APREL Laboratories

Certification Report on

Specific Absorption Rate (SAR)
Experimental Analysis

NeoPoint Inc.

Single Band
Dual Mode Cellular Phone

Date: 16 September, 1999

- Telecommunications Approval Board - Spectrum Sciences Institute
SAR Certified
APREL Laboratories
A992-NP1600

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CERTIFICATION REPORT

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

Product: Single Band Dual Mode Cellular Telephone

Model: NP1600

Client: NeoPoint, Inc.

Address: 4225 Executive Square
Suite 700
La Jolla, CA 92037

Project #: NEOB-NP1600-3291

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

Tested by ______________________ Date: ______________
Heike Wünschmann, C.E.T.

Submitted by ______________________ Date: ______________
Dr. Paul G. Cardinal
Director, Laboratories

Approved by ______________________ Date: ______________
Dr. Jacek J. Wojcik, P. Eng.

FCC ID: N5WNP16PSBDMHJKH2
Applicant: NeoPoint, Inc.
Equipment: Single Band Dual Mode Cellular phone
Model: NP1600
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 NeoPoint NP1600 single band dual mode cellular phone. The measurements were carried out in accordance with FCC 96-326. The dual mode cellular phone was evaluated for its nominal maximum AMPS power level of 500 mW (27 dBm) and CDMA power level of 316 mW (25 dBm).

The NP1600 was tested at high, middle, and low frequencies in both AMPS and CDMA modes with the antenna extended and retracted as well as for both battery types. The maximum SAR coinciding with the peak performance RF output power of channel 383 (middle, 836 MHz) in AMPS mode, with the antenna out and with the slim battery. Test data and graphs are presented in this report.

Based on the test results, it is certified that the product meets the requirements as set forth in the above specifications, for uncontrolled RF exposure environment.

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1. INTRODUCTION

Tests were conducted to determine the Specific Absorption Rate (SAR) of a sample of a NeoPoint NP1600 dual mode cellular phone. 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 95.3-1992, 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

- NeoPoint NP1600, single band cellular dual mode CDMA/AMPS phone, pre-production sample
- Slim battery (model #: NP1-SB)
- Extended battery (model #: NP1-EB)

The phone's antenna is a retractable whip antenna with a nominal gain of 2 dB when it is extended and 0 dB when it is retracted. It is located on the right hand side of the top of the phone. Please refer to Appendix B for photographs and detailed specifications of the antenna. The axis of the antenna is 17 mm from the front surface plane of the handset.

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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 # 201334
- R&S NRVS power meter, s/n 864268/017, Asset # 100851
- R&S NRV-Z7 power sensor, s/n 862 509/006, Asset # 100852
- APREL UH-1, Universal Head-Arm, s/n 001, Asset # 301376
- Tissue Recipe and Calibration Requirements, APREL procedure SSI/DRB-TP-D01-033

5. TEST METHODOLOGY

1. The test methodology utilised in the certification of the dual mode cellular phone 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 dual mode cellular phone is positioned in such a way that it simulates the normal usage position.

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7. All tests were performed with the highest power available from the sample dual mode cellular phone, under transmit conditions.

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

6. TEST RESULTS

6.1. TRANSMITTER CHARACTERISTICS

The 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 sampled before and after each SAR run. In the case of the dual mode cellular phone which has an externally accessible feedpoint the conducted power was measured. A power meter was connected to the device via cable (loss 1 dB). The following table shows the difference between the measured power before and after each of the six sets of data used for the worst case SAR in this report. (The device was operating in the AMPS mode, for the worst case SAR.)

Scan		**Power Reading (dBm) corrected for cable loss**			**Battery #**
Type	Height (mm)	Before	After	Δ	
Area	2.5	27.17	26.36	-0.81	2
Area	12.5	27.16	26.04	-1.12	2
Zoom	2.5	27.18	26.19	-0.99	1
Zoom	7.5	27.16	26.18	-0.98	3
Zoom	12.5	27.18	26.48	-0.70	2
Depth	2.5 – 17.5	27.16	26.31	-0.85	3

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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 1 gram of tissue.

2) The NeoPoint NP1600 dual mode cellular phone (DUT) was put into test mode for the SAR measurements via communications software supplied by the manufacturer running on a PC to control the mode, channel and operating power. The phone was initially set to operate in the AMPS mode on channel 383 (middle, 836 MHz) and its maximum operating power (nominally 500 mW, 27 dBm), with a slim battery and the antenna extended.

3) Figure 3 in Appendix A shows a contour plot of the SAR measurements for the NeoPoint NP1600 dual mode cellular phone sample. The presented values were taken 2.5 mm into the simulated tissue from the Universal Head-Arm's (UH-a) solid inner surface. Figures 1 and 2 in Appendix A show the UH-a used in the measurements, with its arm (empty) in position to hold the DUT against the simulated head. A grid is shown inside of the UH-a indicating the orientation of the x-y grid used, with the origin 0,0 at the top of the pinna. The x-axis is positive towards the left and the y-axis is positive towards the bottom. The phone's antenna is located at the right side of the device, (see Appendix B).

   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 10 in Appendix A shows an overlay of the phone's outline superimposed onto a similar contour plot to that 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.

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4) Wide area scans were performed for the low (991), the middle (383) and the high (779) channels for both modes (AMPS and CDMA) with the antenna both extended (out) and retracted (in). Measurements were also made with the two battery types. The peak single point SAR for the scans were:

Mode	Channel	Antenna Position	Channel #	Battery Type	Frequency (MHz)	Peak Single Point SAR (W/kg)
AMPS	Low	in	991	slim	824.04	0.56
AMPS	Middle	in	383	slim	836.49	0.80
AMPS	High	in	799	slim	848.97	0.76
AMPS	Low	out	991	slim	824.04	1.36
AMPS	Middle	out	383	slim	836.49	1.47
AMPS	High	out	799	slim	848.97	1.30
AMPS	Low	in	991	extended	824.04	0.59
AMPS	Middle	in	383	extended	836.49	0.71
AMPS	High	in	799	extended	848.97	0.67
AMPS	Low	out	991	extended	824.04	1.26
AMPS	Middle	out	383	extended	836.49	1.40
AMPS	High	out	799	extended	848.97	1.20
CDMA	Low	in	1013	slim	824.7	0.30
CDMA	Middle	in	383	slim	836.5	0.38
CDMA	High	in	777	slim	848.3	0.38
CDMA	Low	out	1013	slim	824.7	0.67
CDMA	Middle	out	383	slim	836.5	0.75
CDMA	High	out	777	slim	848.3	0.68

Subsequent testing was performed on the middle (383, 836 MHz) channel in AMPS mode with the antenna out and using the slim battery.

