TCC

Test & Certification Center (TCC) – Dallas

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SAR Compliance Test Report

Test report no.:	WR206.002	Date of report:	30-Apr-04
Template version:	2	Number of pages:	16
Testing laboratory:	Test & Certification Center (TCC) Dallas Nokia Mobile Phones 6021 Connection Drive Irving, TX 75039, USA Tel. +1 972 894 5000 Fax. +1 972 894 4988	Client:	Nokia Inc. 12278 Scripps Summit Drive San Diego, CA 92131, USA Tel. +1 858 831 5000 Fax. +1 858 831 6500
Responsible test engineer:	J. Torres	Product contact person:	J. Goertz
Measurements made by:			
Tested device:	RH-57		
FCC ID:	QMNRH-57	IC:	Not Applicable
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 Dallas.

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: 30-Apr-04

For the contents:

Nerina Walton
Lab Manager

Jesse Torres
Test Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	20-Apr-04 to 21-Apr-04
SN, HW and SW numbers of tested device	SN: 044/00152820 HW: 3001 SW: 0100b03
Batteries used in testing	BL-5C
Headsets used in testing	HS-5, HS-2R
Other accessories used in testing	-
State of sample	Prototype Type 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)	Conducted power	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
CDMA 800	1013 / 824.7	25.2 dBm	Right Cheek	1.6 W/kg	1.26 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	Conducted power	Separation distance	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
CDMA 800	384 / 836.52	25.5 dBm	1.5 cm	1.6 W/kg	1.13 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	-0.16 dB

1.2.4 Measurement Uncertainty

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

2. DESCRIPTION OF THE DEVICE UNDER TEST

Device category	Portable
Exposure environment	Uncontrolled Exposure

Modes and Bands of Operation	CDMA 800
Modulation Mode	QPSK
Duty Cycle	1
Transmitter Frequency Range (MHz)	824.73 – 848.31

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:	20-Apr-04 to 21-Apr-04
Ambient temperature (°C):	21 to 23
Ambient humidity (RH %):	41 to 54

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.

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	377	12 months	12/2004
E-field Probe ET3DV6	1504	12 months	12/2004
Dipole Validation Kit, D835V2	486	24 months	05/2005

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	Agilent 8648C	3836A04346	12 months	06/2004
Amplifier	Amplifier Research 5S1G4	25583	-	-
Power Meter	Boonton 4232A	26001	12 months	08/2004
Power Sensor	Boonton 51015	31143	12 months	08/2004
Power Sensor	Boonton 51015	31144	12 months	08/2004
Call Tester	Anritsu MT8802A	MT26889	12 months	10/2004
Vector Network Analyzer	Agilent 8720D	US38431353	12 months	07/2004
Dielectric Probe Kit	Agilent 85070C	US99360172	-	-

4.1.1 Isotropic E-field Probe 1504

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:

800MHz band

Ingredient	Head (% by weight)	Body (% by weight)
Deionised Water	51.07	65.45
HEC	0.23	-
Sugar	47.31	34.31
Preservative	0.24	0.10
Salt	1.15	0.62

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 stimulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
835	Reference result	2.45	42.8	0.89	N/A
	± 10% window	2.21 – 2.70			
	20-Apr-04	2.43	40.9	0.89	21.2

System verification, body tissue stimulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
835	Reference result	2.47	55.0	0.98	N/A
	± 10% window	2.22 – 2.72			
	20-Apr-04	2.40	54.3	0.95	21.1
	21-Apr-04	2.40	54.2	0.95	21.3

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]	
836.5	Recommended value	41.5	0.90	N/A
	± 5% window	39.4 – 43.6	0.86 – 0.95	
	20-Apr-04	40.9	0.89	21.2

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
836.5	Recommended value	55.2	0.97	N/A
	± 5% window	52.4 – 58.0	0.92 – 1.02	
	20-Apr-04	54.3	0.95	21.1
	21-Apr-04	54.2	0.95	21.3

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”.

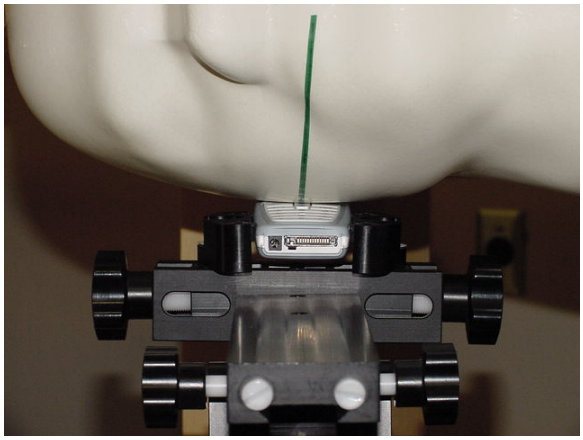


Photo of the device in “cheek” position

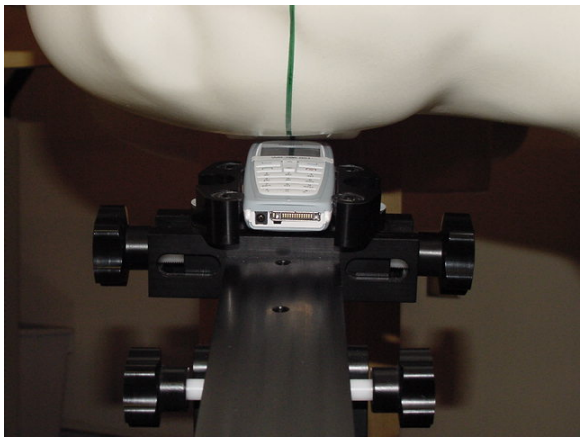


Photo of the device in “tilt” position

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.

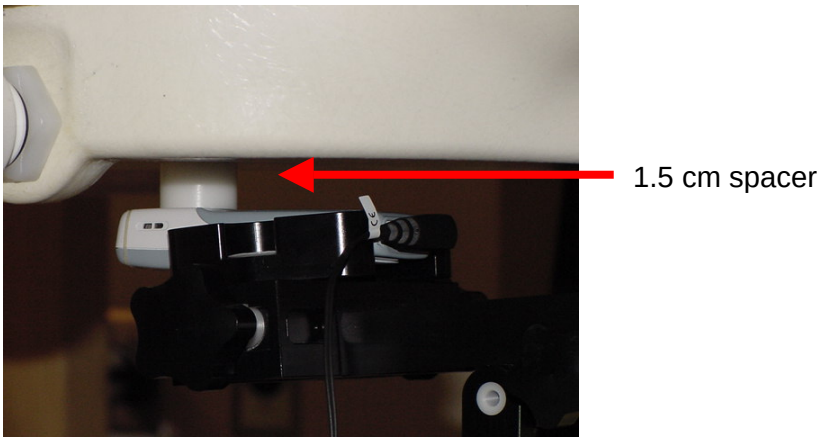


Photo of the device positioned for Body SAR measurement.

