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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UKAS TESTING
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Calibration Data

This appendix contains the calibration data and certificates.

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A1235

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:	
Approved by:	

Schmid & Partner
Engineering AG

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

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**	± 5%
Conductivity	**0.95 mho/m**	± 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 ± 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:	Re{Z} = **50.8 Ω**
	Im {Z} = **-5.6 Ω**
Return Loss at 900 MHz	**-25.4 dB**

4. Handling

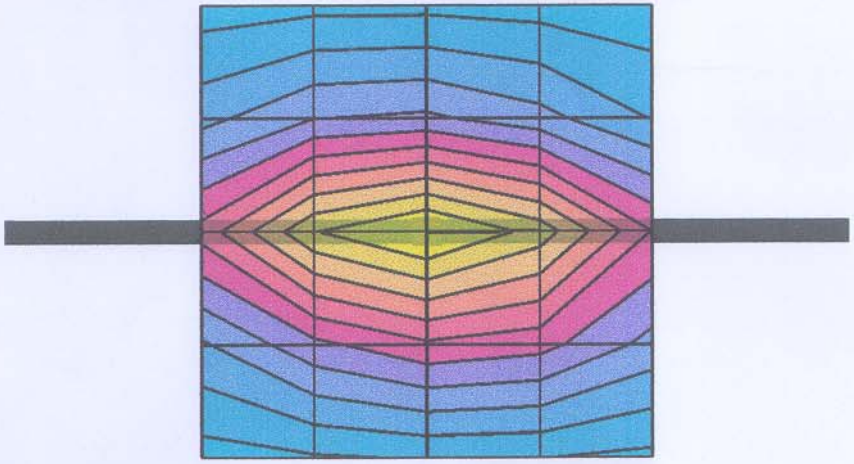
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

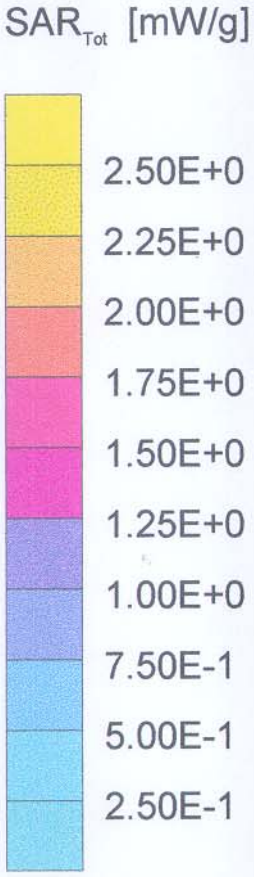
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

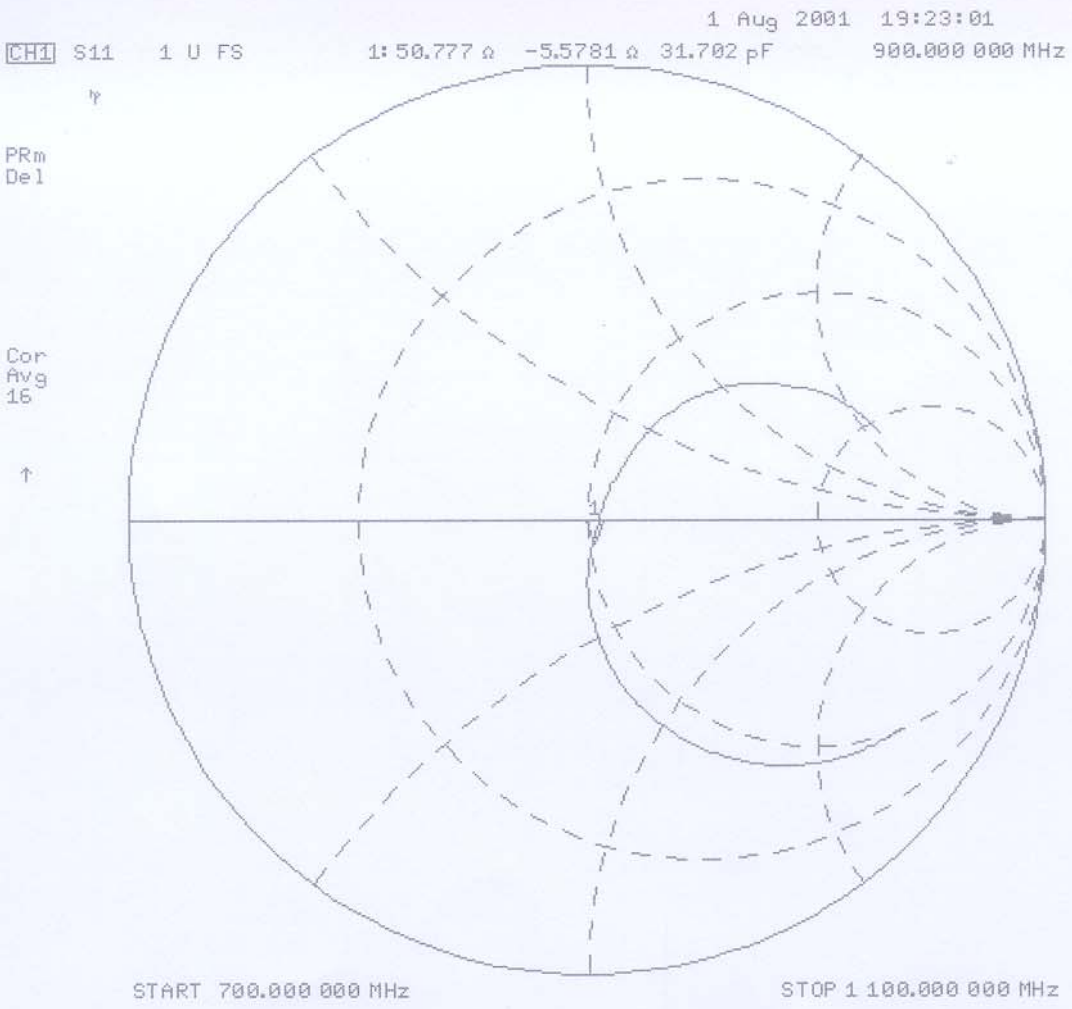
After prolonged use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

