APPENDIX D: PROBE CALIBRATION

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client PC Test

CALIBRATION CERTIFICATE

Object(s) ES3DV2 - SN:3022

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

Calibration date: September 23, 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:	Niels Kuster	Quality Manager	

Date issued: October 5, 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.

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Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Last calibration: September 23, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3022

Sensitivity in Free Space

Diode Compression

NormX	1.00 $\mu V/(V/m)^2$	DCP X	95	mV
NormY	1.04 $\mu V/(V/m)^2$	DCP Y	95	mV
NormZ	0.98 $\mu V/(V/m)^2$	DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

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

ConvF X	6.1 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.1 ± 9.5% (k=2)	Alpha	0.32
ConvF Z	6.1 ± 9.5% (k=2)	Depth	1.65

Head **1800 MHz** ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

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

ConvF X	5.0 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.0 ± 9.5% (k=2)	Alpha	0.25
ConvF Z	5.0 ± 9.5% (k=2)	Depth	2.30

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary	1 mm	2 mm
SAR_{be} [%] Without Correction Algorithm	5.5	2.5
SAR_{be} [%] With Correction Algorithm	0.1	0.4

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

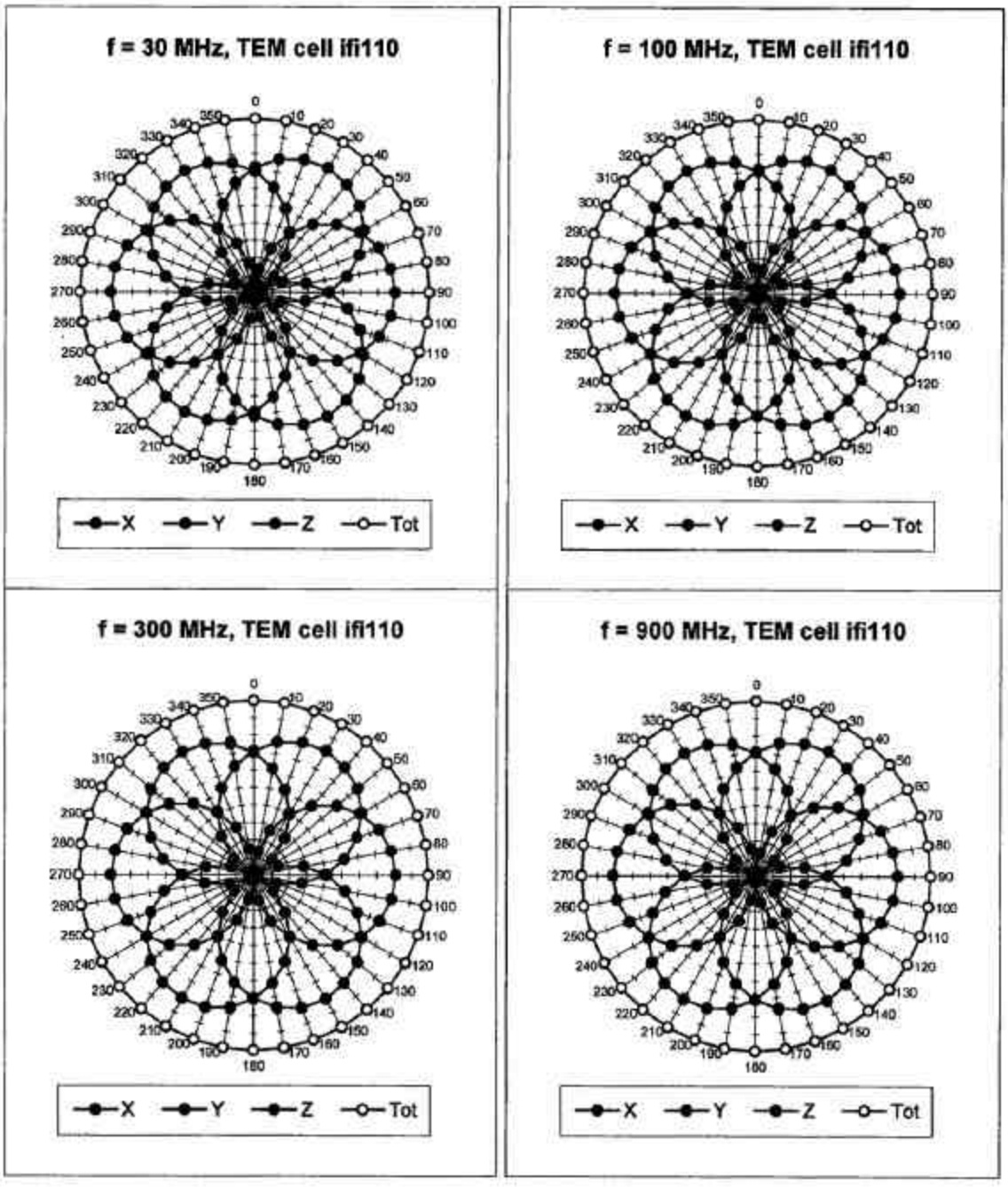
Probe Tip to Boundary	1 mm	2 mm
SAR_{be} [%] Without Correction Algorithm	7.1	4.4
SAR_{be} [%] With Correction Algorithm	0.0	0.1

