10

Minstrel S

Novatel Wireless Technologies Ltd.

FCC ID: NBZNRM6834

**SAR Report
(With Test Set-up Photographs)**

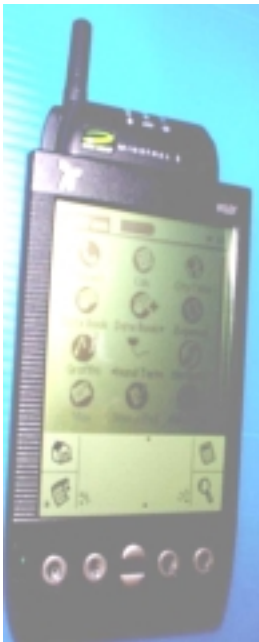
Certification Report on

Specific Absorption Rate (SAR)
Experimental Analysis

Novatel Wireless Technologies Ltd.

Minstrel S

Test Date: 11 August, 2000



NVWB-Minstrel S-3510

51 Spectrum Way Nepean ON K2R 1E6
Tel: (613) 820-2730 Fax: (613) 820-4161
email: info@aprel.com

CERTIFICATION REPORT

Subject: **Specific Absorption Rate (SAR) Experimental Analysis**

Product: Wireless CDPD Modem

Model: Minstrel S

Client: Novatel Wireless Technologies Ltd.

Address: Suite 200
6715 - 8th Street N. E.
Calgary, Alberta
Canada, T2E 7H7

Project #: NVWB-MINSTREL S-3510

Prepared by: APREL Laboratories
51 Spectrum Way
Nepean, Ontario
K2R 1E6



Tested by

Ken O'Donnell
Engineering Staff

Date: 11 Aug 00

Submitted by

Dr. Paul G. Cardinal
Director, Laboratories

Date: 15 Aug 00

Approved by

Dr. Jacek J. Wojcik, P. Eng.

Date: Aug 16/2000



FCC ID: **NBZNRM6834**
Applicant: Novatel Wireless Technologies Ltd.
Equipment: Wireless CDPD Modem
Model: Minstrel S
Standard: FCC 96 –326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation

ENGINEERING SUMMARY

This report contains the results of the engineering evaluation performed on a Novatel Wireless Minstrel S wireless CDPD modem. The measurements were carried out in accordance with FCC 96-326. The Minstrel S was evaluated for its maximum power level.

The Minstrel S wireless CDPD modem is an attachment for the Handspring Visor PDA. The assembled device is intended to transmit while being operated from the user's hand.

The Minstrel S was tested at high, middle, and low frequencies and on the top, LCD, back, antenna and other sides. The maximum 10 g SAR (2.92 W/kg) coincided with the peak performance RF output power of channel 799 (high, 849 MHz) for the back side of the assemble device. Test data and graphs are presented in this report.

At a separation distance of 4 cm from the device, the maximum 1 g SAR is 0.19 W/kg.

The user manual will have a warning to keep bystanders, and parts of the user's body other than their hands, at least 4cm away from the antenna

Based on the test results and how the device will be used, it is certified that the product meets the requirements as set forth in the above specifications, for an uncontrolled RF exposure environment.

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



TABLE OF CONTENTS

1. Introduction.....4
2. Applicable Documents4
3. Equipment Under Test4
4. Test Equipment5
5. Test Methodology5
6. Test Results.....6
 6.1. Transmitter Characteristics6
 6.2. SAR Measurements.....7
7. Bystander / Non-Extremities.....9
8. Conclusions11
Appendix A.....12
Appendix B.....19
Appendix C20
Appendix D.....21
Appendix E.....24



1. INTRODUCTION

Tests were conducted to determine the Specific Absorption Rate (SAR) of a sample of a Novatel Wireless Minstrel S wireless CDPD modem. These tests were conducted at APREL Laboratories' facility located at 51 Spectrum Way, Nepean, Ontario, Canada. A view of the SAR measurement setup can be seen in Appendix A Figure 1. This report describes the results obtained.

2. APPLICABLE DOCUMENTS

The following documents are applicable to the work performed:

- 1) FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation
- 2) ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- 3) ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.
- 4) OET Bulletin 65 (Edition 97-01) Supplement C (Edition 97-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".

3. EQUIPMENT UNDER TEST

- Novatel Wireless Technologies Ltd. Minstrel S wireless CDPD modem, installed on a
- Handspring Visor personal digital assistant (PDA)

The Handspring Visor PDA with the Novatel Wireless Minstrel S CDPD modem attached will be called the DUI (Device Under Investigation) in the following report.

This DUI can operate in the frequency range 824-849 MHz. The antenna at the top left side of the DUI is a $\frac{1}{4} \lambda$ helical antenna, 2.25 cm long (tip-shoulder). A photograph of



the DUI can be found in Appendix B. See the manufacturer's submission documentation for drawings and more design detail.

4. TEST EQUIPMENT

- APREL Triangular Dosimetric Probe Model E-009, s/n 115, Asset # 301420
- CRS Robotics A255 articulated robot arm, s/n RA2750, Asset # 301335
- CRS Robotics C500 robotic system controller, s/n RC584, Asset # 301334
- Hewlett Packard power meter, s/n 2502A01684, Asset # 301417
- Hewlett Packard power sensor, s/n 2652A15128, Asset # 301418
- APREL F-1, flat manikin, s/n 001
- Tissue Recipe and Calibration Requirements, APREL procedure SSI/DRB-TP-D01-033
- Radiated Power Jig, Asset # 301326

5. TEST METHODOLOGY

1. The test methodology utilised in the certification of the Minstrel S wireless CDPD modem complies with the requirements of FCC 96-326 and ANSI/IEEE C95.3-1992.
2. The E-field is measured with a small isotropic probe (output voltage proportional to E^2).
3. The probe is moved precisely from one point to the next using the robot (10 mm increments for wide area scanning, 5 mm increments for zoom scanning, and 2.5 mm increments for the final depth profile measurement).
4. The probe travels in the homogeneous liquid simulating human tissue. Appendix D contains information about the recipe and properties of the simulated tissue used for these measurements.



5. The liquid is contained in a manikin simulating a portion of the human body.
6. The DUT is positioned in such a way that it touches the bottom of the phantom with either its top or its bottom side.
7. All tests were performed with the highest power available from the sample Minstrel S wireless CDPD modem, under transmit conditions.

