SAR Compliance Test Report

Test report no.:	02-RF-0230.001	**Date of report:**	13 February, 2003
Number of pages:	18	**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-21, Model 3520, HWID 420f** BLC-2, BLC-1, HDE-2
Supplement reports:	-
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:

For the contents:

13 February, 2003

Alan C. Ewing
TCC Line Manager

Nerina Walton
Test Engineer

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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.

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2. SUMMARY FOR SAR TEST REPORT

Date of test	11- 15 December 2002
Contact person	Nerina Walton
Test plan referred to	-
FCC ID	GMLRH-21
Type, SN, HW and SW numbers of tested device	Type: RH-21, ESN: 2355316509, HW: 3.0/420f, SW: 2.07.03
Accessories used in testing	BLC-2 Battery, BLC-1 Battery, HDE-2 Headset
Notes	-
Document code	02-RF-0230.001
Responsible test engineer	N. Walton
Measurement performed by	Elizabeth Parish / Mark Severson

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.

2.1.1 Head Configuration

Mode	Ch / *f* (MHz)	Power (dBm)	Position	Limit (mW/g)	Measured (mW/g)	Result
AMPS	799 / 848.97	24.56	Left Touch Position	1.6	1.16	**PASSED**
TDMA 800	384 / 836.52	27.54	Left Touch Position	1.6	0.70	**PASSED**

2.1.2 Body Worn Configuration

Mode	Ch / *f* (MHz)	Power (dBm)	Position	Limit (mW/g)	Measured (mW/g)	Result
AMPS	384 / 836.52	24.63	Flat - Back of Phone	1.6	0.60	**PASSED**
TDMA 800	384 / 836.52	27.54	Flat - Back of Phone	1.6	0.43	**PASSED**

2.1.3 Measurement Uncertainty

Combined Standard Uncertainty	± **13.6%**
Expanded Standard Uncertainty (k=2)	± **27.1%**

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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
Maximum Device Rating	Power Class III	Power Class III
Modulation Mode	Frequency Modulation	Quadrature Phase Shift Keying
Duty Cycle	1	1/3
Transmitter Frequency Range (MHz)	824.04 - 848.97	824.04 - 848.97

3.1 Picture of Phone

The tested device, GMLRH-21 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.

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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 (%)	43

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.

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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
Dipole Validation Kit	D835V2	2951	415	05/03

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	0409	3836A04346	06/03
Amplifier	AR 5S1G4	0188	25583	-
Coupler	AR DC7144	2057	25304	-
Power Meter	Boonton 4232A	2996	64701	05/03
Power Sensor	Boonton 51015	2997	32187	05/03
Power Sensor	Boonton 51015	2998	32188	05/03
Thermometer	Omega CL27	3391	T-228450	03/03
Network Analyzer	HP 8720D	0455	US38431353	06/03
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.

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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 HP 8720D 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. 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 (Date Measured)	SAR (W/kg), 1g	Dielectric Parameters		Temp (°C)
				ε_r	σ (S/m)	
Head	835	11-Dec-02	9.9	41.3	0.88	19.6
		12-Dec-02	10.9	40.6	0.87	19.8
		13-Dec-02	10.7	40.2	0.87	19.6
		14-Dec-02	10.6	41.0	0.88	19.6
		Reference Result	10.1	41.7	0.89	N/A

5.1.2 Muscle Tissue

Tissue	*f* (MHz)	Description (Date Measured)	SAR (W/kg), 1g	Dielectric Parameters		Temp (°C)
				ε_r	σ (S/m)	
Muscle	835	12-Dec-02	10.5	54.6	0.93	20.0
		15-Dec-02	10.5	54.6	0.94	20.0
		Reference Result	10.4	55.4	0.97	N/A

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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 (Date Measured)**	**Dielectric Parameters**		**Temp (°C)**
		ε_r	σ (S/m)	
836.52	11-Dec-02	41.3	0.89	19.6
	12-Dec-02	40.6	0.88	19.8
	13-Dec-02	40.2	0.87	19.6
	14-Dec-02	41.0	0.88	19.6
	Recommended Values	41.5	0.90	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 (Date Measured)**	**Dielectric Parameters**		**Temp (°C)**
		ε_r	σ (S/m)	
836.52	12-Dec-02	54.6	0.93	20.0
	15-Dec-02	54.6	0.94	20.0
	Recommended Values	55.2	0.97	N/A

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

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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

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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.

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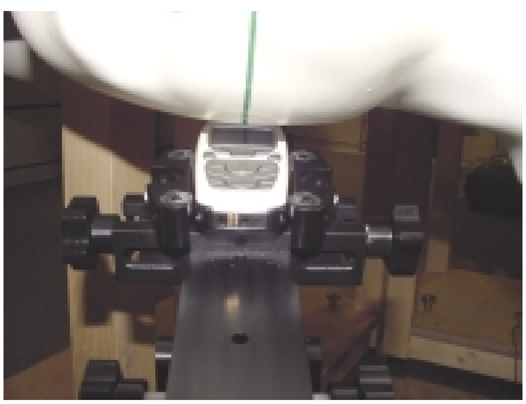
The following picture shows the tested device in the right touch position:

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.

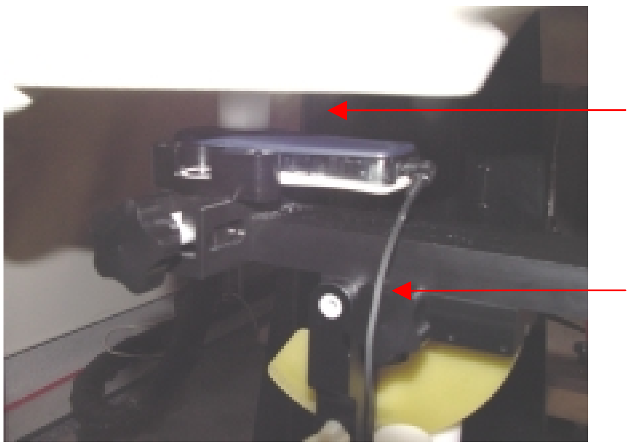
The following picture shows the tested device in the right tilt position:



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: -



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.

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7. MEASUREMENT UNCERTAINTY

7.1 Description of Individual Measurement Uncertainty

7.1.1 Assessment Uncertainty

Uncertainty description	Uncert. value %	Probability distribution	Div.	c_i	Stand. uncert (1g) %	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.4	normal	1	1	± 4.4	∞
Axial isotropy of the probe	± 4.7	rectangular	√3	$(1-c_p)^{1/2}$	± 1.9	∞
Sph. Isotropy of the probe	± 9.6	rectangular	√3	$(c_p)1^{/2}$	± 3.9	∞
Spatial resolution	± 0.0	rectangular	√3	1	± 0.0	∞
Boundary effects	± 5.5	rectangular	√3	1	± 3.2	∞
Probe linearity	± 4.7	rectangular	√3	1	± 2.7	∞
Detection limit	± 1.0	rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	normal	1	1	± 1.0	∞
Response time	± 0.8	rectangular	√3	1	± 0.5	∞
Integration time	± 1.4	rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 3.0	rectangular	√3	1	± 1.7	∞
Mech. constrains of robot	± 0.4	rectangular	√3	**1**	± 0.2	∞
Probe positioning	± 2.9	rectangular	√3	1	± 1.7	∞
Extrap. and integration	± 3.9	rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 6.0	normal	0.89	1	± 6.7	12
Device holder uncertainty	± 5.0	normal	0.84	1	± 5.9	8
Power drift	± 5.0	rectangular	√3	1	± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	rectangular	√3	**1**	± 2.3	∞
Liquid conductivity (target)	± 5.0	rectangular	√3	**0.6**	± 1.7	∞
Liquid conductivity (meas.)	± 10.0	rectangular	√3	**0.6**	± 3.5	∞
Liquid permittivity (target)	± 5.0	rectangular	√3	**0.6**	± 1.7	∞
Liquid permittivity (meas.)	± 5.0	rectangular	√3	**0.6**	± 1.7	∞
Combined Standard Uncertainty					± 13.6	
Expanded Standard Uncertainty (k=2)					± 27.1	

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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.

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	24.43	0.87	-	0.80	-
	384 / 836.52	24.63	1.13	0.73	1.06	0.71
	799 / 848.97	24.56	1.16	-	1.09	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
TDMA 800	991 / 824.04	27.52	-	-	-	-
	384 / 836.52	27.54	0.70	0.47	0.70	0.44
	799 / 848.97	27.53	-	-	-	-

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	24.43	-	-	-	-
	384 / 836.52	24.63	-	0.72	-	0.62
	799 / 848.97	24.56	1.09	-	1.07	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)			
			Left-hand		Right-hand	
			Touch	Tilt	Touch	Tilt
TDMA 800	991 / 824.04	27.52	-	-	-	-
	384 / 836.52	27.54	0.65	0.46	0.65	0.41
	799 / 848.97	27.53	-	-	-	-

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8.2 Body Worn Configuration

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

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)
			HDE-2
AMPS	991 / 824.04	24.43	-
	384 / 836.52	24.63	0.59
	799 / 848.97	24.56	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
TDMA 800	991 / 824.04	27.52	-
	384 / 836.52	27.54	0.43
	799 / 848.97	27.53	-

Battery Check with BLC-1

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
AMPS	991 / 824.04	24.43	-
	384 / 836.52	24.63	0.60
	799 / 848.97	24.56	-

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
TDMA 800	991 / 824.04	27.52	-
	384 / 836.52	27.54	0.35
	799 / 848.97	27.53	-

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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.

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.

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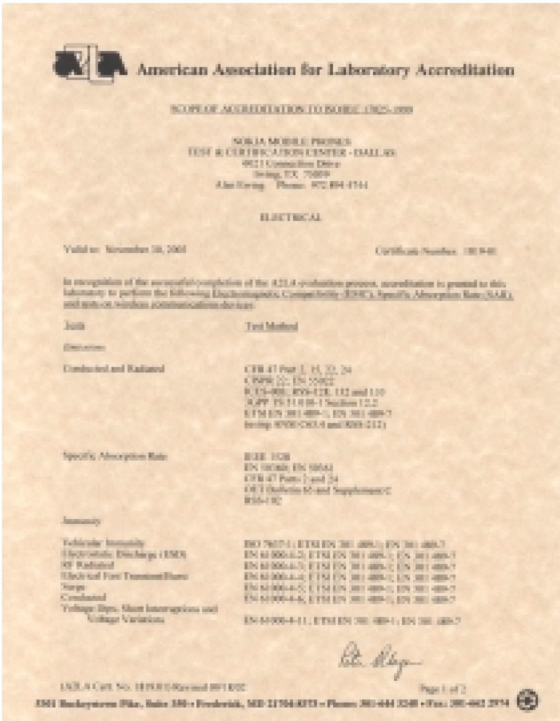
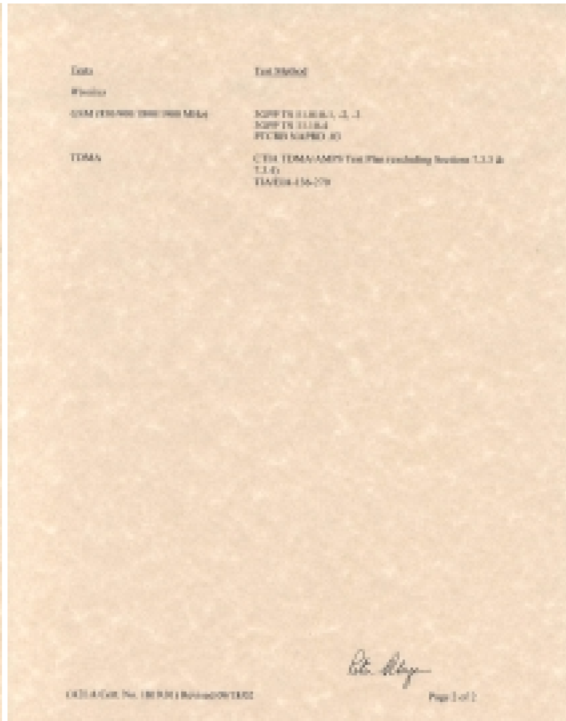

American Association for Laboratory Accreditation

ELECTRICAL


TDMA

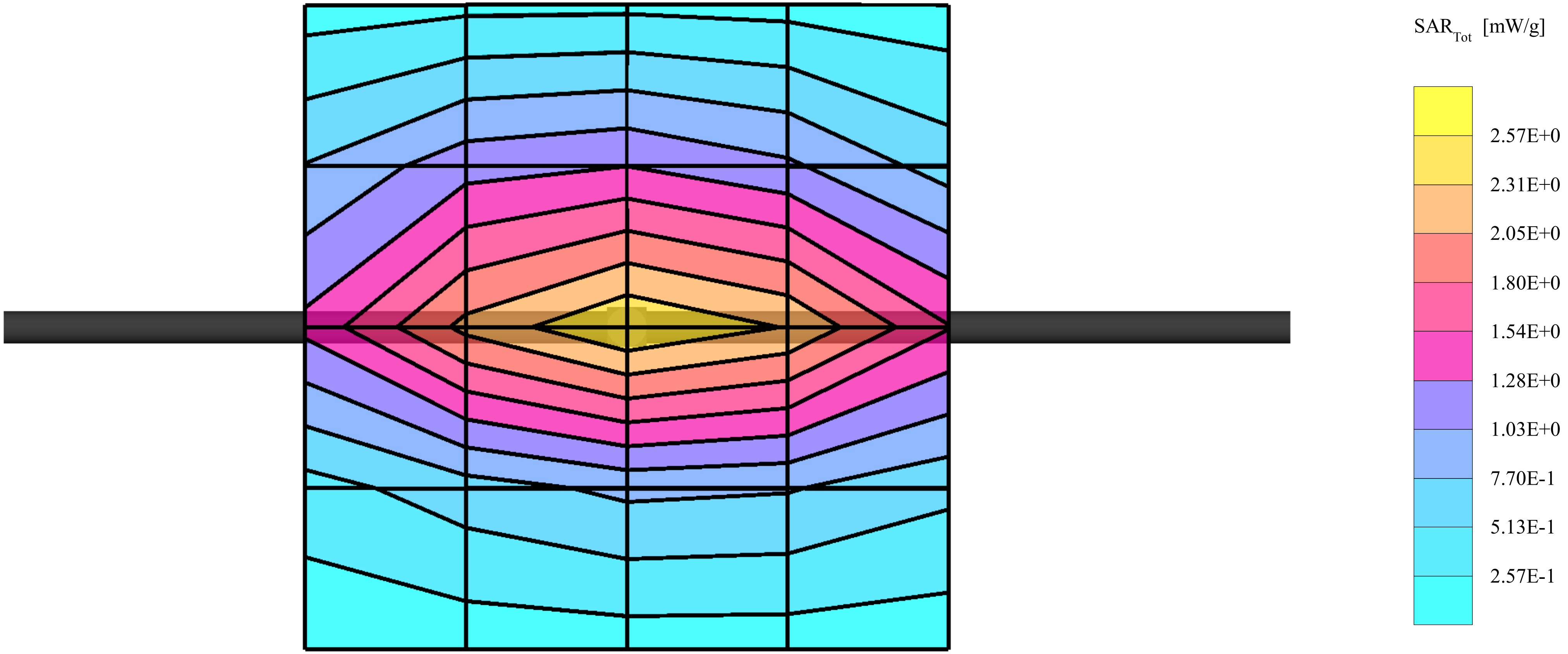
"This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined to be in accordance with the laboratory's terms of accreditation unless stated otherwise in the report."

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

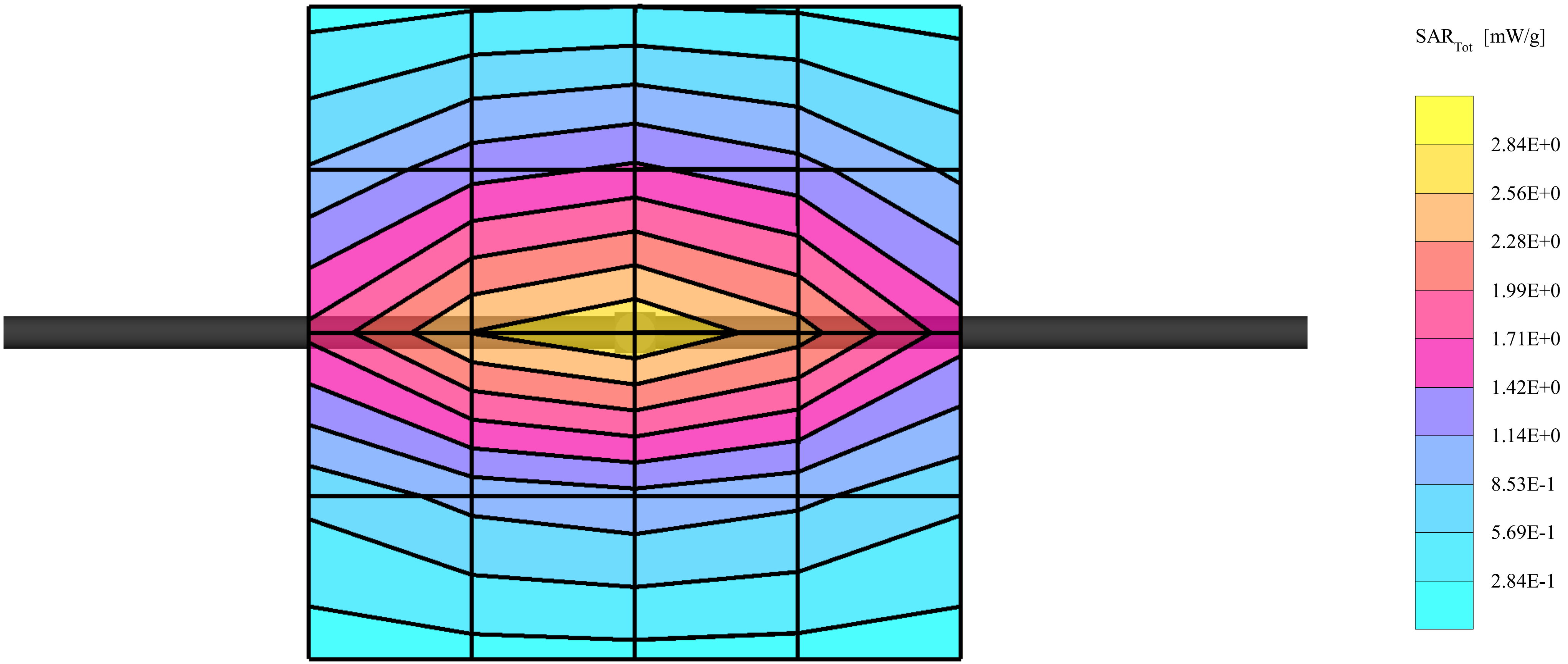
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.88 mho/m ε_r = 41.3 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.47 mW/g ± 0.05 dB, SAR (10g): 1.61 mW/g ± 0.06 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.00 dB
Liquid Temperature (°C):19.6



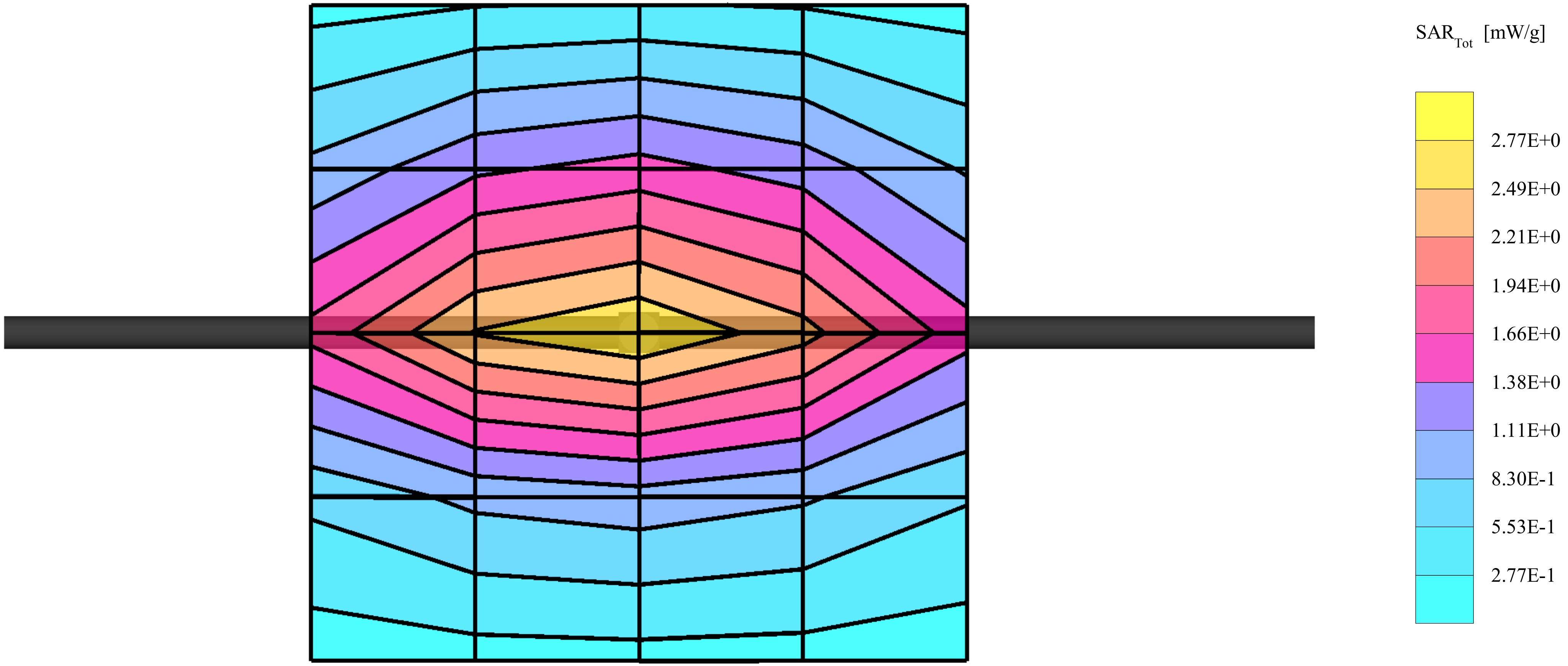
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.87 mho/m ε_r = 40.6 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.73 mW/g ± 0.04 dB, SAR (10g): 1.75 mW/g ± 0.05 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.04 dB
Liquid Temperature (°C):19.8



