DECLARATION OF COMPLIANCE
SAR EVALUATION

Test Lab

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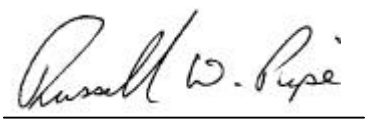
Applicant Information

MIDLAND RADIO CORPORATION
1120 Clay Street
North Kansas City, MO 64155

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:	**MMAGM222**
Model(s):	**M222P**
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:	**1.3 Watts (GMRS)**
Antenna Type(s):	**Fixed**
Battery Type(s):	**1.5V AA Alkaline (x3)**
Body-Worn Accessories:	**Belt-Clip, Earpiece/Lapel-Mic, Headset/Boom-Mic**
Max. SAR Measured:	**1.20 W/kg Face-held / 1.50 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 §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.



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: M222P Portable UHF GMRS/FRS PTT Radio Transceiver FCC ID: MMAGM222 with 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.

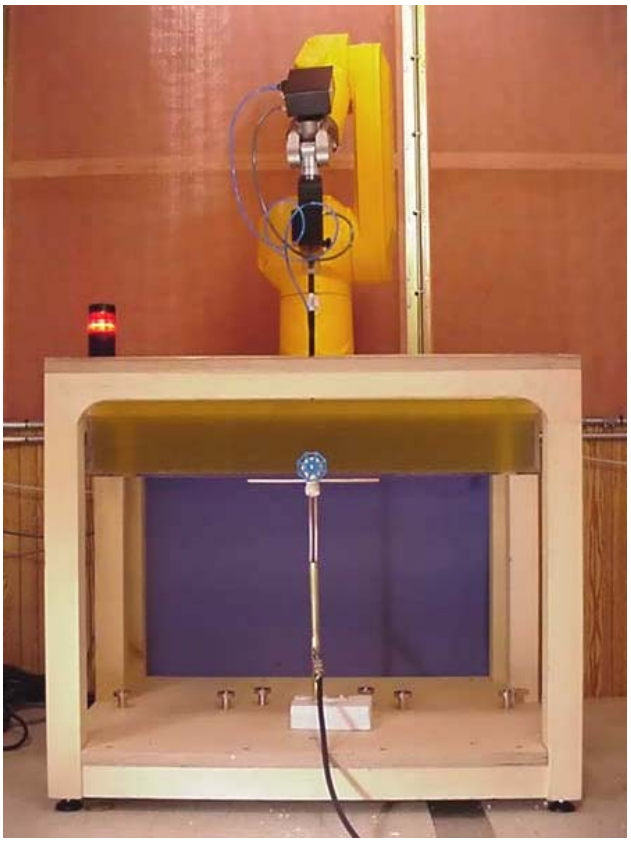
2.0 DESCRIPTION of Device Under Test (DUT)

FCC Rule Part(s)	47 CFR §2.1093
Test Procedure	FCC OET Bulletin 65, Supplement C (01-01)
Device Type	Portable GMRS/FRS PTT Radio Transceiver
FCC ID	MMAGM222
Model(s)	M222P
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	1.3 Watts (GMRS)
Battery Type(s)	1.5V AA Alkaline (x3)
Antenna Type(s)	Fixed
Body-Worn Accessories Tested	Belt-Clip, Earpiece/Lapel-Mic, Headset/Boom-Mic

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	Separation Distance (cm)	Fluid Type	SAR (w/kg)	
										100% Duty Cycle	50% Duty Cycle
Face	462.6250	18	CW	1.3 W	-0.18	Alkaline	-	2.5	Brain	1.20	0.600
Body	462. 6250	18	CW	1.3 W	-0.11	Alkaline	Earpiece	1.0	Muscle	1.31	0.655
Body	462. 6250	18	CW	1.3 W	-0.16	Alkaline	Headset	1.0	Muscle	1.50	0.750

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	102.7 kPa
	Target	Measured	Target	Measured	Relative Humidity	34 %
	43.5	44.2	56.7	57.4	Ambient Temperature	22.5 °C
Conductivity	Brain 450MHz		Body 450MHz		Fluid Temperature	˜ 21.0 °C
	Target	Measured	Target	Measured	Fluid Depth	≥ 15 cm
	0.87	0.85	0.94	0.90	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]).

5.0 DETAILS OF SAR EVALUATION

The Midland Radio Corporation Model: M222P Portable UHF GMRS/FRS PTT Radio Transceiver FCC ID: MMAGM222 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 SAM planar phantom. A 2.5 cm separation distance was maintained between the front side of the DUT and the outer surface of the SAM 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 SAM planar phantom. The attached belt-clip was touching the planar phantom and provided a 1.0 cm separation distance between the back of the DUT and the outer surface of the SAM planar phantom. The DUT was first tested for body-worn SAR with earpiece/lapel-microphone accessory connected, and subsequently with headset/boom-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 continuously 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.

Face-held SAR Test Setup

Body-worn SAR Test Setup

6.0 EVALUATION PROCEDURES

a. The SAR evaluation was performed using the applicable phantom type depending on the 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. 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 15mm x 15mm.
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.

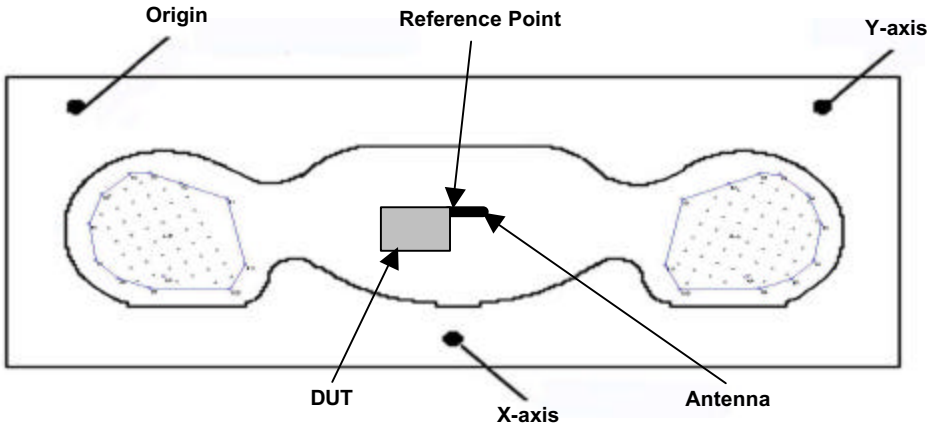


Figure 1. Phantom Reference Point & DUT Positioning (Face-held)

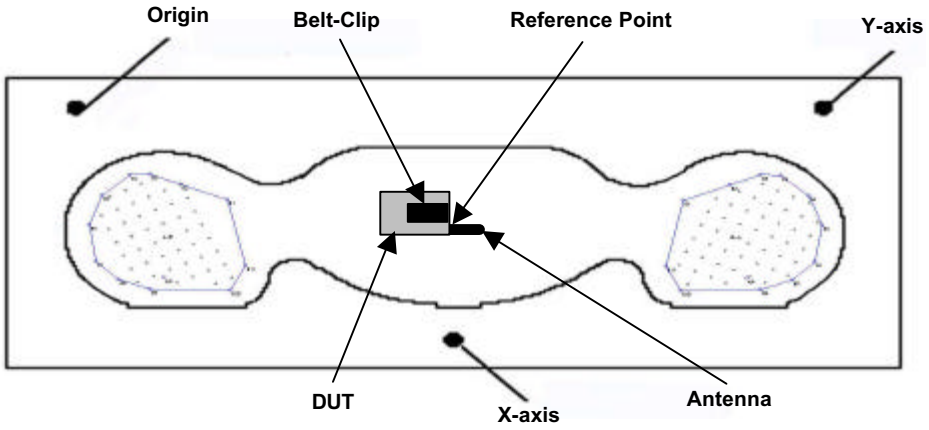


Figure 2. Phantom Reference Point & DUT Positioning (Body-worn)

7.0 SYSTEM VALIDATION

Prior to the evaluation the system was verified using a planar phantom with a 450MHz dipole (see Appendix C for dipole calibration procedure). The simulated tissue fluids were verified 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 ±10% (see Appendix B for system validation test plot).

SYSTEM VALIDATION											
Test Date	Equiv. Tissue	Target SAR 1g (w/kg)	Measured 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				
10/11/02	450MHz (Brain)	1.44	1.36	43.5 ±5%	44.2	0.87 ±5%	0.85	1000	22.5 °C	21.0 °C	≥ 15 cm

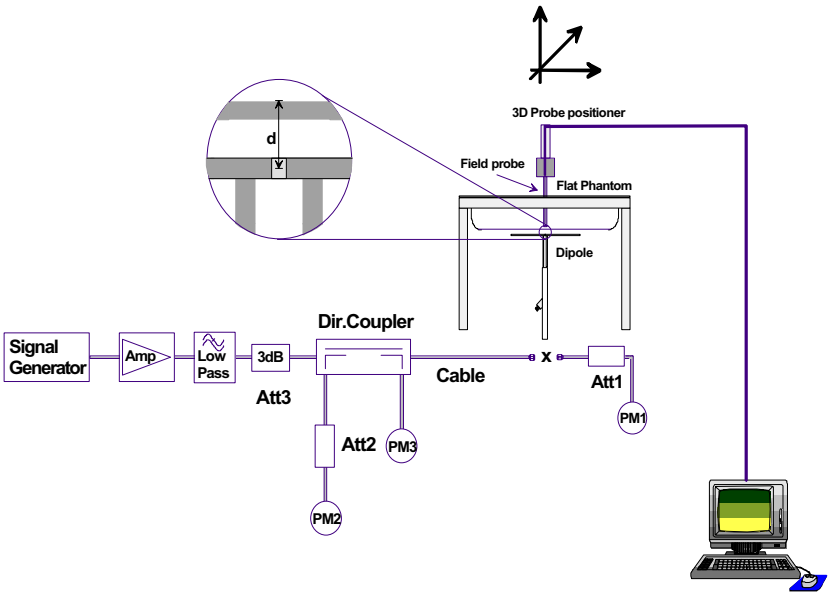


Figure 3. System Validation Setup Diagram

450MHz Dipole Validation Setup

8.0 SIMULATED TISSUES

The 450MHz 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		
INGREDIENT	**450MHz Brain (System Validation & 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 ≤ 450MHz)

Type:	Large Planar Phantom
Shell Material:	Plexiglas
Bottom Thickness:	6.2 mm ± 0.1mm
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 ± 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

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 2001 Oct 2001 June 2001 June 2001 Oct 2001 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 2001
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 ±%	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) (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.

