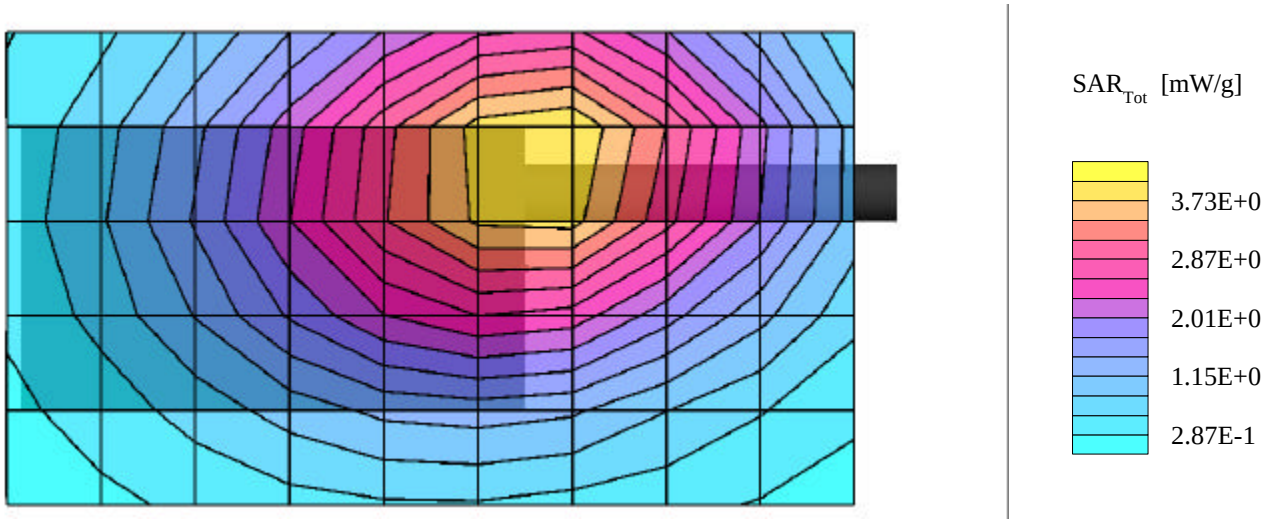
APPENDIX A - SAR MEASUREMENT DATA

KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7 Powerdrift: -0.13 dB
SAR (1g): 3.68 mW/g, SAR (10g): 2.66 mW/g

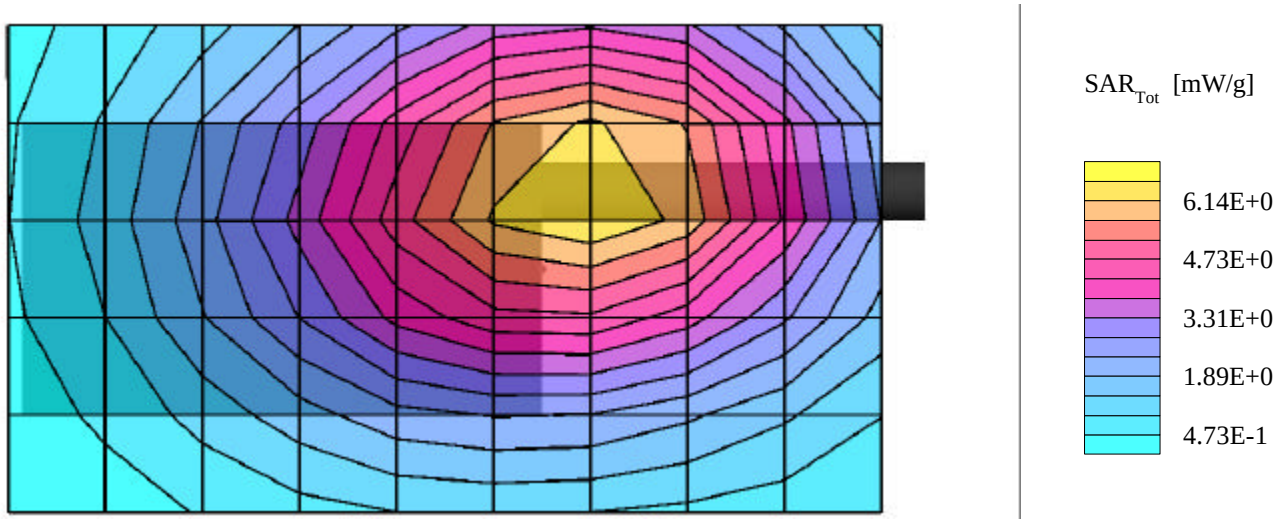
Face SAR with 2.5cm Separation Distance
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
Low Channel [470.05 MHz]
Conducted Power: 4.3 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.12 dB
SAR (1g): 7.48 mW/g, SAR (10g): 4.61 mW/g

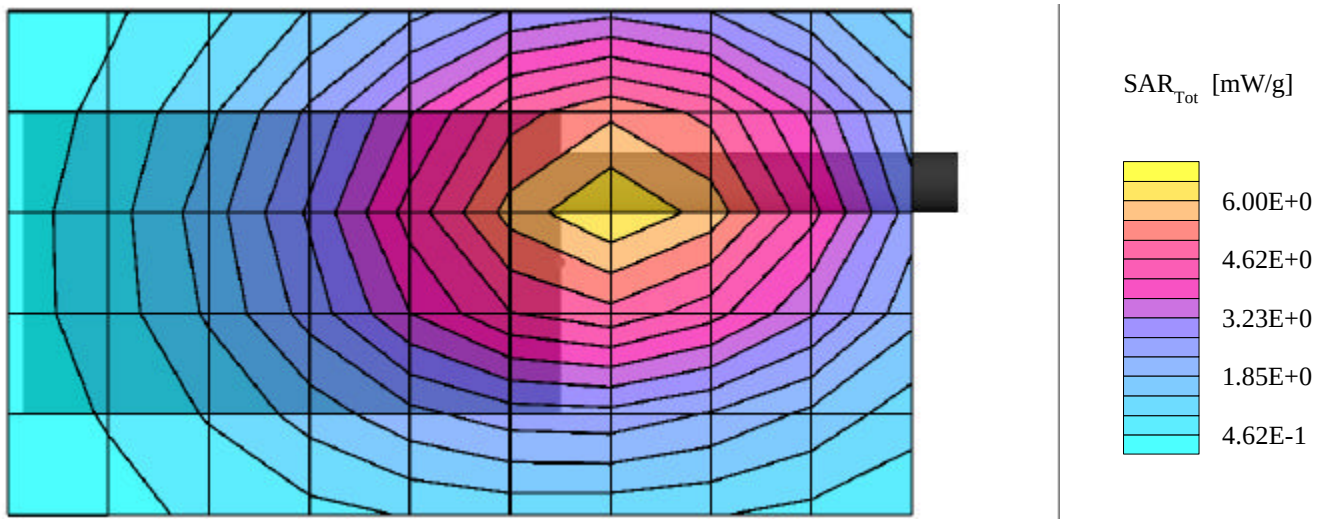
Face SAR with 2.5cm Separation Distance
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
Mid Channel [490.05 MHz]
Conducted Power: 4.2 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.09 dB
SAR (1g): 4.21 mW/g, SAR (10g): 3.04 mW/g

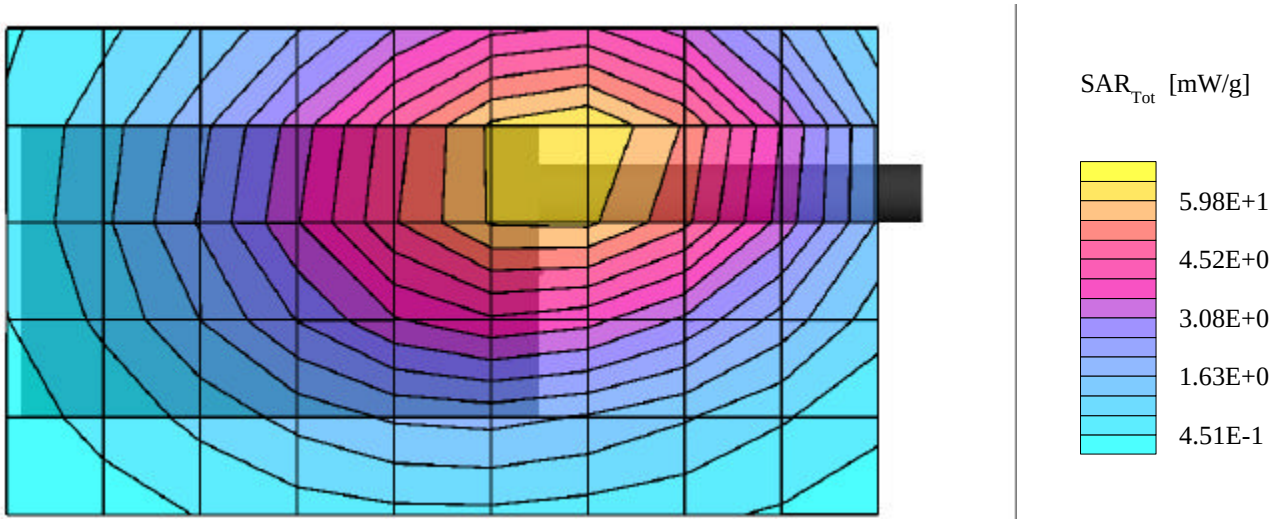
Face SAR with 2.5cm Separation Distance
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
High Channel [511.95 MHz]
Conducted Power: 4.1 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.17 dB
SAR (1g): 7.27 mW/g, SAR (10g): 4.39 mW/g

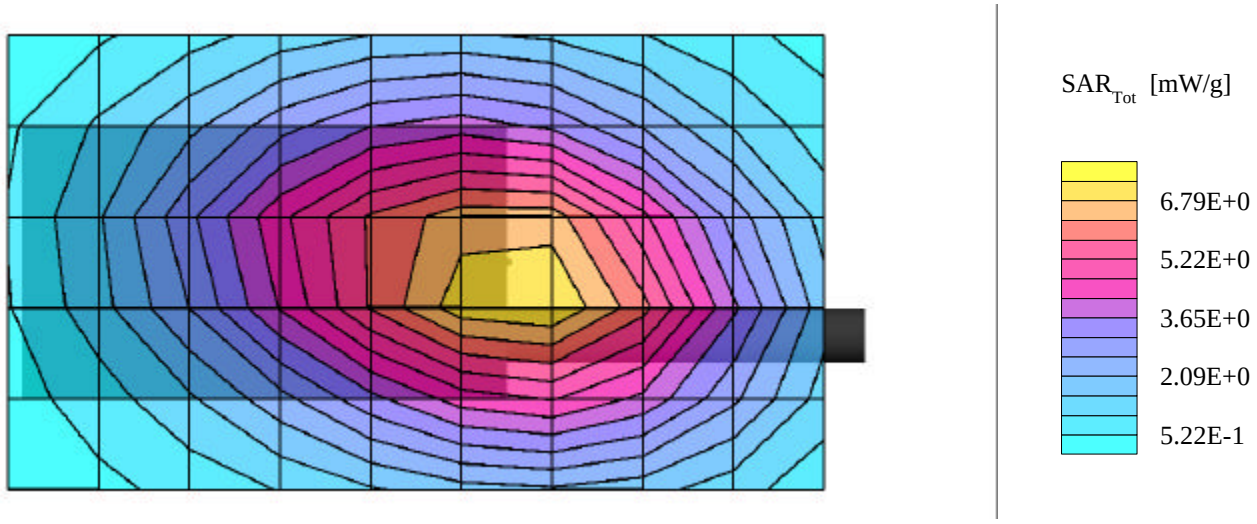
Face SAR with 2.5cm Separation Distance
7.2VDC Ni-Cd 1200mAh Battery
Continuous Wave Mode
Mid Channel [490.05 MHz]
Conducted Power: 4.2 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.23,7.23,7.23); Crest factor: 1.0
450 MHz Muscle: σ = 0.94 mho/m ε_r = 56.7 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7 Powerdrift: -0.11 dB
SAR (1g): 7.19 mW/g, SAR (10g): 5.17 mW/g

