

ATTACHMENT R
PROBE CALIBRATION

DIGITAL EMC

Schmid & Partner Engineering AG

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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1703

Place of Assessment:

Zurich

Date of Assessment:

February 10, 2003

Probe Calibration Date:

February 7, 2003

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:



Probe ET3DV6

SN:1703

Manufactured:	July 3, 2002
Last calibration:	July 29, 2002
Recalibrated:	February 7, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1703**Sensitivity in Free Space**

NormX	1.64 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	95	mV
DCP Y	95	mV
DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid

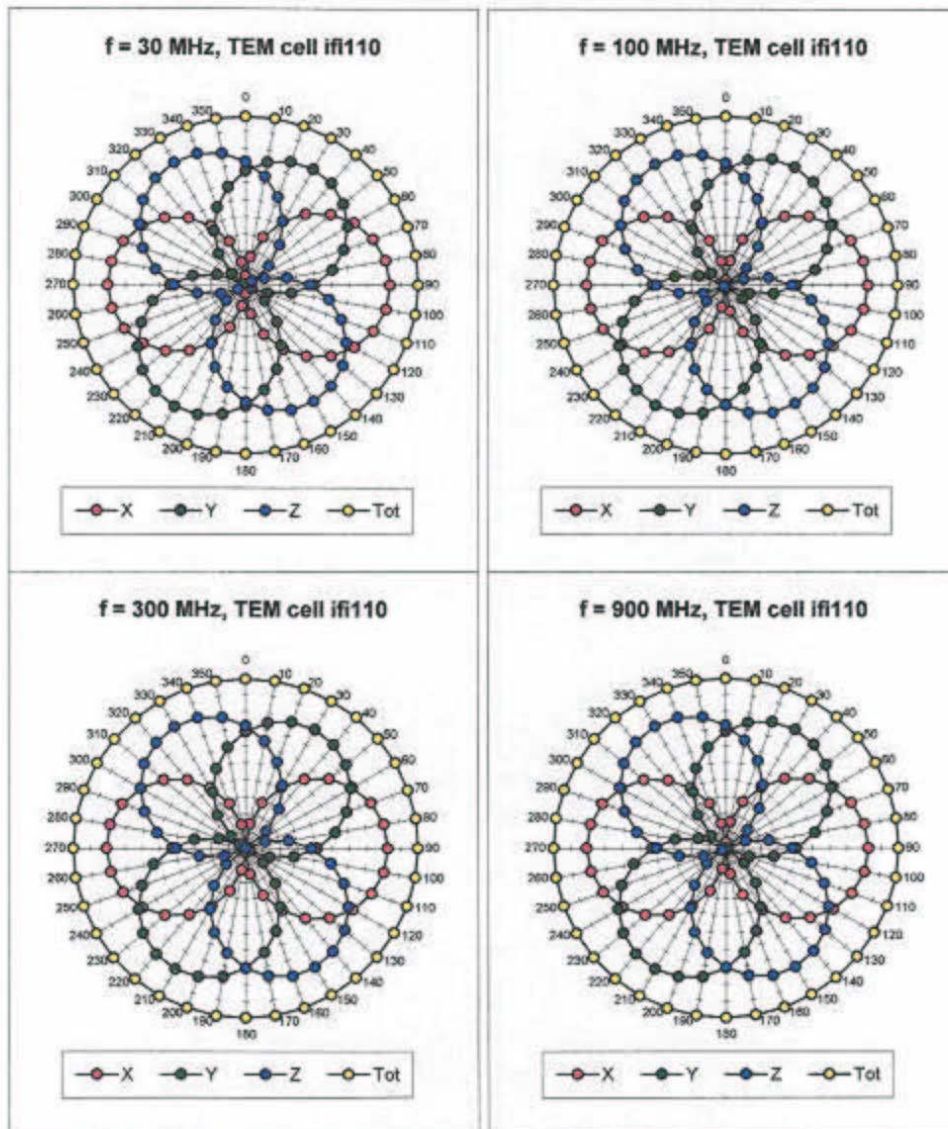
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
ConvF X	6.8 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.8 $\pm 9.5\%$ (k=2)	Alpha	0.35
ConvF Z	6.8 $\pm 9.5\%$ (k=2)	Depth	2.73
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
ConvF X	5.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.4 $\pm 9.5\%$ (k=2)	Alpha	0.47
ConvF Z	5.4 $\pm 9.5\%$ (k=2)	Depth	2.78

