NOKIA
Oulu

SAR Compliance Test Report

Test report no.:	Not numbered	**Date of report:**	2004-03-23
		Number of pages:	32
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Responsible test engineer:	Anne Kiviniemi	**Product contact person:**	Janne Siltari
Measurements made by:	Anne Kiviniemi		
Tested device:	RM-37		
FCC ID (USA):	LJPRM-37	**Industry Canada ID:**	661E-RM37
Supplement reports:	DTX10200-EN		

Testing has been carried out in accordance with:

47CFR §2.1093
Radiofrequency Radiation Exposure Evaluation: Portable Devices

FCC OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01)
Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

RSS-102
Evaluation Procedure for Mobile and Portable Radio Transmitters with Respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields

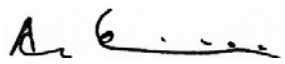
IEEE 1528 - 2003
IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

Documentation: This document 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: **2004-03-23**

For the contents:



Anne Kiviniemi
Test Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2004-03-09, 2004-03-10
SN, HW and SW numbers of tested device	SN: 004400/43/164694/0; HW: 1465; SW: 3.00
Batteries used in testing	BLD-3
Headsets used in testing	HDS-3
Other accessories used in testing	-
State of sample	prototype
Notes	-

1.2 Maximum Results

The maximum measured SAR values for Head configuration and Body Worn configuration are given in section 1.2.1 and 1.2.2 respectively. The device conforms to the requirements of the standard(s) when the maximum measured SAR value is less than or equal to the limit.

1.2.1 Head Configuration

Mode	Ch / *f* (MHz)	Conducted power/ EIRP	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GSM 1900	512/1850.2	32.1 dBm	Right, Tilt	1.6 W/kg	0.97 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	Conducted power/ EIRP	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS 1900	661/1880	31.2 dBm	2.2 cm	1.6 W/kg	1.05 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	0.08 dB

1.2.4 Measurement Uncertainty

Extended Uncertainty (k=2) 95%	± 29.1 %

2. DESCRIPTION OF THE DEVICE UNDER TEST

Device category	portable
Exposure environment	uncontrolled

Modes and Bands of Operation	GSM 1900	GPRS (GSM)
Modulation Mode	GMSK	GMSK
Duty Cycle	1/8	1/8 or 2/8
Transmitter Frequency Range (MHz)	1850.2 - 1909.8	1850.2 - 1909.8

Outside of USA and Canada, the transmitter of the device is capable of operating also in GSM900 and GSM1800, which are not part of this filing.

2.1 Picture of the Device

2.2 Description of the Antenna

The device has an internal antenna.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Period of measurement:	09.03.2004 to 10.03.2004
Ambient temperature (°C):	21.9 to 22.8
Ambient humidity (RH %):	30

3.2 Test Signal, Frequencies, and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.

The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.

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

The power output was measured by a separate test laboratory on the same unit as used for SAR testing.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement System and Components

The measurements were performed using an automated near-field scanning system, DASY 4 software version 4.1, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements on the device was the 'worst-case extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DAE 3	371	12 months	11/2004
E-field Probe ET3DV6	1381	12 months	11/2004
Dipole Validation Kit, D1900V2	511	24 months	02/2005

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	Agilent E4433B	GB40050947	12 months	09/2004
Amplifier	Amplifier Research 5S1G4	27573	-	-
Power Meter	R&S NRT	835065/049	12 months	06/2004
Power Sensor	R&S NRT-Z44	835374/021	12 months	06/2004
Radio Communication tester	R&S CMU200	101026	12 months	12/2004
Network Analyzer	Hewlett Packard 8753D	3410A05782	12 months	05/04
Dielectric Probe Kit	Agilent 85070C	US99360106	-	-
Thermometer	Fluke 54II	77800145	-	-

4.1.1 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., butyl diglycol)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to 3 GHz (dosimetry); Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
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; Linearity: ± 0.2 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

4.2 Phantoms

The phantom used for all tests i.e. for both validation testing and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528 - 2003.

Validation tests were performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

The SPEAG device holder (see Section 5.1) was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.3 Simulating Liquids

Recommended values for the dielectric parameters of the simulating liquids are given in IEEE 1528 - 2003 and FCC Supplement C to OET Bulletin 65. All tests were carried out using liquids whose dielectric parameters were within ± 5% of the recommended values. All tests were carried out within 24 hours of measuring the dielectric parameters.

The depth of the liquid was 15.0 ± 0.5 cm measured from the ear reference point during validation and device measurements.

4.3.1 Liquid Recipes

The following recipes were used for Head and Body liquids:

1900MHz band

Ingredient	Head (% by weight)	Body (% by weight)
Deionised Water	54.88	69.02
Butyl Diglycol	44.91	30.76
Salt	0.21	0.22

4.3.2 Verification of the System

The manufacturer calibrates the probes annually. Dielectric parameters of the simulating liquids were measured every day using the dielectric probe kit and the network analyser. A SAR measurement was made following the determination of the dielectric parameters of the liquids, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The validation results (dielectric parameters and SAR values) are given in the table below.

System verification, head tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
1900	Reference result	10.3	38.6	1.46	N/A
	± 10% window	9.3 – 11.3			
	09.03.2004	10.7	38.5	1.47	22

System verification, body tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
1900	Reference result	10.6	51.2	1.59	N/A
	± 10% window	9.5 – 11.7			
	10.03.2004	10.2	51.6	1.58	22

Plots of the Verification scans are given in Appendix A.

