

Appendix 4

Probe Calibration Certificates

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1391

Place of Calibration:

Zurich

Date of Calibration:

October 25, 2001

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 of the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

M. Loosli-Meriano

Approved by:

Thomas Kappeler

Probe ET3DV6

SN:1391

Manufactured:	October 1, 1999
Remade:	October 11, 2001
Recalibrated:	October 25, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1391**Sensitivity in Free Space**

NormX	1.86 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.73 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.76 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	97 mV
DCP Y	97 mV
DCP Z	97 mV

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** $\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 10\%$ mho/m

ConvF X	6.75 extrapolated	Boundary effect	
ConvF Y	6.75 extrapolated	Alpha	0.39
ConvF Z	6.75 extrapolated	Depth	2.39

Head **800 - 1000 MHz** $\epsilon_r = 39.0 - 43.5$ $\sigma = 0.80 - 1.10$ mho/m

ConvF X	6.31 $\pm 9.5\%$ (k=2)	Boundary effect	
ConvF Y	6.31 $\pm 9.5\%$ (k=2)	Alpha	0.47
ConvF Z	6.31 $\pm 9.5\%$ (k=2)	Depth	2.30

Head **1500 MHz** $\epsilon_r = 40.4 \pm 5\%$ $\sigma = 1.23 \pm 10\%$ mho/m

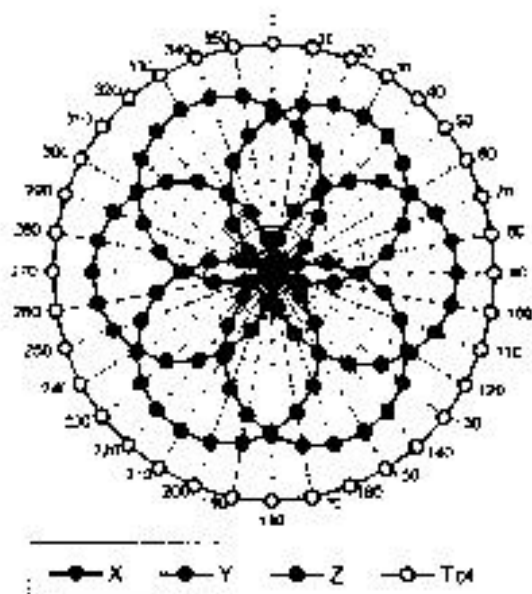
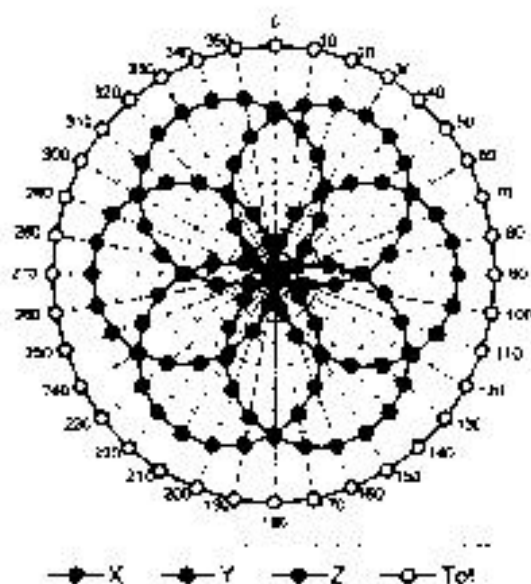
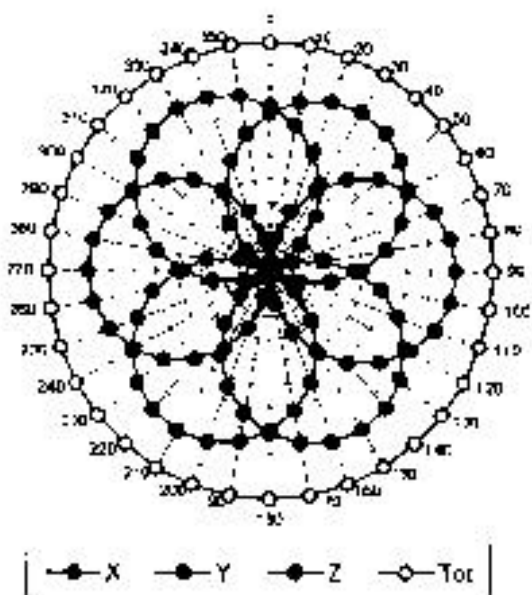
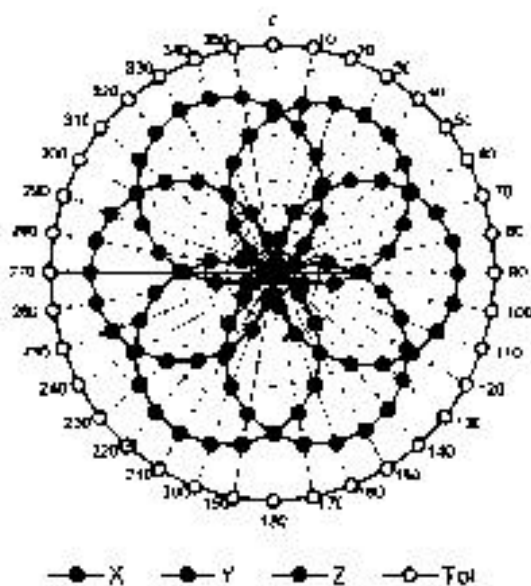
ConvF X	5.73 interpolated	Boundary effect	
ConvF Y	5.73 interpolated	Alpha	0.58
ConvF Z	5.73 interpolated	Depth	2.19

