

Client

CCS, USA

CALIBRATION CERTIFICATE

Object(s)

ES3DV2 - SN:3021

Calibration procedure(s)

QA CAL-01.v2

Calibration procedure for dosimetric E-field probes

Calibration date:

July 29, 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
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	

Approved by:	Fin Bornholt	R&D Director
--------------	--------------	--------------



Date issued: July 29, 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 ES3DV2

SN:3021

Manufactured:	December 5, 2002
Last calibration:	July 29, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3021

Sensitivity in Free Space

NormX	1.43 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.20 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.29 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head 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	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha 0.93
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth 0.96

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	5.1 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.1 $\pm 9.5\%$ (k=2)	Alpha 0.21
ConvF Z	5.1 $\pm 9.5\%$ (k=2)	Depth 2.73

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

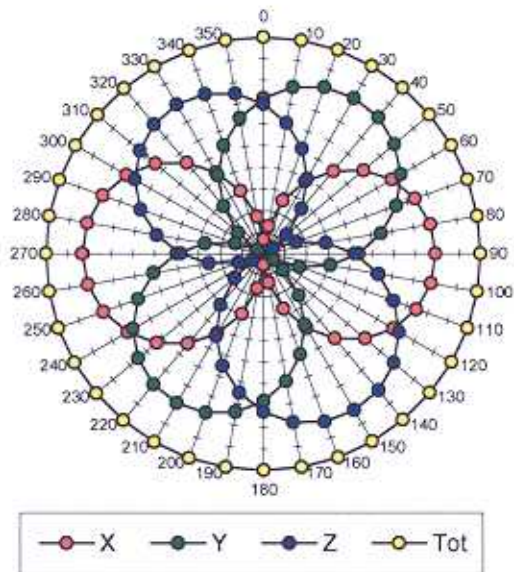
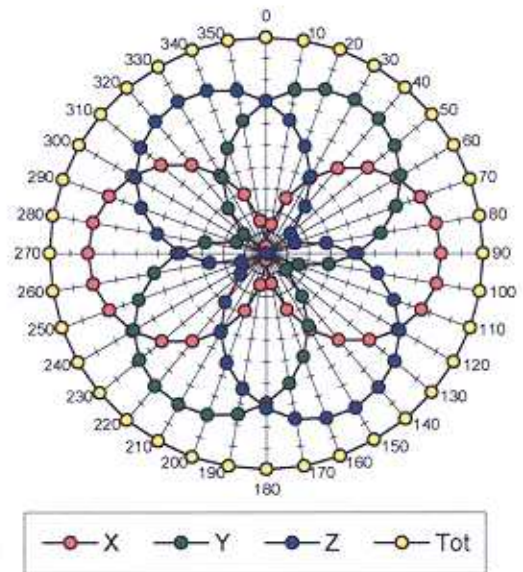
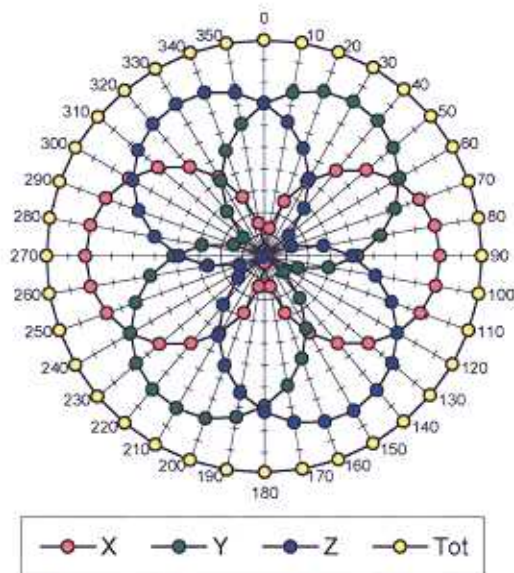
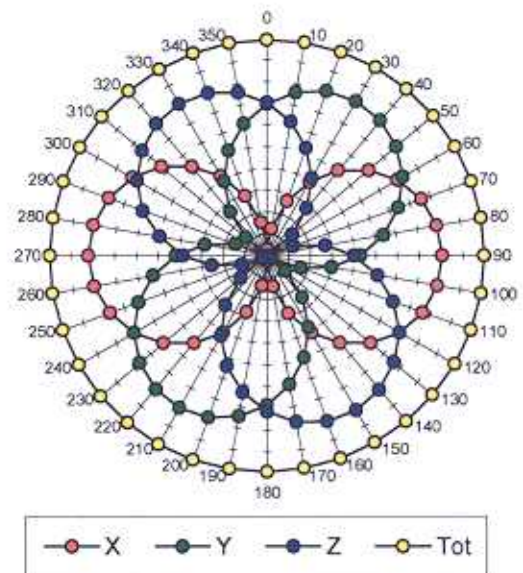
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		3.8	1.5
SAR _{be} [%] With Correction Algorithm		0.0	0.2

