
APPENDIX C - SYSTEM VALIDATION

2450MHz SYSTEM VALIDATION DIPOLE

Type:

2450MHz Validation Dipole

Serial Number:

150

Place of Calibration:

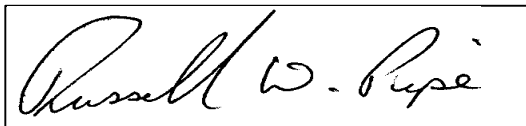
Celltech Research Inc.

Date of Calibration:

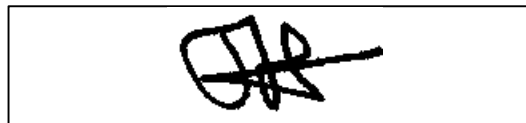
October 24, 2002

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

Calibrated by:



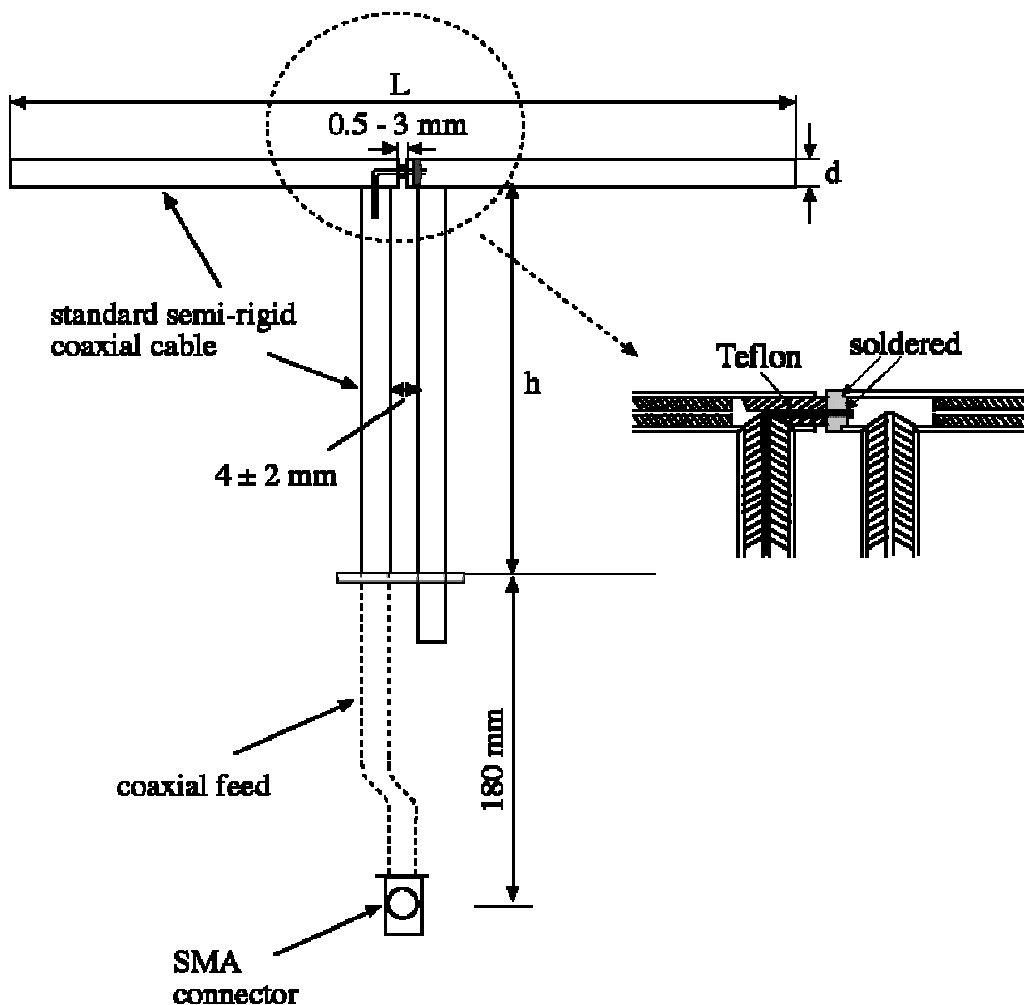
Approved by:



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	$\text{Re}\{Z\} = 49.838\Omega$ $\text{Im}\{Z\} = 0.2207\Omega$
Return Loss at 2450MHz	-49.398 dB



