

APPENDIX C.

Calibration Certificate(s)

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1599

Place of Calibration

Zurich

Date of Calibration

August 31, 2001

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:

Nicolosi, Mariana

Approved by:

Volker Kofa

Probe ET3DV6

SN:1599

Manufactured:	July 30, 2001
Calibrated:	August 31, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1599

Sensitivity in Free Space

NormX	1.75 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.79 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.80 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head 450 MHz $\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 10\%$ mho/m

ConvF X	7.13 extrapolated	Boundary effect:
ConvF Y	7.13 extrapolated	Alpha 0.46
ConvF Z	7.13 extrapolated	Depth 1.97

Head 900 MHz $\epsilon_r = 42 \pm 5\%$ $\sigma = 0.97 \pm 10\%$ mho/m

ConvF X	6.59 $\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	6.59 $\pm 7\%$ (k=2)	Alpha 0.49
ConvF Z	6.59 $\pm 7\%$ (k=2)	Depth 2.07

Head 1500 MHz $\epsilon_r = 40.4 \pm 5\%$ $\sigma = 1.23 \pm 10\%$ mho/m

ConvF X	5.87 interpolated	Boundary effect:
ConvF Y	5.87 interpolated	Alpha
ConvF Z	5.87 interpolated	Depth

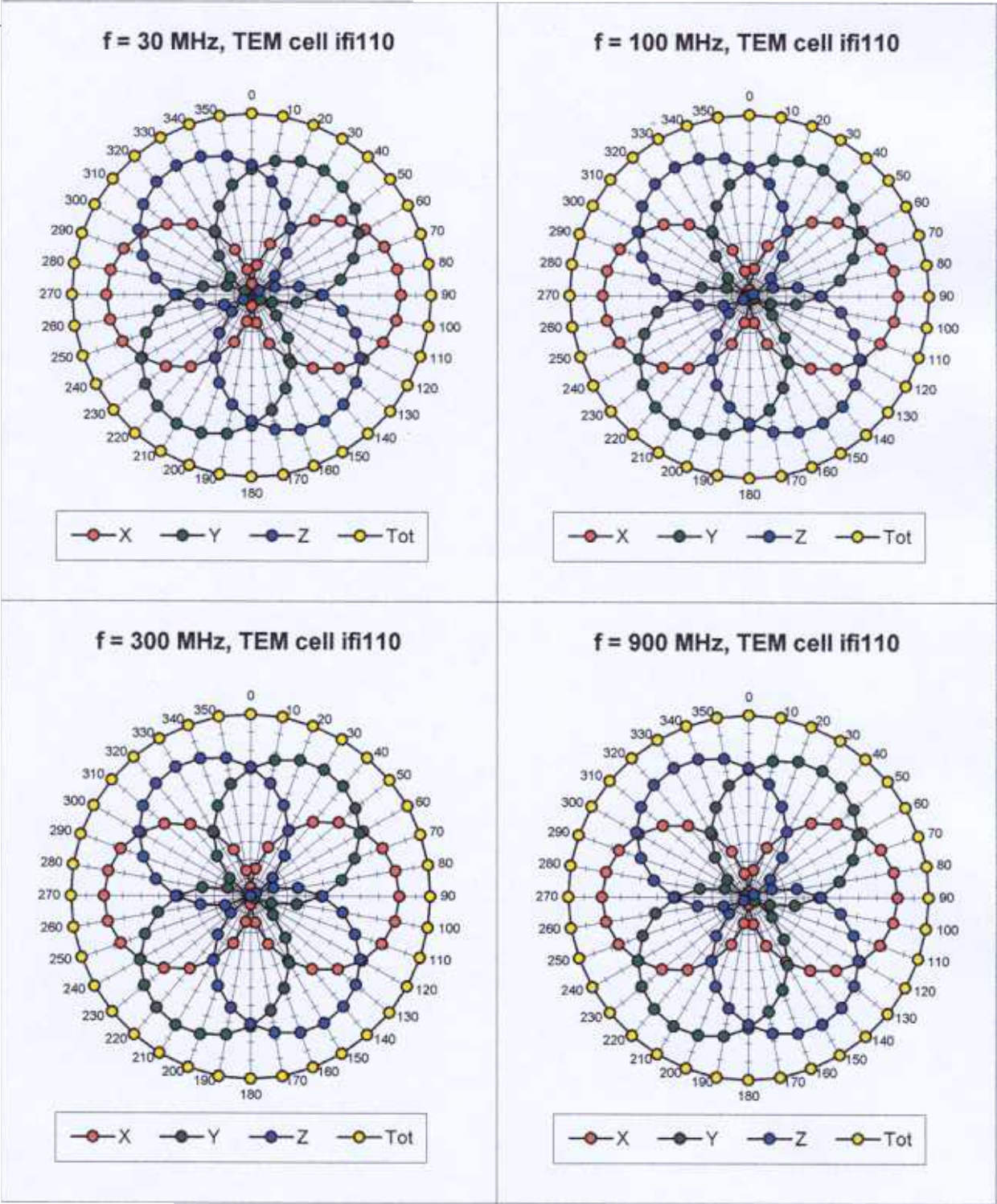
Head 1800 MHz $\epsilon_r = 40 \pm 5\%$ $\sigma = 1.40 \pm 10\%$ mho/m

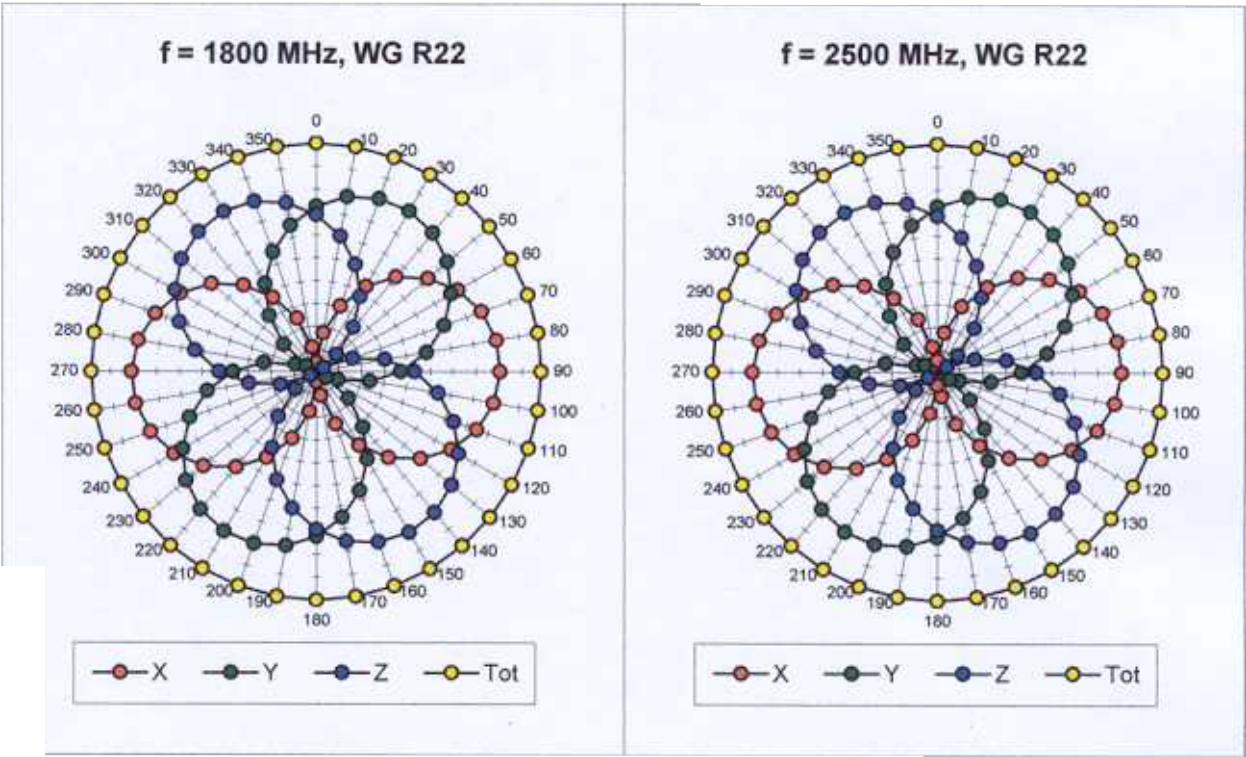
ConvF X	5.51 $\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	5.51 $\pm 7\%$ (k=2)	Alpha
ConvF Z	5.51 $\pm 7\%$ (k=2)	Depth 2.27

