RF EXPOSURE EVALUATION

SPECIFIC ABSORPTION RATE

SAR TEST REPORT

FOR

ZEBRA TECHNOLOGIES CORPORATION

ZLAN11G 802.11b/g WLAN

INSTALLED IN

RW220, RW420 Wireless Portable Printers

FCC ID: I28MD-ZLAN11G

IC: 3798A-ZLAN11G

TEST STANDARD(S) & PROCEDURE(S) APPLIED
FCC OET Bulletin 65, Supplement C (01-01)
Industry Canada RSS-102 Issue 2

Test Report Serial No.

092106I28-T777-S15W

Test Report Revision No.

Revision 1.0 (Initial Release)

Test Lab and Location

Celltech Compliance Testing & Engineering Lab
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Certificate No. 2470.01

Test Report Prepared By:	Test Report Reviewed By:
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DECLARATION OF COMPLIANCE
SAR RF EXPOSURE EVALUATION

Test Lab and Location

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Company Information

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FCC IDENTIFIER:	**I28MD-ZLAN11G**
IC IDENTIFIER:	**3798A-ZLAN11G**
Model(s):	**ZLAN11G**
Test Requirement(s):	**FCC 47 CFR §2.1093; Health Canada Safety Code 6**
Test Procedure(s):	**FCC OET Bulletin 65, Supplement C (Edition 01-01)** **Industry Canada RSS-102 Issue 2**
FCC Device Classification:	**Digital Transmission System (DTS)**
IC Device Classification:	**Low Power Licence-Exempt Radiocommunication Device (RSS-210)**
Transmitter Type:	**802.11b/g WLAN Radio Module**
Host Device(s):	**RW220, RW420 Wireless Portable Printers**
Mode(s) of Operation:	**Direct Sequence Spread Spectrum (DSSS)**
Transmit Frequency Range:	**2412 - 2462 MHz**
Max. RF Output Power Tested:	**18.85 dBm (76.74 mW) Peak Conducted (2462 MHz, 1 Mbps)**
Data Rate(s):	**802.11b: 1, 2, 5.5, 11 Mbps** **802.11g: 6, 9, 12, 24, 36, 48, 54 Mbps**
Battery Type(s) Tested:	**Lithium-ion 7.4 VDC P/N: CT17497-1 (RW220)** **Lithium-ion 7.4 VDC P/N: CT17102-2 (RW420)**
Antenna Type(s) Tested:	**Internal**
Body-Worn Accessories Tested:	**Plastic Belt-Clip**
Audio Accessories Tested:	**None (not applicable)**
Max. SAR Level(s) Evaluated:	**Body-Worn - RW220: 0.004 W/kg (Peak SAR measured from Area Scan)** **Body-Worn - RW420: 0.004 W/kg (Peak SAR measured from Area Scan)**
Class II Permissive Change(s):	**Add New Printer Models RW220, RW420**

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 2 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.

Test Report Approved By:
Sean Johnston
SAR Lab Manager
Celltech Labs Inc.

RW220 Printer

RW420 Printer

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1.0 INTRODUCTION

This measurement report demonstrates that the Zebra Technologies Corporation Model: ZLAN11G 802.11b/g WLAN Radio Module FCC ID: I28MD-ZLAN11G installed in RW220, RW420 Wireless Portable Printers 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 2 (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)

Test Requirement(s)	FCC Rule Part 47 CFR §2.1093				
	Health Canada Safety Code 6				
Test Procedure(s)	FCC OET Bulletin 65, Supplement C (01-01)				
	Industry Canada RSS-102 Issue 2				
FCC Device Classification	Digital Transmission System (DTS)			47 CFR §15C	
IC Device Classification	Low Power License-Exempt Radiocommunication Device			RSS-210 Issue 6	
RF Exposure Category	General Population / Uncontrolled Environment				
Transmitter Type	802.11b/g WLAN Radio Module				
Host Device Type(s)	RW220, RW420 Wireless Portable Printers				
Model(s)	ZLAN11G				
FCC IDENTIFER	I28MD-ZLAN11G				
IC IDENTIFER	3798A-ZLAN11G				
Test Sample(s) Serial No.(s)	ZLAN11G	V05091539697	Production Unit		
	RW220	XXRD06-24-5035	Production Unit		
	RW420	XXRC06-24-5108	Production Unit		
Transmission Type(s)	Direct Sequence Spread Spectrum (DSSS)				
Transmit Frequency Range	2412 - 2462 MHz				
Data Rate(s)	802.11b	1, 2, 5.5, 11 Mbps			
	802.11g	6, 9, 12, 18, 24, 36, 48, 54 Mbps			

Max. RF Conducted Output Power Measured	**Mode**	**Peak Conducted Power**		**Data Rate**	**Frequency**	**Channel**
	802.11b	18.42 dBm	69.50 mW	1 Mbps	2412 MHz	1
	802.11b	18.51 dBm	70.96 mW	1 Mbps	2437 MHz	6
	802.11b	**18.85 dBm**	**76.74 mW**	**1 Mbps**	**2462 MHz**	**11**
	802.11b	18.30 dBm	67.61 mW	11 Mbps	2462 MHz	11
	802.11g	16.00 dBm	39.81 mW	6 Mbps	2462 MHz	11

Host Battery Type(s) Tested	Lithium-ion	7.4 VDC	P/N: CT17497-1	RW220 Printer
	Lithium-ion	7.4 VDC	P/N: CT17102-2	RW420 Printer
Antenna Type(s) Tested	Internal			
Body-Worn Accessories Tested	Plastic Belt-Clip			
Audio Accessories Tested	None (not applicable)			
Class II Permissive Change(s)	Add New Printer Models RW220, RW420			

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 & planar phantom

DASY4 SAR Measurement System with planar phantom and validation dipole

4.0 MEASUREMENT SUMMARY

BODY-WORN SAR EVALUATION RESULTS

Freq.[2] (MHz)	Chan.	WLAN Mode[3]	Data Rate[3] (Mbps)	Test Mode	Battery Type	DUT Position to Planar Phantom	Body-worn Accessory	Host Device Separation Distance to Planar Phantom	Conducted Power Before Test (dBm)	SAR Drift During Test[4] (dB)	Peak SAR Measured from the Area Scan[5] (W/kg)
ZLAN11G installed in RW420 Printer											
2462	11	802.11b	1	DSSS	Li-ion	Back Side	None	0.0 cm Touch	18.85	--[4]	0.003
2462	11	802.11b	1	DSSS	Li-ion	Back Side	Belt-Clip	1.3 cm belt-clip	18.85	--[4]	**0.004**
ZLAN11G installed in RW220 Printer											
2462	11	802.11b	1	DSSS	Li-ion	Back Side	None	0.0 cm Touch	18.85	--[4]	0.003
2462	11	802.11b	1	DSSS	Li-ion	Back Side	Belt-Clip	1.3 cm belt-clip	18.85	--[4]	**0.004**

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)	September 26, 2006				**Relative Humidity**	38	%
Measured Fluid Type	**2450 MHz Body**				**Atmospheric Pressure**	101.2	kPa
Dielectric Constant ε_r	**IEEE Target**		**Measured**	**Deviation**	**Ambient Temperature**	24.0	°C
	52.7	**± 5%**	51.4	-2.5%	**Fluid Temperature**	23.5	°C
Conductivity σ (mho/m)	**IEEE Target**		**Measured**	**Deviation**	**Fluid Depth**	15	cm
	1.95	**± 5%**	2.03	+4.1%	**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 levels measured at the highest output channel were ≥ 3 dB below the SAR limit, SAR evaluation for all other selected channels was optional (per October 2005 FCC TCB Council Workshop - see reference [6]).
3. Higher data rates and 802.11g mode were required to be evaluated only if the RF conducted output power levels measured were 0.25 dB > output power levels measured at the lowest data rate (per October 2005 TCB Council Workshop - see reference [6]).
4. The power drifts were measured at the reference point of the phantom with low SAR. The drift values are inaccurate due to the SAR value at the reference point is close to the measurement noise floor and therefore are not reported.
5. The 1g-averaged SAR was not measured because the peak SAR value from the area scan evaluations for each test configuration was less than 1% of the 1g average limit. The peak SAR values measured during the area scan evaluations for each test configuration are reported. The mathematical formula used to extrapolate the SAR value at the surface from the zoom scan SAR values measured at 5 mm steps leading away from the surface assumes a curving slope (i.e. the SAR values gradually decrease as the probe moves away from the surface). When the peak SAR of a device is so low that the RF noise level is competing with the level of the SAR, the Zoom Scan measurements leading away from the surface are no longer a curving slope and the extrapolation formula cannot accurately estimate the 1g average SAR. In this manner, we have reported the peak values from the area scan in place of the 1g averaged SAR values whenever the peak values are less than 1% of the average limit. This avoids gross uncertainties in the 1g average SAR calculation while maintaining a conservative estimation of the SAR level.
6. The host device battery was fully charged prior to the SAR evaluations.
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: ZLAN11G 802.11b/g WLAN Radio Module FCC ID: I28MD-ZLAN11G installed in RW220, RW420 Wireless Portable Printers 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 D.

1. The RW220 and RW420 printers were evaluated for body-worn SAR on the back side (battery side) with the plastic belt-clip accessory removed (operating configuration when used with optional shoulder strap accessory containing no metallic components). The back side of the printer was positioned parallel to, and touching, the outer surface of the planar phantom.
2. The RW220 and RW420 printers were evaluated for body-worn SAR on the back side (battery side) with the plastic belt-clip accessory attached. The back side of the printer was positioned parallel to, with belt-clip touching, the outer surface of the planar phantom. The belt-clip accessory provided 1.3 cm spacing from the outer surface of the planar phantom to the battery end of the printer.
3. The DUT was programmed in test mode via internal software using the printer keypad buttons and was operating at maximum power in modulated DSSS continuous transmit mode for the duration of the SAR evaluations.
4. The peak conducted power levels of the ZLAN11G card were measured prior to the SAR evaluations using a Gigatronics 8652A Universal Power Meter according to the procedures described in FCC 47 CFR §2.1046.
5. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluations. The temperatures reported were consistent for all measurement periods.
6. The dielectric parameters of the simulated tissue mixture were measured prior to the SAR evaluations using an ALS-PR-DIEL Dielectric Probe Kit and an HP 8753ET Network Analyzer (see Appendix C).

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 F). 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 evaluations a system check was performed using a planar phantom with a 2450MHz dipole (see Appendix E for system validation procedures). The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using an ALS-PR-DIEL Dielectric Probe Kit and an HP 8753ET Network Analyzer (see Appendix C). 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 plot). See Table 1 below for the SAR system manufacturer's reference body SAR values from the DASY4 Operation Manual (see reference [7]).

SYSTEM PERFORMANCE CHECK EVALUATION

Test Date	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)
	MHz	IEEE Target	Meas.	Dev.	IEEE Target	Meas.	Dev.	IEEE Target	Meas.	Dev.						
9/26/06	Body 2450	12.8 ±10%	13.6	+6.3%	52.7 ±5%	51.4	-2.5%	1.95 ±5%	2.03	+4.1%	1000	24.0	23.5	≥ 15	38	101.2
Note(s)		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.														

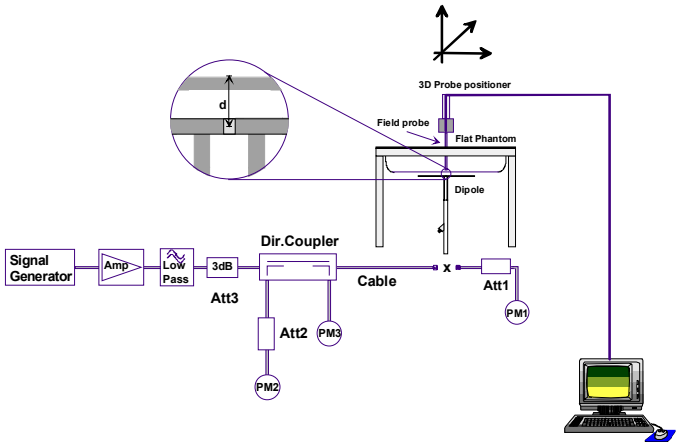
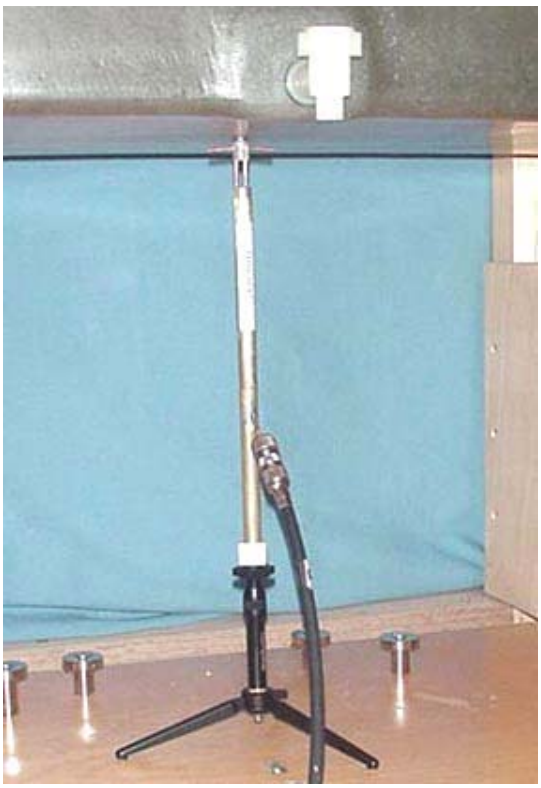


Figure 1. System Performance Check Measurement Setup

Dipole Type	Distance [mm]	Frequency [MHz]	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D300V2	15	300	3.02	2.06	4.36
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1500V2	10	1500	30.8	17.1	52.1
D1640V2	10	1640	34.4	18.7	59.4
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6
D3000V2	10	3000	61.9	24.8	136.7

Table 32.1: Numerical reference SAR values for SPEAG dipoles and flat phantom filled with body-tissue simulating liquid. Note: All SAR values normalized to 1 W forward power.