Sensor Offset

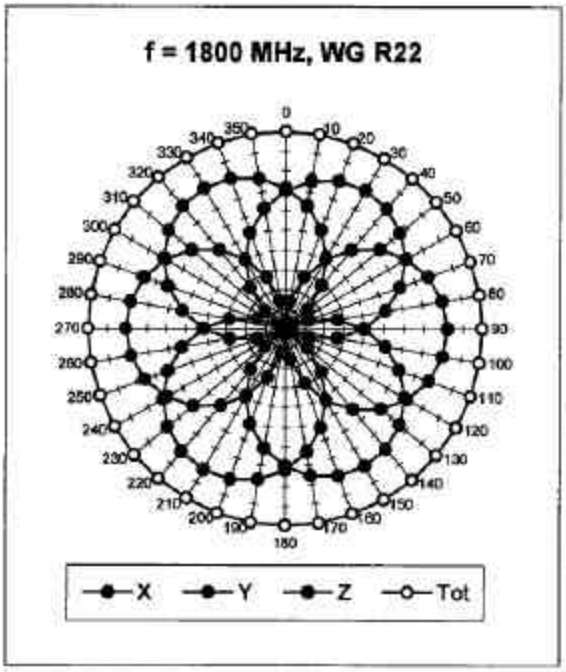
Probe Tip to Sensor Center	2.0	mm

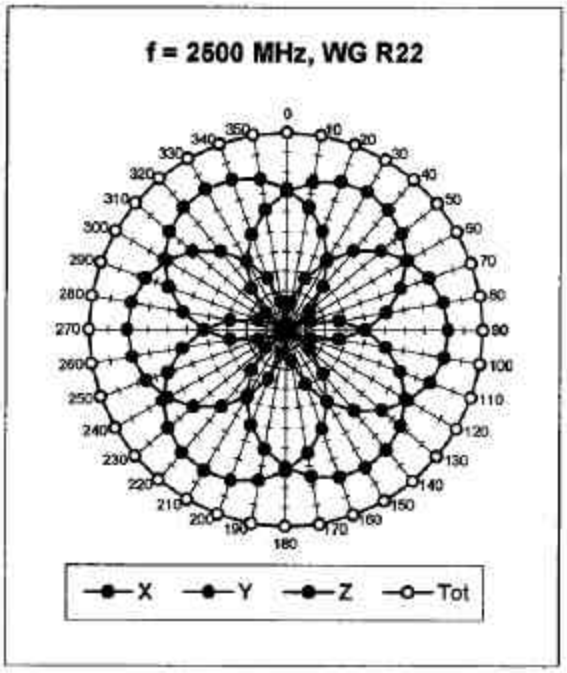
ES3DV2 SN:3022 **September 23, 2003**

Receiving Pattern (ϕ , θ = 0°

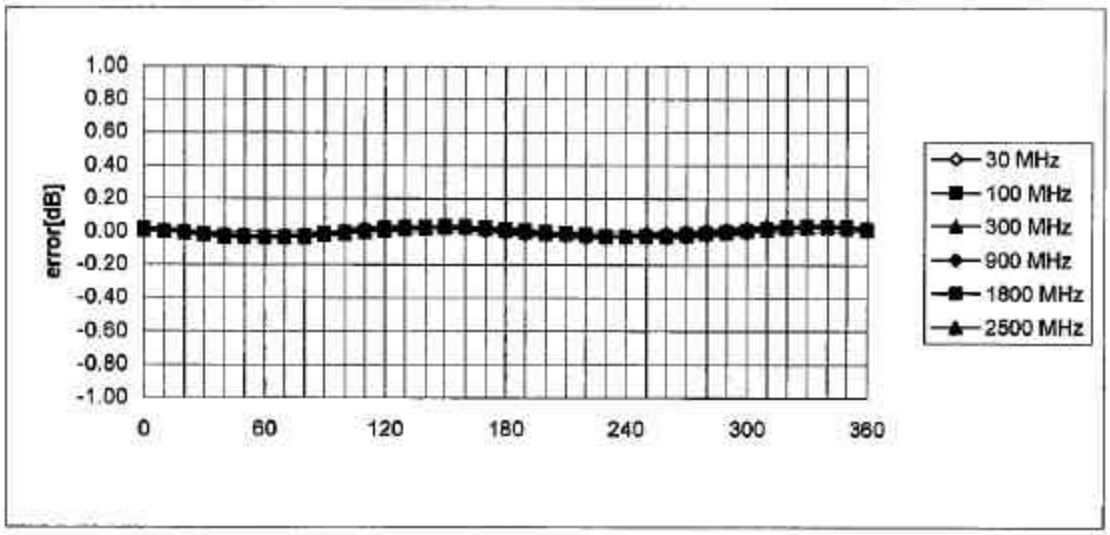


ES3DV2 SN:3022 **September 23, 2003**



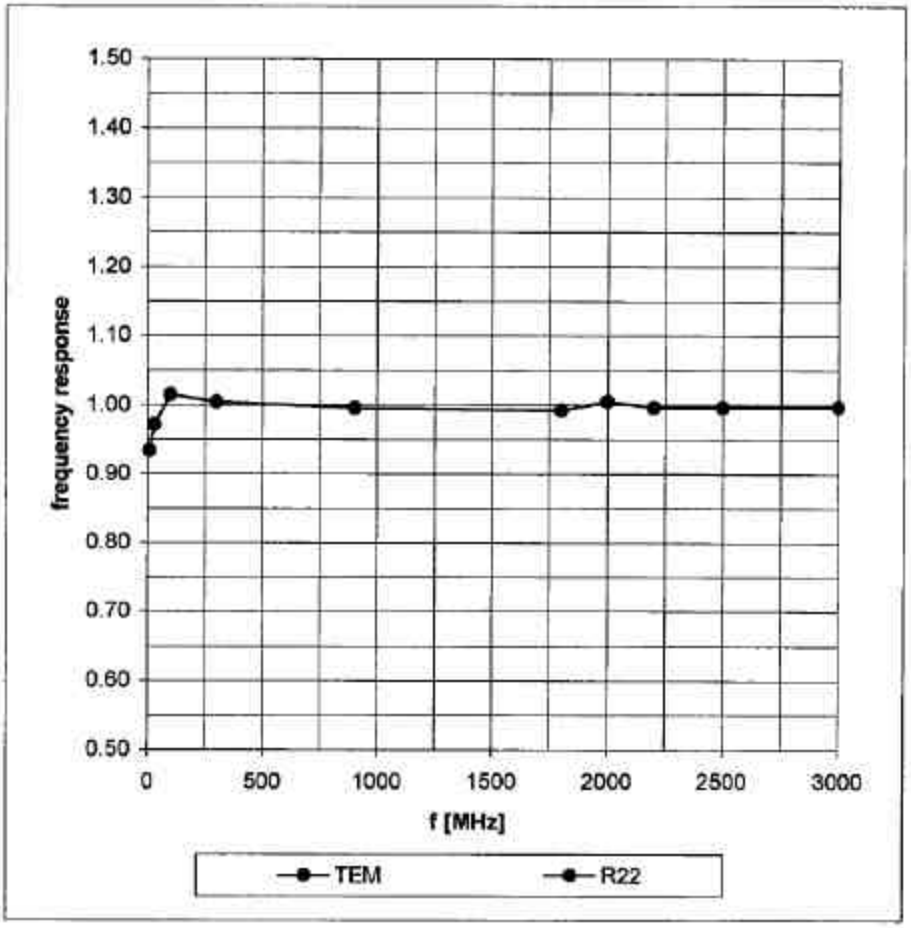