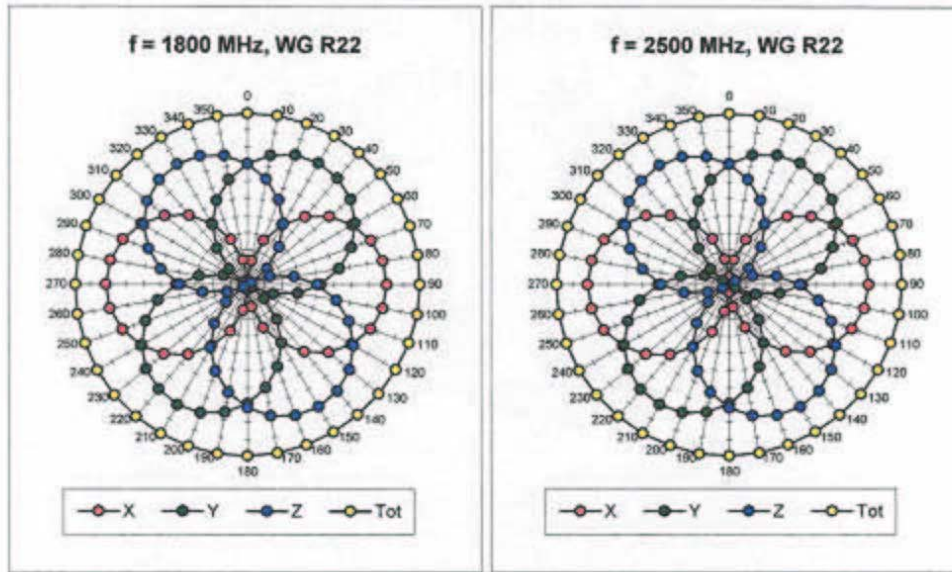
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm		
	Probe Tip to Boundary		1 mm	2 mm
	SAR _{be} [%] Without Correction Algorithm		10.3	6.0
	SAR _{be} [%] With Correction Algorithm		0.4	0.6
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
	Probe Tip to Boundary		1 mm	2 mm
	SAR _{be} [%] Without Correction Algorithm		13.8	9.5
	SAR _{be} [%] With Correction Algorithm		0.2	0.1

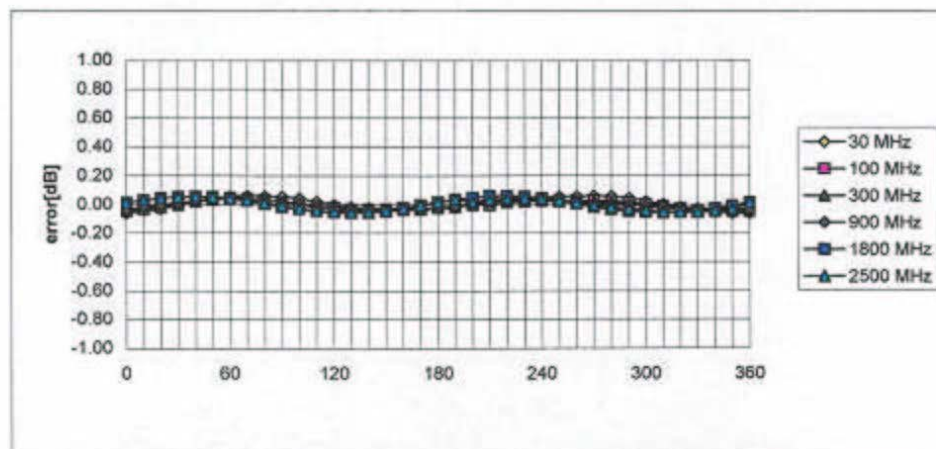
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ 

