

DECLARATION OF COMPLIANCE SAR EVALUATION

Test Lab

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Applicant Information

HITACHI DATA SYSTEMS
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Rule Part(s):	FCC 47 CFR §2.1093
Test Procedure(s):	FCC OET Bulletin 65, Supplement C (01-01)
FCC Device Classification:	Part 15 Spread Spectrum Transmitter (DSS)
FCC ID:	Q9Z-PC5NR3-J
Trade Name / Model:	PC5NR3-XXXXXXXXXX
Device Type:	PC Tablet with internal Agere Systems Mini-PCI DSSS WLAN Module
Tx Frequency Range:	2412 - 2462 MHz
Max. Output Power Tested:	15.4 dBm Conducted (2462 MHz)
Modulation:	DSSS
Battery Type:	Lithium-Ion 11.1V, 1.7Ah (Hitachi Model: PC-AB5900) Lithium-Ion 11.1V, 3.4Ah (Hitachi Model: PC-AB5910)
Antenna Type:	Dual Internal
Max. SAR Measured:	0.572 W/kg (Top Side – Left Antenna – Standard Battery)

Celltech Labs 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 Labs Inc. The results and statements contained in this report pertain only to the device(s) evaluated.



Russell Pipe
Senior Compliance Technologist
Celltech Labs Inc.



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1.0 INTRODUCTION

This measurement report demonstrates that the HITACHI DATA SYSTEMS Model: PC5NR3 PC Tablet FCC ID: Q9Z-PC5NR3-J with internal Agere Systems Mini-PCI DSSS WLAN Module complies with the RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) for the General Population 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, operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

2.0 DESCRIPTION of Equipment Under Test (EUT)

FCC Rule Part(s)	47 CFR §2.1093
Test Procedure	FCC OET Bulletin 65, Supplement C (01-01)
FCC Device Classification	Part 15 Spread Spectrum Transmitter (DSS)
Device Type	PC Tablet with internal Agere Systems Mini-PCI DSSS WLAN Module
FCC ID	Q9Z-PC5NR3-J
Model	Hitachi PC5NR3-XXXXXXXXXX
Serial No.	Z9A65C010
Tx Frequency Range	2412 - 2462 MHz
Max. RF Output Power Tested	15.4 dBm Conducted (2462 MHz)
Antenna Type	PCB Diversity
Battery Type(s)	Lithium-Ion 11.1V, 1.7Ah (Hitachi Model: PC-AB5900) Lithium-Ion 11.1V, 3.4Ah (Hitachi Model: PC-AB5910)

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

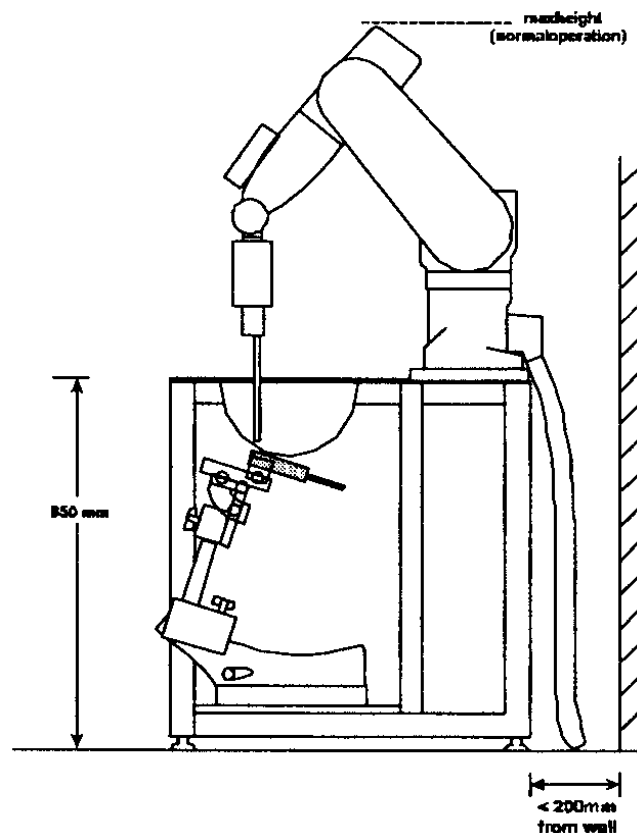


Figure 1. DASY3 Compact Version - Side View

4.0 MEASUREMENT SUMMARY

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

BODY SAR MEASUREMENT RESULTS									
Freq. (MHz)	Mode	Battery	Conducted Power (dBm)		Phantom Section	Antenna	Laptop PC Position to Planar Phantom	Separation Distance (cm)	Measured SAR 1g (W/kg)
			Before	After					
2437	DSSS	Standard	15.3	15.1	Planar	Left	Back	0.0	0.0698
2437	DSSS	Standard	15.3	15.3	Planar	Left	Top	0.0	0.572
2437	DSSS	Standard	15.3	15.2	Planar	Left	Left	0.0	0.157
2437	DSSS	Standard	15.3	15.2	Planar	Right	Back	0.0	0.103
2437	DSSS	Standard	15.3	15.2	Planar	Right	Top	0.0	0.0960
2437	DSSS	Standard	15.3	15.4	Planar	Right	Right	0.0	0.330
2437	DSSS	Extended	15.3	15.3	Planar	Left	Top	0.0	0.0865
2437	DSSS	Extended	15.3	15.4	Planar	Right	Right	0.0	0.328
ANSI / IEEE C95.1 1992 - SAFETY LIMIT BODY: 1.6 W/kg (averaged over 1 gram) Spatial Peak - Uncontrolled Exposure / General Population									
Test Date(s)		08/07/03			Relative Humidity		45 %		
Measured Mixture Type		2450MHz Muscle			Atmospheric Pressure		101.5 kPa		
Dielectric Constant ϵ_r		Target	Measured		Ambient Temperature		25.5 °C		
		52.7 ±5%	50.1		Fluid Temperature		23.8 °C		
Conductivity σ (mho/m)		Target	Measured		Fluid Depth		≥ 15 cm		
		1.95 ±5%	1.99		ρ (Kg/m ³)		1000		

Note(s):

1. If the SAR measurements performed at the middle channel were ≥ 3 dB below the SAR limit, then SAR evaluation for the low and high channels was optional (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 shown above were consistent for all measurement periods.
3. The dielectric properties of the simulated body fluid were verified prior to the evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters).
4. Left and right antenna positions are referenced in EUT profile photos in appendix G.

5.0 DETAILS OF SAR EVALUATION

The HITACHI DATA SYSTEMS Model: PC5NR3 PC tablet FCC ID: Q9Z-PC5NR3-J with internal Agere Systems Mini-PCI DSSS WLAN Module was found to be compliant for localized Specific Absorption Rate based on the following test provisions and conditions described below. The detailed test setup photographs are shown in Appendix G.

1. The EUT was tested for body SAR with the back (back of LCD display) of the PC tablet facing parallel to, and touching, the outer surface of the planar phantom. Both the left and right sides of the back of the PC tablet were evaluated due to the dual antenna placement internal to the EUT.
2. The EUT was tested for body SAR with the top (antenna edge) of the PC tablet facing parallel to, and touching, the outer surface of the planar phantom. Both the left and right sides of the top of the PC tablet were evaluated due to the dual antenna placement internal to the EUT.
3. The EUT was tested for body SAR with the left side of the PC tablet (left antenna) facing parallel to the outer surface of the planar phantom (0.0 cm separation distance).
4. The EUT was tested for body SAR with the right of the PC tablet (right antenna) facing parallel to the outer surface of the planar phantom (0.0 cm separation distance).
5. The conducted power levels were measured before and after each test using a Gigatronics 8652A Universal Power Meter according to the procedures described in FCC 47 CFR §2.1046. If the conducted power level measured after the SAR evaluation varied more than 5% from the initial power level, then the EUT was retested. Any unusual anomalies over the course of the test also warranted a re-evaluation.
6. Due to the dimensions of the EUT the initial coarse scans did not cover the entire area of the PC tablet in some configurations. Subsequently, a second coarse scan was performed to show there were no secondary SAR locations within 3dB of the primary cube values. At this time there is no approved flat phantom available that is twice the dimensions of the PC tablet.
7. The EUT was tested with all accessories attached (microphone, earphones, mouse, keyboard).
8. Due to the accessories' plug-in position on the right side, two scans were required on the right side of the PC tablet. One scan, with the accessories, to cover the primary cube scan location only. A second scan, without the accessories, covers the whole device to show that there is no other hotspot location within 3 dB of the primary cube measured.
9. Due to the larger size (increased separation distance) of the extended battery, the worst case configuration (top side with left antenna) used from the standard battery, resulted in a lower SAR value. A second scan, with the second worst configuration (right side with right antenna), was then done to show the difference in SAR between the two batteries with the same separation distance found with the standard battery.
10. The EUT was controlled via internal software and tested in modulated fixed frequency continuous transmit mode (100% duty cycle).
11. The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the device and its antenna(s).
12. The EUT was tested with a fully charged battery.
13. Due to the dimensions of the EUT, a stack of low-density, low-loss dielectric foamed polystyrene was used in place of the device holder.

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.)

