

Client **Samsung Suwon (Dymstec)**

CALIBRATION CERTIFICATE

Object(s) ET3DV6 - SN:1551

Calibration procedure(s) QA CAL-01.v2
Calibration procedure for dosimetric E-field probes

Calibration date: April 27, 2004

Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

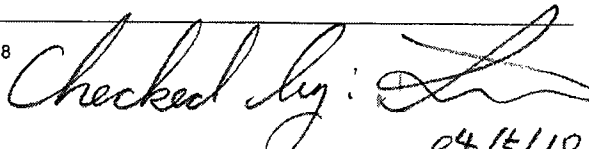
Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: April 27, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Checked by: 
04/15/10

Probe ET3DV6

SN:1551

Manufactured:	October 16, 2000
Last calibrated:	August 28, 2003
Recalibrated:	April 27, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1551

Sensitivity in Free Space

Diode Compression^A

NormX	$1.56 \mu\text{V}/(\text{V}/\text{m})^2$	DCP X	95	mV
NormY	$1.58 \mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	95	mV
NormZ	$1.47 \mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	8.5	4.6
SAR _{be} [%]	With Correction Algorithm	0.1	0.3

Head 1800 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	12.3	8.4
SAR _{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

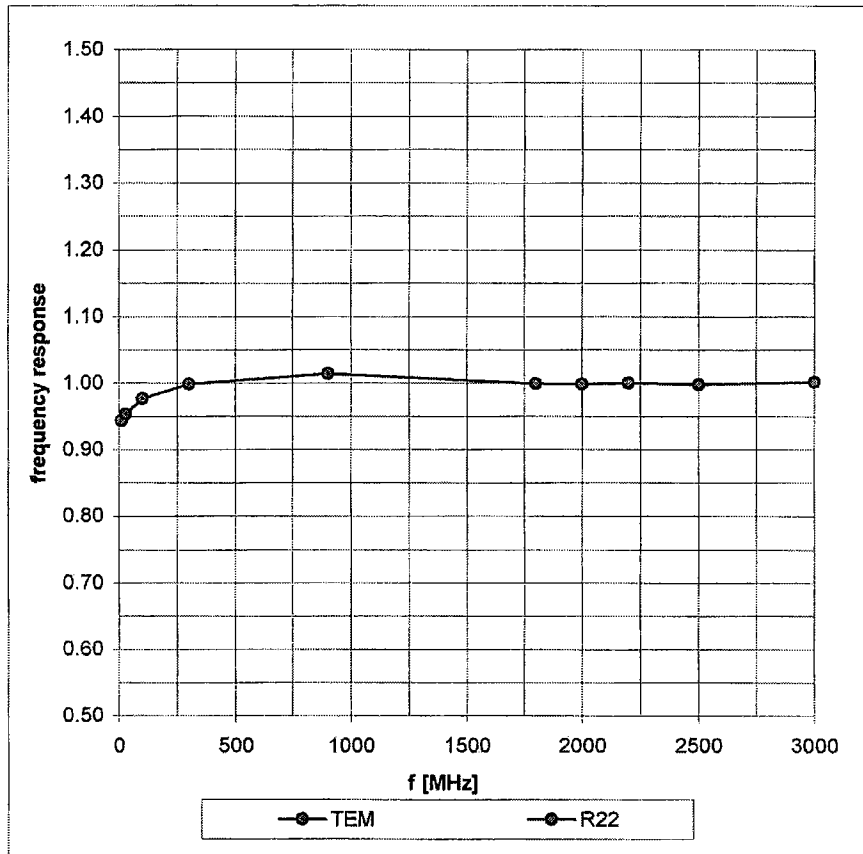
Probe Tip to Sensor Center	2.7 mm
Optical Surface Detection	in tolerance

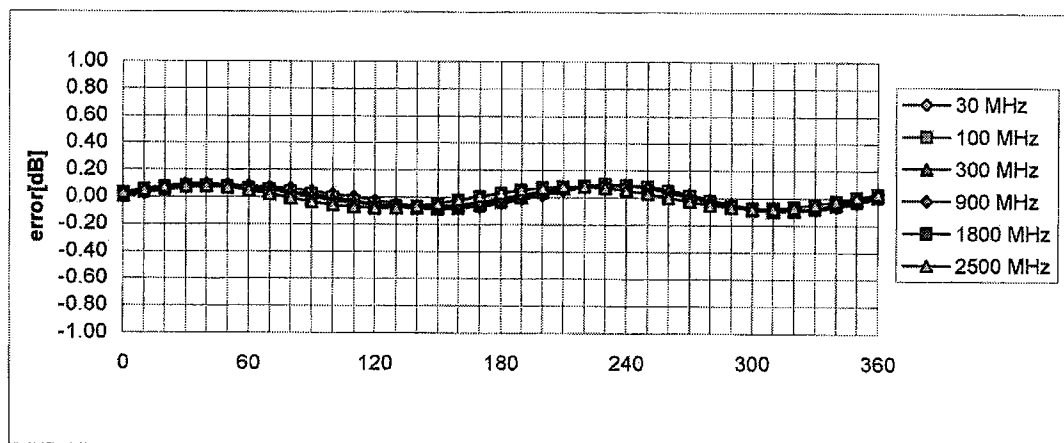
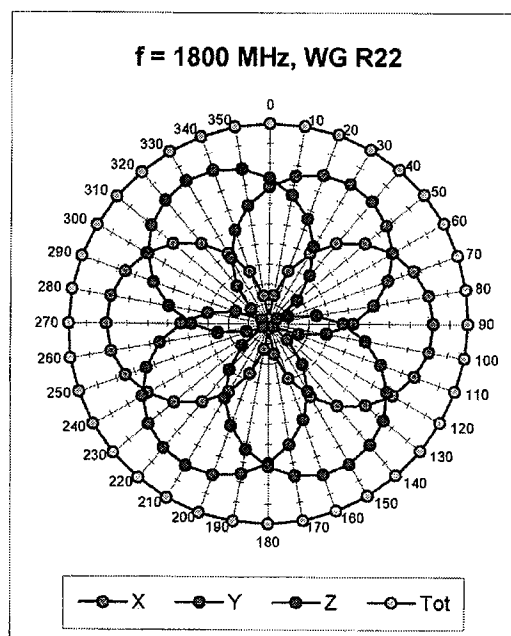
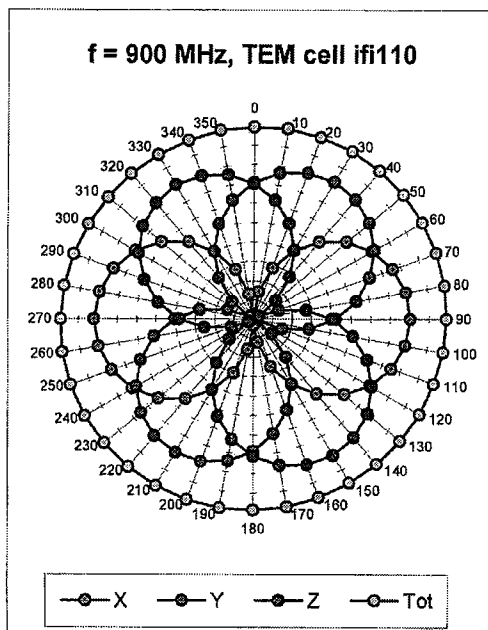
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A numerical linearization parameter: uncertainty not required