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 32x32x30 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 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	Section in IEEE 1528	Tol. (%)	Prob Dist	Div	c_i	$c_i . u_i$ (%)	v_i
Measurement System							
Probe Calibration	E2.1	±4.8	N	1	1	±4.8	∞
Axial Isotropy	E2.2	±4.7	R	√3	$(1-c_p)^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$(c_p)^{1/2}$	±3.9	∞
Boundary Effect	E2.3	±8.3	R	√3	1	±4.8	∞
Linearity	E2.4	±4.7	R	√3	1	±2.7	∞
System Detection Limits	E2.5	±1.0	R	√3	1	±0.6	∞
Readout Electronics	E2.6	±1.0	N	1	1	±1.0	∞
Response Time	E2.7	±0.8	R	√3	1	±0.5	∞
Integration Time	E2.8	±2.6	R	√3	1	±1.5	∞
RF Ambient Conditions - Noise	E6.1	±3.0	R	√3	1	±1.7	∞
RF Ambient Conditions - Reflections	E6.1	±3.0	R	√3	1	±1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	±0.4	R	√3	1	±0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	±2.9	R	√3	1	±1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	±3.9	R	√3	1	±2.3	∞
Test sample Related							
Test Sample Positioning	E4.2.1	±6.0	N	1	1	±6.0	11
Device Holder Uncertainty	E4.1.1	±5.0	N	1	1	±5.0	7
Output Power Variation - SAR drift measurement	6.6.3	±10.0	R	√3	1	±5.8	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	±4.0	R	√3	1	±2.3	∞
Liquid Conductivity Target - tolerance	E3.2	±5.0	R	√3	0.64	±1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	±5.5	N	1	0.64	±3.5	5
Liquid Permittivity Target tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			**±14.5**	187
Coverage Factor for 95%			**k=2**				
Expanded Standard Uncertainty						**±29.1**	

7. RESULTS

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

CDMA 800 Head SAR results

Position		SAR, averaged over 1g (W/kg)		
		Ch 1013 824.70 MHz	Ch 384 836.52 MHz	Ch 777 848.31 MHz
Power level		25.2 dBm	25.5 dBm	24.2 dBm
Left	Cheek	1.17	1.24	1.14
	Tilt	0.58	0.48	0.63
Right	Cheek	**1.26**	1.21	1.22
	Tilt	0.64	0.55	0.71

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

CDMA 800 Body SAR results

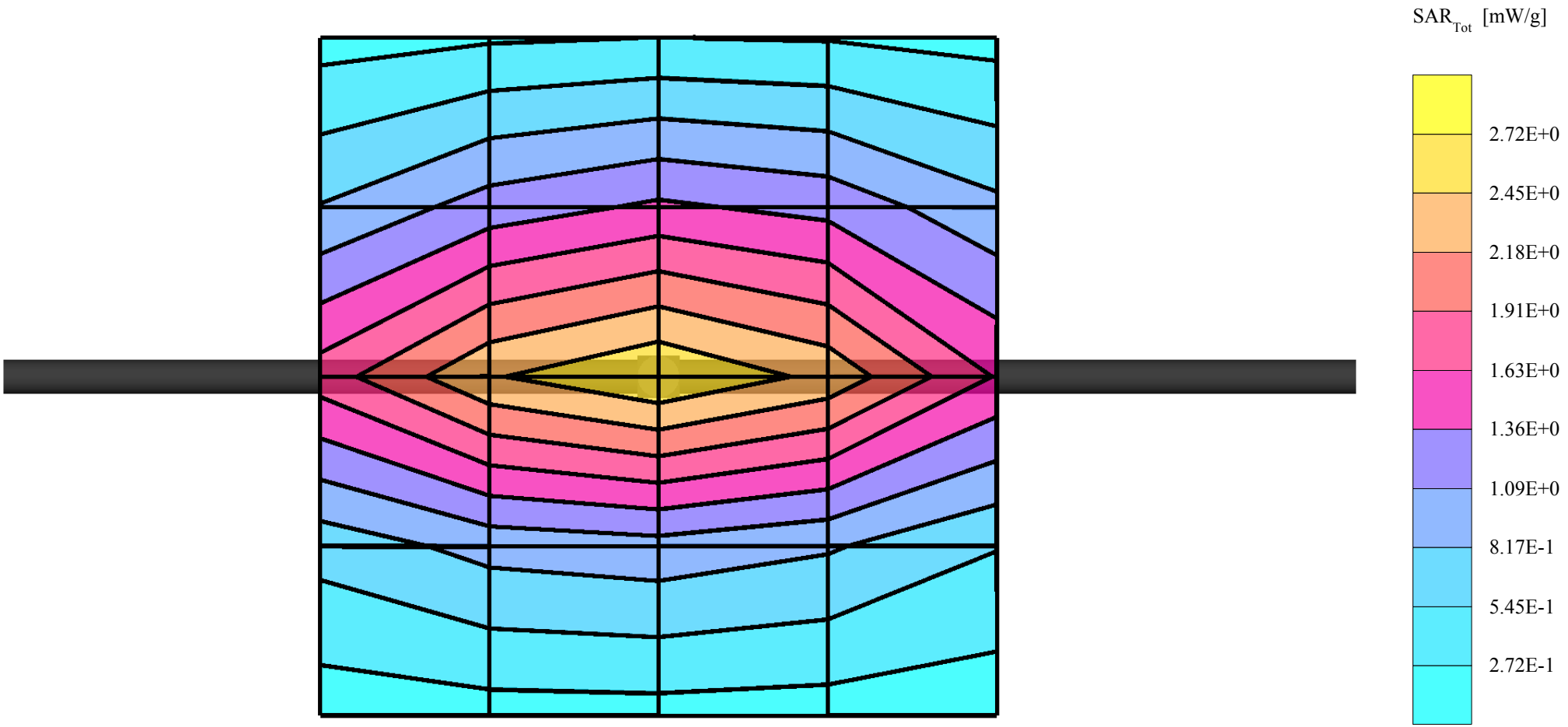
Body-worn location setup	SAR, averaged over 1g (W/kg)		
	Ch 1013 824.70 MHz	Ch 384 836.52 MHz	Ch 777 848.31 MHz
Power level	25.2 dBm	25.5 dBm	24.2 dBm
HS-2R Headset	1.06	1.06	0.69
HS-5 Headset	0.76	**1.13**	0.72

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

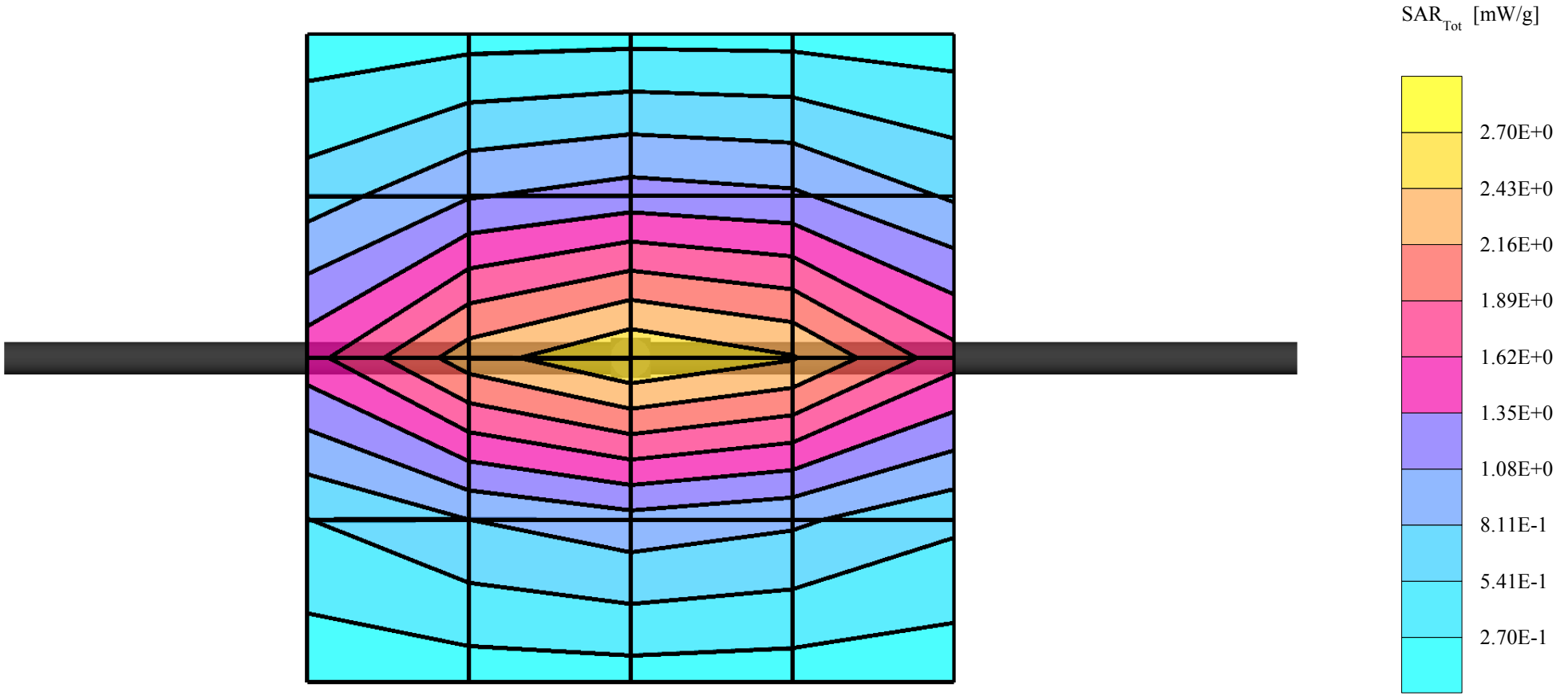
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cubes (2): SAR (1g): 2.43 mW/g ± 0.09 dB, SAR (10g): 1.60 mW/g ± 0.10 dB, (Advanced extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.16 dB
Liquid Temperature (°C): 21.2



