MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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Dosimetric Assessment
Test Report

for the

Kenwood
TK-3202

Tested and Evaluated In Accordance With
FCC OET 65 Supplement C: 01-01

Prepared for

Kenwood Communications Corporation
3975 Johns Creek Court, Suite 300
Suwanee, GA 30024

Engineering Statement: The measurements shown in this report were made in accordance with the procedures specified in Supplement C to OET Bulletin 65 of the Federal Communications Commission (FCC) Guidelines [FCC 2001] for uncontrolled exposure. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment evaluated is capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1999.

ACCREDITED
Union City Certificate
0591-02

SAR Evaluation
Certificate of Compliance

FCC ID: ALH36923230
APPLICANT: Kenwood

Applicant Name and Address: Kenwood Communications Corporation
3975 Johns Creek Court, Suite 300
Suwanee, GA 30024

Test Location: **MET Laboratories, Inc.**
4855 Patrick Henry Dr. Bldg #6
Santa Clara, CA 95054
USA

EUT:	Kenwood TK-3202		
Date of Receipt:	November 15, 2005		
Device Category:	Licensed Non-Broadcast Transmitter Held to Face (TNF)		
RF exposure environment:	Controlled Exposure/Occupational		
RF exposure category:	Portable FM UHF PTT Radio Transceiver		
Power supply:	1100mAh Ni-MH, 7.2VDC 1500mAh Ni-CAD 7.2VDC		
Antenna(s):	170mm Whip 75mm Stubby		
Production/prototype:	Production		
Modulation:	FM		
Duty Cycle:	100%		
TX Range:	400.0 – 430.0 MHz		
Maximum Tested RF Output Power in CW Mode:	400.0 MHz	Peak Conducted	36.7dBm/4.67W
	415.0 MHz	Peak Conducted	36.7dBm/4.67W
	430.0 MHz	Peak Conducted	36.7dBm/4.67W
Maximum SAR Measurement @ 50% Duty Cycle:	**Body: 5.01mW/g**	**Head: 3.63mW/g**	

Shawn McMillen

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INTRODUCTION

This measurement report demonstrates that the Kenwood TK-3202 FCC ID: ALH36923230 described within this report complies with the Specific Absorption Rate (SAR) RF exposure requirements specified in ANSI/IEEE Std. C95.1-1999 and FCC 47 CFR §2.1093 for the General Population / Uncontrolled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C, Edition 01-01 were employed.

A description of the device under test, device operating configuration and test conditions, measurement and site description, methodology and procedures used in the evaluation, equipment used, detailed summary of the test results and the various provisions of the rules are included in this dosimetric assessment test report.

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 (ρ). 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).

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

where:

σ - conductivity of the tissue - simulant material (S/m)
ρ - mass density of the tissue - simulant material (kg/m3)
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.

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DESCRIPTION OF DEVICE UNDER TEST (EUT)

Applicant:	Kenwood		
Description of Test Item:	Portable FM UHF PTT Radio Transceiver		
FCC ID:	ALH36923230		
Model Number:	TK-3202		
Serial Number:	70700151		
Battery Type(s) Tested:	1100mAh Ni-MH, 7.2VDC 1500mAh Ni-CAD 7.2VDC		
Antenna Type(s) Tested:	170mm Whip 75mm Stubby		
Body Worn Accessories:	Plastic Belt Clip Speaker Mic Head Set		
Maximum Duty Cycle Tested:	100%		
Transmitter Frequency Range (MHz):	410.0 – 430.0 MHz		
Tested Frequencies (MHz):	400.0 MHz	415.0 MHz	415.0 MHz
Maximum Tested RF Power Output CW Mode:	400.0 MHz	Peak Conducted	36.7dBm/4.67W
	415.0 MHz	Peak Conducted	36.7dBm/4.67W
	430.0 MHz	Peak Conducted	36.7dBm/4.67W
Maximum SAR Measurement @ 50% Duty Cycle:	**Body: 5.01mW/g**	**Head: 3.63 mW/g**	
Application Type:	Certification		
FCC Classification:	Licensed Non-Broadcast Transmitter Held to Face (TNF)		
Exposure Category:	Controlled Exposure/Occupational		
FCC Rule Part(s):	FCC 47 CFR §2.1093,		
Standards:	IEEE Std. 1528-2003, FCC OET Bulletin 65, Supplement C, Edition 01-01		

Notes: This portable handheld transceiver model TK-3202 FCC ID: ALH36923230, operates using frequency Modulation (FM) utilizing simplex two-way radio transmission. This device will be marketed for Occupation use. This device is intended to be operated in front of the users face and by means of body-worn accessory(s). The operational band of this device is 400.0 – 430.0 MHz with 1 and 4 watts selectable power.

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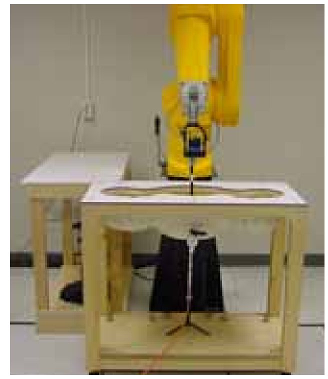
SAR MEASUREMENT SYSTEM



MET Laboratories, Inc SAR measurement facility utilizes the DASY4 Professional Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland for performing SAR compliance tests. 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). The Cell controller system contain 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.

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MEASUREMENT SUMMARY

FACE-HELD SAR MEASUREMENT RESULTS 450MHz Band ANSI/IEEE C95.1 1999 – SAFETY LIMIT HEAD: 8.0 W/kg (averaged over 1 gram) Spatial Peak – Controlled Exposure/Occupational												
Freq (MHz)	Chan	Cond. Power Before (dBm)	Cond. Power After (dBm)	Battery Type	Antenna Type	Sep Dist (cm)	Test Pos	Accessory	SAR over 1g	Drift (dB)	Adjusted SAR Over 1g Duty Cycle 100%	50%
415.0	Mid	36.7	36.1	Ni-CAD	Whip	2.5	Face Held	None	5.70	-0.554	6.48	3.24
415.0	Mid	36.7	36.1	NI-MH	Whip	2.5	Face Held	None	5.91	-0.602	6.79	3.39
400.0	Low	36.7	36.2	Ni-CAD	Whip	2.5	Face Held	None	5.49	-0.511	6.18	3.09
430.0	High	36.7	36.5	Ni-CAD	Whip	2.5	Face Held	None	5.42	-0.208	5.69	2.84
415.0	Mid	36.7	36.1	Ni-CAD	Stubby	2.5	Face Held	None	5.09	-0.579	5.82	2.91
415.0	Mid	36.7	36.2	NI-MH	Stubby	2.5	Face Held	None	5.04	-0.481	5.63	2.82
400.0	Low	36.7	36.2	Ni-CAD	Stubby	2.5	Face Held	None	6.48	-0.489	7.25	3.63
430.0	High	36.7	36.0	Ni-CAD	Stubby	2.5	Face Held	None	5.67	-0.683	6.64	3.32

Measured Mixture Type	450 MHz Head		Date Tested	November 15, 2005
Dielectric Constant εr	IEEE Target	Measured	Relative Humidity	37%
	43.5	45.8	Ambient Temperature (C)	22.7
Conductivity σ (mho/m)	IEEE Target	Measured	Fluid Temperature (C)	21.6
	0.87	0.83	Fluid Depth	≥15cm

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BODY-WORN SAR MEASUREMENT RESULTS 450MHz Band
ANSI/IEEE C95.1 1999 – SAFETY LIMIT
BODY: 8.0 W/kg (averaged over 1 gram)
Spatial Peak – Controlled Exposure/Occupational

Freq (MHz)	Chan	Cond. Power Before (dBm)	Cond. Power After (dBm)	Battery Type	Antenna Type	Sep Dist (cm)	Test Pos	Accessory	SAR over 1g 100% Duty cycle	Drift (dB)	Adjusted SAR due to drift Over 1g Duty Cycle 100%	Adjusted SAR due to drift Over 1g Duty Cycle 50%
415.0	Mid	36.7	36.1	Ni-CAD	Whip	1.1	Body	Speaker Mic	8.80	-0.560	10.01	5.01
415.0	Mid	36.7	36.0	NI-MH	Whip	1.1	Body	Head Set	7.44	-0.663	8.67	4.33
415.0	Mid	36.7	36.2	Ni-CAD	Whip	1.1	Body	Speaker Mic	8.08	-0.530	9.13	4.56
400.0	Low	36.7	36.1	Ni-CAD	Whip	1.1	Body	Speaker Mic	8.64	-0.604	9.93	4.96
430.0	High	36.7	36.5	Ni-CAD	Whip	1.1	Body	Speaker Mic	7.01	-0.195	7.33	3.67
415.0	Mid	36.7	36.3	Ni-CAD	Stubby	1.1	Body	Speaker Mic	8.02	-0.412	8.82	4.41
415.0	Mid	36.7	36.3	NI-MH	Stubby	1.1	Body	Head Set	7.76	-0.445	8.60	4.30
415.0	Mid	36.7	36.5	Ni-CAD	Stubby	1.1	Body	Speaker Mic	7.73	-0.235	8.16	4.08
400.0	Low	36.7	36.2	Ni-CAD	Stubby	1.1	Body	Speaker Mic	8.86	-0.455	9.84	4.92
430.0	High	36.7	35.9	Ni-CAD	Stubby	1.1	Body	Speaker Mic	7.78	-0.786	9.32	4.66

Measured Mixture Type	450 MHz Body		Date Tested	November 15, 2005
Dielectric Constant εr	IEEE Target	Measured	Relative Humidity	37%
	56.7	57.1	Ambient Temperature (C)	22.6
Conductivity σ (mho/m)	IEEE Target	Measured	Fluid Temperature (C)	22.0
	0.94	0.90	Fluid Depth	≥15cm

DETAILS OF SAR EVALUATION

The Kenwood TK-3202 FCC ID: ALH36923230 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 the Appendix.

1. The EUT was tested for body-worn SAR with a belt-clip accessory. The belt-clip provided 1.1cm separation between the back of the EUT and the outer surface of the planar phantom.

2. The EUT was tested for face-held configurations with the front of the EUT facing the planar phantom. The EUT was placed at a separation distance of 2.5cm from the outer surface of the phantom.

3. The device was positioned next to the phantom surface using either the DASY device positioner or low-loss polystyrene.

4. The EUT was tested at a 100% duty cycle in CW mode. The SAR values were scaled to account for any negative drift which occurred over the course of the test. A 50% duty cycle was applied to the final SAR values based on an equal transmit and receive time.

5. A SAR versus time sweep was carried out on the configuration that produced the highest measured SAR. The probe was positioned at the power measurement reference position.

6. The conducted power levels were measured before and after each test using a HP E4418B Power Meter according to the procedures described in FCC 47 CFR 2.1046. The EUT was set to the maximum power level for each SAR evaluation.

7. The SAR evaluations were performed with a fully charged battery.

8. The fluid temperature was measured prior to and after each SAR evaluation to ensure the temperature remained within ±2 deg C of the temperature of the fluid when the dielectric properties were measured.

9. The dielectric parameters of the simulated body fluid were measured prior to the evaluation using an 85070D Dielectric Probe Kit and an 8722D Network Analyzer.

10. During the SAR evaluations if a distribution produced several hotspots over the course of the area scan, each hotspot was evaluated separately.

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EVALUATION PROCEDURES

The evaluation was performed in the applicable area of the phantom depending on the type of device being tested.

(i) 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.

The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference 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:

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.

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:

Based on the area scan, a 32mm x 32mm x 34mm (7x7x7 data points) zoom scan was assessed at the position where the greatest V/m was detected. The data at the surface was extrapolated since the distance from the probes sensors to the surface is 3.9cm. A least squares fourth-order polynomial was used to generate points between the probe detector and the inner surface of the phantom.

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).

Z-Scan was determined as follows:

The Z-scan measures points along a vertical straight line. The line runs along a line normal to the inner surface of the phantom surface.

DATA EVALUATION PROCEDURES

The DASY4 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe Parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion Factor	$ConvF_i$
	- Dipole Compression Point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC - transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = Compensated signal of channel i (i = x, y, z)
U_i = Input signal of channel i (i = x, y, z)
cf = Crest factor of exciting field (DASY parameter)
dcp_i = Diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E} - \text{fieldprobes :} \qquad E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

$$\text{H} - \text{fieldprobes :} \qquad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$$

with V_i = Compensated signal of channel i (i = x, y, z)
$Norm_i$ = Sensor sensitivity of channel i (i = x, y, z)
$\mu V/(V/m)^2$ for E-field probes
$ConvF$ = Sensitivity enhancement in solution
a_{ij} = Sensor sensitivity factors for H-field probes
f = Carrier frequency (GHz)
E_i = Electric field strength of channel i in V/m
H_i = Magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with P_{pwe} = Equivalent power density of a plane wave in mW/cm2
E_{tot} = total electric field strength in V/m
H_{tot} = total magnetic field strength in A/m

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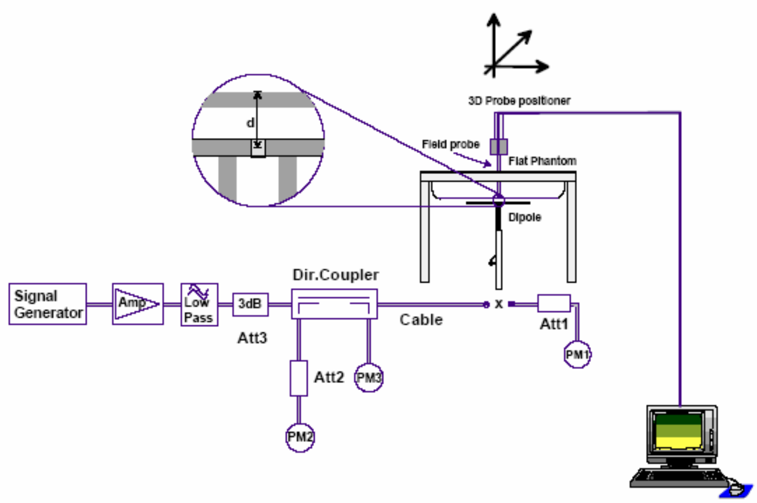
SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed with a 450 MHz dipole using the validation phantom. The dielectric parameters of the simulated brain fluid were measured prior to the system performance check using an 85070C Dielectric Probe Kit and an 8722D Network Analyzer. A forward power of 250mW was applied to the dipole and the system was verified to a tolerance of ±10%.

Test Date	450MHz Equivalent Tissue	SAR 1g (W/kg)		Permittivity Constant εr		Conductivity σ (mho/m)		Ambient Temp. (C)	Fluid Temp. (C)	Fluid Depth (cm)
		Calibrated Target	Measured	IEEE Target	Measured	IEEE Target	Measured			
11/15/05	Head	1.31±5%	1.27	43.5 ±5%	45.7	0.87±10%	0.83	22.7	21.6	≥15
11/16/05	Head	1.31±5%	1.25	43.5 ±5%	45.7	0.87±10%	0.83	22.0	21.9	≥15

Note: The ambient and fluid temperatures were measured prior to the fluid parameter check and the system performance check. The temperatures listed in the table above were consistent for all measurement periods.



SIMULATED EQUIVALENT TISSUES

Simulated Tissue Mixture		
Ingredient	**450MHz Head**	**450MHz Body**
Water	38.56%	52.00%
Sugar	56.32%	45.65%
Salt	3.95%	1.75%
HEC	0.98%	0.50%
Bactericide	0.19%	0.10%

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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 1g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.0	20.0

Notes:

1. Uncontrolled exposure environments are locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.

2. Controlled exposure environments are 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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ROBOT SYSTEM SPECIFICATIONS

1.1. SPECIFICATIONS

Positioner:

Robot:	Staubli Unimation Corp. Robot Model: RX90
Repeatability:	0.02 mm
No. of axis:	6

1.2. DATA ACQUISITION ELECTRONIC (DAE) SYSTEM:

Cell Controller

Processor:	Compaq Evo
	Clock Speed:2.4 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.:	1793
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

EX-Probe

Model:	EX3DV3
Serial No.	3511
Construction:	Triangular core
Frequency:	10 MHz to > 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

1.3. PHANTOM(S):

Validation & Evaluation Phantom

Type:	SAM V4.0C
Shell Material:	Fiberglass
Thickness:	2.0 ± 0.1 mm
Volume:	Approx. 20 liters

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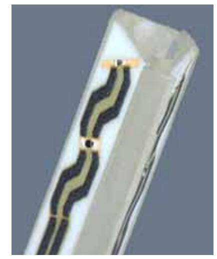
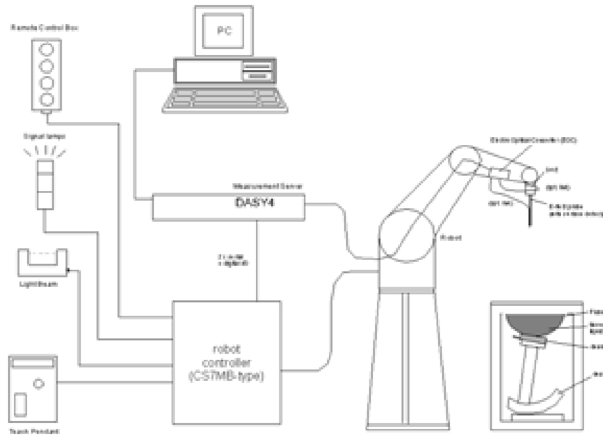
PROBE SPECIFICATIONS (ET3DV6)



Construction:	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g. glycolether)
Calibration:	Basic Broadband calibration in air from 10 MHz to 3 GHz
Frequency:	10 MHz to 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic Range:	5 µ W/g to > 100 mW/g; Linearity: ± 0.2 dB
Surface Detection:	± 0.2 mm repeatability in air and clear liquid over diffuse reflecting surfaces
Dimensions:	Overall length: 330 mm (Tip: 16 mm) Tip diameter (including protective cover): 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetric measurements up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms

SAR Measurement System



Measurement System Diagram

1.4. RX90BL ROBOT

The Stäubli RX90BL Robot is a standard high precision 6-axis robot with an arm extension for accommodating the data acquisition electronics (DAE).

1.5. ROBOT CONTROLLER

The CS7MB Robot Controller system drives the robot motors. The system consists of a power supply, robot controller, and remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.

1.6. LIGHT BEAM SWITCH

The Light Beam Switch (Probe alignment tool) allows automatic ”tooling” of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured as well as the probe length and the horizontal probe offset. The software then corrects all movements, so that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

1.7. DATA ACQUISITION ELECTRONICS

The Data Acquisition Electronics consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain switching multiplexer, a fast 16-bit A/D converter and a command decoder and control logic unit. Some of the task the DAE performs is signal amplification, signal multiplexing, A/D conversion, and offset measurements. The DAE also contains the mechanical probe-mounting device, which contains two different sensor systems for frontal and sideways probe contacts used for probe collision detection and mechanical surface detection for controlling the distance between the probe and the inner surface of the phantom shell. Transmission from the DAE to the measurement server, via the EOC, is through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

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1.8. ELECTO-OPTICAL CONVERTER (EOC)

The Electro-Optical Converter performs the conversion between the optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC connects to, and transfers data to, the DASY4 measurement server. The EOC also contains the fiber optical surface detection system for controlling the distance between the probe and the inner surface of the phantom shell.

1.9. MEASUREMENT SERVER

The Measurement Server performs time critical tasks such as signal filtering, all real-time data evaluation for field measurements and surface detection, controls robot movements, and handles safety operation. The PC-operating system cannot interfere with these time critical processes. A watchdog supervises all connections, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements.

1.10. DOSIMETRIC PROBE

Dosimetric Probe is a symmetrical design with triangular core that incorporates three 3 mm long dipoles arranged so that the overall response is close to isotropic. The probe sensors are covered by an outer protective shell, which is resistant to organic solvents i.e. glycol. The probe is equipped with an optical multi-fiber line, ending at the front of the probe tip, for optical surface detection. This line connects to the EOC box on the robot arm and provides automatic detection of the phantom surface. The optical surface detection works in transparent liquids and on diffuse reflecting surfaces with a repeatability of better than ±0.1mm.