5) The middle channel (383) SAR peak was then explored on a refined 0.5 mm grid in three dimensions. Figures 7, 8, and 9 show the measurements made at 2.5, 7.5, and 12.5 mm respectively. The SAR value averaged over 1 gram was determined from these measurements by averaging the 27 points (3x3x3) comprising a 1 cm cube. The maximum SAR value measured averaged over 1 gram was determined from these measurements to be 1.05 W/kg.

6) To extrapolate the maximum SAR value averaged over 1 gram 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 11 in

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Appendix A shows the data gathered and the exponential curves fit to them. The average exponential coefficient was determined to be (-0.0612 ± 0.0004) / 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 1 gram that was determined previously, we obtain **the maximum SAR value at the surface averaged over 1 cm^3** of 1.40 W/kg.

7. CONCLUSIONS

The maximum Specific Absorption Rate (SAR) averaged over 1 g, determined in the AMPS mode at 836 MHz (middle channel, 383), of the NeoPoint single band dual mode cellular phone, is 1.40 W/kg. The overall margin of uncertainty for this measurement is ± 16.1 % (Appendix C). The SAR limit given in the FCC 96-326 safety guideline is 1.6 W/kg.

This unit as tested, and as it will be marketed, is found to be compliant with this requirement

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APPENDIX A

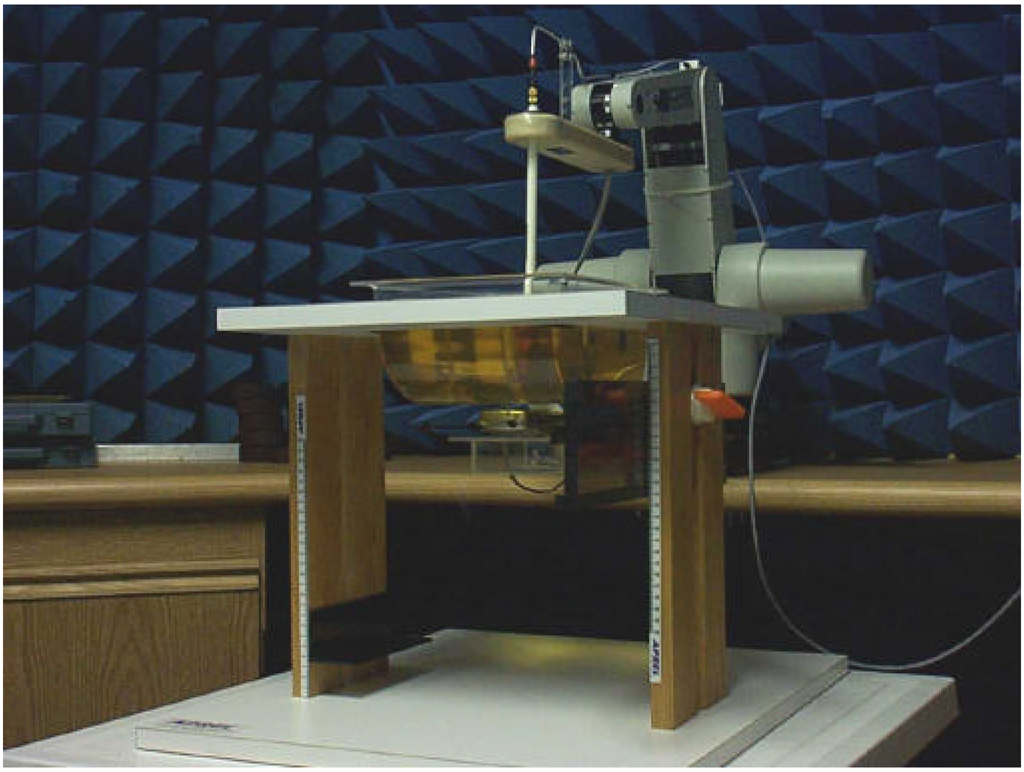

Figure 1

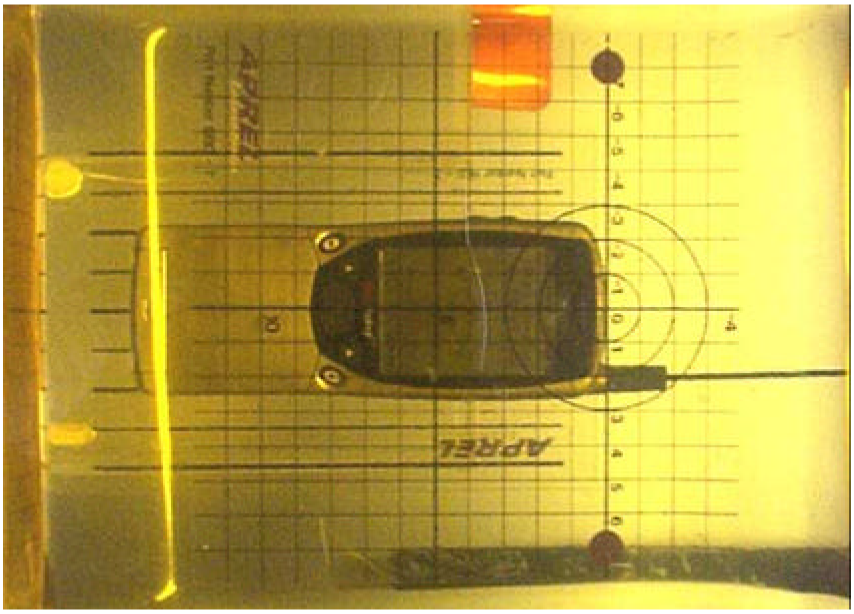

Figure 2

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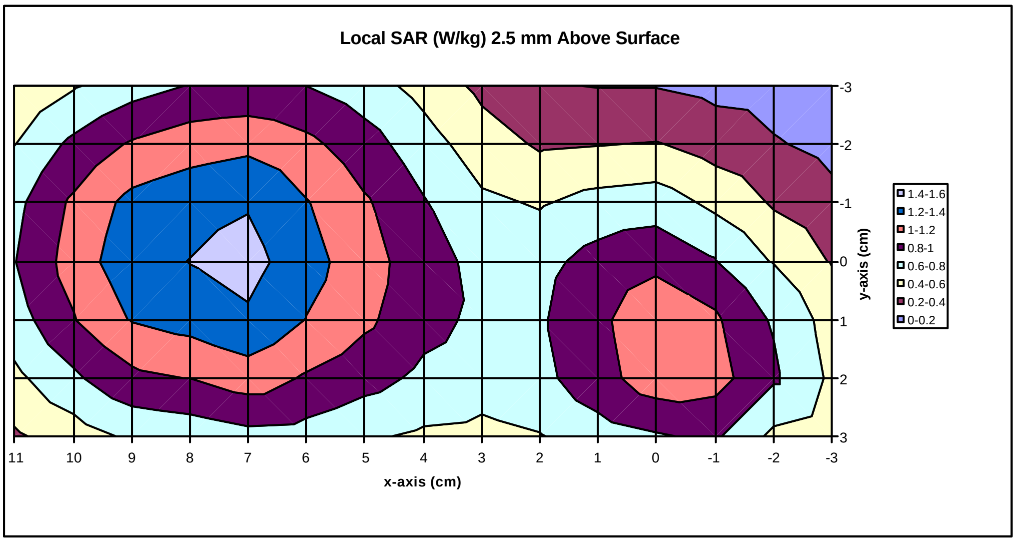

Figure 3

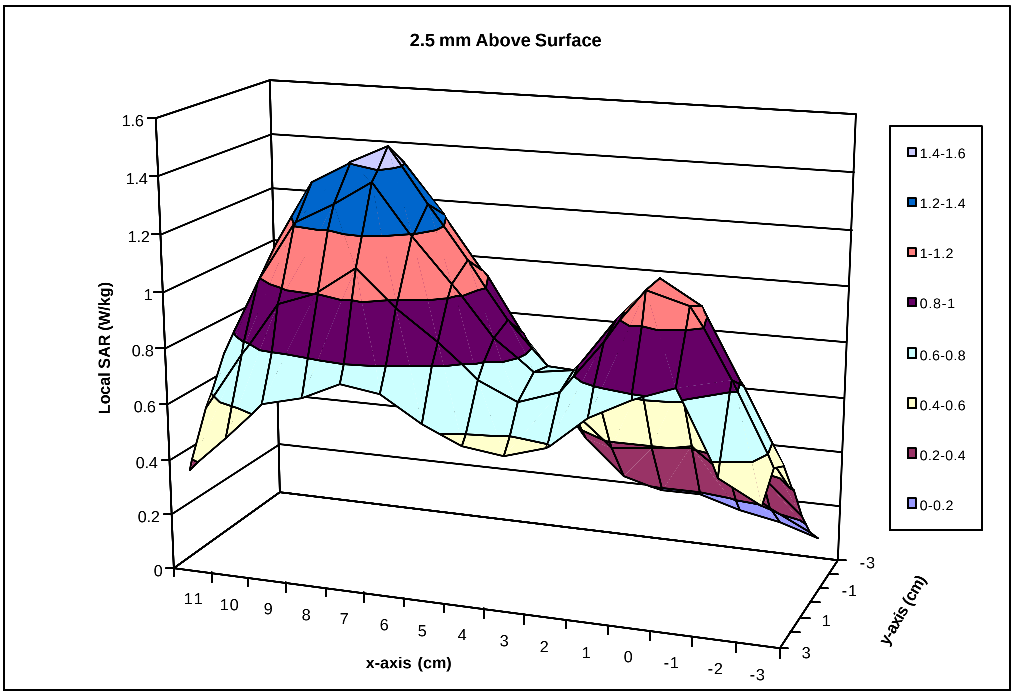

Figure 4

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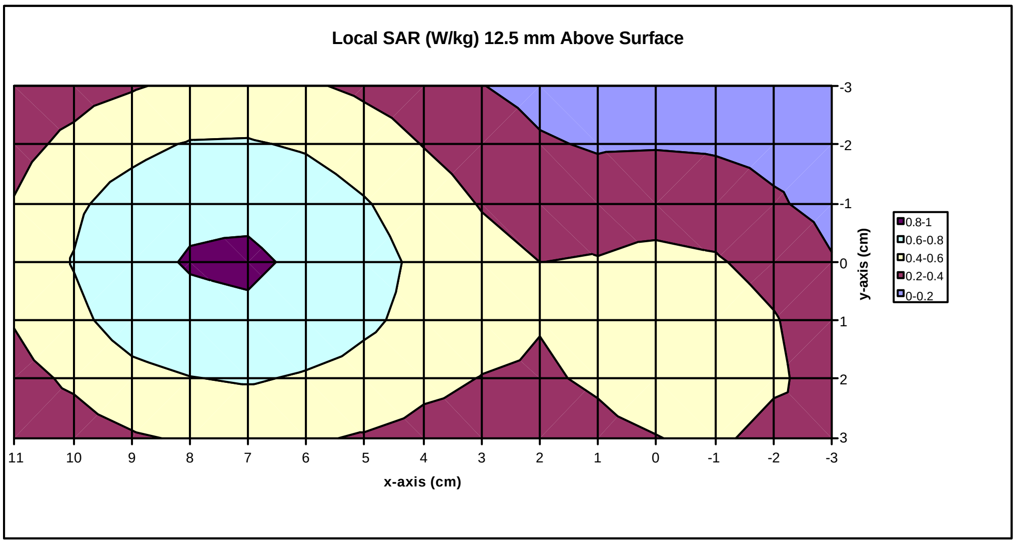

