SAR Compliance Test Report

Test report no.:	03-SA-0122.002	**Date of report:**	14 August, 2003
Number of pages:	99	**Contact person:**	Nerina Walton
		Responsible test engineer:	Nerina Walton
Testing laboratory:	Test & Certification Center (TCC) Dallas Nokia Mobile Phones, Inc 6021 Connection Drive Irving TX 75039, USA Tel. +1 972 894 5000 Fax. +1 972 894 4988	**Client:**	Nokia Mobile Phones, Inc 6021 Connection Drive Irving TX 75039, USA Tel. +1 972 894 5000 Fax. +1 972 894 4988

Tested devices: **GMLRH-14, Model 3560**
BLC-2, BLC-1, HDE-2

Testing has been carried out in accordance with:
IEEE Std 1528-200X, Draft CBD 1.0 - April 4, 2002
Draft Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques
FCC Supplement C Edition, 01-01
Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at Test & Certification Center (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: 14 August, 2003

For the contents:

Alan C. Ewing
TCC Line Manager

Mark Severson
Test Engineer

CONTENTS

1. QUALITY SYSTEM

The quality system in place for TCC-Dallas conforms to ISO/IEC 17025 and has been audited to the standard by A2LA (American Association of Laboratory Accreditation). Appendix D of this report contains the scope of accreditation for A2LA. TCC – Dallas has also been audited using the ISO 9000 Quality System, as part of Nokia Mobile Phones, Inc., by ABS (American Bureau of Shipping) Quality Evaluations Inc.

TCC-Dallas is a recognized laboratory with the Federal Communications Commission in filing applications for Certification under Parts 15 and 18, Registration Number 100060, and Industry Canada, Registration Number IC 661.

2. SUMMARY FOR SAR TEST REPORT

Date of test	21-June-03 to 5-August-03
Contact person	Nerina Walton
Test plan referred to	-
FCC ID	GMLRH-14
Type, SN, HW and SW numbers of tested device	Type: RH-14 ESN: 7201957513, HW: 1102f ESN: 7201941557, HW: 1101f SW: 2.6a
Accessories used in testing	BLC-2 Battery, BLC-1 Battery, HDE-2 Headset
Notes	-
Document code	03-SA-0122.002
Responsible test engineer	N. Walton
Measurement performed by	E.Parish / J. Love

2.1 Maximum Results Found during SAR Evaluation

The equipment is deemed to fulfill the requirements if the measured values are less than or equal to the limit.

Note: this device also operates in TDMA 800 mode however, since these were 'spot-check' measurements and AMPS and TDMA 1900 were considered worst-case, it was determined that testing in the TDMA 800 mode would be unnecessary.

2.1.1 Head Configuration

Mode	Ch / *f* (MHz)	Power (dBm)	Position	Limit (mW/g)	Measured (mW/g)	Result
AMPS	384 / 836.52	24.61	Left Touch	1.6	1.10	**PASSED**
TDMA 1900	1000 / 1880.00	27.61	Left Touch	1.6	0.74	**PASSED**

2.1.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	Power (dBm)	Position	Limit (mW/g)	Measured (mW/g)	Result
AMPS	991 / 824.04	24.75	Flat Back with 22mm Separation Distance	1.6	0.57	**PASSED**
TDMA 1900	1000 / 1880.00	27.61	Flat Back with 22mm Separation Distance	1.6	0.60	**PASSED**

2.1.3 Measurement Uncertainty

Combined Standard Uncertainty	**± 14.5%**
Expanded Standard Uncertainty (k=2)	**± 29.1%**

3. DESCRIPTION OF TESTED DEVICE

Device category	Portable device		
Exposure environment	Uncontrolled exposure		
Unit type	Prototype unit		
Case type	Fixed case		
Mode of Operation	AMPS	TDMA 800	TDMA 1900
Maximum Device Rating	Power Class III	Power Class III	Power Class III
Modulation Mode	Frequency Modulation (FM)	Quadrature Phase Shift Keying	Quadrature Phase Shift Keying
Duty Cycle	1	1/3	1/3
Transmitter Frequency Range (MHz)	824.04 - 848.97	824.04 - 848.97	1850.04 – 1909.92

3.1 Picture of Phone

The tested device, GMLRH-14 is shown below: -

3.2 Description of the Antenna

Type	Internal integrated antenna
Location	Inside the back cover, near the top of the device

3.3 Battery Options

There are two battery options available for the tested device, a BLC-2 and a BLC-1. Both batteries are rechargeable Li-ion.

3.4 Body Worn Operation

Body SAR was evaluated with a minimum separation distance of 22mm and with the HDE-2 headset connected.

4. TEST CONDITIONS

4.1 Ambient Conditions

Ambient temperature (°C)	22±2
Tissue simulating liquid temperature (°C)	20±2
Humidity (%)	49

4.2 RF characteristics of the test site

Tests were performed in a fully enclosed RF shielded environment.

4.3 Test Signal, Frequencies, and Output Power

The device was controlled by using a radio tester. Communication between the device and the tester was established by air link.

Measurements were performed on the lowest, middle and highest channels of the operating band.

The phone was set to maximum power level during all tests and at the beginning of each test the battery was fully charged.

The DASY3 system measures power drift during SAR testing by comparing e-field in the same location at the beginning and at the end of measurement. These records were used to monitor stability of power output.

5. DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with an automated near-field scanning system, DASY3, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland.

Test Equipment	Model	NMP #	Serial Number	Due Date
DASY3, Data Acquisition	DAE V1	2292	389	07/03
E-field Probe	ET3DV6	2954	1504	07/03
DASY3, Data Acquisition	DAE V1	2108	377	11/03
E-field Probe	ET3DV6	2956	1505	09/03
Dipole Validation Kit	D835V2	3745	486	05/04
Dipole Validation Kit	D835V2	3453	455	07/04
Dipole Validation Kit	D1900V2	3457	5d004	07/03

E-field probe and dipole validation kit calibration records are presented in Appendix D.

Additional equipment (required for validation).

Test Equipment	Model	NMP #	Serial Number	Due Date
Signal Generator	HP 8648C	2667	3847U02985	11/03
Amplifier	AR 5S1G4	0188	25583	-
Coupler	AR DC7144	2057	25304	-
Power Meter	Boonton 4232A	0147	26001	07/03
Power Sensor	Boonton 51015	0163	31143	07/03
Power Sensor	Boonton 51015	0164	31144	07/03
Thermometer	Omega CL27	3392	T-228448	07/03
Power Meter	Boonton 4232A	2996	64701	07/04
Power Sensor	Boonton 51015	2997	32187	07/04
Power Sensor	Boonton 51015	2998	32188	07/04
Thermometer	Omega CL27	3391	T-228450	06/04
Network Analyzer	Agilent 8753ES	2605	US39174932	01/04
Dielectric Probe Kit	Agilent 85070C	3089	US99360172	-

The calibration interval on all items listed above can be obtained from the Engineering Services Group within NMP, Product Creation - Dallas. Where relevant, measuring equipment is subjected to in-service checks between testing. TCC - Dallas shall notify clients promptly, in writing, of identification of defective measuring equipment that casts doubt on the validity of results given in this report.

5.1 System Accuracy Verification

The manufacturer calibrates the probes annually. Dielectric parameters of the simulating liquids are measured using an Agilent 85070C dielectric probe kit and an Agilent 8753ES network analyzer.

SAR measurements of the tested device were performed within 24 hours of system accuracy verification, which was done using the dipole validation kit.

The dipole antenna's, which are manufactured by Schmid & Partner Engineering AG, are matched to be used near a flat phantom filled with tissue simulating solution. Length of the 835MHz dipole is 161mm with an overall height of 330mm; length of the 1900MHz dipole is 68mm with an overall height of 300mm. A specific distance holder is used in the positioning to ensure correct spacing between the phantom and the dipole.

A power level of 250 mW was supplied to the dipole antenna placed under the flat section of the SAM phantom. Validation results are in the table below and a print out of the validation tests are presented in Appendix B. All the measured parameters were within specification.

5.1.1 Head Tissue

Tissue	f (MHz)	Description	SAR (W/kg), 1g	Dielectric Parameters		Temp (°C)
				ε_r	σ (S/m)	
Head	835	21-June-03	10.0	40.9	0.89	21.1
		22-June-03	10.4	41.9	0.92	21.1
		23-June-03	9.8	41.7	0.91	20.9
		24-June-03	10.6	40.8	0.90	21.3
		25-June-03	10.3	41.9	0.91	21.1
		Reference Result	10.1	41.7	0.89	N/A
Head	1900	27-June-03	42.4	41.5	1.47	21.0
		02-July-03	43.6	40.9	1.48	20.5
		17-July-03	46.0	40.1	1.47	19.6
		Reference Result	42.8	38.5	1.44	N/A

5.1.2 Muscle Tissue

Tissue	*f* (MHz)	Description	SAR (W/kg), 1g	Dielectric Parameters		Temp (°C)
				ε_r	σ (S/m)	
Muscle	835	26-June-03	10.0	56.2	0.96	21.6
		Reference Result	10.4	55.4	0.97	N/A
Muscle	1900	15-July-03	40.4	54.1	1.51	19.6
		05-Aug-03	46.4	53.9	1.54	20.5
		Reference Result	43.6	51.9	1.58	N/A

5.2 Tissue Simulants

All dielectric parameters of tissue simulants were measured within 24 hours of SAR measurements. The depth of the tissue simulant in the ear reference point of the phantom was 15cm ± 5mm during all tests. Volume for each tissue simulant was 26 litres.

5.2.1 Head Tissue Simulant

The composition of the brain tissue simulating liquid for 835 MHz is: -

51.07% De-Ionized Water
47.31% Sugar
1.15% Salt
0.23% HEC
0.24% Bactericide

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ε_r	σ (S/m)	
836.52	21-June-03	40.9	0.89	21.1
	22-June-03	41.9	0.92	21.1
	23-June-03	41.6	0.91	20.9
	24-June-03	40.8	0.92	21.3
	25-June-03	41.8	0.91	21.1
	Recommended Values	41.5	0.90	N/A

The composition of the brain tissue simulating liquid for 1900 MHz is: -

44.91% 2-(2-butoxyethoxy) Ethanol
54.88% De-Ionized Water
0.21% Salt

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ε_r	σ (S/m)	
1880	27-June-03	41.6	1.46	21.0
	02-July-03	41.0	1.46	20.5
	17-July-03	40.2	1.45	19.6
	Recommended Values	40.0	1.40	N/A

Recommended values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

5.2.2 Muscle Tissue Simulant

The composition of the muscle tissue simulating liquid for 835 MHz is: -

65.45% De-Ionized Water
34.31% Sugar
0.62% Salt
0.10% Bactericide

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ε_r	σ (S/m)	
836.52	26-June-03	56.1	0.96	21.6
	Recommended Values	55.2	0.97	N/A

The composition of the muscle tissue simulating liquid for 1900 MHz is: -

69.02% De-Ionized Water
30.76% Diethylene Glycol Monobutyl Ether
0.22% Salt

f (MHz)	Description	Dielectric Parameters		Temp (°C)
		ε_r	σ (S/m)	
1880	15-July-03	54.2	1.49	19.6
	05-Aug-03	54.0	1.52	20.5
	Recommended Values	53.3	1.52	N/A

Recommended values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

5.3 Phantoms

"SAM v4.0" phantom", manufactured by SPEAG, was used during the measurement. It has a fiberglass shell integrated into a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. Reference markings on the phantom allow the complete set-up of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

The thickness of phantom shell is 2 mm except for the ear, where an integrated ear spacer provides a 6 mm spacing from the tissue boundary. Manufacturer reports tolerance in shell thickness to be ±0.1mm.

5.4 Isotropic E-Field Probe ET3DV6

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., glycol ether)
Calibration	Calibration certificate in Appendix D
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

6. DESCRIPTION OF THE TEST PROCEDURE

6.1 Test Positions

The device was placed into a holder using a special positioning tool, which aligns the bottom of the device with the holder and ensures that holder contacts only to the sides of the device. After positioning is done, the tool is removed. This method provides standard positioning and separation, and also ensures free space for antenna.

Device holder was provided by SPEAG together with the DASY3.

6.1.1 Against Phantom Head

Measurements were made on both the "left hand" and "right hand" side of the phantom.

The device was positioned against phantom according to OET Bulletin 65 (97-01) Supplement C (01-01). Definitions of terms used in aligning the device to a head phantom are available in IEEE Std 1528-200X "Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

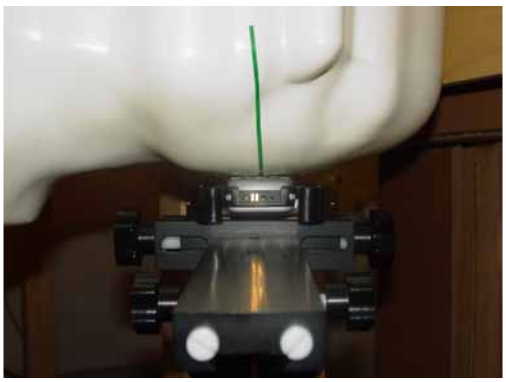
6.1.1.1 Initial Ear Position

The device was initially positioned with the earpiece region pressed against the ear spacer of a head phantom parallel to the "Neck-Front" line defined along the base of the ear spacer that contains the "ear reference point". The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane".

6.1.1.2 Touch Position

"Initial ear position" alignments are maintained and the device is brought toward the mouth of the head phantom by pivoting along the "Neck-Front" line until any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom or when any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.

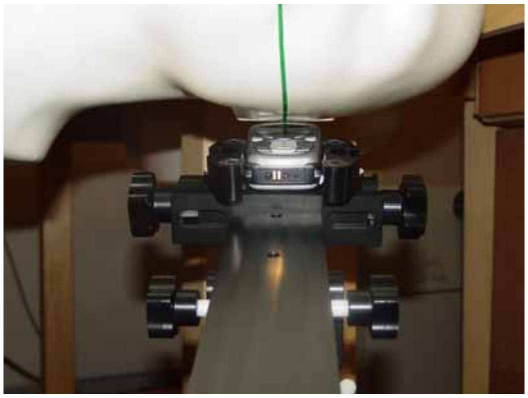
The following picture shows the tested device in the left touch position:



6.1.1.3 Tilt Position

In the "Touch Position", if the earpiece of the device is not in full contact with the phantom's ear spacer and the peak SAR location for the "touch position" is located at the ear spacer region or corresponds to the earpiece region of the handset, the device is returned to the "initial ear position" by rotating it away from the mouth until the earpiece is in full contact with the ear spacer. Otherwise, the device is moved away from the cheek perpendicular to the line passes through both "ear reference points" for approximate 2-3 cm. While it is in this position, the device is tilted away from the mouth with respect to the "test device reference point" by 15°. After the tilt, it is then moved back toward the head perpendicular to the line passes through both "ear reference points" until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process is repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously.

