TCC
Nokia

T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	Cph_SAR_0501_4	Date of report:	January 5, 2005
Template version:	2	Number of pages:	20
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Responsible test engineer:	Leif Funch Klysner	Product contact person:	Ernest Mayer
Measurements made by:	Leif Funch Klysner		
Tested device:	RM-51		
FCC ID:	QTKRM-51	IC:	661AD-RM51
Supplement reports:	-		

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

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: January 5, 2005

For the contents:

Leif Funch Klysner
Test Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	December 29, 2004 – January 4, 2005
SN, HW and SW numbers of tested device	IMEI: 004400/58/178612/4 HW: 0501c SW: 1.0452.0 DUT#28771
Batteries used in testing	BL-5B, DUT#28777, #28778, #28774, #28844
Headsets used in testing	HDS-3, DUT#28786
Other accessories used in testing	MMC Card, DUT#28773
State of sample	Prototype unit
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)	EIRP	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS1900	512 / 1850.2	27.93 dBm	Right, Tilt	1.6 W/kg	0.81 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	EIRP	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS1900	661 / 1880.0	26.15 dBm	2.2 cm	1.6 W/kg	0.23 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	0.2 dB

1.2.4 Measurement Uncertainty

Extended Uncertainty (k=2) 95%	± 29.8 %

2. DESCRIPTION OF THE DEVICE UNDER TEST

Device category	Portable
Exposure environment	General population/uncontrolled

Modes and Bands of Operation	GSM 1900	GPRS (GSM)	BT
Modulation Mode	GMSK	GMSK	GFSK
Duty Cycle	1/8	1/8 or 2/8	
Transmitter Frequency Range (MHz)	1850.2 - 1909.8	1850.2 - 1909.8	2400.0 – 2483.5

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

This device has Push-to-Talk/Voice-over-IP capability for use at the ear. Therefore, SAR for 2-slot GPRS mode was also evaluated against the head profile of the phantom.

2.1 Picture of the Device

2.2 Description of the Antenna

The device has an internal patch antenna.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Period of measurement (dd.mm.yyyy):	29.12.2004 – 04.01.2005
Ambient temperature (°C):	21.0 ±1
Ambient humidity (RH %):	45 ±10

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 4.4, 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
DAE3	339	12 months	08/2005
E-field Probe ET3DV6	1813	12 months	09/2005
Dipole Validation Kit, D1900V2	5d026	24 months	04/2005

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	SMIQ03B	826046/034	36 months	02/2007
Amplifier	ZHL-42W	E012903	-	-
Power Meter	NRVD	840297/008	24 months	11/2005
Power Sensor	NRV-Z51	100184	24 months	11/2005
Call Tester	4400M	0411216	-	-
Call Tester	CMU200	105900	-	-
Vector Network Analyzer	AT8753ES	MY40001091	12 months	08/2005
Dielectric Probe Kit	HP85070B	US33020403	-	-

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]	
	Reference result	10.4	38.6	1.46	N/A
	± 10% window	9.36 – 11.44			
1900	January 4, 2005	10.2	38.1	1.45	21.2

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	9.54 – 11.66			
	December 29, 2004	10.8	51.3	1.62	21.3
	December 30, 2004	10.7	51.2	1.62	21.3
	January 3, 2005	10.9	51.1	1.62	21.1

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	
	January 4, 2005	38.2	1.43	21.2

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	
	December 29, 2004	51.3	1.59	21.3
	December 30, 2004	51.3	1.60	21.3
	January 3, 2005	51.2	1.59	21.1

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”.

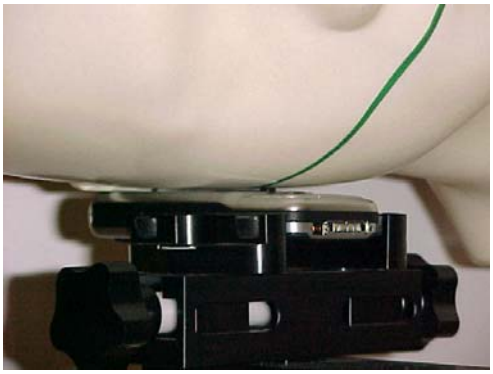

Photo of the device in “cheek” position

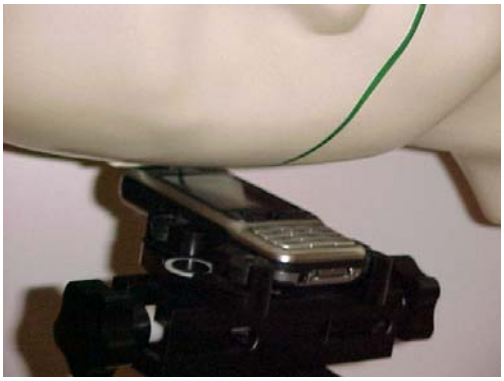

Photo of the device in “tilt” position

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.

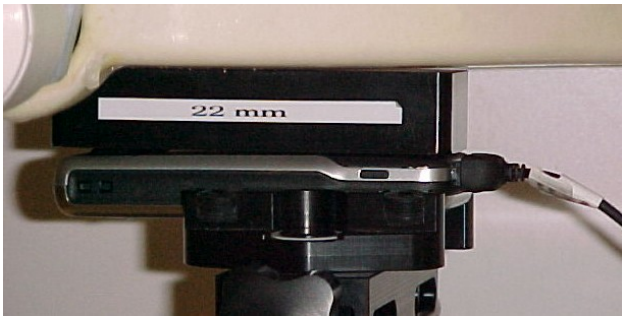

Photo of the device positioned for Body SAR measurement. The spacer was removed for the tests.

