NOKIA

NOKIA CORPORATION
Nokia Mobile Phones
Joensuunkatu 7e
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Tel. +358 7180 08000

Jan 16, 2003

Federal Communications Commission,
Authorization & Evaluation Division,
7435 Oakland Mills Road
Columbia, MD. 21046

Attention: Equipment Authorization Branch

We hereby certify that the transceiver FCC ID: PYANHL-4J complies with ANSI/IEEE C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

Compliance was determined by testing appropriate parameters according to standard.

NOKIA CORPORATION

Kari Pitkäranta
Product Program Manager, PC Center Salo

TCC
Salo

FINAS AKKREDITOINTI SUOMI FINLAND
T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	SAR0251_10.doc	Date of report:	2003-01-17
Number of pages:	46	Contact person:	Hannu Söderholm
		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 Corporation P.O. Box 86 Joensuunkatu 7E FIN-24101 SALO, FINLAND Tel. +358 (0) 7180 08000 Fax. +358 (0) 7180 44277

Tested devices:	**PYANHL-4J** Battery: BLD-3, Headset: HDB-4
Supplement reports:	-
Testing has been carried out in accordance with:	FCC CFR. 47, Part 2.1093 and IEEE 1528-200X Draft 6.5 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: 2003-01-17

For the contents:

Arto Hihnala	Virpi Tuominen
Engineering Manager, EMC	Senior Design Engineer

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory.

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1. SUMMARY FOR SAR TEST REPORT

Date of receipt	2002-12-10
Date of test	2002-12-16 to 2002-12-17
Contact person	Hannu Söderholm
Test plan referred to	DTX04568-EN Sub Certification Plan HDF-16
FCC ID	PYANHL-4J
SN, HW, SW and DUT numbers	DUT: 06221 SN: 004400/12/166790/9 HW: 0510 SW: Vp 2.01
Accessories	Battery BLD-3 DUT #'s: 06136, 06137, 06139, 06167, 06222 Headset HDB-4 DUT: 06223 HW: 1.0
Notes	All tests were performed in GSM 1900 voice call mode at maximum power level.
Document code	SAR0251_10.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)	Power	Position	Limit 1g (avg)	Measured 1g (avg)	Result
512 / 1850	32.48 dBm	Right hand tilt position	1.6 mW/g	0.69 mW/g	PASSED

1.1.2 Body Worn Configuration

Ch / *f* (MHz)	Power	Accessory	Limit 1g (avg)	Measured 1g (avg)	Result
660 / 1880	32.94 dBm	Headset HDB-4	1.6 mW/g	0.35 mW/g	PASSED

1.1.3 Body Worn Configuration, SAR values doubled, corresponding to GPRS mode

Ch / *f* (MHz)	Power	Accessory	Limit 1g (avg)	Measured 1g (avg)	Result
660 / 1880	32.94 dBm	Headset HDB-4	1.6 mW/g	0.70 mW/g	PASSED

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1.1.4 Measurement Uncertainty

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

1.2 EIRP Measurements

The measurement of the EIRP from the PYANHL-4J was performed by RFI test laboratory in UK.

Radio Frequency Investigation Ltd
Ewhurst Park, Ramsdell, Basingstoke
Hampshire RG26 5RQ
UK

Report#: RFI/MPTB1/RP44021JD01A

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2. DESCRIPTION OF THE TESTED DEVICE(S)

2.1 Device description

FCC ID Number	PYANHL-4J	
Device category	Portable	
RF Exposure Limits	General population / Uncontrolled	
Unit type	Prototype unit	
Case type	Fixed case	
Modes of Operation	GSM 1900	GPRS
Modulation Mode	GMSK	GMSK
Duty Cycle	1/8	2/8
Maximum Device Rating	Power class II	Power class II
Transmitter Frequency Range (MHz)	1850.2 - 1909.8	1850.2 - 1909.8

Acronyms: GMSK = Gaussian Minimum Shift Keying

Outside of USA, transmitter of tested device may capable of transmitting also in [GSM 900 and GSM 1800] modes, which are not part of this filing.

2.2 Picture of Phone

Fig. 2.2.1. Phone PYANHL-4J

2.3 Description of the Antenna

Type	Internal integrated antenna
Location	Inside the back cover, near the top of the device

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2.4 Battery Options

There is only one battery available for the tested device, a rechargeable Li-ion battery, type BLD-3.

2.5 Accessories

Headset HDB-4 was 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, Schwitzerland

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

3.2 Robot

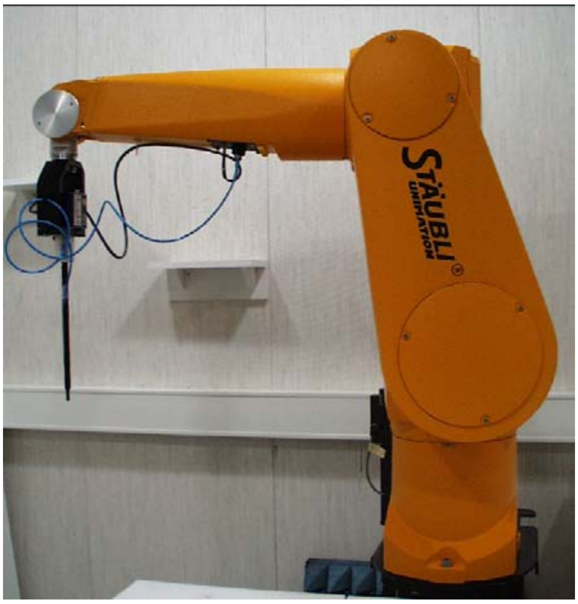

Fig. 3.2.1 Robot

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 1800 MHz dipole antenna is matched for use near flat phantoms filled with head/body simulation solutions. The dipole is equipped with 10 mm distance holder.

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

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3.6 Phantom

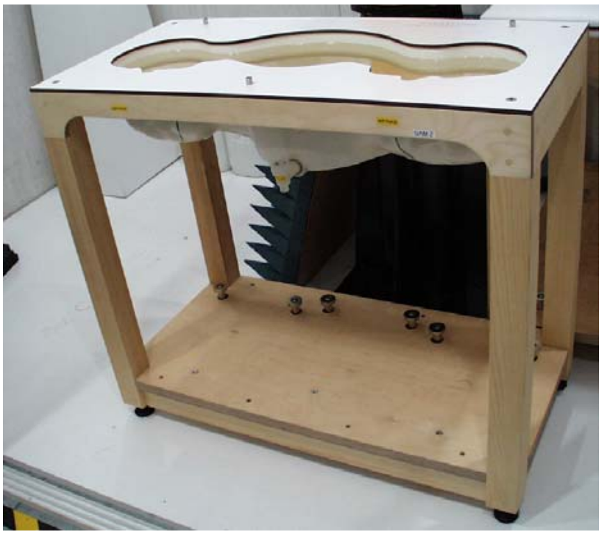

Fig. 3.6.1. SAM-phantom

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 FCC-ID 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.