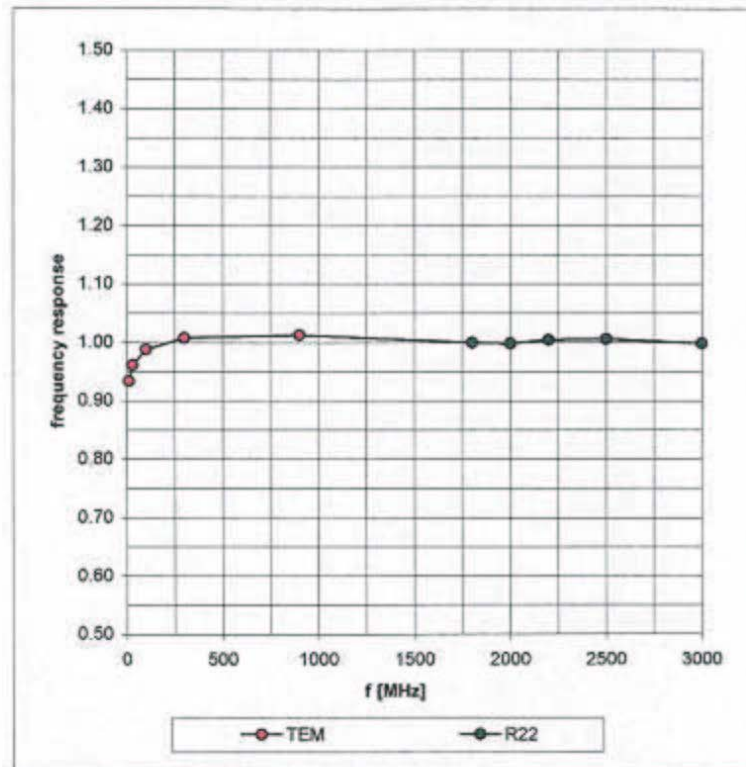


Isotropy Error (ϕ), $\theta = 0^\circ$

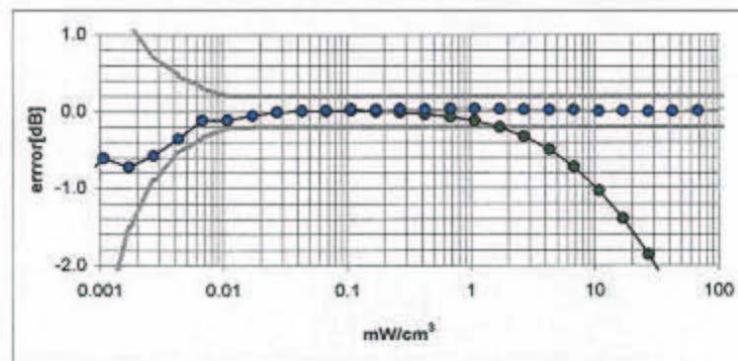
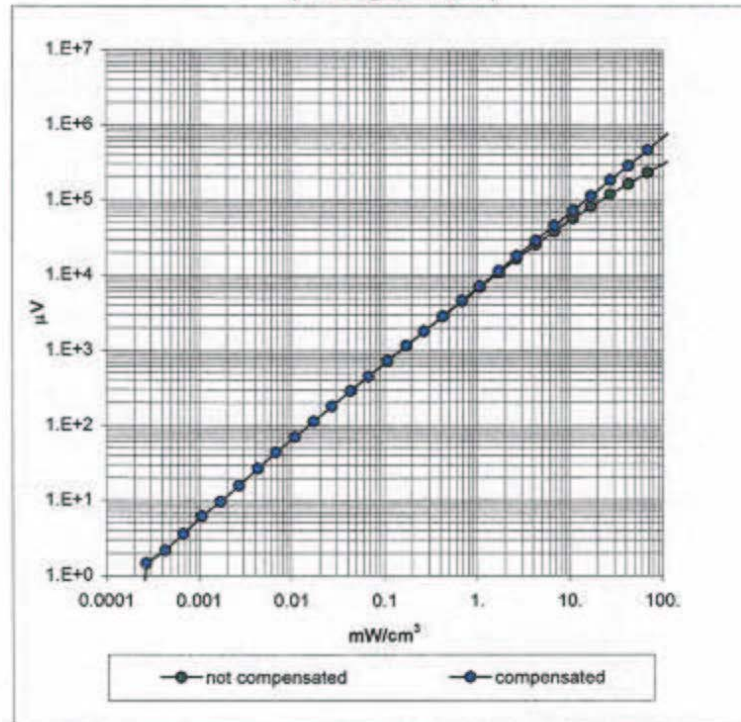