1.11. SAM PHANTOM

The SAM (Specific Anthropomorphic Mannequin) twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm) integrated into a wooden table. The shape of the shell corresponds to the phantom defined by SCC34-SC2. It enables the dosimetric evaluation of left hand, right hand phone usage as well as body mounted usage at the flat phantom region. The flat section is also used for system validation and the length and width of the flat section are at least 0.75 λO and 0.6 λO respectively at frequencies of 824 MHz and above (λO = wavelength in air).

Reference markings on the phantom top allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. A white cover is provided to cover the phantom during off-periods preventing water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible. The phantom is filled with a tissue simulating liquid to a depth of at least 15 cm at each ear reference point. The bottom plate of the wooden table contains three pair of bolts for locking the device holder.

1.12. PLANAR PHANTOM

The planar phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of handheld radio transceivers. The outer dimensions of the planar phantom are 50cm x 50cm x 23cm. The planar phantom is mounted on the wooden table of the DASY4 system.

1.13. VALIDATION PLANAR PHANTOM

The validation planar phantom is constructed of Plexiglas material with a 6.0 mm shell thickness for system validations at 450MHz and below. The validation planar phantom is mounted on the wooden table of the DASY4 system.

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1.14. SPLIT PLANAR PHANTOM

The Split Planar Phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of handheld radio transceivers. The outer dimensions of each cell are 70cm x 20cm x 23cm and each side is separated by a 2.0mm Plexiglas wall. The Split Planar Phantom is mounted on the wooden table of the DASY4 system.

1.15. DEVICE HOLDER

The device holder is designed to cope with the different measurement positions in the three sections of the SAM phantom given in the standard. It has two scales, one for device rotation (with respect to the body axis) and one for device inclination (with respect to the line between the ear openings). The rotation center for both scales is the ear opening, thus the device needs no repositioning when changing the angles. The plane between the ear openings and the mouth tip has a rotation angle of 65°.

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

The dielectric properties of the liquid conform to all the tabulated values [2-5]. Liquids are prepared according to Annex A and dielectric properties are measured according to Annex B.

1.16. SYSTEM VALIDATION KITS

Power Capability: > 100 W (f < 1GHz); > 40 W (f > 1GHz)

Construction: Symmetrical dipole with l/4 balun Enables measurement of feed point impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

Frequency: 300, 450, 835, 1900, 2450 MHz

Return loss: >20 dB at specified validation position

Dimensions:
300 MHz Dipole: Length: 396mm; Overall Height:430 mm; Diameter: 6 mm
450 MHz Dipole: Length: 270 mm; Overall Height: 347 mm; Diameter: 6 mm
835 MHz Dipole: Length: 161 mm; Overall Height: 270 mm; Diameter: 3.6 mm
1900 MHz Dipole: Length: 68 mm; Overall Height: 219 mm; Diameter: 3.6 mm
2450 MHz Dipole: Length: 51.5 mm; Overall Height: 300 mm; Diameter: 3.6 mm

TEST EQUIPMENT LIST

Test Equipment	Serial Number	Calibration Date
DASY4 System Robot ETVDV6 EX3DV3 DAE3 300MHz Dipole 450MHz Dipole 835MHz Dipole 1900MHz Dipole 2450MHz Dipole SAM Phantom V4.0C EUT Planar Phantom Validation Phantom	 FO3/SX19A1/A/01 1793 3511 584 003 004 493 001 002 N/A N/A N/A	 N/A Sept 2005 Jan 2004 Sept 2005 Dec 2004 Dec 2004 Sept 2005 June 2004 June 2004 N/A N/A N/A
85070D Dielectric Probe Kt	N/A	N/A
83650B Signal Generator	3844A00910	June 2005
HP E4418B Power Meter	GB40205140	June 2005
HP 8482A Power Sensor	2607A11286	June 2005
HP 8722D Vector Network Analyzer	3S36140188	March 2005
Anritsu Power Meter	6K00001832	June 2005
Anritsu Power Sensor	030864	Jan 2005
Mini-Circuits Power Amplifier	D111903#8	N/A

MEASUREMENT UNCERTANTIES

UNCERTAINTY ASSESSMENT FOR EUT

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.6	Rectangular	√3	(1-cp)1/2	± 1.9	∞
Spherical isotropy of the probe	± 9.7	Rectangular	√3	(cp)1/2	± 3.9	∞
Boundary effects	± 8.5	Rectangular	√3	1	± 4.8	∞
Probe linearity	± 4.5	Rectangular	√3	1	± 2.7	∞
Detection limit	± 0.9	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.9	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.2	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 0.54	Rectangular	√3	1	± 0.43	∞
Mech. constraints of robot	± 0.5	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 2.7	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 2.2	Normal	1	1	± 2.23	11
Device holder uncertainty	± 5.0	Normal	1	1	± 5.0	7
Power drift	± 5.0	Rectangular	√3		± 2.9	∞
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 3.5./1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 12.14/11.76	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 24.29/23.51	

Table: Worst-case uncertainty for DASY4 assessed according to IEEE P1528.
The budget is valid for the frequency range 300MHz to 6GHz and represents a worst-case analysis.

UNCERTAINTY ASSESSMENT FOR SYSTEM VALIDATION

Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	c_i 1g	Standard Uncertainty ±% (1g)	v_i or v_{eff}
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8	∞
Axial isotropy of the probe	± 4.7	Rectangular	√3	(1-cp)1/2	± 2.7	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(cp)1/2	± 3.8	∞
Boundary effects	± 1.0	Rectangular	√3	1	± 0.0	∞
Probe linearity	± 4.7	Rectangular	√3	1	± 3.2	∞
Detection limit	± 1.0	Rectangular	√3	1	± 0.6	∞
Readout electronics	± 1.0	Normal	1	1	± 1.0	∞
Response time	± 0.8	Rectangular	√3	1	± 0.5	∞
Integration time	± 1.3	Rectangular	√3	1	± 0.8	∞
RF ambient conditions	± 3.0	Rectangular	√3	1	± 1.7	∞
Mech. constraints of robot	± 0.4	Rectangular	√3	1	± 0.2	∞
Probe positioning	± 1.4	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 4.0	Rectangular	√3	1	± 2.3	∞
Dipole						
Dipole Axis to liquid distance	± 2.0	Normal	1	1	± 1.2	11
Input Power	± 5.0	Normal	1	1	± 2.7	7
Phantom and Setup						
Phantom uncertainty	± 4.0	Rectangular	√3	1	± 2.3	∞
Liquid conductivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid conductivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (target)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Liquid permittivity (measured)	± 5.0	Rectangular	√3	0.6	± 1.7	∞
Combined Standard Uncertainty					± 9.8	
Coverage Factor for 95%		Kp=2				
Expanded Uncertainty (k=2)					± 19.7	

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Test Setup Photos

Photograph 1. KT-3202 Face Held with Whip Antenna

Photograph 2. KT-3202 Face Held with Whip Antenna

Photograph 3. KT-3202 Face Held with Whip Antenna

Photograph 4. KT-3202 Face Held with Stubby Antenna

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Photograph 5 KT-3202 Face Held with Stubby Antenna

Photograph 6. KT-3202 Face Held with Stubby Antenna

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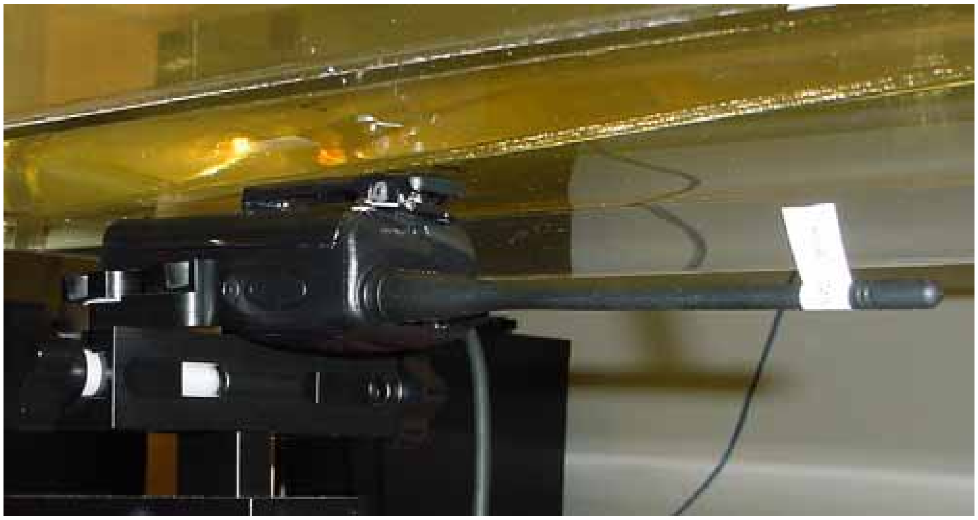
Photograph 7. KT-3202 Body Worn with Whip Antenna

Photograph 8. KT-3202 Body Worn with Whip Antenna

© 2005, MET Laboratories, Inc.



Photograph 9. KT-3202 Body Worn with Whip Antenna

Photograph 10. KT-3202 Body Worn with Whip Antenna

Photograph 11. KT-3202 Body Worn with Stubby Antenna

Photograph 12. KT-3202 Body Worn with Whip Antenna

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External Photos

Photograph 13. TK-3202 Front/Back and Side views with Whip Antenna

Photograph 14. TK-3202 Front/Back a views with Whip Antenna

Photograph 15. TK-3202 with Battery Removed

Photograph 16. TK-3202 Ni-CAD and Ni-MH Batteries

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Photograph 17. TL-3202 With Speaker Mic and Head Set

Photograph 18. TK-3202 Whip and Stubby Antennas

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Photograph 19. TK-3202 Speaker Mic and Headset Accessories

Photograph 20. TK-3202 Label Location

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Appendix A – SAR MEASUREMENT DATA

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Mid Ch Face Held Whip/Ni-MH

Date/Time: 11/16/2005 10:03:00 AM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

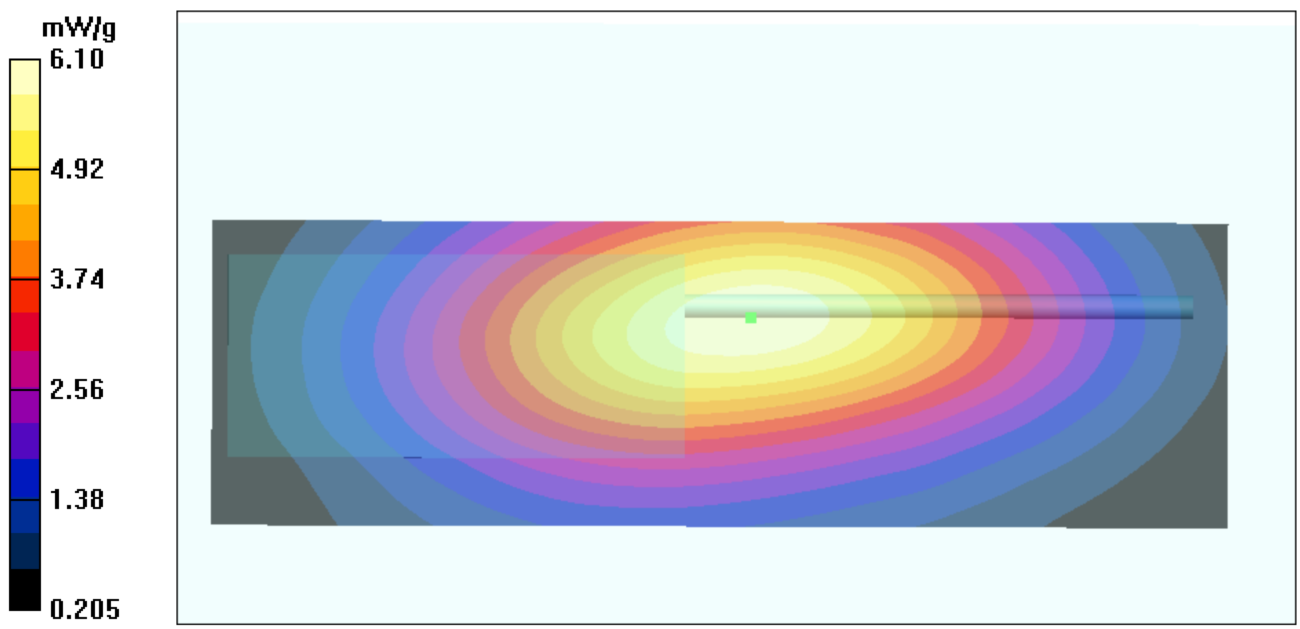
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 6.10 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.2 V/m; Power Drift = -0.554 dB
Peak SAR (extrapolated) = 8.71 W/kg
SAR(1 g) = 5.7 mW/g; SAR(10 g) = 4.13 mW/g
Maximum value of SAR (measured) = 5.93 mW/g



Mid Ch Face Held Whip/Ni-CAD

Date/Time: 11/16/2005 9:38:41 AM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

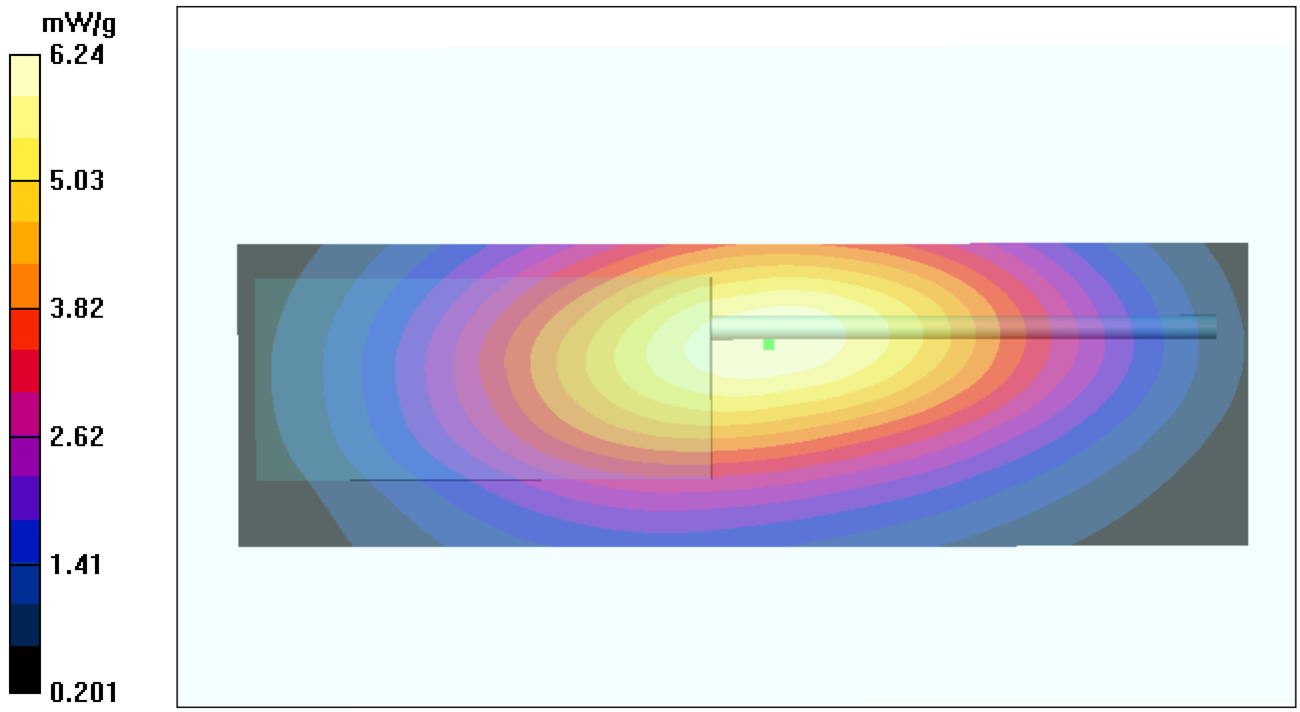
DUT: Kenwood; Type: TK-3202; Serial: 70700151

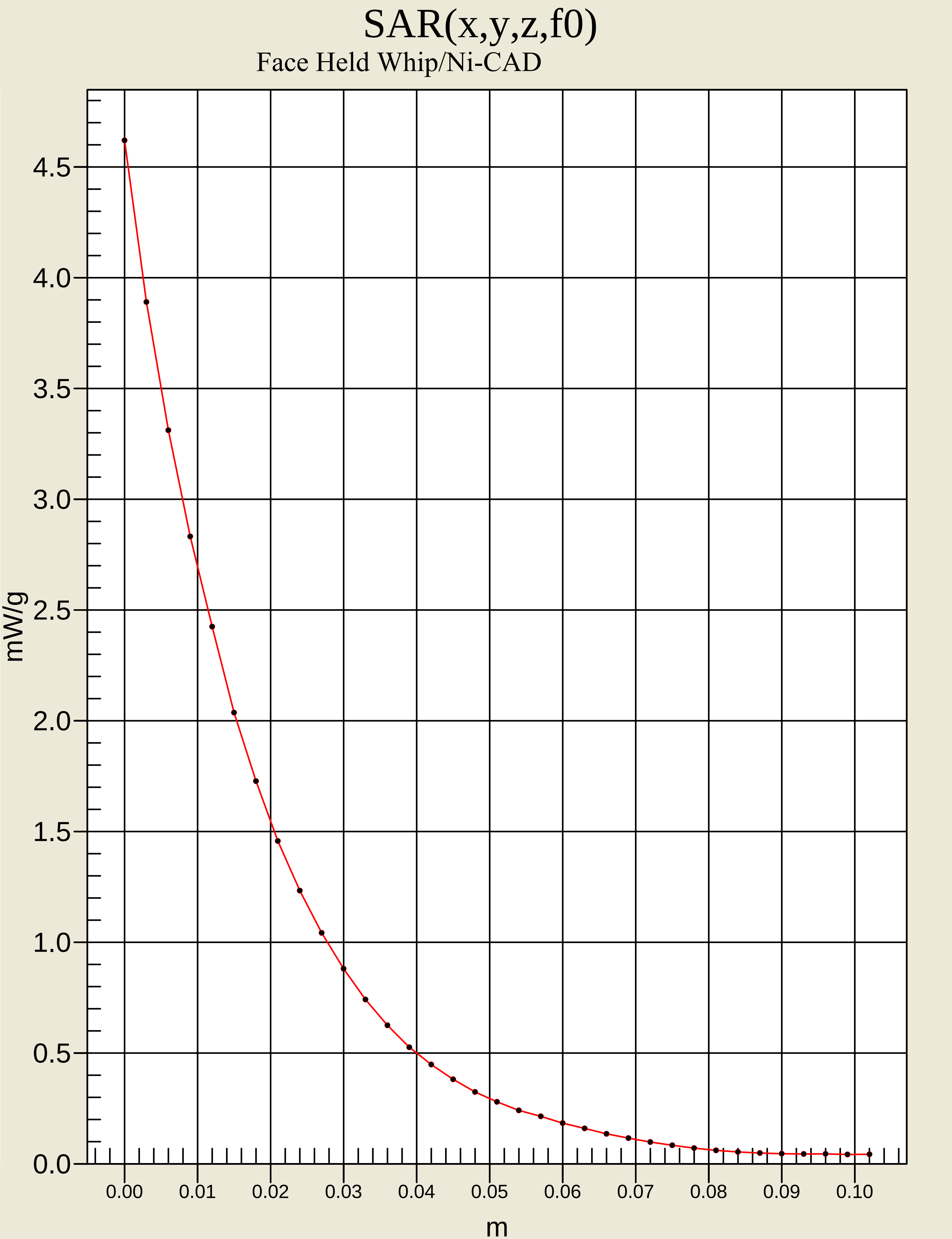
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 6.24 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.0 V/m; Power Drift = -0.602 dB
Peak SAR (extrapolated) = 9.08 W/kg
SAR(1 g) = 5.91 mW/g; SAR(10 g) = 4.28 mW/g
Maximum value of SAR (measured) = 6.16 mW/g