Isotropy Error (ϕ), θ = 0°

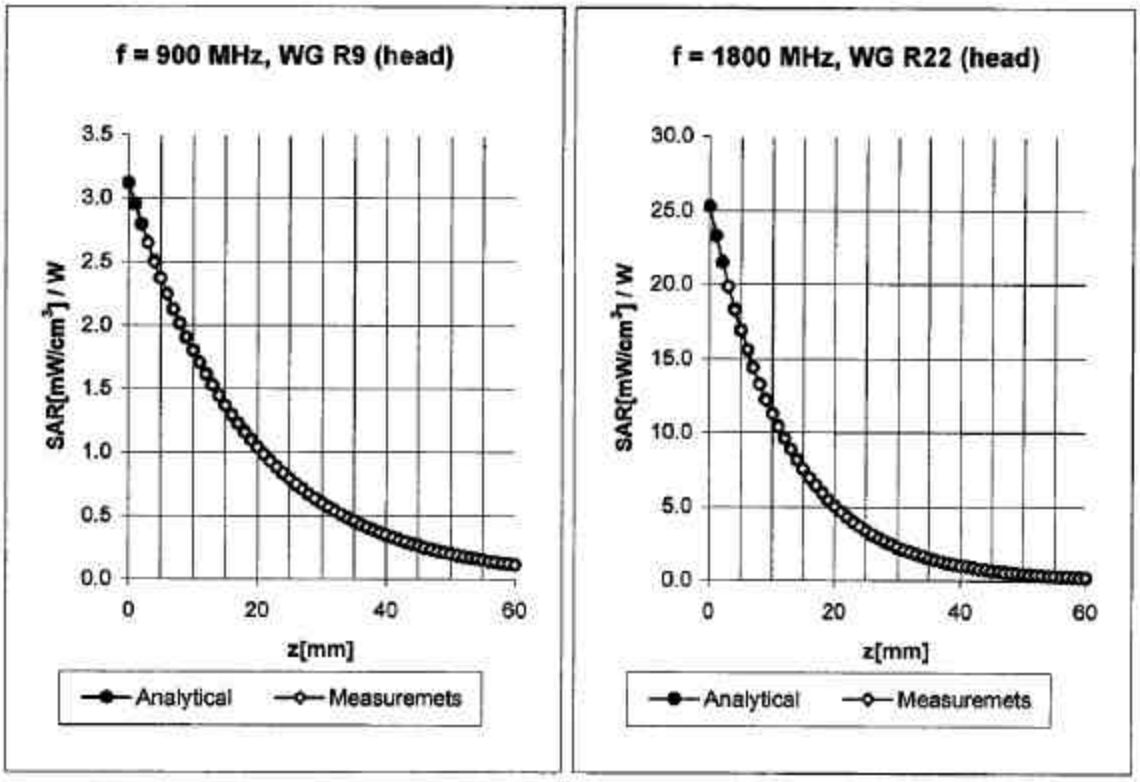


Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



Conversion Factor Assessment



Head **900 MHz** ε_r = **41.5 ± 5%** σ = **0.97 ± 5% mho/m**

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

ConvF X	**6.1** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.1** ± 9.5% (k=2)	Alpha	**0.32**
