DECLARATION OF COMPLIANCE
SAR RF EXPOSURE EVALUATION

Test Lab

CELLTECH LABS INC.
Testing and Engineering Services
1955 Moss Court
Kelowna, B.C.
Canada V1Y 9L3
Phone: 250-448-7047
Fax: 250-448-7046
e-mail: info@celltechlabs.com
web site: www.celltechlabs.com

Applicant Information

ZEBRA TECHNOLOGIES CORPORATION
30 Plan Way
Warwick, RI 02886

Rule Part(s):	**FCC 47 CFR §2.1093; IC RSS-102 Issue 1 (Provisional)**
Test Procedure(s):	**FCC OET Bulletin 65, Supplement C (01-01)**
FCC Device Classification:	**Part 15 Spread Spectrum Transmitter (DSS)**
IC Device Classification:	**Low Power Licence-Exempt Radiocommunication Device (RSS-210)**
DUT Type:	**FHSS WLAN Module installed in QL420 Wireless Portable Printer**
Modulation:	**Frequency Hopping Spread Spectrum (FHSS)**
FCC ID:	**I28MD-QL3021**
Model No.:	**AN16973-1**
Tx Frequency Range:	**2402 - 2480 MHz**
Max. Output Power Measured:	**19.7 dBm Peak Conducted (2402 MHz)**
	20.2 dBm Peak Conducted (2440 MHz)
	20.2 dBm Peak Conducted (2480 MHz)
Antenna Type:	**Internal**
Battery Type(s):	**Lithium-ion 7.4VDC 4200mAh (P/N: AT16293-1)**
Body-Worn Accessories:	**Belt-Clip, Shoulder Strap**
Max. SAR Measured:	**0.920 W/kg (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.

Russell Pipe
Senior Compliance Technologist
Celltech Labs Inc.

TABLE OF CONTENTS

1.0 INTRODUCTION

This measurement report demonstrates that the Zebra Technologies Corporation Model: AN16973-1 FHSS WLAN Module FCC ID: I28MD-QL3021 installed in Wireless Portable Printer Model: QL420 complies with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) 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) 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	Part 15 Spread Spectrum Transmitter (DSS)
IC Device Classification	Low Power Licence-Exempt Radiocommunication Device (RSS-210)
Device Type	FHSS WLAN Module installed in QL420 Wireless Portable Printer
FCC ID	I28MD-QL3021
Model(s)	AN16973-1
Serial No.	XXQF02-12-0090 (Production Unit)
Modulation	Frequency Hopping Spread Spectrum (FHSS)
Tx Frequency Range	2402 - 2480 MHz
Max. RF Output Power Measured	19.7 dBm Peak Conducted (2402 MHz) 20.2 dBm Peak Conducted (2440 MHz) 20.2 dBm Peak Conducted (2480 MHz)
Antenna Type(s)	Internal
Battery Type(s)	Lithium-ion 7.4VDC 4200mAh (P/N: AT16293-1)
Body-Worn Accessories Tested	Belt-Clip, Shoulder Strap

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 SAR MEASUREMENT RESULTS

Freq. (MHz)	Channel	Test Mode	Peak Conducted Power Before Test (dBm)	Power Drift During Test (dB)	Body-Worn Accessory	DUT Position to Planar Phantom	Separation Distance to Planar Phantom (cm)	Measured SAR 1g (W/kg)	Max. Power Drift (dB)	Scaled SAR 1g (W/kg)
2440	Mid	Modulated	20.2	-0.32	Belt-Clip	Bottom Side	0.0	P 0.00189 S 0.00189	-0.58	P 0.00216 S 0.00216
2440	Mid	Modulated	20.2	0.049	Shoulder Strap	Bottom Side	0.0	0.00212	-0.58	0.00242
2440	Mid	Modulated	20.2	-0.58	Shoulder Strap	Top Side	1.0	0.709	-0.58	0.810
2402	Low	Modulated	19.7	-0.42	Shoulder Strap	Top Side	1.0	0.636	-0.58	0.727
2480	High	Modulated	20.2	-0.30	Shoulder Strap	Top Side	1.0	0.787	-0.58	0.899 **0.920** [3]
2440	Mid	Modulated	20.2	0.65	Shoulder Strap	Front Side	0.0	0.0263	-0.58	0.0301
2440	Mid	Modulated	20.2	-0.28	Shoulder Strap	Left Side	0.0	0.00198	-0.58	0.00226
2440	Mid	Modulated	20.2	-0.18	Shoulder Strap	Right Side	0.0	0.0135	-0.58	0.0154

ANSI / IEEE C95.1 1992 - SAFETY LIMIT
BODY: 1.6 W/kg (averaged over 1 gram)
Spatial Peak - Uncontrolled Exposure / General Population

Date Tested:	11/12/03		**Relative Humidity**	65 %
Measured Mixture Type	2450MHz Body		**Atmospheric Pressure**	103.2 kPa
Dielectric Constant ε_r	**IEEE Target**	**Measured**	**Ambient Temperature**	23.3 °C
	52.7 ±5%	50.5	**Fluid Temperature**	23.7 °C
Conductivity **σ (mho/m)**	**IEEE Target**	**Measured**	**Fluid Depth**	≥ 15 cm
	1.95 ±5%	2.04	**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 middle channel were ≥ 3dB 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]).
3. Scaled SAR value to show increase in SAR based on 1/10 dB increase in measured conducted power for the high channel listed in the EMC test report (EMC conducted power levels measured at Rhein Tech Laboratories).
4. Secondary peak SAR locations within 2dB of the maximum were evaluated and reported as shown in the table above table and Appendix A (SAR Test Plots) - P = Primary, S = Secondary.
5. The power drift measured by the SAR measurement system was > 5%. The maximum measured power drift was added to the measured SAR levels to show scaled SAR results as listed in the above table.
6. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures listed were consistent for all measurement periods.
7. The dielectric properties of the simulated body tissue were measured 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).

5.0 DETAILS OF SAR EVALUATION

The Zebra Technologies Corporation Model: AN16973-1 FHSS WLAN Module FCC ID: I28MD-QL3021 installed in Wireless Portable Printer Model: QL420 was found to be compliant for localized Specific Absorption Rate based on the test provisions and conditions described below. Detailed photographs of the measurement setup are shown in Appendix H.

1. The DUT was tested for body 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 and the printer end of the DUT were touching the outer surface of the planar phantom.
2. The DUT was tested for body SAR on the bottom side (battery side) of the device 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.
3. The DUT was tested for body SAR on the top side (antenna / printer side) of the device with the shoulder strap accessory attached. The top side of the DUT was positioned parallel to the outer surface of the planar phantom. A 1.0 cm separation distance was maintained between the top side of the DUT and the outer surface of the planar phantom.
4. The DUT was 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 DUT was tested for body SAR on the left side of the device with the shoulder strap accessory attached. 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. The right side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
7. The DUT was placed into test mode via internal software and evaluated for SAR at maximum power with the frequency hopping disabled, on a fixed frequency, and with a modulated signal.
8. The peak conducted power levels were measured before the tests using a Gigatronics 8652A Universal Power Meter according to the procedures described in FCC 47 CFR §2.1046.
9. The power drift of the DUT measured by the SAR measurement system was > 5%. The maximum measured power drift was added to the measured SAR levels to show scaled SAR results, as shown in the test data table (page 5).
10. The DUT was tested with a fully charged battery.
11. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures listed were consistent for all measurement periods.
12. The dielectric properties of the simulated tissue were measured 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).
13. 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 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).

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 properties of the simulated brain tissue were measured 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 ±10% (see Appendix B for system check test plot).

SYSTEM PERFORMANCE CHECK													
Test Date	2450MHz Equiv. Tissue	SAR 1g (W/kg)		Dielectric Constant ε_r		Conductivity σ (mho/m)		ρ (Kg/m^3)	Amb. Temp. (°C)	Fluid Temp. (°C)	Fluid Depth (cm)	Humid. (%)	Barom. Press. (kPa)
		IEEE Target	Measured	IEEE Target	Measured	IEEE Target	Measured						
11/12/03	Brain	13.1 ±10%	13.7 +4.6%	39.2 ±5%	37.4	1.80 ±5%	1.89	1000	23.3	24.0	≥ 15	65	103.2

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

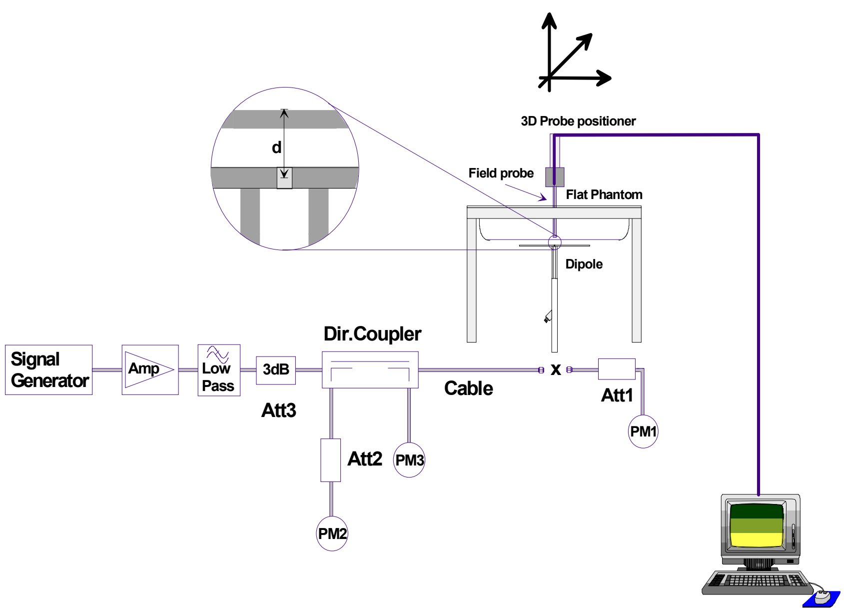


Figure 1. System Performance Check Setup Diagram

2450MHz Dipole Setup

8.0 SIMULATED TISSUE MIXTURES

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 Check)**	**2450MHz Body (DUT 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:	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. 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 ± 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 DASY 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
-ET3DV6 E-Field Probe	1387	Feb 2003
-300MHz Validation Dipole	135	Oct 2003
-450MHz Validation Dipole	136	Nov 2003
-900MHz Validation Dipole	054	June 2003
-1800MHz Validation Dipole	247	June 2003
-2450MHz Validation Dipole	150	Sept 2003
-SAM Phantom V4.0C	1033	N/A
-Barski Planar Phantom	03-01	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

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	± 4.8	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)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					**± 13.3**	
Expanded Uncertainty (k=2)					**± 26.6**	

Measurement Uncertainty Table in accordance with IEEE Standard 1528-200X (Draft - 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	± 4.8	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**	

Measurement Uncertainty Table in accordance with IEEE Standard 1528-200X (Draft - 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 Standards Coordinating Committee 34, Std 1528-200X, “DRAFT Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”.

APPENDIX A - SAR MEASUREMENT DATA

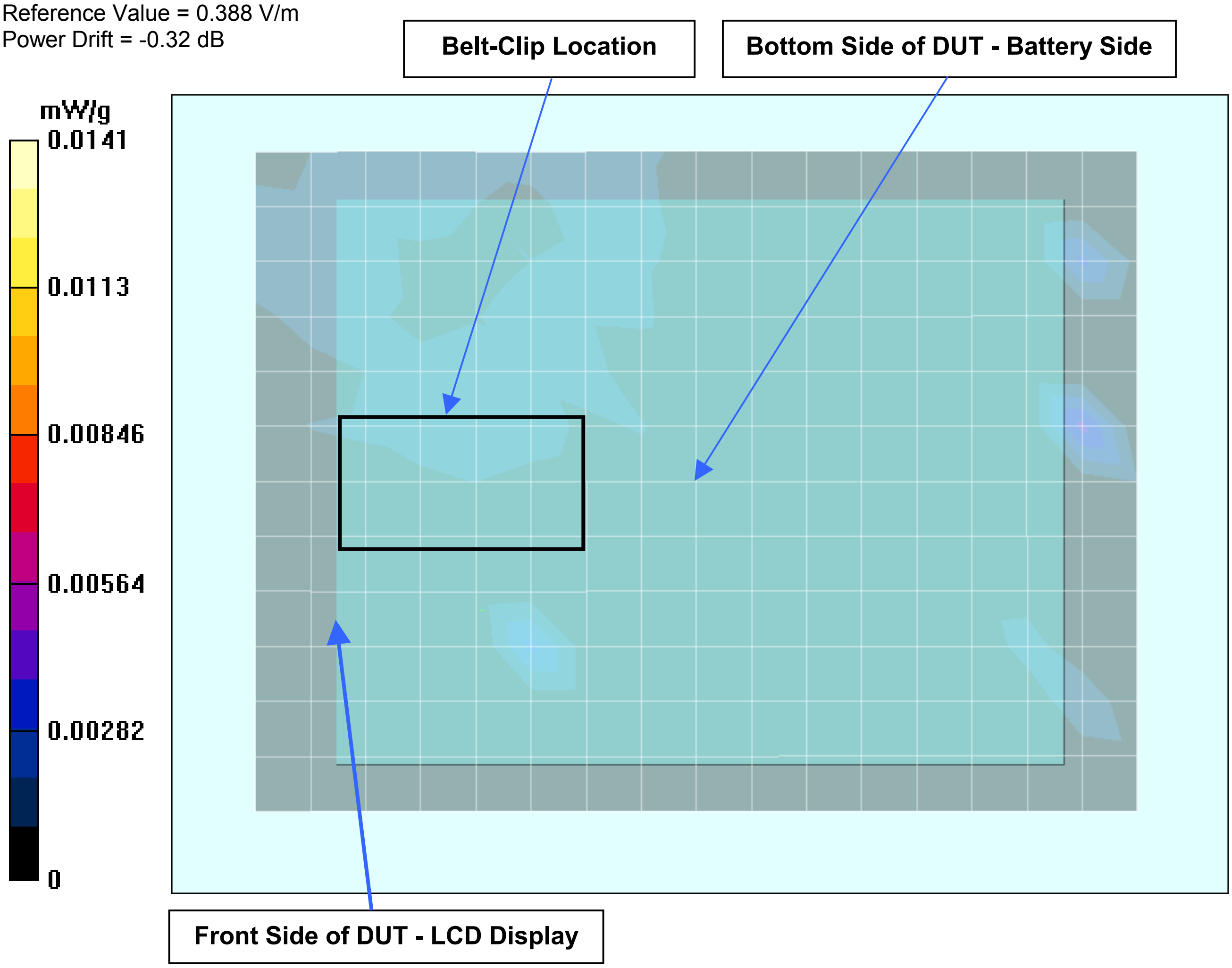
Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Bottom Side of DUT with Belt-Clip/Area Scan (13x17x1): Measurement grid: dx=15mm, dy=15mm
Body-Worn - Bottom Side of DUT with Belt-Clip/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.00565 W/kg
SAR(1 g) = 0.00189 mW/g; SAR(10 g) = 0.00127 mW/g
Body-Worn - Bottom Side of DUT with Belt-Clip/Zoom Scan (7x7x7)/Cube 1:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0157 W/kg
SAR(1 g) = 0.00189 mW/g; SAR(10 g) = 0.000694 mW/g
Reference Value = 0.388 V/m
Power Drift = -0.32 dB



Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

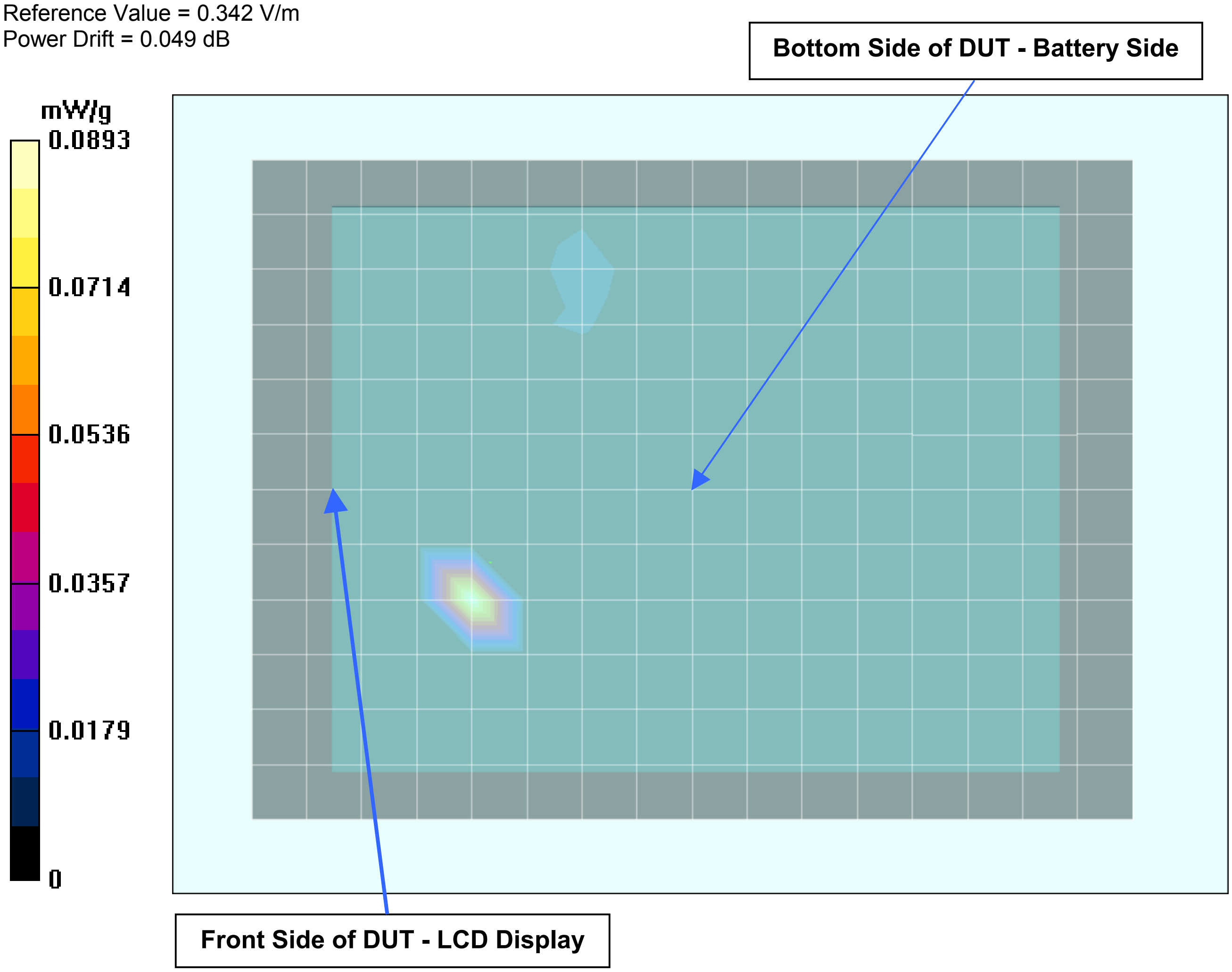
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Bottom Side of DUT with Shoulder Strap/Area Scan (13x17x1): Measurement grid: dx=15mm, dy=15mm

Body-Worn - Bottom Side of DUT with Shoulder Strap/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0108 W/kg
SAR(1 g) = 0.00212 mW/g; SAR(10 g) = 0.000993 mW/g
Reference Value = 0.342 V/m
Power Drift = 0.049 dB



Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance/Area Scan (13x17x1):
Measurement grid: dx=15mm, dy=15mm
Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.709 mW/g; SAR(10 g) = 0.329 mW/g
Reference Value = 5.75 V/m
Power Drift = -0.58 dB

Date Tested: 11/12/03

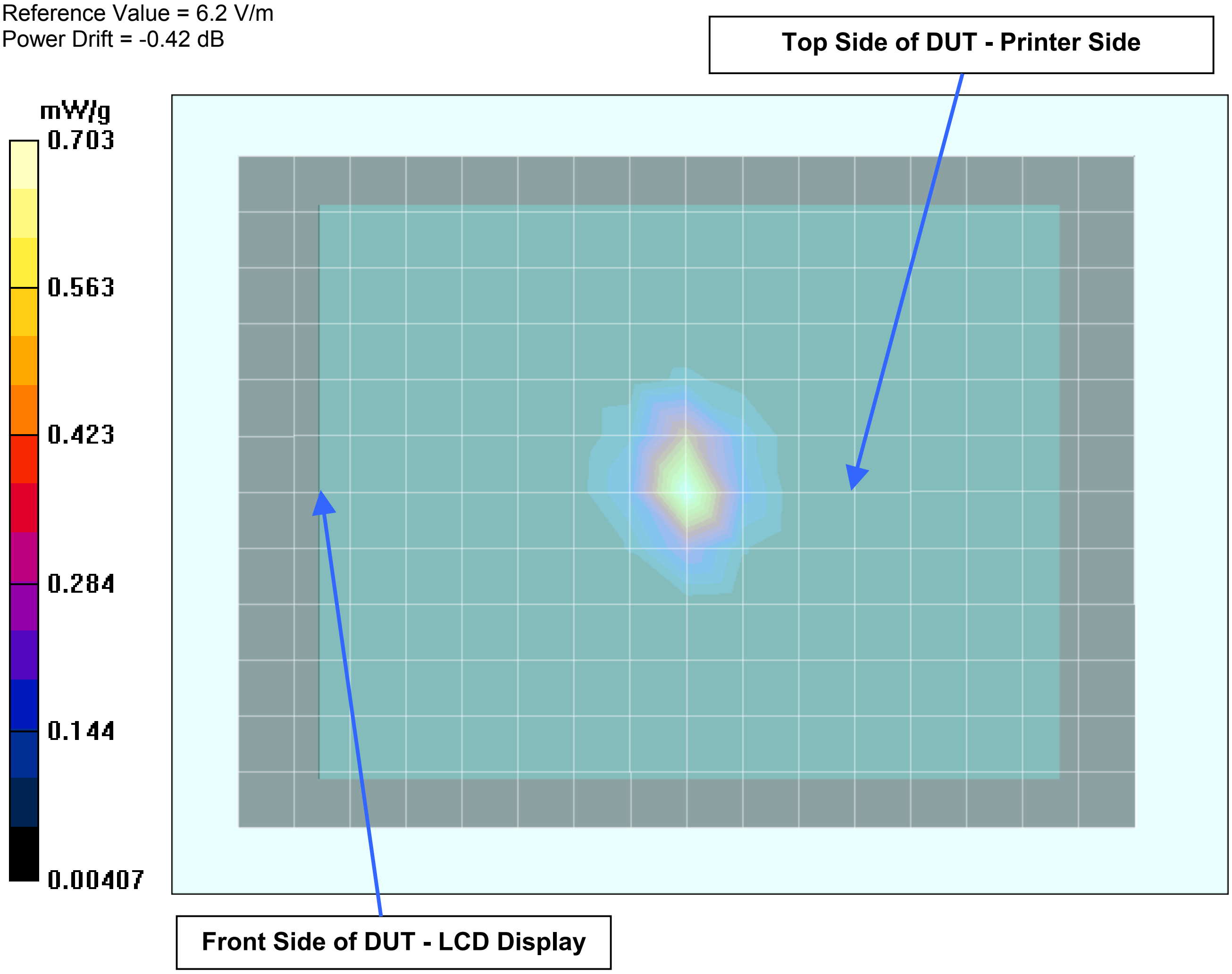
DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 19.7 dBm (Peak Conducted)
Frequency: 2402 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance /Area Scan (13x17x1):
Measurement grid: dx=15mm, dy=15mm
Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 1.34 W/kg
SAR(1 g) = 0.636 mW/g; SAR(10 g) = 0.293 mW/g
Reference Value = 6.2 V/m
Power Drift = -0.42 dB



Date Tested: 11/12/03

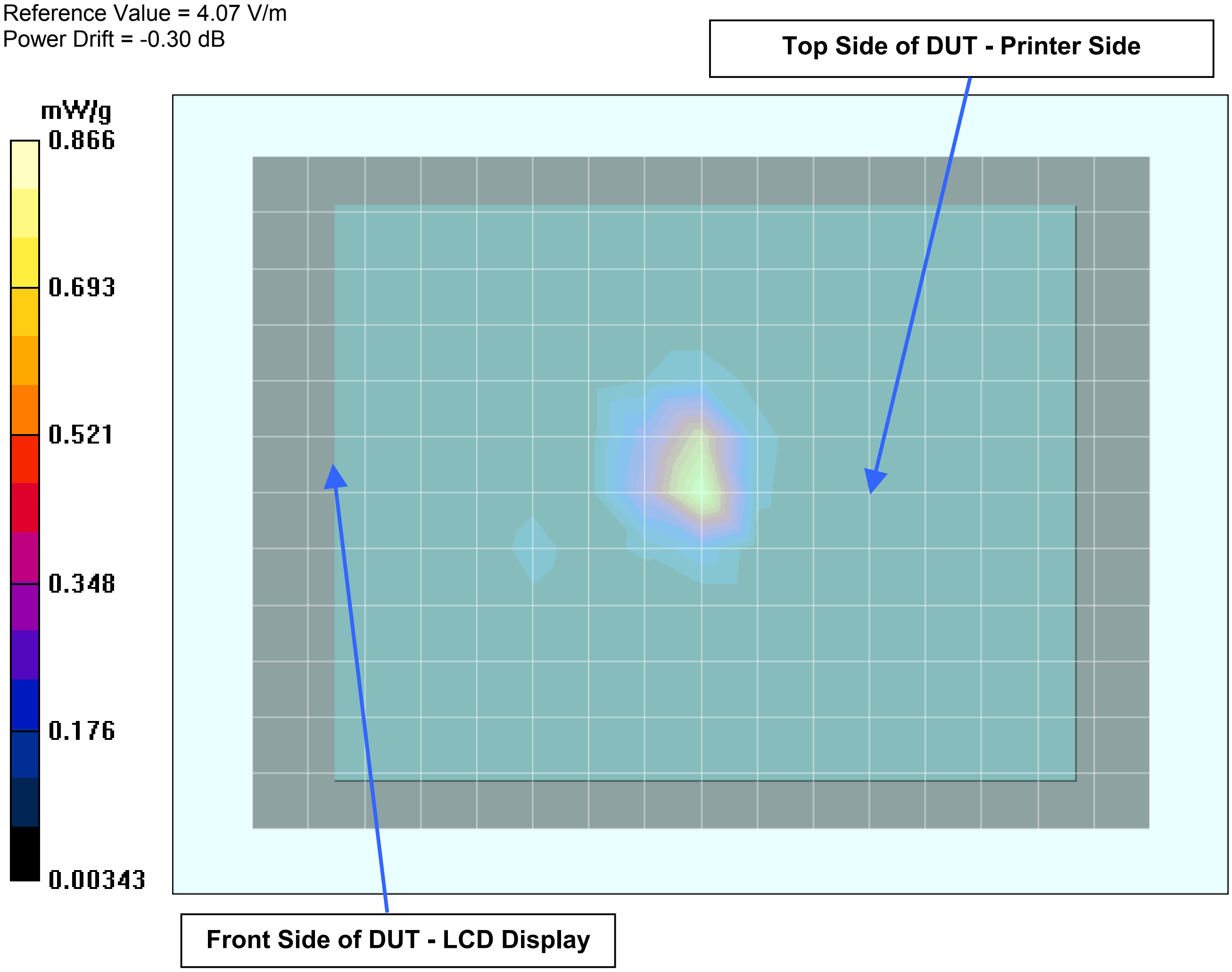
DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

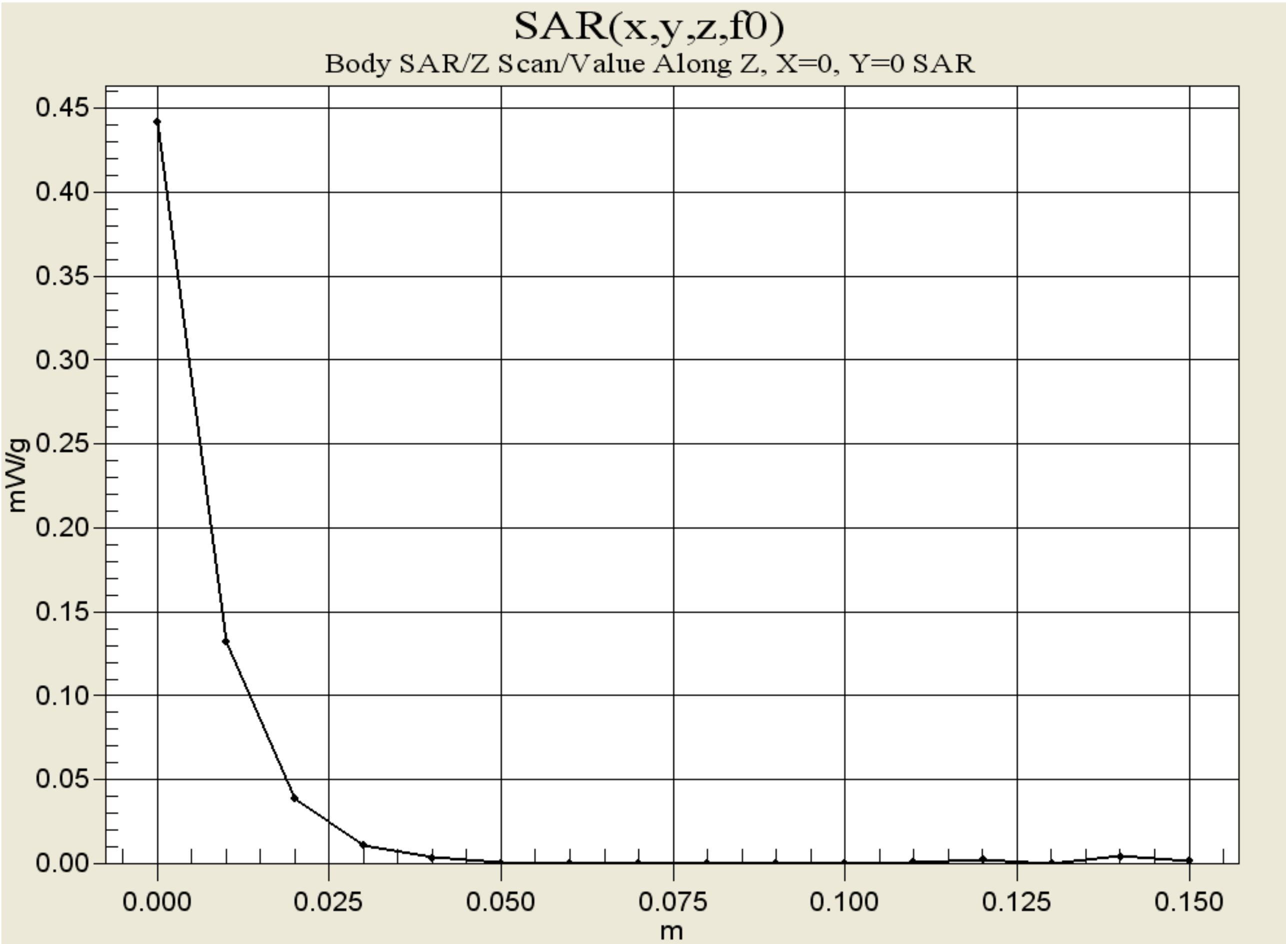
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2480 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance /Area Scan (13x17x1):
Measurement grid: dx=15mm, dy=15mm
Body-Worn - Top Side of DUT with Shoulder Strap - 1.0 cm Separation Distance /Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 1.66 W/kg
SAR(1 g) = 0.787 mW/g; SAR(10 g) = 0.36 mW/g
Reference Value = 4.07 V/m
Power Drift = -0.30 dB