Table 1. SAR system manufacturer's reference body SAR values



2450MHz Dipole Setup

8.0 SIMULATED EQUIVALENT TISSUES

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

SIMULATED TISSUE MIXTURES		
INGREDIENT	**2450 MHz Body**	**2450 MHz Body**
	System Performance Check	DUT Evaluation
Water	69.98 %	69.98 %
Glycol Monobutyl	30.00 %	30.00 %
Salt	0.02 %	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
Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.		
Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.		

10.0 ROBOT SYSTEM SPECIFICATIONS

Specifications	
Positioner	Stäubli Unimation Corp. Robot Model: RX60L
Repeatability	0.02 mm
No. of axis	6
Data Acquisition Electronic (DAE) System	
Cell Controller	
Processor	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	Measurement Software: DASY4, V4.7 Build 44
	Postprocessing Software: SEMCAD, V1.8 Build 171
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	EX3DV4
Serial No.	3547
Construction	Symmetrical design with triangular core
Frequency	10 MHz to 6 GHz
Linearity	±0.2 dB (30 MHz to 3 GHz)
Phantom(s)	
Type	Planar Phantom
Shell Material	Fiberglass
Thickness	2.0 ±0.1 mm
Volume	Approx. 70 liters

11.0 PROBE SPECIFICATION (EX3DV4)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. DGBE)
Calibration:	Basic Broadband Calibration in air: 10-3000 MHz Conversion Factors (CF) for HSL 900 and HSL 1750
Frequency:	10 MHz to >6 GHz; Linearity: ±0.2 dB (30 MHz to 3 GHz)
Directivity:	±0.3 dB in HSL (rotation around probe axis) ±0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range:	10 μW/g to >100 mW/g; Linearity: ±0.2 dB (noise: typically < 1 μW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1.0 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better than 30%.

EX3DV4 E-Field Probe

12.0 PLANAR PHANTOM

The planar phantom is a fiberglass shell phantom with a 2.0 mm (+/-0.2 mm) 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). The planar phantom was also utilized for the system performance check evaluation.

Planar Phantom

13.0 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. For evaluations of larger devices a Plexiglas platform is attached to the device holder.

Device Holder

14.0 TEST EQUIPMENT LIST

TEST EQUIPMENT		ASSET NO.	SERIAL NO.	DATE CALIBRATED		CALIBRATION DUE DATE
USED	DESCRIPTION					
x	Schmid & Partner DASY4 System	-	-	-		-
x	-DASY4 Measurement Server	00158	1078	N/A		N/A
x	-Robot	00046	599396-01	N/A		N/A
x	-DAE4	00019	353	21Jun06		21Jun07
	-DAE3	00018	370	08Feb06		08Feb07
	-ET3DV6 E-Field Probe	00016	1387	16Mar06		16Mar07
x	-EX3DV4 E-Field Probe	00125	3547	14Feb06		14Feb07
	-300MHz Validation Dipole	00023	135	25Oct05		25Oct06
	-450MHz Validation Dipole	00024	136	25Oct05		25Oct06
	-835MHz Validation Dipole	00022	411	**Brain**	28Mar06	28Mar07
				Body	27Mar06	27Mar07
	-900MHz Validation Dipole	00020	054	**Brain**	06Jun06	06Jun07
				Body	06Jun06	06Jun07
	-1640MHz Validation Dipole	00212	0175	**Brain**	14Aug06	14Aug07
	-1800MHz Validation Dipole	00021	247	**Brain**	08Jun06	08Jun07
				Body	09Jun06	09Jun07
	-1900MHz Validation Dipole	00032	151	**Brain**	09Jun06	09Jun07
				Body	12Jun06	12Jun07
x	-2450MHz Validation Dipole	00025	150	**Body**	24Apr06	24Apr07
	-5800MHz Validation Dipole	00126	1031	**Brain**	15Mar06	15Mar07
	-SAM Phantom V4.0C	00154	1033	N/A		N/A
x	-Barski Planar Phantom	00155	03-01	N/A		N/A
	-Plexiglas Side Planar Phantom	00156	161	N/A		N/A
	-Plexiglas Validation Planar Phantom	00157	137	N/A		N/A
x	ALS-PR-DIEL Dielectric Probe Kit	00160	260-00953	N/A		N/A
x	Gigatronics 8652A Power Meter	00110	1835801	12Apr06		12Apr07
x	Gigatronics 8652A Power Meter	00007	1835272	03Feb06		03Feb07
x	Gigatronics 80701A Power Sensor	00011	1833542	03Feb06		03Feb07
x	Gigatronics 80701A Power Sensor	00013	1833713	03Feb06		03Feb07
x	HP 8753ET Network Analyzer	00134	US39170292	18Apr06		18Apr07
x	HP 8648D Signal Generator	00005	3847A00611	N/A		N/A
	Rohde & Schwarz SMR40 Signal Generator	00006	100104	06Apr06		06Apr07
x	Amplifier Research 5S1G4 Power Amplifier	00106	26235	N/A		N/A
	HP E4408B Spectrum Analyzer	00015	US39240170	02Feb06		02Feb07

15.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
Error Description	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	**ci 1g**	**Uncertainty Value ±% (1g)**	**V_i or V_{eff}**
Measurement System						
Probe calibration	5.9	Normal	1	1	5.9	∞
Axial isotropy of the probe	4.7	Rectangular	1.732050808	0.7	1.9	∞
Spherical isotropy of the probe	9.6	Rectangular	1.732050808	0.7	3.9	∞
Spatial resolution	0	Rectangular	1.732050808	1	0.0	∞
Boundary effects	1	Rectangular	1.732050808	1	0.6	∞
Probe linearity	4.7	Rectangular	1.732050808	1	2.7	∞
Detection limit	1	Rectangular	1.732050808	1	0.6	∞
Readout electronics	0.3	Normal	1	1	0.3	∞
Response time	0.8	Rectangular	1.732050808	1	0.5	∞
Integration time	2.6	Rectangular	1.732050808	1	1.5	∞
RF ambient conditions	3	Rectangular	1.732050808	1	1.7	∞
Mech. constraints of robot	0.4	Rectangular	1.732050808	1	0.2	∞
Probe positioning	2.9	Rectangular	1.732050808	1	1.7	∞
Extrapolation & integration	1	Rectangular	1.732050808	1	0.6	∞
Test Sample Related						
Device positioning	2.9	Normal	1	1	2.9	12
Device holder uncertainty	3.6	Normal	1	1	3.6	8
Power drift	5	Rectangular	1.732050808	1	2.9	∞
Phantom and Setup						
Phantom uncertainty	4	Rectangular	1.732050808	1	2.3	∞
Liquid conductivity (target)	5	Rectangular	1.732050808	0.64	1.8	∞
Liquid conductivity (measured)	2.5	Normal	1	0.64	1.6	∞
Liquid permittivity (target)	5	Rectangular	1.732050808	0.6	1.7	∞
Liquid permittivity (measured)	2.5	Normal	1	0.6	1.5	∞
Combined Standard Uncertainty					**10.79**	
Expanded Uncertainty (k=2)					**21.59**	

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	ci 1g	Uncertainty Value ±% (1g)	V_i or V_{eff}
Measurement System						
Probe calibration	5.9	Normal	1	1	5.9	∞
Axial isotropy of the probe	4.7	Rectangular	1.732050808	1	2.7	∞
Spherical isotropy of the probe	0	Rectangular	1.732050808	1	0.0	∞
Spatial resolution	0	Rectangular	1.732050808	1	0.0	∞
Boundary effects	1	Rectangular	1.732050808	1	0.6	∞
Probe linearity	4.7	Rectangular	1.732050808	1	2.7	∞
Detection limit	1	Rectangular	1.732050808	1	0.6	∞
Readout electronics	0.3	Normal	1	1	0.3	∞
Response time	0	Rectangular	1.732050808	1	0.0	∞
Integration time	0	Rectangular	1.732050808	1	0.0	∞
RF ambient conditions	3	Rectangular	1.732050808	1	1.7	∞
Mech. constraints of robot	0.4	Rectangular	1.732050808	1	0.2	∞
Probe positioning	2.9	Rectangular	1.732050808	1	1.7	∞
Extrapolation & integration	1	Rectangular	1.732050808	1	0.6	∞
Test Sample Related						
Dipole Positioning	2	Normal	1.732050808	1	1.2	∞
Power & Power Drift	4.7	Normal	1.732050808	1	2.7	∞
Phantom and Setup						
Phantom uncertainty	4	Rectangular	1.732050808	1	2.3	∞
Liquid conductivity (target)	5	Rectangular	1.732050808	0.64	1.8	∞
Liquid conductivity (measured)	2.5	Normal	1	0.64	1.6	∞
Liquid permittivity (target)	5	Rectangular	1.732050808	0.6	1.7	∞
Liquid permittivity (measured)	2.5	Normal	1	0.6	1.5	∞
Combined Standard Uncertainty					**9.04**	
Expanded Uncertainty (k=2)					**18.08**	

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

16.0 REFERENCES

[1] Federal Communications Commission - “Radiofrequency radiation exposure evaluation: portable devices”, Rule Part 47 CFR §2.1093: 1999.

[2] Health Canada - “Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz”, Safety Code 6: 1999.

[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 - “Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)”, Radio Standards Specification RSS-102 Issue 2: November 2005.

[5] IEEE Standard 1528-2003 - “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”: December 2003.

[6] FCC TCB Council Workshop - “RF Exposure (RFx) Mobile and Portable Device Review and Approval Procedures, 802.11abg SAR Procedures (Proposed Testing Guidance)”: October 2005.

[7] Schmid & Partner Engineering AG - “DASY4 Manual”, V4.5: March 2005.

APPENDIX A - SAR MEASUREMENT DATA

Date Tested: 09/26/2006

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW420 Printer (without belt-clip) - 2462 MHz

DUT: Zebra Model: ZLAN11G; Type: 802.11bg WLAN installed in RW420 Wireless Printer; Serial: XXRC06-24-5108

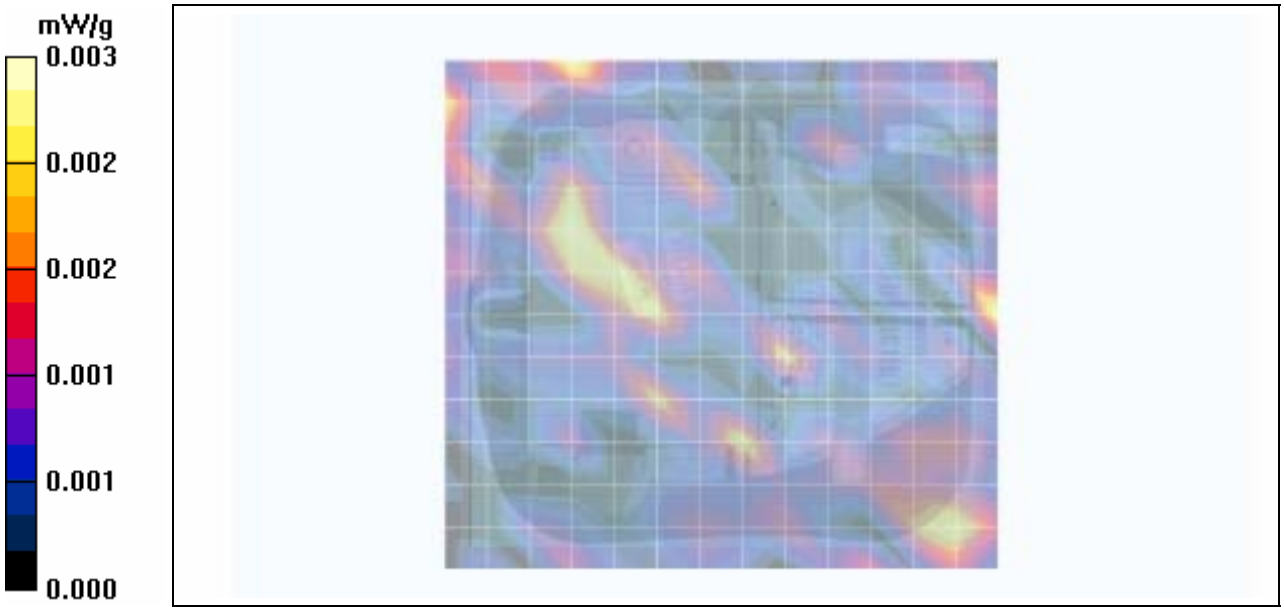
Body-Worn Accessory: None; Audio Accessory: N/A

Ambient Temp: 24.0°C; Fluid Temp: 23.5°C; Barometric Pressure: 101.2 kPa; Humidity: 38%

Communication System: DSSS WLAN
Frequency: 2462 MHz; Duty Cycle: 1:1
RF Output Power: 18.85 dBm (Conducted)
7.4V Li-ion Battery Pack (P/N: CT17102-2)
Medium: M2450 Medium parameters used: f = 2462 MHz; σ = 2.03 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3547; ConvF(7.53, 7.53, 7.53); Calibrated: 14/02/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW420 Printer Touching Planar Phantom - Channel 11
Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.003 mW/g



Date Tested: 09/26/2006

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW420 Printer (with Belt-Clip) - 2462 MHz

DUT: Zebra Model: ZLAN11G; Type: 802.11bg WLAN installed in RW420 Wireless Printer; Serial: XXRC06-24-5108

