SAR Compliance Test Report

Test report no.:	03-SA-0122.01	**Date of report:**	14 August, 2003
Number of pages:	65	**Contact person:**	Nerina Walton
		Responsible test engineer:	Nerina Walton

Testing laboratory:
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Client:
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Tested devices:
GMLRH-21, Model 3520
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 26-June-03
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: 07201941611, HW: 1151f ESN: 07201941766, HW: 1152f SW: 2.6a
Accessories used in testing	BLC-2 Battery, BLC-1 Battery, HDE-2 Headset
Notes	-
Document code	03-SA-0122.01
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 was 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	24.45	Left Touch	1.6	1.10	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	24.45	Flat - Back of Phone with 22mm Measurement Distance	1.6	0.52	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
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.

3.4 Body Worn Operation

Body SAR was evaluated with a 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.

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	3745	486	05/05
Dipole Validation Kit	D835V2	3453	455	07/04

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
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 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 835 MHz 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	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	41.8	0.91	21.1
		26-June-03	10.2	40.8	0.90	21.2
		Reference Result	9.8	42.8	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	26-June-03	9.7	56.1	0.96	21.6
		Reference Result	10.1	55.3	0.95	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 27 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	21-June-03	40.9	0.92	21.1
	22-June-03	41.9	0.92	21.1
	23-June-03	41.7	0.91	20.9
	24-June-03	41.7	0.91	21.3
	25-June-03	41.8	0.91	21.1
	26-June-03	41.8	0.91	21.2
	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	26-June-03	56.1	0.96	21.6
	Recommended Values	55.2	0.97	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 right touch position:

Tilt Position

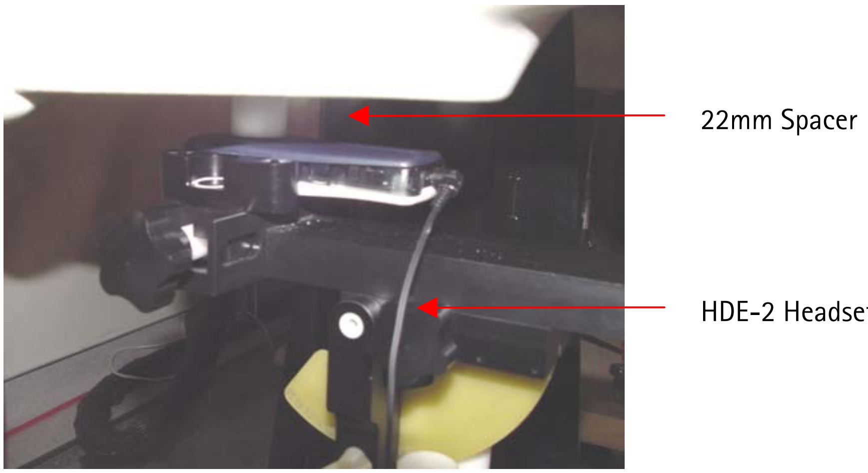
In the "Touch Position", if the earpiece of the device is not in full contact with the phantom's ear spacer and the peak SAR location for the "touch position" is located at the ear spacer region or corresponds to the earpiece region of the handset, the device is returned to the "initial ear position" 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 before 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	$(1-cp)^{1/2}$	±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(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							
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	24.45	0.92	-	0.90	-
	384 / 836.52	24.45	1.07	0.76	1.03	0.69
	799 / 848.97	24.53	1.10	-	1.07	-

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	24.45	0.83	-	0.82	-
	384 / 836.52	24.45	1.00	0.74	0.98	0.65
	799 / 848.97	24.53	1.06	-	0.99	-

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	24.45	0.52
	384 / 836.52	24.45	0.47
	799 / 848.97	24.53	0.47

Battery Check with BLC-1

Mode	Channel/ *f* (MHz)	Power (dBm)	SAR, averaged over 1g (mW/g)
			HDE-2
AMPS	991 / 824.04	24.45	0.44
	384 / 836.52	24.45	-
	799 / 848.97	24.53	-

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

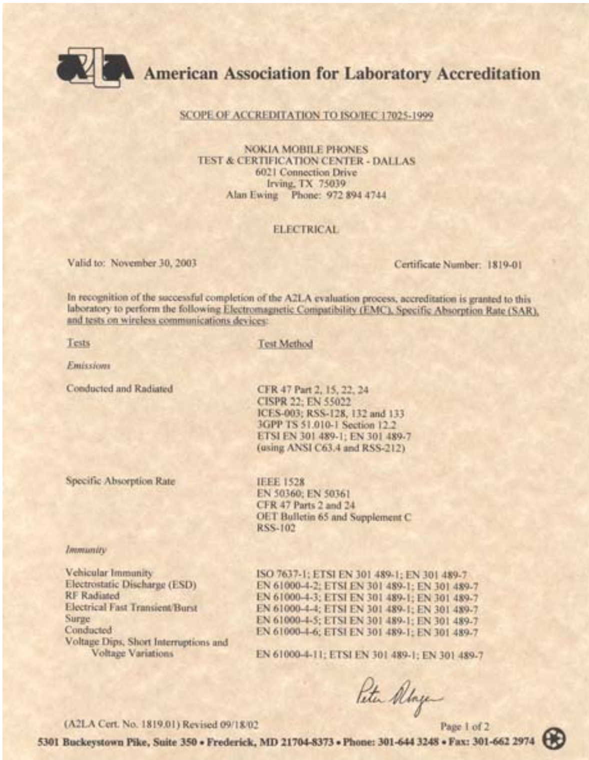
The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified 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

NOKIA MOBILE PHONES
TEST & CERTIFICATION CENTER - DALLAS
6021 Connection Drive
Irving, TX 75039
Alan Ewing Phone: 972 894 4744

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

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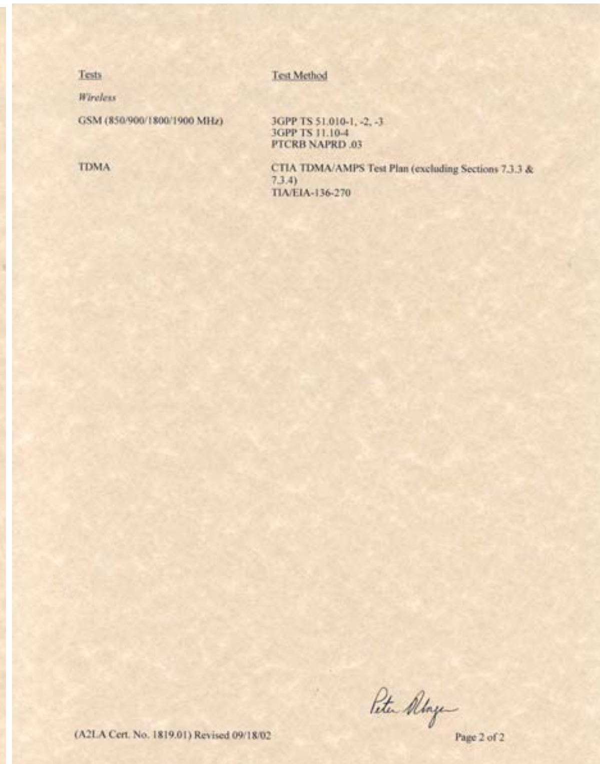


Tests	Test Method
Wireless	
GSM (850/900/1800/1900 MHz)	3GPP TS 51.010-1, -2, -3 3GPP TS 11.10-4 PTCRB NAPRD .03
TDMA	CTIA TDMA/AMPS Test Plan (excluding Sections 7.3.3 & 7.3.4) TIA/EIA-136-270

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

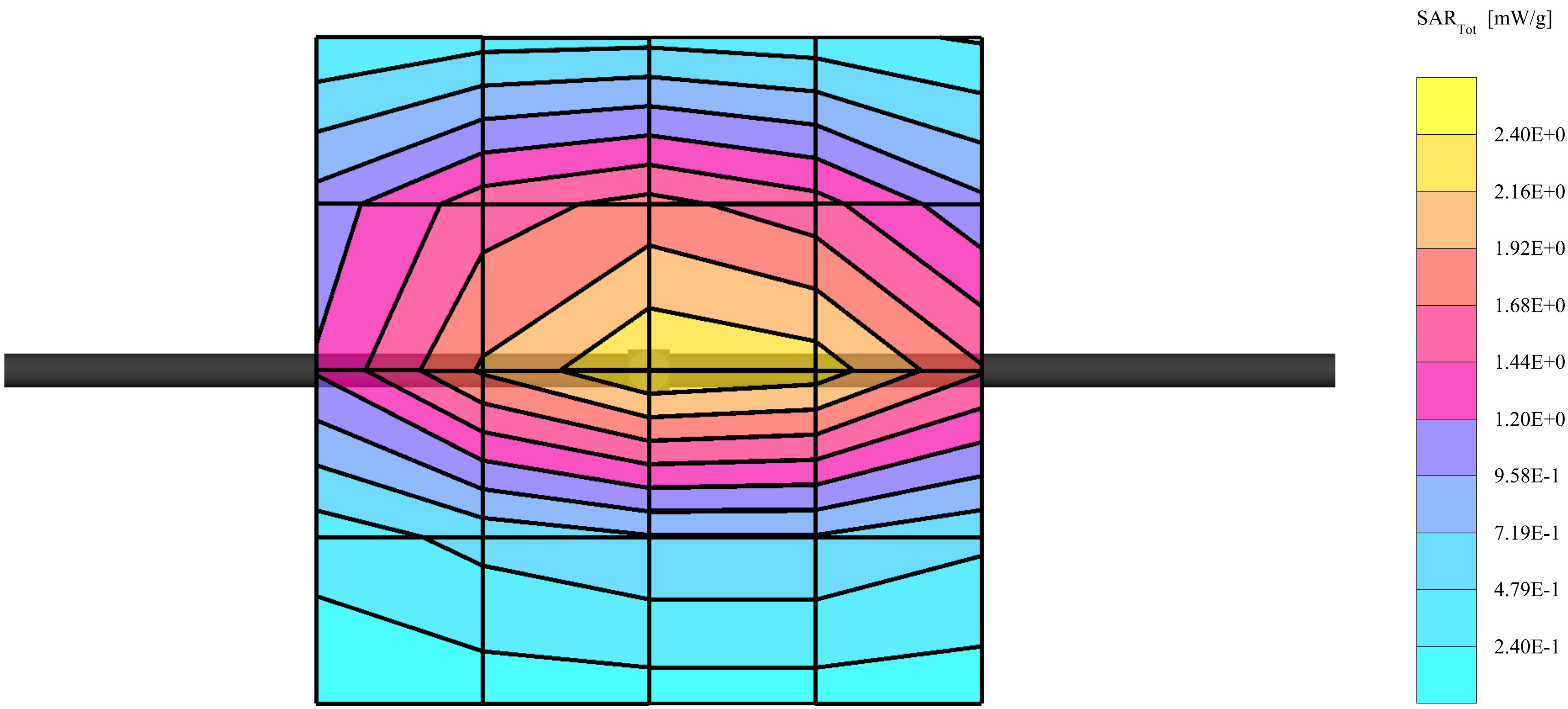
"This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined to be in accordance with the laboratory's terms of accreditation unless stated otherwise in the report."

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

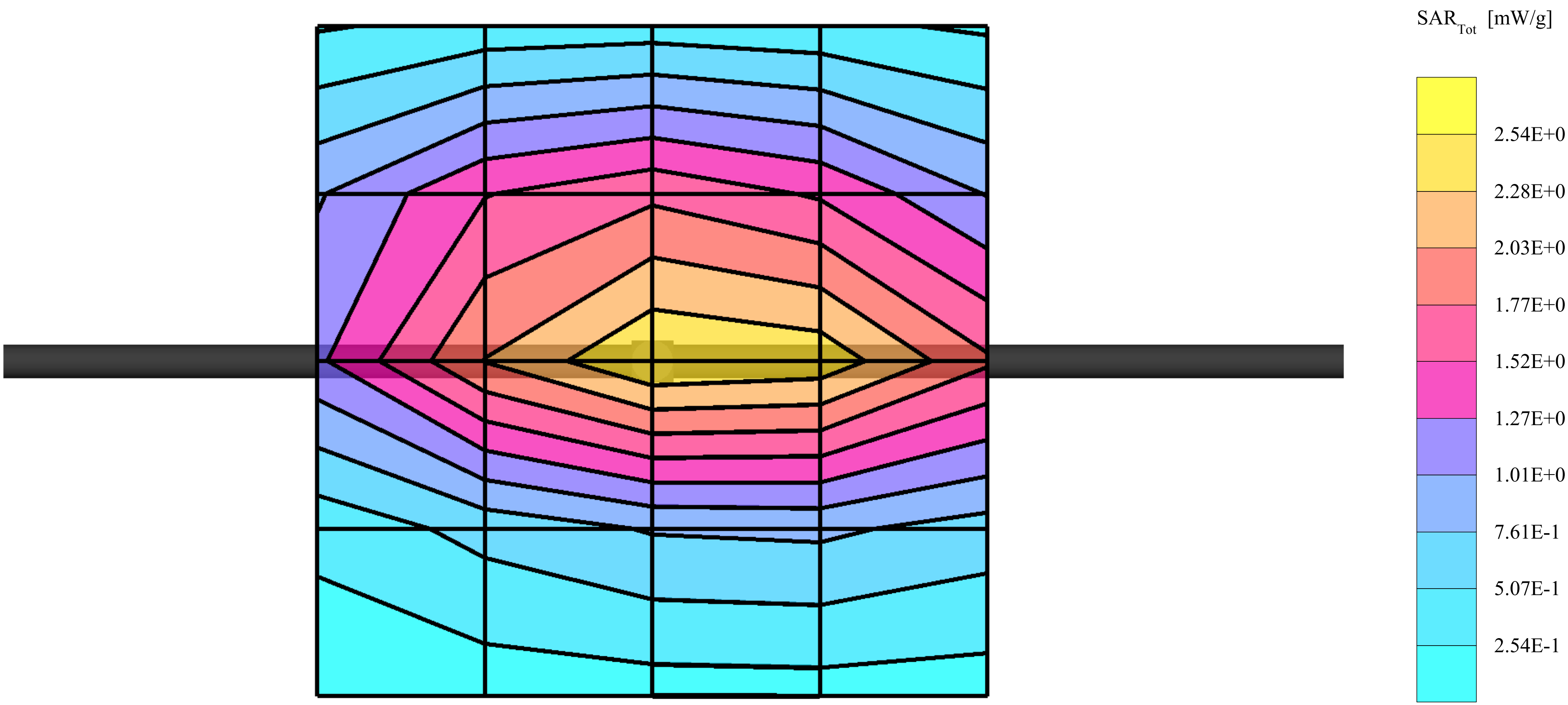
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
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): Peak: 3.97 mW/g ± 0.00 dB, SAR (1g): 2.50 mW/g ± 0.00 dB, SAR (10g): 1.60 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 11.9 (10.6, 13.6) [mm]
Powerdrift: -0.35 dB
Liquid Temperature: 21.1



