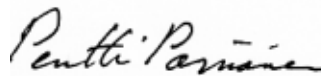


SAR Compliance Test Report

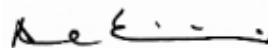
Test report no.:	Not numbered	Date of report:	2003-08-18
Number of pages:	67	Contact person:	Pentti Pärnänen
		Responsible test engineer:	Pentti Pärnänen
Testing laboratory:	Nokia Corporation Elektroniikkatie 10 P.O. Box 50 FIN-90571 OULU Finland Tel. +358-7180-08000 Fax. +358-7180-47222	Client:	Nokia Corporation Elektroniikkatie 10 P.O. Box 50 FIN-90571 OULU Finland Tel. +358-7180-08000 Fax. +358-7180-47222
Tested devices:	LJPRH-31 (Detailed information for each device is listed in section 1).		
Supplement reports:			
Testing has been carried out in accordance with:	47CFR §2.1093 Radiofrequency Radiation Exposure Evaluation: Portable Devices IEEE P1528-200X Draft 6.4 Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01) Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields		
Documentation:	The documentation of the testing performed on the tested devices is archived for 15 years at TCC Oulu		
Test results:	The tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		

Date and signatures:
For the contents:

2003-08-18



Pentti Pärnänen
Manager, TCC Oulu



Anne Kiviniemi
Test Engineer

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1. SUMMARY FOR SAR TEST REPORT

Date of test	2003-07-30, 2003-07-31, 2003-08-11
Contact person	Pentti Pärnänen
Test plan referred to	-
FCC ID	LJPRH-31
SN, HW, SW and DUT numbers of tested device	SN: 001004/00/116804/7; HW: 0953; SW: Vpa1.093
Accessories used in testing	Battery BLD-3; headset HS-5; headset HDS-3
Notes	-
Document code	DTX07956-EN
Responsible test engineer	Pentti Pärnänen
Measurement performed by	Anne Kiviniemi

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. Maximum found results are reported per operating band.

1.1.1 Head Configuration

Mode	Ch / f (MHz)	Power	Position	Limit	Measured	Result
GSM 850	251/848.80	31.1 dBm ERP	Cheek	1.6 W/kg	0.97 W/kg	PASSED
GSM 1900	512/1850.20	31.2 dBm EIRP	Cheek	1.6 W/kg	0.48 W/kg	PASSED

1.1.2 Body Worn Configuration

Mode	Ch / f (MHz)	Power	Accessory	Limit	Measured	Result
GPRS 850	251/848.80	31.1 dBm ERP	Separation distance 22 mm	1.6 W/kg	0.79 W/kg	PASSED
GPRS 1900	512/1850.20	31.2 dBm EIRP	Separation distance 22 mm	1.6 W/kg	0.97 W/kg	PASSED

1.1.3 Measurement Uncertainty

Combined Standard Uncertainty	± 13.6%
Expanded Standard Uncertainty (k=2)	± 27.1%

2. DESCRIPTION OF TESTED DEVICE

Device category	Portable device		
Exposure environment	Uncontrolled exposure		
Unit type	Prototype unit		
Case type	Fixed case		
Modes of Operation	GSM850, GSM1900	GPRS850, GPRS1900	EGPRS850, EGPRS1900
Modulation Mode	GMSK	GMSK	8PSK
Duty Cycle	1/8	1/8, 2/8	1/8
Transmitter Frequency Range (MHz)	824.2 – 848.8, 1850.2 - 1909.8	824.2 – 848.8, 1850.2 - 1909.8	824.2 – 848.8, 1850.2 - 1909.8

Outside of USA, transmitter of tested device is capable of operating also in GSM1800 mode, which is not part of this filing.

EGPRS mode was not measured, because maximum averaged output power is more than 3dB lower in EGPRS mode than in GPRS mode.

2.1 Picture of Phone



LJPRH-31

2.2 Description of the Antenna

Type	Internal integrated antenna	
Dimensions (mm)	Maximum width	40.5 mm
	Maximum length	36.8 mm
Location	Inside the back cover, near the top of the device	

2.3 Battery Options

There is only one battery, BLD-3, available for tested device.

2.4 Body Worn Accessories

Compliance to the FCC body-worn RF exposure guidelines was measured using Twin SAM v4.0 flat phantom region. Separation distance between LJPRH-31 and flat-phantom was 22 mm.

3. TEST CONDITIONS**3.1 Ambient Conditions**

Ambient temperature (°C)	22±2
Tissue simulating liquid temperature (°C)	22±1
Humidity	65 %
Humidity 2003-08-11	45 %

3.2 RF characteristics of the test site

Tests were performed in an enclosed RF shielded environment.

3.3 Test Signal, Frequencies, and Output Power

The device was controlled by using a special test mode.

In all operating bands the measurements were performed on lowest, middle and highest channels.

The phone was set to maximum power level during the all tests and at the beginning of the each test the battery was fully charged. Power output was measured by A2LA accredited test laboratory, M. Flom Associates, Inc , on the same unit used in SAR testing.

DASY4 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement. These records were used to monitor stability of power output.

4. DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with an automated near-field scanning system, DASY4, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland.

Test Equipment	Serial Number	Due Date
DAE V1	371	10/03
E-field Probe ET3DV6	1381	10/03
Dipole Validation Kit, D835V2	448	02/05
Dipole Validation Kit, D1900V2	511	02/05

E-field probe calibration records are presented in Appendix C.

Additional equipment needed in validation

Test Equipment	Model	Serial Number	Due Date
Signal Generator	Agilent E4433B	GB40050947	09/04
Amplifier	Amplifier Research 5S1G4	27573	-
Power Meter	R&S NRT	835065/049	06/04
Power Sensor	R&S NRT-Z44	835374/021	06/04
Thermometer	Fluke 54II	77800145	-
Network Analyzer	Hewlett Packard 8753E	US38432701	05/04
Dielectric Probe Kit	Agilent 85070C	US99360106	-

4.1 System Accuracy Verification

The probes are calibrated annually by the manufacturer. Dielectric parameters of the simulating liquids are measured using a dielectric probe kit and network analyzer.

The SAR measurement of the DUT were done within 24 hours of system accuracy verification, which was done using the dipole validation kit.

The dipole antenna, which is manufactured by Schmid & Partner Engineering AG, is matched to be used near flat phantom filled with tissue simulating solution. Length of 835 MHz dipole is 161mm with overall height of 330mm. Dipole length for 1900 MHz is 68 mm with overall height of 300mm. A specific distance holder is used in the positioning of both antennas to ensure correct spacing between the phantom and the dipole. Manufacturer's reference dipole 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 validation results are in the table below and printout of the validation test is presented in Appendix A. All the measured parameters were within the specification.

Tissue	f (MHz)	Description	SAR (W/kg), 1g	Dielectric Parameters		Temp (°C)
				ϵ_r	σ (S/m)	
Head	835	Measured 07/30/03	2.49	41.1	0.90	22
		Reference Result	2.43	41.5	0.89	N/A
Head	1900	Measured 07/31/03	11.3	39.7	1.46	22
		Reference Result	10.3	38.6	1.46	N/A
Muscle	835	Measured 08/11/03	2.60	55.3	0.94	22
		Reference Result	2.53	54.0	0.96	N/A
Muscle	1900	Measured 07/31/03	10.8	52.6	1.55	22
		Reference Result	10.6	51.2	1.59	N/A

4.2 Tissue Simulants

All dielectric parameters of tissue simulants were measured within 24 hours of SAR measurements. The depth of the tissue simulant in the ear reference point of the phantom was $15\text{cm} \pm 5\text{mm}$ during all the tests. Volume for each tissue simulant was 26 liters.

4.2.1 Head Tissue Simulant

The composition of the brain tissue simulating liquid for 835MHz is

58.31% Sugar
39.74% De-Ionized Water
1.55% Salt
0.25% HEC
0.15% Bactericide

and for 1900MHz

54.88% De-Ionized Water
44.91% 2-(2-butoxyethoxy) Ethanol
0.21% Salt

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ϵ_r	σ (S/m)	
836	Measured 07/30/03	41.1	0.90	22
	Recommended Values	41.5	0.90	20-26
1880	Measured 07/31/03	39.8	1.44	22
	Recommended Values	40.0	1.40	20-26

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

4.2.2 Muscle Tissue Simulant

The composition of the muscle tissue simulating liquid for 835MHz is

55.97% De-Ionized Water
41.76% Sugar
1.21% HEC
0.79% Salt
0.27% Preservative

and for 1900MHz

69.02% De-Ionized Water
30.76% 2-(2-butoxyethoxy) Ethanol
0.22% Salt

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ϵ_r	σ (S/m)	
836	Measured 08/11/03	55.3	0.94	22
	Recommended Values	55.2	0.97	20-26
1880	Measured 07/31/03	52.6	1.54	22
	Recommended Values	53.3	1.52	20-26

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

4.3 Phantoms

"SAM v4.0" phantom", manufactured by SPEAG, was used during the measurement. It has fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric



evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

The thickness of phantom shell is 2 mm except for the ear, where an integrated ear spacer provides a 6 mm spacing from the tissue boundary. Manufacturer reports tolerance in shell thickness to be $\pm 0.1\text{mm}$.

4.4 Isotropic E-Field Probe ET3DV6

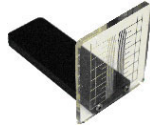
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycolether)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to 3 GHz (dosimetry); Linearity: $\pm 0.2\text{ dB}$ (30 MHz to 3 GHz)
Optical Surface Detection	$\pm 0.2\text{ mm}$ repeatability in air and clear liquids over diffuse reflecting surfaces
Directivity	$\pm 0.2\text{ dB}$ in HSL (rotation around probe axis) $\pm 0.4\text{ dB}$ in HSL (rotation normal to probe axis)
Dynamic Range	$5\text{ }\mu\text{W/g}$ to $> 100\text{ mW/g}$; Linearity: $\pm 0.2\text{ dB}$
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
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms



5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Test Positions

The device was placed in holder using a special positioning tool, which aligns the bottom of the device with holder and ensures that holder contacts only to the sides of the device. After positioning is done, tool is removed. This method provides standard positioning and separation, and also ensures free space for antenna.



Device holder was provided by SPEAG together with DASY4.

5.1.1 Against Phantom Head

Measurements were made on both the "left hand" and "right hand" side of the phantom.

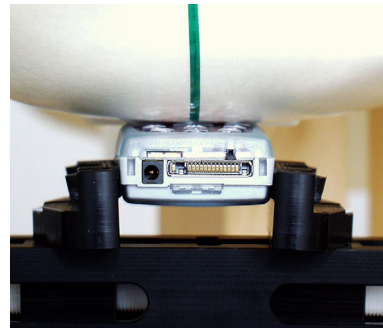
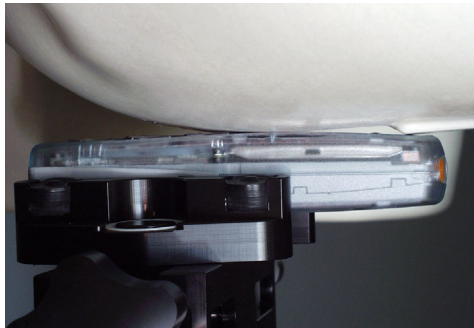
The device was positioned against phantom according to OET Bulletin 65 (97-01) Supplement C (01-01) . Definitions of terms used in aligning the device to a head phantom are available in IEEE Draft Standard P1528-2001 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

5.1.1.1 Initial Ear Position

The device was initially positioned with the earpiece region pressed against the ear spacer of a head phantom parallel to the "Neck-Front" line defined along the base of the ear spacer that contains the "ear reference point". The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane".

5.1.1.2 Cheek Position

"Initial ear position" alignments are maintained and the device is brought toward the mouth of the head phantom by pivoting along the "Neck-Front" line until any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom or when any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.



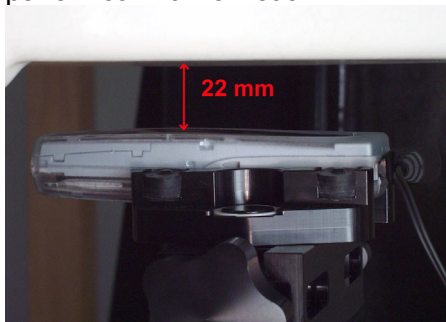
5.1.1.3 Tilt Position

In the “Cheek Position”, if the earpiece of the device is not in full contact with the phantom’s ear spacer and the peak SAR location for the “cheek position” is located at the ear spacer region or corresponds to the earpiece region of the handset, the device is returned to the “initial ear position” by rotating it away from the mouth until the earpiece is in full contact with the ear spacer. Otherwise, the device is moved away from the cheek perpendicular to the line passes through both “ear reference points” for approximate 2-3 cm. While it is in this position, the device is tilted away from the mouth with respect to the “test device reference point” by 15°. After the tilt, it is then moved back toward the head perpendicular to the line passes through both “ear reference points” until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process is repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously.



5.1.2 Body Worn Configuration

Body worn SAR measurements were performed with antenna facing towards the flat part of the phantom with a separation distance of 22 mm. Headsets HS-5 and HDS-3 were connected during measurements. Body worn measurements were performed in GPRS mode.



5.2 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Next a cube scan, 5x5x7 points; spacing between each point 7.5x7.5x5 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.

6. MEASUREMENT UNCERTAINTY

6.1 Description of Individual Measurement Uncertainty

6.1.1 Assessment Uncertainty

Uncertainty Component	P1528 Sec	Tol. (%)	Prob Dist	Div	c_i	u_i (%)	v_i
Measurement System							
Probe Calibration	E2.1	±4.8	N	1	1	±4.8	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1-c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±1.0	R	√3	1	±0.6	∞
Linearity	E2.4	±4.7	R	√3	1	±2.7	∞
System Detection Limits	E2.5	±1.0	R	√3	1	±0.6	∞
Readout Electronics	E2.6	±1.0	N	1	1	±1.0	∞
Response Time	E2.7	±0.8	R	√3	1	±0.5	∞
Integration Time	E2.8	±2.6	R	√3	1	±1.5	∞
RF Ambient Conditions - Noise	E6.1	±3.0	R	√3	1	±1.7	∞
RF Ambient Conditions - Reflections	E6.1	±3.0	R	√3	1	±1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	±0.4	R	√3	1	±0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	±2.9	R	√3	1	±1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	±1.0	R	√3	1	±0.6	∞
Test sample Related							
Test Sample Positioning	E4.2.1	±6.0	N	1	1	±6.0	11
Device Holder Uncertainty	E4.1.1	±5.0	N	1	1	±5.0	7
Output Power Variation - SAR drift measurement	6.6.3	±10.0	R	√3	1	±5.8	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	±4.0	R	√3	1	±2.3	∞
Liquid Conductivity Target - tolerance	E3.2	±5.0	R	√3	0.64	±1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	±5.5	N	1	0.64	±3.5	5
Liquid Permittivity Target tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			±13.6	161
Coverage Factor for 95%			k=2				
Expanded Standard Uncertainty						±27.1	

7. RESULTS

Corresponding SAR distribution printouts of maximum results in every operating mode and position are shown in Appendix B. It also includes Z-plots of maximum measurement results in head and body worn configurations. The SAR distributions are substantially similar or equivalent to the plots submitted regardless of used channel in each mode and position. The coarse scans used in the head configuration measurements cover the whole head region.

7.1 Head Configuration

Mode	Channel/ <i>f</i> (MHz)	Power ERP (dBm)	SAR, averaged over 1g (W/kg)			
			Left-hand		Right-hand	
			Cheek	Tilted	Cheek	Tilted
GSM 850	128/824.20	29.4	0.75	0.42	0.88	0.53
	190/836.60	29.8	0.90	0.51	0.88	0.53
	251/848.80	31.1	0.97	0.55	0.91	0.55

Mode	Channel/ <i>f</i> (MHz)	Power EIRP (dBm)	SAR, averaged over 1g (W/kg)			
			Left-hand		Right-hand	
			Cheek	Tilted	Cheek	Tilted
GSM 1900	512/1850.20	31.2			0.48	
	661/1880.00	28.9	0.39	0.39	0.40	0.36
	810/1909.80	25.9			0.30	

7.2 Body Worn Configuration

Mode	Channel/ <i>f</i> (MHz)	Power ERP (dBm)	SAR, averaged over 1g (W/kg)	
			HS-5	HDS-3
GPRS 850	128/824.20	29.4	0.62	0.68
	190/836.60	29.8	0.77	0.76
	251/848.80	31.1	0.79	0.79

Mode	Channel/ <i>f</i> (MHz)	Power EIRP (dBm)	SAR, averaged over 1g (W/kg)	
			HS-5	HDS-3
GPRS 1900	512/1850.20	31.2	0.94	0.97
	661/1880.00	28.9	0.89	0.94
	810/1909.80	25.9	0.82	0.84

APPENDIX A.

