

APPENDIX D : Calibration Certificates

Schmid & Partner 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:

1729

Place of Calibration:

Zurich

Date of Calibration:

November 20, 2002

Calibration Interval:

12 months

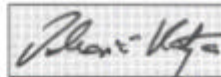
Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

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:1729

Manufactured: October 1, 2002
Last calibration: November 20, 2002

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1729

November 20, 2002

DASY - Parameters of Probe: ET3DV6 SN:1729

Sensitivity in Free Space

NormX	1.59 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.53 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.75 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	95	mV
DCP Y	95	mV
DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid

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	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha	0.47
ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth	2.12
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	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha	0.52
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth	2.44

Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{90%} [%]	Without Correction Algorithm	9.2	5.0	
SAR _{90%} [%]	With Correction Algorithm	0.2	0.4	
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{90%} [%]	Without Correction Algorithm	12.6	8.4	
SAR _{90%} [%]	With Correction Algorithm	0.2	0.2	

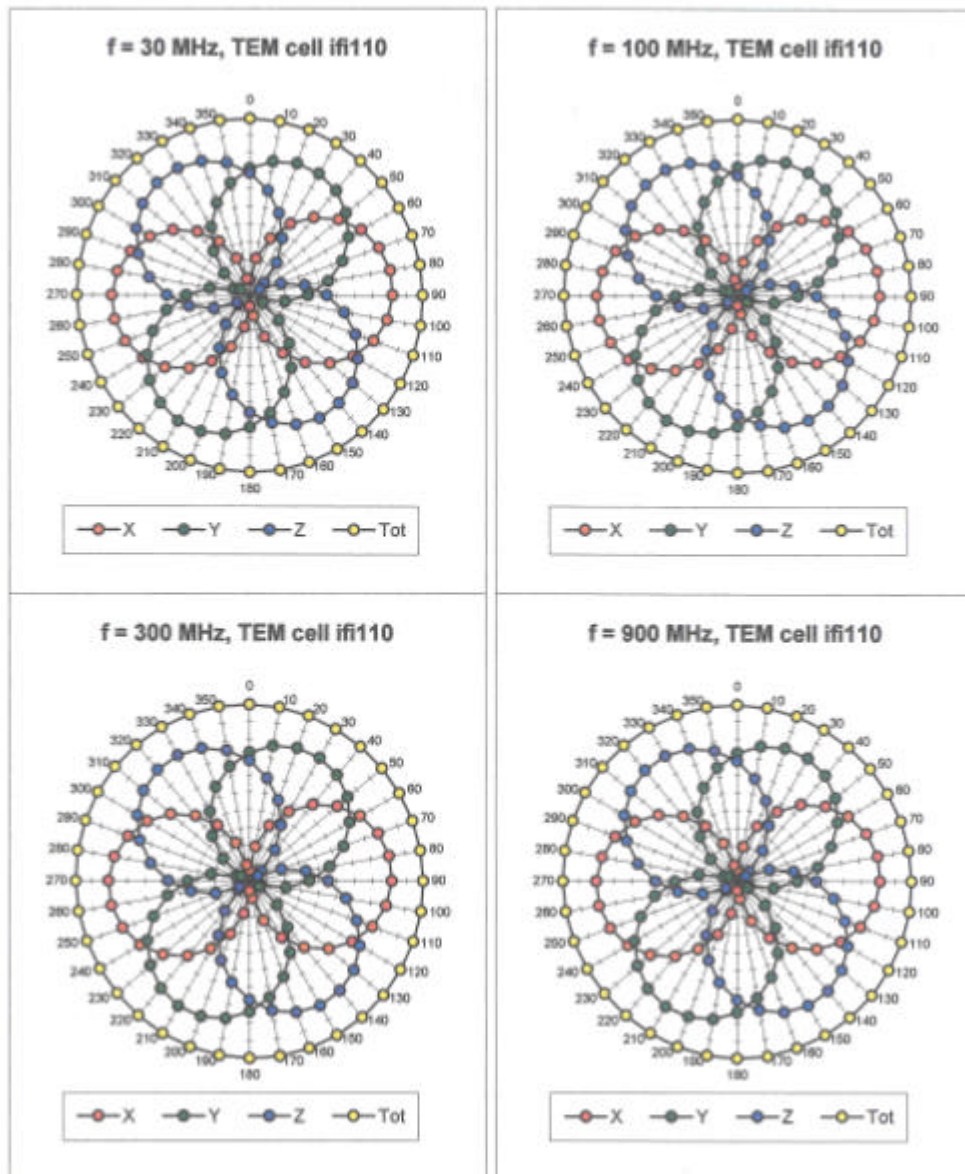
Sensor Offset

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

ET3DV6 SN:1729

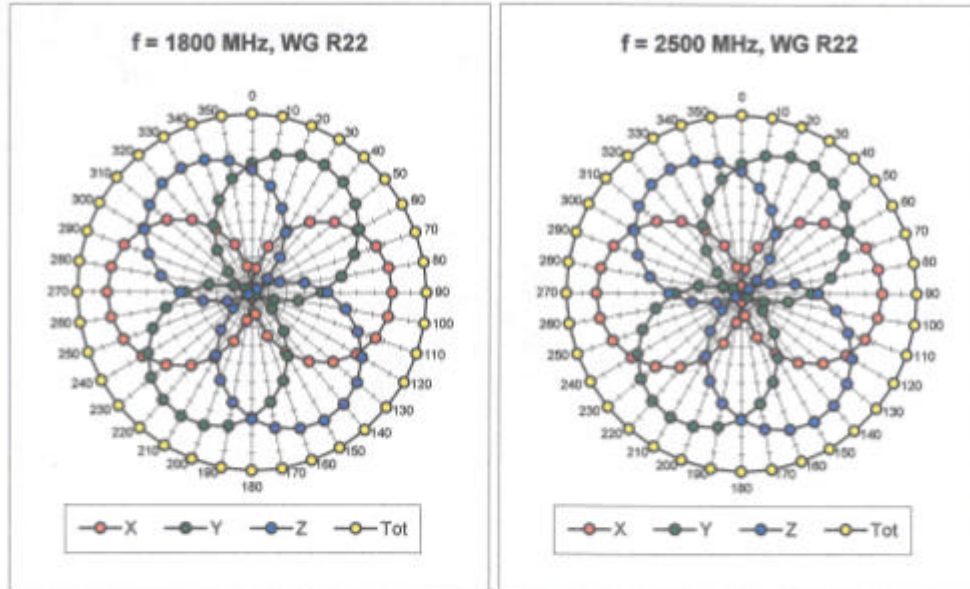
November 20, 2002

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

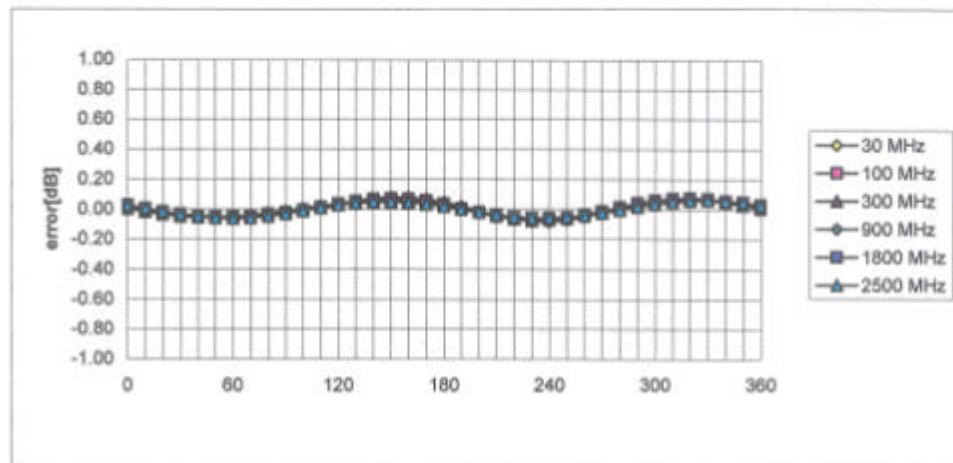


ET3DV6 SN:1729

November 20, 2002



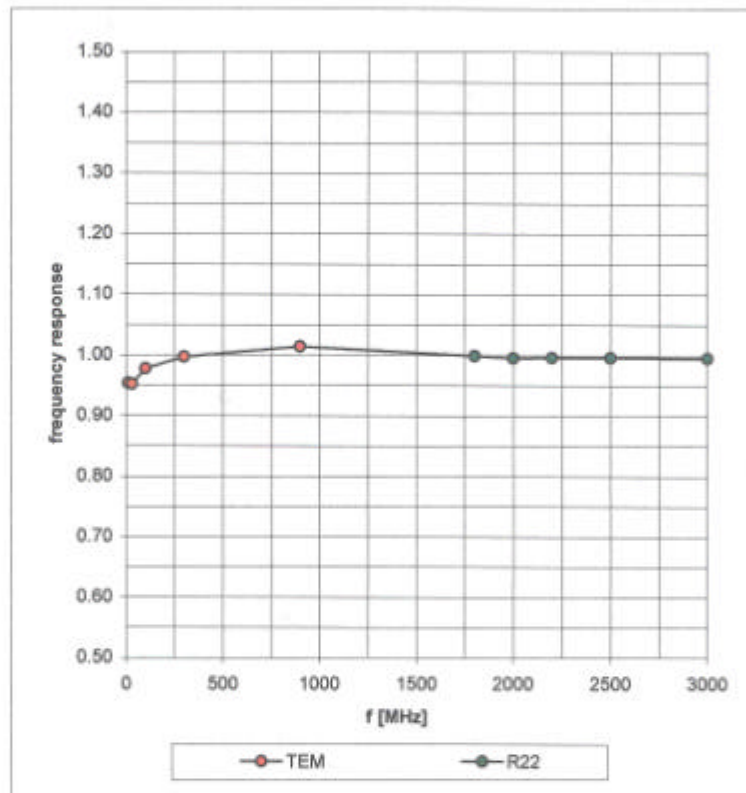
Isotropy Error (ϕ), $\theta = 0^\circ$



ET3DV6 SN:1729

November 20, 2002

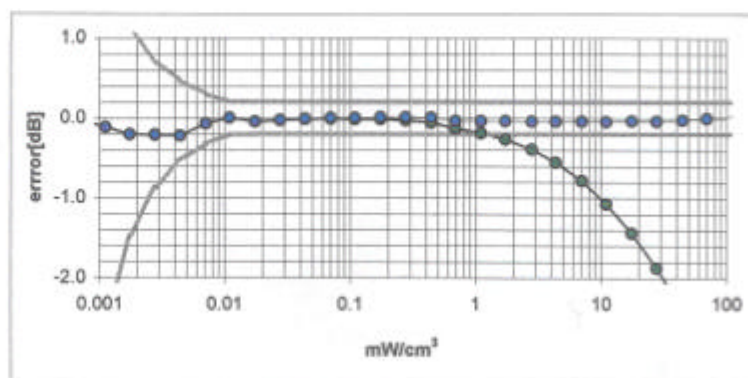
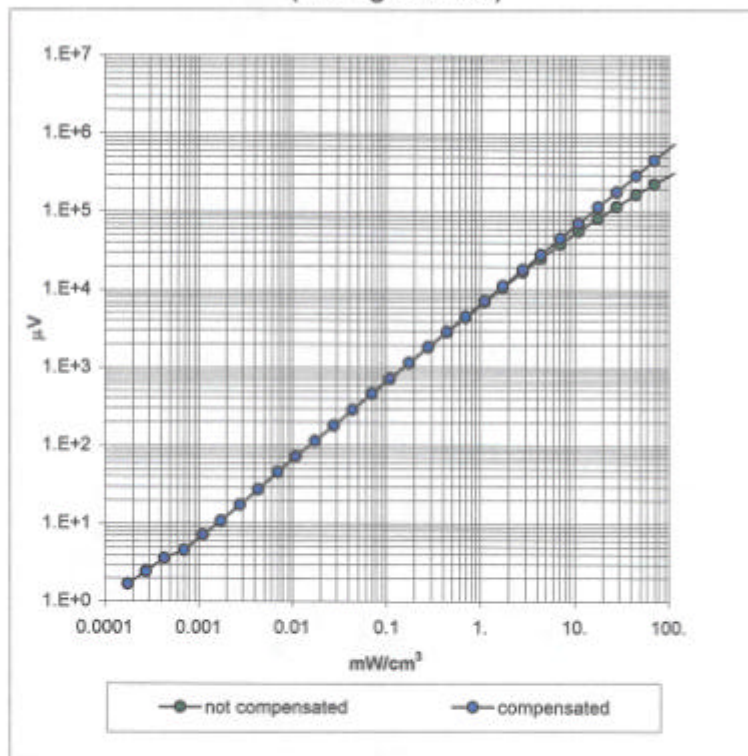
Frequency Response of E-Field (TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1729

