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Author Data Daoud Attayi	Dates of Test May 26 – 27, Oct. 08 - 09, 2003	Test Report No RIM-0071-0310-03	FCC ID: L6ARAO30GN

APPENDIX D: PROBE & DIPOLE CALIBRATION DATA

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Daoud Attayi	May 26 – 27, Oct. 08 - 09, 2003	RIM-0071-0310-03	L6ARAO30GN

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:

1642

Place of Calibration:

Zurich

Date of Calibration:

July 26, 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. Vetter

Approved by:

Daoud Attayi

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**Schmid & Partner
Engineering AG**


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

Probe ET3DV6

SN:1642

Manufactured:	November 7, 2001
Last calibration:	November 26, 2001
Recalibrated:	July 26, 2002

Calibrated for System DASY3

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ET3DV6 SN:1642

July 26, 2002

DASY3 - Parameters of Probe: ET3DV6 SN:1642

Sensitivity in Free Space

NormX **1.62** $\mu\text{V}/(\text{V}/\text{m})^2$
 NormY **1.85** $\mu\text{V}/(\text{V}/\text{m})^2$
 NormZ **1.61** $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X **96** mV
 DCP Y **96** mV
 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

ConvF X	6.5 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 8.9\%$ (k=2)	Alpha	0.34
ConvF Z	6.5 $\pm 8.9\%$ (k=2)	Depth	2.68

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

ConvF X	5.4 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	5.4 $\pm 8.9\%$ (k=2)	Alpha	0.53
ConvF Z	5.4 $\pm 8.9\%$ (k=2)	Depth	2.33

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm


Probe Tip to Boundary		1 mm	2 mm
SAR ₉₀ [%] Without Correction Algorithm		9.9	5.7
SAR ₉₀ [%] With Correction Algorithm		0.4	0.5

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR ₉₀ [%] Without Correction Algorithm		12.0	7.8
SAR ₉₀ [%] With Correction Algorithm		0.2	0.2

Sensor Offset

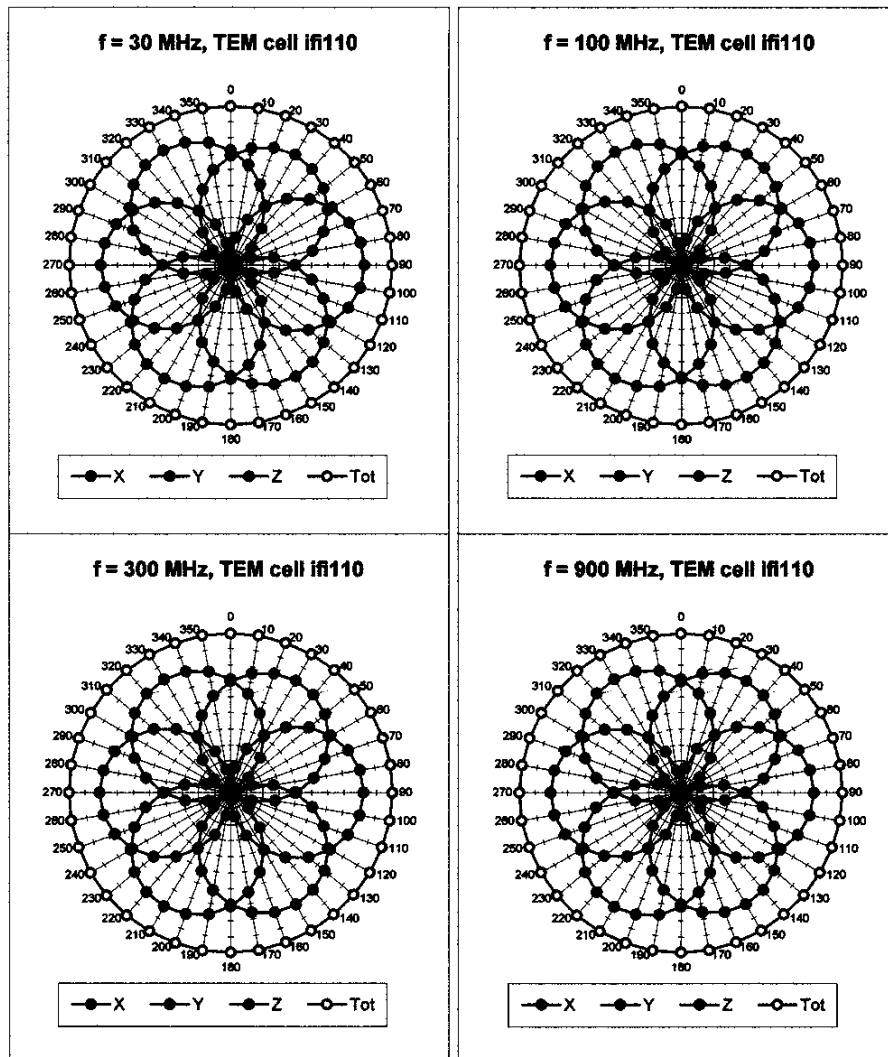
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.1 \pm 0.2	mm

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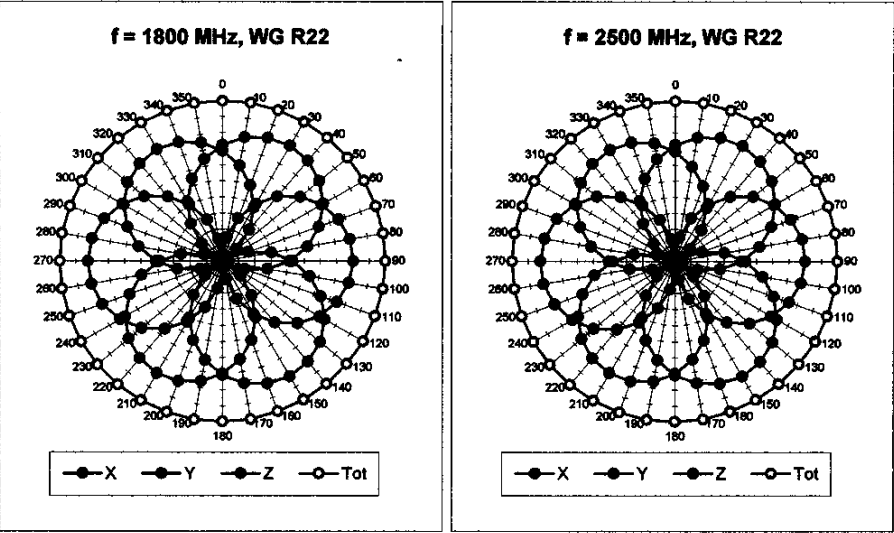
July 26, 2002