Sensor Offset

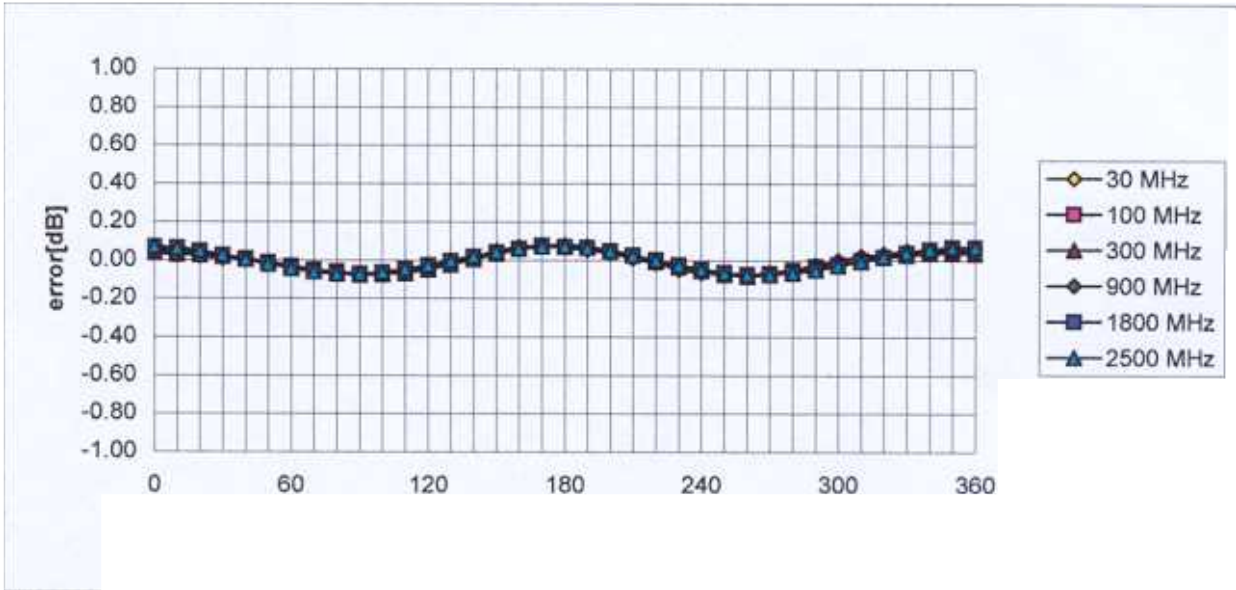
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.9 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$