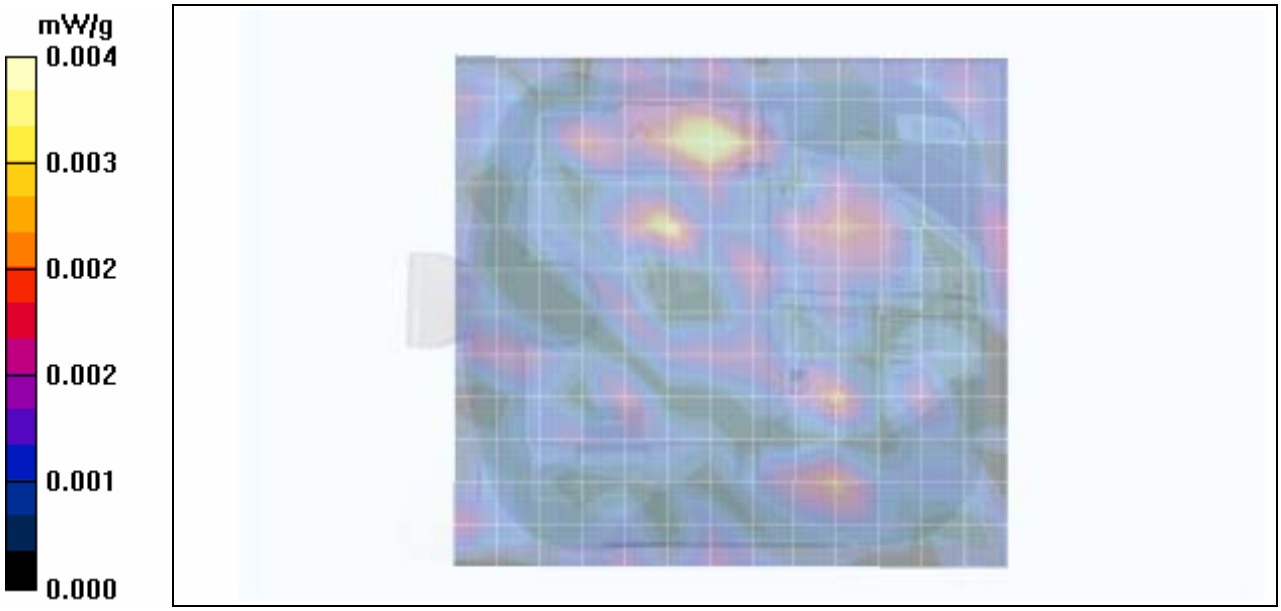
Body-Worn Accessory: Plastic Belt-Clip; Audio Accessory: N/A

Ambient Temp: 24.0°C; Fluid Temp: 23.5°C; Barometric Pressure: 101.2 kPa; Humidity: 38%

Communication System: DSSS WLAN
Frequency: 2462 MHz; Duty Cycle: 1:1
RF Output Power: 18.85 dBm (Conducted)
7.4V Li-ion Battery Pack (P/N: CT17102-2)
Medium: M2450 Medium parameters used: f = 2462 MHz; σ = 2.03 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3547; ConvF(7.53, 7.53, 7.53); Calibrated: 14/02/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW420 Printer - 1.3 cm Belt-Clip Spacing to Phantom - Channel 11
Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.004 mW/g



Date Tested: 09/26/2006

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW220 Printer (without belt-clip) - 2462 MHz

DUT: Zebra Model: ZLAN11G; Type: 802.11bg WLAN installed in RW220 Wireless Printer; Serial: XXRD06-24-5035

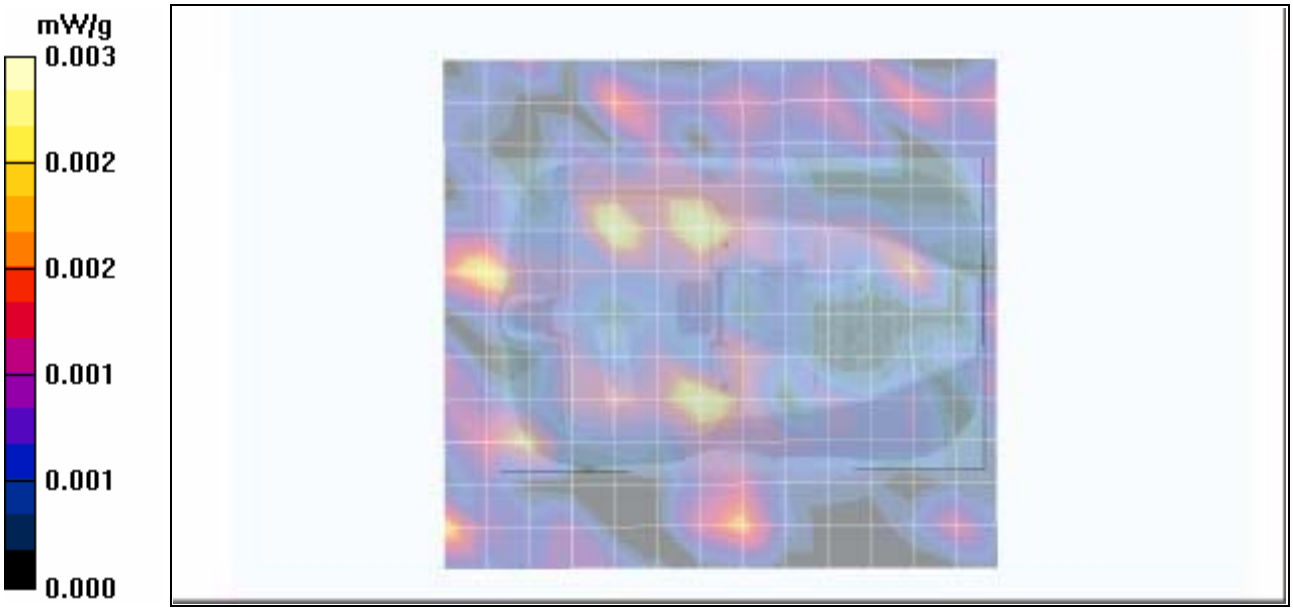
Body-Worn Accessory: None; Audio Accessory: N/A

Ambient Temp: 24.0°C; Fluid Temp: 23.5°C; Barometric Pressure: 101.2 kPa; Humidity: 38%

Communication System: DSSS WLAN
Frequency: 2462 MHz; Duty Cycle: 1:1
RF Output Power: 18.85 dBm (Conducted)
7.4V Li-ion Battery Pack (P/N: CT17497-1)
Medium: M2450 Medium parameters used: f = 2462 MHz; σ = 2.03 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3547; ConvF(7.53, 7.53, 7.53); Calibrated: 14/02/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW220 Printer Touching Planar Phantom - Channel 11
Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.003 mW/g



Date Tested: 09/26/2006

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW220 Printer (with Belt-Clip) - 2462 MHz

DUT: Zebra Model: ZLAN11G; Type: 802.11bg WLAN installed in RW220 Wireless Printer; Serial: XXRD06-24-5035

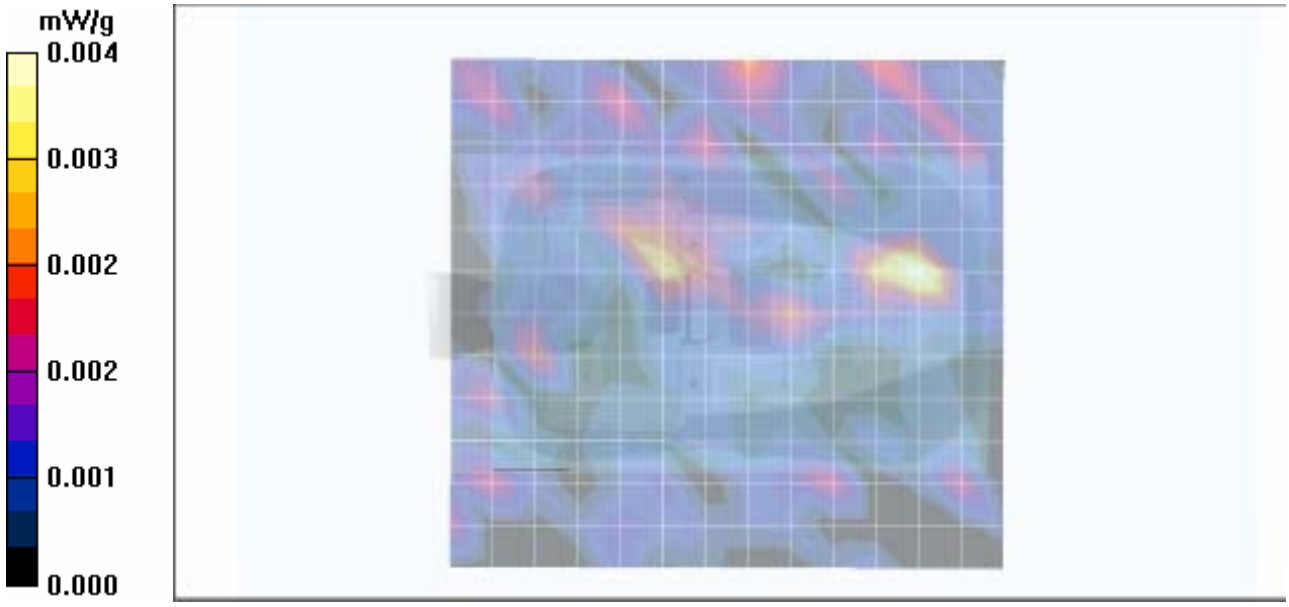
Body-Worn Accessory: Plastic Belt-Clip; Audio Accessory: N/A

Ambient Temp: 24.0°C; Fluid Temp: 23.5°C; Barometric Pressure: 101.2 kPa; Humidity: 38%

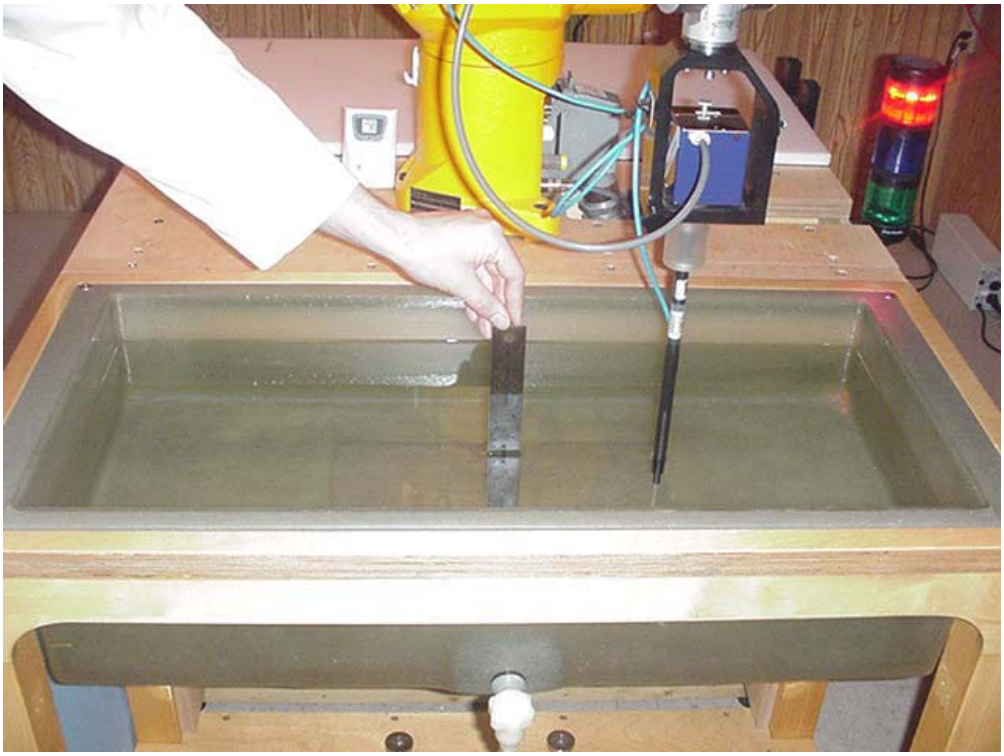
Communication System: DSSS WLAN
Frequency: 2462 MHz; Duty Cycle: 1:1
RF Output Power: 18.85 dBm (Conducted)
7.4V Li-ion Battery Pack (P/N: CT17497-1)
Medium: M2450 Medium parameters used: f = 2462 MHz; σ = 2.03 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

- Probe: EX3DV4 - SN3547; ConvF(7.53, 7.53, 7.53); Calibrated: 14/02/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of RW220 Printer - 1.3 cm Belt-Clip Spacing to Phantom - Channel 11
Area Scan (13x14x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.004 mW/g



Fluid Depth (≥ 15 cm)



APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

Date Tested: 09/26/2006

System Performance Check (Body) - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Serial: 150; Validation: 04/24/2006