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

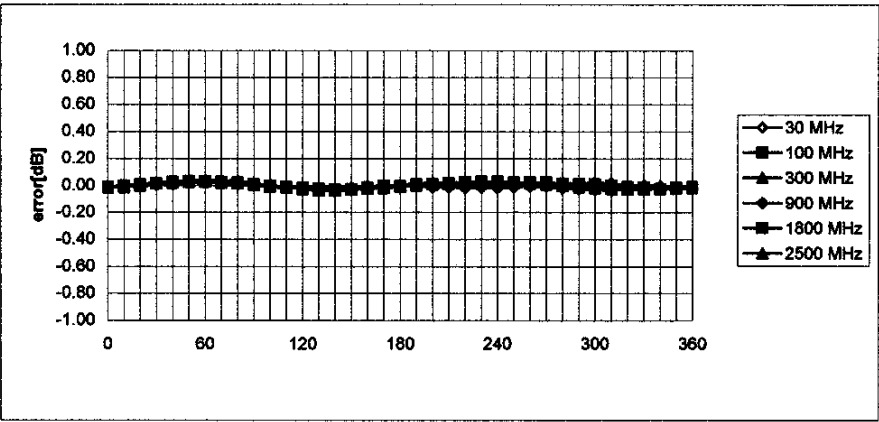



ET3DV6 SN:1642

July 26, 2002



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



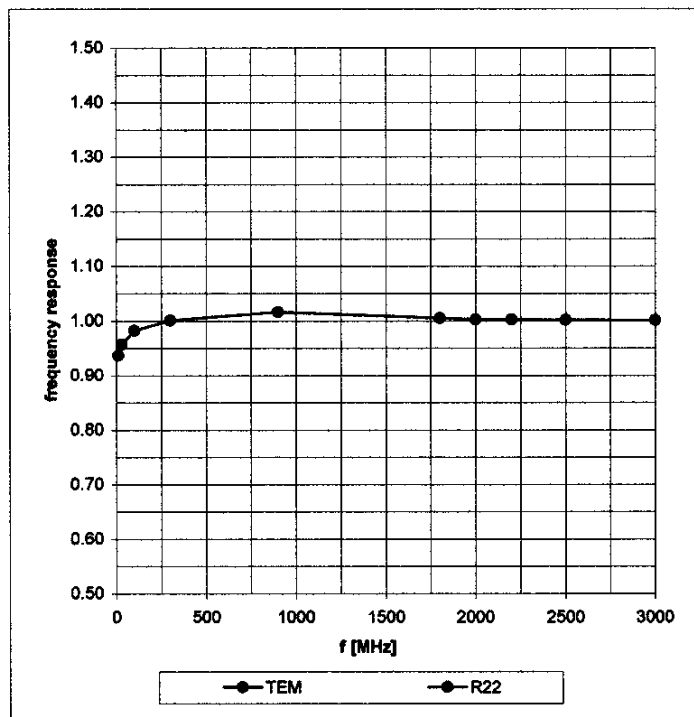
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ET3DV6 SN:1642

July 26, 2002

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)

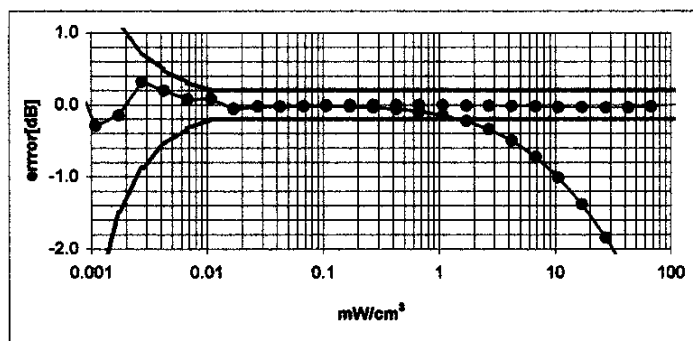
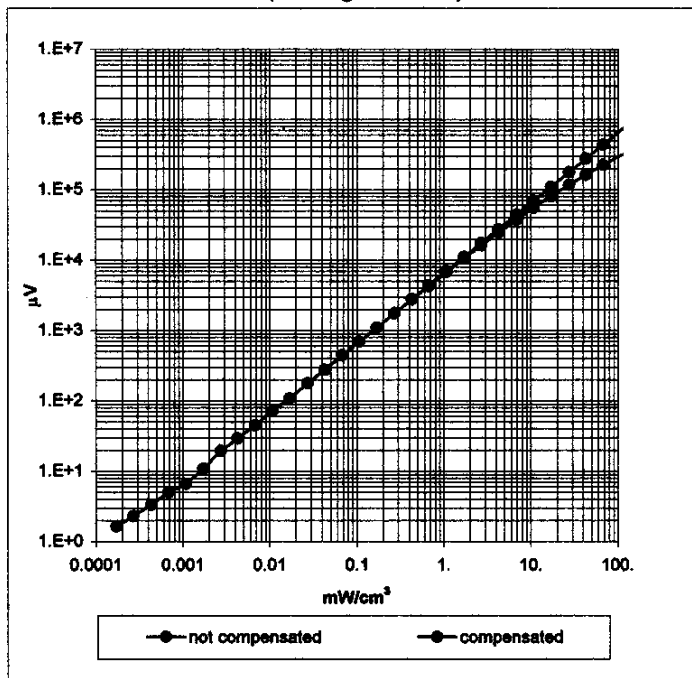


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July 26, 2002

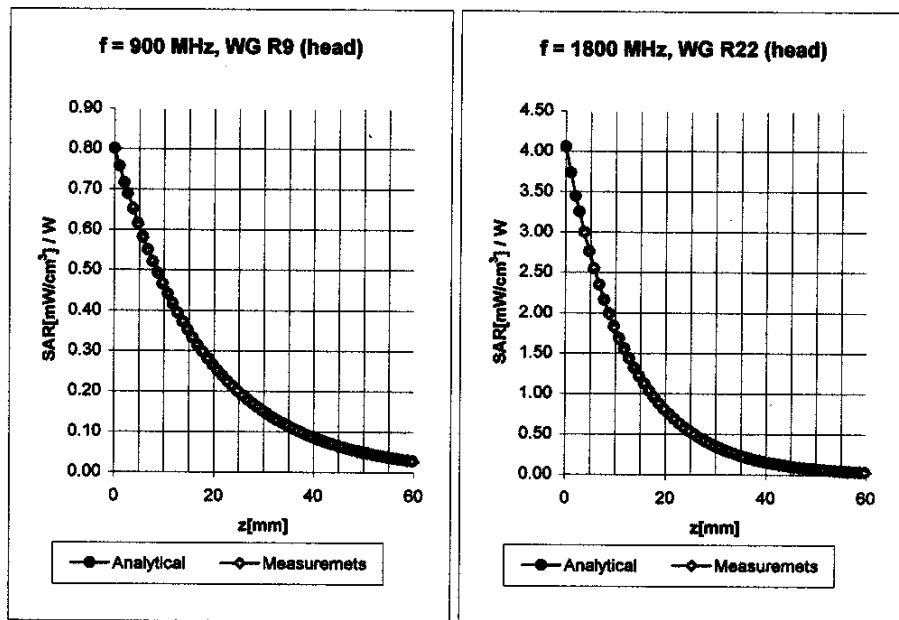
Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



ET3DV6 SN:1642

July 26, 2002

Conversion Factor Assessment

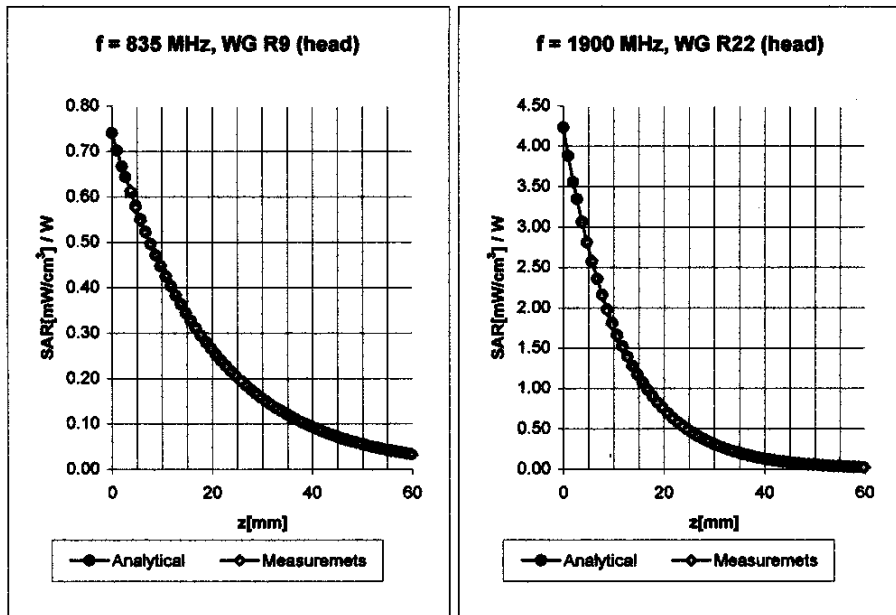


Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
ConvF X	6.5	$\pm 8.9\% (k=2)$	Boundary effect:
ConvF Y	6.5	$\pm 8.9\% (k=2)$	Alpha 0.34
ConvF Z	6.5	$\pm 8.9\% (k=2)$	Depth 2.68
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.4	$\pm 8.9\% (k=2)$	Boundary effect:
ConvF Y	5.4	$\pm 8.9\% (k=2)$	Alpha 0.53
ConvF Z	5.4	$\pm 8.9\% (k=2)$	Depth 2.33