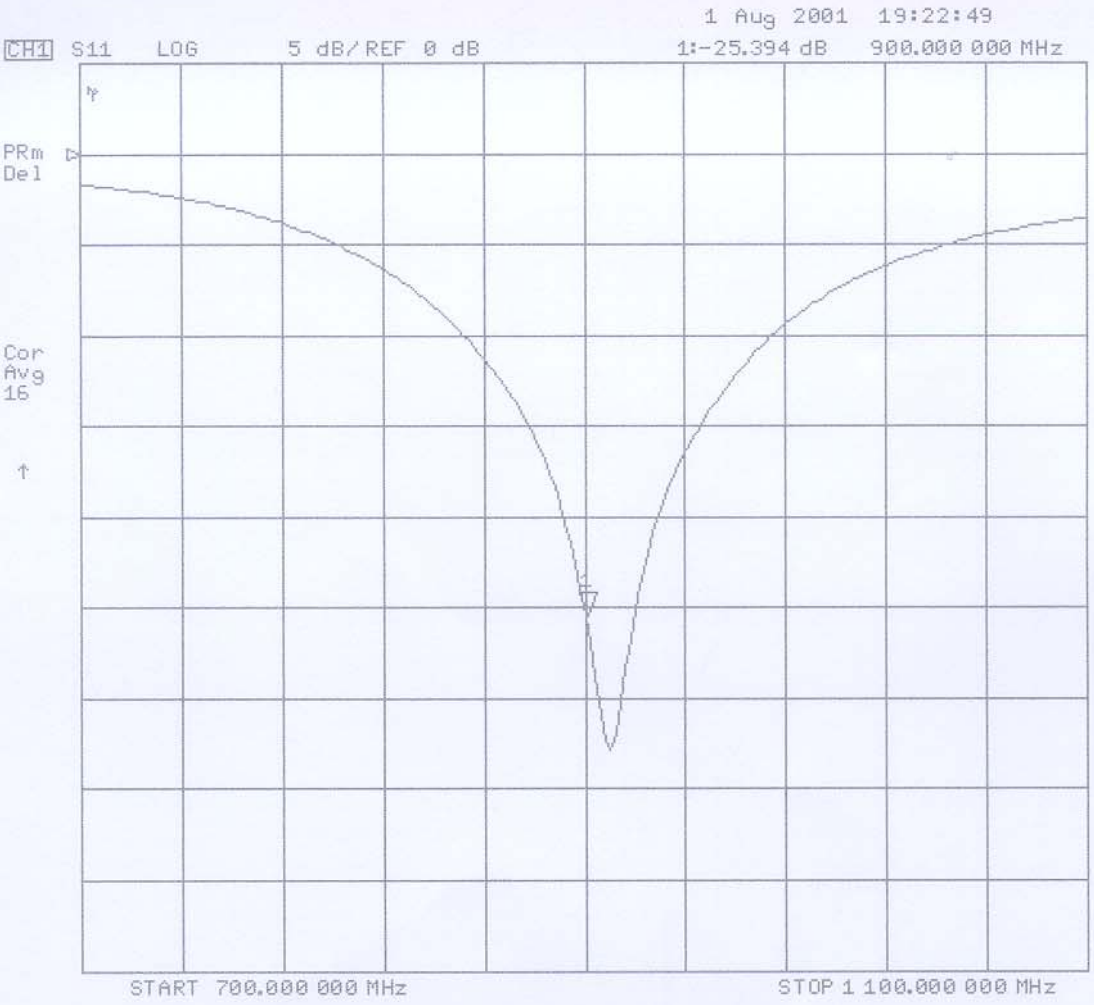
Validation Dipole D900V2 SN:124, d = 15 mm

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; σ = 0.95 mho/m ε_r = 40.3 ρ = 1.00 g/cm^3
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






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
PRm
Del
Cor
Avg
16
START 700.000 000 MHz
STOP 1 100.000 000 MHz

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

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:	

Schmid & Partner
Engineering AG

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

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 permitivity	**39.5**	± 5%
Conductivity	**1.47 mho/m**	± 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 ± 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:	Re{Z} = **45.1 Ω**
	Im {Z} = **-9.6 Ω**
Return Loss at 1900 MHz	**- 19.0 dB**

4. Handling

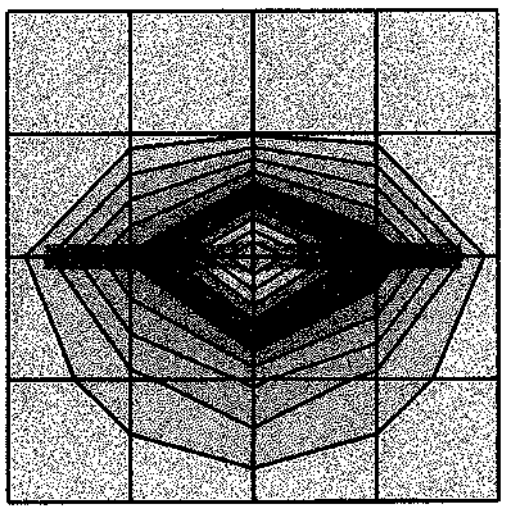
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

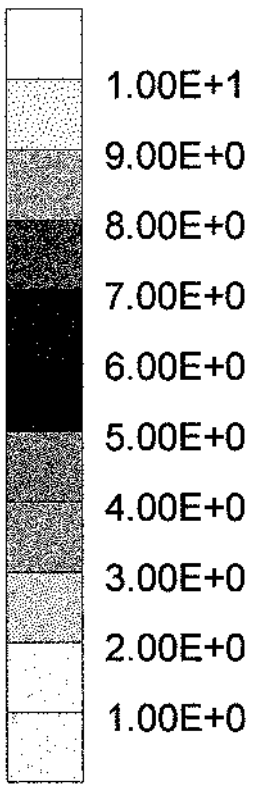
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