More detailed descriptions of the test method is given in Section 6 when appropriate.

6. TEST RESULTS

6.1. TRANSMITTER CHARACTERISTICS

A battery-powered transmitter will consume energy from its batteries, which may affect its transmission characteristics. In order to gage this effect the output of the transmitter is normally sampled before and after each SAR run. In the case of the Minstrel S, only one scan could be performed per full charge, with the DUI operating at its maximum power level. At least an hour was required to recharge the Minstrel S. This necessitated that the AC charger be attached so that the investigation could be conducted in a reasonable amount of time. The following table indicates the peak local SAR measurement for the worst case condition conducted under battery power and with the AC charger attached:

Scan		Battery / AC Charger	Peak Single Point SAR (W/kg)
Type	Height (mm)		
Area	2.5	AC charger	4.99
Zoom	2.5	AC charger	4.62
Depth	2.5	AC charger	4.58
Zoom	2.5	Battery	4.77

The peak value measured under battery power is within 1% of the average value of the peak values measured under AC charger power, with the device operating under the same conditions. As a consequence of these measurements it was



judged acceptable to make the bulk of the measurements with the AC charger attached.

6.2. SAR MEASUREMENTS

- 1) RF exposure is expressed as a Specific Absorption Rate (SAR). SAR is calculated from the E-field, measured in a grid of test points as shown in Appendix A Figure 2. SAR is expressed as RF power per kilogram of mass, averaged in 10 grams of tissue for the extremities and 1 gram of tissue elsewhere.
- 2) The DUI was put into test mode for the SAR measurements using manufacturer supplied touch screen commands entered on the Handspring Visor to control the channel and maximum operating power (power level 2).
- 3) Figure 3 in Appendix A shows a contour plot of the SAR measurements for the DUI (H, 799, 849 MHz). The presented values were taken 2.5 mm into the simulated tissue from the flat phantom's solid inner surface. Figures 1 and 2 in Appendix A show the flat phantom used in the measurements. A grid is shown inside of the phantom indicating the orientation of the x-y grid used, with the coordinates 0,0 at the top left corner. The x-axis is positive towards the bottom and the y-axis is positive towards the right.

A different presentation of the same data is shown in Appendix A Figure 4. This is a surface plot, where the measured SAR values provide the vertical dimension, which is useful as a visualisation aid.

Similar data was obtained 12.5 mm into the simulated tissue. These measurements are presented as a contour plot in Appendix A Figure 5 and surface plot in Figure 6.

Figure 12 in Appendix A shows an overlay of the pager's outlines, superimposed onto the contour plot previously shown as Figure 3.

Figures 3 through 6 in Appendix A show that there is a dominant peak, in the contour plots, that diminishes in magnitude with depth into the tissue simulation.

- 4) Wide area scans were performed for the middle channel (383, 836.49 MHz) on the top, LCD, back, antenna and other (opposite antenna) sides of the DUI. Wide area scans were then performed for the worst case side on the low (991, 824.04 MHz)



and high (799, 848.97 MHz) channels. The peak single point SAR for the scans were:

DUI Side	Channel			Peak Single Point SAR (W/kg)
		#	Frequency (MHz)	
top	Middle	383	836.49	1.62
LCD	Middle	383	836.49	1.16
back	Middle	383	836.49	4.36
antenna	Middle	383	836.49	0.84
other	Middle	383	836.49	0.62
back	Low	991	824.04	4.63
back	High	799	848.97	4.99

All subsequent testing was performed on the high channel (799, 849 MHz) the LCD down, i.e. with the back of the DUI against the phantom.

- 5) Wide area scans were also performed for the high channel (799, 848.97 MHz) versus separation. The peak single point SAR for the scans were:

DUT – phantom separation (mm)	Highest local SAR (W/kg)
0	4.99
30	0.28
40	0.15
50	0.10

Figure 14 in Appendix A shows the data plotted as a function of separation and the exponential curve fit to them.

- 6) The high channel (799) SAR peak was then explored on a refined 5 mm grid in three dimensions. Figures 7, 8, 9, 10, and 11 show the measurements made at 2.5, 7.5, 12.5, 15, and 17.5 mm respectively. The SAR value averaged over 10 grams was determined from these measurements by averaging the 125 points (5x5x5) comprising a 2 cm x 2 cm x 2 cm cube. The maximum SAR value measured averaged over 10 grams was determined from these measurements to be 2.02 W/kg.



- 7) To extrapolate the maximum SAR value averaged over 10 grams to the inner surface of the head phantom a series of measurements were made at a few (x,y) coordinates within the refined grid as a function of depth, with 2.5 mm spacing. Figure 13 in Appendix A shows the data gathered and the exponential curves fit to them. The average exponential coefficient was determined to be $(-0.075 \pm 0.003) / \text{mm}$.

The distance from the probe tip to the inner surface of the head phantom for the lowest point is 2.5 mm. The distance from the probe tip to the tip of the measuring dipole within the APREL Triangular Dosimetric Probe Model E-009 is 2.3 mm. The total extrapolation distance is 4.8 mm, the sum of these two.

Applying the exponential coefficient over the 4.8 mm to the maximum SAR value average over 10 grams that was determined previously, we obtain **the maximum SAR value at the surface averaged over 10g** of 2.90 W/kg.

7. BYSTANDER / NON-EXTREMITIES

The measurements from the previous section can be used to determine the bystander exposure during operation (or the parts of the body of the user other than their extremities).

The SAR value averaged over 1 gram was determined from the 2.5, 7.5, and 12.5 mm zoom scans (section 6.2.6) by averaging the 27 points (3x3x3) comprising a 1 cm x 1 cm x 1 cm cube. The maximum measured SAR valued averaged over 1 gram was determined from these measurements to be 2.96 W/kg.

Applying the exponential coefficient over the 4.8 mm (section 6.2.7) to the maximum SAR value averaged over 1 gram determined above, we obtain **the maximum SAR value at the surface averaged over 1 gram** of 4.23 W/kg.

The measurements of highest local SAR versus separation of the antenna housing from the bottom of the phantom (Section 6.2.5) will enable the peak 1g SAR for a separation of 2.5 mm (phantom shell thickness) to be interpolated for other separations.