SAR(x,y,z,f0)
Body SAR/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.000
0.025
0.050
0.075
0.100
0.125
0.150
m

Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

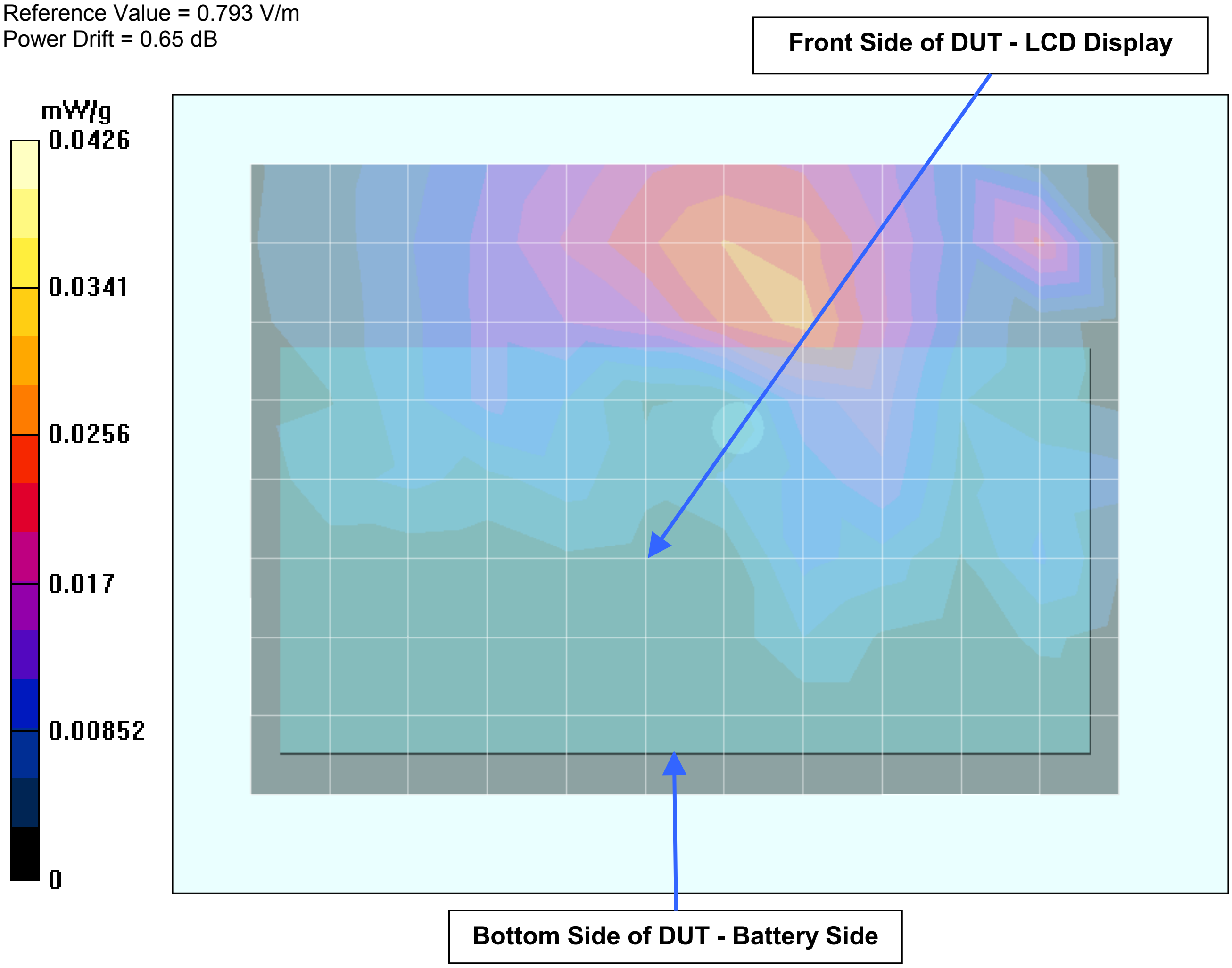
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Front Side of DUT with Shoulder Strap/Area Scan (9x12x1): Measurement grid: dx=15mm, dy=15mm

Body-Worn - Front Side of DUT with Shoulder Strap/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.259 W/kg
SAR(1 g) = 0.0263 mW/g; SAR(10 g) = 0.0152 mW/g
Reference Value = 0.793 V/m
Power Drift = 0.65 dB



Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

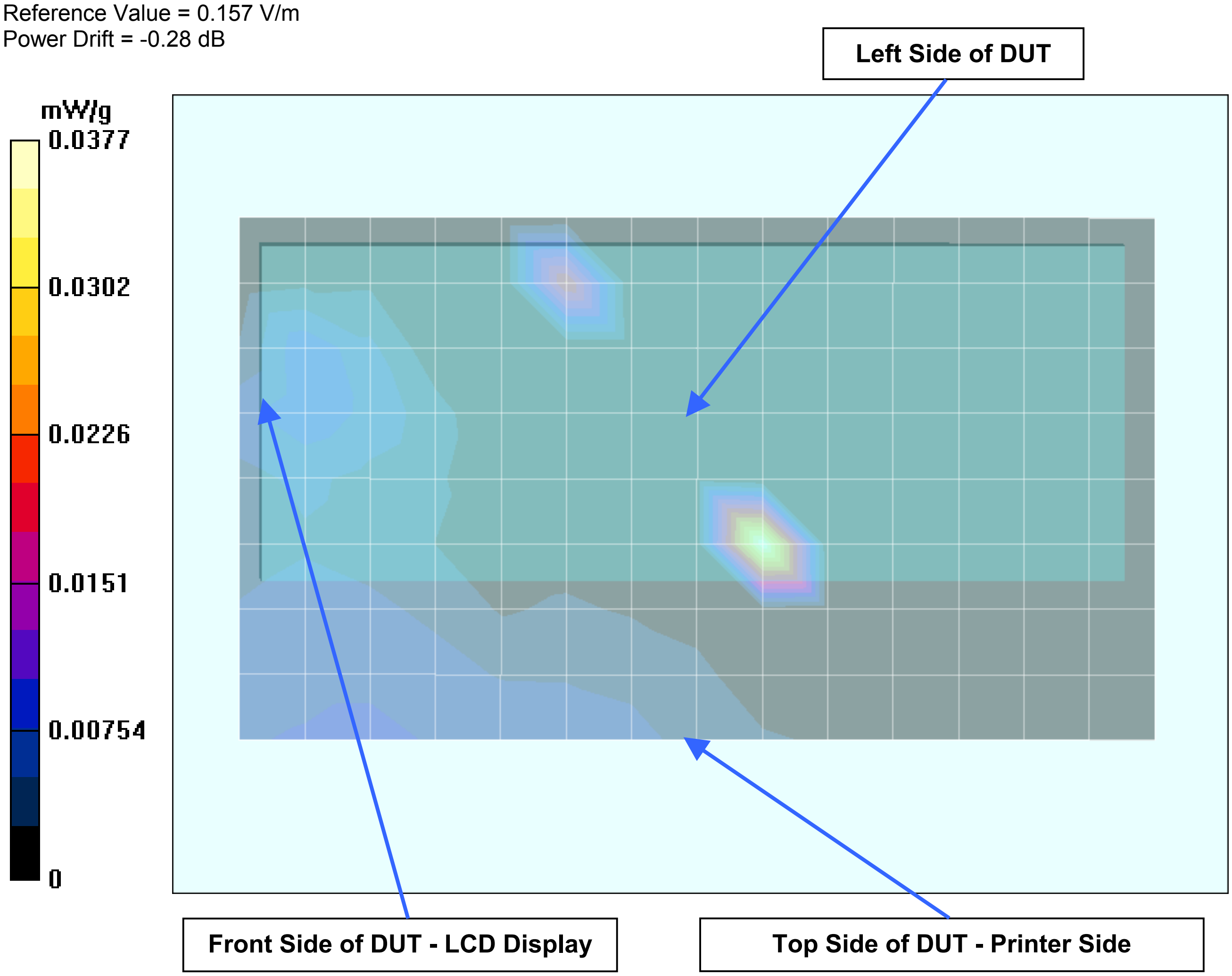
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Left Side of DUT with Shoulder Strap/Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

Body-Worn - Left Side of DUT with Shoulder Strap/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0279 W/kg
SAR(1 g) = 0.00198 mW/g; SAR(10 g) = 0.00131 mW/g
Reference Value = 0.157 V/m
Power Drift = -0.28 dB



Date Tested: 11/12/03

DUT: Zebra AN16973-1 FHSS WLAN Module installed in QL420 Wireless Portable Printer; Serial: XXQF02-12-0090

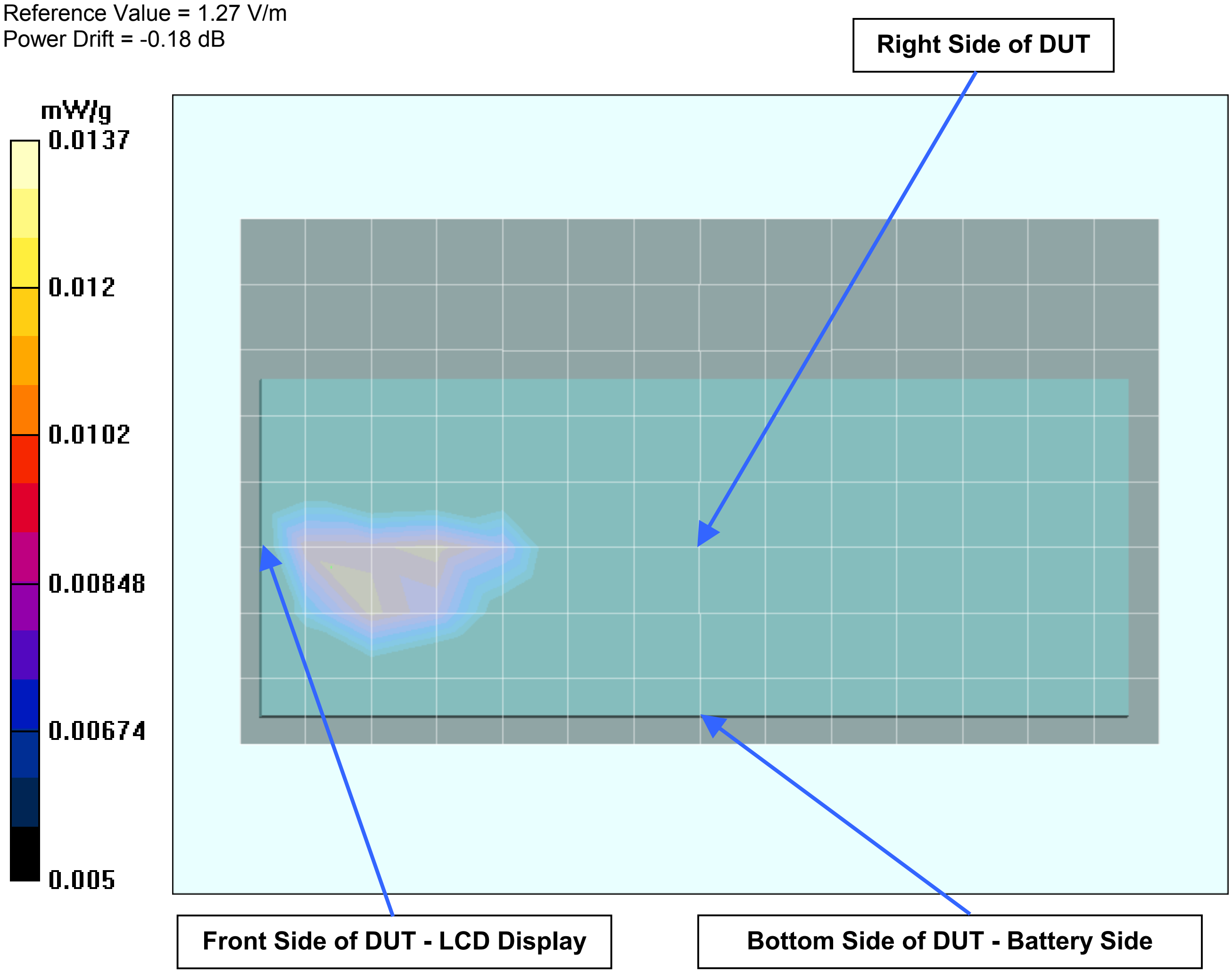
Ambient Temp: 23.3°C; Fluid Temp: 23.7°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

Communication System: Modulated Transmit
RF Output Power: 20.2 dBm (Peak Conducted)
Frequency: 2440 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 2.04 mho/m, ε_r = 50.5, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(4.6, 4.6, 4.6); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Fiberglas Planar; Type: Barski Industries; Serial: 03-01
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Body-Worn - Right Side of DUT with Shoulder Strap/Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

Body-Worn - Right Side of DUT with Shoulder Strap/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 0.0274 W/kg
SAR(1 g) = 0.0135 mW/g; SAR(10 g) = 0.00669 mW/g
Reference Value = 1.27 V/m
Power Drift = -0.18 dB



APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

Date Tested: 11/12/03

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150

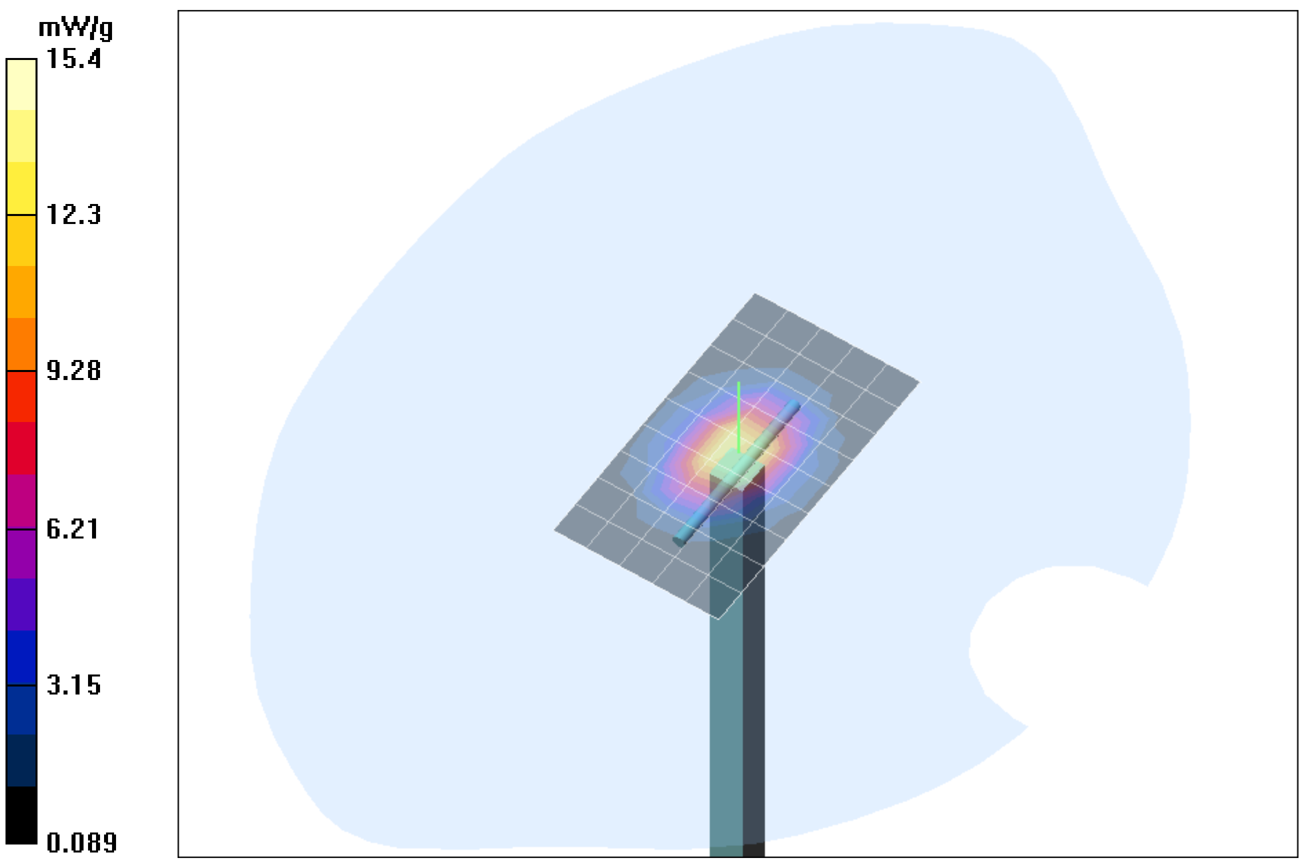
Ambient Temp: 23.3°C; Fluid Temp: 24.0°C; Barometric Pressure: 103.2 kPa; Humidity: 65%

