DECLARATION OF COMPLIANCE
SAR RF EXPOSURE EVALUATION

Test Lab

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Applicant Information

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Rule Part(s):	**FCC 47 CFR §2.1093; IC RSS-102 Issue 1 (Provisional)**
Test Procedure(s):	**FCC OET Bulletin 65, Supplement C (Edition 01-01)**
Device Type:	**Portable UHF FRS/GMRS PTT Radio Transceiver**
FCC IDENTIFIER:	**K7GT6500**
Model(s):	**T6500 / T6550**
Modulation:	**FM (UHF)**
Tx Frequency Range(s):	**462.5500 - 462.7250 MHz (GMRS Channels 15-22)** **462.5625 - 462.7125 MHz (FRS/GMRS Channels 1-7)** **467.5625 - 467.7125 MHz (FRS Channels 8-14)**
RF Output Power Tested:	**0.581 Watts ERP (GMRS 462.7125 MHz)**
Antenna Type(s) Tested:	**Fixed**
Battery Type(s) Tested:	**NiCd (3.6 V, 600 mAh), Alkaline x3 (1.5 V AA)** **Alkaline Type 1: Duracell Procell (2850 mAh)** **Alkaline Type 2: Energizer E91 (2850 mAh)**
Body-Worn Accessories Tested:	**Plastic Swivel Belt-Clip (P/N: NTN9392B)** **Earbud with Lapel-Microphone (P/N: NTN8870C)** **Earpiece with Boom-Microphone (P/N: NTN9396BW)** **Headset with Boom-Microphone (P/N: NTN8868B)**
Maximum SAR Levels Measured:	**0.938 W/kg - Face-held (50% duty cycle)** **1.08 W/kg - Body-worn (50% duty cycle)**

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

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

This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Labs Inc. The results and statements contained in this report pertain only to the device(s) evaluated.

Russell W. Pipe
Senior Compliance Technologist
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1.0 INTRODUCTION

This measurement report demonstrates compliance of the Giant Electronics Ltd. Models: T6500/T6550 Portable UHF FRS/GMRS PTT Radio Transceiver FCC ID: K7GT6500 with the SAR (Specific Absorption Rate) RF exposure requirements specified in FCC 47 CFR §2.1093 (see reference [1]), and Health Canada's Safety Code 6 (see reference [2]) for the General Population / Uncontrolled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C (Edition 01-01) (see reference [3]) and IC RSS-102 Issue 1 (Provisional) (see reference [4]), were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the provisions of the rules are included within this test report.

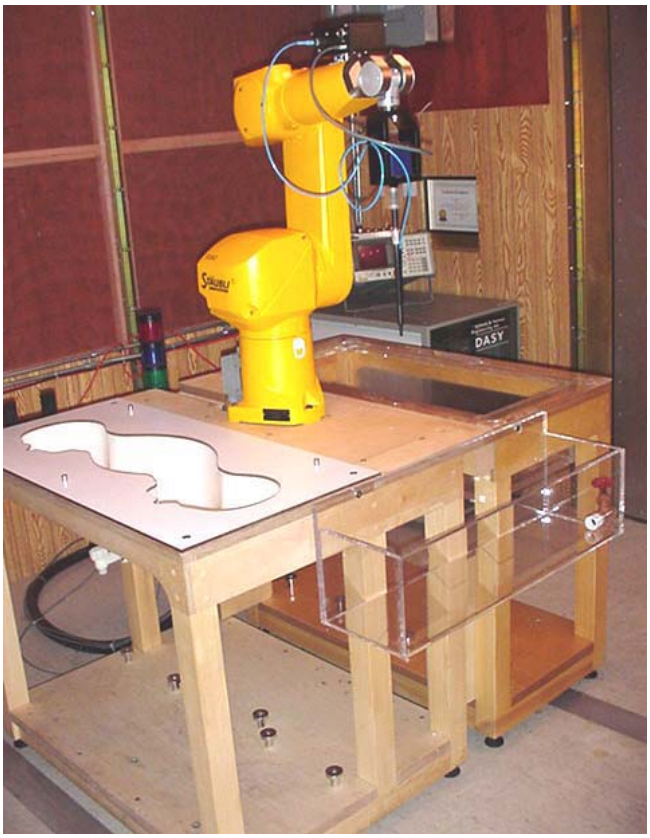
2.0 DESCRIPTION OF DEVICE UNDER TEST (DUT)

Rule Part(s)	FCC 47 CFR §2.1093		
	IC RSS-102 Issue 1 (Provisional)		
Test Procedure	FCC OET Bulletin 65, Supplement C (01-01)		
Device Type	Portable UHF FRS/GMRS PTT Radio Transceiver		
FCC IDENTIFIER	K7GT6500		
Model(s)	T6500 / T6550		
Serial No.	# 1 (Production Unit)		
Modulation	FM (UHF)		
Tx Frequency Range(s)	462.5500 - 462.7250 MHz (GMRS Channels 15-22)		
	462.5625 - 462.7125 MHz (FRS/GMRS Channels 1-7)		
	467.5625 - 467.7125 MHz (FRS Channels 8-14)		
RF Output Power Tested	0.581 Watts ERP (GMRS 462.7125 MHz)		
Battery Type(s) Tested	NiCd	3.6 V	600 mAh
	Alkaline AA (x3)	1.5 V	Duracell Procell 2850 mAh
			Energizer E91 2850 mAh
Antenna Type(s) Tested	Fixed		
Body-Worn Accessories Tested	Plastic Swivel Belt-Clip (P/N: NTN9392B)		
	Earbud with Lapel-Microphone (P/N: NTN8870C)		
	Earpiece with Boom-Microphone (P/N: NTN9396BW)		
	Headset with Boom-Microphone (P/N: NTN8868B)		

3.0 SAR MEASUREMENT SYSTEM

Celltech Labs Inc. SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 measurement system is comprised of the measurement server, robot controller, computer, near-field probe, probe alignment sensor, specific anthropomorphic mannequin (SAM) phantom, and various planar phantoms for brain and/or body SAR evaluations. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the DASY4 measurement server. The DAE4 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the DASY4 measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. The sensor systems are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

DASY4 SAR Measurement System with validation phantom



DASY4 SAR Measurement System with Plexiglas planar phantom

4.0 MEASUREMENT SUMMARY

SAR EVALUATION RESULTS

Test Date	Test Type	Freq. (MHz)	Chan.	Test Mode	Battery Type	Antenna Position	Body-Worn Accessories	Separation Distance to Planar Phantom (cm)	ERP Before Test (Watts)	Measured SAR 1g (W/kg) Duty Cycle 100%	Measured SAR 1g (W/kg) Duty Cycle 50%	SAR Drift During Test (dB)	Scaled SAR 1g (W/kg) Duty Cycle 100%	Scaled SAR 1g (W/kg) Duty Cycle 50%
04/20/04	Face	462.7125	7	CW	NiCd	Fixed	--	2.5	0.581	1.52	0.760	-0.736	1.80	0.900
04/20/04	Face	462.7125	7	CW	Duracell Alkaline	Fixed	--	2.5	0.581	1.60	0.800	-0.689	1.88	0.938
04/19/04	Body	462.7125	7	CW	NiCd	Fixed	Belt-Clip Earbud	1.7	0.581	1.58	0.790	-0.874	1.93	0.966
04/19/04	Body	462.7125	7	CW	NiCd	Fixed	Belt-Clip Earpiece	1.7	0.581	1.39	0.695	-0.757	1.65	0.827
04/19/04	Body	462.7125	7	CW	NiCd	Fixed	Belt-Clip Headset	1.7	0.581	1.15	0.575	-0.805	1.38	0.692
04/19/04	Body	462.7125	7	CW	Duracell Alkaline	Fixed	Belt-Clip Earbud	1.7	0.581	1.10	0.550	-1.03	1.39	0.697
04/19/04	Body	462.7125	7	CW	Duracell Alkaline	Fixed	Belt-Clip Earpiece	1.7	0.581	1.47	0.735	-0.983	1.84	0.922
04/19/04	Body	462.7125	7	CW	Duracell Alkaline	Fixed	Belt-Clip Headset	1.7	0.581	1.74	0.870	-0.943	2.16	1.08
04/19/04	Body	462.7125	7	CW	Energizer Alkaline	Fixed	Belt-Clip Headset	1.7	0.581	1.43	0.715	-0.923	1.77	0.884

ANSI / IEEE C95.1 1999 - SAFETY LIMIT
BRAIN / BODY: 1.6 W/kg (averaged over 1 gram)
Spatial Peak - Uncontrolled Exposure / General Population

Dielectric Constant ε_r	**450 MHz Brain**		**450 MHz Body**		**Ambient Temperature**	Brain	22.3 °C	Body	23.4 °C
	IEEE Target	**Measured**	**IEEE Target**	**Measured**	**Fluid Temperature**	Brain	21.3 °C	Body	21.1 °C
	43.5 (± 5%)	44.9	**56.7 (± 5%)**	57.2	**Atmospheric Pressure**	Brain	101.6 kPa	Body	101.7 kPa
Conductivity σ **(mho/m)**	**450 MHz Brain**		**450 MHz Body**		**Relative Humidity**	Brain	32%	Body	33%
	IEEE Target	**Measured**	**IEEE Target**	**Measured**	**Fluid Depth**	Brain	≥ 15 cm	Body	≥ 15 cm
	0.87 (± 5%)	0.91	**0.94 (± 5%)**	0.90	ρ **(Kg/m^3)**	Brain	1000	Body	1000

Note(s):

1. The measurement results were obtained with the DUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the DUT are reported in Appendix A.
2. The transmission band of the DUT is less than 10 MHz, therefore mid channel data only is reported (per FCC OET Bulletin 65, Supplement C, Edition 01-01 - see reference [3]).
3. The DUT was evaluated for SAR with Duracell Procell alkaline batteries. To report a SAR comparison between alternate alkaline battery types, the highest SAR level configuration evaluated with the Duracell Procell alkaline batteries was repeated using Energizer E91 alkaline batteries.
4. The power drifts measured by the DASY system for the duration of the SAR evaluations were >5% from the start power. The power drifts were subsequently added to the measured SAR levels to report scaled SAR results as shown in the above table.
5. A SAR versus time power drift evaluation was performed for the duration of the area scan measurement in the test configuration that reported the highest scaled SAR level (body-worn with headset, Duracell Procell alkaline batteries). See Appendix A (SAR Test Plots) for SAR versus Time power drift evaluation plot.
6. The ambient and fluid temperatures were measured prior to, and during, the fluid dielectric parameter check and the SAR evaluation. The temperatures reported were consistent for all measurement periods.
7. The dielectric parameters of the simulated tissues were measured prior to the evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters).
8. The SAR evaluations were performed within 24 hours of the system performance check.

5.0 DETAILS OF SAR EVALUATION

The Giant Electronics Ltd. Models: T6500/T6550 Portable UHF FRS/GMRS PTT Radio Transceiver FCC ID: K7GT6500 was compliant for localized Specific Absorption Rate (General Population / Uncontrolled Exposure) based on the test provisions and conditions described below. The detailed test setup photographs are shown in Appendix F.

1. The DUT was evaluated in a face-held configuration with the front of the radio placed parallel to the outer surface of the planar phantom. A 2.5 cm separation distance was maintained between the front side of the DUT and the outer surface of the planar phantom for the duration of the tests.
2. The DUT was tested in a body-worn configuration with the back of the radio placed parallel to the outer surface of the planar phantom. The attached Plastic Swivel Belt-Clip accessory was touching the planar phantom and provided a 1.7 cm separation distance from the back of the DUT to the outer surface of the planar phantom. The DUT was evaluated for body-worn SAR with the Earbud/Lapel-Microphone accessory, Earpiece/Boom-Microphone accessory, and Headset/Boom-Microphone accessory.
3. The conducted output power of the DUT could not be measured for the SAR evaluations due to a non-detachable antenna. The DUT was evaluated for SAR at the maximum conducted power level set by the manufacturer.
4. The DUT was evaluated for SAR at the maximum ERP level measured prior to the SAR evaluation on a 3-meter Open Area Test Site using the signal substitution method in accordance with ANSI TIA/EIA-603-A-2001.
5. The power drifts measured by the DASY system for the duration of the SAR evaluations were >5% from the start power. The power drifts were subsequently added to the measured SAR levels to report scaled SAR results as shown in the test data table (page 5).
6. A SAR versus time power drift evaluation was performed for the duration of the area scan measurement in the test configuration that reported the highest scaled SAR level (body-worn with headset, Duracell Procell alkaline batteries). See Appendix A (SAR Test Plots) for SAR versus Time power drift evaluation plot.
7. The area scan evaluation was performed with fully charged batteries. After the area scan was completed the radio was cooled down to room temperature and the batteries were replaced with fully charged batteries prior to the zoom scan evaluation.
8. The DUT was tested in unmodulated continuous transmit operation (Continuous Wave mode at 100% duty cycle) with the transmit key constantly depressed. For a push-to-talk device the 50% duty cycle compensation reported assumes a transmit/receive cycle of equal time base.
9. The SAR evaluations were performed using a Plexiglas planar phantom.
10. A stack of low-density, low-loss dielectric foamed polystyrene was used in place of the device holder.

6.0 EVALUATION PROCEDURES

a. (i) The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For devices held to the ear during normal operation, both the left and right ear positions were evaluated using the SAM phantom.
(ii) For body-worn and face-held devices a planar phantom was used.

b. The SAR was determined by a pre-defined procedure within the DASY4 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 15mm x 15mm.

An area scan was determined as follows:

c. Based on the defined area scan grid, a more detailed grid is created to increase the points by a factor of 10. The interpolation function then evaluates all field values between corresponding measurement points.

d. A linear search is applied to find all the candidate maxima. Subsequently, all maxima are removed that are >2 dB from the global maximum. The remaining maxima are then used to position the cube scans.

A 1g and 10g spatial peak SAR was determined as follows:

e. Extrapolation is used to find the points between the dipole center of the probe and the surface of the phantom. This data cannot be measured, since the center of the dipoles is 2.7 mm away form the tip of the probe and the distance between the surface and the lowest measuring point is 1.4 mm (see probe calibration document in Appendix D). The extrapolation was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.

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

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

7.0 SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluation a system check was performed with a Plexiglas planar phantom and 450MHz dipole (see Appendix C for system validation procedures). The dielectric parameters of the simulated brain tissue mixture were measured prior to the system performance check using an HP 85070C Dielectric Probe Kit and HP 8753E Network Analyzer (see Appendix E for printout of measured fluid dielectric parameters). A forward power of 250mW was applied to the dipole and the system was verified to a tolerance of ±10% (see Appendix B for system performance check test plot).

SYSTEM PERFORMANCE CHECK

Test Date	450MHz Equiv. Tissue	SAR 1g (W/kg)		Dielectric Constant ε_r		Conductivity σ (mho/m)		ρ (Kg/m^3)	Amb. Temp. (°C)	Fluid Temp. (°C)	Fluid Depth (cm)	Humid. (%)	Barom. Press. (kPa)
		IEEE Target	Measured	IEEE Target	Measured	IEEE Target	Measured						
04/19/04	Brain	1.23 (±10%)	1.32 (7.3%)	43.5 ±5%	44.3	0.87 ±5%	0.90	1000	23.3	21.4	≥ 15	33	101.9

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

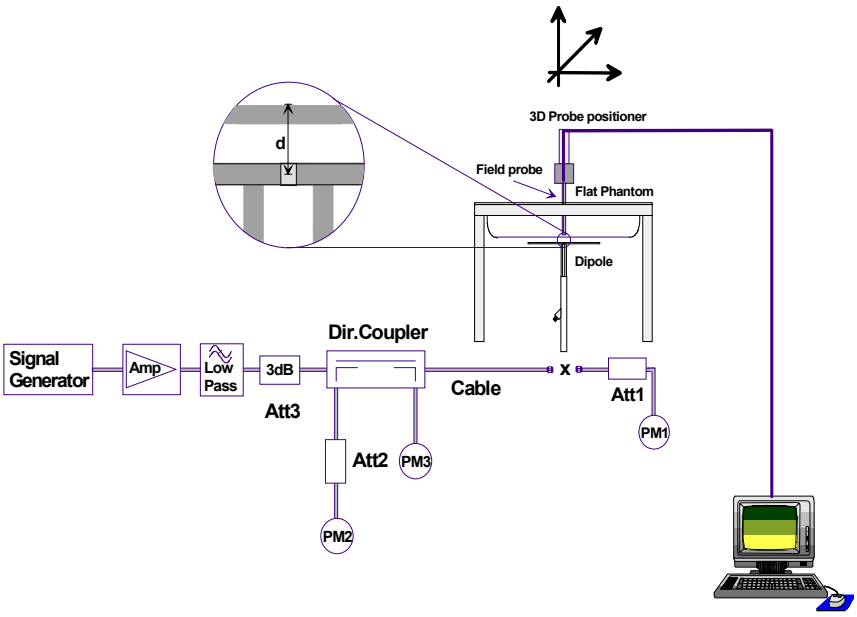
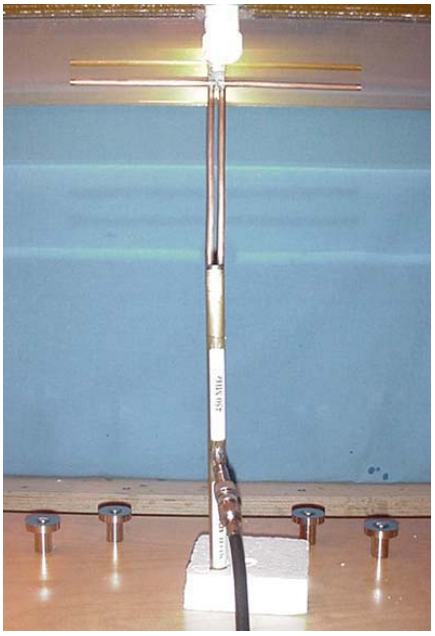


Figure 1. System Performance Check Setup Diagram



450 MHz Dipole Setup

8.0 SIMULATED EQUIVALENT TISSUES

The 450MHz brain and body simulated tissue mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The fluid was prepared according to standardized procedures, and measured for dielectric parameters (permittivity and conductivity).