If the data for Figure 14 is fitted to an exponential equation we get:

$$\text{Peak Local SAR} = 5.6026 e^{-0.0822 * (\text{separation})}$$

A similar equation will exist for the maximum 1g SAR versus separation:



$$\text{Maximum 1g SAR} = k e^{-0.0822 * (\text{separation})}$$

Using this equation with the data earlier in this section:

Maximum 1g SAR at surface = 4.23 W/kg

Tissue – DUI separation = 2.5 mm

results in a $k = 5.195$ W/kg, which corresponds to the maximum 1g SAR when the separation is 0 mm. A conservative maximum 1g SAR of 1.36 W/kg (1.6 W/kg reduced by our measurement uncertainty) would occur for a separation of 16.3 mm from the antenna axis.

At a standard separation distance of 4cm the maximum 1g SAR would be 0.19 W/kg.



8. CONCLUSIONS

The maximum Specific Absorption Rate (SAR) averaged over 10 grams, determined at 849 MHz (high channel, 799), of the Novatel Wireless Minstrel S Wireless CDPD modem, is 2.90 W/kg. The overall margin of uncertainty for this measurement is $\pm 15.1\%$ (Appendix C). The SAR limit given in the FCC 96-326 safety guideline is 4 W/kg for uncontrolled **hand exposure** for the general population.

For a bystander (or user) exposing a part of the body other than the extremities, at a separation distance of 4cm from the device, the maximum Specific Absorption Rate (SAR) averaged over 1g is 0.19 W/kg. The SAR limit given in the FCC 96-326 safety guideline is 1.6 W/kg for uncontrolled **partial body exposure** of the general population. The minimum separation distance that will ensure that the limit minus the measurement uncertainty ($1.6 - 15.1\% = 1.36$ W/kg) is not exceeded is 16.3 mm.

The product under investigation will be used in a general population/uncontrolled exposure environment. The user manual will have a warning to keep bystanders, and parts of the user's body other than their hands, at least 4cm away from the antenna. Considering the above, this unit as tested, as it will be marketed and used, is found to be compliant with these requirements.



