

DECLARATION OF COMPLIANCE SAR EVALUATION

Test Lab

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Applicant Information

MIDLAND RADIO CORPORATION

1120 Clay Street
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Rule Part(s):	FCC 47 CFR §2.1093
Test Procedure(s):	FCC OET Bulletin 65, Supplement C (01-01)
Device Type:	Portable UHF GMRS/FRS PTT Radio Transceiver
FCC ID:	MMAG225
Model(s):	G225
Modulation:	FM (UHF)
Tx Frequency Range:	462.5500 - 462.7250 MHz (GMRS Channels 15-22)
	462.5625 - 462.7125 MHz (FRS Channels 1-7)
	467.5625 - 467.7125 MHz (FRS Channels 8-14)
RF Conducted Power Tested:	1.8 Watts (GMRS)
Antenna Type(s):	Fixed
Battery Type(s):	1.5V AAA Alkaline (x4)
Body-Worn Accessories:	Belt-Clip (supplied with radio)
	Headset/Boom-Microphone (Model: 22540)
	Earpiece/Lapel-Microphone (Model: 22405)
Max. SAR Measured:	0.892 W/kg Face-held / 1.12 W/kg Body-worn

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 FCC 47 CFR §2.1093. The device was tested in accordance with the measurement standards and procedures specified in FCC OET Bulletin 65, Supplement C, Edition 01-01 (General Population / Uncontrolled Exposure).

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.

This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Research Inc. The results and statements contained in this report pertain only to the device(s) evaluated.



Russell W. Pipe
Senior Compliance Technologist
Celltech Research Inc.



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1.0 INTRODUCTION

This measurement report demonstrates compliance of the Midland Radio Corporation Model: G225 Portable UHF GMRS/FRS PTT Radio Transceiver FCC ID: MMAG225 with the RF exposure safety requirements set forth in FCC 47 CFR §2.1093 (see reference [1]) (General Population/Uncontrolled Exposure environment). The test procedures described in 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 Device Under Test (DUT)

FCC Rule Part(s)	47 CFR §2.1093
Test Procedure	FCC OET Bulletin 65, Supplement C (01-01)
Device Type	Portable UHF GMRS/FRS PTT Radio Transceiver
FCC ID	MMAG225
Model(s)	G225
Serial No.	Pre-production
Modulation	FM (UHF)
Tx Frequency Range	462.5500 - 462.7250 MHz (GMRS Channels 15-22) 462.5625 - 462.7125 MHz (FRS Channels 1-7) 467.5625 - 467.7125 MHz (FRS Channels 8-14)
RF Conducted Power Tested	1.8 Watts (GMRS)
Battery Type(s)	1.5V AAA Alkaline (x4)
Antenna Type(s)	Fixed
Body-Worn Accessories Tested	Belt-Clip (supplied with radio) Headset/Boom-Microphone (Model: 22540) Earpiece/Lapel-Microphone (Model: 22405)

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, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms for brain and/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 SAM Phantom



DASY3 SAR Measurement System with validation phantom

4.0 MEASUREMENT SUMMARY

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

SAR EVALUATION RESULTS											
Test Type	Freq. (MHz)	Chan.	Mode	Conducted RF Output Power	Power Drift (dB)	Battery Type	Accessory Type(s)	Separation Distance (cm)	Fluid Type	SAR (W/kg)	
										100% Duty Cycle	50% Duty Cycle
Face	462.6250	18	CW	1.8 W	-0.02	Alkaline	-	2.5	Brain	0.892	0.446
Body	462. 6250	18	CW	1.8 W	-0.02	Alkaline	Belt-Clip Headset	Belt-Clip	Muscle	0.702	0.351
Body	462. 6250	18	CW	1.8 W	-0.02	Alkaline	Belt-Clip Earpiece	Belt-Clip	Muscle	1.12	0.560
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak - Uncontrolled Exposure / General Population BRAIN / BODY: 1.6 W/kg / (averaged over 1 gram)											
Dielectric Constant				Brain 450MHz		Body 450MHz		Atmospheric Pressure		101.3 kPa	
				Target	Measured	Target	Measured	Relative Humidity		46 %	
				43.5 (± 5%)	44.3	56.7 (± 5%)	59.0	Ambient Temperature		23.1 °C	
Conductivity				Brain 450MHz		Body 450MHz		Fluid Temperature		22.3 °C	
				Target	Measured	Target	Measured	Fluid Depth		≥ 15 cm	
				0.87 (± 5%)	0.86	0.94 (± 5%)	0.96	Phantom Section		Planar	

Note(s):

1. The transmission band of the DUT is less than 10 MHz, therefore mid channel data only is reported (per FCC OET Bulletin 65, Supplement C, Edition 01-01 - see reference [2]).
2. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures listed in the table above were consistent for all measurement periods.

5.0 DETAILS OF SAR EVALUATION

The Midland Radio Corporation Model: G225 Portable UHF GMRS/FRS PTT Radio Transceiver FCC ID: MMAG225 was found to be compliant for localized Specific Absorption Rate (General Population / Uncontrolled Exposure environment) based on the test provisions and conditions described below. The detailed test setup photographs are shown in Appendix G.

1. The DUT was evaluated in a face-held configuration with the front of the device placed parallel to the outer surface of the planar phantom. A 2.5 cm separation distance was maintained between the front side of the DUT and the outer surface of the planar phantom for the duration of the test.
2. The DUT was tested in a body-worn configuration with the back of the device placed parallel to the outer surface of the planar phantom. The attached belt-clip was touching the planar phantom. The DUT was tested for body-worn SAR with the headset/boom-microphone accessory connected, and subsequently with the earpiece/lapel-microphone accessory connected.
3. The DUT was operated for an appropriate period prior to the evaluation in order to minimize power drift.
4. The conducted power level of the DUT could not be measured for the SAR evaluation. The DUT was evaluated for SAR at the maximum conducted power level set by the manufacturer.
5. The DUT was tested in unmodulated continuous transmit operation (Continuous Wave mode, 100% duty cycle) with the transmit key constantly depressed. For a push-to-talk device 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 DUT was tested with fully charged alkaline batteries.

6.0 EVALUATION PROCEDURES

- 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 evaluated in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01) using the SAM phantom.
(ii) For body-worn and face-held devices a planar phantom was used.
- 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 with a grid spacing of 20mm x 20mm.
- c. Based on the area scan data, the area of maximum absorption was determined by spline interpolation. Around this point, a volume of 40 x 40 x 35 mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points.
- d. The 1g and 10g spatial peak SAR was determined as follows:
 1. The first step was an extrapolation to find the points between the dipole center of the probe and the surface of the phantom. This data cannot be measured, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.3 mm (see probe calibration document in Appendix D). The extrapolation was based on a least square algorithm [W. Gander, Computermathematik, p.168-180] (see reference [4]). Through the points in the first 3 cm in all z-axis, polynomials of the fourth order were calculated. This polynomial was then used to evaluate the points between the surface and the probe tip.
 2. The next step used 3D-spline interpolation to get all points within the measured volume in a 1mm grid (35000 points). 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 -direction) [Numerical Recipes in C, Second Edition, p.123ff] (see reference [4]).
 3. The maximal interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-spline interpolation algorithm. 8000 points (20x20x20) were interpolated to calculate the average.

EVALUATION PROCEDURES (Cont.)

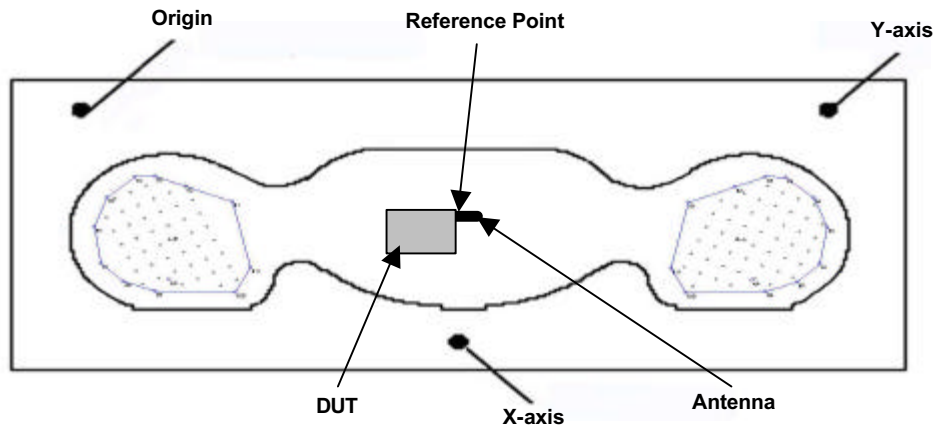


Figure 1. Phantom Reference Point & DUT Positioning (Face-held)

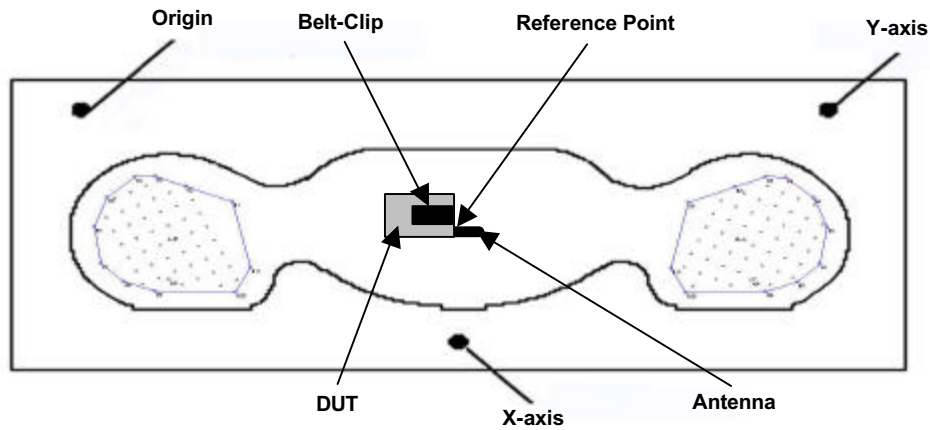


Figure 2. Phantom Reference Point & DUT Positioning (Body-worn)

7.0 SYSTEM PERFORMANCE CHECK

Prior to the evaluation a system check was performed with a planar phantom and a 450MHz dipole (see Appendix C for system validation procedures). The dielectric parameters of the simulated tissue fluids were measured prior to the validation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters). A forward power of 250mW was applied to the dipole and system was verified to a tolerance of $\pm 10\%$ (see Appendix B for system check test plot).

SYSTEM VALIDATION

Test Date	Equiv. Tissue	SAR 1g (W/kg)		Dielectric Constant ϵ_r		Conductivity σ (mho/m)		ρ (Kg/m ³)	Ambient Temp.	Fluid Temp.	Fluid Depth
		Target	Measured	Target	Measured	Target	Measured				
12/20/02	450MHz (Brain)	1.23 $\pm 10\%$	1.28	43.5 $\pm 5\%$	44.3	0.87 $\pm 5\%$	0.86	1000	23.1 °C	22.3 °C	≥ 15 cm

Note(s):

1. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the system performance check. The temperatures listed in the table above were consistent for all measurement periods.