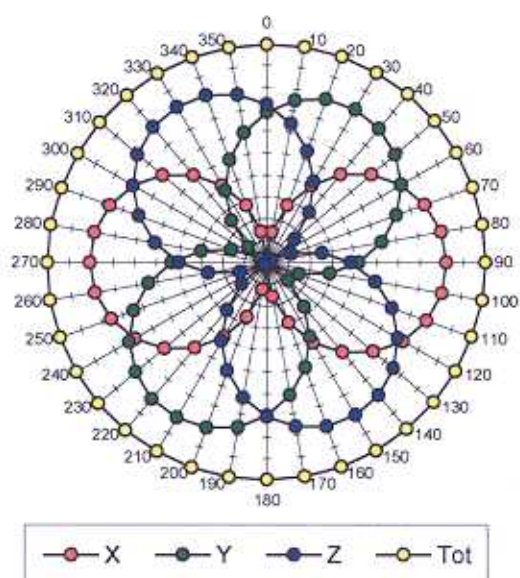
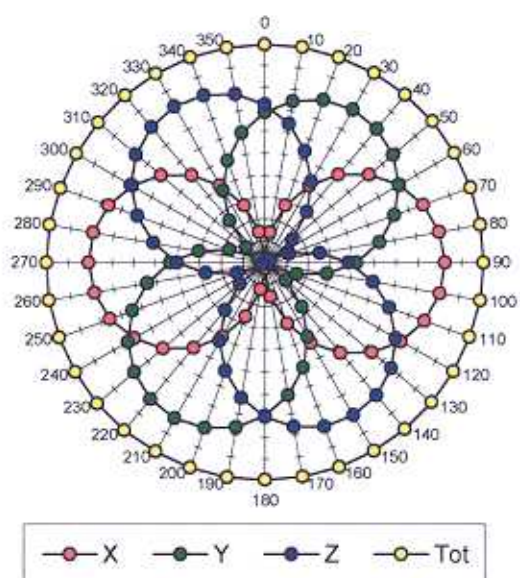
Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		7.1	4.6
SAR _{be} [%] With Correction Algorithm		0.0	0.2

