APPENDIX C - DIPOLE CALIBRATION

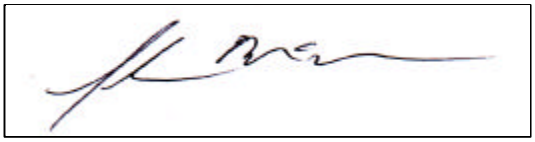
Celltech
Testing and Engineering Services Lab

2450MHz SYSTEM VALIDATION DIPOLE

Type:	**2450MHz Validation Dipole**
Serial Number:	**150**
Place of Calibration:	**Celltech Research Inc.**
Date of Calibration:	**October 24, 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
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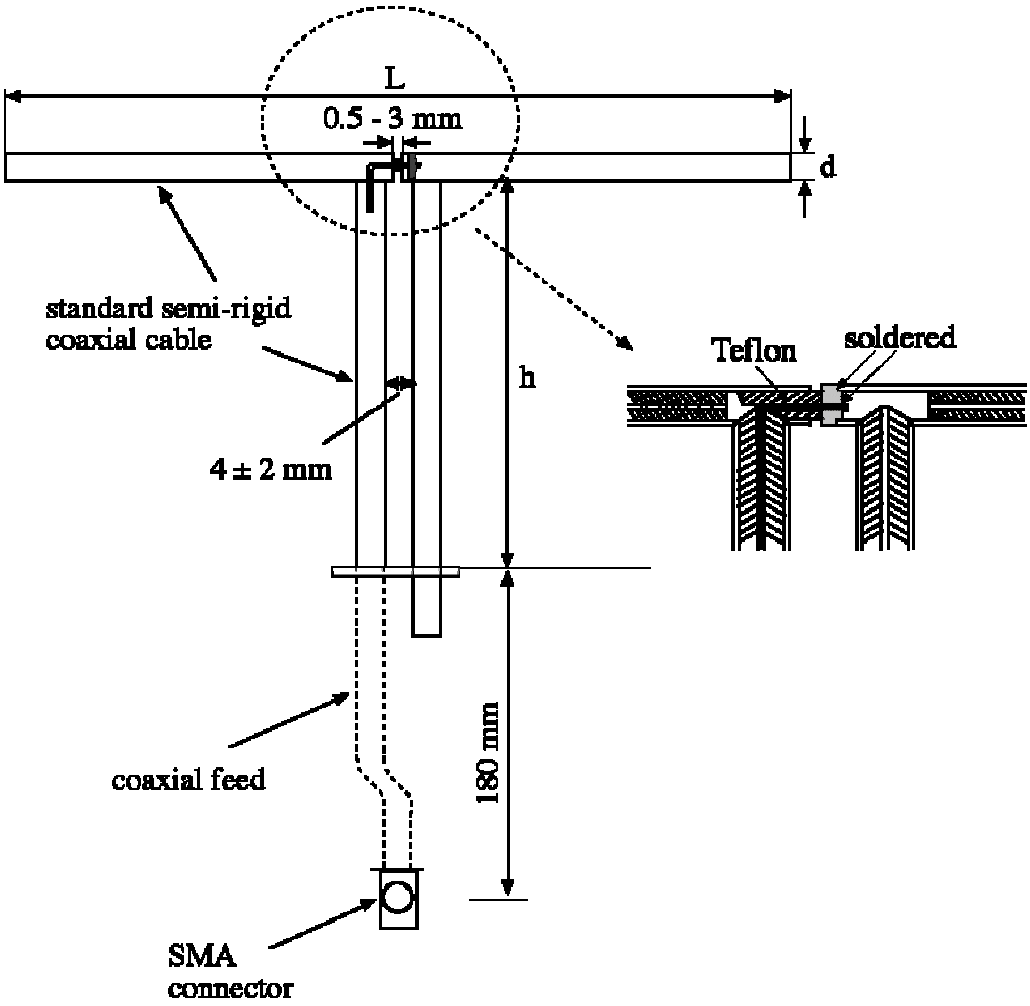
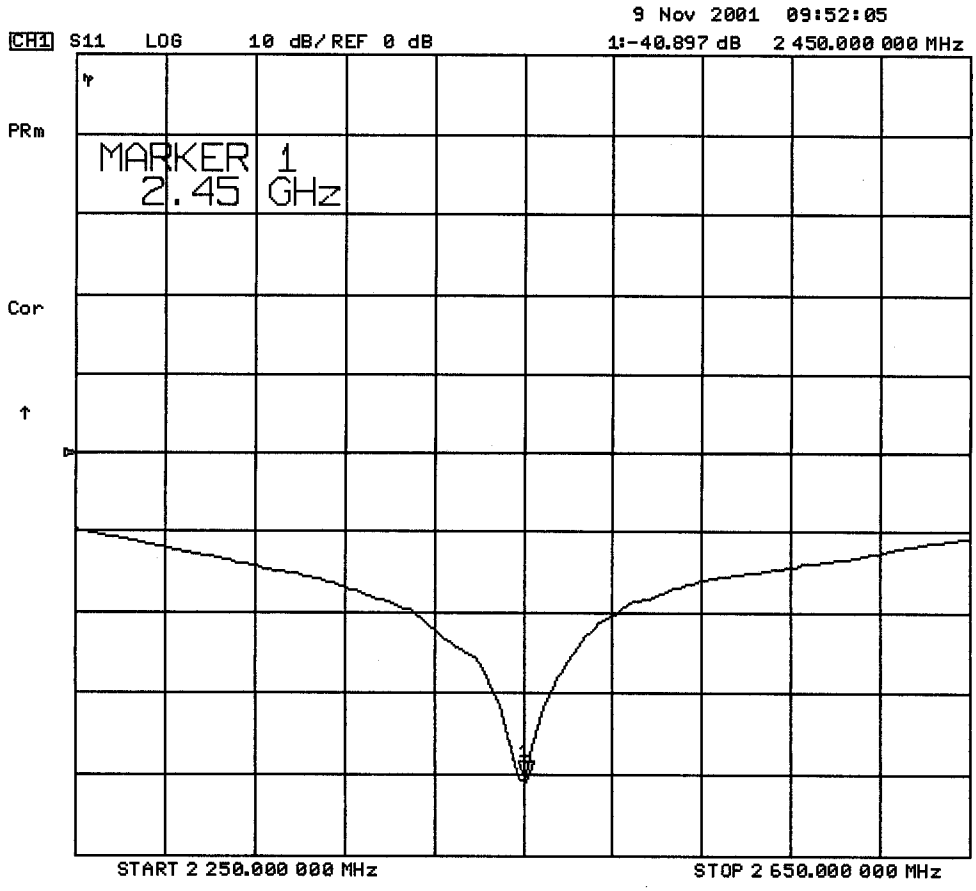
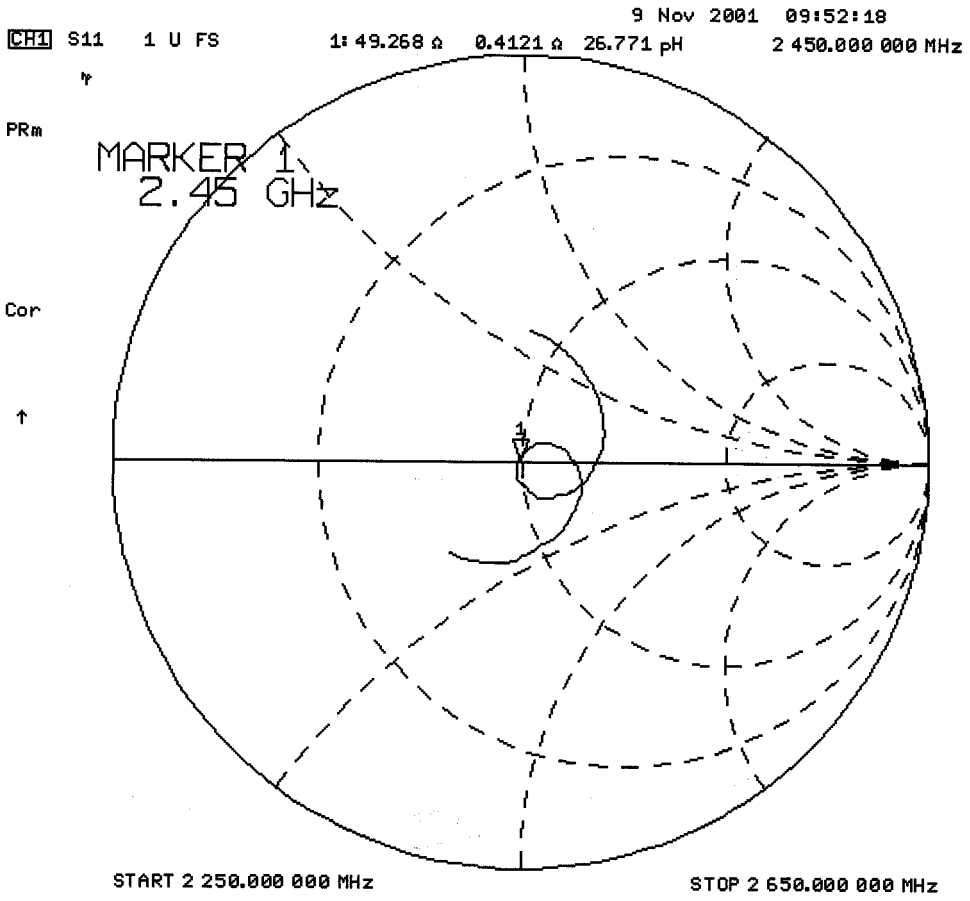
1. Dipole Construction & Electrical Characteristics

