

Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

RF EXPOSURE EVALUATION

SPECIFIC ABSORPTION RATE

SAR TEST REPORT

FOR

ZEBRA TECHNOLOGIES CORPORATION

Wireless Portable Printer with 802.11b/g WLAN

Model(s): QL220plus, QL320plus, QL420plus

FCC ID: I28MD-ZLAN11G

IC: 3798A-ZLAN11G

Test Report Serial Number

041106I28-T739-S15W

Test Report Issue Number

S739W-050206-R0

Test Lab

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Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

DECLARATION OF COMPLIANCE SAR RF EXPOSURE EVALUATION

<u>Test Lab</u>	<u>Company Information</u>
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FCC IDENTIFIER: I28MD-ZLAN11G IC IDENTIFIER: 3798A-ZLAN11G Model(s): QL220plus, QL320plus, QL420plus	
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) Device Description: Wireless Portable Printer with internal 802.11b/g WLAN Internal Transmitter: Samsung SWL-2460 802.11b/g WLAN Mode(s) of Operation: Direct Sequence Spread Spectrum (DSSS)	
Transmit Frequency Range: 2412 - 2462 MHz Max. RF Output Power Tested: 19.0 dBm (79.4 mW) Peak Conducted (2412 MHz, 11 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: AT16004-1 (QL220plus & QL320plus) Lithium-ion 7.4 VDC P/N: AT16293-1 (QL420plus)	
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 - QL220plus: 0.005 W/kg (Peak SAR measured from Area Scan) Body-Worn - QL320plus: 0.002 W/kg (Peak SAR measured from Area Scan) Body-Worn - QL420plus: 0.004 W/kg (Peak SAR measured from Area Scan)	

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.

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

Tested By: Sean Johnston Compliance Technologist Celltech Labs Inc.	Reviewed By: Spencer Watson Senior Compliance Technologist Celltech Labs Inc.	 QL220plus	 QL320plus	 QL420plus
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Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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1.0 INTRODUCTION

This measurement report demonstrates that the Zebra Technologies Corporation Models: QL220plus, QL320plus, QL420plus Wireless Portable Printer FCC ID: I28MD-ZLAN11G with internal 802.11b/g WLAN 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			
Device Description	Wireless Portable Printer with internal 802.11b/g WLAN						
Internal Transmitter	Samsung SWL-2460 802.11b/g WLAN						
RF Exposure Category	General Population / Uncontrolled Environment						
FCC IDENTIFIER	I28MD-ZLAN11G						
IC IDENTIFIER	3798A-ZLAN11G						
Model(s)	QL220plus	QL320plus	QL420plus				
Test Sample Serial No.(s)	XXVA06-05-5043	XXVQ06-05-5077	XXVT06-05-5036				
	Identical Prototype	Identical Prototype	Identical Prototype				
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	17.8 dBm	60.3 mW	1 Mbps	2412 MHz	1	
	802.11b	17.4 dBm	55.0 mW	1 Mbps	2437 MHz	6	
	802.11b	17.5 dBm	56.2 mW	1 Mbps	2462 MHz	11	
	802.11b	17.0 dBm	50.1 mW	2 Mbps	2412 MHz	1	
	802.11b	18.0 dBm	63.1 mW	5.5 Mbps	2412 MHz	1	
	802.11b	19.0 dBm	79.4 mW	11 Mbps	2412 MHz	1	
	802.11g	15.2 dBm	33.1 mW	6 Mbps	2412 MHz	1	
	Note: The channels and data modes highlighted above are the selected test channels based on the FCC proposed testing guidance for 802.11abg devices from the October 2005 TCB training (see reference 6).						
Battery Type(s) Tested	Lithium-ion	7.4 VDC	P/N: AT16004-1	QL220plus, QL320plus			
	Lithium-ion	7.4 VDC	P/N: AT16293-1	QL420plus			
Antenna Type(s) Tested	Internal						
Body-Worn Accessories Tested	Plastic Belt-Clip						
Audio Accessories Tested	None (not applicable)						

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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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 planar phantom and validation dipole

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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4.0 MEASUREMENT SUMMARY

BODY-WORN SAR EVALUATION RESULTS (802.11b WLAN)

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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5.0 DETAILS OF SAR EVALUATION

The Zebra Technologies Corporation Models: QL220plus, QL320plus, QL420plus Wireless Portable Printer FCC ID: I28MD-ZLAN11G with internal 802.11b/g WLAN 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 QL220plus, QL320plus, and QL420plus printers were evaluated for body-worn SAR on the back side (battery side) of the device without the plastic belt-clip accessory (possible operating configuration when used with an optional shoulder strap accessory containing no metallic components). The back side of the DUT was positioned parallel to, and touching, the outer surface of the planar phantom.
2. The QL220plus, QL320plus, and QL420plus printers were evaluated for body-worn SAR on the back side (battery side) of the device with the plastic belt-clip accessory attached (tested in the worst-case data rate mode from SAR evaluations without belt-clip). The back side of the DUT 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 keypad commands using internal software and operating at maximum power in modulated DSSS continuous transmit mode for the duration of the evaluations.
4. The peak conducted output power levels were measured prior to the SAR evaluations using a spectrum analyzer according to the procedures described in FCC 47 CFR §2.1046. A PC controller was used to record the spectrum analyzer display. Software was used to integrate the values recorded within the EBW. The resulting channel power was recorded and reported herein.
5. The power drifts of the DUT during the SAR evaluations were measured by the DASY4 system.
6. The DUT battery was fully charged prior to the SAR evaluations.
7. 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.
8. 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).
9. The SAR evaluations were performed within 24 hours of the system performance check.

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 from 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.

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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 $\pm 10\%$ (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]).

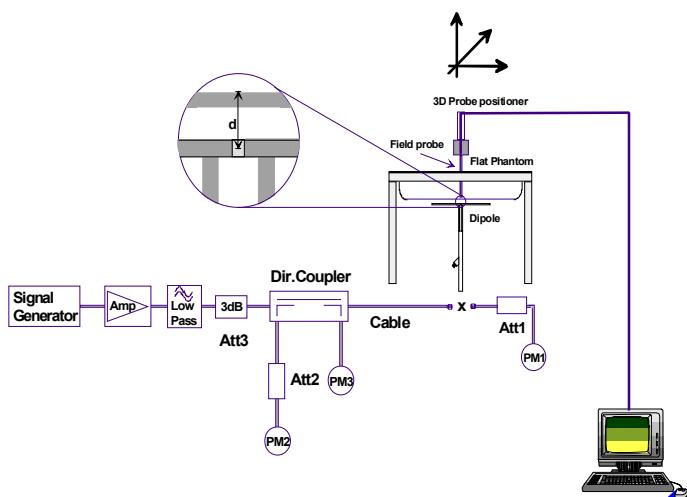
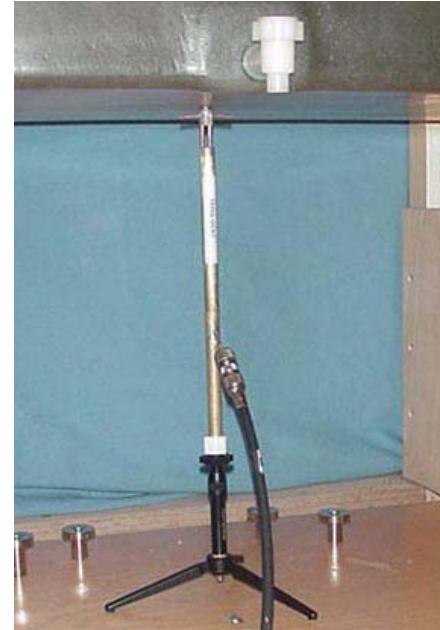


Figure 1. System Performance Check Setup Diagram

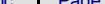
Dipole Type	Distance [mm]	Frequency [MHz]	SAR (1g) [W/kg]	SAR (10g) [W/kg]	SAR (peak) [W/kg]
D300V2	15	300	3.02	2.06	4.36
D450V2	15	450	5.01	3.36	7.22
D835V2	15	835	9.71	6.38	14.1
D900V2	15	900	11.1	7.17	16.3
D1450V2	10	1450	29.6	16.6	49.8
D1500V2	10	1500	30.8	17.1	52.1
D1640V2	10	1640	34.4	18.7	59.4
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



2450MHz Dipole Setup

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

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Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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8.0 SIMULATED EQUIVALENT TISSUES

The 2450MHz 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	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.		

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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.:	1590
Construction:	Triangular core fiber optic detection system
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. 72 liters

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11.0 PROBE SPECIFICATION (ET3DV6)

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycol)
Calibration:	In air from 10 MHz to 2.5 GHz In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy \pm 8%)
Frequency:	10 MHz to >6 GHz; Linearity: \pm 0.2 dB (30 MHz to 3 GHz)
Directivity:	\pm 0.2 dB in brain tissue (rotation around probe axis) \pm 0.4 dB in brain tissue (rotation normal to probe axis)
Dynamic Range:	5 μ W/g to >100 mW/g; Linearity: \pm 0.2 dB
Surface Detection:	\pm 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
Application:	Distance from probe tip to dipole centers: 2.7 mm General dosimetry up to 3 GHz Compliance tests of mobile phone



ET3DV6
E-Field Probe

12.0 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

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 pairs 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

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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	15Jun05	15Jun06
	-DAE3	00018	370	08Feb06	08Feb07
	-ET3DV6 E-Field Probe	00016	1387	16Mar06	16Mar07
x	-ET3DV6 E-Field Probe	00017	1590	20May05	20May06
	-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
				Body	27Mar06
	-900MHz Validation Dipole	00020	054	Brain	10Jun05
				Body	10Jun05
	-1800MHz Validation Dipole	00021	247	Brain	14Jun05
				Body	14Jun05
	-1900MHz Validation Dipole	00032	151	Brain	17Jun05
				Body	22Apr05
	-2450MHz Validation Dipole	00025	150	Brain	20Sep05
x				Body	22Apr05
	-5800MHz Validation Dipole	00126	1031	Brain	15Mar06
	-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
	Gigatronics 8652A Power Meter	00110	1835801	12Apr06	12Apr07
	Gigatronics 8652A Power Meter	00007	1835272	03Feb06	03Feb07
x	Gigatronics 8652A Power Meter	00008	1835267	29Apr05	29Apr06
	Gigatronics 80701A Power Sensor	00011	1833542	03Feb06	03Feb07
x	Gigatronics 80701A Power Sensor	00012	1834350	12Sep05	12Sep06
	Gigatronics 80701A Power Sensor	00013	1833713	03Feb06	03Feb07
	Gigatronics 80701A Power Sensor	00014	1833699	07Sep05	07Sep06
x	Gigatronics 80701A Power Sensor	00109	1834366	N/A	N/A
x	HP 8753ET Network Analyzer	00134	US39170292	18Apr06	18Apr07
x	HP 8648D Signal Generator	00005	3847A00611	29Apr05	29Apr06
	Rohde & Schwarz SMR40 Signal Generator	00006	100104	06Apr06	06Apr07
x	Amplifier Research 5S1G4 Power Amplifier	00106	26235	N/A	N/A
x	HP E4408B Spectrum Analyzer	00015	US39240170	02Feb06	02Feb07

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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15.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
Error Description	Uncertainty Value $\pm\%$	Probability Distribution	Divisor	ci 1g	Uncertainty Value $\pm\%$ (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						
Expanded Uncertainty (k=2)						
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						
Expanded Uncertainty (k=2)						
18.08						

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

 Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0	
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093

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.

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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 Testing and Engineering Services Lab	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006	
Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX A - SAR MEASUREMENT DATA

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-220plus - 802.11b - 1 Mbps - Back of DUT (without belt-clip) - 2412 MHz

DUT: Zebra Model: QL220plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVA06-05-5043

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 17.8 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

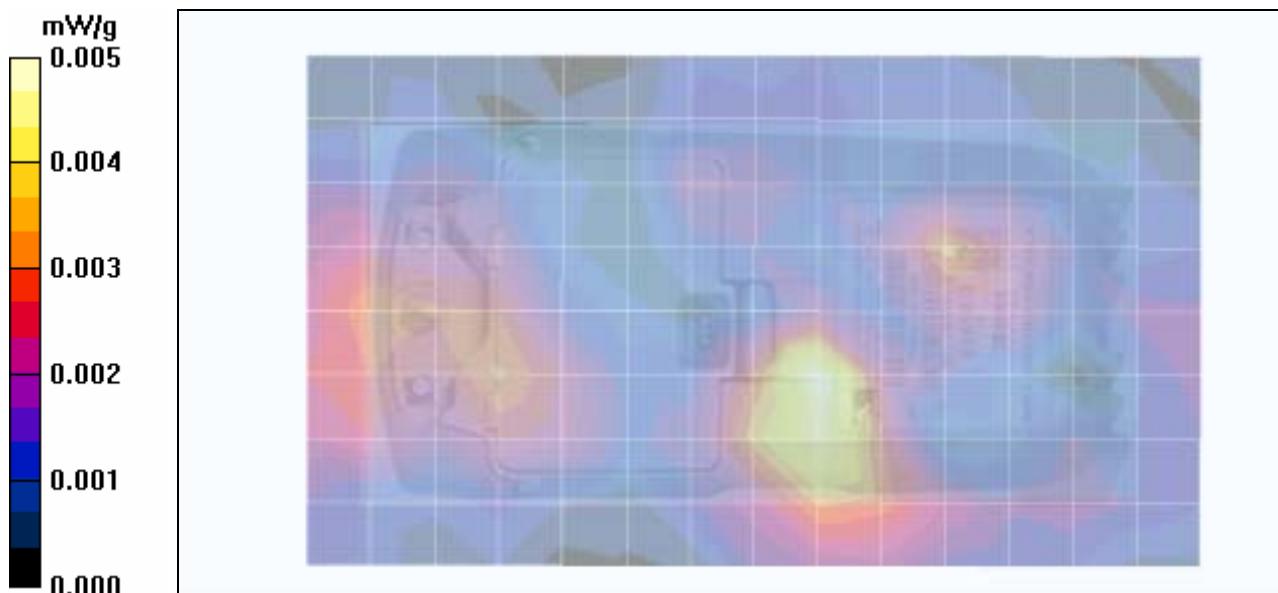
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.005 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G					
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN							
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-220plus - 802.11b - 11 Mbps - Back of DUT (without belt-blip) - 2412 MHz