APPENDIX A

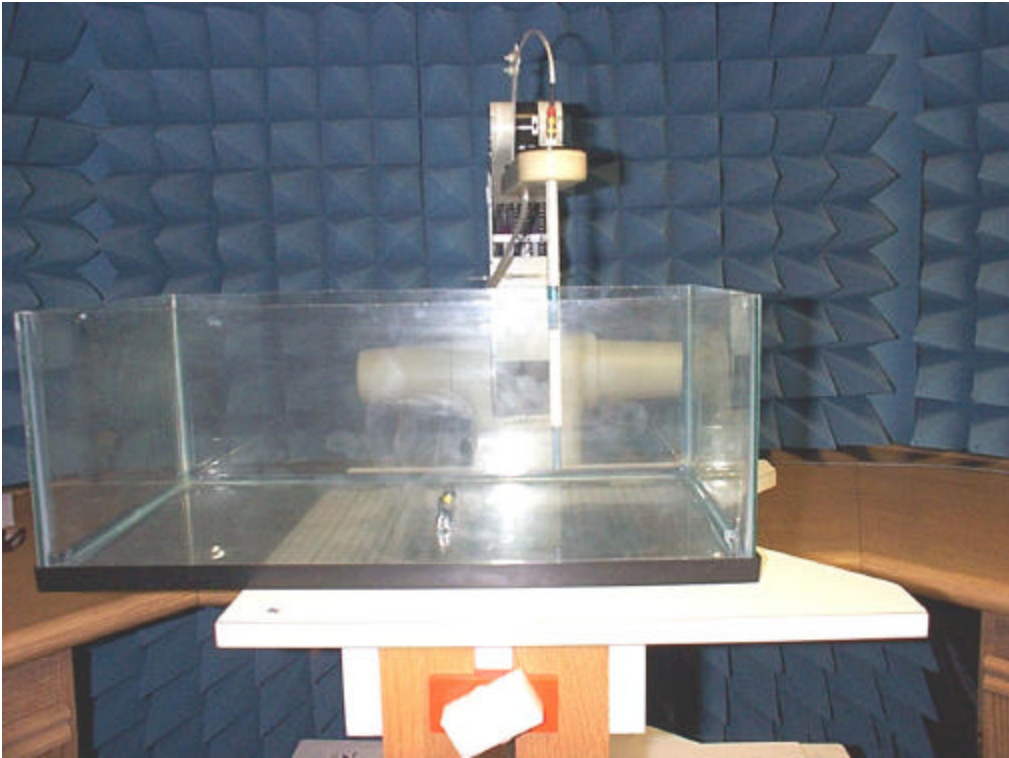


Figure 1

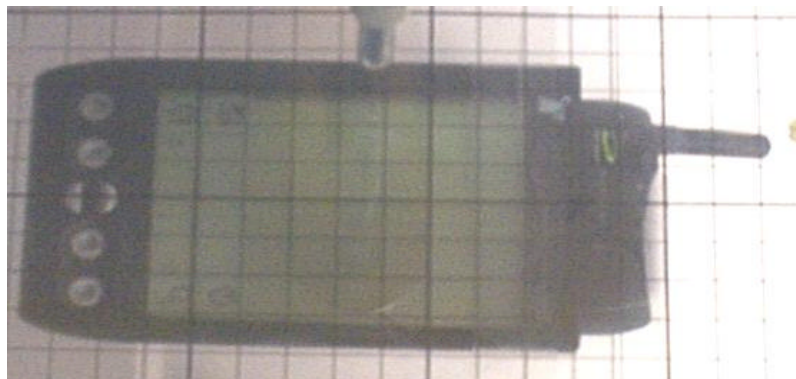


Figure 2



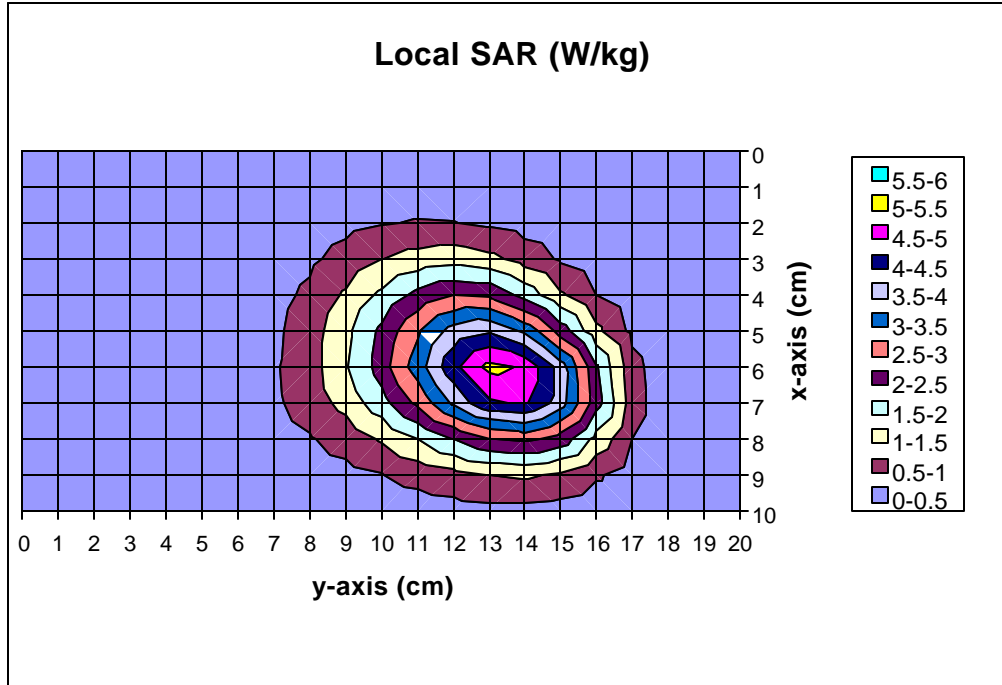


Figure 3 Area Scan

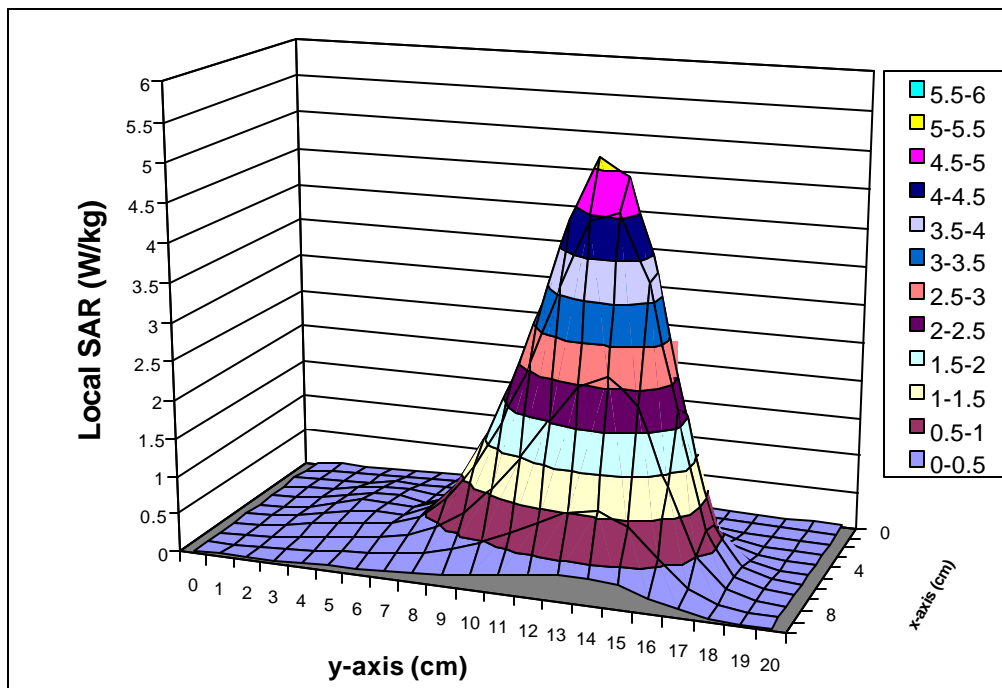


Figure 4 Contour Scan



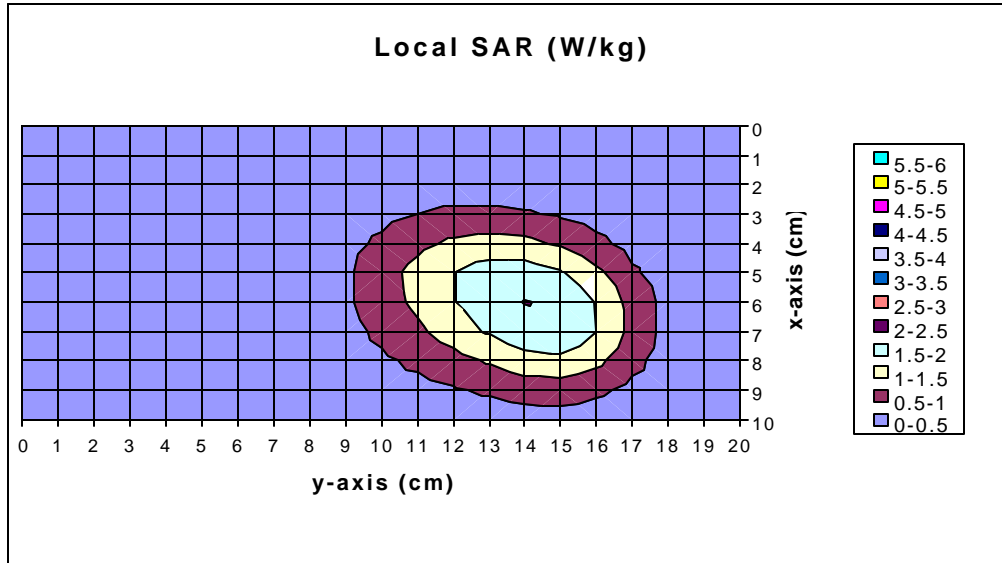


Figure 5

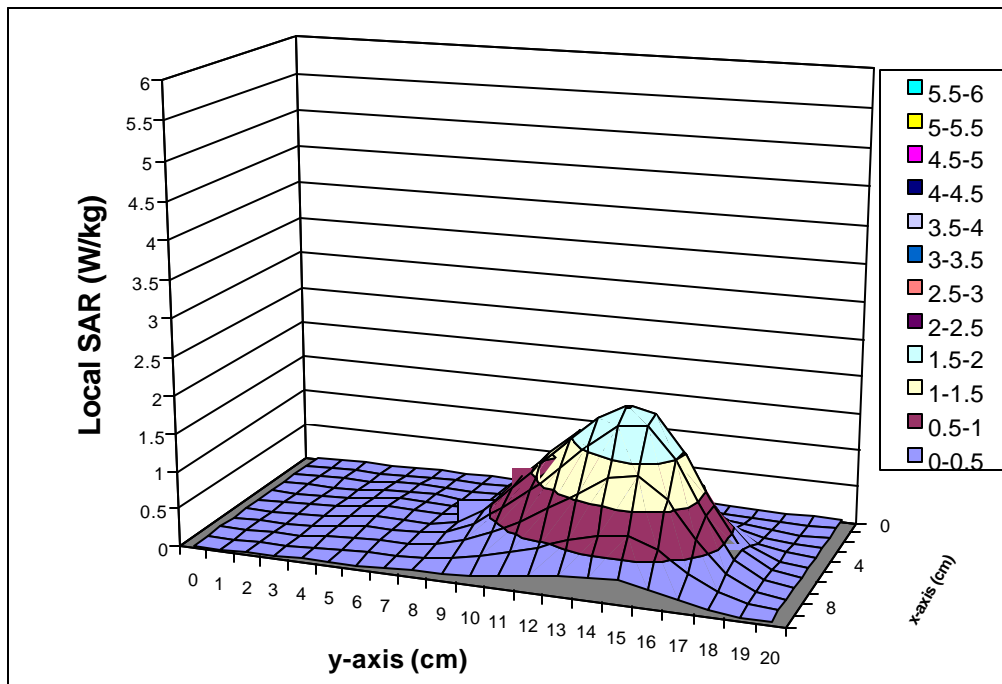


Figure 6



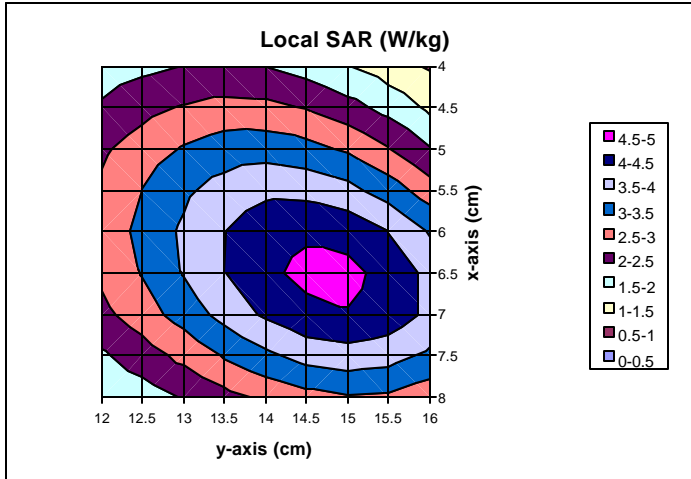


Figure 7

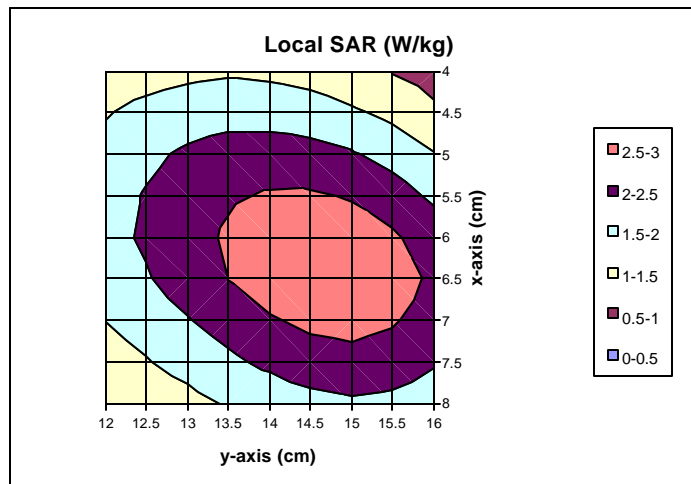


Figure 8

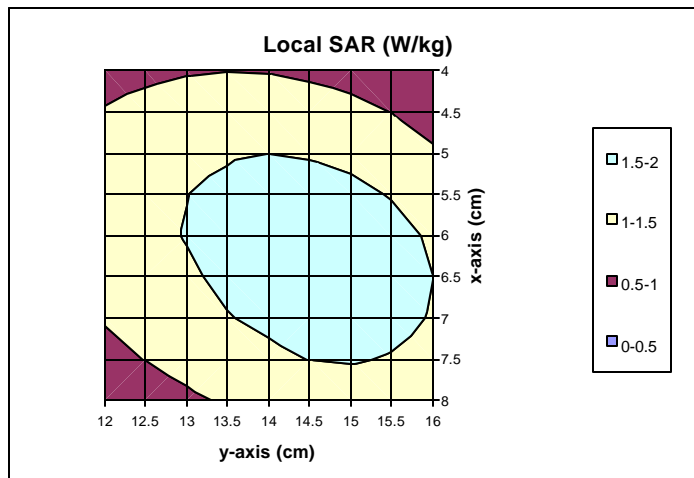


Figure 9



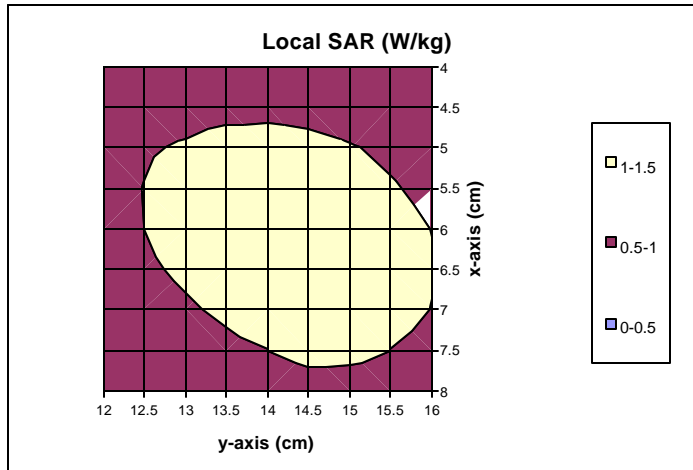


Figure 10

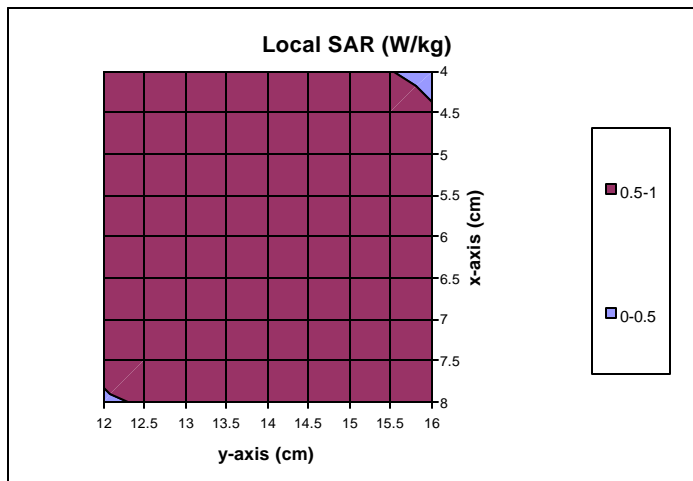


Figure 11



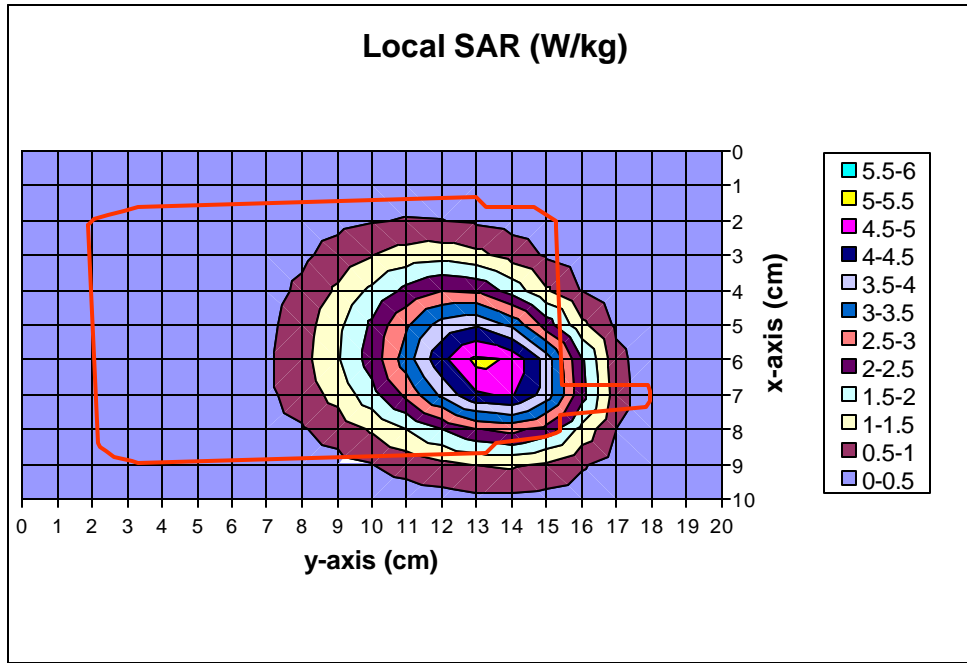


Figure 12

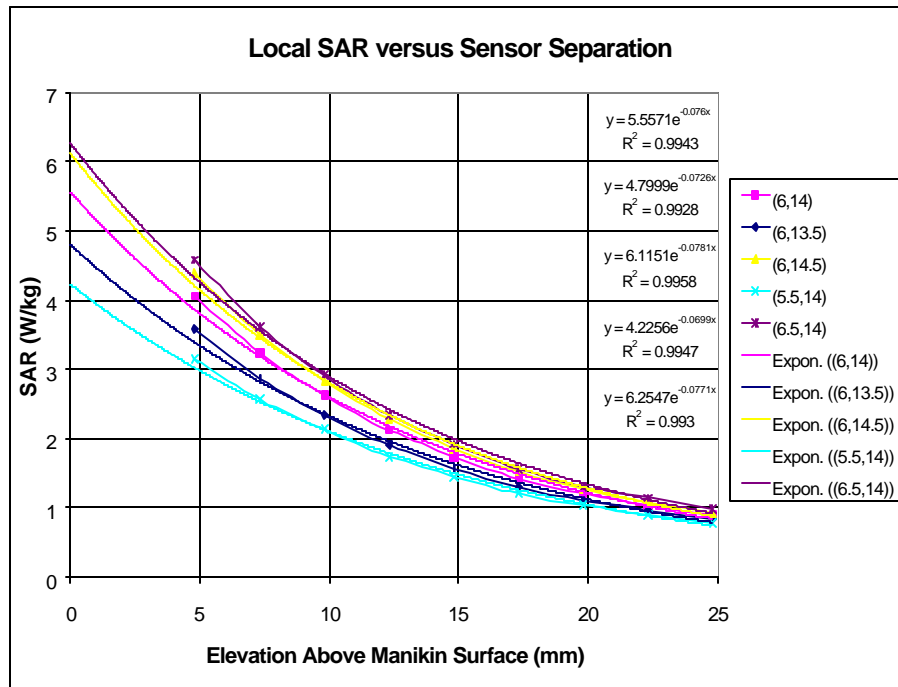