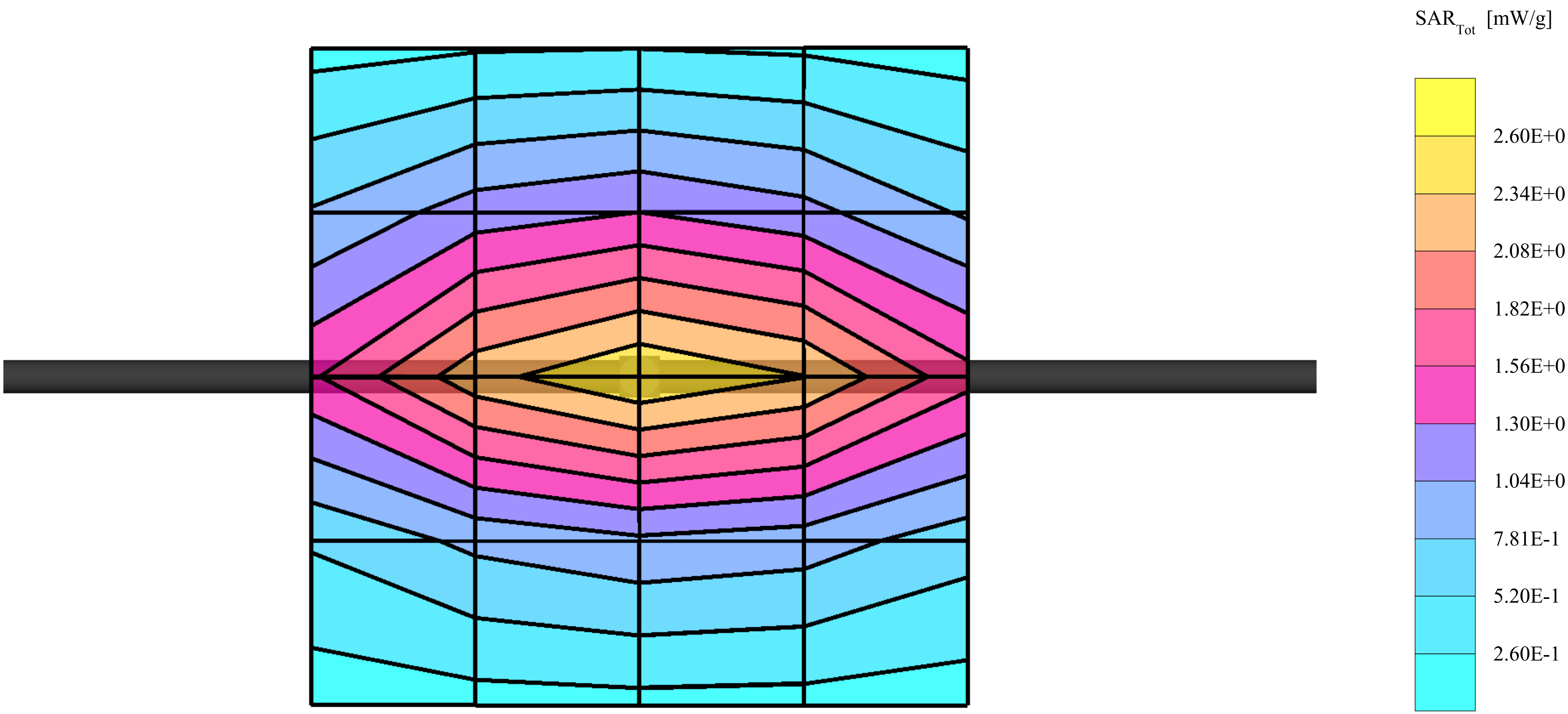
Dipole 835 MHz, Head Validation

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: 21.1



Dipole 835 MHz, Head Validation

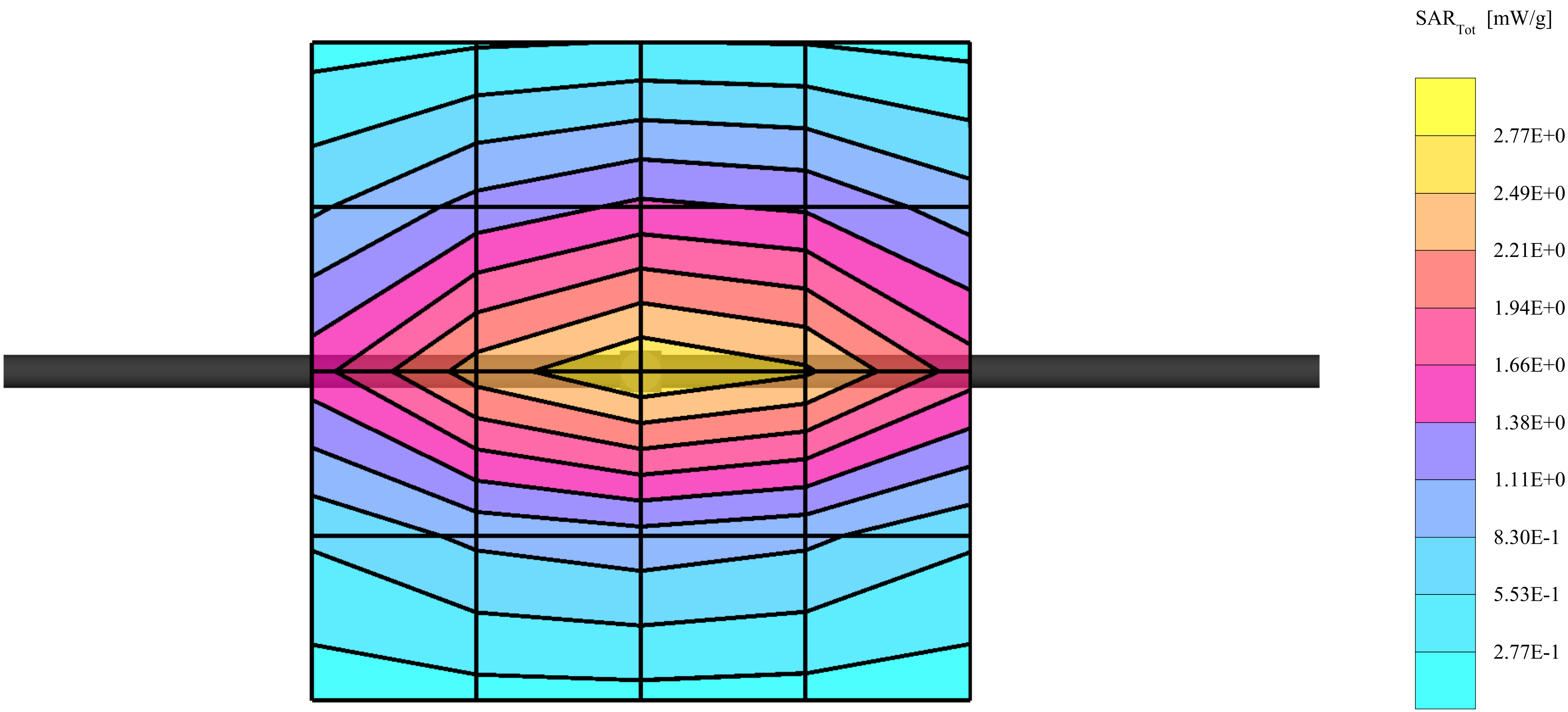
SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.91 mho/m ε_r = 41.7 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.91 mW/g ± 0.01 dB, SAR (1g): 2.46 mW/g ± 0.01 dB, SAR (10g): 1.57 mW/g ± 0.00 dB, (Worst-case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



06/24/03

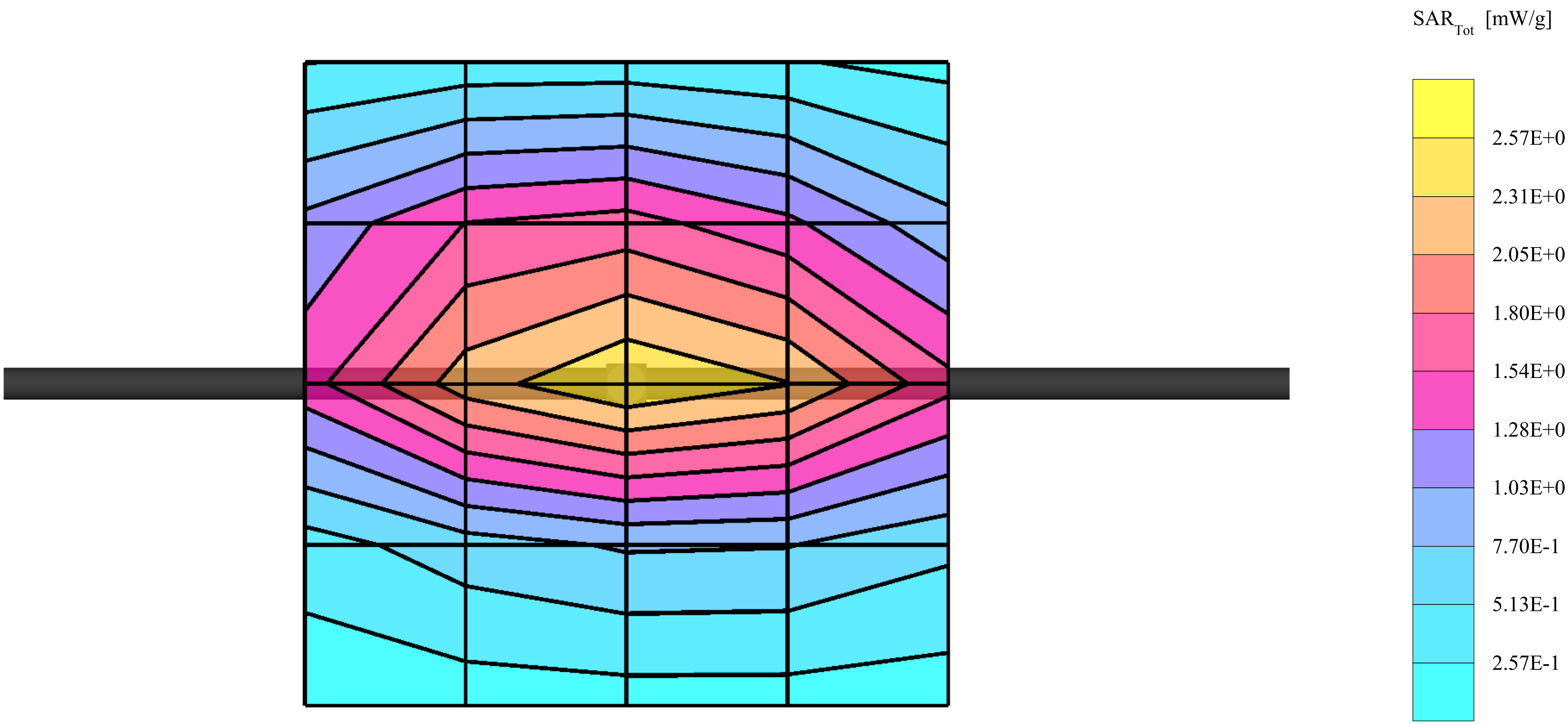
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.90 mho/m ε_r = 40.8 ρ = 1.00 g/cm³
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: 21.3



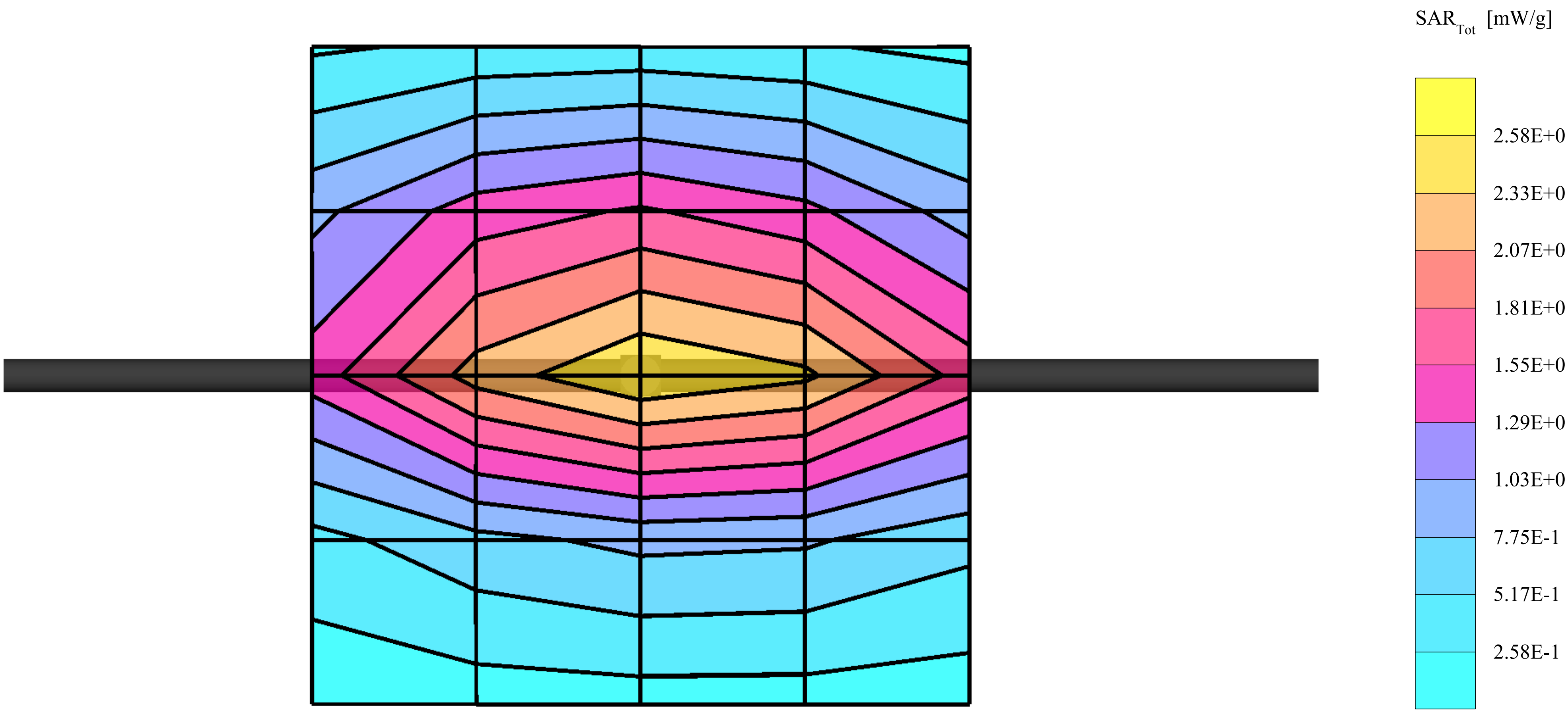
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.91 mho/m ε_r = 41.8 ρ = 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: 21.1