4.3.3 Tissue Simulants used in the Measurements

Head tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
1880	Recommended value	40.0	1.40	N/A
	± 5% window	38.0 – 42.0	1.33 – 1.47	
	09.03.2004	38.5	1.46	22

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
1880	Recommended value	53.3	1.52	N/A
	± 5% window	50.6 – 56.0	1.44 – 1.60	
	10.03.2004	51.4	1.57	22

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

A Nokia designed spacer (illustrated below) was used to position the device within the SPEAG holder. The spacer positions the device so that the holder has minimal effect on the test results but still holds the device securely. The spacer was removed before the tests.

Nokia spacer

5.2 Test Positions

5.2.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to IEEE 1528 - 2003 "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”.

Photo of the device in “cheek” position

Photo of the device in “tilt” position

5.2.2 Body Worn Configuration

The device was placed in the SPEAG holder using the Nokia spacer and placed below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance indicated in the photo below using a separate flat spacer that was removed before the start of the measurements. The device was oriented with its antenna facing the phantom since this orientation gave higher results.

Photo of the device positioned for Body SAR measurement. The spacer was removed for the tests.

5.3 Scan Procedures

First coarse scans were used for determination of the field distribution. Next a cube scan, 5x5x7 points covering a volume of 30x30x30 mm was performed around the highest E-field value to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the coarse scan and again at the end of the cube scan.

5.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within Dasy4 are all based on the modified Quadratic Shepard's method (Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A trivariate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighbouring points by a least-square method. For the cube scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the cube scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

6. MEASUREMENT UNCERTAINTY

Table 6.1 – Measurement uncertainty evaluation

Uncertainty Component	Section in IEEE 1528	Tol. (%)	Prob Dist	Div	c_i	$c_i . u_i$ (%)	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	±8.3	R	√3	1	±4.8	∞
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	±3.9	R	√3	1	±2.3	∞
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			**±14.5**	187
Coverage Factor for 95%			**k=2**				
Expanded Standard Uncertainty						**±29.1**	

7. RESULTS

The measured Head SAR values for the test device are tabulated below:

1900MHz Head SAR results

Mode and Band	Position		SAR, averaged over 1g (W/kg)		
			Ch 512 1850.2 MHz	Ch 661 1880 MHz	Ch 810 1909.8 MHz
GSM1900	Power level		32.1 dBm	31.2 dBm	29.5 dBm
	Left	Cheek		0.57	
		Tilt		0.79	
	Right	Cheek	0.92	0.87	0.30
		Tilt	**0.97**	0.92	0.42

The measured Body SAR values for the test device are tabulated below:

1900MHz Body SAR results

Mode and Band	Body-worn location setup	SAR, averaged over 1g (W/kg)		
		Ch 512 1850.2 MHz	Ch 661 1880 MHz	Ch 810 1909.8 MHz
GPRS1900	Power level	32.1 dBm	31.2 dBm	29.5 dBm
	Without headset	0.85	**1.05**	0.72
	Headset HDS-3	0.92	1.04	0.78

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

Date/Time: 03/09/04 08:59:45

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

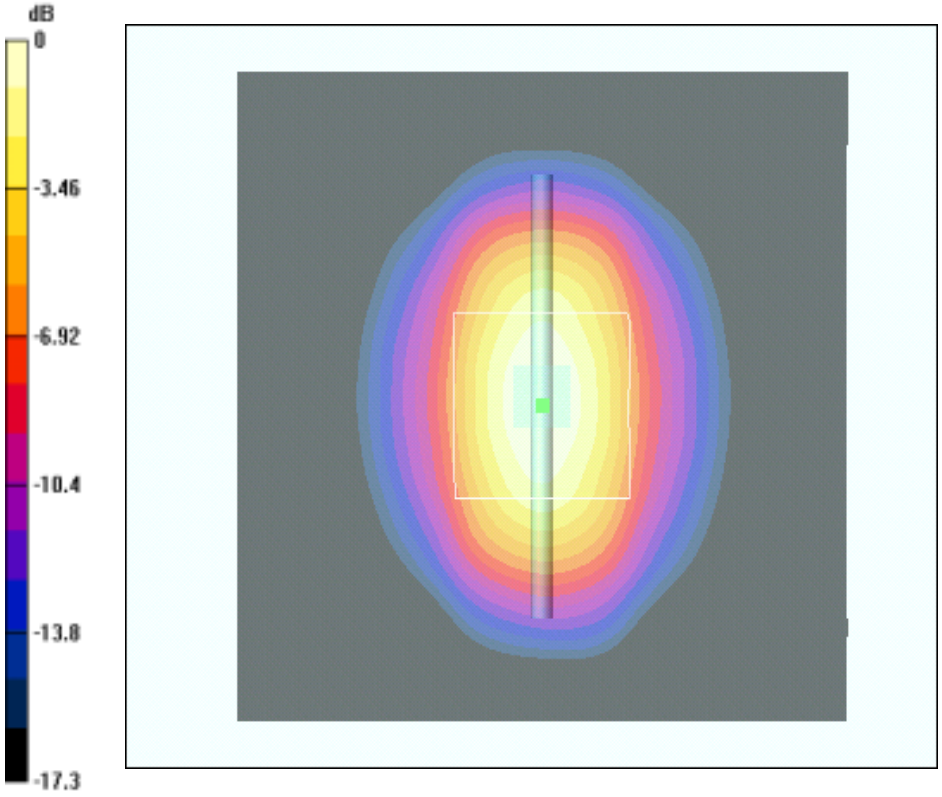
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 511