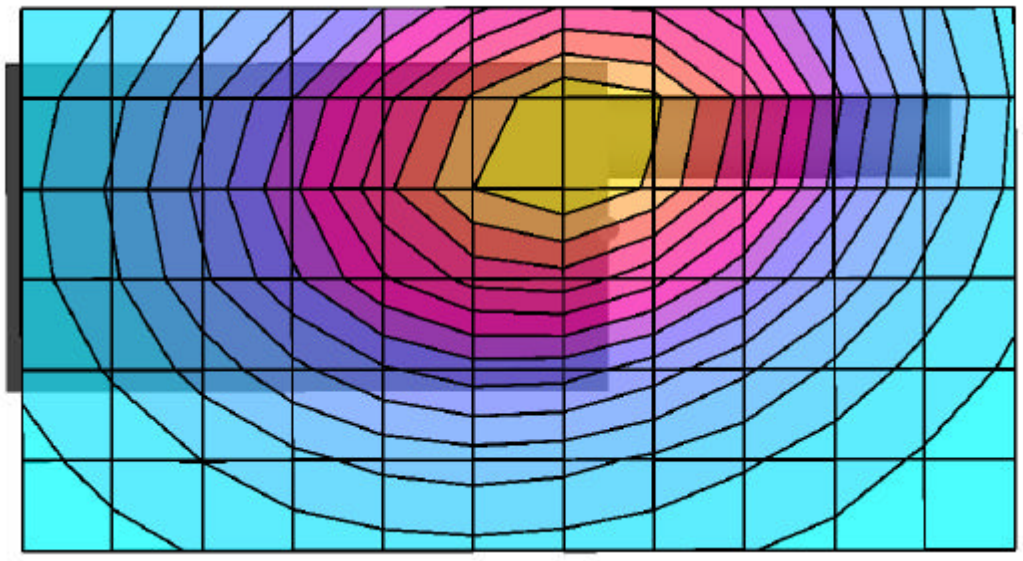
[3] IEEE Standards Coordinating Committee 34, Std 1528-200X, “DRAFT Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

APPENDIX A - SAR MEASUREMENT DATA

Midland Radio Corporation FCC ID: MMAGM222

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1387; ConvF(7.30,7.30,7.30); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.85$ mho/m $\varepsilon_r = 44.2$ $\rho = 1.00$ g/cm^3
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.18 dB
SAR (1g): 1.20 mW/g, SAR (10g): 0.837 mW/g

Face-held SAR at 2.5 cm Separation Distance
M222P UHF GMRS/FRS PTT Radio Transceiver
1.5V AA Alkaline Batteries (x3)
Continuous Wave Mode
GMRS Mid Channel [462.6250 MHz]
Conducted Power: 1.3 Watts
Ambient Temp. 22.5°C; Fluid Temp. 21.0°C
Date Tested: October 11, 2002

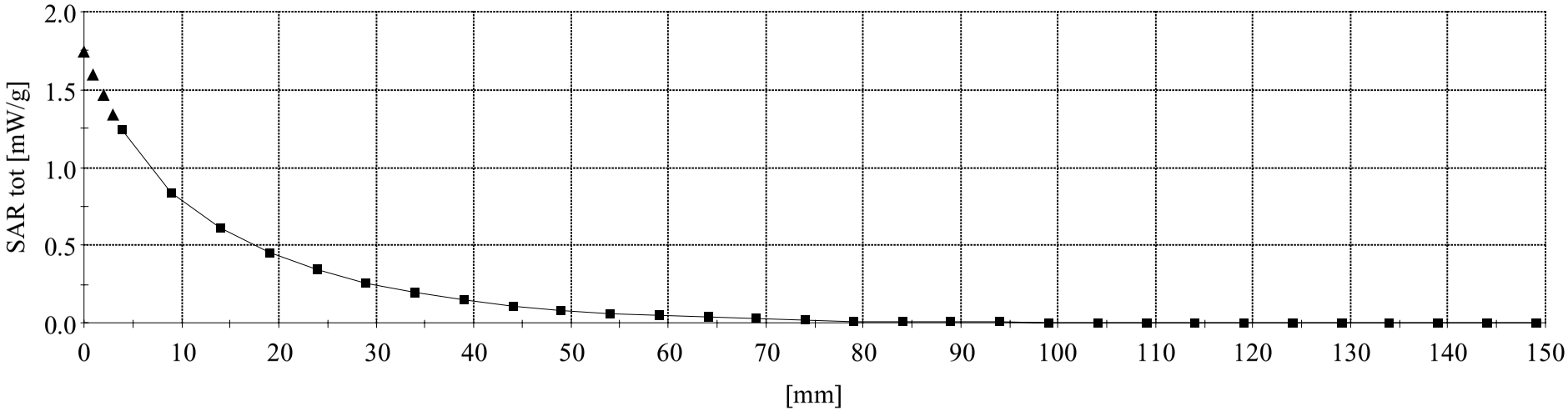


Midland Radio Corporation FCC ID: MMAGM222

SAM Phantom; Flat Section
Probe: ET3DV6 - SN1387; ConvF(7.30,7.30,7.30); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.85$ mho/m $\varepsilon_r = 44.2$ $\rho = 1.00$ g/cm^3

Z-Axis Extrapolation at Peak SAR Location

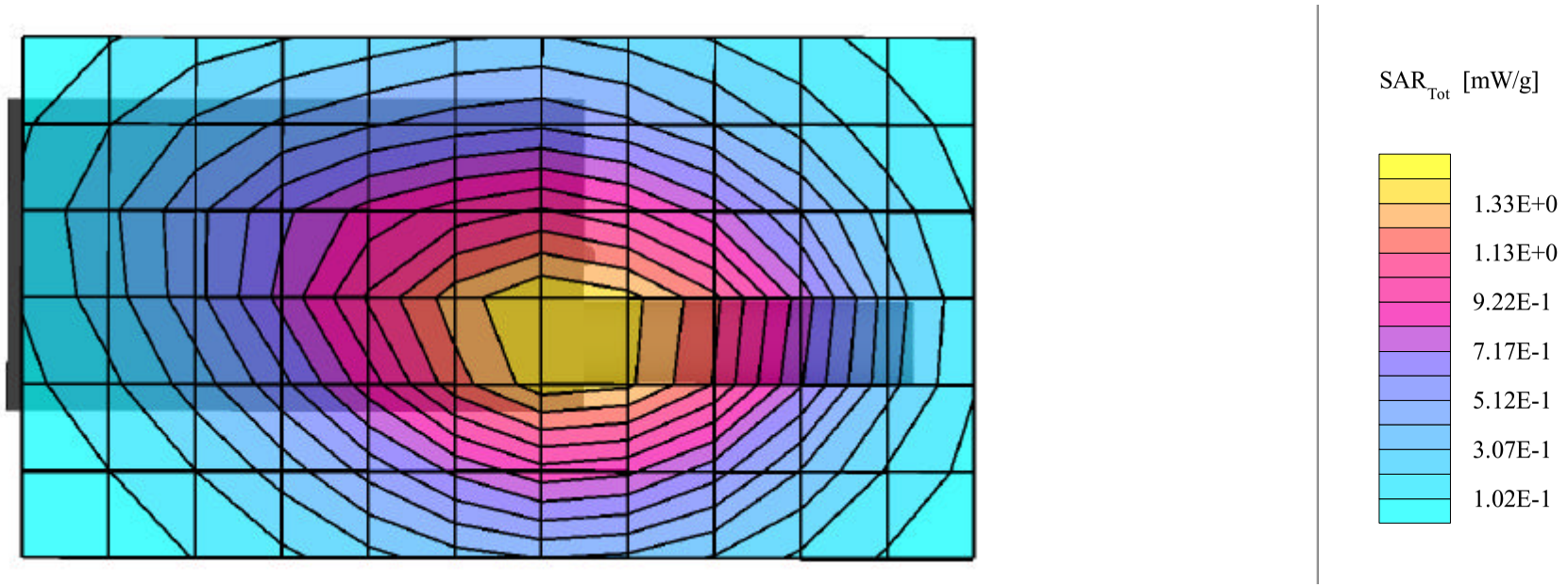
Face-held SAR at 2.5 cm Separation Distance
M222P UHF GMRS/FRS PTT Radio Transceiver
1.5V AA Alkaline Batteries (x3)
Continuous Wave Mode
GMRS Mid Channel [462.6250 MHz]
Conducted Power: 1.3 Watts
Ambient Temp. 22.5°C; Fluid Temp. 21.0°C
Date Tested: October 11, 2002



Midland Radio Corporation FCC ID: MMAGM222

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.90$ mho/m $\varepsilon_r = 57.4$ $\rho = 1.00$ g/cm^3
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.11 dB
SAR (1g): 1.31 mW/g, SAR (10g): 0.921 mW/g

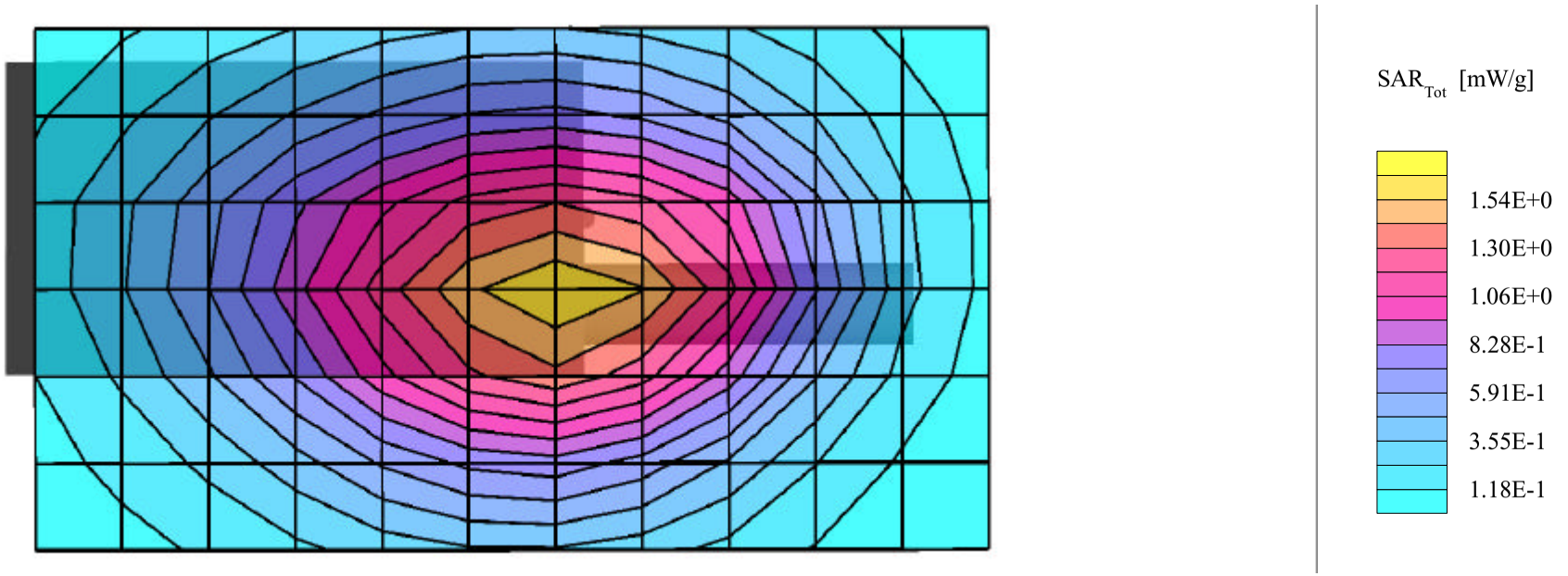
Body-Worn SAR with 1.0 cm Belt-Clip Separation
M222P UHF GMRS/FRS PTT Radio Transceiver
with Earpiece/Lapel-Microphone Accessory
1.5V AA Alkaline Batteries (x3)
Continuous Wave Mode
GMRS Mid Channel [462.6250 MHz]
Conducted Power: 1.3 Watts
Ambient Temp. 22.5°C; Fluid Temp. 21.0°C
Date Tested: October 11, 2002