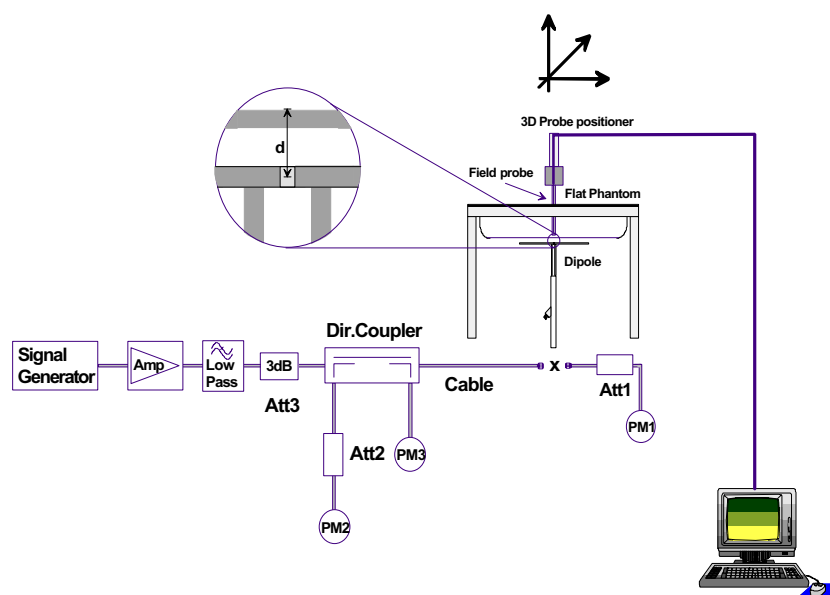


Figure 3. System Check Setup Diagram



450MHz System Check Setup Photograph

8.0 SIMULATED TISSUES

The 450MHz brain and body simulated 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 (permittivity and conductivity).

TISSUE MIXTURES		
INGREDIENT	450MHz Brain (System Check & EUT Evaluation)	450MHz Body (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 %

9.0 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)	1.60	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.
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.

10.0 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: SAM V4.0C
Shell Material: Fiberglass
Thickness: 2.0 ± 0.1 mm
Volume: Approx. 20 liters

Validation Phantom (for devices ≤ 450 MHz)

Type: Large Planar Phantom
Shell Material: Plexiglas
Bottom Thickness: $6.2 \text{ mm} \pm 0.1 \text{ mm}$
Dimensions: 83.5cm (L) x 36.9cm (W) x 21.8cm (H)

11.0 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 $\pm 8\%$)
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 μ W/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

12.0 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

13.0 SAM PHANTOM V4.0C

The SAM phantom V4.0C is a fiberglass shell phantom with a 2.0mm shell thickness for left and right head and flat planar area integrated in a wooden table. The shape of the fiberglass shell corresponds to the phantom defined by SCC34-SC2. The device holder positions are adjusted to the standard measurement positions in the three sections.



SAM Phantom

14.0 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

15.0 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 -Medium Planar Phantom -Large Planar Phantom	599396-01 1387 135 136 054 247 150 N/A N/A N/A N/A	N/A Feb 2002 Oct 2002 Oct 2002 June 2001 June 2001 Oct 2002 N/A N/A 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 2002
8594E Spectrum Analyzer	3543A02721	Feb 2002
8753E Network Analyzer	US38433013	Feb 2002
8648D Signal Generator	3847A00611	Feb 2002
5S1G4 Amplifier Research Power Amplifier	26235	N/A

16.0 MEASUREMENT UNCERTAINTIES

Error Description	Uncertainty Value $\pm\%$	Probability Distribution	Divisor	C_i 1g	Standard Uncertainty $\pm\%$ (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	$\sqrt{3}$	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	$\sqrt{3}$	(c_p)	± 3.9	∞
Spatial resolution	± 0.0	Rectangular	$\sqrt{3}$	1	± 0.0	∞
Boundary effects	± 5.5	Rectangular	$\sqrt{3}$	1	± 3.2	∞
Probe linearity	± 4.7	Rectangular	$\sqrt{3}$	1	± 2.7	∞
Detection limit	± 1.0	Rectangular	$\sqrt{3}$	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	$\sqrt{3}$	1	± 0.5	∞
Integration time	± 1.4	Rectangular	$\sqrt{3}$	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	$\sqrt{3}$	1	± 0.2	∞
Probe positioning	± 2.9	Rectangular	$\sqrt{3}$	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Test Sample Related						
Device positioning	± 6.0	Normal	$\sqrt{3}$	1	± 6.7	12
Device holder uncertainty	± 5.0	Normal	$\sqrt{3}$	1	± 5.9	8
Power drift	± 5.0	Rectangular	$\sqrt{3}$		± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	$\sqrt{3}$	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	$\sqrt{3}$	0.6	± 1.7	∞
Combined Standard Uncertainty					± 13.7	
Expanded Uncertainty (k=2) (95% Confidence Level)					± 27.5	

Measurement Uncertainty Table in accordance with IEEE Std 1528 (Draft - see reference [3])

17.0 REFERENCES

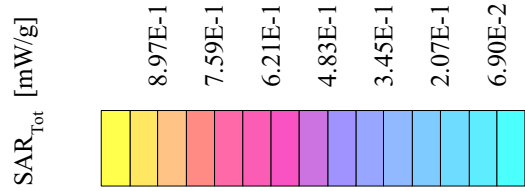
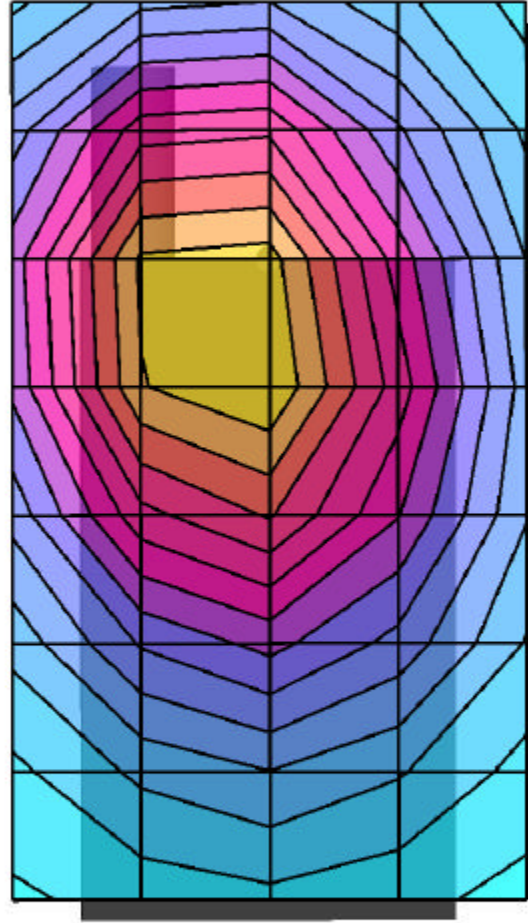
- [1] Federal Communications Commission, "Radiofrequency radiation exposure evaluation: portable devices", Rule Part 47 CFR §2.1093: 1999.
- [2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.
- [3] IEEE Standards Coordinating Committee 34, 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".
- [4] W. Gander, *Computermathematick*, Birkhaeuser, Basel: 1992.

APPENDIX A - SAR MEASUREMENT DATA

Midland Radio Corporation FCC ID: MMAG225

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1387; ConvF(7.30,7.30,7.30); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.86 \text{ mho/m}$ $\epsilon_r = 44.3$ $\rho = 1.00 \text{ g/cm}^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.02 dB
SAR (1g): 0.892 mW/g, SAR (10g): 0.625 mW/g

Face-held SAR - 2.5 cm Separation Distance
Portable UHF FRS/GMRS Radio Model: G225
AAA Alkaline Batteries (x4)
Continuous Wave Mode
Mid Channel [462.6250 MHz]
Conducted Power: 1.8 Watts (GMRS)
Ambient Temp 23.1°C; Fluid Temp 22.3°C
Date Tested: December 20, 2002



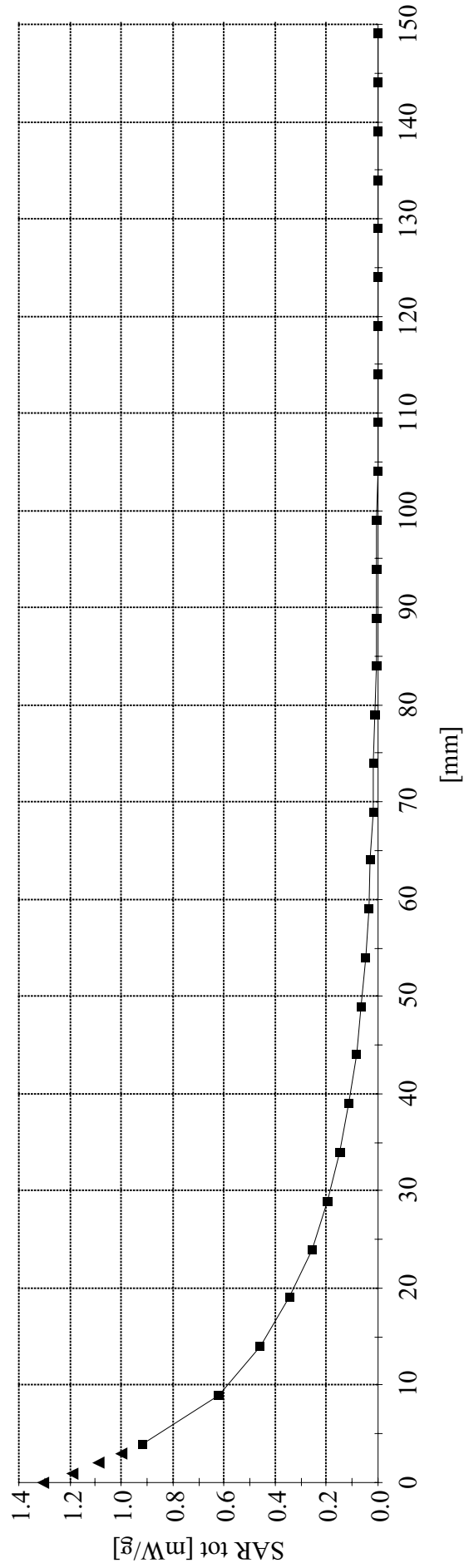
Midland Radio Corporation FCC ID: MMAG225

SAM Phantom; Flat Section

Probe: ET3DV6 - SN1387; ConvF(7.30,7.30,7.30); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.86$ mho/m $\epsilon_r = 44.3$ $\rho = 1.00$ g/cm³

Z-Axis Extrapolation at Peak SAR Location

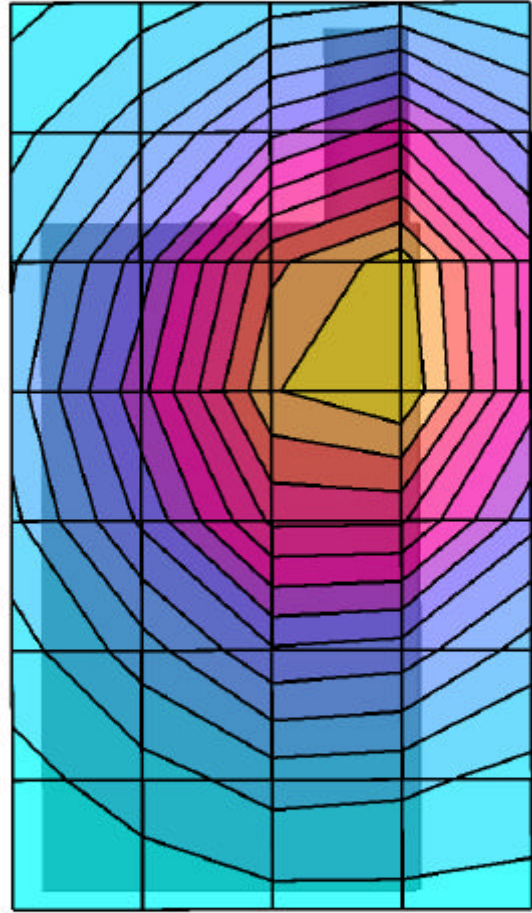
Face-held SAR - 2.5 cm Separation Distance
Portable UHF FRS/GMRS Radio Model: G225
AAA Alkaline Batteries (x4)
Continuous Wave Mode
Mid Channel [462.6250 MHz]
Conducted Power: 1.8 Watts (GMRS)
Ambient Temp 23.1°C; Fluid Temp 22.3°C
Date Tested: December 20, 2002



Midland Radio Corporation FCC ID: MMAG225

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.96 \text{ mho/m}$ $\epsilon_r = 59.0$ $\rho = 1.00 \text{ g/cm}^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.02 dB
SAR (1g): 0.702 mW/g, SAR (10g): 0.494 mW/g