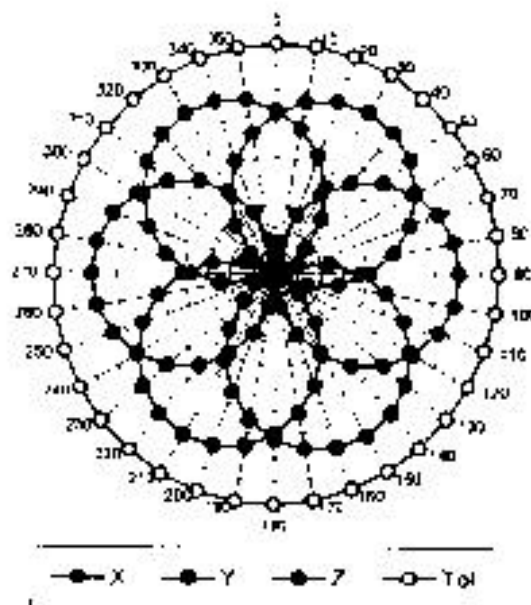
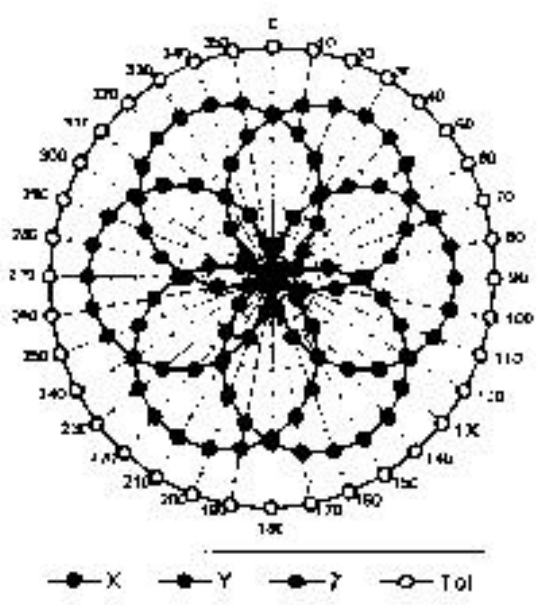
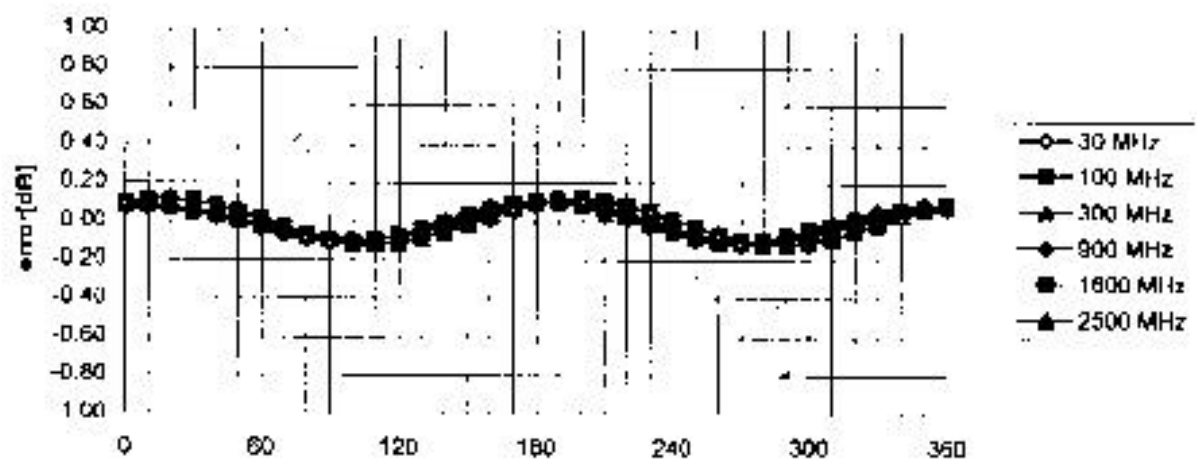
Head **1700 - 1910 MHz** $\epsilon_r = 39.6 - 41.0$ $\sigma = 1.20 - 1.55$ mho/m

ConvF X	5.43 $\pm 9.5\%$ (k=2)	Boundary effect	
ConvF Y	5.43 $\pm 9.5\%$ (k=2)	Alpha	0.63
ConvF Z	5.43 $\pm 9.5\%$ (k=2)	Depth	2.13

Sensor Offset

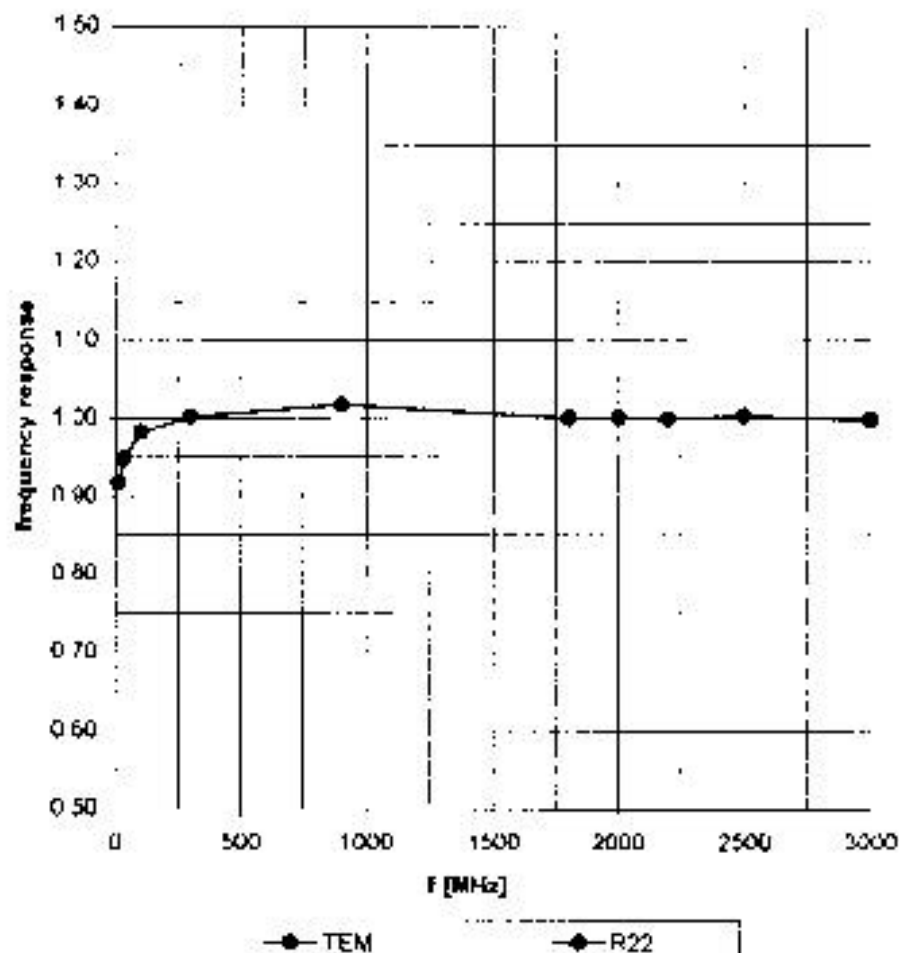
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.5 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30 \text{ MHz}$, TEM cell if110 $f = 100 \text{ MHz}$, TEM cell if110 $f = 300 \text{ MHz}$, TEM cell if110 $f = 900 \text{ MHz}$, TEM cell if110