ConvF Z	**6.1** ± 9.5% (k=2)	Depth	**1.65**

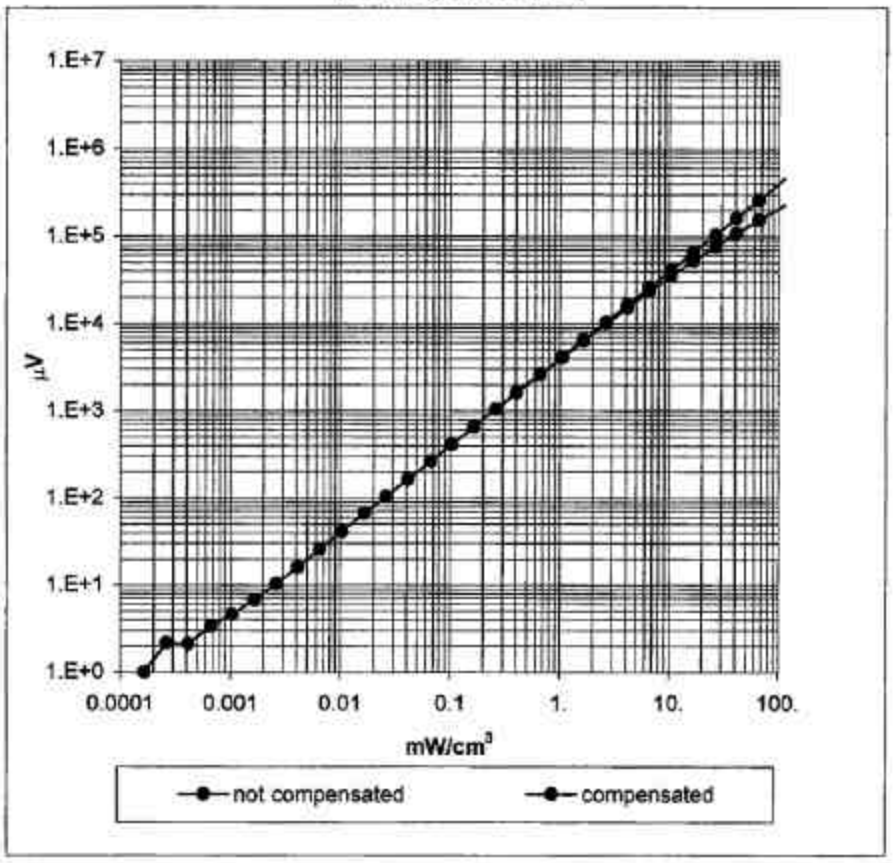
Head **1800 MHz** ε_r = **40.0 ± 5%** σ = **1.40 ± 5% mho/m**

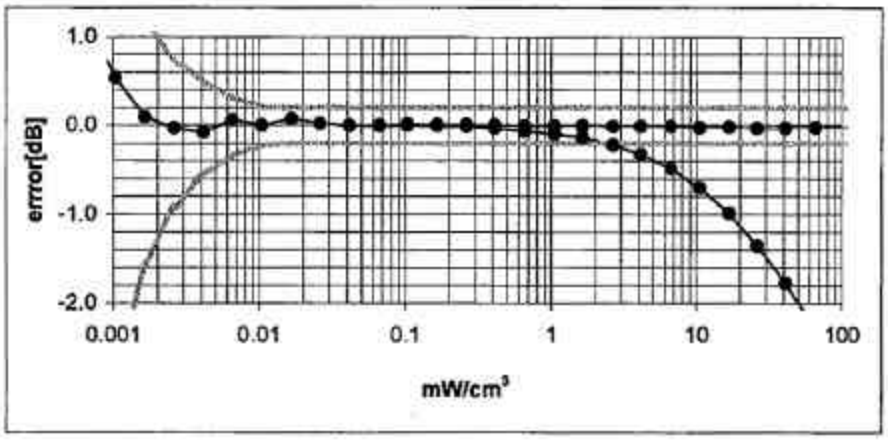
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.25**
ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.30**

