TCC
Copenhagen

DANAK
Reg. Nr. 416

SAR Compliance Test Report

Test Report no.:	DTX04255-EN	**Date of Report:**	26th of March 2002
Number of pages:	17	**Contact person:**	Darin Yeoman
		Responsible Test engineer:	Ruben Chr. Hansen

Testing laboratory:	TCC Copenhagen Nokia Danmark A/S Frederikskaj DK-1790 Copenhagen V Denmark Tel. +45 33 29 29 29 Fax. +45 33 29 20 01	**Client:**	Nokia USA 12278 Scripps Summit Dr. San Diego CA 92131, USA Tel. +1.858.831.5000 Fax.+1.858.831.6500

Tested device: FCC ID: GMLNHP-2FX, Model 6370, ESN: 235/14004992, HW: B4.0, SW: 320B7.1, DUT#: 231441

Supplement reports:

Testing has been Carried out in Accordance with: IEEE Std 1528-200X Draft 6.4
Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at Test & Certification Center, Copenhagen

Test Results: The tested device complies with the requirements in respect of all parameters subject to the test.
The test results and statements relate only to the items tested.
The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures: 03/26/2002

For the contents:

Svend Bøgsted **TCC Manager**	**Ruben Chr. Hansen** **SAR Test Engineer**

CONTENTS

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1. SUMMARY FOR SAR TEST REPORT

The tests described in this report have been performed in order to demonstrate that the equipment under test complies with the requirements in IEEE Std 1528-200X Draft 6.4 Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

Date of receipt	2002.01.17
Date of test	2002.01.17- 2002.01.21
Deadline for test report	2002.03.26
Contact person	Robert Taylor, TCC San Diego, Nokia Mobile Phones, CA, USA
Testplan referred to	-
Phone with FCC ID, ESN, HW, SW and DUT numbers	GMLNHP-2FX, ESN: 235/14004992, HW: B4.0, SW: 320B7.1 DUT #: 231441
Accessories	Battery, Type: BLB-3* DUT #: 231443, Headset, Type: HDE-1 DUT #: 231468, Headset, Type: HDC-5 DUT #231469:Carrying Case, Type CSL-21 DUT #: 231442.
Document code	V:\TCC\EMC\Reports\Columbia\DTX04255-EN.doc
Responsible SAR Test Engineer	Ruben Chr. Hansen
Measurements performed by	Leif Funch Klysner

* BLB-3 is the only battery accessory planned for this product

1.1 Maximum Results Found during SAR Evaluation

The equipment is deemed to fulfil the requirements if the measured values are less than or equal to the limit.

1.1.1 Head Configuration

Mode of operation	Ch / *f* [MHz]	Power [dBm]	Position	Limit [mW/g]	Measured [mW/g]	Result
CDMA PCS	25 / 1851	24.0	Touch, Left Hand, Antenna Retracted	1.6	0.888	**PASSED**

1.1.2 Body Worn Configuration

Mode of Operation	Ch / *f* [MHz]	Power [dBm]	Position	Limit [mW/g]	Measured [mW/g]	Result
CDMA PCS	25 / 1851	24.0	Flat Section, Carrying Case, Headset HDE-1	1.6	0.244	**PASSED**
CDMA PCS	25 / 1851	24.0	Flat Section, Carrying Case, Headset HDC-5	1.6	0.306	**PASSED**

1.1.3 Measurement Uncertainty

Combined Uncertainty	± **12.11%**
Expanded Uncertainty (k=2) 95.5%	± **24.23%**

2. DESCRIPTION OF THE DEVICE

2.1 Picture of GMLNHP-2FX (NOKIA 6370)

Figure 1 GMLNHP-2FX (NOKIA 6370)

2.2 Description of the antenna

The GMLNHP-2FX (NOKIA 6370) cellular phone has an integral patch antenna and a retractable antenna.

Figure 2 GMLNHP-2FX with antenna extended

2.3 Battery

A Li-Ion battery, BLB-3 was used during the measurement.

2.4 Body Worn Accessory

The following body worn accessory is available for the GMLNHP-2FX (NOKIA 6370) cellular phone.

Figure 3 Carrying case CSL-21.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature: 23° ± 1° C

Tissue simulating liquid temperature: 23° ± 1° C

Ambient humidity: 36% r.h.

3.2 Test signal, frequencies, and output power

The GMLNHP-2FX (NOKIA 6370) was put in operation using an Agilent 8960 Mobile Station Test Set. Communication between the phone and the tester was established by air link using a Schwarzbech BBHA 9120 rigid horn antenna.

The battery is a Li-Ion rechargeable type. The battery holds enough energy for at least 2 hours of continous transmission.

The Phone was set to maximum power level during all the tests.

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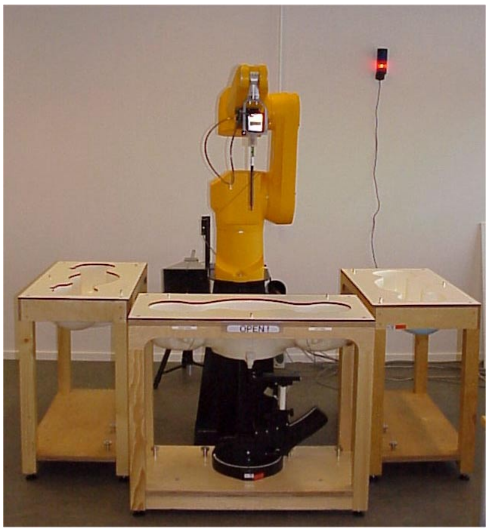
4. DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with an automated near-field scanning system, **DASY3**.

4.1 Manufacturer of DASY3

Schmid & Partner Engineering AG (SPEAG).
Zeughausstrasse 43
8004 Zurich, Switzerland
Phone 41 1 245 97 00, Fax 41 1 245 97 79
www.speag.com



4.2 Robot

The robot is a RX90L manufactured by Stäubli France, www.staubli.com

Number of axis:	6
Payload:	3.5 kg
Reach:	1185 mm
Repeatability:	± 0.025 mm
Control unit:	CS7/cs7M

4.3 Isotrophic E-field probe ET3DV6R

Frequency:	10 MHz to 3 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic range:	5 µW/g to > 100mW/g; Linearity: ± 0.2 dB
Dimension:	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 6.8 mm Distance from probe tip to dipole centers: 2.7 mm

4.4 Device holder

The holder was provided by SPEAG as a part of the DASY3 system.

4.5 Dipole antennas for validation

The dipole antennas are matched for use near flat phantoms filled with head/body simulation solutions. The dipoles are equipped with 10 or 15 mm distance holders.

4.6 Phantom

The phantoms enables dosimetric evaluation of left and right hand phone usage, as well as body mounted usage at the flat phantom region.

Shell thickness: 2 ± 0.2 mm, except at Ear Reference Point, where an integrated spacer provides a 6 mm spacing from tissue simulating liquid.

4.7 Liquid depth

The liquid level was during measurement at least 15 cm.

4.8 Calibration and validation procedures

The probes are calibrated annually by the manufacturer. The tissue simulating liquids are measured using a HP 85070A dielectric probe kit. The SAR measurements were validated using a dipole antenna placed under the flat section of the generic twin phantom. A power level of 250 mW supplied to the dipole antenna was used for the validation. The results are normalised to 1 W input power. The power level was controlled during validation, using a directional coupler and a power meter.

Liquid	Frequency [MHz]	Description	SAR averaged over 1g [mW/g]	Dielectric Parameters	
				ε_r	σ [S/m]
Head	900	Measured	NA		
		Reference	11.44	41.5	0.97
	1800	Measured	38.08	39.3	1.38
		Reference	37.4	40.7	1.35
Body	900	Measured	NA		
		Reference	11.84	55.4	1.04
	1800	Measured	41.2	52.9	1.49
		Reference	40.8	53.5	1.45

4.9 Synthetic brain tissue simulating liquid parameters, measured values:

Target Frequency [MHz]	Description	ε_r Relative permittivity	σ [S/m] Conductivity
835	Measured	NA	NA
	Recommended	41.5	0.90
1880	Measured	39.3	1.38
	Recommended	40.0	1.40

4.10 Synthetic body tissue simulating liquid parameters, measured values:

Frequency band [MHz]	Description	ε_r Relative permittivity	σ [S/m] Conductivity
835	Measured	NA	NA
	Recommended	55.2	0.97
1880	Measured	52.9	1.49
	Recommended	53.3	1.52

Recommended values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

4.11 Synthetic tissue simulating liquid recipes

4.11.1 835 MHz

Ingredients	Head (% by weight)	Body (% by weight)
De-ionized Water	39.74	55.97
Hydroxyethyl Cellulose	0.25	1.21
Sugar	58.31	41.76
Preservative	0.15	0.27
Salt	1.55	0.79

4.11.2 1880 MHz

Ingredients	Head (% by weight)	Body (% by weight)
De-ionized Water	54.88	69.02
Di(ethylene glycol) butyl ether	44.91	30.76
Salt	0.21	0.22

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5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Test positions

The cellular phone was measured in 2 positions on both the "left hand" and "right hand" side of the phantom with the antenna in both extended and retracted positions. Furthermore the cellular phone was measured in the carrying case under the flat section of the phantom.

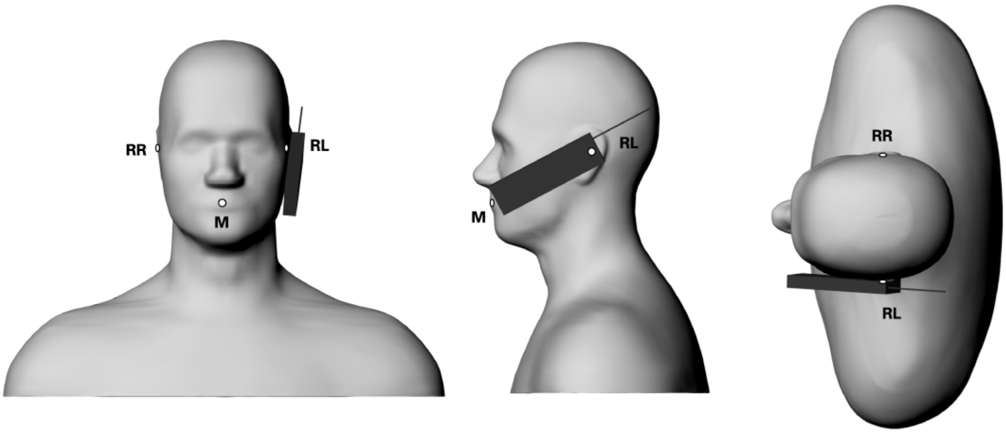


Figure 4. "Cheek/Touch" Position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

5.1.1 Cheek/Touch Position

1) The phone was positioned with the vertical center line of the body of the phone and the horizontal line crossing the center of the ear piece in a plane parallel to the sagittal plane of the phantom ("initial position"). While maintaining the phone in this plane, the vertical center line was aligned with the reference plane containing the three ear and mouth reference points (RE, LE and M) and the center of the ear piece was aligned with the line RE-LE
2) The mobile phone was moved towards the phantom with the earpiece aligned with the line LE-RE until the phone touched the ear. While maintaining the phone contact with the ear, the bottom of the phone was moved until a point on the front side was in contact with the cheek of the phantom or until contact with the ear was lost.

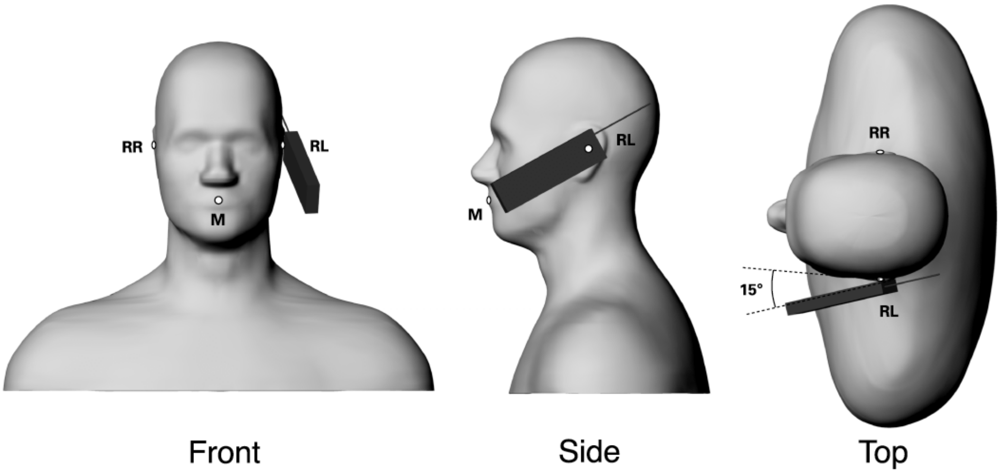


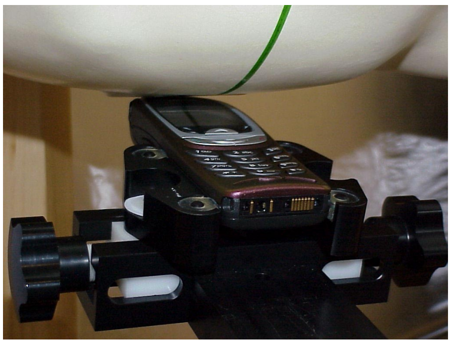
Figure 5. "Ear/Tilted Position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

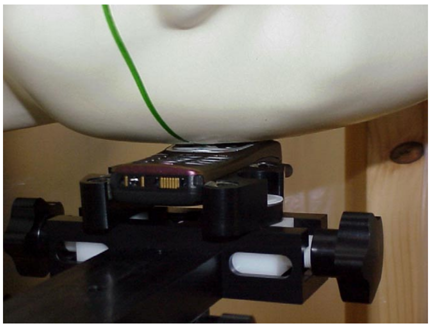
5.1.2 Ear/Tilted Position

1) The phone was positioned in the "cheek/touch" position as described above;
2) While the phone was maintained in the reference plane described above and pivoting against the ear, the phone was moved outward away from the mouth by an angle of 15 degrees or until contact with the ear was lost.

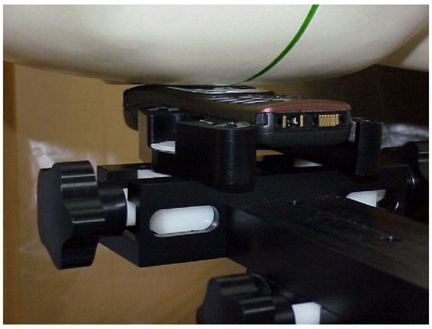
5.1.3 Photos of setup


Tilted, left hand


Tilted, right hand



Touch, left hand



Touch, right hand

5.1.4 Body Worn Configuration

The phone was positioned into the CSL-21 carrying case and placed below the flat section of the phantom.
The measurement was performed in 2 positions, first with headset HDE-1 connected to the bottom connector, and the secondly with the headset HDC-5 connected to the TTY connector on the side of the phone. The system connector and TTY/TTD jack are only accessible when the phone is inserted correctly in the CSL-21, with the integral antenna pointing away from users body. When the phone is placed in the carrying case, the whip antenna cannot be extended.

