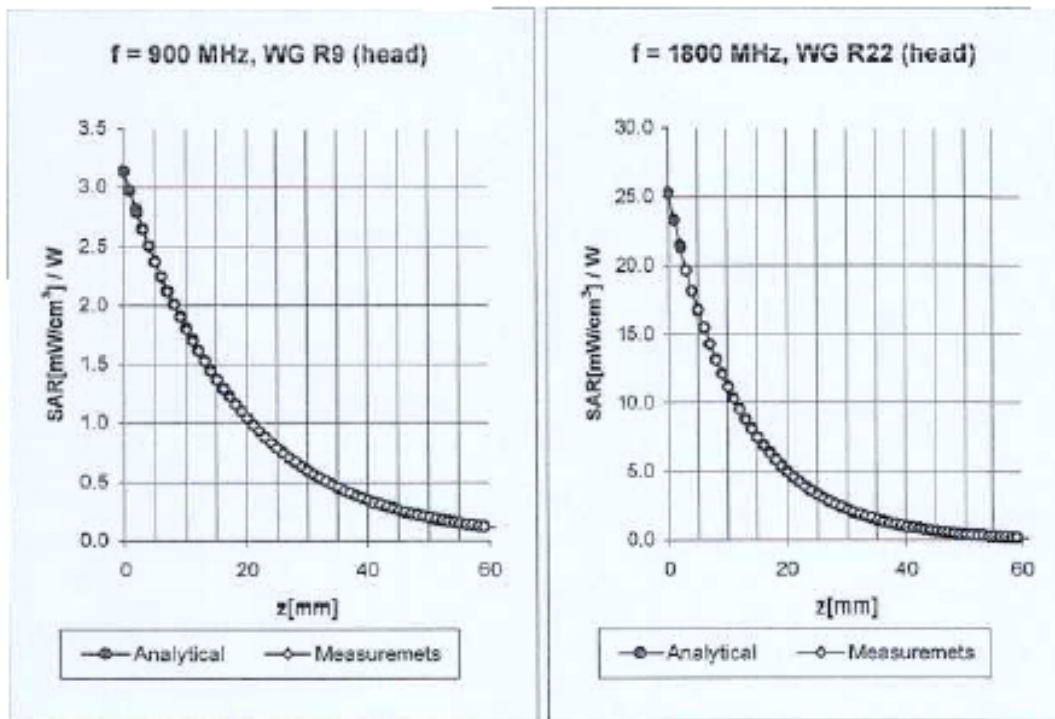


ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



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	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha 0.68
ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth 1.11

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

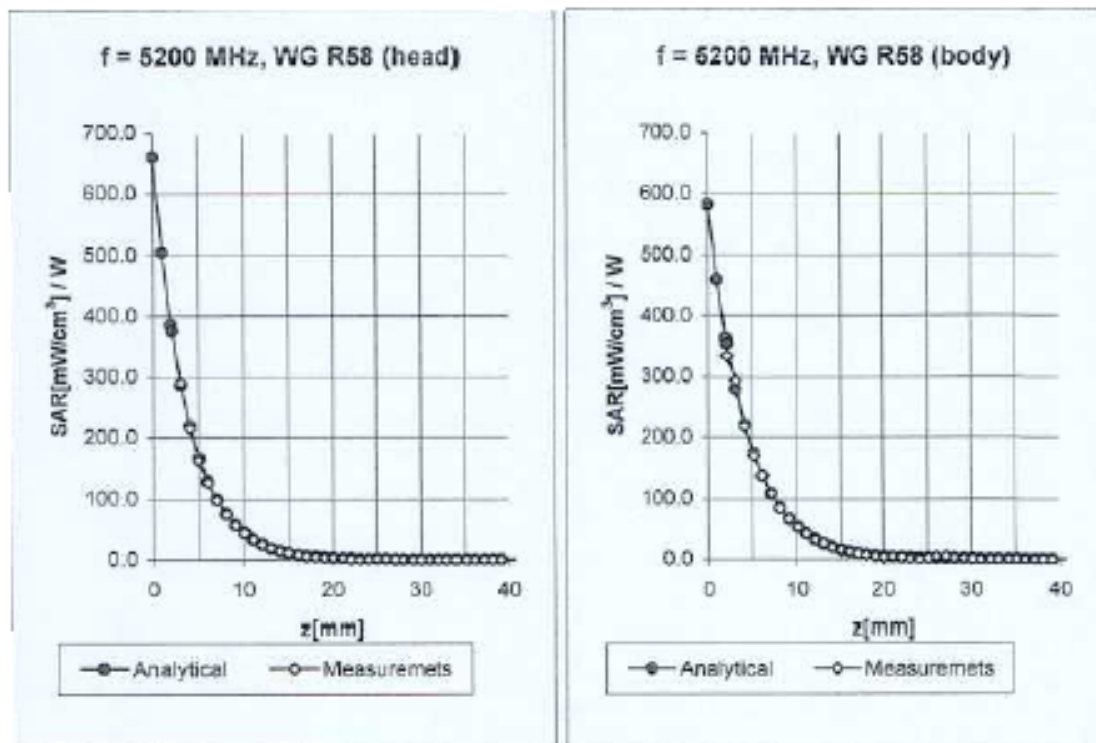
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha 0.21
ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth 2.78

ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



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

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

ConvF X	$2.3 \pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	$2.3 \pm 14.6\%$ (k=2)	Alpha	1.05
ConvF Z	$2.3 \pm 14.6\%$ (k=2)	Depth	1.50

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

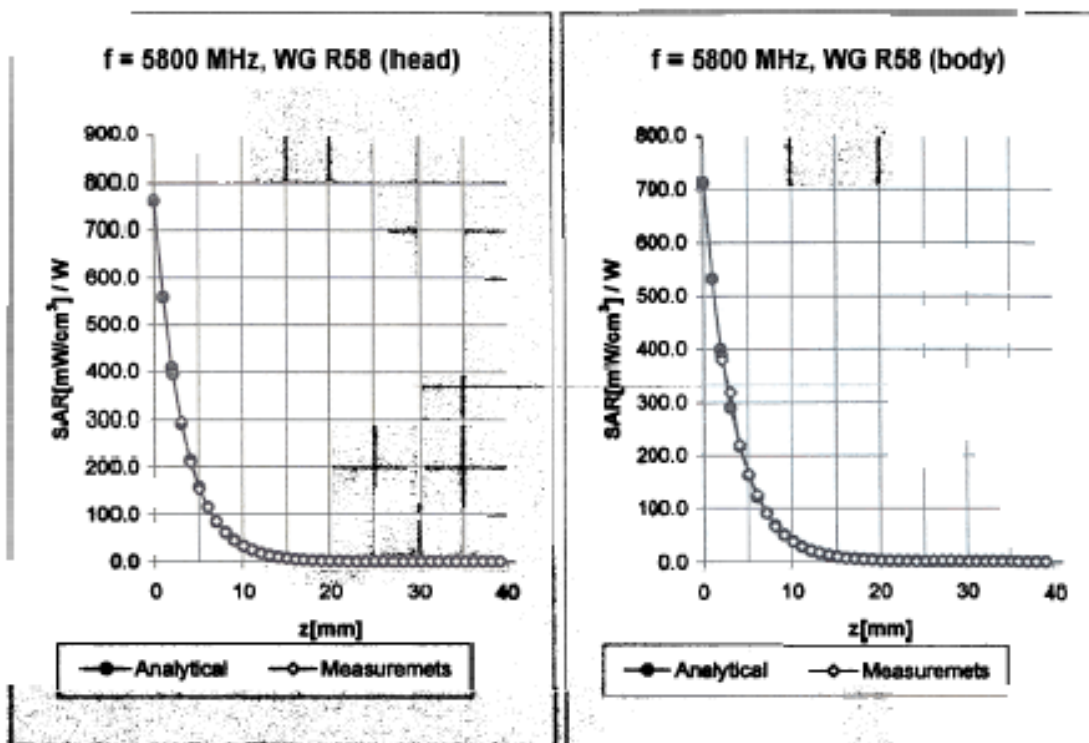
Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	$1.4 \pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	$1.4 \pm 14.6\%$ (k=2)	Alpha	1.01
ConvF Z	$1.4 \pm 14.6\%$ (k=2)	Depth	1.85