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 ; σ = 1.47 mho/m ε_r = 39.5 ρ = 1.00 g/cm^3
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

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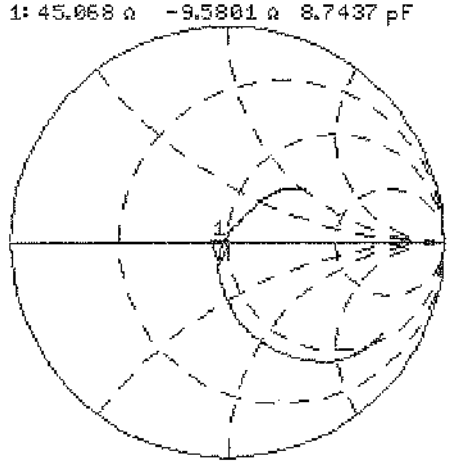
Del

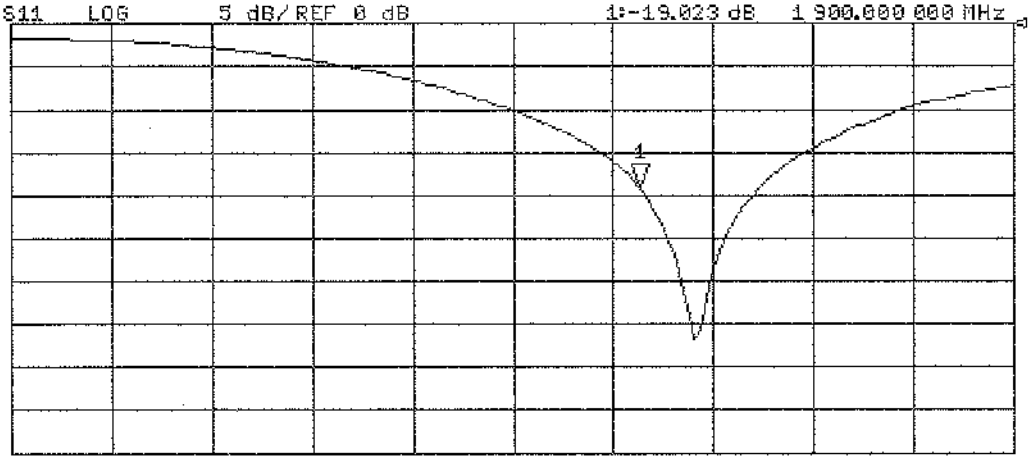
PRm

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

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Engineering AG

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

Calibration Certificate

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:	
Approved by:	

Schmid & Partner
Engineering AG

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

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**	$\mu V/(V/m)^2$	DCP X	**96**	mV
NormY	**1.95**	$\mu V/(V/m)^2$	DCP Y	**96**	mV
NormZ	**1.71**	$\mu V/(V/m)^2$	DCP Z	**96**	mV

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**
Head **835 MHz** ε_r **= 41.5 ± 5%** σ **= 0.90 ± 5% mho/m**

ConvF X	**6.3**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3**	± 9.5% (k=2)	Alpha	**0.28**
ConvF Z	**6.3**	± 9.5% (k=2)	Depth	**3.32**

Head **1800 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head **1900 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.54**
ConvF Z	**5.2**	± 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**

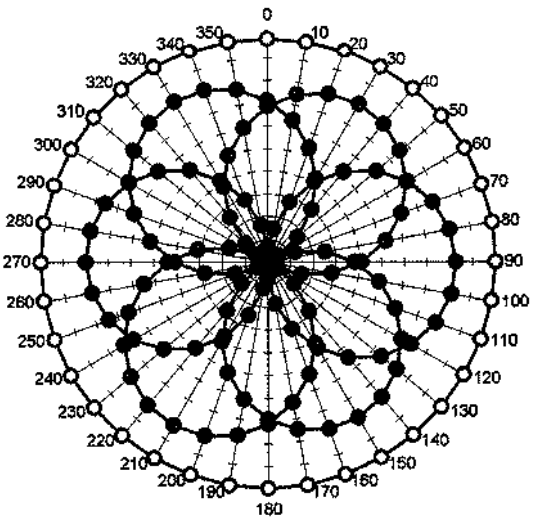
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	12.2	8.0
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

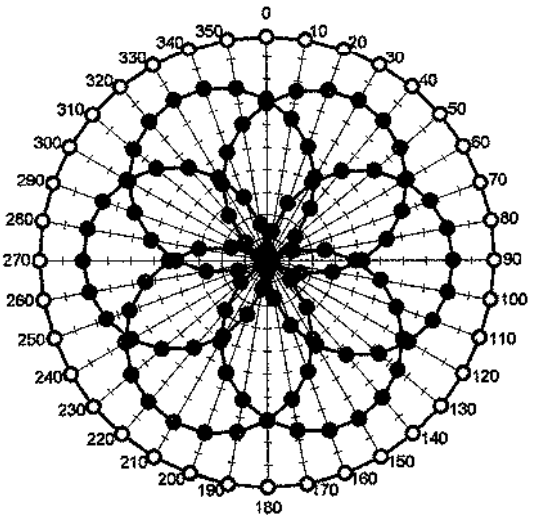
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.3 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

