CERTIFICATE OF COMPLIANCE
SAR EVALUATION

Test Lab:	**Applicant Information:**
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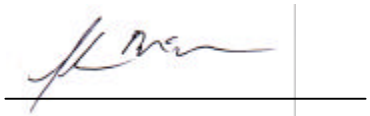
FCC Rule Part(s):	**2.1093; ET Docket 96-326**
FCC ID:	**O7KPL5164**
Model(s):	**PL5164**
EUT Type:	**Portable UHF PTT Radio Transceiver**
Modulation:	**FM (UHF Band)**
Tx Frequency Range:	**450 - 490 MHz**
Nominal Conducted Power:	**5.0 Watts**
Antenna Type:	**Helical Whip**
Antenna P/N:	**ACC-145**
Battery Type:	**7.2V NiMH**
Body-Worn Accessory:	**Plastic Belt-Clip**

Celltech Research Inc. declares under its sole responsibility that this device was found to be in compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in OET Bulletin 65, Supplement C, Edition 01-01 (Occupational/Controlled Exposure), and was tested in accordance with the appropriate measurement standards, guidelines, and recommended practices specified in American National Standards Institute C95.1-1992.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Shawn McMillen
General Manager
Celltech Research Inc.

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1.0 INTRODUCTION

This measurement report shows that the TOPAZ3 PL5164 Portable UHF PTT Radio Transceiver FCC ID: O7KPL5164 with plastic belt-clip complies with FCC Part 2.1093, ET Docket 96-326 Rules for mobile and portable devices (controlled exposure, body-worn operation). The test procedures, as described in American National Standards Institute C95.1-1992 (see reference [1]), and FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [2]) were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Rule Part(s)	FCC 2.1093; ET Docket 96.326
EUT Type	Portable UHF PTT Radio Transceiver
FCC ID	O7KPL5164
Model No.(s)	PL5164
Serial No.	Pre-production
Modulation	FM (UHF Band)
Tx Frequency Range	450-490 MHz
Nominal RF Conducted Output Power	5.0 Watts
Antenna Type	Helical Whip
Antenna P/N	ACC-145
Battery Type	7.2V DC NiMH
Body-Worn Accessory Tested	Plastic Belt-Clip

3.0 SAR MEASUREMENT SYSTEM

Celltech Research SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, SAM phantom, and various planar phantoms for brain or body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

DASY3 SAR Measurement System with small planar phantom

DASY3 SAR Measurement System with validation phantom

4.0 MEASUREMENT SUMMARY

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the EUT are reported in Appendix A.

BODY-WORN SAR EVALUATION RESULTS									
Freq. (MHz)	**Channel**	**Mode**	**Cond. Power Before (W)**	**Cond. Power After (W)**	**Antenna Position**	**Phantom Section**	**Belt-Clip Separation Distance (cm)**	**SAR (w/kg)**	
								100% Duty Cycle	**50% Duty Cycle**
450.0125	Low	CW	5.04	4.93	Fixed	Planar	1.0	10.6	5.3
470.0125	Mid	CW	5.10	4.94	Fixed	Planar	1.0	10.8	5.4
489.9875	High	CW	5.05	4.88	Fixed	Planar	1.0	9.89	4.95
ANSI / IEEE C95.1 1992 - SAFETY LIMIT BODY: 8.0 W/kg (averaged over 1 gram) Spatial Peak Controlled Exposure / Occupational									
Measured Mixture Type	**Body**			**Relative Humidity**			**31.8 %**		
Dielectric Constant	**58.1**			**Atmospheric Pressure**			**102.43 kPa**		
Conductivity	**0.94**			**Fluid Temperature**			**≈ 23.0 °C**		
Ambient Temperature	**23.9 °C**			**Liquid Depth**			**≥ 15 cm**		

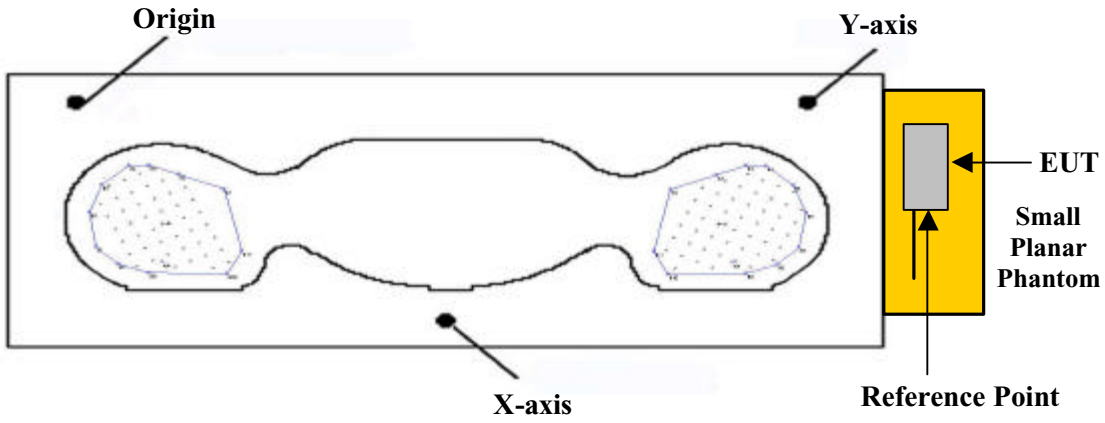
Notes:

1. The SAR values measured were below the maximum limit of 8.0 w/kg (controlled exposure, 50% duty cycle).
2. The highest body-worn SAR value measured was 5.4 w/kg (50% duty cycle, mid channel).
3. The EUT was tested for body-worn SAR with the attached plastic belt-clip providing a 1.0cm separation distance between the back of the EUT and the outer surface of the planar phantom.
4. The EUT was tested for body-worn SAR with speaker-microphone connected.
5. During the entire test the conducted power was maintained to within 5% of the initial conducted power.

5.0 DETAILS OF SAR EVALUATION

The TOPAZ3 PL5164 Portable UHF PTT Radio Transceiver FCC ID: O7KPL5164 with plastic belt-clip was found to be compliant for localized Specific Absorption Rate (controlled exposure, body-worn operation) based on the following test provisions and conditions:

1. The EUT was evaluated in a body-worn configuration with the back of the EUT placed parallel to the outer surface of the small planar phantom. The plastic belt-clip was touching the outer surface of the planar phantom for the duration of the test, and provided a 1.0cm separation distance between the back of the EUT and the outer surface of the small planar phantom.
2. The EUT was tested for body-worn SAR with a speaker-microphone connected.
3. The EUT was evaluated for SAR at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimize drift. The conducted power levels were checked before and after each test. If the conducted power level deviated more than 5% of the initial power level, then the EUT was retested. Any unusual anomalies over the course of the test also warranted a re-evaluation.
4. The conducted power was measured according to the procedures described in FCC Part 2.1046.
5. The EUT was tested with the transmitter in continuous operation (100% duty cycle) throughout the SAR evaluation. This is a push-to-talk device, therefore the 50% duty cycle compensation reported assumes a transmit/receive cycle of equal time base.
6. The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the device and its antenna.
7. The EUT was tested with a fully charged battery.



Phantom Reference Point & EUT Positioning

6.0 EVALUATION PROCEDURES

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

a. (i) The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For devices held to the ear during normal operation both the left and right ear positions were first evaluated at the middle frequency of the band at maximum power with all available battery options and antenna positions as applicable. If the SAR values measured at mid channel were 3.0dB or greater below the SAR limit, only mid channel data was reported. Otherwise, the device was further evaluated at the low and high frequencies of the band at maximum power. The positioning of the ear-held device relative to the phantom was performed in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01) using the SAM phantom.

(ii) For face-held and body-worn devices a planar phantom was used. Depending on the phantom used for the evaluation, all other phantoms were drained of fluid.

b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface using a uniform grid spacing.

c. A 5x5x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.

d. The depth of the simulating tissue in the phantom used for the SAR evaluation and system validation was no less than 15.0cm.

Body-Worn SAR Test Setup

7.0 SYSTEM VALIDATION

Prior to the assessment, the system was verified in a planar phantom with a 450MHz dipole. A forward power of 250mW was applied to the dipole and the system was verified to a tolerance of ±10%. The applicable verifications are listed below (see Appendix B for system validation test plots and Appendix C for dipole calibration information):

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)	Fluid Temperature	Fluid Depth	Validation Date
450MHz	1.47	1.45	≈23.0 °C	≥ 15cm	04/23/02

8.0 TISSUE PARAMETERS

The dielectric parameters of the fluids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer. The dielectric parameters of the fluid are listed below (see Appendix E for printout of measured fluid dielectric parameters).

BRAIN TISSUE PARAMETERS – SYSTEM VALIDATION			
Equivalent Tissue	**Dielectric Constant ε_r**	**Conductivity σ (mho/m)**	**ρ (Kg/m^3)**
450MHz Brain (Target)	43.5 ± 5%	0.87 ± 5%	1000
450MHz Brain (Measured: 04/23/02)	44.8	0.86	1000

BODY TISSUE PARAMETERS - EUT EVALUATION			
Equivalent Tissue	**Dielectric Constant ε_r**	**Conductivity σ (mho/m)**	**ρ (Kg/m^3)**
450MHz Body (Target)	56.7 ±5%	0.94 ±5%	1000
450MHz Body (Measured: 04/23/02)	58.1	0.94	1000

9.0 SIMULATED TISSUES

The brain and body tissue mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The fluid was prepared according to standardized procedures, and measured for dielectric parameters (permitivity and conductivity).

TISSUE MIXTURES - SYSTEM VALIDATION & EUT EVALUATION		
INGREDIENT	**450MHz Brain Mixture (System Validation) %**	**450MHz Body Mixture (EUT Evaluation) %**
Water	38.56	52.00
Sugar	56.32	45.65
Salt	3.95	1.75
HEC	0.98	0.50
Bactericide	0.19	0.10

10.0 SAR SAFETY LIMITS

EXPOSURE LIMITS	**SAR (W/Kg)**	
	(General Population / Uncontrolled Exposure Environment)	**(Occupational / Controlled Exposure Environment)**
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1g of tissue)	1.6	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.0	20.0

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

11.0 ROBOT SYSTEM SPECIFICATIONS

Specifications

POSITIONER:	Stäubli Unimation Corp. Robot Model: RX60L
Repeatability:	0.02 mm
No. of axis:	6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor:	Pentium III
Clock Speed:	450 MHz
Operating System:	Windows NT
Data Card:	DASY3 PC-Board

Data Converter

Features:	Signal Amplifier, multiplexer, A/D converter, and control logic
Software:	DASY3 software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock

PC Interface Card

Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16-bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot

E-Field Probe

Model:	ET3DV6
Serial No.:	1387
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

Evaluation Phantom

Type:	Small Planar Phantom
Shell Material:	Plexiglas
Bottom Thickness:	2.0 mm ± 0.1mm
Dimensions:	Box: 36.5cm (L) x 22.5cm (W) x 20.3cm (H); Back Plane: 25.3cm (H)

Validation Phantom (≤ 450MHz)

Type:	Large Planar Phantom
Shell Material:	Plexiglas
Bottom Thickness:	6.2 mm ± 0.1mm
Dimensions:	86.0cm (L) x 39.5cm (W) x 21.8cm (H)

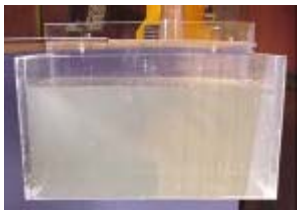
12.0 PROBE SPECIFICATION (ET3DV6)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycol)
Calibration:	In air from 10 MHz to 2.5 GHz In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy ± 8%)
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation normal to probe axis)
Dynam. Rnge:	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Srfce. Detect.	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
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 phone


ET3DV6 E-Field Probe

13.0 SMALL PLANAR PHANTOM

The small planar phantom is constructed of Plexiglas material with a 2.0mm shell thickness for face-held and body-worn SAR evaluations. The small planar phantom is mounted onto the outer left hand section of the DASY3 system.