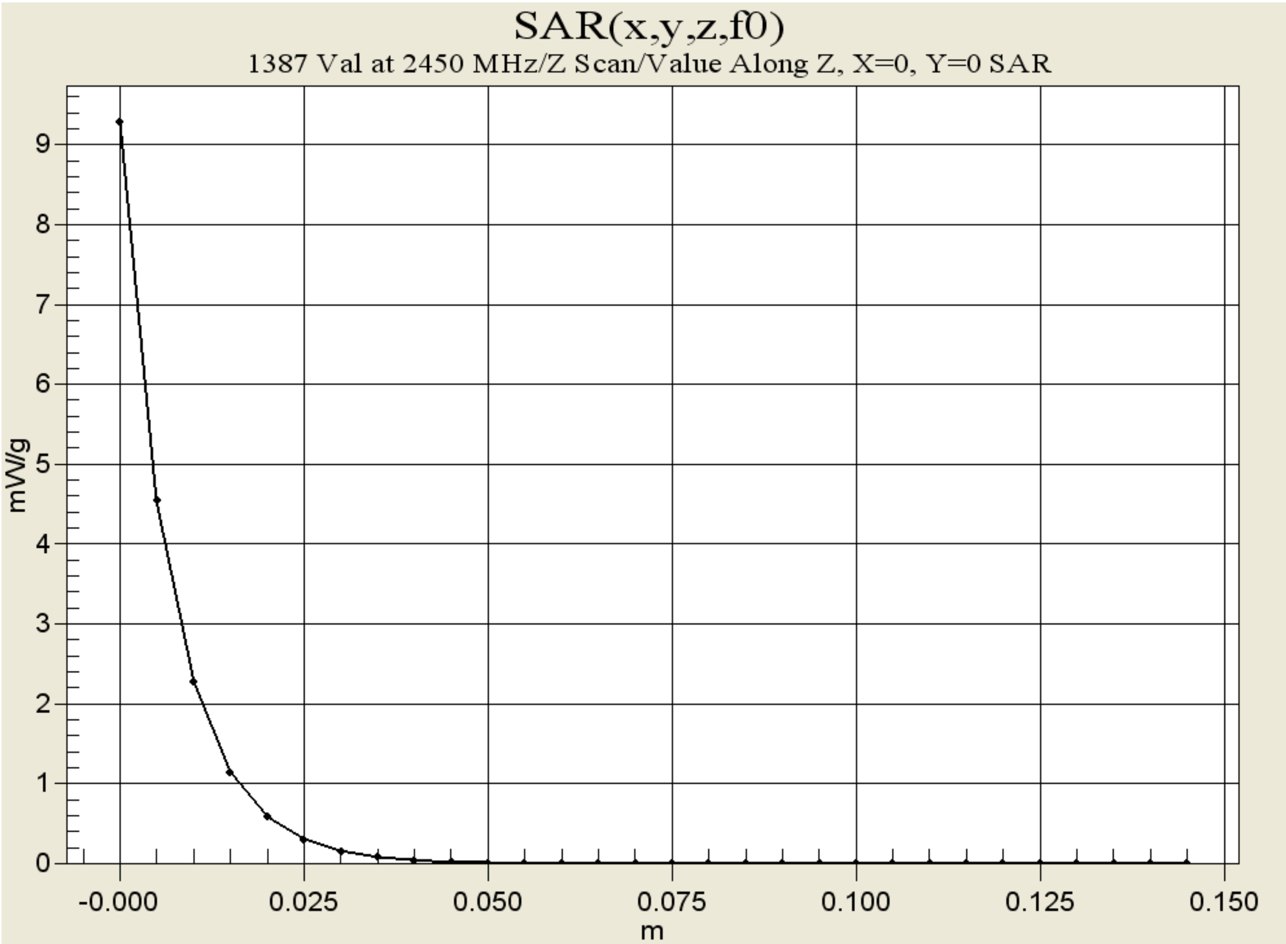
Communication System: CW
Forward Conducted Power: 250 mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.89 mho/m, ε_r = 37.4, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(5, 5, 5); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: SAM front; Type: SAM 4.0; Serial: 1033
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

System Validation at 2450 MHz/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 96.5 V/m
Power Drift = -0.008 dB

System Validation at 2450 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 28.3 W/kg
SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.25 mW/g
Reference Value = 96.5 V/m
Power Drift = -0.008 dB




SAR(x,y,z,f0)
1387 Val at 2450 MHz/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
9
8
7
6
5
4
3
2
1
0
-0.000
0.025
0.050
0.075
0.100
0.125
0.150
m

APPENDIX C - SYSTEM VALIDATION

Celltech
Testing and Engineering Services Lab

2450MHz SYSTEM VALIDATION DIPOLE

Type:	**2450MHz Validation Dipole**
Serial Number:	**150**
Place of Calibration:	**Celltech Labs Inc.**
Date of Calibration:	**September 17, 2003**

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

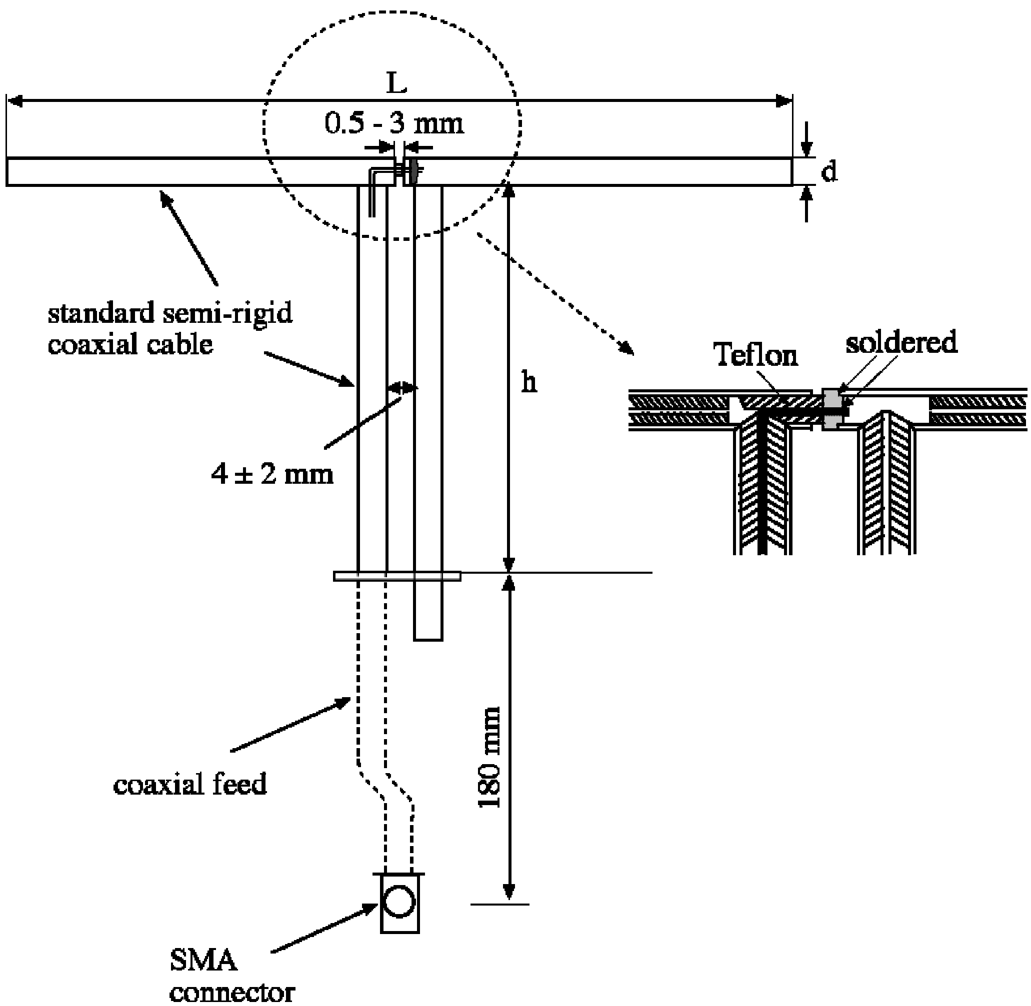
Calibrated by:	Spencer Watson
Approved by:	Russell W. Pipe

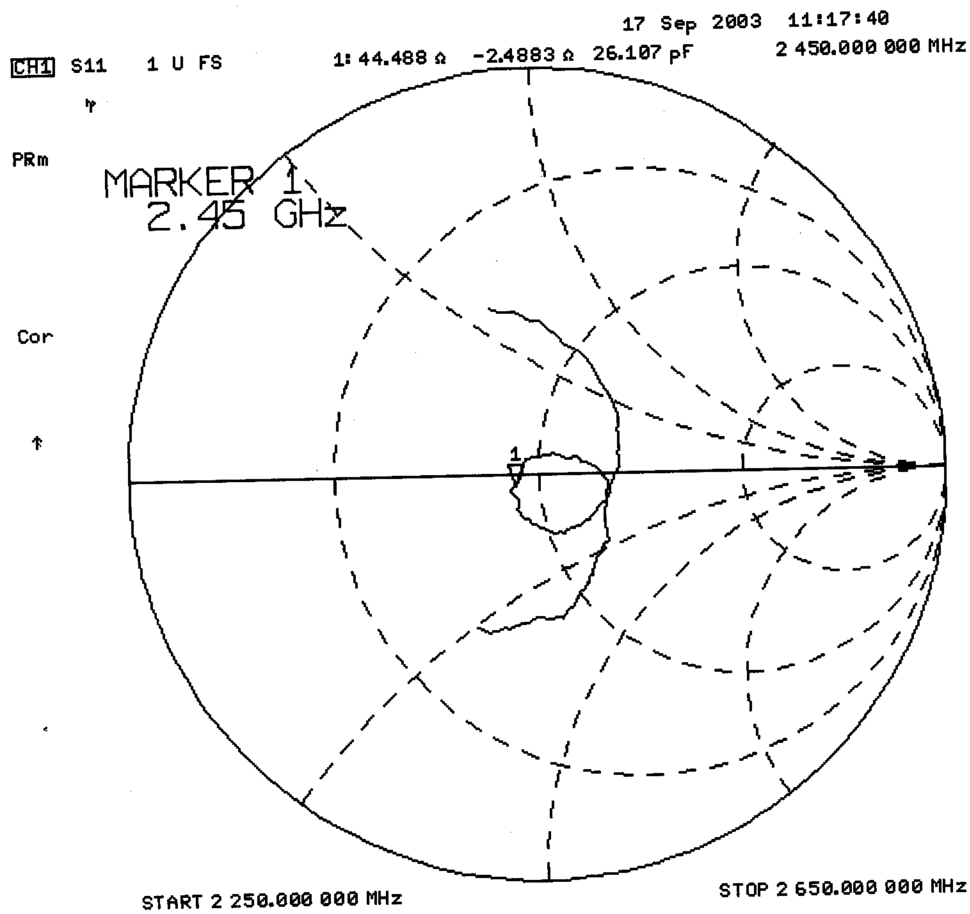
Celltech Labs Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
www.celltechlabs.com

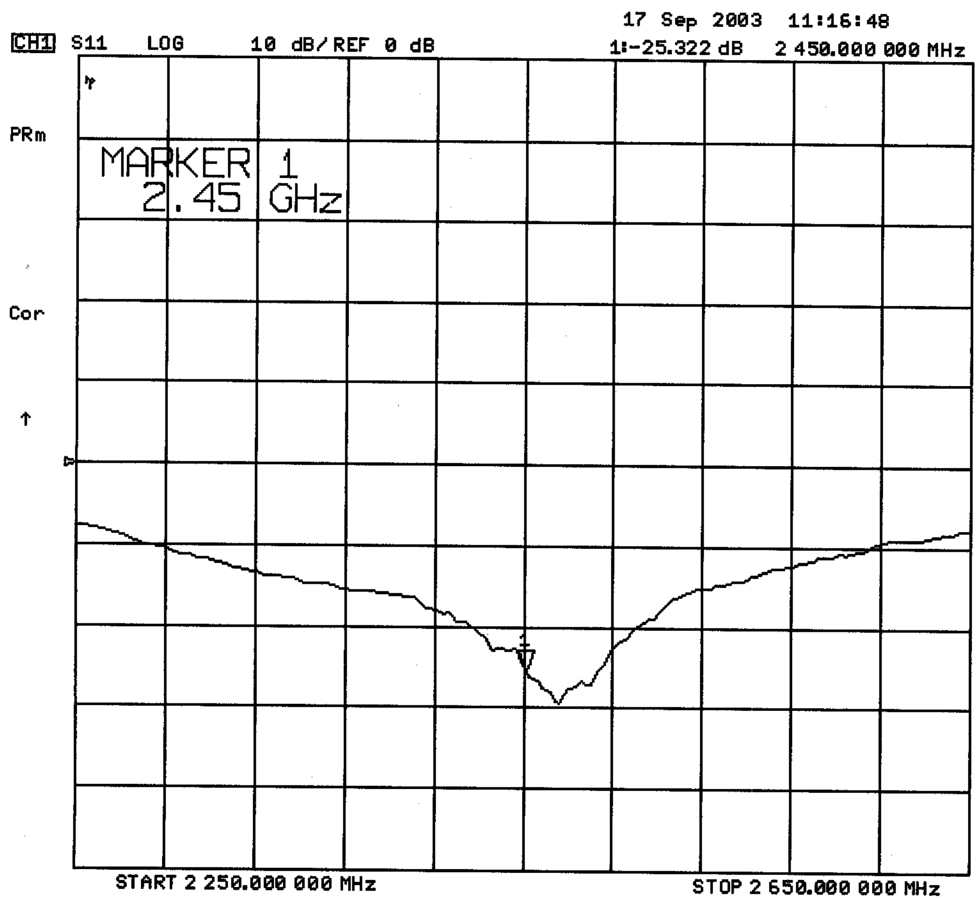
1. Dipole Construction & Electrical Characteristics

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 2450MHz	Re{Z} = 44.488Ω
	Im{Z} = -2.4883Ω
Return Loss at 2450MHz	-25.322 dB




17 Sep 2003 11:17:40
CH1 S11 1 U FS
1: 44.488 Ω -2.4883 Ω 26.107 pF
2 450.000 000 MHz
PRm
MARKER 1
2.45 GHz
Cor
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz


17 Sep 2003 11:16:48
CH1 S11 LOG 10 dB/ REF 0 dB
1:-25.322 dB 2 450.000 000 MHz
PRm
Cor
MARKER 1
2.45 GHz
START 2 250.000 000 MHz
STOP 2 650.000 000 MHz

Celltech
Testing and Engineering Services Lab

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)

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:

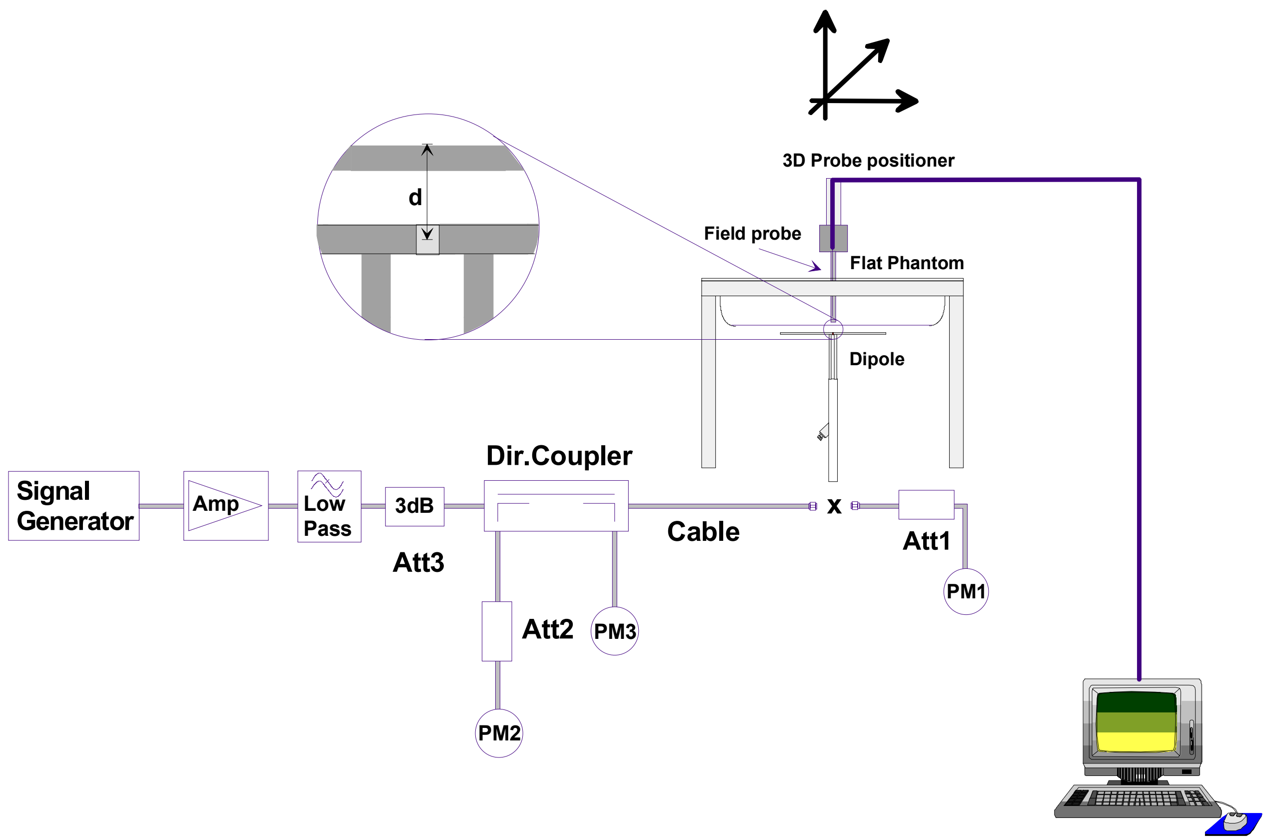
Relative Permittivity:	37.3
Conductivity:	1.88 mho/m
Ambient Temperature:	21.6°C
Fluid Temperature:	23.9°C
Fluid Depth:	≥ 15cm

The 2450MHz simulating tissue 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%)

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	13.9	55.6	6.27	25.08	29.5
Test 2	13.9	55.6	6.25	25.00	29.1
Test 3	13.9	55.6	6.24	24.96	28.9
Test 4	14.0	56.0	6.31	25.24	29.1
Test 5	14.0	56.0	6.27	25.08	29.7
Test 6	13.8	55.2	6.25	25.00	29.3
Test 7	13.9	55.6	6.22	24.88	29.3
Test 8	13.9	55.6	6.24	24.96	29.4
Test 9	14.0	56.0	6.29	25.16	30.0
Test10	13.8	55.2	6.17	24.68	29.3
Average Value	13.91	55.64	6.251	25.00	29.36

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

Averaged over 1cm (1g) of tissue: 55.64 mW/g

Averaged over 10cm (10g) of tissue: 25.00 mW/g

Test Date: 09/17/03

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:150

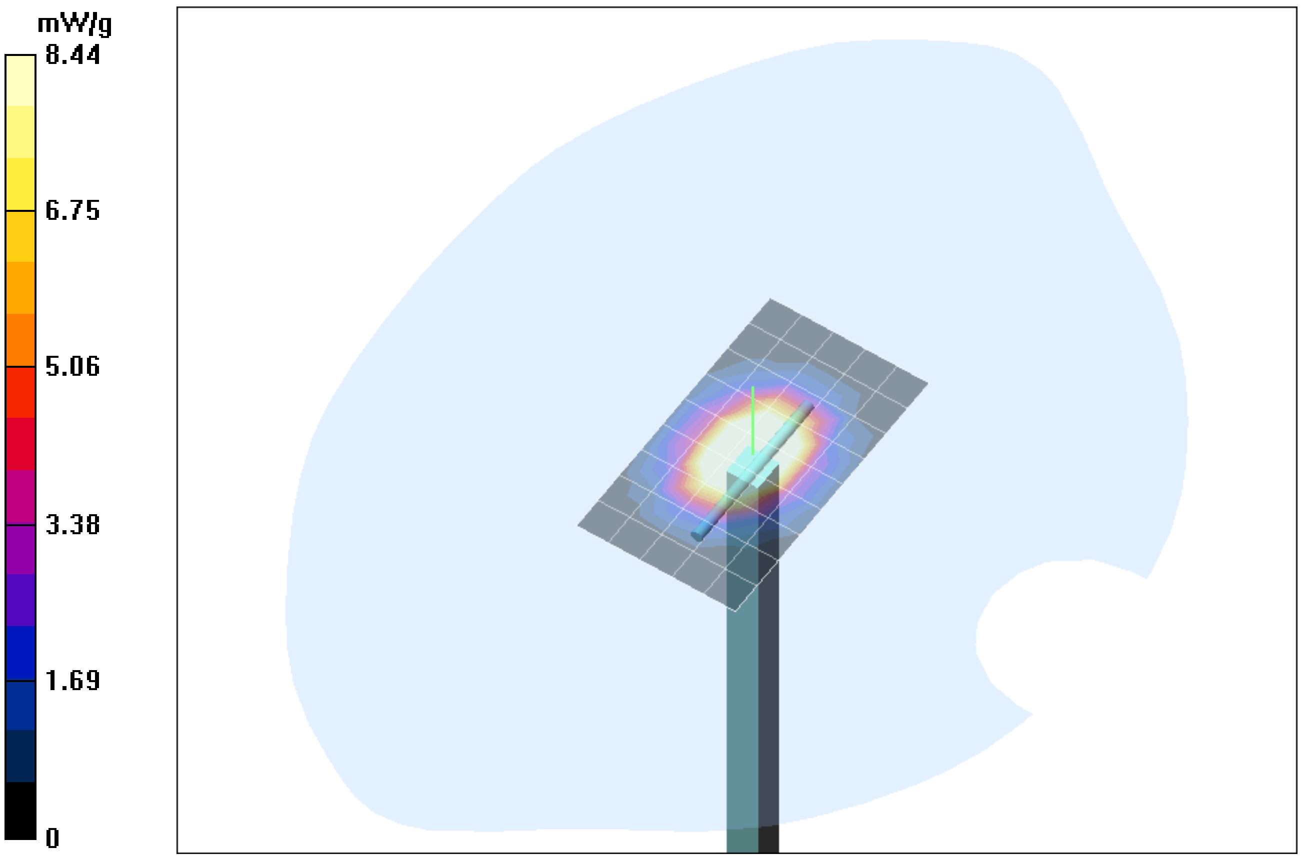
Ambient Temp: 22.2C; Fluid Temp: 23.8C
Barometric Pressure: 101.9 kPa; Humidity: 52%

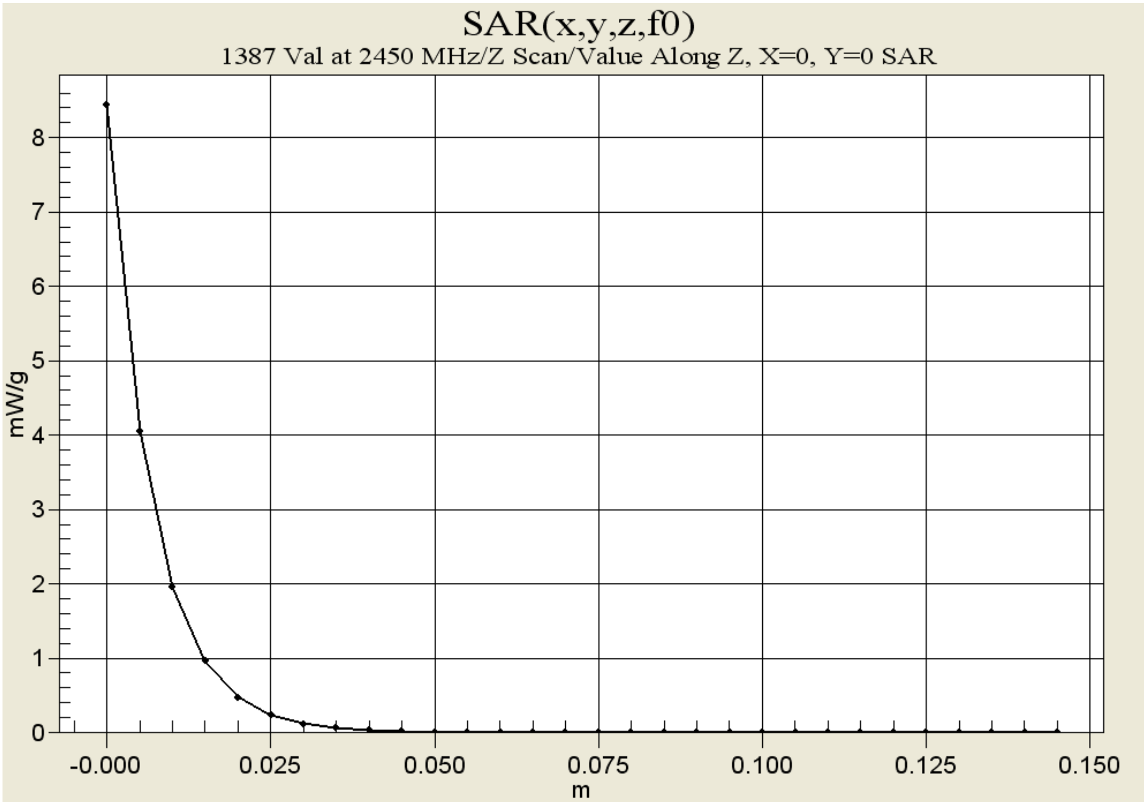
Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450 (σ = 1.88 mho/m, ε_r = 37.3, ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(5, 5, 5); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: SAM front; Type: SAM 4.0; Serial: 1033
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

Probe SN1387 Validation at 2450 MHz/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm

Probe SN1387 Validation at 2450 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 29.5 W/kg
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.27 mW/g
Reference Value = 96.7 V/m
Power Drift = -0.08 dB




SAR(x,y,z,f0)
1387 Val at 2450 MHz/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
8
7
6
5
4
3
2
1
0
-0.000
0.025
0.050
0.075
0.100
0.125
0.150
m

2450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

September 17, 2003

Frequency	e'	e''
2.350000000 GHz	37.7457	13.5170
2.360000000 GHz	37.7101	13.5534
2.370000000 GHz	37.6951	13.5903
2.380000000 GHz	37.6613	13.6228
2.390000000 GHz	37.6411	13.6368
2.400000000 GHz	37.5853	13.6598
2.410000000 GHz	37.5236	13.6742
2.420000000 GHz	37.4573	13.7091
2.430000000 GHz	37.4063	13.7484
2.440000000 GHz	37.3419	13.7798
2.450000000 GHz	37.2875	13.8226
2.460000000 GHz	37.2447	13.8618
2.470000000 GHz	37.2198	13.8951
2.480000000 GHz	37.1940	13.9293
2.490000000 GHz	37.1679	13.9423
2.500000000 GHz	37.1333	13.9571
2.510000000 GHz	37.0990	13.9745
2.520000000 GHz	37.0410	14.0116
2.530000000 GHz	36.9938	14.0375
2.540000000 GHz	36.9185	14.0546
2.550000000 GHz	36.8657	14.0912

APPENDIX D - PROBE CALIBRATION

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

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

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	N. Vetterli
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.

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

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**	$\mu V/(V/m)^2$
NormY	**1.65**	$\mu V/(V/m)^2$
NormZ	**1.64**	$\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

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

ConvF X	**6.6**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.6**	± 9.5% (k=2)	Alpha	**0.37**
ConvF Z	**6.6**	± 9.5% (k=2)	Depth	**2.61**

Head 1800 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**
Head 1900 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.50**
ConvF Z	**5.2**	± 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_{be} [%]	Without Correction Algorithm	10.2	5.9
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

Head 1800 MHz Typical SAR gradient: 10 % per mm

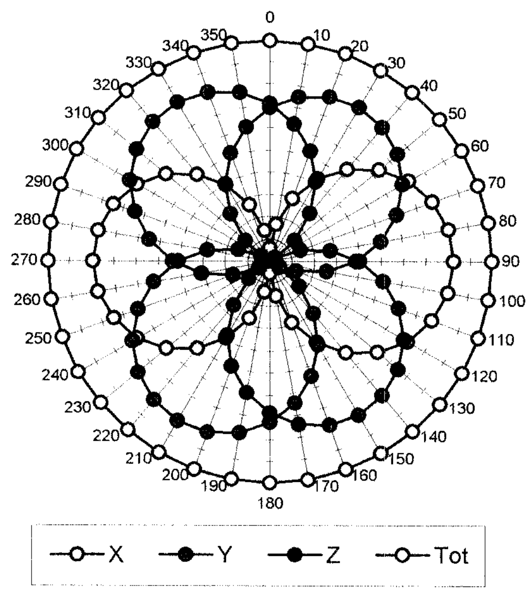
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	14.6	9.8
SAR_{be} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

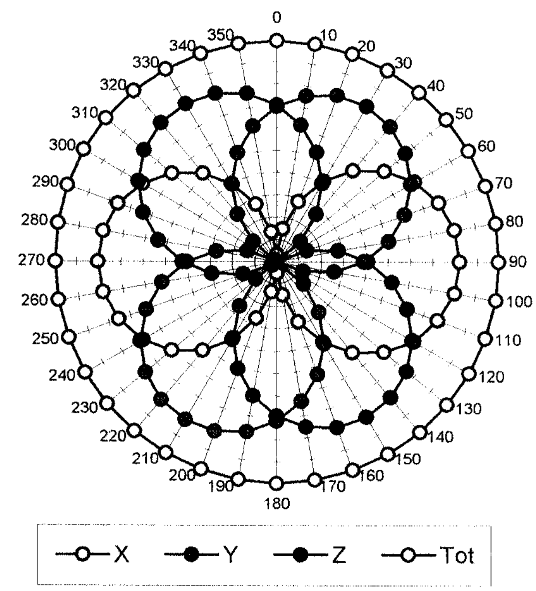
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.4 ± 0.2**	mm