ES3DV2 SN: 3019

July 12, 2003

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	0.90
ConvF Z	$1.8 \pm 14.6\%$ (k=2)	Depth	1.90

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

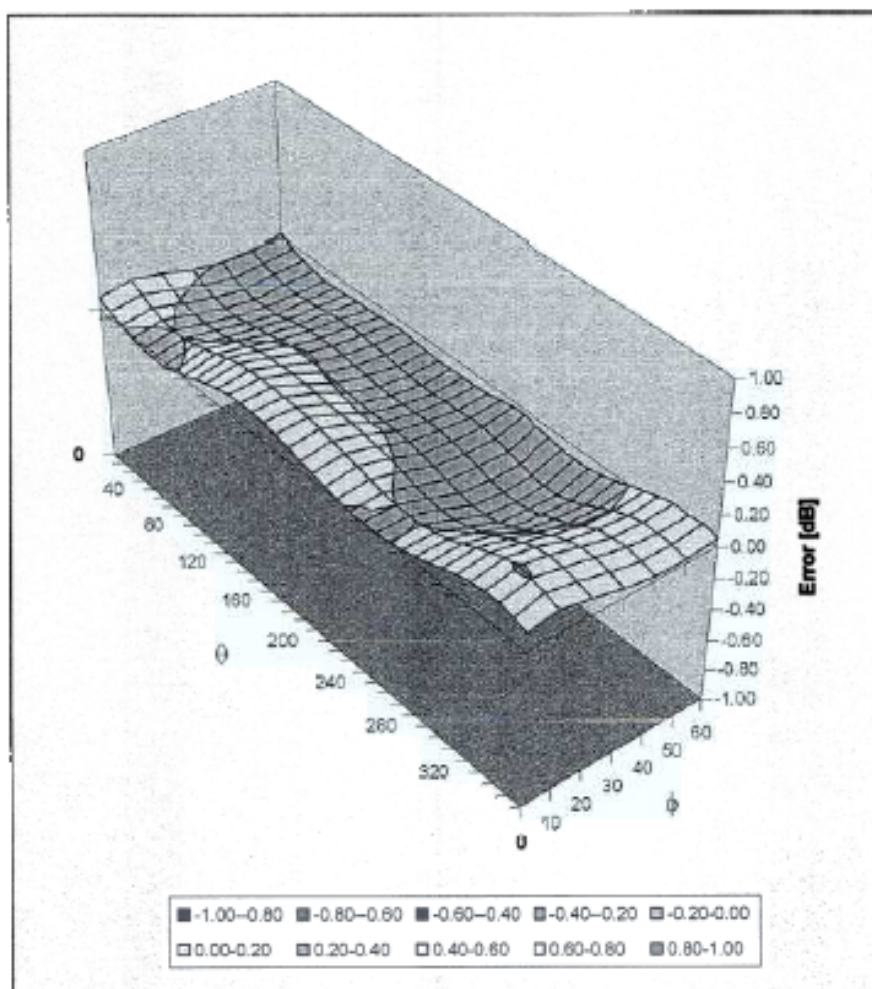
ConvF X	$1.2 \pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	$1.2 \pm 14.6\%$ (k=2)	Alpha	1.18
ConvF Z	$1.2 \pm 14.6\%$ (k=2)	Depth	1.65

ES3DV2 SN: 3019

July 12, 2003

Deviation from Isotropy in HSL

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



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Probe ES3DV2

SN:3019

Additional Conversion Factors

Manufactured:	December 5, 2002
Last calibration:	July 12, 2003
Add. calibration:	October 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3019**Sensitivity in Free Space**

NormX	1.05 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.14 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$