Small Planar Phantom

14.0 LARGE PLANAR PHANTOM

The large planar phantom is constructed of Plexiglas material with a 6.0 mm shell thickness for SAR validations at and below 450MHz. The large planar phantom is mounted in the DASY3 compact system in place of the SAM phantom.


Large Planar Phantom

15.0 DEVICE HOLDER

The DASY3 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.


Device Holder

16.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
EQUIPMENT	**SERIAL NO.**	**CALIBRATION DATE**
DASY3 System -Robot -ET3DV6 E-Field Probe -300MHz Validation Dipole -450MHz Validation Dipole -900MHz Validation Dipole -1800MHz Validation Dipole -2450MHz Validation Dipole -SAM Phantom V4.0C -Small Planar Phantom	 599396-01 1387 135 136 054 247 150 N/A N/A	 N/A Feb 2002 Oct 2001 Oct 2001 June 2001 June 2001 Oct 2001 N/A N/A
85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8652A Power Meter -Power Sensor 80701A -Power Sensor 80701A	1835272 1833535 1833542	Feb 2002 Feb 2002 Mar 2002
E4408B Spectrum Analyzer	US39240170	Nov 2001
8594E Spectrum Analyzer	3543A02721	Mar 2002
8753E Network Analyzer	US38433013	Nov 2001
8648D Signal Generator	3847A00611	Aug 2001
5S1G4 Amplifier Research Power Amplifier	26235	N/A

17.0 MEASUREMENT UNCERTAINTIES

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	√3	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(c_p)	± 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. constraints of robot	± 0.4	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 2.9	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 6.0	Normal	√3	1	± 6.7	12
Device holder uncertainty	± 5.0	Normal	√3	1	± 5.9	8
Power drift	± 5.0	Rectangular	√3		± 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 (measured)	± 10.0	Rectangular	√3	0.6	± 3.5	∞
Liquid permitivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permitivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					**± 13.7**	
Expanded Uncertainty (k=2)					**± 27.5**	

Measurement Uncertainty Table in accordance with IEEE Std 1528 (Draft - see reference [5])

18.0 REFERENCES

[1] ANSI, ANSI/IEEE C95.1: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 Ghz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY: 1992.

[2] Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE Transaction on Microwave Theory and Techniques, Vol. 44, pp. 105 -113: January 1996.

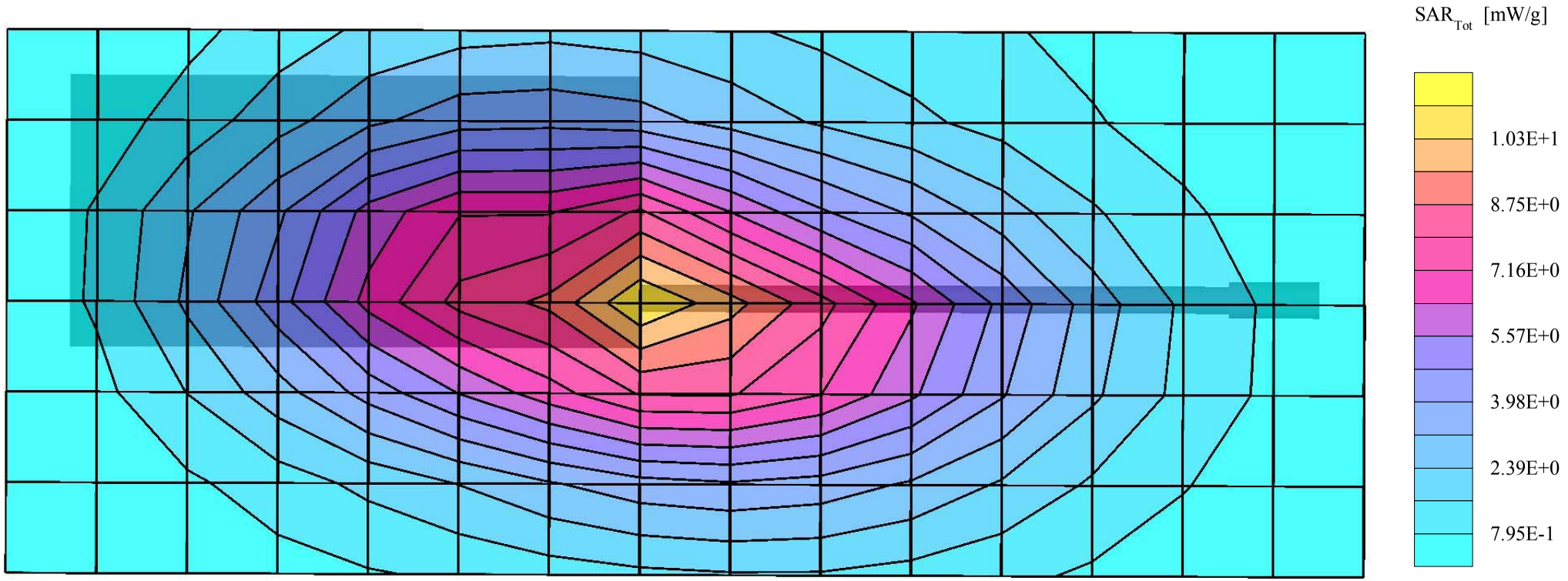
[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with know precision”, IEICE Transactions of Communications, vol. E80-B, no. 5, pp. 645-652: May 1997.

[5] IEEE Standards Coordinating Committee 34, Std. P1528, DRAFT Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques: Draft, December 2001.

APPENDIX A - SAR MEASUREMENT DATA

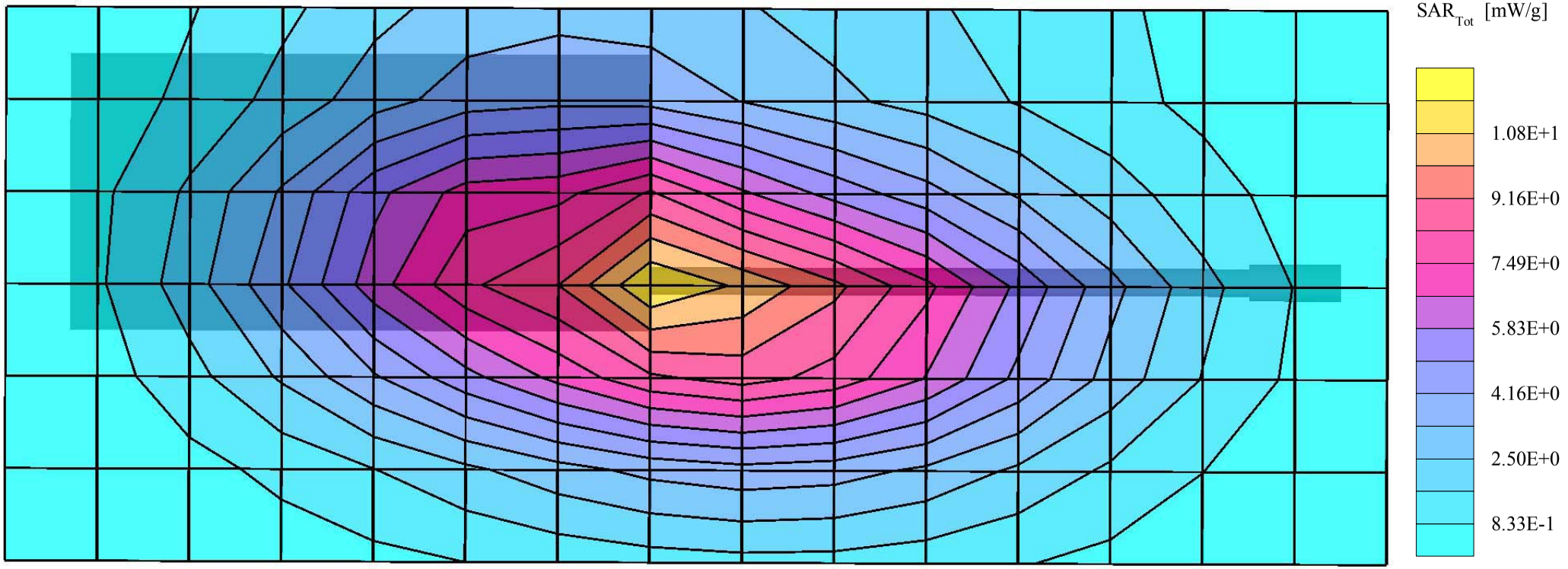
Topaz 3 L.L.C. FCC ID: O7KPL5164

Small Planar Phantom; Planar Section; Position: (270°,180°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.94$ mho/m $\varepsilon_r = 58.1$ $\rho = 1.00$ g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.14 dB
SAR (1g): 10.6 mW/g, SAR (10g): 7.28 mW/g
Ambient TEMP: 23.9°C; Liquid TEMP: 23.0°C
Body-Worn SAR with 1.0cm Plastic Belt-Clip
Portable UHF PTT Radio Transceiver
Antenna: ACC-145
Topaz3 Model: PL5164
Continuous Wave Mode
Low Channel [450.0125 MHz]
Conducted Power: 5.04 Watts
Date Tested: April 23, 2002



Topaz 3 L.L.C. FCC ID: O7KPL5164

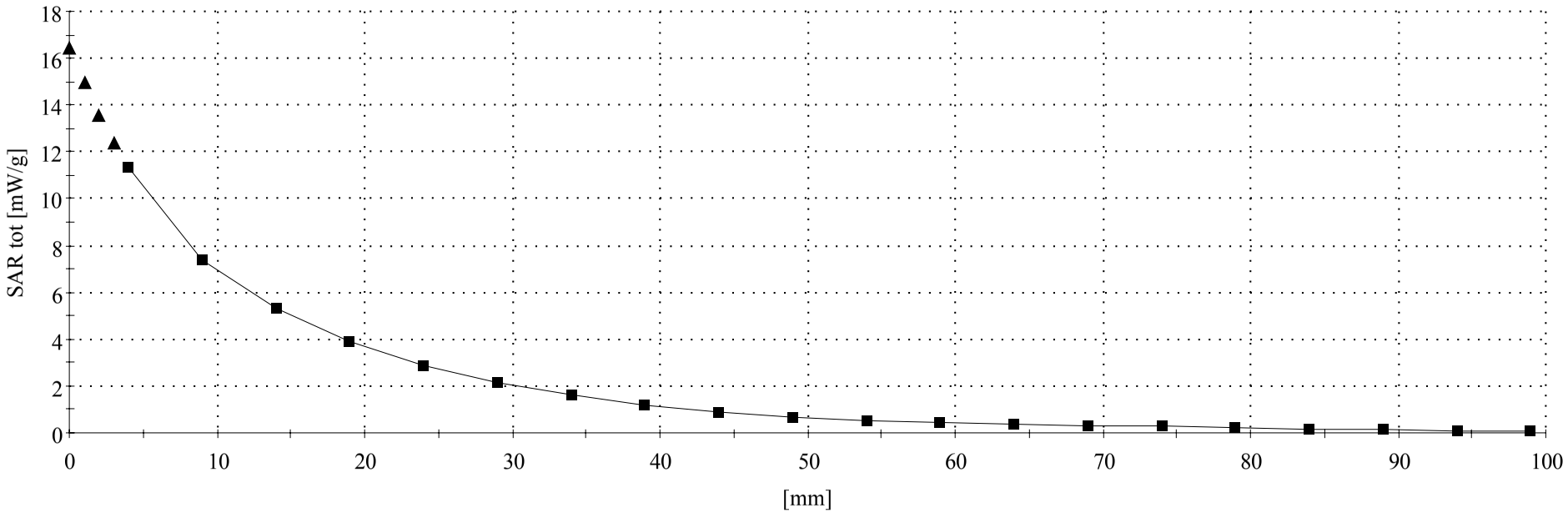
Small Planar Phantom; Planar Section; Position: (270°,180°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.94$ mho/m $\varepsilon_r = 58.1$ $\rho = 1.00$ g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.18 dB
SAR (1g): 10.8 mW/g, SAR (10g): 7.40 mW/g
Ambient TEMP: 23.9°C; Liquid TEMP: 23.0°C
Body-Worn SAR with 1.0cm Plastic Belt-Clip
Portable UHF PTT Radio Transceiver
Antenna: ACC-145
Topaz3 Model: PL5164
Continuous Wave Mode
Mid Channel [470.0125 MHz]
Conducted Power: 5.10 Watts
Date Tested: April 23, 2002