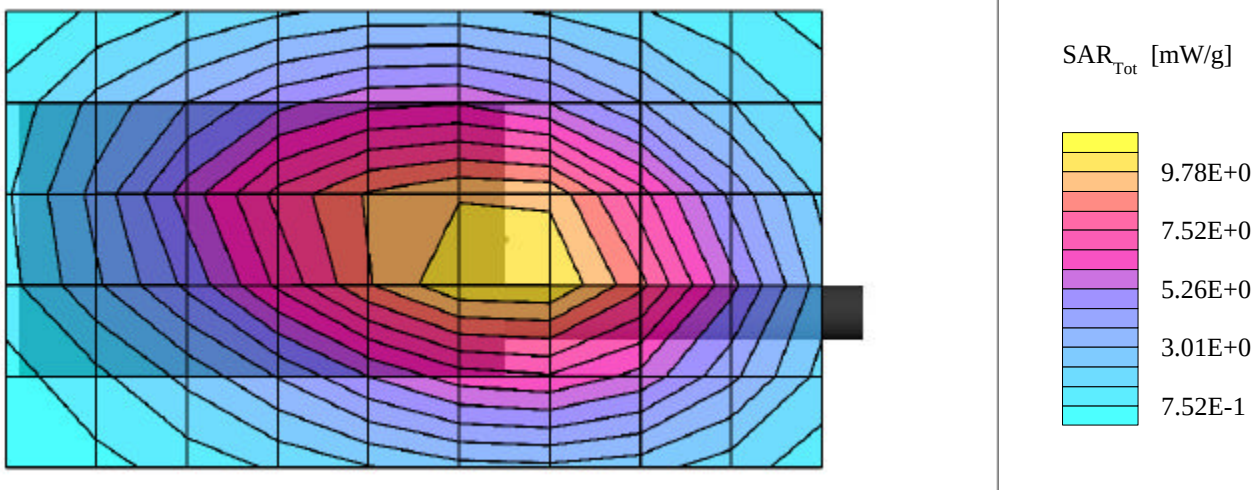
Body-Worn SAR with 1.0cm Belt-Clip & Speaker-Mic
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
Low Channel [470.05 MHz]
Conducted Power: 4.3 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.23,7.23,7.23); Crest factor: 1.0
450 MHz Muscle: σ = 0.94 mho/m ε_r = 56.7 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7 Powerdrift: -0.12 dB
SAR (1g): 10.2 mW/g, SAR (10g): 7.40 mW/g

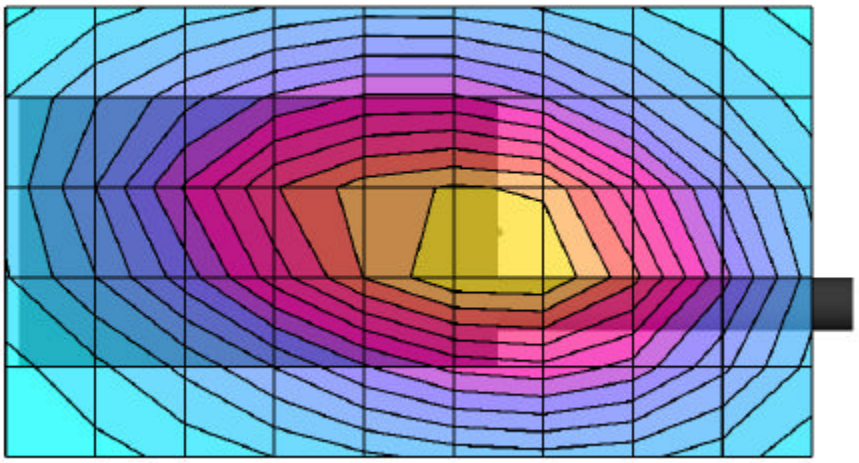
Body-Worn SAR with 1.0cm Belt-Clip & Speaker-Mic
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
Mid Channel [490.05 MHz]
Conducted Power: 4.2 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.23,7.23,7.23); Crest factor: 1.0
450 MHz Muscle: σ = 0.94 mho/m ε_r = 56.7 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7 Powerdrift: -0.18 dB
SAR (1g): 7.14 mW/g, SAR (10g): 5.12 mW/g

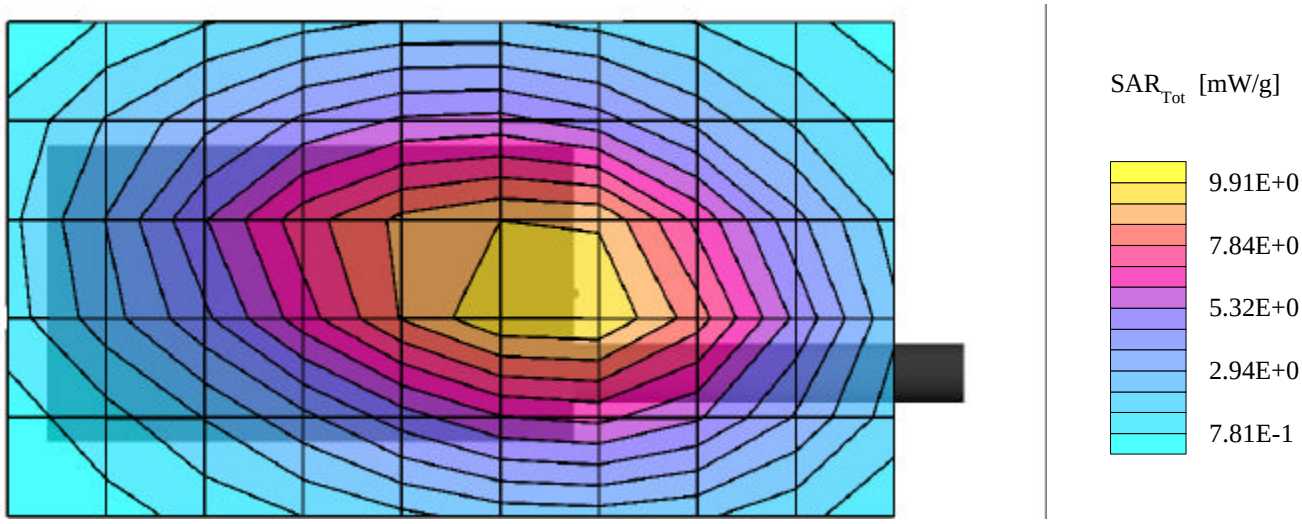
Body-Worn SAR with 1.0cm Belt-Clip & Speaker-Mic
7.2VDC Ni-MH 2000mAh Battery
Continuous Wave Mode
High Channel [511.95 MHz]
Conducted Power: 4.1 Watts
Dated Tested: November 29, 2001



KENWOOD COMM. CORP. TK-3140-2 / FCC ID: ALH32263120

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.23,7.23,7.23); Crest factor: 1.0
450 MHz Muscle: σ = 0.94 mho/m ε_r = 56.7 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.13 dB
SAR (1g): 9.85 mW/g, SAR (10g): 7.06 mW/g

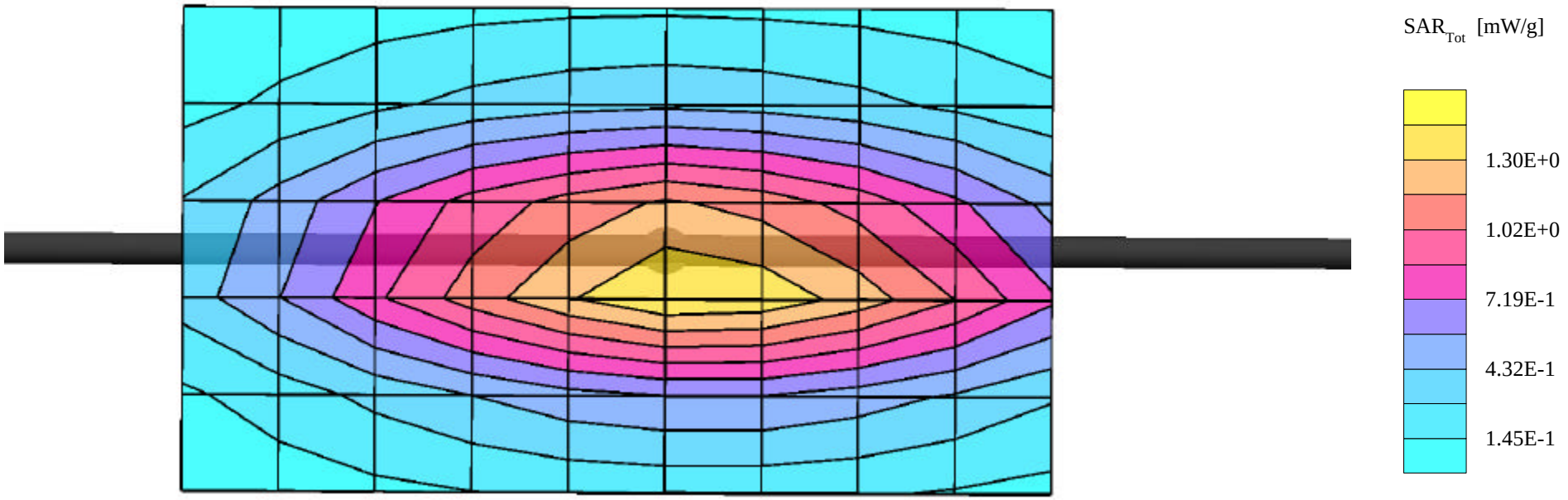
Body-Worn SAR with 1.0cm Belt-Clip & Speaker-Mic
7.2VDC Ni-Cd 1200mAh Battery
Continuous Wave Mode
Mid Channel [490.05 MHz]
Conducted Power: 4.2 Watts
Dated Tested: November 29, 2001