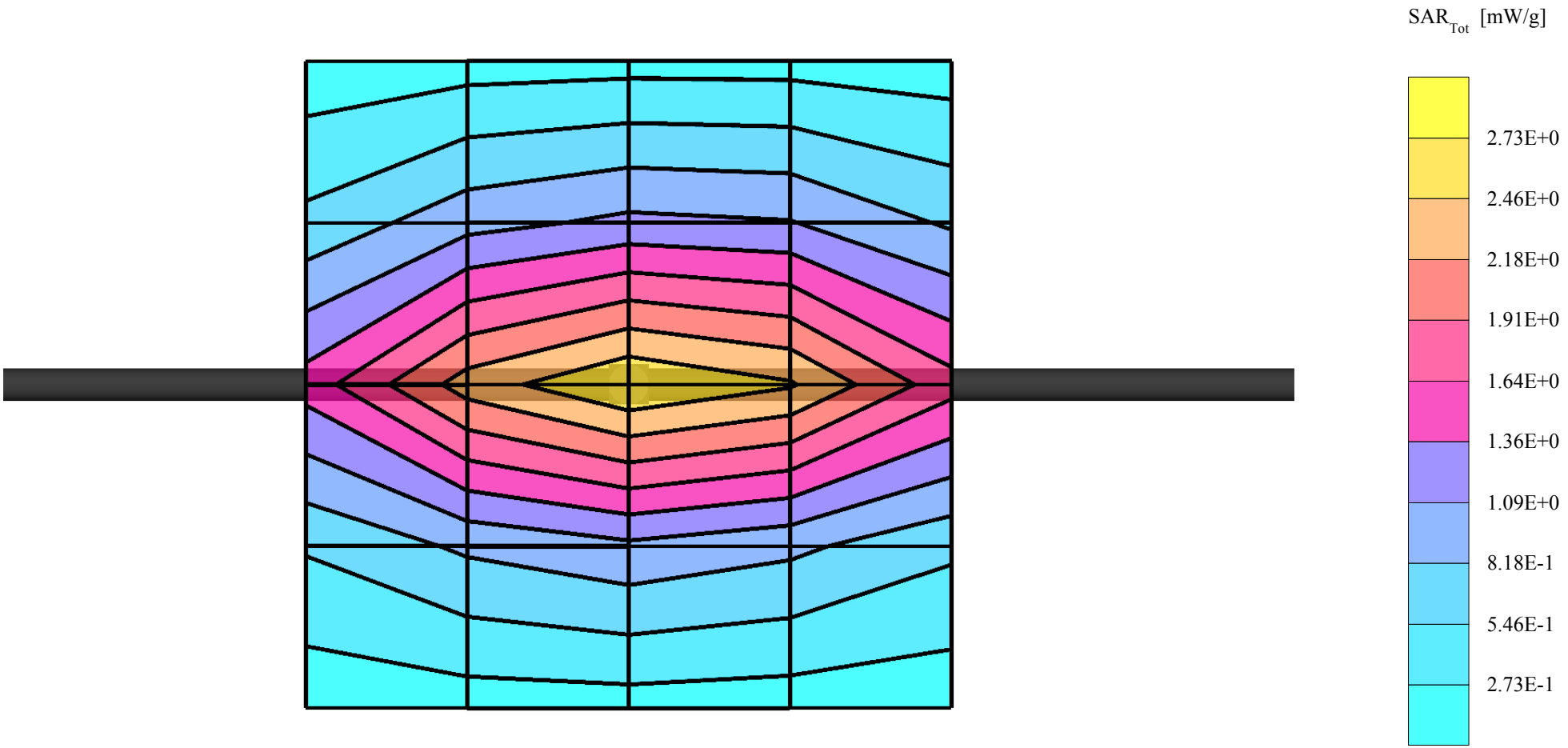
Dipole 835 MHz, Body Validation

SAM 2 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: σ = 0.95 mho/m ε_r = 54.3 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cubes (2): Peak: 3.49 mW/g ± 0.10 dB, SAR (1g): 2.40 mW/g ± 0.09 dB, SAR (10g): 1.60 mW/g ± 0.09 dB, (Advanced extrapolation)
Penetration depth: 13.8 (13.5, 14.4) [mm]
Powerdrift: -0.13 dB
Liquid Temperature (°C): 21.1



Dipole 835 MHz, Body Validation

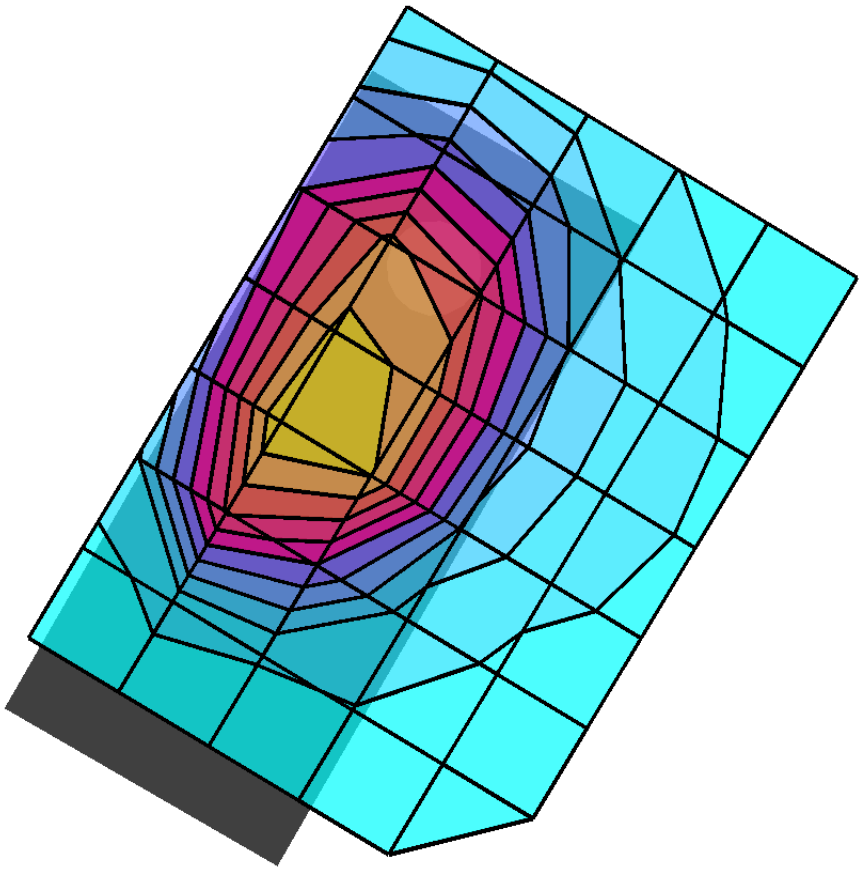
SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: $\sigma = 0.95$ mho/m $\varepsilon_r = 54.2$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cubes (2): SAR (1g): 2.40 mW/g ± 0.08 dB, SAR (10g): 1.60 mW/g ± 0.09 dB, (Advanced extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.17 dB
Liquid Temperature (°C): 21.3

