Date/Time: 04/15/03 15:34:41

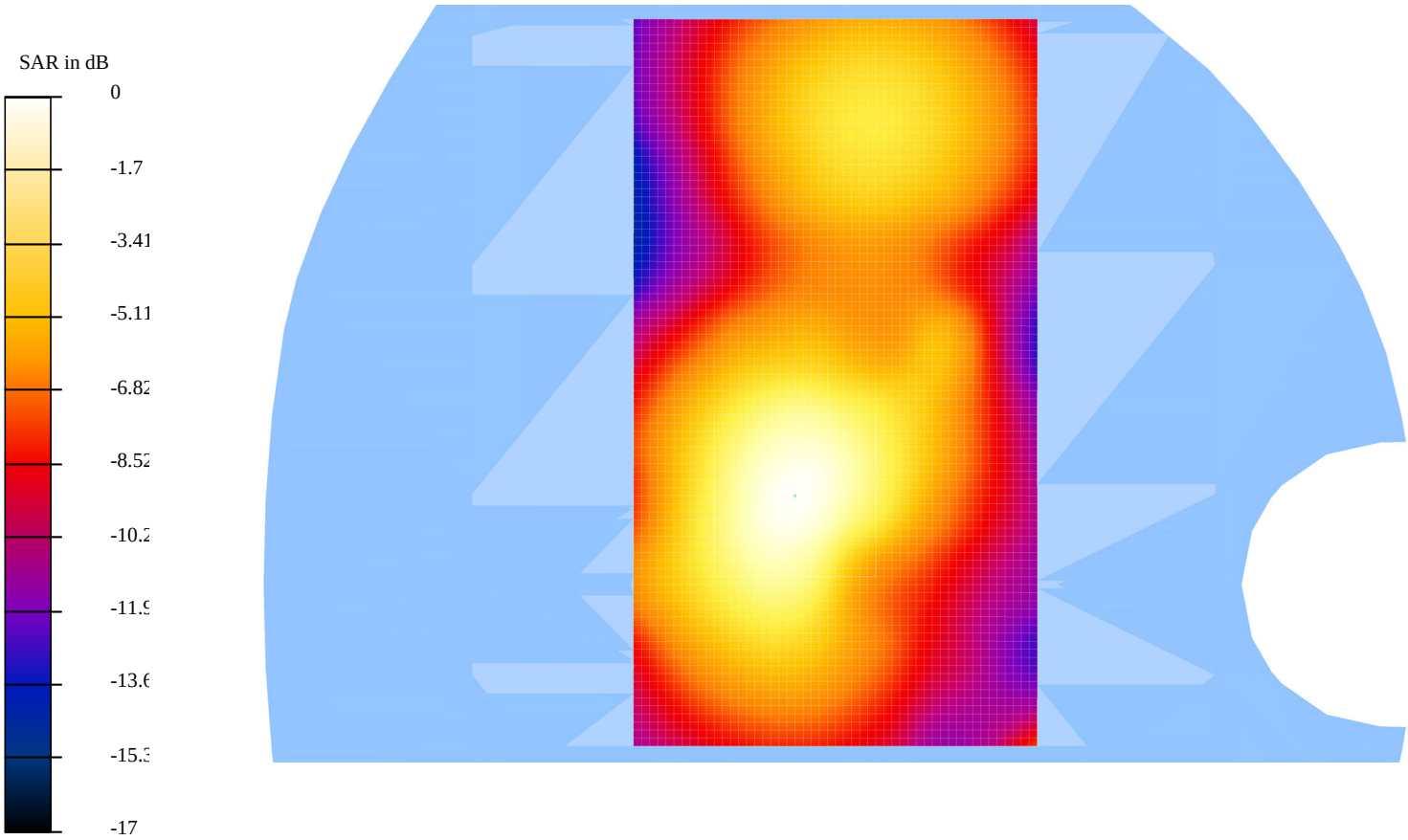
Test Laboratory: NOKIA Oulu; DTX07046-EN
File Name: y2A.da4

DUT: QTL-RH4 Type & Serial Number: 004400/18/172203/2
Program: Body worn; headset HS-5, T = 21.3; worst case extrapolation

Communication System: GPRS 1900; Frequency: 1880 MHz; Duty Cycle: 1:4.2
Medium: muscle 1900 MHz (σ = 1.55819 mho/m, ε = 51.6045, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM - TP:TP-1128
- Software: DASY4, V4.0 Build 51

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm
Reference Value = 14.5 V/m
Peak SAR = 1.68 mW/g
SAR(1 g) = 0.793 mW/g; SAR(10 g) = 0.428 mW/g
Power Drift = 0.2 dB
Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm



Date/Time: 04/15/03 15:29:58

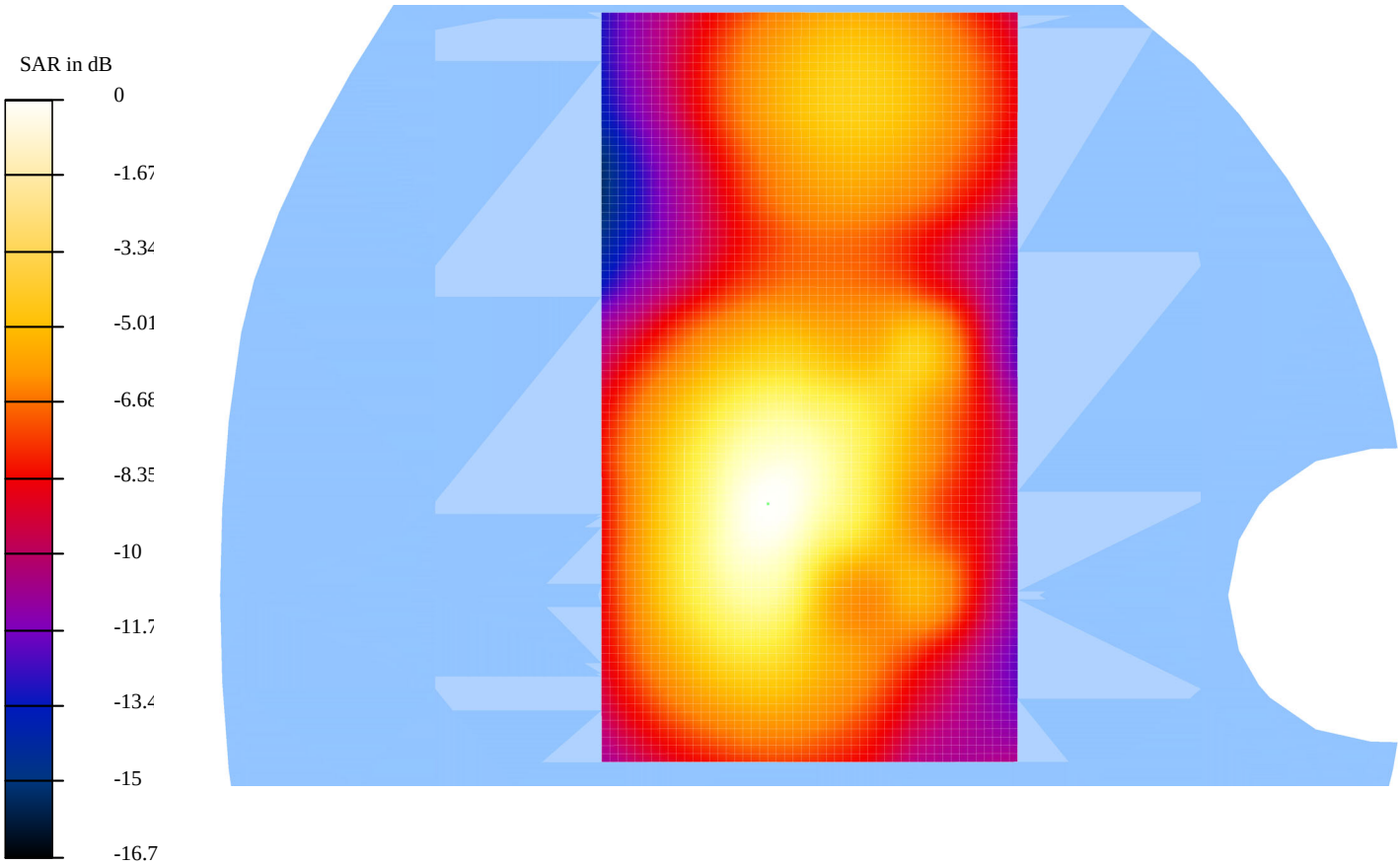
Test Laboratory: NOKIA Oulu; DTX07046-EN
File Name: y7A.da4