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Head 1900 MHz (σ = 1.46569 mho/m, ε_r = 38.4934, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

HSL 1900; T = 22.2 °C/Area Scan (71x71x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 96.8 V/m
Power Drift = 0.06 dB
Maximum value of SAR = 12.4 mW/g

HSL 1900; T = 22.2 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 18.4 W/kg
SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.5 mW/g
Reference Value = 96.8 V/m
Power Drift = 0.06 dB
Maximum value of SAR = 12 mW/g



0 dB = 12mW/g

Date/Time: 03/10/04 09:34:43

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

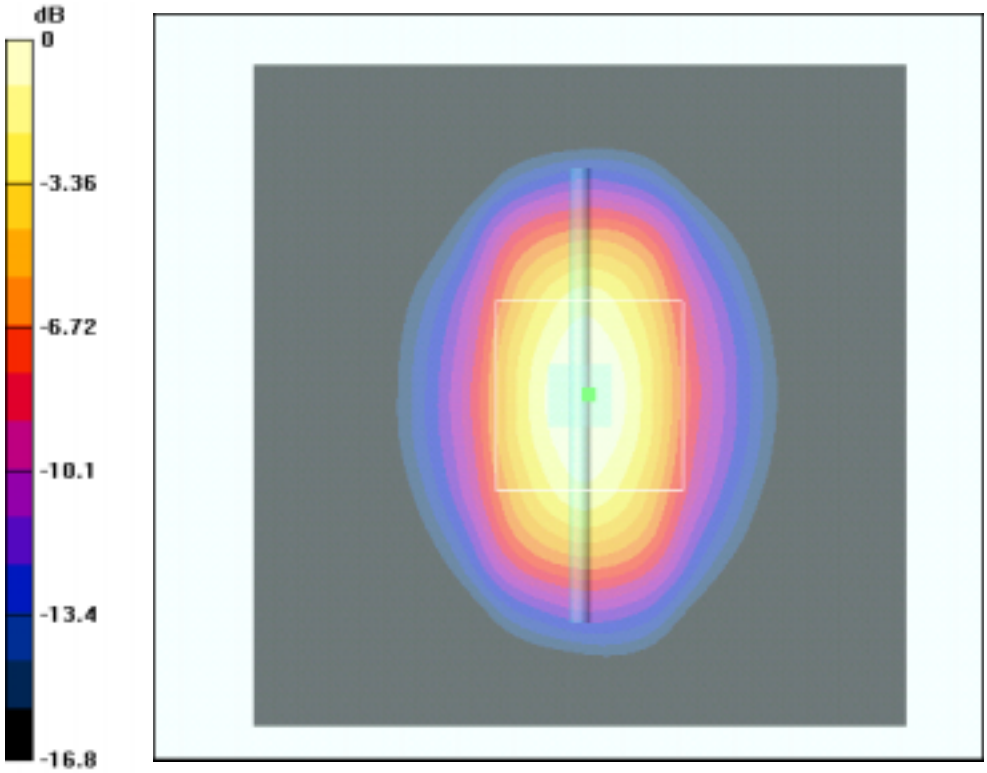
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 511

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: muscle 1900 MHz (σ = 1.57843 mho/m, ε_r = 51.6389, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

muscle 1900; T = 22.8 °C/Area Scan (71x71x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 92.8 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 12.2 mW/g

muscle 1900; T = 22.8 °C/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 17.2 W/kg
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.38 mW/g
Reference Value = 92.8 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 11.5 mW/g



0 dB = 11.5mW/g

APPENDIX B: MEASUREMENT SCANS

Date/Time: 03/09/04 12:26:24

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

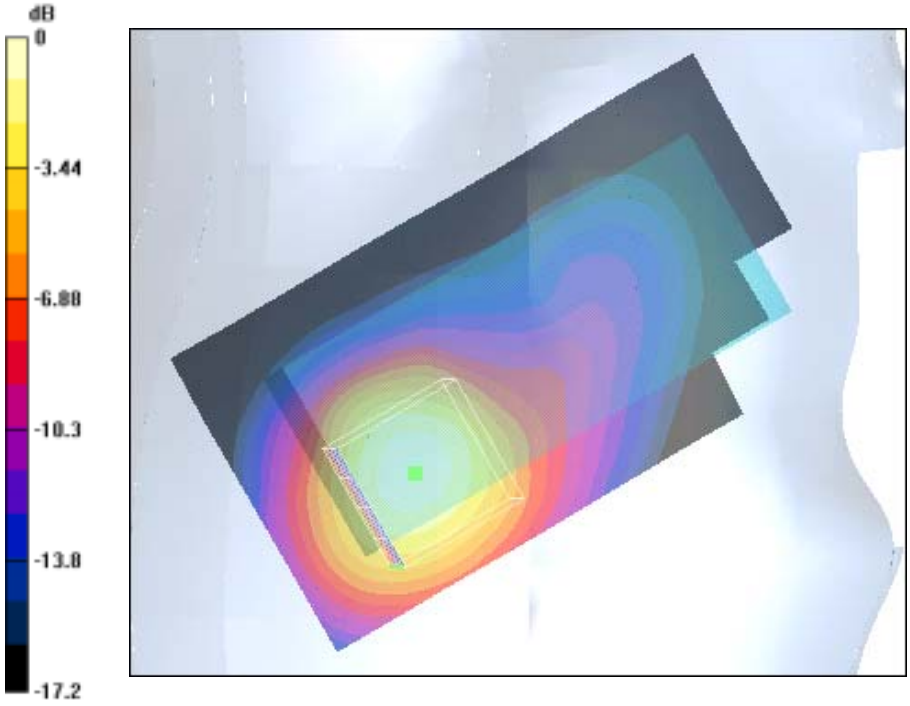
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GSM 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 MHz (σ = 1.42439 mho/m, ε_r = 38.833, ρ = 1000 kg/m^3)
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Tilted, T = 22.1 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 21.5 V/m
Power Drift = 0.002 dB
Maximum value of SAR = 0.992 mW/g

