DECLARATION OF COMPLIANCE
SAR RF EXPOSURE EVALUATION

Test Lab

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Applicant Information

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FCC IDENTIFIER:	**I28MD-RW4137**
IC IDENTIFIER:	**3798A-RW4137**
Model(s):	**QL220, QL320, QL420, RW420**
Rule Part(s):	**FCC 47 CFR §2.1093; IC RSS-102 Issue 1 (Provisional)**
Test Procedure(s):	**FCC OET Bulletin 65, Supplement C (Edition 01-01)**
FCC Device Classification:	**Digital Transmission System (DTS)**
IC Device Classification:	**Low Power Licence-Exempt Radiocommunication Device (RSS-210)**
Device Description:	**Wireless Portable Printer with Symbol LA-4137 Compact Flash DSSS WLAN Card**
Modulation Type:	**Direct Sequence Spread Spectrum (DSSS)**
Tx Frequency Range:	**2412 - 2462 MHz**
Max. RF Output Power Measured:	**20.0 dBm (100 mW) - Peak Conducted (2412 MHz)** **18.2 dBm (66.1 mW) - Peak Conducted (2437 MHz)** **17.8 dBm (60.3 mW) - Peak Conducted (2462 MHz)**
Antenna Type(s) Tested:	**Internal**
Battery Type(s) Tested:	**Li-ion 7.4 VDC P/N: AT16004-1 (Printer Models: QL220, QL320)** **Li-ion 7.4 VDC P/N: AT16293-1 (Printer Model: QL420)** **Li-ion 7.4 VDC P/N: CT17102-2 (Printer Model: RW420)**
Body-Worn Accessories:	**Shoulder Strap** **Plastic Belt-Clip with metal screws (Printer Models: QL220, QL320, QL420)** **Plastic Belt-Clip (Printer Model: RW420)**
Max. SAR Levels Evaluated:	**QL220: 0.0618 W/kg body-worn (1g average)** **QL320: 0.0500 W/kg body-worn (1g average)** **QL420: 0.0155 W/kg body-worn (1g average)** **RW420: 0.0432 W/kg body-worn (1g average)**

Celltech Labs Inc. declares under its sole responsibility that this wireless portable device has demonstrated compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in FCC 47 CFR §2.1093 and Health Canada's Safety Code 6. The device was tested in accordance with the measurement standards and procedures specified in FCC OET Bulletin 65, Supplement C (Edition 01-01) and Industry Canada RSS-102 Issue 1 (Provisional) for the General Population / Uncontrolled Exposure environment. All measurements were performed in accordance with the SAR system manufacturer recommendations.

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.

Performed By:

Spencer Watson
Compliance Technologist
Celltech Labs Inc.

Reviewed By:

Russell W. Pipe
Senior Compliance Technologist
Celltech Labs Inc.




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1.0 INTRODUCTION

This measurement report demonstrates that the Zebra Technologies Corporation Model(s): QL220, QL320, QL420, RW420 Wireless Portable Printer FCC ID: I28MD-RW4137 with internal Symbol LA-4137 Compact Flash DSSS WLAN Card complies with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]), and Health Canada's Safety Code 6 (see reference [2]) for the General Population / Uncontrolled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [3]), and Industry Canada RSS-102 Issue 1 (Provisional) (see reference [4]) 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 DEVICE UNDER TEST (DUT)

FCC Rule Part(s)	47 CFR §2.1093			
IC Rule Part(s)	RSS-102 Issue 1 (Provisional)			
Test Procedure(s)	FCC OET Bulletin 65, Supplement C (01-01)			
FCC Device Classification	Digital Transmission System (DTS)			
IC Device Classification	Low Power Licence-Exempt Radiocommunication Device (RSS-210)			
Device Description	Wireless Portable Printer with internal Symbol LA-4137 Compact Flash DSSS WLAN			
FCC IDENTIFER	I28MD-RW4137			
IC IDENTIFER	3798A-RW4137			
Model(s)	QL220	QL320	QL420	RW420
Serial No.(s)	XXVA03-12-0096	QL220	Production Unit	
	CVVQ03-10-0033	QL320	Production Unit	
	XXVT04-33-0027	QL420	Production Unit	
	XXRC04-37-0085	RW420	Production Unit	
Modulation	Direct Sequence Spread Spectrum (DSSS)			
Tx Frequency Range	2412 - 2462 MHz			
Antenna Type(s) Tested	Internal			
Max. RF Output Power Measured	20.0 dBm	100 mW	Peak Conducted	2412 MHz
	18.2 dBm	66.1 mW	Peak Conducted	2437 MHz
	17.8 dBm	60.3 mW	Peak Conducted	2462 MHz
Battery Type(s) Tested	QL220	Li-ion	7.4 VDC	P/N: AT16004-1
	QL320			
	QL420	Li-ion	7.4 VDC	P/N: AT16293-1
	RW420	Li-ion	7.4 VDC	P/N: CT17102-2
Body-Worn Accessories Tested	Shoulder Strap			
	Belt-Clip tested with Printer Models: QL220, QL320, QL420 (containing metal screws) Note: Belt-Clip for Model: RW420 contains no metallic components, therefore worst-case configuration only was tested (without belt-clip, with shoulder strap accessory)			

3.0 SAR MEASUREMENT SYSTEM

Celltech Labs Inc. SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 measurement system is comprised of the measurement server, 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 DASY4 measurement server. The DAE4 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 DASY4 measurement server 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. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

DASY4 SAR Measurement System with planar phantom

DASY4 SAR Measurement System with SAM phantom

4.0 MEASUREMENT SUMMARY

BODY-WORN SAR EVALUATION RESULTS

Test Date	DUT Model	Freq (MHz)	Chan.		Test Mode	Antenna Position	Body-worn Accessories	DUT Position to Planar Phantom	Separation Distance to Planar Phantom (cm)	Cond. Power Before Test (dBm)	Measured SAR 1g (W/kg)	SAR Drift During Test (dB)	Scaled SAR 1g (W/kg)
Nov-17	QL220	2437	Mid	6	DSSS	Internal	Shoulder Strap	Front Side	0.0	18.2	0.0194	-1.37	0.0266
Nov-17	QL220	2437	Mid	6	DSSS	Internal	--	Left Side	0.0	18.2	0.0426	-0.237	0.0450
Nov-17	QL220	2437	Mid	6	DSSS	Internal	--	Right Side	0.0	18.2	0.0500	0.286	0.0500
Nov-18	QL320	2437	Mid	6	DSSS	Internal	Shoulder Strap	Front Side	0.0	18.2	0.0181	-0.322	0.0195
Nov-18	QL320	2437	Mid	6	DSSS	Internal	Shoulder Strap	Left Side	0.0	18.2	0.0497	-0.0275	0.0500
Nov-18	QL320	2437	Mid	6	DSSS	Internal	Shoulder Strap	Right Side	0.0	18.2	0.0213	-0.182	0.0222
Nov-19	QL420	2437	Mid	6	DSSS	Internal	Shoulder Strap	Front Side	0.0	18.2	0.0148	-0.214	0.0155
Nov-19	RW420	2437	Mid	6	DSSS	Internal	Shoulder Strap	Front Side	0.0	18.2	0.0415	-0.173	0.0432
Nov-19	QL220	2412	Low	1	DSSS	Internal	--	Right Side	0.0	20.0	0.0610	-0.0583	0.0618

ANSI / IEEE C95.1 1999 - SAFETY LIMIT
BODY: 1.6 W/kg (averaged over 1 gram)
Spatial Peak - Uncontrolled Exposure / General Population

Test Date(s)	November 17, 2004 November 18, 2004 November 19, 2004				
Measured Fluid Type	2450 MHz Body				
Dielectric Constant ε_r	**IEEE Target**		**Measured**		
			Nov-17	Nov-18	Nov-19
	52.7	± 5%	50.9	50.1	50.8
Conductivity σ **(mho/m)**	**IEEE Target**		**Measured**		
			Nov-17	Nov-18	Nov-19
	1.95	± 5%	2.01	2.01	1.98

Test Date(s)	Nov-17	Nov-18	Nov-19	Unit
Relative Humidity	30	31	30	%
Atmospheric Pressure	103.1	101.9	103.2	kPa
Ambient Temperature	25.8	25.3	25.6	°C
Fluid Temperature	23.9	23.9	23.9	°C
Fluid Depth	≥ 15	≥ 15	≥ 15	cm
ρ (Kg/m^3)	1000			

Note(s):

1. 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.
2. If the SAR measurements performed at the mid channel were ≥ 3 dB below the SAR limit; SAR evaluation for the low and high channels was optional (per FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [3]). Based on the peak conducted power level measured at the low channel was .18 dB higher than the mid channel, a SAR evaluation was performed at the low channel in the worst-case mid channel configuration in order to show compliance at the higher power level as shown in the above test data table.
3. The power drifts measured by the DASY4 system for the duration of the SAR evaluations were added to the measured SAR levels to report scaled SAR results as shown in the above table.
4. The QL220 unit was tested without shoulder strap accessory for the left and right side configurations in order to report a worst-case result with 0.0 cm gap (shoulder strap links are on the sides of the unit and provide a spacing when the shoulder strap is attached).
5. For the QL220 & QL320 units the Bottom Side Peak SAR level measured during the area scan was <1% of the General Population / Uncontrolled exposure limit, therefore the zoom scan was not evaluated based on the 1 gram average SAR level determined to be near the measurement noise floor. See Appendix A for area scan evaluation plot.
6. For the QL420 & RW420 units the Bottom Side, Left Side & Right Side Peak SAR levels measured during the area scan were <1% of the General Population / Uncontrolled exposure limit, therefore the zoom scan was not evaluated based on the 1 gram average SAR level determined to be near the measurement noise floor. See Appendix A for area scan evaluation plots.
7. The SAR evaluations were performed within 24 hours of the system performance check.

5.0 DETAILS OF SAR EVALUATION

The Zebra Technologies Corporation Model(s): QL220, QL320, QL420, RW420 Wireless Portable Printer FCC ID: I28MD-RW4137 with internal Symbol LA-4137 Compact Flash DSSS WLAN Card was compliant for localized Specific Absorption Rate (General Population / Uncontrolled Exposure) based on the test provisions and conditions described below. Detailed photographs of the measurement setup are shown in Appendix H.

1. The QL220, QL320, and QL420 models were tested for body-worn SAR on the bottom side (battery side) of the device with the belt-clip accessory attached. The bottom side of the DUT was positioned parallel to the outer surface of the planar phantom. The belt-clip accessory for the QL220 model provided a 1.6 cm spacing from the bottom of the printer to the outer surface of the planar phantom. The belt-clip accessory for the QL320 and QL420 models provided a 1.8 cm spacing from the bottom of the printer to the outer surface of the planar phantom. The belt-clip accessories for the QL220, QL320, and QL420 printer models contain metallic screws.
2. The RW420 model was tested for body-worn SAR without the belt-clip accessory in a worst-case configuration, with the bottom of the unit touching the outer surface of the planar phantom. The belt-clip accessory for the RW420 model contains no metallic components; therefore the worst-case configuration only was tested without belt-clip accessory and with shoulder strap accessory.
3. The QL220, QL320, and QL420 models were tested for body-worn SAR on the bottom side (battery side) of the device (without belt-clip accessory) with the shoulder strap accessory attached. The bottom side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
4. The printers were tested for body SAR on the front side (LCD display side) of the device with the shoulder strap accessory attached. The front side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
5. The printers were tested for body SAR on the left side of the device with the shoulder strap accessory attached (except for model QL220 the shoulder strap links are on the sides of the unit and provide a spacing when the shoulder strap is attached, therefore was tested without the shoulder strap accessory in order to report a worst-case result with 0.0 cm gap). The left side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
6. The DUT was tested for body SAR on the right side of the device with the shoulder strap accessory attached (except for model QL220 the shoulder strap links are on the sides of the unit and provide a spacing when the shoulder strap is attached, therefore was tested without the shoulder strap accessory in order to report a worst-case result with 0.0 cm gap). The right side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
7. If the Peak SAR level measured during the area scan was <1% of the General Population / Uncontrolled exposure limit, then the zoom scan was not evaluated based on the 1 gram average SAR level determined to be near the measurement noise floor. See Appendix A for area scan evaluation plots.
8. The DUT was placed into test mode using internal software and operated at maximum power in modulated DSSS continuous transmit mode for the duration of the tests.
9. The conducted power levels were measured before each test using a Gigatronics 8652A Universal Power Meter according to the procedures described in FCC 47 CFR §2.1046.
10. The power drifts measured by the DASY4 system for the duration of the SAR evaluations were added to the measured SAR levels to report scaled SAR results as shown in the test data table (page 5).
11. Each SAR evaluation was performed with a fully charged battery in the DUT.
12. For certain printer models and test positions it was not possible for the DUT to be positioned in the device holder, in which case a stack of low-density, low-loss dielectric foamed polystyrene was used.
13. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures reported were consistent for all measurement periods.
14. The dielectric parameters of the simulated tissue were measured prior to the evaluations using an HP 85070C Dielectric Probe Kit and an HP 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters).

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 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 DASY4 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.

An area scan was determined as follows:

c. Based on the defined area scan grid, a more detailed grid is created to increase the points by a factor of 10. The interpolation function then evaluates all field values between corresponding measurement points.

d. A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.

A 1g and 10g spatial peak SAR was determined as follows:

e. Extrapolation is used 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 form the tip of the probe and the distance between the surface and the lowest measuring point is 1.4 mm (see probe calibration document in Appendix D). The extrapolation was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.

f. Interpolated data is used to calculate the average SAR over 1g and 10g cubes by spatially discretizing the entire measured cube. The volume used to determine the averaged SAR is a 1mm grid (42875 interpolated points).

g. A zoom scan volume of 32 mm x 32 mm x 30 mm (5 x 5 x 7 points) centered at the peak SAR location determined from the area scan is used for all zoom scans for devices with a transmit frequency < 800 MHz. Zoom scans for frequencies ≥ 800 MHz are determined with a scan volume of 30 mm x 30 mm x 30 mm (7 x 7 x 7) to ensure complete capture of the peak spatial-average SAR.