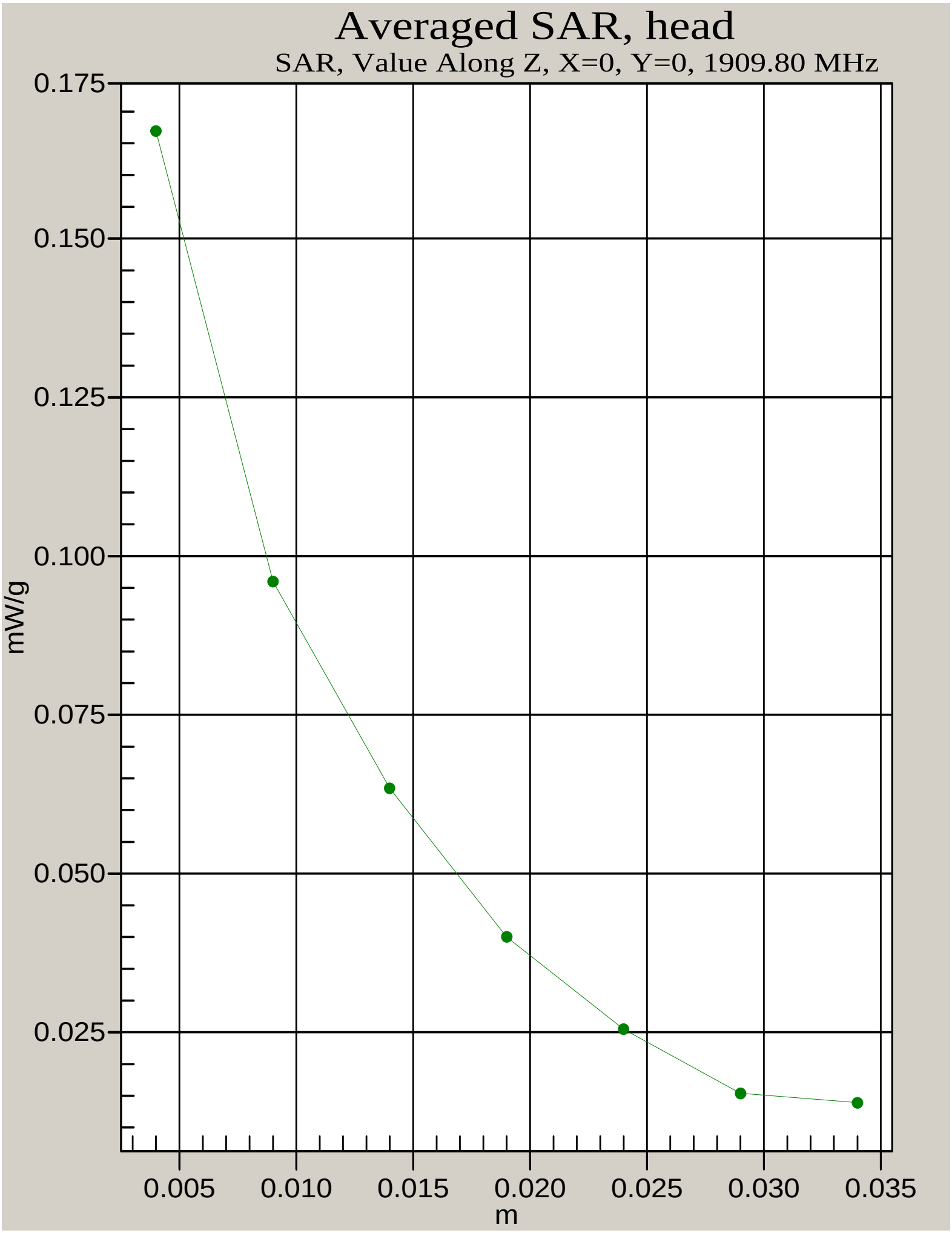
DUT: QTL-RH4 Type & Serial Number: 004400/18/172203/2
Program: Body worn; headset HS-1C, T = 21.4; worst case extrapolation

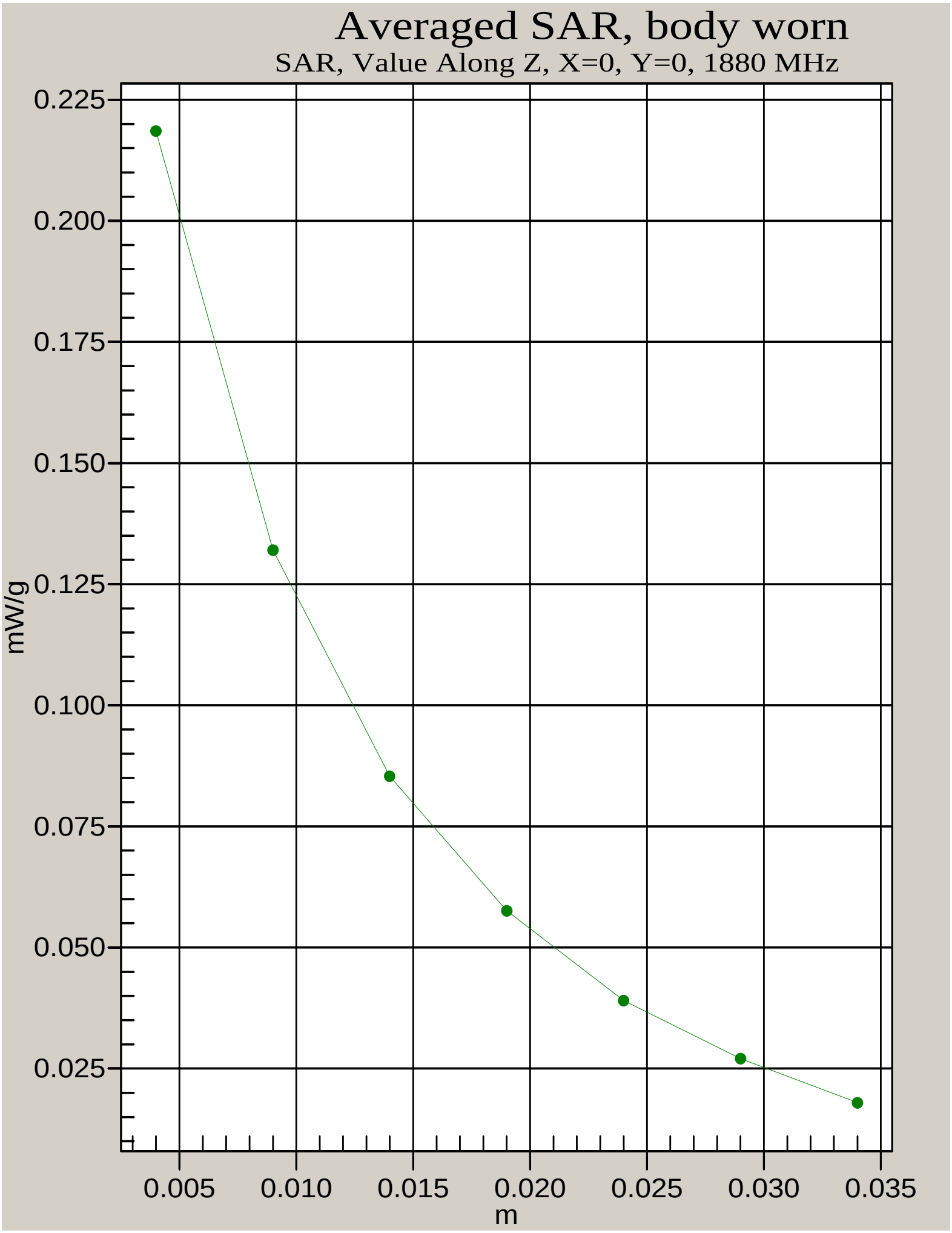
Communication System: GPRS 1900; Frequency: 1880 MHz; Duty Cycle: 1:4.2
Medium: muscle 1900 MHz (σ = 1.55819 mho/m, ε = 51.6045, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM - TP:TP-1128
- Software: DASY4, V4.0 Build 51

Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm
Reference Value = 15.9 V/m
Peak SAR = 1.68 mW/g
SAR(1 g) = 0.801 mW/g; SAR(10 g) = 0.432 mW/g
Power Drift = -0.0005 dB
Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm




Averaged SAR, head
SAR, Value Along Z, X=0, Y=0, 1909.80 MHz
0.175
0.150
0.125
0.100
0.075
0.050
0.025
mW/g
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m


Averaged SAR, body worn
SAR, Value Along Z, X=0, Y=0, 1880 MHz
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
mW/g
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m

APPENDIX C.