Topaz 3 L.L.C. FCC ID: O7KPL5164

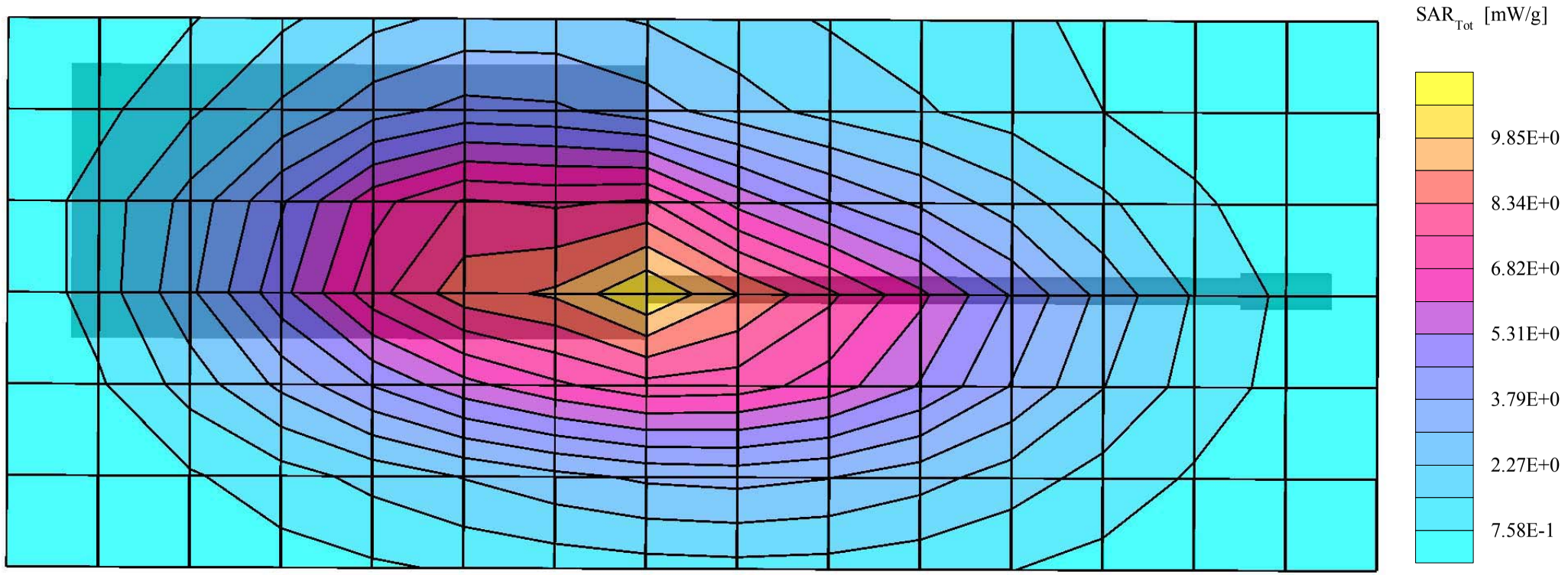
Small Planar Phantom
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0;
450 MHz Muscle: $\sigma = 0.94$ mho/m $\varepsilon_r = 58.1$ $\rho = 1.00$ g/cm^3

Z-Axis Extrapolation at Peak SAR Location
Ambient TEMP: 23.9°C; Liquid TEMP: 23.0°C
Body-Worn SAR with 1.0cm Plastic Belt-Clip
Portable UHF PTT Radio Transceiver
Antenna: ACC-145
Topaz3 Model: PL5164
Continuous Wave Mode
Mid Channel [470.0125 MHz]
Conducted Power: 5.10 Watts
Date Tested: April 23, 2002



Topaz 3 L.L.C. FCC ID: O7KPL5164

Small Planar Phantom; Planar Section; Position: (270°,180°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.94$ mho/m $\varepsilon_r = 58.1$ $\rho = 1.00$ g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.19 dB
SAR (1g): 9.89 mW/g, SAR (10g): 6.75 mW/g
Ambient TEMP: 23.9°C; Liquid TEMP: 23.0°C
Body-Worn SAR with 1.0cm Plastic Belt-Clip
Portable UHF PTT Radio Transceiver
Antenna: ACC-145
Topaz3 Model: PL5164
Continuous Wave Mode
High Channel [489.9875 MHz]
Conducted Power: 5.05 Watts
Date Tested: April 23, 2002



APPENDIX B - SYSTEM VALIDATION

450MHz Validation Dipole

Large Planar Phantom; Planar Section

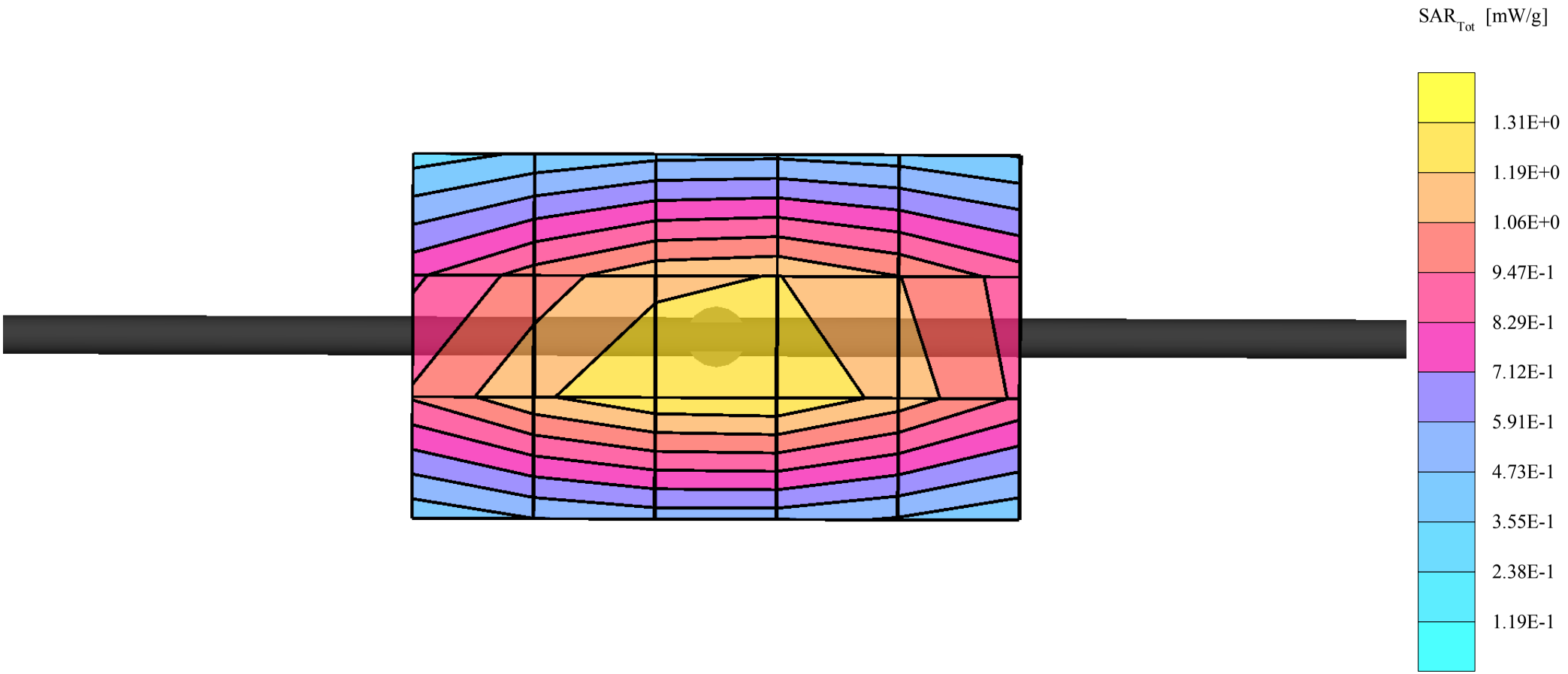
Probe: ET3DV6 - SN1387; ConvF(7.3,7.3,7.3); Crest factor: 1.0; 450 MHz Brain: $\sigma = 0.86$ mho/m $\varepsilon_r = 44.8$ $\rho = 1.00$ g/cm^3

Cube 5x5x7: Peak: 2.32 mW/g, SAR (1g): 1.45 mW/g, SAR (10g): 0.946 mW/g, (Worst-case extrapolation)

Penetration depth: 12.9 (11.2, 15.3) [mm]

Powerdrift: -0.01 dB; Conducted Input Power: 250 [mW]

Validation Date: April 23, 2002



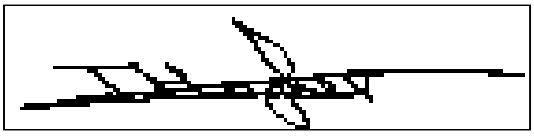
APPENDIX C - DIPOLE CALIBRATION

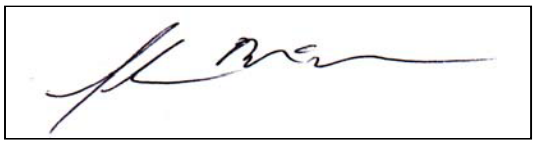
Celltech
Testing and Engineering Services Lab

450MHz SYSTEM VALIDATION DIPOLE

Type:	**450MHz Validation Dipole**
Serial Number:	**136**
Place of Calibration:	**Celltech Research Inc.**
Date of Calibration:	**October 17, 2001**

Celltech Research Inc. hereby certifies that this device has been calibrated on the date indicated above.