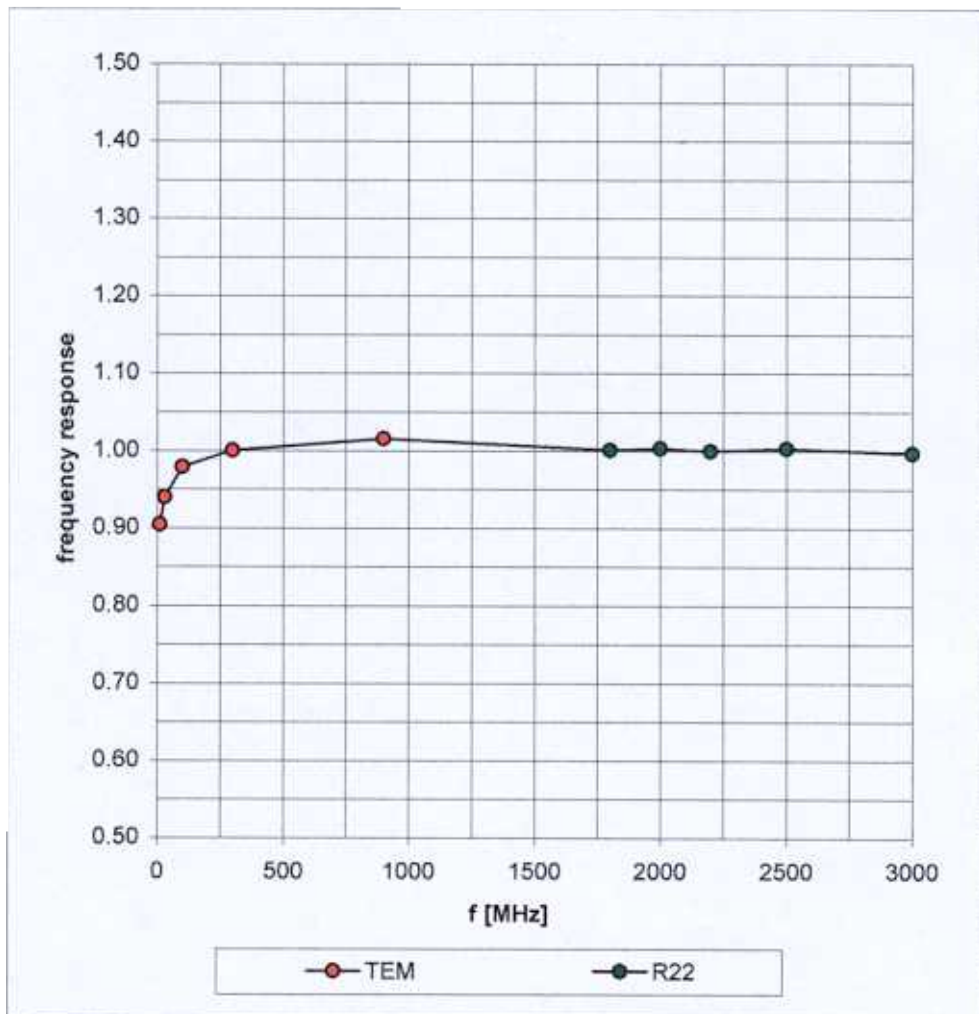


Isotropy Error (ϕ), $\theta = 0^\circ$

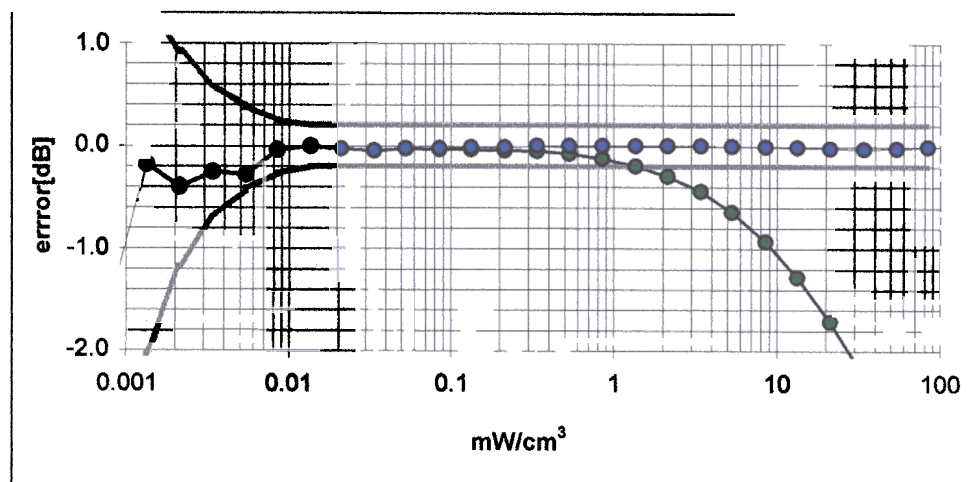
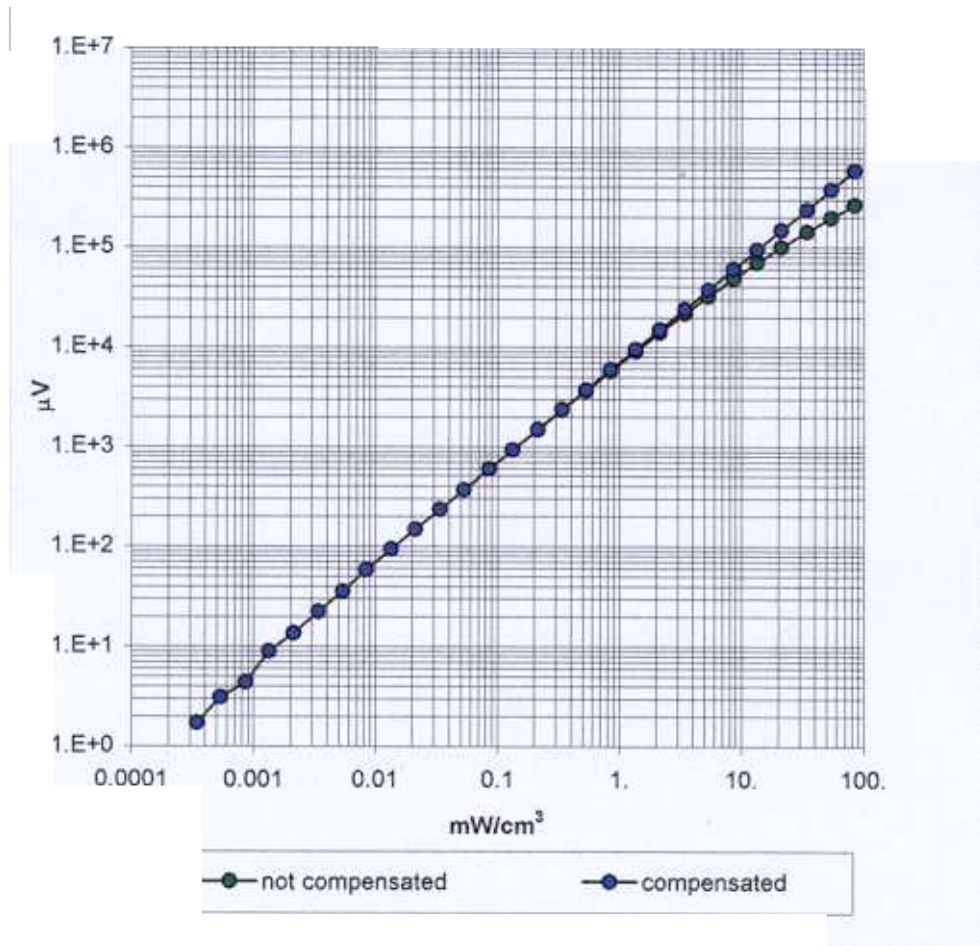


Frequency Response of E-Field

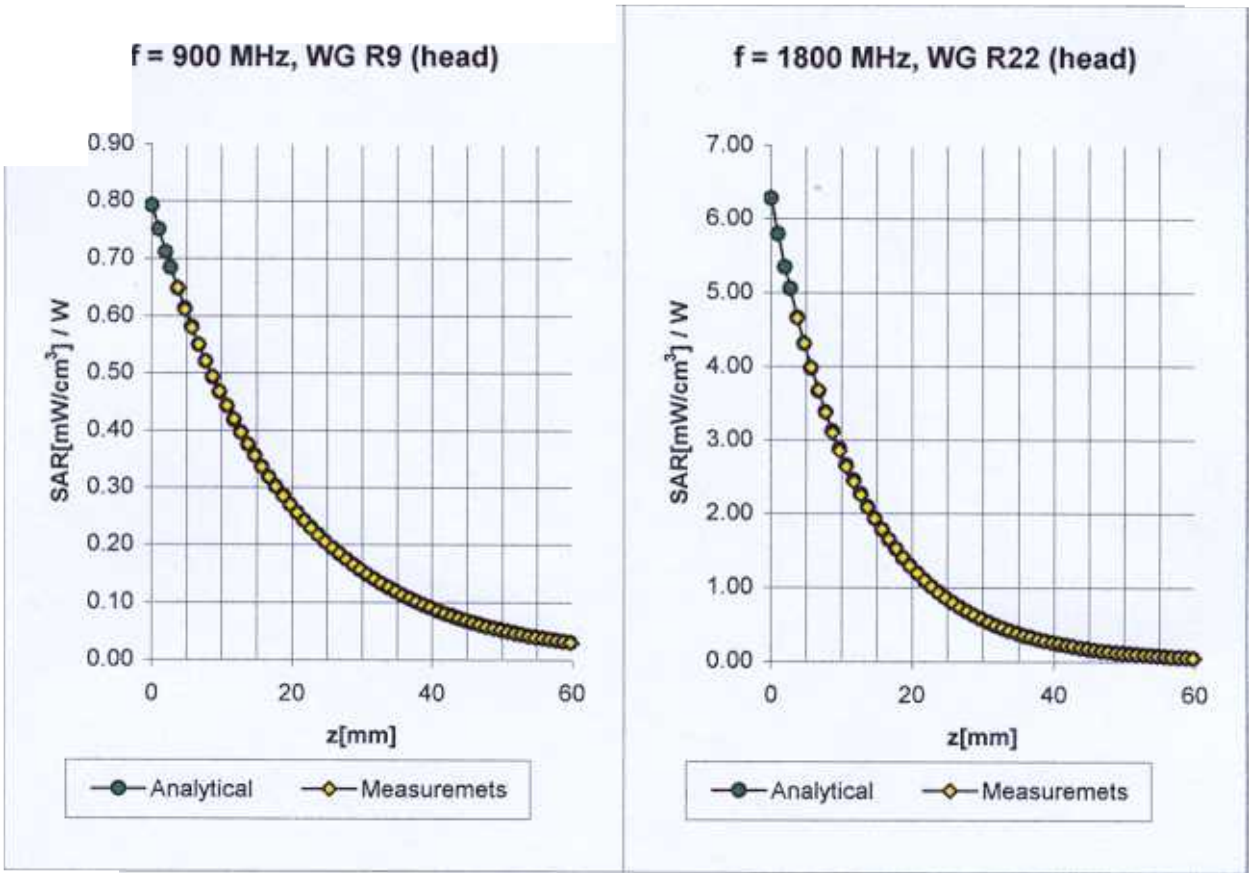
(TEM-Cell:ifi110, Waveguide R22)



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



Conversion Factor Assessment



Head 900 MHz $\epsilon_r = 42 \pm 5\%$ $\sigma = 0.97 \pm 10\%$ mho/m

ConvF X	6.59 $\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	6.59 $\pm 7\%$ (k=2)	Alpha 0.49
ConvF Z	6.59 $\pm 7\%$ (k=2)	Depth

Head 1800 MHz $\epsilon_r = 40 \pm 5\%$ $\sigma = 1.40 \pm 10\%$ mho/m

ConvF X	5.51 $\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	5.51 $\pm 7\%$ (k=2)	Alpha
ConvF Z	5.51 $\pm 7\%$ (k=2)	Depth

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1396

Place of Calibration:

Zurich

Date of Calibration:

January 29, 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:

N. Koloski Neriana

Approved by:

Oliver Kof

Probe ET3DV6

SN:1396

Manufactured:	October 1, 1999
Last calibration:	April 23, 2001
Recalibrated:	January 29, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1396

Sensitivity in Free Space

NormX	1.76 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.78 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.90 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	95
DCP Y	95
DCP Z	95 mV