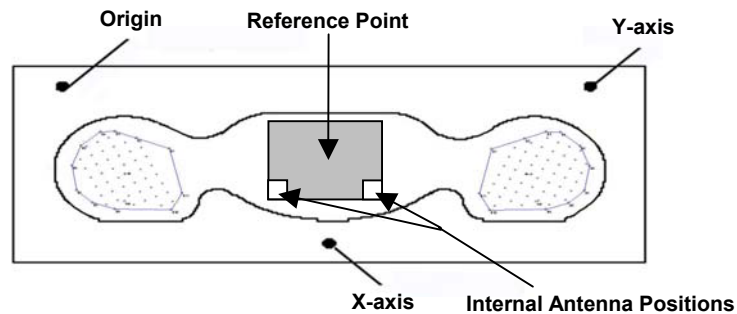


**Figure 2. Phantom Reference Point & EUT Positioning
Back of PC Tablet (Back of LCD Display)**

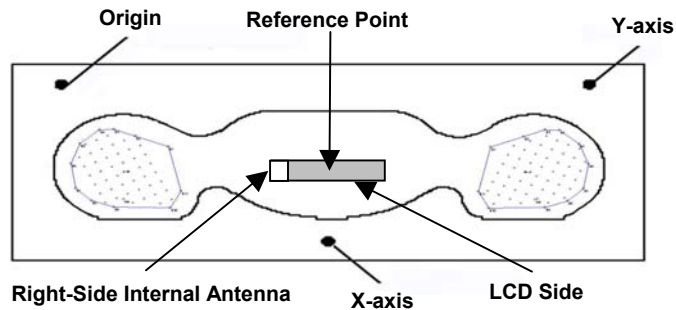


**Figure 3. Phantom Reference Point & EUT Positioning
Right Side of PC Tablet - Right-Side Antenna**

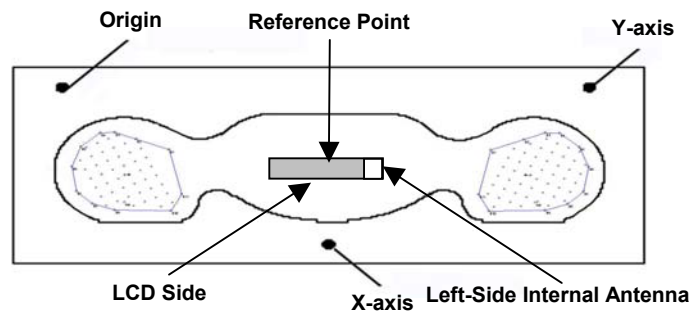


**Figure 4. Phantom Reference Point & EUT Positioning
Left Side of PC Tablet - Left-Side Antenna**

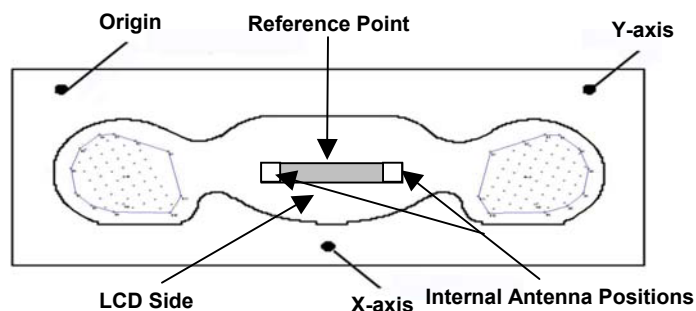


**Figure 5. Phantom Reference Point & EUT Positioning
Top Side of PC Tablet**

7.0 SYSTEM PERFORMANCE CHECK

Prior to the assessment a system performance check was performed in the planar section of the SAM phantom with a 2450MHz dipole (see Appendix C for detailed system validation procedures). The fluids were verified 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 250 mW was applied to the dipole and the system was verified to a tolerance of $\pm 10\%$ (see Appendix B for system check test plot).

SYSTEM PERFORMANCE CHECK											
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
08/07/03	2450MHz (Brain)	Target	Measured	Target	Measured	Target	Measured	1000	25.5 °C	23.8 °C	≥ 15 cm
		13.1 ±10%	14.3	39.2 ±5%	37.3	1.80 ±5%	1.86				

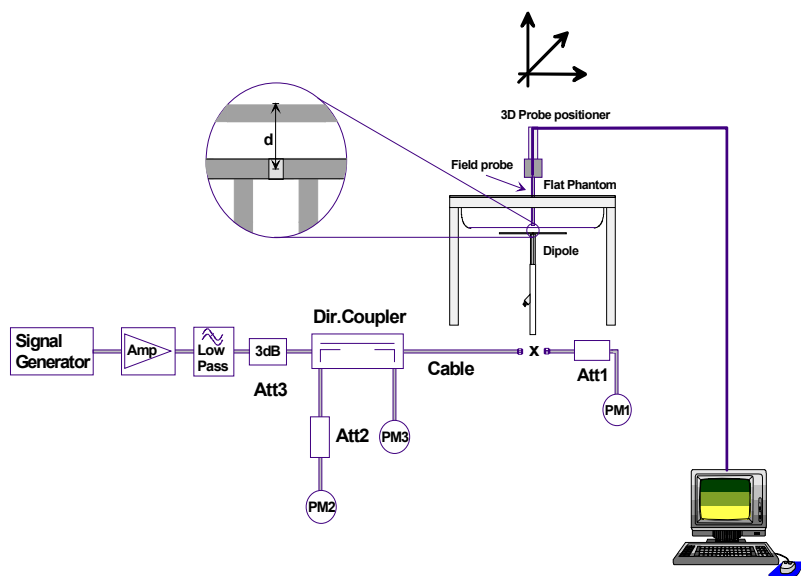


Figure 6. System Performance Check Setup Diagram



2450MHz System Performance Check Setup

8.0 EQUIVALENT TISSUES

The 2450MHz brain and body mixtures consist of Glycol-monobutyl, water, and salt (body mixture only). The fluid was prepared according to standardized procedures and measured for dielectric parameters (permittivity and conductivity).

TISSUE MIXTURES		
INGREDIENT	2450MHz Brain (System Performance Check)	2450MHz Body (EUT Evaluation)
Water	55.20 %	69.95 %
Glycol Monobutyl	44.80 %	30.00 %
Salt	-	0.05 %

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 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

Notes:

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

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)

Phantom

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

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 SAM PHANTOM V4.0C

The SAM phantom V4.0C is a fiberglass shell phantom with a 2.0 mm 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

13.0 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

14.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
TEST EQUIPMENT	SERIAL NO.	CALIBRATION DATE
Schmid & Partner DASY3 System	-	-
-Robot	599396-01	N/A
-ET3DV6 E-Field Probe	1387	Feb 2003
-300MHz Validation Dipole	135	Oct 2002
-450MHz Validation Dipole	136	Oct 2002
-900MHz Validation Dipole	054	June 2003
-1800MHz Validation Dipole	247	June 2003
-2450MHz Validation Dipole	150	Oct 2002
-SAM Phantom V4.0C	N/A	N/A
-Planar Phantom	N/A	N/A
-Validation Planar Phantom	N/A	N/A
HP 85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8651A Power Meter	8650137	April 2003
Gigatronics 8652A Power Meter	1835267	April 2003
Power Sensor 80701A	1833542	Feb 2003
Power Sensor 80701A	1833699	April 2003
HP E4408B Spectrum Analyzer	US39240170	Dec 2002
HP 8594E Spectrum Analyzer	3543A02721	April 2003
HP 8753E Network Analyzer	US38433013	May 2003
HP 8648D Signal Generator	3847A00611	May 2003
Amplifier Research 5S1G4 Power Amplifier	26235	N/A

15.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
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)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (target)	± 10.0	Rectangular	√3	0.6	± 3.5	∞
Liquid permittivity (measured)	± 10.0	Rectangular	√3	0.6	± 3.5	∞
Combined Standard Uncertainty					± 14.0	
Expanded Uncertainty (k=2)					± 28.0	

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

MEASUREMENT UNCERTAINTIES (Cont.)

UNCERTAINTY BUDGET FOR SYSTEM VALIDATION						
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	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0	Rectangular	√3	1	± 1.2	∞
Input Power	± 4.7	Rectangular	√3	1	± 2.7	∞
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)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty						
					± 9.9	
Expanded Uncertainty (k=2)						
					± 19.8	

16.0 REFERENCES

- [1] Federal Communications Commission, "Radiofrequency radiation exposure evaluation: portable devices", Rule Part 47 CFR §2.1093: 1999.
- [2] Health Canada, "Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz", Safety Code 6.
- [3] 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.
- [4] Industry Canada, "Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields", Radio Standards Specification RSS-102 Issue 1 (Provisional): September 1999.
- [5] 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".
- [6] W. Gander, *Computermathematick*, Birkhaeuser, Basel: 1992.

APPENDIX B - SYSTEM PERFORMANCE CHECK

Dipole 2450 MHz

SAM Phantom; Flat Section

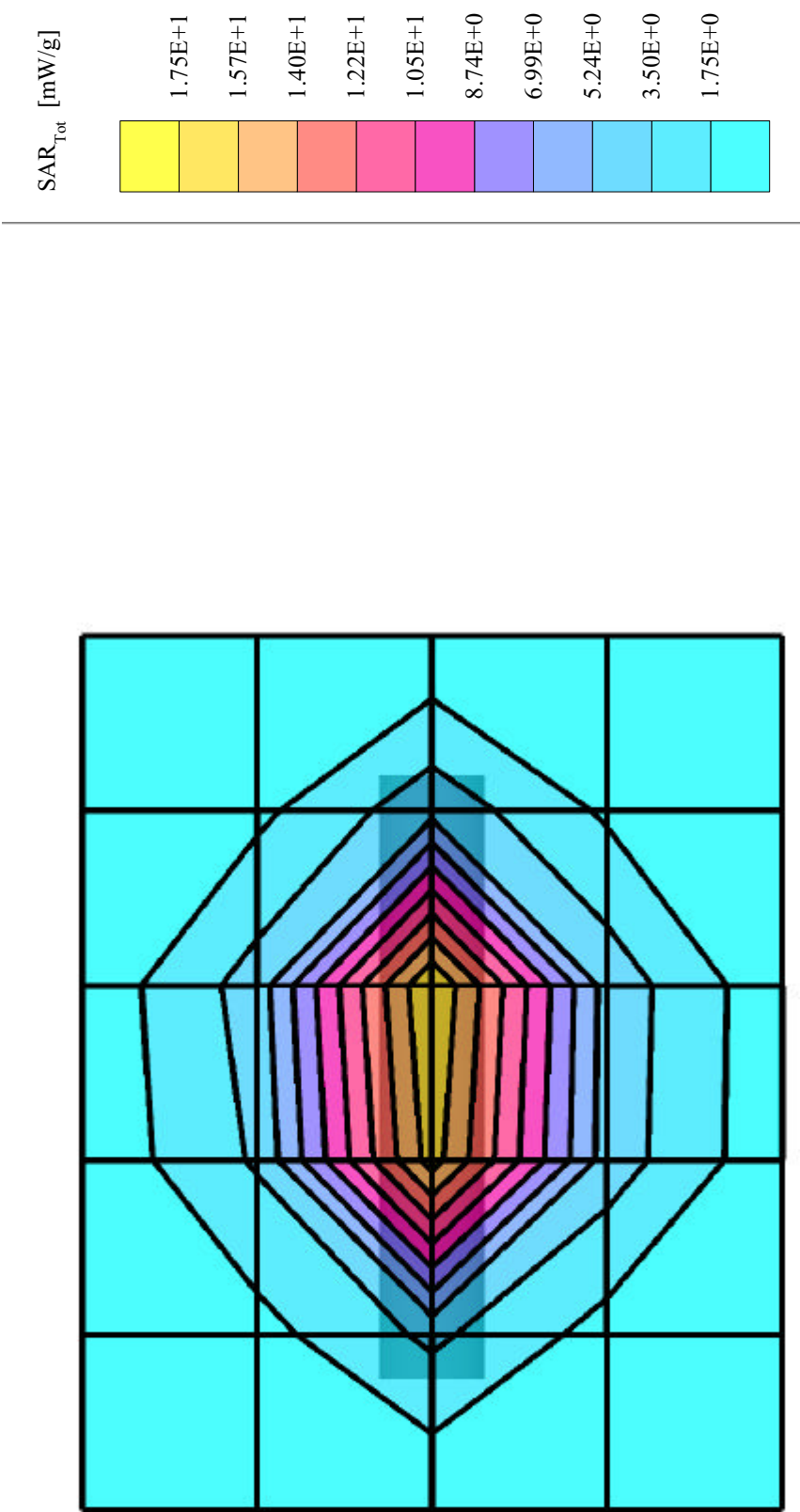
Probe: ET3DV6 - SN1387; ConvF(5.00,5.00,5.00); Crest factor: 1.0; Brain 2450 MHz: $\sigma = 1.86 \text{ mho/m}$ $\epsilon_r = 37.3$ $\rho = 1.00 \text{ g/cm}^3$

