

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:

1503

Place of Calibration:

Zurich

Date of Calibration:

November 16, 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:

Nikolaus Meriana

Approved by:

Heinrich Käfer

Probe ET3DV6

SN:1503

Manufactured:	October 24, 1999
Remade:	November 2, 2001
Calibrated:	November 16, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1503

Sensitivity in Free Space

NormX	2.25 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	2.10 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.95 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** $\epsilon_r = 40.4 \pm 5\%$ $s = 0.87 \pm 5\% \text{ mho/m}$

ConvF X	6.92 extrapolated	Boundary effect:	
ConvF Y	6.92 extrapolated	Alpha	0.31
ConvF Z	6.92 extrapolated	Depth	2.46

Head **900 MHz** $\epsilon_r = 41.5 \pm 5\%$ $s = 0.97 \pm 5\% \text{ mho/m}$

Head **835 MHz** $\epsilon_r = 41.5 \pm 5\%$ $s = 0.90 \pm 5\% \text{ mho/m}$

ConvF X	6.36 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.36 $\pm 9.5\%$ (k=2)	Alpha	0.39
ConvF Z	6.36 $\pm 9.5\%$ (k=2)	Depth	2.42

Head **1500 MHz** $\epsilon_r = 40.4 \pm 5\%$ $s = 1.23 \pm 5\% \text{ mho/m}$

ConvF X	5.61 interpolated	Boundary effect:	
ConvF Y	5.61 interpolated	Alpha	0.49
ConvF Z	5.61 interpolated	Depth	2.36

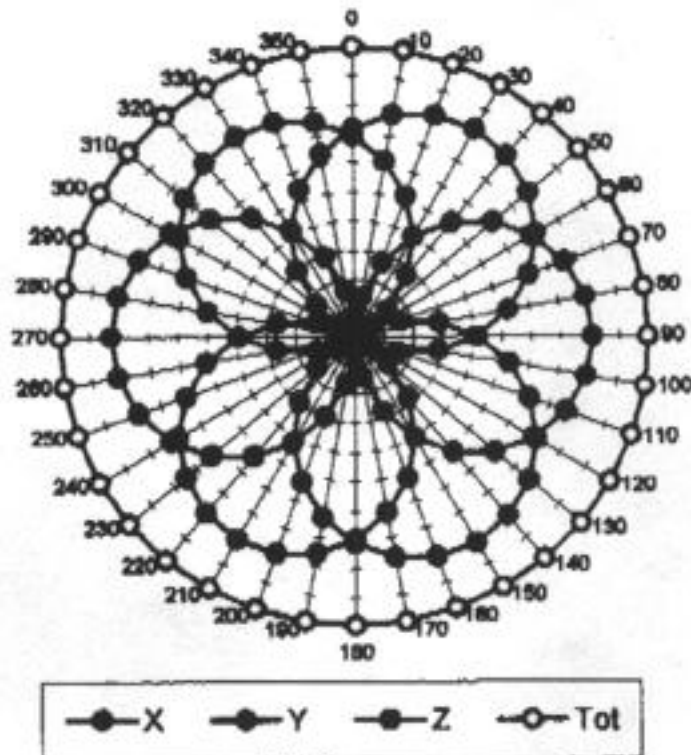
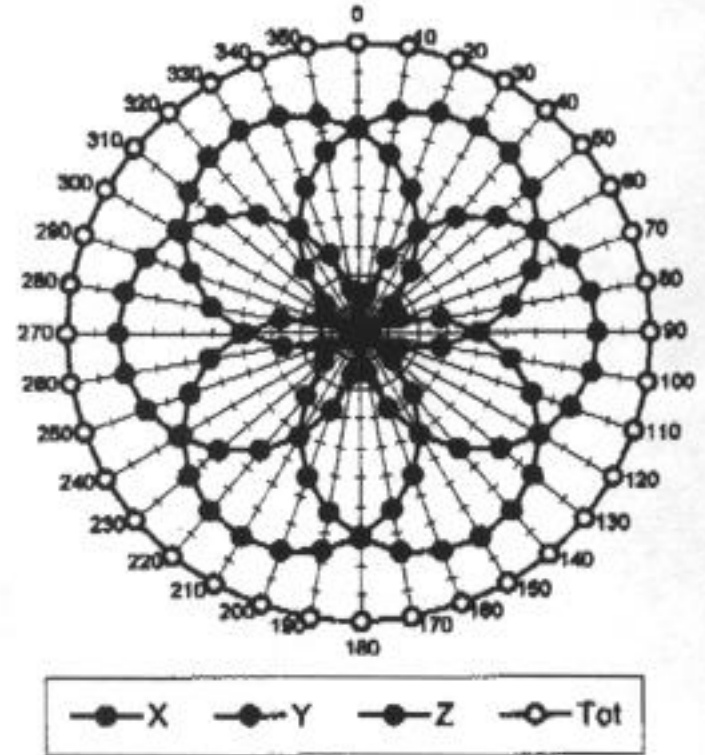
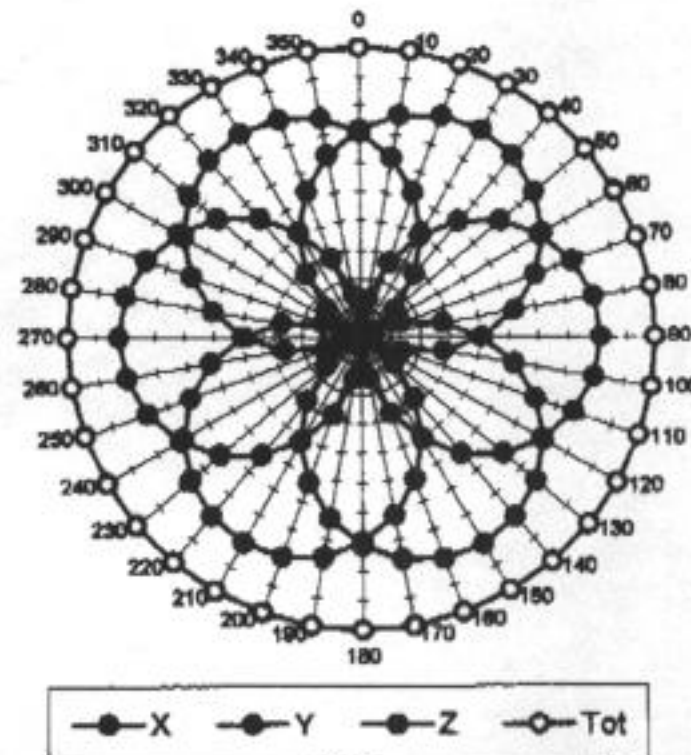
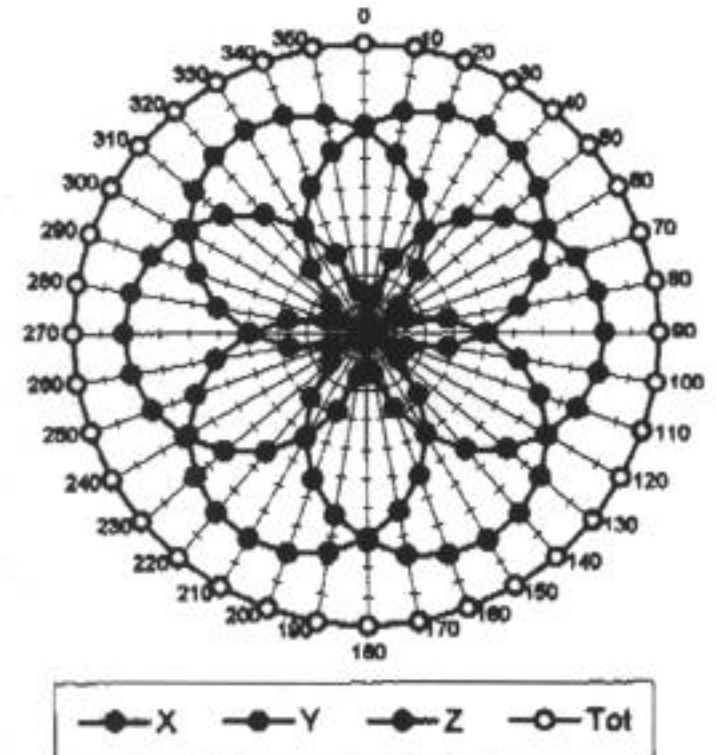
Head **1800 MHz** $\epsilon_r = 40.0 \pm 5\%$ $s = 1.40 \pm 5\% \text{ mho/m}$

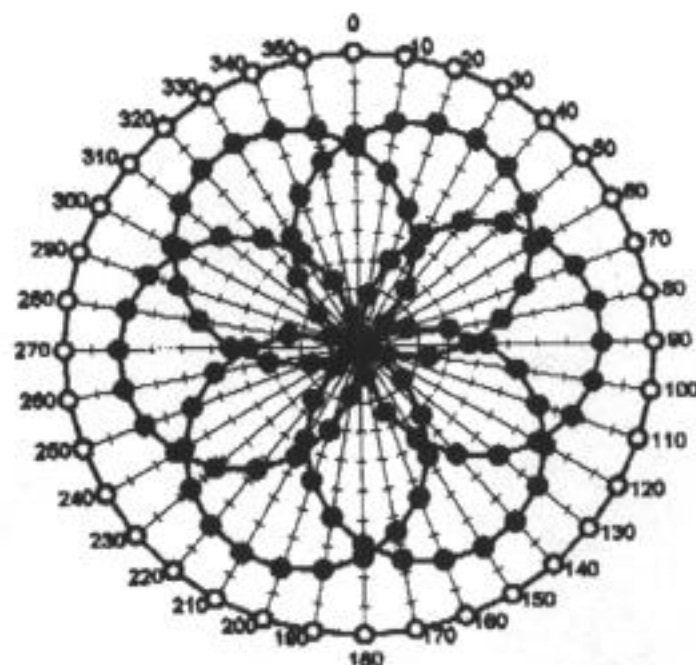
Head **1900 MHz** $\epsilon_r = 40.0 \pm 5\%$ $s = 1.40 \pm 5\% \text{ mho/m}$

ConvF X	5.24 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.24 $\pm 9.5\%$ (k=2)	Alpha	0.54
ConvF Z	5.24 $\pm 9.5\%$ (k=2)	Depth	2.33

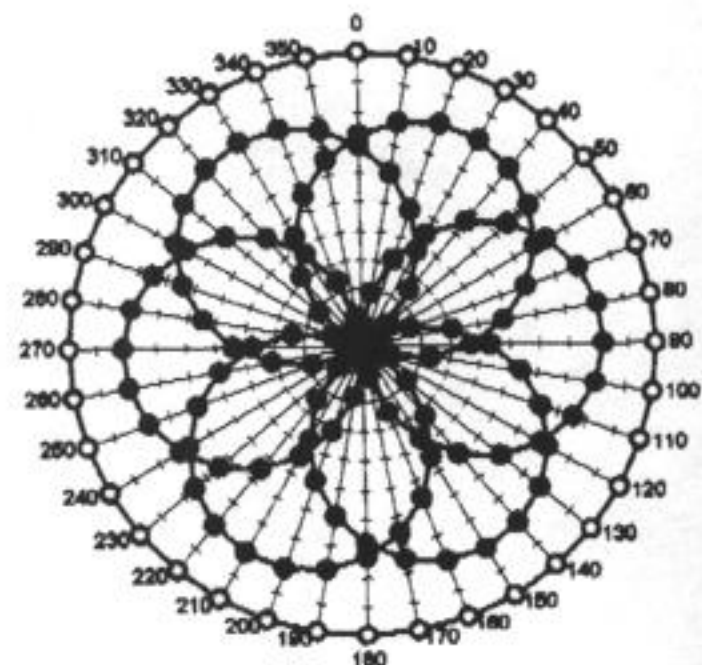
Sensor Offset

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

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30$ MHz, TEM cell I#110 $f = 100$ MHz, TEM cell I#110 $f = 300$ MHz, TEM cell I#110 $f = 900$ MHz, TEM cell I#110