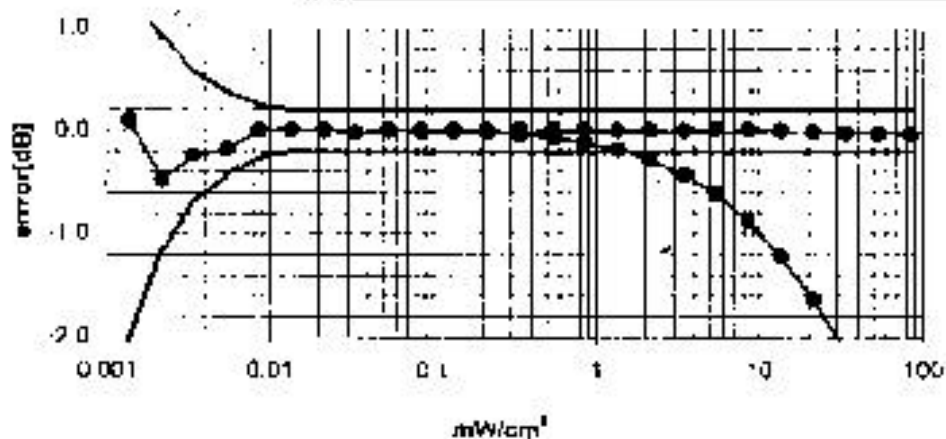
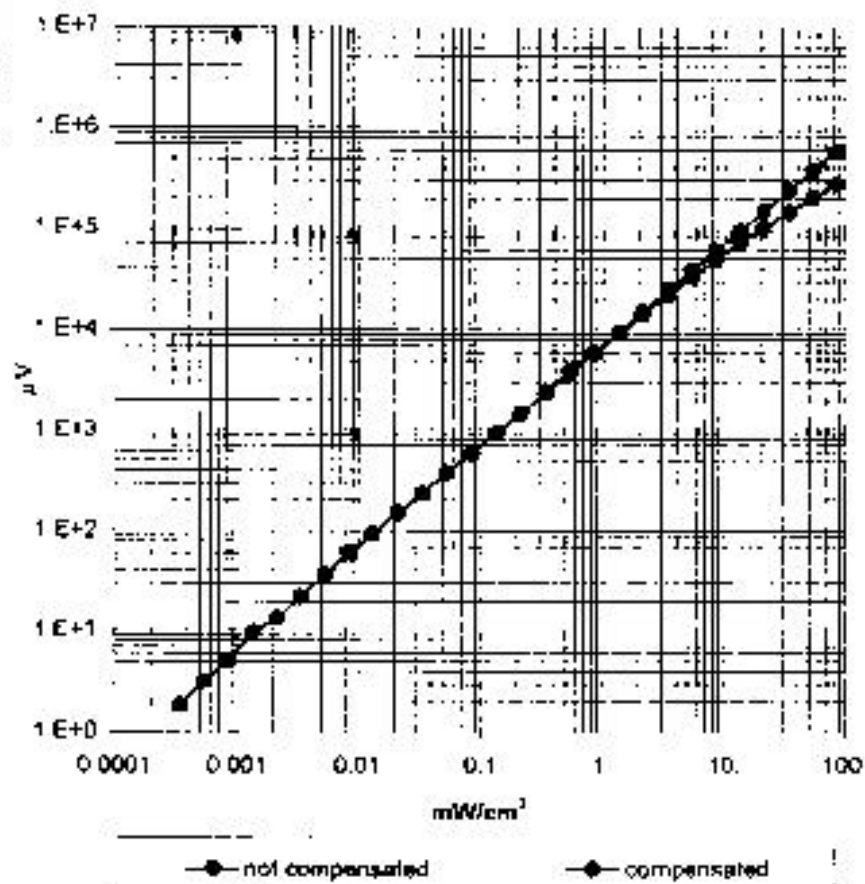
$f = 1800 \text{ MHz, WG R22}$  $f = 2500 \text{ MHz, WG R22}$ Isotropy Error (ϕ), $\theta = 0^\circ$ 

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)

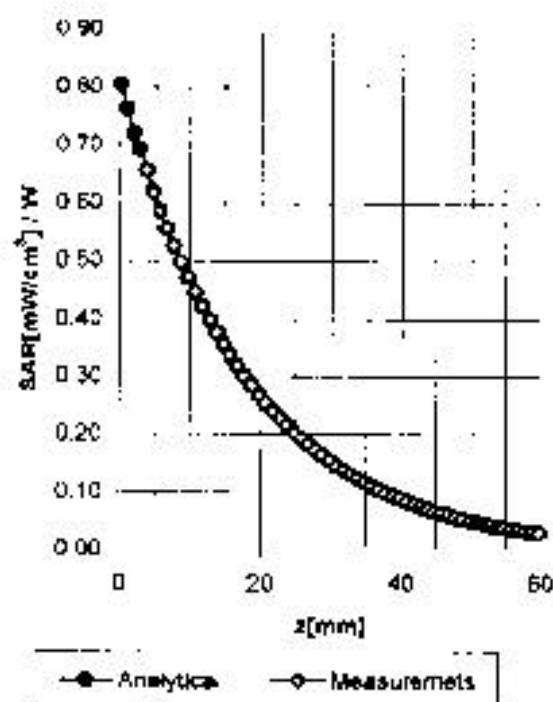


Dynamic Range f(SAR_{brain}) (Waveguide R22)