Cube 5x5x7; Peak: 28.0 mW/g, SAR (1g): 14.3 mW/g, SAR (10g): 6.68 mW/g, (Advanced extrapolation)

Penetration depth: 7.1 (7.0, 7.3) [mm]

Powerdrift: -0.02 dB

Forward Conducted Power: 250mW
Ambient Temp. 25.5°C; Fluid Temp. 23.8°C
Date Tested: August 7, 2003



APPENDIX C - SYSTEM VALIDATION

2450MHz SYSTEM VALIDATION DIPOLE

Type:

2450MHz Validation Dipole

Serial Number:

150

Place of Calibration:

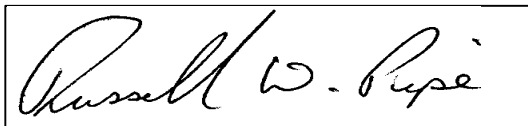
Celltech Research Inc.

Date of Calibration:

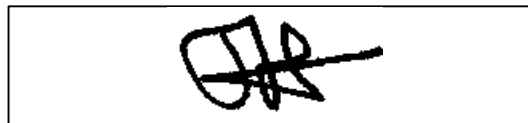
October 24, 2002

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

Calibrated by:



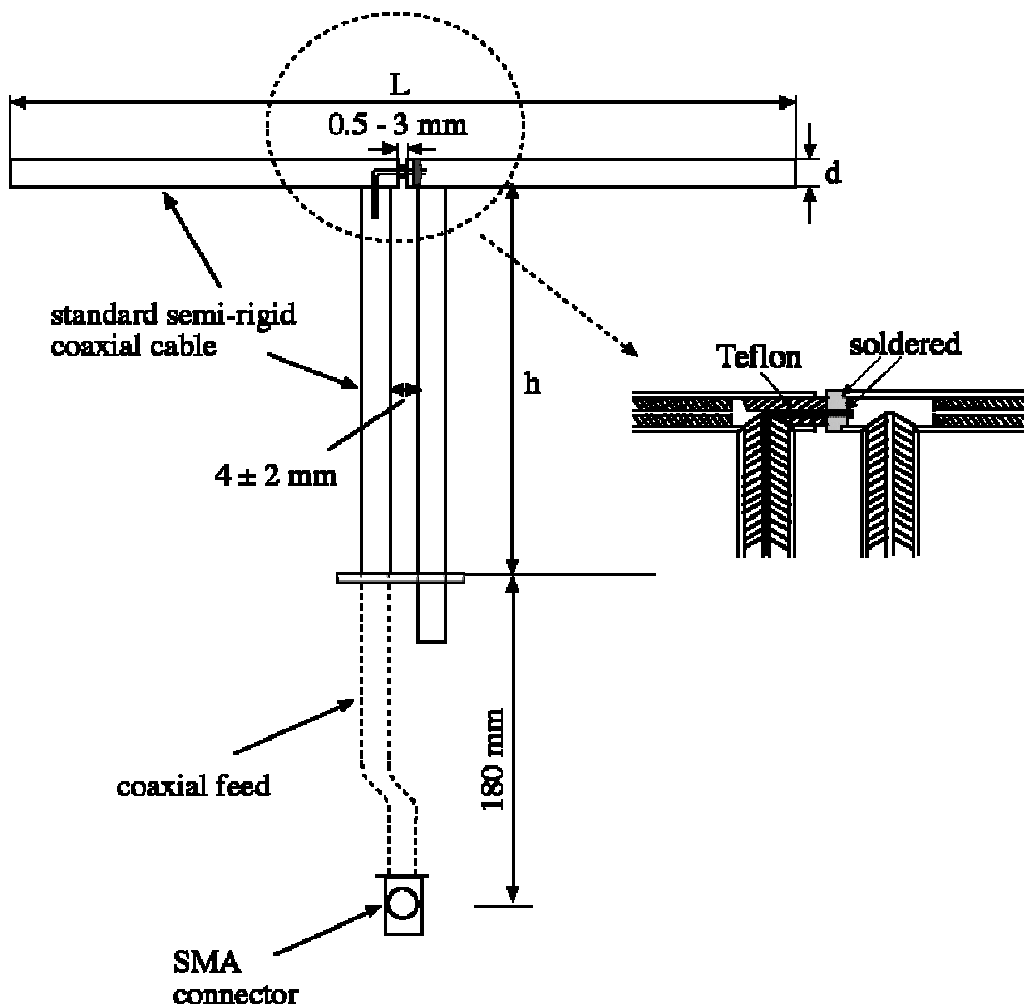
Approved by:



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 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 2450MHz	$\text{Re}\{Z\} = 49.838\Omega$ $\text{Im}\{Z\} = 0.2207\Omega$
Return Loss at 2450MHz	-49.398 dB



Validation Dipole Dimensions

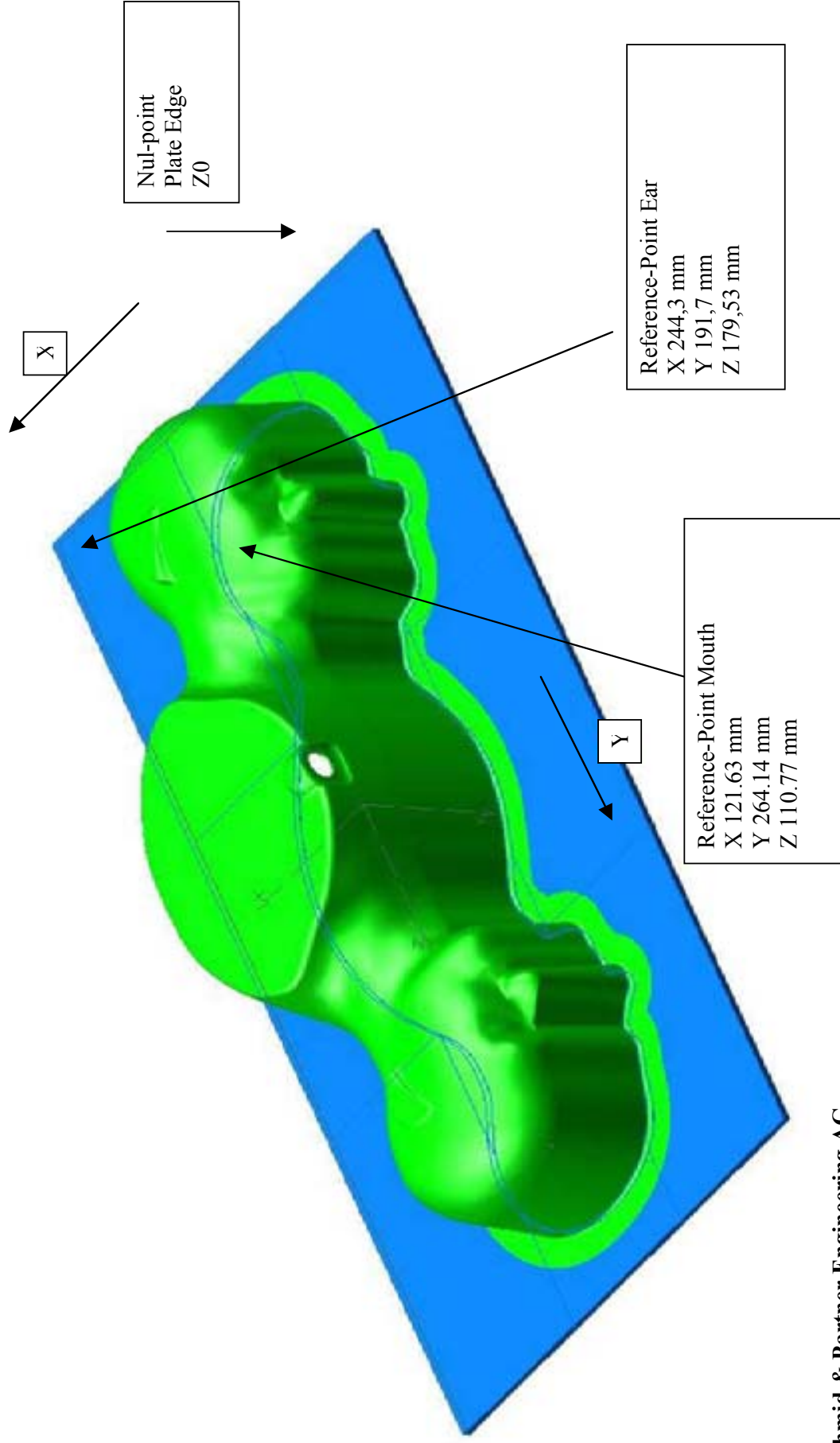
Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

2. Validation Phantom

The validation phantom is the SAM (Specific Anthropomorphic Mannequin) phantom manufactured by Schmid & Partner Engineering AG. The SAM phantom is a Fiberglass shell integrated in a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness: 2.0 ± 0.1 mm
Filling Volume: Approx. 20 liters
Dimensions: 50 cm (W) x 100 cm (L)

SAM Twin-Phantom



Schmid & Partner Engineering AG

2450MHz Dipole Calibration



2450MHz Dipole Calibration



3. Measurement Conditions

The planar phantom was filled with brain simulating tissue having the following electrical parameters at 2450MHz:

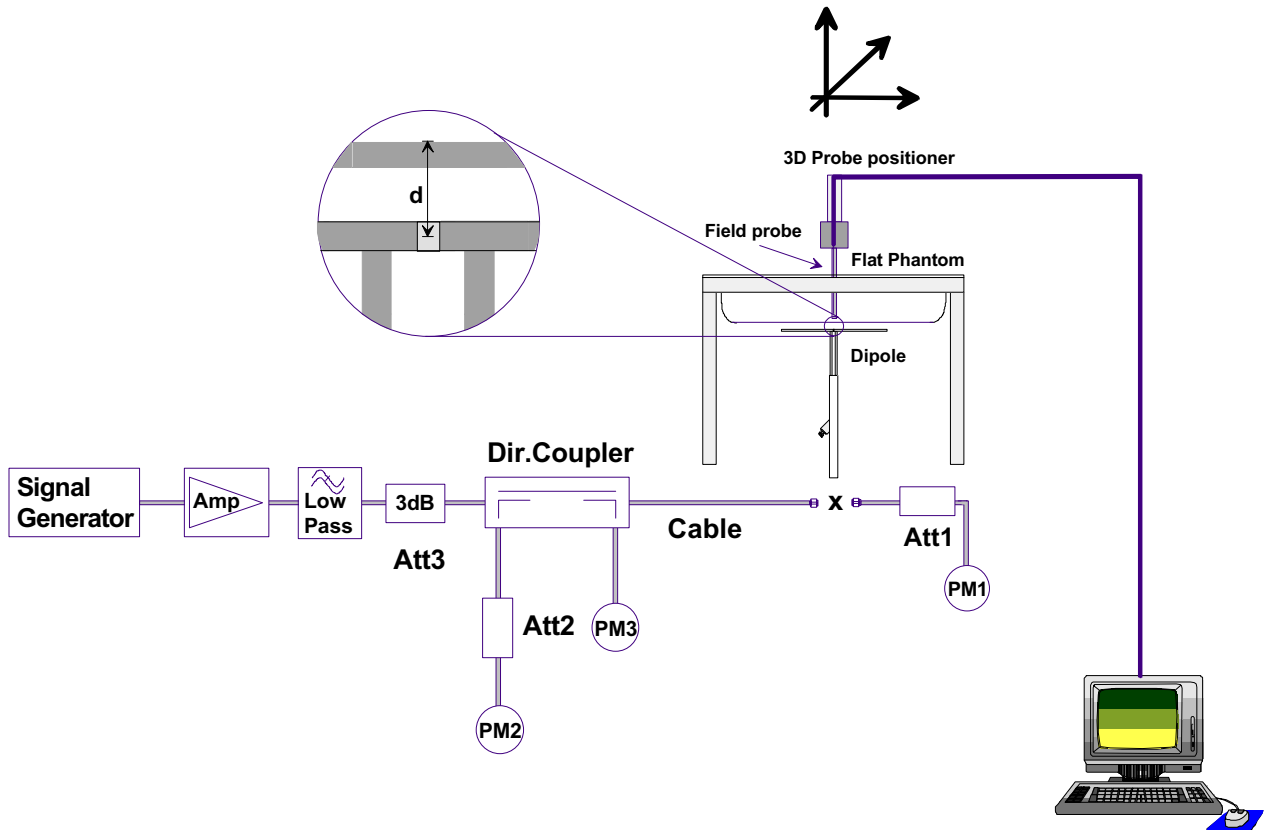
Relative Permittivity:	36.8
Conductivity:	1.79 mho/m
Ambient Temperature:	23.6°C
Fluid Temperature:	23.8°C
Fluid Depth:	≥ 15cm

The 2450MHz simulating tissue consists of the following ingredients:

Ingredient	Percentage by weight
Water	55.20%
Glycol Monobutyl	44.80%
Target Dielectric Parameters at 22°C	$\epsilon_r = 39.2$ (+/-10%) $\sigma = 1.80$ S/m (+/-5%)

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

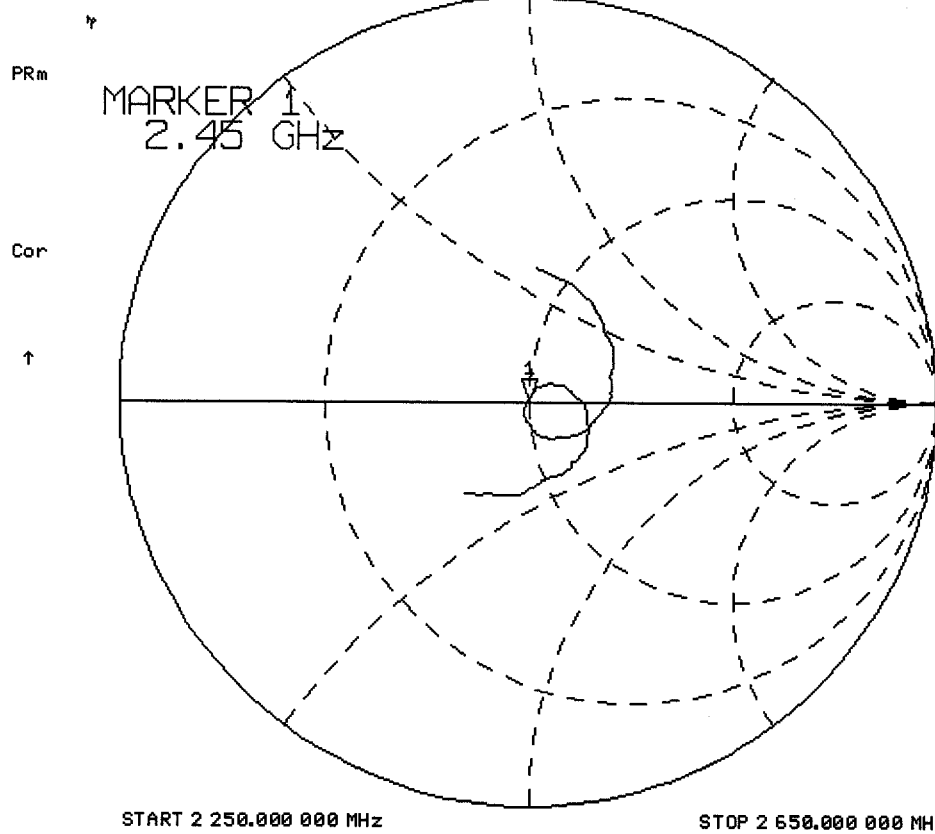
Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	14.4	57.6	6.55	26.20	30.5
Test 2	14.2	56.8	6.44	25.76	30.0
Test 3	14.0	56.0	6.35	25.40	29.7
Test 4	13.9	55.6	6.32	25.28	29.5
Test 5	14.0	56.0	6.33	25.32	29.7
Test 6	14.0	56.0	6.33	25.32	29.7
Test 7	13.9	55.6	6.31	25.24	29.5
Test 8	13.8	55.2	6.28	25.12	29.3
Test 9	13.8	55.2	6.28	25.12	29.4
Test10	14.0	56.0	6.33	25.32	29.7
Average Value	14.0	56.0	6.35	25.41	29.7

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

Averaged over 1cm (1g) of tissue: 56.00 mW/g

Averaged over 10cm (10g) of tissue: 25.41 mW/g

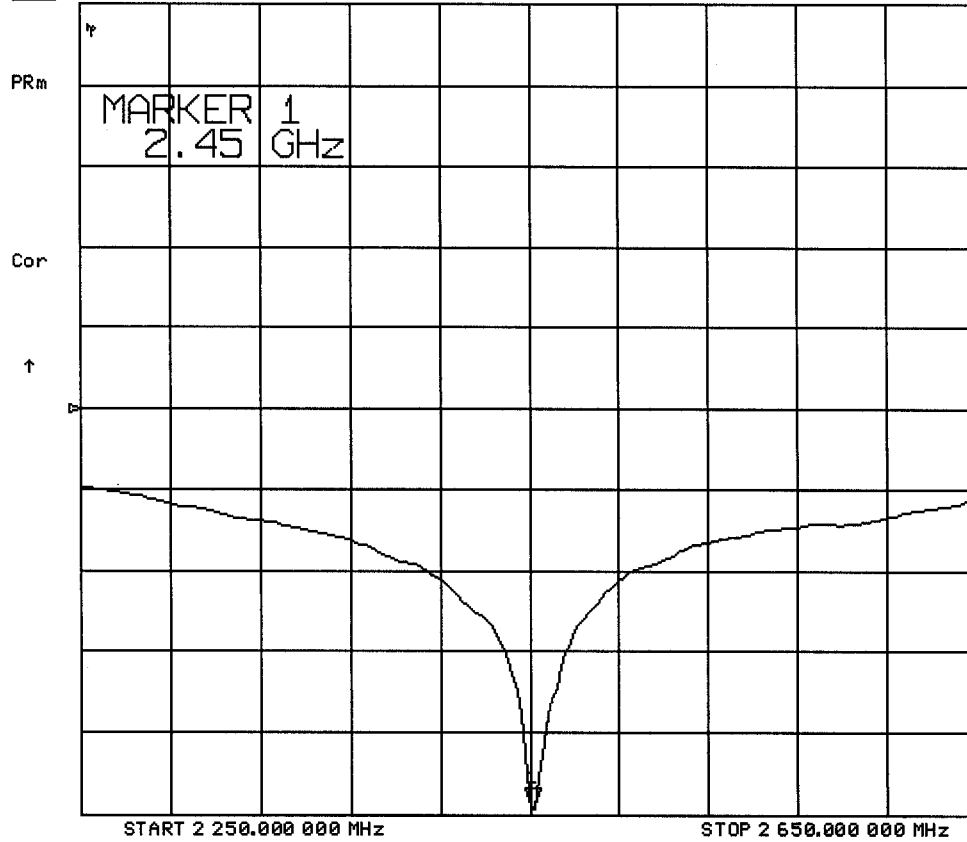
24 Oct 2002 09:28:50
CH1 S11 1 U FS 1: 49.838 Ω 0.2207 Ω 14.337 pF 2 450.000 000 MHz



24 Oct 2002 09:28:12

CH1 S11 LOG 10 dB/REF 0 dB

11-49.398 dB 2 450.000 000 MHz



Dipole 2450MHz

SAM Phantom; Flat Section

Probe: ET3DV6 - SNI1387; ConvF(4.70,4.70,4.70); Crest factor: 1.0; 2450 MHz Brain: $\sigma = 1.79 \text{ mho/m}$ $\epsilon_r = 36.8$ $\rho = 1.00 \text{ g/cm}^3$