Frequency Response of E-Field

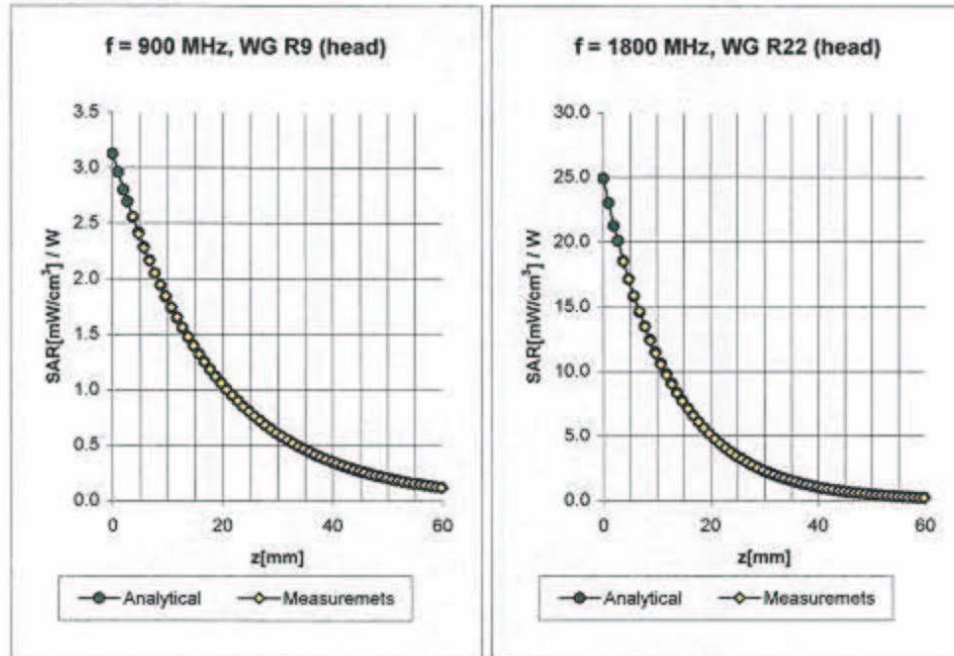
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)