Test Equipment	Digital radiocommunication Tester
Model	CMU 200
Serial number	1100.0008.02
Calibration	Mar-02
Due date	Mar -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-02	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

Ambient temperature (°C)	22 ± 1°C
Humidity	26-36 % RH

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 system performance check, which was done using the dipole validation kit.

The dipole antenna is matched to be used near flat section of the phantom filled with tissue simulating solution. Length of 1800 MHz dipole is 72 mm with overall height of 295 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 printout of the test is 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	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	9.49 – 10.49	37.6 – 41.6	1.30 – 1.44
	2002-12-17	9.84	38.6	1.35
MUSCLE 1800 MHz	Reference Result	9.87	53.5	1.45
	Requirement	8.88 – 10.86	50.8 – 56.2	1.38 – 1.52
	2003-01-09	9.90	54.1	1.39

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4.3 Tissue Simulants

4.3.1 Measured values of liqid 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 given in OET Bulletin 65, Supplement C, Edition 01-01.

Tissue	Recommended		Measuring date	Mid ch	
	ε_r	σ		ε_r	σ
HEAD 1880 MHz	38.0 – 42.0	1.33 – 1.47	2002-12-17	38.3	1.43
MUSCLE 1880 MHz	50.6 – 56.0	1.44 – 1.60	2002-12-16	53.5	1.49
			2003-01-09	53.7	1.47

4.3.2 Recipes of tissue simulating liquids

Tissue simulating liquids on 1900 MHz

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

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5. 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. Furthermore, the cellular phone was measured under the flat section of the phantom. 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.

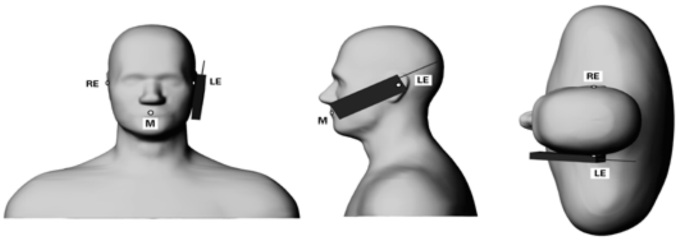

Fig. 5.1.1. Cheek/Touch position

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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.

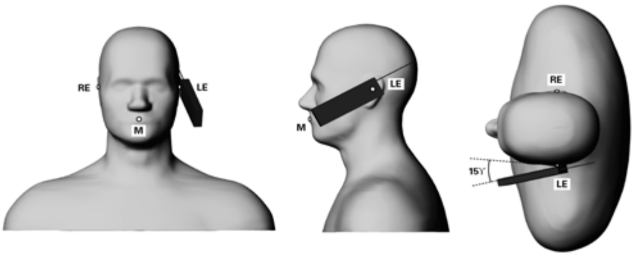

Fig. 5.1.2. Ear/Tilt Position.

5.1.3 Photos of setup

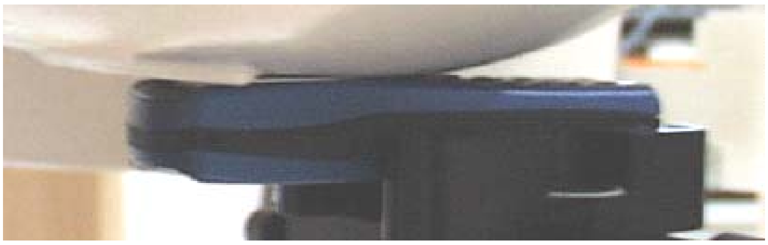

Fig. 5.1.3.1. PYANHL-4J in cheek position.

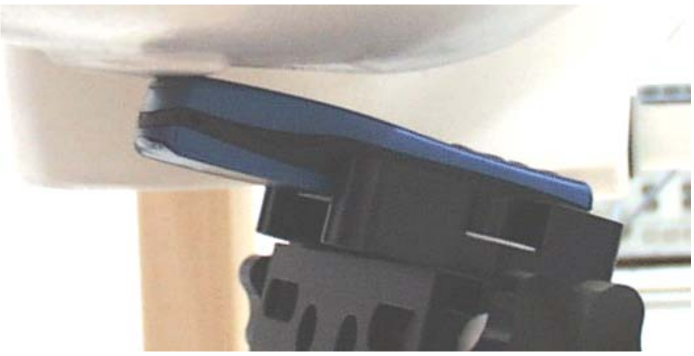

Fig. 5.1.3.2. PYANHL-4J in tilt position.

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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 22 mm separation distance. Measurements were performed with the antenna side towards the phantom.

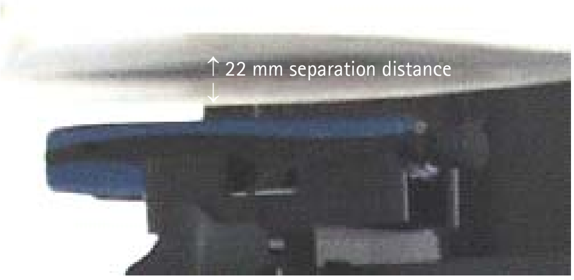

Fig. 5.1.4.1. PYANHL-4J in body position.

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

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 results of the different test configurations are included in the appendix B as SAR distribution plots.

7.1 Head Configuration

Options	GSM 1900			
	Channel	Low	Mid	High
	Channel #	512	661	810
	EIRP (dBm)	32.48	32.94	30.80
No slide or antenna options	Cheek, left hand	0.503	0.455	0.289
	Tilt, left hand	0.596	0.510	0.289
	Cheek, right hand	0.624	0.452	0.268
	Tilt, right hand	**0.689**	0.552	0.304

7.2 Body configuration

Accessory	GSM 1900			
	Channel	Low	Mid	High
	Channel #	512	661	810
	EIRP (dBm)	32.48	32.94	30.80
HDB-4	Separation distance: 22 mm	0.334	**0.350**	0.228

7.3 Body configuration with GPRS

Accessory	GSM 1900			
	Channel	Low	Mid	High
	Channel #	512	661	810
	EIRP (dBm)	32.48	32.94	30.80
HDB-4	Separation distance: 22 mm	0.668	**0.700**	0.456

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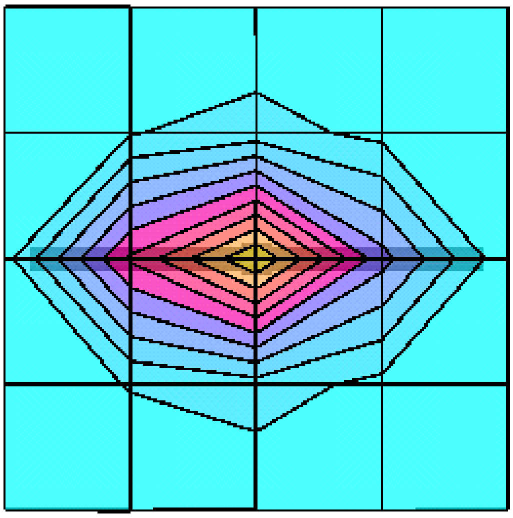
APPENDIX A.

