TCC
Salo

T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	SAR0341_03	**Date of report:**	2003-10-09
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Measurements made by:	Virpi Tuominen		
Tested devices:	NHL-9		
FCC ID (USA):	PYANHL-9	**Industry Canada ID:**	661V-NHL9
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 P1528/D1.2, April 21, 2003
Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques

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

Test results: **The tested device complies with the requirements in respect of all parameters subject to the test.** The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures: **2003-10-09**

For the contents:

Kai Uusitalo
Engineering Manager, EMC

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2003-10-03 to 2003-10-06
SN, HW, SW and DUT numbers of tested device	SN: 004400/32/172504/4, HW: 1601, SW: 2.04, DUT: 06800
Accessories used in testing	Battery BL-5C, DUT #'s: 06418, 06671, 06799 Headset HS-5, DUT: 06512, HW: 0.2, MV: 0.1 Loopset LPS-4, DUT: 06260, HW: 4.0, SW: B6.0
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	661 / 1880	29.3 dBm	Left Cheek	1.6 W/kg	0.66 W/kg	PASSED

Note: The radiated power for this device was measured by an accredited test lab.

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	EIRP	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS 1900	512 / 1850	29.7 dBm	1.5 cm	1.6 W/kg	1.20 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	-0.24 dB

1.2.4 Measurement Uncertainty

Extended Uncertainty (k=2) 95%	±29.1%

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

Device category	Portable			
Exposure environment	General population/uncontrolled			
Unit type	Prototype unit			
Modes and Bands of Operation	GSM 1900	GPRS (GSM)	EGPRS (EDGE)	BT
Modulation Mode	GMSK	GMSK	8PSK	
Duty Cycle	1/8	2/8		
Transmitter Frequency Range (MHz)	1850.2 - 1909.8	1850.2 - 1909.8	1850.2 - 1909.8	2400.0 – 2483.5

Outside of USA and Canada, the transmitter of tested device is capable of operating also in GSM900 and in 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 Device

Flip closed

Flip open

2.2 Description of the Antenna

The device has an internal patch antenna.

2.3 Batteries

The device was measured with battery BL-5C.

2.4 Headsets

The device was measured with headset HS-5 and loopset LPS-4.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Period of measurement:	2003-10-03 to 2003-10-09
Ambient temperature (°C):	22.1 to 22.2
Ambient humidity (RH %):	35 to 41

3.2 Test Signal, Frequencies, and Output Power

The device was put into operation by using two call testers, one for GSM or GPRS calls and one for BT. 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.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement system and components

The measurements were performed using an automated near-field scanning system, DASY 3 software version 3.1d, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements on the test device was the 'worst-case extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration expiry
DASY3 DAE V1	372	08/2004
E-field Probe ET3DV6	1395	08/2004
Dipole Validation Kit, D835V2	462	07/2004
Dipole Validation Kit, D1900V2	5d013	07/2004

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration expiry
Signal Generator	SML03	101265	06/2004
Amplifier	TL-2001	501137	-
Power Meter	NRVS	849305/028	07/2004
Power Sensor	NRV-Z32	839176/020	07/2004
Digital Radiocommunication Tester	CMU 200	835734/049	04/2004
Digital Radiocommunication Tester	CMU 200	101111	07/2004
Vector Network Analyzer	8753E	US38432928	10/2003
Dielectric Probe Kit	85070C	US33020420	-

4.1.1 Isotropic E-field probe, SN: 1395

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 A
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 P1528/D1.2, April 21, 2003 (as established by sub committee SCC-34/SC-2).

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 test 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 P1528/D1.2, April 21, 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)	Muscle (% 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 ε_r	Dielectric Parameters σ [S/m]	Temp [°C]
1900	Reference result	11.0	39.8	1.46	N/A
	± 10% window	9.90 to 12.1			
	2003-10-03	11.3	38.0	1.44	21.2

System verification, body tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters ε_r	Dielectric Parameters σ [S/m]	Temp [°C]
1900	Reference result	10.6	51.0	1.57	N/A
	± 10% window	9.54 to 11.7			
	2003-10-06	9.74	50.6	1.55	20.3
	2003-10-09	9.83	50.7	1.55	21.4

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 to 42.0	1.33 to 1.47	
	2003-10-03	38.1	1.43	21.0

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 to 56.0	1.44 to 1.60	
	2003-10-06	50.7	1.52	21.0
	2003-10-09	50.7	1.52	21.0

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Device Holder

The test 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 test device within the SPEAG holder. The spacer positions the test 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 P1528/D1.2 April 21 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

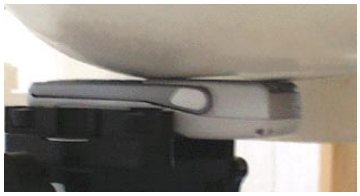


Photo of the device with flip closed in “cheek” position.