Sensitivity in Tissue Simulating Liquid

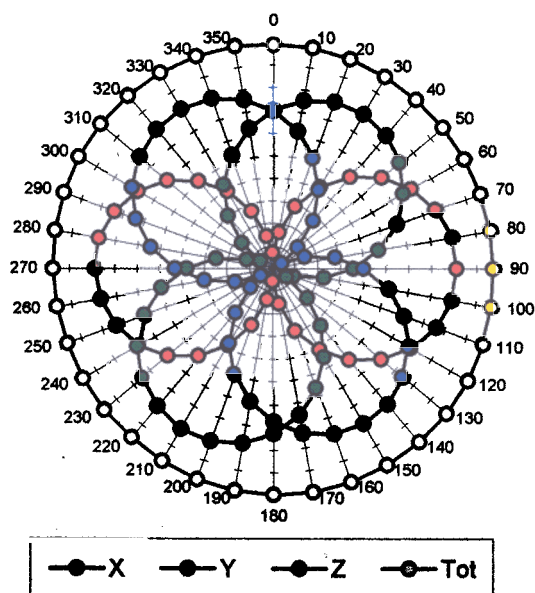
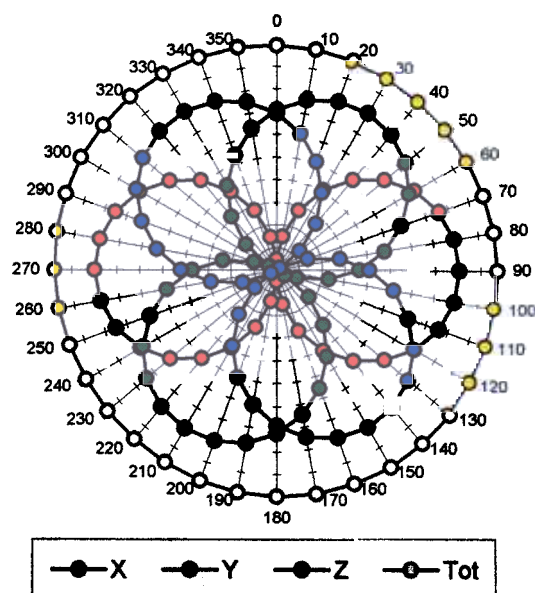
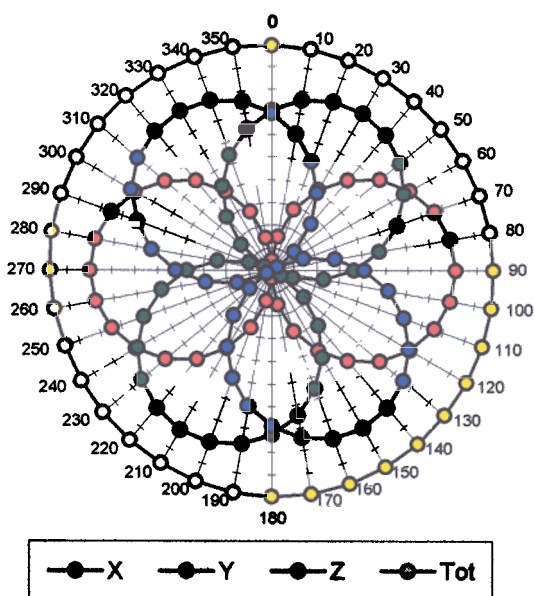
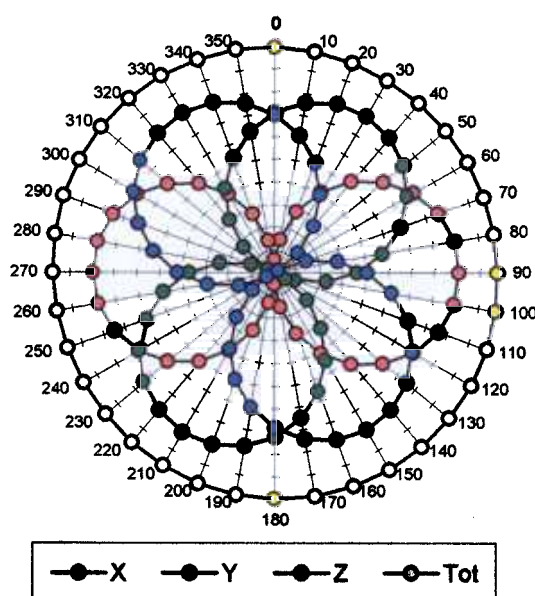
Head	800 - 1000 MHz	$\epsilon_r = 39.0 - 43.5$	$\sigma = 0.80 - 1.10 \text{ mho}/\text{m}$
ConvF X	6.8 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.8 $\pm 9.5\%$ (k=2)	Alpha	0.34
ConvF Z	6.8 $\pm 9.5\%$ (k=2)	Depth	2.57
Head	1700 - 1910 MHz	$\epsilon_r = 39.5 - 41.0$	$\sigma = 1.20 - 1.55 \text{ mho}/\text{m}$
ConvF X	5.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.5 $\pm 9.5\%$ (k=2)	Alpha	0.49
ConvF Z	5.5 $\pm 9.5\%$ (k=2)	Depth	2.37

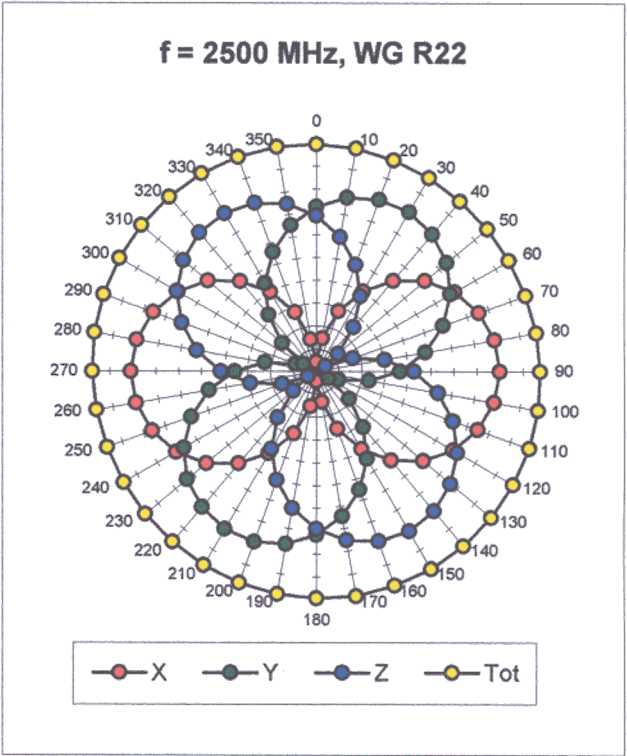
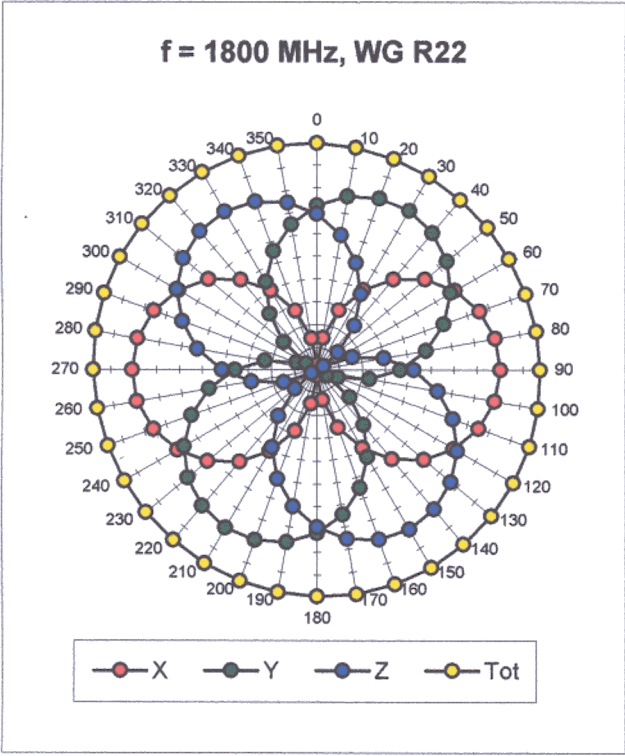
Boundary Effect