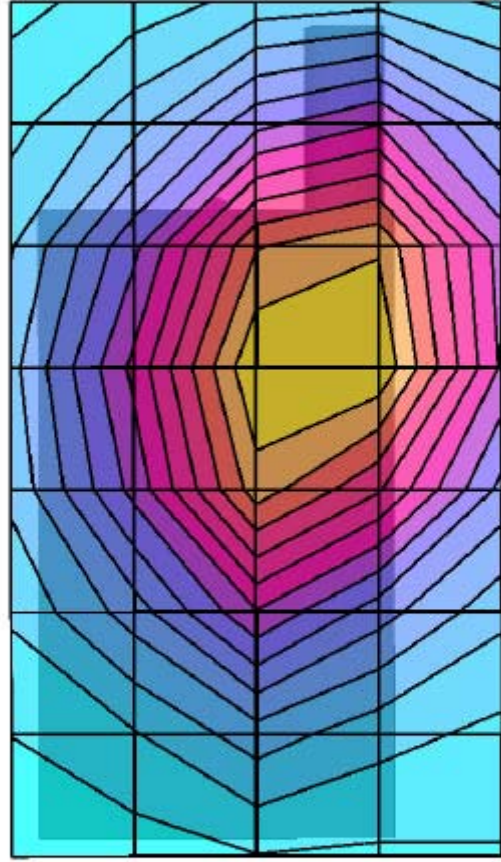
Body-Worn SAR - 1.7 cm Belt-Clip Separation Distance
Portable UHF FRS/GMRS Radio Model: G225
with Boom-Microphone Headset Accessory
AAA Alkaline Batteries (x4)
Continuous Wave Mode
Mid Channel [462.6250 MHz]
Conducted Power: 1.8 Watts (GMRS)
Ambient Temp 23.1° C; Fluid Temp 22.3° C
Date Tested: December 20, 2002



Midland Radio Corporation FCC ID: MMAG225

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.96$ mho/m $\epsilon_r = 59.0$ $\rho = 1.00$ g/cm³
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.02 dB
SAR (1g): 1.12 mW/g, SAR (10g): 0.786 mW/g

Body-Worn SAR - 1.7 cm Belt-Clip Separation Distance
Portable UHF FRS/GMRS Radio Model: G225
with Earpiece/Lapel-Microphone Accessory
AAA Alkaline Batteries (x4)
Continuous Wave Mode
Mid Channel [462.6250 MHz]
Conducted Power: 1.8 Watts (GMRS)
Ambient Temp 23.1° C; Fluid Temp 22.3° C
Date Tested: December 20, 2002

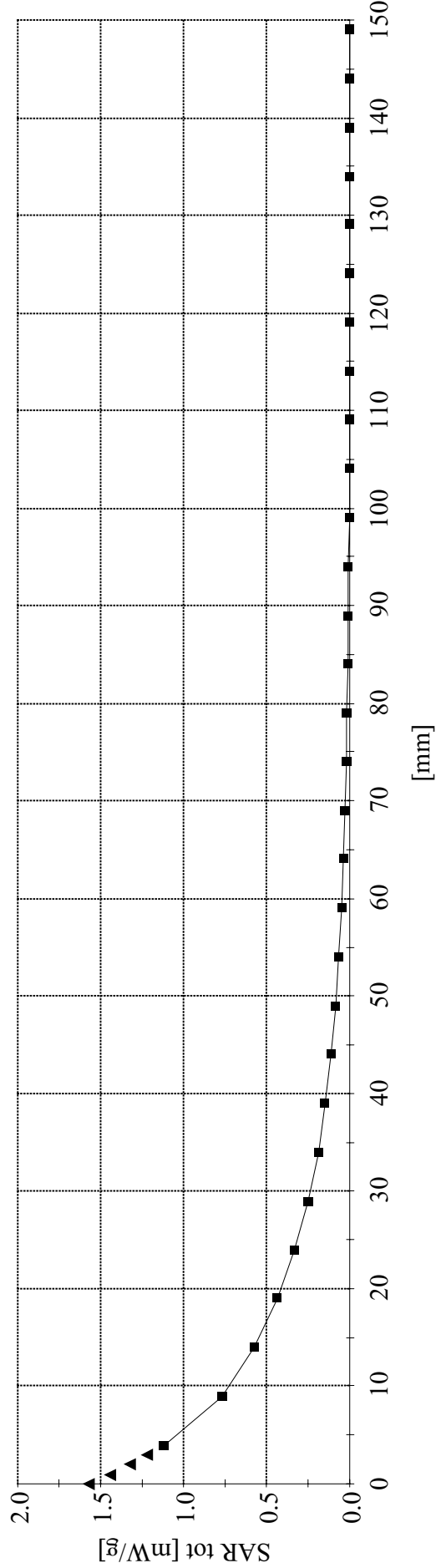


Midland Radio Corporation FCC ID: MMAG225

SAM Phantom; Flat Section
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.96$ mho/m $\epsilon_r = 59.0$ $\rho = 1.00$ g/cm³

Z-Axis Extrapolation at Peak SAR Location

Body-Worn SAR - 1.7 cm Belt-Clip Separation Distance
Portable UHF FRS/GMRS Radio Model: G225
with Earpiece/Lapel-Microphone Accessory
AAA Alkaline Batteries (x4)
Continuous Wave Mode
Mid Channel [462.6250 MHz]
Conducted Power: 1.8 Watts (GMRS)
Ambient Temp 23.1° C; Fluid Temp 22.3° C
Date Tested: December 20, 2002



APPENDIX B - SYSTEM PERFORMANCE CHECK

System Performance Check - 450MHz Dipole

Large Planar Phantom; Planar Section

Probe: ET3DV6 - SNI387; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Brain: $\sigma = 0.86$ mho/m $\epsilon_r = 44.3$ $\rho = 1.00$ g/cm³

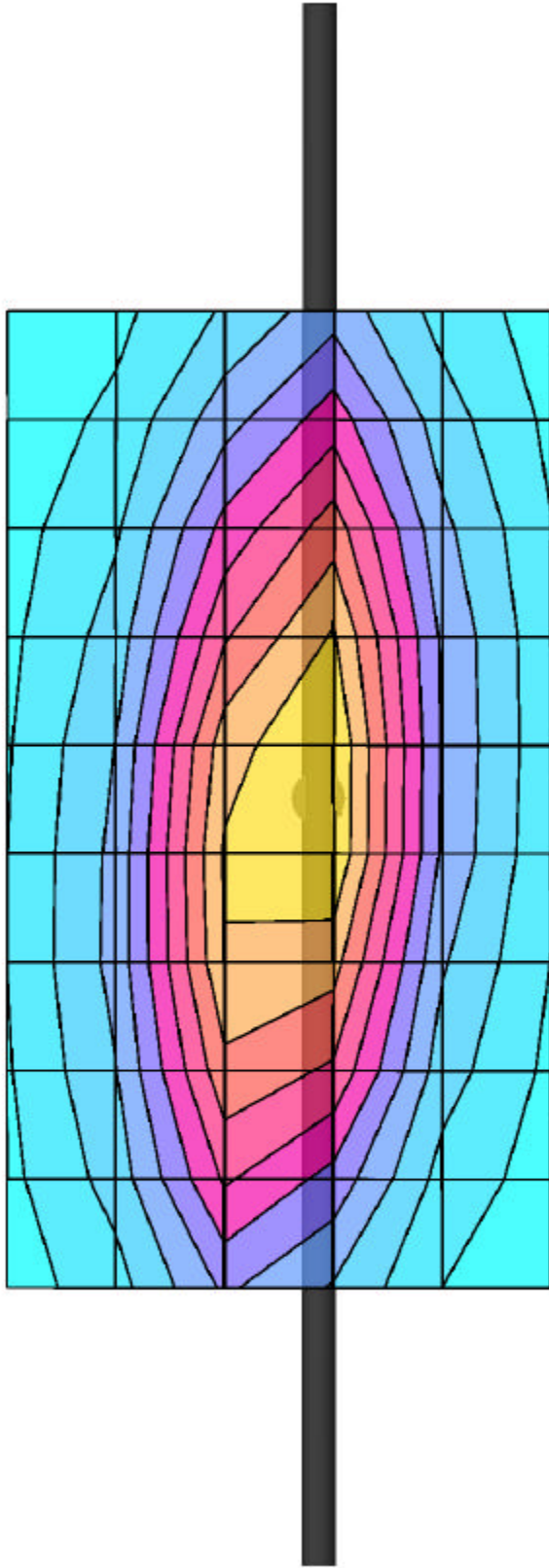
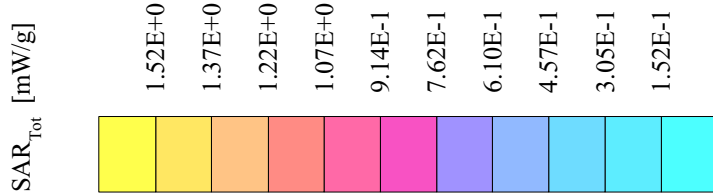
Cube 5x5x7; Peak: 2.05 mW/g, SAR (1g): 1.28 mW/g, SAR (10g): 0.836 mW/g, (Worst-case extrapolation)

Penetration depth: 12.0 (10.4, 14.1) [mm]; Powerdrift: -0.02 dB

Ambient Temp 23.1°C; Fluid Temp 22.3°C

Forward Conducted Power: 250 mW

Date Tested: December 20, 2002



APPENDIX C - SYSTEM VALIDATION

450MHz SYSTEM VALIDATION DIPOLE

Type:

450MHz Validation Dipole

Serial Number:

136

Place of Calibration:

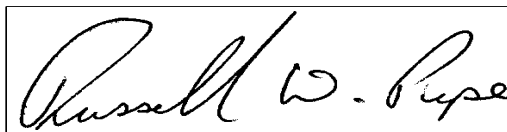
Celltech Research Inc.

Date of Calibration:

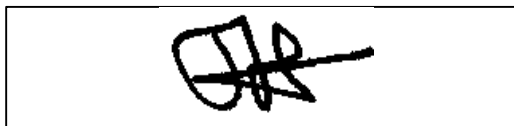
October 17, 2002

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

Calibrated by:



Approved by:

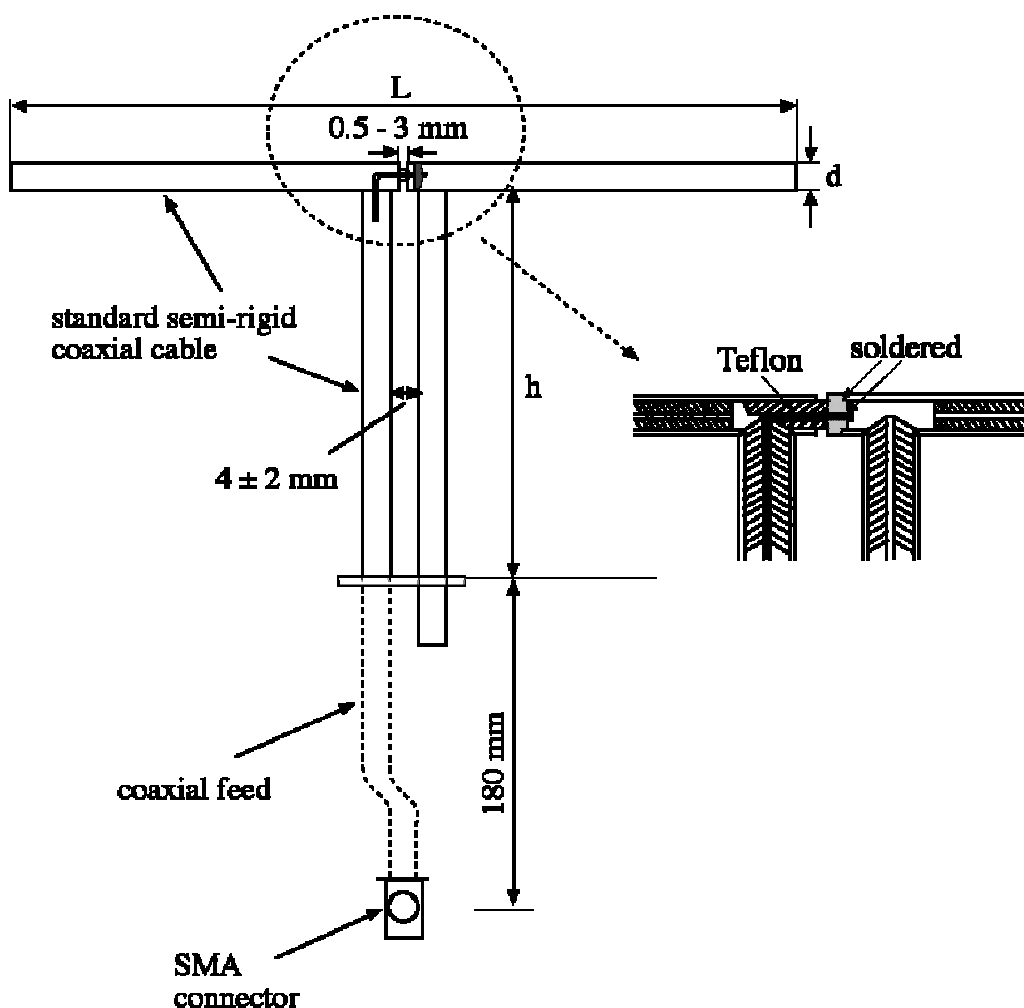


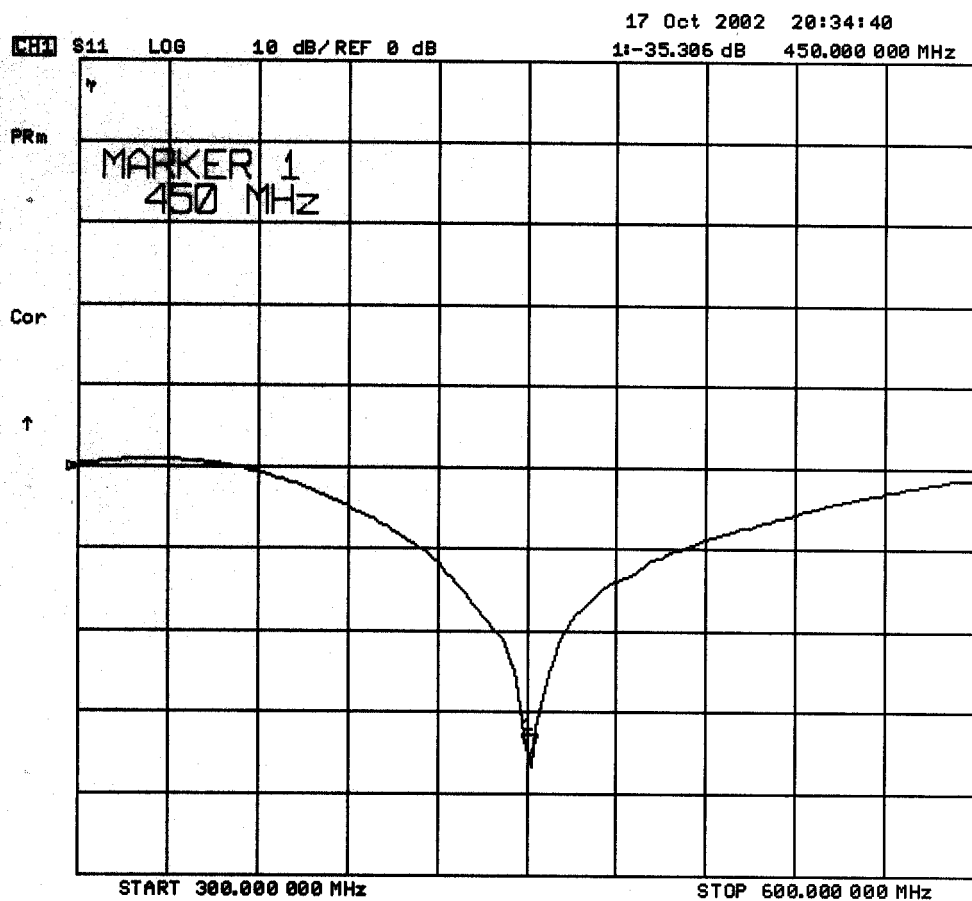
1. Dipole Construction & Electrical Characteristics

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:

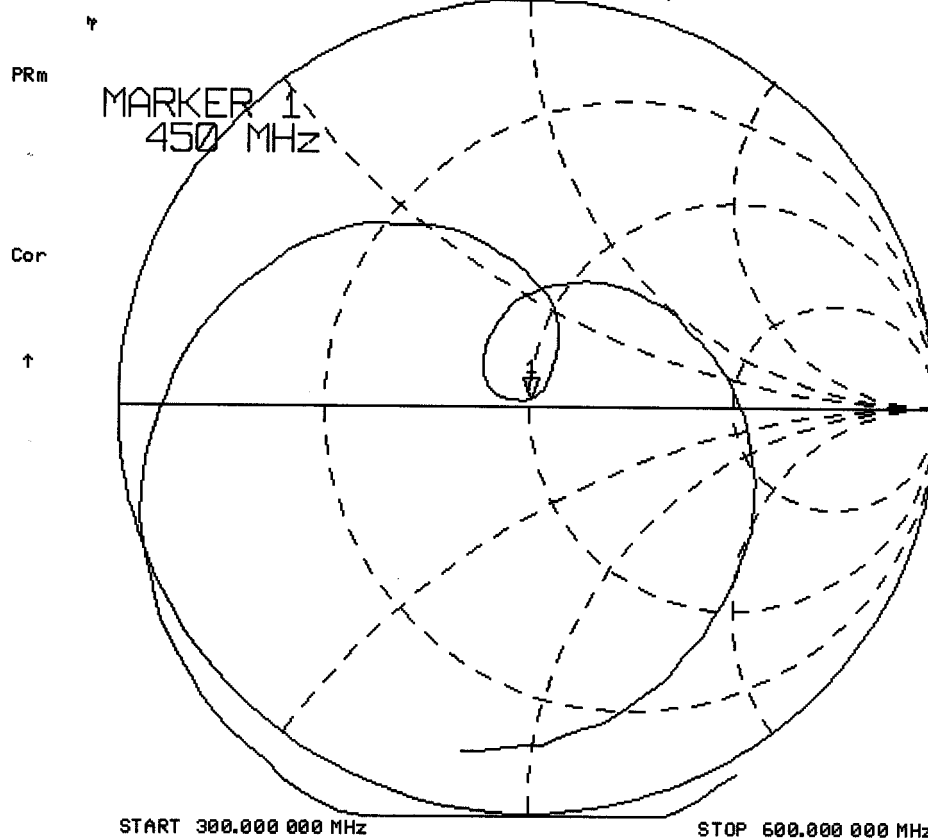
Feed point impedance at 450MHz	$\text{Re}\{Z\} = 50.299\Omega$
	$\text{Im}\{Z\} = 1.6660\Omega$

Return Loss at 450MHz	-35.306dB
-----------------------	-----------





17 Oct 2002 20:34:13
[CH1] S11 1 U FS 1: 50.299 Ω 1.6660 Ω 589.23 μ H 450.000 000 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

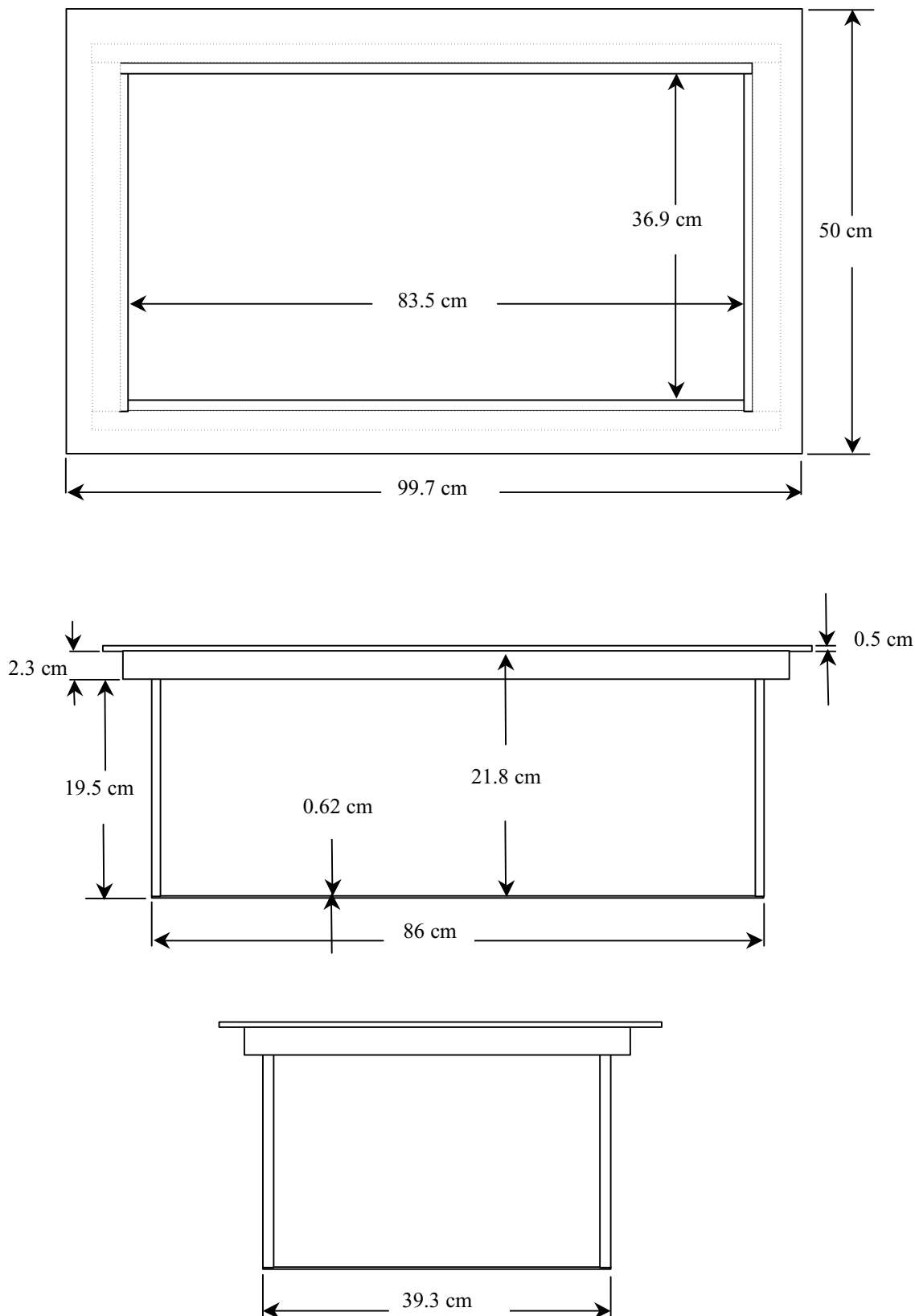
2. Validation Phantom

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 ± 0.1 mm Plexiglas.