Photo of the device with flip open in "cheek" position.

Photo of the device with flip closed in "tilt" position.

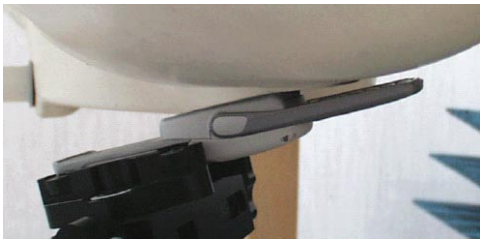
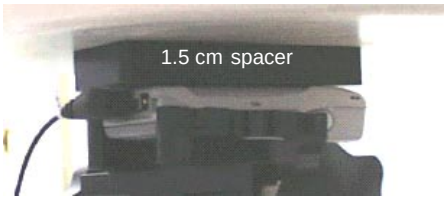
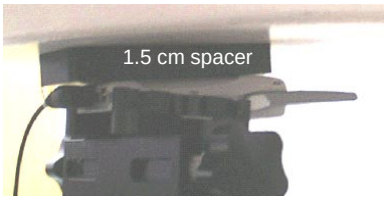


Photo of the device with flip open in "tilt" position.

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 1.5 cm 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.





Photos of the device positioned for Body SAR measurement with flip closed and open. 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 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 of the points was done with a 3d-Spline. The 3d-Spline comprised three one-dimensional splines with the "Not a knot" -condition [W. Gander, Computermathematik, p. 141-150] (x, y and z -directions) [Numerical Recipes in C, Second Edition, p 123].

The extrapolation was based on least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 30 mm in all z-axis, a fourth order polynomial was calculated. This polynomial was then used to evaluate the points between the phantom surface and the probe tip. The points, calculated from the phantom surface, were at 1mm spacing.

6. MEASUREMENT UNCERTAINTY

Table 6.1 – Measurement uncertainty evaluation

Uncertainty Component	P1528 Sec	Tol. (%)	Prob Dist	Div	c_i	u_i (%)	v_i
Measurement System							
Probe Calibration	E2.1	±4.8	N	1	1	±4.8	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1-c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±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**	208
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	Flip option	Position		SAR, averaged over 1g (W/kg)		
				Ch 512 1850 MHz	Ch 661 1880 MHz	Ch 810 1910 MHz
GSM 1900	closed	**Power level**		**29.7 dBm**	**29.3 dBm**	**29.4 dBm**
		Left	Cheek	0.466	**0.650**	0.531
			Tilt	-	0.591	-
		Right	Cheek	-	0.471	-
			Tilt	-	0.479	-
	open	**Power level**		**29.6 dBm**	**28.6 dBm**	**27.6 dBm**
		Left	Cheek	-	0.552	-
			Tilt	-	0.522	-
		Right	Cheek	-	0.569	-
			Tilt	0.530	**0.589**	0.398
GSM 1900	closed	Highest SAR value measurement in this band repeated with BT active		-	**0.657**	-
	open	Highest SAR value measurement in this band repeated with BT active		-	0.574	-

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

1900MHz Body SAR results

Mode and Band	Flip option	Body-worn location setup	SAR, averaged over 1g (W/kg)		
			Ch 512 1850 MHz	Ch 661 1880 MHz	Ch 810 1910 MHz
GPRS 1900	closed	**Power level**	**29.7 dBm**	**29.3 dBm**	**29.4 dBm**
		Headset HS-5	**1.20**	1.08	0.764
		Loopset LPS-4	1.08	1.02	0.761
	open	**Power level**	**29.6 dBm**	**28.6 dBm**	**27.6 dBm**
		Headset HS-5	**0.812**	0.665	0.486
		Loopset LPS-4	0.757	0.652	0.555
GPRS 1900	closed	Highest SAR value measurement (with HS-5) in this mode repeated with BT active	1.15	-	-
	open	Highest SAR value measurement (with HS-5) in this mode repeated with BT active	0.806	-	-

