



**CALIBRATION SECTION
FOR RFI TEST REPORT SERIAL NO:
RFI/SARB1/RP43652JD05A**

Test Of: Sendo Ltd.
SND251 Mobile Telephone Handset

To: OET Bulletin 65 Supplement C: (2001-01)

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RADIO FREQUENCY INVESTIGATION LTD.

EMC Department

Calibration Section

S.No. RFI/SARB1/RP43652JD05A

Issue Date: 03 October 2002

Test Of: Sendo Ltd.

SND251 Mobile Telephone Handset

To: OET Bulletin 65 Supplement C: (2001-01)

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Calibration Data

This appendix contains the calibration data and certificates.

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Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

900 MHz System Validation Dipole

Type:

D900V2

Serial Number:

124

Place of Calibration:

Zurich

Date of Calibration:

August 3, 2001

Calibration Interval:

24 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:

Alain Kaji

Approved by:

V. Kaji

DASY

Dipole Validation Kit

Type: D900V2

Serial: 124

Manufactured: July 4, 2001

Calibrated: August 3, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating solution of the following electrical parameters at 900 MHz:

Relative Dielectricity	40.3	$\pm 5\%$
Conductivity	0.95 mho/m	$\pm 5\%$

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.27 at 900 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 section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm 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 250mW $\pm 3\%$. 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:	11.28 mW/g
averaged over 10 cm ³ (10 g) of tissue:	7.16 mW/g

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:	1.425 ns	(one direction)
Transmission factor:	0.992	(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 900 MHz:	$\text{Re}\{Z\} = $ 50.8 Ω
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$\text{Im}\{Z\} = $ -5.6 Ω

Return Loss at 900 MHz	-25.4 dB
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4. Handling

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.

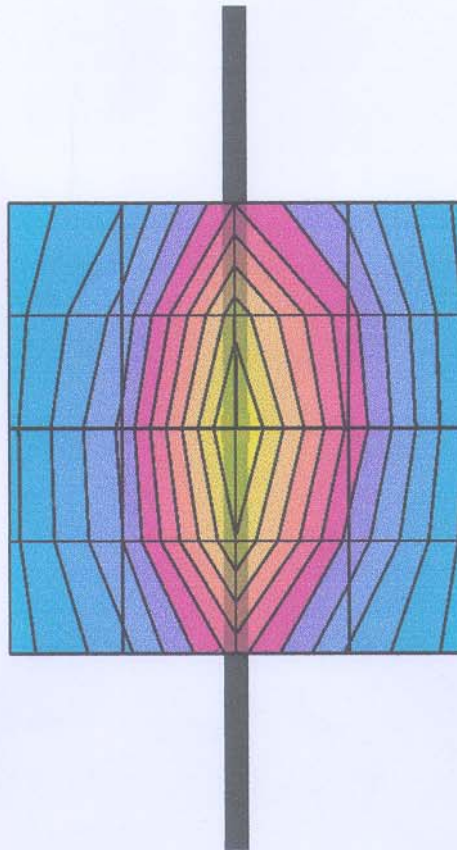
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

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

Validation Dipole D900V2 SN:124, d = 15 mm

Frequency: 900 MHz; Antenna Input Power: 250 [mW]
 SAM Phantom; Flat - SAM Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
 Probe: ET3DV6 - SN1507; ConvF(6.27,6.27,6.27) at 900 MHz; IEEE1528 900 MHz; $\sigma = 0.95$ mho/m $\epsilon_r = 40.3$ $\rho = 1.00$ g/cm³
 Cubes (2): Peak: 4.46 mW/g ± 0.04 dB, SAR (1g): 2.82 mW/g ± 0.03 dB, SAR (10g): 1.79 mW/g ± 0.02 dB, (Worst-case extrapolation)
 Penetration depth: 11.6 (10.7, 12.9) [mm]
 Powerdrift: -0.01 dB

SAR_{Tot} [mW/g]



