TCC
Salo

T117 (EN ISO/IEC 17025)

SAR Compliance Test Report

Test report no.:	Salo_SAR0403_01	**Date of report:**	2004-03-01
Template version:	2	**Number of pages:**	60
Testing laboratory:	TCC Salo, P.O. Box 86 Joensuunkatu 7E / Kiila 1B FIN-24101 SALO, FINLAND Tel. +358 (0) 7180 08000 Fax. +358 (0) 7180 45220	**Client:**	Nokia Corporation P.O. Box 12 Mattilanniemi 6 FIN-40101 Jyväskylä, FINLAND Tel. +358 (0) 7180 080112200 Fax. +358 (0) 7180 78000
Responsible test engineer:	Virpi Tuominen	**Product contact person:**	Mikael Honkanen
Measurements made by:	Virpi Tuominen		
Tested device:	NHL-12		
FCC ID (USA):	QURNHL-12	**Industry Canada ID:**	661AC-NHL12
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: **2004-03-01**

For the contents:

Kai Uusitalo
Engineering Manager, EMC

Virpi Tuominen
Senior Design Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	2004-01-02 to 2004-01-12
SN, HW and SW numbers of tested device	SN: 004400/23/165683/4, HW: 1001, SW: 1.12.0, DUT: 06905
Batteries used in testing	Battery: BL-5C, DUT #'s: 06799, 06813, 06814
Headsets used in testing	Headset: HS-5, DUT: 06908 Headset: HDS-3, DUT: 06909
Other accessories used in testing	MMC-card: Hitachi DTS-32, DUT: 06907
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)	ERP / EIRP	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GSM 850	190 / 836	30.77 dBm	Left cheek	1.6 W/kg	1.06 W/kg	PASSED
GSM 1900	661 / 1880	27.75 dBm	Right tilt	1.6 W/kg	0.51 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	ERP / EIRP	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
GPRS 850 1-slot TX	128 / 824	30.48 dBm	1.5 cm	1.6 W/kg	0.60 W/kg	PASSED
GPRS 1900 2-slot TX	512 / 1850	29.09 dBm	1.5 cm	1.6 W/kg	1.22 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	-0.23 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 850	GSM 1900	GPRS (GSM 850)	GPRS (GSM 1900)	EGPRS (EDGE)	EGPRS (EDGE)	BT
Modulation Mode	GMSK	GMSK	GMSK	GMSK	8PSK	8PSK	GFSK
Duty Cycle	1/8	1/8	1 or 2/8	1 or 2/8			
Transmitter Frequency Range (MHz)	824.2 – 848.8	1850.2 - 1909.8	824.2 – 848.8	1850.2 - 1909.8	824.2 – 848.8	1850.2 - 1909.8	2400.0 – 2483.5

Outside of USA and Canada, the transmitter of the device is capable of operating also in GSM1800, which is 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 antenna.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Period of measurement:	2004-01-02 to 2004-01-12
Ambient temperature (°C):	22.0 to 22.2
Ambient humidity (RH %):	36 to 39

3.2 Test Signal, Frequencies, and Output Power

The device was put into operation by using call testers, one for GSM and GPRS calls and another for BT. Communication between the device and the call tester was established by air links.

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: TCC Tampere, Sinitaival 5, FIN-33720 Tampere.

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 device was the 'worst-case extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Serial Number	Calibration interval	Calibration expiry
DASY3 DAE V1	372	12 months	08/2004
E-field Probe ET3DV6	1395	12 months	08/2004
Dipole Validation Kit, D835V2	462	24 months	07/2004
Dipole Validation Kit, D1900V2	5d013	24 months	07/2004

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	SML03	101265	12 months	06/2004
Amplifier	ZHL-42 (SMA)	N072095-5	-	-
Power Meter	NRVS	849305/028	12 months	07/2004
Power Sensor	NRV-Z32	839176/020	12 months	07/2004
Call Tester	CMU 200	101111	12 months	07/2004
Call Tester	CMU 200	835734/049	12 months	04/2004
Vector Network Analyzer	8753E	US38432928	12 months	10/2004
Dielectric Probe Kit	85070B	US33020420	-	-

4.1.1 Isotropic E-field Probe 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 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:

800MHz band

Ingredient	Head (% by weight)	Body (% by weight)
Deionised Water	39.74	50.75
HEC	0.25	-
Sugar	58.31	48.21
Preservative	0.15	0.10
Salt	1.55	0.94

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]	
835 MHz	Reference result ± 10% window	2.45 2.21 to 2.70	42.5	0.90	N/A
	2004-01-02	2.69	41.5	0.91	20.3
	2004-01-05	2.62	41.0	0.90	21.4
1900 MHz	Reference result ± 10% window	11.0 9.90 to 12.1	39.8	1.46	N/A
	2004-01-08	11.3	38.1	1.46	21.4

System verification, body tissue simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
835 MHz	Reference result ± 10% window	2.48 2.23 to 2.73	55.5	0.96	N/A
	2004-01-07	2.50	53.1	0.95	21.3
1900 MHz	Reference result ± 10% window	10.6 9.54 to 11.7	51.0	1.57	N/A
	2004-01-12	10.0	50.4	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]	
836 MHz	Recommended value ± 5% window	41.5 39.4 to 43.6	0.90 0.86 to 0.95	N/A
	2004-01-02	41.5	0.91	21.0
	2004-01-05	40.9	0.91	21.0
1880 MHz	Recommended value ± 5% window	40.0 38.0 to 42.0	1.40 1.33 to 1.47	N/A
	2004-01-08	38.2	1.44	21.0

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
836 MHz	Recommended value ± 5% window	55.2 52.5 to 58.0	0.97 0.92 to 1.02	N/A
	2004-01-07	53.1	0.95	21.0
1880 MHz	Recommended value ± 5% window	53.3 50.6 to 56.0	1.52 1.44 to 1.60	N/A
	2003-01-12	50.6	1.53	21.0

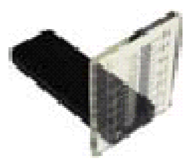
5. DESCRIPTION OF THE TEST PROCEDURE

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 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 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 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.

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 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.

Surface detection distance used in the SAR calculation algorithm was 1.4 mm.