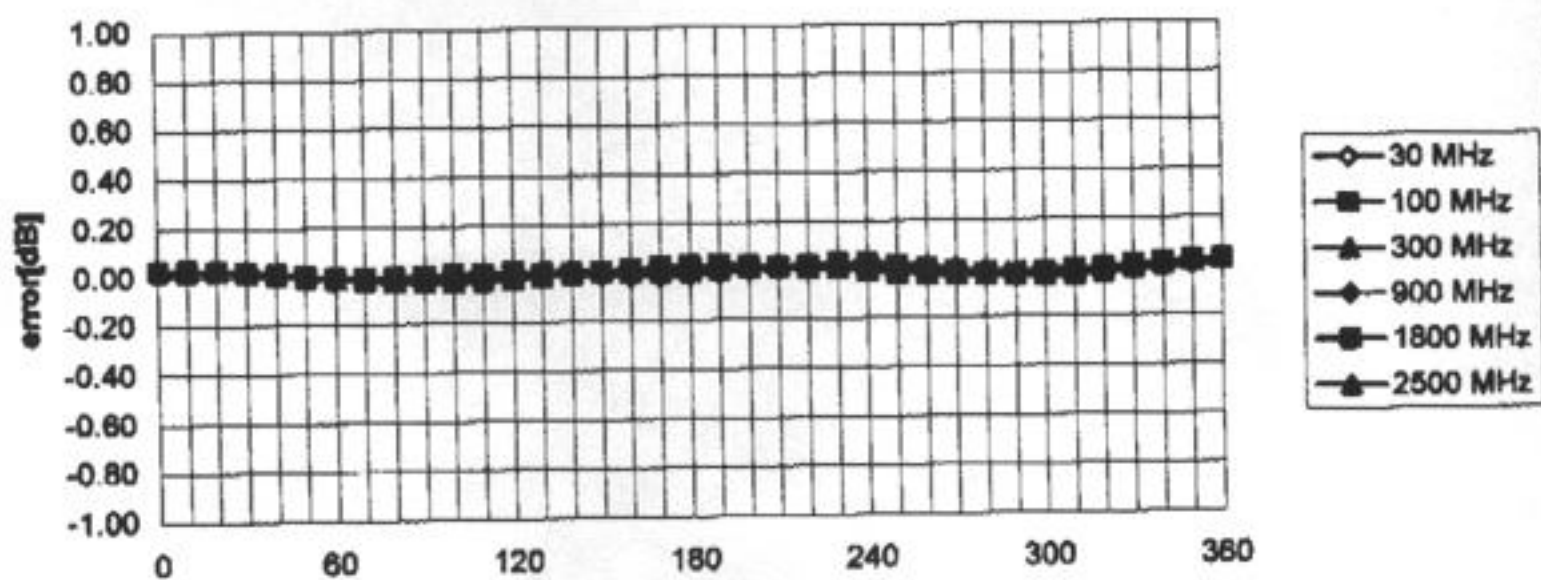
$f = 1800 \text{ MHz, WG R22}$ 

—●— X —●— Y —●— Z —○— Tot

 $f = 2500 \text{ MHz, WG R22}$ 

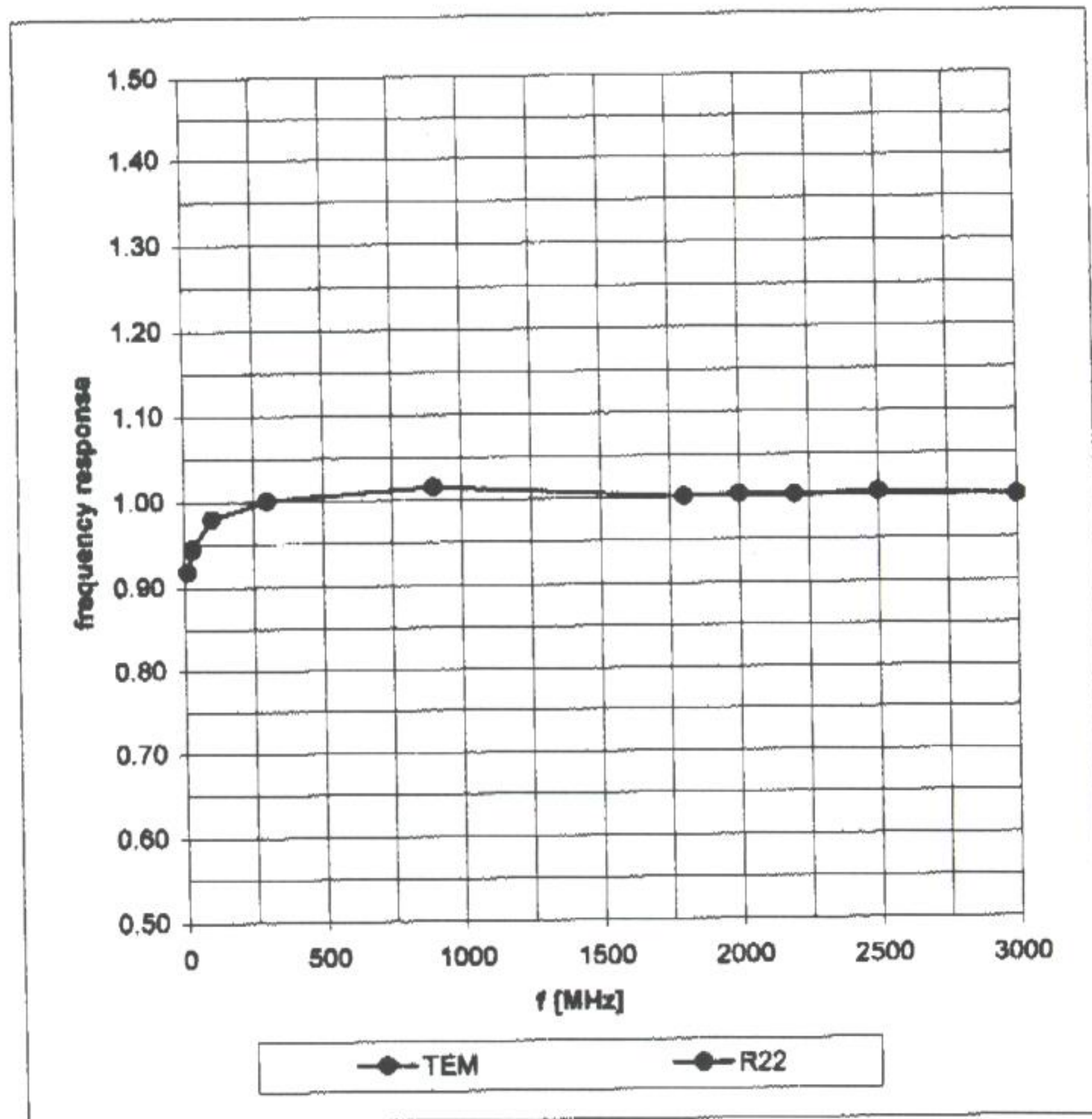
—●— X —●— Y —●— Z —○— Tot

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

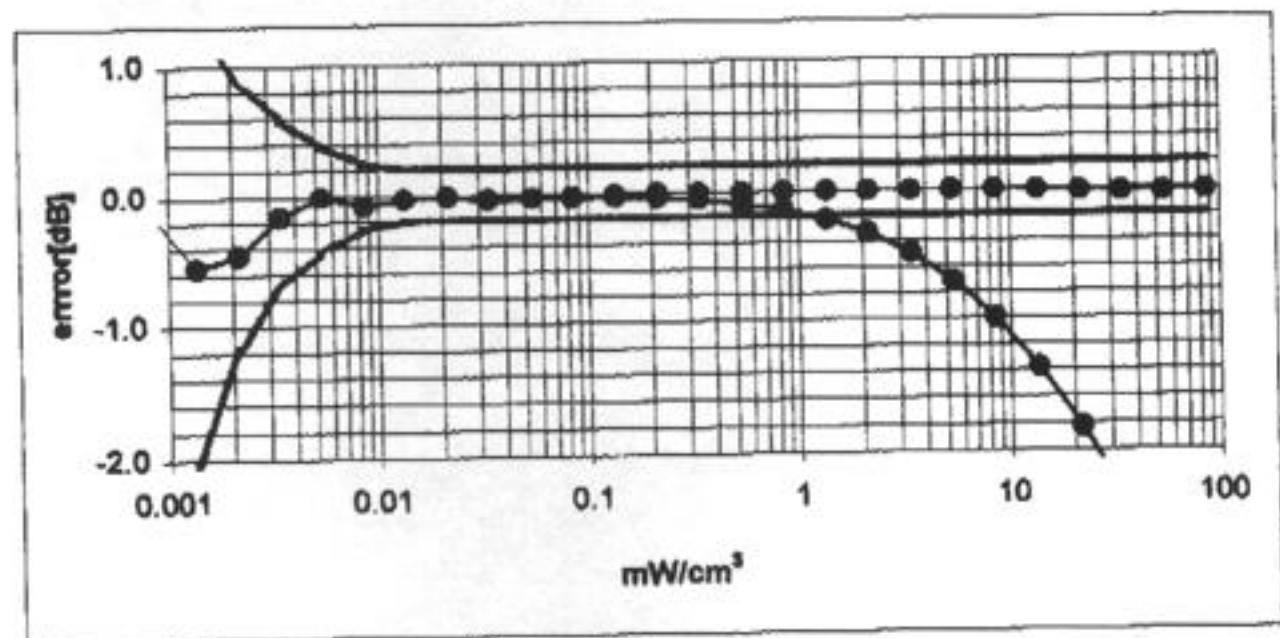
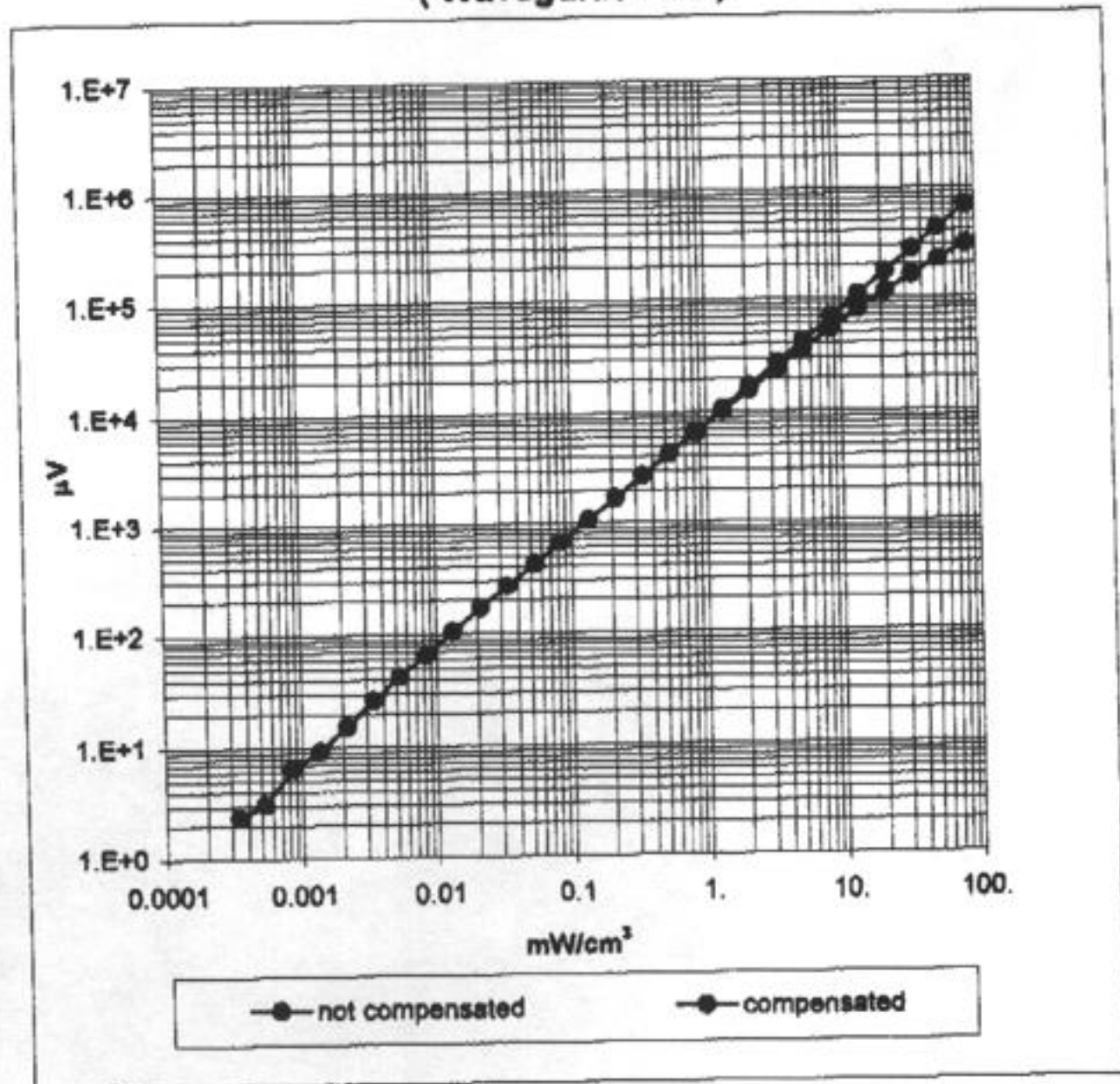