Calibration Certificate(s)

Schmid & Partner
Engineering AG

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

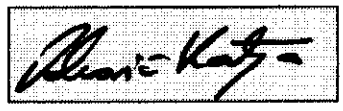
Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1381**
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:	
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:1381

Manufactured:	September 18, 1999
Last calibration:	October 25, 2001
Recalibrated:	October 21, 2002

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1381

Sensitivity in Free Space

NormX	**1.57**	$\mu V/(V/m)^2$
NormY	**1.69**	$\mu V/(V/m)^2$
NormZ	**1.78**	$\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

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

ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.43**
ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.44**

Head **1880 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head **1800 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.1** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.1** ± 9.5% (k=2)	Alpha	**0.61**
ConvF Z	**5.1** ± 9.5% (k=2)	Depth	**2.32**

Boundary Effect

Head **835 MHz** **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	11.0	6.1
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

Head **1880 MHz** **Typical SAR gradient: 10 % per mm**

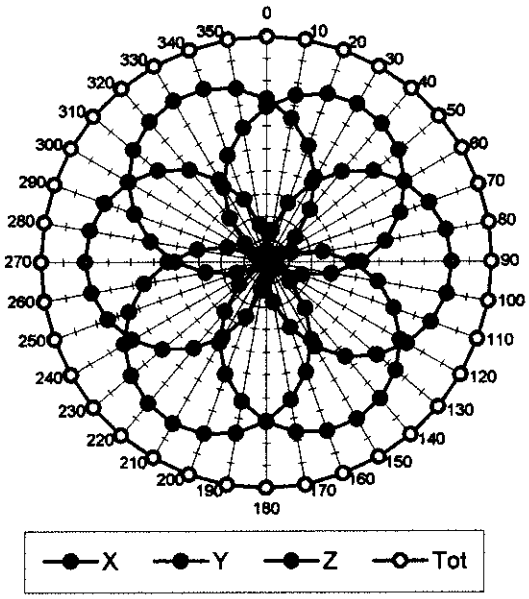
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	13.9	8.9
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

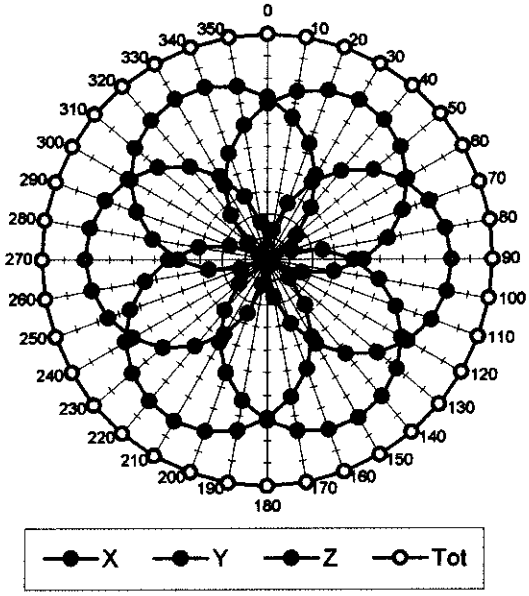
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.6 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