Validation Dipole Dimensions

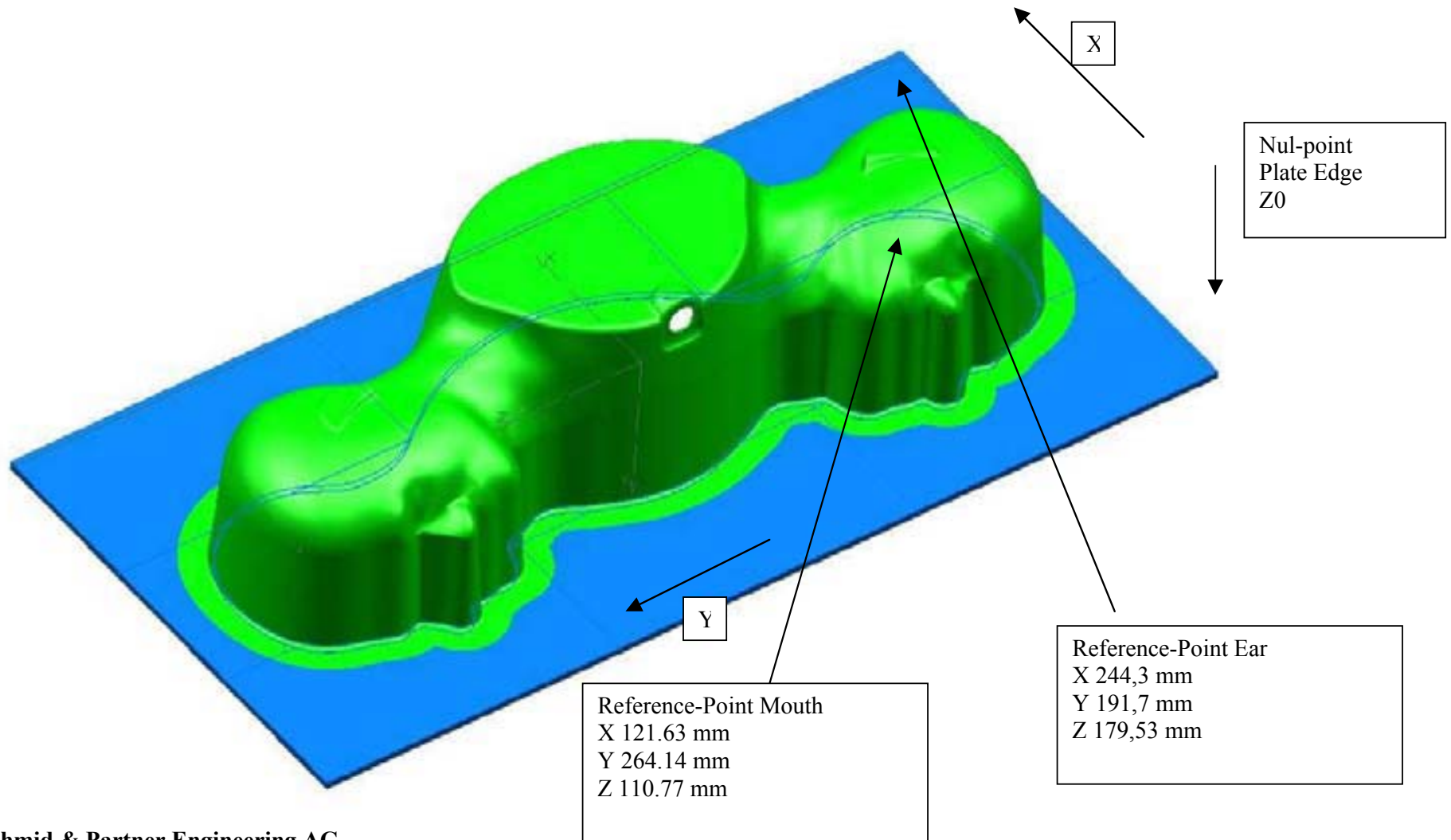
Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

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

SAM Twin-Phantom



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:

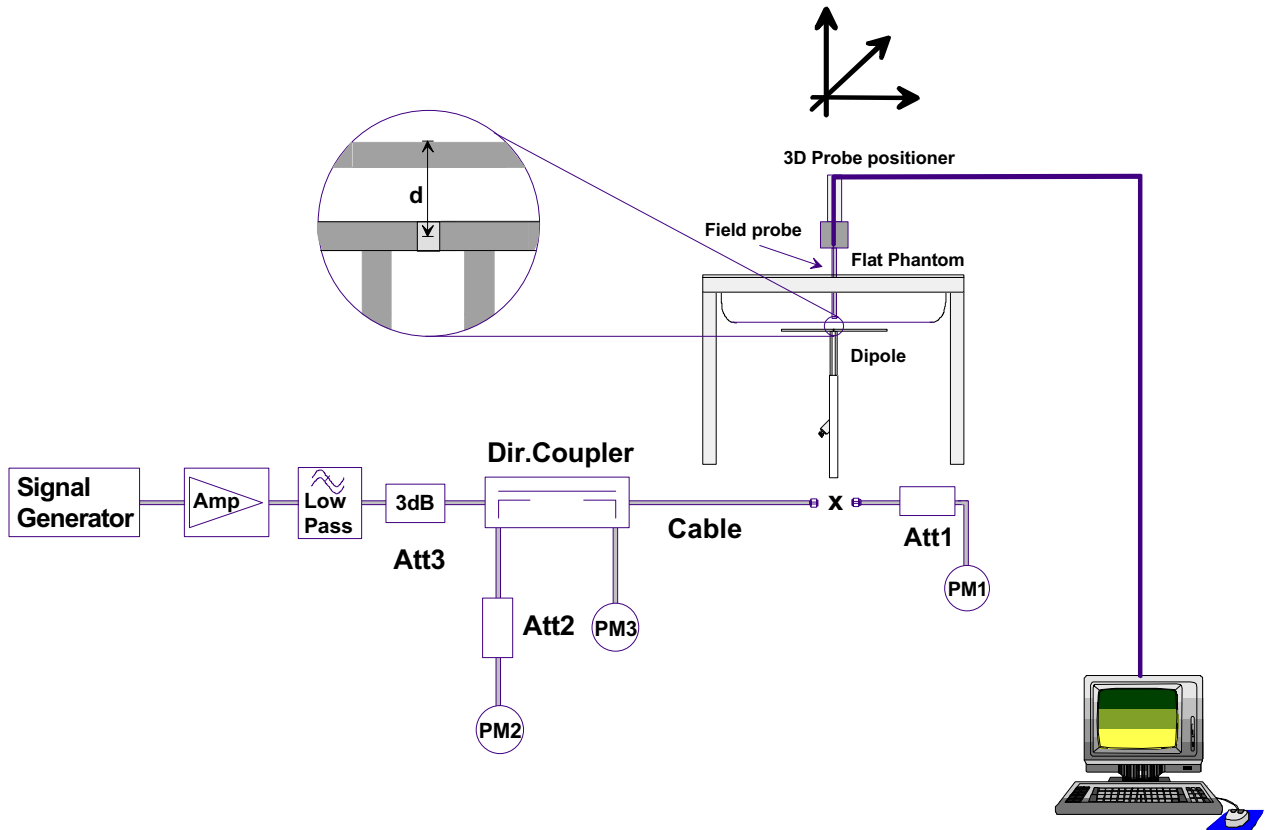
Relative Permittivity:	36.8
Conductivity:	1.79 mho/m
Ambient Temperature:	23.6°C
Fluid Temperature:	23.8°C
Fluid Depth:	≥ 15cm

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	$\epsilon_r = 39.2$ (+/-10%) $\sigma = 1.80$ S/m (+/-5%)

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

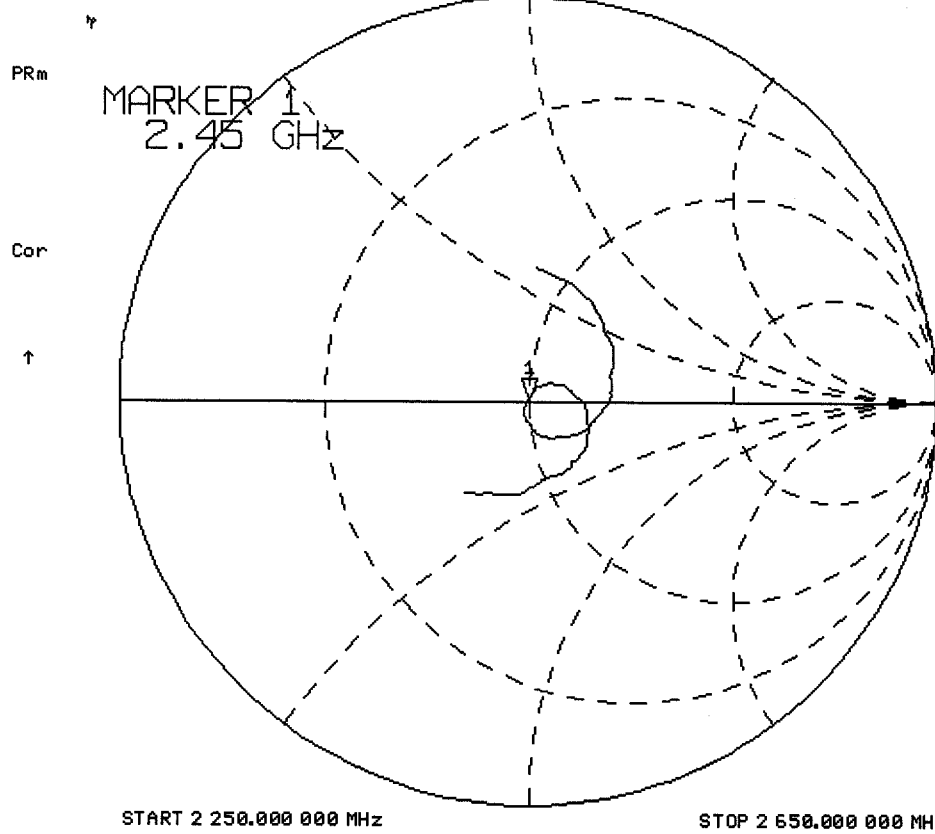
Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	14.4	57.6	6.55	26.20	30.5
Test 2	14.2	56.8	6.44	25.76	30.0
Test 3	14.0	56.0	6.35	25.40	29.7
Test 4	13.9	55.6	6.32	25.28	29.5
Test 5	14.0	56.0	6.33	25.32	29.7
Test 6	14.0	56.0	6.33	25.32	29.7
Test 7	13.9	55.6	6.31	25.24	29.5
Test 8	13.8	55.2	6.28	25.12	29.3
Test 9	13.8	55.2	6.28	25.12	29.4
Test10	14.0	56.0	6.33	25.32	29.7
Average Value	14.0	56.0	6.35	25.41	29.7