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 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 2450MHz	Re{Z} = 49.268Ω
	Im{Z} = 0.4121Ω
Return Loss at 2450MHz	-40.897dB




9 Nov 2001 09:52:05
CH1 S11 LOG 10 dB/ REF 0 dB
1:-40.897 dB 2 450.000 000 MHz
PRm
MARKER 1
2.45 GHz
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz


9 Nov 2001 09:52:18
CH1 S11 1 U FS
1: 49.268 Ω 0.4121 Ω 26.771 pH
2 450.000 000 MHz
PRm
MARKER 1
2.45 GHz
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz

Validation Dipole Dimensions

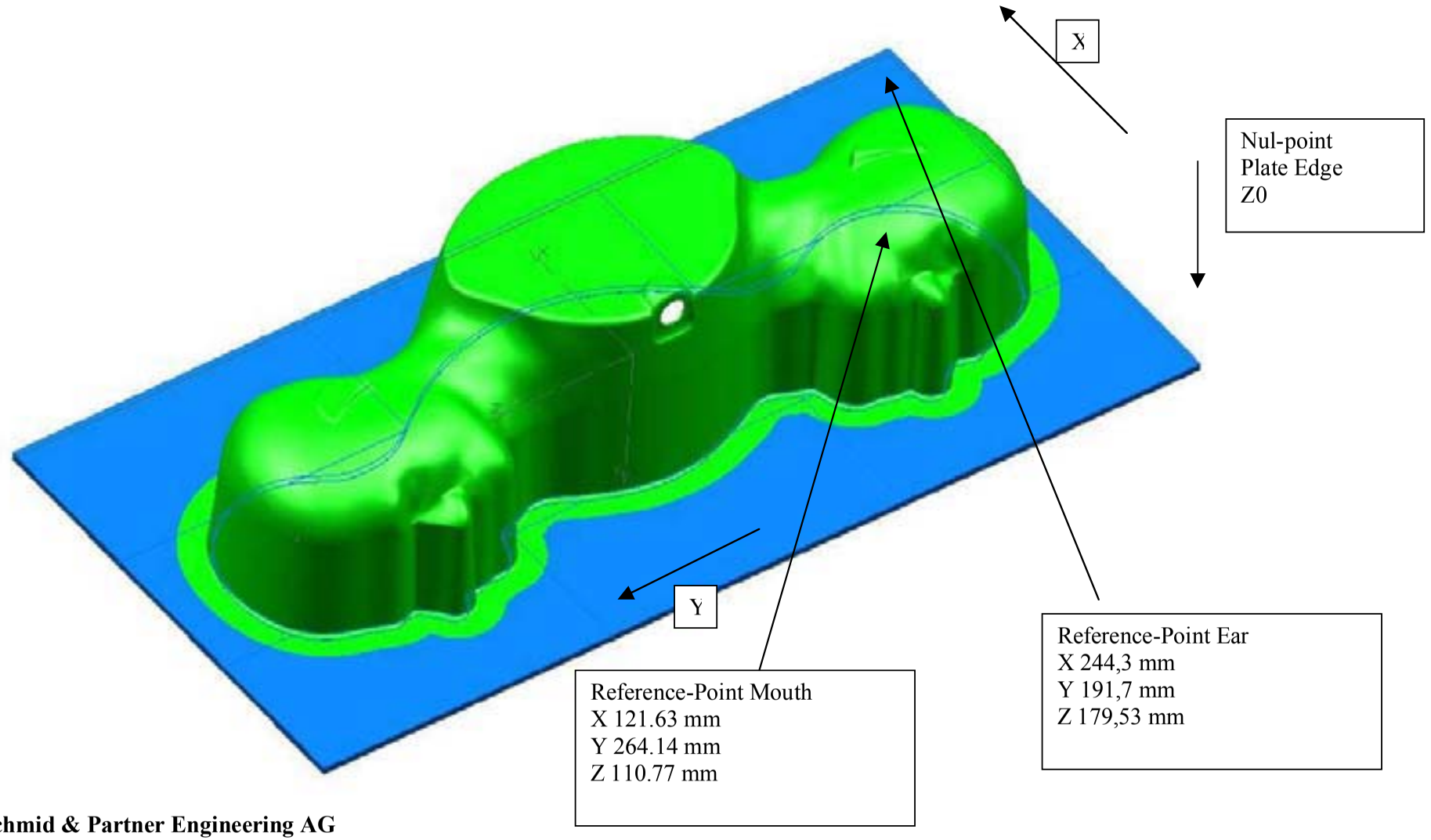
Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

2. Validation Phantom

The validation phantom is the SAM (Specific Anthropomorphic Mannequin) phantom manufactured by Schmid & Partner Engineering AG. The SAM phantom is a Fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness: 2 ± 0.1 mm
Filling Volume: Approx. 20 liters
Dimensions: 50 cm (W) x 100 cm (L)

SAM Twin-Phantom



Schmid & Partner Engineering AG

2450MHz Dipole Calibration

2450MHz Dipole Calibration

3. Measurement Conditions

The planar phantom was filled with brain simulating tissue having the following electrical parameters at 2450MHz:

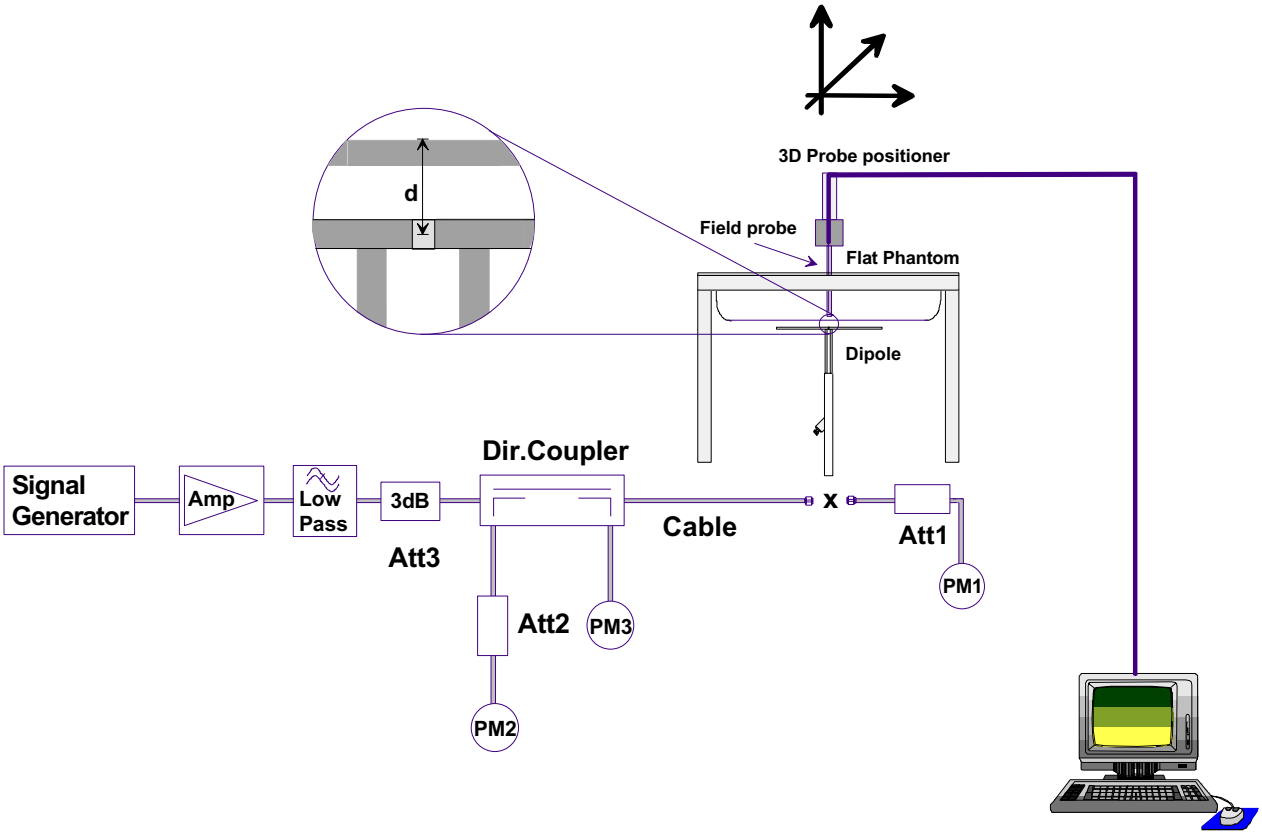
Relative Permitivity:	39.2	± 5%
Conductivity:	1.80 mho/m	± 5%
Temperature:	23.1°C	