SAR(x,y,z,f0)
Face Held Whip/Ni-CAD
mW/g
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

Low Ch Face Held whip/Ni-CAD

Date/Time: 11/16/2005 10:03:00 AM

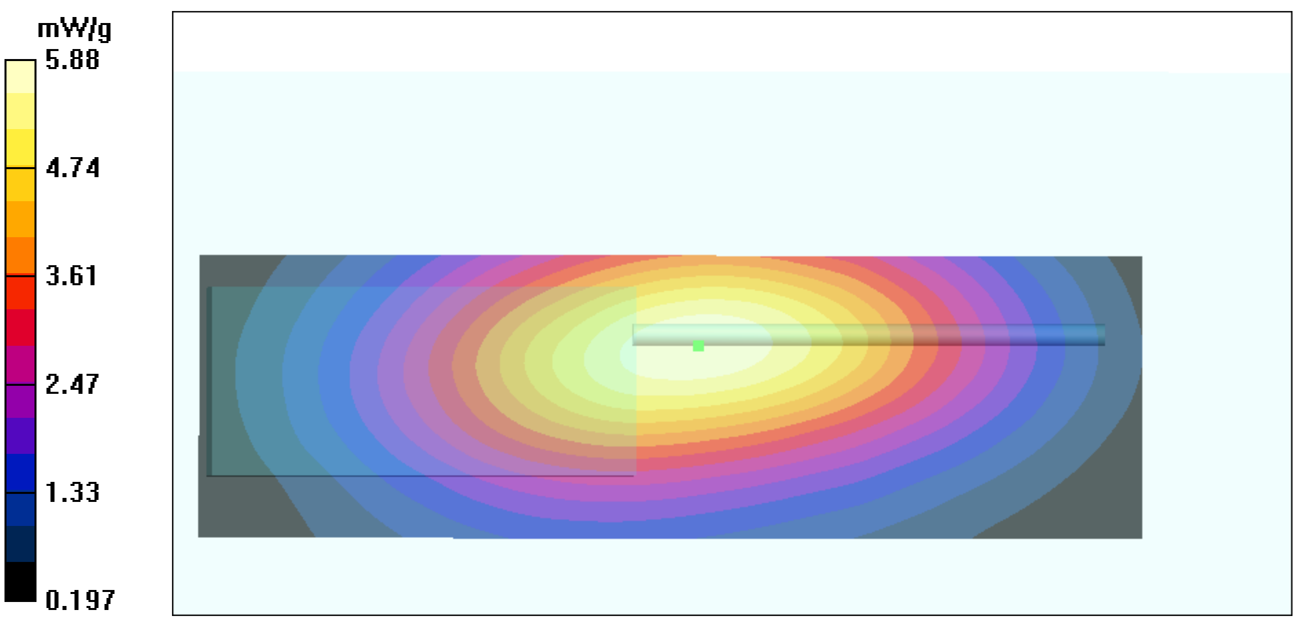
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.88 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 86.2 V/m; Power Drift = -0.511 dB
Peak SAR (extrapolated) = 8.40 W/kg
SAR(1 g) = 5.49 mW/g; SAR(10 g) = 3.98 mW/g
Maximum value of SAR (measured) = 5.71 mW/g



High Ch Face Held whip/Ni-CAD

Date/Time: 11/16/2005 11:03:18 AM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

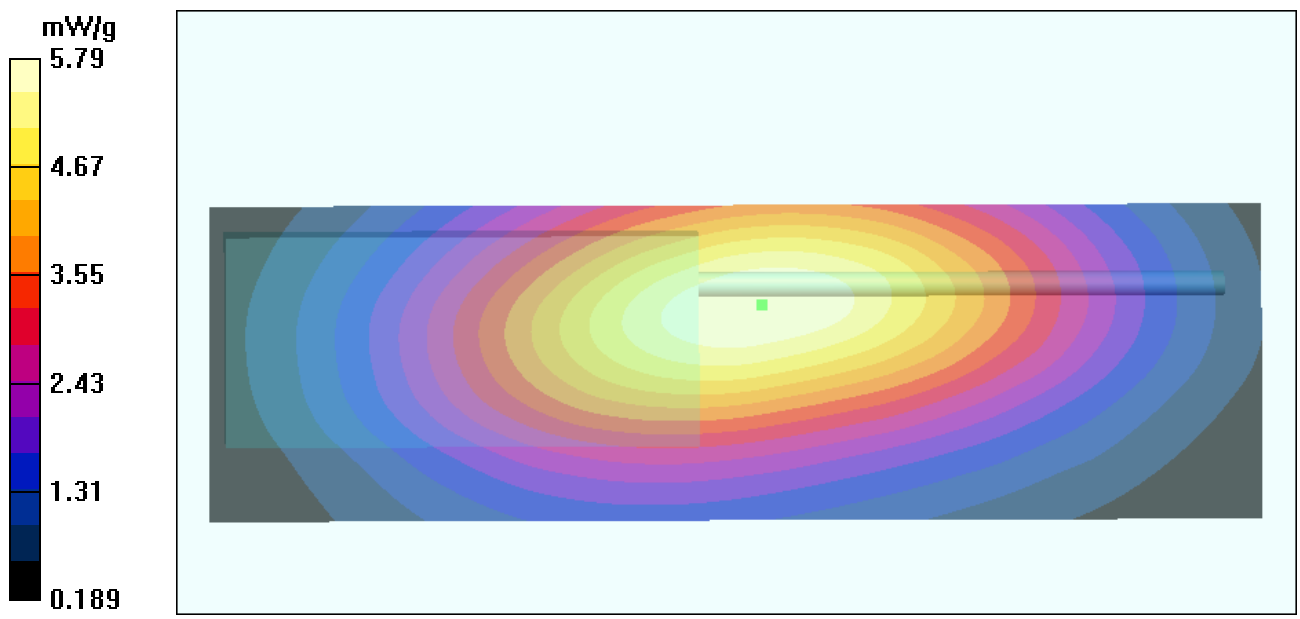
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.79 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 87.1 V/m; Power Drift = -0.208 dB
Peak SAR (extrapolated) = 8.37 W/kg
SAR(1 g) = 5.42 mW/g; SAR(10 g) = 3.9 mW/g
Maximum value of SAR (measured) = 5.62 mW/g



Mid Ch Face Held stubby/Ni-CAD

Date/Time: 11/16/2005 12:37:33 PM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

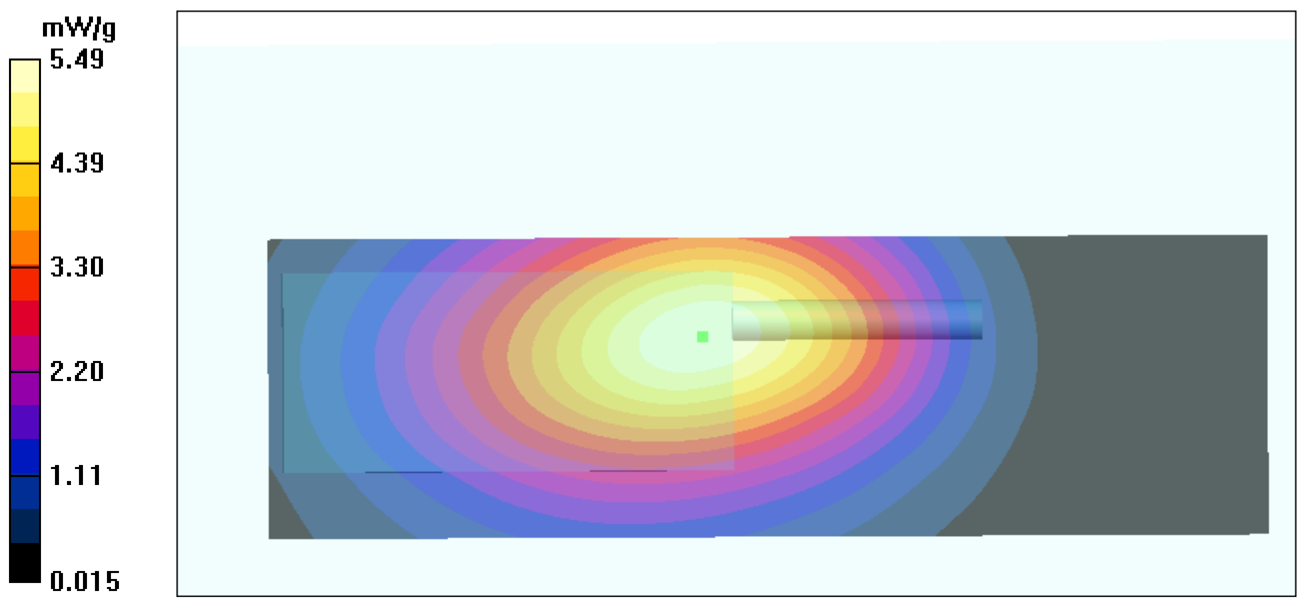
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; $\sigma = 0.83$ mho/m; $\varepsilon_r = 45.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.49 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 80.8 V/m; Power Drift = -0.579 dB
Peak SAR (extrapolated) = 7.85 W/kg
SAR(1 g) = 5.09 mW/g; SAR(10 g) = 3.66 mW/g
Maximum value of SAR (measured) = 5.32 mW/g



Mid Ch Face Held Stubby/Ni-MH

Date/Time: 11/16/2005 1:09:32 PM

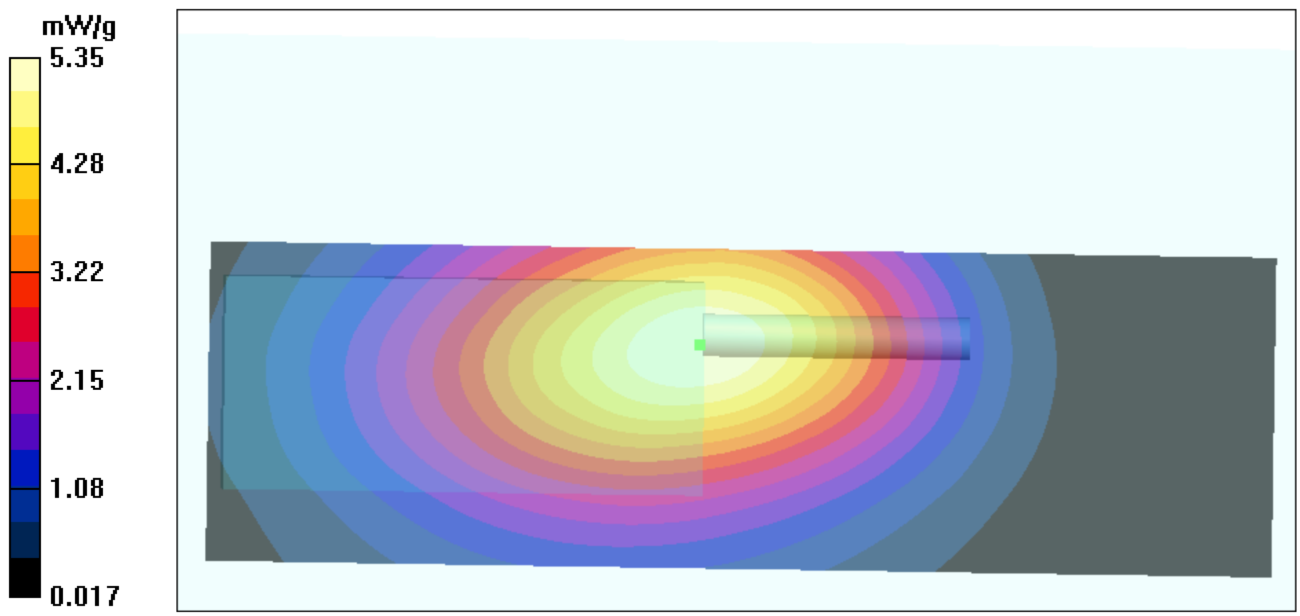
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; $\sigma = 0.83$ mho/m; $\varepsilon_r = 45.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 5.35 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 79.2 V/m; Power Drift = -0.481 dB
Peak SAR (extrapolated) = 7.76 W/kg
SAR(1 g) = 5.04 mW/g; SAR(10 g) = 3.63 mW/g
Maximum value of SAR (measured) = 5.24 mW/g



Low Ch Face Held Stubby/Ni-CAD

Date/Time: 11/16/2005 1:37:42 PM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

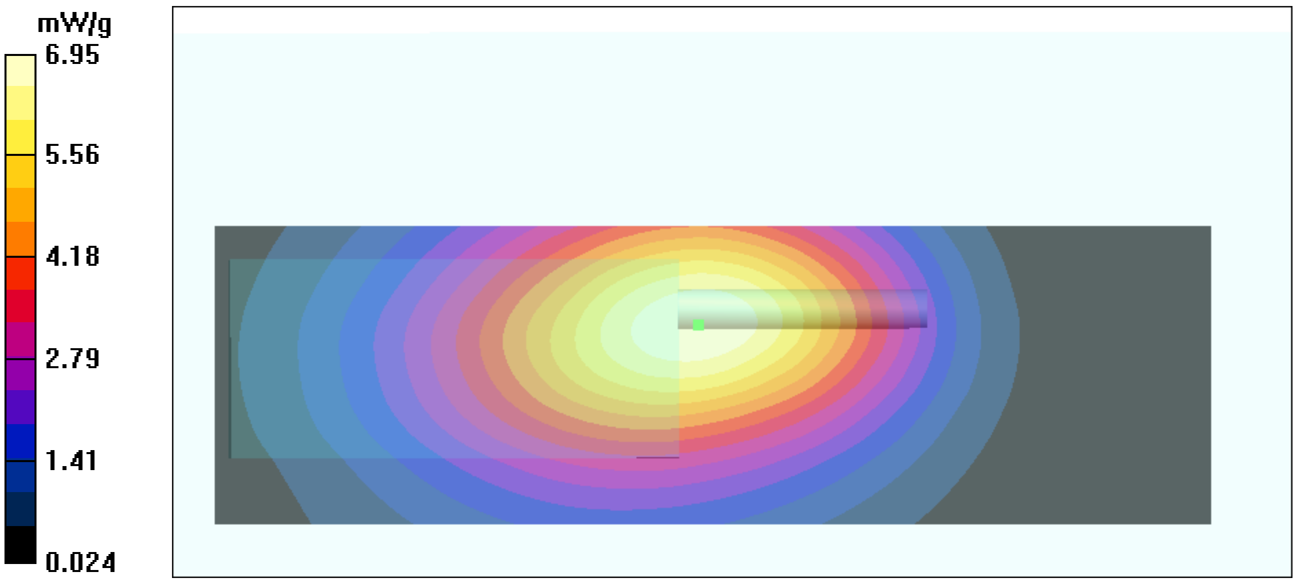
DUT: Kenwood; Type: TK-3202; Serial: 70700151

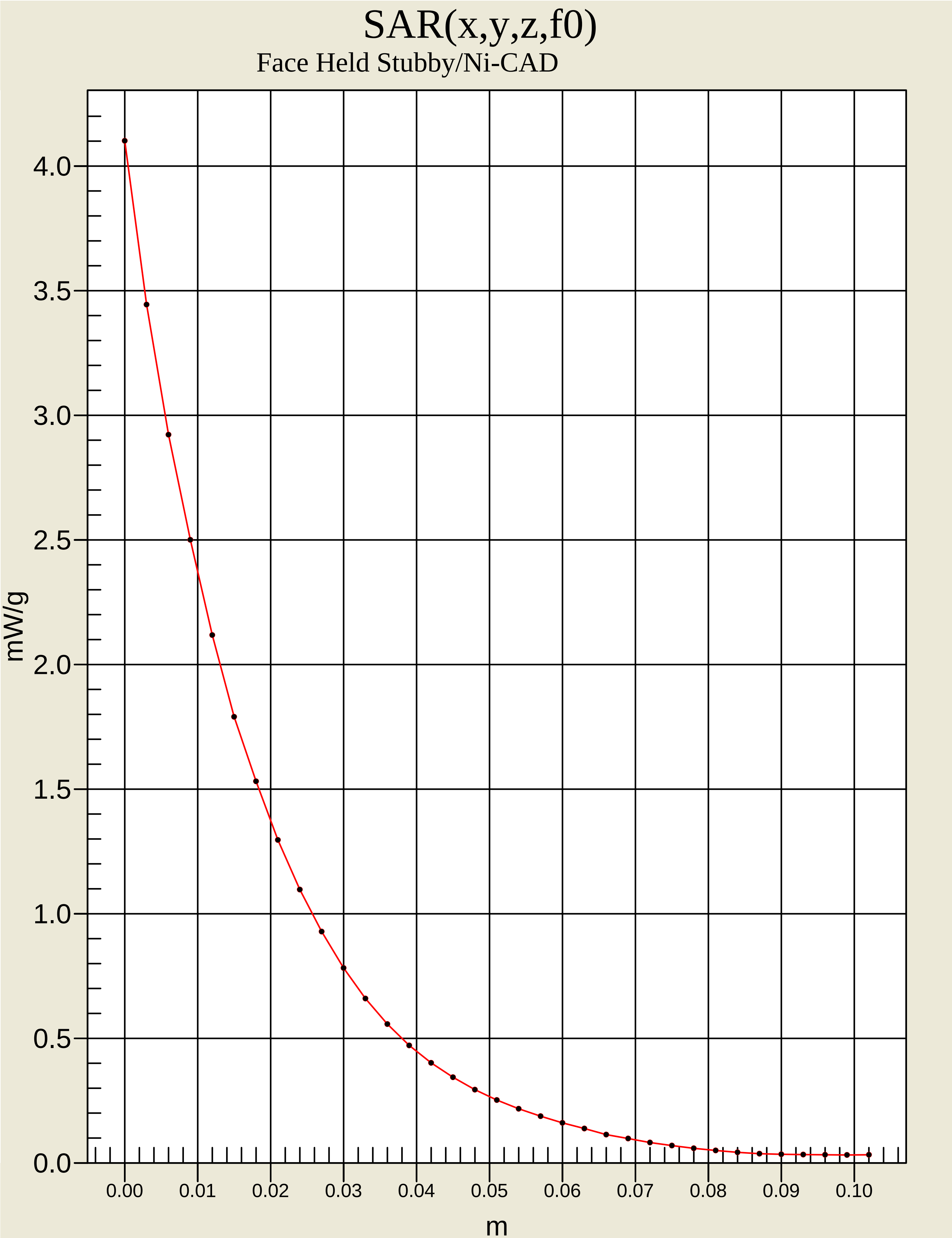
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.8; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 6.95 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.2 V/m; Power Drift = -0.489 dB
Peak SAR (extrapolated) = 9.98 W/kg
SAR(1 g) = 6.48 mW/g; SAR(10 g) = 4.65 mW/g
Maximum value of SAR (measured) = 6.72 mW/g





SAR(x,y,z,f0)
Face Held Stubby/Ni-CAD
mW/g
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

High Ch Face Held Stubby/Ni-CAD

Date/Time: 11/16/2005 2:05:38 PM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