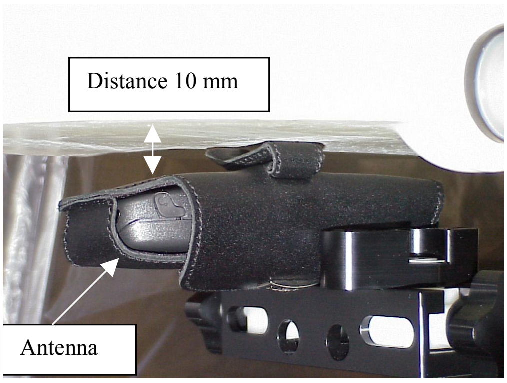


Figure 6 GMLNHP-2FX in Carrying Case CSL-21.

5.2 Scan Procedure

First coarse scans are used for quick determination of the field distribution. Next a cube scan, 7x7x7 with a spacing of 5 mm between each scan point, is performed to determine the averaged SAR-distribution for 1g and 10g.

5.3 SAR averaging methods

The maximum SAR value is averaged over its volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot" –condition [W. Gander, Computermathematik, p. 141-150] (x,y and z –directions) [Numerical Recipes in C, Second Edition, p 123ff].

The extrapolation is based on least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3cm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1mm from one another.

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6. MEASUREMENT UNCERTAINTY

6.1 Description of individual measurement uncertainty

Uncertainty description	Error	Distrib.	Weight	Std. Dev.
- axial isotropy	±0.2 dB	U-shape	0.5	±2.4%
- spherical isotropy	±0.4 dB	U-shape	0.5	±4.8%
- Spatial resolution	±0.5 dB	Normal	1	±0.5%
- Linearity error	±0.2 dB	Rectang.	1	±2.7%
- Calibration error	±3.3%	Normal	1	±3.3%
Total Probe Uncertainty				±**6.87%**
- Data acquisition error	±1%	Rectang.	1	±0.6%
- ELF and RF disturbances	±0.25%	Normal	1	±0.25%
- Conductivity assessment	±10%	Rectang.	1	±5.8%
Total SAR Evaluation Uncertainty				±**5.84%**
- Extrapol + boundary effect	±3%	Normal	1	±3%
- Probe positioning error	±0.1mm	Normal	1	±1%
- Integrat and cube orient	±3%	Normal	1	±3%
- Cube shape inaccuracies	±2%	Rectang.	1	±1.2%
Total Spatial Peak SAR Evaluation Uncertainty				±**4.52%**
Total Measurement Uncertainty				±**10.09%**

6.2 Source Uncertainty

Uncertainty description	Error	Distrib.	Weight	Std. Dev.
- Device positioning	±6%	Normal	1	±6%
- Laboratory set up	±3%	Normal	1	±3%
Total Source Uncertainty				±**6.71%**

6.3 Estimation of the total measurement uncertainty

Uncertainty description	**Uncertainty**
- Total Measurement Uncertainty	±10.09%
- Total Source Uncertainty	±6.71%
Combined Uncertainty	**±12.11%**
Expanded Uncertainty (k=2) 95.5%	**±24.23%**

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7. RESULTS

7.1 CDMA PCS

Position		CDMA PCS		
		Channel		
		25	600	1175
		Power [dBm]		
		24.0	24.0	24.0
Touch, left hand	Antenna in	**0.888**	0.781	0.601
Touch, left hand	Antenna out	0.870	0.755	0.558
Tilted, left hand	Antenna in	0.806	0.787	0.613
Tilted, left hand	Antenna out	0.810	0.694	0.550
Touch, right hand	Antenna in	0.873	0.700	0.596
Touch, right hand	Antenna out	0.820	0.639	0.525
Tilted, right hand	Antenna in	0.842	0.682	0.556
Tilted, right hand	Antenna out	0.696	0.557	0.436
Body, HDE-1	Pos. 1	0.244	0.208	0.176
Body, HDC-5	Pos. 2	**0.306**	0.220	0.165

8. LIST OF INSTRUMENTS

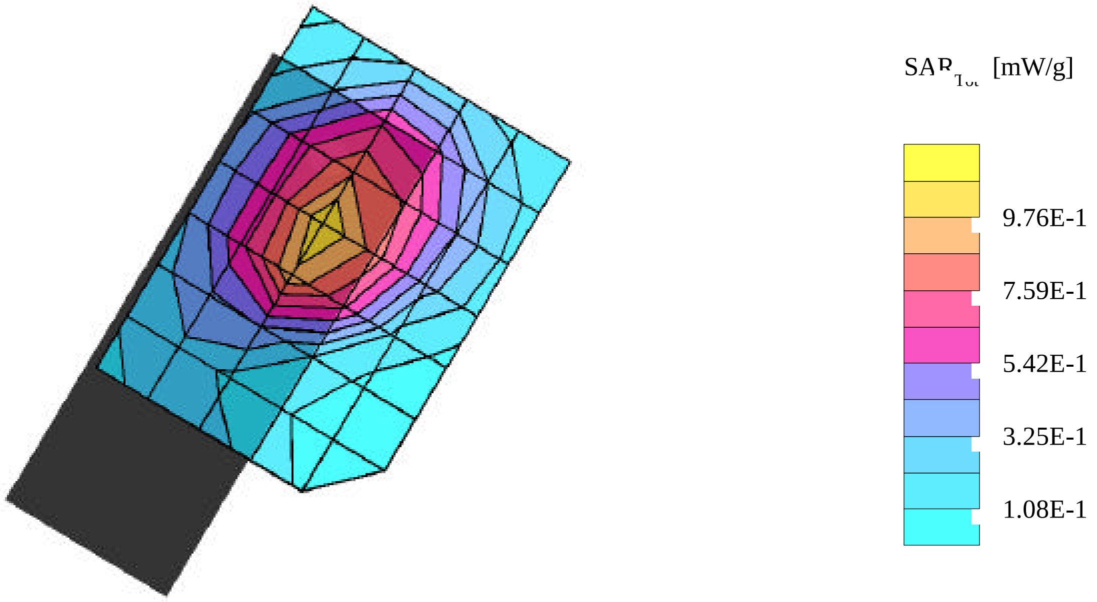
Equipment no	Equipment	Type	Serial no	Manufacturer	Last week	Last year	Next week	Next year	Calibration lab
13172	Power Supply 15V DC 4 A	PL154	043068	Thurlby&Thandar					
13393	RF Amplifier 10-2,4GHz	ZHL-42W	D091395-1	Mini-Circuits					
14509	Double Ridged Horn Antenna	BBHA9120-LF	BBHA 9120 LF-A/105	Schwarzbech Mess El.	27	98			Schwarzbech
14824	Vector Signal Generator	SMIQ03B	826046/034	Rohde&Schwarz	33	2000	33	2003	R&S
14867	Digital Weight 0-3100g 0,01g	BP3100S	81006038	Sartorius					
15001	Digital Radio Comm. Tester	CTS55	828273/014	Rohde&Schwarz					
15199	Industrial Robot f SAR	RX90L	598299-01	Stäubli					
15200	Robot Controller Unit	Dasy3	-----------------	Stäubli					
15201	Phantom	Generic Twin Phantom V3.0	-----------------	Schmid&Partner					
15202	Phantom	Generic Twin Phantom V3.0	-----------------	Schmid&Partner					
17737	SCC-34/SC-2 Phantom	Generic Twin Phantom V4.1	-----------------	Schmid&Partner					
15203	Phone Test Fixture f Test	-----------------	-----------------	Stäubli					
15204	Dipole Antenna 900MHz SMA	D900V2	033	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15205	Dipole Antenna 1800MHz SMA	D1800V2	230	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15206	Dummy Probe f SAR	-----------------	-----------------	Schmid&Partner					
15207	Probe f SAR Measurements	ET3DV5	1345	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15208	Probe f SAR Measurements	ET3DV5	1344	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15209	Dielectric Probe Kit	HP85070B	US33020403	Hewlett Packard					
15319	Closed Torso Mannequin V2.0	V2.0	-----------------	Schmid&Partner					
15859	Digital Radio Communication	4201S	0113217	Wavetek					
15883	RF Shielded Box	248390	LX658054	Wavetek					
16744	Dosimetric Assessment	DAE3V1	339	Schmid&Partner	34	2001	34	2002	Schmid&Partner
17266	RF S-Parameter Network	AT8753ES	MY40001091	Agilent Technologies	7	2001	7	2002	AT Factory
17555	Dosimetric Assessment	DAE3V1	435	Schmid&Partner	46	2001	46	2002	Scmid & Partner
17556	Dosimetric E-Field Probe f	ET3DV6R	1429	Schmid&Partner	36	2001	36	2002	Schmid&Partner
17752	Dosimetric E-Field Probe f	ET3DV6R	1431	Schmid&Partner	51	2001	51	2002	Schmid&Partner
	CDMA Mobile Station Test Set	8960	US 40480197	Agilent	21	2001	21	2003	Agilent

9. ANNEX A: SAR DISTRIBUTION PRINTOUTS

01/17/02 Temp = 23° C ± 1°

Columbia

SAM Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
; SAM touch left CH 25, Antenna in; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1900 MHz (SAM): σ = 1.46 mho/m ϵ_r = 38.9 ρ = 1.00 g/cm^3
: , ()
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0



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Columbia

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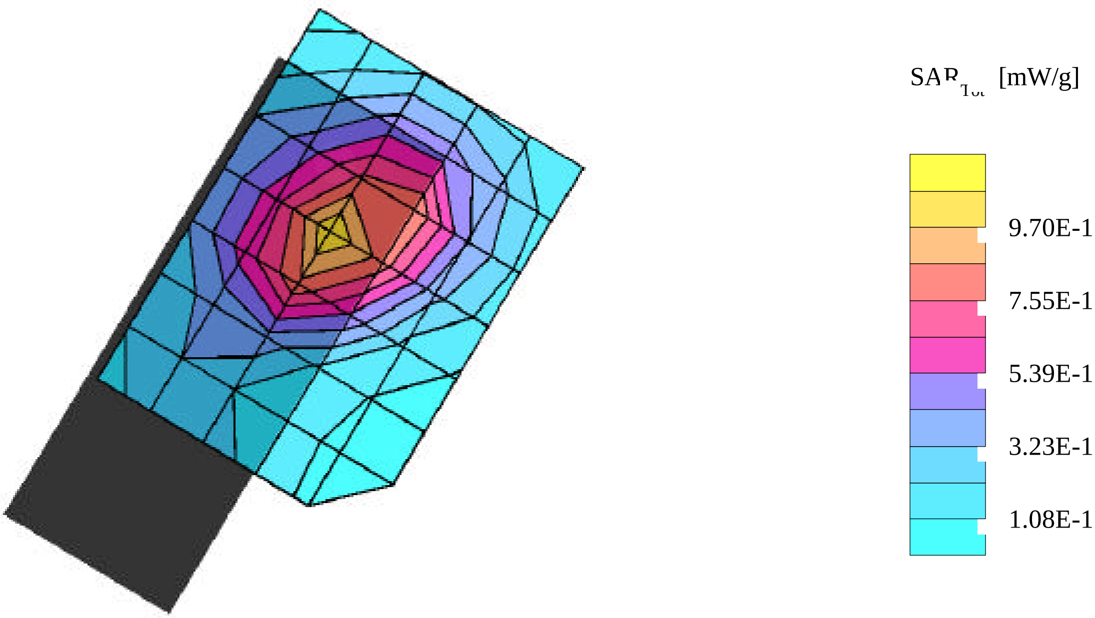

Columbia

SAM Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
; SAM plus15° left CH 25, Antenna in; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1900 MHz (SAM): σ = 1.46 mho/m ε_r = 38.9 ρ = 1.00 g/cm³
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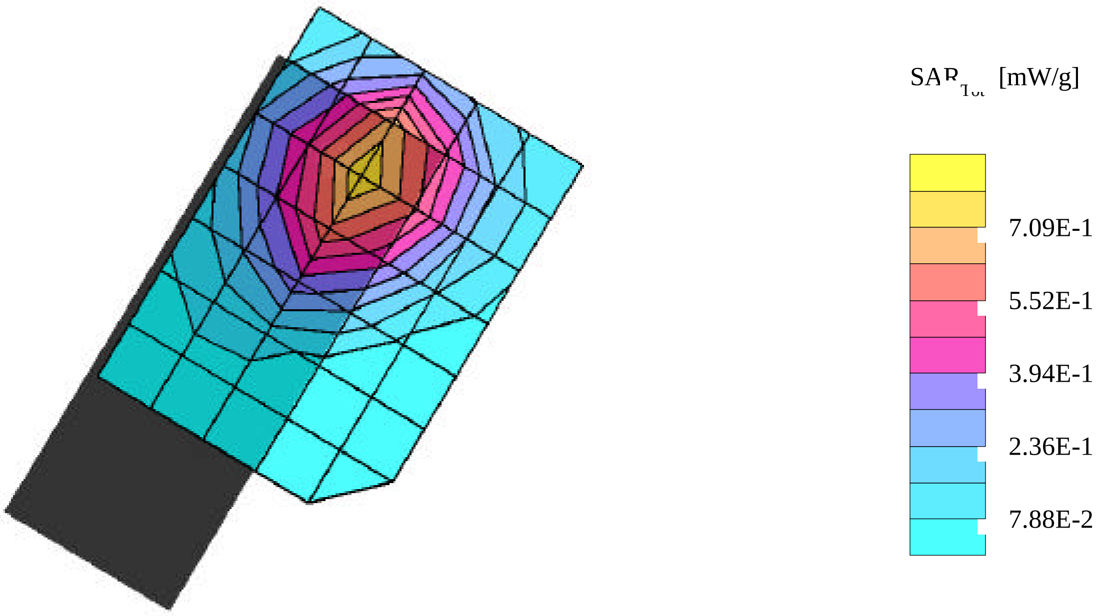