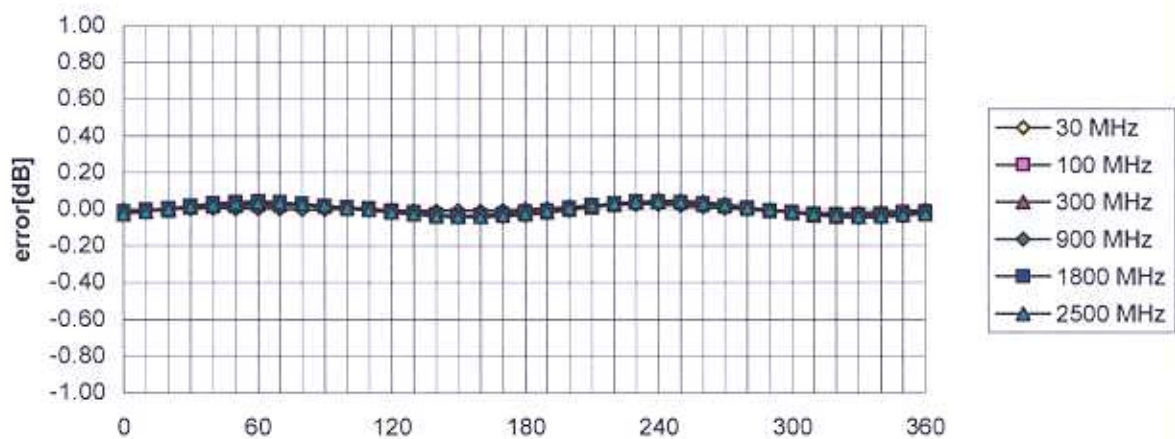
Sensor Offset

Probe Tip to Sensor Center	2.1	mm
----------------------------	------------	----

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

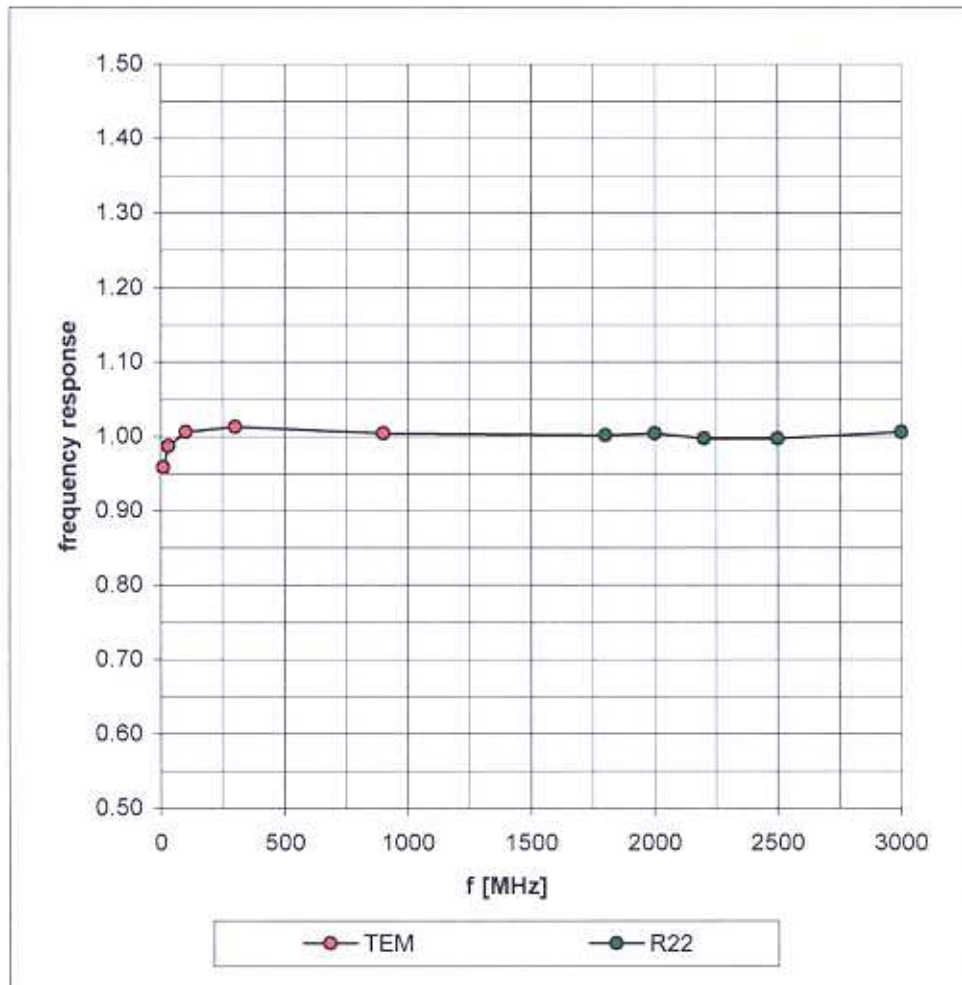
$f = 1800 \text{ MHz, WG R22}$  $f = 2500 \text{ MHz, WG R22}$ 

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

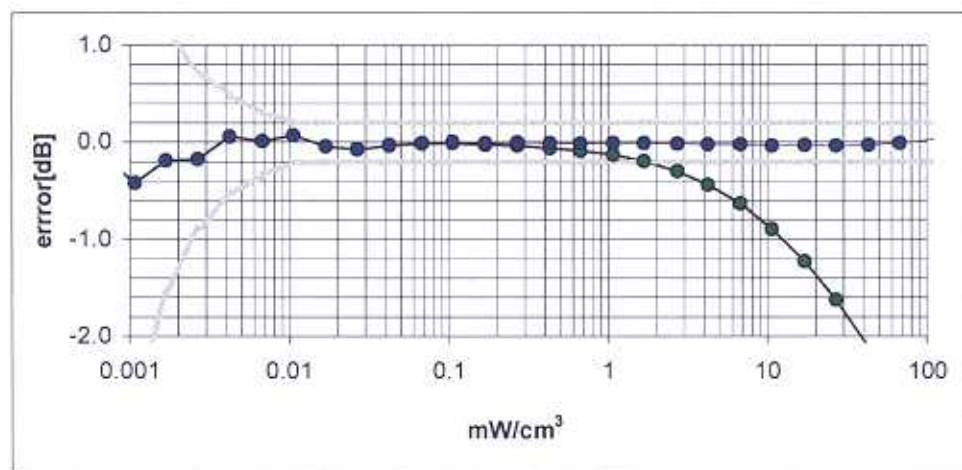
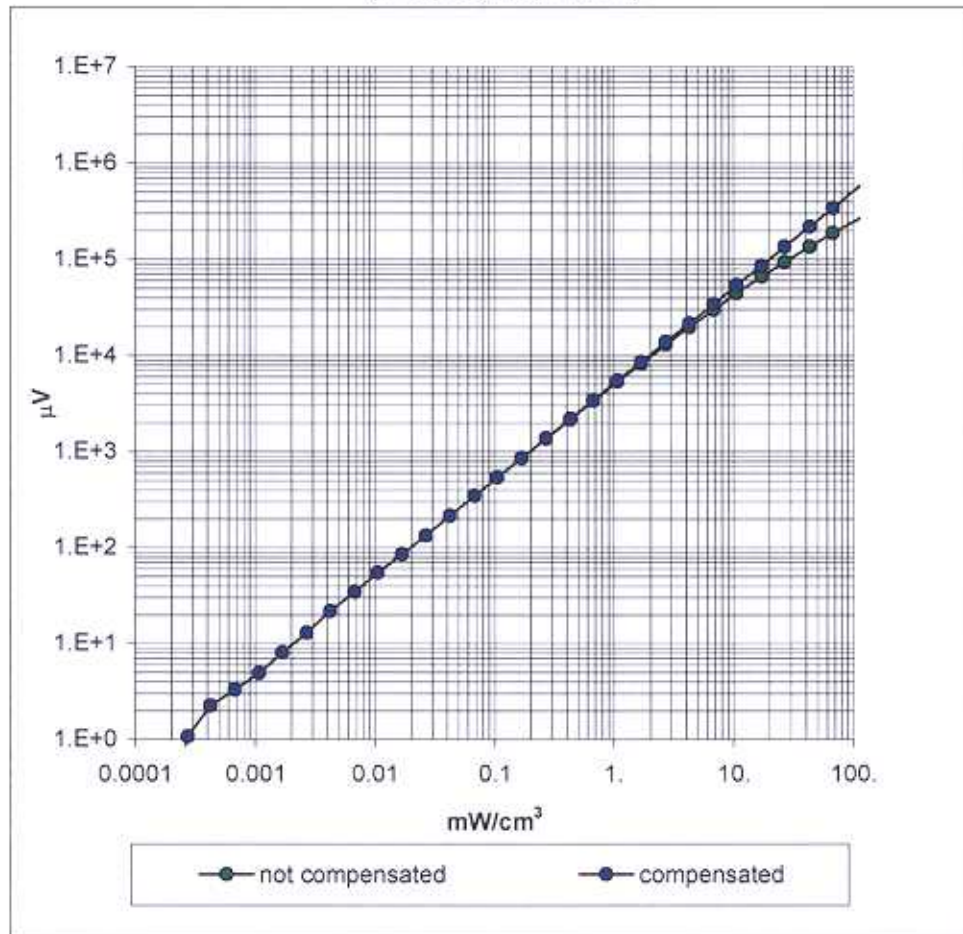


