# RF EXPOSURE EVALUATION

# SPECIFIC ABSORPTION RATE

# SAR TEST REPORT

**FOR THE**

## VOCOLLECT INC.

## MODEL: HERCULES

## WAIST-WORN TERMINAL
**WITH**
## 802.11b WLAN & BLUETOOTH

## FCC ID: MQOTT700-10000

## IC: 2570A-TT700100

**Test Report Serial Number**

**100605MQO-T682-S15W**
**Revision 0**

**Test Report Issue Date**

**October 21, 2005**


**Celltech Compliance Testing & Engineering Lab**
**(Celltech Labs Inc.)**
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# DECLARATION OF COMPLIANCE
# SAR RF EXPOSURE EVALUATION


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**Applicant Information**

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| | |
|---|---|
| **FCC IDENTIFIER:** | **MQOTT700-10000** |
| **IC IDENTIFIER:** | **2570A-TT7001000** |
| **Model(s):** | **Hercules** |
| **Rule Part(s):** | **FCC §2.1093; IC RSS-102 Issue 1 (Provisional)** |
| **Test Procedure(s):** | **FCC OET Bulletin 65 Supplement C (01-01)** |
| **Device Classification:** | **Digital Transmission System (DTS)** |
| **Device Description:** | **Waist-Worn Terminal** |
| **Internal Transmitter(s):** | **USI WM-BB-AG-01 802.11b / Bluetooth Combination** |
| **Modulation Type(s):** | **Direct Sequence Spread Spectrum (DSSS) - 802.11b WLAN**<br>**Frequency Hopping Spread Spectrum (FHSS) - Bluetooth** |
| **Tx Frequency Range(s):** | **2412 - 2462 MHz (802.11b WLAN)**<br>**2402 - 2480 MHz (Bluetooth)** |
| **Max. RF Conducted Power Measured:** | **36.77 mW (15.65 dBm) Peak (WLAN) 2437 MHz**<br>**1.74 mW (2.4 dBm) Peak (Bluetooth) 2441 MHz** |
| **Battery Type(s) Tested:** | **Lithium-ion 3.6 V 4400 mAh (Model: 730022)** |
| **Antenna Type(s) Tested:** | **WLAN: Internal / Bluetooth: Internal** |
| **Body-Worn Accessories Tested:** | **Belt with Belt-Clip (P/N: BL-700-4)** |
| **Audio Accessories Tested:** | **Headset-Microphone (P/N: HD-700-1)** |
| **Max. SAR Level(s) Measured:** | **Body-worn: 0.471 W/kg (1g average)** |

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

**I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.**


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| Tested By: | Reviewed By: |
|---|---|
| Sean Johnston<br>Compliance Technologist<br>Celltech Labs Inc. | Spencer Watson<br>Senior Compliance Technologist<br>Celltech Labs Inc. |

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# 1.0 INTRODUCTION

This measurement report demonstrates that the VOCOLLECT INC. Model: Hercules Waist-Worn Terminal with internal 802.11b/Bluetooth Combination FCC ID: MQOTT700-10000 complies with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]) for the General Population / Uncontrolled Exposure environment and Health Canada Safety Code 6 (see reference [2]). The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [3]) and IC RSS-102 Issue 1 (Provisional) (see reference [4]), were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

# 2.0 DESCRIPTION of DEVICE UNDER TEST (DUT)

| | | | | | |
|---|---|---|---|---|---|
| **FCC Rule Part(s)** | 47 CFR §2.1093 | | | | |
| **IC Rule Part(s)** | RSS-102 Issue 1 (Provisional) | | | | |
| **Test Procedure(s)** | FCC OET Bulletin 65, Supplement C (01-01) | | | | |
| **FCC Device Classification** | Digital Transmission System (DTS) | | | | 15C |
| **IC Device Classification** | Low Power License-Exempt Radiocommunication Device: Category 1 Equipment | | | | RSS-210 Issue 6 |
| **Device Description** | Waist-Worn Terminal | | | | |
| **Internal Transmitters** | USI WM-BB-AG-01 802.11b / Bluetooth Combination | | | | |
| **Co-located Transmit Operation** | 802.11b WLAN and Bluetooth transmitters can transmit simultaneously | | | | |
| **FCC IDENTIFIER** | MQOTT700-10000 | | | | |
| **IC IDENTIFIER** | 2570A-TT700100 | | | | |
| **Model(s)** | Hercules | | | | |
| **Test Sample Serial No.** | 188 | | | Production Unit | |
| **Mode(s) of Operation** | 802.11b WLAN | | DSSS | Direct Sequence Spread Spectrum | |
| | Bluetooth | | FHSS | Frequency Hopping Spread Spectrum | |
| **Modulation Type(s)** | 802.11b WLAN | | DBPSK, DQPSK, CCK | | |
| **Tx Frequency Range(s)** | 2412 - 2462 MHz | | | 802.11b WLAN | |
| | 2402 - 2480 MHz | | | Bluetooth | |
| **Max. RF Peak Conducted Output Power Measured** | 30.39 mW | 14.83 dBm | 2412 MHz | 802.11b WLAN | |
| | 36.77 mW | 15.65 dBm | 2437 MHz | | |
| | 33.23 mW | 15.22 dBm | 2462 MHz | | |
| | 1.74 mW | 2.4 dBm | 2441 MHz | Bluetooth | |
| **Battery Type(s) Tested** | Lithium-ion | | 3.6 V | 4400 mAh | Model: 730022 |
| **Antenna Type(s) Tested** | Internal | | | 802.11b WLAN | |
| | Internal | | | Bluetooth | |
| **Body-Worn Accessories Tested** | Belt with Belt-Clip | | | P/N: BL-700-4 | |
| **Audio Accessories Tested** | Headset-Microphone | | | P/N: HD-700-1 | |


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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**



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# 4.0 MEASUREMENT SUMMARY

## BODY-WORN SAR MEASUREMENT RESULTS

| Transmitter | Test Mode | Freq. (MHz) | Chan. | Data Rate | Battery Type | Accessories | | DUT Position to Planar Phantom | Separ. Distance to Planar Phantom (cm) | Cond. Power Before Test (dBm) | SAR Drift During Test (dB) | Measured SAR 1g (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Body-Worn | Audio | | | | | |
| 802.11b WLAN | DSSS | 2437 | 6 | 1 Mbps | Li-ion | Belt with Belt-Clip | Headset Mic | Front Side (Battery Side) | 0.0 | 15.65 | -0.111 | **0.471** |
| 802.11b WLAN | DSSS | 2437 | 6 | 1 Mbps | Li-ion | Belt with Belt-Clip | Headset Mic | Back Side (Belt-Clip Side) | 0.0 | 15.65 | 0.146 | 0.0239 |
| 802.11b WLAN | DSSS | 2437 | 6 | 1 Mbps | Li-ion | Belt with Belt-Clip | Headset Mic | Top Side (Button Side) | 0.0 | 15.65 | -0.0443 | 0.0363 |
| 802.11b WLAN | DSSS | 2437 | 6 | 1 Mbps | Li-ion | Belt with Belt-Clip | Headset Mic | Bottom Side | 0.0 | 15.65 | -0.215 | 0.0383 |
| 802.11b WLAN | DSSS | 2437 | 6 | 1 Mbps | Li-ion | Belt with Belt-Clip | Headset Mic | Front Side (Battery Side) | 0.0 | 15.65 | -0.117 | 0.444 |
| Bluetooth | Modulated Fixed Freq. | 2441 | 39 | n/a | | | | | | 2.4 | | |
| **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)** | October 13, 2005 | | | | **Relative Humidity** | 32 | % |
|---|---|---|---|---|---|---|---|
| **Measured Fluid Type** | **2450 MHz Body** | | | | **Atmospheric Pressure** | 101.9 | kPa |
| **Dielectric Constant** $\varepsilon_r$ | **IEEE Target** | | **Measured** | **Deviation** | **Ambient Temperature** | 23.2 | °C |
| | **52.7** | **±5%** | 50.6 | -4.0% | **Fluid Temperature** | 22.2 | °C |
| **Conductivity** $\sigma$ **(mho/m)** | **IEEE Target** | | **Measured** | **Deviation** | **Fluid Depth** | ≥ 15 | Cm |
| | **1.95** | **±5%** | 1.93 | -1.0% | **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 scaled SAR levels evaluated at the mid channel were ≥ 3 dB below the SAR limit, SAR evaluation for the low and high channels was optional (per FCC OET Bulletin 65, Supplement C, Edition 01-01 - see reference [3]).
3. The power drifts measured by the DASY4 system for the duration of the SAR evaluations were ≤5% from the start power.
4. The maximum SAR level configuration for single-transmit operation was subsequently re-evaluated with both the 802.11b WLAN and Bluetooth transmitters enabled to report a SAR result for simultaneous transmit operation.
5. The DUT battery was fully charged prior to each SAR evaluation.
6. 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.
7. 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).
8. The SAR evaluations were performed within 24 hours of the system performance check.


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# 5.0 DETAILS OF SAR EVALUATION

The VOCOLLECT INC. Model: Hercules Waist-Worn Terminal with internal 802.11b / Bluetooth Combination FCC ID: MQOTT700-10000 was determined to be compliant for localized Specific Absorption Rate based on the test provisions and conditions described below. Detailed test setup photographs are shown in Appendix D.

**SAR Test Configurations**

1. The DUT was tested for body-worn SAR with the back side (belt-clip side) of the device placed parallel to, and touching, the outer surface of the planar phantom.
2. The DUT was tested for body-worn SAR with the front side (battery side) of the device placed parallel to, and touching, the outer surface of the planar phantom.
3. The DUT was tested for body-worn SAR with the top side (button side) of the device placed parallel to, and touching, the outer surface of the planar phantom.
4. The DUT was tested for body-worn SAR with the bottom side of the device placed parallel to, and touching, the outer surface of the planar phantom.
5. The belt-clip, belt, and headset-microphone accessories were attached to the DUT for the duration of the tests.
6. The SAR evaluations were performed within 24 hours of the daily system performance check.

**Test Modes & Power Settings**

7. The peak conducted power levels were measured prior to the SAR evaluations using the Agilent E4408B spectrum analyzer and a 30 dB attenuator according to the procedures described in FCC 47 CFR §2.1046.
8. The DUT was placed into test mode using an executable test software program controlled from a PC connected to the DUT via serial cable.
9. The 802.11b WLAN was tested at maximum power in modulated DSSS continuous transmit mode at 100% duty cycle. For the co-located simultaneous transmit SAR evaluation, the Bluetooth transmitter was tested in continuous transmit mode with a modulated signal on a fixed frequency (frequency hopping disabled).
10. The power drifts measured by the DASY4 system for the duration of the SAR evaluations were $\leq$5% from the start power.
11. The DUT battery was fully charged prior to each SAR evaluation.

# 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 D). The extrapolation was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.

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

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


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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 ±10% (see Appendix B). See Table 1 below for the SAR system manufacturer's reference body SAR values from the DASY4 Operation Manual (see reference [6]).

## SYSTEM PERFORMANCE CHECK EVALUATION

| Test Date | 2450MHz Equiv. Tissue | SAR 1g (W/kg) | | | Dielectric Constant $\varepsilon_r$ | | | Conductivity $\sigma$ (mho/m) | | | $\rho$ (Kg/m$^3$) | Amb. Temp. (°C) | Fluid Temp. (°C) | Fluid Depth (cm) | Humid. (%) | Barom. Press. (kPa) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | IEEE Target | Meas. | Dev. | IEEE Target | Meas. | Dev. | IEEE Target | Meas. | Dev. | | | | | | |
| 10/13/05 | Body | **12.8 ±10%** | 14.0 | +9.4% | **52.7 ±5%** | 50.6 | -4.0% | **1.95 ±5%** | 1.93 | -1.0% | 1000 | 22.8 | 22.2 | ≥ 15 | 32 | 101.9 |

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

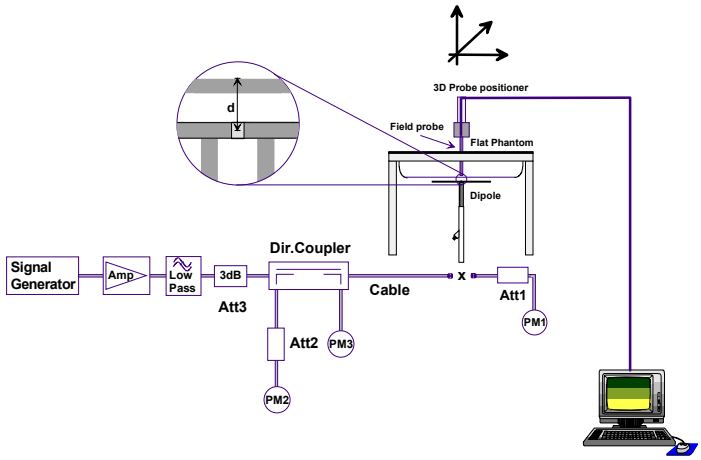
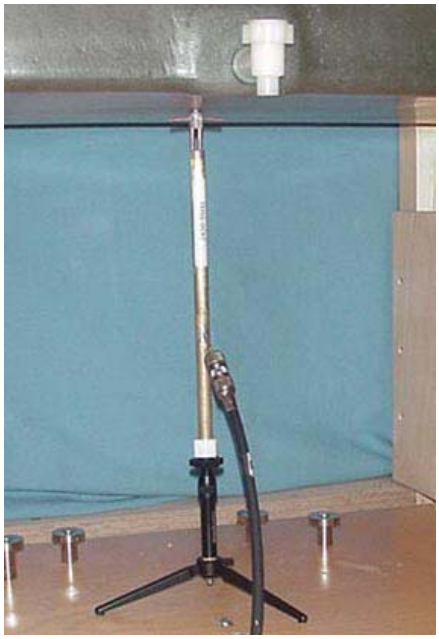



**Figure 1. System Performance Check Measurement Setup**

| 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**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## 8.0 SIMULATED EQUIVALENT TISSUES

The 2450MHz simulated tissue mixtures consist of Glycol-monobutyl, water, and salt. The fluids were 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 |

Notes:

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


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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.:** 1387
**Construction:** Triangular core fiber optic detection system
**Frequency:** 10 MHz to 6 GHz
**Linearity:** ±0.2 dB (30 MHz to 3 GHz)

**Phantom(s)**

**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<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g. glycol) |
| Calibration: | In air from 10 MHz to 2.5 GHz<br>In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy ± 8%) |
| Frequency: | 10 MHz to >6 GHz; Linearity: ±0.2 dB (30 MHz to 3 GHz) |
| Directivity: | ±0.2 dB in brain tissue (rotation around probe axis)<br>±0.4 dB in brain tissue (rotation normal to probe axis) |
| Dynamic Range: | 5 μW/g to >100 mW/g; Linearity: ±0.2 dB |
| Surface Detection: | ±0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces |
| Dimensions: | Overall length: 330 mm<br>Tip length: 16 mm<br>Body diameter: 12 mm<br>Tip diameter: 6.8 mm<br>Distance from probe tip to dipole centers: 2.7 mm |
| Application: | General dosimetry up to 3 GHz<br>Compliance tests of portable devices |

**ET3DV6 E-Field Probe**

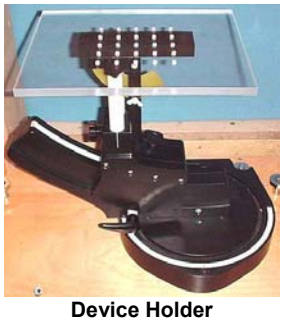
## 12.0 PLANAR PHANTOM

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 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 such as Laptop and Tablet PCs, 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 | 25Jan05 | | 25Jan06 |
| x | -ET3DV6 E-Field Probe | 00016 | 1387 | 18Mar05 | | 18Mar06 |
| | -ET3DV6 E-Field Probe | 00017 | 1590 | 20May05 | | 20May06 |
| | -EX3DV4 E-Field Probe | 00125 | 3547 | 21Jan05 | | 21Jan06 |
| | -300MHz Validation Dipole | 00023 | 135 | 26Oct04 | | 26Oct05 |
| | -450MHz Validation Dipole | 00024 | 136 | 04Nov04 | | 04Nov05 |
| | -835MHz Validation Dipole | 00022 | 411 | **Brain** | 30Mar05 | 30Mar06 |
| | | | | **Body** | 12Apr05 | 12Apr06 |
| | -900MHz Validation Dipole | 00020 | 054 | **Brain** | 10Jun05 | 10Jun06 |
| | | | | **Body** | 10Jun05 | 10Jun06 |
| | -1800MHz Validation Dipole | 00021 | 247 | **Brain** | 14Jun05 | 14Jun06 |
| | | | | **Body** | 14Jun05 | 14Jun06 |
| | -1900MHz Validation Dipole | 00032 | 151 | **Brain** | 17Jun05 | 17Jun06 |
| | | | | **Body** | 22Apr05 | 22Apr06 |
| | -2450MHz Validation Dipole | 00025 | 150 | **Brain** | 20Sep05 | 20Sep06 |
| x | | | | **Body** | 22Apr05 | 22Apr06 |
| | -5000MHz Validation Dipole | 00126 | 1031 | **Brain** | 11Jan05 | 11Jan06 |
| | | | | **Body** | 11Jan05 | 11Jan06 |
| | -SAM Phantom V4.0C | 00154 | 1033 | N/A | | N/A |
| x | -Barski Planar Phantom | 00155 | 03-01 | N/A | | N/A |
| | -Plexiglas Planar Phantom | 00156 | 161 | N/A | | N/A |
| | -Validation Planar Phantom | 00157 | 137 | N/A | | N/A |
| | HP 85070C Dielectric Probe Kit | 00033 | N/A | N/A | | N/A |
| x | ALS-PR-DIEL Dielectric Probe Kit | 00160 | 260-00953 | N/A | | N/A |
| x | HP/Agilent E4408B Spectrum Analyzer | 00015 | US39240170 | 24Jan05 | | 24Jan06 |
| x | Pasternack PE7014-30 30 dB Attenuator | 00076 | none | 01Nov04 | | 01Nov05 |
| x | Gigatronics 8652A Power Meter | 00110 | 1835801 | 16Apr05 | | 16Apr06 |
| x | Gigatronics 80701A Power Sensor | 00012 | 1834350 | 12Sep05 | | 12Sep06 |
| x | Gigatronics 80701A Power Sensor | 00014 | 1833699 | 07Sep05 | | 07Sep06 |
| | Gigatronics 80701A Power Sensor | 00109 | 1834366 | 16Apr05 | | 16Apr06 |
| x | HP 8753ET Network Analyzer | 00134 | US39170292 | 04May05 | | 04May06 |
| x | HP 8648D Signal Generator | 00005 | 3847A00611 | 29Apr05 | | 29Apr06 |
| | Rohde & Schwarz SMR40 Signal Generator | 00006 | 100104 | 12Apr05 | | 12Apr06 |
| x | Amplifier Research 5S1G4 Power Amplifier | 00106 | 26235 | N/A | | N/A |



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# 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])**


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# 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])**


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## 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, “Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada’s Safety Code 6 for Exposure of Humans to Radio Frequency Fields”, Radio Standards Specification RSS-102 Issue 1 (Provisional): September 1999.

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





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# APPENDIX A - SAR MEASUREMENT DATA


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Date Tested: 10/13/2005

## Body-Worn SAR - 802.11b WLAN - Front Side of DUT (Battery Side) - 0.0 cm Spacing

**DUT: Vocollect Model: Hercules; Type: Waist-Worn Terminal with 802.11b/Bluetooth Combination; Serial: 188**

Ambient Temp: 23.2 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

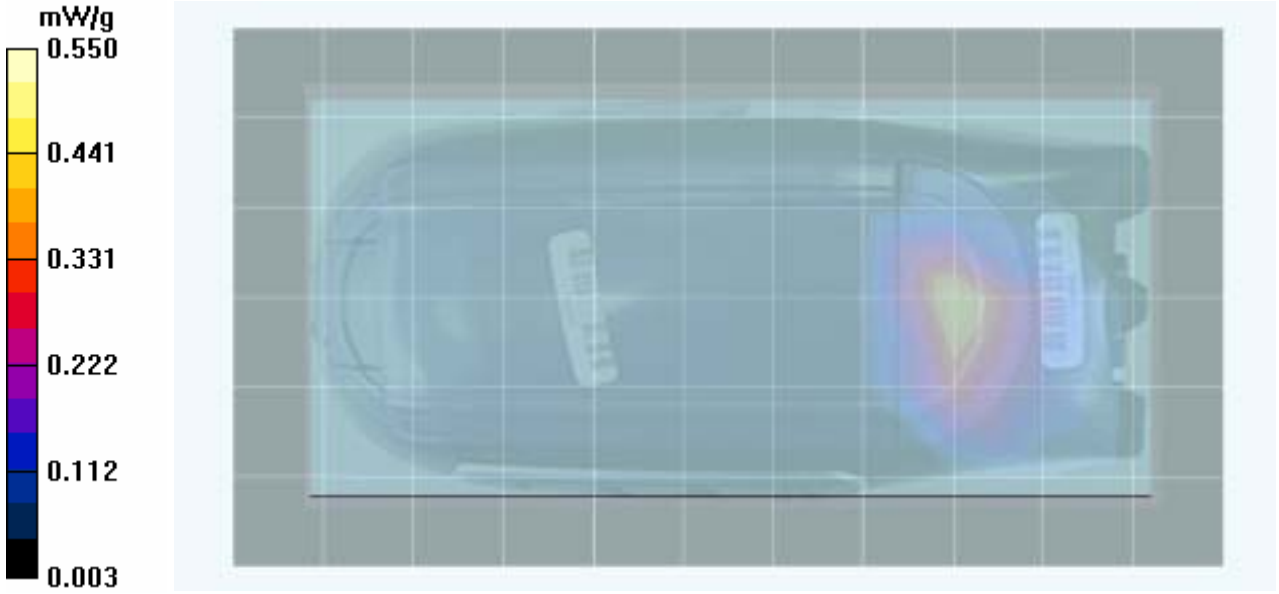
Body-Worn Accessories: Belt with Belt-Clip (P/N: BL-700-4); Audio Accessories: Headset-Microphone (P/N: HD-700-1)

Communication System: DSSS WLAN
RF Output Power: 15.65 dBm (Peak Conducted)
Frequency: 2437 MHz; Channel 6; Duty Cycle: 1:1
3.6V 4400mAh Li-ion Battery Pack (Model: 730022)
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Front Side of DUT to Planar Phantom - Mid Channel Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Front Side of DUT to Planar Phantom - Mid Channel Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 15.3 V/m; Power Drift = -0.111 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.471 mW/g; SAR(10 g) = 0.192 mW/g**





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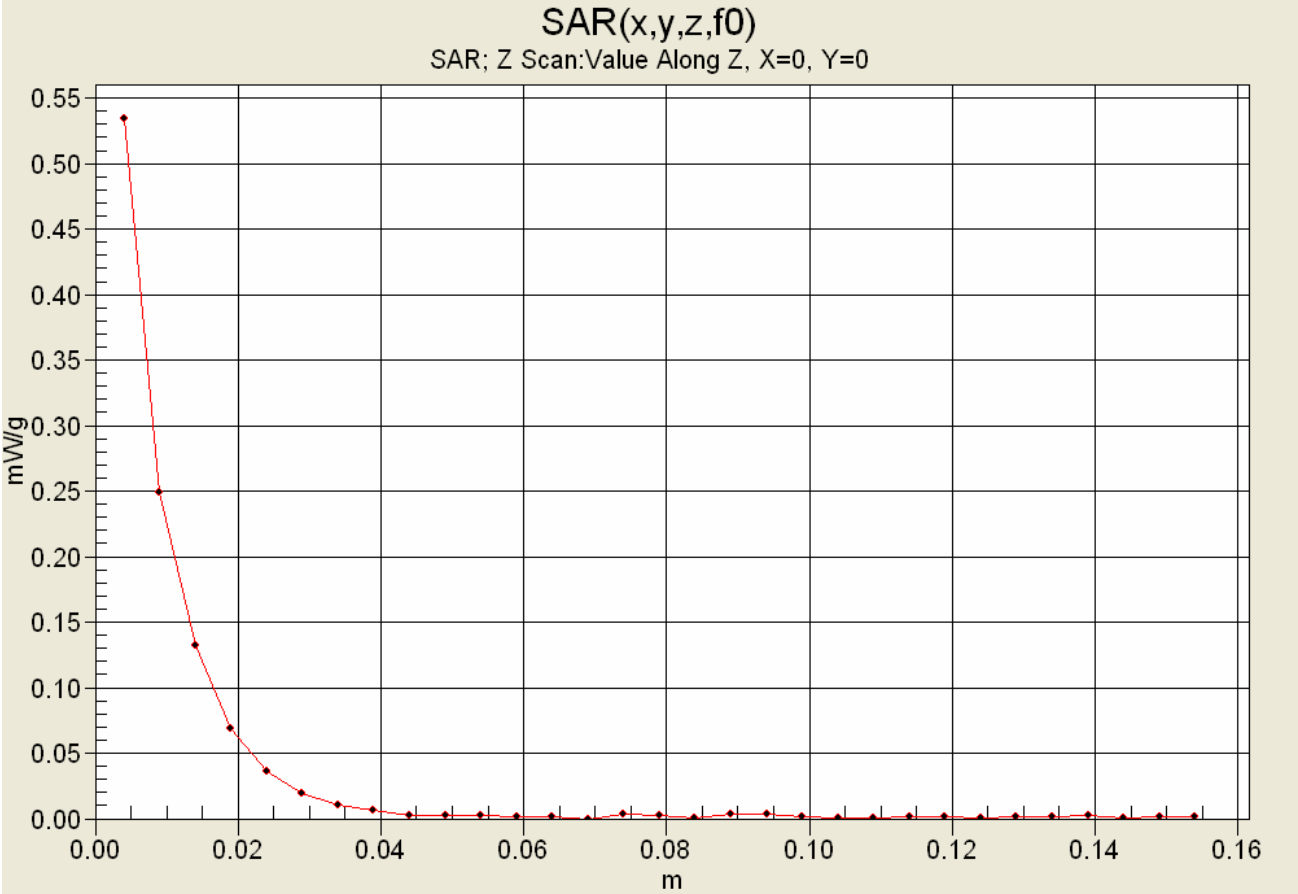
## Z-Axis Scan



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Date Tested: 10/13/2005

## Body-Worn SAR - 802.11b WLAN - Back Side of DUT (Belt-Clip Side) - 0.0 cm Spacing

**DUT: Vocollect Model: Hercules; Type: Waist-Worn Terminal with 802.11b/Bluetooth Combination; Serial: 188**

Ambient Temp: 23.2 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

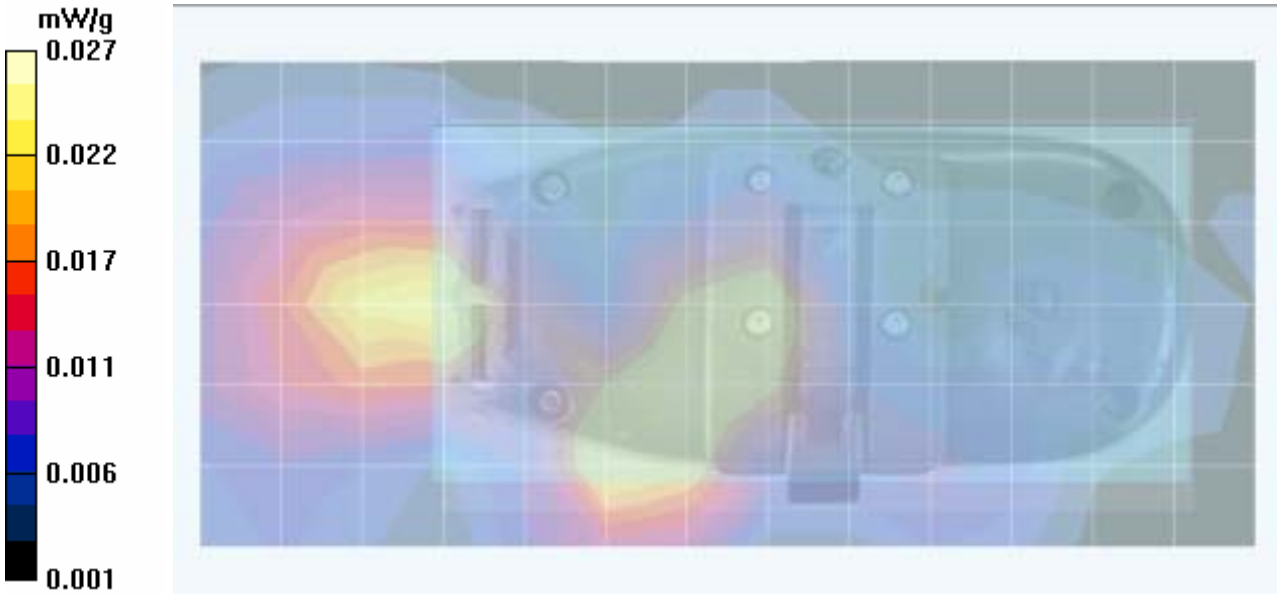
Body-Worn Accessories: Belt with Belt-Clip (P/N: BL-700-4); Audio Accessories: Headset-Microphone (P/N: HD-700-1)

Communication System: DSSS WLAN
RF Output Power: 15.65 dBm (Peak Conducted)
Frequency: 2437 MHz; Channel 6; Duty Cycle: 1:1
3.6V 4400mAh Li-ion Battery Pack (Model: 730022)
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Back Side of DUT to Planar Phantom - Mid Channel Area Scan (7x14x1):** Measurement grid: dx=15mm, dy=15mm

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Back Side of DUT to Planar Phantom - Mid Channel Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.66 V/m; Power Drift = 0.146 dB
Peak SAR (extrapolated) = 0.047 W/kg
**SAR(1 g) = 0.0239 mW/g; SAR(10 g) = 0.014 mW/g**





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Date Tested: 10/13/2005

## Body-Worn SAR - 802.11b WLAN - Top Side of DUT (Button Side) - 0.0 cm Spacing

**DUT: Vocollect Model: Hercules; Type: Waist-Worn Terminal with 802.11b/Bluetooth Combination; Serial: 188**

Ambient Temp: 23.2 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

Body-Worn Accessories: Belt with Belt-Clip (P/N: BL-700-4); Audio Accessories: Headset-Microphone (P/N: HD-700-1)

Communication System: DSSS WLAN
RF Output Power: 15.65 dBm (Peak Conducted)
Frequency: 2437 MHz; Channel 6; Duty Cycle: 1:1
3.6V 4400mAh Li-ion Battery Pack (Model: 730022)
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Top Side of DUT to Planar Phantom - Mid Channel Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Top Side of DUT to Planar Phantom - Mid Channel Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.68 V/m; Power Drift = -0.0443 dB
Peak SAR (extrapolated) = 0.068 W/kg
**SAR(1 g) = 0.0363 mW/g; SAR(10 g) = 0.022 mW/g**



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Date Tested: 10/13/2005

## Body-Worn SAR - 802.11b WLAN - Bottom Side of DUT - 0.0 cm Spacing

**DUT: Vocollect Model: Hercules; Type: Waist-Worn Terminal with 802.11b/Bluetooth Combination; Serial: 188**

Ambient Temp: 23.2 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

Body-Worn Accessories: Belt with Belt-Clip (P/N: BL-700-4); Audio Accessories: Headset-Microphone (P/N: HD-700-1)

Communication System: DSSS WLAN
RF Output Power: 15.65 dBm (Peak Conducted)
Frequency: 2437 MHz; Channel 6; Duty Cycle: 1:1
3.6V 4400mAh Li-Ion Battery Pack (Model: 730022)
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Bottom Side of DUT to Planar Phantom - Mid Channel Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

**Body-Worn SAR - 802.11b - 0.0 cm Separation Distance from Bottom Side of DUT to Planar Phantom - Mid Channel Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.84 V/m; Power Drift = -0.215 dB
Peak SAR (extrapolated) = 0.068 W/kg
**SAR(1 g) = 0.0383 mW/g; SAR(10 g) = 0.022 mW/g**



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Date Tested: 10/13/2005

## Body-Worn SAR - 802.11b WLAN - Front Side of DUT (Battery Side) - 0.0 cm Spacing Simultaneous Transmit with Co-Located Bluetooth

**DUT: Vocollect Model: Hercules; Type: Waist-Worn Terminal with 802.11b/Bluetooth Combination; Serial: 188**

Ambient Temp: 23.2 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

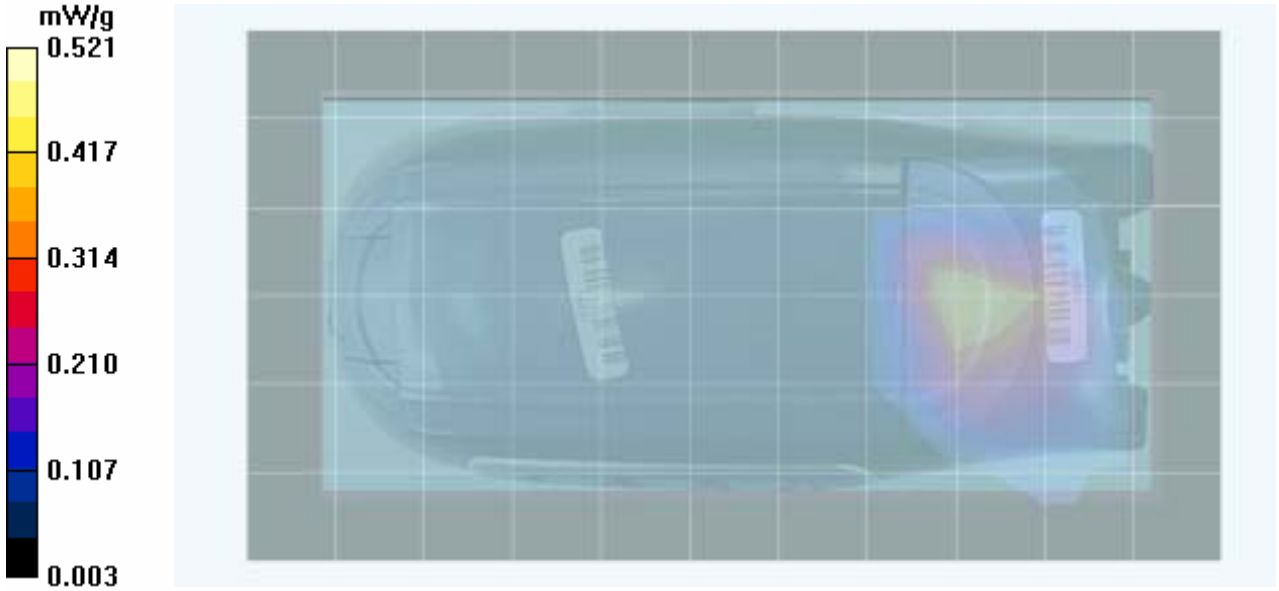
Body-Worn Accessories: Belt with Belt-Clip (P/N: BL-700-4); Audio Accessories: Headset-Microphone (P/N: HD-700-1)

Communication System: DSSS WLAN
RF Output Power: 15.65 dBm (Peak Conducted)
Frequency: 2437 MHz; Channel 6; Duty Cycle: 1:1
3.6V 4400mAh Li-ion Battery Pack (Model: 730022)
Communication System: Modulated Fixed Frequency (Bluetooth)
RF Output Power: 2.4 dBm (Peak Conducted)
Frequency: 2441 MHz; Channel 39; Duty Cycle: 1:1
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

**Body-Worn SAR - 802.11b with Bluetooth - 0.0 cm Separation Distance from Front Side of DUT to Planar Phantom - Mid Channel Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

**Body-Worn SAR - 802.11b with Bluetooth - 0.0 cm Separation Distance from Front Side of DUT to Planar Phantom - Mid Channel Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 13.4 V/m; Power Drift = -0.117 dB
Peak SAR (extrapolated) = 1.11 W/kg
**SAR(1 g) = 0.444 mW/g; SAR(10 g) = 0.182 mW/g**





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# APPENDIX B - SYSTEM PERFORMANCE CHECK DATA


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Date Tested: 10/13/2005

## System Performance Check (Body) - 2450 MHz Dipole

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

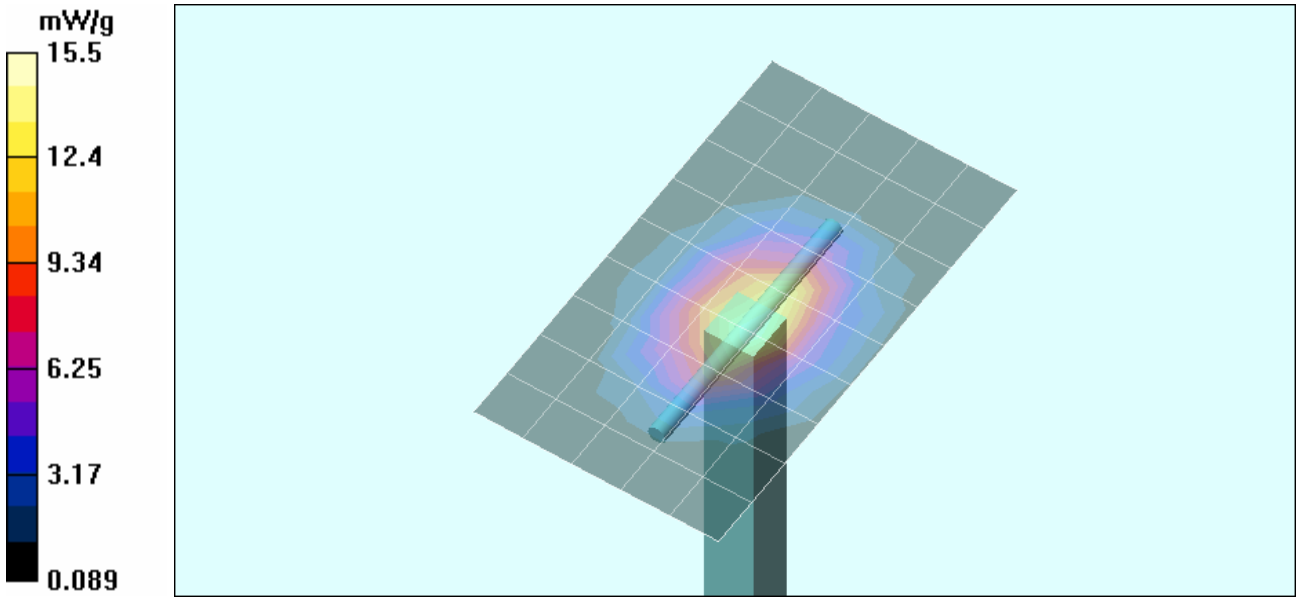
Ambient Temp: 22.8 °C; Fluid Temp: 22.2 °C; Barometric Pressure: 101.9 kPa; Humidity: 32%

Communication System: CW
Forward Conducted Power: 250 mW
Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: M2450 ($\sigma$ = 1.93 mho/m; $\varepsilon_r$ = 50.6; $\rho$ = 1000 kg/m$^3$)

- Probe: ET3DV6 - SN1387; ConvF(4.3, 4.3, 4.3); Calibrated: 18/03/2005
- 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 19; Postprocessing SW: SEMCAD, V1.8 Build 159

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

**2450 MHz Dipole - System Performance Check/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 91.0 V/m; Power Drift = 0.010 dB
Peak SAR (extrapolated) = 32.3 W/kg
**SAR(1 g) = 14.0 mW/g; SAR(10 g) = 6.28 mW/g**





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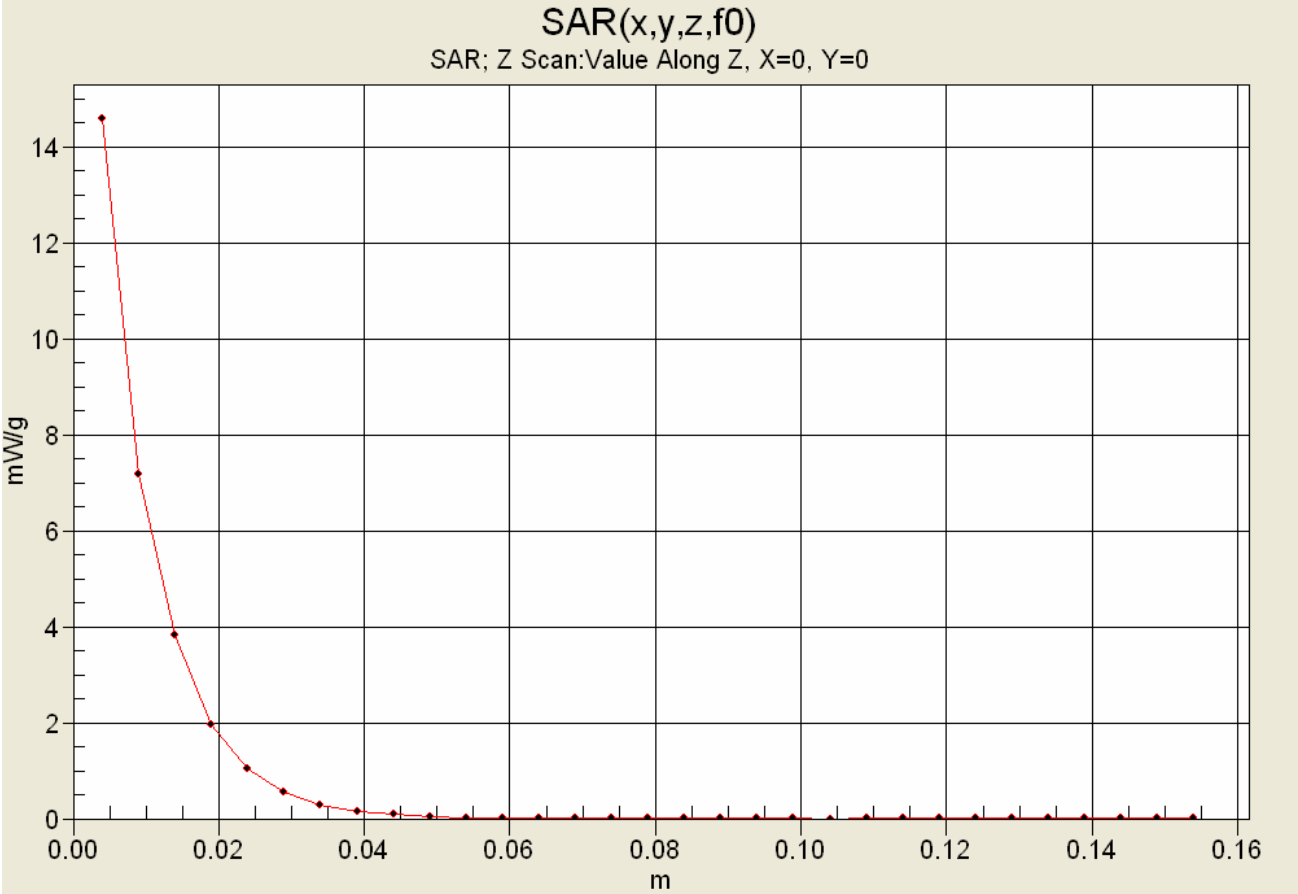
## Z-Axis Scan



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# APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS



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## 2450 MHz System Performance Check & DUT Evaluation (Body)

**********

Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
Thu 13/Oct/2005
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 | 50.77 | 1.827 |
| 2.3600 | 52.82 | 1.86 | 50.73 | 1.838 |
| 2.3700 | 52.81 | 1.87 | 50.88 | 1.872 |
| 2.3800 | 52.79 | 1.88 | 50.88 | 1.892 |
| 2.3900 | 52.78 | 1.89 | 51.07 | 1.919 |
| 2.4000 | 52.77 | 1.90 | 51.00 | 1.927 |
| 2.4100 | 52.75 | 1.91 | 50.97 | 1.913 |
| 2.4200 | 52.74 | 1.92 | 50.92 | 1.921 |
| 2.4300 | 52.73 | 1.93 | 50.71 | 1.911 |
| 2.4400 | 52.71 | 1.94 | 50.68 | 1.920 |
| 2.4500 | 52.70 | 1.95 | 50.56 | 1.925 |
| 2.4600 | 52.69 | 1.96 | 50.42 | 1.967 |
| 2.4700 | 52.67 | 1.98 | 50.52 | 2.007 |
| 2.4800 | 52.66 | 1.99 | 50.49 | 2.023 |
| 2.4900 | 52.65 | 2.01 | 50.76 | 2.059 |
| 2.5000 | 52.64 | 2.02 | 50.76 | 2.080 |
| 2.5100 | 52.62 | 2.04 | 50.85 | 2.085 |
| 2.5200 | 52.61 | 2.05 | 50.74 | 2.091 |
| 2.5300 | 52.60 | 2.06 | 50.72 | 2.090 |
| 2.5400 | 52.59 | 2.08 | 50.42 | 2.073 |
| 2.5500 | 52.57 | 2.09 | 50.38 | 2.085 |


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# APPENDIX D - SAR TEST SETUP PHOTOGRAPHS


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# SAR TEST SETUP PHOTOGRAPHS

**0.0 cm Separation Distance from Front Side (Battery Side) of DUT to Planar Phantom**
**With Belt, Belt-Clip, & Headset-Microphone Accessories**



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# SAR TEST SETUP PHOTOGRAPHS

**0.0 cm Separation Distance from Back Side (Belt-Clip Side) of DUT to Planar Phantom**
**With Belt, Belt-Clip, & Headset-Microphone Accessories**



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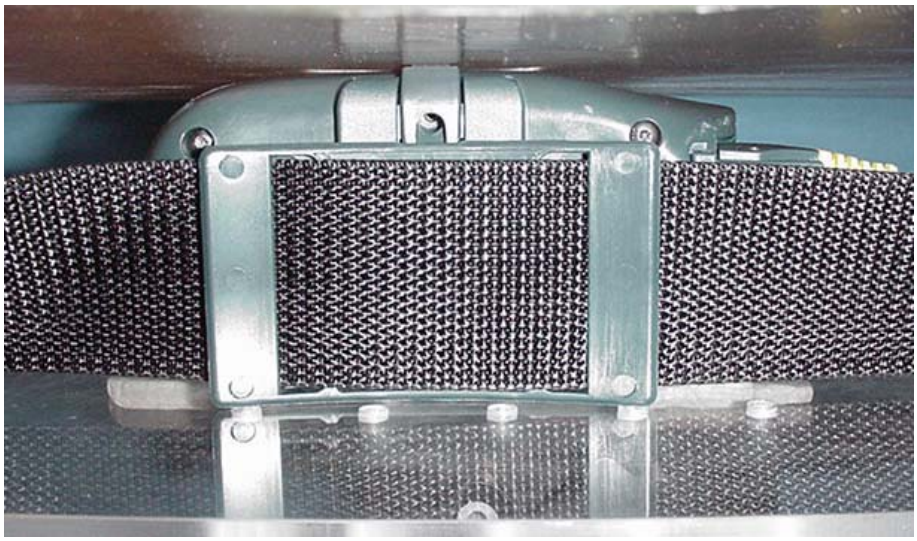
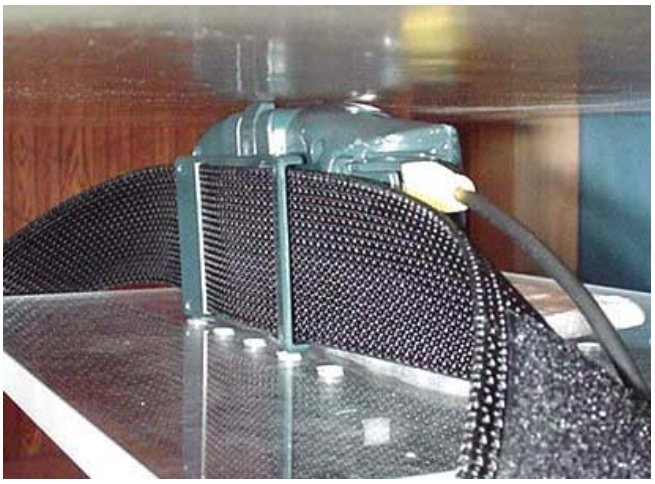
# SAR TEST SETUP PHOTOGRAPHS

**0.0 cm Separation Distance from Top Side (Button Side) of DUT to Planar Phantom**
**With Belt, Belt-Clip, & Headset-Microphone Accessories**







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# SAR TEST SETUP PHOTOGRAPHS

**0.0 cm Separation Distance from Bottom Side of DUT to Planar Phantom**
**With Belt, Belt-Clip, & Headset-Microphone Accessories**



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# DUT PHOTOGRAPHS


**Front Side of DUT**

**Back Side of DUT**



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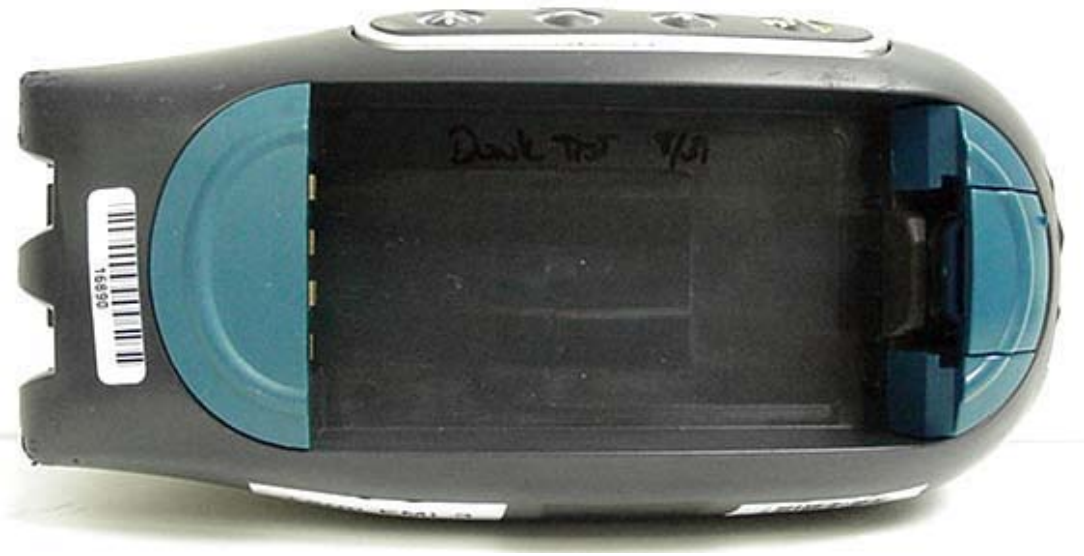
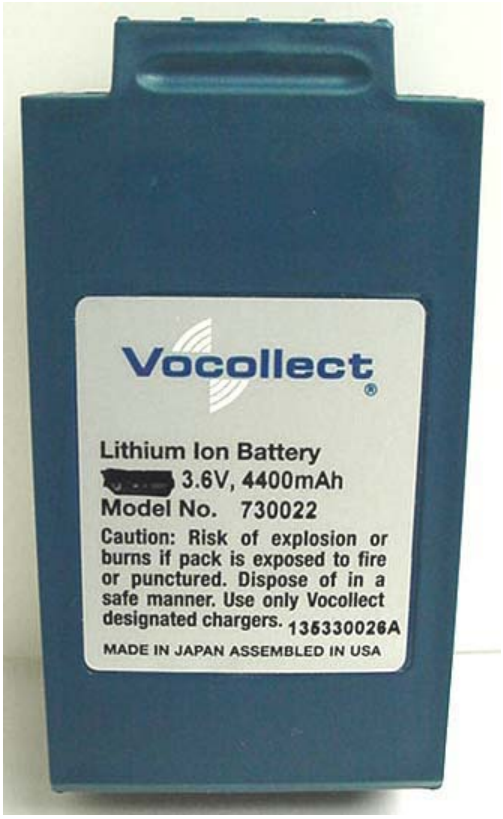
# DUT PHOTOGRAPHS



**DUT Battery Compartment**




**Lithium-ion Battery**



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# DUT PHOTOGRAPHS

**DUT with Belt & Belt-Clip Accessory (P/N: BL-700-4)**

**DUT with Belt & Belt-Clip Accessory (P/N: BL-700-4)**

**DUT with Headset-Microphone Accessory (P/N: HD-700-1)**



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# DUT PHOTOGRAPHS

**Top Side of DUT**


**Bottom Side of DUT**


**Battery Latch end**


**Plug-in Accessory end**



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# APPENDIX E - SYSTEM VALIDATION


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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.**

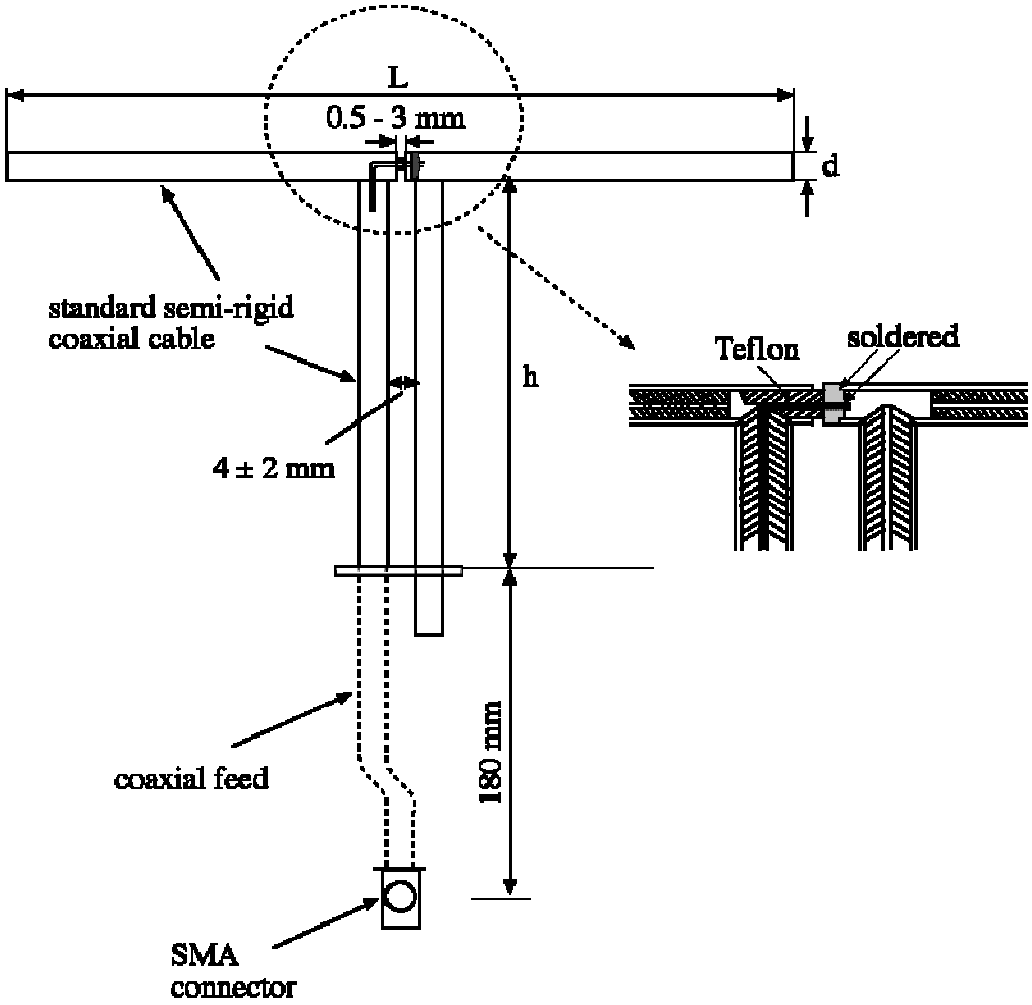
Calibrated by: 

Approved by: 

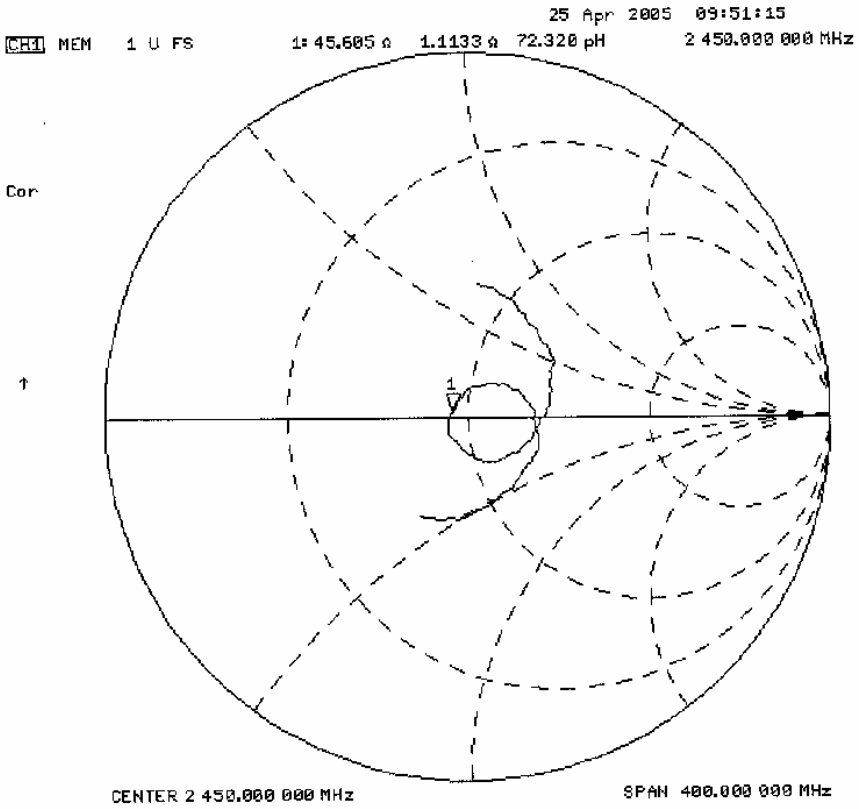
## 1. Dipole Construction & Electrical Characteristics

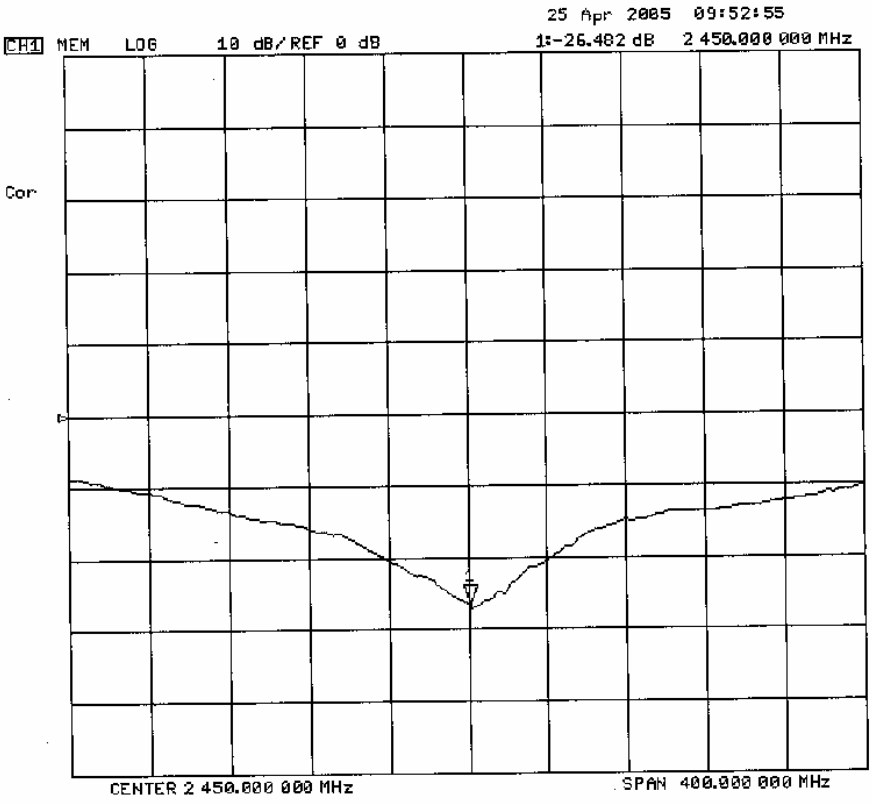
The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network 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 | Re{Z} = 45.605Ω |
| | Im{Z} = 1.1133Ω |
| Return Loss at 2450 MHz | -26.482 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:

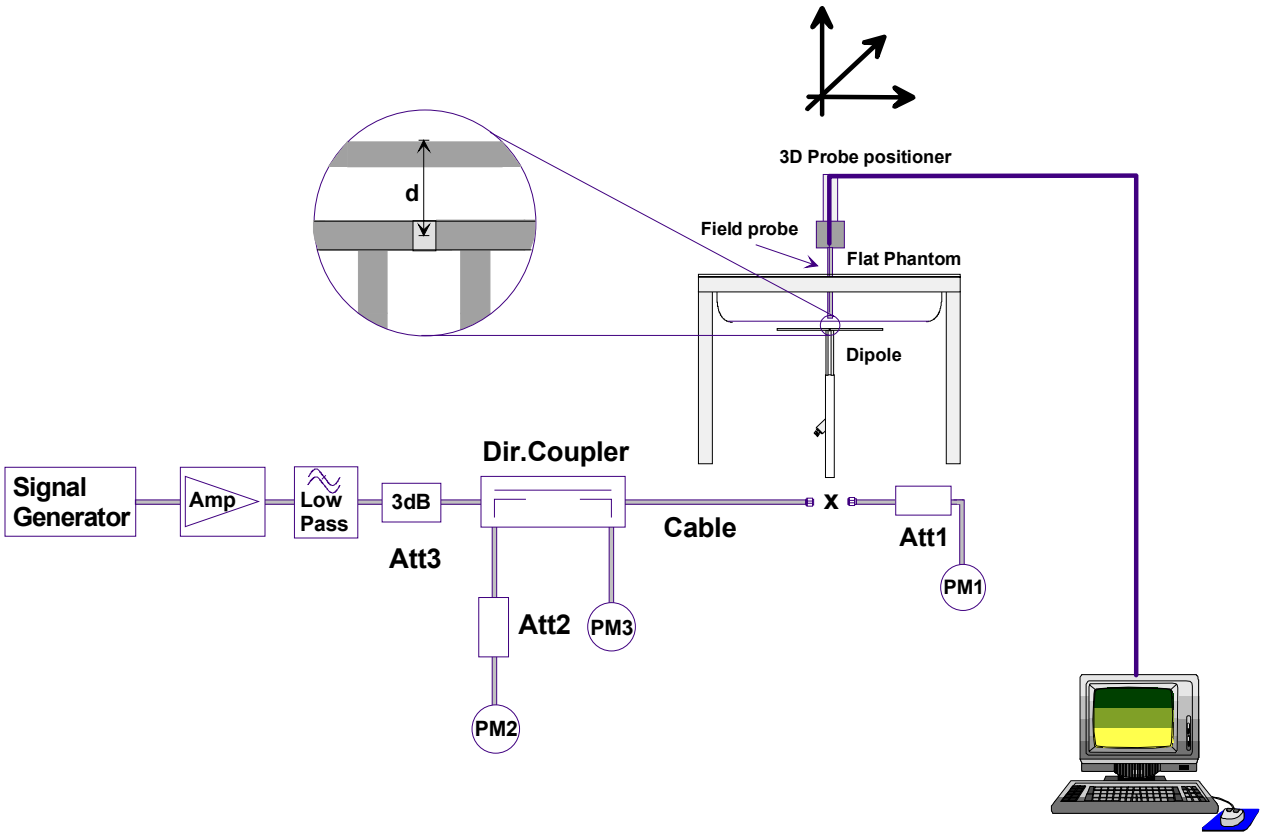
| | |
|---|---|
| Ambient Temperature: | 25.7 °C |
| Humidity: | 30 % |
| Barometric Pressure: | 102.6 kPa |

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 | $\varepsilon_r$ = 52.7 (+/-5%)<br>$\sigma$ = 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% | 23.48 | - 0.93 |

| 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 ºC; Fluid Temp: 23.9 ºC; 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; $\varepsilon_r$ = 50.2; $\rho$ = 1000 kg/m$^3$
- 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**

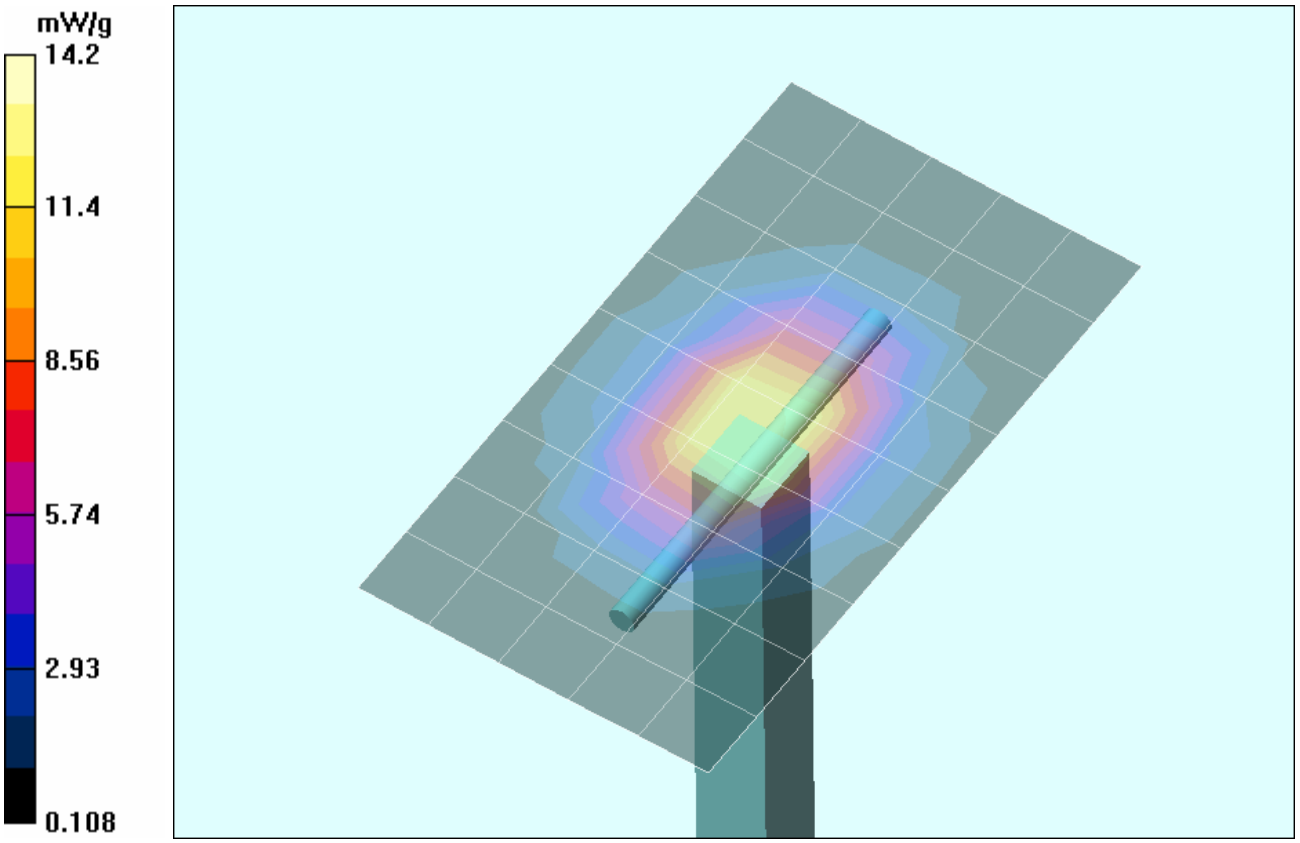
**2450 MHz System Validation/Zoom Scan 6 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.0 V/m; Power Drift = -0.042 dB
Peak SAR (extrapolated) = 27.8 W/kg
**SAR(1 g) = 12.6 mW/g; SAR(10 g) = 5.87 mW/g**

**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**

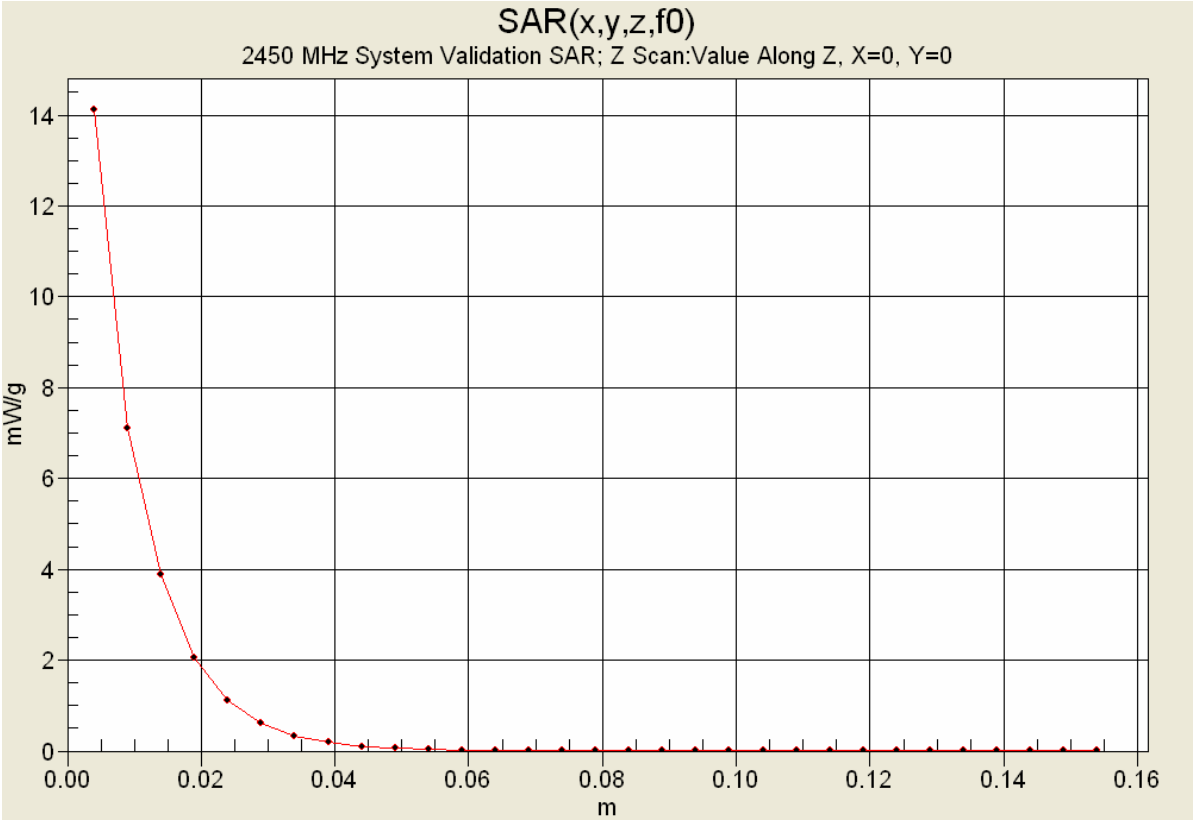
**2450 MHz System Validation/Zoom Scan 8 (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.4 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 27.8 W/kg
**SAR(1 g) = 12.7 mW/g; SAR(10 g) = 5.88 mW/g**

**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 | e' | e" |
|---|---|---|
| 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 |

# APPENDIX G - PLANAR PHANTOM CERTIFICATE OF CONFORMITY



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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<br>Relative permittivity<5<br>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**

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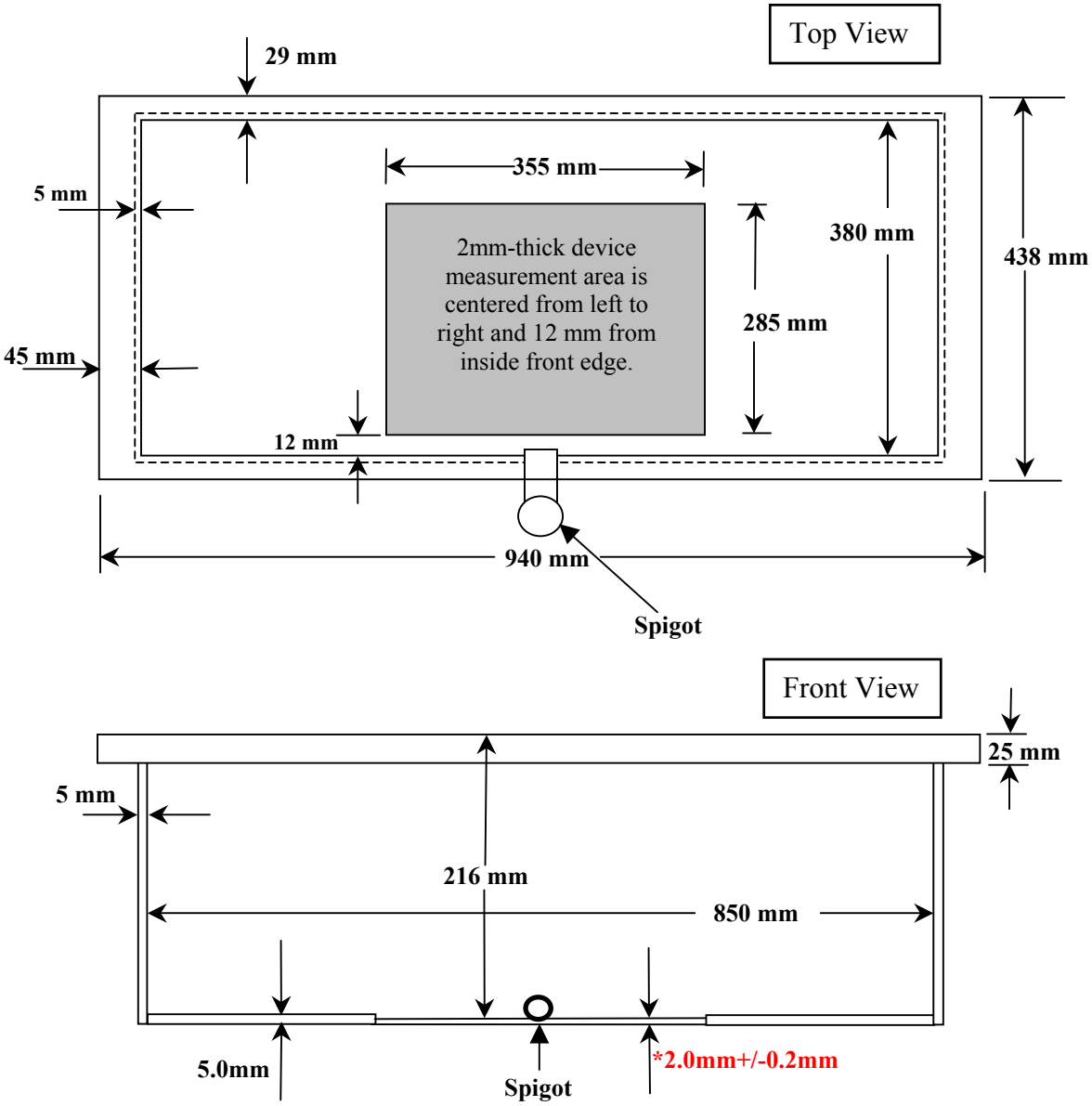
# Dimensions of Fiberglass Planar Phantom

**(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.**

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