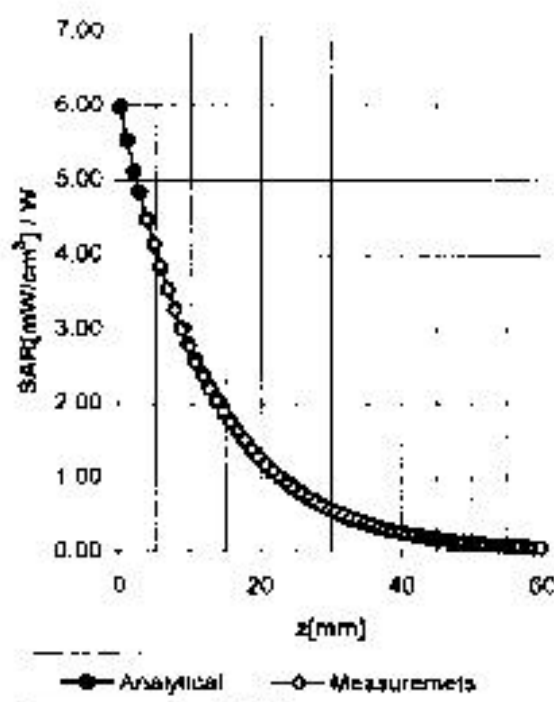


Conversion Factor Assessment

f = 900 MHz, WG R9 (head)



f = 1800 MHz, WG R22 (head)



Head 800 - 1000 MHz

$\epsilon_r = 39.0 - 43.5$

$\sigma = 0.80 - 1.10$ mho/m

ConvF X **6.31** $\pm 9.5\%$ (k=2)

Boundary effect

ConvF Y **6.31** $\pm 9.5\%$ (k=2)

Alpha **0.47**

ConvF Z **6.31** $\pm 9.5\%$ (k=2)

Depth **2.30**

Head 1700 - 1910 MHz

$\epsilon_r = 39.5 - 41.0$

$\sigma = 1.20 - 1.56$ mho/m

ConvF X **5.43** $\pm 9.5\%$ (k=2)

Boundary effect

ConvF Y **5.43** $\pm 9.5\%$ (k=2)

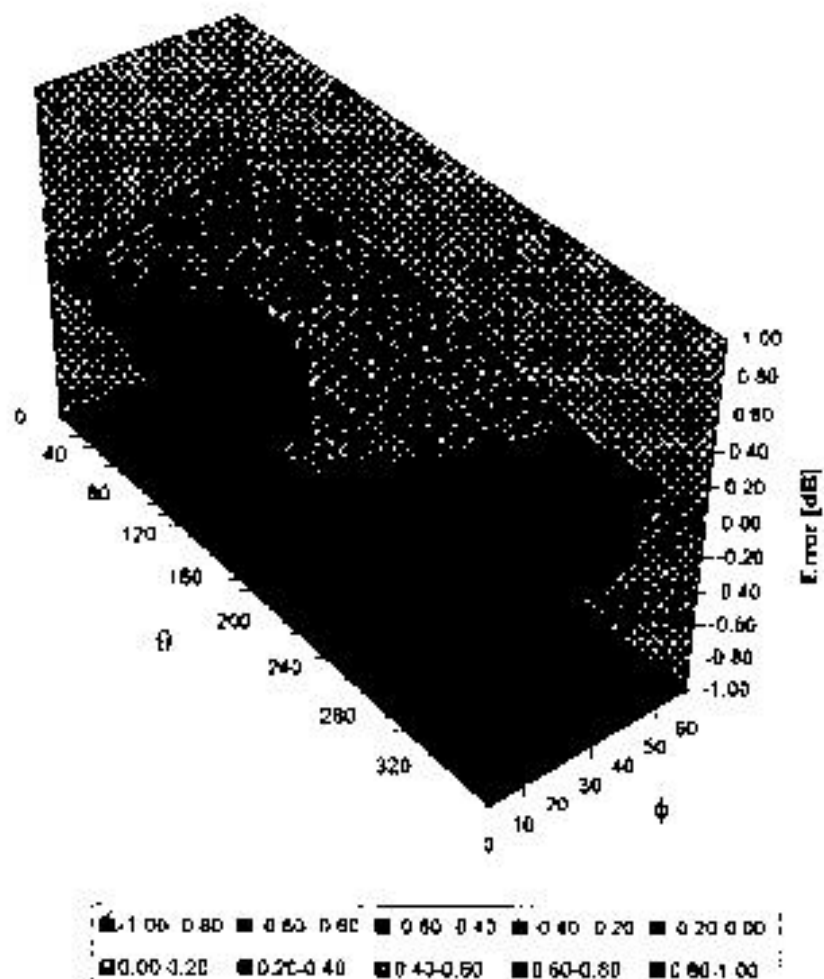
Alpha **0.63**

ConvF Z **5.43** $\pm 9.5\%$ (k=2)

Depth **2.13**

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Schmid & Partner Engineering AG

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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1391

Place of Assessment:

Zurich

Date of Assessment:

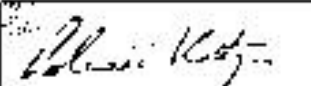
November 14, 2001

Probe Calibration Date:

October 25, 2001

Schmid & Partner Engineering AG hereby certifies that conversion factors of this probe have been evaluated on the date indicated above. The assessment was performed using the FIDU numerical code SFMCAD 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:1391

(Conversion factor ϵ = standard deviation)

835 MHz ConvF $6.4 \pm 8\%$

$$\epsilon_r = 41.5$$

$$\sigma = 0.90 \text{ mho/m}$$

(head tissue)

1950 MHz ConvF $5.2 \pm 8\%$

$$\epsilon_r = 40.0$$

$$\sigma = 1.40 \text{ mho/m}$$

(head tissue)

835 MHz ConvF $6.2 \pm 8\%$

$$\epsilon_r = 55.2$$

$$\sigma = 0.97 \text{ mho/m}$$

(body tissue)

900 MHz ConvF $6.1 \pm 8\%$

$$\epsilon_r = 55.0$$

$$\sigma = 1.05 \text{ mho/m}$$

(body tissue)

1800 MHz ConvF $5.0 \pm 8\%$

$$\epsilon_r = 53.3$$

$$\sigma = 1.52 \text{ mho/m}$$

(body tissue)

1950 MHz ConvF $4.7 \pm 8\%$

$$\epsilon_r = 53.3$$

$$\sigma = 1.52 \text{ mho/m}$$

(body tissue)

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1398

Place of Calibration:

Zurich

Date of Calibration:

August 31, 2001

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:

M. Eulack-Herrmann

Approved by:

Blasius Witzig

Probe ET3DV6

SN:1398

Manufactured:	October 24, 1999
Repaired:	August 24, 2001
Calibrated:	August 31, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1398**Sensitivity in Free Space**