Frequency Response of E-Field

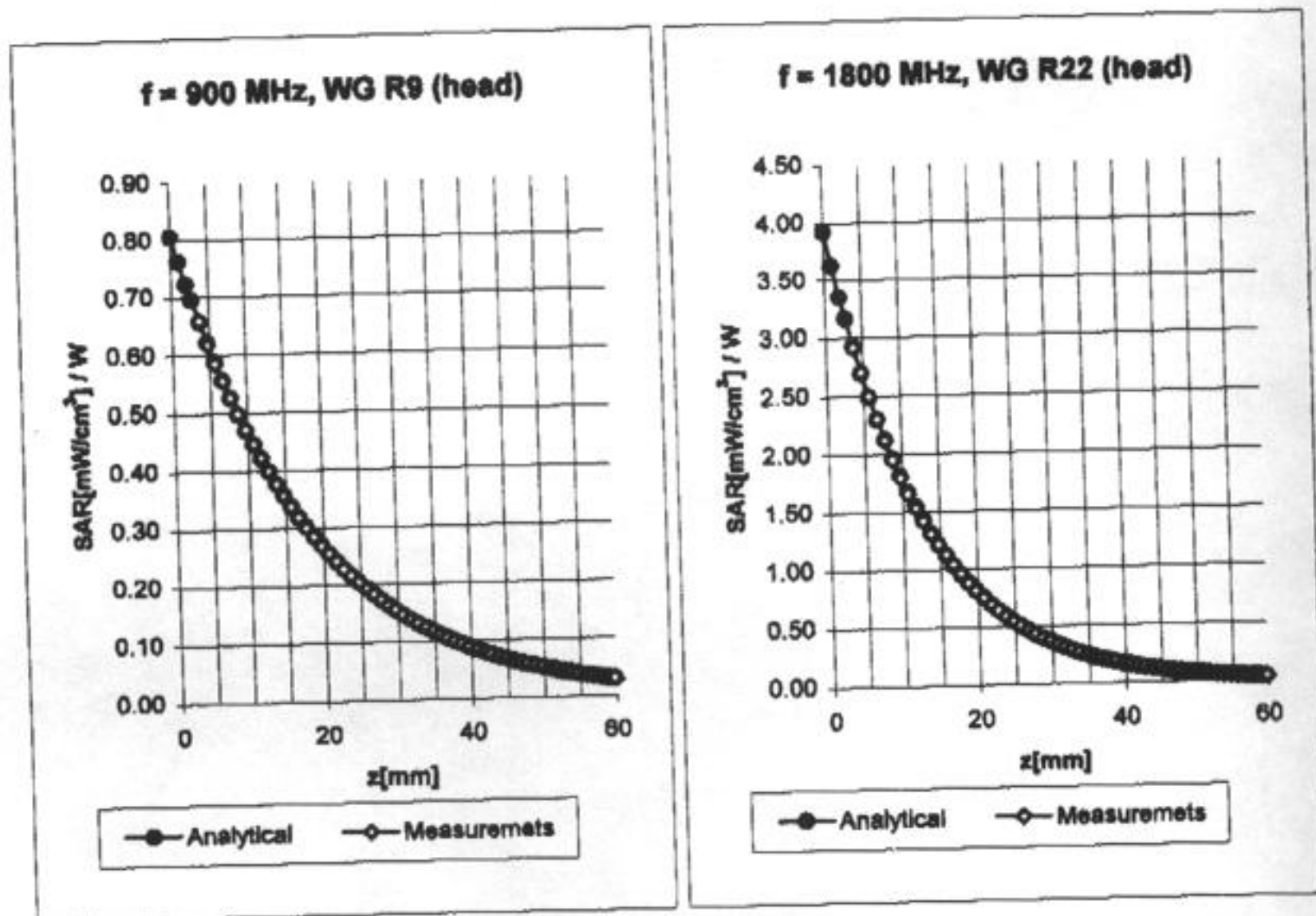
(TEM-Cell:ifl110, Waveguide R22)



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



Conversion Factor Assessment



Head 800 - 1000 MHz

 $\epsilon_r = 39.0 - 43.5$ $\sigma = 0.80 - 1.10 \text{ mho/m}$ ConvF X **6.36** $\pm 9.5\%$ (k=2)ConvF Y **6.36** $\pm 9.5\%$ (k=2)ConvF Z **6.36** $\pm 9.5\%$ (k=2)

Boundary effect:

Alpha **0.39**Depth **2.42**

Head 1700 - 1910 MHz

 $\epsilon_r = 39.5 - 41.0$ $\sigma = 1.20 - 1.55 \text{ mho/m}$ ConvF X **5.24** $\pm 9.5\%$ (k=2)ConvF Y **5.24** $\pm 9.5\%$ (k=2)ConvF Z **5.24** $\pm 9.5\%$ (k=2)

Boundary effect:

Alpha **0.54**Depth **2.33**

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1503

Place of Assessment:

Zurich

Date of Assessment:

November 22, 2001

Probe Calibration Date:

November 16, 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 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:

Oliver Kofler

Dosimetric E-Field Probe ET3DV6 SN:1503

Conversion factor ($\pm$ standard deviation)

835 MHz ConvF $6.5 \pm 8\%$

$$\epsilon_r = 41.5$$

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

(head tissue)

1950 MHz ConvF $5.0 \pm 8\%$

$$\epsilon_r = 40.0$$

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

(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 $4.9 \pm 8\%$

$$\epsilon_r = 53.3$$

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

(body tissue)

1950 MHz ConvF $4.7 \pm 8\%$

$$\epsilon_r = 53.3$$

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

(body tissue)

gaeps94

Spring 94

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:

ET3DV6R

Serial Number:

1513

Place of Calibration:

Zurich

Date of Calibration:

May 8, 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:

D. Vetter

Approved by:

Heinrich Vetter

Probe ET3DV6R

SN:1513

Manufactured:	November 24, 1999
Last calibration:	February 20, 2001
Remake ET3DV6R:	May 3, 2002
Recalibrated:	May 8, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6R SN:1513**Sensitivity in Free Space****Diode Compression**

NormX	1.96 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	2.02 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	2.02 $\mu\text{V}/(\text{V}/\text{m})^2$

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

Sensitivity in Tissue Simulating Liquid

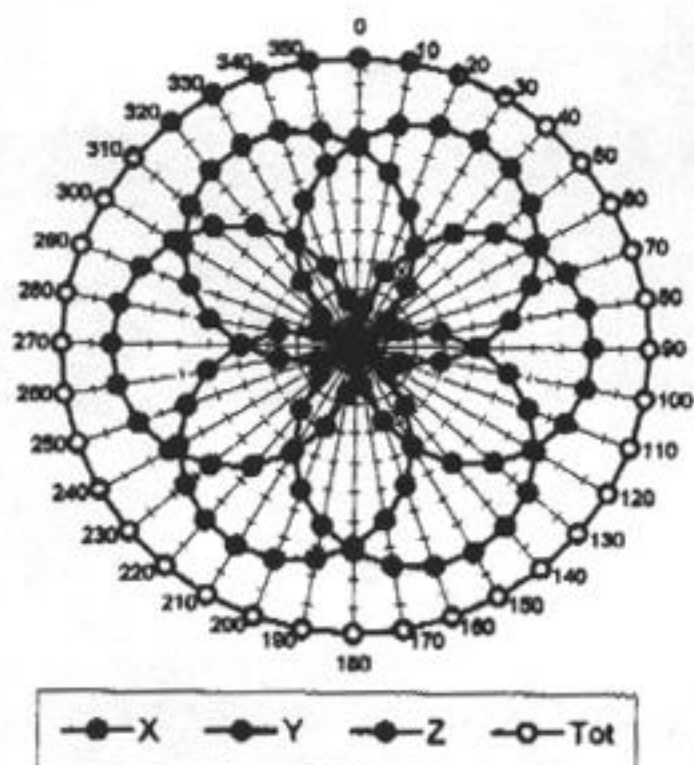
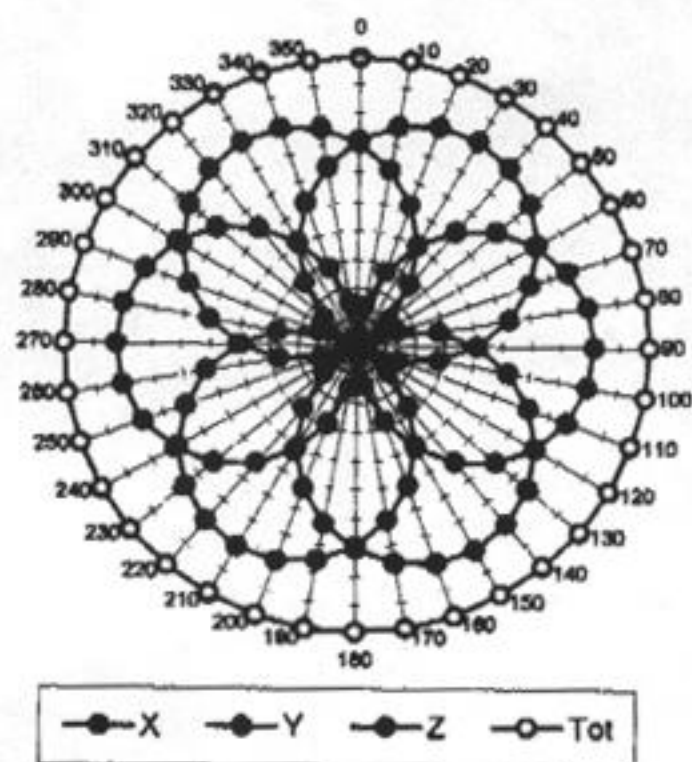
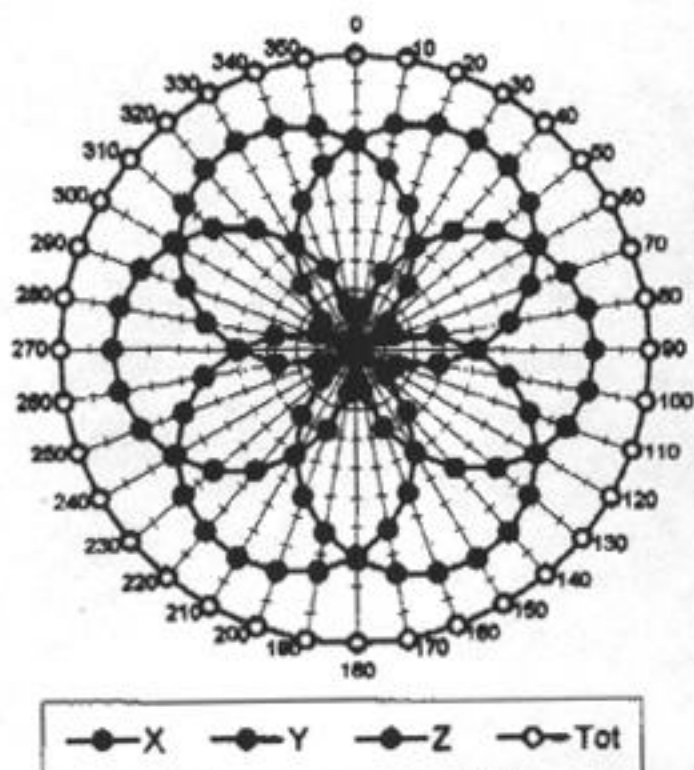
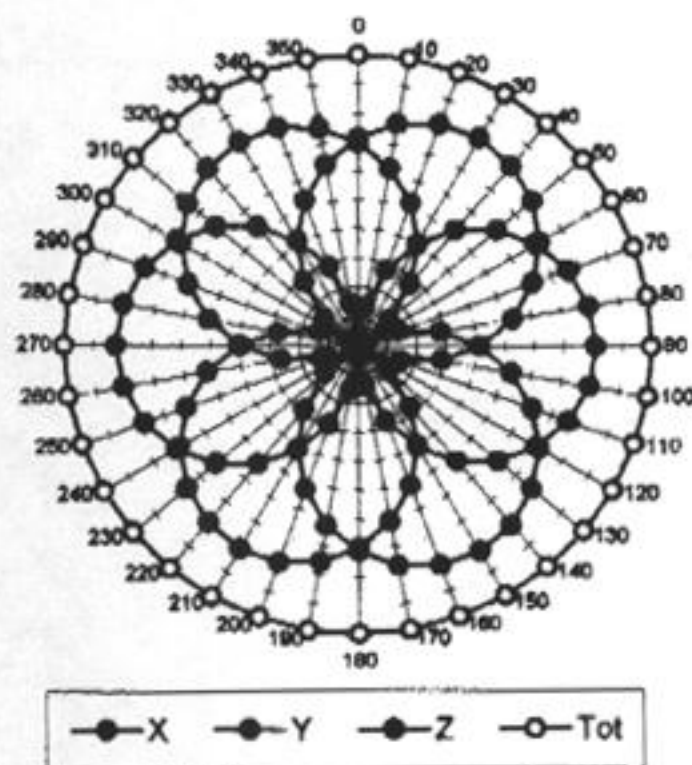
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha	0.81
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth	1.64
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha	0.61
ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth	2.13