1 Aug 2001 19:23:01

CH1 S11 1 U FS

1: 50.777 Ω -5.5781 Ω 31.702 pF

900.000 000 MHz

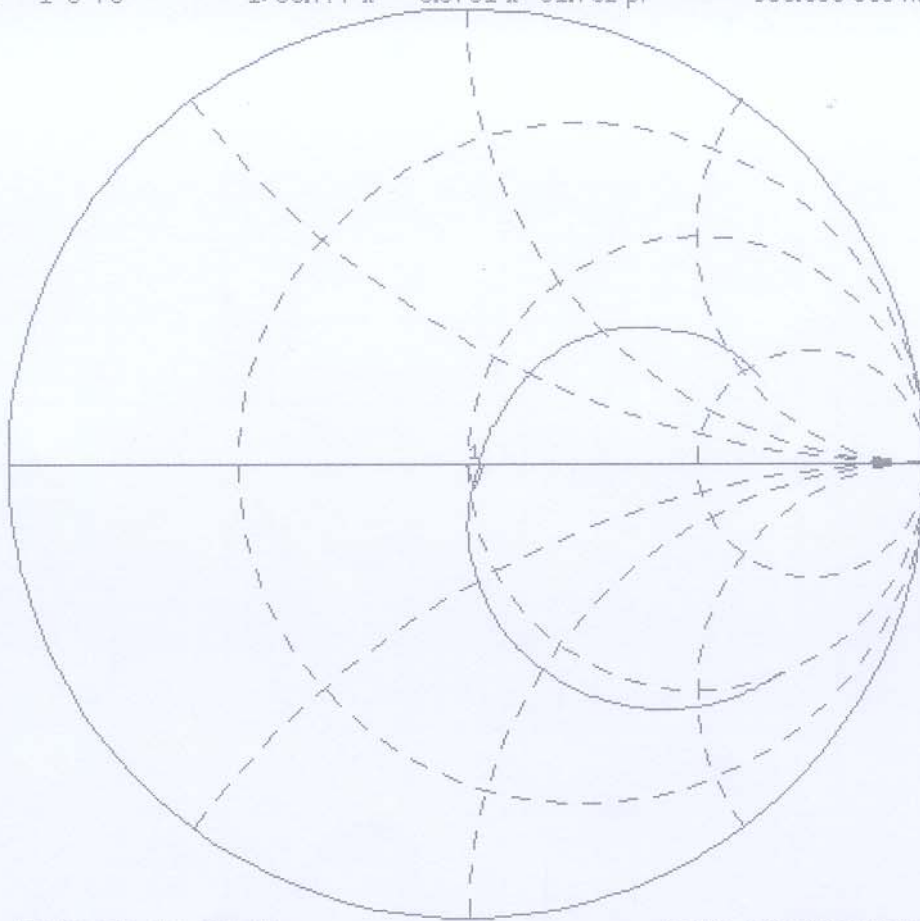
PRm
Del

Cor
Avg
16

↑

START 700.000 000 MHz

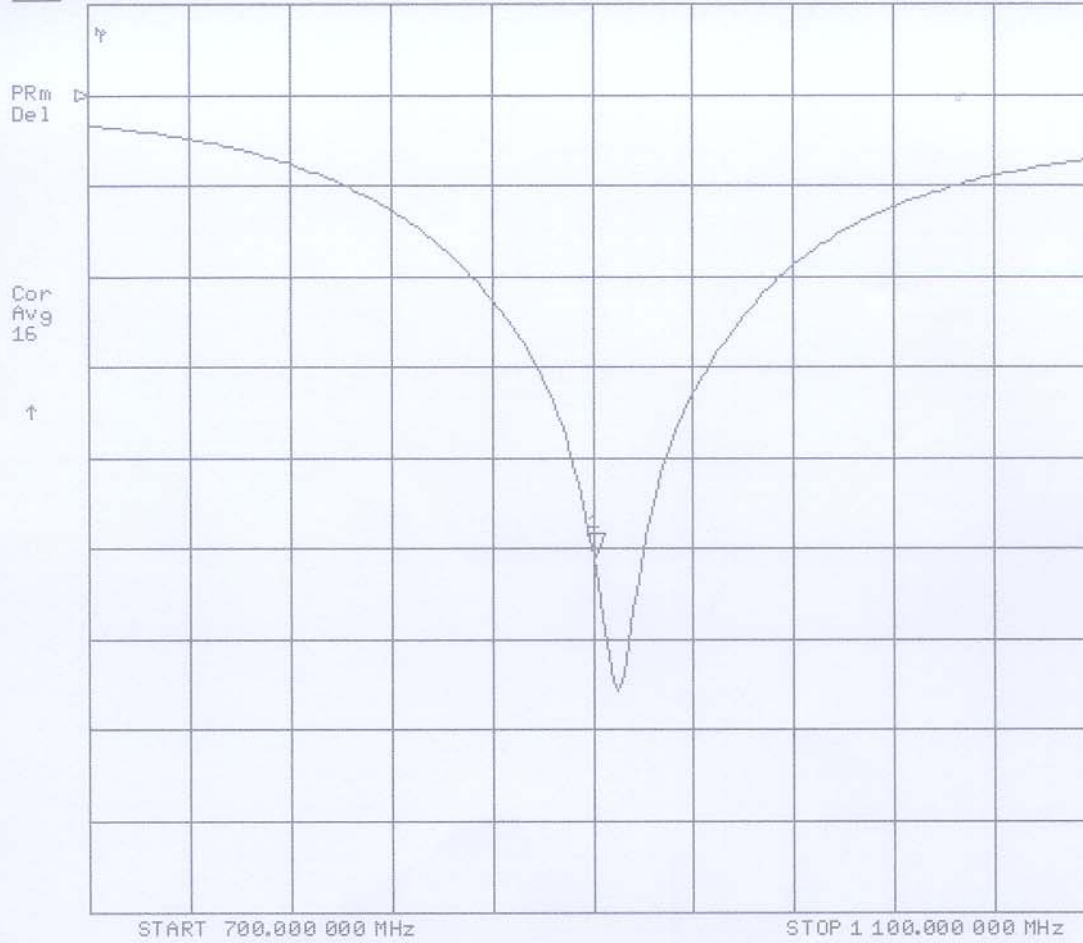
STOP 1 100.000 000 MHz



1 Aug 2001 19:22:49

CH1 S11 LOG 5 dB/REF 0 dB

1:-25.394 dB 900.000 000 MHz



Calibration Certificate

1900 MHz System Validation Dipole

Type:

D1900V2

Serial Number:

540

Place of Calibration:

Zurich

Date of Calibration:

August 6, 2001

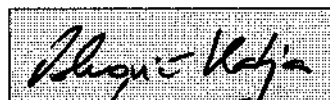
Calibration Interval:

24 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:



Approved by:



DASY3

Dipole Validation Kit

Type: D1900V2

Serial: 540

Manufactured: July 26, 2001

Calibrated: August 6, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with brain simulating sugar solution of the following electrical parameters at 1900 MHz:

Relative permittivity	39.5	$\pm 5\%$
Conductivity	1.47 mho/m	$\pm 10\%$

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, conversion factor 5.57 at 1800 MHz) was used for the measurements.

The dipole feedpoint was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm 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 250mW $\pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the head phantom according to the measurement conditions described in section 1. The results (see figure) 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:	42.4 mW/g
averaged over 10 cm ³ (10 g) of tissue:	21.5 mW/g

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. The estimated sensitivities of SAR-values and penetration depths to the liquid parameters are listed in the DASY Application Note 4: 'SAR Sensitivities'.

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:	1.214 ns	(one direction)
Transmission factor:	0.997	(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 1900 MHz:	$\text{Re}\{Z\} = 45.1 \, \Omega$
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$\text{Im}\{Z\} = -9.6 \, \Omega$

Return Loss at 1900 MHz	- 19.0 dB
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4. Handling

