TCC
Salo

T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	SAR0246_03.doc	Date of report:	2002-12-18
Number of pages:	63	Contact person:	Kevin Li
		Responsible test engineer:	Virpi Tuominen
Testing laboratory:	TCC Salo P.O. Box 86 Joensuunkatu 7E / Kiila 1B FIN-24101 SALO, FINLAND Tel. +358 (0) 7180 08000 Fax. +358 (0) 7180 45220	Client:	Nokia, INC 12278 Scripps Summit Dr. San Diego CA 92131, USA Tel. +1 858 831 5000 Fax. +1 858 831 6500

Tested devices: **QMNRH-17**
Battery: BL-5C, Headset: HDB-4

Supplement reports: -

Testing has been carried out in accordance with: FCC CFR. 47, Part 2.1093 and IEEE 1528-200X Draft CBD 1.0 Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques and FCC OET Bulletin 65, Supplement C, Edition 01-01.

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at TCC Salo.

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.

Date and signatures: 2002-12-18

For the contents:

Arto Hihnala	Virpi Tuominen
Engineering Manager, EMC	Senior Design Engineer, EMC

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1. SUMMARY FOR SAR TEST REPORT

Date of receipt	2002-11-11
Date of test	2002-11-11 to 2002-11-14
Contact person	Kevin Li
Test plan referred to	-
FCC ID	QMNRH-17
SN, HW, SW and DUT numbers	DUT: 06130 SN: 235/14062886 HW: 2001 SW: F100-02 W33-5.nbr PSN: 91132
Accessories	Battery: BL-5C DUT #'s: 06123, 06124, 06125, 06128, 06129
	Headset: HDB_4 DUT: 06131
Notes	-
Document code	SAR0246_03.doc
Responsible test engineer	Virpi Tuominen
Measurement performed by	Virpi Tuominen

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

Ch / *f* (MHz)	Mode of operation	Conducted Power	Position / Antenna Option	Limit	Measured	Result
991 / 824	AMPS	23.5 dBm	Right hand touch position / Antenna retracted	1.6 mW/g	1.22 mW/g	PASSED

1.1.2 Body Worn Configuration

Ch / *f* (MHz)	Mode of operation	Conducted Power	Accessory / Antenna Option	Limit	Measured	Result
383 / 836	CDMA	24.7 dBm	HDB-4 / Antenna retracted	1.6 mW/g	0.98 mW/g	PASSED

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1.1.3 Measurement Uncertainty

Combined Standard Uncertainty	± **12.3%**
Expanded Standard Uncertainty (k=2)	± **24.7%**

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2. DESCRIPTION OF THE TESTED DEVICE(S)

2.1 Device description

FCC ID Number	QMNRH-17	
Device category	Portable Device	
RF Exposure Limits	General population / Uncontrolled	
Unit type	Prototype unit	
Case type	Fixed case	
Modes of Operation	AMPS 800	CDMA 800
Modulation Mode	FM	QPSK
Duty Cycle	1	1
Maximum Device Rating	Power Class III	Power Class III
Transmitter Frequency Range (MHz)	824.04 - 848.97	824.70 – 848.31

Acronyms: QPSK = Quadrature Phase Shift Keying
FM = Frequency Modulation

2.2 Picture of Phone

Fig. 2.2.1
QMNRH-17 antenna retracted.

Fig. 2.2.2
QMNRH-17 antenna extended.

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2.3 Description of the Antenna

Type	Rectractable whip antenna with PIFA
Location	PIFA: inside the back cover at the top of the device. Rectractable whip: back of phone, right hand side.

2.4 Battery Options

There is only one battery available for the tested device, a rechargeable Li-ion battery, type BL-5C.

2.5 Accessories

Headset HDB-4 was used for the measurements.

2.6 Body Worn Accessories

The body worn measurements were made with 15 mm minimum separation distance .

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3. DESCRIPTION OF THE TEST EQUIPMENT

3.1 Automated near-field scanning system

The measurements were performed with an automated near-field scanning system, DASY3 manufactured by Schmidt & Partner Engineering AG (SPEAG) in Switzerland.

Schmidt & Partner Engineering AG (SPEAG)
Zeughausstrasse 43
8004 Zurich, Schwitzerland

Tel. +41 1 245 97 00
Fax. +41 1 245 97 79
www.speag.com

3.2 Robot

Fig. 3.2.1. Robot RX90L.

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

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3.3 Isotropic E-field probe ET3DV6R

Serial number	1395
Frequency	10 MHz to 3 GHz
Linearity	± 0.2 dB
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 >100 mW/g
Dimensions	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
Calibration	2002-08-27 (see Appendix C)
Due date	Aug-03

In Figure 3.2.1 the E-field probe is connected to the robot arm.

3.4 Device holder

Fig. 3.4.1. Device holder

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

3.5 Dipole antennas for validation

The 900 MHz dipole antenna is matched for use near flat phantoms filled with head/body simulation solutions. The dipole is equipped with 15 mm distance holders.

Antenna	Type	Serial number	Calibration	Due date
900 MHz dipole	D900V2	056	2002-01-29	Jan -04

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3.6 Phantom

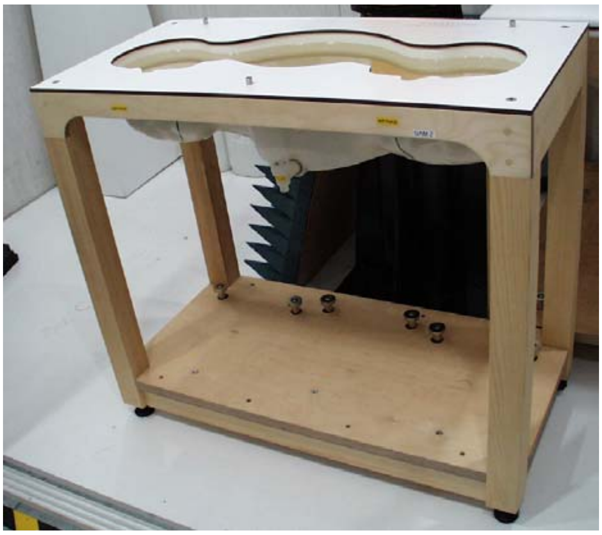

Fig. 3.6.1. SAM-phantom.

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
Liquid depth	15 ± 0.5 cm

3.7 Base Station Simulaltor

The QMNRH-17 cellular phone was put into operation using a Rhode & Schwarz digital radio tester, CMU 200. Communication between the phone and the tester was established by air link. The tests were performed with two CMU-testers, the first one had CDMA-option and the second one had both the CDMA- and AMPS-options.

Test Equipment	Digital radiocommunication Tester with CDMA-option	Digital radiocommunication Tester with CDMA- and AMPS-options.
Model	CMU 200	CMU 200
Serial number	841044/010	837728/022
Calibration	2002-03-07	2002-07-29
Due date	Mar-03	Jul-03

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3.8 Additional equipment needed in system check

Test Equipment	Model	Serial Number	Calibration	Due Date
Signal Generator	HP 8642B	2513A00178	Jan-02	Jan-03
Amplifier	Minicircuit ZHL-42	N072095-5	-	N/A
Power Meter	R&S NRVS	838624/032	Jul-02	Jul-04
Power Meter	R&S NRVS	849305/028	Jul-02	Jul-04
Power Sensor	R&S NRV-Z32	825600/004	Jul-02	Jul-04
Power Sensor	R&S NRV-Z32	839176/020	Jul/2002	Jul-04
Thermometer	Lambrecht		Nov-02	Nov-03
Vector Network Analyzer	HP8753E	US38432928	Oct-02	Oct-03
Dielectric Probe Kit	HP85070B	US33020420	-	-

3.9 RF characteristics of the test site

Tests were performed in RF shielded environment.

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4. TEST CONDITIONS

4.1 Ambient Conditions

Date	2002-11-11	2002-11-12	2002-11-13	2002-11-14
Ambient temperature (°C)	21.5	21.5	21.0	20.5
Humidity (% RH)	35	30	27	25
Tissue simulating liquid temperature (°C)	21.0-21.3	20.5-21.3	19.0-20.6	20.0-20.8

4.2 System Performance Check

The manufacturer calibrates the probes annually. Dielectric parameters of the simulating liquids are measured using a dielectric probe kit HP85070B and a vector network analyzer HP8753E.

The SAR measurements of the DUT were done within 24 hours of liquid parameter measurements and system performance check.

The dipole antenna is matched to be used near flat section of the phantom filled with tissue simulating solution. Length of 900 MHz dipole is 149 mm with overall height of 330 mm. A specific distance holder is used in the positioning of relevant antenna to ensure correct spacing between the phantom and the dipole. Manufacturer's reference dipole data (=calibration data) is presented in Appendix C.

Power level of 250 mW was supplied to a dipole antenna placed under the flat section of SAM phantom. The results are in the table below and printouts of the tests are presented in Appendix A. The references are the calibration results of the dipole antenna. The reference results of the liquid parameters are those used by Speag during dipole calibrations. The requirements for SAR values are calculated from the reference results (reference ± 10%).

Tissue	*f* (MHz)	Measuring date	SAR (W/kg), 1g	Dielectric Parameters	
				ε_r	σ (S/m)
Head	900	Requirement	2.50 – 3.05	39.0 – 43.2	0.90 – 1.00
		Reference Result	2.78	41.1	0.95
		2002-11-11	2.99	40.3	0.96
		2002-11-12	3.00	40.7	0.97
Muscle	900	Requirement	2.63 – 3.21	52.1 – 57.5	0.95 – 1.05
		Reference Result	2.92	54.8	1.00
		2002-11-13	2.93	57.1	1.01
		2002-11-14.	2.96	56.8	1.00

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4.3 Tissue Simulants

4.3.1 Measured values of liquid parameters

The tissue simulating liquids are measured by using a HP 85070B dielectric probe kit. The measured dielectric parameters are compared to the recommended values for 835 MHz given in OET Bulletin 65 (97-01) Supplement C (01-01).

Tissue	Reference		Measuring date	Low ch		Mid ch		High ch	
	ε_r	σ		ε_r	σ	ε_r	σ	ε_r	σ
HEAD	39.4 - 43.6	0.86 - 0.95	2002-11-11	41.2	0.89	41.1	0.90	40.9	0.91
			2002-11-12	41.5	0.90	41.3	0.91	41.2	0.92
BODY	52.4 – 58.0	0.92 – 1.02	2002-11-13	57.6	0.93	57.6	0.95	57.5	0.96
			2002-11-14	57.3	0.93	57.2	0.94	57.1	0.95

4.3.2 Recipes of tissue simulating liquids

Tissue simulating liquids on 835 MHz

Ingredient	Head (% by weight)	Body (% by weight)
Sugar	58.31	41.76
De-Ionized Water	39.74	55.97
Salt	1.55	0.79
HEC	0.25	1.21
Bactericide	0.15	0.27

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5. DEVICE POSITIONING

5.1 Positioning procedures

The cellular phone was measured in 2 positions on both "left hand" and "right hand" side of the phantom with the antenna in both extended and retracted positions. Furthermore, the cellular phone was measured under the flat section of the phantom antenna side towards the phantom and antenna extended and retracted. A headset was connected to the phone during the body SAR measurements.