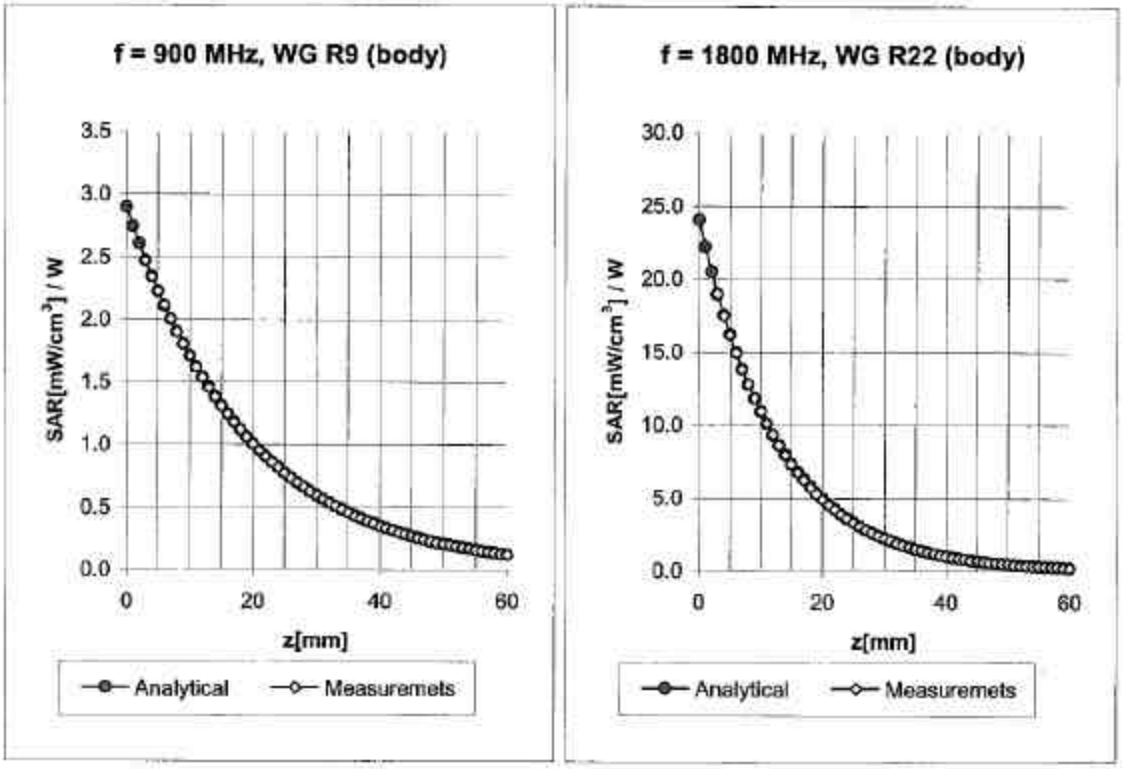
Dynamic Range f(SAR_{brain})

(Waveguide R22)





Conversion Factor Assessment



Body **900 MHz** ε_r = 55.0 ± 5% σ = 1.05 ± 5% mho/m

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

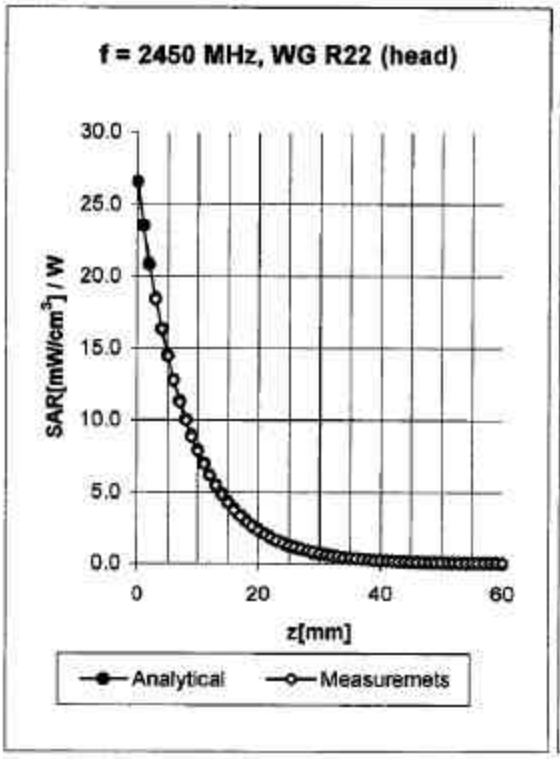
ConvF X	**6.0** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.0** ± 9.5% (k=2)	Alpha	**0.38**
ConvF Z	**6.0** ± 9.5% (k=2)	Depth	**1.47**