Validation Test Printouts

Date/Time: 07/30/03 09:58:23

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: Dipole 835 MHz; Type: D835V2; Serial: 448

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Head 835 MHz ($\sigma = 0.902363$ mho/m, $\epsilon_r = 41.0581$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

HSL835; t = 22.6 °C/Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 57 V/m

Power Drift = -0.01 dB

Maximum value of SAR = 2.6 mW/g

HSL835; t = 22.6 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

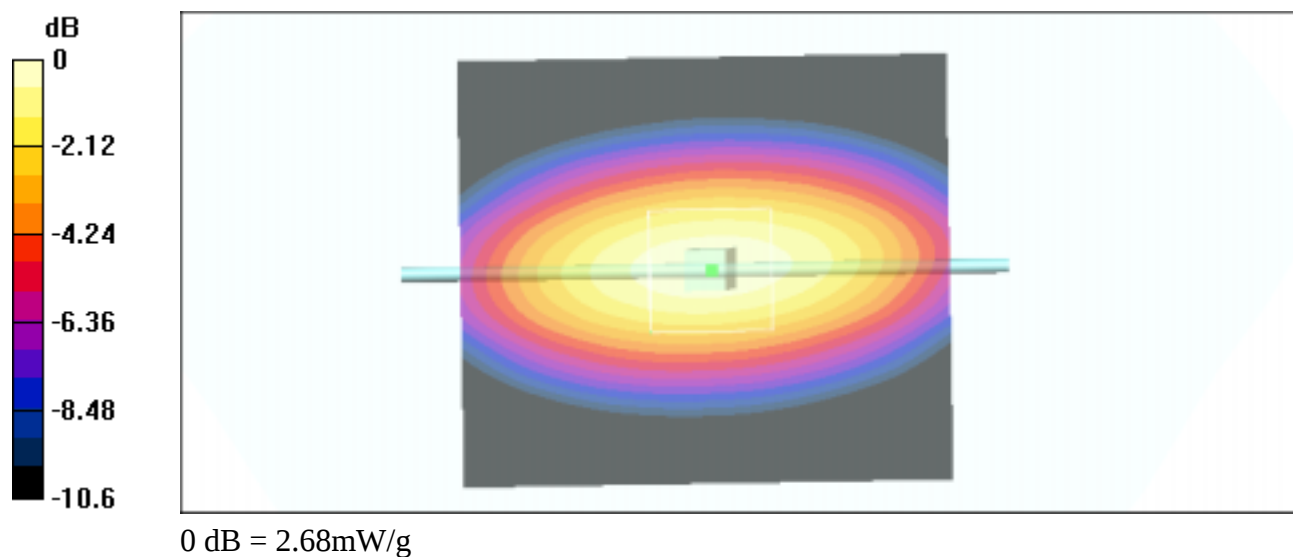
Peak SAR (extrapolated) = 3.65 W/kg

SAR(1 g) = 2.49 mW/g; SAR(10 g) = 1.61 mW/g

Reference Value = 57 V/m

Power Drift = -0.01 dB

Maximum value of SAR = 2.68 mW/g



Date/Time: 08/11/03 11:01:57

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: Dipole 835 MHz; Type: D835V2; Serial: 448

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Muscle 850 MHz ($\sigma = 0.939225$ mho/m, $\epsilon_r = 55.3334$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.1, 6.1, 6.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

muscle 835; T = 21.4 °C/Area Scan (71x81x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 56.9 V/m

Power Drift = 0.03 dB

Maximum value of SAR = 2.74 mW/g

muscle 835; T = 21.4 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

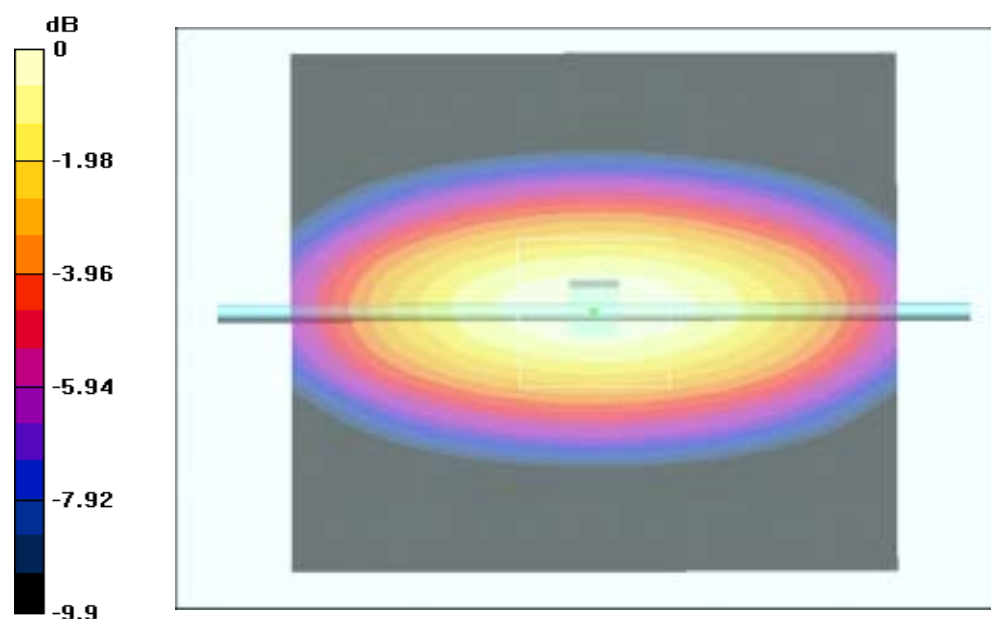
Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.6 mW/g; SAR(10 g) = 1.71 mW/g

Reference Value = 56.9 V/m

Power Drift = 0.03 dB

Maximum value of SAR = 2.79 mW/g



0 dB = 2.79mW/g

Date/Time: 07/31/03 09:24:03

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 511

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: Head 1900 MHz ($\sigma = 1.45581$ mho/m, $\epsilon_r = 39.7315$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

HSL 1900; T = 22.0 °C/Area Scan (71x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 98.5 V/m

Power Drift = 0.08 dB

Maximum value of SAR = 13.2 mW/g

HSL 1900; T = 22.0 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

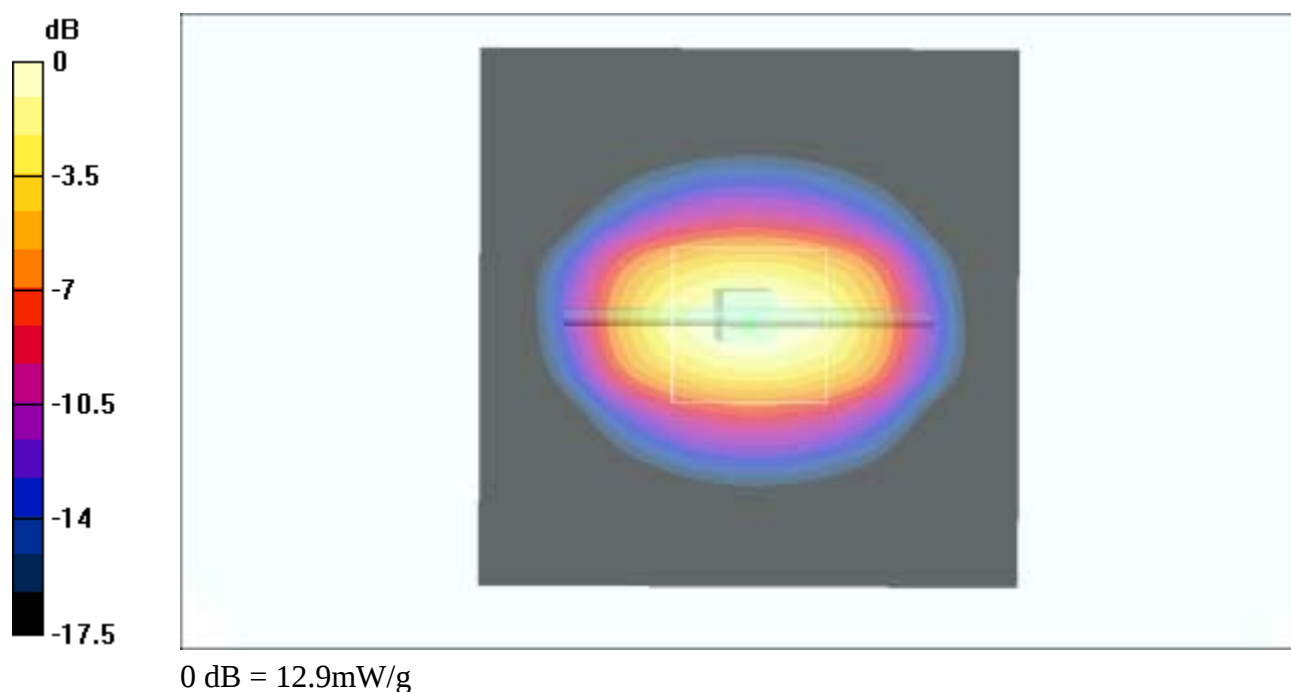
Peak SAR (extrapolated) = 20.1 W/kg

SAR(1 g) = 11.3 mW/g; SAR(10 g) = 5.85 mW/g

Reference Value = 98.5 V/m

Power Drift = 0.08 dB

Maximum value of SAR = 12.9 mW/g



Date/Time: 07/31/03 14:56:43

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 511

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: muscle 1900 MHz ($\sigma = 1.55428$ mho/m, $\epsilon_r = 52.5721$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

muscle 1900; T = 22.0 °C/Area Scan (71x71x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 93.7 V/m

Power Drift = 0.04 dB

Maximum value of SAR = 12.7 mW/g

muscle 1900; T = 22.0 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

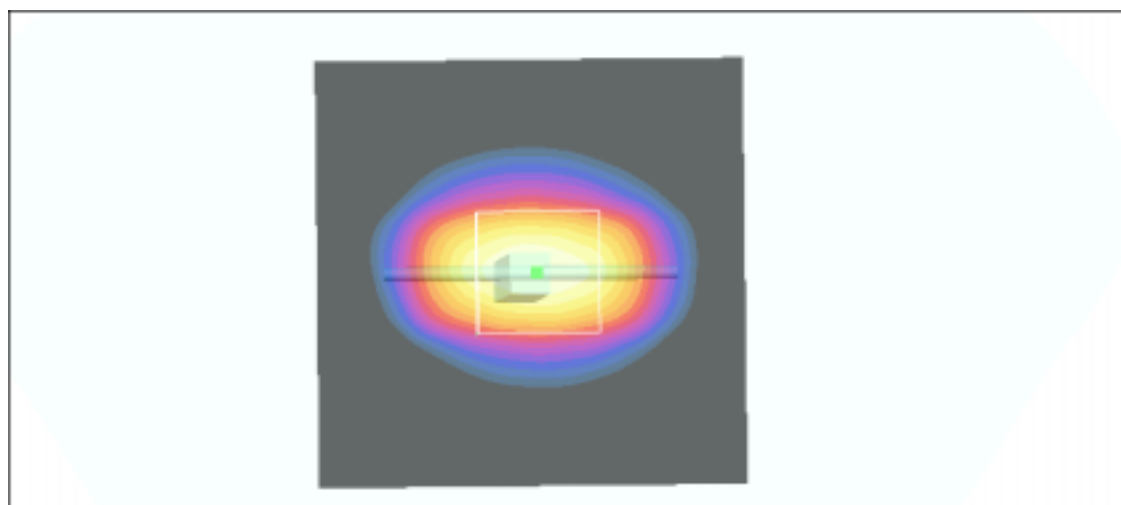
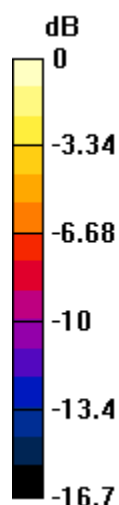
Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 10.8 mW/g; SAR(10 g) = 5.62 mW/g

Reference Value = 93.7 V/m

Power Drift = 0.04 dB

Maximum value of SAR = 12.1 mW/g



0 dB = 12.1mW/g

APPENDIX B.

SAR Distribution Printouts

Date/Time: 07/30/03 12:22:25

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium: Head 835 MHz ($\sigma = 0.914141$ mho/m, $\epsilon_r = 40.8776$, $\rho = 1000$ kg/m³)

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.3 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 26.1 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 1 mW/g

Cheek, T = 22.3 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

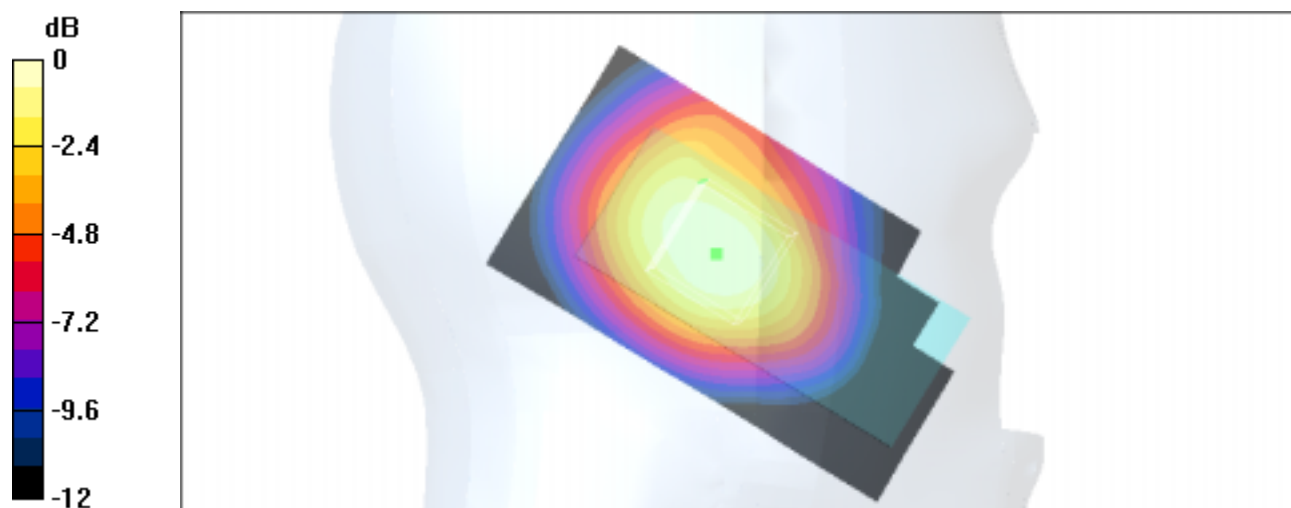
Peak SAR (extrapolated) = 1.51 W/kg

SAR(1 g) = 0.913 mW/g; SAR(10 g) = 0.609 mW/g

Reference Value = 26.1 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 0.949 mW/g



0 dB = 0.949mW/g

Date/Time: 07/30/03 12:46:33

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium: Head 835 MHz ($\sigma = 0.914141$ mho/m, $\epsilon_r = 40.8776$, $\rho = 1000$ kg/m³)

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Tilted, T = 21.0 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 22.8 V/m

Power Drift = 0.003 dB

Maximum value of SAR = 0.592 mW/g

Tilted, T = 21.0 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=7.5mm, dy=7.5mm, dz=5mm

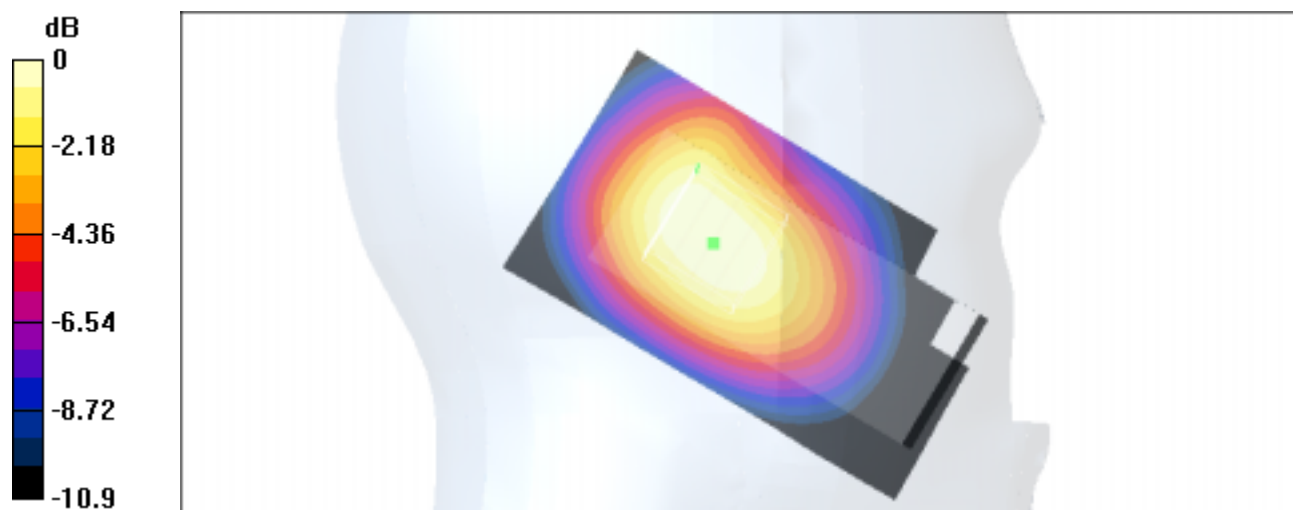
Peak SAR (extrapolated) = 0.867 W/kg

SAR(1 g) = 0.546 mW/g; SAR(10 g) = 0.363 mW/g

Reference Value = 22.8 V/m

Power Drift = 0.003 dB

Maximum value of SAR = 0.566 mW/g



0 dB = 0.566mW/g

Date/Time: 07/30/03 14:47:52

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium: Head 835 MHz ($\sigma = 0.914141$ mho/m, $\epsilon_r = 40.8776$, $\rho = 1000$ kg/m³)