5.1.1 Cheek/Touch Position

1) The phone was positioned with the vertical centerline of the body of the phone and the horizontal line crossing the center of the earpiece in a plane parallel to the sagittal plane of the phantom ("initial position"). While maintaining the phone in this plane, the vertical centerline was aligned with the reference plane containing the three ear and mouth reference points (RE, LE and M) and the center of the earpiece 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 any point of the phone was in contact with a phantom point below the ear.

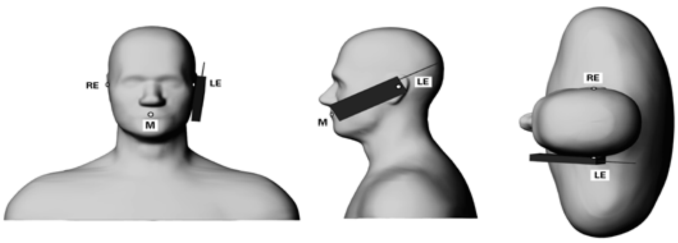

Fig. 5.1.1. Cheek/Touch position

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.

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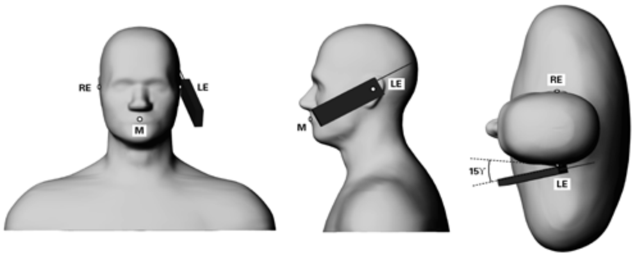

Fig. 5.1.2. Ear/Tilt Position.

5.1.3 Photos of setup

Fig. 5.1.3.1. QMNRH-17 in touch position.

Fig. 5.1.3.2. QMNRH-17 in tilted position.

5.1.4 Body Worn Configuration

The phone was postioned into the holder and placed below the flat section of the phantom. The measurements were made to show compliance with 15 mm minimum separation distance. Measurements were performed with the antenna side towards the phantom.

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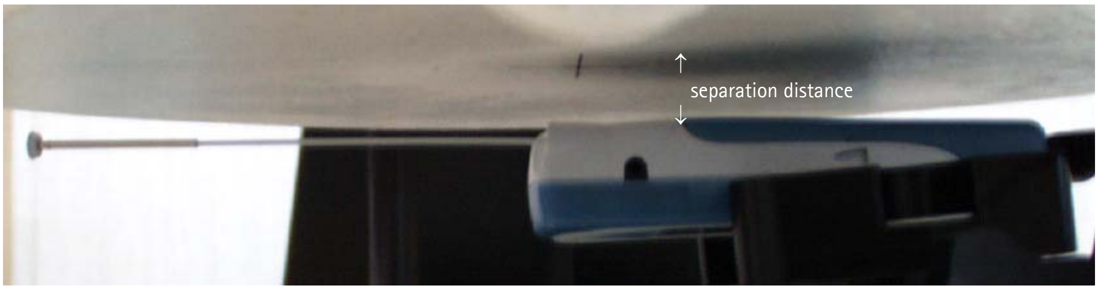

5.2 Scan Procedures

First coarse scan is used for quick determination of the field distribution. Next a cube scan, 5x5x7 points; spacing between each point 8x8x5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

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 123].

The extrapolation is based on least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 30 mm 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	Probability distribution	Weight	Standard Deviation
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	rectangular	1	± 2.7%
Calibration error	± 3.3 dB	normal	1	± 3.3%
Total Probe Uncertainty				**± 6.87%**
Data acquisition error	± 1%	rectangular	1	± 0.6%
ELF and RF disturbances	± 0.25%	normal	1	± 0.25%
Conductivity assessment	± 2.4%	rectangular	1	± 5.8%
Total SAR Evaluation Uncertainty				**± 5.84%**
Extrapolation + boundary effect	± 3%	normal	1	± 3%
Probe positioning error	± 0.1mm	normal	1	± 1%
Integration and cube orientation	± 3%	normal	**1**	± 3%
Cube shape inaccuracies	± 2%	rectangular	1	± 1.2%
Total Spatial Peak SAR Evaluation Uncertainty				**± 4.52%**
Total Measurement Uncertainty				**± 10.09%**
Device positioning	± 6%	normal	1	± 6%
Phantom dimensions	± 4%	rectangular	1	± 2.3%
Laboratory set up	± 3%	normal	**1**	± 3%
Total Source Uncertainty				**± 7.09%**
Combined Uncertainty				**± 12.33%**
Expanded Uncertainty (k=2) 95.5%				**± 24.66%**

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7. RESULTS

The SAR results shown in the tables are maximum SAR values averaged over 1g of tissue. The results indicated as bold numbers in the tables are included in the appendix B as SAR distribution plots.

7.1 Head Configuration

Position	AMPS 800			
	Channel	Low	Mid	High
	Channel #	991	383	799
	Conducted power (dBm)	23.5	24.7	24.4
Touch, left hand	Antenna retracted	1.11	1.03	**1.15**
	Antenna extended	**1.18**	1.03	0.921
Tilt, left hand	Antenna retracted	0.731	0.662	**0.793**
	Antenna extended	0.656	0.647	**0.713**
Touch, right hand	Antenna retracted	**1.22**	1.08	1.21
	Antenna extended	**1.18**	1.10	0.964
Tilt, right hand	Antenna retracted	0.734	0.659	**0.790**
	Antenna extended	0.659	0.602	**0.680**

Position	CDMA 800			
	Channel	Low	Mid	High
	Channel #	1013	383	777
	Conducted power (dBm)	23.6	24.7	24.4
Touch, left hand	Antenna retracted	**1.12**	1.00	1.07
	Antenna extended	**1.20**	1.06	0.886
Tilt, left hand	Antenna retracted	0.708	0.654	**0.779**
	Antenna extended	0.652	0.647	**0.684**
Touch, right hand	Antenna retracted	1.13	1.06	**1.17**
	Antenna extended	**1.12**	1.06	0.907
Tilt, right hand	Antenna retracted	0.739	0.644	**0.768**
	Antenna extended	**0.687**	0.603	0.666

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7.2 Body configuration

Body SAR measurements were performed with the headset HDB-4 connected. Antenna side of the phone was towards the phantom in order to achieve the highest SAR values. The maximum results with 15 mm minimum separation distance are listed in the tables below.

Accessory	AMPS 800			
	Channel	Low	Mid	High
	Channel #	991	383	799
	Conducted power (dBm)	23.5	24.7	24.4
Headset HDB-4	Antenna retracted	0.772	**0.971**	0.895
	Antenna extended	0.635	**0.681**	0.672

Accessory	CDMA 800			
	Channel	Low	Mid	High
	Channel #	1013	383	777
	Conducted power (dBm)	23.6	24.7	24.4
Headset HDB-4	Antenna retracted	0.569	**0.975**	0.891
	Antenna extended	0.623	**0.798**	0.657

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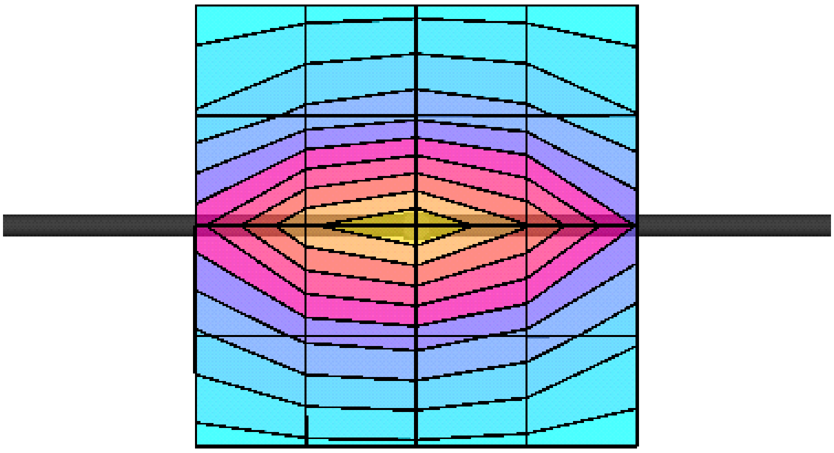
APPENDIX A.

Validation Test Printouts

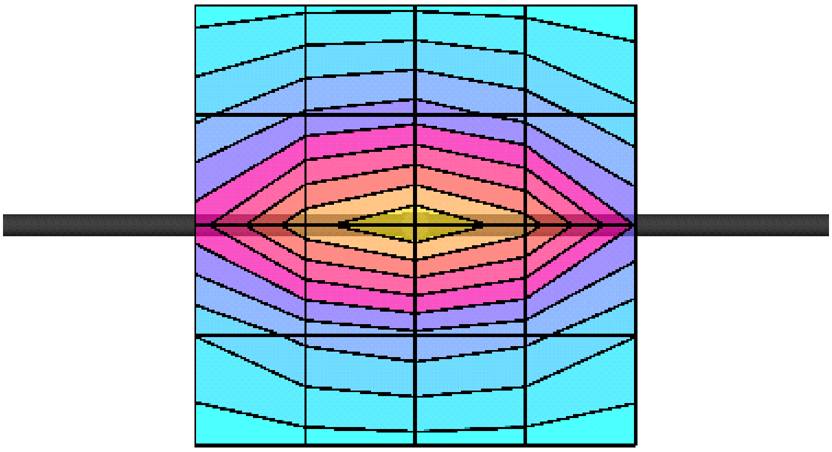
Dipole 900 MHz

2002-11-11
SAM 1; Flat
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 900 MHz: σ = 0.96 mho/m ε_r = 40.3 ρ = 1.00 g/cm^3; t=21.0°C;
Cubes (2): Peak: 4.81 mW/g ± 0.01 dB, SAR (1g): 2.99 mW/g ± 0.00 dB, SAR (10g): 1.89 mW/g ± 0.03 dB;
Penetration depth: 11.6 (10.6, 13.1) [mm]
Powerdrift: -0.12 dB