SIMULATED TISSUE MIXTURES		
INGREDIENT	**450MHz Brain (System Check & DUT Evaluation)**	**450MHz Body (DUT Evaluation)**
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 %

9.0 SAR SAFETY LIMITS

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	**(Occupational / Controlled Exposure Environment)**
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.0	20.0

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

10.0 ROBOT SYSTEM SPECIFICATIONS

Specifications

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

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: AMD Athlon XP 2400+
Clock Speed: 2.0 GHz
Operating System: Windows XP Professional

Data Converter

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

DASY4 Measurement Server

Function: Real-time data evaluation for field measurements and surface detection
Hardware: PC/104 166MHz Pentium CPU; 32 MB chipdisk; 64 MB RAM
Connections: COM1, COM2, DAE, Robot, Ethernet, Service Interface

E-Field Probe

Model: ET3DV6
Serial No.: 1387
Construction: Triangular core fiber optic detection system
Frequency: 10 MHz to 6 GHz
Linearity: ±0.2 dB (30 MHz to 3 GHz)

Phantom(s)

Evaluation Phantom

Type: Planar Phantom
Shell Material: Plexiglas
Bottom Thickness: 2.0 mm ± 0.1 mm
Outer Dimensions: 75.0 cm (L) x 22.5 cm (W) x 20.5 cm (H); Back Plane: 25.7 cm (H)

Validation Phantom (≤ 450MHz)

Type: Planar Phantom
Shell Material: Plexiglas
Bottom Thickness: 6.2 mm ± 0.1 mm
Outer Dimensions: 86.0 cm (L) x 39.5 cm (W) x 21.8 cm (H)

11.0 PROBE SPECIFICATION (ET3DV6)

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

ET3DV6 E-Field Probe

12.0 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 planar phantom is mounted on the side of the DASY4 compact system table.

Plexiglas Planar Phantom

13.0 VALIDATION PLANAR PHANTOM

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

Validation Planar Phantom

14.0 DEVICE HOLDER

The DASY4 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.

Device Holder

15.0 TEST EQUIPMENT LIST

TEST EQUIPMENT	SERIAL NO.	CALIBRATION DATE
Schmid & Partner DASY4 System	-	-
DASY4 Measurement Server	1078	N/A
-Robot	599396-01	N/A
DAE3	353	Sept 2003
DAE3	370	May 2004
-ET3DV6 E-Field Probe	1387	Mar 2004
-ET3DV6 E-Field Probe	1590	May 2004
-300MHz Validation Dipole	135	Oct 2003
-450MHz Validation Dipole	136	Nov 2003
-835MHz Validation Dipole	411	Mar 2004
-900MHz Validation Dipole	054	June 2003
-1800MHz Validation Dipole	247	June 2003
-2450MHz Validation Dipole	150	Sept 2003
-SAM Phantom V4.0C	1033	N/A
-Barski Planar Phantom	03-01	N/A
-Plexiglas Planar Phantom	161	N/A
-Validation Planar Phantom	137	N/A
HP 85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8651A Power Meter	8650137	April 2004
Gigatronics 8652A Power Meter	1835267	April 2004
Power Sensor 80701A	1833535	April 2004
Power Sensor 80701A	1833542	April 2004
Power Sensor 80701A	1834350	April 2004
HP E4408B Spectrum Analyzer	US39240170	Dec 2003
HP 8594E Spectrum Analyzer	3543A02721	April 2004
HP 8753E Network Analyzer	US38433013	April 2004
HP 8648D Signal Generator	3847A00611	April 2004
Amplifier Research 5S1G4 Power Amplifier	26235	N/A

16.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
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	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(c_p)	± 3.9	∞
Spatial resolution	± 0.0	Rectangular	√3	1	± 0.0	∞
Boundary effects	± 5.5	Rectangular	√3	1	± 3.2	∞
Probe linearity	± 4.7	Rectangular	√3	1	± 2.7	∞
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	± 1.4	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	± 2.9	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	√3	1	± 2.3	∞
Test Sample Related						
Device positioning	± 6.0	Normal	√3	1	± 6.7	12
Device holder uncertainty	± 5.0	Normal	√3	1	± 5.9	8
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	± 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					**± 13.3**	
Expanded Uncertainty (k=2)					**± 26.6**	

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

MEASUREMENT UNCERTAINTIES (Cont.)

UNCERTAINTY BUDGET FOR SYSTEM VALIDATION						
Error Description	**Uncertainty Value ±%**	**Probability Distribution**	**Divisor**	**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	$(1-c_p)$	± 1.9	∞
Spherical isotropy of the probe	± 9.6	Rectangular	√3	(c_p)	± 3.9	∞
Spatial resolution	± 0.0	Rectangular	√3	1	± 0.0	∞
Boundary effects	± 5.5	Rectangular	√3	1	± 3.2	∞
Probe linearity	± 4.7	Rectangular	√3	1	± 2.7	∞
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	± 1.4	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	± 2.9	Rectangular	√3	1	± 1.7	∞
Extrapolation & integration	± 3.9	Rectangular	√3	1	± 2.3	∞
Dipole						
Dipole Axis to Liquid Distance	± 2.0	Rectangular	√3	1	± 1.2	∞
Input Power	± 4.7	Rectangular	√3	1	± 2.7	∞
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					**± 9.9**	
Expanded Uncertainty (k=2)					**± 19.8**	

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

17.0 REFERENCES

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

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

[3] Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields”, OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.

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

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

APPENDIX A - SAR MEASUREMENT DATA

Face-Held SAR - NiCd Battery Pack

Date Tested: 04/20/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

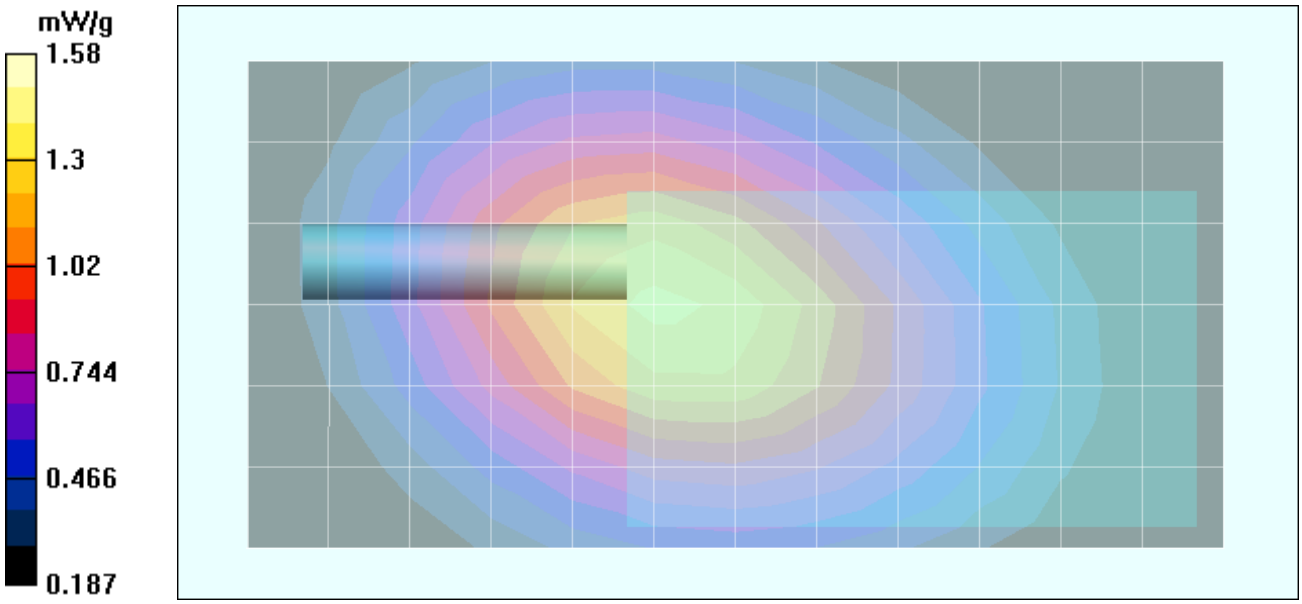
Ambient Temp: 22.3 °C; Fluid Temp: 21.3 °C; Barometric Pressure: 101.6 kPa; Humidity: 32%

3.6V 600mAh NiCd Battery Pack
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: HSL450 (σ = 0.91 mho/m; ε_r = 44.9; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.5, 7.5, 7.5); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Face-Held - 2.5 cm Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Face-Held - 2.5 cm Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 41.8 V/m; Power Drift = -0.736 dB
Peak SAR (extrapolated) = 2.39 W/kg
SAR(1 g) = 1.52 mW/g; SAR(10 g) = 1.06 mW/g



Face-Held SAR - Alkaline Batteries (Duracell Procell)

Date Tested: 04/20/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

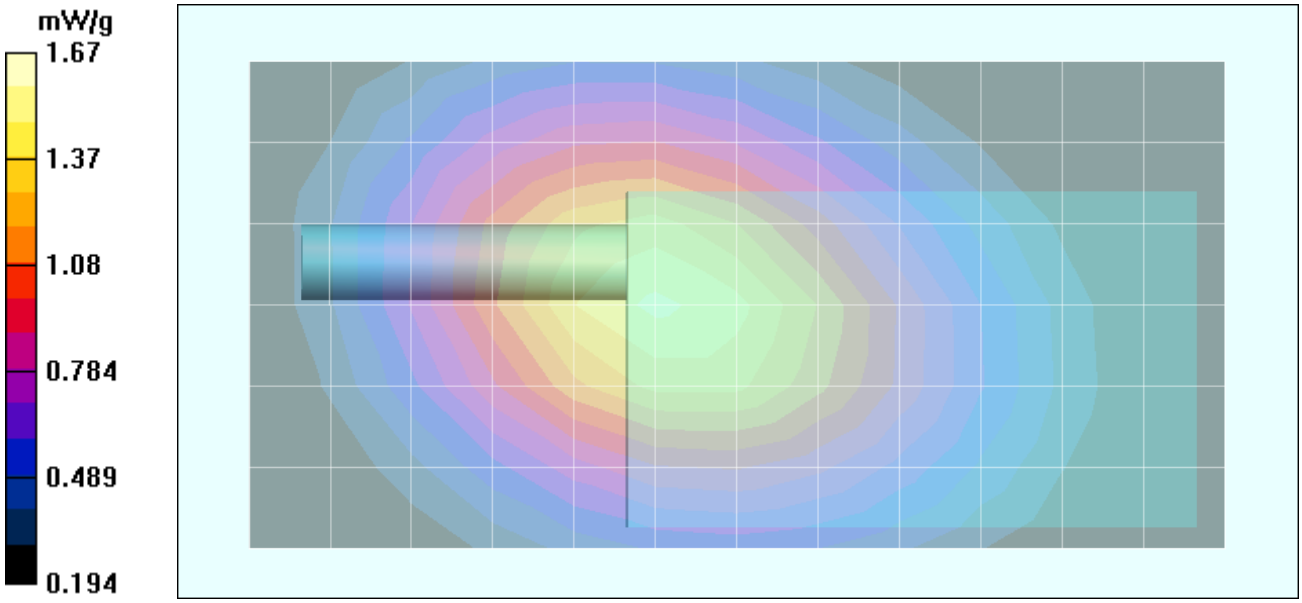
Ambient Temp: 22.3 °C; Fluid Temp: 21.3 °C; Barometric Pressure: 101.6 kPa; Humidity: 32%

1.5V 2850mAh Duracell ProCell AA Alkaline Batteries (x3)
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: HSL450 (σ = 0.91 mho/m; ε_r = 44.9; ρ = 1000 kg/m^3)

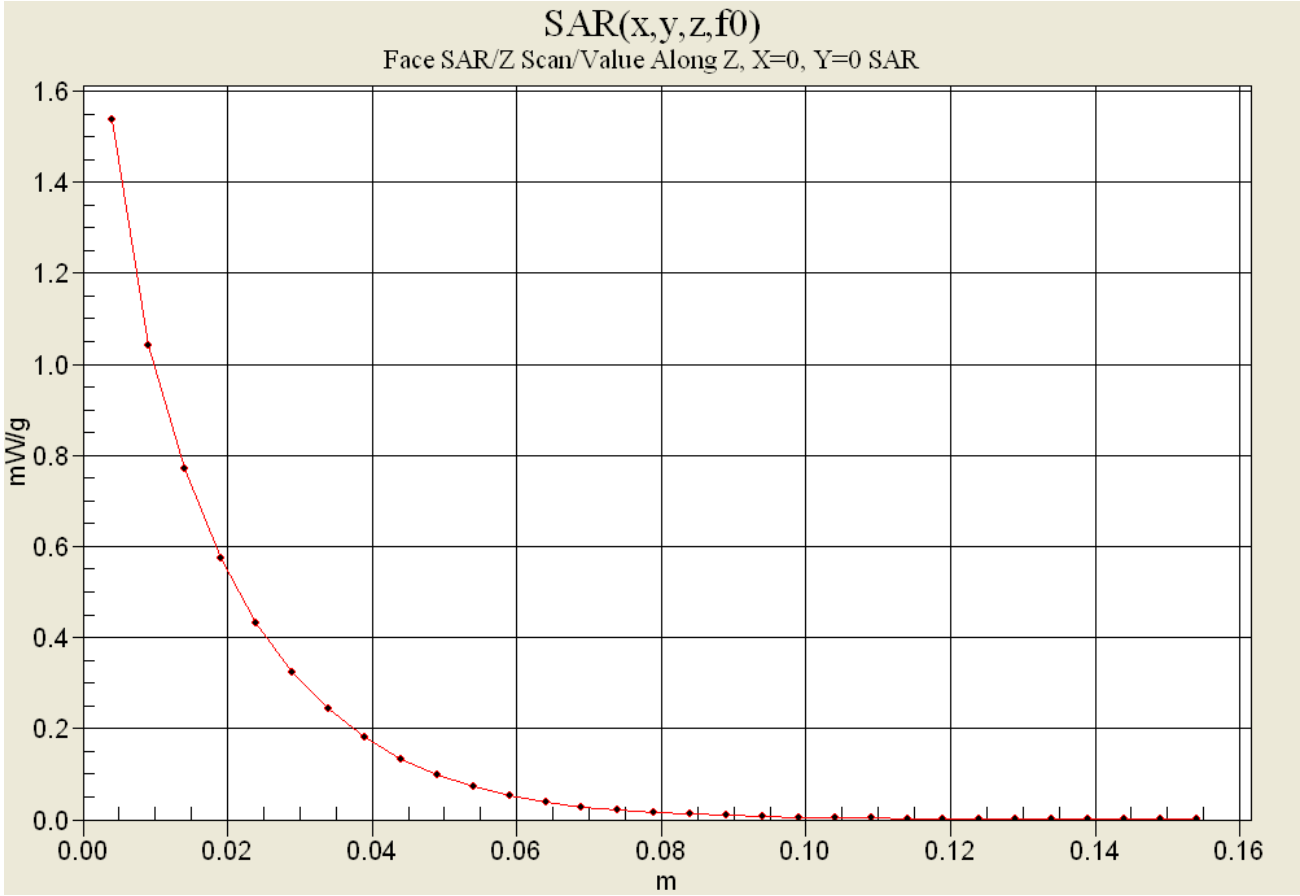
- Probe: ET3DV6 - SN1387; ConvF(7.5, 7.5, 7.5); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Face-Held - 2.5 cm Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Face-Held - 2.5 cm Separation Distance /Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 42.6 V/m; Power Drift = -0.689 dB
Peak SAR (extrapolated) = 2.54 W/kg
SAR(1 g) = 1.60 mW/g; SAR(10 g) = 1.12 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
Face SAR/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