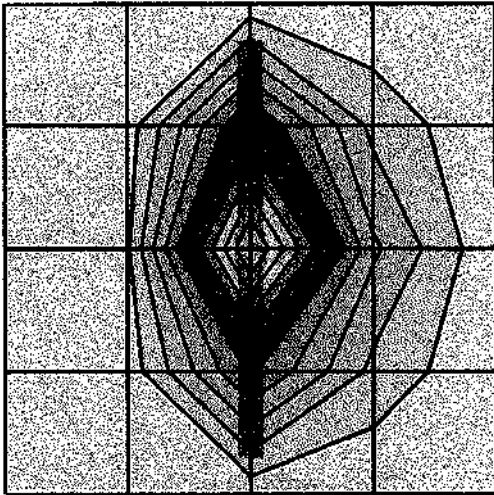
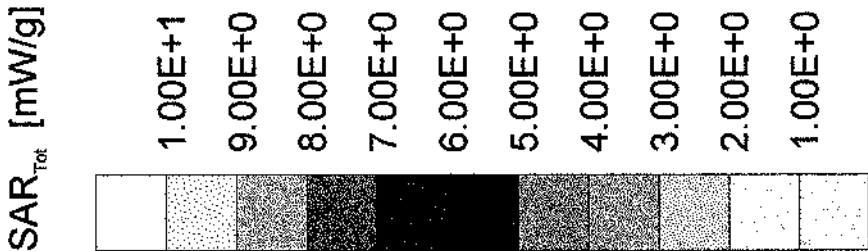
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D1900V2 SN:540, d = 10 mm

Frequency: 1900 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat - SAM Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.57,5.57,5.57) at 1800 MHz; IEEE1528 1900 MHz; $\sigma = 1.47$ mho/m $\epsilon_r = 39.5$ $\rho = 1.00$ g/cm³
Cubes (2): Peak: 20.4 mW/g ± 0.01 dB, SAR (1g): 10.6 mW/g ± 0.02 dB, SAR (10g): 5.38 mW/g ± 0.04 dB, (Worst-case extrapolation)
Penetration depth: 7.9 (7.4, 8.9) [mm]
Powerdrift: -0.06 dB



5 Aug 2001 18:18:01

CH1 S11 1 U FS

1: 45.068 Ω -9.5801 Ω 8.7437 pF

1 900.000 000 MHz

γ

Del

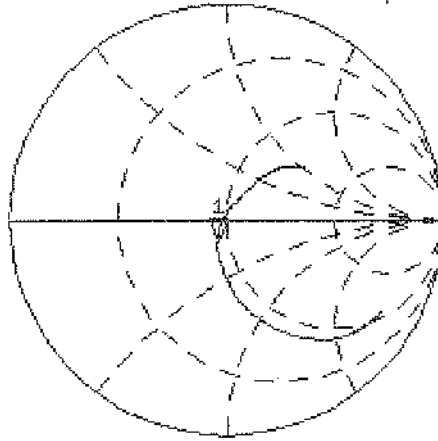
PRM

Cor

Avg

16

↑



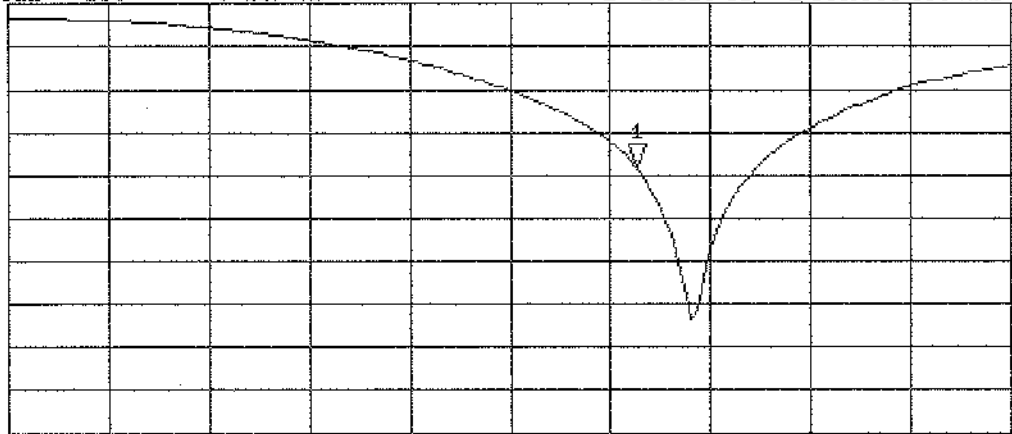
CH2 S11 LOG 5 dB/REF 0 dB

1: -19.023 dB 1 900.000 000 MHz

PRM

Cor

↑



START 1 400.000 000 MHz

STOP 2 200.000 000 MHz

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

*Checked 20-6-2
Andreas P. Gamm*

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1529

Place of Calibration:

Zurich

Date of Calibration:

June 13, 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. Vetterli

Approved by:

Blaise Katt

Probe ET3DV6

SN:1529

Manufactured:	March 21, 2000
Last calibration:	May 23, 2001
Repaired:	June 6, 2002
Recalibrated:	June 13, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1529**Sensitivity in Free Space****Diode Compression**

NormX	1.66 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	96	mV
NormY	1.95 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	96	mV
NormZ	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	96	mV