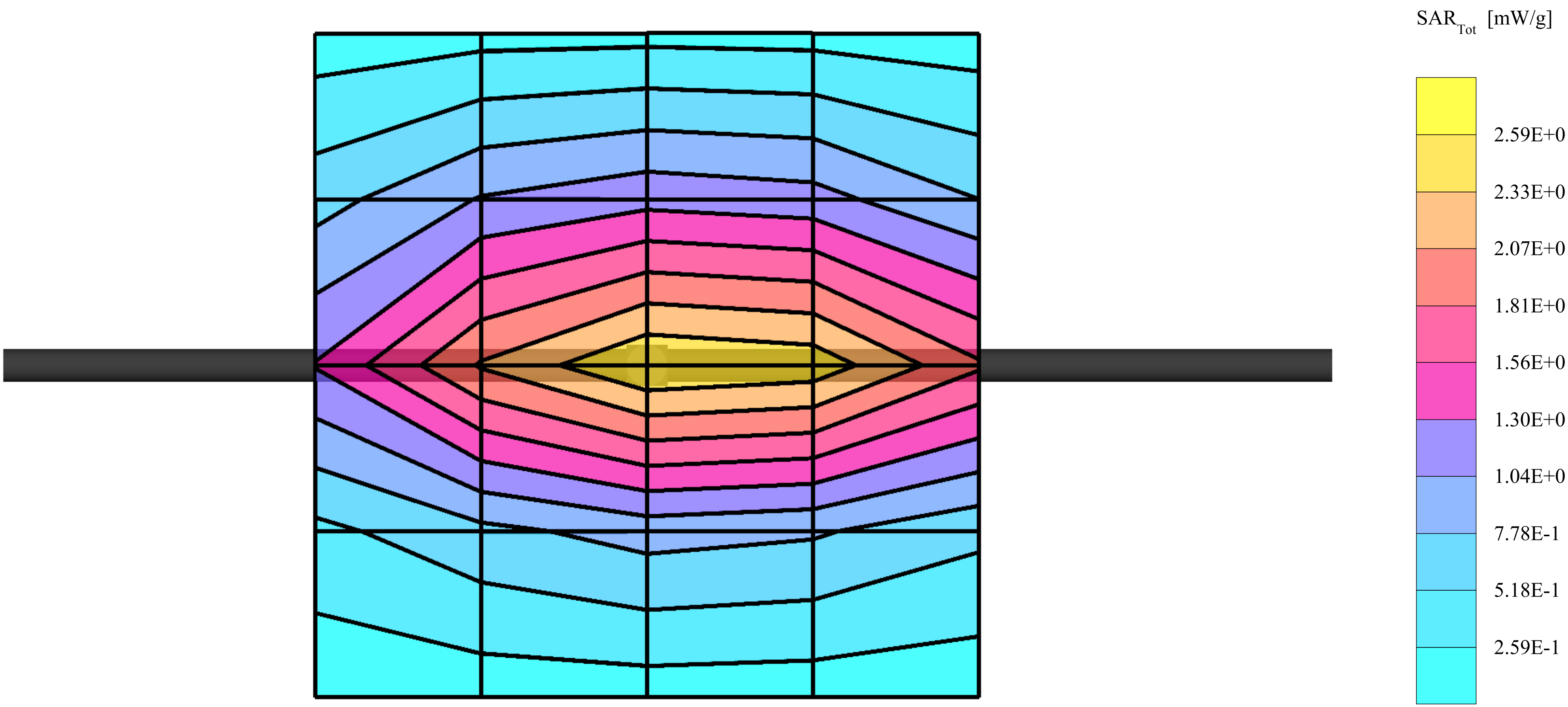
Dipole 835 MHz, Head Validation

SAM 1 (Cellular - Brain Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Brain Tissue: σ = 0.90 mho/m ε_r = 40.8 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 4.04 mW/g ± 0.00 dB, SAR (1g): 2.54 mW/g ± 0.00 dB, SAR (10g): 1.63 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 11.9 (10.6, 13.6) [mm]
Powerdrift: -0.17 dB
Liquid Temperature: 21.2



Dipole 835 MHz, Body Validation

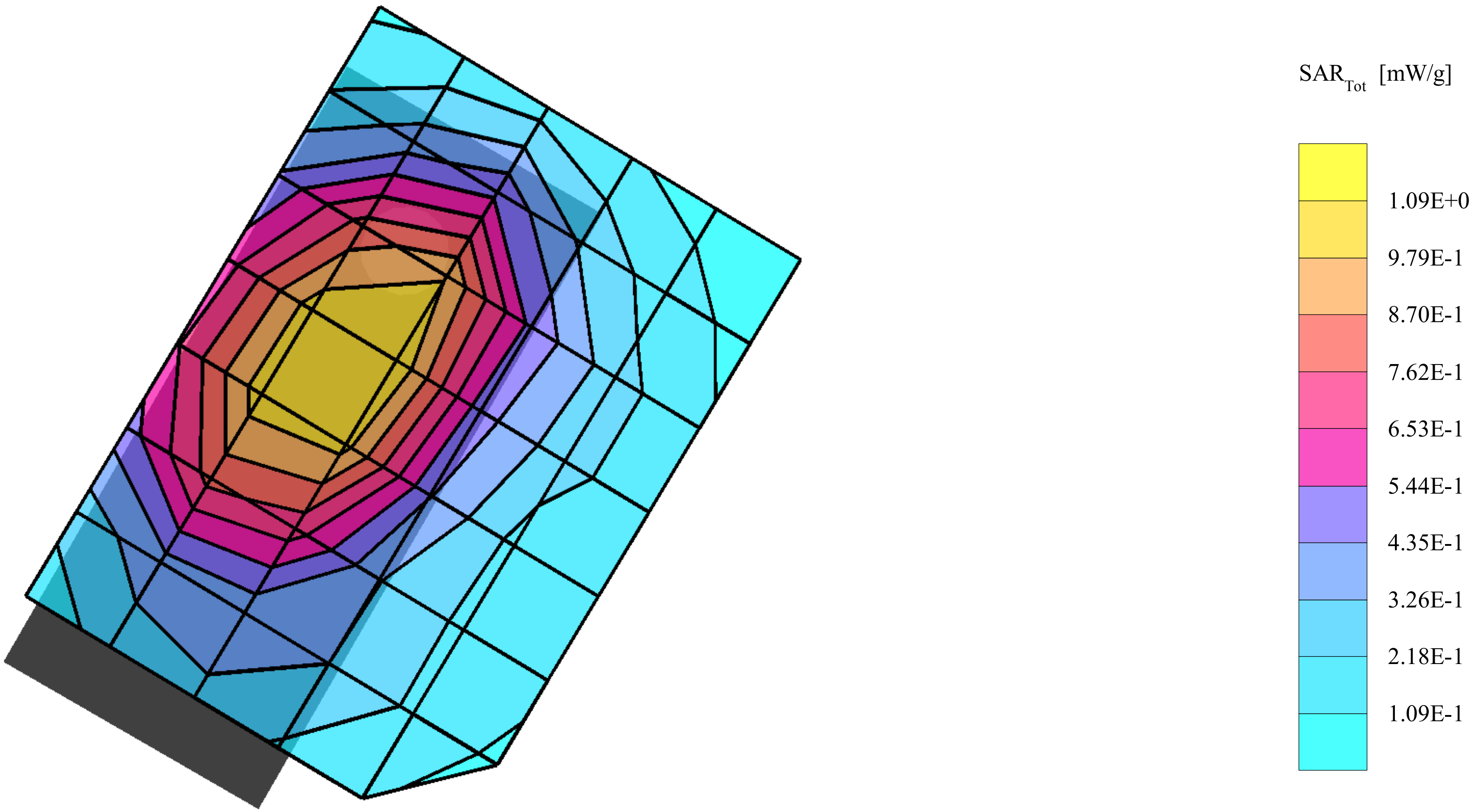
SAM 2 (Cellular - Muscle Tissue)
Frequency: 835 MHz; Crest factor: 1.0
Validation 835MHz - Muscle Tissue: σ = 0.96 mho/m ε_r = 56.1 ρ = 1.00 g/cm³
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cubes (2): Peak: 3.88 mW/g ± 0.00 dB, SAR (1g): 2.49 mW/g ± 0.00 dB, SAR (10g): 1.61 mW/g ± 0.00 dB, (Worst-case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



APPENDIX C: SAR DISTRIBUTION PRINTOUTS

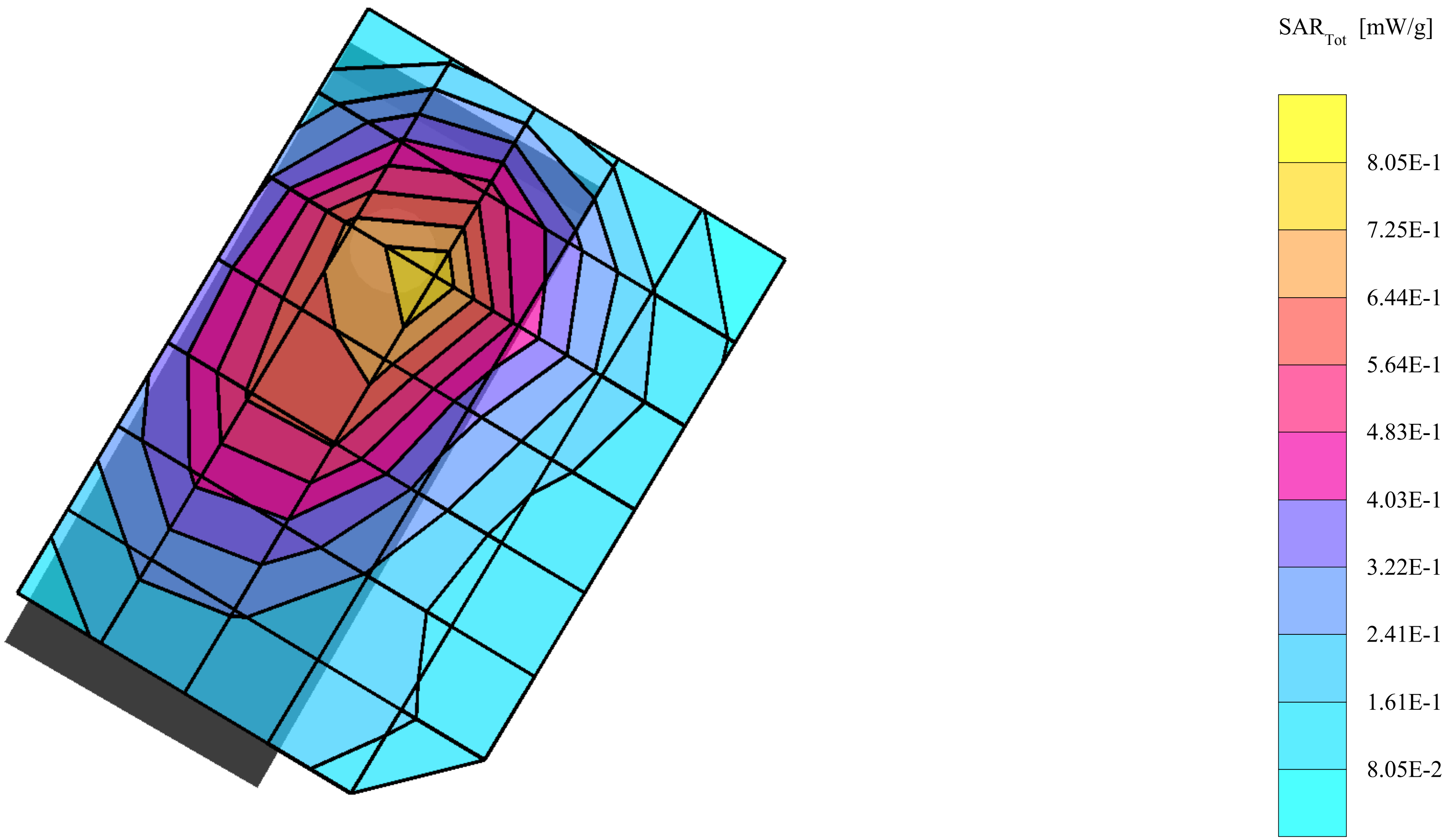
GMLRH-21, AMPS, Channel 799, Left Touch Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ mho/m $\varepsilon_r = 41.6$ $\rho = 1.00$ g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.10 mW/g, SAR (10g): 0.755 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: -0.06 dB
Liquid Temperature (°C): 20.9



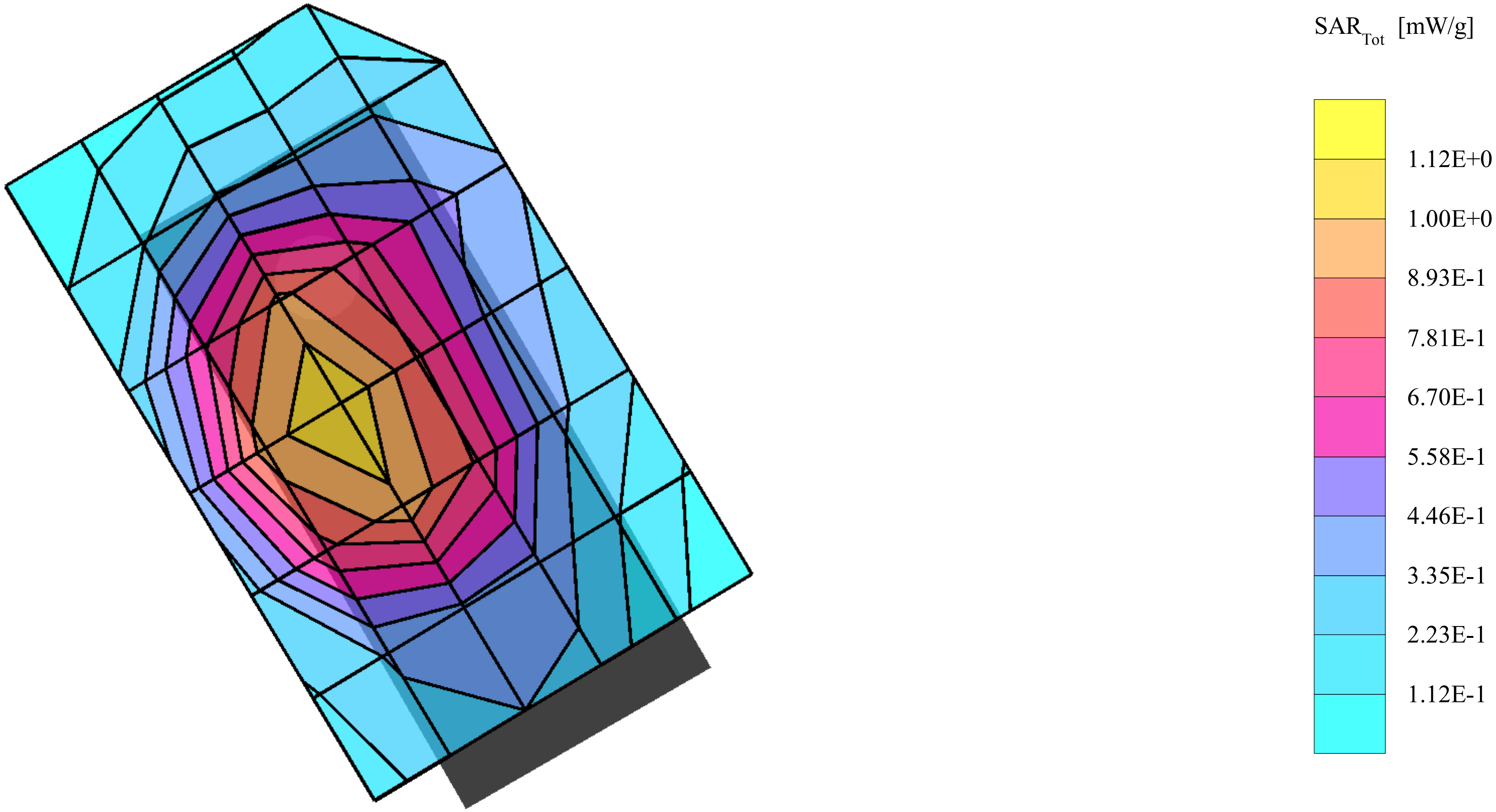
GMLRH-21, AMPS, Channel 384, Left Tilt Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: 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)
Cube 5x5x7: SAR (1g): 0.760 mW/g, SAR (10g): 0.481 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Powerdrift: 0.13 dB
Liquid Temperature: 21.2