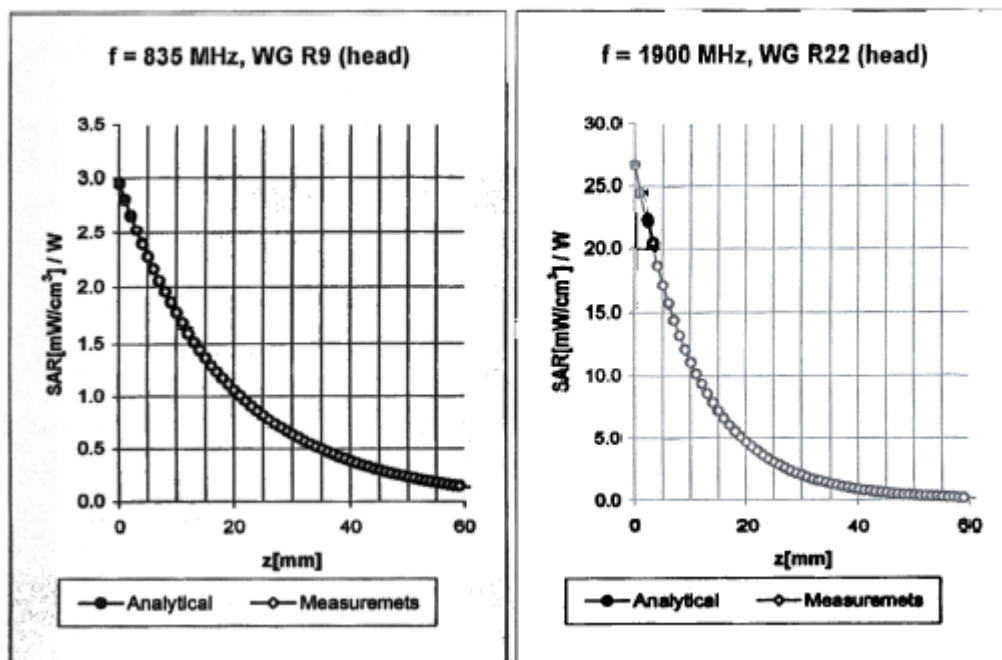
Diode Compression

DCP X	99
DCP Y	99
DCP Z	99

Sensor Offset

Probe Tip to Sensor Center	2.1	mm
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Conversion Factor Assessment



Head 835 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.90 \pm 5\%$ mho/m

Valid for f=793-877 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

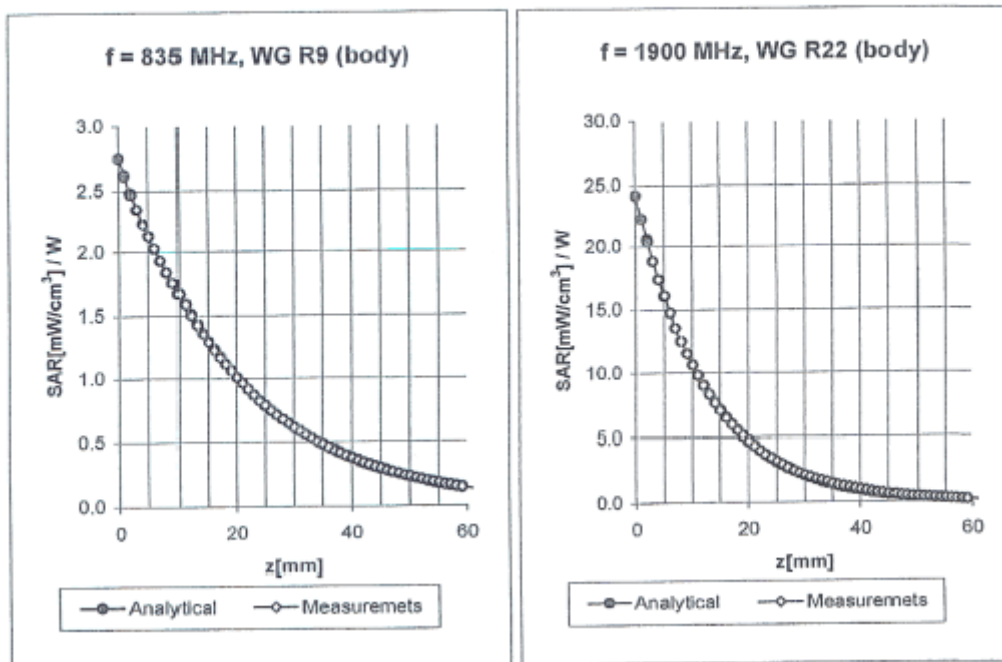
ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha	0.35
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth	1.46