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.3 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 26.8 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 1.04 mW/g

Cheek, T = 22.3 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

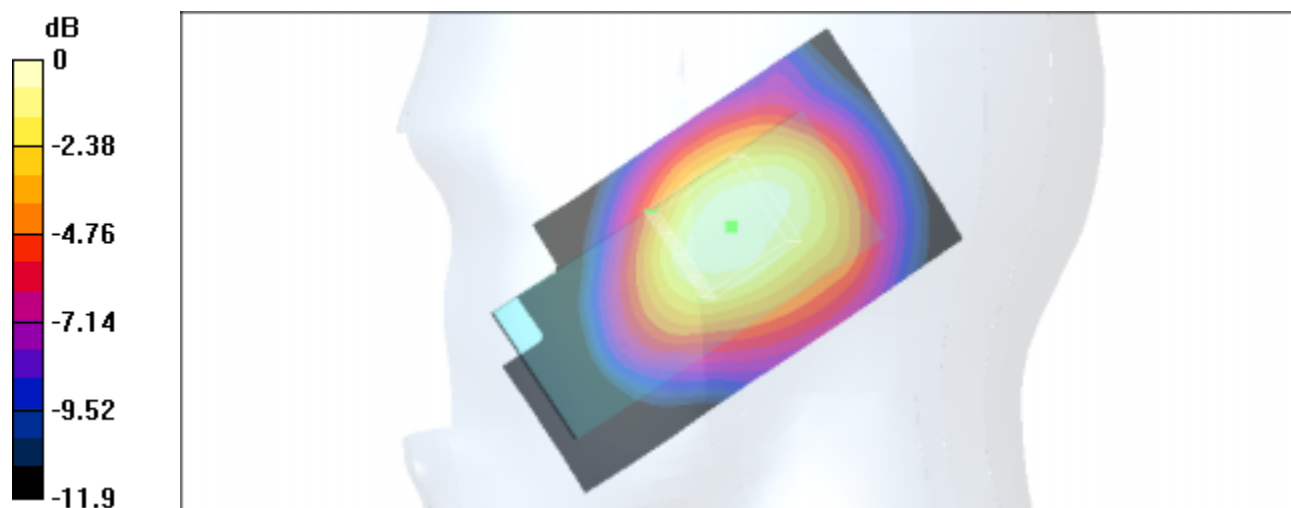
Peak SAR (extrapolated) = 1.68 W/kg

SAR(1 g) = 0.965 mW/g; SAR(10 g) = 0.63 mW/g

Reference Value = 26.8 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 0.989 mW/g



0 dB = 0.989mW/g

Date/Time: 07/30/03 15:08:43

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium: Head 835 MHz ($\sigma = 0.914141$ mho/m, $\epsilon_r = 40.8776$, $\rho = 1000$ kg/m³)

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Tilted, T = 22.5 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 23.1 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 0.591 mW/g

Tilted, T = 22.5 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=7.5mm, dy=7.5mm, dz=5mm

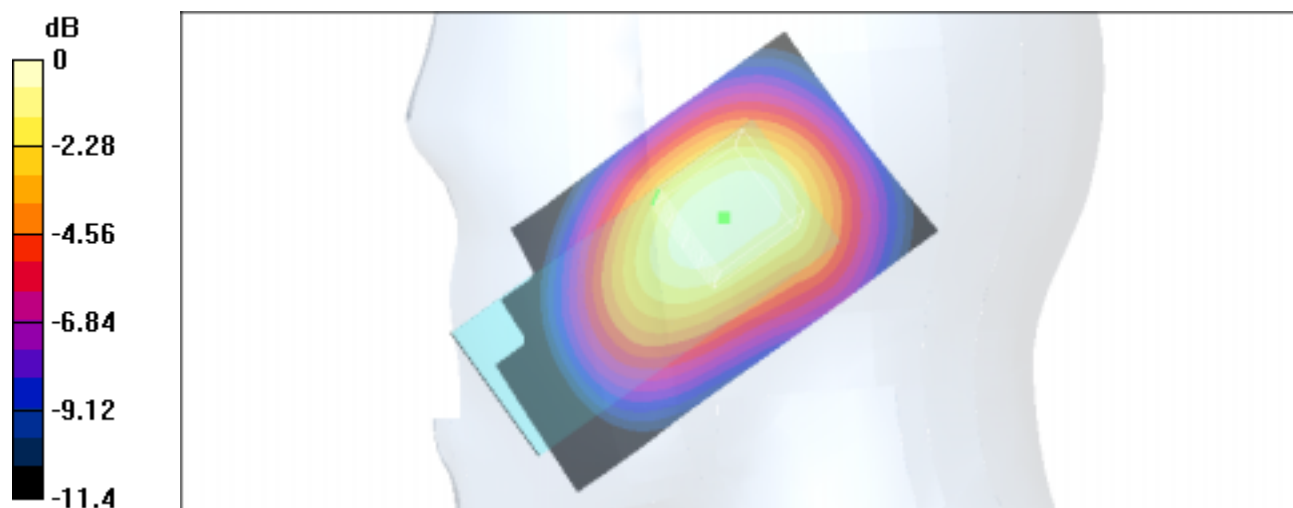
Peak SAR (extrapolated) = 0.897 W/kg

SAR(1 g) = 0.553 mW/g; SAR(10 g) = 0.365 mW/g

Reference Value = 23.1 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 0.575 mW/g



0 dB = 0.575mW/g

Date/Time: 07/31/03 10:38:11

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: Head 1900 MHz ($\sigma = 1.4356$ mho/m, $\epsilon_r = 39.7724$, $\rho = 1000$ kg/m³)

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.6 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 16.4 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.416 mW/g

Cheek, T = 22.6 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Peak SAR (extrapolated) = 0.696 W/kg

SAR(1 g) = 0.386 mW/g; SAR(10 g) = 0.222 mW/g

Reference Value = 16.4 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.404 mW/g

Cheek, T = 22.6 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

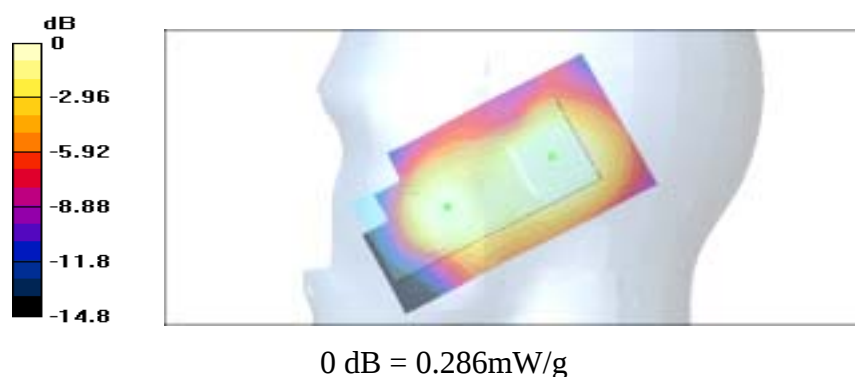
Peak SAR (extrapolated) = 0.475 W/kg

SAR(1 g) = 0.27 mW/g; SAR(10 g) = 0.164 mW/g

Reference Value = 16.4 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.286 mW/g



Date/Time: 07/31/03 12:01:58

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: head 1900 MHz ($\sigma = 1.4356$ mho/m, $\epsilon_r = 39.7724$, $\rho = 1000$ kg/m³)

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Tilted, T = 22.8 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 17 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.454 mW/g

Tilted, T = 22.8 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=7.5mm, dy=7.5mm, dz=5mm

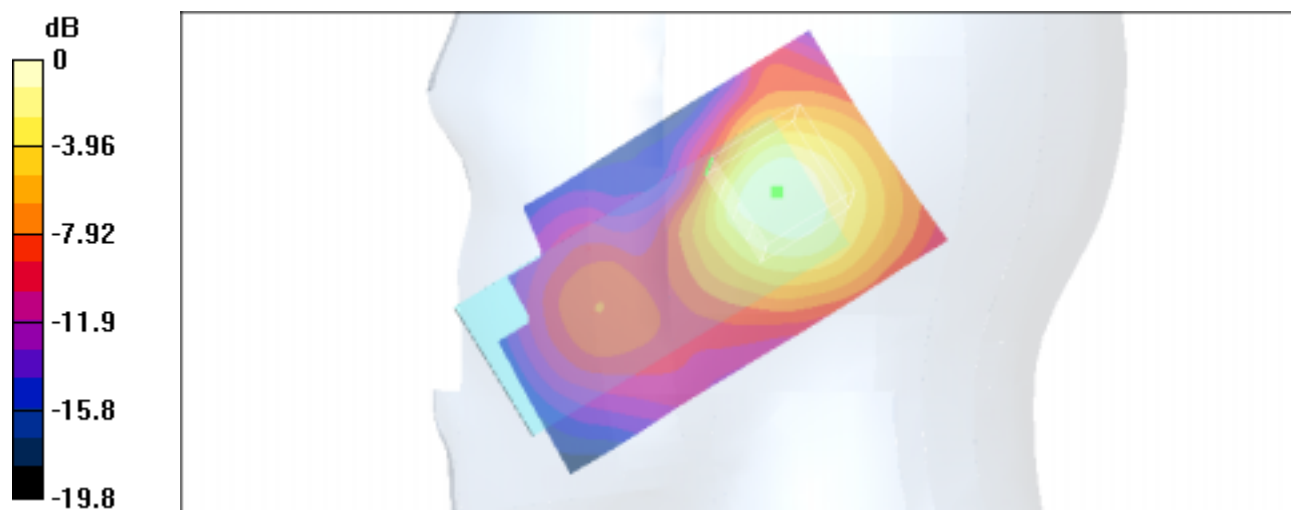
Peak SAR (extrapolated) = 0.724 W/kg

SAR(1 g) = 0.392 mW/g; SAR(10 g) = 0.224 mW/g

Reference Value = 17 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.411 mW/g



0 dB = 0.411mW/g

Date/Time: 07/31/03 13:13:42

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium: head 1900 MHz ($\sigma = 1.40952$ mho/m, $\epsilon_r = 39.9093$, $\rho = 1000$ kg/m³)

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.9 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.517 mW/g

Cheek, T = 22.9 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Peak SAR (extrapolated) = 0.965 W/kg

SAR(1 g) = 0.481 mW/g; SAR(10 g) = 0.268 mW/g

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.503 mW/g

Cheek, T = 22.9 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

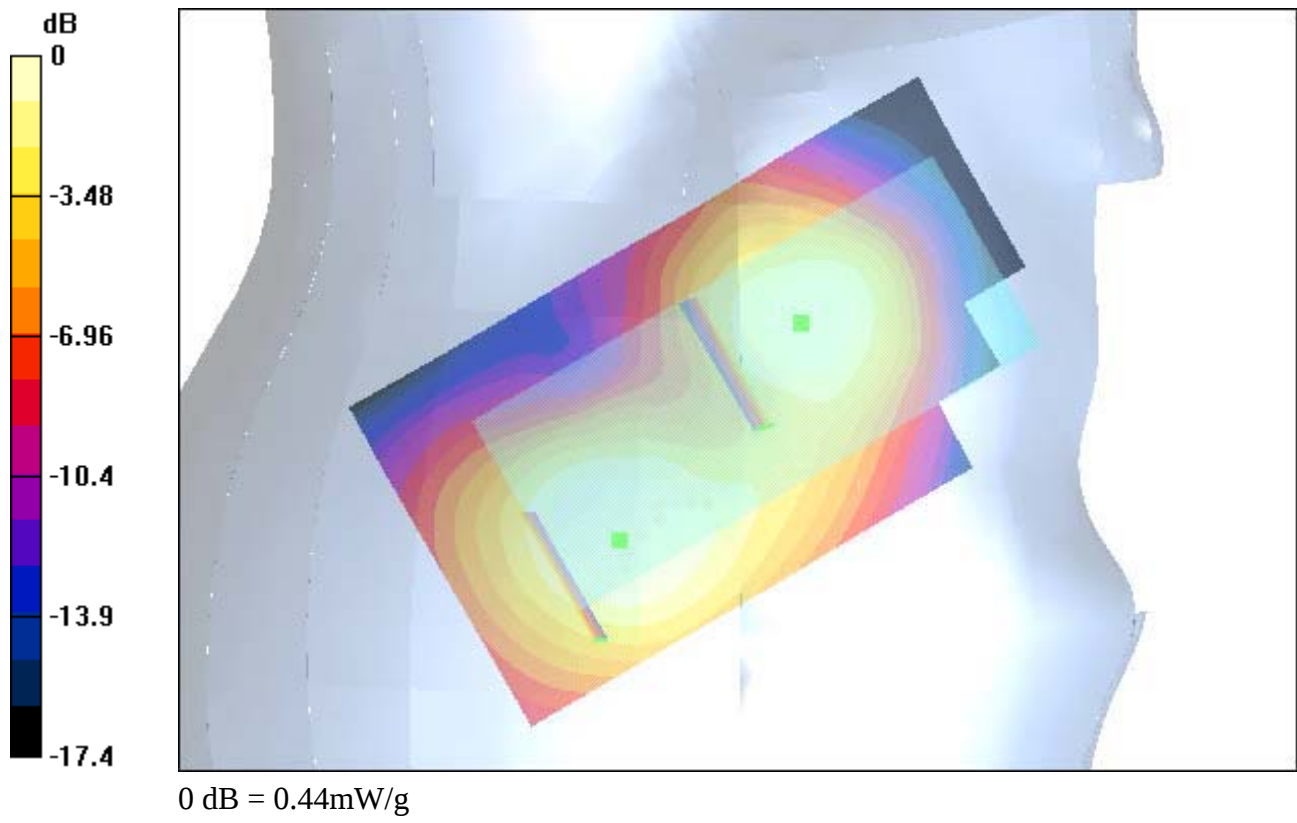
Peak SAR (extrapolated) = 0.719 W/kg

SAR(1 g) = 0.415 mW/g; SAR(10 g) = 0.24 mW/g

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.44 mW/g



Date/Time: 07/31/03 12:12:24

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 1900; Frequency: 1880 MHz; Duty Cycle: 1:8.3

Medium: head 1900 MHz ($\sigma = 1.4356$ mho/m, $\epsilon_r = 39.7724$, $\rho = 1000$ kg/m³)

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Tilted, T = 22.5 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 16.2 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 0.383 mW/g

Tilted, T = 22.5 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid:

dx=7.5mm, dy=7.5mm, dz=5mm

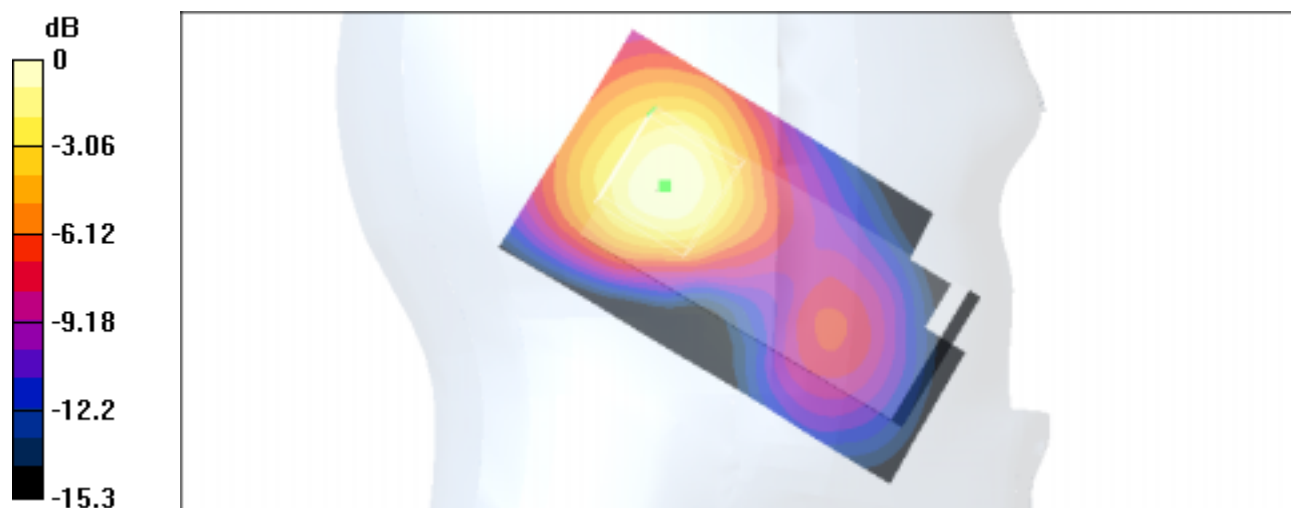
Peak SAR (extrapolated) = 0.66 W/kg

SAR(1 g) = 0.362 mW/g; SAR(10 g) = 0.211 mW/g

Reference Value = 16.2 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 0.381 mW/g