The 2450MHz simulating tissue consists of the following ingredients:

Ingredient	Percentage by weight
Water	55.20 %
Glycol Monobutyl	44.80 %
Target Dielectric Parameters at 22°C	ε_r = 39.2 σ = 1.80 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	14.2	56.80	6.33	25.32	30.5
Test 2	14.3	57.20	6.34	25.36	30.8
Test 3	14.2	56.80	6.33	25.32	30.4
Test 4	14.1	56.40	6.32	25.28	30.1
Test 5	14.3	57.20	6.33	25.32	30.7
Test 6	14.0	56.00	6.31	25.24	30.0
Test 7	14.2	56.80	6.33	25.32	30.4
Test 8	14.2	56.80	6.33	25.32	30.5
Test 9	14.4	57.60	6.34	25.36	30.8
Test10	14.2	56.80	6.32	25.28	30.4
Average Value	14.21	56.84	6.32	25.31	30.46

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

Averaged over 1cm (1g) of tissue: 56.84 mW/g

Averaged over 10cm (10g) of tissue: 25.31 mW/g

Dipole 2450MHz

SAM Phantom; Flat Section

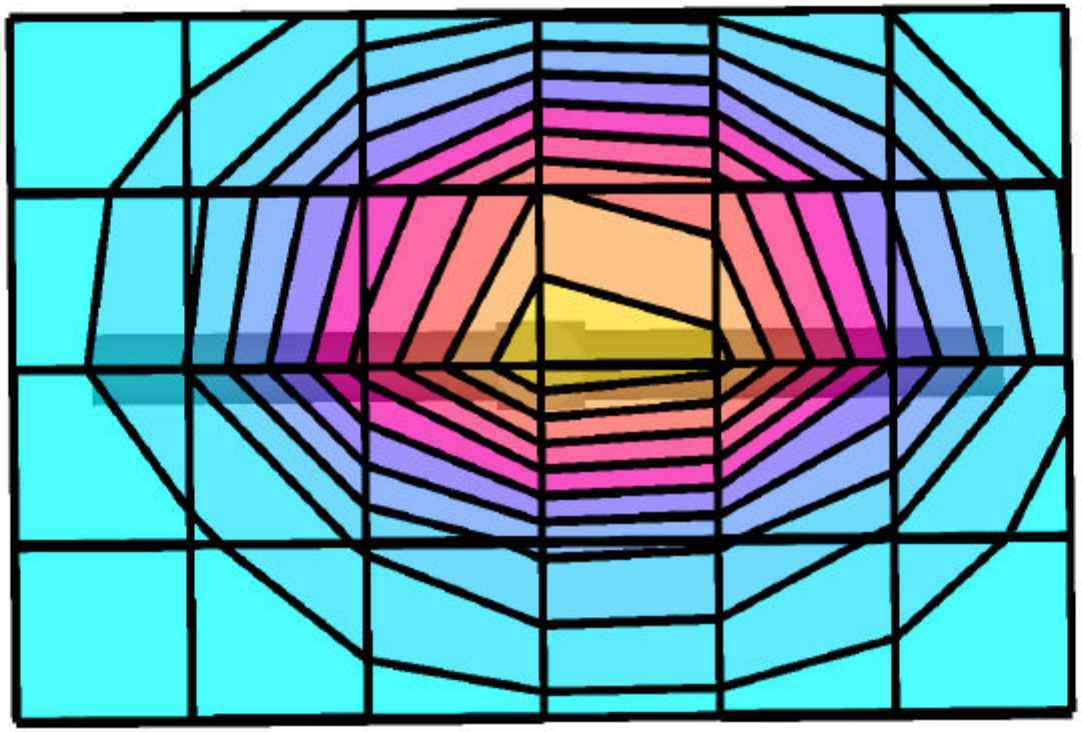
Probe: ET3DV6 - SN1590; ConvF(4.93,4.93,4.93); Crest factor: 1.0; 2450 MHz Brain: σ = 1.80 mho/m ε_r = 39.2 ρ = 1.00 g/cm^3

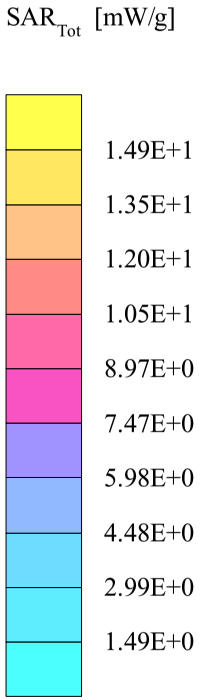
Cube 5x5x7: Peak: 30.5 mW/g, SAR (1g): 14.2 mW/g, SAR (10g): 6.33 mW/g, (Worst-case extrapolation)

Penetration depth: 6.2 (5.9, 7.0) [mm]; Ambient Temp: 21.5°C; Fluid Temp: 23.1°C

Powerdrift: 0.03 dB

Calibration Date: October 24, 2001





APPENDIX D - PROBE CALIBRATION

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

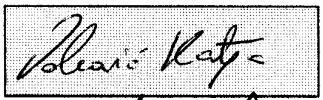
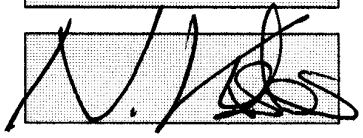
Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Calibration:	**Zurich**
Date of Calibration:	**February 22, 2002**
Calibration Interval:	**12 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	
Approved by:	

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibration:	September 22, 1999
Recalibrated:	February 22, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

Diode Compression

NormX	**1.58**	$\mu V/(V/m)^2$	DCP X	**97**	mV
NormY	**1.67**	$\mu V/(V/m)^2$	DCP Y	**97**	mV
NormZ	**1.67**	$\mu V/(V/m)^2$	DCP Z	**97**	mV

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** **ε_r = 41.5 ± 5%** **σ = 0.97 ± 5% mho/m**
Head **835 MHz** **ε_r = 41.5 ± 5%** **σ = 0.90 ± 5% mho/m**

ConvF X	**6.6**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.6**	± 9.5% (k=2)	Alpha	**0.40**
ConvF Z	**6.6**	± 9.5% (k=2)	Depth	**2.38**

Head **1800 MHz** **ε_r = 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**
Head **1900 MHz** **ε_r = 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

ConvF X	**5.4**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.4**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**5.4**	± 9.5% (k=2)	Depth	**2.18**

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	9.7	5.4
SAR_{be} [%]	With Correction Algorithm	0.3	0.6