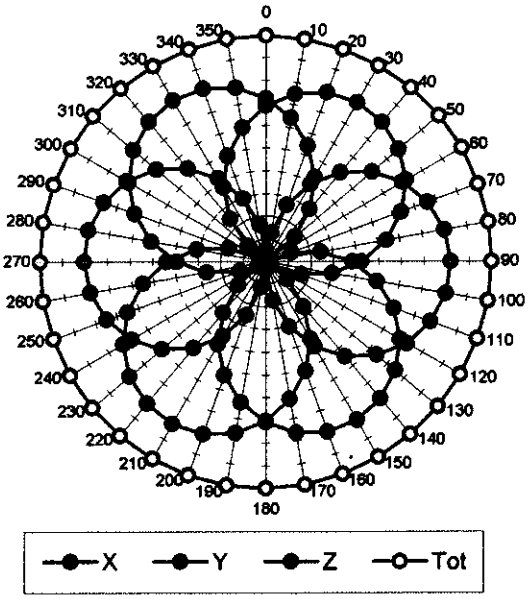
f = 30 MHz, TEM cell ifi110



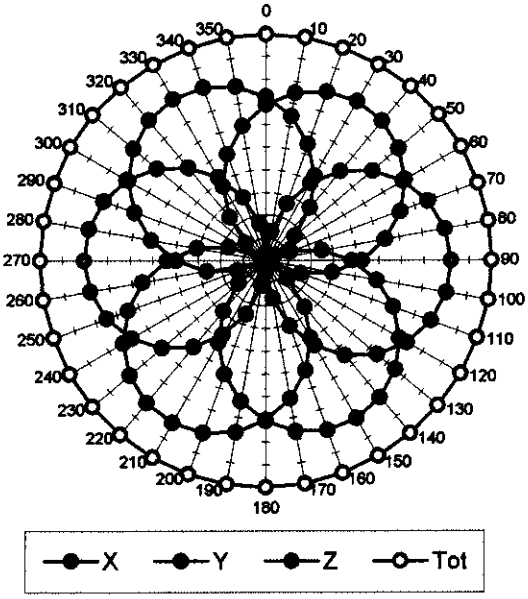
f = 100 MHz, TEM cell ifi110

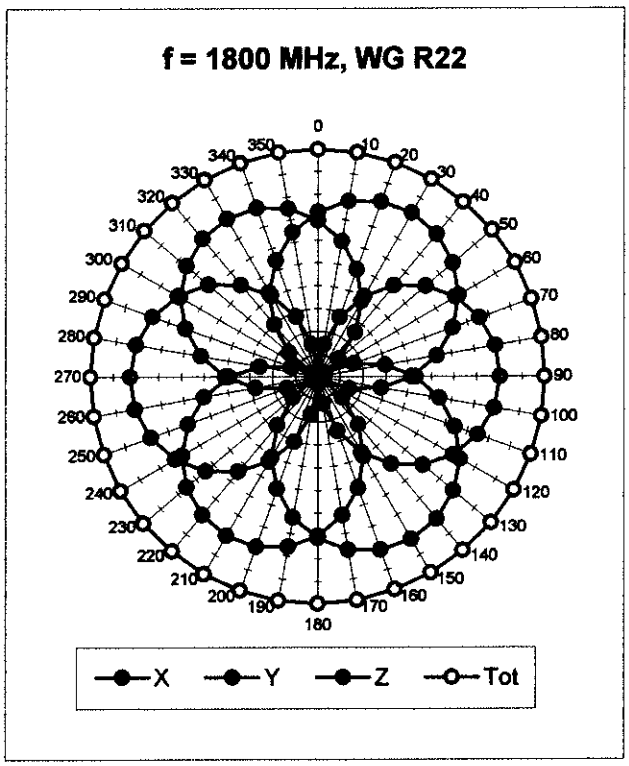


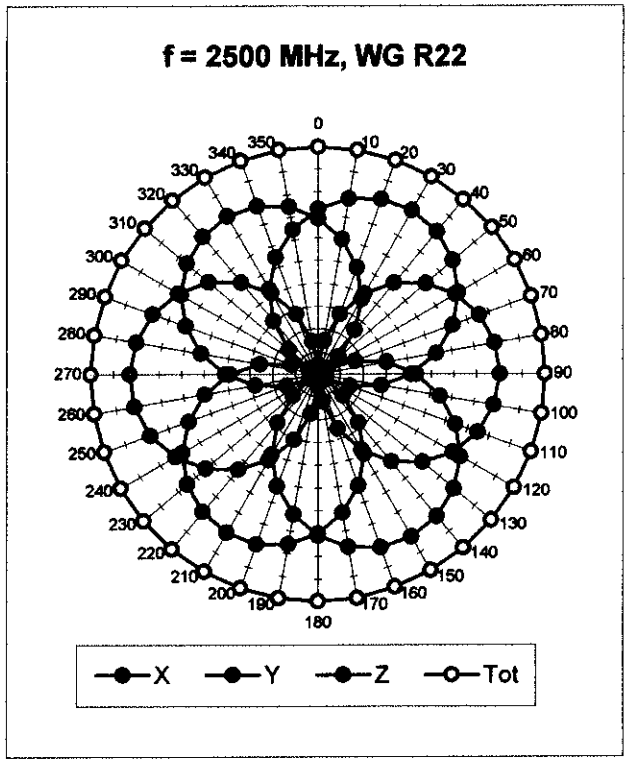
f = 300 MHz, TEM cell ifi110



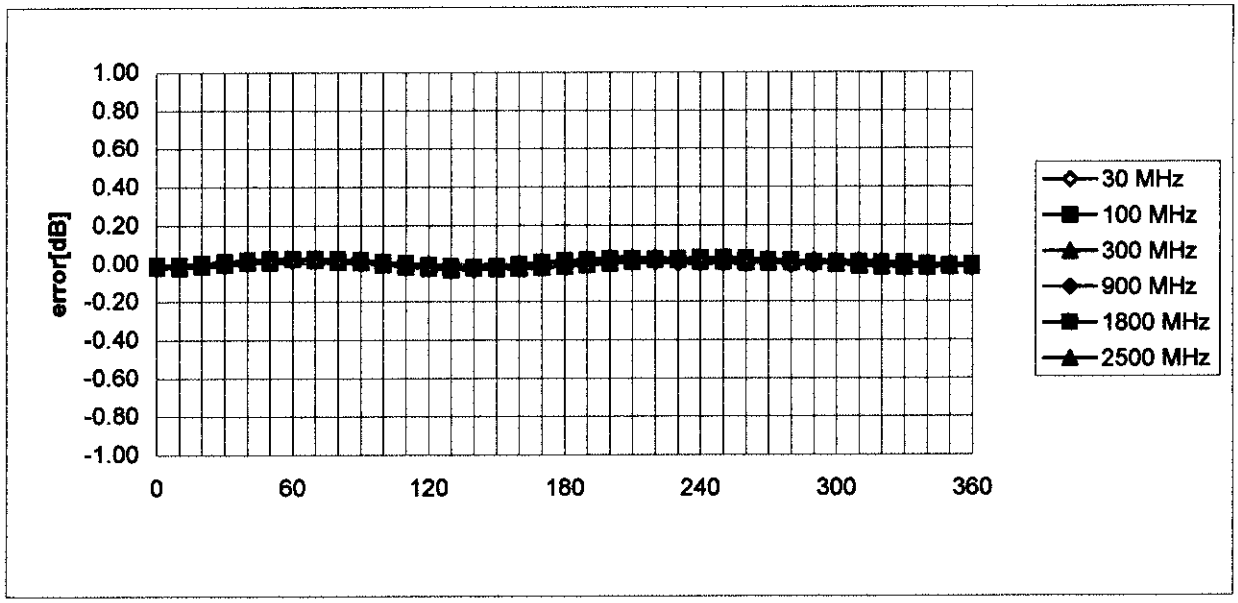
f = 900 MHz, TEM cell ifi110