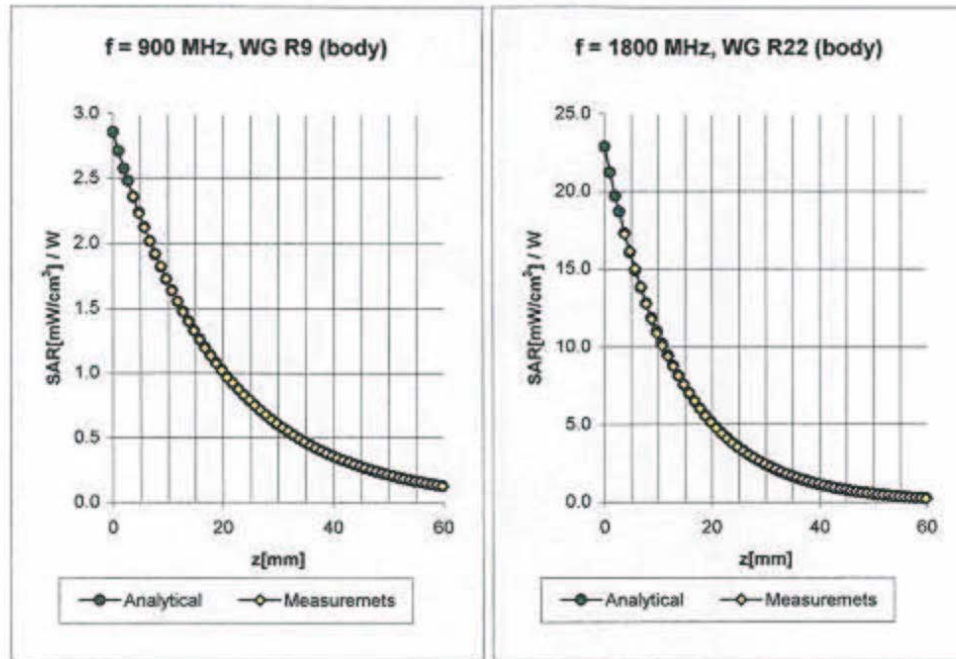


Conversion Factor Assessment



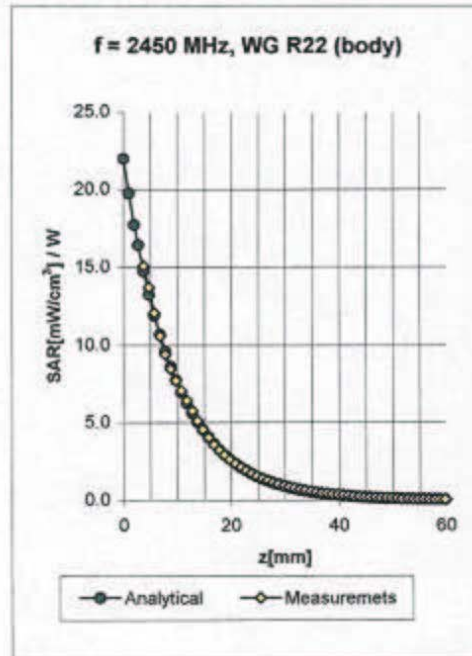
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
	ConvF X	$6.8 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$6.8 \pm 9.5\%$ (k=2)	Alpha 0.35
	ConvF Z	$6.8 \pm 9.5\%$ (k=2)	Depth 2.73
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
	ConvF X	$5.4 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$5.4 \pm 9.5\%$ (k=2)	Alpha 0.47
	ConvF Z	$5.4 \pm 9.5\%$ (k=2)	Depth 2.78

Conversion Factor Assessment



Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\%$ mho/m
Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
	ConvF X	$6.6 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$6.6 \pm 9.5\%$ (k=2)	Alpha 0.42
	ConvF Z	$6.6 \pm 9.5\%$ (k=2)	Depth 2.37
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\%$ mho/m
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\%$ mho/m
	ConvF X	$4.9 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$4.9 \pm 9.5\%$ (k=2)	Alpha 0.53
	ConvF Z	$4.9 \pm 9.5\%$ (k=2)	Depth 2.77