Midland Radio Corporation FCC ID: MMAGM222

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: σ = 0.90 mho/m ε_r = 57.4 ρ = 1.00 g/cm^3
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Cube 5x5x7; Powerdrift: -0.16 dB
SAR (1g): 1.50 mW/g, SAR (10g): 1.05 mW/g

Body-Worn SAR with 1.0 cm Belt-Clip Separation
M222P UHF GMRS/FRS PTT Radio Transceiver
with Headset/Boom-Microphone Accessory
1.5V AA Alkaline Batteries (x3)
Continuous Wave Mode
GMRS Mid Channel [462.6250 MHz]
Conducted Power: 1.3 Watts
Ambient Temp. 22.5°C; Fluid Temp. 21.0°C
Date Tested: October 11, 2002



Midland Radio Corporation FCC ID: MMAGM222

SAM Phantom; Flat Section
Probe: ET3DV6 - SN1387; ConvF(7.70,7.70,7.70); Crest factor: 1.0
450 MHz Muscle: $\sigma = 0.90$ mho/m $\varepsilon_r = 57.4$ $\rho = 1.00$ g/cm^3

Z-Axis Extrapolation at Peak SAR Location

Body-Worn SAR with 1.0 cm Belt-Clip Separation
M222P UHF GMRS/FRS PTT Radio Transceiver
with Headset/Boom-Microphone Accessory
1.5V AA Alkaline Batteries (x3)
Continuous Wave Mode
GMRS Mid Channel [462.6250 MHz]
Conducted Power: 1.3 Watts
Ambient Temp. 22.5°C; Fluid Temp. 21.0°C
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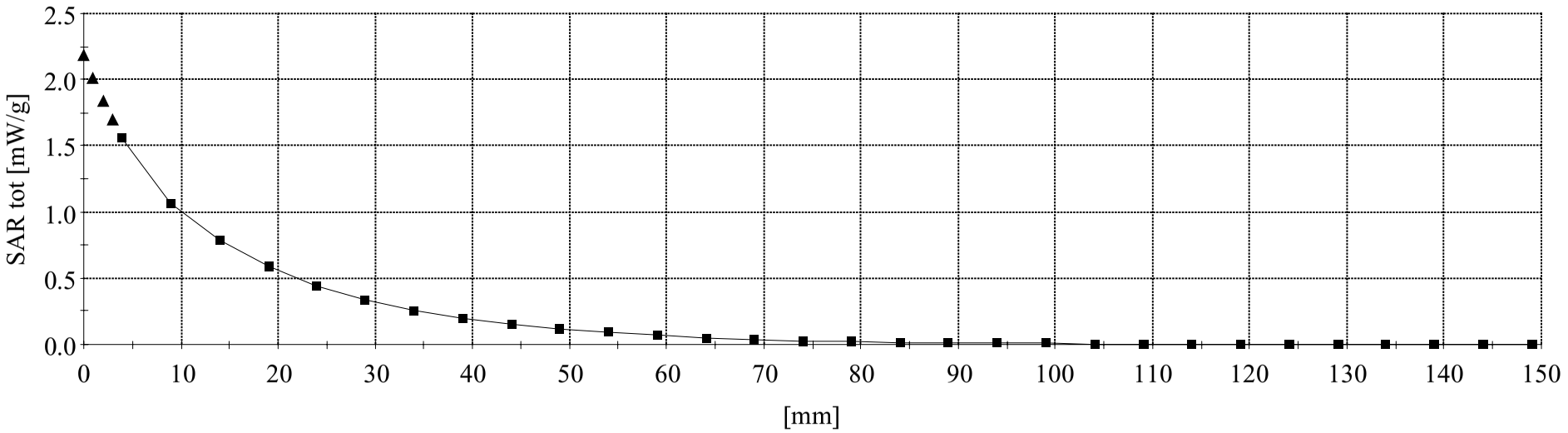


APPENDIX B - SYSTEM VALIDATION

Dipole 450MHz

Large Planar Phantom; Planar Section

Probe: ET3DV6 - SN1387; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Brain: $\sigma = 0.85$ mho/m $\varepsilon_r = 44.2$ $\rho = 1.00$ g/cm^3

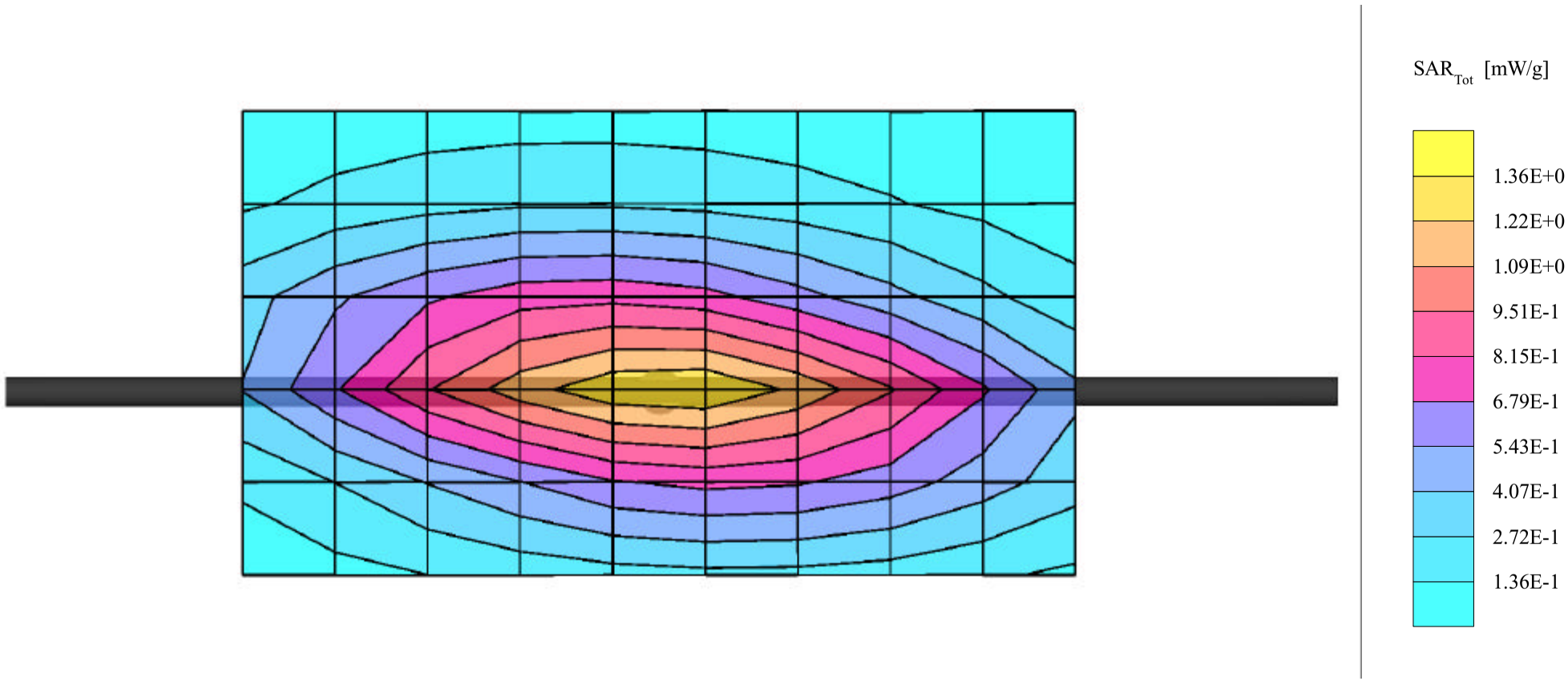
Cube 5x5x7: Peak: 2.18 mW/g, SAR (1g): 1.36 mW/g, SAR (10g): 0.883 mW/g, (Worst-case extrapolation)

Penetration depth: 12.1 (10.4, 14.3) [mm]; Ambient Temp. 22.5°C; Fluid Temp. 21.0°C

Powerdrift: -0.09 dB

450MHz Dipole Validation

Date: October 11, 2002



APPENDIX C - DIPOLE CALIBRATION

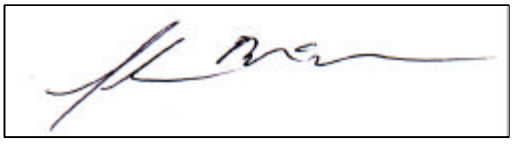
Celltech
Testing and Engineering Services Lab

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: 

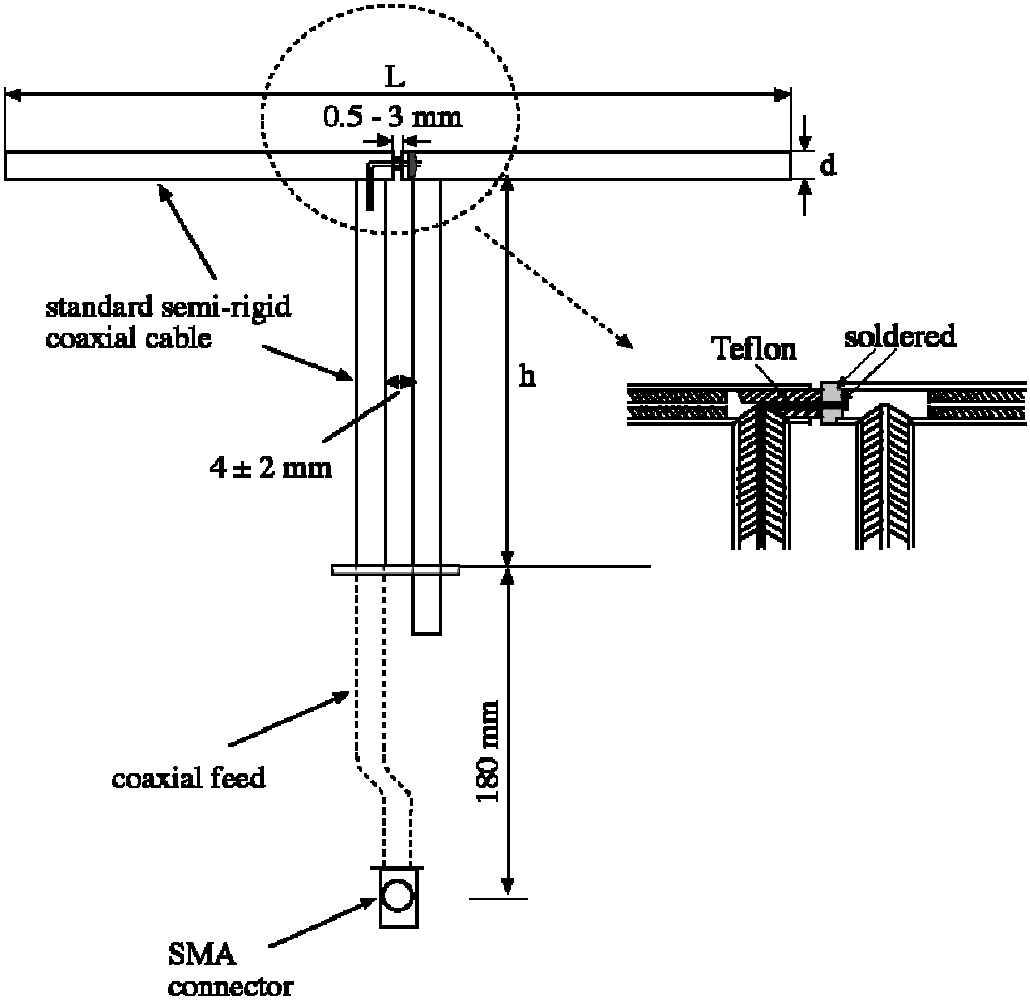
Approved by: 