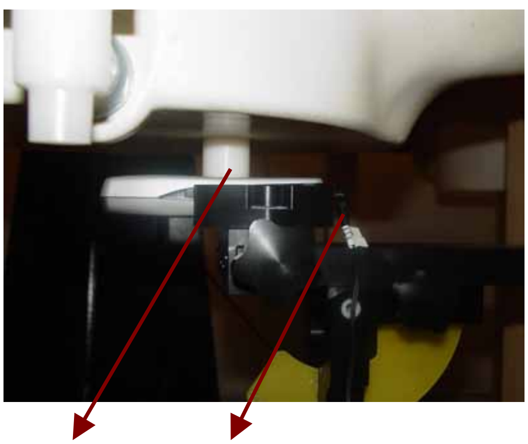
The following picture shows the tested device in the left tilt position:



6.1.2 Body Worn Configuration

Body SAR measurements were performed with the antenna facing towards the flat part of the phantom with a separation distance of 22mm and with the HDE-2 headset connected.

The following picture shows the tested device in the body test position: -



22mm Spacer HDE-2 Headset

Note: the 22mm spacer was removed during the SAR measurement.

6.2 Scan Procedures

First coarse scans are used for quick determination of the field distribution. Next a cube scan, 5x5x7 points; spacing between each point 8x8x5 mm, is performed around the highest E-field value to determine the averaged SAR-distribution over 1g.

6.3 SAR Averaging Methods

The maximum SAR value is averaged over its volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of 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 is based on least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 30 mm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1mm from one another.

7. MEASUREMENT UNCERTAINTY

7.1 Description of Individual Measurement Uncertainty

7.1.1 Assessment Uncertainty

a	*b*	*c*	*d*	*e = f(d,k)*	*F*	*h = c x f / e*	*k*
Uncertainty Component	**Section in P1528.**	**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	$(1\text{-cp})^{1/2}$	±1.9	∞
Hemispherical Isotropy	E2.2	±9.6	R	√3	$\sqrt{c_p}$	±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
a	*b*	*c*	*d*	*e =*	*F*	*h =*	*k*

				f(d,k)		c x f / e	
Uncertainty Component	**Section in P1528.**	**Tol. (%)**	**Prob. Dist.**	**Div.**	c_i	u_i **(%)**	v_i
Measurement System							
Liquid Permittivity Target tolerance	E3.2	±5.0	R	√3	0.6	±1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	±2.9	N	1	0.6	±1.7	5
Combined Standard Uncertainty			RSS			**±14.5**	208
Expanded Uncertainty (95% CONFIDENCE INTERVAL)						**±29.1**	

8. RESULTS

Corresponding SAR distribution print outs of maximum results in every operating mode and position are shown in Appendix C; z-axis plots of the maximum measurement results in head and body worn configurations are also included. The SAR distributions are substantially similar or equivalent to the plots submitted, regardless of used channel in each mode and position unless otherwise presented.

Note: the results recorded in the following tables for head and body are the highest values measured from the two HWID's that were tested.

8.1 Head Configuration

Testing was initially performed on the mid-channel - if the measured SAR value was 0.80mW/g or higher, then testing was also performed on the low and high channels.

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
AMPS	991 / 824.04	24.75	0.93	-	0.90	-
	384 / 836.52	24.61	1.10	0.74	1.07	0.66
	799 / 848.97	24.64	0.97	-	0.95	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
TDMA 1900	2 / 1850.04	27.35	-	-	-	-
	1000 / 1880.00	27.61	0.74	0.71	0.57	0.73
	1998 / 1909.92	26.78	-	-	-	-

Battery Check with BLC-1

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
AMPS	991 / 824.04	24.75	0.78	-	0.76	-
	384 / 836.52	24.61	0.99	0.70	0.98	0.60
	799 / 848.97	24.64	0.91	-	0.89	-

Battery Check with BLC-1

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
TDMA 1900	2 / 1850.04	27.35	-	-	-	-
	1000 / 1880.00	27.61	0.69	0.70	0.58	0.70
	1998 / 1909.92	26.78	-	-	-	-

8.2 Body Worn Configuration

Body SAR measurements were performed with the HDE-2 headset connected.

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
AMPS	991 / 824.04	24.75	0.57
	384 / 836.52	24.61	0.55
	799 / 848.97	24.64	0.54

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
TDMA 1900	2 / 1850.04	27.35	-
	1000 / 1880.00	27.61	0.60
	1998 / 1909.92	26.78	-

Battery Check with BLC-1

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
AMPS	991 / 824.04	24.75	0.46
	384 / 836.52	24.61	-
	799 / 848.97	24.64	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
TDMA 1900	2 / 1850.04	27.35	-
	1000 / 1880.00	27.61	0.58
	1998 / 1909.92	26.78	-

APPENDIX A: SCOPE OF ACCREDITATION FOR A2LA

TCC-Dallas is accredited by the American Association for Laboratory Accreditation (A2LA) as shown in the scope below:

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

NOKIA MOBILE PHONES
Test & Certification Center - Dallas
Irving, TX

for technical competence in the field of

Electrical Testing

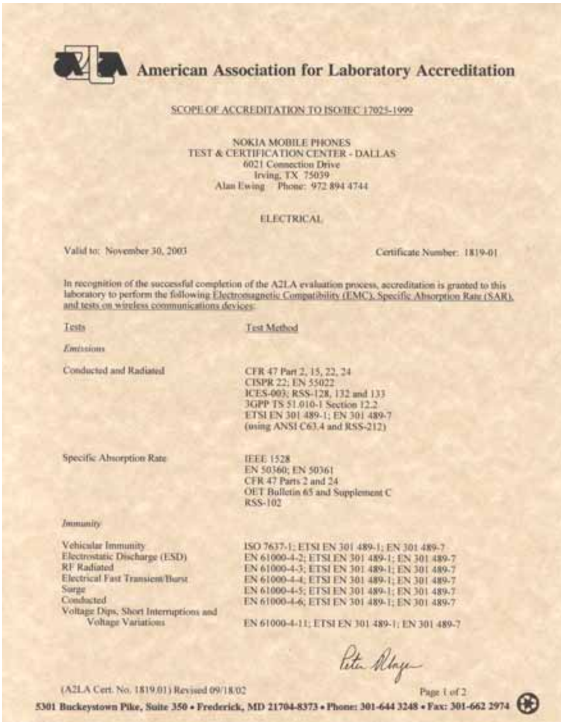
The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002.

Presented this 1st day of October, 2001.

SEAL

President
For the Accreditation Council
Certificate Number 1819.01
Valid to November 30, 2003

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation



American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

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ELECTRICAL

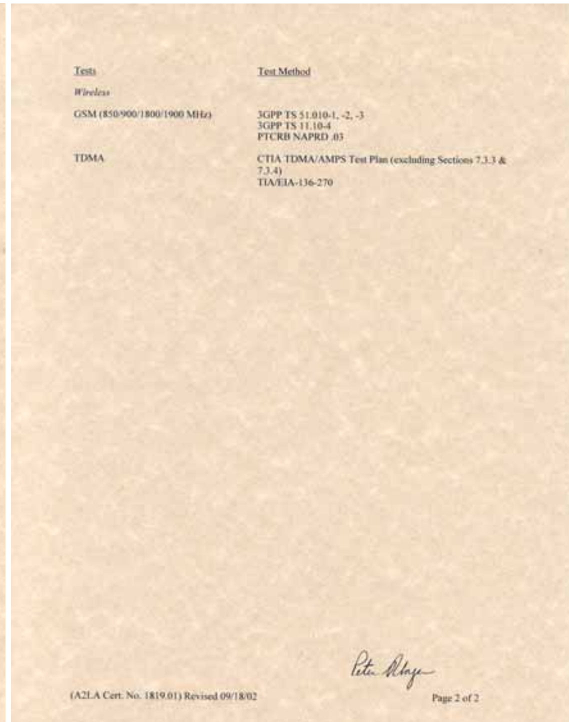
Valid to: November 30, 2003 Certificate Number: 1819-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following Electromagnetic Compatibility (EMC), Specific Absorption Rate (SAR), and tests on wireless communications devices:

Tests	Test Method
Emissions	
Conducted and Radiated	CFR 47 Part 2, 15, 22, 24 CISPR 22; EN 55022 ICES-003; RSS-128, 132 and 133 3GPP TS 51.010-1 Section 12.2 ETSI EN 301 489-1; EN 301 489-7 (using ANSI C63.4 and RSS-212)
Specific Absorption Rate	IEEE 1528 EN 50360; EN 50361 CFR 47 Parts 2 and 24 OET Bulletin 65 and Supplement C RSS-102
Immunity	
Vehicular Immunity	ISO 7637-1; ETSI EN 301 489-1; EN 301 489-7
Electrostatic Discharge (ESD)	EN 61000-4-2; ETSI EN 301 489-1; EN 301 489-7
RF Radiated	EN 61000-4-3; ETSI EN 301 489-1; EN 301 489-7
Electrical Fast Transient/Burst	EN 61000-4-4; ETSI EN 301 489-1; EN 301 489-7
Surge	EN 61000-4-5; ETSI EN 301 489-1; EN 301 489-7
Conducted	EN 61000-4-6; ETSI EN 301 489-1; EN 301 489-7
Voltage Dips, Short Interruptions and Voltage Variations	EN 61000-4-11; ETSI EN 301 489-1; EN 301 489-7

(A2LA Cert. No. 1819.01) Revised 09/18/02 Page 1 of 2

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974



Tests	Test Method
Wireless	
GSM (850/900/1800/1900 MHz)	3GPP TS 51.010-1, -2, -3 3GPP TS 11.10-4 PTCRB NAPRD .03
TDMA	CTIA TDMA/AMPS Test Plan (excluding Sections 7.3.3 & 7.3.4) TIA/EIA-136-270

(A2LA Cert. No. 1819.01) Revised 09/18/02 Page 2 of 2

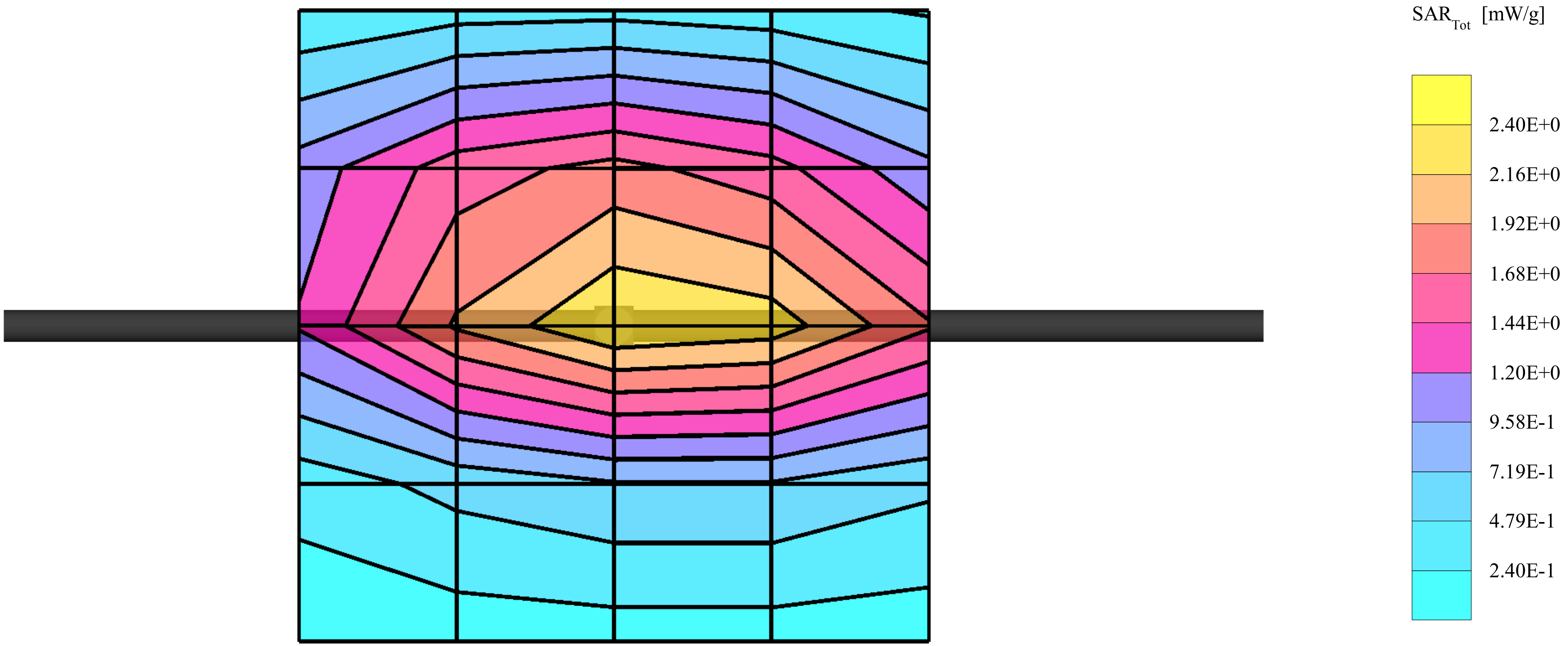
"This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined to be in accordance with the laboratory's terms of accreditation unless stated otherwise in the report."

Should this report contain any data for tests for which we are not accredited, such data would not be covered by this laboratory's A2LA accreditation.

