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T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	SAR0309_03.doc	**Date of report:**	2003-03-05
Number of pages:	83	**Contact person:**	Mary Washington
		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-3DNG** Battery: BL-5C, Headsets: HDB-4 and HDK-1K
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: 2003-03-05

For the contents:

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

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1. SUMMARY FOR SAR TEST REPORT

Date of receipt	2003-02-17
Date of test	2003-02-18 to 2003-02-28
Contact person	Mary Washington
Test plan referred to	-
FCC ID	QMNRH-3DNG
SN, HW, SW and DUT numbers	Phone: QMNRH-3DNG DUT: 06299, SN: 072/06710299, HW: 4003, SW: V G100b04.nep
Accessories	Battery: BL-5C DUT #'s: 06123, 06128, 06278, 06279, 06281, 06285
	Headsets: HDB-4, DUT: 06131 HDK-1K, DUT: 06293
Notes	-
Document code	SAR0309_03.doc
Responsible test engineer	Virpi Tuominen
Measurement performed by	Virpi Tuominen, Tomi Lipponen

1.1 Maximum Results Found during SAR Evaluation

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

1.1.1 Head Configuration / CDMA 800

Ch / *f* (MHz)	Conducted Power	Position / Antenna Option	Limit 1 g avg	Measured 1 g avg	Result
384 / 836	25.4 dBm	Left hand cheek position / Antenna extended	1.6 mW/g	1.04 mW/g	**PASSED**

1.1.2 Head Configuration / CDMA 1900

Ch / *f* (MHz)	Conducted Power	Position / Antenna Option	Limit 1 g avg	Measured 1 g avg	Result
25 / 1851	23.2 dBm	Left hand tilt position / Antenna extended	1.6 mW/g	1.10 mW/g	**PASSED**

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1.1.3 Body Worn Configuration / CDMA 800

Ch / *f* (MHz)	Conducted Power	Accessory / Antenna Option	Separation distance	Limit 1 g avg	Measured 1 g avg	Result
384 / 836	25.4 dBm	HDK-1K / Antenna retracted	22 mm	1.6 mW/g	1.10 mW/g	**PASSED**

1.1.4 Body Worn Configuration / CDMA 1900

Ch / *f* (MHz)	Conducted Power	Accessory / Antenna Option	Separation distance	Limit 1 g avg	Measured 1 g avg	Result
1175 / 1909	23.5 dBm	HDK-1K / Antenna retracted	22 mm	1.6 mW/g	0.44 mW/g	**PASSED**

1.1.5 Measurement Uncertainty

Combined Standard Uncertainty	± 14.0%
Expanded Standard Uncertainty (k=2)	± 28.0%

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2. DESCRIPTION OF THE TESTED DEVICE(S)

2.1 Device description

FCC ID Number	QMNRH-3DNG	
Device category	Portable Device	
RF Exposure Limits	General population / Uncontrolled	
Unit type	Prototype unit	
Case type	Fixed case	
Modes of Operation	CDMA 800	CDMA 1900
Modulation Mode	QPSK	QPSK
Duty Cycle	1	1
Maximum Device Rating	Power Class III	Power Class II
Transmitter Frequency Range (MHz)	824.70 - 848.31	1851.25 - 1908.75

Acronyms: QPSK = Quadrature Phase Shift Keying

2.2 Picture of Phone

Fig. 2.2.1.
QMNRH-3DNG antenna retracted.

Fig. 2.2.2.
QMNRH-3DNG antenna extended.

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2.3 Description of the Antenna

Type	Retractable whip antenna with PIFA
Location	PIFA: inside the back cover at the top of the device. Retractable 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

Headsets HDB-4 and HDK-1K were used for the measurements.

2.6 Body Worn Accessories

The body worn measurements were made with 22 mm 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, Switzerland

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	1396
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 Tip distance to phantom inner surface: 1.5 mm
Calibration	Jan-03 (see Appendix C)
Due date	Jan-04

The E-field probe is connected to the robot arm as can be seen in Figure 3.2.1.

3.4 Device holder

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

Fig. 3.4.1. Device holder

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3.5 Dipole antennas for validation

The 900 MHz and 1800 MHz dipole antennas are matched for use near flat phantoms filled with head/body simulation solutions. The dipoles are equipped with 15 mm or 10 mm distance holders, respectively.

Antenna	Type	Serial number	Calibration	Due date
900 MHz dipole	D900V2	056	Jan-02	Jan-04
1800 MHz dipole	D1800V2	256	Jan-02	Jan-04

3.6 Phantom

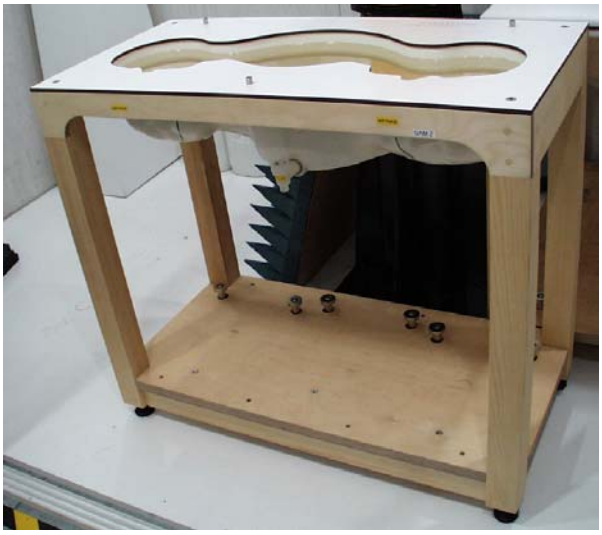

Fig. 3.6.1. SAM-phantom.

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

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3.7 Base Station Simulator

The QMNRH-3DNG 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.

Test Equipment	Digital radiocommunication Tester
Model	CMU 200
Serial number	101111
Calibration	Mar-02
Due date	Mar-03

3.8 Additional equipment needed in system check

Test Equipment	Model	Serial Number	Calibration	Due Date
Signal Generator	HP 8642B	2531A00362	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-02	Jul-04
Thermometer	175-H2	20004475/211	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	03-02-18	03-02-24	03-02-25	03-02-26	03-02-27	03-02-28
Ambient temperature (°C)	22.5	22.5	21.9	22.0	21.9	22.2
Humidity (% RH)	42	36	42	38	41	44

4.2 System Performance Check

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. The dimensions of 1800 MHz dipole are 72 mm and 300 mm, respectively. 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 antennas. The reference results of the liquid parameters are those used by Speag during dipole calibrations. The ±10%-limits for SAR values and the ±5%-limits for liquid parameters are calculated from the reference values.

Tissue	Measuring date	SAR (W/kg), 1g	Dielectric Parameters	
			ε_r	σ (S/m)
Head 900 MHz	Reference Result	2.78	41.1	0.95
	Requirement	2.50 – 3.06	39.1 – 43.2	0.90 – 1.00
	2003-02-25	2.95	40.0	0.95
	2003-02-26	2.99	40.2	0.95
Muscle 900 MHz	Reference Result	2.92	54.8	1.03
	Requirement	2.63 – 3.21	52.1 – 57.5	0.98 – 1.08
	2003-02-27	3.01	55.5	1.00

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Tissue	Measuring date	SAR (W/kg), 1g	Dielectric Parameters	
			ε_r	σ (S/m)
Head 1800 MHz	Reference Result	9.99	39.6	1.37
	Requirement	8.99 – 10.99	37.6 – 41.6	1.30 – 1.44
	2003-02-18	10.2	40.5	1.33
	2003-02-24	10.7	40.5	1.36
Muscle 1800 MHz	Reference Result	9.87	53.5	1.45
	Requirement	8.88 – 10.86	50.8 – 56.2	1.38 – 1.52
	2003-02-28	10.5	52.1	1.44

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 and for 1800-1900 MHz given in OET Bulletin 65, Supplement C, Edition 01-01.

Tissue	Measuring date	836 MHz	
		ε_r	σ
Head 836 MHz	Recommended	41.5	0.90
	Limits (± 5%)	39.4-43.6	0.86-0.95
	2003-02-25	40.8	0.89
	2003-02-26	41.0	0.89
Muscle 836 MHz	Recommended	55.2	0.97
	Limits (± 5%)	49.7-58.0	0.92-1.02
	2003-02-27	56.0	0.94

Tissue	Measuring date	1880 MHz	
		ε_r	σ
Head 1880 MHz	Recommended	40.0	1.40
	Limits (± 5%)	38.0-42.0	1.33-1.47
	2003-02-18	40.1	1.41
	2003-02-24	40.1	1.44
Muscle 1880 MHz	Recommended	53.3	1.52
	Limits (± 5%)	50.6-56.0	1.44-1.60
	2003-02-28	52.2	1.50

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4.3.2 Recipes of tissue simulating liquids

Tissue simulating liquids on 835-900 MHz

Ingredient	Head (% by weight)	Muscle (% 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

Tissue simulating liquids on 1800-1900 MHz

Ingredient	Head (% by weight)	Muscle (% 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. 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.

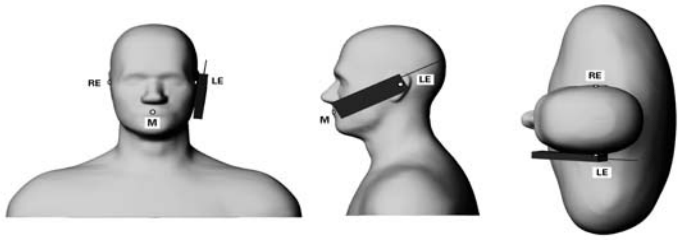

Fig. 5.1.1. Cheek/Touch position

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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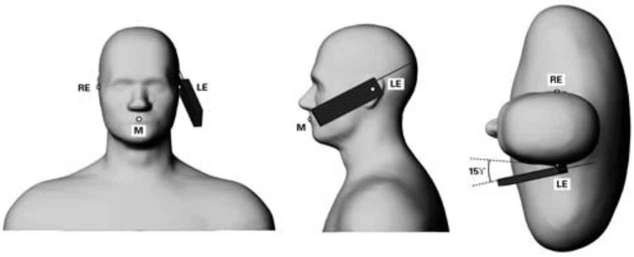

Fig. 5.1.2. Ear/Tilt Position.

5.1.3 Photos of setup

Fig. 5.1.3.1. QMNRH-3DNG in cheek position.

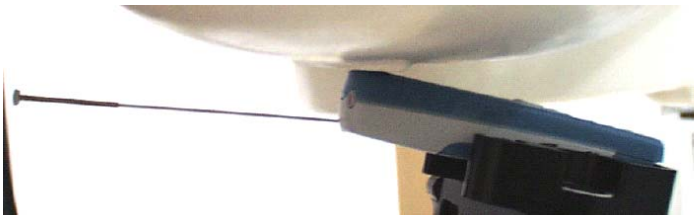

Fig. 5.1.3.2. QMNRH-3DNG in tilted position.

5.1.4 Body Worn Configuration

The phone was positioned into the holder and placed below the flat section of the phantom. The measurements were made to show compliance with 22 mm separation distance. Measurements were performed with the antenna side towards the phantom.

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Fig. 5.1.4.1. QMNRH-3DNG in body position with antenna extended and headset HDB-4 connected.

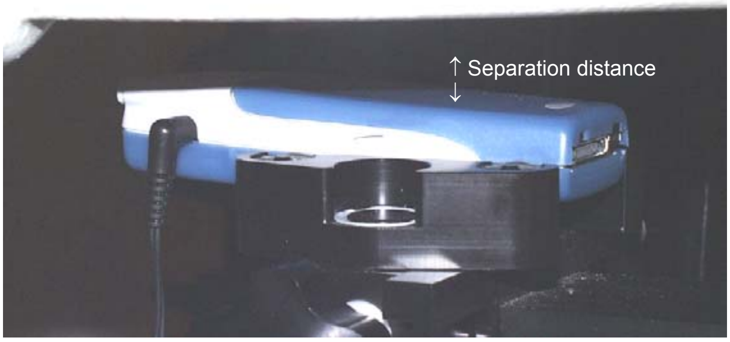

Fig. 5.1.4.2. QMNRH-3DNG in body position with antenna retracted and headset HDK-1K connected.