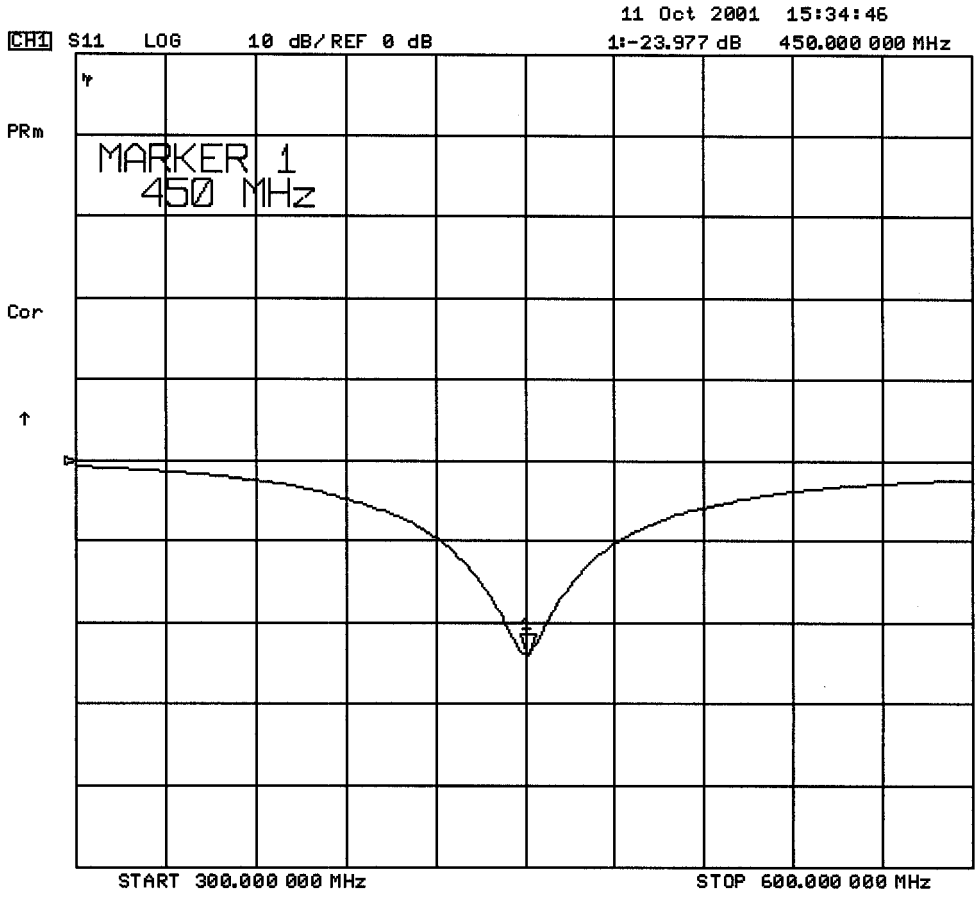
Celltech Research Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
www.celltechlabs.com

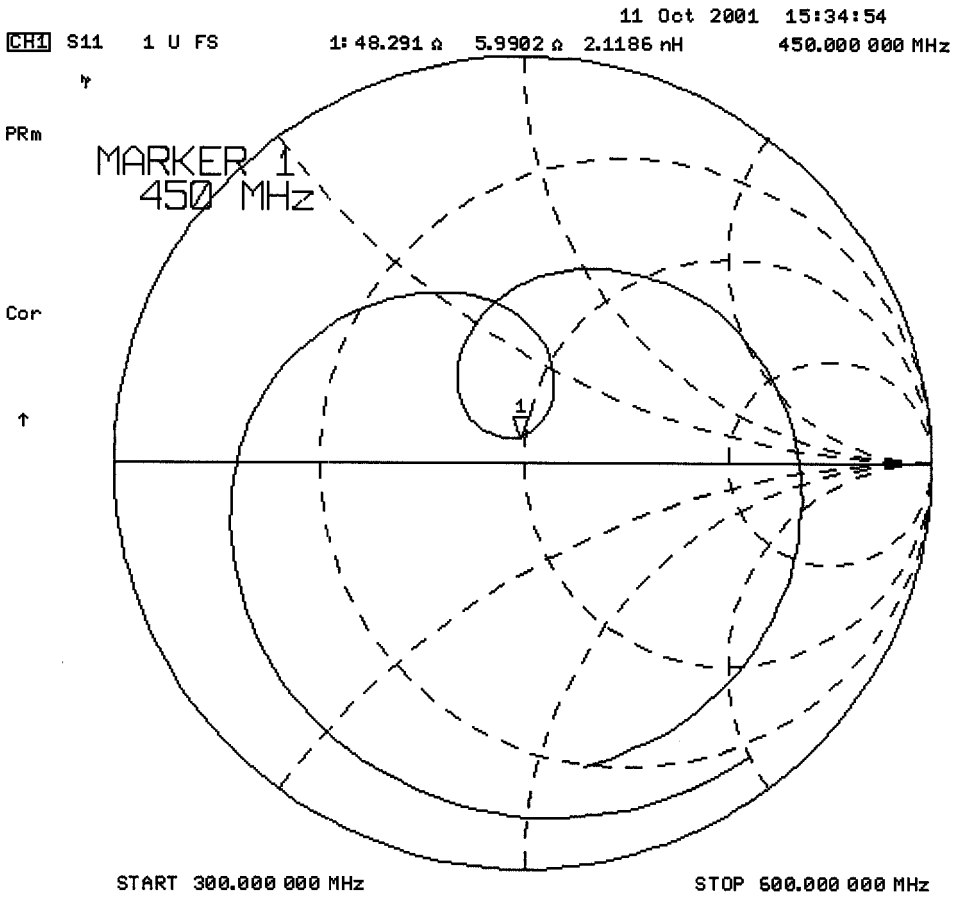
1. Dipole Construction & Electrical Characteristics

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	Re{Z} = 48.291Ω
	Im{Z} = 5.9902Ω
Return Loss at 450MHz	-23.9777dB




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

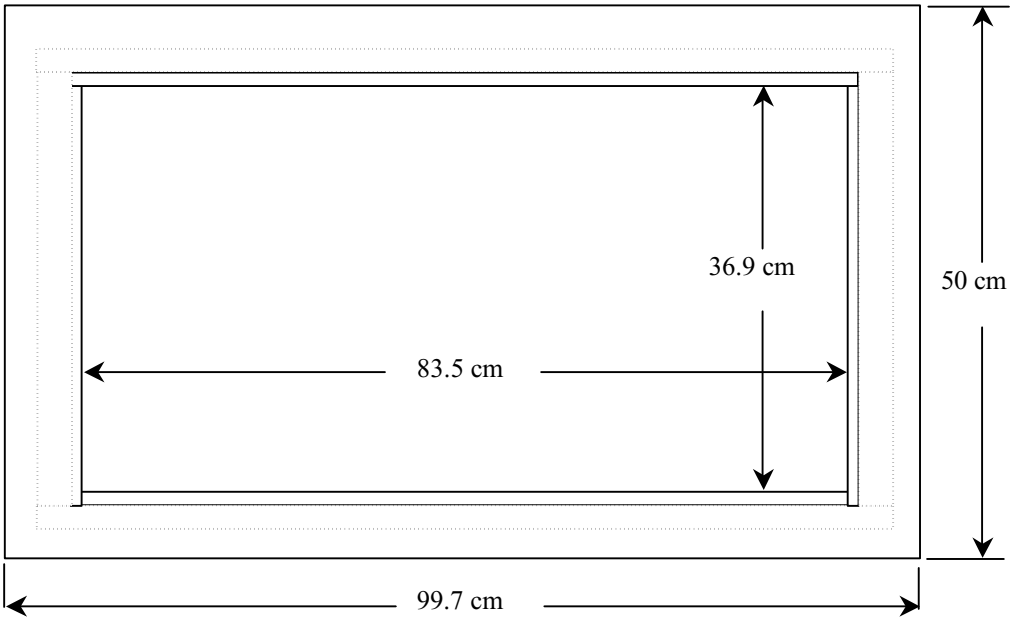
2. Validation Phantom

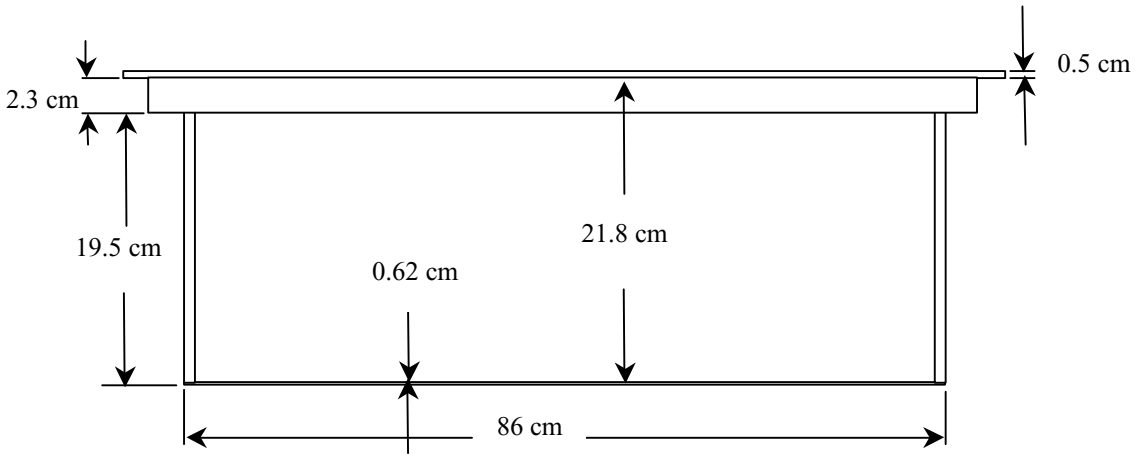
The validation phantom was constructed using relatively low-loss tangent Plexiglas material. The dimensions of the phantom are as follows:

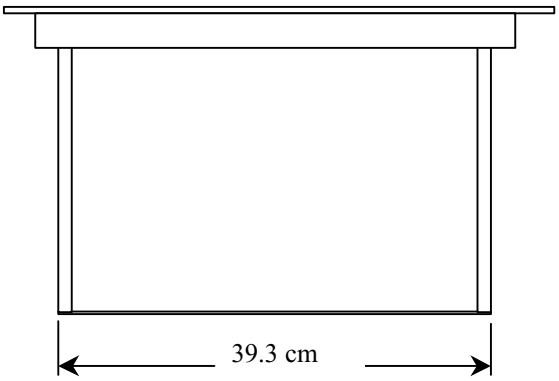
Length: 83.5 cm
Width: 36.9 cm
Height: 21.8 cm

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

Dimensions of Plexiglas Planar Phantom







450MHz Dipole Calibration Setup

450MHz Dipole Calibration Setup

3. Measurement Conditions

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

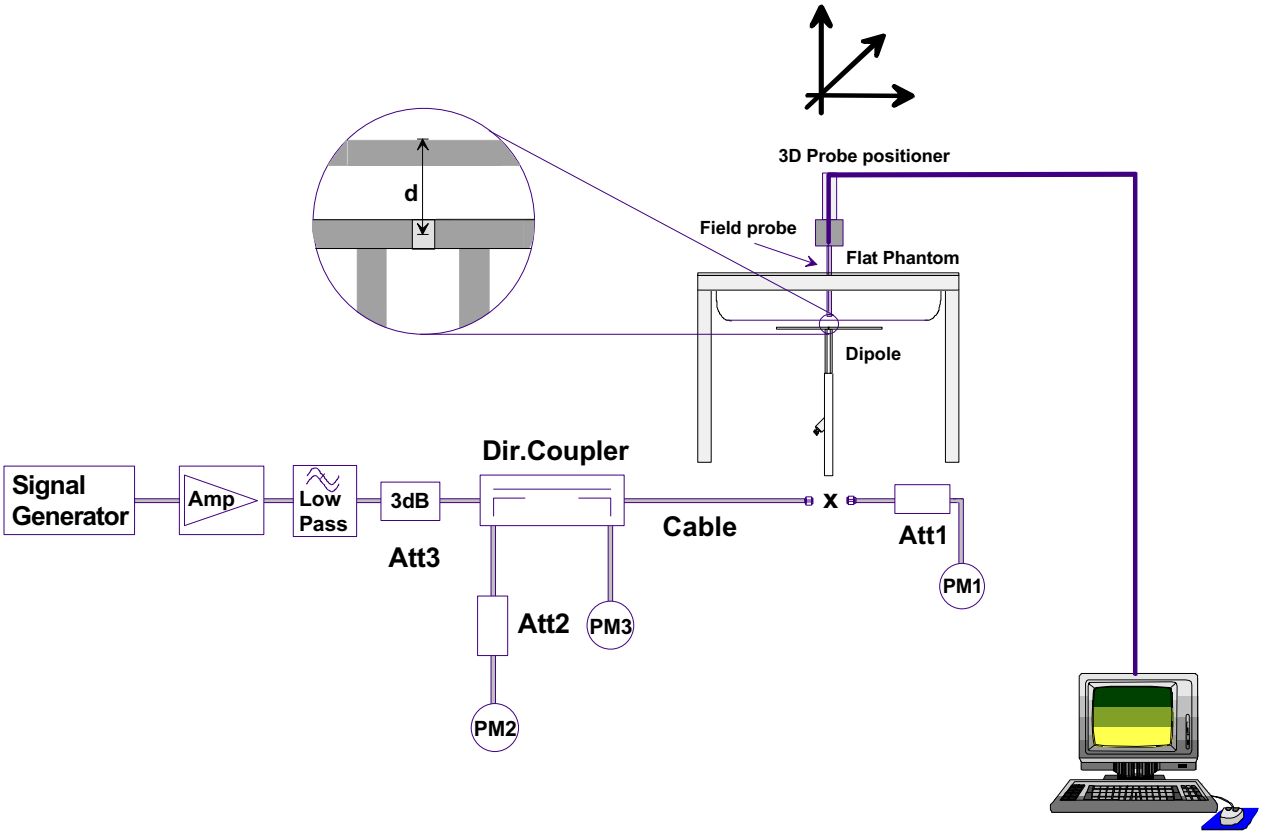
Relative Permitivity:	43.5 ± 5%
Conductivity:	0.86 mho/m ± 5%
Temperature:	23.1°C

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	ε_r = 43.5 σ = 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

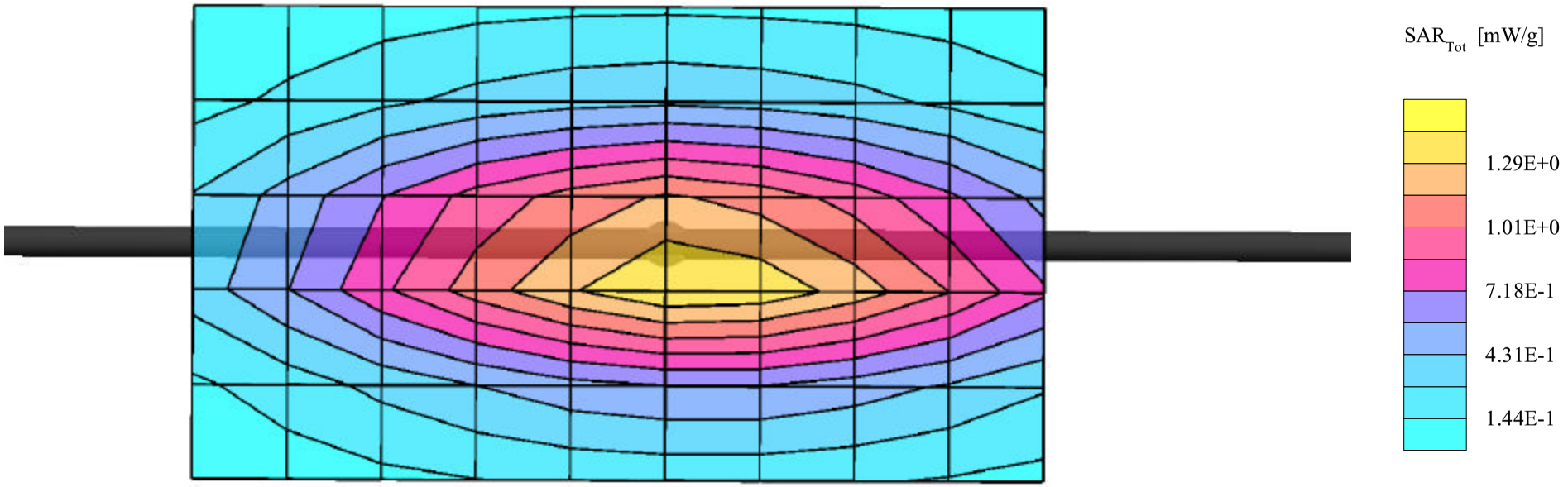
The results have been normalized to 1W (forward power) into the dipole.

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

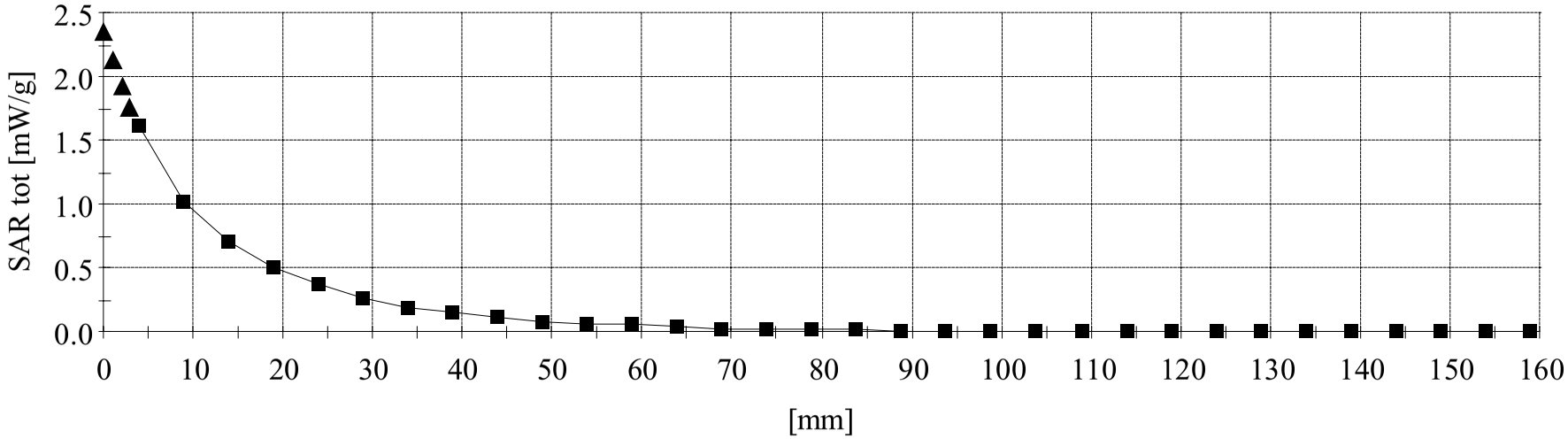
Frequency: 450 MHz; Antenna Input Power: 250 [mW]
Large Planar Phantom; Planar Section
Probe: ET3DV6 - SN1590; ConvF(7.36,7.36,7.36); Crest factor: 1.0
450 MHz Brain: $\sigma = 0.87$ mho/m $\varepsilon_r = 43.5$ $\rho = 1.00$ g/cm^3
Cube 5x5x7: Peak: 2.34 mW/g, SAR (1g): 1.47 mW/g, SAR (10g): 0.963 mW/g, (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

Large Planar 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

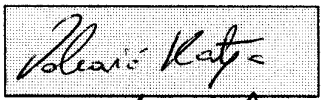
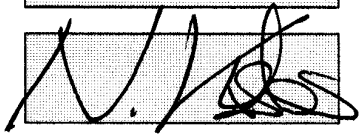
Calibration Certificate