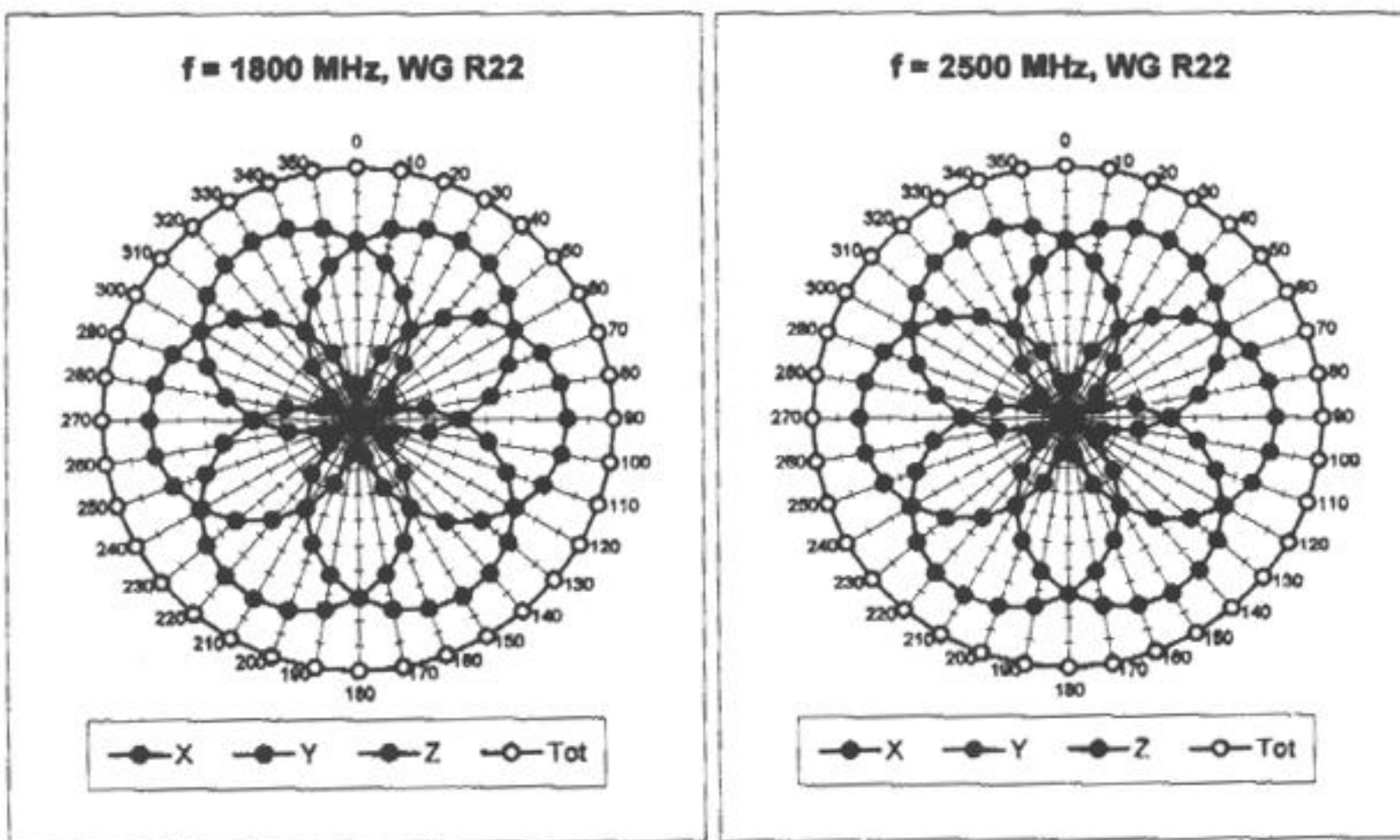
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	9.3	4.6
SAR _{be} [%]	With Correction Algorithm	0.0	0.1
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	11.8	7.3
SAR _{be} [%]	With Correction Algorithm	0.2	0.1

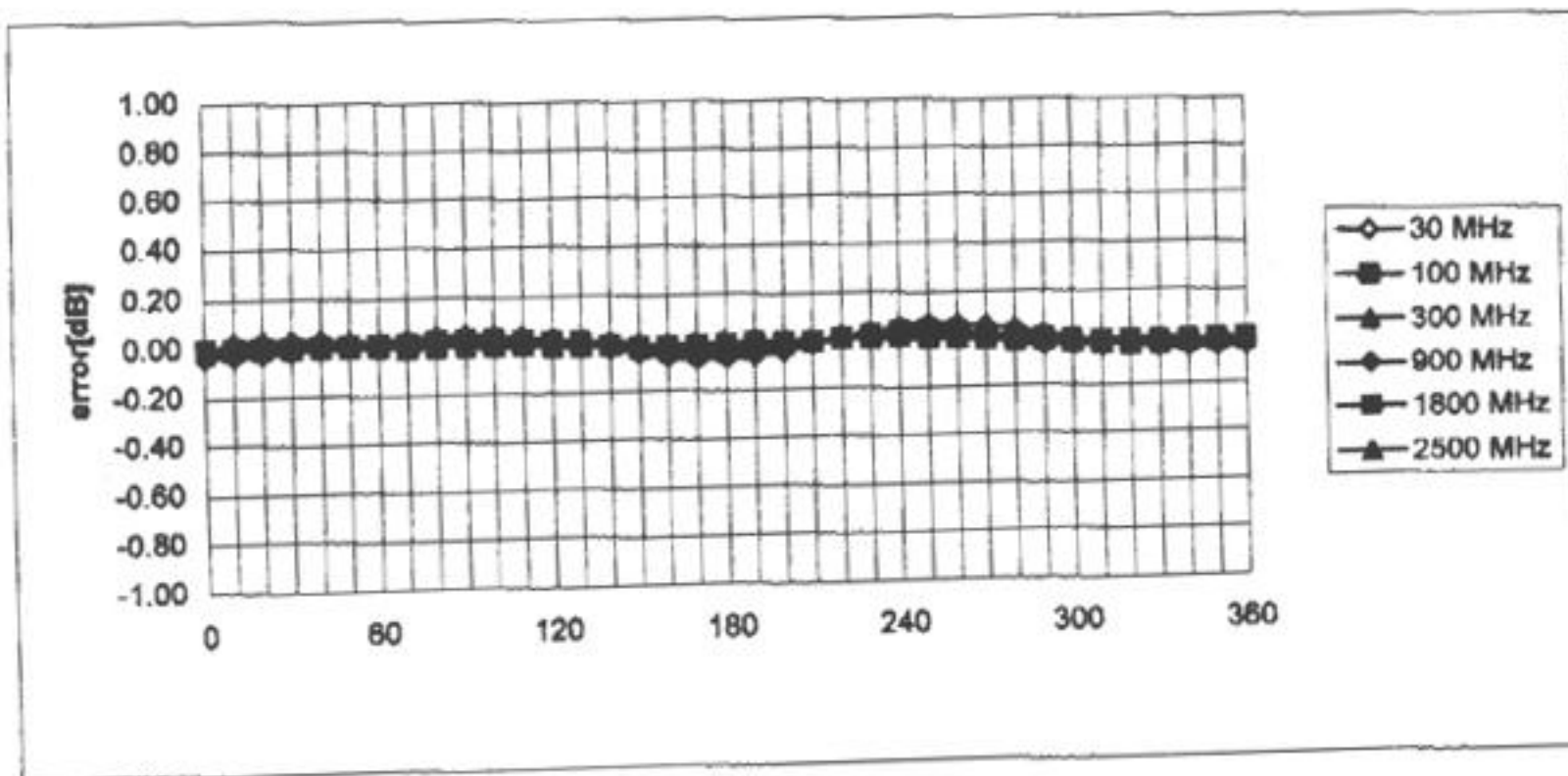
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
----------------------------	------------	----

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30$ MHz, TEM cell IIR110 $f = 100$ MHz, TEM cell IIR110 $f = 300$ MHz, TEM cell IIR110 $f = 900$ MHz, TEM cell IIR110