Head	800 - 1000 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		9.1	5.2
SAR _{be} [%] With Correction Algorithm		0.3	0.5
Head	1700 - 1910 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		11.3	7.5
SAR _{be} [%] With Correction Algorithm		0.2	0.2

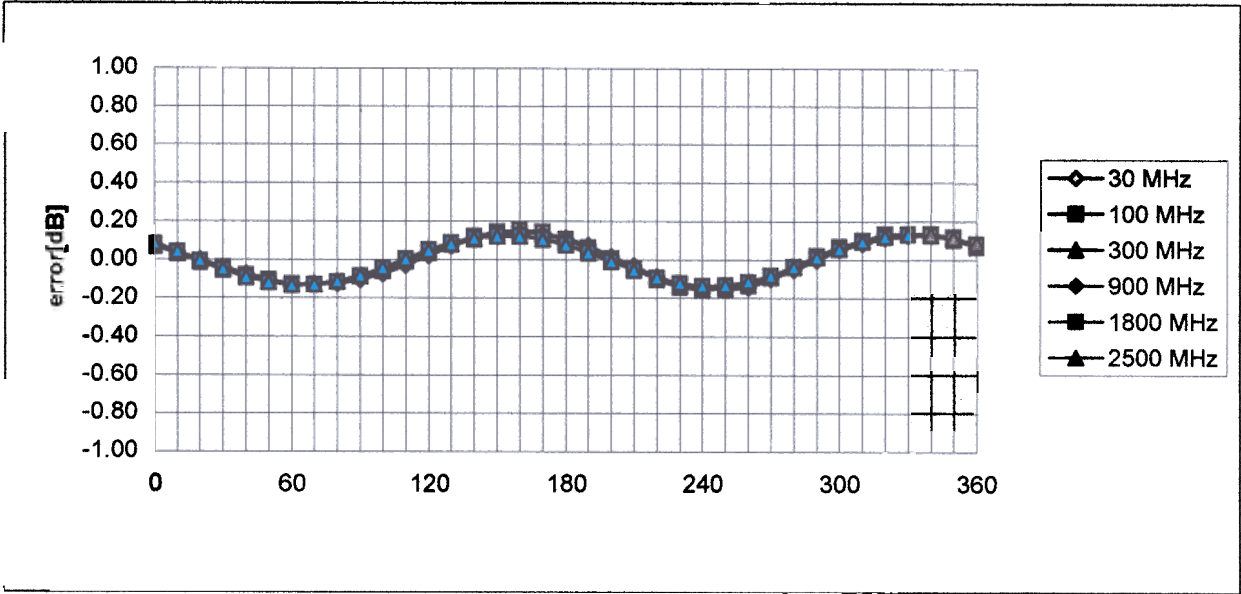
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.5 $\pm$ 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**