APPENDIX B - DIPOLE VALIDATION

Dipole 450MHz

Frequency: 450 MHz; Conducted Input Power: 250 [mW]
Large Planar Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0; 450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Cube 5x5x7: Peak: 2.29 mW/g, SAR (1g): 1.46 mW/g, SAR (10g): 0.959 mW/g, (Worst-case extrapolation)
Penetration depth: 12.1 (10.5, 14.1) [mm]
Powerdrift: 0.01 dB
Validation Date: Nov. 29, 2001

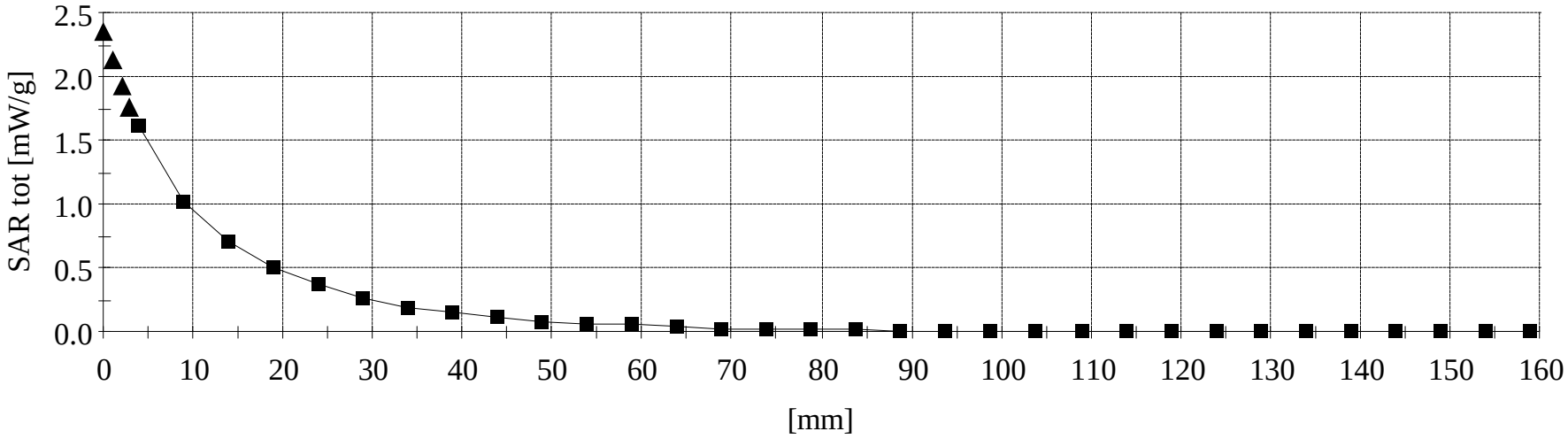


Validation Dipole 450MHz, d = 15 mm

Large Planar Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Z-Axis scan to show minimum fluid depth of 15cm was maintained

Test Date: November 29, 2001
conducted power: 250 mW



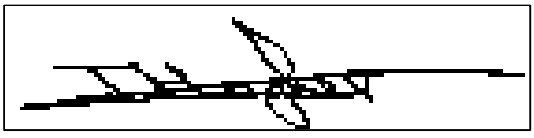
APPENDIX C - DIPOLE CALIBRATION

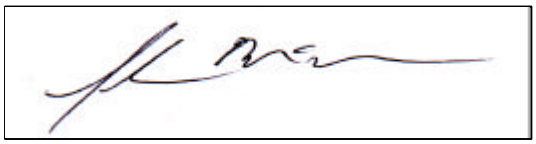
Celltech
Testing and Engineering Services Lab

450MHz SYSTEM VALIDATION DIPOLE

Type:	**450MHz Validation Dipole**
Serial Number:	**136**
Place of Calibration:	**Celltech Research Inc.**
Date of Calibration:	**October 17, 2001**

Celltech Research Inc. hereby certifies that this device has been calibrated on the date indicated above.

Calibrated by: 

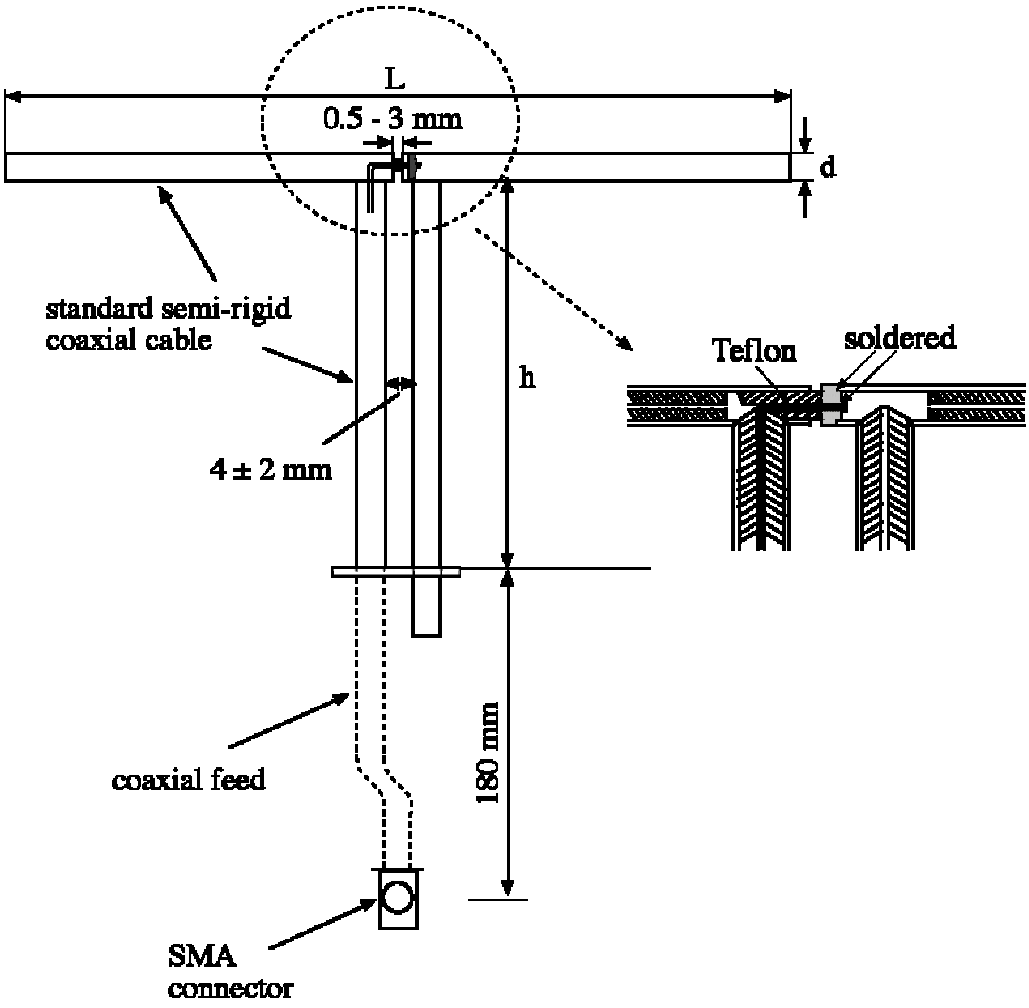
Approved by: 

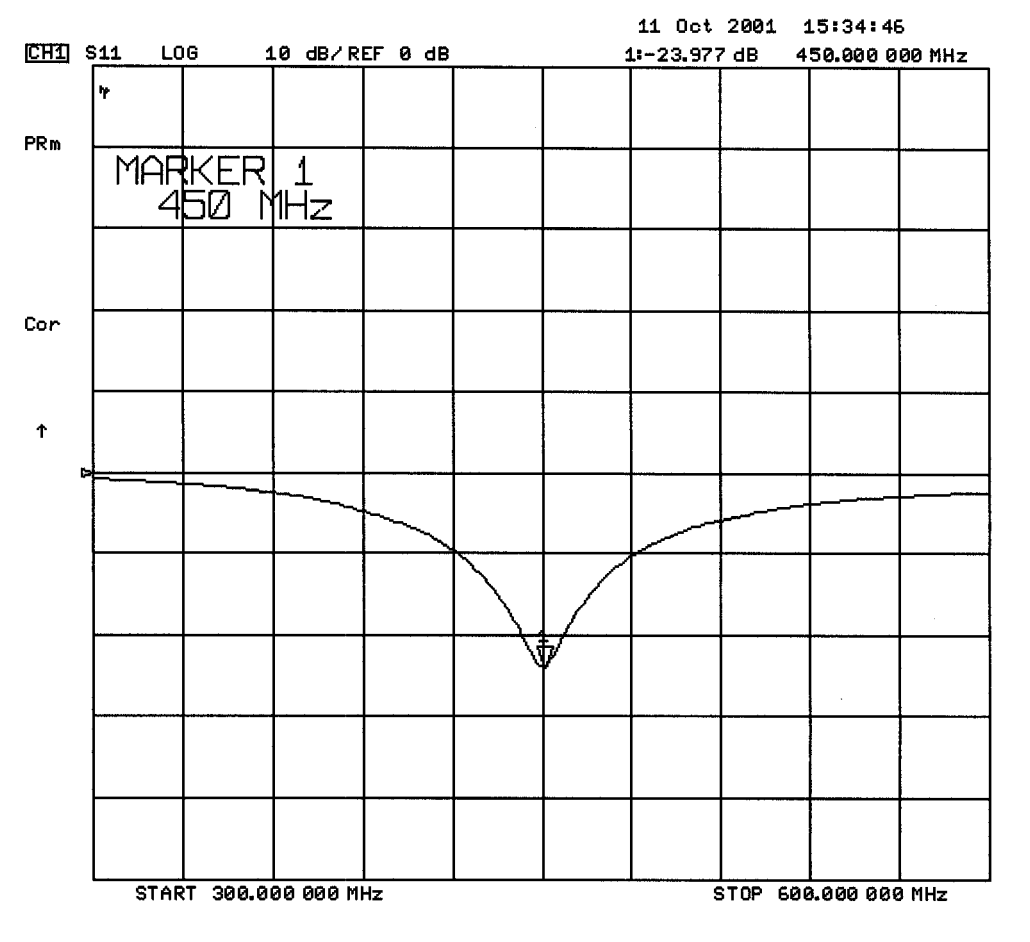
Celltech Research Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-860-3130 · Fax. 250-860-3110 · e-mail: info@celltechlabs.com
www.celltechlabs.com