Tilted, T = 22.1 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 1.96 W/kg
SAR(1 g) = 0.974 mW/g; SAR(10 g) = 0.507 mW/g
Reference Value = 21.5 V/m
Power Drift = 0.002 dB
Maximum value of SAR = 1.03 mW/g



0 dB = 1.03mW/g

Date/Time: 03/09/04 10:04:40

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

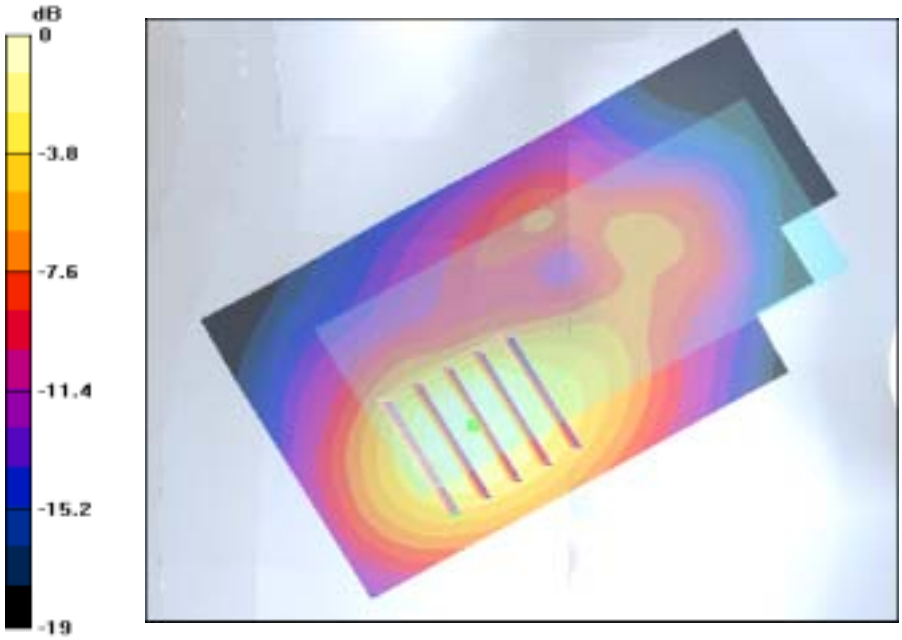
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GSM 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 MHz (σ = 1.42439 mho/m, ε_r = 38.833, ρ = 1000 kg/m^3)
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Cheek, T = 21.9 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 0.999 mW/g

Cheek, T = 21.9 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 1.84 W/kg
SAR(1 g) = 0.918 mW/g; SAR(10 g) = 0.484 mW/g
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 0.968 mW/g



0 dB = 0.968mW/g

Date/Time: 03/09/04 13:44:21

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

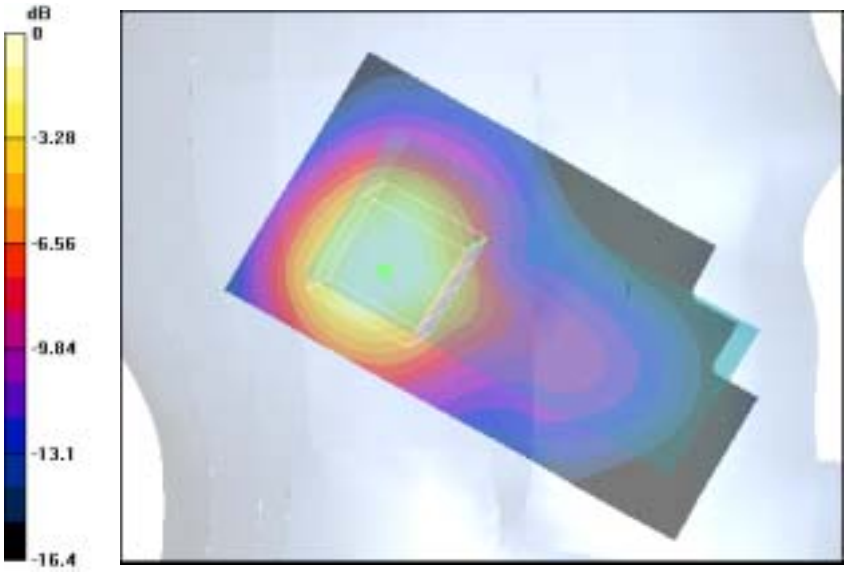
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 MHz (σ = 1.46272 mho/m, ε_r = 38.5296, ρ = 1000 kg/m^3)
Phantom section: Left Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Tilted, T = 22.5 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 21.4 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 0.828 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) = 1.52 W/kg
SAR(1 g) = 0.787 mW/g; SAR(10 g) = 0.428 mW/g
Reference Value = 21.4 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 0.807 mW/g