Receiving Pattern (ϕ), θ = 0°

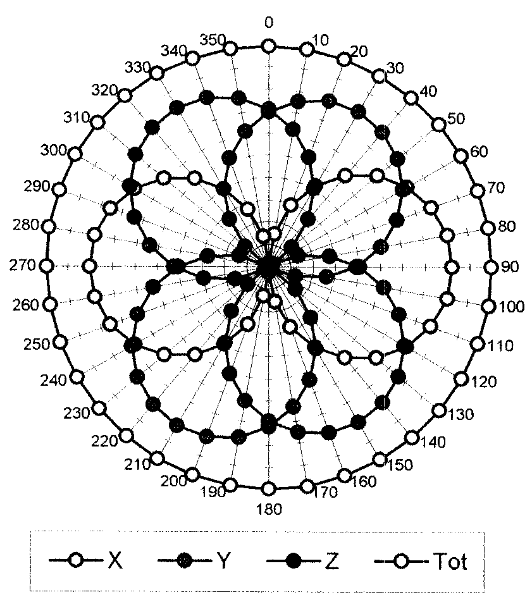
f = 30 MHz, TEM cell ifi110



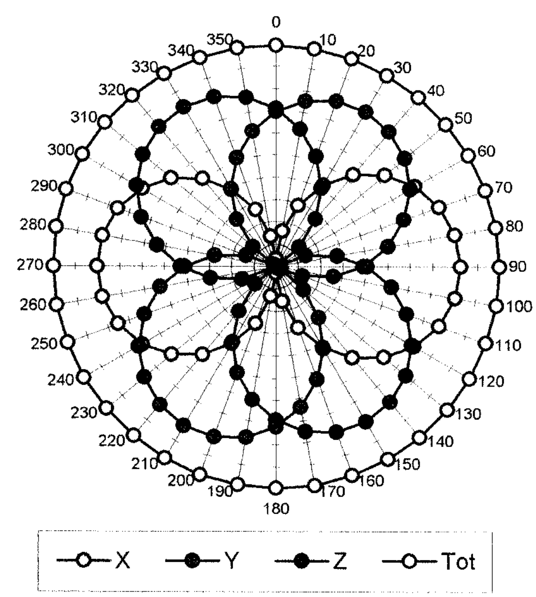
f = 100 MHz, TEM cell ifi110

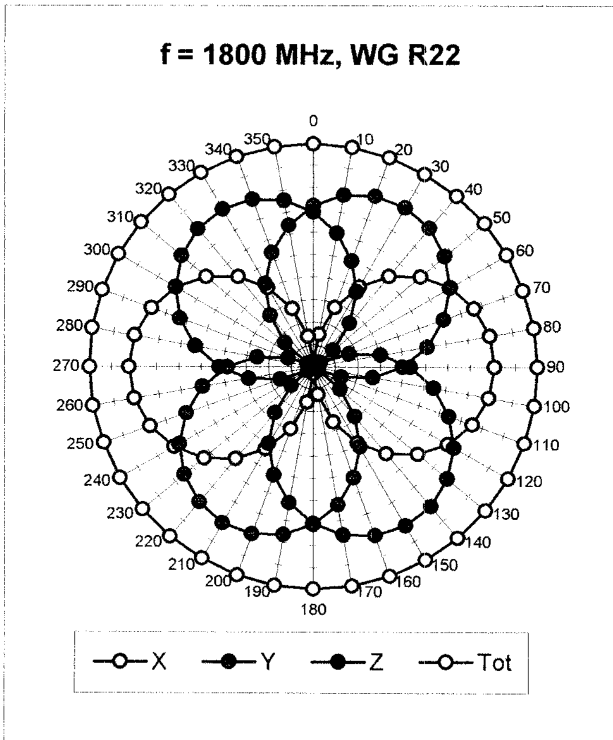


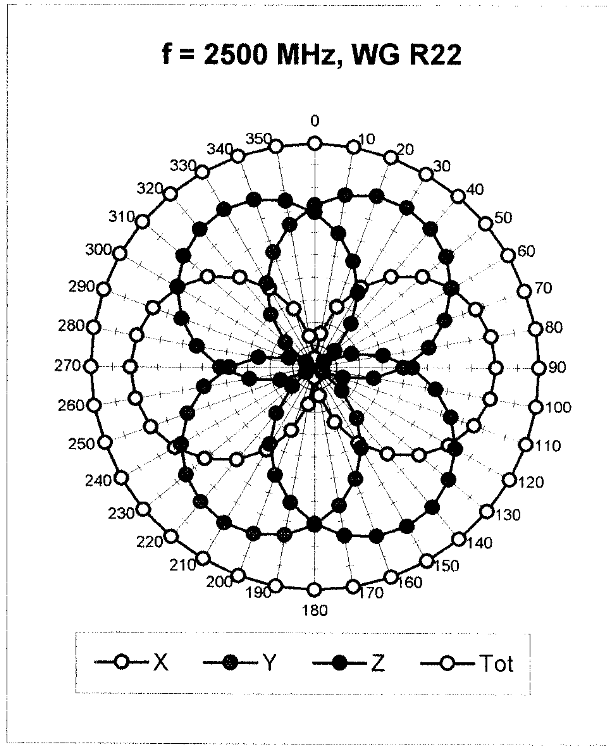
f = 300 MHz, TEM cell ifi110



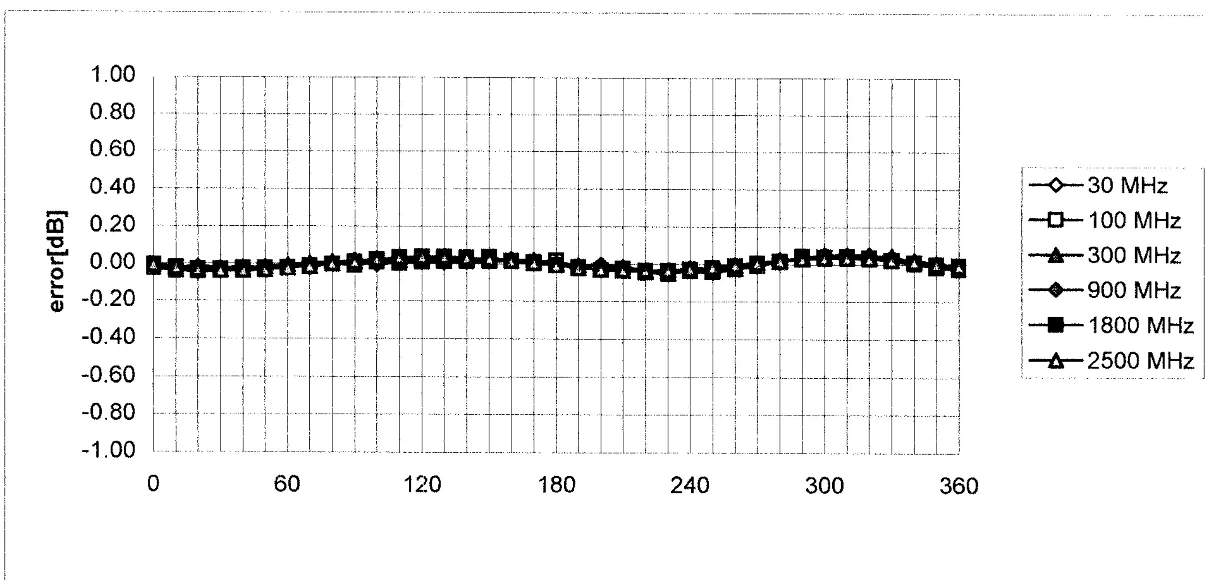
f = 900 MHz, TEM cell ifi110





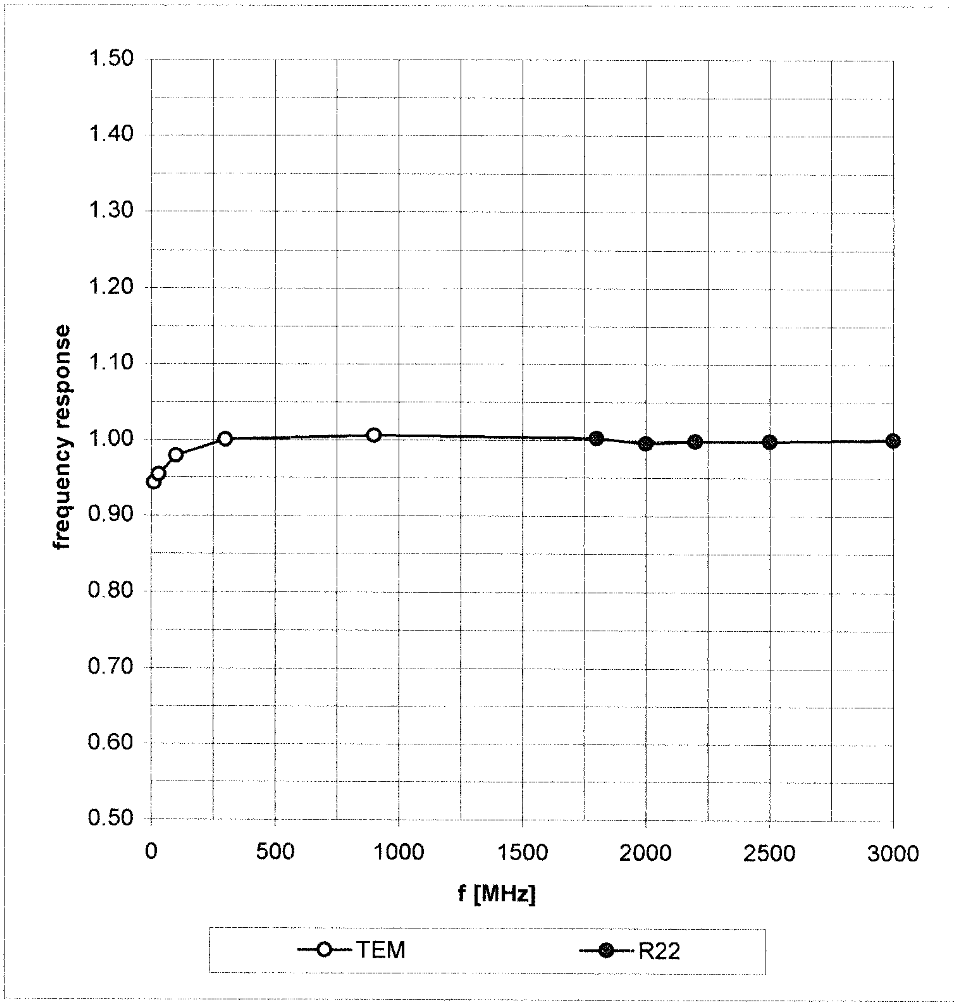


Isotropy Error (ϕ), θ = 0°



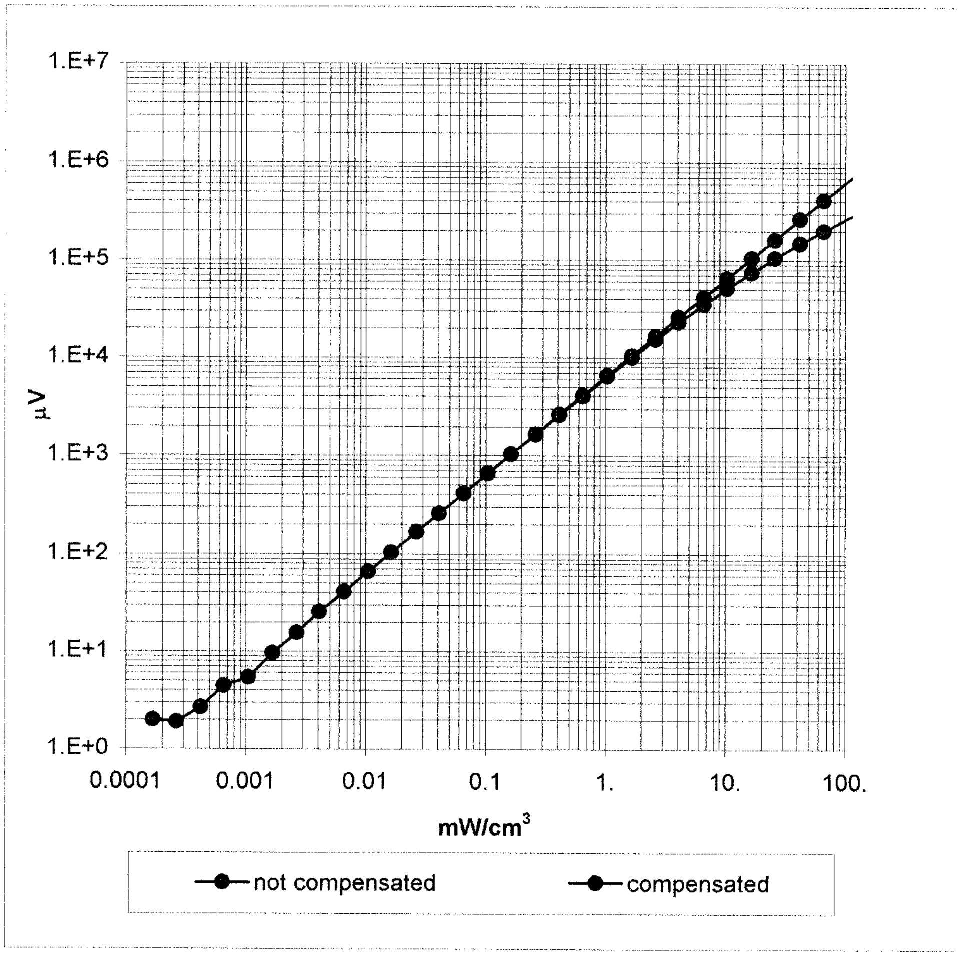
Frequency Response of E-Field

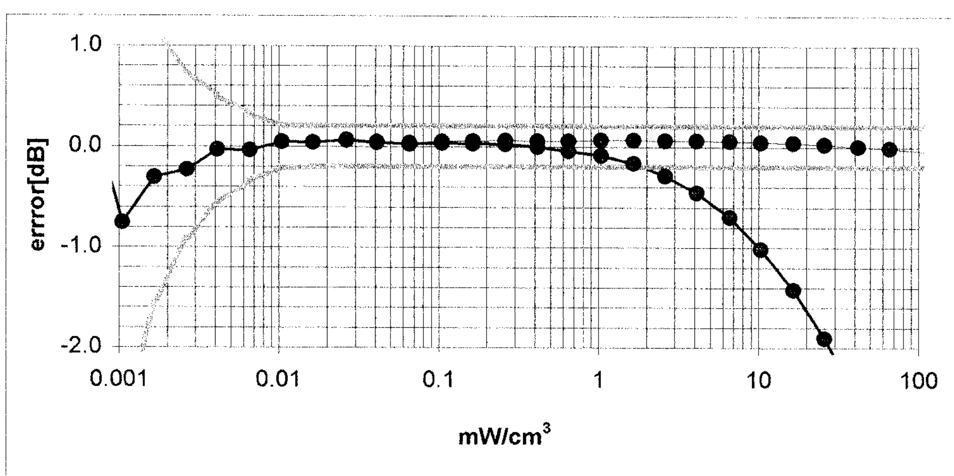
(TEM-Cell:ifi110, Waveguide R22)



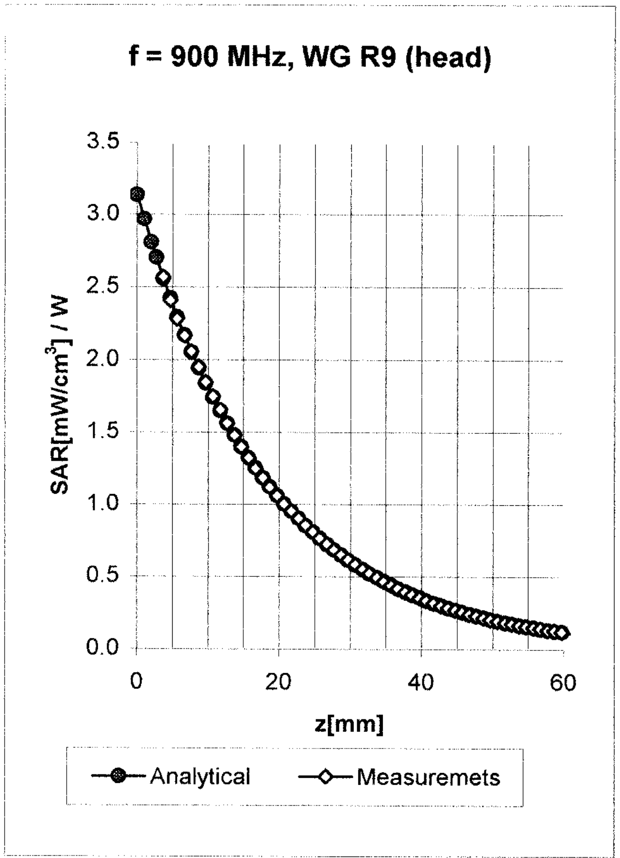
Dynamic Range f(SAR_{brain})