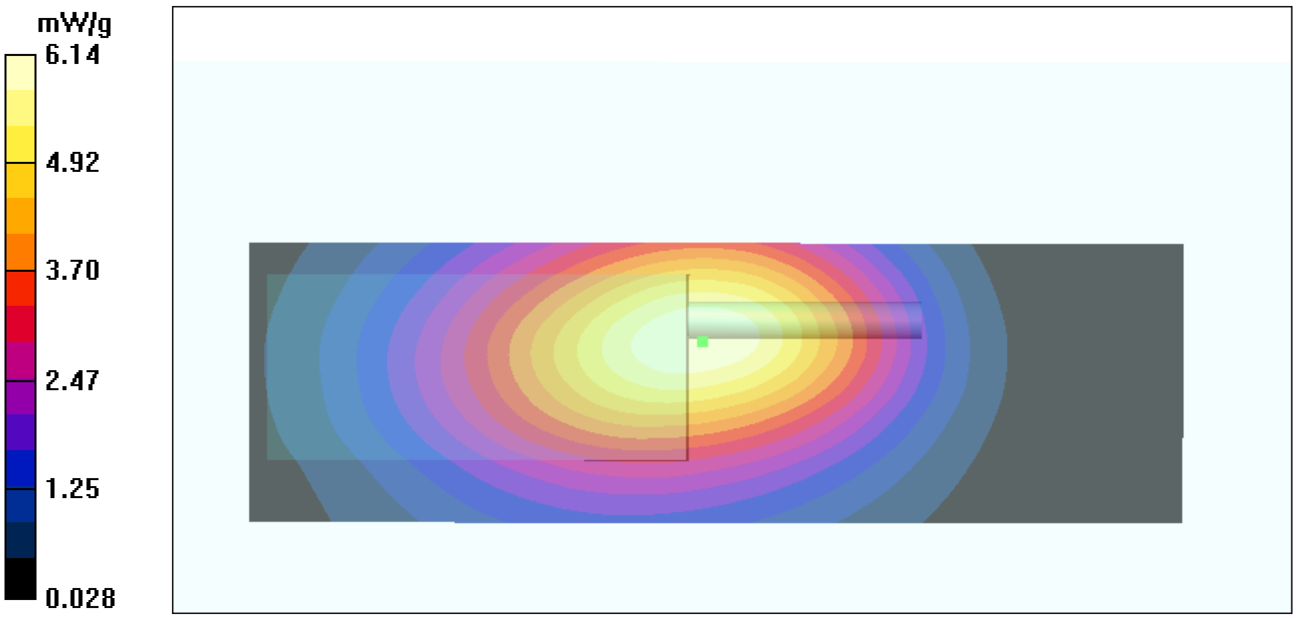
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; $\sigma = 0.83$ mho/m; $\varepsilon_r = 45.8$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 6.14 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 89.4 V/m; Power Drift = -0.683 dB
Peak SAR (extrapolated) = 8.79 W/kg
SAR(1 g) = 5.67 mW/g; SAR(10 g) = 4.07 mW/g
Maximum value of SAR (measured) = 5.90 mW/g



Mid Ch Body whip/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 10:13:56 AM

DUT: Kenwood; Type: TK-3202; Serial: 70700151

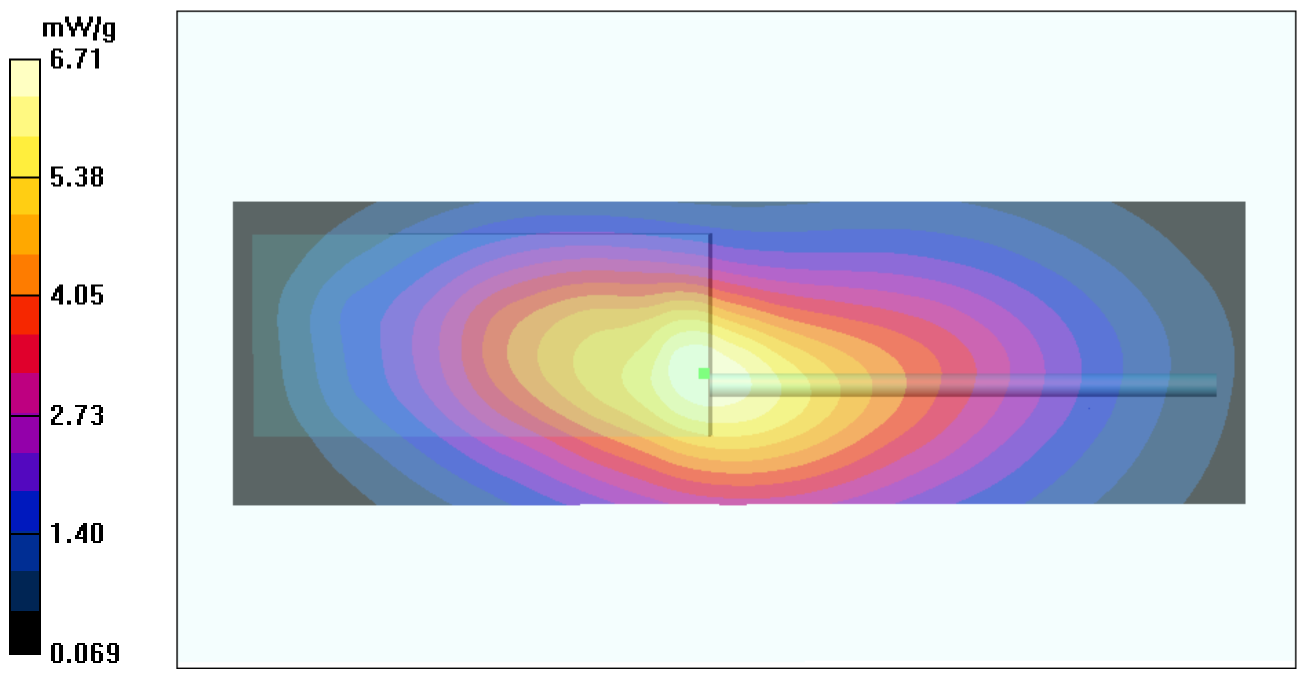
Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

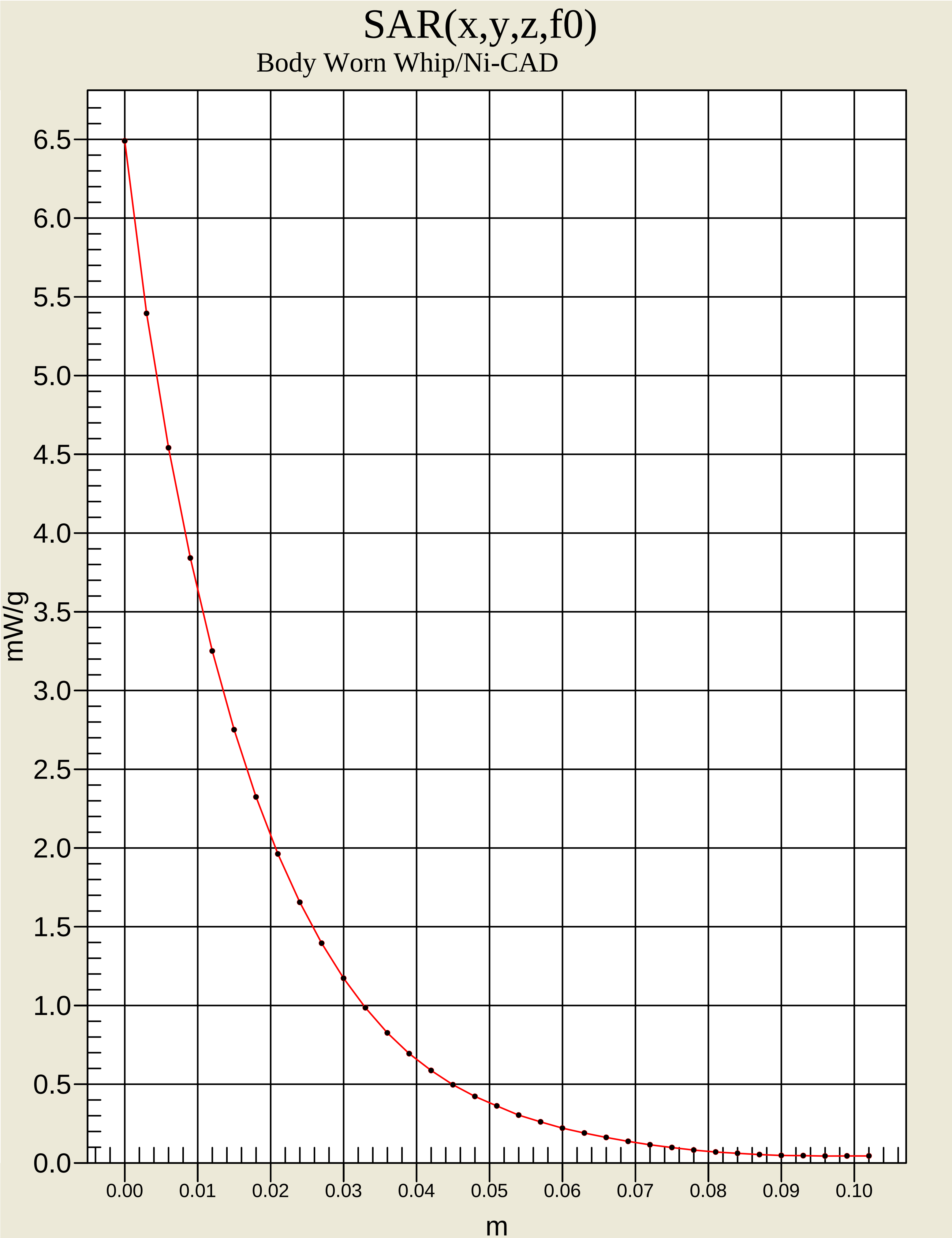
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 6.71 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.9 V/m; Power Drift = -0.56 dB
Peak SAR (extrapolated) = 14.5 W/kg
SAR(1 g) = 8.8 mW/g; SAR(10 g) = 6.11 mW/g
Maximum value of SAR (measured) = 9.14 mW/g





SAR(x,y,z,f0)
Body Worn Whip/Ni-CAD
mW/g
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

Mid Ch Body whip/Headset/Ni-CAD

Date/Time: 11/15/2005 9:49:15 AM

DUT: Kenwood; Type: TK-3202; Serial: 70700151

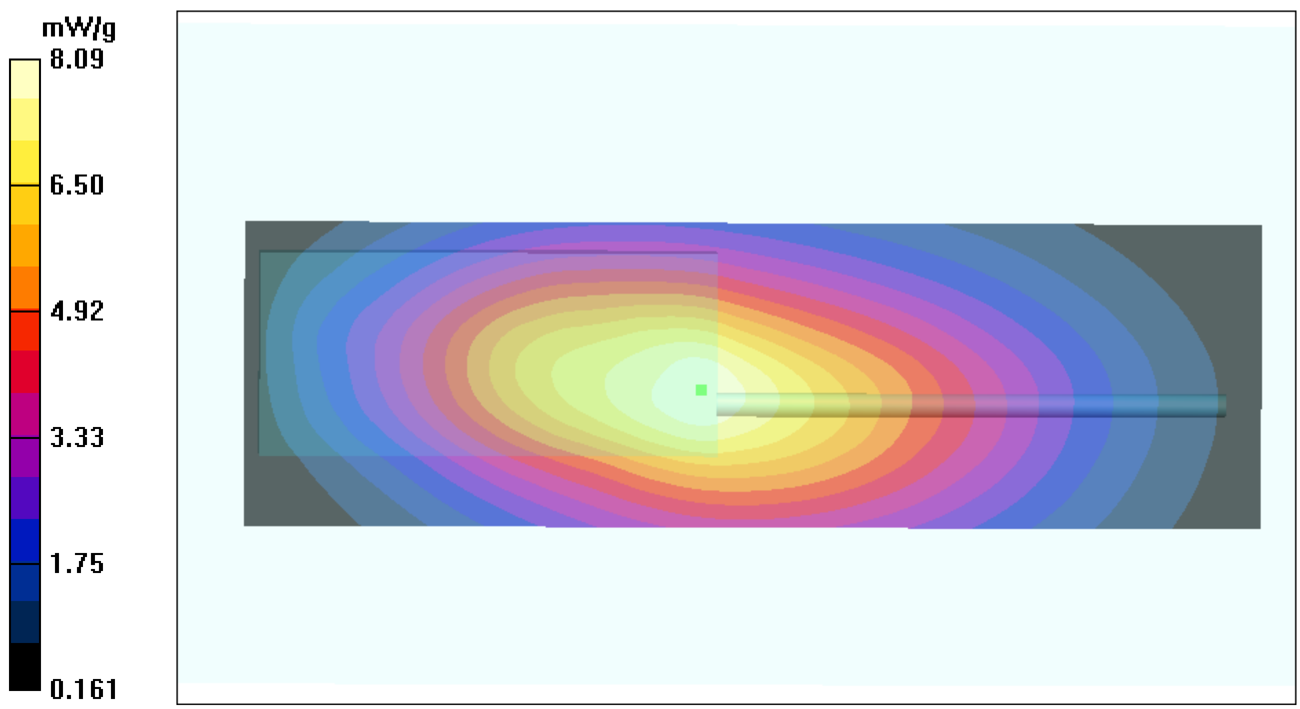
Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 8.09 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.0 V/m; Power Drift = -0.663 dB
Peak SAR (extrapolated) = 11.8 W/kg
SAR(1 g) = 7.44 mW/g; SAR(10 g) = 5.25 mW/g
Maximum value of SAR (measured) = 7.71 mW/g



Mid Ch Body whip/speaker-mic/Ni-MH

Date/Time: 11/15/2005 9:24:19 AM

DUT: Kenwood; Type: TK-3202; Serial: 70700151

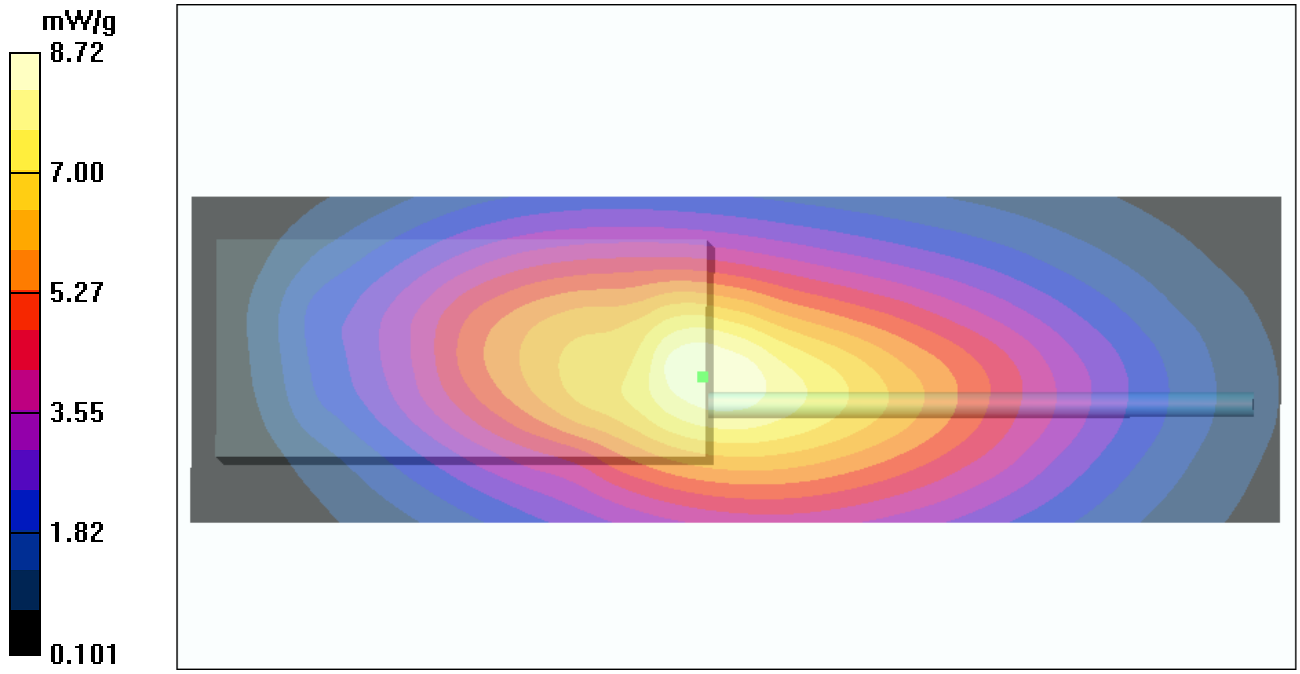
Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; $\sigma = 0.9$ mho/m; $\varepsilon_r = 57.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 8.72 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.0 V/m; Power Drift = -0.530 dB
Peak SAR (extrapolated) = 13.2 W/kg
SAR(1 g) = 8.08 mW/g; SAR(10 g) = 5.63 mW/g
Maximum value of SAR (measured) = 8.44 mW/g



Low Ch Body Whip/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 15:39:01 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

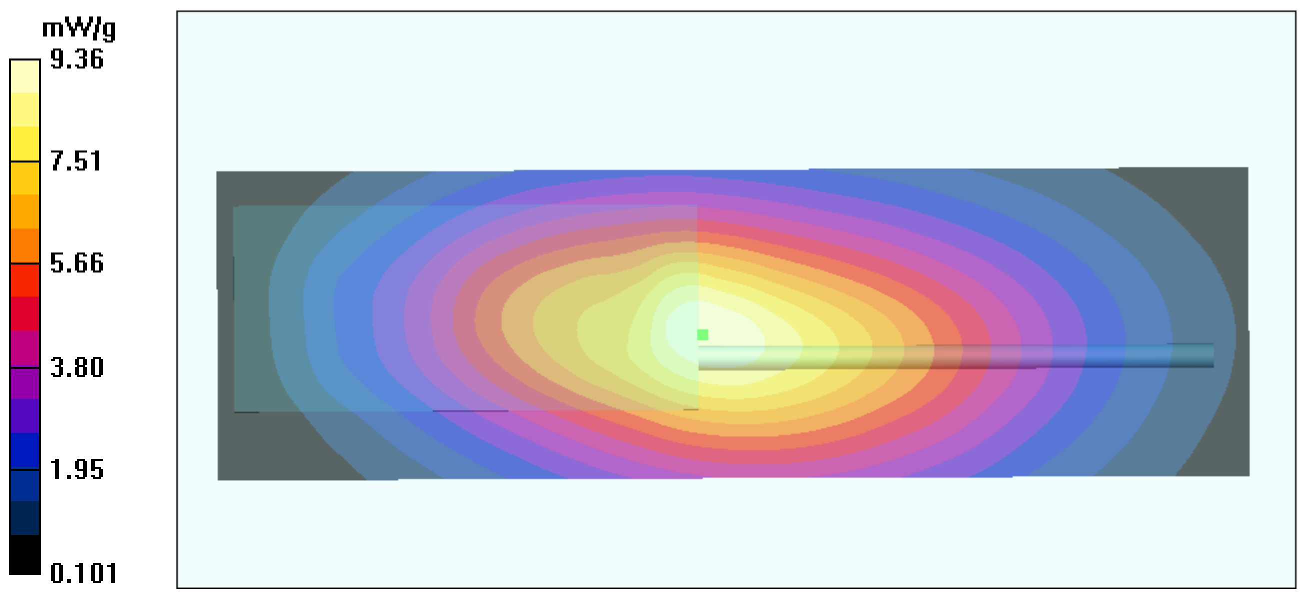
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; $\sigma = 0.9$ mho/m; $\varepsilon_r = 57.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 9.36 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 105.1 V/m; Power Drift = -0.609 dB
Peak SAR (extrapolated) = 13.8 W/kg
SAR(1 g) = 8.64 mW/g; SAR(10 g) = 6.1 mW/g
Maximum value of SAR (measured) = 9.05 mW/g



High Ch Body whip/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 16:01:27 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