0 dB = 0.381mW/g

Date/Time: 08/11/03 14:18:06

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 850; Frequency: 848.8 MHz; Duty Cycle: 1:4.2

Medium: Muscle 850 MHz ($\sigma = 0.95115$ mho/m, $\epsilon_r = 55.2378$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.1, 6.1, 6.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HS-5, t = 21.8 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 13.5 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.831 mW/g; worst case extrapolation

Body worn, HS-5, t = 21.8 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

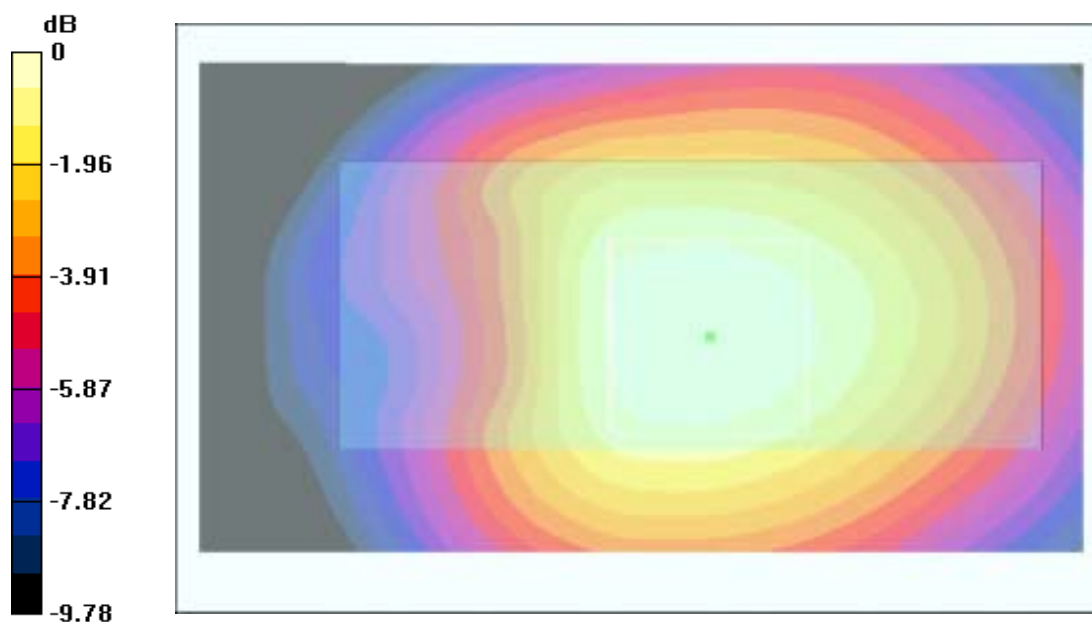
Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.791 mW/g; SAR(10 g) = 0.546 mW/g

Reference Value = 13.5 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.821 mW/g; worst case extrapolation



0 dB = 0.821mW/g

Date/Time: 08/11/03 15:34:16

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 850; Frequency: 848.8 MHz; Duty Cycle: 1:4.2

Medium: Muscle 850 MHz ($\sigma = 0.95115$ mho/m, $\epsilon_r = 55.2378$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.1, 6.1, 6.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HDS-3, t = 22.0 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 12.9 V/m

Power Drift = 0.004 dB

Maximum value of SAR = 0.818 mW/g; worst case extrapolation

Body worn, HDS-3, t = 22.0 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

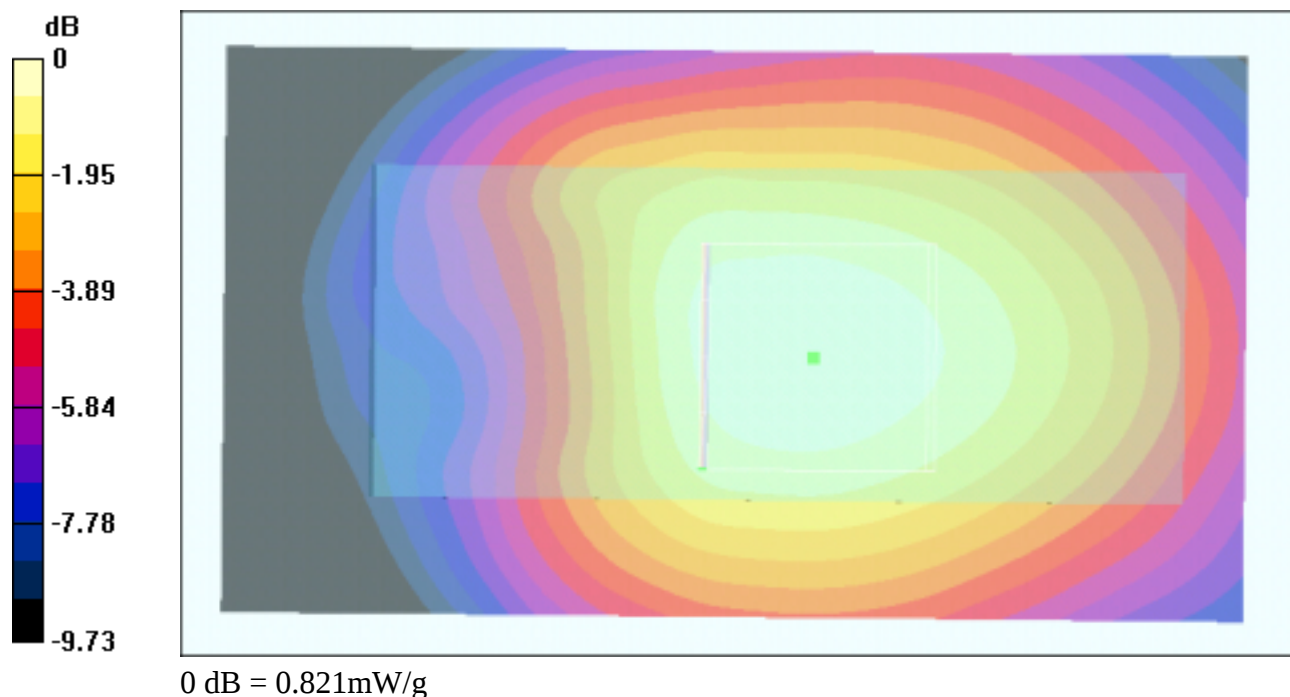
Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.788 mW/g; SAR(10 g) = 0.543 mW/g

Reference Value = 12.9 V/m

Power Drift = 0.004 dB

Maximum value of SAR = 0.821 mW/g; worst case extrapolation



Date/Time: 07/31/03 15:46:15

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.2

Medium: muscle 1900 MHz ($\sigma = 1.51069$ mho/m, $\epsilon_r = 52.7539$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HS-5, t = 22.9 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 20.4 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 0.992 mW/g; worst case extrapolation

Body worn, HS-5, t = 22.9 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

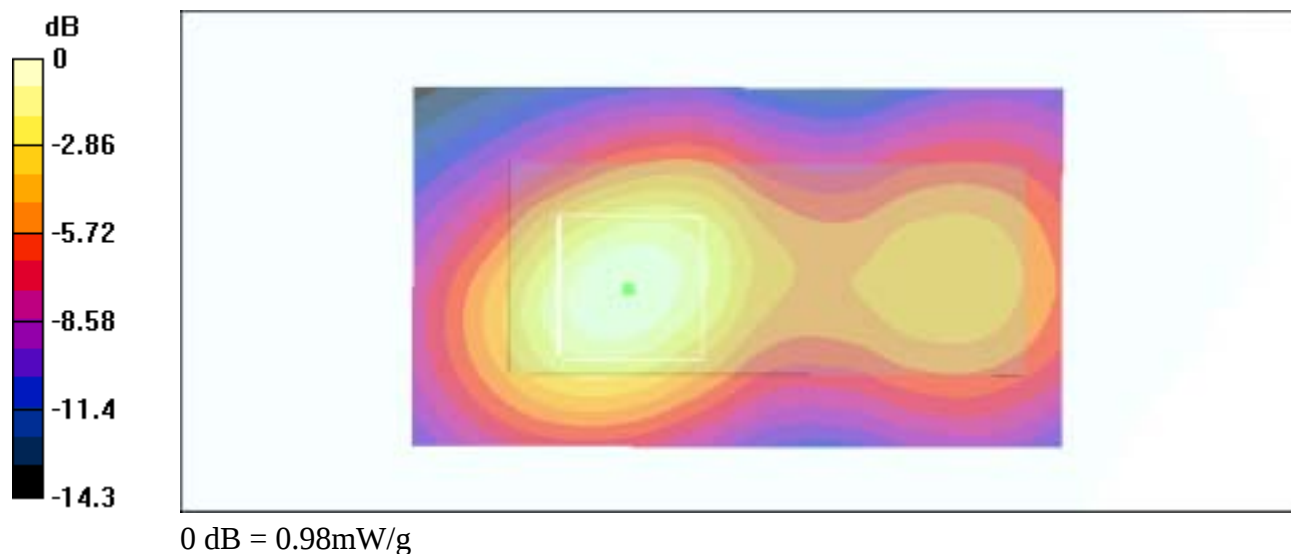
Peak SAR (extrapolated) = 1.79 W/kg

SAR(1 g) = 0.936 mW/g; SAR(10 g) = 0.543 mW/g

Reference Value = 20.4 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 0.98 mW/g; worst case extrapolation



Date/Time: 07/31/03 17:42:41

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.2

Medium: muscle 1900 MHz ($\sigma = 1.51069$ mho/m, $\epsilon_r = 52.7539$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HDS-3, t = 22.6 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 21.8 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 1.01 mW/g; worst case extrapolation

Body worn, HDS-3, t = 22.6 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

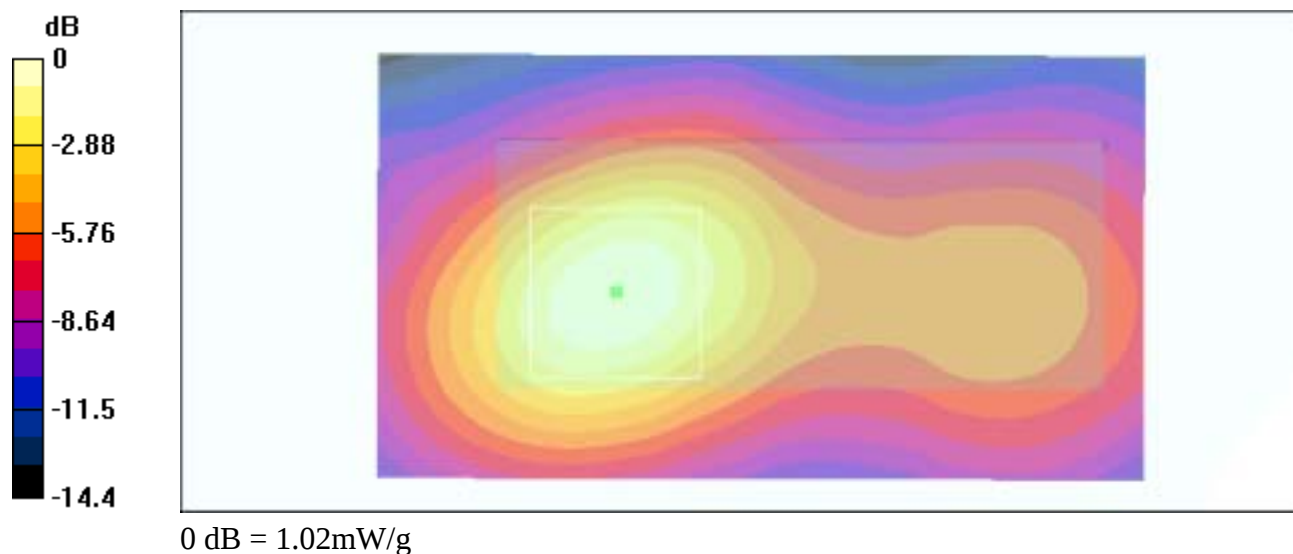
Peak SAR (extrapolated) = 1.86 W/kg

SAR(1 g) = 0.973 mW/g; SAR(10 g) = 0.562 mW/g

Reference Value = 21.8 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 1.02 mW/g; worst case extrapolation



Date/Time: 07/30/03 14:47:52

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3

Medium: Head 835 MHz ($\sigma = 0.914141$ mho/m, $\epsilon_r = 40.8776$, $\rho = 1000$ kg/m³)

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.3, 6.3, 6.3); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.3 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 26.8 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 1.04 mW/g

Cheek, T = 22.3 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

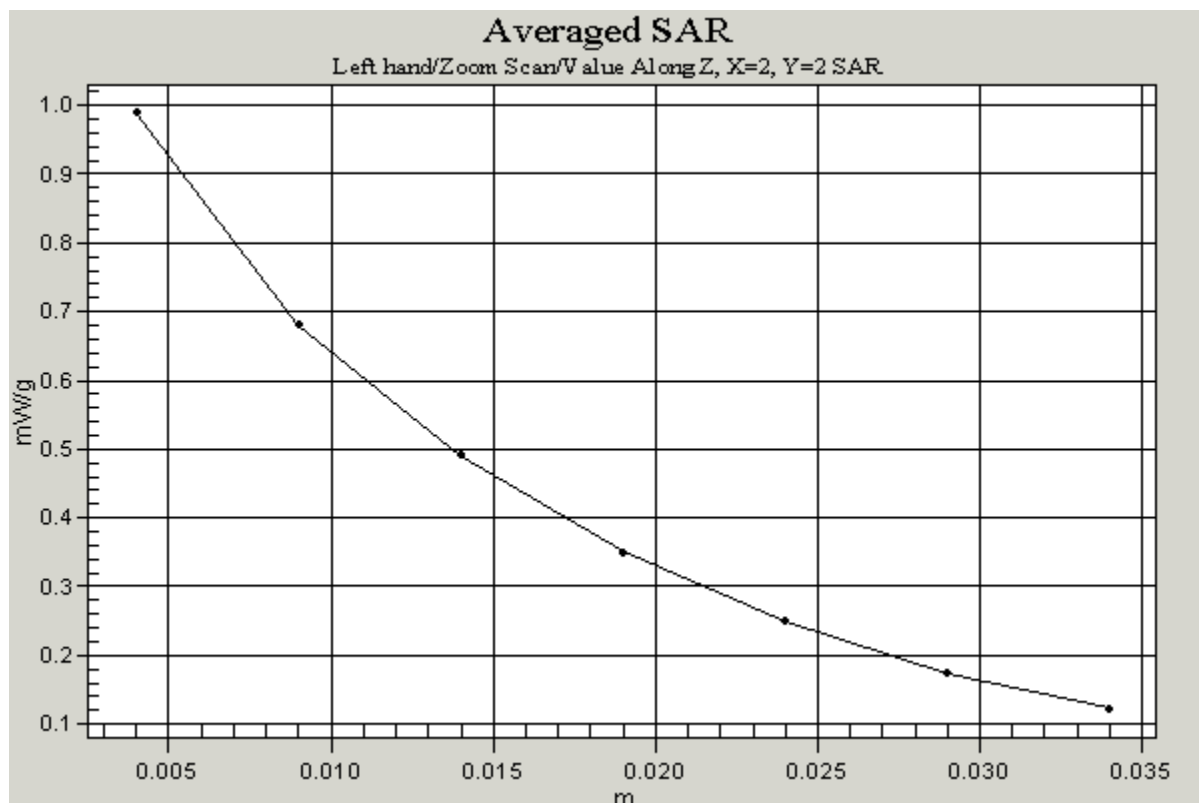
Peak SAR (extrapolated) = 1.68 W/kg

SAR(1 g) = 0.965 mW/g; SAR(10 g) = 0.63 mW/g

Reference Value = 26.8 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 0.989 mW/g



Date/Time: 07/31/03 13:13:42

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GSM 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium: head 1900 MHz ($\sigma = 1.40952$ mho/m, $\epsilon_r = 39.9093$, $\rho = 1000$ kg/m³)

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(5.1, 5.1, 5.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Cheek, T = 22.9 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.517 mW/g

Cheek, T = 22.9 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Peak SAR (extrapolated) = 0.965 W/kg