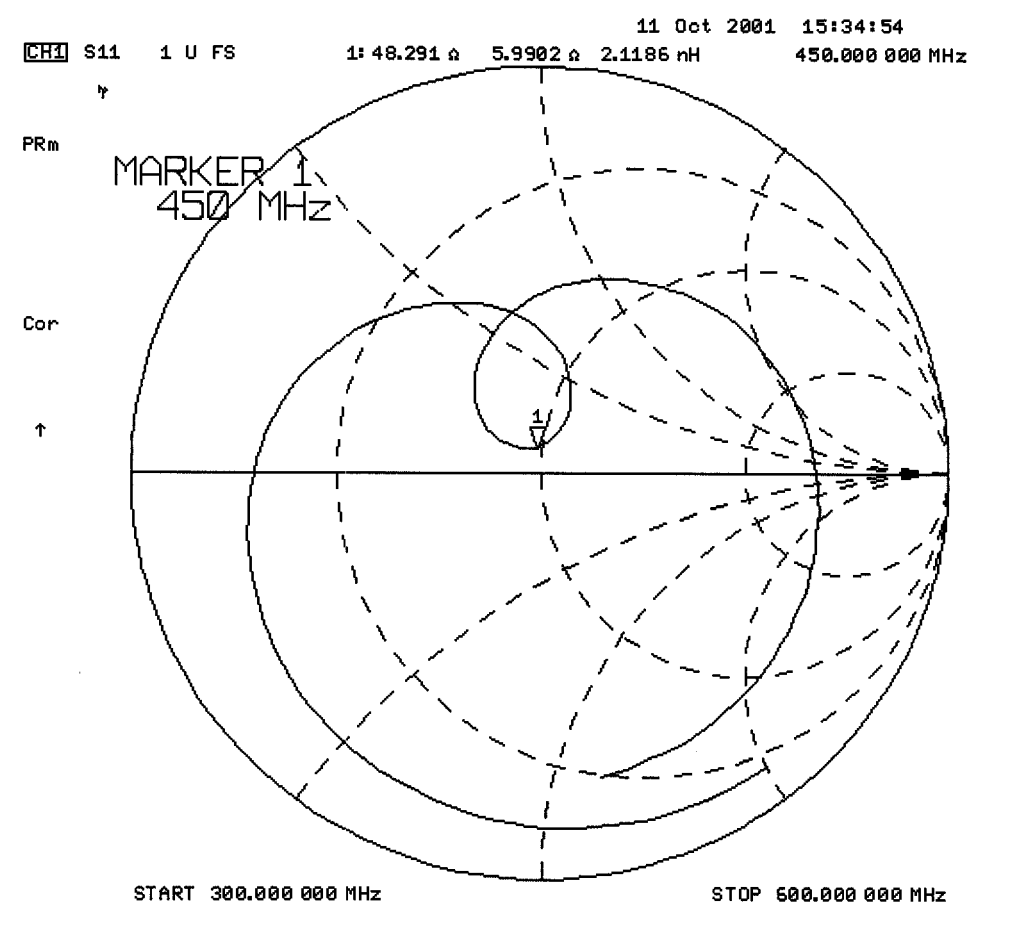
1. Dipole Construction & Electrical Characteristics

The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 15.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 450MHz	Re{Z} = 49.982Ω
	Im{Z} = 5.8594Ω
Return Loss at 450MHz	-24.714dB




11 Oct 2001 15:34:46
CH1 S11 LOG 10 dB/ REF 0 dB
1:-23.977 dB 450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
START 300.000 000 MHz
STOP 600.000 000 MHz


11 Oct 2001 15:34:54
CH1 S11 1 U FS
1: 48.291 Ω 5.9902 Ω 2.1186 nH
450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
1
START 300.000 000 MHz
STOP 600.000 000 MHz

Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

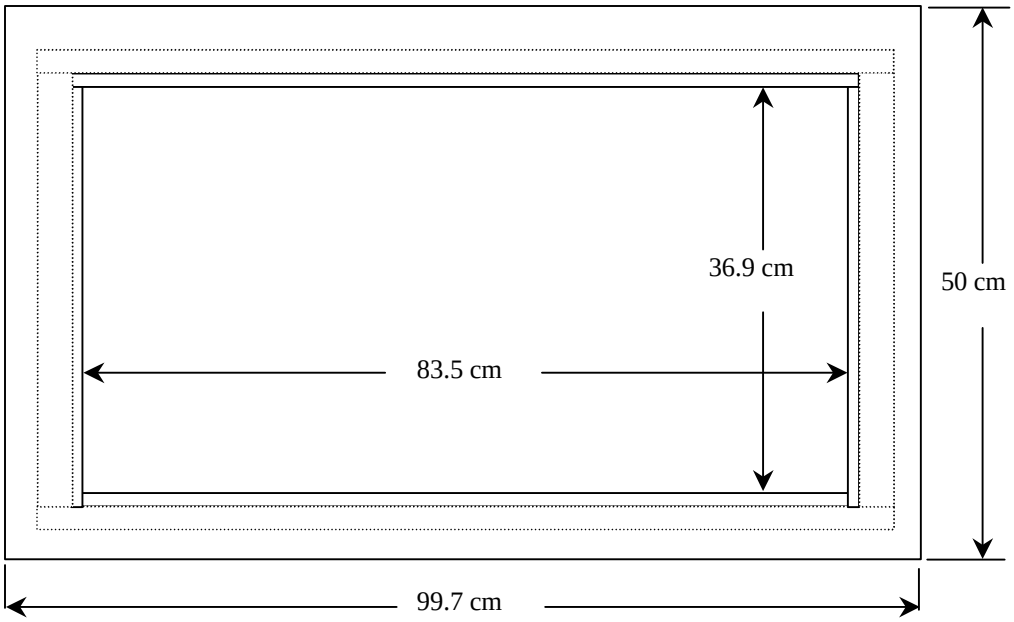
2. Validation Phantom

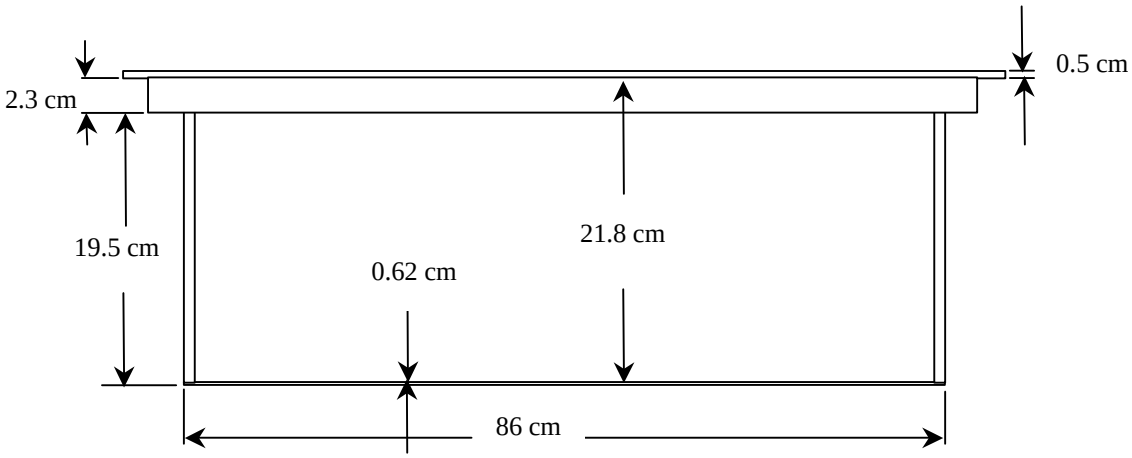
The validation phantom was constructed using relatively low-loss tangent Plexiglas material. The dimensions of the phantom are as follows:

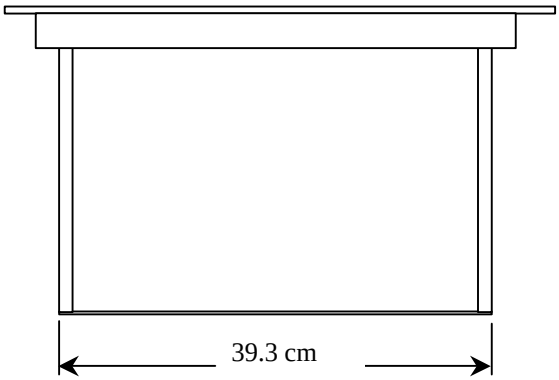
Length: 83.5 cm
Width: 36.9 cm
Height: 21.8 cm

The bottom of the phantom is constructed of 6.2 ± 0.1mm Plexiglas.

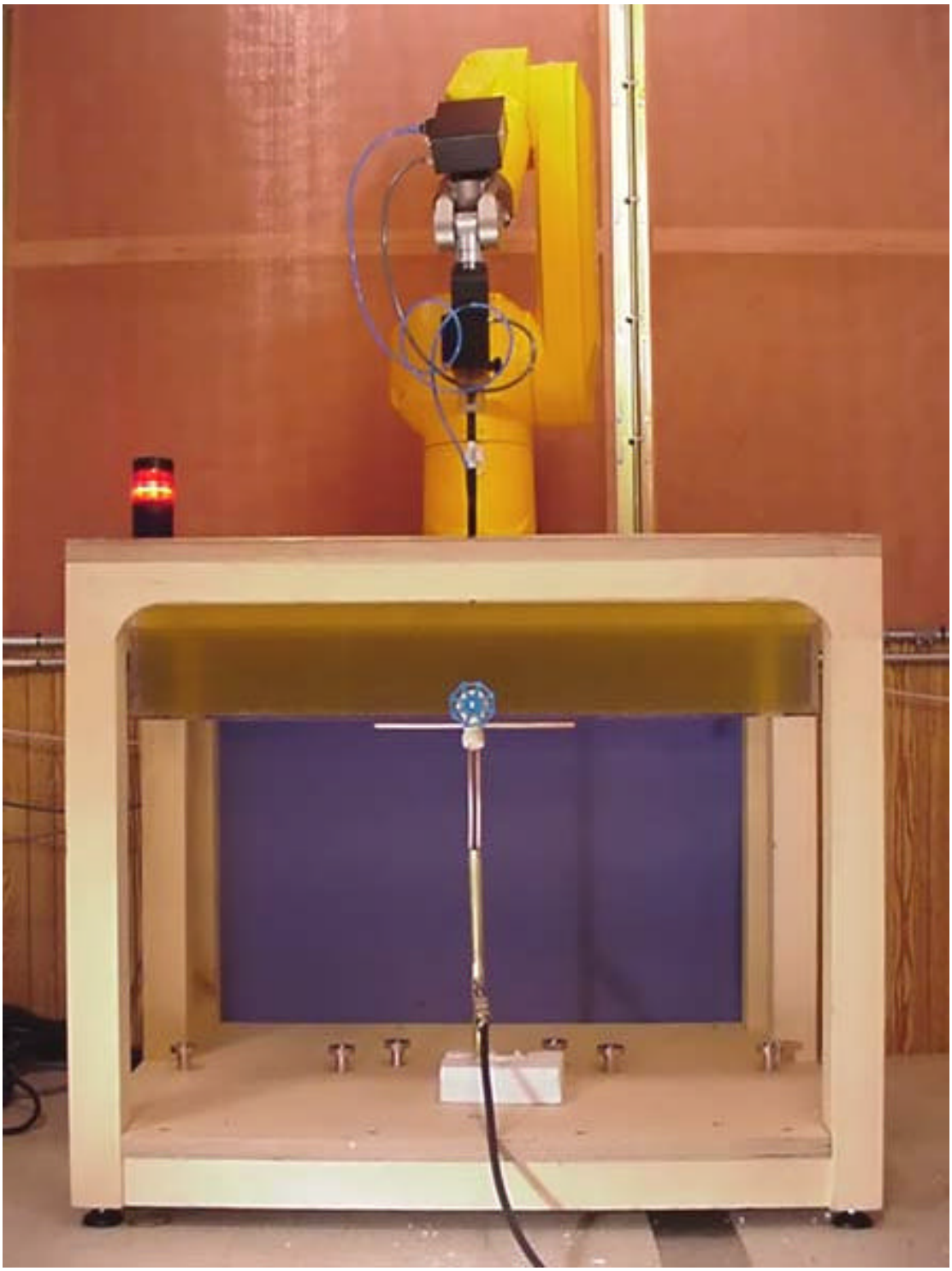
Dimensions of Plexiglas Planar Phantom







450MHz Dipole Calibration Photo



450MHz Dipole Calibration Photo

3. Measurement Conditions

The planar phantom was filled with brain simulating tissue having the following electrical parameters at 450MHz:

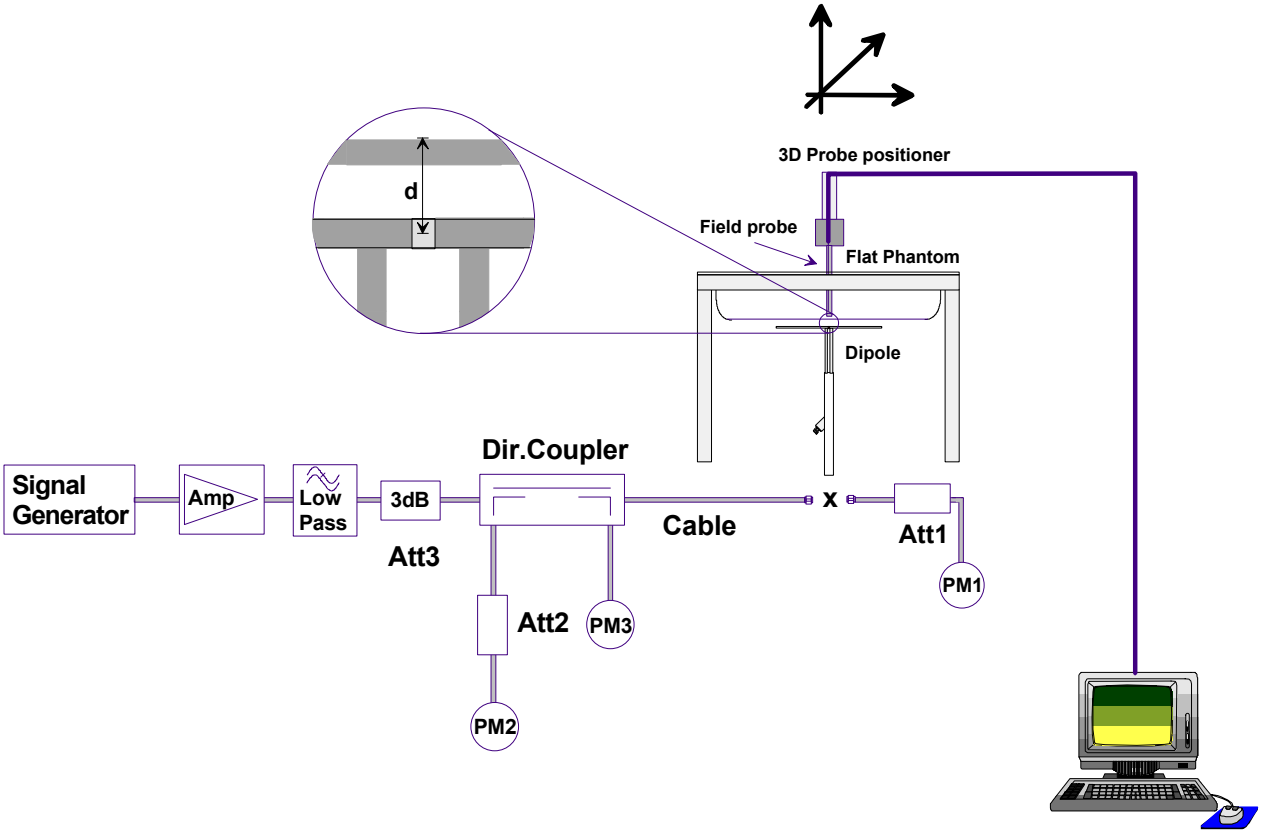
Relative Permitivity:	43.8	± 5%
Conductivity:	0.86 mho/m	± 5%
Temperature:	23.1°C	

The 450MHz simulating tissue consists of the following ingredients:

Ingredient	Percentage by weight
Water	38.56%
Sugar	56.32%
Salt	3.95%
HEC	0.98%
Dowicil 75	0.19%
Target Dielectric Parameters at 22°C	$\varepsilon_r = 43.5$ $\sigma = 0.87$ S/m

4. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 20dB below the forward power.

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Dipole SAR Test Results

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	1.47	5.88	0.971	3.88	2.31
Test 2	1.43	5.72	0.949	3.80	2.25
Test 3	1.45	5.80	0.961	3.84	2.27
Test 4	1.44	5.76	0.954	3.82	2.26
Test 5	1.46	5.84	0.969	3.88	2.29
Test 6	1.42	5.68	0.939	3.76	2.23
Test 7	1.45	5.80	0.960	3.84	2.27
Test 8	1.41	5.64	0.928	3.71	2.22
Test 9	1.43	5.72	0.950	3.80	2.25
Test10	1.46	5.84	0.971	3.88	2.29
Average Value	1.44	5.77	0.946	3.82	2.26

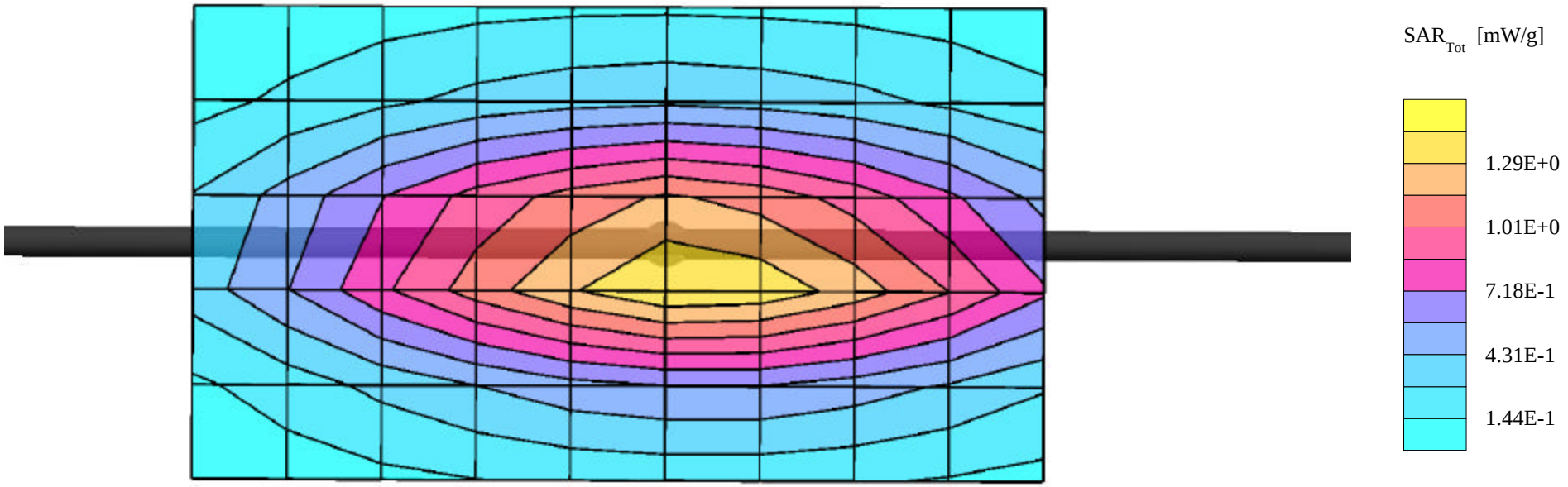
The results have been normalized to 1W (forward power) into the dipole.

Averaged over 1cm (1g) of tissue: 5.77 mW/g

Averaged over 10cm (10g) of tissue: 3.82 mW/g

Validation Dipole 450MHz, d = 15 mm

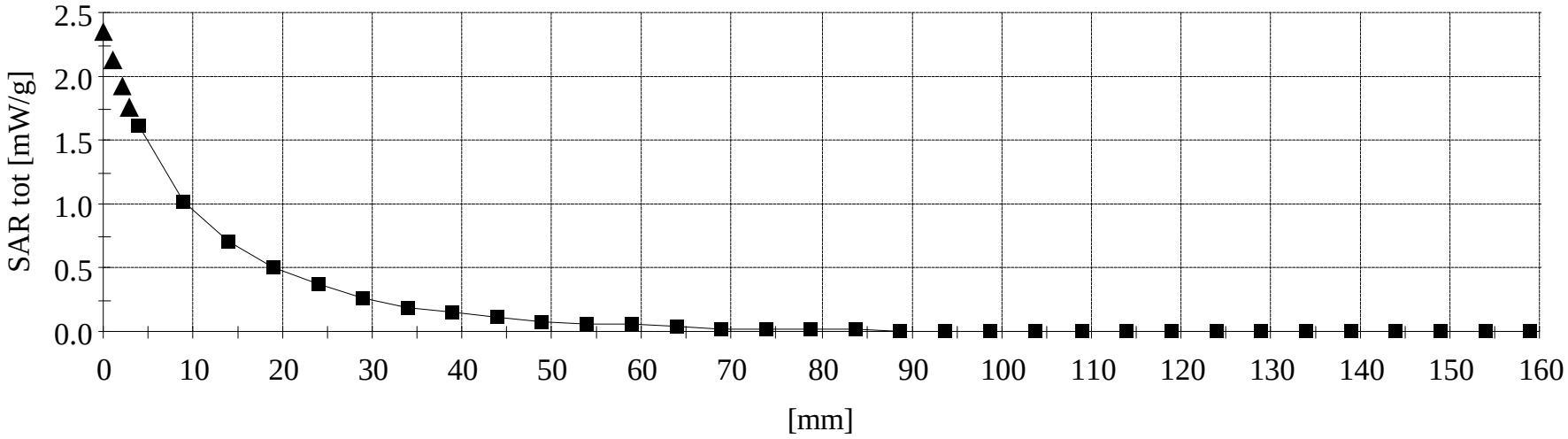
Frequency: 450 MHz; Antenna Input Power: 250 [mW]
Flat Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Cube 5x5x7: Peak: 2.34 mW/g, SAR (1g): 1.47 mW/g, SAR (10g): 0.963 mW/g, (Worst-case extrapolation)
Penetration depth: 12.3 (10.7, 14.4) [mm]
Powerdrift: 0.02 dB
Calibration Date: Oct. 17, 2001