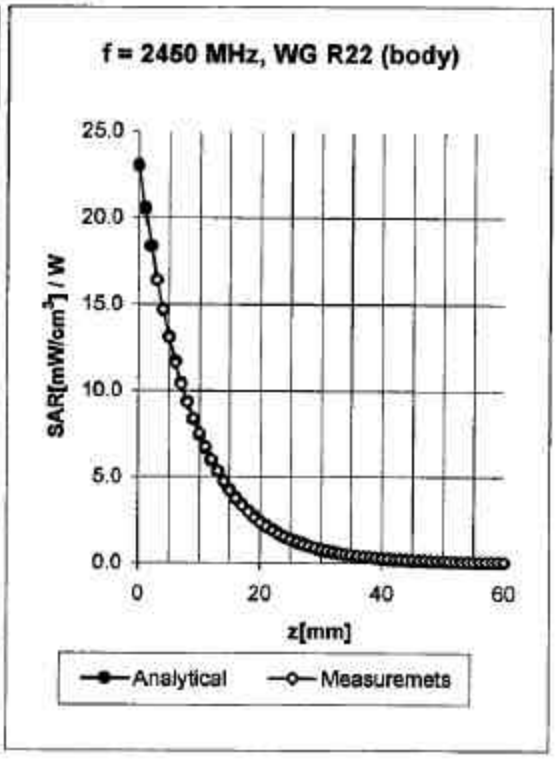
Body **1800 MHz** ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)	Alpha	**0.22**
ConvF Z	**4.5** ± 9.5% (k=2)	Depth	**3.42**

Conversion Factor Assessment





Head **2450 MHz** ε_r = 39.2 ± 5% σ = 1.80 ± 5% mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

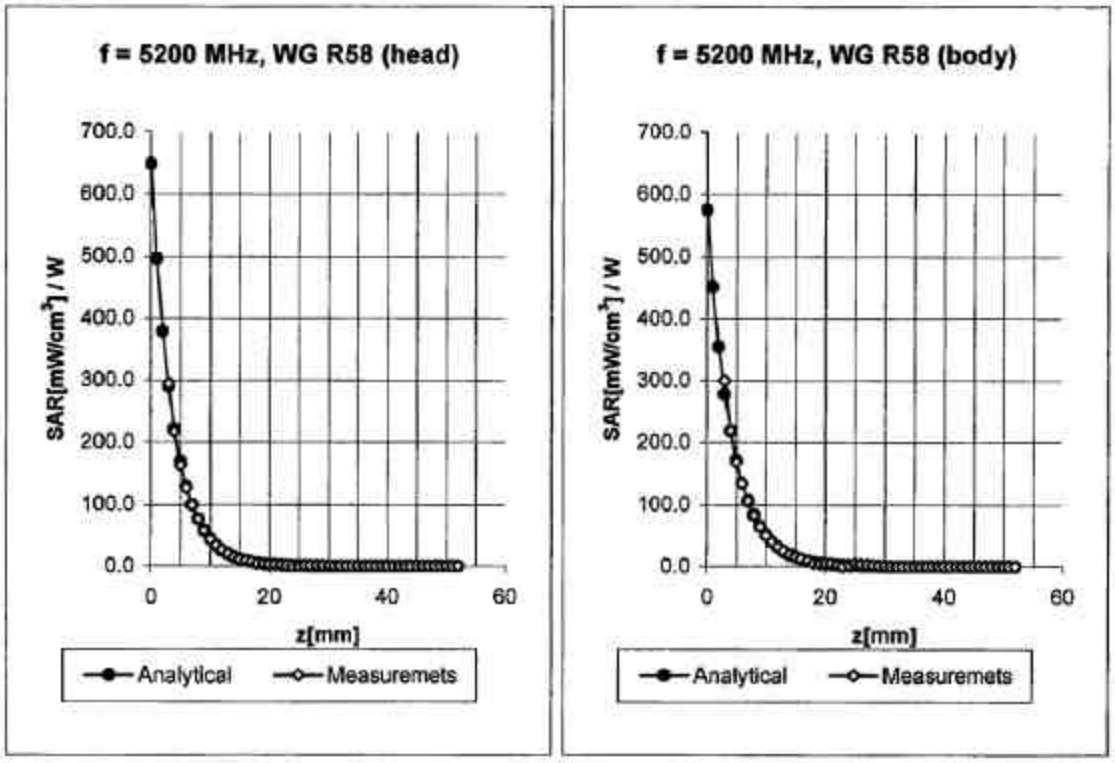
ConvF X	**4.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)	Alpha	**0.42**
ConvF Z	**4.5** ± 9.5% (k=2)	Depth	**1.56**

Body **2450 MHz** ε_r = 52.7 ± 5% σ = 1.95 ± 5% mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.2** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.2** ± 9.5% (k=2)	Alpha	**0.42**
ConvF Z	**4.2** ± 9.5% (k=2)	Depth	**1.65**