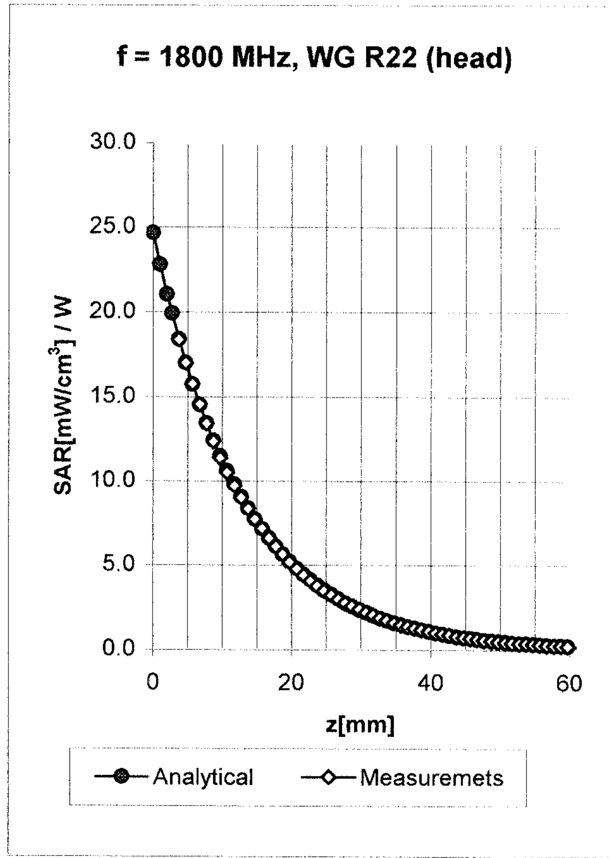
(Waveguide R22)





Conversion Factor Assessment

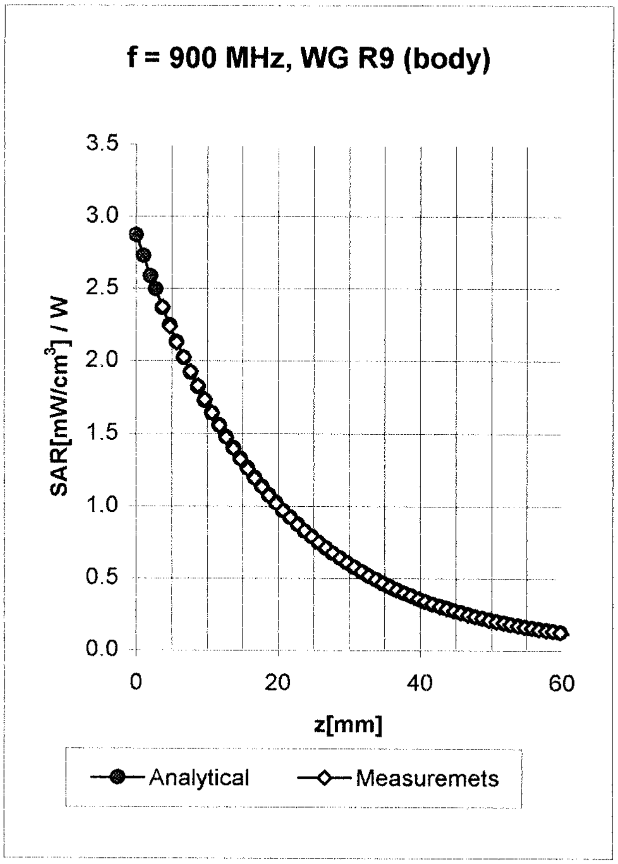


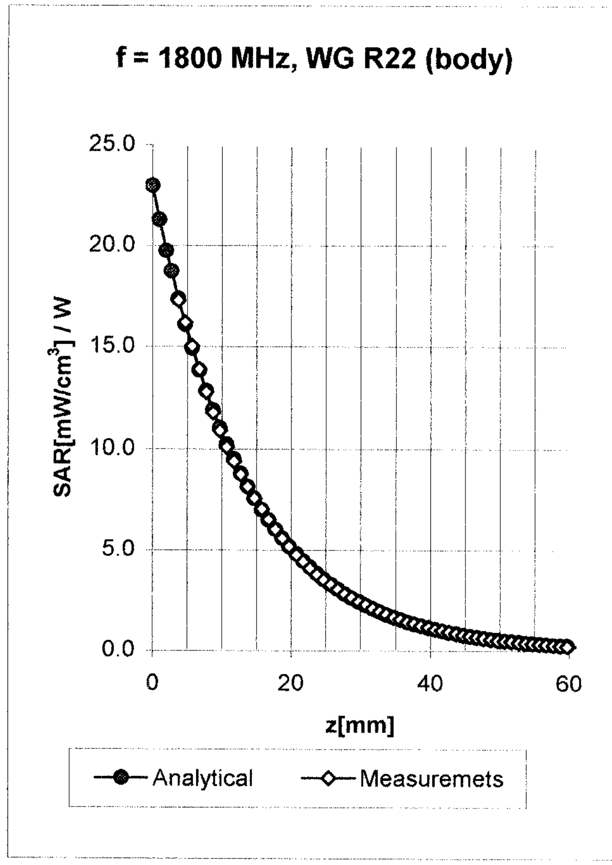


Head	**900 MHz**		ε_r = **41.5 ± 5%**	σ = **0.97 ± 5% mho/m**	
Head	**835 MHz**		ε_r = **41.5 ± 5%**	σ = **0.90 ± 5% mho/m**	
	ConvF X	**6.6**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.6**	± 9.5% (k=2)	Alpha	**0.37**
	ConvF Z	**6.6**	± 9.5% (k=2)	Depth	**2.61**

Head	**1800 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**	
Head	**1900 MHz**		ε_r = **40.0 ± 5%**	σ = **1.40 ± 5% mho/m**	
	ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.50**
	ConvF Z	**5.2**	± 9.5% (k=2)	Depth	**2.73**

Conversion Factor Assessment

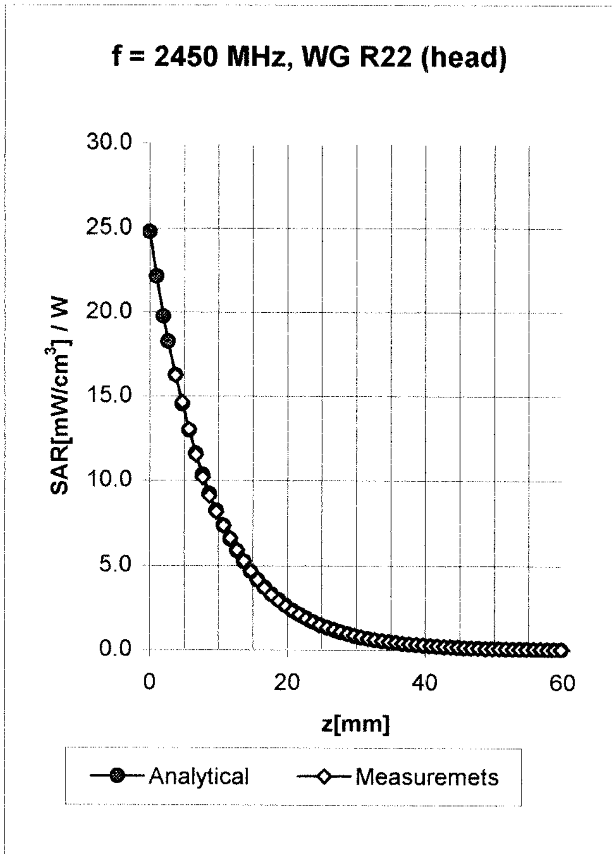


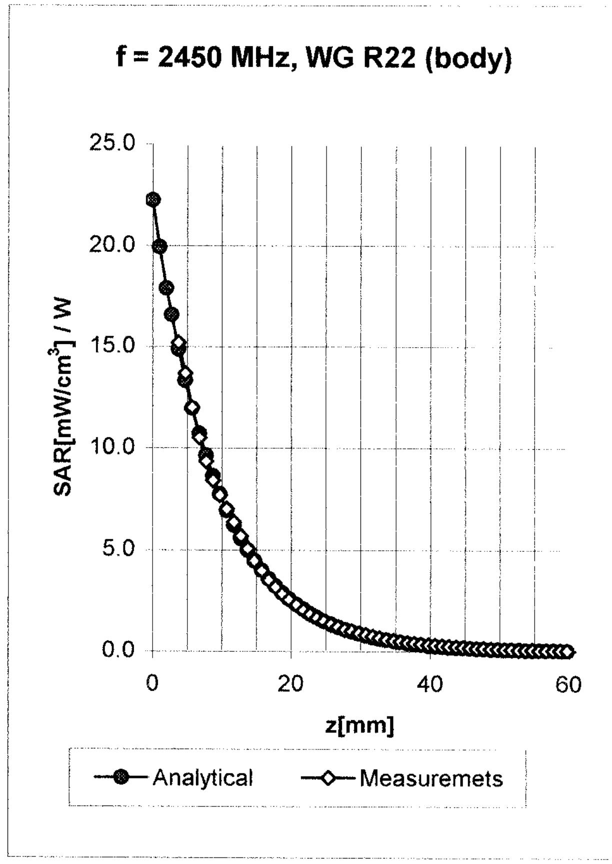


Body	**900 MHz**		ε_r **= 55.0 ± 5%**	σ **= 1.05 ± 5% mho/m**	
Body	**835 MHz**		ε_r **= 55.2 ± 5%**	σ **= 0.97 ± 5% mho/m**	
	ConvF X	**6.4**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.4**	± 9.5% (k=2)	Alpha	**0.45**
	ConvF Z	**6.4**	± 9.5% (k=2)	Depth	**2.35**

Body	**1800 MHz**		ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
Body	**1900 MHz**		ε_r **= 53.3 ± 5%**	σ **= 1.52 ± 5% mho/m**	
	ConvF X	**4.9**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**4.9**	± 9.5% (k=2)	Alpha	**0.60**
	ConvF Z	**4.9**	± 9.5% (k=2)	Depth	**2.59**

Conversion Factor Assessment





Head	**2450**	**MHz**	ε_r **= 39.2 ± 5%**	σ **= 1.80 ± 5% mho/m**

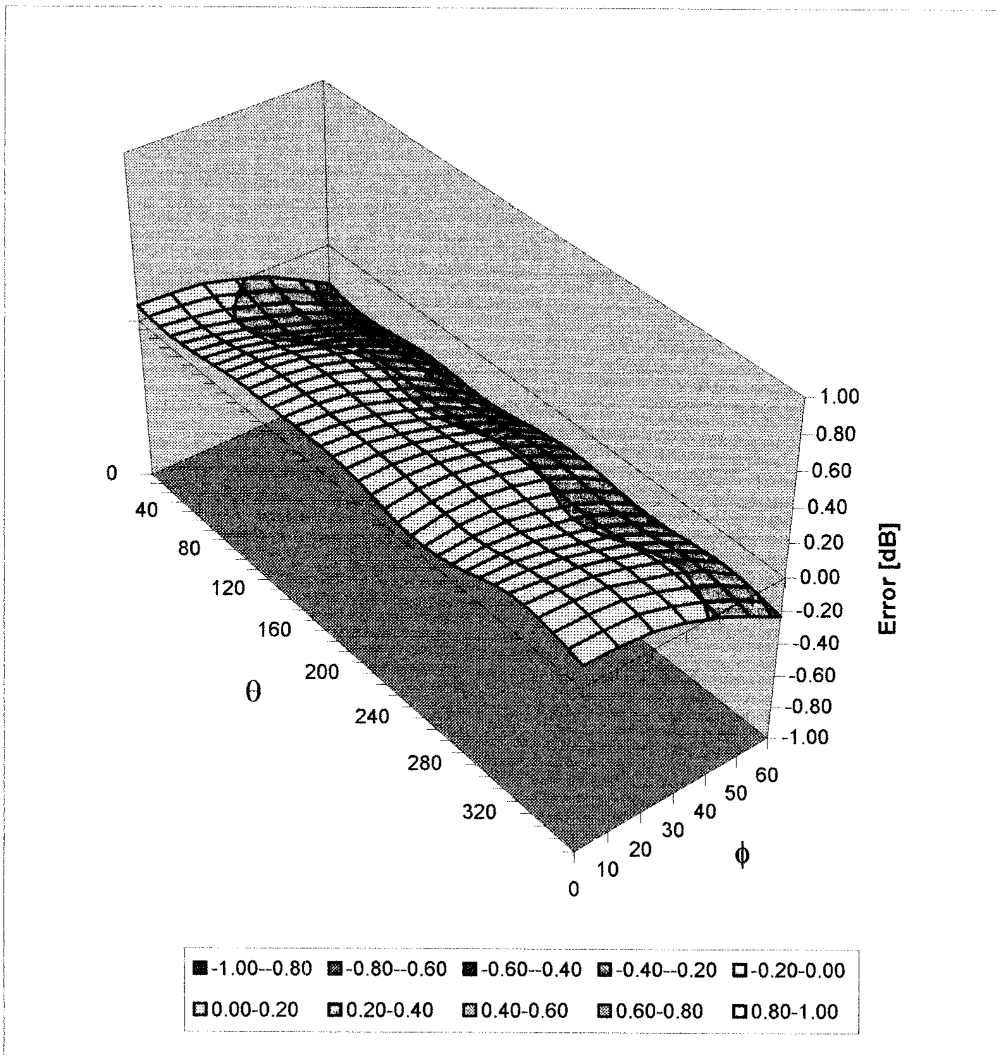
ConvF X	**5.0**	± 8.9% (k=2)	Boundary effect:	
ConvF Y	**5.0**	± 8.9% (k=2)	Alpha	**1.04**
ConvF Z	**5.0**	± 8.9% (k=2)	Depth	**1.85**

Body	**2450**	**MHz**	ε_r **= 52.7 ± 5%**	σ **= 1.95 ± 5% mho/m**

ConvF X	**4.6**	± 8.9% (k=2)	Boundary effect:	
ConvF Y	**4.6**	± 8.9% (k=2)	Alpha	**1.20**
ConvF Z	**4.6**	± 8.9% (k=2)	Depth	**1.60**

Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



Schmid & Partner
Engineering AG

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Assessment:	**Zurich**
Date of Assessment:	**February 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 (± standard deviation)

150 MHz	ConvF	**9.1 ± 8%**	**ε_r = 52.3** **σ = 0.76 mho/m** (head tissue)
300 MHz	ConvF	**7.9 ± 8%**	**ε_r = 45.3** **σ = 0.87 mho/m** (head tissue)
450 MHz	ConvF	**7.5 ± 8%**	**ε_r = 43.5** **σ = 0.87 mho/m** (head tissue)
150 MHz	ConvF	**8.8 ± 8%**	**ε_r = 61.9** **σ = 0.80 mho/m** (body tissue)
300 MHz	ConvF	**8.0 ± 8%**	**ε_r = 58.2** **σ = 0.92 mho/m** (body tissue)
450 MHz	ConvF	**7.7 ± 8%**	**ε_r = 56.7** **σ = 0.94 mho/m** (body tissue)

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

2450MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

November 12, 2003

Frequency	e'	e"
2.350000000 GHz	37.8546	13.5836
2.360000000 GHz	37.8125	13.6219
2.370000000 GHz	37.7982	13.6523
2.380000000 GHz	37.7517	13.6616
2.390000000 GHz	37.7212	13.6832
2.400000000 GHz	37.6784	13.6984
2.410000000 GHz	37.6292	13.7080
2.420000000 GHz	37.5583	13.7543
2.430000000 GHz	37.5298	13.7945
2.440000000 GHz	37.4671	13.8349
2.450000000 GHz	37.4185	13.8917
2.460000000 GHz	37.3828	13.9193
2.470000000 GHz	37.3638	13.9799
2.480000000 GHz	37.3423	13.9993
2.490000000 GHz	37.3205	14.0272
2.500000000 GHz	37.2812	14.0560
2.510000000 GHz	37.2321	14.0551
2.520000000 GHz	37.1762	14.0846
2.530000000 GHz	37.1314	14.1135
2.540000000 GHz	37.0585	14.1334
2.550000000 GHz	37.0161	14.1826