Figure 13



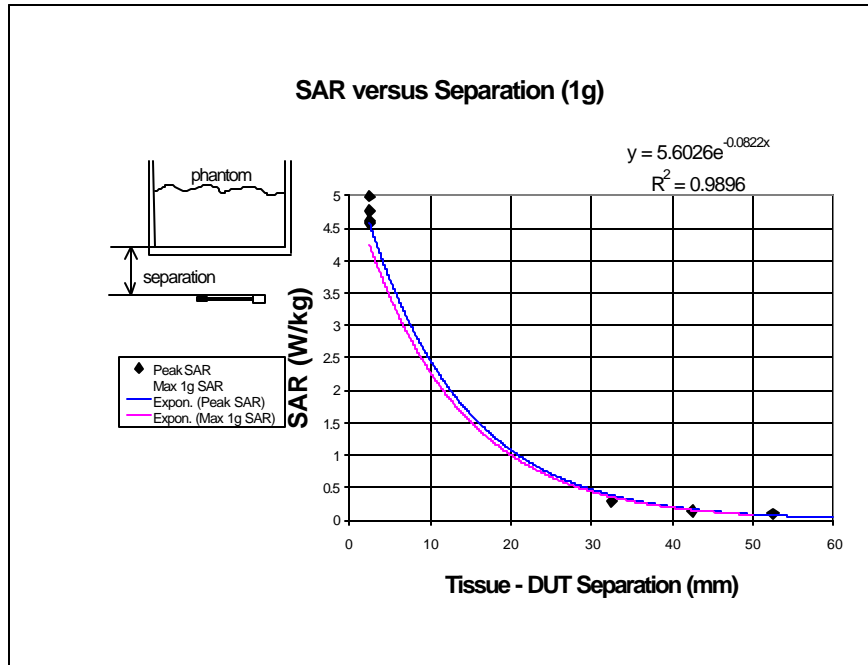


Figure 14



APPENDIX B

Manufacturer's Specification



Novatel Wireless Minstrel S wireless CDPD modem installed on Handspring Visor

(see manufacturer's submission documentation for drawings and more design details)



APPENDIX C

Uncertainty Budget

Uncertainties Contributing to the Overall Uncertainty		
Type of Uncertainty	Specific to	Uncertainty
Power variation due to battery condition	phone	4.7%
Extrapolation due to curve fit of SAR vs depth	phone	9.1%
Extrapolation due to depth measurement	setup	3.7%
Conductivity	setup	6.0%
Density	setup	2.6%
Tissue enhancement factor	setup	7.0%
Voltage measurement	setup	2.1%
Probe sensitivity factor	setup	3.5%