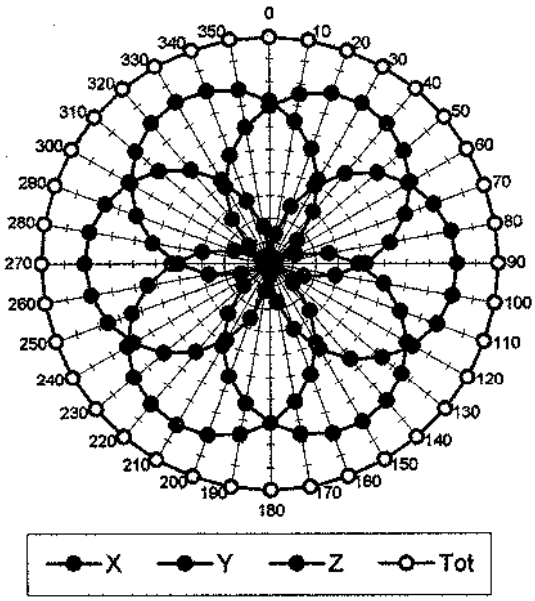
f = 30 MHz, TEM cell ifi110



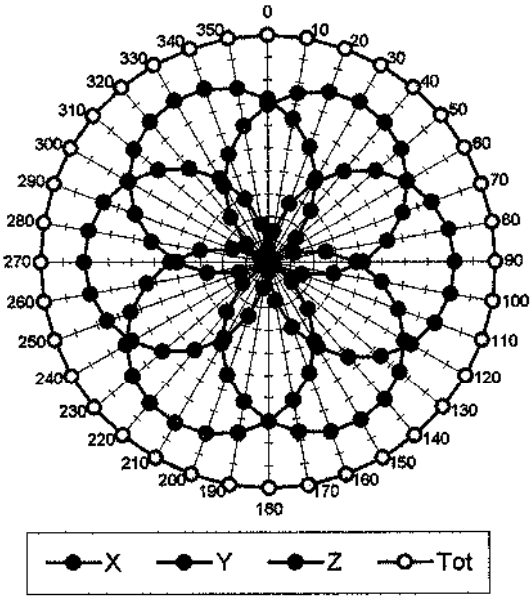
f = 100 MHz, TEM cell ifi110

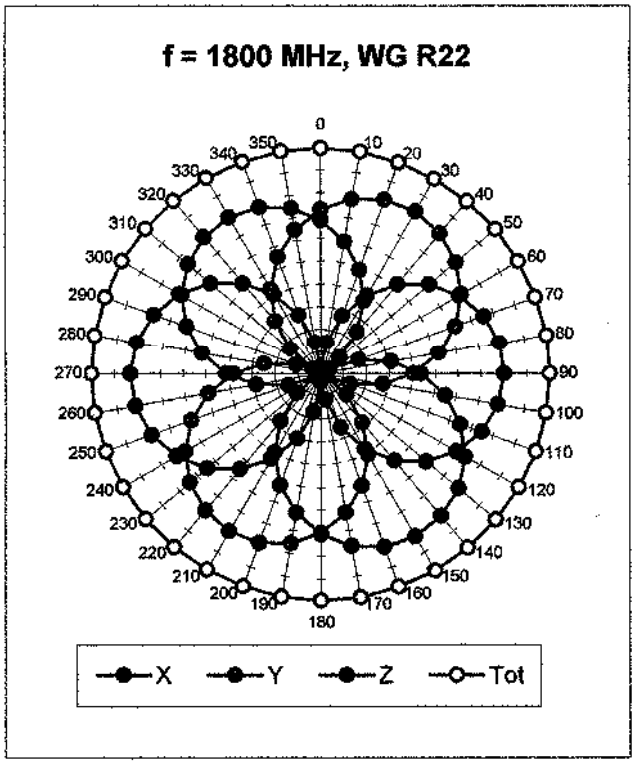


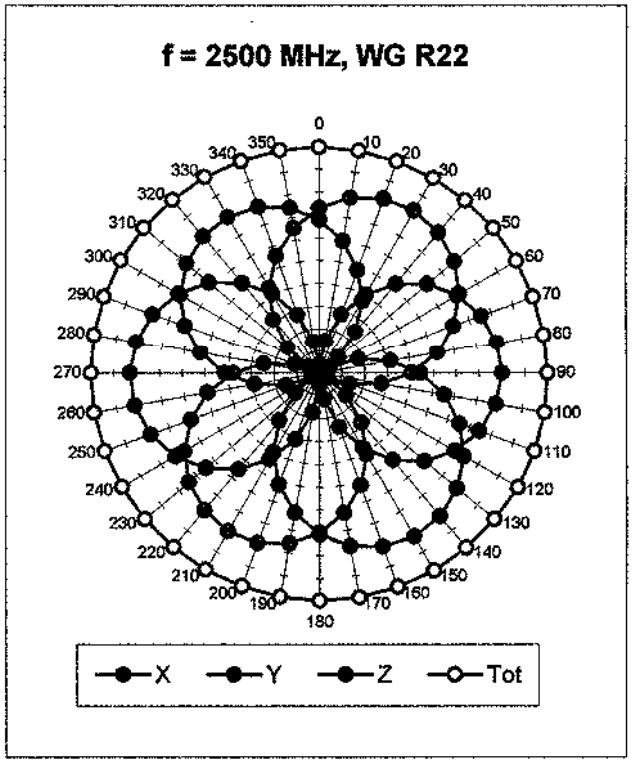