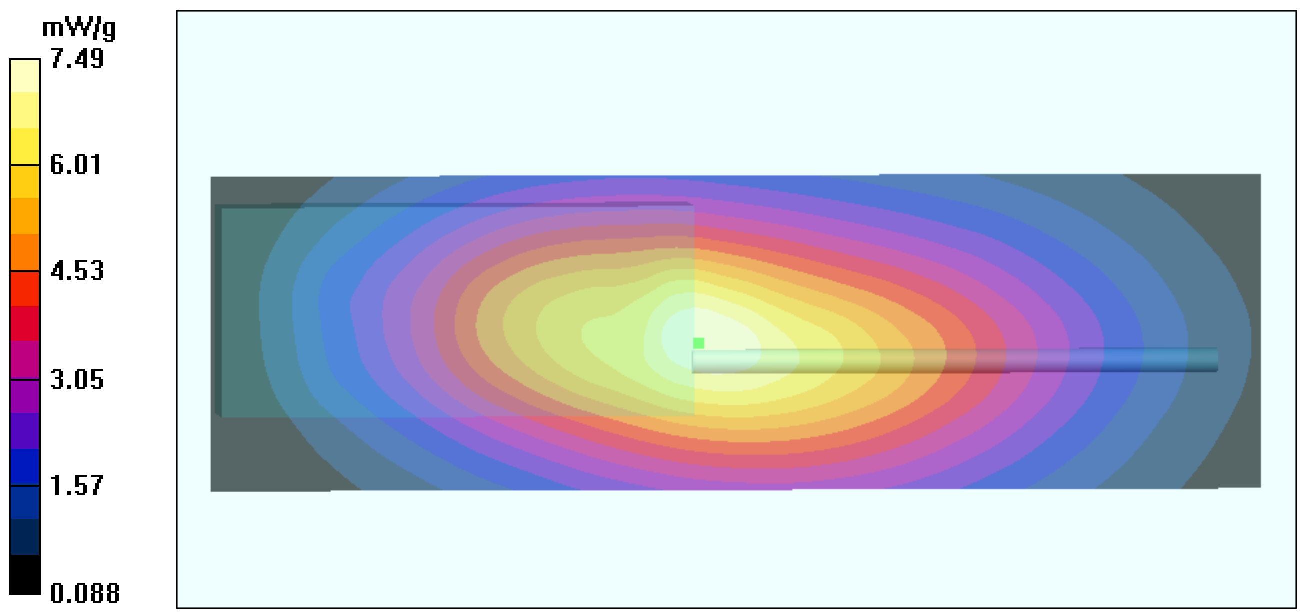
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 7.49 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.6 V/m; Power Drift = -0.195 dB
Peak SAR (extrapolated) = 11.2 W/kg
SAR(1 g) = 7.01 mW/g; SAR(10 g) = 4.93 mW/g
Maximum value of SAR (measured) = 7.30 mW/g



Mid Ch Body stubby/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 12:19:24 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

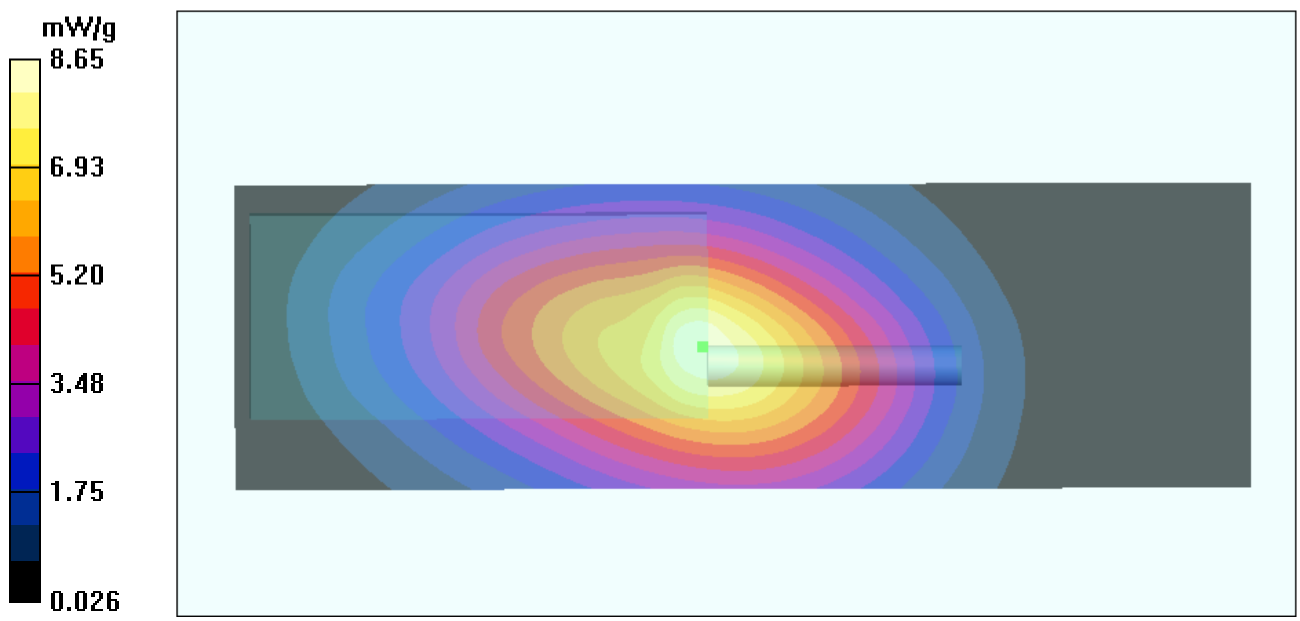
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 8.65 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.1 V/m; Power Drift = -0.412 dB
Peak SAR (extrapolated) = 13.1 W/kg
SAR(1 g) = 8.02 mW/g; SAR(10 g) = 5.52 mW/g
Maximum value of SAR (measured) = 8.38 mW/g



Mid Ch Body stubby/Headset/Ni CAD

Date/Time: 11/15/2005 12:43:23 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

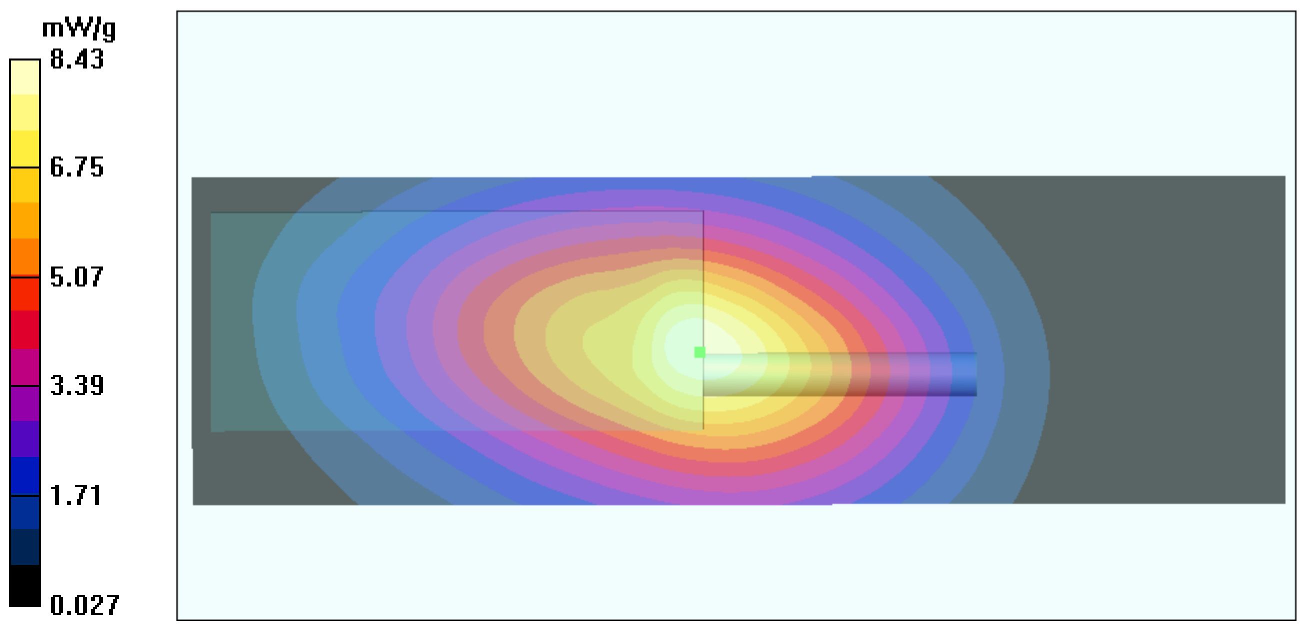
DUT: Kenwood; Type: TK-3202; Serial: Not Specified

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 8.43 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.0 V/m; Power Drift = -0.445 dB
Peak SAR (extrapolated) = 12.9 W/kg
SAR(1 g) = 7.76 mW/g; SAR(10 g) = 5.32 mW/g
Maximum value of SAR (measured) = 8.10 mW/g



Mid Ch Body stubby/speaker-mic/Ni-MH

Date/Time: 11/15/2005 12:43:23 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

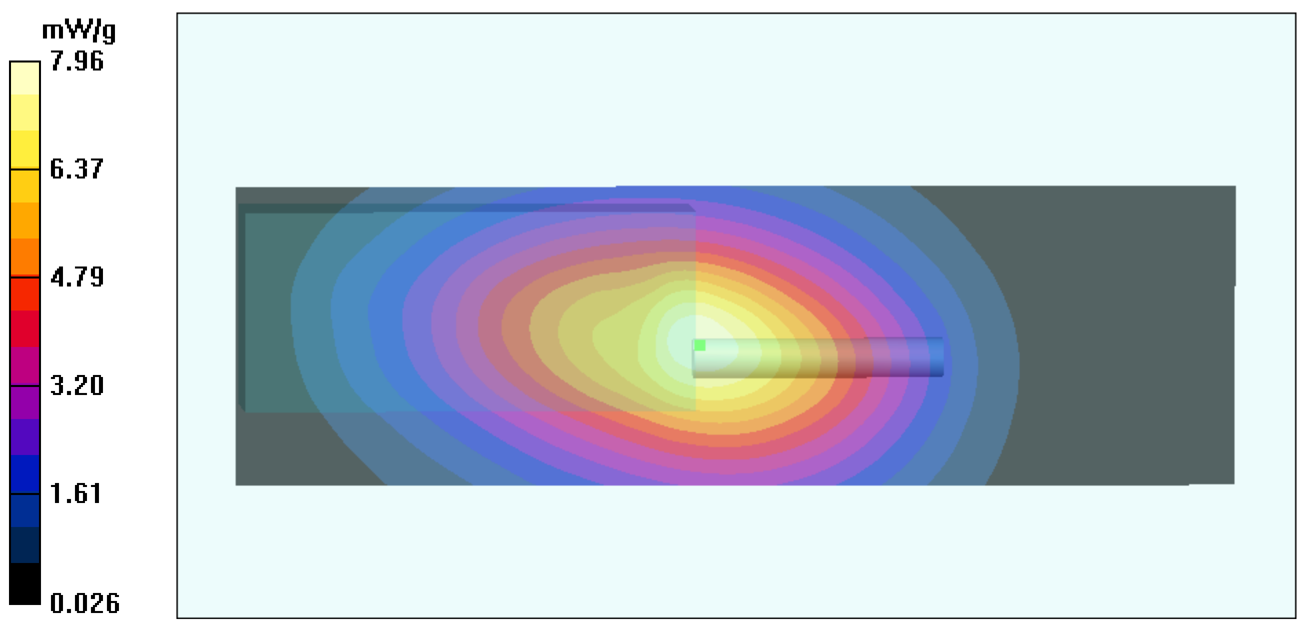
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 7.96 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.0 V/m; Power Drift = -0.235 dB
Peak SAR (extrapolated) = 12.2 W/kg
SAR(1 g) = 7.33 mW/g; SAR(10 g) = 5.03 mW/g
Maximum value of SAR (measured) = 7.65 mW/g



Low Ch Body stubby/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 1:23:07 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

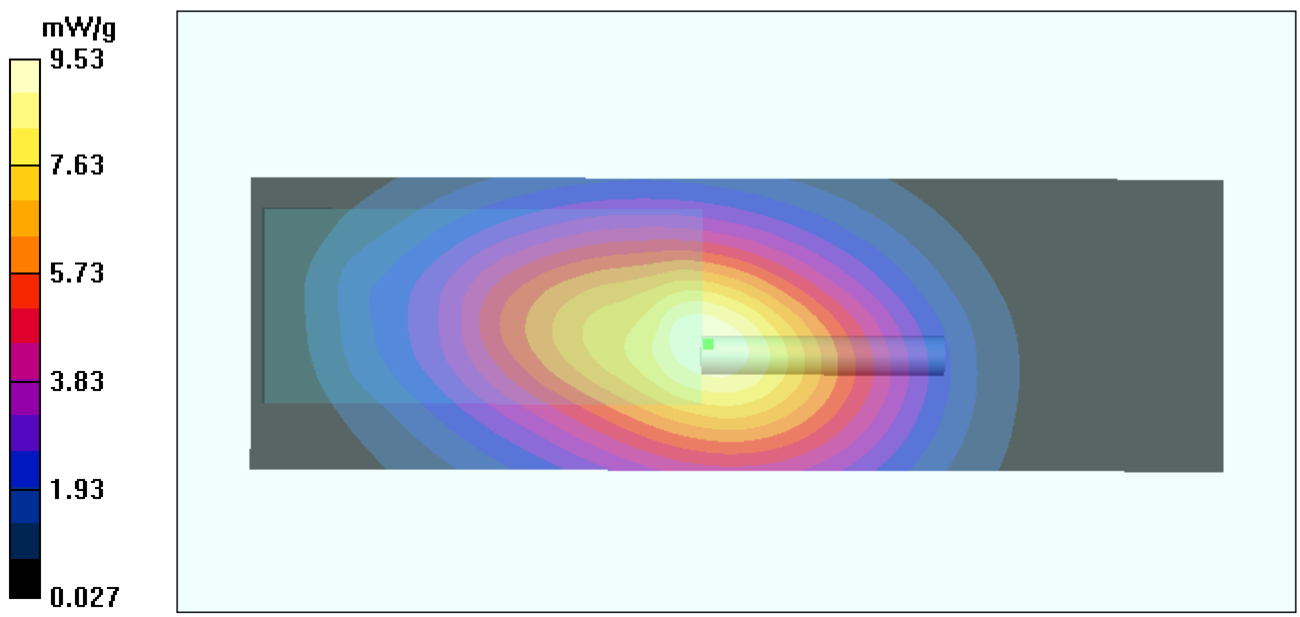
DUT: Kenwood; Type: TK-3202; Serial: 70700151

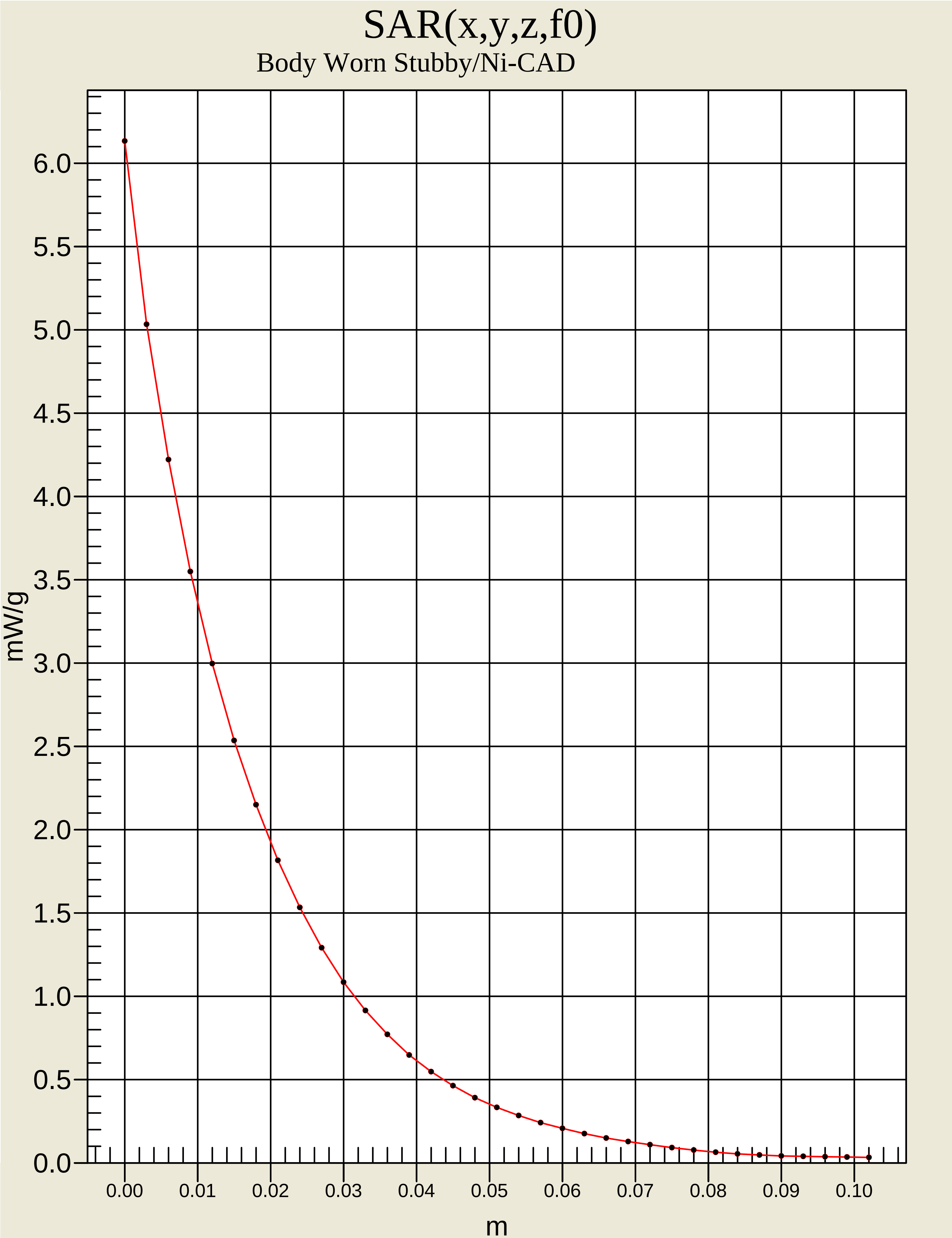
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; σ = 0.9 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 9.53 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.9 V/m; Power Drift = -0.455 dB
Peak SAR (extrapolated) = 14.1 W/kg
SAR(1 g) = 8.86 mW/g; SAR(10 g) = 6.14 mW/g
Maximum value of SAR (measured) = 9.26 mW/g




SAR(x,y,z,f0)
Body Worn Stubby/Ni-CAD
mW/g
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

High Ch Body stubby/speaker-mic/Ni-CAD

Date/Time: 11/15/2005 1:53:10 PM

Fluid Temp: 22.0 deg C; Ambient Temp: 22.6 deg C

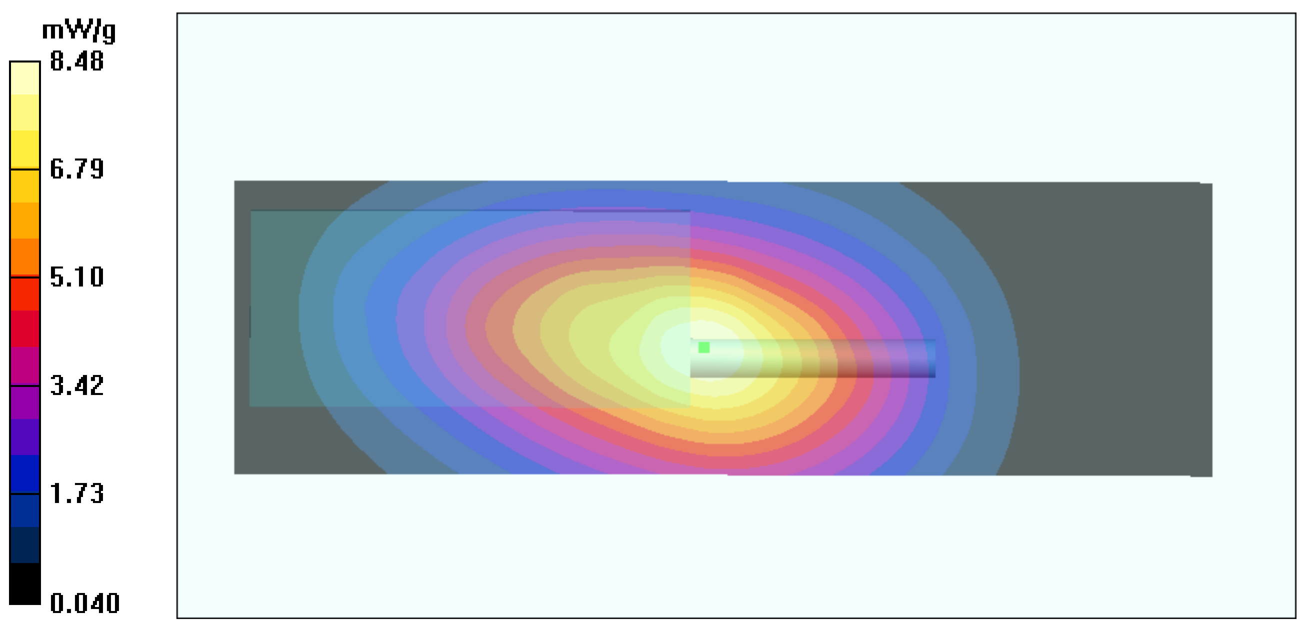
DUT: Kenwood; Type: TK-3202; Serial: 70700151