Columbia

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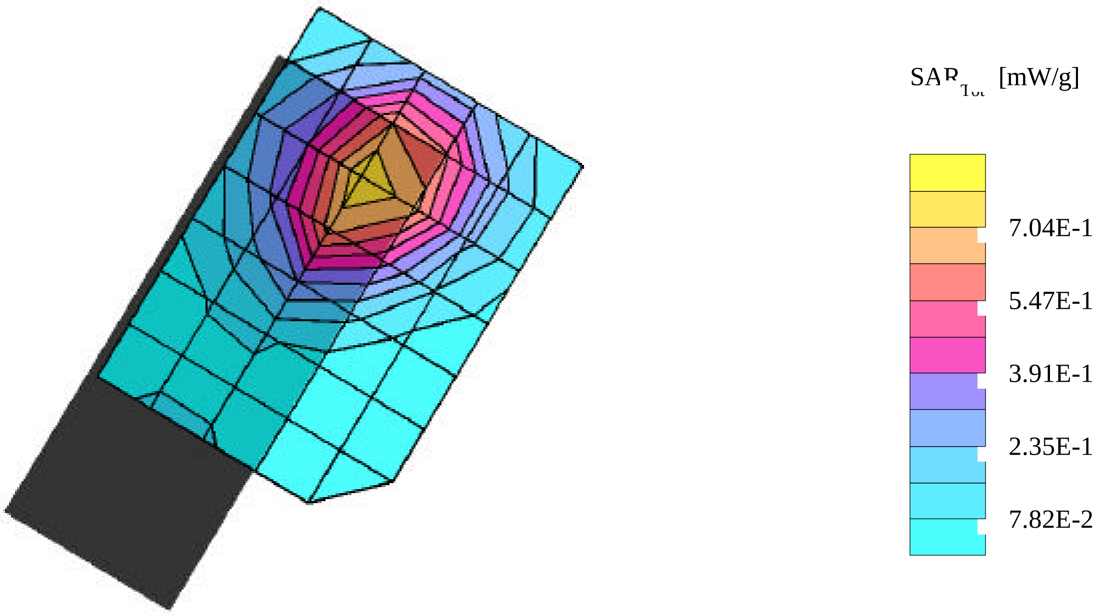

01/18/02 Temp = 23° C ± 1°

Columbia

SAM Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
; SAM touch right CH 25, Antenna in; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1900 MHz (SAM): σ = 1.46 mho/m ε_r = 38.9 ρ = 1.00 g/cm^3
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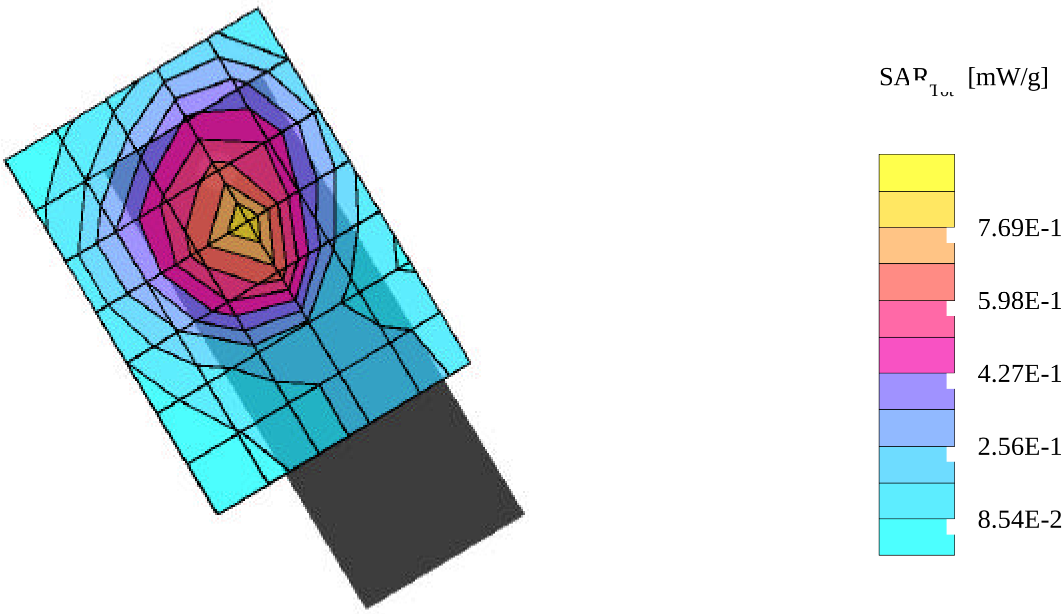

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01/18/02 Temp = 23° C ± 1°

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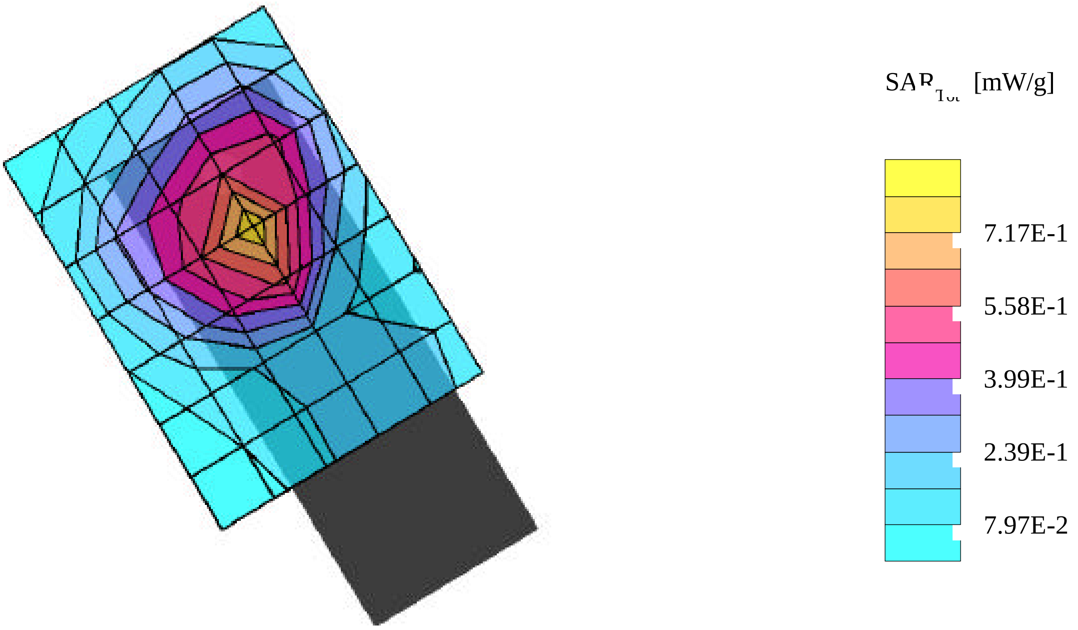

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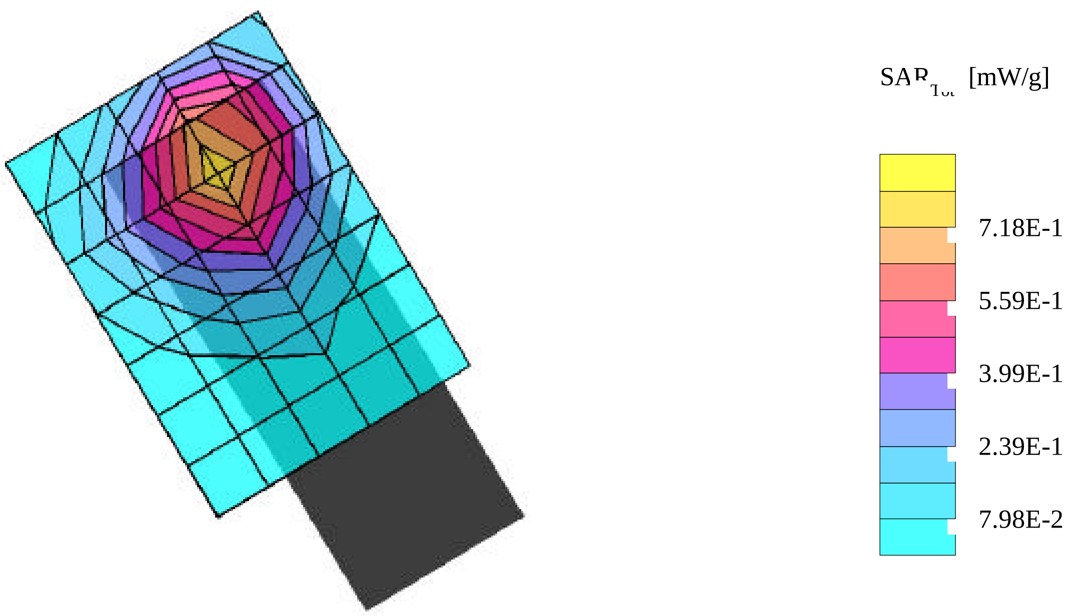

01/21/02 Temp = 23° C ± 1°

Columbia

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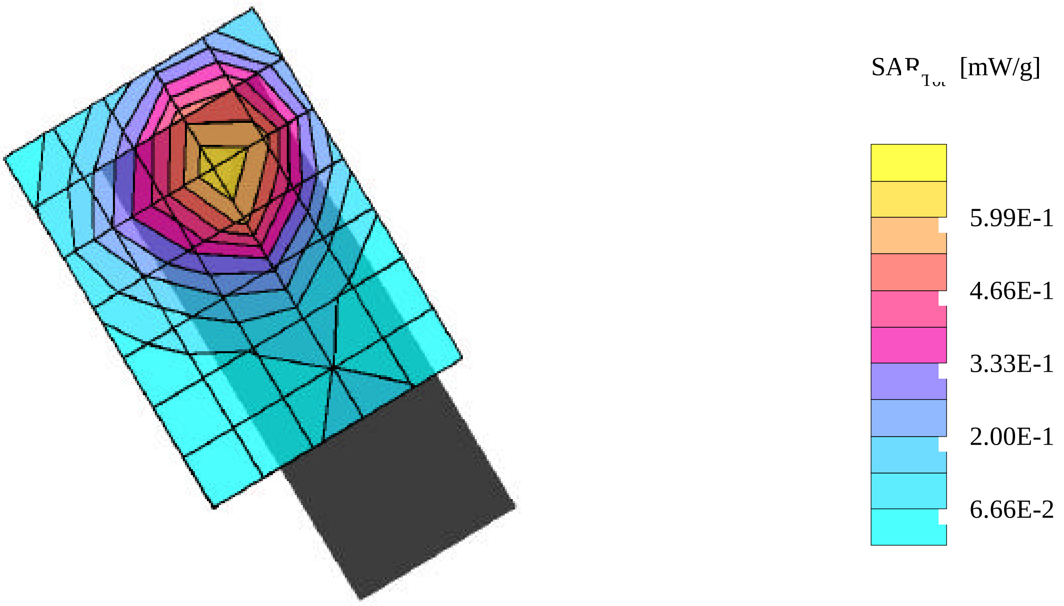
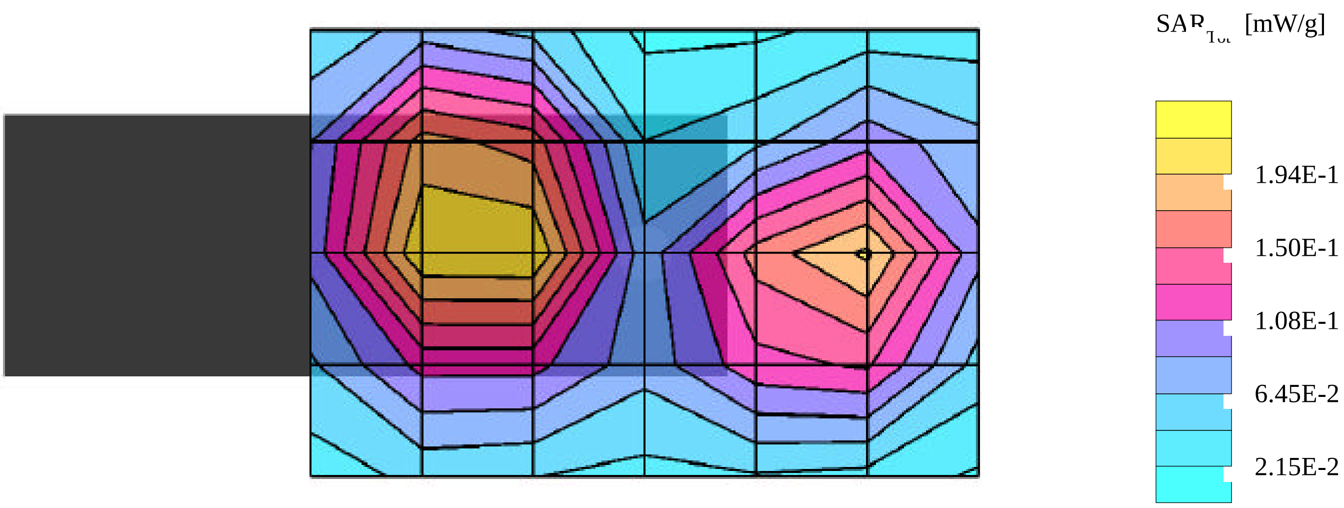
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0



01/21/02 Temp = 23° C ± 1°

Columbia

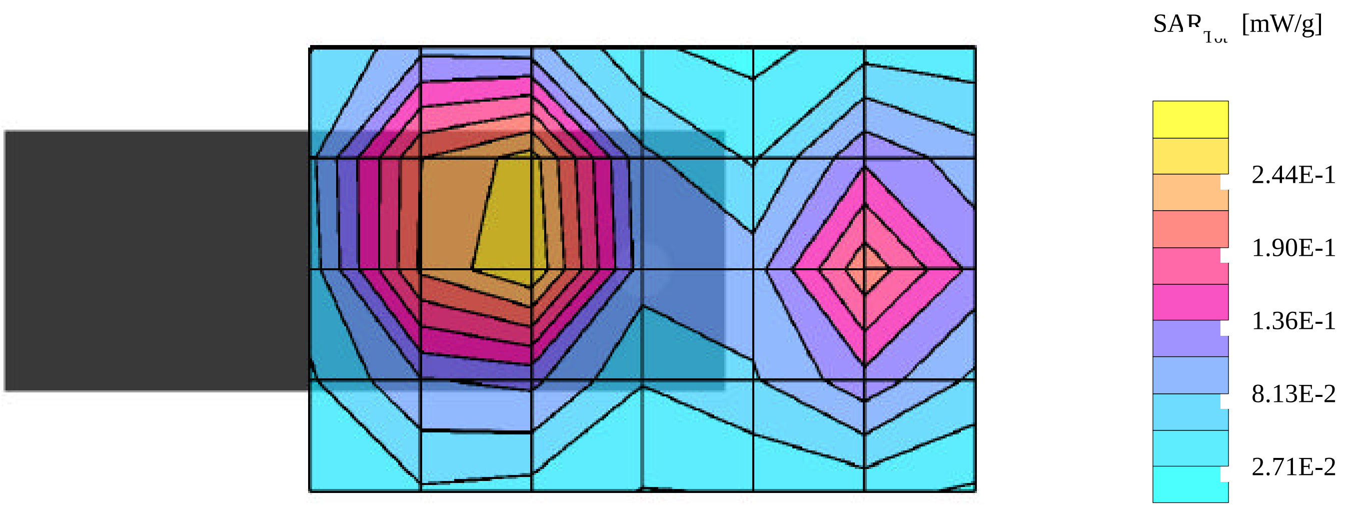
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
; SAM Body, CH 25, Pos; Probe: ET3DV6R - SN1431; ConvF(4.52,4.52,4.52); Crest factor: 1.0; Body 1800-2000 MHz
(SAM): $\sigma = 1.50$ mho/m $\varepsilon_r = 53.0$ $\rho = 1.00$ g/cm^3
: , ()
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0