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**	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:

800MHz Head SAR results

Mode and Band	MMC-card option	Position		SAR, averaged over 1g (W/kg) Ch 128 824 MHz	Ch 190 836 MHz	Ch 251 849 MHz
GSM 850		Power level (ERP)		30.48 dBm	30.77 dBm	29.63 dBm
	Not used	Left	Cheek	0.794	**1.03**	1.01
			Tilt	-	0.713	-
		Right	Cheek	0.736	0.992	1.01
			Tilt	-	0.717	-
	With MMC	Left	Cheek	0.788	**1.05**	1.02
			Tilt	-	-	-
		Right	Cheek	-	1.01	0.985
			Tilt	-	-	-
	With MMC	Left Cheek, BT active		-	**1.06**	-

1900MHz Head SAR results

Mode and Band	MMC-card option	Position		SAR, averaged over 1g (W/kg)		
				Ch 512 1850 MHz	Ch 661 1880 MHz	Ch 810 1910 MHz
GSM 1900	Not used	Power level (EIRP)		**29.09 dBm**	**27.75 dBm**	**25.52 dBm**
		Left	Cheek	-	0.302	-
			Tilt	-	0.409	-
		Right	Cheek	-	0.418	-
			Tilt	0.441	**0.513**	0.389
	With MMC	Right	Tilt	0.448	0.510	0.409
	Not used	Right Tilt, BT active		-	0.484	-

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

800MHz Body SAR results

Mode and Band	MMC-card option	Body-worn location setup	SAR, averaged over 1g (W/kg)		
			Ch 128 824 MHz	Ch 190 836 MHz	Ch 251 849 MHz
GPRS 850 1-slot TX	Not used	Power level (ERP)	**30.48 dBm**	**30.77 dBm**	**29.63 dBm**
		Headset HS-5	0.580	0.572	0.491
		Headset HDS-3	0.570	0.546	0.486
	With MMC	Headset HS-5	**0.604**	0.573	0.558
	With MMC	Headset HS-5 BT active	0.592	-	-

In 800 MHz band, power class for 2-slot GPRS mode is lower than in 1-slot mode. Maximum SAR result was found with 1-slot transmission.

1900MHz Body SAR results

Mode and Band	MMC-card option	Body-worn location setup	SAR, averaged over 1g (W/kg)		
			Ch 512 1850 MHz	Ch 661 1880 MHz	Ch 810 1910 MHz
GPRS 850 2-slot TX	Not used	**Power level (EIRP)**	**29.09 dBm**	**27.75 dBm**	**25.52 dBm**
		Headset HS-5	1.19	1.10	0.761
		Headset HDS-3	1.21	1.11	0.797
	With MMC	Headset HDS-3	**1.22**	1.01	0.709
	With MMC	Headset HDS-3 BT active	1.15	-	-

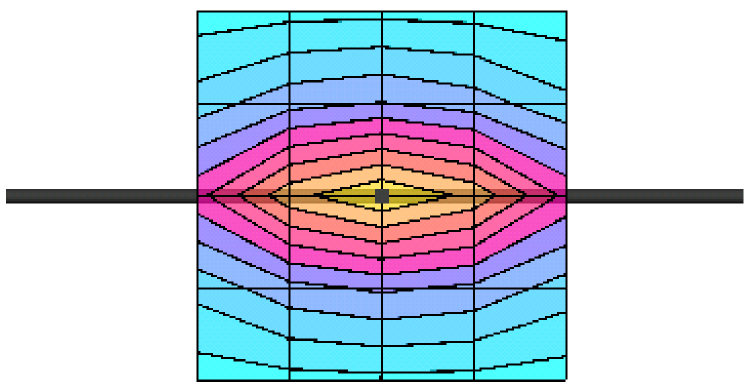
Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

System verification, head tissue simulant, 835 MHz
2004-01-02
t(liq.)=20.3°C

Dipole 835 MHz

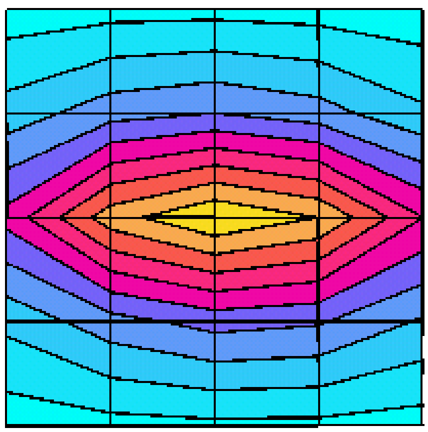
SAM 2; Flat
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0; Brain 835 MHz: σ = 0.91 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.35 mW/g ± 0.01 dB, SAR (1g): 2.69 mW/g ± 0.01 dB, SAR (10g): 1.71 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 11.7 (10.3, 13.6) [mm]
Powerdrift: -0.01 dB



System verification, head tissue simulant, 835 MHz
2004-01-05
t(liq.)=21.4°C

835 dipole

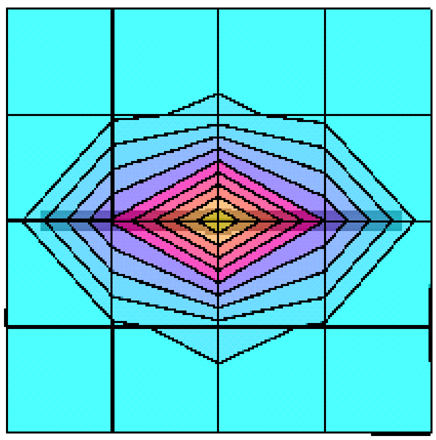
SAM 2;
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 1.0; Brain 835 MHz: σ = 0.90 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.21 mW/g ± 0.07 dB, SAR (1g): 2.62 mW/g ± 0.05 dB, SAR (10g): 1.67 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 11.8 (10.5, 13.6) [mm]
Powerdrift: -0.01 dB



System verification, head tissue simulant, 1900 MHz
2004-01-08
t(liq.)=21.4°C

Dipole 1900 MHz

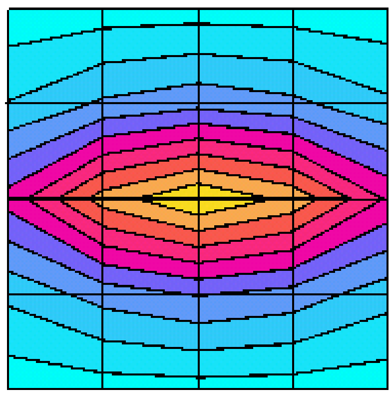
SAM; Flat
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 1.0; Brain 1900 MHz: σ = 1.46 mho/m ε_r = 38.1 ρ = 1.00 g/cm^3
Cubes (2): Peak: 21.8 mW/g ± 0.04 dB, SAR (1g): 11.3 mW/g ± 0.04 dB, SAR (10g): 5.68 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 7.8 (7.3, 8.8) [mm]
Powerdrift: -0.02 dB