f = 300 MHz, TEM cell ifi110



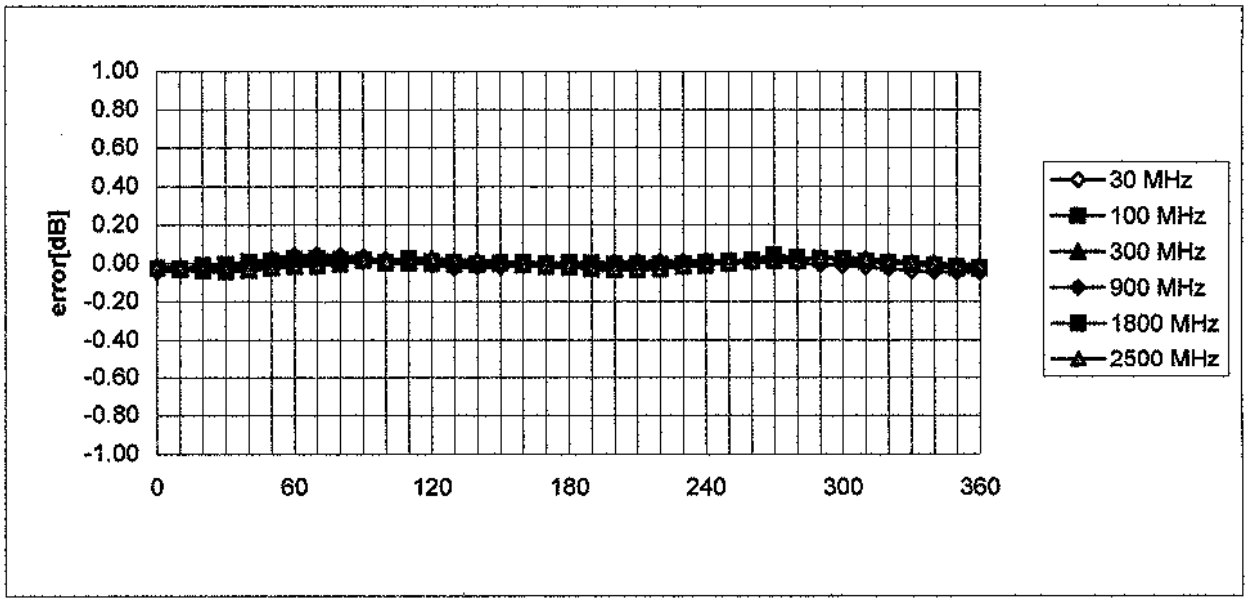
f = 900 MHz, TEM cell ifi110





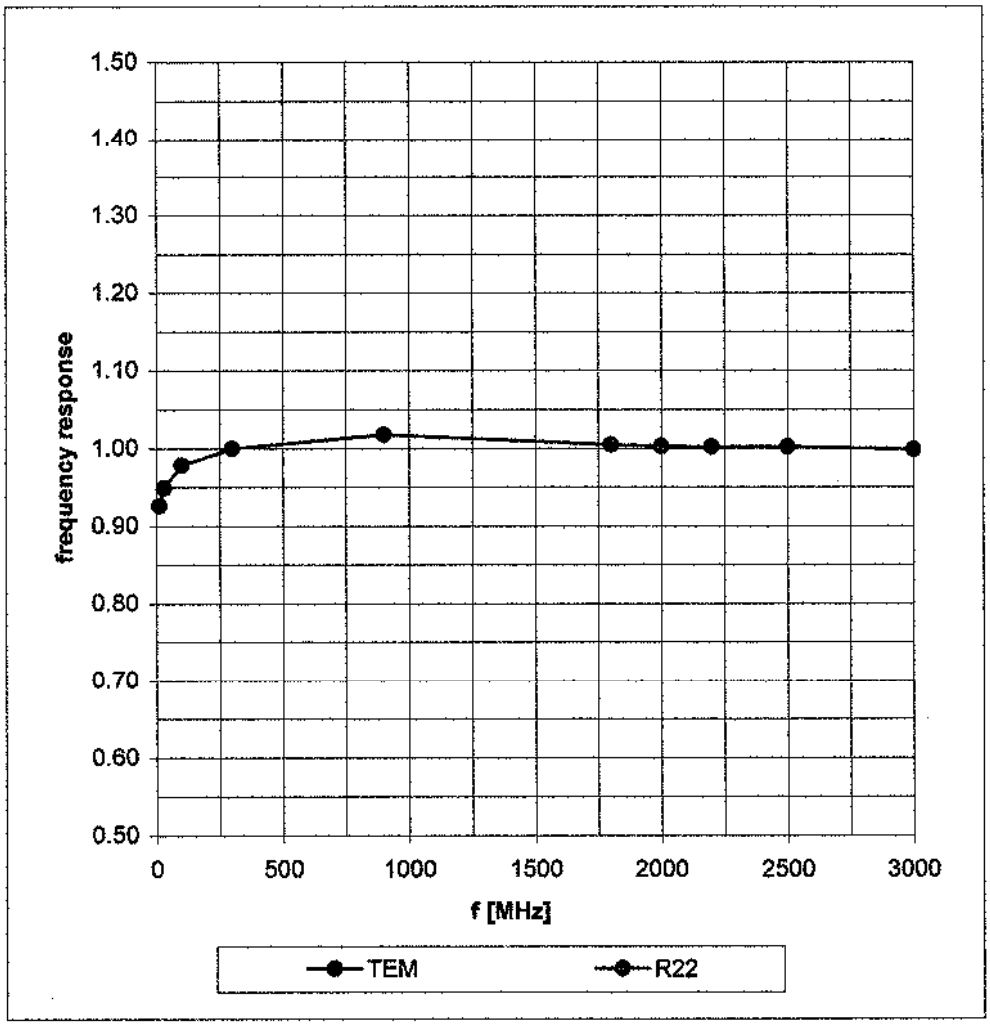


Isotropy Error (ϕ), θ = 0°