Figure 5

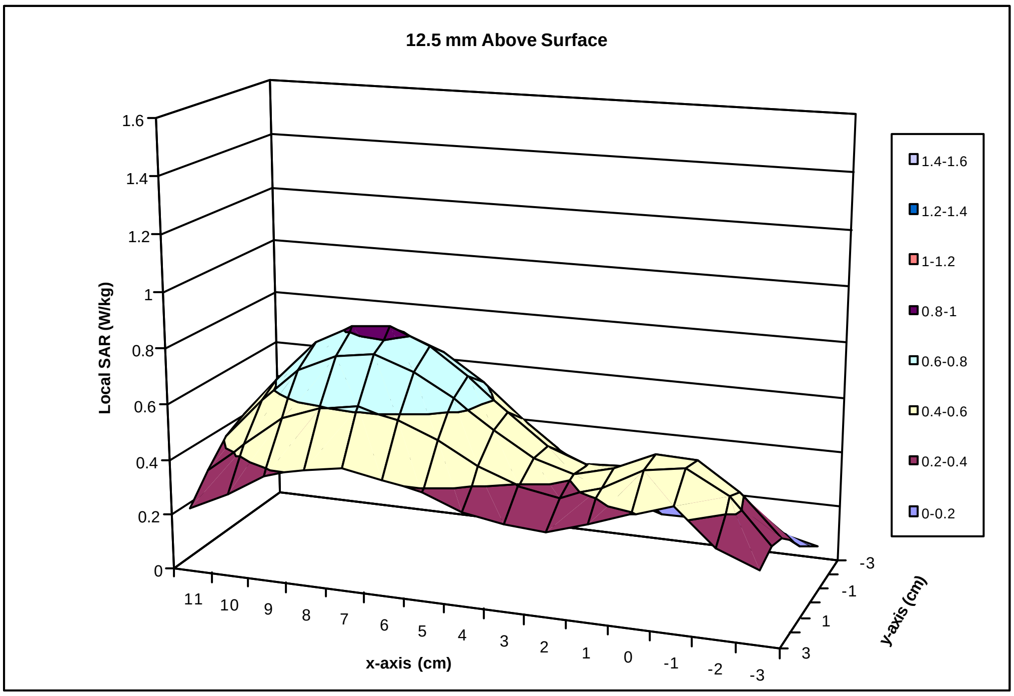

Figure 6

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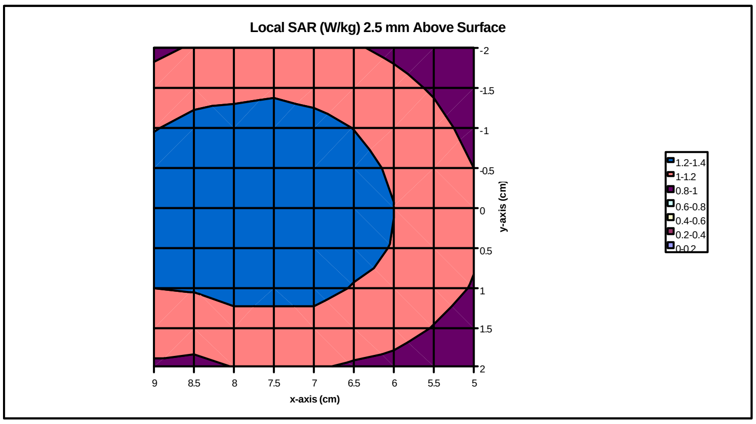

Figure 7

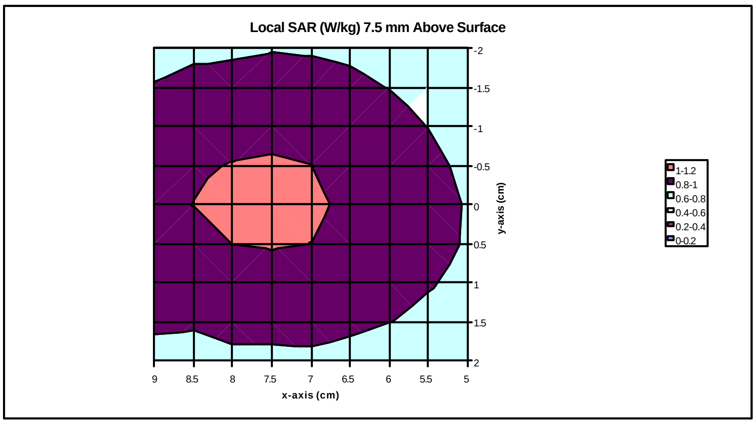

Figure 8

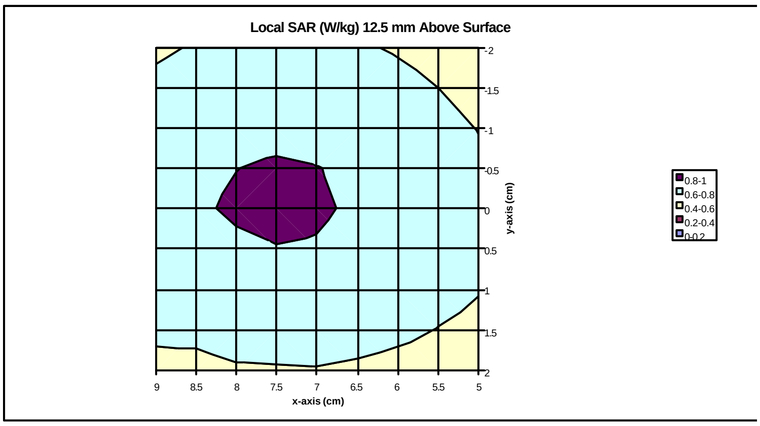

Figure 9

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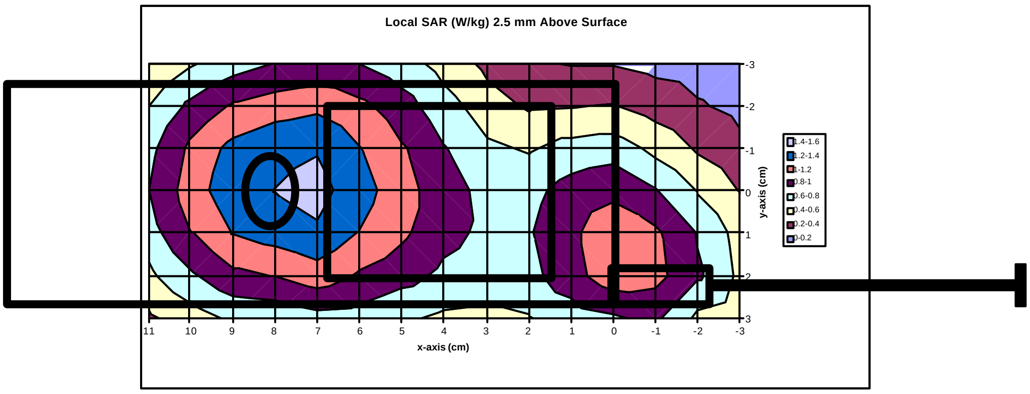