Frequency Response of E-Field

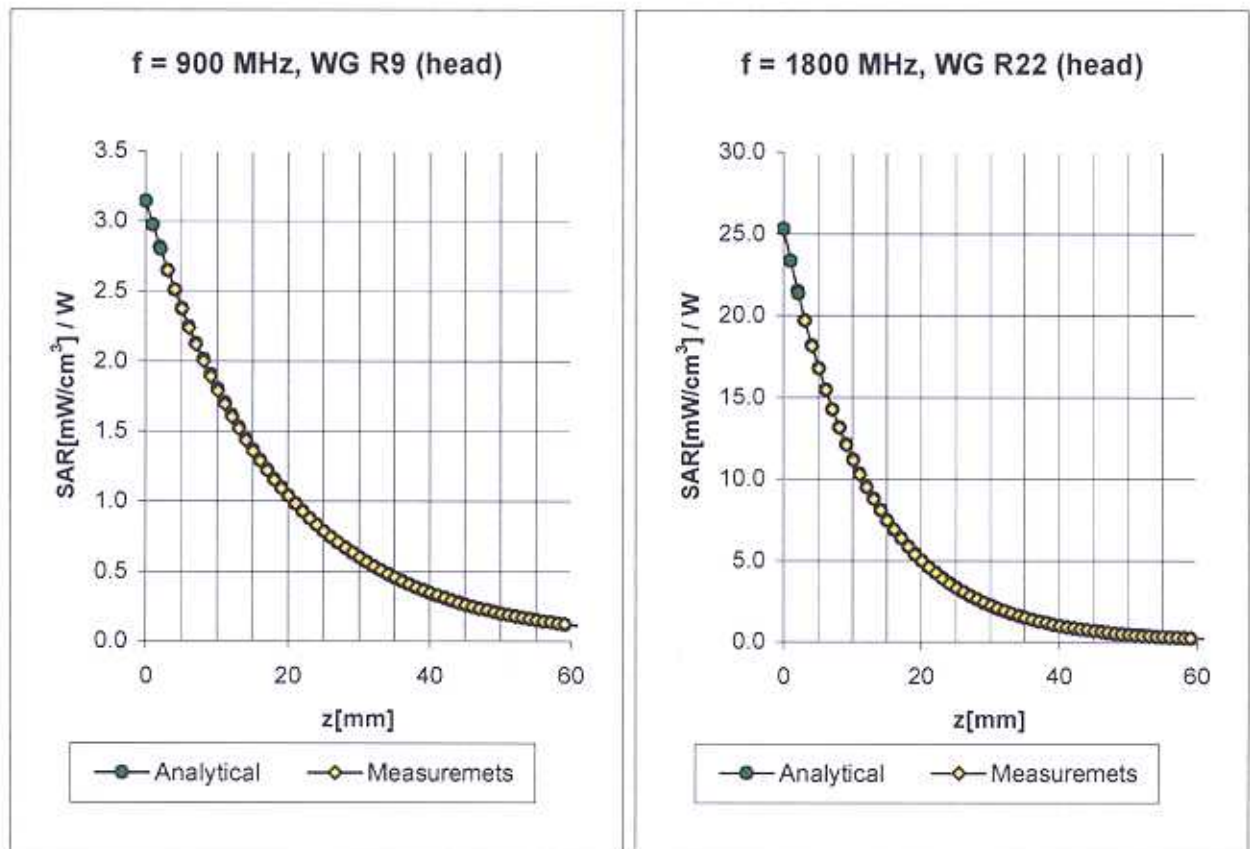
(TEM-Cell:ifi110, Waveguide R22)