7.0 SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed in the planar section of the SAM phantom with a 2450MHz dipole (see Appendix C for system validation procedures). The dielectric parameters of the simulated tissue were measured prior to the system performance check using an HP 85070C Dielectric Probe Kit and an HP 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 ±10% (see Appendix B for system performance check test plots).

SYSTEM PERFORMANCE CHECK

Test Date	2450MHz Equiv. Tissue	SAR 1g (W/kg)		Dielectric Constant ε_r		Conductivity σ (mho/m)		ρ (Kg/m³)	Amb. Temp. (°C)	Fluid Temp. (°C)	Fluid Depth (cm)	Humid. (%)	Barom. Press. (kPa)
		IEEE Target	Measured	IEEE Target	Measured	IEEE Target	Measured						
11/17/04	**Brain**	**13.1 ±10%**	13.0 (-0.8%)	**39.2 ±5%**	38.6	**1.80 ±5%**	1.89	1000	24.9	23.9	≥ 15	30	103.1
11/18/04	**Brain**	**13.1 ±10%**	13.7 (+4.6%)	**39.2 ±5%**	38.2	**1.80 ±5%**	1.89	1000	25.2	23.9	≥ 15	30	101.9
11/19/04	**Brain**	**13.1 ±10%**	13.5 (+3.1%)	**39.2 ±5%**	38.1	**1.80 ±5%**	1.86	1000	24.4	23.9	≥ 15	30	103.0
11/26/04	**Brain**	**13.1 ±10%**	13.7 (+4.6%)	**39.2 ±5%**	38.4	**1.80 ±5%**	1.87	1000	25.5	23.9	≥ 15	30	102.2

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 reported in the table above were consistent for all measurement periods.

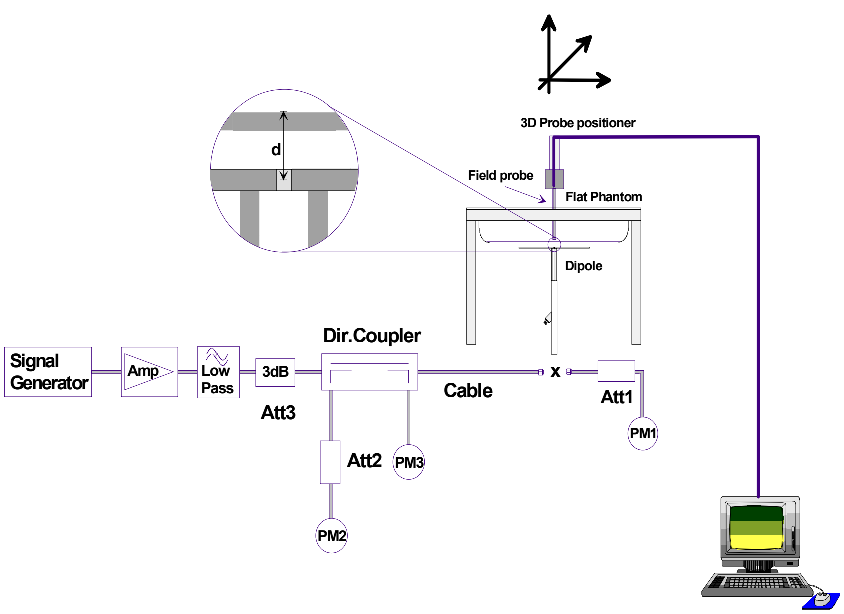


Figure 1. System Performance Check Setup Diagram

2450MHz Dipole Setup

8.0 SIMULATED EQUIVALENT TISSUES

The 2450MHz brain and body simulated tissue 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).

SIMULATED TISSUE MIXTURES		
INGREDIENT	2450MHz Brain System Performance Check	2450MHz Body DUT Evaluation
Water	52.00 %	69.98 %
Glycol Monobutyl	48.00 %	30.00 %
Salt	-	0.02 %

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: AMD Athlon XP 2400+
Clock Speed: 2.0 GHz
Operating System: Windows XP Professional

Data Converter
Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY4 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

DASY4 Measurement Server

Function: Real-time data evaluation for field measurements and surface detection
Hardware: PC/104 166MHz Pentium CPU; 32 MB chipdisk; 64 MB RAM
Connections: COM1, COM2, DAE, Robot, Ethernet, Service Interface

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(s)

Evaluation Phantom
Type: Planar Phantom
Shell Material: Fiberglass
Thickness: 2.0 ±0.1 mm
Volume: Approx. 72 liters

Validation Phantom
Type: SAM V4.0C
Shell Material: Fiberglass
Thickness: 2.0 ±0.1 mm
Volume: Approx. 25 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 ± 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)
Dynamic Range:	5 µW/g to >100 mW/g; Linearity: ±0.2 dB
Surface Detection:	±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 (+/-0.2 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 (see Appendix F for specifications of the SAM phantom V4.0C).


SAM Phantom

13.0 PLANAR PHANTOM

The planar phantom is a fiberglass shell phantom with a 2.0 mm (+/-0.2mm) thick device measurement area at the center of the phantom for SAR evaluations of devices with a larger surface area than the planar section of the SAM phantom. The planar phantom is integrated in a wooden table (see Appendix G for dimensions and specifications of the planar phantom).


Planar Phantom

14.0 DEVICE HOLDER

The DASY4 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

TEST EQUIPMENT	SERIAL NO.	CALIBRATION DATE
Schmid & Partner DASY4 System	-	-
DASY4 Measurement Server	1078	N/A
-Robot	599396-01	N/A
-DAE3	353	Dec 2003
-DAE3	370	May 2004
-ET3DV6 E-Field Probe	1387	Mar 2004
-ET3DV6 E-Field Probe	1590	May 2004
-300MHz Validation Dipole	135	Oct 2004
-450MHz Validation Dipole	136	Nov 2004
-835MHz Validation Dipole	411	Mar 2004
-900MHz Validation Dipole	054	June 2004
-1800MHz Validation Dipole	247	June 2004
-1900MHz Validation Dipole	151	June 2004
-2450MHz Validation Dipole	150	Sept 2004
-SAM Phantom V4.0C	1033	N/A
-Barski Planar Phantom	03-01	N/A
-Plexiglas Planar Phantom	161	N/A
-Validation Planar Phantom	137	N/A
HP 85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8651A Power Meter	8650137	April 2004
Gigatronics 8652A Power Meter	1835267	April 2004
Gigatronics 80701A Power Sensor	1833535	April 2004
Gigatronics 80701A Power Sensor	1833542	April 2004
Gigatronics 80701A Power Sensor	1834350	April 2004
HP E4408B Spectrum Analyzer	US39240170	Dec 2003
HP 8594E Spectrum Analyzer	3543A02721	April 2004
HP 8753E Network Analyzer	US38433013	April 2004
HP 8648D Signal Generator	3847A00611	April 2004
Amplifier Research 5S1G4 Power Amplifier	26235	N/A

16.0 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	± 4.85	Normal	1	1	± 4.85	∞
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)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					**± 13.32**	
Expanded Uncertainty (k=2)					**± 26.64**	

Measurement Uncertainty Table in accordance with IEEE Standard 1528-2003 (see reference [5])

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	± 4.85	Normal	1	1	± 4.85	∞
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					**± 9.97**	
Expanded Uncertainty (k=2)					**± 19.93**	

Measurement Uncertainty Table in accordance with IEEE Standard 1528-2003 (see reference [5])

17.0 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 Std 1528-2003, “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”: June 2003.

APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

Date 11/17/04

System Performance Check - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150; Calibrated: 09/30/2004

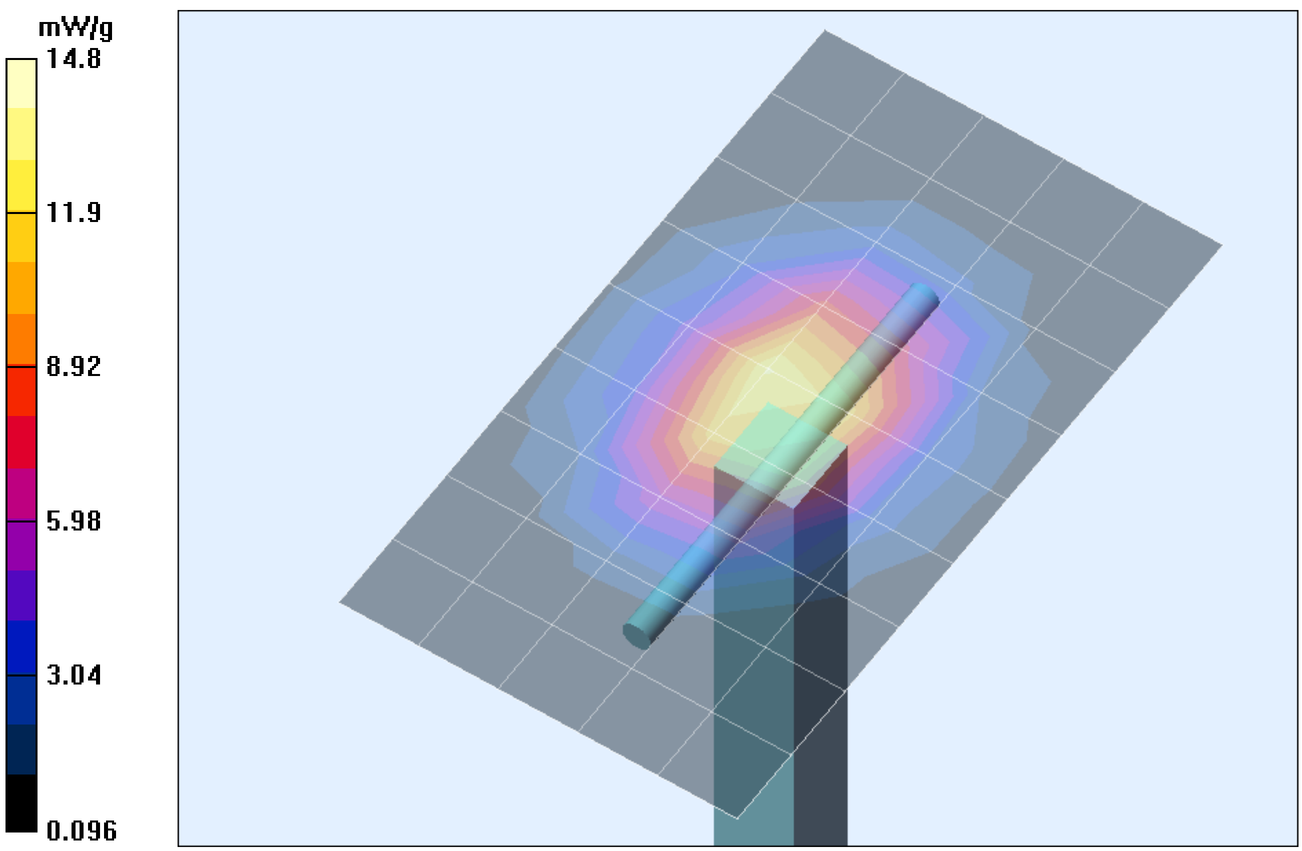
Ambient Temp: 24.9 ºC; Fluid Temp: 23.9 ºC; Barometric Pressure: 103.1 kPa; Humidity: 30%

Communication System: CW
Forward Conducted Power: 250mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.89 mho/m; ε_r = 38.6; ρ = 1000 kg/m^3)

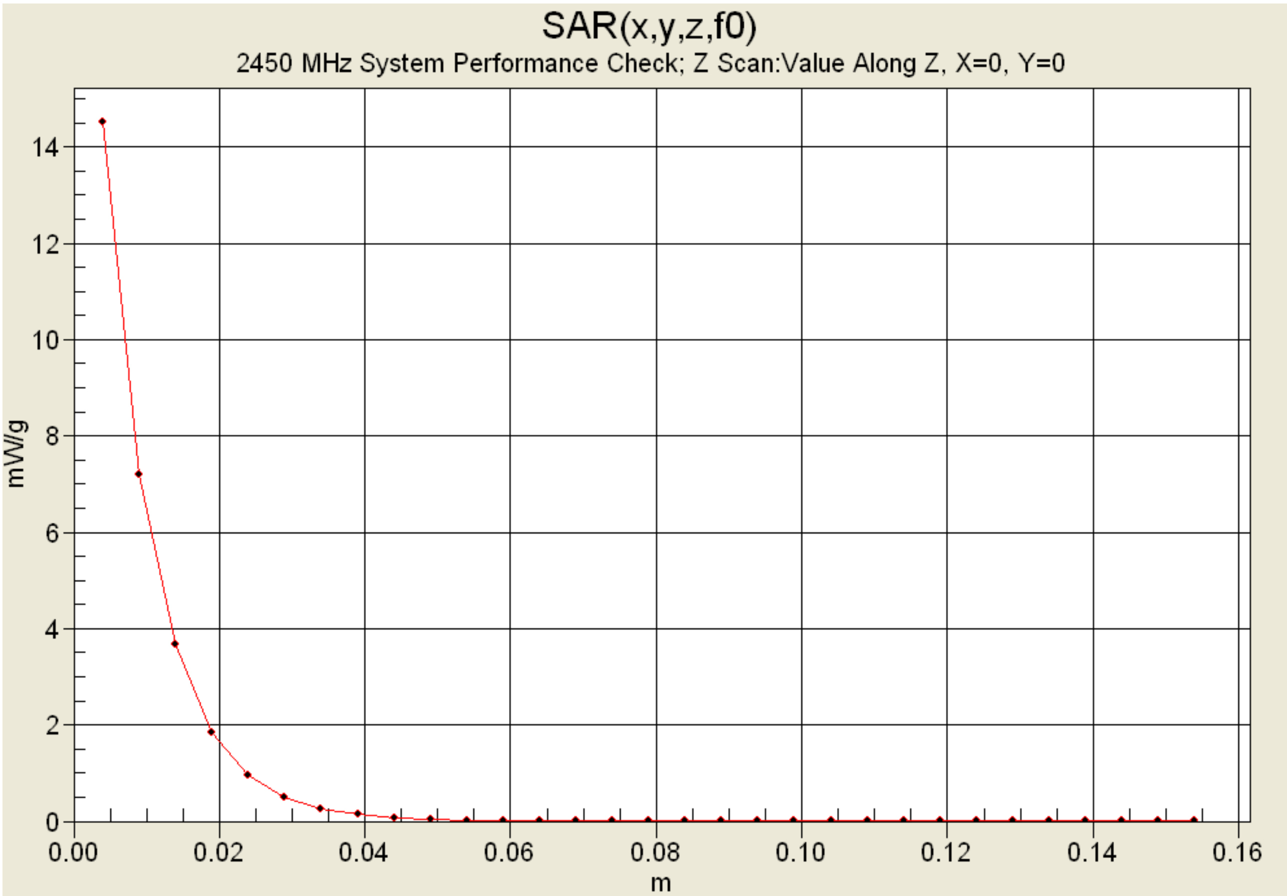
- Probe: ET3DV6 - SN1387; ConvF(4.77, 4.77, 4.77); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 14/05/2004
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