Body-Worn SAR - NiCd Battery Pack

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

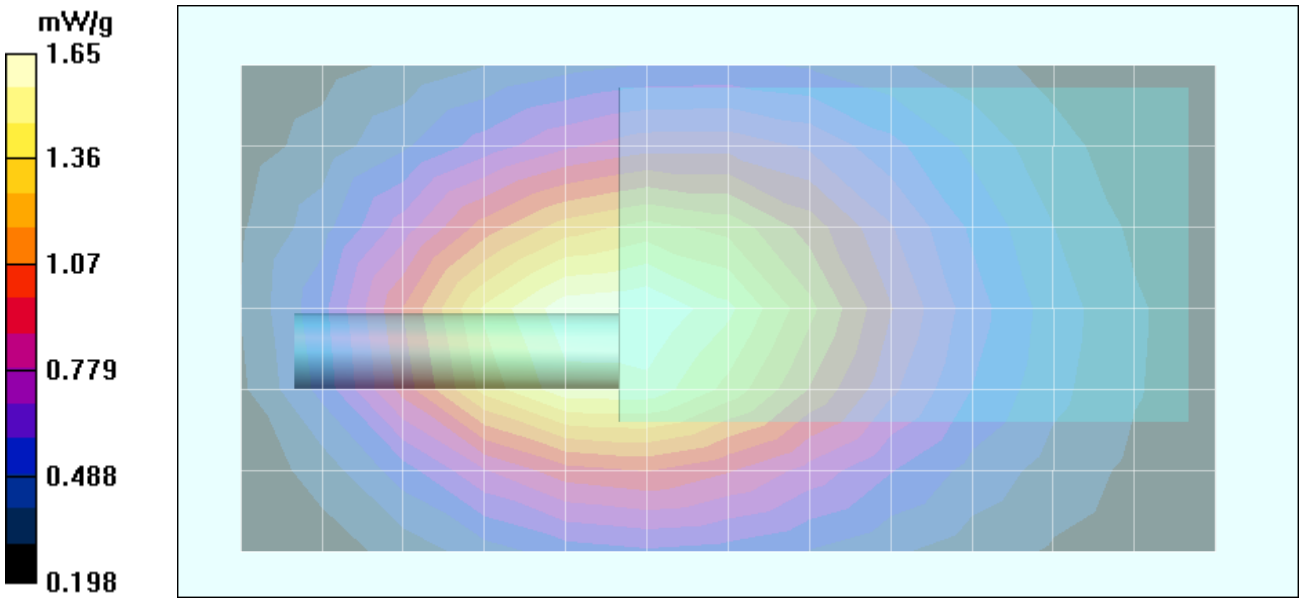
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Earbud with Lapel-Microphone (P/N: NTN8870C)

3.6V 600mAh NiCd Battery Pack
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 41.6 V/m; Power Drift = -0.874 dB
Peak SAR (extrapolated) = 2.49 W/kg
SAR(1 g) = 1.58 mW/g; SAR(10 g) = 1.11 mW/g



Body-Worn SAR - NiCd Battery Pack

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

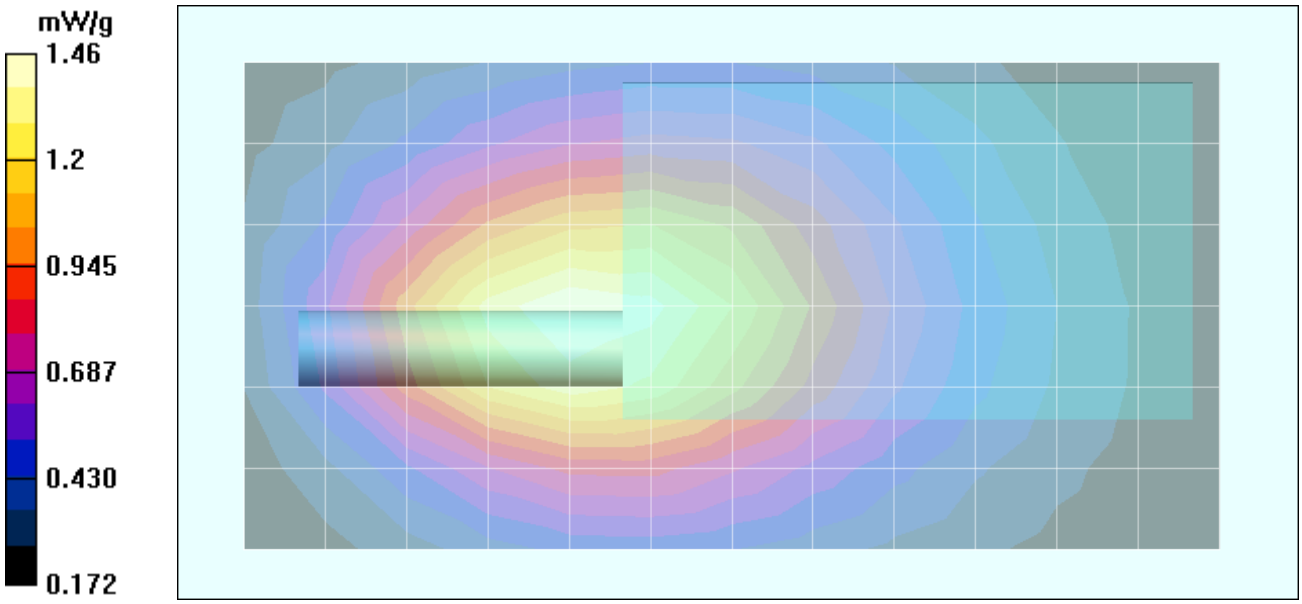
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Earpiece with Boom-Microphone (P/N: NTN9396BW)

3.6V 600mAh NiCd Battery Pack
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 39.4 V/m; Power Drift = -0.757 dB
Peak SAR (extrapolated) = 2.19 W/kg
SAR(1 g) = 1.39 mW/g; SAR(10 g) = 0.967 mW/g



Body-Worn SAR - NiCd Battery Pack

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

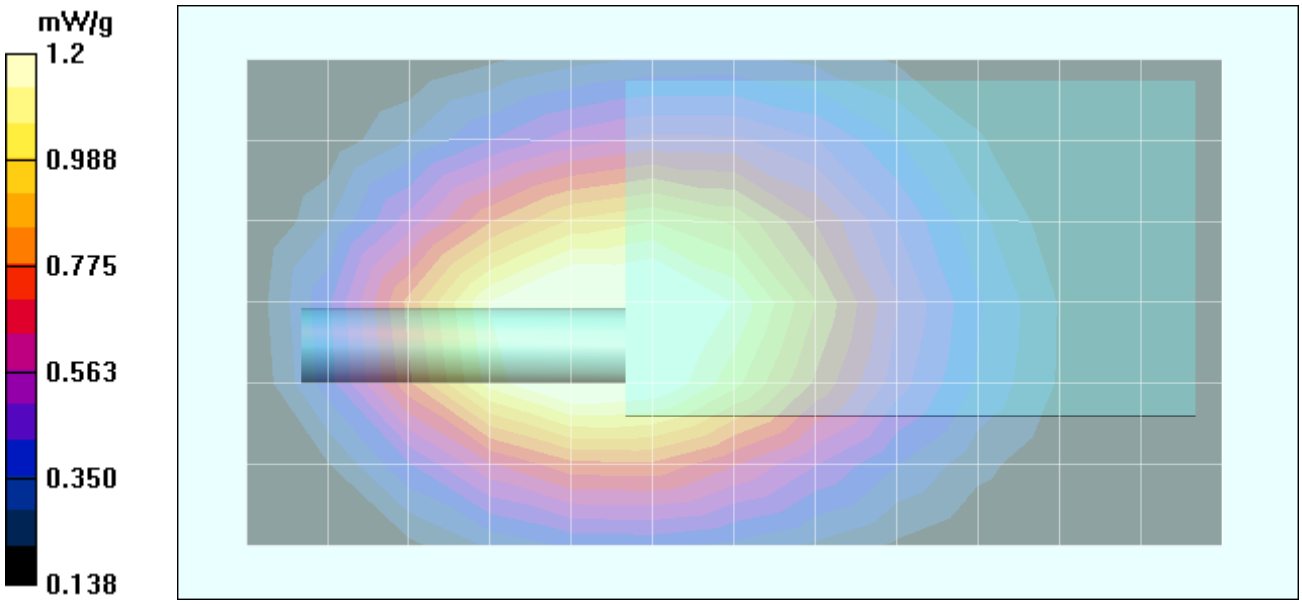
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Headset with Boom-Microphone (P/N: NTN8868B)

3.6V 600mAh NiCd Battery Pack
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.6 V/m; Power Drift = -0.805 dB
Peak SAR (extrapolated) = 1.83 W/kg
SAR(1 g) = 1.15 mW/g; SAR(10 g) = 0.799 mW/g



Body-Worn SAR - Alkaline Batteries (Duracell Procell)

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

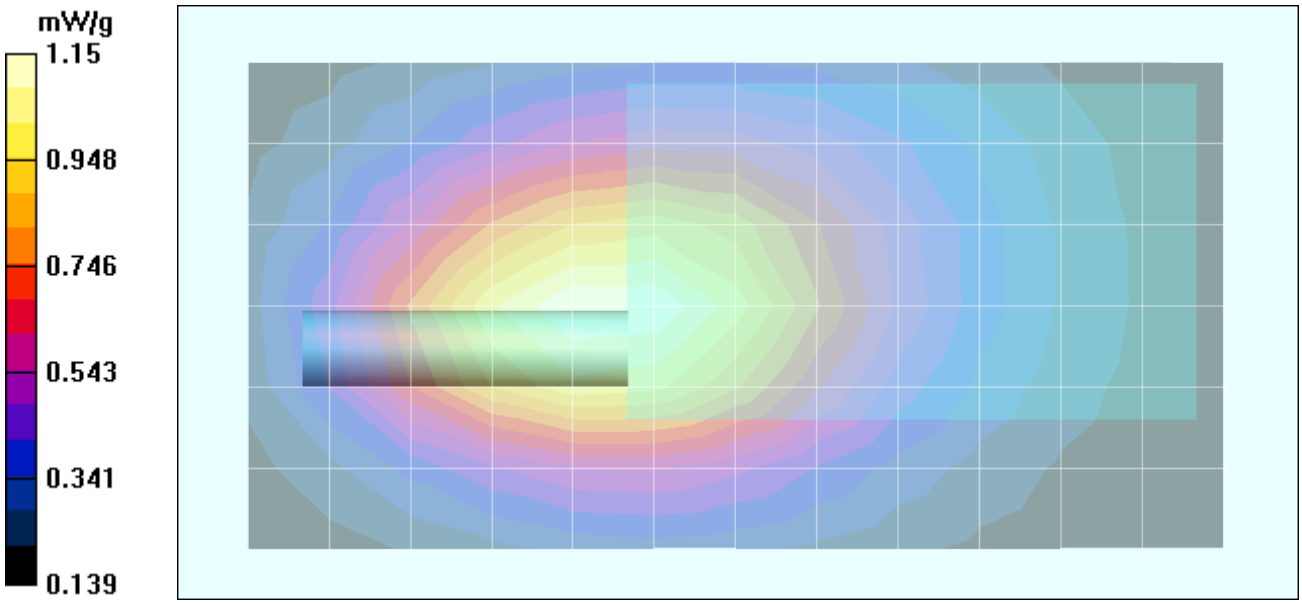
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Earbud with Lapel-Microphone (P/N: NTN8870C)

1.5V 2850mAh Duracell ProCell AA Alkaline Batteries (x3)
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.6 V/m; Power Drift = -1.03 dB
Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.10 mW/g; SAR(10 g) = 0.764 mW/g



Body-Worn SAR - Alkaline Batteries (Duracell Procell)

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

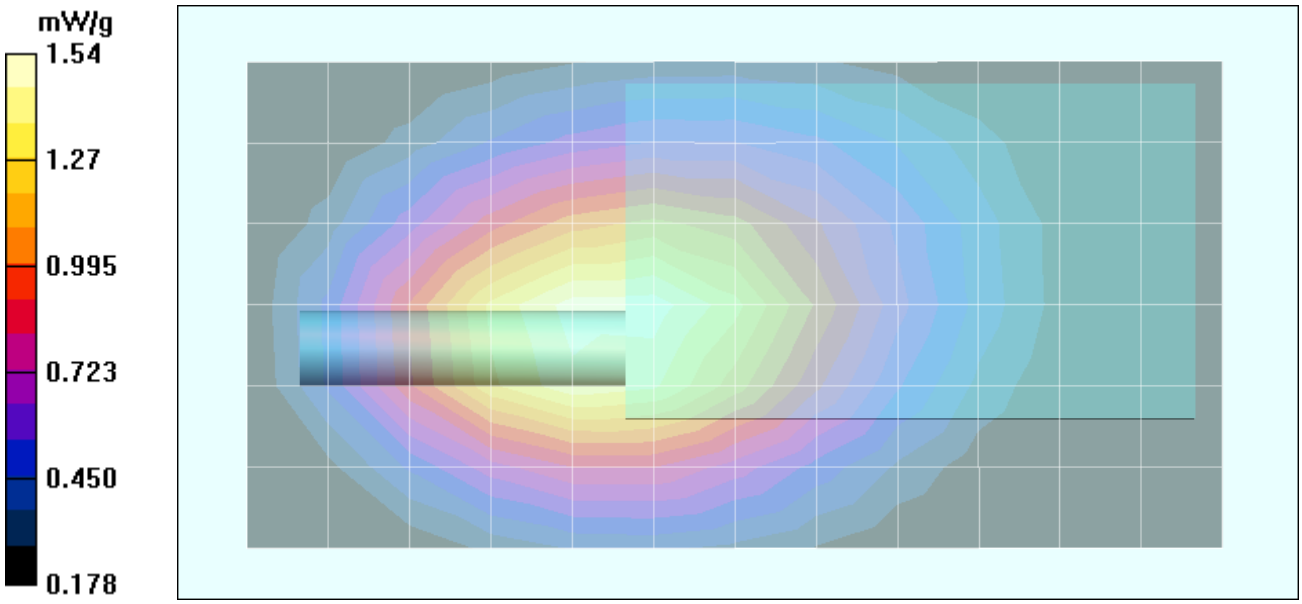
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Earpiece with Boom-Microphone (P/N: NTN9396BW)

1.5V 2850mAh Duracell ProCell AA Alkaline Batteries (x3)
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 40.8 V/m; Power Drift = -0.983 dB
Peak SAR (extrapolated) = 2.33 W/kg
SAR(1 g) = 1.47 mW/g; SAR(10 g) = 1.02 mW/g



Body-Worn SAR - Alkaline Batteries (Duracell Procell)

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

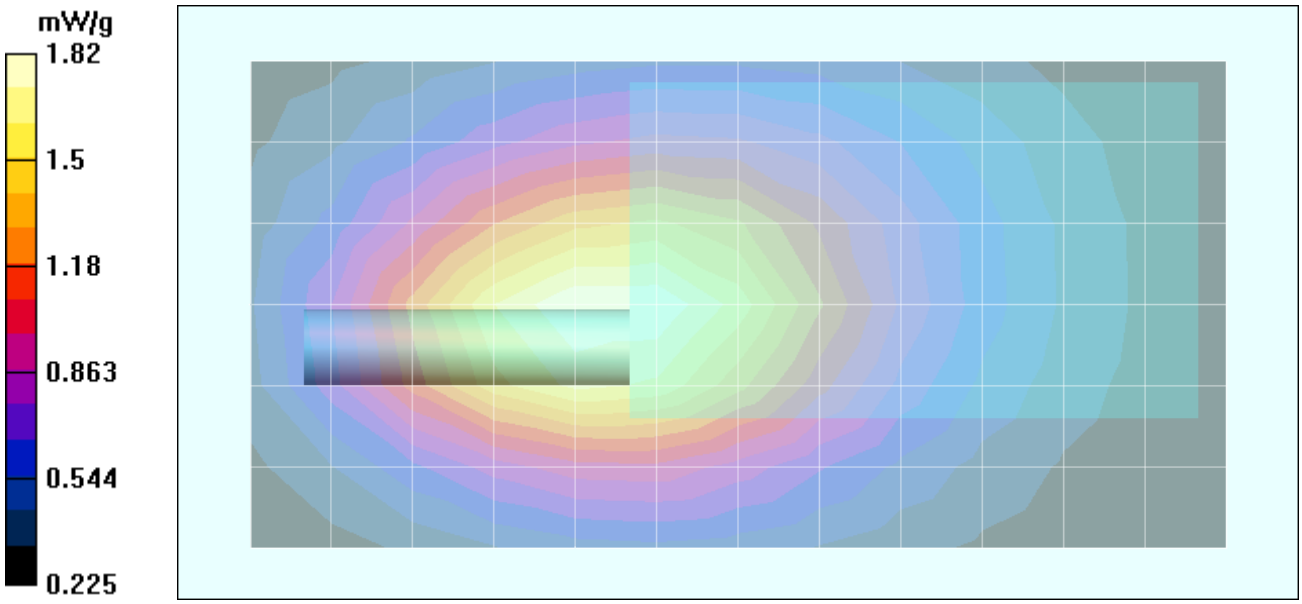
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Headset with Boom-Microphone (P/N: NTN8868B)

1.5V 2850mAh Duracell ProCell AA Alkaline Batteries (x3)
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