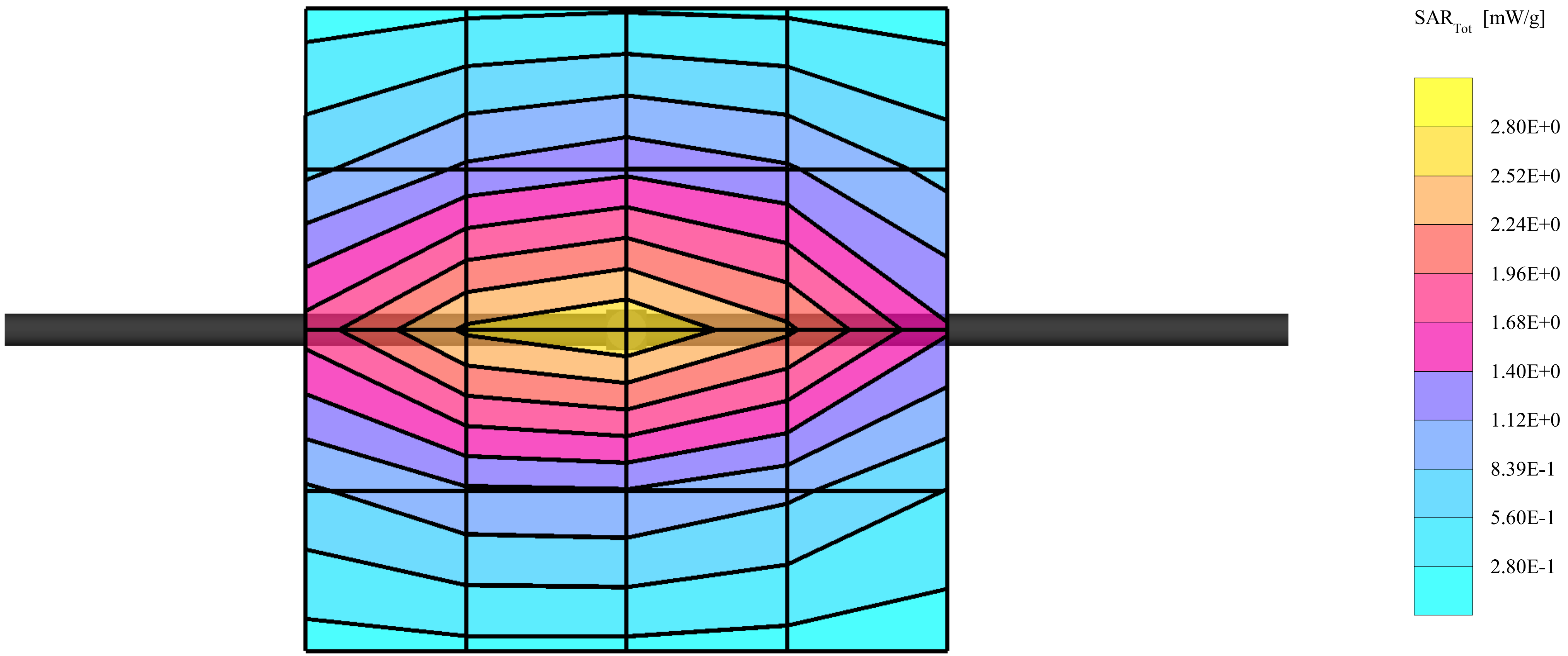
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.87 mho/m ε_r = 40.2 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.67 mW/g ± 0.04 dB, SAR (10g): 1.71 mW/g ± 0.04 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB
Liquid Temperature (°C):19.6



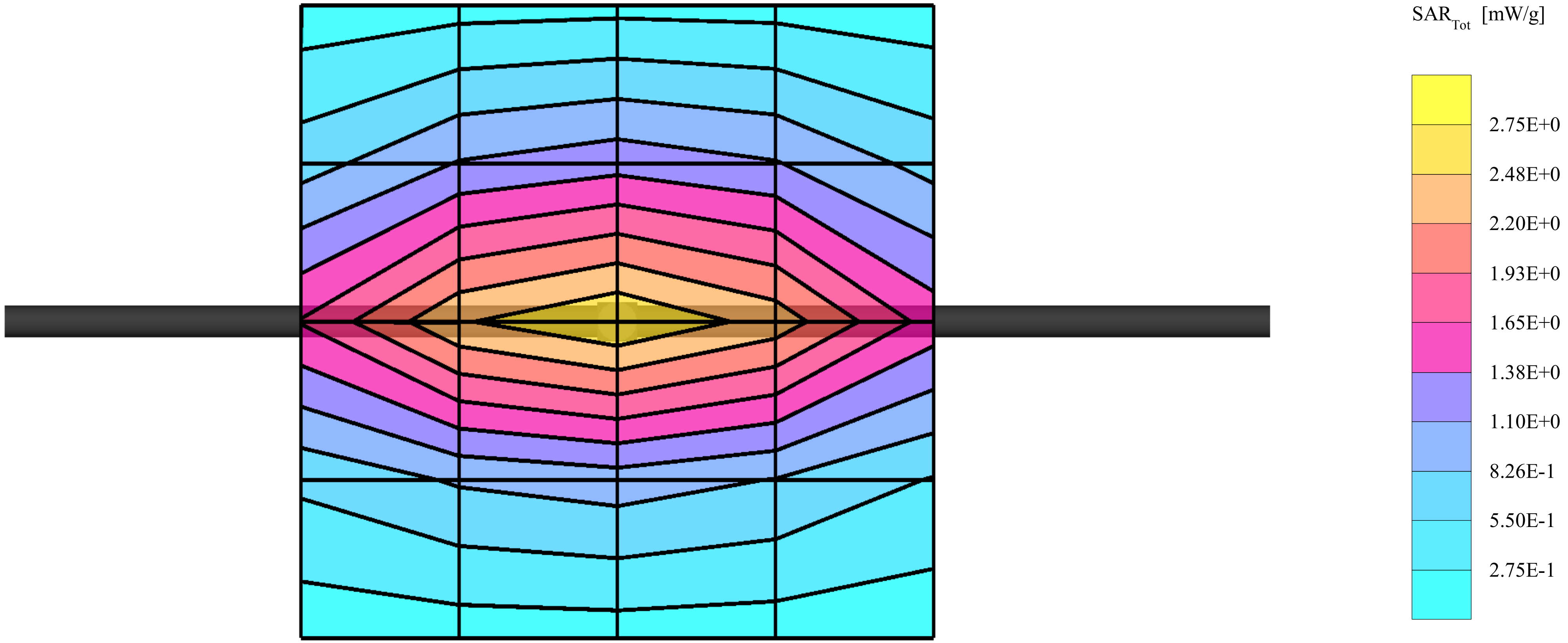
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 41.0 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.66 mW/g ± 0.04 dB, SAR (10g): 1.70 mW/g ± 0.04 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.07 dB
Liquid Temperature (°C):19.6



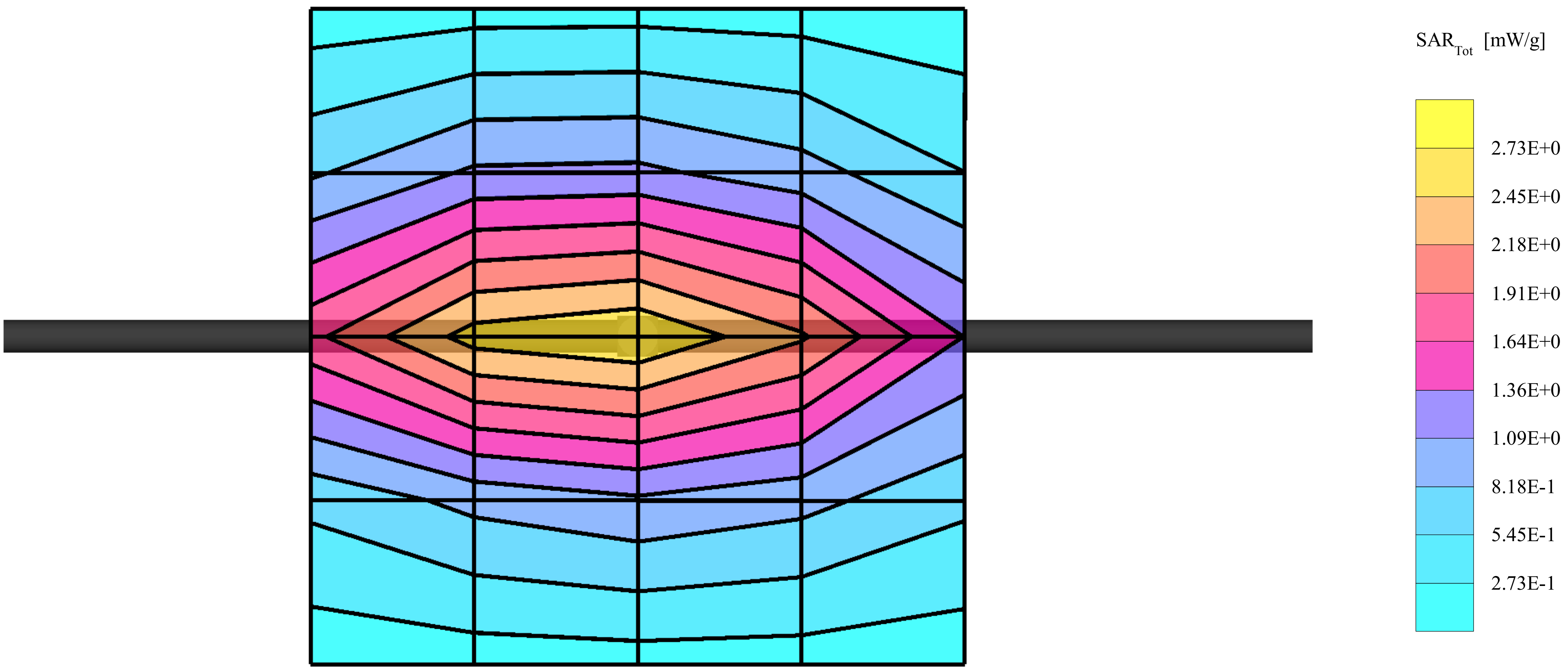
Dipole 835 MHz, Body Validation

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: σ = 0.93 mho/m ε_r = 54.6 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.63 mW/g ± 0.05 dB, SAR (10g): 1.71 mW/g ± 0.05 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.03 dB
Liquid Temperature (°C):20.0



Dipole 835 MHz, Body Validation

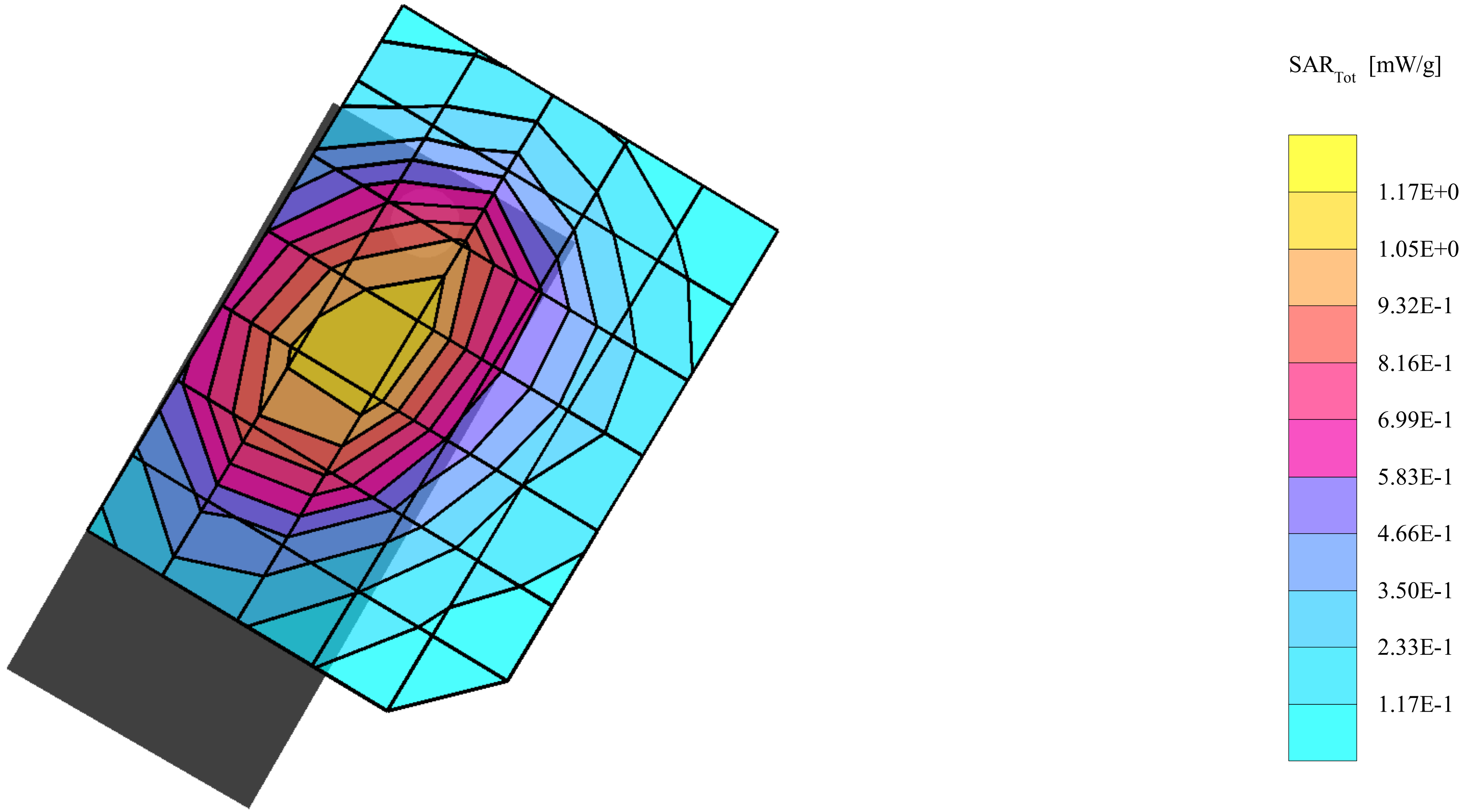
SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 835 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.94 mho/m ε_r = 54.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 2.62 mW/g ± 0.05 dB, SAR (10g): 1.70 mW/g ± 0.06 dB, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB
Liquid Temperature (°C):20.0



APPENDIX C: SAR DISTRIBUTION PRINTOUTS

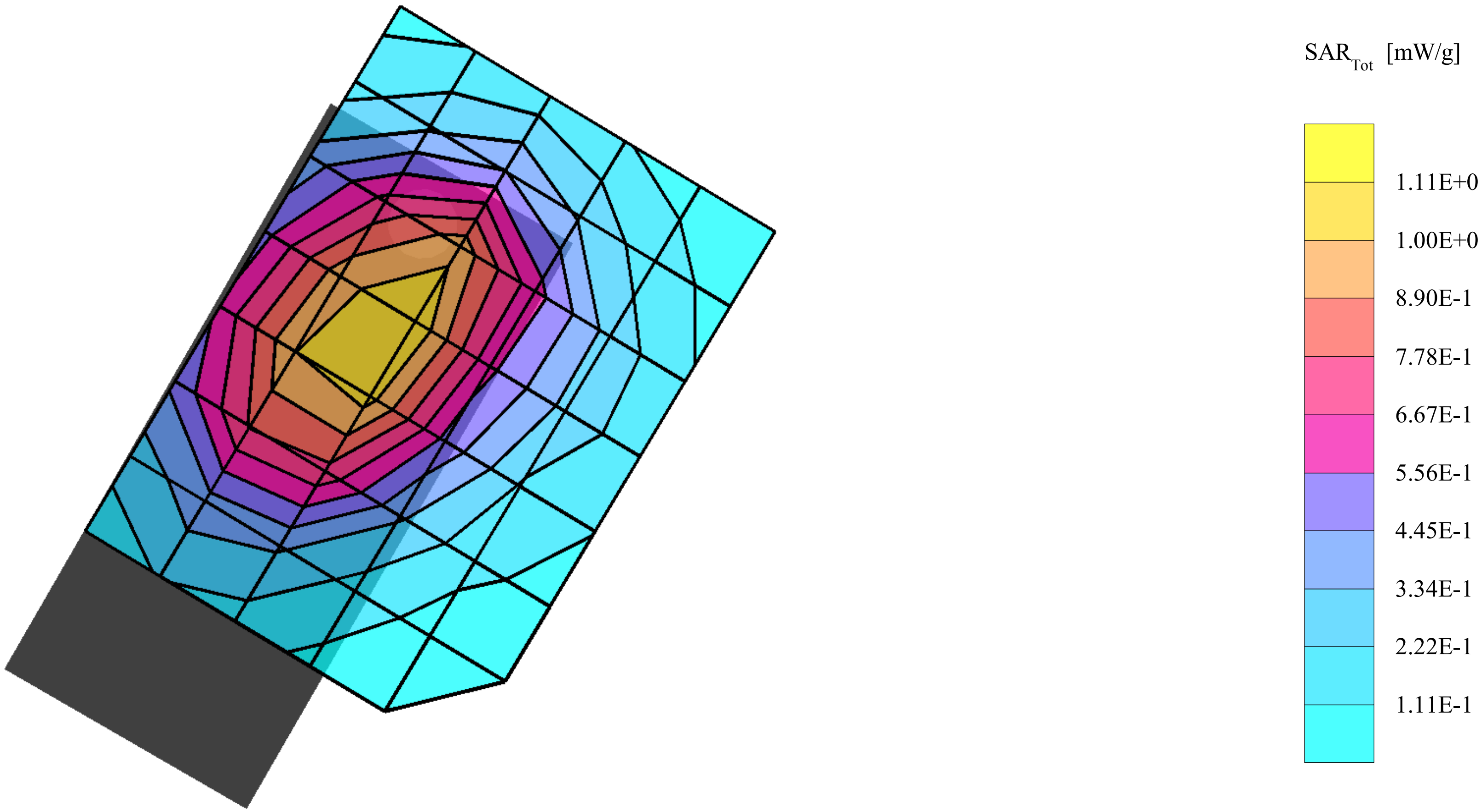
GMLRH-21, AMPS, Channel 799, Left Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 41.3 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.16 mW/g, SAR (10g): 0.809 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.05 dB
Liquid Temperature (°C):19.6