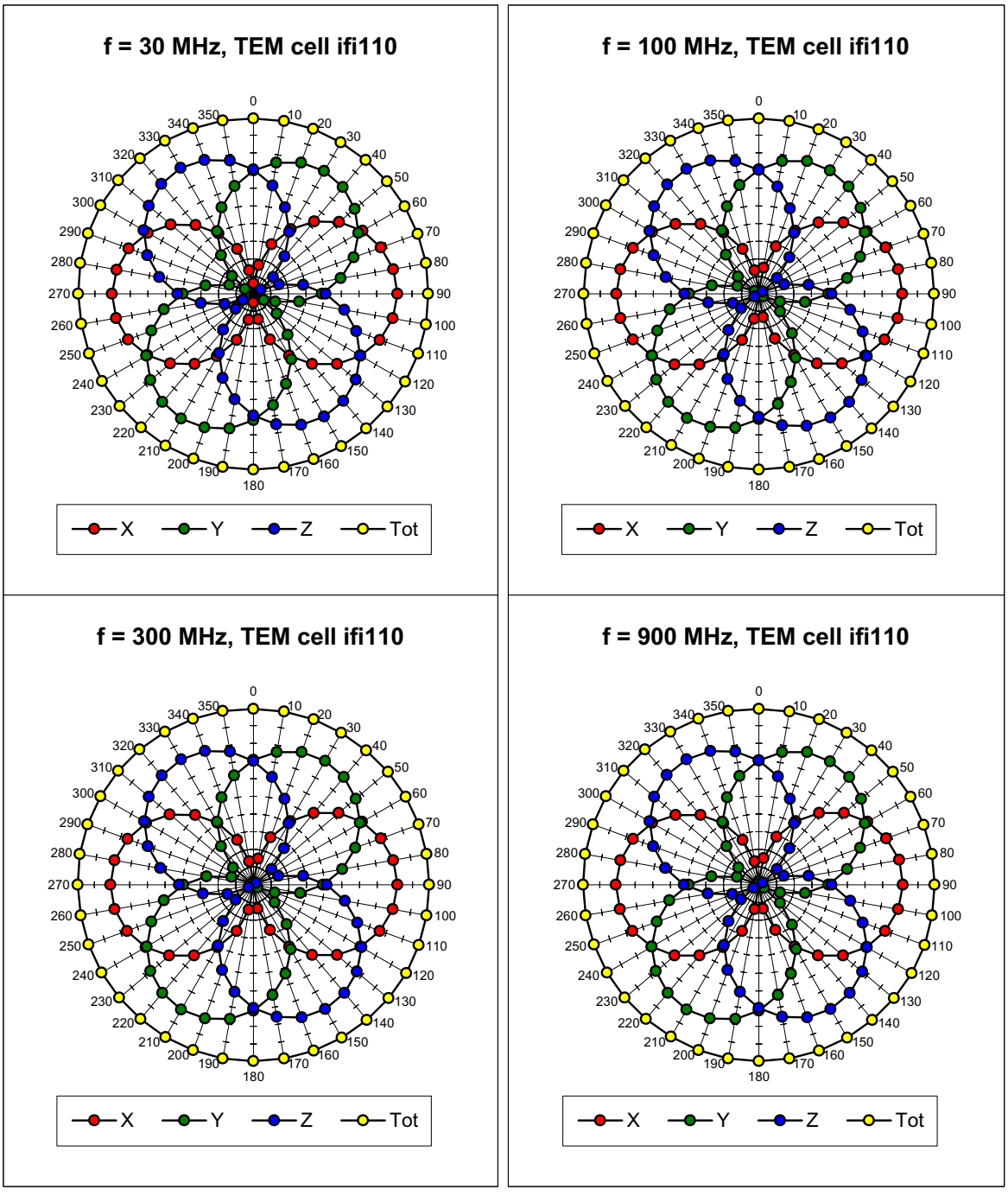
Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

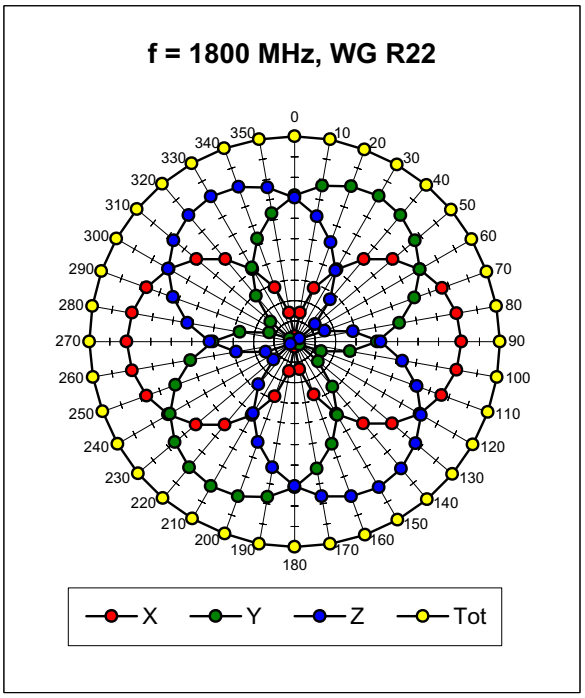
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	11.5	7.3
SAR_{be} [%]	With Correction Algorithm	0.1	0.3

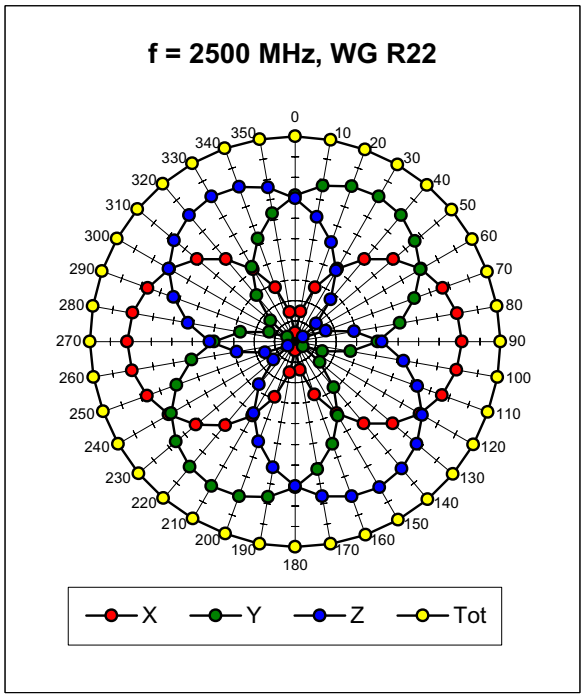
Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.3 ± 0.2**	mm