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

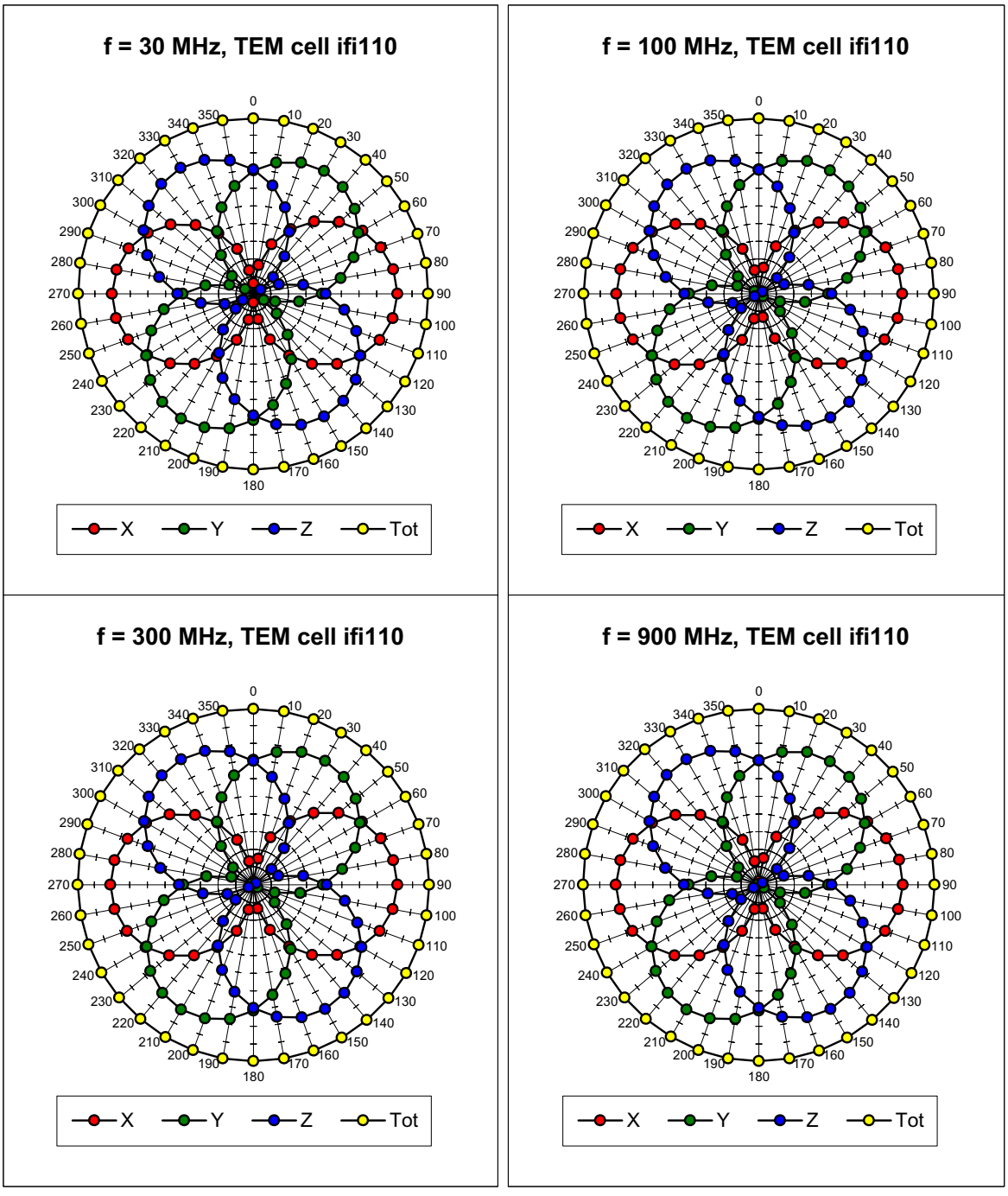
Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

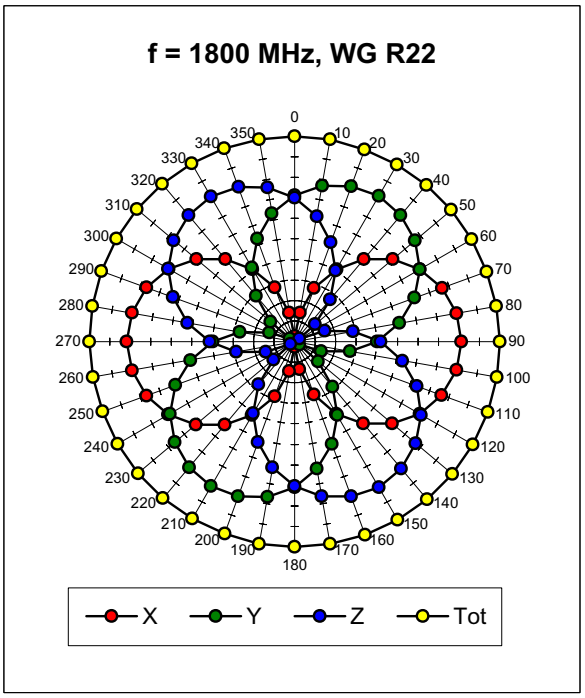
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	11.5	7.3
SAR_{be} [%]	With Correction Algorithm	0.1	0.3