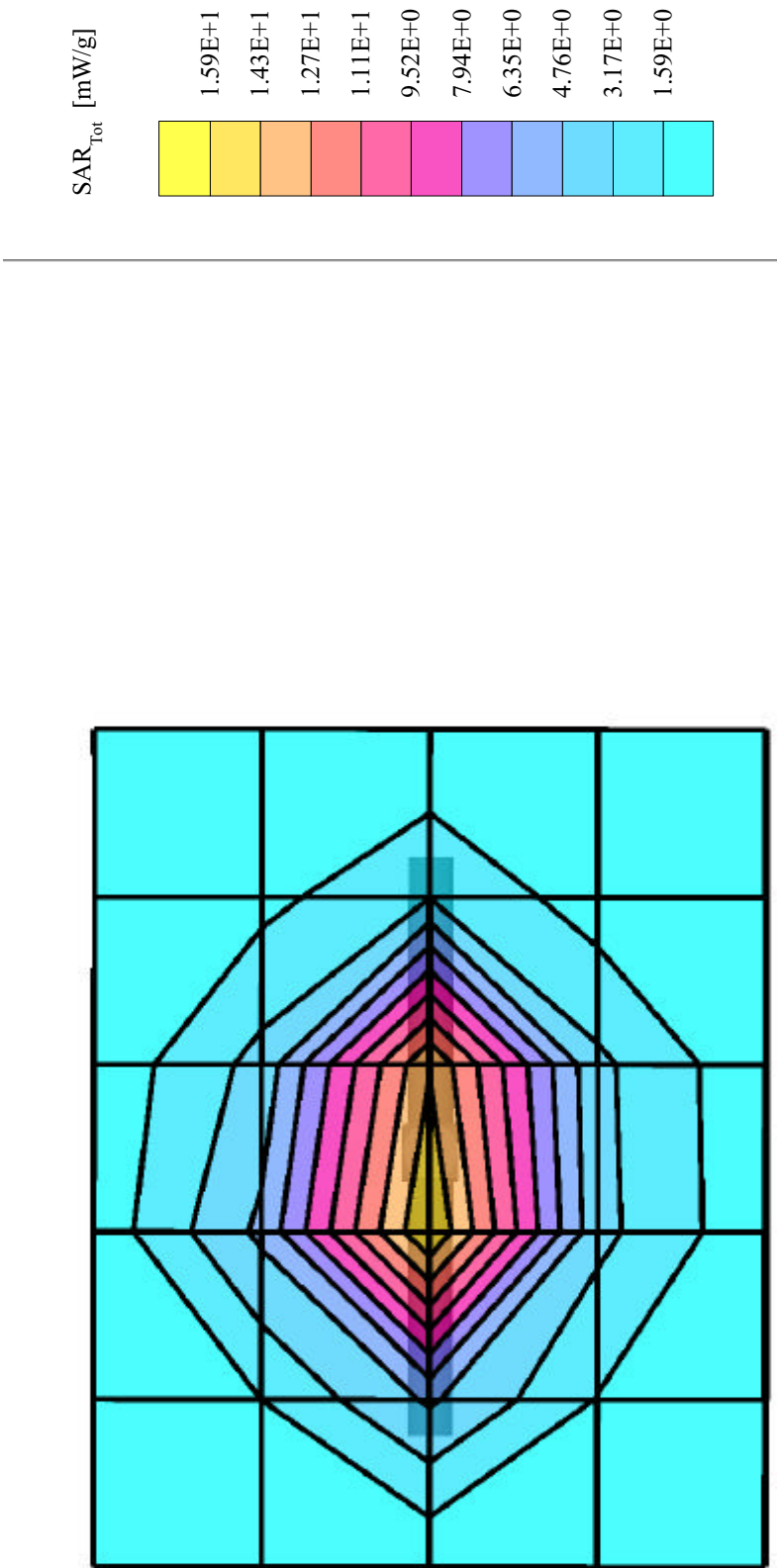
Cubes (4): Peak: 29.7 mW/g $\pm 0.04 \text{ dB}$, SAR (1g): 14.0 mW/g $\pm 0.04 \text{ dB}$, SAR (10g): 6.35 mW/g $\pm 0.04 \text{ dB}$, (Worst-case extrapolation)

Penetration depth: 6.4 (6.1, 7.2) [mm]; Powerdrift: -0.04 dB

Ambient Temp.: 23.6°C; Fluid Temp.: 23.8°C

Forward Conducted Power: 250 mW

Calibration Date: October 24, 2002



2450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

October 24, 2002

Frequency	ϵ'	ϵ''
2.350000000 GHz	37.2108	12.9039
2.360000000 GHz	37.1695	12.9350
2.370000000 GHz	37.1398	12.9630
2.380000000 GHz	37.1057	12.9945
2.390000000 GHz	37.0746	13.0290
2.400000000 GHz	37.0424	13.0464
2.410000000 GHz	36.9746	13.0743
2.420000000 GHz	36.9322	13.1074
2.430000000 GHz	36.8908	13.1372
2.440000000 GHz	36.8449	13.1527
2.450000000 GHz	36.7983	13.1767
2.460000000 GHz	36.7651	13.2038
2.470000000 GHz	36.7300	13.2377
2.480000000 GHz	36.7004	13.2677
2.490000000 GHz	36.6658	13.2862
2.500000000 GHz	36.6120	13.2988
2.510000000 GHz	36.5655	13.3268
2.520000000 GHz	36.5147	13.3582
2.530000000 GHz	36.4743	13.3922
2.540000000 GHz	36.4044	13.4131
2.550000000 GHz	36.3807	13.4402

APPENDIX D - PROBE CALIBRATION

Client

Celltech Labs

CALIBRATION CERTIFICATE

Object(s)

ET3DV6 - SN: 1387

Calibration procedure(s)

QA CAL-01.v2
Calibration procedure for dosimetric E-field probes

Calibration date:

February 26, 2003

Condition of the calibrated item

In Tolerance (according to the specific calibration document)

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

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

Calibrated by:

Name

Nico Vetterli

Function

Technician

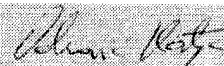
Signature



Approved by:

Katja Pokovic

Laboratory Director



Date issued: February 26, 2003

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

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibration:	February 22, 2002
Recalibrated:	February 26, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

NormX	1.55 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.65 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.64 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	92	mV
DCP Y	92	mV
DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid

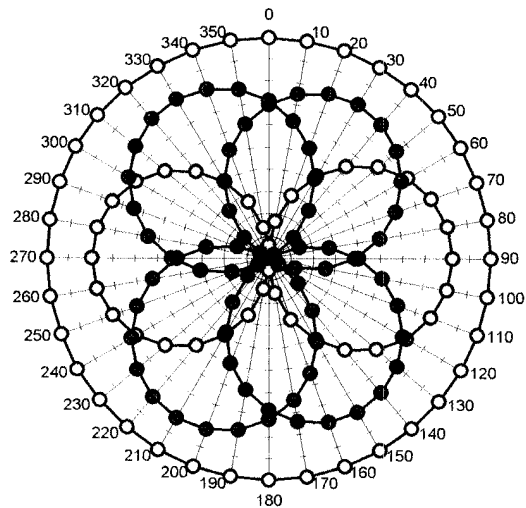
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha	0.37
ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth	2.61
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha	0.50
ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth	2.73

Boundary Effect

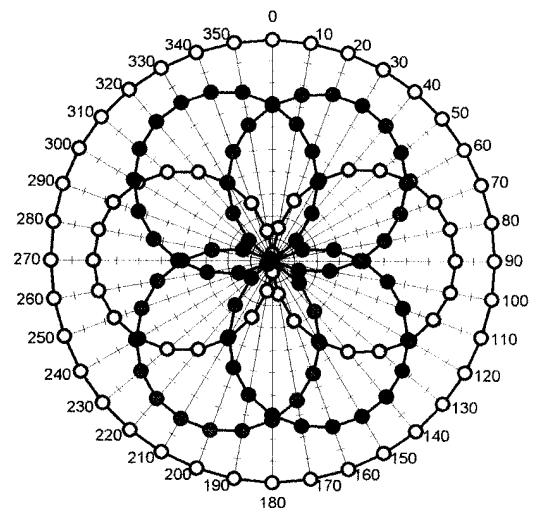
Head	900 MHz	Typical SAR gradient: 5 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{pe} [%]	Without Correction Algorithm	10.2	5.9
SAR _{pe} [%]	With Correction Algorithm	0.4	0.6
Head	1800 MHz	Typical SAR gradient: 10 % per mm	
Probe Tip to Boundary		1 mm	2 mm
SAR _{pe} [%]	Without Correction Algorithm	14.6	9.8
SAR _{pe} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

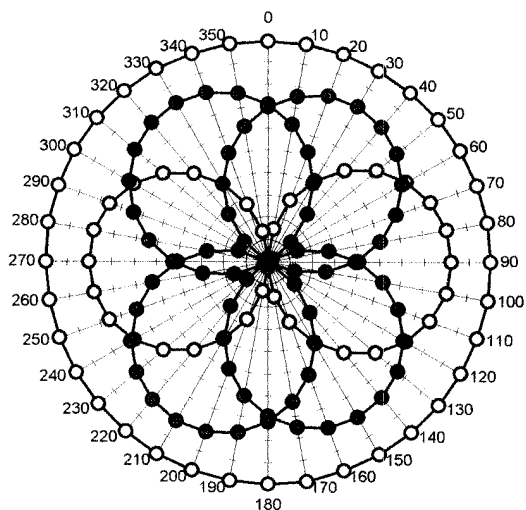
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.4 $\pm$ 0.2	mm