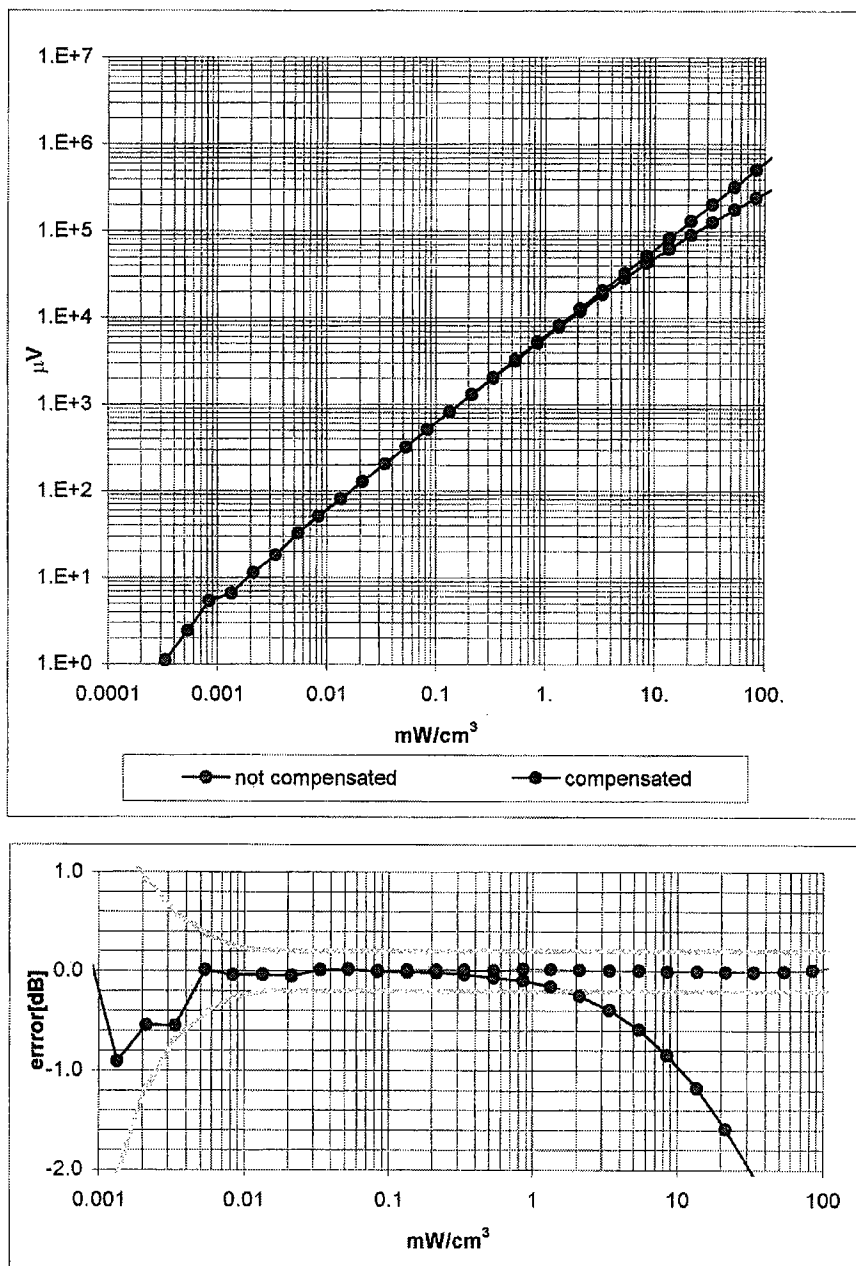
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