Calibrated by: 

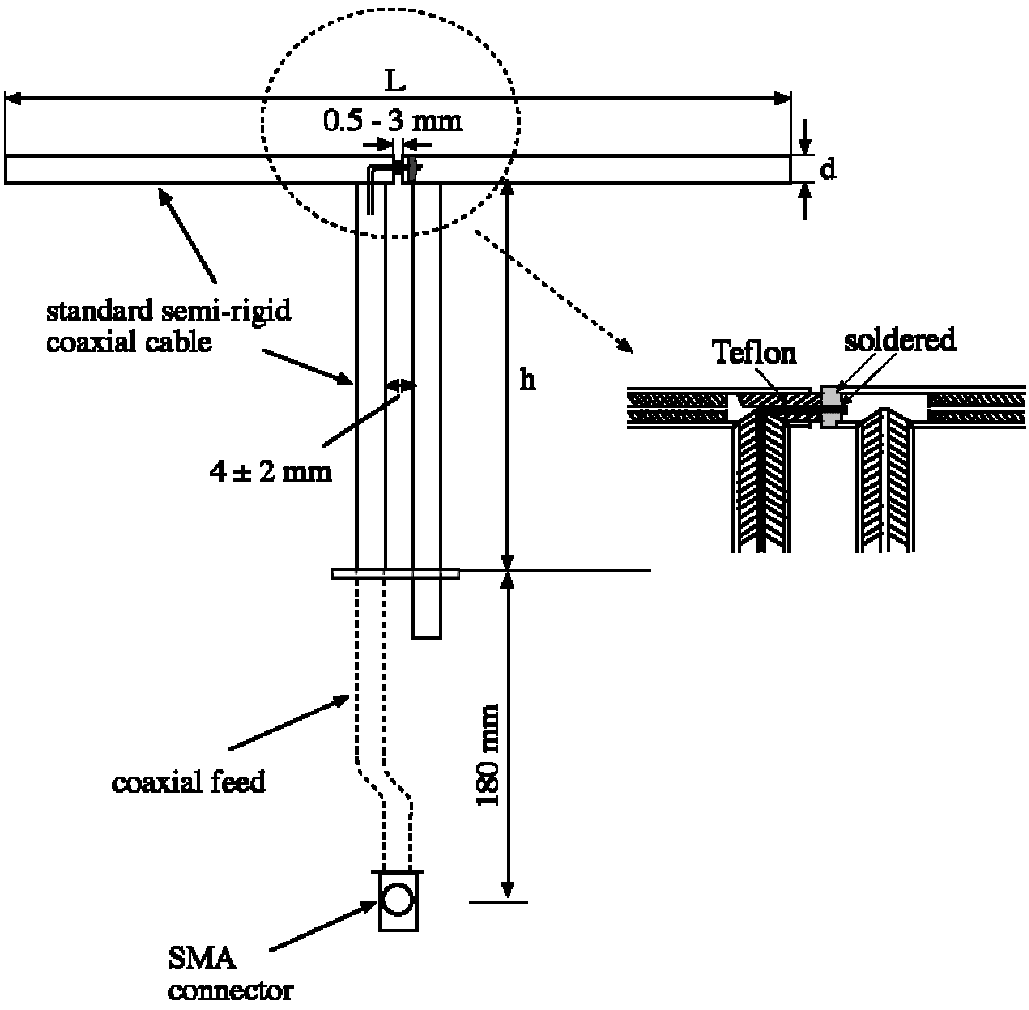
Approved by: 

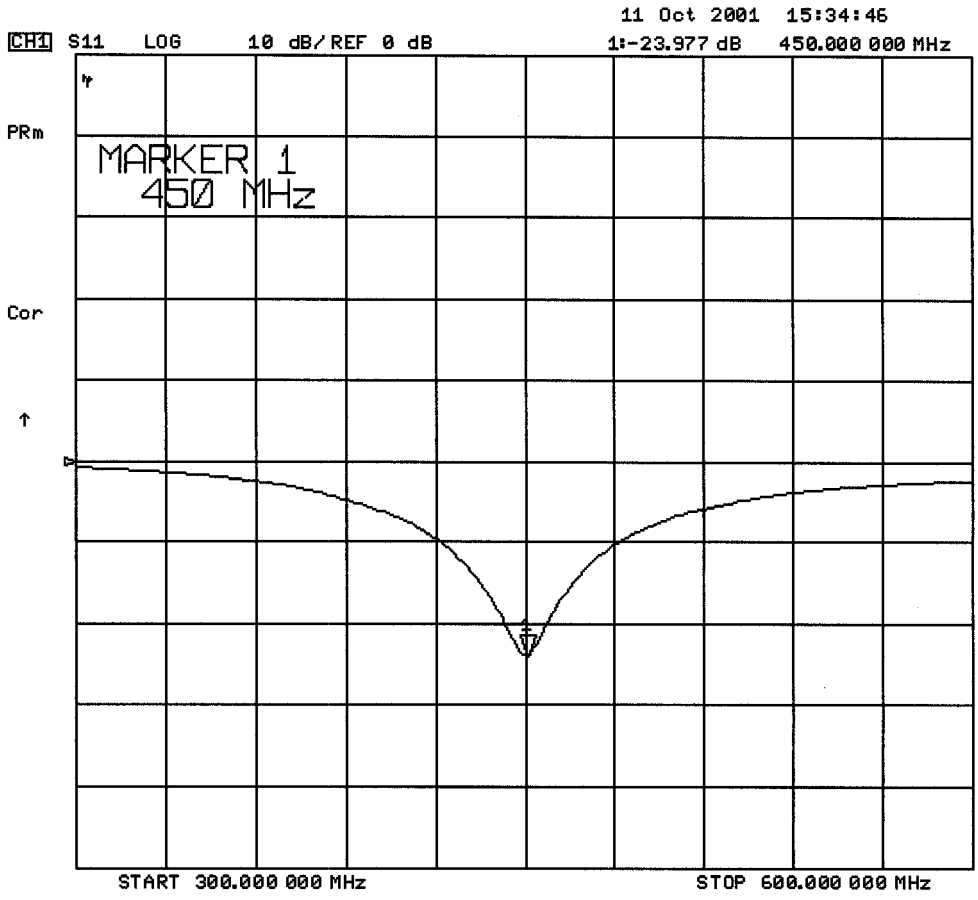
Celltech Research Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-860-3130 • Fax. 250-860-3110 • e-mail: info@celltechlabs.com
www.celltechlabs.com

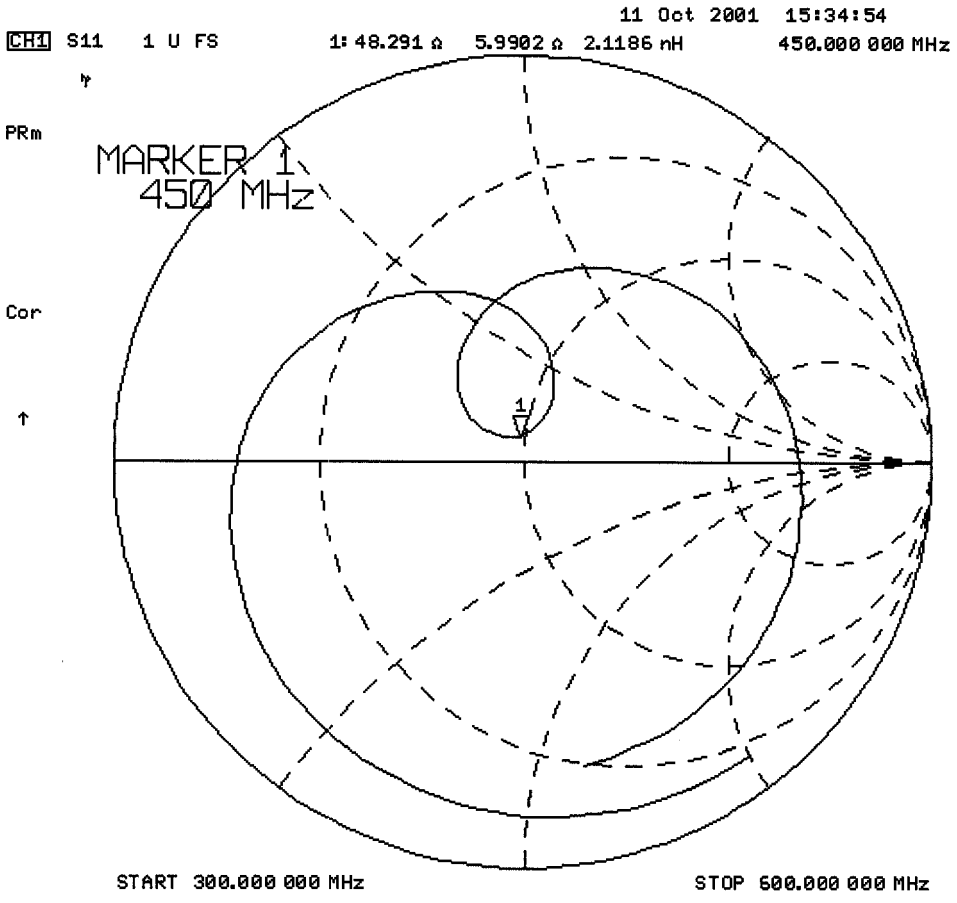
1. Dipole Construction & Electrical Characteristics

The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 15.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 450MHz	$\mathrm{Re}\{Z\} = 49.982\Omega$
	$\mathrm{Im}\{Z\} = 5.8594\Omega$
Return Loss at 450MHz	-24.714dB




11 Oct 2001 15:34:46
CH1 S11 LOG 10 dB/ REF 0 dB
1:-23.977 dB 450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
START 300.000 000 MHz
STOP 600.000 000 MHz


11 Oct 2001 15:34:54
CH1 S11 1 U FS
1: 48.291 Ω 5.9902 Ω 2.1186 nH
450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
START 300.000 000 MHz
STOP 600.000 000 MHz

Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

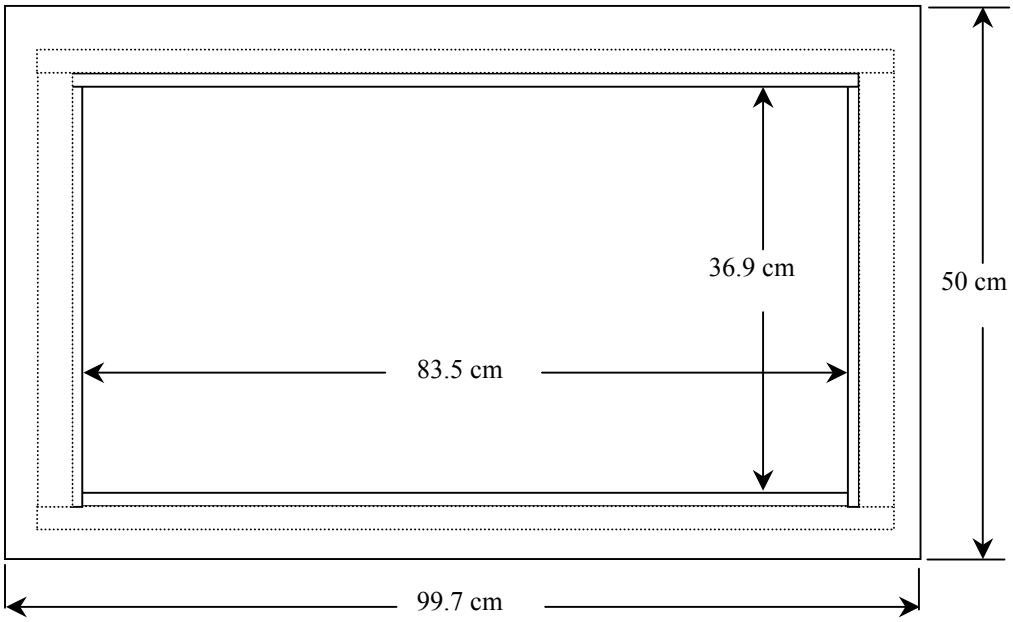
2. Validation Phantom

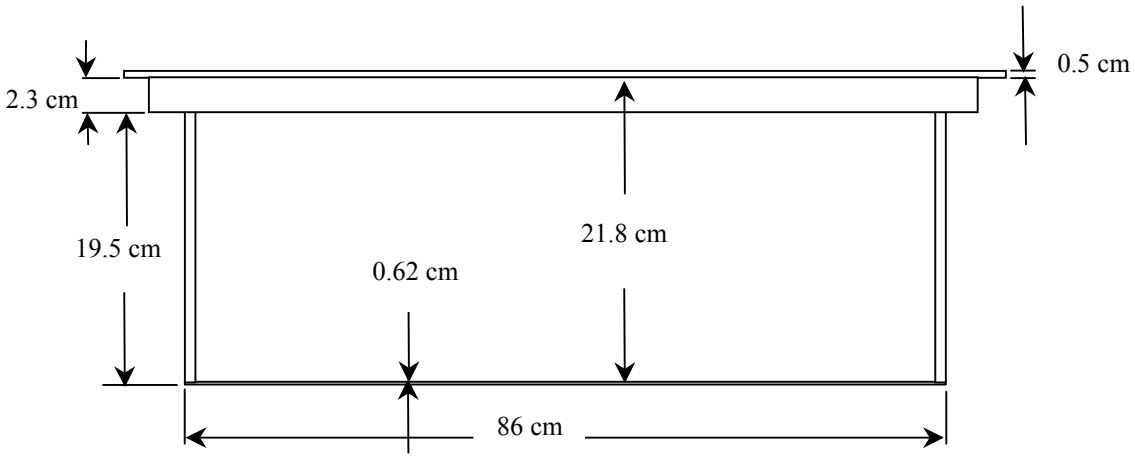
The validation phantom was constructed using relatively low-loss tangent Plexiglas material. The dimensions of the phantom are as follows:

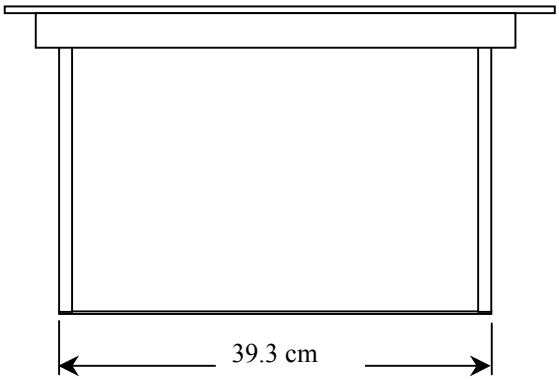
Length: 83.5 cm
Width: 36.9 cm
Height: 21.8 cm

The bottom of the phantom is constructed of 6.2 ± 0.1mm Plexiglas.