System verification, body tissue simulant, 835 MHz
2004-01-07
t(liq.)=21.3°C

835 dipole

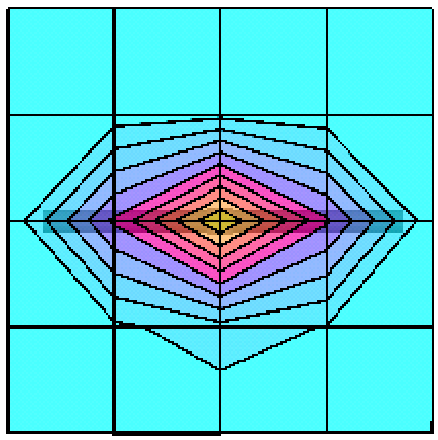
SAM 2;
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 1.0; B0DY 835 MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cubes (2): Peak: 3.67 mW/g ± 0.06 dB, SAR (1g): 2.50 mW/g ± 0.00 dB, SAR (10g): 1.65 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 14.0 (13.6, 14.5) [mm]
Powerdrift: 0.02 dB



System verification, body tissue simulant, 1900 MHz
2004-01-12
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; B0DY 1900 MHz: σ = 1.55 mho/m ε_r = 50.4 ρ = 1.00 g/cm^3
Cubes (2): Peak: 17.7 mW/g ± 0.09 dB, SAR (1g): 10.0 mW/g ± 0.03 dB, SAR (10g): 5.22 mW/g ± 0.01 dB, (Advanced extrapolation)
Penetration depth: 9.5 (9.3, 9.9) [mm]
Powerdrift: -0.07 dB

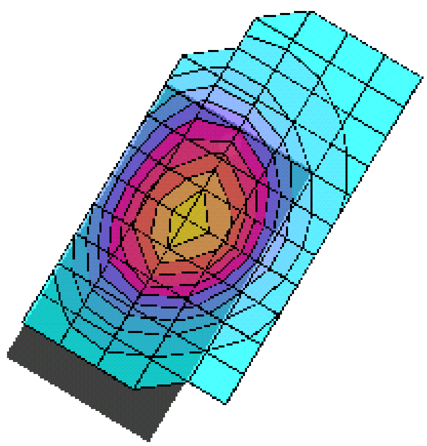


APPENDIX B: MEASUREMENT SCANS

Left Cheek

NHL-12, no MMC, GSM 850
2004-01-02
t(liq.)=20.3°C

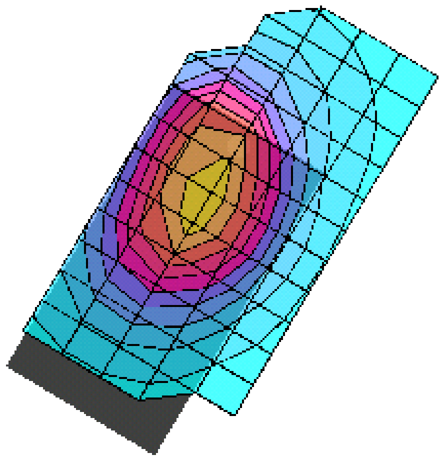
SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.03 mW/g, SAR (10g): 0.726 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.02 dB



Left Tilt

NHL-12, no MMC, GSM 850
2004-01-02
t(liq.)=20.3°C

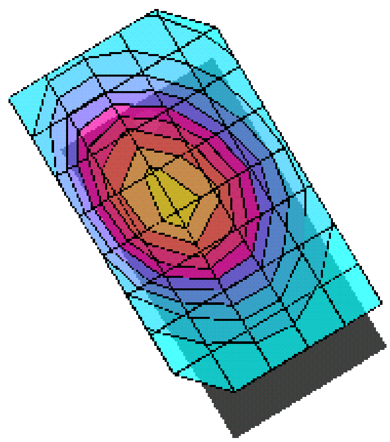
SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.713 mW/g, SAR (10g): 0.502 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.01 dB



Right cheek

NHL-12, no MMC, GSM 850
2004-01-02
t(liq.)=20.3°C

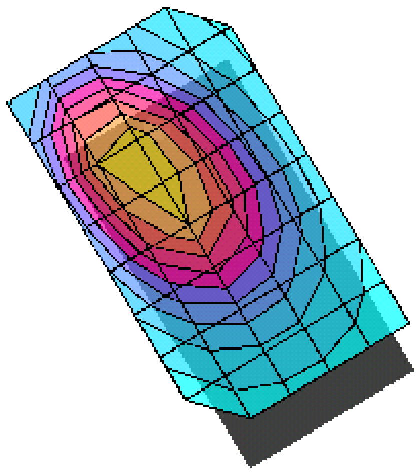
SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 849 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.01 mW/g, SAR (10g): 0.715 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.01 dB



Right tilt

NHL-12, no MMC, GSM 850
2004-01-02
t(liq.)=20.2°C

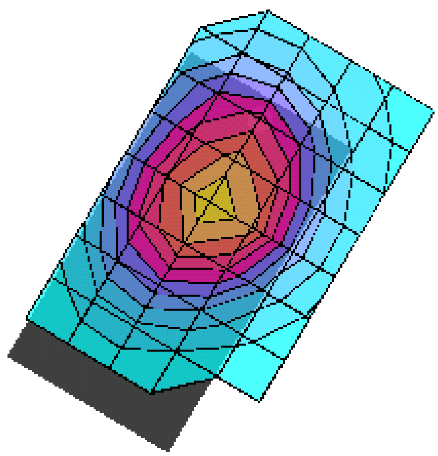
SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 41.5 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.717 mW/g, SAR (10g): 0.500 mW/g * Max outside, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.01 dB