Validation Test Printouts

Dipole 1800 MHz

2002-12-17
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 1.0;
Brain 1800 MHz: $\sigma = 1.35$ mho/m $\varepsilon_r = 38.6$ $\rho = 1.00$ g/cm^3; t=22.2°C
Cubes (2): Peak: 18.3 mW/g ± 0.02 dB, SAR (1g): 9.84 mW/g ± 0.00 dB, SAR (10g): 5.15 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 8.3 (7.8, 9.4) [mm]
Powerdrift: -0.01 dB



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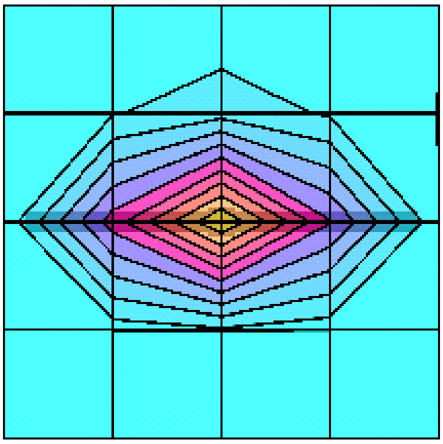
Dipole 1800 MHz

2003-01-09
t(liq.)=21.7°C
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 1.0; BODY 1800 MHz: σ = 1.39 mho/m ε_r = 54.1 ρ = 1.00 g/cm^3
Cubes (2): Peak: 18.1 mW/g ± 0.10 dB, SAR (1g): 9.90 mW/g ± 0.08 dB, SAR (10g): 5.28 mW/g ± 0.05 dB, (Worst-case extrapolation)
Penetration depth: 9.2 (8.3, 10.8) [mm]
Powerdrift: 0.02 dB



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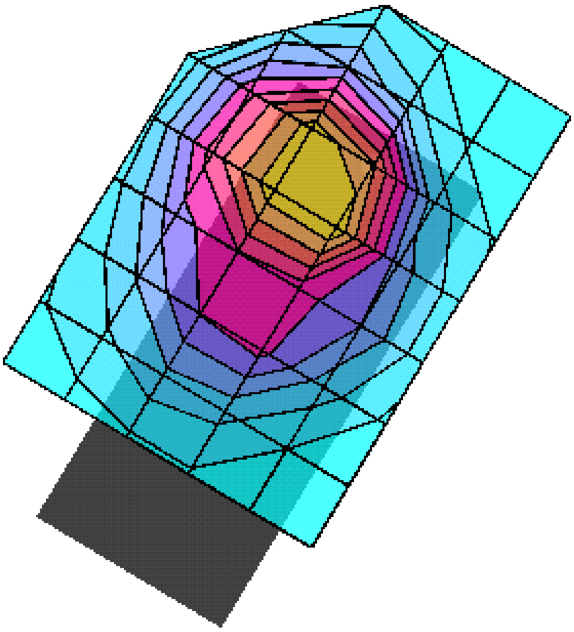
APPENDIX B.

SAR Distribution Printouts

PYANHL-4J, LEFT CHEEK, LOW CHANNEL

2002-12-17
t(liq.)=20.4°C

SAM 2 Phantom; Left Hand Section;Cheek Position; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.503 mW/g, SAR (10g): 0.294 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB



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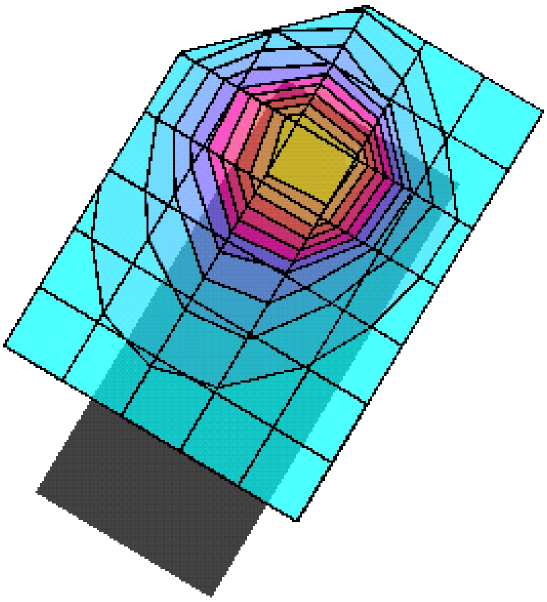
PYANHL-4J, LEFT TILT, LOW CHANNEL

2002-12-17
t(liq.)=20.4°C

SAM 2 Phantom; Left Hand Section;Tilt Position; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.596 mW/g, SAR (10g): 0.338 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB



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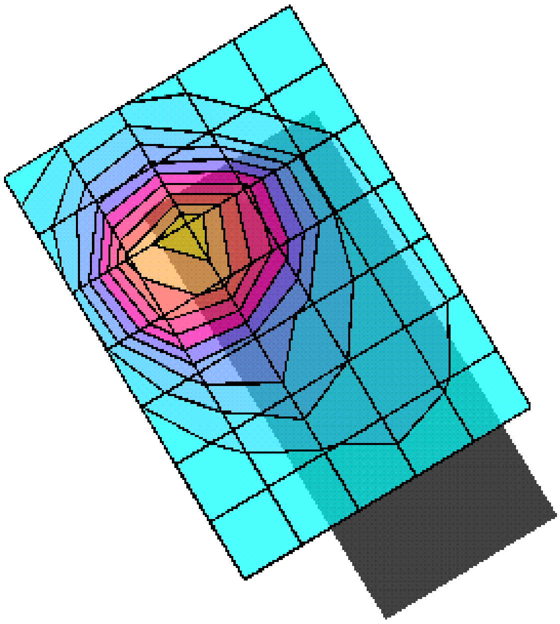
T117 (EN ISO/IEC 17025)