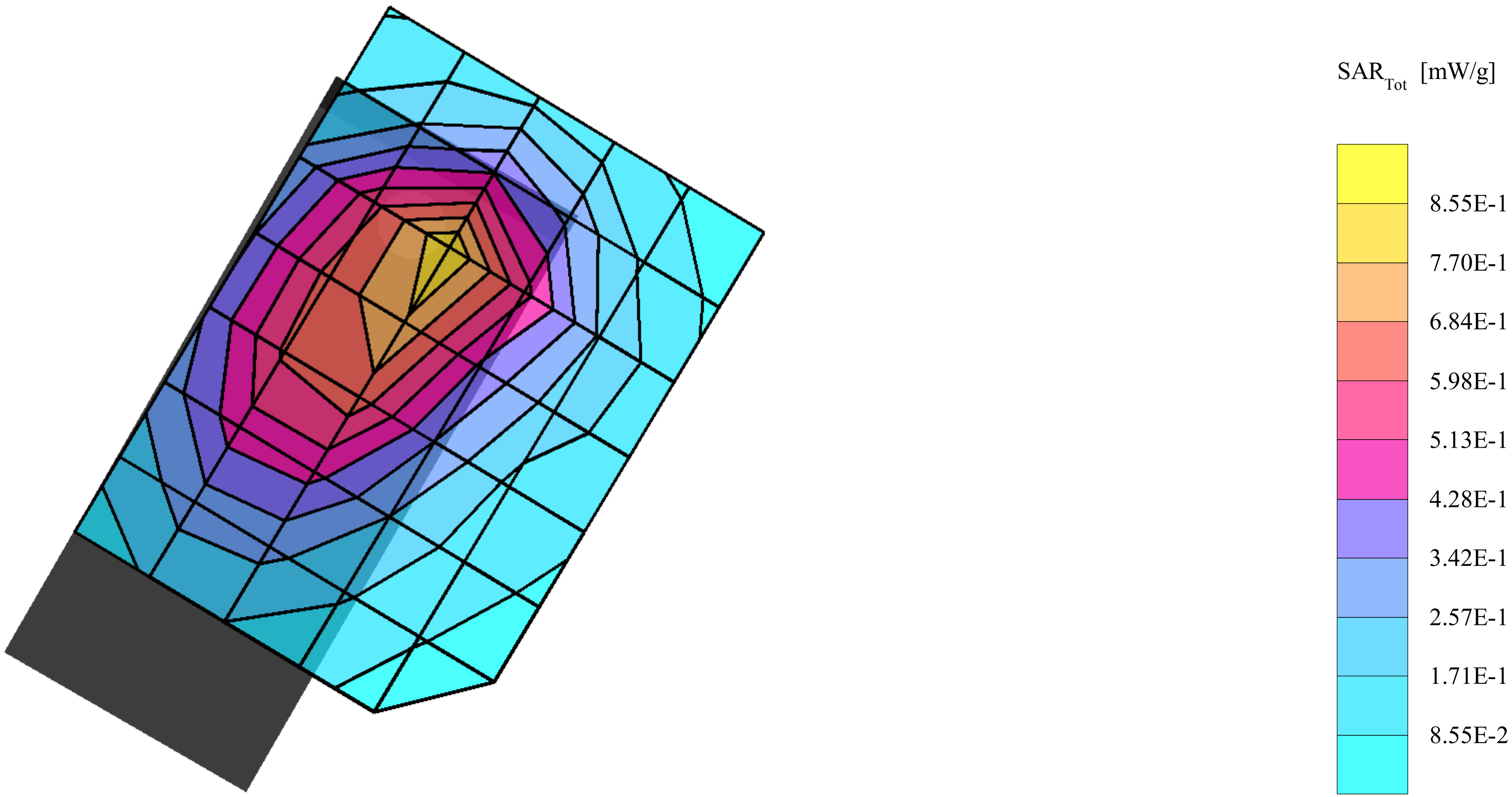
GMLRH-21, AMPS, Channel 799, Left Touch Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 40.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.09 mW/g, SAR (10g): 0.752 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.11 dB
Liquid Temperature (°C):19.8



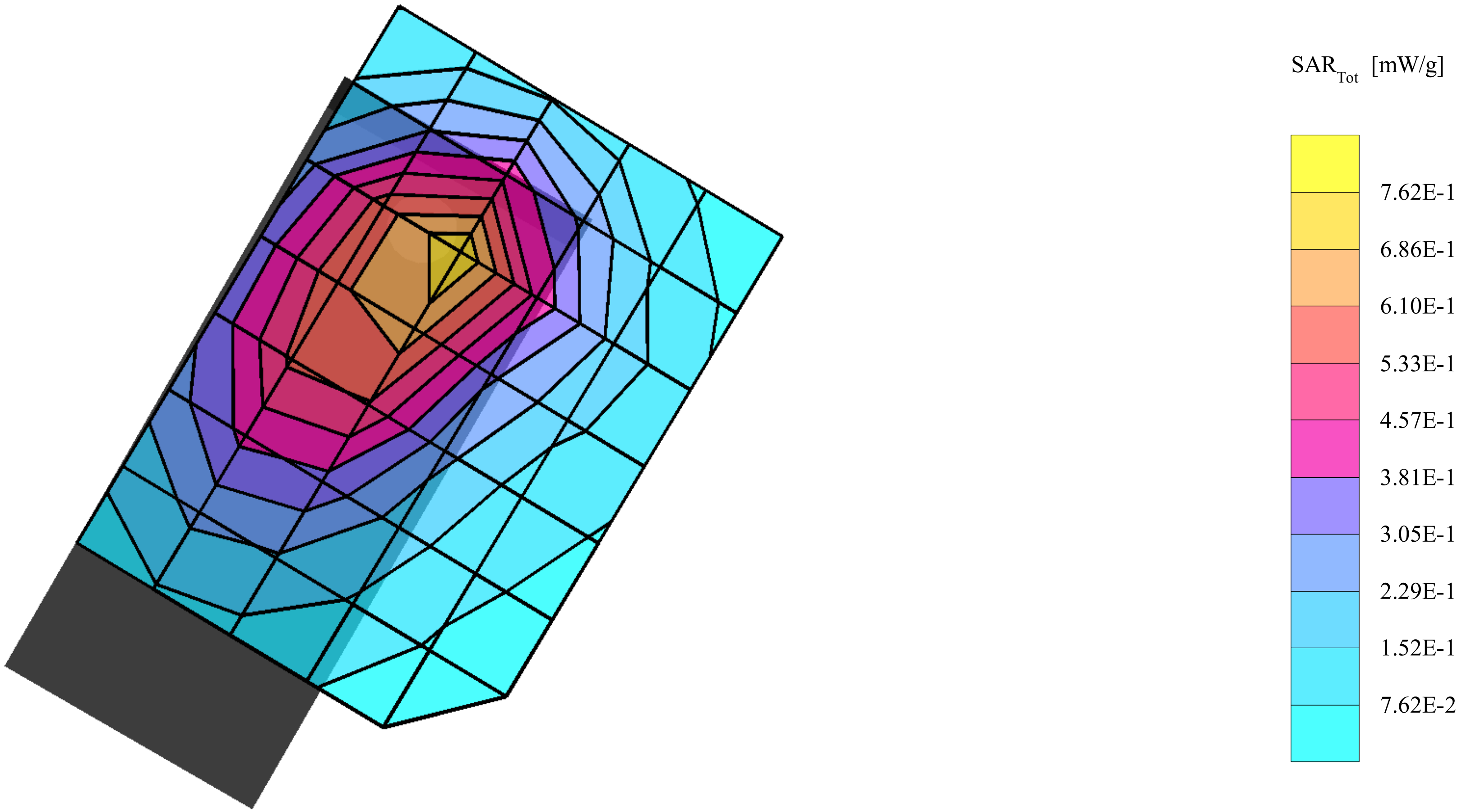
GMLRH-21, AMPS, Channel 384, Left Tilt Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 41.3$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.788 mW/g, SAR (10g): 0.509 mW/g , (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.06 dB
Liquid Temperature (°C):19.6



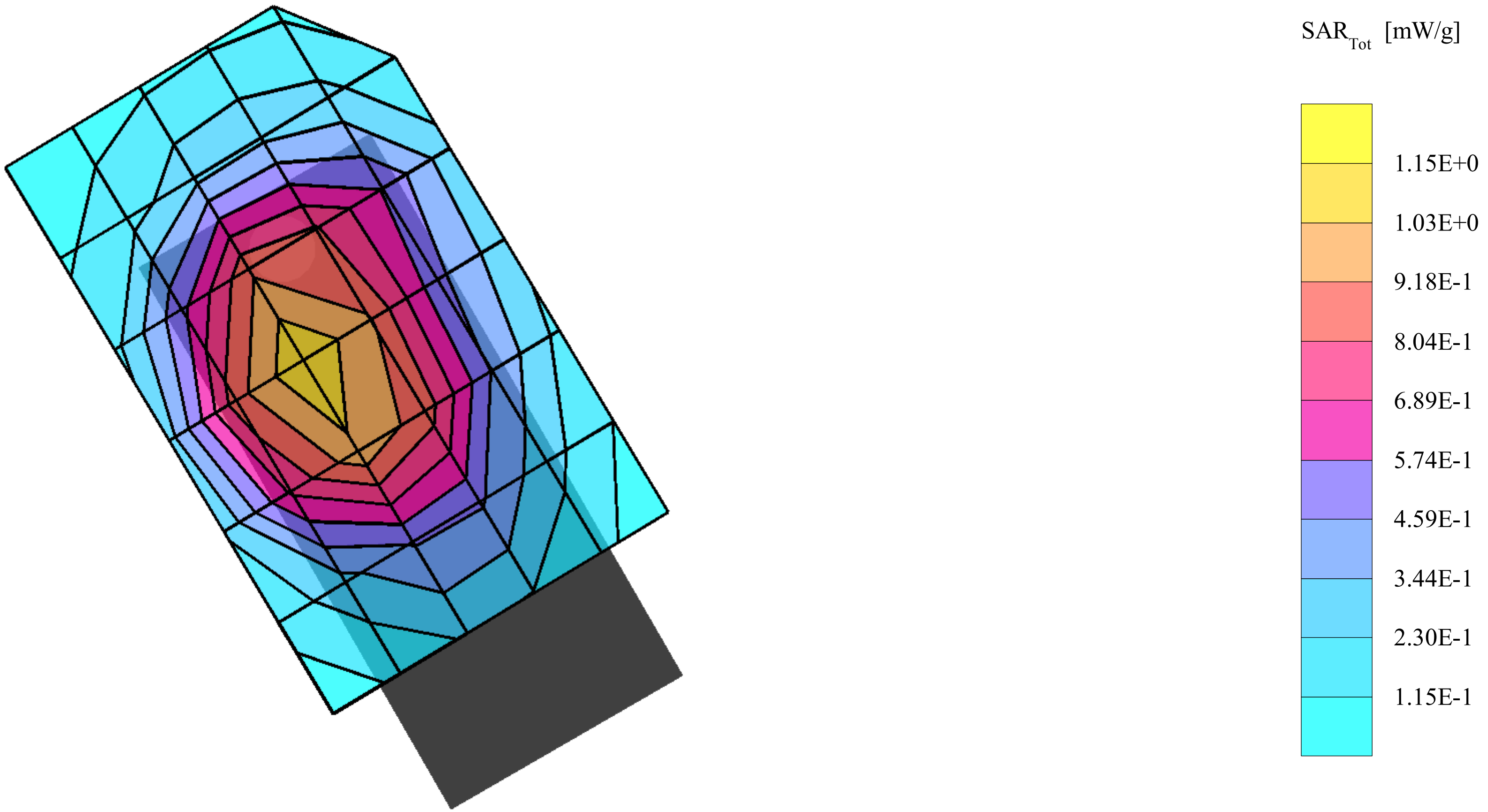
GMLRH-21, AMPS, Channel 384, Left Tilt Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 40.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.719 mW/g, SAR (10g): 0.461 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.10 dB
Liquid Temperature (°C):19.8



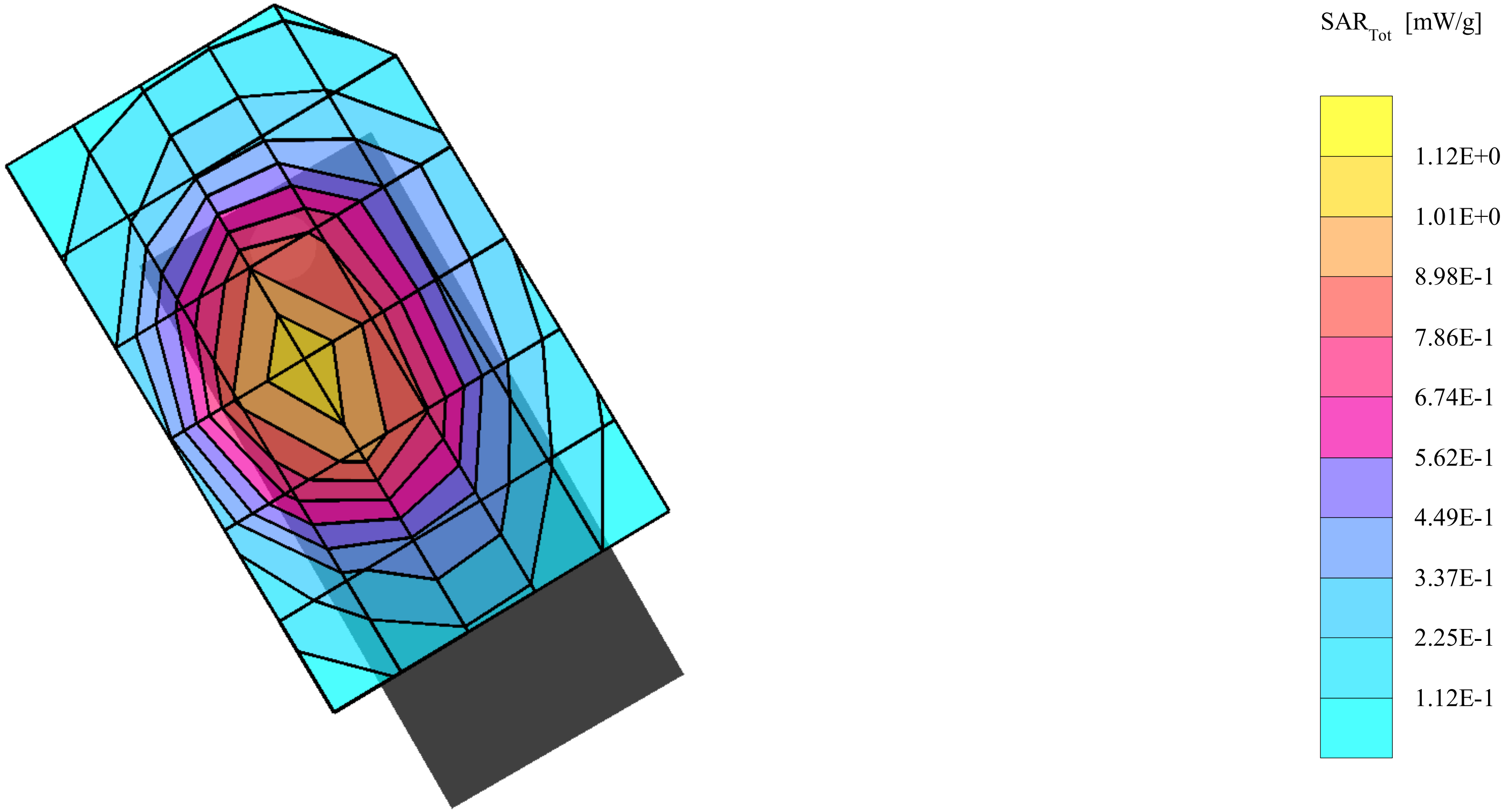
GMLRH-21, AMPS, Channel 799, Right Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 41.3 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.09 mW/g, SAR (10g): 0.767 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.00 dB
Liquid Temperature (°C):19.6



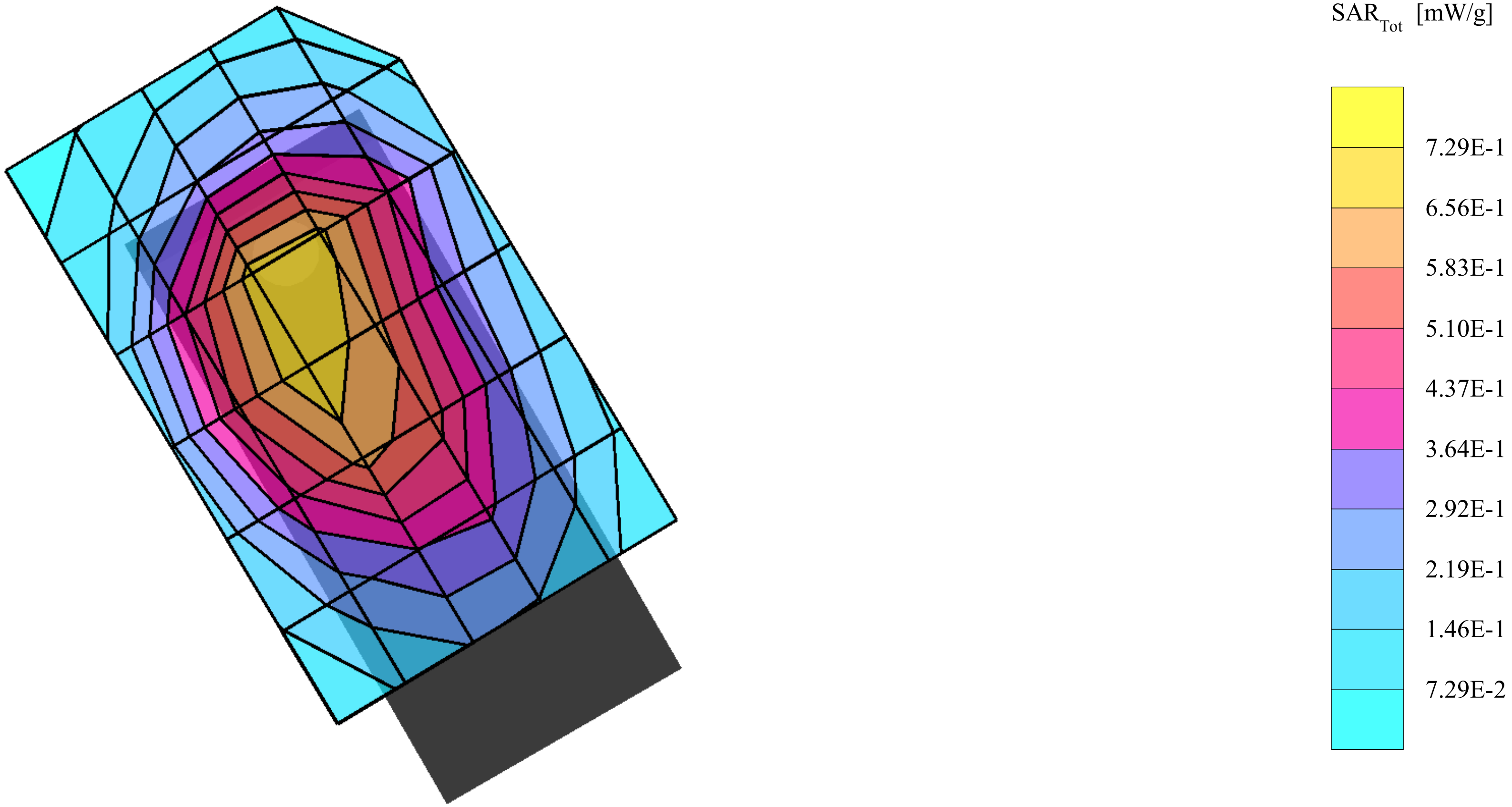
GMLRH-21, AMPS, Channel 799, Right Touch Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 40.6 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): 0.750 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.34 dB
Liquid Temperature (°C):19.8



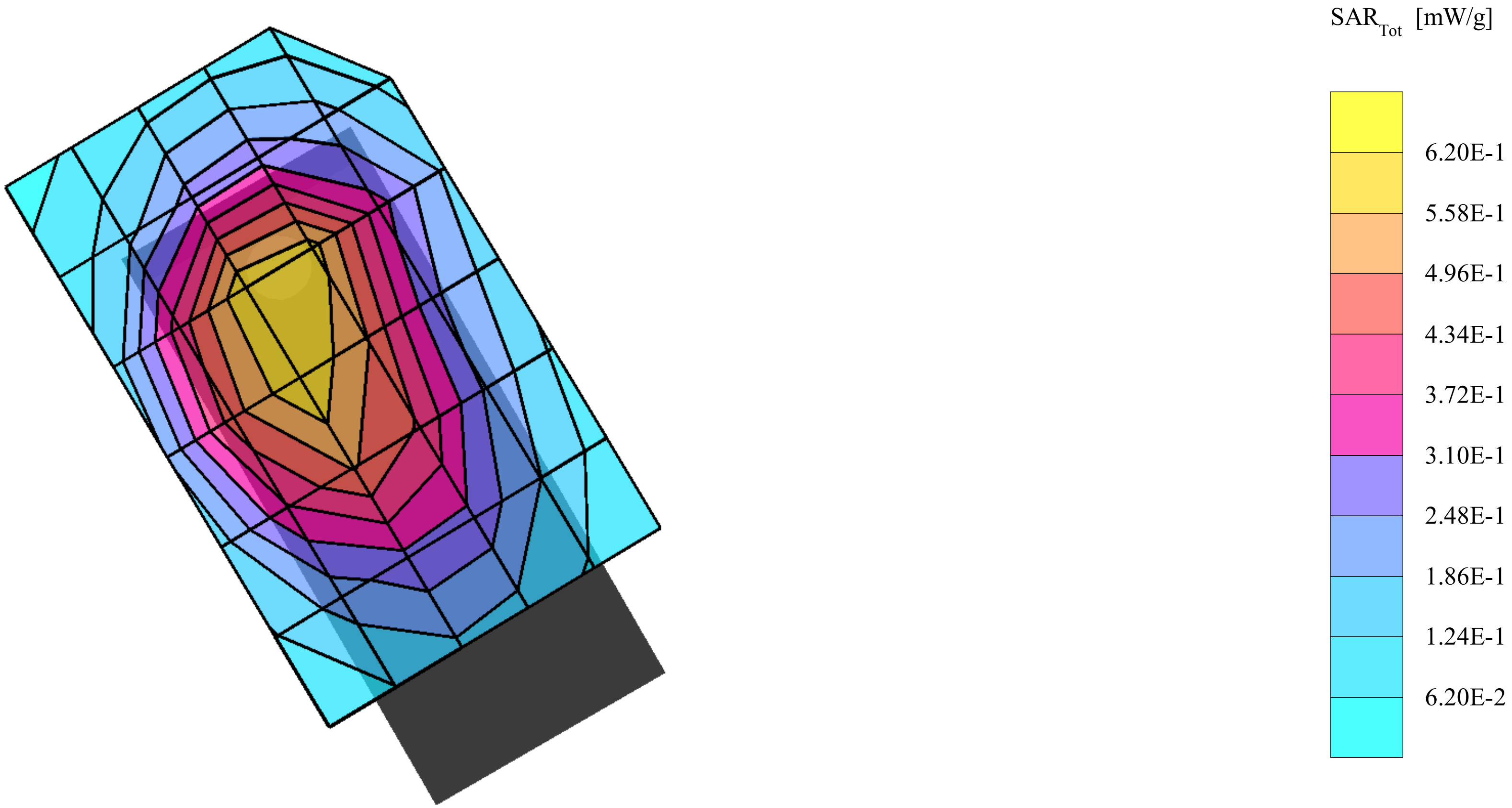
GMLRH-21, AMPS, Channel 384, Right Tilt Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.89$ mho/m $\varepsilon_r = 41.3$ $\rho = 1.00$ g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.710 mW/g, SAR (10g): 0.499 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.09 dB
Liquid Temperature (°C):19.6