2450 MHz Dipole - System Performance Check/Area Scan (6x10x1):
Measurement grid: dx=10mm, dy=10mm

2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93 V/m; Power Drift = 0.006 dB
Peak SAR (extrapolated) = 27 W/kg
SAR(1 g) = 13.0 mW/g; SAR(10 g) = 6.02 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
2450 MHz System Performance Check; Z Scan:Value Along Z, X=0, Y=0
mW/g
14
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

Date: 11/18/04

System Performance Check - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150; Calibrated: 09/30/2004

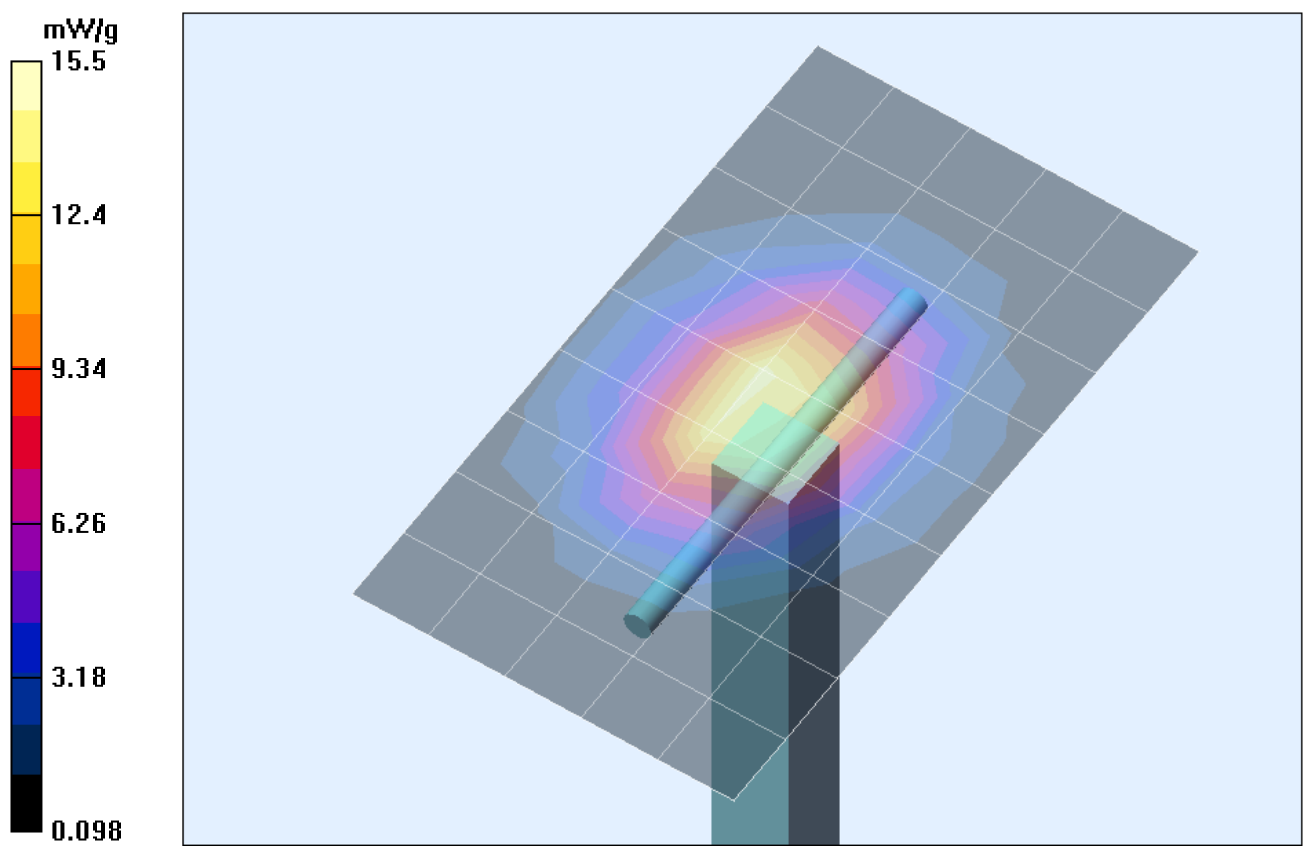
Ambient Temp: 25.2 ºC; Fluid Temp: 23.9 ºC; Barometric Pressure: 101.9 kPa; Humidity: 30%

Communication System: CW
Forward Conducted Power: 250mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.89 mho/m; ε_r = 38.2; ρ = 1000 kg/m^3)

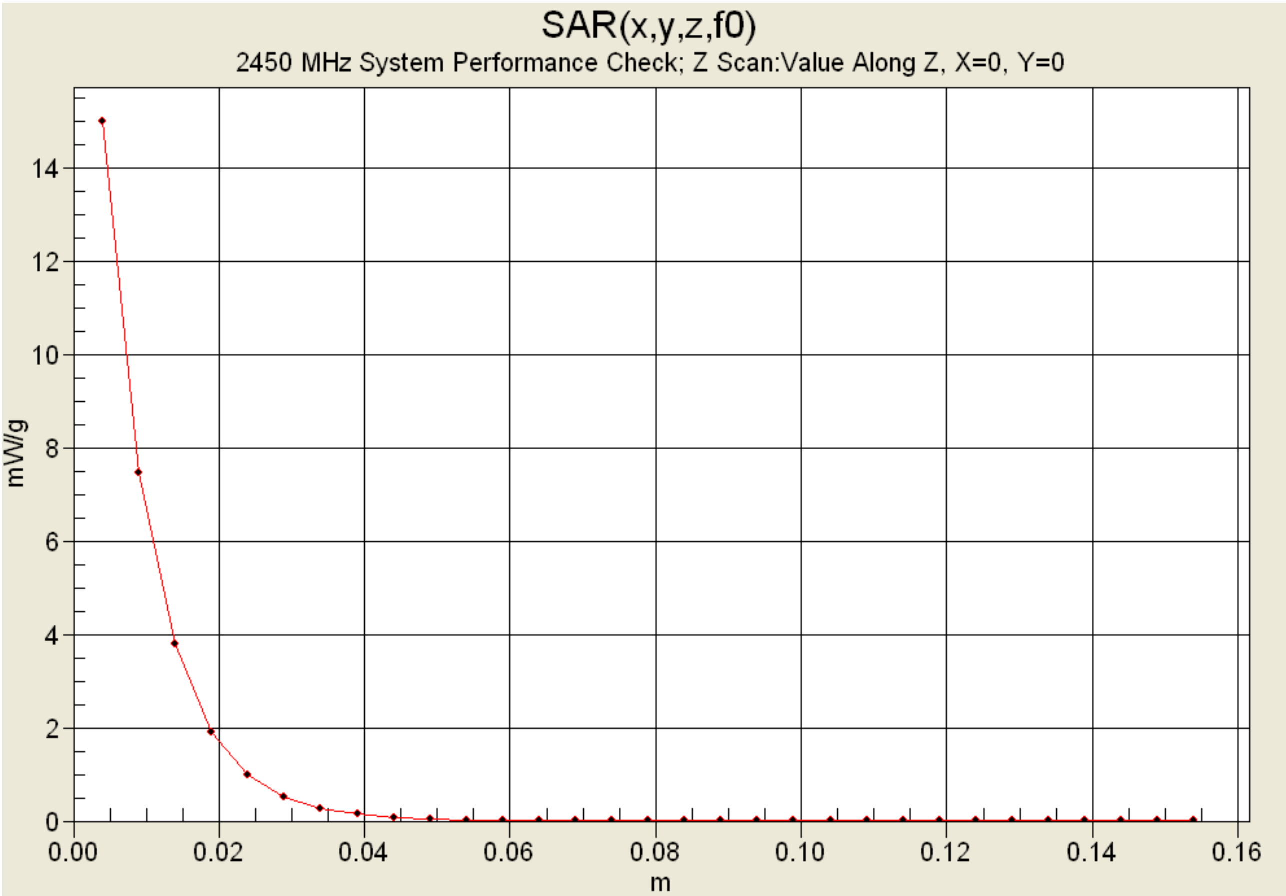
- Probe: ET3DV6 - SN1387; ConvF(4.77, 4.77, 4.77); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 14/05/2004
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

2450 MHz Dipole - System Performance Check/Area Scan (6x10x1):
Measurement grid: dx=10mm, dy=10mm

2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.7 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.37 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
2450 MHz System Performance Check; Z Scan:Value Along Z, X=0, Y=0
mW/g
0
2
4
6
8
10
12
14
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

Date: 11/19/04

System Performance Check - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150; Calibrated: 09/30/2004

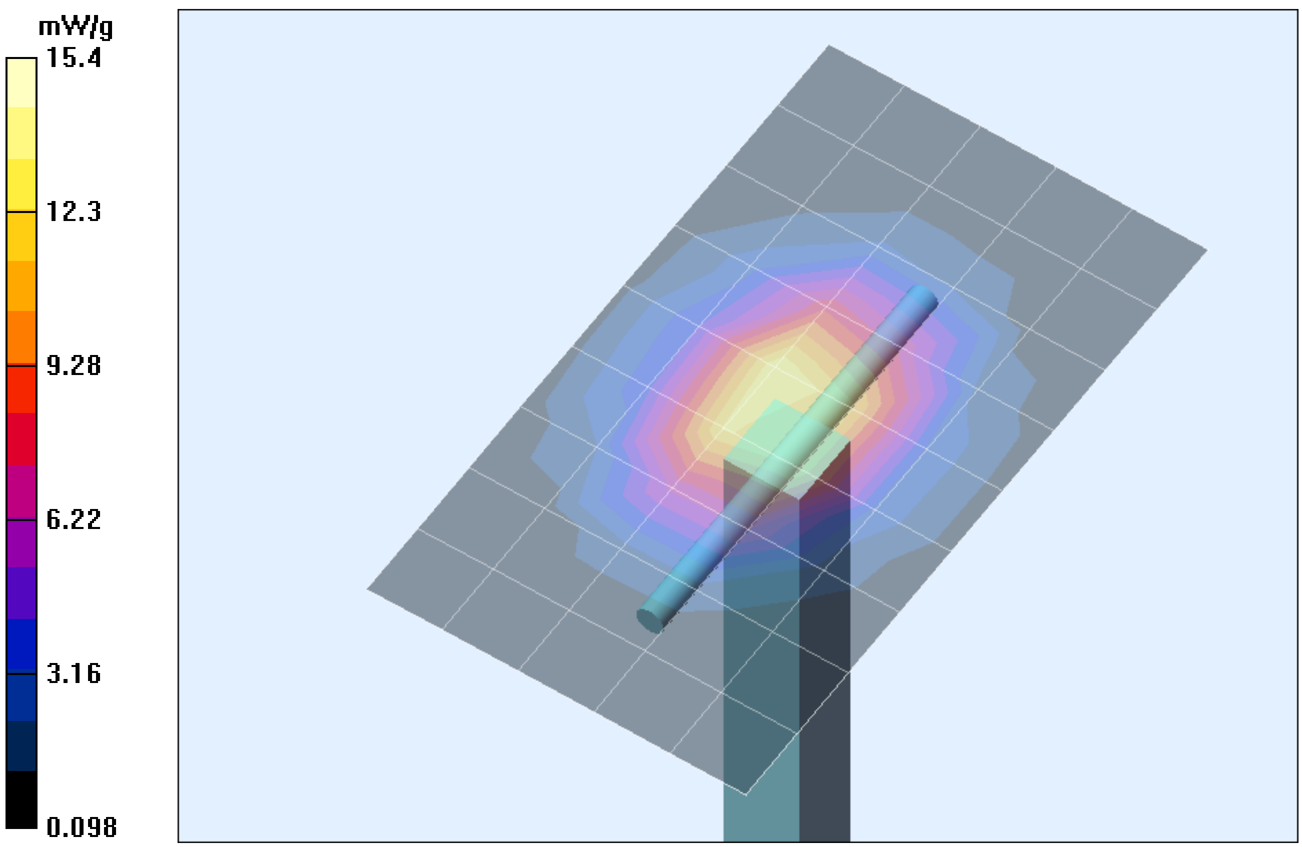
Ambient Temp: 24.4 °C; Fluid Temp: 23.9 °C; Barometric Pressure: 103.0 kPa; Humidity: 30%

Communication System: CW
Forward Conducted Power: 250mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.86 mho/m; ε_r = 38.1; ρ = 1000 kg/m^3)