PYANHL-4J, RIGHT CHEEK, LOW CHANNEL

2002-12-17
t(liq.)=21.8 °C

SAM 2 Phantom; Righ Hand Section;Cheek Position; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.624 mW/g, SAR (10g): 0.356 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.00 dB



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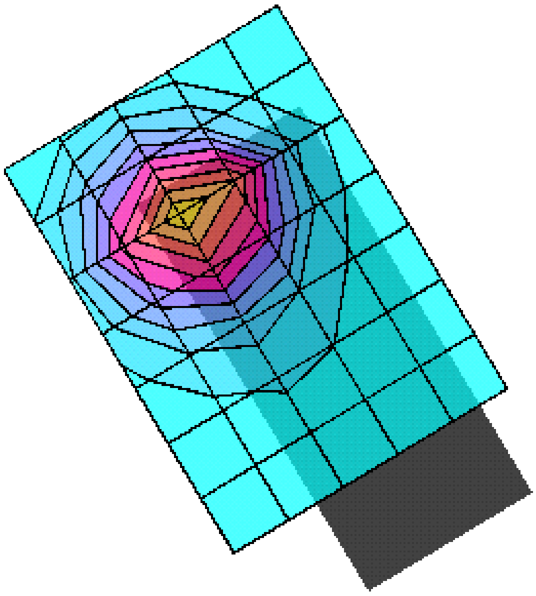
PYANHL-4J, RIGHT TILT, LOW CHANNEL

2002-12-17
t(liq.)=21.6 °C

SAM 2 Phantom; Righ Hand Section;Tilt Position; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.689 mW/g, SAR (10g): 0.384 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.04 dB



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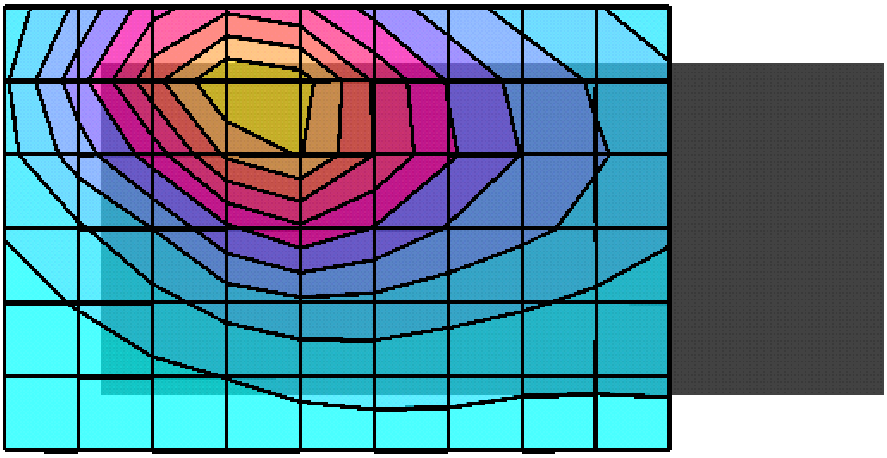
PYANHL-4J WITH HDB-4, BODY, MID CHANNEL

2003-01-09
t(liq.)=21.1 °C

SAM 2 Phantom; Flat Section; Body Position; Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 8.0; BODY 1880 MHz: σ = 1.47 mho/m ε_r = 53.7 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.350 mW/g, SAR (10g): 0.198 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: 0.06 dB



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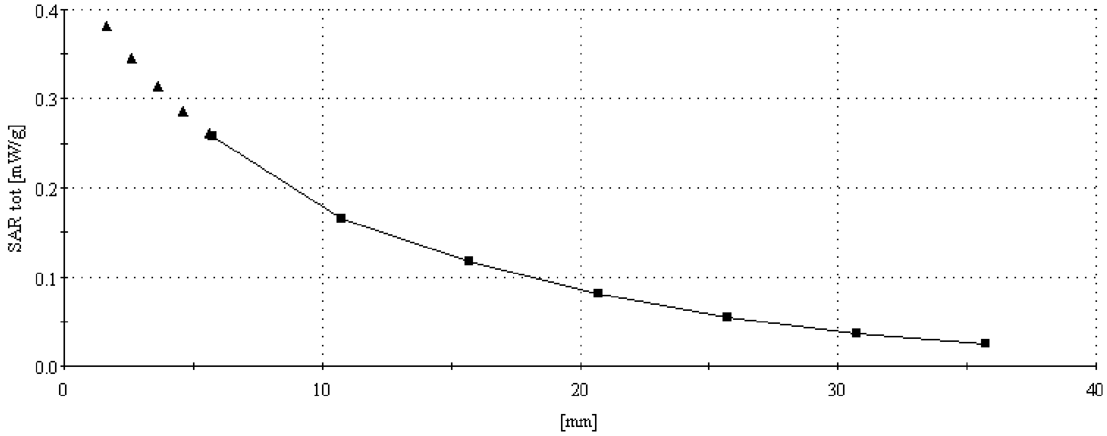
Z-plots of the highest head and body results:

PYANHL-4J, RIGHT TILT, LOW CHANNEL
2002-12-17
t(liq.)=21.6 °C

SAM 2 Phantom; Righ Hand Section;Tilt Position; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(5.40,5.40,5.40); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.3 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.689 mW/g, SAR (10g): 0.384 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0



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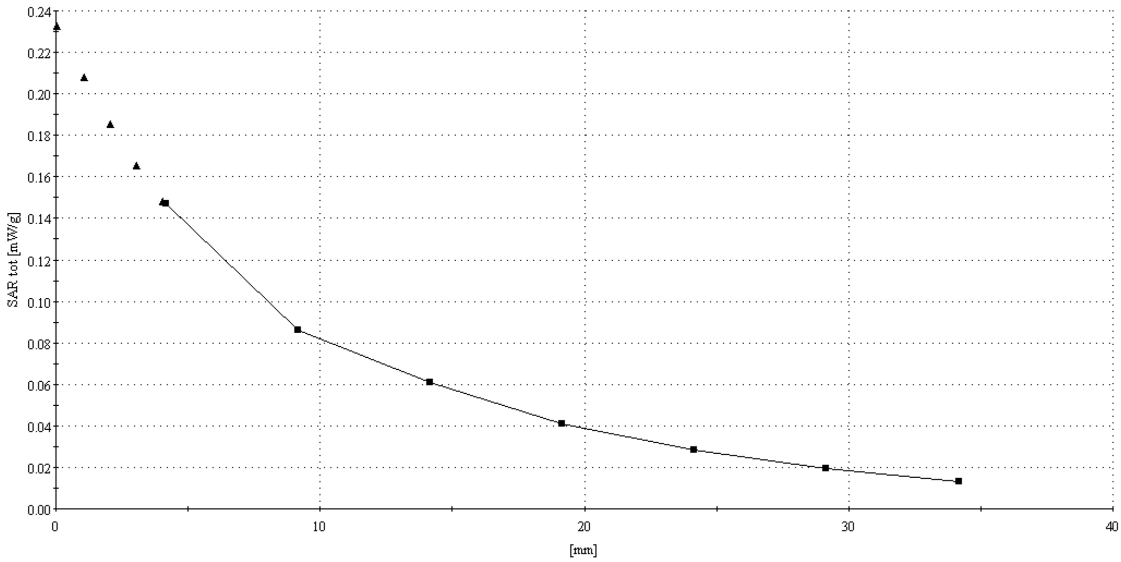
PYANHL-4J WITH HDB-4, BODY, MID CHANNEL