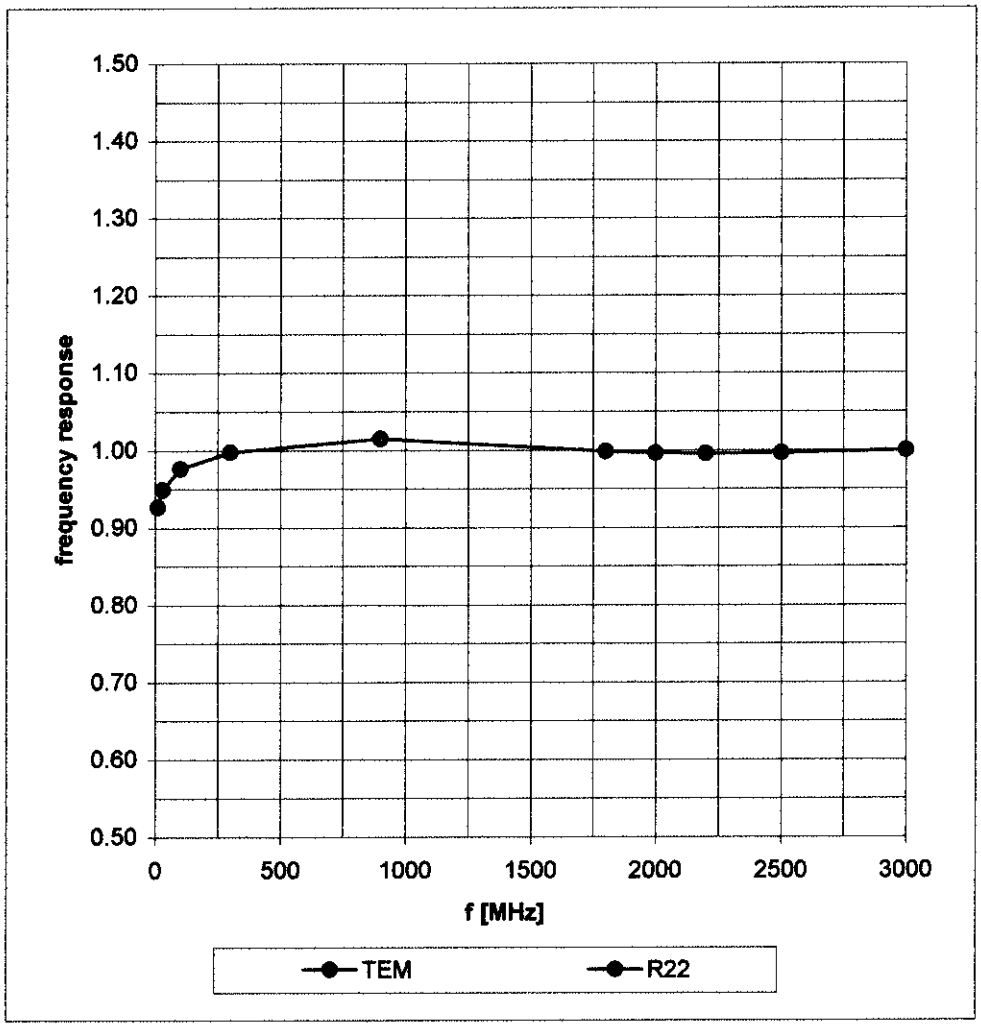


Isotropy Error (ϕ), θ = 0°



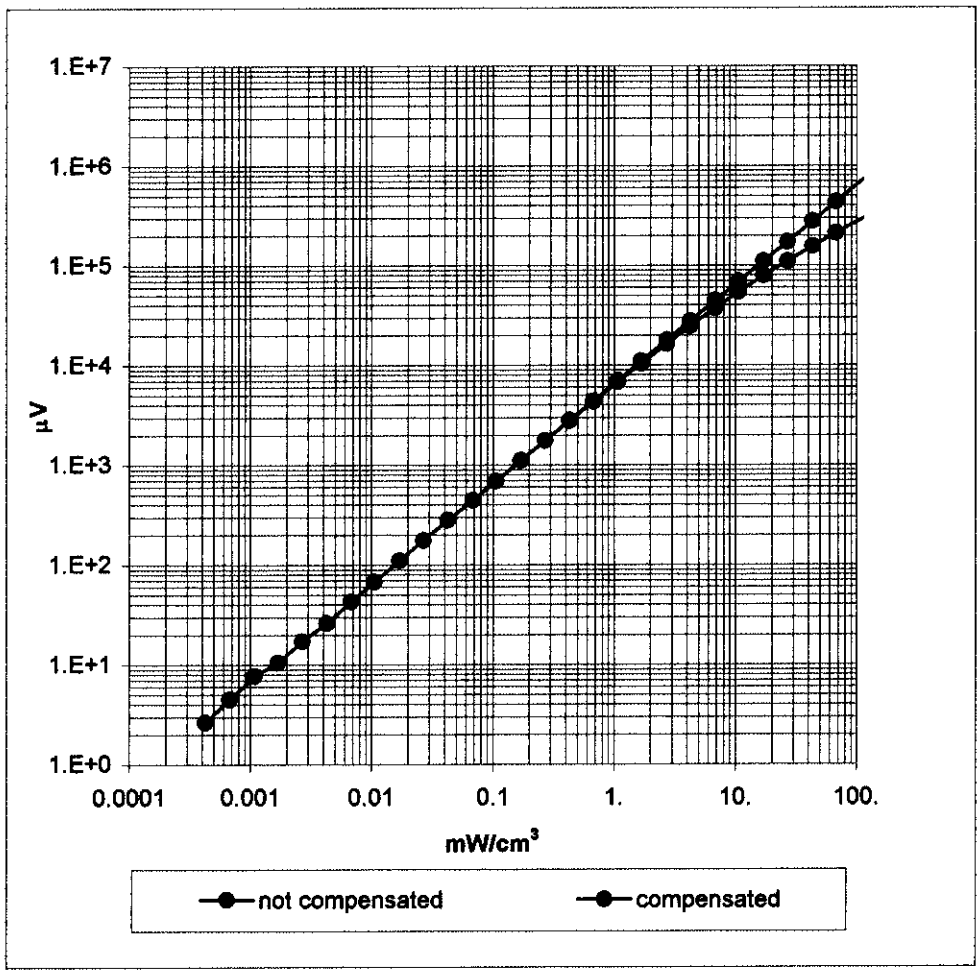
Frequency Response of E-Field

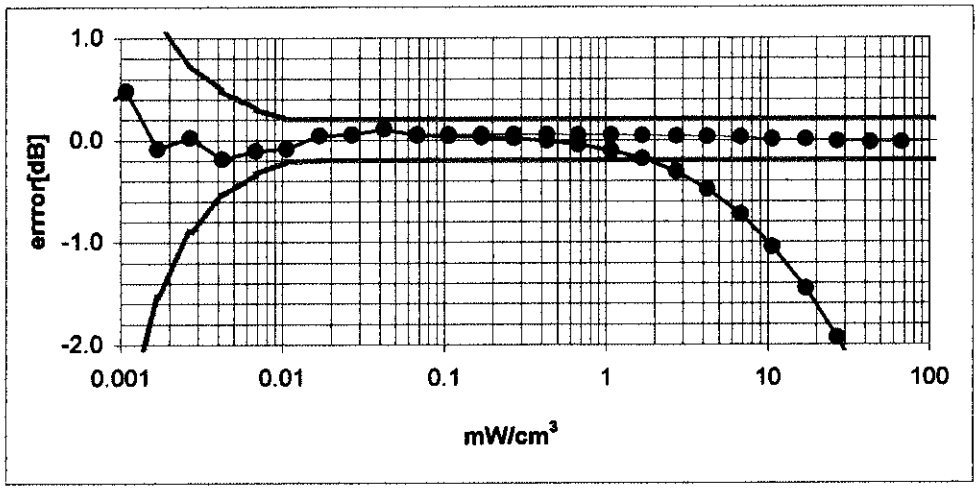
(TEM-Cell:ifi110, Waveguide R22)



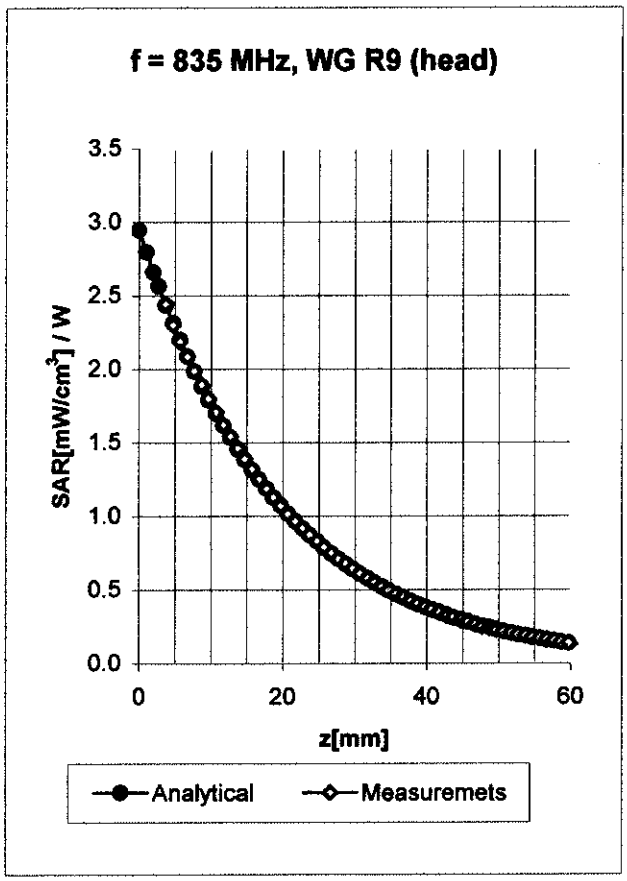
Dynamic Range f(SAR_{brain})

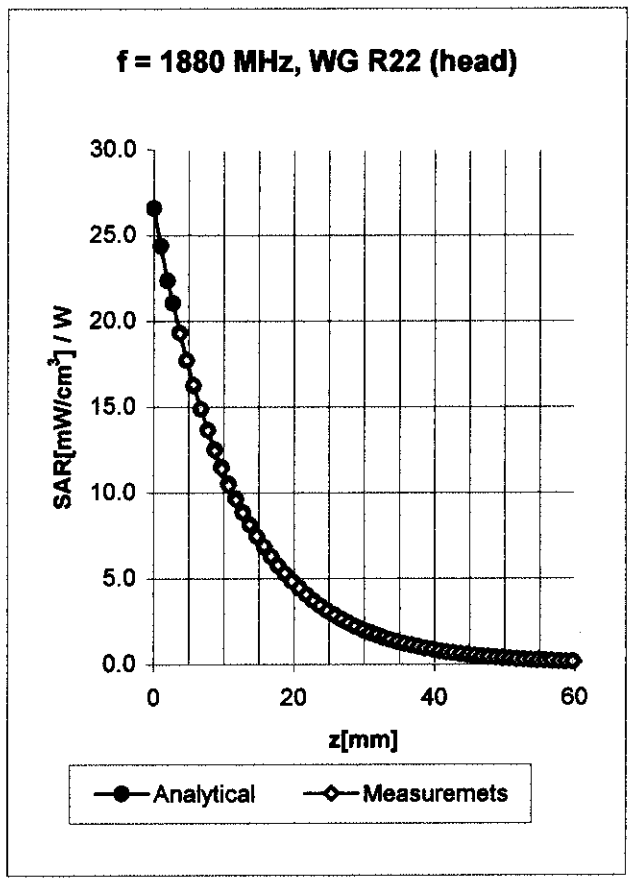
(Waveguide R22)