0 dB = 0.807mW/g

Date/Time: 03/09/04 13:29:16

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 MHz (σ = 1.46272 mho/m, ε_r = 38.5296, ρ = 1000 kg/m^3)
Phantom section: Left Section

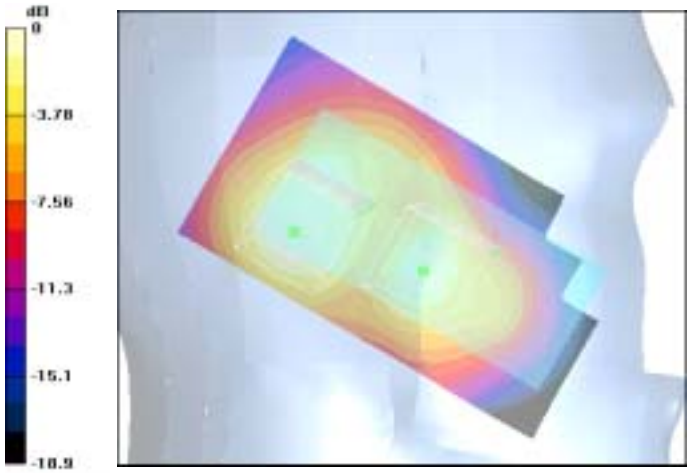
DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Cheek, T = 22.4 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 17.2 V/m
Power Drift = 0.04 dB
Maximum value of SAR = 0.597 mW/g

Cheek, T = 22.4 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.572 mW/g; SAR(10 g) = 0.326 mW/g
Reference Value = 17.2 V/m
Power Drift = 0.04 dB
Maximum value of SAR = 0.587 mW/g

Warning: Maximum averaged SAR over 10 g is located on the boundary of the measurement cube. This cube might not incorporate the absolute averaged SAR. Please consider a refinement of the Area Scan measurement.

Cheek, T = 22.4 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 0.999 W/kg
SAR(1 g) = 0.496 mW/g; SAR(10 g) = 0.252 mW/g
Reference Value = 17.2 V/m
Power Drift = 0.04 dB
Maximum value of SAR = 0.602 mW/g



0 dB = 0.602mW/g

Date/Time: 03/10/04 10:10:02

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

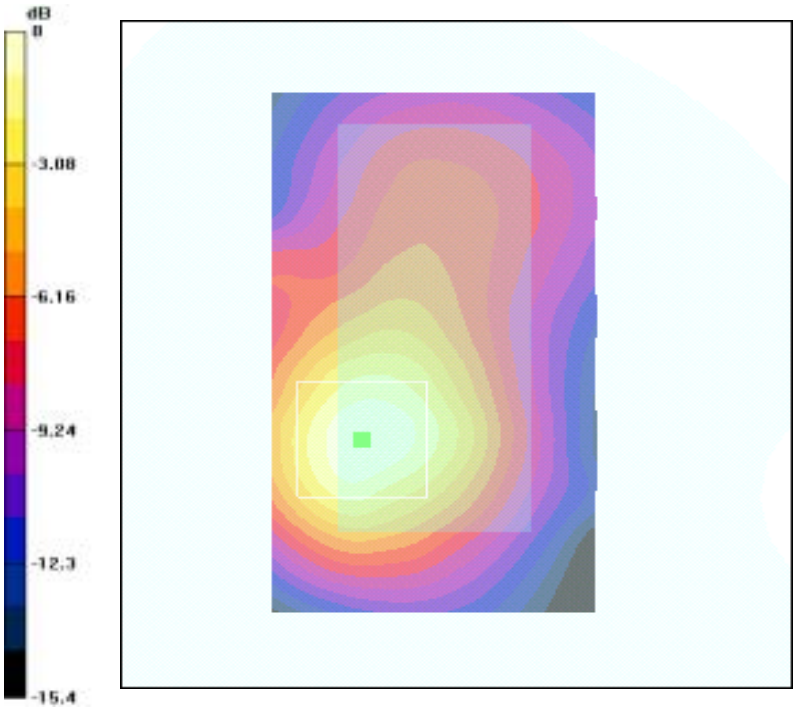
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GPRS 1900; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: muscle 1900 MHz (σ = 1.56717 mho/m, ε_r = 51.3576, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body worn + 22 mm, T = 22.2 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 1.08 mW/g

Body worn + 22 mm, T = 22.2 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 2.24 W/kg
SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.579 mW/g
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 1.09 mW/g