Dimensions of Plexiglas Planar Phantom



450MHz System Validation Setup



450MHz System Validation Setup



3. Measurement Conditions

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

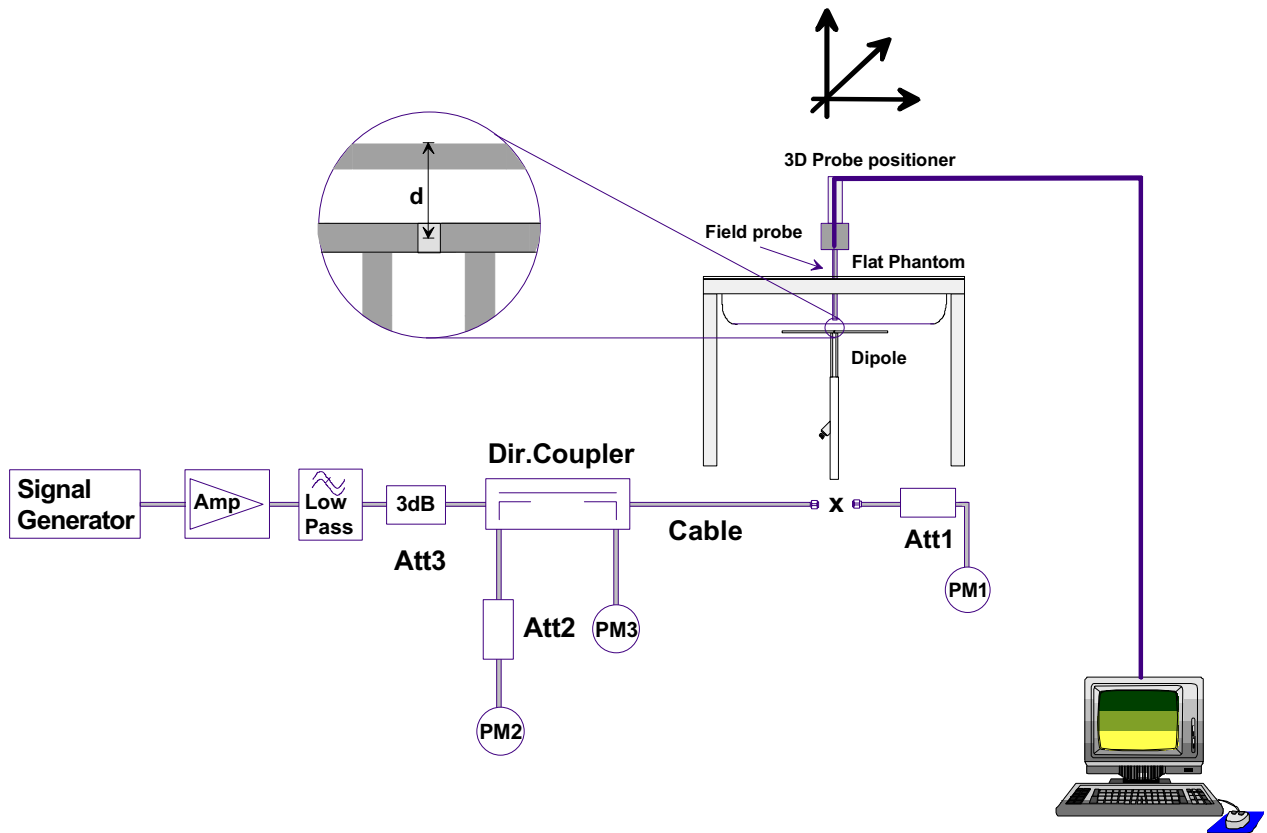
Relative Permittivity: 44.1
Conductivity: 0.88 mho/m
Ambient Temperature: 23.3 °C
Fluid Temperature: 22.2 °C
Fluid Depth: ≥ 15.0 cm

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	$\epsilon_r = 43.5$ $\sigma = 0.87$ 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	1.32	5.28	0.887	3.55	2.20
Test 2	1.26	5.04	0.856	3.42	2.09
Test 3	1.38	5.52	0.931	3.72	2.30
Test 4	1.36	5.44	0.917	3.67	2.27
Test 5	1.37	5.48	0.922	3.69	2.28
Test 6	1.33	5.32	0.896	3.58	2.22
Test 7	1.34	5.36	0.902	3.61	2.24
Test 8	1.33	5.32	0.895	3.58	2.21
Test 9	1.39	5.56	0.931	3.72	2.31
Test10	1.36	5.44	0.917	3.67	2.27
Average Value	1.34	5.38	0.905	3.62	2.24

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

Averaged over 1cm (1g) of tissue: 5.38 mW/g

Averaged over 10cm (10g) of tissue: 3.62 mW/g

Dipole 450MHz, d = 15 mm

Frequency: 450 MHz; Antenna Input Power: 250 [mW]

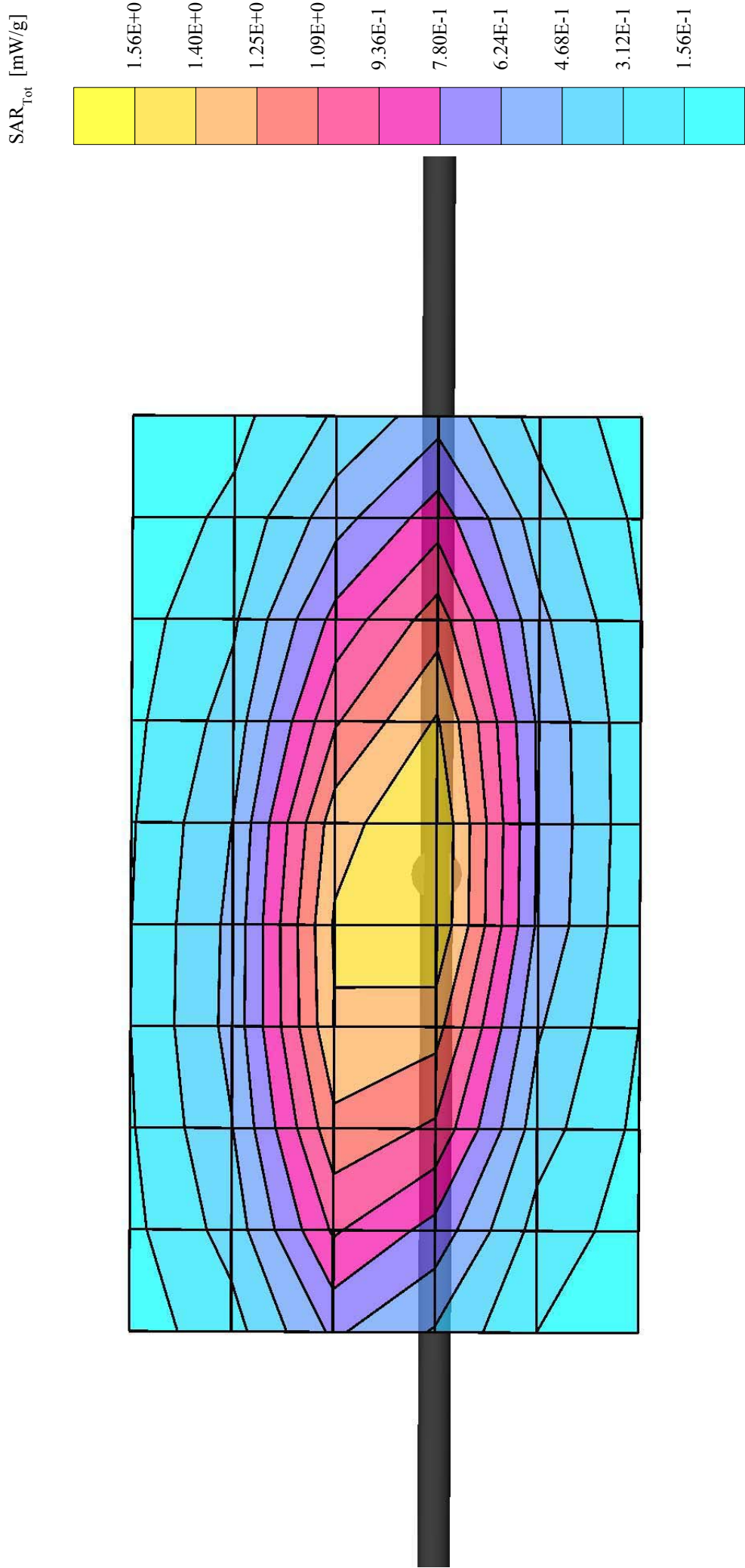
Large Planar Phantom; Planar Section

Probe: ET3DV6 - SNI387; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Brain: $\sigma = 0.88$ mho/m $\epsilon_r = 44.1$ $\rho = 1.00$ g/cm³

Cube 5x5x7: Peak: 2.24 mW/g, SAR (1g): 1.34 mW/g, SAR (10g): 0.905 mW/g, (Worst-case extrapolation)

Penetration depth: 12.0 (10.5, 14.0) [mm]; Powerdrift: 0.01 dB; Ambient Temp.: 23.3°C; Fluid Temp.: 22.2°C

Calibration Date: October 17, 2002



450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

October 17, 2002

Frequency	ϵ'	ϵ''
350.000000 MHz	46.6334	40.6323
360.000000 MHz	46.3629	40.0034
370.000000 MHz	46.1498	39.3672
380.000000 MHz	45.8833	38.6723
390.000000 MHz	45.5947	38.0484
400.000000 MHz	45.3226	37.4538
410.000000 MHz	45.0977	36.9636
420.000000 MHz	44.8241	36.4841
430.000000 MHz	44.5839	35.9541
440.000000 MHz	44.3183	35.5098
450.000000 MHz	44.0572	35.0854
460.000000 MHz	43.8600	34.7069
470.000000 MHz	43.6544	34.3371
480.000000 MHz	43.4507	33.9296
490.000000 MHz	43.2880	33.5147
500.000000 MHz	43.0921	33.1731
510.000000 MHz	42.8781	32.7813
520.000000 MHz	42.6765	32.4193
530.000000 MHz	42.5864	32.1000
540.000000 MHz	42.4644	31.7180
550.000000 MHz	42.3042	31.4503

APPENDIX D - PROBE CALIBRATION

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1387

Place of Calibration:

Zurich

Date of Calibration:

February 22, 2002

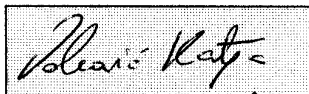
Calibration Interval:

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

NormX	1.58 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.67 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.67 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

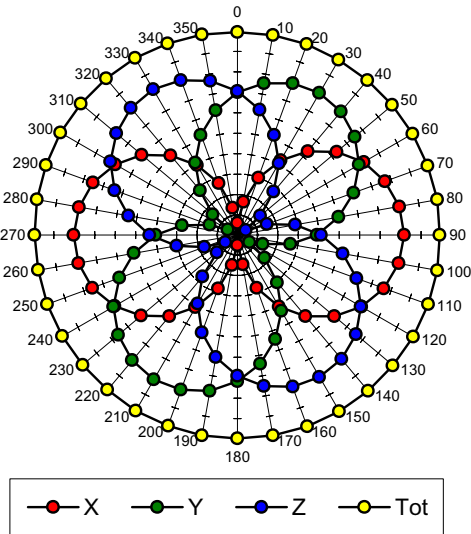
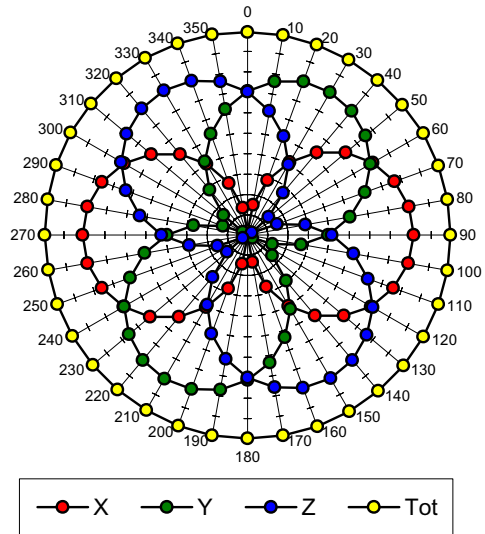
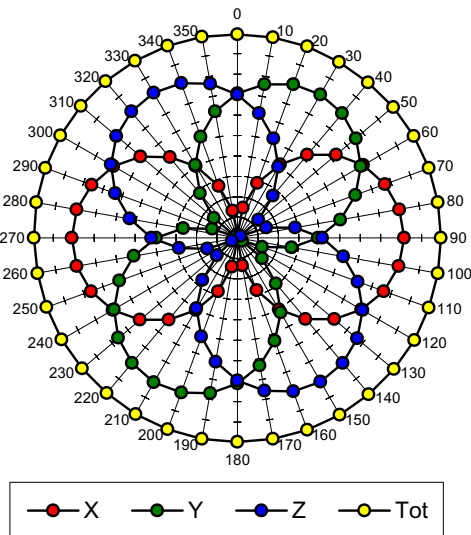
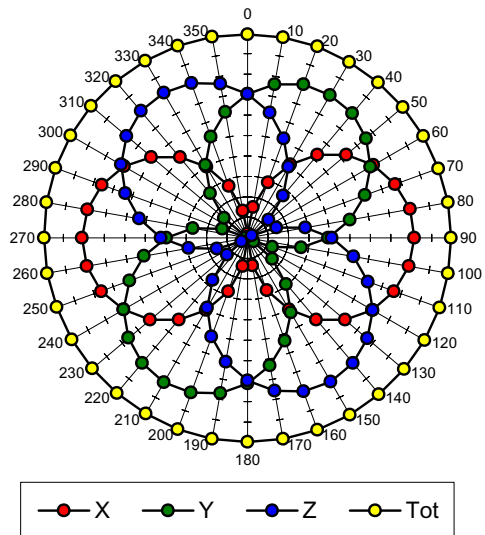
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha	0.40
ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth	2.38
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.4 $\pm 9.5\%$ (k=2)	Alpha	0.57
ConvF Z	5.4 $\pm 9.5\%$ (k=2)	Depth	2.18