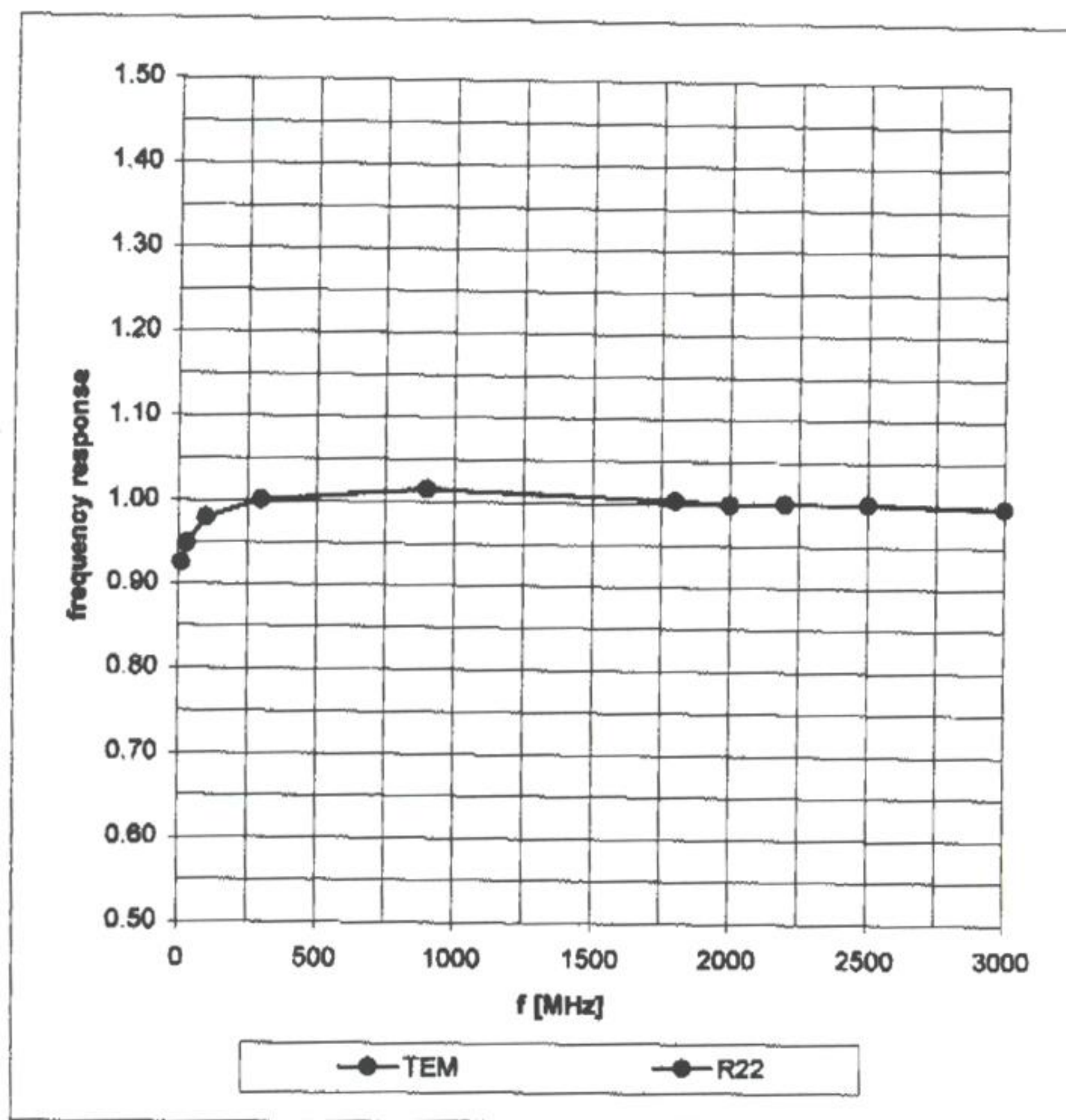


Isotropy Error (ϕ), $\theta = 0^\circ$

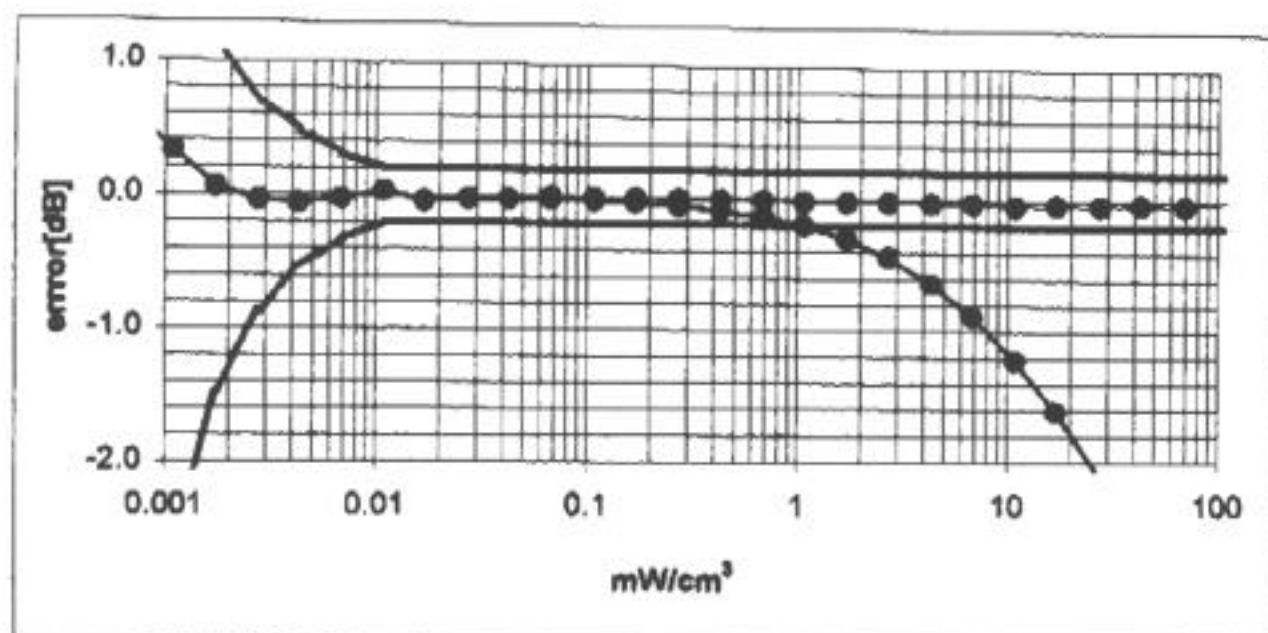
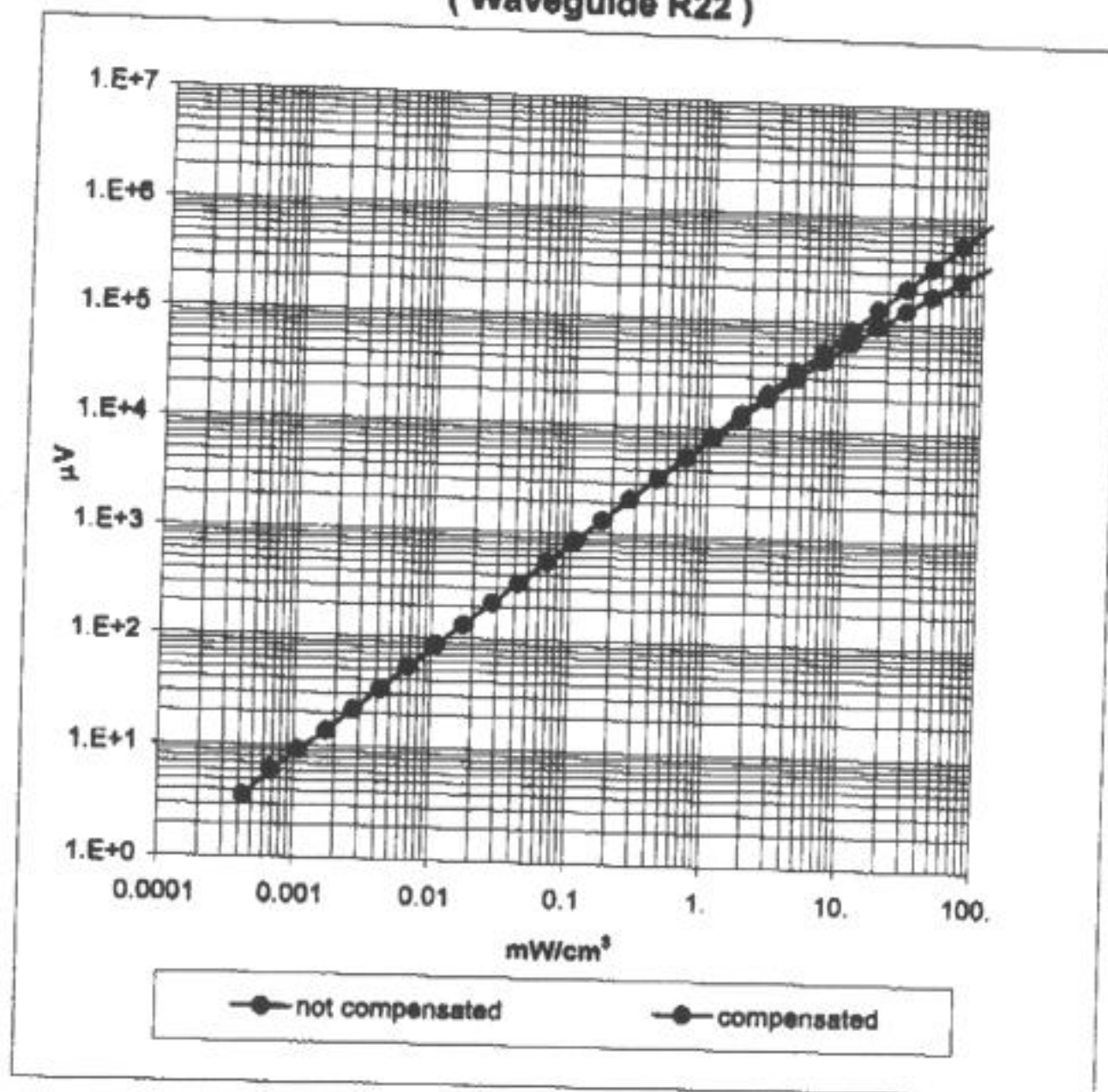


Frequency Response of E-Field

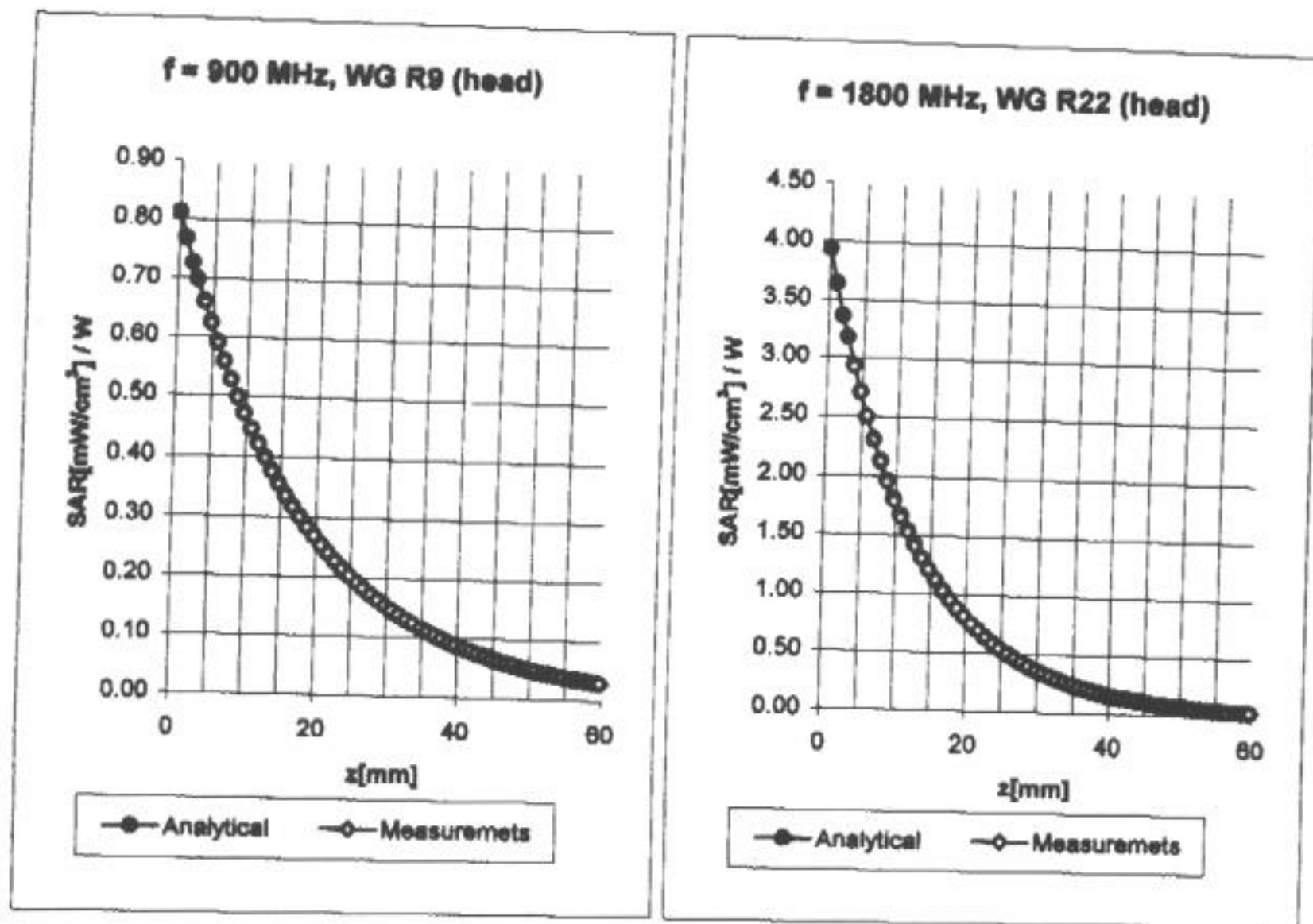
(TEM-Cell:ifl110, Waveguide R22)



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



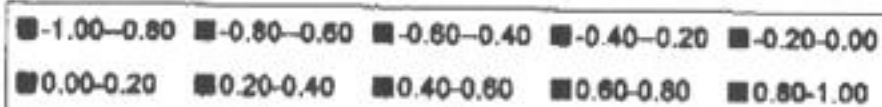
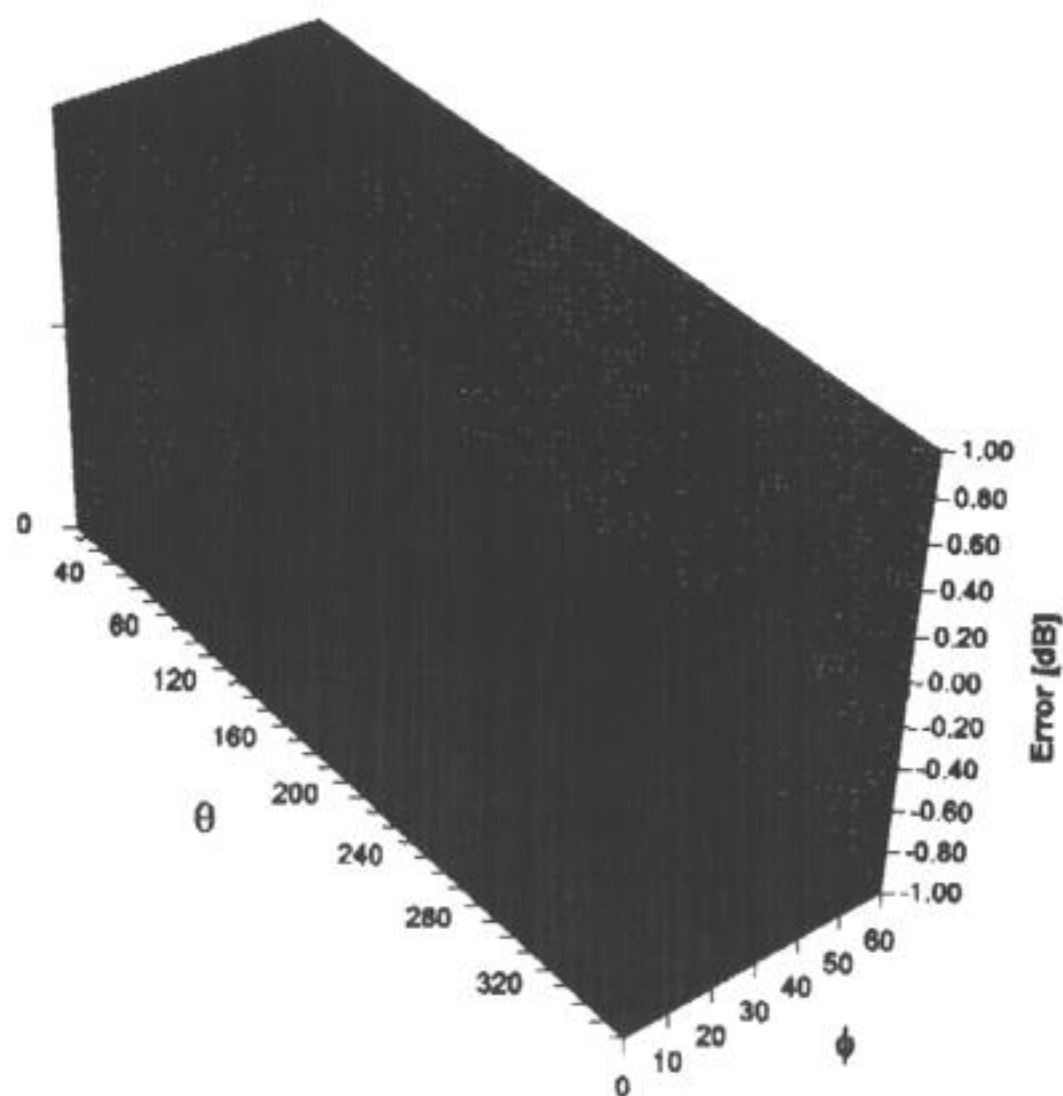
Conversion Factor Assessment