Dimensions of Plexiglas Planar Phantom







450MHz Dipole Calibration Photo

450MHz Dipole Calibration Photo

3. Measurement Conditions

The planar phantom was filled with brain simulating tissue having the following electrical parameters at 450MHz:

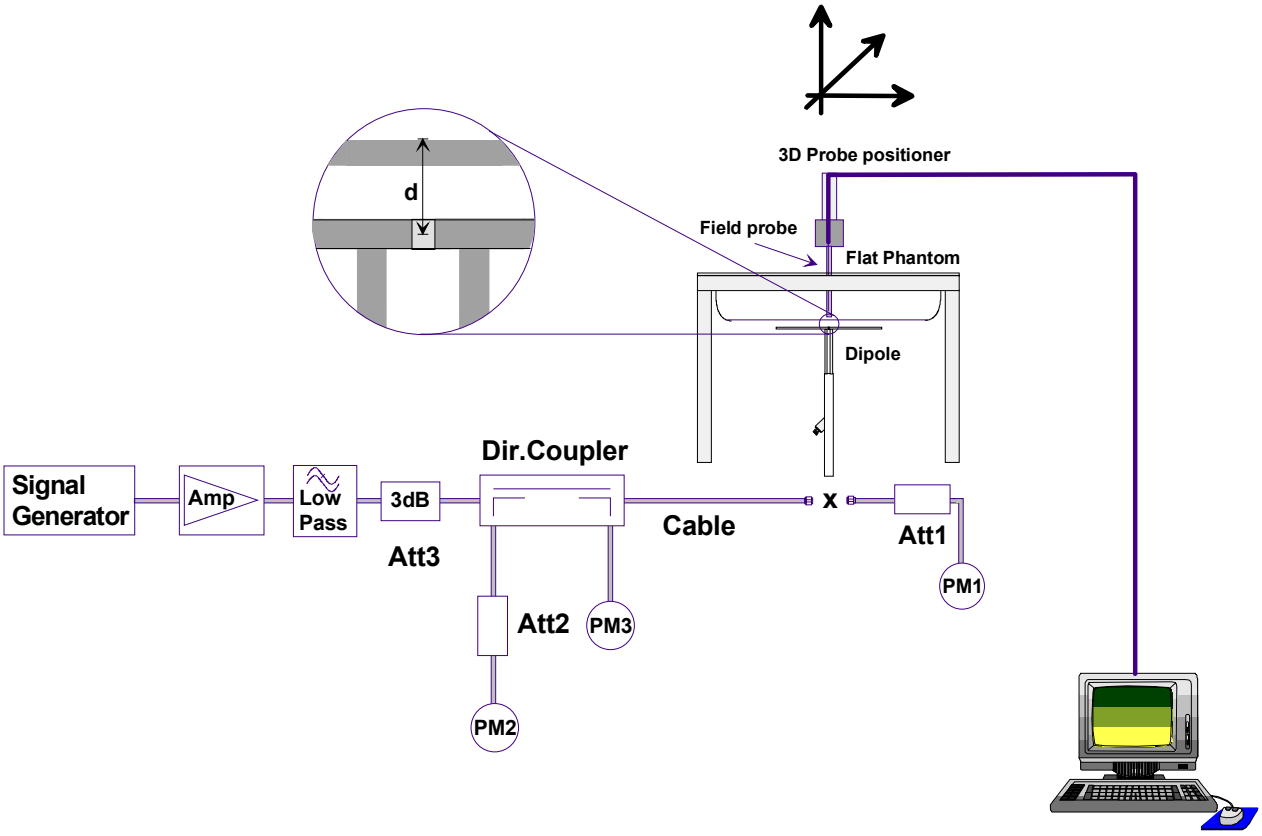
Relative Permitivity:	43.8	± 5%
Conductivity:	0.86 mho/m	± 5%
Temperature:	23.1°C	

The 450MHz simulating tissue consists of the following ingredients:

Ingredient	Percentage by weight
Water	38.56%
Sugar	56.32%
Salt	3.95%
HEC	0.98%
Dowicil 75	0.19%
Target Dielectric Parameters at 22°C	$\varepsilon_r = 43.5$ $\sigma = 0.87$ S/m

4. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 20dB below the forward power.

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Dipole SAR Test Results

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	1.47	5.88	0.971	3.88	2.31
Test 2	1.43	5.72	0.949	3.80	2.25
Test 3	1.45	5.80	0.961	3.84	2.27
Test 4	1.44	5.76	0.954	3.82	2.26
Test 5	1.46	5.84	0.969	3.88	2.29
Test 6	1.42	5.68	0.939	3.76	2.23
Test 7	1.45	5.80	0.960	3.84	2.27
Test 8	1.41	5.64	0.928	3.71	2.22
Test 9	1.43	5.72	0.950	3.80	2.25
Test10	1.46	5.84	0.971	3.88	2.29
Average Value	1.44	5.77	0.946	3.82	2.26

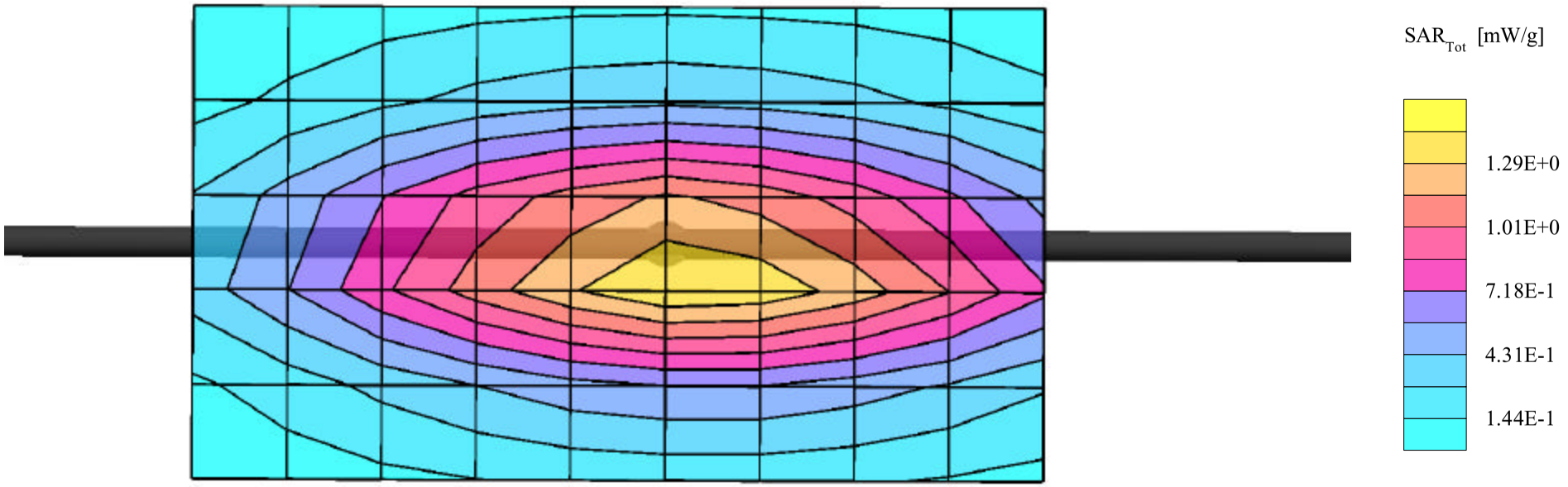
The results have been normalized to 1W (forward power) into the dipole.

Averaged over 1cm (1g) of tissue: 5.77 mW/g

Averaged over 10cm (10g) of tissue: 3.82 mW/g

Validation Dipole 450MHz, d = 15 mm

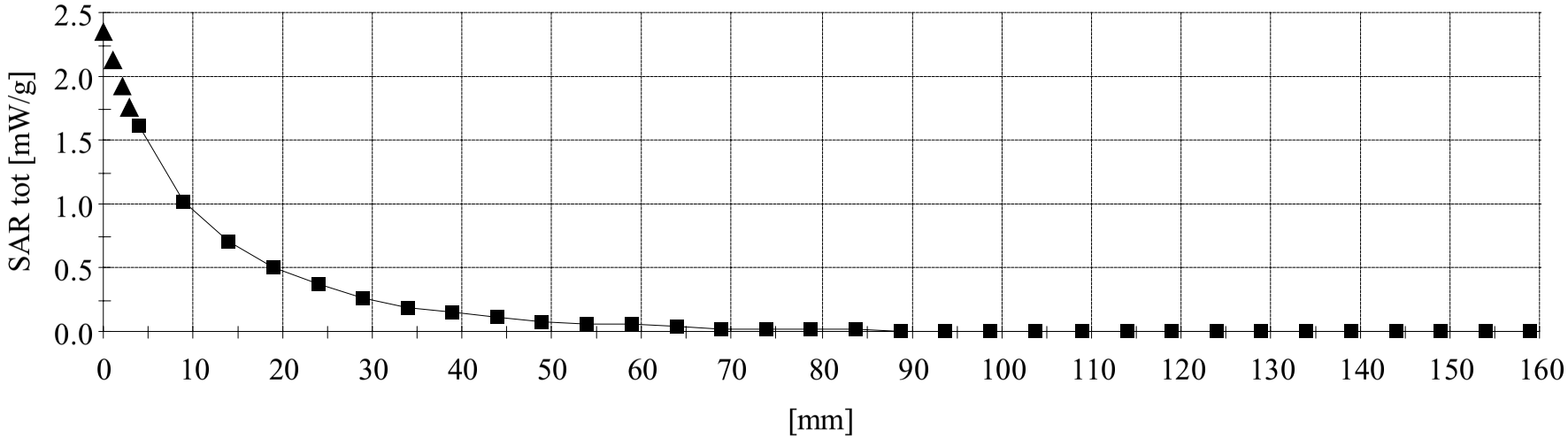
Frequency: 450 MHz; Antenna Input Power: 250 [mW]
Flat Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.87$ mho/m $\varepsilon_r = 43.5$ $\rho = 1.00$ g/cm^3
Cube 5x5x7: Peak: 2.34 mW/g, SAR (1g): 1.47 mW/g, SAR (10g): 0.963 mW/g, (Worst-case extrapolation)
Penetration depth: 12.3 (10.7, 14.4) [mm]
Powerdrift: 0.02 dB
Calibration Date: Oct. 17, 2001



Validation Dipole 450MHz, d = 15 mm

Flat Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: σ = 0.87 mho/m ε_r = 43.5 ρ = 1.00 g/cm^3
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Test Date: October 17, 2001
conducted power: 250 mW