01/22/02 Temp = 23° C ± 1°

Columbia

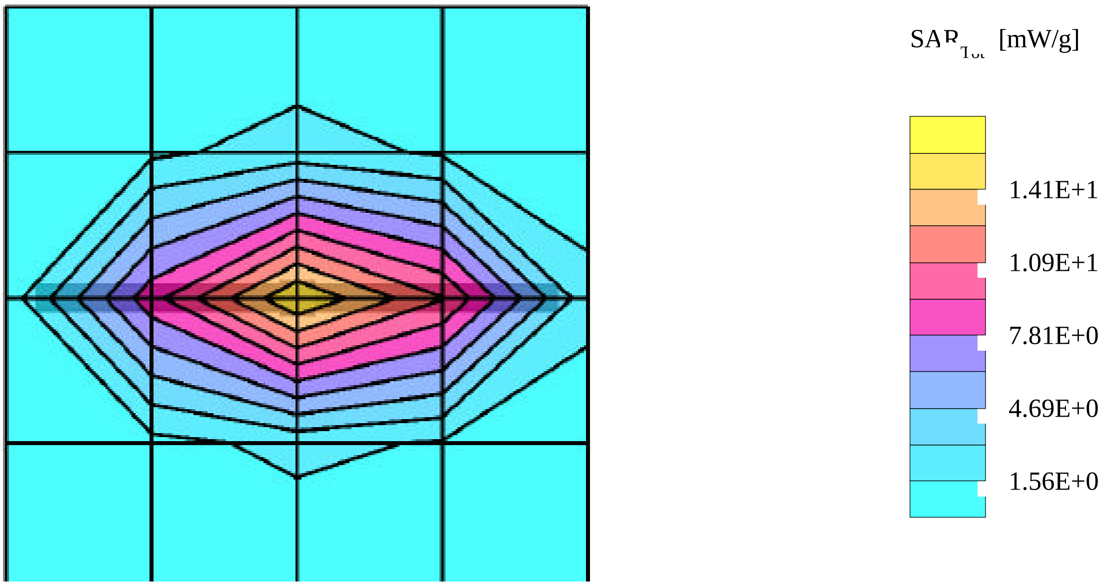
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1880 MHz
; SAM Body, CH 25, Pos; Probe: ET3DV6R - SN1431; ConvF(4.52,4.52,4.52); Crest factor: 1.0; Body 1800-2000 MHz (SAM): σ = 1.50 mho/m ϵ_r = 53.0 ρ = 1.00 g/cm³
: , ()
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0



10. ANNEX B: VALIDATION PLOTS

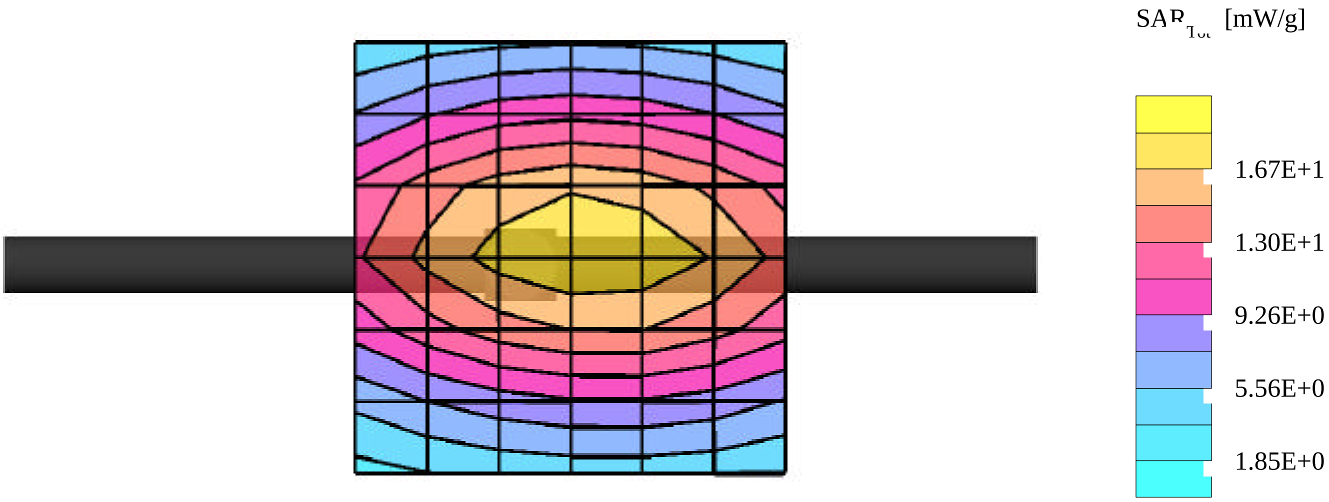
Dipole 1800 MHz

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz
; 17; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1800 MHz (SAM): σ = 1.40 mho/m ε_r = 39.2 ρ = 1.00 g/cm³
: , ()
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0



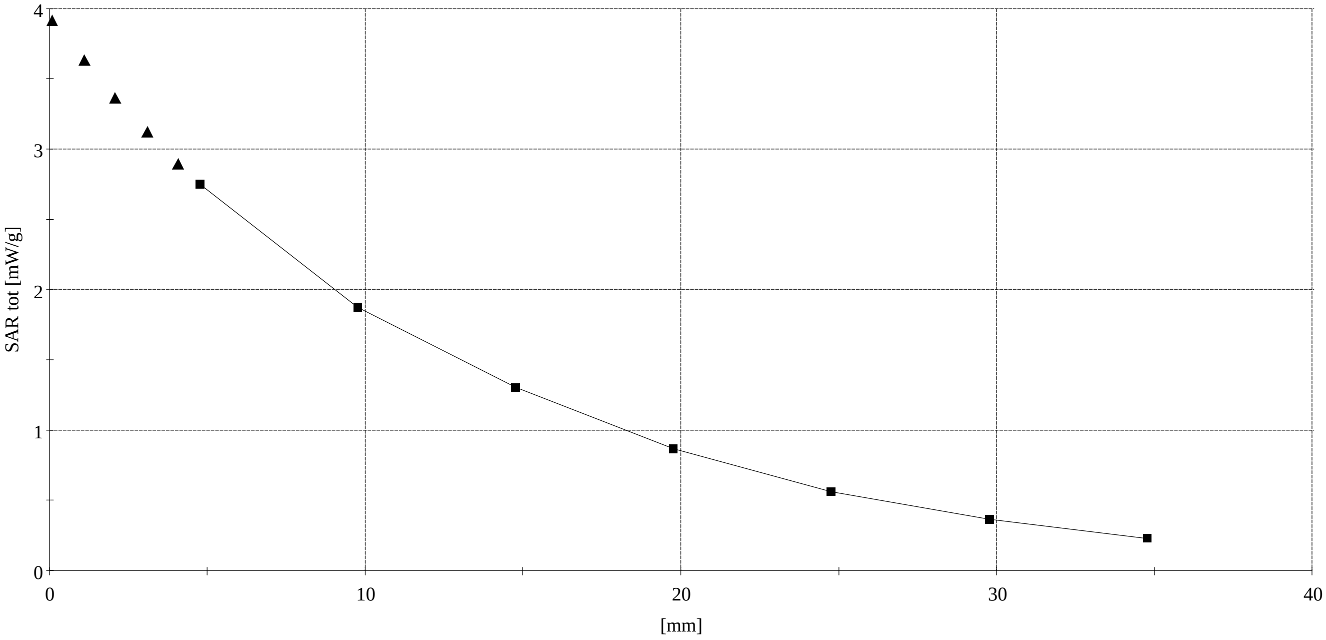
Dipole 1800 MHz

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz
; 18; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1800 MHz (SAM): σ = 1.38 mho/m ε_r = 39.3 ρ = 1.00 g/cm^3
Cube 7x7x7: SAR (1g): 10.1 mW/g, SAR (10g): 5.31 mW/g, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



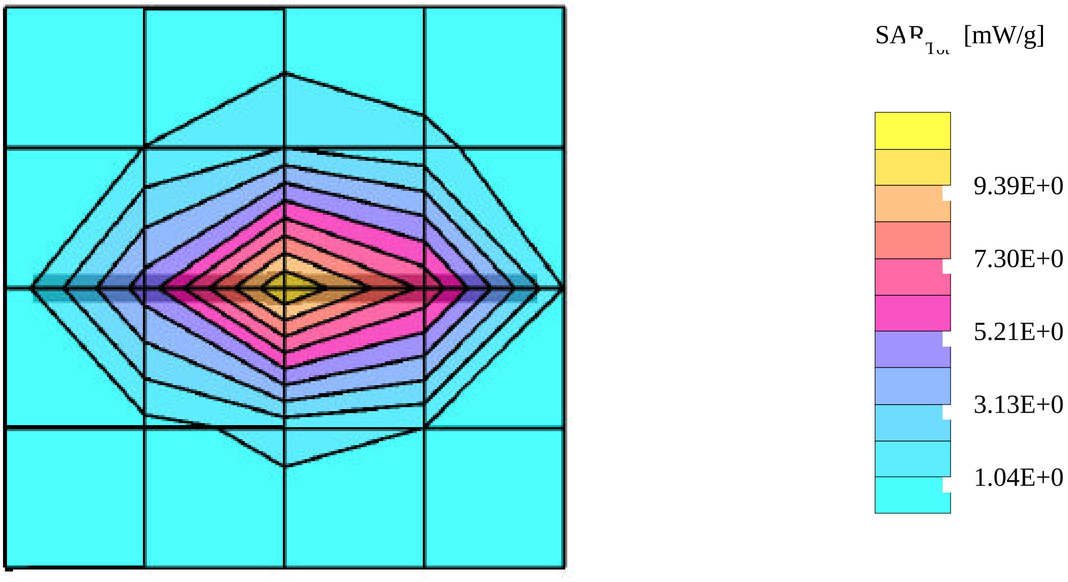
Dipole 1800 MHz

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz
; 18; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1800 MHz (SAM): σ = 1.38 mho/m ε_r = 39.3 ρ = 1.00 g/cm³
Cube 7x7x7: SAR (1g): 10.1 mW/g, SAR (10g): 5.31 mW/g, (Worst-case extrapolation)
Cube 7x7x7: Dx = 5.0, Dy = 5.0, Dz = 5.0



Dipole 1800 MHz

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz
; 21; Probe: ET3DV6R - SN1431; ConvF(4.95,4.95,4.95); Crest factor: 1.0; Brain 1800 MHz (SAM): σ = 1.38 mho/m ε_r = 39.3 ρ = 1.00 g/cm³
: , ()
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0



11. ANNEX C: 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:	**ET3DV6R**
Serial Number:	**1431**
Place of Calibration:	**Zurich**
Date of Calibration:	**December 19, 2001**
Calibration Interval:	**12 months**

17752

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: Nikolai Ne... [signature]

Approved by: [signature]

Schmid & Partner
Engineering AG

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

Probe ET3DV6R

SN:1431

Manufactured: May 18, 2001
Calibrated: December 19, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6R SN:1431

Sensitivity in Free Space

NormX	**2.33**	$\mu V/(V/m)^2$
NormY	**2.23**	$\mu V/(V/m)^2$
NormZ	**2.02**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**99**	mV
DCP Y	**99**	mV
DCP Z	**99**	mV

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** ε_r **= 43.5 ± 5%** σ **= 0.87 ± 10% mho/m**

ConvF X	**6.65**	extrapolated	Boundary effect:	
ConvF Y	**6.65**	extrapolated	Alpha	**0.57**
ConvF Z	**6.65**	extrapolated	Depth	**1.84**

Head **800 - 1000 MHz** ε_r **= 39.0 - 43.5** σ **= 0.80 - 1.10 mho/m**

ConvF X	**6.09**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.09**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**6.09**	± 9.5% (k=2)	Depth	**1.95**

Head **1500 MHz** ε_r **= 40.4 ± 5%** σ **= 1.23 ± 10% mho/m**

ConvF X	**5.33**	interpolated	Boundary effect:	
ConvF Y	**5.33**	interpolated	Alpha	**0.57**
ConvF Z	**5.33**	interpolated	Depth	**2.10**

Head **1700 - 1910 MHz** ε_r **= 39.5 - 41.0** σ **= 1.20 - 1.55 mho/m**

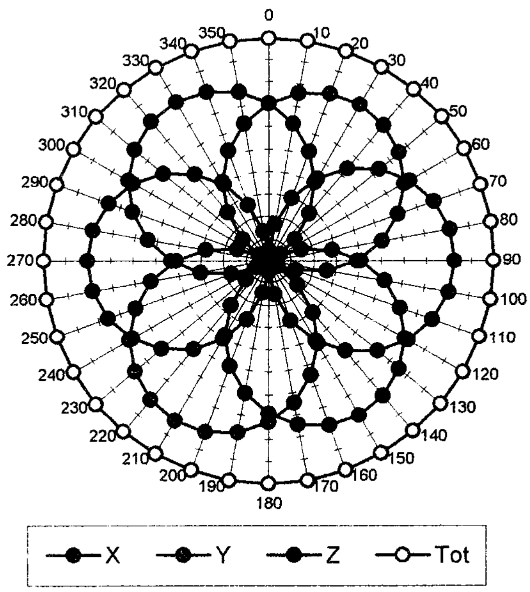
ConvF X	**4.95**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.95**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**4.95**	± 9.5% (k=2)	Depth	**2.17**