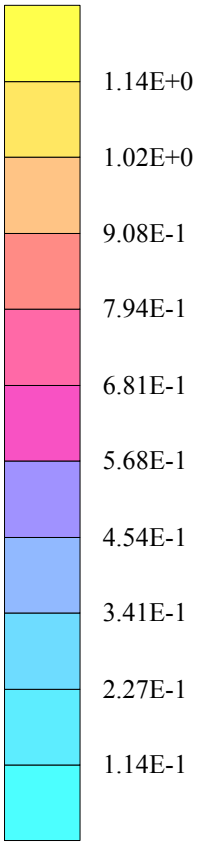


APPENDIX B: MEASUREMENT SCANS

RH-57, CDMA 800, Channel 384, Left Cheek Position with BL-5C Battery

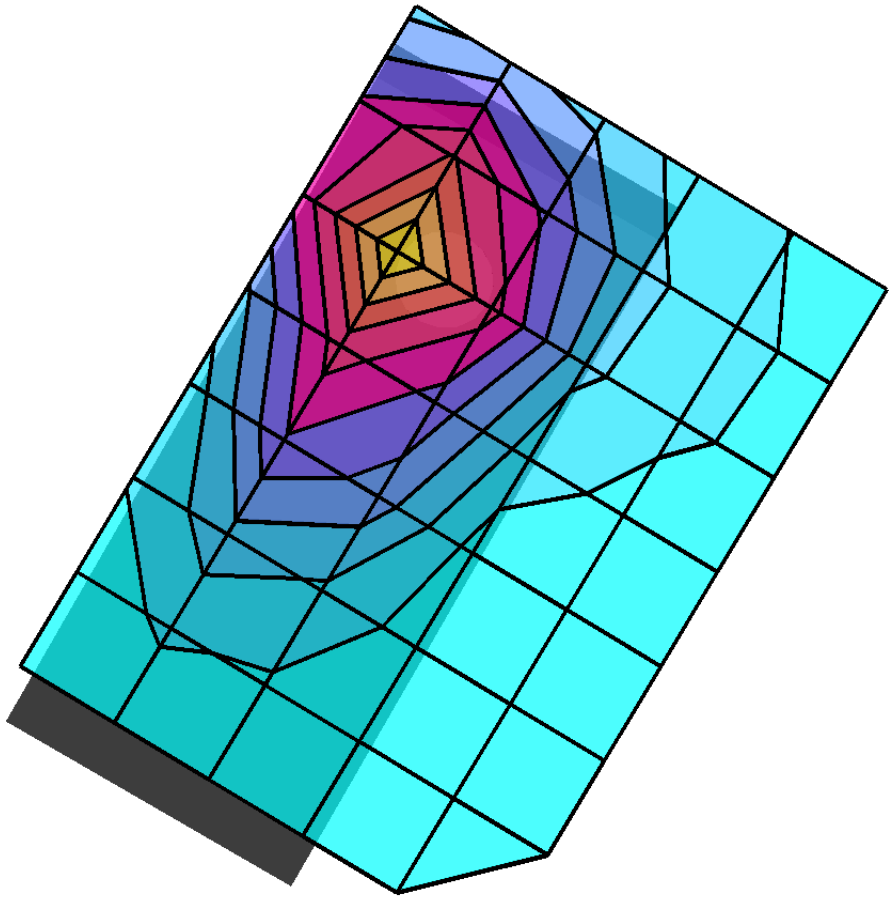
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 1.24 mW/g, SAR (10g): 0.773 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.12 dB
Liquid Temperature (°C): 21.2

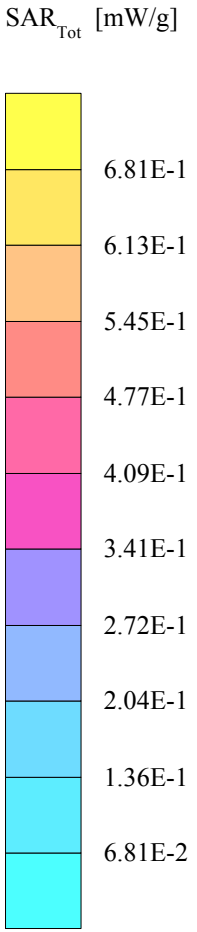




RH-57, CDMA 800, Channel 777, Left Tilt Position with BL-5C Battery

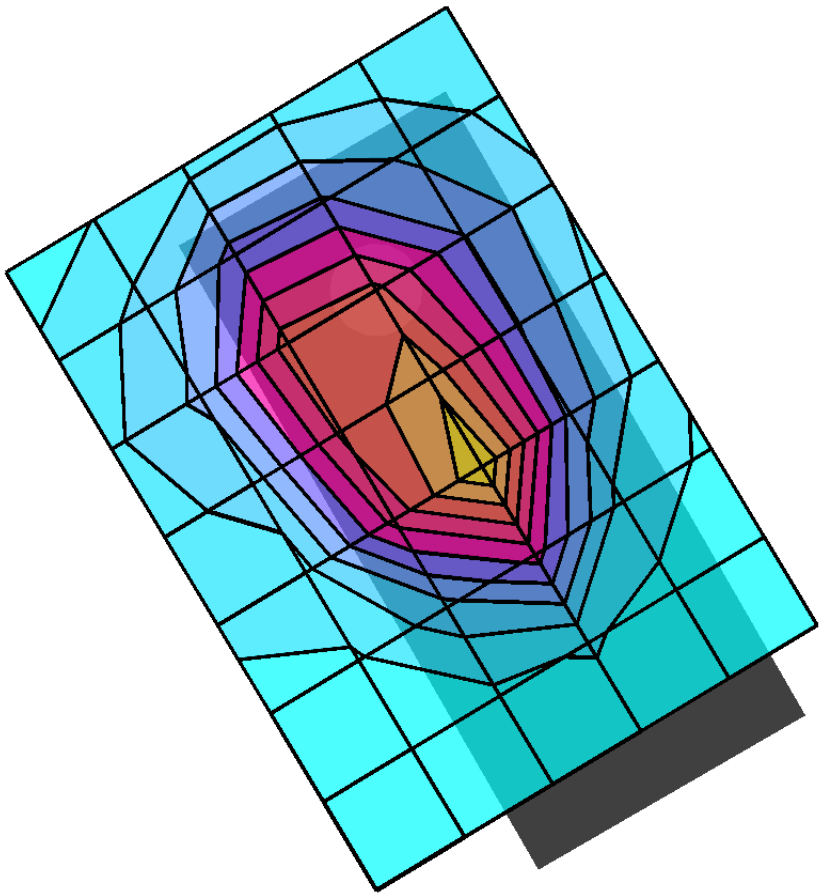
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 848 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 0.625 mW/g, SAR (10g): 0.367 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.12 dB
Liquid Temperature (°C): 21.2