2450MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

November 12, 2003

Frequency	e'	e''
2.350000000 GHz	50.8686	14.5505
2.360000000 GHz	50.8269	14.6005
2.370000000 GHz	50.7940	14.6443
2.380000000 GHz	50.7555	14.6880
2.390000000 GHz	50.7270	14.7389
2.400000000 GHz	50.6785	14.7776
2.410000000 GHz	50.6179	14.8170
2.420000000 GHz	50.5753	14.8794
2.430000000 GHz	50.5439	14.9073
2.440000000 GHz	50.4867	14.9669
2.450000000 GHz	50.4531	15.0025
2.460000000 GHz	50.4029	15.0443
2.470000000 GHz	50.3706	15.0724
2.480000000 GHz	50.3421	15.0965
2.490000000 GHz	50.2971	15.1270
2.500000000 GHz	50.2688	15.1668
2.510000000 GHz	50.2086	15.1917
2.520000000 GHz	50.1580	15.2497
2.530000000 GHz	50.1059	15.2994
2.540000000 GHz	50.0662	15.3344
2.550000000 GHz	50.0361	15.3875

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

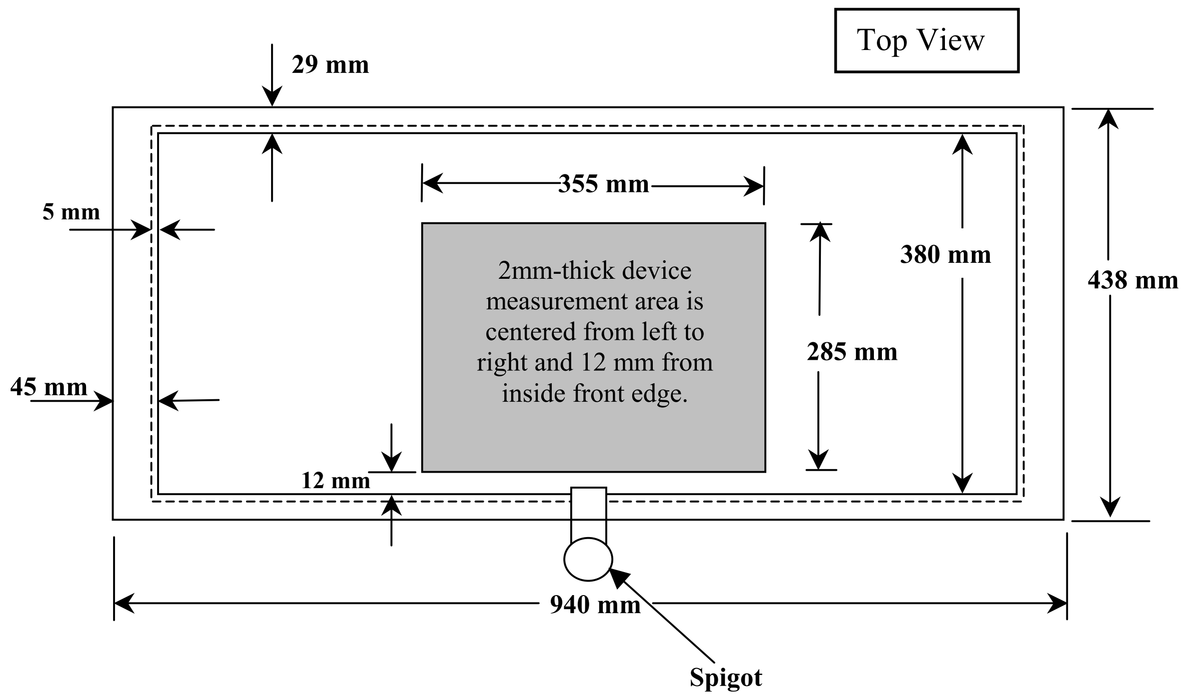
Fiberglass Planar Phantom - Front View

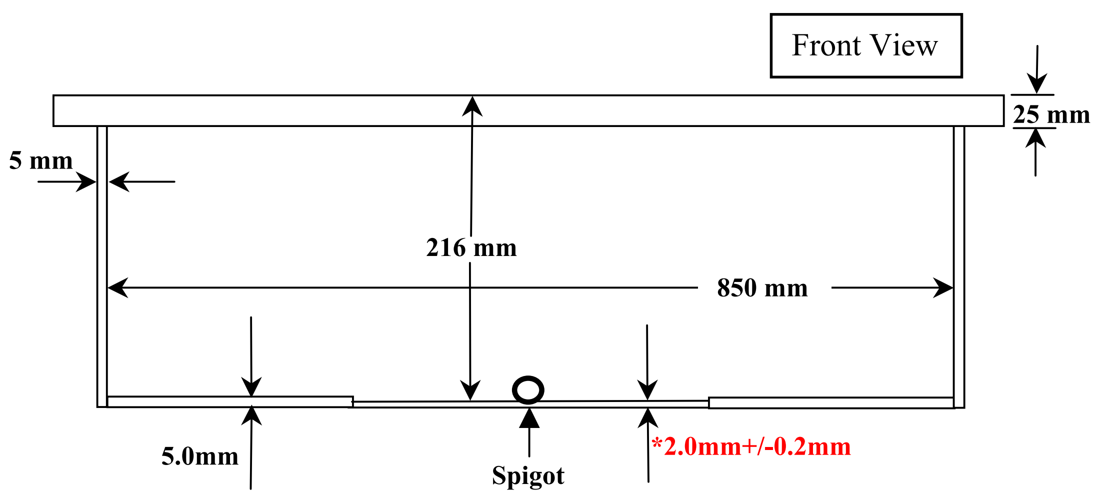
Fiberglass Planar Phantom - Back View

Fiberglass Planar Phantom - Bottom View

Dimensions of Fiberglass Planar Phantom

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

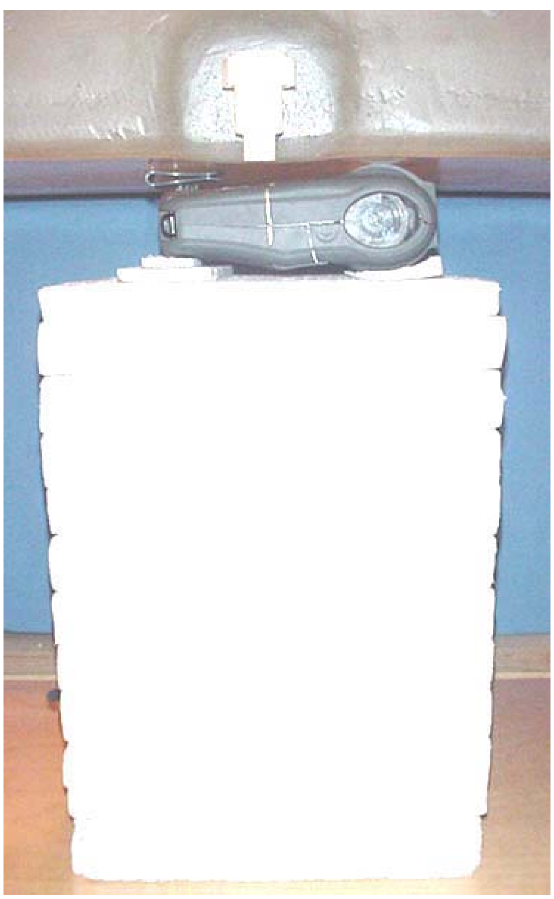




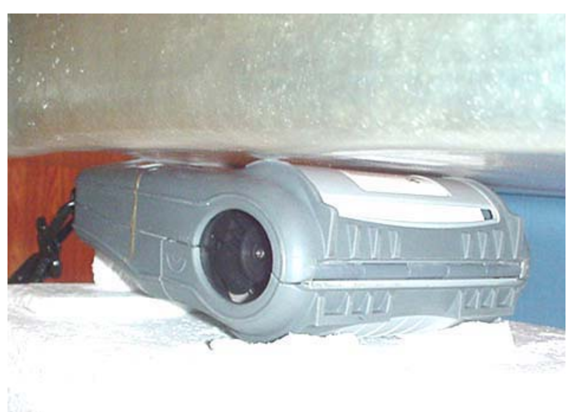
Note: Measurements that aren't repeated for the opposite sides are the same as the side measured. This drawing is not to scale.

APPENDIX H - SAR TEST SETUP & DUT PHOTOGRAPHS

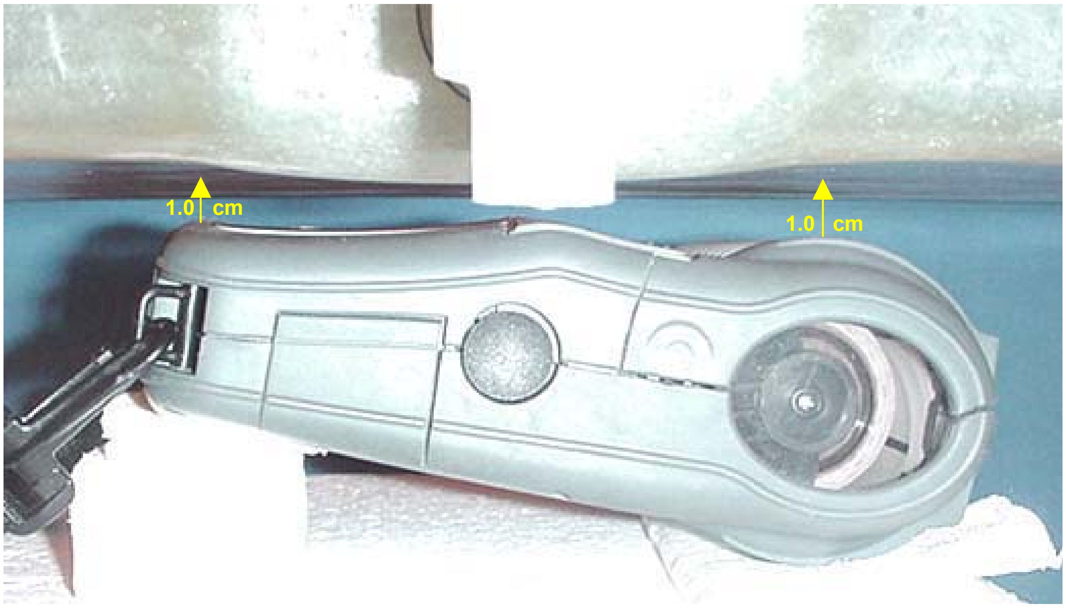
BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Bottom Side of DUT (Battery Side) with Belt-Clip Accessory
(Belt-Clip and Printer End Touching Planar Phantom)

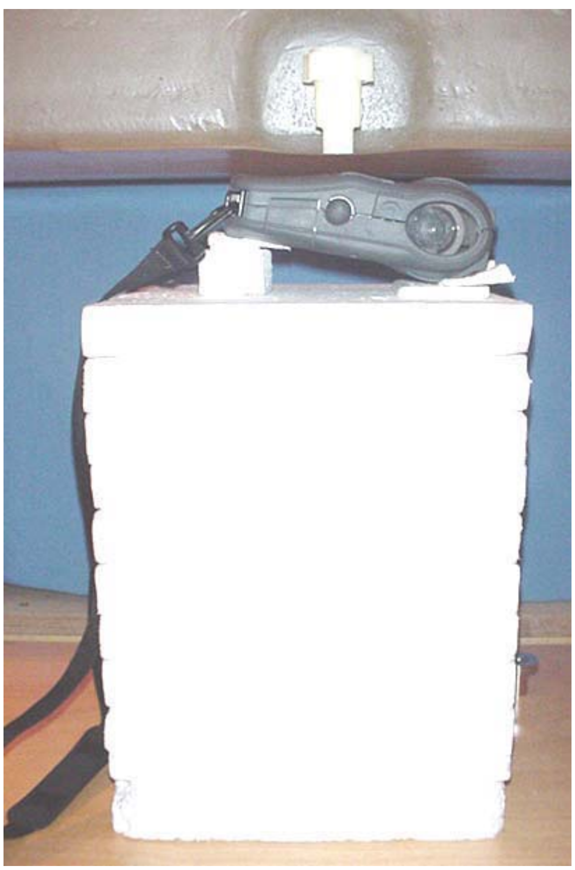


BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Bottom Side of DUT (Battery Side) with Shoulder Strap Accessory
(0.0 cm Separation Distance to Planar Phantom)

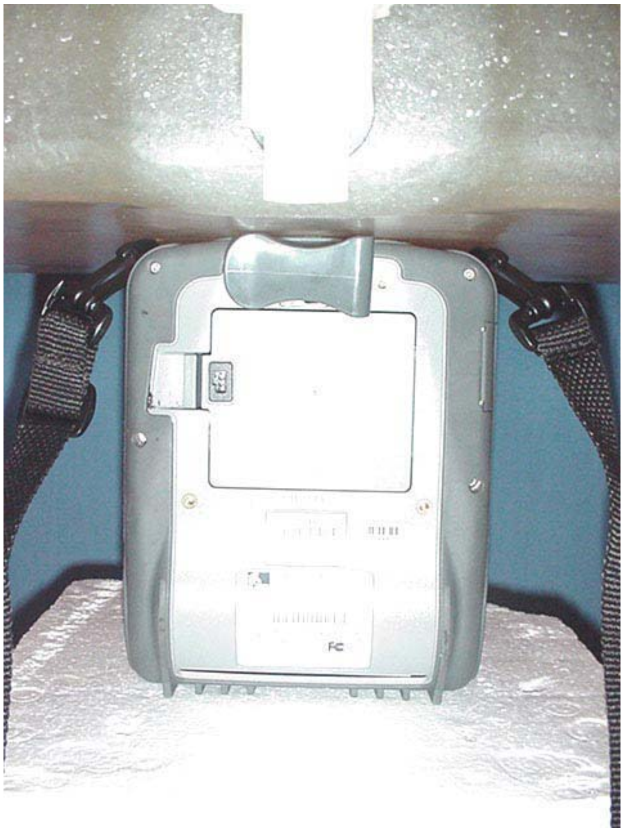


BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Top Side of DUT (Antenna/Printer Side) with Shoulder Strap Accessory
(1.0 cm Separation Distance to Planar Phantom)





BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Front Side of DUT (LCD Side) with Shoulder Strap Accessory
(0.0 cm Separation Distance to Planar Phantom)



BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Left Side of DUT with Shoulder Strap Accessory
(0.0 cm Separation Distance to Planar Phantom)

BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Right Side of DUT with Shoulder Strap Accessory
(0.0 cm Separation Distance to Planar Phantom)

DUT PHOTOGRAPHS
AN16973-1 WLAN Module Installed in QL420 Wireless Portable Printer

Front Side of DUT (LCD Side)
with Belt-Clip Accessory

Back Side of DUT

Top Side of DUT (Antenna/Printer Side)
with Belt-Clip Accessory

Bottom Side of DUT (Battery Side)
with Belt-Clip Accessory

DUT PHOTOGRAPHS
AN16973-1 WLAN Module Installed in QL420 Wireless Portable Printer

Top Side of DUT (Antenna/Printer Side)
with Shoulder Strap Accessory

Bottom Side of DUT (Battery Side)
with Shoulder Strap Accessory

Left Side of DUT
with Shoulder Strap Accessory

Right Side of DUT
with Shoulder Strap Accessory

DUT PHOTOGRAPHS

AN16973-1 WLAN Module Installed in QL420 Wireless Portable Printer

Bottom Side of DUT - Battery Compartment

DUT Top Cover Open

7.4V Lithium-ion Battery Pack

7.4V Lithium-ion Battery Pack

DUT PHOTOGRAPHS
AN16973-1 WLAN Module Installed in QL420 Wireless Portable Printer