2003-01-09

t(liq.)=21.1 °C

SAM 2 Phantom; Flat Section; Body Position; Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 8.0; B0DY 1880 MHz: σ = 1.47 mho/m ε_r = 53.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.350 mW/g, SAR (10g): 0.198 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0



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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:	D.Vetter
Approved by:	[illegible]

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Schmid & Partner
Engineering AG

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

Probe ET3DV6

SN:1395

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

Calibrated for System DASY3

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ET3DV6 SN:1395 August 27, 2002

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

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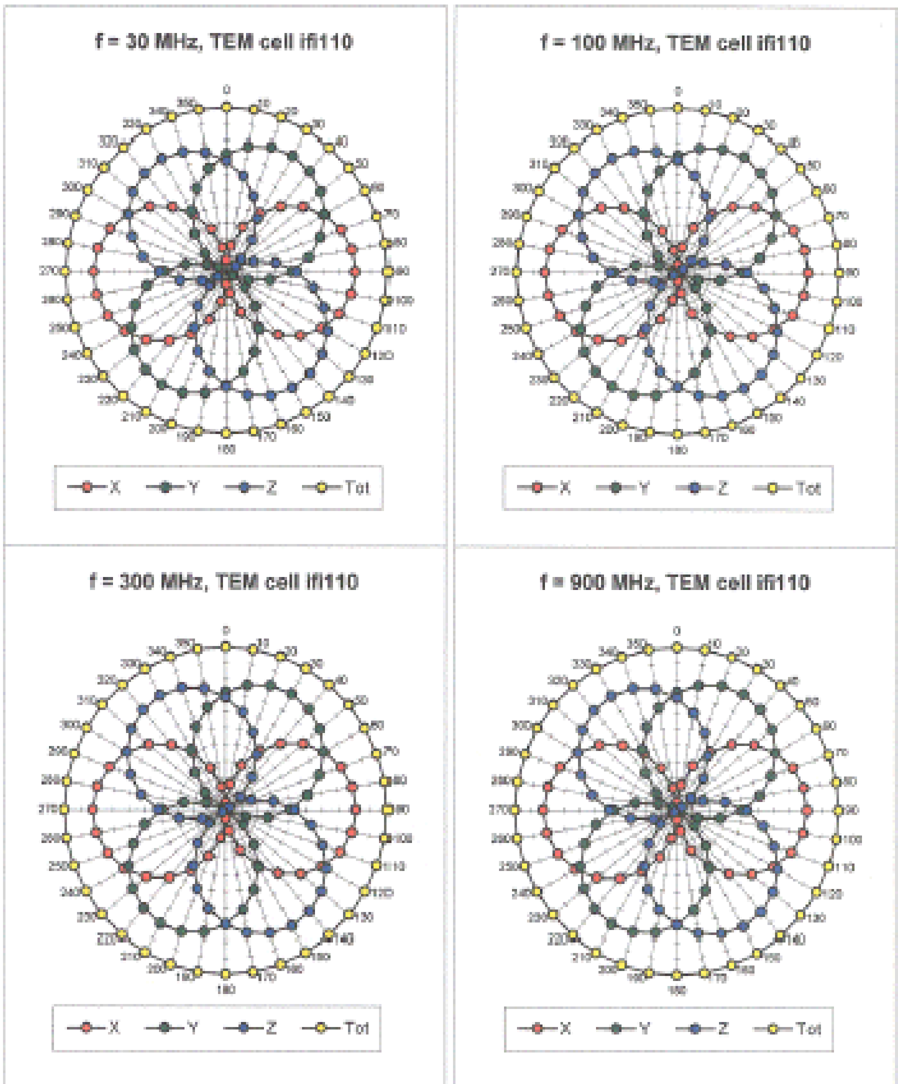
Receiving Pattern (ϕ), θ = 0°



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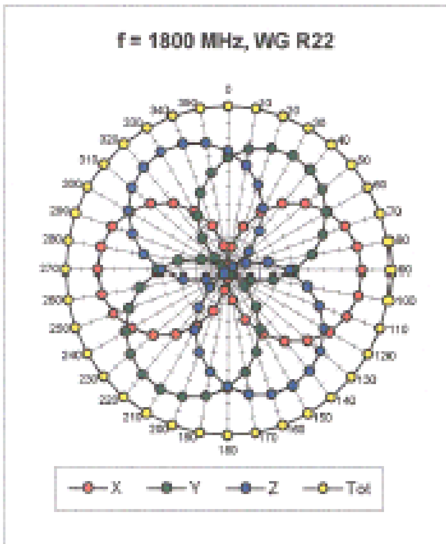
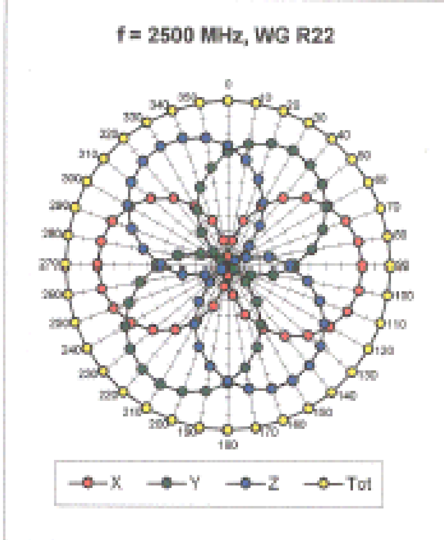
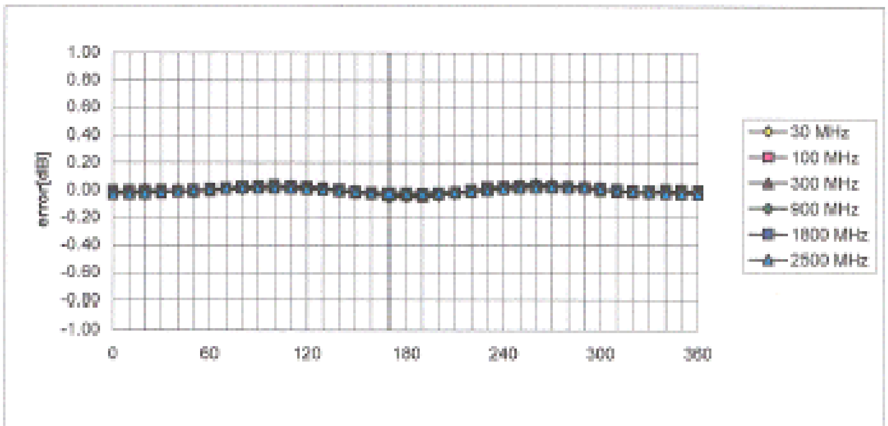
ET3DV6 SN:1395 August 27, 2002