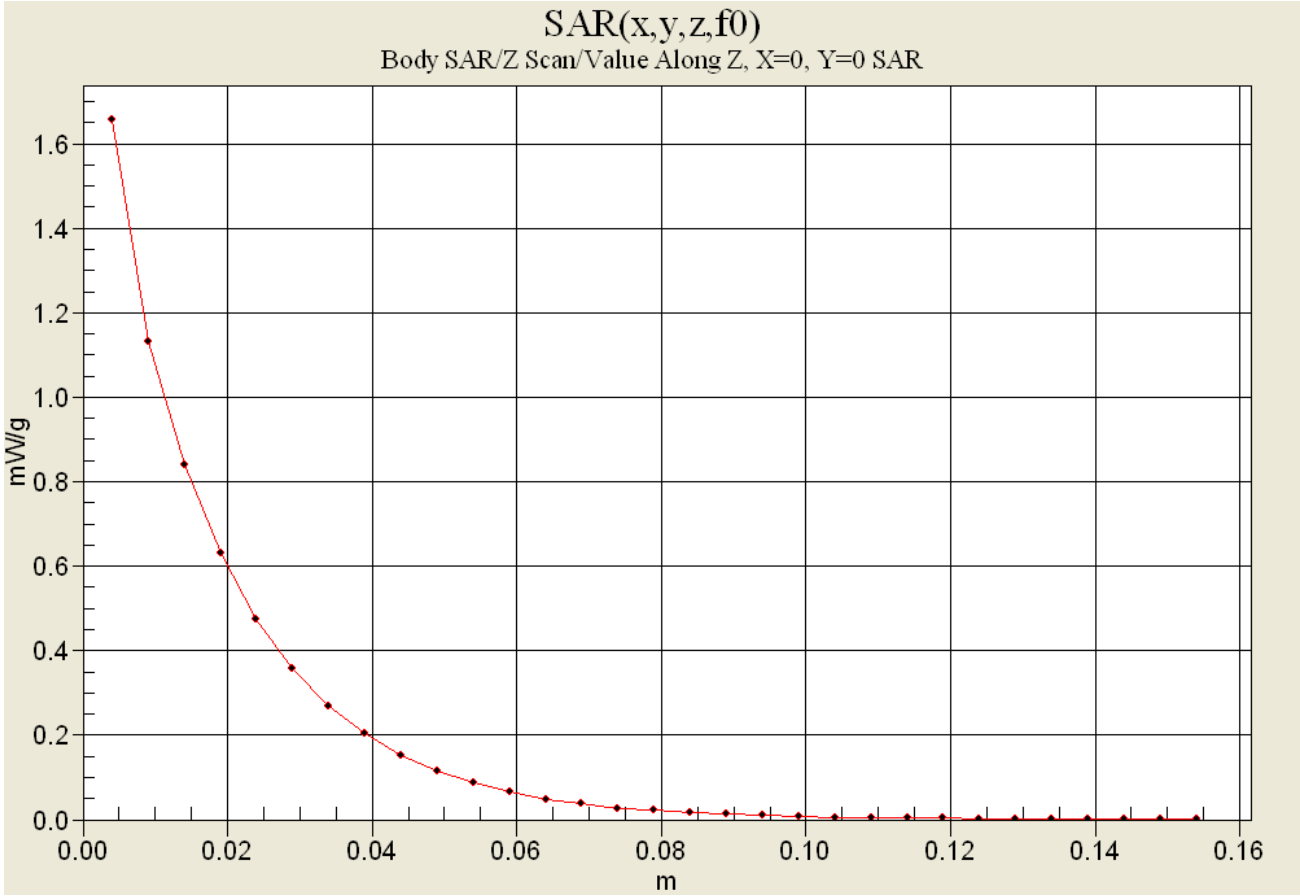
- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

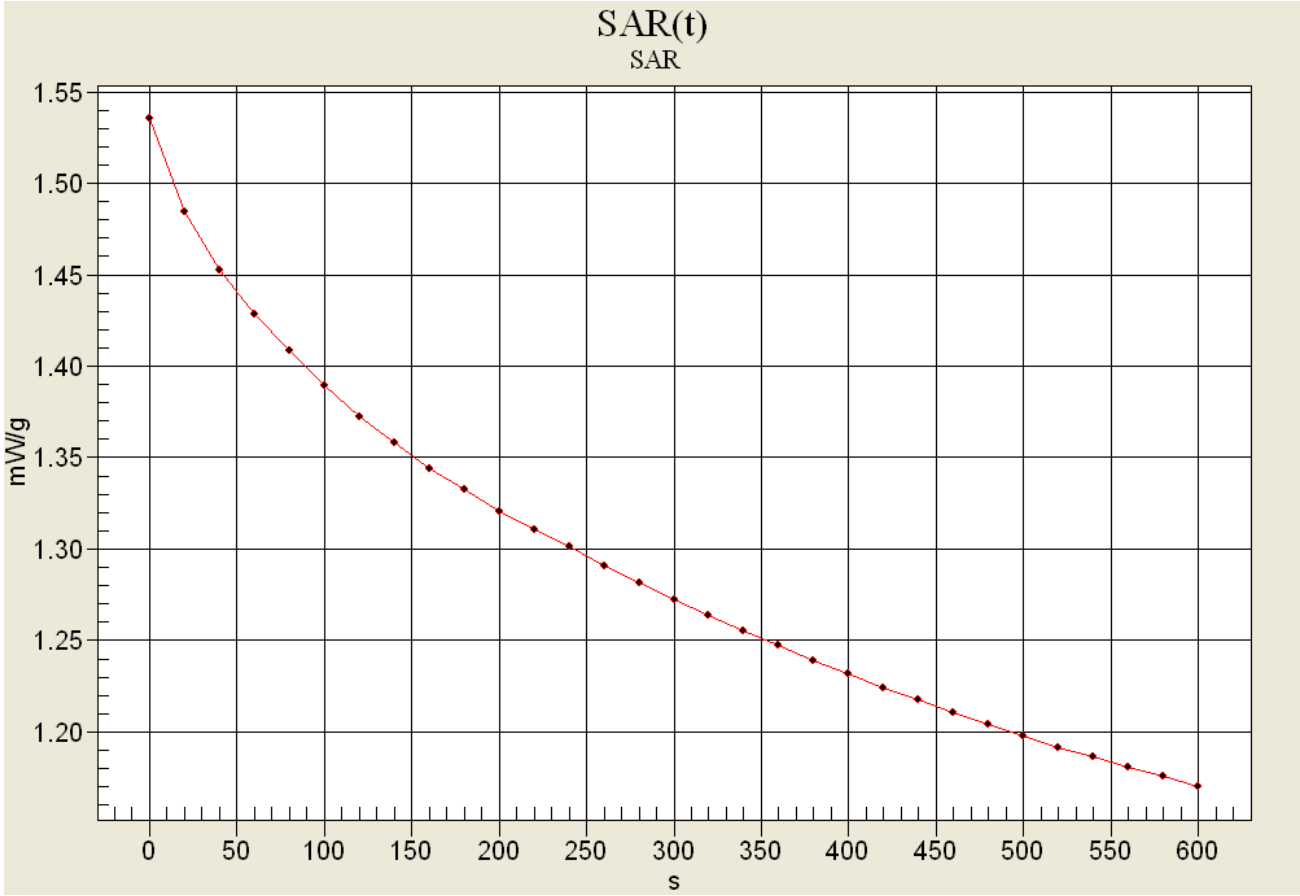
Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 44 V/m; Power Drift = -0.943 dB
Peak SAR (extrapolated) = 2.75 W/kg
SAR(1 g) = 1.74 mW/g; SAR(10 g) = 1.21 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
Body SAR/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

SAR-versus-Time Power Drift Evaluation
Body-worn SAR with Belt-Clip & Headset
Duracell Procell Alkaline Batteries



Initial SAR: 1.536 mW/g
End SAR: 1.172 mW/g (-1.175dB)
SAR after 300s: 1.274 mW/g (-0.812dB)
(300s = Zoom Scan Duration)
(600s = Area Scan Duration)

Body-Worn SAR - Alkaline Batteries (Energizer E91)

Date Tested: 04/19/04

DUT: Giant Electronics Model: T6500; Type: Portable UHF FRS/GMRS PTT Radio Transceiver; Serial: Unit #1

Ambient Temp: 23.4 °C; Fluid Temp: 21.1 °C; Barometric Pressure: 101.7 kPa; Humidity: 33%

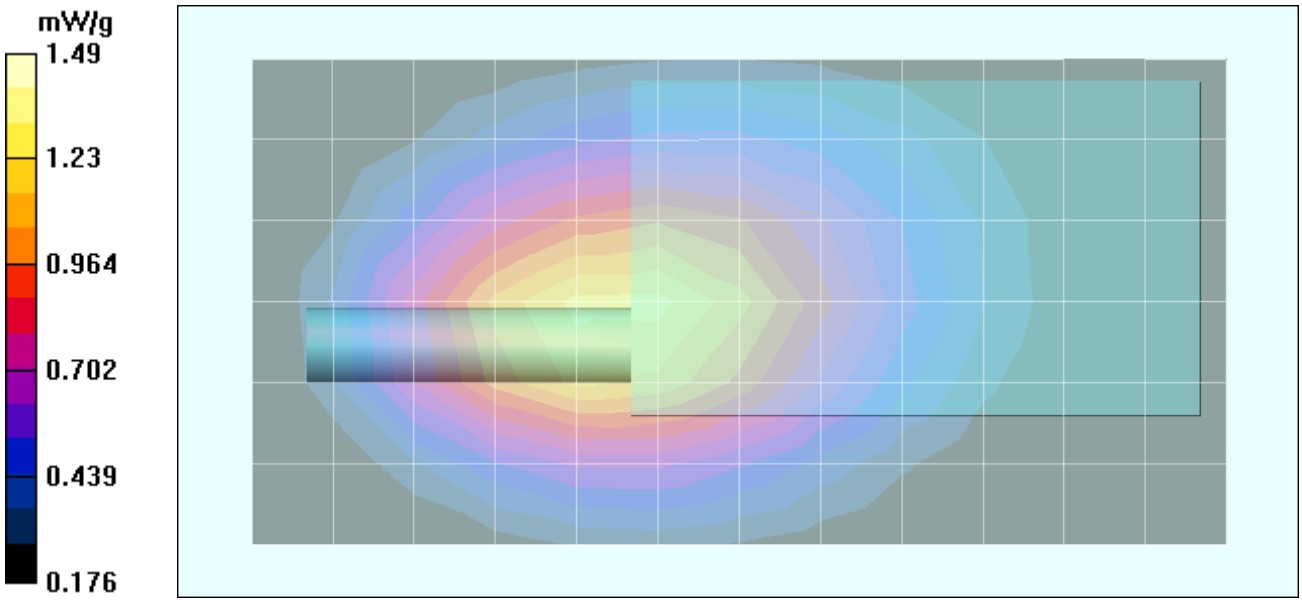
Body-Worn Accessories: Plastic Swivel Belt-Clip (P/N: NTN9392B), Headset with Boom-Microphone (P/N: NTN8868B)

1.5V 2850mAh Energizer E91 AA Alkaline Batteries (x3)
Communication System: FM UHF
RF Output Power: 0.581 Watts (ERP)
Frequency: 462.7125 MHz; Duty Cycle: 1:1
Medium: M450 (σ = 0.90 mho/m; ε_r = 57.2; ρ = 1000 kg/m^3)

- Probe: ET3DV6 - SN1387; ConvF(7.6, 7.6, 7.6); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Area Scan (7x13x1):
Measurement grid: dx=15mm, dy=15mm

Body-Worn - 1.7 cm Belt-Clip Separation Distance/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 40.3 V/m; Power Drift = -0.923 dB
Peak SAR (extrapolated) = 2.26 W/kg
SAR(1 g) = 1.43 mW/g; SAR(10 g) = 0.994 mW/g



APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

System Performance Check - 450 MHz Dipole

Date Tested: 04/19/04

DUT: Dipole 450 MHz; Model: D450V2; Type: System Performance Check; Serial: 136

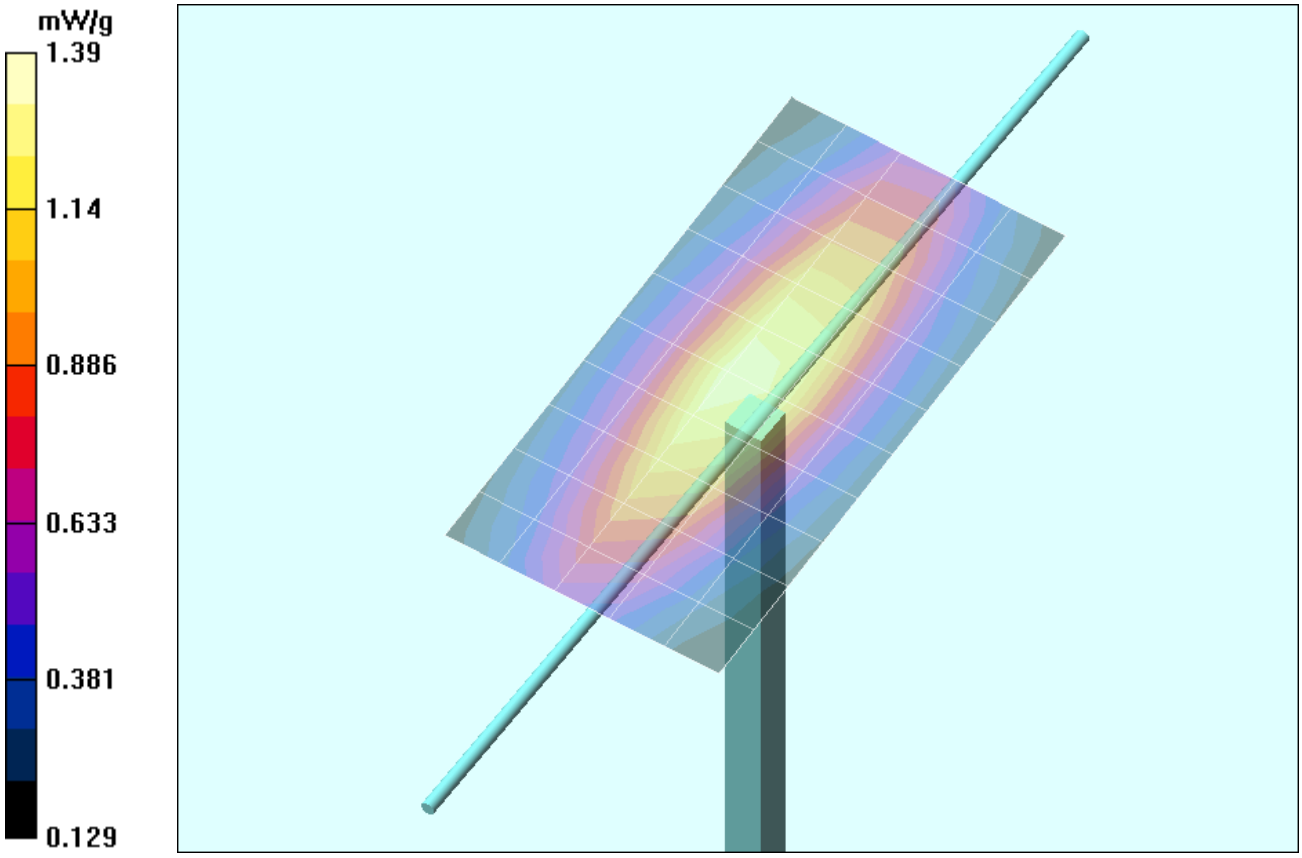
Ambient Temp: 23.3 °C; Fluid Temp: 21.4 °C; Barometric Pressure: 101.9 kPa; Humidity: 33%

Communication System: CW
Forward Conducted Power: 250mW
Frequency: 450 MHz; Duty Cycle: 1:1
Medium: HSL450 (σ = 0.90 mho/m; ε_r = 44.3; ρ = 1000 kg/m^3)

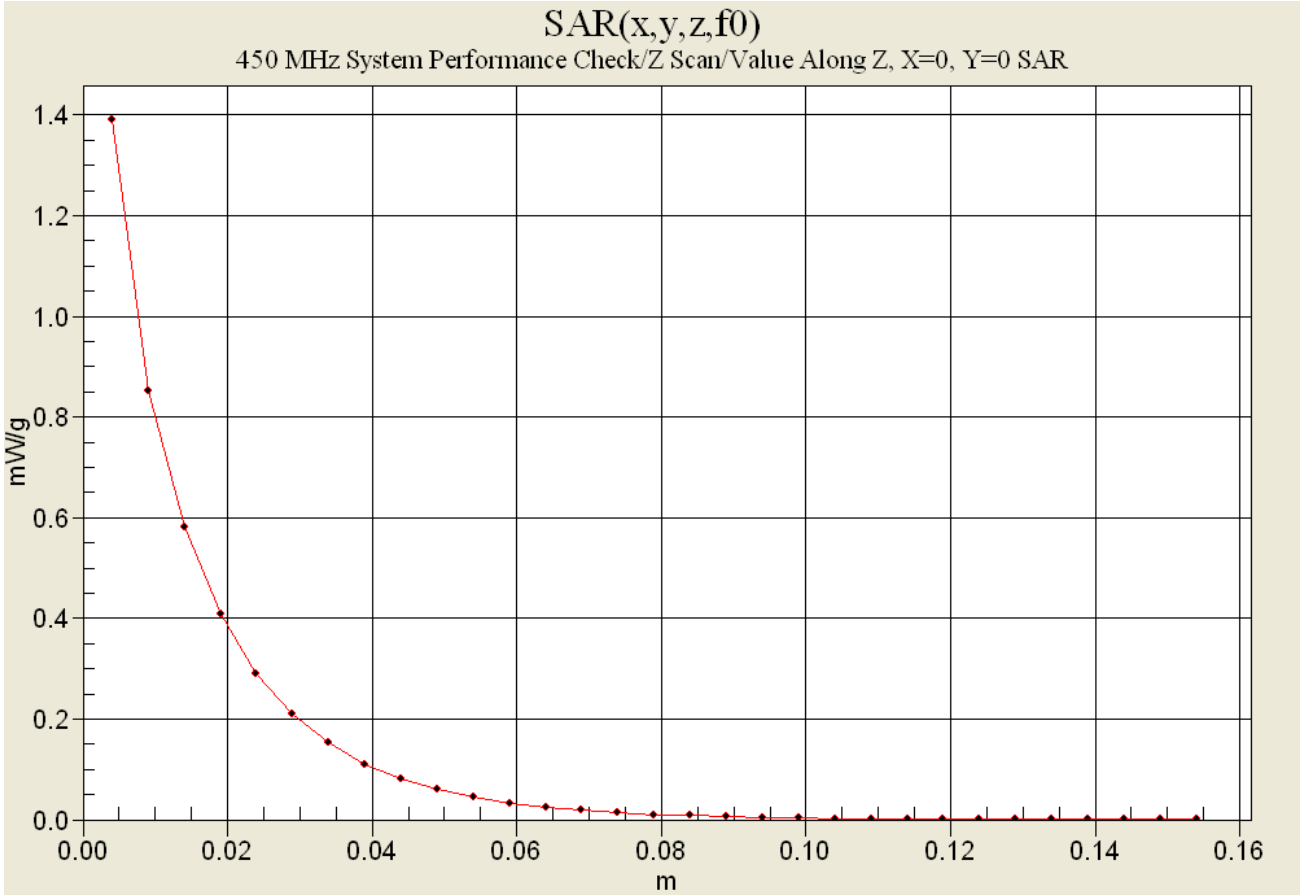
- Probe: ET3DV6 - SN1387; ConvF(7.5, 7.5, 7.5); Calibrated: 18/03/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn353; Calibrated: 19/12/2003
- Phantom: Validation Planar; Type: Plexiglas; Serial: 137
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

450 MHz System Performance Check/Area Scan (6x11x1):
Measurement grid: dx=15mm, dy=15mm

450 MHz System Performance Check/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 39.5 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 2.35 W/kg
SAR(1 g) = 1.32 mW/g; SAR(10 g) = 0.839 mW/g



Z-Axis Scan


SAR(x,y,z,f0)
450 MHz System Performance Check/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
m

APPENDIX C - SYSTEM VALIDATION

Celltech
Testing and Engineering Services Lab

450MHz SYSTEM VALIDATION DIPOLE

Type:	**450MHz Validation Dipole**
Serial Number:	**136**
Place of Calibration:	**Celltech Labs Inc.**
Date of Calibration:	**November 4, 2003**

Celltech Labs Inc. hereby certifies that this device has been calibrated on the date indicated above.