Figure 10

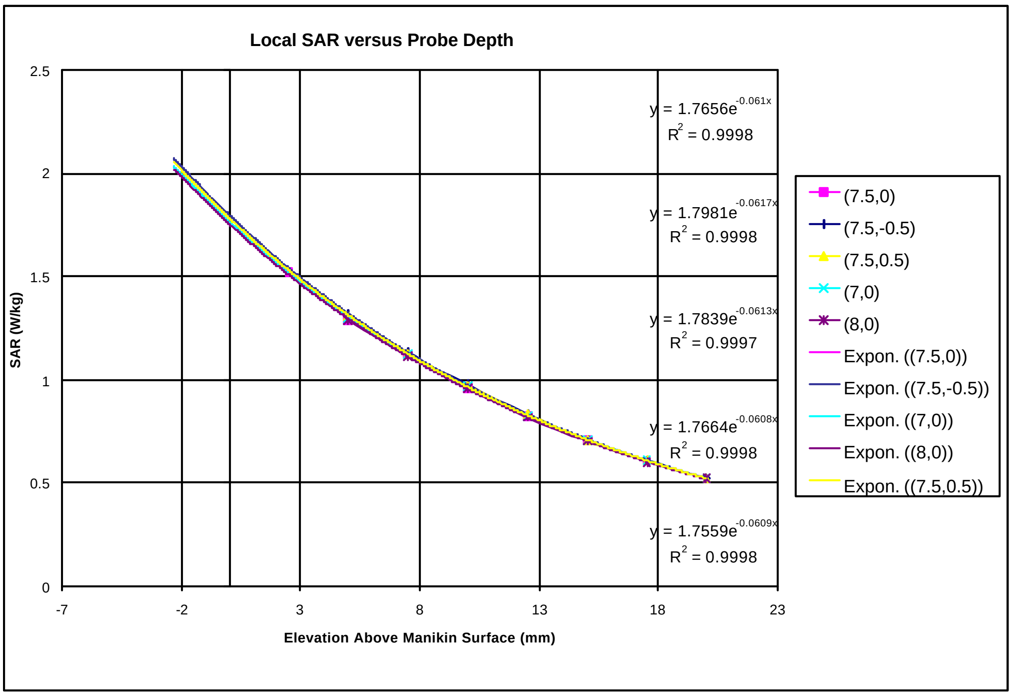

Figure 11

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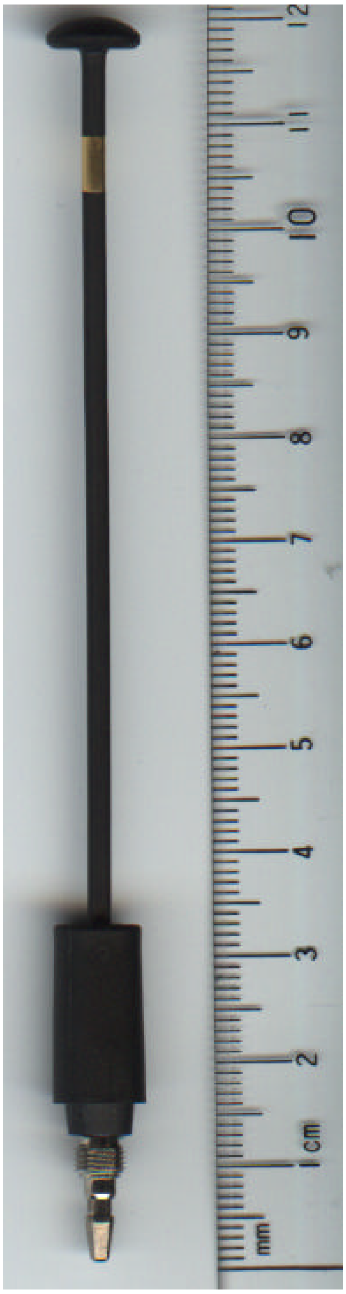
APPENDIX B

Manufacturer's Antenna Specifications



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Centurion
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Communications*

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CENTURION RETRACTABLE ELECTRICAL PERFORMANCE DATA

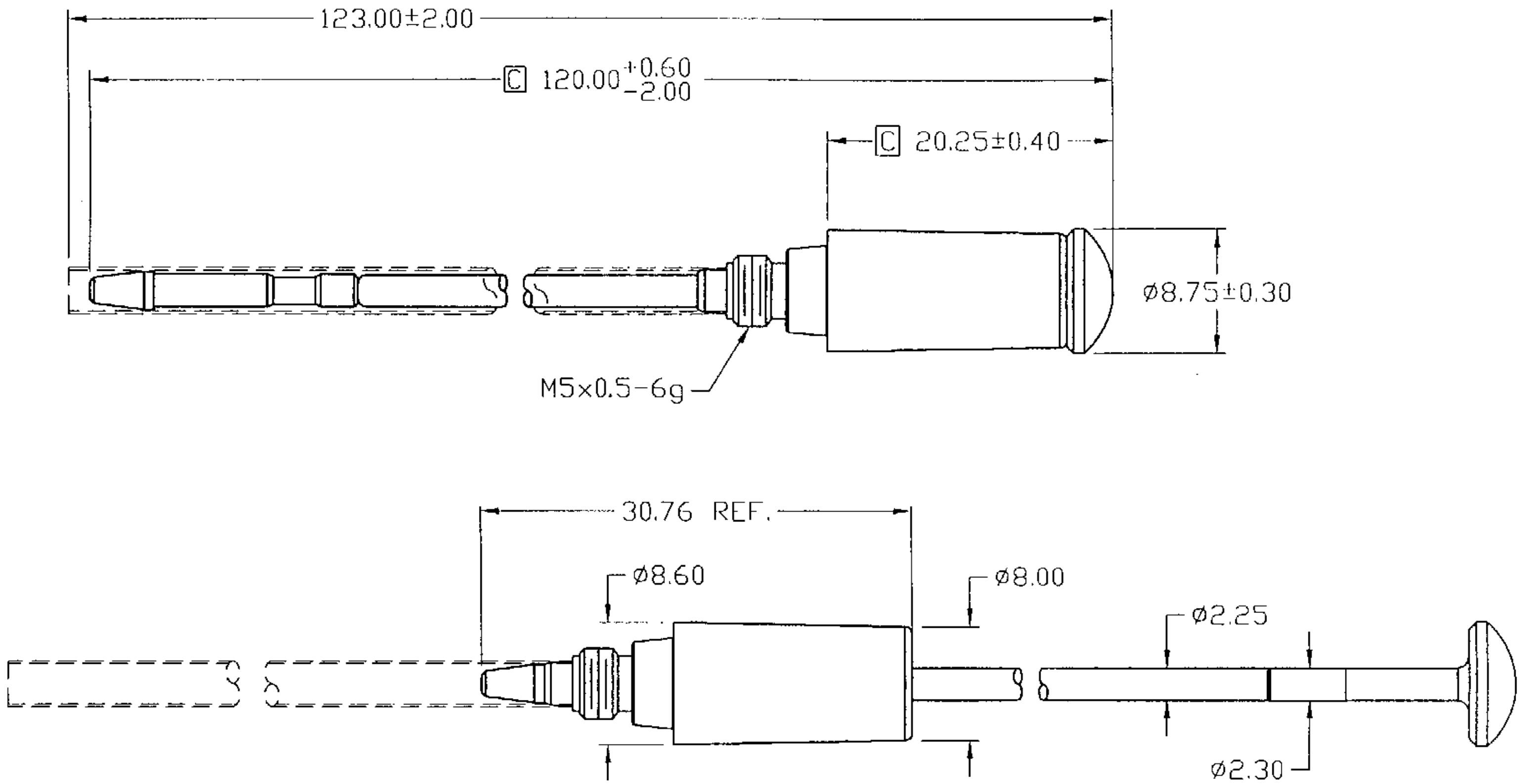
Presented to:

INNOVATIVE GLOBAL SOLUTION, INC.