ET3DV6 SN:1642

July 26, 2002

Conversion Factor Assessment

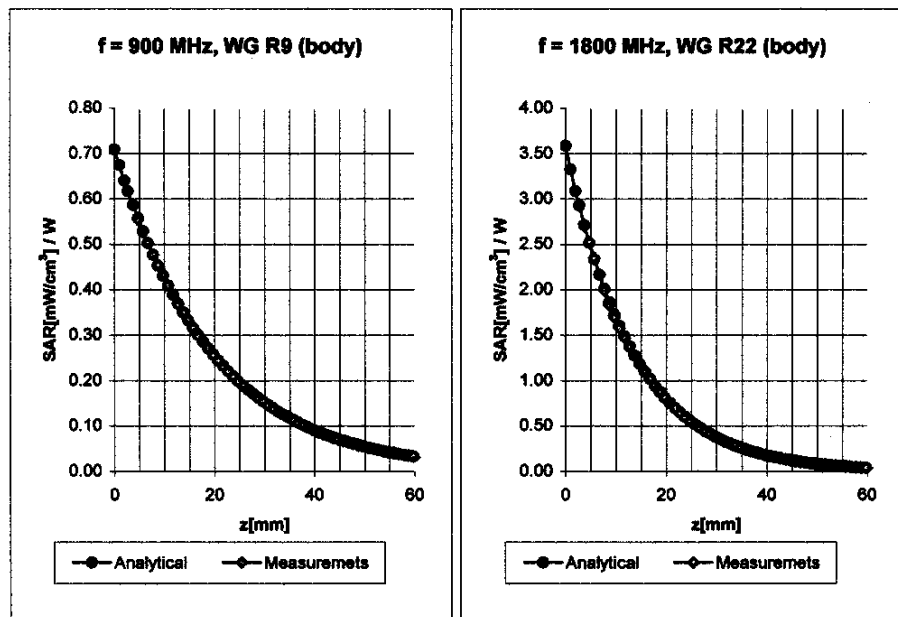


Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	$6.5 \pm 8.9\% (k=2)$	Boundary effect:
	ConvF Y	$6.5 \pm 8.9\% (k=2)$	Alpha 0.34
	ConvF Z	$6.5 \pm 8.9\% (k=2)$	Depth 2.65
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	$5.3 \pm 8.9\% (k=2)$	Boundary effect:
	ConvF Y	$5.3 \pm 8.9\% (k=2)$	Alpha 0.57
	ConvF Z	$5.3 \pm 8.9\% (k=2)$	Depth 2.28

ET3DV6 SN:1642

July 26, 2002

Conversion Factor Assessment

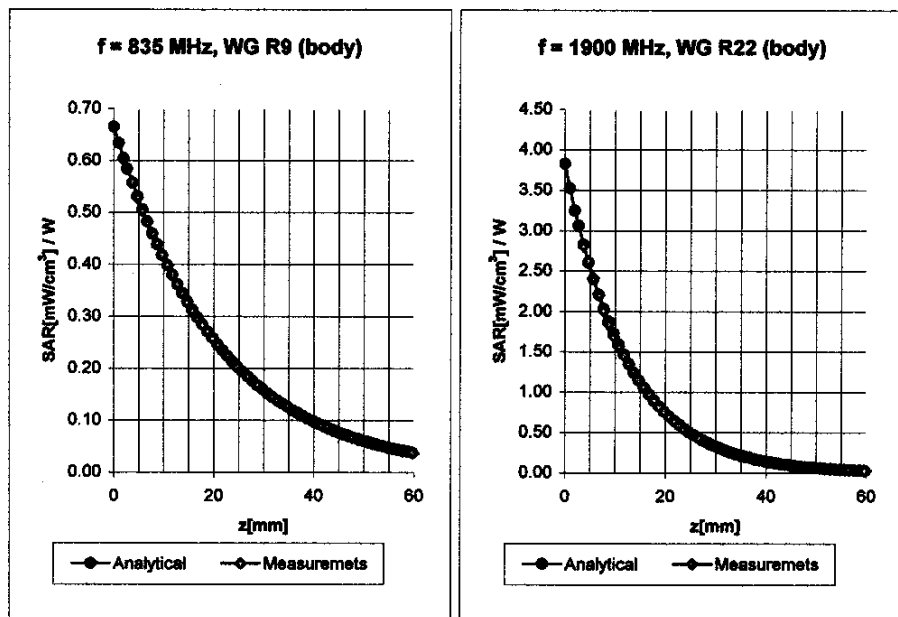


Body	900 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
ConvF X	6.3 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 8.9\%$ (k=2)	Alpha	0.36
ConvF Z	6.3 $\pm 8.9\%$ (k=2)	Depth	2.63
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
ConvF X	5.2 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 8.9\%$ (k=2)	Alpha	0.61
ConvF Z	5.2 $\pm 8.9\%$ (k=2)	Depth	2.30

ET3DV6 SN:1642

July 26, 2002

Conversion Factor Assessment



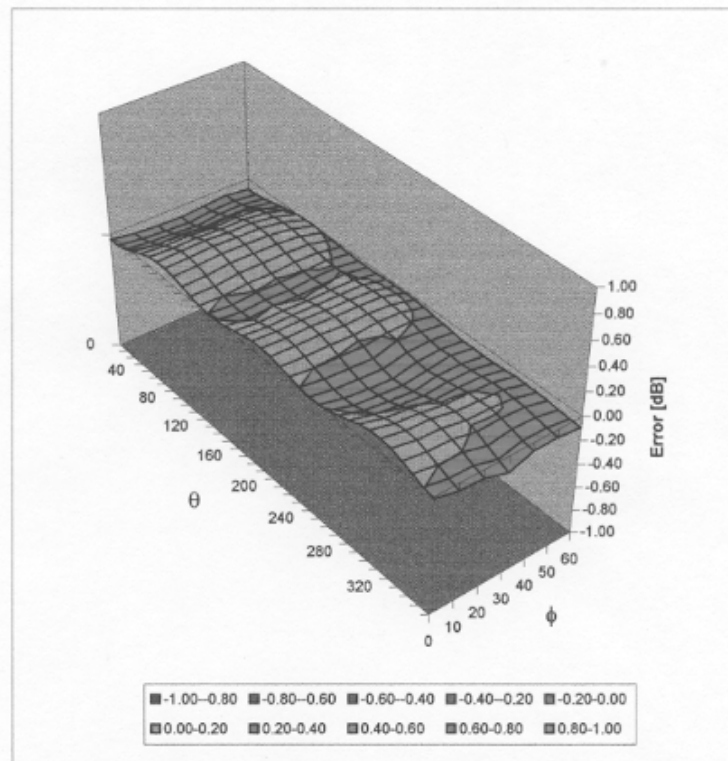
Body	835 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\% \text{ mho/m}$
ConvF X	6.4 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	6.4 $\pm 8.9\%$ (k=2)	Alpha	0.36
ConvF Z	6.4 $\pm 8.9\%$ (k=2)	Depth	2.66
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
ConvF X	4.8 $\pm 8.9\%$ (k=2)	Boundary effect:	
ConvF Y	4.8 $\pm 8.9\%$ (k=2)	Alpha	0.74
ConvF Z	4.8 $\pm 8.9\%$ (k=2)	Depth	2.07