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz Body Medium parameters used: f = 450 MHz; $\sigma = 0.9$ mho/m; $\varepsilon_r = 57.1$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.5, 7.5, 7.5); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Twin Box HSL; Type: HSL; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (61x201x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 8.48 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 115.0 V/m; Power Drift = -0.786 dB
Peak SAR (extrapolated) = 12.8 W/kg
SAR(1 g) = 7.78 mW/g; SAR(10 g) = 5.37 mW/g
Maximum value of SAR (measured) = 8.11 mW/g



Appendix B – SYSTEM VALIDATION

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450MHz Validation

Fluid Temp: 21.9 deg C; Ambient Temp: 22.0 deg C

Date/Time: 11/15/2005 10:05:18 AM

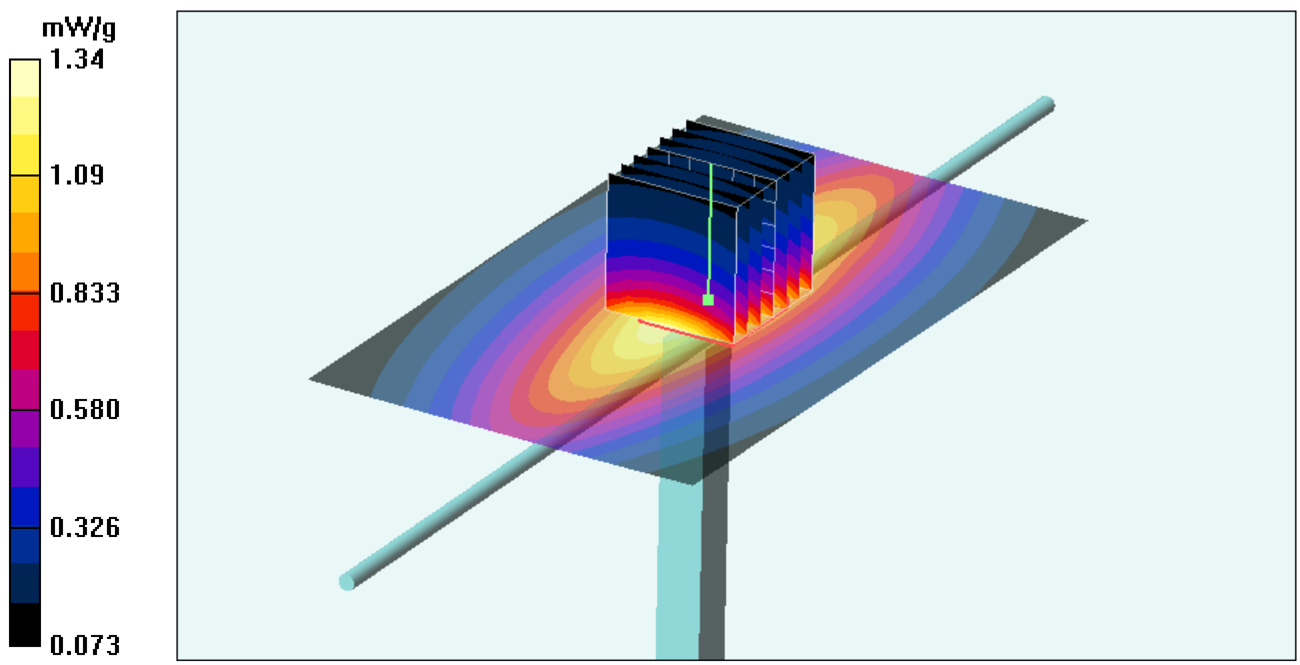
DUT: Dipole 450 MHz; Type: D450V2; Serial: 004

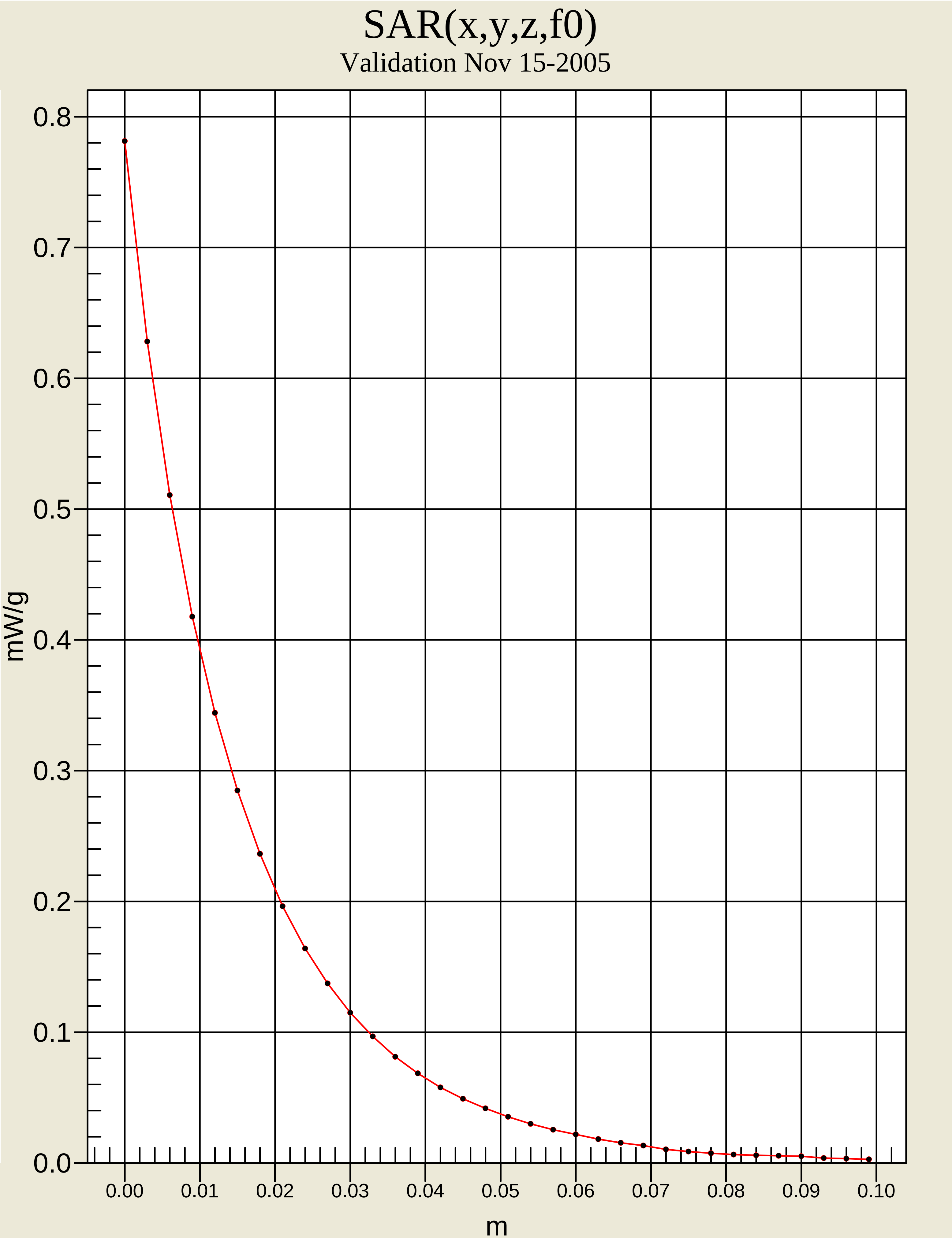
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.83 mho/m; ε_r = 45.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Validation Phantom in front of RX90; Type: Plexiglas; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (101x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.34 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.9 V/m; Power Drift = -0.02dB
Peak SAR (extrapolated) = 2.26 W/kg
SAR(1 g) = 1.27 mW/g; SAR(10 g) = 0.816 mW/g
Maximum value of SAR (measured) = 1.35 mW/g





SAR(x,y,z,f0)
Validation Nov 15-2005
mW/g
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

450MHz Validation

Date/Time: 11/16/2005 07:05:18 AM

Fluid Temp: 21.6 deg C; Ambient Temp: 22.7 deg C

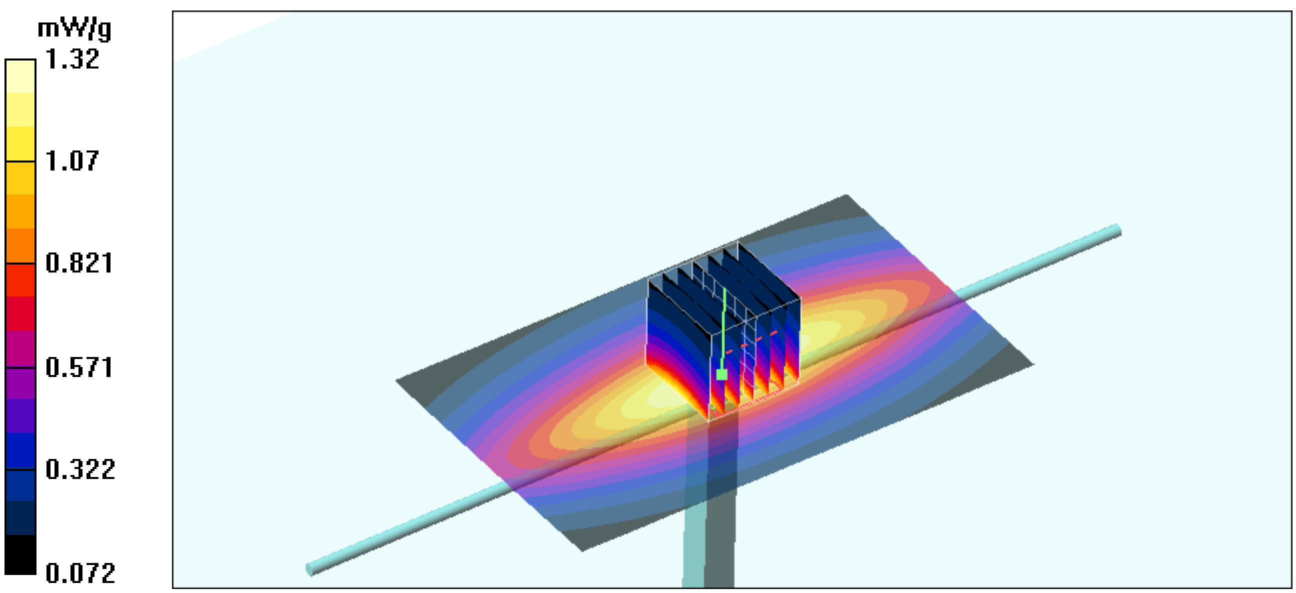
DUT: Dipole 450 MHz; Type: D450V2; Serial: 004

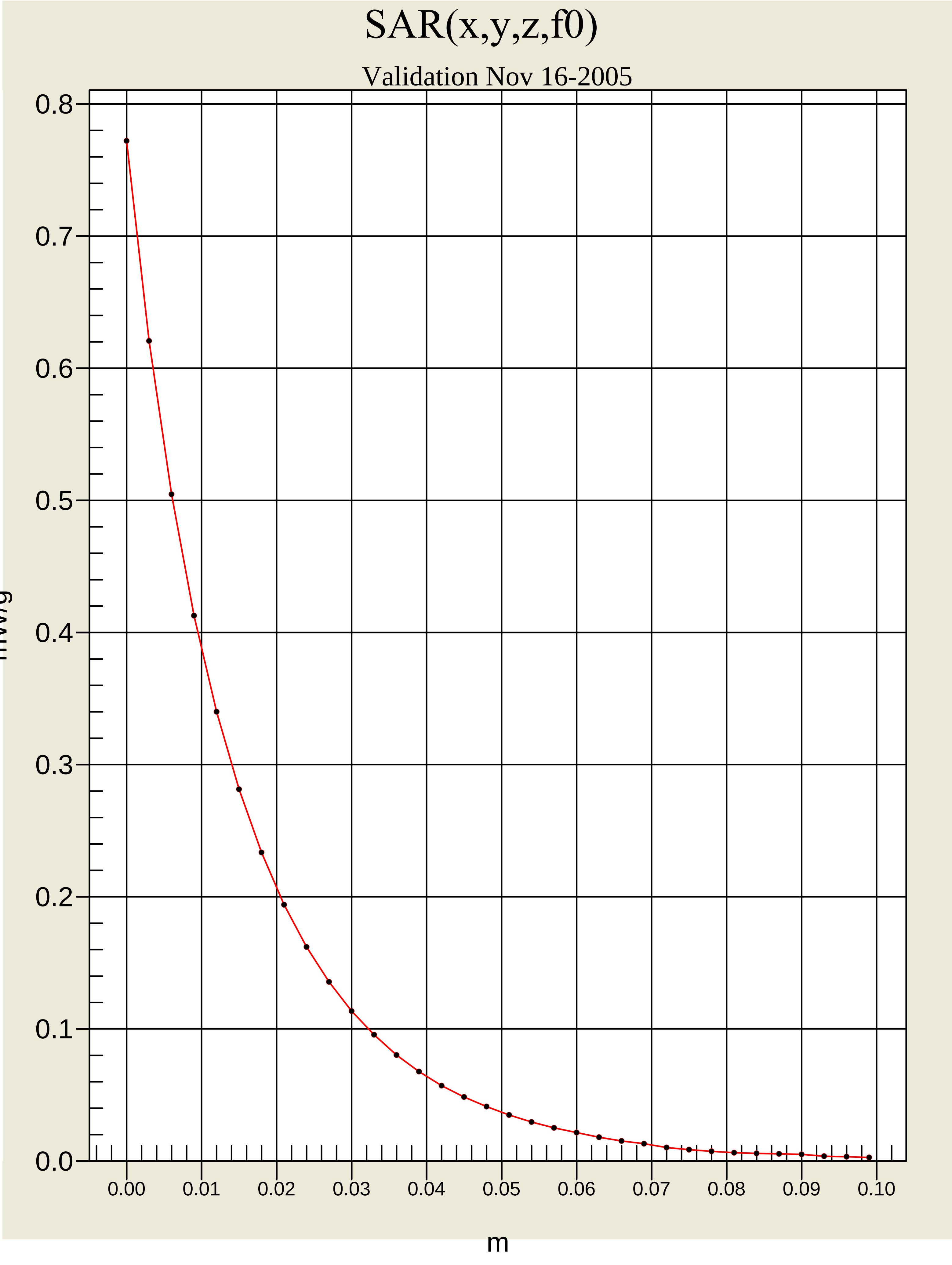
Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz head Medium parameters used: f = 450 MHz; σ = 0.82 mho/m; ε_r = 45.7; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.6, 7.6, 7.6); Calibrated: 9/20/2005
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/22/2005
- Phantom: Validation Phantom in front of RX90; Type: Plexiglas; Serial: 001
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Area Scan (101x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 1.32 mW/g

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.9 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.23 W/kg
SAR(1 g) = 1.25 mW/g; SAR(10 g) = 0.807 mW/g
Maximum value of SAR (measured) = 1.33 mW/g




SAR(x,y,z,f0)
Validation Nov 16-2005
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
mW/g
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
m

Appendix C – PROBE CALIBRATION CERTIFICATE

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152441

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

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

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

Accreditation No.: SCS 108

Client **MET Laboratories**

Certificate No: ET3-1793_Sep05

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1793
Calibration procedure(s)	QA CAL-01.v5 Calibration procedure for dosimetric E-field probes
Calibration date:	September 20, 2005
Condition of the calibrated item	In Tolerance

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41495277	3-May-05 (METAS, No. 251-00466)	May-06
Power sensor E4412A	MY41498087	3-May-05 (METAS, No. 251-00466)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	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:	Nico Vetterli	Laboratory Technician	N. Vetterli
Approved by:	Katja Pokovic	Technical Manager	Pokovic Katja

Issued: September 21, 2005

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

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

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Accredited by the Swiss Federal Office of Metrology and Accreditation
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Accreditation No.: SCS 108

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ET3DV6

SN:1793

Manufactured:	May 28, 2005
Last calibrated:	September 15, 2003
Recalibrated:	September 20, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1793

Sensitivity in Free Space[A]

NormX	**1.72** ± 10.1%	$\mu V/(V/m)^2$
NormY	**1.71** ± 10.1%	$\mu V/(V/m)^2$
NormZ	**1.76** ± 10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	**93** mV
DCP Y	**93** mV
DCP Z	**93** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL 900 MHz Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	8.3	4.4
SAR_{be} [%]	With Correction Algorithm	0.1	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	12.7	8.6
SAR_{be} [%]	With Correction Algorithm	0.9	0.1

Sensor Offset

Probe Tip to Sensor Center **2.7** mm

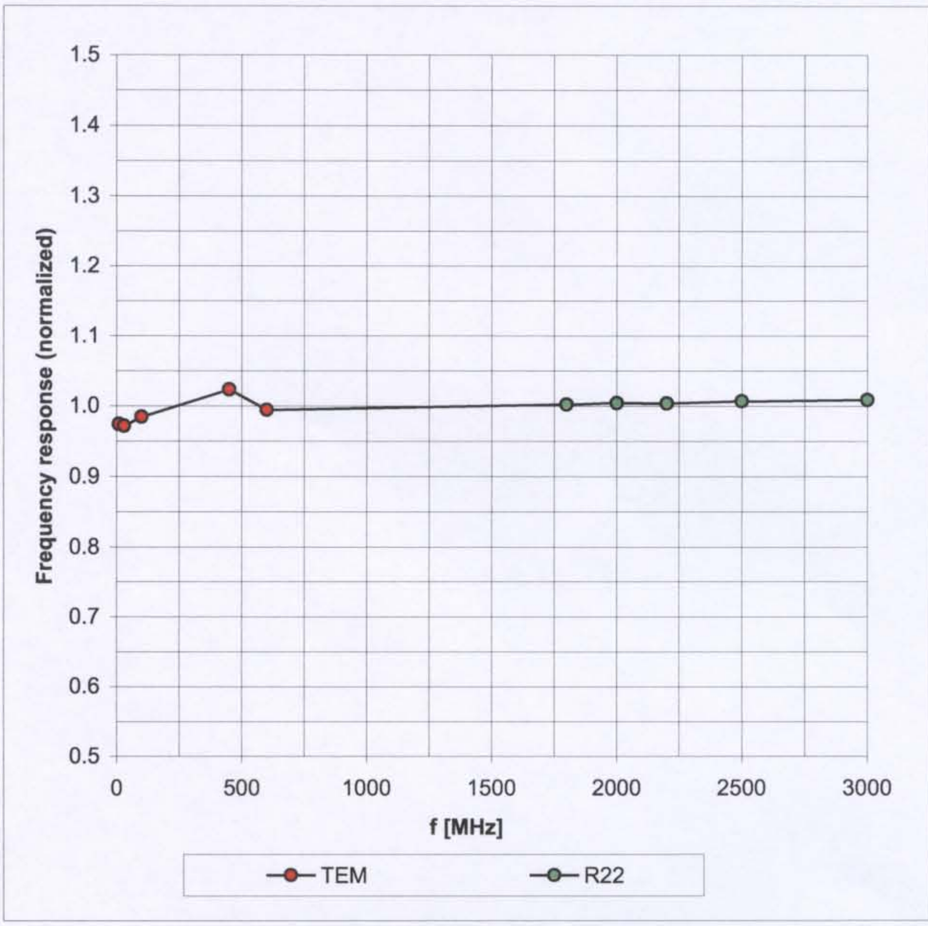
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

[B] Numerical linearization parameter: uncertainty not required.