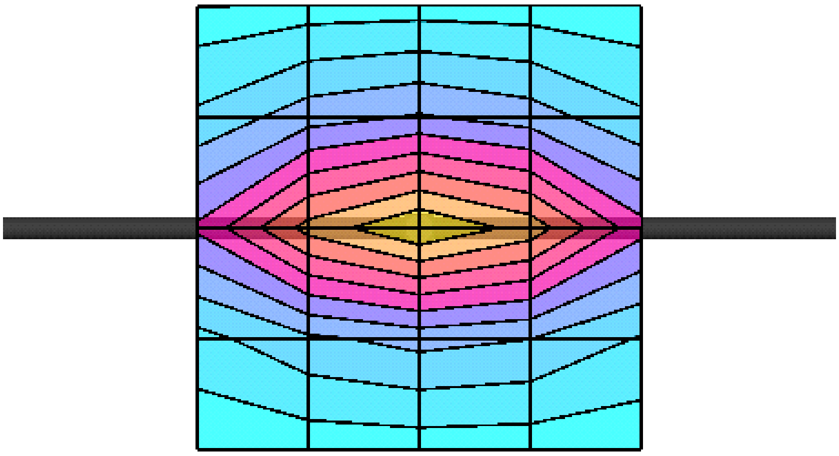
Dipole 900 MHz

2002-11-12
SAM 1; Flat
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 900 MHz: σ = 0.97 mho/m ε_r = 40.7 ρ = 1.00 g/cm^3; t=21.3°C;
Cubes (2): Peak: 4.81 mW/g ± 0.08 dB, SAR (1g): 3.00 mW/g ± 0.07 dB, SAR (10g): 1.90 mW/g ± 0.05 dB;
Penetration depth: 11.5 (10.4, 13.0) [mm]
Powerdrift: -0.12 dB



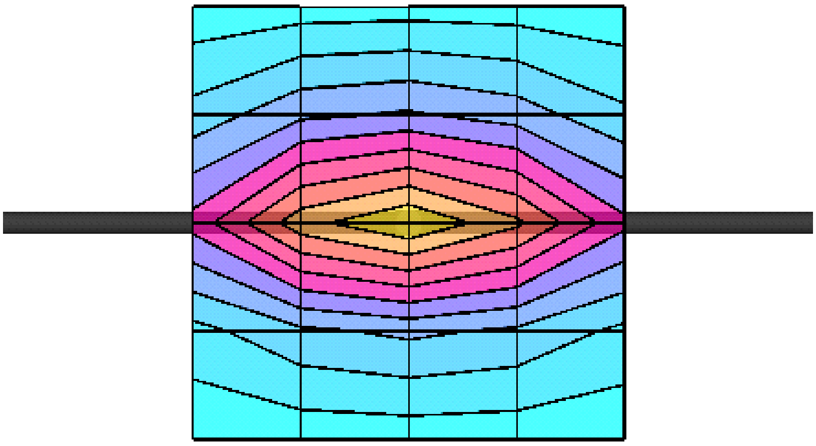
Dipole 900 MHz

2002-11-13
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body900 MHz: σ = 1.01 mho/m ε_r = 57.1 ρ = 1.00 g/cm^3; t=20.6°C;
Cubes (2): Peak: 4.68 mW/g ± 0.17 dB, SAR (1g): 2.93 mW/g ± 0.11 dB, SAR (10g): 1.87 mW/g ± 0.05 dB,
Penetration depth: 12.2 (10.6, 14.2) [mm]
Powerdrift: -0.04 dB



Dipole 900 MHz

2002-11-14
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body900 MHz: σ = 1.00 mho/m ε_r = 56.8 ρ = 1.00 g/cm^3; t=20.4°C
Cubes (2): Peak: 4.69 mW/g ± 0.05 dB, SAR (1g): 2.96 mW/g ± 0.04 dB, SAR (10g): 1.89 mW/g ± 0.04 dB,
Penetration depth: 12.4 (11.1, 14.2) [mm]
Powerdrift: -0.04 dB

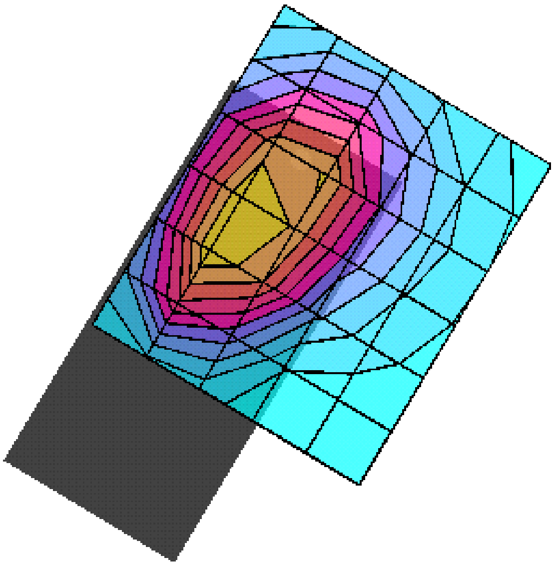


APPENDIX B.

SAR Distribution Printouts

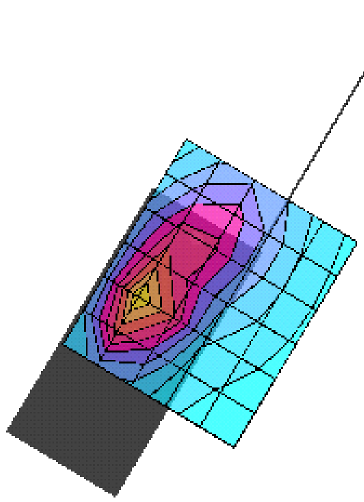
GMLRH-17, antenna retracted, left cheek, AMPS

2002-11-11
SAM 1 Phantom; Left Hand Section; Cheek Position; Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 849 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3; t=21.0°C
Cube 5x5x7: SAR (1g): 1.15 mW/g, SAR (10g): 0.772 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.09 dB



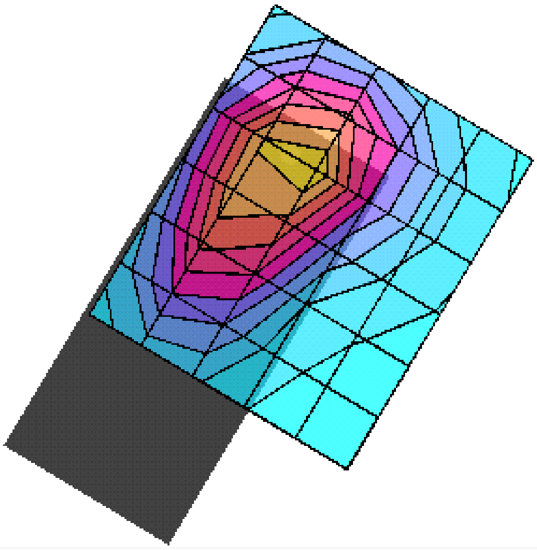
GMLRH-17, antenna extended, left cheek, AMPS

2002-11-11
SAM 1 Phantom; Left Hand Section; Cheek Position:; Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 824 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.0°C
Cube 5x5x7: SAR (1g): 1.18 mW/g, SAR (10g): 0.695 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.22 dB



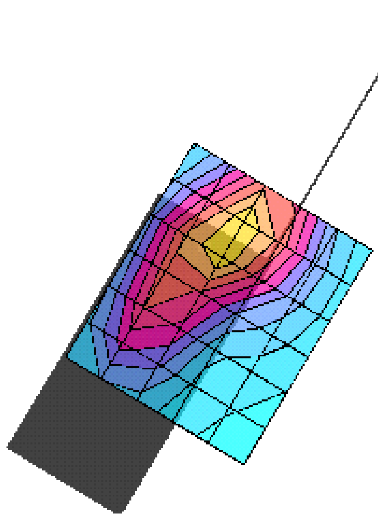
GMLRH-17, antenna retracted, left tilt, AMPS

2002-11-12
SAM 1 Phantom; Left Hand Section; Tilt Position; Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 849 MHz: $\sigma = 0.92$ mho/m $\varepsilon_r = 41.2$ $\rho = 1.00$ g/cm^3; t=21.3°C
Cube 5x5x7: SAR (1g): 0.793 mW/g, SAR (10g): 0.509 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.13 dB



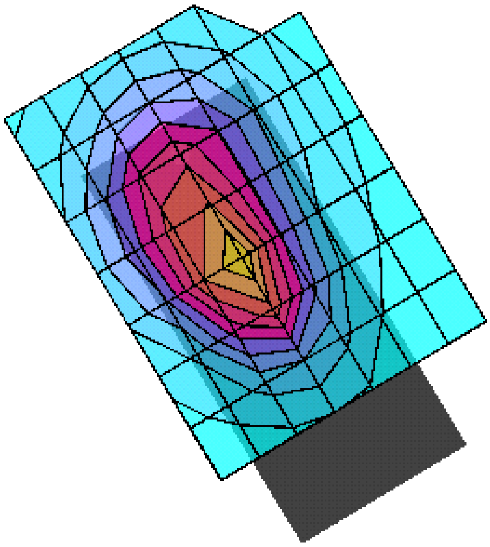
GMLRH-17, antenna extended, left tilt, AMPS

2002-11-12
SAM 1 Phantom; Left Hand Section;Tilt Position; Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 849 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t= 21.3°C
Cube 5x5x7: SAR (1g): 0.713 mW/g, SAR (10g): 0.447 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.11 dB



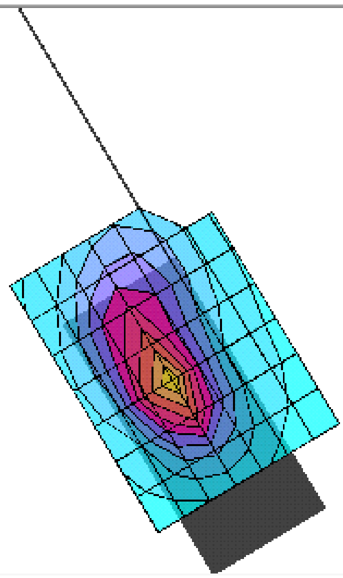
GMLRH-17, antenna retracted, right cheek, AMPS

2002-11-11
SAM 1 Phantom; Righ Hand Section;Cheek Position; Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 824 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.1°C
Cube 5x5x7: SAR (1g): 1.22 mW/g, SAR (10g): 0.747 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.23 dB