Left cheek

NHL-12, with MMC, GSM 850
2004-01-05
t(liq.)=21.0°C

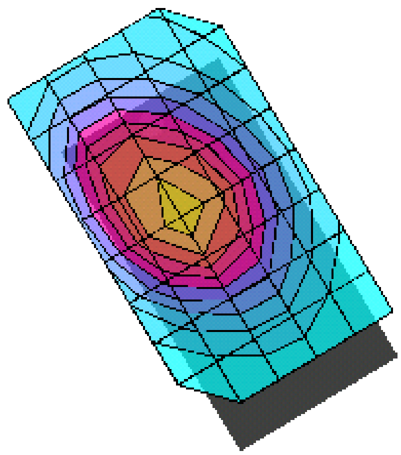
SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.05 mW/g, SAR (10g): 0.735 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.07 dB



Right cheek

NHL-12, with MMC, GSM 850
2004-01-05
t(liq.)=20.8°C

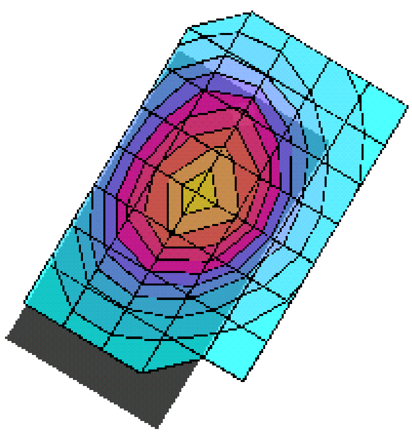
SAM 2 Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.01 mW/g, SAR (10g): 0.705 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.00 dB



Left cheek

NHL-12, with MMC, BT active, GSM 850
2004-01-05
t(liq.)=20.8°C

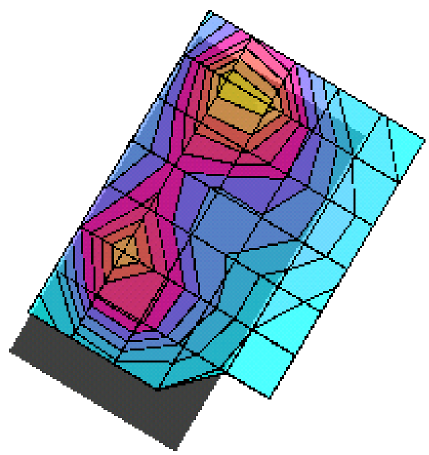
SAM 2 Phantom; Left Hand Section; Position: (90°,59°); Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.06 mW/g, SAR (10g): 0.741 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.02 dB



Left cheek

NHL-12, no MMC, GSM 1900
2004-01-08
t(liq.)=21.4°C

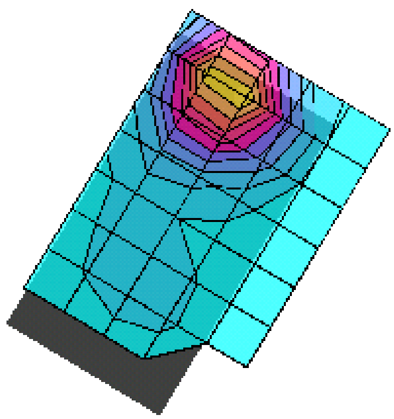
SAM Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.302 mW/g, SAR (10g): 0.172 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.13 dB



Left tilt

NHL-12, no MMC, GSM 1900
2004-01-08
t(liq.)=21.3°C

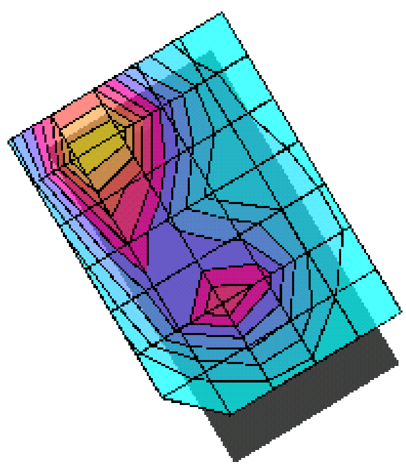
SAM Phantom; Left Hand Section; Position: (90°,59°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.409 mW/g, SAR (10g): 0.228 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB



Right cheek

NHL-12, no MMC, GSM 1900
2004-01-08
t(liq.)=21.0°C

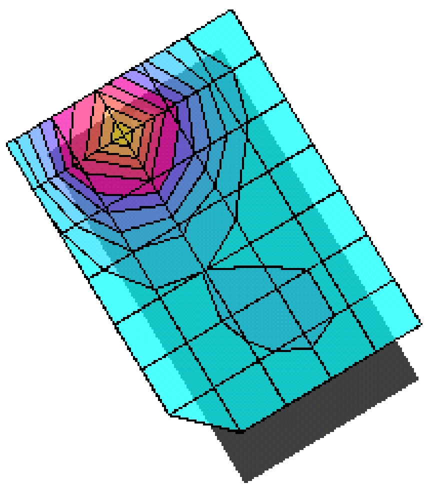
SAM Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.418 mW/g, SAR (10g): 0.228 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.13 dB



Right tilt

NHL-12, no MMC, GSM 1900
2004-01-08
t(liq.)=21.0°C

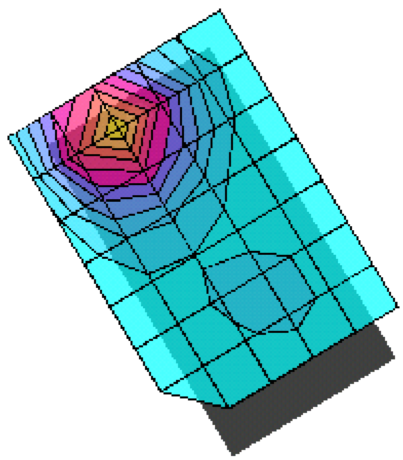
SAM Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.513 mW/g, SAR (10g): 0.282 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB



Right tilt

NHL-12, with MMC, GSM 1900
2004-01-08
t(liq.)=21.7°C

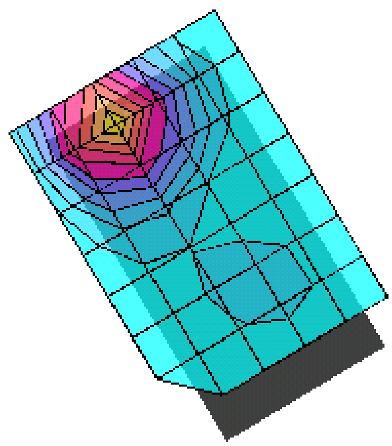
SAM Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.510 mW/g, SAR (10g): 0.281 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.05 dB