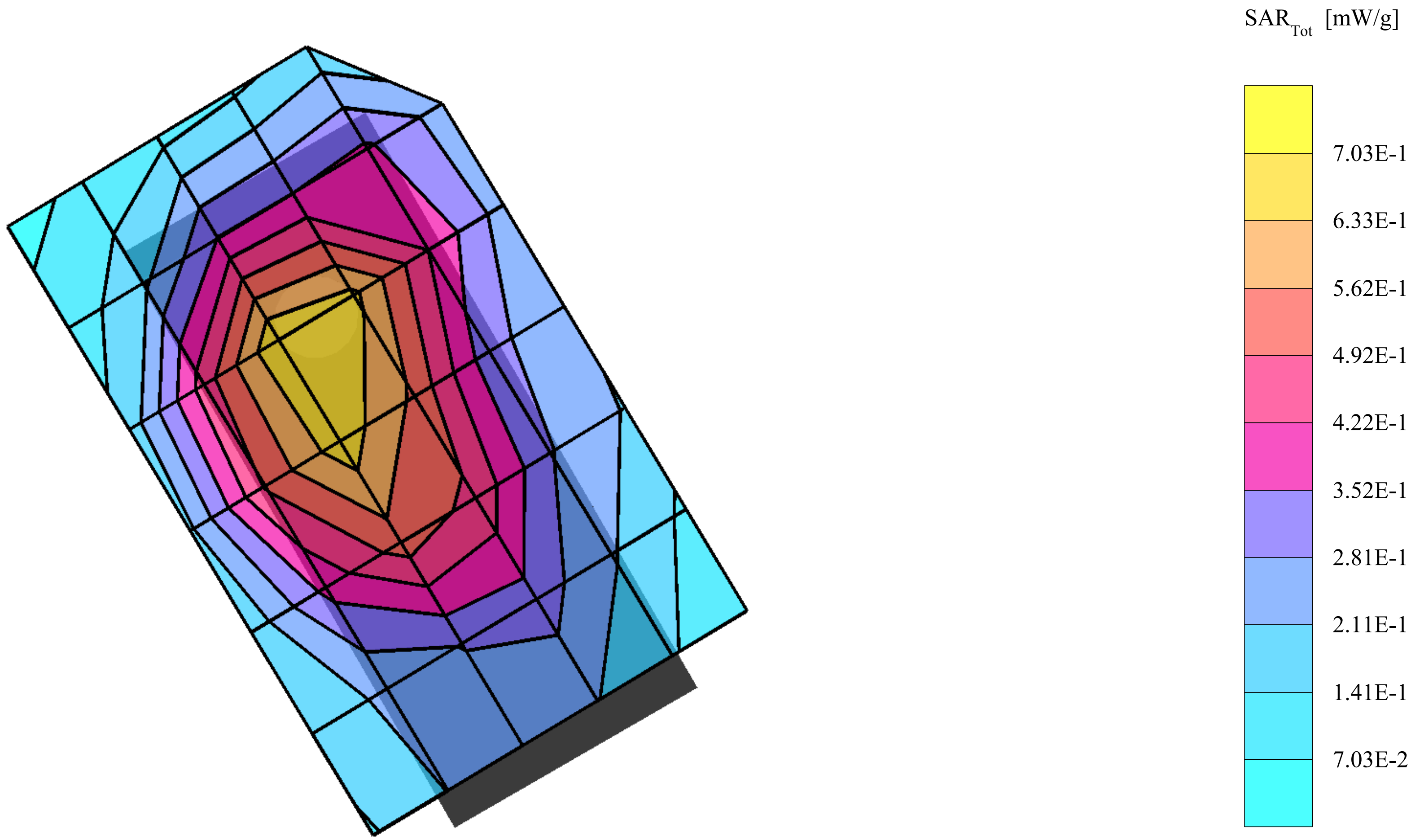
GMLRH-21, AMPS, Channel 799, Right Touch Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.91 mho/m ε_r = 41.6 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): 0.747 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: -0.00 dB
Liquid Temperature (°C): 20.9



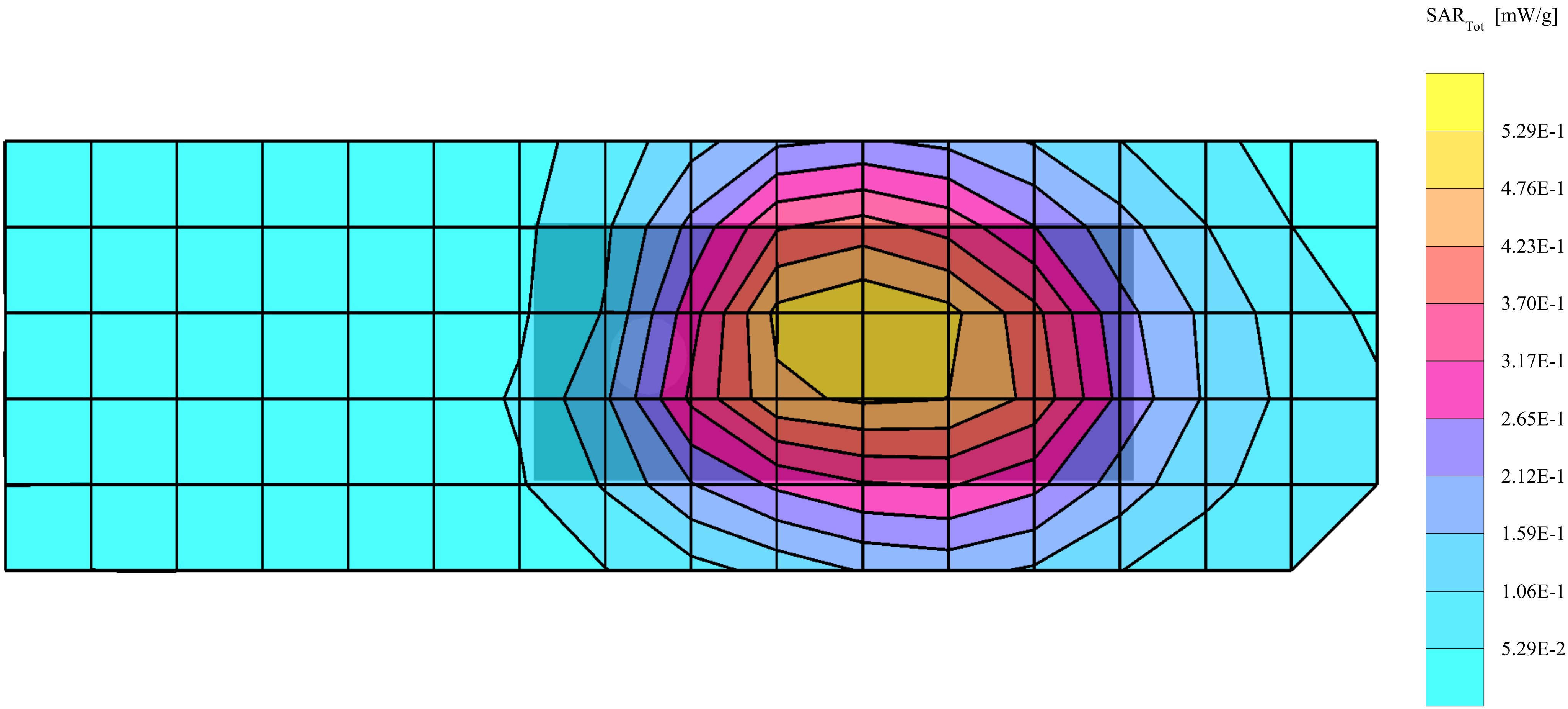
GMLRH-21, AMPS, Channel 384, Right Tilt Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 837 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: $\sigma = 0.91$ 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): 0.691 mW/g, SAR (10g): 0.471 mW/g, (Worst-case extrapolation)
Coarse: Dx = 19.0, Dy = 14.0, Dz = 10.0
Powerdrift: 0.08 dB
Liquid Temperature: 21.1



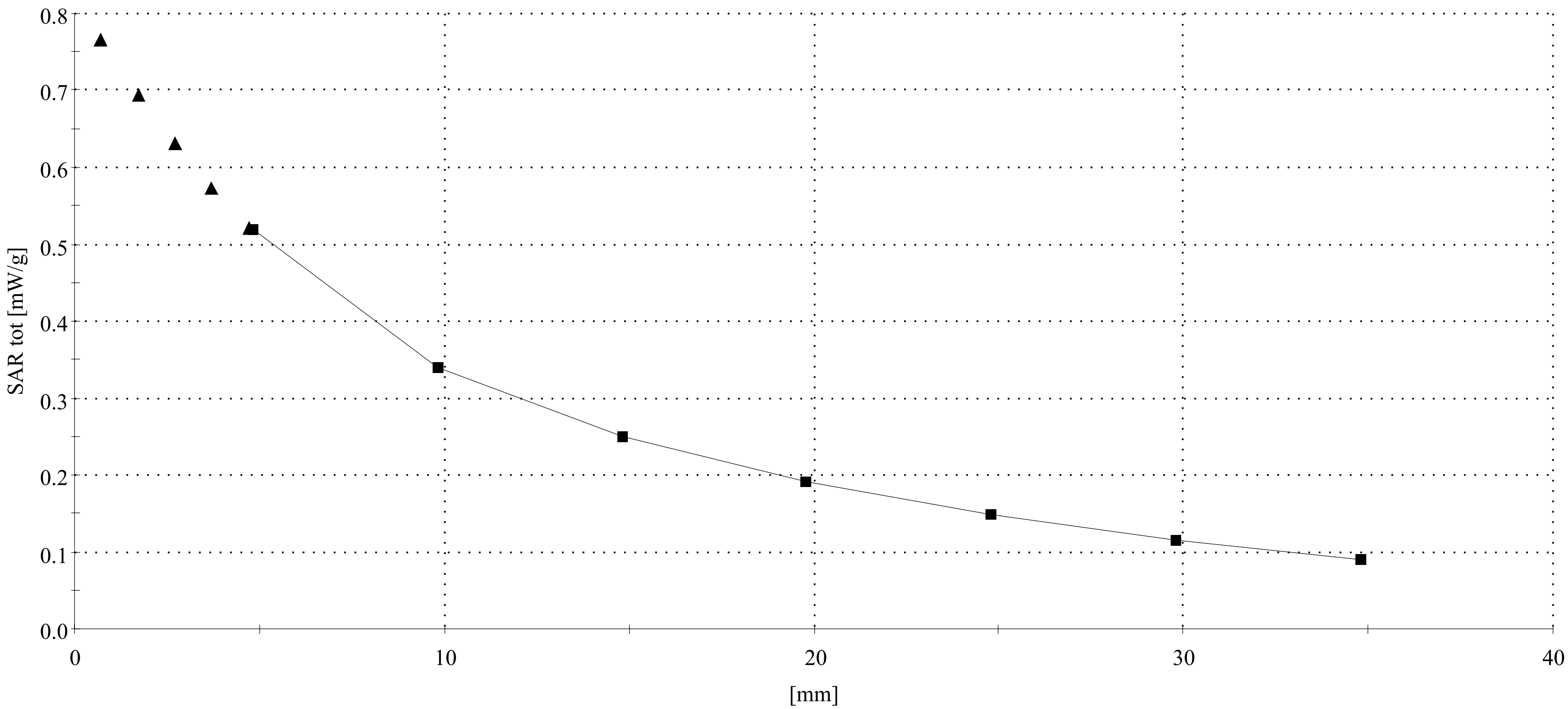
GMLRH-21, AMPS, Channel 991, Flat Position with 22mm Spacer, BLC-2 Battery and HDE-2 Headset

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): 0.516 mW/g, SAR (10g): 0.372 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 12.0
Powerdrift: 0.15 dB
Liquid Temperature: 21.6



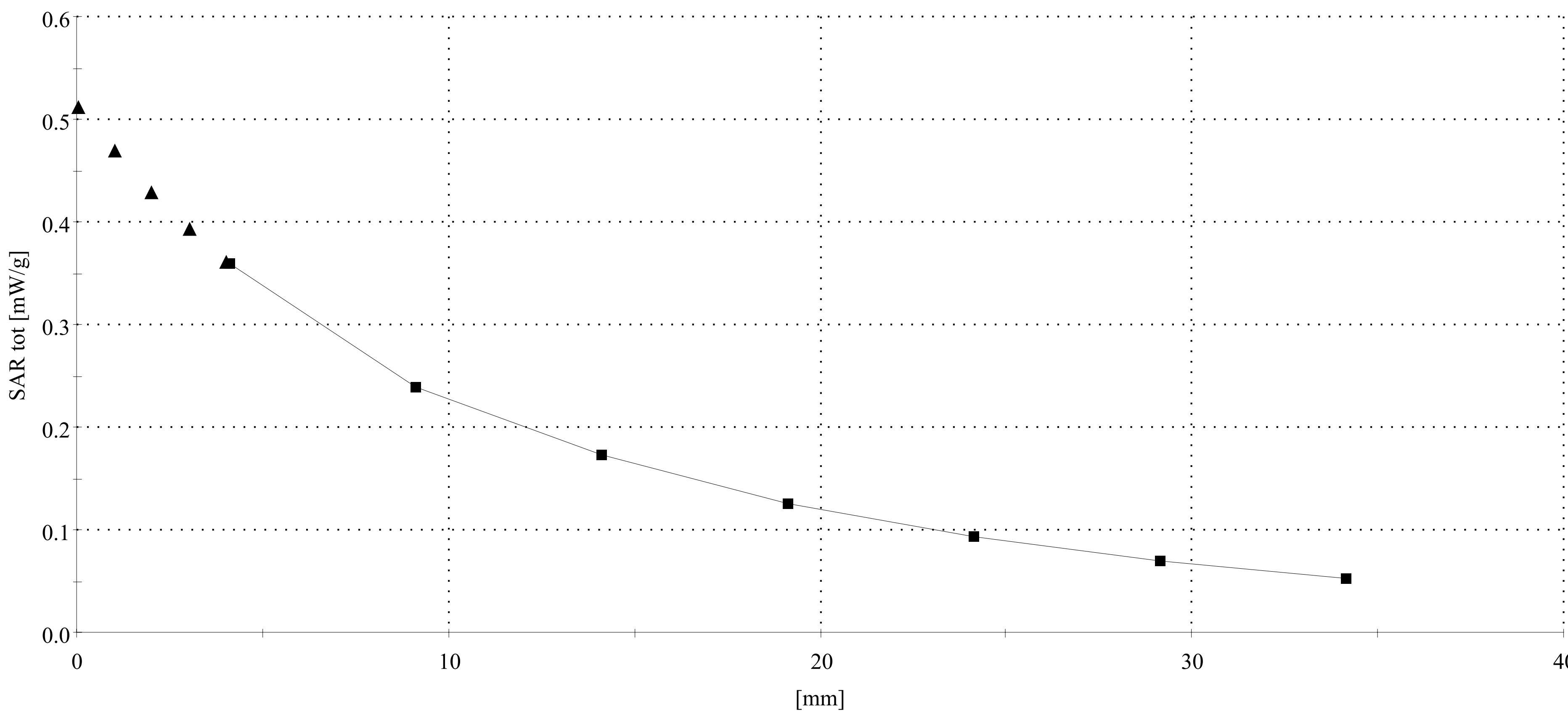
GMLRH-21, AMPS, Channel 799, Left Touch Position with BLC-2 Battery