ET3DV6 SN:1642

July 26, 2002

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



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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

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1644

Place of Calibration:

Zurich

Date of Calibration:

October 21, 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. Vetter

Approved by:

Daoud Attayi

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**Schmid & Partner
Engineering AG**

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


Probe ET3DV6

SN:1644

Manufactured: November 7, 2001
 Last calibration: November 26, 2001
 Recalibrated: October 21, 2002

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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ET3DV6 SN:1644

October 21, 2002

DASY - Parameters of Probe: ET3DV6 SN:1644

Sensitivity in Free Space

Diode Compression

NormX	1.73 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	95	mV
NormY	1.88 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	95	mV
NormZ	1.83 $\mu\text{V}/(\text{V}/\text{m})^2$	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	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha	0.32
ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth	2.91
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	5.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.4 $\pm 9.5\%$ (k=2)	Alpha	0.49
ConvF Z	5.4 $\pm 9.5\%$ (k=2)	Depth	2.47

Boundary Effect

Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		10.4	6.1
SAR _{be} [%] With Correction Algorithm		0.5	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		0.1	0.1

Sensor Offset

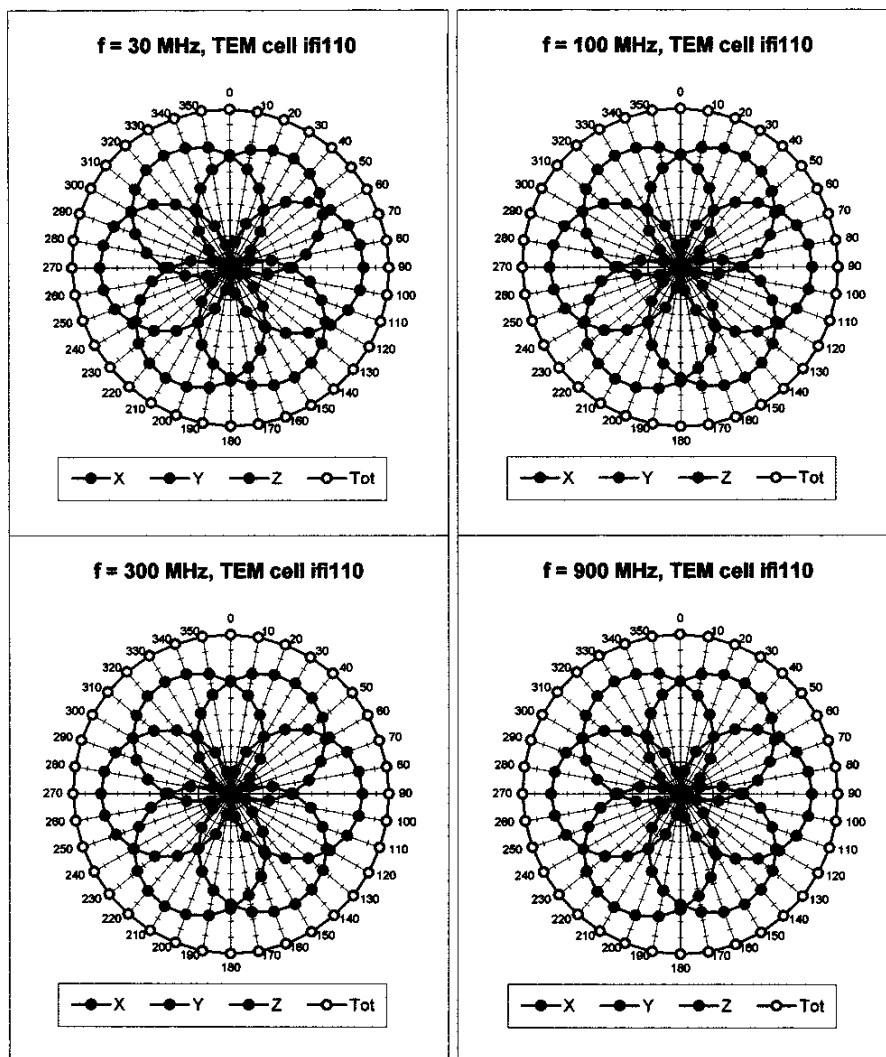
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.4 \pm 0.2	mm

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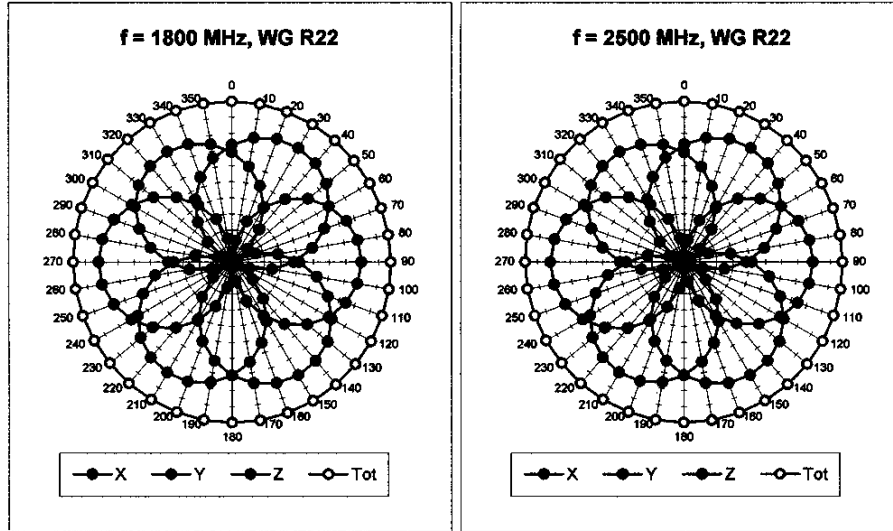
October 21, 2002