Conversion Factor Assessment



Head **5200 MHz** ε_r = **36.0 ± 5%** σ = **4.66 ± 5% mho/m**

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET65-SuppC

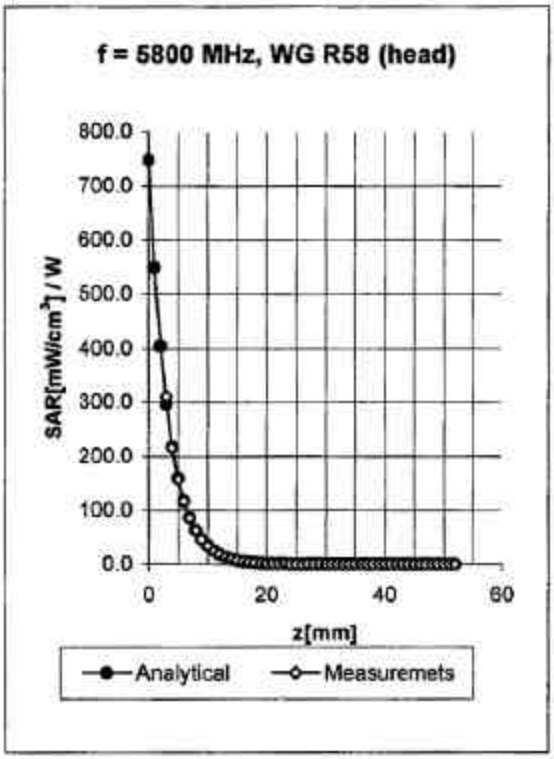
ConvF X	**2.60** ± 16.6% (k=2)	Boundary effect:	
ConvF Y	**2.60** ± 16.6% (k=2)	Alpha	**0.93**
ConvF Z	**2.60** ± 16.6% (k=2)	Depth	**1.50**

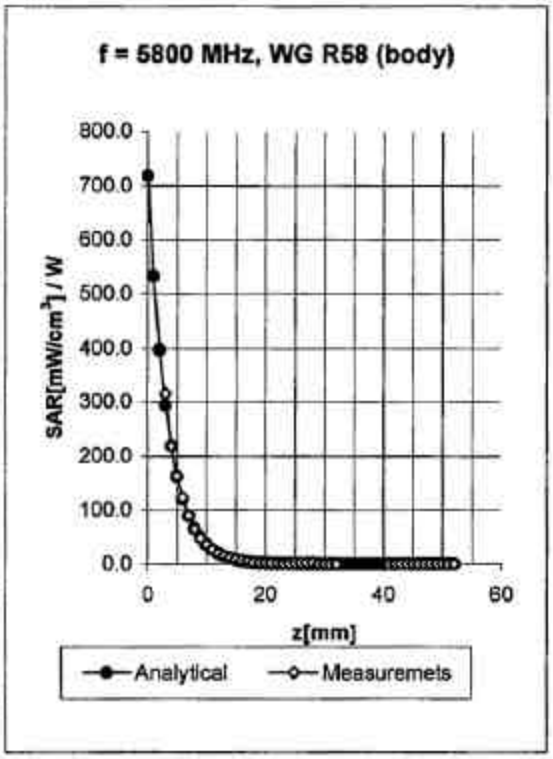
Body **5200 MHz** ε_r = **49.0 ± 5%** σ = **5.30 ± 5% mho/m**

Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET65-SuppC

ConvF X	**1.80** ± 16.6% (k=2)	Boundary effect:	
ConvF Y	**1.80** ± 16.6% (k=2)	Alpha	**1.05**
ConvF Z	**1.80** ± 16.6% (k=2)	Depth	**1.60**

Conversion Factor Assessment





Head **5800 MHz** ε_r = 35.3 ± 5% σ = 5.27 ± 5% mho/m

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET65-SuppC

ConvF X	**2.15** ± 16.6% (k=2)	Boundary effect:	
ConvF Y	**2.15** ± 16.6% (k=2)	Alpha	**1.04**
ConvF Z	**2.15** ± 16.6% (k=2)	Depth	**1.50**