November 20, 2002

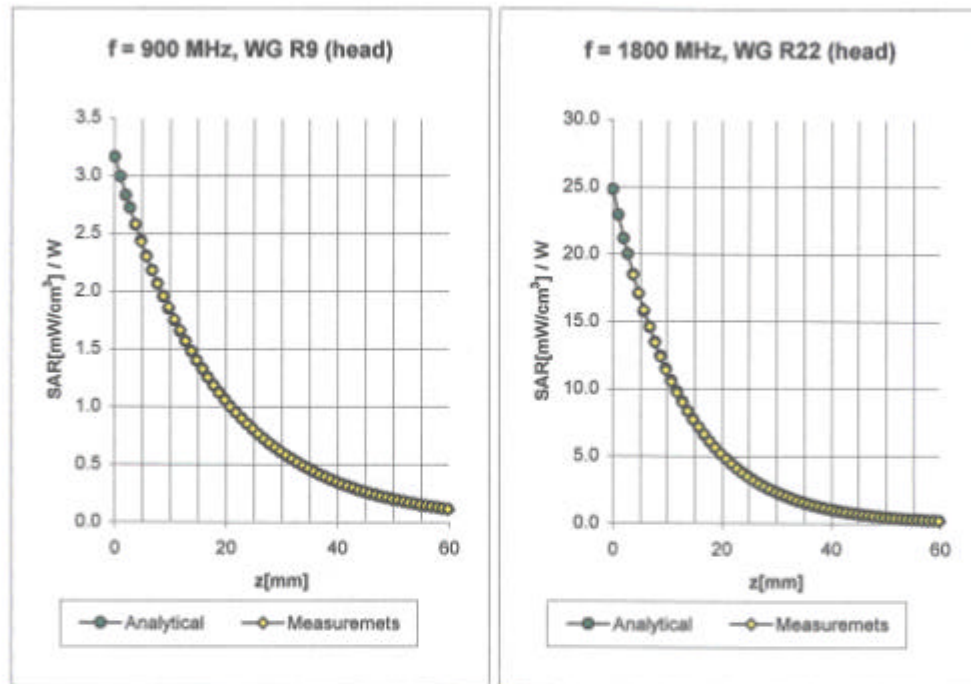
Dynamic Range f(SAR_{brain}) (Waveguide R22)