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



Conversion Factor Assessment



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

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

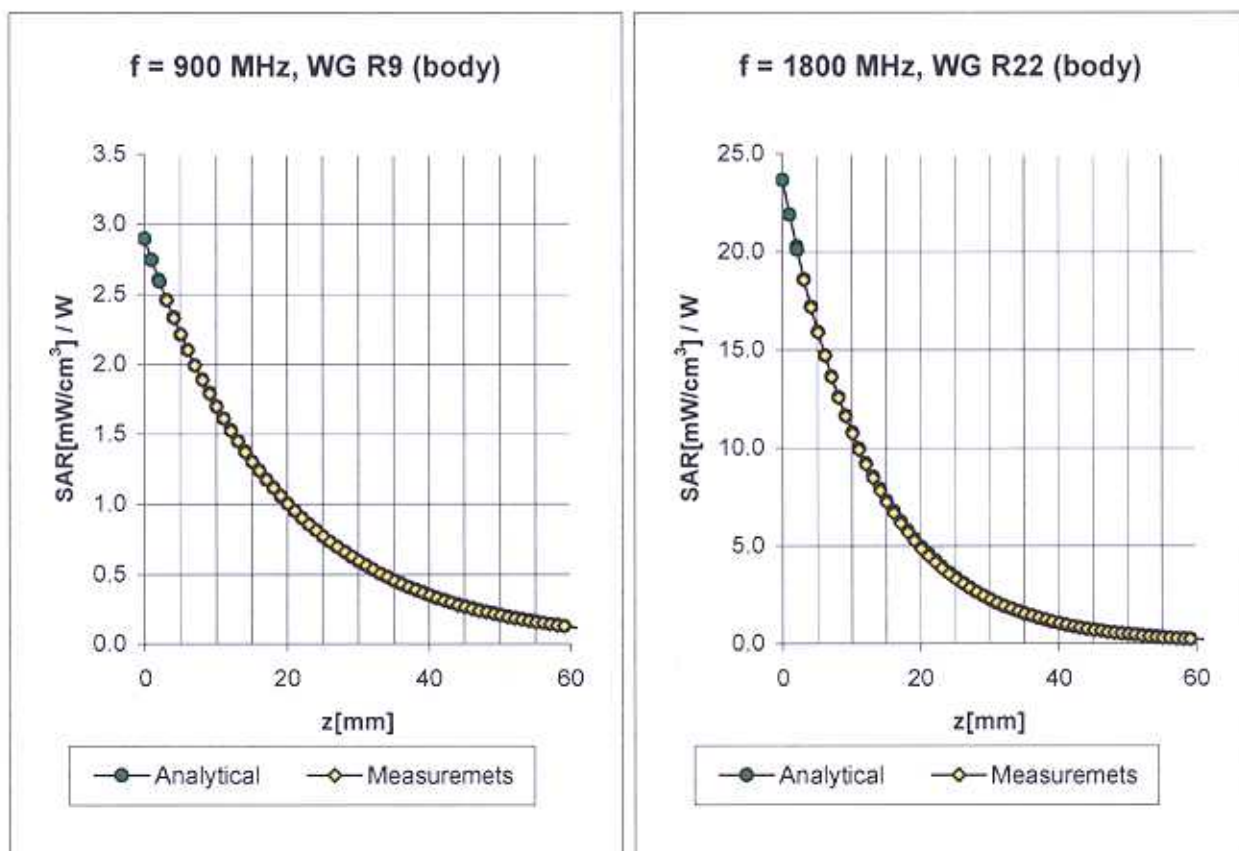
ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha	0.93
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth	0.96

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

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

ConvF X	5.1 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.1 $\pm 9.5\%$ (k=2)	Alpha	0.21
ConvF Z	5.1 $\pm 9.5\%$ (k=2)	Depth	2.73