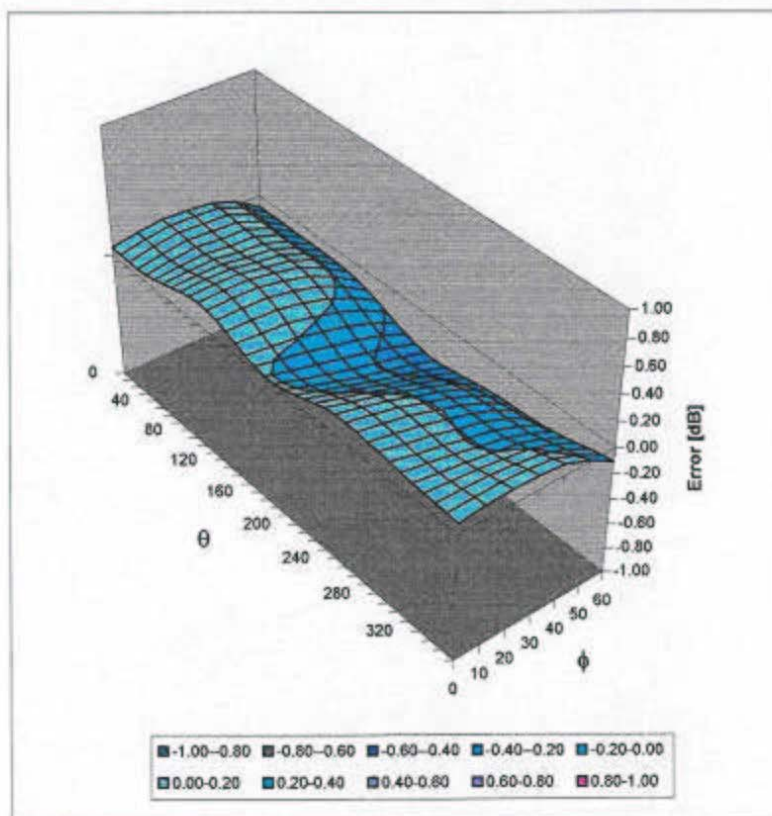
Conversion Factor Assessment



2450	Body	MHz	$\epsilon_r = 52.7 \pm 5\%$	$\sigma = 1.95 \pm 5\% \text{ mho/m}$
ConvF X			$4.7 \pm 8.9\% (k=2)$	Boundary effect:
ConvF Y			$4.7 \pm 8.9\% (k=2)$	Alpha 1.50
ConvF Z			$4.7 \pm 8.9\% (k=2)$	Depth 1.45

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



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SN:1703

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(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1703**Sensitivity in Free Space****Diode Compression**

NormX	1.64 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	95	mV
NormY	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	95	mV
NormZ	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid

Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
ConvF X	6.8 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.8 $\pm 9.5\%$ (k=2)	Alpha	0.35
ConvF Z	6.8 $\pm 9.5\%$ (k=2)	Depth	2.73
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ConvF X	5.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.4 $\pm 9.5\%$ (k=2)	Alpha	0.47
ConvF Z	5.4 $\pm 9.5\%$ (k=2)	Depth	2.78

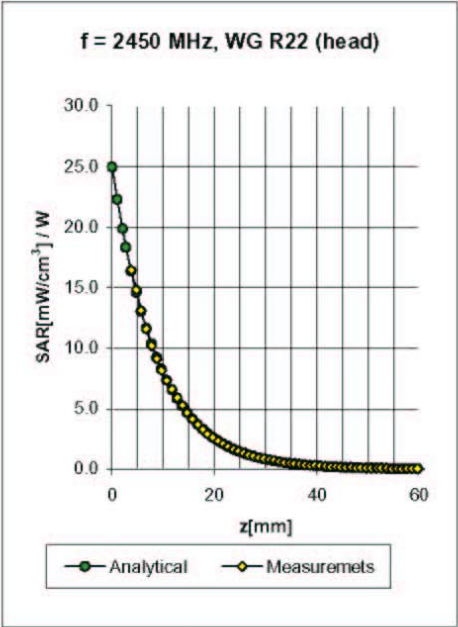
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%]	Without Correction Algorithm	10.3	6.0	
SAR _{be} [%]	With Correction Algorithm	0.4	0.6	
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%]	Without Correction Algorithm	13.8	9.5	
SAR _{be} [%]	With Correction Algorithm	0.2	0.1	

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 $\pm$ 0.2	mm

Conversion Factor Assessment



Head	2450	MHz	$\epsilon_r = 39.2 \pm 5\%$	$\sigma = 1.80 \pm 5\%$ mho/m
ConvF X	5.1	$\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	5.1	$\pm 8.9\%$ (k=2)	Alpha	0.90
ConvF Z	5.1	$\pm 8.9\%$ (k=2)	Depth	1.93