SAM 1 (Cellular - Brain Tissue) Phantom
Frequency: 849 MHz; Crest factor: 1.0
Cellular Band - Brain Tissue: σ = 0.91 mho/m ε_r = 41.6 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 1.10 mW/g, SAR (10g): 0.755 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature (°C): 20.9



GMLRH-21, AMPS, Channel 991, Flat Position with 22mm Spacer, BLC-2 Battery and HDE-2 Headset

SAM 2 (Cellular - Muscle Tissue) Phantom
Frequency: 824 MHz; Crest factor: 1.0
Cellular Band - Muscle Tissue: σ = 0.96 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Probe: ET3DV6 - SN1504; ConvF(6.50,6.50,6.50)
Cube 5x5x7: SAR (1g): 0.516 mW/g, SAR (10g): 0.372 mW/g, (Worst-case extrapolation)
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0
Liquid Temperature: 21.6



APPENDIX D: CALIBRATION CERTIFICATE (S)

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

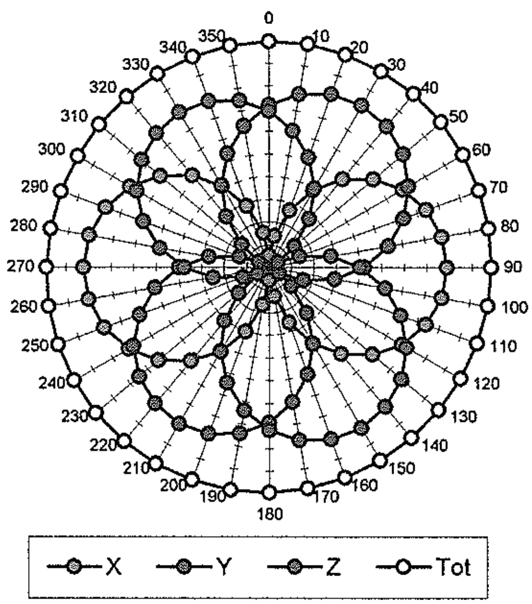
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	13.0	8.5
SAR_{be} [%]	With Correction Algorithm	0.2	0.2

Sensor Offset

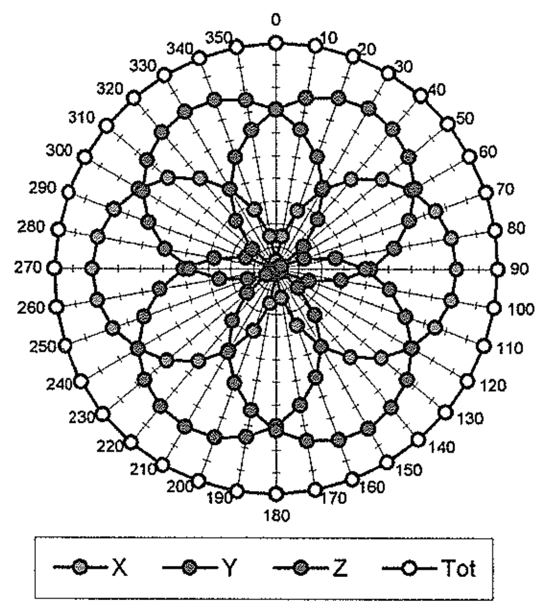
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.4 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