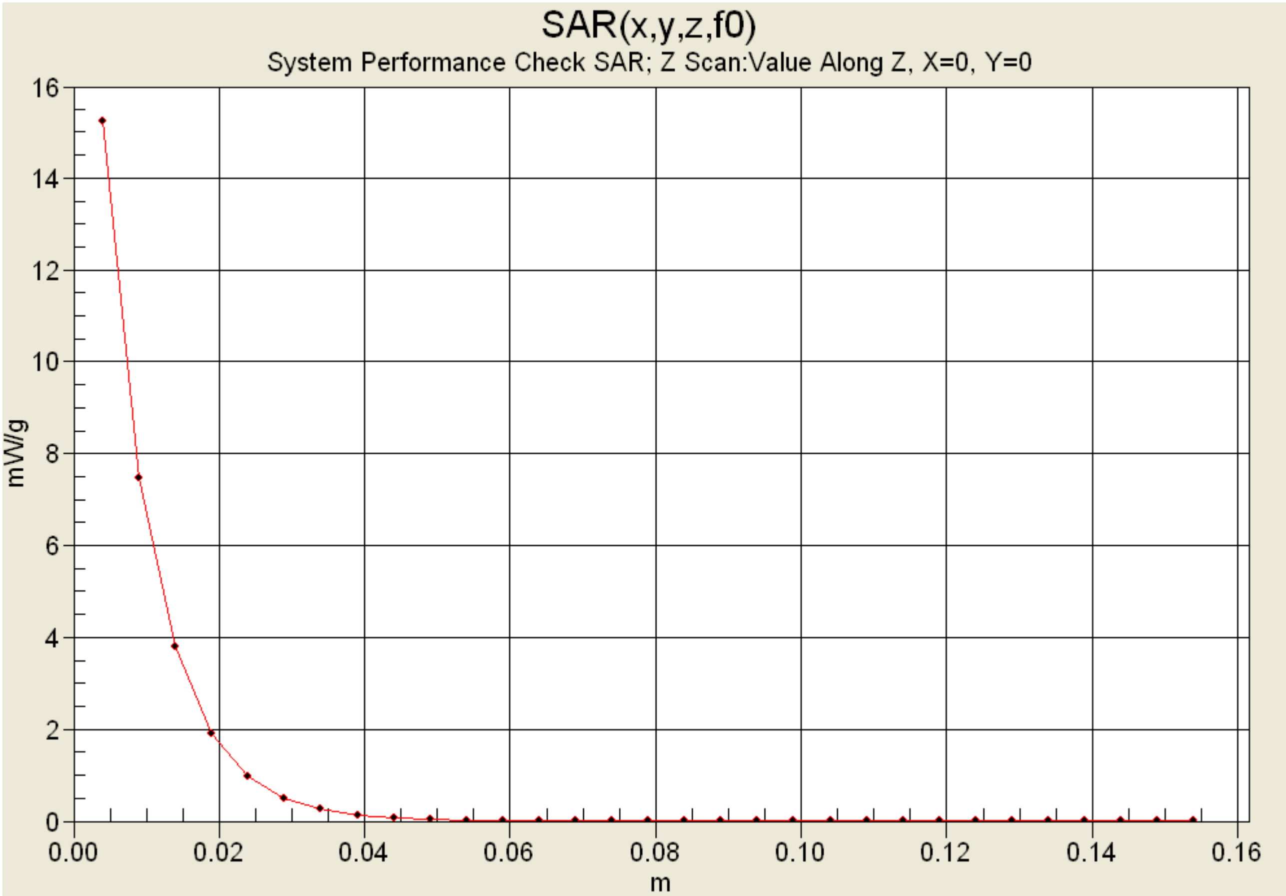
- Probe: ET3DV6 - SN1387; ConvF(4.77, 4.77, 4.77); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 14/05/2004
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

2450 MHz Dipole - System Performance Check/Area Scan (6x10x1):
Measurement grid: dx=10mm, dy=10mm

2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.8 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 29 W/kg
SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.21 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
System Performance Check SAR; Z Scan:Value Along Z, X=0, Y=0
mW/g
0
2
4
6
8
10
12
14
16
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

Date Tested: 11/26/04

System Performance Check - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150; Calibrated: 09/30/2004

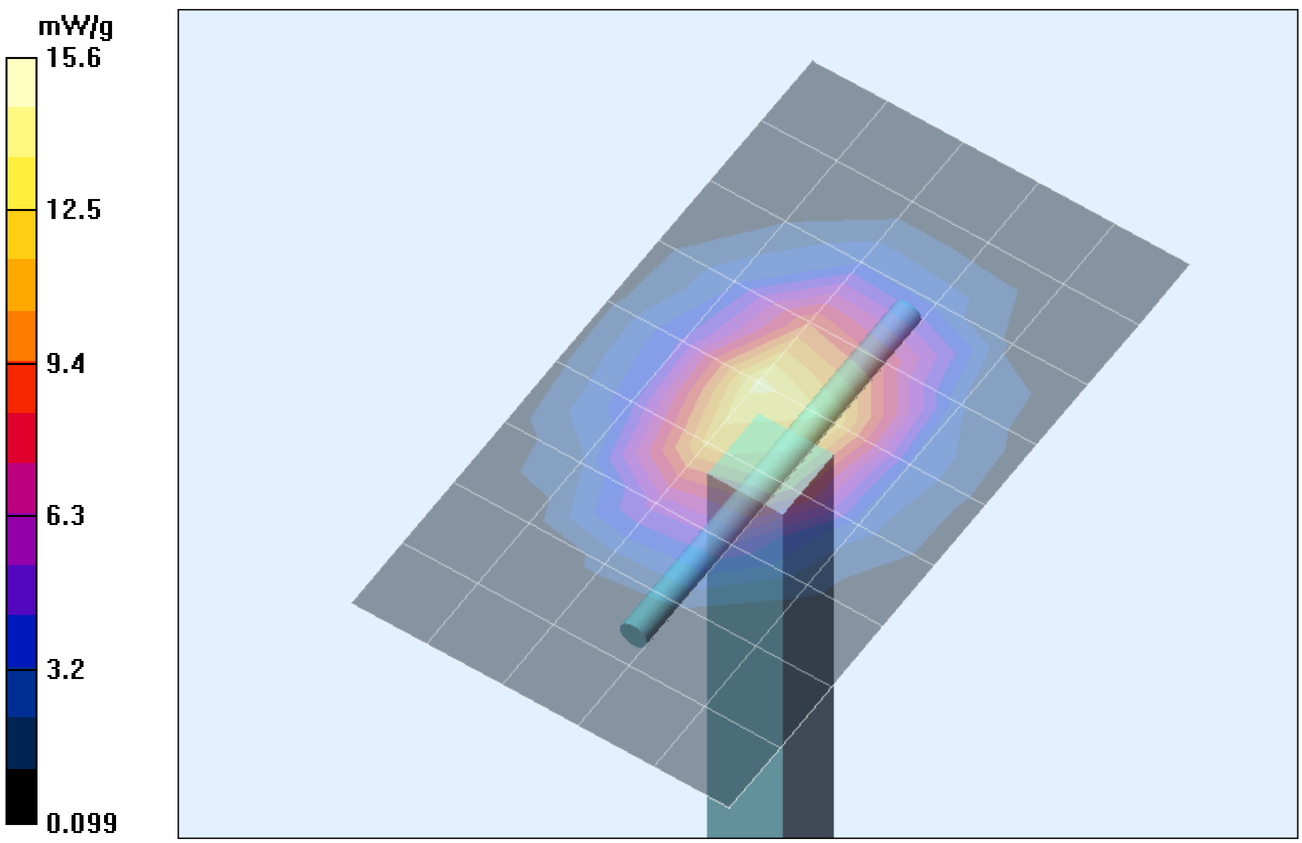
Ambient Temp: 25.5 ºC; Fluid Temp: 23.9 ºC; Barometric Pressure: 102.2 kPa; Humidity: 30%

Communication System: CW
Forward Conducted Power: 250mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.87 mho/m; ε_r = 38.4; ρ = 1000 kg/m^3)

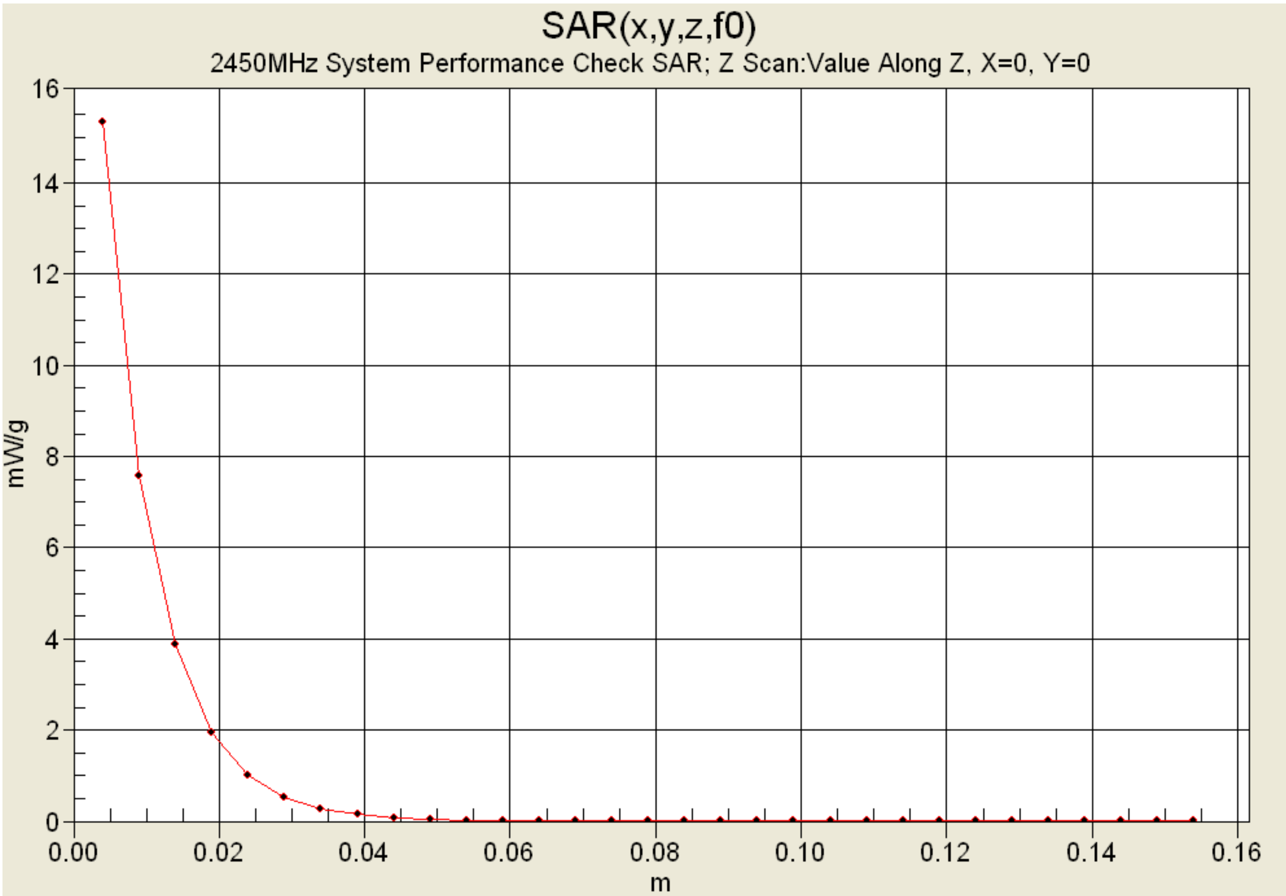
- Probe: ET3DV6 - SN1387; ConvF(4.77, 4.77, 4.77); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 14/05/2004
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build

2450 MHz Dipole - System Performance Check/Area Scan (6x10x1):
Measurement grid: dx=10mm, dy=10mm

2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.8 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.35 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
2450MHz System Performance Check SAR; Z Scan:Value Along Z, X=0, Y=0
mW/g
16
14
12
10
8
6
4
2
0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

APPENDIX C - SYSTEM VALIDATION

Celltech
Testing and Engineering Services Lab

2450 MHz SYSTEM VALIDATION DIPOLE

Type:	**2450 MHz Validation Dipole**
Serial Number:	**150**
Place of Calibration:	**Celltech Labs Inc.**
Date of Calibration:	**September 30, 2004**

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

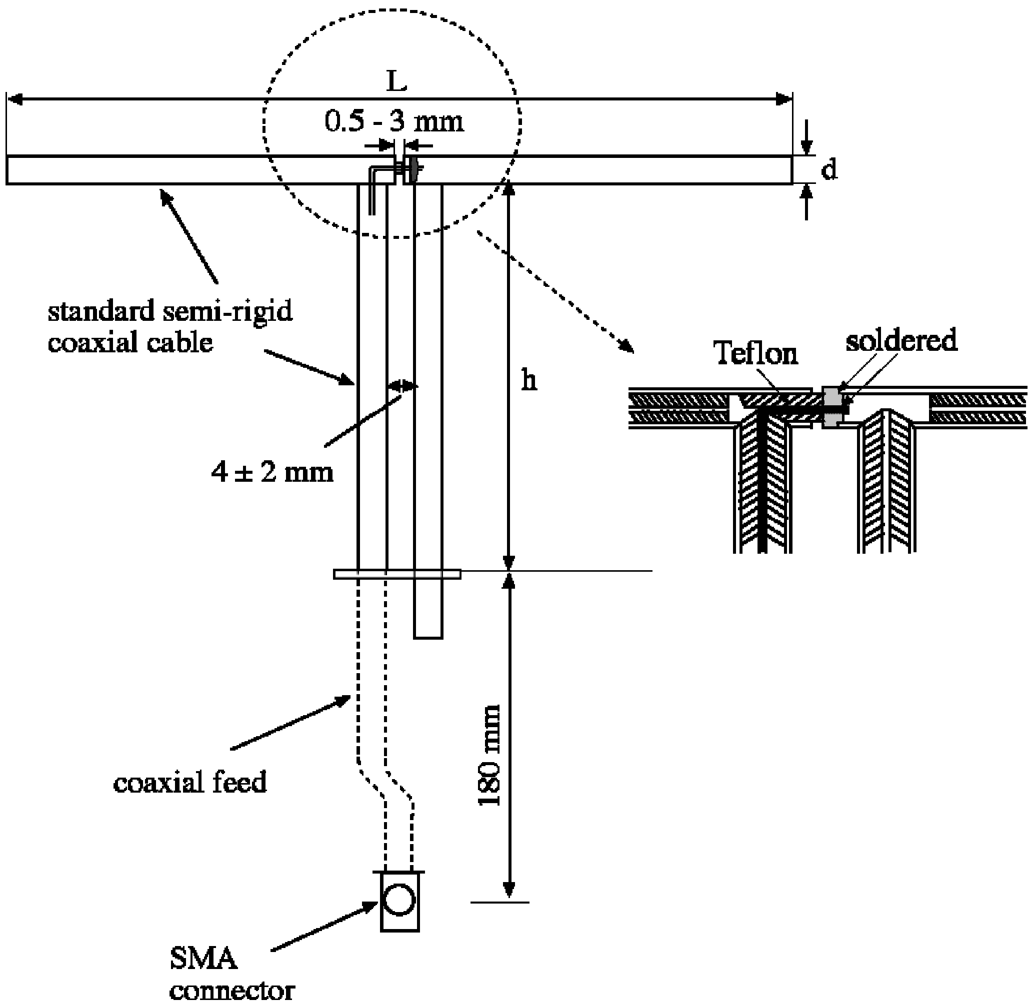
Calibrated by:	Spencer Watson
Approved by:	Russell W. Pipe