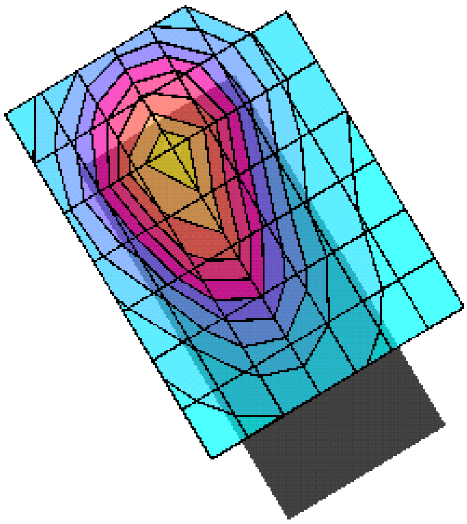
GMLRH-17, antenna extended, right cheek, AMPS

2002-11-11
SAM 1 Phantom; Righ Hand Section; Cheek Position; Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 824 MHz: σ = 0.89 mho/m ϵ_r = 41.2 ρ = 1.00 g/cm^3; t=21.1°C
Cube 5x5x7: SAR (1g): 1.19 mW/g, SAR (10g): 0.699 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.17 dB



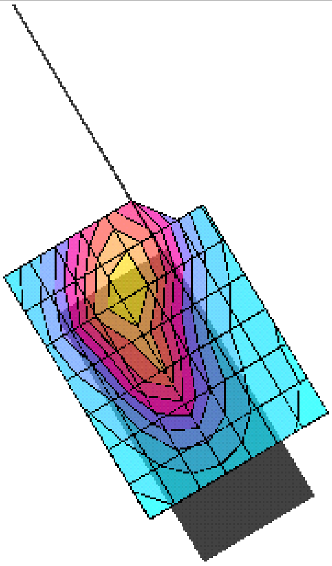
GMLRH-17, antenna retracted, right tilt, AMPS

2002-11-12
SAM 1 Phantom; Righ Hand Section; Tilt Position; Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 849 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.2°C
Cube 5x5x7: SAR (1g): 0.790 mW/g, SAR (10g): 0.514 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.11 dB



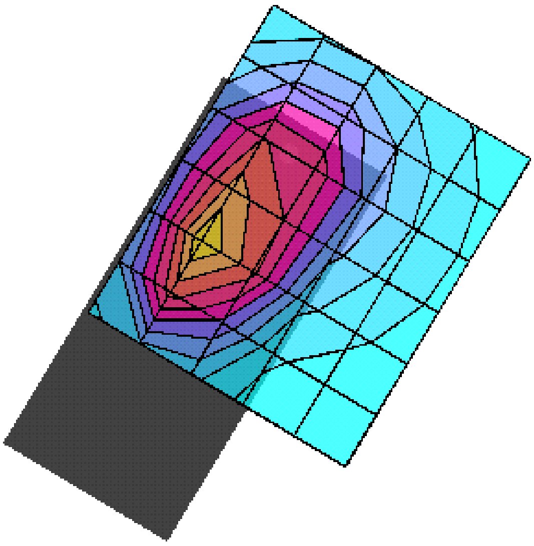
GMLRH-17, antenna extended, right tilt, AMPS

2002-11-12
SAM 1 Phantom; Righ Hand Section;Tilt Position; Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 849 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.2°C
Cube 5x5x7: SAR (1g): 0.680 mW/g, SAR (10g): 0.429 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.11 dB



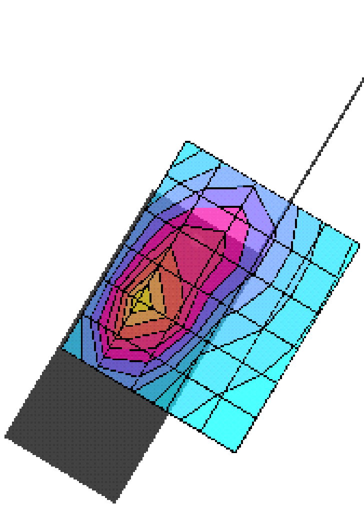
GMLRH-17, antenna retracted, left cheek, CDMA

2002-11-11
SAM 1 Phantom; Left Hand Section;Cheek Position; Frequency: 825 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 825 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.2°C
Cube 5x5x7: SAR (1g): 1.12 mW/g, SAR (10g): 0.697 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.23 dB



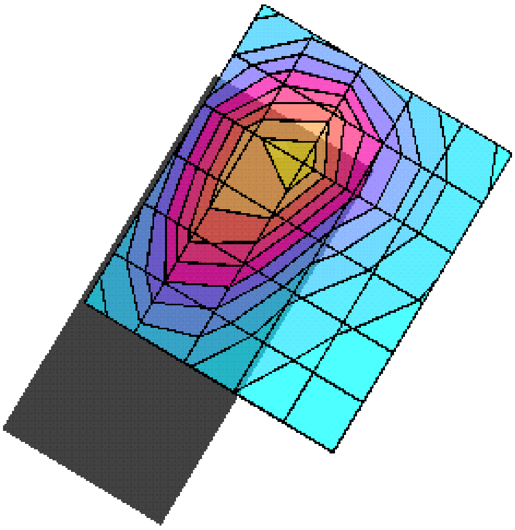
GMLRH-17, antenna extended, left cheek, CDMA

2002-11-11
SAM 1 Phantom; Left Hand Section; Cheek Position; Frequency: 825 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 825 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.2°C
Cube 5x5x7: SAR (1g): 1.20 mW/g, SAR (10g): 0.698 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.04 dB



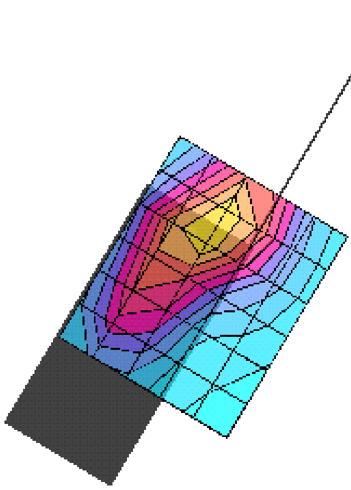
GMLRH-17, antenna retracted, left tilt, CDMA

2002-11-12
SAM 1 Phantom; Left Hand Section;Tilt Position; Frequency:848 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 848 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=20.7°C
Cube 5x5x7: SAR (1g): 0.779 mW/g, SAR (10g): 0.498 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.17 dB



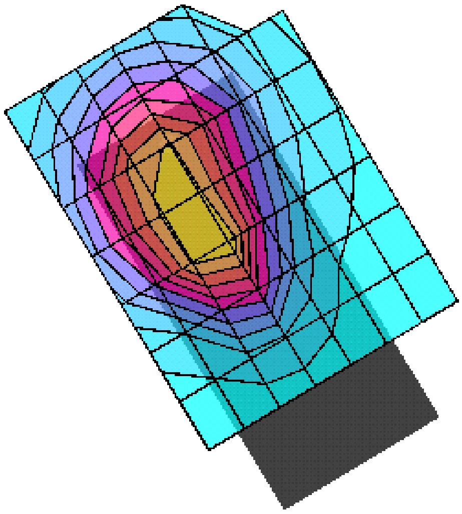
GMLRH-17, antenna extended, left tilt, CDMA

2002-11-12
SAM 1 Phantom; Left Hand Section;Tilt Position; Frequency: 848 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 848 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=20.6°C
Cube 5x5x7: SAR (1g): 0.684 mW/g, SAR (10g): 0.431 mW/g,
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.07 dB



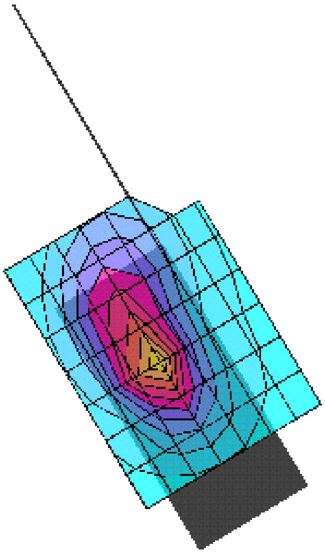
GMLRH-17, antenna retracted, right cheek, CDMA

2002-11-11
SAM 1 Phantom; Righ Hand Section;Cheek Position; Frequency: 848 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 848 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3; t=21.3°C
Cube 5x5x7: SAR (1g): 1.17 mW/g, SAR (10g): 0.761 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.06 dB



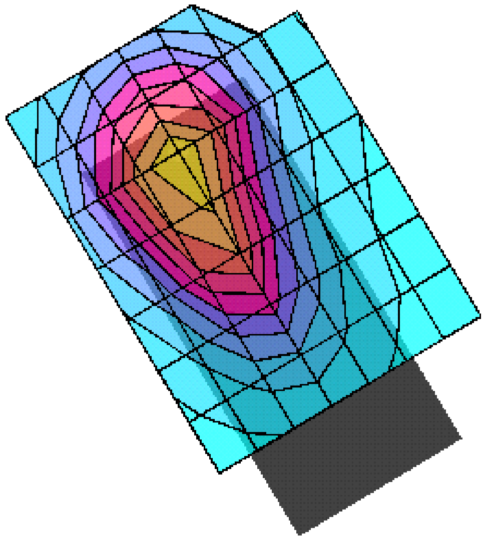
GMLRH-17, antenna extended, right cheek, CDMA

2002-11-11
SAM 1 Phantom; Righ Hand Section;Cheek Position; Frequency: 825 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 825 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.0°C
Cube 5x5x7: SAR (1g): 1.12 mW/g, SAR (10g): 0.655 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.15 dB



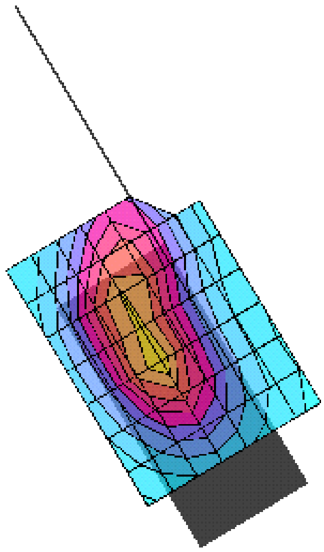
GMLRH-17, antenna retracted, left tilt, CDMA

2002-11-12
SAM 1 Phantom; Righ Hand Section; Tilt Position; Frequency: 848 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 848 MHz: σ = 0.92 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=20.6°C
Cube 5x5x7: SAR (1g): 0.768 mW/g, SAR (10g): 0.511 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: -0.02 dB



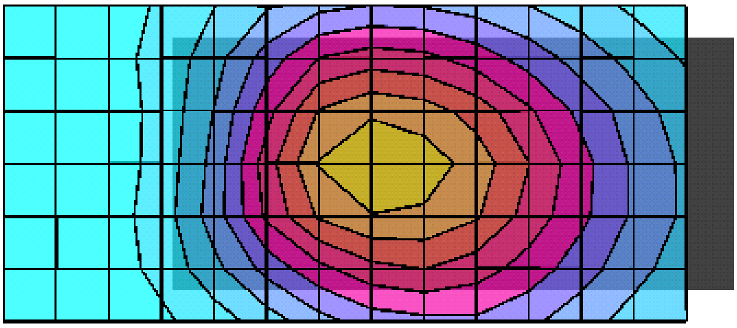
GMLRH-17, antenna extended, right tilt, CDMA