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	6.1 $\pm$ 9.5% (k=2)	Boundary effect:
	ConvF Y	6.1 $\pm$ 9.5% (k=2)	Alpha 0.81
	ConvF Z	6.1 $\pm$ 9.5% (k=2)	Depth 1.64
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	5.0 $\pm$ 9.5% (k=2)	Boundary effect:
	ConvF Y	5.0 $\pm$ 9.5% (k=2)	Alpha 0.61
	ConvF Z	5.0 $\pm$ 9.5% (k=2)	Depth 2.13

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors
for Dosimetric E-Field Probe

Type:

ET3DV6R

Serial Number:

1513

Place of Assessment:

Zurich

Date of Assessment:

May 8, 2002

Probe Calibration Date:

May 8, 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:

Heinrich Kutz

Dosimetric E-Field Probe ET3DV6R SN:1513

Conversion factor ($\pm$ standard deviation)

835 MHz ConvF $6.2 \pm 8\%$

$\epsilon_r = 41.5 \pm 5\%$
 $\sigma = 0.90 \pm 5\% \text{ mho/m}$
(head tissue)

1950 MHz ConvF $4.8 \pm 8\%$

$\epsilon_r = 40.0 \pm 5\%$
 $\sigma = 1.40 \pm 5\% \text{ mho/m}$
(head tissue)

835 MHz ConvF $6.0 \pm 8\%$

$\epsilon_r = 55.2 \pm 5\%$
 $\sigma = 0.97 \pm 5\% \text{ mho/m}$
(body tissue)

900 MHz ConvF $5.9 \pm 8\%$

$\epsilon_r = 55.0 \pm 5\%$
 $\sigma = 1.05 \pm 5\% \text{ mho/m}$
(body tissue)

1800 MHz ConvF $4.6 \pm 8\%$

$\epsilon_r = 53.3 \pm 5\%$
 $\sigma = 1.52 \pm 5\% \text{ mho/m}$
(body tissue)

1950 MHz ConvF $4.4 \pm 8\%$

$\epsilon_r = 53.3 \pm 5\%$
 $\sigma = 1.52 \pm 5\% \text{ mho/m}$
(body tissue)

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:

ET3DV6R

Serial Number:

1522

Place of Calibration:

Zurich

Date of Calibration:

April 25, 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:

U. Vella

Approved by:

Marie Kutz

Probe ET3DV6R

SN:1522

Manufactured:	March 21, 2000
Last calibration:	May 11, 2001
Remade ET3DV6R:	April 12, 2002
Recalibrated:	April 25, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6R SN:1522**Sensitivity in Free Space**

NormX	$1.41 \mu\text{V}/(\text{V}/\text{m})^2$
NormY	$1.26 \mu\text{V}/(\text{V}/\text{m})^2$
NormZ	$1.29 \mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	96	mV
DCP Y	96	mV
DCP Z	96	mV

Sensitivity in Tissue Simulating Liquid

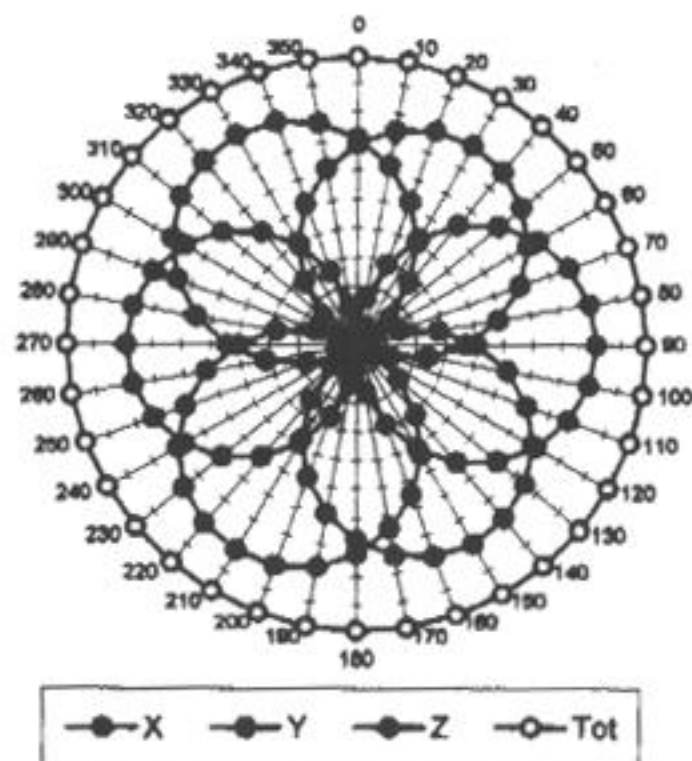
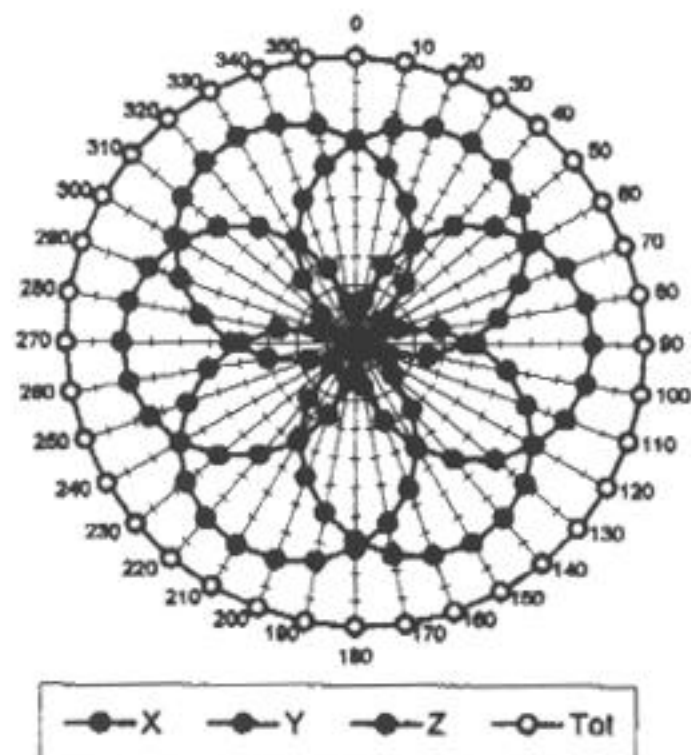
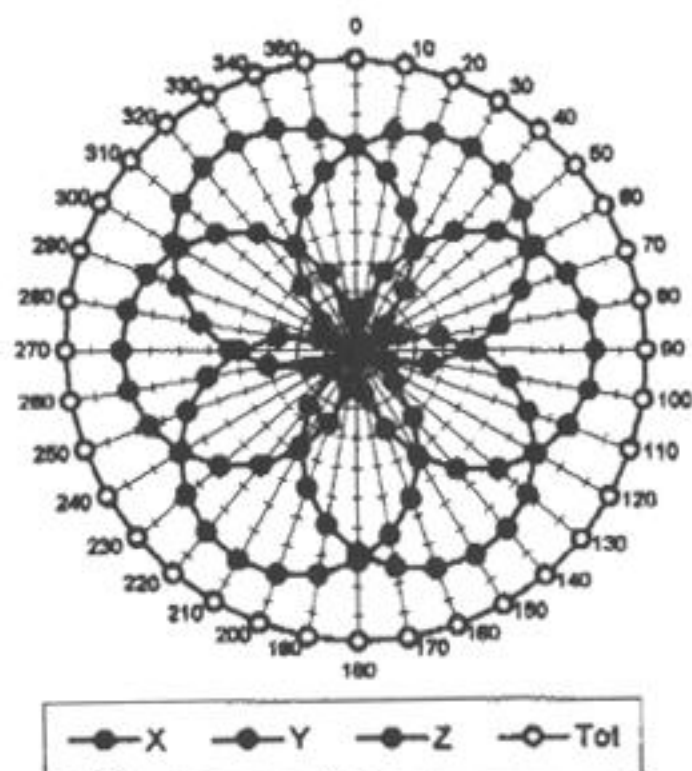
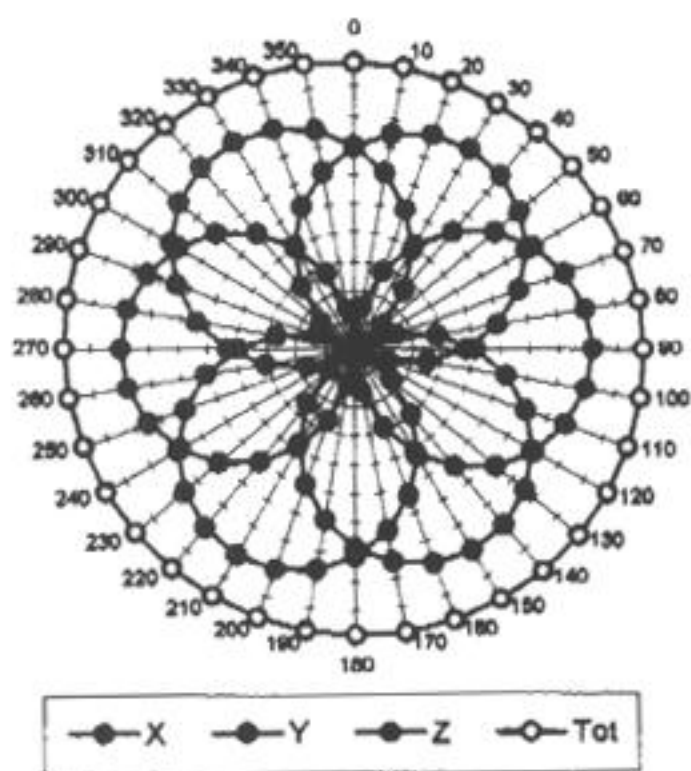
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho}/\text{m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho}/\text{m}$
ConvF X	4.5	$\pm 9.5\% (k=2)$	Boundary effect:
ConvF Y	4.5	$\pm 9.5\% (k=2)$	Alpha 0.50
ConvF Z	4.5	$\pm 9.5\% (k=2)$	Depth 1.97
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho}/\text{m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho}/\text{m}$
ConvF X	3.4	$\pm 9.5\% (k=2)$	Boundary effect:
ConvF Y	3.4	$\pm 9.5\% (k=2)$	Alpha 0.46
ConvF Z	3.4	$\pm 9.5\% (k=2)$	Depth 2.74

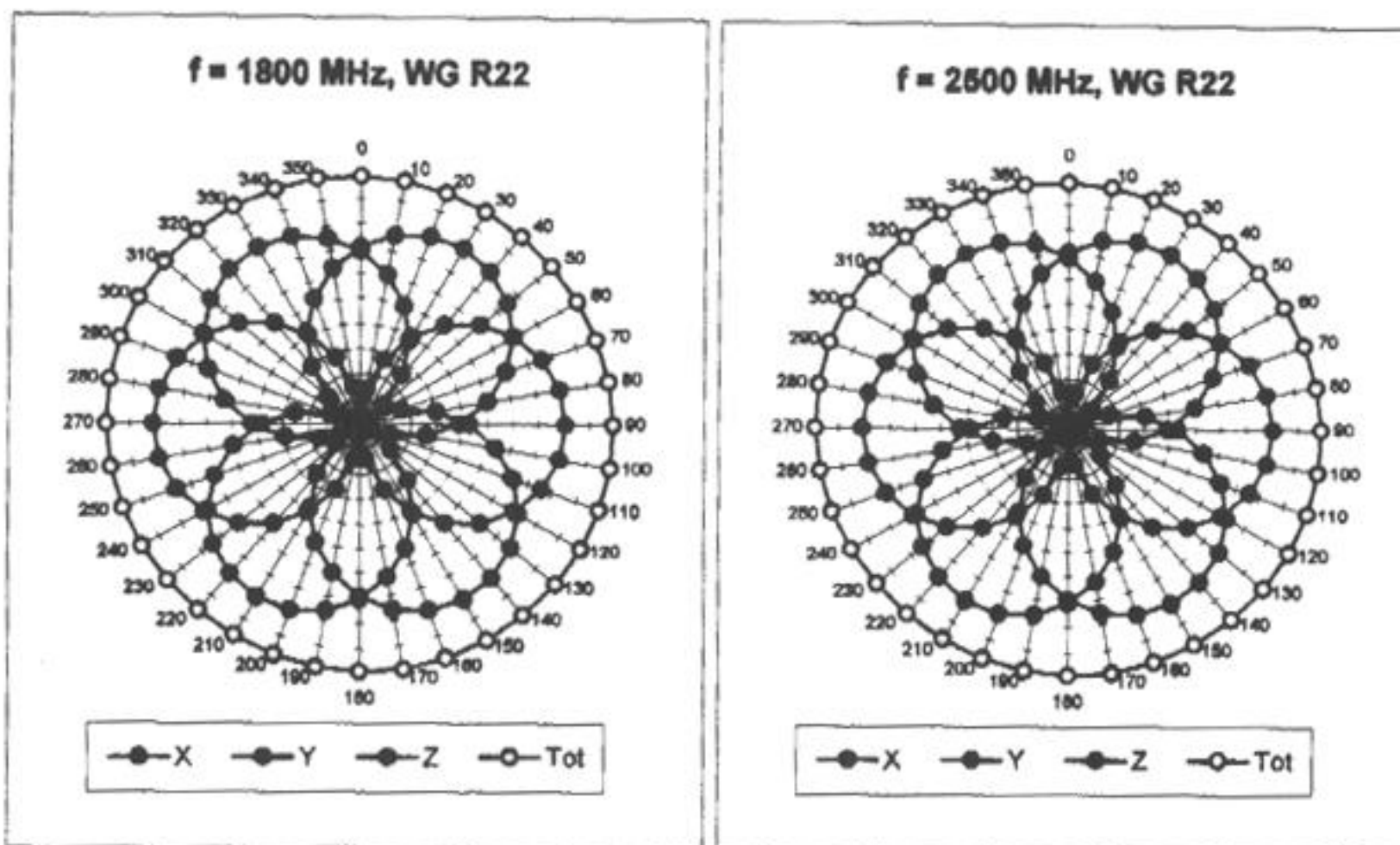
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{ba} [%] Without Correction Algorithm		8.3	4.8
SAR _{ba} [%] With Correction Algorithm		0.0	0.1
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{ba} [%] Without Correction Algorithm		13.1	9.6
SAR _{ba} [%] With Correction Algorithm		0.4	0.5