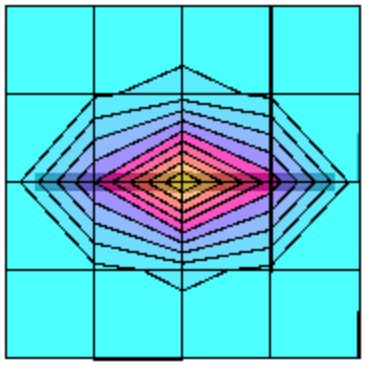
Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

System verification, head tissue simulant, 1900 MHz

2003-10-03
t(liq.)=21.2°C

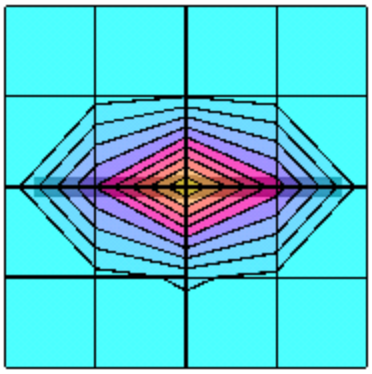
Dipole 1900 MHz
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 1.0; Brain 1900 MHz: σ = 1.44 mho/m ε_r = 38.0 ρ = 1.00 g/cm^3
Cubes (2): Peak: 21.8 mW/g ± 0.07 dB, SAR (1g): 11.3 mW/g ± 0.05 dB, SAR (10g): 5.70 mW/g ± 0.04 dB, (Worst-case extrapolation)
Penetration depth: 7.7 (7.3, 8.8) [mm]
Powerdrift: -0.02 dB



System verification, body tissue simulant, 1900 MHz
2003-10-06
t(liq.)=20.3°C

Dipole 1900 MHz

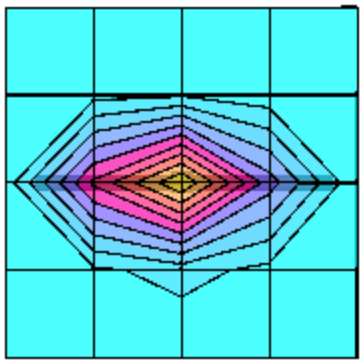
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 1.0; BODY 1900 MHz: σ = 1.55 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cubes (2): Peak: 17.5 mW/g ± 0.13 dB, SAR (1g): 9.74 mW/g ± 0.03 dB, SAR (10g): 5.10 mW/g ± 0.01 dB, (Advanced extrapolation)
Penetration depth: 9.2 (9.0, 9.6) [mm]
Powerdrift: 0.02 dB



System verification, body tissue simulant, 1900 MHz
2003-10-09
t(liq.)=21.4°C

Dipole 1900 MHz

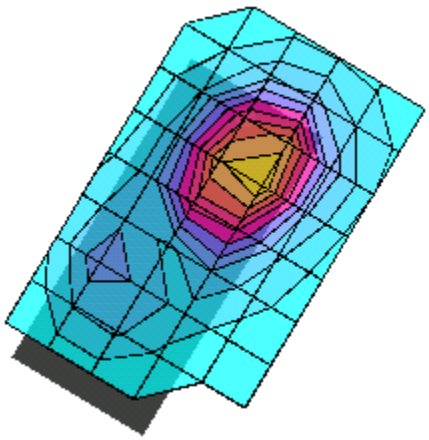
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 1.0; BODY 1900 MHz: σ = 1.55 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cubes (2): Peak: 17.1 mW/g ± 0.01 dB, SAR (1g): 9.83 mW/g ± 0.01 dB, SAR (10g): 5.22 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 9.4 (9.2, 9.9) [mm]
Powerdrift: 0.04 dB



APPENDIX B: MEASUREMENT SCANS

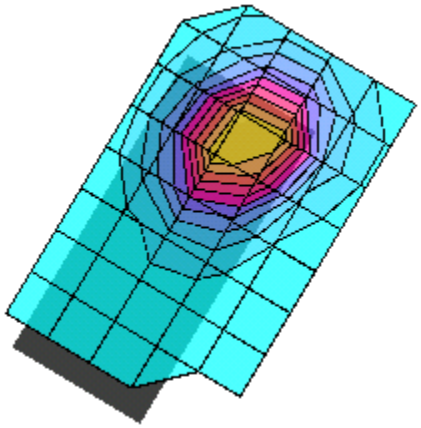
NHL-9, Flip closed, Left Cheek, GSM1900
2003-10-03
t(liq.)=21.0°C

SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.650 mW/g, SAR (10g): 0.360 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.11 dB