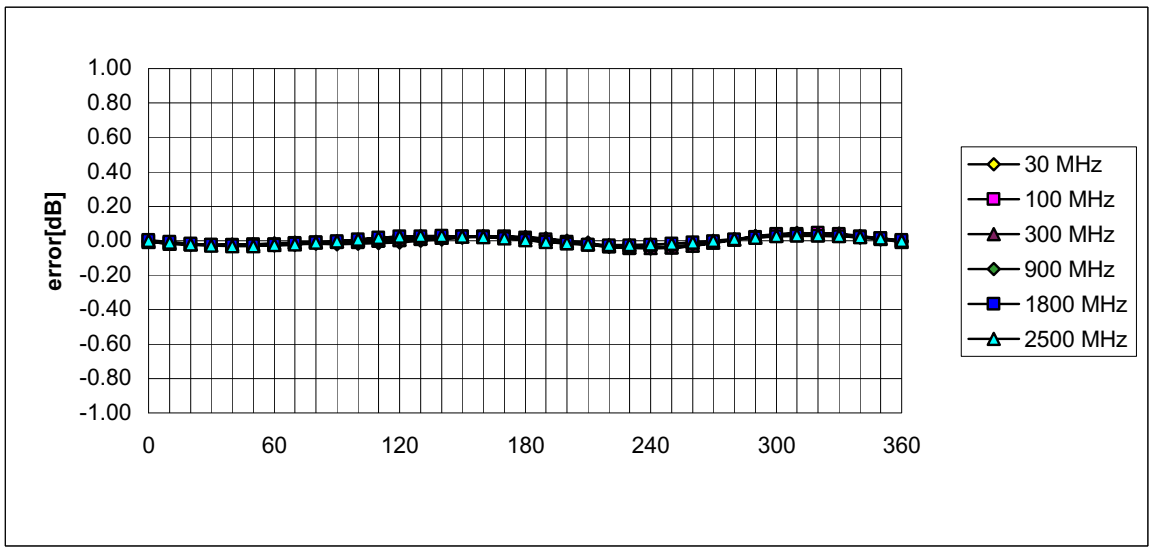
Receiving Pattern (ϕ , θ = 0°





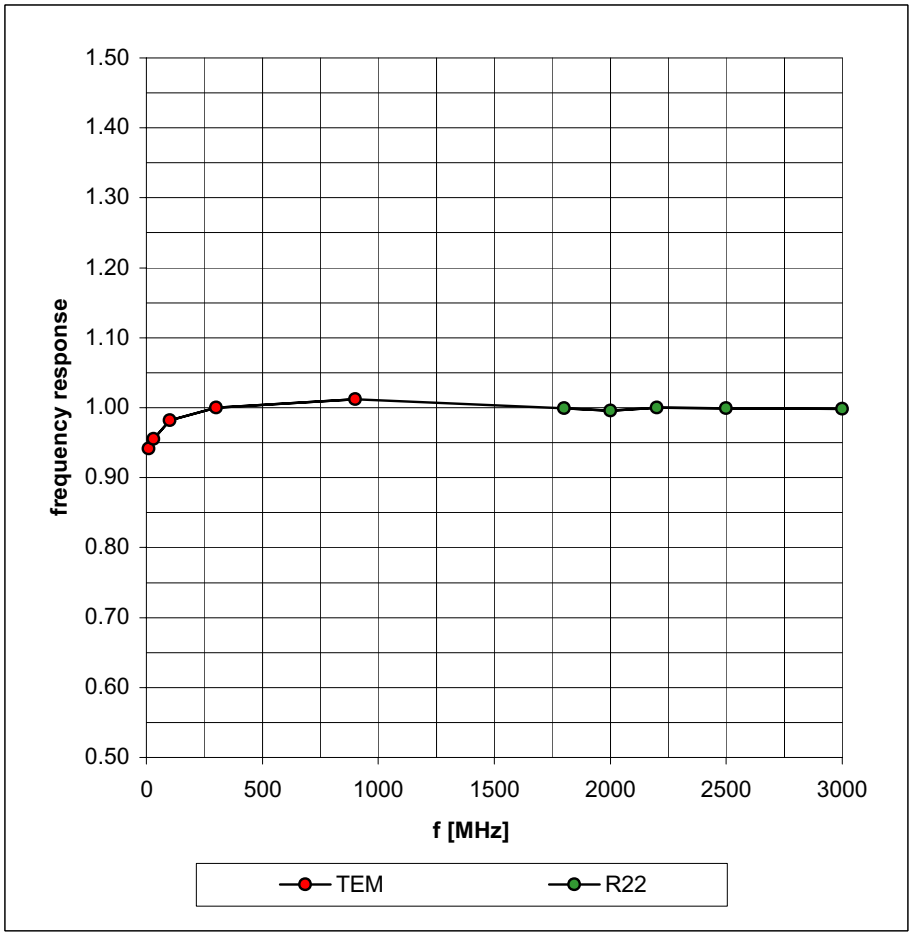


Isotropy Error (ϕ), θ = 0°



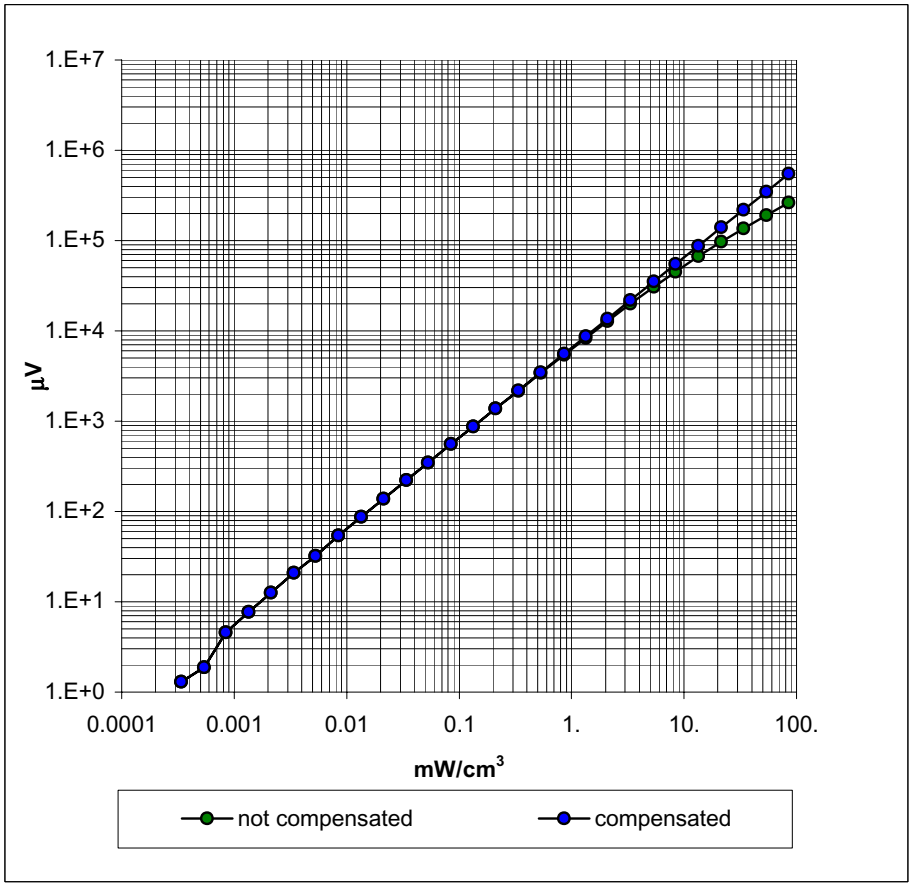
Frequency Response of E-Field

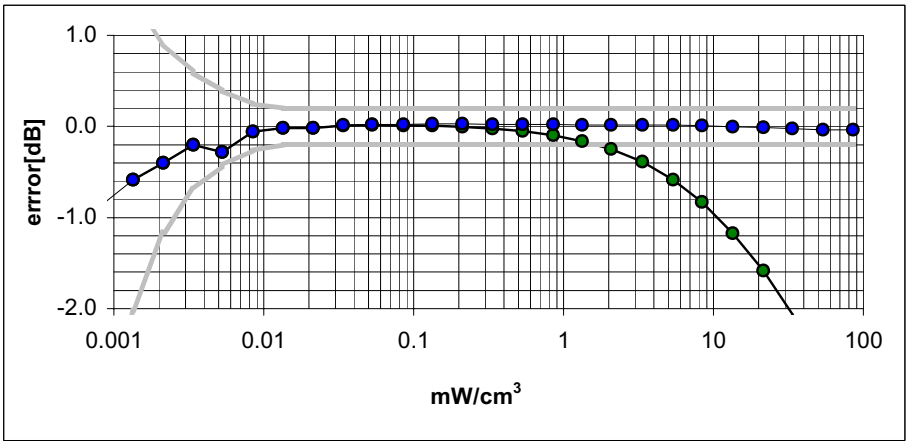
(TEM-Cell:ifi110, Waveguide R22)



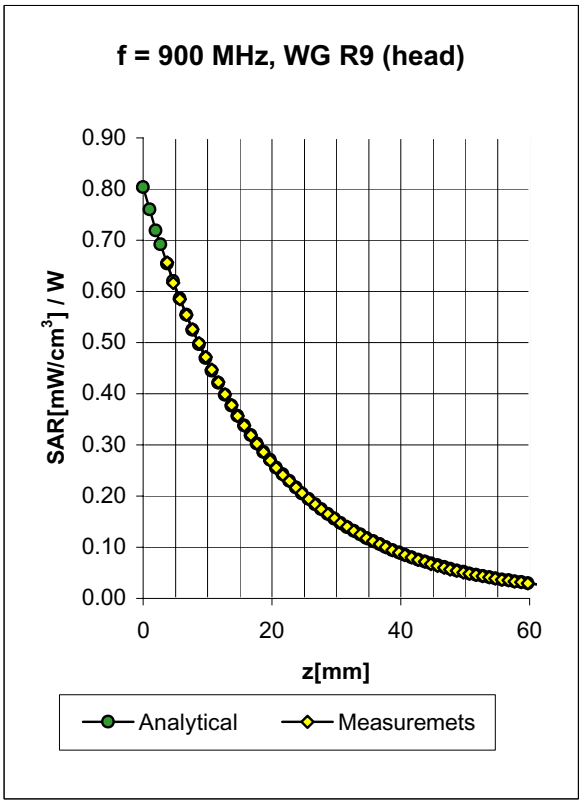
Dynamic Range f(SAR_{brain})