2002-11-12
SAM 1 Phantom; Righ Hand Section;Cheek Position: (90°,301°); Frequency: 825 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 825 MHz: σ = 0.90 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3; t=21.3°C
Cube 5x5x7: SAR (1g): 0.687 mW/g, SAR (10g): 0.451 mW/g,
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: 0.08 dB



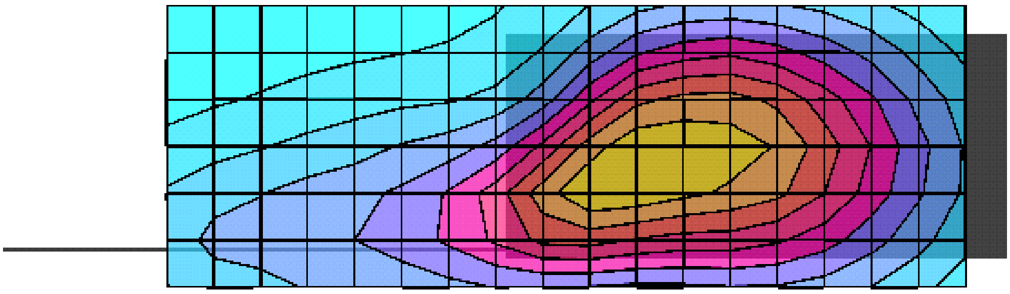
GMLRH-17 with HDB-4, antenna retracted, body, AMPS

2002-11-14
SAM 2 Phantom; Flat Section;Body Position: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body 836MHz: σ = 0.94 mho/m ε_r = 57.2 ρ = 1.00 g/cm^3, t=20.8°C
Cube 5x5x7: SAR (1g): 0.971 mW/g, SAR (10g): 0.695 mW/g,
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: 0.06 dB



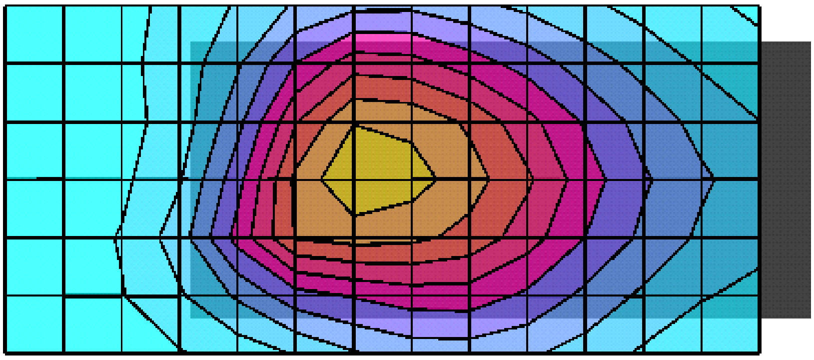
GMLRH-17 with HDB-4, antenna extended, body, AMPS

2002-11-14
SAM 2 Phantom; Flat Section;Body Position; Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body 836MHz: σ = 0.94 mho/m ε_r = 57.2 ρ = 1.00 g/cm^3; t=20.1°C
Cube 5x5x7: SAR (1g): 0.681 mW/g, SAR (10g): 0.471 mW/g,
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.36 dB



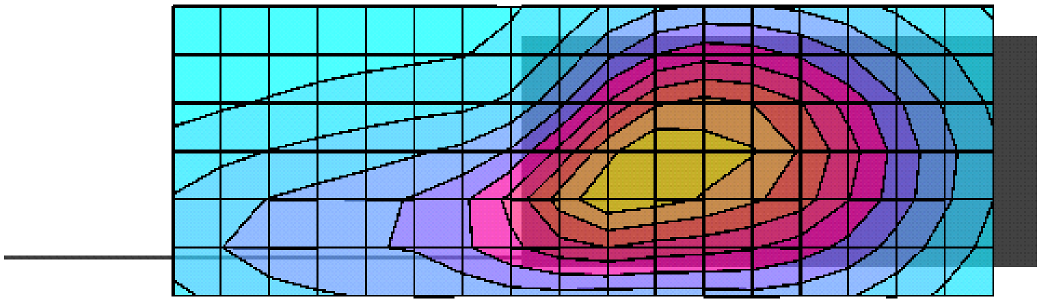
GMLRH-17 with HDB-4, antenna retracted, body CDMA

2002-11-14
SAM 2 Phantom; Flat Section;Body Position; Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body 836MHz: σ = 0.94 mho/m ϵ_r = 57.2 ρ = 1.00 g/cm^3; t=20.8°C
Cube 5x5x7: SAR (1g): 0.975 mW/g, SAR (10g): 0.667 mW/g,
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: 0.04 dB



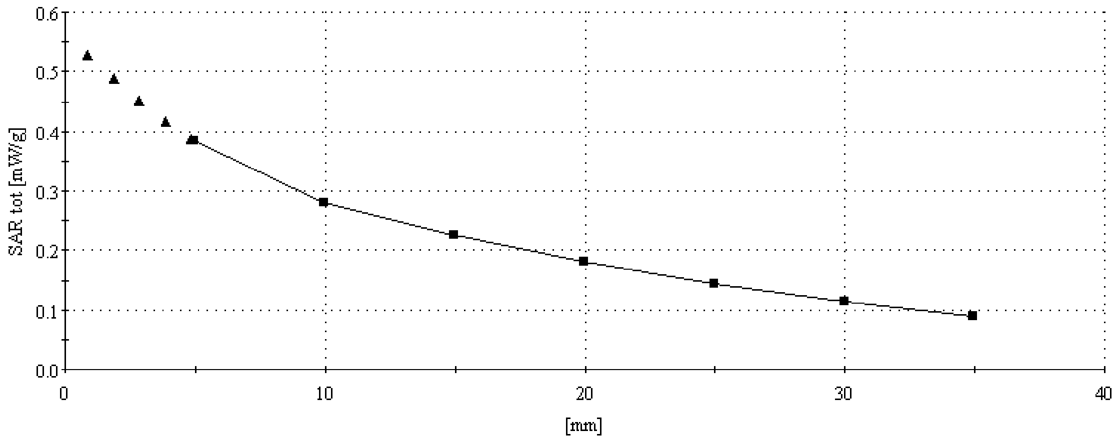
GMLRH-17 with HDB-4, antenna extended, body, CDMA

2002-11-14
SAM 2 Phantom; Flat Section;Body Position; Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body 836MHz: σ = 0.94 mho/m ε_r = 57.2 ρ = 1.00 g/cm^3; t=20.0°C
Cube 5x5x7: SAR (1g): 0.798 mW/g, SAR (10g): 0.556 mW/g,
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.03 dB



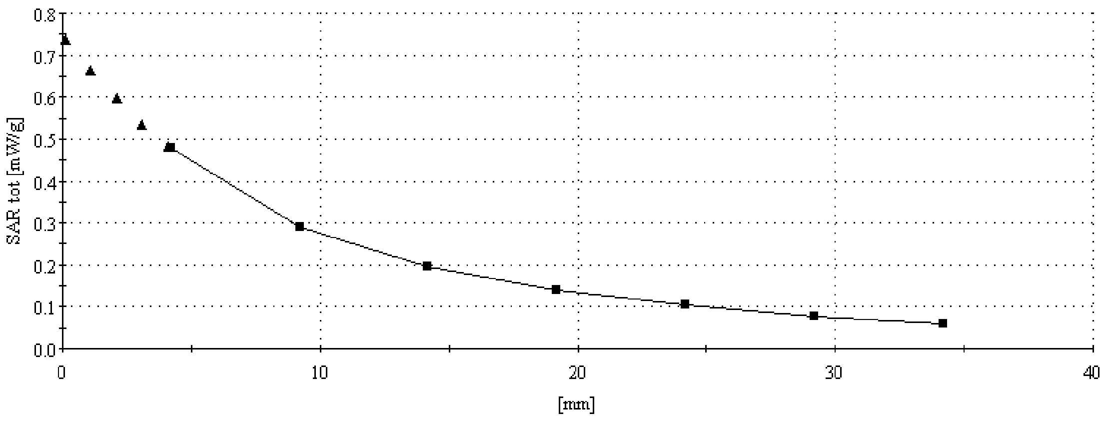
GMLRH-17, antenna retracted, right cheek, AMPS

2002-11-11
SAM 1 Phantom; Righ Hand Section;Cheek Position; Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0;
Brain 824 MHz: σ = 0.89 mho/m ε_r = 41.2 ρ = 1.00 g/cm^3; t=21.1°C
Cube 5x5x7: SAR (1g): 1.22 mW/g, SAR (10g): 0.747 mW/g,



GMLRH-17 with HDB-4, antenna retracted, body, CDMA

2002-11-14
SAM 2 Phantom; Flat Section;Body Position; Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0;
Body 836MHz: σ = 0.94 mho/m ε_r = 57.2 ρ = 1.00 g/cm^3; t=20.8°C
Cube 5x5x7: SAR (1g): 0.975 mW/g, SAR (10g): 0.667 mW/g,
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0



APPENDIX 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:	ET3DV6
Serial Number:	1395
Place of Calibration:	Zurich
Date of Calibration:	August 27, 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:	[signature]

Schmid & Partner
Engineering AG

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

Probe ET3DV6

SN:1395

Manufactured:	October 1, 1999
Last calibration:	July 25, 2001
Recalibrated:	August 27, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1395

Sensitivity in Free Space

NormX	1.69	$\mu V/(V/m)^2$
NormY	1.73	$\mu V/(V/m)^2$
NormZ	1.67	$\mu V/(V/m)^2$

Diode Compression

DCP X	94	mV
DCP Y	94	mV
DCP Z	94	mV

Sensitivity in Tissue Simulating Liquid

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

ConvF X	6.3	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.3	± 9.5% (k=2)	Alpha	0.42
ConvF Z	6.3	± 9.5% (k=2)	Depth	2.57

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m
Head 1900 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

ConvF X	5.4	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.4	± 9.5% (k=2)	Alpha	0.61
ConvF Z	5.4	± 9.5% (k=2)	Depth	2.26

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	11.5	6.7
SAR_{be} [%]	With Correction Algorithm	0.3	0.6