Sensor Offset

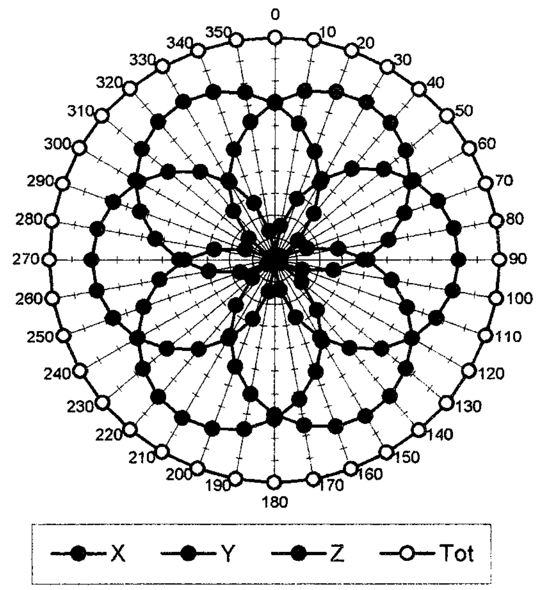
Probe Tip to Sensor Center	**2.7**	mm

Receiving Pattern (ϕ), θ = 0°

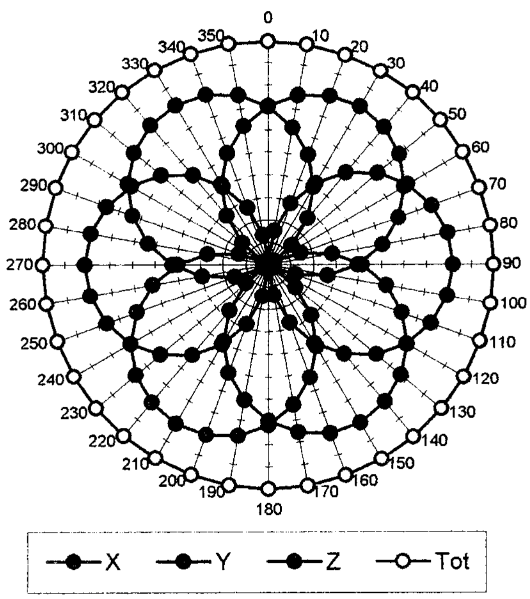
f = 30 MHz, TEM cell ifi110



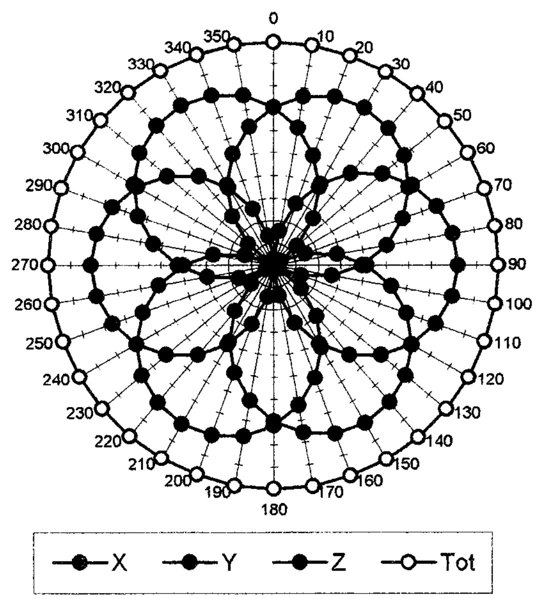
f = 100 MHz, TEM cell ifi110

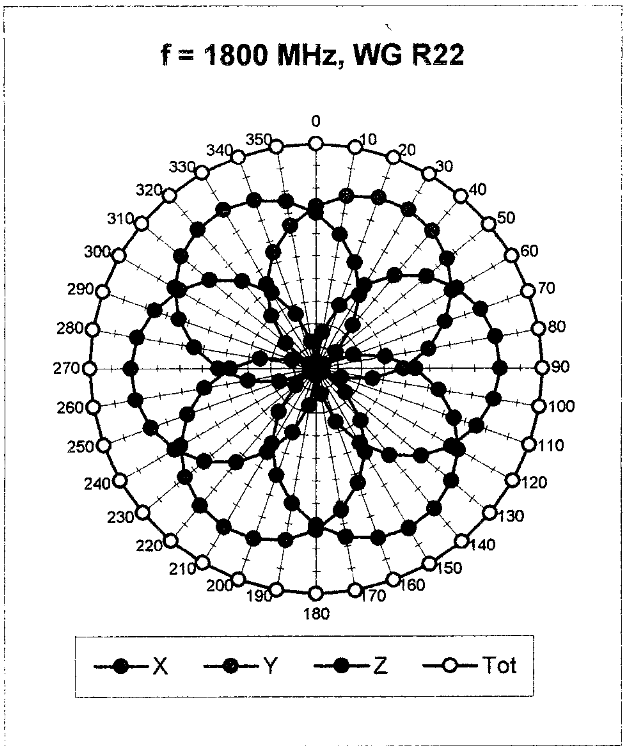


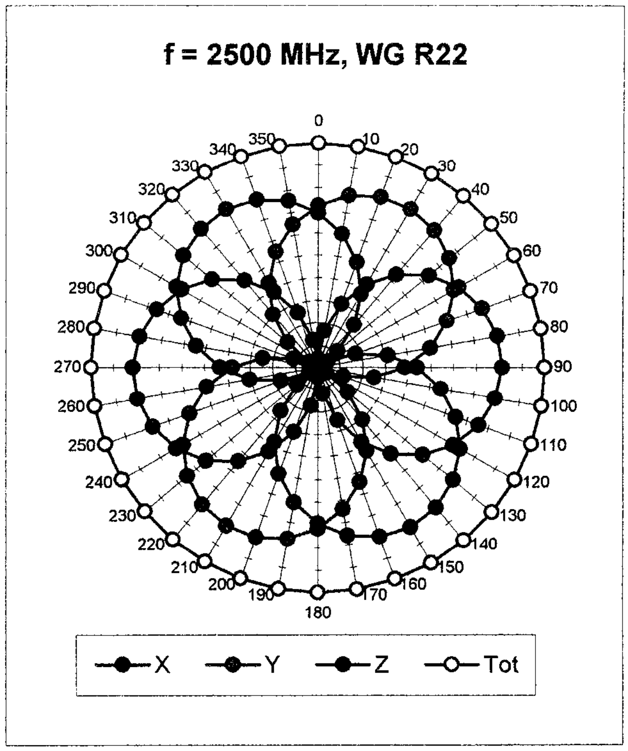
f = 300 MHz, TEM cell ifi110



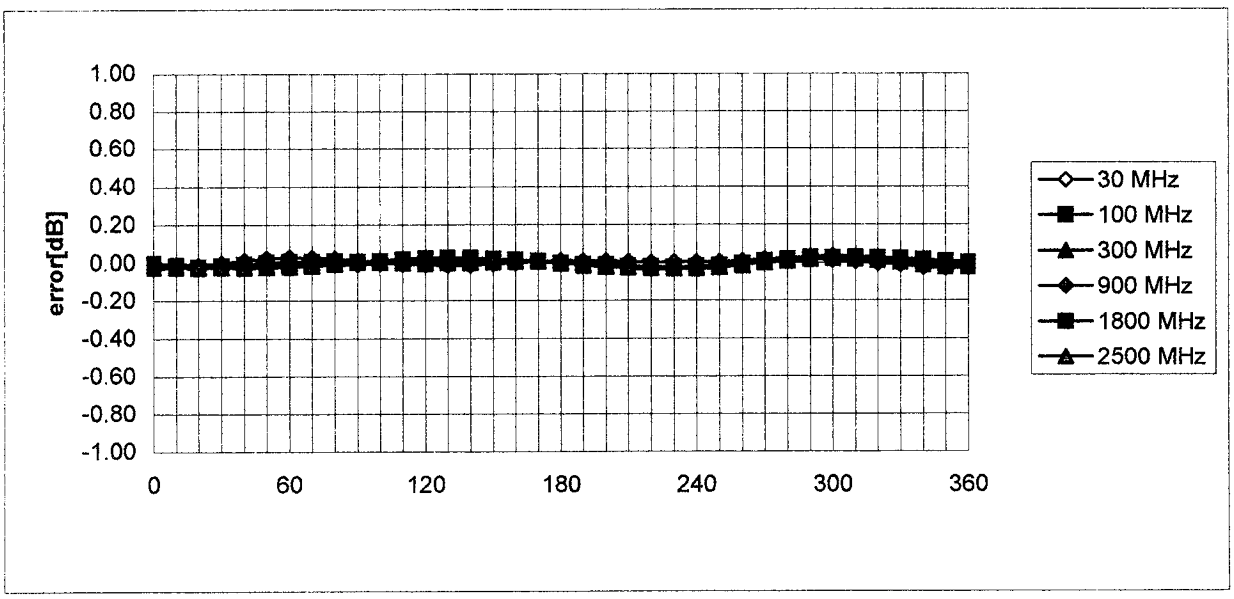
f = 900 MHz, TEM cell ifi110





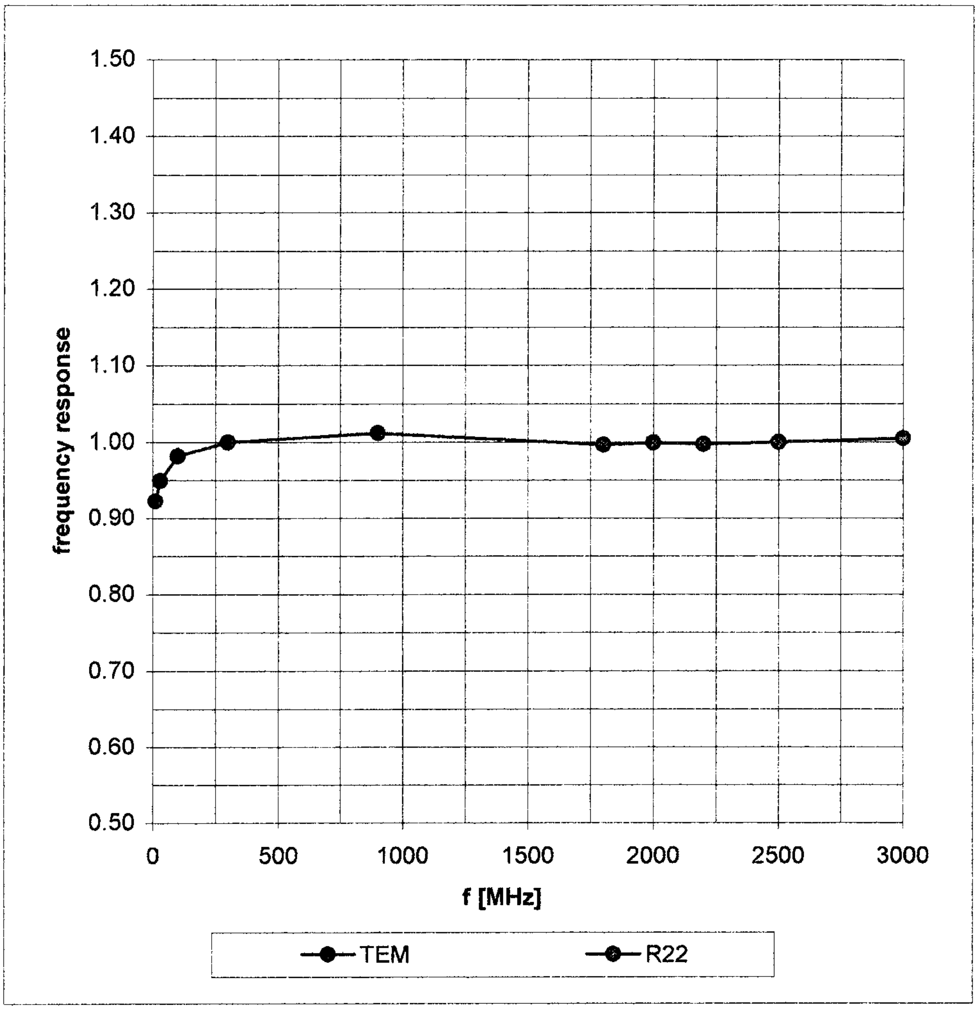


Isotropy Error (ϕ), θ = 0°



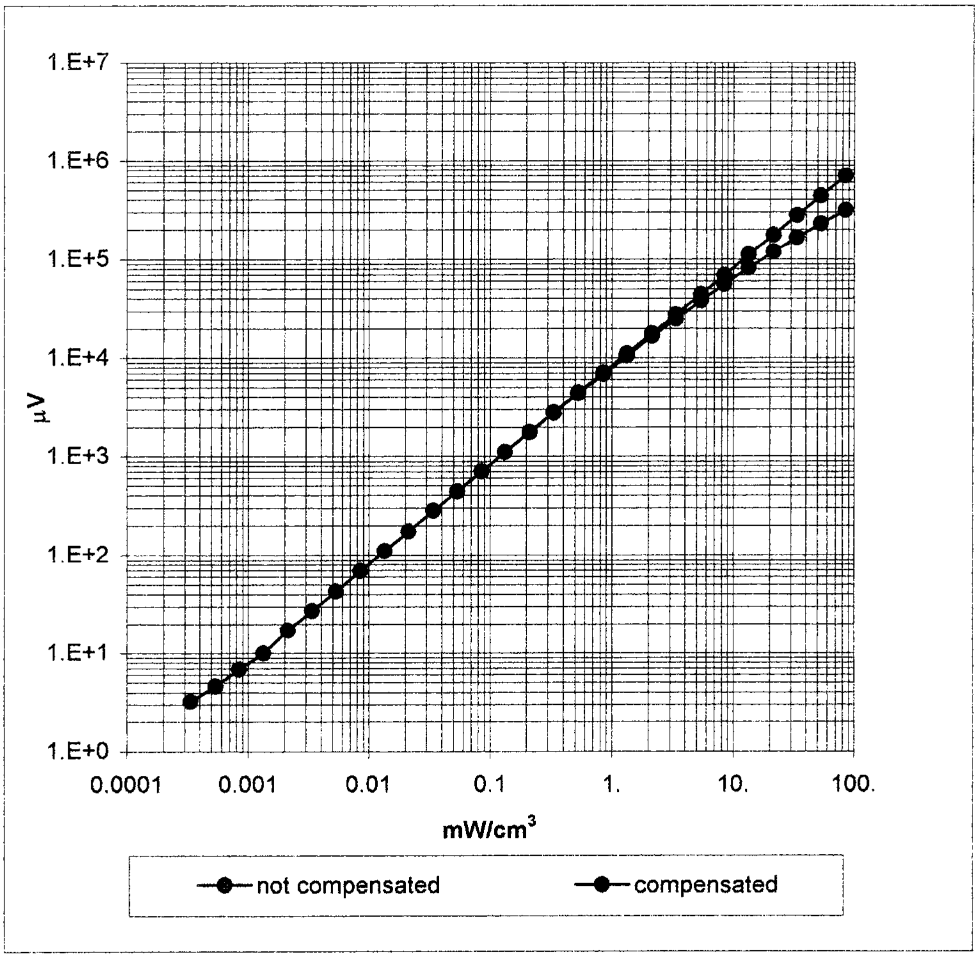
Frequency Response of E-Field

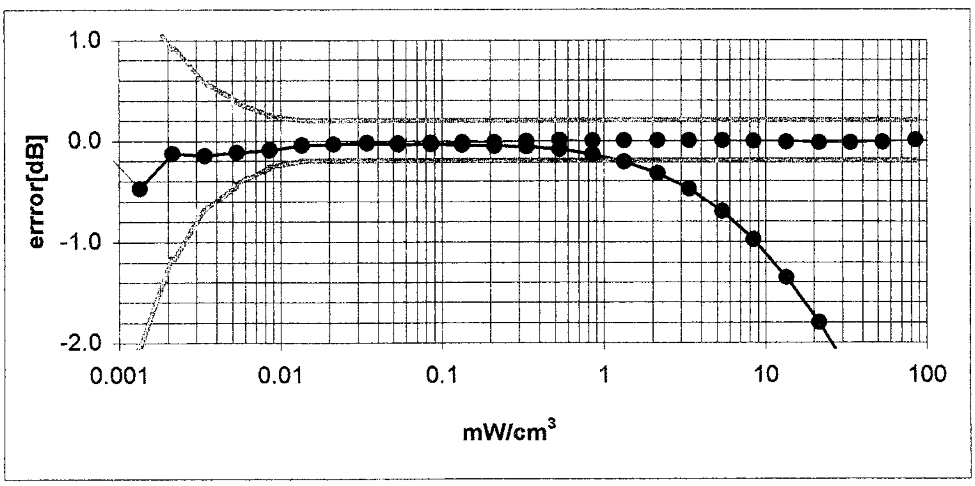
(TEM-Cell:ifi110, Waveguide R22)