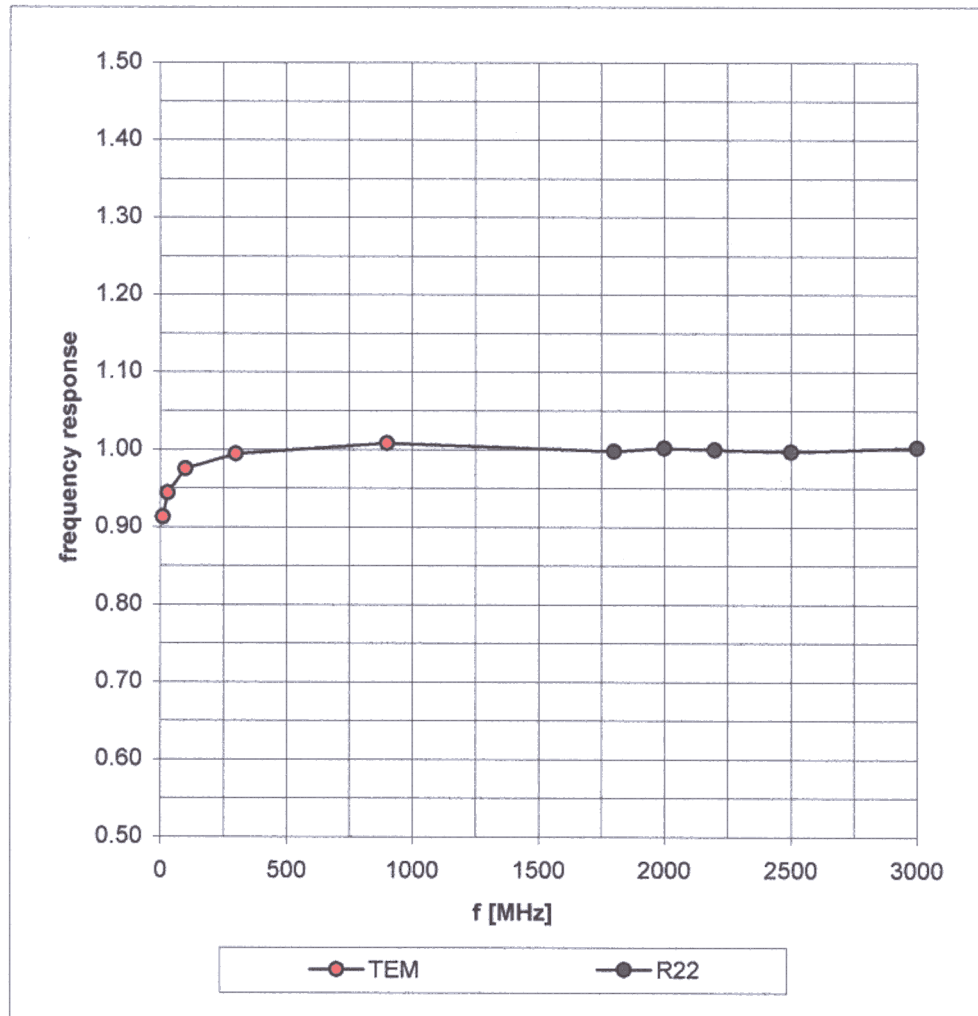


Isotropy Error (ϕ), $\theta = 0^\circ$

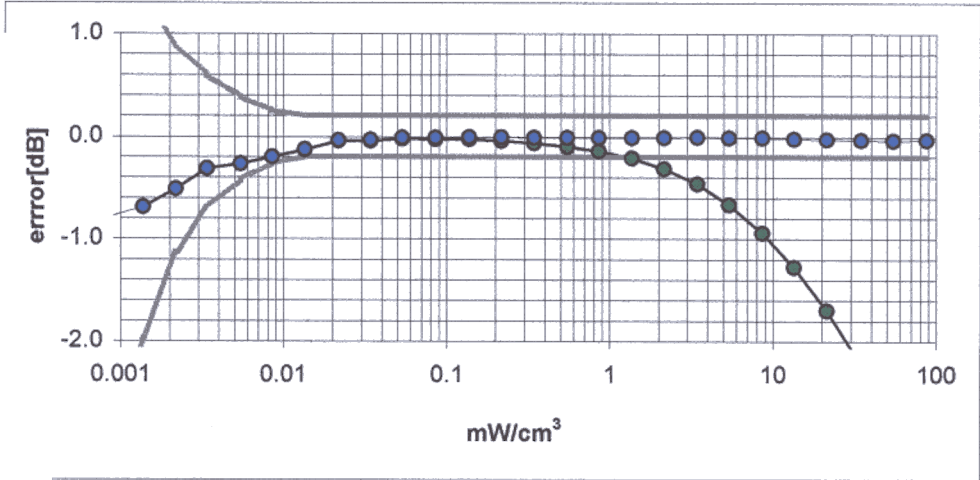
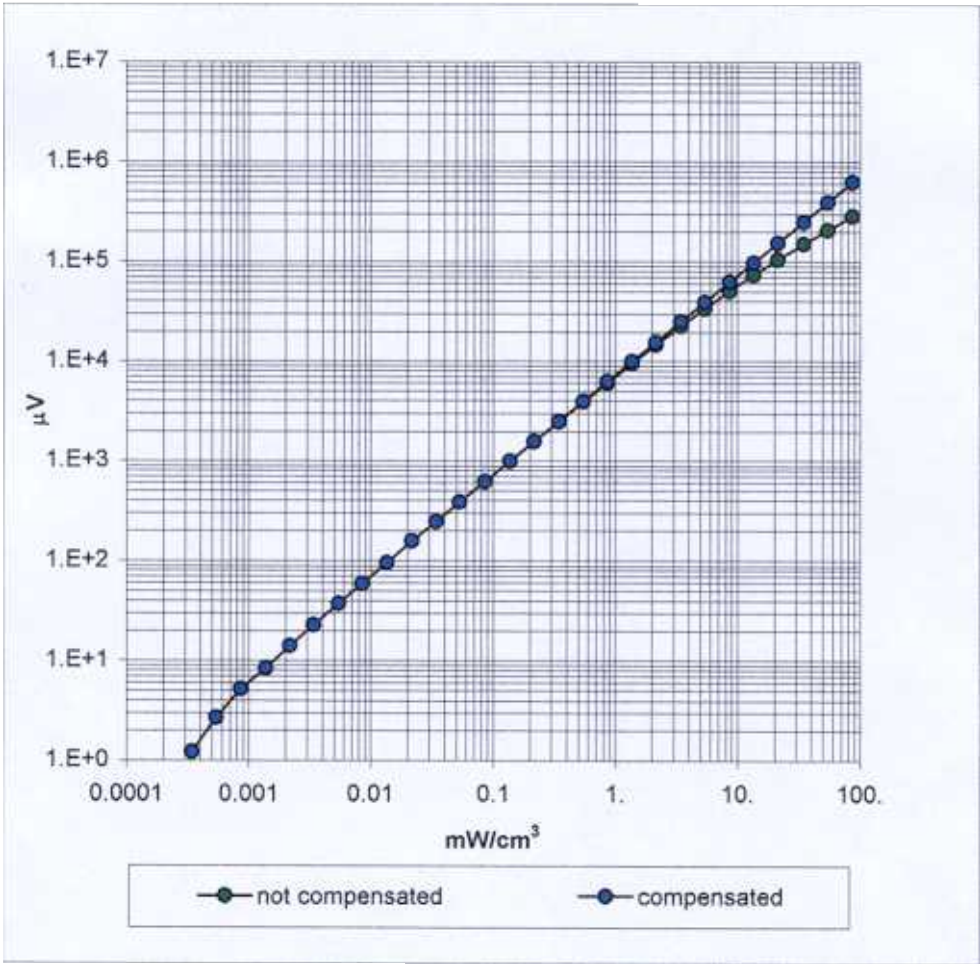


Frequency Response of E-Field

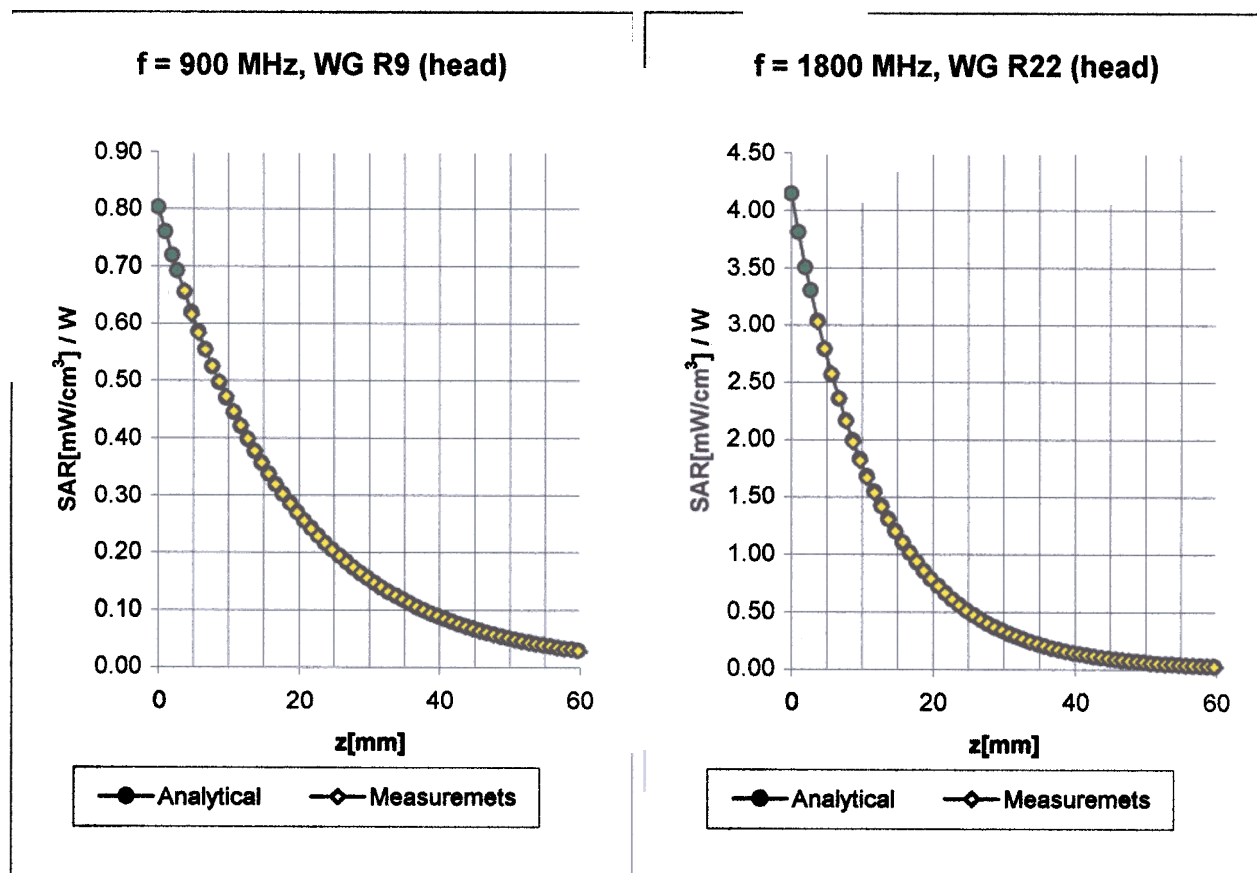
(TEM-Cell:ifi110, Waveguide R22)



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



Conversion Factor Assessment



800 - 1000 MHz

 $\epsilon_r = 39.0 - 43.5$ $\sigma = 0.80 - 1.10$ mho/mConvF X **6.8** $\pm 9.5\%$ (k=2)

Boundary effect:

ConvF Y **6.8** $\pm 9.5\%$ (k=2)Alpha **0.34**ConvF Z **6.8** $\pm 9.5\%$ (k=2)Depth **2.57**