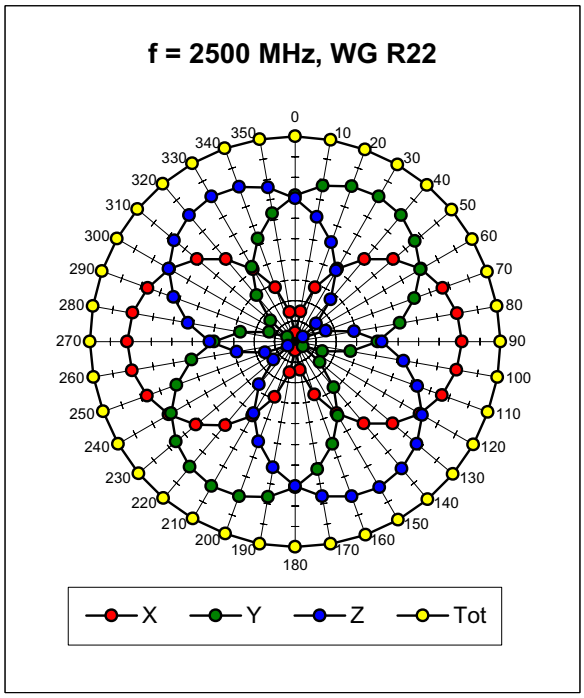
Sensor Offset

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

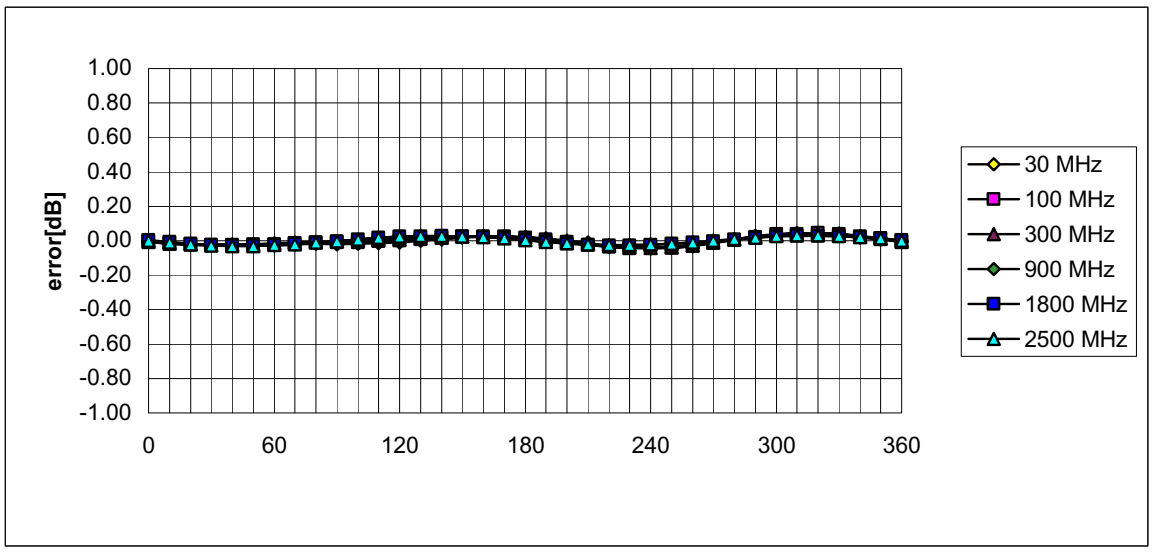
Receiving Pattern (ϕ , θ = 0°





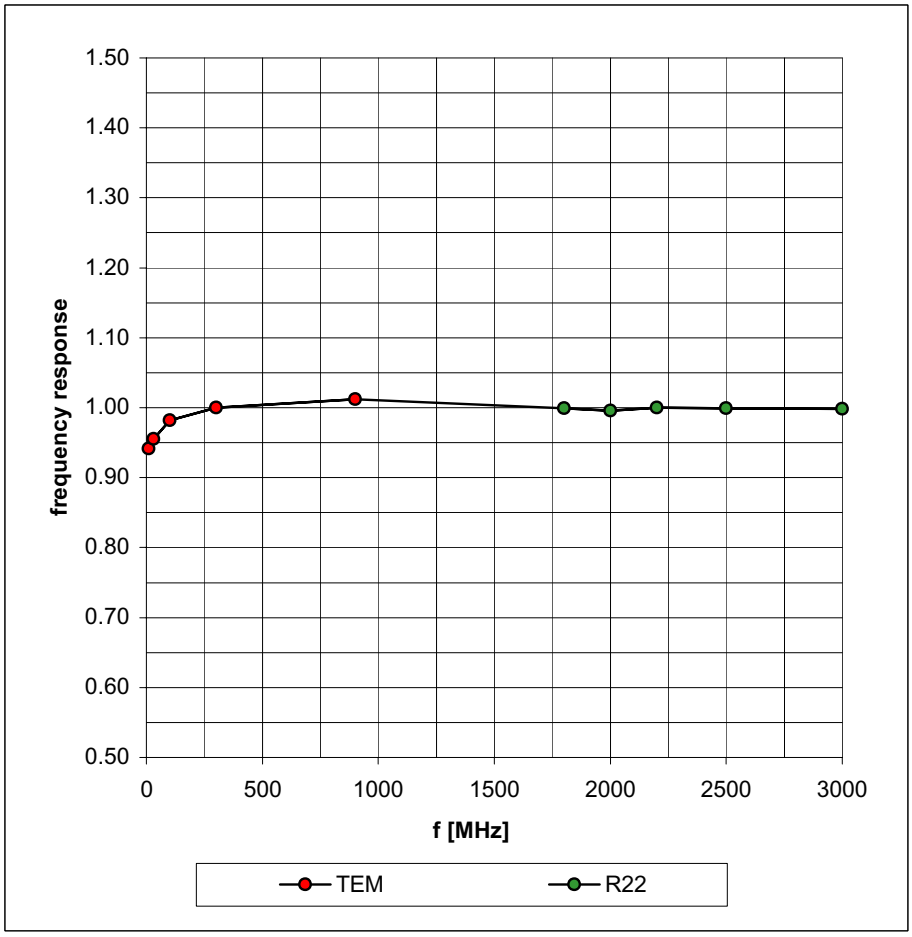


Isotropy Error (ϕ), θ = 0°



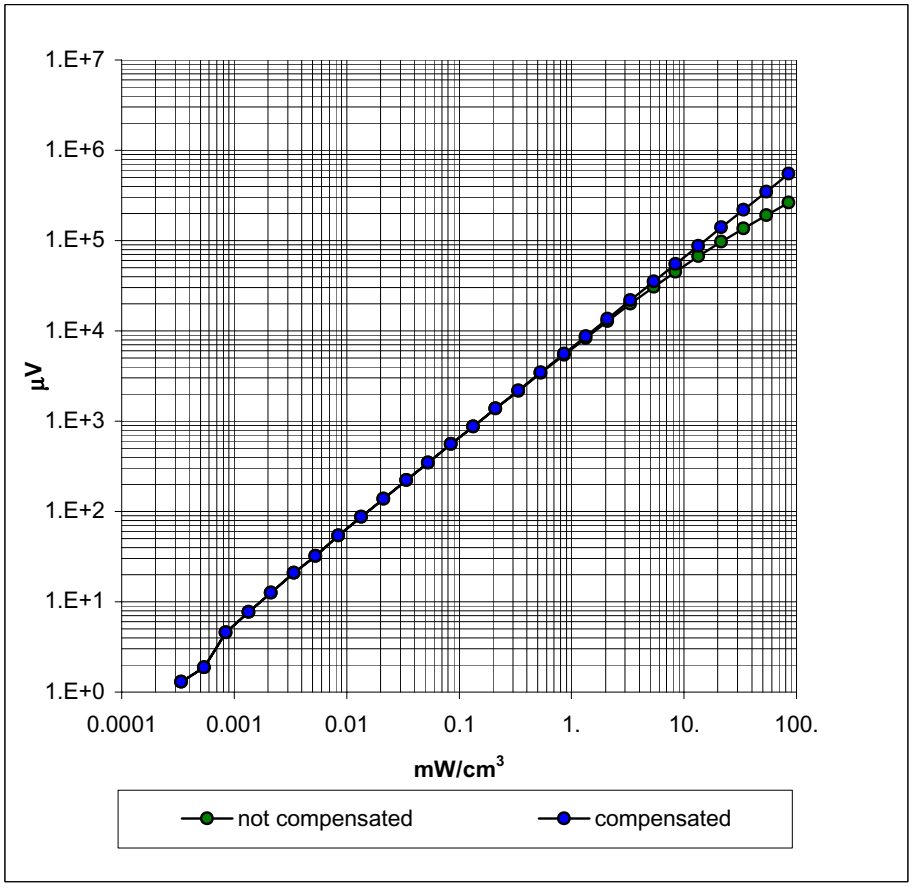
Frequency Response of E-Field

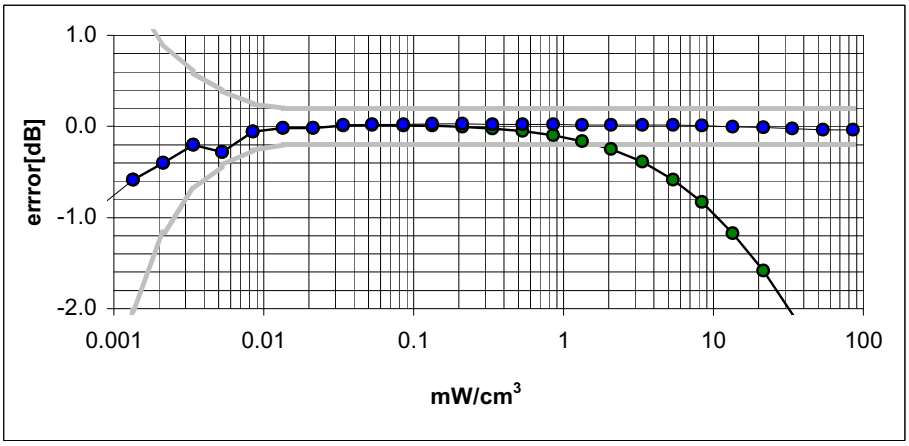
(TEM-Cell:ifi110, Waveguide R22)



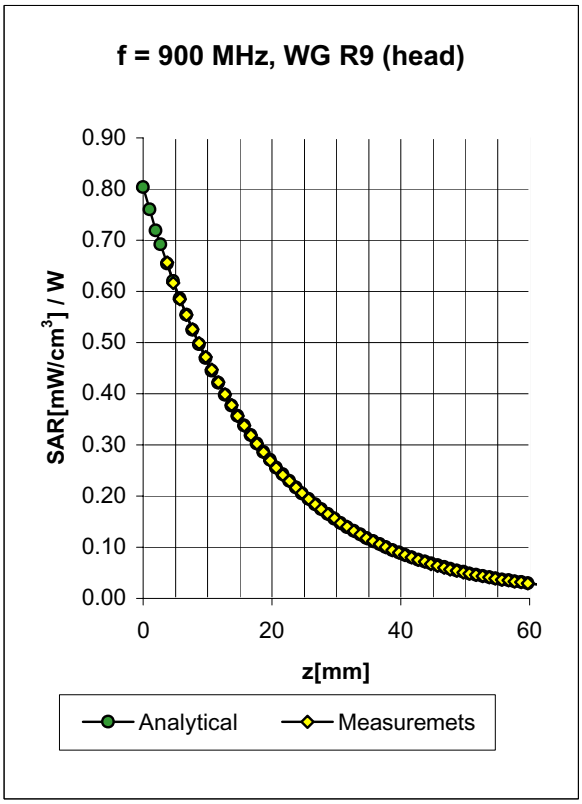
Dynamic Range f(SAR_{brain})

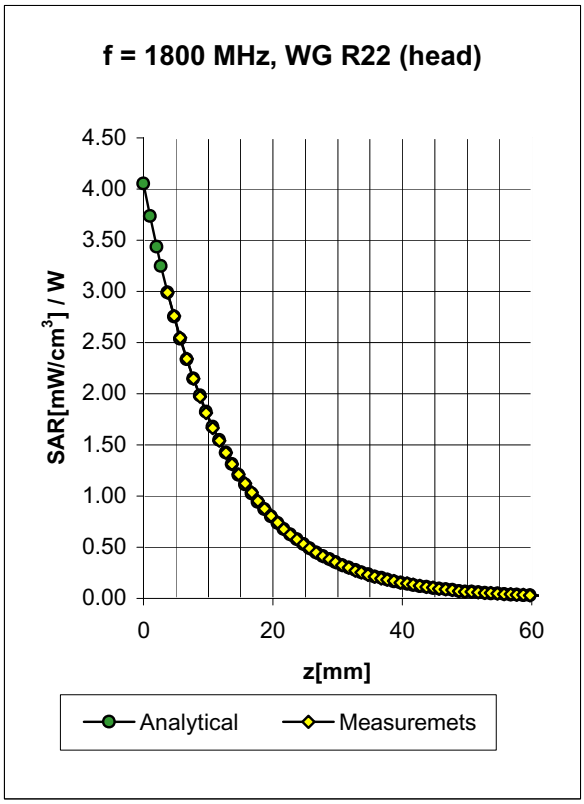
(Waveguide R22)





Conversion Factor Assessment



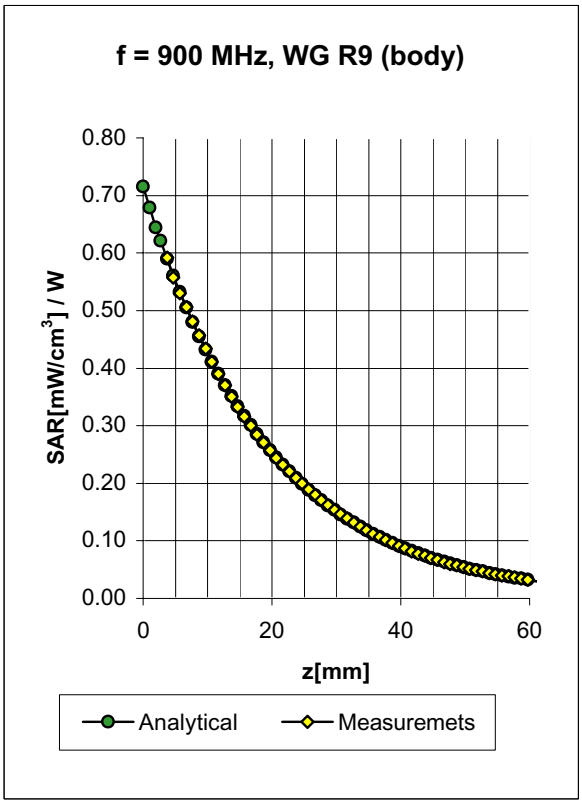


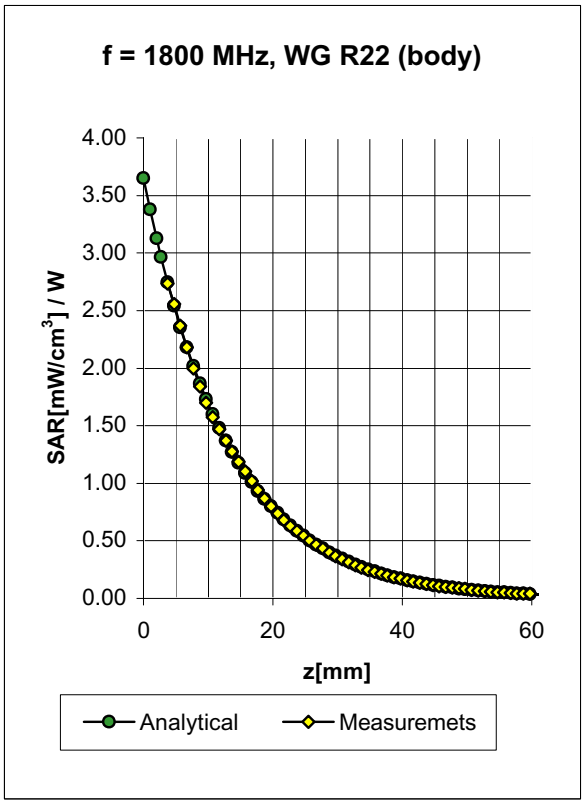
Head	**900 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.97 ± 5% mho/m**
Head	**835 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.90 ± 5% mho/m**
	ConvF X	**6.6** ± 9.5% (k=2)		Boundary effect:
	ConvF Y	**6.6** ± 9.5% (k=2)		Alpha **0.40**
	ConvF Z	**6.6** ± 9.5% (k=2)		Depth **2.38**