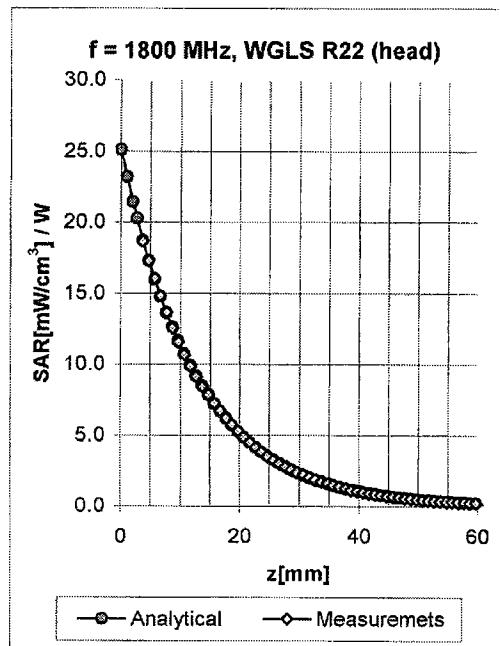
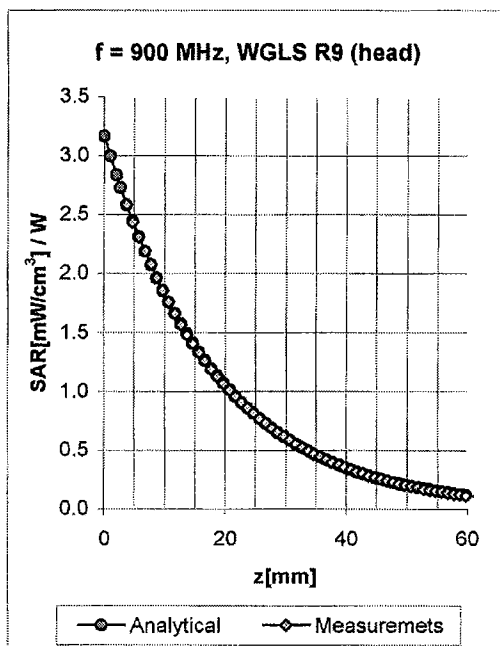
Receiving Pattern (ϕ) , $\theta = 0^\circ$ **Axial Isotropy Error $< \pm 0.2$ dB**

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



Probe Linearity $< \pm 0.2 \text{ dB}$

Conversion Factor Assessment

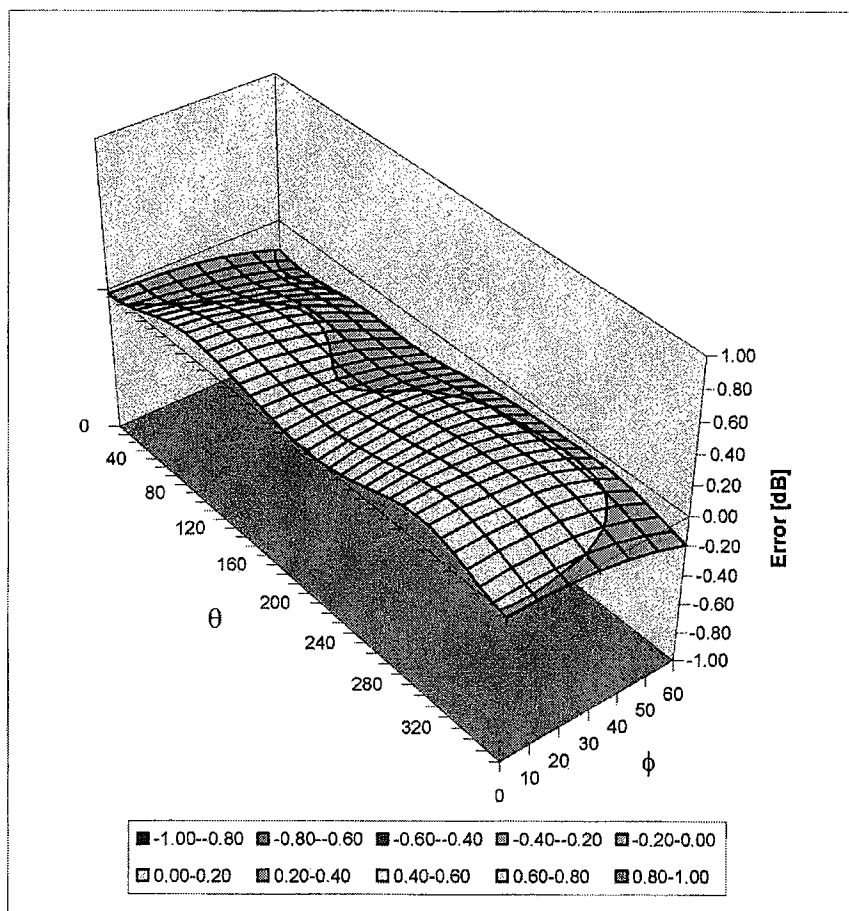


f [MHz]	Validity [MHz] ^B	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	785-885	Head	41.5 ± 5%	0.90 ± 5%	0.70	1.62	6.54 ± 9.7% (k=2)
900	850-950	Head	41.5 ± 5%	0.97 ± 5%	0.48	2.02	6.37 ± 9.7% (k=2)
1750	1700-1800	Head	40.0 ± 5%	1.40 ± 5%	0.45	2.72	5.23 ± 9.7% (k=2)
1900	1850-1950	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.73	5.00 ± 9.7% (k=2)
1950	1900-2000	Head	40.0 ± 5%	1.40 ± 5%	0.48	2.69	4.91 ± 9.7% (k=2)
835	785-885	Body	55.2 ± 5%	0.97 ± 5%	0.43	2.28	6.34 ± 9.7% (k=2)
900	850-950	Body	55.0 ± 5%	1.05 ± 5%	0.46	2.22	6.09 ± 9.7% (k=2)
1750	1700-1800	Body	53.3 ± 5%	1.52 ± 5%	0.50	2.99	4.73 ± 9.7% (k=2)
1900	1850-1950	Body	53.3 ± 5%	1.52 ± 5%	0.55	2.92	4.51 ± 9.7% (k=2)
1950	1900-2000	Body	53.3 ± 5%	1.52 ± 5%	0.62	2.60	4.36 ± 9.7% (k=2)