Conversion Factor Assessment

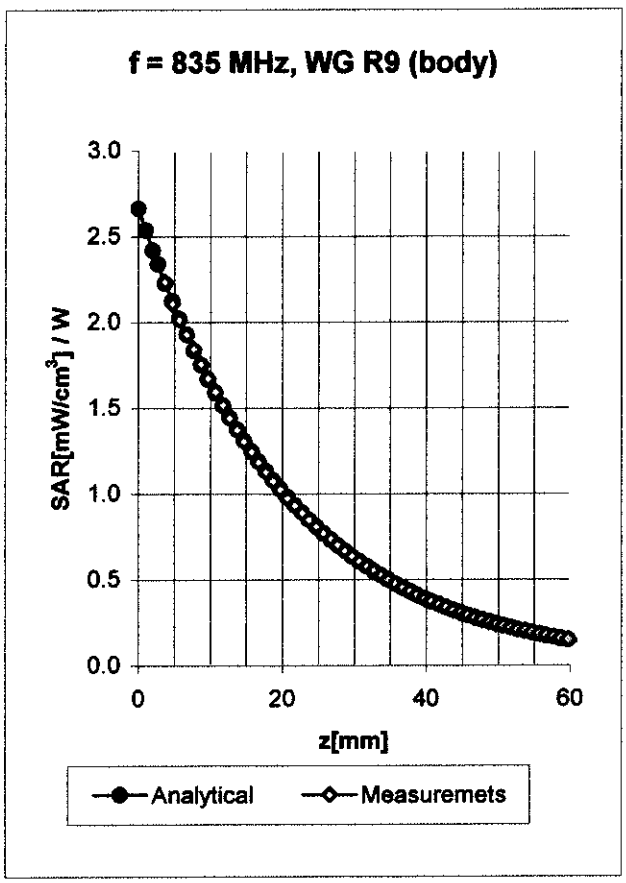


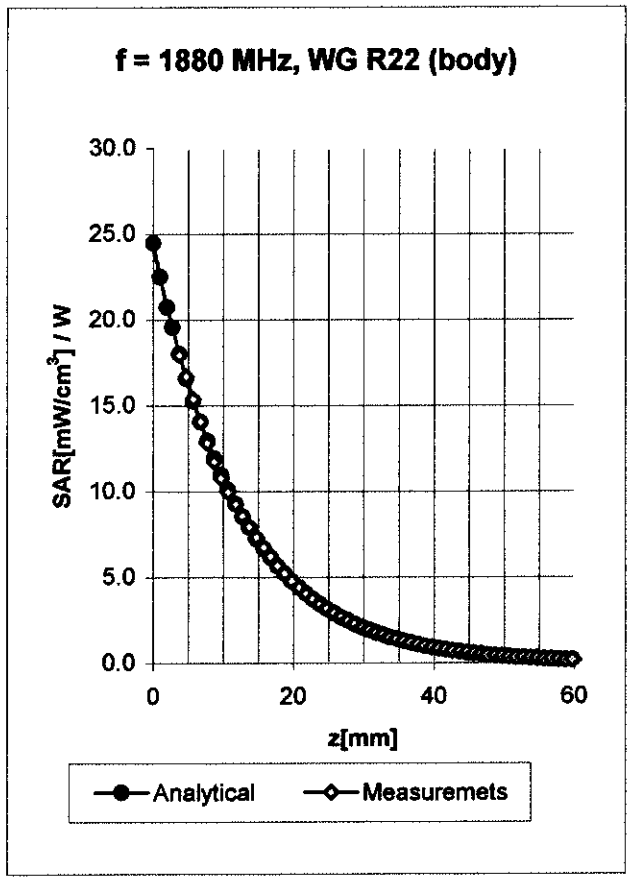


Head	**835 MHz**	ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**	
Head	**900 MHz**	ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**	
	ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.43**
	ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.44**

Head	**1880 MHz**	ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**	
Head	**1800 MHz**	ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**	
	ConvF X	**5.1** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.1** ± 9.5% (k=2)	Alpha	**0.61**
	ConvF Z	**5.1** ± 9.5% (k=2)	Depth	**2.32**

Conversion Factor Assessment

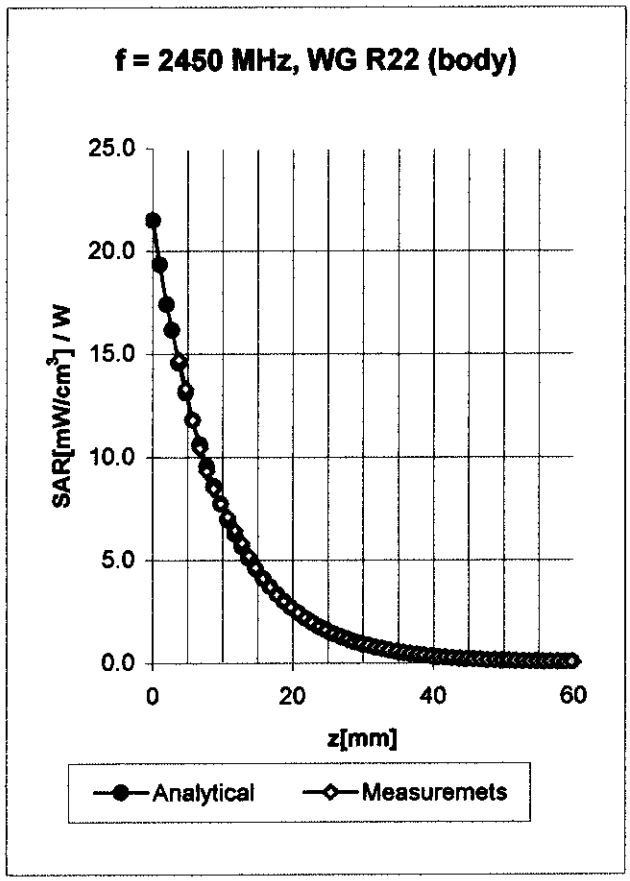




Body	**835 MHz**	ε_r = **55.2 ± 5%**	σ = **0.97 ± 5% mho/m**	
Body	**900 MHz**	ε_r = **55.0 ± 5%**	σ = **1.05 ± 5% mho/m**	
	ConvF X	**6.1** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.1** ± 9.5% (k=2)	Alpha	**0.49**
	ConvF Z	**6.1** ± 9.5% (k=2)	Depth	**2.35**

Body	**1880 MHz**	ε_r = **53.3 ± 5%**	σ = **1.52 ± 5% mho/m**	
Body	**1800 MHz**	ε_r = **53.3 ± 5%**	σ = **1.52 ± 5% mho/m**	
	ConvF X	**4.9** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.9** ± 9.5% (k=2)	Alpha	**0.81**
	ConvF Z	**4.9** ± 9.5% (k=2)	Depth	**2.07**