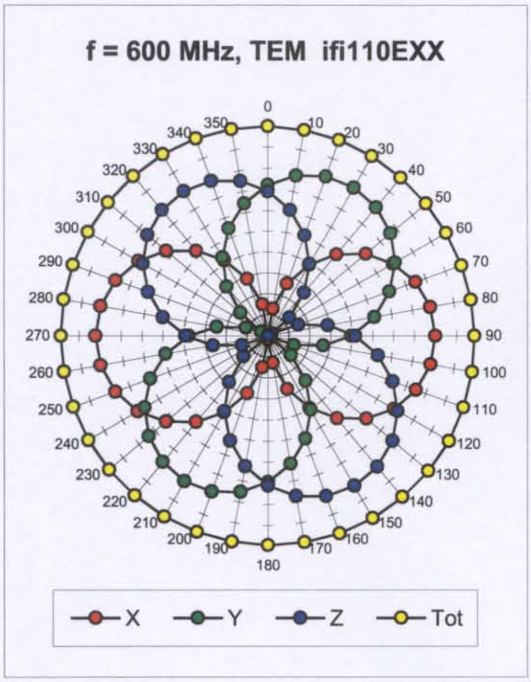
Frequency Response of E-Field

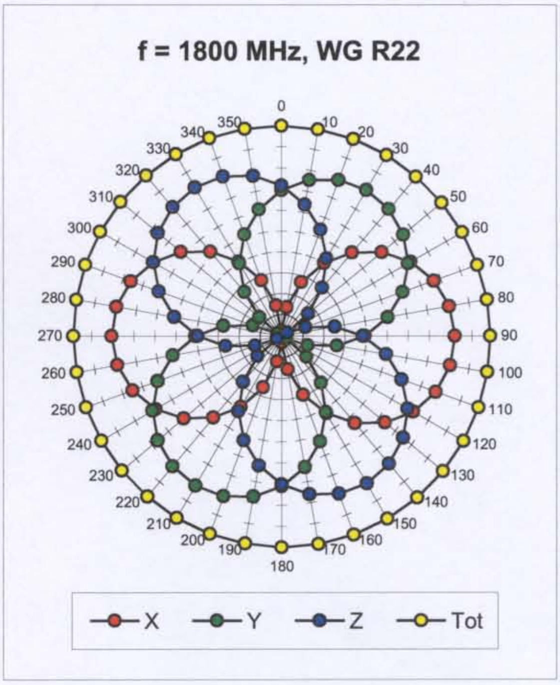
(TEM-Cell:ifi110 EXX, Waveguide: R22)

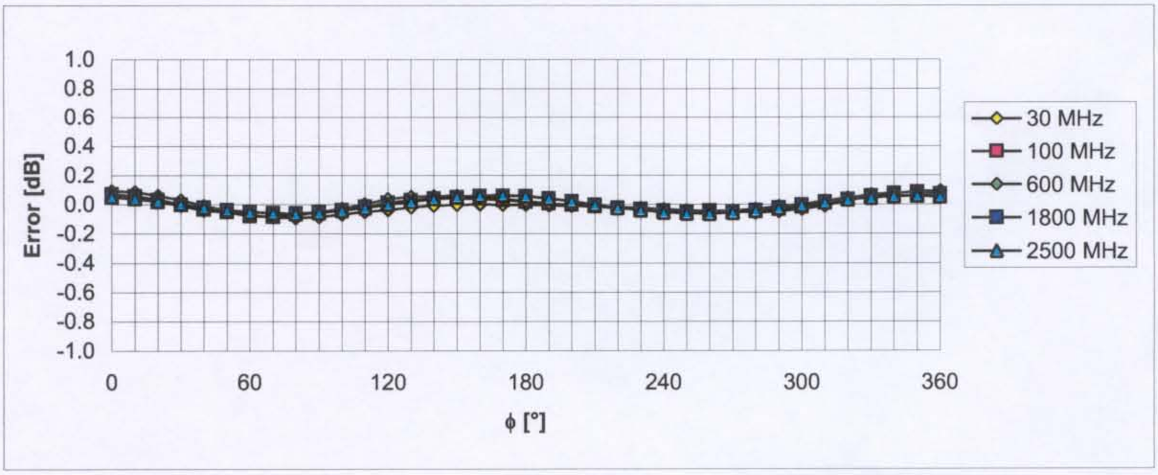


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$



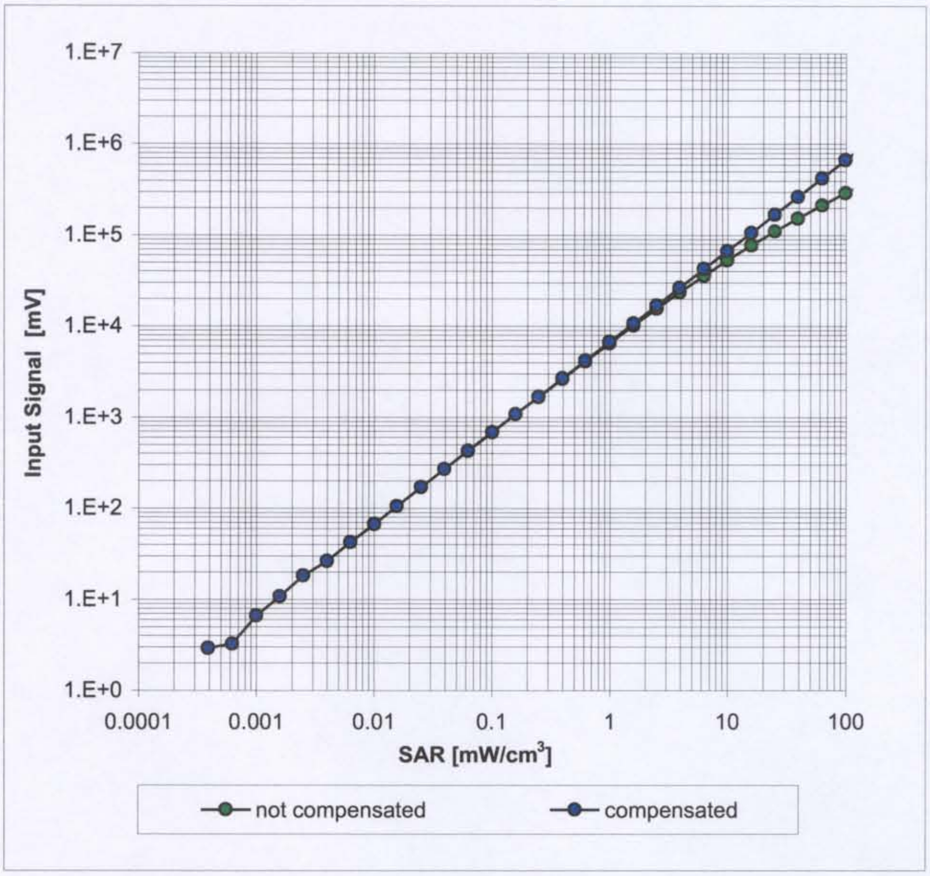


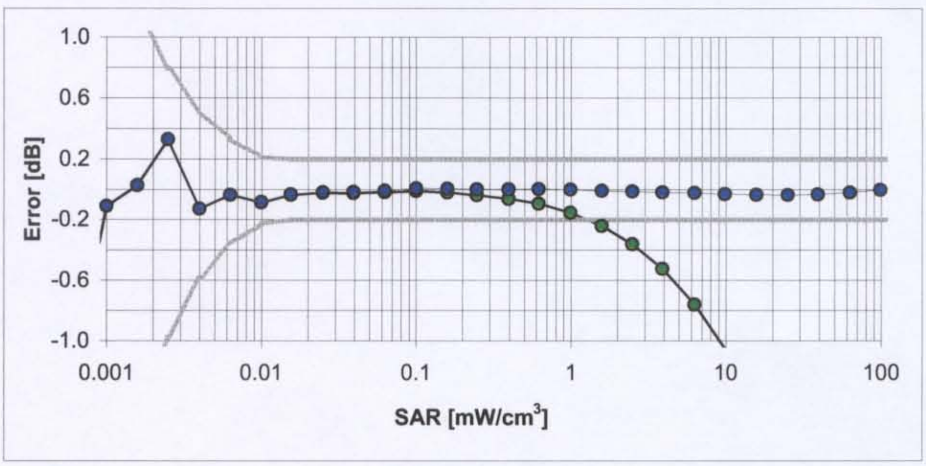


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

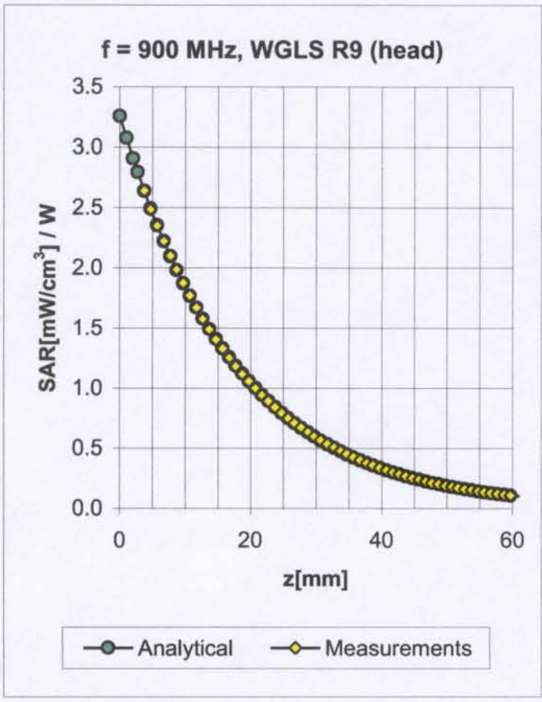
(Waveguide R22, f = 1800 MHz)

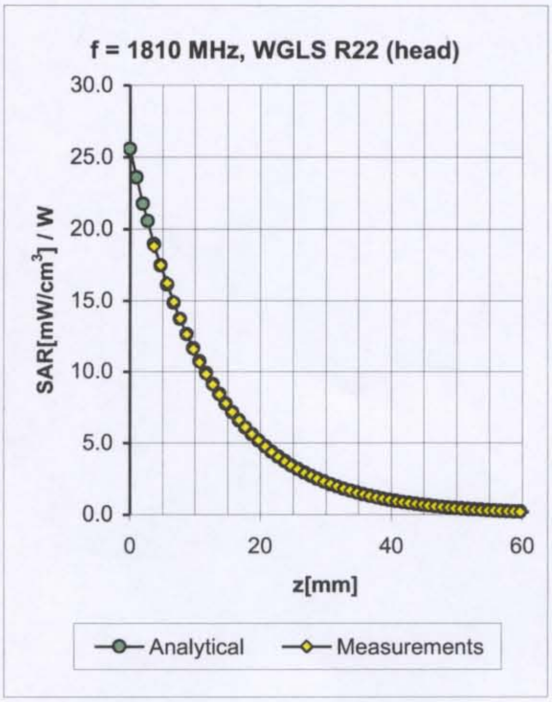




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



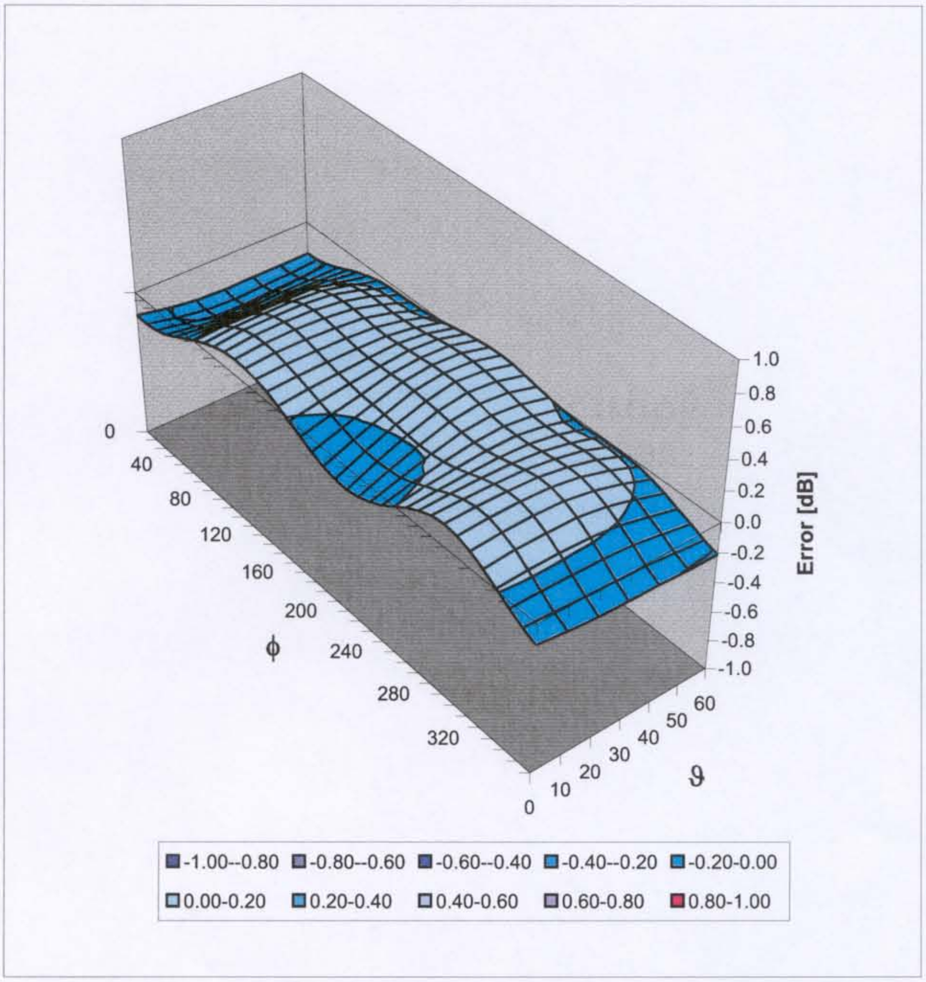


f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.55	1.86	6.27	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.60	2.29	5.22	± 11.0% (k=2)

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

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

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

Dosimetric E-Field Probe ET3DV6 SN:1793

Conversion factor (± standard deviation)

450 MHz	ConvF	**7.6 ± 8%**	ε_r = **43.5 ± 5%** σ = **0.87 ± 5% mho/m** (head tissue)
450 MHz	ConvF	**7.5 ± 8%**	ε_r = **56.7 ± 5%** σ = **0.94 ± 5% mho/m** (body tissue)
900 MHz	ConvF	**6.3 ± 8%**	ε_r = **55.0 ± 5%** σ = **1.05 ± 5% mho/m** (body tissue)
1800 MHz	ConvF	**4.8 ± 8%**	ε_r = **53.3 ± 5%** σ = **1.52 ± 5% mho/m** (body tissue)

Appendix D – DIPOLE CALIBRATION CERTIFICATE

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CALIBRATION CERTIFICATE

Object: 450MHz Validation Dipole; serial # 004

Calibration Procedure: Calibration procedure for a validation dipole

Calibration Date: December 9, 2004

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 a closed laboratory facility: environment temperature $(21 \pm 3)\,^{o}C$ and humidity < 70%

Calibration equipment used

Model Type	Serial Number	MET Asset #	Cal due Date
Anritsu Power Meter ML2488A	6K00001832	1S2430	June 2005
Anritsu Power Sensor	030864	1S2432	June 2005
HP E4418B Power Meter	GB40205140	1S2276	June 2005
HP 8482A Power Sensor	2607A11286	1S2140	June 2005
83650B Signal Generator	3844A00910	1S2278	June 2005
HP 8722D Vector Network Analyzer	3S36140188	1S2272	March 2005

Calibrated by: Shawn McMillen (Name) — Senior Engineer (Function) — Signature

This calibration certificate shall not be reproduced except in full

Date of Issue: December 9, 2004

Calibration procedure for validation dipole

Calibration is performed according to the following standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300MHz – 3GHz), July 2001
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Bulletin 65 Supplement C (Edition01-01).

Additional Documents

d) DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All Figures stated in the certificate are valid at the frequency indicated.
- Antenna flatness: The antenna is checked for straightness using a straight edge place parallel to the dipole arms.
- Antenna Parameters with Tissue Simulating Liquid (TSL): The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Vector Network Analyzer: The network analyzer is calibrated as per the user's manual.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. A Return Loss >20dB ensures low reflected power. No uncertainty required.
- Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No Uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1W at the antenna connector. No Uncertainty required
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the SAR results.

Measurement Conditions

DASY system configuration

DASY Version	DASY4	V4.4
Extrapolation	Advanced Extrapolation	
Phantom	Planar Validation Phantom	1S2450
Dipole Spacer		
Distance Dipole Center-TSL	15.14mm ± 0.2mm	With spacer
Area Scan resolution	dx, dy = 10mm	
Zoom Scan resolution	dx, dy, dz = 5mm	
Frequency	450MHz ± 1MHz	

Head TSL Parameters

The following parameters and calculations were applied

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL Parameters	22.0 ^{o}C	43.5	0.87
Measured Head TSL Parameters		43.5 ±5%	0.87 ±5%
Head TSL Temperature during Test	20.8 ^{o}C	--	--

Measurement Uncertainty of Dipole Calibration

Error Description	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	c_i **1g**	**Standard Uncertainty ±% (1g)**
Anritsu Power Meter ML2488A	± 1.4	normal	2	1	± 0.7
Anritsu Power Sensor	± 1.4	normal	2	1	± 0.7
HP E4418B Power Meter	± 0.2	normal	2	1	± 0.1
HP 8482A Power Sensor	± 0.8	normal	2	1	± 0.4
83650B Signal Generator	± 2.0	normal	2	1	± 1.0
HP 8722D Vector Network Analyzer	± 2.0	normal	2	1	± 1.0
Combined Standard Uncertainty					± 3.9

SAR results with Head TSL and system uncertainty

SAR averaged over 1 cm^3 (1g) of Head TSL	Condition	
SAR Normalized	Normalized to 1 W	5.24 mW/g
SAR for nominal Head TSL Parameters	Normalized to 1W	5.24 ± 24.29% mW/g (k=2)

SAR averaged over 1 cm^3 (10g) of Head TSL	Condition	
SAR Normalized	Normalized to 1 W	3.51 mW/g
SAR for nominal Head TSL Parameters	Normalized to 1W	3.51 ± 23.51% mW/g (k=2)

450 MHz System Validation Dipole

Type:	450Mhz
Serial Number:	004
Place of Calibration:	**MET Laboratories, Inc.** 4855 Patrick Henry Dr. Bldg #6 Santa Clara, CA 95054USA
Date of Calibration:	December 9, 2004

MET Laboratories, Inc certifies that this device has been calibrated on the date indicated above.

:

Approved By:

Shawn McMillen
SAR Compliance Manager

1. Measurement Conditions

The DASY4 System with a dosimetric E-Field probe ET3DV6 (SN1793, Conversion factor 7.6 at 450 MHz) was used for the measurements.

The target dielectric parameters for the head simulating solution used for the calibration at 450MHz is:

Relative Dielectricity	43.5 ±5%
Conductivity	0.87 ±5%

The measurements were performed in an 82x40x22cm flat Plexiglas Phantom filled with head stimulant tissue.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to solution surface. A loss-less dielectric spacer was used during measurements for accurate distance positioning.