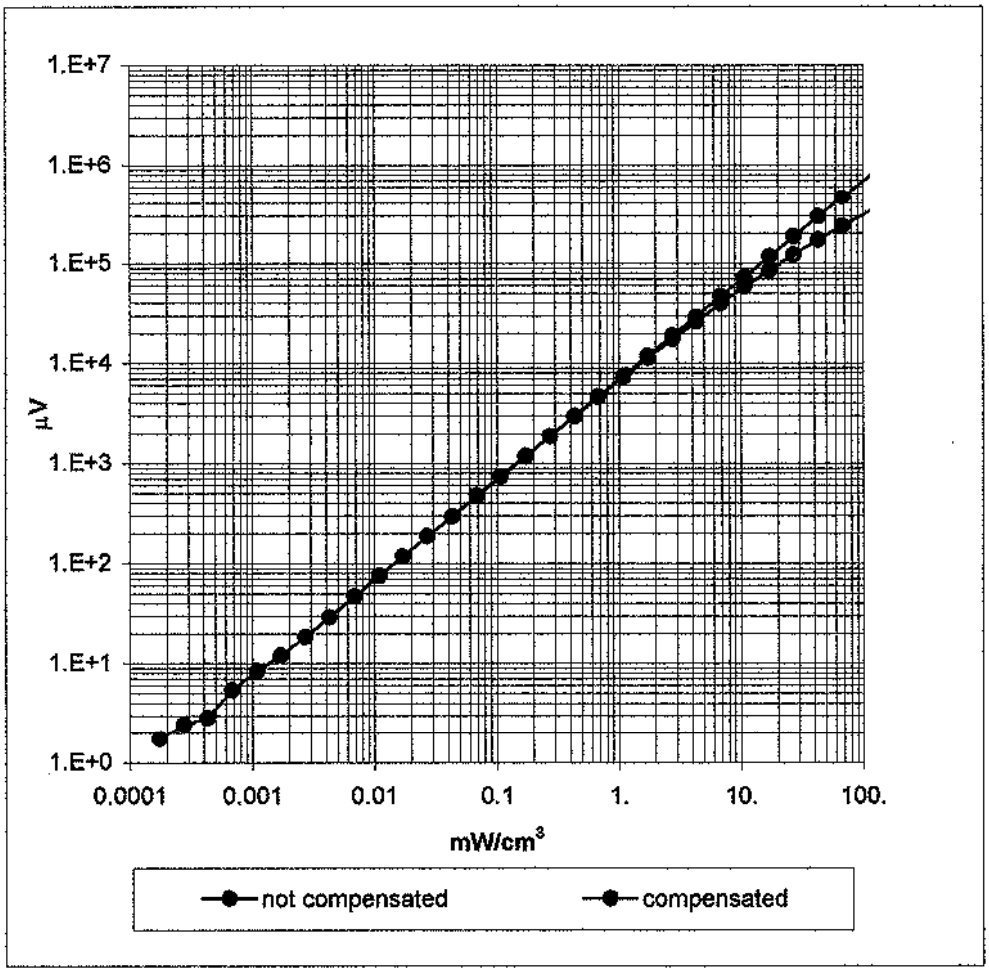
Frequency Response of E-Field

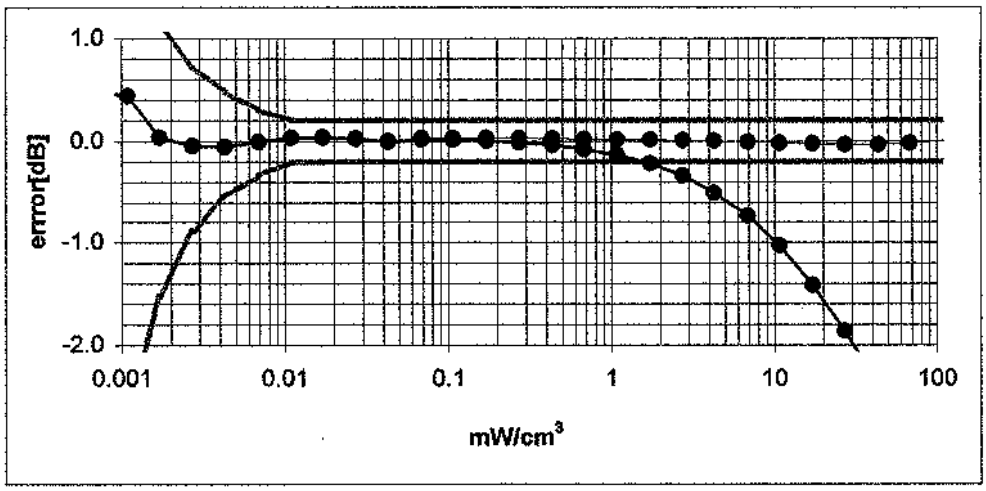
(TEM-Cell:ifi110, Waveguide R22)



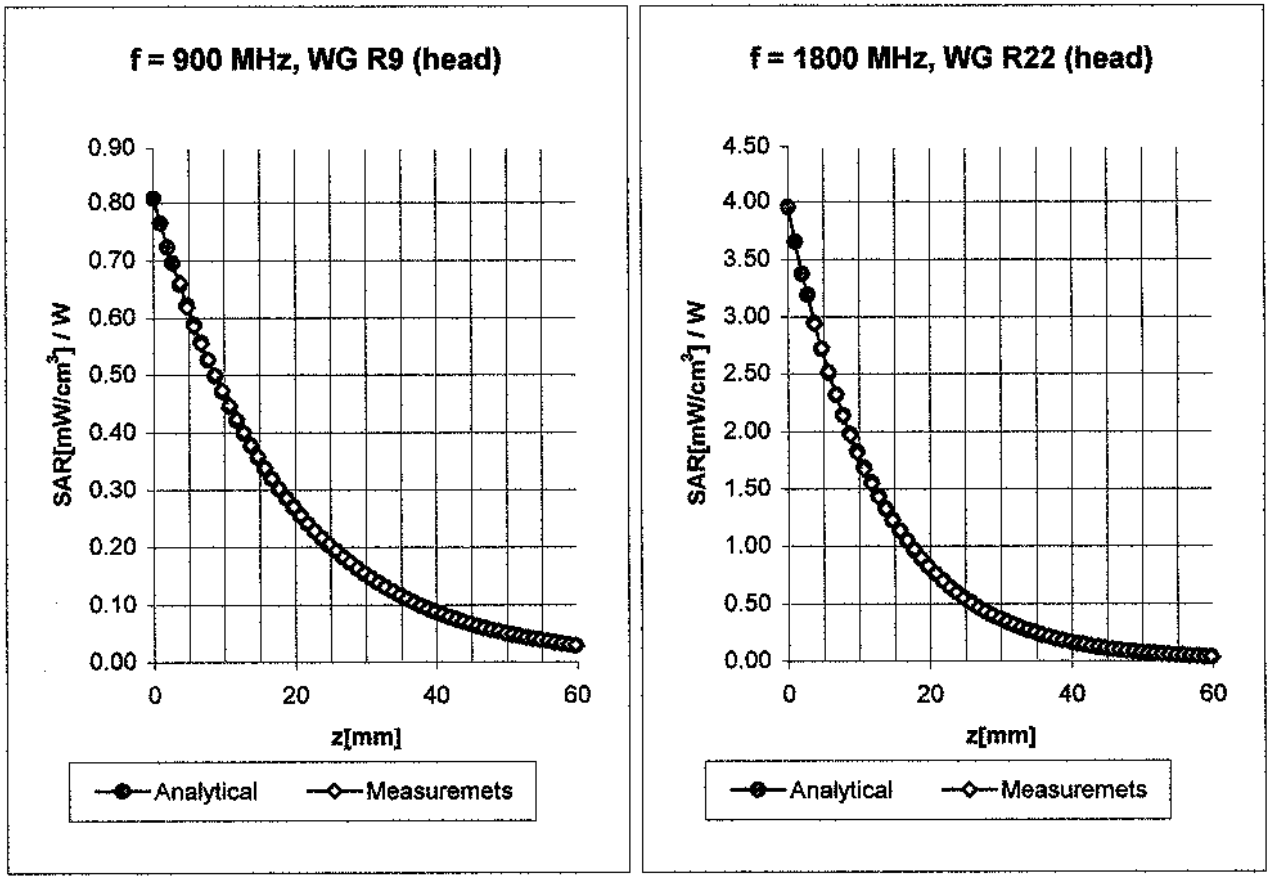
Dynamic Range f(SAR_{brain})