Sensitivity in Tissue Simulating Liquid

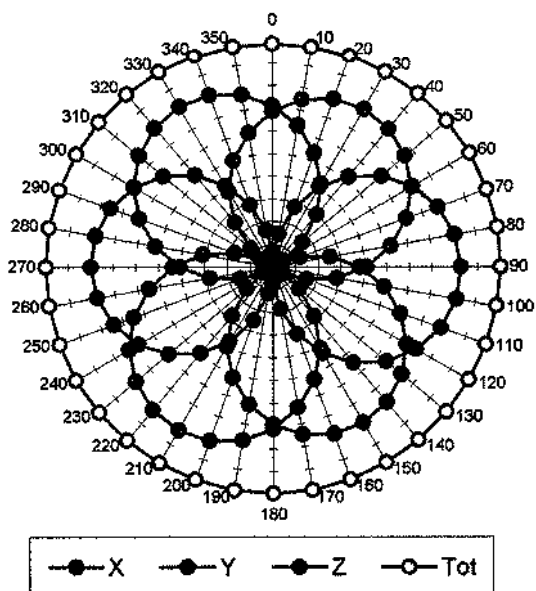
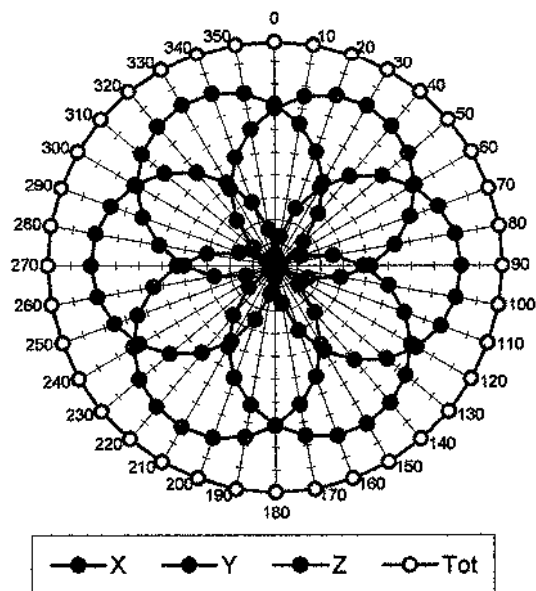
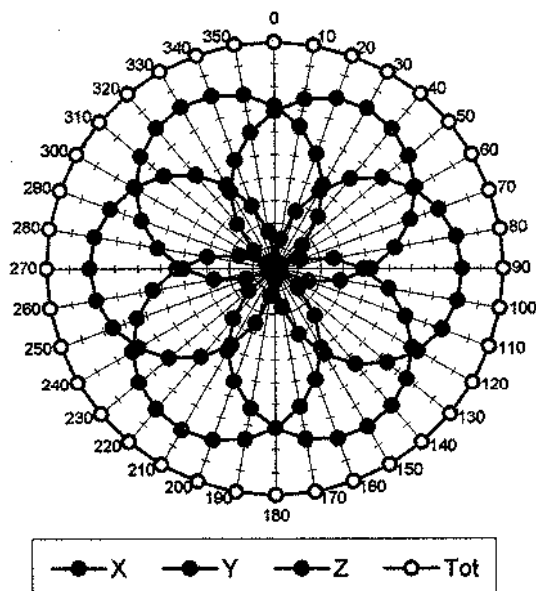
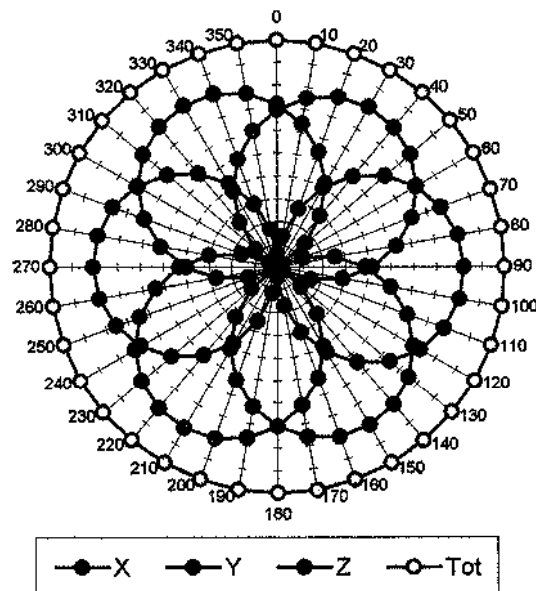
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha	0.28
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth	3.32
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.54
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.34

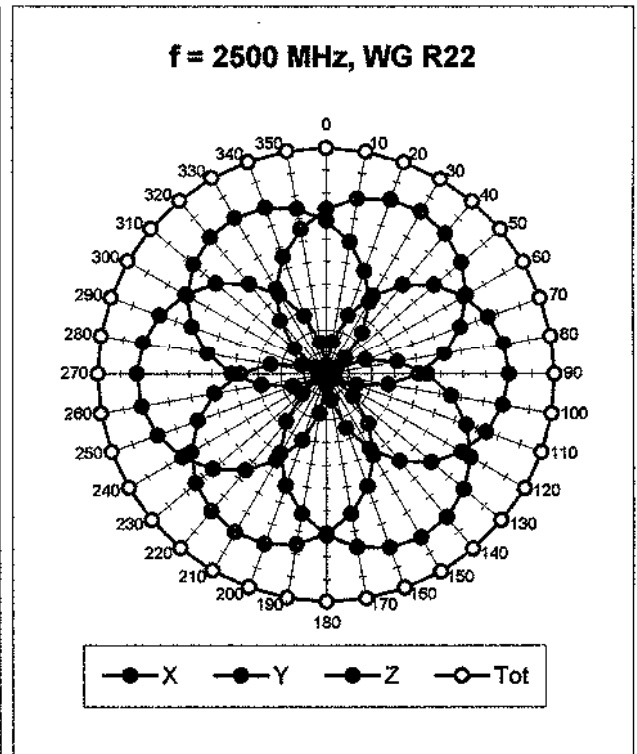
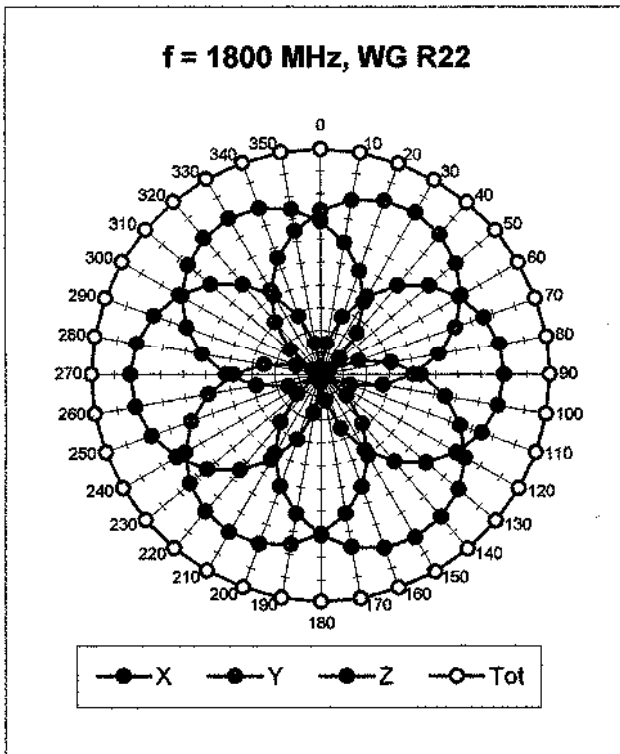
Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%]	Without Correction Algorithm	10.7	6.6	
SAR _{be} [%]	With Correction Algorithm	0.6	0.6	
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%]	Without Correction Algorithm	12.2	8.0	
SAR _{be} [%]	With Correction Algorithm	0.2	0.2	