Conversion Factor Assessment

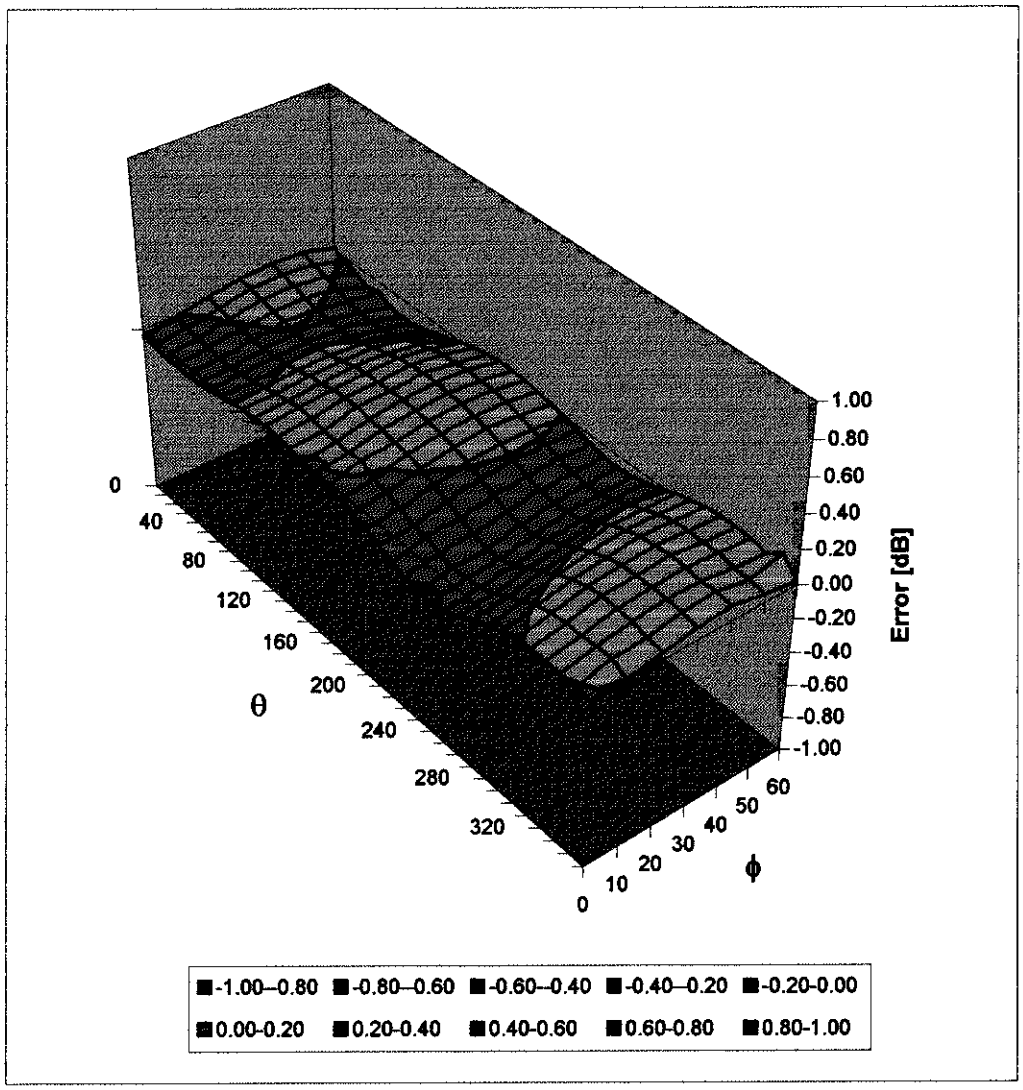


2450	**Body**	**MHz**	ε_r = **52.7 ± 5%**	σ = **1.95 ± 5% mho/m**

ConvF X	**4.5** ± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 8.9% (k=2)	Alpha	**1.00**
ConvF Z	**4.5** ± 8.9% (k=2)	Depth	**1.99**

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



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

Client Nokia Mobile Phones (Oulu)

CALIBRATION CERTIFICATE

Object(s)	D1900V2 - SN:511
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	February 27, 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	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Nikita Kuster	Quality Manager	

Date issued: February 27, 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.

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

DASY

Dipole Validation Kit

Type: D1900V2

Serial: 511

Manufactured: October 20, 1999
Calibrated: February 27, 2003

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	**38.6**	± 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 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 ± 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** ± 17.5 % (k=2)[1]
averaged over 10 cm^3 (10 g) of tissue:	**20.8 mW/g** ± 17.5 % (k=2)[1]

[1] validation uncertainty

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:	**1.187 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} = **48.8 Ω**
	Im {Z} = **0.9 Ω**
Return Loss at 1900 MHz	**-36.1 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with body simulating solution of the following electrical parameters at 1900 MHz:

Relative Dielectricity	**51.2**	± 5%
Conductivity	**1.59 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.8 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 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 ± 3 %. The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. 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:	**42.4 mW/g** ± 17.5 % $(k=2)^2$
averaged over 10 cm^3 (10 g) of tissue:	**21.6 mW/g** ± 17.5 % $(k=2)^2$

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 1900 MHz:	Re{Z} = **45.1 Ω**
	Im {Z} = **1.7 Ω**
Return Loss at 1900 MHz	**-25.3 dB**

7. 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.

8. 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.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Section 1. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

9. Power Test

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

---

[2] validation uncertainty

Date/Time: 02/26/03 18:15:55

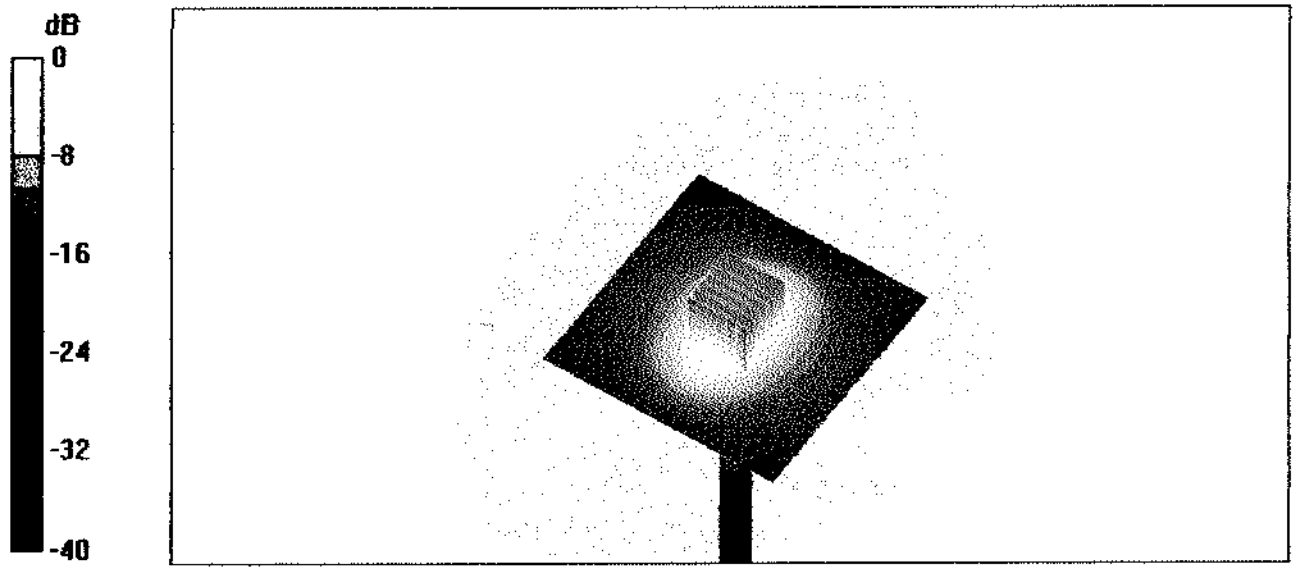
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN511_SN1507_HSL1900_260203.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN511
Program: Dipole Calibration

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz; (σ = 1.46 mho/m, ε_r = 38.6, ρ = 1000 kg/m^3)
Phantom section: Flat Section

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 25; Postprocessing SW: SEMCAD, V1.6 Build 105

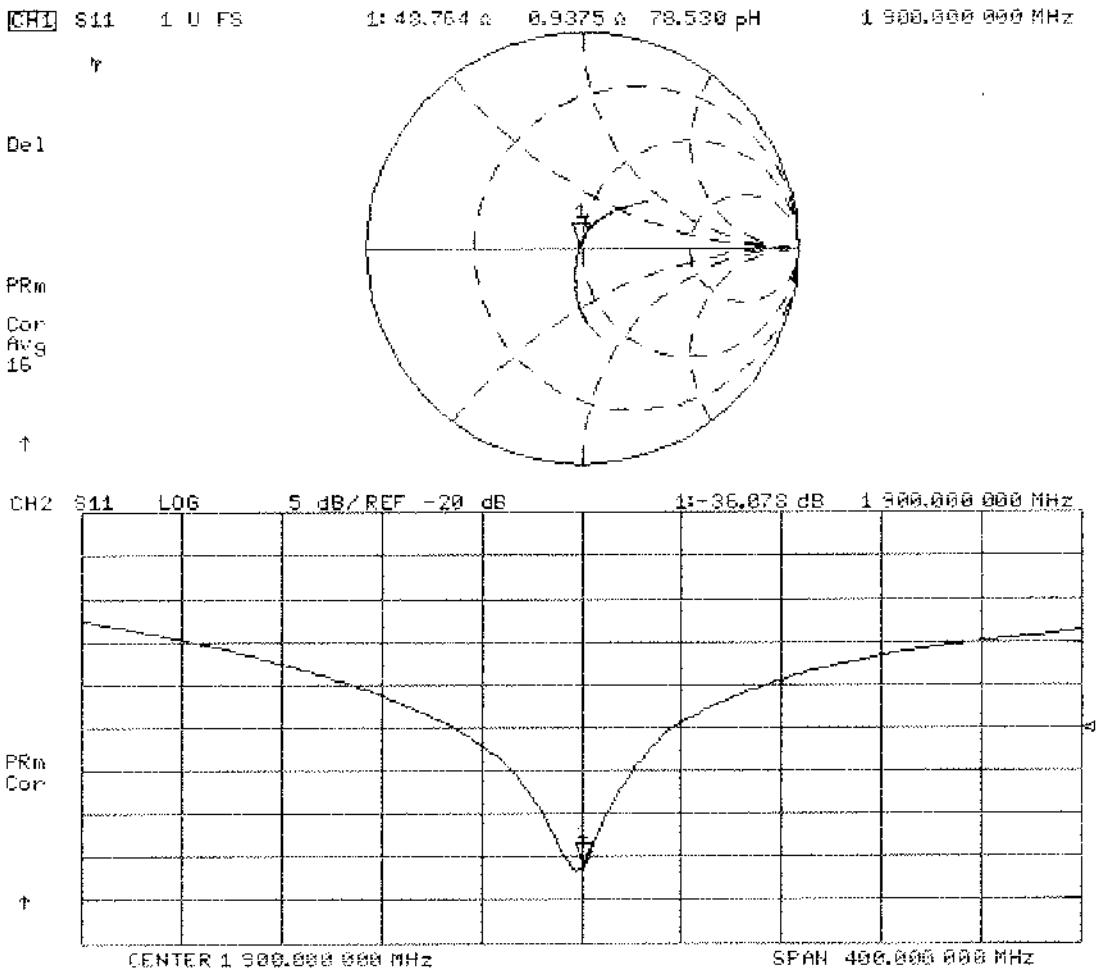
Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.1 V/m
Peak SAR = 18.2 W/kg
SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.2 mW/g
Power Drift = 0.06 dB