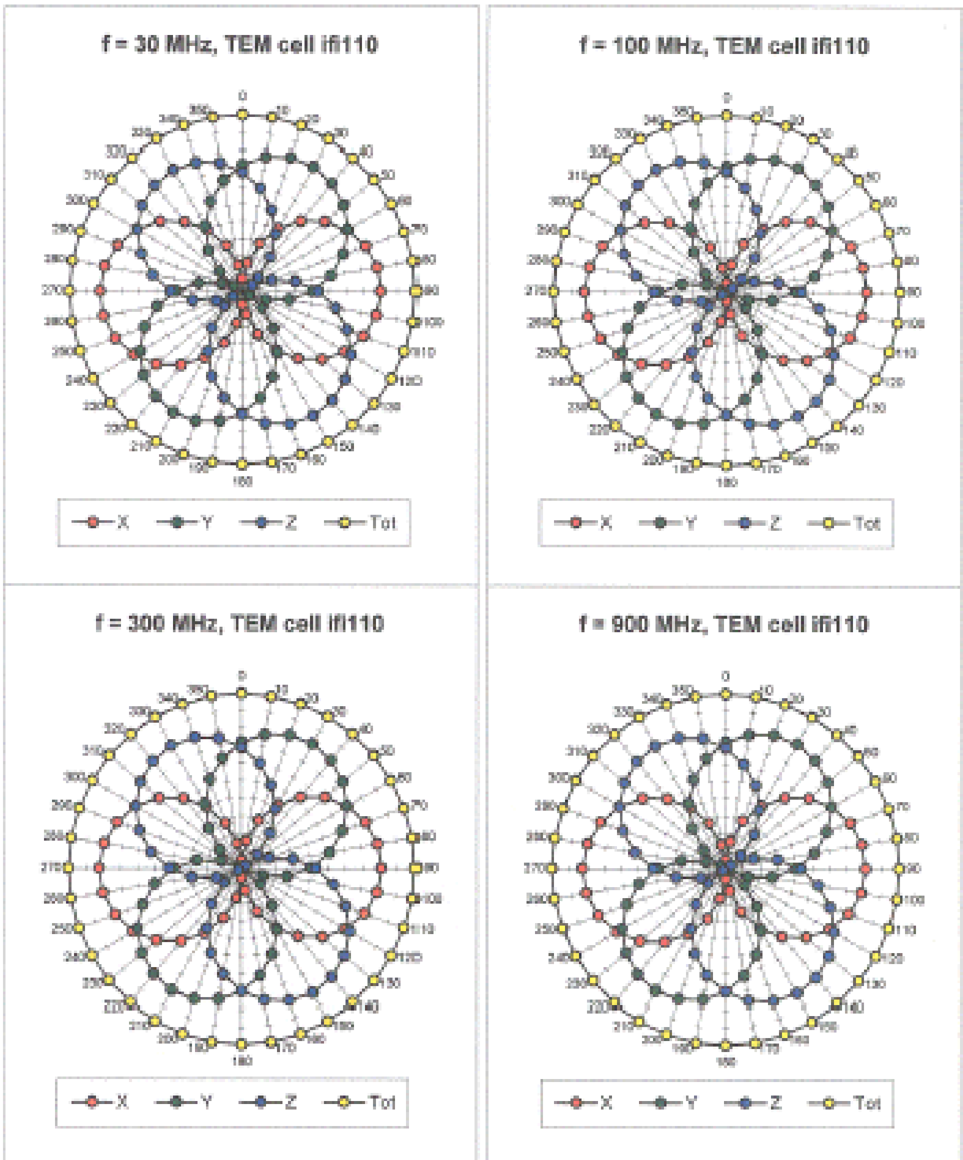
Head 1800 MHz Typical SAR gradient: 10 % per mm

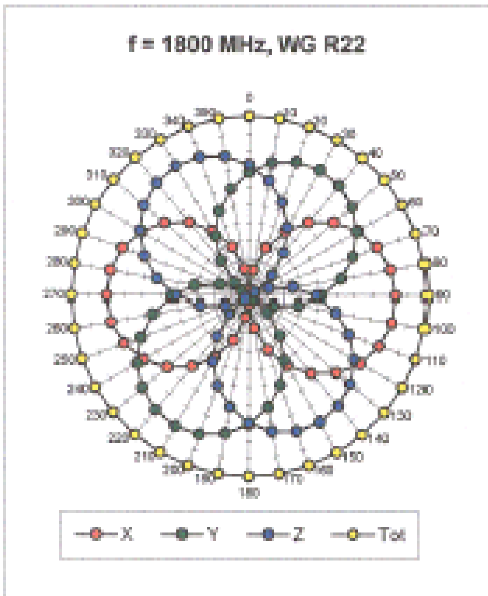
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	13.2	8.4
SAR_{be} [%]	With Correction Algorithm	0.1	0.2

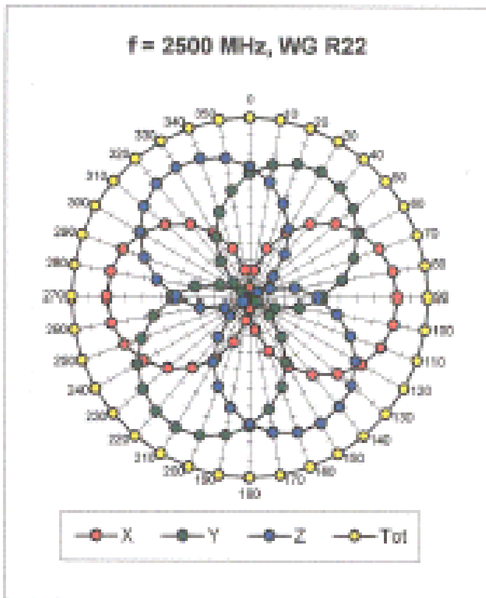
Sensor Offset

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

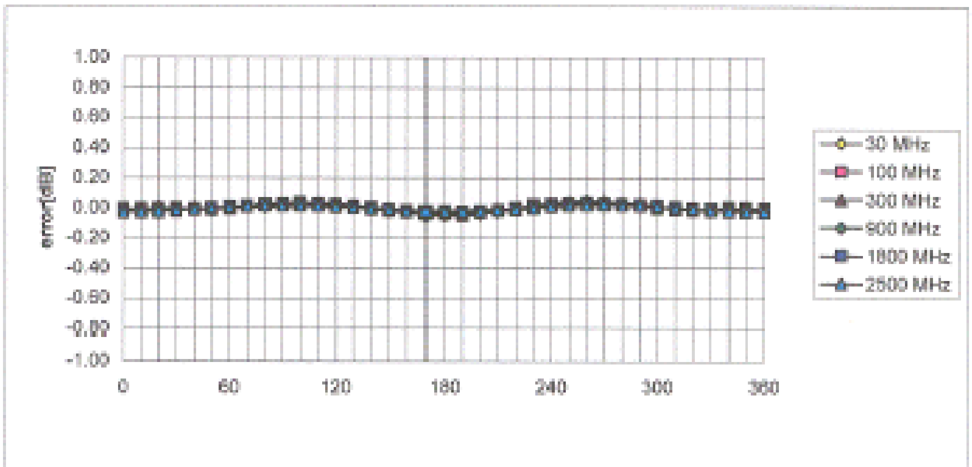
Receiving Pattern (ϕ), $\theta = 0°$





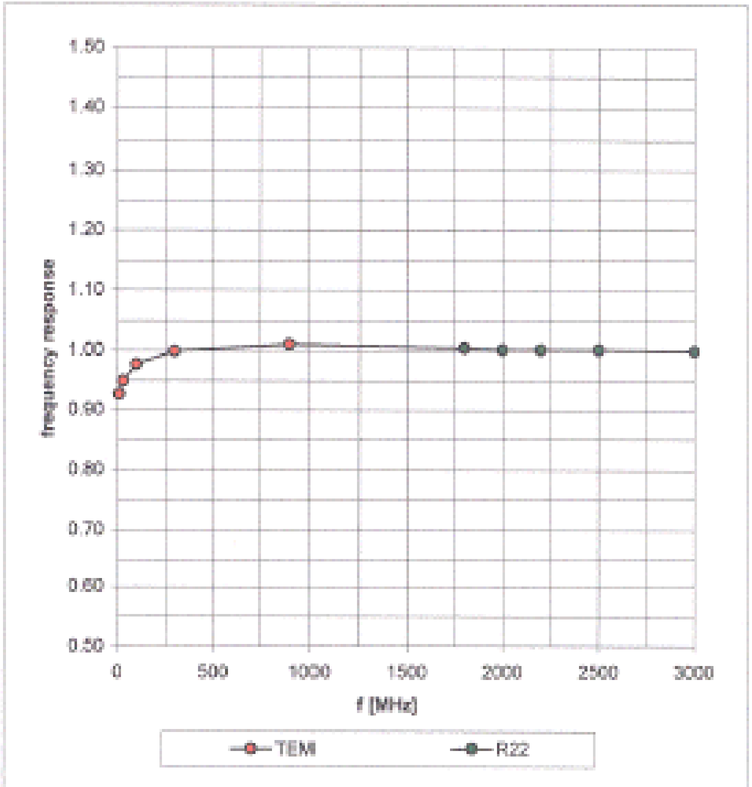


Isotropy Error (ϕ), θ = 0°



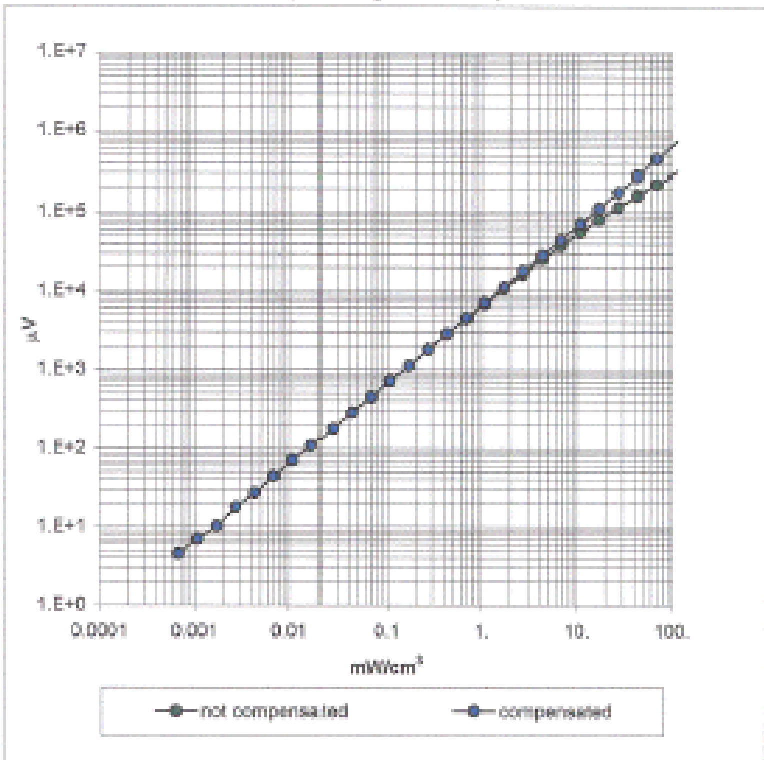
Frequency Response of E-Field

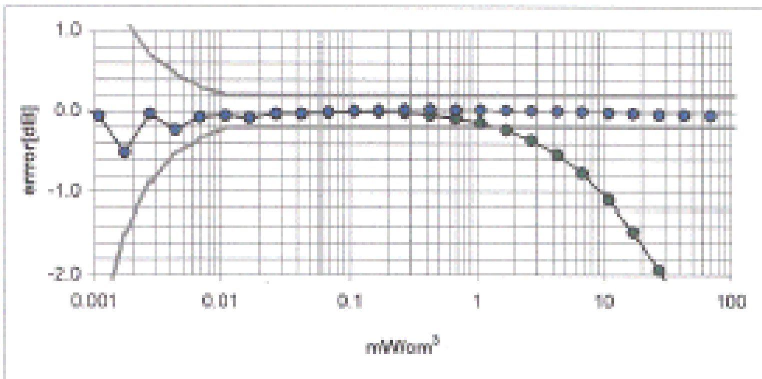
(TEM-Cell:ifi110, Waveguide R22)