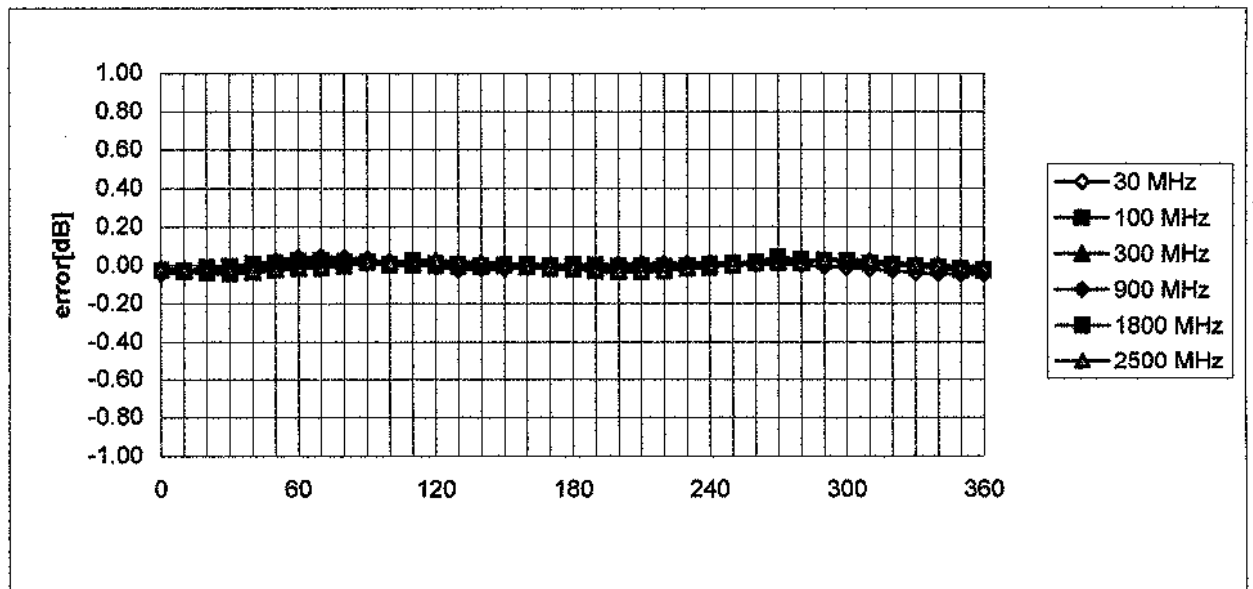
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 $\pm$ 0.2	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**