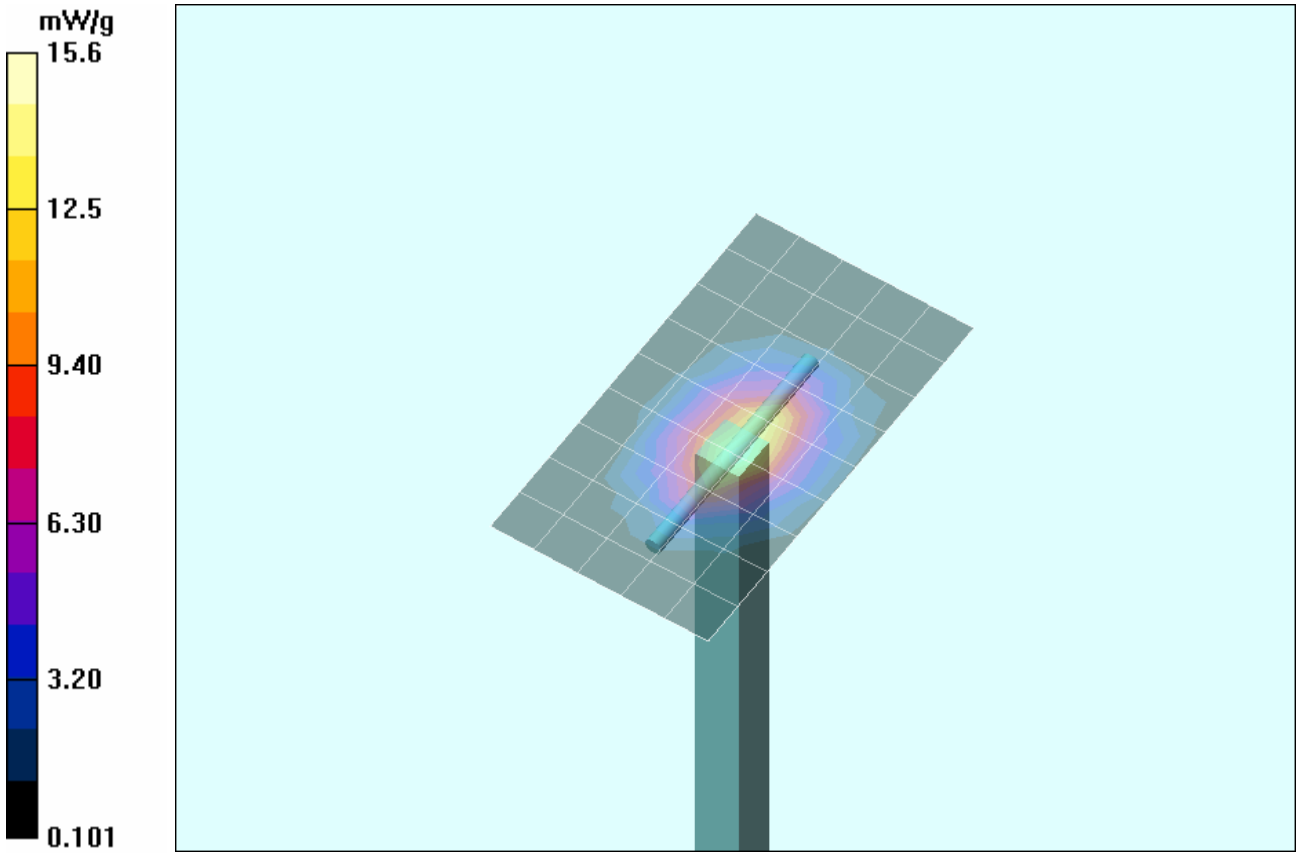
Ambient Temp: 24.0°C; Fluid Temp: 23.5°C; Barometric Pressure: 101.2 kPa; Humidity: 38%

Communication System: CW
Forward Conducted Power: 250 mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: M2450 Medium parameters used: f = 2450 MHz; σ = 2.03 mho/m; ε_r = 51.4; ρ = 1000 kg/m^3

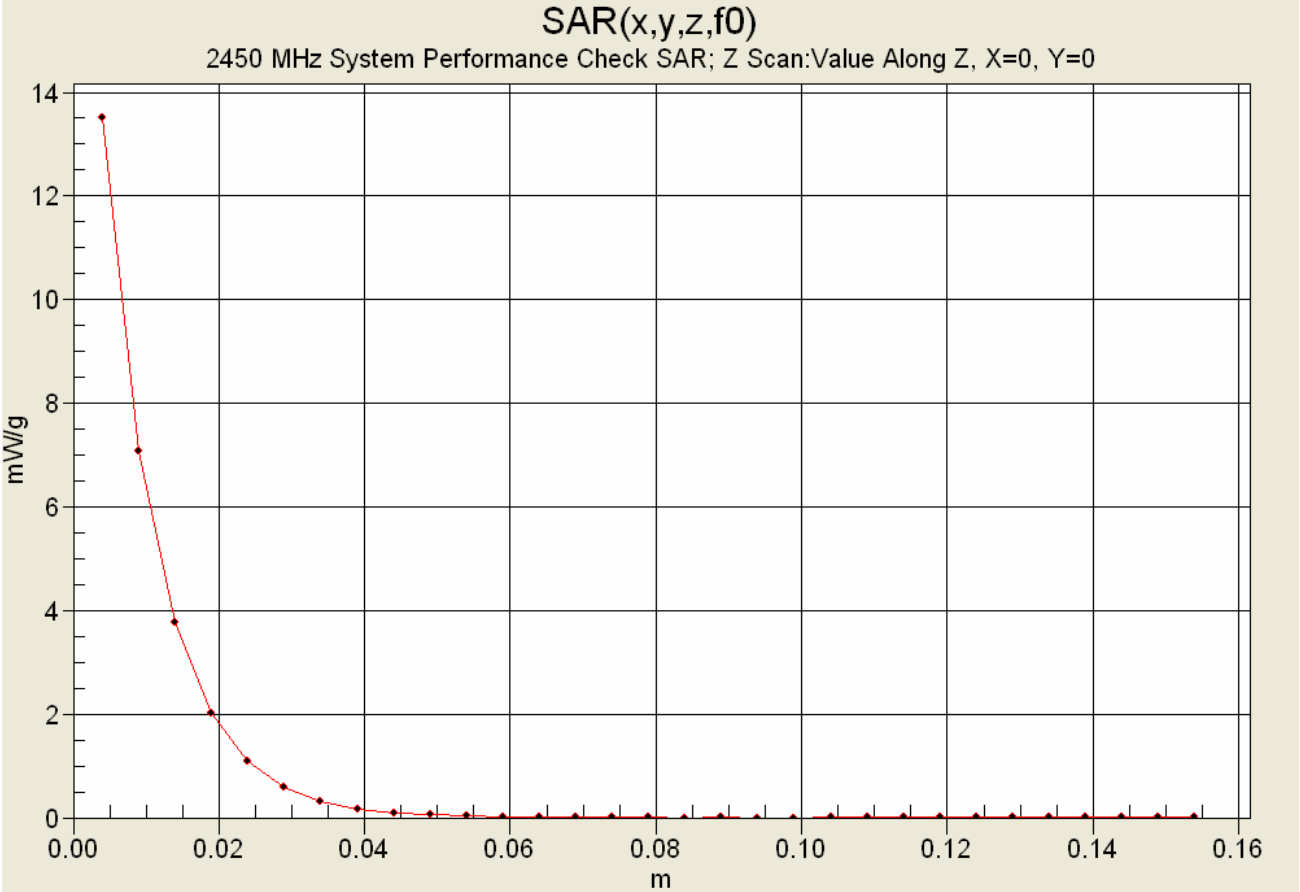
- Probe: EX3DV4 - SN3547; ConvF(7.53, 7.53, 7.53); Calibrated: 14/02/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

2450 MHz Dipole - System Performance Check/Area Scan (6x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 14.9 mW/g

2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 80.4 V/m; Power Drift = 0.012 dB
Peak SAR (extrapolated) = 28.6 W/kg
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.22 mW/g
Maximum value of SAR (measured) = 15.6 mW/g



Z-Axis Scan



APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

2450 MHz System Performance Check and DUT Evaluation

****

Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
Tue 26/Sep/2006
Frequency (GHz)
FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.3500	52.83	1.85	51.67	1.92
2.3600	52.82	1.86	51.66	1.92
2.3700	52.81	1.87	51.49	1.95
2.3800	52.79	1.88	51.54	1.96
2.3900	52.78	1.89	51.52	1.96
2.4000	52.77	1.90	51.39	1.97
2.4100	52.75	1.91	51.41	1.99
2.4200	52.74	1.92	51.34	2.01
2.4300	52.73	1.93	51.46	2.01
2.4400	52.71	1.94	51.38	2.03
2.4500	52.70	1.95	51.39	2.03
2.4600	52.69	1.96	51.28	2.04
2.4700	52.67	1.98	51.33	2.07
2.4800	52.66	1.99	51.24	2.07
2.4900	52.65	2.01	51.03	2.09
2.5000	52.64	2.02	51.07	2.09
2.5100	52.62	2.04	51.16	2.10
2.5200	52.61	2.05	51.05	2.13
2.5300	52.60	2.06	51.03	2.14
2.5400	52.59	2.08	50.98	2.16
2.5500	52.57	2.09	50.96	2.18

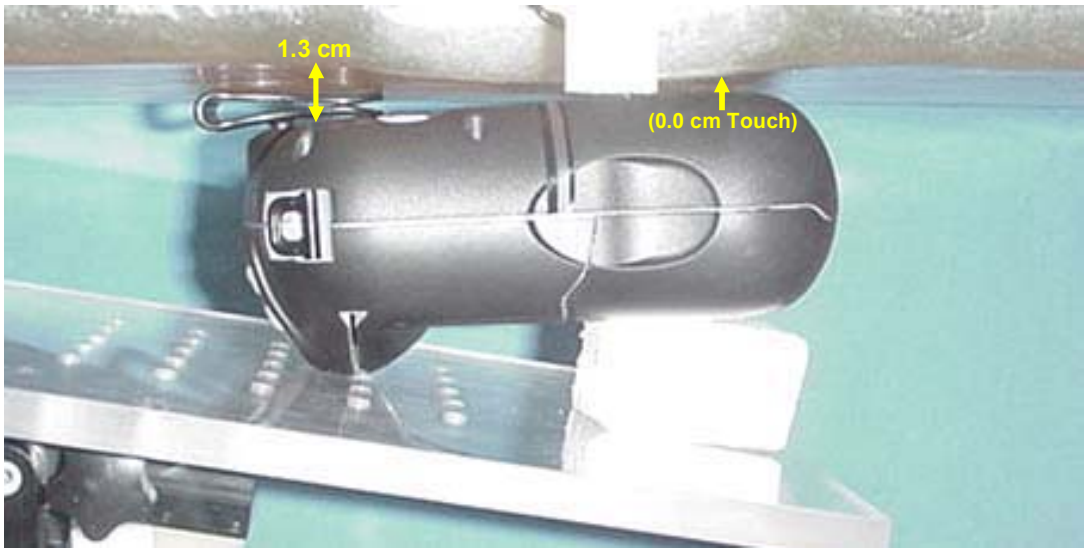
APPENDIX D - SAR TEST SETUP & DUT PHOTOGRAPHS

BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of RW420 Printer (Battery Side) Touching Planar Phantom
(Without Belt-Clip accessory)

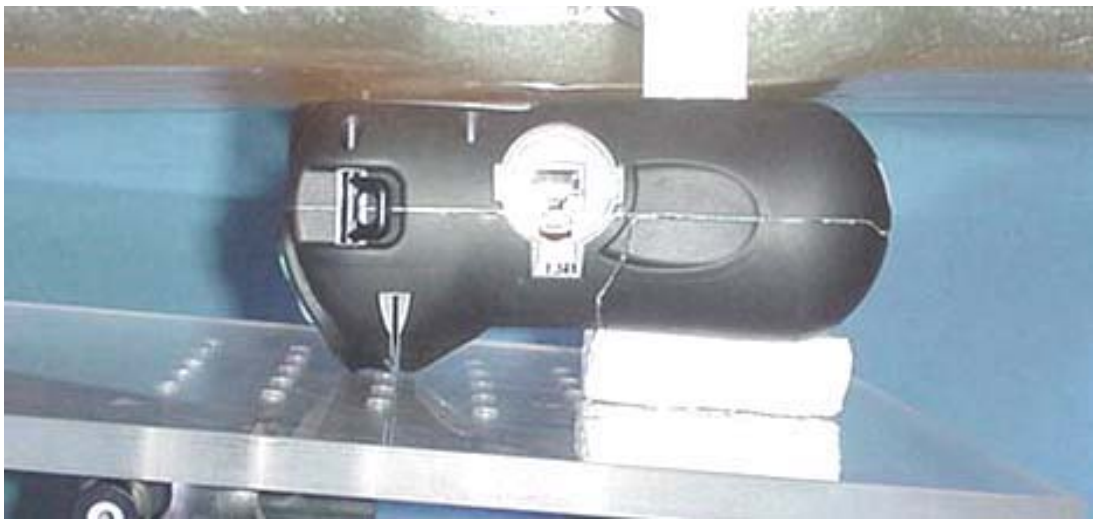
BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of RW420 Printer (Battery Side) with 1.3 cm Belt-Clip Spacing to Planar Phantom



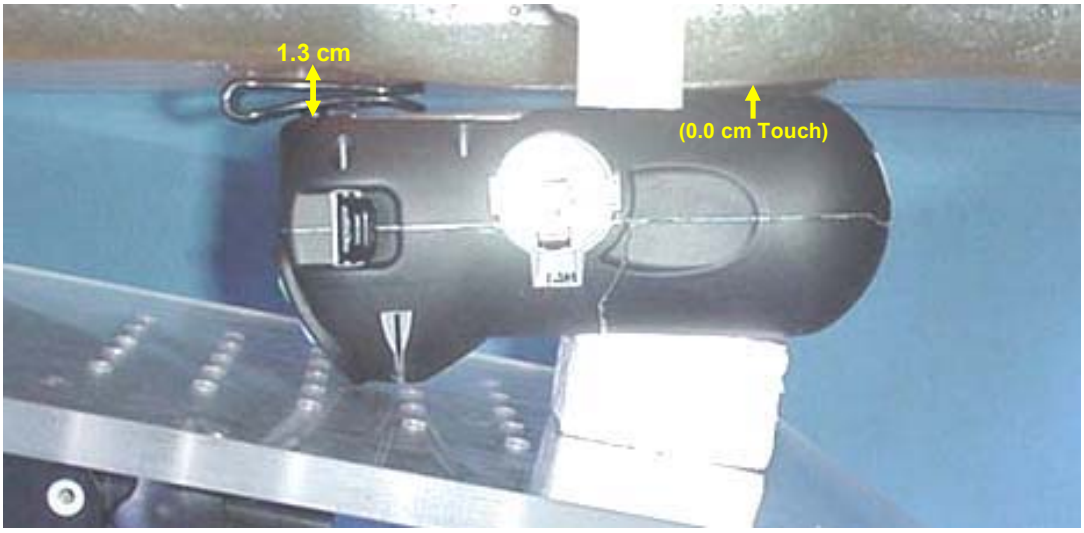
BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of RW220 Printer (Battery Side) Touching Planar Phantom
(Without Belt-Clip accessory)



BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of RW220 Printer (Battery Side) with 1.3 cm Belt-Clip Spacing to Planar Phantom



DUT PHOTOGRAPHS
RW420 Printer

Top end of RW420 (LCD Side)

Bottom end of RW420

Front Side of RW420 (Antenna/Printer Side)

Back Side of RW420 (Battery Side) with Plastic Belt-Clip Accessory

Back Side of RW420 (Battery Side) without Belt-Clip Accessory

DUT PHOTOGRAPHS
RW420 Printer

D-Ring for shoulder strap attachment

Left Side of RW420

Right Side RW420

DUT PHOTOGRAPHS
RW420 Printer

Back Side of RW420 - Battery Compartment

7.4V Lithium-ion Battery Pack (P/N: CT17102-2)

DUT PHOTOGRAPHS
RW220 Printer

Top end of RW220 (LCD Side)

Bottom end of RW220

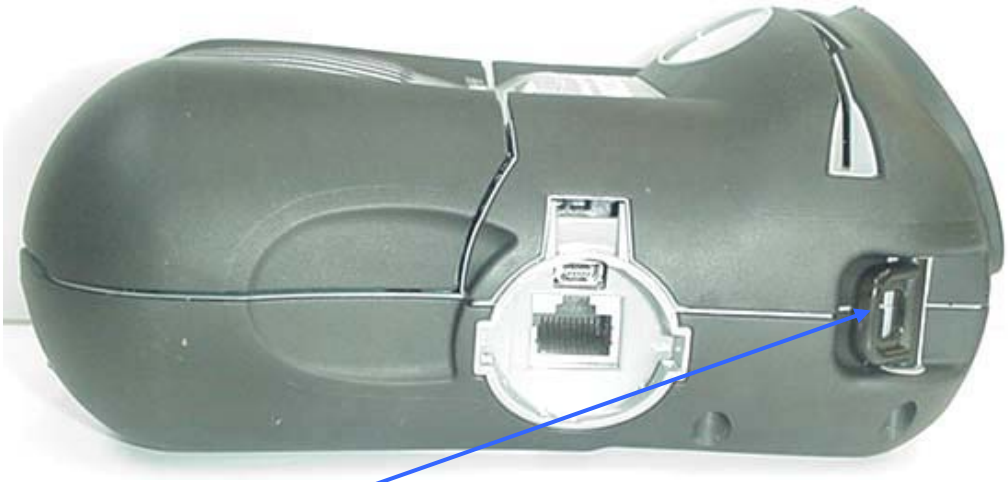
Front Side of RW220 (Antenna/Printer Side)

Back Side of RW220 (Battery Side) with Plastic Belt-Clip Accessory

Back Side of RW220 (Battery Side) without Belt-Clip Accessory

DUT PHOTOGRAPHS

RW220 Printer



Left Side of RW220

D-Ring for shoulder strap attachment

Right Side RW220

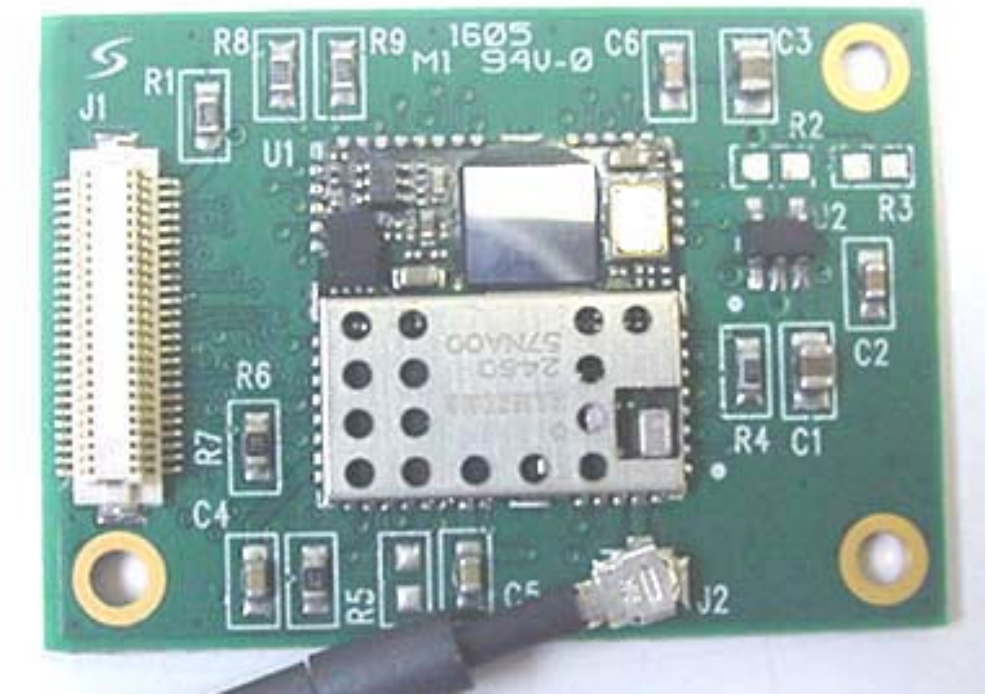
DUT PHOTOGRAPHS
RW220 Printer

Back Side of RW220 - Battery Compartment

7.4V Lithium-ion Battery Pack (P/N: CT17497-1)

DUT PHOTOGRAPHS

ZLAN11G 802.11b/g WLAN Radio Module



ZLAN11G 802.11b/g WLAN Radio Module

APPENDIX E - SYSTEM VALIDATION

2450 MHz SYSTEM VALIDATION DIPOLE

Type:	**2450 MHz Validation Dipole**
Asset Number:	**00025**
Serial Number:	**150**
Place of Validation:	**Celltech Labs Inc.**
Date of Validation:	**April 24, 2006**

Celltech Labs Inc. hereby certifies that the 2450 MHz System Validation (Body) was performed on the date indicated above.

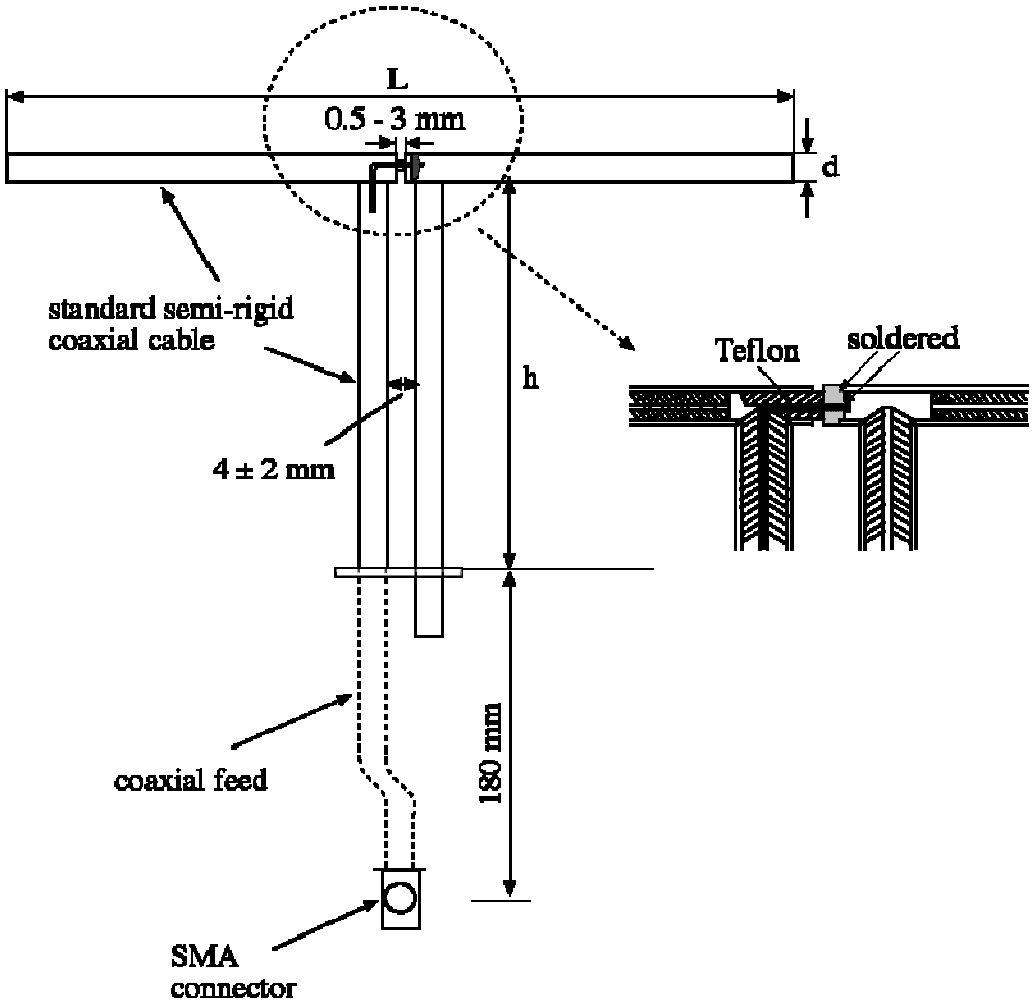
Performed by:	**Sean Johnston**
Approved by:	**Spencer Watson**

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

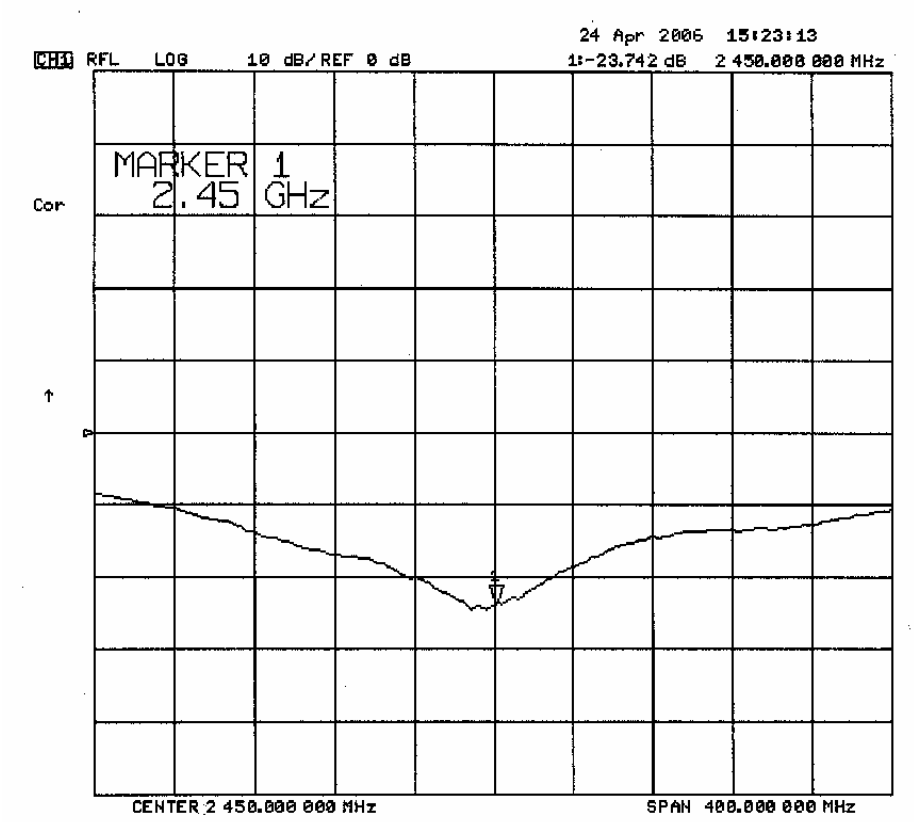
1. Dipole Construction & Electrical Characteristics

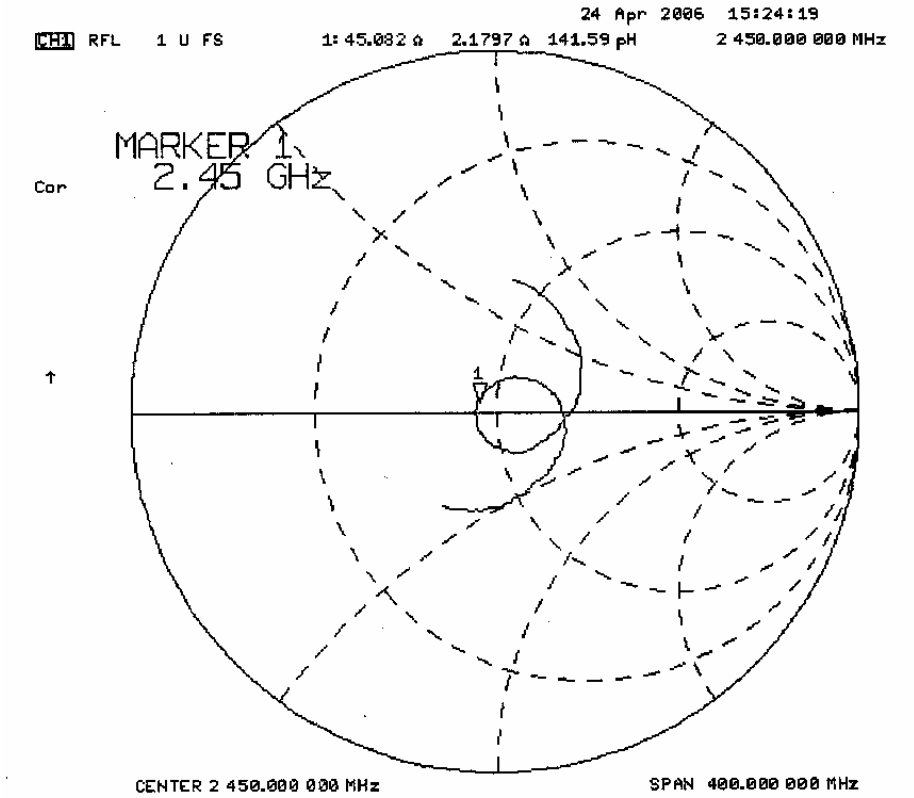
The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network 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} = 45.082Ω
	Im{Z} = 2.1797Ω
Return Loss at 2450 MHz	-23.742dB



2. Validation Dipole VSWR Data





3. 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

4. Validation Phantom

The validation phantom is a Fiberglass shell planar phantom manufactured by Barski Industries Ltd. The phantom is in conformance with the requirements defined by IEEE SCC34-SC2 for the dosimetric evaluations of body-worn and lap-held operating configurations. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids.