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

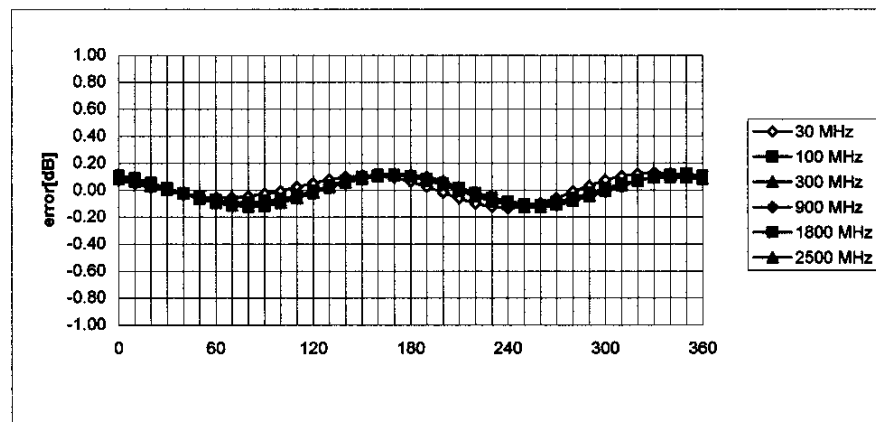



ET3DV6 SN:1644

October 21, 2002



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



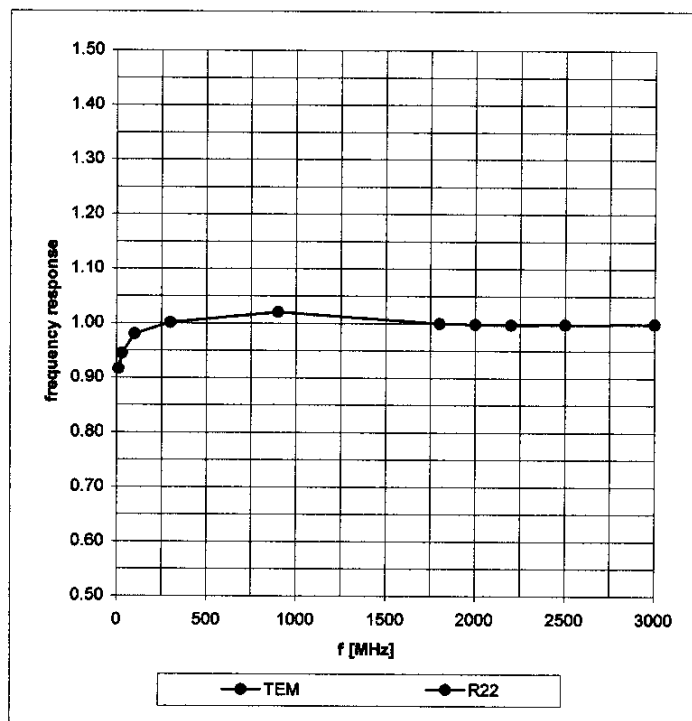
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October 21, 2002

Frequency Response of E-Field

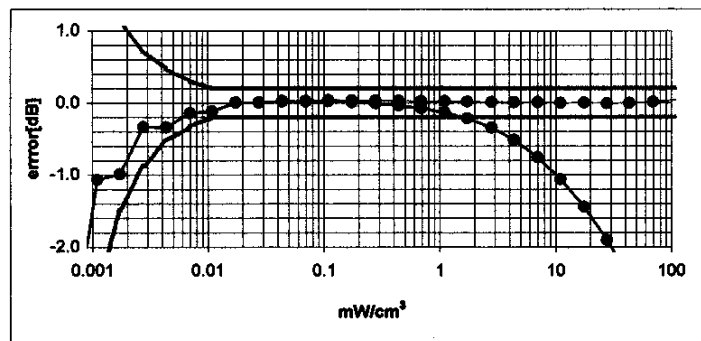
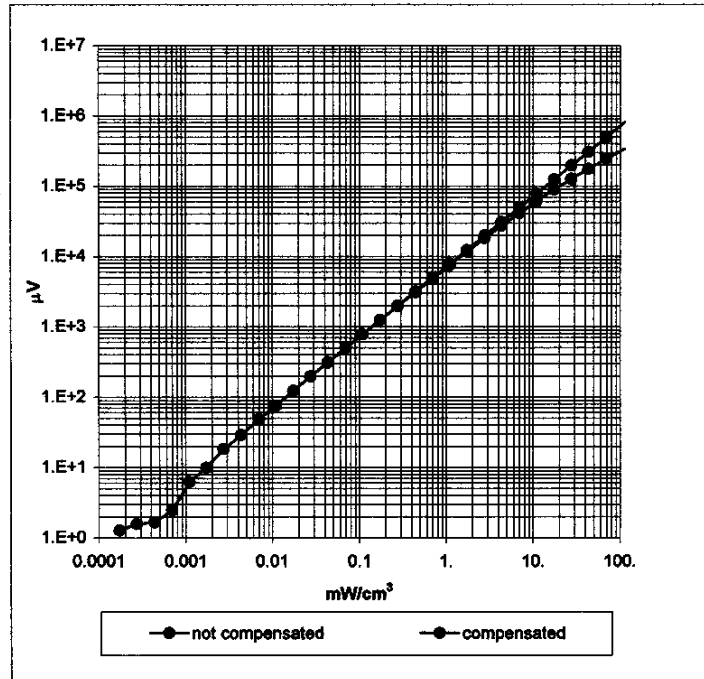
(TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1644

October 21, 2002

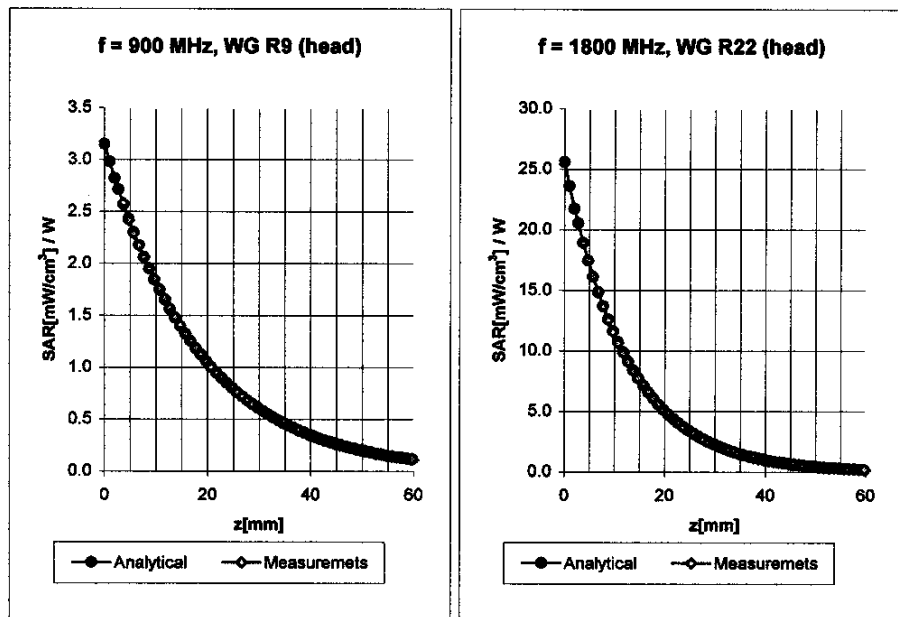
Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



ET3DV6 SN:1644

October 21, 2002

Conversion Factor Assessment

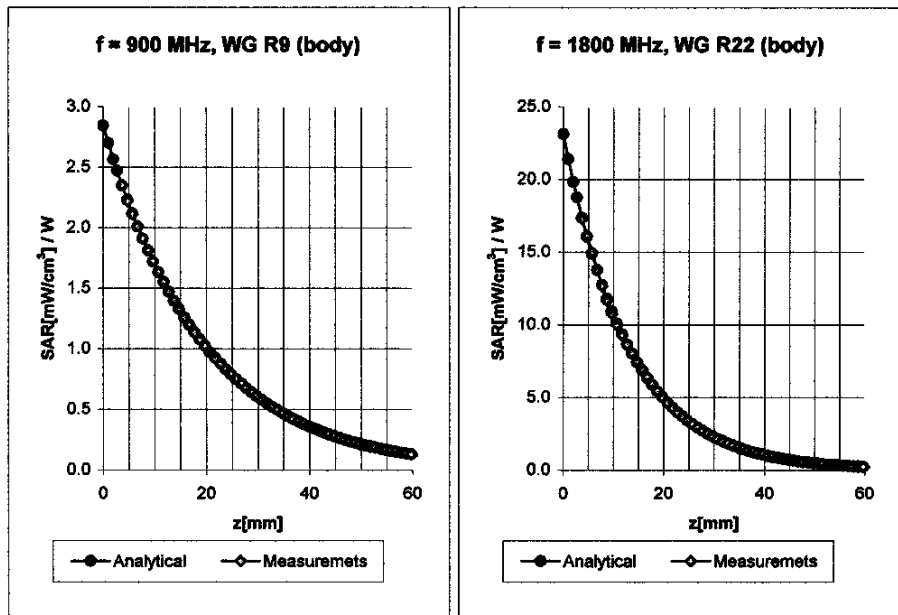


Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	$6.6 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.6 \pm 9.5\% (k=2)$	Alpha 0.32
	ConvF Z	$6.6 \pm 9.5\% (k=2)$	Depth 2.91
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	$5.4 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$5.4 \pm 9.5\% (k=2)$	Alpha 0.49
	ConvF Z	$5.4 \pm 9.5\% (k=2)$	Depth 2.47