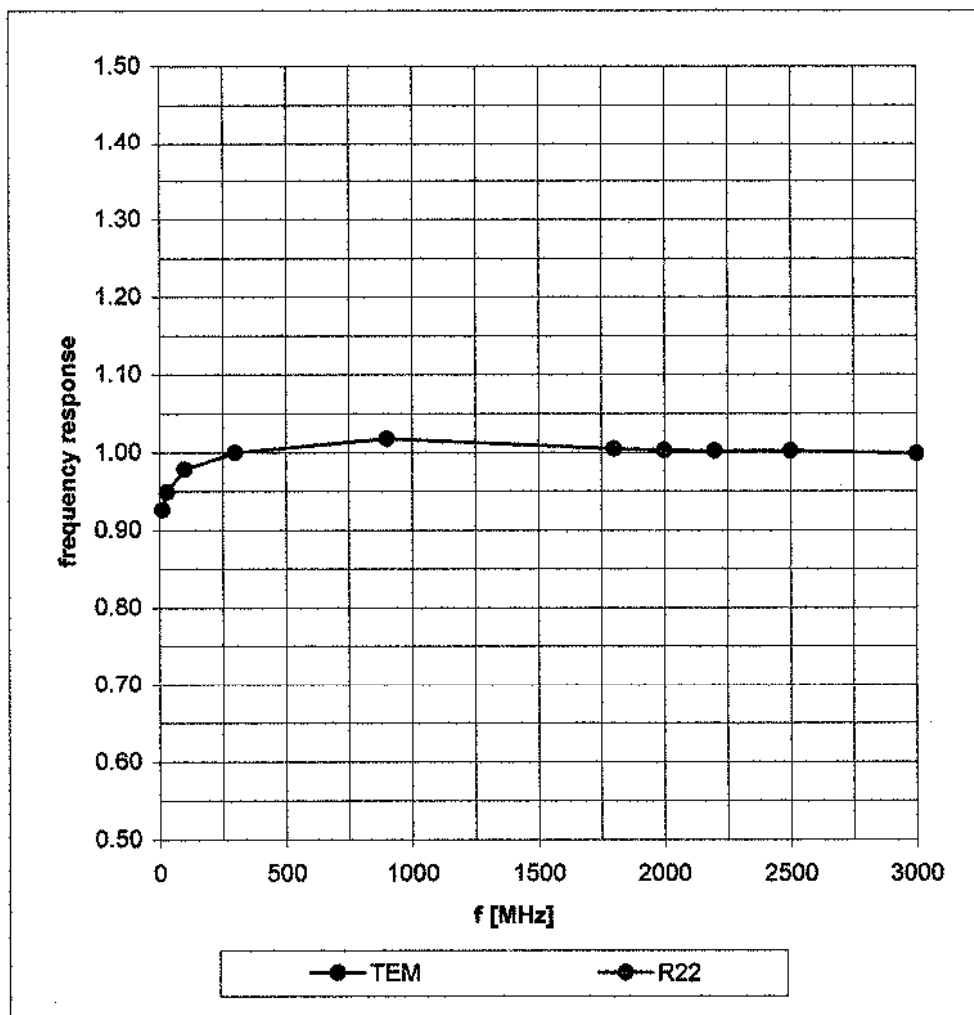


Isotropy Error (ϕ), $\theta = 0^\circ$

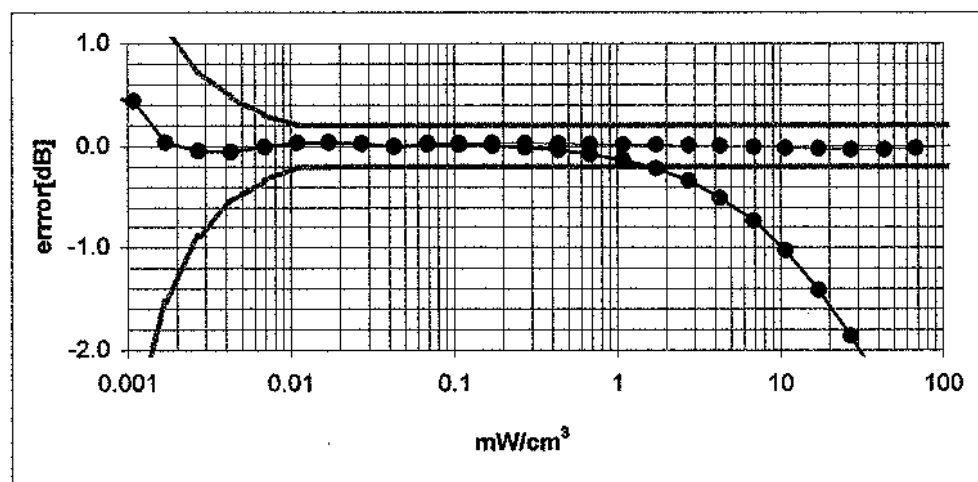
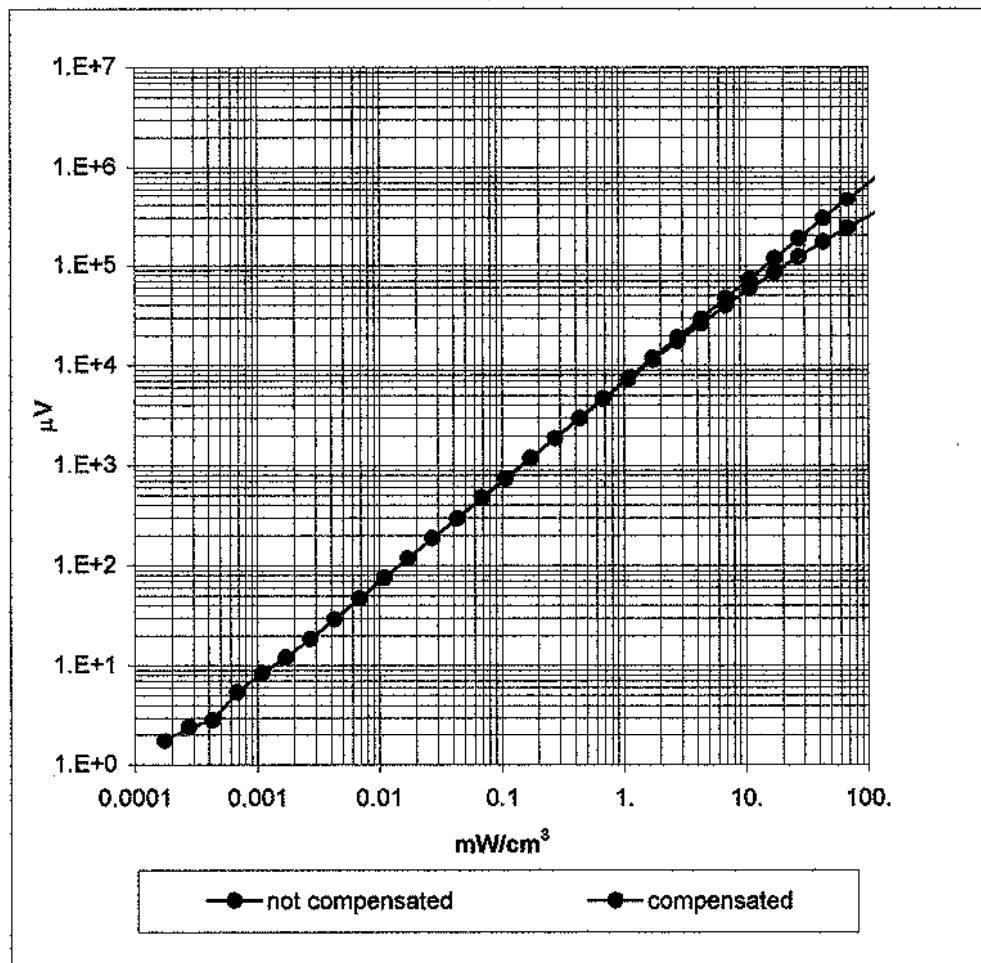


Frequency Response of E-Field

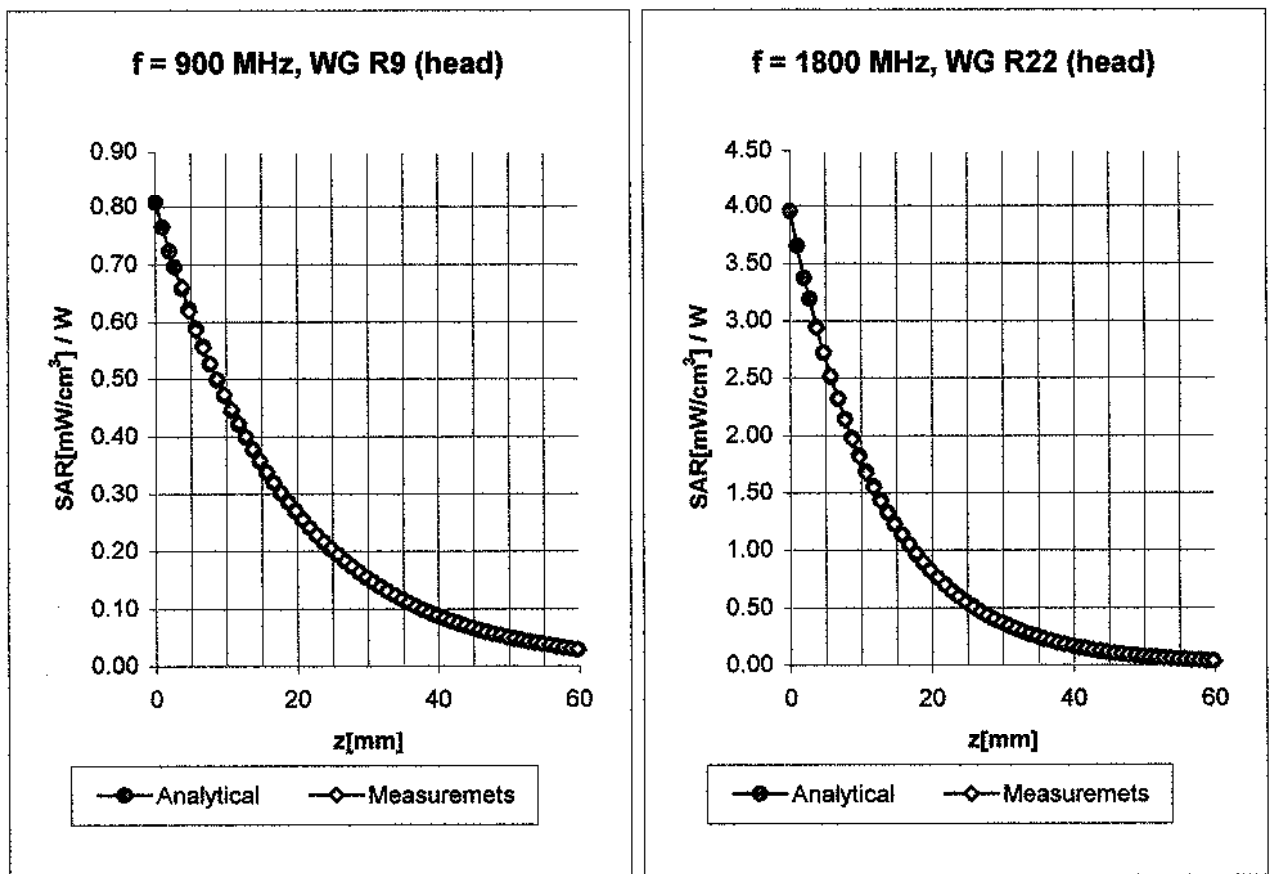
(TEM-Cell:ifi110, Waveguide R22)