APPENDIX D - PROBE CALIBRATION

Schmid & Partner
Engineering AG

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

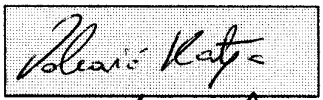
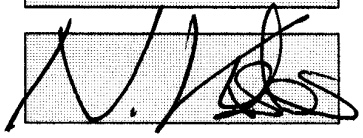
Calibration Certificate

Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Calibration:	**Zurich**
Date of Calibration:	**February 22, 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:	
Approved by:	

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibration:	September 22, 1999
Recalibrated:	February 22, 2002

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

Diode Compression

NormX	**1.58**	$\mu V/(V/m)^2$	DCP X	**97**	mV
NormY	**1.67**	$\mu V/(V/m)^2$	DCP Y	**97**	mV
NormZ	**1.67**	$\mu V/(V/m)^2$	DCP Z	**97**	mV

Sensitivity in Tissue Simulating Liquid

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

ConvF X	**6.6**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.6**	± 9.5% (k=2)	Alpha	**0.40**
ConvF Z	**6.6**	± 9.5% (k=2)	Depth	**2.38**

Head **1800 MHz** **ε_r = 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**
Head **1900 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	**0.57**
ConvF Z	**5.4**	± 9.5% (k=2)	Depth	**2.18**

Boundary Effect

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

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	9.7	5.4
SAR_{be} [%]	With Correction Algorithm	0.3	0.6

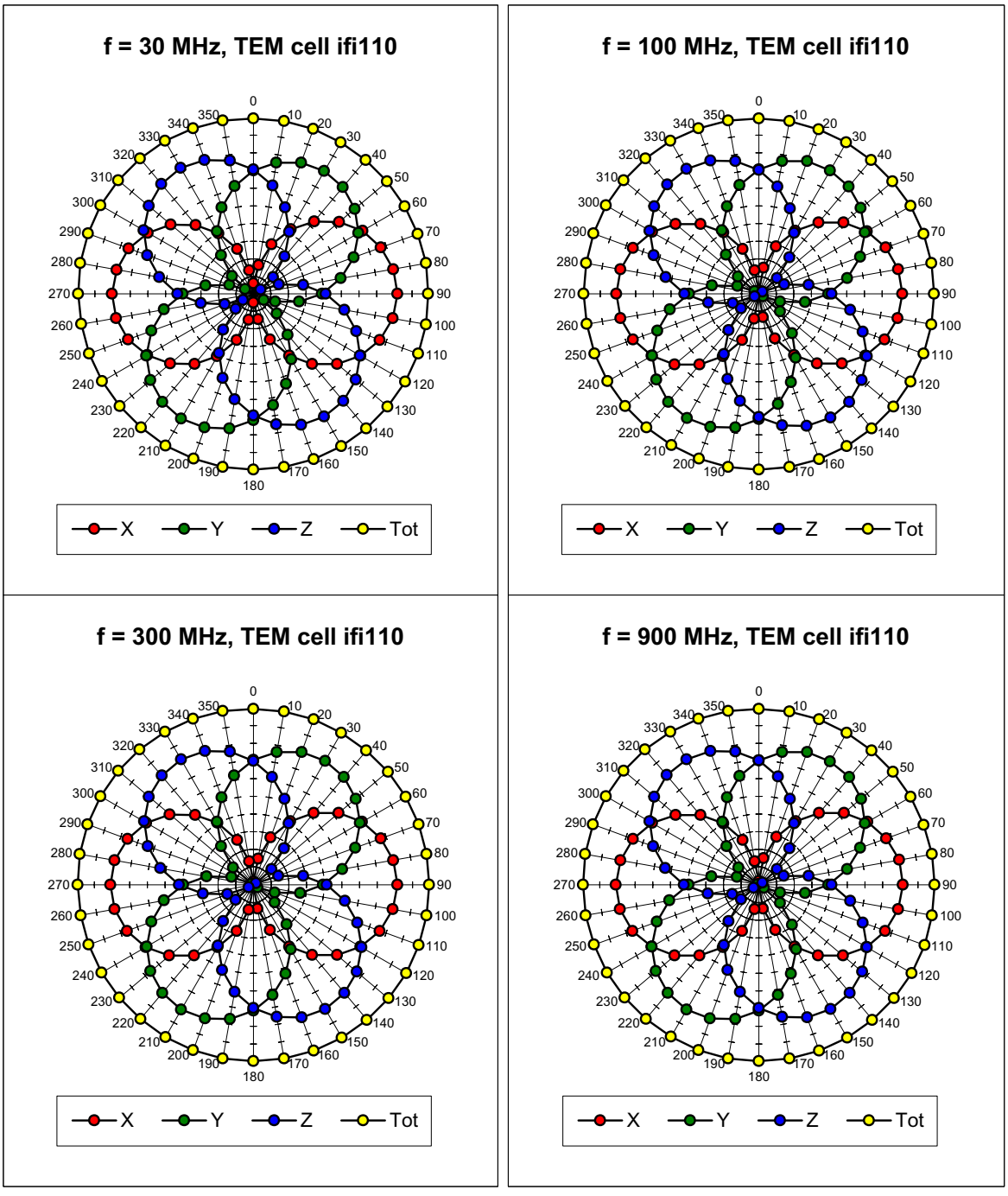
Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

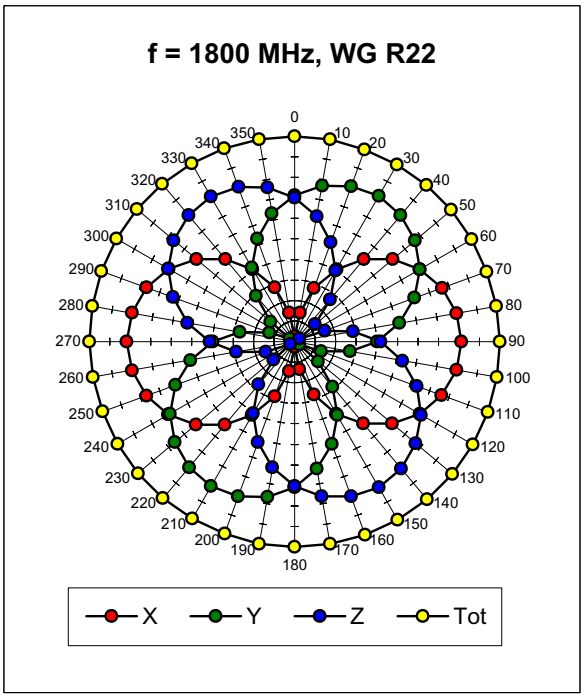
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	11.5	7.3
SAR_{be} [%]	With Correction Algorithm	0.1	0.3