Right tilt

NHL-12, no MMC, BT active, GSM 1900
2004-01-08
t(liq.)=21.5°C

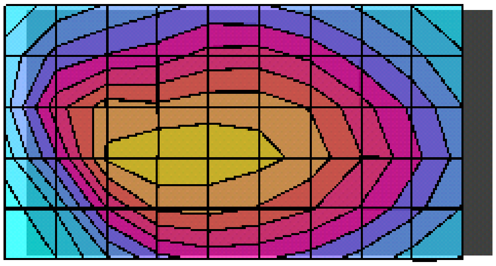
SAM Phantom; Righ Hand Section; Position: (90°,301°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.484 mW/g, SAR (10g): 0.264 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB



Body position

NHL-12, HS-5, no MMC, GPRS 850, 1-slot TX
2004-01-07
t(liq.)=21.0°C

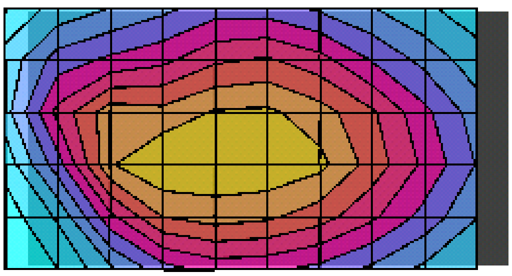
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 8.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.580 mW/g, SAR (10g): 0.401 mW/g * Max outside, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: 0.03 dB



Body position

NHL-12, HDS-3, no MMC, GPRS 850, 1-slot TX
2004-01-07
t(liq.)=20.5°C

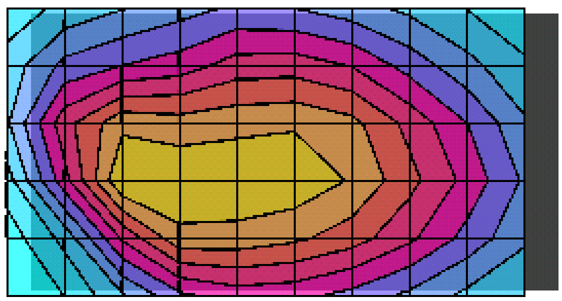
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 8.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.570 mW/g, SAR (10g): 0.405 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.04 dB



Body position

NHL-12, HS-5, with MMC, GPRS 850, 1-slot TX
2004-01-07
t(liq.)=20.5°C

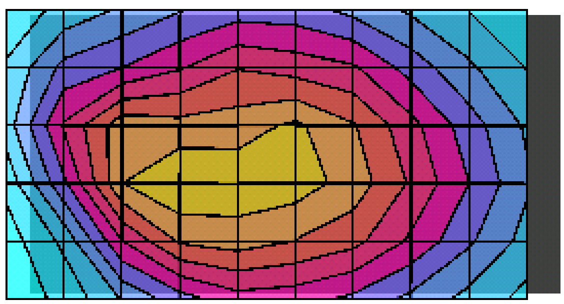
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 8.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.604 mW/g, SAR (10g): 0.408 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.03 dB



Body position

NHL-12, HS-5, with MMC, GPRS 850, 2-slot TX
2004-01-07
t(liq.)=20.3°C

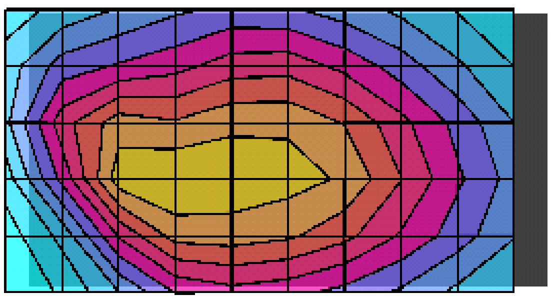
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 4.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.549 mW/g, SAR (10g): 0.396 mW/g * Max outside, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: 0.03 dB



Body position

NHL-12, HS-5, with MMC, BT active, GPRS 850, 1-slot TX
2004-01-07
t(liq.)=20.4°C

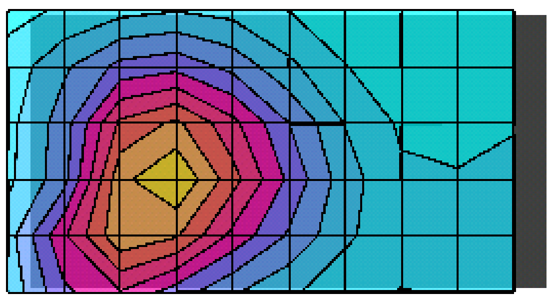
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 8.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.592 mW/g, SAR (10g): 0.408 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.04 dB



Body position

NHL-12, HS-5, no MMC, GPRS 1900, 1-slot TX
2004-01-12
t(liq.)=21.3°C

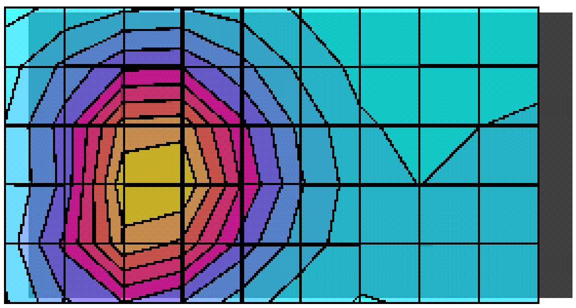
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 8.0; B0DY 1880 MHz: σ = 1.53 mho/m ϵ_r = 50.6 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.602 mW/g, SAR (10g): 0.354 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.07 dB



Body position

NHL-12, HS-5, no MMC, GPRS 1900, 2-slot TX
2004-01-12
t(liq.)=21.0°C

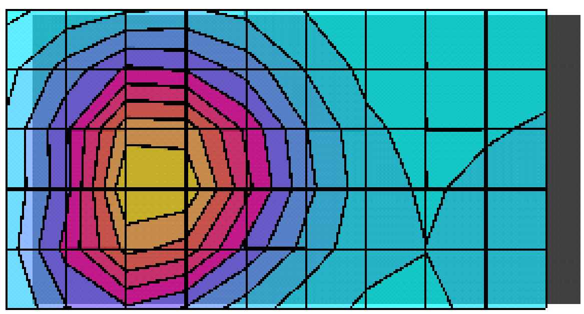
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; BODY 1880 MHz: σ = 1.53 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.19 mW/g, SAR (10g): 0.686 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.13 dB