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

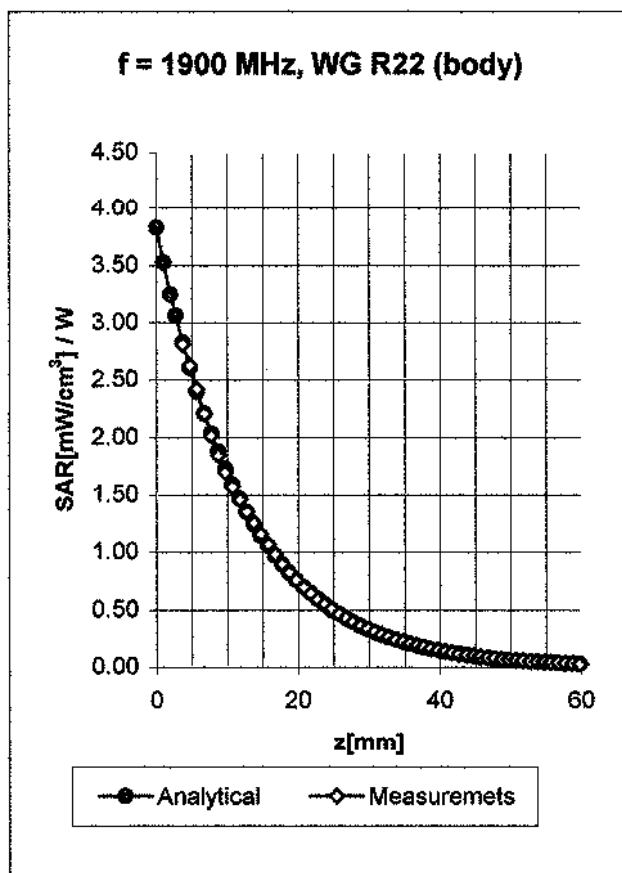


Conversion Factor Assessment



Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	$6.3 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.3 \pm 9.5\% (k=2)$	Alpha 0.28
	ConvF Z	$6.3 \pm 9.5\% (k=2)$	Depth 3.32
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	$5.2 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$5.2 \pm 9.5\% (k=2)$	Alpha 0.54
	ConvF Z	$5.2 \pm 9.5\% (k=2)$	Depth 2.34