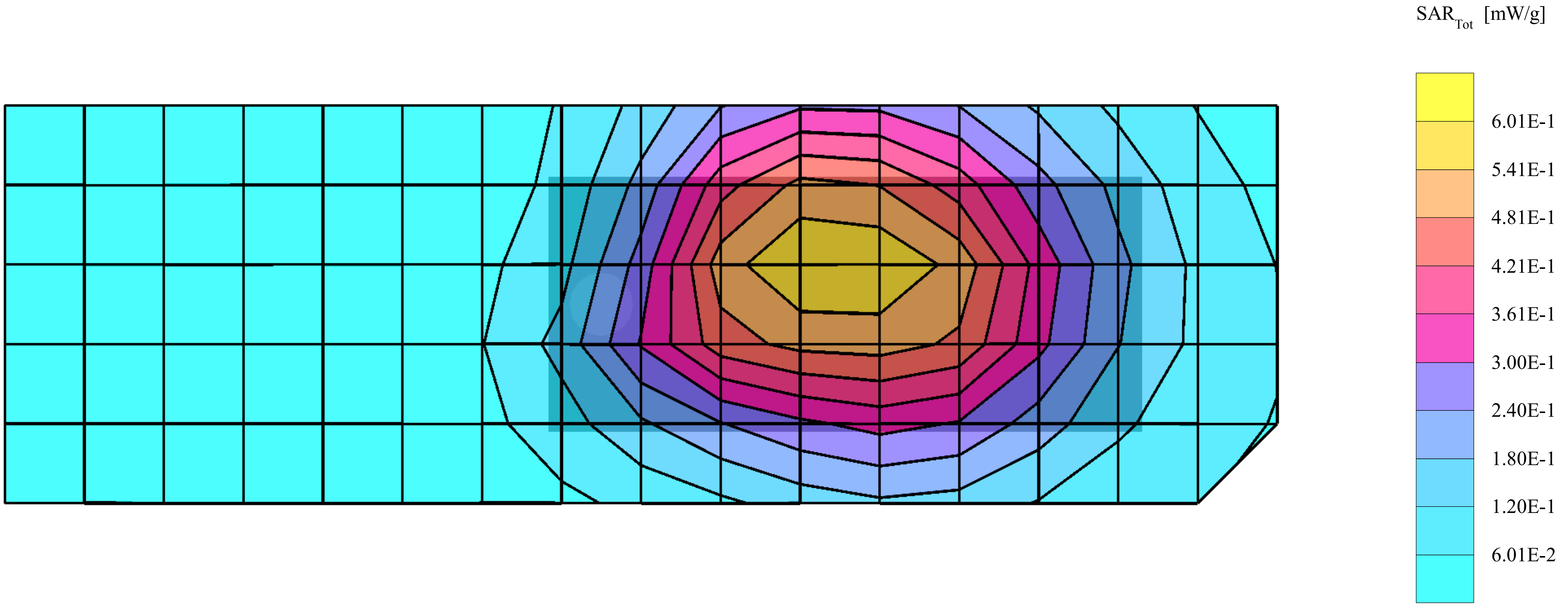
GMLRH-21, AMPS, Channel 384, Right Tilt Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 40.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): SAR (1g): 0.615 mW/g ± 0.05 dB, SAR (10g): 0.425 mW/g ± 0.03 dB, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.07 dB
Liquid Temperature (°C):19.8



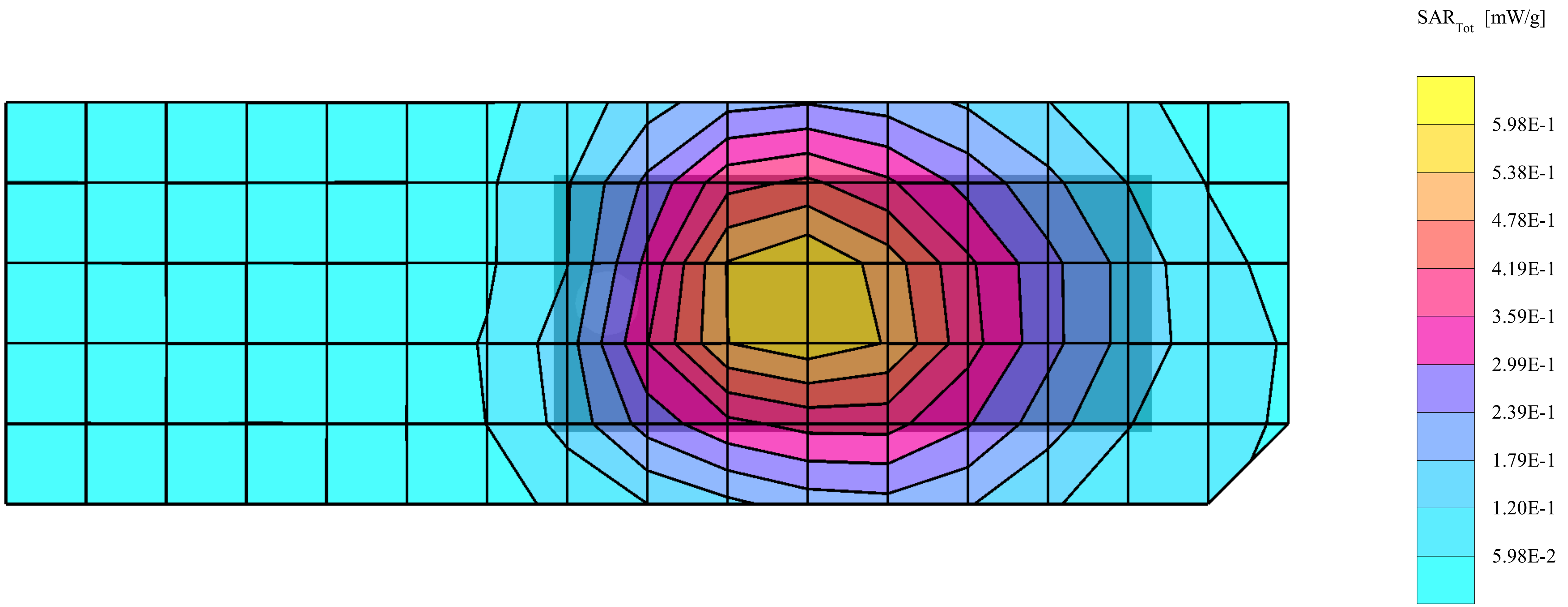
GMLRH-21, AMPS, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-2

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.93 mho/m ε_r = 54.8 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.589 mW/g, SAR (10g): 0.426 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.21 dB
Liquid Temperature (°C):19.8



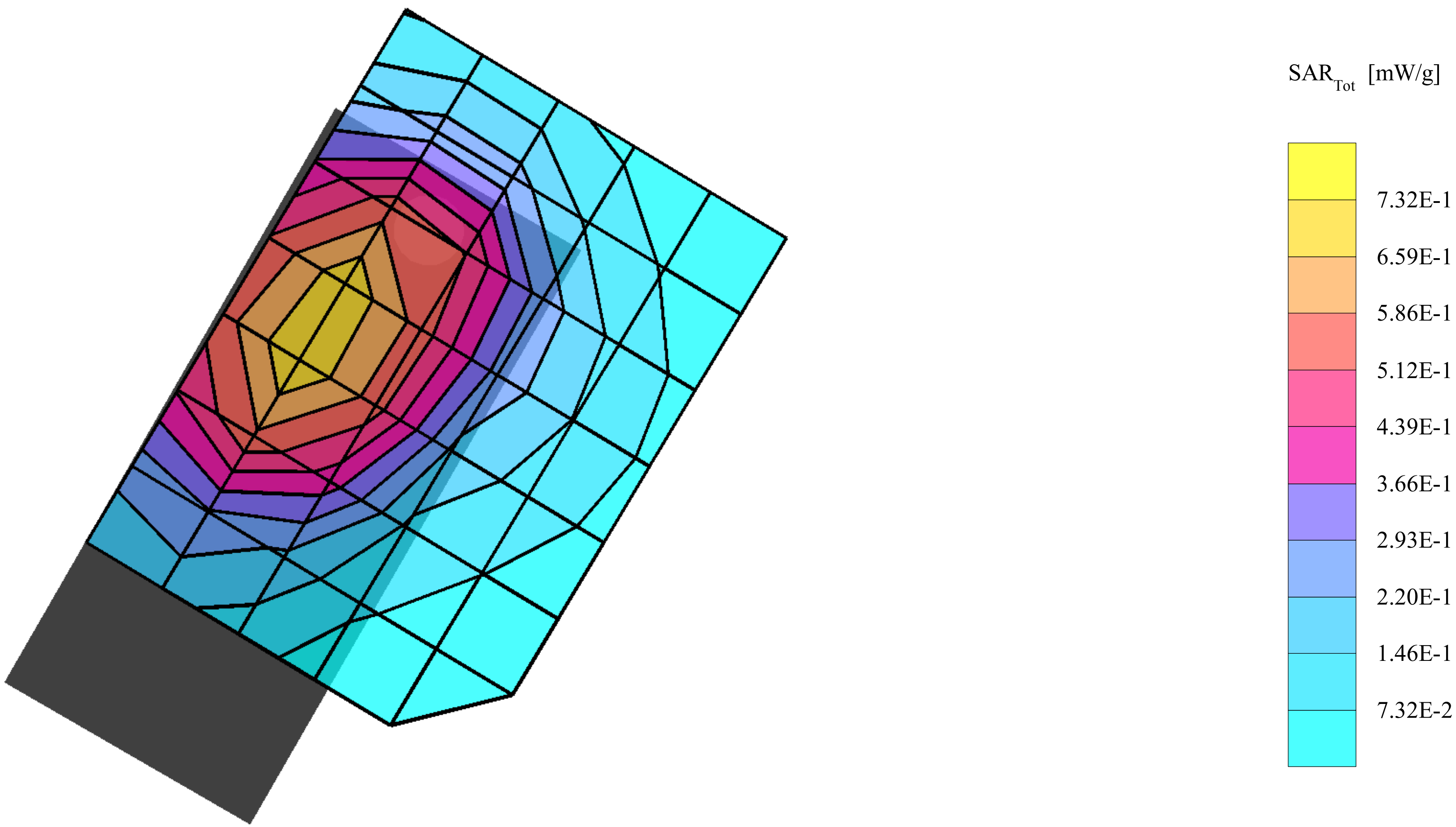
GMLRH-21, AMPS, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-1

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: $\sigma = 0.93$ mho/m $\varepsilon_r = 54.6$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.597 mW/g, SAR (10g): 0.425 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.05 dB
Liquid Temperature (°C):19.8



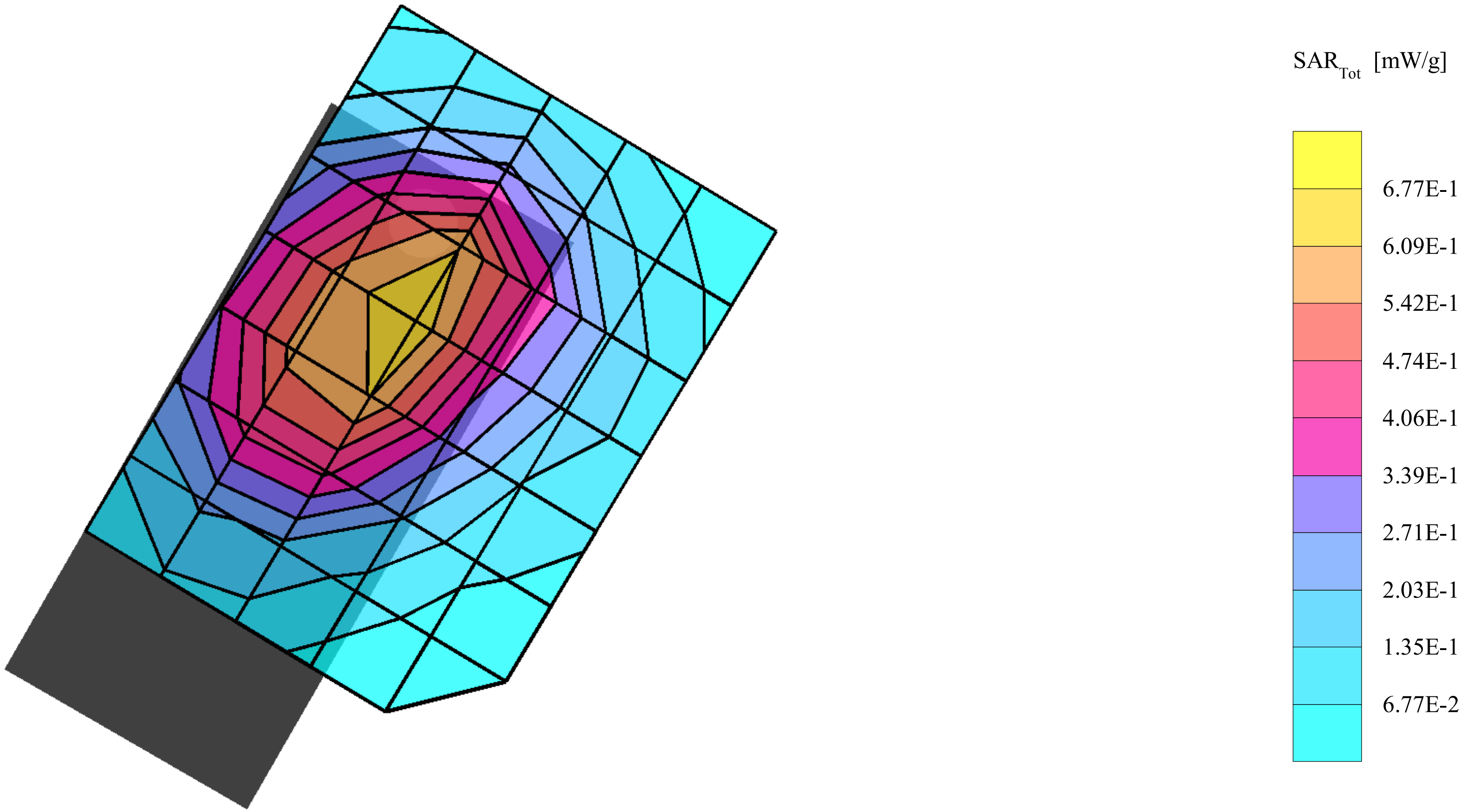
GMLRH-21, TDMA800, Channel 384, Left Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 40.2$ $\rho = 1.00$ g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.702 mW/g, SAR (10g): 0.483 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.09 dB
Liquid Temperature (°C):19.6



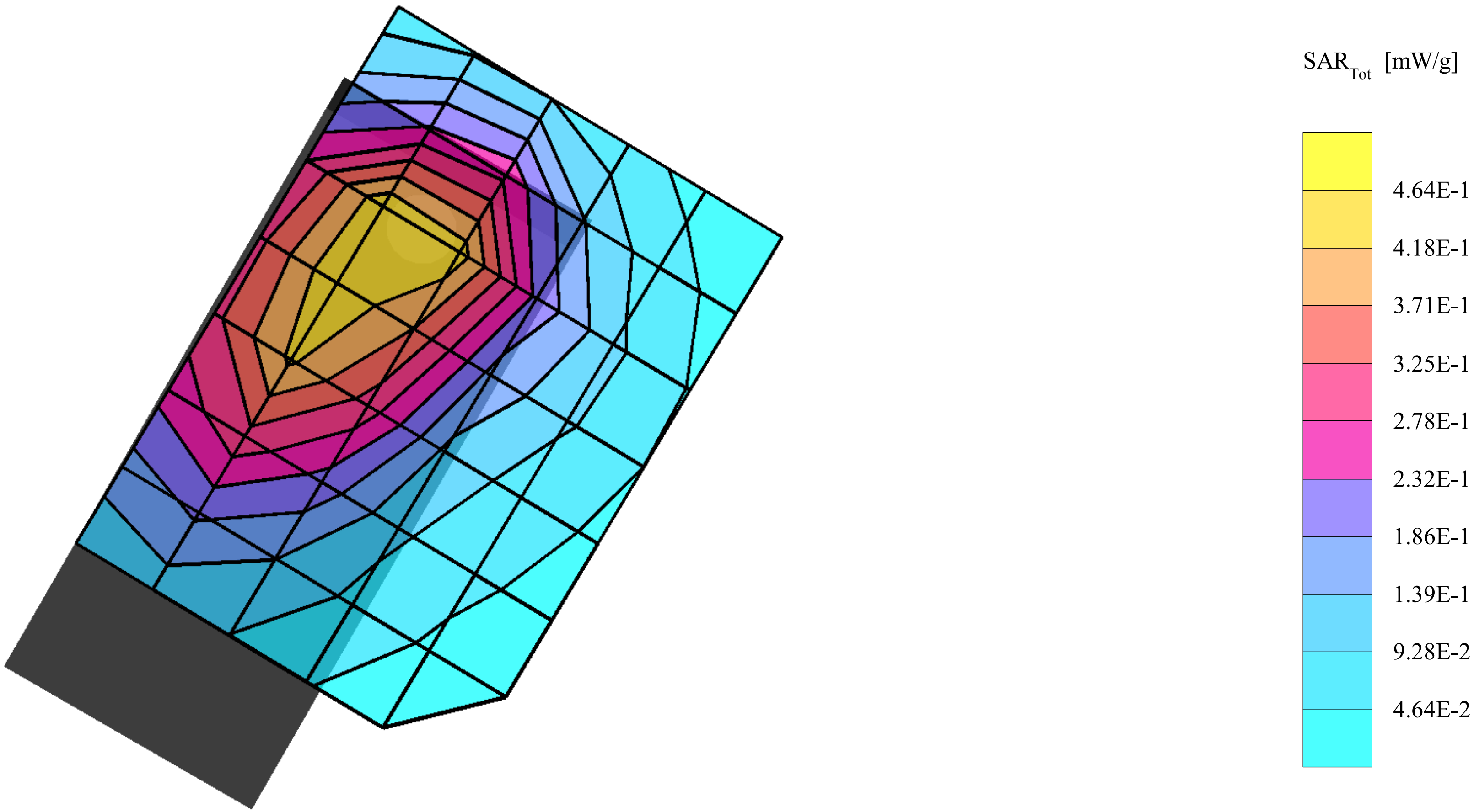
GMLRH-21, TDMA800, Channel 384, Left Touch Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: σ = 0.87 mho/m ε_r = 40.2 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.652 mW/g, SAR (10g): 0.444 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.07 dB
Liquid Temperature (°C):19.6



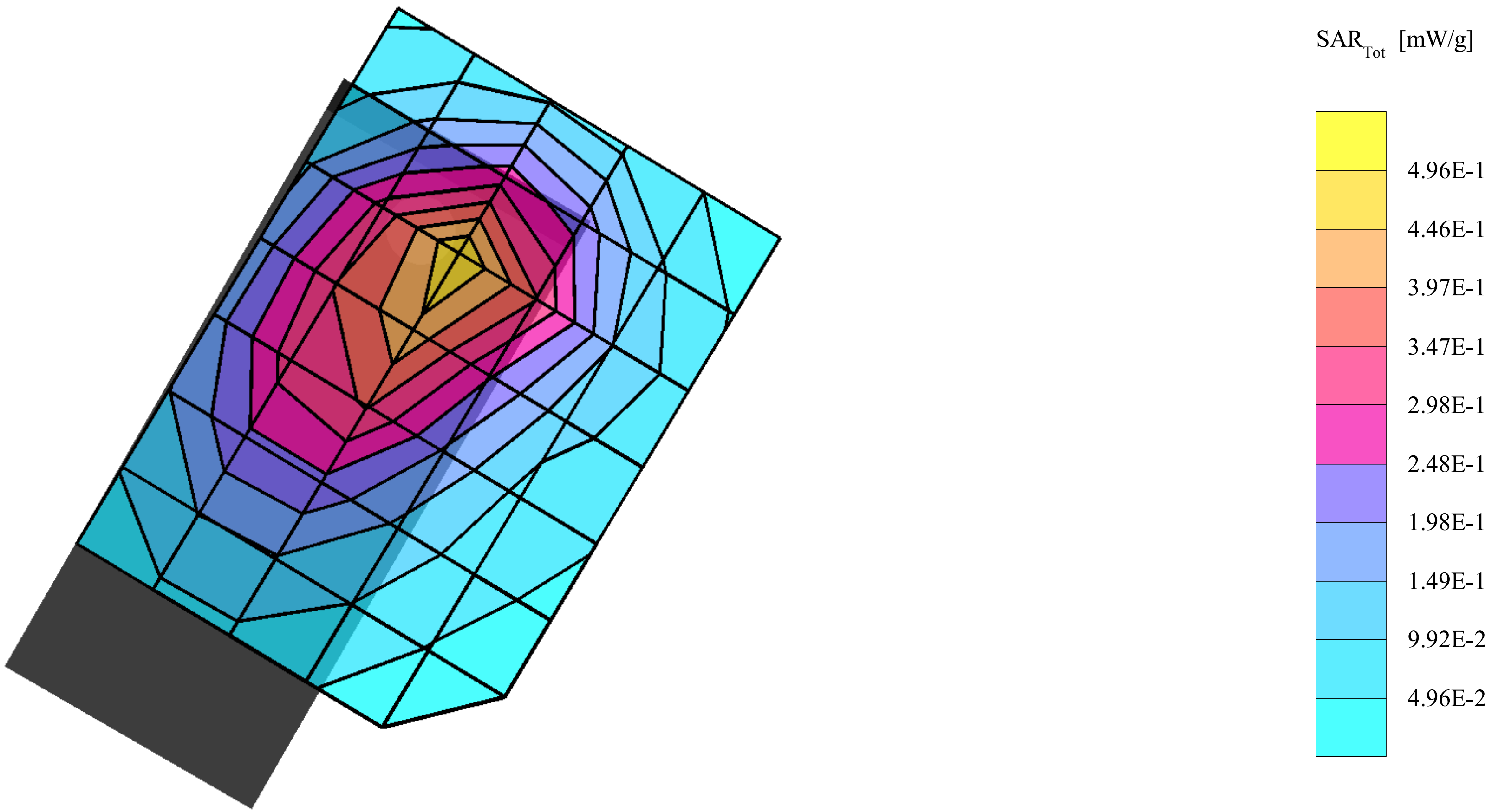
GMLRH-21, TDMA800, Channel 384, Left Tilt Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 40.2$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.473 mW/g, SAR (10g): 0.311 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.10 dB
Liquid Temperature (°C):19.6