(Waveguide R22)





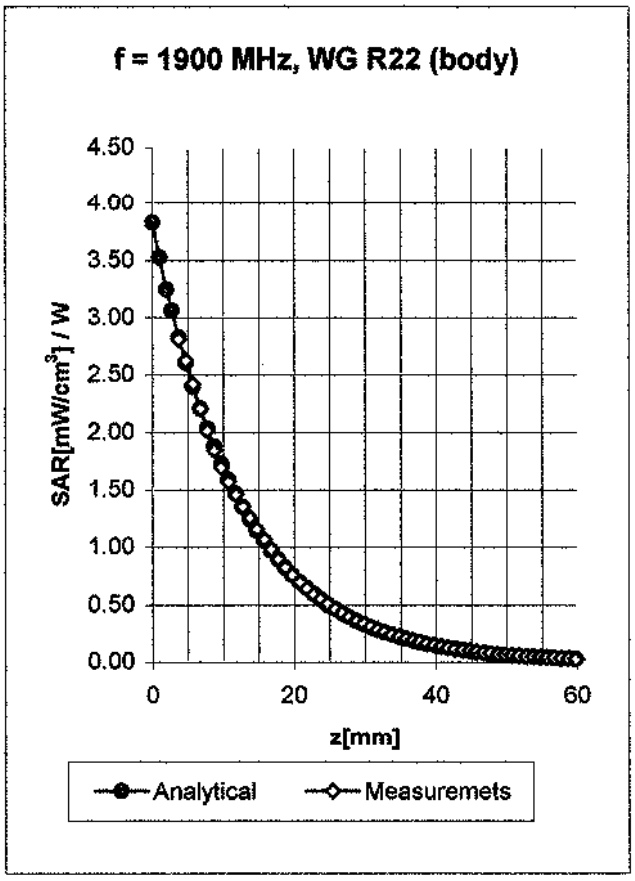
Conversion Factor Assessment



Head	**900 MHz**		ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**
Head	**835 MHz**		ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**
	ConvF X	**6.3** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**6.3** ± 9.5% (k=2)		Alpha **0.28**
	ConvF Z	**6.3** ± 9.5% (k=2)		Depth **3.32**

Head	**1800 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**
Head	**1900 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**
	ConvF X	**5.2** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**5.2** ± 9.5% (k=2)		Alpha **0.54**
	ConvF Z	**5.2** ± 9.5% (k=2)		Depth **2.34**