Validation Dipole 450MHz, d = 15 mm

Flat Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Test Date: October 17, 2001
conducted power: 250 mW



APPENDIX D - PROBE CALIBRATION

Probe ET3DV6

SN:1590

Manufactured:	March 19, 2001
Calibrated:	March 26, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1590

Sensitivity in Free Space

NormX	**1.77**	$\mu V/(V/m)^2$
NormY	**1.91**	$\mu V/(V/m)^2$
NormZ	**1.67**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**100**	mV
DCP Y	**100**	mV
DCP Z	**100**	mV

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** e_r **= 43.5 ± 5%** s **= 0.87 ± 10% mho/m**

ConvF X	**7.36**	extrapolated	Boundary effect:	
ConvF Y	**7.36**	extrapolated	Alpha	**0.29**
ConvF Z	**7.36**	extrapolated	Depth	**2.72**

Head **900 MHz** e_r **= 42 ± 5%** s **= 0.97 ± 10% mho/m**

ConvF X	**6.83**	± 7% (k=2)	Boundary effect:	
ConvF Y	**6.83**	± 7% (k=2)	Alpha	**0.37**
ConvF Z	**6.83**	± 7% (k=2)	Depth	**2.48**

Head **1500 MHz** e_r **= 40.4 ± 5%** s **= 1.23 ± 10% mho/m**

ConvF X	**6.13**	interpolated	Boundary effect:	
ConvF Y	**6.13**	interpolated	Alpha	**0.47**
ConvF Z	**6.13**	interpolated	Depth	**2.17**

Head **1800 MHz** e_r **= 40 ± 5%** s **= 1.40 ± 10% mho/m**

ConvF X	**5.78**	± 7% (k=2)	Boundary effect:	
ConvF Y	**5.78**	± 7% (k=2)	Alpha	**0.53**
ConvF Z	**5.78**	± 7% (k=2)	Depth	**2.01**

Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.2 ± 0.2**	mm

DASY3 - Parameters of Probe: ET3DV6 SN: 1590

Body **450 MHz** e_r **= 56.7 ± 5%** σ **= 0.94 ± 10% mho/m**

ConvF X	**7.23**	extrapolated
ConvF Y	**7.23**	extrapolated
ConvF Z	**7.23**	extrapolated

Body **900 MHz** e_r **= 55.0 ± 5%** σ **= 1.05 ± 10% mho/m**

ConvF X	**6.61**	± 7% (k=2)
ConvF Y	**6.61**	± 7% (k=2)
ConvF Z	**6.61**	± 7% (k=2)

Body **1500 MHz** e_r **= 54.0 ± 5%** σ **= 1.30 ± 10% mho/m**

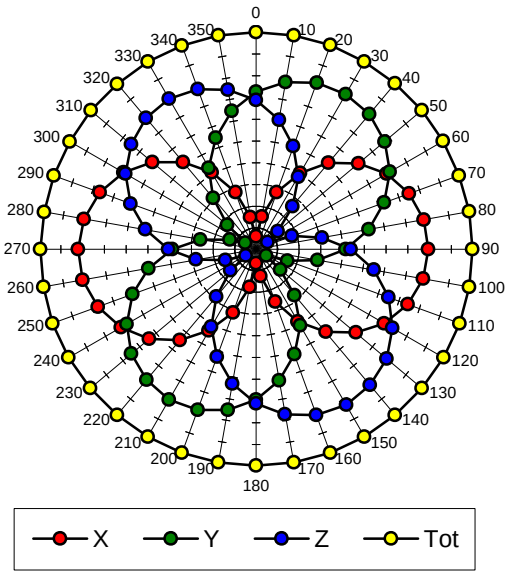
ConvF X	**5.78**	interpolated
ConvF Y	**5.78**	interpolated
ConvF Z	**5.78**	interpolated

Body **1800 MHz** e_r **= 53.3 ± 5%** σ **= 1.52 ± 10% mho/m**

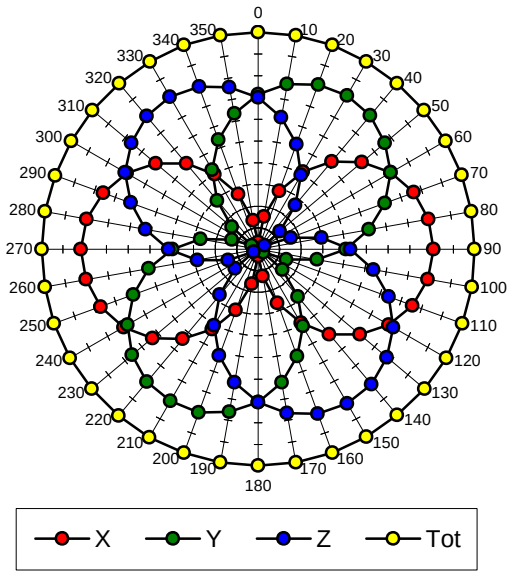
ConvF X	**5.36**	± 7% (k=2)
ConvF Y	**5.36**	± 7% (k=2)
ConvF Z	**5.36**	± 7% (k=2)