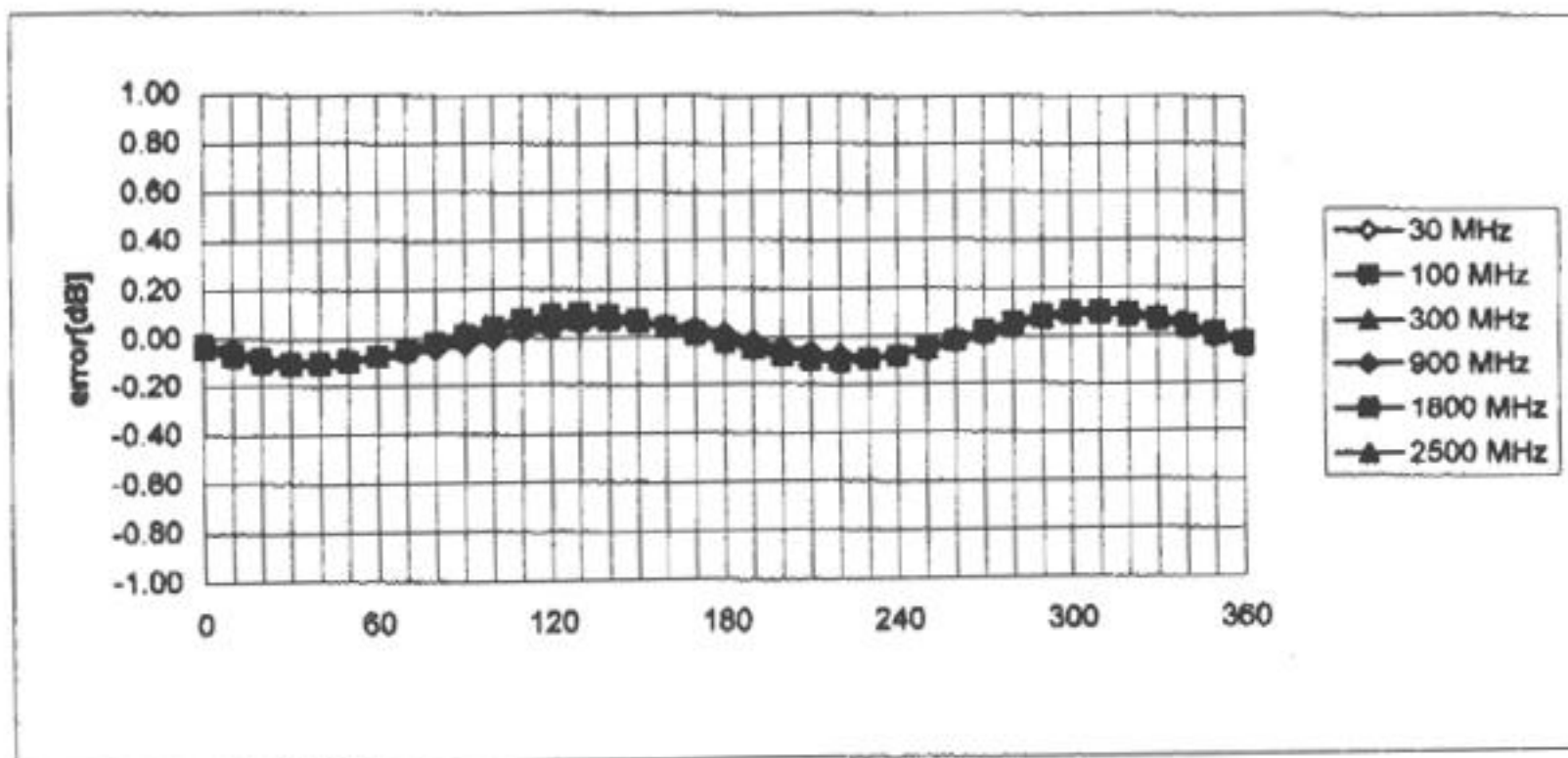
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
----------------------------	------------	----

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30$ MHz, TEM cell I#110 $f = 100$ MHz, TEM cell I#110 $f = 300$ MHz, TEM cell I#110 $f = 900$ MHz, TEM cell I#110

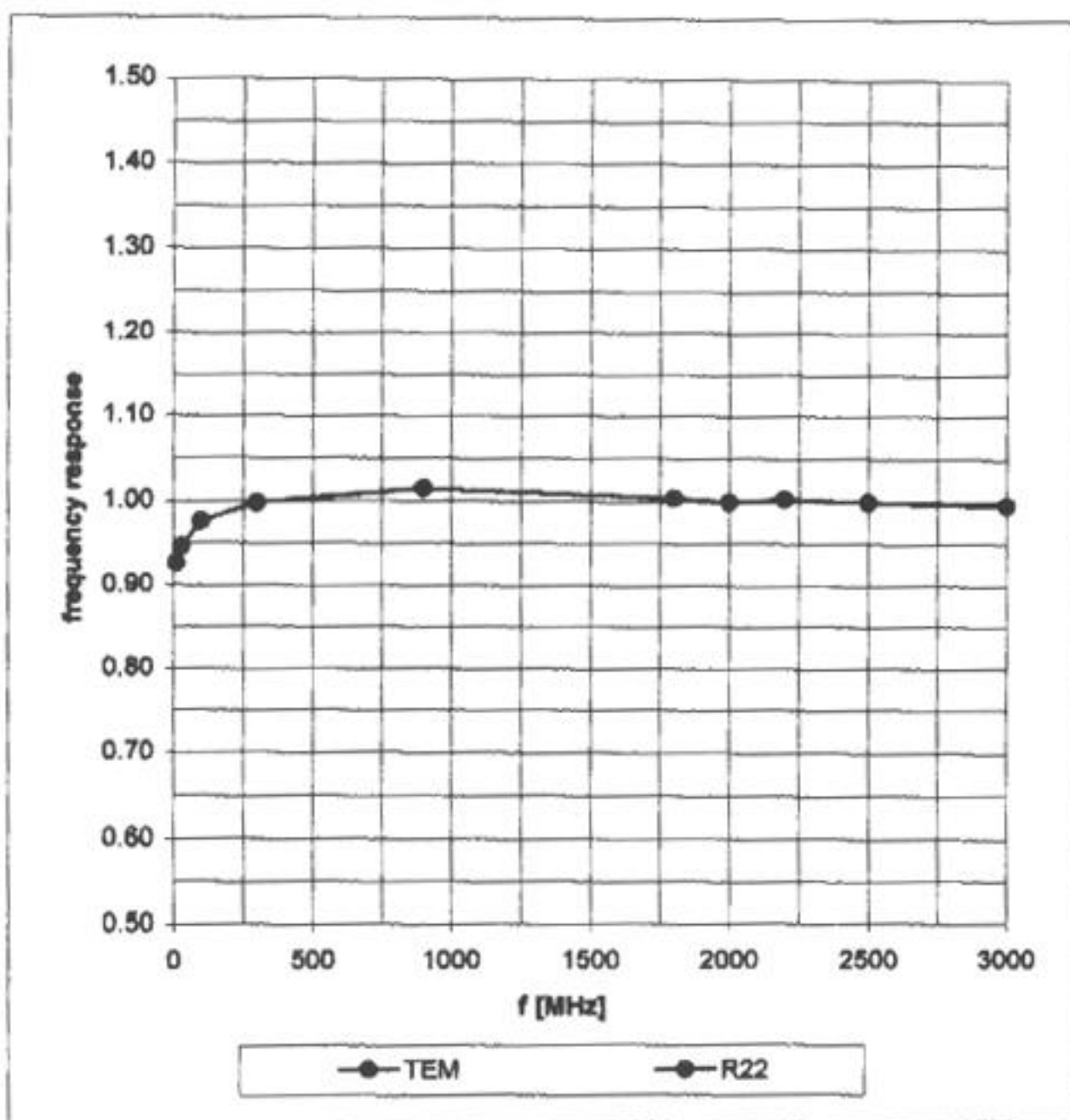


Isotropy Error (ϕ), $\theta = 0^\circ$

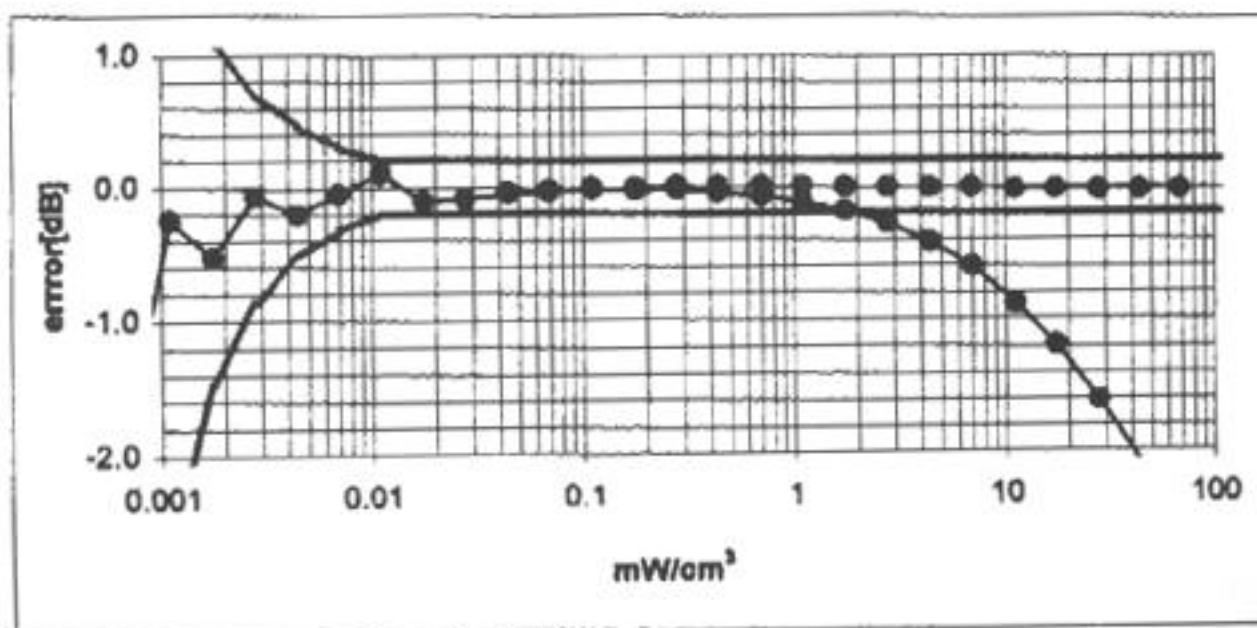
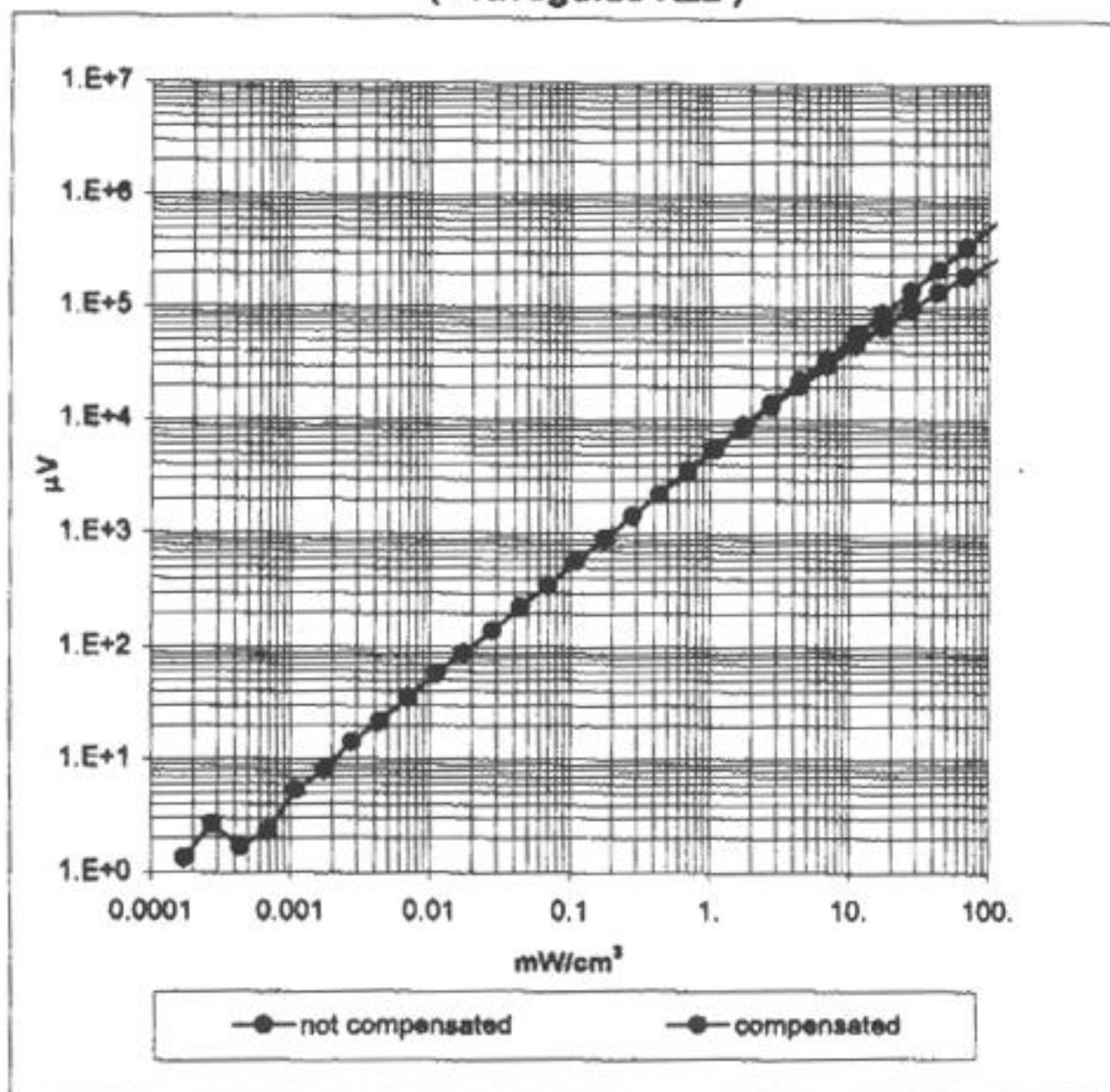