SAR(1 g) = 0.481 mW/g; SAR(10 g) = 0.268 mW/g

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.503 mW/g

Cheek, T = 22.9 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

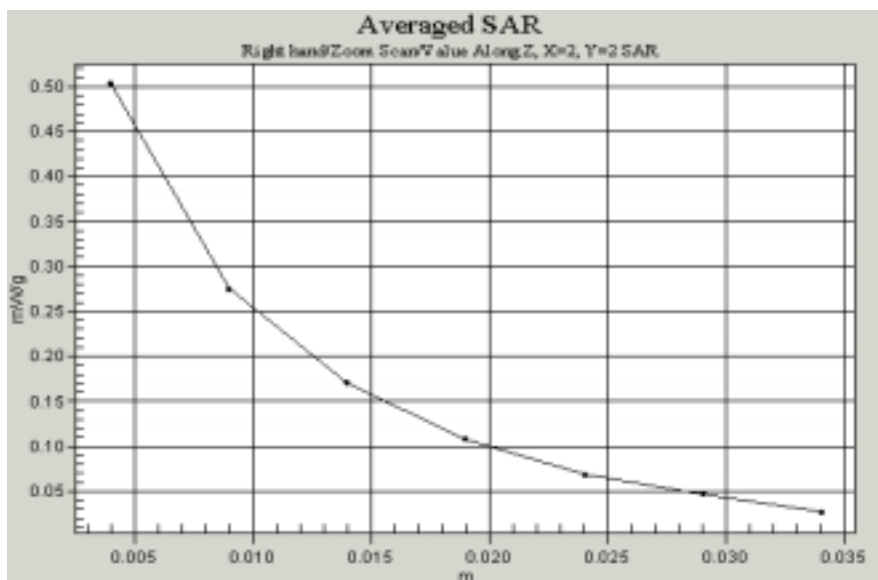
Peak SAR (extrapolated) = 0.719 W/kg

SAR(1 g) = 0.415 mW/g; SAR(10 g) = 0.24 mW/g

Reference Value = 16 V/m

Power Drift = -0.1 dB

Maximum value of SAR = 0.44 mW/g



Date/Time: 08/11/03 14:18:06

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 850; Frequency: 848.8 MHz; Duty Cycle: 1:4.2

Medium: Muscle 850 MHz ($\sigma = 0.95115$ mho/m, $\epsilon_r = 55.2378$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(6.1, 6.1, 6.1); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HS-5, $t = 21.8$ °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 13.5 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.831 mW/g

Body worn, HS-5, $t = 21.8$ °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

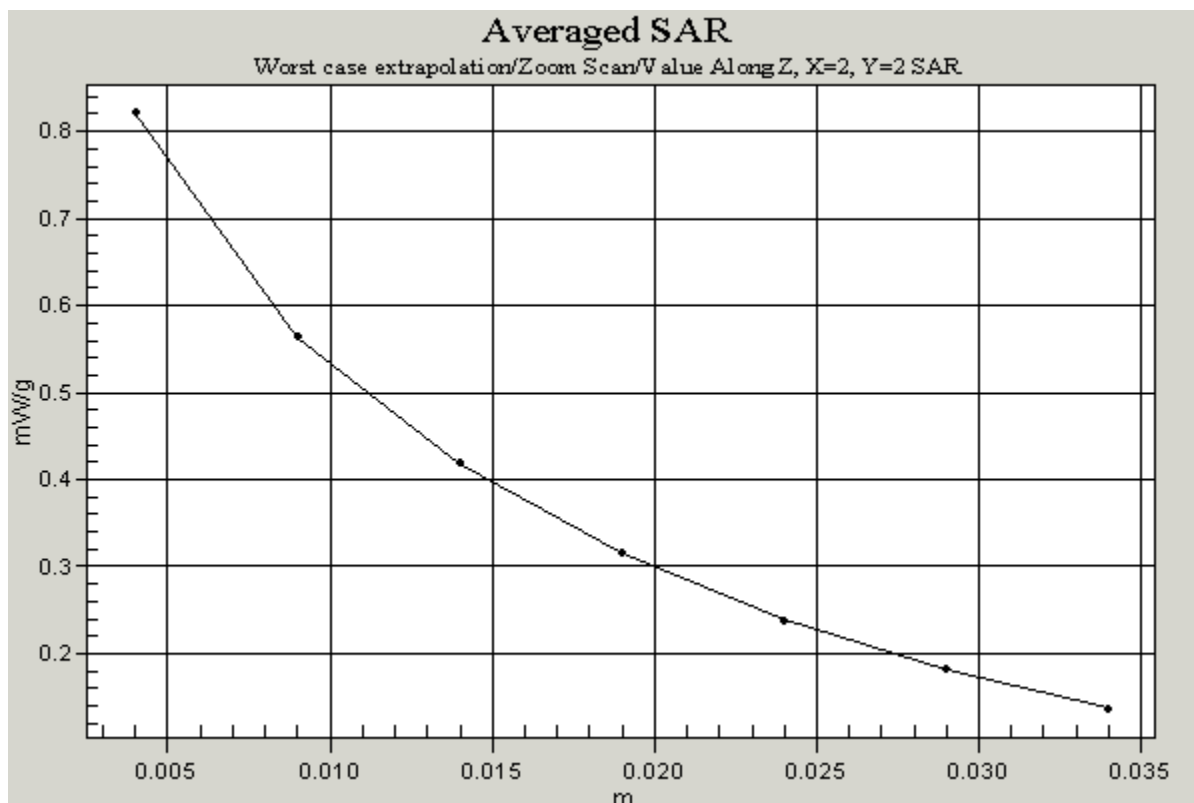
Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.791 mW/g; SAR(10 g) = 0.546 mW/g

Reference Value = 13.5 V/m

Power Drift = -0.04 dB

Maximum value of SAR = 0.821 mW/g



Date/Time: 07/31/03 17:42:41

Test Laboratory: Nokia Mobile Phones, Oulu, DTX07956-EN

DUT: LJPRH-31; Type: RH-31; Serial: 001004/00/116804/7

Communication System: GPRS 1900; Frequency: 1850.2 MHz; Duty Cycle: 1:4.2

Medium: muscle 1900 MHz ($\sigma = 1.51069$ mho/m, $\epsilon_r = 52.7539$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.10.2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 18.10.2002
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

Body worn, HDS-3, $t = 22.6$ °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 21.8 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 1.01 mW/g

Body worn, HDS-3, $t = 22.6$ °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

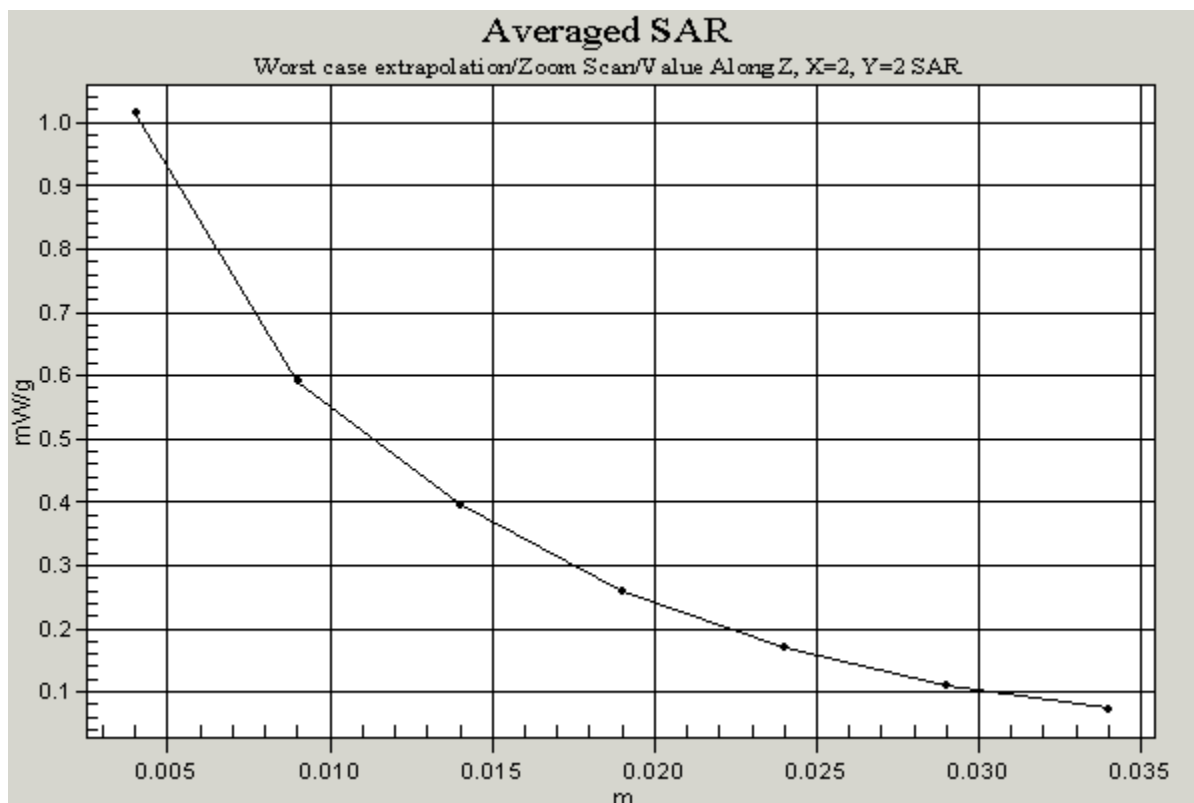
Peak SAR (extrapolated) = 1.86 W/kg

SAR(1 g) = 0.973 mW/g; SAR(10 g) = 0.562 mW/g

Reference Value = 21.8 V/m

Power Drift = -0.09 dB

Maximum value of SAR = 1.02 mW/g



APPENDIX C.

Calibration Certificate(s)

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1381

Place of Calibration:

Zurich

Date of Calibration:

October 21, 2002

Calibration Interval:

12 months

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

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

Calibrated by:

N. Vetter

Approved by:

Alain Kutz

Probe ET3DV6

SN:1381

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

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1381

Sensitivity in Free Space

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

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

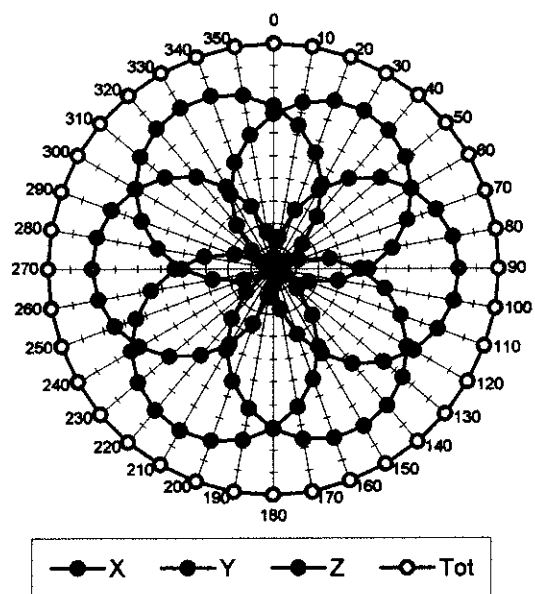
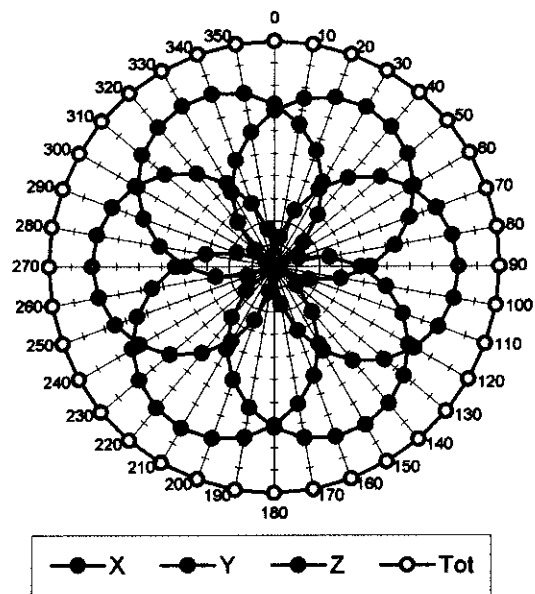
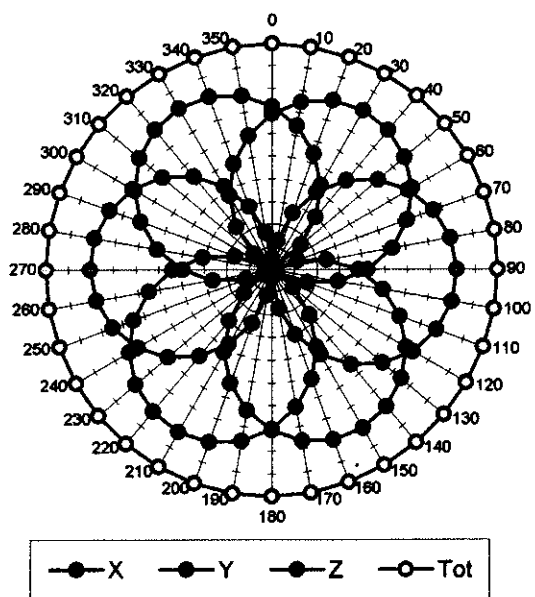
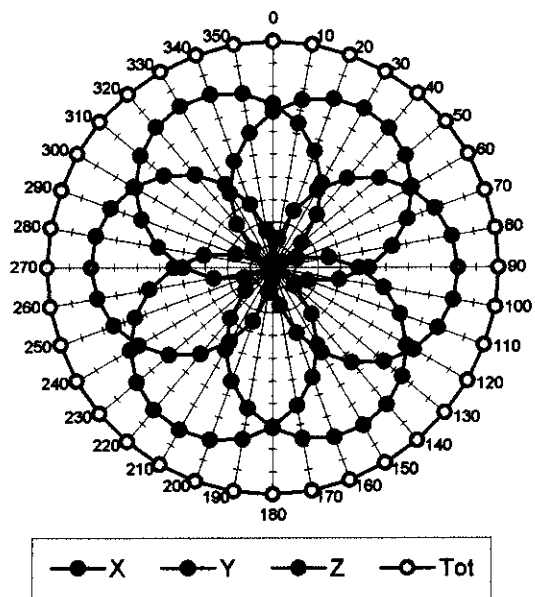
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha	0.43
ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth	2.44
Head	1880 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.1 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.1 $\pm 9.5\%$ (k=2)	Alpha	0.61
ConvF Z	5.1 $\pm 9.5\%$ (k=2)	Depth	2.32

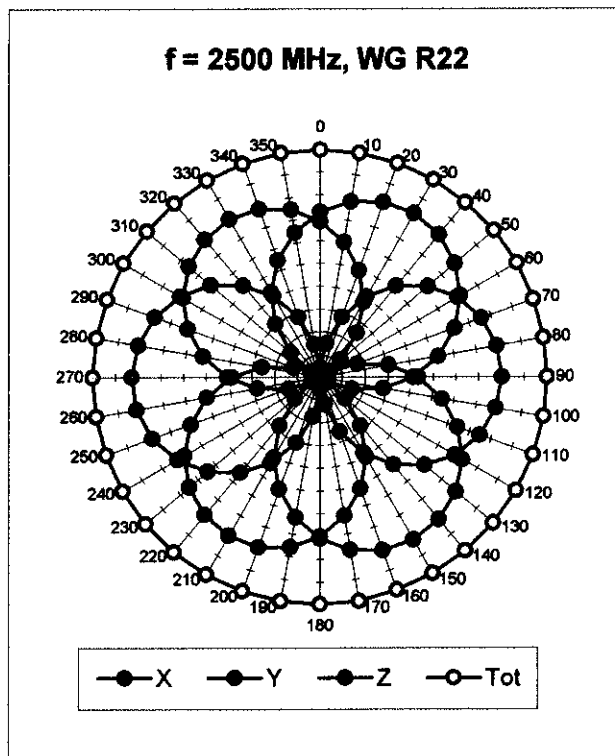
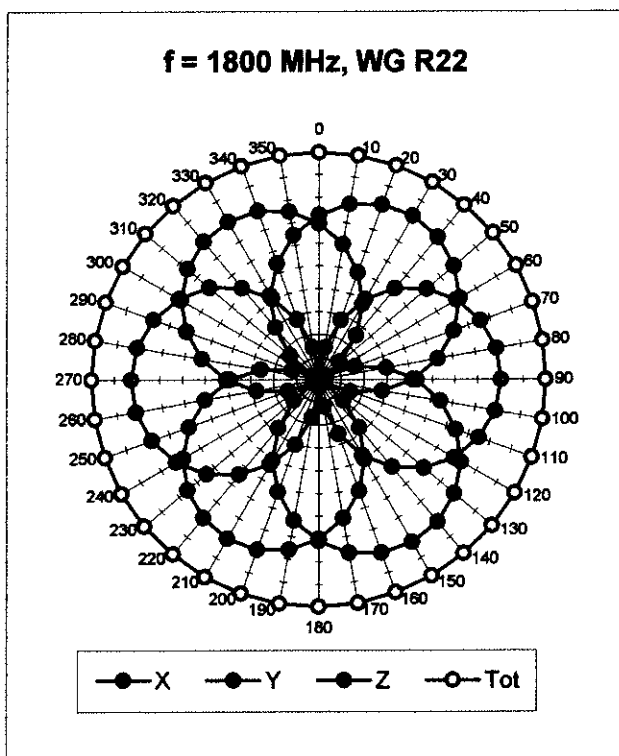
Boundary Effect

Head	835 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	11.0	6.1
SAR _{be} [%]	With Correction Algorithm	0.4	0.6
Head	1880 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%]	Without Correction Algorithm	13.9	8.9
SAR _{be} [%]	With Correction Algorithm	0.2	0.2