Calibrated by: Spencer Watson

Approved by: Russell W. Pipe

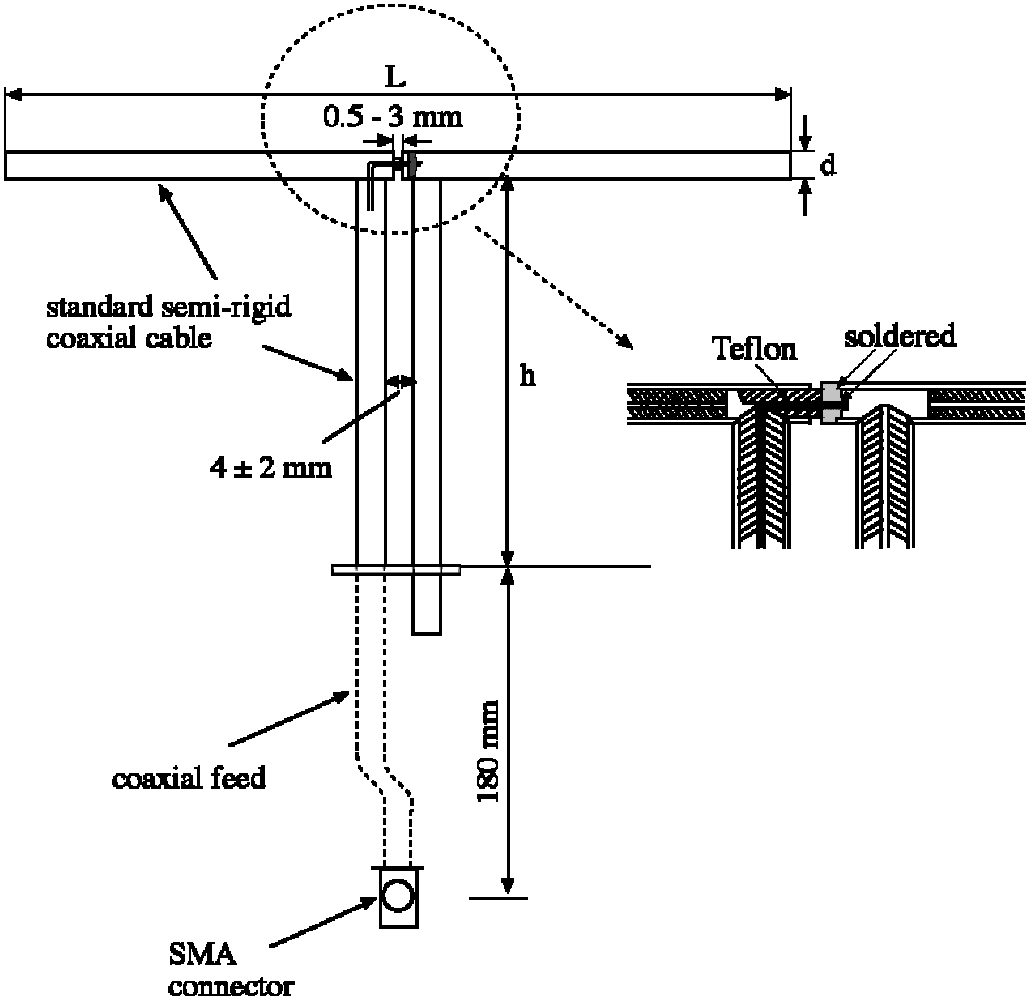
Celltech Labs Inc. 1955 Moss Court, Kelowna, B.C. Canada V1Y 9L3
Tel. 250-448-7047 • Fax. 250-448-7046 • e-mail: info@celltechlabs.com
www.celltechlabs.com

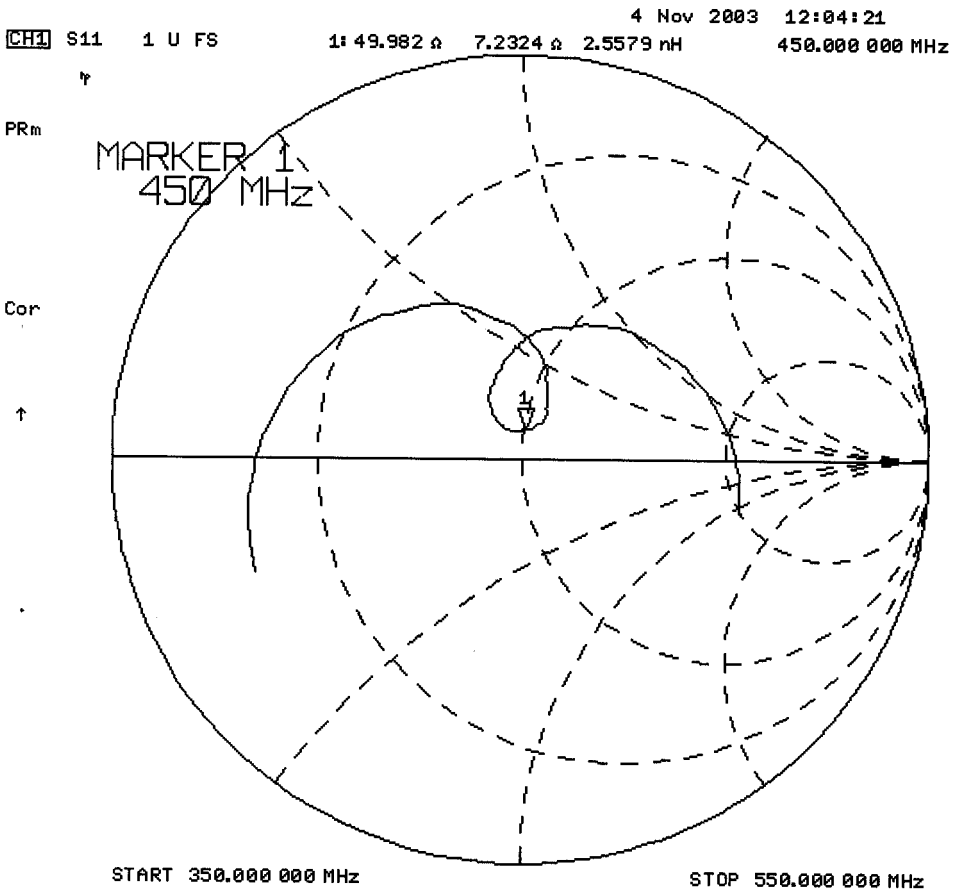
2003 Celltech Labs Inc.

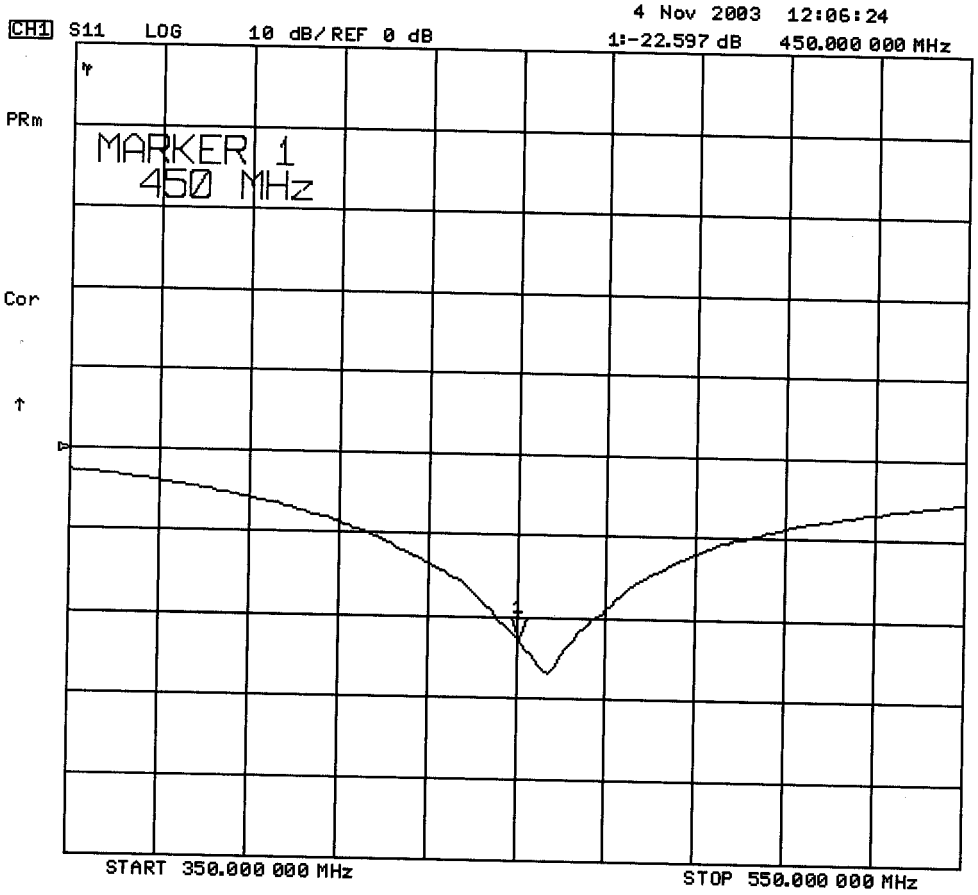
1. Dipole Construction & Electrical Characteristics

The validation dipole was constructed in accordance with the IEEE Std "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques". The electrical properties were measured using an HP 8753E Network Analyzer. The network analyzer was calibrated to the validation dipole N-type connector feed point using an HP85032E Type N calibration kit. The dipole was placed parallel to a planar phantom at a separation distance of 15.0mm from the simulating fluid using a loss-less dielectric spacer. The measured input impedance is:

Feed point impedance at 450MHz	Re{Z} = 49.982Ω
	Im{Z} = 7.2324Ω
Return Loss at 450MHz	-22.597dB




4 Nov 2003 12:04:21
CH1 S11 1 U FS
1: 49.982 Ω 7.2324 Ω 2.5579 nH
450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
1
START 350.000 000 MHz
STOP 550.000 000 MHz


CH1 S11 LOG 10 dB/ REF 0 dB
4 Nov 2003 12:06:24
1:-22.597 dB 450.000 000 MHz
PRm
MARKER 1
450 MHz
Cor
START 350.000 000 MHz
STOP 550.000 000 MHz

2. Validation Dipole Dimensions

Frequency (MHz)	L (mm)	h (mm)	d (mm)
300	420.0	250.0	6.2
450	288.0	167.0	6.2
835	161.0	89.8	3.6
900	149.0	83.3	3.6
1450	89.1	51.7	3.6
1800	72.0	41.7	3.6
1900	68.0	39.5	3.6
2000	64.5	37.5	3.6
2450	51.8	30.6	3.6
3000	41.5	25.0	3.6

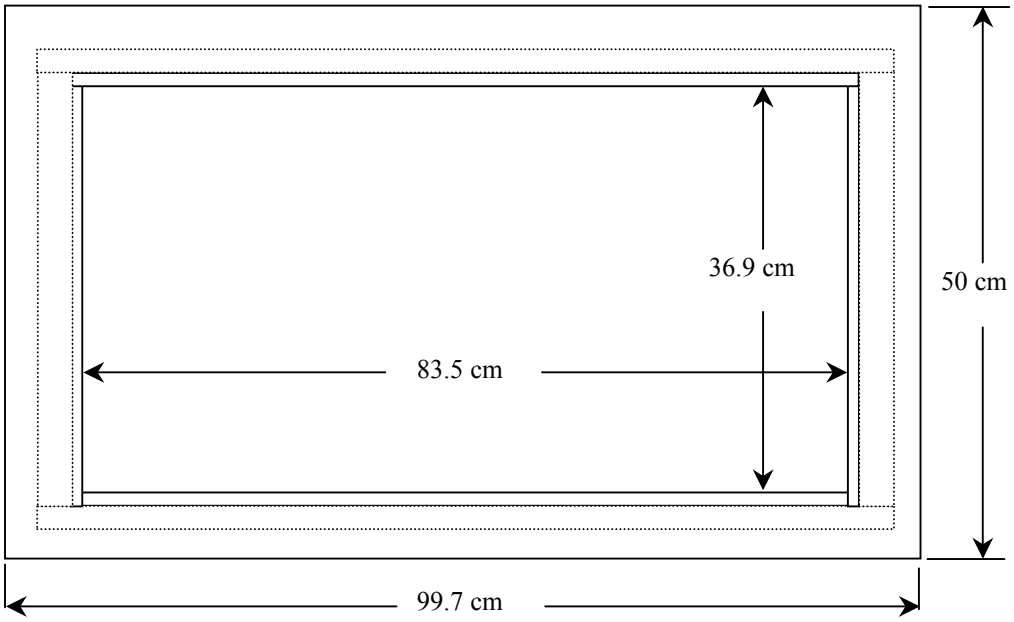
3. Validation Phantom

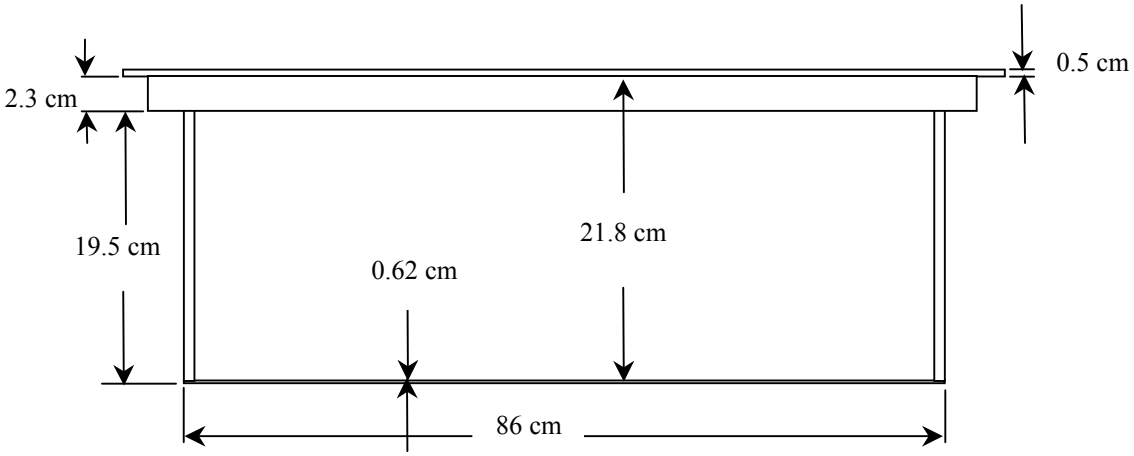
The validation phantom was constructed using relatively low-loss tangent Plexiglas material. The inner dimensions of the phantom are as follows:

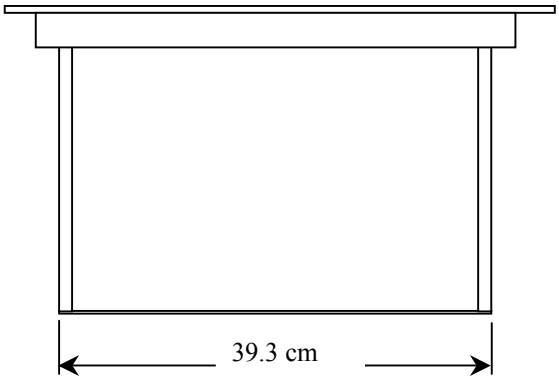
Length: 83.5 cm
Width: 36.9 cm
Height: 21.8 cm

The bottom section of the validation phantom is constructed of 6.2 ± 0.1mm Plexiglas.