APPENDIX B: VALIDATION TEST PRINTOUTS

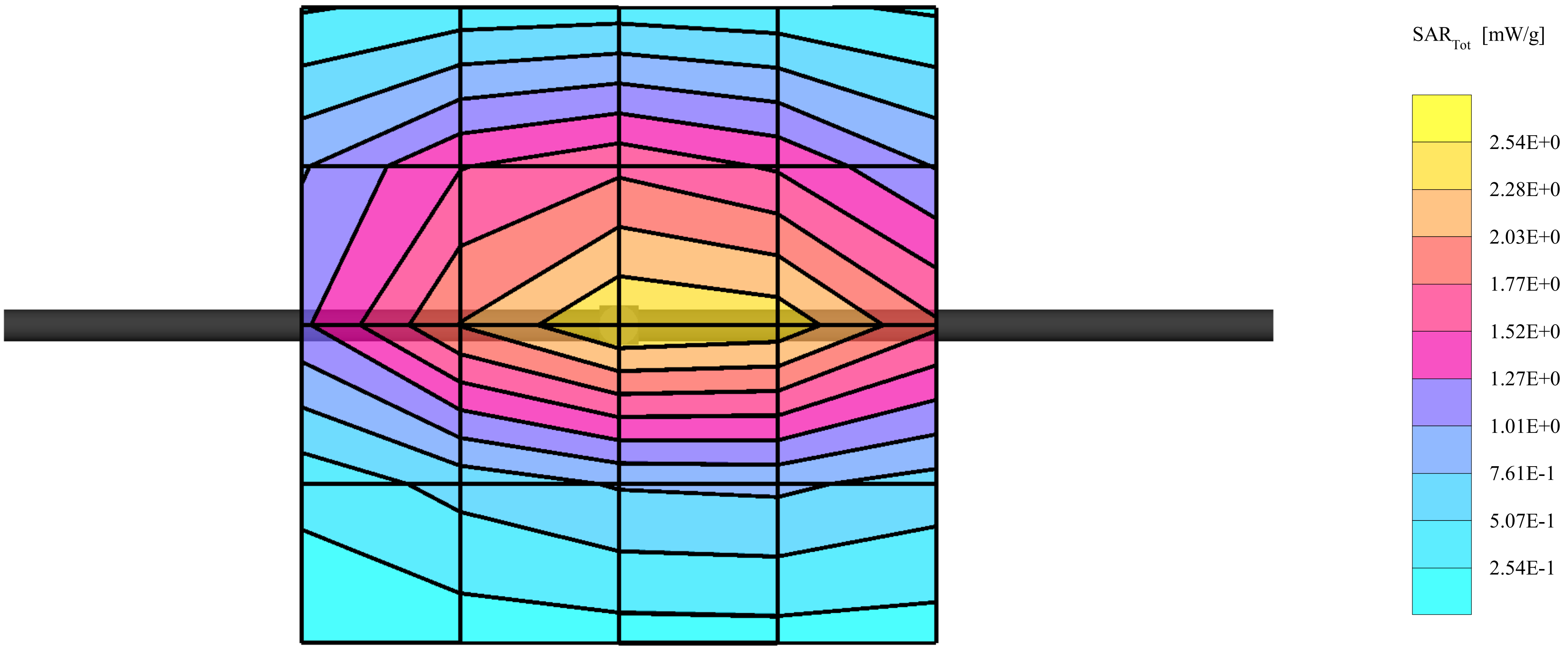
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.89 mho/m ε_r = 40.9 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.50 mW/g ± 0.00 dB, SAR (10g): 1.60 mW/g ± 0.00 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.35 dB
Liquid Temperature (°C): 21.1



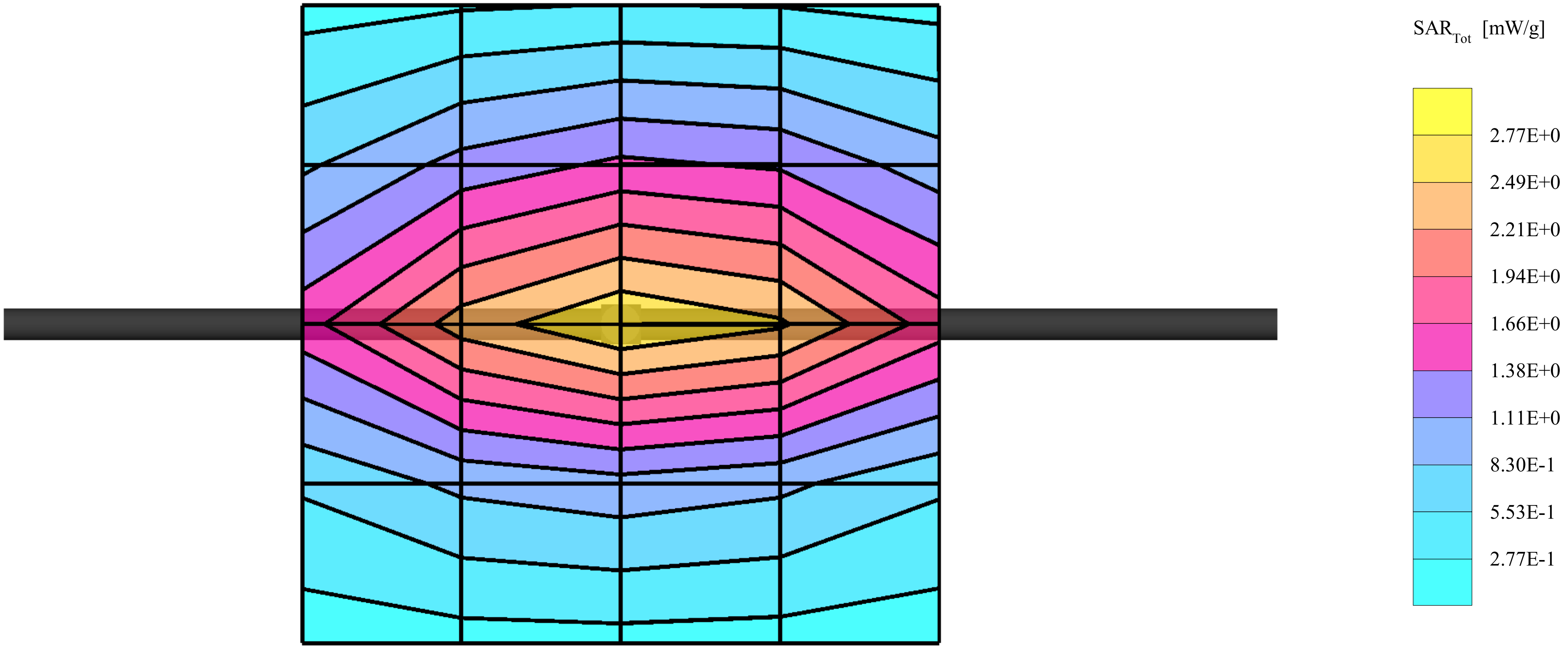
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.92$ mho/m $\varepsilon_r = 41.9$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 4.13 mW/g ± 0.02 dB, SAR (1g): 2.60 mW/g ± 0.02 dB, SAR (10g): 1.66 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 12.0 (10.7, 13.6) [mm]
Powerdrift: -0.22 dB
Liquid Temperature (°C): 21.1



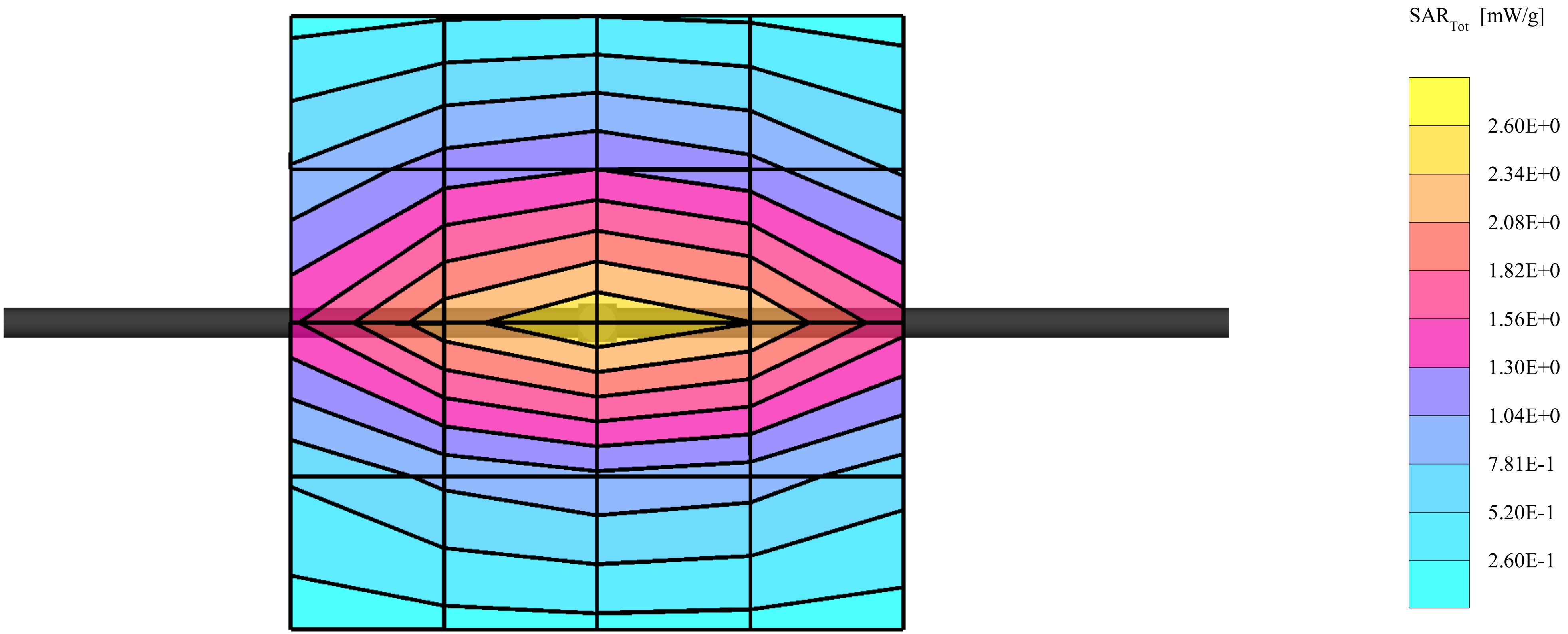
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.90$ mho/m $\varepsilon_r = 40.8$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 4.20 mW/g ± 0.01 dB, SAR (1g): 2.64 mW/g ± 0.01 dB, SAR (10g): 1.69 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 11.9 (10.7, 13.5) [mm]
Powerdrift: -0.11 dB
Liquid Temperature (°C): 21.3



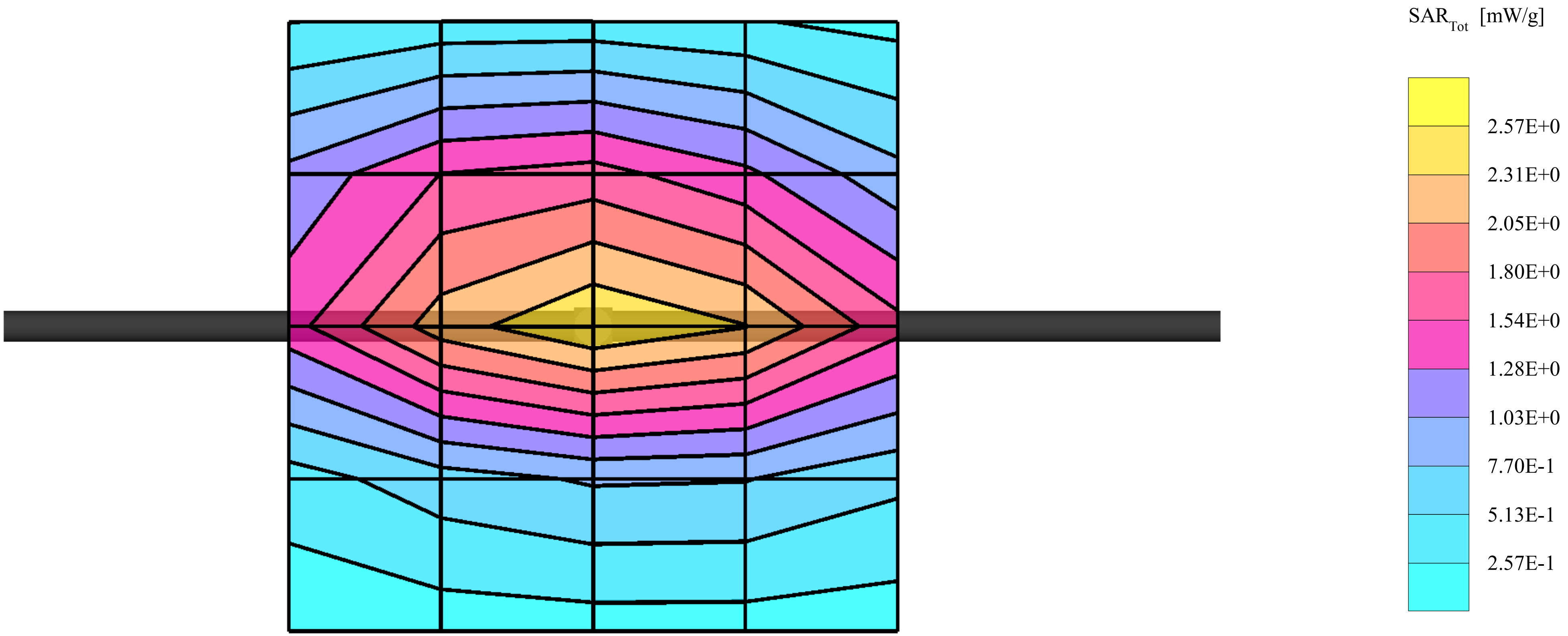
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.91 mho/m ε_r = 41.7 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.91 mW/g ± 0.01 dB, SAR (1g): 2.46 mW/g ± 0.01 dB, SAR (10g): 1.57 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 11.9 (10.7, 13.5) [mm]
Powerdrift: -0.07 dB
Liquid Temperature (°C): 20.9



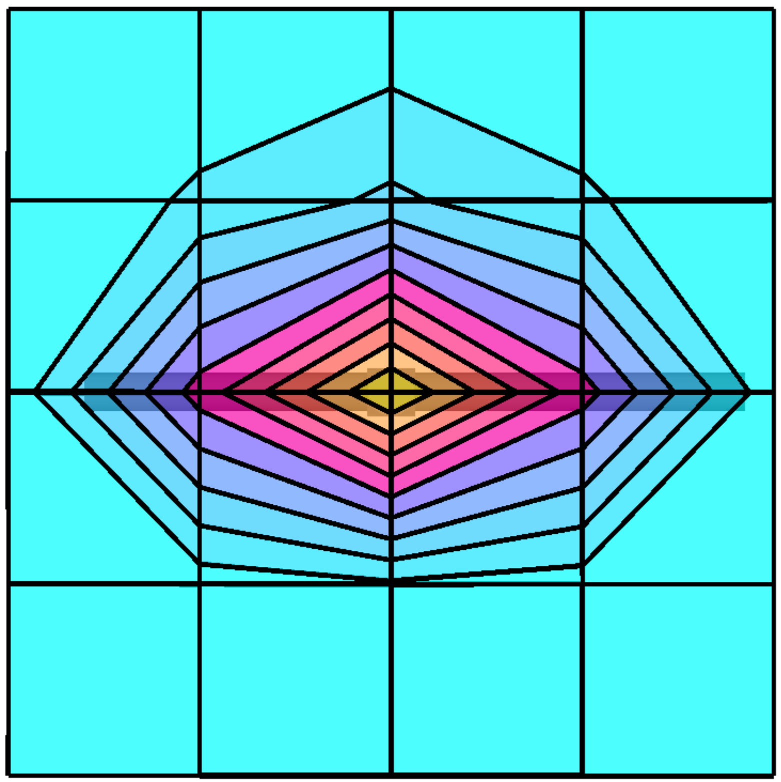
Dipole 835 MHz, Head Validation

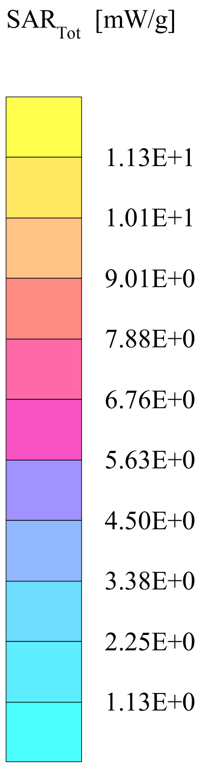
SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.8$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 4.07 mW/g ± 0.01 dB, SAR (1g): 2.57 mW/g ± 0.01 dB, SAR (10g): 1.64 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.0 (10.7, 13.6) [mm]
Powerdrift: -0.38 dB
Liquid Temperature (°C): 21.1