		15.1% RSS



APPENDIX D

Simulated Tissue Material and Calibration Technique

The mixture used was based on that presented SSI/DRB-TP-D01-033, “Tissue Recipe and Calibration Requirements”.

De-ionised water	52.8 %
Sugar	45.3 %
Salt	1.5 %
HEC	0.3 %
Bactericide	0.1 %

Mass density, ρ 1.30 g/ml
 (The density used to determine SAR from the measurements was the recommended 1040 kg/m³ found in Appendix C of Supplement C to OET Bulletin 65, Edition 97-01)

Dielectric parameters of the simulated tissue material were determined using a Hewlett Packard 8510 Network Analyser, a Hewlett Packard 809B Slotted Line Carriage, and an APREL SLP-001 Slotted Line Probe.

The dielectric properties are:

	APREL	OET 65 Supplement	Δ / % (OET)
Dielectric constant, ϵ_r	58.6	56.11	+4.4
Conductivity, σ / [S/m]	1.09	0.946	+15.3
Tissue Conversion Factor, γ	7.8	-	-



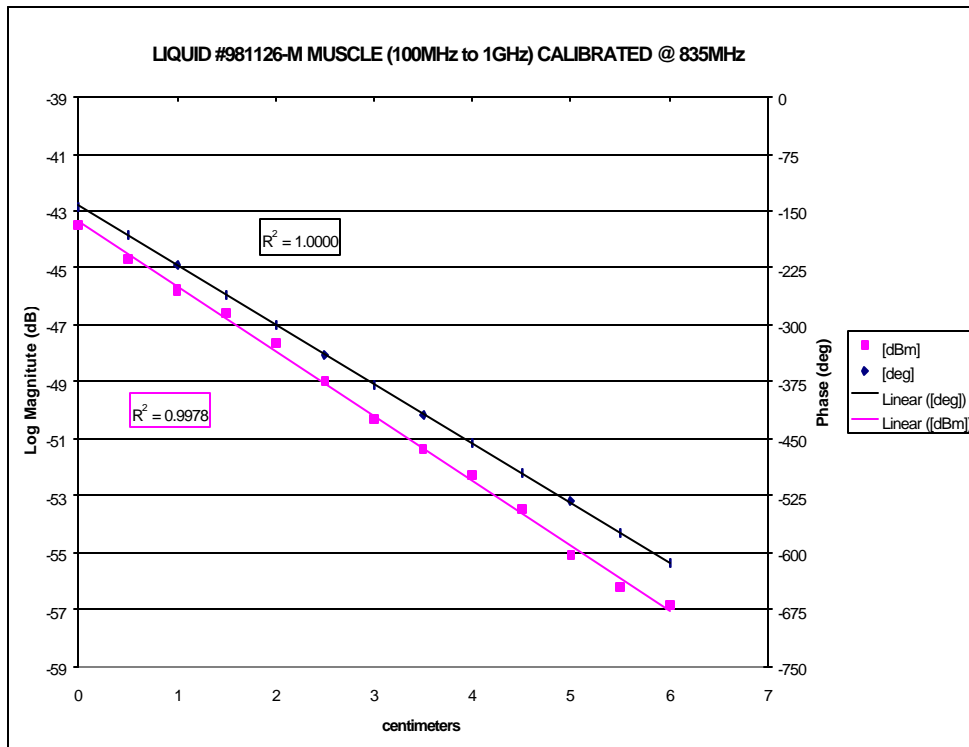
SIMULATION FLUID # 981126-M
 CALIBRATION DATE 31-Jul-09
 CALIBRATED BY Ken O'Donnell
 Frequency Range 100MHz-1GHz
 Frequency Calibrated 835 MHz
 Tissue Type Muscle

Position [cm]	Amplitude [dBm]	Phase [deg]	Phase [deg]
0	-43.48	-143.7	-143.7
0.5	-44.66	177.8	-182.2
1	-45.77	138.3	-221.7
1.5	-46.58	99.6	-260.4
2	-47.61	61.03	-298.97
2.5	-48.99	21.06	-338.94
3	-50.3	-18.14	-378.14
3.5	-51.34	-58.06	-418.06
4	-52.27	-96.03	-456.03
4.5	-53.47	-134.13	-494.13
5	-55.04	-171.99	-531.99
5.5	-56.22	145.77	-574.23
6	-56.8	105.82	-614.18