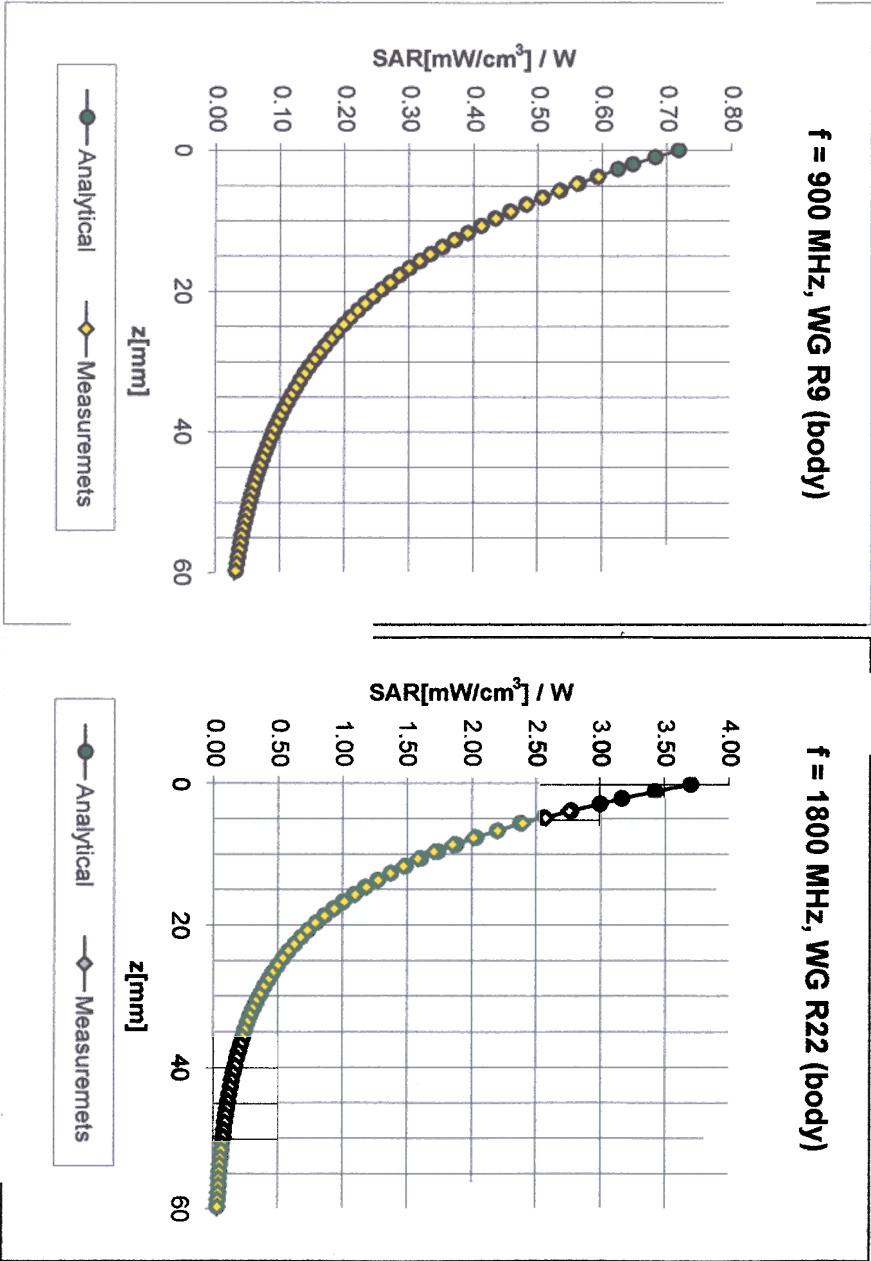
1700 - 1910 MHz

 $\epsilon_r = 39.5 - 41.0$ $\sigma = 1.20 - 1.55$ mho/mConvF X **5.5** $\pm 9.5\%$ (k=2)

Boundary effect:

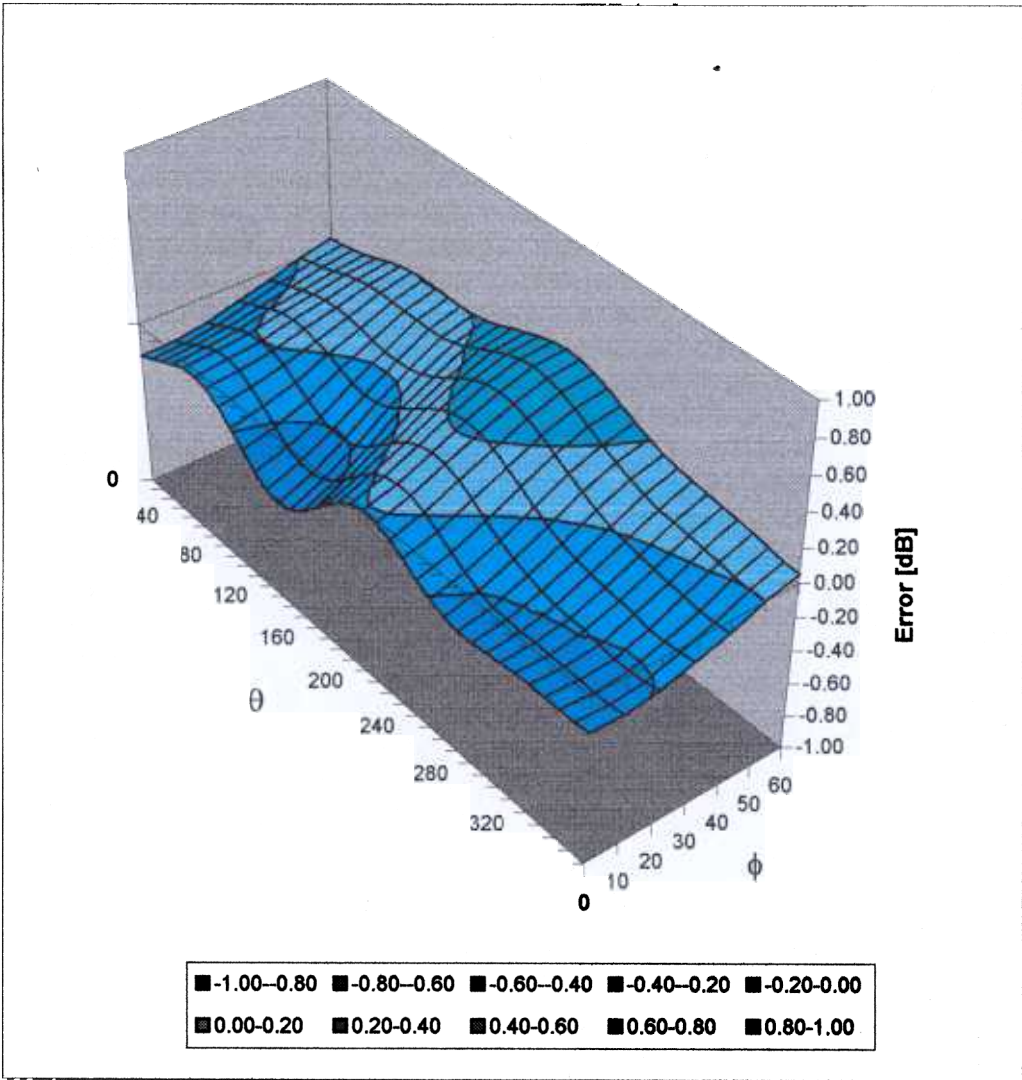
ConvF Y **5.5** $\pm 9.5\%$ (k=2)Alpha **0.49**ConvF Z **5.5** $\pm 9.5\%$ (k=2)Depth **2.37**

Conversion Factor Assessment



Body	800 - 1000 MHz	$\epsilon_r = 52.3 - 57.8$	$\sigma = 0.96 - 1.15$ mho/m
		Boundary effect:	
	ConvF X	6.6 ± 9.5% (k=2)	Alpha
	ConvF Y	6.6 ± 9.5% (k=2)	Alpha
	ConvF Z	6.6 ± 9.5% (k=2)	Depth
Body	1700 - 1910 MHz	$\epsilon_r = 50.6 - 56.0$	$\sigma = 1.35 - 1.65$ mho/m
		Boundary effect:	
	ConvF X	5.2 ± 9.5% (k=2)	Alpha
	ConvF Y	5.2 ± 9.5% (k=2)	Alpha
	ConvF Z	5.2 ± 9.5% (k=2)	Depth

Deviation from Isotropy in HSL
Error (θ, ϕ), $f = 900 \text{ MHz}$



Calibration Certificate

900 MHz System Validation Dipole

Type:

D900V2

Serial Number:

003

Place of Calibration

Zurich

Date of Calibration

January 10, 2002

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:

Nikolaus Neviana

Approved by

Oliver Katz

DASY

Dipole Validation Kit

Type: D900V2

Serial: 003

Manufactured: August 1995
Calibrated: January 10, 2002

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	40.6	± 5%
Conductivity	0.95 mho/m	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.48 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 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 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:	11.2 mW/g
averaged over 10 cm ³ (10 g) of tissue:	7.04 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:	1.412 ns	(one direction)
Transmission factor:	0.984	(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:	$\text{Re}\{Z\} = 49.4 \, \Omega$
	$\text{Im}\{Z\} = -3.7 \, \Omega$
Return Loss at 900 MHz	-28.5 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.