Head 1900 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1805-1995 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.7 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	4.7 $\pm 9.5\%$ (k=2)	Alpha	0.22
ConvF Z	4.7 $\pm 9.5\%$ (k=2)	Depth	3.48

Conversion Factor Assessment



Body **835 MHz** $\epsilon_r = 55.2 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

Valid for f=793-877 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

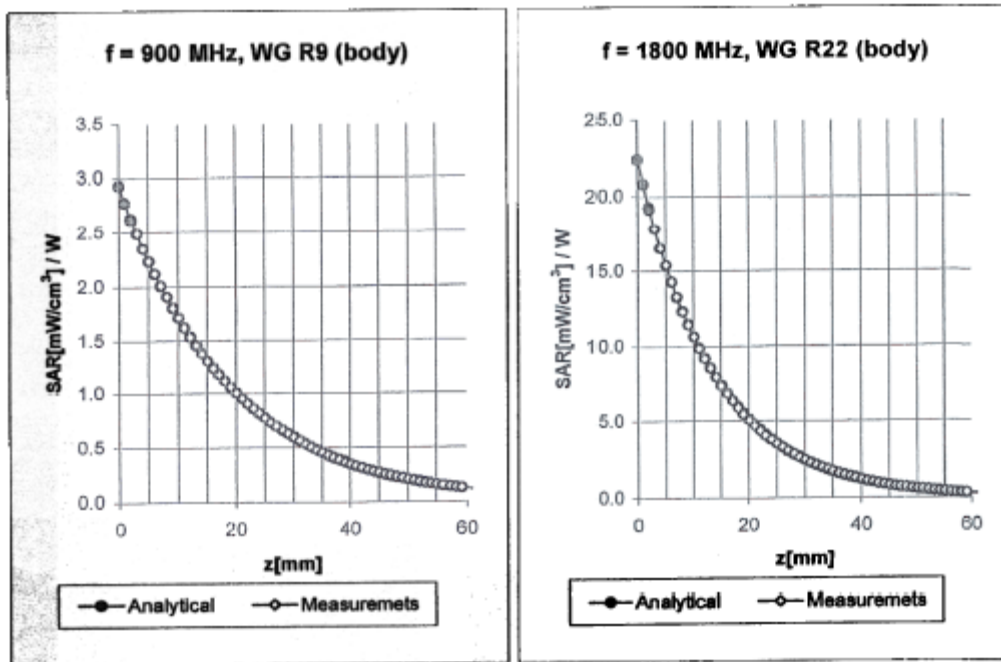
ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha 0.24
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth 2.00

Body **1900 MHz** $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

Valid for f=1805-1995 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.6 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.6 $\pm 9.5\%$ (k=2)	Alpha 0.24
ConvF Z	4.6 $\pm 9.5\%$ (k=2)	Depth 2.64