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

Averaged over 1cm (1g) of tissue: 56.00 mW/g

Averaged over 10cm (10g) of tissue: 25.41 mW/g

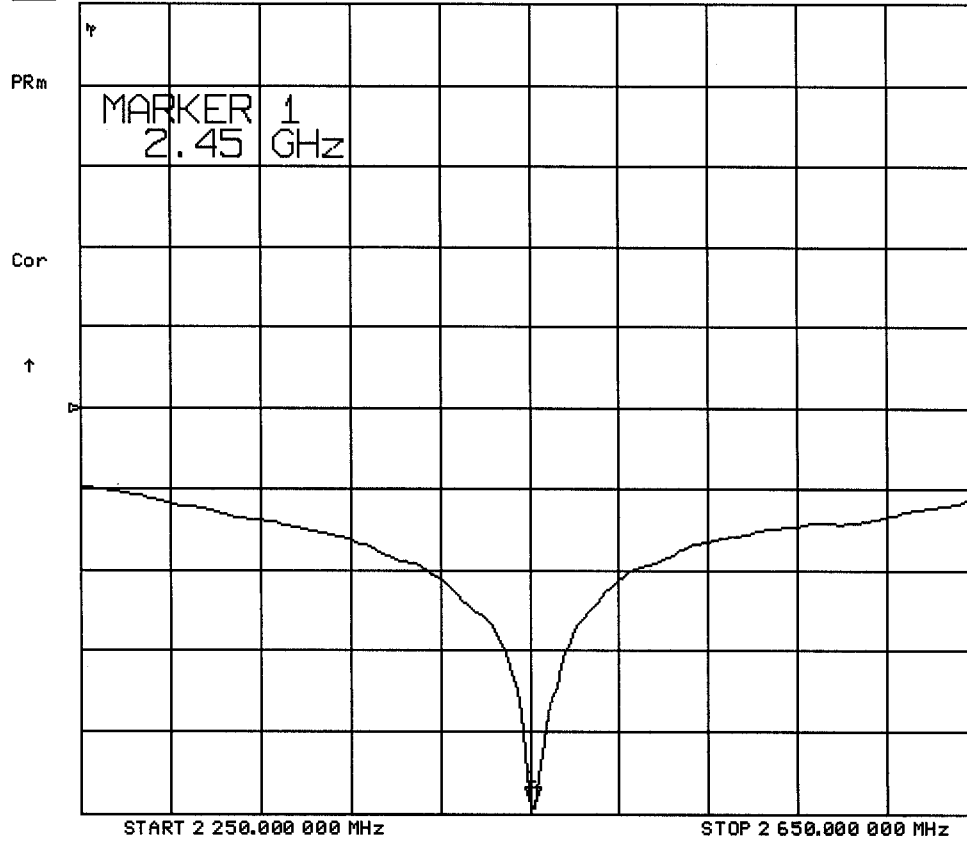
24 Oct 2002 09:28:50
CH1 S11 1 U FS 1: 49.838 Ω 0.2207 Ω 14.337 pH 2 450.000 000 MHz