Conversion Factor Assessment



Body **900 MHz** $\epsilon_r = 55.0 \pm 5\%$ $\sigma = 1.05 \pm 5\%$ mho/m

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

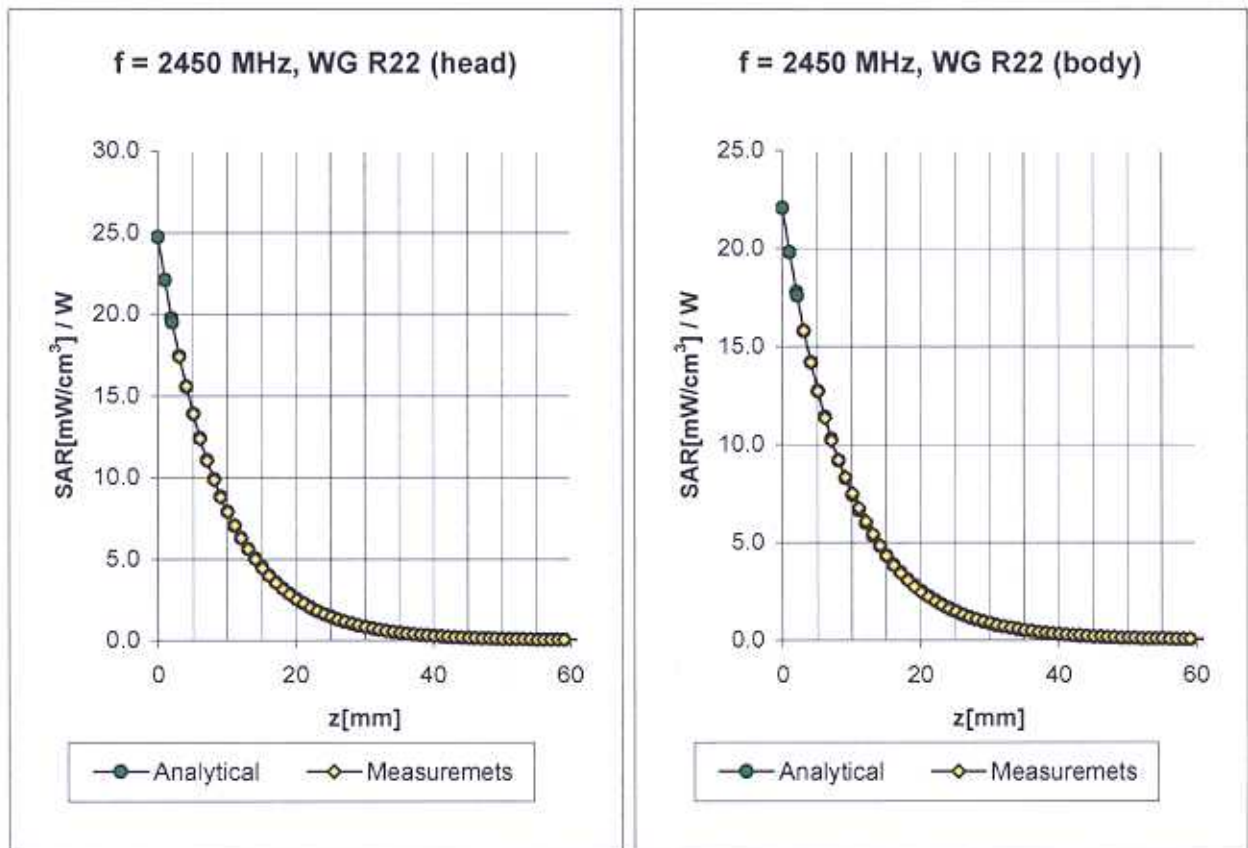
ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha	0.58
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth	1.22

Body **1800 MHz** $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\%$ mho/m

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

ConvF X	4.8 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	4.8 $\pm 9.5\%$ (k=2)	Alpha	0.22
ConvF Z	4.8 $\pm 9.5\%$ (k=2)	Depth	2.90

Conversion Factor Assessment



Head **2450 MHz** $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ mho/m

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

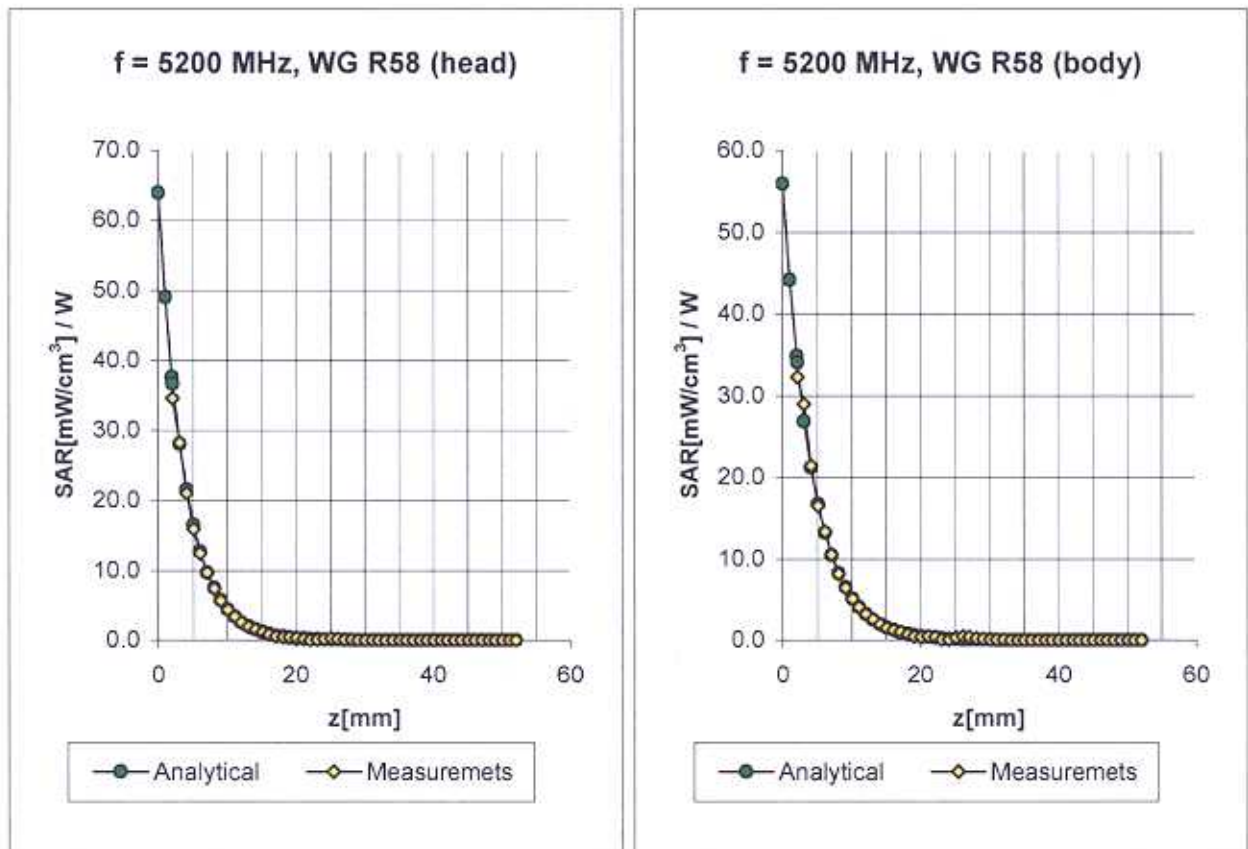
ConvF X	4.5 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	4.5 $\pm 8.9\%$ (k=2)	Alpha	0.37
ConvF Z	4.5 $\pm 8.9\%$ (k=2)	Depth	1.75