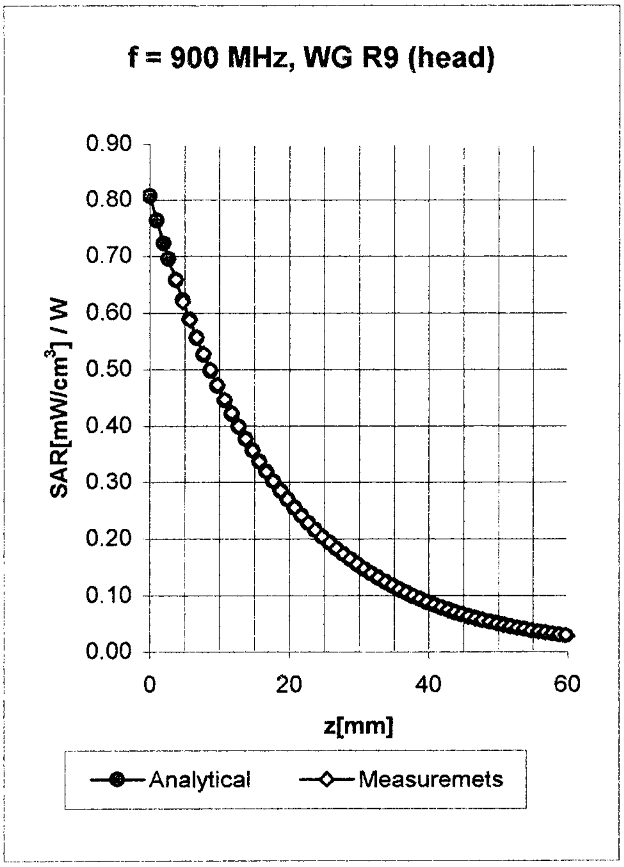
Dynamic Range f(SAR_{brain})

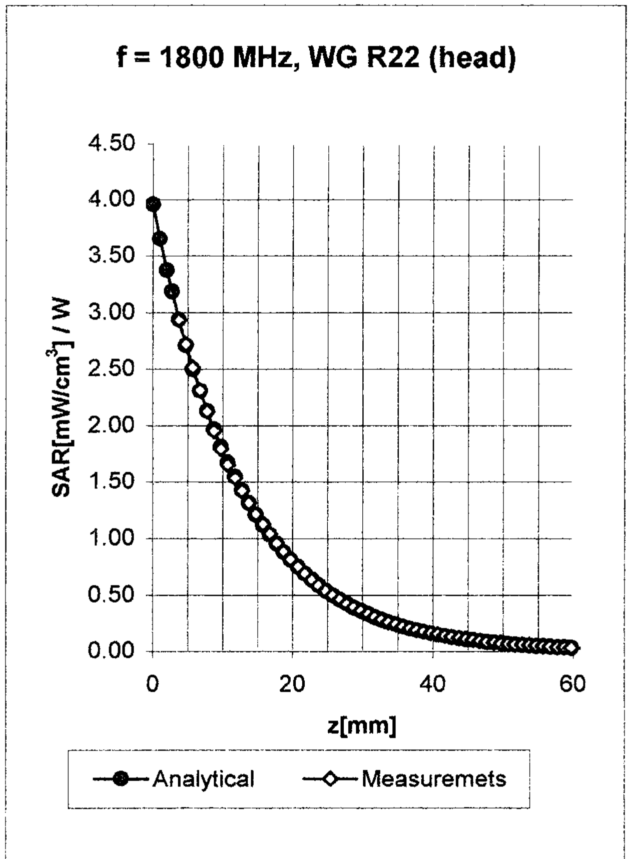
(Waveguide R22)





Conversion Factor Assessment





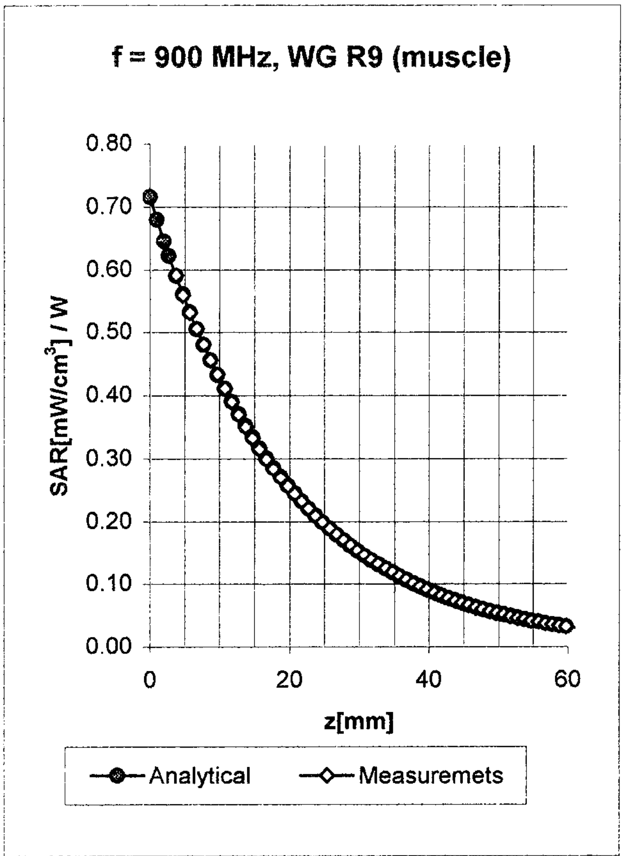
Head **800 - 1000 MHz** ε_r **= 39.0 - 43.5** σ **= 0.80 - 1.10 mho/m**

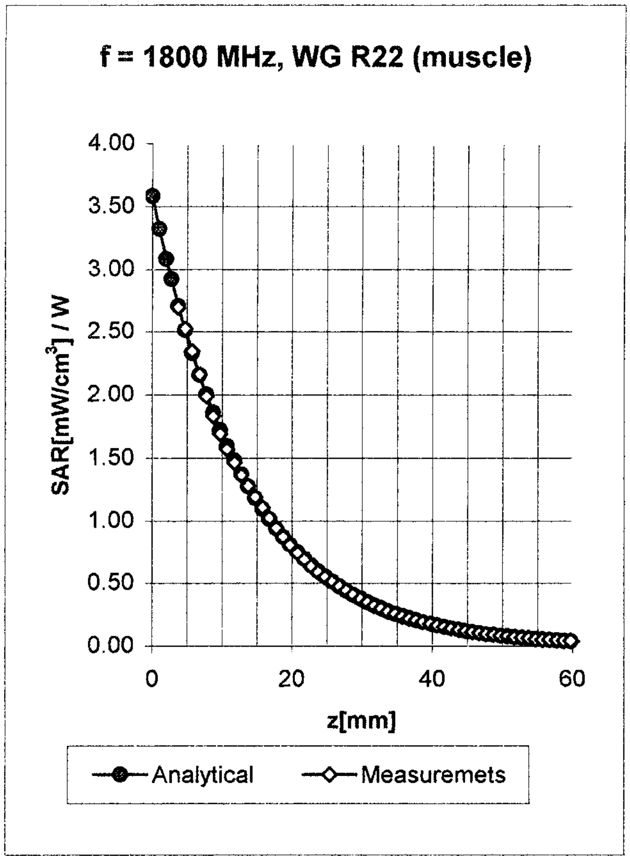
ConvF X	**6.09**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.09**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**6.09**	± 9.5% (k=2)	Depth	**1.95**

Head **1700 - 1910 MHz** ε_r **= 39.5 - 41.0** σ **= 1.20 - 1.55 mho/m**

ConvF X	**4.95**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.95**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**4.95**	± 9.5% (k=2)	Depth	**2.17**

Conversion Factor Assessment





Muscle **900 MHz** **ε_r = 52.3 - 57.8** **σ = 0.96 - 1.15 mho/m**

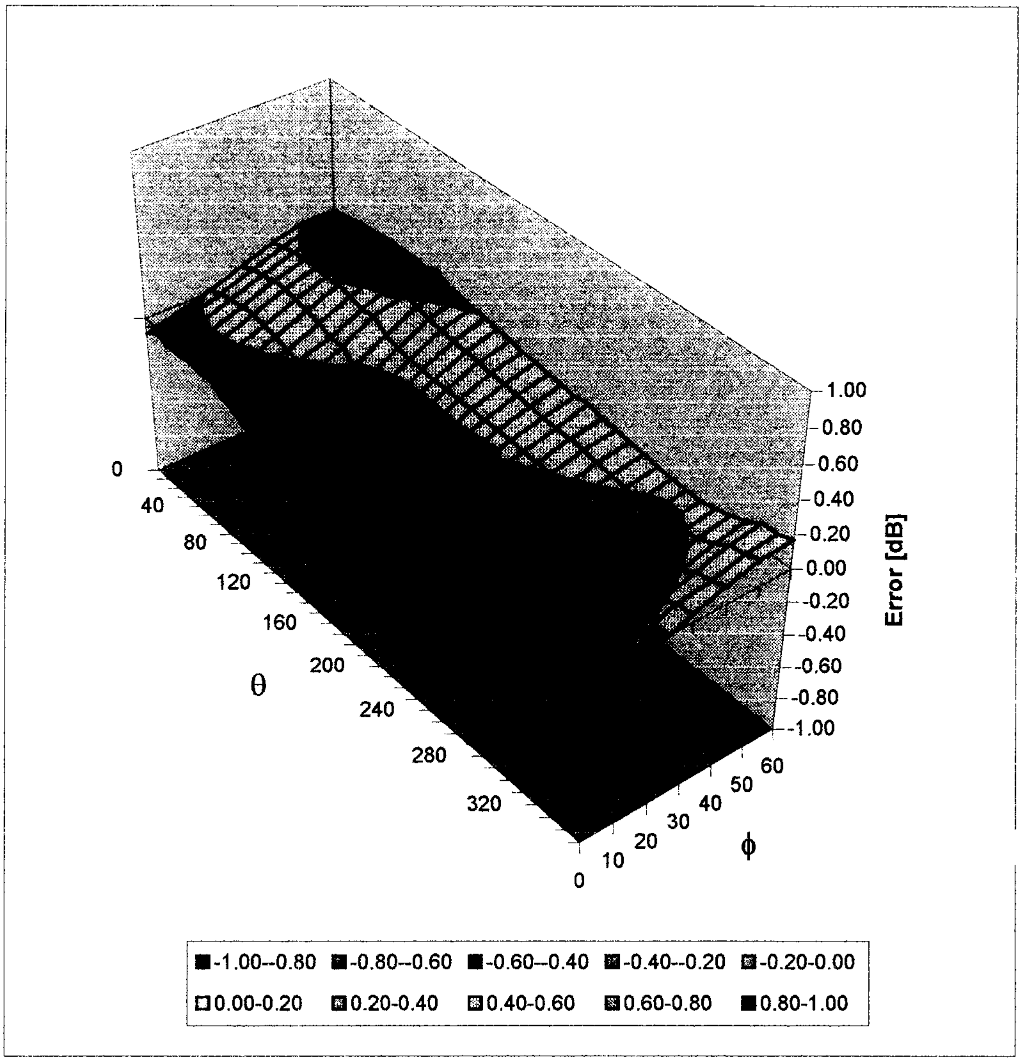
ConvF X	**5.85**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.85**	± 9.5% (k=2)	Alpha	**0.58**
ConvF Z	**5.85**	± 9.5% (k=2)	Depth	**2.01**

Muscle **1800 MHz** **ε_r = 50.6 - 56.0** **σ = 1.35 - 1.65 mho/m**

ConvF X	**4.52**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.52**	± 9.5% (k=2)	Alpha	**0.70**
ConvF Z	**4.52**	± 9.5% (k=2)	Depth	**2.17**

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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:	**033**
Place of Calibration:	**Zurich**
Date of Calibration:	**October 23, 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: 033

Manufactured: July 9, 1998
Calibrated: October 23, 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	**41.5**	± 5%
Conductivity	**0.97 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:	**11.44 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**7.24 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:	**1.417 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 900 MHz:	Re{Z} = **50.5 Ω**
	Im {Z} = **-1.8 Ω**
Return Loss at 900 MHz	**-34.7 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with muscle simulating solution of the following electrical parameters at 900 MHz:

Relative Dielectricity	**55.4**	± 5%
Conductivity	**1.04 mho/m**	± 5%

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.02 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.

5. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 4. 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:	**11.84 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**7.52 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.