0 dB = 1.09mW/g

Date/Time: 03/09/04 12:26:24

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

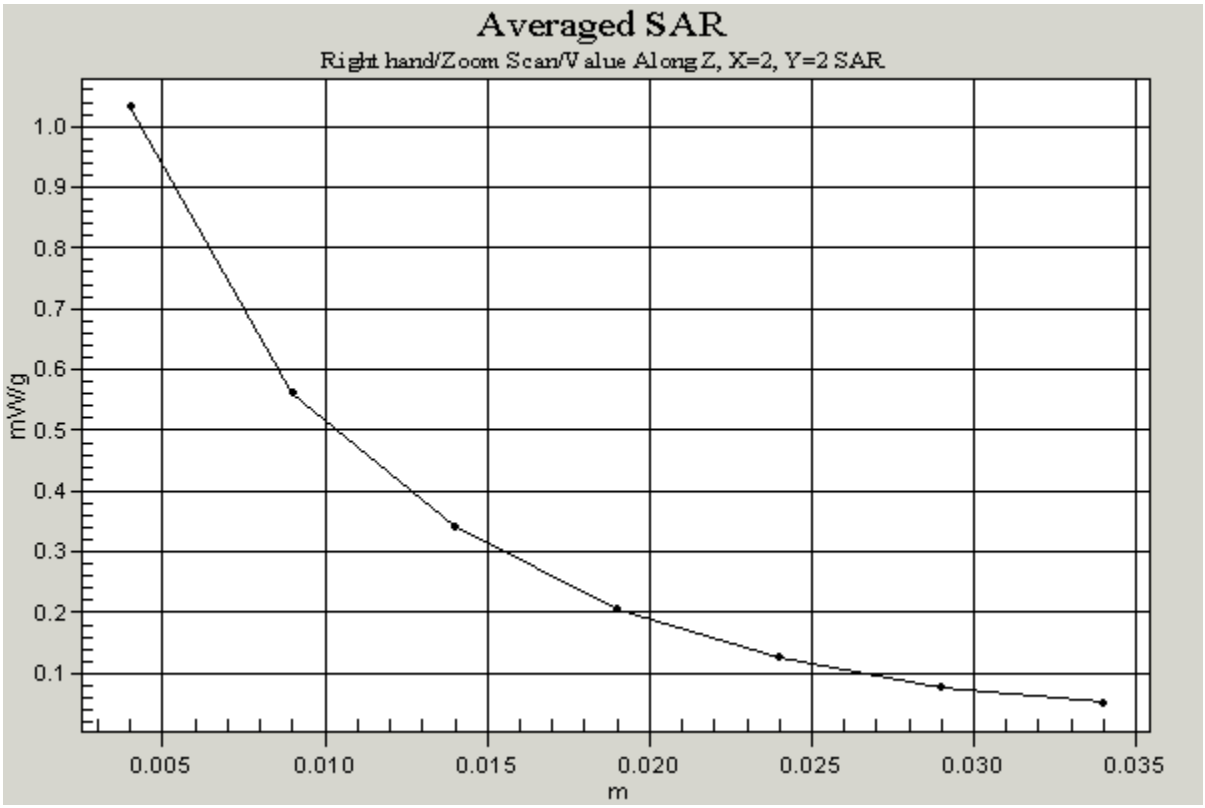
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GSM 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 MHz (σ = 1.42439 mho/m, ε_r = 38.833, ρ = 1000 kg/m^3)
Phantom section: Right Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(5.4, 5.4, 5.4); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_2; Type: SAM; Serial: TP-1003
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Tilted, T = 22.1 °C, worst case extrapolation/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 21.5 V/m
Power Drift = 0.002 dB
Maximum value of SAR = 0.992 mW/g

Tilted, T = 22.1 °C, worst case extrapolation/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 1.96 W/kg
SAR(1 g) = 0.974 mW/g; SAR(10 g) = 0.507 mW/g
Reference Value = 21.5 V/m
Power Drift = 0.002 dB
Maximum value of SAR = 1.03 mW/g



Date/Time: 03/10/04 10:10:02

Test Laboratory: Nokia Oulu, Elektroniikkatie 10

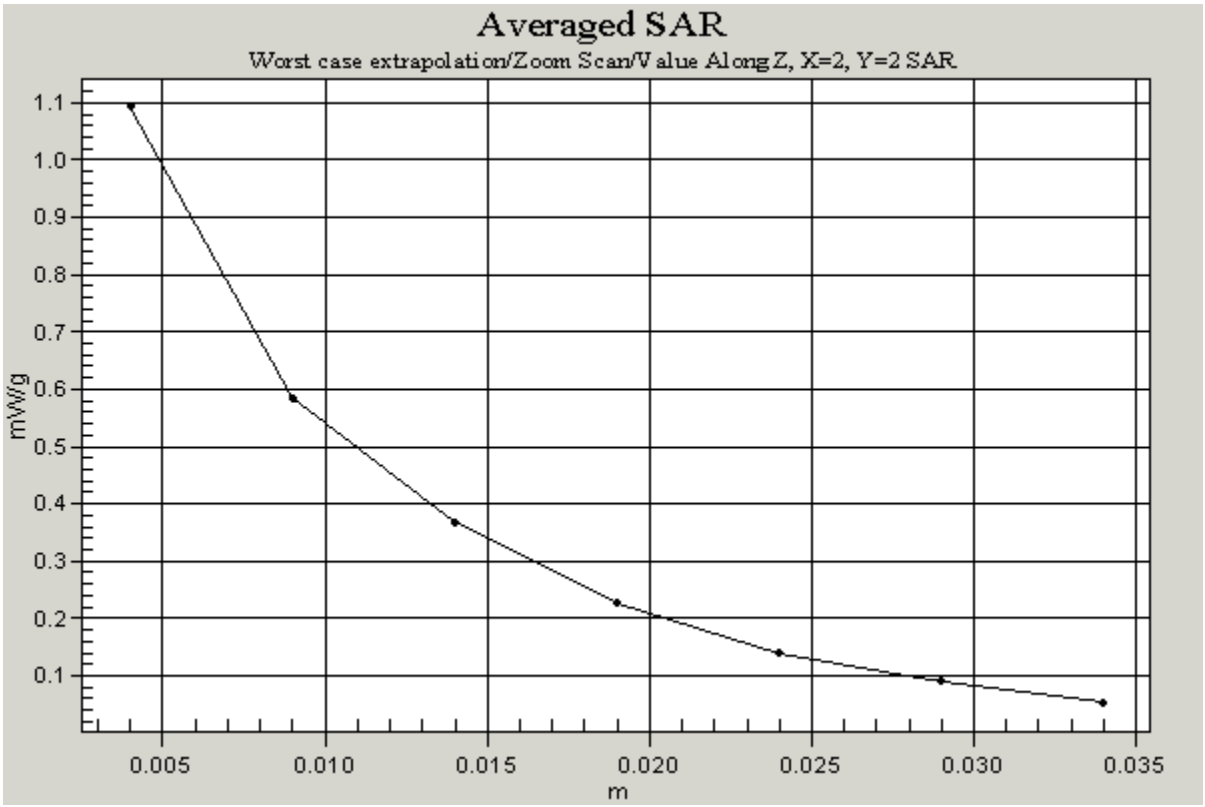
DUT: RM-37; Type: RM-37; Serial: 004400/43/164694/0

Communication System: GPRS 1900; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: muscle 1900 MHz (σ = 1.56717 mho/m, ε_r = 51.3576, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1381; ConvF(4.9, 4.9, 4.9); Calibrated: 21.11.2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn371; Calibrated: 20.11.2003
- Phantom: SAM_1; Type: SAM; Serial: TP-1128
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body worn + 22 mm, T = 22.2 °C/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 1.08 mW/g

Body worn + 22 mm, T = 22.2 °C/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Peak SAR (extrapolated) = 2.24 W/kg
SAR(1 g) = 1.05 mW/g; SAR(10 g) = 0.579 mW/g
Reference Value = 16 V/m
Power Drift = 0.05 dB
Maximum value of SAR = 1.09 mW/g



APPENDIX C: PROBE CALIBRATION REPORT

550066

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

Client Nokia Oulu

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1391
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	November 21, 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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: November 21, 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 - Parameters of Probe: ET3DV6 SN:1381

Sensitivity in Free Space

Diode Compression

NormX	1.55 $\mu V/(V/m)^2$	DCP X	93	mV
NormY	1.65 $\mu V/(V/m)^2$	DCP Y	93	mV
NormZ	1.74 $\mu V/(V/m)^2$	DCP Z	93	mV

Sensitivity in Tissue Simulating Liquid

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

Valid for f=760-950 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.7 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.7 ± 9.5% (k=2)	Alpha	0.48
ConvF Z	6.7 ± 9.5% (k=2)	Depth	2.33

Head **1880 MHz** ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1800-2000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2 ± 9.5% (k=2)	Alpha	0.59
ConvF Z	5.2 ± 9.5% (k=2)	Depth	2.54

Boundary Effect

Head **835 MHz** **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	11.3	6.2
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

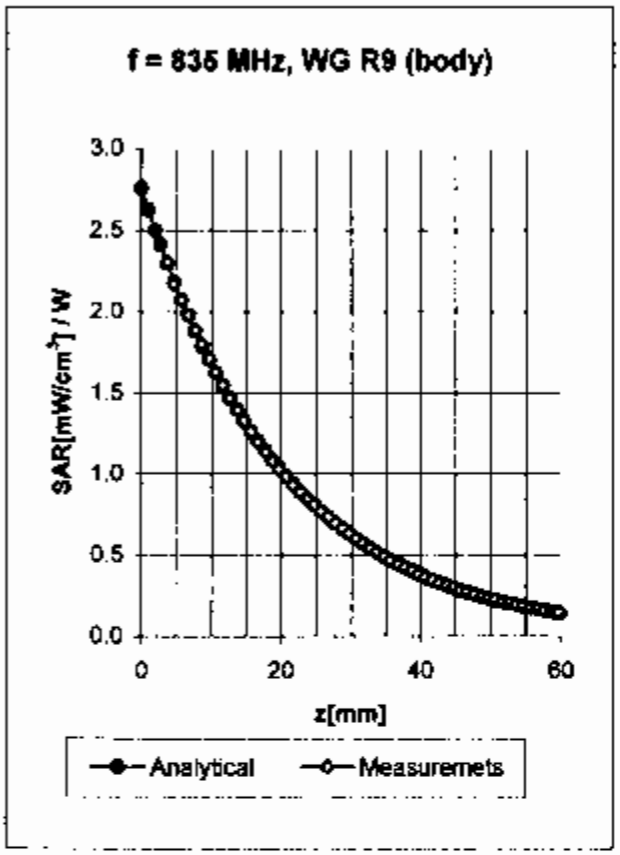
Head **1880 MHz** **Typical SAR gradient: 10 % per mm**