Conversion Factor Assessment



Body

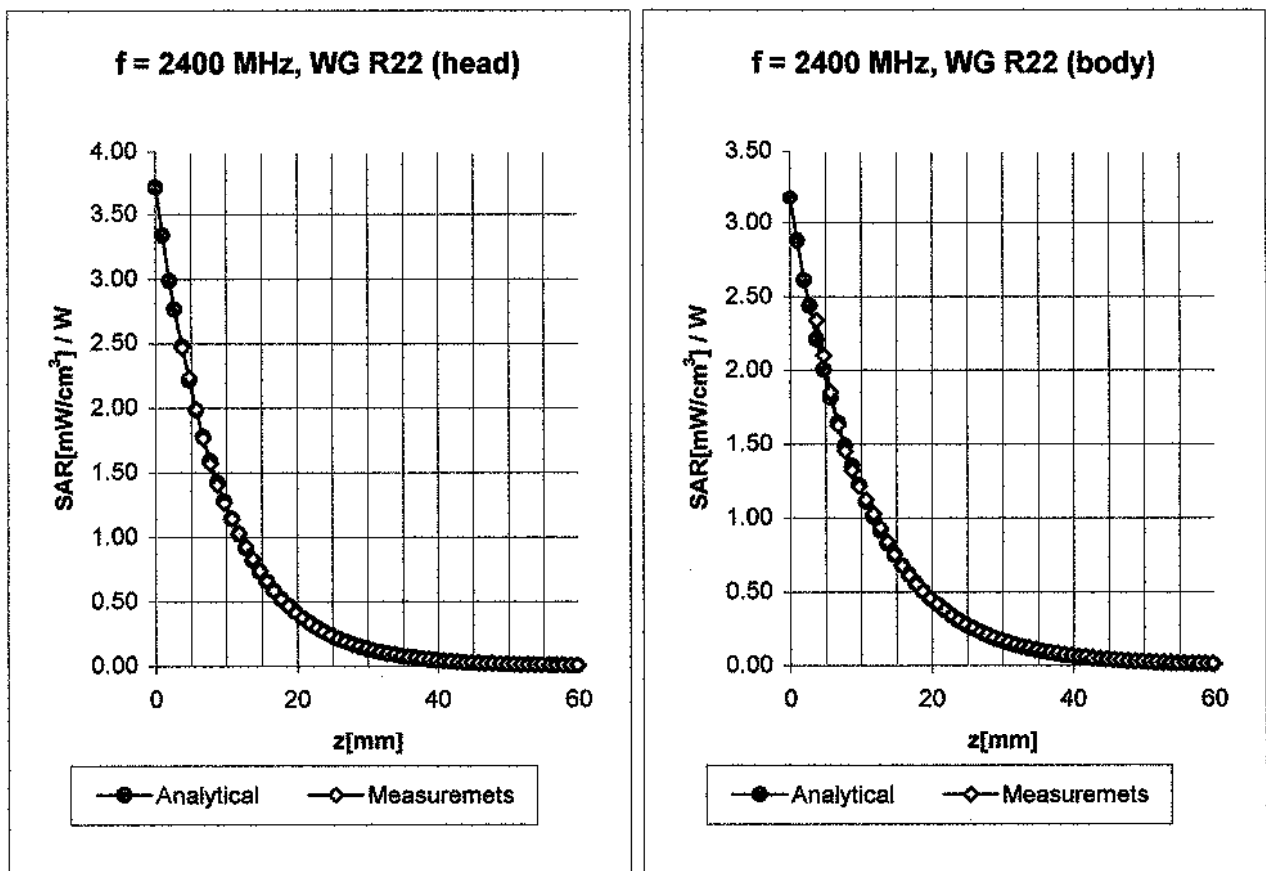
1900 MHz

 $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\%$ mho/mConvF X **4.7** $\pm 8.9\%$ (k=2)

Boundary effect:

ConvF Y **4.7** $\pm 8.9\%$ (k=2)Alpha **0.80**ConvF Z **4.7** $\pm 8.9\%$ (k=2)Depth **2.04**

Conversion Factor Assessment



Head 2400 MHz $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 10\%$ mho/m

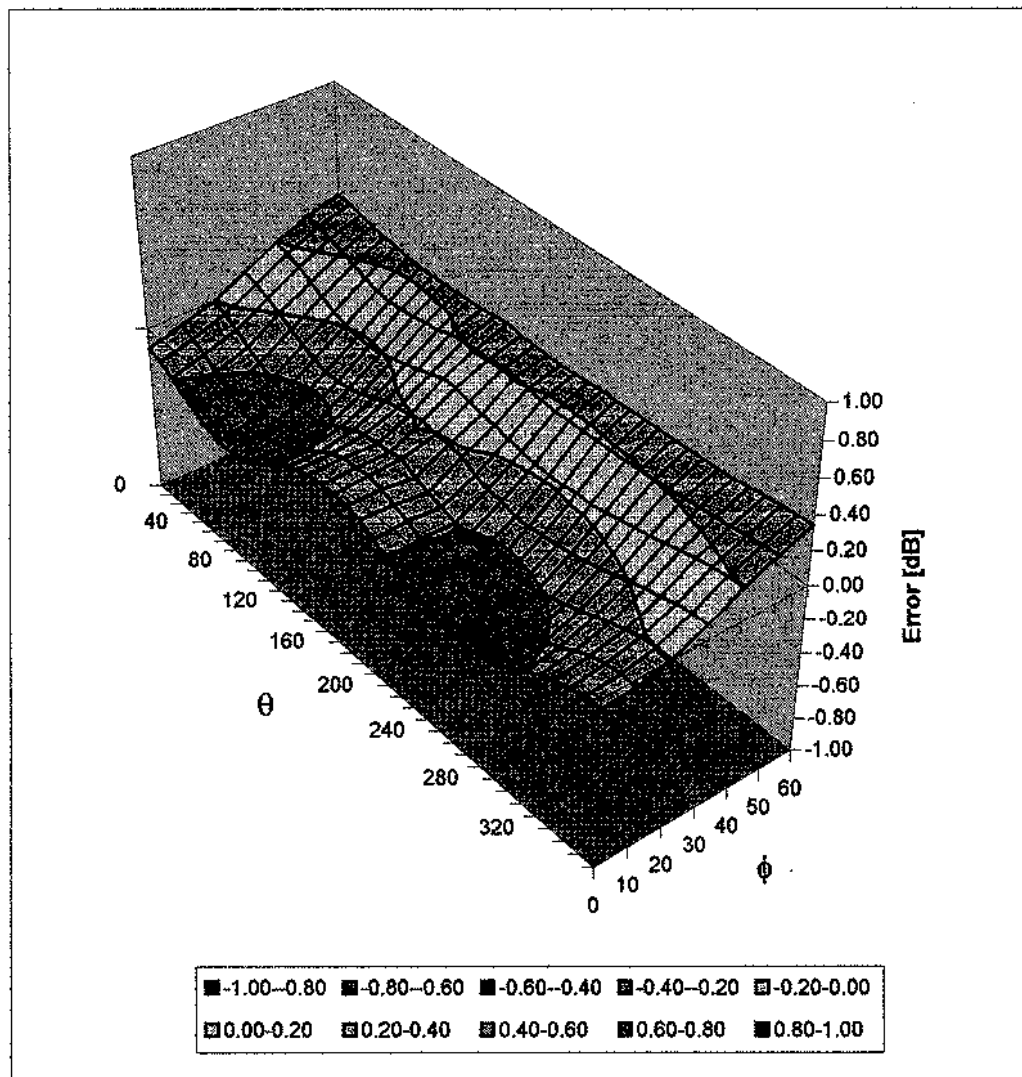
ConvF X	4.9 $\pm 8.9\%$ (k=2)	Boundary effect:
ConvF Y	4.9 $\pm 8.9\%$ (k=2)	Alpha 0.94
ConvF Z	4.9 $\pm 8.9\%$ (k=2)	Depth 1.96

Body 2400 MHz $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 10\%$ mho/m

ConvF X	4.3 $\pm 8.9\%$ (k=2)	Boundary effect:
ConvF Y	4.3 $\pm 8.9\%$ (k=2)	Alpha 1.00
ConvF Z	4.3 $\pm 8.9\%$ (k=2)	Depth 1.57

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors
for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1529

Place of Assessment:

Zurich

Date of Assessment:

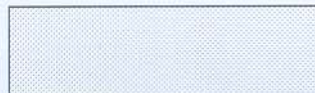
September 1, 2002

Probe Calibration Date:

June 12, 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 ET3DV6 SN:1529

Conversion factor ($\pm$ standard deviation)

835 MHz ConvF $6.1 \pm 8\%$

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

900 MHz ConvF $6.0 \pm 8\%$

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