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





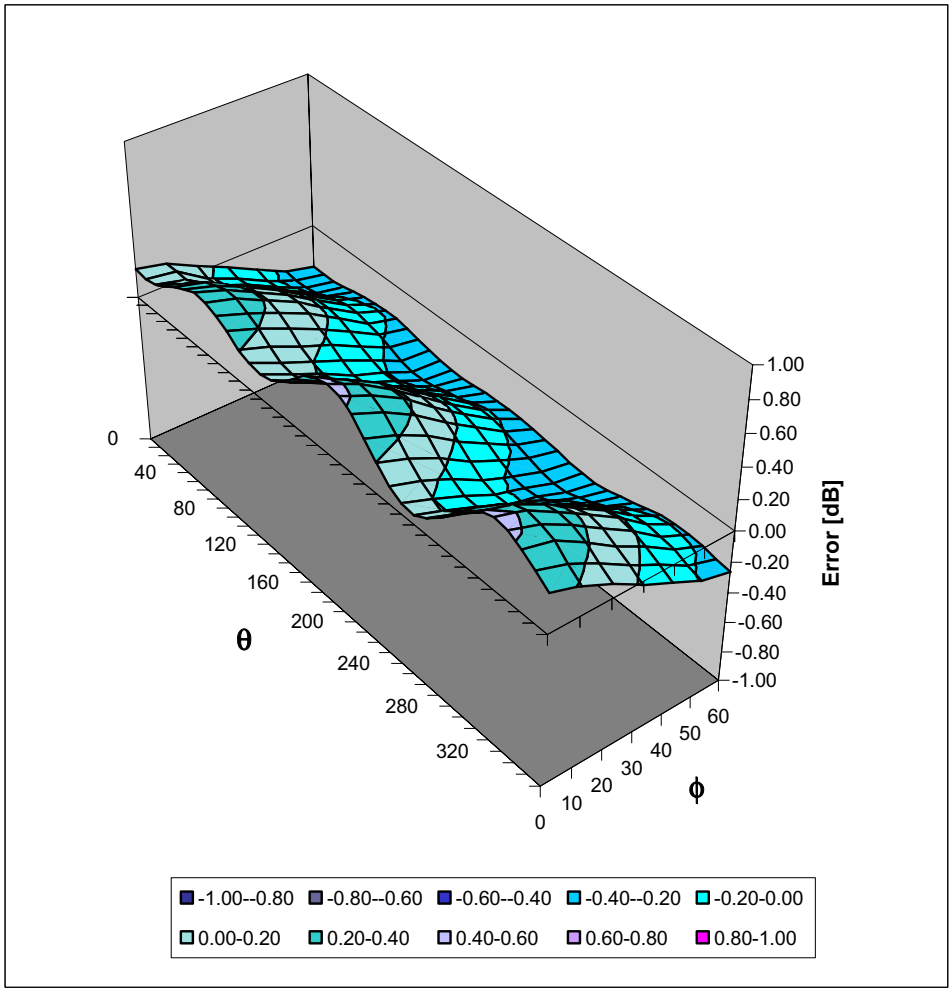
Body	**900 MHz**	ε_r **= 55.0 ± 5%**	**σ = 1.05 ± 5% mho/m**	
Body	**835 MHz**	ε_r **= 55.2 ± 5%**	**σ = 0.97 ± 5% mho/m**	
	ConvF X	**6.3** ± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.3** ± 9.5% (k=2)	Alpha	**0.42**
	ConvF Z	**6.3** ± 9.5% (k=2)	Depth	**2.44**

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 & DUT Evaluation (Face)

Measured Fluid Dielectric Parameters (Brain)

October 11, 2002

Frequency	e'	e''
350.000000 MHz	46.5322	39.3059
360.000000 MHz	46.2842	38.6284
370.000000 MHz	46.0024	38.1153
380.000000 MHz	45.8045	37.6292
390.000000 MHz	45.5120	37.1598
400.000000 MHz	45.3244	36.5952
410.000000 MHz	45.0624	36.0276
420.000000 MHz	44.8371	35.5018
430.000000 MHz	44.5868	34.9456
440.000000 MHz	44.3782	34.4754
450.000000 MHz	44.1562	34.0469
460.000000 MHz	43.9708	33.6773
470.000000 MHz	43.7660	33.3627
480.000000 MHz	43.5605	32.9912
490.000000 MHz	43.2895	32.6983
500.000000 MHz	43.0778	32.3912
510.000000 MHz	42.8784	32.0110
520.000000 MHz	42.6937	31.6760
530.000000 MHz	42.5045	31.3709
540.000000 MHz	42.3568	30.9509
550.000000 MHz	42.1888	30.6119

450MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

October 11, 2002

Frequency	e'	e''
350.000000 MHz	59.1260	41.8126
360.000000 MHz	58.9227	41.0870
370.000000 MHz	58.7361	40.4066
380.000000 MHz	58.5833	39.8092
390.000000 MHz	58.3602	39.1438
400.000000 MHz	58.2410	38.5332
410.000000 MHz	58.0795	37.8949
420.000000 MHz	57.9397	37.3411
430.000000 MHz	57.7809	36.7646
440.000000 MHz	57.6171	36.2813
450.000000 MHz	57.4234	35.8524
460.000000 MHz	57.3572	35.3676
470.000000 MHz	57.2152	34.9899
480.000000 MHz	57.0930	34.5499
490.000000 MHz	56.8734	34.1298
500.000000 MHz	56.6836	33.8062
510.000000 MHz	56.5215	33.4202
520.000000 MHz	56.3828	33.1097
530.000000 MHz	56.2290	32.7803
540.000000 MHz	56.1549	32.3863
550.000000 MHz	56.0304	32.1044

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].

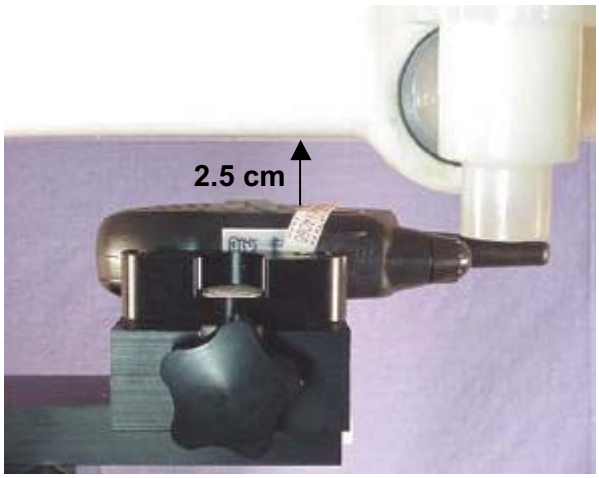
Date 18.11.2001

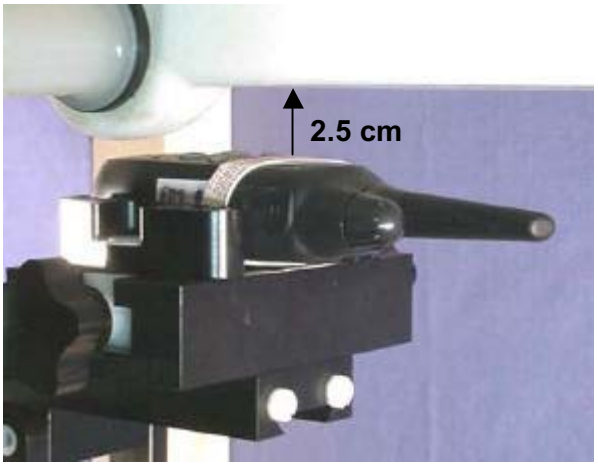
Signature / Stamp Schmid & Partner Engineering AG
Zeughausstrasse 43, CH-8004 Zurich
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

APPENDIX G - SAR TEST SETUP & DUT PHOTOGRAPHS

FACE-HELD SAR TEST SETUP PHOTOGRAPHS

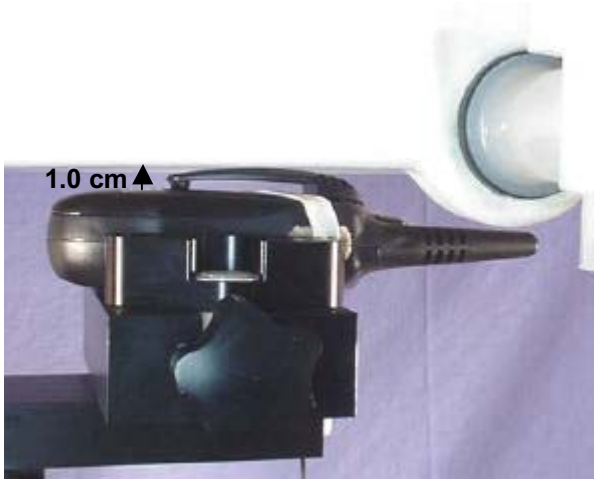
2.5 cm Separation Distance from front of DUT to planar phantom





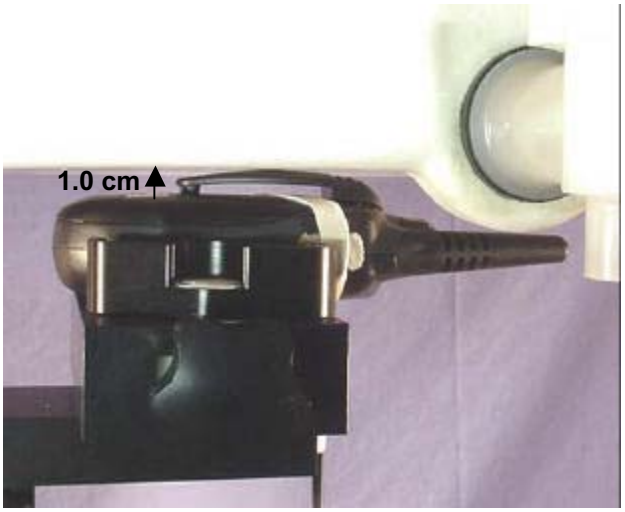
BODY-WORN SAR TEST SETUP PHOTOGRAPHS

1.0 cm Belt-Clip Separation Distance from back of DUT to planar phantom with Earpiece/Lapel-Microphone



BODY-WORN SAR TEST SETUP PHOTOGRAPHS

1.0 cm Belt-Clip Separation Distance from back of DUT to planar phantom with Headset/Boom-Microphone



DUT PHOTOGRAPHS

Front of DUT

Back of DUT with Belt-Clip

Left Side of DUT with Belt-Clip

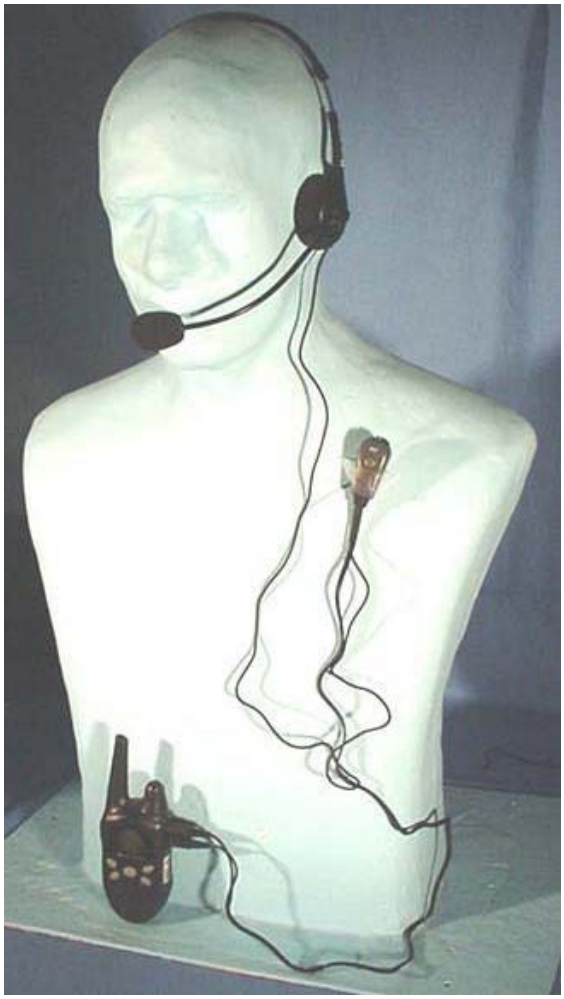
Right Side of DUT with Belt-Clip

Earpiece/Lapel-Microphone Accessory

Headset/Boom-Microphone Accessory

DUT PHOTOGRAPHS

DUT with Earpiece/Lapel-Microphone



DUT with Headset/Boom-Microphone