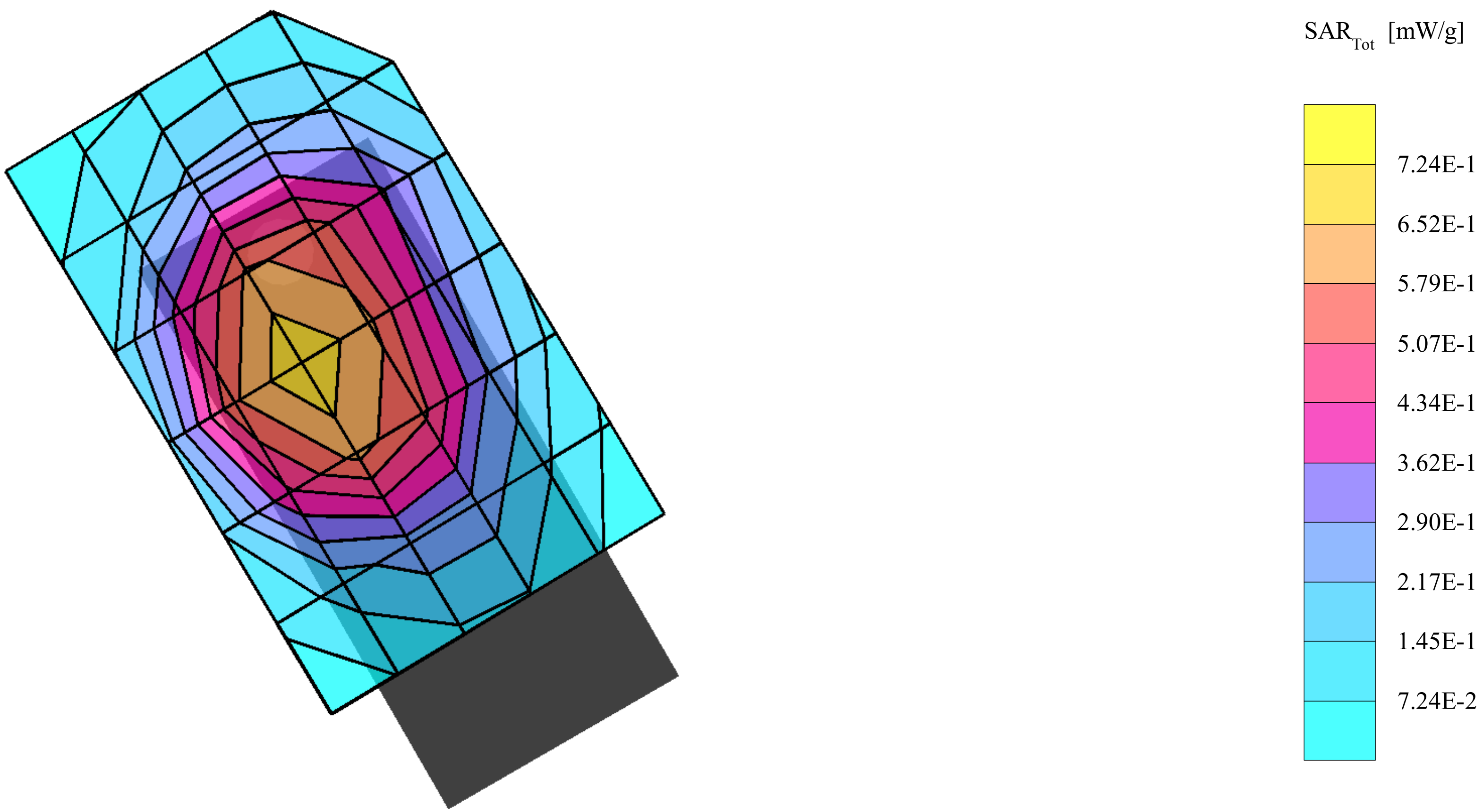
GMLRH-21, TDMA800, Channel 384, Left Tilt Position with BLC-1

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 40.2$ $\rho = 1.00$ g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.460 mW/g, SAR (10g): 0.293 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.02 dB
Liquid Temperature (°C):19.6



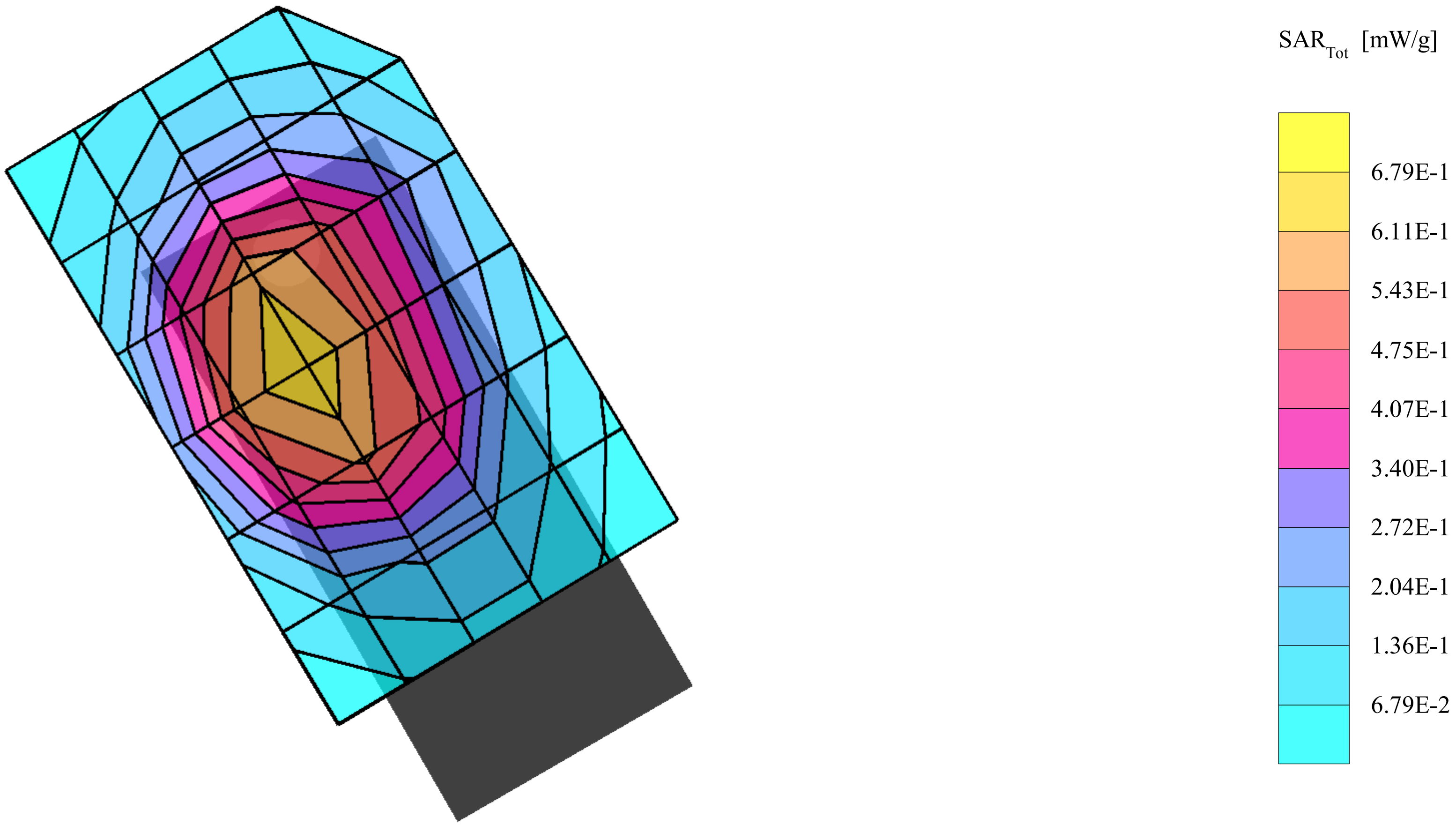
GMLRH-21, TDMA800, Channel 384, Right Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: $\sigma = 0.88$ mho/m $\varepsilon_r = 41.0$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.700 mW/g, SAR (10g): 0.495 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.01 dB
Liquid Temperature (°C):19.6



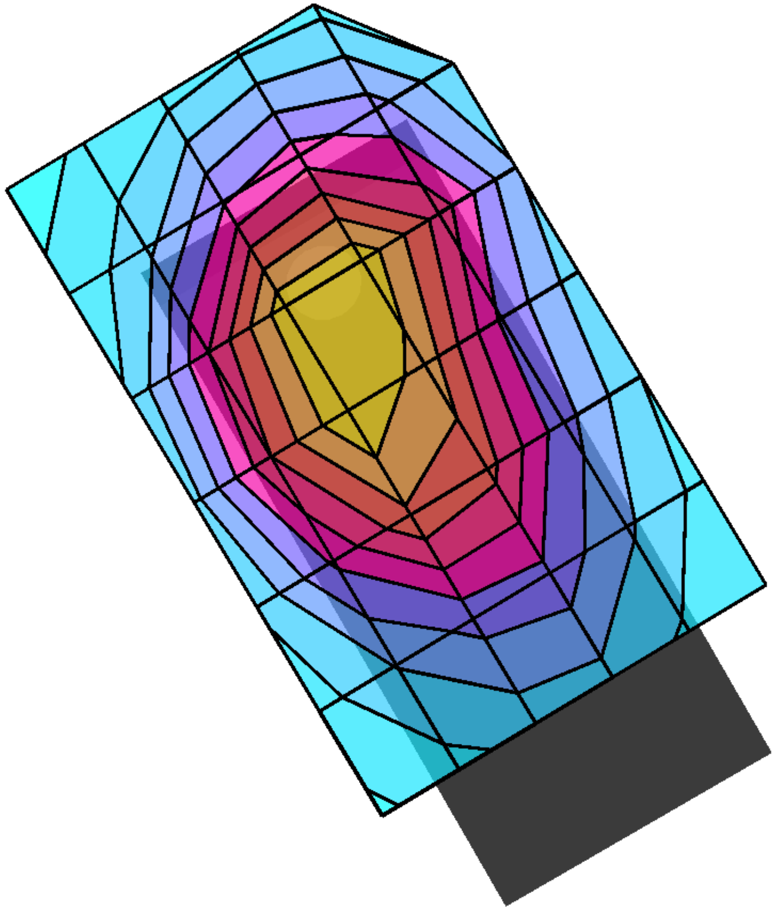
GMLRH-21, TDMA800, Channel 384, Right Touch Position with BLC-1

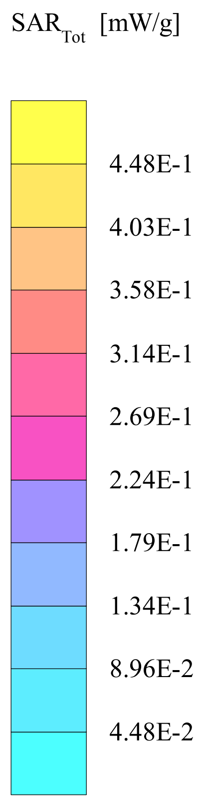
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.650 mW/g, SAR (10g): 0.458 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.07 dB
Liquid Temperature (°C):19.6



GMLRH-21, TDMA800, Channel 384, Right Tilt Position with BLC-2

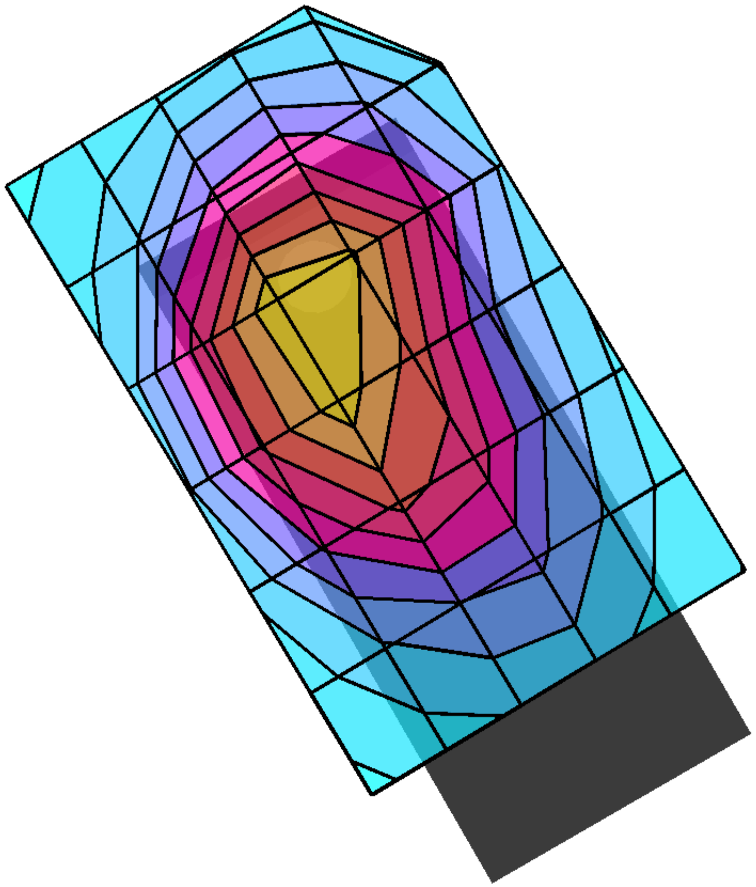
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.442 mW/g, SAR (10g): 0.312 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.16 dB
Liquid Temperature (°C):19.6

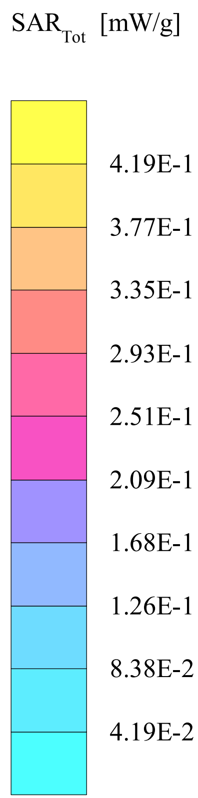




GMLRH-21, TDMA800, Channel 384, Right Tilt Position with BLC-1

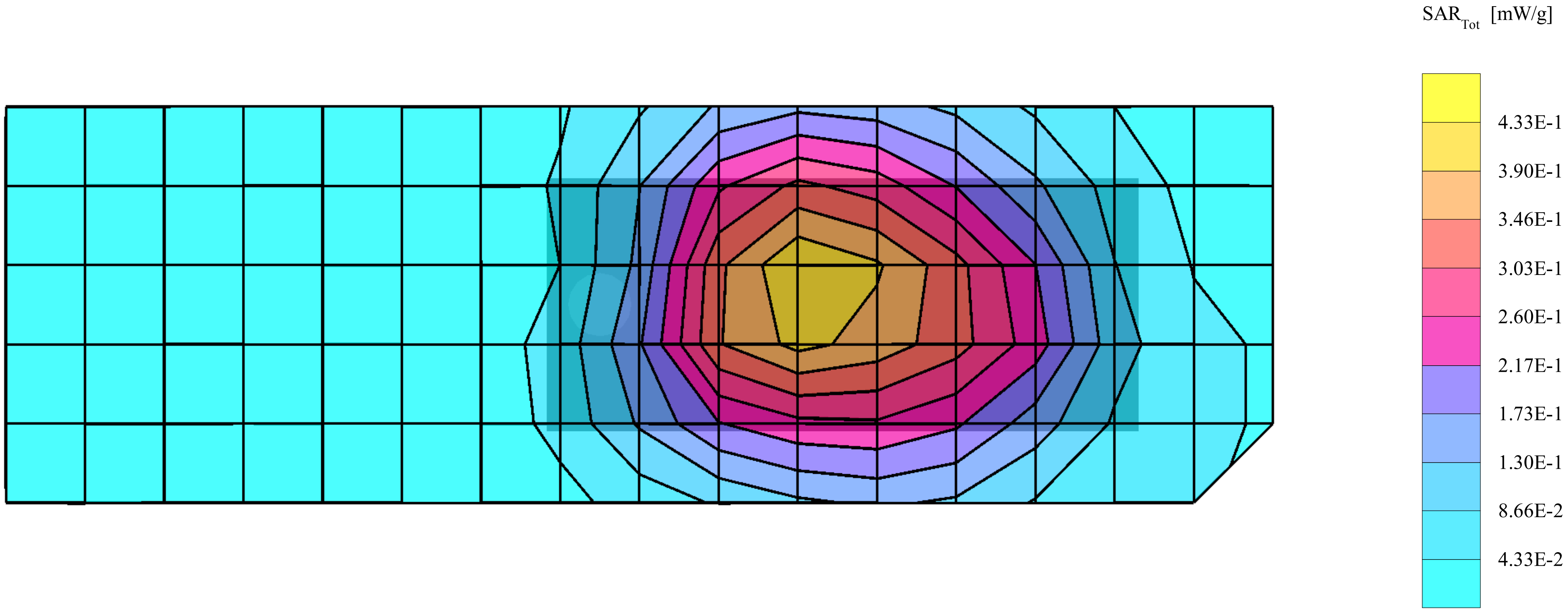
SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: σ = 0.88 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.409 mW/g, SAR (10g): 0.281 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.10 dB
Liquid Temperature (°C):19.6





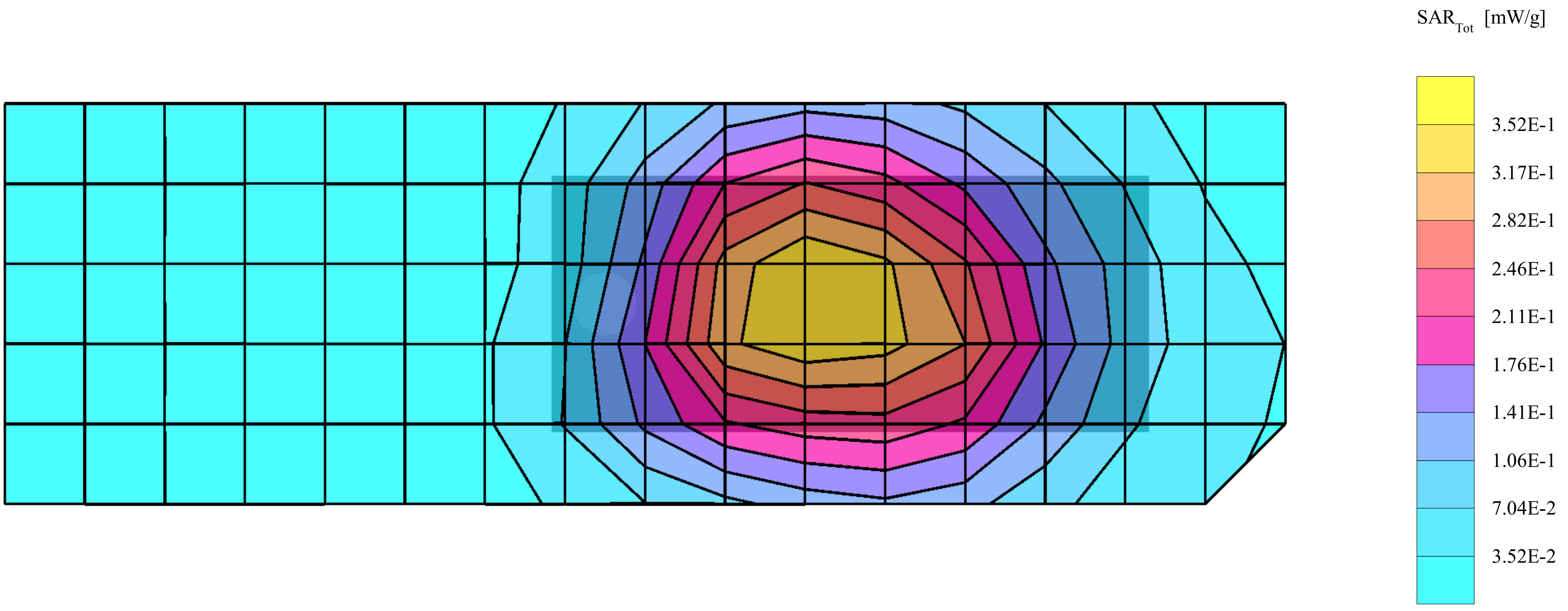
GMLRH-21, TDMA800, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-2