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 30x30x30mm 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	±5.8	N	1	1	±5.8	∞
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			**±14.9**	206
Coverage Factor for 95%			**k=2**				
Expanded Standard Uncertainty						**±29.8**	

7. RESULTS

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

GPRS1900 Head SAR results

Position		SAR, averaged over 1g (W/kg)		
		Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz
Power level		27.93 dBm	26.15 dBm	25.37 dBm
Left	Cheek		0.33	
	Tilt		0.53	
Right	Cheek		0.50	
	Tilt	0.67	**0.70**	0.61
Highest SAR value measurement in this band repeated with BT active			0.73	
Highest SAR configuration repeated with MMC card		**0.81**	0.73	0.70

GSM1900 Head SAR results

Position		SAR, averaged over 1g (W/kg)		
		Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz
Power level		30.83 dBm	29.52 dBm	28.53 dBm
Left	Cheek		0.33	
	Tilt		0.52	
Right	Cheek		0.53	
	Tilt		**0.69**	

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

GPRS1900 Body SAR results

Body-worn location setup	SAR, averaged over 1g (W/kg)		
	Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz
Power level	27.93 dBm	26.15 dBm	25.37 dBm
Without headset	0.22	**0.23**	0.20
Headset HDS-3	0.21	0.21	0.21
Highest SAR value measurement in this mode repeated with BT active		0.20	
Highest SAR configuration repeated with MMC card	**0.22**	0.21	0.19

GSM1900 Body SAR results

Body-worn location setup	SAR, averaged over 1g (W/kg)		
	Ch 512 1850.2 MHz	Ch 661 1880.0 MHz	Ch 810 1909.8 MHz
Power level	30.83 dBm	29.52 dBm	28.53 dBm
Without headset	0.21	**0.22**	0.22

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

See the following pages.

Date/Time: 01/04/05 09:27:24

TCC

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DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d026

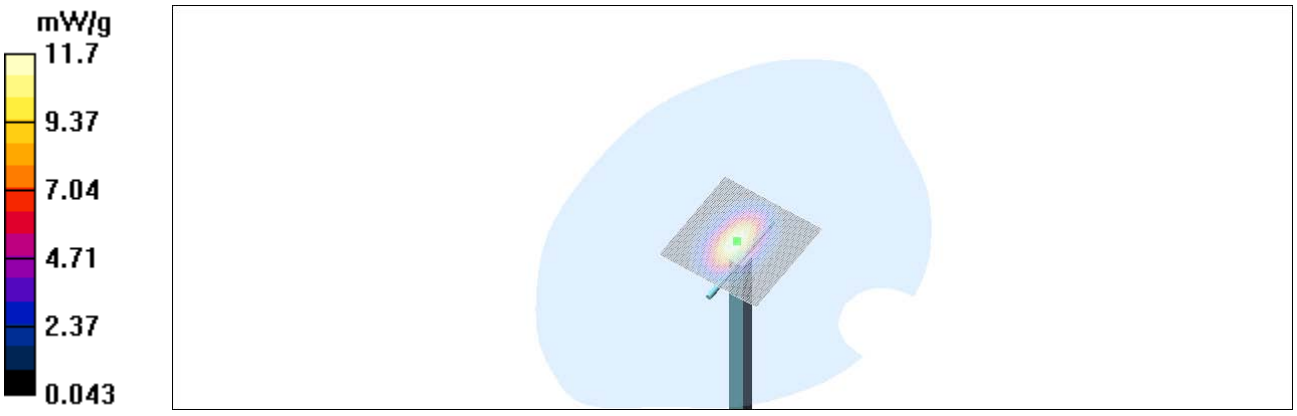
Communication System: Continuous Wave; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Head 1900 Medium parameters used: f = 1900 MHz; σ = 1.45 mho/m; ε_r = 38.1; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

d=10mm, Pin=250mW/Area Scan (71x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 11.7 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 17.4 W/kg
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.34 mW/g
Maximum value of SAR (measured) = 11.6 mW/g



Date/Time: 12/29/04 09:48:40

TCC

Nokia

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d026

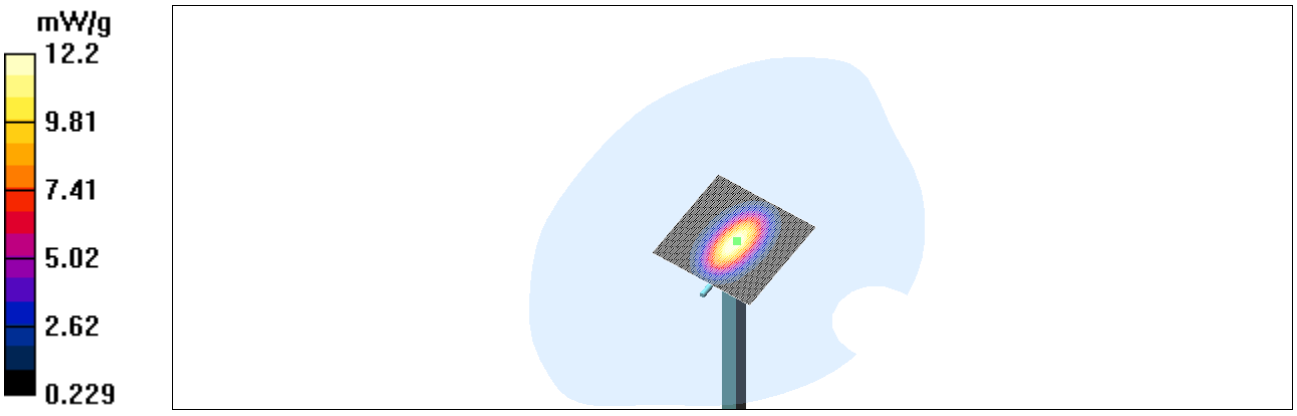
Communication System: Continuous Wave; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Body 1900 Medium parameters used: f = 1900 MHz; σ = 1.62 mho/m; ε_r = 51.3; ρ = 1000 kg/m^3 Medium temperature: 21.3 °C
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813; ConvF(4.41, 4.41, 4.41); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High band; Type: Twin Phantom; Serial: TP-1274
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

d=10mm, Pin=250mW/Area Scan (71x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 12.5 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.8 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 10.8 mW/g; SAR(10 g) = 5.72 mW/g
Maximum value of SAR (measured) = 12.2 mW/g