Conversion Factor Assessment



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

Valid for f=855-945 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

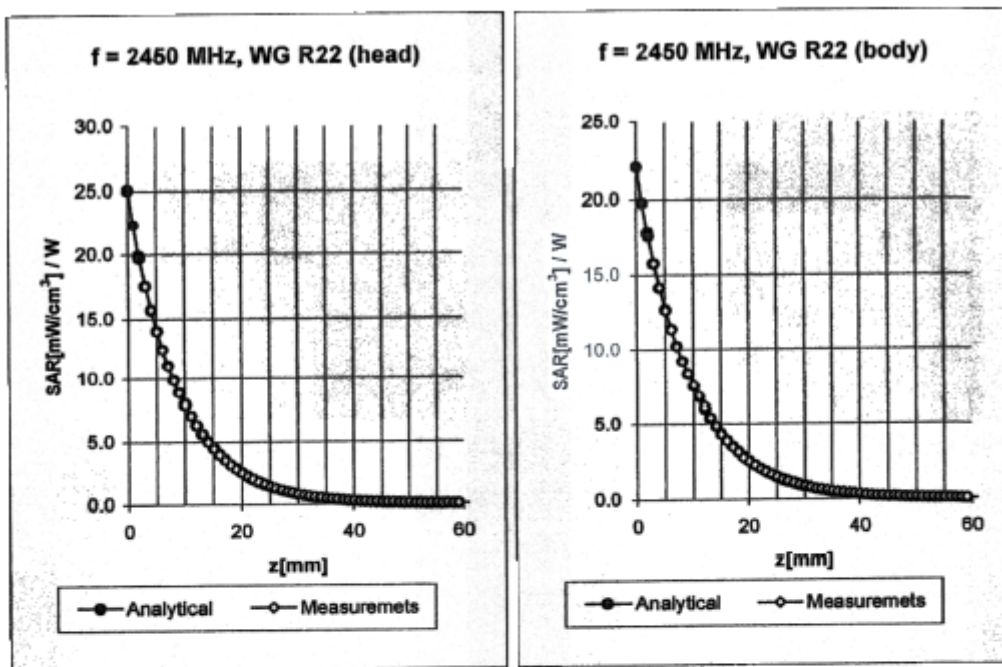
ConvF X	6.1 $\pm$ 9.5% (k=2)	Boundary effect:
ConvF Y	6.1 $\pm$ 9.5% (k=2)	Alpha 0.27
ConvF Z	6.1 $\pm$ 9.5% (k=2)	Depth 1.82

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

Valid for f=1710-1890 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.7 $\pm$ 9.5% (k=2)	Boundary effect:
ConvF Y	4.7 $\pm$ 9.5% (k=2)	Alpha 0.23
ConvF Z	4.7 $\pm$ 9.5% (k=2)	Depth 2.99

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 60381, P1528-200X

ConvF X	4.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.5 $\pm 9.5\%$ (k=2)	Alpha 0.40
ConvF Z	4.5 $\pm 9.5\%$ (k=2)	Depth 1.62

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	4.2 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.2 $\pm 9.5\%$ (k=2)	Alpha 0.32
ConvF Z	4.2 $\pm 9.5\%$ (k=2)	Depth 1.98

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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3019

Place of Assessment:

Zurich

Date of Assessment:

October 13, 2003

Probe Calibration Date:

October 9, 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:



ES3DV2-SN:3019

October 13, 2003

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Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor ($\pm$ standard deviation)

150 MHz ConvF **$8.7 \pm 8\%$**

$\epsilon_r = 52.3 \pm 5\%$
 $\sigma = 0.76 \pm 5\%$ mho/m
(head tissue)

150 MHz ConvF **$8.3 \pm 8\%$**

$\epsilon_r = 61.9 \pm 5\%$
 $\sigma = 0.80 \pm 5\%$ mho/m
(body tissue)

450 MHz ConvF **$7.4 \pm 8\%$**

$\epsilon_r = 43.5 \pm 5\%$
 $\sigma = 0.87 \pm 5\%$ mho/m
(head tissue)

450 MHz ConvF **$7.3 \pm 8\%$**

$\epsilon_r = 56.7 \pm 5\%$
 $\sigma = 0.94 \pm 5\%$ mho/m
(body tissue)

ES3DV2-SN:3019

October 13, 2003

APPENDIX C – DIPOLE CALIBRATION CERTIFICATES

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

Client **BACL**

CALIBRATION CERTIFICATE

Object(s) **D300V2 - SN:1004**

Calibration procedure(s) **QA CAL-15.v2
Calibration procedure for dipole validation kits below 800 MHz**

Calibration date: **August 25, 2003**

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

This calibration statement documents traceability of M&E 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&E 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: 6086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04
Power sensor HP 8481A	MY41062180	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 Polkovic	Laboratory Director	
Approved by:	Fin Bombolt	R&D Director	

Date issued: September 23, 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.