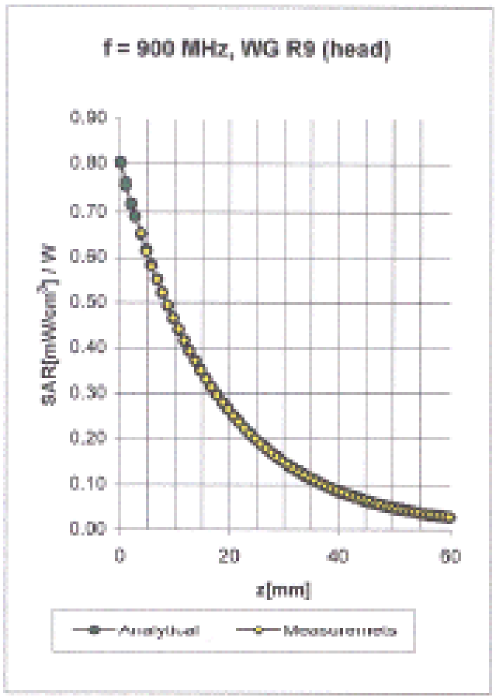
Dynamic Range f(SAR_{brain})

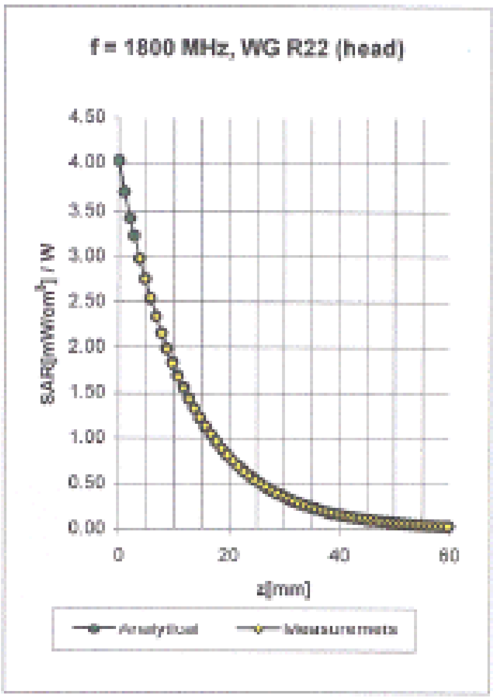
(Waveguide R22)





Conversion Factor Assessment

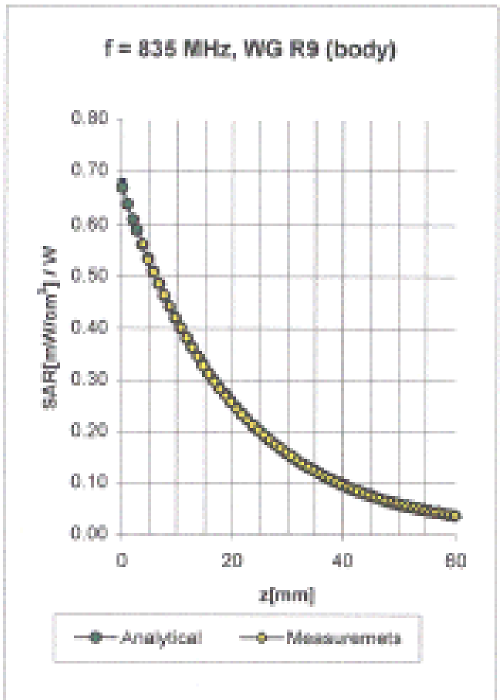


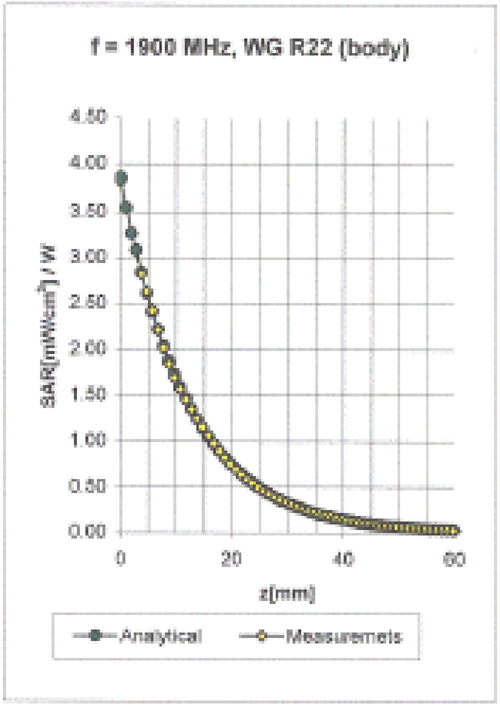


Head	900 MHz		ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m	
Head	835 MHz		ε_r = 41.5 ± 5%	σ = 0.90 ± 5% mho/m	
	ConvF X	6.3	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	6.3	± 9.5% (k=2)	Alpha	0.42
	ConvF Z	6.3	± 9.5% (k=2)	Depth	2.57

Head	1800 MHz		ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m	
Head	1900 MHz		ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m	
	ConvF X	5.4	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	5.4	± 9.5% (k=2)	Alpha	0.61
	ConvF Z	5.4	± 9.5% (k=2)	Depth	2.26

Conversion Factor Assessment



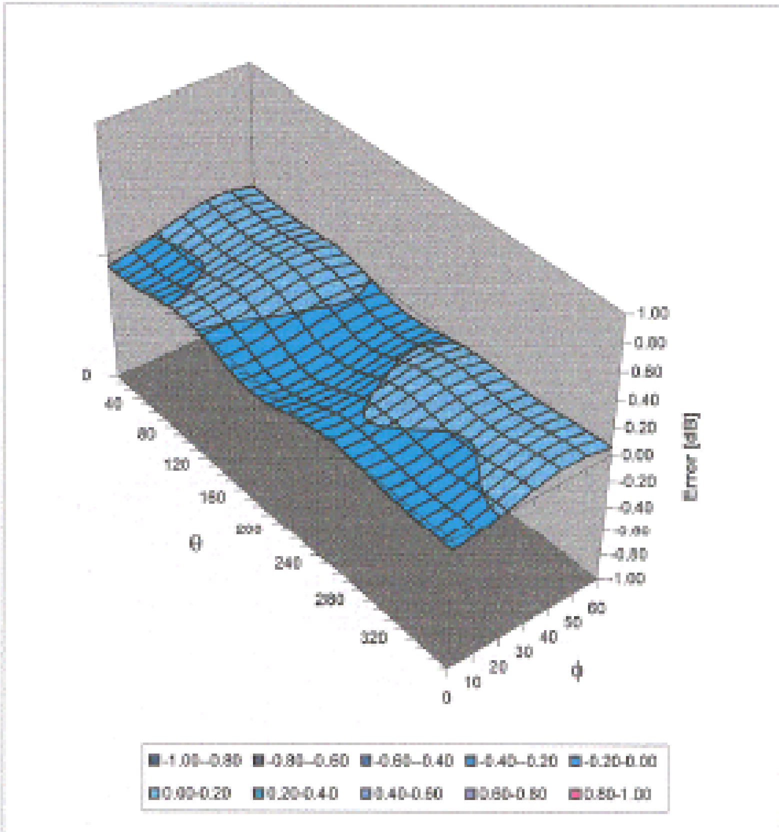


Body	835 MHz		ε_r = 55.2 ± 5%	σ = 0.97 ± 5% mho/m	
Body	900 MHz		ε_r = 55.0 ± 5%	σ = 1.05 ± 5% mho/m	
	ConvF X	6.2	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	6.2	± 9.5% (k=2)	Alpha	0.50
	ConvF Z	6.2	± 9.5% (k=2)	Depth	2.28

Body	1900 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	0.84
	ConvF Z	4.9	± 9.5% (k=2)	Depth	2.01

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:	**056**
Place of Calibration:	**Zurich**
Date of Calibration:	**January 29, 2002**
Calibration Interval:	**24 months**

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

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

Calibrated by:	N.Kolos E. Meriana
Approved by:	[signature]

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: 056

Manufactured: September 25, 1999
Calibrated: January 29, 2002

1. Measurement Conditions

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

Relative Dielectricity	**41.1**	± 5%
Conductivity	**0.95 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.48 at 900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue: **11.1 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **7.00 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:	**1.348 ns**	(one direction)
Transmission factor:	**0.986**	(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} = **50.2 Ω**
	Im {Z} = **-0.7 Ω**
Return Loss at 900 MHz	**-42.9 dB**

4. Measurement Conditions

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

Relative Dielectricity	**54.8**	± 5%
Conductivity	**1.03 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.17 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.

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:	**11.7 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**7.44 mW/g**

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} = **45.7 Ω**
	Im {Z} = **-2.4 Ω**
Return Loss at 900 MHz	**-25.7 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.

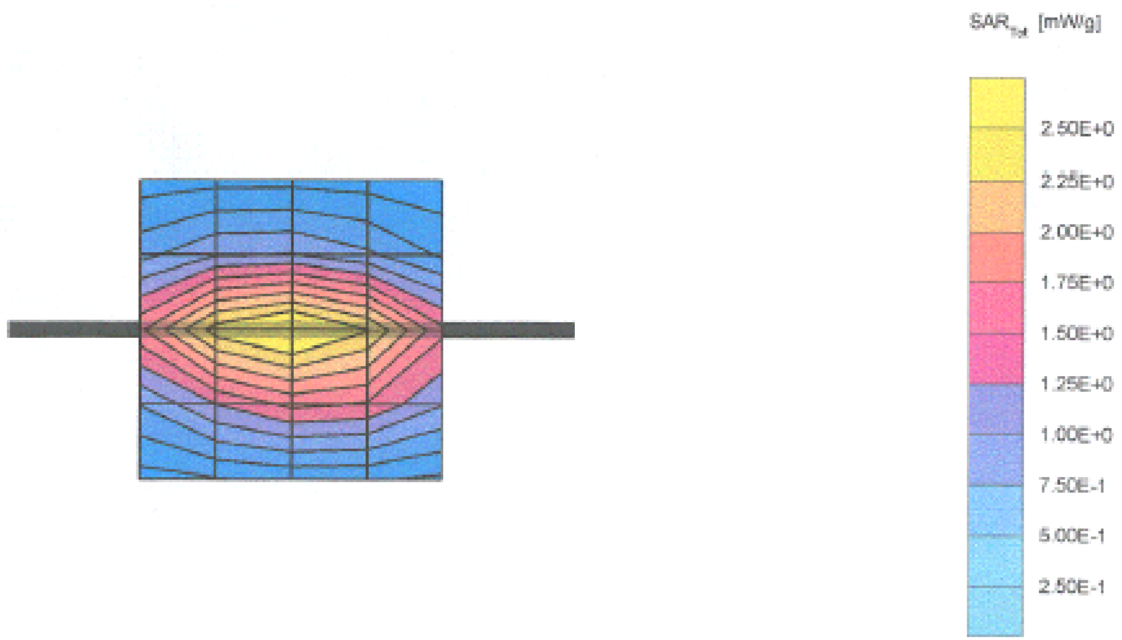
9. Power Test

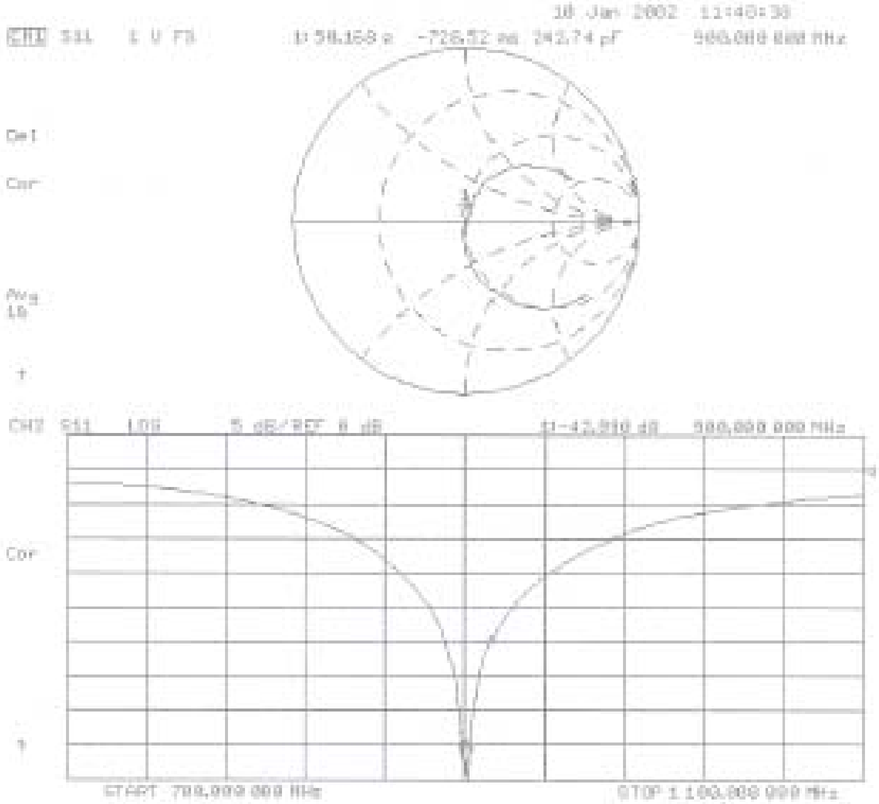
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

01/28/02

Validation Dipole D900V2 SN:056, d = 15 mm

Frequency: 900 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.48,6.48,6.48) at 900 MHz; IEEE1528 900 MHz; σ = 0.95 mho/m ϵ_r = 41.1 ρ = 1.00 g/cm³
Cubes (2): Peak: 4.48 mW/g ± 0.01 dB, SAR (1g): 2.78 mW/g ± 0.02 dB, SAR (10g): 1.75 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 11.5 (10.3, 13.0) [mm]
Powerdrift: -0.02 dB

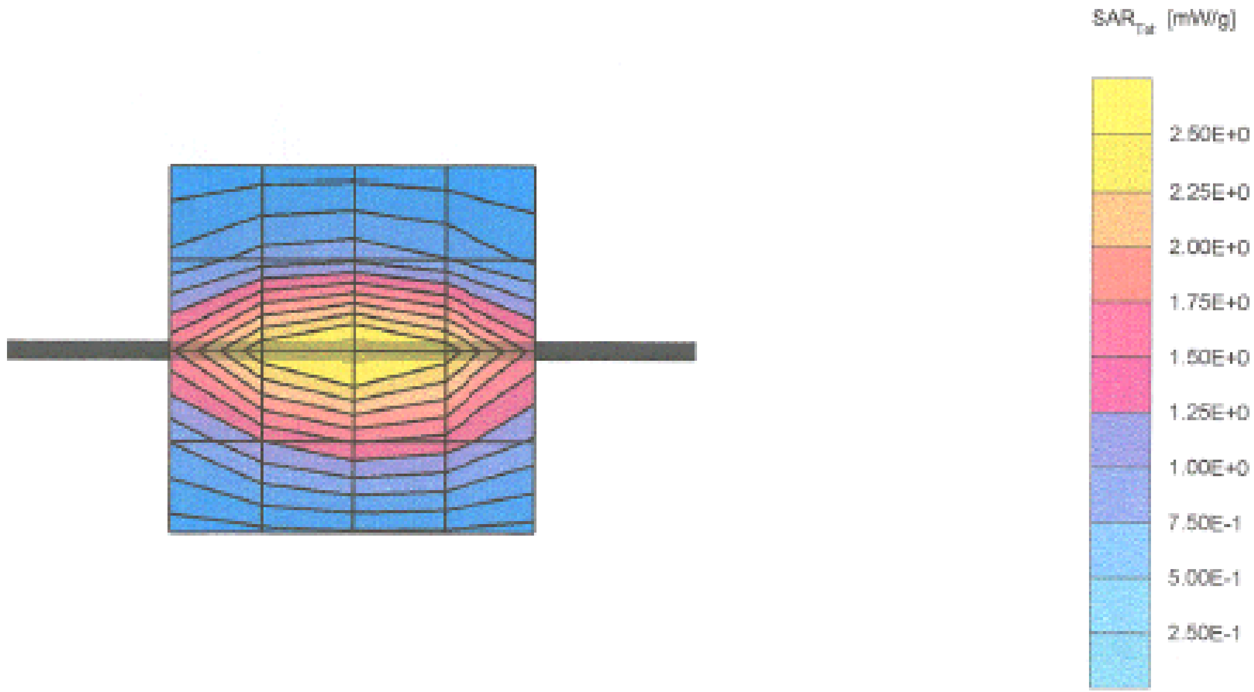


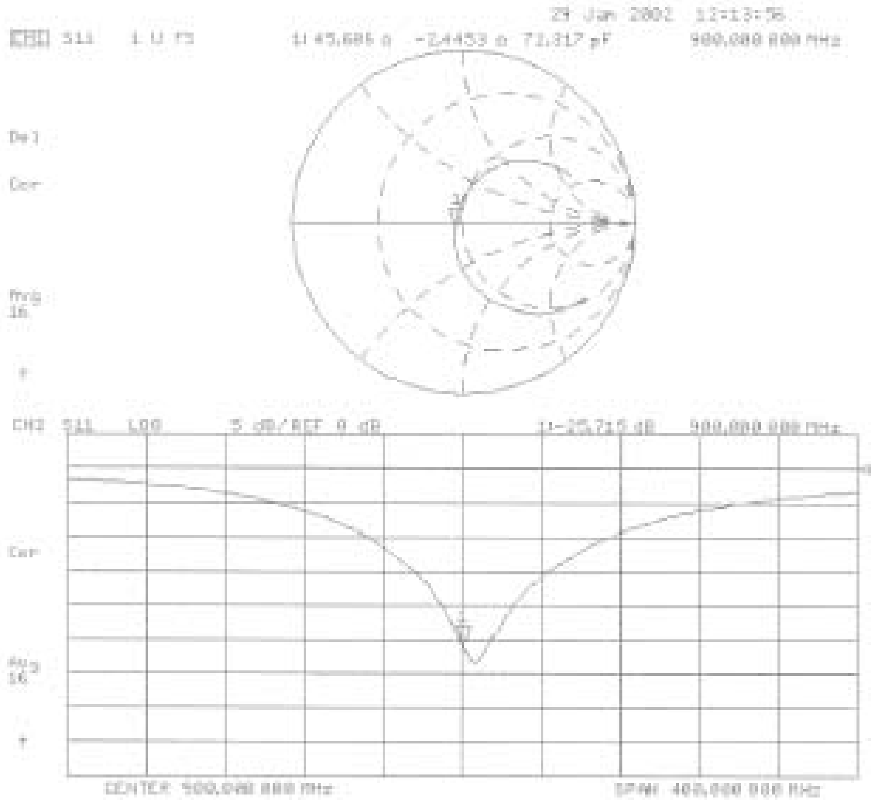

CH1 S11
Del
Cor
Avg
CH2 S11 LOG
Cor
STOP 1 100.000 000 MHz

01/29/02

Validation Dipole D900V2 SN:056, 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(6.17,6.17,6.17) at 900 MHz; Muscle 900 MHz; σ = 1.03 mho/m ϵ_r = 54.8 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.65 mW/g ± 0.01 dB, SAR (1g): 2.92 mW/g ± 0.00 dB, SAR (10g): 1.86 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.0 (10.7, 13.7) [mm]
Powerdrift: -0.02 dB




29 Jan 2002 12:13:56
CH1 S11 1 U FS
1: 45.686 Ω -2.4453 Ω 72.317 pF
900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/REF 0 dB
1:-25.715 dB 900.000 000 MHz
Cor
Avg
16
CENTER 900.000 000 MHz
SPAN 400.000 000 MHz