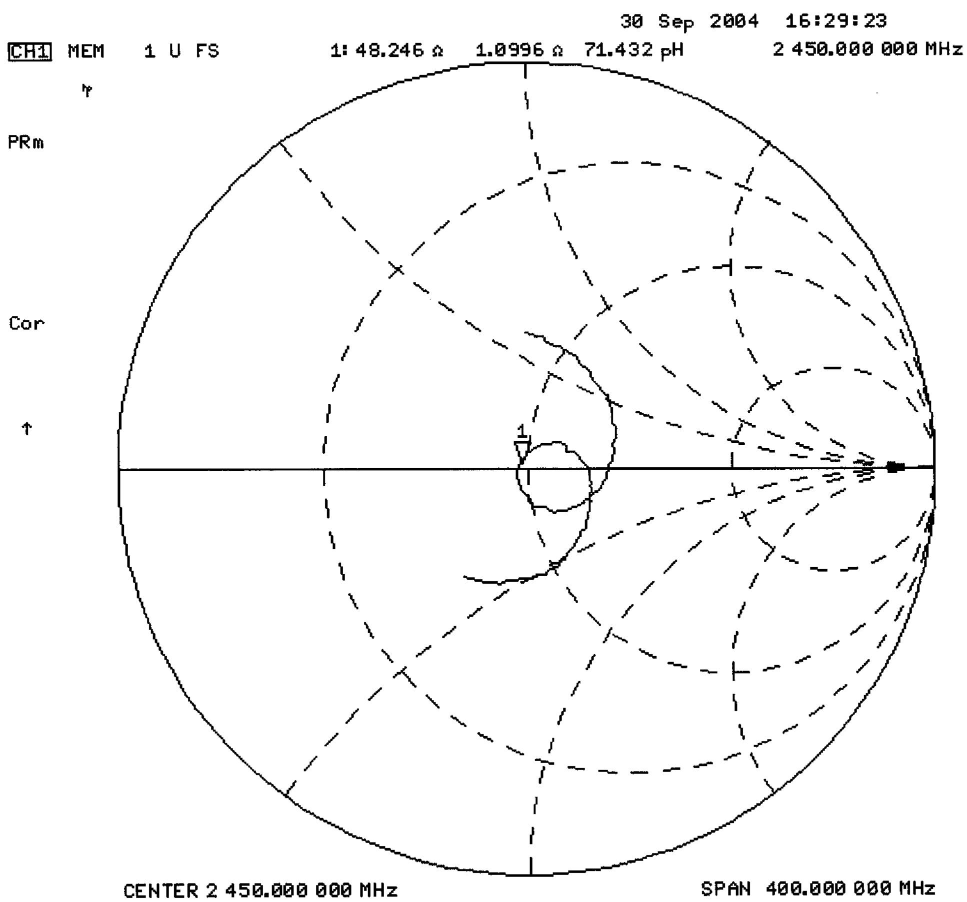
Celltech Labs Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
www.celltechlabs.com

1. Dipole Construction & Electrical Characteristics

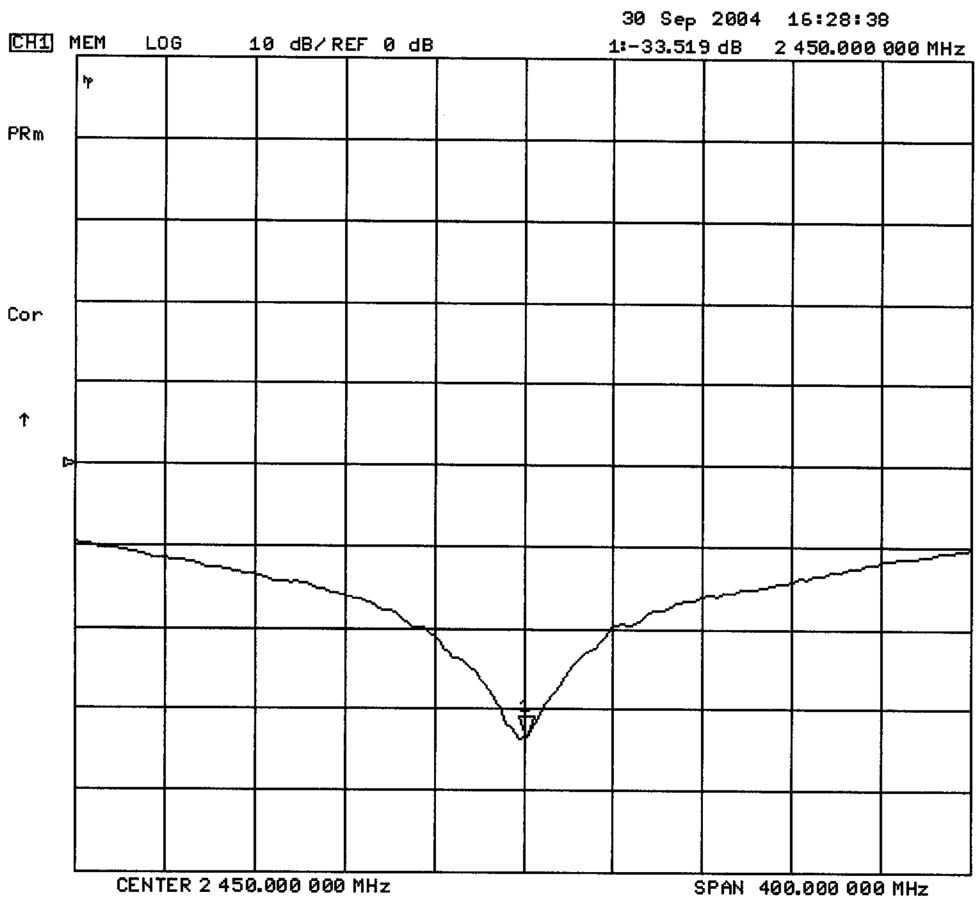
The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network 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 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 2450 MHz	Re{Z} = 48.246Ω
	Im{Z} = 1.0996Ω
Return Loss at 2450 MHz	-33.519 dB





30 Sep 2004 16:29:23
CH1 MEM 1 U FS
1: 48.246 Ω 1.0996 Ω 71.432 pH
2 450.000 000 MHz
PRm
Cor
CENTER 2 450.000 000 MHz
SPAN 400.000 000 MHz


30 Sep 2004 16:28:38
CH1 MEM LOG 10 dB/ REF 0 dB
1:-33.519 dB 2 450.000 000 MHz
PRm
Cor
CENTER 2 450.000 000 MHz
SPAN 400.000 000 MHz

2. 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

3. 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. 25 liters
Dimensions: 50 cm (W) x 100 cm (L)

4. 2450 MHz System Validation Setup

5. 2450 MHz Dipole Setup

6. Measurement Conditions

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

Relative Permittivity:	38.5
Conductivity:	1.86 mho/m
Fluid Temperature:	23.7 °C
Fluid Depth:	≥ 15.0 cm

Environmental Conditions:

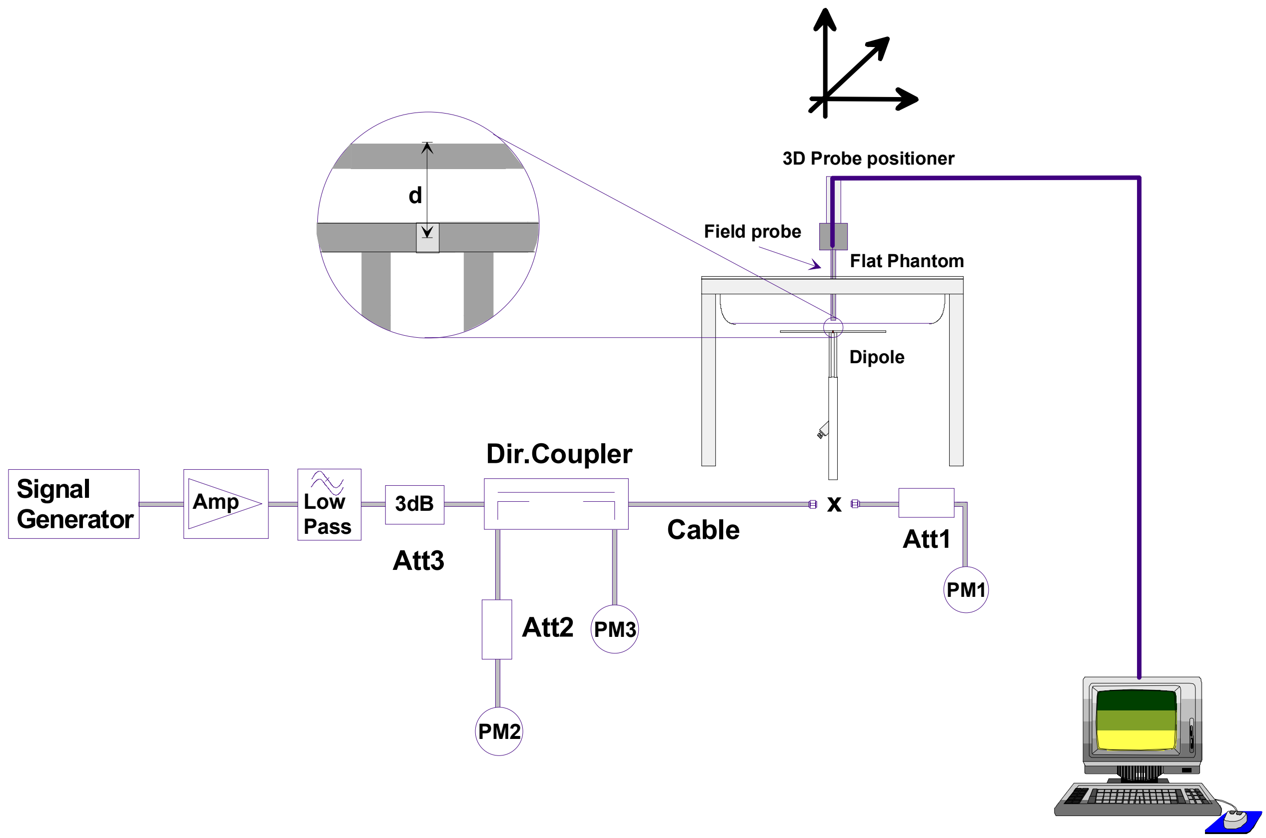
Ambient Temperature:	25.3 °C
Humidity:	32 %
Barometric Pressure:	102.7 kPa

The 2450 MHz simulated brain tissue mixture consists of the following ingredients:

Ingredient	Percentage by weight
Water	52.00%
Glycol Monobutyl	48.00%
Target Dielectric Parameters at 22°C	ε_r = 39.2 (+/-5%) σ = 1.80 S/m (+/-5%)

7. 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.

8. Validation Dipole SAR Test Results

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

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	14.2	56.8	6.58	26.32	30.4
Test 2	14.1	56.4	6.54	26.16	30.2
Test 3	14.1	56.4	6.54	26.16	30.4
Test 4	14.1	56.4	6.51	26.04	30.6
Test 5	14.0	56.0	6.51	26.04	29.8
Test 6	14.0	56.0	6.49	25.96	29.6
Test 7	14.1	56.4	6.54	26.16	30.0
Test 8	14.1	56.4	6.53	26.12	30.1
Test 9	14.0	56.0	6.50	26.00	29.8
Test10	14.0	56.0	6.47	25.88	30.0
Average Value	14.07	56.28	6.52	26.08	30.09

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

IEEE Target over $1cm^3$ (1g) of tissue: 52.4 mW/g (+/- 10%)

Averaged over 1cm (1g) of tissue: 56.28 mW/g (+ 7.4% deviation)

IEEE Target over $10cm^3$ (10g) of tissue: 24.0 mW/g (+/- 10%)

Averaged over 10cm (10g) of tissue: 26.08 mW/g (+ 8.7% deviation)

2540 MHz System Validation - September 30, 2004

DUT: Dipole 2450 MHz; Model: D2450V2; Serial: 150; Calibrated: 09/30/2004
Ambient Temp: 25.3 °C; Fluid Temp: 23.7 °C; Barometric Pressure: 102.7 kPa; Humidity: 32%

Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.86 mho/m; ε_r = 38.5; ρ = 1000 kg/m^3)
- Probe: ET3DV6 - SN1590; ConvF(4.44, 4.44, 4.44); Calibrated: 24/05/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 14/05/2004
- Phantom: SAM 4.0; Type: Fiberglas; Serial: 1033
- Measurement SW: DASY4, V4.3 Build 22; Postprocessing SW: SEMCAD, V1.8 Build 127

2450 MHz System Validation/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm

2450 MHz System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.9 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 14.2 mW/g; SAR(10 g) = 6.58 mW/g

2450 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.9 V/m; Power Drift = -0.002 dB
Peak SAR (extrapolated) = 30.2 W/kg
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.54 mW/g

2450 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.5 V/m; Power Drift = -0.001 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.54 mW/g

2450 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.1 V/m; Power Drift = 0.008 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.51 mW/g