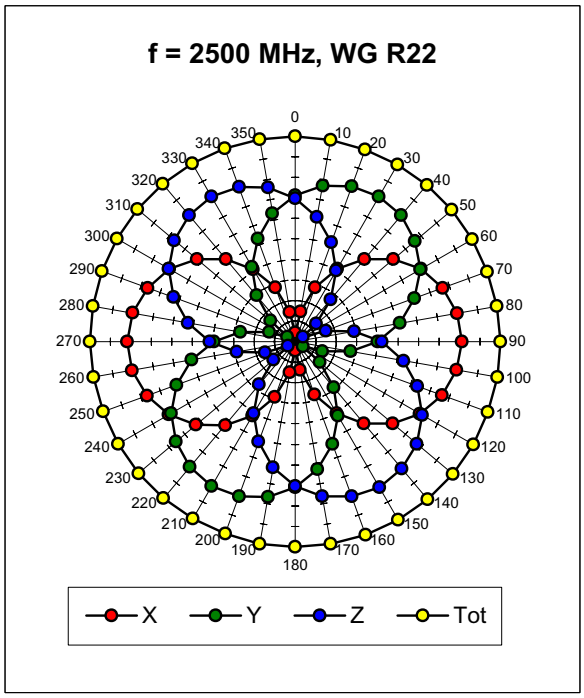
Sensor Offset

Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.3 ± 0.2**	mm

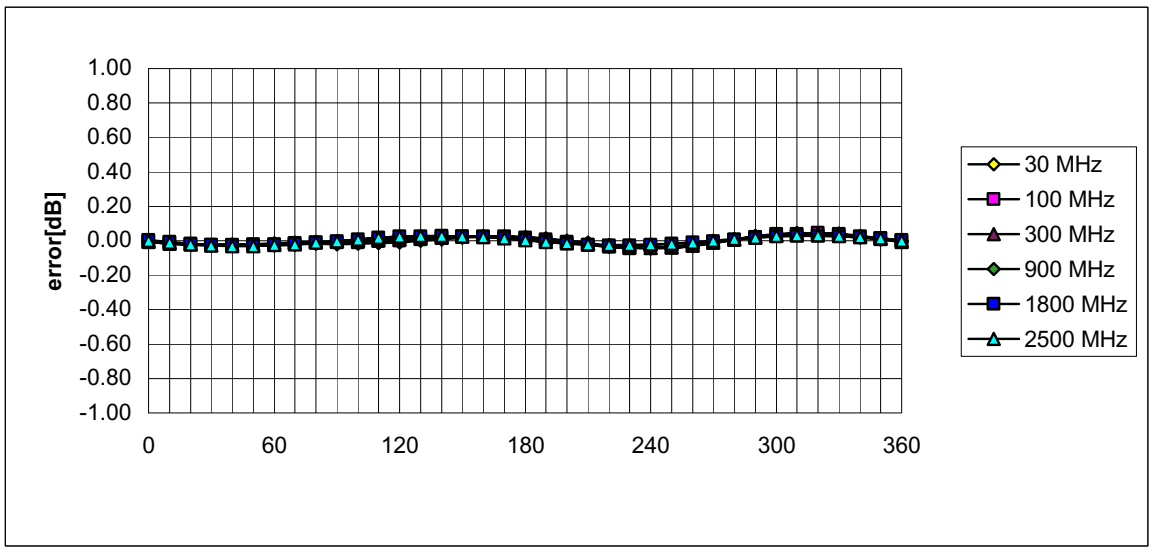
Receiving Pattern (ϕ , θ = 0°





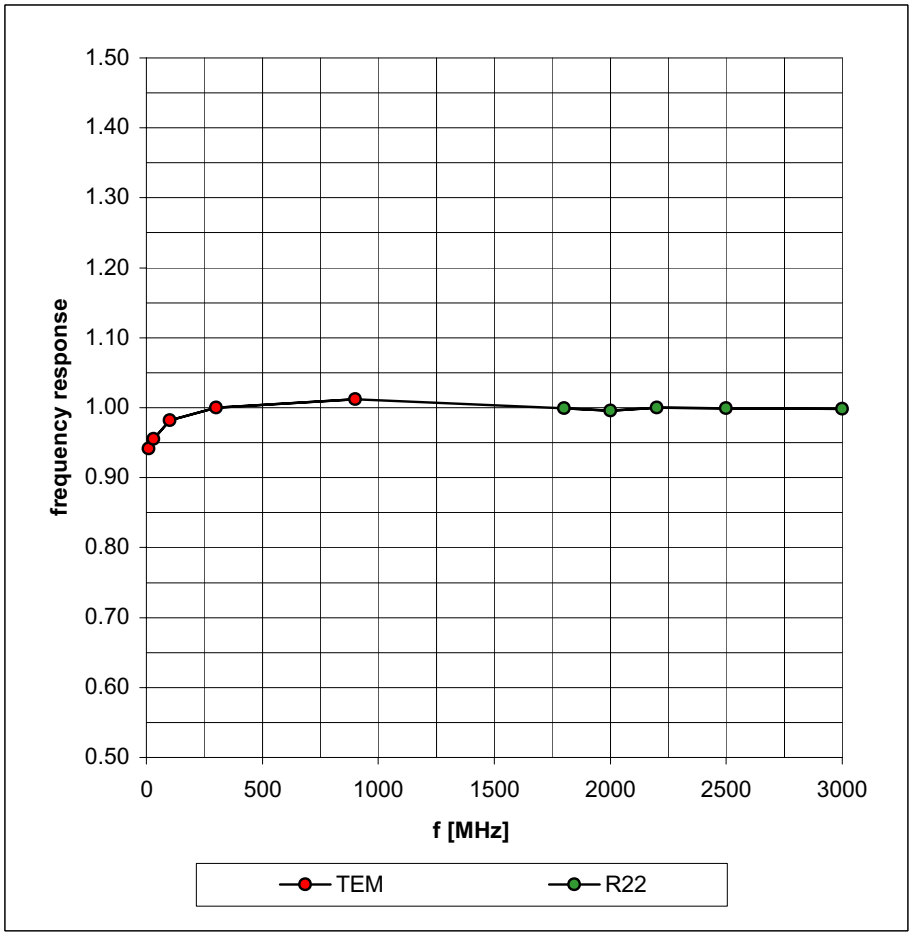


Isotropy Error (ϕ), θ = 0°



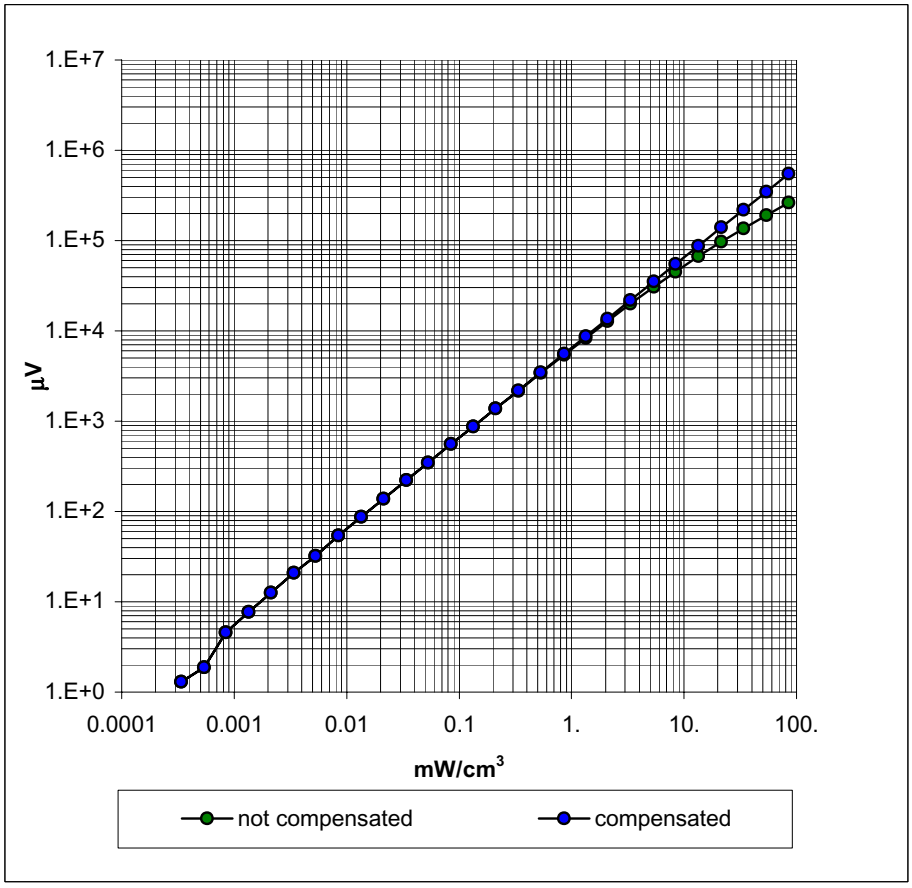
Frequency Response of E-Field

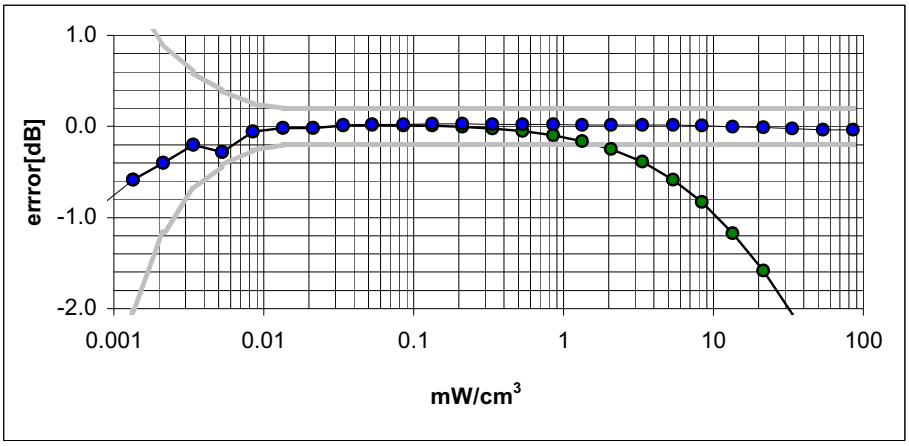
(TEM-Cell:ifi110, Waveguide R22)



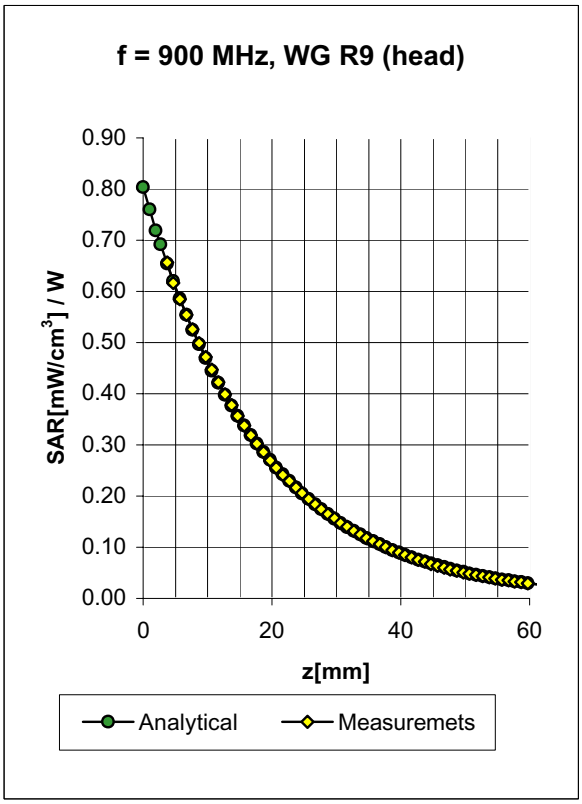
Dynamic Range f(SAR_{brain})

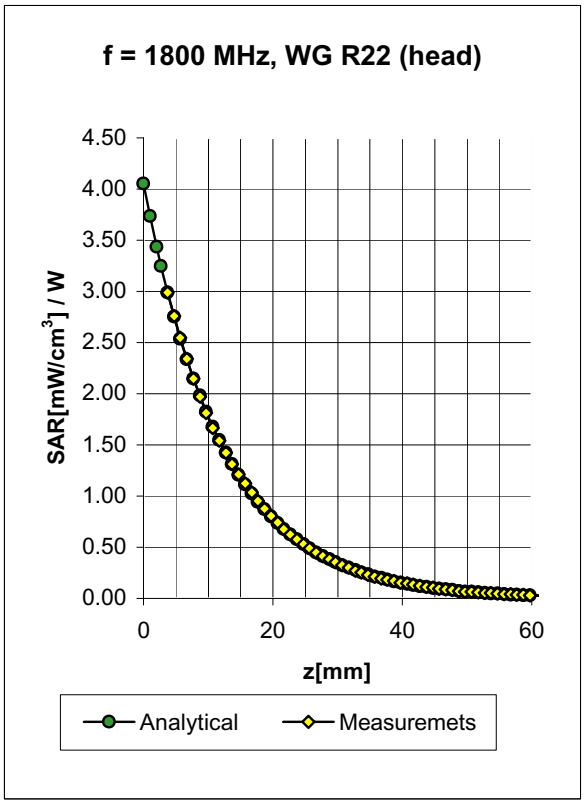
(Waveguide R22)





Conversion Factor Assessment



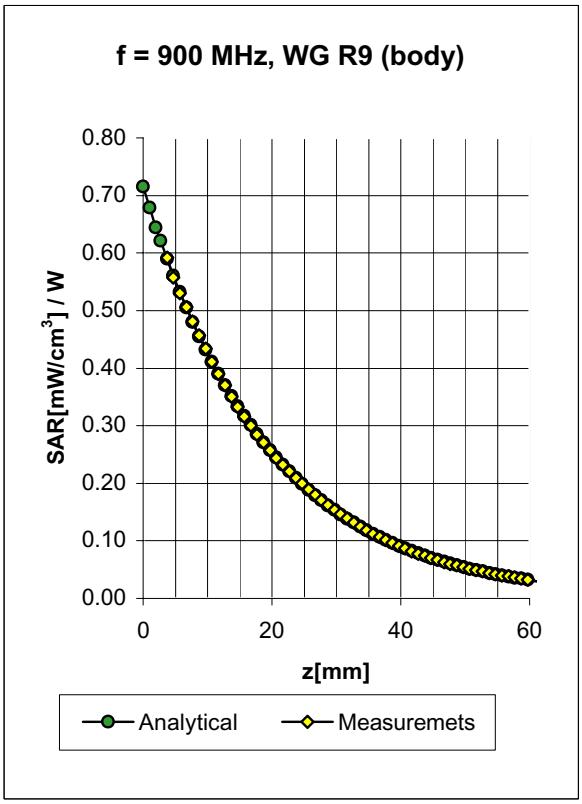


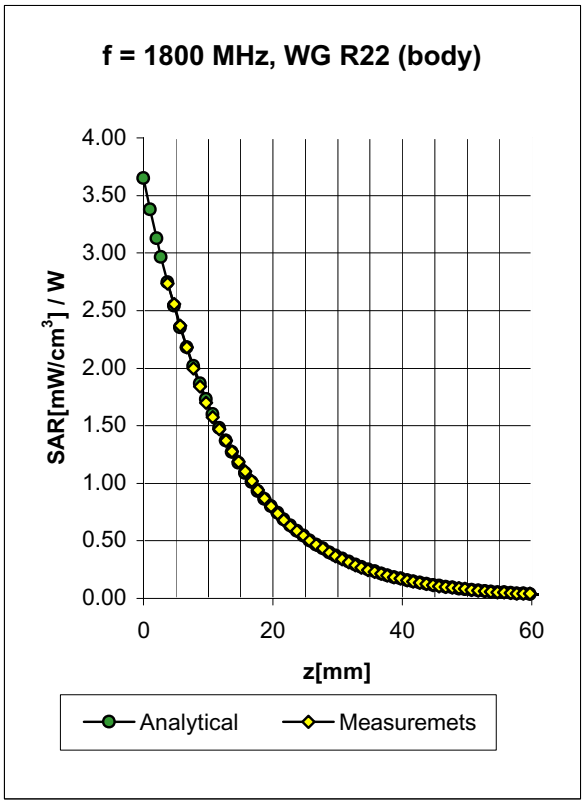
Head	**900 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.97 ± 5% mho/m**
Head	**835 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.90 ± 5% mho/m**
	ConvF X	**6.6** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**6.6** ± 9.5% (k=2)		Alpha **0.40**
	ConvF Z	**6.6** ± 9.5% (k=2)		Depth **2.38**

Head	**1800 MHz**		**ε_r = 40.0 ± 5%**	**σ = 1.40 ± 5% mho/m**
Head	**1900 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 **0.57**
	ConvF Z	**5.4** ± 9.5% (k=2)		Depth **2.18**