^B The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Spherical Isotropy Error < ± 0.4 dB

Client **Samsung (Dymstec)**

CALIBRATION CERTIFICATE

Object(s) **ET3DV6 - SN 1617**

Calibration procedure(s) **QA CAL-01 v2
Calibration procedure for dosimetric E-field probes**

Calibration date: **September 18, 2003**

Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Fin Bortholt	R&D Director	

Date issued: September 18, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1617

Manufactured:	January 25, 2002
Last calibration:	July 16, 2002
Recalibrated:	September 18, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1617

Sensitivity in Free Space

NormX	1.78 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.75 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.79 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha 0.40
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth 2.60

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha 0.52
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth 2.54

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

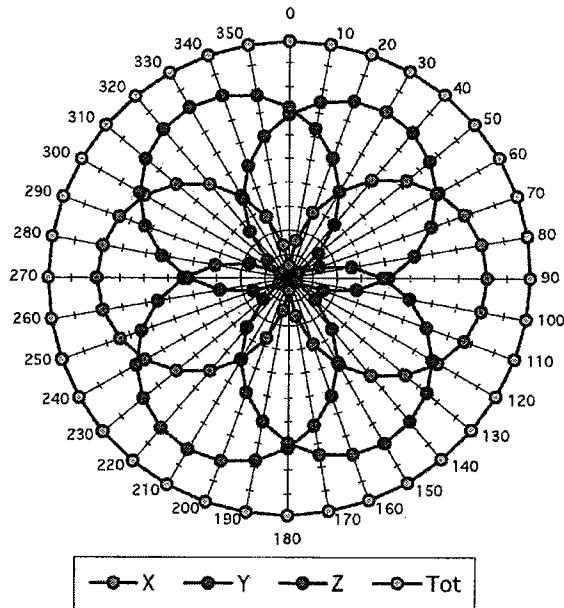
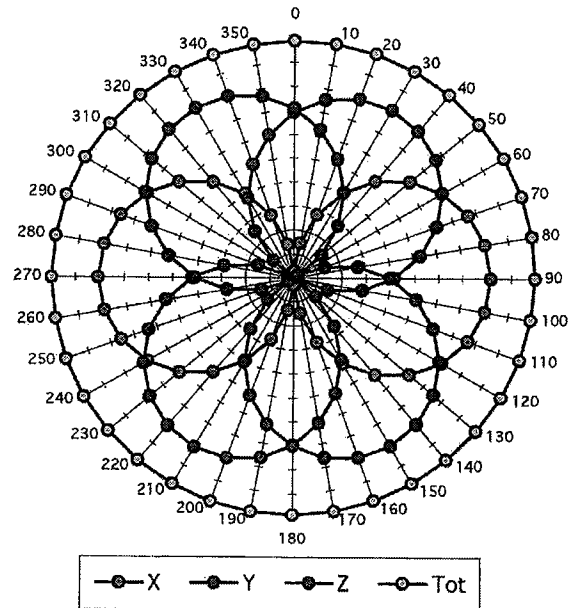
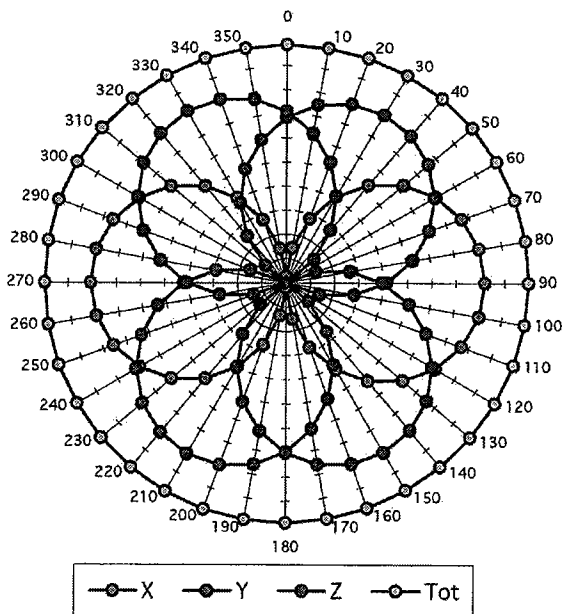
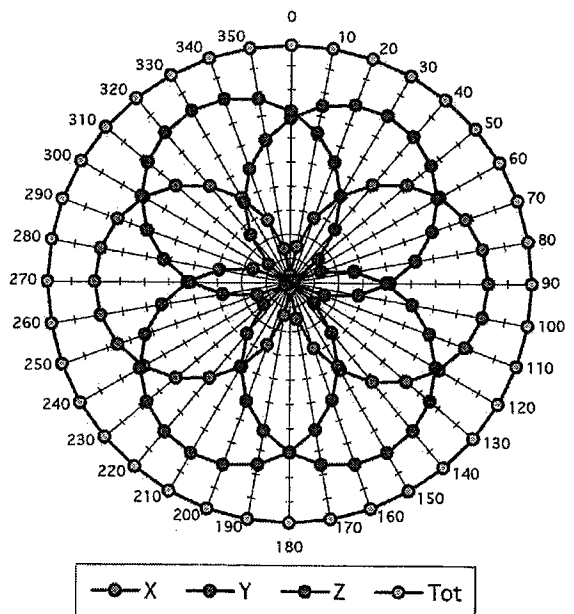
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	11.1	6.4
SAR _{be} [%]	With Correction Algorithm	0.3	0.6