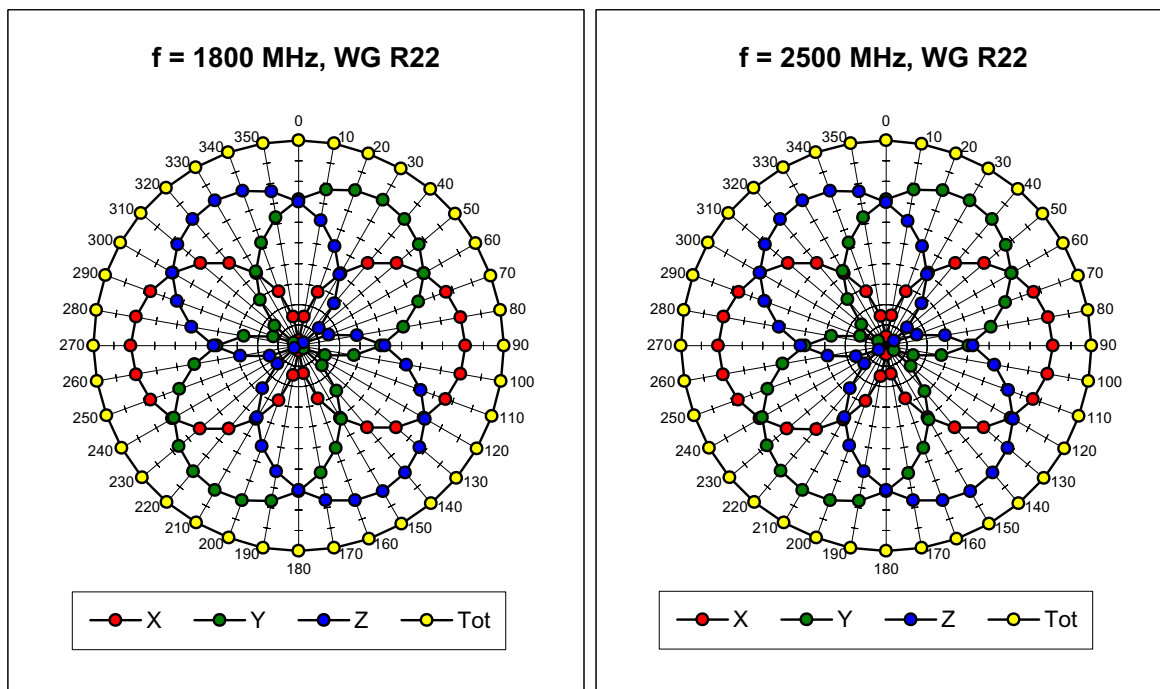
Boundary Effect

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

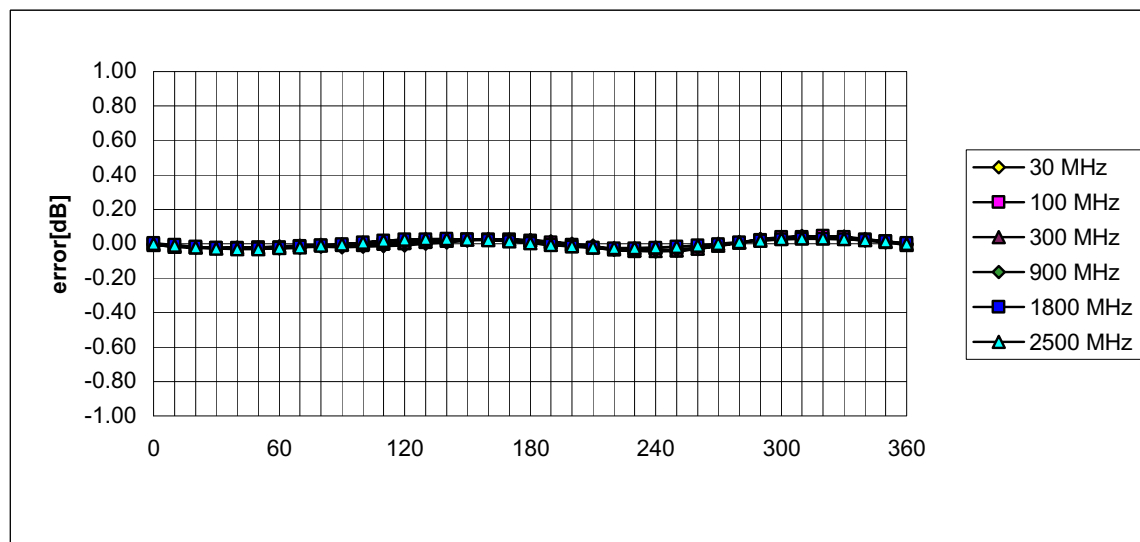
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 $\pm$ 0.2	mm

Receiving Pattern (ϕ , $\theta = 0^\circ$)**f = 30 MHz, TEM cell ifi110****f = 100 MHz, TEM cell ifi110****f = 300 MHz, TEM cell ifi110****f = 900 MHz, TEM cell ifi110**

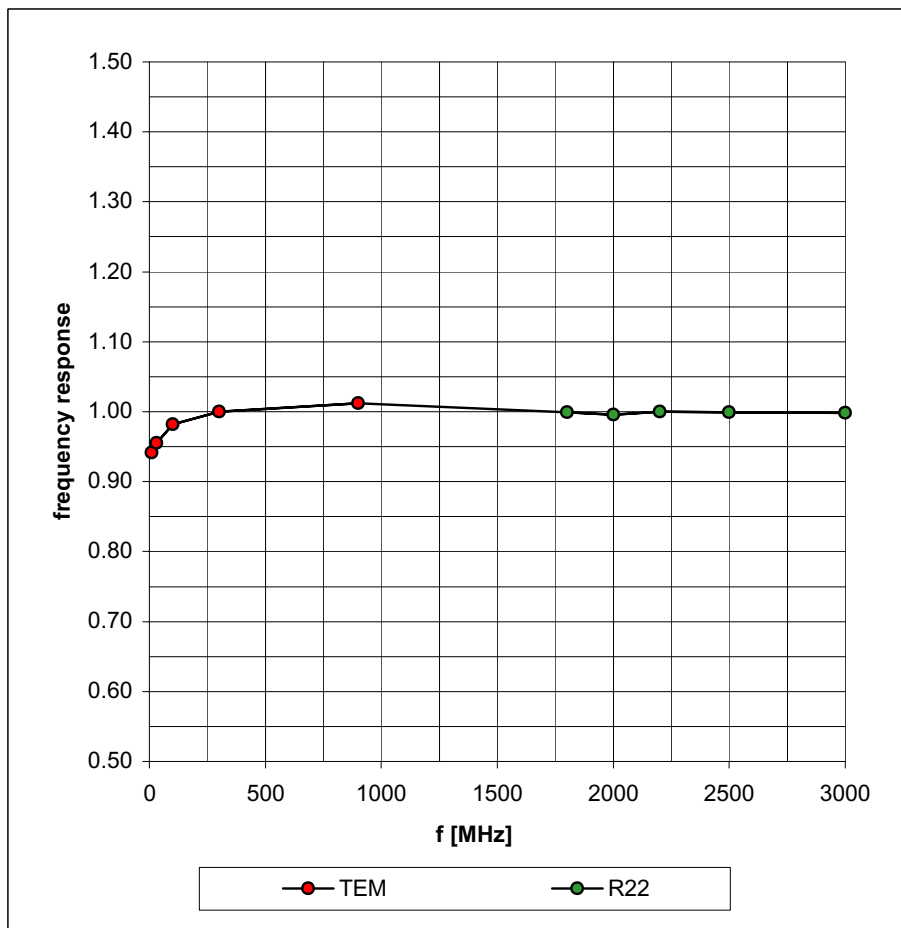


Isotropy Error (ϕ), $\theta = 0^\circ$

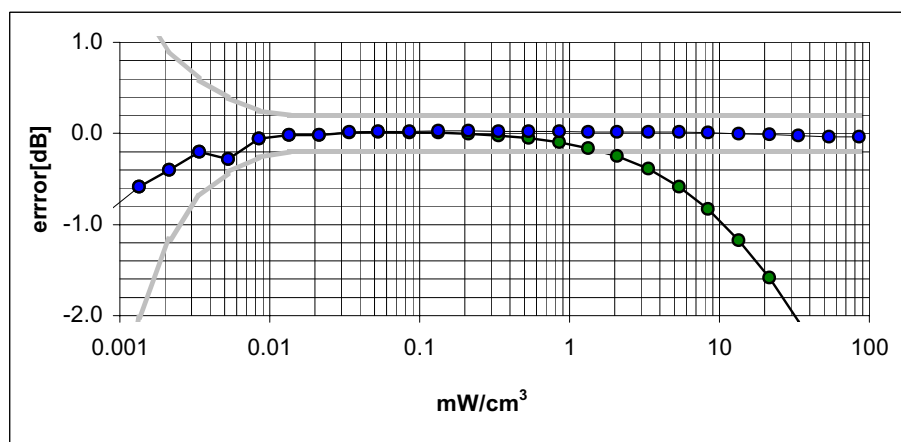
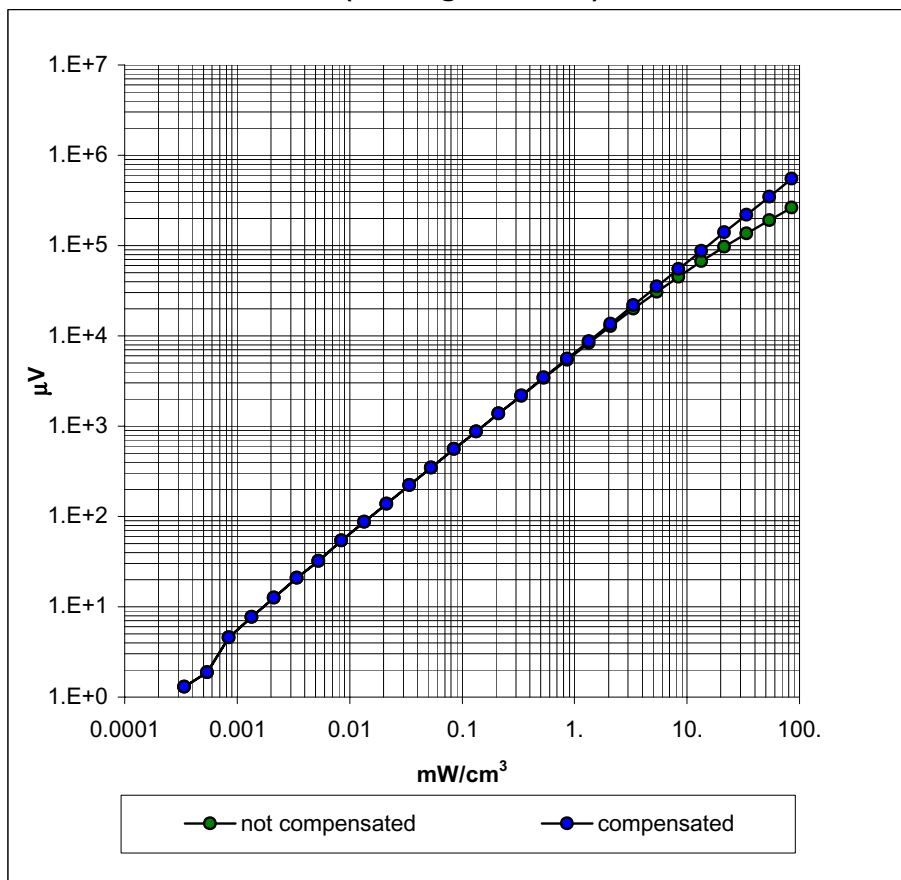