ET3DV6 SN:1387 **February 22, 2002**

Conversion Factor Assessment





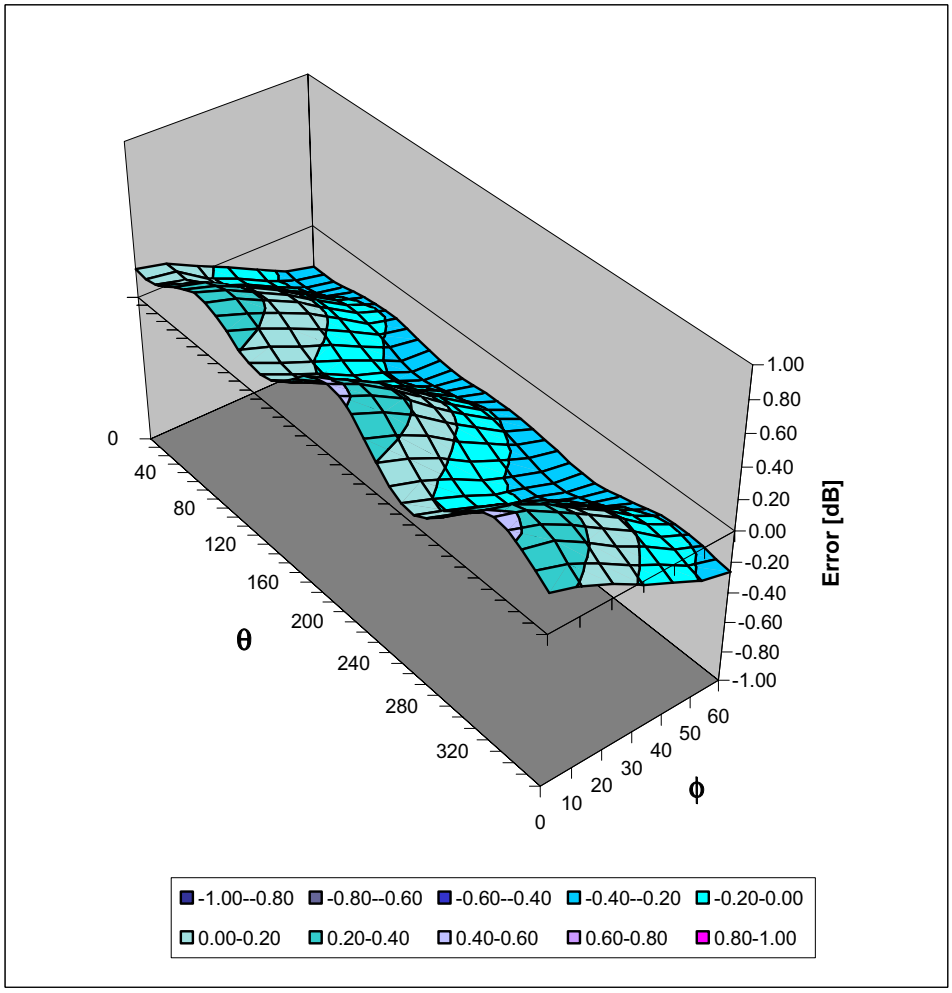
Body	**900 MHz**	ε_r **= 55.0 ± 5%**	**σ = 1.05 ± 5% mho/m**	
Body	**835 MHz**	ε_r **= 55.2 ± 5%**	**σ = 0.97 ± 5% mho/m**	
	ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.42**
	ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.44**

Body	**1800 MHz**	ε_r **= 53.3 ± 5%**	**σ = 1.52 ± 5% mho/m**	
Body	**1900 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	**0.76**
	ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.01**

ET3DV6 SN:1387 **February 22, 2002**

Deviation from Isotropy in HSL

Error ($\theta\phi$), f = 900 MHz



Schmid & Partner
Engineering AG

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Assessment:	**Zurich**
Date of Assessment:	**February 25, 2002**
Probe Calibration Date:	**February 22, 2002**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

Dosimetric E-Field Probe ET3DV6 SN:1387

Conversion Factor (± standard deviation)

150 MHz	ConvF	**9.2 ± 8%**	**ε_r = 52.3** **σ = 0.76 mho/m** (head tissue)
300 MHz	ConvF	**8.0 ± 8%**	**ε_r = 45.3** **σ = 0.87 mho/m** (head tissue)
450 MHz	ConvF	**7.3 ± 8%**	**ε_r = 43.5** **σ = 0.87 mho/m** (head tissue)
2450 MHz	ConvF	**4.7 ± 8%**	**ε_r = 39.2** **σ = 1.80 mho/m** (head tissue)
150 MHz	ConvF	**8.8 ± 8%**	**ε_r = 61.9** **σ = 0.80 mho/m** (body tissue)
450 MHz	ConvF	**7.7 ± 8%**	**ε_r = 56.7** **σ = 0.94 mho/m** (body tissue)
2450 MHz	ConvF	**4.3 ± 8%**	**ε_r = 52.7** **σ = 1.95 mho/m** (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

450MHz System Validation

Measured Liquid Dielectric Parameters (Brain)

April 23, 2002

Frequency	e'	e''
350.000000 MHz	47.4537	39.9195
355.000000 MHz	47.2648	39.6204
360.000000 MHz	47.2088	39.2427
365.000000 MHz	47.0634	38.9554
370.000000 MHz	46.9859	38.6441
375.000000 MHz	46.8722	38.3791
380.000000 MHz	46.7593	38.0222
385.000000 MHz	46.6224	37.7862
390.000000 MHz	46.5197	37.4657
395.000000 MHz	46.3730	37.2656
400.000000 MHz	46.2362	36.9646
405.000000 MHz	46.0800	36.6532
410.000000 MHz	45.9769	36.4030
415.000000 MHz	45.7661	36.0942
420.000000 MHz	45.7154	35.8888
425.000000 MHz	45.5625	35.5256
430.000000 MHz	45.3444	35.3572
435.000000 MHz	45.2465	35.0584
440.000000 MHz	45.1300	34.8746
445.000000 MHz	44.9782	34.6912
450.000000 MHz	44.8460	34.4340
455.000000 MHz	44.7678	34.3225
460.000000 MHz	44.6041	34.1263
465.000000 MHz	44.5701	33.9224
470.000000 MHz	44.3793	33.8027
475.000000 MHz	44.3639	33.5853
480.000000 MHz	44.1630	33.4210
485.000000 MHz	44.1910	33.2394
490.000000 MHz	43.9293	33.0931
495.000000 MHz	43.9544	32.8840
500.000000 MHz	43.7507	32.7354
505.000000 MHz	43.7231	32.5088
510.000000 MHz	43.5999	32.4036
515.000000 MHz	43.5694	32.1515
520.000000 MHz	43.4743	31.9976

450MHz EUT Evaluation

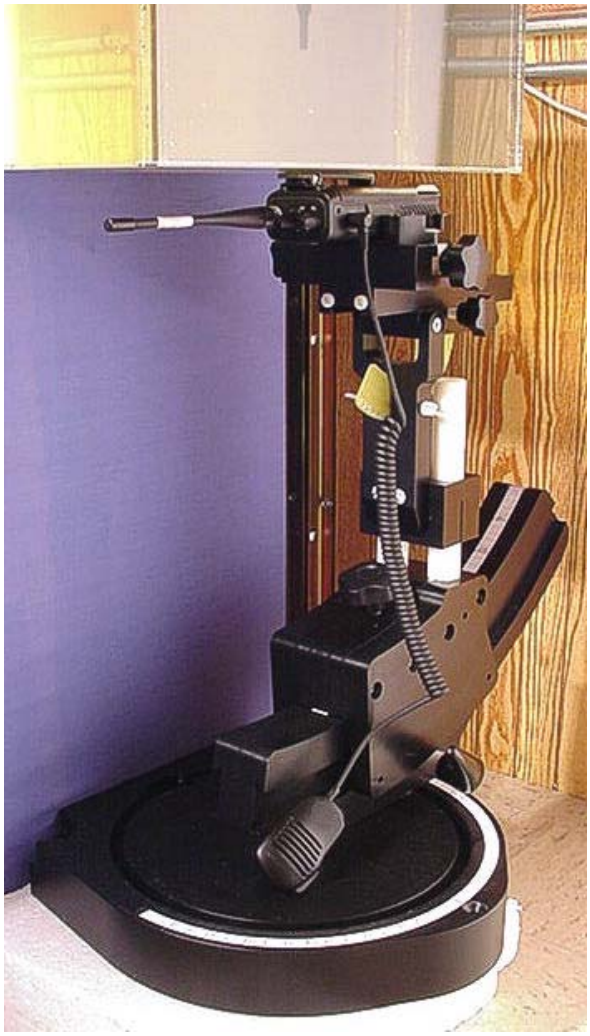
Measured Liquid Dielectric Parameters (Body)

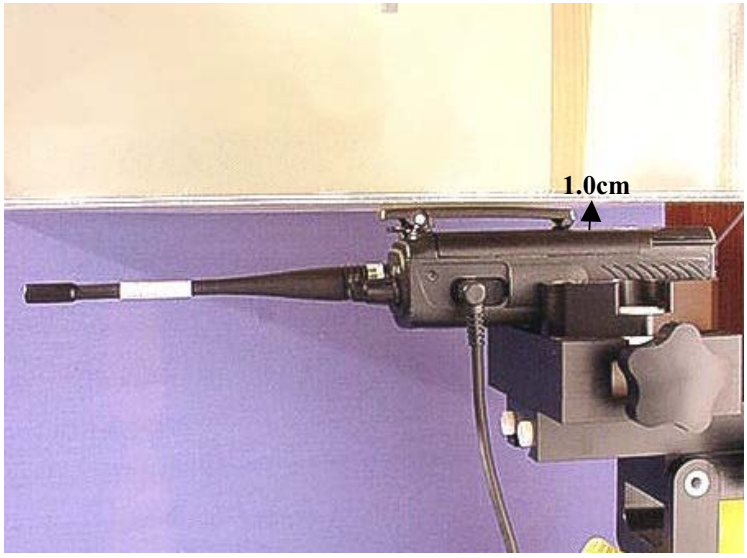
April 23, 2002

Frequency	e'	e''
400.000000 MHz	58.8829	40.6085
402.500000 MHz	58.8365	40.3597
405.000000 MHz	58.8586	40.2488
407.500000 MHz	58.8083	40.0896
410.000000 MHz	58.6627	39.8668
412.500000 MHz	58.7070	39.6520
415.000000 MHz	58.6981	39.5942
417.500000 MHz	58.6111	39.4494
420.000000 MHz	58.6002	39.2709
422.500000 MHz	58.5385	39.1449
425.000000 MHz	58.4896	38.9775
427.500000 MHz	58.4607	38.8078
430.000000 MHz	58.4342	38.6995
432.500000 MHz	58.3757	38.5290
435.000000 MHz	58.3542	38.3430
437.500000 MHz	58.3239	38.3085
440.000000 MHz	58.2976	38.1460
442.500000 MHz	58.2439	38.0396
445.000000 MHz	58.1741	37.8988
447.500000 MHz	58.1202	37.7852
450.000000 MHz	58.1151	37.6724
452.500000 MHz	58.0625	37.5608
455.000000 MHz	58.0179	37.4393
457.500000 MHz	58.0284	37.3074
460.000000 MHz	58.0228	37.1895
462.500000 MHz	57.9444	37.1256
465.000000 MHz	57.8997	36.9526
467.500000 MHz	57.8676	36.8808
470.000000 MHz	57.8512	36.7508
472.500000 MHz	57.8137	36.6082
475.000000 MHz	57.7532	36.5268
477.500000 MHz	57.7691	36.3750
480.000000 MHz	57.7023	36.2607
482.500000 MHz	57.6325	36.1302
485.000000 MHz	57.5882	36.0313

APPENDIX F - SAR TEST SETUP & EUT PHOTOGRAPHS

BODY-WORN SAR TEST PHOTOGRAPHS
with 1.0cm Belt-Clip & Speaker-Microphone





EUT PHOTOGRAPHS
With Belt-Clip