ET3DV6 SN:1644

October 21, 2002

Conversion Factor Assessment



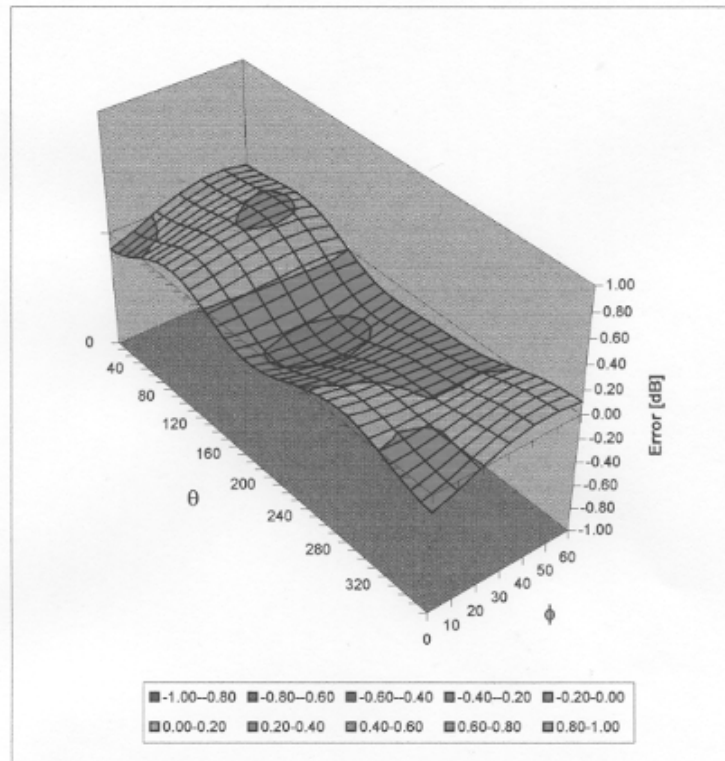
Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\% \text{ mho/m}$
Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
	ConvF X	$6.4 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.4 \pm 9.5\% (k=2)$	Alpha 0.39
	ConvF Z	$6.4 \pm 9.5\% (k=2)$	Depth 2.56
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
	ConvF X	$5.1 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$5.1 \pm 9.5\% (k=2)$	Alpha 0.61
	ConvF Z	$5.1 \pm 9.5\% (k=2)$	Depth 2.35


ET3DV6 SN:1644

October 21, 2002

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



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Schmid & Partner Engineering AG

Zaughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 248 97 00, Fax +41 1 248 97 79

Calibration Certificate

835 MHz System Validation Dipole

Type:

D835V2

Serial Number:

446

Place of Calibration:

Zurich

Date of Calibration:

November 12, 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:



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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


DASY

Dipole Validation Kit

Type: D835V2

Serial: 446

Manufactured: October 24, 2001
Calibrated: November 12, 2001

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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 835 MHz:

Relative Dielectricity	42.3	± 5%
Conductivity	0.91 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 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:	10.7 mW/g
averaged over 10 cm ³ (10 g) of tissue:	6.84 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.

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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: 1.401 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: $\text{Re}\{Z\} = 49.8 \Omega$
 $\text{Im}\{Z\} = -4.8 \Omega$
Return Loss at 835 MHz -26.4 dB

4. Handling

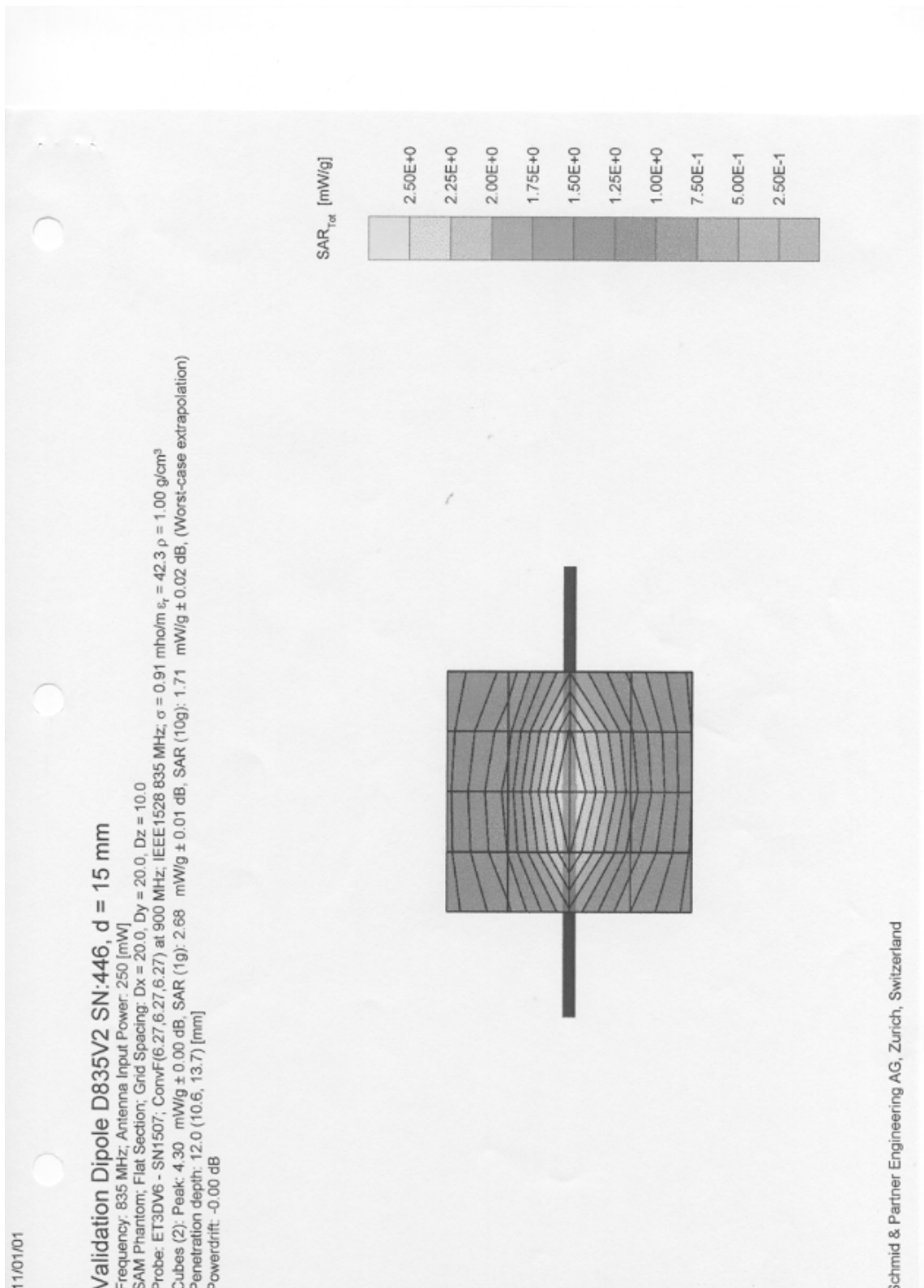
Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.