S11

with caps

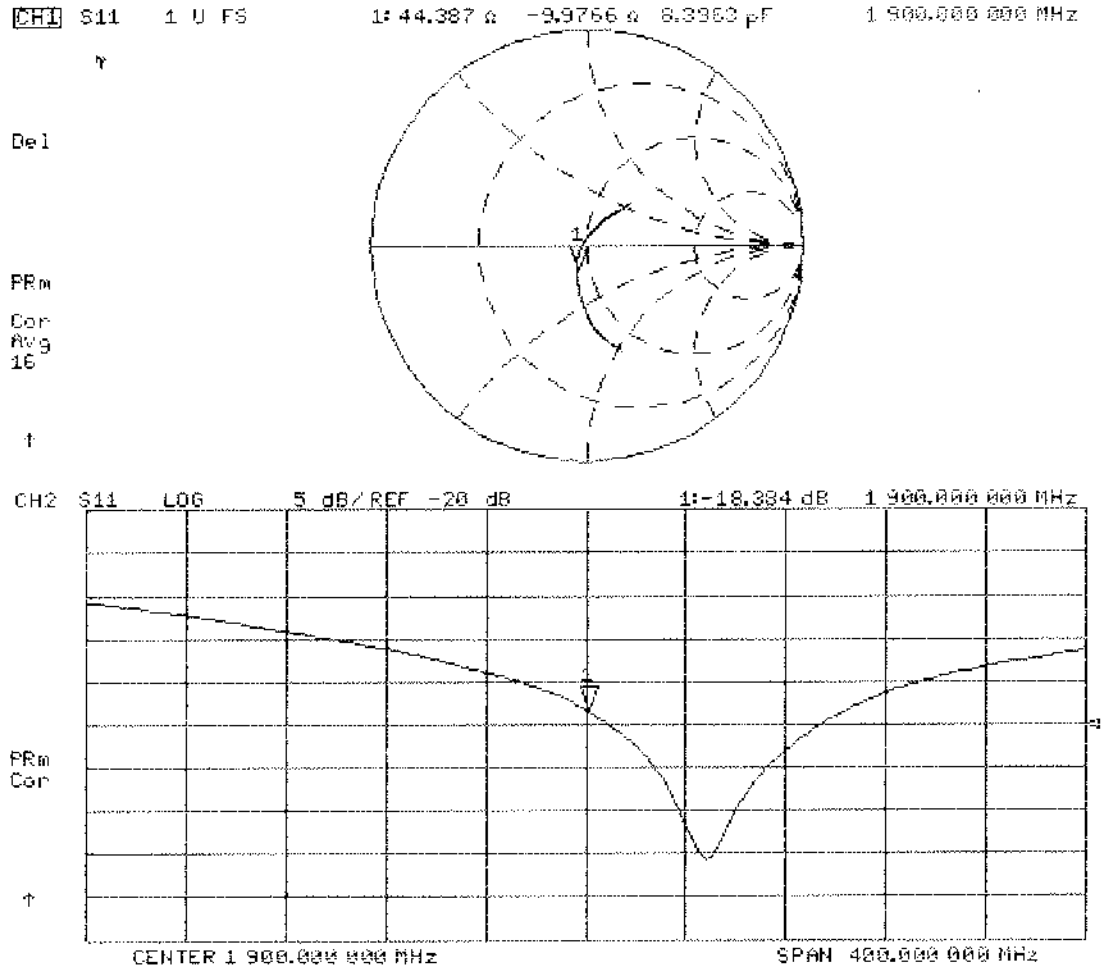
26 Feb 2003 19:08:14



S11

no cap

26 Feb 2003 11:15:49



Date/Time: 02/27/03 13:38:17

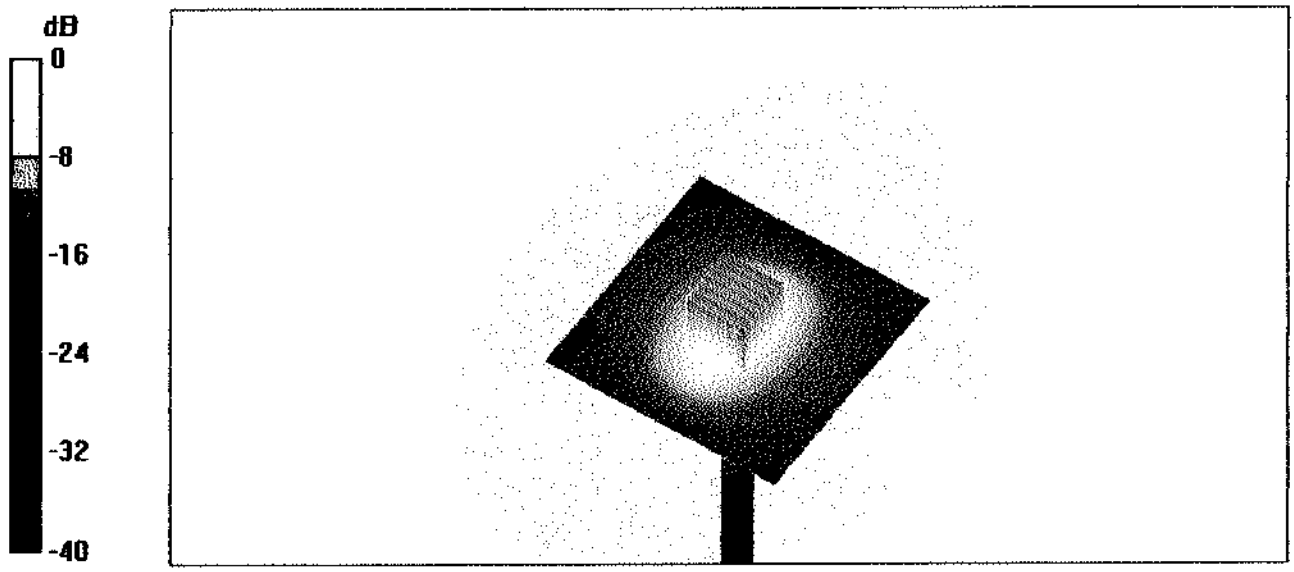
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN511_SN1507_M1900_270203.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN511
Program: Dipole Calibration

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: Muscle 1900 MHz; (σ = 1.59 mho/m, ε_r = 51.2, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(4.8, 4.8, 4.8); 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 25; Postprocessing SW: SEMCAD, V1.6 Build 105

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.8 V/m
Peak SAR = 18.8 W/kg
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.41 mW/g
Power Drift = 0.06 dB



S11

27 Feb 2003 14:56:52

Muscle