**Schmid & Partner
Engineering AG**

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DASY

Dipole Validation Kit

Type: D300V2

Serial: 1004

Manufactured: August 26, 2002

Calibrated: August 25, 2003

1. Measurement Conditions

The measurements were performed in the flat phantom filled with head simulating liquid of the following electrical parameters at 300 MHz:

Relative Dielectricity	45.6	$\pm 5\%$
Conductivity	0.90 mho/m	$\pm 5\%$

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 8.75 at 300 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the longer side of the phantom. The standard measuring distance was 15mm from dipole center to the liquid surface including the 6mm thick phantom shell. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was $395 \text{ mW} \pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	2.86 mW/g (Advanced Extrapolation)
averaged over 10 cm^3 (10 g) of tissue:	1.90 mW/g (Advanced Extrapolation)

Advanced extrapolation has been applied to the measured SAR values to compensate for the probe boundary effect (see DASY User Manual for details).

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well.

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	1.742 ns	(one direction)
Transmission factor:	0.994	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 300 MHz:	$\text{Re}\{Z\} = 55.1 \Omega$
---------------------------------	--------------------------------

	$\text{Im}\{Z\} = -1.8 \Omega$
--	--------------------------------

Return Loss at 300 MHz	-22.2 dB
------------------------	----------

4. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

5. Design

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

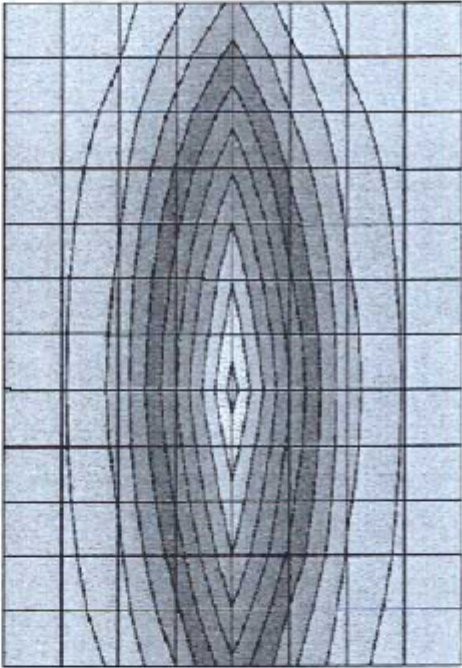
6. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

08/25/03

validation Dipole D300V2 SN:1003, d = 15 mm

frequency: 300 MHz; Antenna Input Power: 395 [mW], Flat Phantom (shell thickness = 5mm)
Irid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
tube: ET3DV6 - SN1507-Y2203; Crest factor: 1.0; Head 300 MHz $\sigma = 0.90$ mho/m $\epsilon_r = 45.6$ $\rho = 1.00$ g/cm³
tubes (2); Peak: 1.74 mW/g ± 0.01 dB, SAR (1g): 1.13 mW/g ± 0.02 dB, SAR (10g): 0.752 mW/g ± 0.03 dB, (Advanced extrapolation)
penetration depth: 13.0 (11.5, 15.0) [mm]



12.5/0.3

Validation Dipole D300V2 SN:1003, d = 15 mm

Frequency: 300 MHz; Antenna Input Power: 395 [mW]; Flat Phantom (shell thickness = 6mm)
Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe ET3DV6 - SN1507-Y2603; CorvF(8.75,8.75); Coeff factor: 1.0; Head 300 MHz: $\sigma = 0.90$ mho/m, $\epsilon_r = 45.6$, $\rho = 1.00$ g/cm³
Tubes (2): Peak: 1.99 mW/g $\pm$ 0.01 dB, SAR (1g): 1.19 mW/g $\pm$ 0.02 dB, SAR (10g): 0.777 mW/g $\pm$ 0.03 dB, (Worst-case extrapolation)
Penetration depth: 12.3 (10.5, 14.8) [mm]