Isotropy Error (ϕ), θ = 0°



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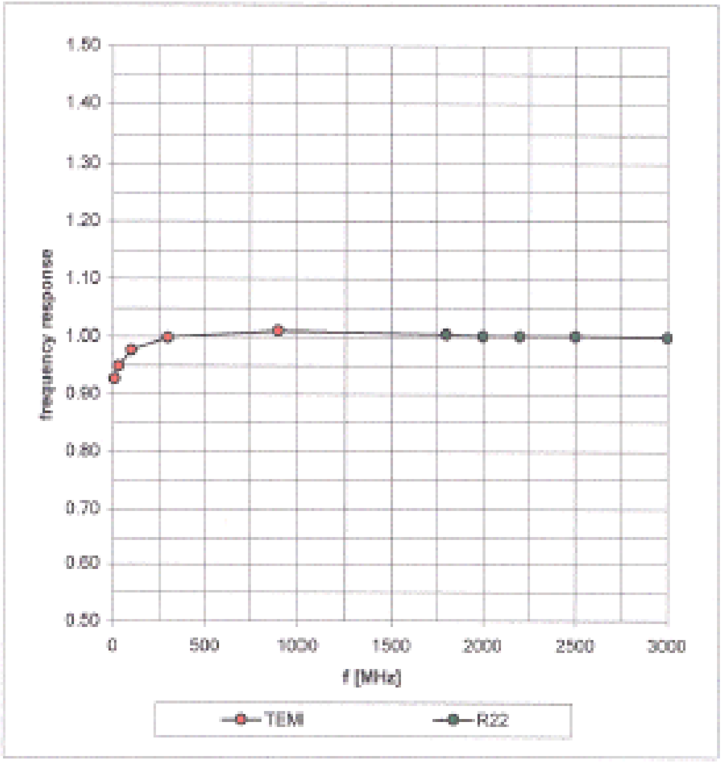
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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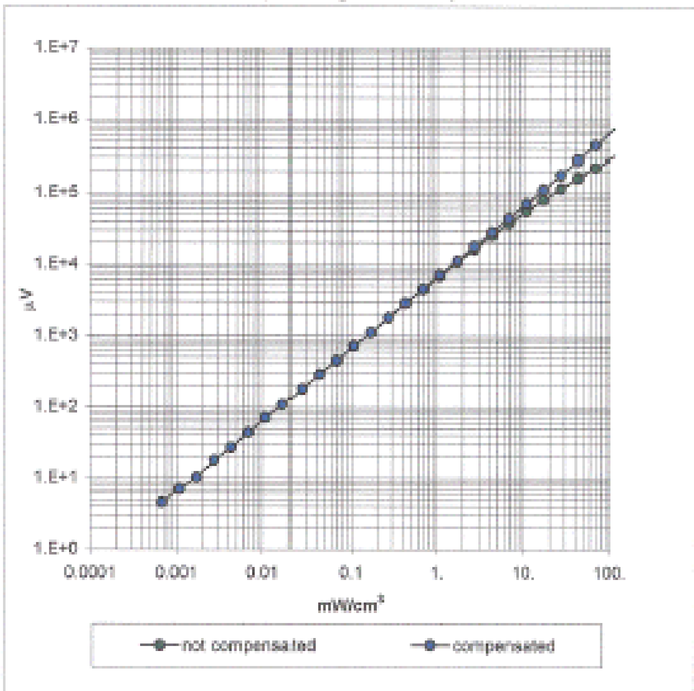
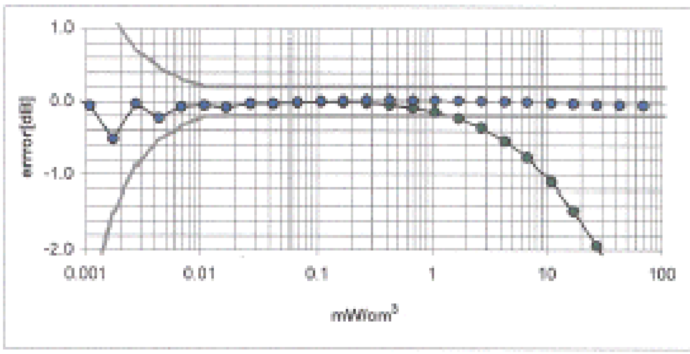
Dynamic Range f(SAR$_{brain}$)

(Waveguide R22)