24 Oct 2002 09:28:12

CH1 S11 LOG 10 dB/REF 0 dB

11-49.398 dB 2 450.000 000 MHz



Dipole 2450MHz

SAM Phantom; Flat Section

Probe: ET3DV6 - SN1387; ConvF(4.70,4.70,4.70); Crest factor: 1.0; 2450 MHz Brain: $\sigma = 1.79$ mho/m $\epsilon_r = 36.8$ $\rho = 1.00$ g/cm³

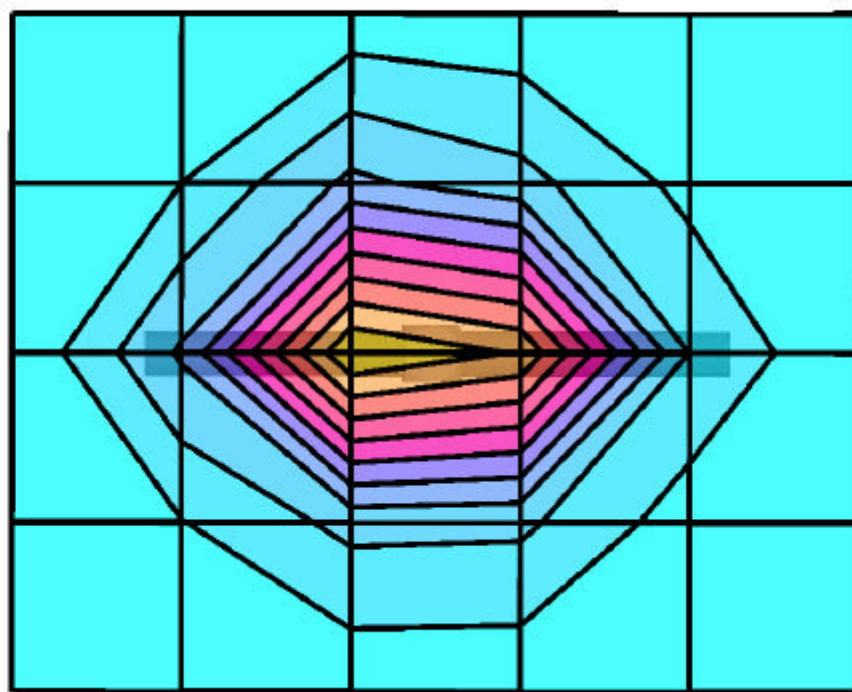
Cubes (4): Peak: 29.7 mW/g ± 0.04 dB, SAR (1g): 14.0 mW/g ± 0.04 dB, SAR (10g): 6.35 mW/g ± 0.04 dB, (Worst-case extrapolation)

Penetration depth: 6.4 (6.1, 7.2) [mm]; Powerdrift: -0.04 dB

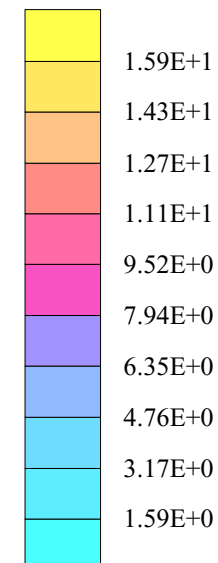
Ambient Temp.: 23.6°C; Fluid Temp.: 23.8°C

Forward Conducted Power: 250 mW

Calibration Date: October 24, 2002



SAR_{Tot} [mW/g]



2450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

October 24, 2002

Frequency	ϵ'	ϵ''
2.350000000 GHz	37.2108	12.9039
2.360000000 GHz	37.1695	12.9350
2.370000000 GHz	37.1398	12.9630
2.380000000 GHz	37.1057	12.9945
2.390000000 GHz	37.0746	13.0290
2.400000000 GHz	37.0424	13.0464
2.410000000 GHz	36.9746	13.0743
2.420000000 GHz	36.9322	13.1074
2.430000000 GHz	36.8908	13.1372
2.440000000 GHz	36.8449	13.1527
2.450000000 GHz	36.7983	13.1767
2.460000000 GHz	36.7651	13.2038
2.470000000 GHz	36.7300	13.2377
2.480000000 GHz	36.7004	13.2677
2.490000000 GHz	36.6658	13.2862
2.500000000 GHz	36.6120	13.2988
2.510000000 GHz	36.5655	13.3268
2.520000000 GHz	36.5147	13.3582
2.530000000 GHz	36.4743	13.3922
2.540000000 GHz	36.4044	13.4131
2.550000000 GHz	36.3807	13.4402