Prepared by:

CENTURION INTERNATIONAL, INC.

August 24, 1999



ALL DIMENSIONS ARE IN MILLIMETERS

LET	REVISION	DATE	CK	APP
D1	UPDATED	06/99		
D2	PROT8662	08/99		

SCALE: 2:1

DR:CAB CK:

TOL. UNLESS NOTED:
.X = ± 0.3
.XX = ± 0.13
ANGULAR ± 30'

CENTURION INT. INC.
PH. 402-467-4491
FAX. 402-467-4528
P.O. BOX 82846
LINCOLN, NE 68501

ANT, AMPS, ECPU

MATERIAL: N/A

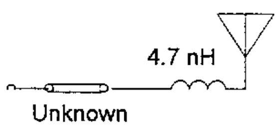
DATE:	DWG NO.:	PG:	REV
04/27/99	CAF95845	1/3	D2

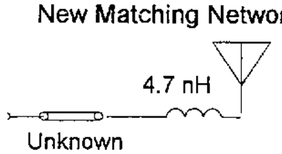
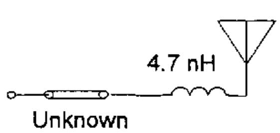
 P4248

Centurion International, Inc.
Wireless Components
Antennas and Power Products

Antenna Summary Sheet

General Information			
Customer:		Innovative Global Solution, Inc.	
Date:		August 22, 1999	
Location:		La Jolla, CA	
Frequency Band, MHz		824 - 894 MHz (AMPS)	
Antenna Type:		Retractable	
Input Connection:		M5 x 0.5 Threaded Connector	
Prepared by:	WRH	File:	G:\CHAMBER\Ant_spec\P4249\P4248_antsum_Aug99.doc
Comments: All Measurements taken at side of phone with antenna Prototype A3.			

Electrical Performance Summary: VSWR (:1.0)			
Specification	< 2.0:1		
Measurement Configuration	Data		
- Free Space - Fixture No.: F1128A - New Matching Network 	Freq. (MHz)	Prototype A3 - Extended	Prototype A3 - Retracted
	824	1.44	1.58
	849	1.38	1.32
	869	1.48	1.47
	894	1.81	1.88

Electrical Performance Summary: Peak Gain (dBi)			
Specification	Minimum 1.0 dBi		
Measurement Configuration	Data		
- Free Space - Fixture No.: F1128A - New Matching Network 	Freq. (MHz)	Prototype A3 - Extended	Prototype A3 - Retracted
	824	2.5	0.5
	849	2.2	0.3
	869	2.5	0.3
	894	2.5	-0.6
- User Position - Fixture No.: F1128A - New Matching Network 	Freq. (MHz)	Prototype A3 - Extended	Prototype A3 - Retracted
	824	0.9	-1.3
	849	0.6	-1.4
	869	1.2	-1.1
	894	1.2	-2.2

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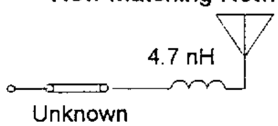
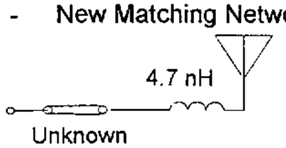
Wireless Components
Antennas and Power Products

Antenna Summary Sheet

Electrical Performance Summary: Average Gain (dBi)			
Specification	Unspecified		
Measurement Configuration	Data		
- Free Space - Fixture No.: F1128A - New Matching Network	Freq. (MHz)	Prototype A3 - Extended	Prototype A3 - Retracted
	824	-1.9	-3.6
	849	-2.4	-3.9
	869	-2.1	-3.8
	894	-2.3	-4.8
- User Position - Fixture No.: F1128A - New Matching Network	Freq. (MHz)	Prototype A3 - Extended	Prototype A3 - Retracted
 	824	-5.7	-8.0
	849	-6.0	-8.2
	869	-5.4	-7.9
	894	-5.3	-9.0

APPENDIX C

Uncertainty Budget

Uncertainties Contributing to the Overall Uncertainty

Type of Uncertainty	Specific to	Uncertainty
Power variation due to battery condition	DUT	12.1%
Extrapolation due to curve fit of SAR vs depth	DUT	1.2%
Extrapolation due to depth measurement	setup	3.0%
Conductivity	setup	6.0%
Density	setup	2.6%
Tissue enhancement factor	setup	7.0%
Voltage measurement	setup	0.4%
Probe sensitivity factor	setup	3.5%
		16.1% RSS

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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	40.6 %
Sugar	58.0 %
Salt	1.0 %
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 1.03 kg/m^3 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	IEEE recommended	OET 65 Supplement	Δ / % (OET)	Δ / % (IEEE)
Dielectric constant, ε_r	44.6	44.0	46.1	-3.2	+1.4
Conductivity, σ/ [S/m]	0.91	0.9	0.74	+23.0	+1.1
Tissue Conversion Factor, γ	8.0				