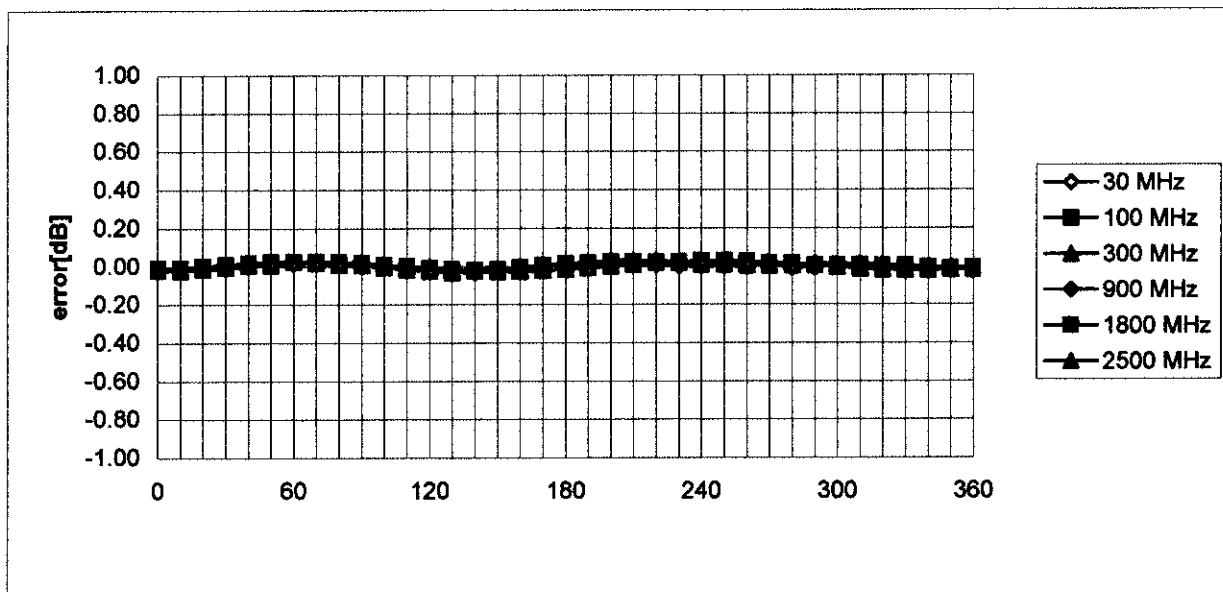
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 $\pm$ 0.2	mm

Receiving Pattern (ϕ), $\theta = 0^\circ$ **f = 30 MHz, TEM cell if110****f = 100 MHz, TEM cell if110****f = 300 MHz, TEM cell if110****f = 900 MHz, TEM cell if110**

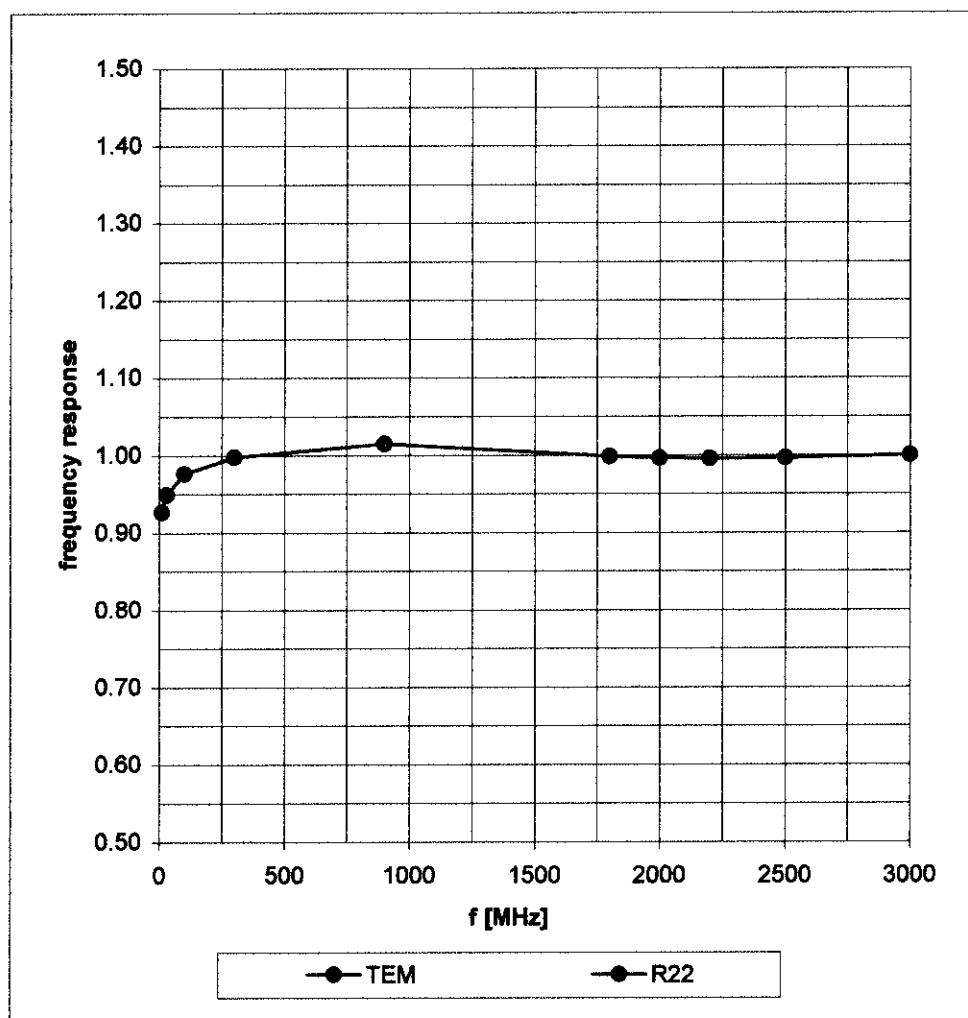


Isotropy Error (ϕ), $\theta = 0^\circ$

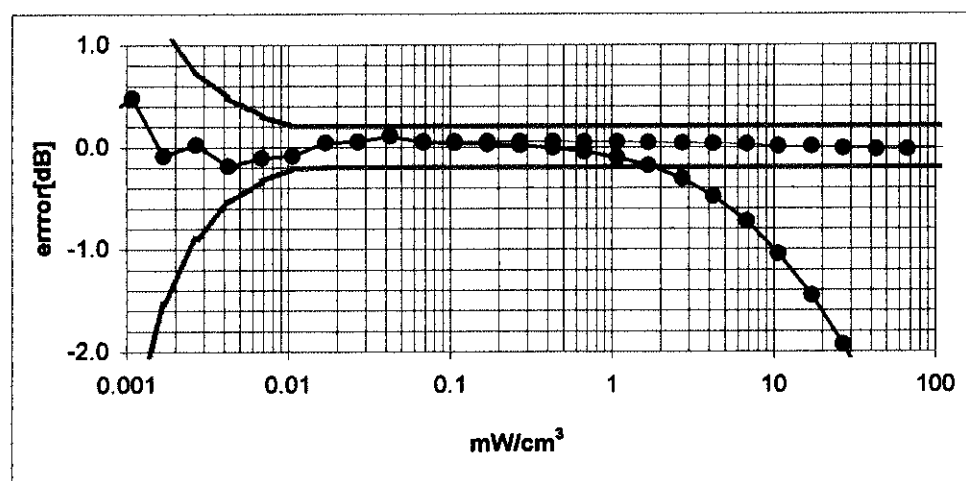
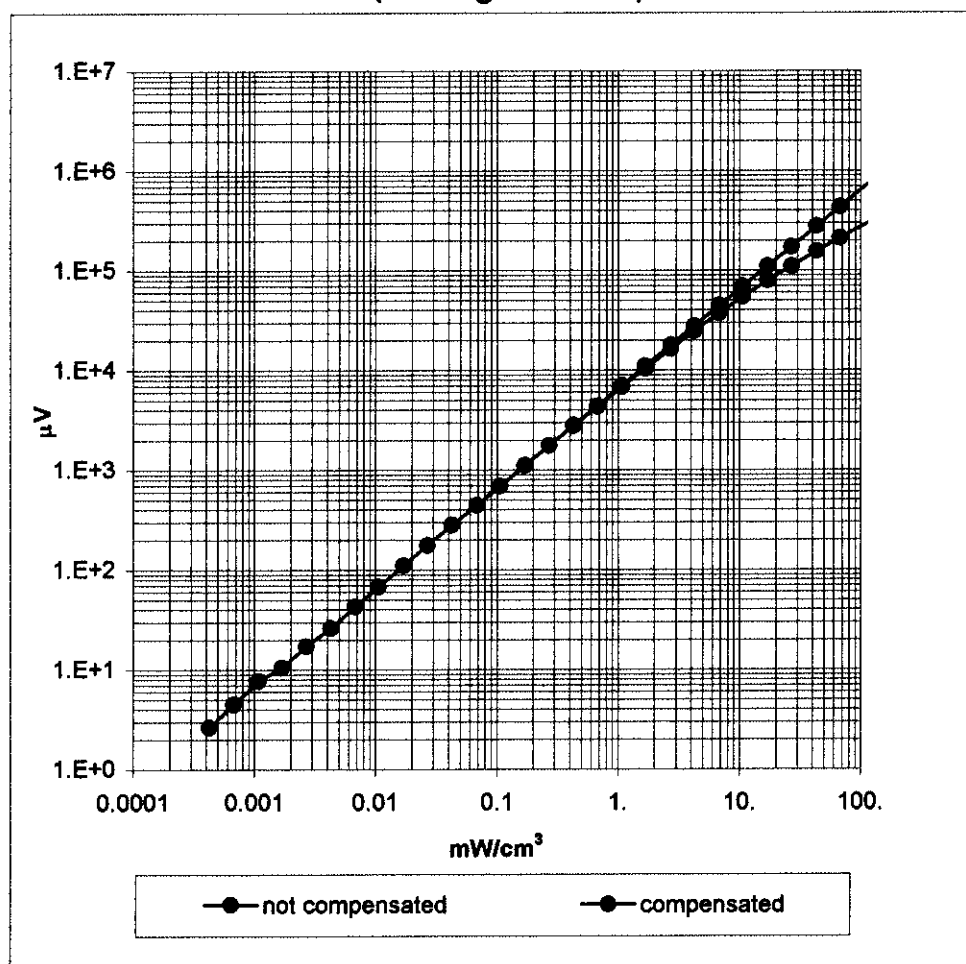


Frequency Response of E-Field

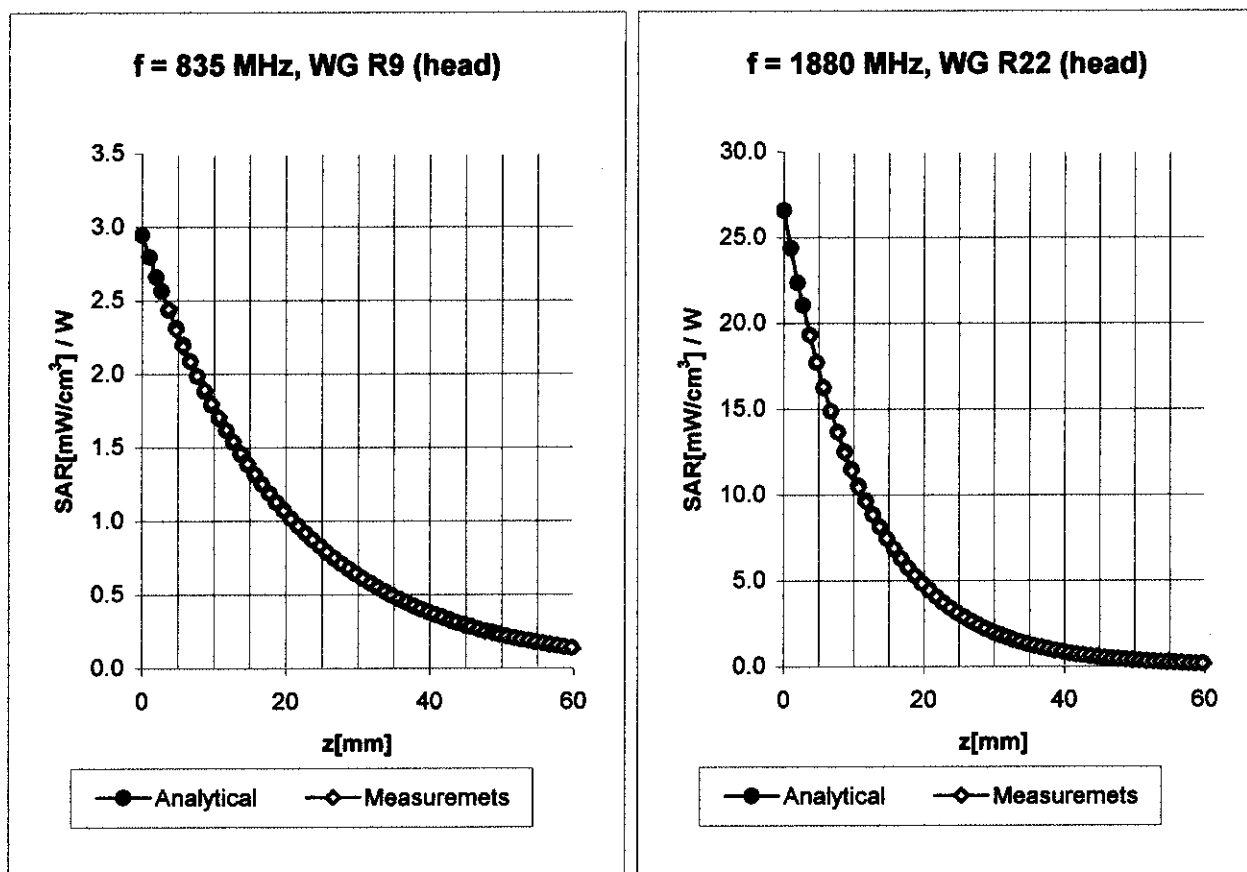
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain}) (Waveguide R22)



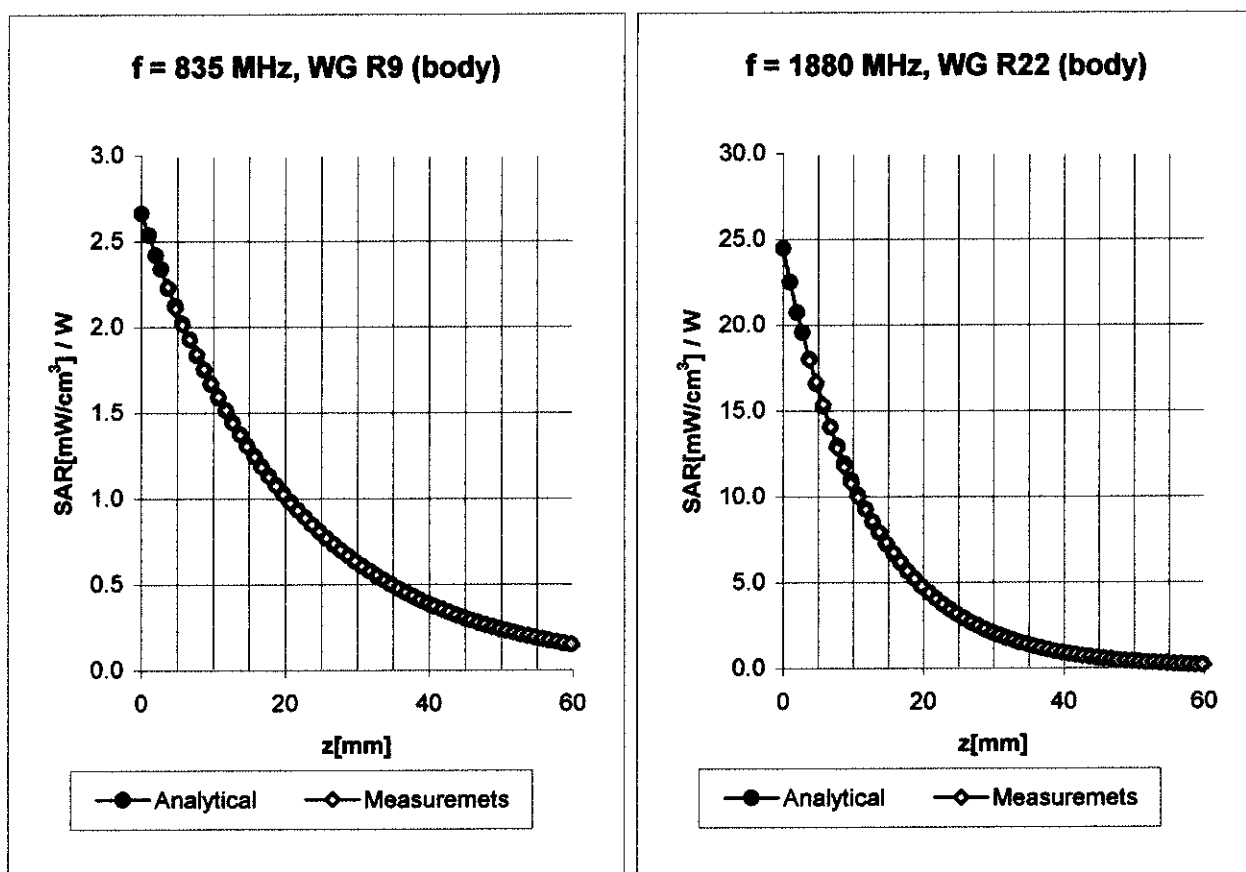
Conversion Factor Assessment



Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
	ConvF X	$6.3 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.3 \pm 9.5\% (k=2)$	Alpha 0.43
	ConvF Z	$6.3 \pm 9.5\% (k=2)$	Depth 2.44