Frequency Response of E-Field

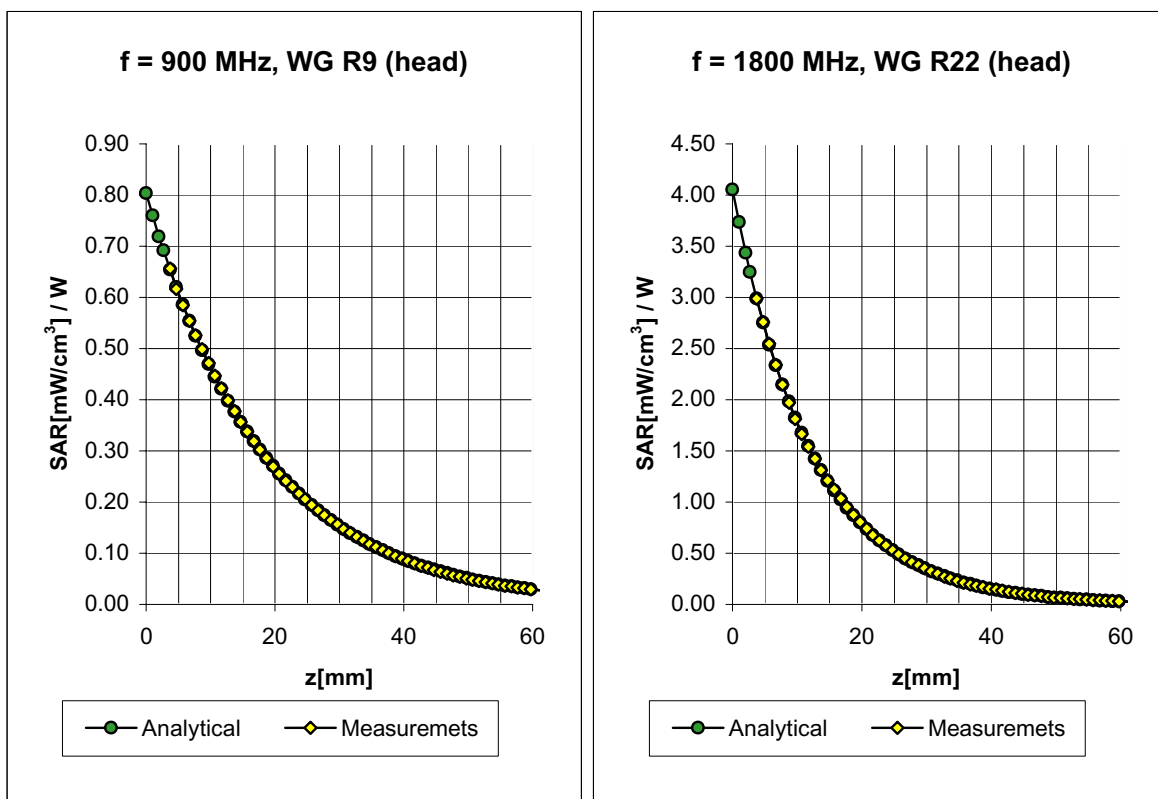
(TEM-Cell:ifi1110, Waveguide R22)



Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



Conversion Factor Assessment

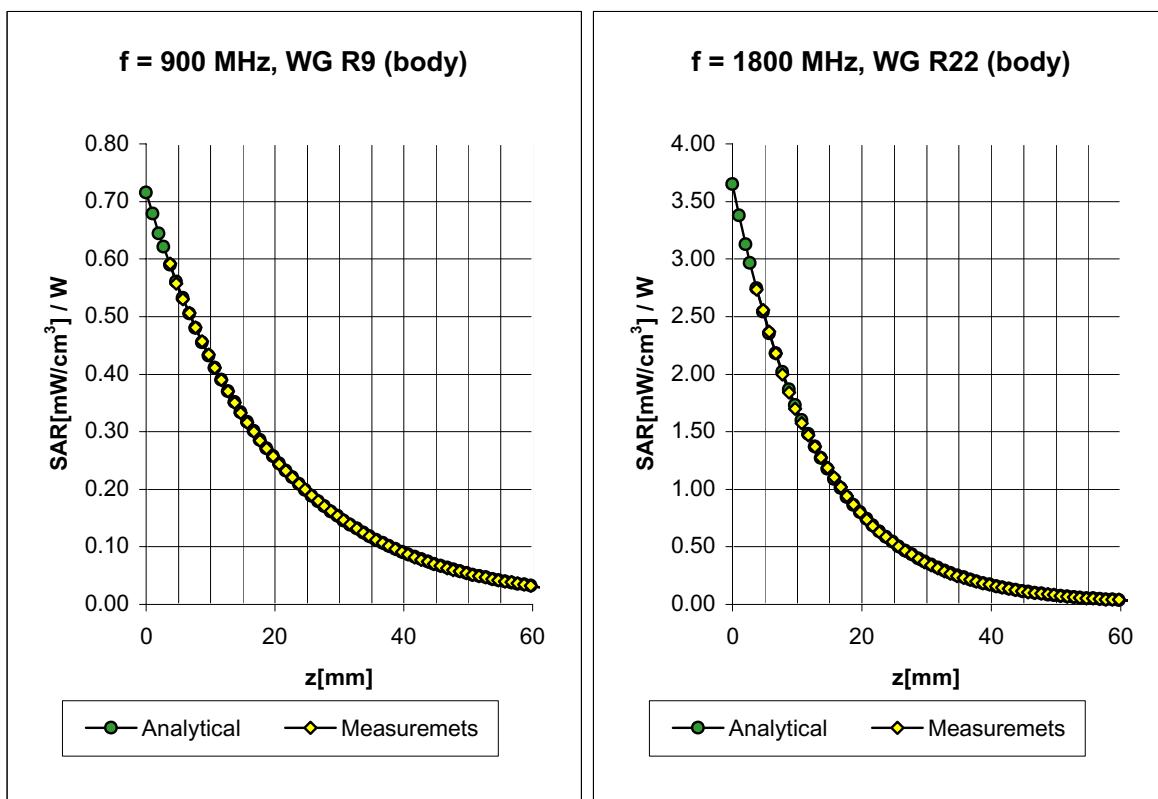


Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha 0.40
	ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth 2.38
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	5.4 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	5.4 $\pm 9.5\%$ (k=2)	Alpha 0.57
	ConvF Z	5.4 $\pm 9.5\%$ (k=2)	Depth 2.18

ET3DV6 SN:1387

February 22, 2002

Conversion Factor Assessment



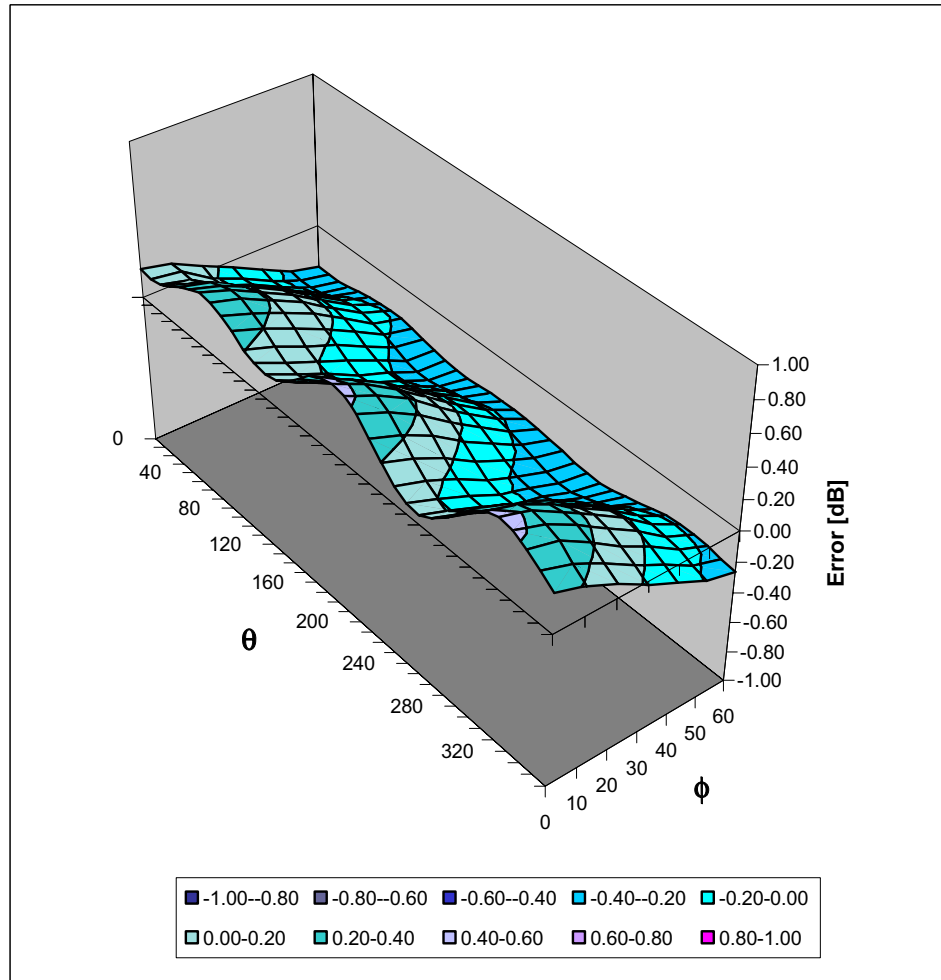
Body	900 MHz	$\epsilon_r = 55.0 \pm 5\%$	$\sigma = 1.05 \pm 5\% \text{ mho/m}$
Body	835 MHz	$\epsilon_r = 55.2 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
	ConvF X	6.3 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.3 $\pm 9.5\%$ (k=2)	Alpha 0.42
	ConvF Z	6.3 $\pm 9.5\%$ (k=2)	Depth 2.44
Body	1800 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
Body	1900 MHz	$\epsilon_r = 53.3 \pm 5\%$	$\sigma = 1.52 \pm 5\% \text{ mho/m}$
	ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha 0.76
	ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth 2.01

ET3DV6 SN:1387

February 22, 2002

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1387

Place of Assessment:

Zurich

Date of Assessment:

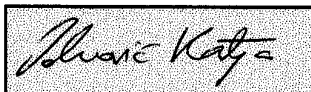
February 25, 2002

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 ($\pm$ standard deviation)

150 MHz	ConvF	$9.2 \pm 8\%$	$\epsilon_r = 52.3$ $\sigma = 0.76 \text{ mho/m}$ (head tissue)
300 MHz	ConvF	$8.0 \pm 8\%$	$\epsilon_r = 45.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
450 MHz	ConvF	$7.3 \pm 8\%$	$\epsilon_r = 43.5$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
2450 MHz	ConvF	$4.7 \pm 8\%$	$\epsilon_r = 39.2$ $\sigma = 1.80 \text{ mho/m}$ (head tissue)
150 MHz	ConvF	$8.8 \pm 8\%$	$\epsilon_r = 61.9$ $\sigma = 0.80 \text{ mho/m}$ (body tissue)
450 MHz	ConvF	$7.7 \pm 8\%$	$\epsilon_r = 56.7$ $\sigma = 0.94 \text{ mho/m}$ (body tissue)
2450 MHz	ConvF	$4.3 \pm 8\%$	$\epsilon_r = 52.7$ $\sigma = 1.95 \text{ mho/m}$ (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