Frequency Response of E-Field

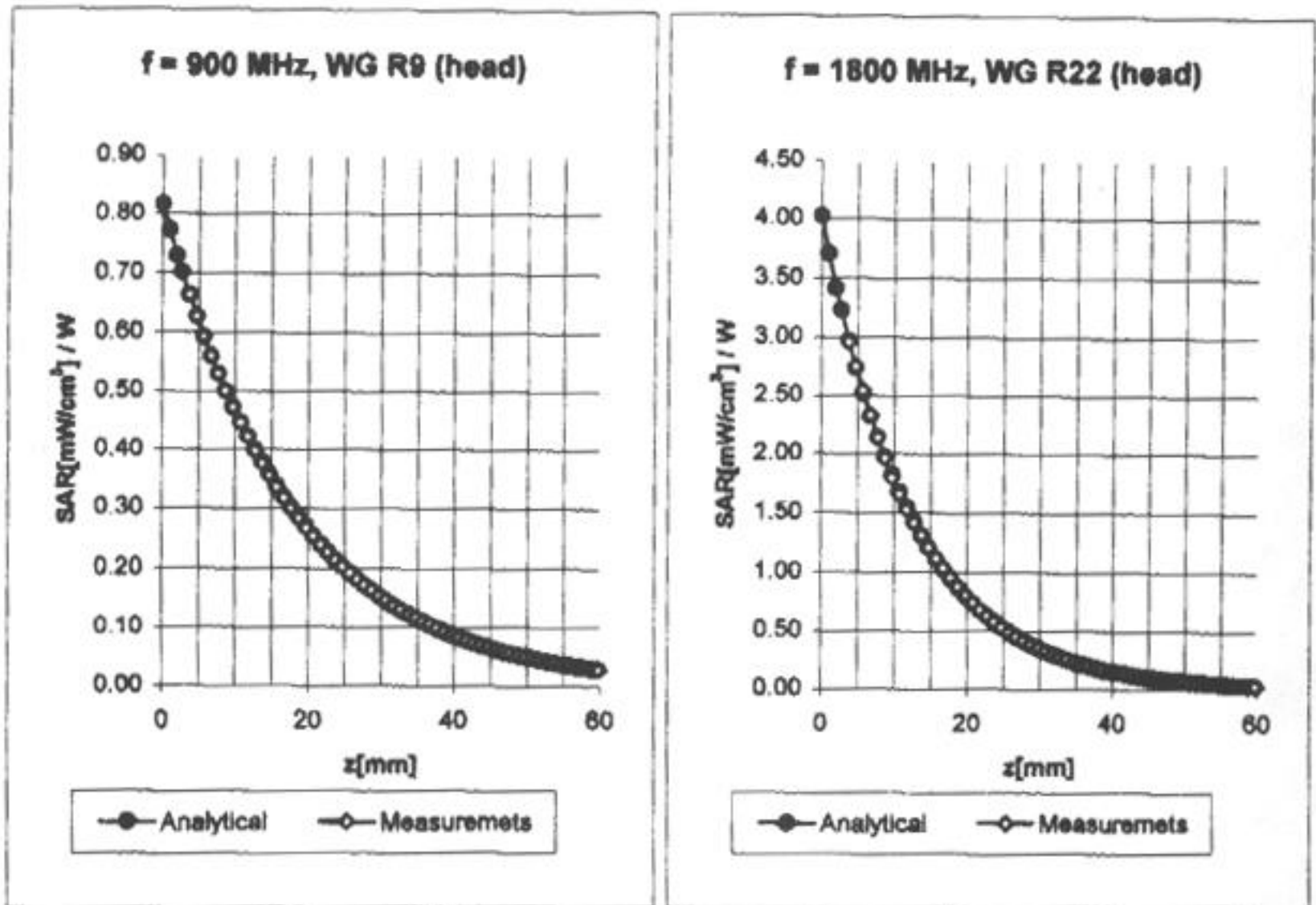
(TEM-Cell:ifl110, Waveguide R22)



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



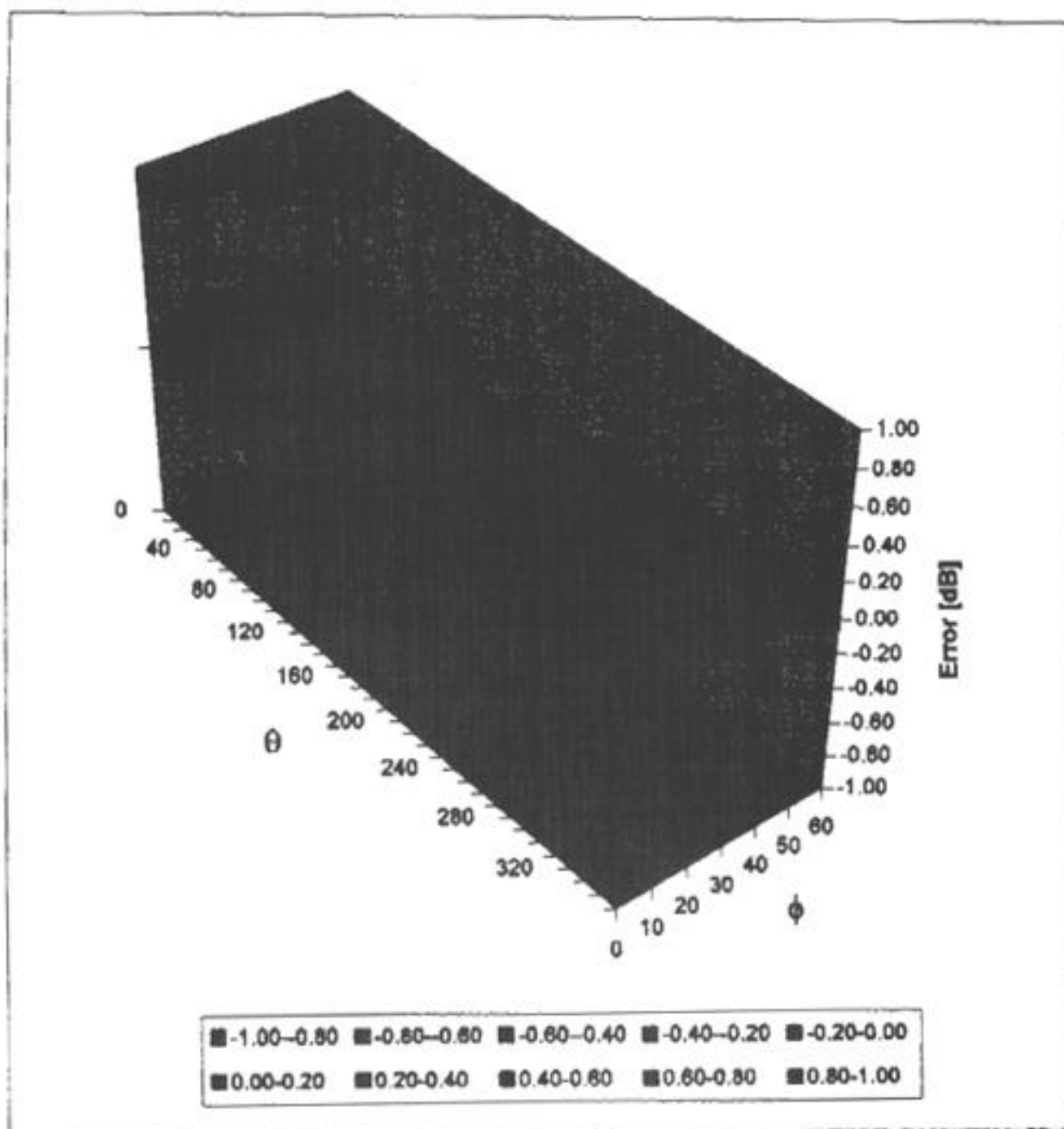
Conversion Factor Assessment



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	4.5 $\pm$ 9.5% (k=2)	Boundary effect:
	ConvF Y	4.6 $\pm$ 9.5% (k=2)	Alpha 0.50
	ConvF Z	4.5 $\pm$ 9.5% (k=2)	Depth 1.97
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	3.4 $\pm$ 9.5% (k=2)	Boundary effect:
	ConvF Y	3.4 $\pm$ 9.5% (k=2)	Alpha 0.46
	ConvF Z	3.4 $\pm$ 9.5% (k=2)	Depth 2.74

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6R

Serial Number:

1522

Place of Assessment:

Zurich

Date of Assessment:

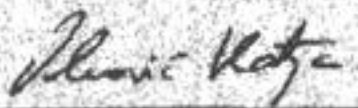
May 8, 2002

Probe Calibration Date:

April 25, 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 ET3DV6R SN:1522

Conversion factor ($\pm$ standard deviation)

835 MHz ConvF $4.6 \pm 8\%$

$\epsilon_r = 41.5 \pm 5\%$
 $\sigma = 0.90 \pm 5\% \text{ mho/m}$
(head tissue)

1950 MHz ConvF $3.2 \pm 8\%$

$\epsilon_r = 40.0 \pm 5\%$
 $\sigma = 1.40 \pm 5\% \text{ mho/m}$
(head tissue)

835 MHz ConvF $4.4 \pm 8\%$

$\epsilon_r = 55.2 \pm 5\%$
 $\sigma = 0.97 \pm 5\% \text{ mho/m}$
(body tissue)

900 MHz ConvF $4.3 \pm 8\%$

$\epsilon_r = 55.0 \pm 5\%$
 $\sigma = 1.05 \pm 5\% \text{ mho/m}$
(body tissue)

1800 MHz ConvF $3.1 \pm 8\%$

$\epsilon_r = 53.3 \pm 5\%$
 $\sigma = 1.52 \pm 5\% \text{ mho/m}$
(body tissue)

1950 MHz ConvF $3.0 \pm 8\%$

$\epsilon_r = 53.3 \pm 5\%$
 $\sigma = 1.52 \pm 5\% \text{ mho/m}$
(body tissue)