Shell Thickness: 2.0 ± 0.2 mm
Filling Volume: Approx. 72 liters
Dimensions: L) 94 cm x (W) 44 cm x (H) 22 cm

5. 2450 MHz System Validation Setup

6. 2450 MHz Dipole Setup

7. Measurement Conditions

The planar phantom was filled with 2450 MHz Body tissue simulant:

Relative Permittivity: 51.2 (-2.8% deviation from target)
Conductivity: 1.89 mho/m (-3% deviation from target)
Fluid Temperature: 23.9 °C
Fluid Depth: ≥ 15.0 cm

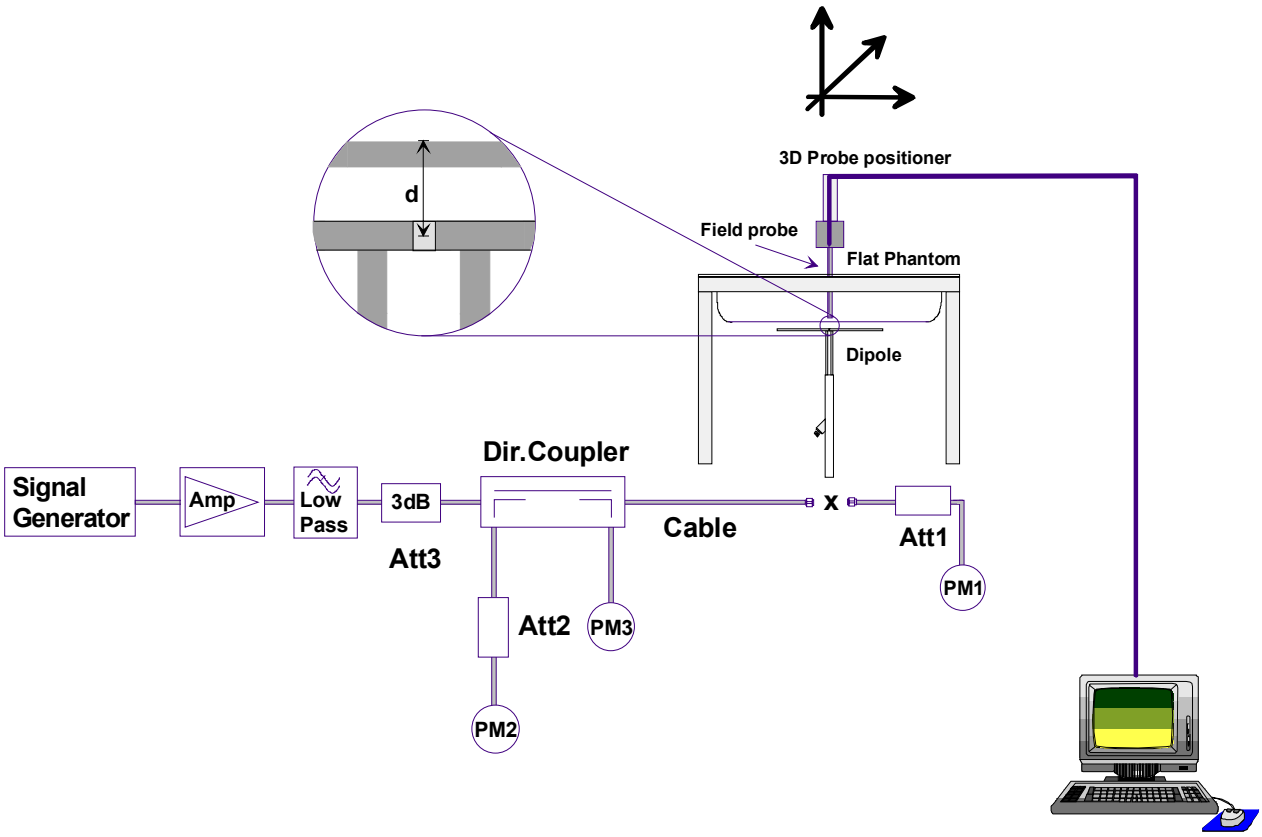
Environmental Conditions:
Ambient Temperature: 24.9 °C
Humidity: 30 %
Barometric Pressure: 101.1 kPa

The 2450 MHz Body tissue simulant consisted of the following ingredients:

Ingredient	Percentage by weight
Water	69.98%
Glycol Monobutyl	30.00%
Salt	0.02%
Target Dielectric Parameters at 22°C	ε_r = 52.7 (+/-5%) σ = 1.95 S/m (+/-5%)

8. SAR Measurement

Measurements were made at the planar section of the SAM phantom using a dosimetric E-field probe ET3DV6 (S/N: 1590, conversion factor 4.22). 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.

9. 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	12.7	50.80	5.87	23.48	14.40
Test 2	12.8	51.20	5.88	23.52	14.40
Test 3	12.6	50.40	5.81	23.24	14.10
Test 4	13.1	52.40	6.05	24.20	14.70
Test 5	12.7	50.80	5.84	23.36	14.20
Test 6	12.6	50.40	5.79	23.16	14.10
Test 7	12.9	51.60	6.00	24.00	14.50
Test 8	12.9	51.60	5.99	23.96	14.50
Test 9	13.1	52.40	6.09	24.36	14.80
Test10	13.2	52.80	6.09	24.36	14.90
Average Value	**12.86**	**51.44**	**5.94**	**23.76**	**14.46**

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

Target SAR @ 1 Watt Input averaged over 1 gram (W/kg)		Measured SAR @ 1 Watt Input averaged over 1 gram (W/kg)	Deviation from Target (%)	Target SAR @ 1 Watt Input averaged over 10 grams (W/kg)		Measured SAR @ 1 Watt Input averaged over 10 grams (W/kg)	Deviation from Target (%)
51.2	+/- 10%	51.44	+0.47%	23.7	+/- 10%	23.76	+0.27%

Dipole Type	Distance [mm]	Frequency [MHz]	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D300V2	15	300	3.02	2.06	4.36
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1500V2	10	1500	30.8	17.1	52.1
D1640V2	10	1640	34.4	18.7	59.4
D1800V2	10	1800	38.5	20.3	67.5
D1900V2	10	1900	39.8	20.8	69.6
D2000V2	10	2000	40.9	21.2	71.5
D2450V2	10	2450	51.2	23.7	97.6
D3000V2	10	3000	61.9	24.8	136.7

Table 32.1: Numerical reference SAR values for SPEAG dipoles and flat phantom filled with body-tissue simulating liquid. Note: All SAR values normalized to 1 W forward power.

2450 MHz Dipole - System Validation (Body) - April 24, 2006

DUT: Dipole 2450 MHz; Model: D2450V2; Serial: 150; Validated: 04/24/2006
Ambient Temp: 24.9 ºC; Fluid Temp: 23.9 ºC; Barometric Pressure: 101.1 kPa; Humidity: 30%
Communication System: CW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: M2450 (σ = 1.89 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3)
- Probe: ET3DV6 - SN1590; ConvF(4.22, 4.22, 4.22); Calibrated: 20/05/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 15/06/2005
- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01
- Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 161

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

2450 MHz System Validation/Zoom Scan 1 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.0 V/m; Power Drift = -0.104 dB
SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.87 mW/g
Maximum value of SAR (measured) = 14.4 mW/g

2450 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 83.9 V/m; Power Drift = -0.070 dB
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.88 mW/g
Maximum value of SAR (measured) = 14.4 mW/g

2450 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.1 V/m; Power Drift = -0.039 dB
SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.81 mW/g
Maximum value of SAR (measured) = 14.1 mW/g

2450 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.2 V/m; Power Drift = -0.026 dB
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.05 mW/g
Maximum value of SAR (measured) = 14.7 mW/g

2450 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 83.3 V/m; Power Drift = 0.014 dB
SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.84 mW/g
Maximum value of SAR (measured) = 14.2 mW/g

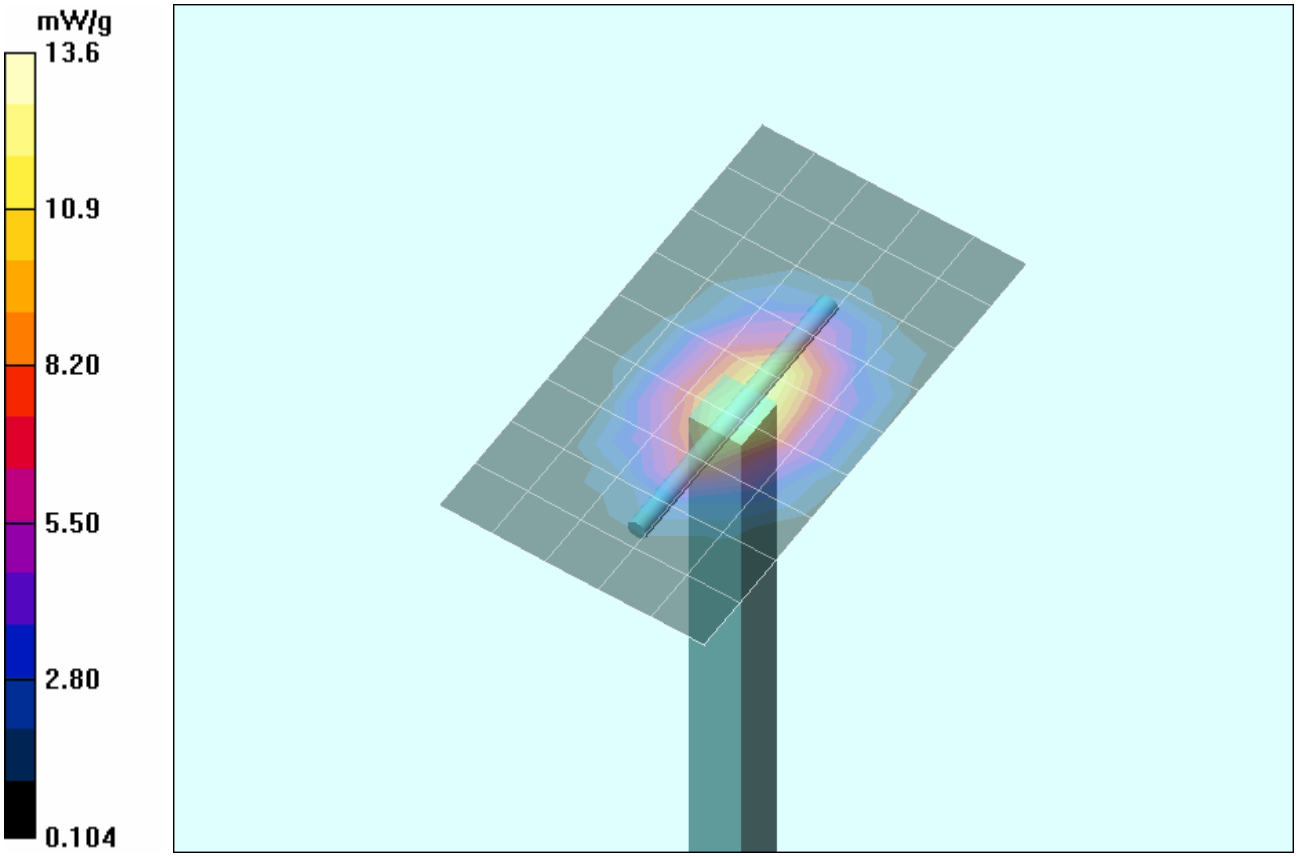
2450 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.5 V/m; Power Drift = -0.037 dB
SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.79 mW/g
Maximum value of SAR (measured) = 14.1 mW/g

2450 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.0 V/m; Power Drift = -0.078 dB
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6 mW/g
Maximum value of SAR (measured) = 14.5 mW/g