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Muscle Tissue: σ = 0.94 mho/m ε_r = 54.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.426 mW/g, SAR (10g): 0.301 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.10 dB
Liquid Temperature (°C):20.0



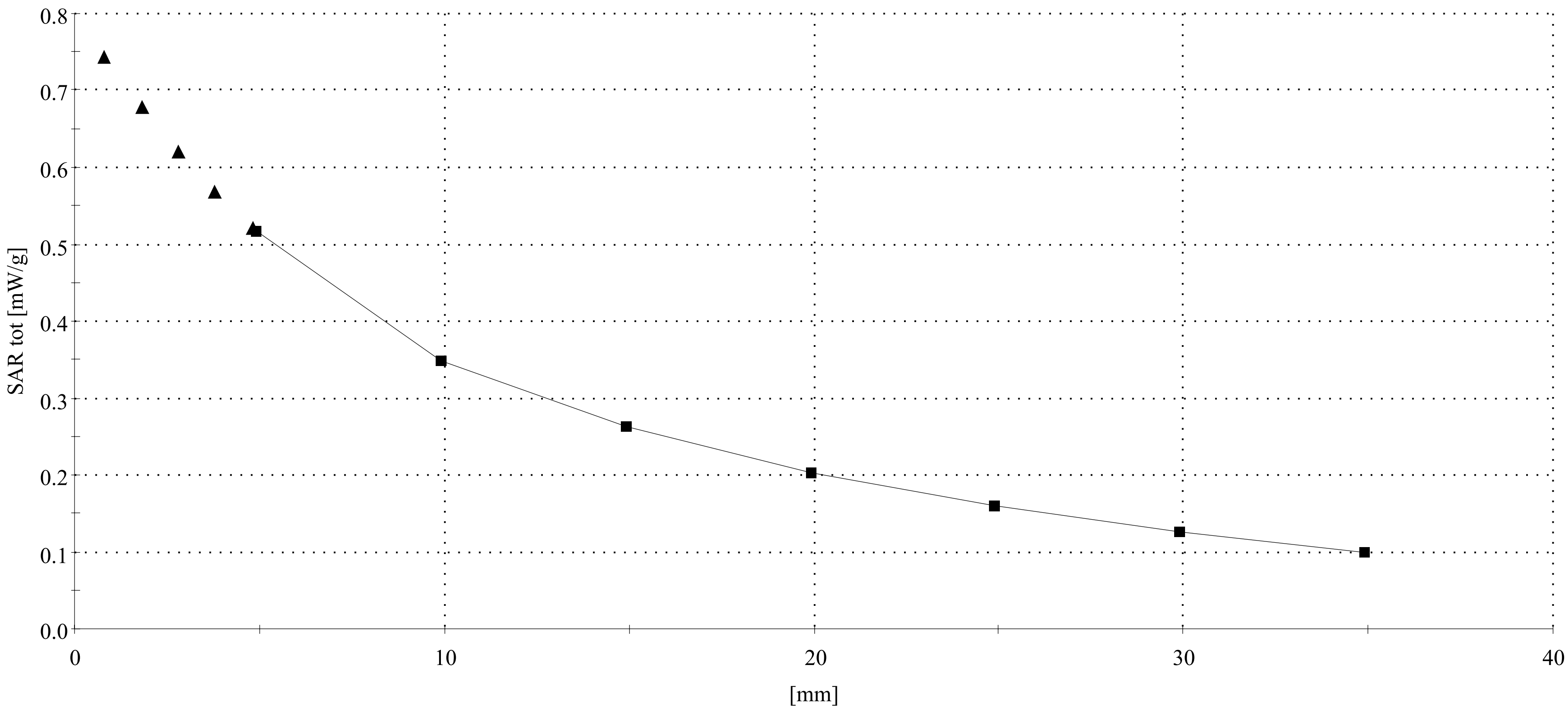
GMLRH-21, TDMA800, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-1

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Muscle Tissue: σ = 0.94 mho/m ε_r = 54.6 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.351 mW/g, SAR (10g): 0.252 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.04 dB
Liquid Temperature (°C):20.0



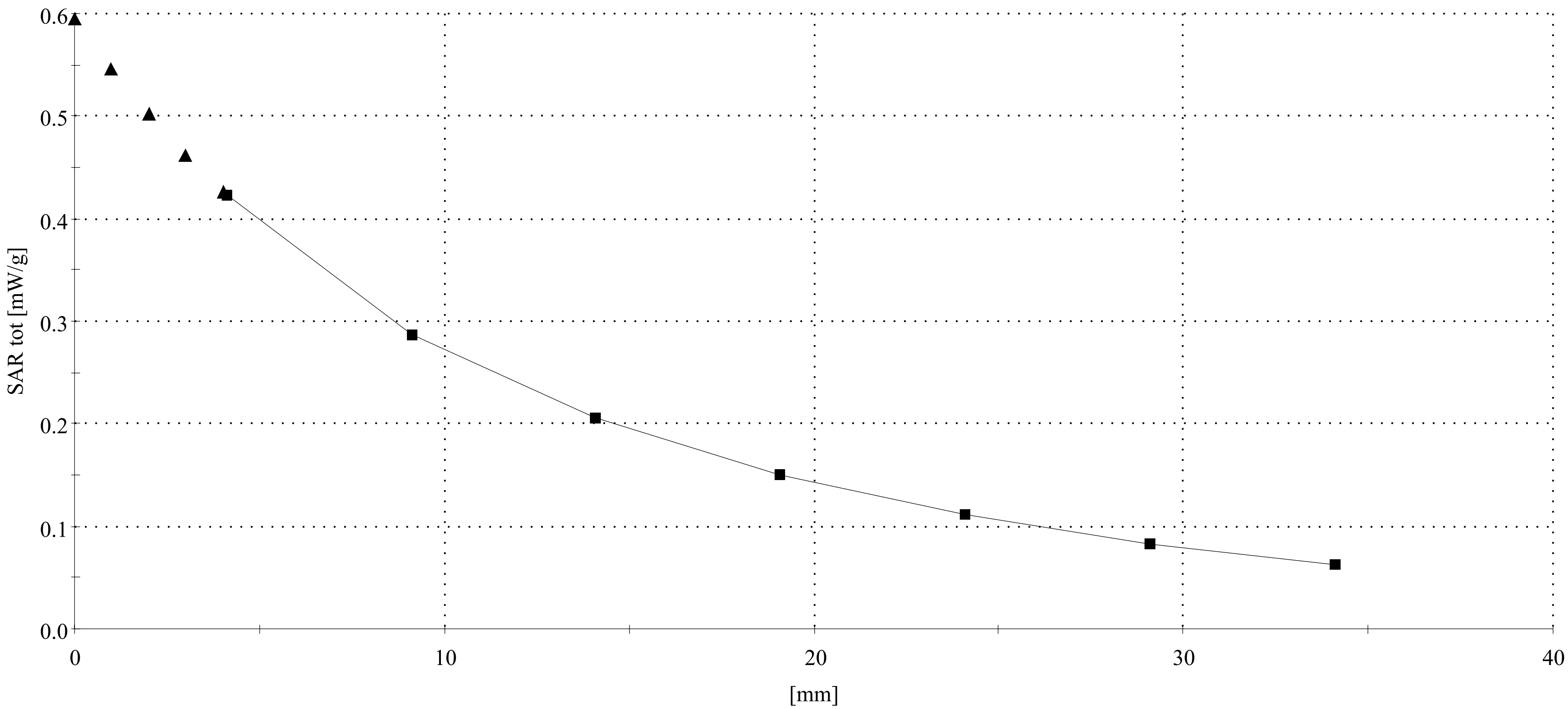
GMLRH-21, AMPS, Channel 799, Left Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.89 mho/m ε_r = 41.3 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.16 mW/g, SAR (10g): 0.809 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C):19.6



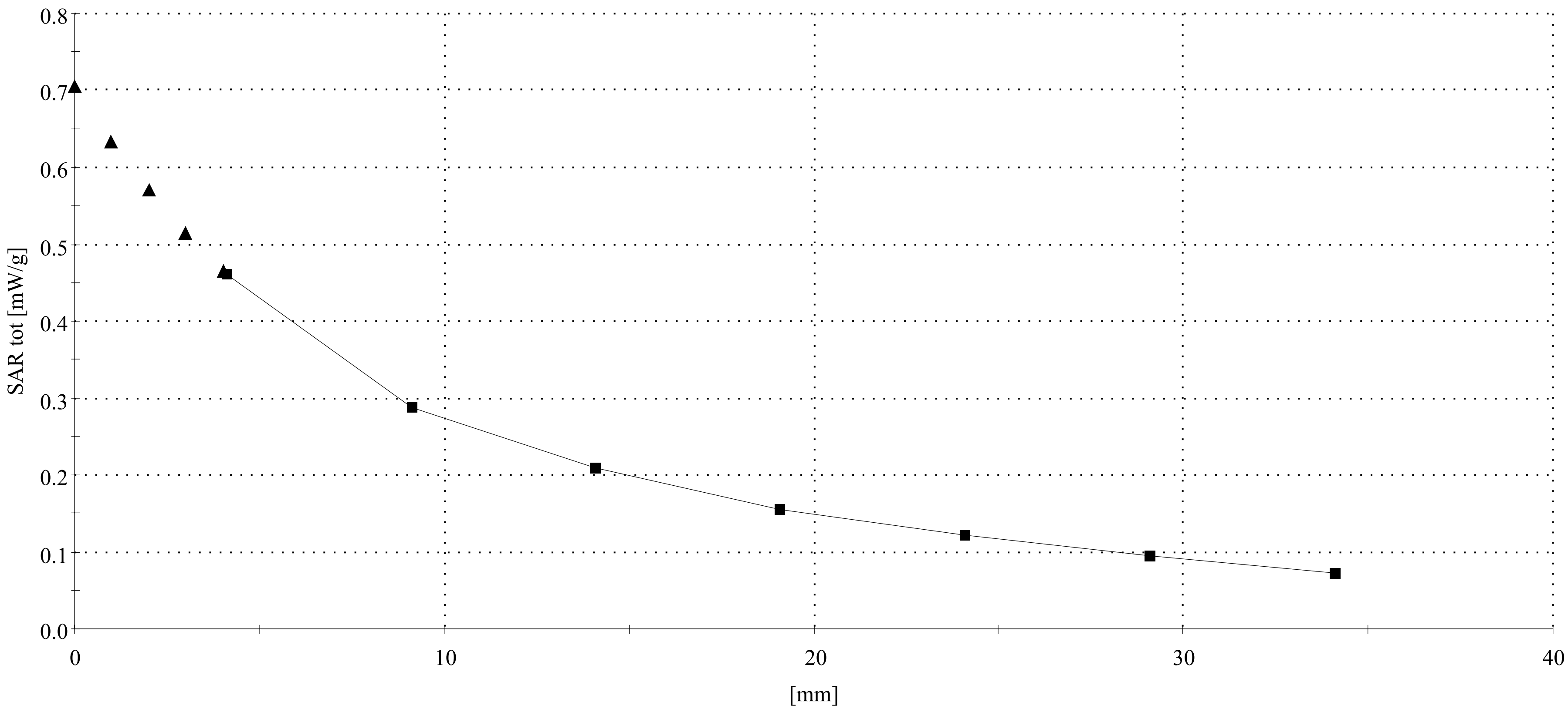
GMLRH-21, AMPS, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-1

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.93 mho/m ε_r = 54.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.597 mW/g, SAR (10g): 0.425 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C):20.0



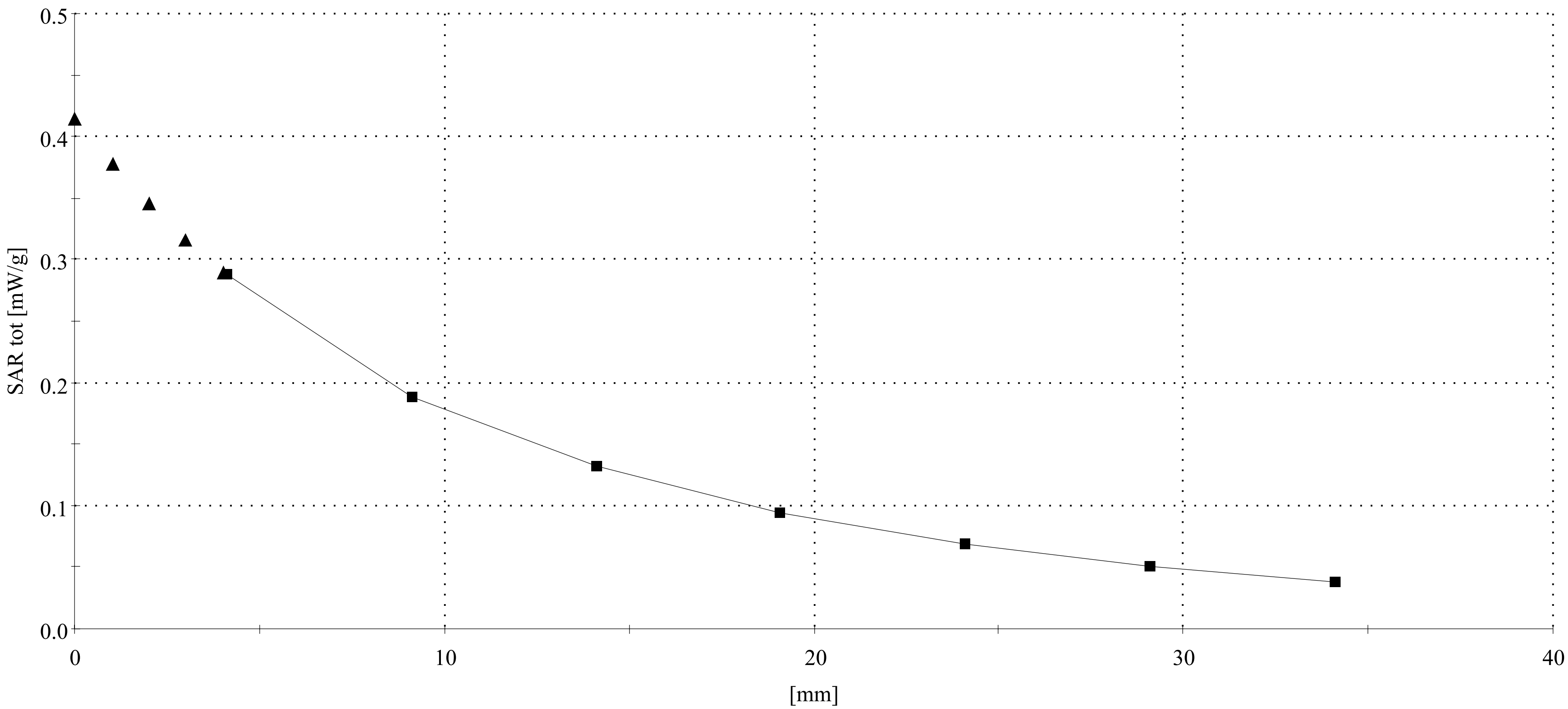
GMLRH-21, TDMA800, Channel 384, Left Touch Position with BLC-2

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Brain Tissue: $\sigma = 0.87$ mho/m $\varepsilon_r = 40.2$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.702 mW/g, SAR (10g): 0.483 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C):19.6



GMLRH-21, TDMA800, Channel 384, Flat Position - Back of Phone with 22mm Spacer, HDE-2 and BLC-2

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 837 MHz; Crest factor: 3.0
Cellular Band - Muscle Tissue: σ = 0.94 mho/m ε_r = 54.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.426 mW/g, SAR (10g): 0.301 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C):20.0



APPENDIX D: CALIBRATION CERTIFICATES

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1504**
Place of Calibration:	**Zurich**
Date of Calibration:	**July 26, 2002**
Calibration Interval:	**12 months**

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

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

Calibrated by:	N. Vetter
Approved by:	[signature]

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

Probe ET3DV6

SN:1504

Manufactured:	October 24, 1999
Last calibration:	January 10, 2002
Recalibrated:	July 26, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1504

Sensitivity in Free Space

NormX	**2.02** $\mu V/(V/m)^2$
NormY	**1.78** $\mu V/(V/m)^2$
NormZ	**1.73** $\mu V/(V/m)^2$

Diode Compression

DCP X	**95**	mV
DCP Y	**95**	mV
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	**6.5**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.39**
ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**2.42**

Head **1880 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	**5.4**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.4**	± 9.5% (k=2)	Alpha	**0.53**
ConvF Z	**5.4**	± 9.5% (k=2)	Depth	**2.44**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	9.6	5.3
SAR_{be} [%]	With Correction Algorithm	0.3	0.5

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

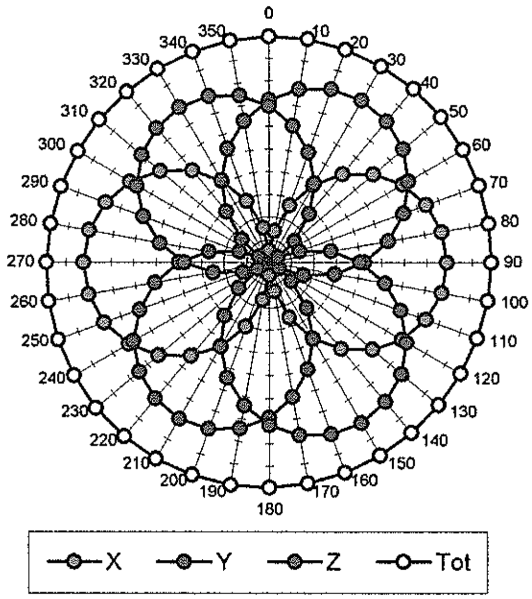
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	13.0	8.5
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

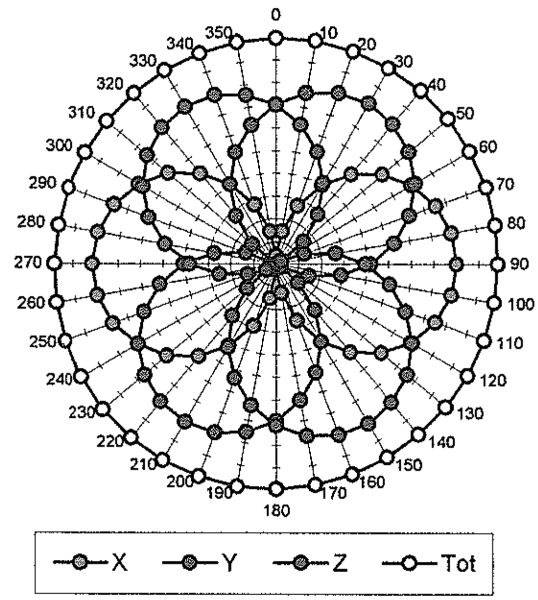
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.4 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