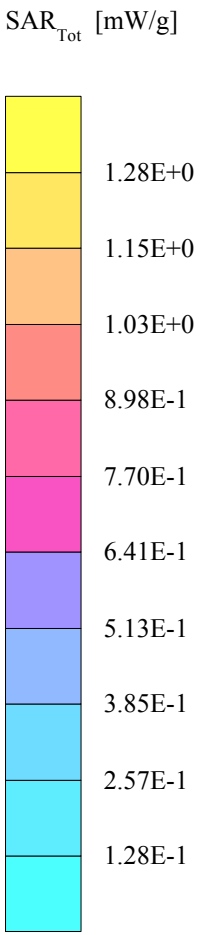




RH-57, CDMA 800, Channel 1013, Right Cheek Position with BL-5C Battery

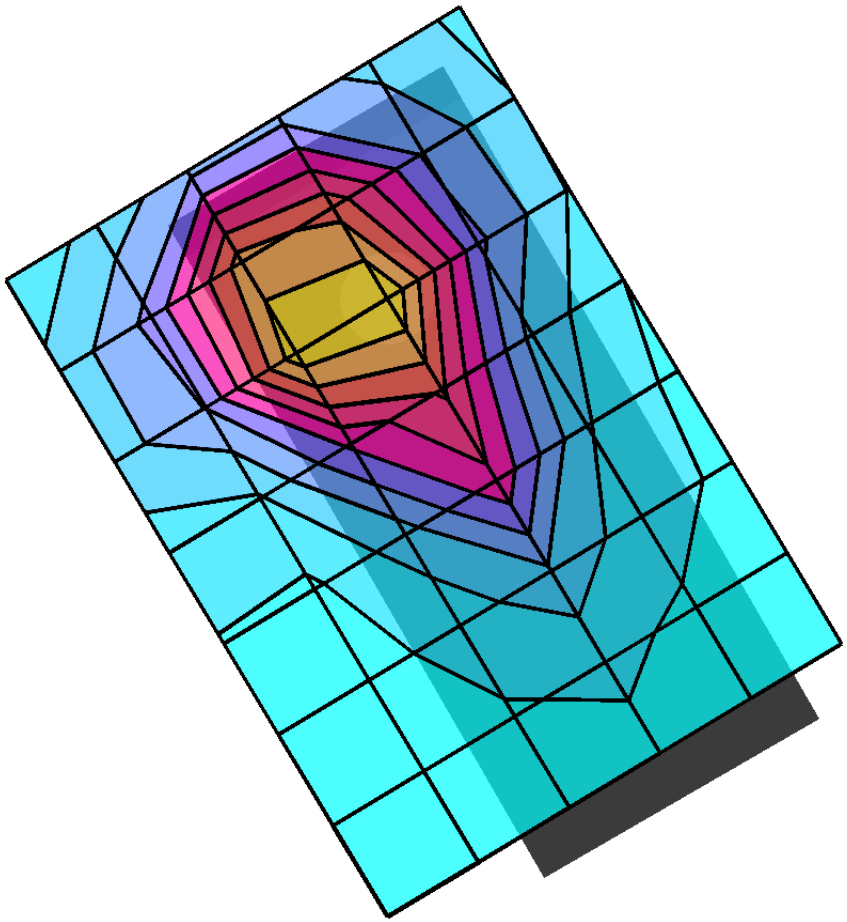
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 825 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 1.26 mW/g, SAR (10g): 0.770 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.13 dB
Liquid Temperature (°C): 21.2

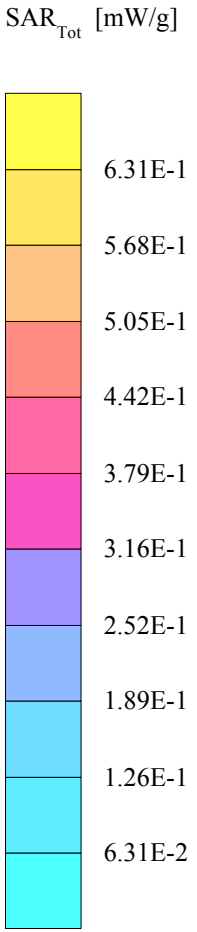




RH-57, CDMA 800, Channel 777, Right Tilt Position with BL-5C Battery

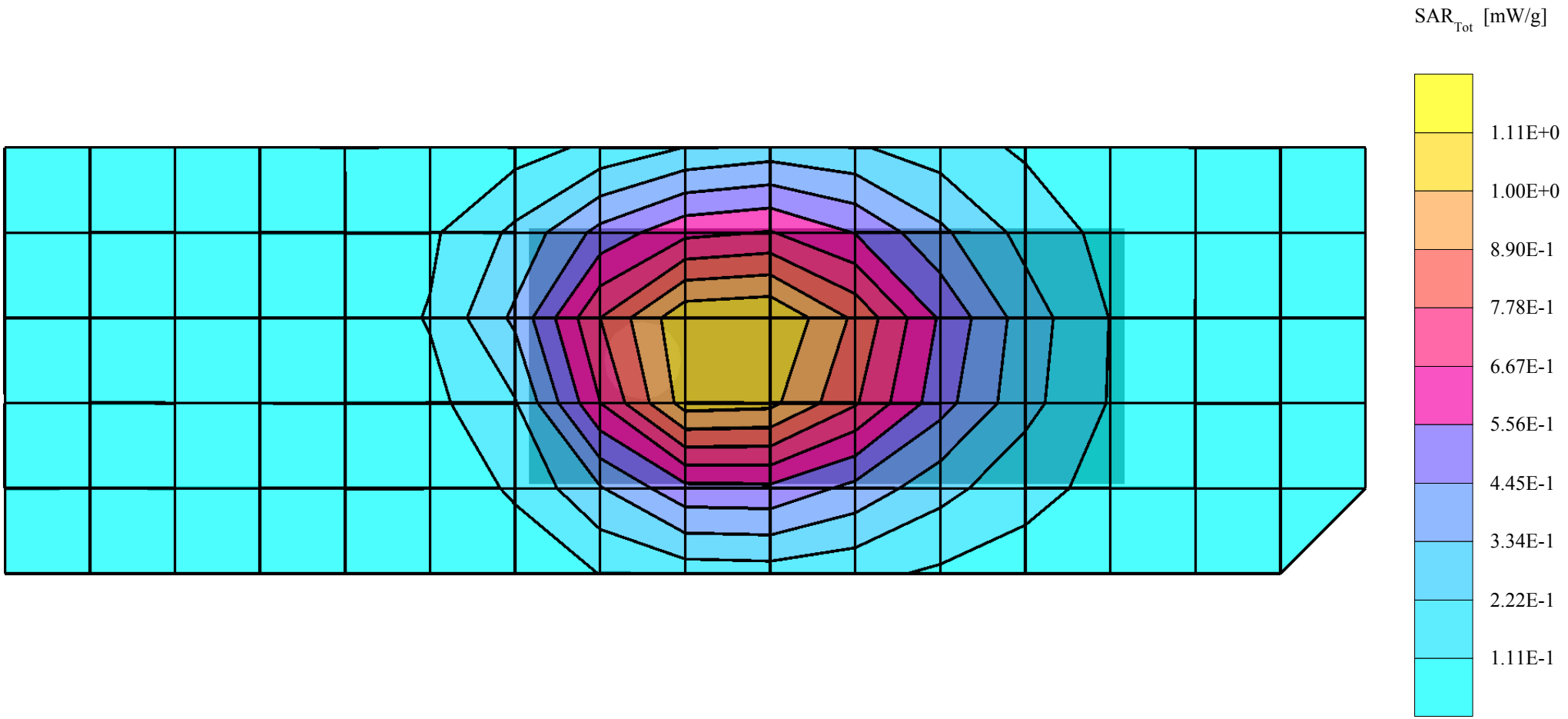
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 848 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 0.711 mW/g, SAR (10g): 0.401 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.13 dB
Liquid Temperature (°C): 21.2





