TCC

Test & Certification Center (TCC) - Dallas

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SAR Compliance Test Report

Test report no.:	WR38.001	Date of report:	13-Jan-04
Template version:	-	Number of pages:	41
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 Mobile Phones 6021 Connection Drive Irving, TX 75039, USA Tel. +1 972 894 5000 Fax. +1 972 894 4988
Responsible test engineer:	N. Walton	Product contact person:	-
Measurements made by:	C.Bertz, J.Love		
Tested device:	RH-42		
FCC ID (USA):	GMLRH-42	Industry Canada ID:	661N-RH42
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 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: 13-Jan-04

For the contents:

Alan Ewing
TCC Line Manager

Nerina Walton
Test Engineer

CONTENTS

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	17-Nov-03 to 25-Nov-03
SN, HW and SW numbers of tested device	ESN: 07202003343 HW: 1152 SW: 3.02
Batteries used in testing	BMC-3, BLC-2
Headsets used in testing	HDE-2
Other accessories used in testing	-
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)	Conducted power	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
AMPS	991 / 824.04	24.4 dBm	Right Cheek	1.6 W/kg	1.23 W/kg	PASSED
TDMA 800	991 / 824.04	27.2 dBm	Right Cheek	1.6 W/kg	0.75 W/kg	PASSED

1.2.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	Conducted power	Position	SAR limit (1g avg)	Measured SAR value (1g avg)	Result
AMPS	384 / 836.52	24.4 dBm	1.5 cm	1.6 W/kg	1.20 W/kg	PASSED
TDMA 800	384 / 836.52	27.3 dBm	1.5 cm	1.6 W/kg	0.83 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	0.22 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	AMPS 800	TDMA 800
Modulation Mode	FM	π/4 QPSK
Duty Cycle	1	1/3
Transmitter Frequency Range (MHz)	824.04 - 848.97	824.04 - 848.97

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:	17-Nov-03 to 25-Nov-03
Ambient temperature (°C):	21 C to 24 C
Ambient humidity (RH %):	17 % to 72 %

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 the lowest, middle and highest channels as considered appropriate.

Power output was measured by a separate accredited test laboratory on the same unit as used for SAR testing.

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement System and Components

The measurements were performed using an automated near-field scanning system, DASY3 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	389	12 months	10/2005
E-field Probe ET3DV6	1516	12 months	02/2004
Dipole Validation Kit, D835V2	487	24 months	05/2005

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	HP 8648C	3836A04346	12 months	06/2004
Amplifier	AR 5S1G2	25583	-	-
Power Meter	Boonton 4232A	64701	12 months	07/2004
Power Sensor	Boonton 51015	32188	12 months	07/2004
Power Sensor	Boonton 51015	32188	12 months	07/2004
Call Tester	Wavetek 4300	064803	12 months	04/2004
Vector Network Analyzer	Agilent 8753ES	US39174932	12 months	01/2004
Dielectric Probe Kit	Agilent 85070D	US01440005	-	-
Power Sensor	Boonton 51015	32188	12 months	07/2004

4.1.1 Isotropic E-field Probe 1516

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 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	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 250mW 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	Reference result	9.80	42.8	0.89	N/A
	± 10% window	8.82 to 10.78			
	17-Nov-03	9.40	40.9	0.90	21.1
	20-Nov-03	9.60	41.1	0.91	20.9
	24-Nov-03	9.84	41.2	0.91	21.1

System Verification, Body Tissue Simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
835	Reference result	10.08	54.0	0.96	N/A
	± 10% window	9.07 to 11.09			
	24-Nov-03	9.68	52.9	0.94	21.3
	25-Nov-03	9.60	52.9	0.94	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 to 43.6	0.86 to 0.95	
	17-Nov-03	40.9	0.91	21.1
	20-Nov-03	41.1	0.91	20.9
	24-Nov-03	41.2	0.91	21.1

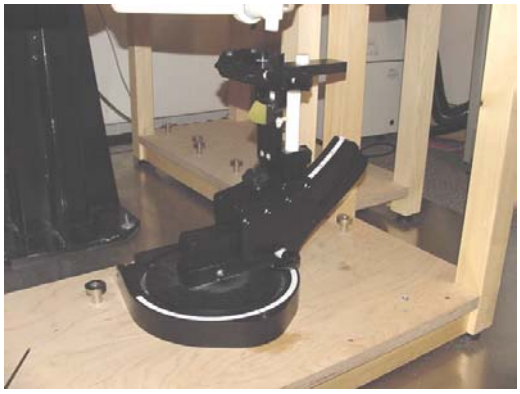
Body Tissue Simulant Measurements

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 to 58.0	0.92 to 1.02	
	24-Nov-03	52.9	0.94	21.3
	25-Nov-03	52.9	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 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”.

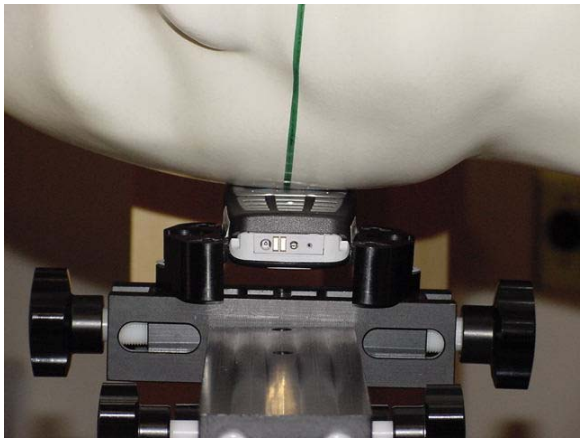


Photo of the device in “cheek” position

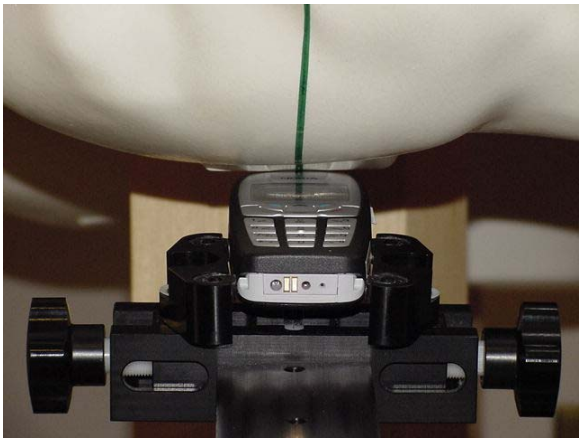


Photo of the device in “tilt” position

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.

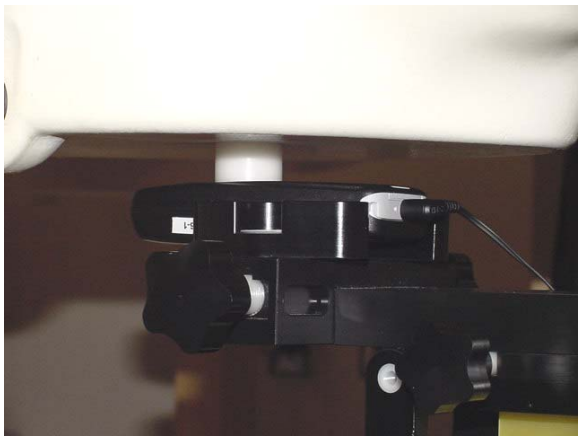


Photo of the device positioned for Body SAR measurement. The spacer was removed for the tests.

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.

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

7. RESULTS

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

Head SAR results

Mode and Band	Battery	Position		SAR, averaged over 1g (W/kg)		
				Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS	BMC-3	Power level		24.4 dBm	24.4 dBm	24.2 dBm
		Left	Cheek	1.14	0.95	1.03
			Tilt	-	**0.75**	-
		Right	Cheek	1.21	1.01	1.08
			Tilt	-	**0.65**	-
TDMA 800	BMC-3	Power level		27.2 dBm	27.3 dBm	26.8 dBm
		Left	Cheek	0.74	-	-
			Tilt	-	0.38	-
		Right	Cheek	0.75	-	-
			Tilt	-	0.43	-

Mode and Band	Battery	Position		SAR, averaged over 1g (W/kg)		
				Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS	BLC-2	Power level		24.4 dBm	24.4 dBm	24.2 dBm
		Left	Cheek	**1.16**	-	-
			Tilt	-	0.70	-
		Right	Cheek	**1.23**	-	-
			Tilt	-	0.62	-
TDMA 800	BLC-2	Power level		27.2 dBm	27.3 dBm	26.8 dBm
		Left	Cheek	0.74	-	-
			Tilt	-	0.37	-
		Right	Cheek	0.74	-	-
			Tilt	-	0.41	-

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

Body SAR results

Mode and Band	Battery	Body-worn location setup	SAR, averaged over 1g (W/kg)		
			Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS	BMC-3	**Power level**	**24.4 dBm**	**24.4 dBm**	**24.2 dBm**
		Headset, HDE-2	1.14	**1.20**	0.85
TDMA 800	BMC-3	**Power level**	**27.2 dBm**	**27.3 dBm**	**26.8 dBm**
		Headset, HDE-2	-	0.83	-

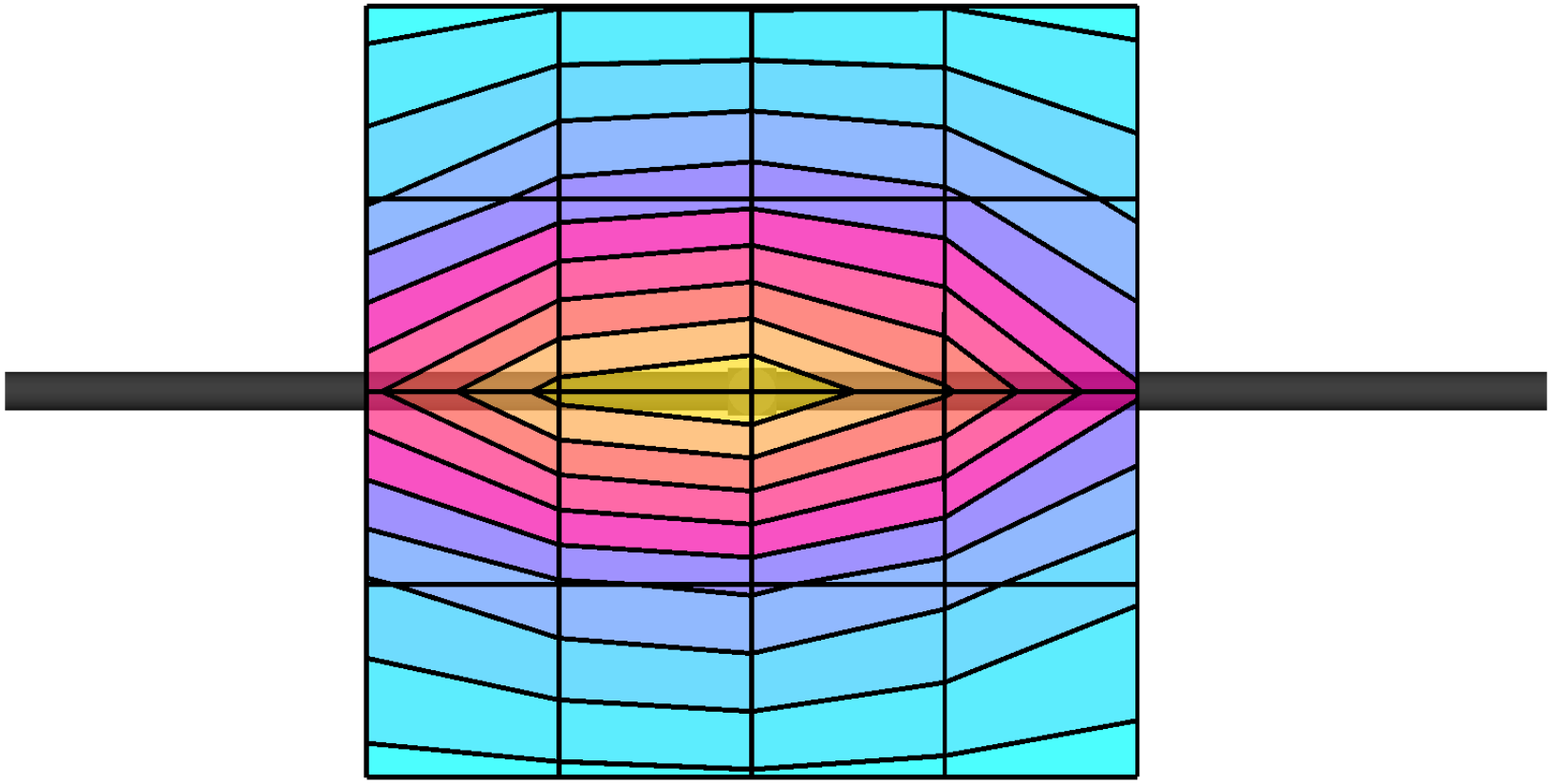
Mode and Band	Battery	Body-worn location setup	SAR, averaged over 1g (W/kg)		
			Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS	BLC-2	**Power level**	**24.4 dBm**	**24.4 dBm**	**24.2 dBm**
		Headset, HDE-2	-	1.10	-
TDMA 800	BLC-2	**Power level**	**27.2 dBm**	**27.3 dBm**	**26.8 dBm**
		Headset, HDE-2	-	0.67	-

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

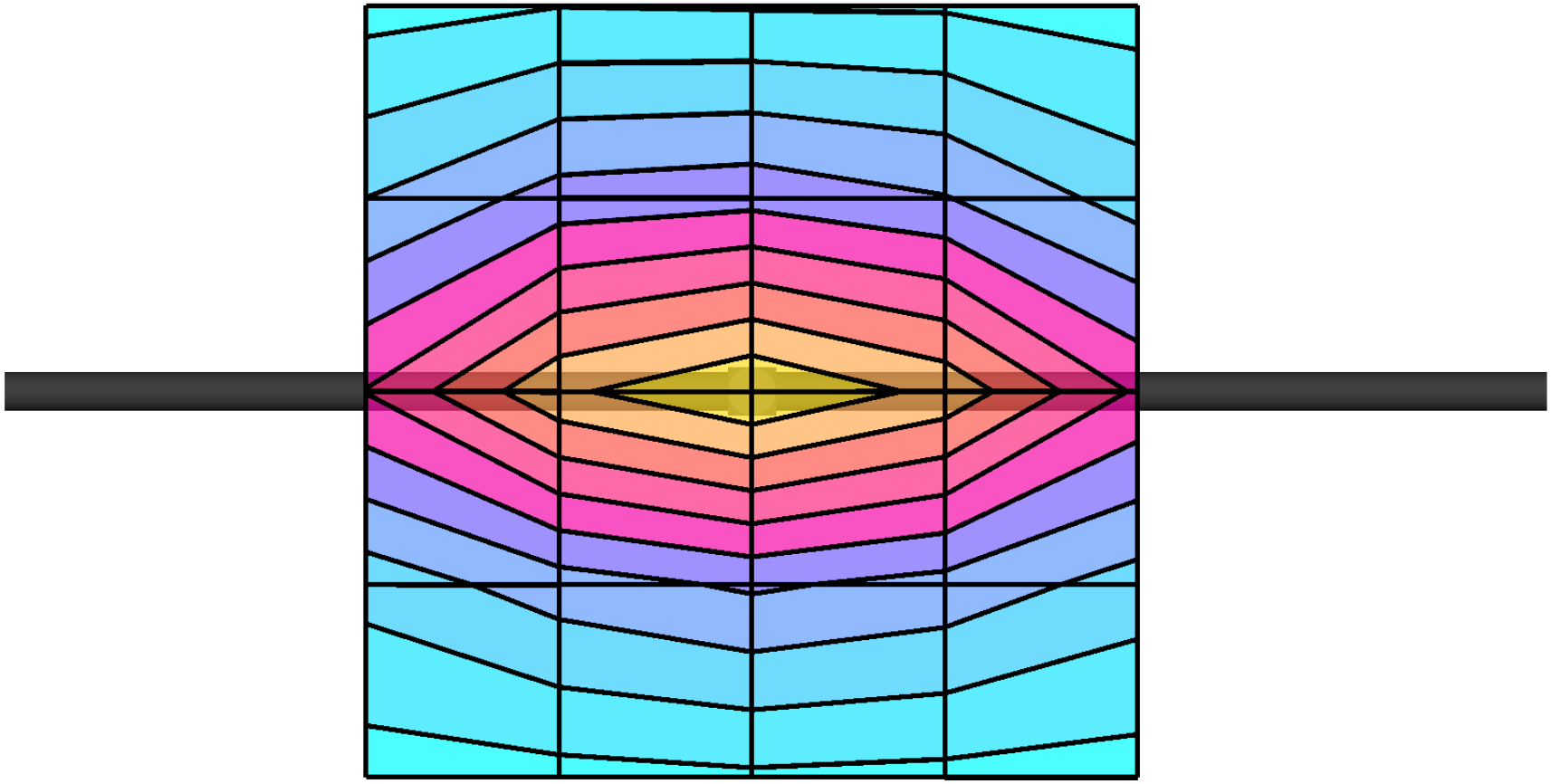
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.90$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cubes (2): Peak: 3.69 mW/g ± 0.00 dB, SAR (1g): 2.35 mW/g ± 0.03 dB, SAR (10g): 1.57 mW/g ± 0.04 dB, (Advanced extrapolation)
Penetration depth: 14.5 (14.4, 14.6) [mm]
Powerdrift: 0.08 dB
Liquid Temperature (°C): 21.1



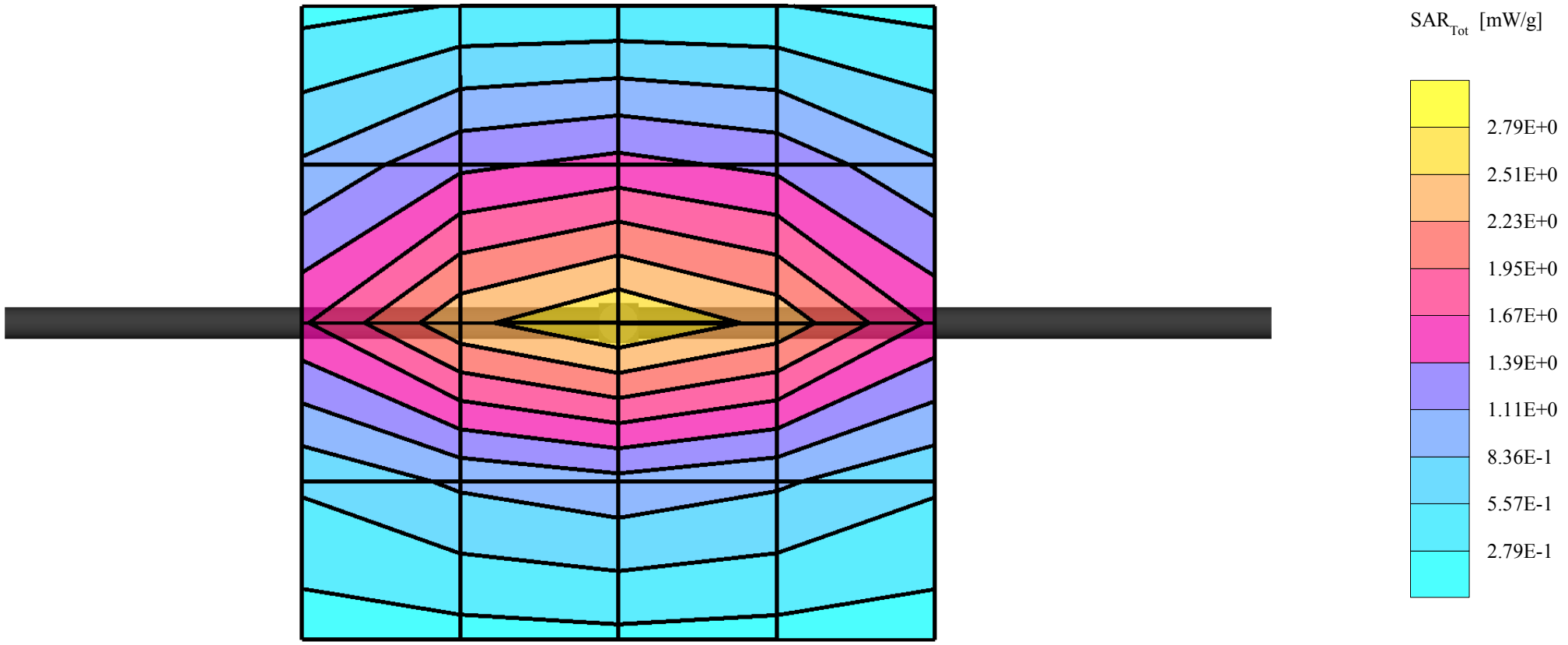
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.1$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cubes (2): Peak: 3.72 mW/g ± 0.02 dB, SAR (1g): 2.40 mW/g ± 0.05 dB, SAR (10g): 1.61 mW/g ± 0.05 dB, (Advanced extrapolation)
Penetration depth: 14.3 (14.2, 14.5) [mm]
Powerdrift: 0.12 dB
Liquid Temperature (°C): 20.9



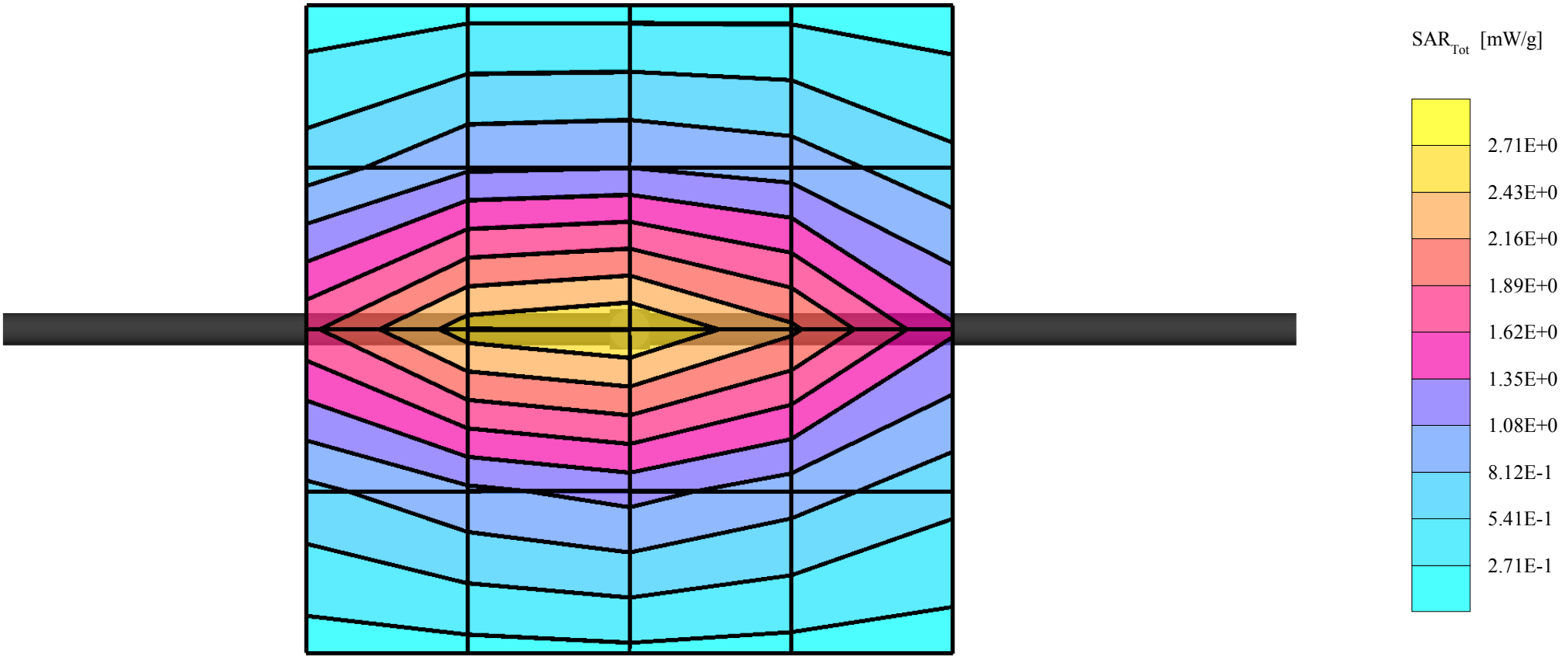
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.2$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cubes (2): Peak: 3.72 mW/g ± 0.02 dB, SAR (1g): 2.46 mW/g ± 0.04 dB, SAR (10g): 1.64 mW/g ± 0.04 dB, (Advanced extrapolation)
Penetration depth: 14.1 (14.0, 14.4) [mm]
Powerdrift: 0.03 dB
Liquid Temperature (°C): 21.1



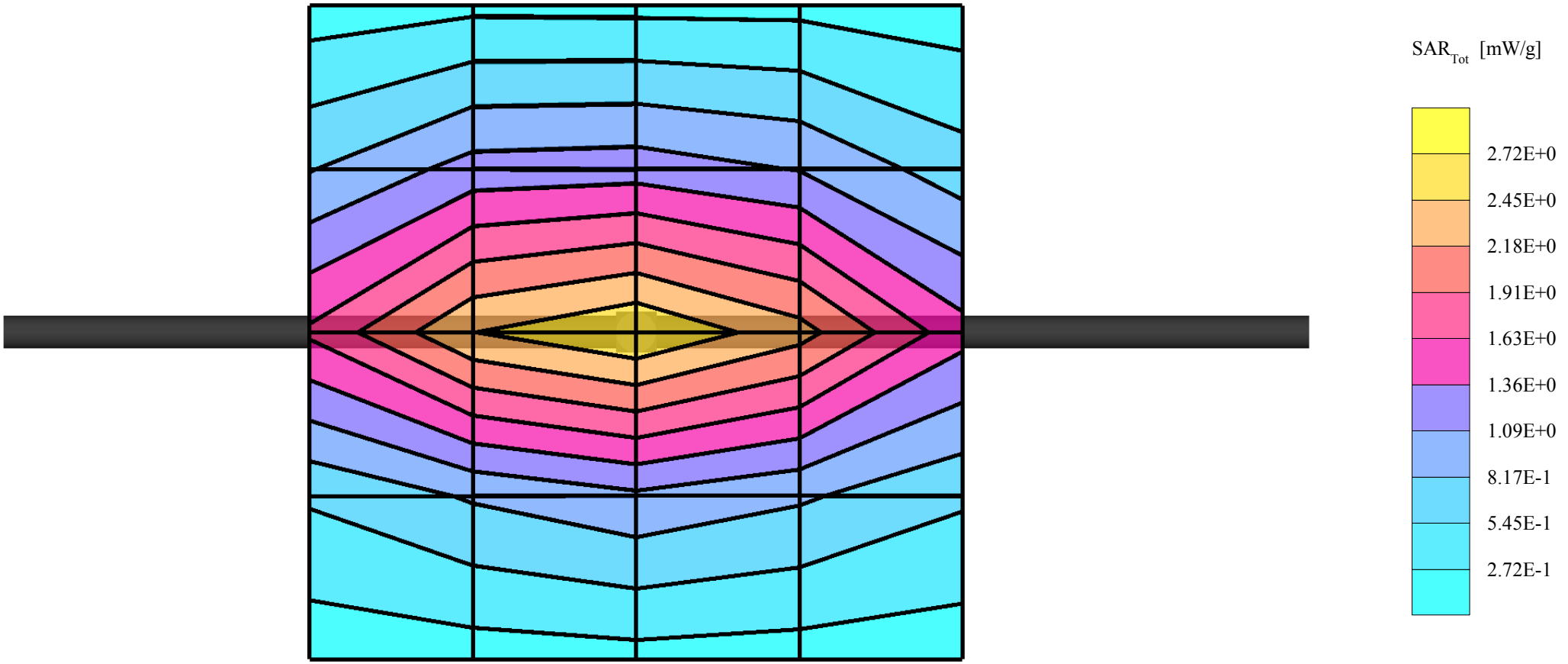
Dipole 835 MHz, Body Validation

SAM 2 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: $\sigma = 0.94$ mho/m $\varepsilon_r = 52.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.61 mW/g ± 0.03 dB, SAR (1g): 2.42 mW/g ± 0.06 dB, SAR (10g): 1.63 mW/g ± 0.06 dB, (Advanced extrapolation)
Penetration depth: 14.8 (14.7, 15.1) [mm]
Powerdrift: 0.07 dB
Liquid Temperature (°C): 21.3



Dipole 835 MHz, Body Validation

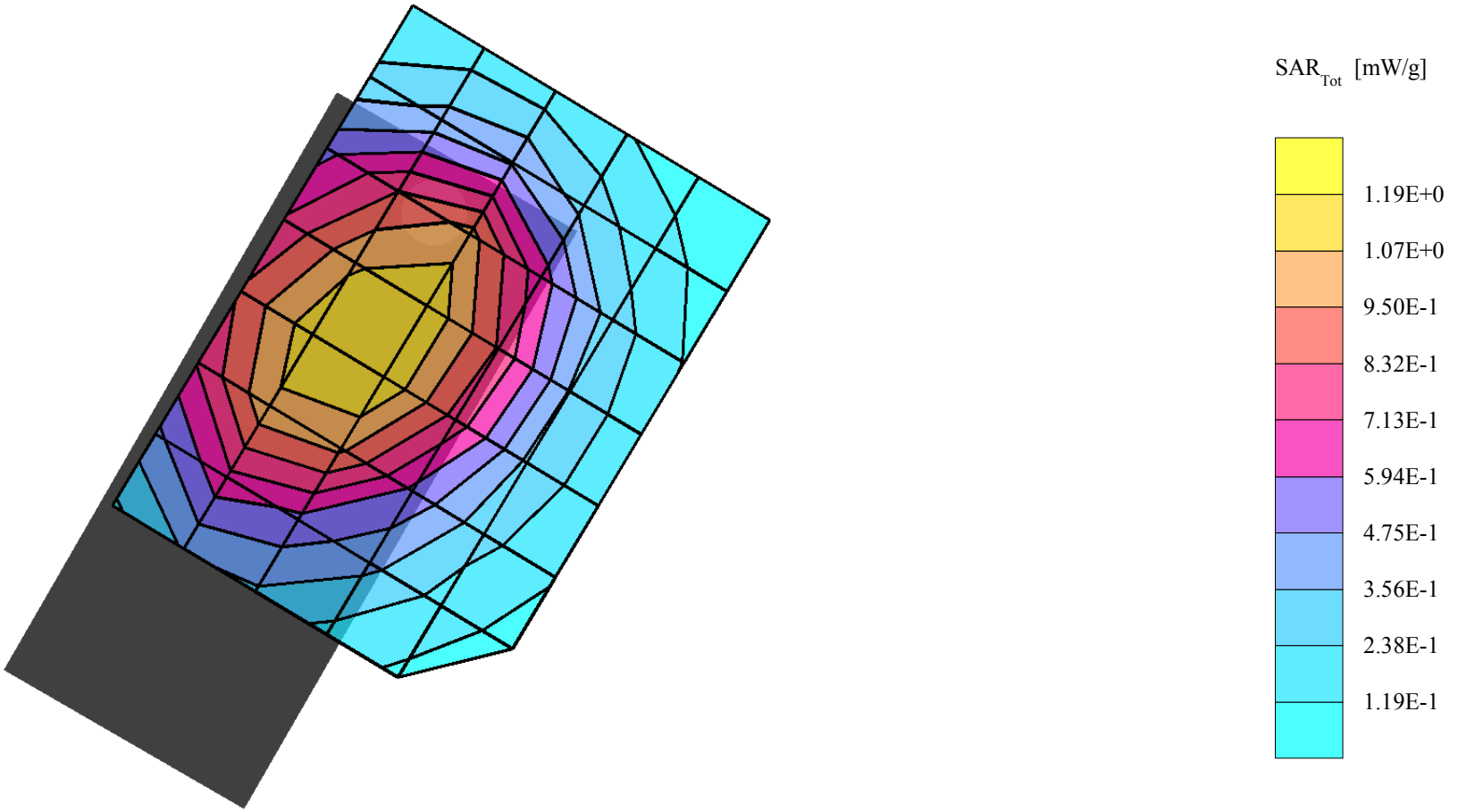
SAM 2 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: $\sigma = 0.94$ mho/m $\varepsilon_r = 52.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.54 mW/g ± 0.01 dB, SAR (1g): 2.40 mW/g ± 0.04 dB, SAR (10g): 1.62 mW/g ± 0.05 dB, (Advanced extrapolation)
Penetration depth: 14.8 (14.7, 15.0) [mm]
Powerdrift: 0.10 dB
Liquid Temperature (°C): 21.3



APPENDIX B: MEASUREMENT SCANS

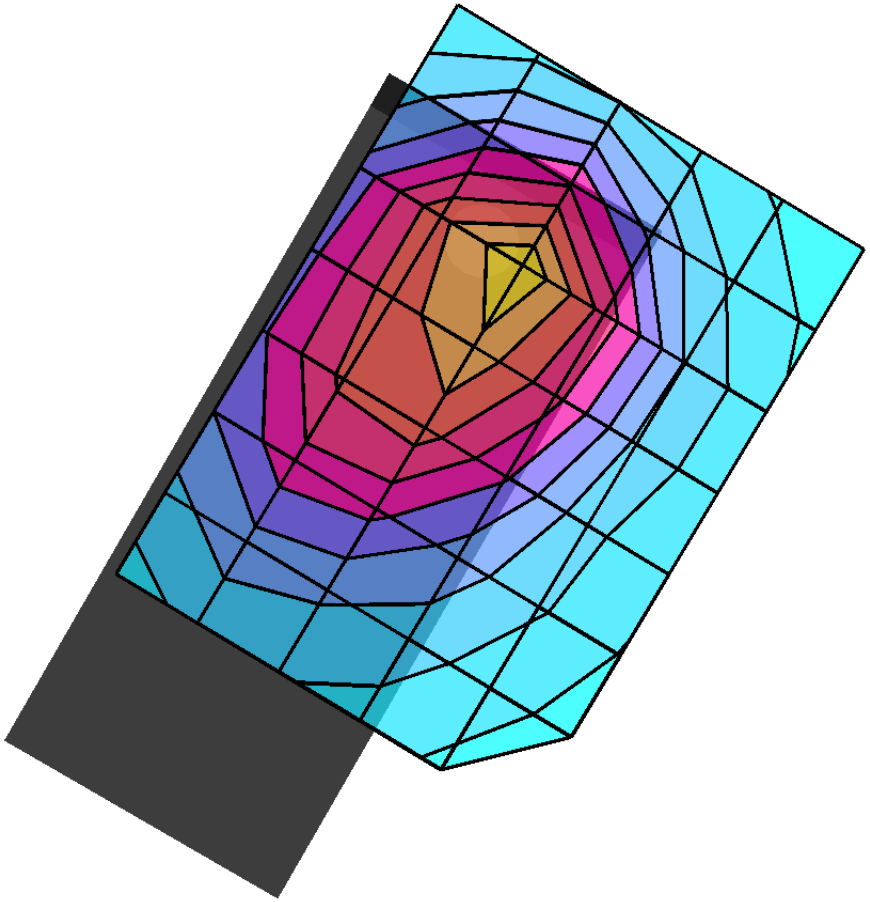
RH-42, AMPS, Channel 991, Left Cheek Position, BLC-2

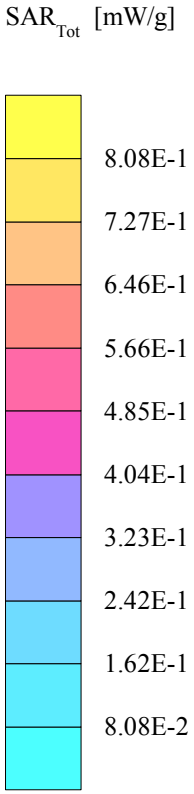
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cube 5x5x7: SAR (1g): 1.16 mW/g, SAR (10g): 0.866 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.11 dB
Liquid Temperature (°C): 21.1



RH-42, AMPS, Channel 384, Left Tilt Position, BMC-3

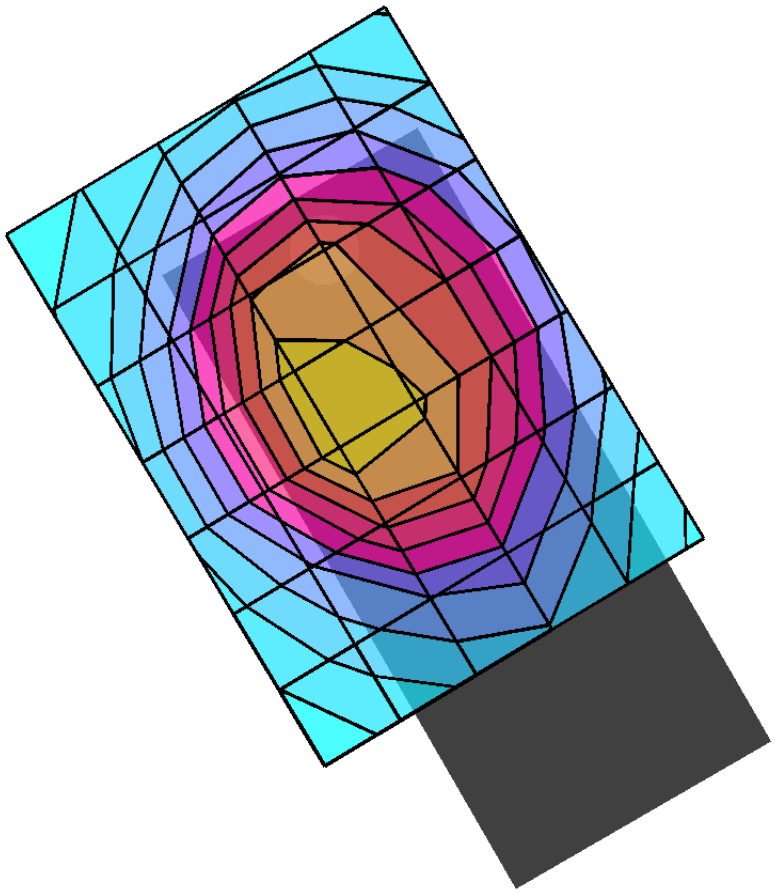
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.1$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cube 5x5x7: SAR (1g): 0.746 mW/g, SAR (10g): 0.507 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.03 dB
Liquid Temperature (°C): 20.9

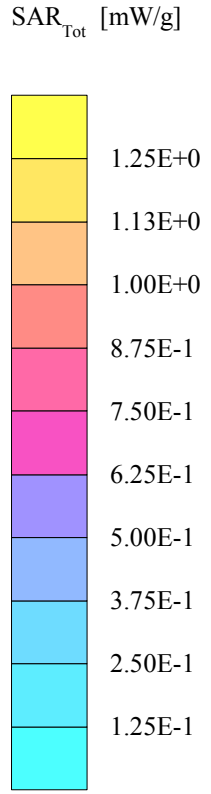




RH-42, AMPS, Channel 991, Right Cheek Position, BLC-2

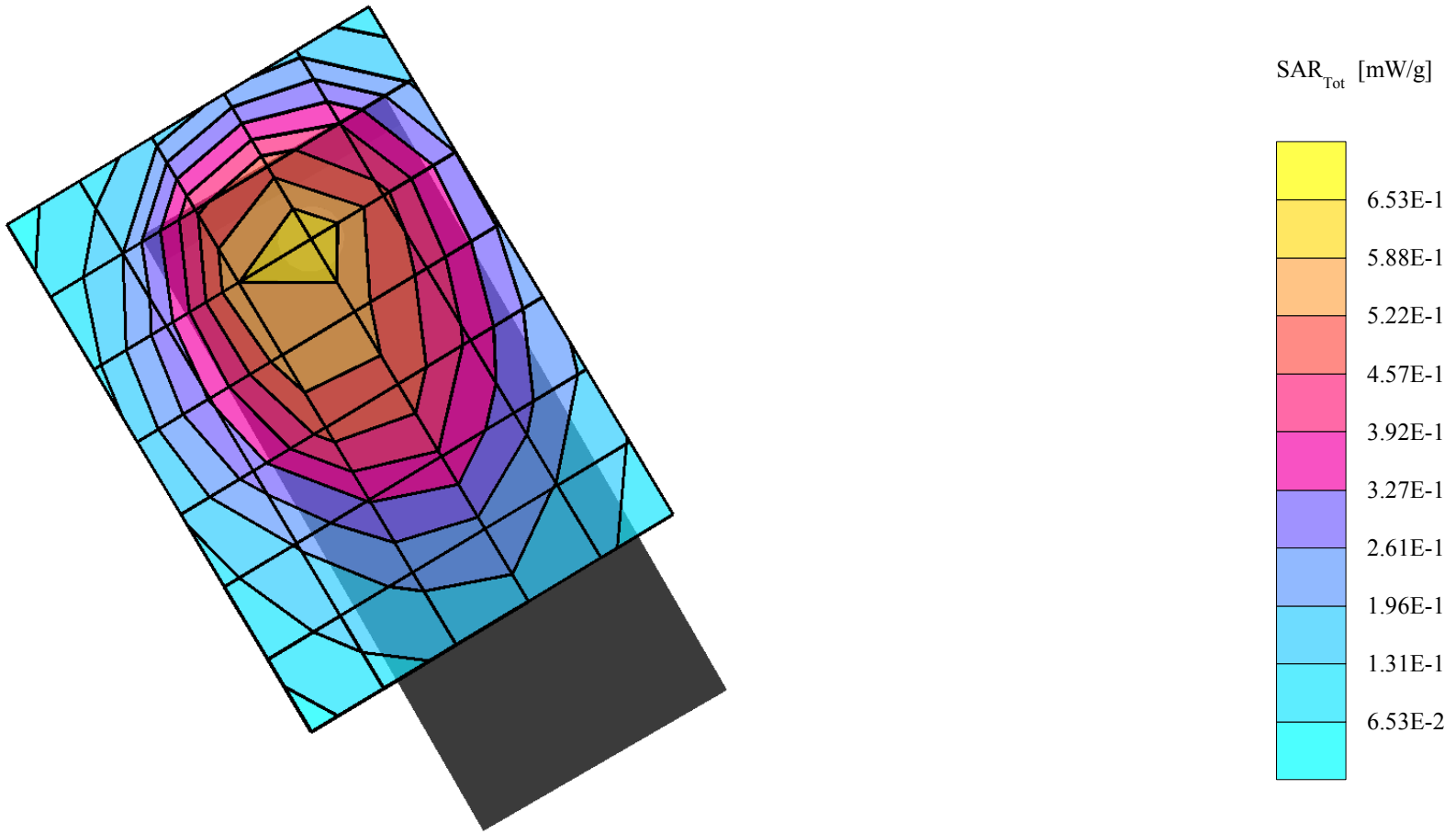
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cube 5x5x7: SAR (1g): 1.23 mW/g, SAR (10g): 0.905 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.12 dB
Liquid Temperature (°C): 21.1





RH-42, AMPS, Channel 384, Right Tilt Position, BMC-3

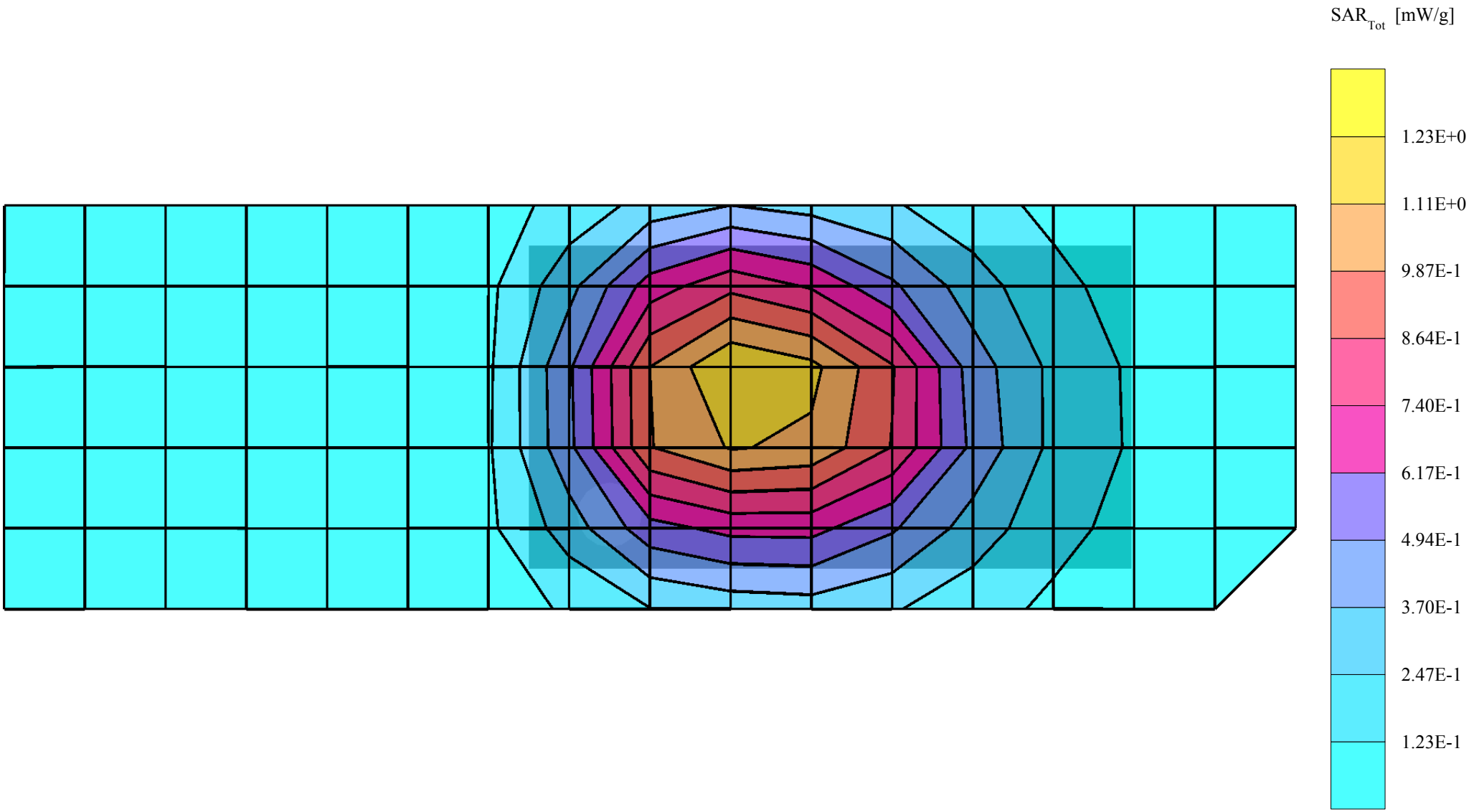
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.1$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cube 5x5x7: SAR (1g): 0.646 mW/g, SAR (10g): 0.443 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB
Liquid Temperature (°C): 20.9



11/25/03

RH-42, AMPS, Channel 384, Flat Position with 1.5cm Spacer, BMC-3 and HDE-2

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.95 mho/m ε_r = 52.9 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.20 mW/g, SAR (10g): 0.856 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.02 dB
Liquid Temperature (°C): 21.3

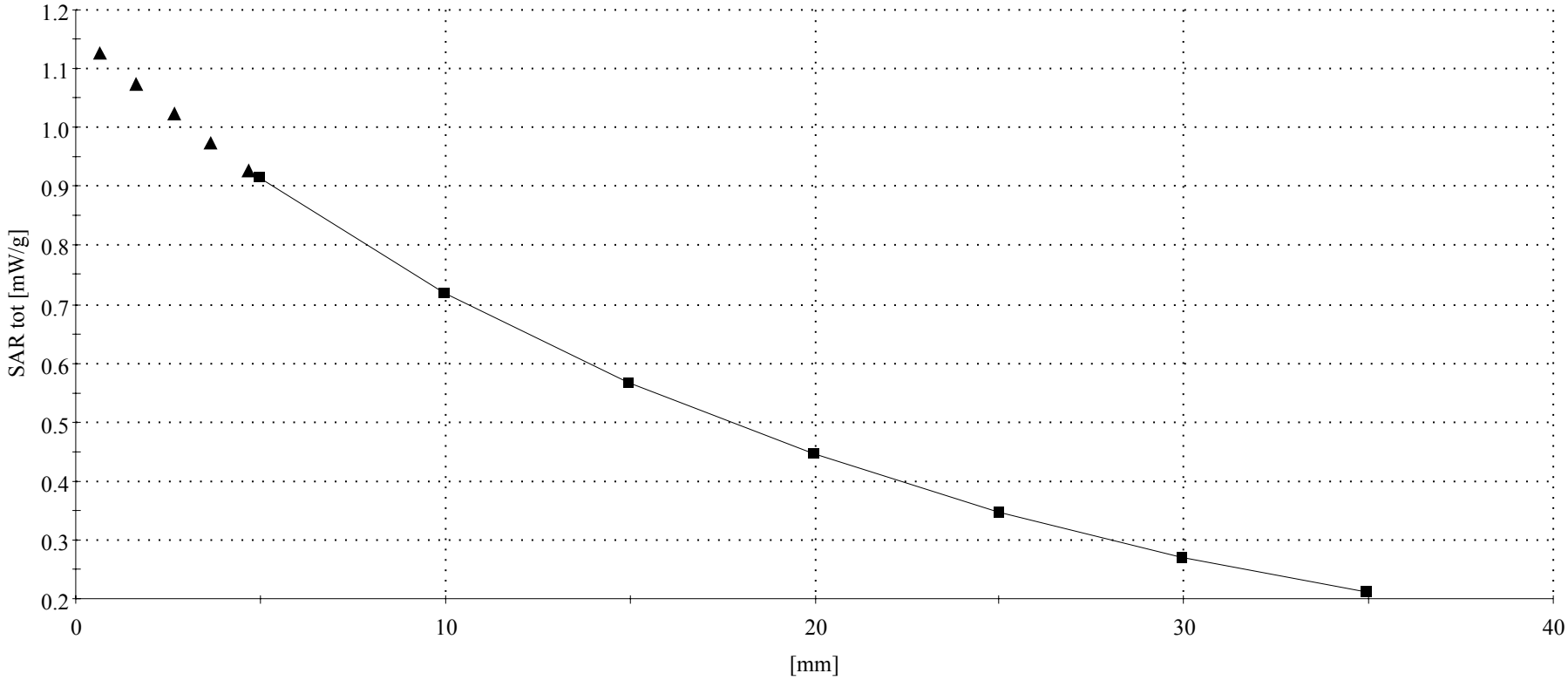


TCC Dallas

RH-42, AMPS, Channel 991, Right Cheek Position, BLC-2

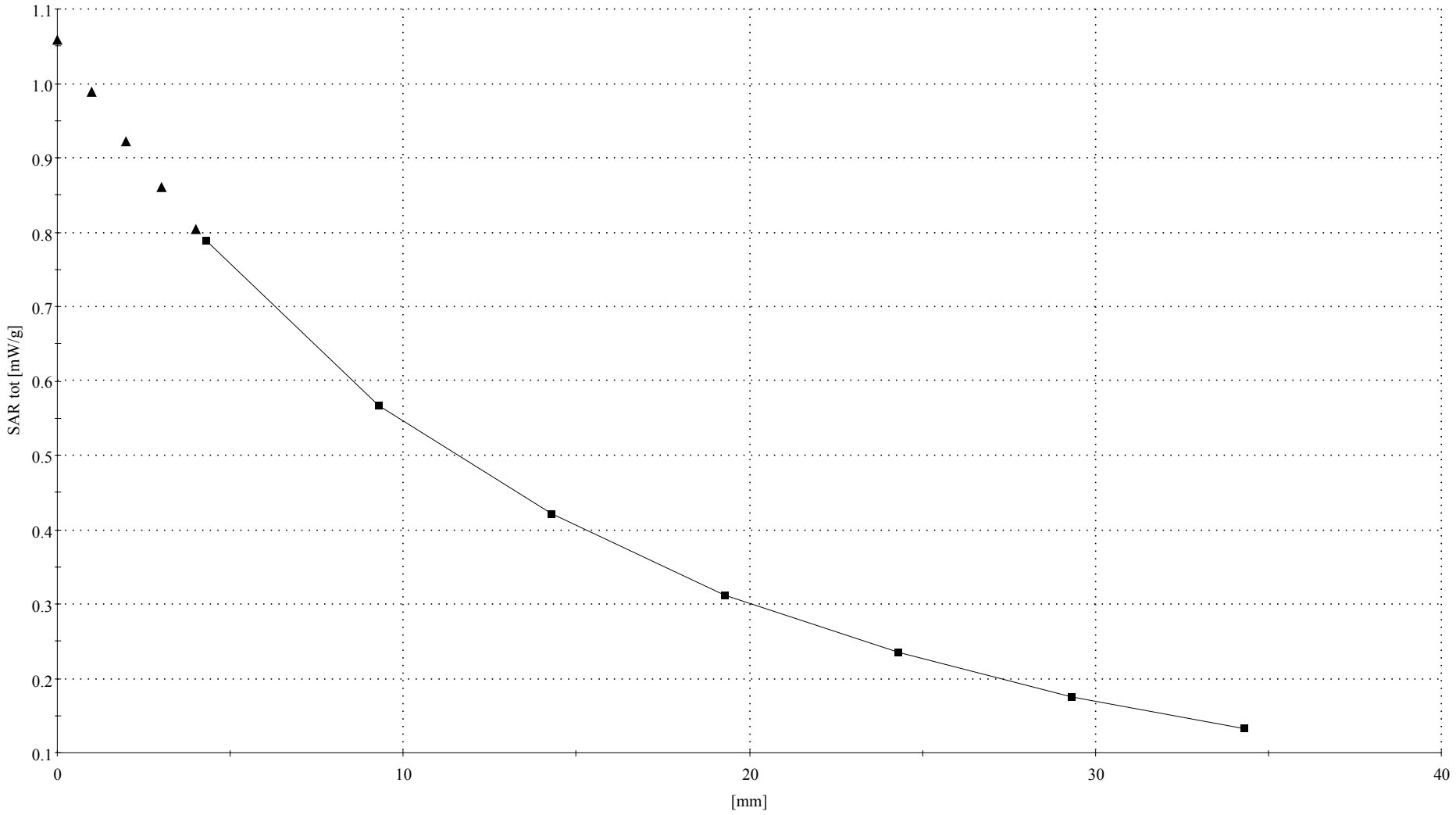
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 40.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.60,6.60,6.60)
Cube 5x5x7: SAR (1g): 1.23 mW/g, SAR (10g): 0.905 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0

Liquid Temperature (°C): 21.1



RH-42, AMPS, Channel 384, Flat Position with 1.5cm Spacer, BMC-3 and HDE-2

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: $\sigma = 0.95$ mho/m $\varepsilon_r = 52.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1516; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.20 mW/g, SAR (10g): 0.856 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 21.3



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

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

Client **Nokia Mobile Phones (San Diego)**

CALIBRATION CERTIFICATE

Object(s) ET3DV6 - SN:1516

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

Calibration date: February 26, 2003

Condition of the calibrated item In Tolerance (according to the specific calibration document)

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

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator 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: February 26, 2003

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

DASY - Parameters of Probe: ET3DV6 SN:1516

Sensitivity in Free Space

NormX	**1.67**	$\mu V/(V/m)^2$	DCP X	**95**	mV
NormY	**1.52**	$\mu V/(V/m)^2$	DCP Y	**95**	mV
NormZ	**1.69**	$\mu V/(V/m)^2$	DCP Z	**95**	mV

Sensitivity in Tissue Simulating Liquid

Head **835 MHz** ε_r **= 41.5 ± 5%** σ **= 0.90 ± 5% mho/m**
Head **900 MHz** ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**

ConvF X	**6.6**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.6**	± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.6**	± 9.5% (k=2)	Depth	**2.76**

Head **1900 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head **1800 MHz** ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.0**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0**	± 9.5% (k=2)	Alpha	**0.57**
ConvF Z	**5.0**	± 9.5% (k=2)	Depth	**2.57**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	10.7	6.1
SAR_{be} [%]	With Correction Algorithm	0.5	0.7

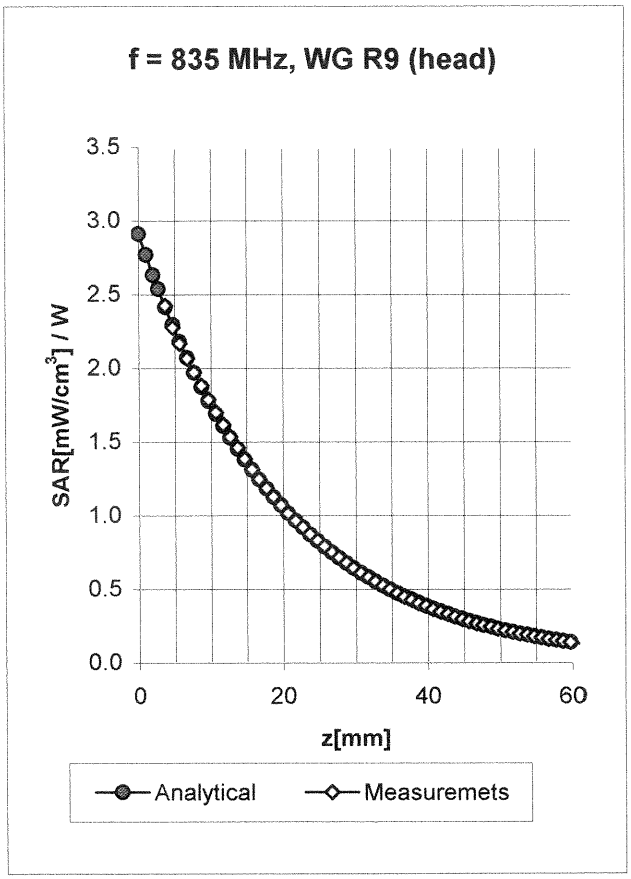
Head **1900 MHz** **Typical SAR gradient: 10 % per mm**

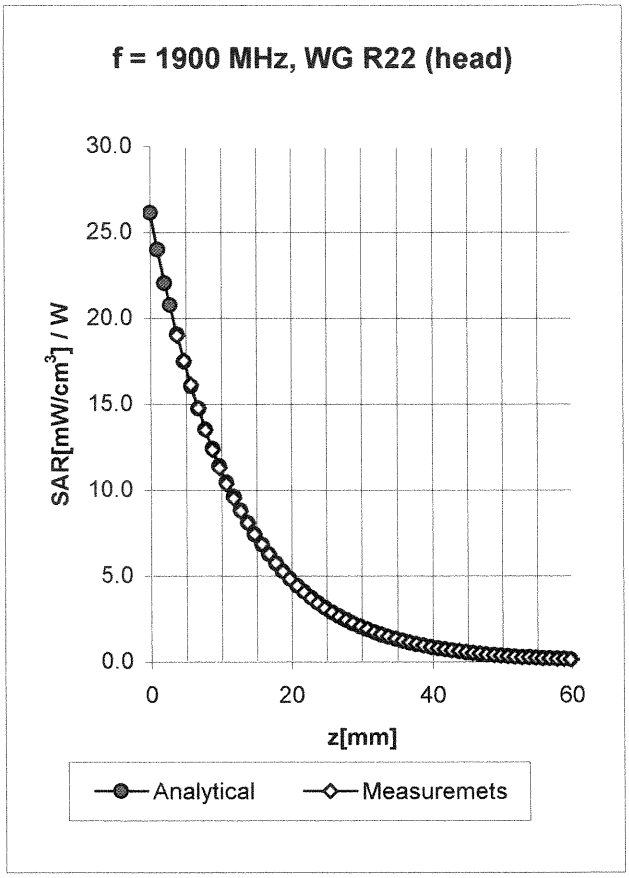
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	15.4	10.4
SAR_{be} [%]	With Correction Algorithm	0.2	0.3

Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.6 ± 0.2**	mm

Conversion Factor Assessment

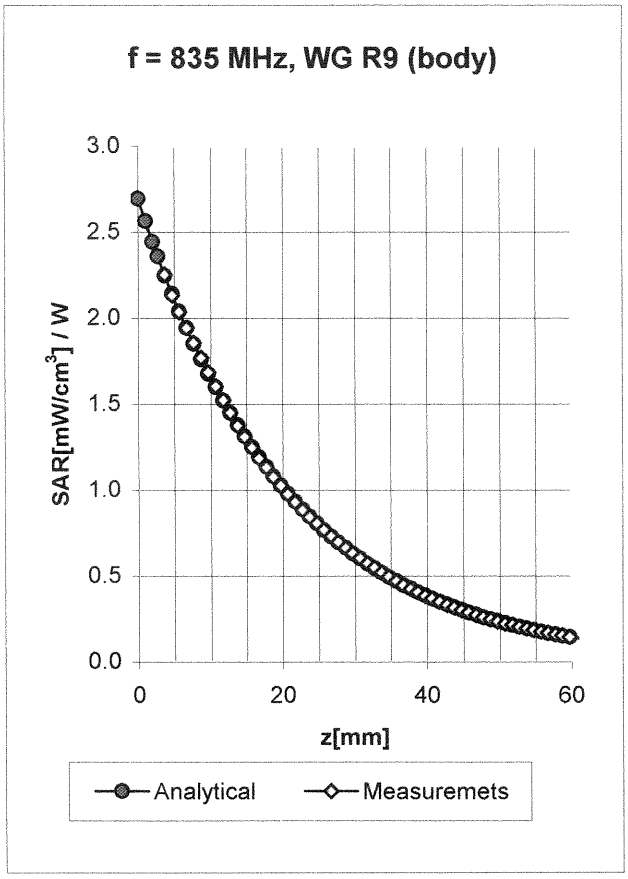


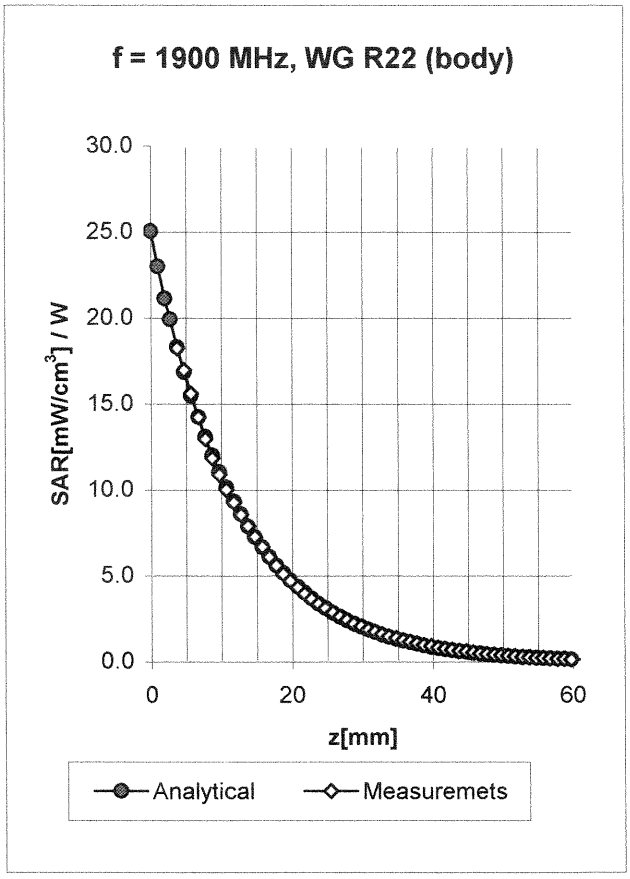


Head	**835 MHz**	ε_r **= 41.5 ± 5%**	σ **= 0.90 ± 5% mho/m**	
Head	**900 MHz**	ε_r **= 41.5 ± 5%**	σ **= 0.97 ± 5% mho/m**	
	ConvF X	**6.6** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.6** ± 9.5% (k=2)	Alpha	**0.35**
	ConvF Z	**6.6** ± 9.5% (k=2)	Depth	**2.76**

Head	**1900 MHz**	ε_r **= 40.0 ± 5%**	σ **= 1.40 ± 5% mho/m**	
Head	**1800 MHz**	ε_r **= 40.0 ± 5%**	σ **= 1.40 ± 5% mho/m**	
	ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.57**
	ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.57**

Conversion Factor Assessment





Body	**835 MHz**	ε_r **= 55.2 ± 5%**	σ **= 0.97 ± 5% mho/m**	
Body	**900 MHz**	ε_r **= 55.0 ± 5%**	σ **= 1.05 ± 5% mho/m**	
	ConvF X	**6.5** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.5** ± 9.5% (k=2)	Alpha	**0.52**
	ConvF Z	**6.5** ± 9.5% (k=2)	Depth	**2.12**

Body	**1900 MHz**	ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
Body	**1800 MHz**	ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
	ConvF X	**4.8** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.8** ± 9.5% (k=2)	Alpha	**0.71**
	ConvF Z	**4.8** ± 9.5% (k=2)	Depth	**2.32**

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:487
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 17:53:50

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN487_SN1507_HSL835_260503.da4

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN487
Program: Dipole Calibration

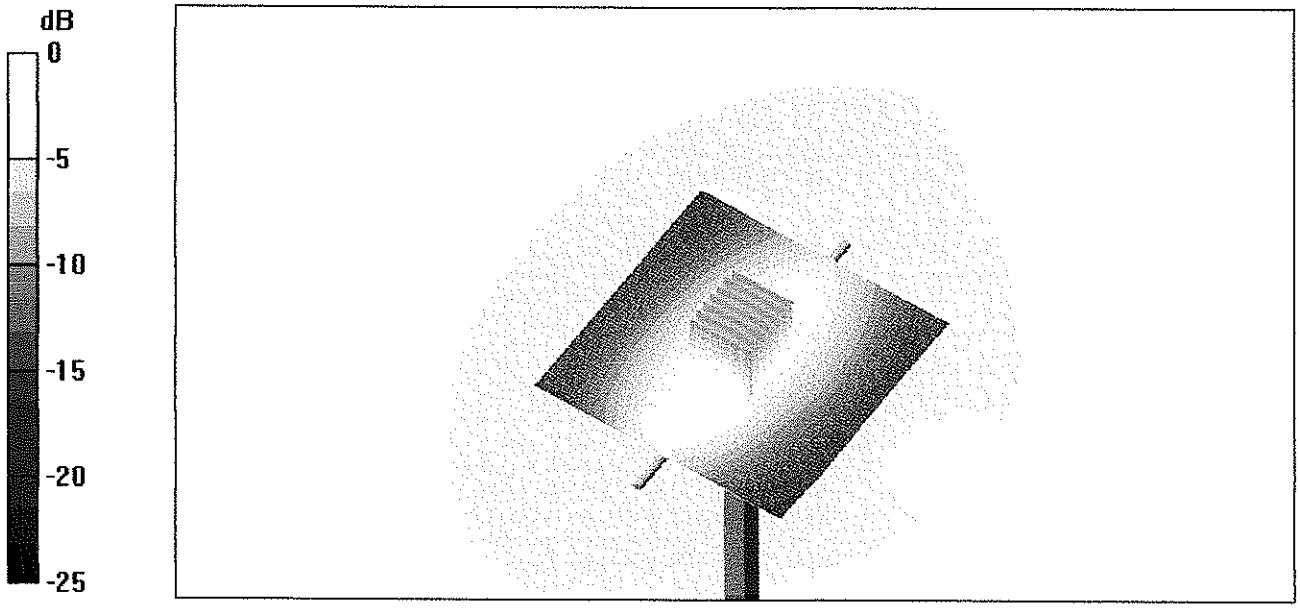
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835 MHz (σ = 0.89 mho/m, ε_r = 42.8, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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 = 56.4 V/m
Power Drift = 0.004 dB
Maximum value of SAR = 2.63 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) = 2.45 mW/g; SAR(10 g) = 1.6 mW/g
Reference Value = 56.4 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:487
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	July 17, 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	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: July 17, 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: 07/17/03 17:15:44

Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN487_SN1507_M835_170703.da4

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN487
Program: Dipole Calibration

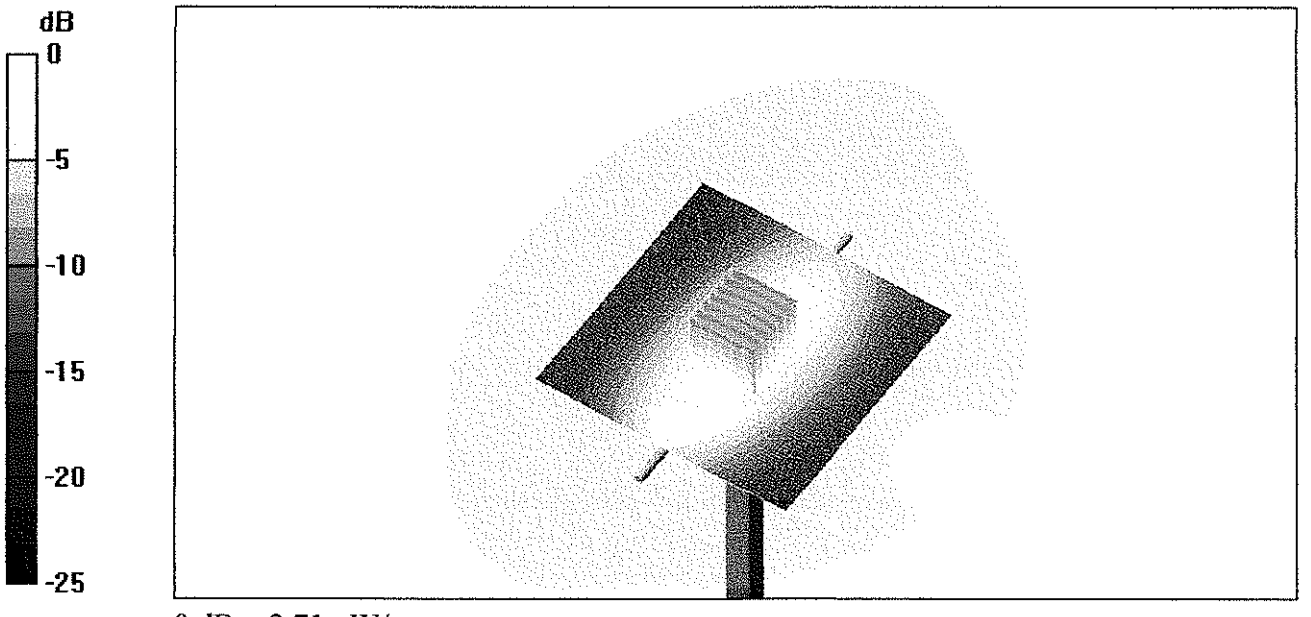
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Muscle 835 MHz (σ = 0.96 mho/m, ε_r = 54.03, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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, V1.6 Build 115

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 55.2 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 2.7 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.52 mW/g; SAR(10 g) = 1.66 mW/g
Reference Value = 55.2 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 2.71 mW/g



0 dB = 2.71mW/g