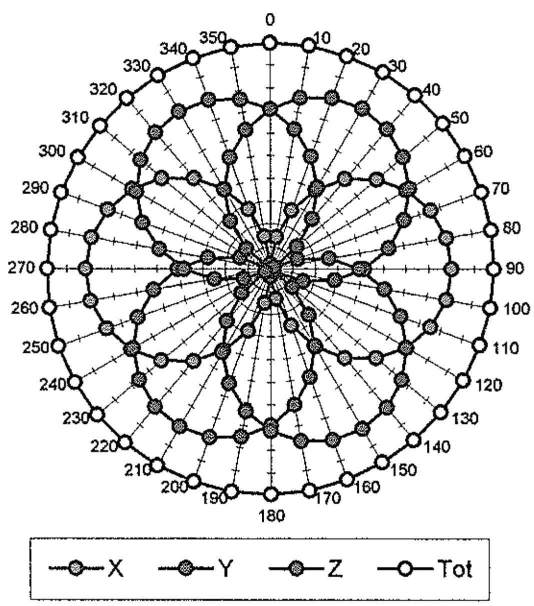
f = 30 MHz, TEM cell ifi110



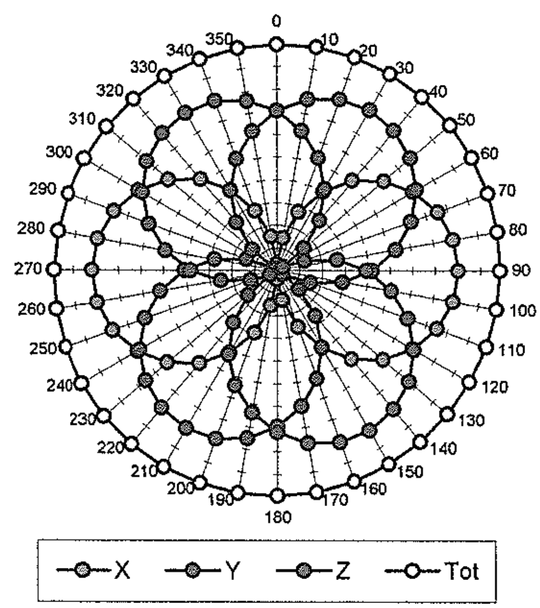
f = 100 MHz, TEM cell ifi110

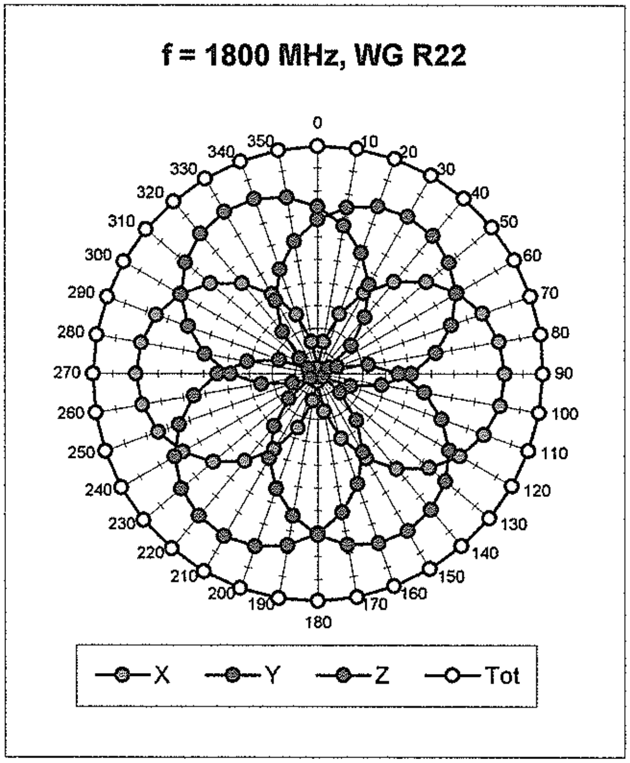


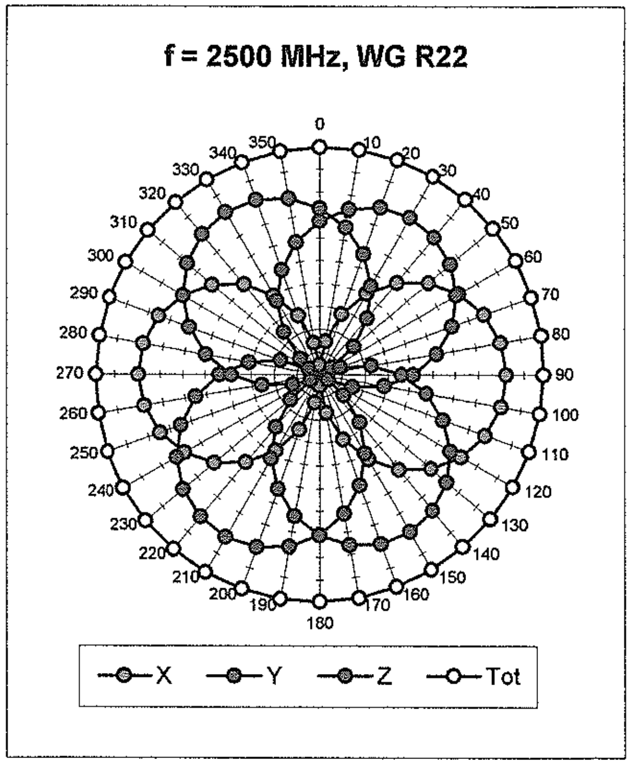
f = 300 MHz, TEM cell ifi110



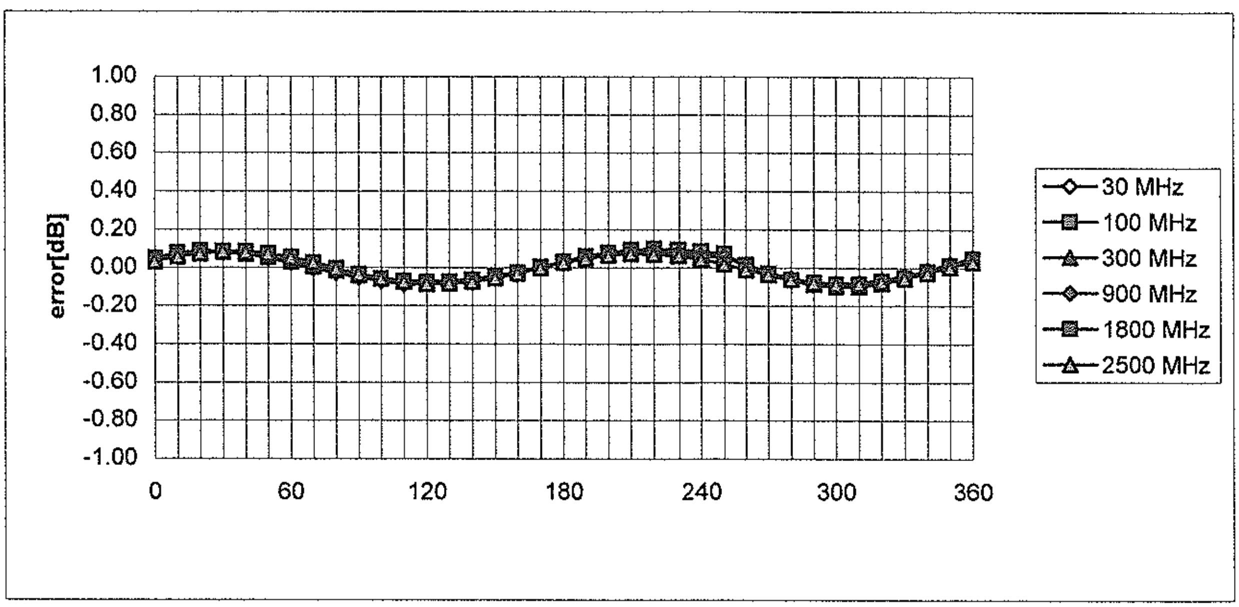
f = 900 MHz, TEM cell ifi110





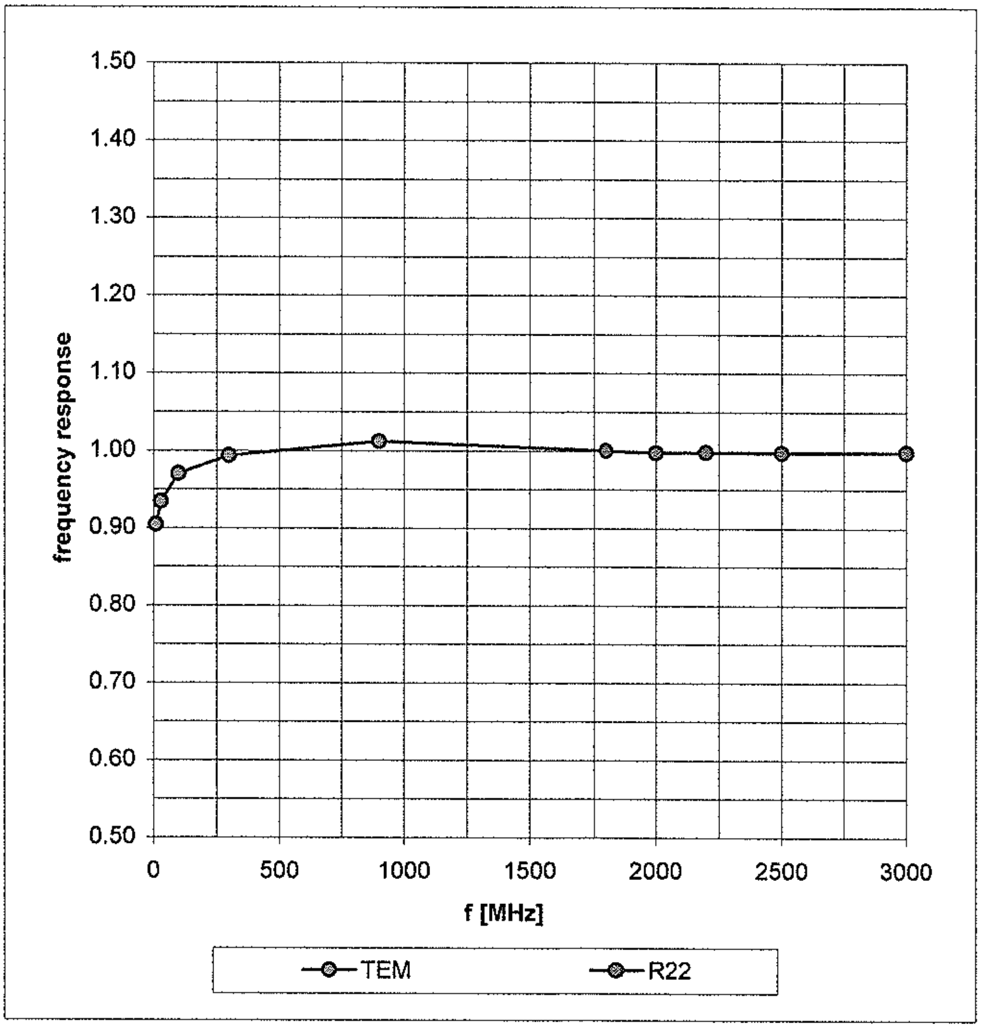


Isotropy Error (ϕ), θ = 0°



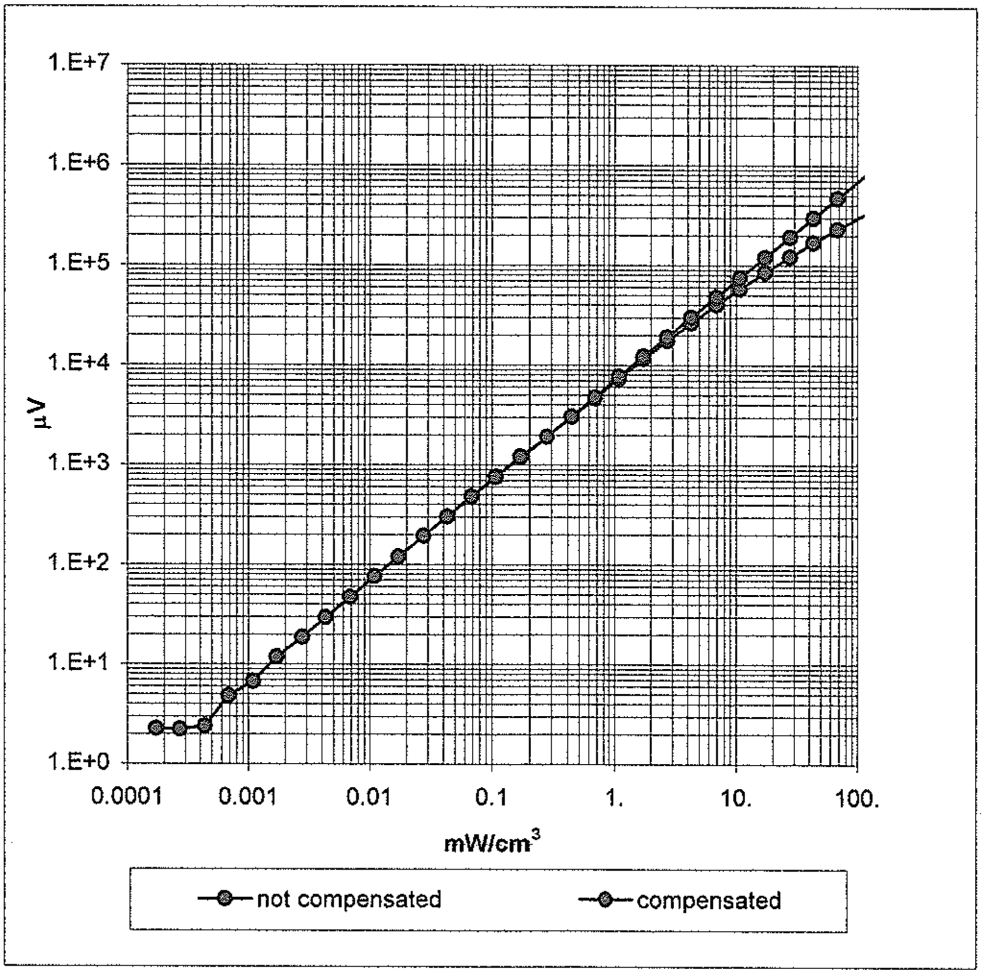
Frequency Response of E-Field

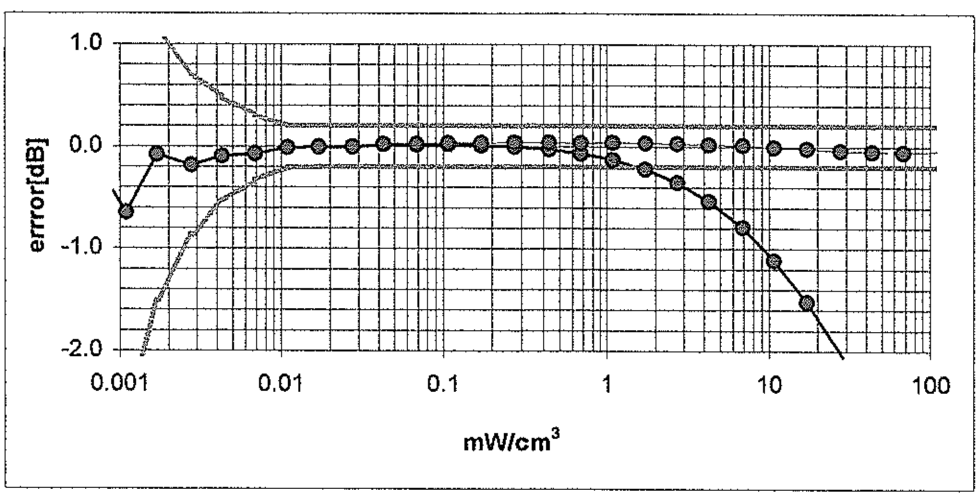
(TEM-Cell:ifi110, Waveguide R22)



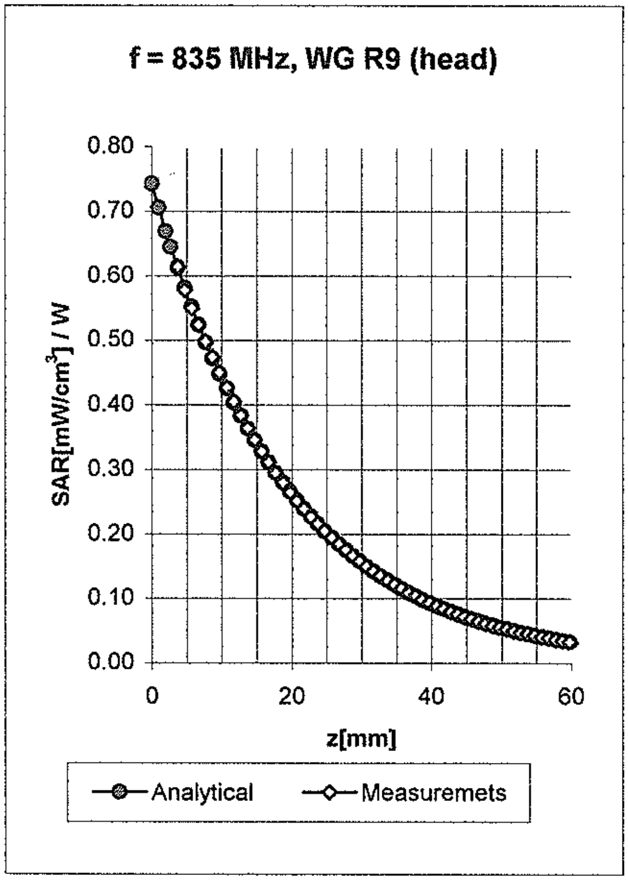
Dynamic Range f(SAR_{brain})

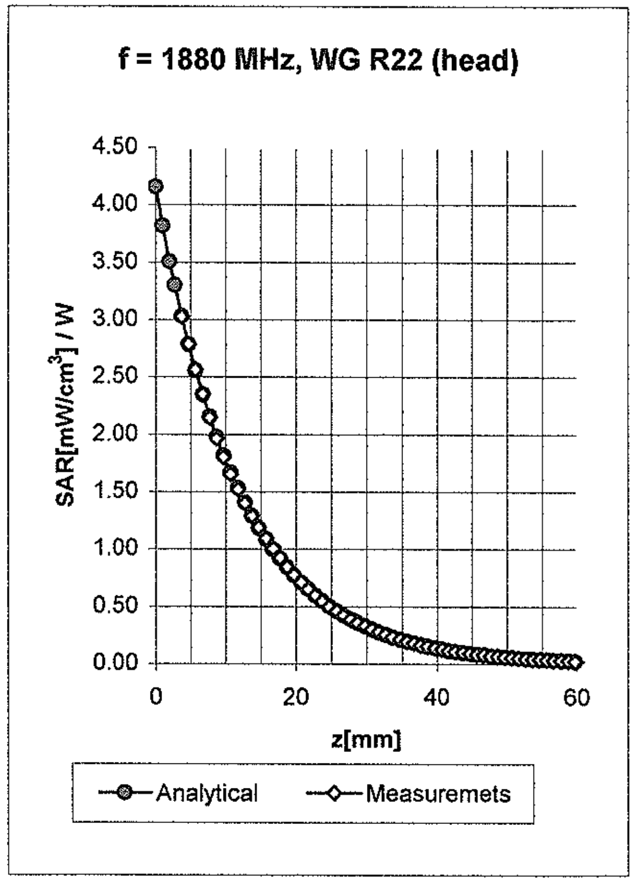
(Waveguide R22)





Conversion Factor Assessment

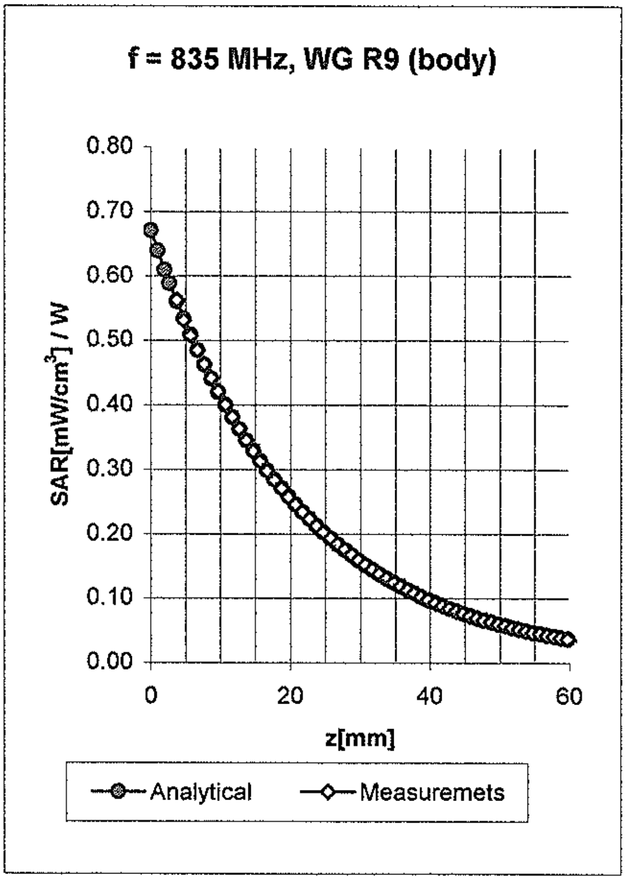


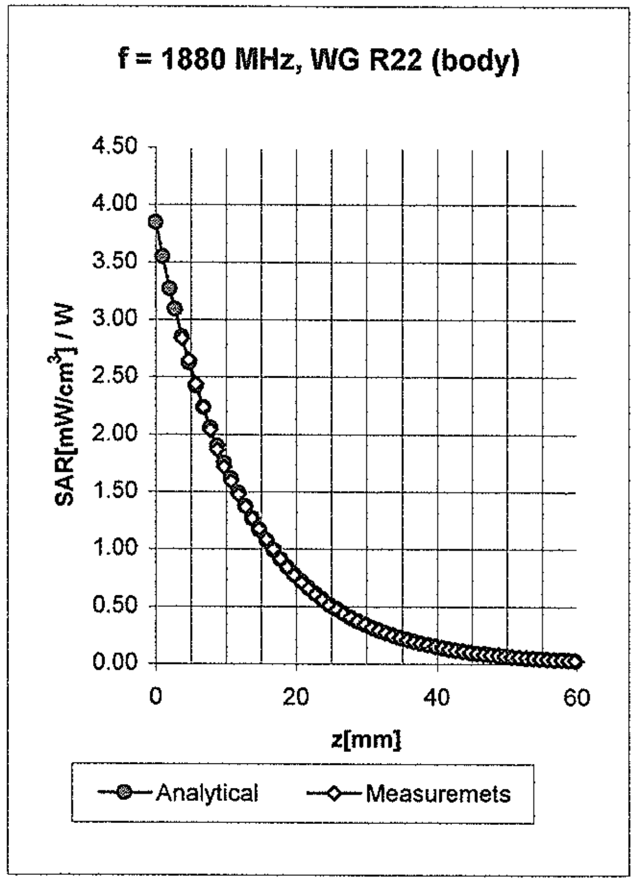


Head	**835 MHz**		ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**		
Head	**900 MHz**		ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**		
	ConvF X	**6.5**	± 9.5% (k=2)	Boundary effect:		
	ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.39**	
	ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**2.42**	

Head	**1880 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	**5.4**	± 9.5% (k=2)	Boundary effect:		
	ConvF Y	**5.4**	± 9.5% (k=2)	Alpha	**0.53**	
	ConvF Z	**5.4**	± 9.5% (k=2)	Depth	**2.44**	