ΔdB_1	-6.82	Δdeg_1	-234.44
ΔdB_2	-6.68	Δdeg_2	-235.86
ΔdB_3	-6.5	Δdeg_3	-234.33
ΔdB_4	-6.89	Δdeg_4	-233.73
ΔdB_5	-7.43	Δdeg_5	-233.02
ΔdB_6	-7.23	Δdeg_6	-235.29
ΔdB_7	-6.5	Δdeg_7	-236.04
$\Delta dB_{avg}[dB]$	-6.86	$\Delta deg_{avg}[deg]$	-234.6728571
$dB_{avg} f_{avg}$ [dB/cm]	-2.29	$deg_{avg} f_{avg}$ [deg/cm]	-78.22428571
f_{avg} [NP/cm]	-0.263426699	f_{avg} [rad/cm]	-1.365271341

f [Hz]	8.35E+08
μ [H/cm]	1.25664E-08
ϵ_0 [F/cm]	8.854E-14

ϵ_r 58.6
 $\epsilon_{r \text{ effective}}$ 1.09



835 MHz Data (Heike & Tony) Muscle with E-115

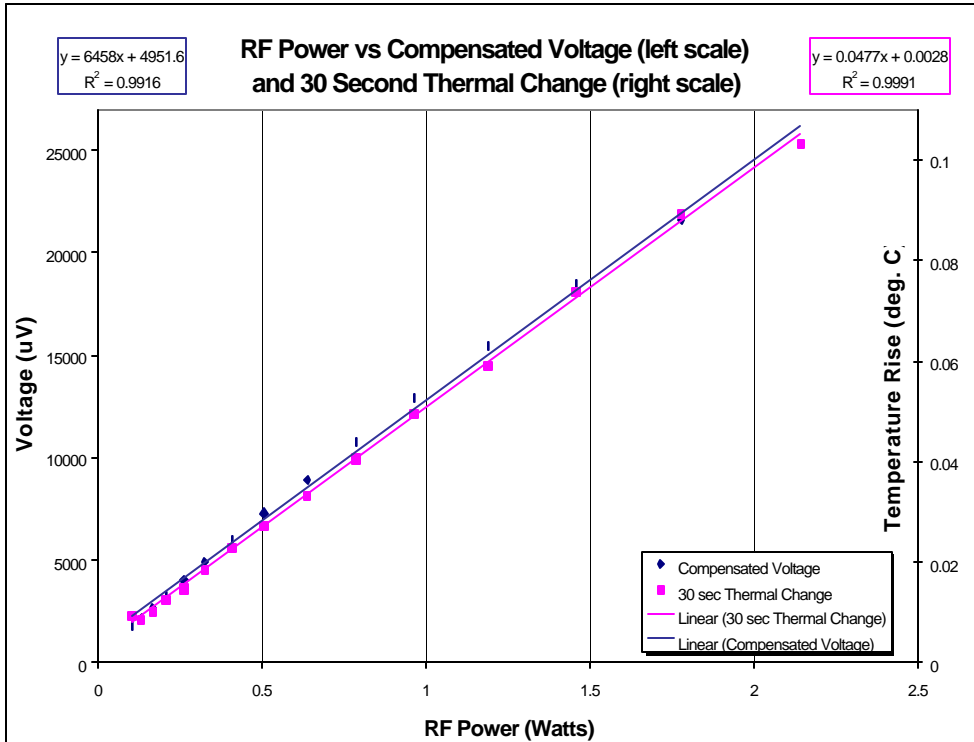
RF Power			Ch0	Ch1	Ch2	delta T	Sum	Thermal
W	dBm	R&S	uV	uV	uV	(30 sec)	V/EI	SAR
						deg. C		W/kg
0.10666	20.28	-25.61	391	1196	2954	0.0093	1792.736	0.86
0.133352	21.25	-24.64	439	1440	3638	0.0086	2177.984	0.80
0.169044	22.28	-23.61	513	1782	4517	0.0102	2689.029	0.94
0.210863	23.24	-22.65	586	2173	5542	0.0125	3276.59	1.16
0.263027	24.2	-21.69	684	2661	6787	0.0147	3939.08	1.36
0.328095	25.16	-20.73	830	3247	8276	0.0185	4875.658	1.71
0.412098	26.15	-19.74	1001	4028	10205	0.0227	6012.429	2.10
0.509331	27.07	-18.82	1196	4932	12402	0.0273	7312.846	2.53
0.639735	28.06	-17.83	1440	6079	15137	0.0331	8940.589	3.06
0.787046	28.96	-16.93	1733	7397	18188	0.0405	10779.67	3.75
0.966051	29.85	-16.04	2100	8960	21680	0.0495	12918.42	4.58
1.188502	30.75	-15.14	2515	10815	25806	0.0592	15441.16	5.48
1.458814	31.64	-14.25	3052	13086	30640	0.0736	18455.06	6.81
1.778279	32.5	-13.39	3662	15503	35718	0.0893	21651.69	8.26
2.142891	33.31	-12.58	4395	18335	41528	0.1031	25349.01	9.54

Directional Coupler factor 25.89 dB (Asset 100251 cal file data)
 Additional inline attenuation 20 dB

Sensitivity (e) 1.658 1.721 1.68 - Sensor Sensitivity in mV/(mW/cm²): 835 MHz cal
 η = 1.50 e 2.487 2.5815 2.52

Density 1.3 g/cm³ 1300 kg/m³
 Conductivity 10.8 mS/cm 1.08 S/m
 Heat Capacity (c) 2.775 J/C/g 2775 J/C/kg
 Exposure Time 30 seconds 30 seconds
 Slope of Measure Voltage (m_v) 11722.36 uV/W 0.011722 V/W
 - standard error or m_v 182.1283 uV/W 0.000182 V/W 1.6%
 Slope of Measure Temp Change (m_t) 0.047724 CW 0.047724 CW
 - standard error or m_t 0.000398 CW 0.000398 CW 0.8%

Tissue Conversion Factor (g) 7.8



APPENDIX E

Validation Scans