Body **2450 MHz** $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ mho/m

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

ConvF X	4.1 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	4.1 $\pm 8.9\%$ (k=2)	Alpha	0.27
ConvF Z	4.1 $\pm 8.9\%$ (k=2)	Depth	2.54

Conversion Factor Assessment



Head **5200 MHz** $\epsilon_r = 36.0 \pm 5\%$ $\sigma = 4.66 \pm 5\% \text{ mho/m}$

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

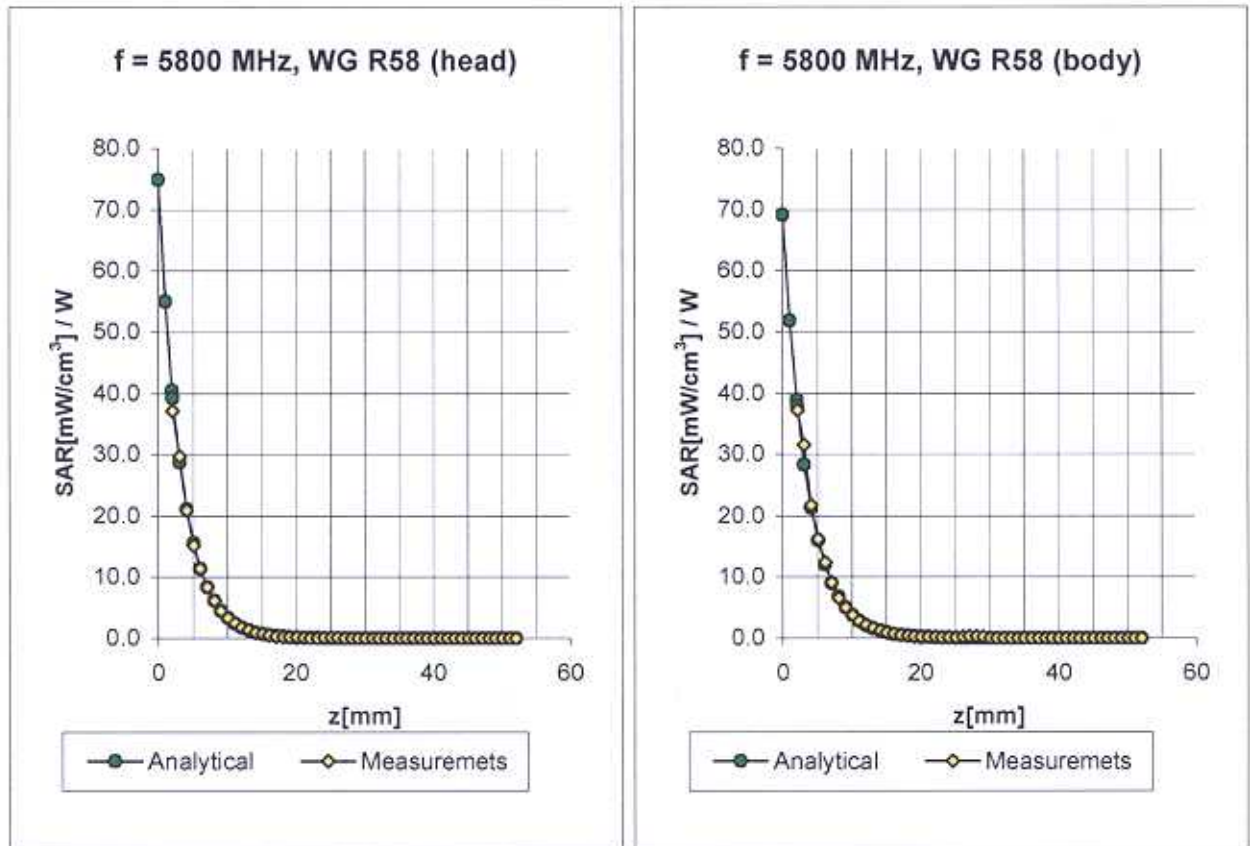
ConvF X	2.2 $\pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	2.2 $\pm 14.6\%$ (k=2)	Alpha	0.99
ConvF Z	2.2 $\pm 14.6\%$ (k=2)	Depth	1.50