2450 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.9 V/m; Power Drift = -0.009 dB
Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 14.0 mW/g; SAR(10 g) = 6.51 mW/g

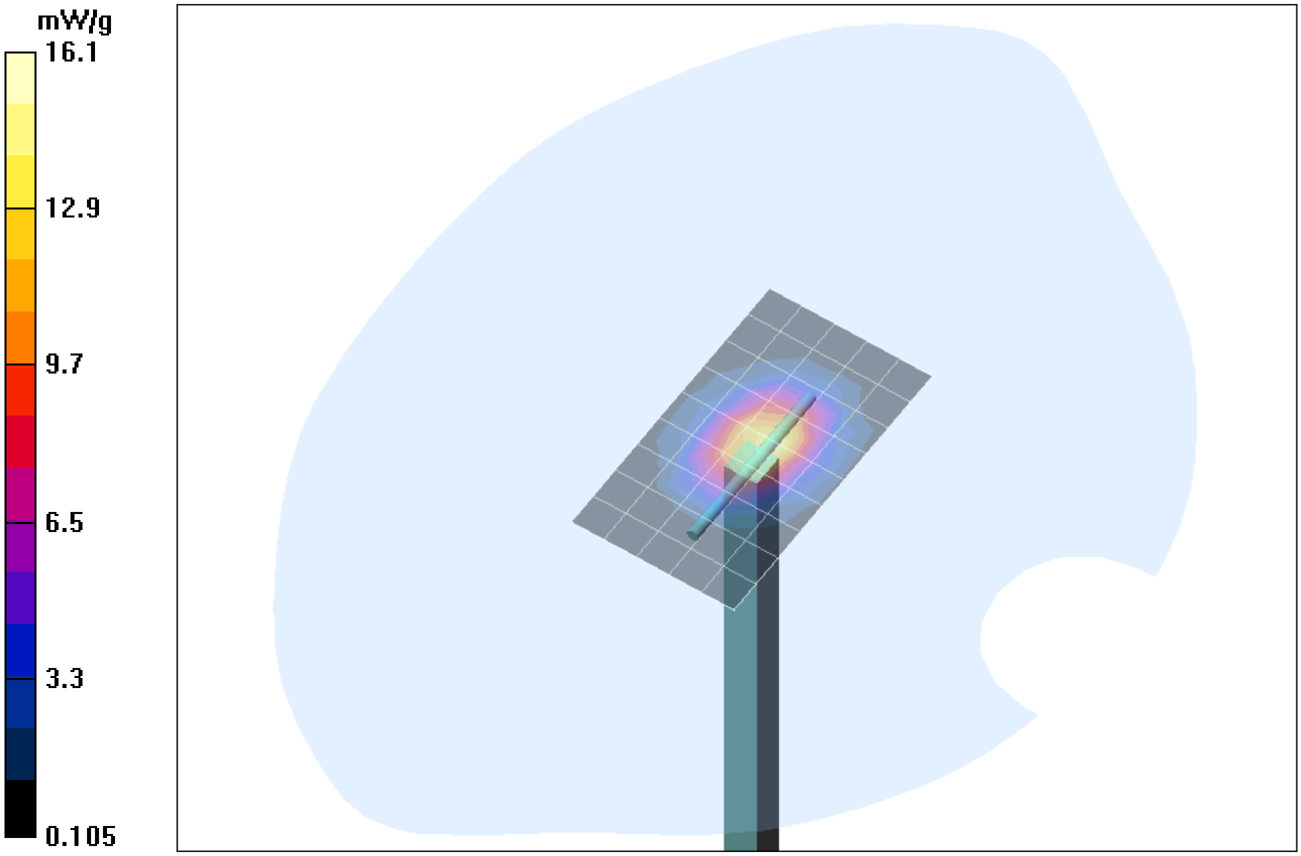
2450 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 29.6 W/kg
SAR(1 g) = 14.0 mW/g; SAR(10 g) = 6.49 mW/g

2450 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = -0.008 dB
Peak SAR (extrapolated) = 30 W/kg
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.54 mW/g

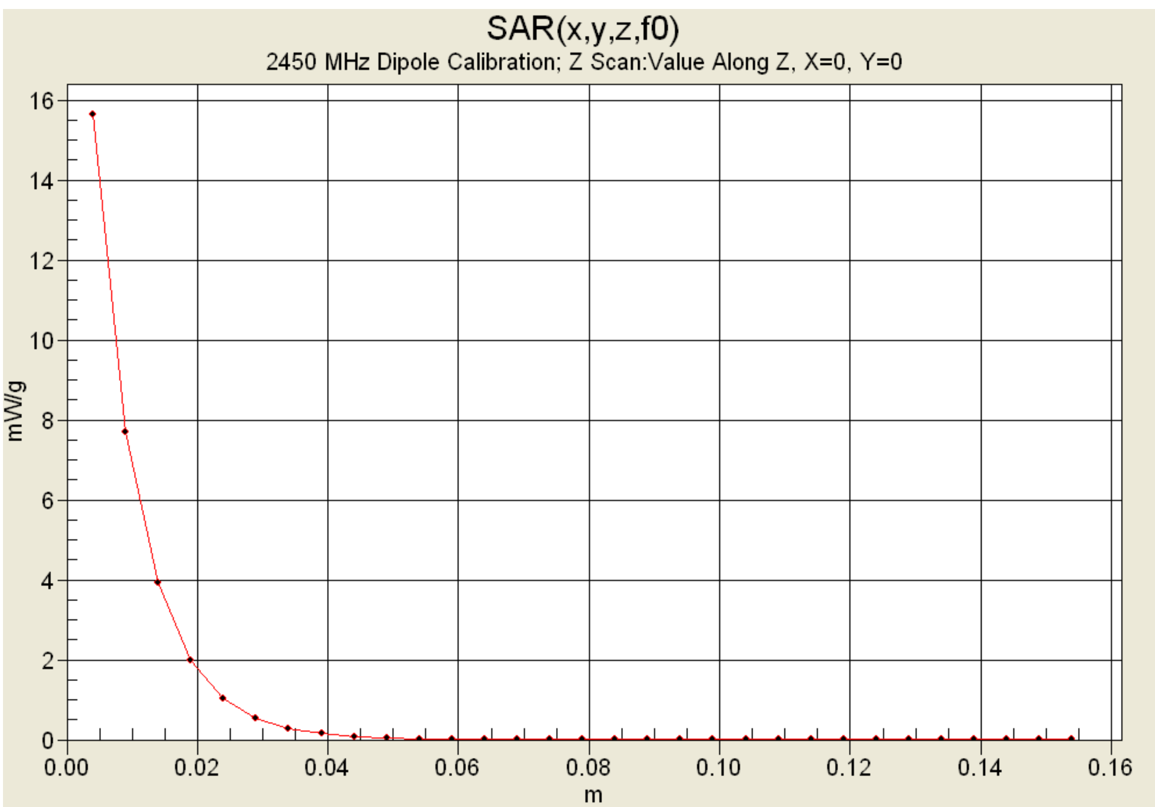
2450 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = -0.004 dB
Peak SAR (extrapolated) = 30.1 W/kg
SAR(1 g) = 14.1 mW/g; SAR(10 g) = 6.53 mW/g

2450 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.3 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 29.8 W/kg
SAR(1 g) = 14.0 mW/g; SAR(10 g) = 6.5 mW/g

2450 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.4 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 30 W/kg
SAR(1 g) = 14.0 mW/g; SAR(10 g) = 6.47 mW/g



1 g average of 10 measurements: 14.07 mW/g
10 g average of 10 measurements: 6.521 mW/g



2450 MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

September 30, 2004

Frequency	e'	e"
2.350000000 GHz	38.9044	13.2920
2.360000000 GHz	38.8598	13.3262
2.370000000 GHz	38.8346	13.3589
2.380000000 GHz	38.7702	13.3903
2.390000000 GHz	38.7465	13.4360
2.400000000 GHz	38.6987	13.4546
2.410000000 GHz	38.6553	13.4975
2.420000000 GHz	38.6023	13.5376
2.430000000 GHz	38.5771	13.5800
2.440000000 GHz	38.5403	13.6072
2.450000000 GHz	38.5010	13.6535
2.460000000 GHz	38.4824	13.6770
2.470000000 GHz	38.4488	13.7080
2.480000000 GHz	38.4153	13.7445
2.490000000 GHz	38.3700	13.7692
2.500000000 GHz	38.3378	13.7887
2.510000000 GHz	38.2798	13.8028
2.520000000 GHz	38.2288	13.8500
2.530000000 GHz	38.1683	13.8945
2.540000000 GHz	38.1113	13.9420
2.550000000 GHz	38.0791	13.9851

APPENDIX D - PROBE CALIBRATION

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

Client **Celltech**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1387
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	March 18, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS, No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	[signature]
Approved by:	Katja Pokovic	Laboratory Director	[signature]

Date issued: March 18, 2004

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 calibrated:	February 26, 2003
Recalibrated:	March 18, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

NormX	**1.62** μV/(V/m)^2
NormY	**1.71** μV/(V/m)^2
NormZ	**1.71** μV/(V/m)^2

Diode Compression[A]

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

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

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

Sensor Cener to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	9.3	4.4
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

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

Sensor to Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	14.8	10.0
SAR_{be} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

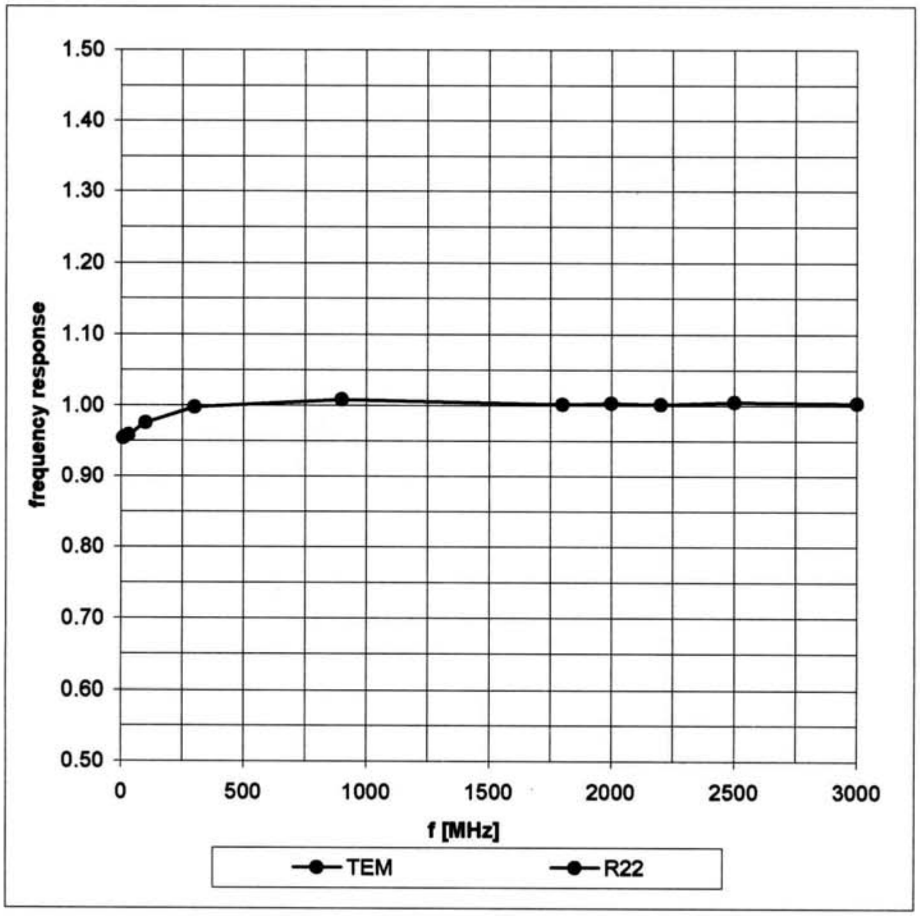
Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

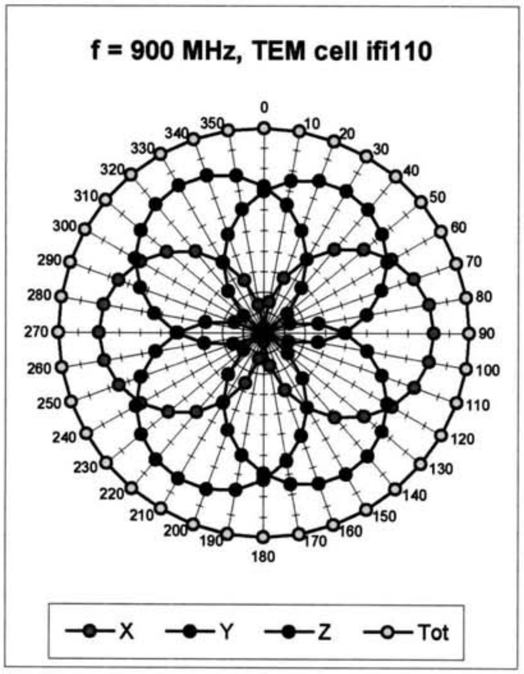
[A] numerical linearization parameter: uncertainty not required