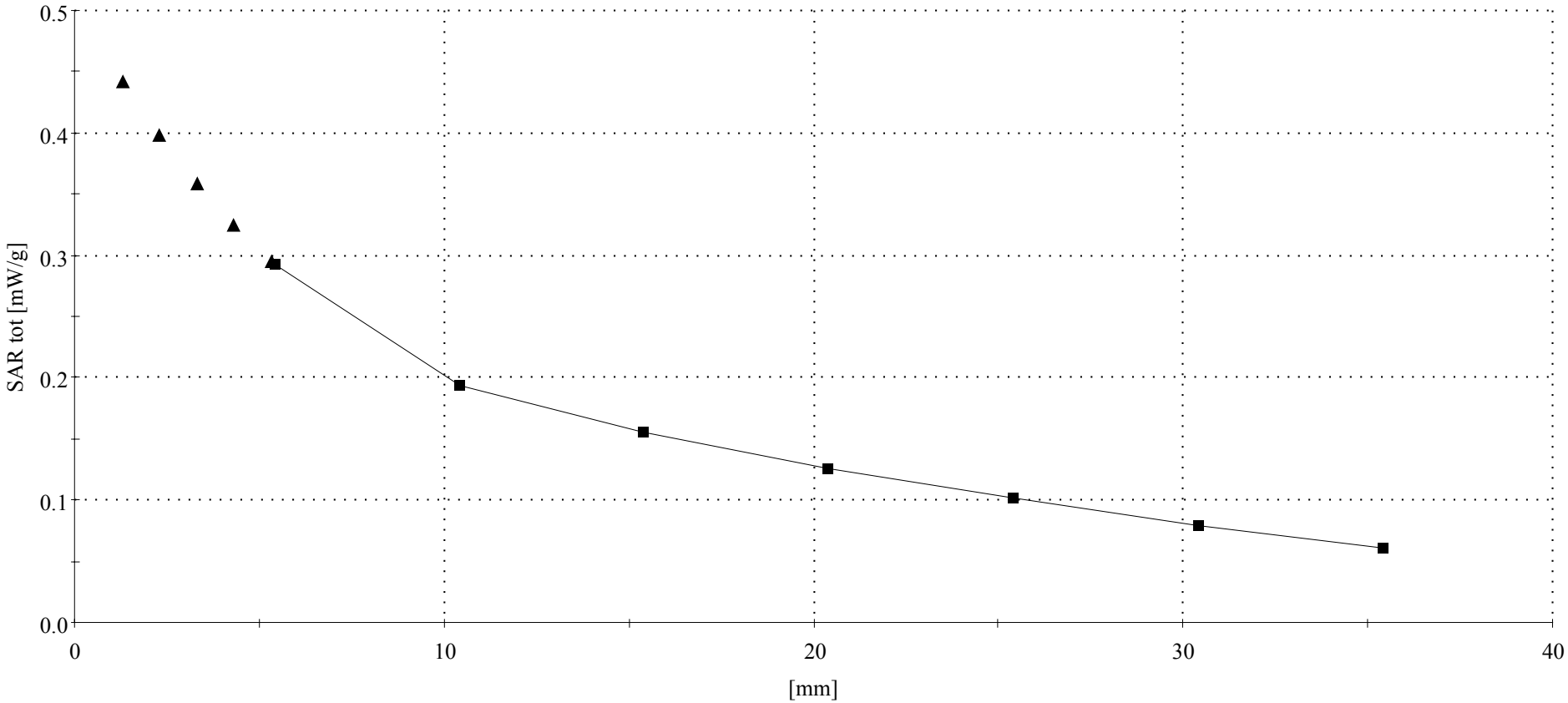
RH-57, CDMA 800, Channel 384, Flat Position with 1.5cm Spacing, BL-5C Battery and HS-5 Headset

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.95 mho/m ε_r = 54.3 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 1.13 mW/g, SAR (10g): 0.779 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: -0.08 dB
Liquid Temperature (°C):



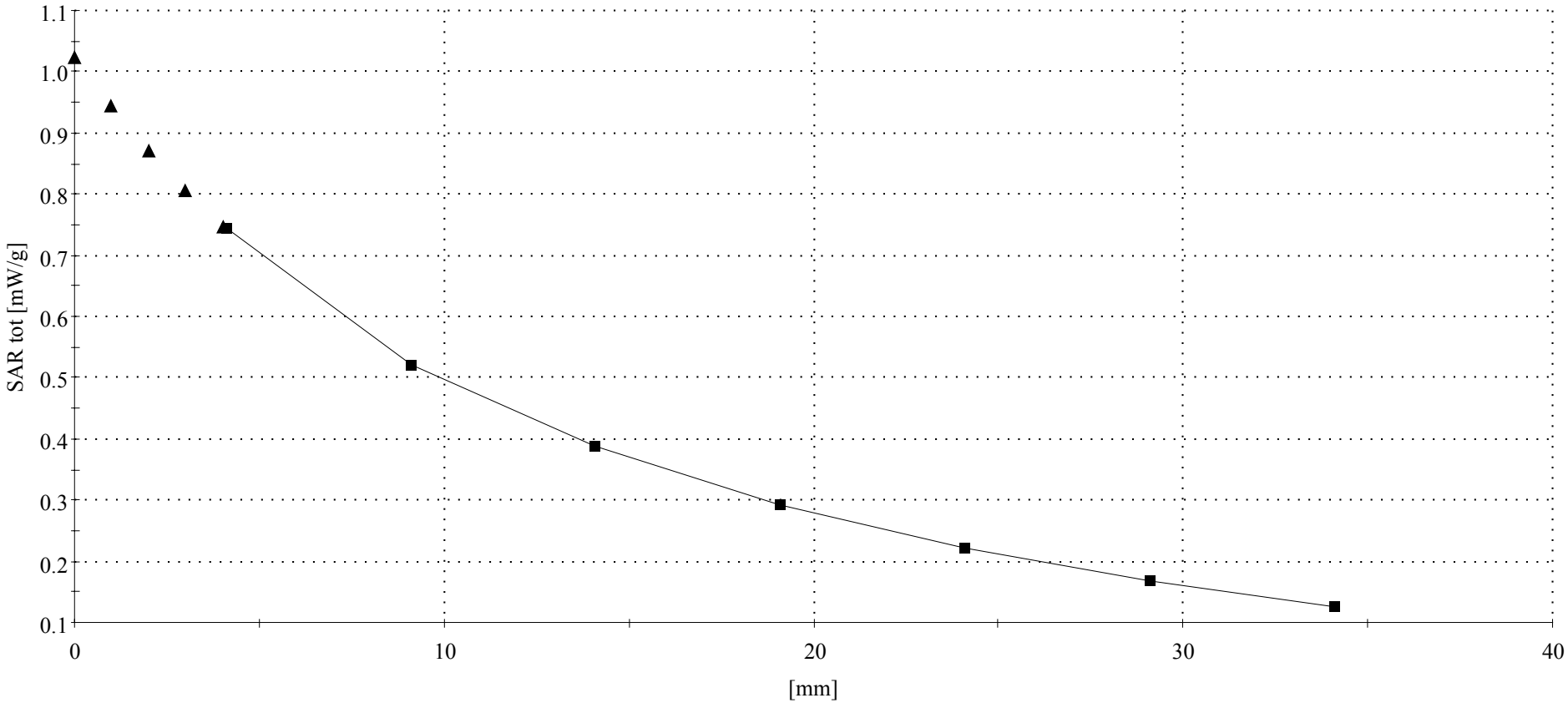
RH-57, CDMA 800, Channel 1013, Right Cheek Positon with BL-5C Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 825 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 1.26 mW/g, SAR (10g): 0.770 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 21.2



RH-57, CDMA 800, Channel 384, Flat Position with 1.5cm Spacing, BL-5C Battery and HS-5 Headset

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.95 mho/m ε_r = 54.3 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.20,6.20,6.20)
Cube 5x5x7: SAR (1g): 1.13 mW/g, SAR (10g): 0.779 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C):



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

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

Client **Nokia Inc. TX**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1504
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	December 18, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