DUT: Zebra Model: QL220plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVA06-05-5043

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 19.0 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

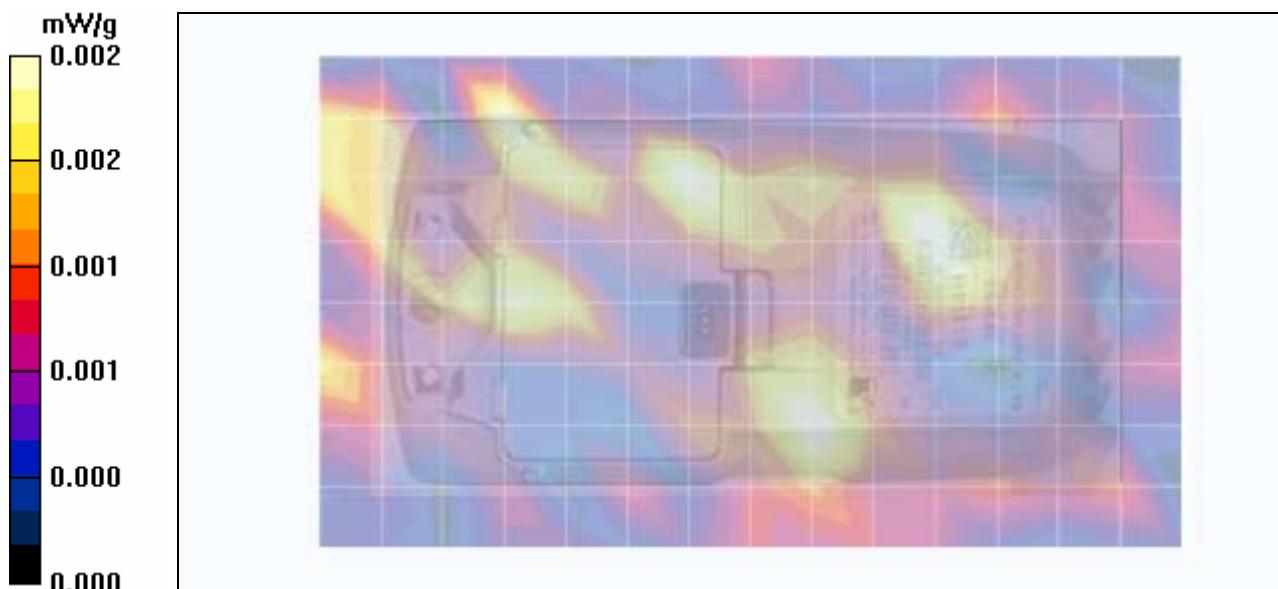
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 11 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.002 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-220plus - 802.11b - 1 Mbps - Back of DUT with Belt-Clip - 2412 MHz

DUT: Zebra Model: QL220plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVA06-05-5043

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 17.8 dBm (Conducted)

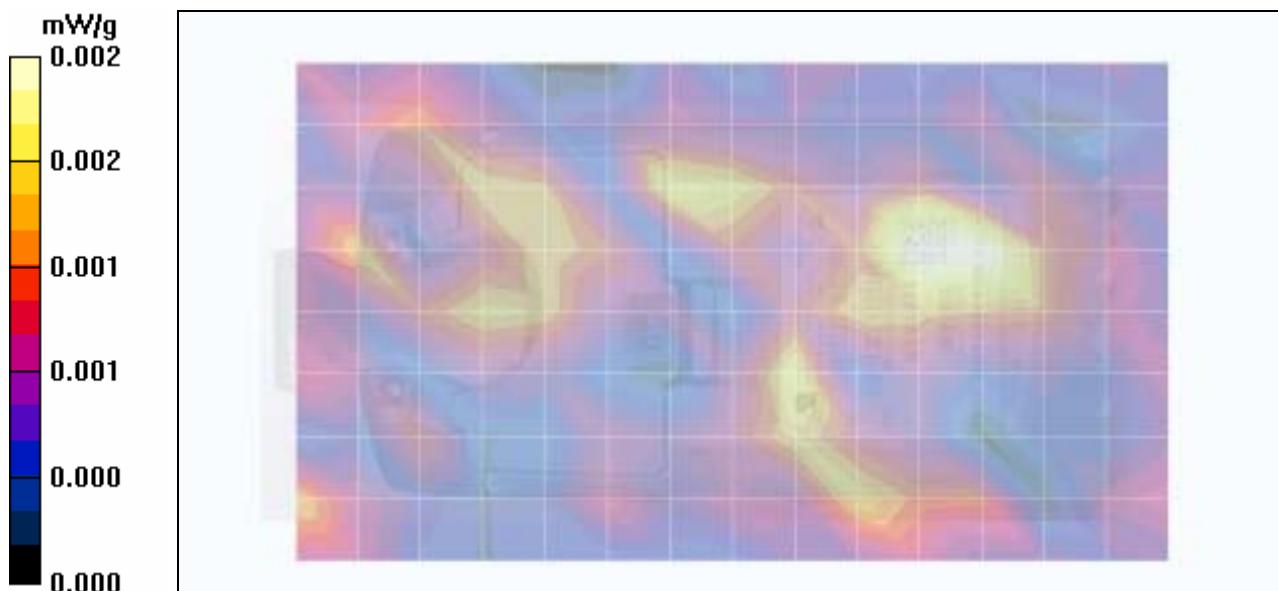
7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of DUT - 1.3 cm Belt-Clip Spacing to Planar Phantom - Low Channel Area Scan (9x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.002 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G		
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN				
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-320plus - 802.11b - 1 Mbps - Back of DUT (without belt-clip) - 2412 MHz

DUT: Zebra Model: QL320plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVQ06-05-5077

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 17.8 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

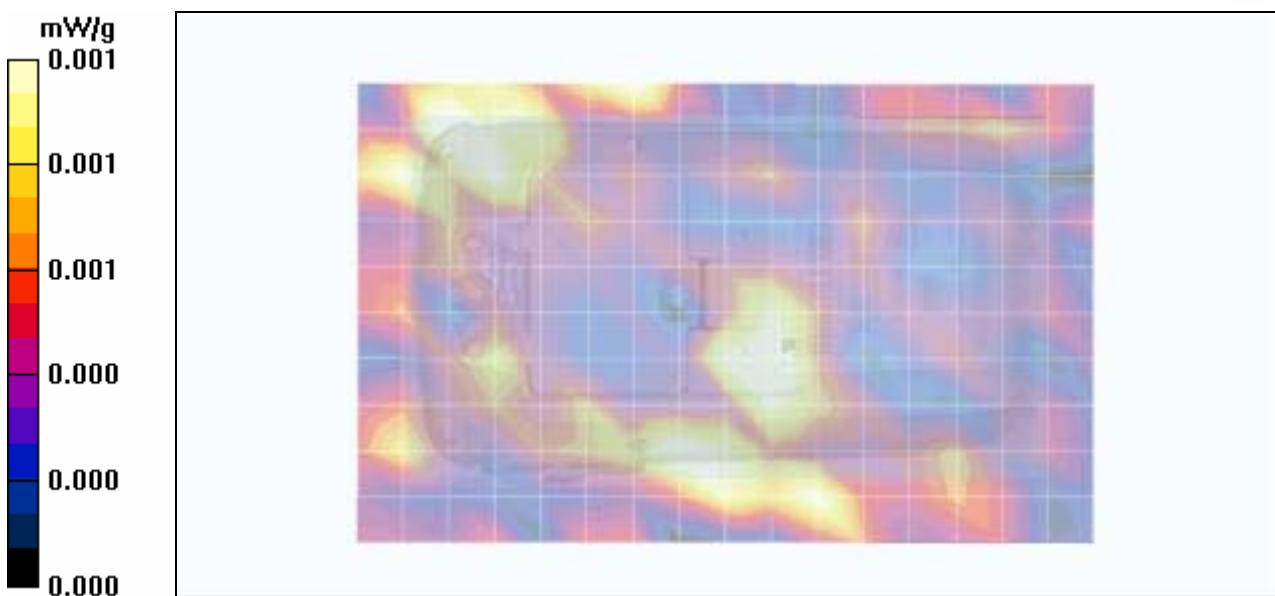
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.001 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-320plus - 802.11b - 11 Mbps - Back of DUT (without belt-clip) - 2412 MHz

DUT: Zebra Model: QL320plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVQ06-05-5077

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 19.0 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

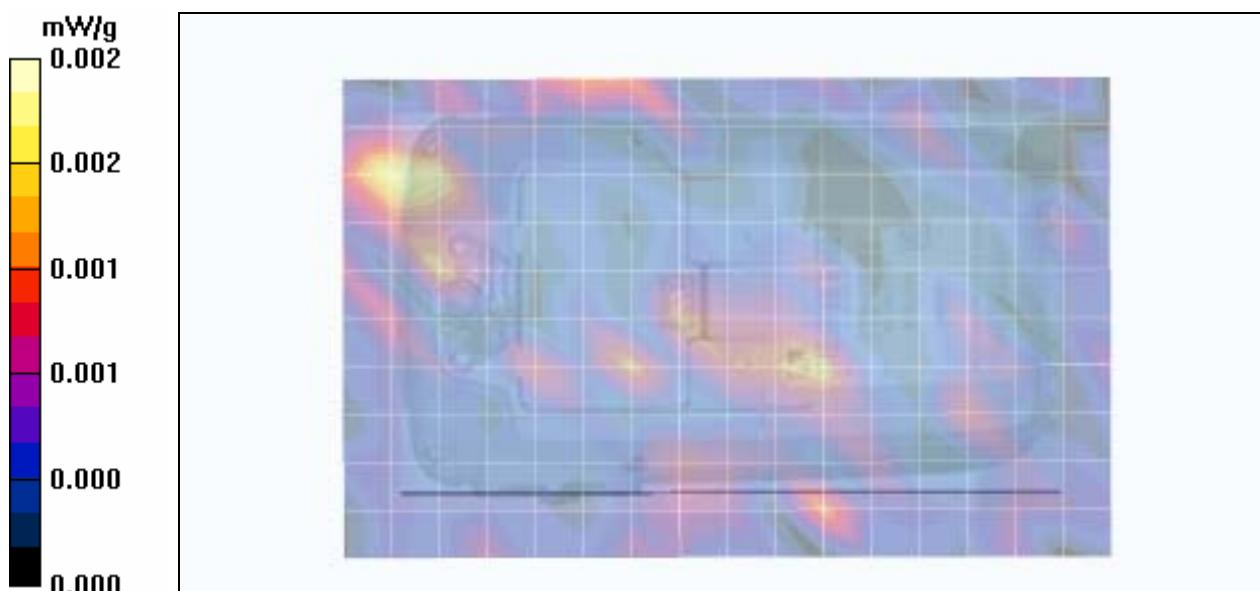
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 11 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.002 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G		
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN				
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-320plus - 802.11b - 11 Mbps - Back of DUT with Belt-Clip - 2412 MHz

DUT: Zebra Model: QL320plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVQ06-05-5077

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 19.0 dBm (Conducted)

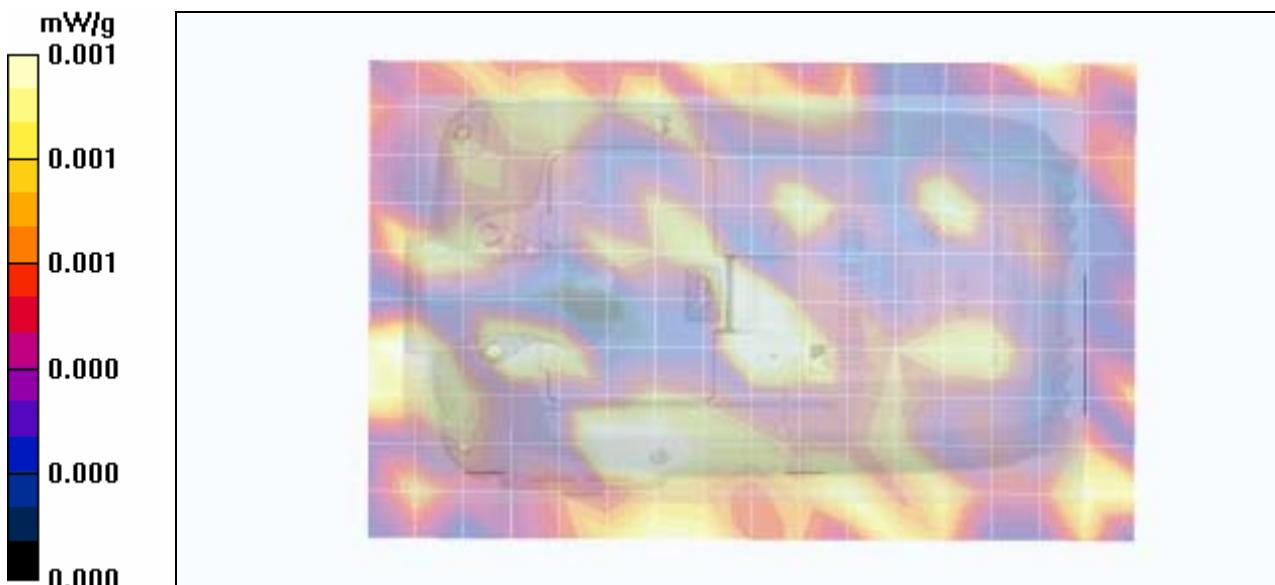
7.4VDC Li-ion Battery Pack (P/N: AT16004-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 11 Mbps - Back Side of DUT - 1.3 cm Belt-Clip Spacing to Planar Phantom - Low Channel Area Scan (11x17x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.001 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-420plus - 802.11b - 1 Mbps - Back of DUT (without belt-clip) - 2412 MHz

DUT: Zebra Model: QL420plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVT06-05-5036

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 17.8 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16293-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

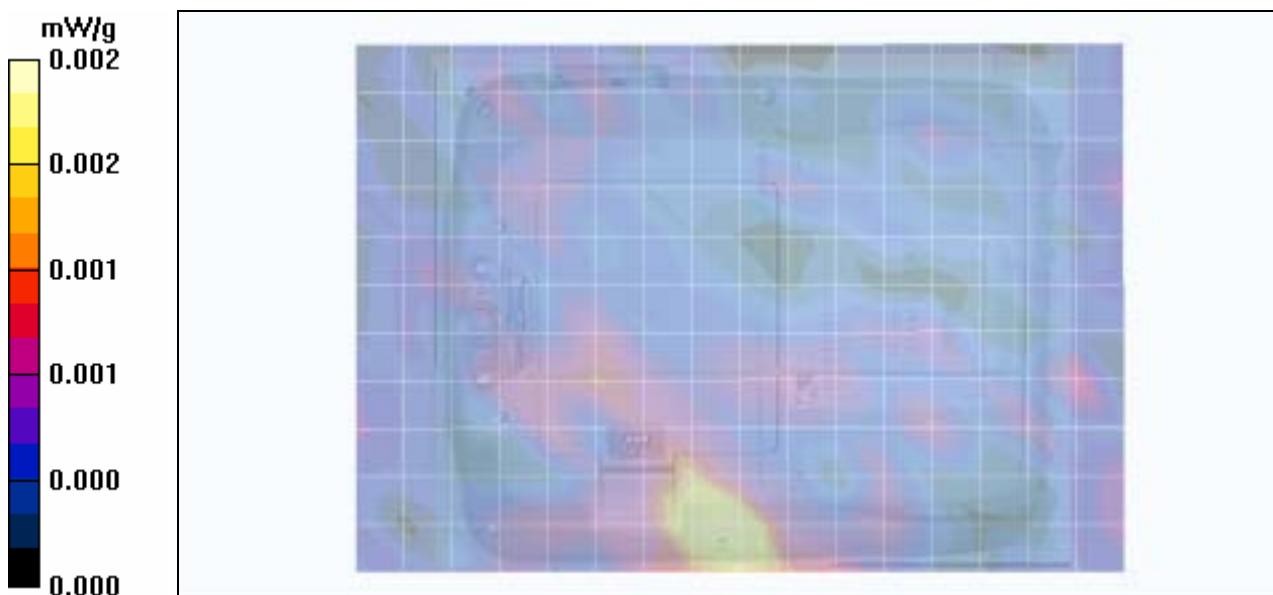
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 1 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (12x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.002 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-420plus - 802.11b - 11 Mbps - Back of DUT (without belt-clip) - 2412 MHz

DUT: Zebra Model: QL420plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVT06-05-5036

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 19.0 dBm (Conducted)

7.4VDC Li-ion Battery Pack (P/N: AT16293-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

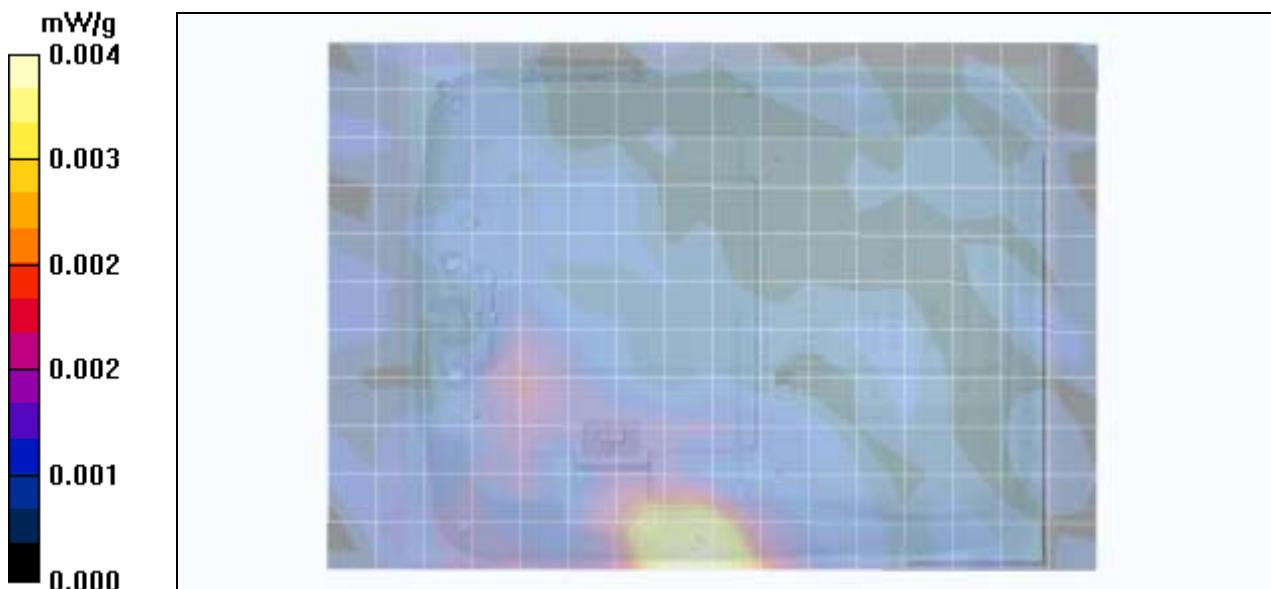
Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 11 Mbps - Back Side of DUT Touching Planar Phantom - Low Channel

Area Scan (12x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum Peak Value of SAR (measured) = 0.004 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

Body-Worn SAR - QL-420plus - 802.11b - 11 Mbps - Back of DUT with Belt-Clip - 2412 MHz

DUT: Zebra Model: QL420plus; Type: Wireless Portable Printer with 802.11b/g WLAN; Serial: XXVT06-05-5036

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

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: DSSS WLAN

RF Output Power: 19.0 dBm (Conducted)

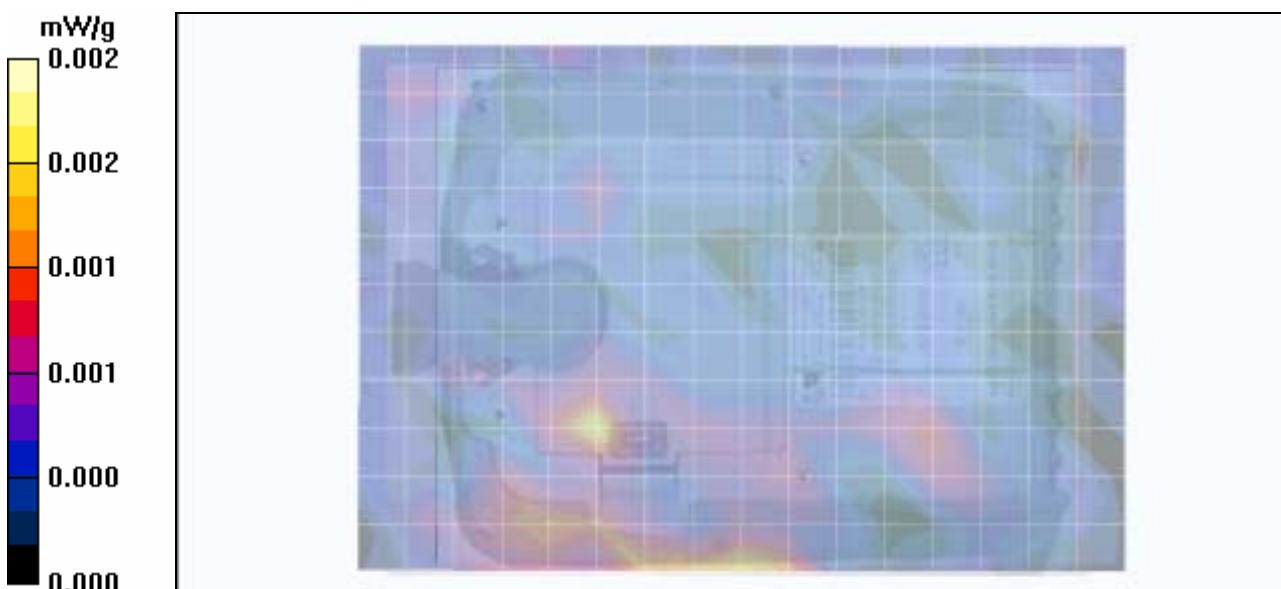
7.4VDC Li-ion Battery Pack (P/N: AT16293-1)

Frequency: 2412 MHz; Channel 1: Duty Cycle: 1:1

Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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

Body-Worn SAR - 802.11b - 11 Mbps - Back Side of DUT - 1.3 cm Belt-Clip Spacing to Planar Phantom - Low Channel /Area Scan (12x17x1): Measurement grid: dx=15mm, dy=15mm
Maximum Peak Value of SAR (measured) = 0.002 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G					
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN							
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Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

Fluid Depth (≥ 15 cm)



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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 Testing and Engineering Services Lab	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
	Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
	Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Date Tested: 04/21/2006

System Performance Check (Body) - 2450 MHz Dipole

DUT: Dipole 2450 MHz; Model: D2450V2; Type: System Performance Check; Serial: 150; Calibrated: 04/22/2005

Ambient Temp: 24.8 °C; Fluid Temp: 23.6 °C; Barometric Pressure: 101.1 kPa; Humidity: 35%

Communication System: CW

RF Output Power Conducted: 250 mW

Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: M2450 ($\sigma = 2.02 \text{ mho/m}$; $\epsilon_r = 50.6$; $\rho = 1000 \text{ kg/m}^3$)

- 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 Performance Check/Area Scan (6x10x1):

Measurement grid: dx=10mm, dy=10mm

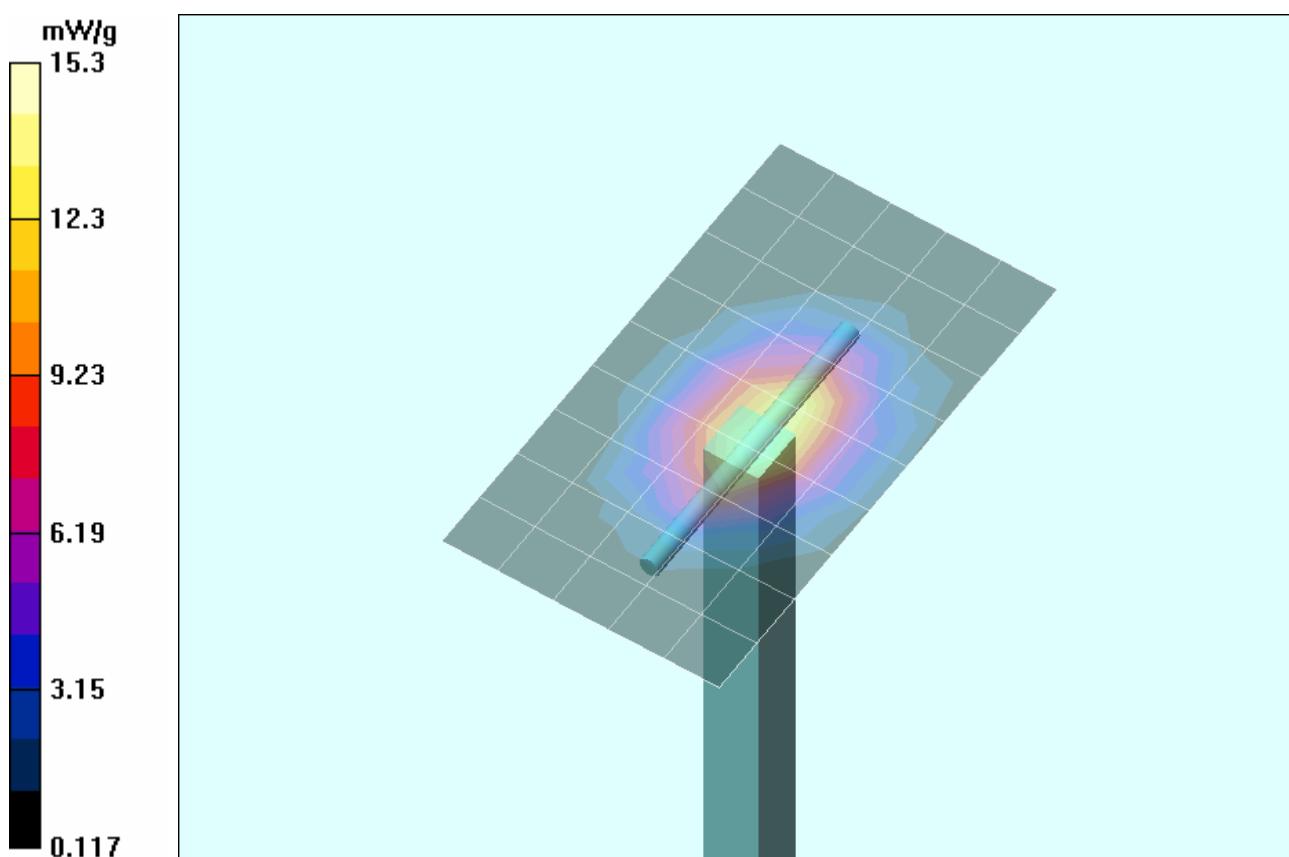
2450 MHz System Performance Check/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.7 V/m; Power Drift = 0.009 dB

Peak SAR (extrapolated) = 31.5 W/kg

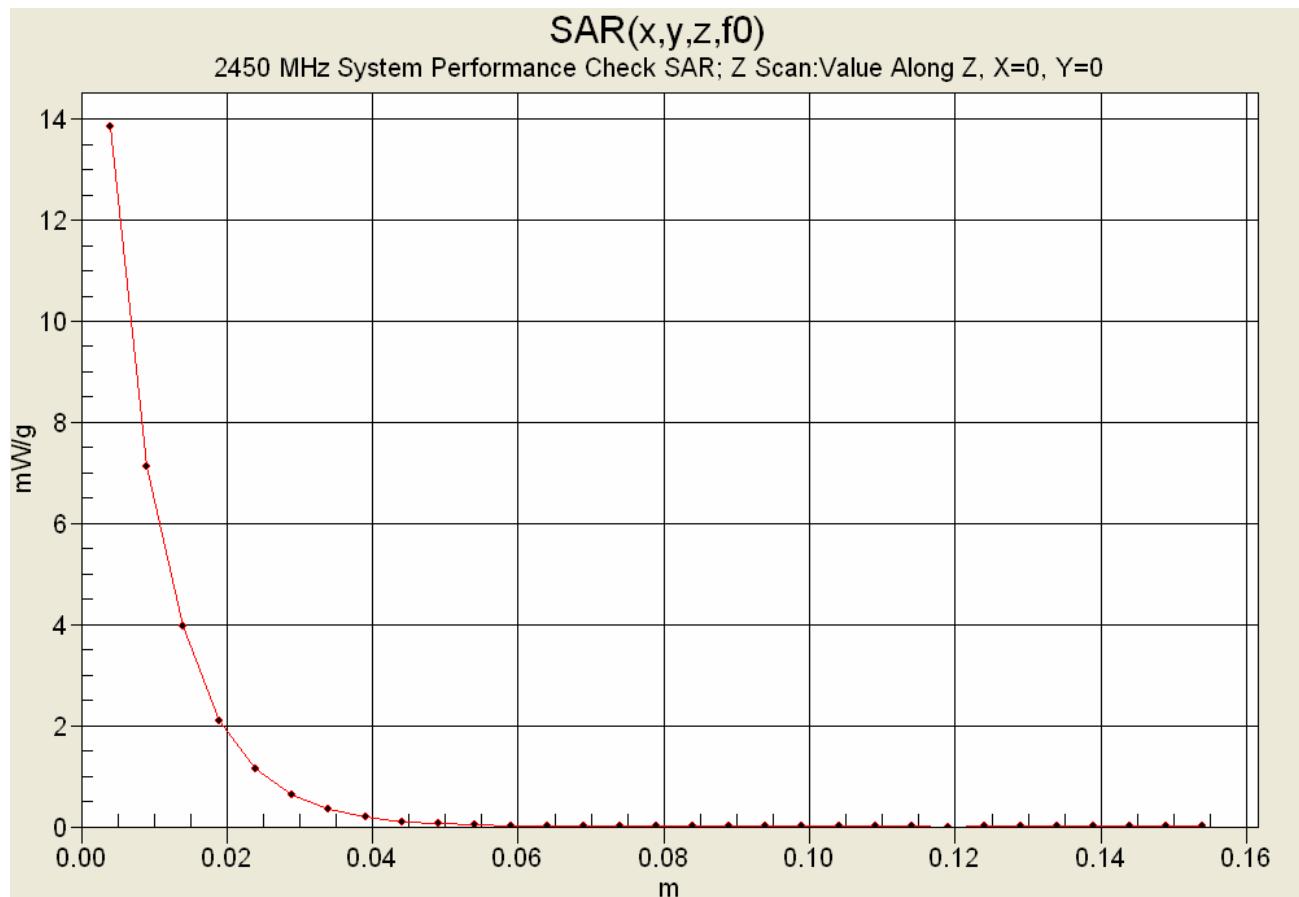
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.35 mW/g



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

Z-Axis Scan



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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 Celltech <small>Testing and Engineering Services Lab</small>	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
	Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
	Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	 <small>Zebra</small>
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Celltech Testing and Engineering Services Lab	Test Report Serial No.: 041106I28-T739-S15W	Test Report Issue No.: S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date: May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093 IC RSS-102 Issue 2

2450 MHz System Performance Check & DUT Evaluation (Body)

Celltech Labs Inc.

Test Result for UIM Dielectric Parameter

Fri 21/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	51.02	1.87
2.3600	52.82	1.86	50.92	1.88
2.3700	52.81	1.87	50.83	1.89
2.3800	52.79	1.88	50.77	1.91
2.3900	52.78	1.89	50.71	1.92
2.4000	52.77	1.90	50.69	1.93
2.4100	52.75	1.91	50.70	1.97
2.4200	52.74	1.92	50.69	1.98
2.4300	52.73	1.93	50.71	2.00
2.4400	52.71	1.94	50.57	2.00
2.4500	52.70	1.95	50.61	2.02
2.4600	52.69	1.96	50.69	2.02
2.4700	52.67	1.98	50.46	2.04
2.4800	52.66	1.99	50.39	2.02
2.4900	52.65	2.01	50.26	2.07
2.5000	52.64	2.02	50.26	2.10
2.5100	52.62	2.04	50.30	2.13
2.5200	52.61	2.05	50.31	2.15
2.5300	52.60	2.06	50.34	2.16
2.5400	52.59	2.08	50.28	2.17
2.5500	52.57	2.09	50.11	2.18

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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 Testing and Engineering Services Lab	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
	Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
	Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093

APPENDIX D - SAR TEST SETUP PHOTOGRAPHS

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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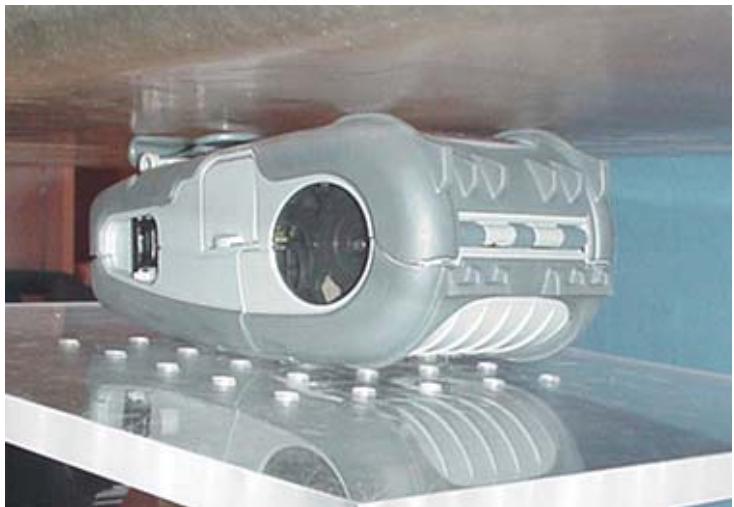
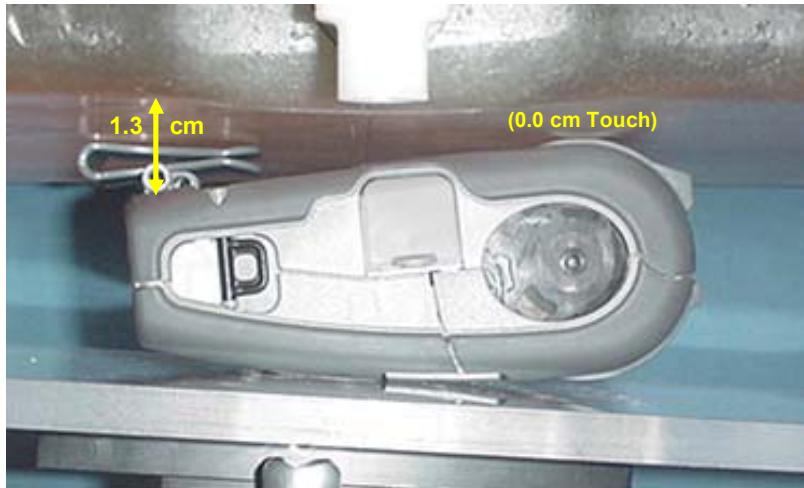
Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

BODY-WORN SAR TEST SETUP PHOTOGRAPHS
 Back Side of DUT (Battery Side) Touching Planar Phantom
 QL220plus Printer



Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Back Side of DUT (Battery Side) with 1.3 cm Plastic Belt-Clip Spacing to Planar Phantom
QL220plus Printer

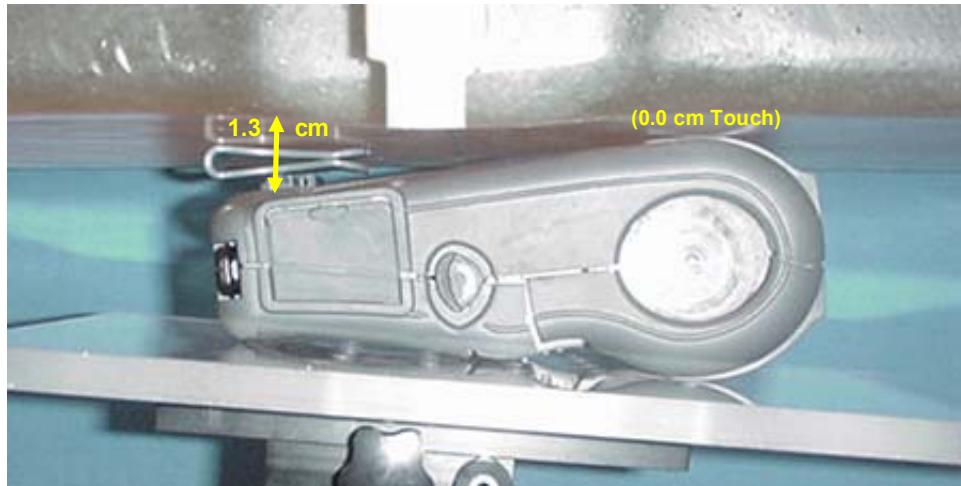


BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of DUT (Battery Side) Touching Planar Phantom
QL320plus Printer

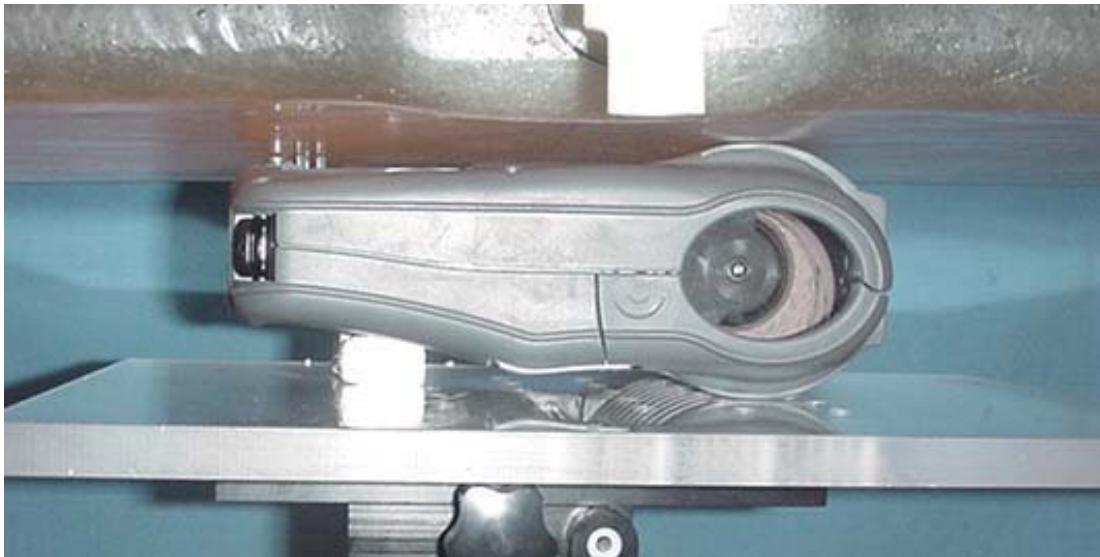


BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Back Side of DUT (Battery Side) with 1.3 cm Plastic Belt-Clip Spacing to Planar Phantom
QL320plus Printer

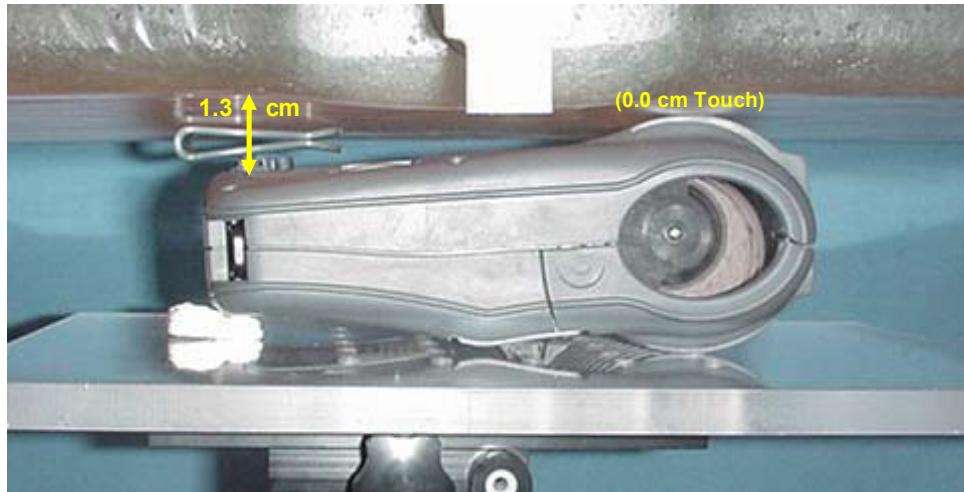


BODY-WORN SAR TEST SETUP PHOTOGRAPHS

Back Side of DUT (Battery Side) Touching Planar Phantom
QL420plus Printer



BODY-WORN SAR TEST SETUP PHOTOGRAPHS
Back Side of DUT (Battery Side) with 1.3 cm Plastic Belt-Clip Spacing to Planar Phantom
QL420plus Printer



DUT PHOTOGRAPHS

QL220plus Printer



Top end of DUT (LCD Side)



Bottom end of DUT



Front Side of DUT (Antenna/Printer Side)



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



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

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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DUT PHOTOGRAPHS

QL220plus Printer



Left Side of DUT



Connector for shoulder strap attachment

Right Side DUT

DUT PHOTOGRAPHS

QL220plus Printer



Back Side of DUT - Battery Compartment



Front Side of DUT - Printer Cover Open



7.4V Lithium-ion Battery Pack (P/N: AT16004-1)

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093

DUT PHOTOGRAPHS

QL320plus Printer



Top end of DUT (LCD Side)



Bottom end of DUT



Front Side of DUT (Antenna/Printer Side)



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



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

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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DUT PHOTOGRAPHS
QL320plus Printer



Left Side of DUT



Right Side DUT

DUT PHOTOGRAPHS

QL320plus Printer



Back Side of DUT - Battery Compartment



Front Side of DUT - Printer Cover Open



7.4V Lithium-ion Battery Pack (P/N: AT16004-1)

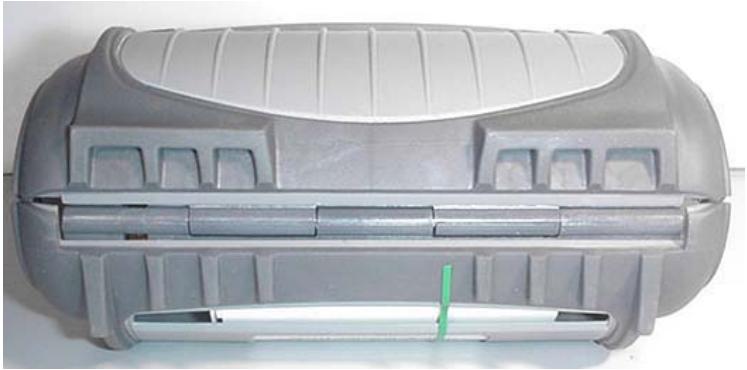
Company:	Zebra Technologies Corporation		FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN				
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DUT PHOTOGRAPHS

QL420plus Printer



Top end of DUT (LCD Side)



Bottom end of DUT



Front Side of DUT (Antenna/Printer Side)



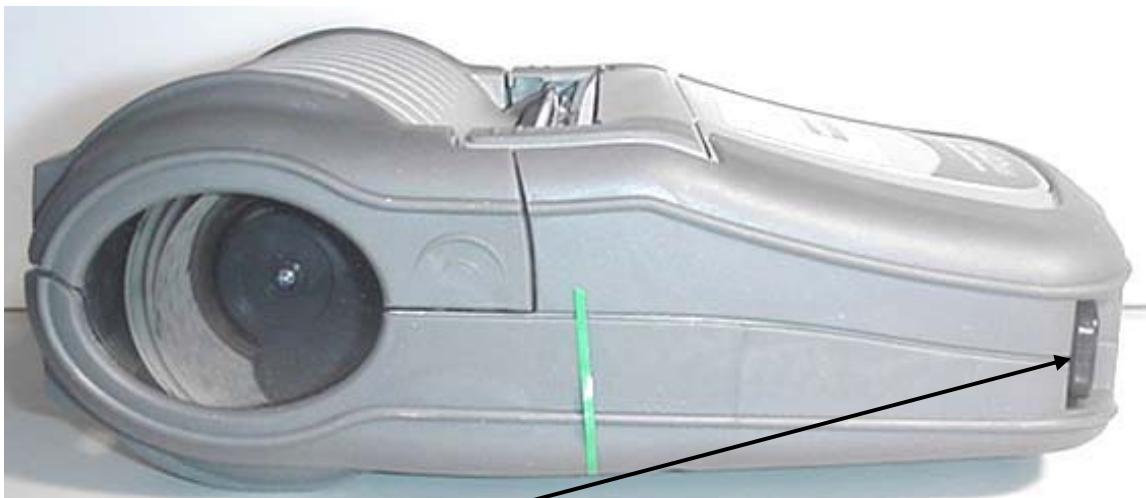
Back Side of DUT (Battery Side)
with Plastic Belt-Clip Accessory



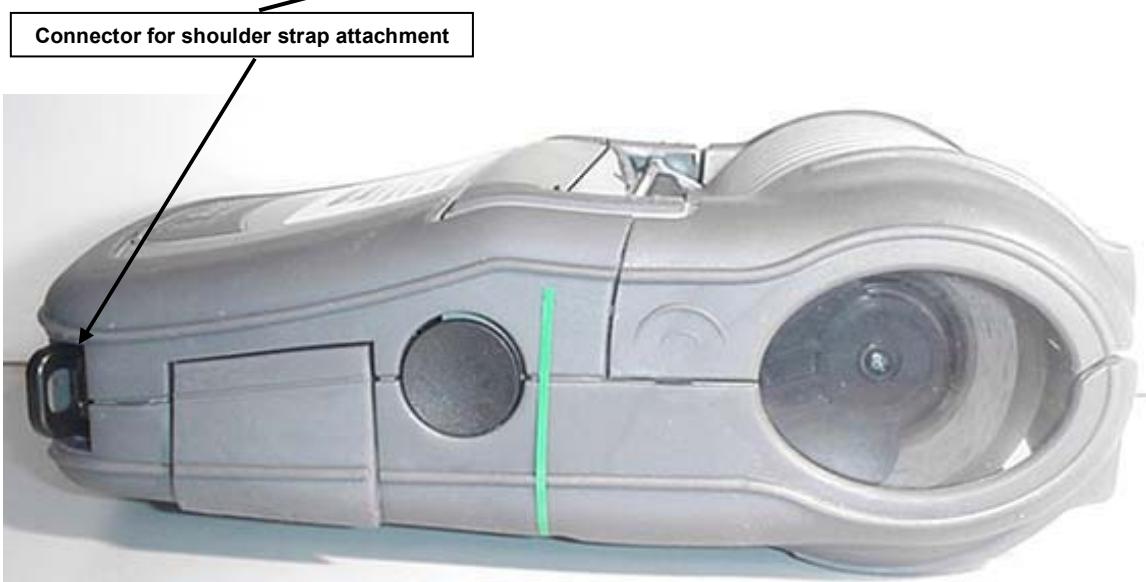
Back Side of DUT (Battery Side)
without Belt-Clip Accessory

DUT PHOTOGRAPHS

QL420plus Printer



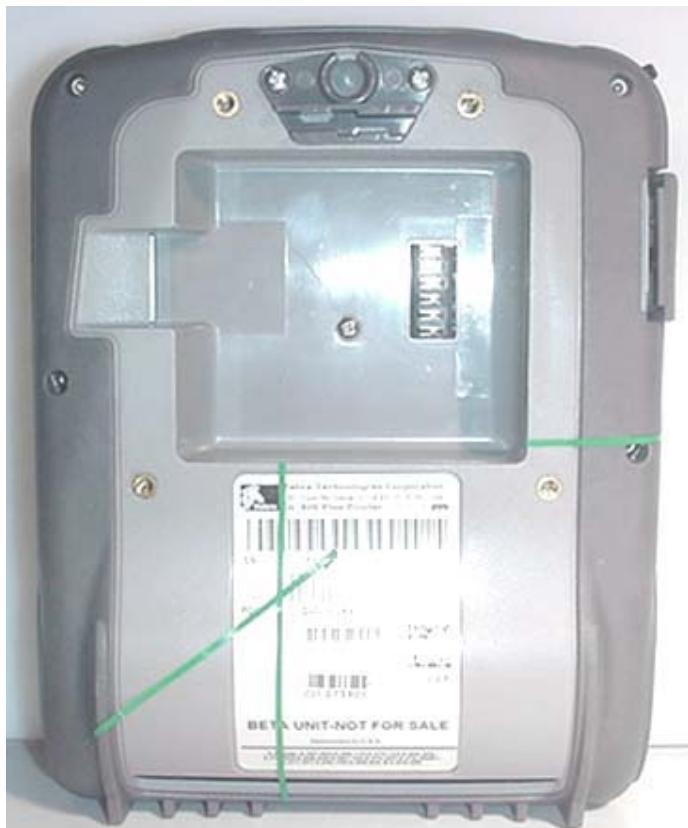
Left Side of DUT



Right Side DUT

DUT PHOTOGRAPHS

QL420plus Printer



Back Side of DUT - Battery Compartment



Front Side of DUT - Printer Cover Open



7.4V Lithium-ion Battery Pack (P/N: AT16004-1)

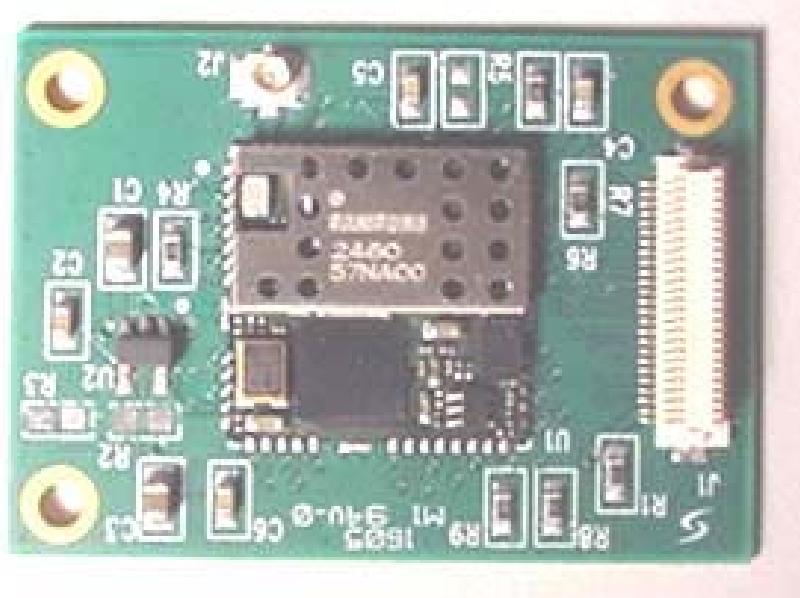
Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093

DUT PHOTOGRAPHS



Samsung SWL-2460 802.11b/g WLAN



Samsung SWL-2460 802.11b/g WLAN

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			

 Celltech <small>Testing and Engineering Services Lab</small>	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
	Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
	Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX E - SYSTEM VALIDATION

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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2450 MHz SYSTEM VALIDATION DIPOLE

Type:

2450 MHz Validation Dipole

Serial Number:

150

Place of Calibration:

Celltech Labs Inc.

Date of Calibration:

April 22, 2005**Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.**

Calibrated by:



Approved by:



1. Dipole Construction & Electrical Characteristics

The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 10.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

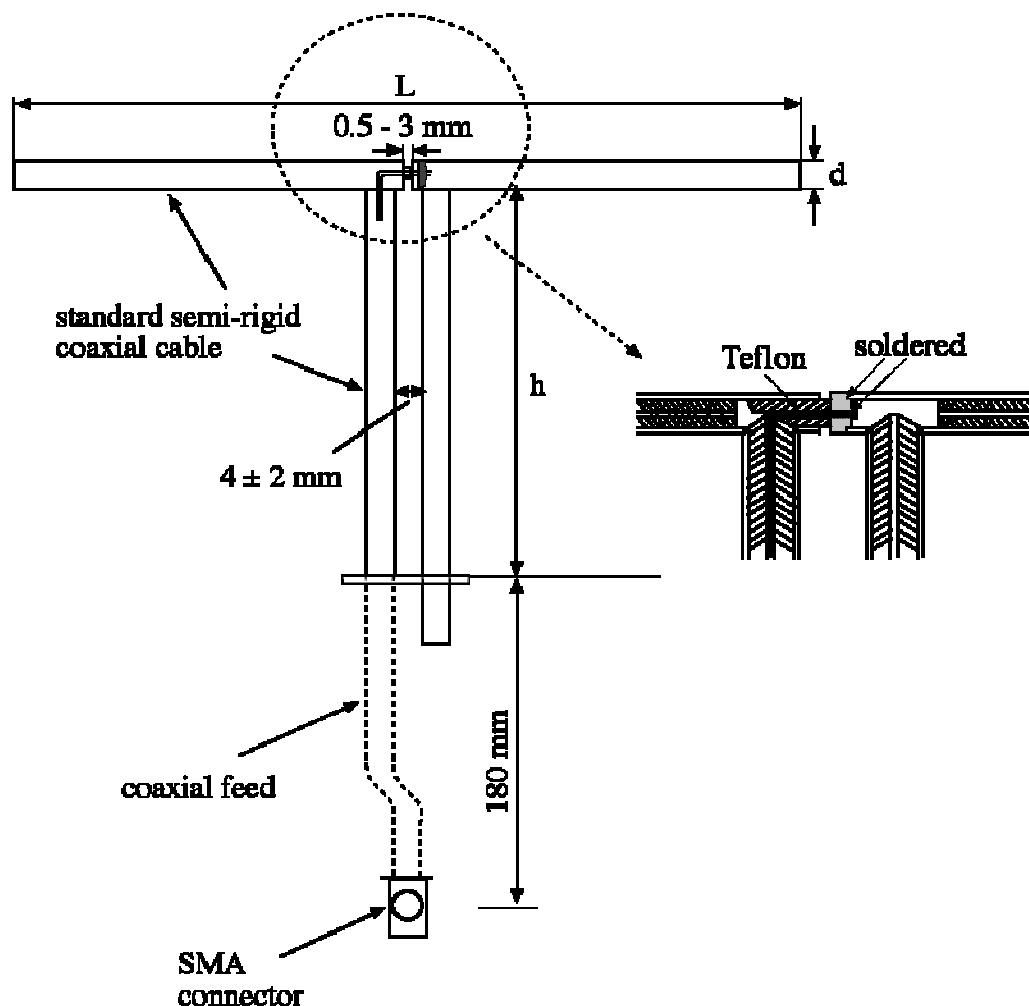
Feed point impedance at 2450 MHz

$$\text{Re}\{Z\} = 45.605\Omega$$

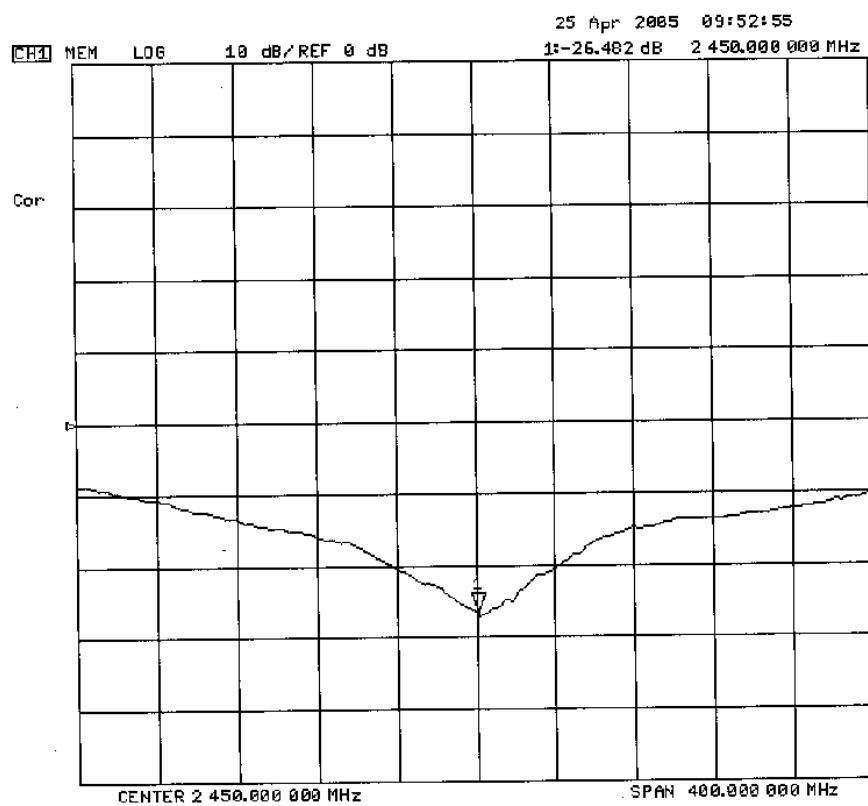
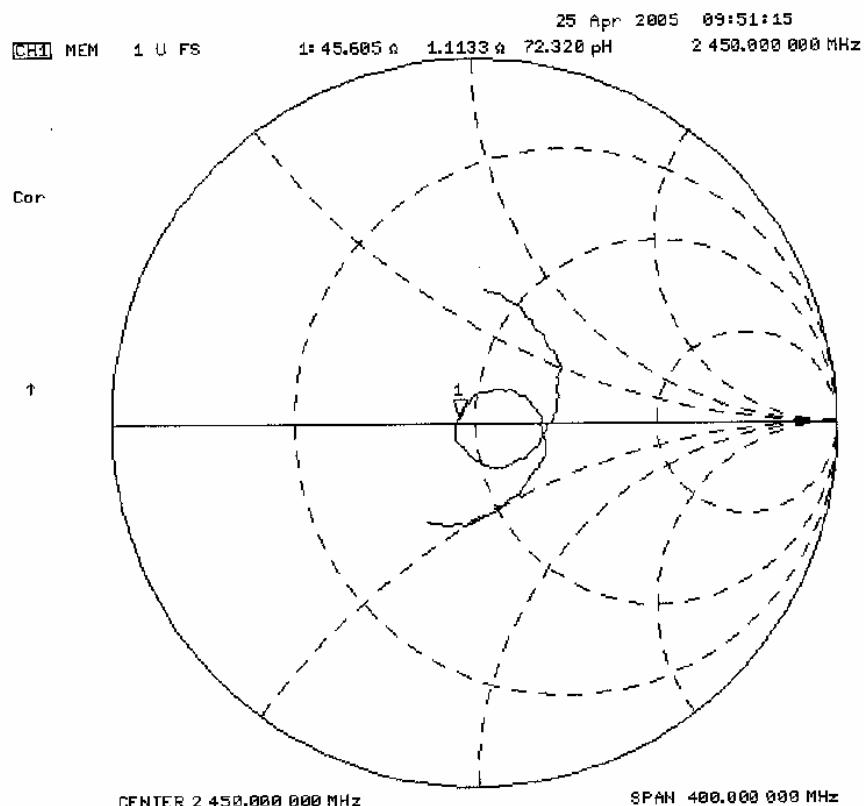
$$\text{Im}\{Z\} = 1.1133\Omega$$

Return Loss at 2450 MHz

$$-26.482 \text{ dB}$$



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. 55 liters
Dimensions: 44 cm (W) x 94 cm (L)

5. 2450 MHz System Validation Setup



6. 2450 MHz Dipole Setup



7. Measurement Conditions

The phantom was filled with 2450 MHz Body simulating tissue:

Relative Permittivity: 50.2
 Conductivity: 1.97 mho/m
 Fluid Temperature: 23.9 °C
 Fluid Depth: ≥ 15.0 cm

Environmental Conditions:

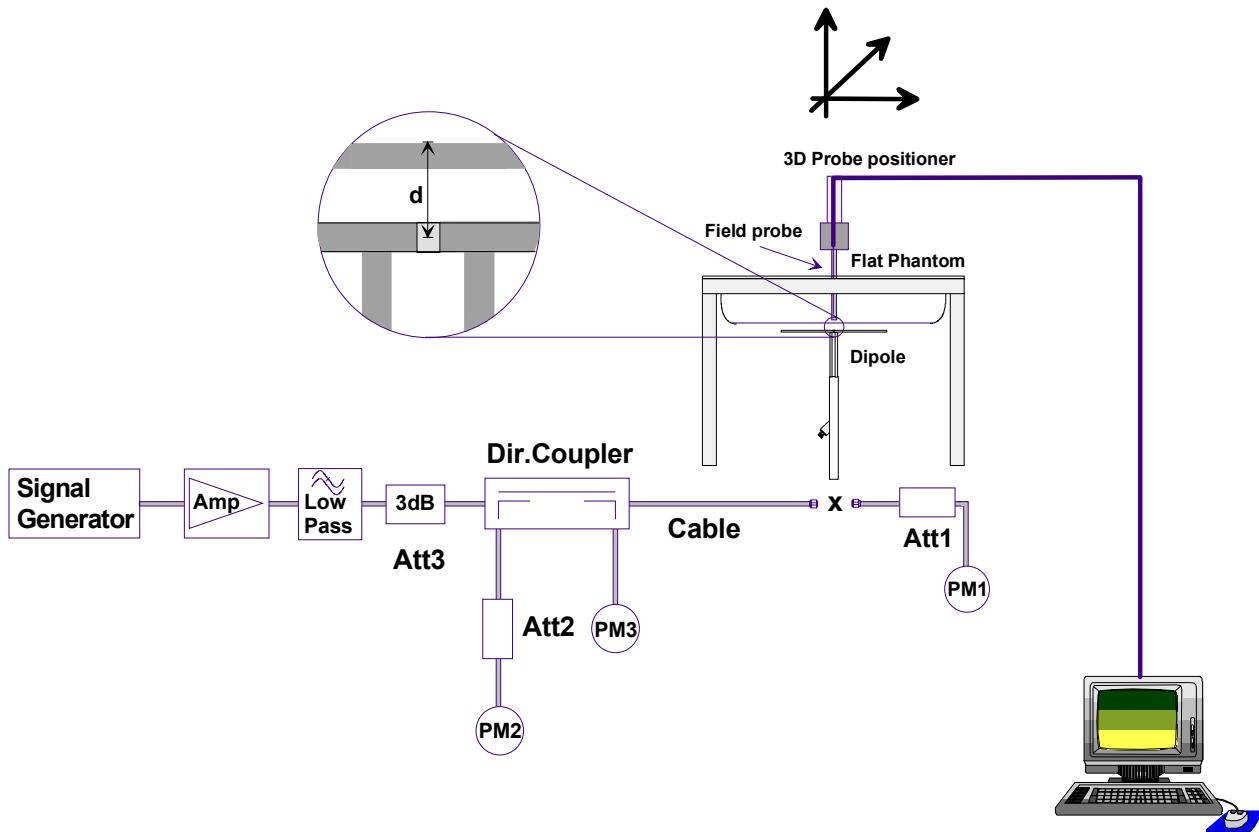
Ambient Temperature: 25.7 °C
 Humidity: 30 %
 Barometric Pressure: 102.6 kPa

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

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

8. 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.

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	12.6	50.4	5.86	23.44	27.7
Test 2	12.6	50.4	5.86	23.44	27.4
Test 3	12.6	50.4	5.87	23.48	27.4
Test 4	12.6	50.4	5.86	23.44	27.3
Test 5	12.6	50.4	5.86	23.44	27.4
Test 6	12.6	50.4	5.87	23.48	27.8
Test 7	12.7	50.8	5.88	23.52	27.7
Test 8	12.7	50.8	5.88	23.52	27.8
Test 9	12.6	50.4	5.87	23.48	27.6
Test10	12.7	50.8	5.88	23.52	27.7
Average Value	12.63	50.52	5.869	23.48	27.58

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%	50.52	- 1.3	23.7	+/- 10%

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 System Validation - April 22, 2005

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 150; Calibrated: 04/22/2005

Ambient Temp: 25.7 °C; Fluid Temp: 23.9 °C; Barometric Pressure: 102.6 kPa; Humidity: 30%

Communication System: CW

Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: M2450 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.97$ mho/m; $\epsilon_r = 50.2$; $\rho = 1000$ kg/m³

- Probe: ET3DV6 - SN1590; ConvF(4.22, 4.22, 4.22); Calibrated: 24/05/2004

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn353; Calibrated: 06/07/2004

- Phantom: Barski Industries; Type: Fiberglas Planar; Serial: 03-01

- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

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

2450 MHz System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.7 V/m; Power Drift = -0.010 dB

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.86 mW/g

2450 MHz System Validation/Zoom Scan 2 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.1 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.86 mW/g

2450 MHz System Validation/Zoom Scan 3 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.0 V/m; Power Drift = 0.015 dB

Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.87 mW/g

2450 MHz System Validation/Zoom Scan 4 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.9 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.86 mW/g

2450 MHz System Validation/Zoom Scan 5 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.5 V/m; Power Drift = 0.010 dB

Peak SAR (extrapolated) = 27.4 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.86 mW/g

2450 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.0 V/m; Power Drift = -0.042 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.87 mW/g

2450 MHz System Validation/Zoom Scan 7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.7 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.88 mW/g

2450 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.4 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.88 mW/g

2450 MHz System Validation/Zoom Scan 9 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.3 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 27.6 W/kg

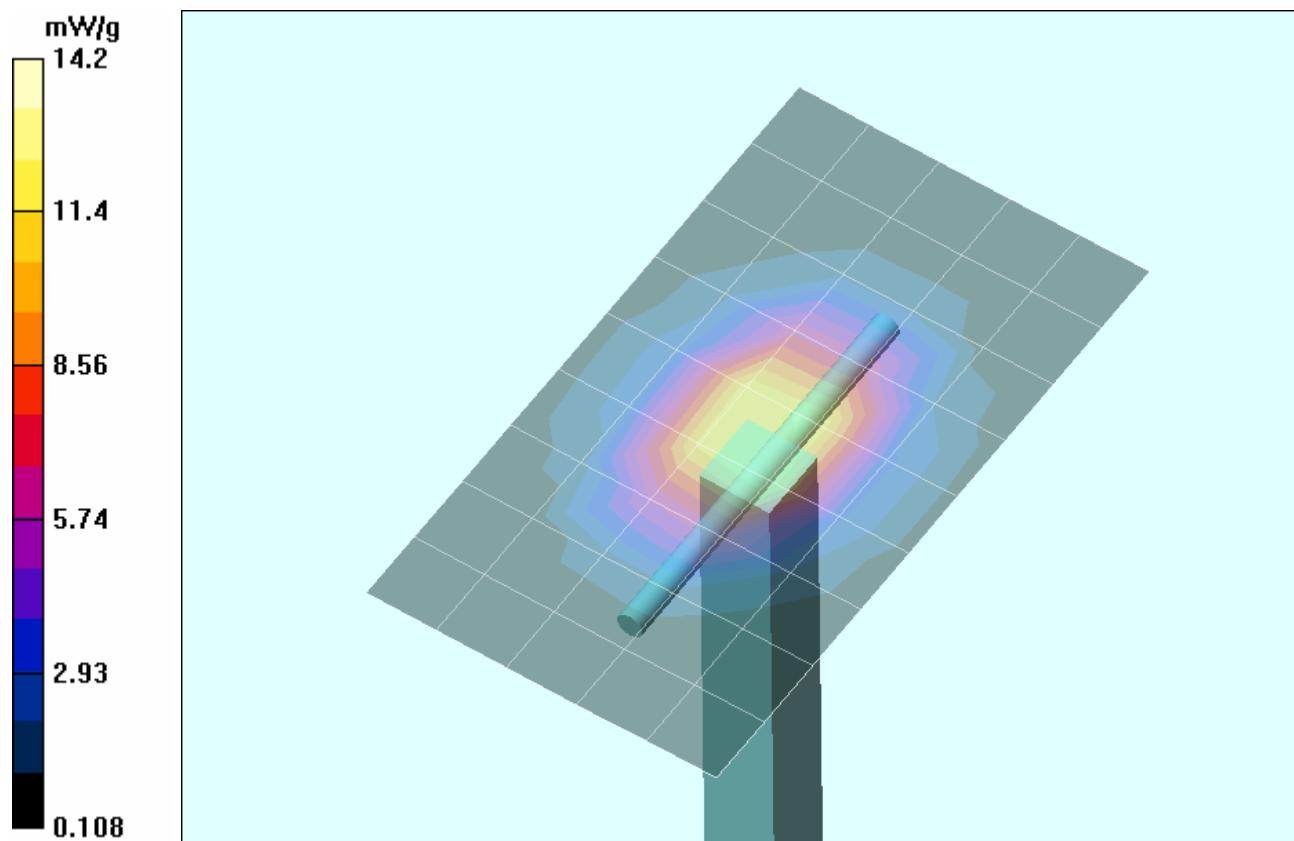
SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.87 mW/g

2450 MHz System Validation/Zoom Scan 10 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.6 V/m; Power Drift = -0.025 dB

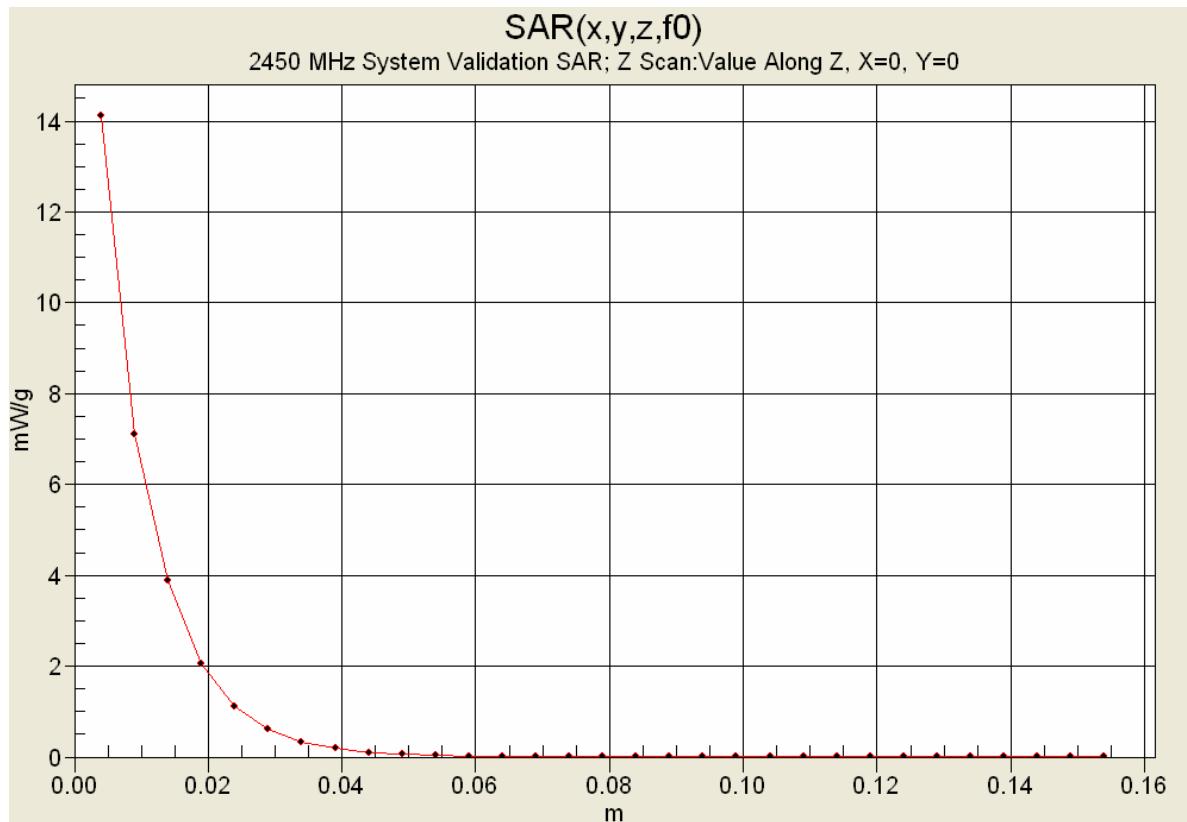
Peak SAR (extrapolated) = 27.7 W/kg

SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.88 mW/g



1 g average of 10 measurements: 12.63 mW/g

10 g average of 10 measurements: 5.869 mW/g



10. Measured Fluid Dielectric Parameters

System Validation - 2450 MHz Dipole

Measured Fluid Dielectric Parameters (Muscle)

April 22, 2005

Frequency	ϵ'	ϵ''
2.350000000 GHz	50.4884	14.1016
2.360000000 GHz	50.4542	14.1475
2.370000000 GHz	50.4295	14.1756
2.380000000 GHz	50.4094	14.2063
2.390000000 GHz	50.3750	14.2541
2.400000000 GHz	50.3395	14.2965
2.410000000 GHz	50.2961	14.3310
2.420000000 GHz	50.2408	14.3481
2.430000000 GHz	50.2047	14.3861
2.440000000 GHz	50.1822	14.4193
2.450000000 GHz	50.1500	14.4611
2.460000000 GHz	50.1035	14.5137
2.470000000 GHz	50.0825	14.5504
2.480000000 GHz	50.0515	14.6073
2.490000000 GHz	50.0191	14.6410
2.500000000 GHz	49.9867	14.6647
2.510000000 GHz	49.9442	14.7231
2.520000000 GHz	49.9042	14.7502
2.530000000 GHz	49.8769	14.7804
2.540000000 GHz	49.8259	14.8081
2.550000000 GHz	49.7900	14.8467

 Testing and Engineering Services Lab	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006	
Description of Test(s):	RF Exposure	SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX F - PROBE CALIBRATION

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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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**

Certificate No: **ET3-1590_May05**

CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1590**

Calibration procedure(s) **QA CAL-01.v5**
Calibration procedure for dosimetric E-field probes

Calibration date: **May 20, 2005**

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)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 617	19-Jan-05 (SPEAG, No. DAE4-617_Jan05)	Jan-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

Calibrated by:	Name	Function	Signature
	Nico Vetterli	Laboratory Technician	

Approved by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	

Issued: May 21, 2005

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Glossary:

TSL	tissue simulating liquid
NORM x,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORM x,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:

- 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
- 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:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not effect the E^2 -field uncertainty inside TSL (see below *ConvF*).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency_response$ (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 $NORM_{x,y,z} * ConvF$ 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 ET3DV6

SN:1590

Manufactured: March 19, 2001
Last calibrated: May 24, 2004
Recalibrated: May 20, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1590

Sensitivity in Free Space ^A			Diode Compression ^B		
NormX	1.82 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	87 mV	
NormY	1.97 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	87 mV	
NormZ	1.70 \pm 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	87 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		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	7.6	3.9
SAR _{be} [%]	With Correction Algorithm	0.1	0.2

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

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	11.8	8.3
SAR _{be} [%]	With Correction Algorithm	0.6	0.1

Sensor Offset

Probe Tip to Sensor Center **2.7 mm**

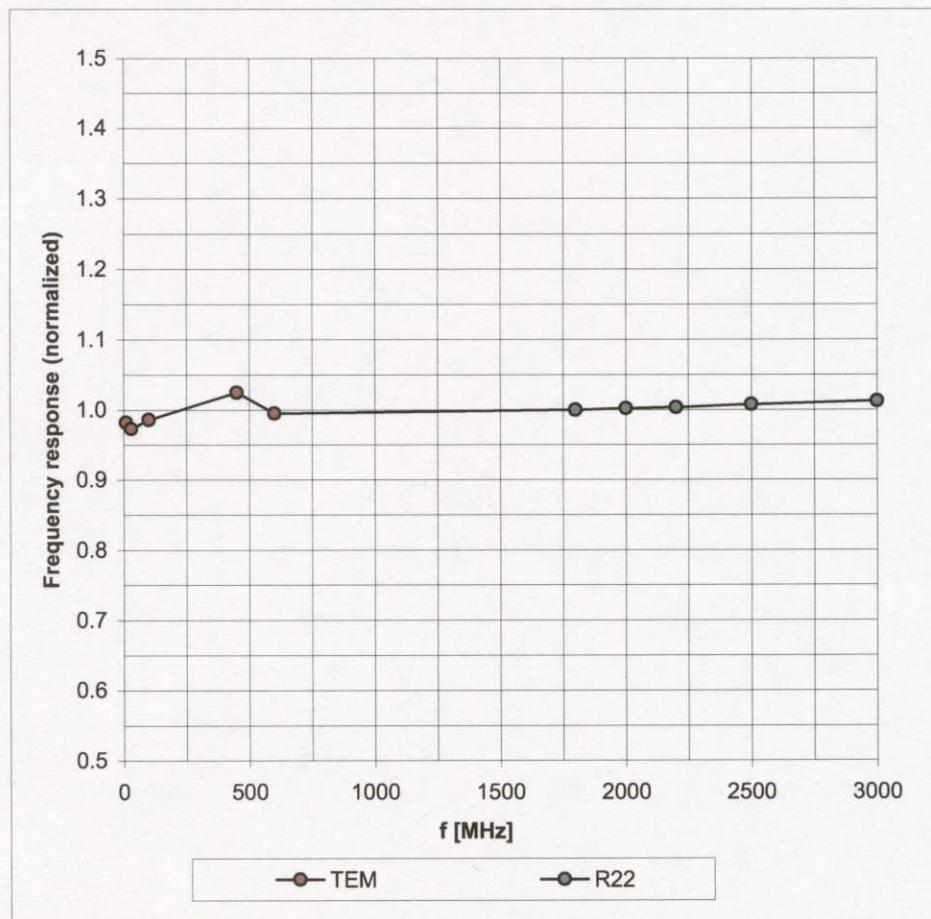
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^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.

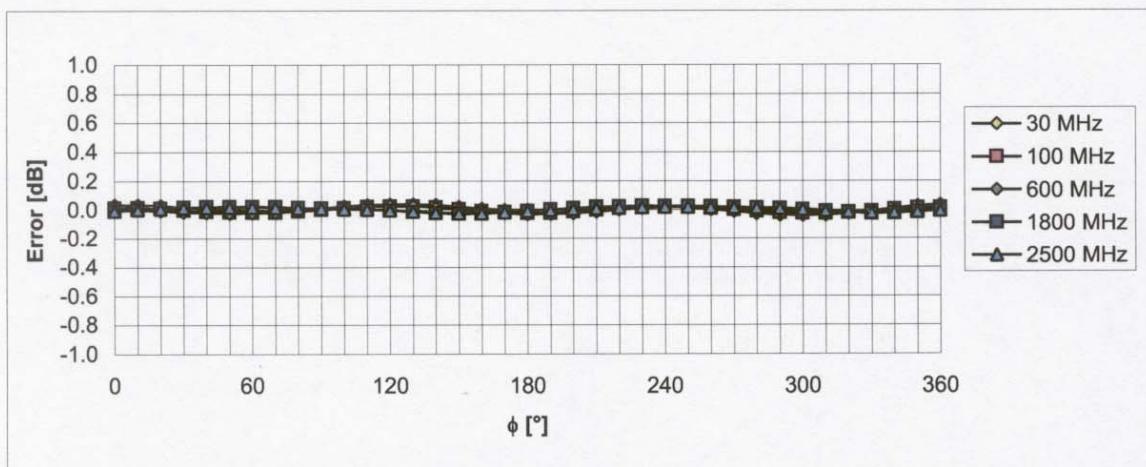
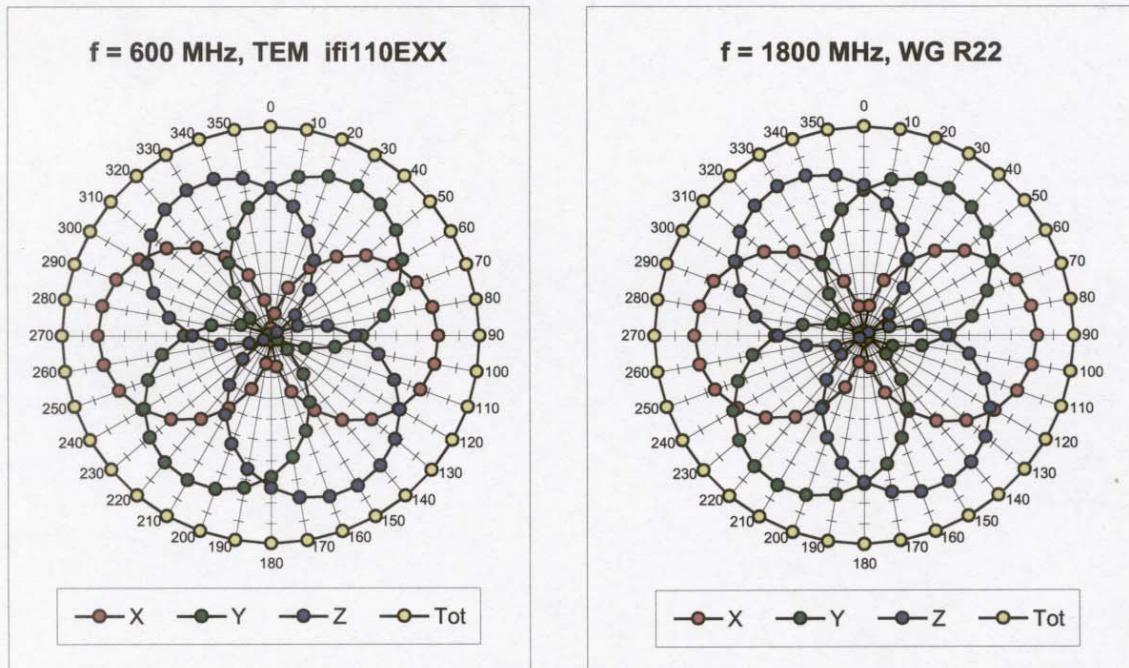
Frequency Response of E-Field

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



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

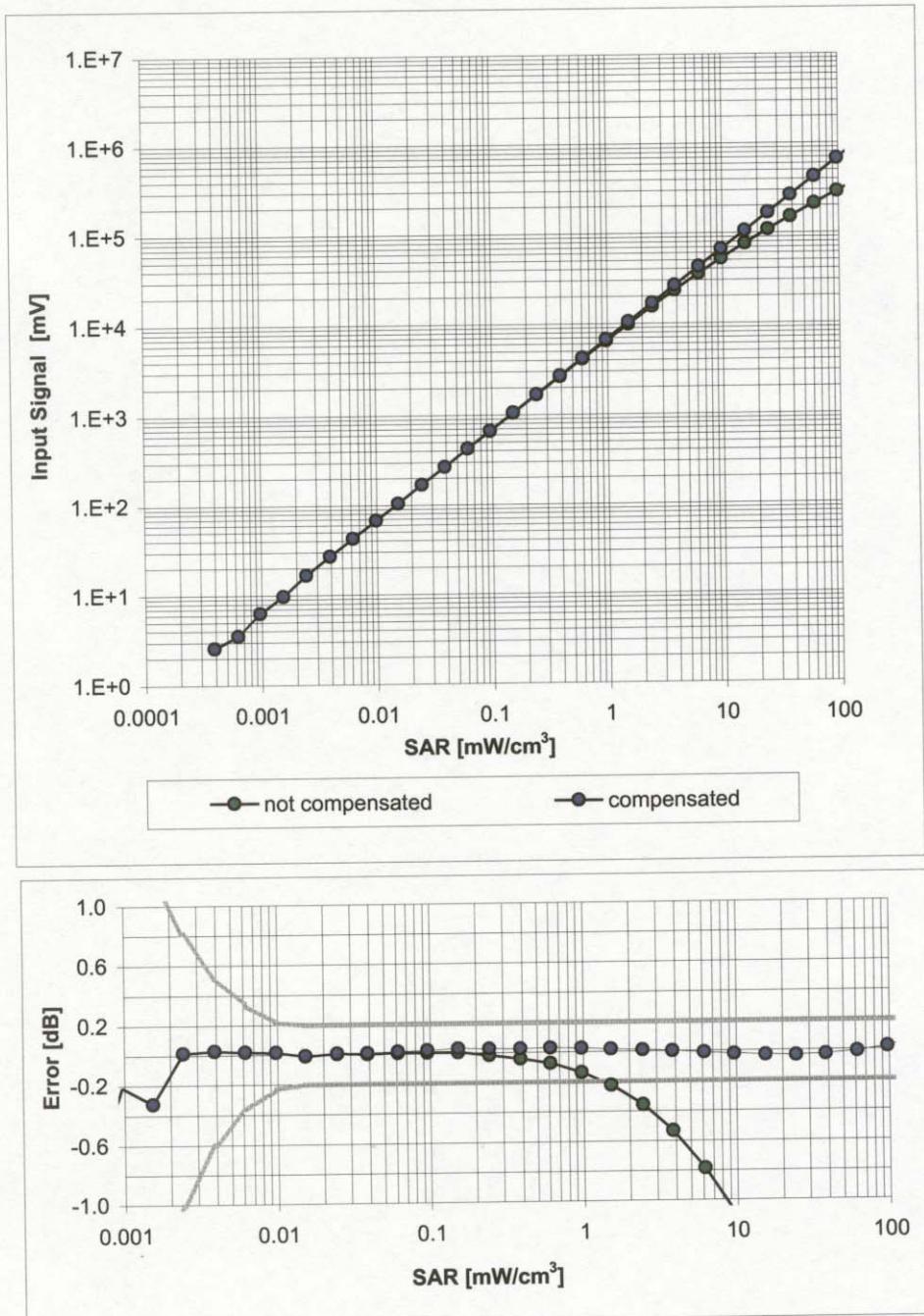
Receiving Pattern (ϕ), $\vartheta = 0^\circ$



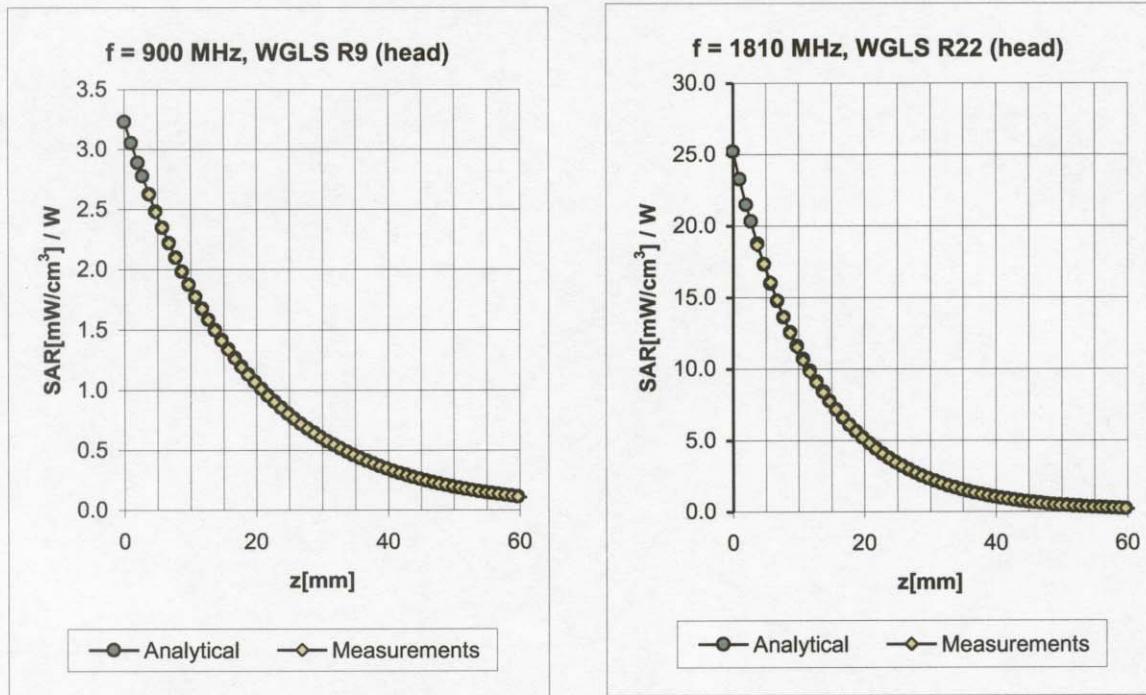
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range $f(\text{SAR}_{\text{head}})$

(Waveguide R22, $f = 1800$ MHz)



Conversion Factor Assessment



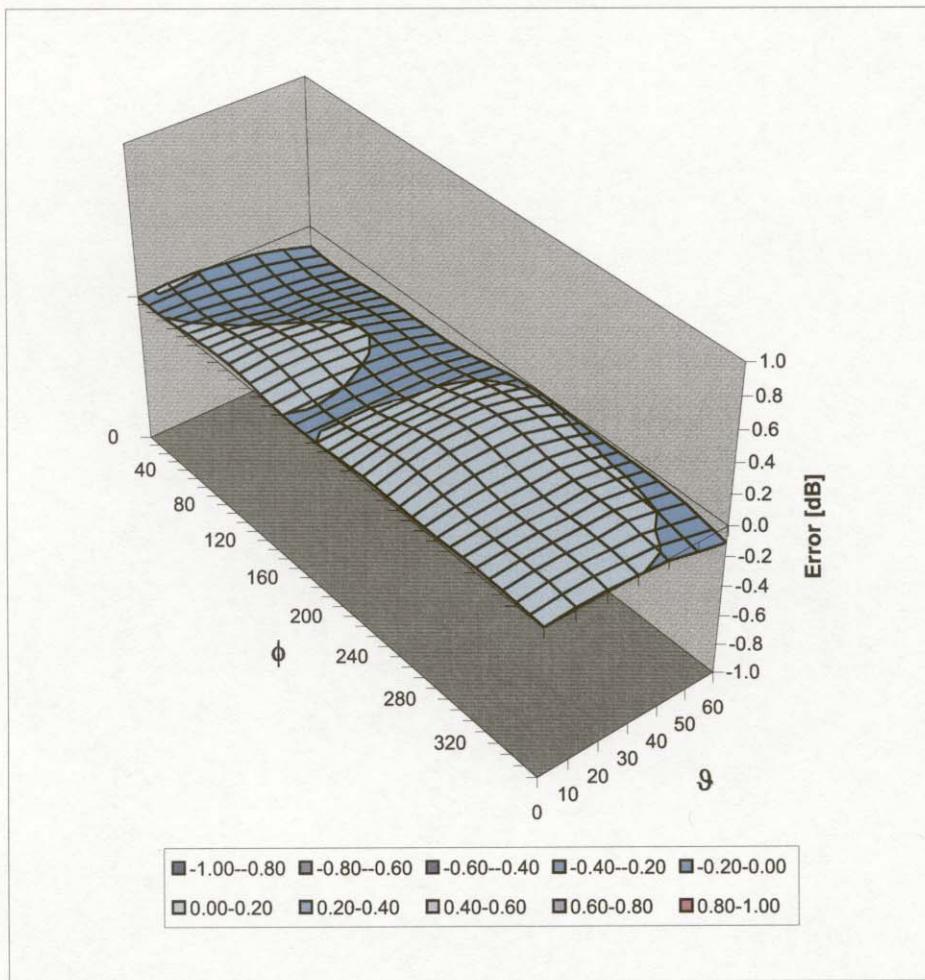
f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	$\pm 50 / \pm 100$	Head	$41.5 \pm 5\%$	$0.97 \pm 5\%$	0.54	1.81	$6.67 \pm 11.0\% \text{ (k=2)}$
1810	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.46	2.62	$5.44 \pm 11.0\% \text{ (k=2)}$
2450	$\pm 50 / \pm 100$	Head	$39.2 \pm 5\%$	$1.80 \pm 5\%$	0.50	2.53	$4.56 \pm 11.8\% \text{ (k=2)}$

900	$\pm 50 / \pm 100$	Body	$55.0 \pm 5\%$	$1.05 \pm 5\%$	0.46	2.09	$6.47 \pm 11.0\% \text{ (k=2)}$
1810	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.44	3.00	$4.85 \pm 11.0\% \text{ (k=2)}$
2450	$\pm 50 / \pm 100$	Body	$52.7 \pm 5\%$	$1.95 \pm 5\%$	0.50	2.42	$4.22 \pm 11.8\% \text{ (k=2)}$

^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: $\pm 2.6\%$ (k=2)

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1590

Place of Assessment:

Zurich

Date of Assessment:

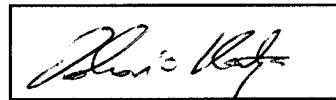
May 23, 2005

Probe Calibration Date:

May 20, 2005

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:1590

Conversion factor (\pm standard deviation)

f = 150 MHz

ConvF

9.1 \pm 10 %

$\epsilon_r = 52.3 \pm 5\%$

$\sigma = 0.76 \pm 5\% \text{ mho/m}$

(head tissue)

f = 300 MHz

ConvF

8.1 \pm 9 %

$\epsilon_r = 45.3 \pm 5\%$

$\sigma = 0.87 \pm 5\% \text{ mho/m}$

(head tissue)

f = 450 MHz

ConvF

7.8 \pm 8 %

$\epsilon_r = 43.5 \pm 5\%$

$\sigma = 0.87 \pm 5\% \text{ mho/m}$

(head tissue)

f = 150 MHz

ConvF

8.6 \pm 10 %

$\epsilon_r = 61.9 \pm 5\%$

$\sigma = 0.80 \pm 5\% \text{ mho/m}$

(body tissue)

f = 450 MHz

ConvF

7.7 \pm 8 %

$\epsilon_r = 56.7 \pm 5\%$

$\sigma = 0.94 \pm 5\% \text{ mho/m}$

(body tissue)

Important Note:

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

Please see also Section 4.7 of the DASY4 Manual.

 Celltech <small>Testing and Engineering Services Lab</small>	Test Report Serial No.:	041106I28-T739-S15W	Test Report Issue No.:	S739W-050206-R0
	Date(s) of Evaluation:	April 21, 2006	Test Report Issue Date:	May 02, 2006
	Description of Test(s):	RF Exposure SAR	FCC 47 CFR §2.1093	IC RSS-102 Issue 2

APPENDIX G - PLANAR PHANTOM CERTIFICATE OF CONFORMITY

Company:	Zebra Technologies Corporation	FCC ID:	I28MD-ZLAN11G	IC ID:	3798A-ZLAN11G	 Zebra
Model(s):	QL220plus, QL320plus, QL420plus	Type:	Wireless Portable Printer with 802.11b/g WLAN			
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2378 Westlake Road
Kelowna, B.C. Canada
V1Z-2V2



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



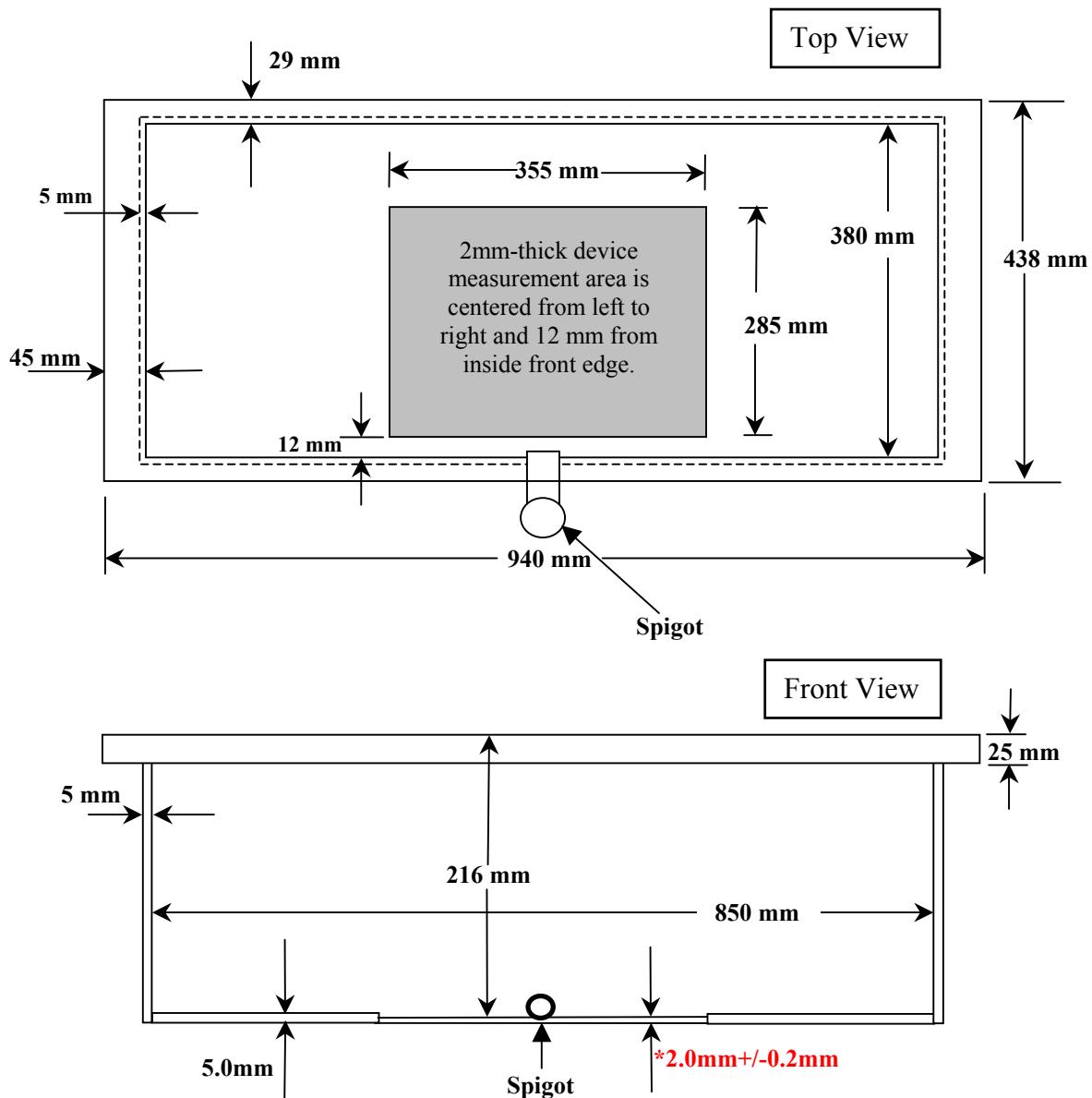
Fiberglass Planar Phantom - Back View



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.