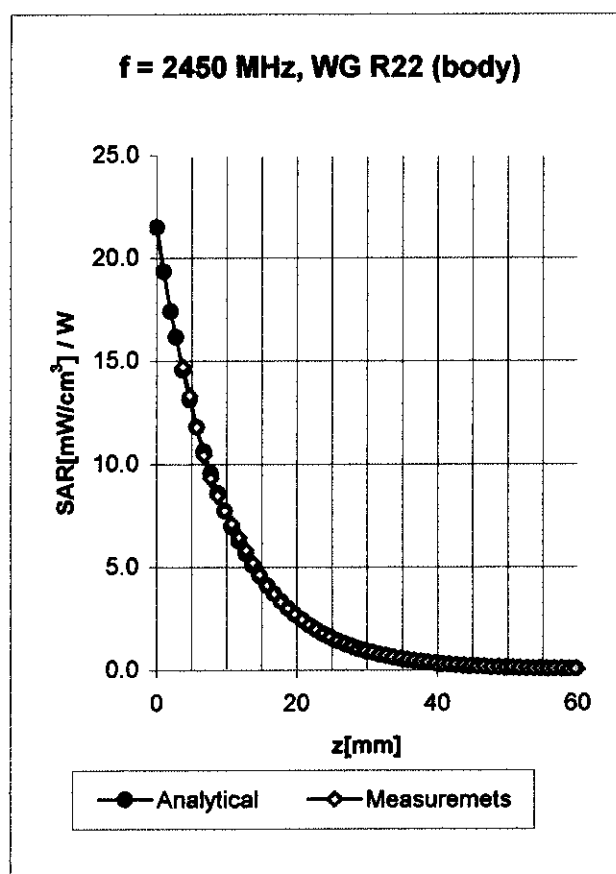
Head	1880 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	$5.1 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$5.1 \pm 9.5\% (k=2)$	Alpha 0.61
	ConvF Z	$5.1 \pm 9.5\% (k=2)$	Depth 2.32

Conversion Factor Assessment



Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\% \text{ mho/m}$
	ConvF X	$6.1 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$6.1 \pm 9.5\% (k=2)$	Alpha 0.49
	ConvF Z	$6.1 \pm 9.5\% (k=2)$	Depth 2.35
Body	1880 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
	ConvF X	$4.9 \pm 9.5\% (k=2)$	Boundary effect:
	ConvF Y	$4.9 \pm 9.5\% (k=2)$	Alpha 0.81
	ConvF Z	$4.9 \pm 9.5\% (k=2)$	Depth 2.07

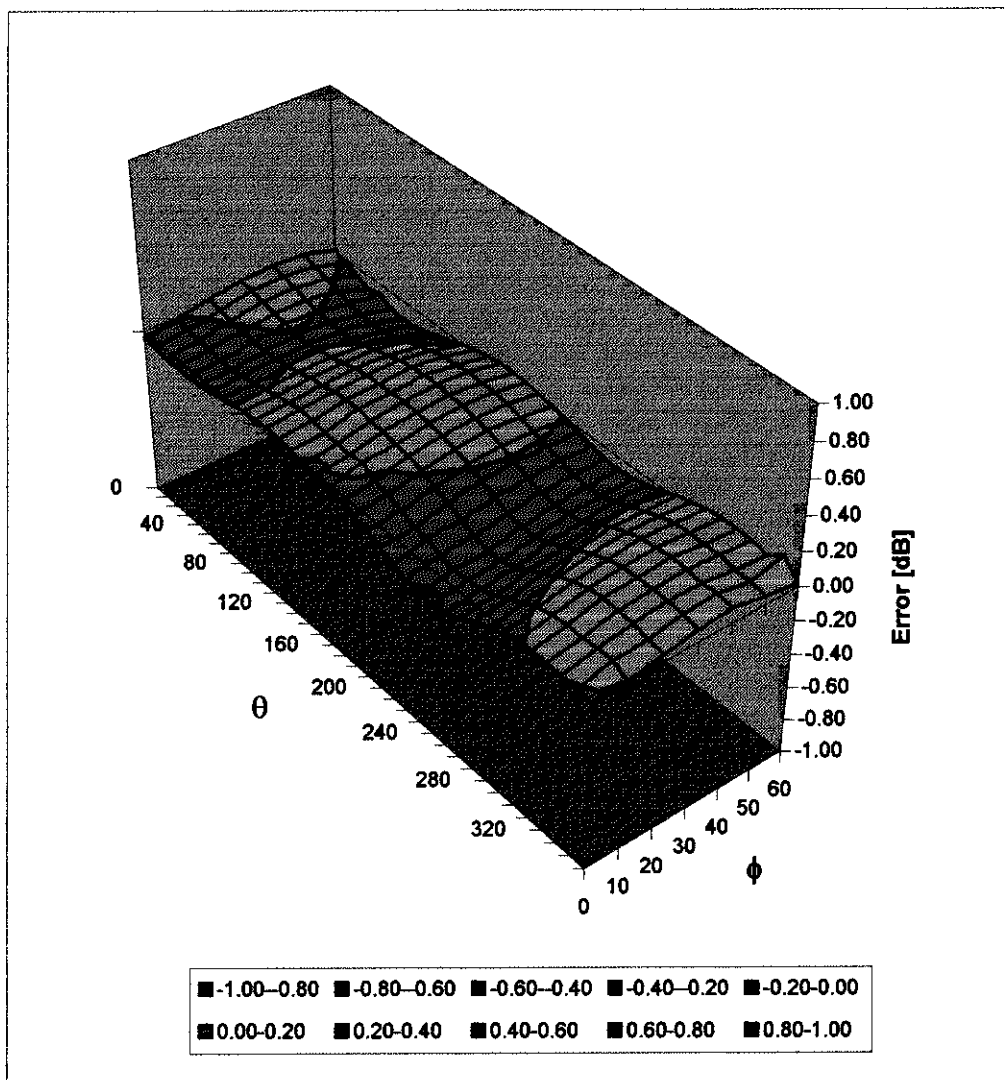
Conversion Factor Assessment



2450	Body	MHz	$\epsilon_r = 52.7 \pm 5\%$	$\sigma = 1.95 \pm 5\% \text{ mho/m}$
	ConvF X		4.5 $\pm 8.9\%$ (k=2)	Boundary effect:
	ConvF Y		4.5 $\pm 8.9\%$ (k=2)	Alpha 1.00
	ConvF Z		4.5 $\pm 8.9\%$ (k=2)	Depth 1.99

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Client **Nokia Mobile Phones (Oulu)**

CALIBRATION CERTIFICATE

Object(s) **D835V2 - SN: 448**

Calibration procedure(s) **QA CAL-05 v2
Calibration procedure for dipole validation kits**

Calibration date: **February 25, 2003**

Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

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

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

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

Date issued: February 26, 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.

DASY

Dipole Validation Kit

Type: D835V2

Serial: 448

Manufactured:	October 24, 2001
Calibrated:	February 25, 2003

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	41.5	$\pm 5\%$
Conductivity	0.89 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.7 at 835 MHz) was used for the measurements.

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

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was $250\text{mW} \pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	9.72 mW/g $\pm 17.5\%$ (k=2)¹
averaged over 10 cm^3 (10 g) of tissue:	6.28 mW/g $\pm 17.5\%$ (k=2)¹

¹ validation uncertainty

3. Dipole Impedance and Return Loss

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

Electrical delay:	1.386 ns	(one direction)
Transmission factor:	0.994	(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 835 MHz:	$\text{Re}\{Z\} = 50.7 \Omega$
	$\text{Im}\{Z\} = -3.7 \Omega$
Return Loss at 835 MHz	-28.5 dB

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with body simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	54.0	$\pm 5\%$
Conductivity	0.96 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.3 at 835 MHz) was used for the measurements.

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

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW $\pm 3\%$. The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: **10.12 mW/g ± 17.5 % (k=2)²**

averaged over 10 cm³ (10 g) of tissue: **6.60 mW/g ± 17.5 % (k=2)²**

6. Dipole Impedance and Return Loss

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

Feedpoint impedance at 835 MHz: **Re{Z} = 45.8 Ω**

Im {Z} = -5.9 Ω

Return Loss at 835 MHz **-22.5 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.

² validation uncertainty

Date/Time: 02/25/03 16:31:55

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN448_SN1507_HSL835_250203.da4

DUT: Dipole 835 MHz; Serial: D835V2 - SN448
Program: Dipole Calibration

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL 835 MHz; ($\sigma = 0.89$ mho/m, $\epsilon_r = 41.5$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.7, 6.7, 6.7); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 23; Postprocessing SW: SEMCAD, V1.6 Build 105

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

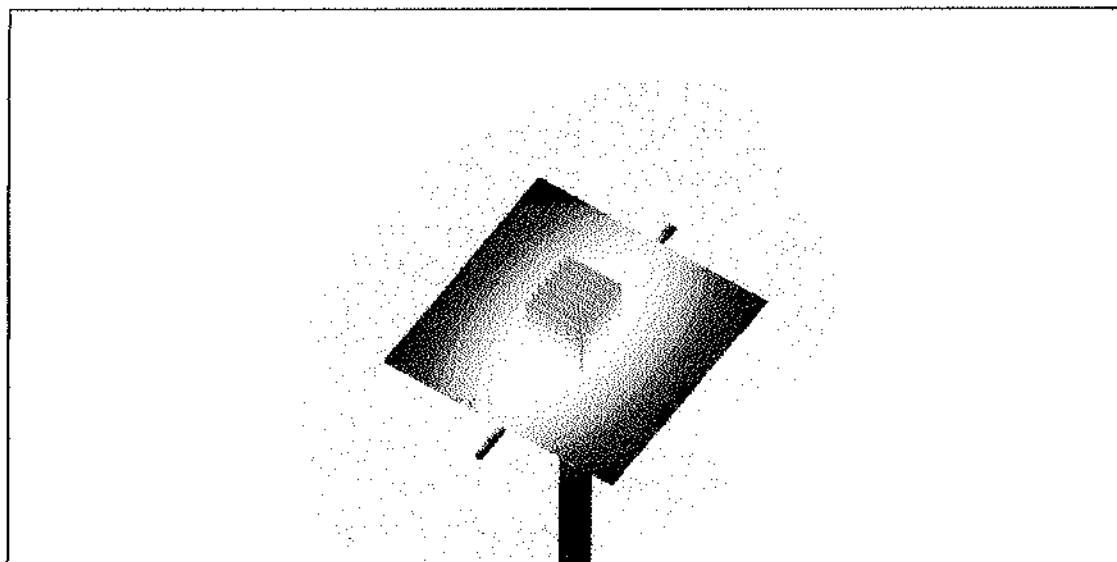
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.4 V/m

Peak SAR = 3.57 W/kg

SAR(1 g) = 2.43 mW/g; SAR(10 g) = 1.57 mW/g

Power Drift = 0.0003 dB



25 Feb 2003 11:06:30

CH1 S11 1 U F8

1: 50.650 $\angle$ -3.7344 $\angle$ 51.041 pF

835.000 000 MHz

De 1

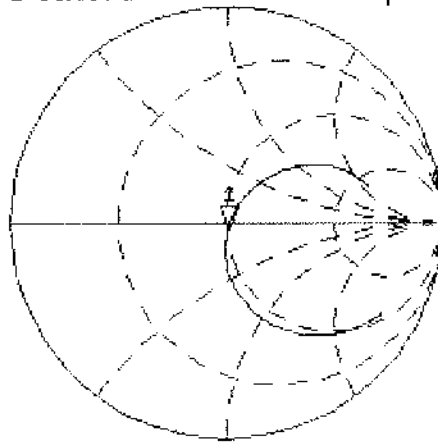
PRm

Cor

Avg

16

↑



CH2

S11

LOG

5 dB/REF -20 dB

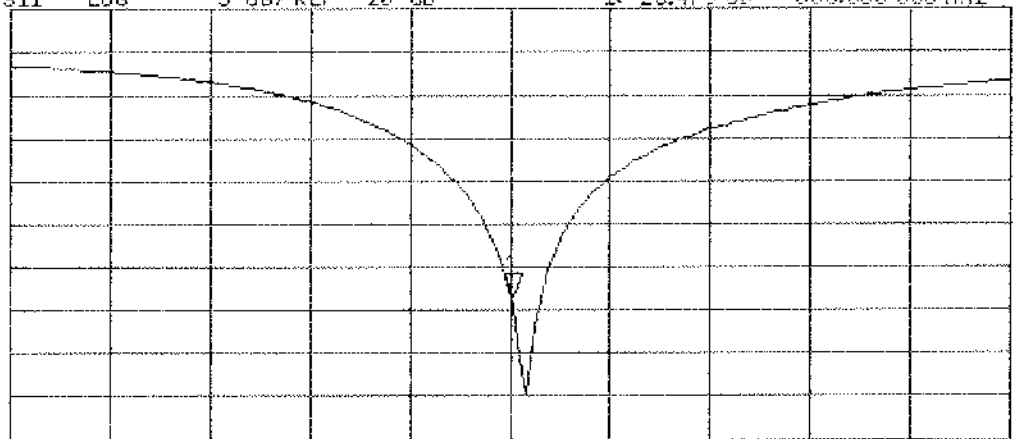
1: -20.423 dB

835.000 000 MHz

PRm

Cor

↑



CENTER 835.000 000 MHz

SPAN 400.000 000 MHz

Date/Time: 02/24/03 12:45:04

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN448_SN1507_M835_240203.da4

SN448_SN1507_M835_240203**Program: Dipole Calibration**

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: Muscle 835 MHz; ($\sigma = 0.96$ mho/m, $\epsilon_r = 54$, $\rho = 1000$ kg/m³)

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.3, 6.3, 6.3); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Software: DASY4, V4.1 Build 21

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

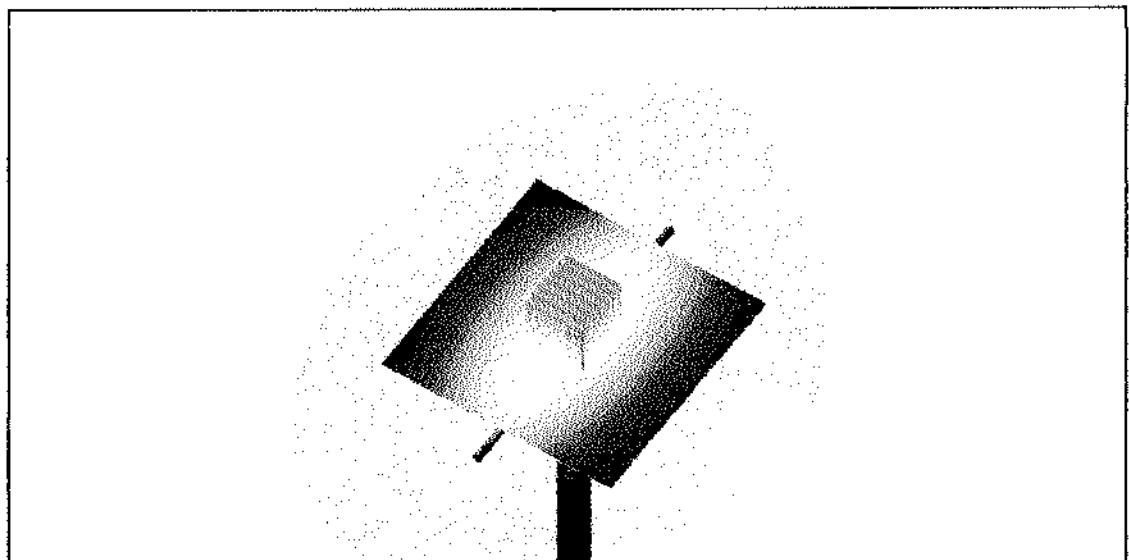
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.8 V/m