5. Design

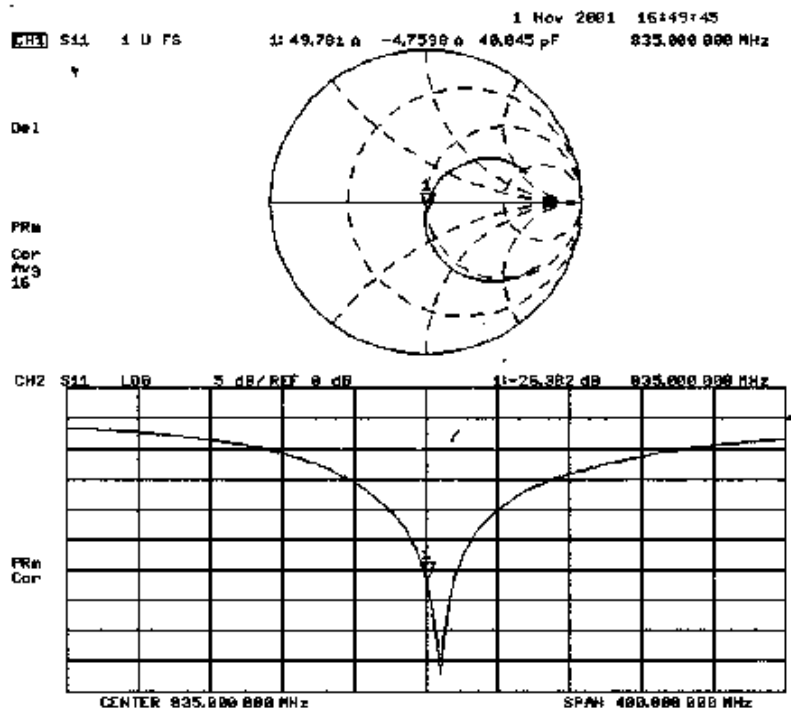
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.


6. Power Test

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




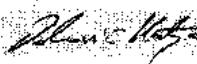
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Calibration Laboratory of
 Schmid & Partner
 Engineering AG
 Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **RIM**

CALIBRATION CERTIFICATE			
Object(s)	D1900V2 - SN:545		
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits		
Calibration date:	August 22, 2003		
Condition of the calibrated item	In Tolerance (according to the specific calibration document)		
This calibration statement documents traceability of M&TE 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&TE critical for calibration)			
Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Calibrated by:	Name Judith Mueller	Function Technician	Signature 
Approved by:	Name Katja Pokovic	Function Laboratory Director	Signature 
Date issued: August 24, 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.			

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DASY


Dipole Validation Kit

Type: D1900V2

Serial: 545

Manufactured: November 15, 2001

Calibrated: August 22, 2003

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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 1900 MHz:

Relative Dielectricity	40.2	± 5%
Conductivity	1.46 mho/m	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.2 at 1900 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 10mm from dipole center to the solution surface. The included distance spacer 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 250 mW ± 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:	41.2 mW/g ± 16.8 % (k=2) ¹
averaged over 10 cm ³ (10 g) of tissue:	21.3 mW/g ± 16.2 % (k=2) ¹

¹ validation uncertainty

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Date/Time: 08/22/03 15:40:53

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN545_SN1507_HSL1900_220803.da4

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN545
Program: Dipole Calibration

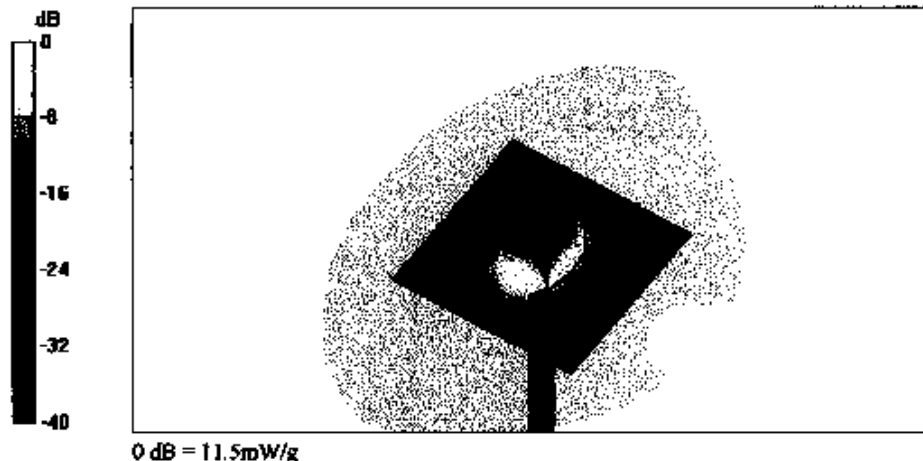
Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz ($\sigma = 1.46 \text{ mho/m}$, $\epsilon_r = 40.17$, $\rho = 1000 \text{ kg/m}^3$)
Phantom section: Flat Section
Measurement Standard: DASy4 (High Precision Assessment)


DASy4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASy4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

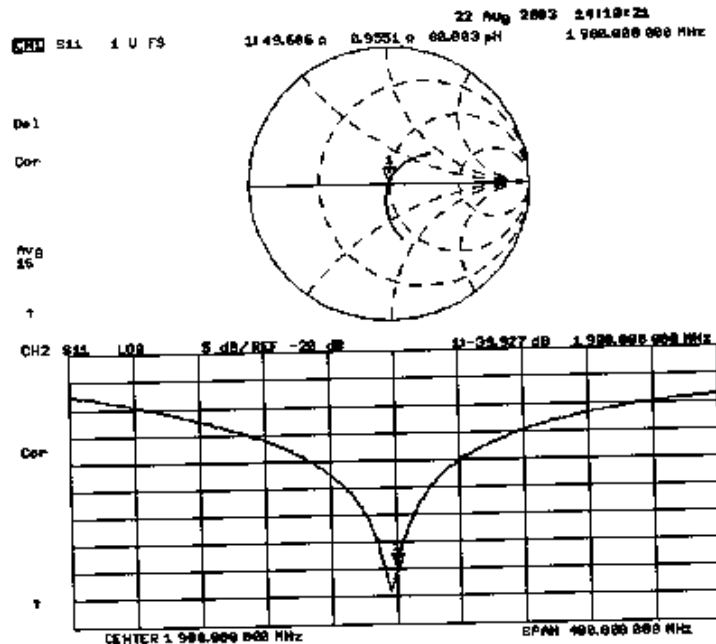
$P_{in} = 250 \text{ mW}$; $d = 10 \text{ mm}$ /Area Scan (81x81x1); Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$
Reference Value = 93.6 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 11.5 mW/g


$P_{in} = 250 \text{ mW}$; $d = 10 \text{ mm}$ /Zoom Scan (7x7x7)/Cube 0; Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.32 mW/g
Reference Value = 93.6 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 11.5 mW/g




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APPENDIX E: SAR SET UP PHOTOS