Conversion Factor Assessment



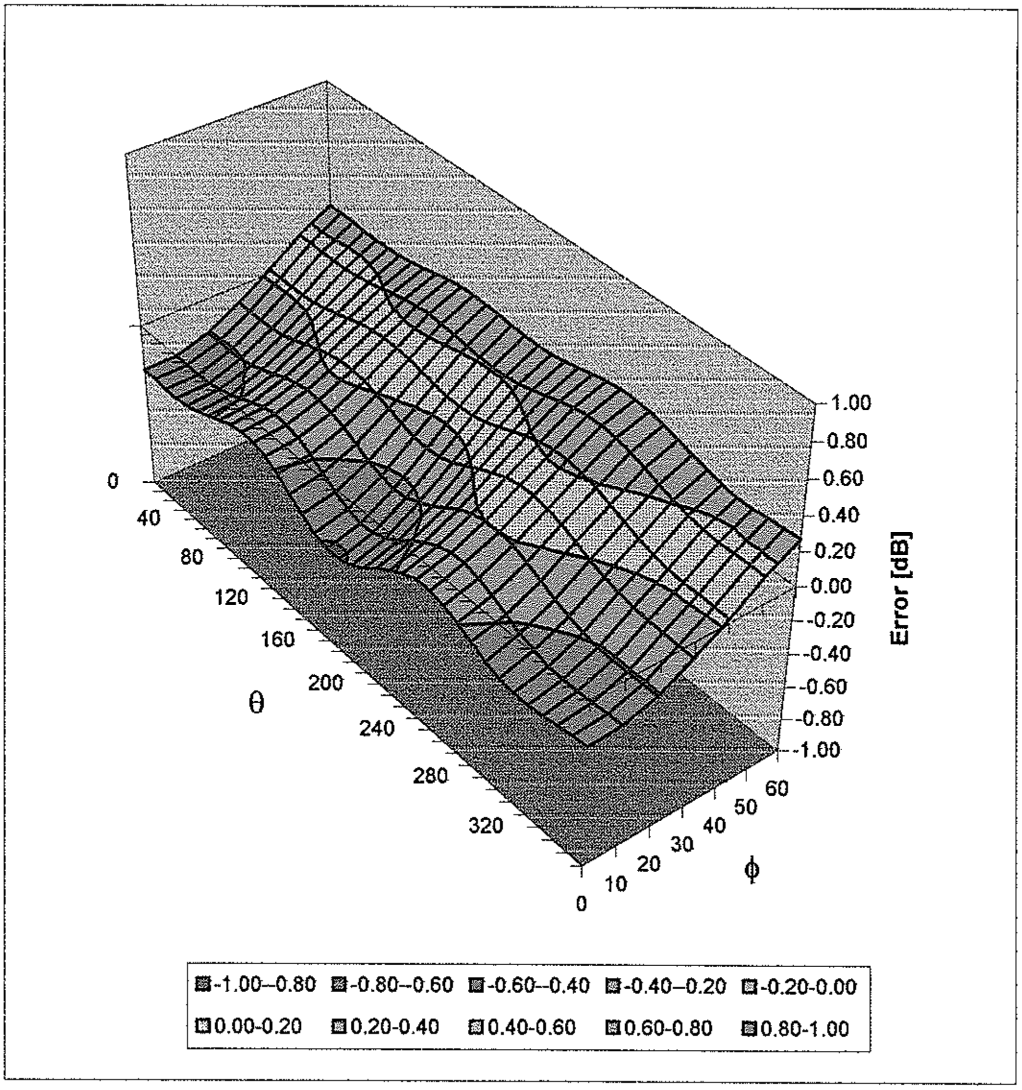


Body	**835 MHz**		ε_r = **55.2 ± 5%**	σ = **0.97 ± 5% mho/m**	
Body	**900 MHz**		ε_r = **55.0 ± 5%**	σ = **1.05 ± 5% mho/m**	
	ConvF X	**6.5**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.42**
	ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**2.38**

Body	**1880 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	**5.0**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.0**	± 9.5% (k=2)	Alpha	**0.74**
	ConvF Z	**5.0**	± 9.5% (k=2)	Depth	**2.06**

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

835 MHz System Validation Dipole

Type:	**D835V2**
Serial Number:	**415**
Place of Calibration:	**Zurich**
Date of Calibration:	**May 14, 2002**
Calibration Interval:	**24 months**

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

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

Calibrated by:	D. Vetter
Approved by:	[illegible]

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D835V2

Serial: 415

Manufactured: October 20, 1999
Calibrated: May 14, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	**41.7**	± 5%
Conductivity	**0.89 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.6) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	**10.1 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**6.4 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well.

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.431 ns**	(one direction)
Transmission factor:	**0.991**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 835 MHz:	Re{Z} = **50.5 Ω**
	Im {Z} = **-1.2 Ω**
Return Loss at 835 MHz	**-37.5 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with body simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	**55.4**	± 5%
Conductivity	**0.97 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.2) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

5. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 4. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	**10.4 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**6.7 mW/g**

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 835 MHz:	Re{Z} = **45.8 Ω**
	Im {Z} = **-4.1 Ω**
Return Loss at 835 MHz	**-24.3 dB**

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

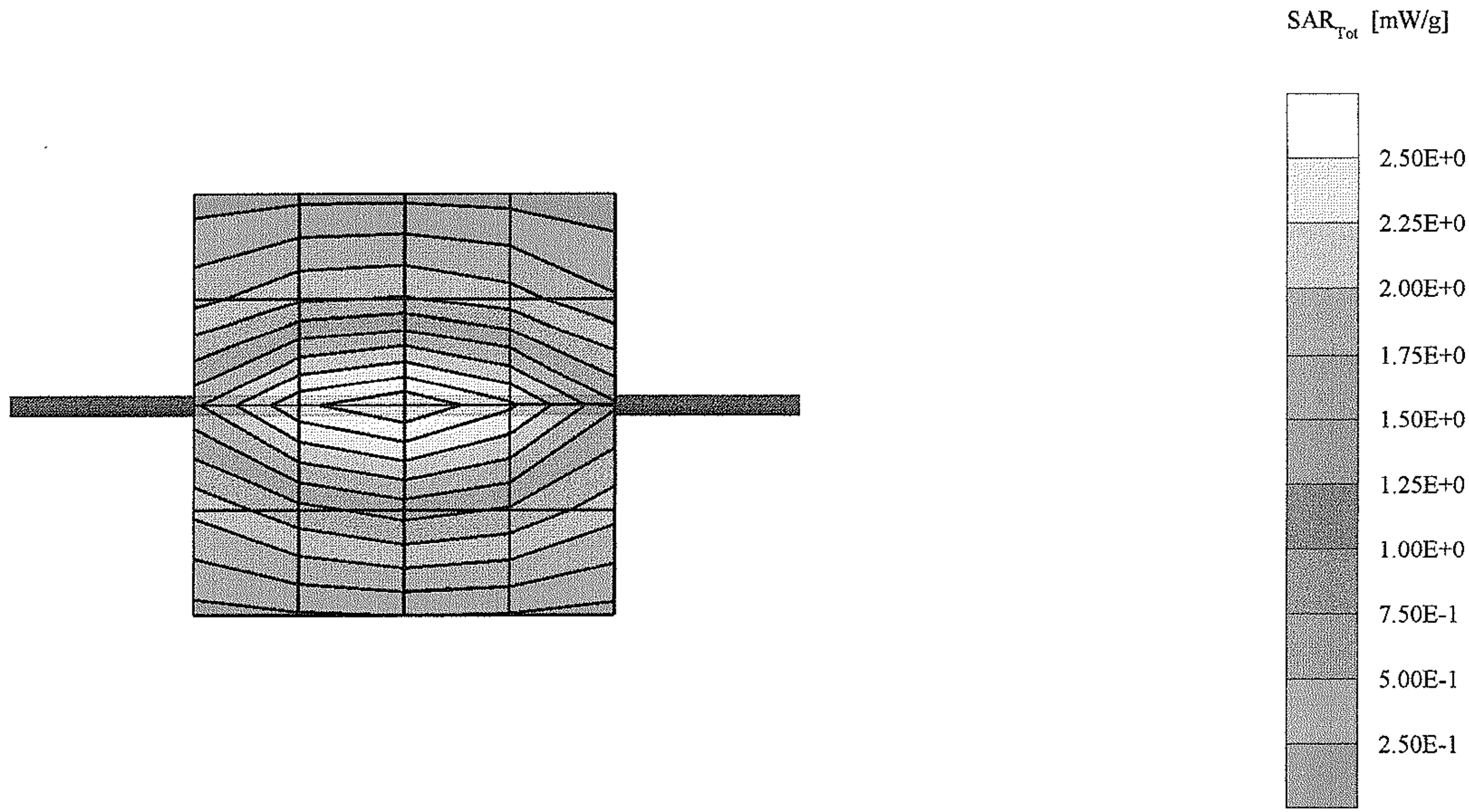
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

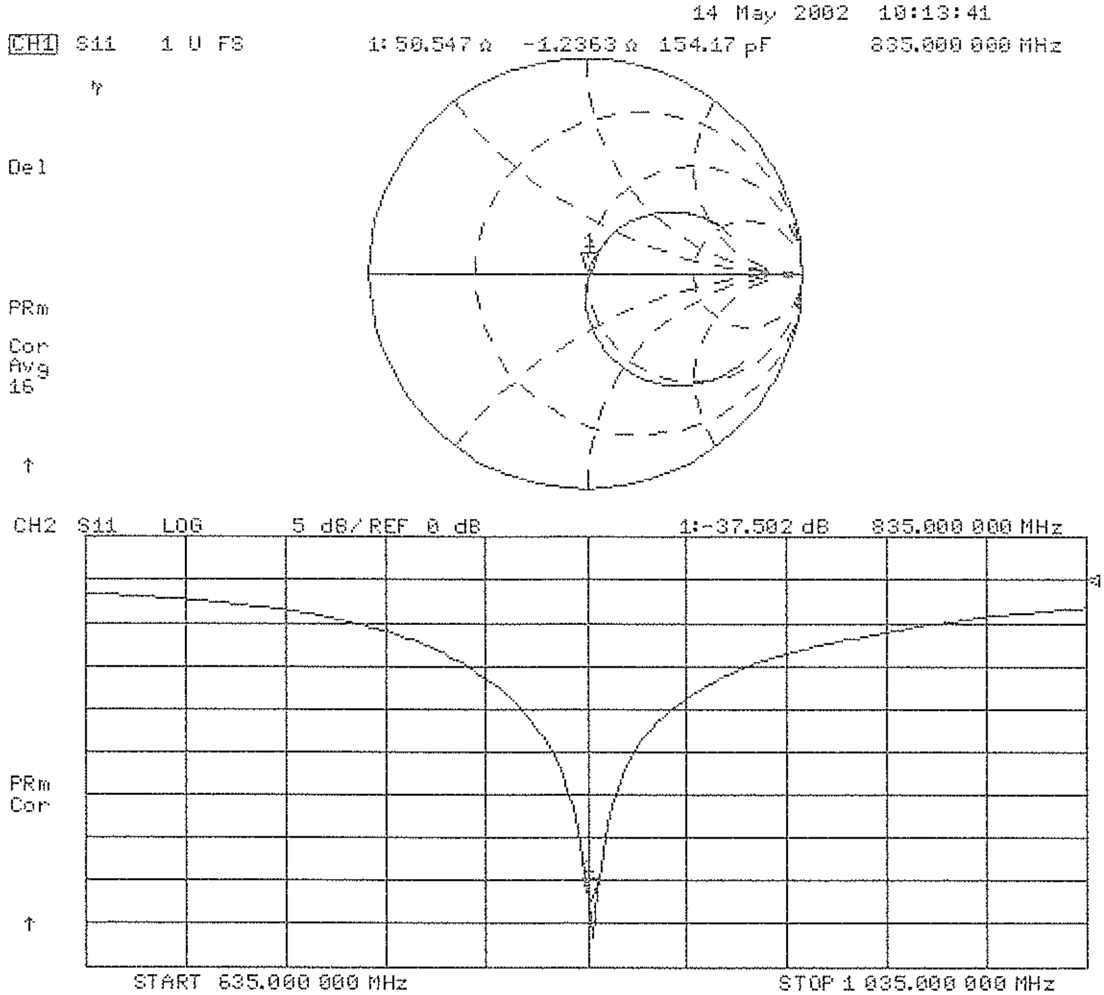
9. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D835V2 SN415, d = 15 mm

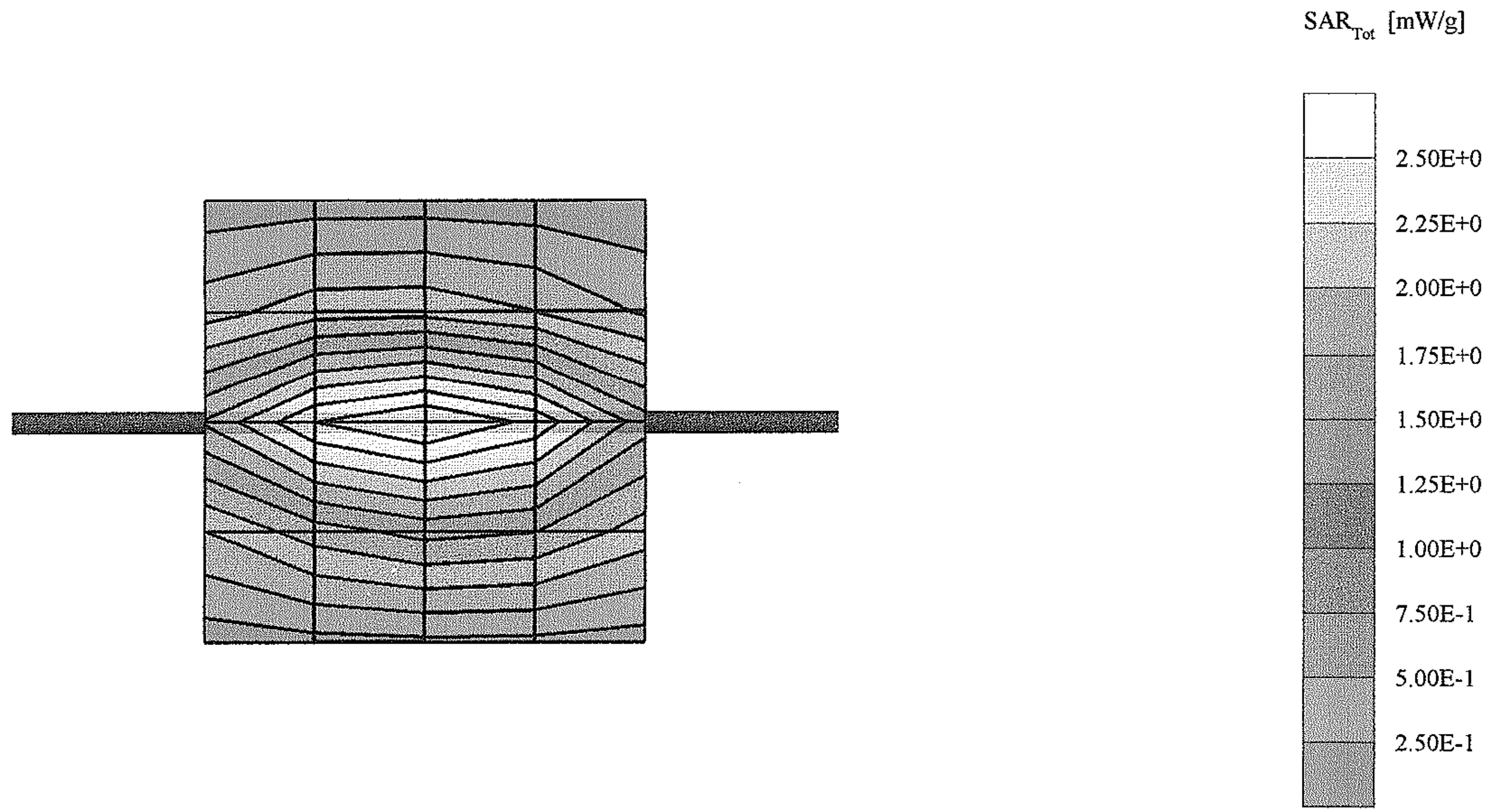
Frequency: 835 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.60,6.60,6.60) at 835 MHz; IEEE1528 835 MHz: $\sigma = 0.89$ mho/m $\varepsilon_r = 41.7$ $\rho = 1.00$ g/cm³
Cubes (2): Peak: 4.02 mW/g ± 0.00 dB, SAR (1g): 2.52 mW/g ± 0.01 dB, SAR (10g): 1.61 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.0 (10.7, 13.7) [mm]
Powerdrift: 0.01 dB

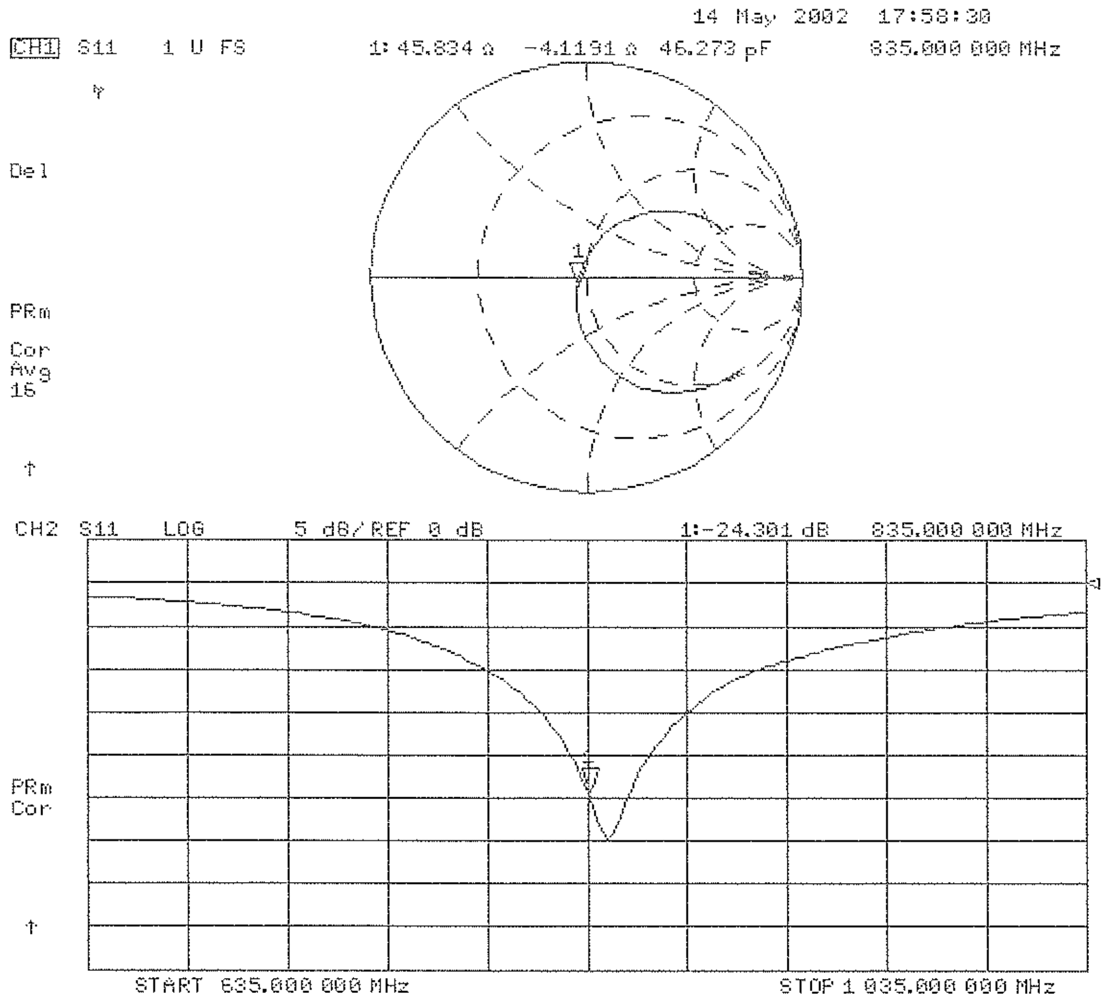



14 May 2002 10:13:41
CH1 S11 1 U FS
1: 50.547 Ω -1.2363 Ω 154.17 pF
835.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-37.502 dB 835.000 000 MHz
PRm
Cor
START 635.000 000 MHz
STOP 1 035.000 000 MHz

Validation Dipole D835V2 SN415, d = 15 mm

Frequency: 835 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.20,6.20,6.20) at 835 MHz; IEEE1528 835 MHz: $\sigma = 0.97$ mho/m $\varepsilon_r = 55.4$ $\rho = 1.00$ g/cm³
Cubes (2): Peak: 4.15 mW/g ± 0.03 dB, SAR (1g): 2.61 mW/g ± 0.01 dB, SAR (10g): 1.68 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.4 (11.0, 14.3) [mm]
Powerdrift: -0.01 dB




14 May 2002 17:58:30
CH1 S11 1 U FS
1: 45.834 Ω -4.1191 Ω 46.273 pF 835.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-24.301 dB 835.000 000 MHz
PRm
Cor
START 635.000 000 MHz
STOP 1 035.000 000 MHz