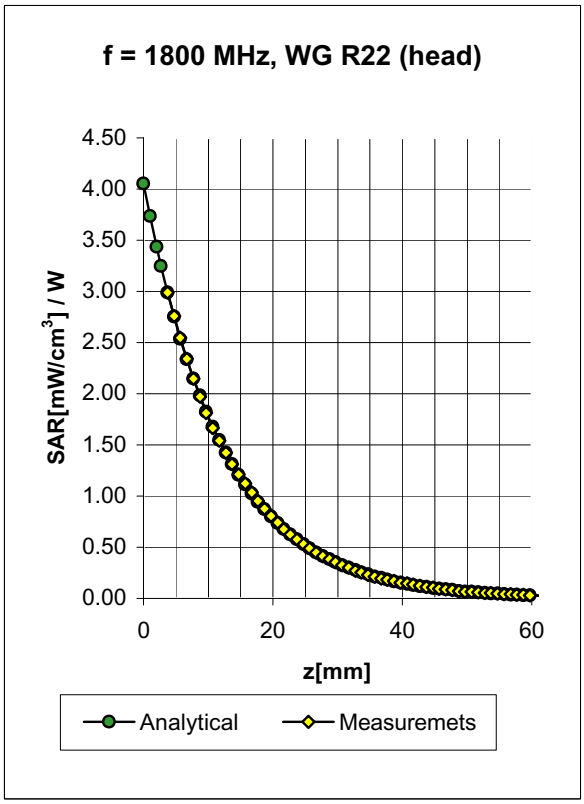
(Waveguide R22)





Conversion Factor Assessment



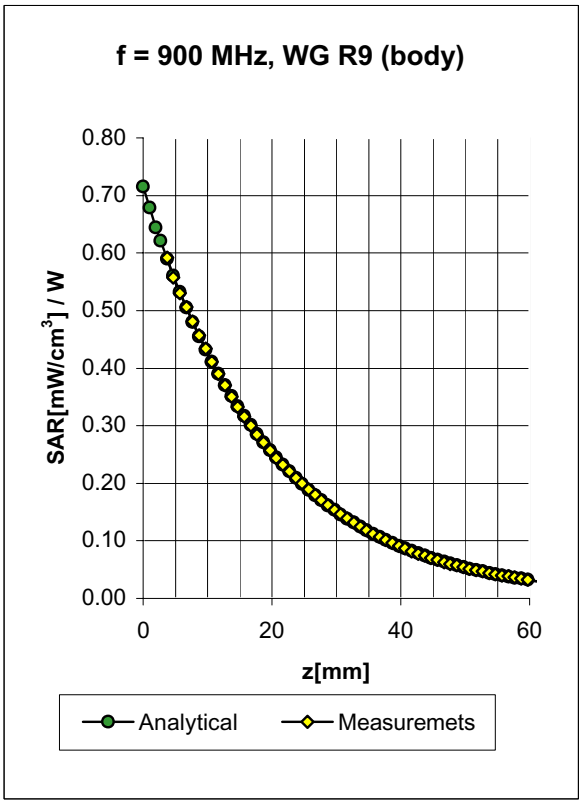


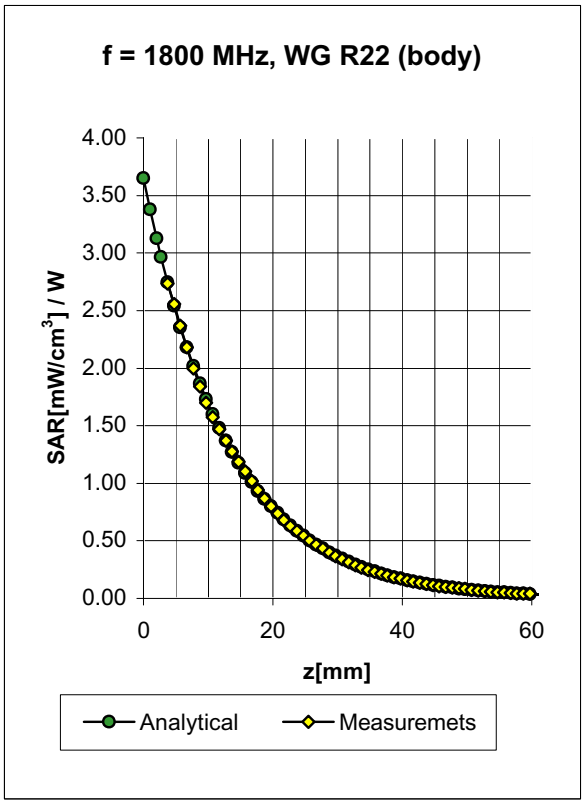
Head	**900 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.97 ± 5% mho/m**
Head	**835 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.90 ± 5% mho/m**
	ConvF X	**6.6** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**6.6** ± 9.5% (k=2)		Alpha **0.40**
	ConvF Z	**6.6** ± 9.5% (k=2)		Depth **2.38**

Head	**1800 MHz**		**ε_r = 40.0 ± 5%**	**σ = 1.40 ± 5% mho/m**
Head	**1900 MHz**		**ε_r = 40.0 ± 5%**	**σ = 1.40 ± 5% mho/m**
	ConvF X	**5.4** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**5.4** ± 9.5% (k=2)		Alpha **0.57**
	ConvF Z	**5.4** ± 9.5% (k=2)		Depth **2.18**

ET3DV6 SN:1387 **February 22, 2002**

Conversion Factor Assessment





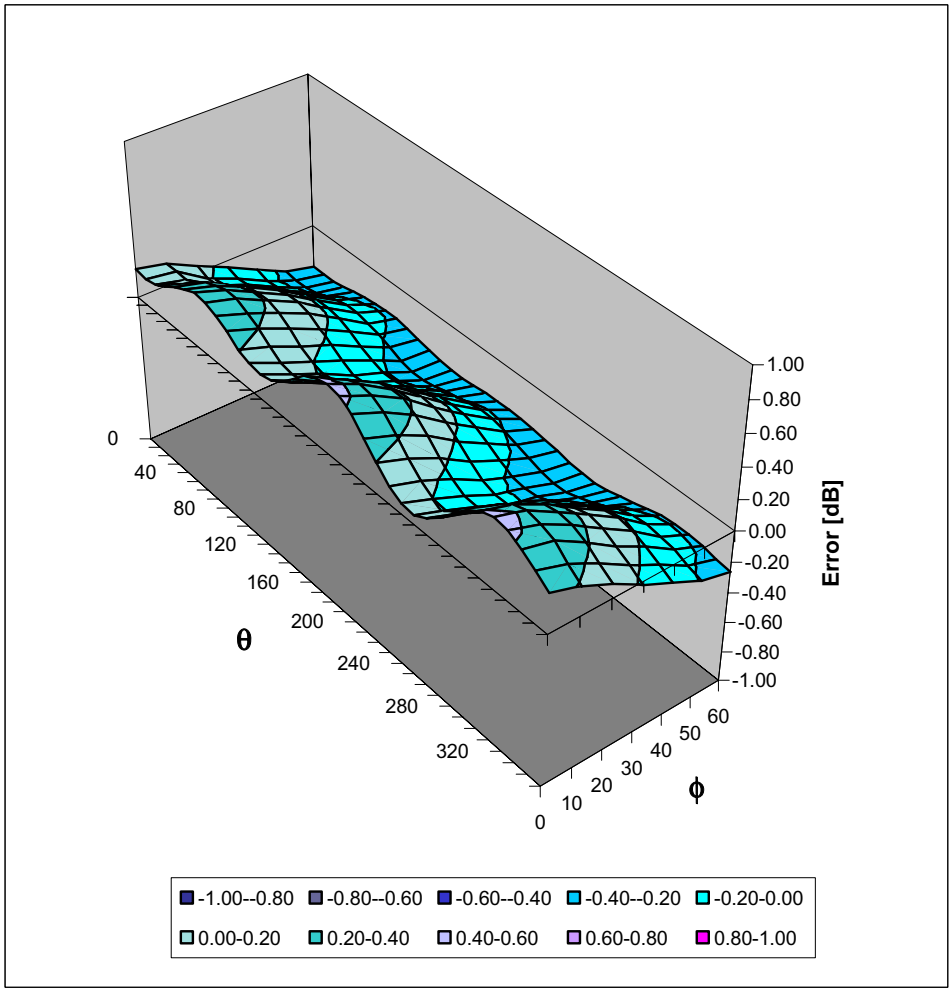
Body	**900 MHz**	ε_r **= 55.0 ± 5%**	**σ = 1.05 ± 5% mho/m**	
Body	**835 MHz**	ε_r **= 55.2 ± 5%**	**σ = 0.97 ± 5% mho/m**	
	ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.42**
	ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.44**