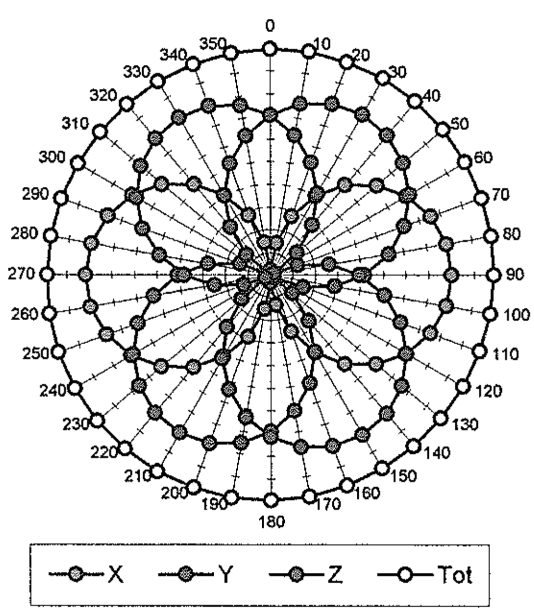
f = 30 MHz, TEM cell ifi110



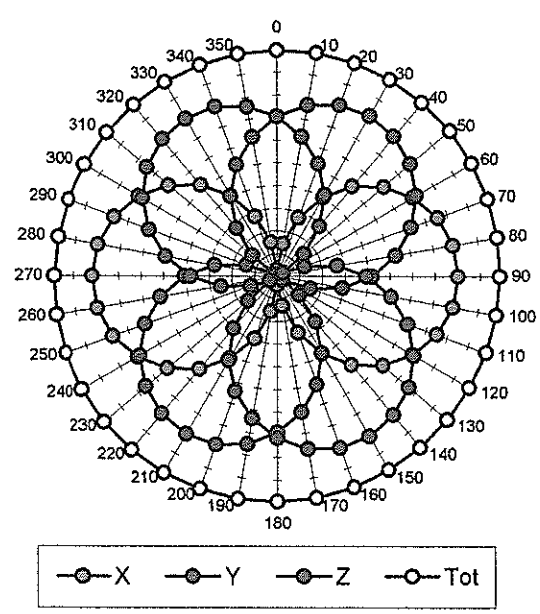
f = 100 MHz, TEM cell ifi110

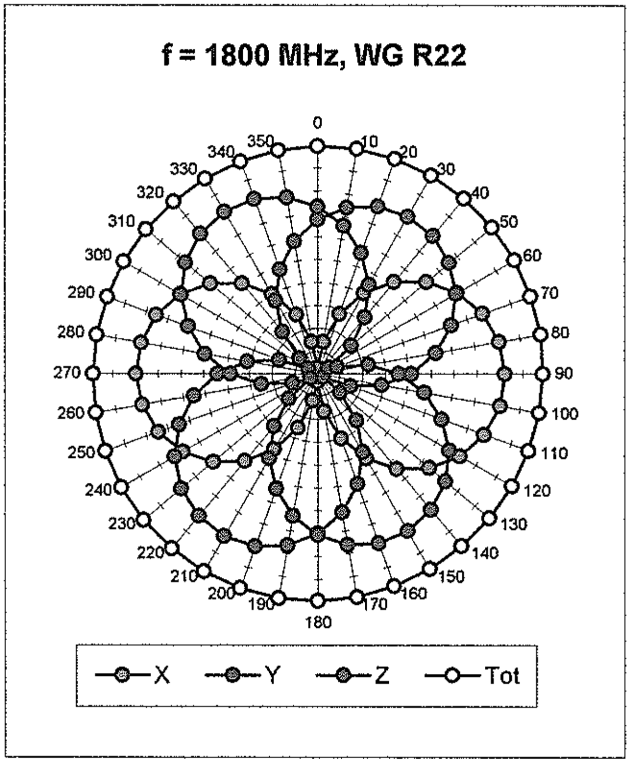


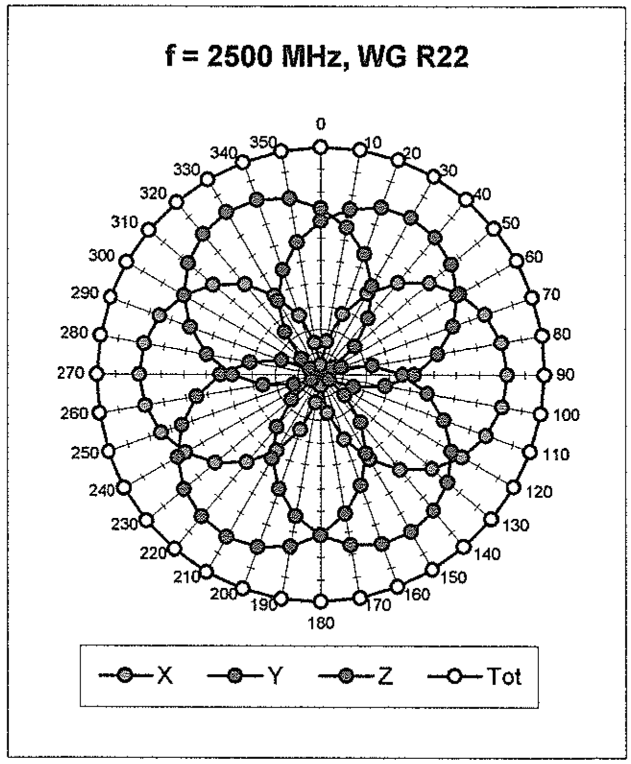
f = 300 MHz, TEM cell ifi110



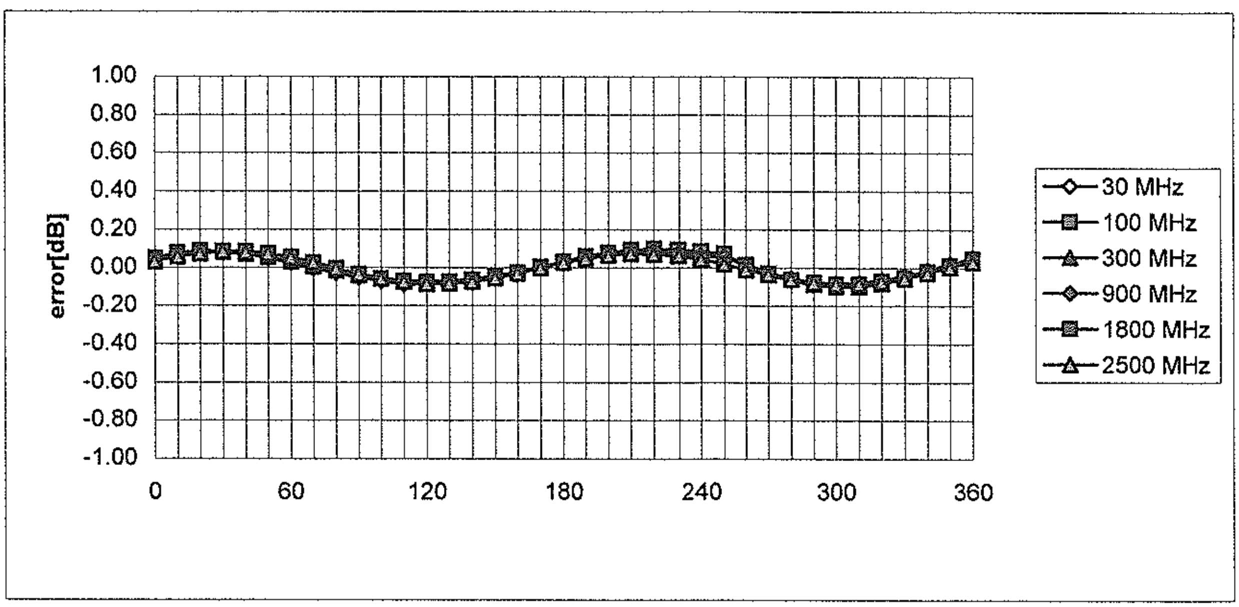
f = 900 MHz, TEM cell ifi110





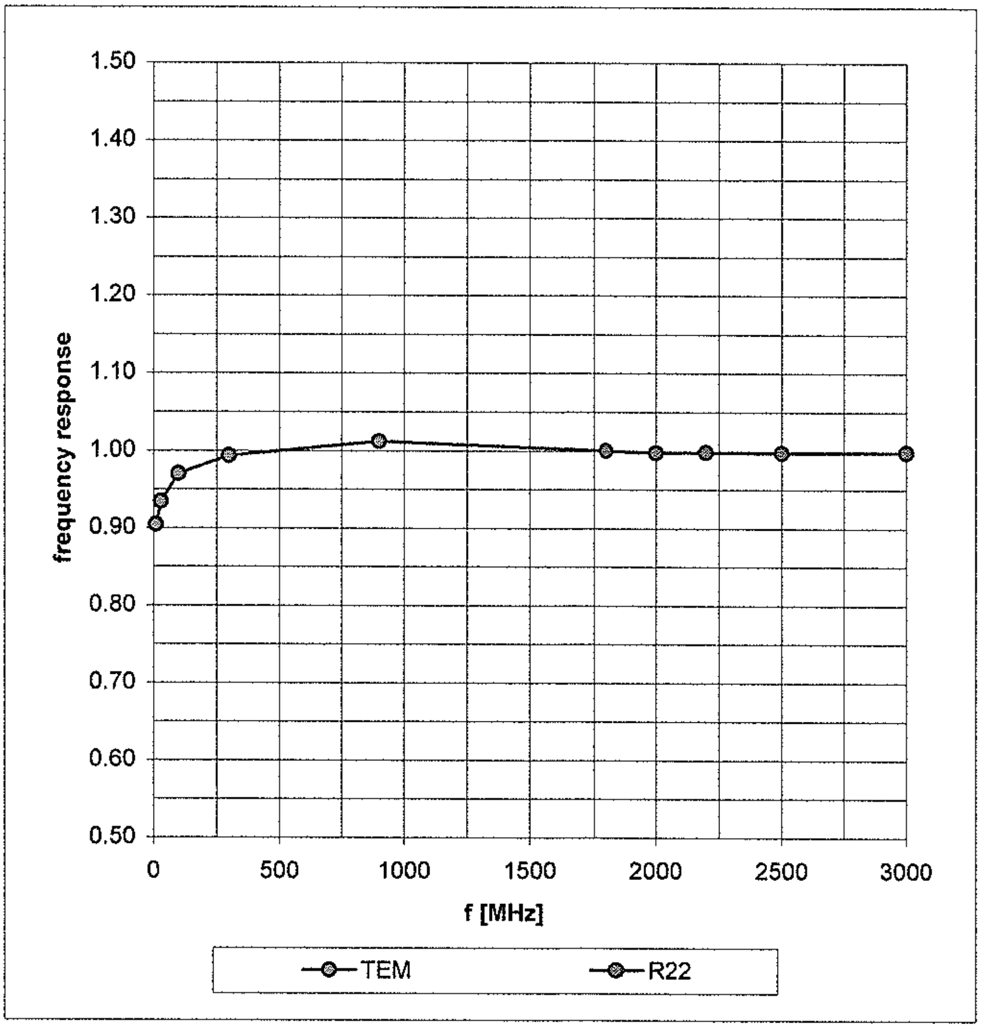


Isotropy Error (ϕ), θ = 0°



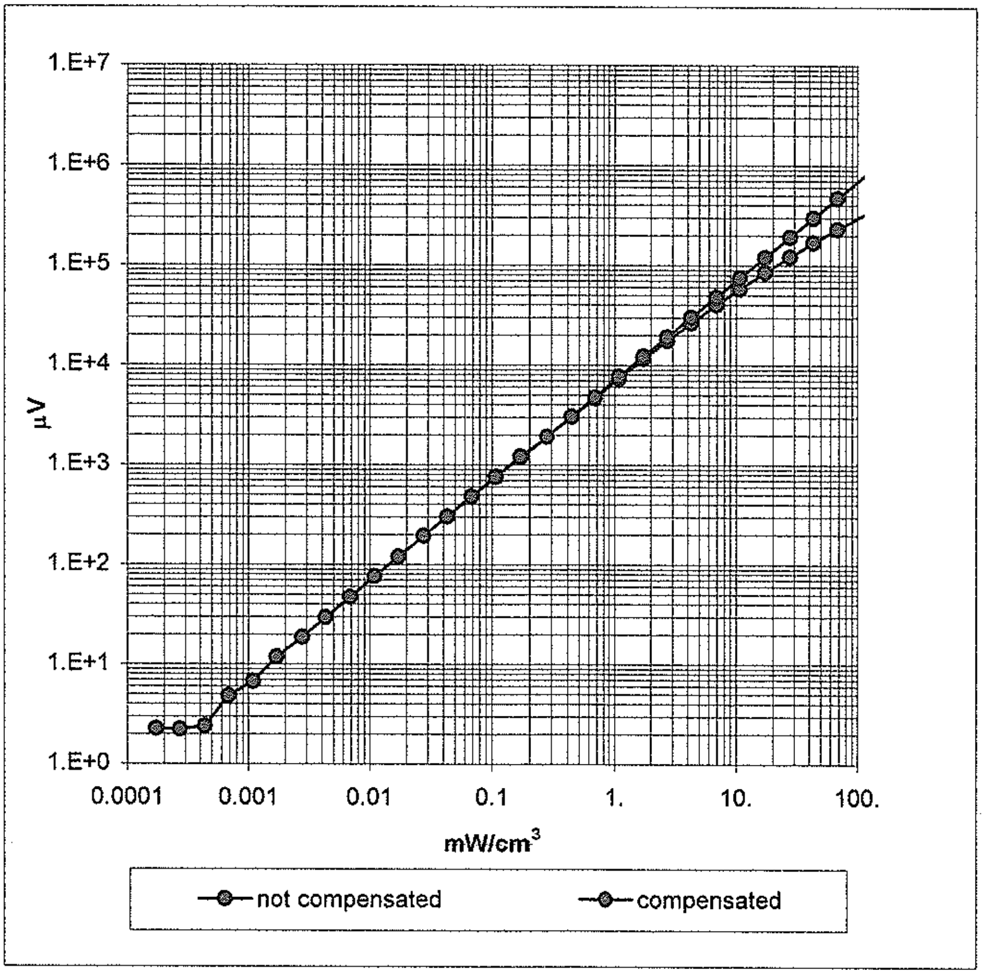
Frequency Response of E-Field

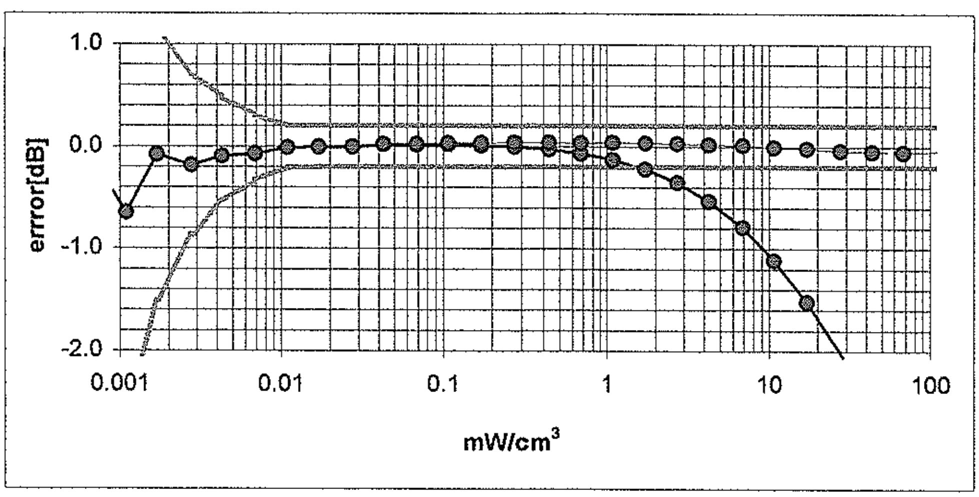
(TEM-Cell:ifi110, Waveguide R22)



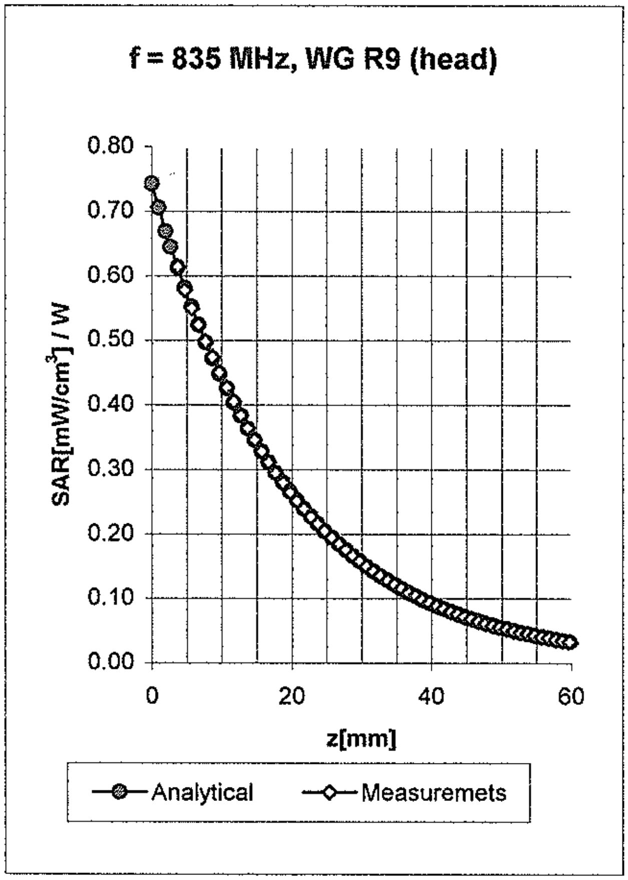
Dynamic Range f(SAR_{brain})

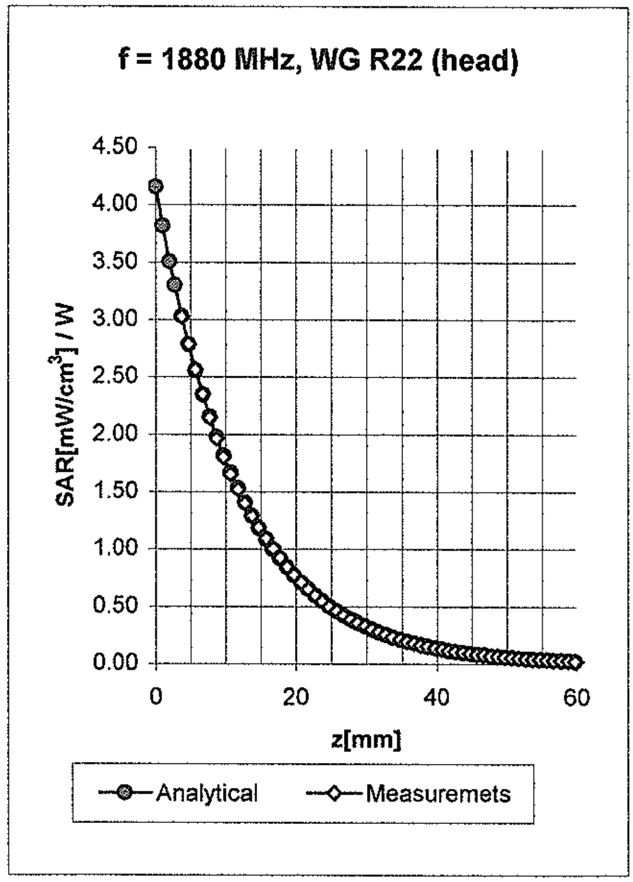
(Waveguide R22)





Conversion Factor Assessment

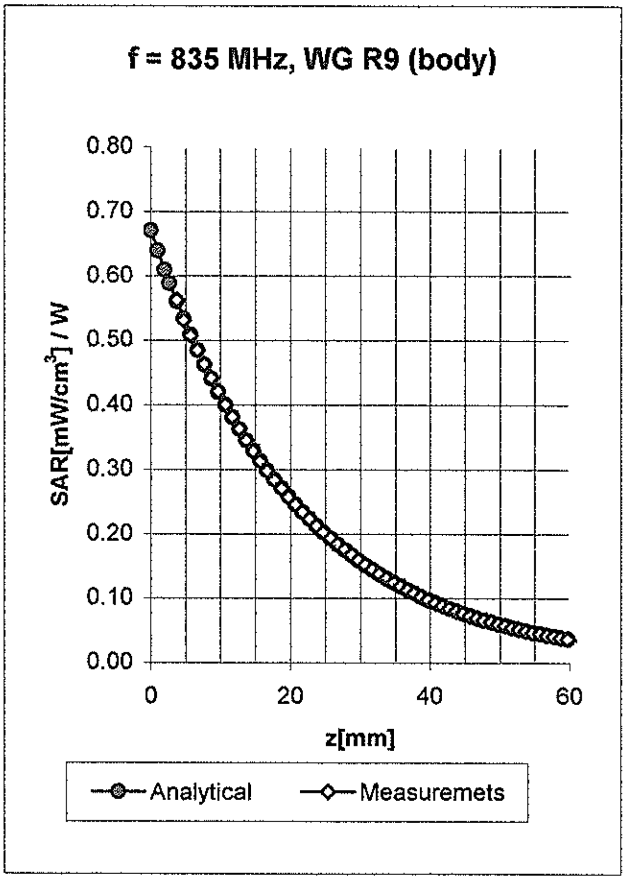


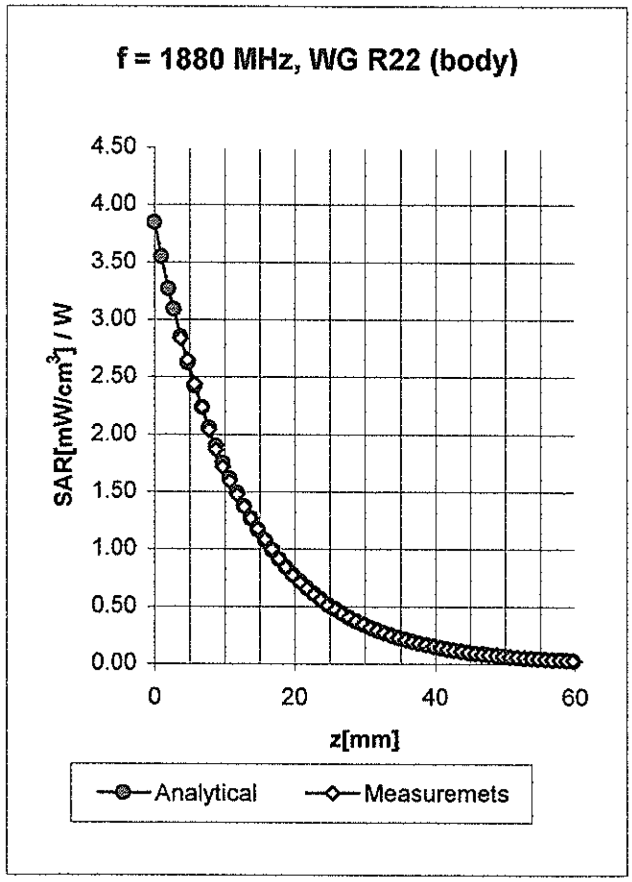


Head	**835 MHz**		ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**	
Head	**900 MHz**		ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**	
	ConvF X	**6.5**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.39**
	ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**2.42**

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



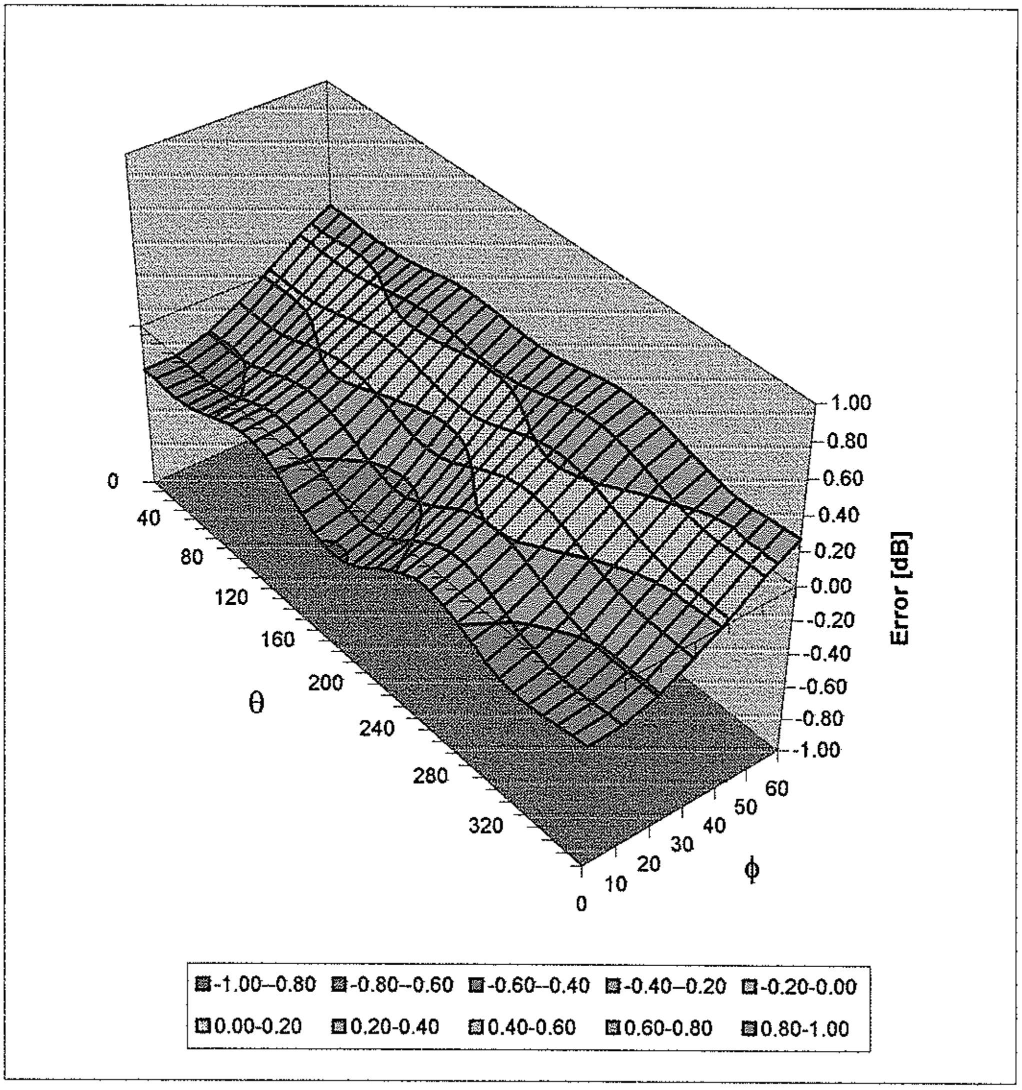


Body	**835 MHz**		ε_r **= 55.2 ± 5%**	**σ = 0.97 ± 5% mho/m**	
Body	**900 MHz**		ε_r **= 55.0 ± 5%**	**σ = 1.05 ± 5% mho/m**	
	ConvF X	**6.5**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.42**
	ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**2.38**

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



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

Client **Nokia Inc. Texas**

CALIBRATION CERTIFICATE

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

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Date issued: May 26, 2003

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

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

DASY

Dipole Validation Kit

Type: D835V2

Serial: 486

Manufactured: May 19, 2003
Calibrated: May 26, 2003

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	**42.8**	± 5%
Conductivity	**0.89 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.7 at 835 MHz) 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 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250 mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **9.80 mW/g** ± 16.8 % (k=2)[1]

averaged over 10 cm^3 (10 g) of tissue: **6.40 mW/g** ± 16.2 % (k=2)[1]

[1] validation uncertainty

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:	**1.389 ns**	(one direction)
Transmission factor:	**0.989**	(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} = **-2.9 Ω**
Return Loss at 835 MHz	**-30.7 dB**

4. 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.