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

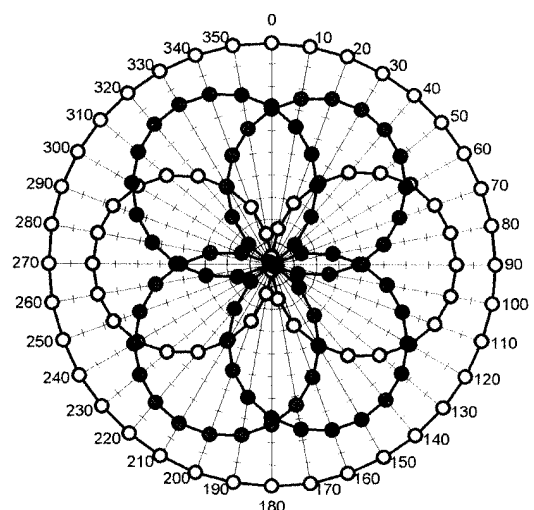
—○— X —●— Y —●— Z —○— Tot

f = 100 MHz, TEM cell ifi110

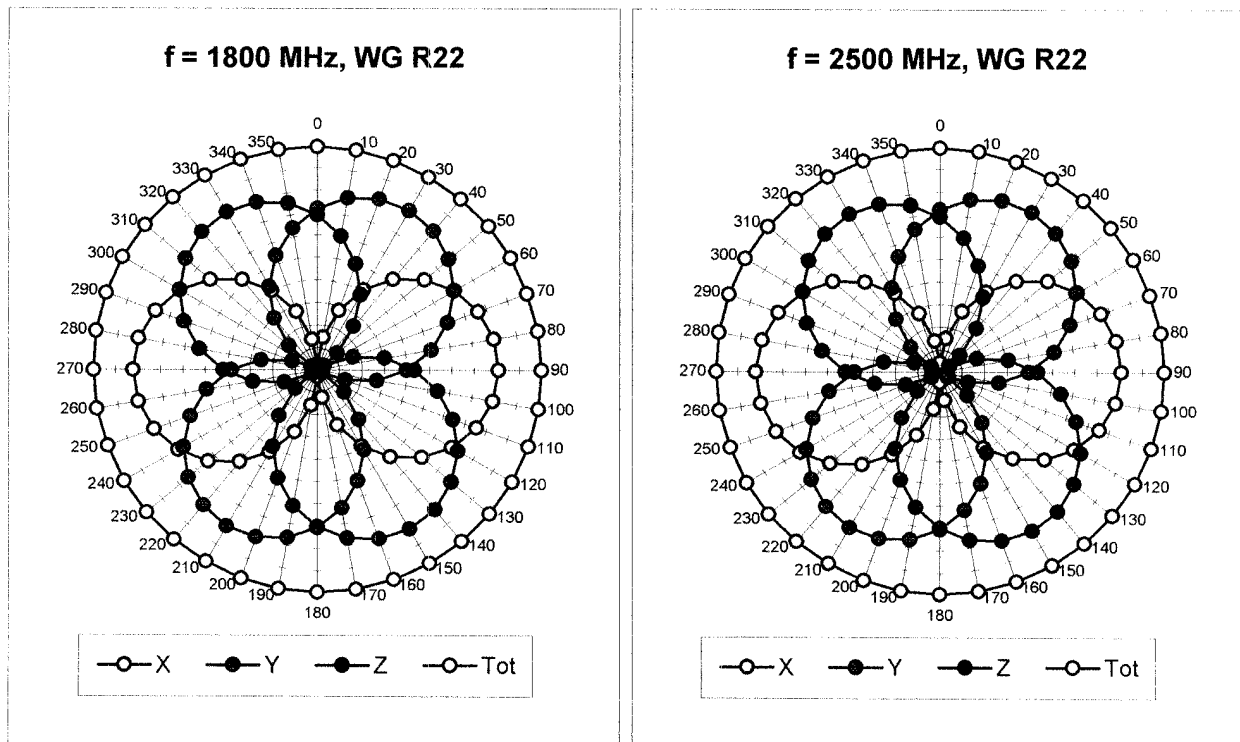
—○— X —●— Y —●— Z —○— Tot

f = 300 MHz, TEM cell ifi110

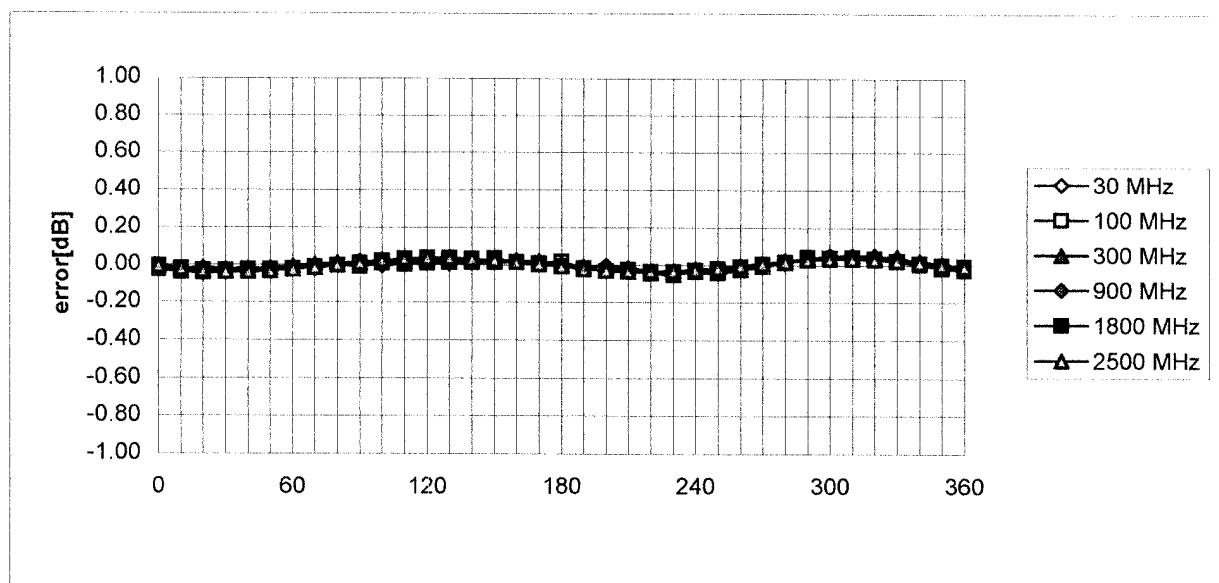
—○— X —●— Y —●— Z —○— Tot

f = 900 MHz, TEM cell ifi110