NormX	1.62 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.57 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

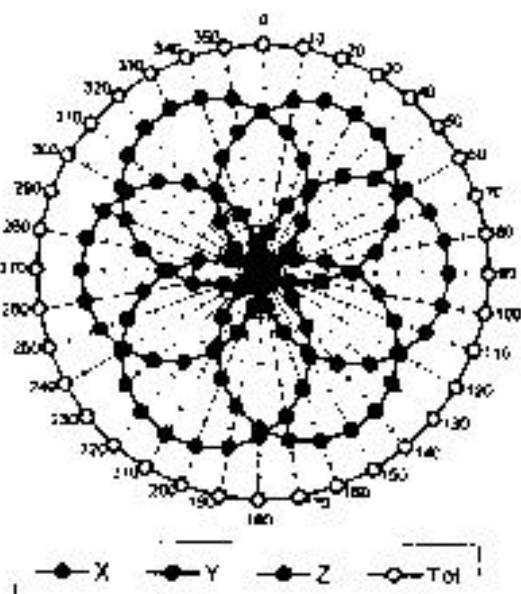
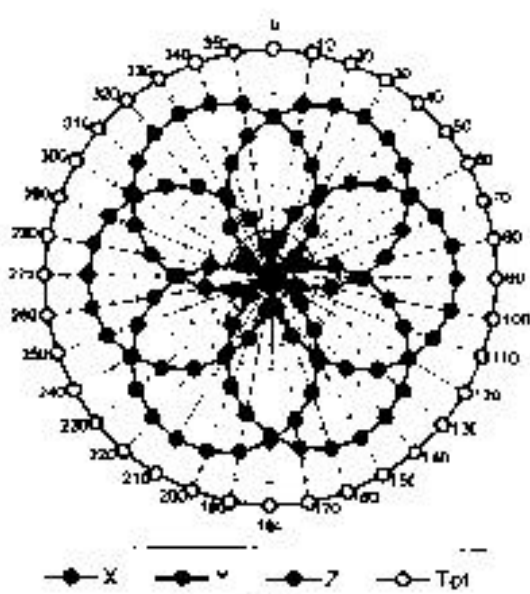
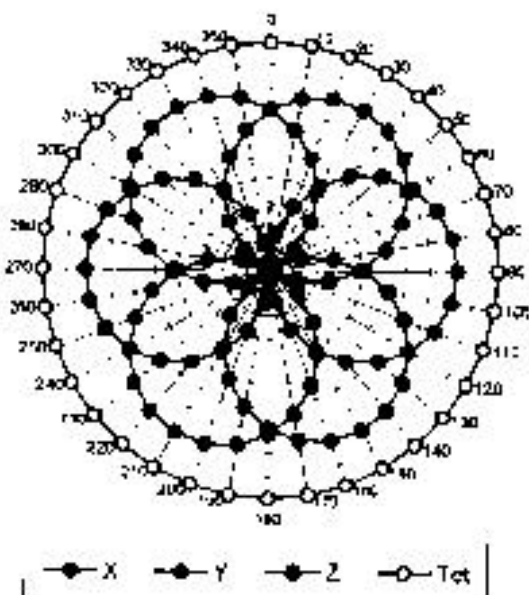
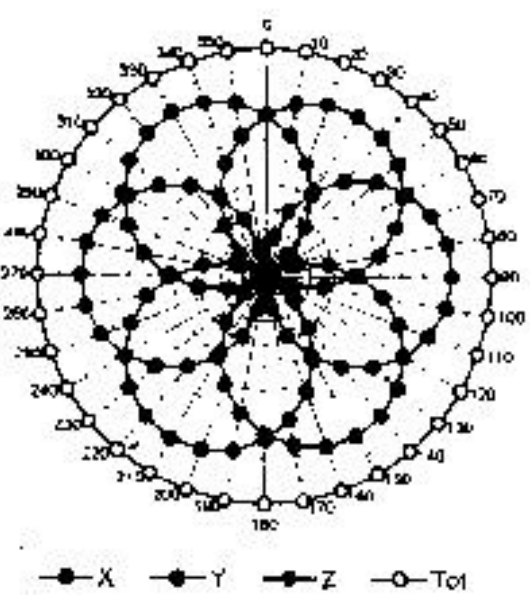
DCP X	97 mV
DCP Y	97 mV
DCP Z	97 mV