ET3DV6 SN:1729

November 20, 2002

Conversion Factor Assessment



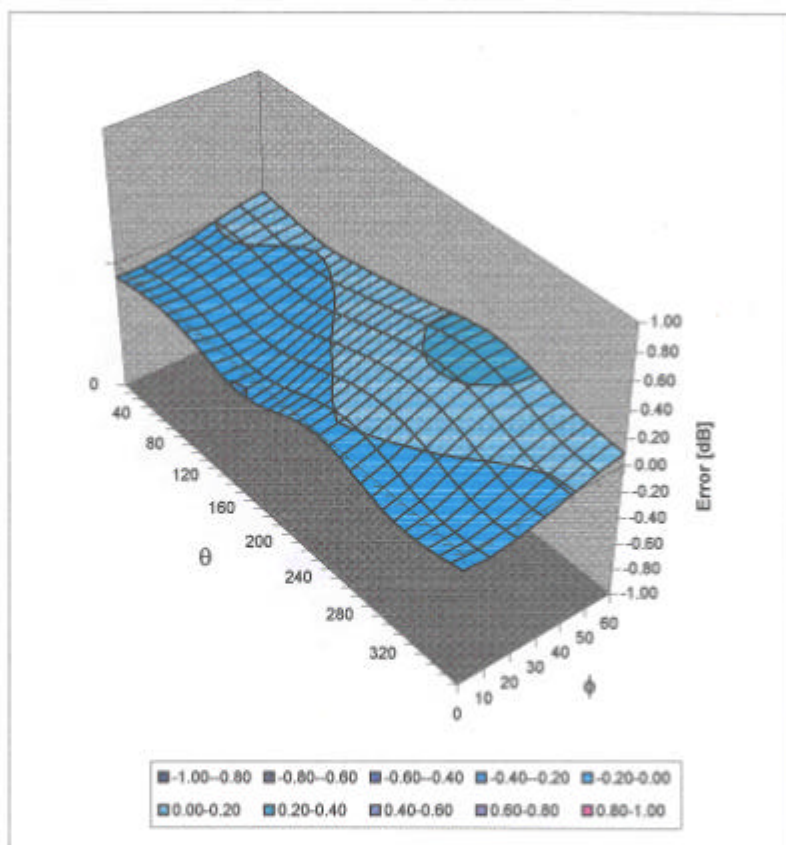
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
	ConvF X	$6.4 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$6.4 \pm 9.5\%$ (k=2)	Alpha 0.47
	ConvF Z	$6.4 \pm 9.5\%$ (k=2)	Depth 2.12
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
	ConvF X	$5.3 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$5.3 \pm 9.5\%$ (k=2)	Alpha 0.52
	ConvF Z	$5.3 \pm 9.5\%$ (k=2)	Depth 2.44

ET3DV6 SN:1729

November 20, 2002

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors

for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1729

Place of Assessment:

Zurich

Date of Assessment:

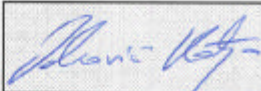
May 22, 2003

Probe Calibration Date:

November 20, 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:1729Conversion factor ($\pm$ standard deviation)**835 MHz** ConvF **$6.3 \pm 8\%$**

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

1900 MHz ConvF **$4.7 \pm 8\%$**

$\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$ (body tissue)

**Schmid & Partner
Engineering AG**

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

Calibration Certificate**835 MHz System Validation Dipole**

Type:	D835V2
Serial Number:	471
Place of Calibration:	Zurich
Date of Calibration:	December 4, 2002
Calibration Interval:	24 months

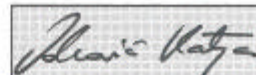
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Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:



Approved by:



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DASY

Dipole Validation Kit

Type: D835V2

Serial: 471

Manufactured: November 15, 2002
Calibrated: December 4, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	43.1	$\pm 5\%$
Conductivity	0.90 mho/m	$\pm 5\%$

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.6 at 835 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 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW $\pm 3\%$. The results are normalized to 1W input power.

2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm ³ (1 g) of tissue:	9.76 mW/g
averaged over 10 cm ³ (10 g) of tissue:	6.28 mW/g

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:	1.383 ns	(one direction)
Transmission factor:	0.993	(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 835 MHz:	$\text{Re}\{Z\} = 50.7 \Omega$
	$\text{Im}\{Z\} = -1.7 \Omega$
Return Loss at 835 MHz	-34.8 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.

Date/Time: 12/04/02 13:27

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN471_SN1507_HSL835_041202.da4**DUT: Dipole 835 MHz Type & Serial Number: D835V2 - SN471**
Program: Dipole Calibration; Pin = 250 mW; d = 15 mmCommunication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL 835 MHz ($\sigma = 0.9 \text{ mho/m}$, $\epsilon = 43.05$, $\rho = 1000 \text{ kg/m}^3$)
Phantom section: FlatSection

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.6, 6.6, 6.6); Calibrated: 1/24/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 56.3 V/m
Peak SAR = 3.64 mW/g
SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.57 mW/g
Power Drift = -0.007 dB