5. 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.

6. Power Test

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

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

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

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

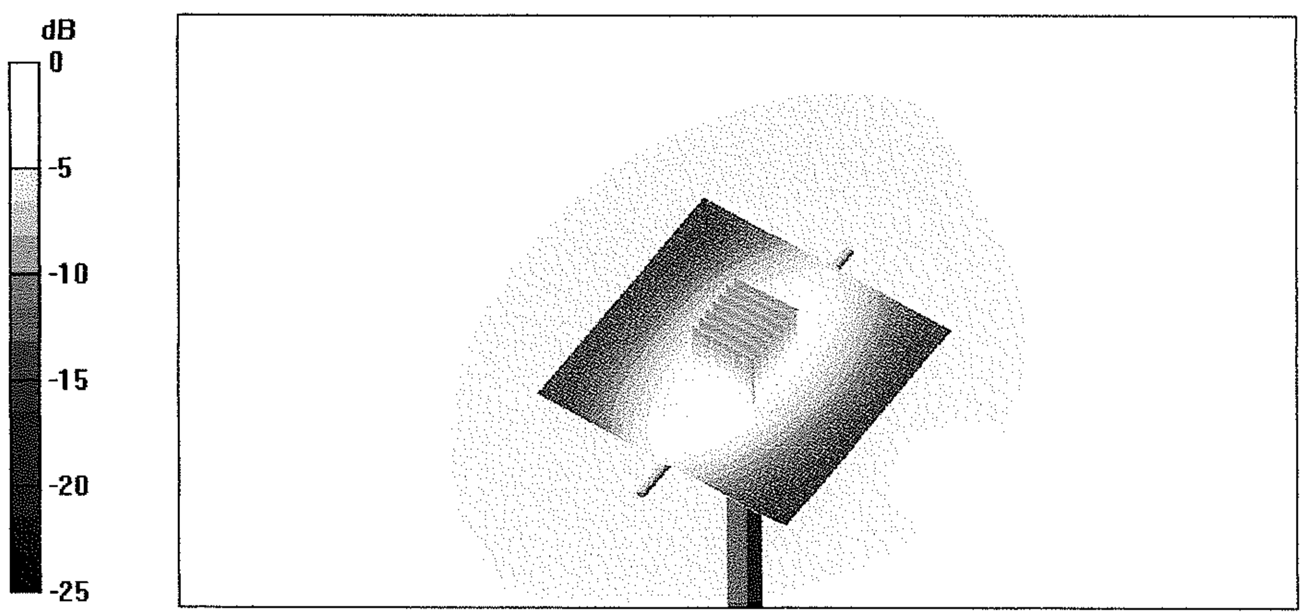
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835 MHz (σ = 0.89 mho/m, ε_r = 42.8, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.7, 6.7, 6.7); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- *Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115*

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

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



0 dB = 2.61mW/g

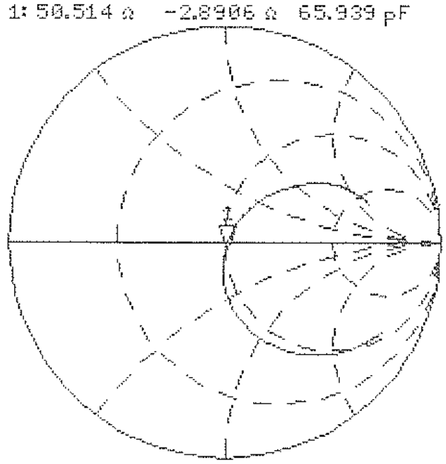
26 May 2003 14:28:05

CH1 S11 1 U FS 1: 50.514 Ω -2.8906 Ω 65.939 pF 835.000 000 MHz

Del

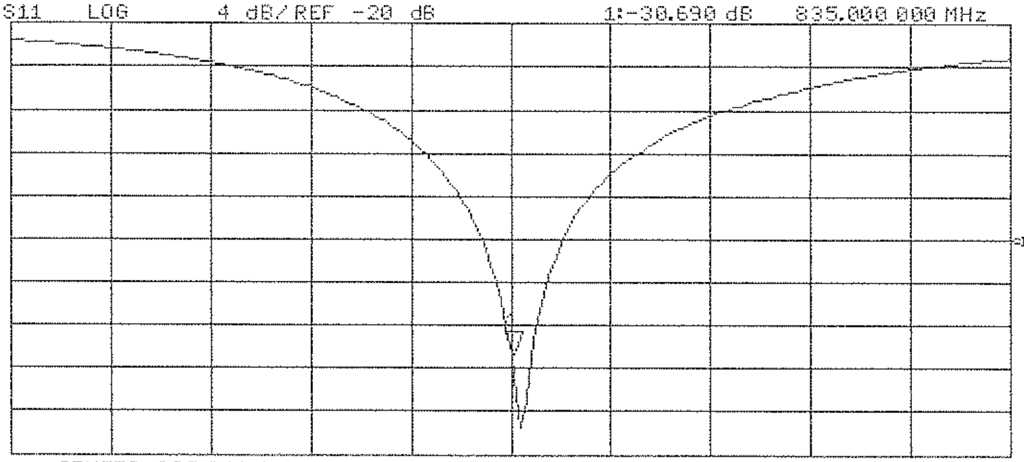
PRm

Cor
Avg
16



CH2 S11 LOG 4 dB/ REF -20 dB 1:-30.690 dB 835.000 000 MHz

PRm
Cor



CENTER 835.000 000 MHz SPAN 400.000 000 MHz

3453

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:	**455**
Place of Calibration:	**Zurich**
Date of Calibration:	**July 16, 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:	N. Vetter
Approved by:	Pokovic Katja

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: 455

Manufactured: January 31, 2002
Calibrated: July 16, 2002

1. Measurement Conditions

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

Relative Dielectricity	**42.5**	± 5%
Conductivity	**0.90 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.6 at 835 MHz) 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.

2.1. SAR Measurement with DASY3 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **9.84 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **6.32 mW/g**

2.2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **9.20 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **6.08 mW/g**

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:	**1.375 ns**	(one direction)
Transmission factor:	**0.992**	(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} = **49.6 Ω**
	Im {Z} = **-1.8 Ω**
Return Loss at 835 MHz	**-34.7 dB**

4. Measurement Conditions

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

Relative Dielectricity	**55.3**	± 5%
Conductivity	**0.95 mho/m**	± 5%

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.2 at 835 MHz) 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.

5.1. SAR Measurement with DASY3 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the worst-case extrapolation are:

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

averaged over 10 cm^3 (10 g) of tissue: **6.60 mW/g**

5.2 SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **9.24 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **6.20 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} = **45.6 Ω**

Im {Z} = **-4.3 Ω**

Return Loss at 835 MHz **-23.7 dB**

4. 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.

5. Design

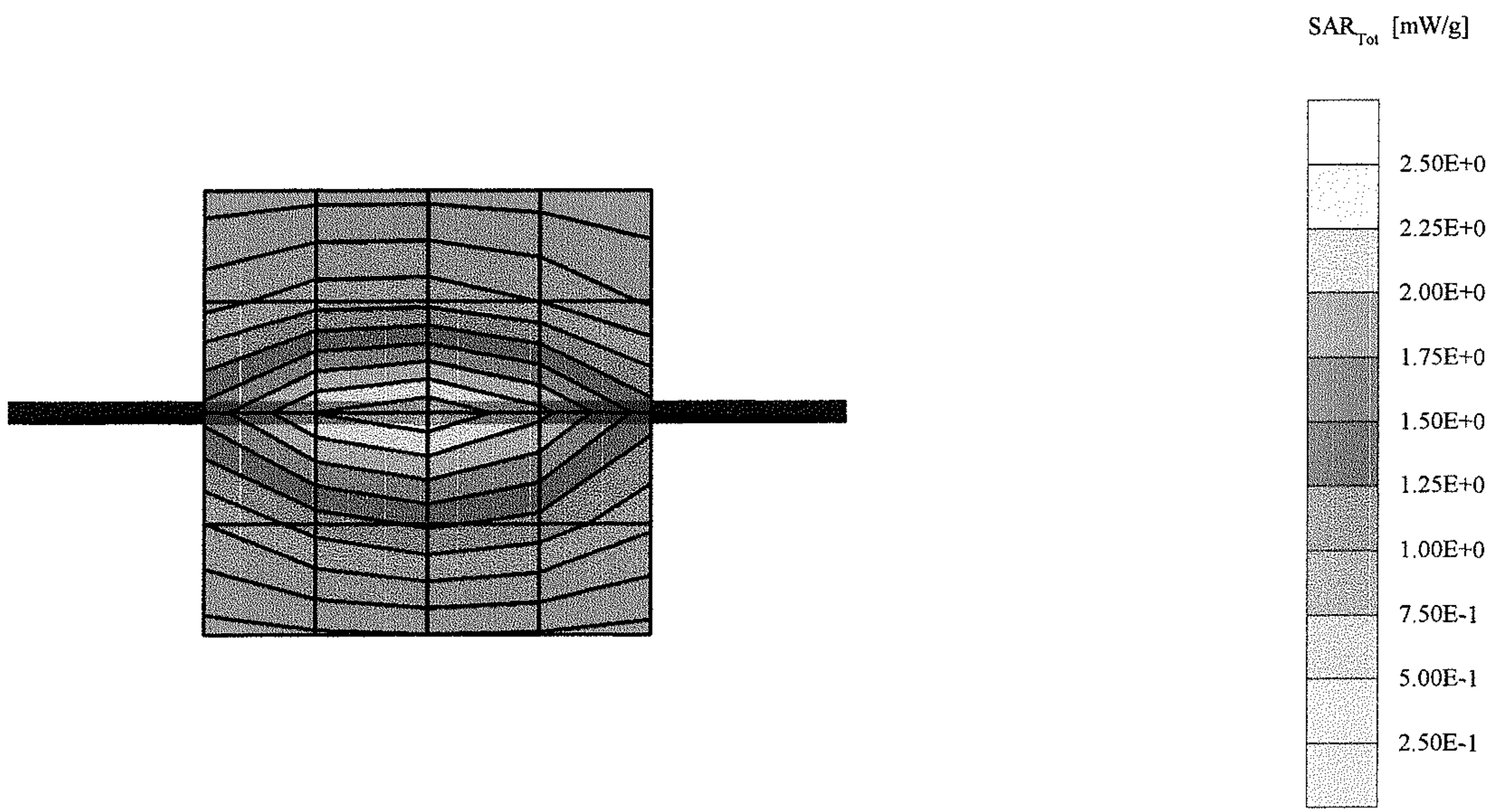
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

6. Power Test

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

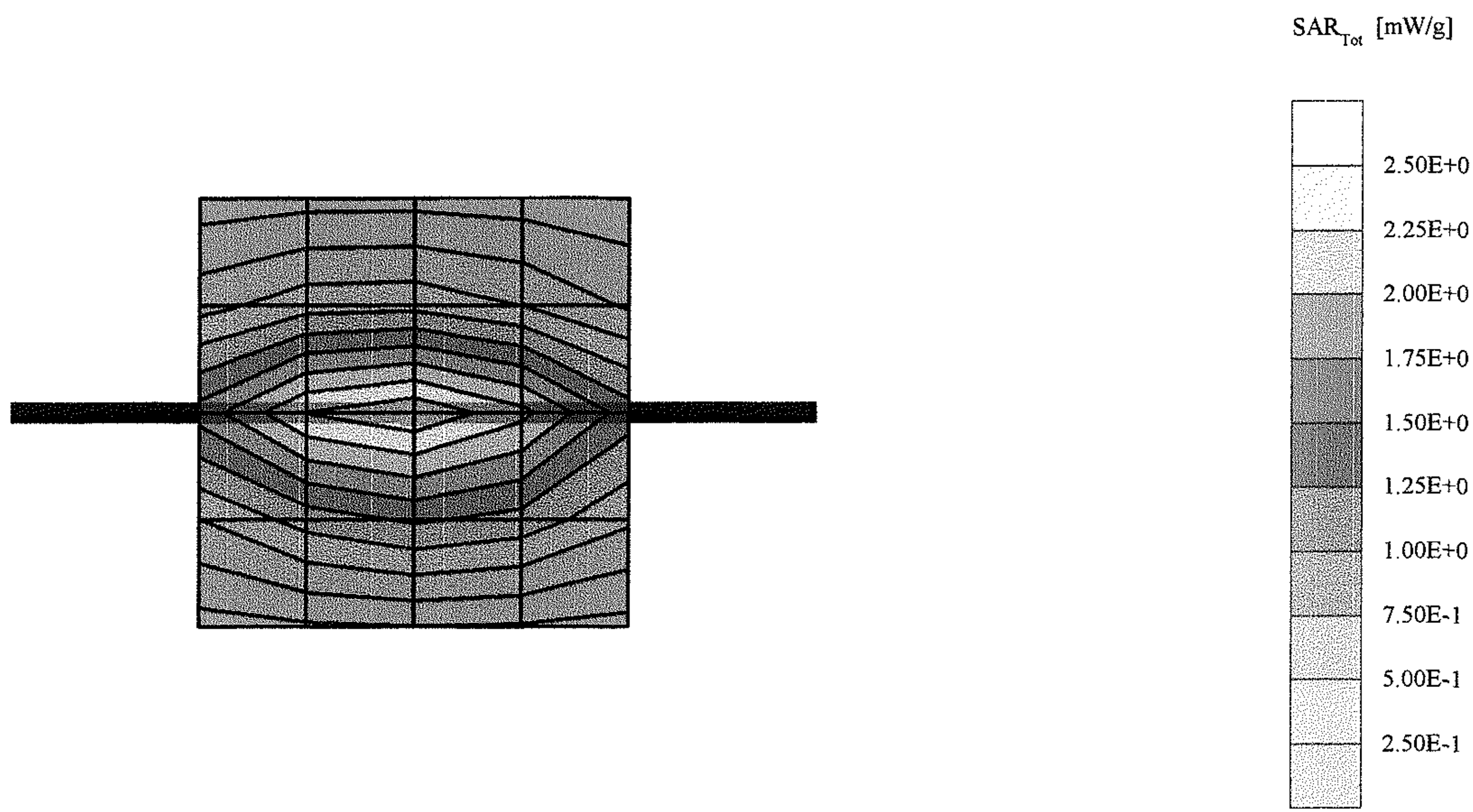
Validation Dipole D835V2 SN455, d = 15 mm