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 900 MHz:	Re{Z} = **47.1 Ω**
	Im {Z} = **-3.7 Ω**
Return Loss at 900 MHz	**-25.8 dB**

7. Handling

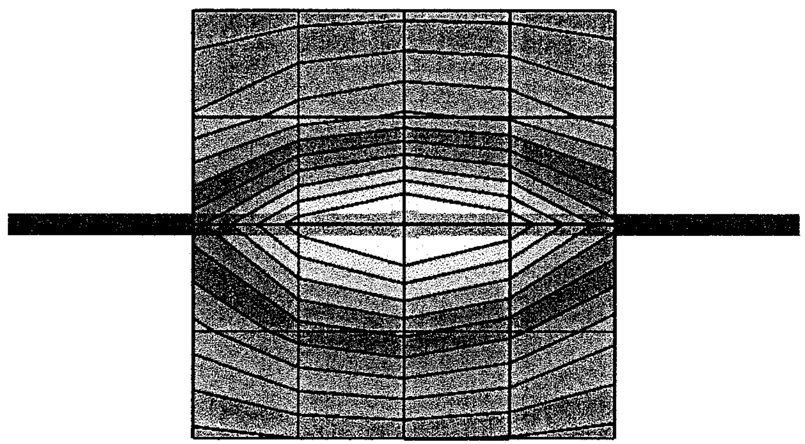
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

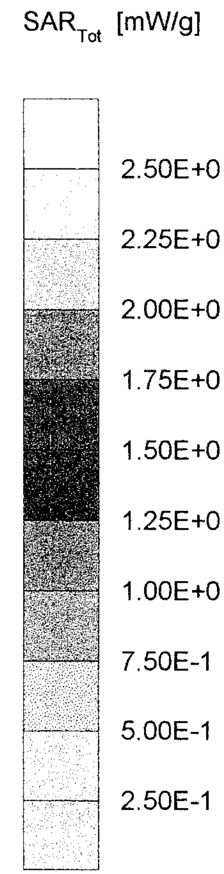
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

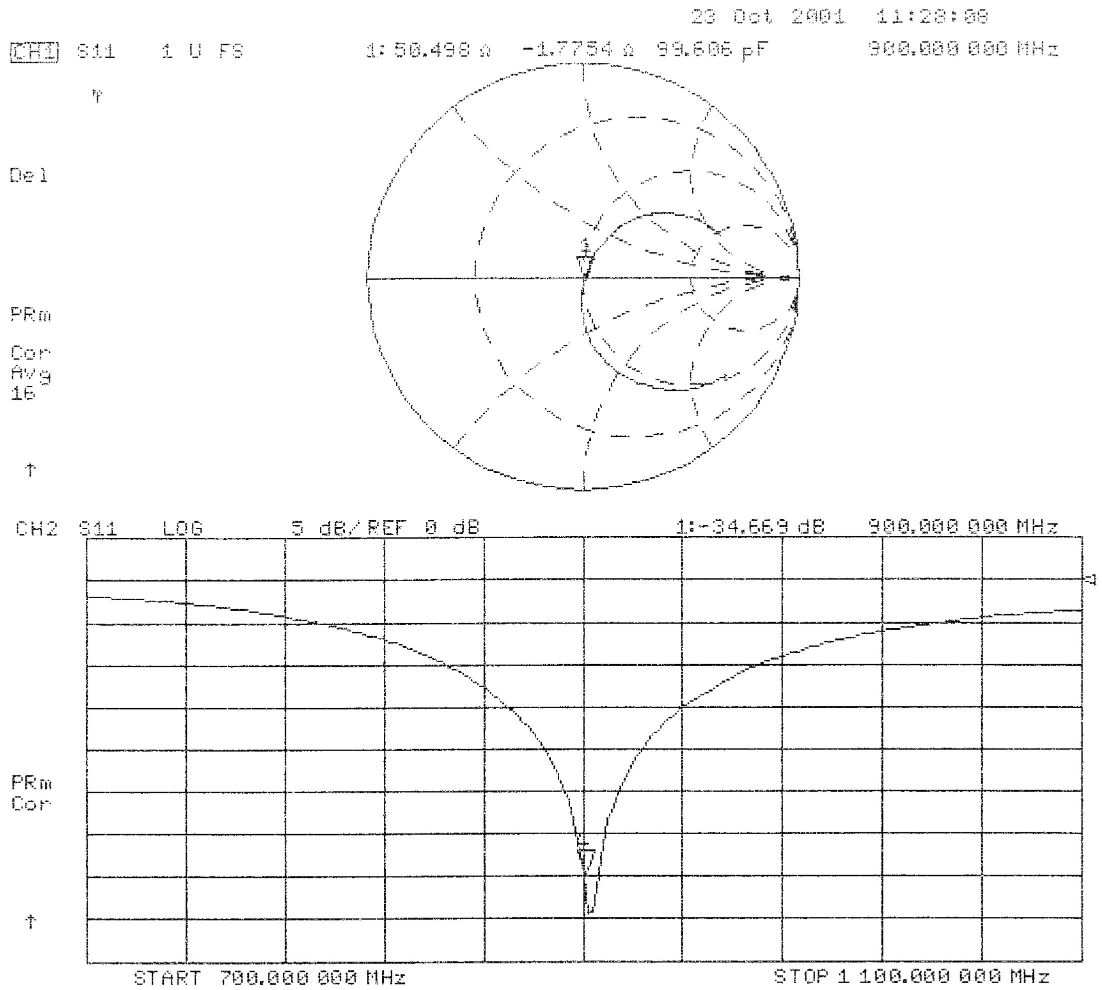
After prolonged use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D900V2 SN:033, 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(6.27,6.27,6.27) at 900 MHz; IEEE1528 900 MHz; σ = 0.97 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.62 mW/g ± 0.04 dB, SAR (1g): 2.86 mW/g ± 0.02 dB, SAR (10g): 1.81 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 11.5 (10.2, 13.2) [mm]
Powerdrift: 0.00 dB

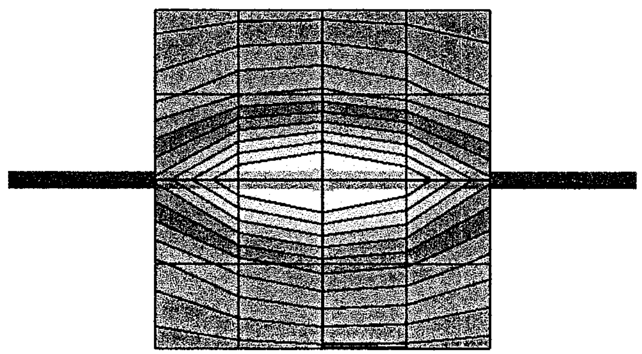


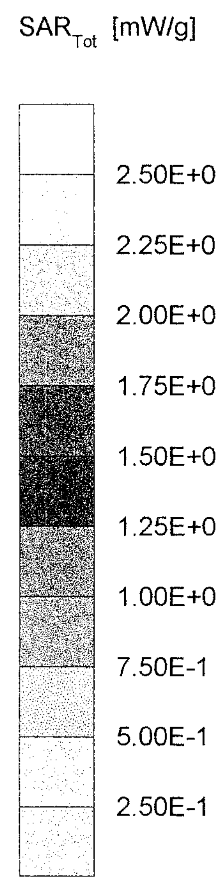


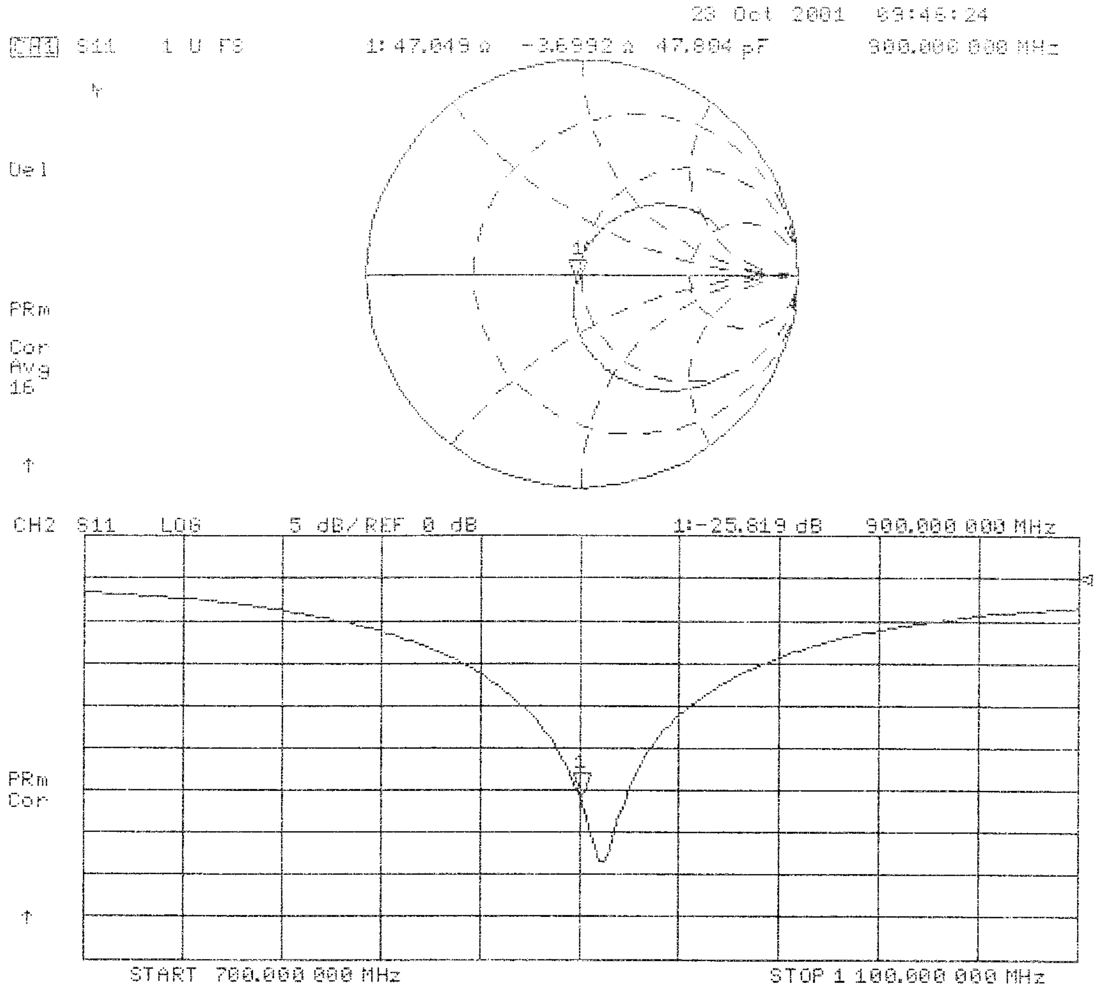

23 Oct 2001 11:28:08
CH1 S11 1 U FS 1: 50.498 Ω -1.7754 Ω 99.606 pF 900.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB 1:-34.669 dB 900.000 000 MHz
PRm
Cor
START 700.000 000 MHz
STOP 1 100.000 000 MHz

Validation Dipole D900V2 SN:033, 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(6.02,6.02,6.02) at 900 MHz; Muscle 900 MHz; σ = 1.04 mho/m ε_r = 55.4 ρ = 1.00 g/cm³
Cubes (2): Peak: 4.76 mW/g ± 0.02 dB, SAR (1g): 2.96 mW/g ± 0.02 dB, SAR (10g): 1.88 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 11.9 (10.5, 13.7) [mm]
Powerdrift: -0.01 dB







23 Oct 2001 09:46:24
CH1 S11 1 U FS 1: 47.049 Ω -3.6992 Ω 47.804 pF 900.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB 1:-25.819 dB 900.000 000 MHz
PRm
Cor
START 700.000 000 MHz
STOP 1 100.000 000 MHz

Schmid & Partner
Engineering AG

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

Calibration Certificate

1800 MHz System Validation Dipole

Type:	**D1800V2**
Serial Number:	**230**
Place of Calibration:	**Zurich**
Date of Calibration:	**October 25, 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: D1800V2

Serial: 230

Manufactured: February 26, 1998
Calibrated: October 25, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**40.7**	± 5%
Conductivity	**1.35 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.57 at 1800 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 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:	**37.4 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**19.7 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:	**1.213 ns**	(one direction)
Transmission factor:	**0.990**	(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 1800 MHz:	Re{Z} = **49.3 Ω**
	Im {Z} = **-6.2 Ω**
Return Loss at 1800 MHz	**-24.0dB**

4. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with muscle simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**53.5**	± 5%
Conductivity	**1.45 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.85 at 1800 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 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.

5. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 4. 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:	**40.8 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**21.4 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'.

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 1800 MHz:	Re{Z} = **44.7 Ω**
	Im {Z} = **-6.5Ω**
Return Loss at 1800 MHz	**-21.1 dB**

7. Handling

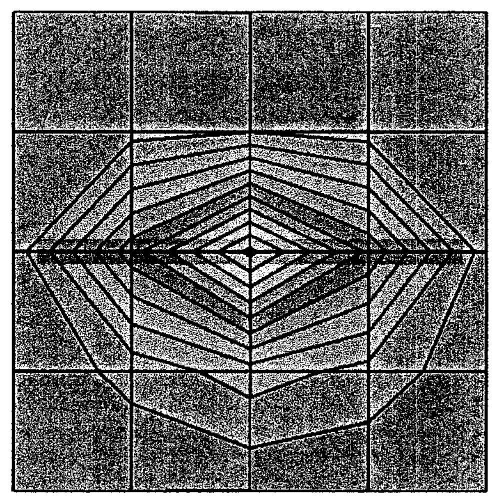
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

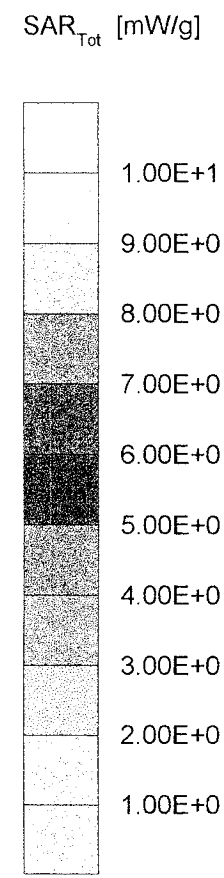
Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