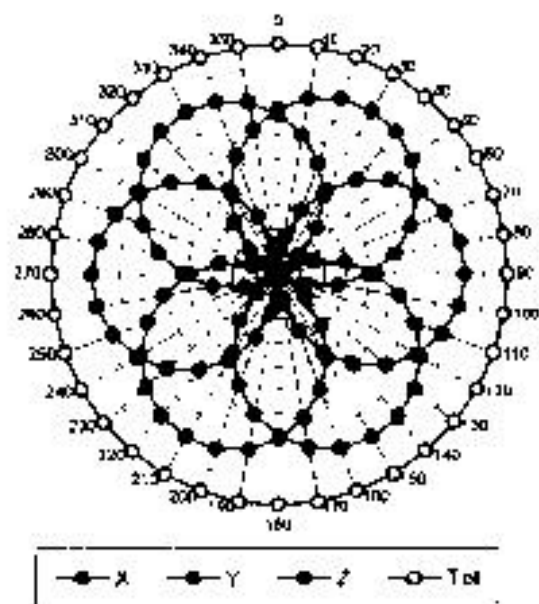
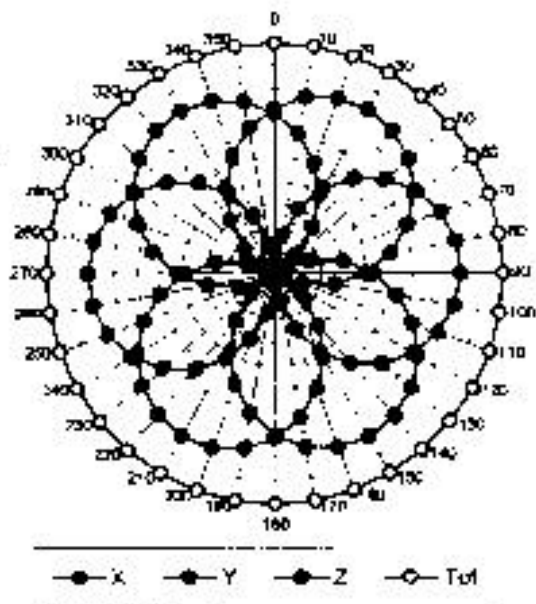
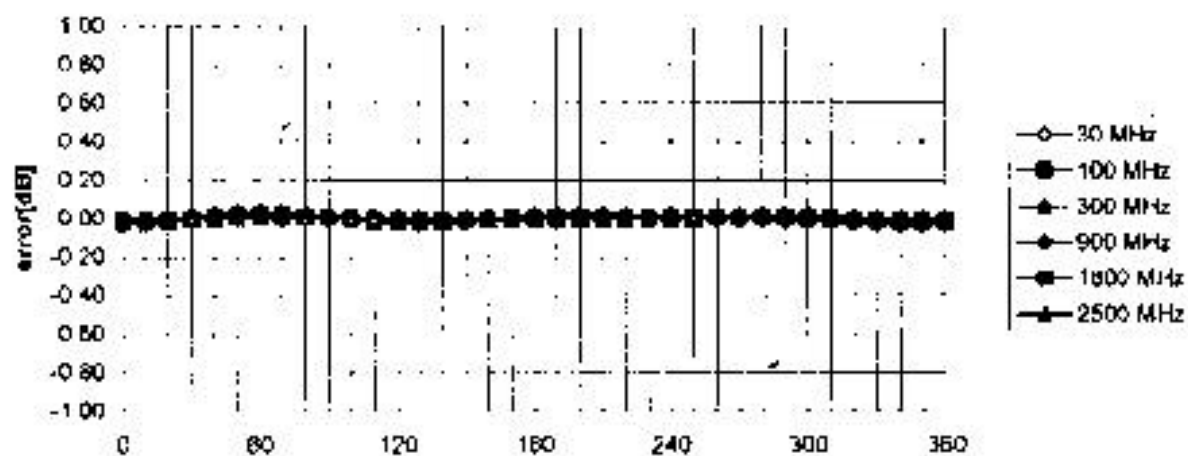
Sensitivity in Tissue Simulating Liquid

Head	450 MHz	$\epsilon_r = 43.6 \pm 5\%$	$\sigma = 0.87 \pm 10\%$ mho/m
ConvF X	6.95 extrapolated	Boundary effect	
ConvF Y	6.95 extrapolated	Alpha	0.45
ConvF Z	6.95 extrapolated	Depth	2.12
Head	900 MHz	$\epsilon_r = 42 \pm 5\%$	$\sigma = 0.97 \pm 10\%$ mho/m
ConvF X	6.43 $\pm 7\%$ (k=2)	Boundary effect	
ConvF Y	6.43 $\pm 7\%$ (k=2)	Alpha	0.49
ConvF Z	6.43 $\pm 7\%$ (k=2)	Depth	2.18
Head	1500 MHz	$\epsilon_r = 40.4 \pm 5\%$	$\sigma = 1.23 \pm 10\%$ mho/m
ConvF X	5.74 interpolated	Boundary effect	
ConvF Y	5.74 interpolated	Alpha	0.54
ConvF Z	5.74 interpolated	Depth	2.26
Head	1800 MHz	$\epsilon_r = 40 \pm 5\%$	$\sigma = 1.40 \pm 10\%$ mho/m
ConvF X	5.39 $\pm 7\%$ (k=2)	Boundary effect	
ConvF Y	5.39 $\pm 7\%$ (k=2)	Alpha	0.56
ConvF Z	5.39 $\pm 7\%$ (k=2)	Depth	2.30

Sensor Offset

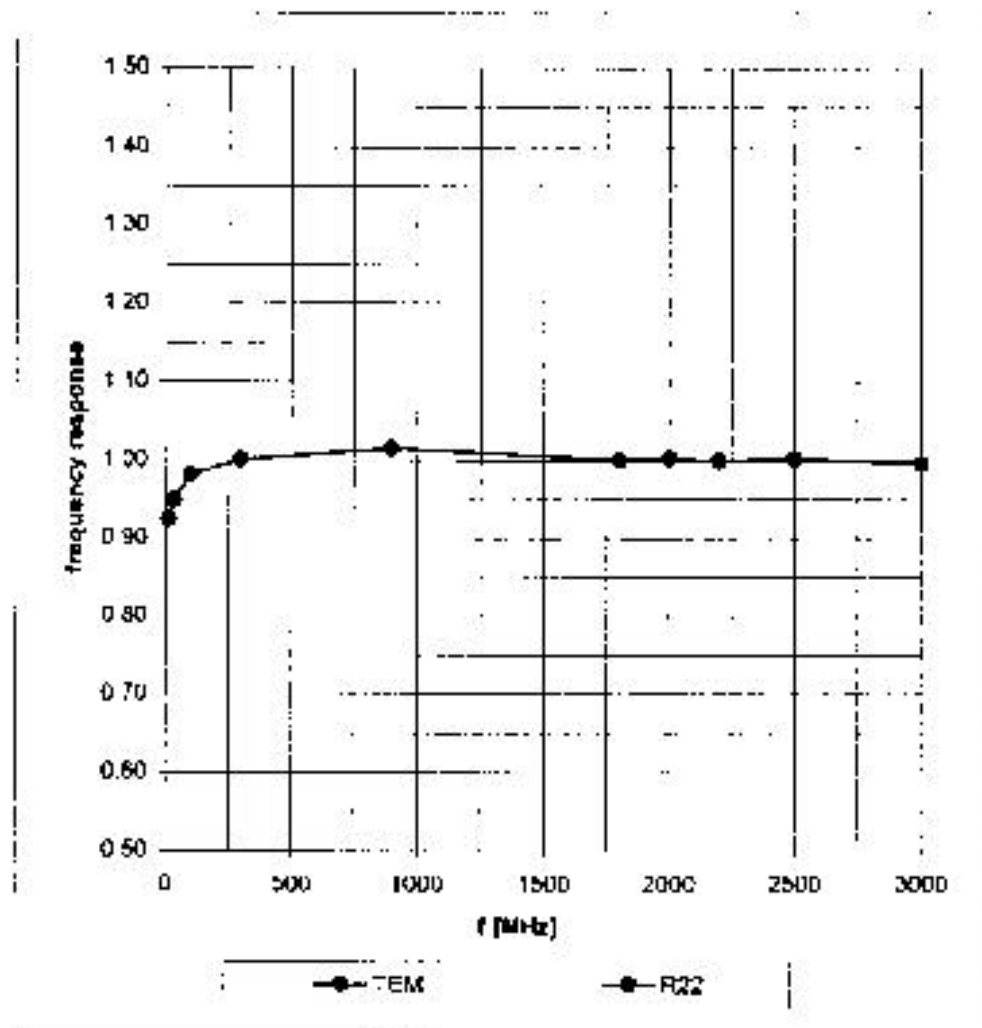
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.2 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30 \text{ MHz}$, TEM cell if110 $f = 100 \text{ MHz}$, TEM cell if110 $f = 300 \text{ MHz}$, TEM cell if110 $f = 900 \text{ MHz}$, TEM cell if110