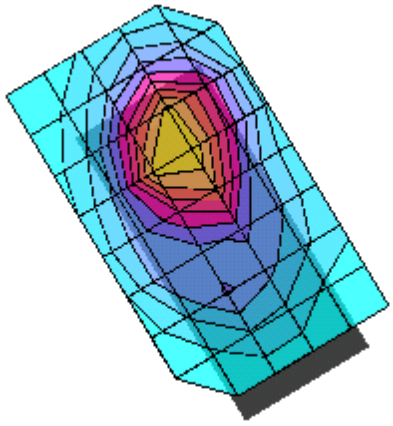
NHL-9, Flip closed, Left Tilt, GSM1900
2003-10-03
t(liq.)=20.9°C

SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.591 mW/g, SAR (10g): 0.326 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.08 dB



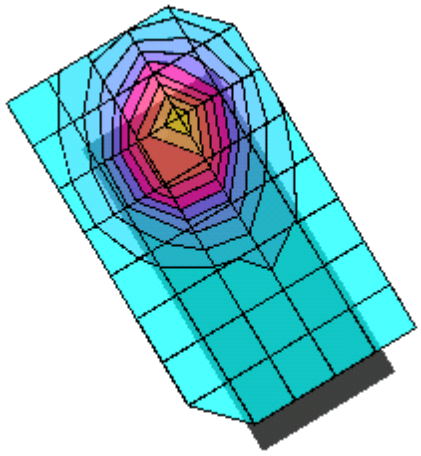
NHL-9, Flip closed, Right Cheek, GSM1900
2003-10-03
t(liq.)=20.2°C

SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.471 mW/g, SAR (10g): 0.278 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.05 dB



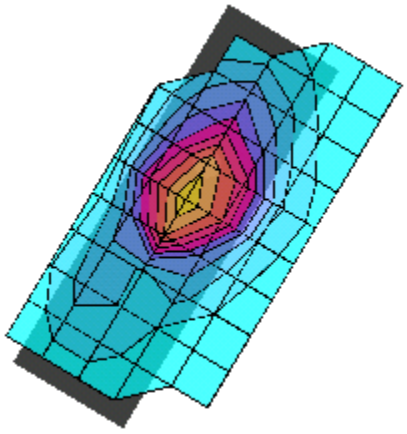
NHL-9, Flip closed, Right Tilt, GSM1900
2003-10-03
t(liq.)=20.2°C

SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.479 mW/g, SAR (10g): 0.268 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.01 dB



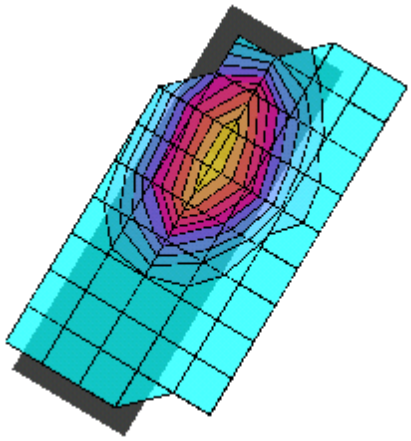
NHL-9, Flip open, Left Cheek, GSM1900
2003-10-03
t(liq.)=20.8°C

SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.552 mW/g, SAR (10g): 0.329 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.00 dB



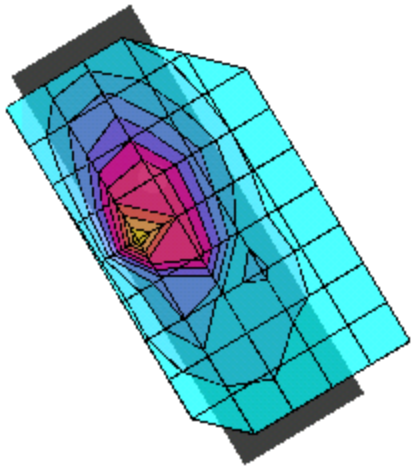
NHL-9, Flip open, Left Tilt, GSM1900
2003-10-03
t(liq.)=20.6°C

SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.522 mW/g, SAR (10g): 0.312 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.00 dB



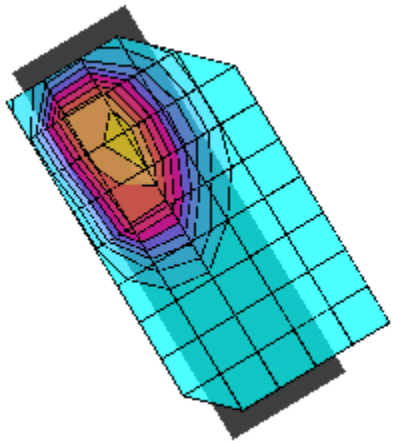
NHL-9, Flip open, Right Cheek, GSM1900
2003-10-03
t(liq.)=20.5°C

SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.569 mW/g, SAR (10g): 0.316 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.10 dB



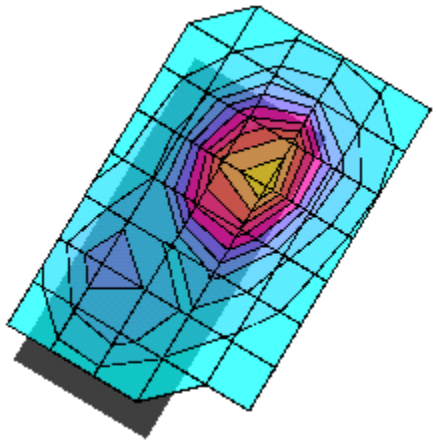
NHL-9, Flip open, Right Tilt, GSM1900
2003-10-03
t(liq.)=20.5°C

SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.589 mW/g, SAR (10g): 0.349 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.02 dB



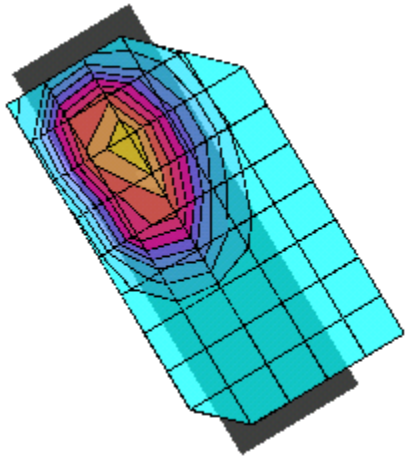
NHL-9, Flip closed, Left Cheek, BT active, GSM1900
2003-10-03
t(liq.)=20.0°C

SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.657 mW/g, SAR (10g): 0.364 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.03 dB



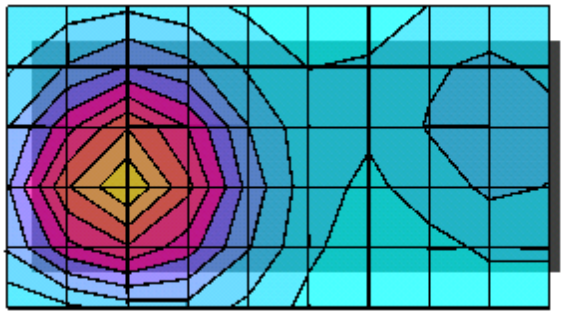
NHL-9, Flip open, Right Tilt, BT active, GSM1900
2003-10-03
t(liq.)=20.0°C

SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.574 mW/g, SAR (10g): 0.337 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.05 dB



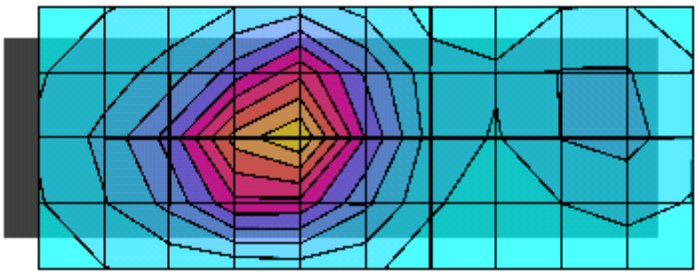
NHL-9, Flip closed, HS-5, Body 1.5 cm, GSM1900
2003-10-06
t(liq.)=20.1°C

SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; B0DY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.20 mW/g, SAR (10g): 0.693 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: 0.08 dB



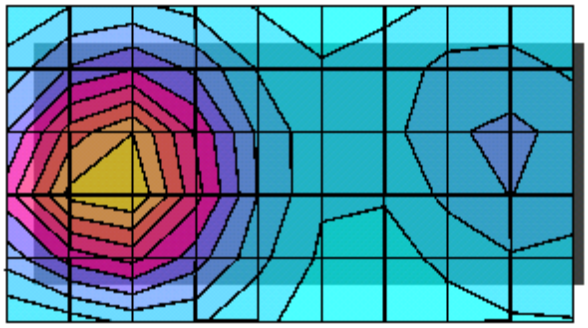
NHL-9, Flip open, HS-5, Body 1.5 cm, GSM1900
2003-10-06
t(liq.)=20.0°C

SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; BODY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.812 mW/g, SAR (10g): 0.468 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 15.0
Powerdrift: 0.03 dB