Body	**1800 MHz**	ε_r **= 53.3 ± 5%**	**σ = 1.52 ± 5% mho/m**	
Body	**1900 MHz**	ε_r **= 53.3 ± 5%**	**σ = 1.52 ± 5% mho/m**	
	ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.76**
	ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.01**

ET3DV6 SN:1387 **February 22, 2002**

Deviation from Isotropy in HSL

Error ($\theta\phi$), f = 900 MHz



Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Assessment:	**Zurich**
Date of Assessment:	**February 25, 2002**
Probe Calibration Date:	**February 22, 2002**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

Dosimetric E-Field Probe ET3DV6 SN:1387

Conversion Factor (± standard deviation)

150 MHz	ConvF	**9.2 ± 8%**	**ε_r = 52.3** **σ = 0.76 mho/m** (head tissue)
300 MHz	ConvF	**8.0 ± 8%**	**ε_r = 45.3** **σ = 0.87 mho/m** (head tissue)
450 MHz	ConvF	**7.3 ± 8%**	**ε_r = 43.5** **σ = 0.87 mho/m** (head tissue)
2450 MHz	ConvF	**4.7 ± 8%**	**ε_r = 39.2** **σ = 1.80 mho/m** (head tissue)
150 MHz	ConvF	**8.8 ± 8%**	**ε_r = 61.9** **σ = 0.80 mho/m** (body tissue)
450 MHz	ConvF	**7.7 ± 8%**	**ε_r = 56.7** **σ = 0.94 mho/m** (body tissue)
2450 MHz	ConvF	**4.3 ± 8%**	**ε_r = 52.7** **σ = 1.95 mho/m** (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

2450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

August 08, 2002

Frequency	e'	e"
2.400000000 GHz	38.0405	13.6232
2.405000000 GHz	38.0131	13.6371
2.410000000 GHz	37.9863	13.6585
2.415000000 GHz	37.9609	13.6710
2.420000000 GHz	37.9324	13.6754
2.425000000 GHz	37.9104	13.6882
2.430000000 GHz	37.8717	13.7031
2.435000000 GHz	37.8458	13.7242
2.440000000 GHz	37.8310	13.7423
2.445000000 GHz	37.8038	13.7646
2.450000000 GHz	37.7755	13.7641
2.455000000 GHz	37.7424	13.7883
2.460000000 GHz	37.7178	13.8062
2.465000000 GHz	37.6935	13.8345
2.470000000 GHz	37.6827	13.8525
2.475000000 GHz	37.6779	13.8713
2.480000000 GHz	37.6568	13.8826
2.485000000 GHz	37.6409	13.8767
2.490000000 GHz	37.6235	13.8876
2.495000000 GHz	37.5972	13.9046
2.500000000 GHz	37.5855	13.9131

2450MHz EUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

August 08, 2002

Frequency	e'	e"
2.350000000 G	50.546	14.1741
2.355000000 G	50.506	14.1766
2.360000000 G	50.479	14.1864
2.365000000 G	50.473	14.1997
2.370000000 G	50.470	14.2327
2.375000000 G	50.466	14.2655
2.380000000 G	50.447	14.3094
2.385000000 G	50.413	14.3609
2.390000000 G	50.382	14.3937
2.395000000 G	50.336	14.4226
2.400000000 G	50.294	14.4478
2.405000000 G	50.262	14.4423
2.410000000 G	50.253	14.4548
2.415000000 G	50.249	14.4569
2.420000000 G	50.243	14.4689
2.425000000 G	50.243	14.4920
2.430000000 G	50.246	14.5080
2.435000000 G	50.230	14.5321
2.440000000 G	50.207	14.5436
2.445000000 G	50.175	14.5475
2.450000000 G	50.147	14.5427
2.455000000 G	50.134	14.5316
2.460000000 G	50.112	14.5311
2.465000000 G	50.099	14.5495
2.470000000 G	50.099	14.5666
2.475000000 G	50.090	14.5942
2.480000000 G	50.078	14.6368
2.485000000 G	50.039	14.6688
2.490000000 G	50.008	14.7098
2.495000000 G	49.957	14.7313
2.500000000 G	49.930	14.7602
2.505000000 G	49.907	14.7657
2.510000000 G	49.884	14.7941
2.515000000 G	49.850	14.8252
2.520000000 G	49.845	14.8646
2.525000000 G	49.820	14.8995
2.530000000 G	49.808	14.9329
2.535000000 G	49.789	14.9604
2.540000000 G	49.774	14.9843
2.545000000 G	49.756	14.9822
2.550000000 G	49.749	14.9658

2450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

September 11, 2002

Frequency	e'	e"
2.300000000 GHz	40.2150	13.0488
2.310000000 GHz	40.1431	13.0728
2.320000000 GHz	40.0882	13.0925
2.330000000 GHz	40.0288	13.1517
2.340000000 GHz	40.0109	13.2204
2.350000000 GHz	39.9963	13.2812
2.360000000 GHz	39.9983	13.3373
2.370000000 GHz	39.9716	13.3938
2.380000000 GHz	39.9442	13.3990
2.390000000 GHz	39.9061	13.3826
2.400000000 GHz	39.8585	13.3604
2.410000000 GHz	39.7917	13.3649
2.420000000 GHz	39.7212	13.3808
2.430000000 GHz	39.6419	13.4152
2.440000000 GHz	39.6048	13.4708
2.450000000 GHz	39.5426	13.5276
2.460000000 GHz	39.5011	13.6742
2.470000000 GHz	39.4769	13.8765
2.480000000 GHz	39.4449	13.7262
2.490000000 GHz	39.4286	13.7172
2.500000000 GHz	39.4013	13.6904

2450MHz EUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

September 11, 2002

Frequency	e'	e''
2.350000000 GHz	51.8750	14.3828
2.355000000 GHz	51.8498	14.3985
2.360000000 GHz	51.8355	14.4267
2.365000000 GHz	51.8108	14.4421
2.370000000 GHz	51.8104	14.4725
2.375000000 GHz	51.7932	14.4939
2.380000000 GHz	51.7653	14.4994
2.385000000 GHz	51.7483	14.5172
2.390000000 GHz	51.7276	14.5253
2.395000000 GHz	51.7079	14.5431
2.400000000 GHz	51.6886	14.5642
2.405000000 GHz	51.6544	14.5812
2.410000000 GHz	51.6447	14.5914
2.415000000 GHz	51.6236	14.6222
2.420000000 GHz	51.5899	14.6356
2.425000000 GHz	51.5876	14.6483
2.430000000 GHz	51.5564	14.6664
2.435000000 GHz	51.5536	14.6871
2.440000000 GHz	51.5111	14.7010
2.445000000 GHz	51.4854	14.7167
2.450000000 GHz	51.4678	14.7481
2.455000000 GHz	51.4519	14.7776
2.460000000 GHz	51.4486	14.7994
2.465000000 GHz	51.4297	14.8257
2.470000000 GHz	51.4061	14.8327
2.475000000 GHz	51.3866	14.8458
2.480000000 GHz	51.3763	14.8695
2.485000000 GHz	51.3571	14.8824
2.490000000 GHz	51.3397	14.8934
2.495000000 GHz	51.3251	14.8976
2.500000000 GHz	51.3026	14.9187
2.505000000 GHz	51.2746	14.9321
2.510000000 GHz	51.2642	14.9390
2.515000000 GHz	51.2394	14.9633

APPENDIX F - SAM PHANTOM CERTIFICATE OF CONFORMITY

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

[1] CENELEC EN 50361
[2] IEEE P1528-200x draft 6.5
[3] IEC PT 62209 draft 0.9
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