Receiving Pattern (ϕ , θ = 0°

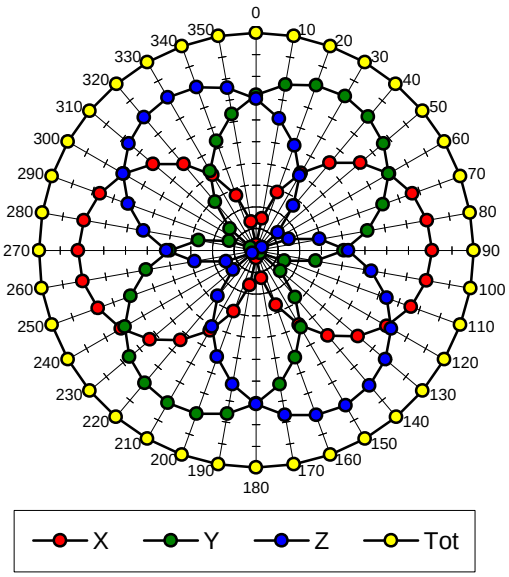
f = 30 MHz, TEM cell ifi110



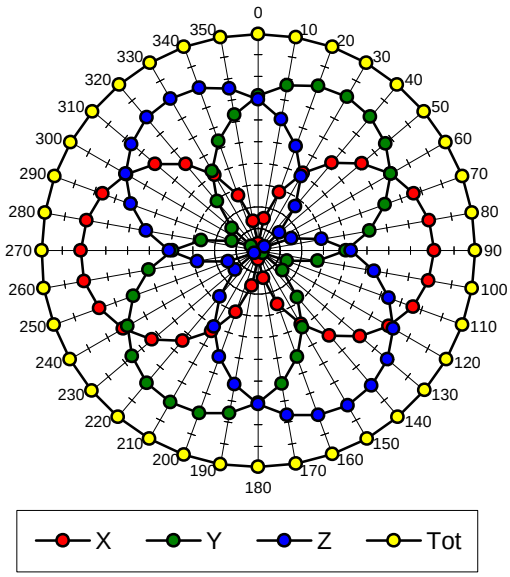
f = 100 MHz, TEM cell ifi110



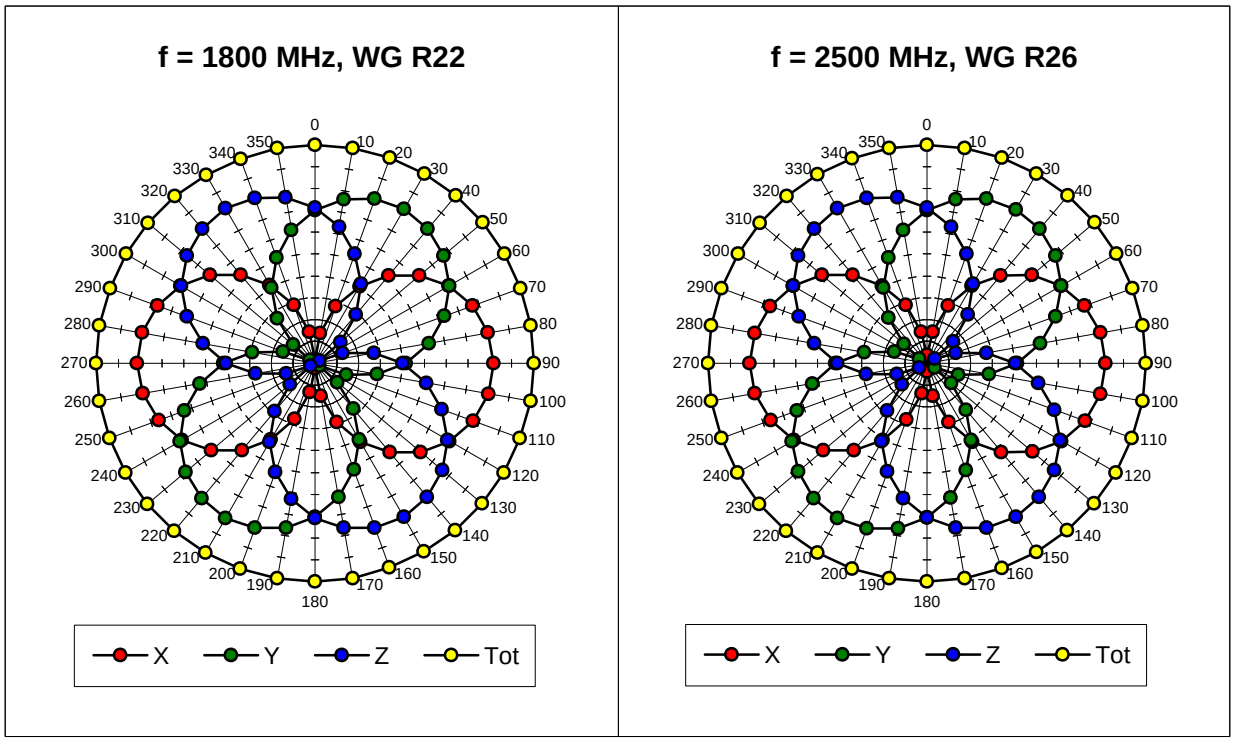
f = 300 MHz, TEM cell ifi110



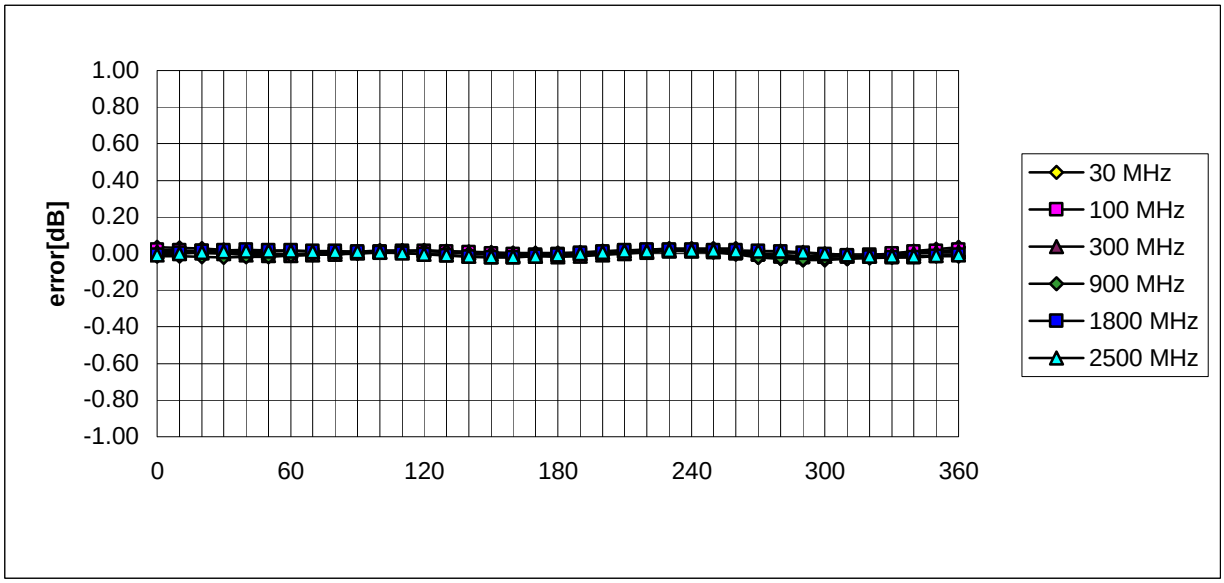
f = 900 MHz, TEM cell ifi110



ET3DV6 SN:1590

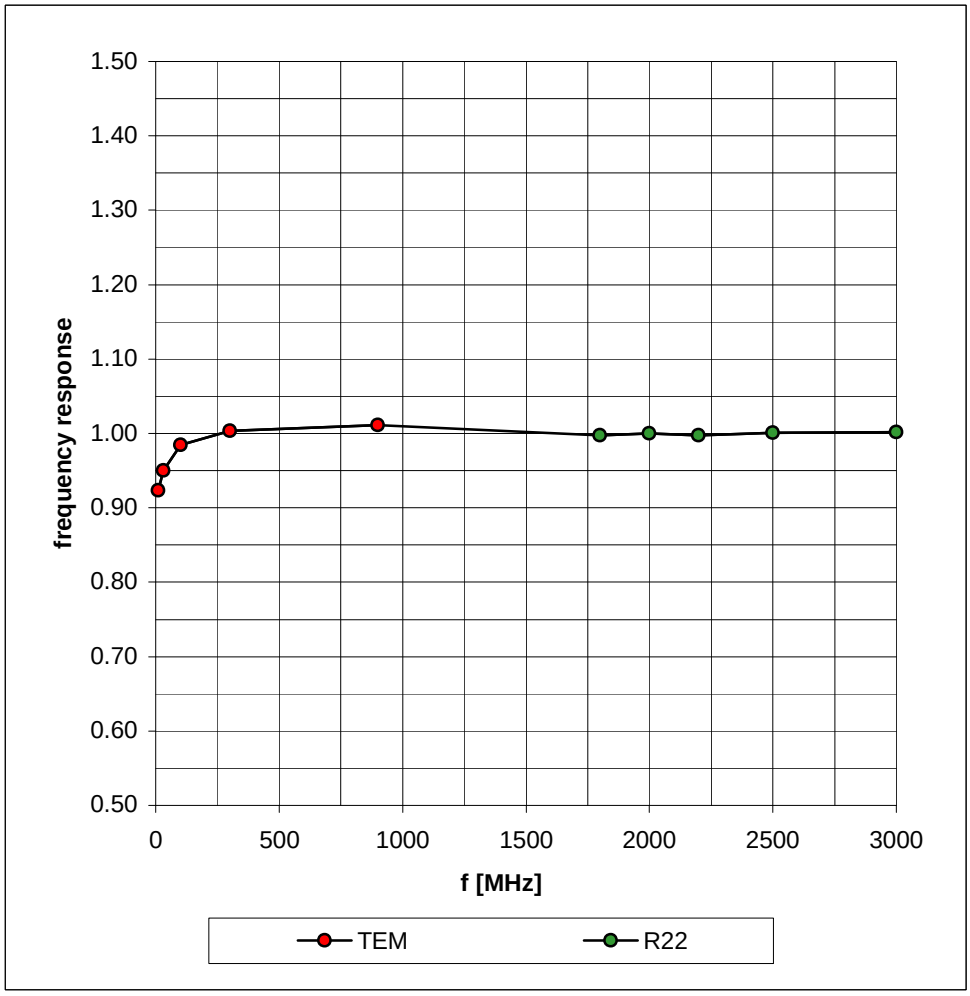


Isotropy Error (f), q = 0°



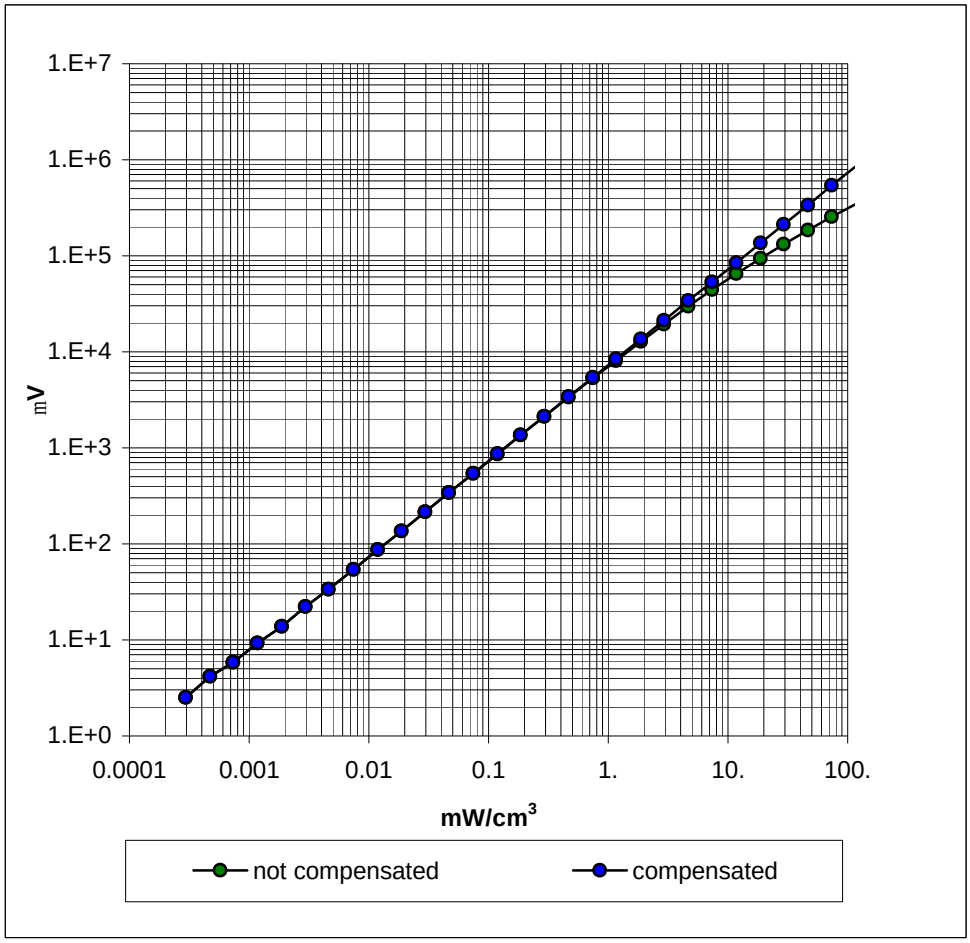
Frequency Response of E-Field

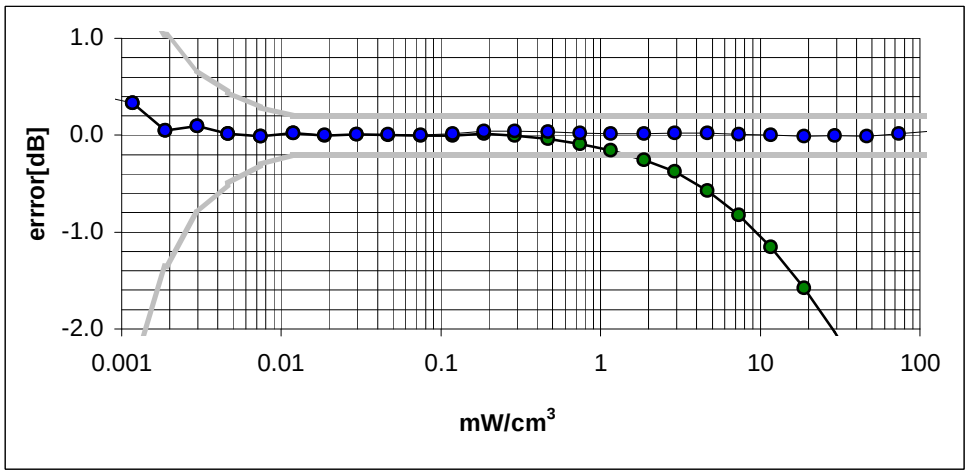
(TEM-Cell:ifi110, Waveguide R22)