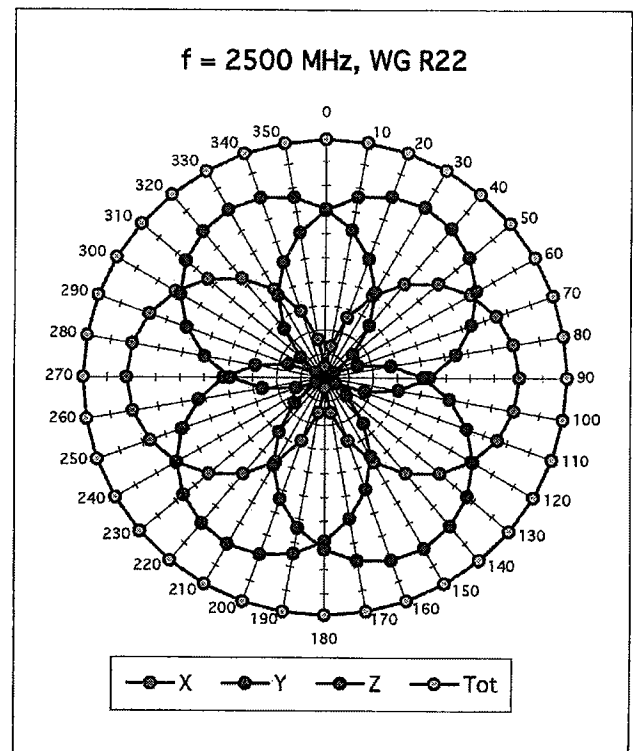
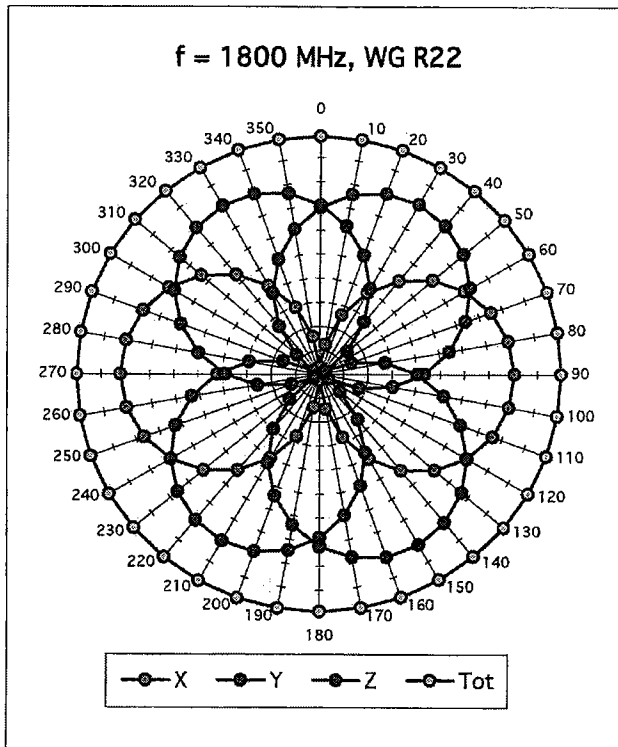
Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	13.5	9.0
SAR _{be} [%]	With Correction Algorithm	0.2	0.1

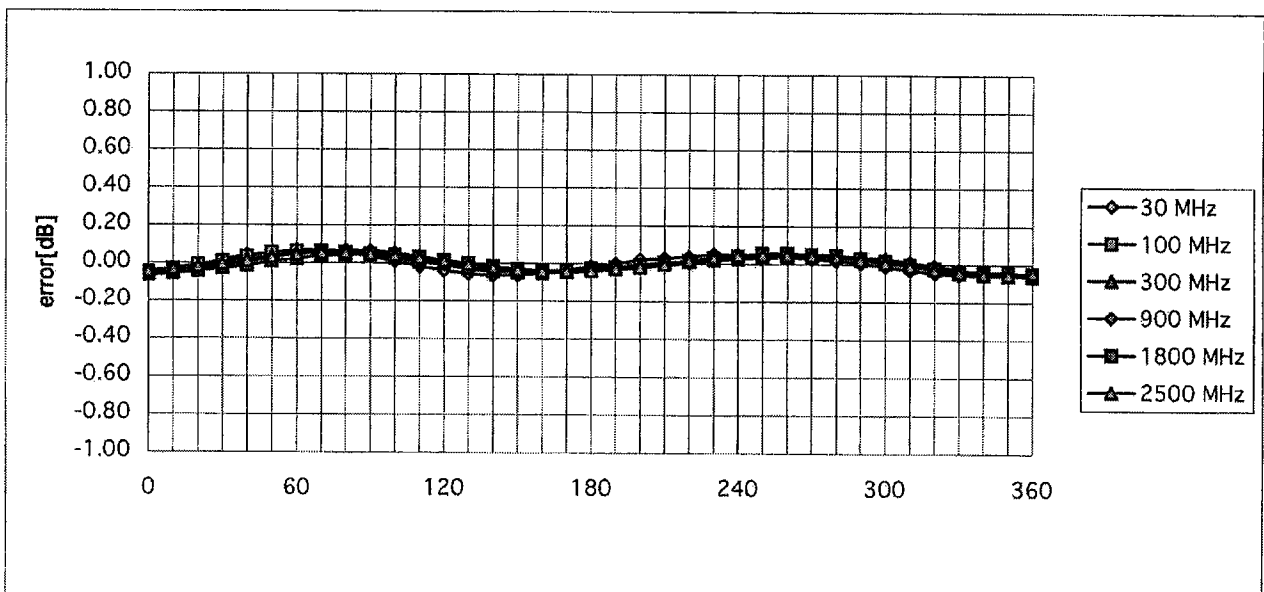
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.4 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ $f = 30 \text{ MHz}$, TEM cell ifi110 $f = 100 \text{ MHz}$, TEM cell ifi110 $f = 300 \text{ MHz}$, TEM cell ifi110 $f = 900 \text{ MHz}$, TEM cell ifi110