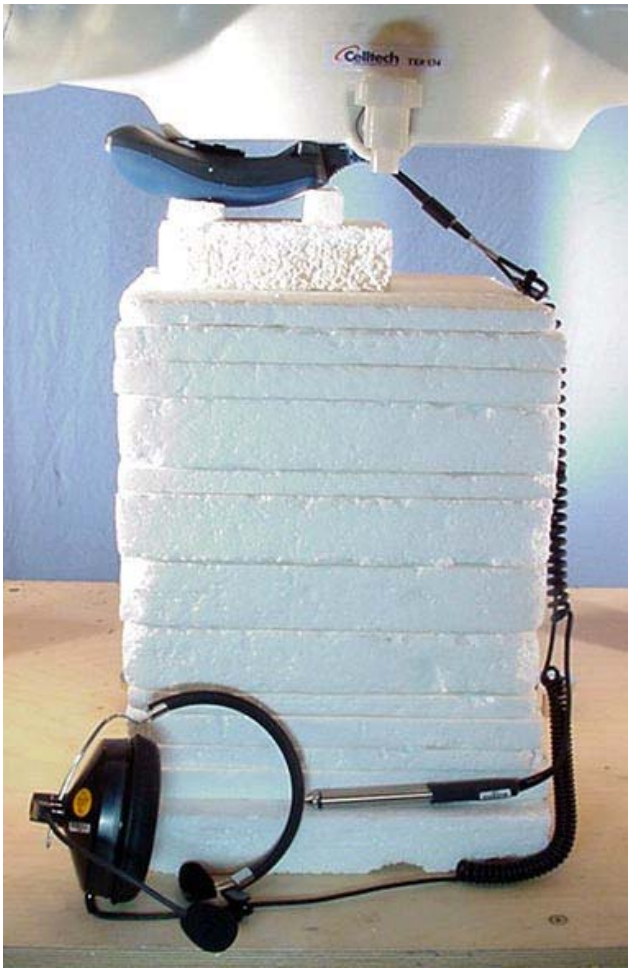
Date 18.11.2001

Signature / Stamp Schmid & Partner Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

APPENDIX G - SAR TEST SETUP & EUT PHOTOGRAPHS

SAR TEST SETUP PHOTOGRAPHS

Belt-Clip Side of EUT - Standard Battery
Right Section (Antenna Side) Touching Planar Phantom



SAR TEST SETUP PHOTOGRAPHS

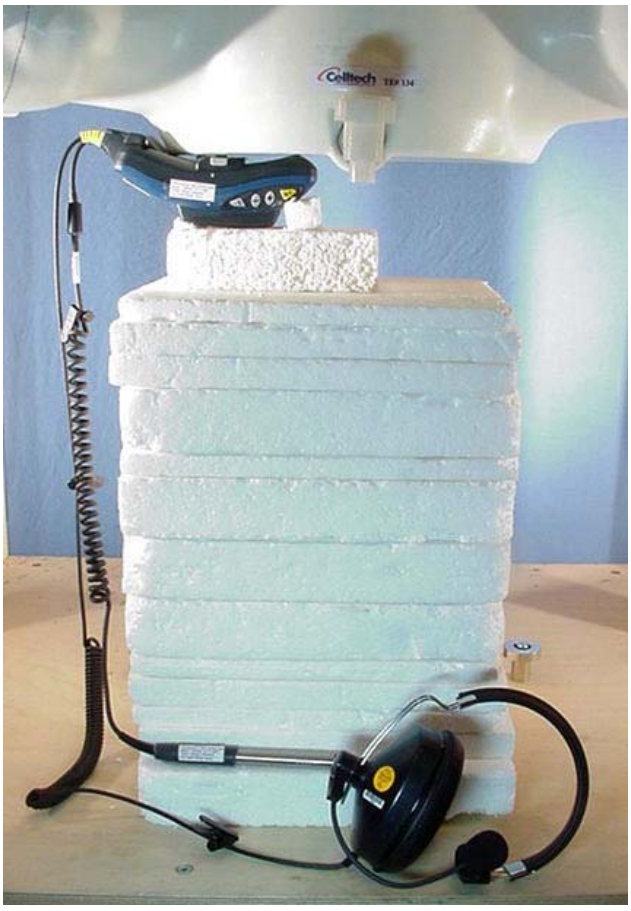
Belt-Clip Side of EUT - Extended Battery
Right Section (Antenna Side) Touching Planar Phantom

SAR TEST SETUP PHOTOGRAPHS

Belt-Clip Side of EUT - Standard Battery
Left Section Touching Planar Phantom

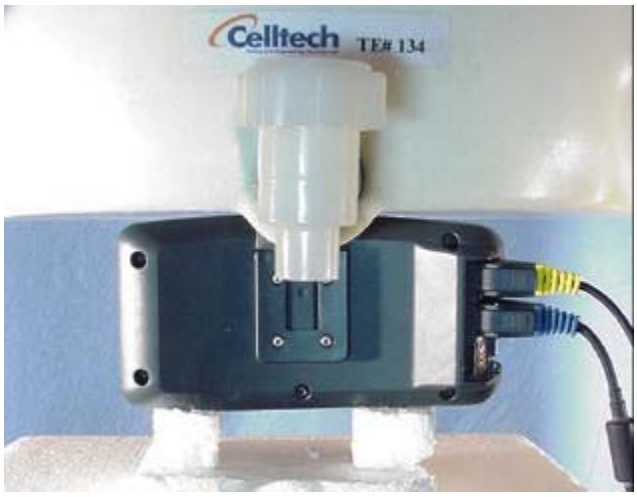
SAR TEST SETUP PHOTOGRAPHS

Belt-Clip Side of EUT - Extended Battery
Belt-Clip & Left Section of EUT Touching Planar Phantom

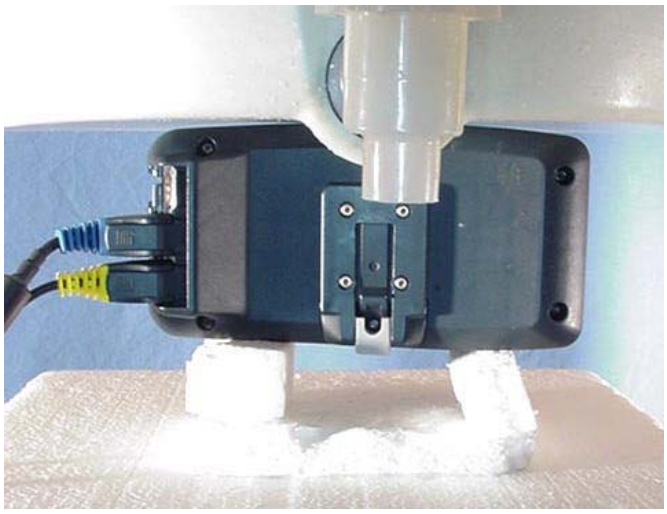


SAR TEST SETUP PHOTOGRAPHS

Top Side of EUT Touching Planar Phantom



SAR TEST SETUP PHOTOGRAPHS
Bottom Side of EUT Touching Planar Phantom



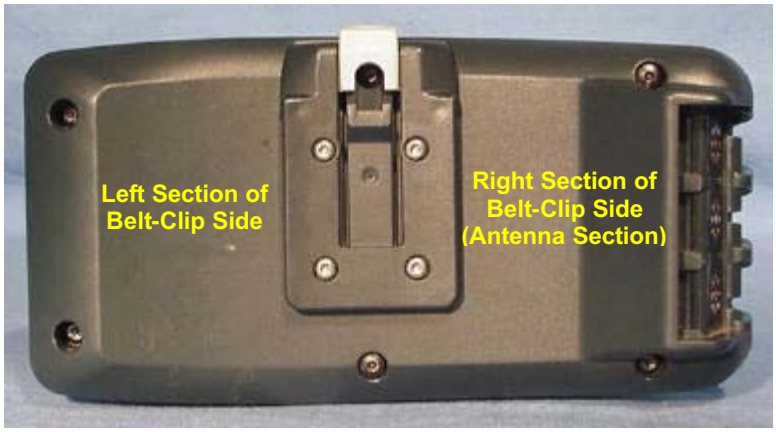
EUT PHOTOGRAPHS

Front Side of EUT without Battery

Front Side of EUT with Standard Lithium-Ion Battery (1500mAh)

Front Side of EUT with Extended Lithium-Ion Battery (3000mAh)

EUT PHOTOGRAPHS



Belt-Clip Side of EUT

Right Section of EUT (Antenna Side) with Waist-Strap Accessory

Left Section of EUT with Waist-Strap Accessory

EUT PHOTOGRAPHS

Top Side of EUT with Standard Lithium-Ion Battery

Top Side of EUT with Extended Lithium-Ion Battery

Bottom Side of EUT with Standard Lithium-Ion Battery

Bottom Side of EUT with Extended Lithium-Ion Battery

EUT PHOTOGRAPHS

EUT with Headset/Microphone & Scanner Accessories

Extended & Standard Lithium-Ion Batteries