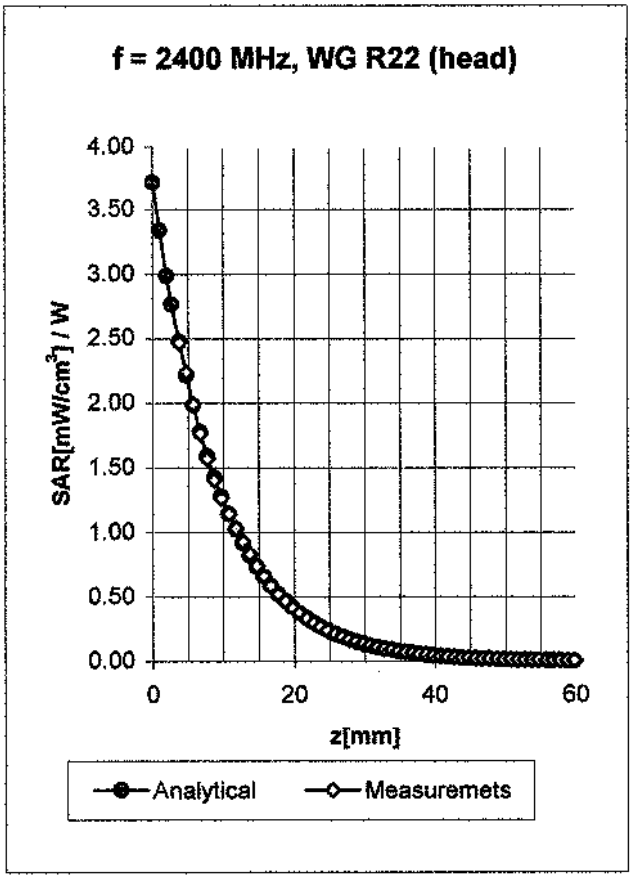
Conversion Factor Assessment

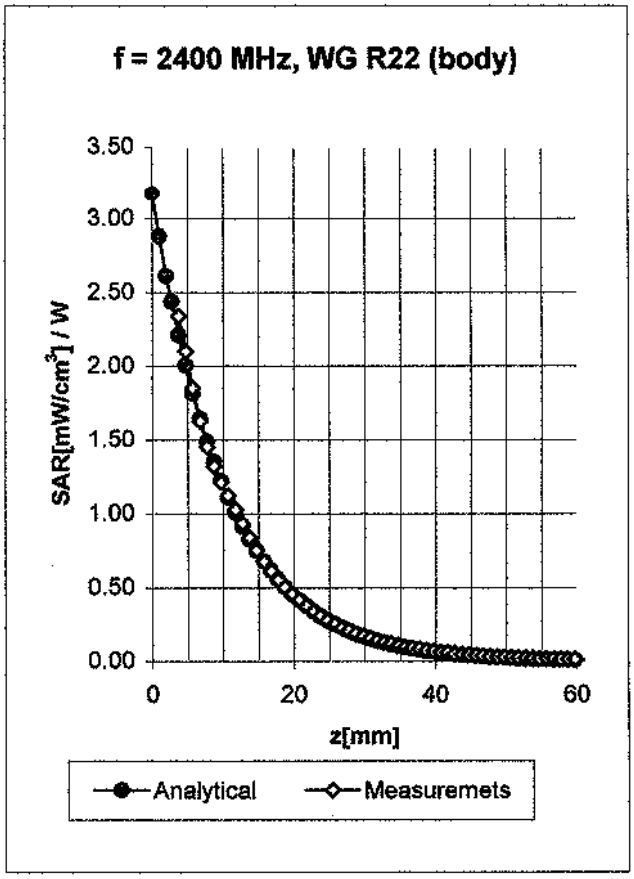


Body **1900 MHz** ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

ConvF X	**4.7** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 8.9% (k=2)	Alpha	**0.80**
ConvF Z	**4.7** ± 8.9% (k=2)	Depth	**2.04**

Conversion Factor Assessment





Head **2400 MHz** ε_r **= 39.2 ± 5%** σ **= 1.80 ± 10% mho/m**

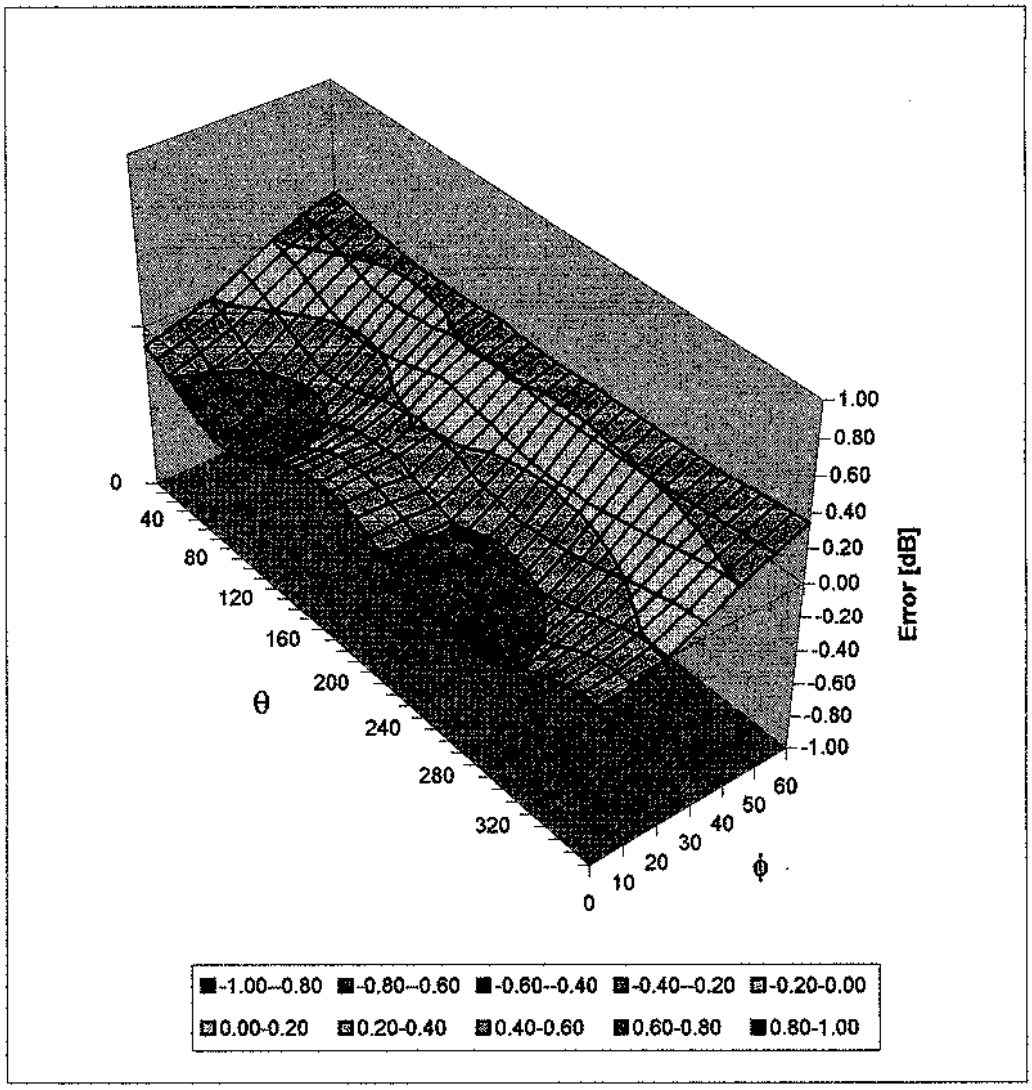
ConvF X	**4.9** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.9** ± 8.9% (k=2)	Alpha	**0.94**
ConvF Z	**4.9** ± 8.9% (k=2)	Depth	**1.96**

Body **2400 MHz** ε_r **= 52.7 ± 5%** σ **= 1.95 ± 10% mho/m**

ConvF X	**4.3** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.3** ± 8.9% (k=2)	Alpha	**1.00**
ConvF Z	**4.3** ± 8.9% (k=2)	Depth	**1.57**

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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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 (± standard deviation)

835 MHz	ConvF	**6.1 ± 8%**	ε_r = **55.2 ± 5%** σ = **0.97 ± 5% mho/m** (body tissue)
900 MHz	ConvF	**6.0 ± 8%**	ε_r = **55.0 ± 5%** σ = **1.05 ± 5% mho/m** (body tissue)