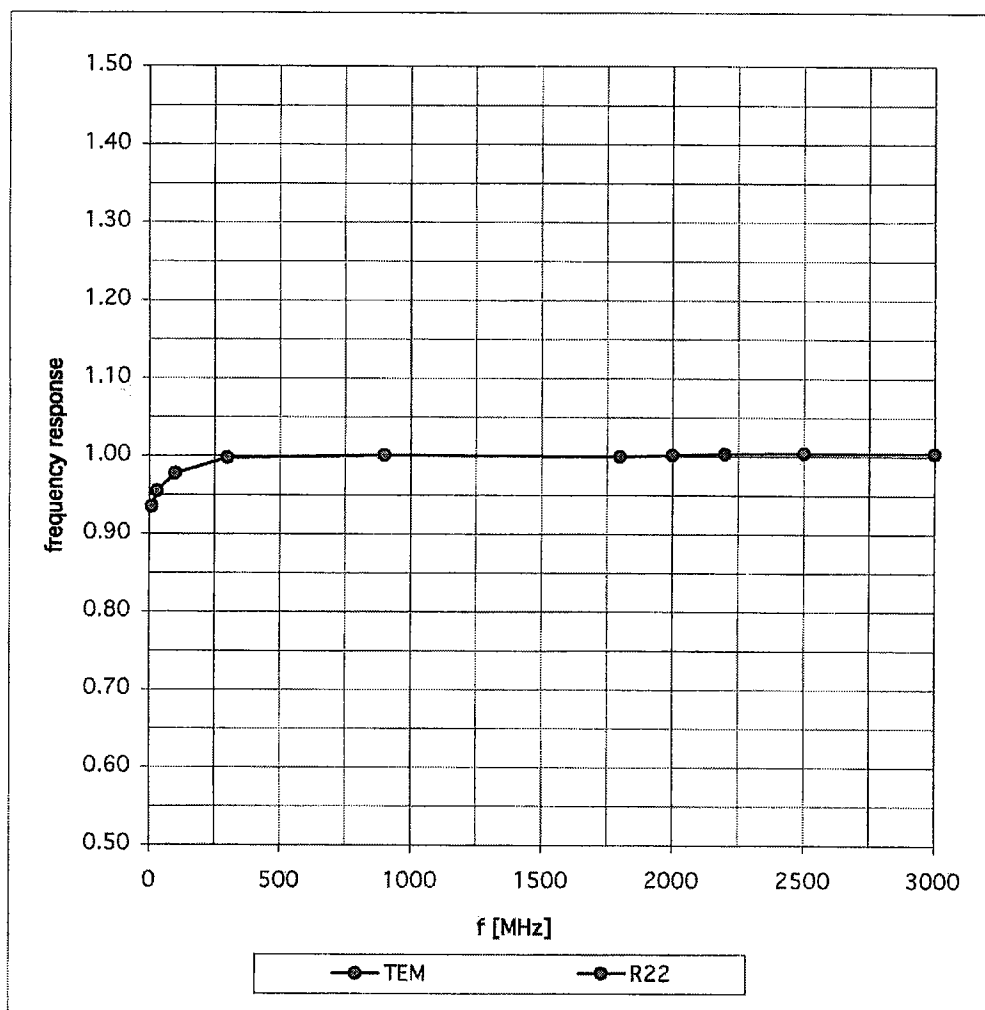


Isotropy Error (ϕ), $\theta = 0^\circ$

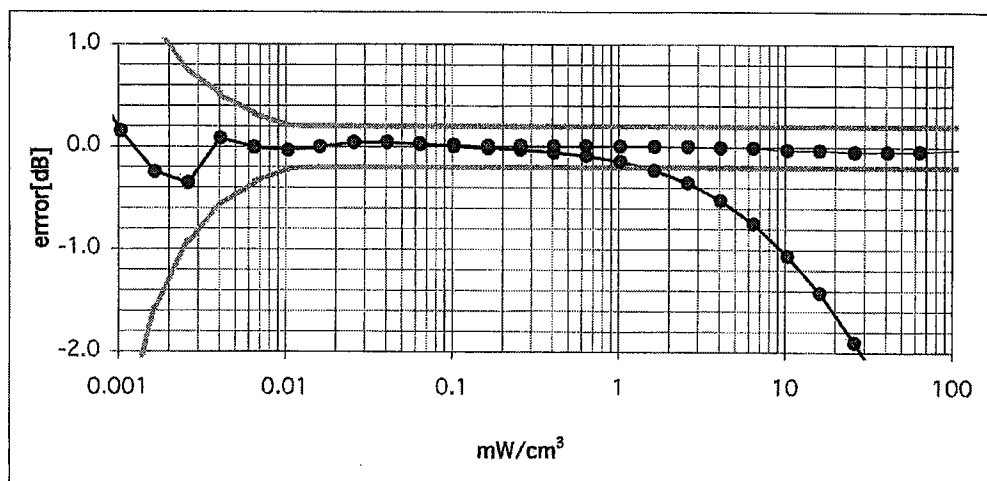
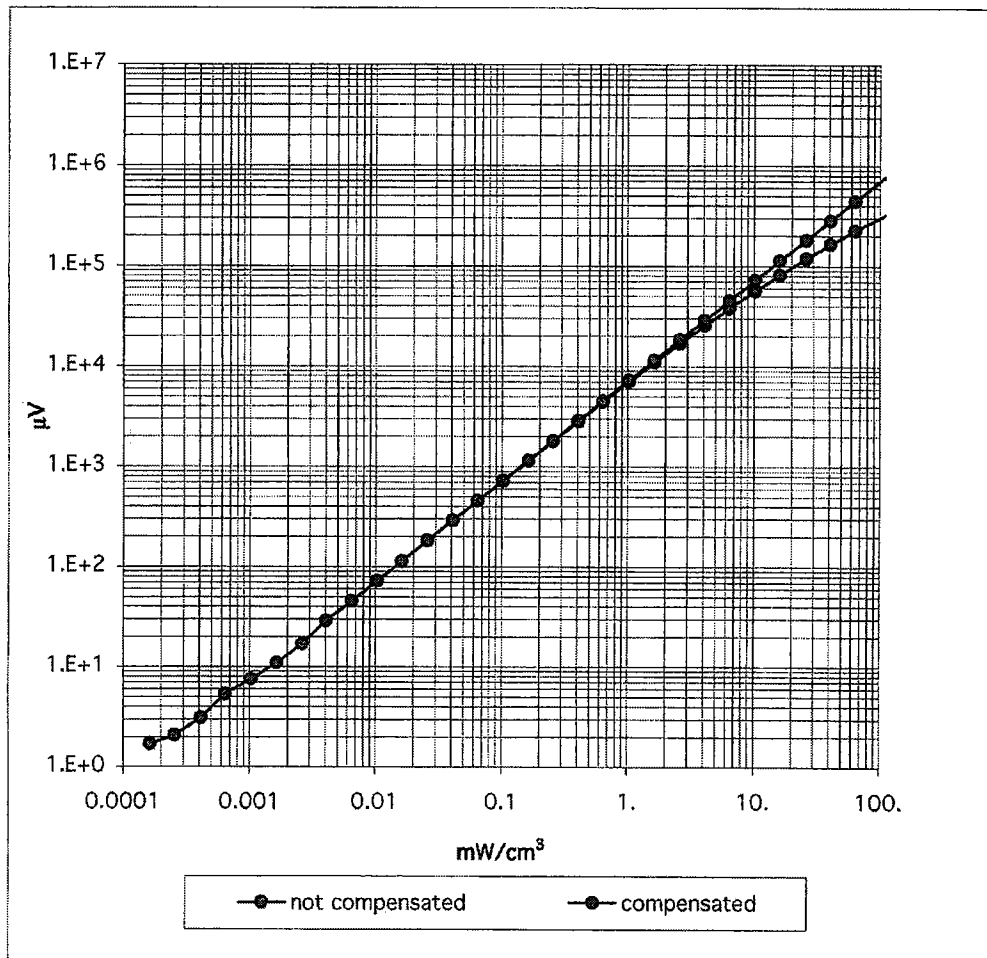