Date/Time: 12/30/04 10:40:40

TCC

Nokia

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d026

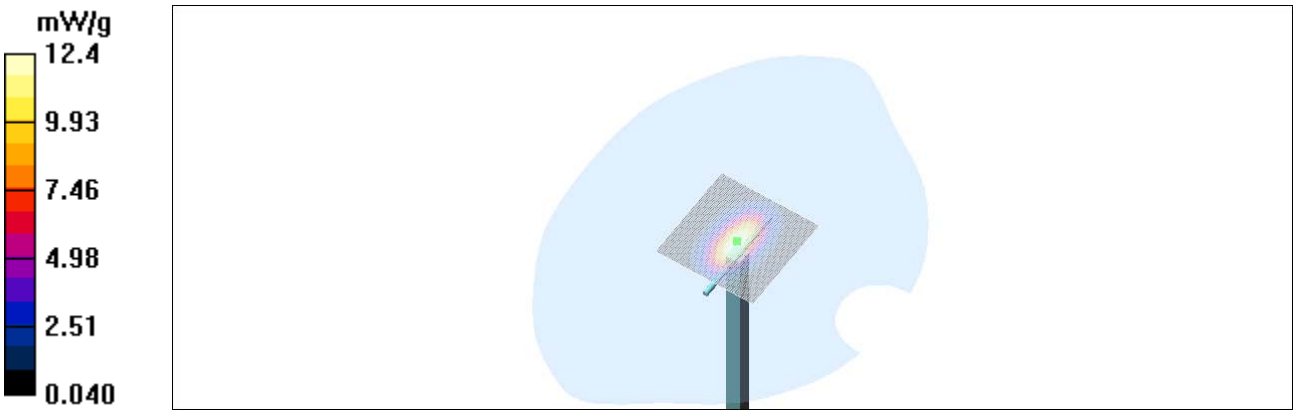
Communication System: Continuous Wave; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Body 1900 Medium parameters used: f = 1900 MHz; σ = 1.62 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3 Medium temperature: 21.3 °C
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813; ConvF(4.41, 4.41, 4.41); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High band; Type: Twin Phantom; Serial: TP-1274
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

d=10mm, Pin=250mW/Area Scan (71x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 12.4 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.6 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 18.1 W/kg
SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.66 mW/g
Maximum value of SAR (measured) = 12.3 mW/g



Date/Time: 01/03/05 10:17:46

TCC

Nokia

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d026

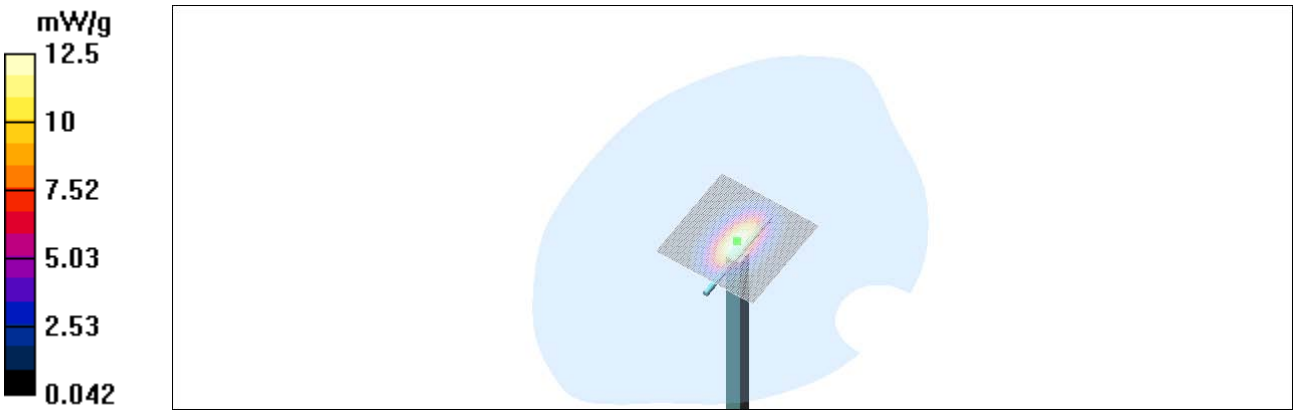
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Body 1900 Medium parameters used: f = 1900 MHz; σ = 1.62 mho/m; ε_r = 51.1; ρ = 1000 kg/m^3 Medium temperature: 21.1 °C
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813; ConvF(4.41, 4.41, 4.41); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High band; Type: Twin Phantom; Serial: TP-1274
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

d=10mm, Pin=250mW/Area Scan (71x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 12.5 mW/g

d=10mm, Pin=250mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 92.4 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 18.3 W/kg
SAR(1 g) = 10.9 mW/g; SAR(10 g) = 5.73 mW/g
Maximum value of SAR (measured) = 12.4 mW/g



APPENDIX B: MEASUREMENT SCANS

See the following pages.

Date/Time: 01/04/05 10:26:41

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

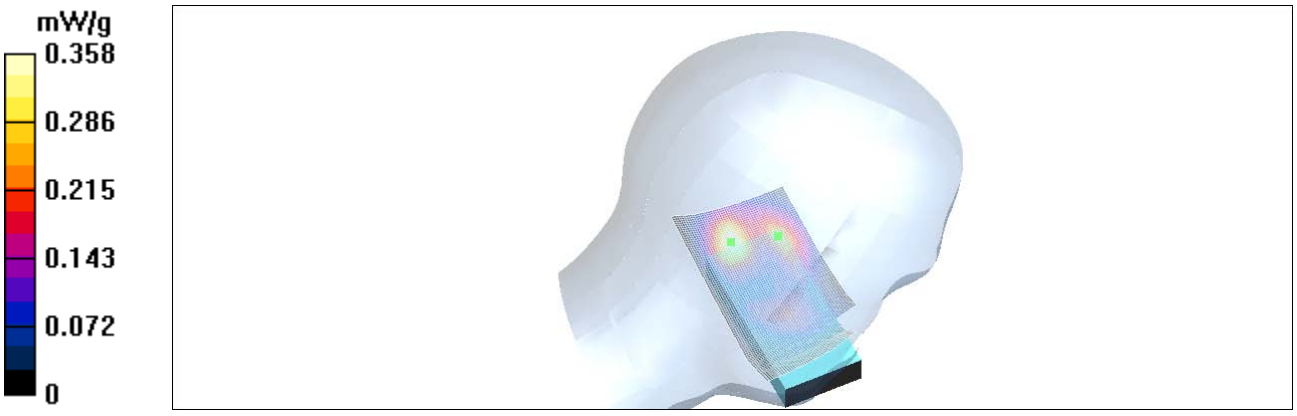
Communication System: 1900 - GPRS - Dual slot; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: Head 1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Touch position - Middle/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.358 mW/g

Touch position - Middle/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 12.2 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 0.667 W/kg
SAR(1 g) = 0.331 mW/g; SAR(10 g) = 0.176 mW/g
Maximum value of SAR (measured) = 0.353 mW/g



Date/Time: 01/04/05 10:26:41

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

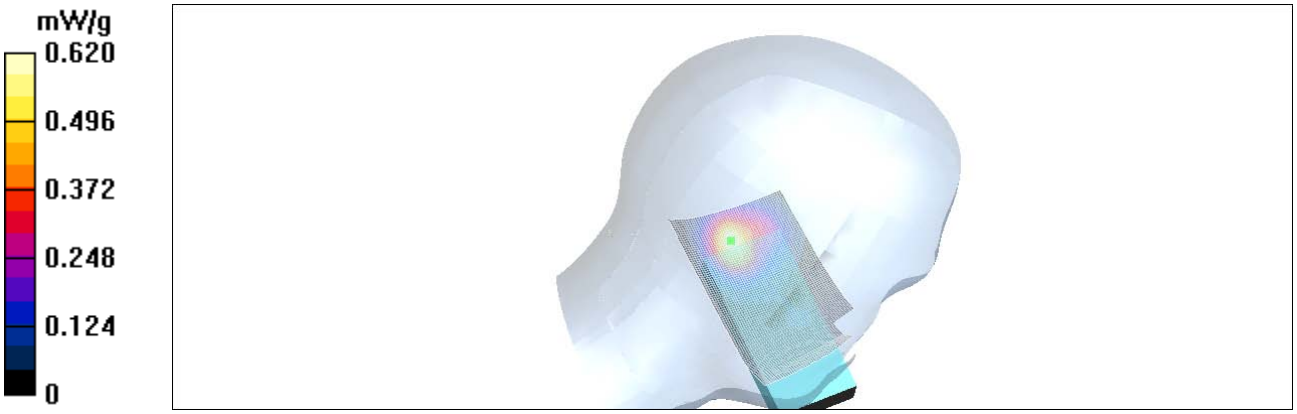
Communication System: 1900 - GPRS - Dual slot; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: Head 1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Tilt position - Middle/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.620 mW/g

Tilt position - Middle/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 16.5 V/m; Power Drift = -0.0003 dB
Peak SAR (extrapolated) = 1.03 W/kg
SAR(1 g) = 0.527 mW/g; SAR(10 g) = 0.286 mW/g
Maximum value of SAR (measured) = 0.563 mW/g



Date/Time: 01/04/05 11:03:30

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

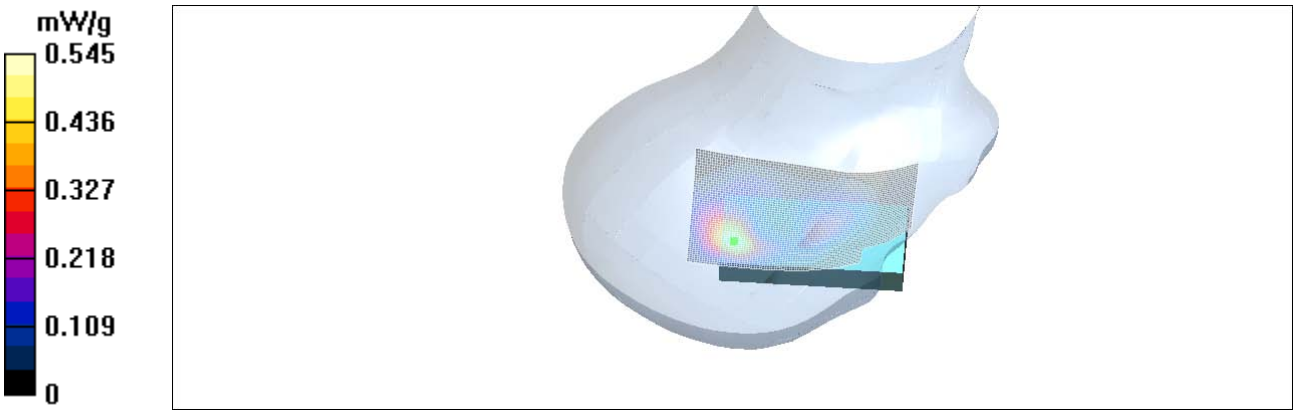
Communication System: DCS 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: Head 1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Touch position - Middle/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.545 mW/g

Touch position - Middle/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 12.4 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 1.1 W/kg
SAR(1 g) = 0.526 mW/g; SAR(10 g) = 0.258 mW/g
Maximum value of SAR (measured) = 0.579 mW/g



Date/Time: 01/04/05 11:47:35

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

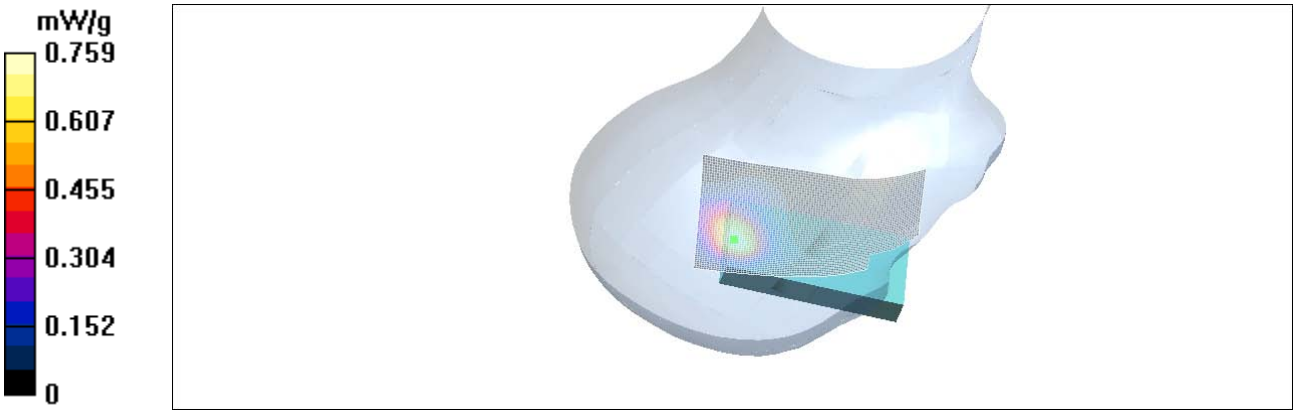
Communication System: GPRS 1900 - Dual Slot; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: Head 1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Tilt position - Middle/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.759 mW/g

Tilt position - Middle/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 17.4 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 1.53 W/kg
SAR(1 g) = 0.701 mW/g; SAR(10 g) = 0.347 mW/g
Maximum value of SAR (measured) = 0.773 mW/g



Date/Time: 01/04/05 11:47:35

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

Communication System: GPRS 1900 - Dual Slot; Frequency: 1850.2 MHz;Duty Cycle: 1:4.2
Medium: Head 1900 Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.4 mho/m; ε_r = 38.3; ρ = 1000 kg/m^3 Medium temperature: 21.2 °C
Phantom section: Right Section

DASY4 Configuration:

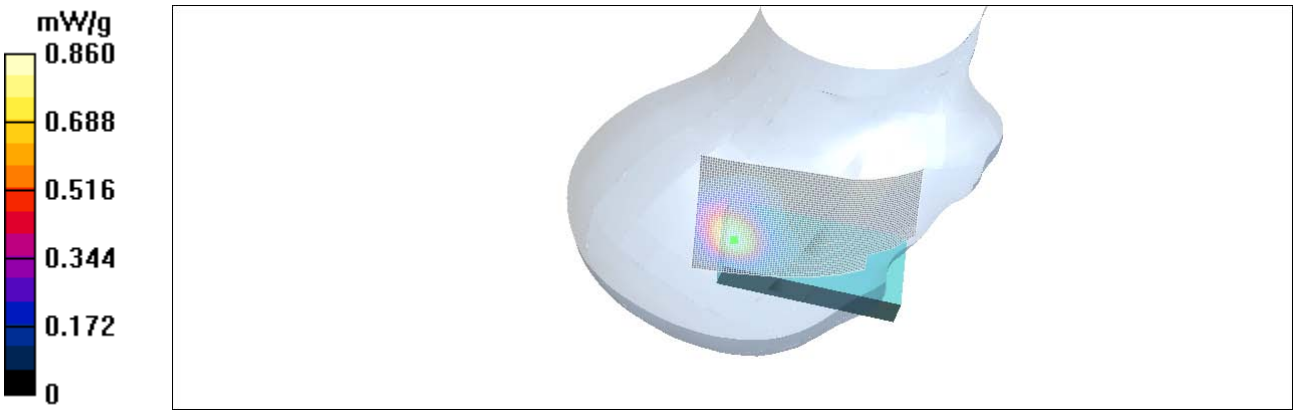
- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.96, 4.96, 4.96); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High Band; Type: QD000P40CB; Serial: TP-1301
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

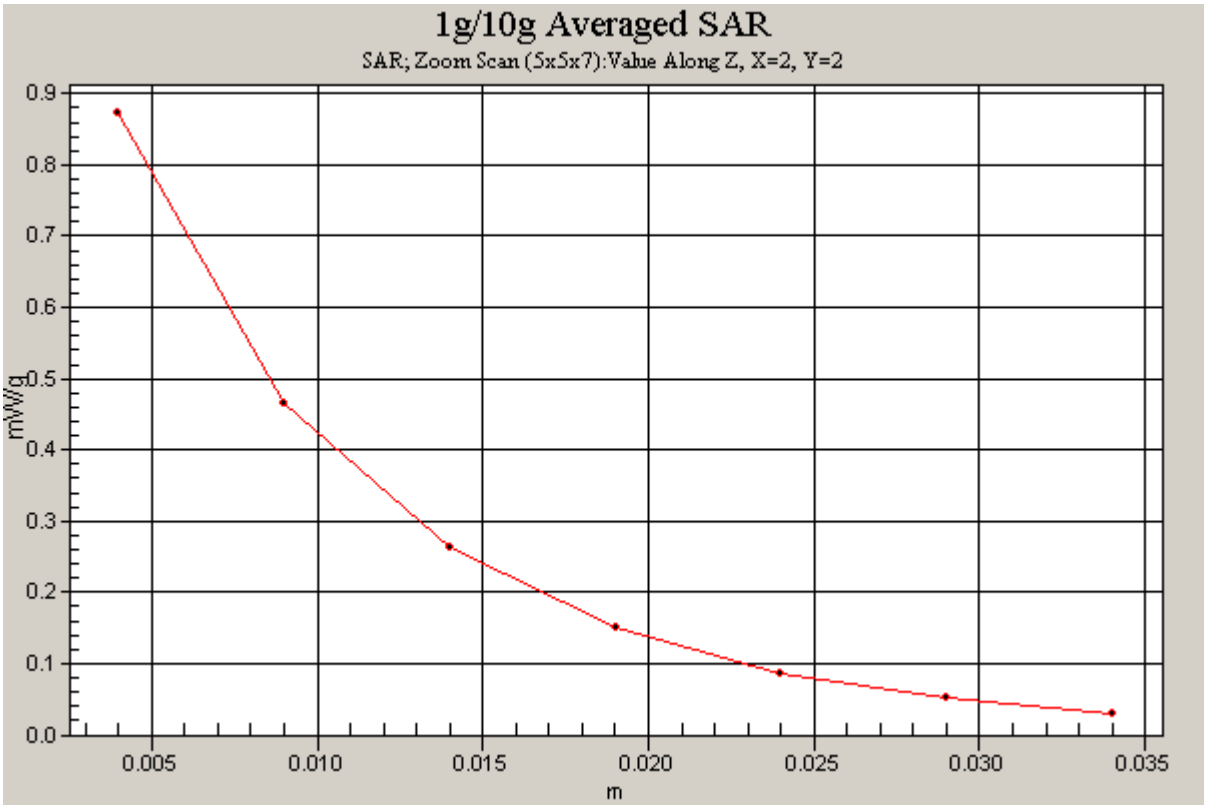
Tilt position - Low - MMC Card/Area Scan (51x91x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (interpolated) = 0.860 mW/g

Tilt position - Low - MMC Card/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 19.4 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 1.78 W/kg
SAR(1 g) = 0.811 mW/g; SAR(10 g) = 0.409 mW/g

Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (measured) = 0.871 mW/g


mW/g
0.860
0.688
0.516
0.344
0.172
0


1g/10g Averaged SAR
SAR; Zoom Scan (5x5x7):Value Along Z, X=2, Y=2
mW/g
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m

Date/Time: 12/29/04 12:02:45

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

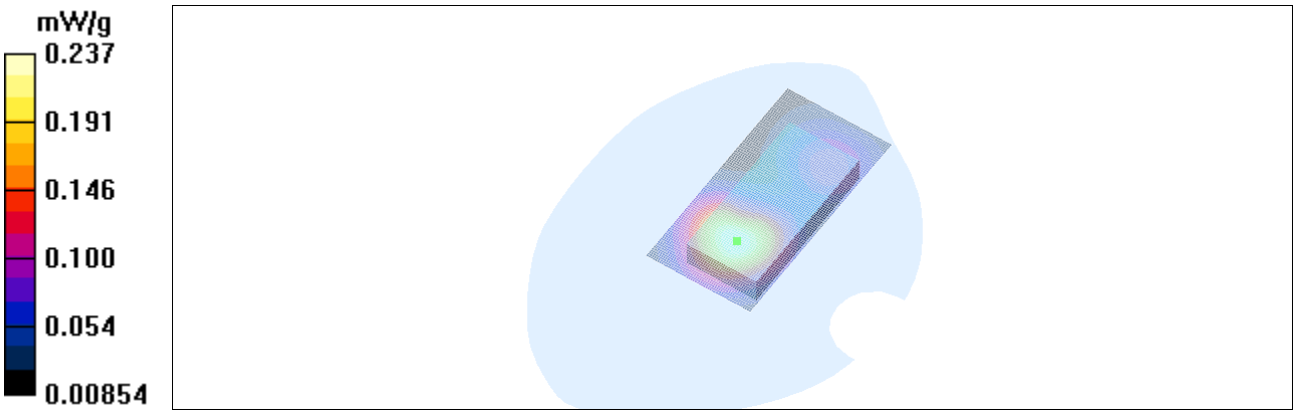
Communication System: GPRS 1900 - Dual Slot; Frequency: 1880 MHz;Duty Cycle: 1:4.2
Medium: Body 1900 Medium parameters used: f = 1880 MHz; σ = 1.59 mho/m; ε_r = 51.3; ρ = 1000 kg/m^3 Medium temperature: 21.3 °C
Phantom section: Flat Section

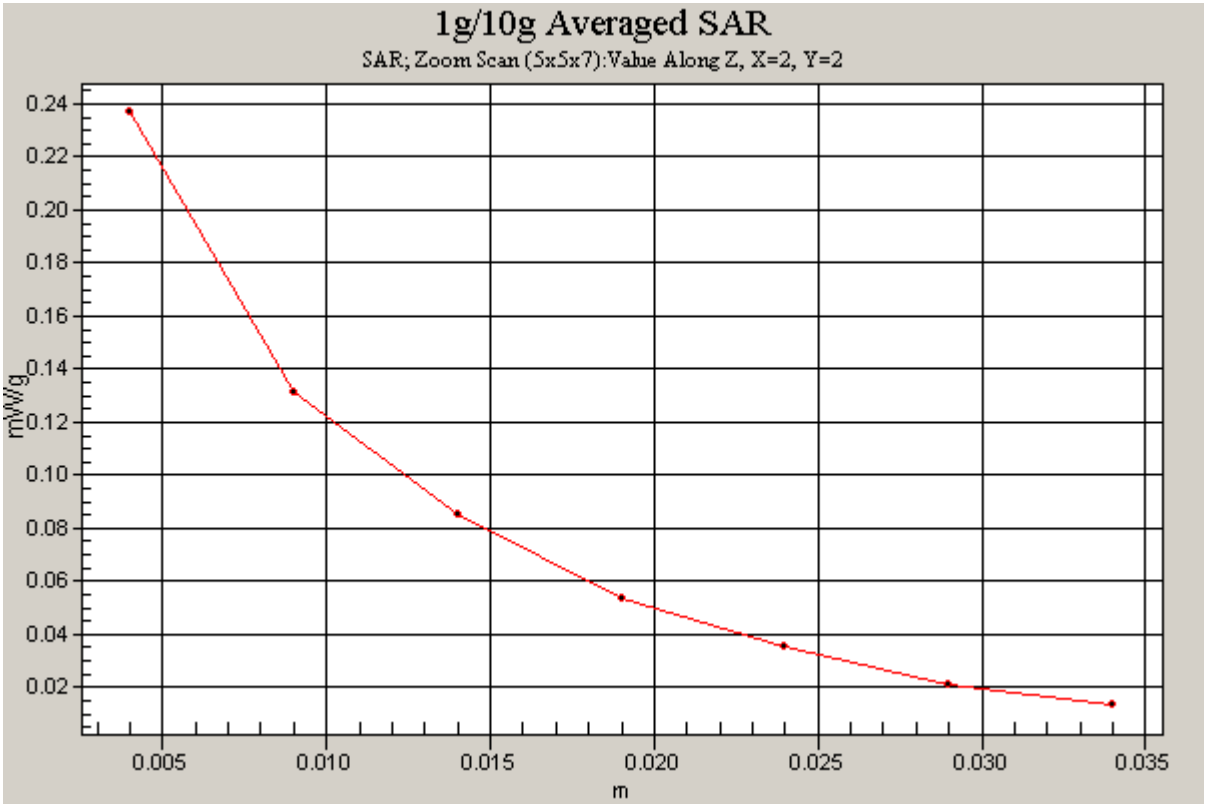
DASY4 Configuration:

- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.41, 4.41, 4.41); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High band; Type: Twin Phantom; Serial: TP-1274
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Body - Middle - No Accessory/Area Scan (51x101x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.242 mW/g

Body - Middle - No Accessory/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 12.2 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 0.464 W/kg
SAR(1 g) = 0.229 mW/g; SAR(10 g) = 0.138 mW/g
Maximum value of SAR (measured) = 0.237 mW/g




1g/10g Averaged SAR
SAR; Zoom Scan (5x5x7):Value Along Z, X=2, Y=2
mW/g
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m

Date/Time: 12/30/04 12:12:40

TCC

Nokia

DUT: 28771; Type: RM-51; Serial: 004400/58/178612/4

Communication System: GPRS 1900 - Dual Slot; Frequency: 1850.2 MHz;Duty Cycle: 1:4.2
Medium: Body 1900 Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.57 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3 Medium temperature: 21.3 °C
Phantom section: Flat Section

DASY4 Configuration:

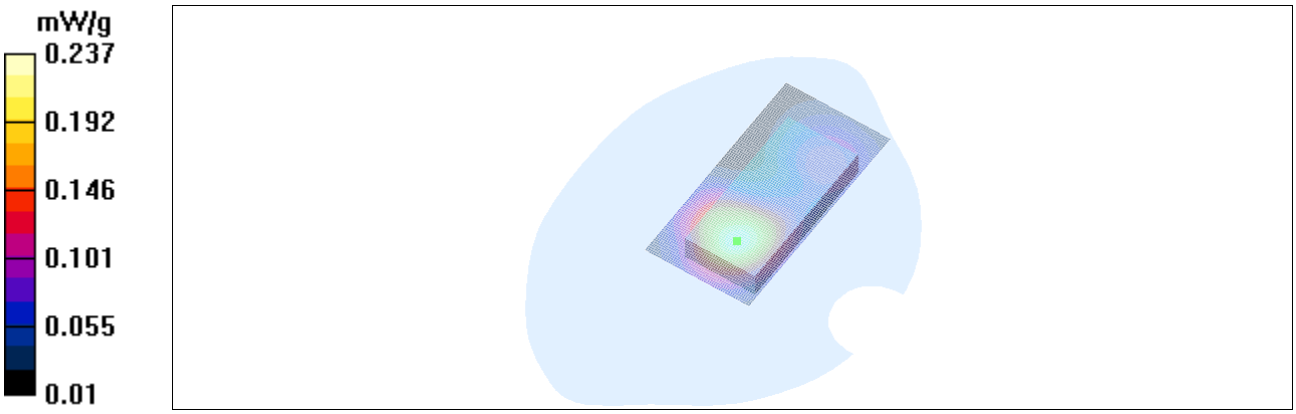
- Probe: ET3DV6 - SN1813 - WCE; ConvF(4.41, 4.41, 4.41); Calibrated: 30.09.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn339; Calibrated: 30.08.2004
- Phantom: SAM High band; Type: Twin Phantom; Serial: TP-1274
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Body - Low - No Accessory - MMC Card/Area Scan (51x101x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (interpolated) = 0.237 mW/g

Body - Low - No Accessory - MMC Card/Zoom Scan (5x5x7) (5x5x7)/Cube 0:
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 12.2 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 0.429 W/kg
SAR(1 g) = 0.219 mW/g; SAR(10 g) = 0.134 mW/g

Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (measured) = 0.228 mW/g


mW/g
0.237
0.192
0.146
0.101
0.055
0.01

APPENDIX C: RELEVANT PAGES FROM PROBE CALIBRATION REPORT(S)

See the following pages.

19368

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Nokia (NMP / Copenhagen)

Certificate No: ET3-1813_Sep04

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1813
Calibration procedure(s)	QA CAL-01.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	September 30, 2004
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

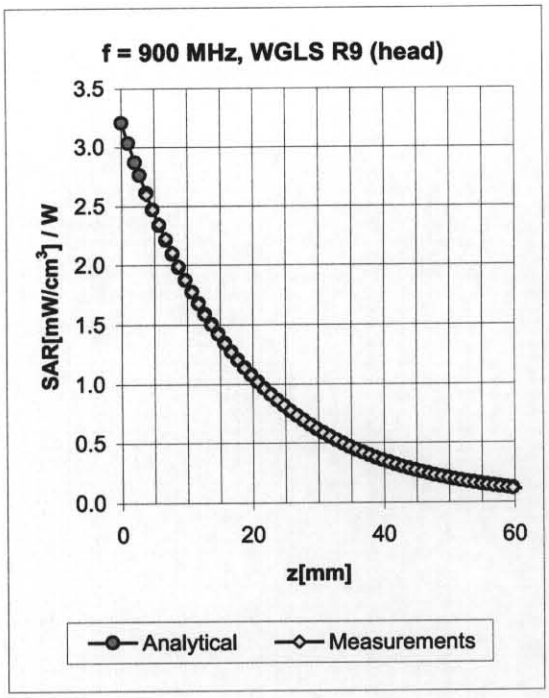
Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	3-Apr-03 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	3-Apr-03 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN:3013	8-Jan-04 (SPEAG, No. ES3-3013_Jan04)	Jan-05
DAE4	SN: 617	26-May-04 (SPEAG, No. DAE4-617_May04)	May-05

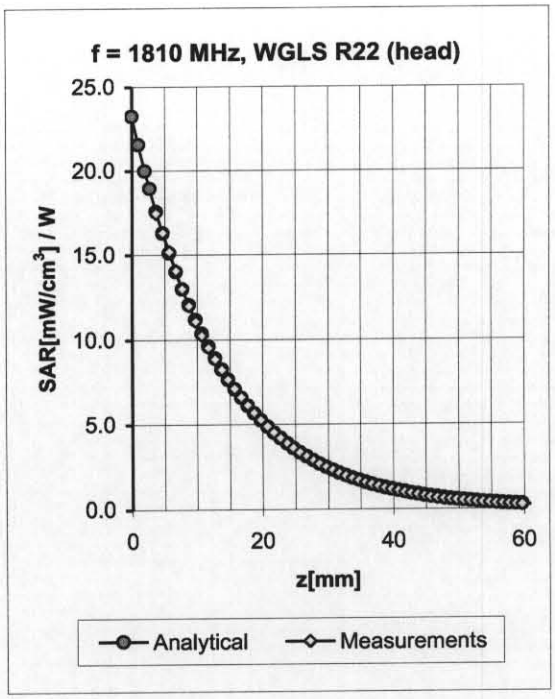
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Nov 04

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 1, 2004

Conversion Factor Assessment





f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	1.02	1.53	6.37 ± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.96	1.59	6.17 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.58	2.33	5.13 ± 11.0% (k=2)
1900	± 50 / ± 101	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.52	4.96 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.77	4.75 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.62	2.37	4.50 ± 11.8% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.99	1.58	6.17 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.93	1.65	5.95 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.53	2.77	4.55 ± 11.0% (k=2)
1900	± 50 / ± 101	Body	53.3 ± 5%	1.52 ± 5%	0.53	2.96	4.41 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.53	2.67	4.42 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.59	2.30	4.21 ± 11.8% (k=2)

[C] **The validity of ± 100 MHz only applies for DASY 4.3 B17 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.**

APPENDIX D: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT(S)

See the following pages.

18307

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

Client **Nokia Danmark A/S**

CALIBRATION CERTIFICATE

Object(s)	D1900V2 - SN:5d026
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	February 26, 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	Pokovic Katja
Approved by:	Niels 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.

Date/Time: 02/26/03 17:17:26

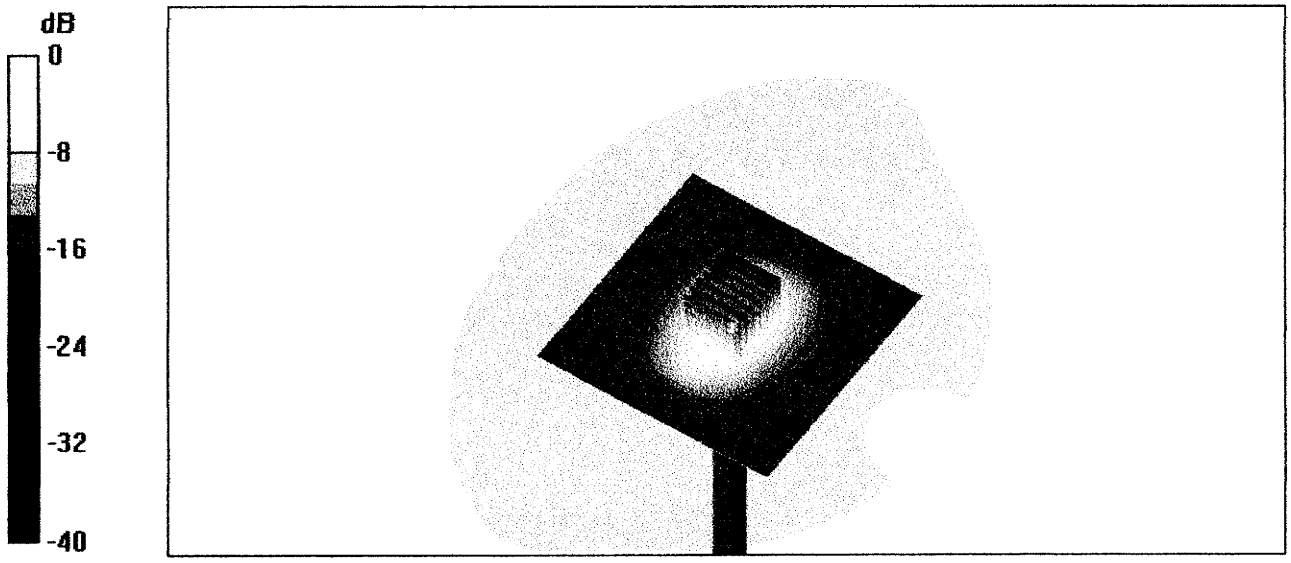
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d026_SN1507_HSL1900_260203.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d026
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 = 95.2 V/m
Peak SAR = 18.6 W/kg
SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.31 mW/g
Power Drift = 0.04 dB



18508

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

Client **Nokia Danmark A/S**

CALIBRATION CERTIFICATE

Object(s)	D1900V2 - SN:5d026
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	April 8, 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:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: April 12, 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: 04/08/03 13:41:14

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d026_SN1507_M1900_080403.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d026
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 33; Postprocessing SW: SEMCAD, V1.6 Build 109

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 = 91.2 V/m
Peak SAR = 18.6 W/kg
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.51 mW/g
Power Drift = 0.09 dB