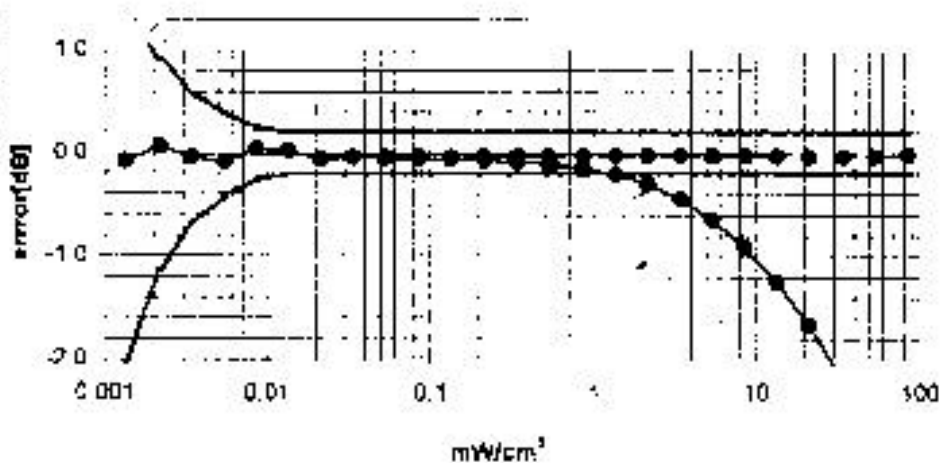
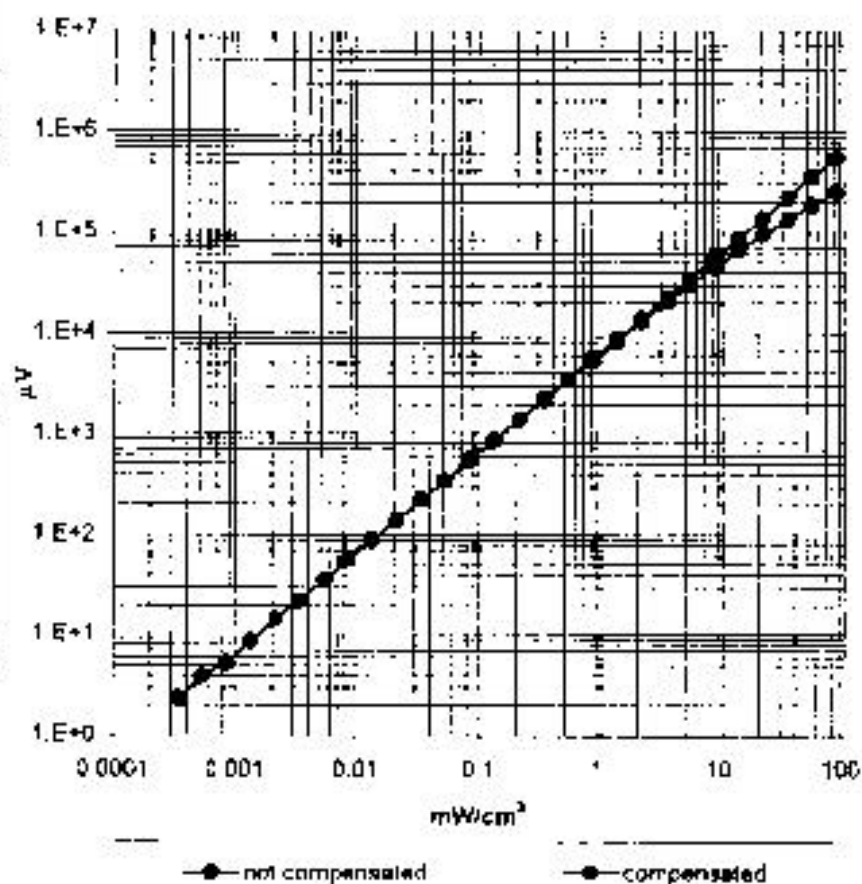
$f = 1800 \text{ MHz}$, WG R22 $f = 2500 \text{ MHz}$, WG R22Isotropy Error (ϕ), $\theta = 0^\circ$ 