Dipole 1900 MHz, Head Validation

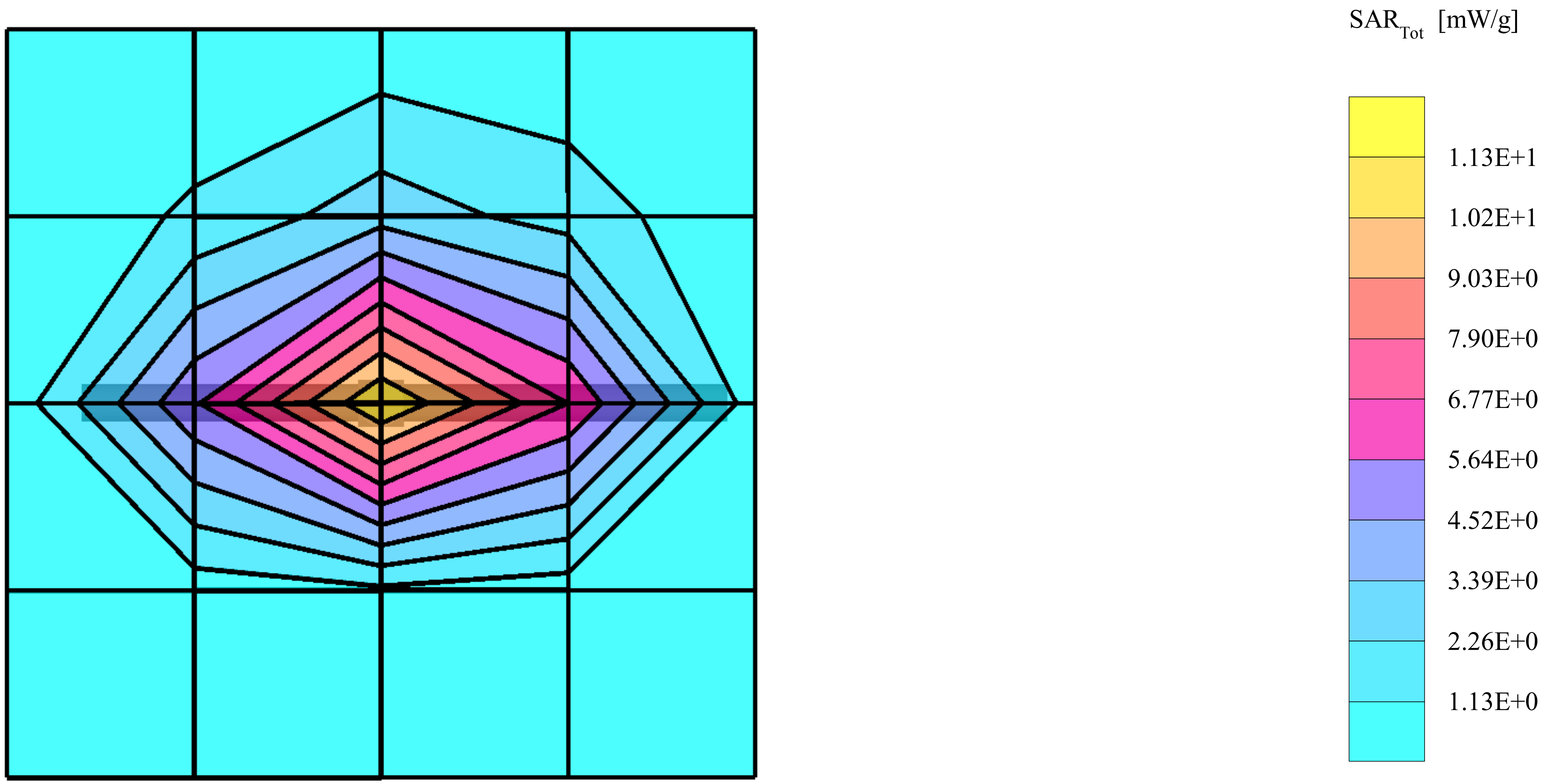
SAM 3 (PCS - Brain / Muscle Tissue)
Frequency: 1900 MHz; Crest factor: 1.0
Validation 1900MHz - Brain Tissue: $\sigma = 1.47$ mho/m $\varepsilon_r = 41.5$ $\rho = 1.00$ g/cm³
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cubes (2): Peak: 20.1 mW/g ± 0.06 dB, SAR (1g): 10.6 mW/g ± 0.02 dB, SAR (10g): 5.45 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.1 (7.7, 9.1) [mm]
Powerdrift: -0.22 dB
Liquid Temperature (°C): 21.0





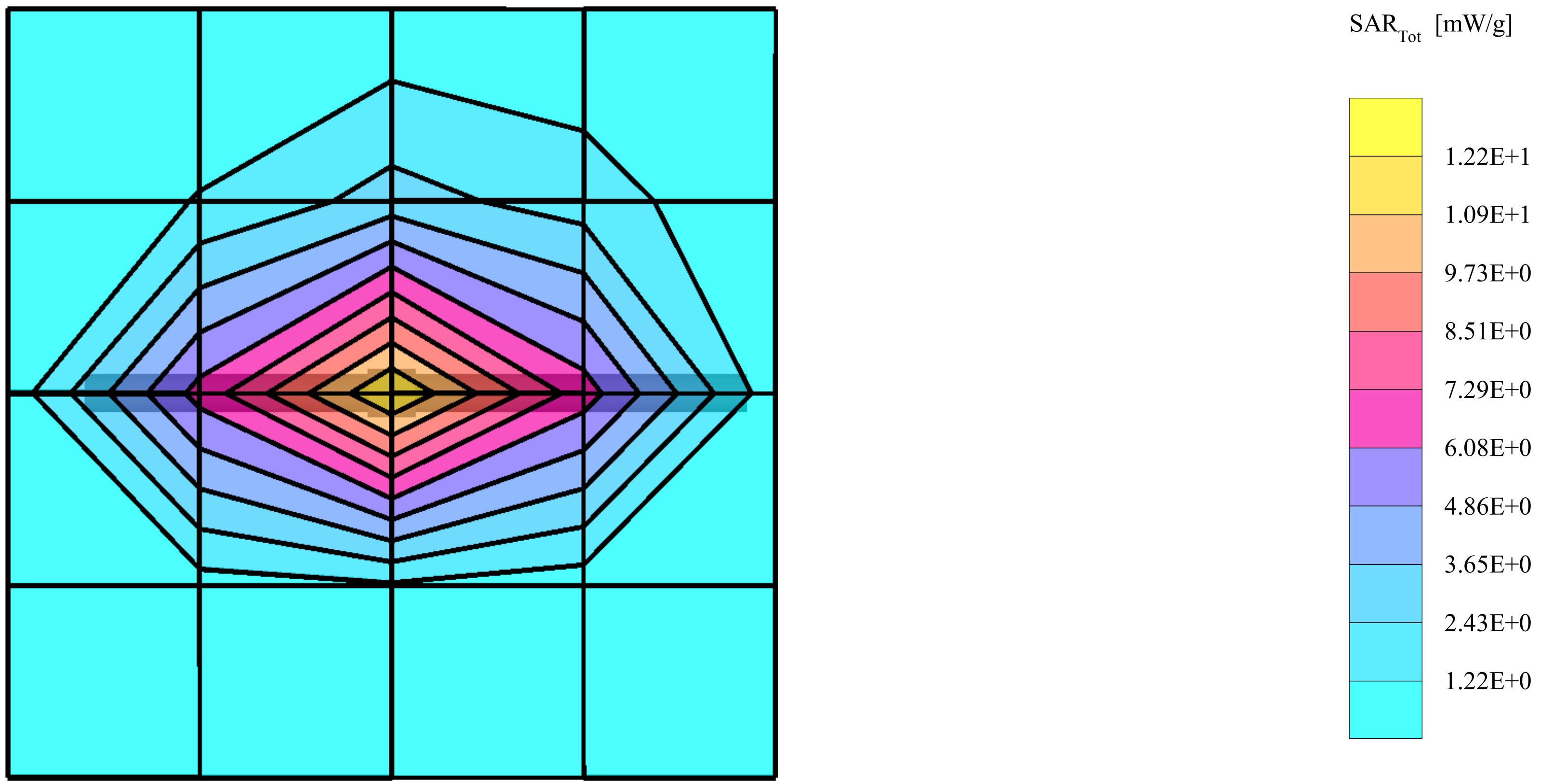
Dipole 1900 MHz, Head Validation

SAM 3 (PCS - Brain / Muscle Tissue)
Frequency: 1900 MHz; Crest factor: 1.0
Validation 1900MHz - Brain Tissue: σ = 1.48 mho/m ε_r = 40.9 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cubes (2): Peak: 20.5 mW/g ± 0.05 dB, SAR (1g): 10.9 mW/g ± 0.00 dB, SAR (10g): 5.58 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 8.2 (7.7, 9.1) [mm]
Powerdrift: -0.13 dB
Liquid Temperature (°C): 20.5



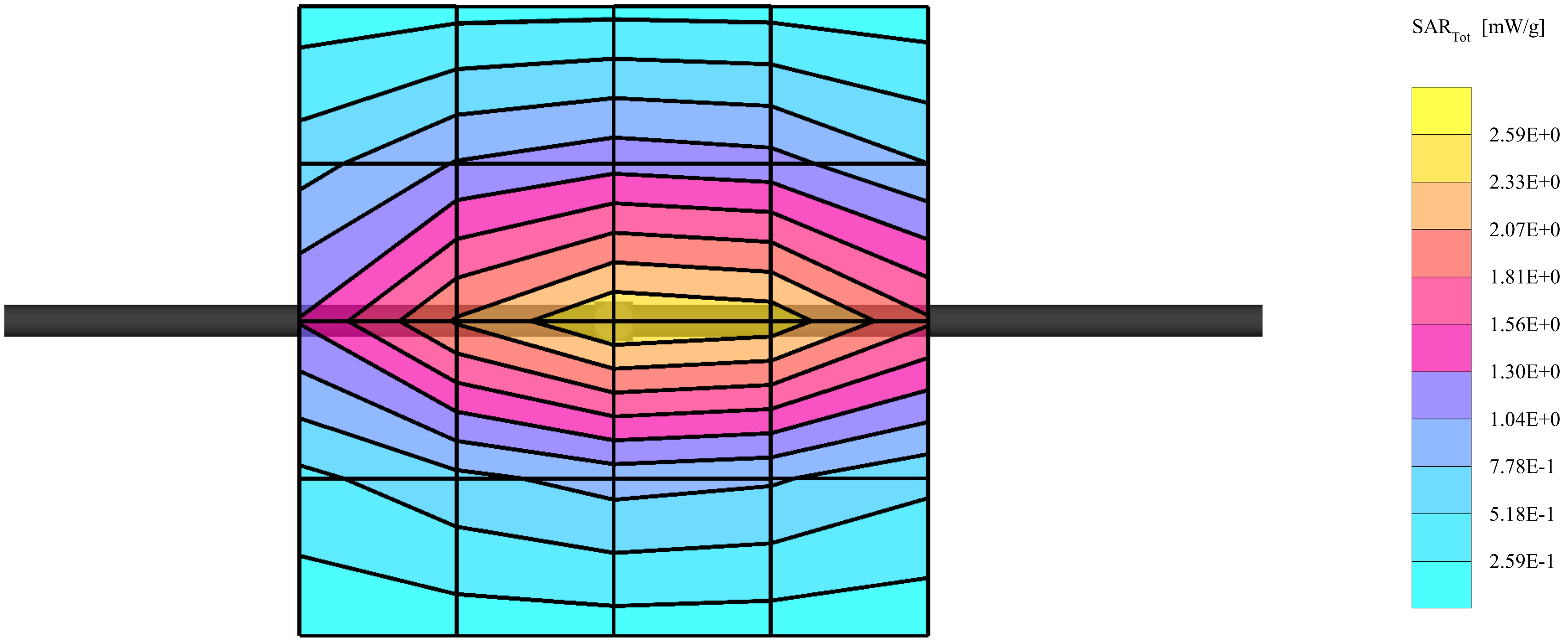
Dipole 1900 MHz, Head Validation

SAM 3 (PCS - Brain / Muscle Tissue)
Frequency: 1900 MHz; Crest factor: 1.0
Validation 1900MHz - Brain Tissue: σ = 1.47 mho/m ε_r = 40.1 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cubes (2): Peak: 21.9 mW/g ± 0.02 dB, SAR (1g): 11.5 mW/g ± 0.01 dB, SAR (10g): 5.86 mW/g ± 0.04 dB, (Worst-case extrapolation)
Penetration depth: 7.9 (7.5, 8.8) [mm]
Powerdrift: 0.09 dB
Liquid Temperature (°C): 19.6