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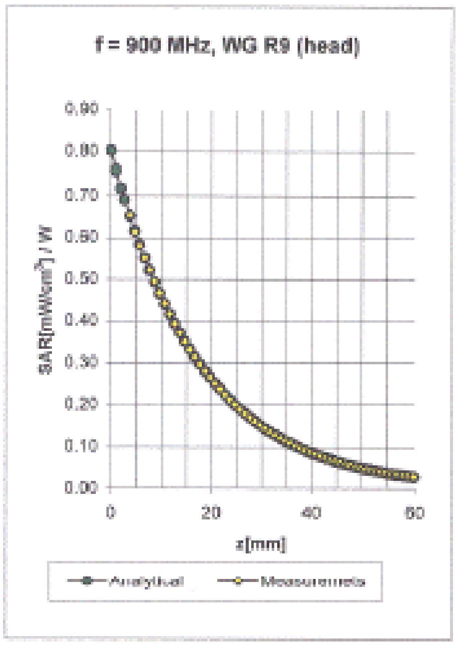
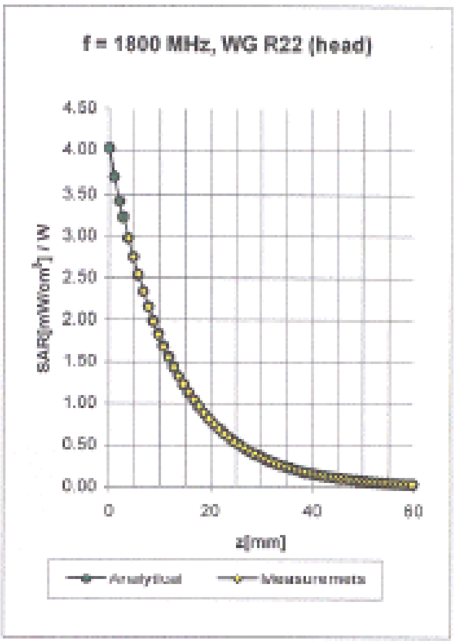
Conversion Factor Assessment





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

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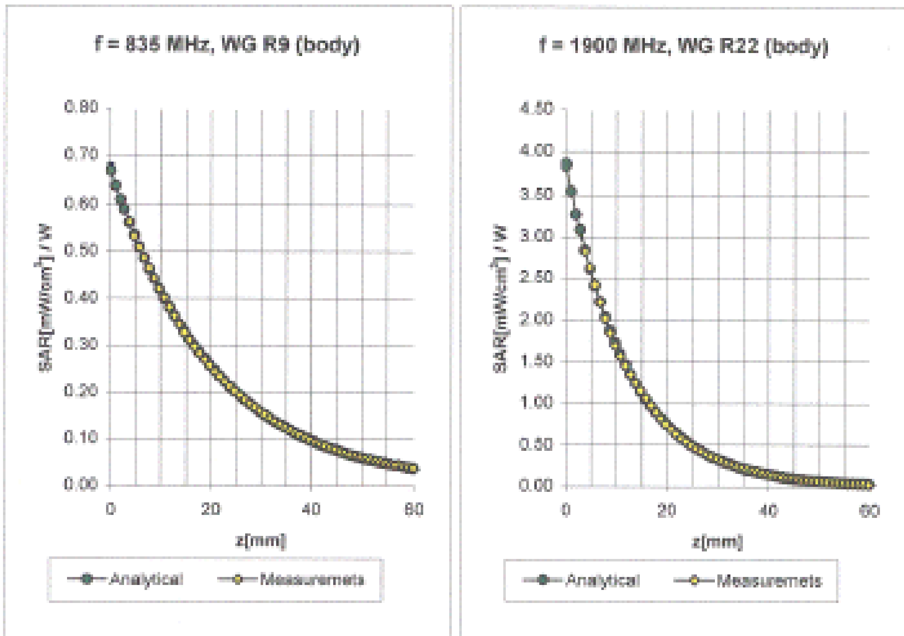
ET3DV6 SN:1395 August 27, 2002

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

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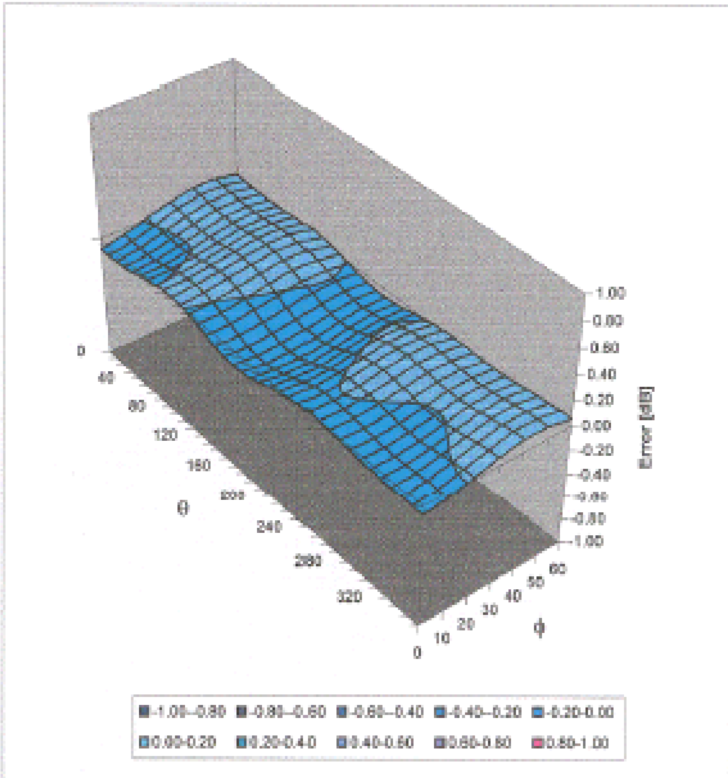
Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



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Schmid & Partner
Engineering AG

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

Calibration Certificate

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:	
Approved by:	

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DASY

Dipole Validation Kit

Type: D1800V2

Serial: 256

Manufactured: December 23, 1999
Calibrated: January 29, 2002

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1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating 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'.

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3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.180 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.

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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.

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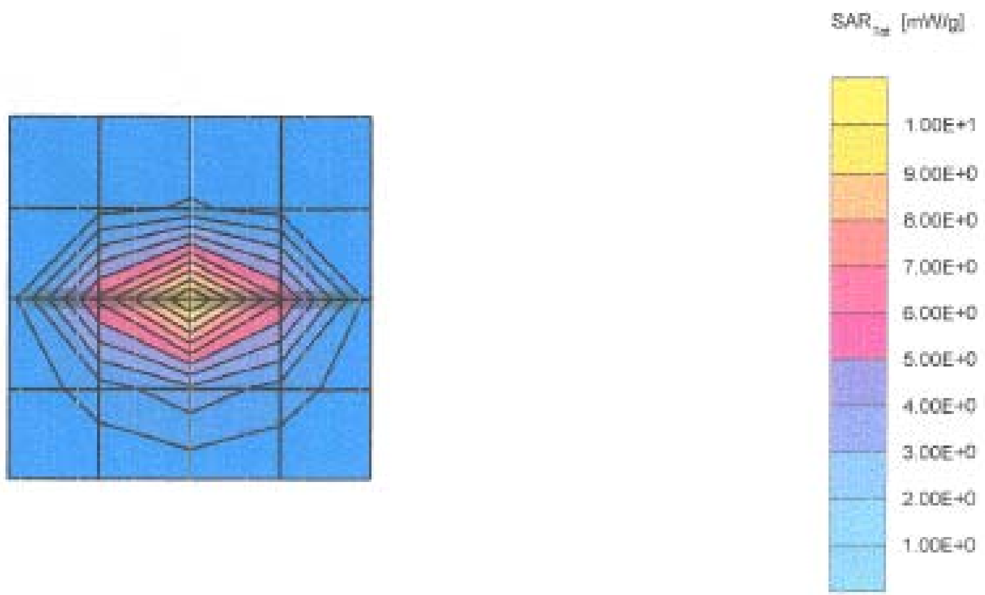
Validation Dipole D1800V2 SN:256, d = 10 mm

