TCC
San Diego

SAR Compliance Test Report

Test report no.:	SD-03-04	**Date of report:**	April 2, 2004
Template version:	3	**Number of pages:**	
Testing laboratory:	Nokia Mobile Phones, Inc 12278 Scripps Summit Drive San Diego, CA 92131 Tel. 1-858-831-4695 Fax 1-858-831-6507	**Client:**	Nokia Mobile Phones, Inc 12278 Scripps Summit Drive San Diego, CA 92131 Tel. 1-858-831-5000 Fax 1-858-831-6500
Responsible test engineer:	Dan Laramie	**Product contact person:**	
Measurements made by:	Julian Kim		
Tested device:	RM-20		
FCC ID (USA):	QMNRM-20	**Industry Canada ID:**	

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 San Diego.

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: **April 2, 2004**

For the contents:

Esa Kontkanen
Engineering Manager

Dan Laramie
Test Engineer

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1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Period of test	Mar 22, 2004 to Mar 25, 2004
SN, HW and SW numbers of tested device	Serial Number 072/02051294 Hardware: 2.950f Software: M100b04B5.nep
Batteries used in testing	BL-6C
Headsets used in testing	HS-9, HS-5, and HS-2R
State of sample	prototype
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 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	25.29 dBm	Right Cheek, Extended	1.6 W/kg	1.24 W/kg	PASSED
CDMA 800	1013/824.70	24.83 dBm	Left Cheek, Extended	1.6 W/kg	1.14 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
AMPS	384/836.52	25.31 dBm	2.2 cm	1.6 W/kg	0.93 W/kg	PASSED
CDMA 800	384/836.52	24.88 dBm	2.2 cm	1.6 W/kg	0.86 W/kg	PASSED

1.2.3 Maximum Drift

Maximum drift during measurements	-0.25 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	AMPS 800	CDMA 800 (IS-95/IS-2000)
Modulation Mode	FM	QPSK
Duty Cycle	1	1
Transmitter Frequency Range (MHz)	824.04 - 848.97	824.70 – 848.31

2.1 Picture of the Device

2.2 Description of the Antenna

The device has an external retractable antenna. It also has an internal patch antenna.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Period of measurement:	Mar 22, 2004 to Mar 25, 2004
Ambient temperature (°C):	20.0 to 23.0
Ambient humidity (RH %):	30 % to 60 %

3.2 Test Signal, Frequencies, and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.

The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence. In all operating bands the measurements were performed on lowest, middle and highest channels.

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

4. DESCRIPTION OF THE TEST EQUIPMENT

4.1 Measurement System and Components

The measurements were performed using an automated near-field scanning system, DASY 3 software version 13.1 4-3100, 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 DAE4	604	12 months	10/2004
E-field Probe ET3DV6	1739	12 months	01/2005
Dipole Validation Kit, D835V2	479	24 months	11/2005
Dipole Validation Kit, D1800V2	215	24 months	01/2006

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration interval	Calibration expiry
Signal Generator	E4436B	US 39260114	24 months	03/2004
Amplifier	Milmega AS0822-8L	1004832	-	-
Power Meter	Agilent E4417A	GB41290918	12 months	11/2004
Power Sensor	Agilent E9327A	US40440164	12 months	02/2005
Power Sensor	Agilent E9327A	US40440896	12 months	11/2004
Call Tester	E5515T	US 40 440119	12 months	02/2005
Vector Network Analyzer	8753ES	MY 40002861	12 months	07/2004
Dielectric Probe Kit	HP85070D	US01440005	-	-

4.1.1 Isotropic E-field Probe 1739

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 simulant

f [MHz]	Description	SAR [W/kg], 1g	Dielectric Parameters		Temp [°C]
			ε_r	σ [S/m]	
835 MHz	Reference result ± 10% window	2.31 2.08 to 2.54	41.2	0.88	N/A
	3/22/04	2.42	40.1	0.89	21.6
	3/23/04	2.40	39.6	0.87	20.4

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 – 2.73	55.0	0.98	N/A
	3/24/04	2.50	54.6	0.96	21.0
	3/25/04	2.53	54.5	0.95	21.5

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 ± 5% window	41.5 39.4 – 43.6	0.90 0.86 – 0.95	N/A
	3/22/04	40.0	0.89	21.6
	3/23/04	39.6	0.87	20.4

Body tissue simulant measurements

f [MHz]	Description	Dielectric Parameters		Temp [°C]
		ε_r	σ [S/m]	
836.5	Recommended value ± 5% window	55.2 52.4 – 58.0	0.97 0.92 – 1.02	N/A
	3/24/04	54.5	0.96	21.0
	3/25/04	54.5	0.96	21.5

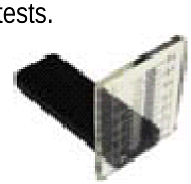
5. DESCRIPTION OF THE TEST PROCEDURE

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 2.2 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.

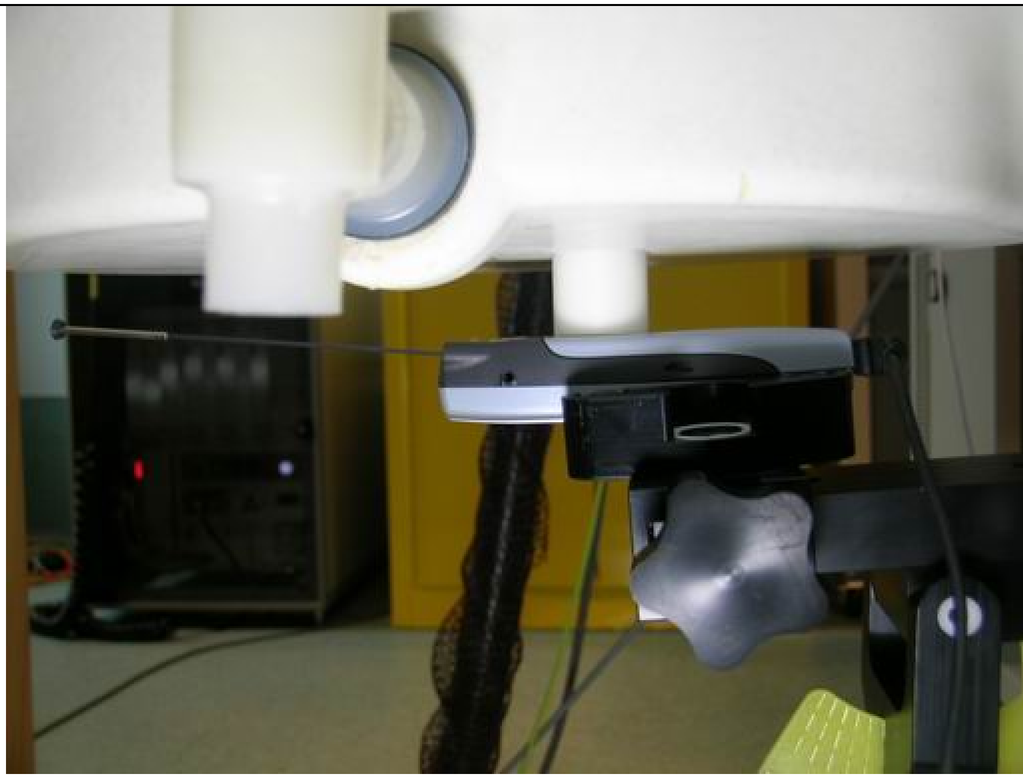


Photo of the device positioned for Body SAR measurement. The spacer was removed for the tests.

5.3 Scan Procedures

First coarse scans were used for determination of the field distribution. Next a cube scan, 5x5x7 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:

800MHz Head SAR results

Mode and Band	Ant Position	Position		SAR, averaged over 1g (W/kg)		
				Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS 800	Retracted	Power level		25.29 dBm	25.31 dBm	25.22 dBm
		Left	Cheek	0.89	1.03	0.98
			Tilt		0.75	
		Right	Cheek	0.94	1.09	1.07
			Tilt		0.75	
AMPS 800	Extended	Power level		25.29 dBm	25.31 dBm	25.22 dBm
		Left	Cheek	1.22	1.21	1.01
			Tilt	0.79	0.80	0.76
		Right	Cheek	1.24	1.15	0.97
			Tilt		0.74	

800MHz Head SAR results

Mode and Band	Ant Position	Position		SAR, averaged over 1g (W/kg)		
				Ch 1013 824.73 MHz	Ch 384 836.52 MHz	Ch 777 848.31 MHz
CDMA 800	Retracted	Power level		24.83 dBm	24.88 dBm	24.85 dBm
		Left	Cheek	0.81	0.92	0.89
			Tilt		0.68	
		Right	Cheek	0.86	0.98	0.96
			Tilt		0.67	
CDMA 800	Extended	Power level		24.83 dBm	24.88 dBm	24.85 dBm
		Left	Cheek	1.14	1.09	0.94
			Tilt		0.73	
		Right	Cheek	1.13	1.05	0.93
			Tilt		0.67	

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

800MHz Body SAR results

Mode and Band	Ant Position	Body-worn location with 2.2 cm space	SAR, averaged over 1g (W/kg)		
			Ch 991 824.04 MHz	Ch 384 836.52 MHz	Ch 799 848.97 MHz
AMPS 800	Retracted	Power level	25.29 dBm	25.31 dBm	25.22 dBm
		Headset HS-9	0.89	0.93	0.90
		Headset HS-5		0.60	
		Headset HS-2R		0.65	
AMPS 800	Extended	Power level	25.29 dBm	25.31 dBm	25.22 dBm
		Headset HS-9		0.62	
		Headset HS-5		0.48	
		Headset HS-2R		0.48	

800MHz Body SAR results

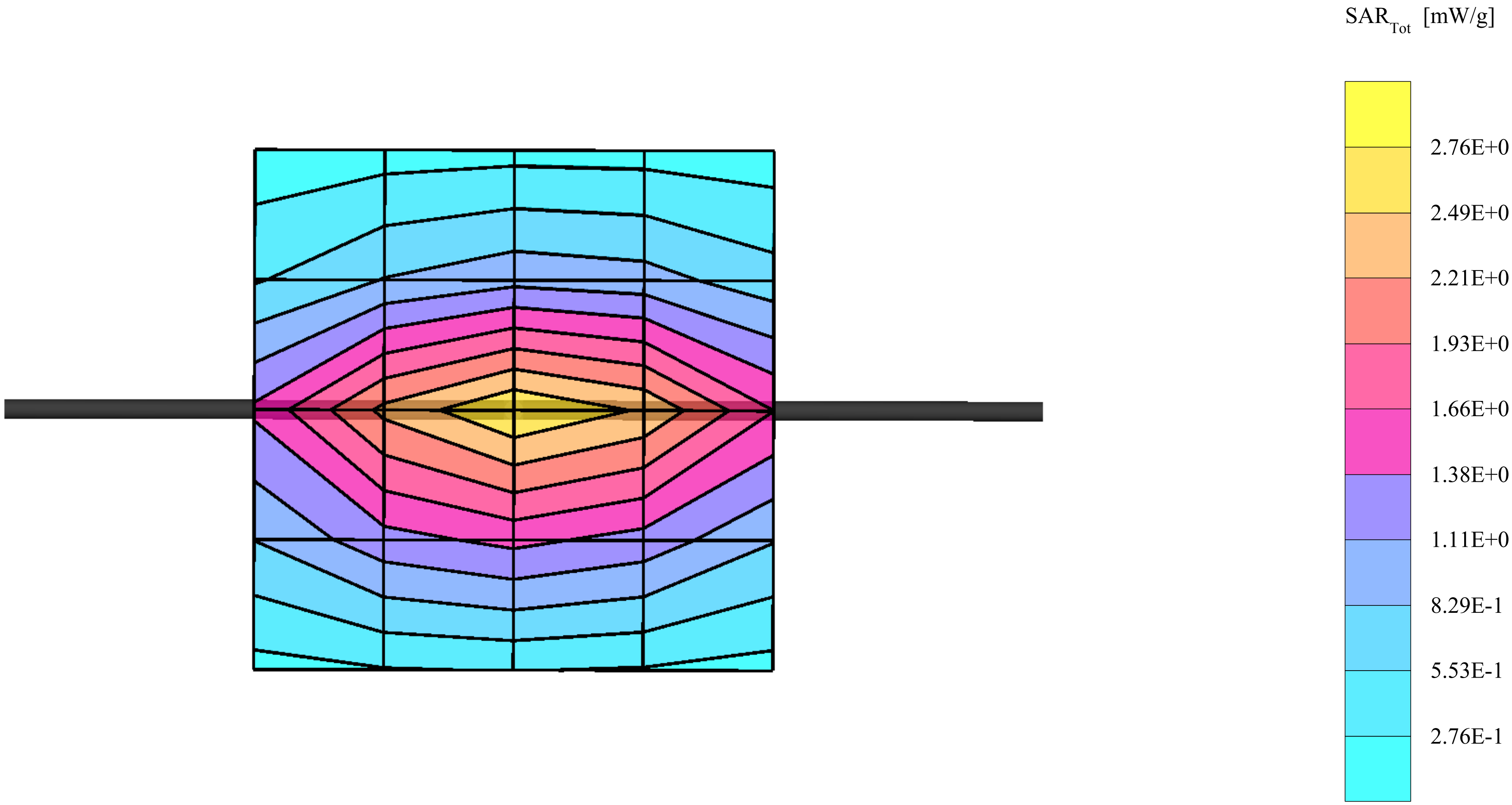
Mode and Band	Front cover option, etc	Body-worn location with 2.2 cm space	SAR, averaged over 1g (W/kg)		
			Ch 1013 824.73 MHz	Ch 384 836.52 MHz	Ch 777 848.31 MHz
CDMA 800	Retracted	Power level	24.83 dBm	24.88 dBm	24.85 dBm
		Headset HS-9	0.83	0.86	0.86
		Headset HS-5		0.51	
		Headset HS-2R		0.54	
CDMA 800	Extended	Power level	24.83 dBm	24.88 dBm	24.85 dBm
		Headset HS-9		0.58	
		Headset HS-5		0.49	
		Headset HS-2R		0.44	

Plots of the Measurement scans are given in Appendix B.

APPENDIX A: VALIDATION SCANS

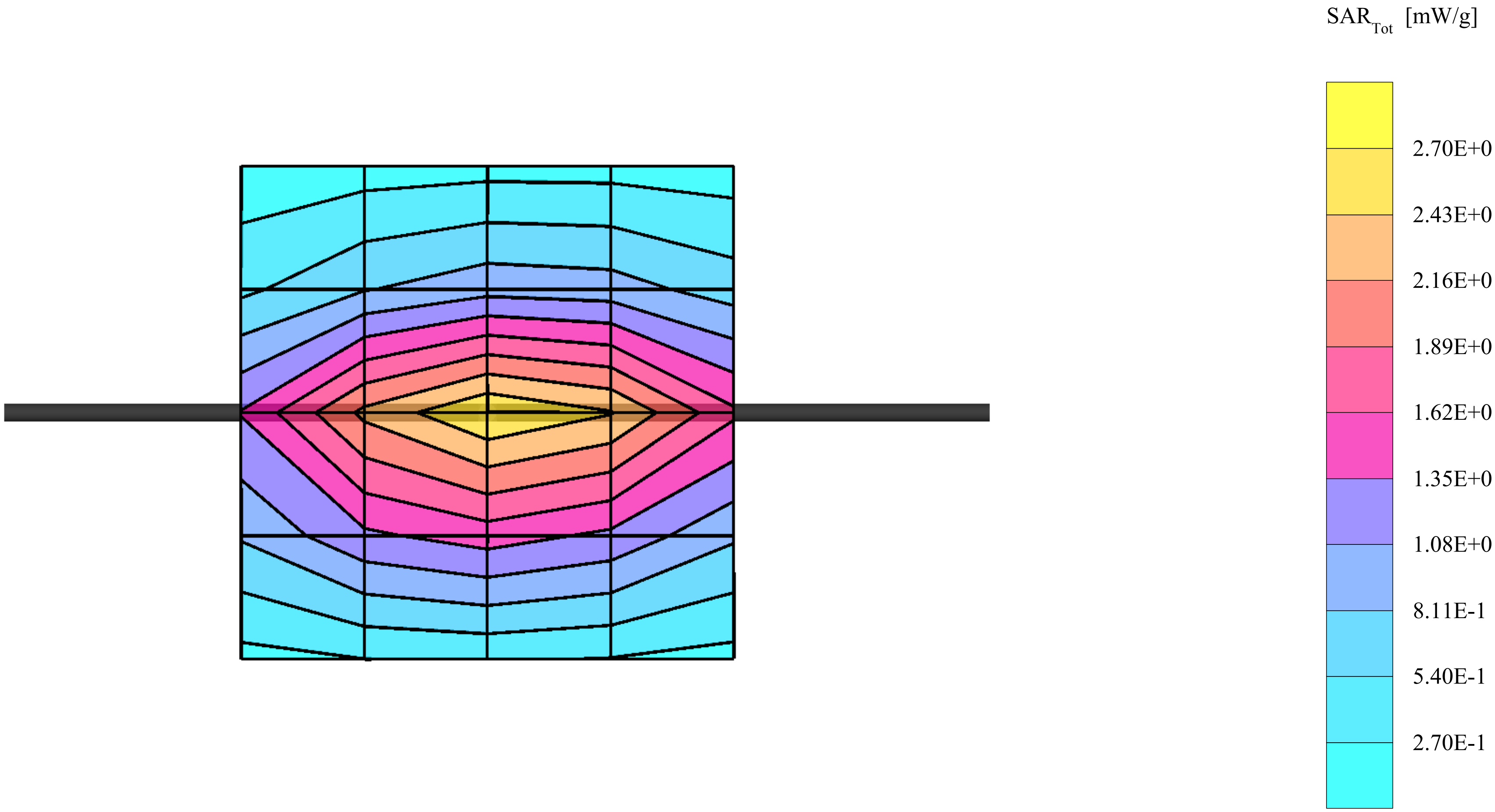
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz, Crest Factor: 1.0
Validation 835 MHz - Brain Tissue: σ = 0.89 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cubes (2): Peak: 3.57 mW/g ± 0.04 dB, SAR (1g): 2.42 mW/g ± 0.03 dB, SAR (10g): 1.60 mW/g ± 0.03 dB, (Advanced extrapolation)
Penetration depth: 13.3 (12.9, 13.8) [mm]
Powerdrift: -0.02 dB
Liquid Temperature (°C): 21.6



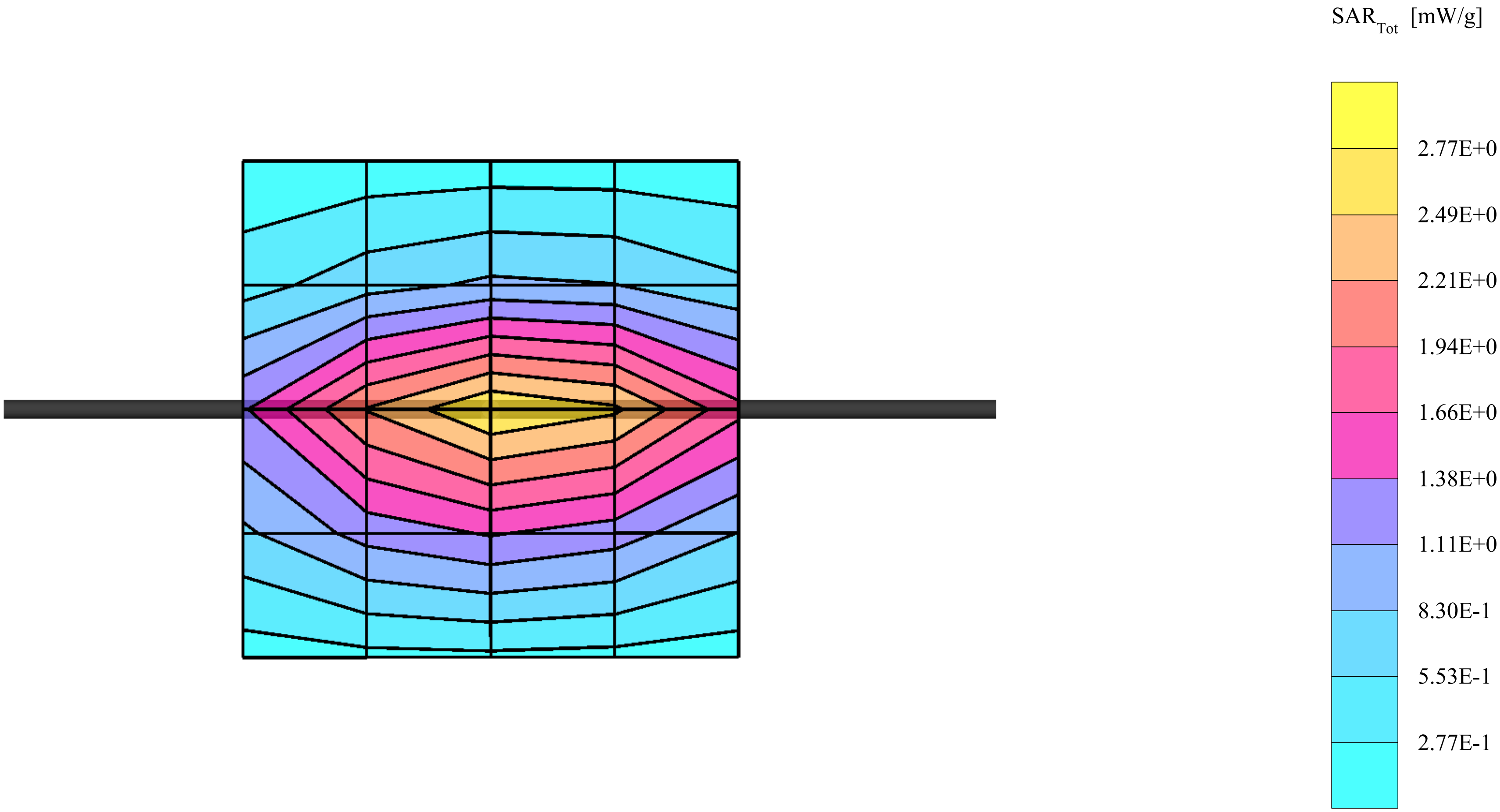
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz, Crest Factor: 1.0
Validation 835 MHz - Brain Tissue: σ = 0.87 mho/m ε_r = 39.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cubes (2): Peak: 3.53 mW/g ± 0.05 dB, SAR (1g): 2.40 mW/g ± 0.04 dB, SAR (10g): 1.58 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 13.3 (13.0, 13.8) [mm]
Powerdrift: -0.02 dB
Liquid Temperature (°C): 20.4



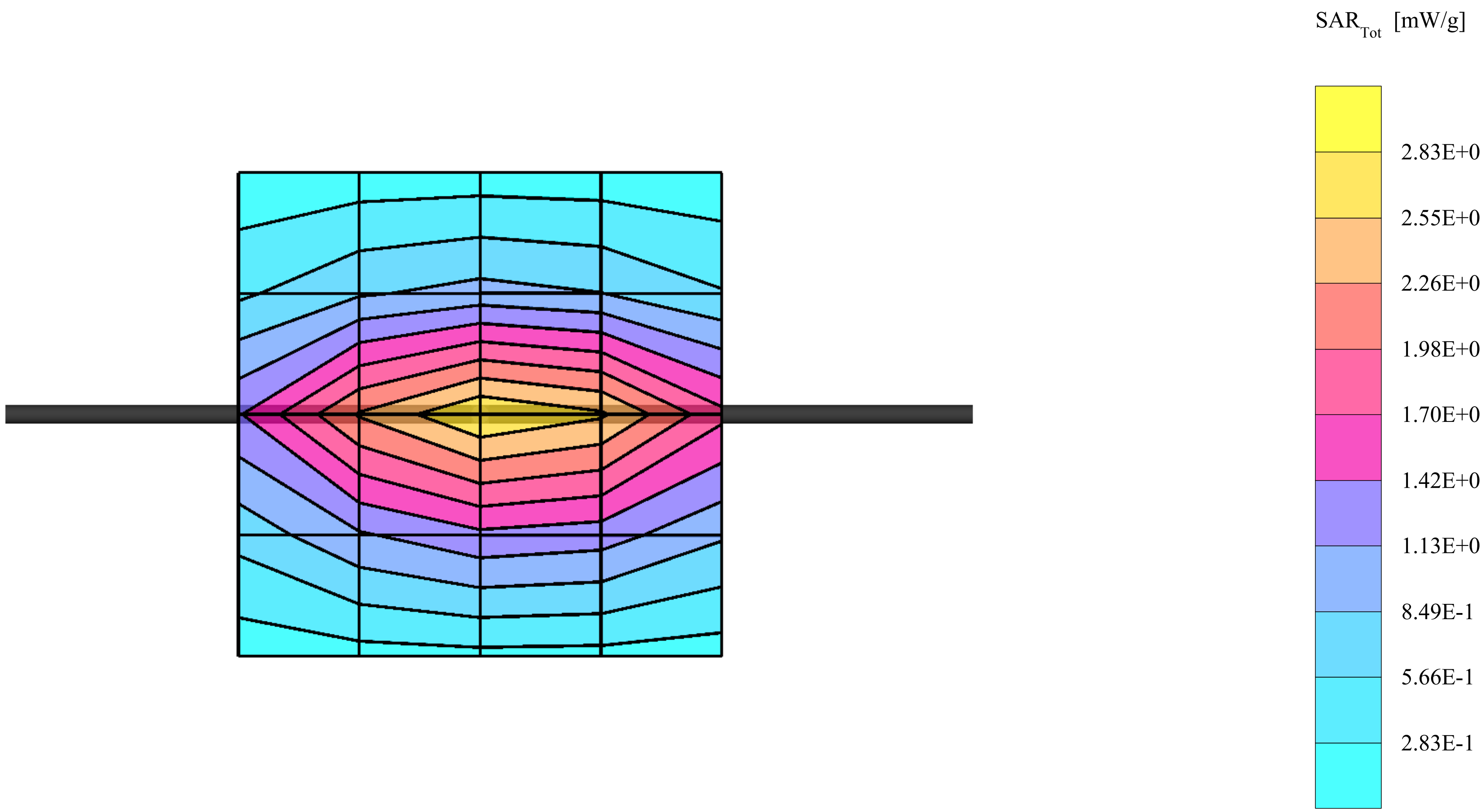
Dipole 835 MHz, Body Validation

SAM 1 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835 MHz - Muscle Tissue: σ = 0.96 mho/m ε_r = 54.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.70,6.70,6.70)
Cubes (2): Peak: 3.64 mW/g ± 0.04 dB, SAR (1g): 2.50 mW/g ± 0.04 dB, SAR (10g): 1.65 mW/g ± 0.04 dB, (Advanced extrapolation)
Penetration depth: 13.8 (13.4, 14.4) [mm]
Powerdrift: 0.01 dB
Liquid Temperature (°C): 21.0



Dipole 835 MHz, Body Validation

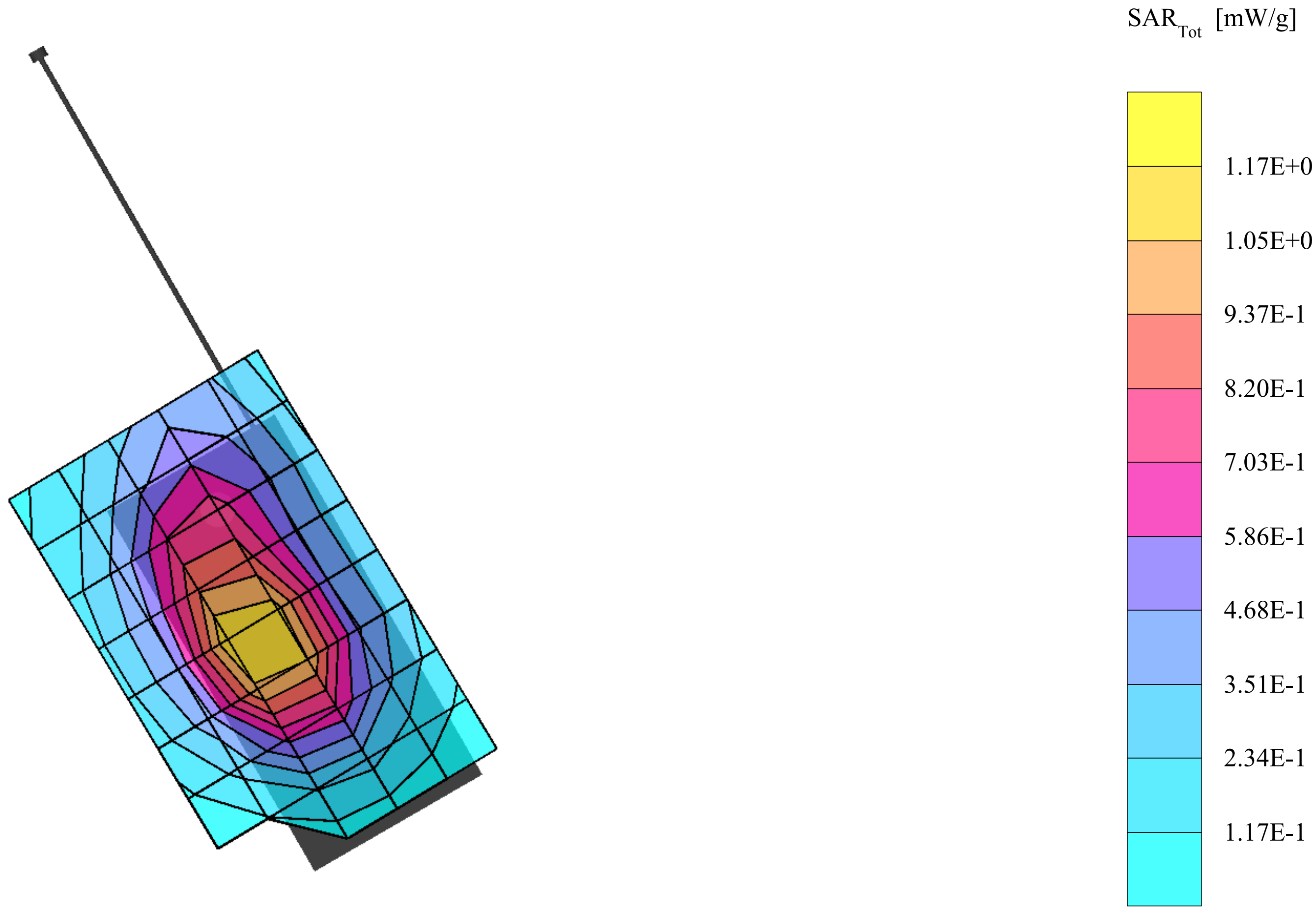
SAM 1 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835 MHz - Muscle Tissue: σ = 0.95 mho/m ε_r = 54.5 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1739; ConvFConvF(6.70,6.70,6.70)
Cubes (2): Peak: 3.69 mW/g ± 0.02 dB, SAR (1g): 2.53 mW/g ± 0.02 dB, SAR (10g): 1.67 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 13.8 (13.3, 14.3) [mm]
Powerdrift: 0.01 dB
Liquid Temperature (°C): 21.5



APPENDIX B: MEASUREMENT SCANS

RM-20, AMPS, Channel 991, Antenna Extended, Right Cheek Position

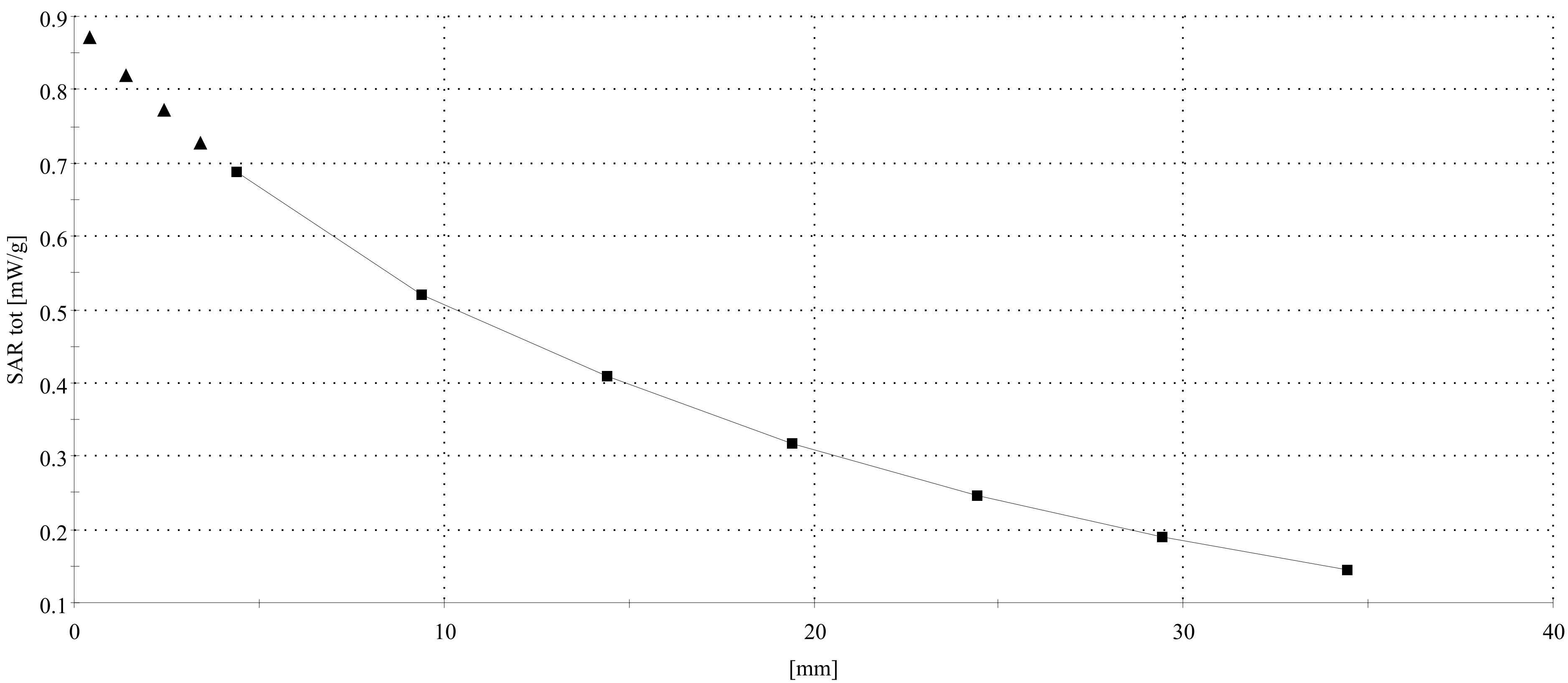
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 1.24 mW/g, SAR (10g): 0.798 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.01 dB
Liquid Temperature (°C): 21.6



RM-20, AMPS, Channel 991, Antenna Extended, Right Cheek Position

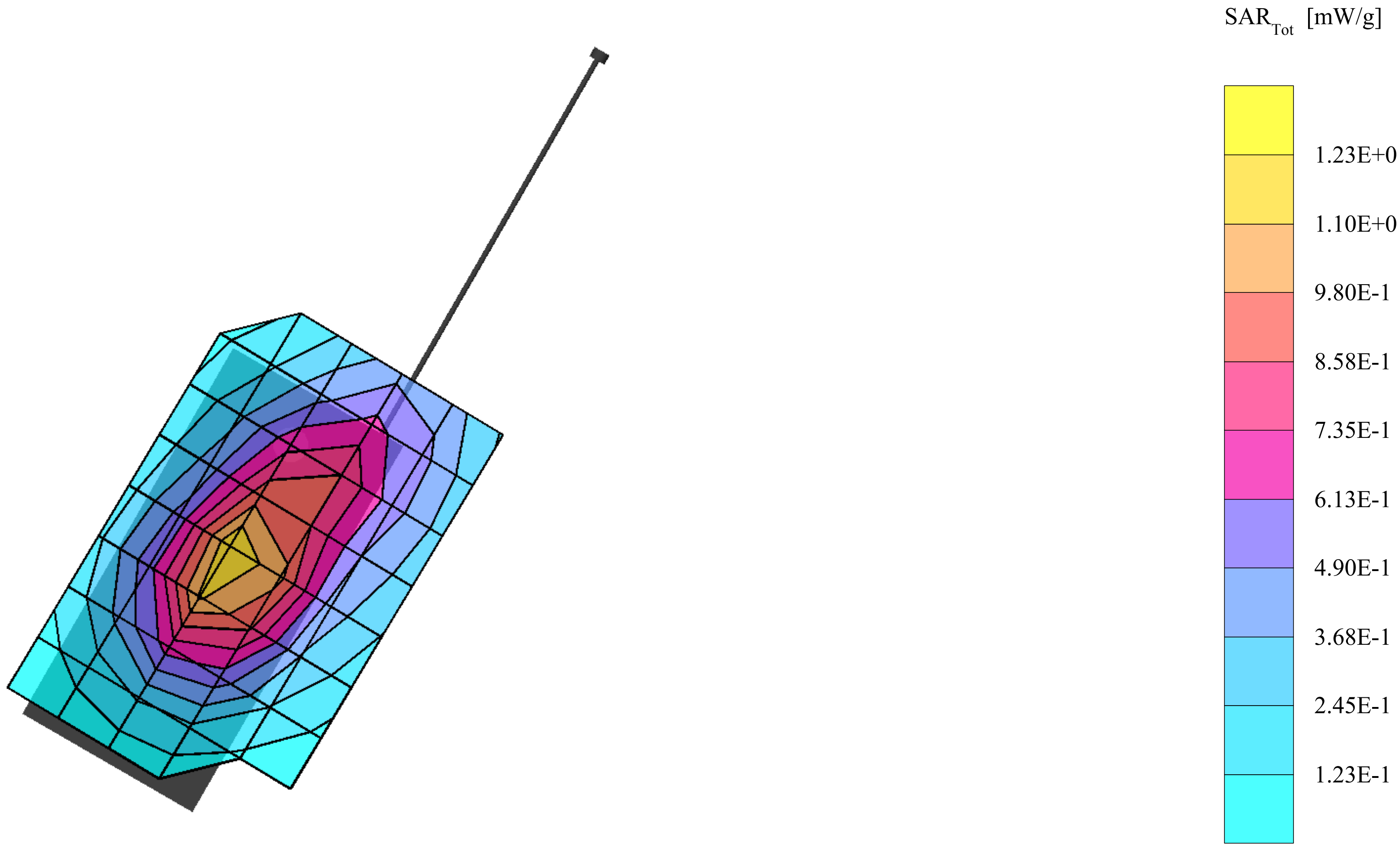
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.0$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 1.24 mW/g, SAR (10g): 0.798 mW/g, (Worst-case extrapolation)
Coarse: Dx = 8.0, Dy = 8.0, Dz = 5.0

Liquid Temperature (°C): 21.6



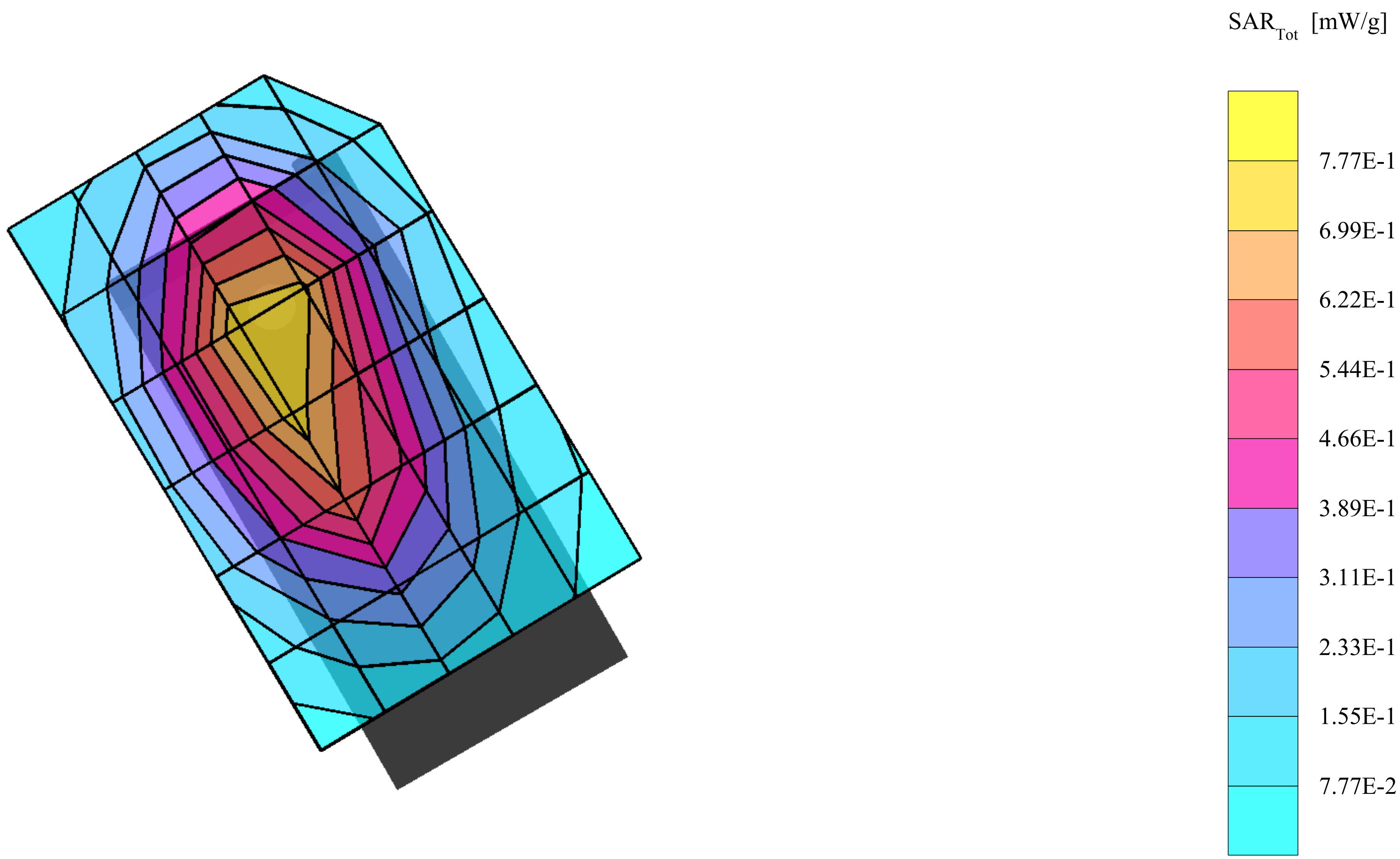
RM-20, AMPS, Channel 991, Antenna Extended, Left Cheek Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 1.22 mW/g, SAR (10g): 0.781 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.08 dB
Liquid Temperature (°C): 21.6



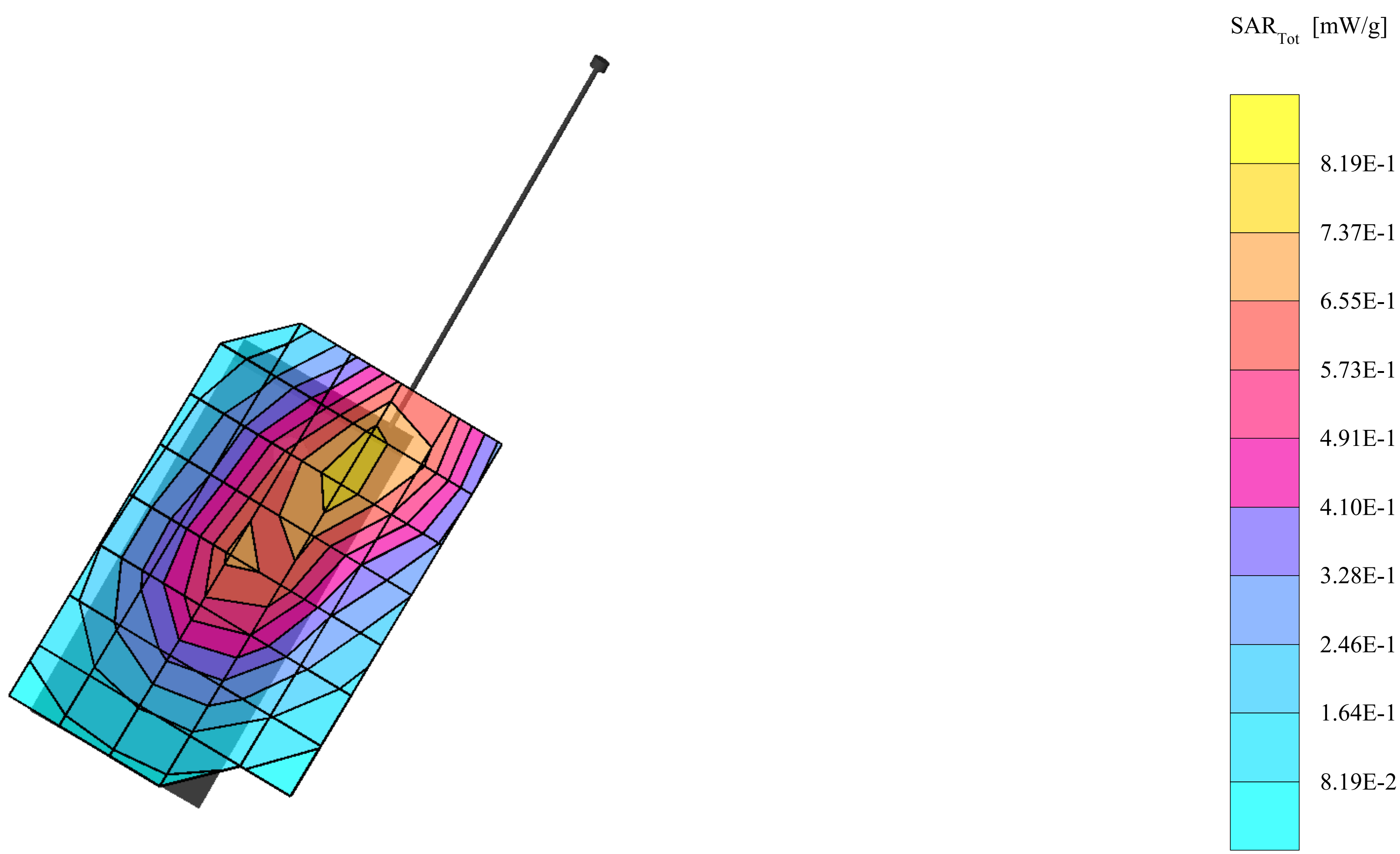
RM-20, AMPS, Channel 384, Antenna Retracted, Right Tilt Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 40.0$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 0.748 mW/g, SAR (10g): 0.484 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.04 dB
Liquid Temperature (°C): 21.6



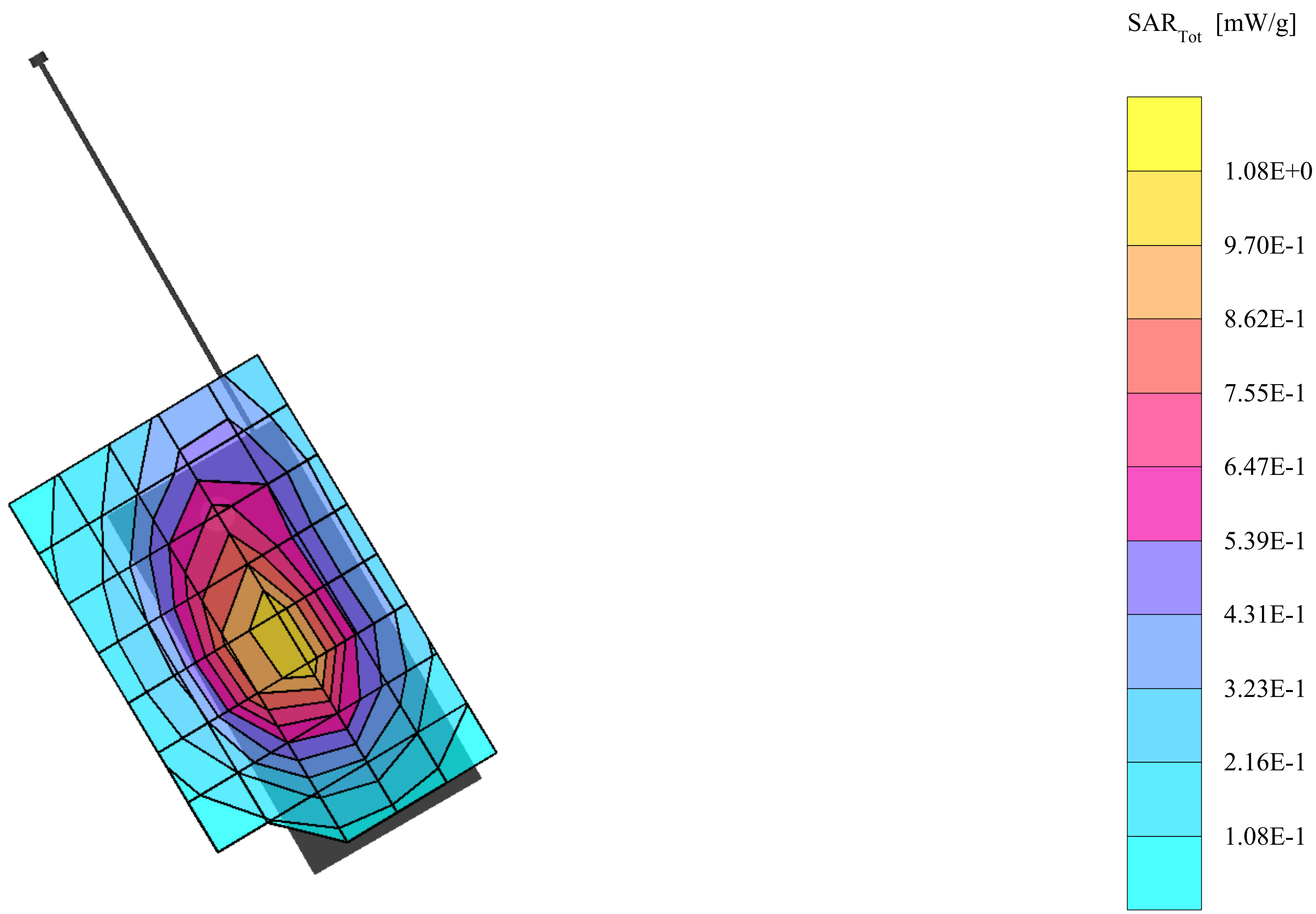
RM-20, AMPS, Channel 384, Antenna Extended, Left Tilt Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.0 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 0.797 mW/g, SAR (10g): 0.496 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.02 dB
Liquid Temperature (°C): 21.6



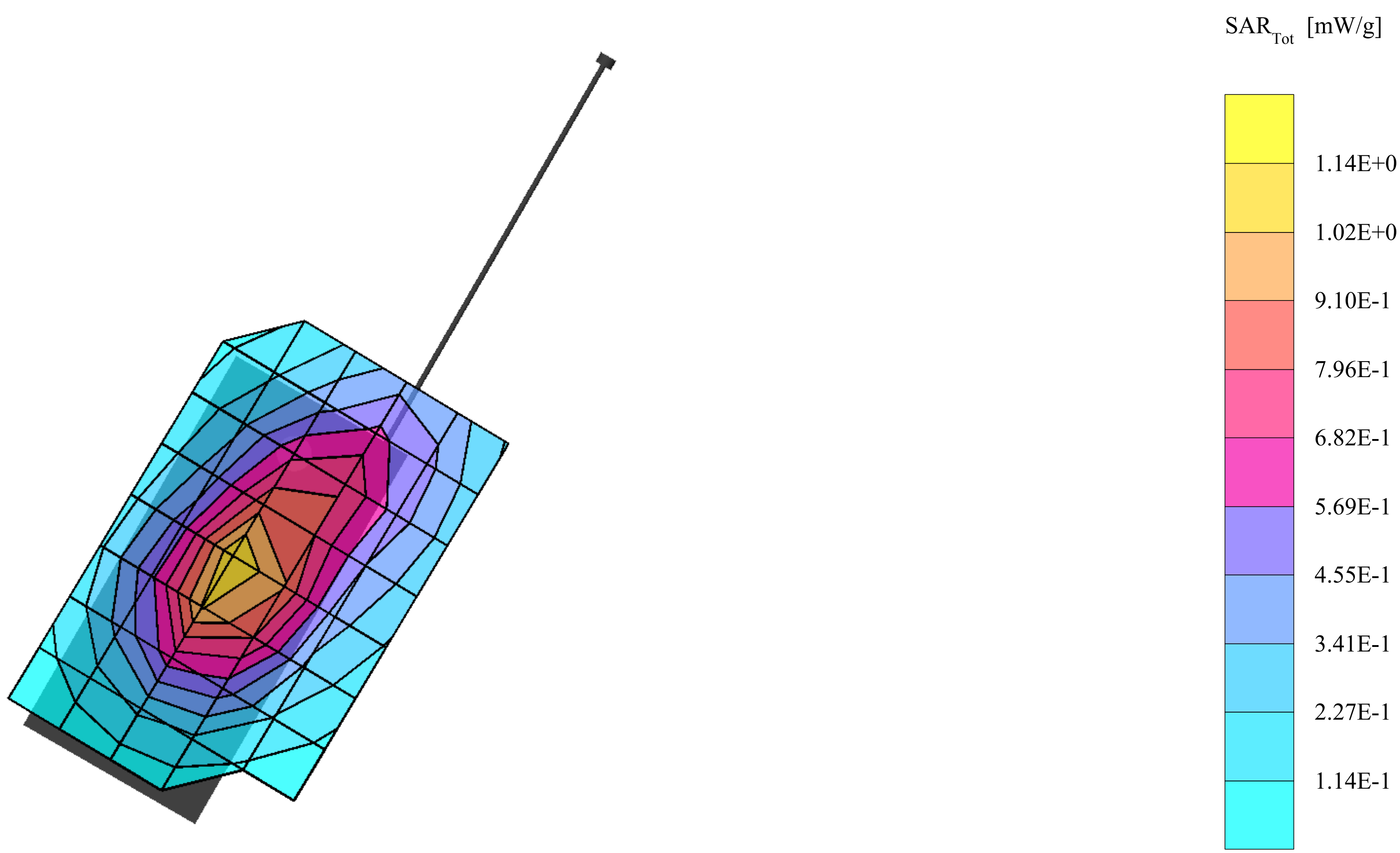
RM-20, CDMA 800, Channel 1013, Antenna Extended, Right Cheek Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 825 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.87 mho/m ε_r = 39.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 1.13 mW/g, SAR (10g): 0.719 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.06 dB
Liquid Temperature (°C): 20.4



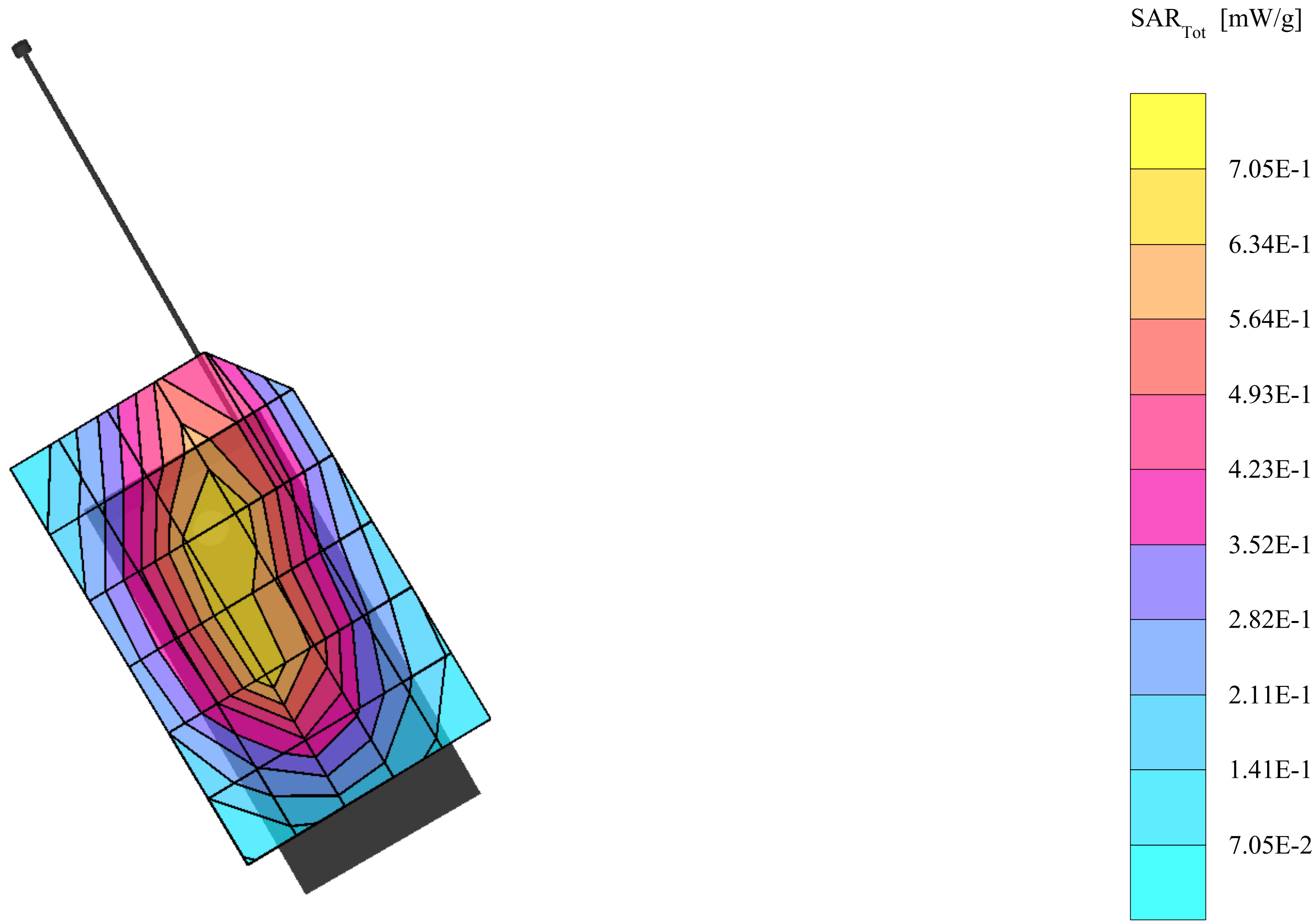
RM-20, CDMA 800, Channel 1013, Antenna Extended, Left Cheek Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 825 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.87 mho/m ε_r = 39.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 1.14 mW/g, SAR (10g): 0.727 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.06 dB
Liquid Temperature (°C): 20.4



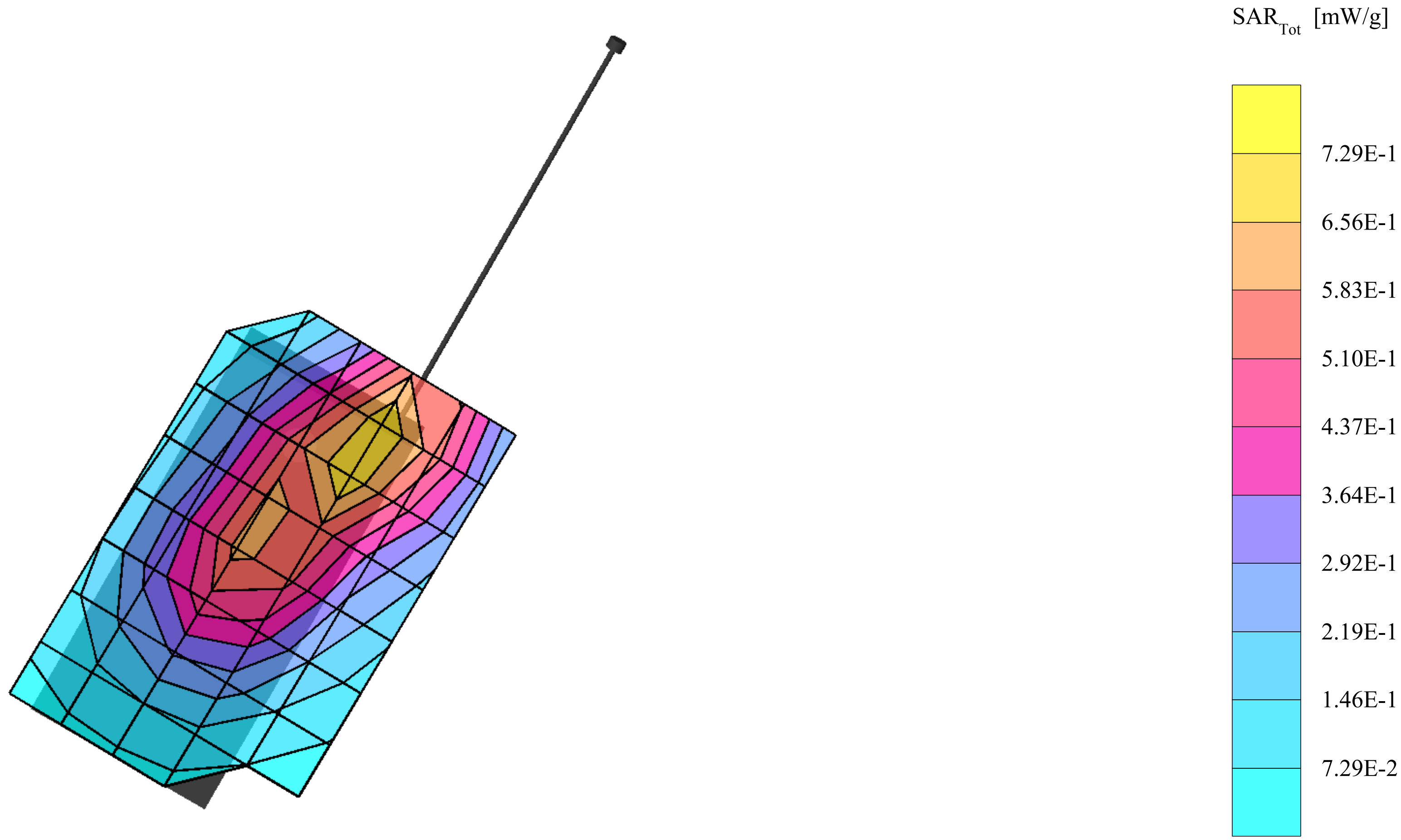
RM-20, CDMA 800, Channel 384, Antenna Extended, Right Tilt Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 39.6$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 0.667 mW/g, SAR (10g): 0.445 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.03 dB
Liquid Temperature (°C): 20.4



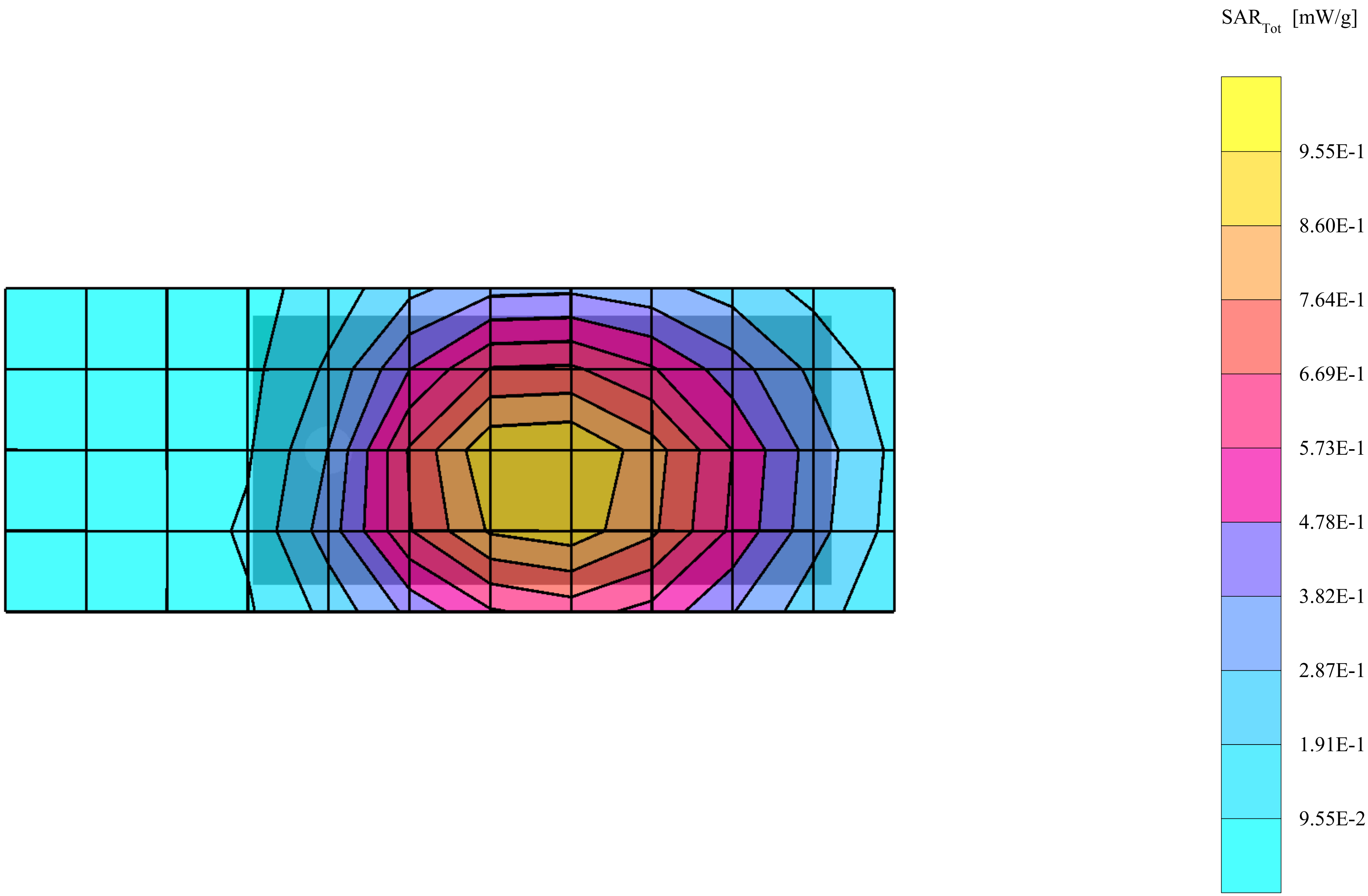
RM-20, CDMA 800, Channel 384, Antenna Extended, Left Tilt Position

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 39.6$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.90,6.90,6.90)
Cube 5x5x7: SAR (1g): 0.731 mW/g, SAR (10g): 0.446 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.06 dB
Liquid Temperature (°C): 20.4



RM-20 with HS-9, AMPS, Channel 384, Antenna Retracted, Body Position

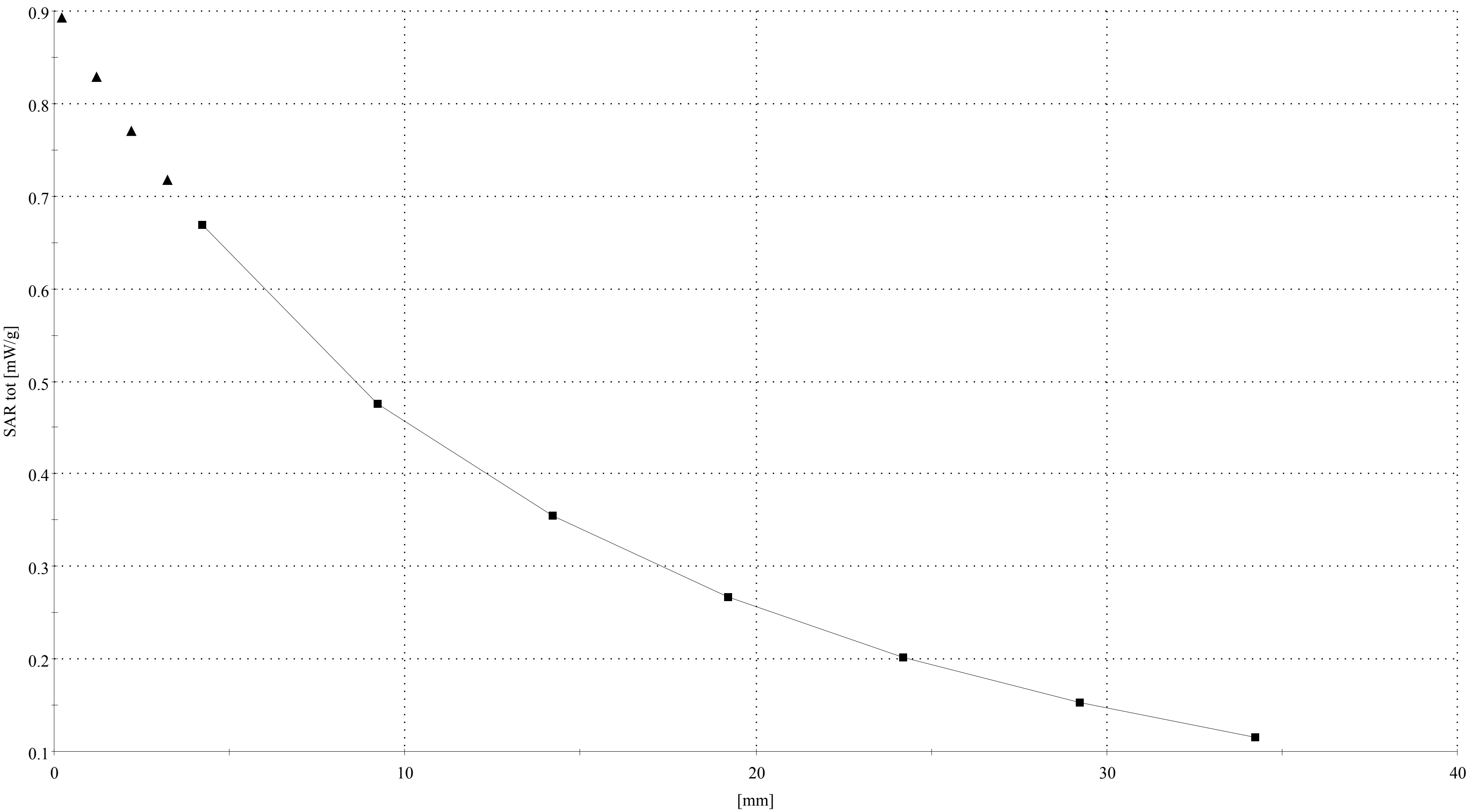
SAM 1 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.96 mho/m ε_r = 54.5 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.70,6.70,6.70)
Cube 5x5x7: SAR (1g): 0.930 mW/g, SAR (10g): 0.668 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB
Liquid Temperature (°C): 21.0



RM-20 with HS-9, AMPS, Channel 384, Antenna Retracted, Body Position

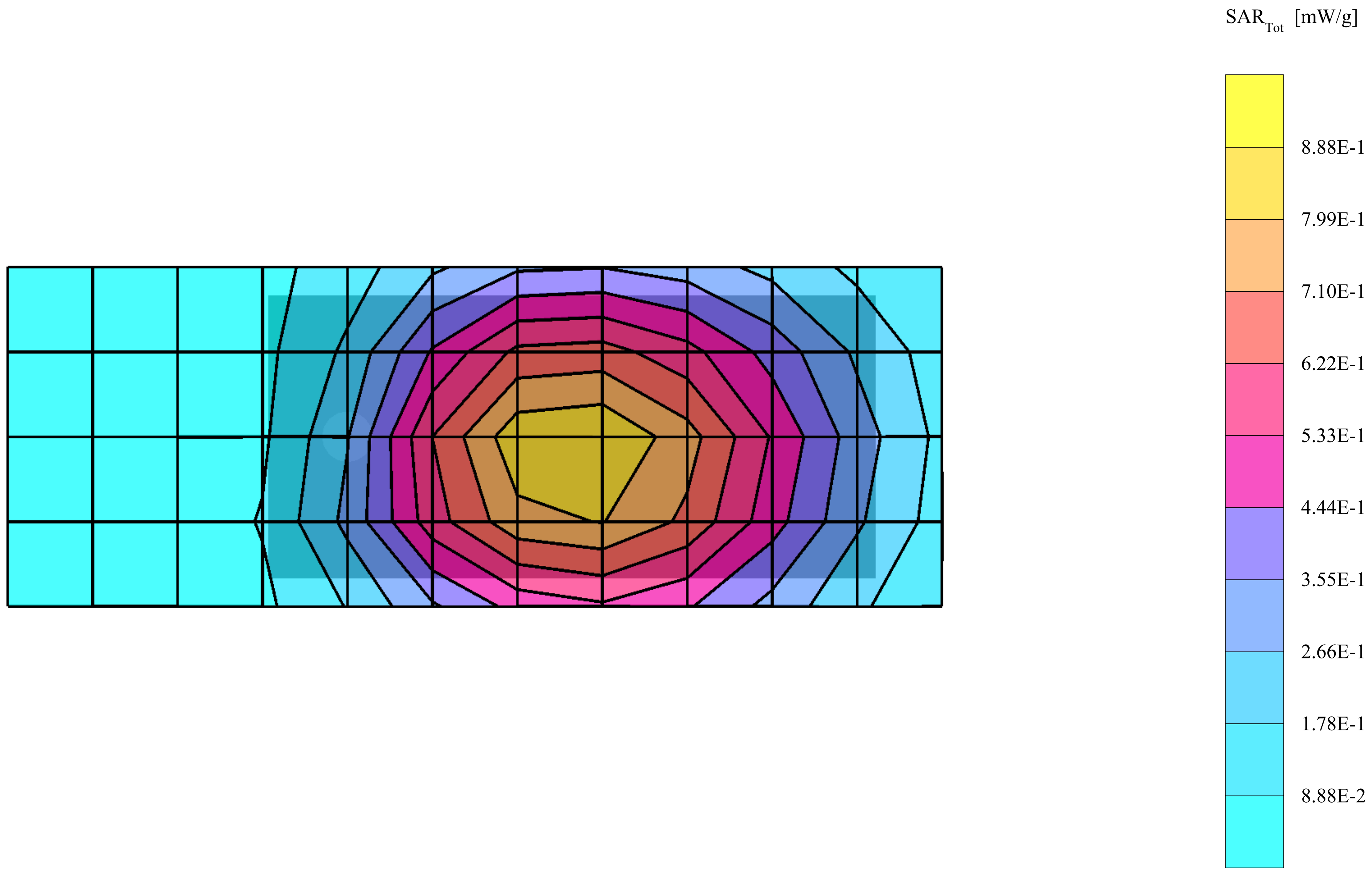
SAM 1 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.96 mho/m ε_r = 54.5 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1739; ConvFConvF(6.70,6.70,6.70)
Cube 5x5x7: SAR (1g): 0.930 mW/g, SAR (10g): 0.668 mW/g, (Worst-case extrapolation)
Coarse: Dx = 8.0, Dy = 8.0, Dz = 5.0

Liquid Temperature (°C): 21.0



RM-20 with HS-9, CDMA 800, Channel 384, Antenna Retracted, Body Position

SAM 1 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.96 mho/m ε_r = 54.5 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1739; ConvFConvF(6.70,6.70,6.70)
Cube 5x5x7: SAR (1g): 0.859 mW/g, SAR (10g): 0.617 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.01 dB
Liquid Temperature (°C): 21.0



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

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

Client **Nokia San Diego**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1739
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	November 19, 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	D. Vetterli
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: November 21, 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.

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

Client **Nokia SD**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1739 (Additional Conversion Factors)
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	January 21, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Date issued: January 22, 2004

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

DASY - Parameters of Probe: ET3DV6 SN:1739

Sensitivity in Free Space

NormX	**1.64** $\mu V/(V/m)^2$	
NormY	**1.50** $\mu V/(V/m)^2$	
NormZ	**1.56** $\mu V/(V/m)^2$	

Diode Compression[A]

DCP X	**97**	mV
DCP Y	**97**	mV
DCP Z	**97**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

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

Sensor Cener to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	7.8	4.2
SAR_{be} [%]	With Correction Algorithm	0.0	0.0

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

Sensor to Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	15.3	11.6
SAR_{be} [%]	With Correction Algorithm	0.0	0.0

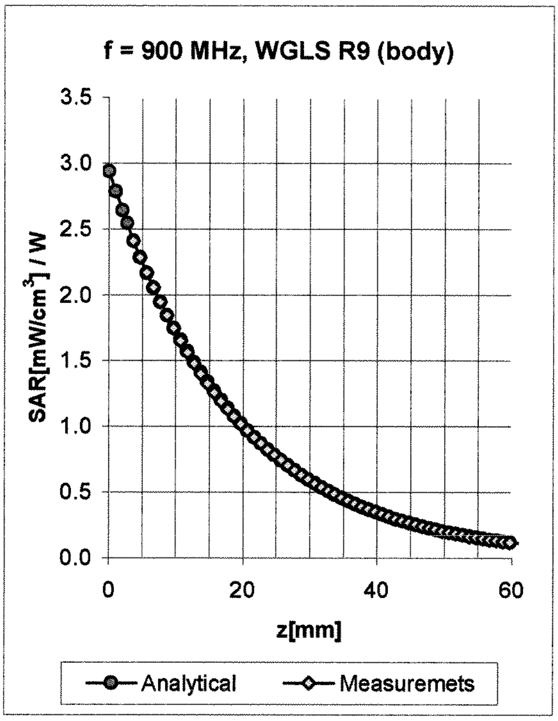
Sensor Offset

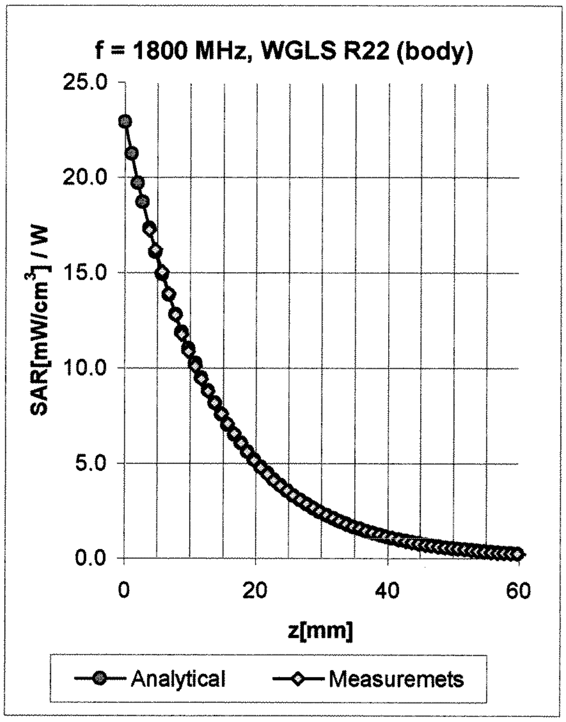
Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

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

[A] numerical linearization parameter: uncertainty not required

Conversion Factor Assessment





f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.54	1.83	6.70	± 11.3% (k=2)
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.50	2.88	4.94	± 11.7% (k=2)

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

DASY - Parameters of Probe: ET3DV6 SN:1739

Sensitivity in Free Space

NormX	**1.64**	$\mu V/(V/m)^2$
NormY	**1.50**	$\mu V/(V/m)^2$
NormZ	**1.56**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**97**	mV
DCP Y	**97**	mV
DCP Z	**97**	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	6.9 ± 9.5% (k=2)		Boundary effect:	
ConvF Y	6.9 ± 9.5% (k=2)		Alpha	**0.32**
ConvF Z	6.9 ± 9.5% (k=2)		Depth	**2.61**

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	5.6 ± 9.5% (k=2)		Boundary effect:	
ConvF Y	5.6 ± 9.5% (k=2)		Alpha	**0.46**
ConvF Z	5.6 ± 9.5% (k=2)		Depth	**2.58**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	8.9	5.1
SAR_{be} [%]	With Correction Algorithm	0.3	0.5

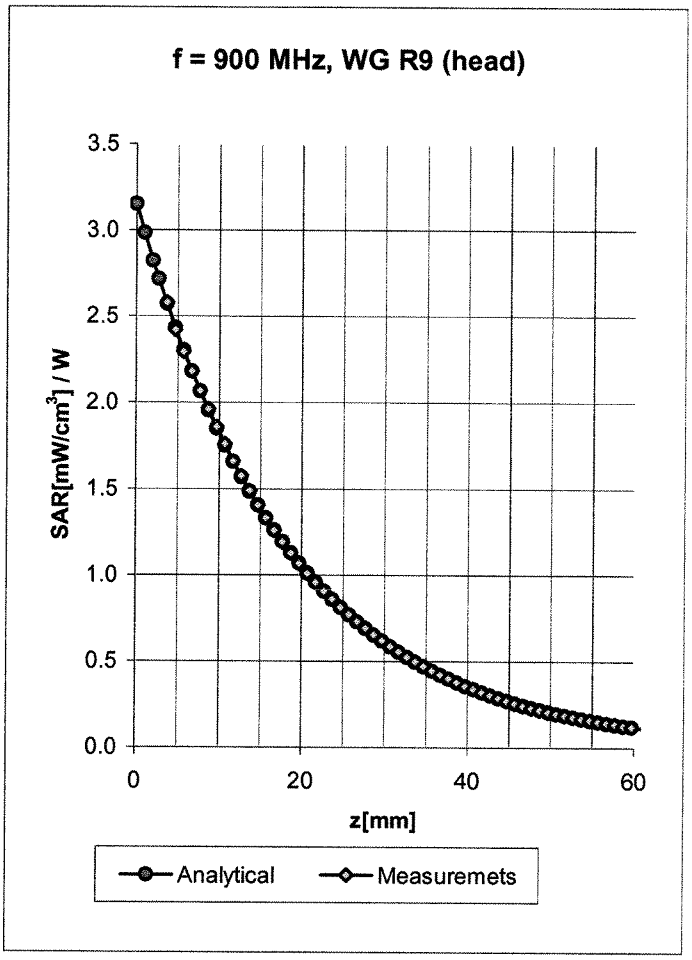
Head **1800** MHz **Typical SAR gradient: 10 % per mm**

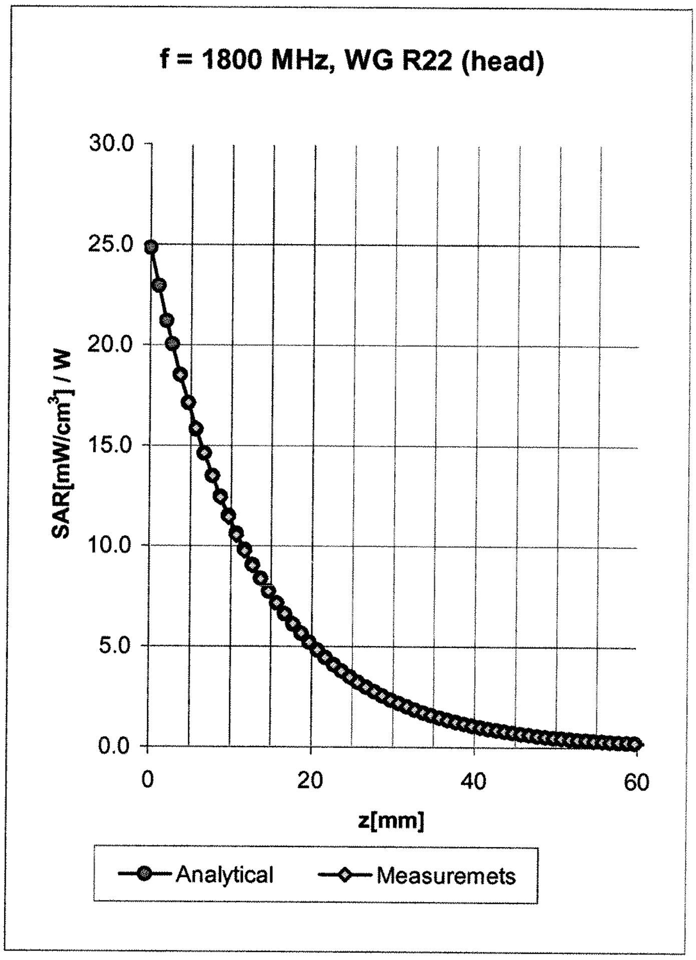
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	12.2	8.3
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

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

Conversion Factor Assessment





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	6.9 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.9 ± 9.5% (k=2)	Alpha	**0.32**
ConvF Z	6.9 ± 9.5% (k=2)	Depth	**2.61**

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	5.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.6 ± 9.5% (k=2)	Alpha	**0.46**
ConvF Z	5.6 ± 9.5% (k=2)	Depth	**2.58**

APPENDIX D: RELEVANT PAGES FROM DIPOLE VALIDATION KIT REPORT

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

Client Nokia San Diego

CALIBRATION CERTIFICATE

Object(s)	D835V2 - SN:479
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	November 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 E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
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 (SPEAG, in house check Nov-03)	In house check: Oct 05

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

Date issued: November 20, 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(6.7, 6.7, 6.7)Date/Time: 11/18/03 18:03:34

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN479

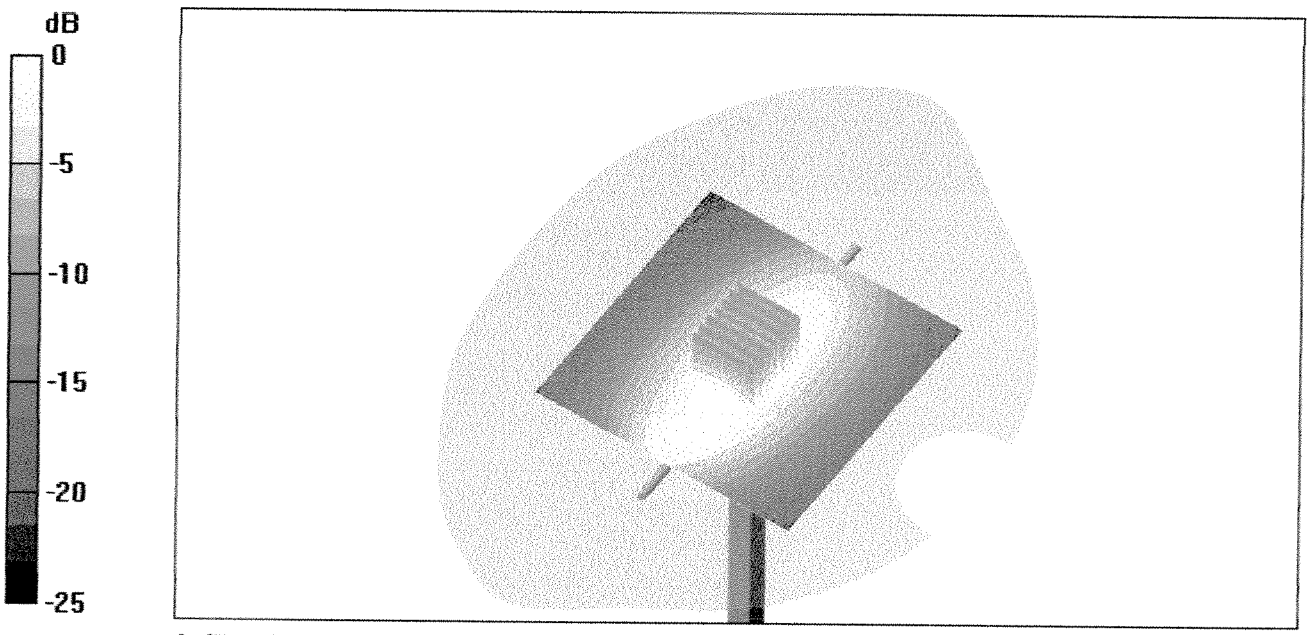
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835 MHz (σ = 0.88 mho/m, ε_r = 41.22, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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, V1.8 Build 60

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 54.6 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 2.47 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.49 W/kg
SAR(1 g) = 2.31 mW/g; SAR(10 g) = 1.51 mW/g
Reference Value = 54.6 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 2.5 mW/g



0 dB = 2.5mW/g

ConvF(6.3, 6.3, 6.3)Date/Time: 11/17/03 14:27:52

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN479

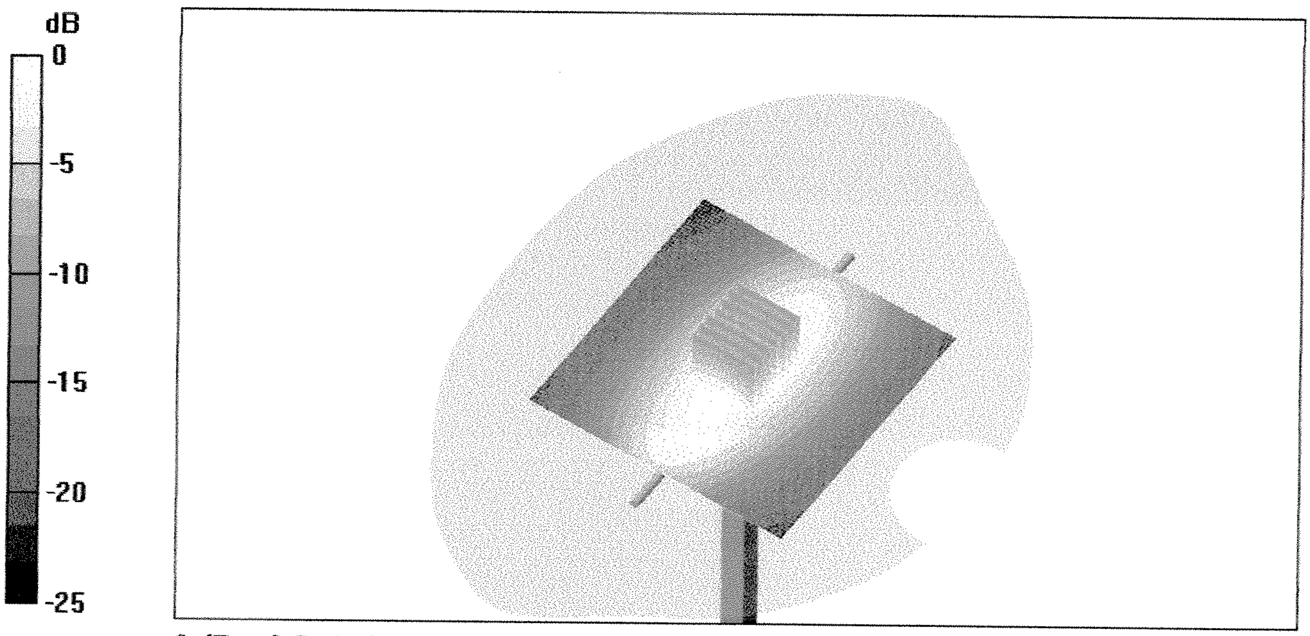
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Muscle 835 MHz (σ = 0.98 mho/m, ε_r = 54.98, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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 = -0.006 dB
Maximum value of SAR = 2.67 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.66 W/kg
SAR(1 g) = 2.48 mW/g; SAR(10 g) = 1.63 mW/g
Reference Value = 54.4 V/m
Power Drift = -0.006 dB
Maximum value of SAR = 2.7 mW/g



0 dB = 2.7mW/g