—○— X —●— Y —●— Z —○— Tot

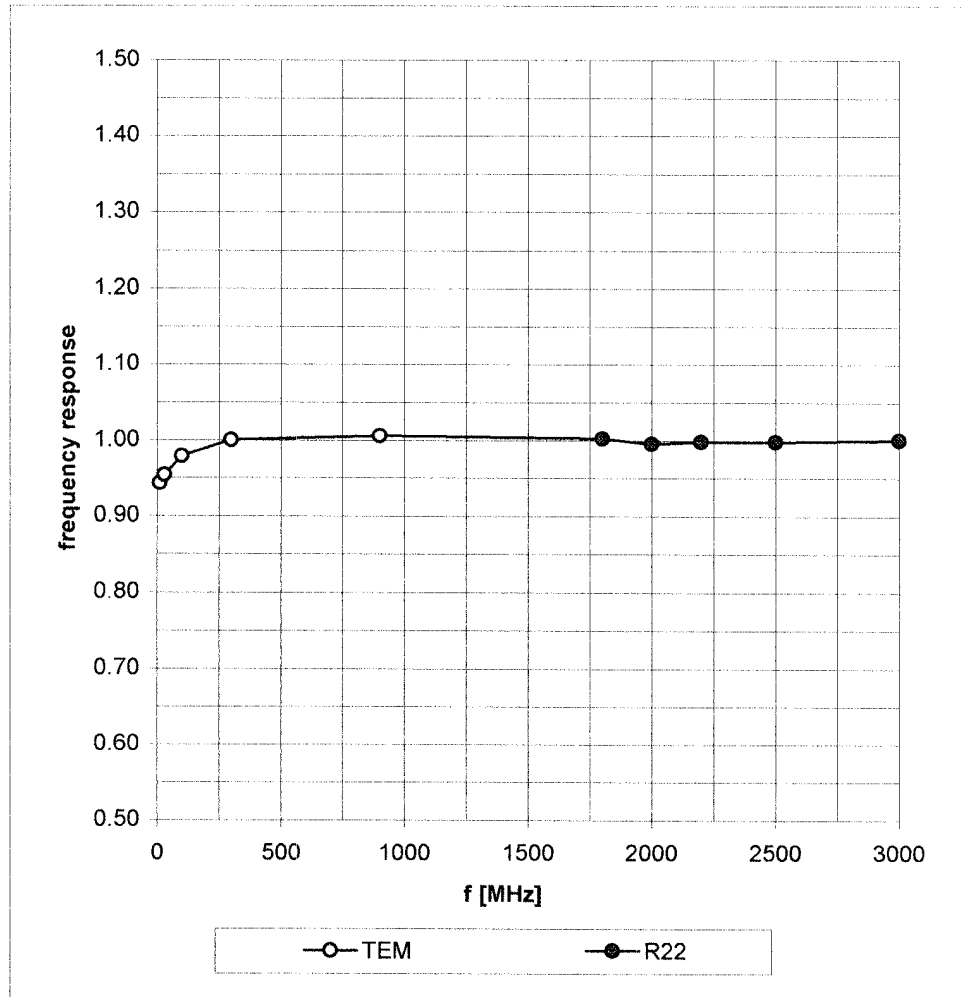


Isotropy Error (ϕ), $\theta = 0^\circ$

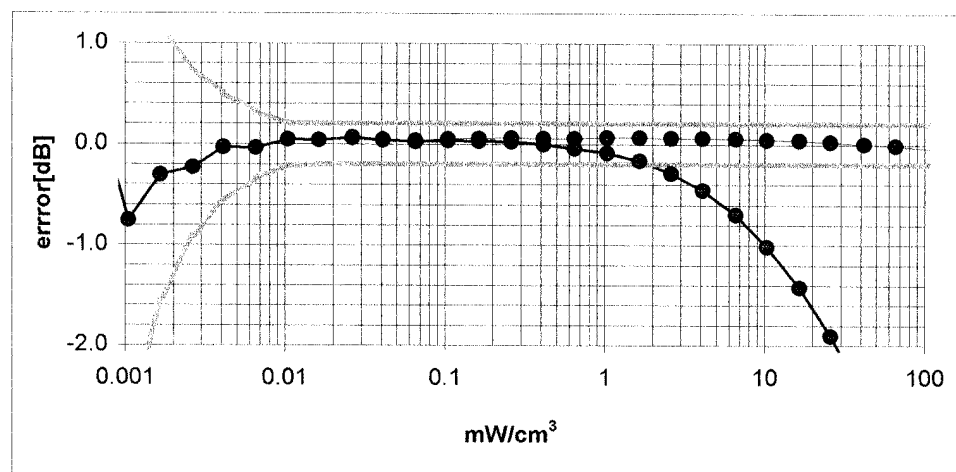
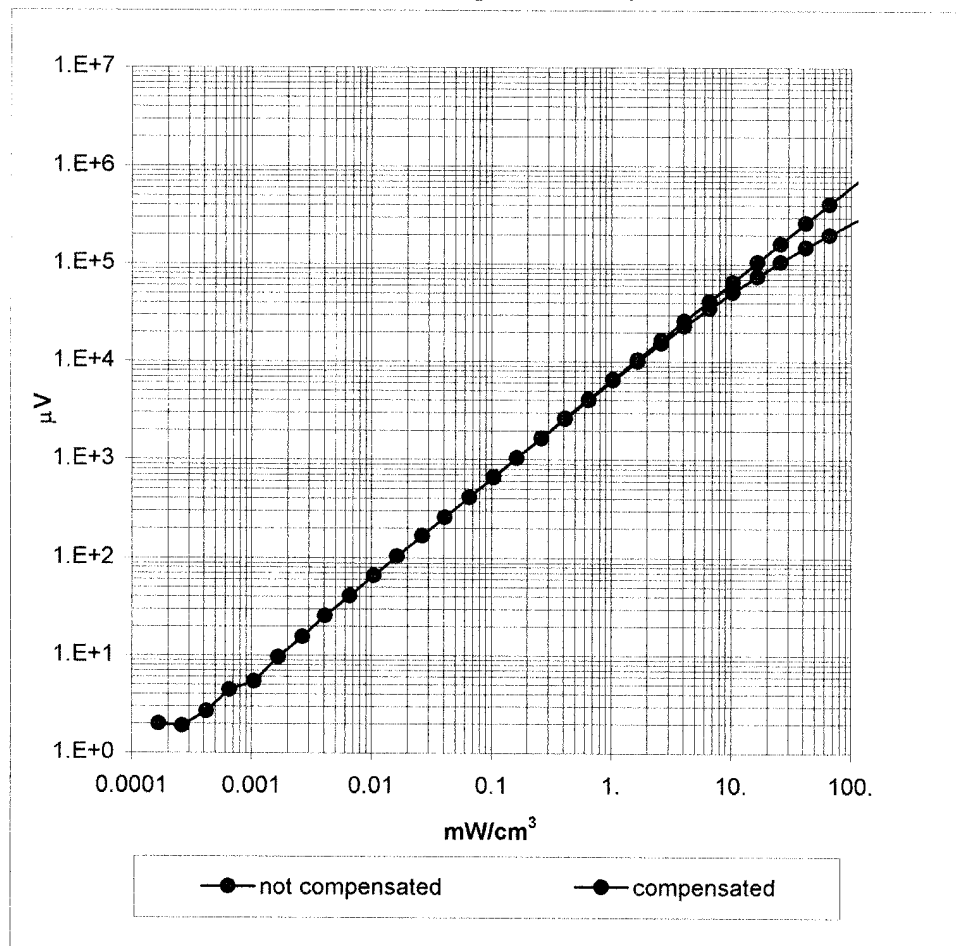


Frequency Response of E-Field

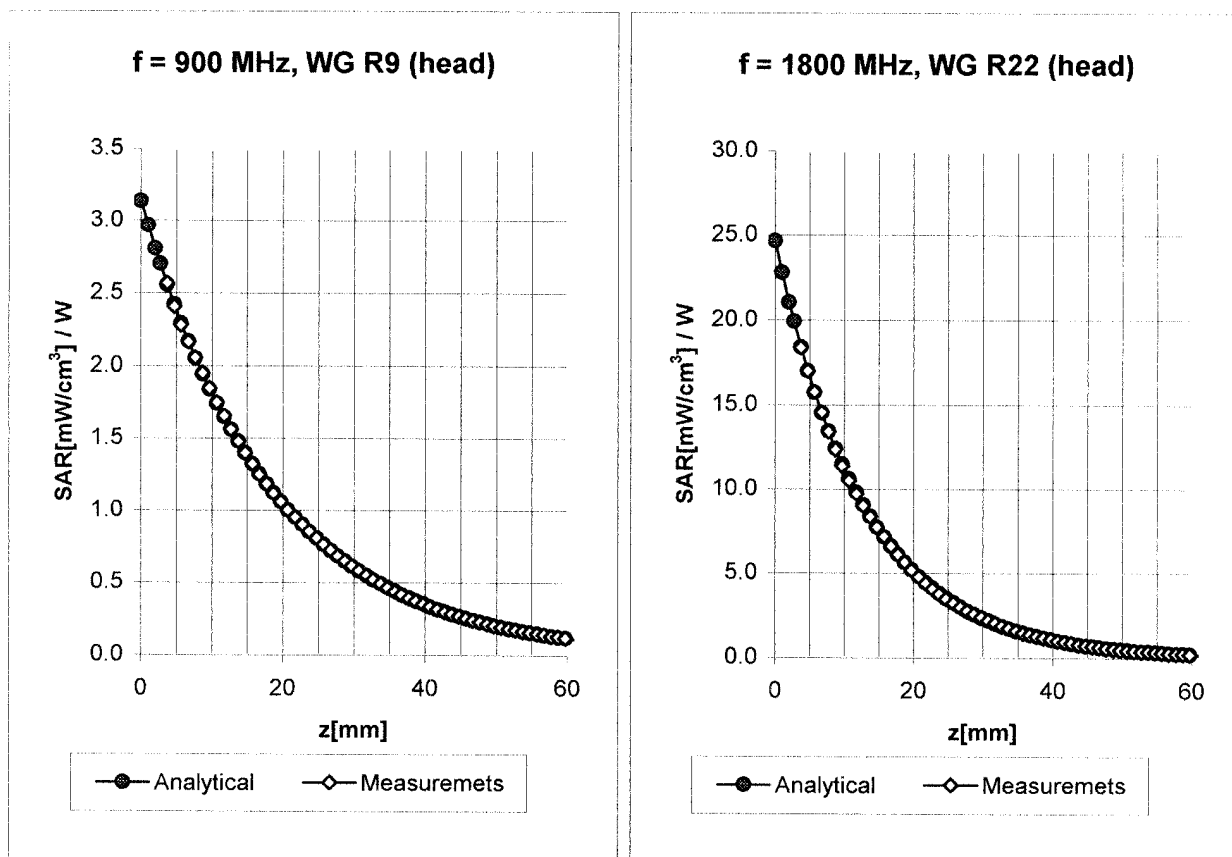
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain}) (Waveguide R22)