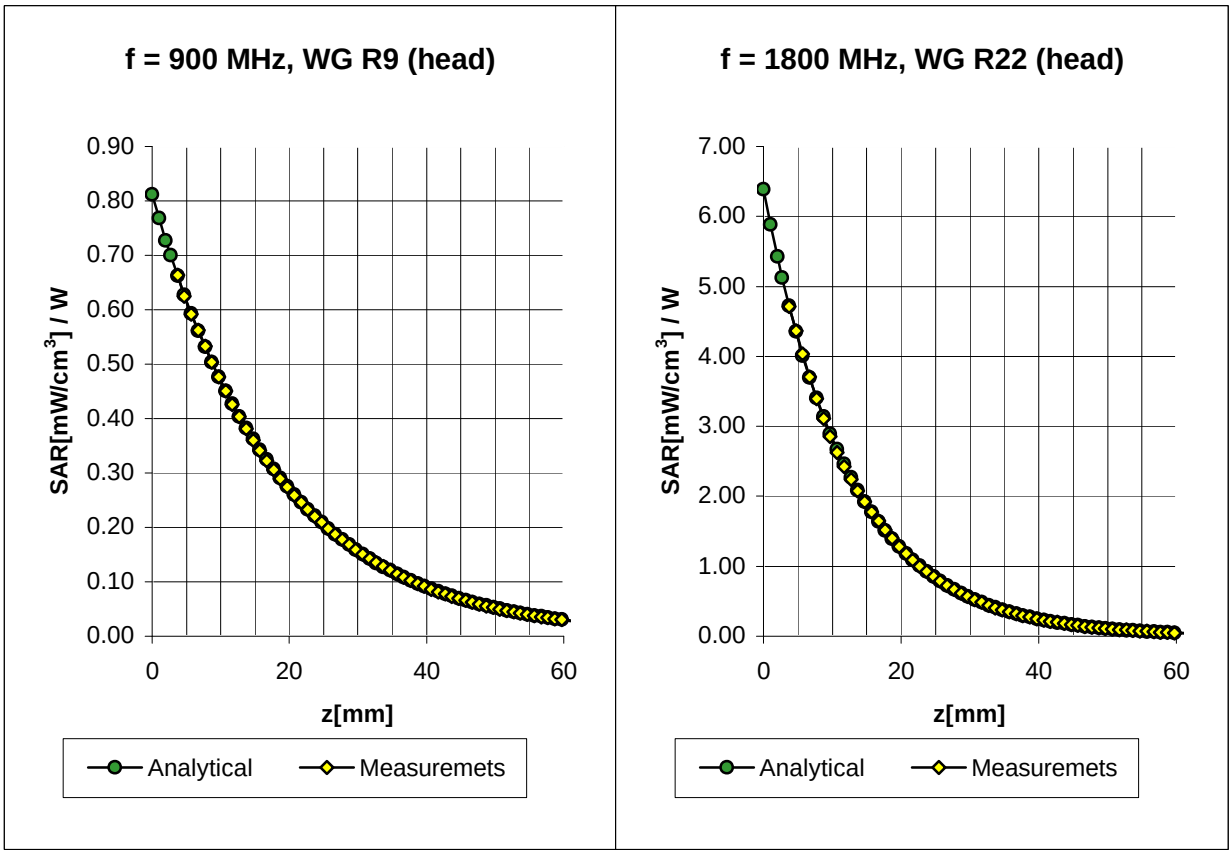
Dynamic Range f(SAR_{brain})

(TEM-Cell:ifi110)





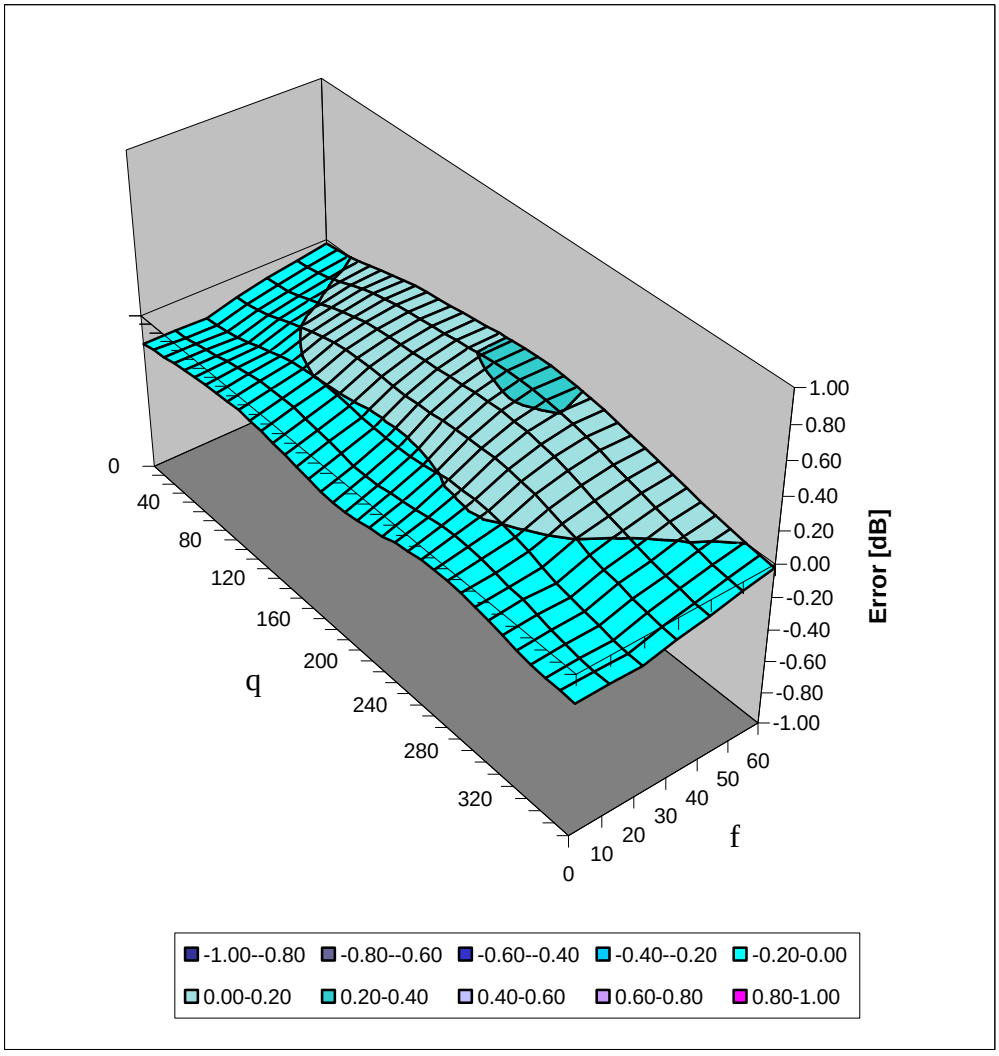
Conversion Factor Assessment



ET3DV6 SN:1590

Deviation from Isotropy in HSL

Error (q,f), f = 900 MHz



APPENDIX E - SAR SENSITIVITIES

Application Note: SAR Sensitivities

Introduction

The measured SAR-values in homogeneous phantoms depend strongly on the electrical parameters of the liquid. Liquids with exactly matching parameters are difficult to produce; there is always a small error involved in the production or measurement of the liquid parameters. The following sensitivities allow the estimation of the influence of small parameter errors on the measured SAR values. The calculations are based on an approximation formula [1] for the SAR of an electrical dipole near the phantom surface and a adapted plane wave approximation for the penetration depth. The sensitivities are given in percent SAR change per percent change in the controlling parameter:

$$S(x) = \frac{d\,SAR / SAR}{d\,x / x}$$

The controlling parameters x are:

- ε : permitivity
- σ : conductivity
- ρ : brain density (= one over integration volume)

For example: If The liquid permitivity increases by 2 percent and the sensitivity of the SAR to permitivity is -0.6 then the SAR will decrease by 1.2 percent.

The sensitivities are given for surface SAR values and averaged SAR values for 1 g and 10 g cubes and for dipole distances d of 10mm (for frequencies below 1000 MHz) and 15mm (for frequencies above 1000 MHz) from the liquid surface.

Liquid parameters are as proposed in the new standards (e.g., IEEE 1528).

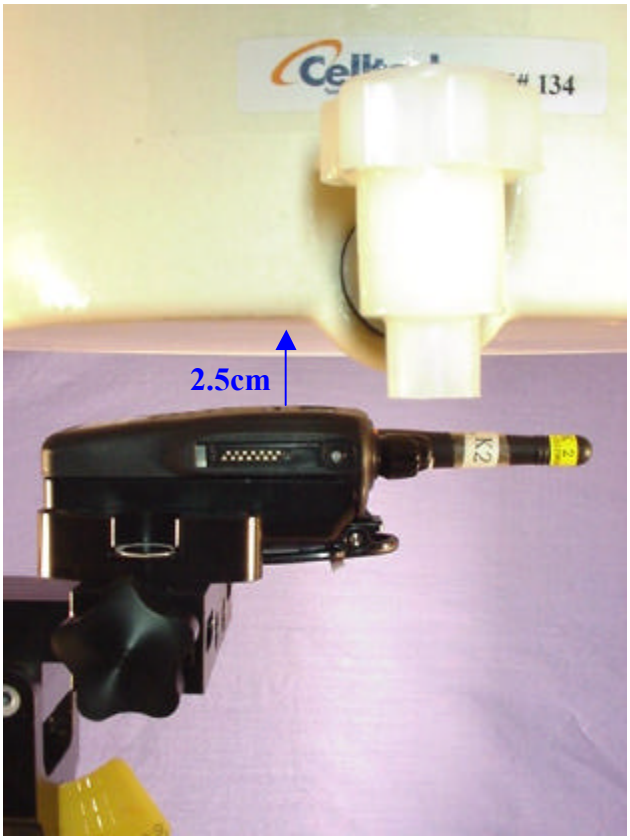
References

[1] N. Kuster and Q. Balzano, “Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300 MHz”, *IEEE Transacions on Vehicular Technology*, vol. 41(1), pp. 17-23, 1992.

Parameter	ε	σ	ρ
f=300 MHz (εr=45.3, σ=0.87S/m, ρ=1g/cm³)			
d=15mm: Surface	- 0.41	+ 0.48	—
1 g	- 0.33	+ 0.28	0.08
10 g	- 0.26	+ 0.09	0.16
f=450 MHz (εr=43.5, σ=0.87S/m, ρ=1g/cm³)			
d=15mm: Surface	- 0.56	+ 0.67	—
1 g	- 0.46	+ 0.43	0.09
10 g	- 0.37	+ 0.22	0.17
f=835 MHz (εr=41.5, σ=0.90S/m, ρ=1g/cm³)			
d=15mm: Surface	- 0.70	+ 0.86	—
1 g	- 0.57	+ 0.59	0.10
10 g	- 0.45	+ 0.35	0.18
f=900 MHz (εr=41.5, σ=0.97S/m, ρ=1g/cm³)			
d=15mm: Surface	- 0.69	+ 0.86	—
1 g	- 0.55	+ 0.57	0.10
10 g	- 0.44	+ 0.32	0.19
f=1450 MHz (εr=40.5, σ=1.20/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.73	+ 0.91	—
1 g	- 0.55	+ 0.55	0.12
10 g	- 0.42	+ 0.27	0.22
f=1800 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.73	+ 0.92	—
1 g	- 0.52	+ 0.51	0.14
10 g	- 0.38	+ 0.21	0.24
f=1900 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.73	+ 0.93	—
1 g	- 0.53	+ 0.51	0.14
10 g	- 0.39	+ 0.22	0.24
f=2000 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.74	+ 0.94	—
1 g	- 0.53	+ 0.52	0.14
10 g	- 0.39	+ 0.22	0.24
f=2450 MHz (εr=39.2, σ=1.80S/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.74	+ 0.93	—
1 g	- 0.49	+ 0.41	0.17
10 g	- 0.34	+ 0.12	0.28
f=3000 MHz (εr=38.5, σ=2.40S/m, ρ=1g/cm³)			
d=10mm: Surface	- 0.75	+ 0.90	—
1 g	- 0.45	+ 0.28	0.21
10 g	- 0.32	+ 0.02	0.31

APPENDIX F - SAR TEST SETUP PHOTOGRAPHS

FACE-HELD SAR TEST SETUP PHOTOGRAPHS
2.5cm Separation Distance



BODY-WORN SAR TEST SETUP PHOTOGRAPHS
with Belt-Clip & Speaker-Microphone
(Belt-Clip providing 1.0cm separation distance)