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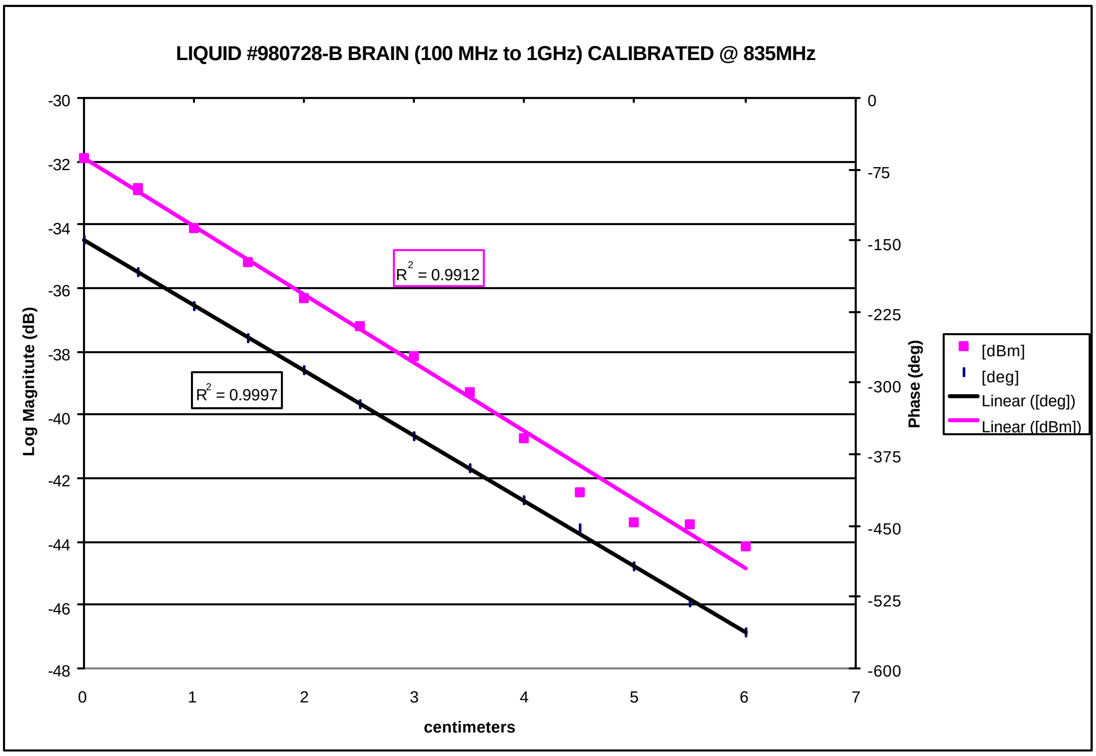
SIMULATION FLUID #	980728-B
CALIBRATION DATE	14-Sep-99
CALIBRATED BY	Heike
Frequency Range	100MHz-1GHz
Frequency Calibrated	835MHz
Tissue Type	BRAIN

Position [cm]	Amplitude [dBm]	Phase [deg]	[deg]
0	-31.89	-148.91	-148.91
0.5	-32.88	176.8	-183.2
1	-34.1	141.27	-218.73
1.5	-35.17	107.56	-252.44
2	-36.31	73	-287
2.5	-37.23	38.19	-321.81
3	-38.13	4.12	-355.88
3.5	-39.26	-29.09	-389.09
4	-40.76	-62.92	-422.92
4.5	-42.44	-92.22	-452.22
5	-43.37	-132.38	-492.38
5.5	-43.44	-170.75	-530.75
6	-44.18	157.44	-562.56

ΔdB_1	-6.24	Δdeg_1	-206.97
ΔdB_2	-6.38	Δdeg_2	-205.89
ΔdB_3	-6.66	Δdeg_3	-204.19
ΔdB_4	-7.27	Δdeg_4	-199.78
ΔdB_5	-7.06	Δdeg_5	-205.38
ΔdB_6	-6.21	Δdeg_6	-208.94
ΔdB_7	-6.05	Δdeg_7	-206.68
ΔdB_{AVG} [dB]	-6.55	$D deg_{AVG}$ [deg]	-205.4042857
dB_{AVG} (α_{AVG}) [dB/cm]	-2.18	deg_{AVG} (β_{AVG}) [deg/cm]	-68.46809524
(α_{AVG}) [NP/cm]	-0.251475186	(β_{AVG}) [rad/cm]	-1.194993694

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

ε_r	44.6	
$\sigma_{effective}$	0.91	S/m



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

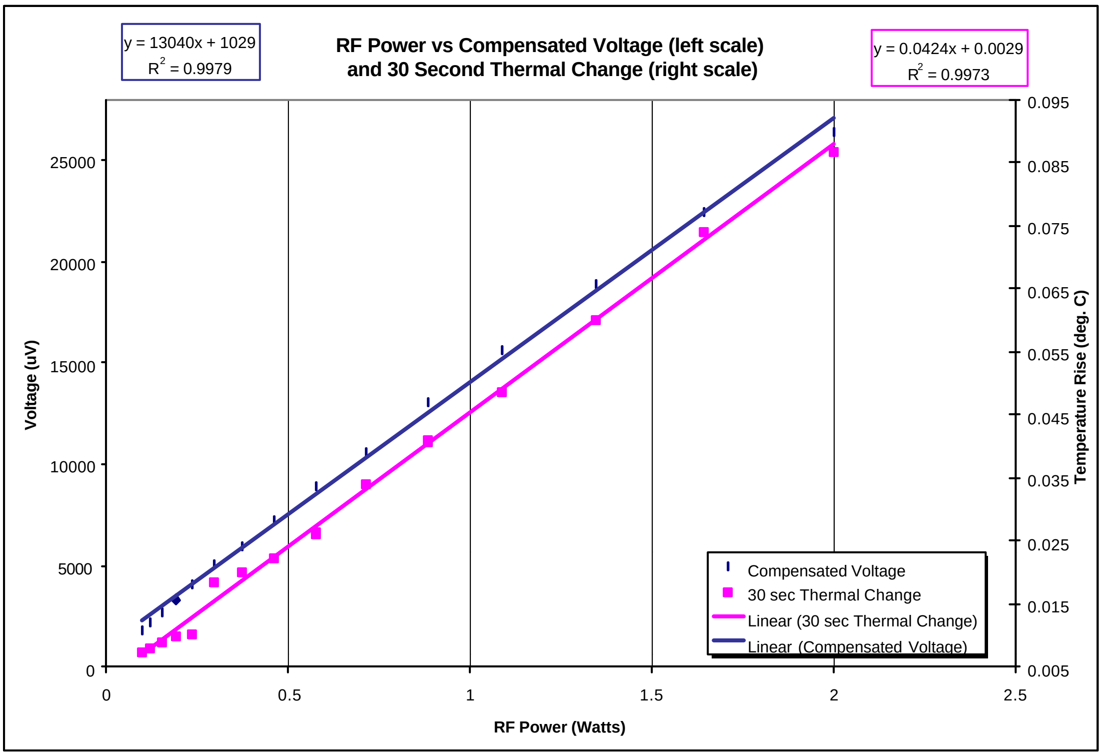
RF Power			Ch0	Ch1	Ch2	delta T (30 sec)	Sum Vi/Ei		Thermal SAR
W	dBm	R&S	uV	uV	uV	deg. C			W/kg
0.095719	19.81	-26.08	757	1221	2588	0.0073	1804.35		0.68
0.11995	20.79	-25.1	903	1489	3174	0.0079	2199.41		0.73
0.151705	21.81	-24.08	1099	1831	3955	0.009	2720.62		0.83
0.189671	22.78	-23.11	1343	2246	4883	0.0098	3347.74		0.91
0.237137	23.75	-22.14	1611	2759	6006	0.0103	4099.86		0.95
0.296483	24.72	-21.17	1978	3394	7373	0.0185	5035.87		1.71
0.37325	25.72	-20.17	2637	3516	8911	0.0199	5958.42		1.84
0.463447	26.66	-19.23	3198	4272	10815	0.0223	7232.41		2.06
0.578096	27.62	-18.27	3955	5273	13281	0.0262	8903.12		2.42
0.716143	28.55	-17.34	4517	6299	16016	0.0339	10611.9		3.14
0.88308	29.46	-16.43	5835	7813	19263	0.0408	13016.8		3.77
1.086426	30.36	-15.53	7080	9473	23022	0.0487	15652.1		4.50
1.348963	31.3	-14.59	8643	11548	27588	0.0601	18896.3		5.56
1.644372	32.16	-13.73	10400	13818	32495	0.0739	22429.3		6.84
1.999862	33.01	-12.88	12354	16357	37866	0.0866	26329.9		8.01