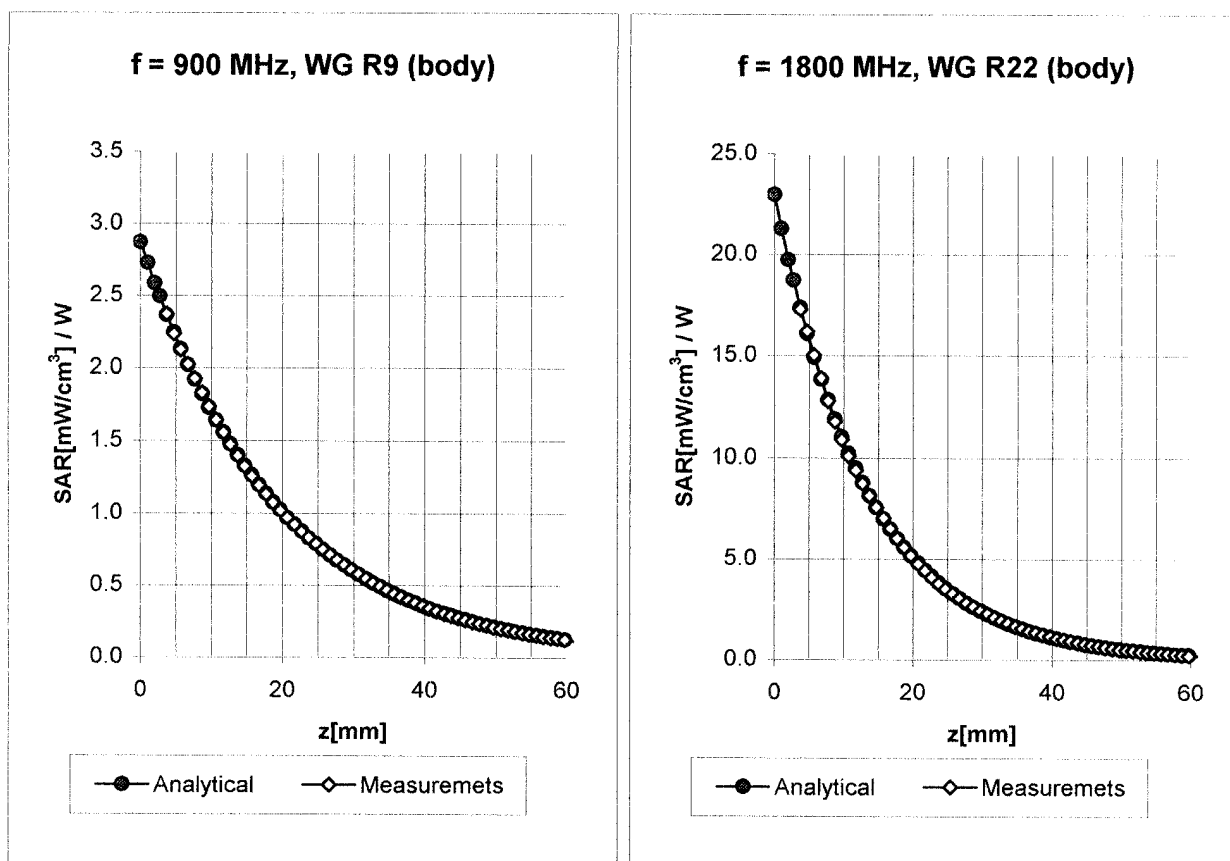


Conversion Factor Assessment



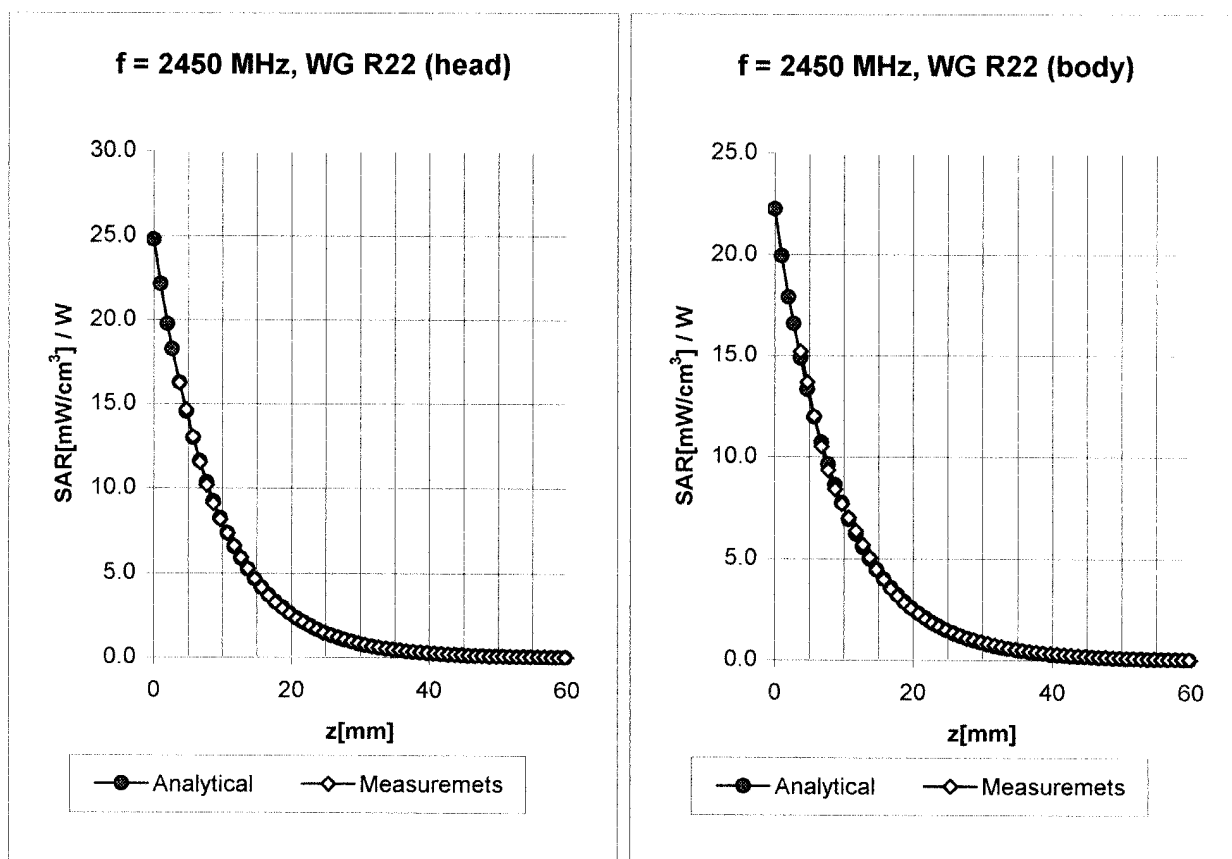
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\% \text{ mho/m}$
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\% \text{ mho/m}$
	ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha 0.37
	ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth 2.61
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\% \text{ mho/m}$
	ConvF X	5.2 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	5.2 $\pm 9.5\%$ (k=2)	Alpha 0.50
	ConvF Z	5.2 $\pm 9.5\%$ (k=2)	Depth 2.73

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	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha 0.45
	ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth 2.35
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	4.9 $\pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	4.9 $\pm 9.5\%$ (k=2)	Alpha 0.60
	ConvF Z	4.9 $\pm 9.5\%$ (k=2)	Depth 2.59

Conversion Factor Assessment



Head 2450 MHz $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ mho/m

ConvF X **5.0** $\pm 8.9\%$ (k=2)

Boundary effect:

ConvF Y **5.0** $\pm 8.9\%$ (k=2)

Alpha **1.04**

ConvF Z **5.0** $\pm 8.9\%$ (k=2)

Depth **1.85**

Body 2450 MHz $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ mho/m

ConvF X **4.6** $\pm 8.9\%$ (k=2)

Boundary effect:

ConvF Y **4.6** $\pm 8.9\%$ (k=2)

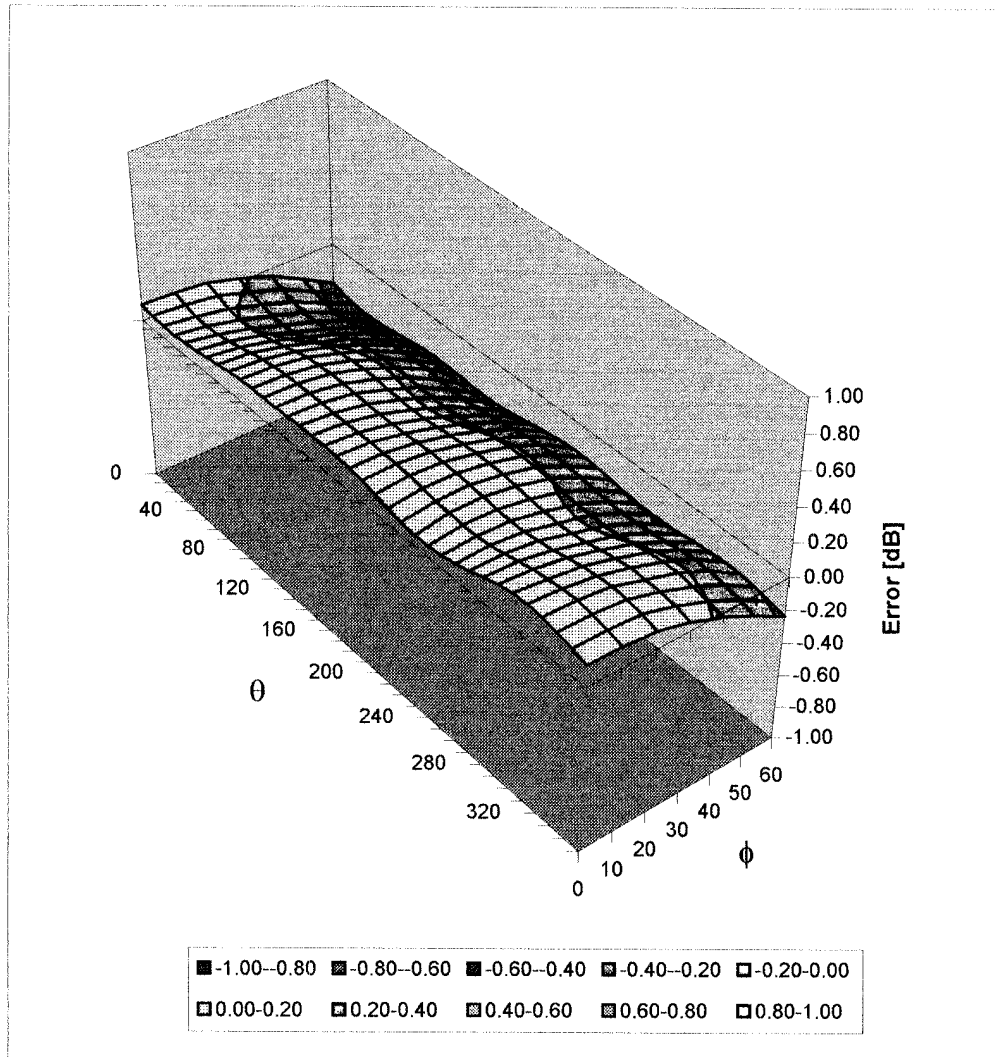
Alpha **1.20**

ConvF Z **4.6** $\pm 8.9\%$ (k=2)

Depth **1.60**

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:

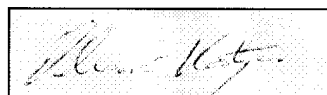
February 28, 2003

Probe Calibration Date:

February 26, 2003

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	$9.1 \pm 8\%$	$\epsilon_r = 52.3$ $\sigma = 0.76 \text{ mho/m}$ (head tissue)
300 MHz	ConvF	$7.9 \pm 8\%$	$\epsilon_r = 45.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
450 MHz	ConvF	$7.5 \pm 8\%$	$\epsilon_r = 43.5$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
150 MHz	ConvF	$8.8 \pm 8\%$	$\epsilon_r = 61.9$ $\sigma = 0.80 \text{ mho/m}$ (body tissue)
300 MHz	ConvF	$8.0 \pm 8\%$	$\epsilon_r = 58.2$ $\sigma = 0.92 \text{ mho/m}$ (body tissue)
450 MHz	ConvF	$7.7 \pm 8\%$	$\epsilon_r = 56.7$ $\sigma = 0.94 \text{ mho/m}$ (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

August 07, 2003

Frequency	ϵ'	ϵ''
2.350000000 GHz	37.6676	13.3920
2.360000000 GHz	37.6304	13.4195
2.370000000 GHz	37.6019	13.4675
2.380000000 GHz	37.5672	13.4853
2.390000000 GHz	37.5395	13.5005
2.400000000 GHz	37.4937	13.5192
2.410000000 GHz	37.4368	13.5470
2.420000000 GHz	37.3989	13.5872
2.430000000 GHz	37.3442	13.6220
2.440000000 GHz	37.3057	13.6659
2.450000000 GHz	37.2617	13.6983
2.460000000 GHz	37.2328	13.7350
2.470000000 GHz	37.1902	13.7667
2.480000000 GHz	37.1653	13.7926
2.490000000 GHz	37.1348	13.8206
2.500000000 GHz	37.1064	13.8201
2.510000000 GHz	37.0648	13.8522
2.520000000 GHz	37.0039	13.8760
2.530000000 GHz	36.9400	13.9214
2.540000000 GHz	36.8878	13.9470
2.550000000 GHz	36.8339	13.9957

2450 MHz EUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

August 07, 2003

Frequency	e'	e''
2.350000000 GHz	50.4901	14.2245
2.360000000 GHz	50.4656	14.2629
2.370000000 GHz	50.4432	14.3172
2.380000000 GHz	50.4233	14.3476
2.390000000 GHz	50.3983	14.3845
2.400000000 GHz	50.3532	14.4060
2.410000000 GHz	50.3088	14.4453
2.420000000 GHz	50.2544	14.4900
2.430000000 GHz	50.2301	14.5465
2.440000000 GHz	50.1795	14.5738
2.450000000 GHz	50.1423	14.6290
2.460000000 GHz	50.1055	14.6772
2.470000000 GHz	50.0717	14.7116
2.480000000 GHz	50.0580	14.7585
2.490000000 GHz	50.0258	14.7741
2.500000000 GHz	49.9995	14.7903
2.510000000 GHz	49.9623	14.8351
2.520000000 GHz	49.8925	14.8700
2.530000000 GHz	49.8558	14.9157
2.540000000 GHz	49.8022	14.9467
2.550000000 GHz	49.7517	14.9966

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

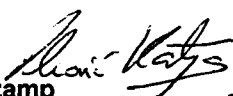
- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9
- (*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

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



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