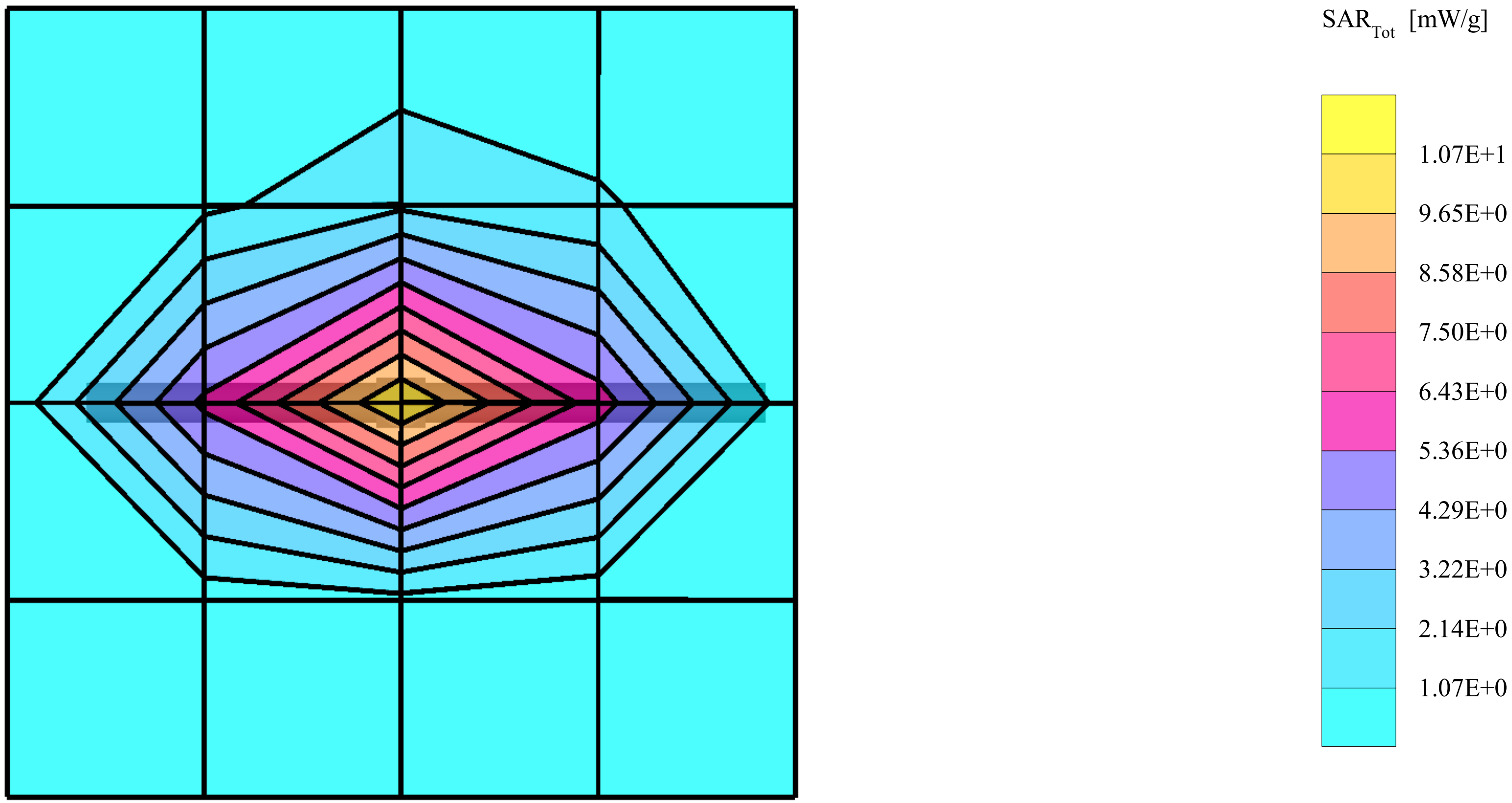
Dipole 835 MHz, Body Validation

SAM 2 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: σ = 0.96 mho/m ε_r = 56.1 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.88 mW/g ± 0.00 dB, SAR (1g): 2.49 mW/g ± 0.00 dB, SAR (10g): 1.61 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 12.6 (11.3, 14.4) [mm]
Powerdrift: -0.25 dB
Liquid Temperature (°C): 21.6



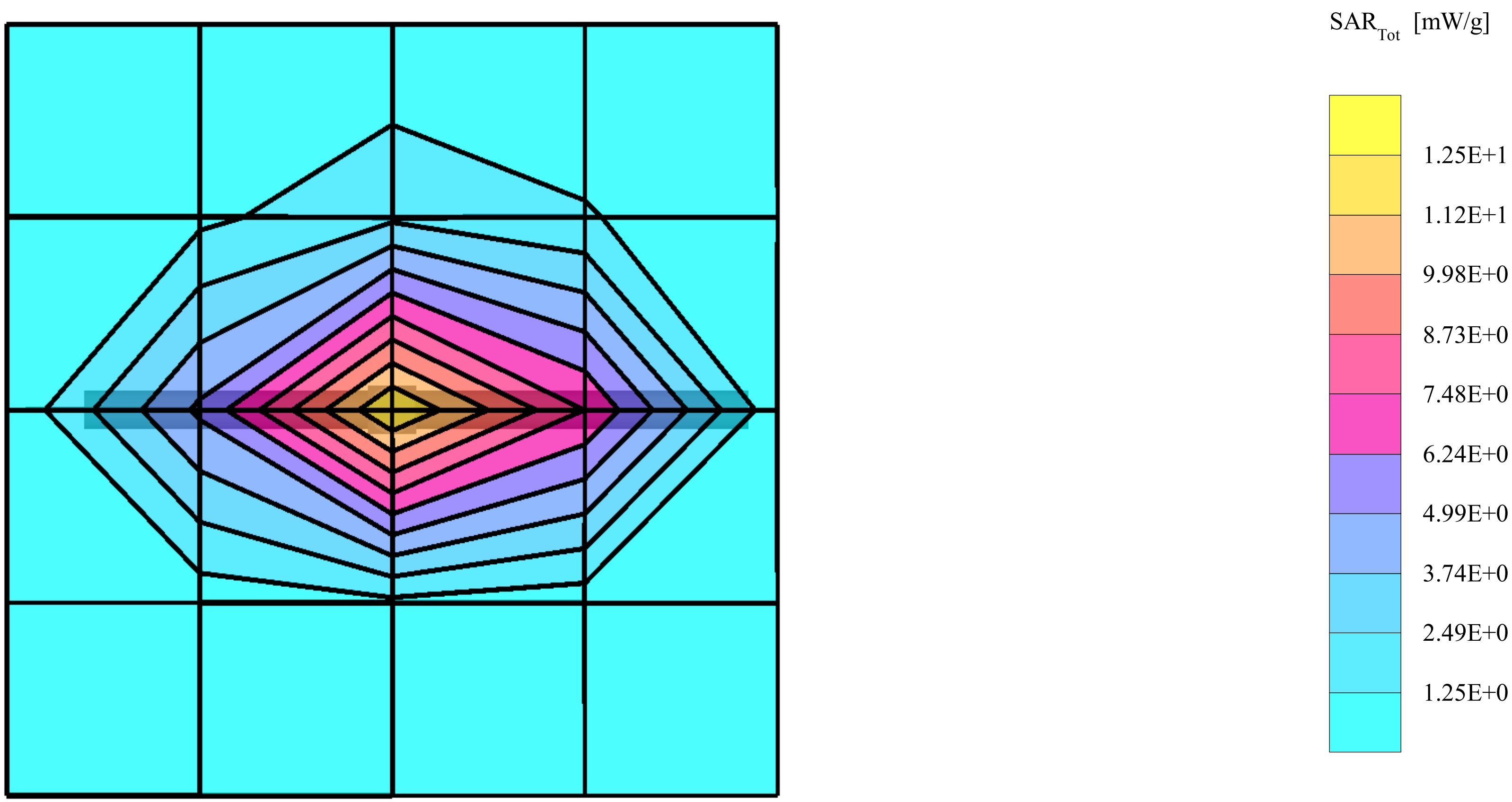
Dipole 1900 MHz, Body Validation

SAM 3 (PCS - Brain / Muscle Tissue)
Frequency: 1900 MHz; Crest factor: 1.0
Validation 1900MHz - Muscle Tissue: σ = 1.51 mho/m ε_r = 54.1 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.00,5.00,5.00)
Cubes (2): Peak: 18.9 mW/g ± 0.04 dB, SAR (1g): 10.1 mW/g ± 0.02 dB, SAR (10g): 5.21 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.7 (7.9, 9.9) [mm]
Powerdrift: -0.14 dB
Liquid Temperature (°C): 19.6



Dipole 1900 MHz, Body Validation

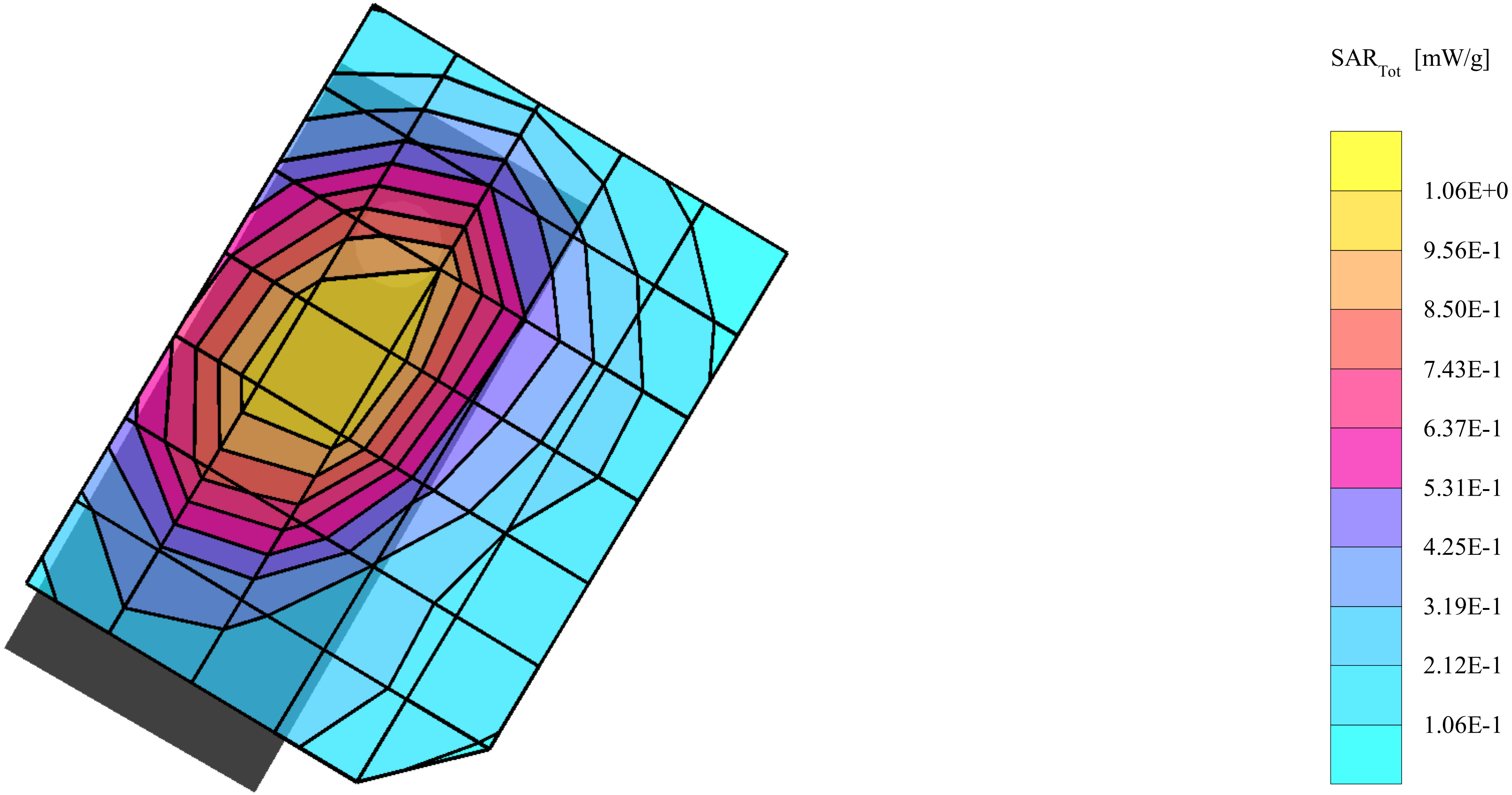
SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1900 MHz; Crest factor: 1.0
Validation 1900MHz - Muscle Tissue: σ = 1.54 mho/m ε_r = 53.9 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1505; ConvF(5.00,5.00,5.00)
Cubes (2): SAR (1g): 11.6 mW/g ± 0.04 dB, SAR (10g): 6.05 mW/g ± 0.05 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.05 dB
Liquid Temperature (°C): 20.5



APPENDIX C: SAR DISTRIBUTION PRINTOUTS

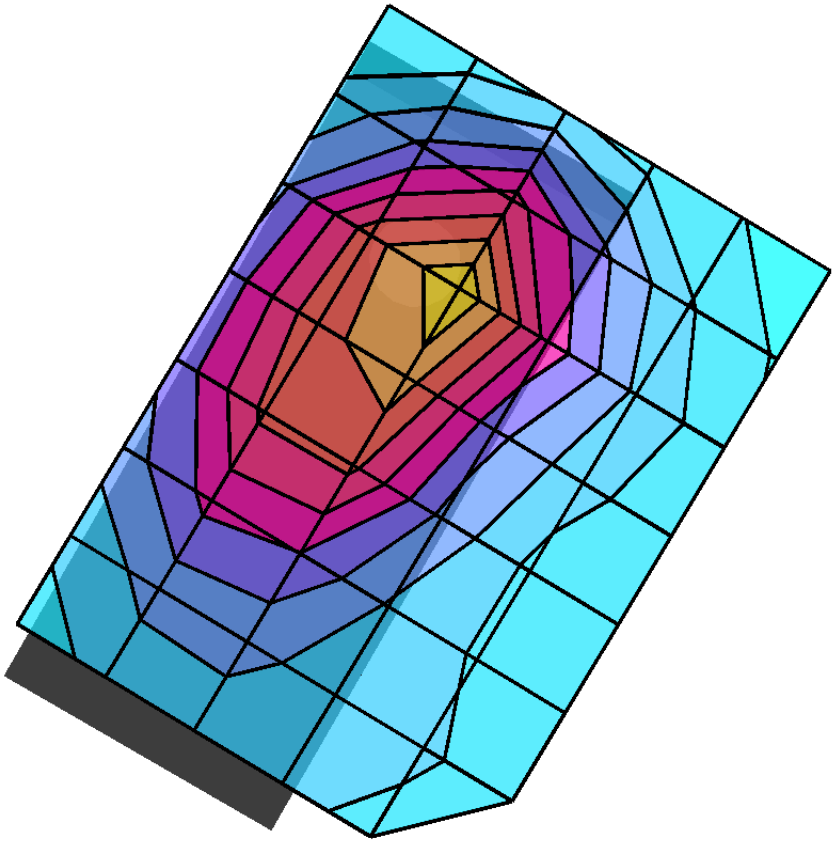
GMLRH-14, AMPS, Channel 384, Left Touch Position with BLC-2 Battery

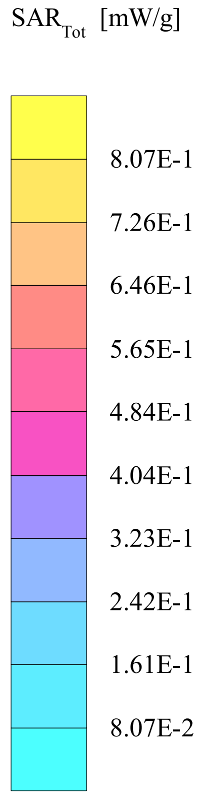
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.07 mW/g, SAR (10g): 0.737 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.07 dB
Liquid Temperature (°C): 21.1



GMLRH-14, AMPS, Channel 384, Left Tilt Position with BLC-2 Battery

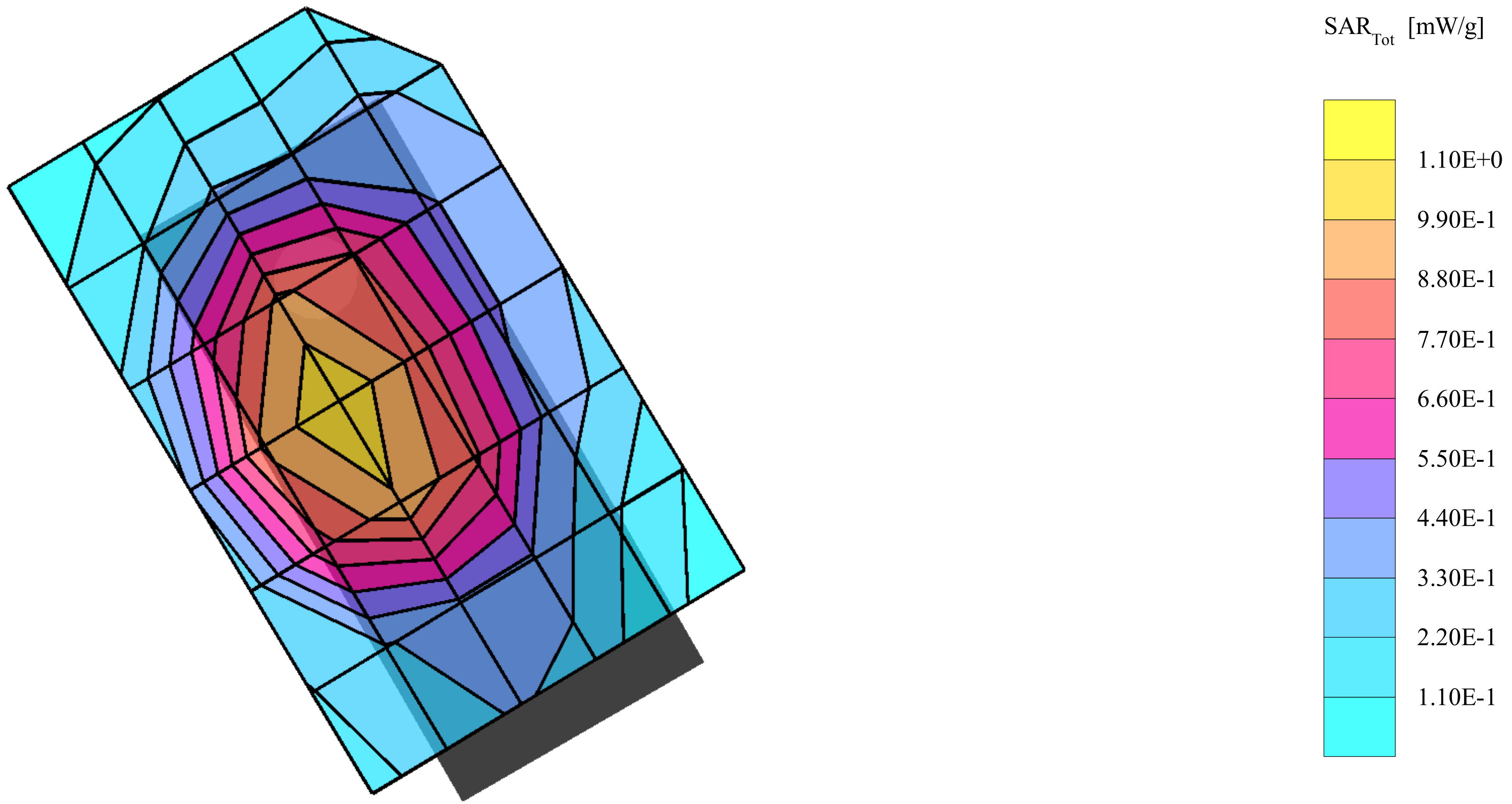
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.8$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.744 mW/g, SAR (10g): 0.474 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.29 dB
Liquid Temperature (°C): 21.1





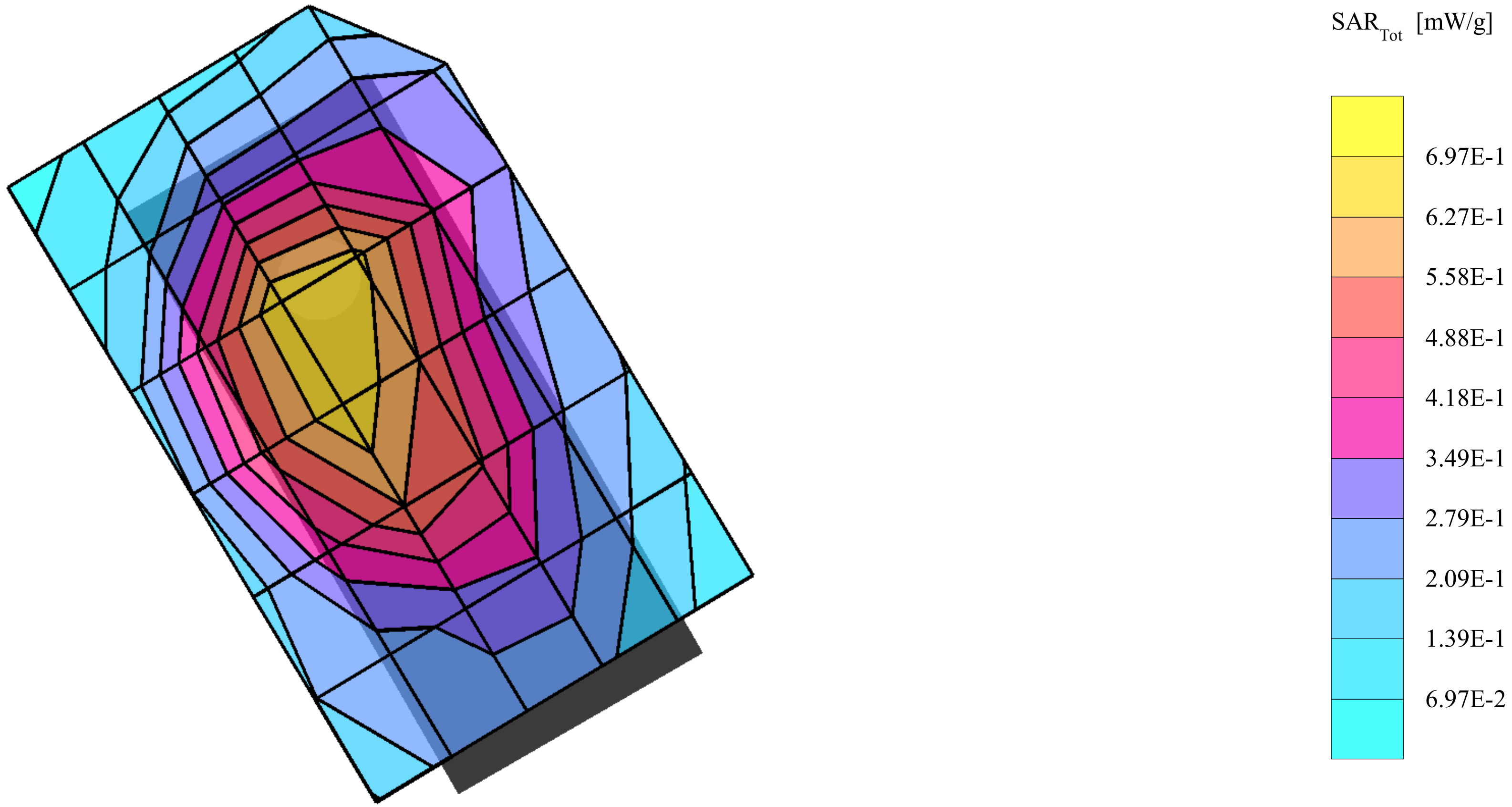
GMLRH-14, AMPS, Channel 384, Right Touch Position with BLC-2 Battery

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(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.04 mW/g, SAR (10g): 0.734 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.12 dB
Liquid Temperature (°C): 21.1



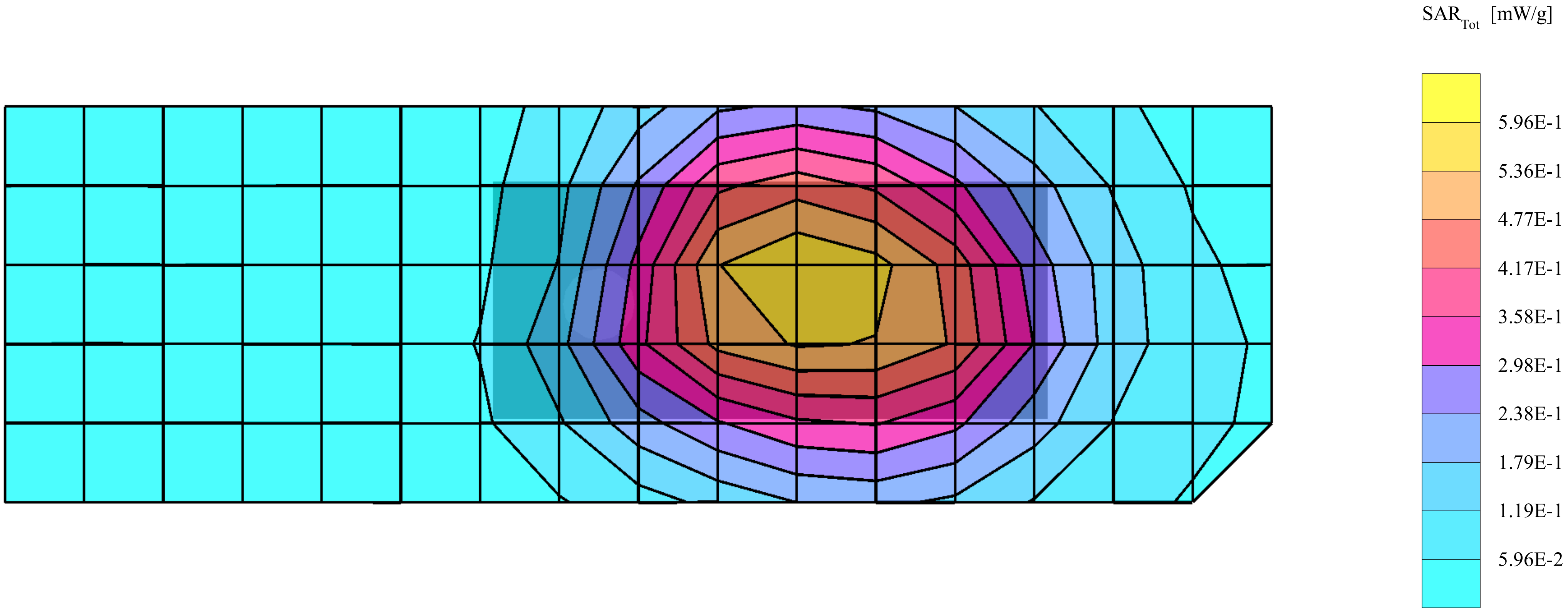
GMLRH-14, AMPS, Channel 384, Right Tilt Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.91 mho/m ε_r = 41.8 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 0.662 mW/g ± 0.11 dB, SAR (10g): 0.458 mW/g ± 0.10 dB, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.13 dB
Liquid Temperature (°C): 21.1



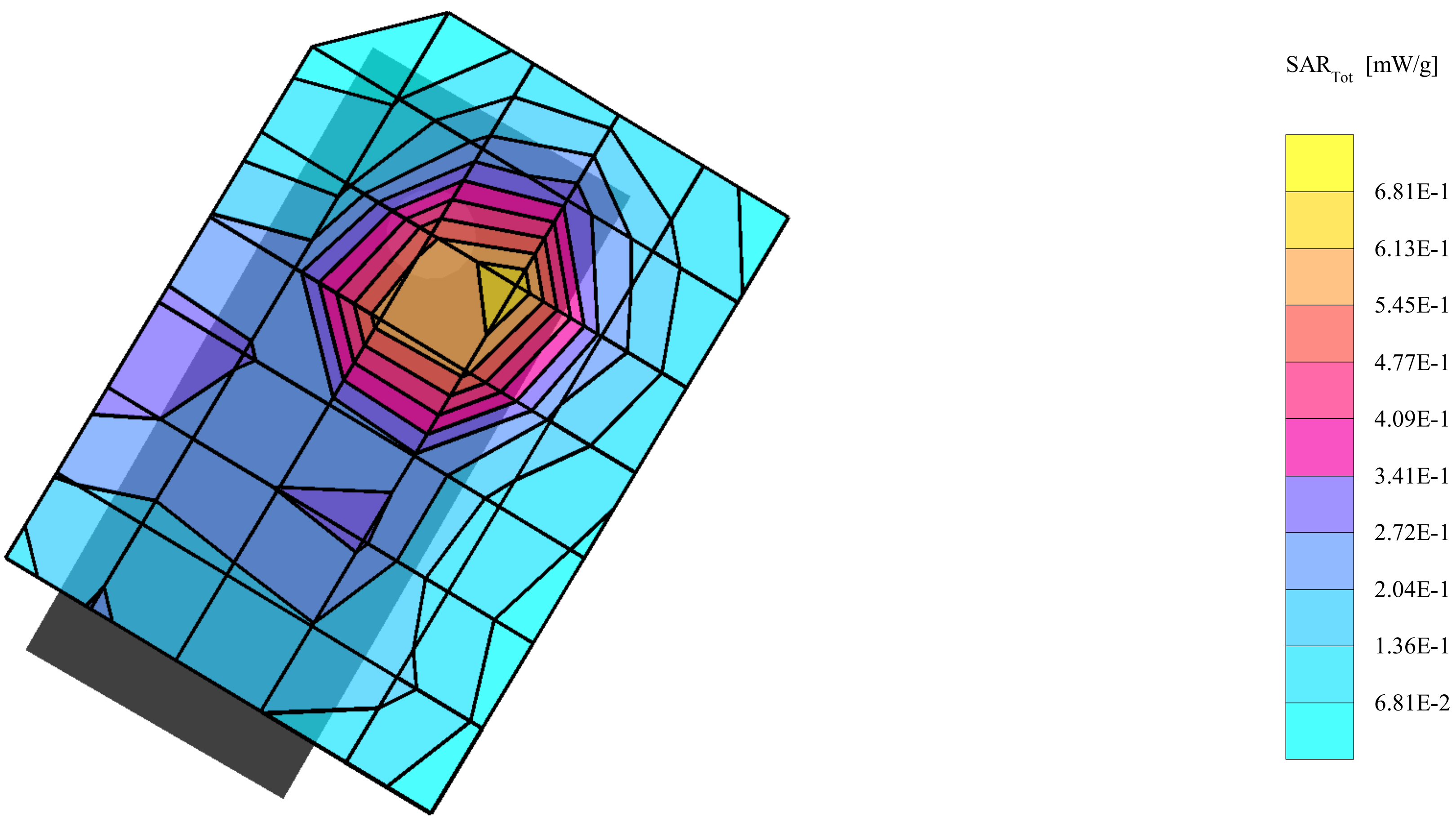
GMLRH-14, AMPS, Channel 991, Flat Position - Back of Phone with 22mm Spacer, HDE-2 Headset, and BLC-2 Battery

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: $\sigma = 0.96$ mho/m $\varepsilon_r = 56.1$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.572 mW/g, SAR (10g): 0.413 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.01 dB
Liquid Temperature (°C): 21.6



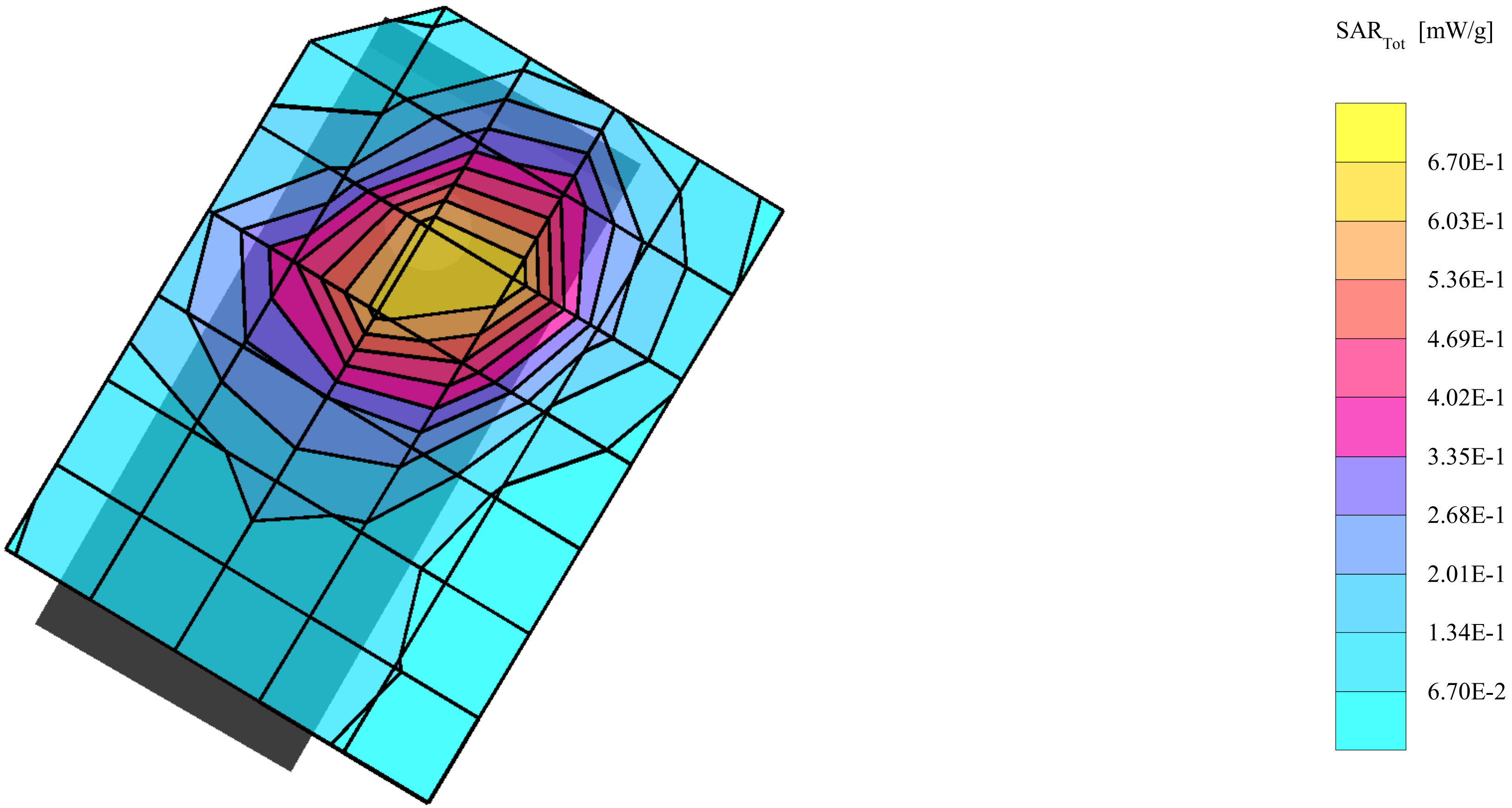
GMLRH-14, TDMA 1900, Channel 1000, Left Touch Position with BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Brain Tissue: σ = 1.46 mho/m ε_r = 41.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cube 5x5x7: SAR (1g): 0.736 mW/g, SAR (10g): 0.400 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.07 dB
Liquid Temperature (°C): 21.0



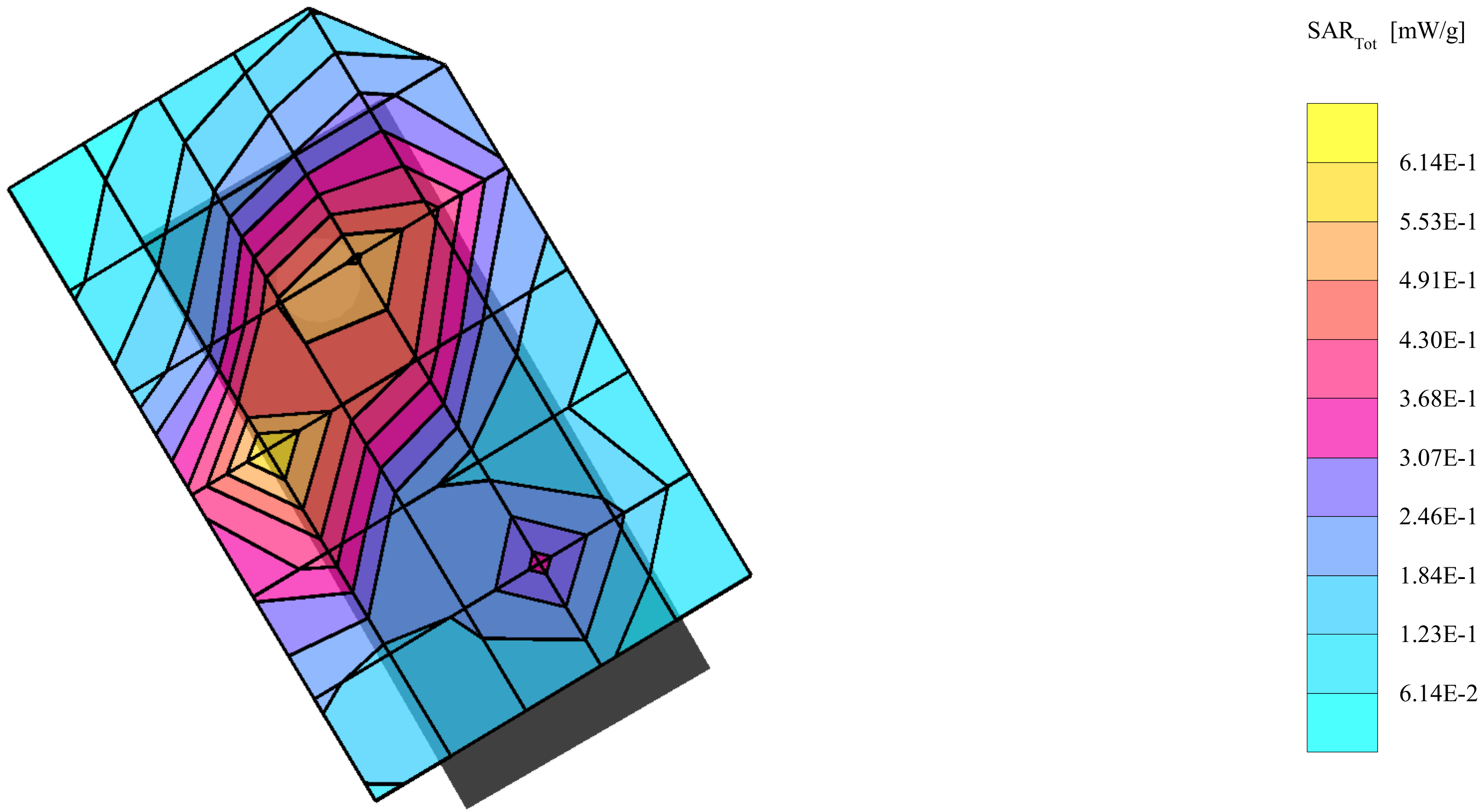
GMLRH-14, TDMA 1900, Channel 1000, Left Tilt Position with BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Brain Tissue: σ = 1.46 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cube 5x5x7: SAR (1g): 0.709 mW/g, SAR (10g): 0.396 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.12 dB
Liquid Temperature (°C): 20.5



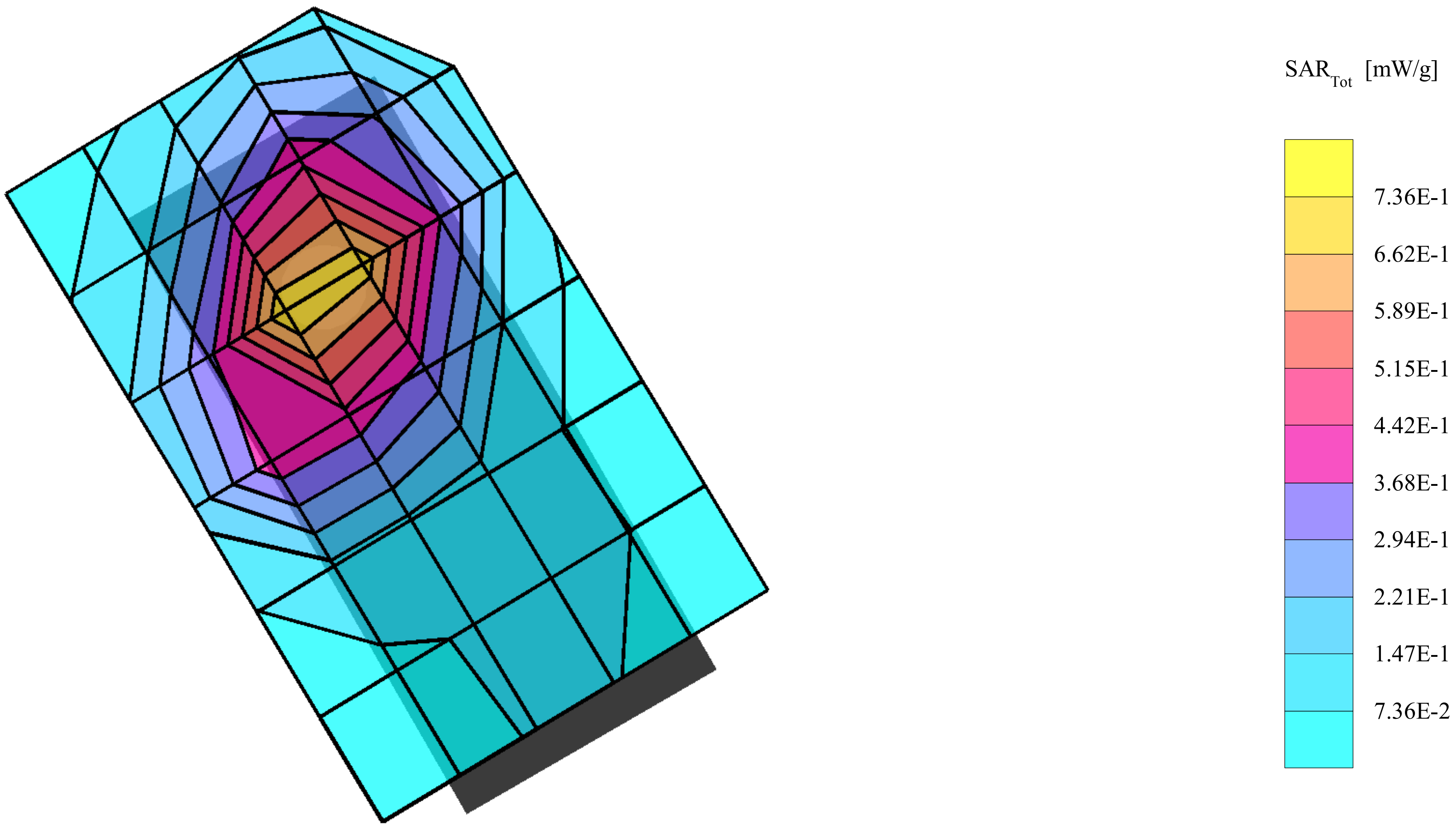
GMLRH-14, TDMA 1900, Channel 1000, Right Touch Position with BLC-1 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Brain Tissue: σ = 1.46 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cubes (2): SAR (1g): 0.579 mW/g ± 0.06 dB, SAR (10g): 0.330 mW/g ± 0.01 dB, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.24 dB
Liquid Temperature (°C): 20.5



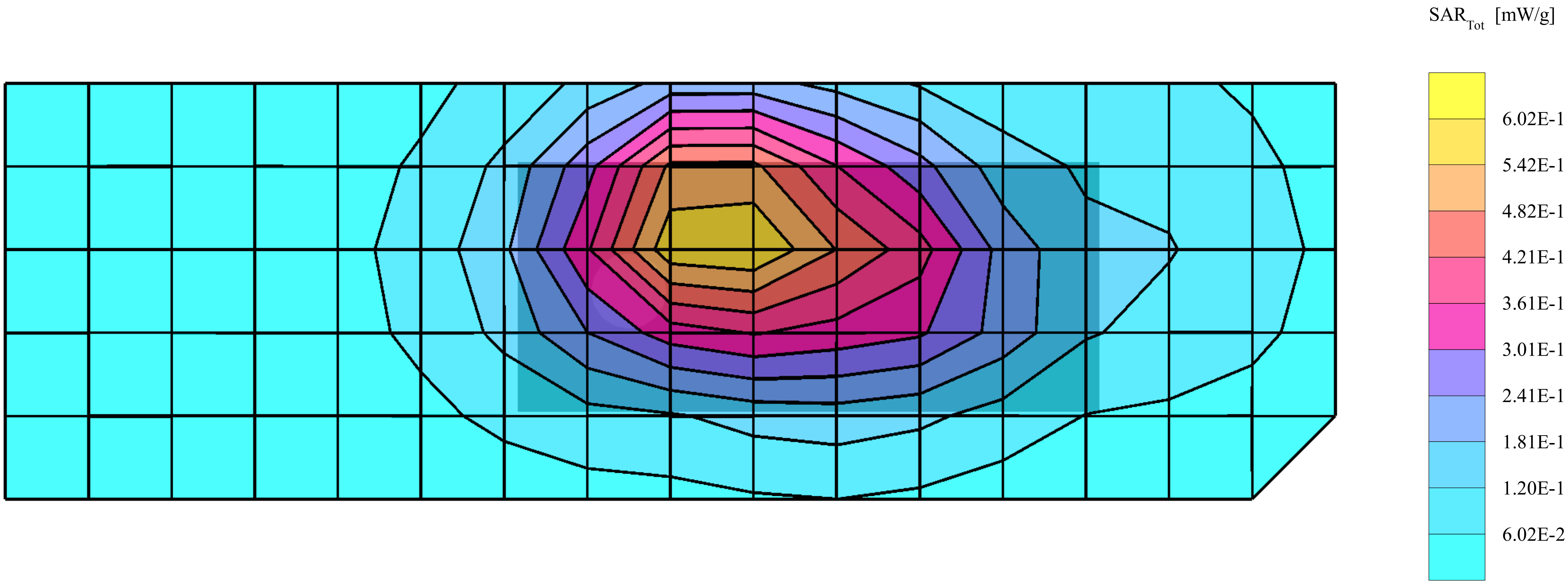
GMLRH-14, TDMA 1900, Channel 1000, Right Tilt Position with BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Brain Tissue: σ = 1.45 mho/m ε_r = 40.2 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cube 5x5x7: SAR (1g): 0.728 mW/g, SAR (10g): 0.420 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.06 dB
Liquid Temperature (°C): 19.6



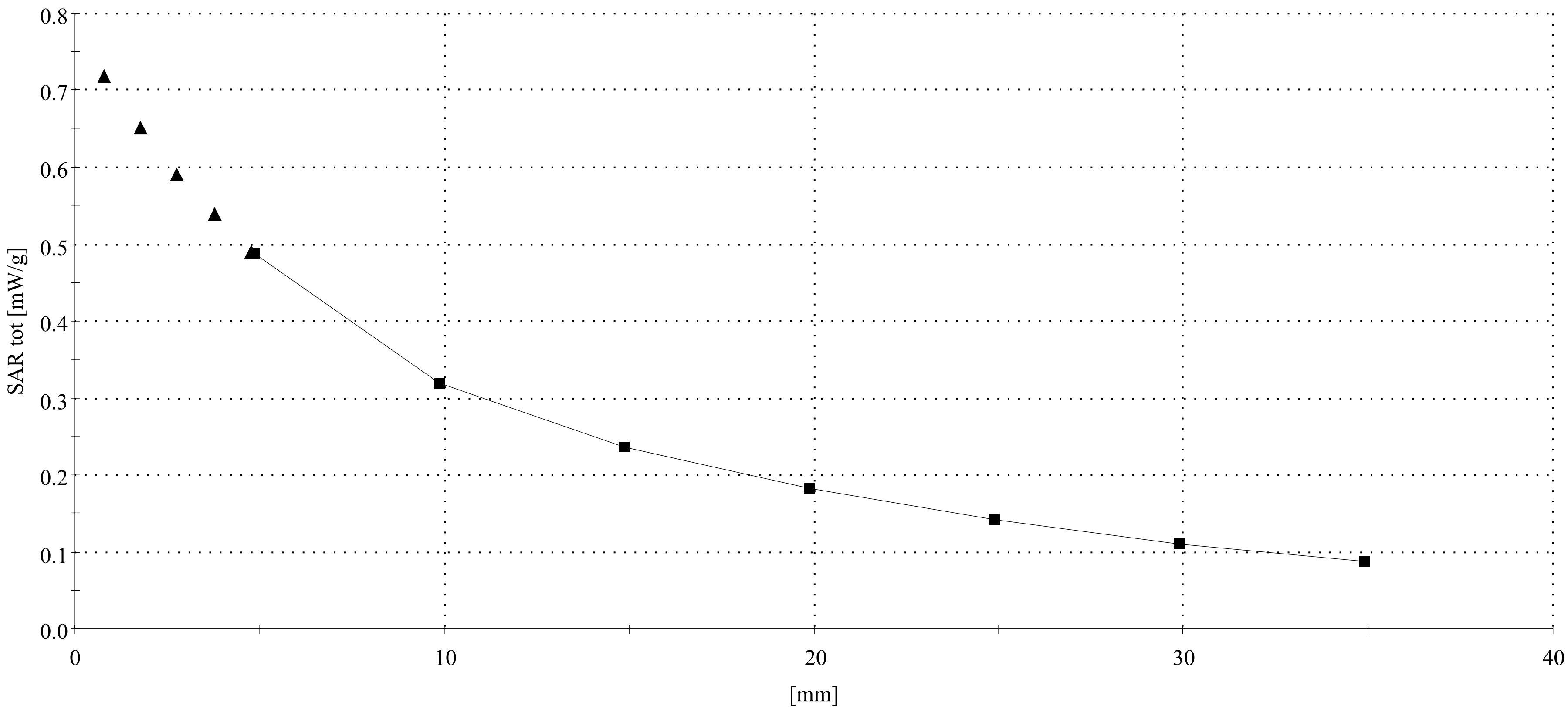
GMLRH-14, TDMA 1900, Channel 1000, Flat Position - Back of Phone with 22mm Spacer, HDE-2 Headset and BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Muscle Tissue: σ = 1.49 mho/m ε_r = 54.2 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.00,5.00,5.00)
Cube 5x5x7: SAR (1g): 0.595 mW/g, SAR (10g): 0.359 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: -0.11 dB
Liquid Temperature (°C): 19.6



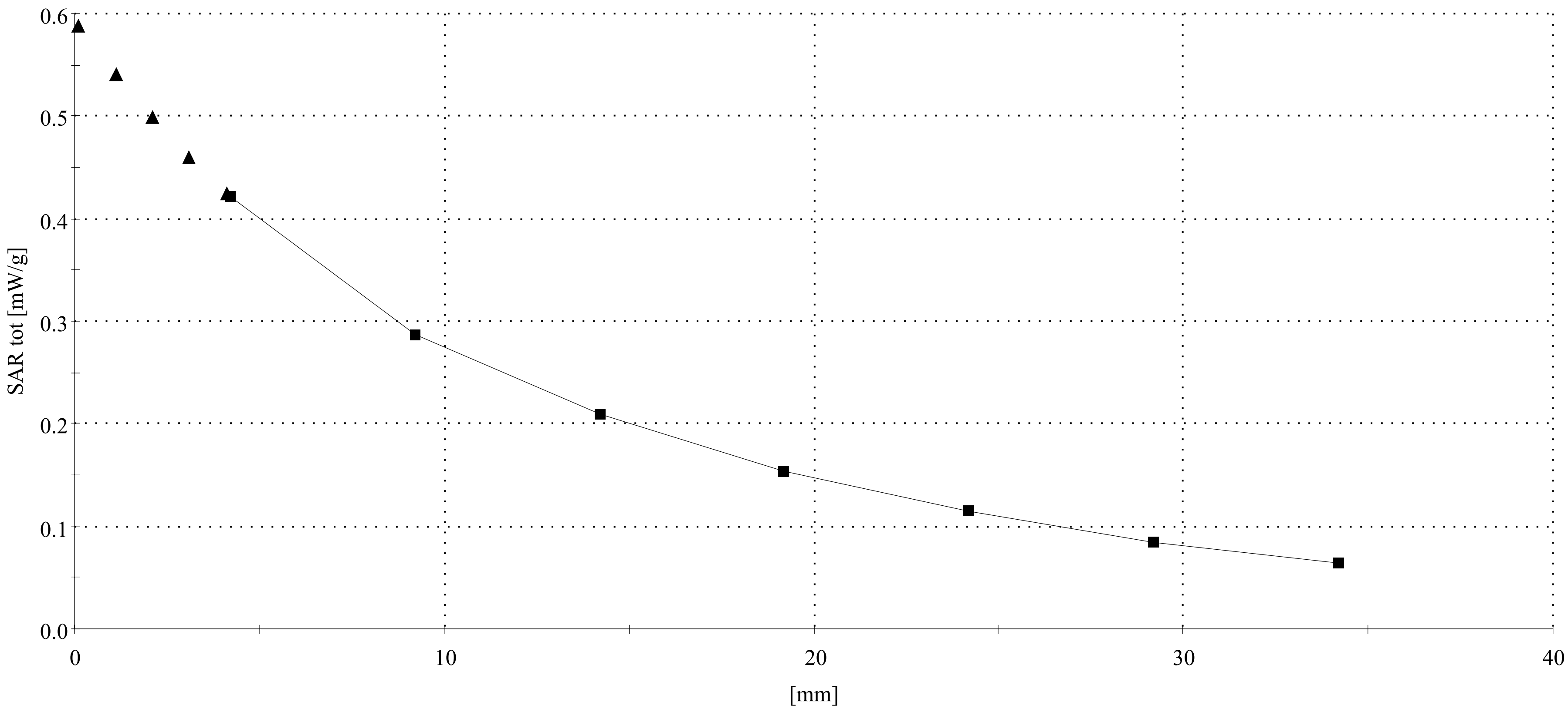
GMLRH-14, AMPS, Channel 384, Left Touch Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 40.9 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.07 mW/g, SAR (10g): 0.737 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 21.1



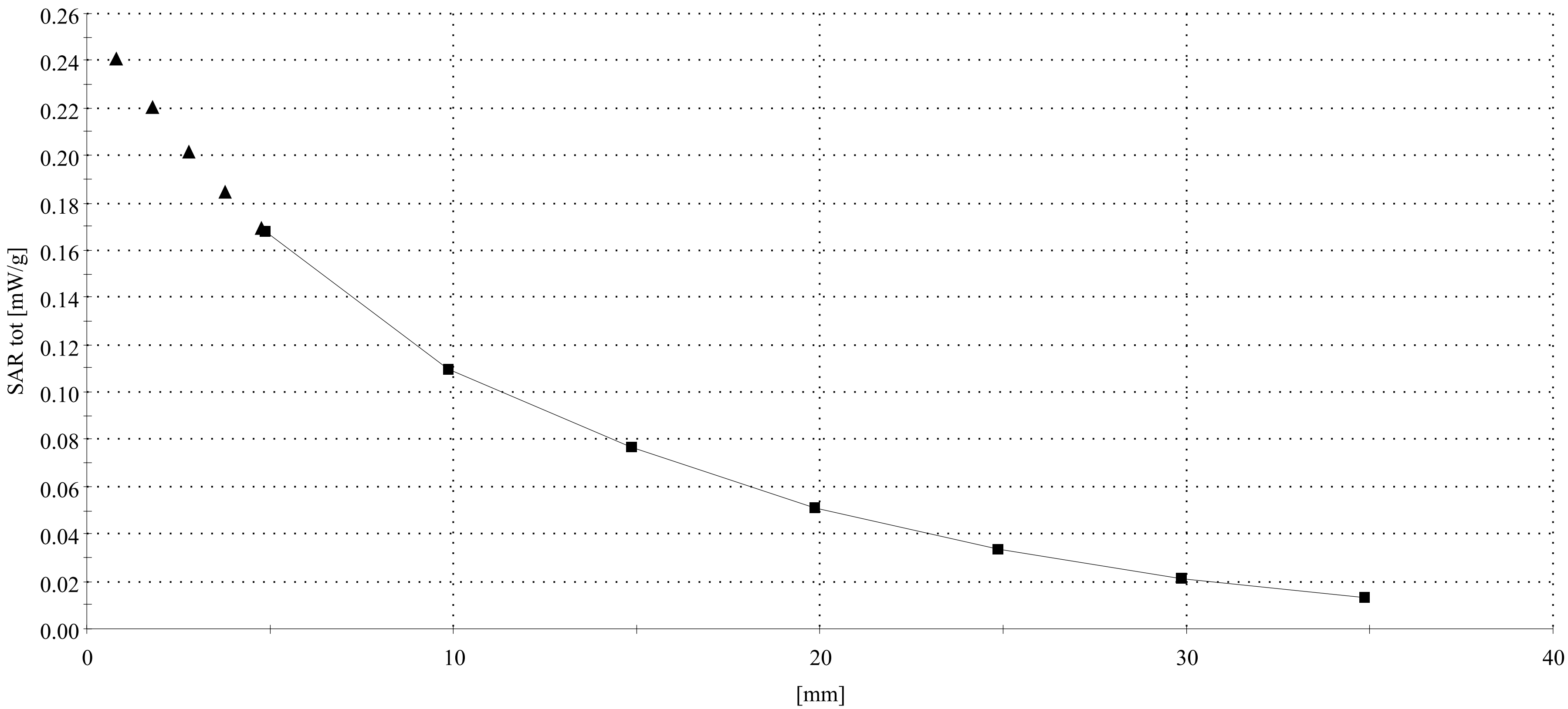
GMLRH-14, AMPS, Channel 991, Flat Position - Back of Phone with 22mm Spacer, HDE-2 Headset and BLC-2 Battery

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: $\sigma = 0.96$ mho/m $\varepsilon_r = 56.1$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.572 mW/g, SAR (10g): 0.413 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 21.6



GMLRH-14, TDMA 1900, Channel 1000, Left Touch Position with BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Brain Tissue: $\sigma = 1.46$ mho/m $\varepsilon_r = 41.6$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.40,5.40,5.40)
Cube 5x5x7: SAR (1g): 0.736 mW/g, SAR (10g): 0.400 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 21.0



GMLRH-14, TDMA 1900, Channel 1000, Flat Position - Back of Phone with 22mm Spacer, HDE-2 Headset and BLC-2 Battery

SAM 3 (PCS - Brain / Muscle Tissue) Phantom
Frequency: 1880 MHz; Crest factor: 3.0
PCS Band - Muscle Tissue: σ = 1.49 mho/m ε_r = 54.2 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(5.00,5.00,5.00)
Cube 5x5x7: SAR (1g): 0.595 mW/g, SAR (10g): 0.359 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 19.6