The course grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration. The dipole input power (forward power) was 250mW ±3%. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR measurement were performed according to the measurement conditions described in section 1. The resulting average SAR values measured with the dosimetric probe ET3DV6 (SN1793) and applying advanced extrapolation are:

Averaged over 1cm^3 (1g) of tissue:	5.24 mW/g
Averaged over 10cm^3 (10g) of tissue:	3.51 mW/g

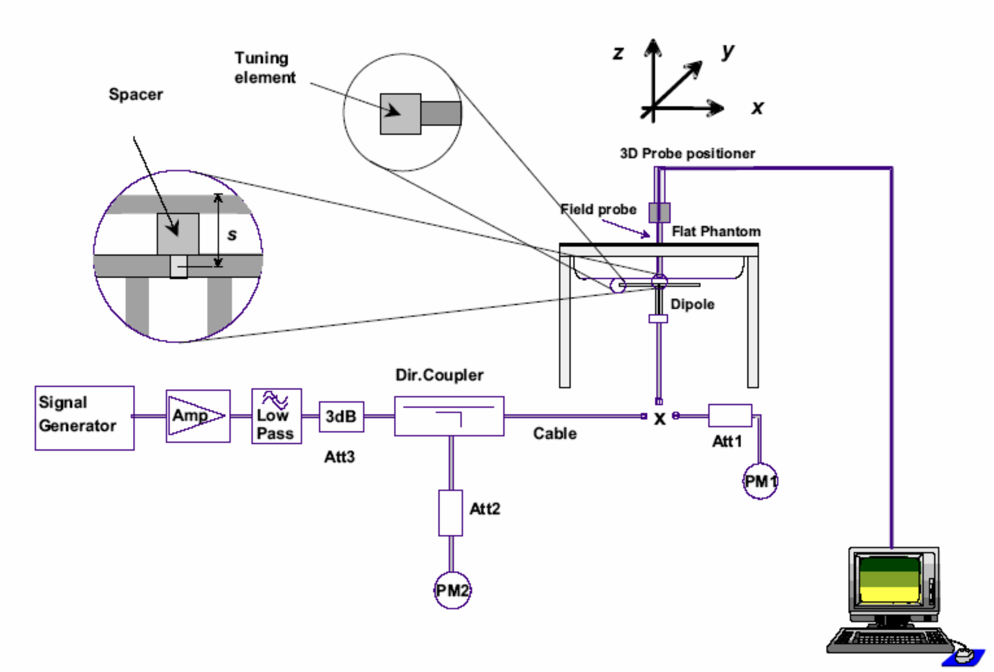
3. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 1 with the 15mm spacer. The impedance and return loss measurements are

Complex impedance at 450 MHz	Re{Z}= 58.014 Ω
	Im {Z}= 6.4277 Ω
Return Loss at 450 MHz	-20.467 dB

4. SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



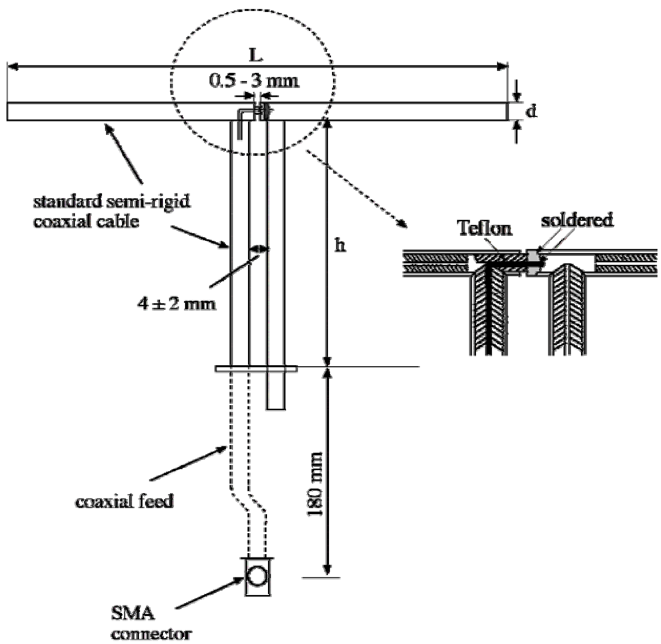
First the power meter PM1 (including attenuator Att1) is connected to the RF cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by 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. The matching of the dipole should be checked using a network analyzer to ensure that the reflected power is at least 20 dB below the forward power.

4. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feed point leading to a damage of the dipole.

5. Design

The validation dipole is made of standard semi ridged coaxial cable and is 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 center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.



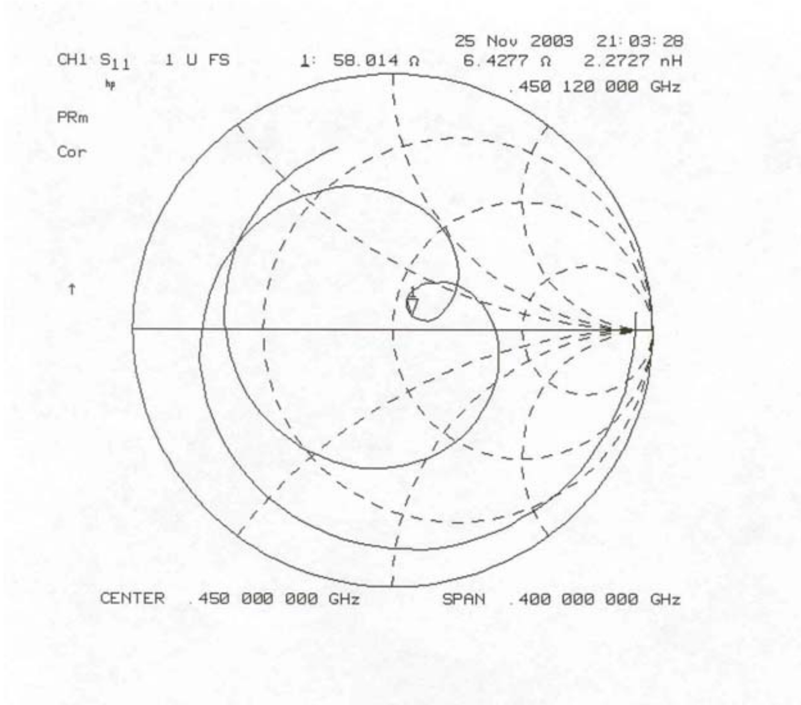
Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	396.0	250.0	6.35
450	270.0	166.7	6.35
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.4	3.6
3000	41.5	25.0	3.6

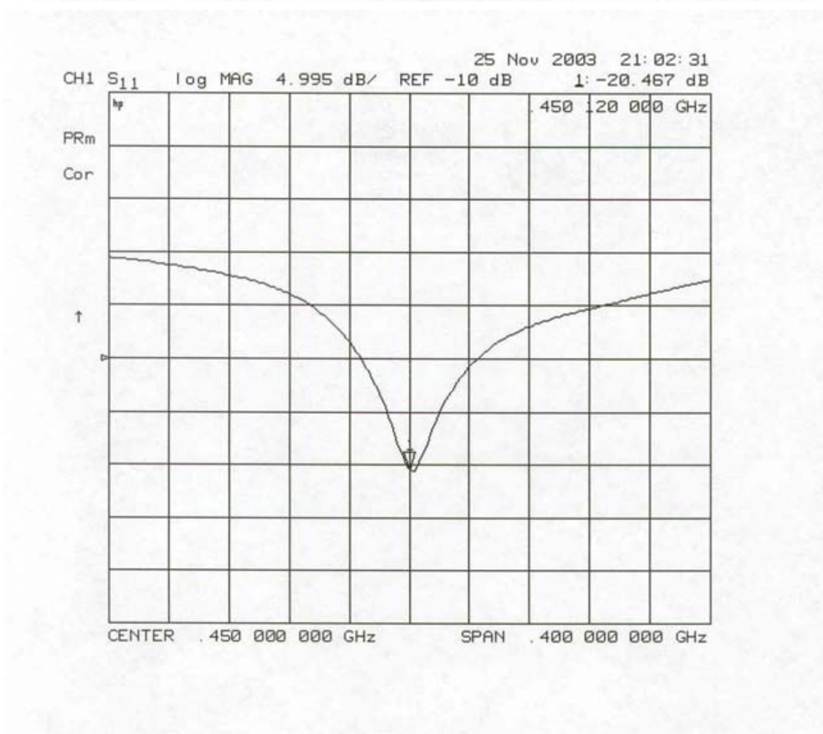
Validation Dipole Dimensions

6. Determination of Target SAR number

A total of 10 test runs were carried out. The fluid dielectric parameters were measured prior to each run. After each run the dipole was removed from the phantom surface, the forward dipole power reset and the dipole repositioned next to the phantom surface.

Test Run	Relative Dielectricity	Conductivity mho/m	SAR@250mW Over 1g	SAR@250mW Over 10g
Run #1	44.5	0.88	1.31	0.876
Run #2	43.7	0.89	1.33	0.877
Run #3	44.6	0.88	1.32	0.878
Run #4	44.6	0.86	1.29	0.876
Run #5	43.9	0.88	1.30	0.874
Run #6	44.5	0.87	1.32	0.877
Run #7	43.8	0.89	1.33	0.875
Run #8	44.9	0.88	1.32	0.880
Run #9	43.7	0.88	1.29	0.875
Run # 10	44.4	0.87	1.31	0.877
		Target Average	1.31	0.877


25 Nov 2003 21:03:28
CH1 S11 1 U FS 1: 58.014 Ω 6.4277 Ω 2.2727 nH
.450 120 000 GHz
PRm
Cor
CENTER .450 000 000 GHz SPAN .400 000 000 GHz


25 Nov 2003 21:02:31
CH1 S11 log MAG 4.995 dB/ REF -10 dB 1:-20.467 dB
.450 120 000 GHz
PRm
Cor
CENTER .450 000 000 GHz SPAN .400 000 000 GHz

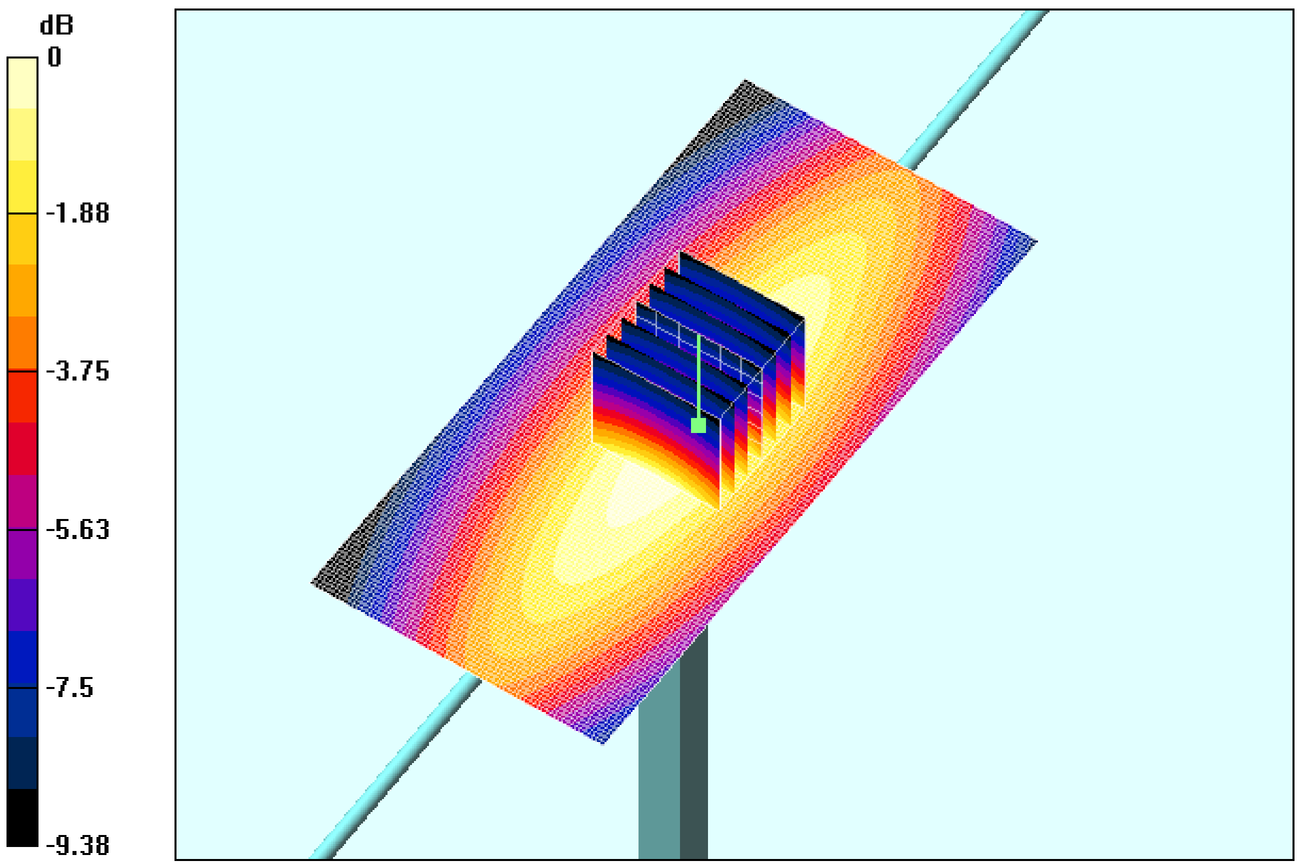
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:004

Communication System: CW; ; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: 450MHz HSL Medium parameters used: f = 450 MHz; σ = 0.87 mho/m; ε_r = 44.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

- Probe: ET3DV6 - SN1793; ConvF(7.1, 7.1, 7.1); Calibrated: 9/15/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn584; Calibrated: 9/16/2003
- Phantom: Validation Phantom in front of RX90; Type: Plexiglas; Serial: 001
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

Area Scan (151x71x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.4 mW/g

/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 40.1 V/m; Power Drift = -0.004 dB
Peak SAR (extrapolated) = 2.01 W/kg
SAR(1 g) = 1.32 mW/g; SAR(10 g) = 0.877 mW/g
Maximum value of SAR (measured) = 1.41 mW/g



0 dB = 1.41mW/g

Appendix E – MEASURED FLUID DIELECTRIC PARAMETERS

 © 2005, MET Laboratories, Inc.

450MHz Head

November 15, 2005 08:29 AM

Frequency	e'	e''
400.000000 MHz	47.2243	35.4588
402.000000 MHz	47.1467	35.3622
404.000000 MHz	47.1134	35.2806
406.000000 MHz	47.0705	35.2012
408.000000 MHz	47.0567	35.1079
410.000000 MHz	46.9565	35.0491
412.000000 MHz	46.9313	35.0099
414.000000 MHz	46.7896	34.8678
416.000000 MHz	46.7339	34.7542
418.000000 MHz	46.7601	34.6490
420.000000 MHz	46.6304	34.5689
422.000000 MHz	46.6061	34.3939
424.000000 MHz	46.5170	34.3097
426.000000 MHz	46.4895	34.2363
428.000000 MHz	46.4180	34.1314
430.000000 MHz	46.3853	34.0213
432.000000 MHz	46.2962	33.9212
434.000000 MHz	46.2140	33.8597
436.000000 MHz	46.1514	33.7957
438.000000 MHz	46.1552	33.6642
440.000000 MHz	46.0564	33.6076
442.000000 MHz	46.0219	33.5317
444.000000 MHz	45.9769	33.5055
446.000000 MHz	45.8822	33.4029
448.000000 MHz	45.9482	33.3595
450.000000 MHz	45.8589	33.3418
452.000000 MHz	45.9097	33.2640
454.000000 MHz	45.7946	33.1956
456.000000 MHz	45.7586	33.1518
458.000000 MHz	45.7110	33.1472
460.000000 MHz	45.5805	32.9731
462.000000 MHz	45.5552	33.0937
464.000000 MHz	45.5417	32.9565
466.000000 MHz	45.5051	32.8968
468.000000 MHz	45.4629	32.8024
470.000000 MHz	45.3713	32.6273
472.000000 MHz	45.3416	32.4970
474.000000 MHz	45.3270	32.4543
476.000000 MHz	45.2287	32.3375
478.000000 MHz	45.2175	32.2598
480.000000 MHz	45.1232	32.1090
482.000000 MHz	45.1001	32.0613
484.000000 MHz	45.0912	31.9940
486.000000 MHz	45.0358	31.9092
488.000000 MHz	45.0344	31.8330

450MHz Head

November 16, 2005 08:27 AM

Frequency	e'	e''
400.000000 MHz	47.1386	35.3049
402.000000 MHz	47.0801	35.1959
404.000000 MHz	47.0152	35.1095
406.000000 MHz	46.9772	35.0611
408.000000 MHz	46.9737	34.9670
410.000000 MHz	46.8493	34.8820
412.000000 MHz	46.7818	34.8299
414.000000 MHz	46.7424	34.6932
416.000000 MHz	46.6672	34.5835
418.000000 MHz	46.6740	34.4821
420.000000 MHz	46.5058	34.4089
422.000000 MHz	46.4717	34.2959
424.000000 MHz	46.4349	34.1645
426.000000 MHz	46.3981	34.0933
428.000000 MHz	46.3335	33.9685
430.000000 MHz	46.2851	33.8812
432.000000 MHz	46.2342	33.7757
434.000000 MHz	46.1680	33.6930
436.000000 MHz	46.0553	33.6764
438.000000 MHz	46.0534	33.5080
440.000000 MHz	45.9721	33.4398
442.000000 MHz	45.9408	33.3832
444.000000 MHz	45.9145	33.3547
446.000000 MHz	45.8490	33.2574
448.000000 MHz	45.8420	33.1703
450.000000 MHz	45.7955	33.1838
452.000000 MHz	45.7588	33.1398
454.000000 MHz	45.7015	33.0811
456.000000 MHz	45.6777	32.9988
458.000000 MHz	45.6065	32.9620
460.000000 MHz	45.5211	32.8363
462.000000 MHz	45.4958	32.9574
464.000000 MHz	45.4678	32.8415
466.000000 MHz	45.4138	32.7853
468.000000 MHz	45.3924	32.7060
470.000000 MHz	45.2922	32.4789
472.000000 MHz	45.2890	32.3985
474.000000 MHz	45.2077	32.2785
476.000000 MHz	45.1158	32.1969
478.000000 MHz	45.1222	32.1169
480.000000 MHz	45.0598	31.9965
482.000000 MHz	45.0097	31.9452
484.000000 MHz	44.9938	31.8359
486.000000 MHz	44.9615	31.7826
488.000000 MHz	44.9970	31.7179

450MHz Body

November 15, 2005 07:45 AM

Frequency	e'	e''
400.000000 MHz	58.1217	38.5765
402.000000 MHz	58.0455	38.4504
404.000000 MHz	58.0107	38.3179
406.000000 MHz	57.9948	38.1726
408.000000 MHz	57.9817	38.1532
410.000000 MHz	57.8981	38.0330
412.000000 MHz	57.8866	37.9623
414.000000 MHz	57.7732	37.7882
416.000000 MHz	57.7825	37.7153
418.000000 MHz	57.7487	37.6308
420.000000 MHz	57.6491	37.5191
422.000000 MHz	57.6368	37.3310
424.000000 MHz	57.5970	37.2102
426.000000 MHz	57.5594	37.1502
428.000000 MHz	57.5302	37.0292
430.000000 MHz	57.4802	36.9531
432.000000 MHz	57.4348	36.7976
434.000000 MHz	57.3745	36.7647
436.000000 MHz	57.3300	36.7093
438.000000 MHz	57.3539	36.5040
440.000000 MHz	57.2635	36.5081
442.000000 MHz	57.2467	36.3909
444.000000 MHz	57.2005	36.3191
446.000000 MHz	57.1528	36.1906
448.000000 MHz	57.1702	36.0978
450.000000 MHz	57.1108	36.0500
452.000000 MHz	57.0628	35.9623
454.000000 MHz	57.0373	35.8896
456.000000 MHz	57.0227	35.7775
458.000000 MHz	56.9618	35.7135
460.000000 MHz	56.8717	35.5064
462.000000 MHz	56.8748	35.6545
464.000000 MHz	56.8323	35.4488
466.000000 MHz	56.8059	35.4079
468.000000 MHz	56.7757	35.3035
470.000000 MHz	56.7245	35.1861
472.000000 MHz	56.7062	35.1357
474.000000 MHz	56.6808	35.0509
476.000000 MHz	56.5652	34.9678
478.000000 MHz	56.5724	34.9044
480.000000 MHz	56.4909	34.8065
482.000000 MHz	56.4531	34.7000
484.000000 MHz	56.4561	34.6571
486.000000 MHz	56.4049	34.5281
488.000000 MHz	56.3821	34.4473