Frequency Response of E-Field

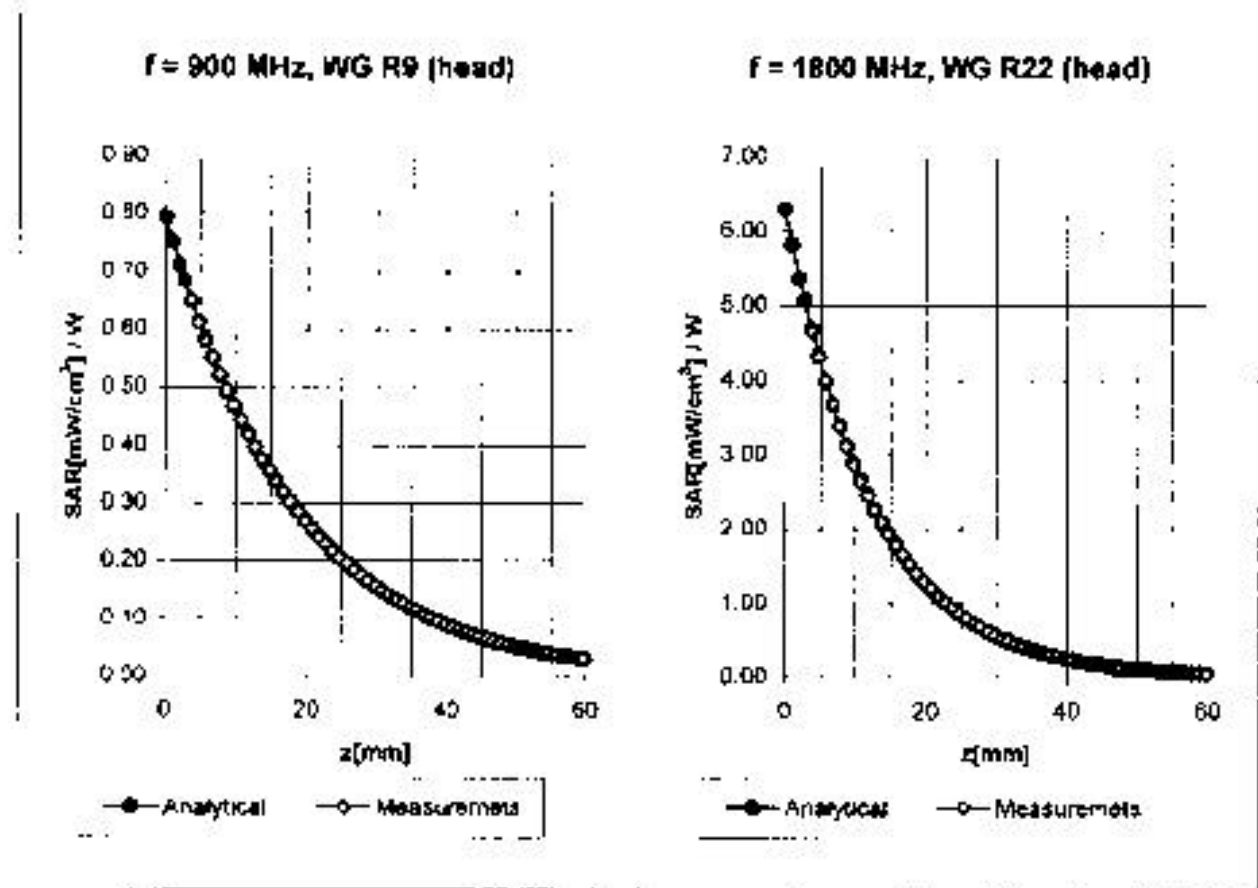
(TEM-Cell:ifi110, Waveguide R22)



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



Conversion Factor Assessment



Head	900 MHz	$\epsilon_1 = 42 \pm 5\%$	$\sigma = 0.97 \pm 10\% \text{ mho/m}$
ConvF X	6.43 $\pm 7\%$ (k=2)	Boundary effect: Alpha 0.49 Depth 2.18	
ConvF Y	6.43 $\pm 7\%$ (k=2)		
ConvF Z	6.43 $\pm 7\%$ (k=2)		
Head	1800 MHz	$\epsilon_1 = 40 \pm 5\%$	$\sigma = 1.40 \pm 10\% \text{ mho/m}$
ConvF X	5.39 $\pm 7\%$ (k=2)	Boundary effect: Alpha 0.56 Depth 2.30	
ConvF Y	5.39 $\pm 7\%$ (k=2)		
ConvF Z	5.39 $\pm 7\%$ (k=2)		

Additional Conversion Factors

for Dosimetric E-Field Probe

Type

ET3DV6

Serial Number:

1398

Place of Assessment:

Zurich

Date of Assessment:

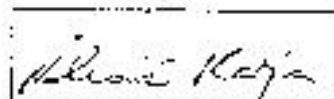
September 7, 2001

Probe Calibration Date:

August 31, 2001

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 SIMCAD 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:1398

(Conversion factor (+ standard deviation))

835 MHz Conv.F $6.5 \pm 8\%$

$\epsilon_r = 41.5$
 $\sigma = 0.90 \text{ mho/m}$
 (head tissue)

835 MHz Conv.F $6.3 \pm 8\%$

$\epsilon_r = 55.2$
 $\sigma = 0.97 \text{ mho/m}$
 (body tissue)

900 MHz Conv.F $6.2 \pm 8\%$

$\epsilon_r = 55.0$
 $\sigma = 1.05 \text{ mho/m}$
 (body tissue)

1950 MHz Conv.F $5.1 \pm 8\%$

$\epsilon_r = 40.0$
 $\sigma = 1.40 \text{ mho/m}$
 (head tissue)

1800 MHz Conv.F $5.0 \pm 8\%$

$\epsilon_r = 53.3$
 $\sigma = 1.52 \text{ mho/m}$
 (body tissue)

1950 MHz Conv.F $4.7 \pm 8\%$

$\epsilon_r = 53.3$
 $\sigma = 1.52 \text{ mho/m}$
 (body tissue)

Dosimetric E-Field Probe ET3DV6 SN:1398

Conversion factor (± standard deviation)

835 MHz	ConvF	6.5 ± 8%	$\epsilon_r = 44.0$ $\sigma = 0.90 \text{ mho/m}$ (brain tissue)
835 MHz	ConvF	6.4 ± 8%	$\epsilon_r = 52.0$ $\sigma = 1.10 \text{ mho/m}$ (muscle tissue)
900 MHz	ConvF	6.4 ± 8%	$\epsilon_r = 42.5$ $\sigma = 0.86 \text{ mho/m}$ (brain tissue)
925 MHz	ConvF	6.3 ± 8%	$\epsilon_r = 44.0$ $\sigma = 0.93 \text{ mho/m}$ (brain tissue)
925 MHz	ConvF	6.3 ± 8%	$\epsilon_r = 52.0$ $\sigma = 1.20 \text{ mho/m}$ (muscle tissue)
1800 MHz	ConvF	5.4 ± 8%	$\epsilon_r = 40.3$ $\sigma = 1.35 \text{ mho/m}$ (brain tissue)
1800 MHz	ConvF	5.5 ± 8%	$\epsilon_r = 41.0$ $\sigma = 1.69 \text{ mho/m}$ (brain tissue)
1900 MHz	ConvF	5.2 ± 8%	$\epsilon_r = 39.9$ $\sigma = 1.42 \text{ mho/m}$ (brain tissue)
1800 MHz	ConvF	5.1 ± 8%	$\epsilon_r = 50.0$ $\sigma = 1.58 \text{ mho/m}$ (muscle tissue)
1900 MHz	ConvF	5.0 ± 8%	$\epsilon_r = 50.0$ $\sigma = 1.64 \text{ mho/m}$ (muscle tissue)