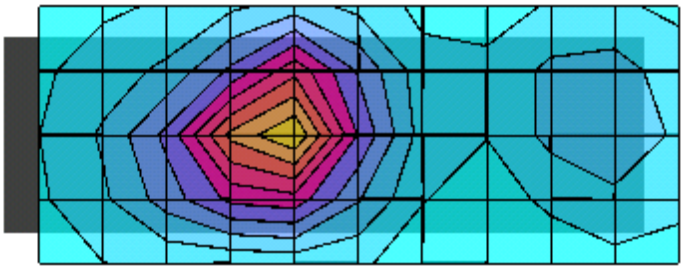
NHL-9, Flip closed, LPS-4, Body 1.5 cm, GSM1900
2003-10-09
t(liq.)=21.1°C

SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; BODY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.08 mW/g, SAR (10g): 0.627 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: 0.03 dB



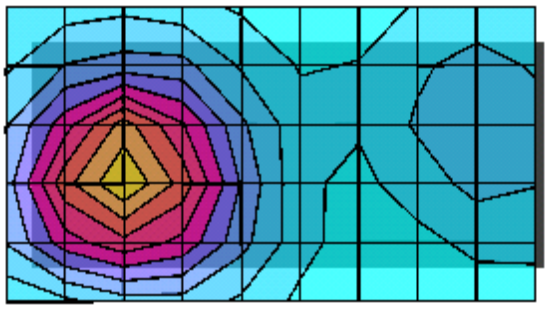
NHL-9, Flip open, LPS-4, Body 1.5 cm, GSM1900
2003-10-09
t(liq.)=20.8°C

SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; BODY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.757 mW/g, SAR (10g): 0.443 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 15.0
Powerdrift: 0.00 dB



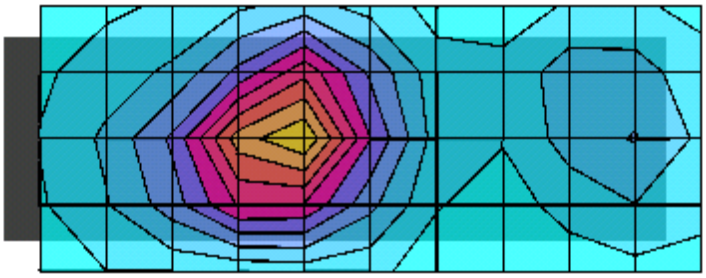
NHL-9, Flip closed, HS-5, Body 1.5 cm, BT active, GSM1900
2003-10-06
t(liq.)=20.1°C

SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; B0DY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.15 mW/g, SAR (10g): 0.662 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.24 dB



NHL-9, Flip open, HS-5, Body 1.5 cm, BT active, GSM1900
2003-10-06
t(liq.)=20.0°C

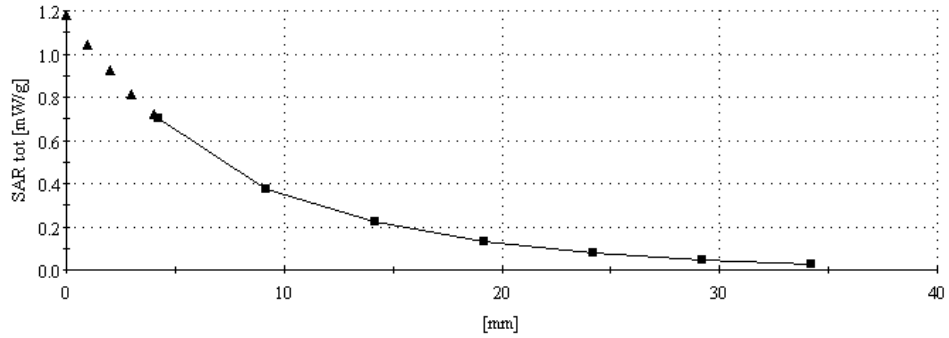
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; BODY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.806 mW/g, SAR (10g): 0.458 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 15.0
Powerdrift: 0.00 dB



Z-PLOT corresponding Maximum Head SAR result / GSM1900:

NHL-9, Flip closed, Left Cheek, BT active, GSM1900
2003-10-03
t(liq.)=20.0°C

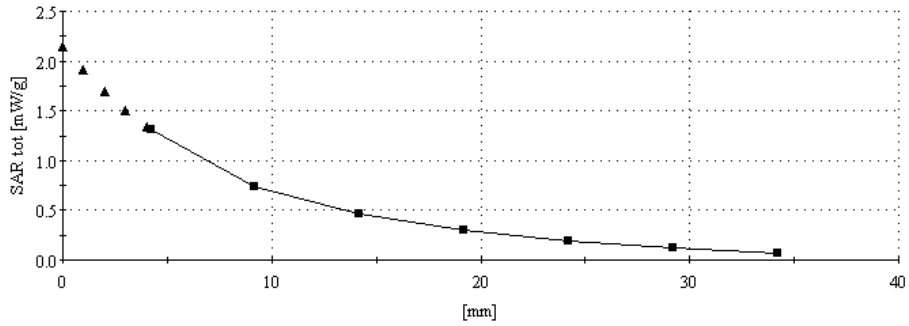
SAM 2 Phantom; Section; Position: ; Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.43 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
:, 0
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



Z-PLOT corresponding Maximum Head SAR result / GSM1900:

NHL-9, Flip closed, HS-5, Body 1.5 cm, GSM1900
2003-10-06
t(liq.)=20.1°C

SAM 2 Phantom; Section; Position: ; Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; B0DY 1880 MHz: σ = 1.52 mho/m ε_r = 50.7 ρ = 1.00 g/cm^3
:, 0
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



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

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

Client Nokia TCC Salo

CALIBRATION CERTIFICATE

Object(s) ET3DV6 - SN:1395

Calibration procedure(s) QA CAL-01.v2
Calibration procedure for dosimetric E-field probes

Calibration date: August 28, 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
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-03
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03

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

Date issued: August 28, 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.

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ET3DV6 SN:1395 August 28, 2003

DASY - Parameters of Probe: ET3DV6 SN:1395

Sensitivity in Free Space

Diode Compression

NormX	1.71 $\mu V/(V/m)^2$	DCP X	94	mV
NormY	1.74 $\mu V/(V/m)^2$	DCP Y	94	mV
NormZ	1.68 $\mu V/(V/m)^2$	DCP Z	94	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.3 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.3 ± 9.5% (k=2)	Alpha	0.42
ConvF Z	6.3 ± 9.5% (k=2)	Depth	2.59

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1710-1910 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	0.54
ConvF Z	5.2 ± 9.5% (k=2)	Depth	2.56

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	11.7	6.7
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	14.5	9.4
SAR_{be} [%]	With Correction Algorithm	0.1	0.1

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.7 ± 0.2	mm

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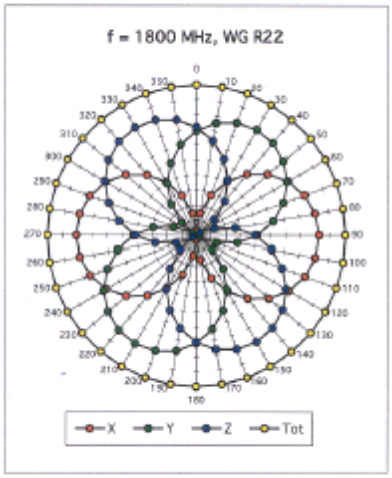
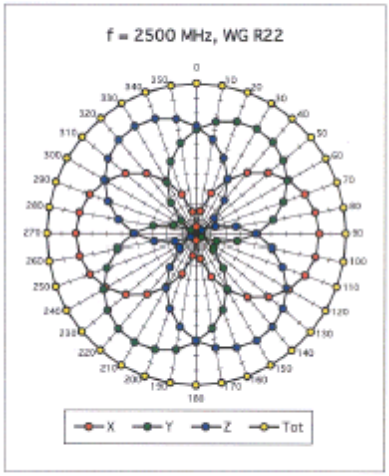
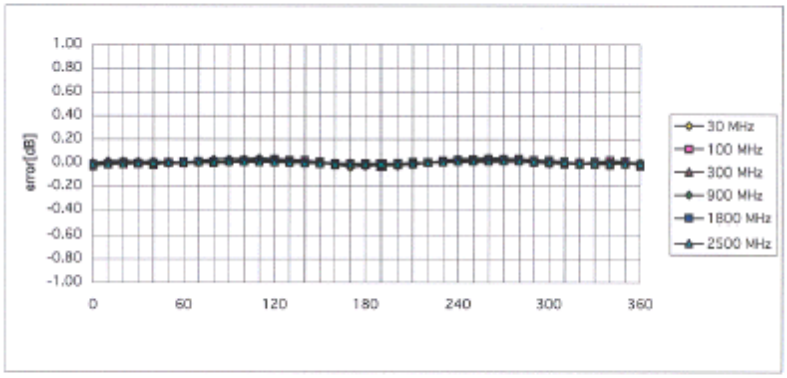
ET3DV6 SN:1395 August 28, 2003