450MHz System Performance Check & EUT Evaluation (Face)

Measured Fluid Dielectric Parameters (Brain)

December 20, 2002

Frequency	e'	e''
350.000000 MHz	46.9078	39.8254
360.000000 MHz	46.6884	39.1511
370.000000 MHz	46.4002	38.4771
380.000000 MHz	46.1076	37.9161
390.000000 MHz	45.8356	37.3281
400.000000 MHz	45.5678	36.8319
410.000000 MHz	45.3067	36.2982
420.000000 MHz	45.0463	35.8302
430.000000 MHz	44.7723	35.3279
440.000000 MHz	44.5660	34.9439
450.000000 MHz	44.3123	34.5004
460.000000 MHz	44.1472	34.1452
470.000000 MHz	43.9199	33.7521
480.000000 MHz	43.7411	33.3324
490.000000 MHz	43.5177	32.9199
500.000000 MHz	43.2967	32.5751
510.000000 MHz	43.1022	32.2397
520.000000 MHz	42.9675	31.9235
530.000000 MHz	42.6931	31.6117
540.000000 MHz	42.5678	31.2380
550.000000 MHz	42.3655	30.9775

450MHz EUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

December 20, 2002

Frequency	ϵ'	ϵ''
350.000000 MHz	60.7614	45.2557
360.000000 MHz	60.5992	44.4327
370.000000 MHz	60.4044	43.5873
380.000000 MHz	60.2459	42.8444
390.000000 MHz	60.0786	42.0832
400.000000 MHz	59.8765	41.4495
410.000000 MHz	59.7041	40.8181
420.000000 MHz	59.5235	40.2162
430.000000 MHz	59.3178	39.6052
440.000000 MHz	59.1906	39.0534
450.000000 MHz	59.0227	38.5610
460.000000 MHz	58.9227	38.0456
470.000000 MHz	58.8270	37.5762
480.000000 MHz	58.6969	37.0585
490.000000 MHz	58.5010	36.6283
500.000000 MHz	58.4492	36.1813
510.000000 MHz	58.3001	35.7544
520.000000 MHz	58.1631	35.3565
530.000000 MHz	57.9980	35.0291
540.000000 MHz	57.9640	34.5410
550.000000 MHz	57.7584	34.2074

APPENDIX F - SAM PHANTOM CERTIFICATE OF CONFORMITY

Schmid & Partner Engineering AG

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

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

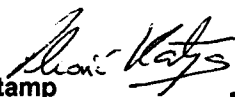
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp



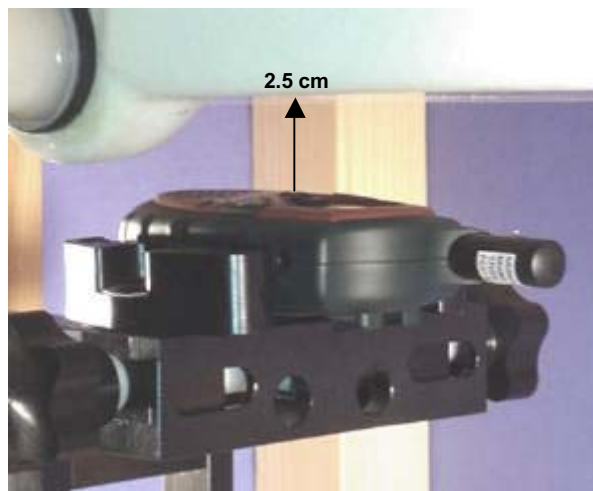
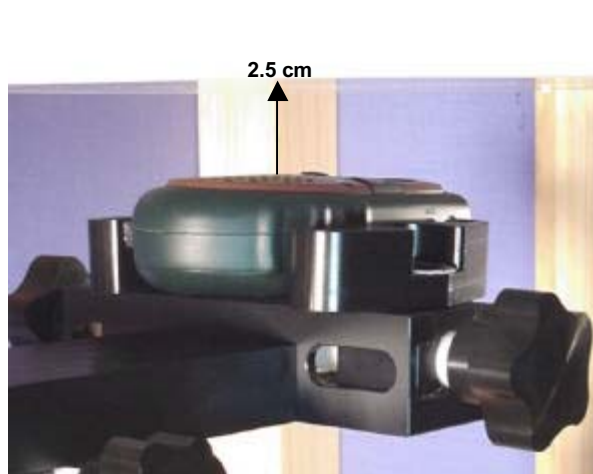
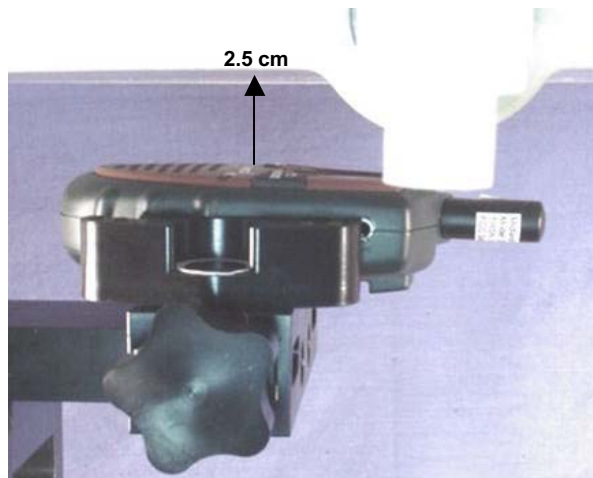
**Schmid & Partner
Engineering AG**



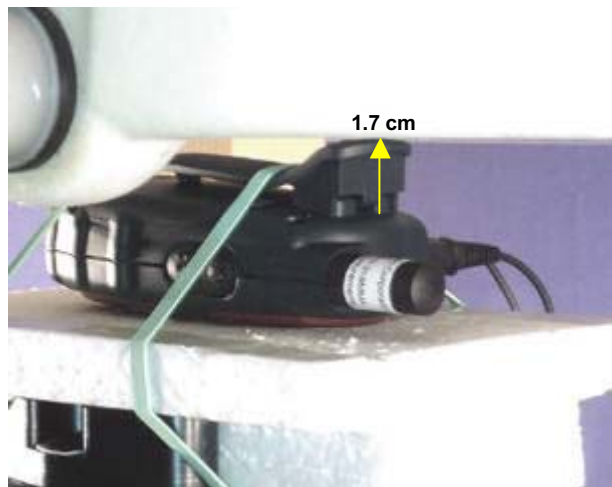
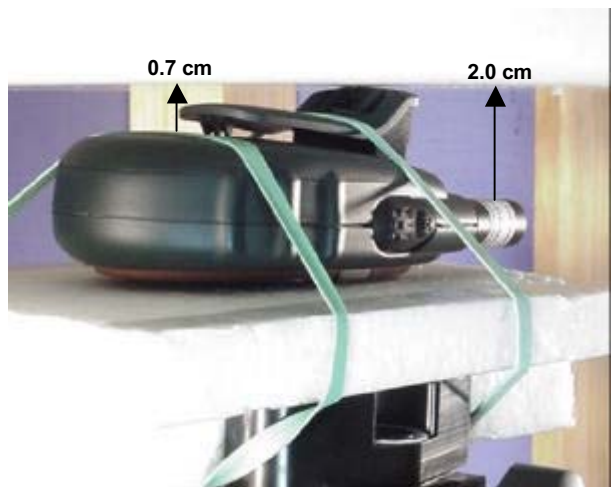
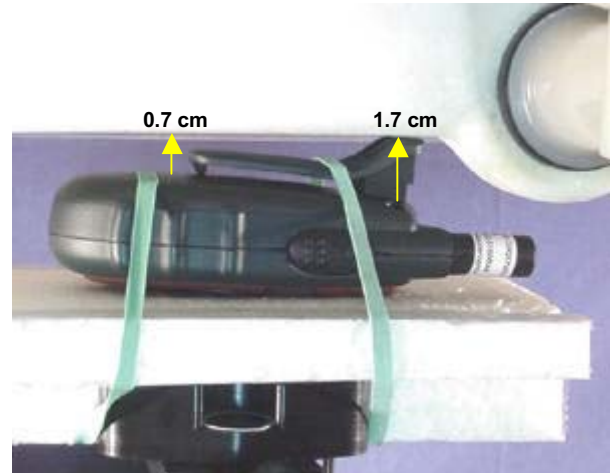
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

APPENDIX G - SAR TEST SETUP & DUT PHOTOGRAPHS

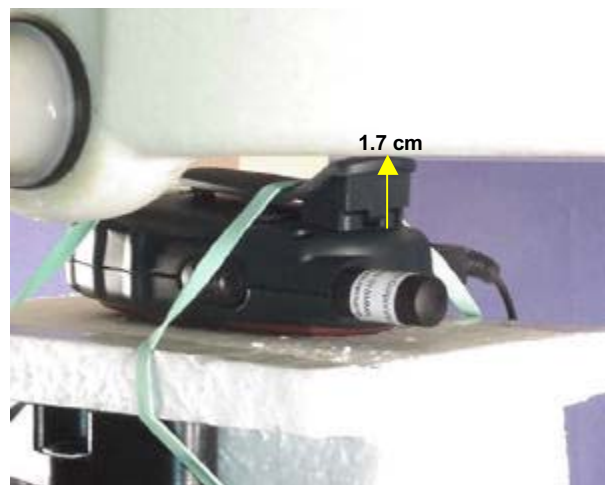
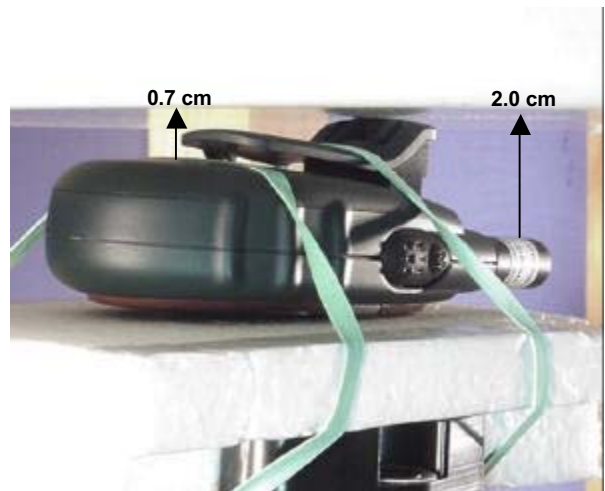
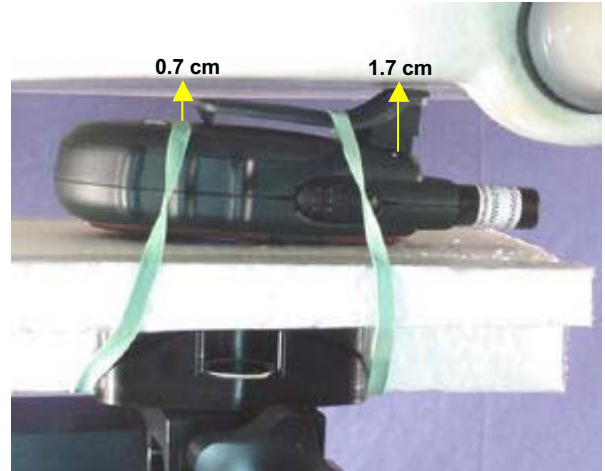
FACE-HELD SAR TEST SETUP PHOTOGRAPHS
2.5 cm Separation Distance from front of DUT to planar phantom



BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Belt-Clip Separation Distance from back of DUT to planar phantom
with Headset/Boom-Microphone Accessory



BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Belt-Clip Separation Distance from back of DUT to planar phantom
with Earpiece/Lapel-Microphone Accessory



DUT PHOTOGRAPHS



Front of DUT



Back of DUT with Belt-Clip



Left Side of DUT with Belt-Clip



Right Side of DUT with Belt-Clip



Back of EUT & Batteries



EUT with Headset/Boom-Microphone Accessory



EUT with Earpiece/Lapel-Microphone Accessory



Headset/Boom-Microphone Accessory



Earpiece/Lapel-Microphone Accessory