5.2 Scan Procedures

First coarse scan is used for quick determination of the field distribution. Next 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, Computermathematatik, p. 141-150] (x, y and z -directions) [Numerical Recipes in C, Second Edition, p 123].

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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

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 %	normal	1	± 0.5%
Linearity error	± 0.2 dB	rectangular	1	± 2.7%
Calibration error	± 3.3 %	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	± 10%	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	± 7%	normal	1	± 7%
Laboratory set up	± 3%	normal	1	± 3%
Total Source Uncertainty				± **9.70%**
Combined Uncertainty				± **14.0%**
Expanded Uncertainty (k=2) 95.5%				± **28.0%**

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7. RESULTS

The SAR results shown in the tables are maximum SAR values averaged over 1g of tissue. The maximum result of every different test configuration is included in the appendix B as SAR distribution plots. Additionally, two other plots are included because the distributions deviate in some degree from the maximum result distributions. The other SAR distribution plots are substantially similar or equivalent to the plots submitted regardless of used channel in each mode and position.

7.1 Head Configuration

Position	CDMA 800			
	Channel	Low	Mid	High
	Channel #	1013	384	777
	Conducted power (dBm)	25.4	25.4	25.4
Cheek, left hand	Antenna retracted	0.581	0.774	0.870
	Antenna extended	0.975	**1.04**	0.922
Tilt, left hand	Antenna retracted	0.407	0.593	0.674
	Antenna extended	0.538	0.707	0.755
Cheek, right hand	Antenna retracted	0.631	0.778	0.841
	Antenna extended	0.995	1.03	0.907
Tilt, right hand	Antenna retracted	0.429	0.566	0.629
	Antenna extended	0.582	0.618	0.660

Position	CDMA 1900			
	Channel	Low	Mid	High
	Channel #	25	600	1175
	Conducted power (dBm)	23.2	23.2	23.5
Cheek, left hand	Antenna retracted	0.636	0.861	0.880
	Antenna extended	1.05	0.944	0.823
Tilt, left hand	Antenna retracted	0.709	0.886	0.892
	Antenna extended	**1.10**	1.04	0.842
Cheek, right hand	Antenna retracted	0.444	0.565	0.590
	Antenna extended	0.755	0.774	0.688
Tilt, right hand	Antenna retracted	0.535	0.700	0.748
	Antenna extended	0.835	0.872	0.635

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7.2 Body configuration

Body SAR measurements were performed with the headset HDB-4 or HDK-1K connected. Antenna side of the phone was towards the phantom in order to achieve the highest SAR values. The results with 22 mm separation distance are listed in the tables below.

Accessory	CDMA 800			
	Channel	Low	Mid	High
	Channel #	1013	384	777
	Conducted power (dBm)	25.4	25.4	25.4
HDB-4	Antenna retracted	0.615	0.750	0.692
	Antenna extended	0.524	0.671	0.607
HDK-1K	Antenna retracted	0.977	**1.10**	1.08
	Antenna extended	0.668	0.763	0.640

Accessory	CDMA 1900			
	Channel	Low	Mid	High
	Channel #	25	600	1175
	Conducted power (dBm)	23.2	23.2	23.5
HDB-4	Antenna retracted	0.287	0.386	0.422
	Antenna extended	0.343	0.408	0.431
HDK-1K	Antenna retracted	0.283	0.404	**0.444**
	Antenna extended	0.383	0.433	0.413

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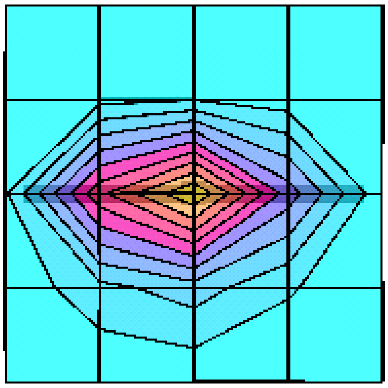
APPENDIX A.

Validation Test Printouts

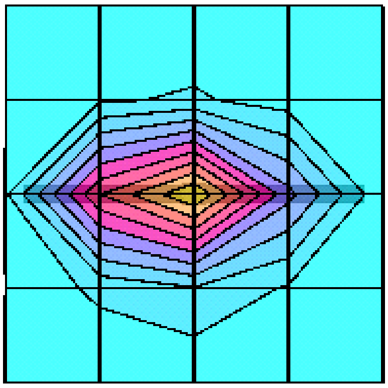
Dipole 1800 MHz

2003-02-18
t(liq.)=21.8°C
SAM 1; Flat
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1800 MHz: σ = 1.33 mho/m ϵ_r = 40.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 18.5 mW/g ± 0.12 dB, SAR (1g): 10.2 mW/g ± 0.11 dB, SAR (10g): 5.38 mW/g ± 0.10 dB, (Worst-case extrapolation)
Penetration depth: 8.7 (8.2, 9.8) [mm]
Powerdrift: -0.02 dB



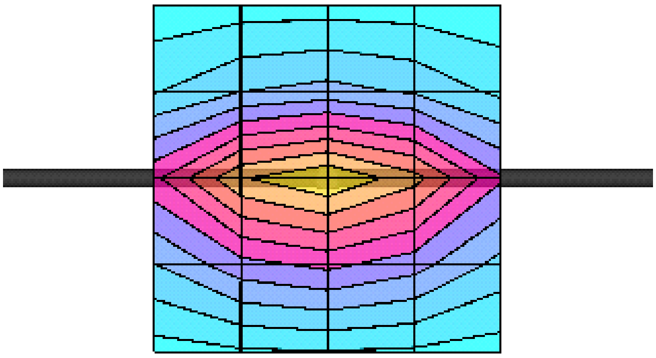
Dipole 1800 MHz

2003-02-24
t(liq.)=22.1°C
SAM 1; Flat
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1800 MHz: σ = 1.36 mho/m ε_r = 40.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 19.9 mW/g ± 0.16 dB, SAR (1g): 10.7 mW/g ± 0.15 dB, SAR (10g): 5.58 mW/g ± 0.14 dB, (Worst-case extrapolation)
Penetration depth: 8.5 (7.9, 9.6) [mm]
Powerdrift: -0.00 dB



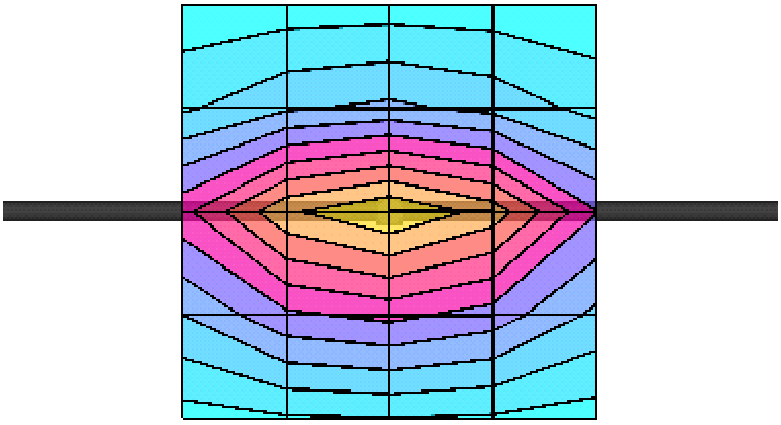
Dipole 900 MHz

2003-02-25
t(liq.)=21.6°C
SAM 2; Flat
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 900 MHz: σ = 0.95 mho/m ε_r = 40.0 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.73 mW/g ± 0.17 dB, SAR (1g): 2.95 mW/g ± 0.14 dB, SAR (10g): 1.86 mW/g ± 0.12 dB, (Worst-case extrapolation)
Penetration depth: 11.5 (10.3, 13.0) [mm]
Powerdrift: -0.01 dB



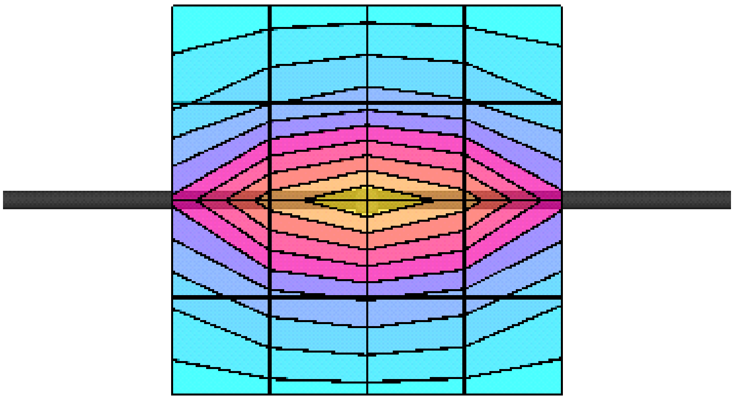
Dipole 900 MHz

2003-02-26
t(liq.)=21.6°C
SAM 2; Flat
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 900 MHz: σ = 0.95 mho/m ε_r = 40.2 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.83 mW/g ± 0.11 dB, SAR (1g): 2.99 mW/g ± 0.11 dB, SAR (10g): 1.88 mW/g ± 0.11 dB, (Worst-case extrapolation)
Penetration depth: 11.4 (10.2, 12.9) [mm]
Powerdrift: -0.05 dB



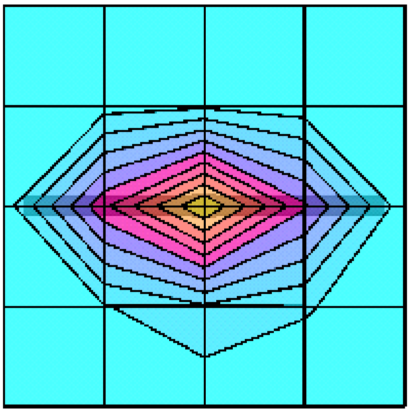
Dipole 900 MHz

2003-02-27
t(liq.)=21.6°C
SAM 1; Flat
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body900 MHz: σ = 1.00 mho/m ε_r = 55.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.77 mW/g ± 0.13 dB, SAR (1g): 3.01 mW/g ± 0.13 dB, SAR (10g): 1.92 mW/g ± 0.11 dB, (Worst-case extrapolation)
Penetration depth: 12.3 (11.0, 14.0) [mm]
Powerdrift: -0.01 dB



Dipole 1800 MHz

2003-02-28
t(liq.)=21.6°C
SAM 2; Flat
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; B0DY 1800 MHz: σ = 1.44 mho/m ε_r = 52.1 ρ = 1.00 g/cm^3
Cubes (2): Peak: 19.2 mW/g ± 0.10 dB, SAR (1g): 10.5 mW/g ± 0.12 dB, SAR (10g): 5.57 mW/g ± 0.14 dB, (Worst-case extrapolation)
Penetration depth: 9.2 (8.4, 10.7) [mm]
Powerdrift: -0.02 dB



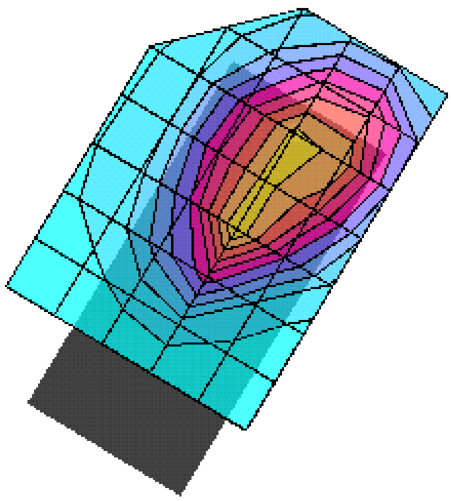
APPENDIX B.

SAR Distribution Printouts

QMNRH-3DNG, ANTENNA RETRACTED, LEFT CHEEK, CDMA 800

2003-02-25
t(liq.)=21.6°C

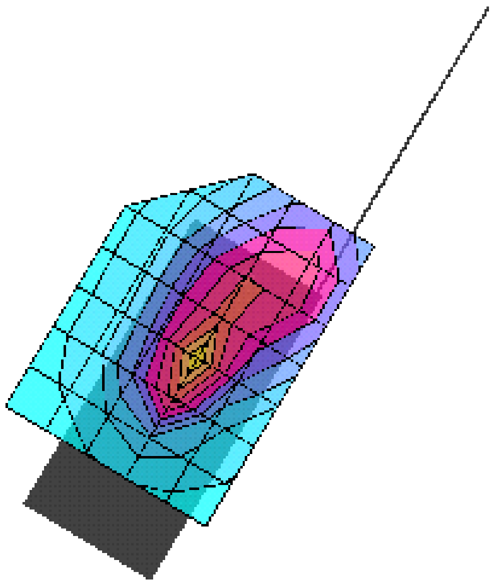
SAM 2 Phantom; Left Hand Section; Cheek Position: (90°,59°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.870 mW/g, SAR (10g): 0.559 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.14 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT CHEEK, CDMA 800, CH 384

2003-02-25
t(liq.)=21.2°C

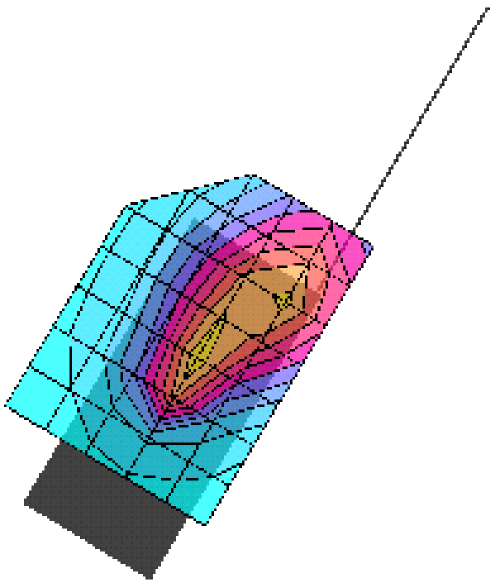
SAM 2 Phantom; Left Hand Section; Cheek Position: (90°,59°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.04 mW/g, SAR (10g): 0.595 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.09 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT CHEEK, CDMA 800, CH 777

2003-02-25
t(liq.)=21.2°C

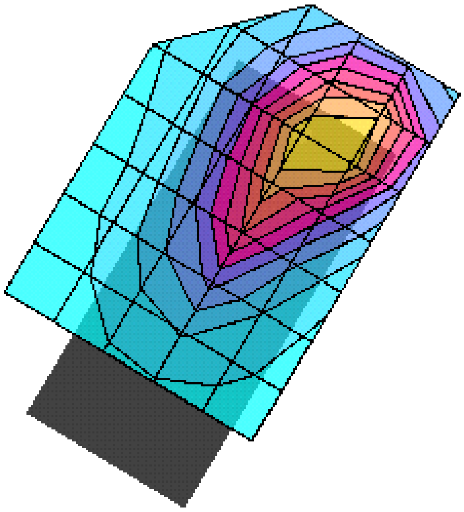
SAM 2 Phantom; Left Hand Section; Cheek Position: (90°,59°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.922 mW/g, SAR (10g): 0.558 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.10 dB



QMNRH-3DNG, ANTENNA RETRACTED, LEFT TILT, CDMA 800

2003-02-25
t(liq.)=21.2°C

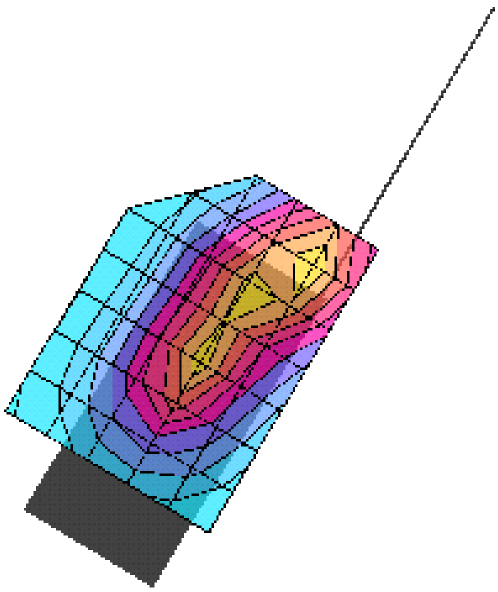
SAM 2 Phantom; Left Hand Section; Tilt Position: (90°,59°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.674 mW/g, SAR (10g): 0.397 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.08 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT TILT, CDMA 800, CH 1013

2003-02-25
t(liq.)=21.0°C

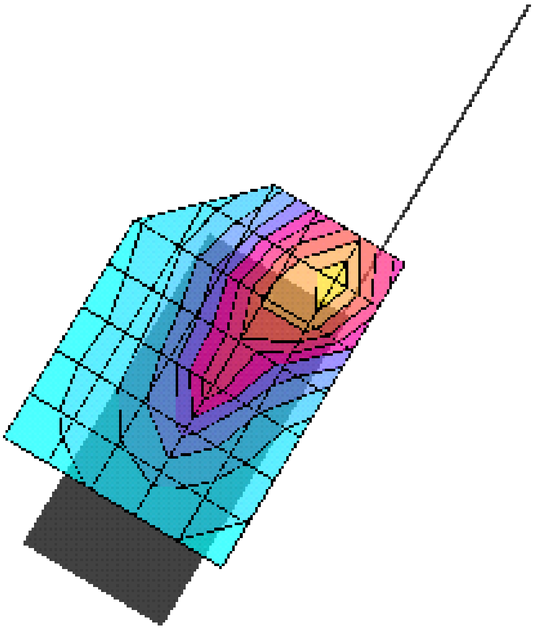
SAM 2 Phantom; Left Hand Section; Tilt Position: (90°,59°); Frequency: 825 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.538 mW/g, SAR (10g): 0.333 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.07 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT TILT, CDMA 800, CH 777

2003-02-25
t(liq.)=21.0°C

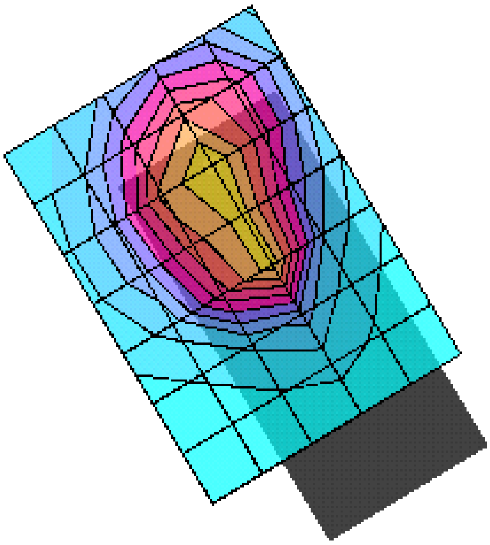
SAM 2 Phantom; Left Hand Section; Tilt Position: (90°,59°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 40.8 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.755 mW/g, SAR (10g): 0.459 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB



QMNRH-3DNG, ANTENNA RETRACTED, RIGHT CHEEK, CDMA 800

2003-02-26
t(liq.)=21.5°C

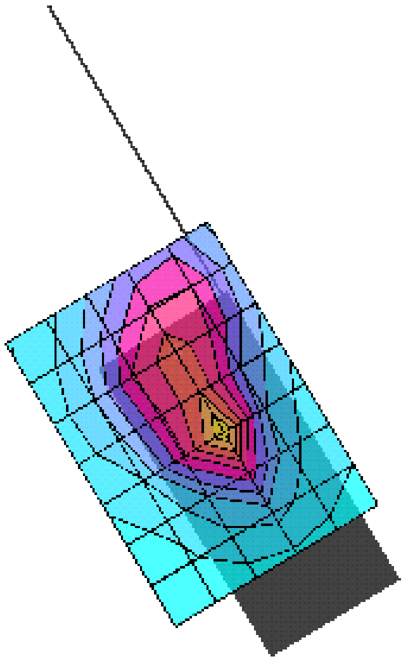
SAM 2 Phantom; Righ Hand Section; Cheek Position: (90°,301°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.841 mW/g, SAR (10g): 0.557 mW/g * Max outside, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.04 dB



QMNRH-3DNG, ANTENNA EXTENDED, RIGHT CHEEK, CDMA 800

2003-02-26
t(liq.)=21.3°C

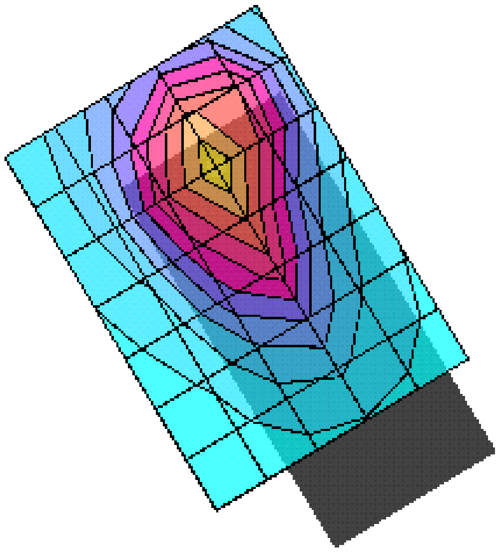
SAM 2 Phantom; Righ Hand Section; Cheek Position: (90°,301°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.03 mW/g, SAR (10g): 0.607 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.14 dB



QMNRH-3DNG, ANTENNA RETRACTED, RIGHT TILT, CDMA 800

2003-02-26
t(liq.)=20.9°C

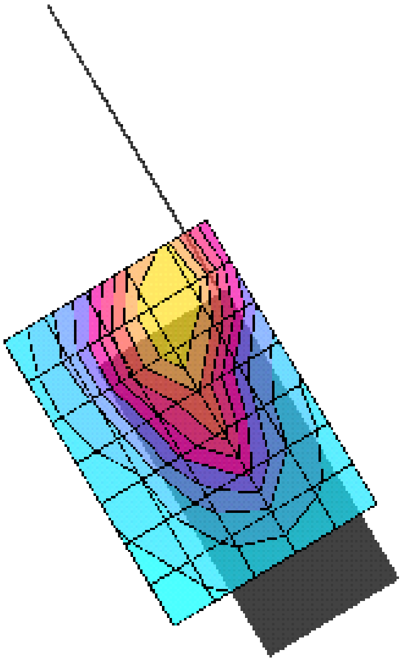
SAM 2 Phantom; Righ Hand Section; Tilt Position: (90°,301°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.629 mW/g, SAR (10g): 0.391 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.00 dB



QMNRH-3DNG, ANTENNA EXTENDED, RIGHT TILT, CDMA 800

2003-02-26
t(liq.)=21.1°C

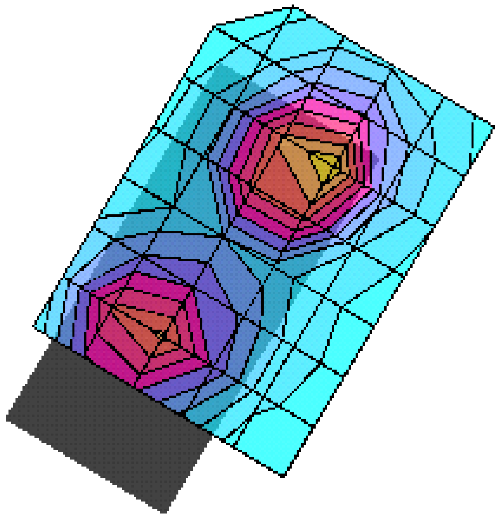
SAM 2 Phantom; Righ Hand Section; Tilt Position: (90°,301°); Frequency: 848 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: σ = 0.89 mho/m ϵ_r = 41.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.660 mW/g, SAR (10g): 0.421 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.11 dB



QMNRH-3DNG, ANTENNA RETRACTED, LEFT CHEEK, CDMA 1900

2003-02-24
t(liq.)=20.8°C

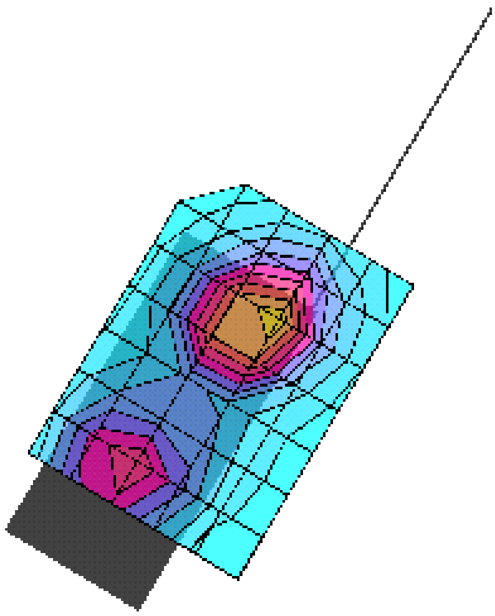
SAM 1 Phantom; Left Hand Section; Cheek Position: (90°,59°); Frequency: 1908 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.880 mW/g, SAR (10g): 0.480 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.12 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT CHEEK, CDMA 1900

2003-02-24
t(liq.)=21.5°C

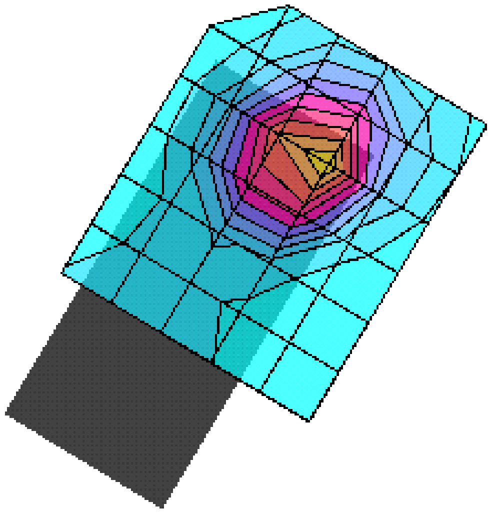
SAM 1 Phantom; Left Hand Section; Cheek Position: (90°,59°); Frequency: 1851 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.05 mW/g, SAR (10g): 0.584 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.08 dB



QMNRH-3DNG, ANTENNA RETRACTED, LEFT TILT, CDMA 1900

2003-02-18
t(liq.)=20.7°C

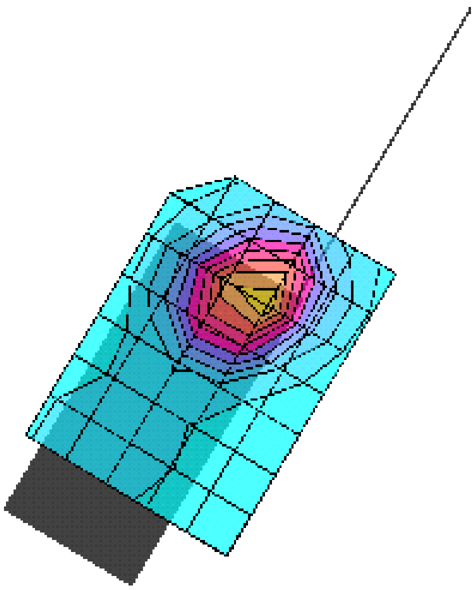
SAM 1 Phantom; Left Hand Section; Tilt Position: (90°,59°); Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.41 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.892 mW/g, SAR (10g): 0.491 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.09 dB



QMNRH-3DNG, ANTENNA EXTENDED, LEFT TILT, CDMA 1900

2003-02-18
t(liq.)=20.0°C

SAM 1 Phantom; Left Hand Section; Tilt Position: (90°,59°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.41 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.10 mW/g, SAR (10g): 0.622 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.03 dB



QMNRH-3DNG, ANTENNA RETRACTED, RIGHT CHEEK, CDMA 1900

2003-02-24

t(liq.)=21.2°C

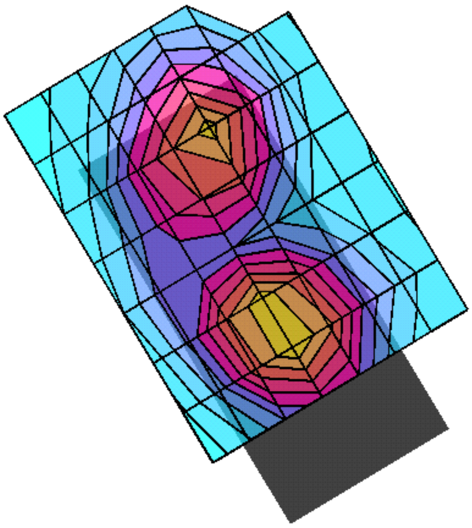
SAM 1 Phantom; Righ Hand Section; Cheek Position: (90°,301°); Frequency: 1908 MHz

Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3

Cube 5x5x7: SAR (1g): 0.590 mW/g, SAR (10g): 0.373 mW/g, (Worst-case extrapolation)

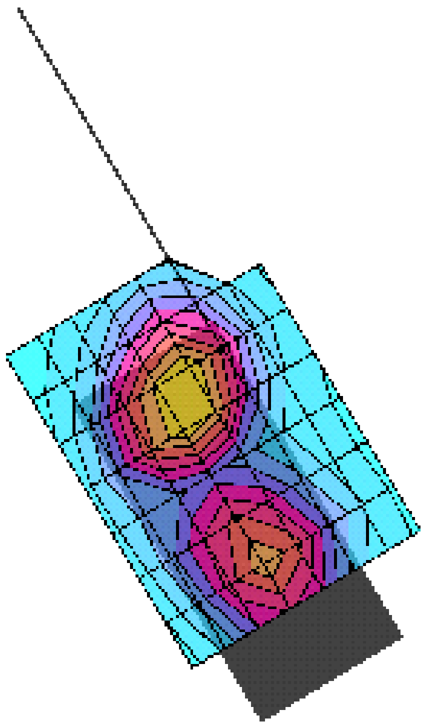
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0

Powerdrift: -0.07 dB



QMNRH-3DNG, ANTENNA EXTENDED, RIGHT CHEEK, CDMA 1900
2003-02-24
t(liq.)=21.1°C

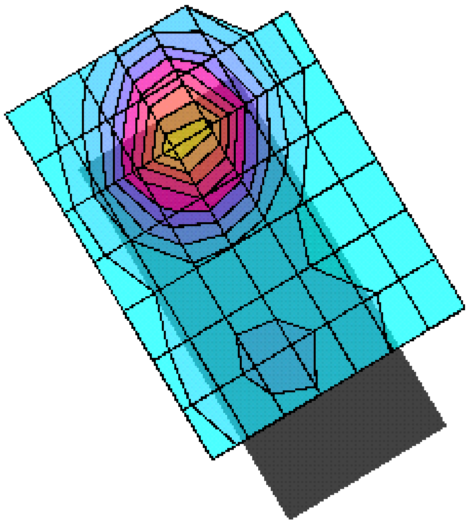
SAM 1 Phantom; Righ Hand Section; Cheek Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.774 mW/g, SAR (10g): 0.456 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: -0.07 dB



QMNRH-3DNG, ANTENNA RETRACTED, RIGHT TILT, CDMA 1900

2003-02-24
t(liq.)=19.9°C

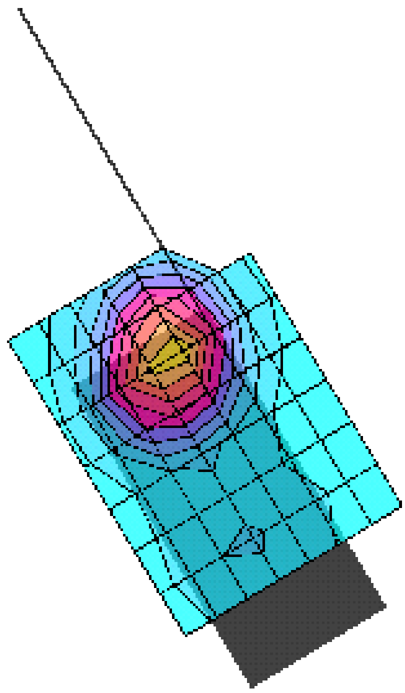
SAM 1 Phantom; Righ Hand Section; Tilt Position: (90°,301°); Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ϵ_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.748 mW/g, SAR (10g): 0.417 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: -0.08 dB



QMNRH-3DNG, ANTENNA EXTENDED, RIGHT TILT, CDMA 1900

2003-02-24
t(liq.)=21.0°C

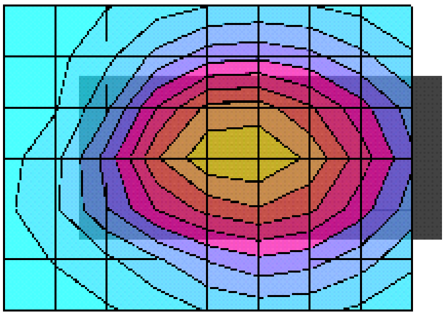
SAM 1 Phantom; Righ Hand Section; Tilt Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.872 mW/g, SAR (10g): 0.508 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 11.0, Dz = 10.0
Powerdrift: -0.05 dB



QMNRH-3DNG WITH HDB-4, ANTENNA RETRACTED, BODY, CDMA 800

2003-02-27
t(liq.)=20.8°C

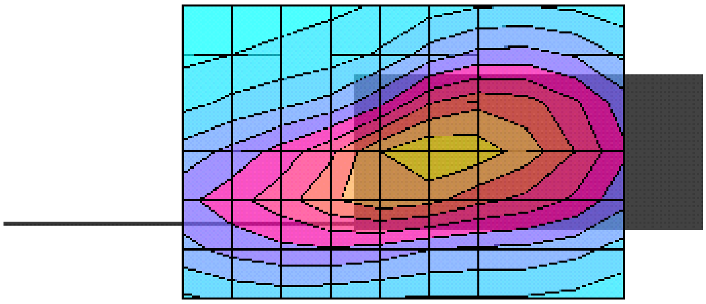
SAM 1 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body 836MHz: σ = 0.94 mho/m ε_r = 56.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.750 mW/g, SAR (10g): 0.535 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.18 dB



QMNRH-3DNG WITH HDB-4, ANTENNA EXTENDED, BODY, CDMA 800

2003-02-27
t(liq.)=20.9 °C

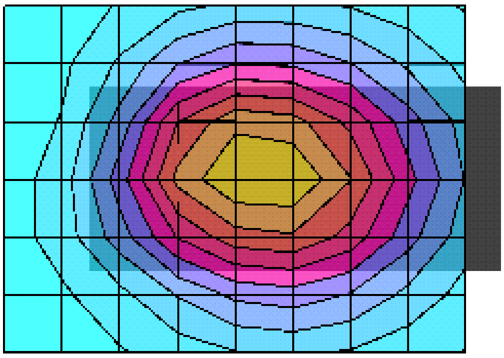
SAM 1 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body 836MHz: σ = 0.94 mho/m ε_r = 56.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.671 mW/g, SAR (10g): 0.473 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.03 dB



QMNRH-3DNG WITH HDK-1K, ANTENNA RETRACTED, BODY, CDMA 800

2003-02-27
t(liq.)= 21.5°C

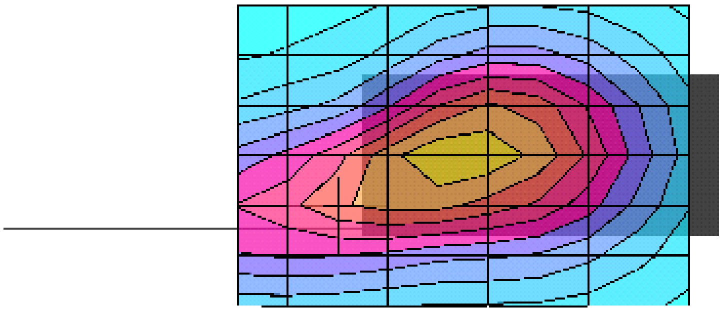
SAM 1 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body 836MHz: σ = 0.94 mho/m ε_r = 56.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.10 mW/g, SAR (10g): 0.785 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.14 dB



QMNRH-3DNG WITH HDK-1K, ANTENNA EXTENDED, BODY, CDMA 800

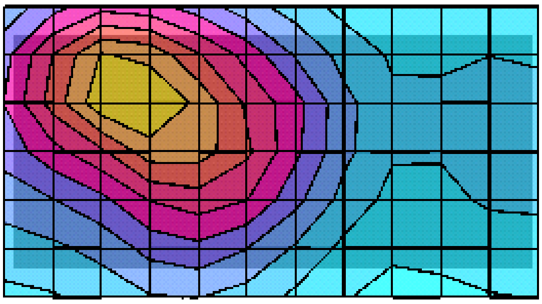
2003-02-24
t(liq.)=21.1°C

SAM 1 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body 836MHz: σ = 0.94 mho/m ε_r = 56.0 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.763 mW/g, SAR (10g): 0.542 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.04 dB



QMNRH-3DNG WITH HDB-4, ANTENNA RETRACTED, BODY, CDMA 1900
2003-02-28
t(liq.)=20.4°C

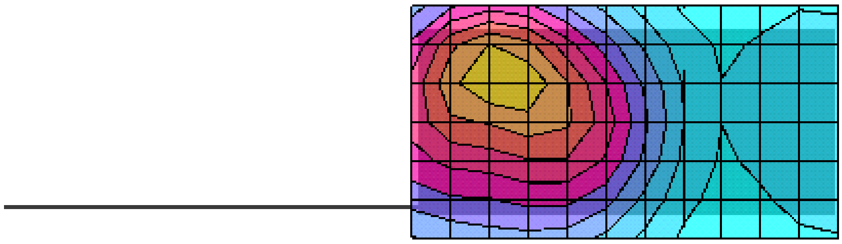
SAM 2 Phantom; Flat Section; BodyPosition: (270°,90°); Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; B0DY 1880 MHz: σ = 1.50 mho/m ε_r = 52.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.422 mW/g, SAR (10g): 0.251 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.09 dB



QMNRH-3DNG WITH HDB-4, ANTENNA EXTENDED, BODY, CDMA 1900

2003-02-28
t(liq.)=20.8°C

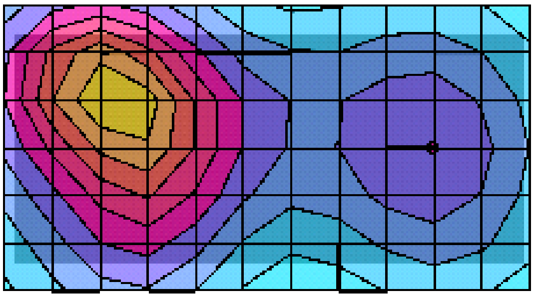
SAM 2 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; BODY 1880 MHz: σ = 1.50 mho/m ε_r = 52.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.431 mW/g, SAR (10g): 0.261 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.05 dB



QMNRH-3DNG WITH HDK-1K, ANTENNA RETRACTED, BODY, CDMA 1900

2003-02-28
t(liq.)=21.4°C

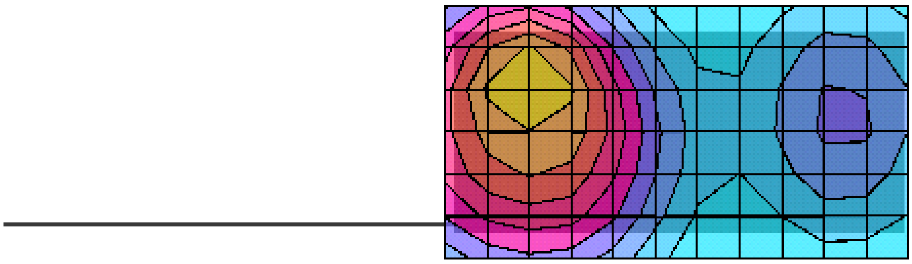
SAM 2 Phantom; Flat Section; Body Position: (270°,90°); Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; B0DY 1880 MHz: σ = 1.50 mho/m ε_r = 52.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.444 mW/g, SAR (10g): 0.266 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.20 dB



QMNRH-3DNG WITH HDK-1K, ANTENNA EXTENDED, BODY, CDMA 1900

2003-02-28
t(liq.)=20.9°C

SAM 2 Phantom; Flat Section;Body Position: (270°,90°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; B0DY 1880 MHz: σ = 1.50 mho/m ε_r = 52.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.433 mW/g, SAR (10g): 0.267 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.03 dB



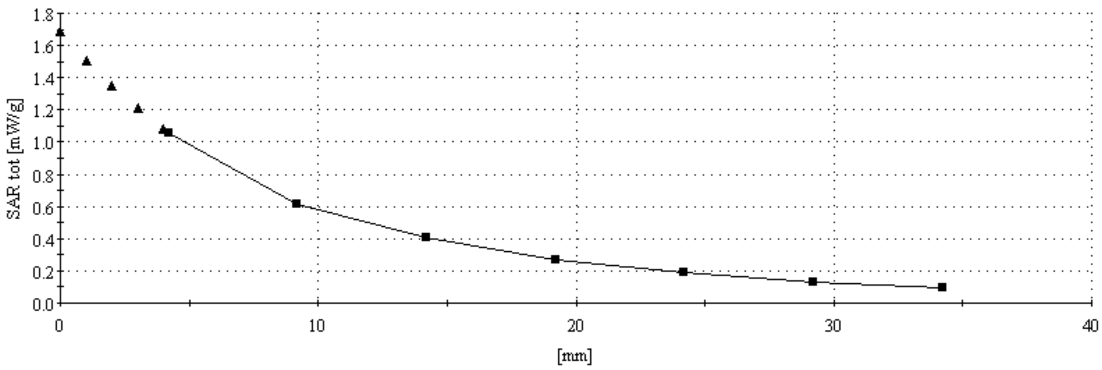
Z-PLOTS OF MAXIMUM RESULTS IN EACH MEASURING LIQUID

QMNRH-3DNG, ANTENNA EXTENDED, LEFT CHEEK, CDMA 800, CH 384

2003-02-25
t(liq.)=21.2°C

Z-plot of the maximum point:

SAM 2 Phantom; Section; Position: ; Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.90,6.90,6.90); Crest factor: 1.0; Brain 835 MHz: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.8$ $\rho = 1.00$ g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

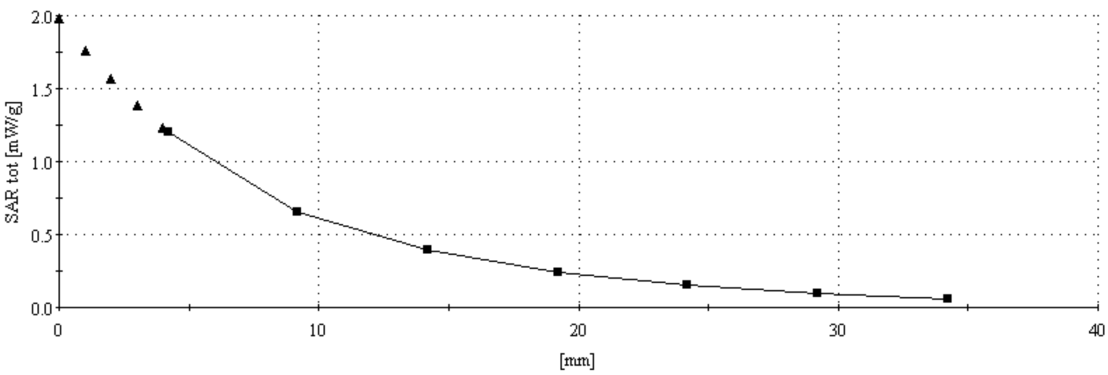


QMNRH-3DNG, ANTENNA EXTENDED, LEFT TILT, CDMA 1900

2003-02-18
t(liq.)=20.0°C

Z-plot of the maximum point:

SAM 1 Phantom; Section; Position: ; Frequency: 1850 MHz
Probe: ET3DV6 - SN1396; ConvF(5.60,5.60,5.60); Crest factor: 1.0; Brain 1880 MHz: $\sigma = 1.41$ mho/m $\varepsilon_r = 40.1$ $\rho = 1.00$ g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

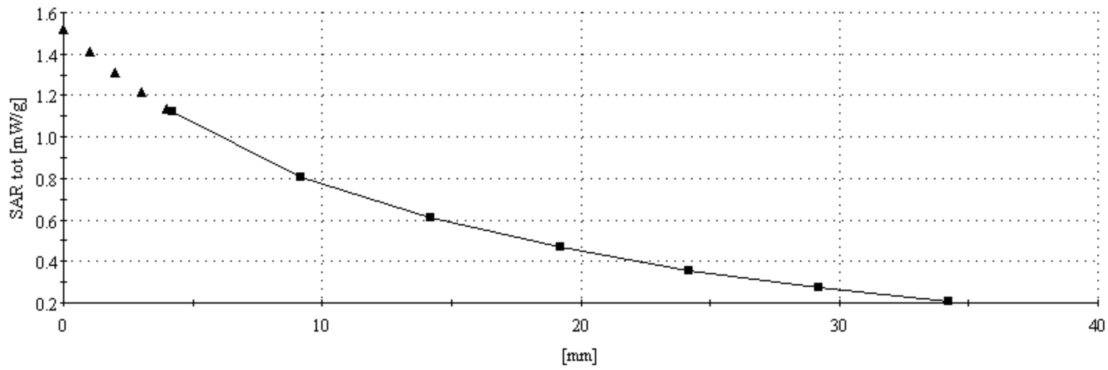


QMNRH-3DNG WITH HDK-1K, ANTENNA RETRACTED, BODY, CDMA 800

2003-02-27
t(liq.)= 21.5°C

Z-plot of the maximum point:

SAM 1 Phantom; Section; Position: ; Frequency: 836 MHz
Probe: ET3DV6 - SN1396; ConvF(6.60,6.60,6.60); Crest factor: 1.0; Body 836MHz: σ = 0.94 mho/m ε_r = 56.0 ρ = 1.00 g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

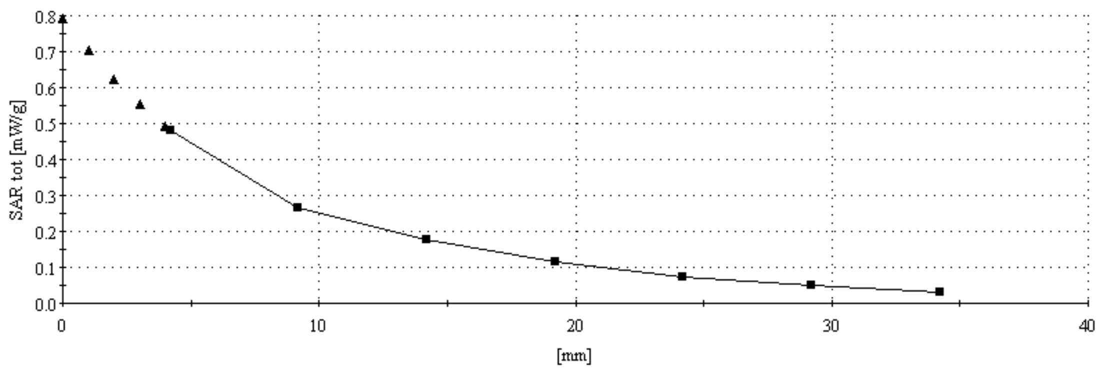


QMNRH-3DNG WITH HDK-1K, ANTENNA RETRACTED, BODY, CDMA 1900

2003-02-28
t(liq.)=21.4°C

Z-plot of the maximum point:

SAM 2 Phantom; Section; Position: ; Frequency: 1909 MHz
Probe: ET3DV6 - SN1396; ConvF(5.10,5.10,5.10); Crest factor: 1.0; B0DY 1880 MHz: σ = 1.50 mho/m ε_r = 52.2 ρ = 1.00 g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



APPENDIX C.
Calibration Certificates

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

Client Nokia Salo (TTC)

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN 1396
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	January 15, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	N. Vetterli
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: January 16, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Schmid & Partner
Engineering AG

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

Probe ET3DV6

SN:1396

Manufactured:	October 1, 1999
Last calibration:	January 29, 2002
Recalibrated:	January 15, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1396

Sensitivity in Free Space

NormX	**1.72**	$\mu V/(V/m)^2$
NormY	**1.73**	$\mu V/(V/m)^2$
NormZ	**1.84**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**93**	mV
DCP Y	**93**	mV
DCP Z	**93**	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	**6.9** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**6.9** ± 9.5% (k=2)		Alpha	**0.35**
ConvF Z	**6.9** ± 9.5% (k=2)		Depth	**2.53**

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	**5.6** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**5.6** ± 9.5% (k=2)		Alpha	**0.46**
ConvF Z	**5.6** ± 9.5% (k=2)		Depth	**2.71**

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	9.2	5.2
SAR_{be} [%]	With Correction Algorithm	0.3	0.5

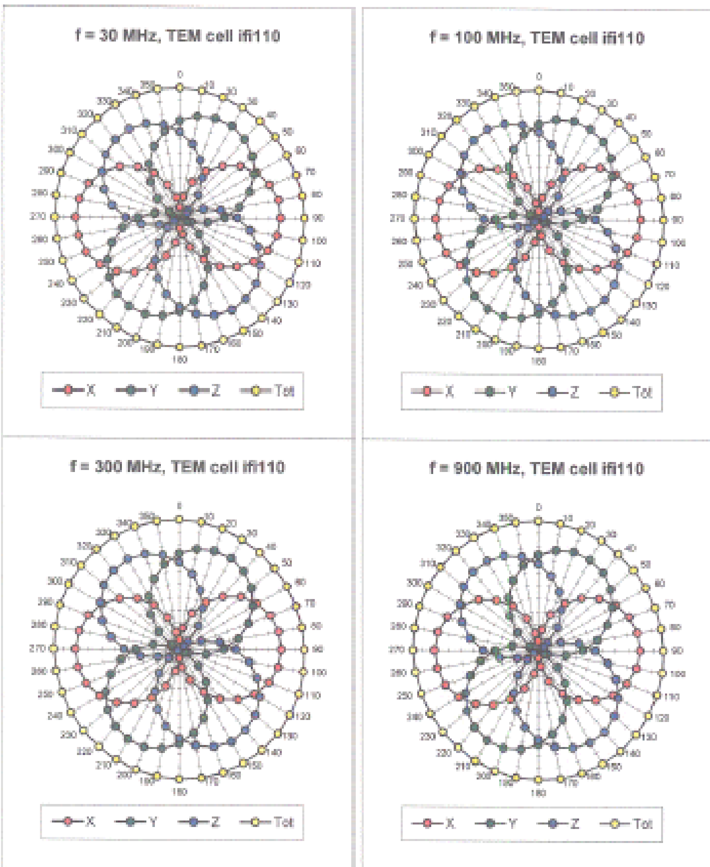
Head 1800 MHz Typical SAR gradient: 10 % per mm

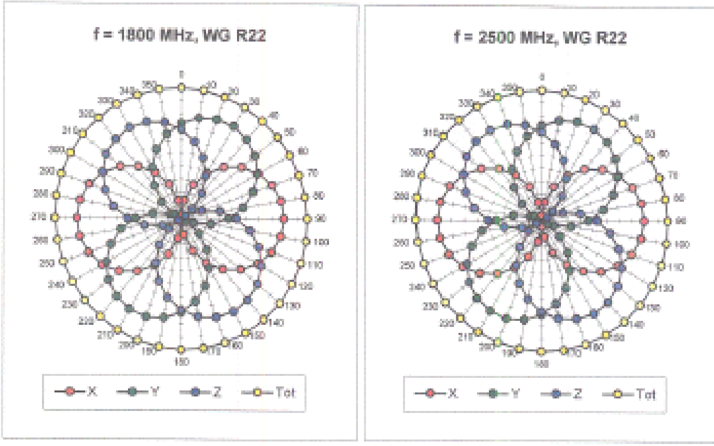
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	13.1	8.9
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

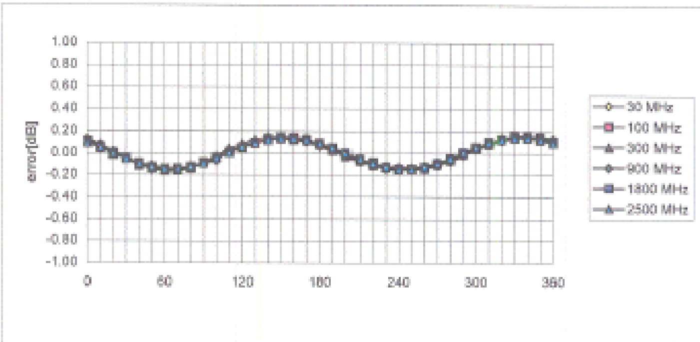
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.5 ± 0.2**	mm

Receiving Pattern (ϕ), $\theta = 0°$



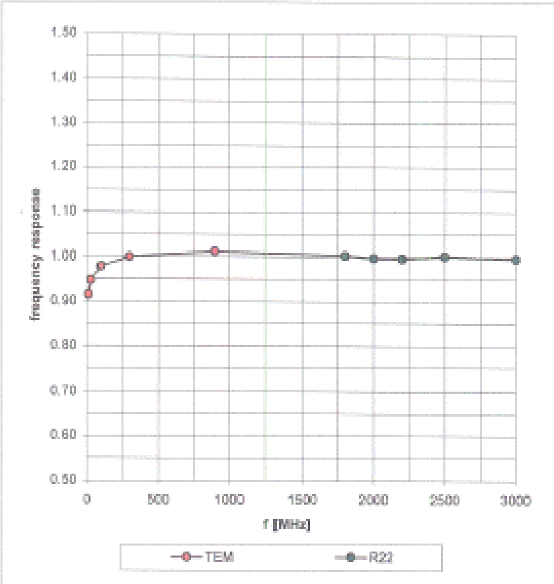


Isotropy Error (ϕ), θ = 0°



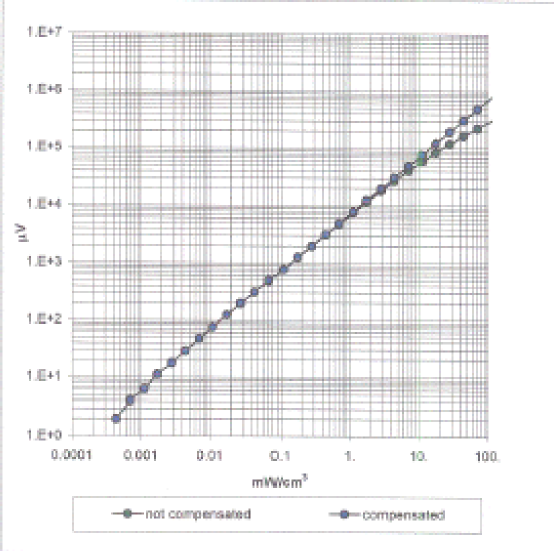
Frequency Response of E-Field

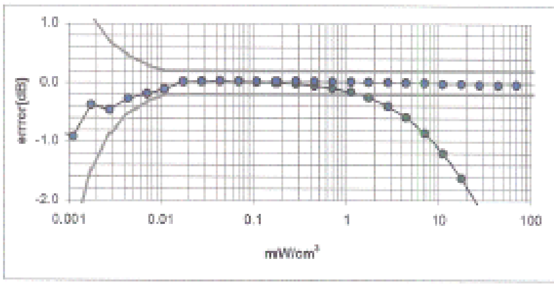
(TEM-Cell:ifi110, Waveguide R22)



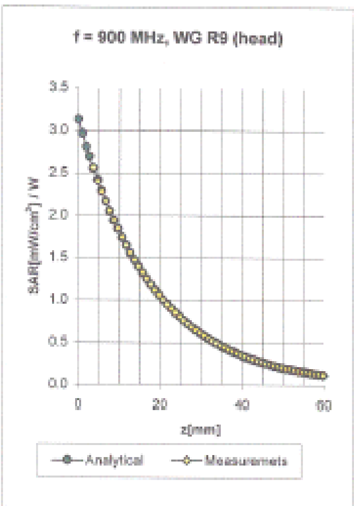
Dynamic Range f(SAR_{brain})

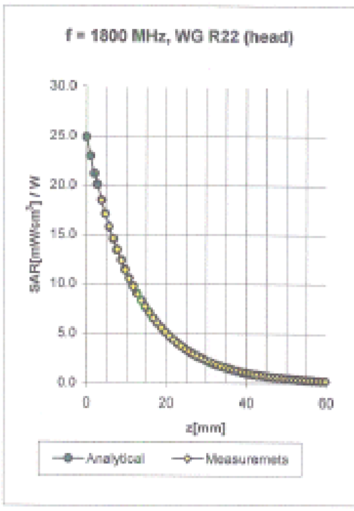
(Waveguide R22)





Conversion Factor Assessment

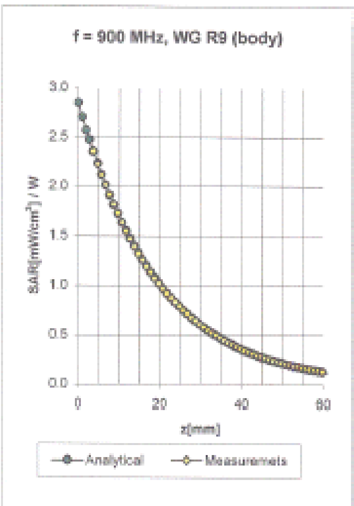


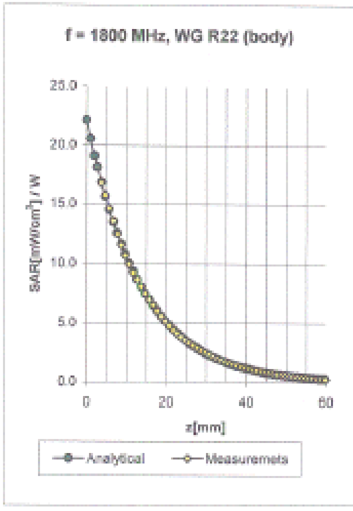


Head	**900 MHz**		ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m	
Head	**835 MHz**		ε_r = 41.5 ± 5%	σ = 0.90 ± 5% mho/m	
	ConvF X	**6.9**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.9**	± 9.5% (k=2)	Alpha	**0.35**
	ConvF Z	**6.9**	± 9.5% (k=2)	Depth	**2.53**

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	**5.6**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.6**	± 9.5% (k=2)	Alpha	**0.46**
	ConvF Z	**5.6**	± 9.5% (k=2)	Depth	**2.71**

Conversion Factor Assessment



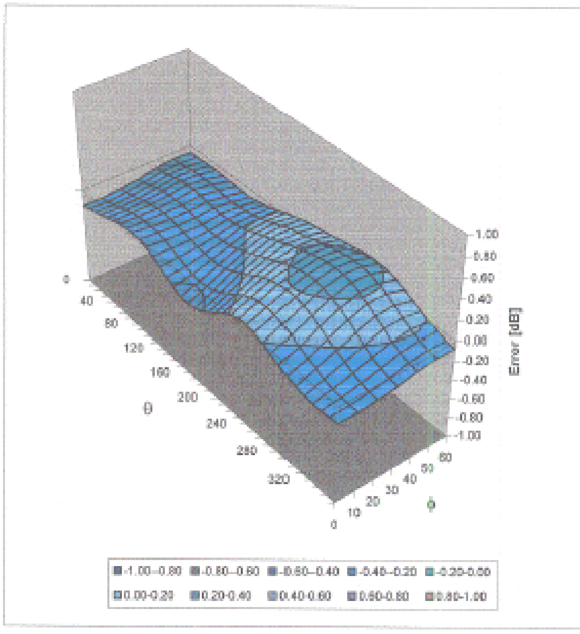


Body	900 MHz	ε_r = 55.0 ± 5%		σ = 1.05 ± 5% mho/m	
Body	835 MHz	ε_r = 55.2 ± 5%		σ = 0.97 ± 5% mho/m	
	ConvF X	6.6	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	6.6	± 9.5% (k=2)	Alpha	0.36
	ConvF Z	6.6	± 9.5% (k=2)	Depth	2.57

Body	1800 MHz	ε_r = 53.3 ± 5%		σ = 1.52 ± 5% mho/m	
Body	1900 MHz	ε_r = 53.3 ± 5%		σ = 1.52 ± 5% mho/m	
	ConvF X	5.1	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	5.1	± 9.5% (k=2)	Alpha	0.53
	ConvF Z	5.1	± 9.5% (k=2)	Depth	2.75

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.Eelds E. Meriano
Approved by:	Alain Katz

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.

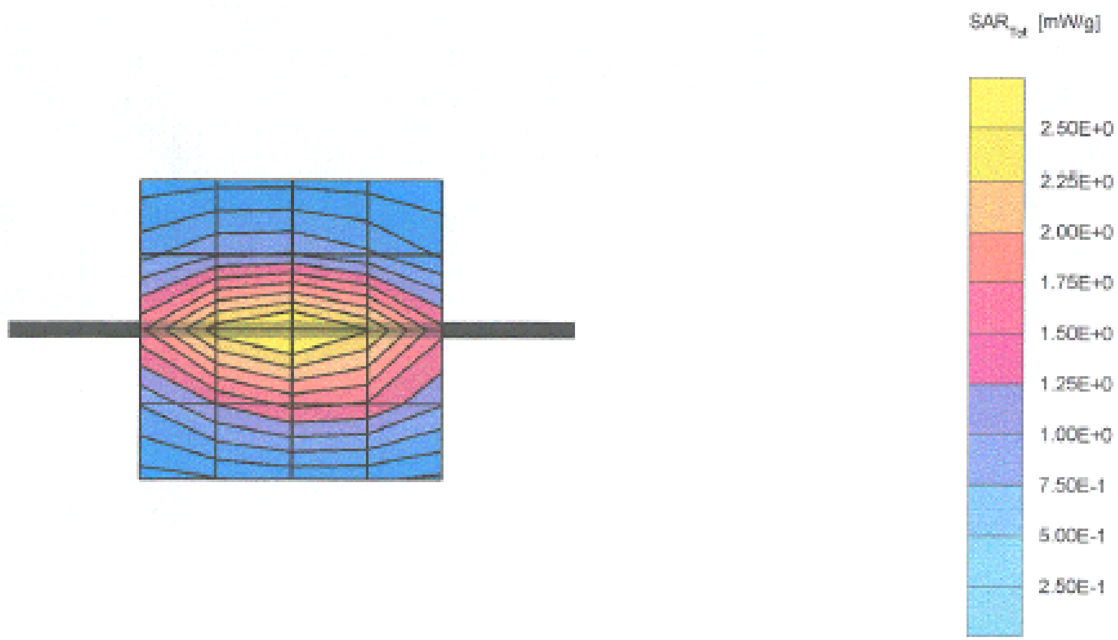
9. Power Test

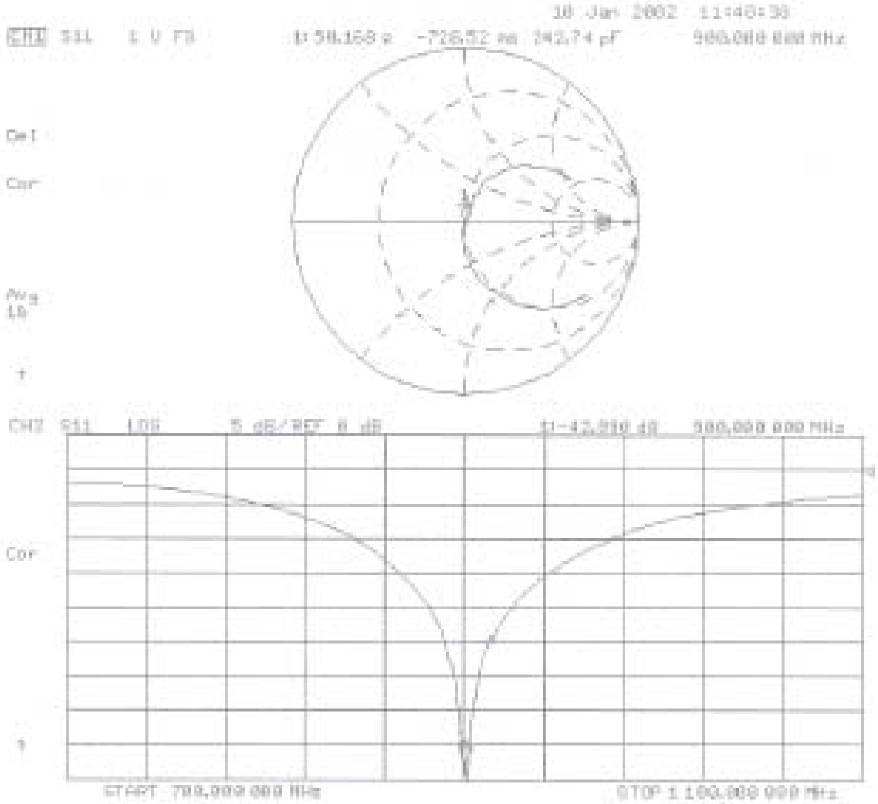
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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



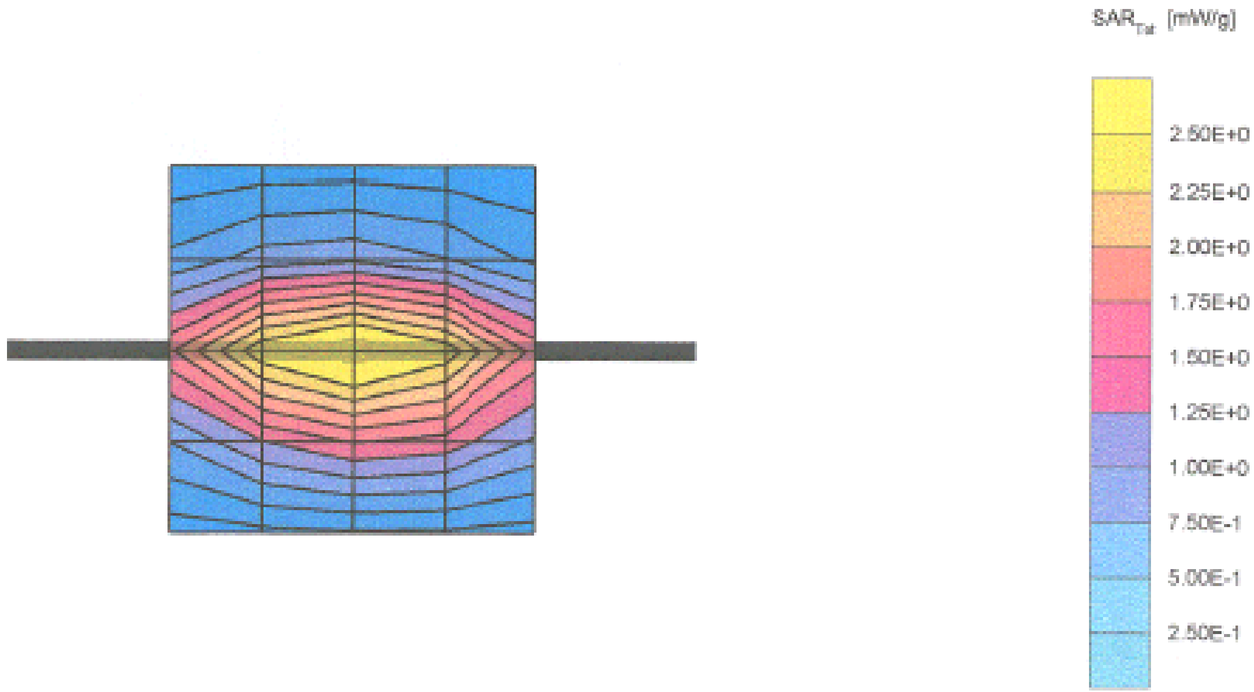


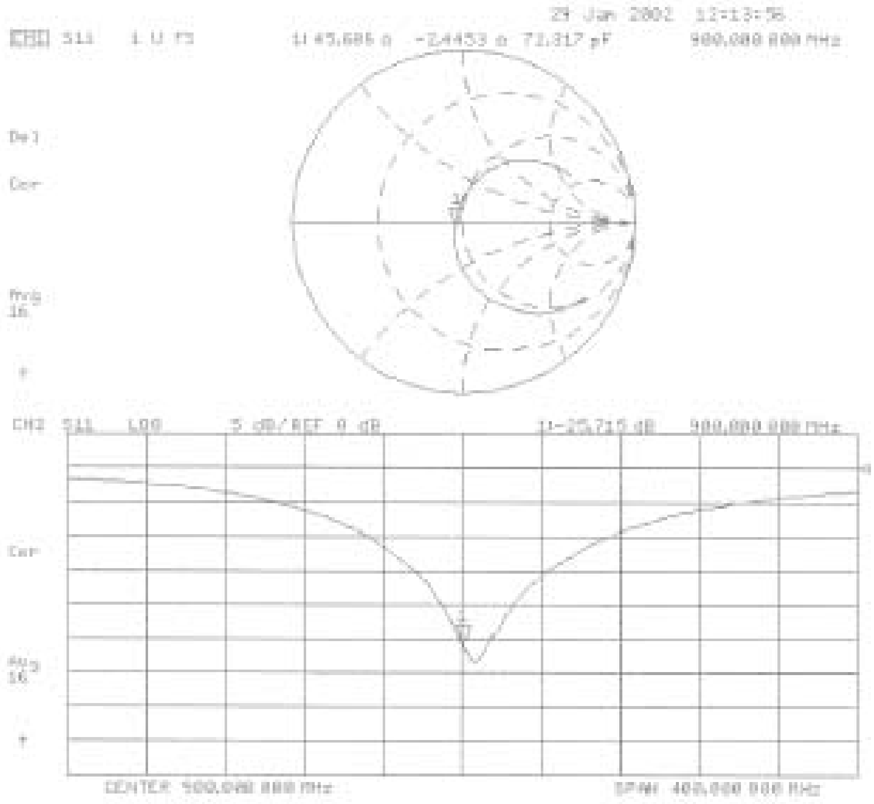
18 Jan 2002 11:40:38
CH1 S11 1 U FS
1: 50.168 Ω -726.52 mΩ 242.74 pF 900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-42.810 dB 900.000 000 MHz
Cor
START 700.000 000 MHz
STOP 1 100.000 000 MHz

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





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:	**256**
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. Kuster Nemana
Approved by:	Ilian Katja

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: 256

Manufactured: December 23, 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 glycol solution of the fol lowing electrical parameters at 1800 MHz:

Relative Dielectricity	**39.6**	± 5%
Conductivity	**1.37 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.31 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 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: **40.0 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **20.8 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:	**1.180 ns**	(one direction)
Transmission factor:	**0.980**	(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} = **47.3 Ω**
	Im {Z} = **-6.6 Ω**
Return Loss at 1800 MHz	**-22.7 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with body 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 5.0 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 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:	**39.5 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**20.4 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 1800 MHz:	Re{Z} = **43.2 Ω**
	Im {Z} = **-6.3 Ω**
Return Loss at 1800 MHz	**-20.1 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

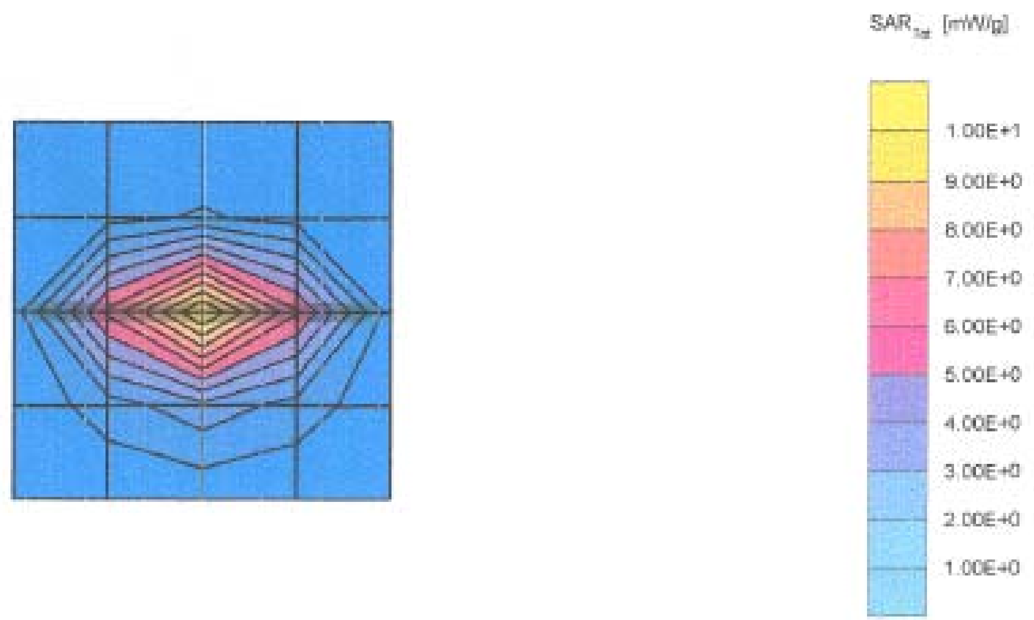
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

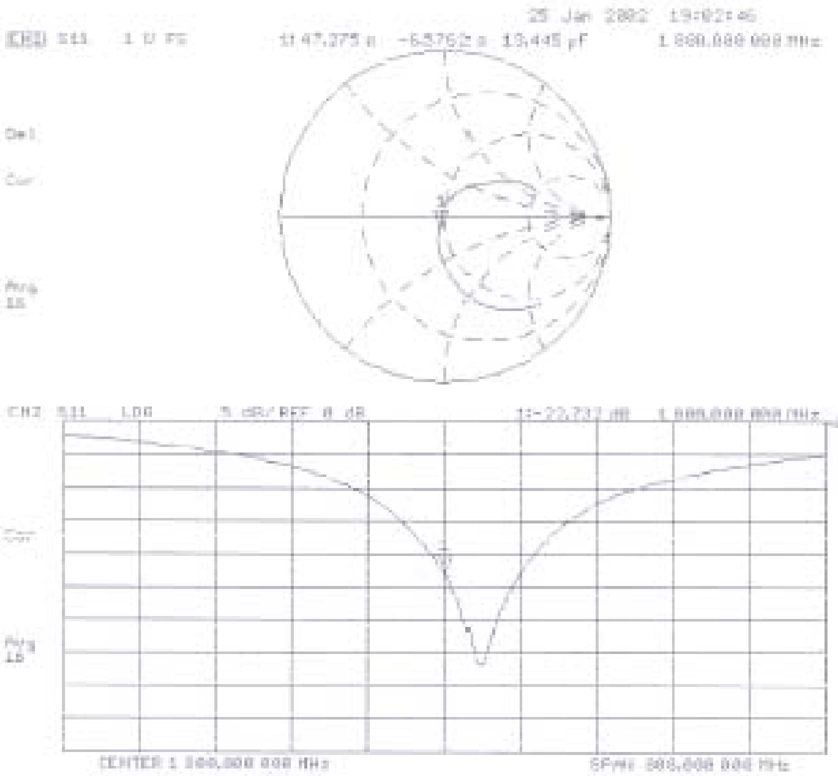
9. Power Test

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

Validation Dipole D1800V2 SN:256, 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(5.31,5.31,5.31) at 1800 MHz; IEEE1528 1800 MHz ; σ = 1.37 mho/m ε_r = 39.6 ρ = 1.00 g/cm³
Cubes (2): Peak: 18.9 mW/g ± 0.04 dB, SAR (1g): 9.99 mW/g ± 0.01 dB, SAR (10g): 5.19 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.2 (7.7, 9.2) [mm]
Powerdrift: -0.02 dB

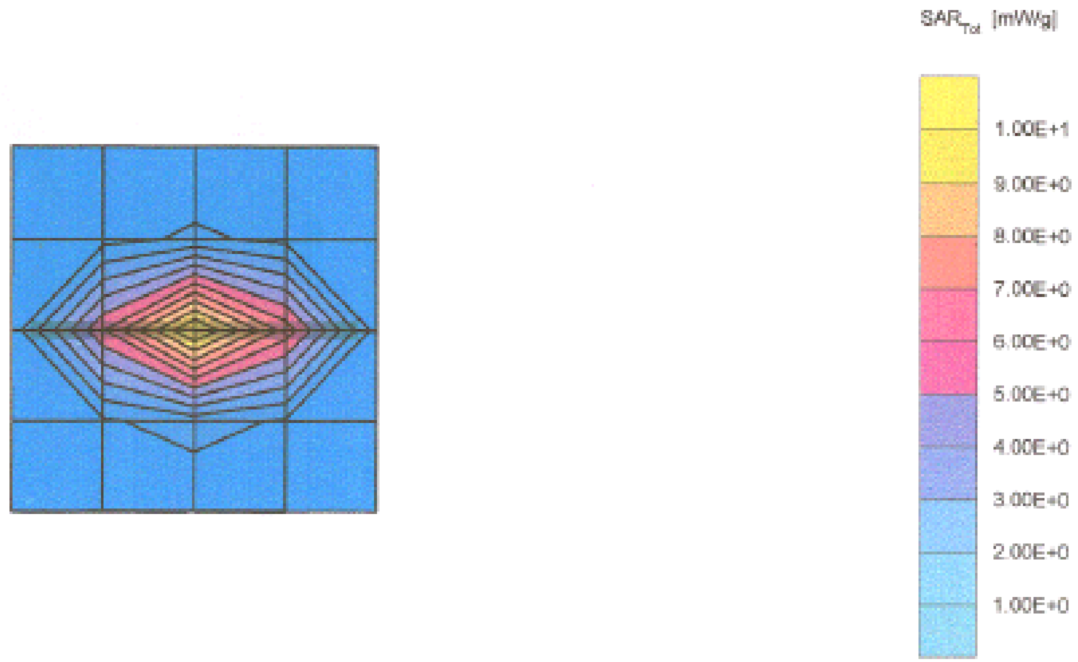


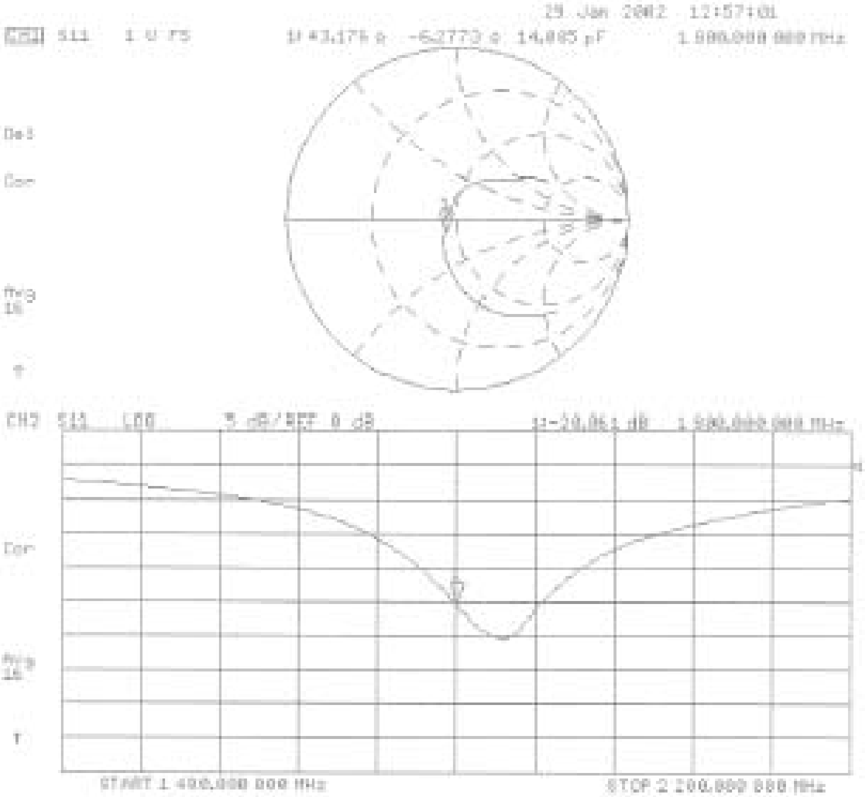

25 Jan 2002 19:02:46
S11 1 U FS
1:47.275 Ω -6.5762 Ω 13.445 pF 1 000.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB 1:-22.732 dB 1 000.000 000 MHz
Cor
Avg
16
CENTER 1 000.000 000 MHz
SPAN 800.000 000 MHz

01/29/02

Validation Dipole D1800V2 SN:256, 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(5.00,5.00,5.00) at 1800 MHz; Muscle 1800 MHz; σ = 1.45 mho/m ε_r = 53.5 ρ = 1.00 g/cm³
Cubes (2): Peak: 18.7 mW/g ± 0.02 dB, SAR (1g): 9.87 mW/g ± 0.01 dB, SAR (10g): 5.11 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.4 (7.7, 9.8) [mm]
Powerdrift: -0.01 dB





29 Jan 2002 12:57:01
CH1 S11 1 U FS
1: 43.176 Ω -6.2773 Ω 14.085 pF 1 800.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/REF 0 dB
1: -20.061 dB 1 800.000 000 MHz
Cor
Avg
16
START 1 400.000 000 MHz
STOP 2 200.000 000 MHz