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

Date issued: December 18, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

DASY - Parameters of Probe: ET3DV6 SN:1504

Sensitivity in Free Space

Diode Compression

NormX	**2.20**	$\mu V/(V/m)^2$	DCP X	**93**	mV
NormY	**1.86**	$\mu V/(V/m)^2$	DCP Y	**93**	mV
NormZ	**1.75**	$\mu V/(V/m)^2$	DCP Z	**93**	mV

Sensitivity in Tissue Simulating Liquid

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

Valid for f=750-950 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**6.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.2**	± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.2**	± 9.5% (k=2)	Depth	**2.67**

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

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

ConvF X	**5.0**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0**	± 9.5% (k=2)	Alpha	**0.53**
ConvF Z	**5.0**	± 9.5% (k=2)	Depth	**2.49**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	10.1	5.8
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

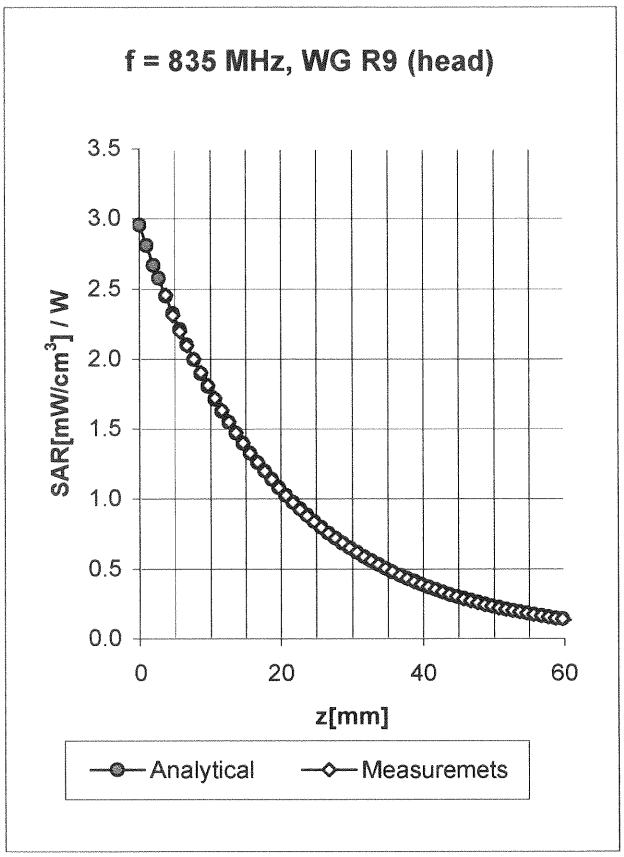
Head **1880 MHz** **Typical SAR gradient: 10 % per mm**

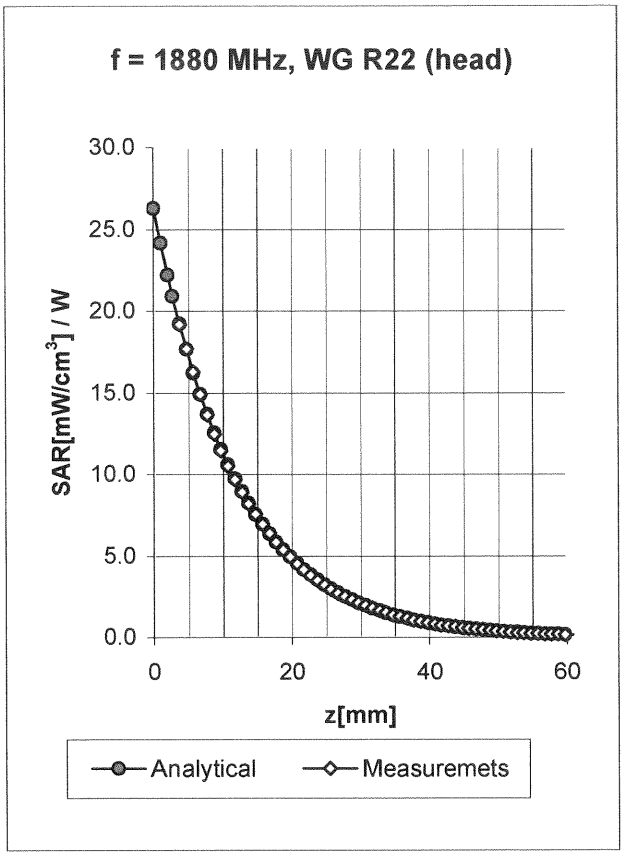
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	13.4	8.9
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.4 ± 0.2**	mm

Conversion Factor Assessment





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

Valid for f=750-950 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

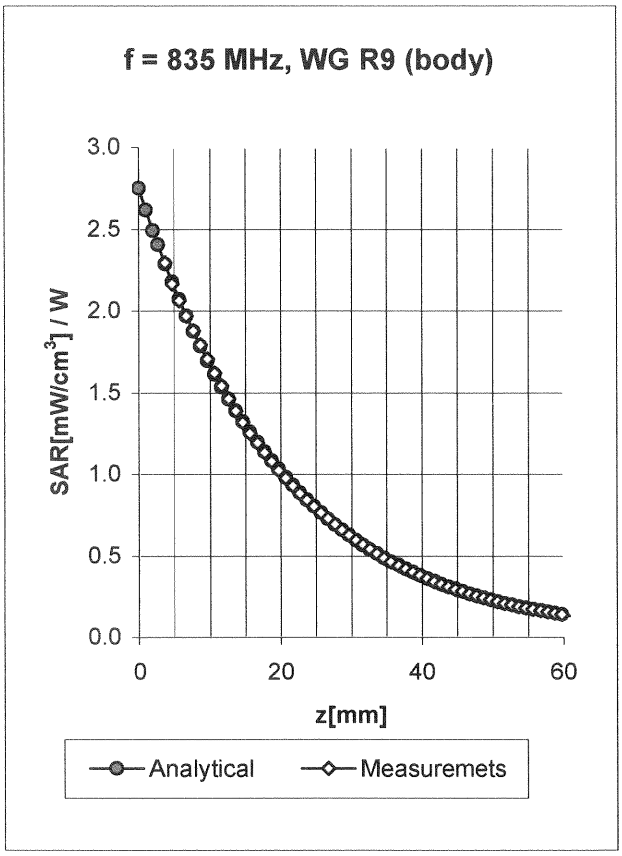
ConvF X	**6.2** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.2** ± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.2** ± 9.5% (k=2)	Depth	**2.67**

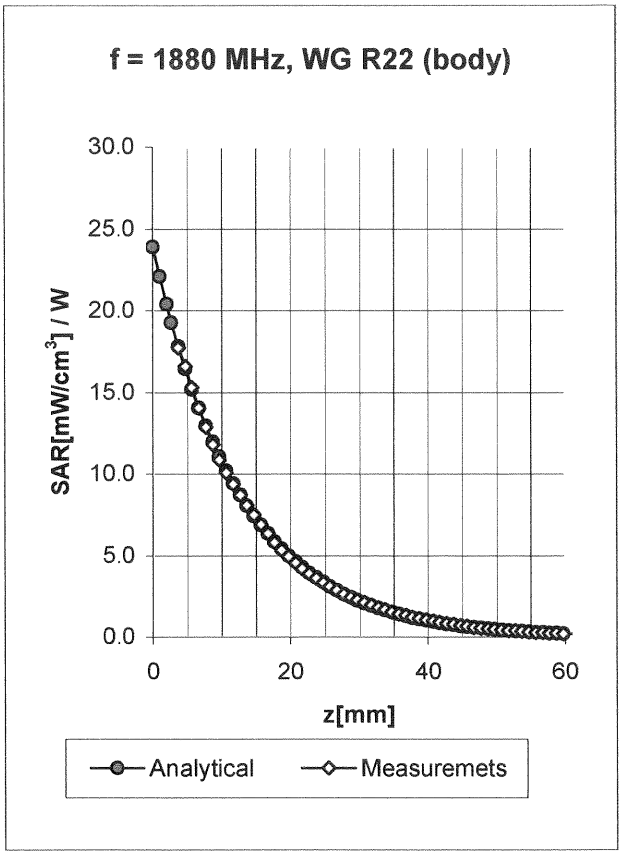
Head **1880 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

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

ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.53**
ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.49**

Conversion Factor Assessment





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

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

ConvF X	**6.2** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.2** ± 9.5% (k=2)	Alpha	**0.42**
ConvF Z	**6.2** ± 9.5% (k=2)	Depth	**2.41**

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

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

ConvF X	**4.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)	Alpha	**0.65**
ConvF Z	**4.5** ± 9.5% (k=2)	Depth	**2.47**

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

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

Client **Nokia Inc. Texas**

CALIBRATION CERTIFICATE

Object(s)	D835V2 - SN:486
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	May 26, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00 (Agilent, No. 8702K064602)	In house check: May 03

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: May 26, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Date/Time: 05/26/03 17:23:08

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN486_SN1507_HSL835_260503.da4

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN486
Program: Dipole Calibration

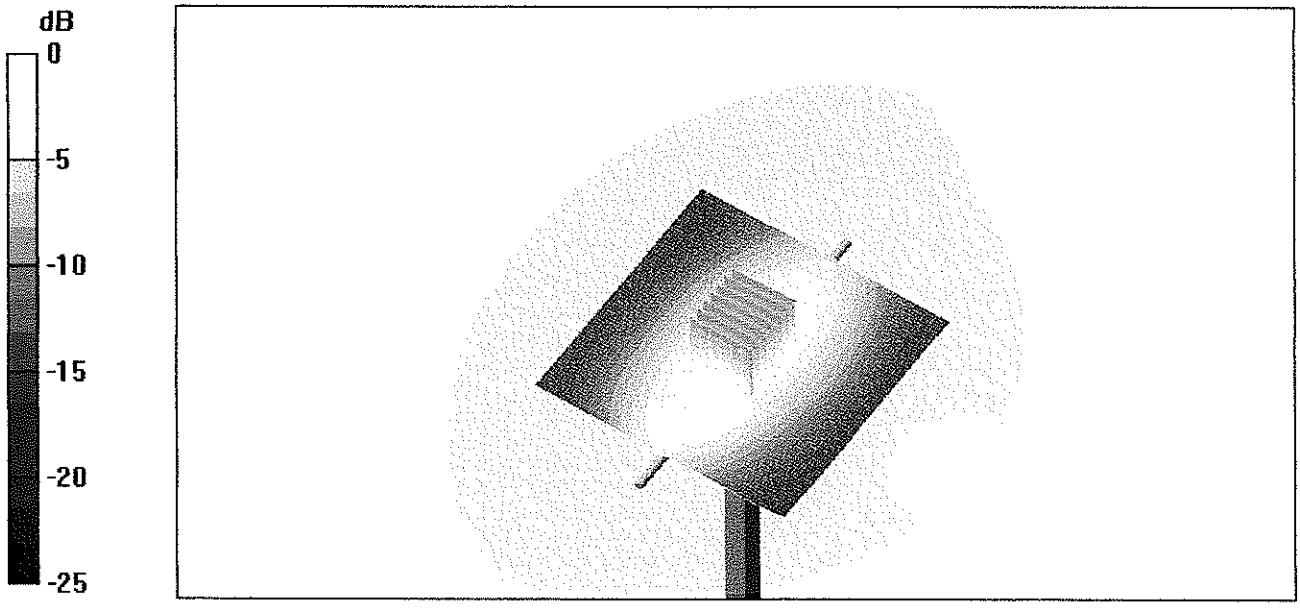
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835 MHz (σ = 0.89 mho/m, ε_r = 42.8, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.7, 6.7, 6.7); 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 47; Postprocessing SW: SEMCAD, V1.6 Build 115*

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 56.8 V/m
Power Drift = -0.004 dB
Maximum value of SAR = 2.61 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.56 W/kg
SAR(1 g) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g
Reference Value = 56.8 V/m
Power Drift = -0.004 dB
Maximum value of SAR = 2.61 mW/g



0 dB = 2.61mW/g

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

Client Nokia Inc., Texas

CALIBRATION CERTIFICATE

Object(s)	D835V2 - SN:486
Calibration procedure(s)	QA CAL-05 v2 Calibration procedure for dipole validation kits
Calibration date:	October 2, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02 (METAS, No. 252-0236)	Oct-03
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: October 9, 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.

ConvF(6.3, 6.3, 6.3)Date/Time: 10/02/03 13:40:15

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN486

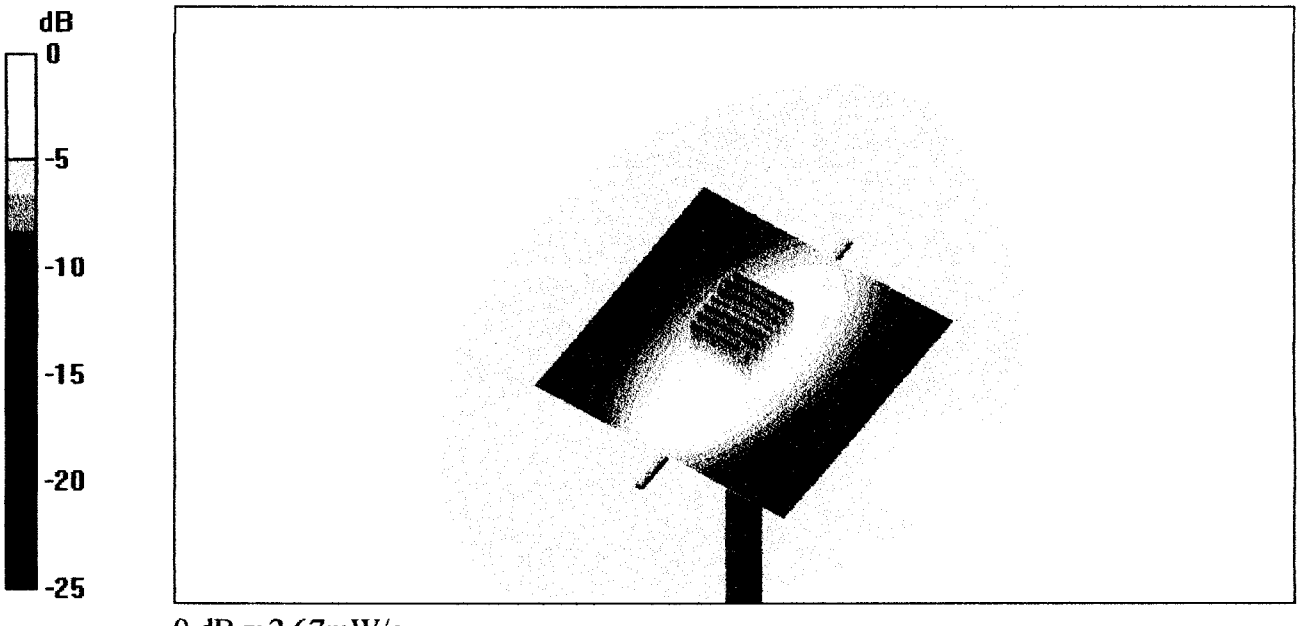
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Muscle 835 MHz (σ = 0.98 mho/m, ε_r = 54.98, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.3, 6.3, 6.3); 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 47; Postprocessing SW: SEMCAD, V1.8 Build 60

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 54.4 V/m
Power Drift = 0.003 dB
Maximum value of SAR = 2.66 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.57 W/kg
SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.63 mW/g
Reference Value = 54.4 V/m
Power Drift = 0.003 dB
Maximum value of SAR = 2.67 mW/g



0 dB = 2.67mW/g