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



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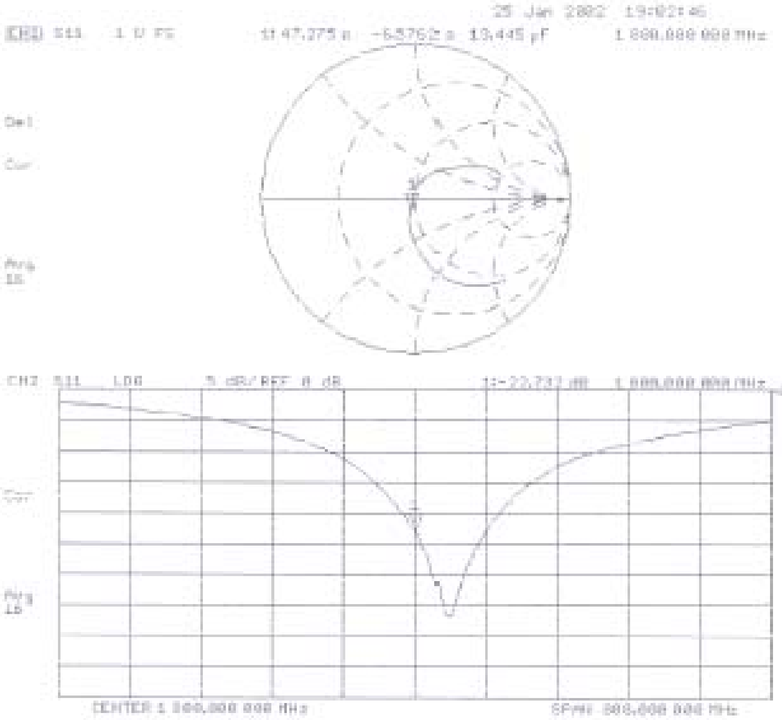

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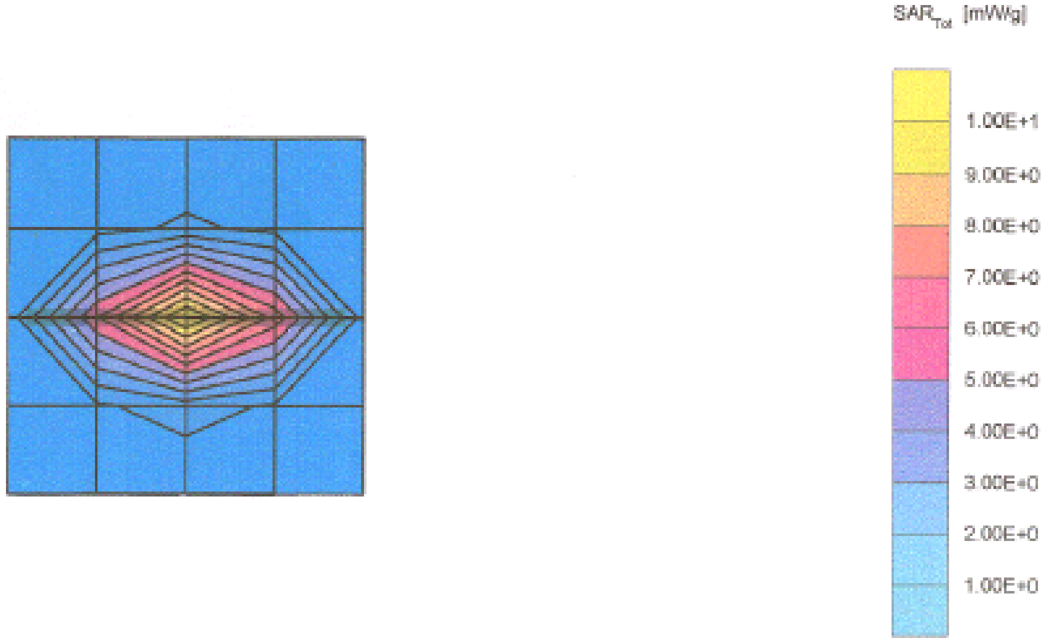
01/29/02

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



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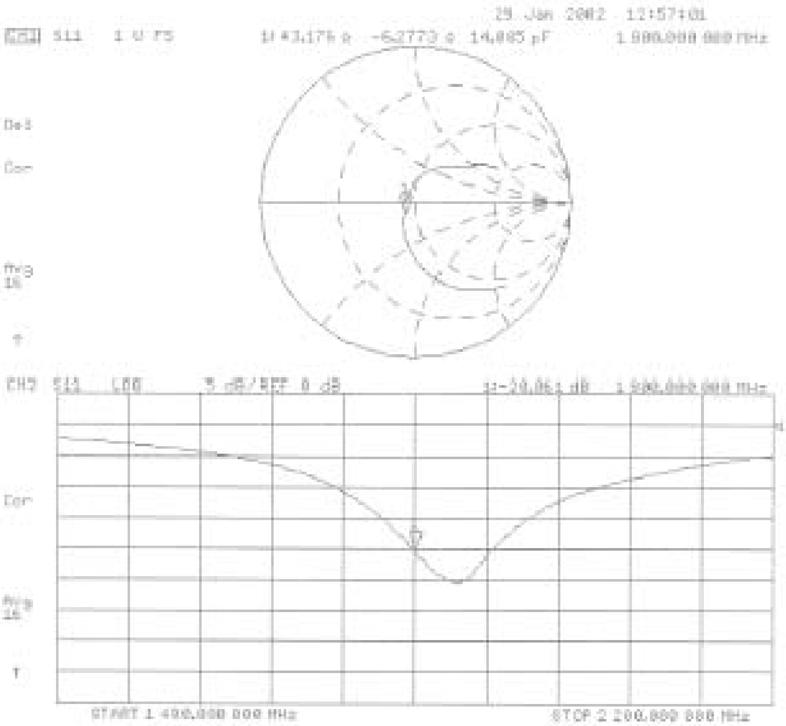

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