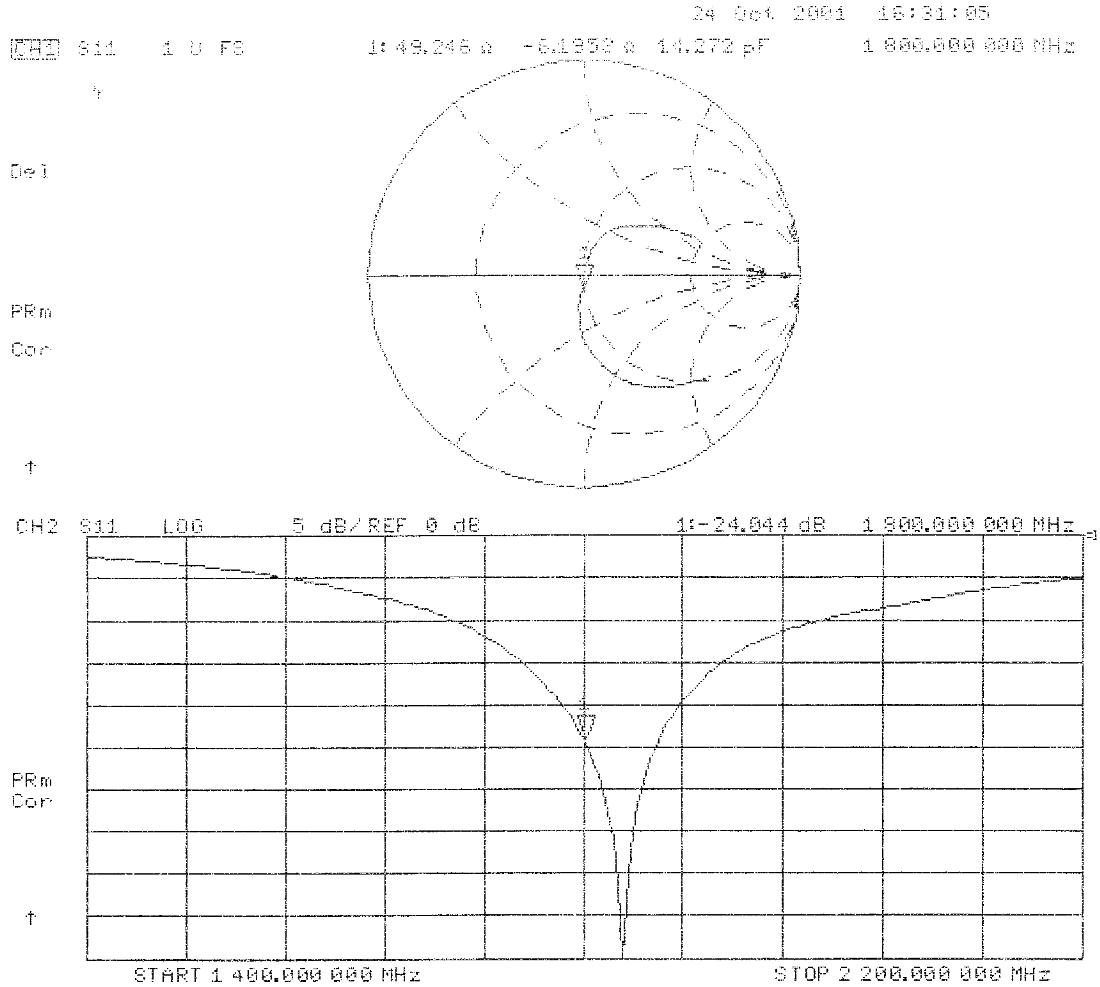
After prolonged use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 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(5.57,5.57,5.57) at 1800 MHz; IEEE1528 1800 MHz ; σ = 1.35 mho/m ε_r = 40.7 ρ = 1.00 g/cm^3
Cubes (2): Peak: 17.5 mW/g ± 0.02 dB, SAR (1g): 9.36 mW/g ± 0.01 dB, SAR (10g): 4.92 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.5 (7.9, 9.6) [mm]
Powerdrift: -0.03 dB



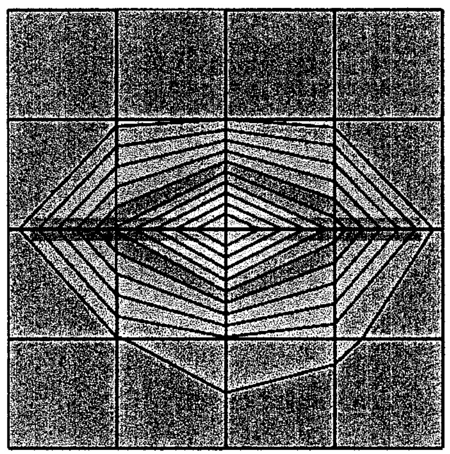


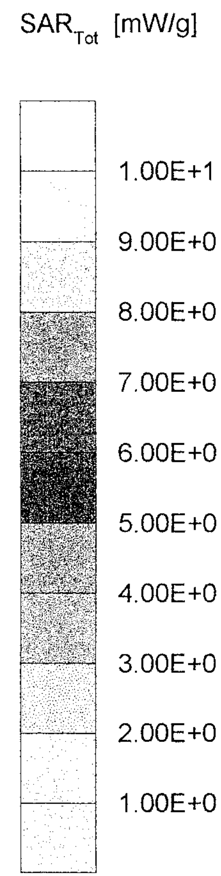


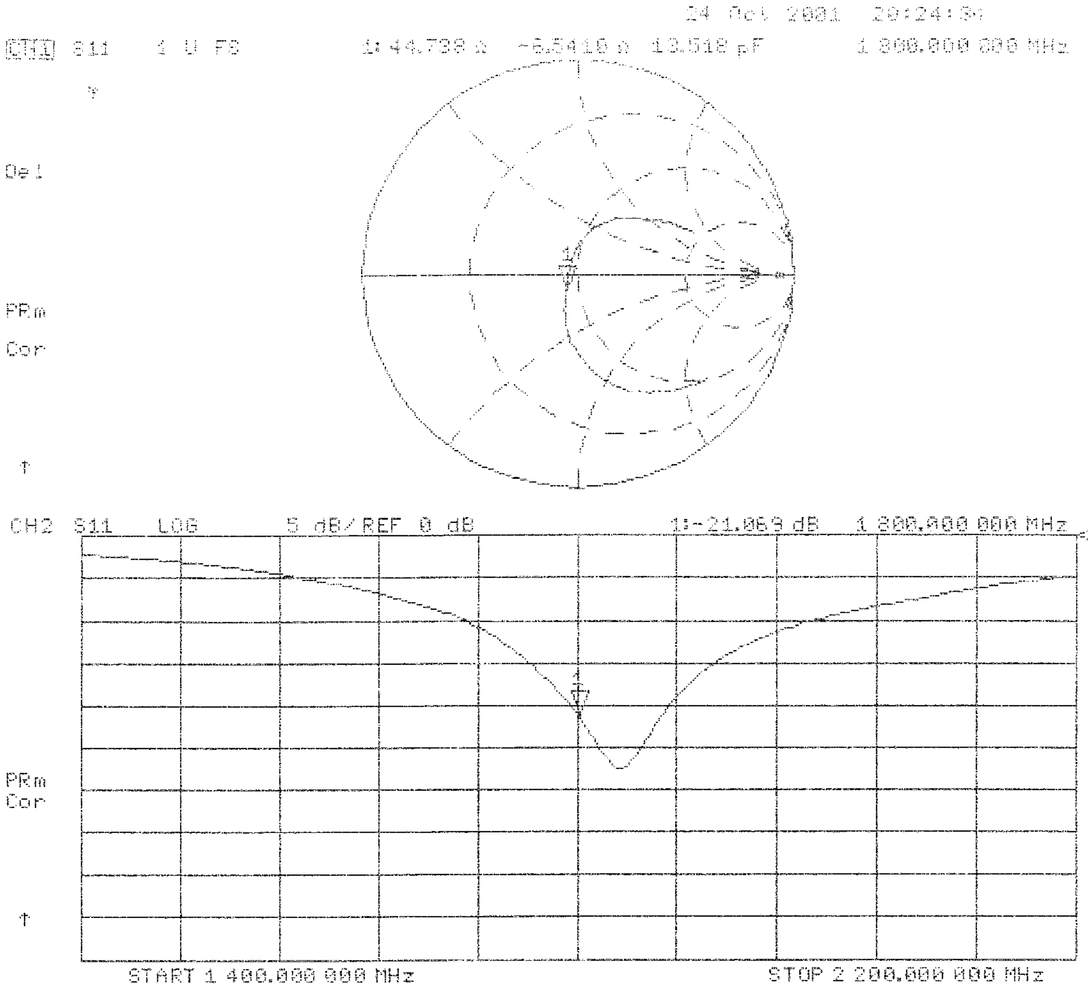
24 Oct 2001 16:31:05
CH1 S11 1 U FS
1: 49.246 Ω -6.1952 Ω 14.272 pF 1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG 5 dB/ REF 0 dB 1:-24.044 dB 1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 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(4.85,4.85,4.85) at 1800 MHz; Muscle 1800 MHz; σ = 1.45 mho/m ε_r = 53.5 ρ = 1.00 g/cm³
Cubes (2): Peak: 19.2 mW/g ± 0.01 dB, SAR (1g): 10.2 mW/g ± 0.02 dB, SAR (10g): 5.34 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.8 (7.9, 10.3) [mm]
Powerdrift: -0.03 dB





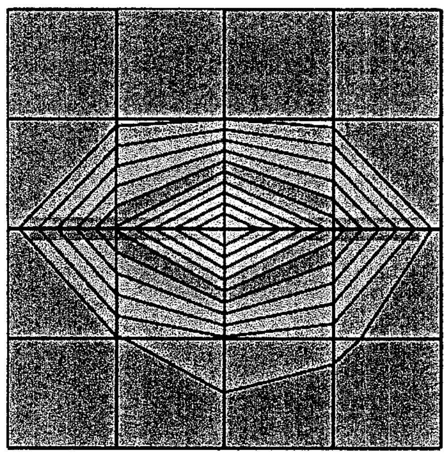


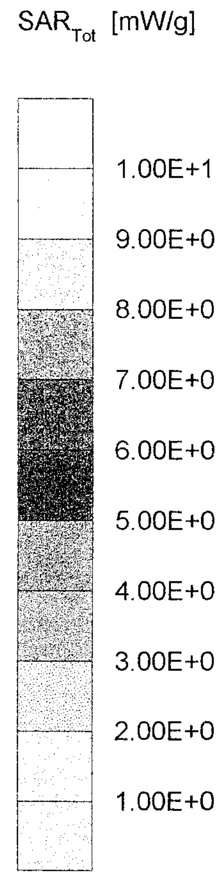
24 Oct 2001 20:24:30
CH1 S11 1 U FS
1: 44.738 Ω -6.5410 Ω 13.518 pF 1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG 5 dB/ REF 0 dB 1:-21.069 dB 1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz

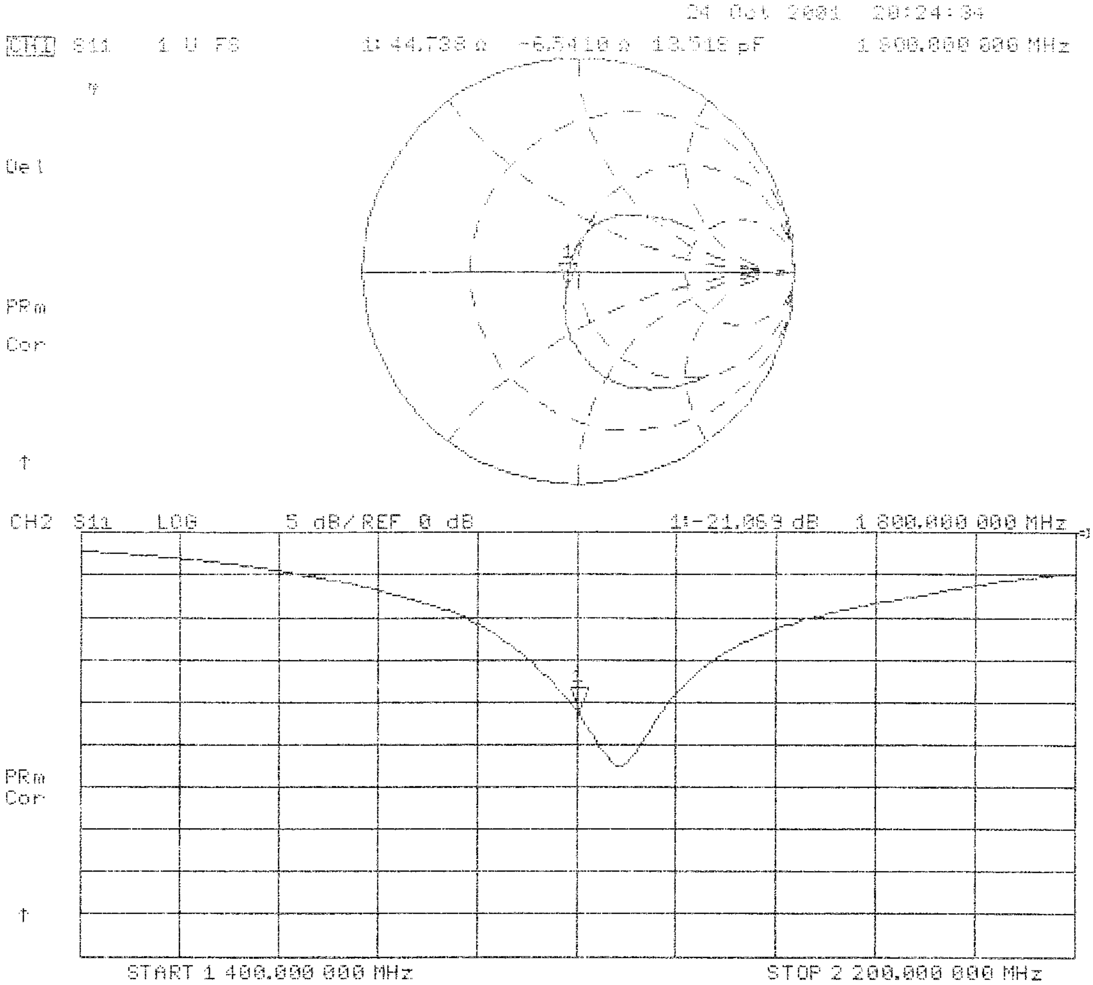
10/24/01

Validation Dipole D1800V2 SN:230, d = 10 mm

Frequency: 1800 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(4.85,4.85,4.85) at 1800 MHz; Muscle 1800 MHz; σ = 1.45 mho/m ε_r = 53.5 ρ = 1.00 g/cm³
Cubes (2): Peak: 19.2 mW/g ± 0.01 dB, SAR (1g): 10.2 mW/g ± 0.02 dB, SAR (10g): 5.34 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 8.8 (7.9, 10.3) [mm]
Powerdrift: -0.03 dB







24 Oct 2001 20:24:34
CH1 S11 1 U FS
1: 44.738 Ω -6.5410 Ω 13.516 pF
1 800.000 000 MHz
Del
PRm
Cor
CH2 S11 LOG 5 dB/ REF 0 dB
1: -21.069 dB 1 800.000 000 MHz
PRm
Cor
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz