

**PCTEST ENGINEERING LABORATORY, INC.**  
**6660 – B Dobbin Road · Columbia, MD 21045 · USA**  
**Telephone 410.290.6652 / Fax 410.290.6654**  
<http://www.pctestlab.com> (email: [randy@pctestlab.com](mailto:randy@pctestlab.com))  
**CERTIFICATE OF COMPLIANCE**  
**(SAR EVALUATION)**



**APPLICANT NAME & ADDRESS:**  
**MOTOROLA, INC.**  
**8000 West Sunrise Blvd.**  
**Ft. Lauderdale, FL 33322**

**DATE & LOCATION OF TESTING:**  
**Dates of Tests: April 18-20, 2006**  
**Additional Test Dates: May 4, 2006**  
**Test Report S/N: 0604170281-R4**  
**Test Site: PCTEST Lab, Columbia MD**

<b>FCC ID:</b>	<b>AZ489FT7010</b>
<b>APPLICANT:</b>	<b>MOTOROLA, INC.</b>

**EUT Type:** Handheld Terminal with GSM, Bluetooth and WLAN Transceivers  
**Tx Frequency:** 824.20 – 848.80MHz (GSM850) / 1850.20MHz – 1909.80MHz (GSM1900)  
 2402 – 2480 MHz (Bluetooth) / 2412 – 2462 MHz (WLAN)  
**Rx Frequency:** 869.20 – 893.80MHz (GSM850) / 1930.20MHz – 1989.80MHz (GSM1900)  
 2402 – 2480 MHz (Bluetooth) / 2412 – 2462 MHz (WLAN)  
**Max. RF Output Power:** 0.630 W GSM850 Conducted; 0.807 W PCS GSM Conducted;  
 56 mW WLAN; 2.0 mW Bluetooth  
**Max. SAR Measurement:** GSM850: 0.1489 W Body SAR; GSM1900: 0.2161 W Body SAR;  
 WLAN: 0.5821 W Body SAR  
**Trade Name/Model(s):** F4423A  
**FCC Classification:** Licensed Portable Transmitter worn on Body (PCT)  
 Digital Transmission System (DTS)  
 Spread Spectrum Transceiver (DSS)  
**FCC Rule Part(s):** §2.1093; FCC/OET Bulletin 65 Supplement C [July 2001]  
**Application Type:** Certification  
**Test Device Serial No.:** pilot vintage [S/N: #00039-082-693-121]

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528 – 2003.

I attest to the accuracy of data. All measurements reported herein 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.

\*NOTE: This revised Test Report (S/N: 0604170281-R4) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued report (S/N: 0604170281/-R1/-R2/-R3) and dispose of it accordingly.

**Grant Conditions:** Power output listed is ERP for Part 22 and EIRP for Part 24. SAR compliance for body-worn operating configuration is based on the specific Belt clip tested in this filing. End-users must be informed of the body-worn operating requirements for satisfying RF exposure compliance.

*PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.*

Randy Ortíz  
President



<b>PCTEST SAR REPORT</b>	<b>FCC MEASUREMENT REPORT</b>				<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 1 of 20

## TABLE OF CONTENTS

<b>1.</b>	<b>INTRODUCTION / SAR DEFINITION .....</b>	<b>3</b>
<b>2.</b>	<b>SAR MEASUREMENT SETUP .....</b>	<b>4</b>
<b>3.</b>	<b>DASY4 E-FIELD PROBE SYSTEM .....</b>	<b>5</b>
<b>4.</b>	<b>PROBE CALIBRATION PROCESS .....</b>	<b>6</b>
<b>5.</b>	<b>PHANTOM &amp; EQUIVALENT TISSUES .....</b>	<b>7</b>
<b>6.</b>	<b>TEST SYSTEM SPECIFICATIONS .....</b>	<b>8</b>
<b>7.</b>	<b>TEST CONFIGURATION POSITIONS .....</b>	<b>9</b>
<b>8.</b>	<b>ANSI/IEEE C95.1 - 1992 RF EXPOSURE LIMITS .....</b>	<b>10</b>
<b>9.</b>	<b>MEASUREMENT UNCERTAINTIES .....</b>	<b>11</b>
<b>10.</b>	<b>SYSTEM VERIFICATION .....</b>	<b>12-13</b>
<b>11.</b>	<b>SAR TEST DATA SUMMARY .....</b>	<b>14-17</b>
<b>12.</b>	<b>SAR TEST EQUIPMENT .....</b>	<b>18</b>
<b>13.</b>	<b>CONCLUSION .....</b>	<b>19</b>
<b>14.</b>	<b>REFERENCES .....</b>	<b>20</b>

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>		<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers <b>FCC ID:</b> AZ489FT7010 Page 2 of 20

# 1. INTRODUCTION / SAR DEFINITION

The FCC has adopted the guidelines for evaluating the environmental effects of radiofrequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.[1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in *IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*. (c) 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017.[2] The measurement procedure described in *IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*[3] is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in *Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields*, NCRP Report No. 86 (c) NCRP, 1986, Bethesda, MD 20814.[6] SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

## SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy ( $dU$ ) absorbed by (dissipated in) an incremental mass ( $dm$ ) contained in a volume element ( $dV$ ) of a given density ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1).

$$SAR = \frac{d}{dt} \left( \frac{dU}{dm} \right) = \frac{d}{dt} \left( \frac{dU}{\rho dV} \right)$$

**Figure 1.1**  
**SAR Mathematical Equation**

**SAR is expressed in units of Watts per Kilogram (W/kg).**

$$SAR = s E^2 / \rho$$

where:

- $s$  = conductivity of the tissue-simulant material (S/m)
- $\rho$  = mass density of the tissue-simulant material (kg/m<sup>3</sup>)
- $E$  = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>		<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers <b>FCC ID:</b> AZ489FT7010 Page 3 of 20

## 2. SAR MEASUREMENT SETUP

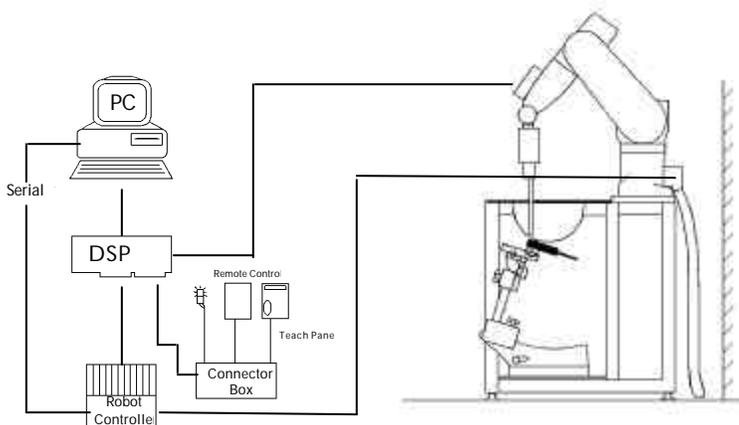
### Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the body equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

### System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Gateway Pentium 4 2.53 GHz computer with Windows XP system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that 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 PC plug-in card.

### System Electronics



**Figure 2.1 SAR Measurement System Setup**

The DAE4 consists of 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 PC-card 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. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010
				Page 4 of 20

## 3. DASY4 E-FIELD PROBE SYSTEM

### Probe Measurement System



Figure 3.1 DAE System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration [7] (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2<sup>nd</sup> order fitting (see Fig.3.1). The approach is stopped at reaching the maximum.

### Probe Specifications

Calibration:	In air from 10 MHz to 6 GHz In head and body simulating tissue at Frequencies of 150 MHz, 450 MHz, 835 MHz, 900 MHz, 1900MHz, 2450MHz, 5300MHz, & 5800MHz
Frequency:	10 MHz to > 6 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
Directivity:	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.4$ dB in HSL (rotation normal probe axis)
Dynamic:	5 mW/g to > 100 mW/g;
Range:	Linearity: $\pm 0.2$ dB
Dimensions:	Overall length: 330 mm Tip length: 16 mm Body diameter: 12 mm Tip diameter: 3 mm Distance from probe tip to dipole centers: 2 mm
Application:	General dosimetry up to 6 GHz Compliance tests of mobile phones  Fast automatic scanning in arbitrary phantoms

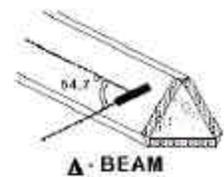


Figure 3.1 Triangular Probe Configuration



Figure 3.2 Probe Thick-Film Technique

<b>PCTEST SAR REPORT</b>	<b>FCC MEASUREMENT REPORT</b>				<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 5 of 20

## 4. Probe Calibration Process

### Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in [8] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [9] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

### Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz (see Fig. 4.1), and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

### Temperature Assessment \*

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The measured free space Efield in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. 4.2).

$$SAR = C \frac{\Delta T}{\Delta t}$$

where:

- $\Delta t$  = exposure time (30 seconds),
- C = heat capacity of tissue (brain or muscle),
- $\Delta T$  = temperature increase due to RF exposure.

SAR is proportional to  $\Delta T / \Delta t$ , the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

$$SAR = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

- $\sigma$  = simulated tissue conductivity,
- $\rho$  = Tissue density (1.25 g/cm<sup>3</sup> for brain tissue)

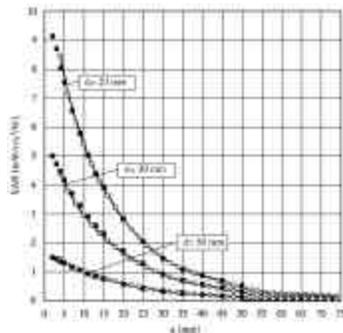


Figure 4.1 E-Field and Temperature measurements at 900MHz [7]

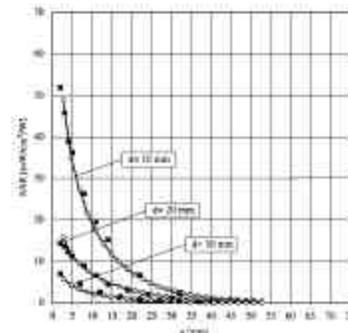


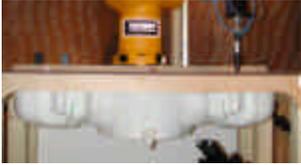
Figure 4.2 E-Field and temperature measurements at 1.9GHz [7]

\*NOTE: The temperature calibration was not performed by PCTEST. For information use only.

<b>PCTEST SAR REPORT</b>	<b>FCC MEASUREMENT REPORT</b>				<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT010	Page 6 of 20

# 5. PHANTOM & EQUIVALENT TISSUES

## SAM Phantom



**Figure 5.1 SAM Twin Phantom**

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [11][12]. It enables the dosimetric evaluation of left and right hand terminal usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 5.1)

## Head & Body Simulating Mixture Characterization



**Figure 5.2 Simulated Tissue**

The head and body mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution (see Table 6.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations. The mixture characterizations used for the head and body tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove [13]. (see Fig. 5.2)

**Table 5.1 Composition of the Head & Body Tissue Equivalent Matter**

INGREDIENTS		SIMULATING TISSUE					
		835MHz Head	835MHz Body	1900MHz Head	1900MHz Body	2450MHz Head	2450MHz Body
Mixture Percentage							
WATER		41.45	52.50	54.90	59.98	62.70	73.2
DGBE		0.000	0.000	44.92	38.41	0.000	26.7
SUGAR		56.00	45.00	0.000	58.00	0.000	0.000
SALT		1.450	1.400	0.180	0.100	0.5	0.04
BACTERIACIDE		0.100	0.100	0.000	0.100	0.000	0.000
HEC		1.000	1.000	0.000	1.410	0.000	0.000
Dielectric Constant	Target	41.50	55.20	40.00	53.30	39.20	52.70
Conductivity (S/m)	Target	0.900	0.970	1.40	1.52	1.80	1.95

## Device Holder for Transmitters



**Figure 5.2 Mounting Device**

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.2) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

\* Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

<b>PCTEST SAR REPORT</b>	<b>FCC MEASUREMENT REPORT</b>				<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 7 of 20

# 6. TEST SYSTEM SPECIFICATIONS

## Automated Test System Specifications

### Positioner

**Robot:** Stäubli Unimation Corp. Robot Model: RX60L  
**Repeatability:** 0.02 mm  
**No. of axis:** 6



Figure 6.1 DASY4 Test System

### Data Acquisition Electronic (DAE) System

#### Cell Controller

**Processor:** Pentium 4  
**Clock Speed:** 2.53 GHz  
**Operating System:** Windows XP Professional

#### Data Converter

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

### PC Interface Card

**Function:** 24 bit (64 MHz) DSP for real time processing  
 Link to DAE4  
 16 bit A/D converter for surface detection system  
 serial link to robot  
 direct emergency stop output for robot

### E-Field Probes

**Model:** EX3DV4                      S/N: 3561  
**Construction:** Triangular core  
**Frequency:** 10 MHz to 6 GHz  
**Linearity:** ± 0.2 dB (30 MHz to 6 GHz)

### Phantom

**Phantom:** SAM Twin Phantom (V4.0)  
**Shell Material:** VIVAC Composite  
**Thickness:** 2.0 ± 0.2 mm

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 8 of 20

## 7. TEST CONFIGURATION POSITIONS

### Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 9.5). A device with a terminal output is tested with a terminal connected to the device. Body dielectric parameters are used.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.



**Figure 9.5 Typical Body Belt Clip & Holster Configurations  
Example Photo Only  
(Not Actual EUT)**

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 9 of 20

## 8. ANSI/IEEE C95.1 - 1992 RF EXPOSURE LIMITS

### Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

### Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 10.1. Safety Limits for Partial Body Exposure [2]**

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR <sup>1</sup> Head	1.60	8.00
SPATIAL AVERAGE SAR <sup>2</sup> Whole Body	0.08	0.40
SPATIAL PEAK SAR <sup>3</sup> Hands, Feet, Ankles, Wrists	4.00	20.00

- 1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
- 2 The Spatial Average value of the SAR averaged over the whole body.
- 3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

<b>PCTEST SAR REPORT</b>	FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010
				Page 10 of 20

## 9. MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = cxf/e	i = cxg/e	k
Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	c <sub>i</sub> (1 - g)	c <sub>i</sub> (10 - g)	1 - g u <sub>i</sub> (± %)	10 - g u <sub>i</sub> (± %)	v <sub>i</sub>
<b>Measurement System</b>									
Probe Calibration	E1.1	5.9	N	1	1	1	5.9	5.9	∞
Axial Isotropy	E1.2	4.7	R	√3	0.7	0.7	1.9	1.9	∞
Hemishperical Isotropy	E1.2	9.6	R	√3	0.7	0.7	3.9	3.9	∞
Boundary Effect	E1.3	1.0	R	√3	1	1	0.6	0.6	∞
Linearity	E1.4	4.7	R	√3	1	1	2.7	2.7	∞
System Detection Limits	E1.5	1.0	R	√3	1	1	0.6	0.6	∞
Readout Electronics	E1.6	1.0	N	1	1	1	1.0	1.0	∞
Response Time	E1.7	0.8	R	√3	1	1	0.5	0.5	∞
Integration Time	E1.8	2.6	R	√3	1	1	1.5	1.5	∞
RF Ambient Conditions	E5.1	3.0	R	√3	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E5.2	0.4	R	√3	1	1	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E5.3	2.9	R	√3	1	1	1.7	1.7	∞
Extrapolation, Interpolation & Integration Algorithms for Max. SAR Evaluation	E4.2	1.0	R	√3	1	1	0.6	0.6	∞
<b>Test Sample Related</b>									
Test Sample Positioning	E3.2.1	2.9	N	1	1	1	2.9	2.9	145
Device Holder Uncertainty	E3.1.1	3.6	N	1	1	1	3.6	3.6	5
Output Power Variation - SAR drift measurement	5.6.2	5.0	R	√3	1	1	2.9	2.9	∞
<b>Phantom &amp; Tissue Parameters</b>									
Phantom Uncertainty (Shape & Thickness tolerances)	E2.1	4.0	R	√3	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E2.2	5.0	R	√3	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E2.2	2.5	N	1	0.64	0.43	1.6	1.1	∞
Liquid Permittivity - deviation from target values	E2.2	5.0	R	√3	0.6	0.5	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E2.2	2.5	N	1	0.6	0.5	1.5	1.2	∞
<b>Combined Standard Uncertainty (k=1)</b>				RSS			10.8	10.6	
<b>Expanded Uncertainty (k=2)</b> (95% CONFIDENCE LEVEL)							21.7	21.2	

The above measurement uncertainties are according to IEEE Std. P1528 D1.2 (April 2003).

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 11 of 20

# 10. SYSTEM VERIFICATION

## Tissue Verification

**Table 12.1 Simulated Tissue Verification [5]**

<b>MEASURED TISSUE PARAMETERS</b>									
Date(s)	04/18/2006 - 04/20/2006 & 05/04/2006	835MHz Head		835MHz Body		1900MHz Head		1900MHz Body	
Liquid Temperature (°C)		Target	Measured	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: $\epsilon$		41.50	42.55	55.20	56.24	40.00	40.98	53.30	52.53
Conductivity: $\sigma$		0.900	0.89	0.970	0.99	1.400	1.37	1.520	1.58
<b>MEASURED TISSUE PARAMETERS</b>									
Date(s)	04/18/2006 - 04/20/2006 & 05/04/2006	2450MHz Head			2450MHz Body				
Liquid Temperature (°C)		Target		Measured		Target		Measured	
Dielectric Constant: $\epsilon$		39.20		38.43		52.70		53.14	
Conductivity: $\sigma$		1.80		1.82		1.95		1.93	
<b>MEASURED TISSUE PARAMETERS</b>									
Date(s)	04/18/2006 - 04/20/2006 & 05/04/2006	835MHz Head		1900MHz Head		2450MHz Head			
Liquid Temperature (°C)		Target	Measured	Target	Measured	Target	Measured		
Dielectric Constant: $\epsilon$		41.50	42.18	40.00	41.13	39.20	38.62		
Conductivity: $\sigma$		0.900	0.90	1.400	1.38	1.800	1.83		

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT		<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010

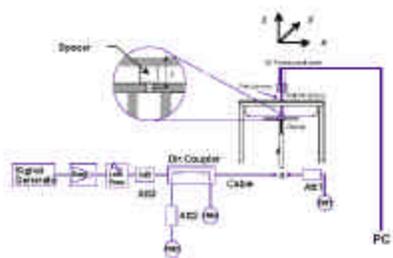
# 10. SYSTEM VERIFICATION (Continued)

## Test System Validation

Prior to assessment, the system is verified to the  $\pm 10\%$  of the specifications at 835MHz, 1900MHz and 2450 MHz by using the system validation kit(s). (Graphic Plots Attached)

**Table 12.2 System Validation [5]**

SYSTEM VALIDATION TARGET & MEASURED							
Date:	Amb. Temp (°C)	Liquid Temp (°C)	Input Power (W)	Tissue	Targeted SAR1g (mW/g)	Measured SAR1g (mW/g)	Deviation (%)
04/19/2006	23.5	21.6	<b>0.250</b>	<b>835 MHz Head</b>	<b>2.38</b>	<b>2.440</b>	<b>2.73</b>
05/04/2006	23.2	21.6				<b>2.490</b>	<b>4.84</b>
04/20/2006	23.4	21.5	<b>0.100</b>	<b>1900 MHz Head</b>	<b>3.97</b>	<b>4.090</b>	<b>3.02</b>
05/04/2006	23.2	21.4				<b>4.130</b>	<b>4.03</b>
04/18/2006	23.4	21.2	<b>0.100</b>	<b>2450MHz Head</b>	<b>5.240</b>	<b>5.460</b>	<b>4.19</b>
05/04/2006	23.2	21.4				<b>5.420</b>	<b>3.43</b>



**Figure 12.1 Dipole Validation Test Setup**

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
SAR Filename: 0604170281-R4	Test Dates: April 18-20, 2006	Additional Test Dates: May 4, 2006	EUT: Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	FCC ID: AZ489FT7010	Page 13 of 20

# 11. SAR TEST DATA SUMMARY

## See Measurement Result Data Pages

### Procedures Used To Establish Test Signal

The terminal was placed into simulated call mode (Cellular GSM, PCS GSM, Bluetooth and WLAN modes) using manufacturers test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR [4]. When test modes are not available or inappropriate for testing a handset, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

### Device Test Conditions

The handset is battery operated. Each SAR measurement was taken with a fully charged battery. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated.

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010 Page 14 of 20

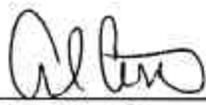
# SAR DATA SUMMARY (Continued)

Mixture Type: 850MHz Body

<b>11.1 MEASUREMENT RESULTS (GSM850 Body SAR)</b>										
FREQUENCY		Modulation	Begin / End POWER <sup>‡</sup>			Carry Case	Device Test Position	SAR W/kg	Drift dB	Cal SAR W/kg
MHz	Ch.		(dBm)	Battery						
836.60	190	GSM	28.02	27.91	FTN6032B	FHN6498A	W/ Holster	<b>0.1450</b>	-0.114	<b>0.1489</b>
836.60	190	GSM	28.02	27.74	FTN6032B	None	Bystander	0.0536	-0.283	0.0572
836.60	190	GSM	28.02	28.08	FTN6032B	None	Touch-Bottom	0.0454	0.061	0.0448
836.60	190	GSM	28.02	28.22	FTN6032B	None	2.5 cm Front	0.0367	0.196	0.0351
836.60	190	GSM	28.02	28.19	FTN6032B	None	2.5 cm Back	0.0558	0.166	0.0537
*836.60	190	GSM	28.00	27.90	FTN6032B	FHN6498A	W/ Holster	<b>0.1440</b>	-0.100	<b>0.1474</b>
<b>ANSI / IEEE C95.1 1992 - SAFETY LIMIT</b>						<b>Body</b>				
<b>Spatial Peak</b>						<b>1.6 W/kg (mW/g)</b>				
<b>Uncontrolled Exposure/General Population</b>						averaged over 1 gram				

**NOTES:**

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated including all data bit rates, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard batteries are the only option.
- |                                     |                                     |                  |                                     |                        |                          |            |
|-------------------------------------|-------------------------------------|------------------|-------------------------------------|------------------------|--------------------------|------------|
| <sup>‡</sup> Power Measured         | <input checked="" type="checkbox"/> | Conducted        | <input type="checkbox"/>            | ERP                    | <input type="checkbox"/> | EIRP       |
| 4. SAR Measurement System           | <input checked="" type="checkbox"/> | DASY4            | <input type="checkbox"/>            | IDX                    | <input type="checkbox"/> |            |
| Phantom Configuration               | <input type="checkbox"/>            | Left Head        | <input checked="" type="checkbox"/> | Flat Phantom           | <input type="checkbox"/> | Right Head |
| 5. SAR Configuration                | <input type="checkbox"/>            | Head             | <input checked="" type="checkbox"/> | Body                   | <input type="checkbox"/> | Hand       |
| 6. Test Signal Call Mode            | <input checked="" type="checkbox"/> | Manu. Test Codes | <input type="checkbox"/>            | Base Station Simulator |                          |            |
| 7. <sup>**</sup> Test Configuration | <input checked="" type="checkbox"/> | With Beltclip    | <input type="checkbox"/>            | Without Beltclip       |                          |            |
8. Tissue parameters and temperatures are listed on the SAR plots.
9. Both sides of the terminal were tested and the worst-case side is reported.
10. Liquid tissue depth is 15.1 cm. ± 0.1
- \*11. EUT tested with Bluetooth ON.

  
 \_\_\_\_\_  
**Alfred Cirwithian**  
 Vice President Engineering

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>		<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers <b>FCC ID:</b> AZ489FT7010 Page 15 of 20

# SAR DATA SUMMARY (Continued)

Mixture Type: 1900MHz Body

<b>11.2 MEASUREMENT RESULTS (GSM1900 Body SAR)</b>										
FREQUENCY		Modulation	Begin / End POWER <sup>‡</sup>			Carry Case	Device Test Position	SAR W/kg	Drift dB	Cal SAR W/kg
MHz	Ch.		(dBm)		Battery					
1880.00	661	GSM	29.08	29.28	FTN6032B	FHN6498A	W/ Holster	<b>0.2260</b>	0.195	<b>0.2161</b>
1880.00	661	GSM	29.08	29.13	FTN6032B	None	Bystander	0.0372	0.046	0.0368
1880.00	661	GSM	29.08	29.34	FTN6032B	None	Touch-Bottom	0.0321	0.264	0.0302
1880.00	661	GSM	29.08	28.92	FTN6032B	None	2.5 cm Front	0.0114	-0.159	0.0118
1880.00	661	GSM	29.08	29.35	FTN6032B	None	2.5 cm Back	0.1350	0.265	0.1270
*1880.00	661	GSM	29.08	29.28	FTN6032B	FHN6498A	W/ Holster	<b>0.2258</b>	0.193	<b>0.2160</b>
<b>ANSI / IEEE C95.1 1992 - SAFETY LIMIT</b>						<b>Body</b>				
<b>Spatial Peak</b>						<b>1.6 W/kg (mW/g)</b>				
<b>Uncontrolled Exposure/General Population</b>						averaged over 1 gram				

**NOTES:**

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated including all data bit rates, and worst-case results are reported.
3. Battery is fully charged for all readings. Standard batteries are the only option.
 

<sup>‡</sup> Power Measured	<input checked="" type="checkbox"/> Conducted	<input type="checkbox"/> ERP	<input type="checkbox"/> EIRP
-----------------------------	-----------------------------------------------	------------------------------	-------------------------------
4. SAR Measurement System
 

<input checked="" type="checkbox"/> DASY4	<input type="checkbox"/> IDX
-------------------------------------------	------------------------------

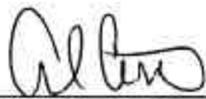
 Phantom Configuration
 

<input type="checkbox"/> Left Head	<input checked="" type="checkbox"/> Flat Phantom	<input type="checkbox"/> Right Head
------------------------------------	--------------------------------------------------	-------------------------------------
5. SAR Configuration
 

<input type="checkbox"/> Head	<input checked="" type="checkbox"/> Body	<input type="checkbox"/> Hand
-------------------------------	------------------------------------------	-------------------------------
6. Test Signal Call Mode
 

<input checked="" type="checkbox"/> Manu. Test Codes	<input type="checkbox"/> Base Station Simulator
------------------------------------------------------	-------------------------------------------------
7. <sup>‡‡</sup>Test Configuration
 

<input checked="" type="checkbox"/> With Beltclip	<input type="checkbox"/> Without Beltclip
---------------------------------------------------	-------------------------------------------
8. Tissue parameters and temperatures are listed on the SAR plots.
9. Both sides of the terminal were tested and the worst-case side is reported.
10. Liquid tissue depth is 15.1 cm. ± 0.1
- \*11. EUT tested with Bluetooth ON.

  
 Alfred Cirwithian  
 Vice President Engineering

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>		<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers <b>FCC ID:</b> AZ489FT7010 Page 16 of 20



## 12. SAR Test Equipment

### Equipment Calibration

Type	Calibration Date	Serial Number
Stäubli Robot RX60L	Oct-05	599131-01
Stäubli Robot Controller	Oct-05	PCT592
Stäubli Teach Pendant (Joystick)	Oct-05	3323-00161
Micron Computer, 450 MHz Pentium III, Windows NT	Oct-05	PCT577
SPEAG EDC3	Oct-05	321
SPEAG DAE4	Sep-05	649
SPEAG E-Field Probe EX3DV4	Aug-05	3561
SPEAG SAM Twin Phantom V4.0 (Main)	Oct-05	TP:1197
SPEAG SAM Twin Phantom V4.0 (Sub)	Oct-05	TP:1357
SPEAG Light Alignment Sensor	Oct-05	205
SPEAG Validation Dipole D835V2	Feb-06	4d026
SPEAG Validation Dipole D1900V2	Feb-06	502
SPEAG Validation Dipole D2450V2	Feb-06	719
Brain Equivalent Matter (835MHz)	Dec-05	PCTBEM101
Brain Equivalent Matter (1900MHz)	Dec-05	PCTBEM301
Brain Equivalent Matter (2450MHz)	Dec-05	PCTBEM501
Muscle Equivalent Matter (835MHz)	Dec-05	PCTMEM201
Muscle Equivalent Matter (1900MHz)	Dec-05	PCTMEM401
Muscle Equivalent Matter (2450MHz)	Dec-05	PCTMEM601
Microwave Amp. Model: 5S1G4, (800MHz - 4.2GHz)	Jan-06	22332
Gigatronics 8651A Power Meter	Jan-06	1835299
HP-8648D (9kHz ~ 4GHz) Signal Generator	Jan-06	PCT530
Amplifier Research 5S1G4 Power Amp	Jan-06	PCT540
HP-8753E (30kHz ~ 3GHz) Network Analyzer	Jun-05	PCT552/ JP8020182
HP85070B Dielectric Probe Kit	Jan-06	PCT501
Ambient Noise/Reflection, etc. <12mW/kg/<3%of SAR	Jan-06	Anechoic Room PCT01

**Table 15.1 Test Equipment Calibration**

**NOTE:**

The E-field probe was calibrated by SPEAG, by waveguide technique procedure. Dipole Validation measurement is performed by PCTEST Lab. before each test. The head simulating material is calibrated by PCTEST using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the head-equivalent material.

<b>PCTEST SAR REPORT</b>	<b>FCC MEASUREMENT REPORT</b>				<b>Reviewed by:</b> Quality Manager
	<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006		

# 13. CONCLUSION

## Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.[3]

<b>PCTEST SAR REPORT</b>		FCC MEASUREMENT REPORT			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010	Page 19 of 20

# 14. REFERENCES

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1 - 1991, *American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz*, New York: IEEE, Aug. 1992.

[3] ANSI/IEEE C95.3 - 1991, *IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*, New York: IEEE, 1992.

[4] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, July 2001.

[5] IEEE Standards Coordinating Committee 34 – IEEE Std. 1528 – 2003, *Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices*.

[6] NCRP, National Council on Radiation Protection and Measurements, *Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields*, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[7] T. Schmid, O. Egger, N. Kuster, *Automated E-field scanning system for dosimetric assessments*, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[8] K. Pokovic, T. Schmid, N. Kuster, *Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies*, ICECOM97, Oct. 1997, pp. 120-124.

[9] K. Poković, T. Schmid, and N. Kuster, *E-field Probe with improved isotropy in head simulating liquids*, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[10] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[11] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, *The Dependence of EM Energy Absorption upon Human Head Modeling at 900 MHz*, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[12] N. Kuster and Q. Balzano, *Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz*, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[13] G. Hartsgrove, A. Kraszewski, A. Surowiec, *Simulated Biological Materials for Electromagnetic Radiation Absorption Studies*, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[14] Q. Balzano, O. Garay, T. Manning Jr., *Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones*, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[15] W. Gander, *Computermathematick*, Birkhaeuser, Basel, 1992.

[16] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, *Numerical Recipes in C, The Art of Scientific Computing*, Second edition, Cambridge University Press, 1992.

[17] Federal Communications Commission, OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields. Supplement C, Dec. 1997.

[18] N. Kuster, R. Kastle, T. Schmid, *Dosimetric evaluation of mobile communications equipment with known precision*, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[19] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[20] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hochschule Zürich, Dosimetric Evaluation of the Cellular Phone.

<b>PCTEST SAR REPORT</b>	 <b>FCC MEASUREMENT REPORT</b>			<b>Reviewed by:</b> Quality Manager
<b>SAR Filename:</b> 0604170281-R4	<b>Test Dates:</b> April 18-20, 2006	<b>Additional Test Dates:</b> May 4, 2006	<b>EUT:</b> Handheld Terminal with GSM, Bluetooth & WLAN Transceivers	<b>FCC ID:</b> AZ489FT7010
				Page 20 of 20

## **APPENDIX A: SAR TEST DATA**

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM850 Motorola; Frequency: 836.6 MHz; Duty Cycle: 1:8

Medium: 835 Muscle ( $\sigma = 0.99$  mho/m,  $\epsilon_r = 56.24$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-19-2006; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.9, 7.9, 7.9); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.190, Li-Ion Battery FTN6032B, Antenna Internal**

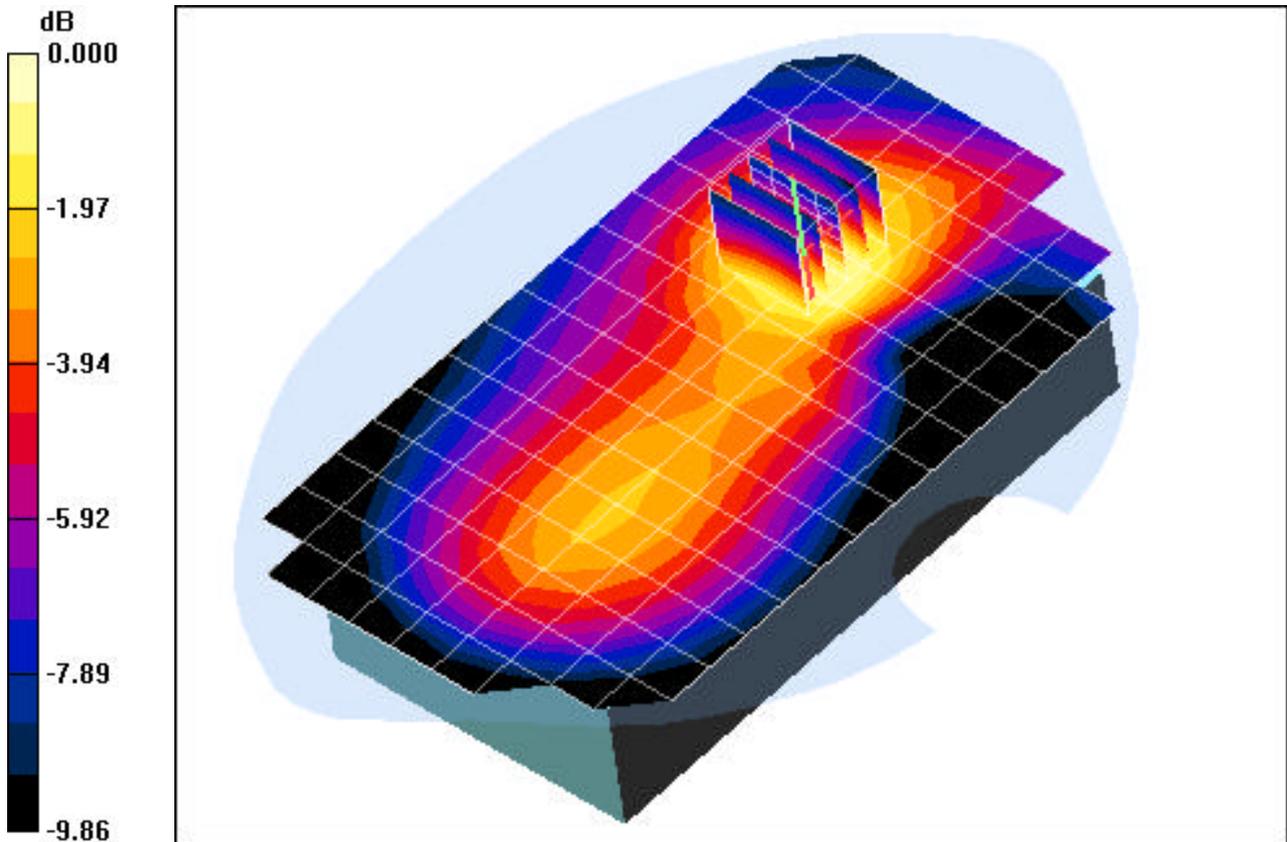
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.87 V/m; Power Drift = -0.114 dB

Peak SAR (extrapolated) = 0.202 W/kg

**SAR(1 g) = 0.145 mW/g; SAR(10 g) = 0.100 mW/g**



0 dB = 0.167mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM850 Motorola; Frequency: 836.6 MHz; Duty Cycle: 1:8

Medium: 835 Muscle ( $\sigma = 0.99$  mho/m,  $\epsilon_r = 56.21$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 2.5cm from DUT to Flat Phantom

Test Date: 04-19-2006; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.9, 7.9, 7.9); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

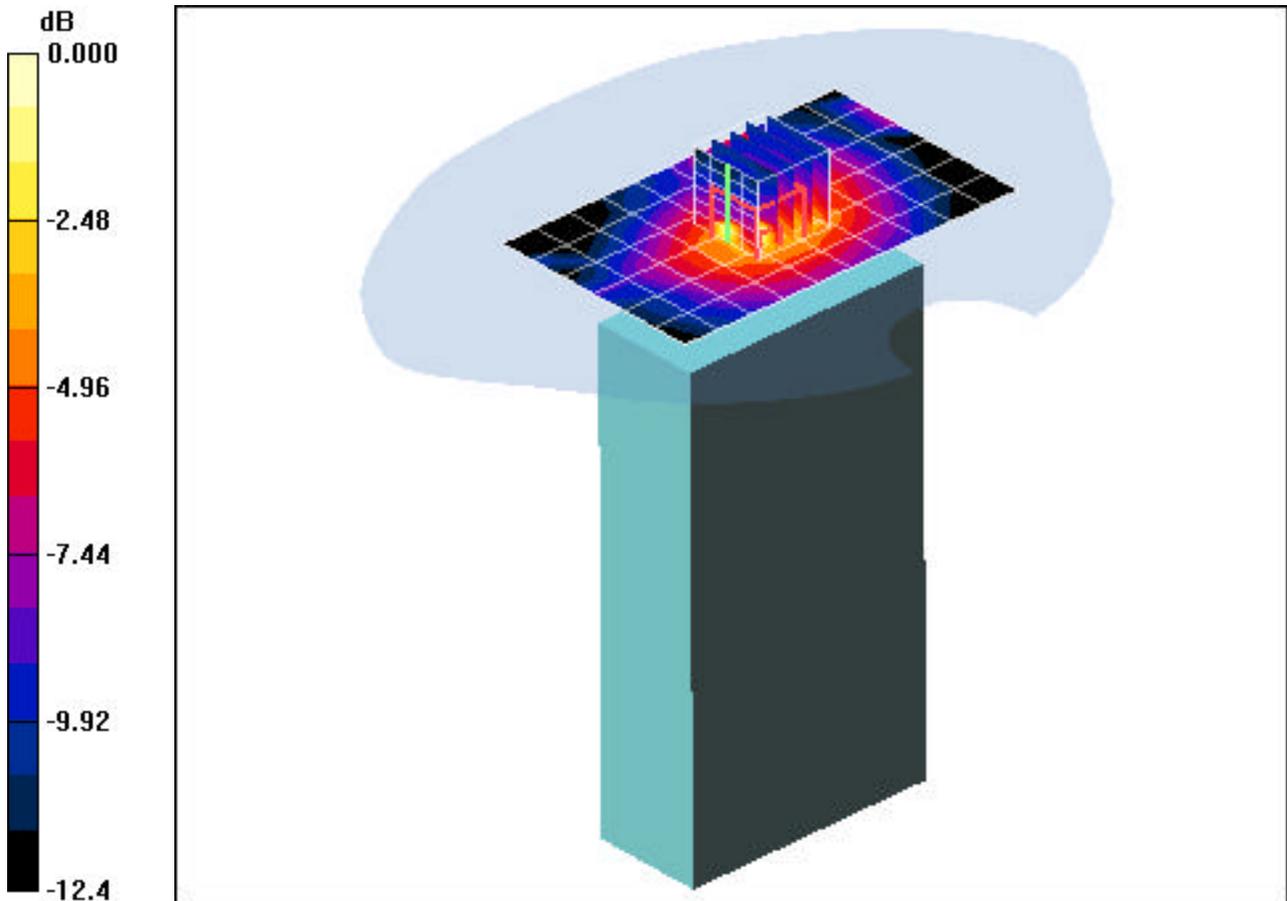
Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Bystander Top side, Ch.190, Li-Ion Battery FTN6032B, Antenna Internal**

**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm  
**(5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 6.55 V/m; Power Drift = -0.283 dB  
Peak SAR (extrapolated) = 0.084 W/kg  
**SAR(1 g) = 0.054 mW/g; SAR(10 g) = 0.029 mW/g**



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM850 Motorola; Frequency: 836.6 MHz; Duty Cycle: 1:8

Medium: 835 Muscle ( $\sigma = 0.99$  mho/m,  $\epsilon_r = 56.21$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-19-2006; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.9, 7.9, 7.9); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Touch Bottom side, Ch.190, Li-Ion Battery FTN6032B, Antenna Internal**

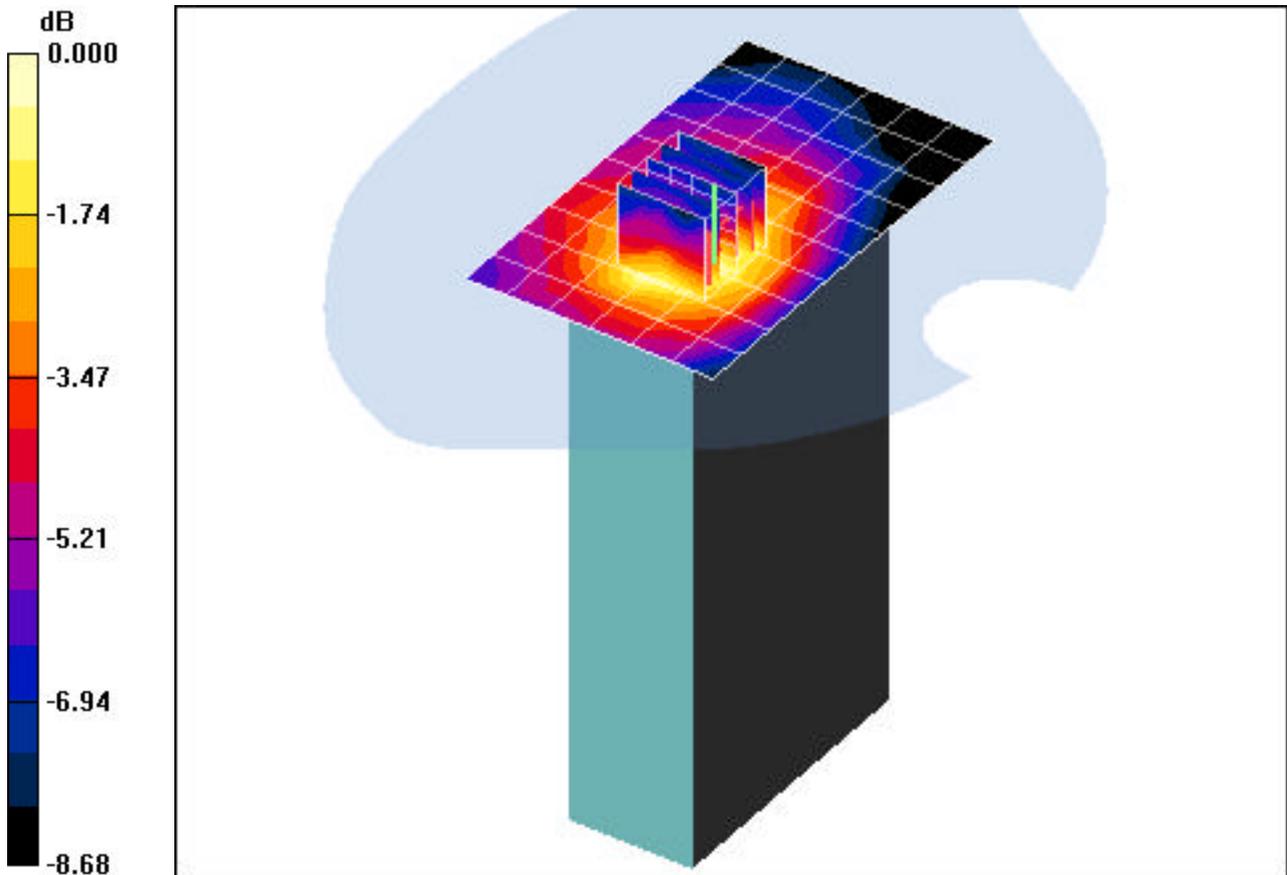
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.27 V/m; Power Drift = 0.061 dB

Peak SAR (extrapolated) = 0.065 W/kg

**SAR(1 g) = 0.045 mW/g; SAR(10 g) = 0.032 mW/g**



0 dB = 0.051mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM1900 Motorola; Frequency: 1880 MHz; Duty Cycle: 1:8

Medium: 1900 Muscle ( $\sigma = 1.58$  mho/m,  $\epsilon_r = 52.53$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-20-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3561; ConvF(6.48, 6.48, 6.48); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.661, Li-Ion Battery FTN6032B, Antenna Internal**

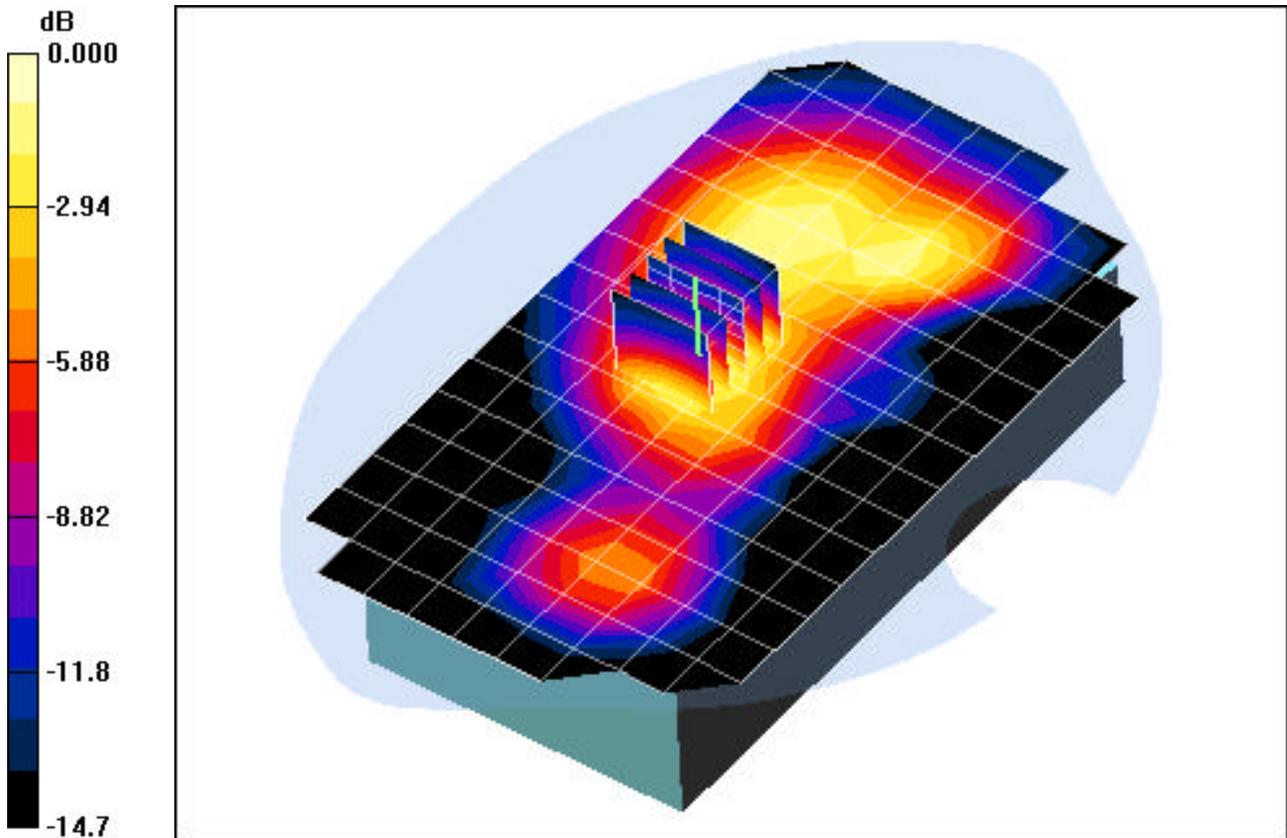
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.81 V/m; Power Drift = 0.195 dB

Peak SAR (extrapolated) = 0.354 W/kg

**SAR(1 g) = 0.226 mW/g; SAR(10 g) = 0.132 mW/g**



0 dB = 0.272mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM1900 Motorola; Frequency: 1880 MHz; Duty Cycle: 1:8

Medium: 1900 Muscle ( $\sigma = 1.58$  mho/m,  $\epsilon_r = 52.53$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 2.5cm from DUT to Flat Phantom

Test Date: 04-20-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3561; ConvF(6.48, 6.48, 6.48); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Bystander Top side, Ch.661, Li-Ion Battery FTN6032B, Antenna Internal**

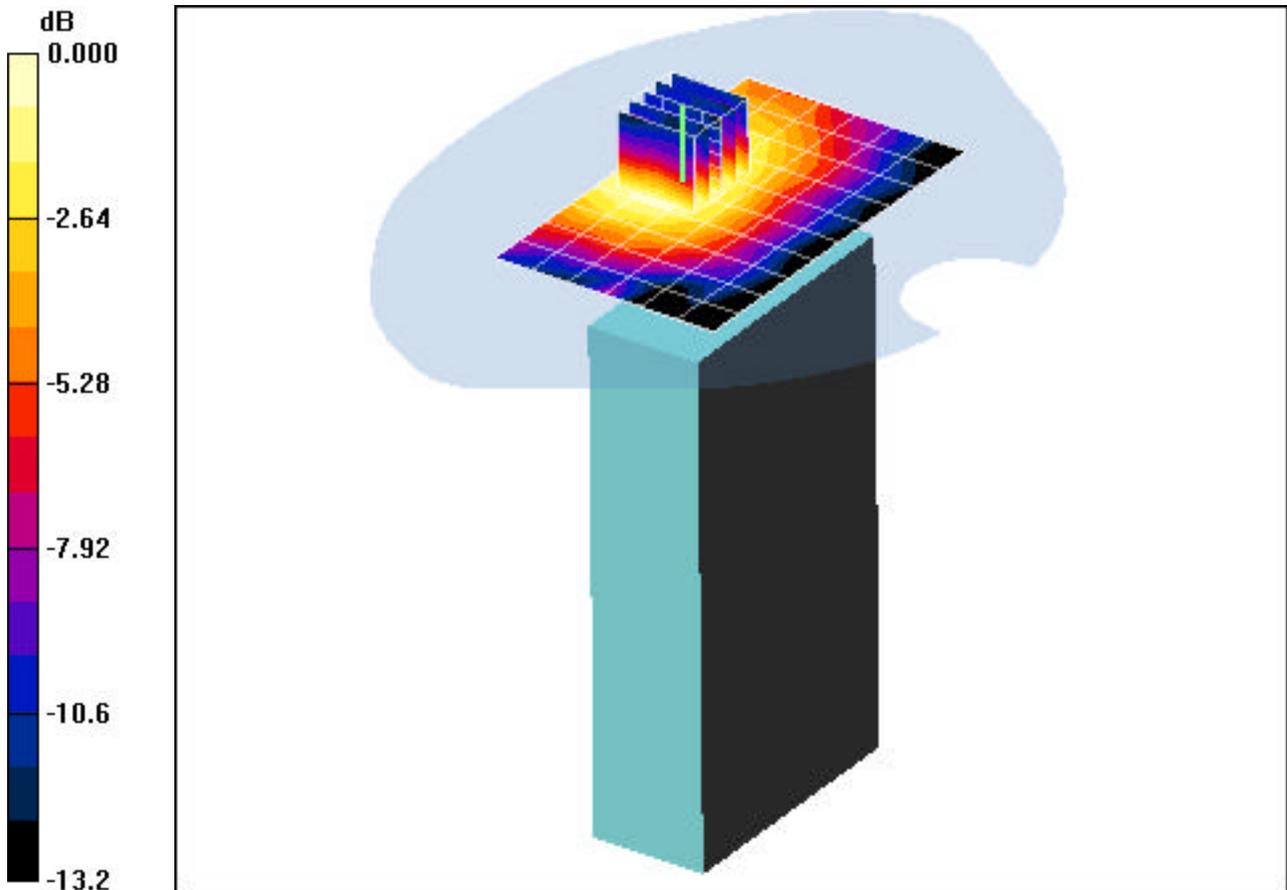
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.23 V/m; Power Drift = 0.046 dB

Peak SAR (extrapolated) = 0.057 W/kg

**SAR(1 g) = 0.037 mW/g; SAR(10 g) = 0.025 mW/g**



0 dB = 0.043mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM1900 Motorola; Frequency: 1880 MHz; Duty Cycle: 1:8

Medium: 1900 Muscle ( $\sigma = 1.58$  mho/m,  $\epsilon_r = 52.53$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-20-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3561; ConvF(6.48, 6.48, 6.48); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Touch Bottom side, Ch.661, Li-Ion Battery FTN6032B, Antenna Internal**

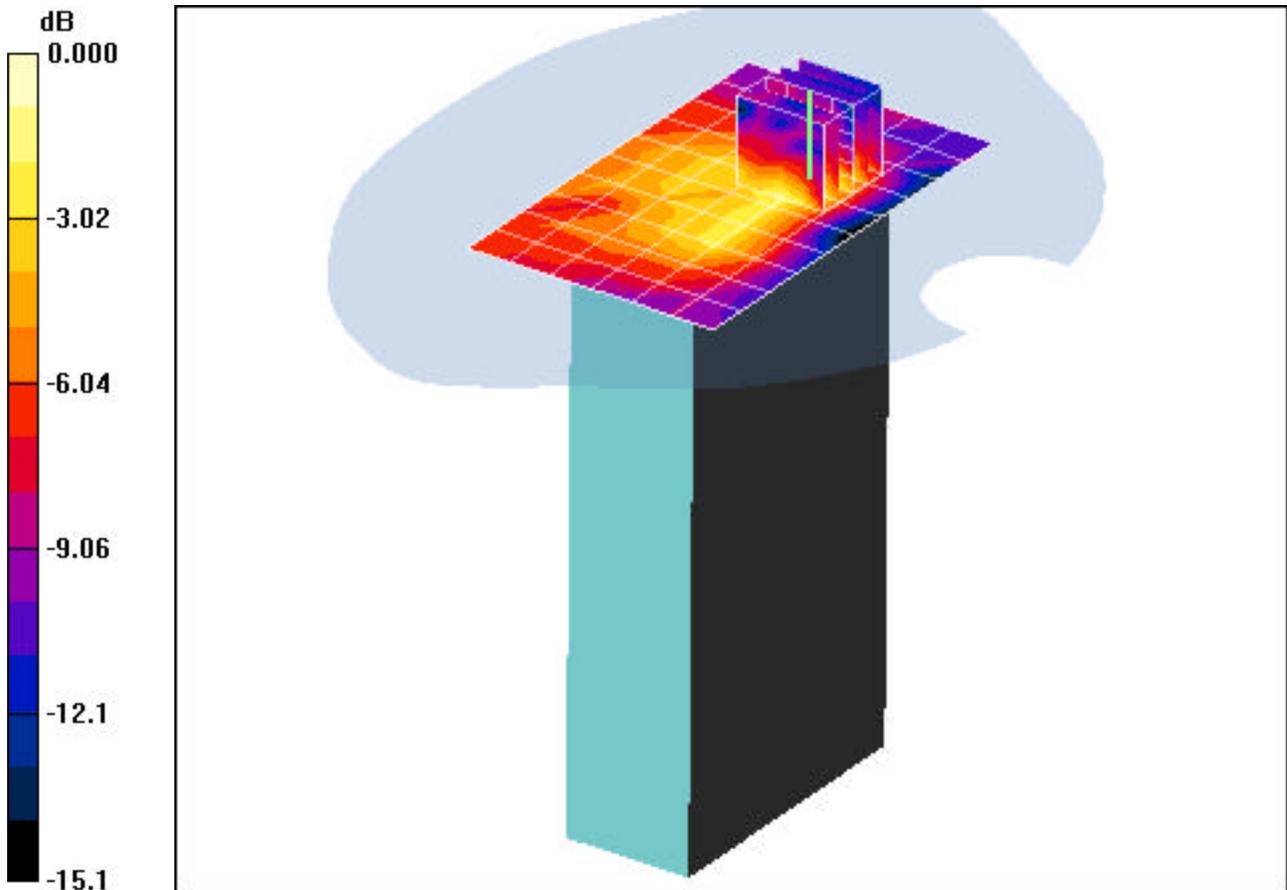
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.97 V/m; Power Drift = 0.264 dB

Peak SAR (extrapolated) = 0.056 W/kg

**SAR(1 g) = 0.032 mW/g; SAR(10 g) = 0.018 mW/g**



0 dB = 0.039mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: IEEE 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1

Medium: 2450 Muscle ( $\sigma = 1.93$  mho/m,  $\epsilon_r = 53.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-18-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3561; ConvF(6.3, 6.3, 6.3); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.06, 5.5 Mbps, Li-Ion Battery FTN6032B, Ant. Internal w/ BT 2441MHz**

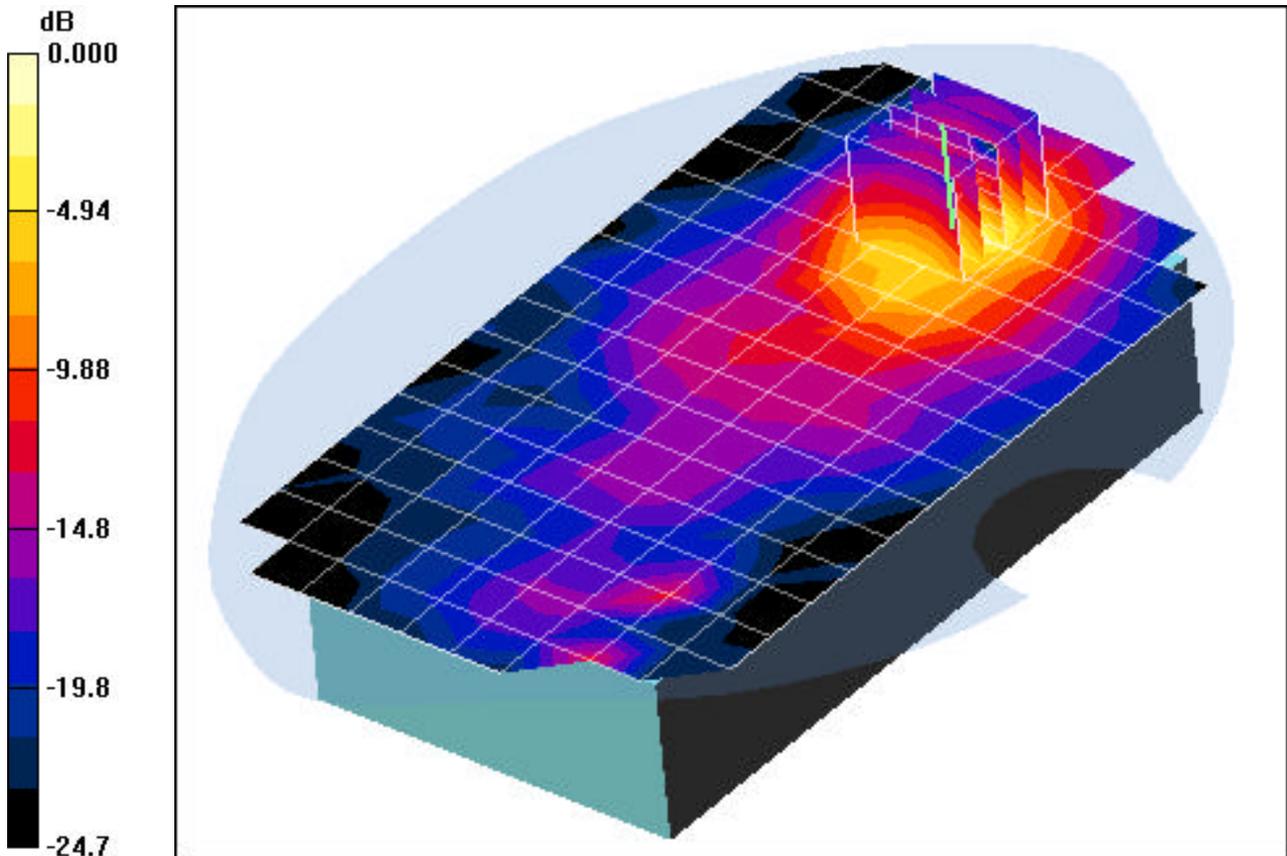
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.33 V/m; Power Drift = 0.232 dB

Peak SAR (extrapolated) = 1.23 W/kg

**SAR(1 g) = 0.614 mW/g; SAR(10 g) = 0.294 mW/g**



0 dB = 0.817mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: IEEE 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1

Medium: 2450 Muscle ( $\sigma = 1.93$  mho/m,  $\epsilon_r = 53.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 2.5cm from DUT to Flat Phantom

Test Date: 04-18-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3561; ConvF(6.3, 6.3, 6.3); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Bystander Top side Ch.06, 5.5 Mbps, Li-Ion Battery FTN6032B, Ant. Internal**

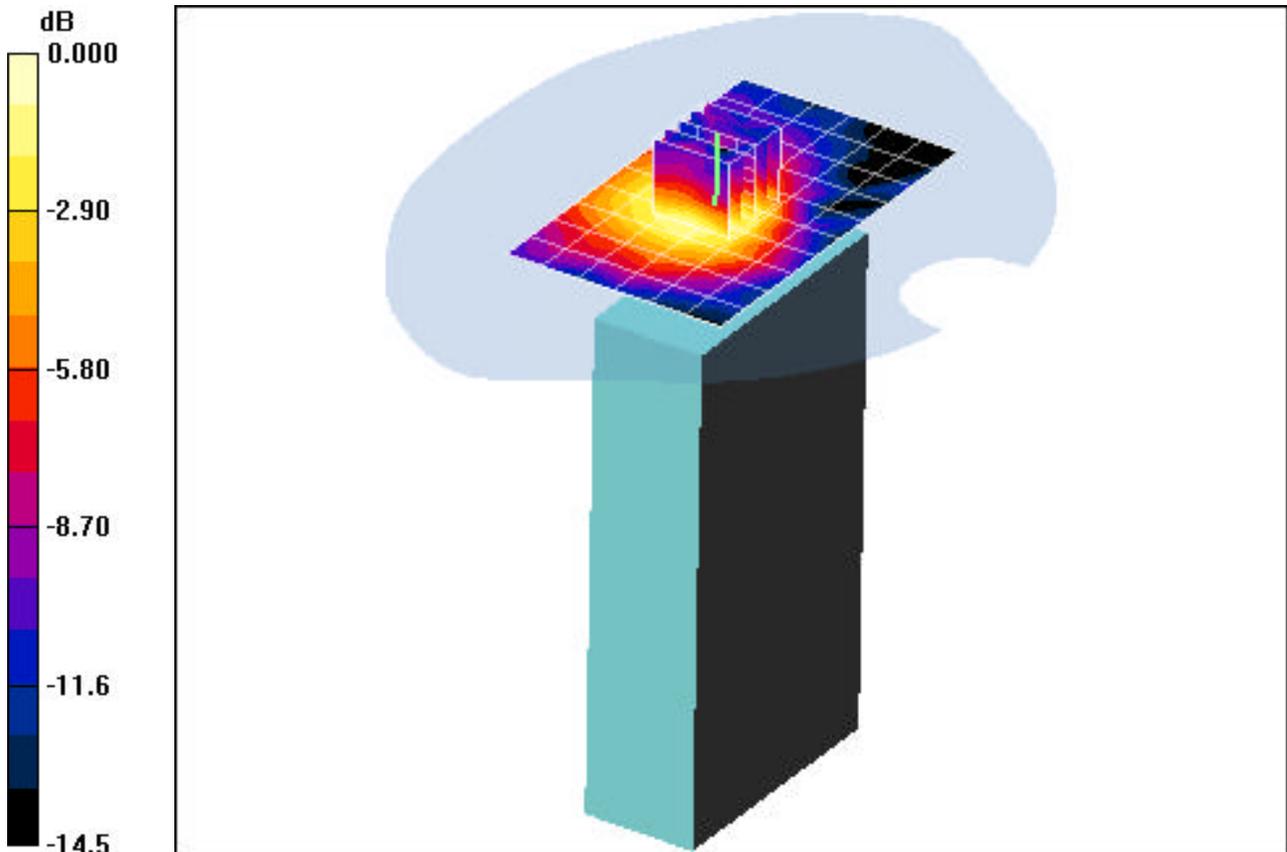
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.71 V/m; Power Drift = 0.285 dB

Peak SAR (extrapolated) = 0.078 W/kg

**SAR(1 g) = 0.046 mW/g; SAR(10 g) = 0.028 mW/g**



0 dB = 0.054mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Muscle ( $\sigma = 1.93$  mho/m,  $\epsilon_r = 53.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-18-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3561; ConvF(6.3, 6.3, 6.3); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, Touch Bottom side, Ch.06, 5.5Mbps, Li-Ion Battery FTN6032B, Ant. Internal**

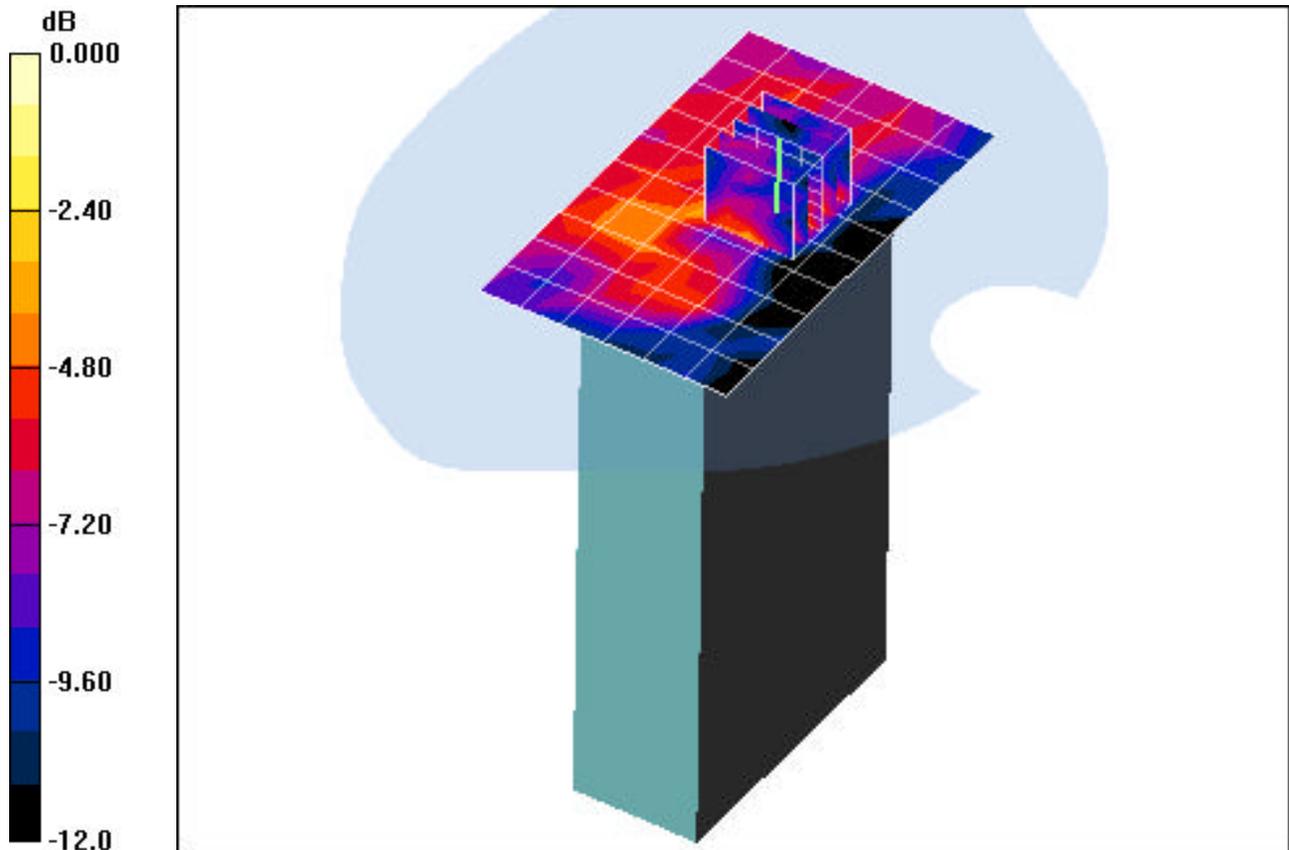
**Area Scan (7x11x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 2.81 V/m; Power Drift = -0.043 dB

Peak SAR (extrapolated) = 0.049 W/kg

**SAR(1 g) = 0.025 mW/g; SAR(10 g) = 0.013 mW/g**



0 dB = 0.030mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM850 Motorola; Frequency: 836.6 MHz; Duty Cycle: 1:8

Medium: 835 Muscle ( $\sigma = 0.99$  mho/m,  $\epsilon_r = 56.24$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-19-2006; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.9, 7.9, 7.9); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.190, Li-Ion Battery FTN6032B, Antenna Internal**

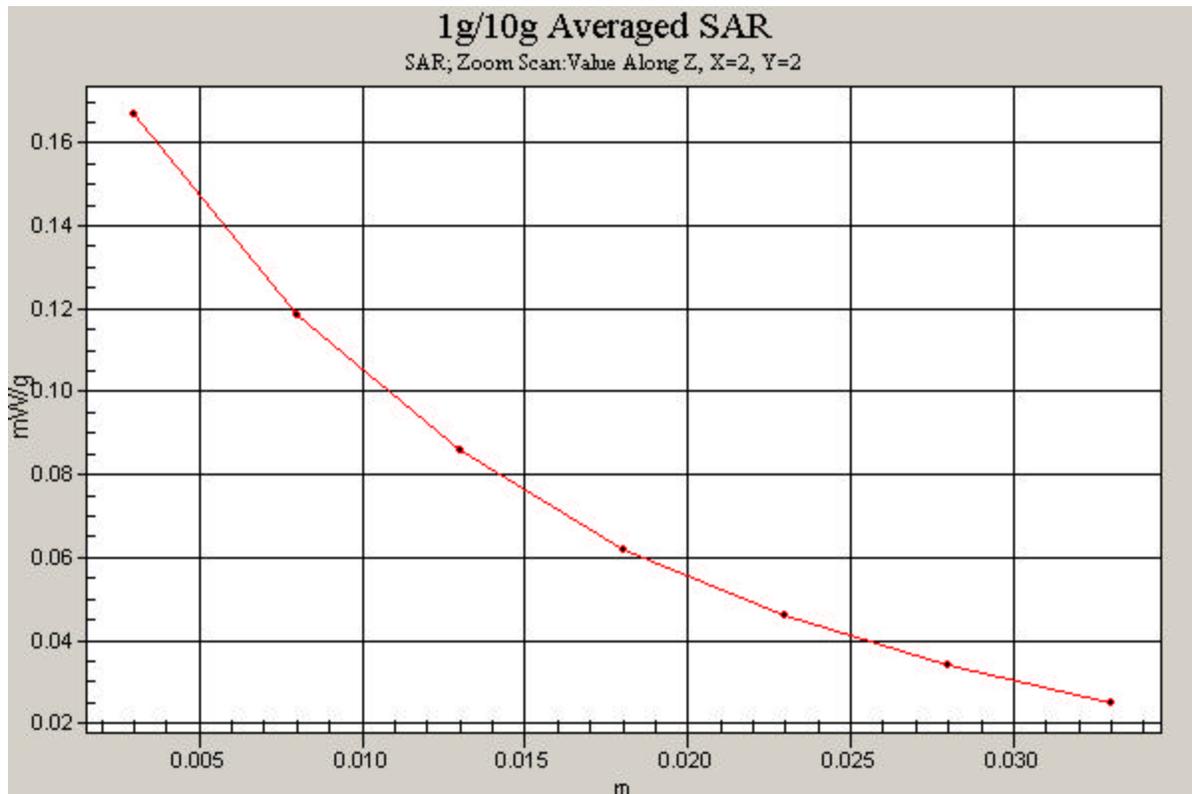
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.87 V/m; Power Drift = -0.114 dB

Peak SAR (extrapolated) = 0.202 W/kg

**SAR(1 g) = 0.145 mW/g; SAR(10 g) = 0.100 mW/g**



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: GSM1900 Motorola; Frequency: 1880 MHz; Duty Cycle: 1:8

Medium: 1900 Muscle ( $\sigma = 1.58$  mho/m,  $\epsilon_r = 52.53$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-20-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3561; ConvF(6.48, 6.48, 6.48); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.661, Li-Ion Battery FTN6032B, Antenna Internal**

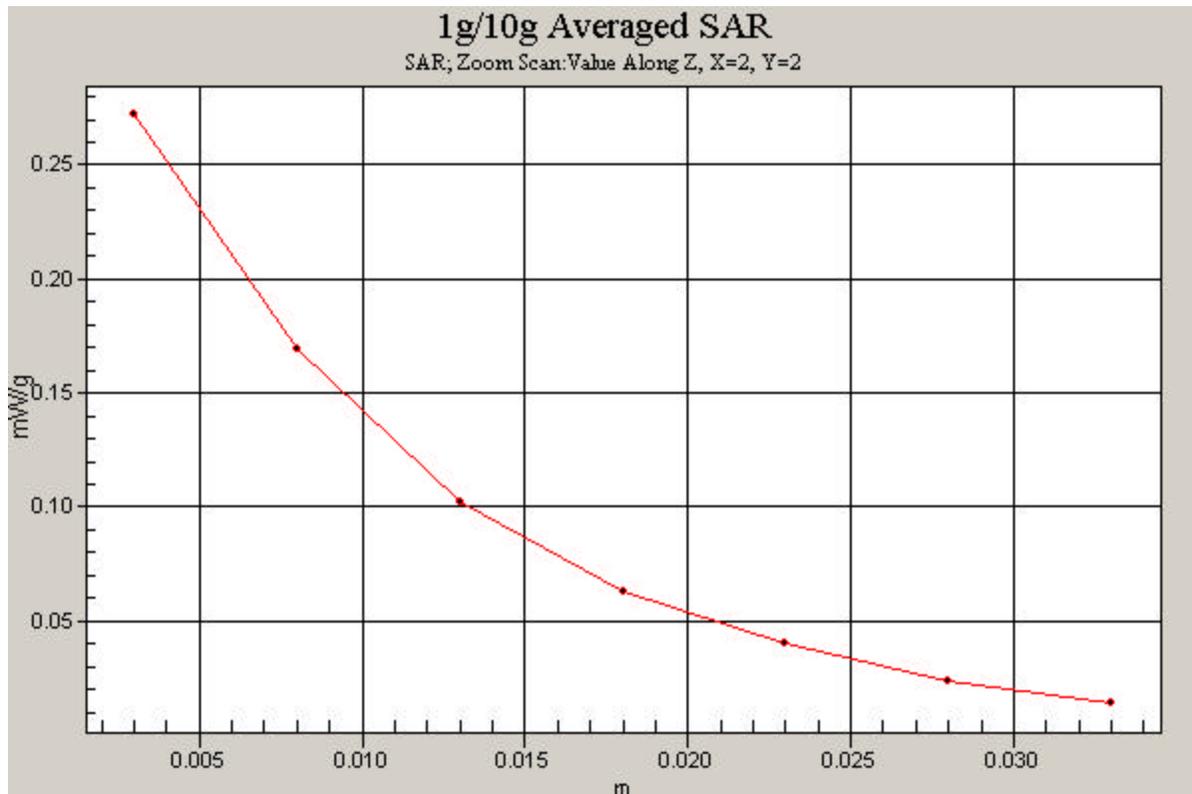
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.81 V/m; Power Drift = 0.195 dB

Peak SAR (extrapolated) = 0.354 W/kg

**SAR(1 g) = 0.226 mW/g; SAR(10 g) = 0.132 mW/g**



# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Motorola Model: F4423A; Type: GSM Dual Band+WLAN+Bluetooth; SN: 00039-082-693-121**

Communication System: IEEE 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 Muscle ( $\sigma = 1.93$  mho/m,  $\epsilon_r = 53.14$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-18-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3561; ConvF(6.3, 6.3, 6.3); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

**Body, w/ Holster, Ch.06, 5.5 Mbps, Li-Ion Battery FTN6032B, Ant. Internal w/ BT 2441**

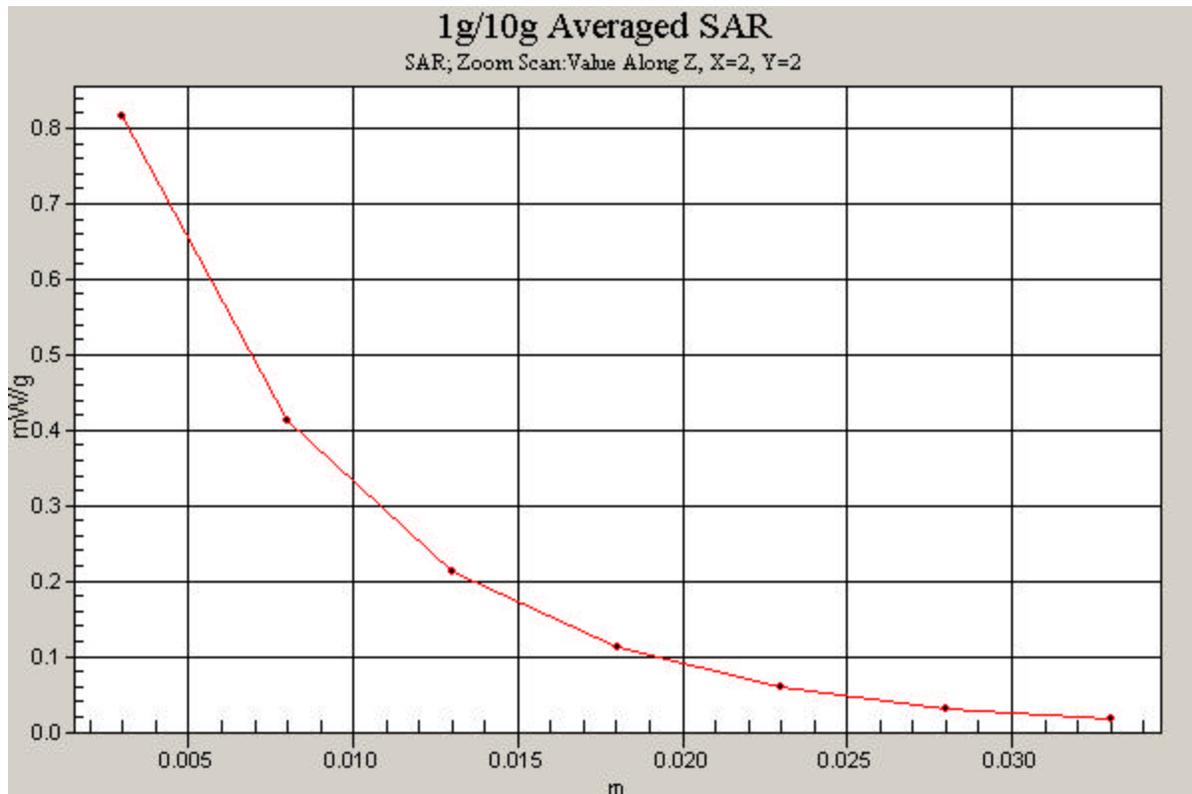
**Area Scan (10x17x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 4.33 V/m; Power Drift = 0.232 dB

Peak SAR (extrapolated) = 1.23 W/kg

**SAR(1 g) = 0.614 mW/g; SAR(10 g) = 0.294 mW/g**



## **APPENDIX B: DIPOLE VALIDATION**

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; SN:719**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Brain ( $\sigma = 1.82$  mho/m,  $\epsilon_r = 38.43$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-18-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.2°C

Probe: EX3DV4 - SN3561; ConvF(6.37, 6.37, 6.37); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 2450MHz Dipole Validation

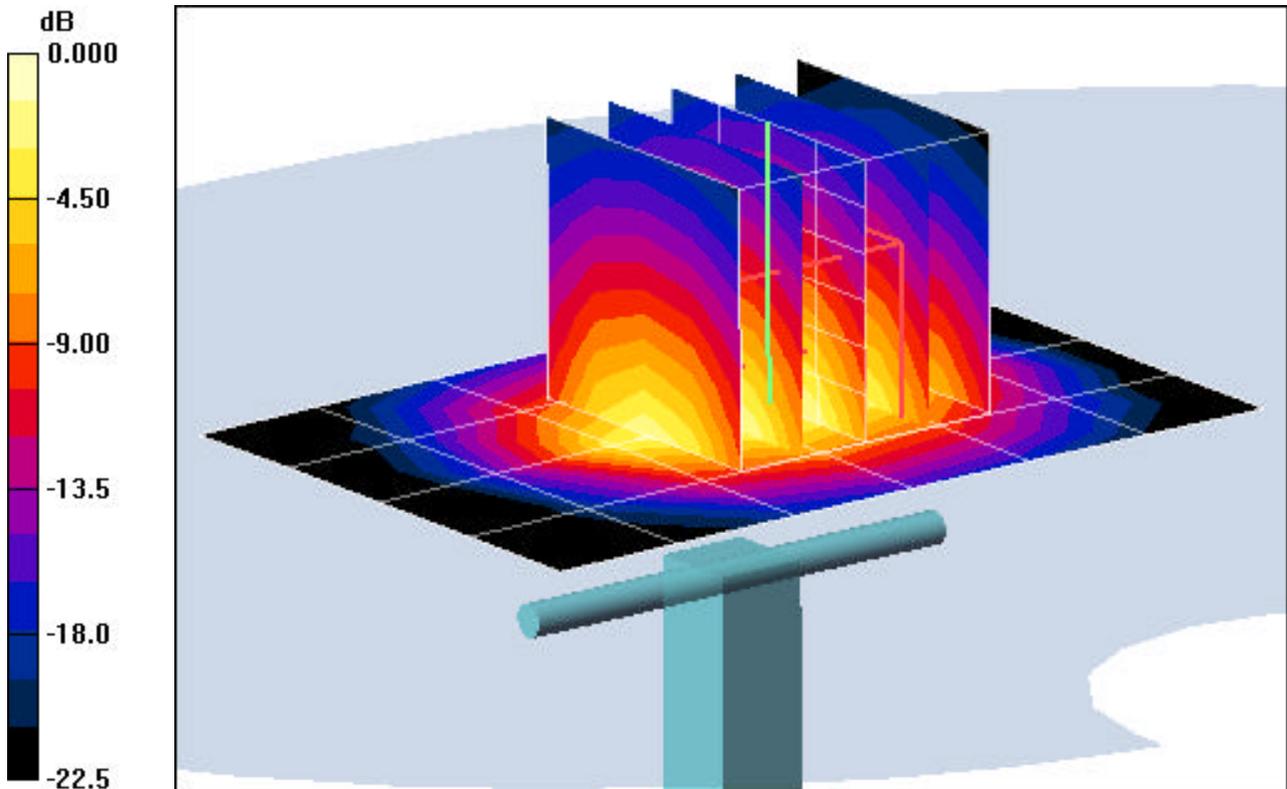
**Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

**SAR(1 g) = 5.46 mW/g; SAR(10 g) = 2.57 mW/g**

Target SAR(1g) = 5.24 mW/g; Deviation = + 4.19 %



0 dB = 6.95mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; SN: 4d026**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Brain ( $\sigma = 0.89$  mho/m,  $\epsilon_r = 42.55$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 04-19-2006; Ambient Temp: 23.5°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.91, 7.91, 7.91); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 835MHz Dipole Validation

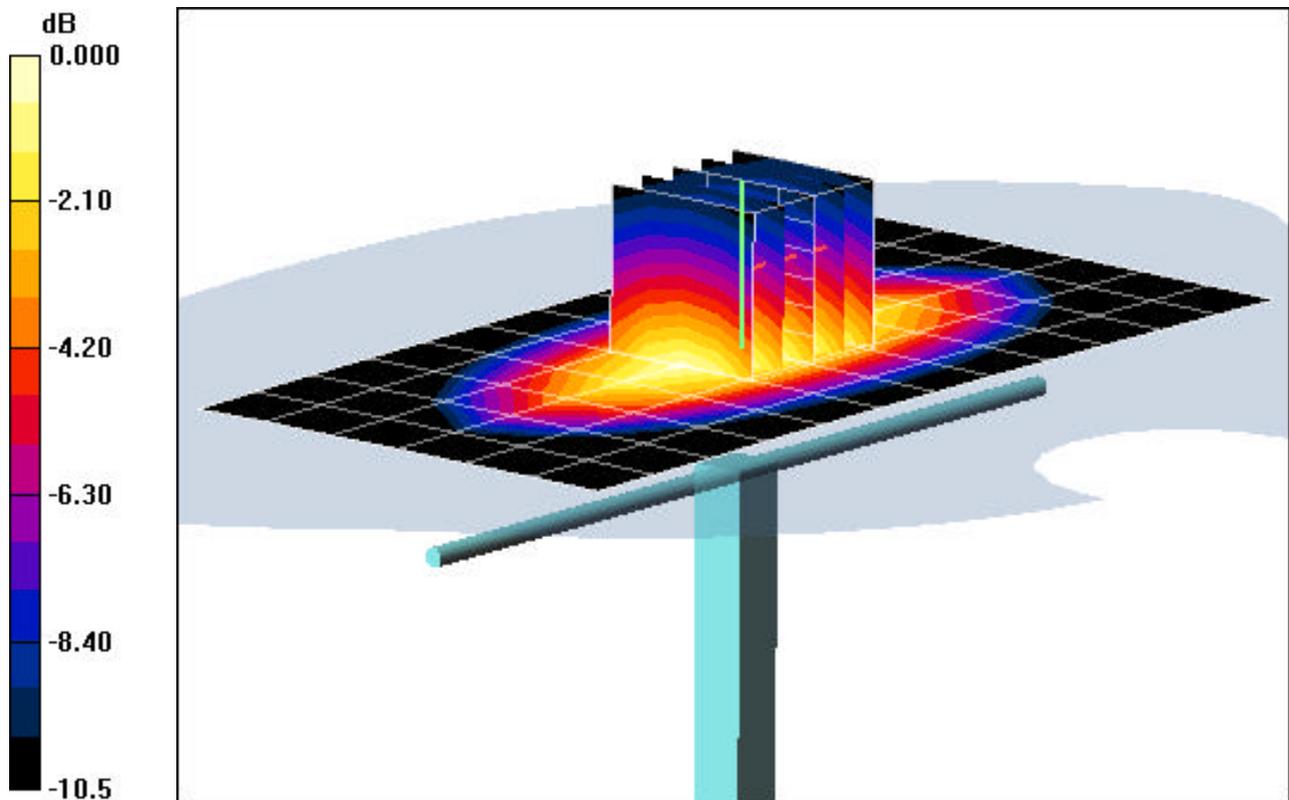
**Area Scan (7x13x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 24.0 dBm (250 mW)

**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.58 mW/g**

Target SAR(1g) = 2.375 mW/g; Deviation = + 2.73 %



0 dB = 2.83mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; SN: 502**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Brain ( $\sigma = 1.37$  mho/m,  $\epsilon_r = 40.98$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 04-20-2006; Ambient Temp: 23.4°C; Tissue Temp: 21.5°C

Probe: EX3DV4 - SN3561; ConvF(7.04, 7.04, 7.04); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 1900MHz Dipole Validation

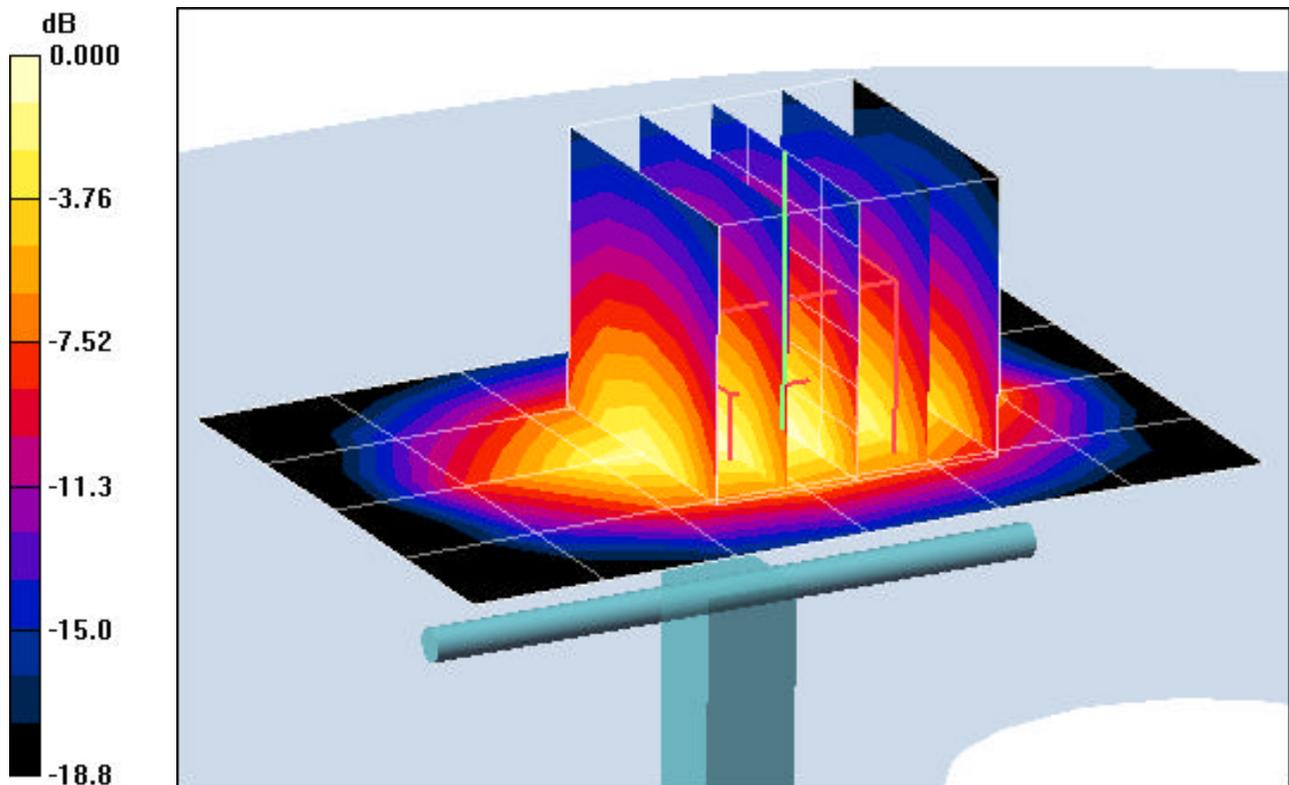
**Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

**SAR(1 g) = 4.09 mW/g; SAR(10 g) = 1.98 mW/g**

Target SAR(1g) = 3.97 mW/g; Deviation = + 3.02 %



0 dB = 4.92mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 2450 MHz; Type: D2450V2; SN: 719**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: 2450 Brain ( $\sigma = 1.83$  mho/m,  $\epsilon_r = 38.62$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Test Date: 05-04-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: EX3DV4 - SN3561; ConvF(6.37, 6.37, 6.37); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 2450MHz Dipole Validation

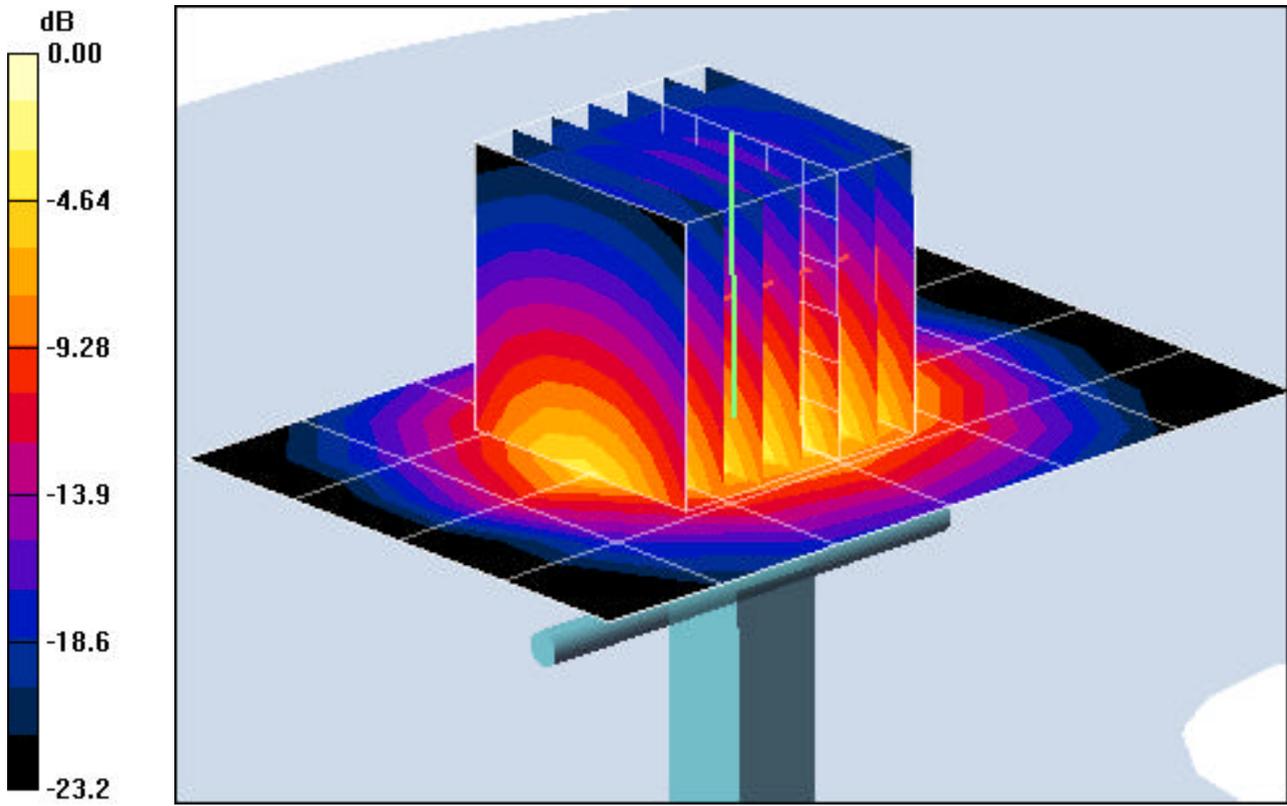
**Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100mW)

**SAR(1 g) = 5.42 mW/g; SAR(10 g) = 2.51 mW/g**

Target SAR(1 g) = 5.24 mW/g; Deviation = +3.43 %



0 dB = 7.58mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d026**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: 835 Brain ( $\sigma = 0.90$  mho/m,  $\epsilon_r = 42.2$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 1.5 cm

Test Date: 05-04-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.6°C

Probe: EX3DV4 - SN3561; ConvF(7.91, 7.91, 7.91); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Main; Type: SAM 4.0; Serial: TP:1197

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 835MHz Dipole Validation

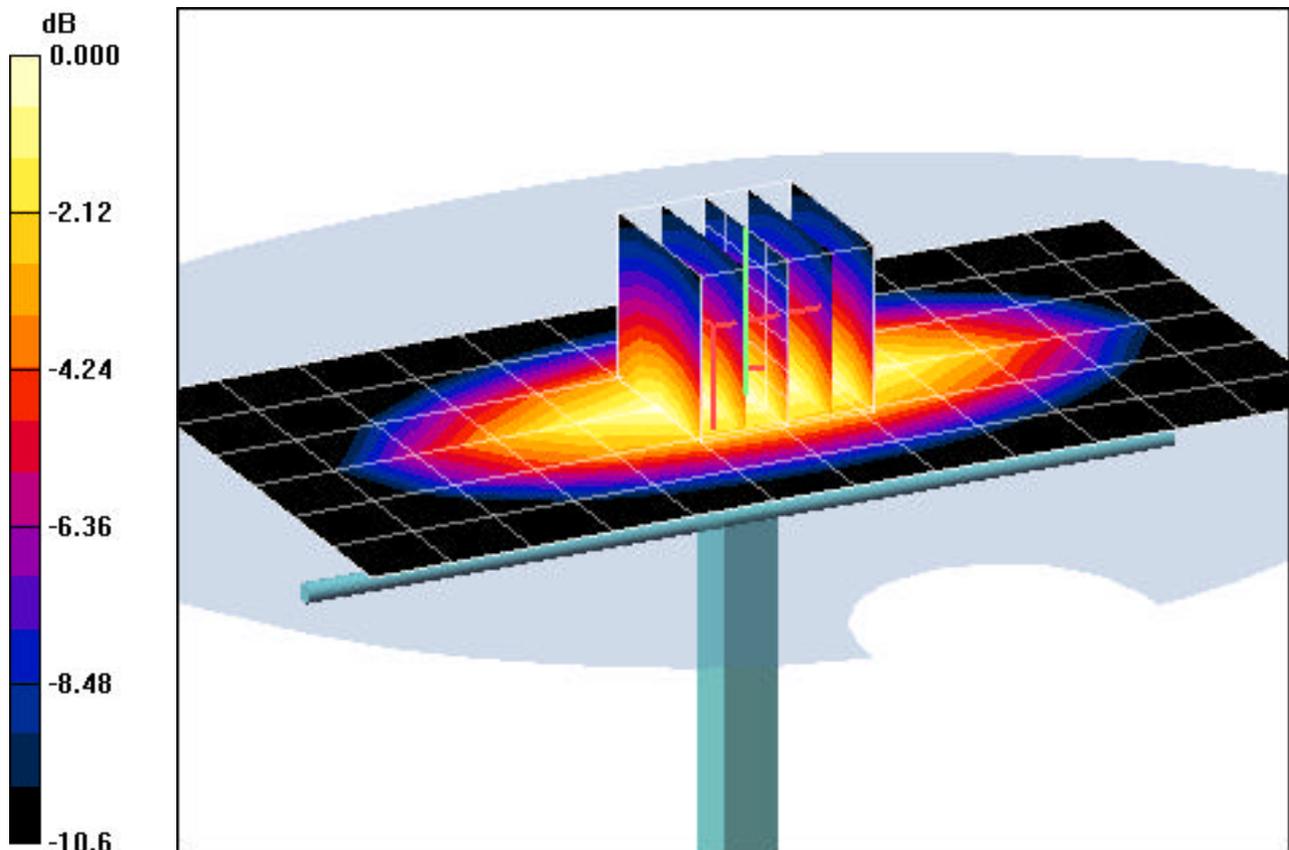
**Area Scan (7x13x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 24.0 dBm (250 mW)

**SAR(1 g) = 2.49 mW/g; SAR(10 g) = 1.64 mW/g**

Target SAR(1g) = 2.375 mW/g; Deviation = +4.84 %



0 dB = 2.91mW/g

# PCTEST ENGINEERING LABORATORY, INC.

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 502**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Brain ( $\sigma = 1.38$  mho/m,  $\epsilon_r = 41.13$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-04-2006; Ambient Temp: 23.2°C; Tissue Temp: 21.4°C

Probe: EX3DV4 - SN3561; ConvF(7.04, 7.04, 7.04); Calibrated: 8/24/2005

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn649; Calibrated: 9/13/2005

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP:1357

Measurement SW: DASY4, V4.6 Build 23; Postprocessing SW: SEMCAD, V1.8 Build 160

## 1900MHz Dipole Validation

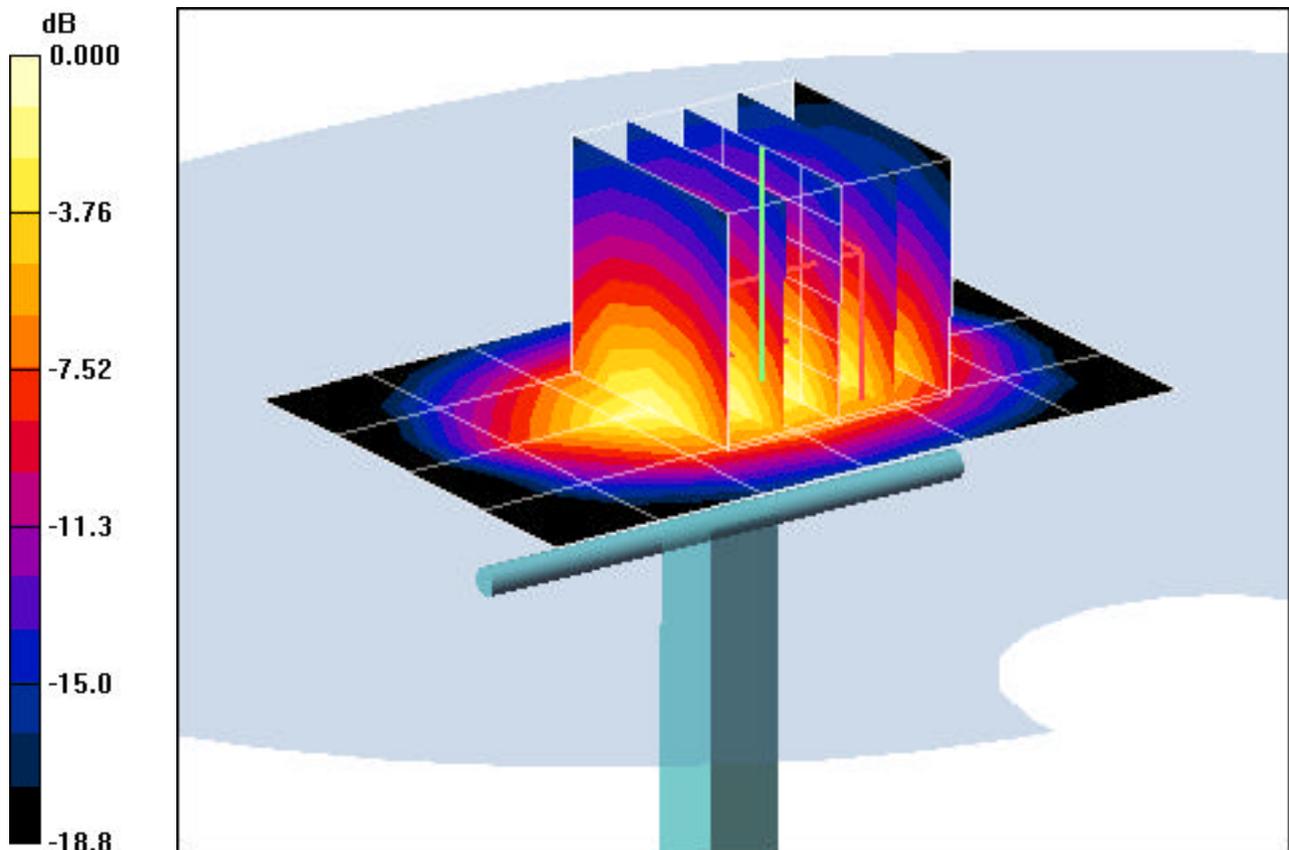
**Area Scan (5x7x1):** Measurement grid: dx=15mm, dy=15mm

**Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

**SAR(1 g) = 4.13 mW/g; SAR(10 g) = 2.16 mW/g**

Target SAR(1g) = 3.97 mW/g; Deviation = +4.03 %



0 dB = 5.14mW/g

## **APPENDIX C: PROBE CALIBRATION**



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 **PC Test**

Certificate No: **EX3-3561\_Aug05**

## CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3561**

Calibration procedure(s) **QA CAL-01 v5 and QA CAL-14 v2  
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 24, 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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	11-Aug-05 (METAS, No. 251-00499)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00467)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	11-Aug-05 (METAS, No. 251-00500)	Aug-06
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 654	29-Nov-04 (SPEAG, No. DAE4-654_Nov04)	Nov-05

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

	Name	Function	Signature
Calibrated by:	<b>Katja Pokovic</b>	<b>Technical Manager</b>	
Approved by:	<b>Niels Kuster</b>	<b>Quality Manager</b>	

Issued: August 24, 2005

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



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

Accreditation No.: **SCS 108**

### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ 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<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* *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*.
- DCP<sub>x,y,z</sub>**: 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<sub>x,y,z</sub> \* *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  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

# Probe EX3DV4

## SN:3561

Manufactured:	February 14, 2005
Calibrated:	August 24, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

## DASY - Parameters of Probe: EX3DV4 SN:3561

### Sensitivity in Free Space<sup>A</sup>

NormX	<b>0.430</b> ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	<b>90</b> mV
NormY	<b>0.470</b> ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	<b>90</b> mV
NormZ	<b>0.430</b> ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	<b>90</b> mV

### Diode Compression<sup>B</sup>

### 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		<b>2.0 mm</b>	<b>3.0 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	3.8	1.5
SAR <sub>be</sub> [%]	With Correction Algorithm	0.0	0.0

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

Sensor Center to Phantom Surface Distance		<b>2.0 mm</b>	<b>3.0 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	4.7	2.8
SAR <sub>be</sub> [%]	With Correction Algorithm	1.1	0.8

### Sensor Offset

Probe Tip to Sensor Center                      **1.0 mm**

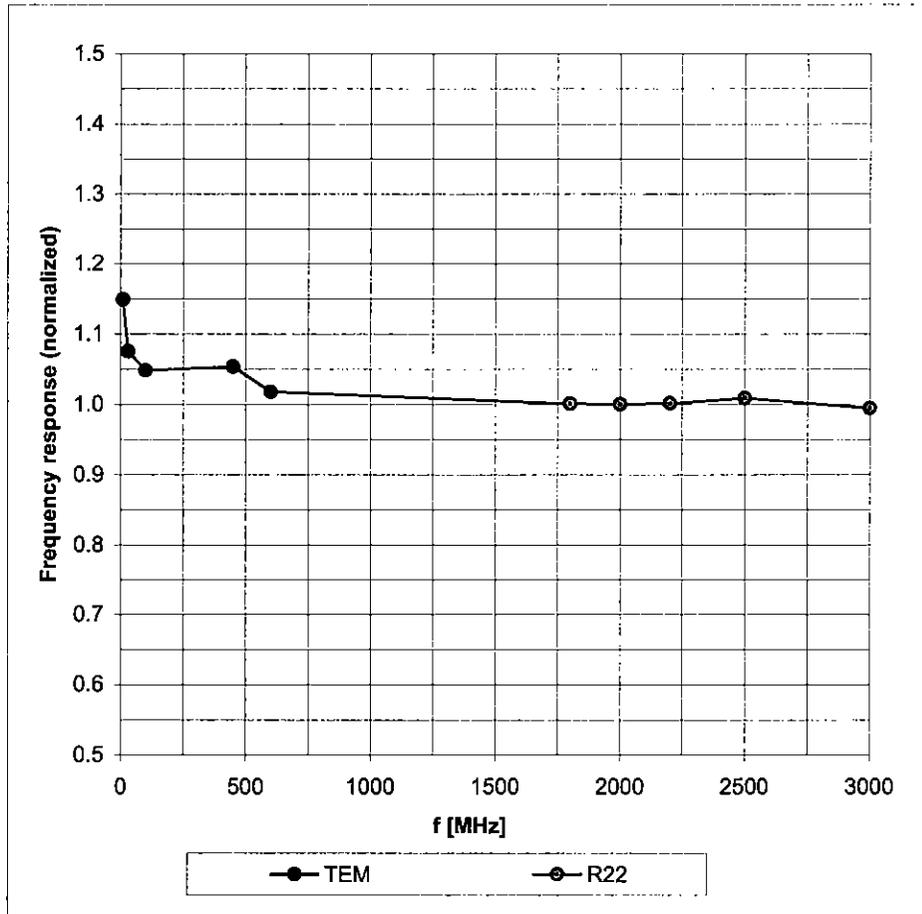
**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

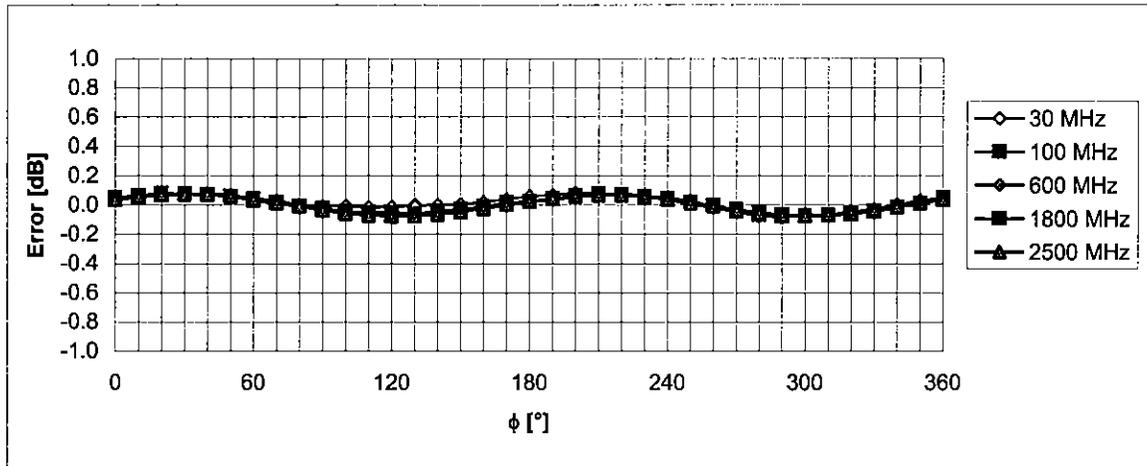
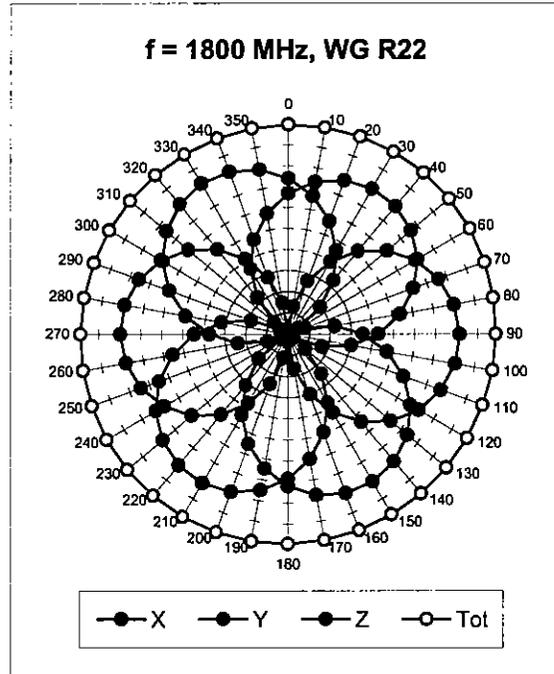
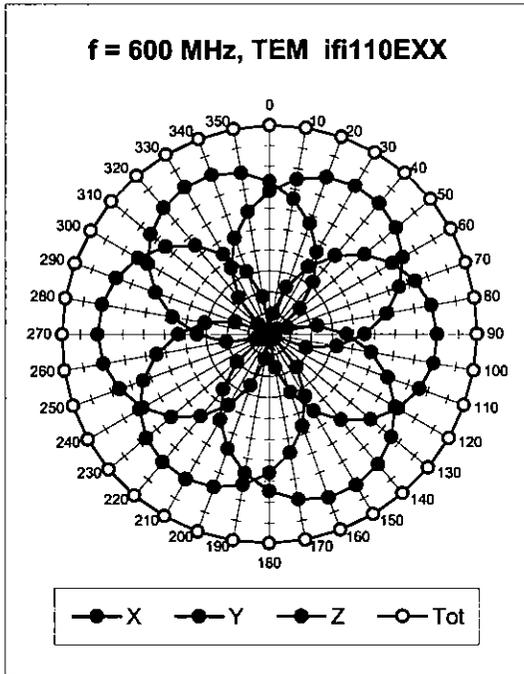
# Frequency Response of E-Field

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



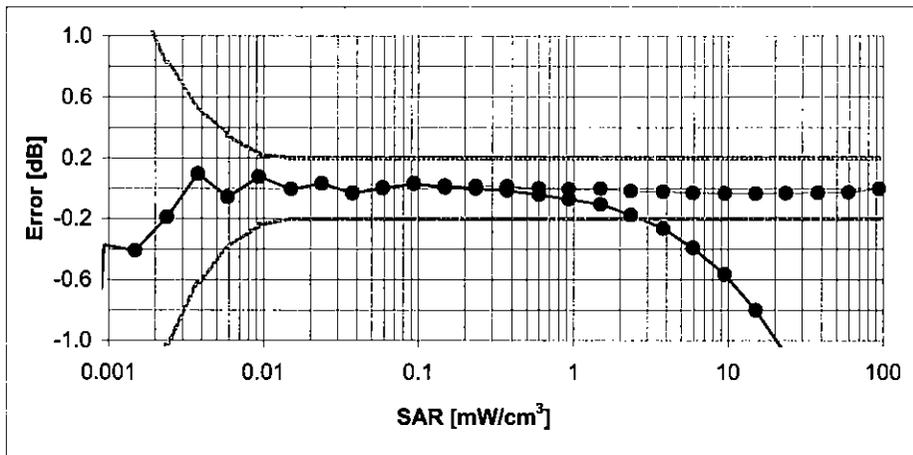
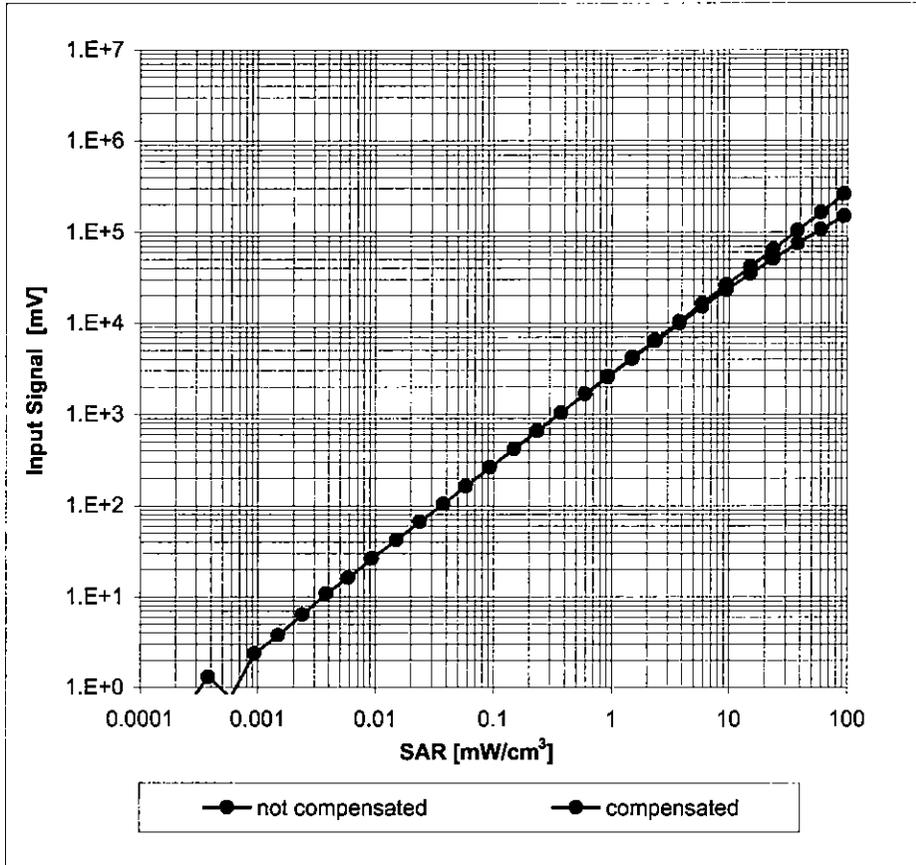
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

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



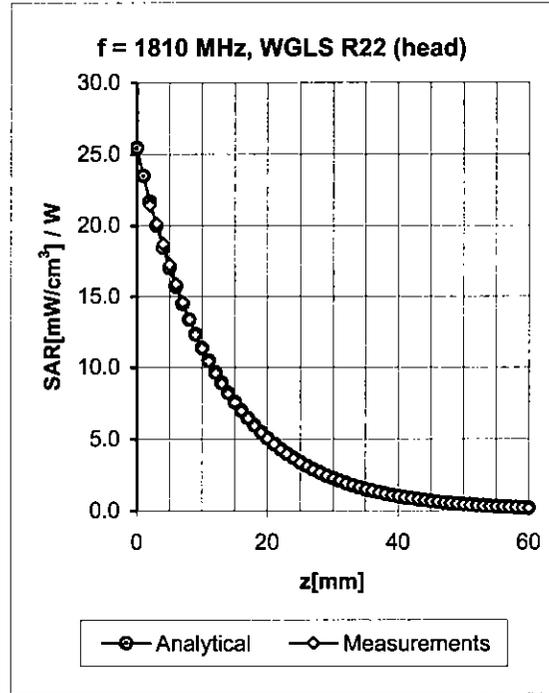
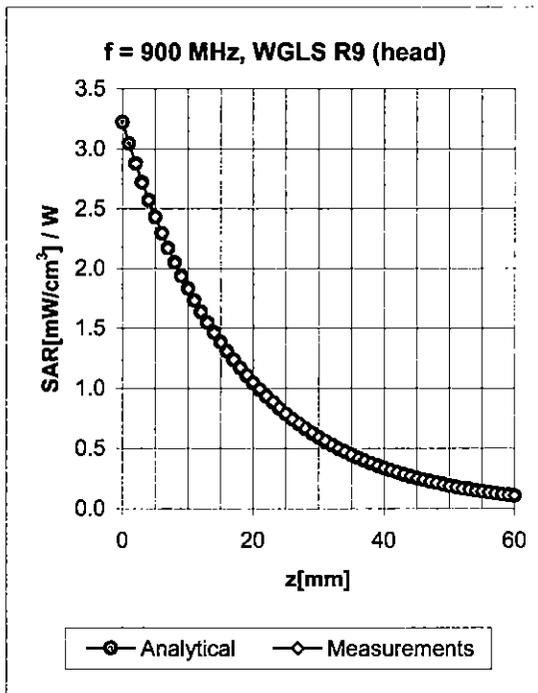
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

### Dynamic Range $f(\text{SAR}_{\text{head}})$ (Waveguide R22, $f = 1800 \text{ MHz}$ )



Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

## Conversion Factor Assessment

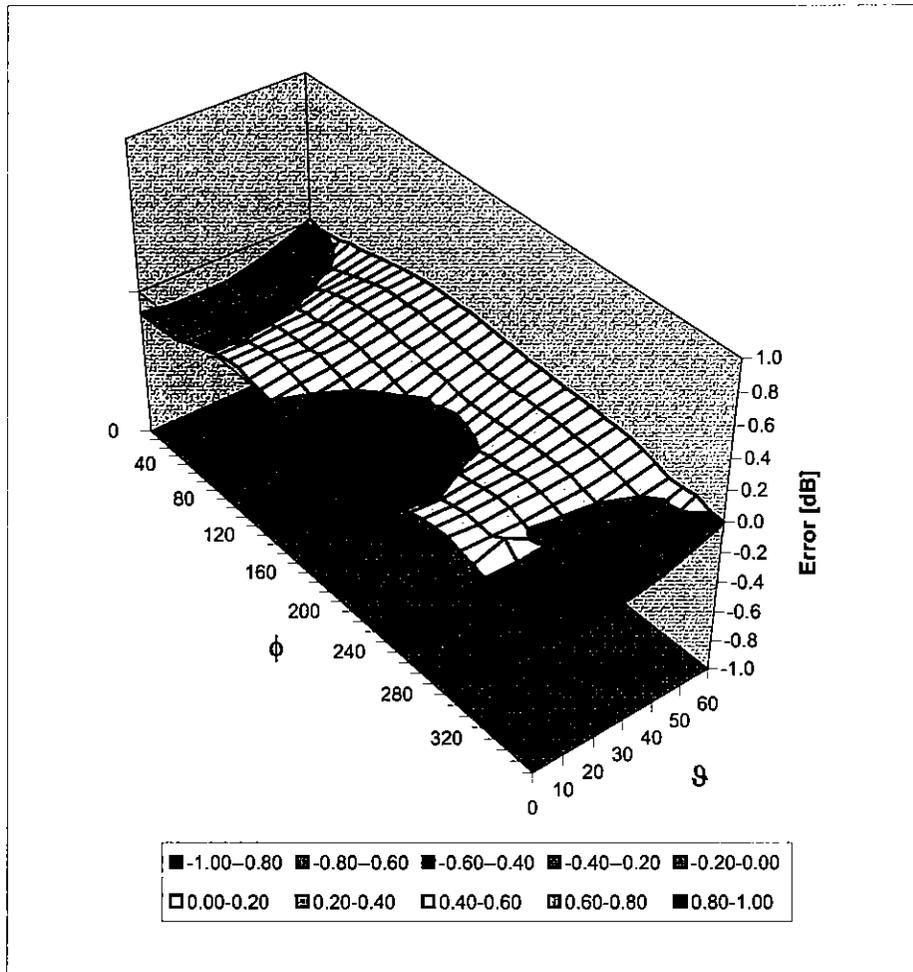


f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.21	1.13	7.91 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.47	0.94	7.04 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.61	0.71	6.37 ± 11.8% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.32	0.93	7.90 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.34	1.60	6.48 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.75	0.62	6.30 ± 11.8% (k=2)

<sup>c</sup> 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.

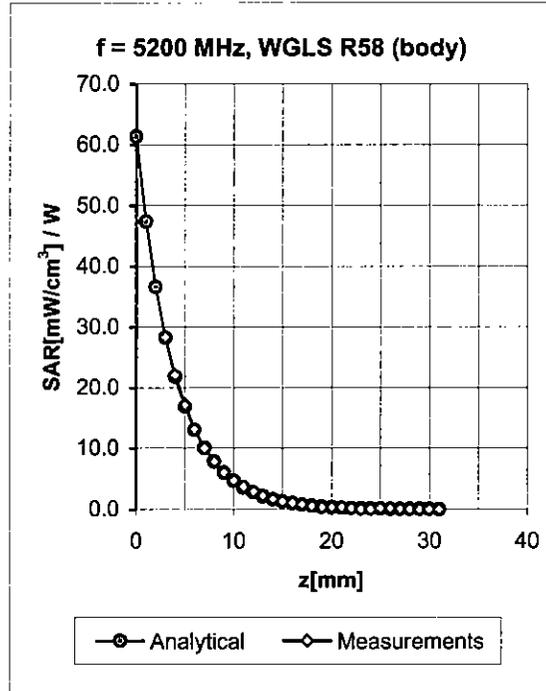
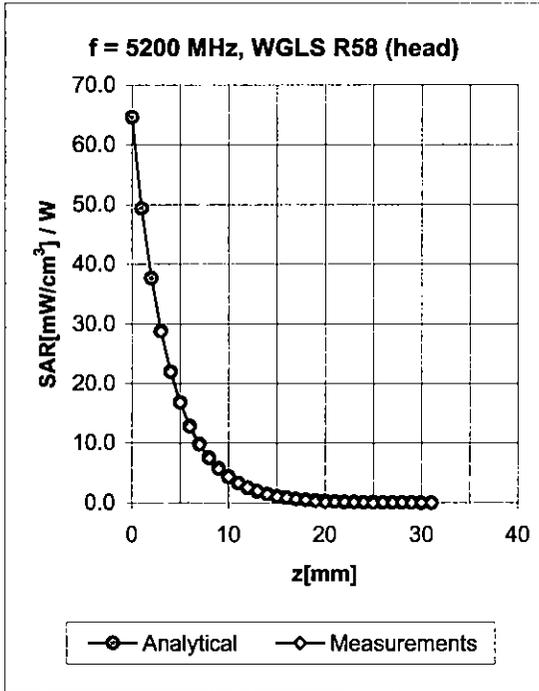
# Deviation from Isotropy in HSL

Error ( $\phi$ ,  $\theta$ ),  $f = 900$  MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )

# Appendix<sup>D</sup>



f [MHz] <sup>D</sup>	Validity [MHz]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
5200	± 50	Head	36.0 ± 5%	4.76 ± 5%	0.49	1.36	4.26 ± 13.6% (k=2)
5800	± 50	Head	35.3 ± 5%	5.27 ± 5%	0.52	1.42	3.75 ± 13.6% (k=2)
5200	± 50	Body	49.0 ± 5%	5.30 ± 5%	0.50	1.63	4.10 ± 13.6% (k=2)
5800	± 50	Body	48.2 ± 5%	6.00 ± 5%	0.49	1.70	3.63 ± 13.6% (k=2)

<sup>D</sup> Accreditation for ConvF assessment above 3000 MHz is currently applied for.