Body **5200 MHz** $\epsilon_r = 49.0 \pm 5\%$ $\sigma = 5.30 \pm 5\% \text{ mho/m}$

Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	1.4 $\pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	1.4 $\pm 14.6\%$ (k=2)	Alpha	1.12
ConvF Z	1.4 $\pm 14.6\%$ (k=2)	Depth	1.65

Conversion Factor Assessment



Head **5800 MHz** $\epsilon_r = 35.3 \pm 5\%$ $\sigma = 5.27 \pm 5\%$ mho/m

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	1.8 $\pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	1.8 $\pm 14.6\%$ (k=2)	Alpha	1.15
ConvF Z	1.8 $\pm 14.6\%$ (k=2)	Depth	1.50

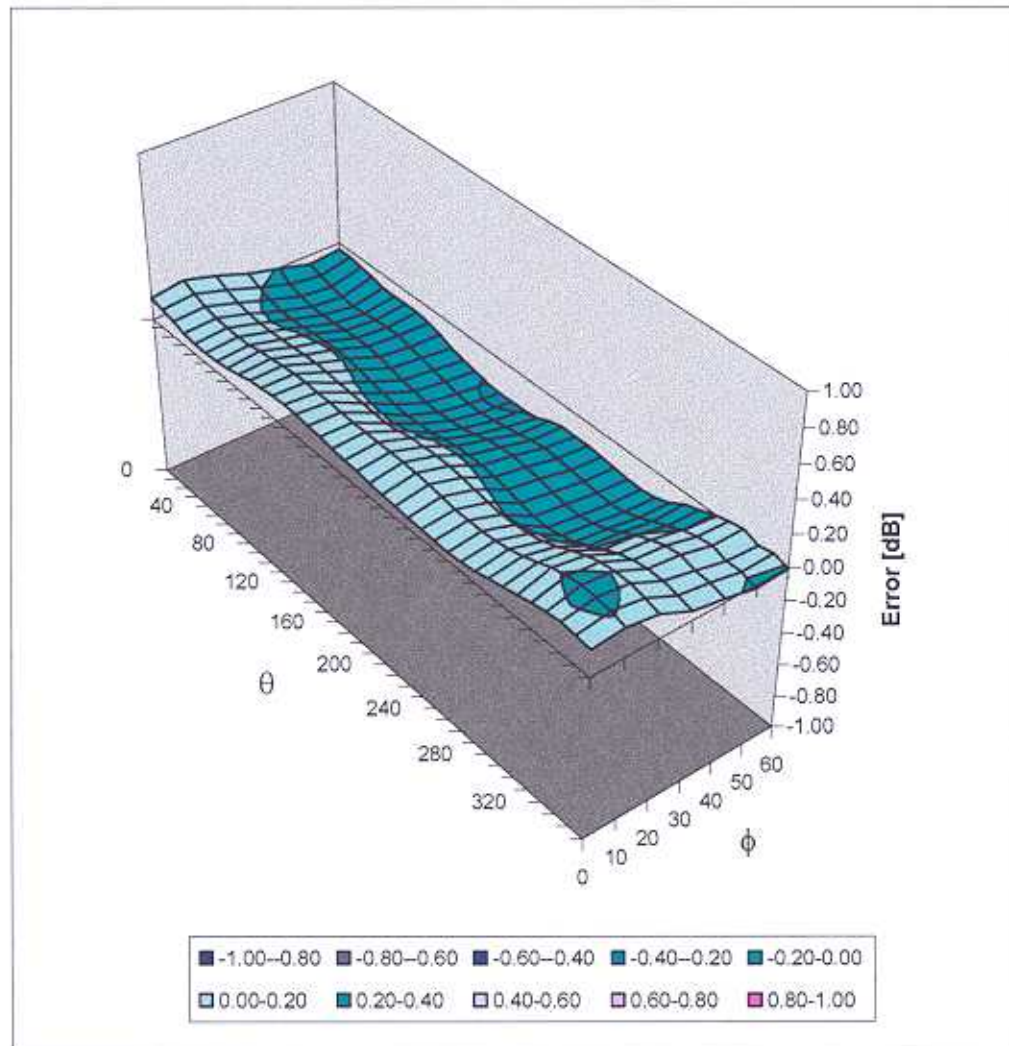
Body **5800 MHz** $\epsilon_r = 48.2 \pm 5\%$ $\sigma = 6.00 \pm 5\%$ mho/m

Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	1.1 $\pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	1.1 $\pm 14.6\%$ (k=2)	Alpha	1.10
ConvF Z	1.1 $\pm 14.6\%$ (k=2)	Depth	1.75

Deviation from Isotropy in HSL

Error ($\theta\phi$), $f = 900$ MHz



Dosimetric E-Field Probe ES3DV2 SN:3021

Conversion factor ($\pm$ standard deviation)

450 MHz	ConvF	$7.6 \pm 8\%$	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 MHz	ConvF	$7.4 \pm 8\%$	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.