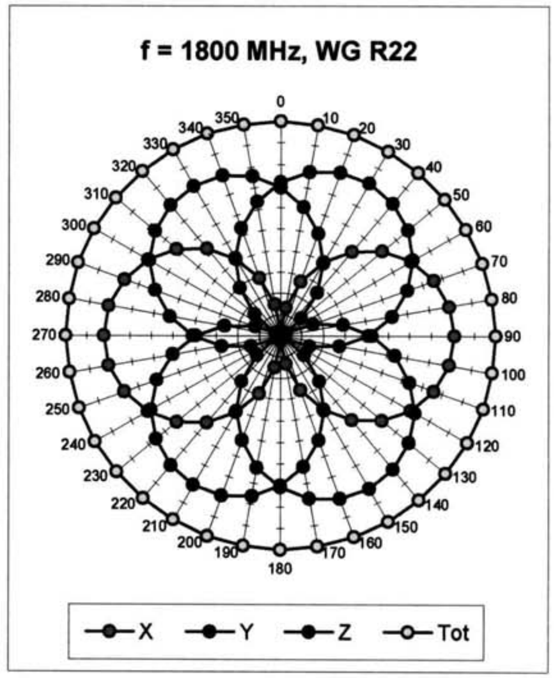
Frequency Response of E-Field

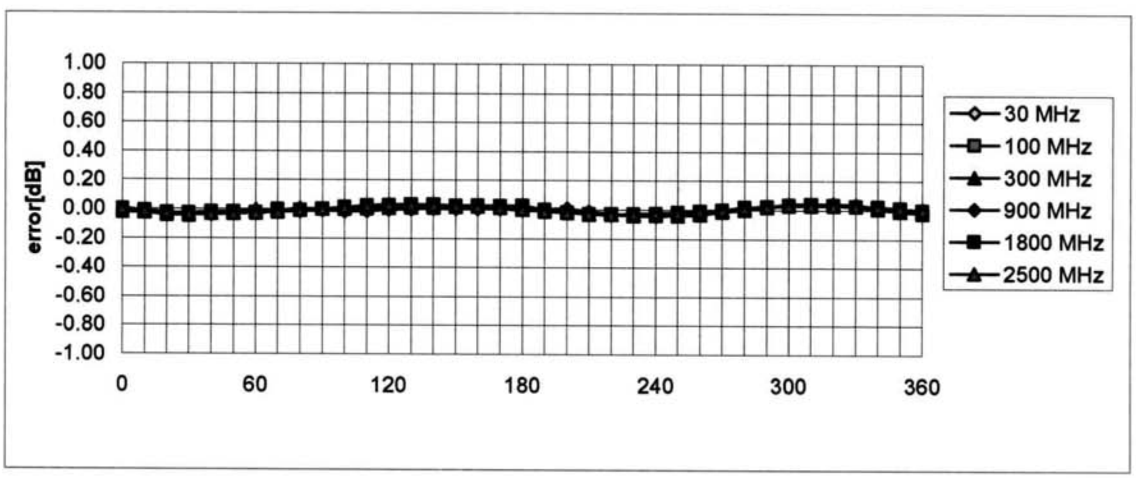
(TEM-Cell:ifi110, Waveguide R22)



Receiving Pattern (ϕ) , θ = 0°



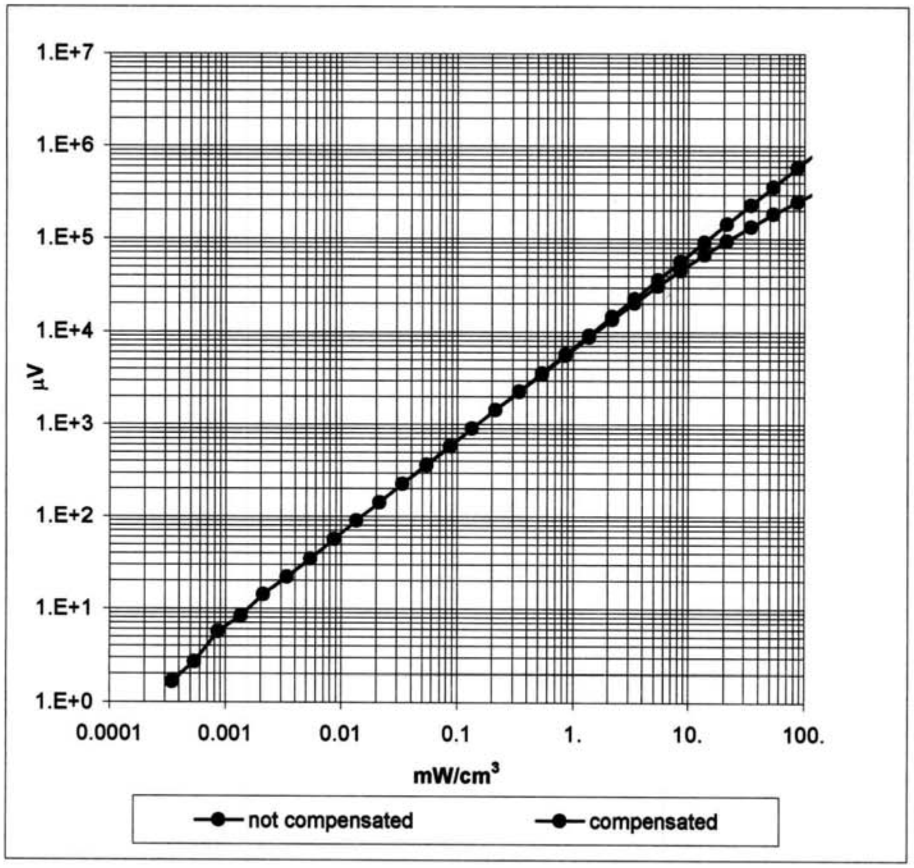


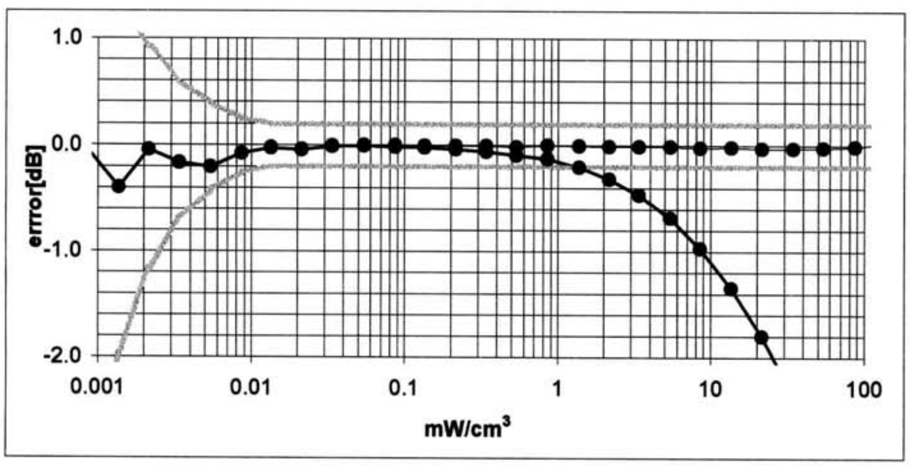


Axial Isotropy Error < ± 0.2 dB

Dynamic Range f(SAR_{head})

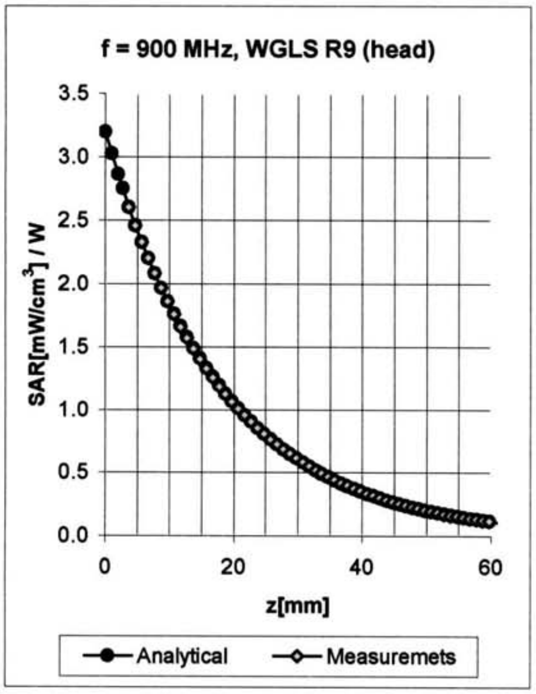
(Waveguide R22)

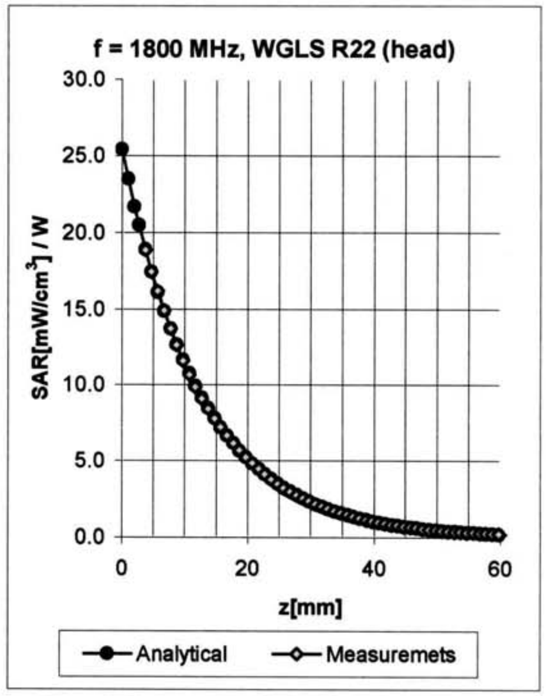




Probe Linearity < ± 0.2 dB

Conversion Factor Assessment



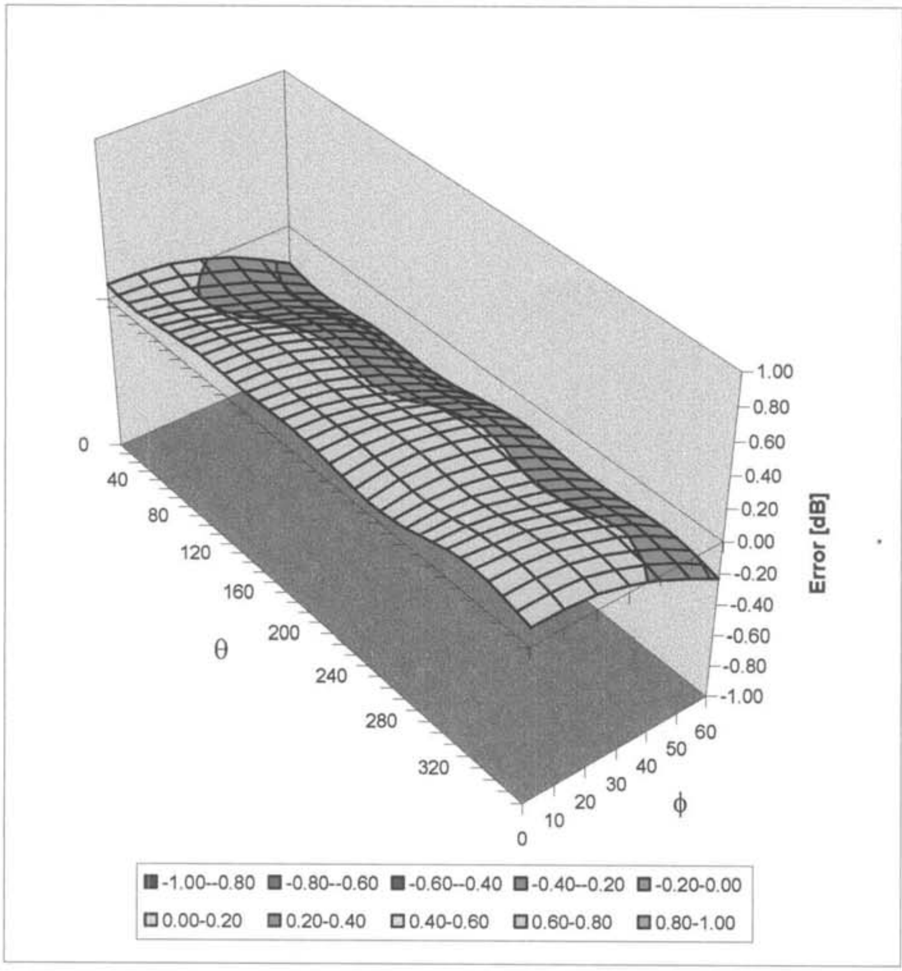


f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
835	750-950	Head	41.5 ± 5%	0.90 ± 5%	0.72	1.78	6.71	± 11.9% (k=2)
1750	1700-1800	Head	40.0 ± 5%	1.40 ± 5%	0.51	2.67	5.38	± 9.7% (k=2)
1900	1850-1950	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.66	5.25	± 9.7% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	0.99	1.89	4.77	± 9.7% (k=2)
835	750-950	Body	55.2 ± 5%	0.97 ± 5%	0.56	2.04	6.24	± 11.9% (k=2)
1750	1700-1800	Body	53.3 ± 5%	1.52 ± 5%	0.58	2.82	4.68	± 9.7% (k=2)
1900	1850-1950	Body	53.3 ± 5%	1.52 ± 5%	0.62	2.77	4.57	± 9.7% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.75	1.28	4.50	± 9.7% (k=2)

[B] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Assessment:	**Zurich**
Date of Assessment:	**March 22, 2004**
Probe Calibration Date:	**March 18, 2004**

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:

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

Dosimetric E-Field Probe ET3DV6 SN:1387

Conversion factor (± standard deviation)

150 MHz	ConvF	**9.1 ± 8%**	**ε_r = 52.3 ± 5%** **σ = 0.76 ± 5% mho/m** (head tissue)
300 MHz	ConvF	**7.8 ± 8%**	**ε_r = 45.3 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)
450 MHz	ConvF	**7.5 ± 8%**	**ε_r = 43.5 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)
150 MHz	ConvF	**8.7 ± 8%**	**ε_r = 61.9 ± 5%** **σ = 0.80 ± 5% mho/m** (body tissue)
450 MHz	ConvF	**7.6 ± 8%**	**ε_r = 56.7 ± 5%** **σ = 0.94 ± 5% mho/m** (body tissue)

Important Note:

For numerically assessed probe conversion factors, parameters Alpha and Delta in the DASY software must have the following entries: Alpha = 0 and Delta = 1.

Please see also Section 4.7 of the DASY4 Manual.