Isotropy Error (ϕ), θ = 0°



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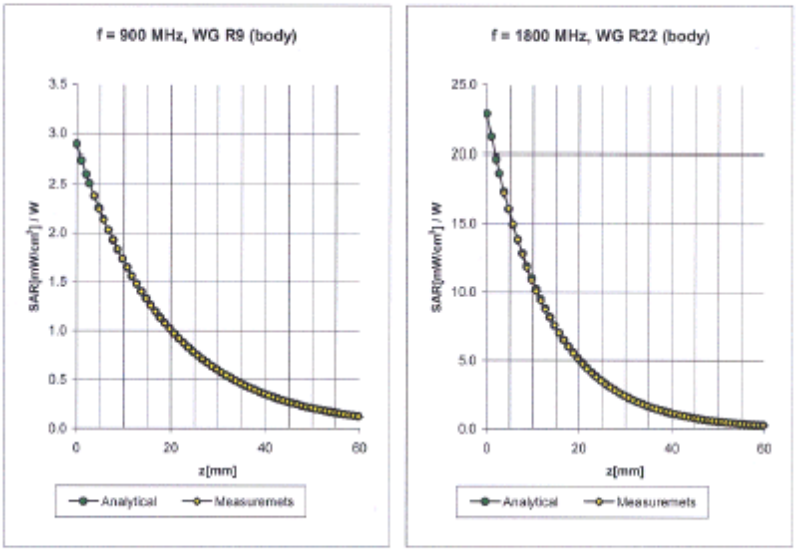
ET3DV6 SN:1395 August 26, 2003

Conversion Factor Assessment



Body 900 MHz ε_r = 55.0 ± 5% σ = 1.05 ± 5% mho/m

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	6.2 ±9.5% (k=2)	Boundary effect:	
ConvF Y	6.2 ±9.5% (k=2)	Alpha	0.49
ConvF Z	6.2 ±9.5% (k=2)	Depth	2.37

Body 1800 MHz ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.9 ±9.5% (k=2)	Boundary effect:	
ConvF Y	4.9 ±9.5% (k=2)	Alpha	0.61
ConvF Z	4.9 ±9.5% (k=2)	Depth	2.60

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

1900 MHz DIPOLE; HEAD CALIBRATION:

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

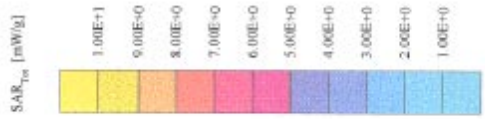
DASY3

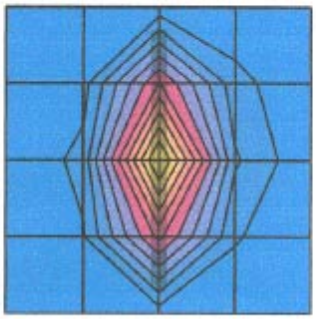
Dipole Validation Kit

Type: D1900V2

Serial: 5d013

Manufactured: April 30, 2002
Calibrated: July 1, 2002





07/01/02

Validation Dipole D1900V2 SN5d013, d = 10 mm
Frequency: 1900 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.20,5.20,5.20) at 1900 MHz; IEEE1528 1900 MHz: σ = 1.46 mho/m ε_r = 39.6 ρ = 1.00 g/cm^3
Cubes (2): Peak: 20.5 mW/g ± 0.03 dB, SAR (1g): 11.0 mW/g ± 0.02 dB, SAR (10g): 5.70 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.1 (7.8, 8.9) [mm]
Powerdrift: 0.02 dB

1900 MHz DIPOLE, BODY CALIBRATION:

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

Client Nokia Inc. Salo TTC

CALIBRATION CERTIFICATE

Object(s) D1900V2 - SN:5d013

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

Calibration date: January 9, 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 HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

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

Date Issued: January 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.

890-KP0301061-A Page 1 (1)

Date/Time: 01/09/03 17:04:5

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d013_SN1507_M1900_090103.da4

DUT: Dipole 1900 MHz Type & Serial Number: D1900V2 - SN5d013
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: Muscle 1900 MHz (σ = 1.57 mho/m, ε = 50.97, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(4.9, 4.9, 4.9); Calibrated: 1/24/2002
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 91.7 V/m
Peak SAR = 19.4 mW/g
SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.44 mW/g
Power Drift = -0.003 dB