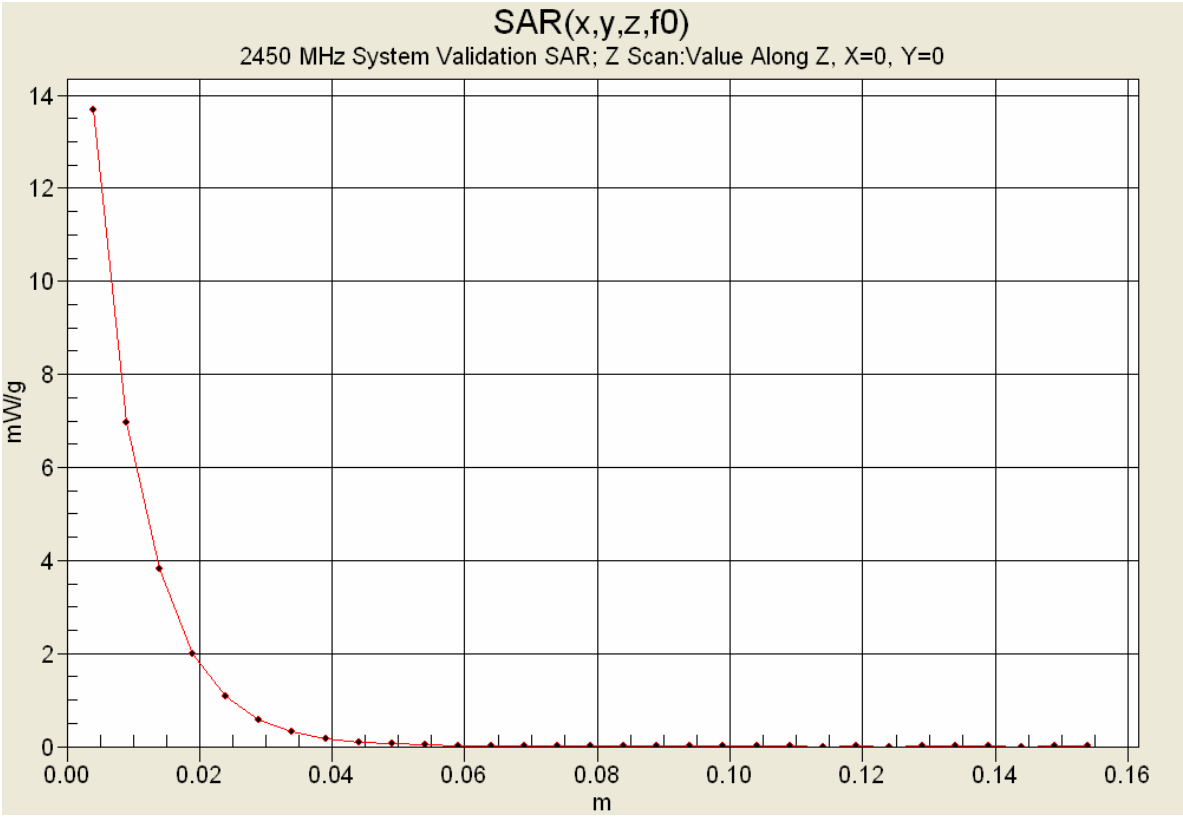
2450 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.1 V/m; Power Drift = -0.069 dB
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 5.99 mW/g
Maximum value of SAR (measured) = 14.5 mW/g

2450 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.8 V/m; Power Drift = -0.076 dB
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.09 mW/g
Maximum value of SAR (measured) = 14.8 mW/g

2450 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.8 V/m; Power Drift = -0.013 dB
SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.09 mW/g
Maximum value of SAR (measured) = 14.9 mW/g



1 g average of 10 measurements: 12.86 mW/g
10 g average of 10 measurements: 5.94 mW/g



10. Measured Fluid Dielectric Parameters

2450 MHz System Validation (Body)

****

Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
Mon 24/Apr/2006
Frequency(GHz)
FCC_eH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sH FCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM

****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.3500	52.83	1.85	51.24	1.76
2.3600	52.82	1.86	51.30	1.78
2.3700	52.81	1.87	51.30	1.79
2.3800	52.79	1.88	51.28	1.81
2.3900	52.78	1.89	51.28	1.82
2.4000	52.77	1.90	51.22	1.81
2.4100	52.75	1.91	51.26	1.85
2.4200	52.74	1.92	51.13	1.85
2.4300	52.73	1.93	51.03	1.86
2.4400	52.71	1.94	51.10	1.86
2.4500	52.70	1.95	51.17	1.89
2.4600	52.69	1.96	51.07	1.92
2.4700	52.67	1.98	51.03	1.92
2.4800	52.66	1.99	51.04	1.92
2.4900	52.65	2.01	51.04	1.93
2.5000	52.64	2.02	51.04	1.93
2.5100	52.62	2.04	50.96	1.95
2.5200	52.61	2.05	50.94	1.97
2.5300	52.60	2.06	51.02	1.97
2.5400	52.59	2.08	50.97	1.99
2.5500	52.57	2.09	50.85	1.98

APPENDIX F - PROBE CALIBRATION

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Celltech Labs

Certificate No: EX3-3547_Feb06

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3547
Calibration procedure(s)	QA CAL-01.v5 and QA CAL-14.v3 Calibration procedure for dosimetric E-field probes
Calibration date:	February 14, 2006
Condition of the calibrated item	In Tolerance

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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe ES3DV2	SN: 3013	2-Jan-06 (SPEAG, No. ES3-3013_Jan06)	Jan-07
DAE4	SN: 654	2-Feb-06 (SPEAG, No. DAE4-654_Feb06)	Feb-07

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: February 14, 2006

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3547

Manufactured:	July 5, 2004
Last calibrated:	January 21, 2005
Recalibrated:	February 14, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: EX3DV4 SN:3547

Sensitivity in Free Space[A] Diode Compression[B]

NormX	**0.399** ± 10.1%	$\mu V/(V/m)^2$	DCP X	**92** mV
NormY	**0.423** ± 10.1%	$\mu V/(V/m)^2$	DCP Y	**92** mV
NormZ	**0.475** ± 10.1%	$\mu V/(V/m)^2$	DCP Z	**92** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

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

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	3.5	1.1
SAR_{be} [%]	With Correction Algorithm	0.1	0.4

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**2.0 mm**	**3.0 mm**
SAR_{be} [%]	Without Correction Algorithm	2.5	1.1
SAR_{be} [%]	With Correction Algorithm	0.2	0.4

Sensor Offset

Probe Tip to Sensor Center	**1.0** mm

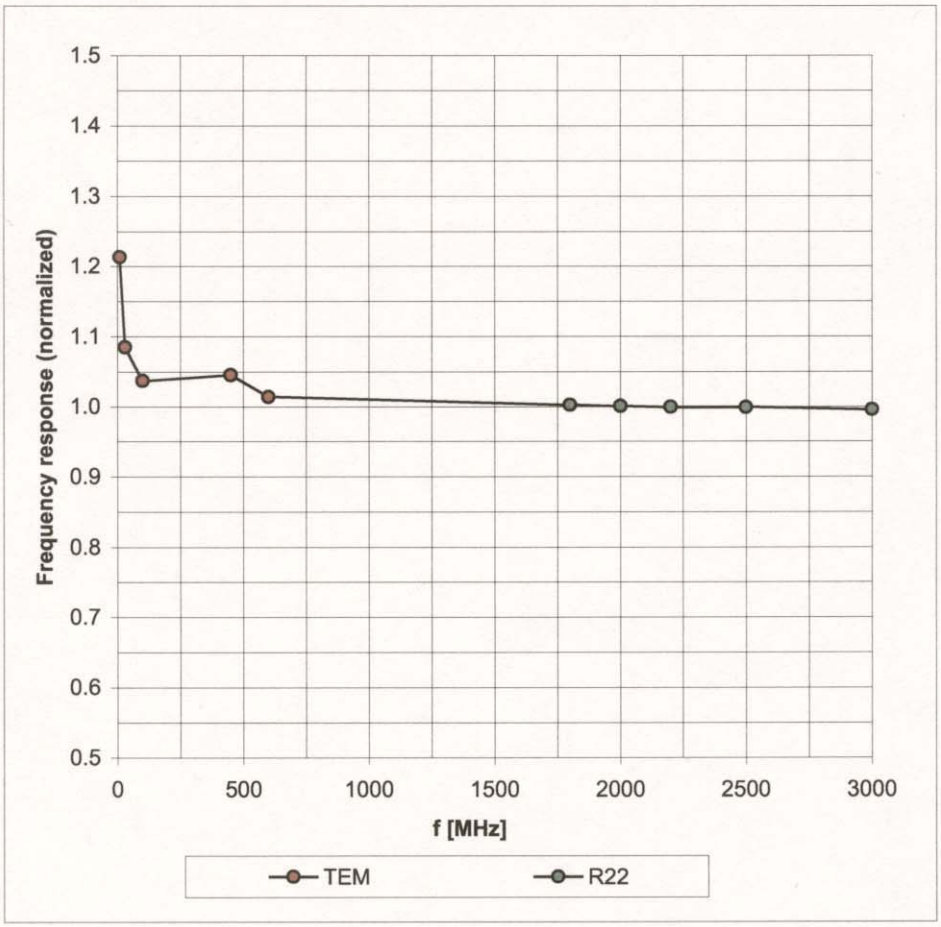
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

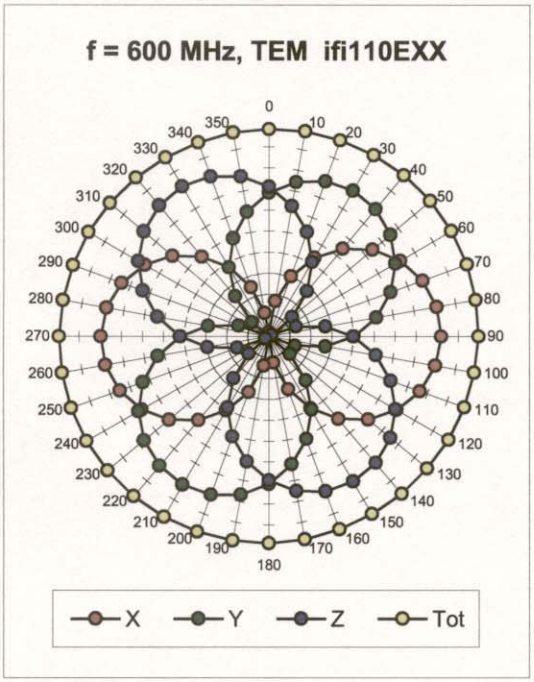
Frequency Response of E-Field

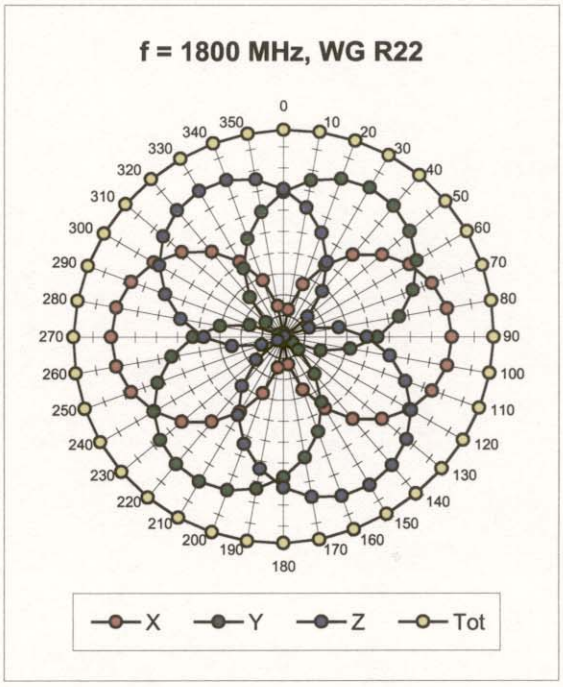
(TEM-Cell:ifi110 EXX, Waveguide: R22)