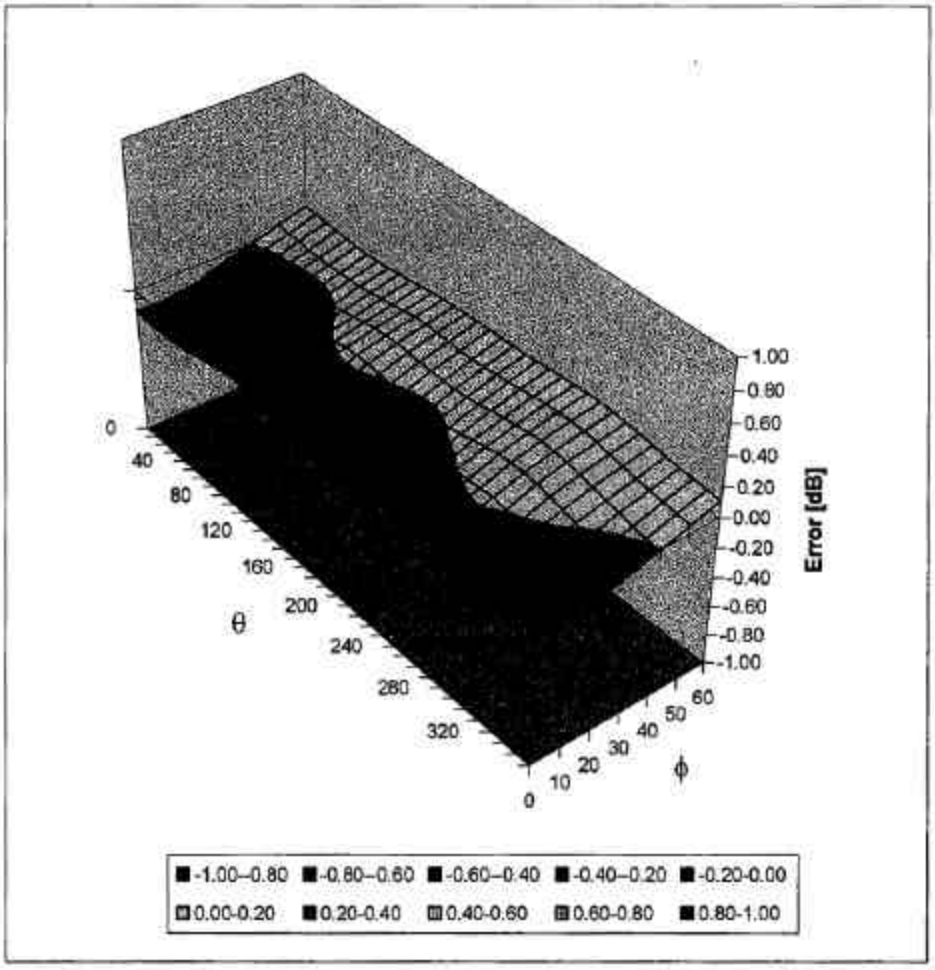
Body **5800 MHz** ε_r = 48.2 ± 5% σ = 6.0 ± 5% mho/m

Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET65-SuppC

ConvF X	**1.57** ± 16.6% (k=2)	Boundary effect:	
ConvF Y	**1.57** ± 16.6% (k=2)	Alpha	**1.15**
ConvF Z	**1.57** ± 16.6% (k=2)	Depth	**1.70**

Deviation from Isotropy in HSL

Error (θφ), f = 900 MHz



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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV2**
Serial Number:	**3022**
Place of Assessment:	**Zurich**
Date of Assessment:	**December 3, 2003**
Probe Calibration Date:	**September 23, 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 ES3DV2 SN:3022

Conversion factor (± standard deviation)

1950 MHz	ConvF	**4.7 ± 9.5%**	**□ = 40.0 ± 5%** **□ = 1.40 ± 5% mho/m** (head tissue)
1950 MHz	ConvF	**4. 3± 9.5%**	**□ = 53.3 ± 5%** **□ = 1.52 ± 5% mho/m** (body tissue)

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV2**
Serial Number:	**3022**
Place of Assessment:	**Zurich**
Date of Assessment:	**October 3, 2003**
Probe Calibration Date:	**September 23, 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.

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Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor (± standard deviation)

150 MHz	ConvF	**8.5 ± 8%**	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
150 MHz	ConvF	**8.0 ± 8%**	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
450 MHz	ConvF	**7.1 ± 8%**	ε_r = 43.5 ± 5% σ = 0.87 ± 5% mho/m (head tissue)
450 MHz	ConvF	**7.2 ± 8%**	ε_r = 56.7 ± 5% σ = 0.94 ± 5% mho/m (body tissue)

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV2**
Serial Number:	**3022**
Place of Assessment:	**Zurich**
Date of Assessment:	**November 28, 2003**
Probe Calibration Date:	**September 23, 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 ES3DV2 SN:3022

Conversion factor (± standard deviation)

1600 MHz	ConvF	**5.2 ± 8%**	**□ = 40.3 ± 5%** **□ = 1.29 ± 5% mho/m** (head tissue)
1600 MHz	ConvF	**4.9 ± 8%**	**□ = 53.8 ± 5%** **□ = 1.40 ± 5% mho/m** (body tissue)

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV2**
Serial Number:	**3022**
Place of Assessment:	**Zurich**
Date of Assessment:	**December 9, 2003**
Probe Calibration Date:	**September 23, 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 ES3DV2 SN:3022

Conversion factor (± standard deviation)

2140 MHz	ConvF	**4.5 ± 8%**	**□ = 39.8 ± 5%** **□ = 1.49 ± 5% mho/m** (brain tissue)