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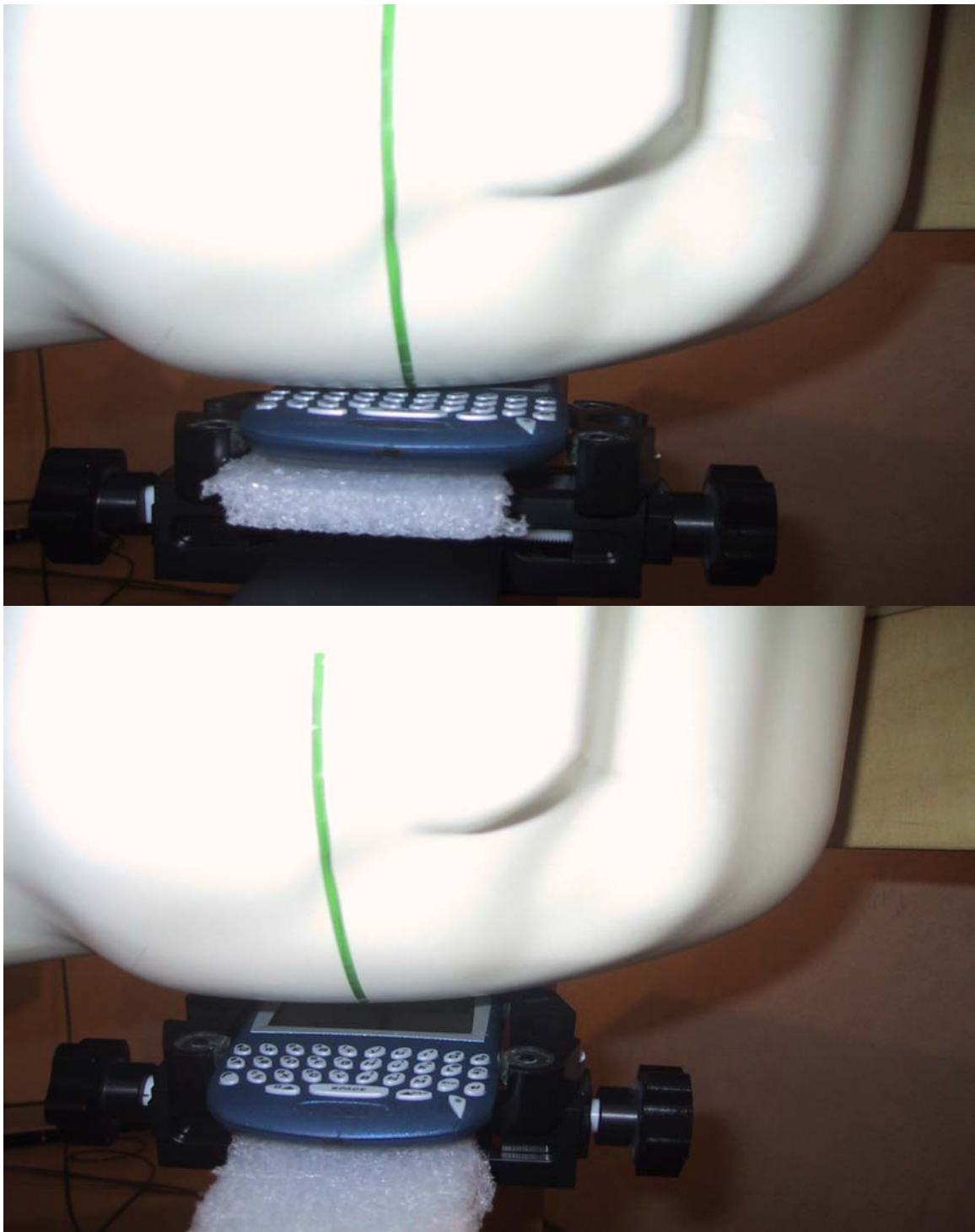



Figure E1. Left ear configuration

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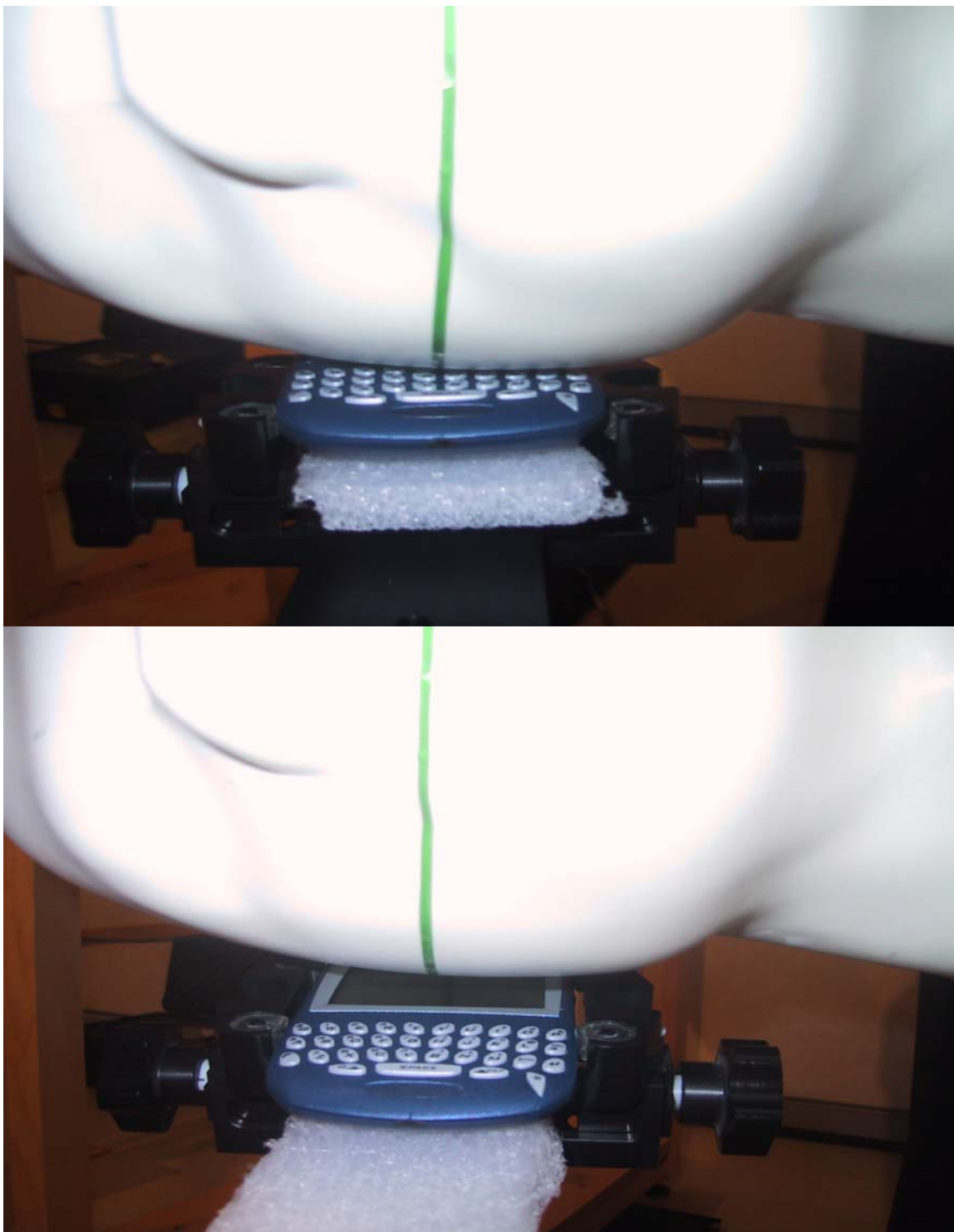



Figure E2. Right ear configuration

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Figure E3. Body worn configuration with Holster and Leather Swivel Headset