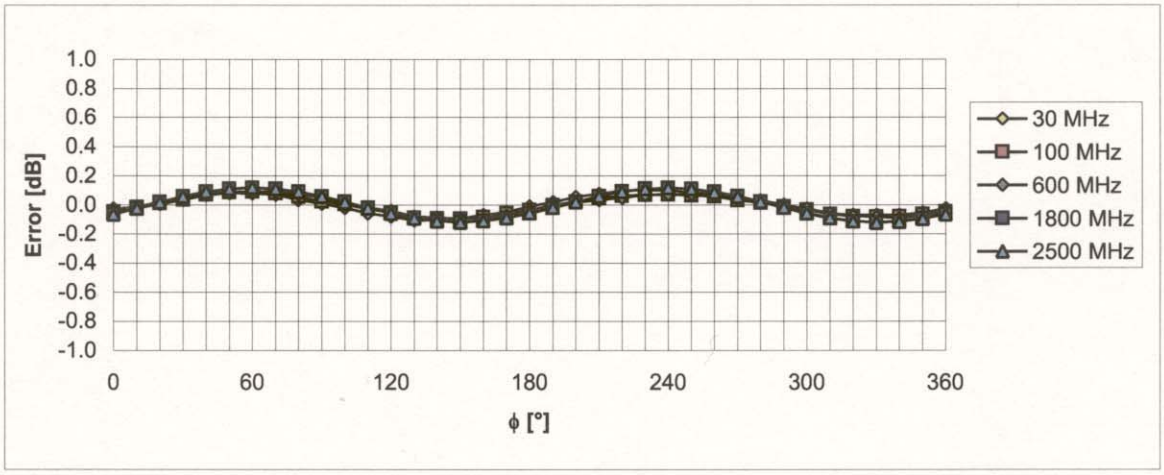


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), ϑ = 0°



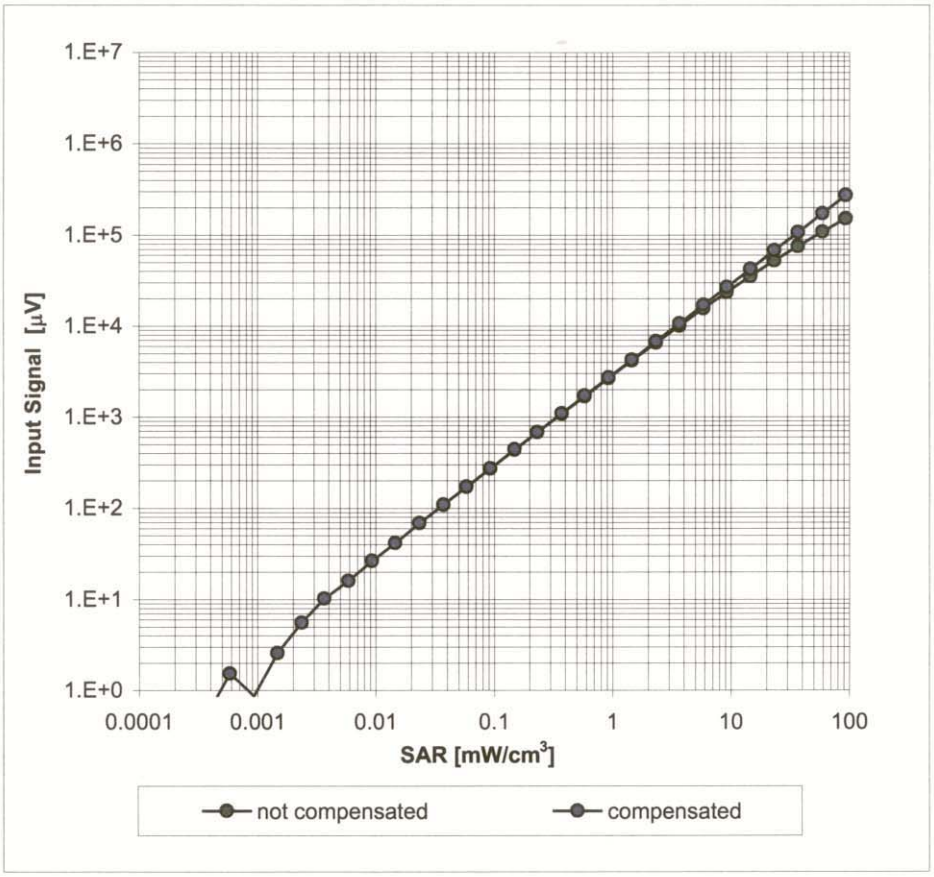


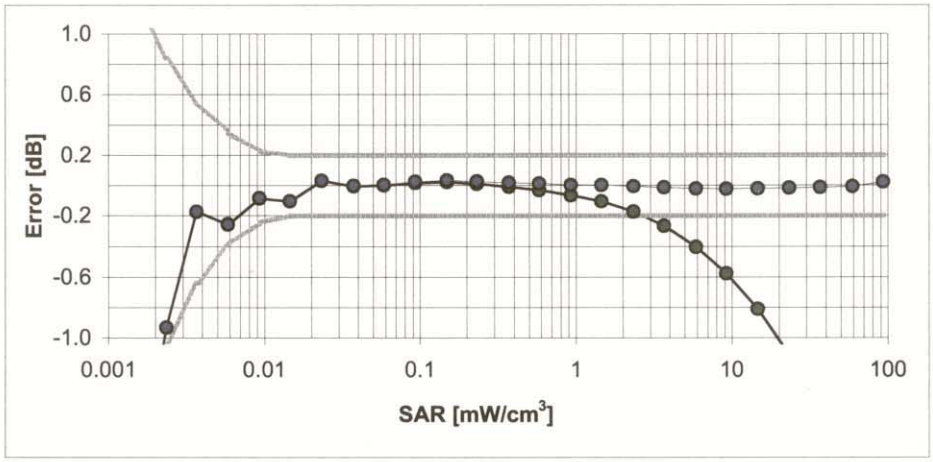


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

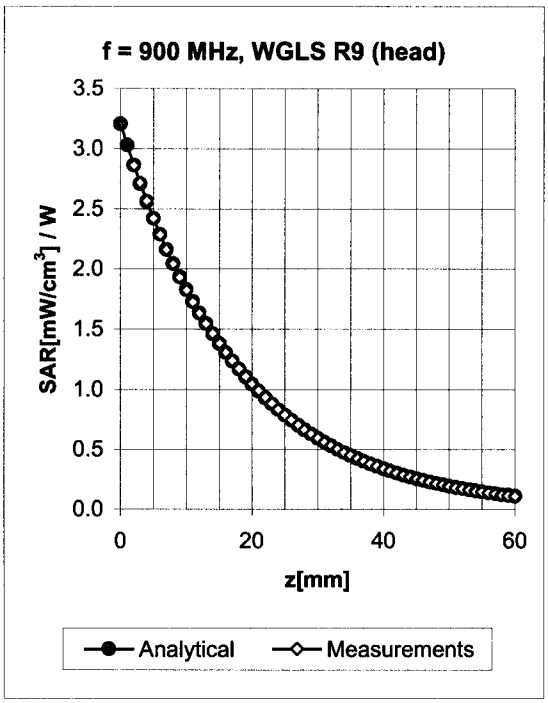
(Waveguide R22, f = 1800 MHz)

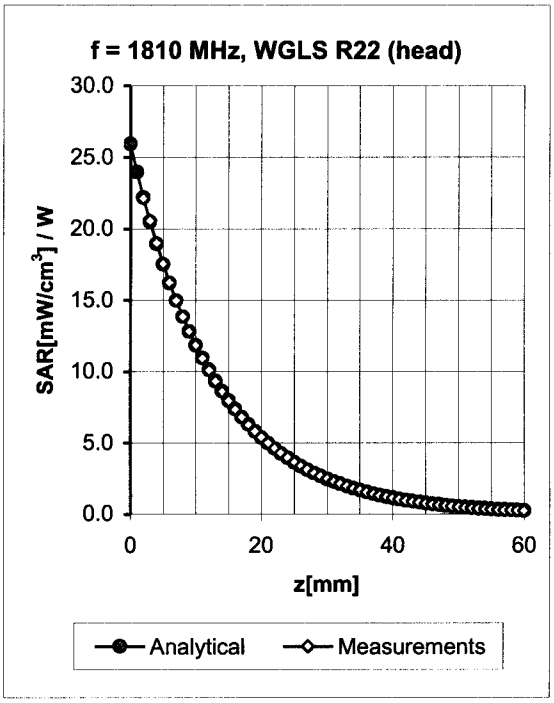




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



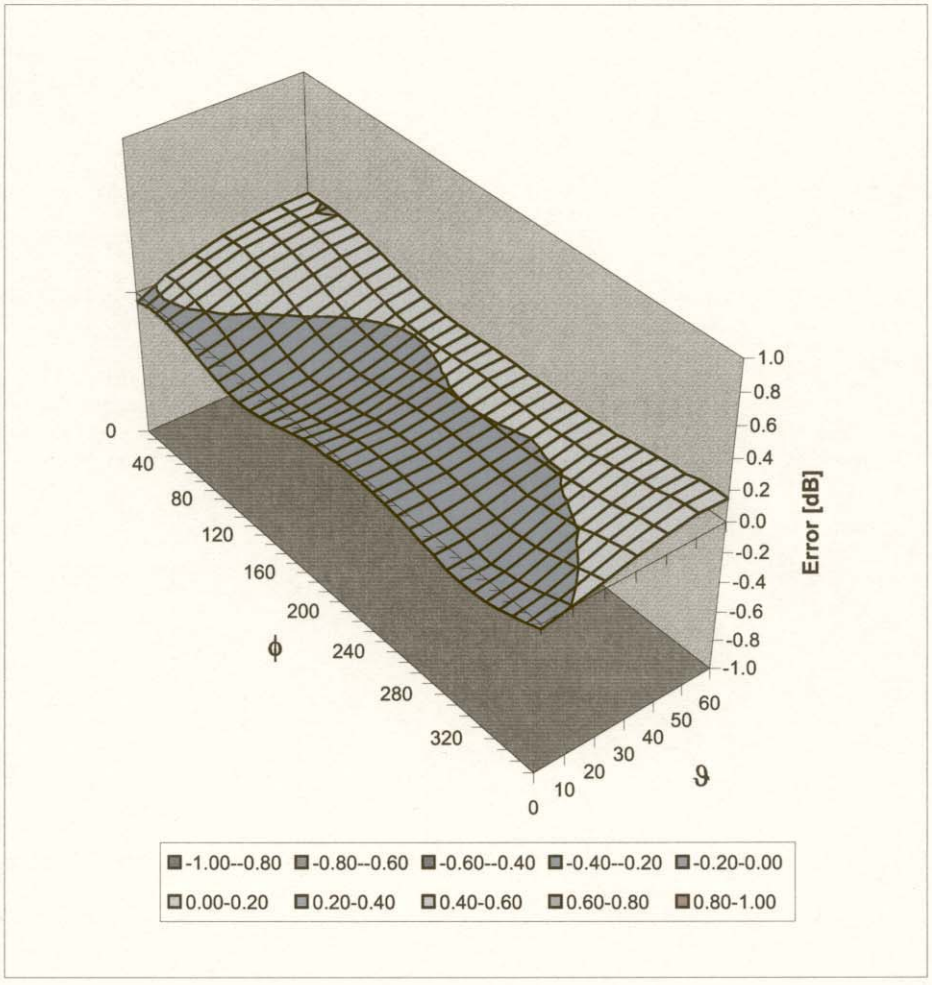


f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.71	0.66	9.20 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.42	0.73	8.20 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.55	0.56	7.41 ± 11.8% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.58	0.93	4.79 ± 13.1% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.79	0.65	9.09 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.10	4.00	7.84 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.58	0.54	7.53 ± 11.8% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.54	1.09	4.87 ± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	5.65 ± 5%	0.57	0.96	4.57 ± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.79	0.70	4.69 ± 13.1% (k=2)

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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

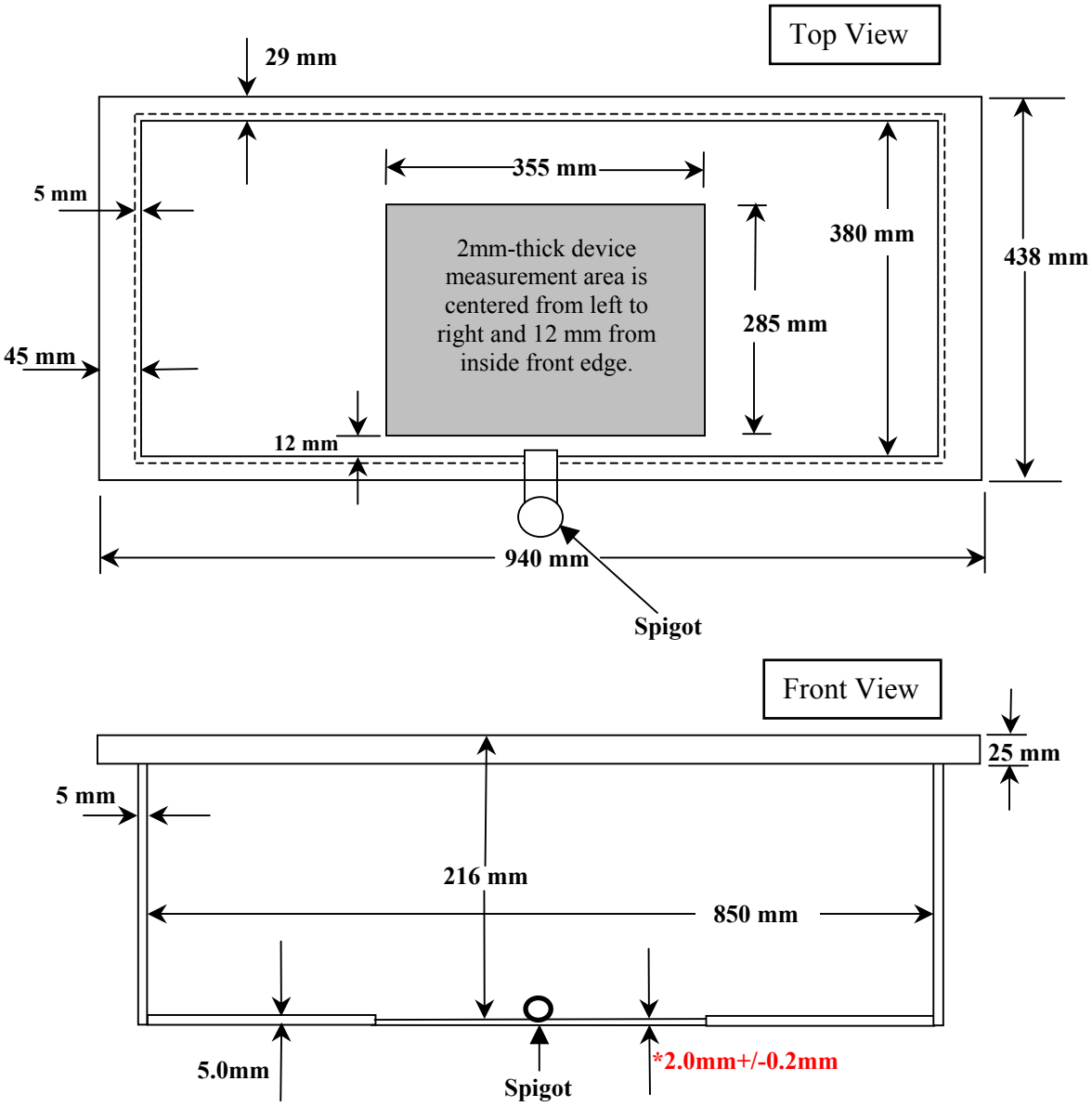
Fiberglass Planar Phantom - Front View

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.