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

November 17, 2004

Frequency	e'	e"
2.350000000 GHz	39.0298	13.5765
2.360000000 GHz	38.9895	13.6011
2.370000000 GHz	38.9405	13.6412
2.380000000 GHz	38.9113	13.6599
2.390000000 GHz	38.8707	13.6771
2.400000000 GHz	38.8301	13.7001
2.410000000 GHz	38.7839	13.7253
2.420000000 GHz	38.7463	13.7632
2.430000000 GHz	38.7027	13.7924
2.440000000 GHz	38.6654	13.8417
2.450000000 GHz	38.6314	13.8635
2.460000000 GHz	38.5812	13.9214
2.470000000 GHz	38.5630	13.9499
2.480000000 GHz	38.5286	13.9812
2.490000000 GHz	38.4972	14.0019
2.500000000 GHz	38.4424	14.0233
2.510000000 GHz	38.3895	14.0491
2.520000000 GHz	38.3300	14.0726
2.530000000 GHz	38.2719	14.1257
2.540000000 GHz	38.2336	14.1622
2.550000000 GHz	38.1933	14.1952

2450 MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

November 17, 2004

Frequency	e'	e"
2.350000000 GHz	51.1755	14.4154
2.360000000 GHz	51.1296	14.4434
2.370000000 GHz	51.1025	14.4862
2.380000000 GHz	51.0825	14.5212
2.390000000 GHz	51.0505	14.5785
2.400000000 GHz	51.0038	14.6283
2.410000000 GHz	50.9660	14.6535
2.420000000 GHz	50.9315	14.6864
2.430000000 GHz	50.9160	14.7337
2.440000000 GHz	50.8860	14.7588
2.450000000 GHz	50.8502	14.7989
2.460000000 GHz	50.8108	14.8258
2.470000000 GHz	50.7899	14.8636
2.480000000 GHz	50.7729	14.9121
2.490000000 GHz	50.7365	14.9557
2.500000000 GHz	50.6671	15.0191
2.510000000 GHz	50.6298	15.0506
2.520000000 GHz	50.5632	15.0902
2.530000000 GHz	50.5291	15.1601
2.540000000 GHz	50.5055	15.1727
2.550000000 GHz	50.4538	15.2147

2450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

November 18, 2004

Frequency	e'	e"
2.350000000 GHz	38.6286	13.5458
2.360000000 GHz	38.5867	13.5924
2.370000000 GHz	38.5595	13.6247
2.380000000 GHz	38.5063	13.6477
2.390000000 GHz	38.4659	13.6716
2.400000000 GHz	38.4417	13.6801
2.410000000 GHz	38.3773	13.7132
2.420000000 GHz	38.3476	13.7570
2.430000000 GHz	38.3004	13.7850
2.440000000 GHz	38.2581	13.8313
2.450000000 GHz	38.2268	13.8661
2.460000000 GHz	38.1921	13.9124
2.470000000 GHz	38.1610	13.9585
2.480000000 GHz	38.1304	13.9742
2.490000000 GHz	38.0877	13.9975
2.500000000 GHz	38.0427	14.0038
2.510000000 GHz	37.9890	14.0315
2.520000000 GHz	37.9484	14.0705
2.530000000 GHz	37.8843	14.0968
2.540000000 GHz	37.8281	14.1442
2.550000000 GHz	37.8034	14.1761

2450 MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

November 18, 2004

Frequency	e'	e''
2.350000000 GHz	50.4517	14.3720
2.360000000 GHz	50.4228	14.4122
2.370000000 GHz	50.3927	14.4471
2.380000000 GHz	50.3443	14.4894
2.390000000 GHz	50.3175	14.5182
2.400000000 GHz	50.2794	14.5391
2.410000000 GHz	50.2287	14.5970
2.420000000 GHz	50.1979	14.6430
2.430000000 GHz	50.1453	14.6723
2.440000000 GHz	50.1226	14.7316
2.450000000 GHz	50.0828	14.7722
2.460000000 GHz	50.0736	14.8309
2.470000000 GHz	50.0434	14.8650
2.480000000 GHz	50.0106	14.8956
2.490000000 GHz	49.9610	14.9291
2.500000000 GHz	49.9262	14.9380
2.510000000 GHz	49.8716	14.9829
2.520000000 GHz	49.8378	15.0318
2.530000000 GHz	49.7665	15.0844
2.540000000 GHz	49.7318	15.1360
2.550000000 GHz	49.7059	15.1702

2450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

November 19, 2004

Frequency	e'	e"
2.350000000 GHz	38.5606	13.3694
2.360000000 GHz	38.5113	13.3864
2.370000000 GHz	38.4717	13.4179
2.380000000 GHz	38.4419	13.4502
2.390000000 GHz	38.4142	13.4700
2.400000000 GHz	38.3646	13.4993
2.410000000 GHz	38.3109	13.5325
2.420000000 GHz	38.2676	13.5739
2.430000000 GHz	38.2300	13.6109
2.440000000 GHz	38.1784	13.6598
2.450000000 GHz	38.1494	13.6848
2.460000000 GHz	38.1003	13.7075
2.470000000 GHz	38.0772	13.7309
2.480000000 GHz	38.0416	13.7678
2.490000000 GHz	38.0127	13.7855
2.500000000 GHz	37.9703	13.8120
2.510000000 GHz	37.9250	13.8276
2.520000000 GHz	37.8576	13.8841
2.530000000 GHz	37.7993	13.9114
2.540000000 GHz	37.7569	13.9693
2.550000000 GHz	37.7187	13.9858

2450 MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

November 19, 2004

Frequency	e'	e"
2.350000000 GHz	51.1252	14.1548
2.360000000 GHz	51.0951	14.1789
2.370000000 GHz	51.0746	14.2282
2.380000000 GHz	51.0546	14.2703
2.390000000 GHz	51.0298	14.3041
2.400000000 GHz	50.9863	14.3390
2.410000000 GHz	50.9467	14.3882
2.420000000 GHz	50.9100	14.4382
2.430000000 GHz	50.8902	14.4829
2.440000000 GHz	50.8342	14.5176
2.450000000 GHz	50.8266	14.5635
2.460000000 GHz	50.7866	14.5909
2.470000000 GHz	50.7667	14.6273
2.480000000 GHz	50.7484	14.6697
2.490000000 GHz	50.7216	14.7158
2.500000000 GHz	50.6699	14.7497
2.510000000 GHz	50.6402	14.7823
2.520000000 GHz	50.5710	14.8176
2.530000000 GHz	50.5159	14.8804
2.540000000 GHz	50.4671	14.9324
2.550000000 GHz	50.4498	14.9671

2450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

November 26, 2004

Frequency	e'	e"
2.350000000 GHz	38.7582	13.4536
2.360000000 GHz	38.6970	13.4904
2.370000000 GHz	38.6447	13.5232
2.380000000 GHz	38.6120	13.5515
2.390000000 GHz	38.5656	13.5857
2.400000000 GHz	38.5303	13.6084
2.410000000 GHz	38.5062	13.6471
2.420000000 GHz	38.4902	13.6710
2.430000000 GHz	38.4532	13.7151
2.440000000 GHz	38.4513	13.7471
2.450000000 GHz	38.4029	13.7485
2.460000000 GHz	38.3661	13.7960
2.470000000 GHz	38.3247	13.8171
2.480000000 GHz	38.2708	13.8518
2.490000000 GHz	38.2195	13.8819
2.500000000 GHz	38.1404	13.8973
2.510000000 GHz	38.0786	13.9453
2.520000000 GHz	38.0280	13.9761
2.530000000 GHz	37.9761	14.0302
2.540000000 GHz	37.9510	14.0565
2.550000000 GHz	37.9233	14.0852

2450 MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

November 26, 2004

Frequency	e'	e"
2.350000000 GHz	50.9770	14.3601
2.360000000 GHz	50.9219	14.3961
2.370000000 GHz	50.8992	14.4491
2.380000000 GHz	50.8493	14.4838
2.390000000 GHz	50.8040	14.5394
2.400000000 GHz	50.7649	14.5775
2.410000000 GHz	50.7477	14.6264
2.420000000 GHz	50.7206	14.6477
2.430000000 GHz	50.7077	14.7036
2.440000000 GHz	50.6988	14.7222
2.450000000 GHz	50.6504	14.7492
2.460000000 GHz	50.6298	14.7978
2.470000000 GHz	50.5926	14.8197
2.480000000 GHz	50.5435	14.8754
2.490000000 GHz	50.4792	14.9176
2.500000000 GHz	50.4027	14.9429
2.510000000 GHz	50.3545	15.0073
2.520000000 GHz	50.3115	15.0366
2.530000000 GHz	50.2654	15.1150
2.540000000 GHz	50.2529	15.1369
2.550000000 GHz	50.2328	15.1691

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 - PLANAR PHANTOM CERTIFICATE OF CONFORMITY

2378 Westlake Road
Kelowna, B.C. Canada
V1Z-2V2

BARSKI INDUSTRIES (1985) LTD.

Ph. # 250-769-6848
Fax # 250-769-6334
E-mail: barskiind@shaw.ca
Web: www.bcfiberglass.com

FIBERGLASS FABRICATORS

Certificate of Conformity

Item : Flat Planar Phantom Unit # 03-01
Date: June 16, 2003
Manufacturer: Barski Industries (1985 Ltd)

Test	Requirement	Details
Shape	Compliance to geometry according to drawing	Supplied CAD drawing
Material Thickness	Compliant with the requirements	2mm +/- 0.2mm in measurement area
Material Parameters	Dielectric parameters for required frequencies Based on Dow Chemical technical data	100 MHz-5 GHz Relative permittivity<5 Loss Tangent<0.05

Conformity

Based on the above information, we certify this product to be compliant to the requirements specified.

Signature: ____________________

Daniel Chailler

Fiberglass Planar Phantom - Top View

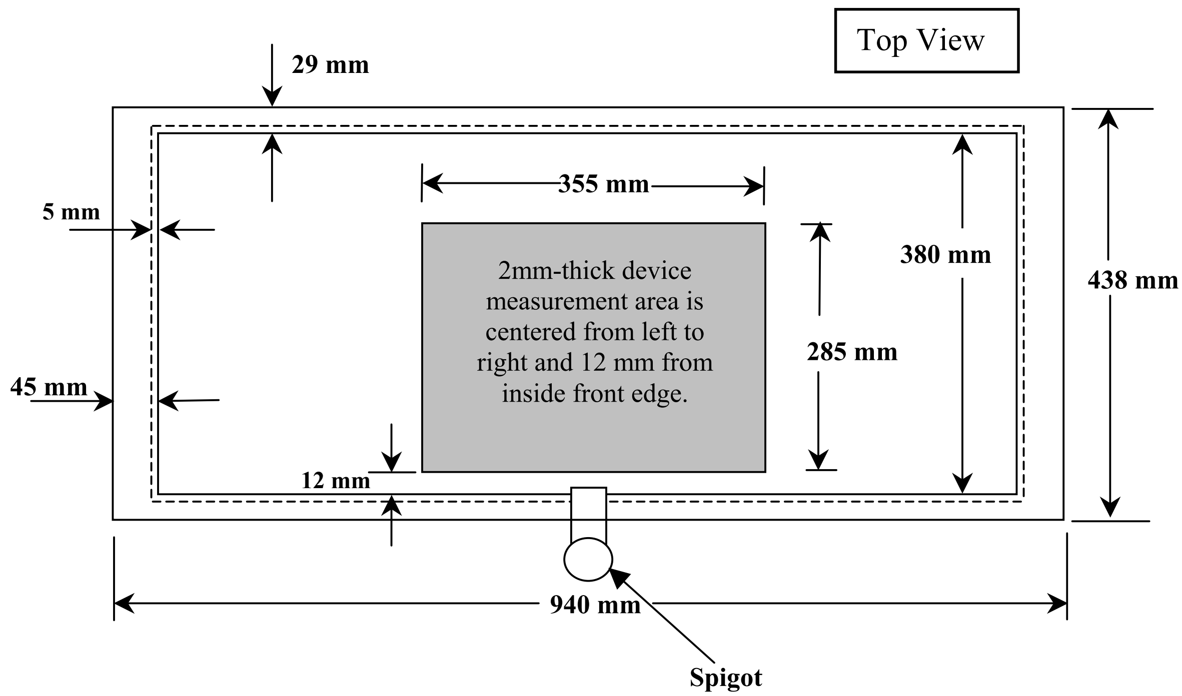
Fiberglass Planar Phantom - Front View

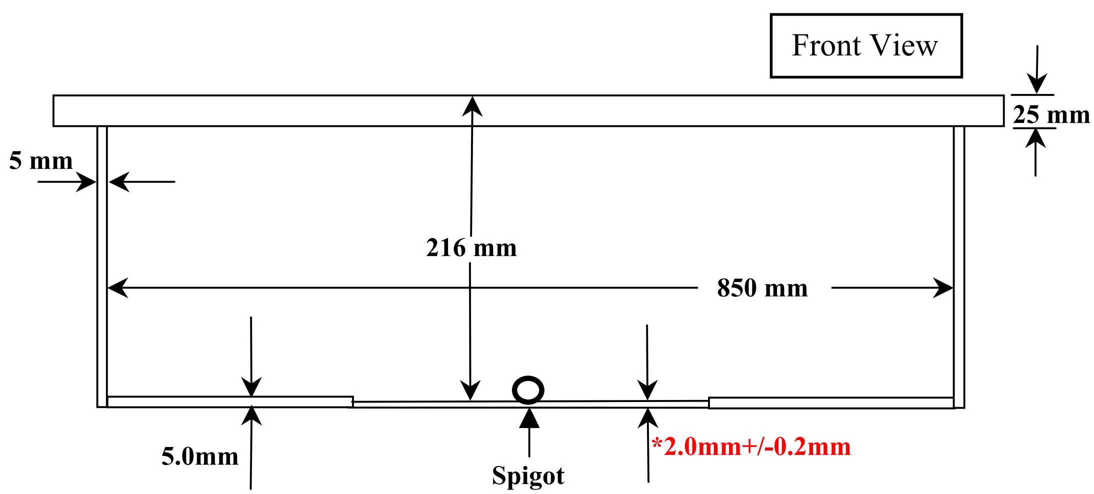
Fiberglass Planar Phantom - Back View

Fiberglass Planar Phantom - Bottom View

Dimensions of Fiberglass Planar Phantom

(Manufactured by Barski Industries Ltd. - Unit# 03-01)





Note: Measurements that aren't repeated for the opposite sides are the same as the side measured. This drawing is not to scale.