Body position

NHL-12, HDS-3, no MMC, GPRS 1900, 2-slot TX
2004-01-12
t(liq.)=20.5°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 = 1.53 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.21 mW/g, SAR (10g): 0.709 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.20 dB

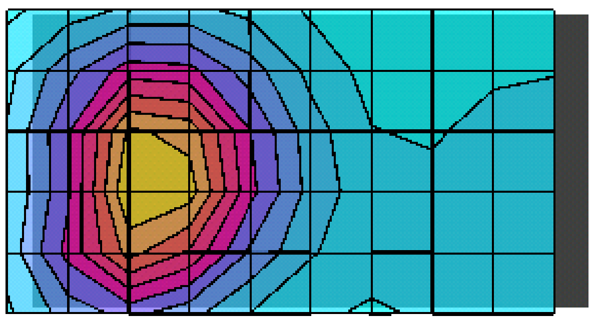


T117 (EN ISO/IEC 17025)

Body position

NHL-12, HDS-3, with MMC, GPRS 1900, 2-slot TX
2004-01-12
t(liq.)=20.4°C

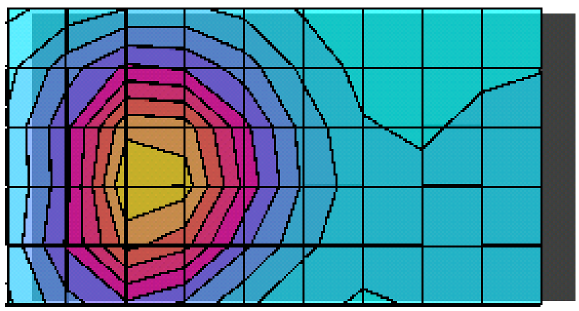
SAM 2 Phantom; Flat Section; Position: (270°,90°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1395; ConvF(4.90,4.90,4.90); Crest factor: 4.0; B0DY 1880 MHz: σ = 1.53 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.22 mW/g, SAR (10g): 0.698 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.14 dB



Body position

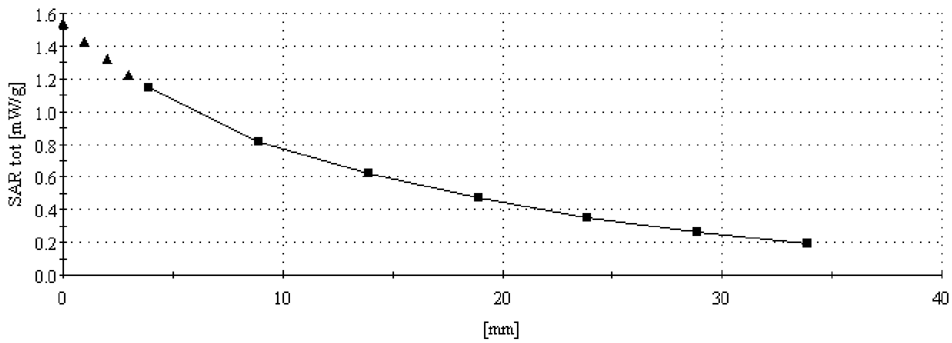
NHL-12, HDS-3, with MMC, BT active, GPRS 1900, 2-slot TX
2004-01-12
t(liq.)=20.2°C

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 = 1.53 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 1.15 mW/g, SAR (10g): 0.665 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 12.0
Powerdrift: -0.16 dB



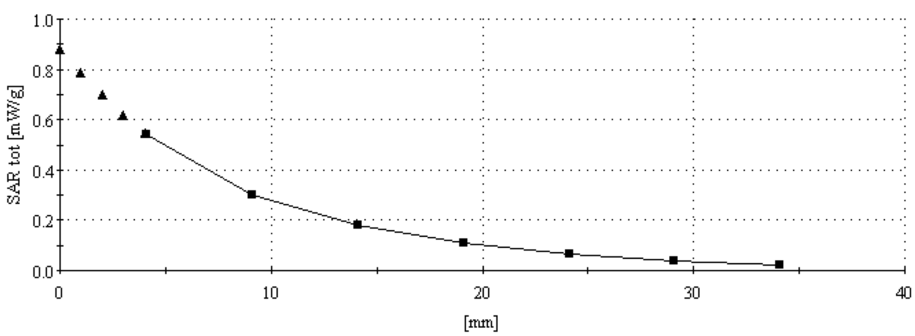
Z-PLOT corresponding Maximum Head SAR result / GSM 850:
Maximum point of
NHL-12, Leftt cheek, with MMC, BT active
2004-01-05
t(liq.)= 20.8°C

SAM 2 Phantom; Section; Position: ; Frequency: 836 MHz
Probe: ET3DV6 - SN1395; ConvF(6.30,6.30,6.30); Crest factor: 8.0; Brain 836 MHz: σ = 0.91 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



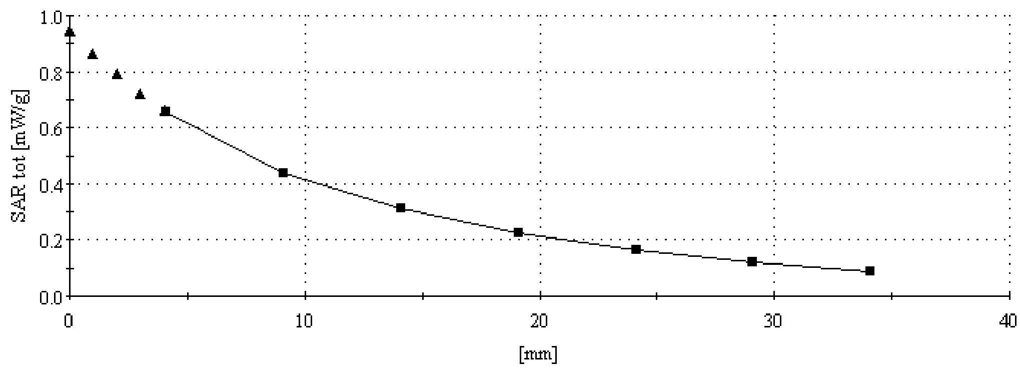
Z-PLOT corresponding Maximum Head SAR result / GSM 1900:
Maximum point of
NHL-12, Right tilt, no MMC
2004-01-08
t(liq.)= 21.0°C