Frequency Response of E-Field

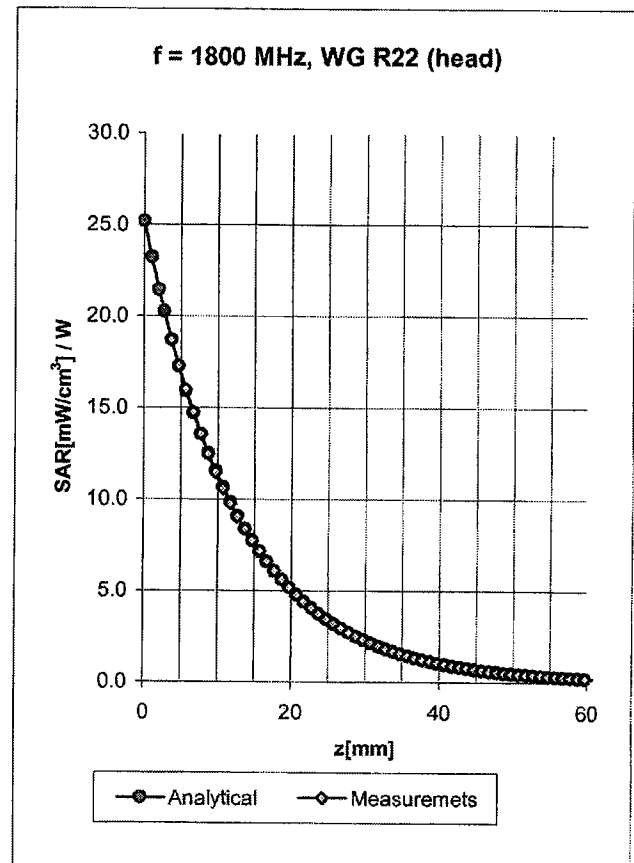
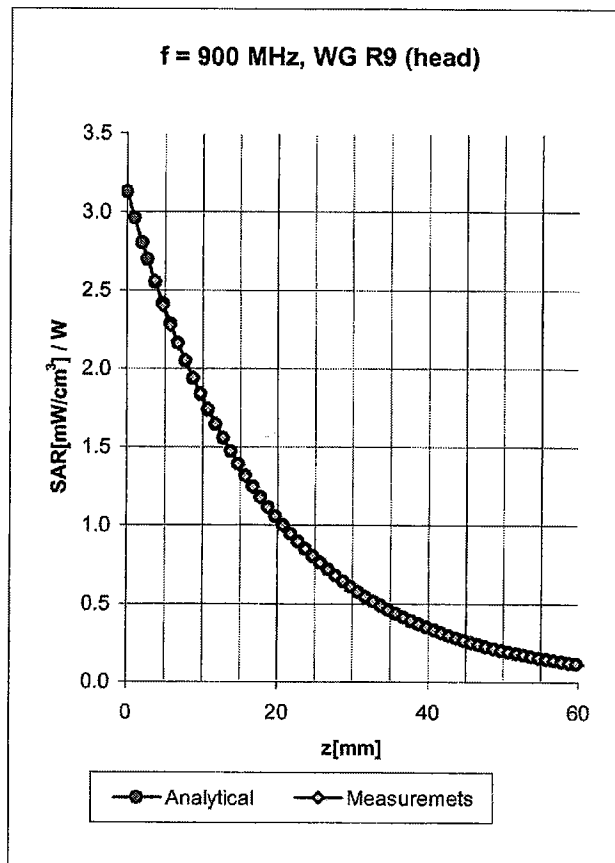
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SARhead) (Waveguide R22)