Peak SAR = 3.61 W/kg

SAR(1 g) = 2.53 mW/g; SAR(10 g) = 1.65 mW/g

Power Drift = 0.01 dB



24 Feb 2003 10:44:17

CR1 S11 1 U FS

1: 45.775 Ω -5.8809 Ω 32.411 pF

835.000 000 MHz

YV8
Body

De1

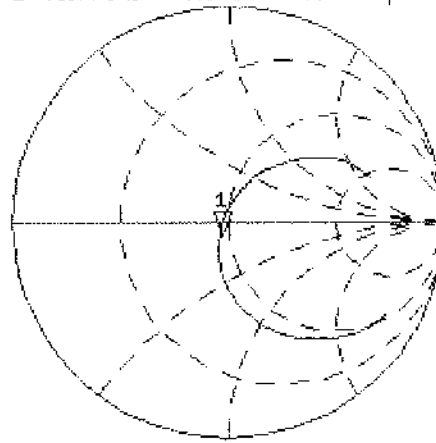
PRM

Cor

Avg

16

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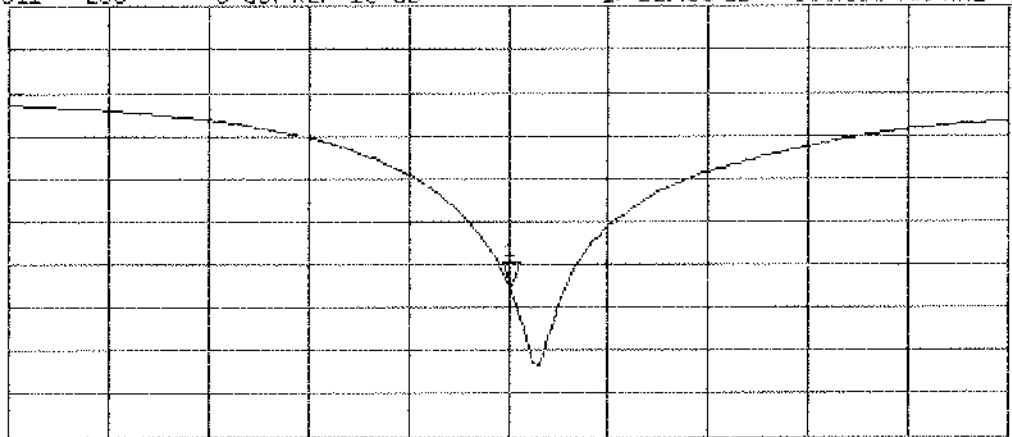


CH2 S11 LOG 5 dB REF 10 dB 1: -22.450 dB 835.000 000 MHz

PRM

Cor

↑



START 635.000 000 MHz

STOP 1 835.000 000 MHz

Client **Nokia Mobile Phones (Gulu)**

CALIBRATION CERTIFICATE

Object(s) **D1900V2 - SN:511**

Calibration procedure(s) **QA CAL-05-v2
Calibration procedure for dipole validation kits**

Calibration date: **February 27, 2003**

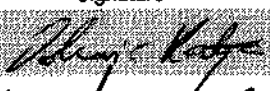
Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

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

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

	Name	Function	Signature
Calibrated by:	Kaga Polovic	Laboratory Director	

	Name	Function
Approved by:	Nils Kuster	Quality Manager

Date issued: February 27, 2003

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

DASY

Dipole Validation Kit

Type: D1900V2

Serial: 511

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

1. Measurement Conditions

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

Relative Dielectricity	38.6	$\pm 5\%$
Conductivity	1.46 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.2 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was $250\text{mW} \pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	$41.2\text{ mW/g} \pm 17.5\% (k=2)^1$
averaged over 10 cm^3 (10 g) of tissue:	$20.8\text{ mW/g} \pm 17.5\% (k=2)^1$

¹ validation uncertainty

3. Dipole Impedance and Return Loss

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

Electrical delay:	1.187 ns	(one direction)
Transmission factor:	0.997	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 1900 MHz:	$\text{Re}\{Z\} = 48.8 \Omega$
	$\text{Im}\{Z\} = 0.9 \Omega$
Return Loss at 1900 MHz	-36.1 dB

4. Measurement Conditions

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

Relative Dielectricity	51.2	$\pm 5\%$
Conductivity	1.59 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.8 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was $250\text{mW} \pm 3\%$. The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: **42.4 mW/g ± 17.5 % (k=2)²**

averaged over 10 cm³ (10 g) of tissue: **21.6 mW/g ± 17.5 % (k=2)²**

6. Dipole Impedance and Return Loss

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

Feedpoint impedance at 1900 MHz: **Re{Z} = 45.1 Ω**

Im {Z} = 1.7 Ω

Return Loss at 1900 MHz **-25.3 dB**

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

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

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

9. Power Test

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

² validation uncertainty

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

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

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

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz; ($\sigma = 1.46$ mho/m, $\epsilon_r = 38.6$, $\rho = 1000$ kg/m³)
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 25; Postprocessing SW: SEMCAD, V1.6 Build 105

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

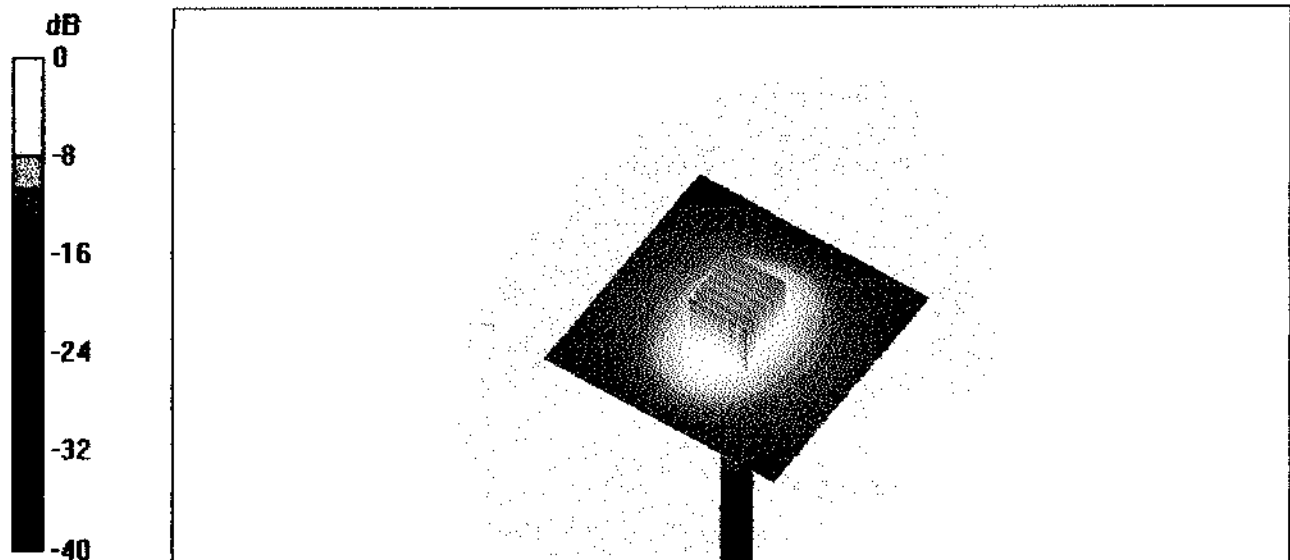
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.1 V/m

Peak SAR = 18.2 W/kg

SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.2 mW/g

Power Drift = 0.06 dB



S11

with caps

26 Feb 2003 19:08:14

CH1 S11 1 U FS 1: 49.764 $\angle$ 0.9375 $\angle$ 78.530 pH 1 900.000 000 MHz

Del

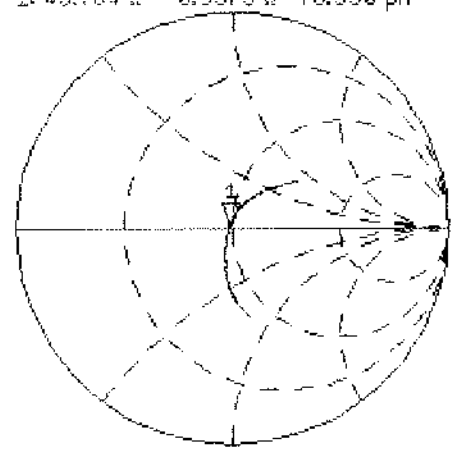
PRM

Cor

Avg

16

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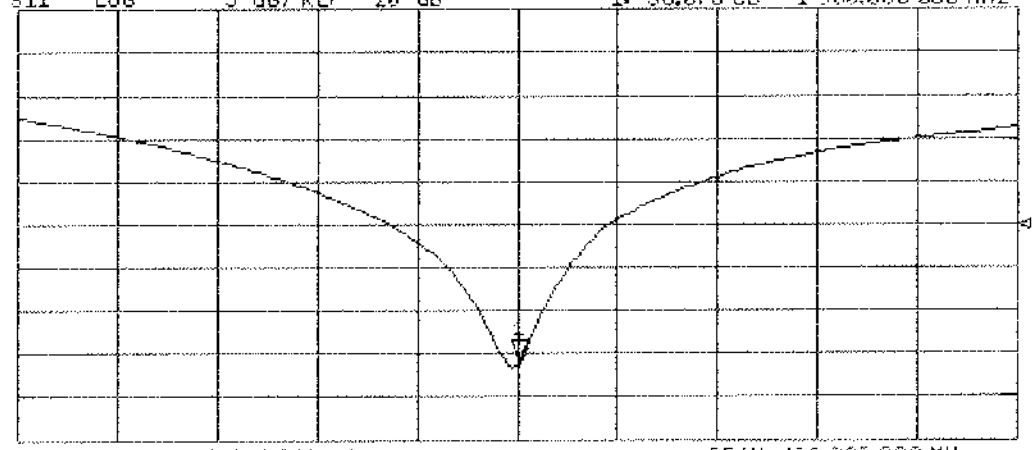


CH2 S11 LOG 5 dB/REF -20 dB 1: -36.073 dB 1 900.000 000 MHz

PRM

Cor

↑



CENTER 1 900.000 000 MHz

SPAN 400.000 000 MHz

S11
10 copy

26 Feb 2003 11:15:49

CH1 S11 1 U FS 1: 44.387 Ω -9.9766 Ω 8.3363 pF 1 900.000 000 MHz

Del

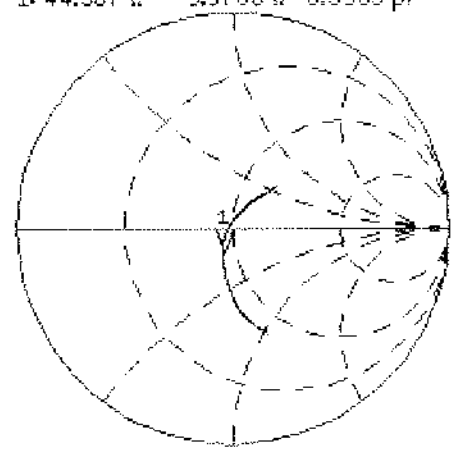
PRM

Cor

Avg

16

↑

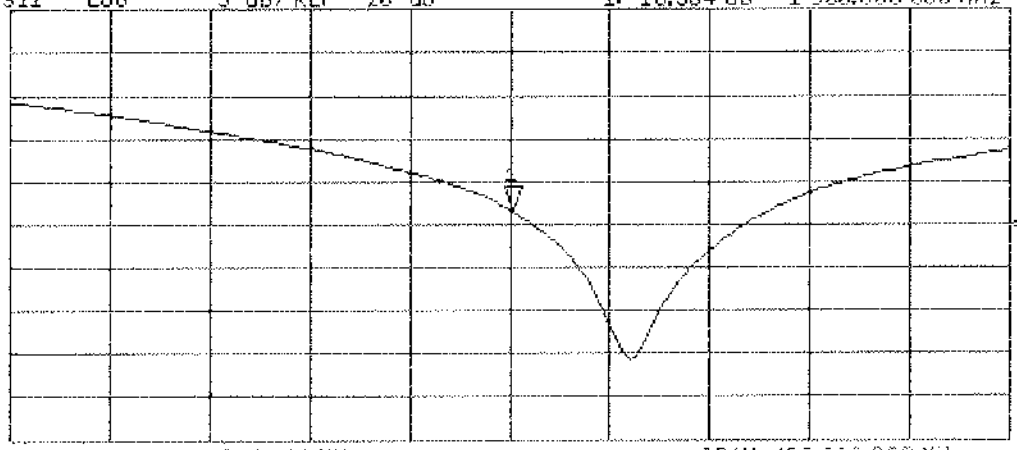


CH2 S11 LOG 5 dB/REF -20 dB 1:-18.384 dB 1 900.000 000 MHz

PRM

Cor

↑



CENTER 1 900.000 000 MHz

SPAN 400.000 000 MHz

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

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

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

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: Muscle 1900 MHz; ($\sigma = 1.59$ mho/m, $\epsilon_r = 51.2$, $\rho = 1000$ kg/m³)
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.8, 4.8, 4.8); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 25; Postprocessing SW: SEMCAD, V1.6 Build 105

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

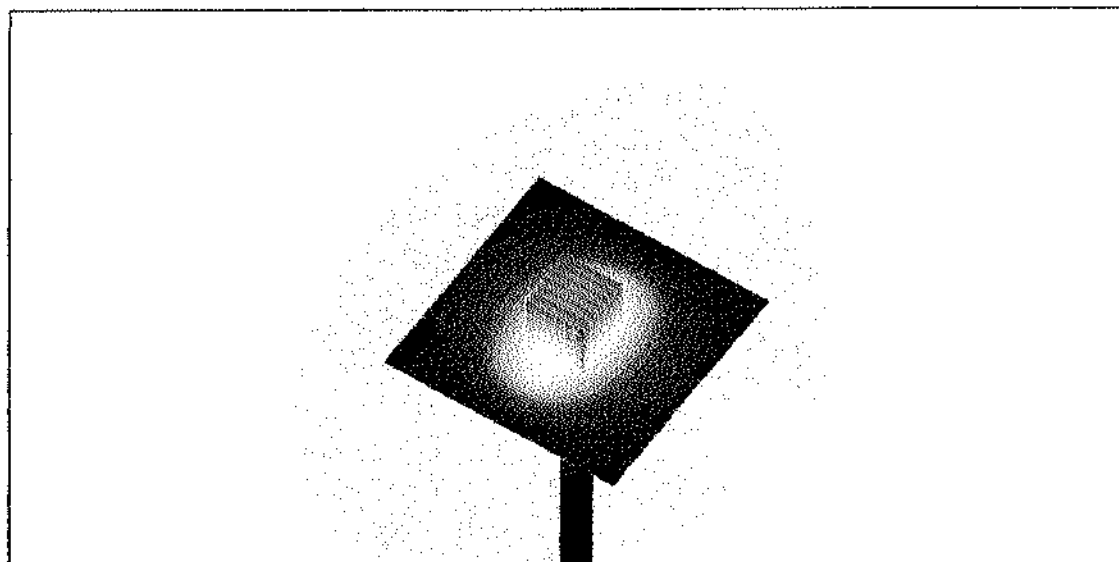
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.8 V/m

Peak SAR = 18.8 W/kg

SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.41 mW/g

Power Drift = 0.06 dB



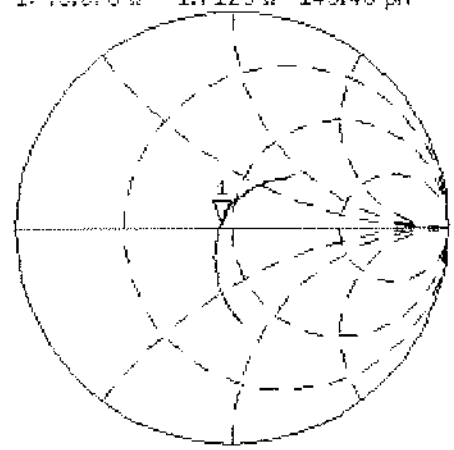
S11

27 Feb 2003 14:56:52

Muscle

CH1 S11 1 U FS 1: 45.078 Ω 1.7129 Ω 143.48 pF 1 900.000 000 MHz

PRM
Cor
Avg
16



Del

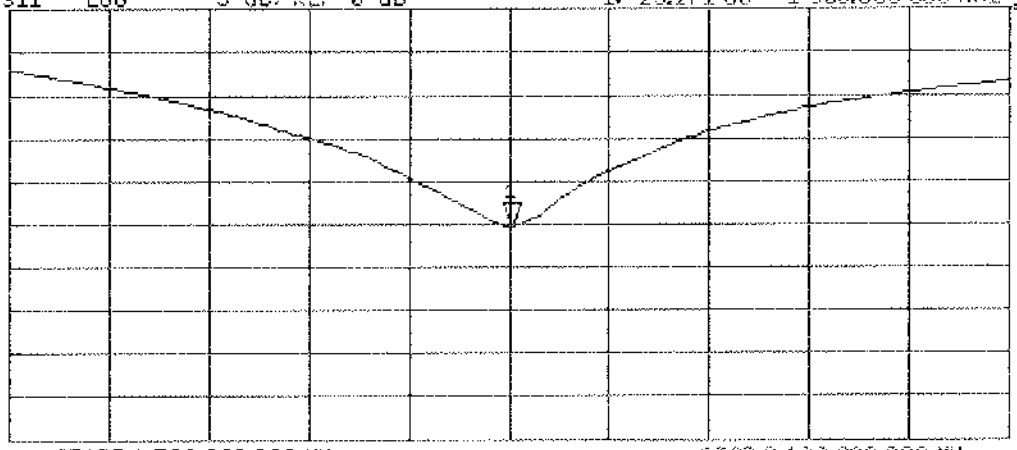
PRM
Cor
Avg
16

↑

CH2 S11 LOG 5 dB/REF 0 dB 1: -25.271 dB 1 900.000 000 MHz

PRM
Cor

↑



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz