TCC
Oulu

T213 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	OULU_SAR0437_04	**Date of report:**	2004-09-28
Template version:	2	**Number of pages:**	35
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Responsible test engineer:	Kai Niskala	**Product contact person:**	Sonja Perälä
Measurements made by:	Kai Niskala		
Tested device:	RM-12		
FCC ID:	LJPRM-12	**IC:**	661E-RM12
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 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: 2004-09-28

For the contents:

Kai Niskala

Test Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2004-9-6 - 2004-9-8
SN, HW and SW numbers of tested device	SN: 004400/52/170303/1, HW: 1140, SW: 1.07
Batteries used in testing	BP-5L; DUT#s: 30208,30209,30210
Headsets used in testing	HS-3; DUT#: 30205
Other accessories used in testing	MMC card
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
GSM 1900	512/1850.2 MHz	26.05 dBm	Right Cheek	1.6 W/kg	0.22 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	EIRP	Separation distanceSeparation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS 1900	512/1850.2 MHz	26.40 dBm	2.2 cm	1.6 W/kg	0.54 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	-0.13 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	general population/uncontrolled			
Modes and Bands of Operation	GSM 1900	GPRS 1900	E-GPRS	BT
Modulation Mode	GMSK	GMSK	8PSK	
Duty Cycle	1/8	1/8 or 2/8	1/8 or 2/8	
Transmitter Frequency Range (MHz)	1850.2 - 1909.8	1850.2-1909.8	1850.2-1909.8	2402.0-2480.0

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

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

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:	2004-09-06 - 2004-09-08
Ambient temperature (°C):	21.0 - 24.0
Ambient humidity (RH %):	30 - 50

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 4.2, 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 V1	555	12 months	02/05
E-field Probe ET3DV6	1765	12 months	02/05
Dipole Validation Kit, D1900V2	5d030	12 months	04/05

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	HP 8657B	3630U08114	12 months	06/05
Amplifier	Amplifier Research 5S1G4	306024	-	-
Power Meter	R&S NRT	101143	12 months	04/05
Power Sensor	R&S NRT-Z43	100239	12 months	04/05
Thermometer	Fluke 51 II	84350048	12 months	06/05
Network Analyzer	HP 8753D	3410A08934	12 months	06/05
Dielectric Probe Kit	Agilent 85070D	US01440162	-	-

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	10.5	38.8	1.44	N/A
	± 10% window	9.5 – 11.6			
	2004-09-06	10.7	38.4	1.45	21.6

System verification, body tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
1900	Reference result	10.7	51.2	1.59	N/A
	± 10% window	9.6 – 11.8			
	2004-09-08	11.0	52.2	1.58	21.8

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	
	2004-09-06	38.5	1.43	22.0

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	
	2004-09-08	52.3	1.56	22.0

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	$(1\text{-}c_p)^{1/2}$	±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:

GSM 1900 Head SAR results

Position		SAR, averaged over 1g (W/kg)		
		Ch 512 1850.2 MHz	Ch 661 1880 MHz	Ch 810 1909.8 MHz
Power level		26.05 dBm	26.18 dBm	26.14 dBm
Left	Cheek		0.12	
	Tilt		0.12	
Right	Cheek	0.22	0.19	0.20
	Tilt		0.11	
Right cheek repeated with MMC card		0.21	0.19	0.20
Maximum result repeated with Bluetooth active		0.22		

GPRS 1900 Body SAR results

Body-worn location setup	SAR, averaged over 1g (W/kg)		
	Ch 512 1850.2 MHz	Ch 661 1880 MHz	Ch 810 1909.8 MHz
Power level	26.40 dBm	24.90 dBm	25.50 dBm
Without headset	0.53	0.45	0.40
Headset HS-3	0.50	0.43	0.38
Without headset and with MMC card	0.52	0.46	0.41
Without headset and without MMC card, Bluetooth active	0.54		

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

Date/Time: 09/06/04 12:56:01

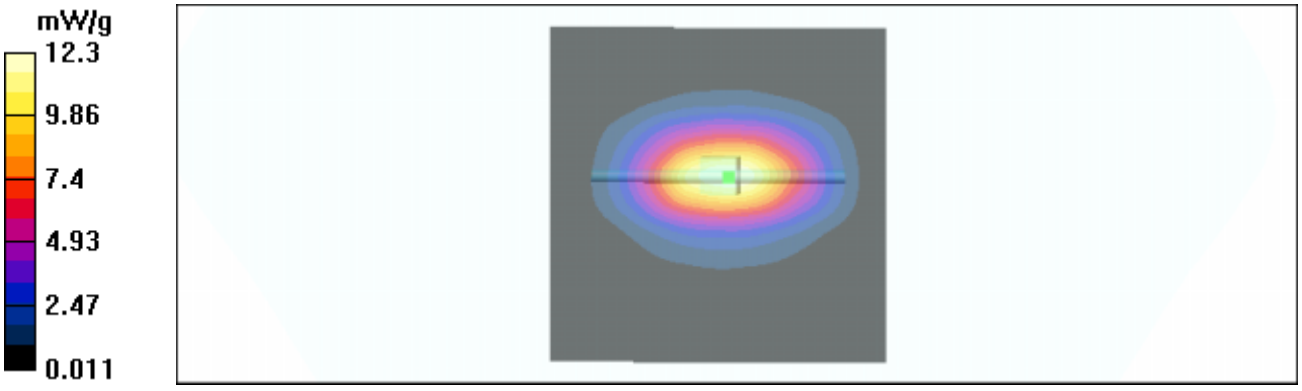
Test Laboratory: TCC Oulu
DUT: Dipole 1900 MHz; Serial: D1900V2 - SN:5d030
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: HSL1900 Medium parameters used (interpolated): f = 1900 MHz; σ = 1.45 mho/m; ε_r = 38.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: ET3DV6 - SN1765; ConvF(5.24, 5.24, 5.24); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

d=10mm, Pin=250mW, t=21.6 C/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 96.8 V/m; Power Drift = -0.0 dB
Maximum value of SAR (interpolated) = 12.3 mW/g

Info: Interpolated medium parameters used for SAR evaluation!

d=10mm, Pin=250mW, t=21.6 C/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.8 V/m; Power Drift = -0.0 dB
Maximum value of SAR (measured) = 12.2 mW/g
Peak SAR (extrapolated) = 19.2 W/kg
SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.56 mW/g

Info: Interpolated medium parameters used for SAR evaluation!



Date/Time: 09/08/04 11:01:46

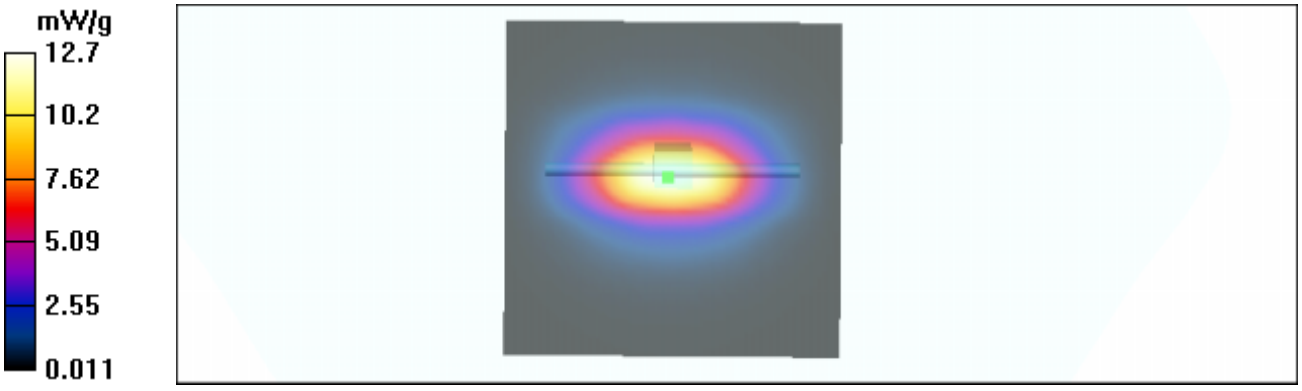
Test Laboratory: TCC Oulu
DUT: Dipole 1900 MHz; Serial: D1900V2 - SN:5d030
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: BSL1900 Medium parameters used (interpolated): f = 1900 MHz; σ = 1.58 mho/m; ε_r = 52.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: ET3DV6 - SN1765; ConvF(4.59, 4.59, 4.59); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

d=10mm, Pin=250mW, t=21.8 C/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 95.9 V/m; Power Drift = -0.0 dB
Maximum value of SAR (interpolated) = 12.7 mW/g

Info: Interpolated medium parameters used for SAR evaluation!

d=10mm, Pin=250mW, t=21.8 C/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.9 V/m; Power Drift = -0.0 dB
Maximum value of SAR (measured) = 12.4 mW/g
Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 11 mW/g; SAR(10 g) = 5.82 mW/g

Info: Interpolated medium parameters used for SAR evaluation!



APPENDIX B: MEASUREMENT SCANS

Date/Time: 09/06/04 13:48:21

Test Laboratory: TCC Oulu

DUT: RM-12; Serial: 004400/52/170303/1

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

Medium: HSL1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(5.27, 5.27, 5.27); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

Cheek position - Middle, t=21.6 C, worst case extrapolation/Area Scan (61x101x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 8.82 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.128 mW/g

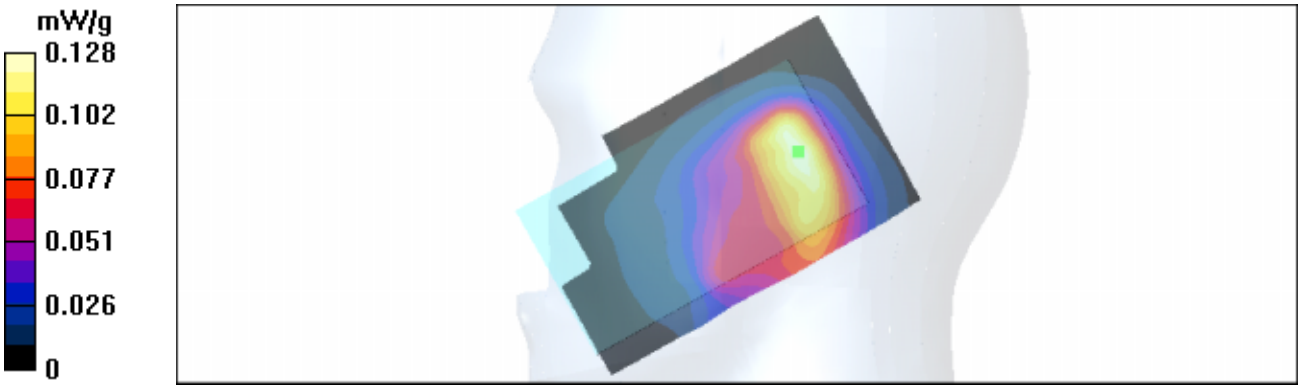
Cheek position - Middle, t=21.6 C, worst case extrapolation/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 8.82 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.124 mW/g

Peak SAR (extrapolated) = 0.213 W/kg

SAR(1 g) = 0.116 mW/g; SAR(10 g) = 0.069 mW/g



Date/Time: 09/06/04 13:48:21

Test Laboratory: TCC Oulu

DUT: RM-12; Serial: 004400/52/170303/1

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

Medium: HSL1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

Phantom section: Left Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(5.27, 5.27, 5.27); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

Tilt position - Middle, t=21.6 C, worst case extrapolation/Area Scan (61x101x1):

Measurement grid: dx=15mm, dy=15mm

Reference Value = 9.19 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.129 mW/g

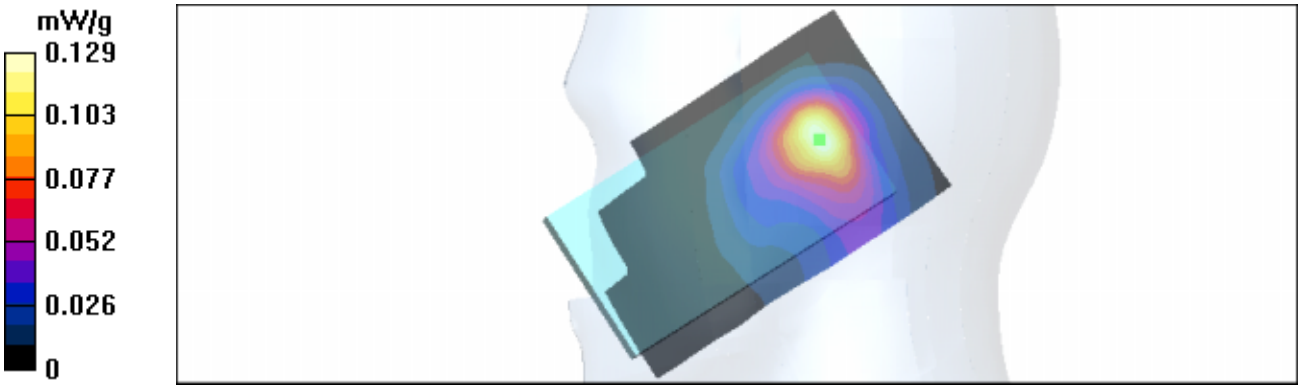
Tilt position - Middle, t=21.6 C, worst case extrapolation/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 9.19 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.125 mW/g

Peak SAR (extrapolated) = 0.217 W/kg

SAR(1 g) = 0.116 mW/g; SAR(10 g) = 0.066 mW/g



Date/Time: 09/06/04 15:08:06

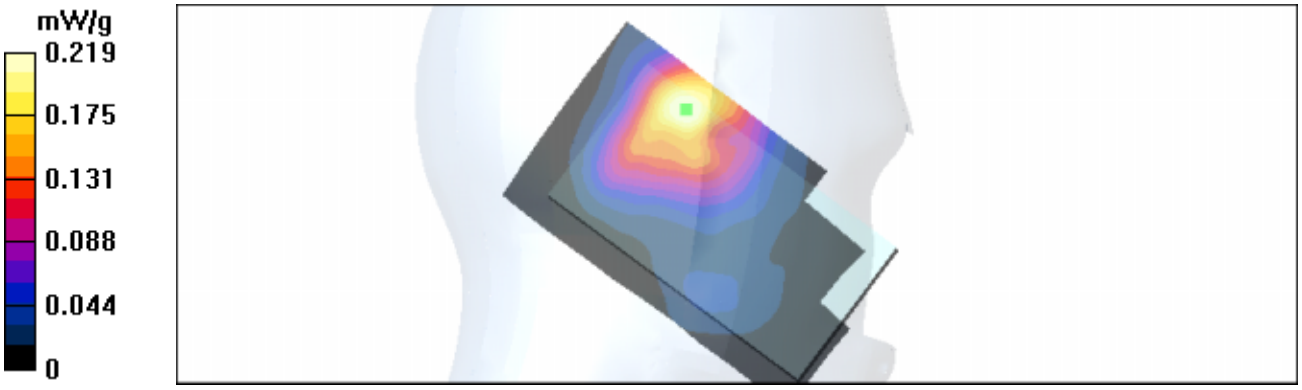
Test Laboratory: TCC Oulu
DUT: RM-12; Serial: 004400/52/170303/1
Communication System: GSM 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:8.3
Medium: HSL1900 Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.4 mho/m; ε_r = 38.6; ρ = 1000 kg/m^3
Phantom section: Right Section
DASY4 Configuration:
- Probe: ET3DV6 - SN1765; ConvF(5.27, 5.27, 5.27); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

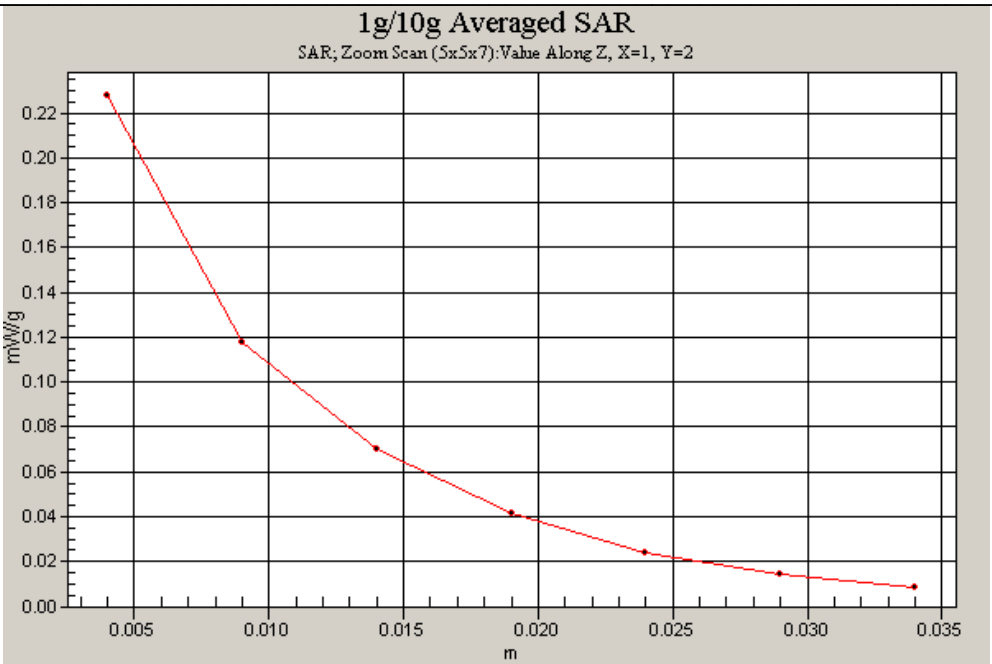
Cheek position - Low, t=21.3 C, worst case extrapolation/Area Scan (61x101x1):
Measurement grid: dx=15mm, dy=15mm
Reference Value = 8.87 V/m; Power Drift = -0.1 dB
Maximum value of SAR (interpolated) = 0.219 mW/g

Info: Interpolated medium parameters used for SAR evaluation!

Cheek position - Low, t=21.3 C, worst case extrapolation/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 8.87 V/m; Power Drift = -0.1 dB
Maximum value of SAR (measured) = 0.227 mW/g
Peak SAR (extrapolated) = 0.488 W/kg
SAR(1 g) = 0.218 mW/g; SAR(10 g) = 0.115 mW/g

Info: Interpolated medium parameters used for SAR evaluation!





Date/Time: 09/06/04 15:08:06

Test Laboratory: TCC Oulu

DUT: RM-12; Serial: 004400/52/170303/1

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

Medium: HSL1900 Medium parameters used: f = 1880 MHz; σ = 1.43 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3

Phantom section: Right Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1765; ConvF(5.27, 5.27, 5.27); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 109

Tilt position - Middle, t=21.4 C, worst case extrapolation/Area Scan (61x101x1):

Measurement grid: dx=15mm, dy=15mm

Reference Value = 8.96 V/m; Power Drift = -0.1 dB

Maximum value of SAR (interpolated) = 0.124 mW/g

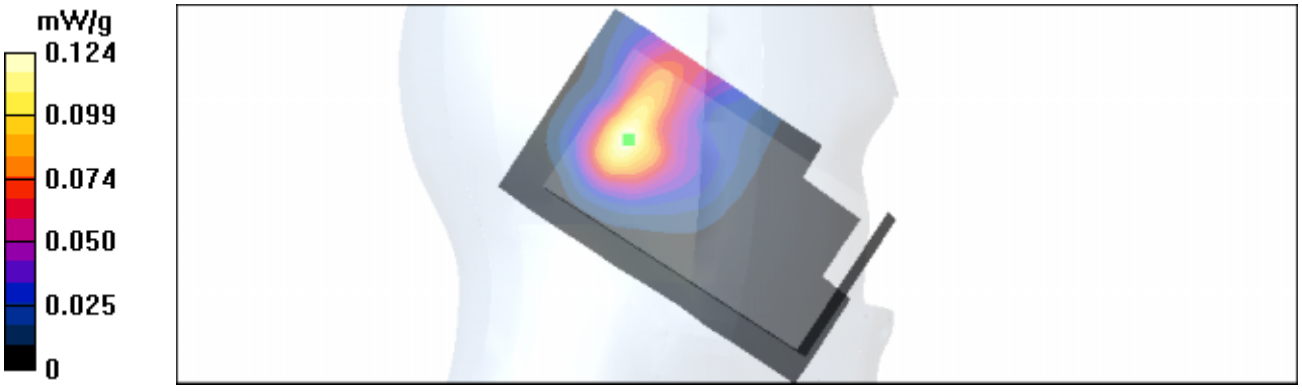
Tilt position - Middle, t=21.4 C, worst case extrapolation/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 8.96 V/m; Power Drift = -0.1 dB

Maximum value of SAR (measured) = 0.118 mW/g

Peak SAR (extrapolated) = 0.211 W/kg

SAR(1 g) = 0.111 mW/g; SAR(10 g) = 0.063 mW/g



Date/Time: 09/08/04 16:45:17

Test Laboratory: TCC Oulu
DUT: RM-12; Serial: 004400/52/170303/1; No headset, no MMC card, BT active
Communication System: GPRS 1900; Frequency: 1850.2 MHz;Duty Cycle: 1:4.2
Medium: BSL1900 Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.54 mho/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
DASY4 Configuration:
- Probe: ET3DV6 - SN1765; ConvF(4.65, 4.65, 4.65); Calibrated: 16.02.2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn555; Calibrated: 10.02.2004
- Phantom: SAM 3; Type: SAM 4.0; Serial: 1215
- Measurement SW: DASY4, V4.2 Build 37; Postprocessing SW: SEMCAD, V1.8 Build 123

Body worn - Low, t=21.6 C, worst case extrapolation/Area Scan (61x101x1):

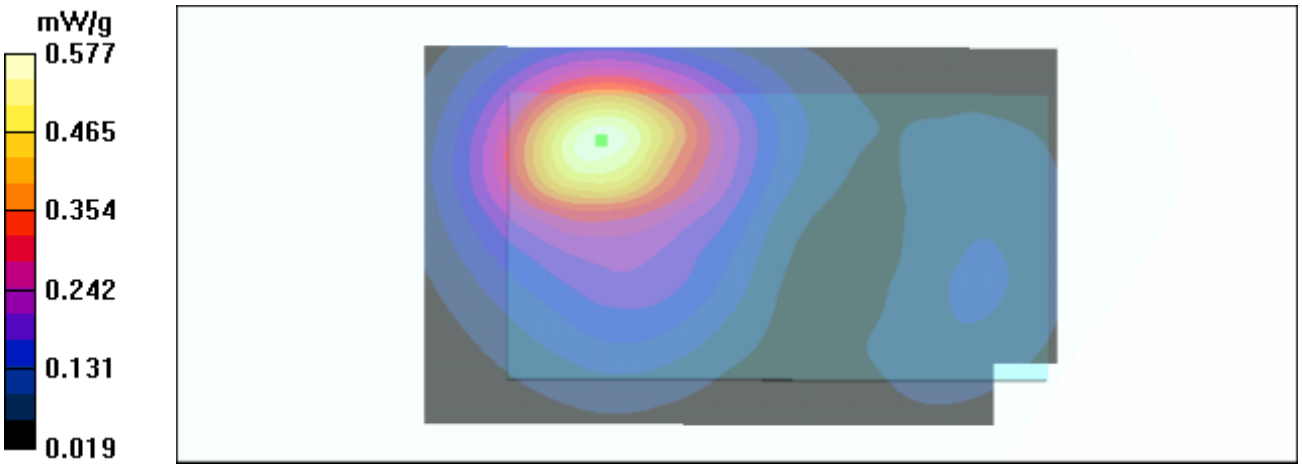
Measurement grid: dx=15mm, dy=15mm

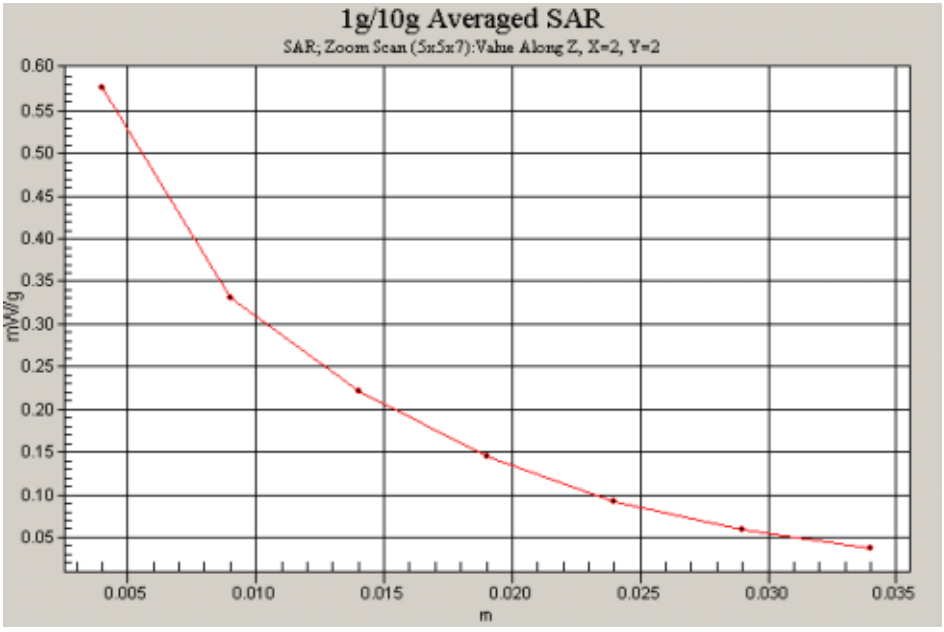
Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (interpolated) = 0.569 mW/g

Body worn - Low, t=21.6 C, worst case extrapolation/Zoom Scan (5x5x7)

(5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 12.2 V/m; Power Drift = -0.2 dB
Peak SAR (extrapolated) = 1.08 W/kg
SAR(1 g) = 0.543 mW/g; SAR(10 g) = 0.313 mW/g

Info: Interpolated medium parameters used for SAR evaluation!
Maximum value of SAR (measured) = 0.577 mW/g





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

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

Client **Nokia Oulu**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1765
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	February 16, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

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 +/- 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:	Katja Pokovic	Laboratory Director	
Approved by:	Niels Kuster	Quality Manager	

Date issued: February 16, 2004

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:1765

Sensitivity in Free Space

Diode Compression[A]

NormX	**1.64** $\mu V/(V/m)^2$	DCP X	**94**	mV
NormY	**1.85** $\mu V/(V/m)^2$	DCP Y	**94**	mV
NormZ	**1.92** $\mu V/(V/m)^2$	DCP Z	**94**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Cener to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	10.6	5.8
SAR_{be} [%]	With Correction Algorithm	0.3	0.6

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Sensor to Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	13.4	8.8
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

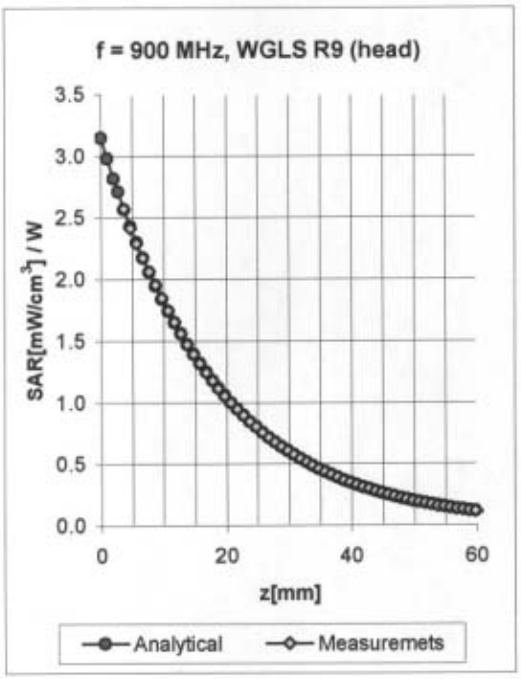
Sensor Offset

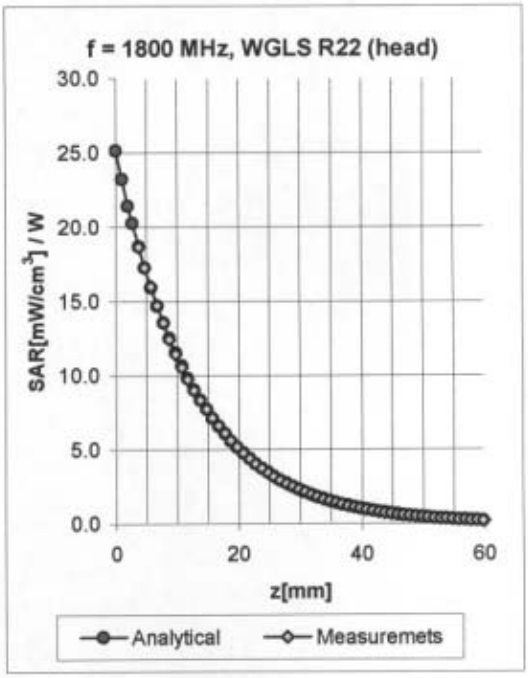
Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

Conversion Factor Assessment





f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	793-877	Head	41.5 ± 5%	0.90 ± 5%	0.68	1.81	6.55 ± 9.5% (k=2)
900	855-945	Head	41.5 ± 5%	0.97 ± 5%	0.44	2.37	6.45 ± 9.6% (k=2)
1800	1710-1890	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.42	5.27 ± 10.9% (k=2)
1880	1786-1974	Head	40.0 ± 5%	1.40 ± 5%	0.56	2.58	5.24 ± 11.0% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	1.07	1.81	4.80 ± 9.7% (k=2)
835	793-877	Body	55.2 ± 5%	0.97 ± 5%	0.43	2.38	6.23 ± 9.5% (k=2)
900	855-945	Body	55.0 ± 5%	1.05 ± 5%	0.47	2.29	6.02 ± 9.6% (k=2)
1800	1710-1890	Body	53.3 ± 5%	1.52 ± 5%	0.63	2.56	4.65 ± 10.9% (k=2)
1880	1786-1974	Body	53.3 ± 5%	1.52 ± 5%	0.64	2.64	4.59 ± 11.0% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.65	1.35	4.18 ± 9.7% (k=2)

[B] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

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

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

Client **Nokia Oyj, Oulu**

CALIBRATION CERTIFICATE

Object(s)	D1900V2 - SN:5d030
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:	Katja Pokovic	Laboratory Director	
Approved by:	Niels Kuster	Quality Manager	

Date issued: April 11, 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: 04/01/03 15:53:35

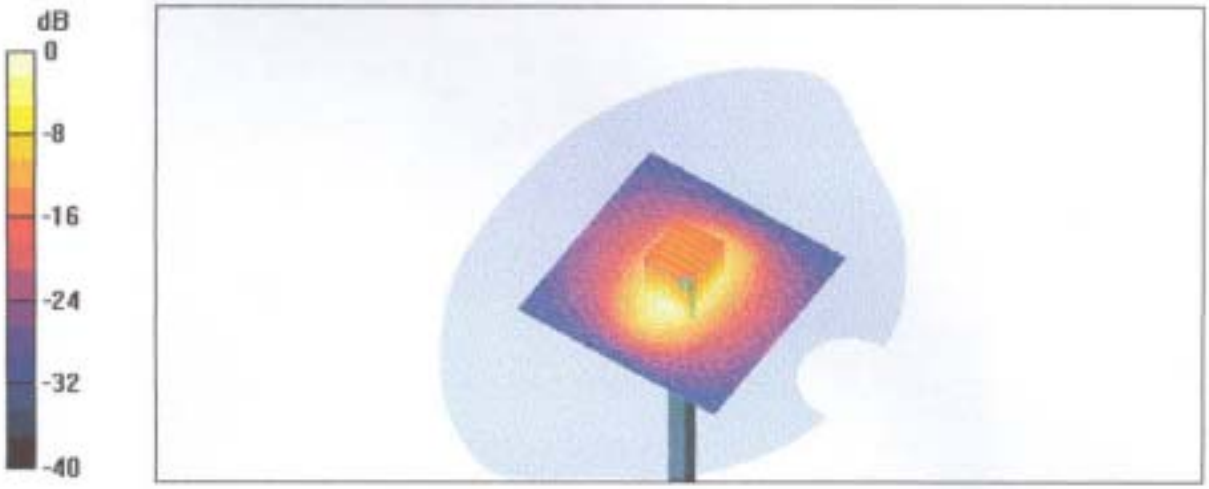
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d030_SN1507_HSL1900_010403.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d030
Program: Dipole Calibration

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz; (σ = 1.44 mho/m, ε_r = 38.78, 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 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 = 94.5 V/m
Peak SAR = 18.4 W/kg
SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.42 mW/g
Power Drift = 0.03 dB



Date/Time: 04/08/03 14:15:07

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d030_SN1507_M1900_080403.da4

DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d030
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 = 91.4 V/m
Peak SAR = 18.7 W/kg
SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.52 mW/g
Power Drift = 0.03 dB