Directional Coupler factor	25.89	dB (Asset 100251 cal file data (Janusz, 21 Jul 96))
Additional inline attenuation	20	dB

Sensitivity (e)	1.658	1.721	1.68	- Sensor Sensitivity in mV/ (mW/cm^2)
η = 1.50 e	2.487	2.5815	2.52	

Density	1.3	g/cm^3	1300	kg/m^3	-Tony, summer 99
Conductivity	8.9	mS/cm	0.89	S/m	- Heike 8-Jul-99
Heat Capacity (c)	2.775	J/C/g	2775	J/C/kg	
Exposure Time	30	seconds	30	seconds	
Slope of Measure Voltage (m_v)	13040	uV/W	0.01304	V/W	
- standard error or m_V	167.424	uV/W	0.00017	V/W	1.3%
Slope of Measure Temp Change (m_T)	0.04244	C/W	0.04244	C/W	
- standard error or m_T	0.00061	C/W	0.00061	C/W	1.4%

Tissue Conversion Factor (γ)	**8.0**



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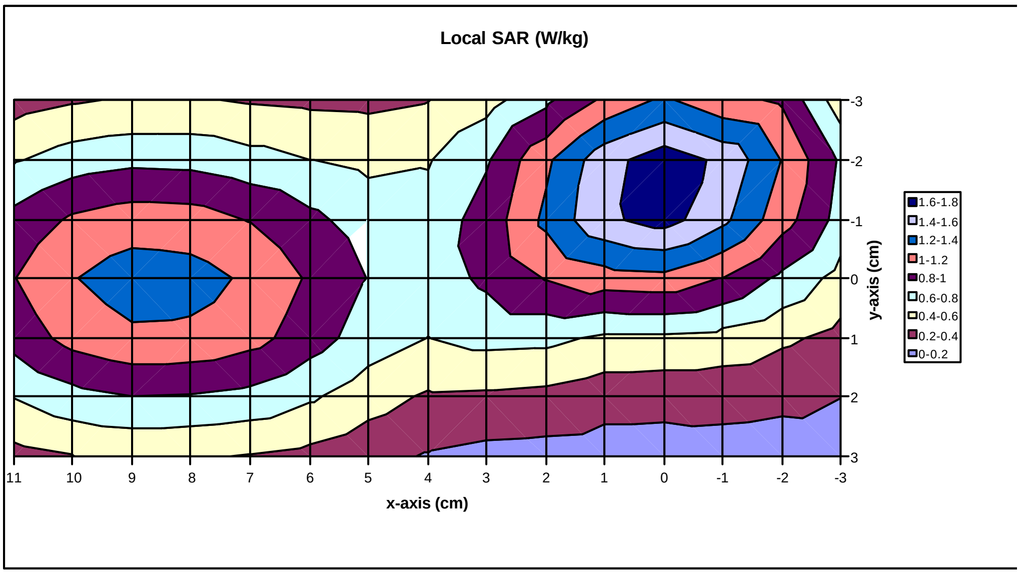
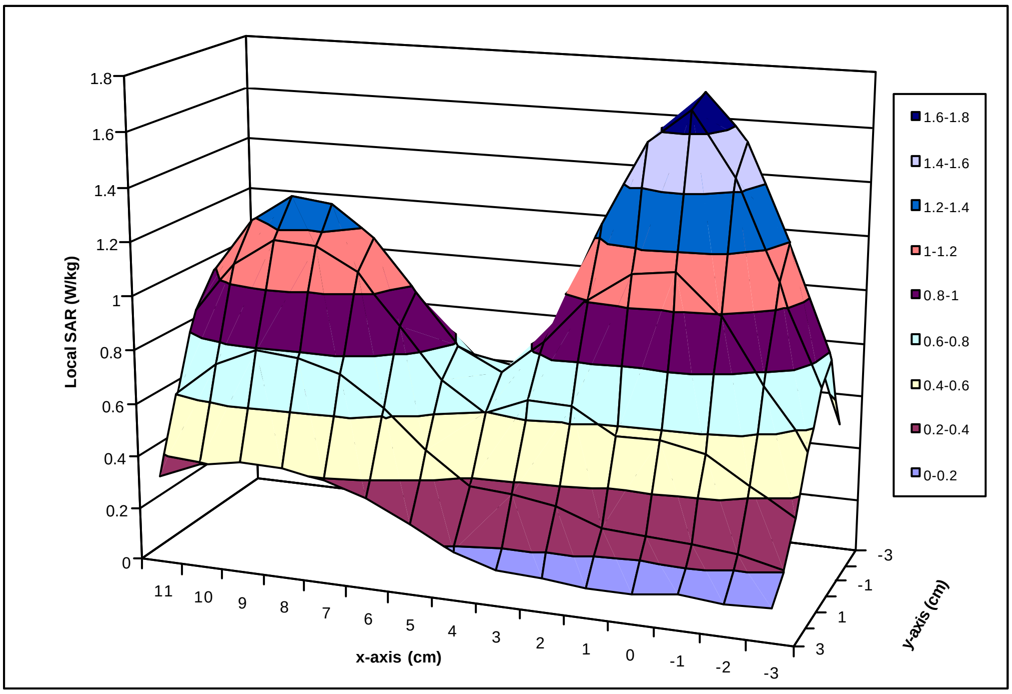
APPENDIX E

Validation Scans





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