SAM Phantom; Section; Position: ; Frequency: 1880 MHz
Probe: ET3DV6 - SN1395; ConvF(5.20,5.20,5.20); Crest factor: 8.0; Brain 1880 MHz: σ = 1.44 mho/m ε_r = 38.2 ρ = 1.00 g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



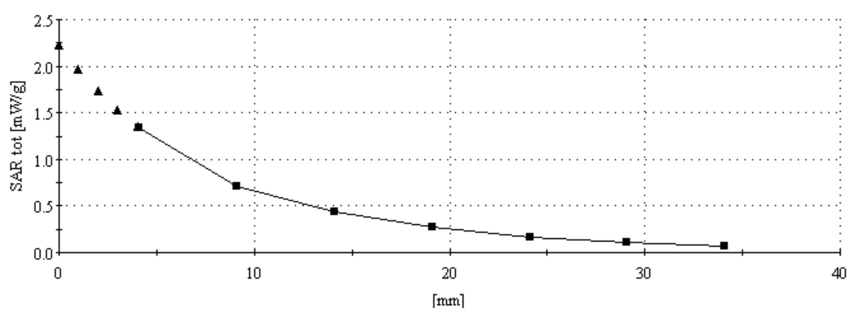
Z-PLOT corresponding Maximum Body SAR result / GSM 850:
Maximum point of
NHL-12, Body, HS-5, with MMC, 1-slot TX
2004-01-07
t(liq.)= 20.5°C

SAM 2 Phantom; Section; Position: ; Frequency: 824 MHz
Probe: ET3DV6 - SN1395; ConvF(6.20,6.20,6.20); Crest factor: 8.0; Body 836MHz: σ = 0.95 mho/m ε_r = 53.1 ρ = 1.00 g/cm^3
:, ()
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0



Z-PLOT corresponding Maximum Body SAR result / GSM 1900:
Maximum point of
NHL-12, Body, HDS-3, with MMC, 2-slot TX
2004-01-12
t(liq.)= 20.4°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 = 1.53 mho/m ε_r = 50.6 ρ = 1.00 g/cm^3
:, ()
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-05
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.

880-KP0301061-A Page 1 (1)

ET3DV6 SN:1395 August 28, 2003

DASY - Parameters of Probe: ET3DV6 SN:1395

Sensitivity in Free Space

NormX	1.71	$\mu V/(V/m)^2$
NormY	1.74	$\mu V/(V/m)^2$
NormZ	1.66	$\mu V/(V/m)^2$

Diode Compression

DCP X	94	mV
DCP Y	94	mV
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**

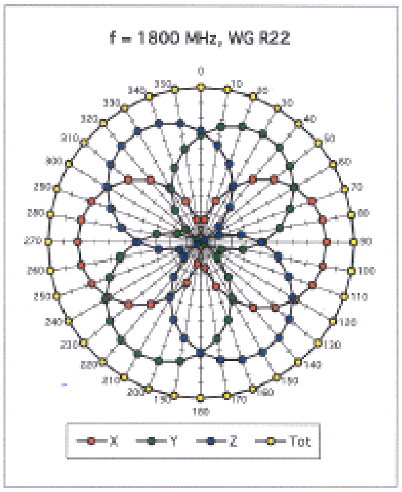
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	14.5	9.4
SAR_{be} [%]	With Correction Algorithm	0.1	0.1

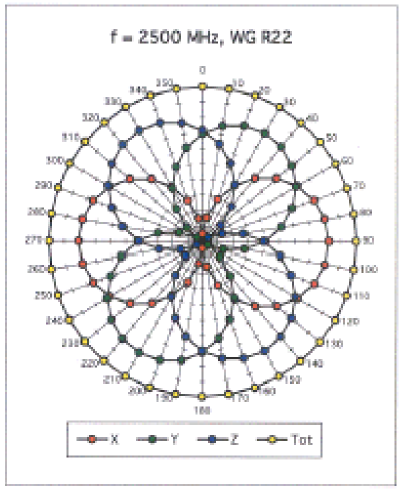
Sensor Offset

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

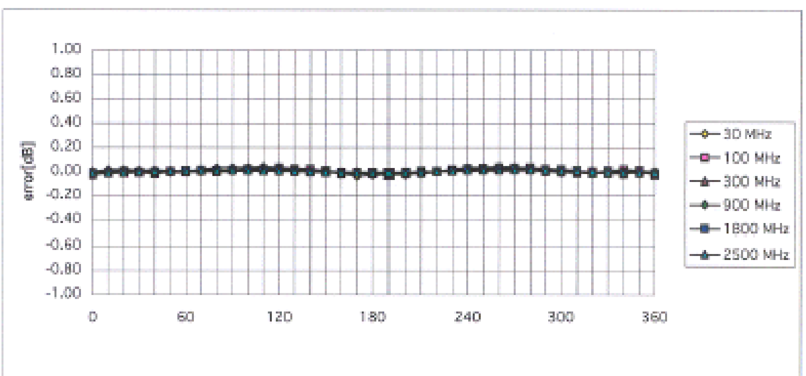
Page 2 of 9

ET3DV6 SN:1395 August 28, 2003



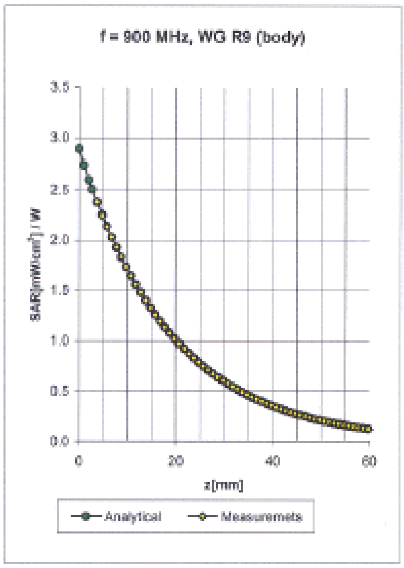


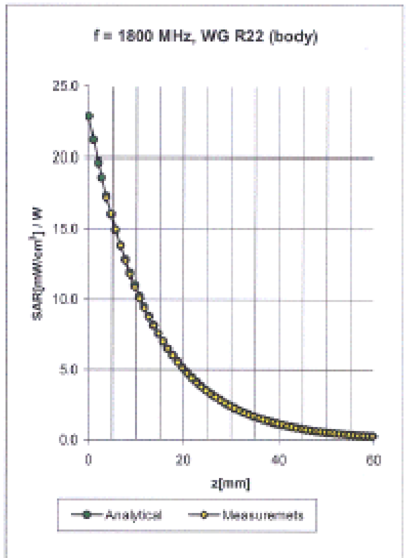
Isotropy Error (φ), θ = 0°



Page 4 of 9

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

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

835 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

Calibration Certificate

835 MHz System Validation Dipole

Type:	**D835V2**
Serial Number:	**462**
Place of Calibration:	**Zurich**
Date of Calibration:	**July 1, 2002**
Calibration Interval:	**24 months**