Conversion Factor Assessment



Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha	0.40
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth	2.60

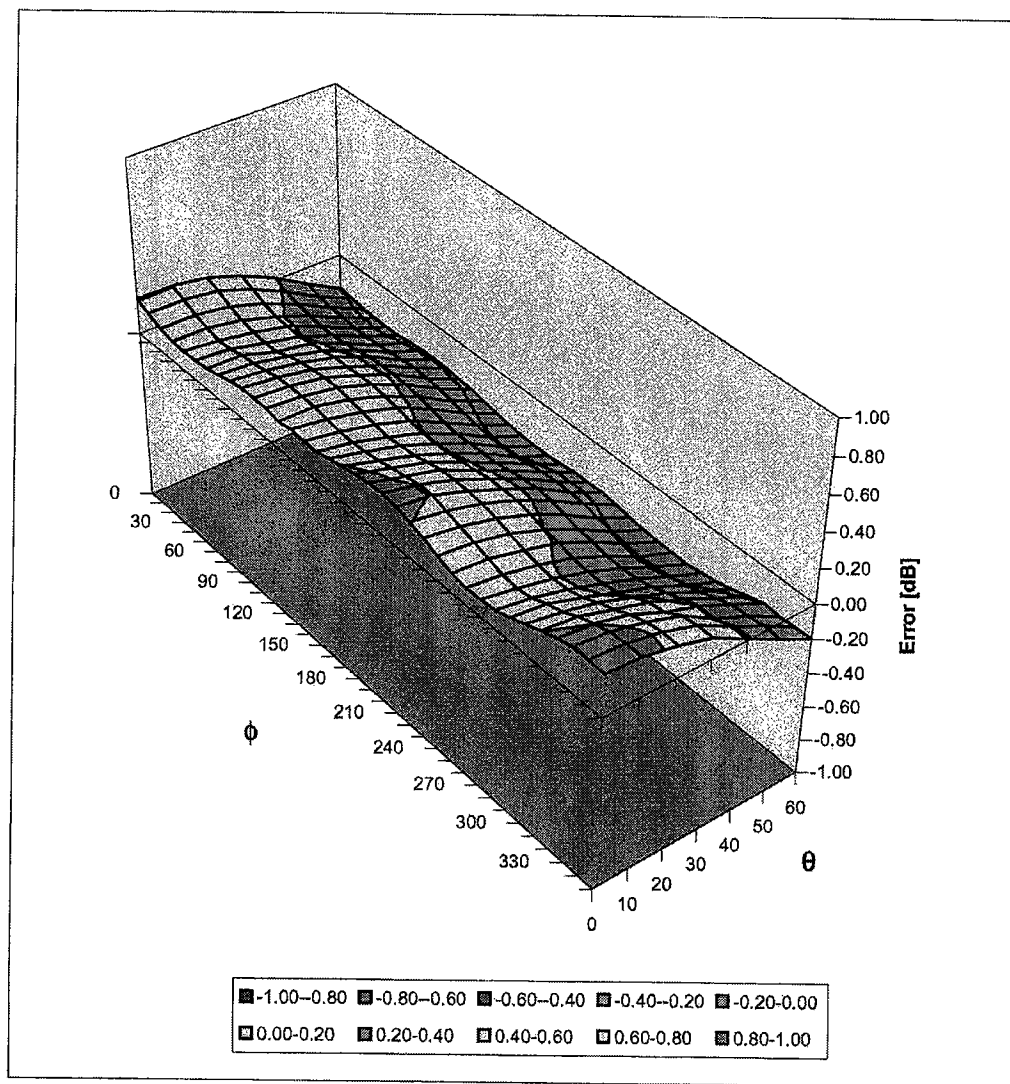
Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha	0.52
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth	2.54

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors

for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1617

Place of Assessment:

Zurich

Date of Assessment:

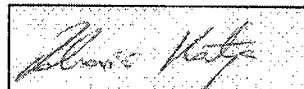
October 6, 2003

Probe Calibration Date:

September 18, 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:



Dosimetric E-Field Probe ET3DV6 SN:1617

Conversion factor ($\pm$ standard deviation)

835 MHz	ConvF	$6.2 \pm 8\%$	$\epsilon_r = 55.2 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$ (body tissue)
1900 MHz	ConvF	$4.7 \pm 8\%$	$\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$ (body tissue)