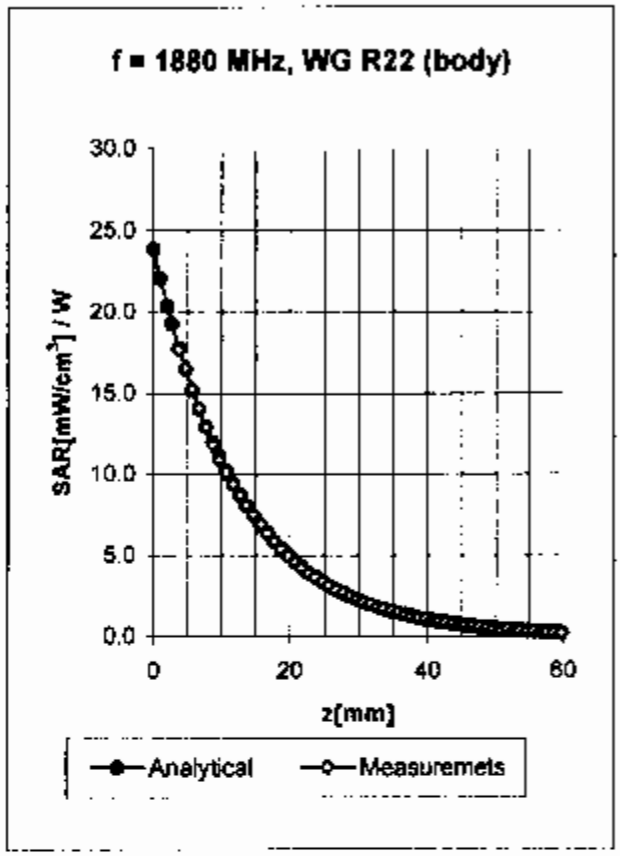
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	15.7	10.2
SAR_{be} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.2 ± 0.2	mm

Conversion Factor Assessment





Body **835 MHz** ε_r = 55.2 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=750-950 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.51**
ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.29**

Body **1880 MHz** ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1800-2000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.8** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.8** ± 9.5% (k=2)	Alpha	**0.75**
ConvF Z	**4.8** ± 9.5% (k=2)	Depth	**2.34**

APPENDIX D: DIPOLE VALIDATION KIT REPORT

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

Client Nokia Mobile Phones (Oulu)

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:	Katja Pokovic	Laboratory Director	
Approved by:	Nikita 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.

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

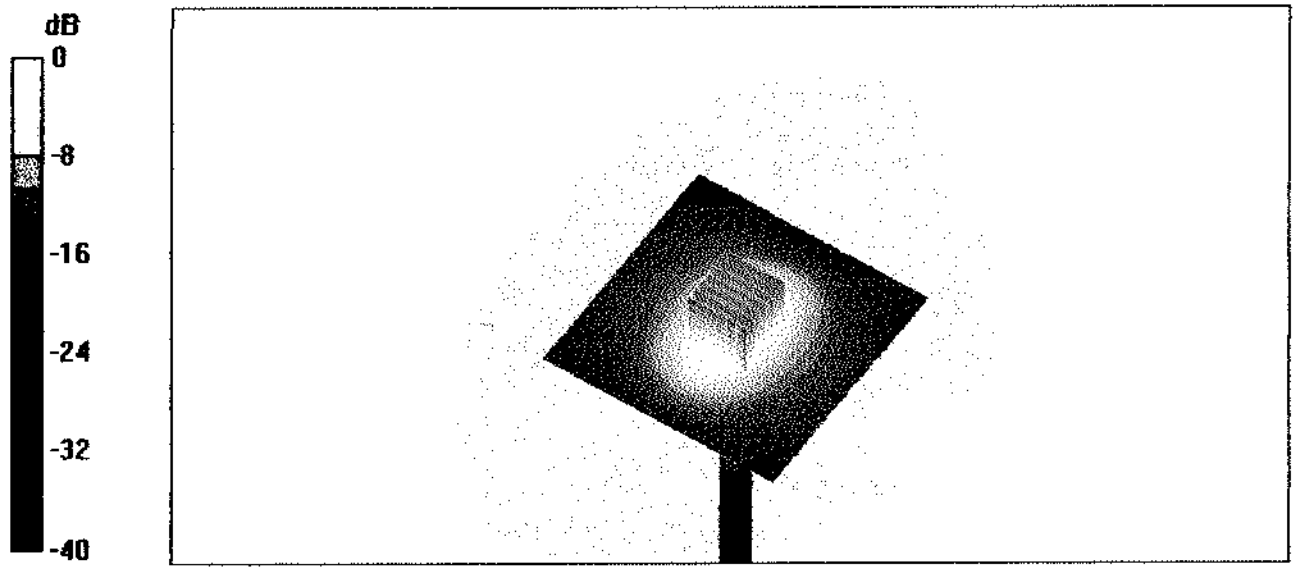
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN511_SN1507_HSL1900_260203.da4

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; (σ = 1.46 mho/m, ε_r = 38.6, ρ = 1000 kg/m^3)
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



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; (σ = 1.59 mho/m, ε_r = 51.2, ρ = 1000 kg/m^3)
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