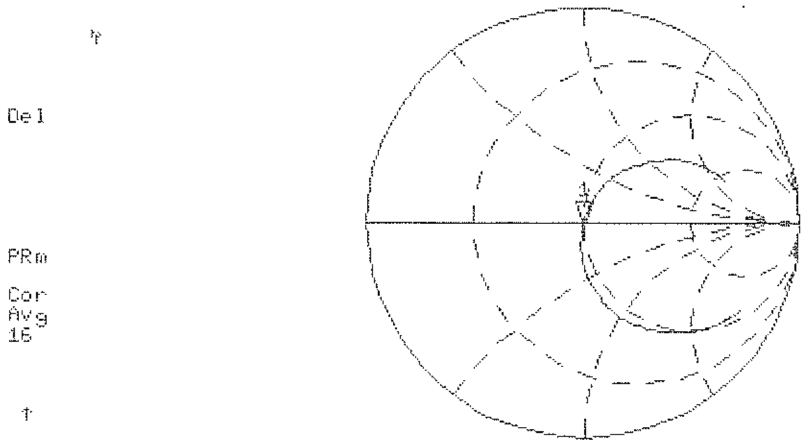
Frequency: 835 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.60,6.60,6.60) at 835 MHz; IEEE1528 835 MHz: $\sigma = 0.90$ mho/m $\varepsilon_r = 42.5$ $\rho = 1.00$ g/cm^3
Cubes (2): Peak: 3.84 mW/g ± 0.02 dB, SAR (1g): 2.46 mW/g ± 0.02 dB, SAR (10g): 1.58 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.1 (11.1, 13.5) [mm]
Powerdrift: 0.00 dB



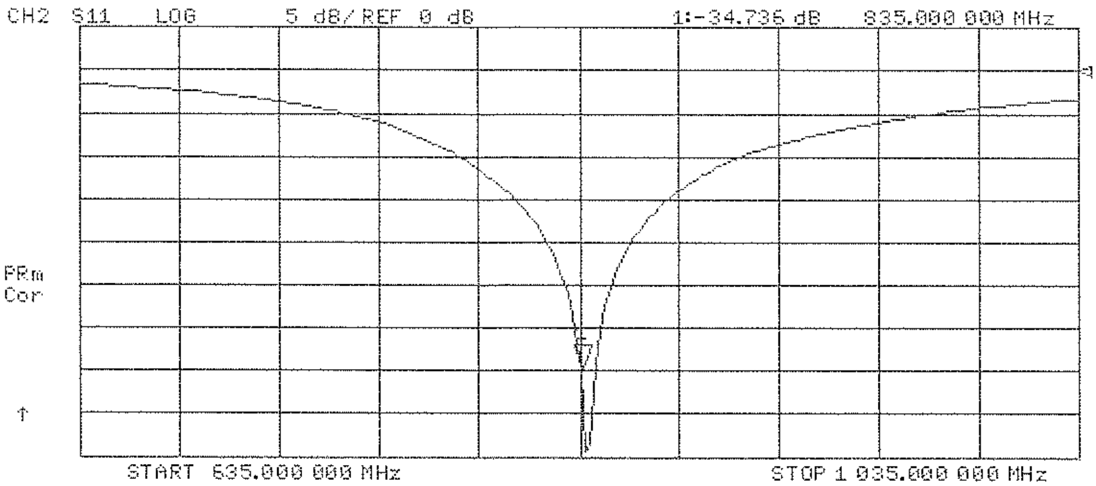
Validation Dipole D835V2 SN455, d = 15 mm

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: σ = 0.90 mho/m ε_r = 42.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 3.40 mW/g ± 0.02 dB, SAR (1g): 2.30 mW/g ± 0.02 dB, SAR (10g): 1.52 mW/g ± 0.01 dB, (Advanced extrapolation)
Penetration depth: 13.1 (12.8, 13.6) [mm]
Powerdrift: 0.00 dB





Del
PRm
Cor
Avg
16

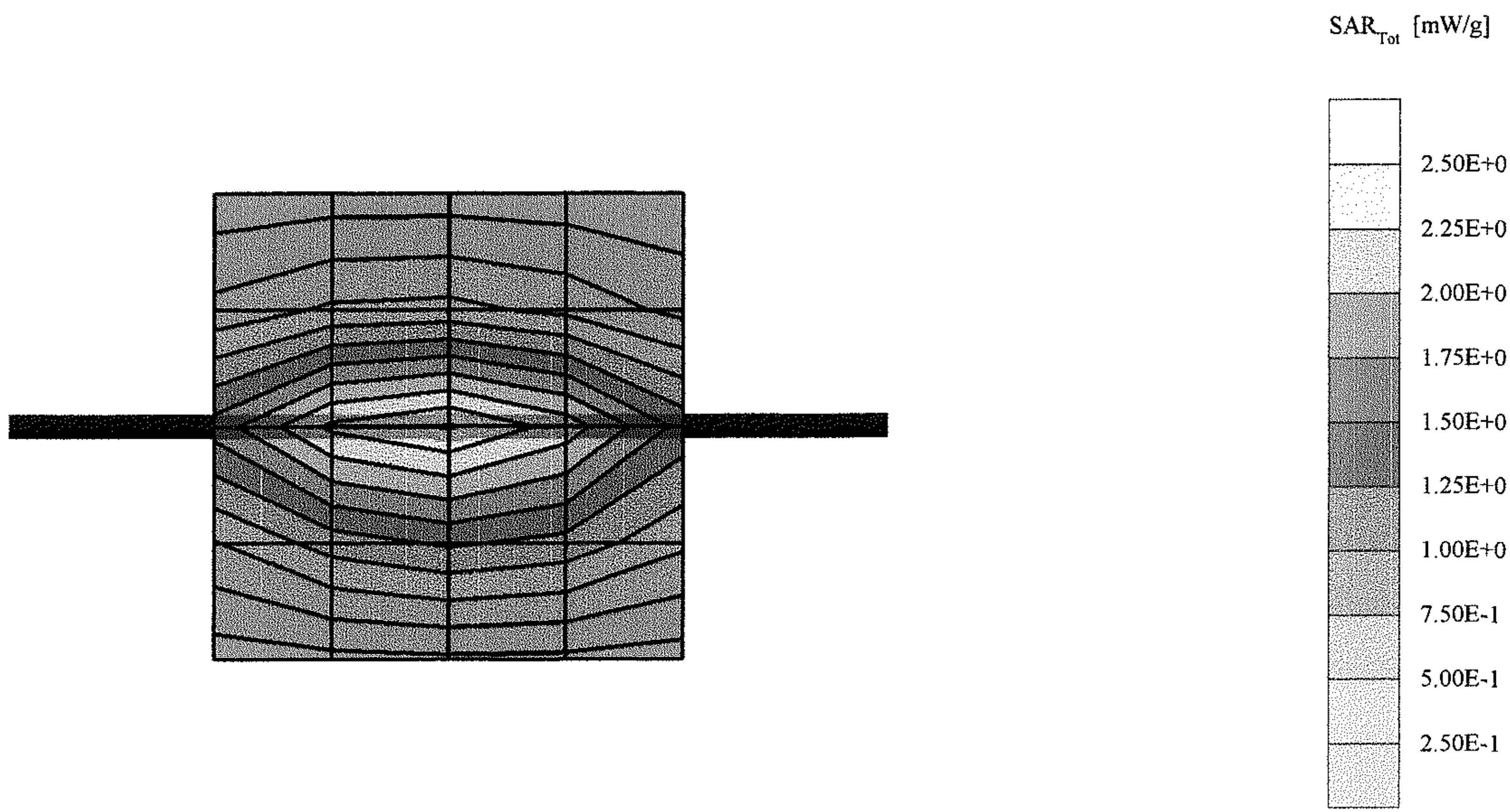


CH2 S11 LOG 5 dB/ REF 0 dB 1:-34.736 dB 835.000 000 MHz
PRm
Cor
START 635.000 000 MHz
STOP 1 035.000 000 MHz

07/16/02

Validation Dipole D835V2 SN455, d = 15 mm

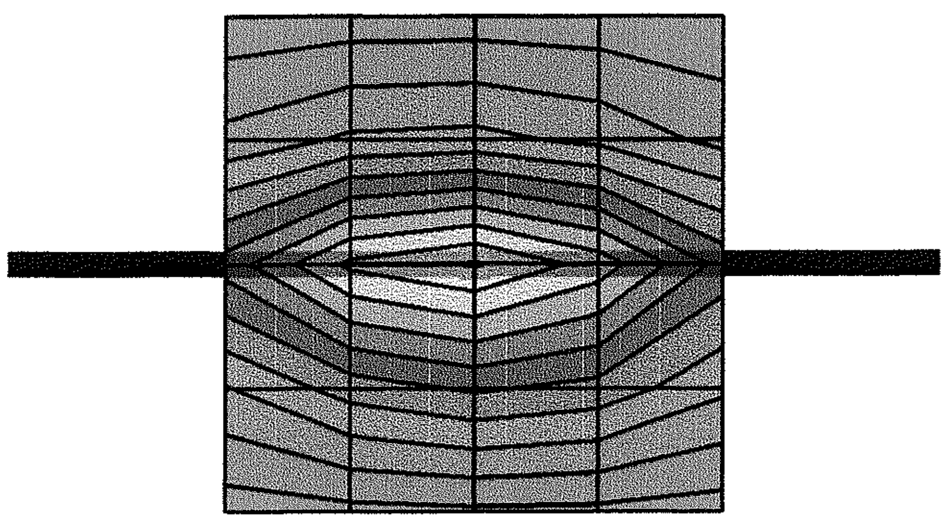
Frequency: 835 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.20,6.20,6.20) at 835 MHz; IEEE1528 835 MHz: $\sigma = 0.95$ mho/m $\varepsilon_r = 55.3$ $\rho = 1.00$ g/cm^3
Cubes (2): Peak: 3.91 mW/g ± 0.01 dB, SAR (1g): 2.53 mW/g ± 0.01 dB, SAR (10g): 1.65 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 12.7 (11.6, 14.2) [mm]
Powerdrift: 0.01 dB

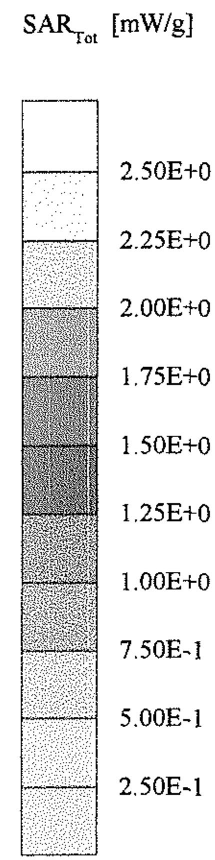


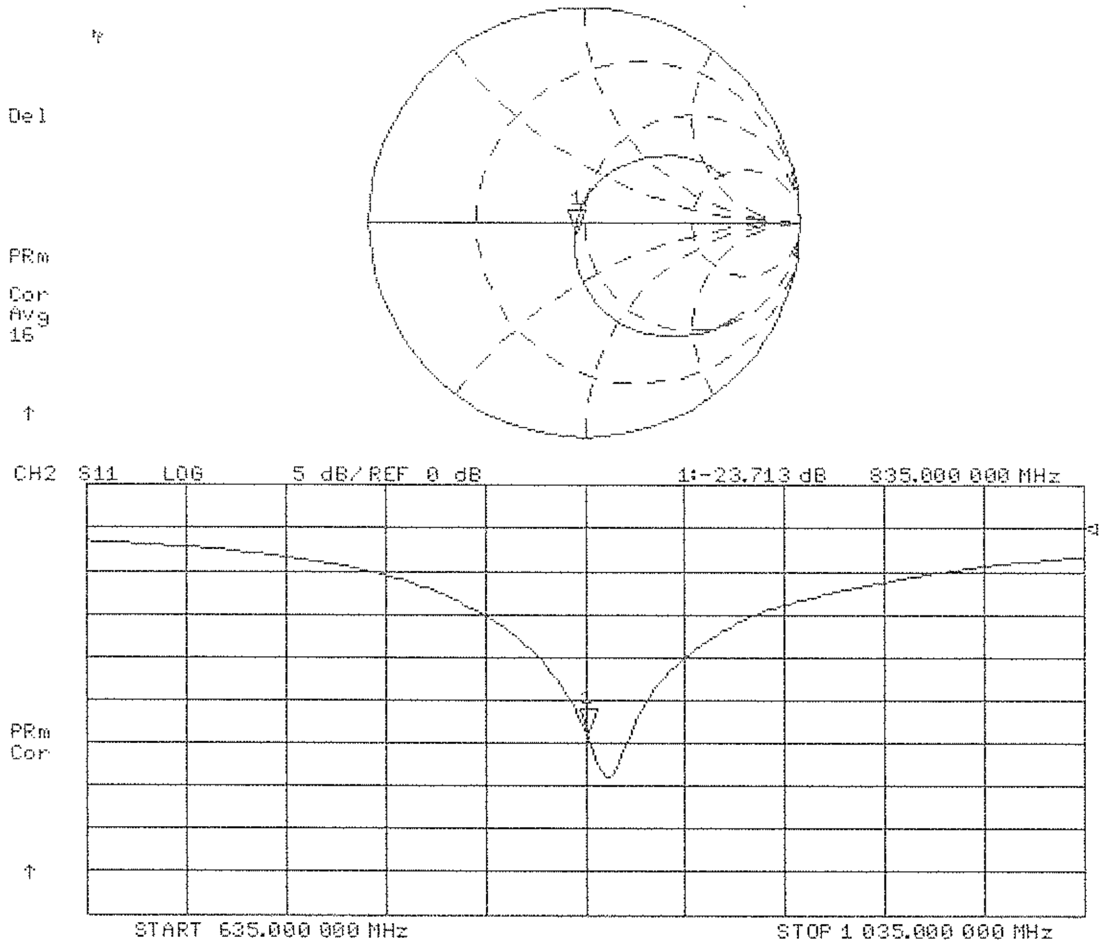
Schmid & Partner Engineering, Zurich, Switzerland

Validation Dipole D835V2 SN455, 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: $\sigma = 0.95$ mho/m $\varepsilon_r = 55.3$ $\rho = 1.00$ g/cm^3
Cubes (2): Peak: 3.30 mW/g ± 0.01 dB, SAR (1g): 2.31 mW/g ± 0.01 dB, SAR (10g): 1.55 mW/g ± 0.01 dB, (Advanced extrapolation)
Penetration depth: 14.3 (14.2, 14.5) [mm]
Powerdrift: 0.01 dB







Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/REF 0 dB 1:-23.713 dB 835.000 000 MHz
PRm
Cor
START 635.000 000 MHz
STOP 1 035.000 000 MHz

3457

Schmid & Partner Engineering AG

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

Calibration Certificate

1900 MHz System Validation Dipole

Type:	**D1900V2**
Serial Number:	**5d004**
Place of Calibration:	**Zurich**
Date of Calibration:	**July 17, 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:	N. Vetter
Approved by:	Pokovic Katja