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

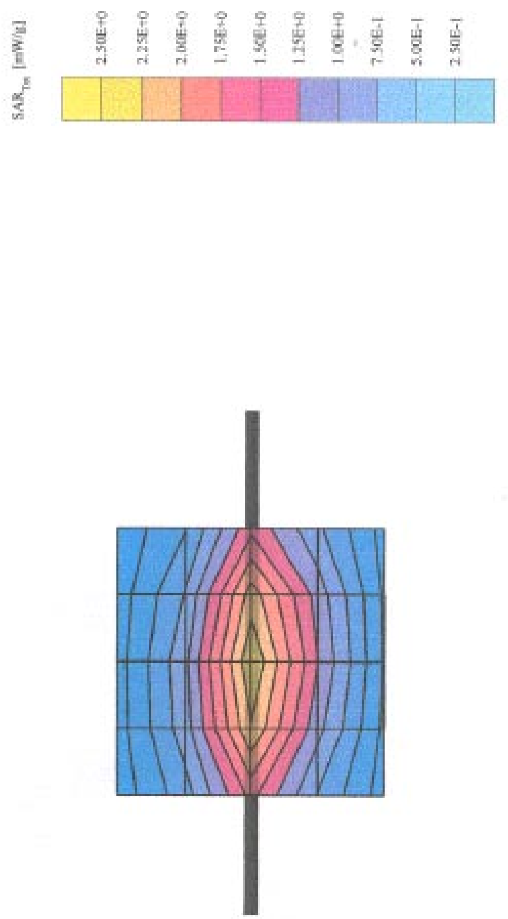
Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	
Approved by:	

07/01/02

Validation Dipole D835V2 SN462, d = 15 mm

Frequency: 835 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(6.60,6.60,6.60) at 835 MHz; IEEE1528 835 MHz: σ = 0.90 mho/m ε_r = 42.5 ρ = 1.00 g/cm³
Cubes (2): Peak: 3.82 mW/g ± 0.02 dB, SAR (1g): 2.45 mW/g ± 0.02 dB, SAR (10g): 1.58 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 12.2 (11.2, 13.5) [mm]
Powerdrift: -0.00 dB



835 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)	D835V2 - SN:462
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	January 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 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	N. Vetterli
Approved by:	Katja Pokovic	Laboratory Director	Pokovic Katja

Date issued: January 10, 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.

880-KP0301061-A

Page 1 (1)

Date/Time: 01/08/03 14:26:58

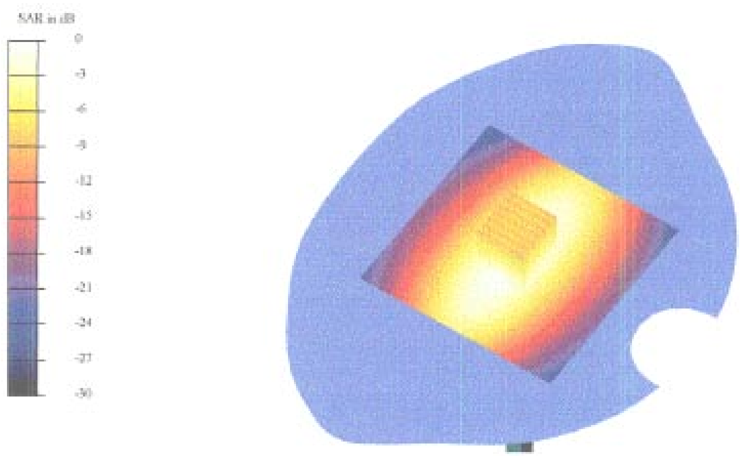
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN462_SN1507_M835_080103.da4

DUT: Dipole 835 MHz Type & Serial Number: D835V2 - SN462
Program: Dipole Calibration; Pin = 250 mW; d = 15 mm

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: Muscle 835 MHz (σ = 0.96 mho/m, ε = 55.47, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(6.2, 6.2, 6.2); 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 = 56 V/m
Peak SAR = 3.45 mW/g
SAR(1 g) = 2.48 mW/g; *SAR(10 g)* = 1.63 mW/g
Power Drift = -0.003 dB



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

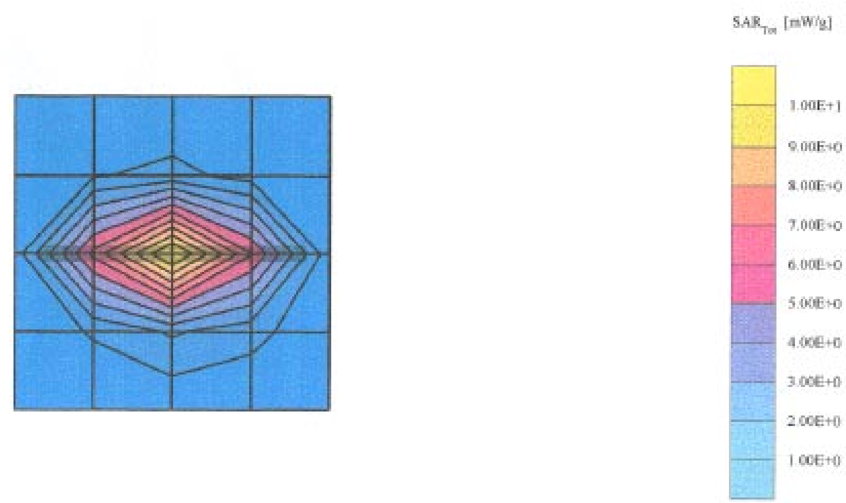
Serial: 5d013

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 = 39.8 ρ = 1.00 g/cm³
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	D. Vetter
Approved by:	Katja Pokovic	Laboratory Director	Pokovic Katja

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.

880-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_r = 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