Validation Dipole D900V2 SN:003, d = 15 mm

Frequency: 900 MHz; Antenna Input Power: 250 [mW]

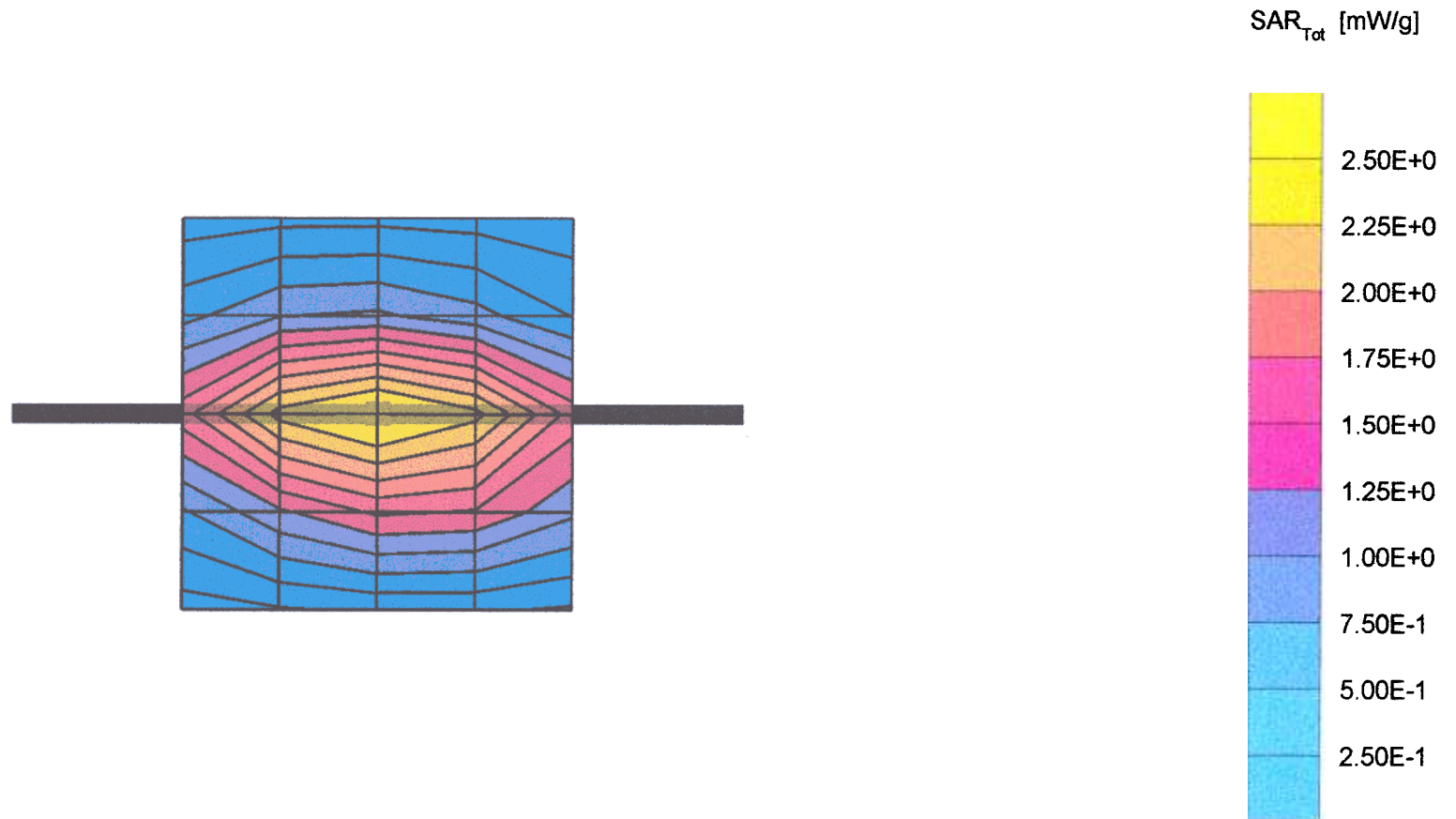
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0

Probe: ET3DV6 - SN1507; ConvF(6.48,6.48,6.48) at 900 MHz; IEEE1528 900 MHz; $\sigma = 0.95$ mho/m $\epsilon_r = 40.6$ $\rho = 1.00$ g/cm³

Cubes (2): Peak: 4.53 mW/g ± 0.06 dB, SAR (1g): 2.79 mW/g ± 0.04 dB, SAR (10g): 1.76 mW/g ± 0.02 dB, (Worst-case extrapolation)

Penetration depth: 11.4 (10.2, 13.1) [mm]

Powerdrift: -0.03 dB



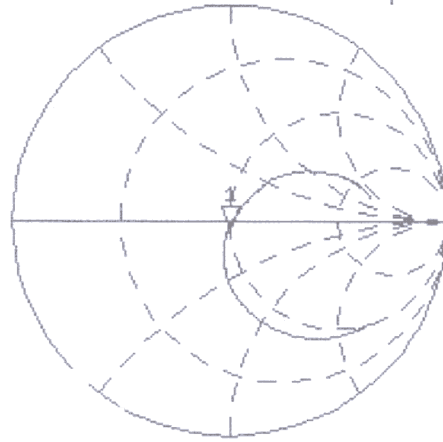
CH1 S11 1 U FS

1: 49.404 Ω -3.7285 Ω 47.429 pF

900.000 000 MHz

De1

Avg
16



CH2 S11

LOG

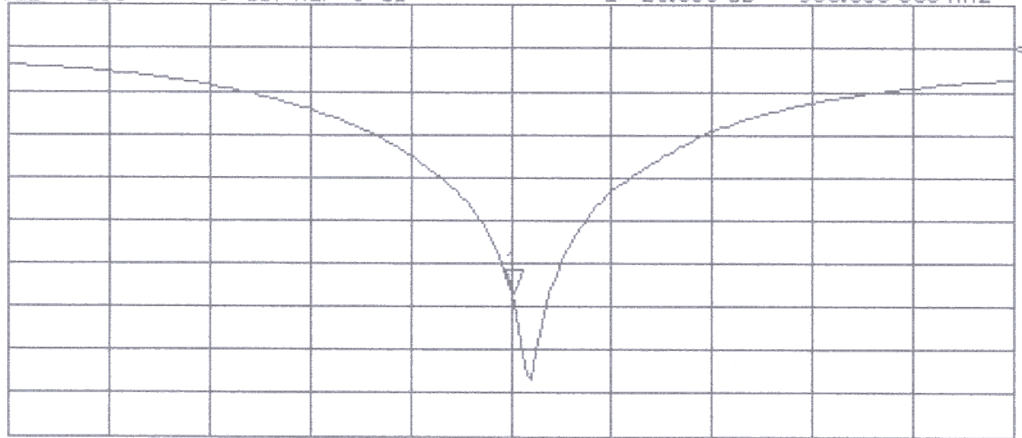
5 dB/REF 0 dB

1:-28.533 dB

900.000 000 MHz

Cor

↑



START 700.000 000 MHz

STOP 1 100.000 000 MHz