4. Dimensions of Plexiglas Planar Phantom







5. 450MHz System Validation Setup

450MHz System Validation Setup

6. Measurement Conditions

The planar phantom was filled with brain simulating tissue having the following parameters at 450MHz:

Relative Permittivity:	43.7
Conductivity:	0.88 mho/m
Fluid Temperature:	22.0 °C
Fluid Depth:	≥ 15.0 cm

Environmental Conditions:

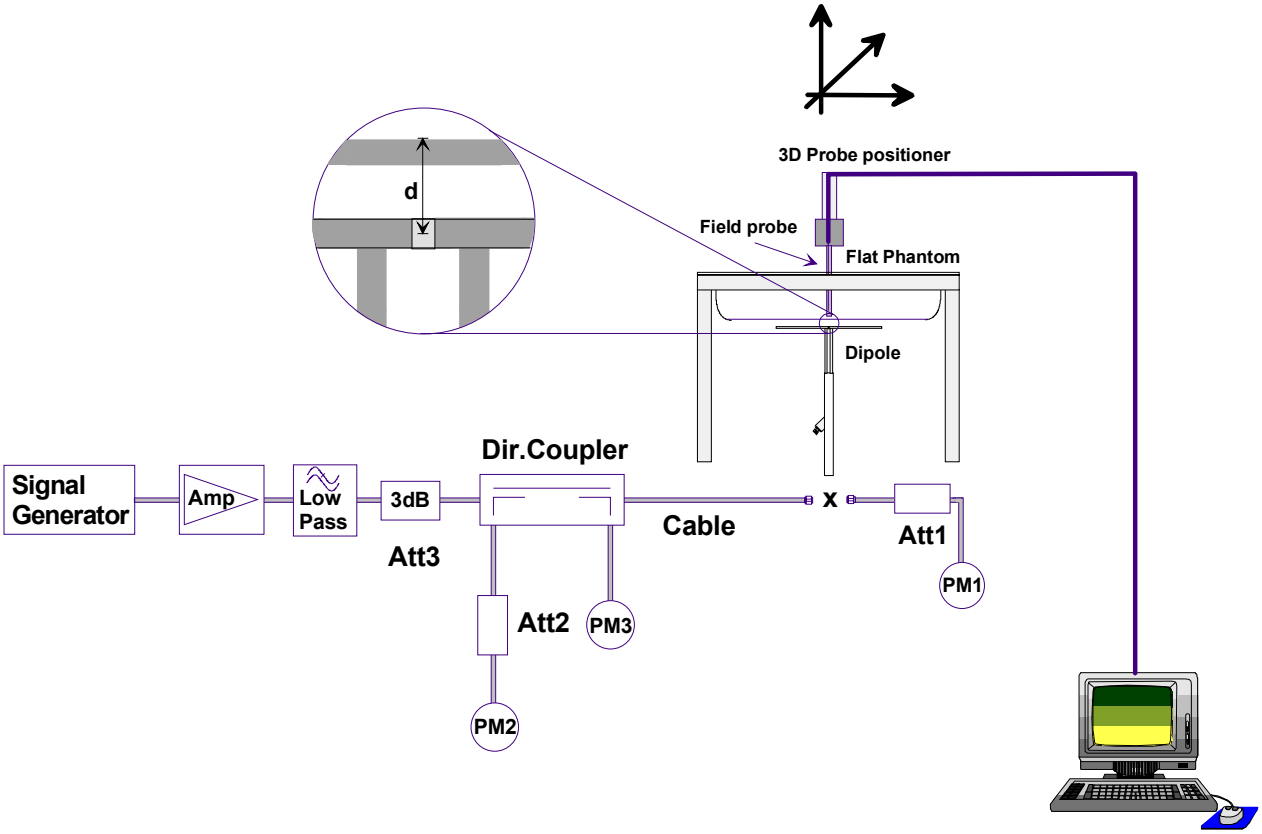
Ambient Temperature:	22.1 °C
Humidity:	49 %
Barometric Pressure:	102.8 kPa

The 450MHz simulated brain tissue mixture consists of the following ingredients:

Ingredient	Percentage by weight
Water	38.56%
Sugar	56.32%
Salt	3.95%
HEC	0.98%
Dowicil 75	0.19%
450MHz Target Dielectric Parameters at 22 °C	ε_r = 43.5 σ = 0.87 S/m

7. SAR Measurement

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



First the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at the dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed from the previous value. The reflected power should be 20dB below the forward power.

8. Validation Dipole SAR Test Results

Ten SAR measurements were performed in order to achieve repeatability and to establish an average target value.

Validation Measurement	SAR @ 0.25W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.25W Input averaged over 10g	SAR @ 1W Input averaged over 10g	Peak SAR @ 0.25W Input
Test 1	1.29	5.16	0.810	3.24	2.28
Test 2	1.31	5.24	0.827	3.31	2.31
Test 3	1.30	5.20	0.823	3.29	2.29
Test 4	1.30	5.20	0.822	3.29	2.29
Test 5	1.29	5.16	0.819	3.28	2.28
Test 6	1.30	5.20	0.826	3.30	2.28
Test 7	1.31	5.24	0.826	3.30	2.30
Test 8	1.31	5.24	0.829	3.32	2.30
Test 9	1.30	5.20	0.822	3.29	2.28
Test 10	1.31	5.24	0.822	3.29	2.33
Average Value	1.30	5.21	0.823	3.29	2.29

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

IEEE Target over $1cm^3$ (1g) of tissue: 1.23 mW/g (+/- 10%)

Averaged over 1cm (1g) of tissue: 5.21 mW/g

Averaged over 10cm (10g) of tissue: 3.29 mW/g

Test Date: 11/04/03

DUT: Dipole 450MHz; Model: D450V2; Type: System Performance Check; Serial: 136

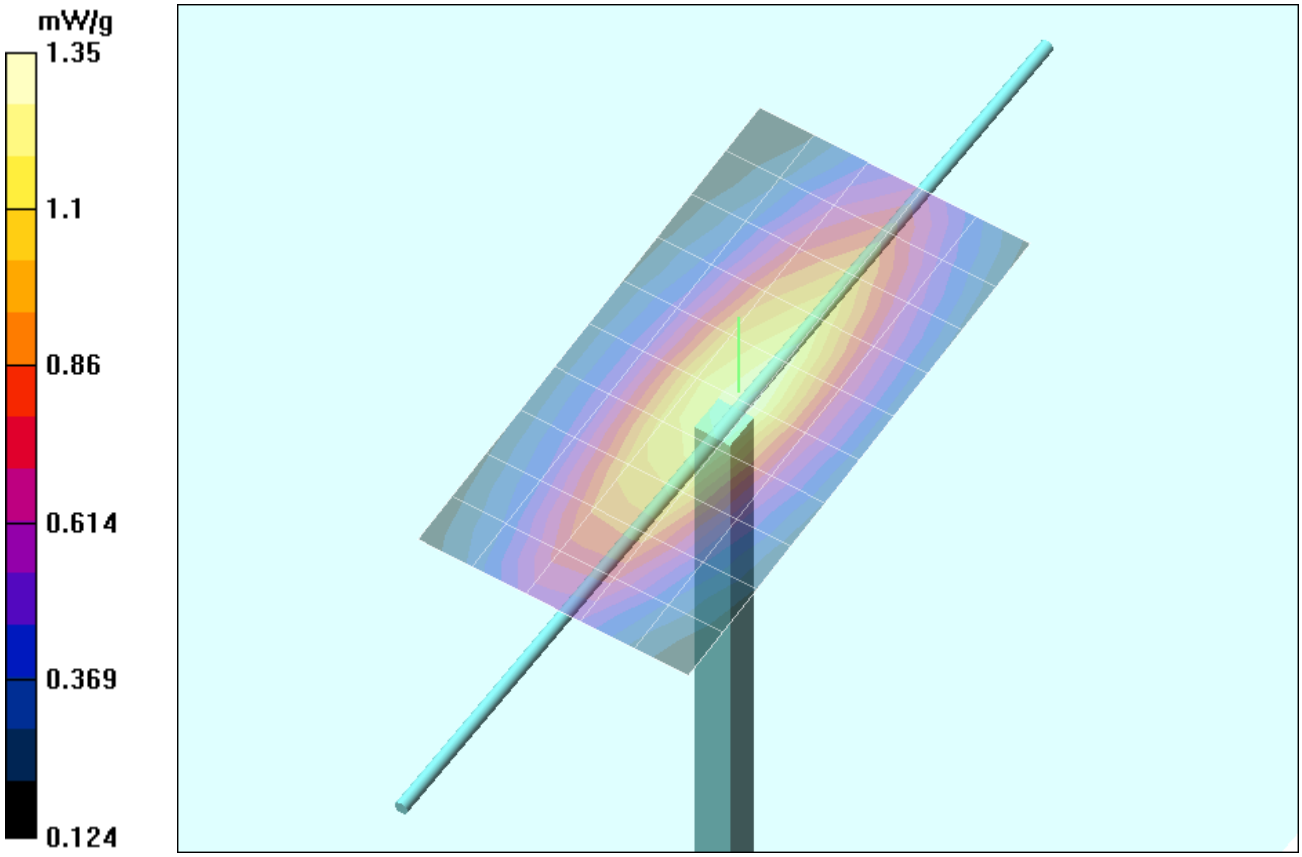
Ambient Temp: 22.1°C; Fluid Temp: 22.0°C; Barometric Pressure: 102.8 kPa; Humidity: 49%

Communication System: CW
Forward Conducted Power: 250 mW
Frequency: 450 MHz; Duty Cycle: 1:1
Medium: HSL450 (σ = 0.88 mho/m, ε_r = 43.7, ρ = 1000 kg/m^3)

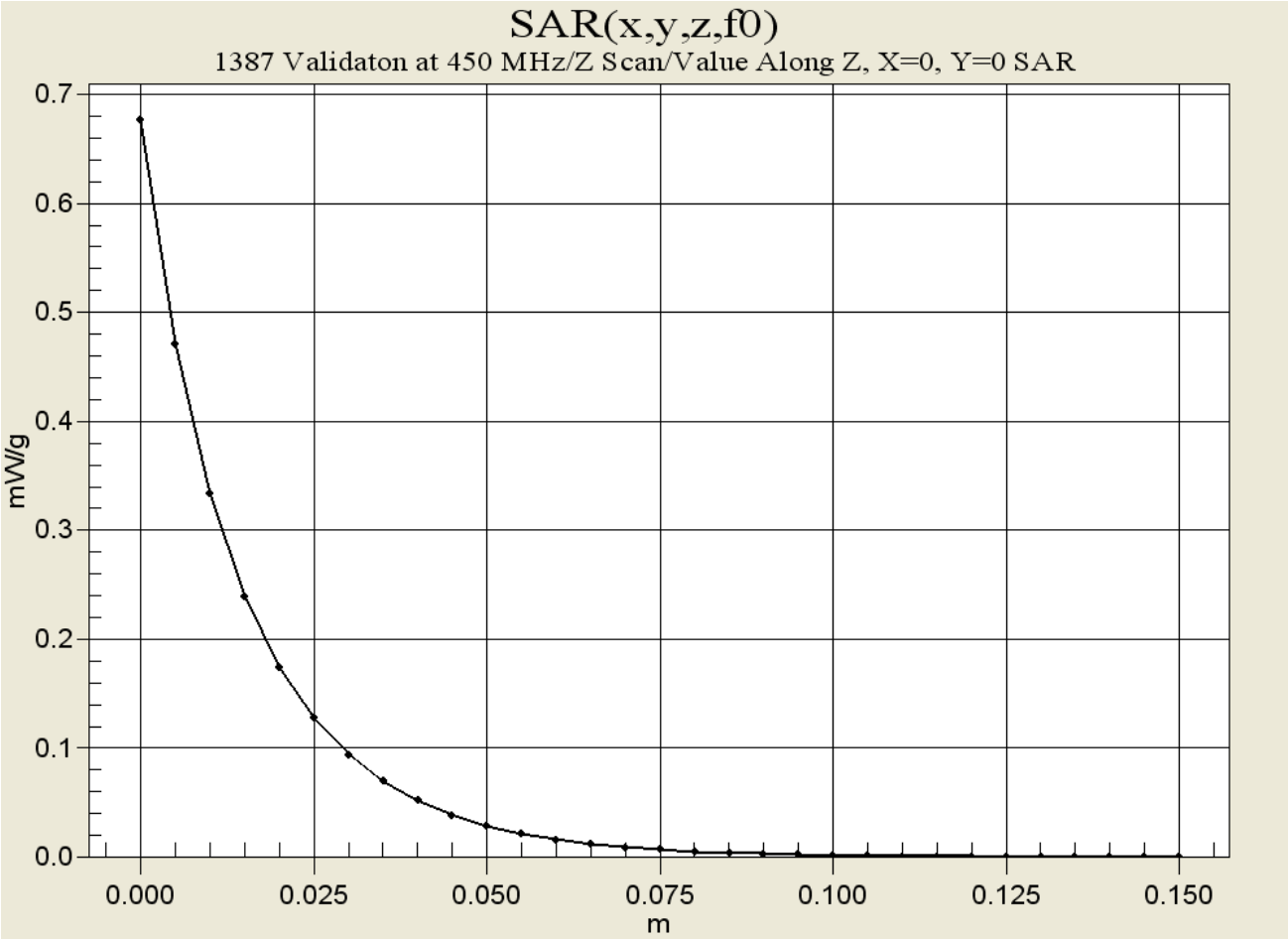
- Probe: ET3DV6 - SN1387; ConvF(7.5, 7.5, 7.5); Calibrated: 26/02/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn370; Calibrated: 19/05/2003
- Phantom: Validation Planar; Type: Plexiglas; Serial: 137
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 116

450 MHz Validation/Area Scan (6x11x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 39 V/m
Power Drift = -0.08 dB
Maximum value of SAR = 1.3 mW/g

450 MHz Validation/Zoom Scan 8 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 2.28 W/kg
SAR(1 g) = 1.3 mW/g; SAR(10 g) = 0.822 mW/g
Reference Value = 39 V/m
Power Drift = 0.08 dB



2003 Celltech Labs Inc.


SAR(x,y,z,f0)
1387 Validaton at 450 MHz/Z Scan/Value Along Z, X=0, Y=0 SAR
mW/g
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.000
0.025
0.050
0.075
0.100
0.125
0.150
m

450MHz System Validation

Measured Fluid Dielectric Parameters (Brain)

November 04, 2003

Frequency	e'	e"
350.000000 MHz	46.2660	40.8224
360.000000 MHz	45.9937	40.0986
370.000000 MHz	45.7556	39.4543
380.000000 MHz	45.5625	38.7387
390.000000 MHz	45.2820	38.1140
400.000000 MHz	45.0146	37.4981
410.000000 MHz	44.7508	36.9734
420.000000 MHz	44.5046	36.4917
430.000000 MHz	44.2494	35.9460
440.000000 MHz	43.9621	35.5647
450.000000 MHz	43.7384	35.2106
460.000000 MHz	43.5513	34.7930
470.000000 MHz	43.2846	34.3970
480.000000 MHz	43.0654	33.9576
490.000000 MHz	42.8566	33.6391
500.000000 MHz	42.6744	33.2270
510.000000 MHz	42.5036	32.8459
520.000000 MHz	42.3492	32.5261
530.000000 MHz	42.1783	32.1727
540.000000 MHz	41.9985	31.7385
550.000000 MHz	41.8097	31.4862

APPENDIX D - PROBE CALIBRATION

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

Client **Celltech**

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1387
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	March 18, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

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 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS, No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: March 18, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibrated:	February 26, 2003
Recalibrated:	March 18, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space

NormX	**1.62** μV/(V/m)^2
NormY	**1.71** μV/(V/m)^2
NormZ	**1.71** μV/(V/m)^2

Diode Compression[A]

DCP X	**92**	mV
DCP Y	**92**	mV
DCP Z	**92**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

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

Sensor Cener to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	9.3	4.4
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Sensor to Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	14.8	10.0
SAR_{be} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

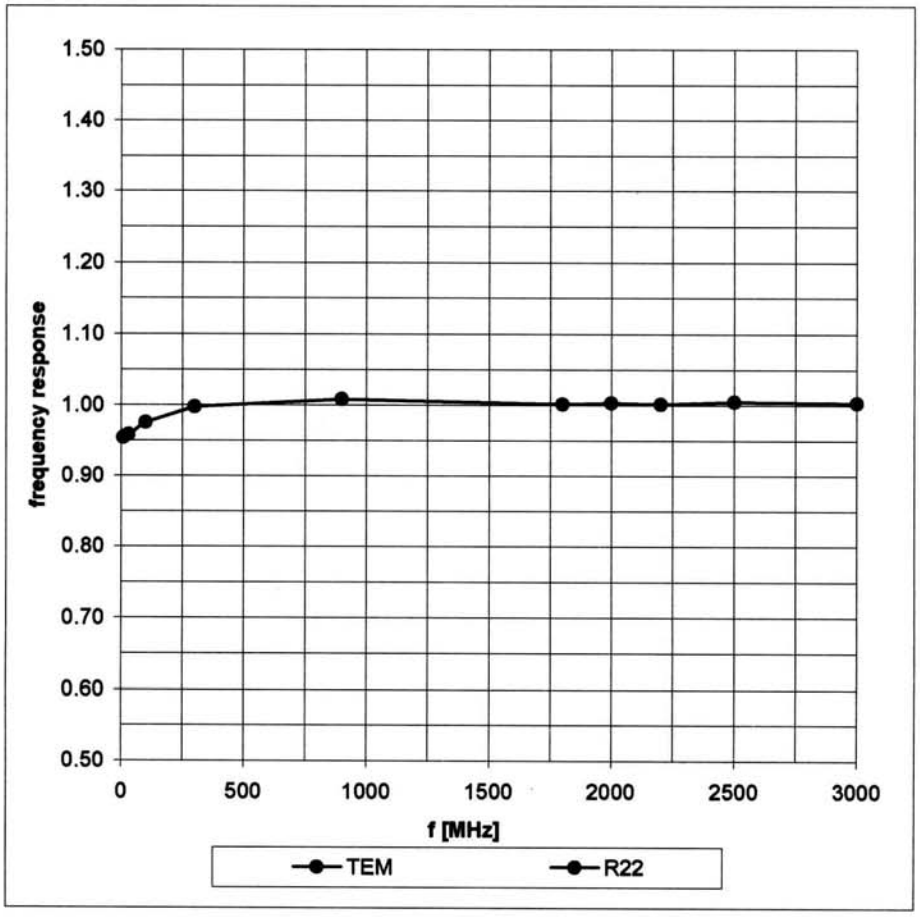
Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

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%.

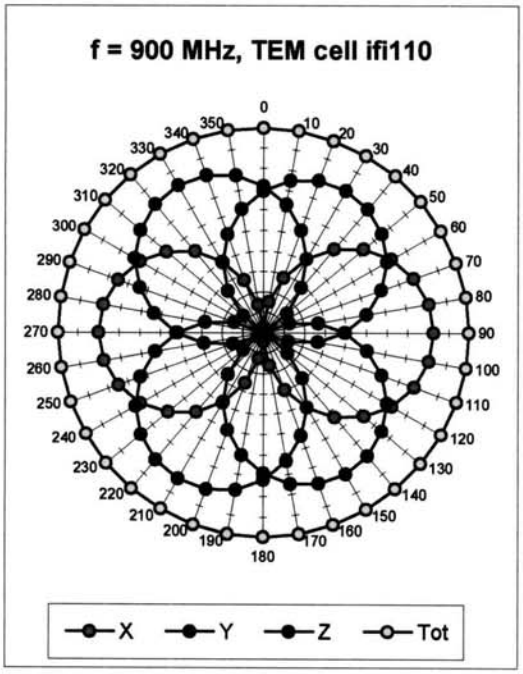
[A] numerical linearization parameter: uncertainty not required

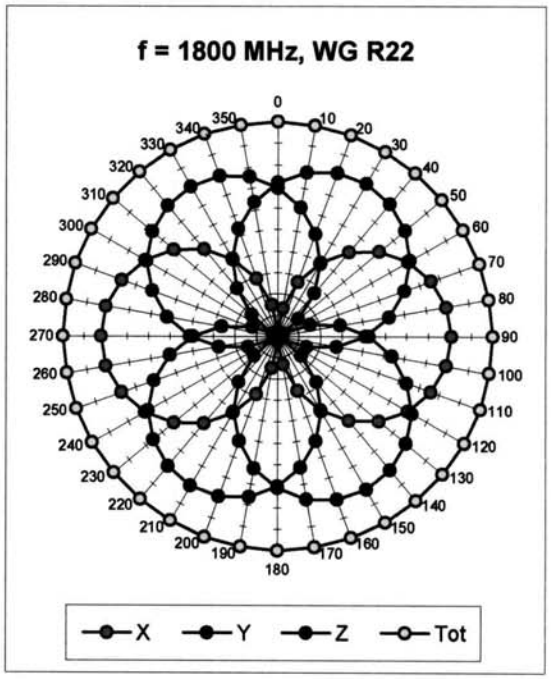
Frequency Response of E-Field

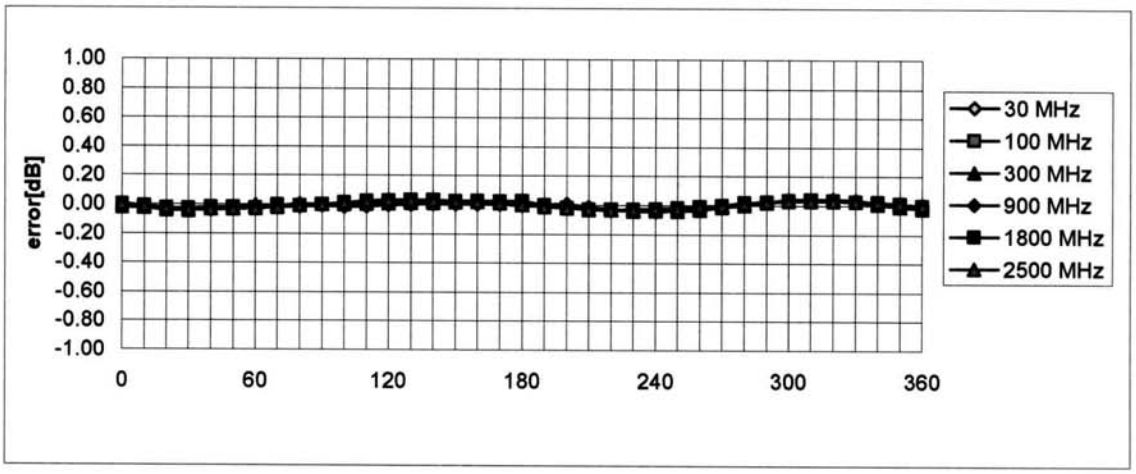
(TEM-Cell:ifi110, Waveguide R22)



Receiving Pattern (ϕ) , θ = 0°



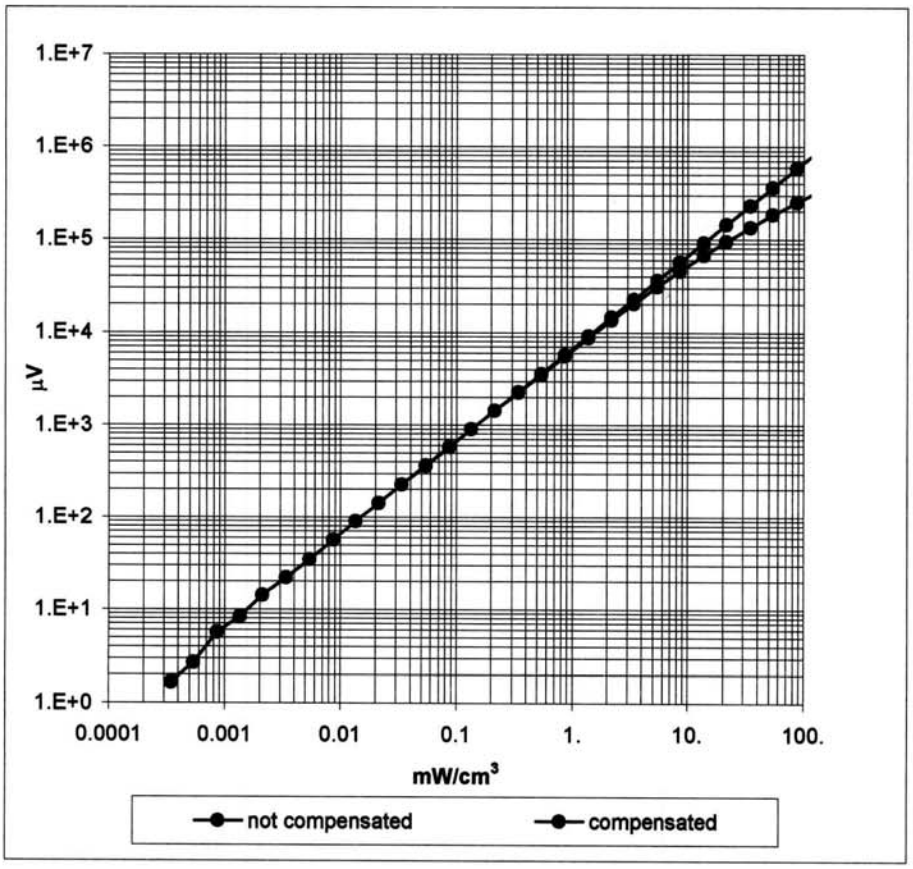


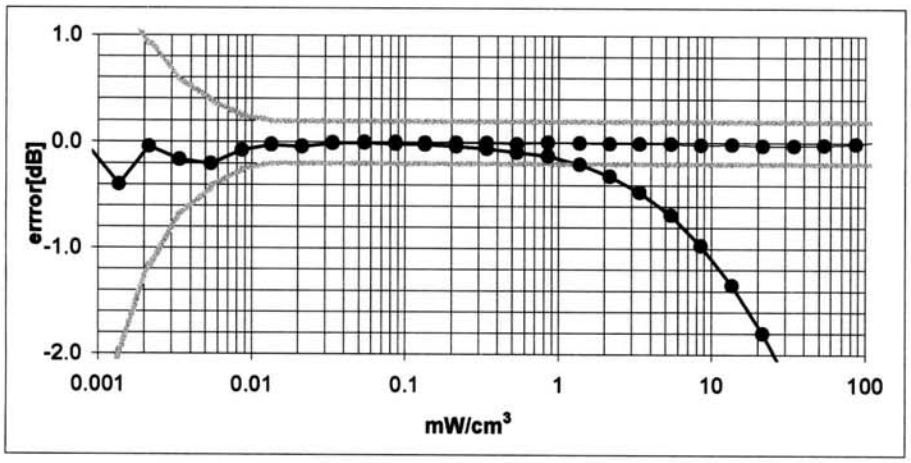


Axial Isotropy Error < ± 0.2 dB

Dynamic Range f(SAR_{head})

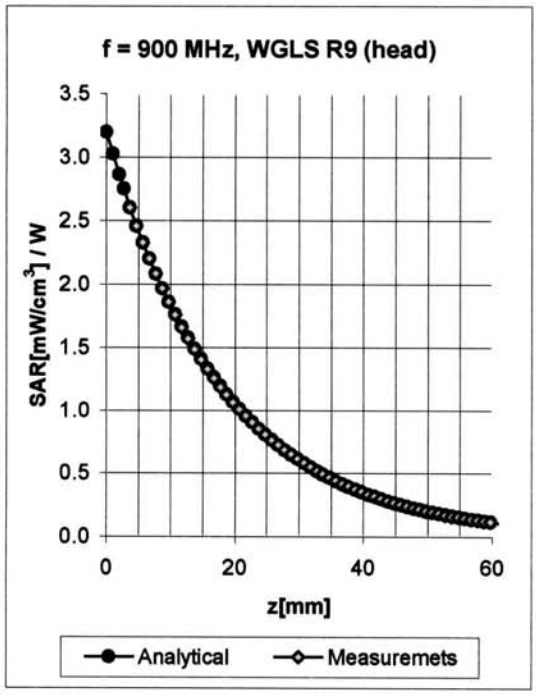
(Waveguide R22)

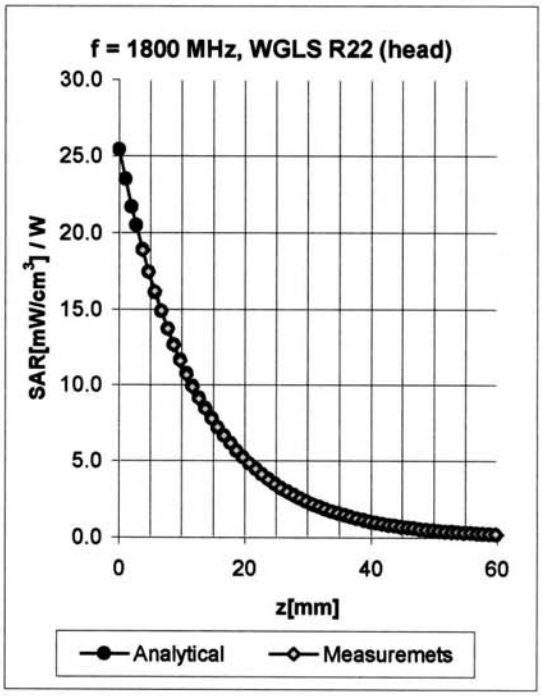




Probe Linearity < ± 0.2 dB

Conversion Factor Assessment



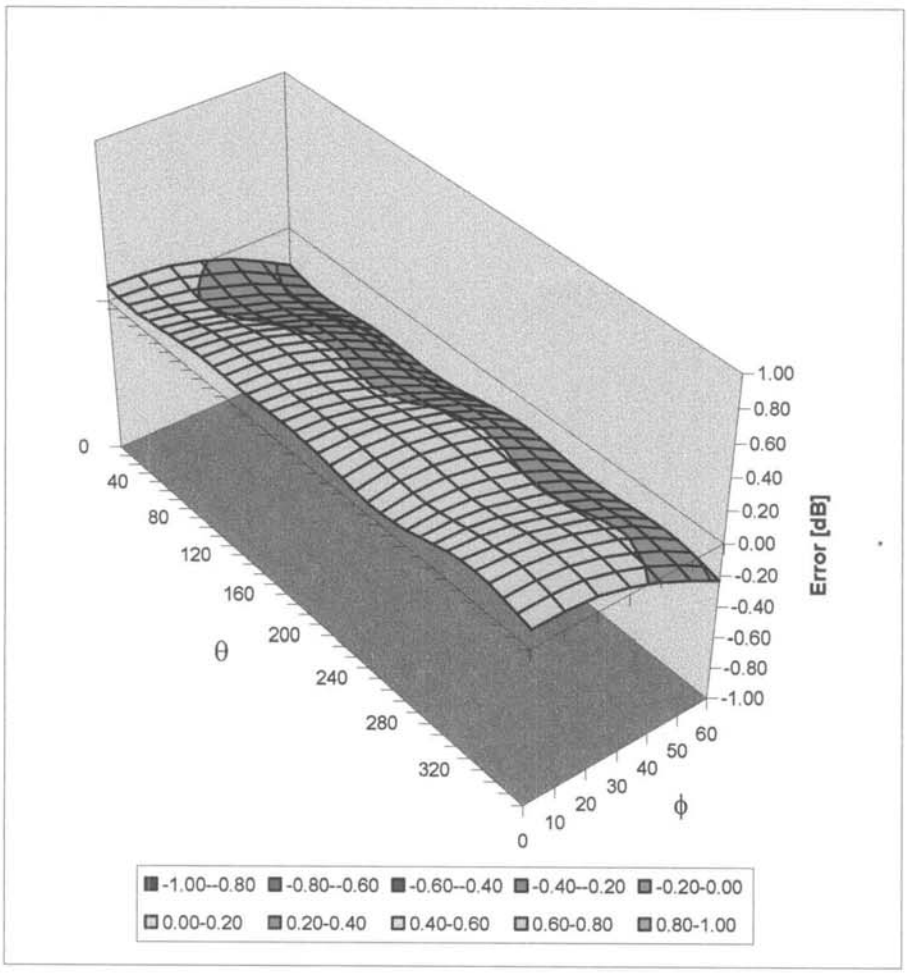


f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
835	750-950	Head	41.5 ± 5%	0.90 ± 5%	0.72	1.78	6.71	± 11.9% (k=2)
1750	1700-1800	Head	40.0 ± 5%	1.40 ± 5%	0.51	2.67	5.38	± 9.7% (k=2)
1900	1850-1950	Head	40.0 ± 5%	1.40 ± 5%	0.55	2.66	5.25	± 9.7% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	0.99	1.89	4.77	± 9.7% (k=2)
835	750-950	Body	55.2 ± 5%	0.97 ± 5%	0.56	2.04	6.24	± 11.9% (k=2)
1750	1700-1800	Body	53.3 ± 5%	1.52 ± 5%	0.58	2.82	4.68	± 9.7% (k=2)
1900	1850-1950	Body	53.3 ± 5%	1.52 ± 5%	0.62	2.77	4.57	± 9.7% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.75	1.28	4.50	± 9.7% (k=2)

[B] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

Schmid & Partner Engineering AG

s p e a g

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1387**
Place of Assessment:	**Zurich**
Date of Assessment:	**March 22, 2004**
Probe Calibration Date:	**March 18, 2004**

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:

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:1387

Conversion factor (± standard deviation)

150 MHz	ConvF	**9.1 ± 8%**	**ε_r = 52.3 ± 5%** **σ = 0.76 ± 5% mho/m** (head tissue)
300 MHz	ConvF	**7.8 ± 8%**	**ε_r = 45.3 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)
450 MHz	ConvF	**7.5 ± 8%**	**ε_r = 43.5 ± 5%** **σ = 0.87 ± 5% mho/m** (head tissue)
150 MHz	ConvF	**8.7 ± 8%**	**ε_r = 61.9 ± 5%** **σ = 0.80 ± 5% mho/m** (body tissue)
450 MHz	ConvF	**7.6 ± 8%**	**ε_r = 56.7 ± 5%** **σ = 0.94 ± 5% mho/m** (body tissue)

Important Note:

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

Please see also Section 4.7 of the DASY4 Manual.

APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

450 MHz System Performance Check

Measured Fluid Dielectric Parameters (Brain)

April 19, 2004

Frequency	e'	e"
350.000000 MHz	46.7325	41.7613
360.000000 MHz	46.3623	41.0462
370.000000 MHz	46.1174	40.3766
380.000000 MHz	45.9004	39.7494
390.000000 MHz	45.6232	39.1625
400.000000 MHz	45.4357	38.5294
410.000000 MHz	45.2626	37.9450
420.000000 MHz	45.0045	37.4205
430.000000 MHz	44.7627	36.8693
440.000000 MHz	44.4926	36.3863
450.000000 MHz	44.2577	35.9388
460.000000 MHz	44.0468	35.5260
470.000000 MHz	43.8161	35.1071
480.000000 MHz	43.5766	34.6898
490.000000 MHz	43.3372	34.3252
500.000000 MHz	43.1620	33.9821
510.000000 MHz	43.0061	33.6157
520.000000 MHz	42.8127	33.2865
530.000000 MHz	42.6141	32.8898
540.000000 MHz	42.4782	32.4968
550.000000 MHz	42.2562	32.2120

450 MHz DUT Evaluation (Body)

Measured Fluid Dielectric Parameters (Muscle)

April 19, 2004

Frequency	e'	e"
350.000000 MHz	58.9796	42.0167
360.000000 MHz	58.7334	41.2826
370.000000 MHz	58.5153	40.5815
380.000000 MHz	58.4398	39.8791
390.000000 MHz	58.1784	39.2201
400.000000 MHz	58.0601	38.5879
410.000000 MHz	57.8417	38.0644
420.000000 MHz	57.6958	37.5507
430.000000 MHz	57.4933	37.0202
440.000000 MHz	57.3627	36.5661
450.000000 MHz	57.1680	36.1433
460.000000 MHz	57.0223	35.6903
470.000000 MHz	56.8347	35.2729
480.000000 MHz	56.6866	34.8364
490.000000 MHz	56.5170	34.4385
500.000000 MHz	56.3364	34.0406
510.000000 MHz	56.2177	33.6604
520.000000 MHz	56.0215	33.3615
530.000000 MHz	55.8703	33.0798
540.000000 MHz	55.7826	32.6625
550.000000 MHz	55.6838	32.4209

450 MHz DUT Evaluation (Face)

Measured Fluid Dielectric Parameters (Brain)

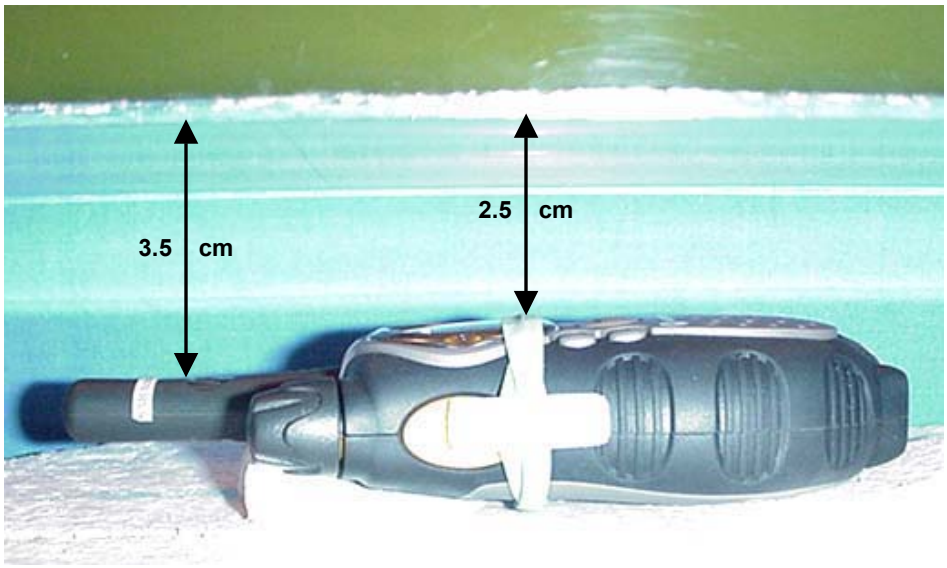
April 20, 2004

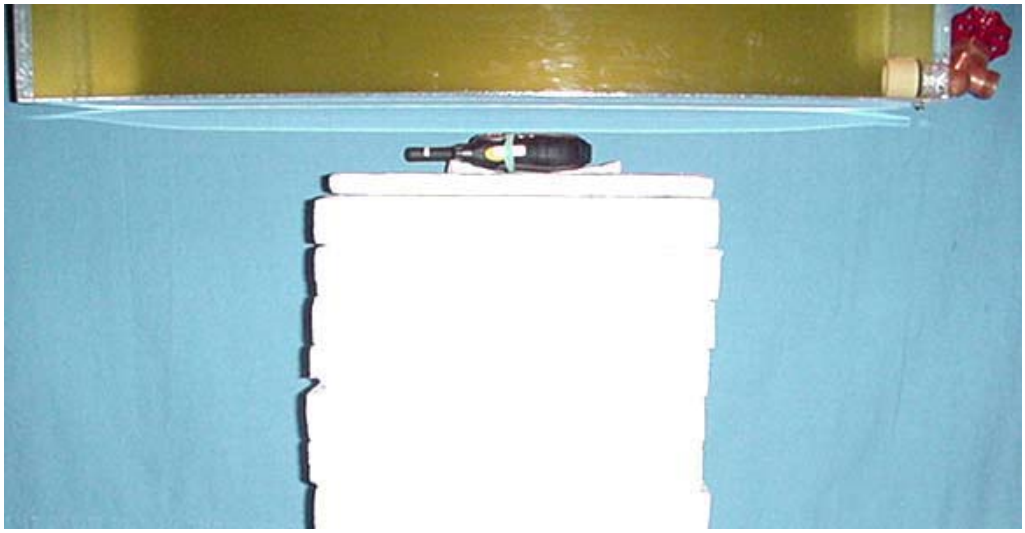
Frequency	e'	e"
350.000000 MHz	47.3861	42.2004
360.000000 MHz	47.1002	41.5282
370.000000 MHz	46.8060	40.8599
380.000000 MHz	46.5269	40.1257
390.000000 MHz	46.3412	39.5129
400.000000 MHz	46.1583	38.8664
410.000000 MHz	46.0127	38.2862
420.000000 MHz	45.7357	37.7325
430.000000 MHz	45.4438	37.1385
440.000000 MHz	45.2083	36.6500
450.000000 MHz	44.9403	36.2549
460.000000 MHz	44.7405	35.8114
470.000000 MHz	44.5452	35.3498
480.000000 MHz	44.2864	34.9983
490.000000 MHz	44.0513	34.6232
500.000000 MHz	43.8440	34.2590
510.000000 MHz	43.6197	33.9464
520.000000 MHz	43.4219	33.6418
530.000000 MHz	43.1875	33.2746
540.000000 MHz	43.0630	32.8535
550.000000 MHz	42.8263	32.5311

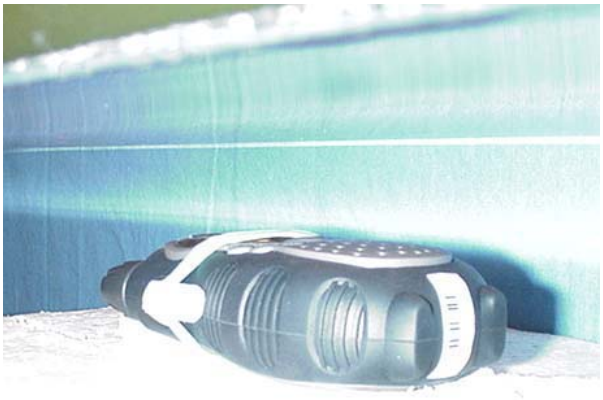
APPENDIX F - SAR TEST SETUP & DUT PHOTOGRAPHS

FACE-HELD SAR TEST SETUP PHOTOGRAPHS

2.5 cm Separation Distance from Front of Radio to Planar Phantom

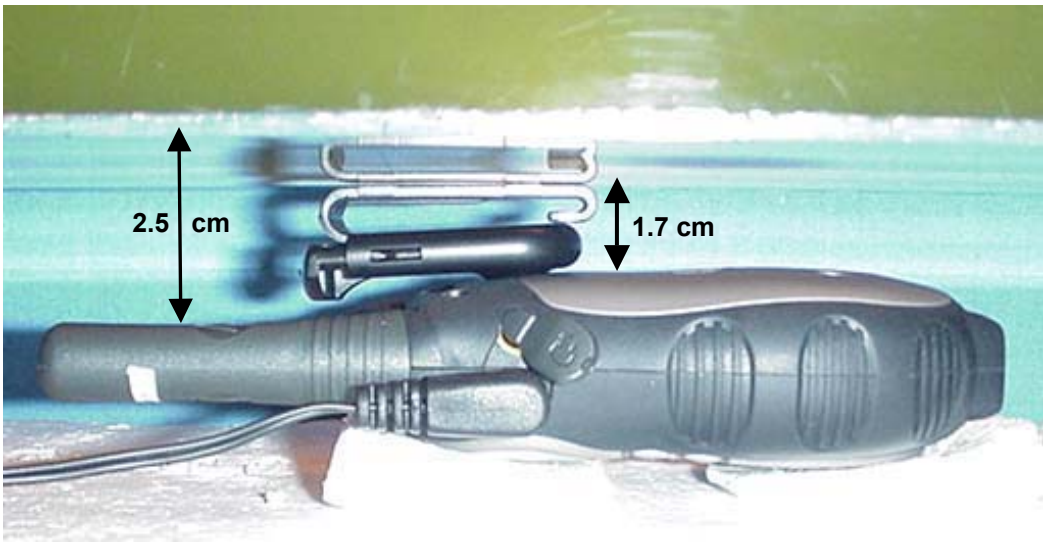






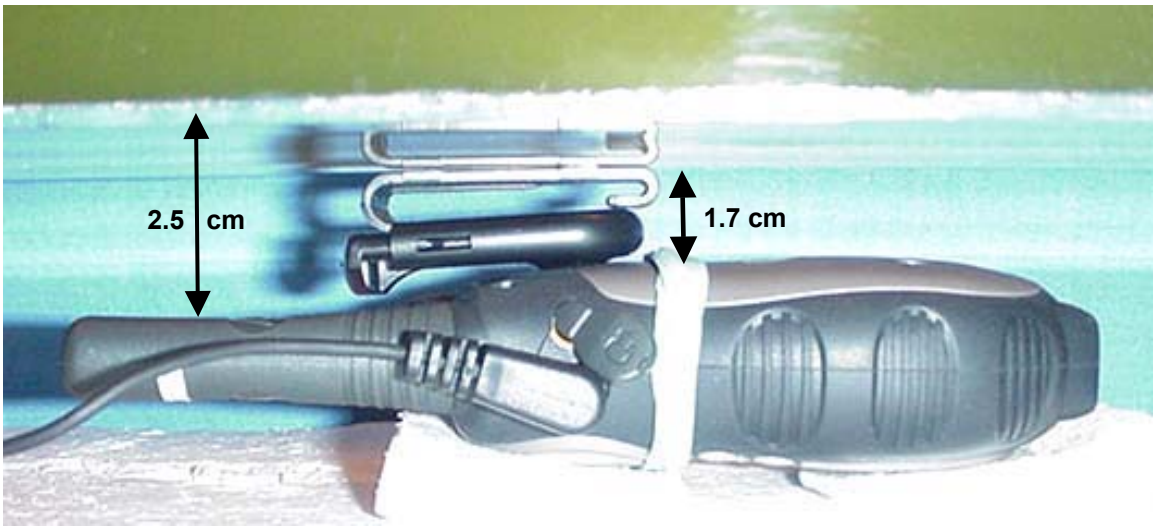
BODY-WORN SAR TEST SETUP PHOTOGRAPHS

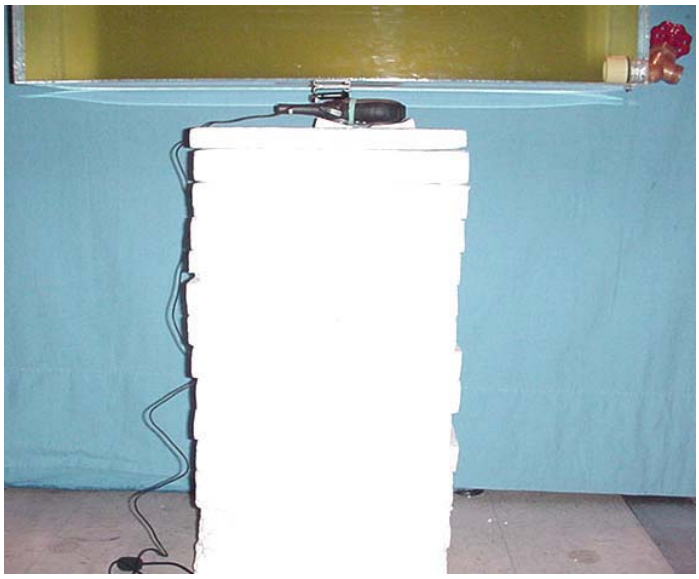
1.7 cm Plastic Swivel Belt-Clip Separation Distance to Planar Phantom with Earbud/Lapel-Microphone Accessory (P/N: NTN8870C)

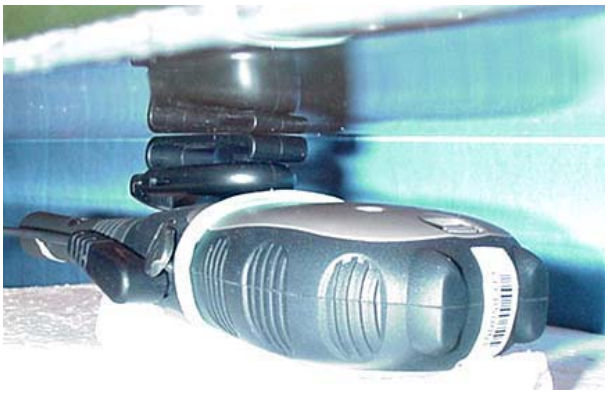


BODY-WORN SAR TEST SETUP PHOTOGRAPHS

1.7 cm Plastic Swivel Belt-Clip Separation Distance to Planar Phantom with Earpiece/Boom-Microphone Accessory (P/N: NTN9396BW)

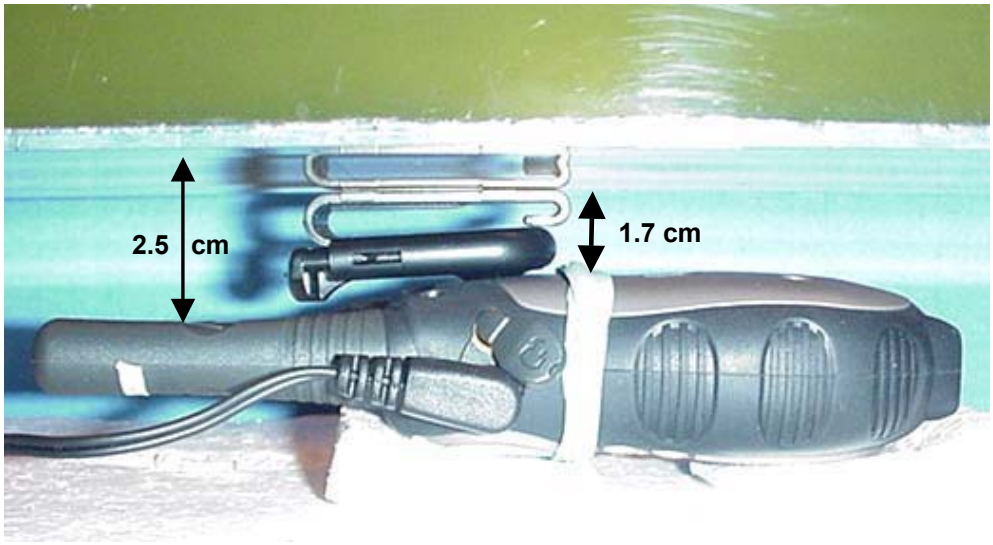






BODY-WORN SAR TEST SETUP PHOTOGRAPHS

1.7 cm Plastic Swivel Belt-Clip Separation Distance to Planar Phantom with Headset/Boom-Microphone Accessory (P/N: NTN8868B)



DUT PHOTOGRAPHS

Front of DUT

Back of DUT

Back of DUT
with Plastic Swivel Belt-Clip

Top of DUT

Bottom of DUT

DUT PHOTOGRAPHS

Left Side of DUT with Plastic Swivel Belt-Clip

Right Side of DUT with Plastic Swivel Belt-Clip

Plastic Swivel Belt-Clip Accessory (P/N: NTN9392B)

DUT PHOTOGRAPHS

DUT with Earbud/Lapel-Microphone accessory (P/N: NTN8870C)

DUT with Earpiece/Boom-Microphone accessory (P/N: NTN9396BW)

DUT with Headset/Boom-Microphone accessory (P/N: NTN8868B)

DUT PHOTOGRAPHS

DUT Battery Compartment

DUT with NiCd Battery Pack

DUT with Duracell Procell AA Alkaline Batteries

DUT with Energizer E91 AA Alkaline Batteries