
	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	

Certificate No. 2470.01

RF EXPOSURE EVALUATION

SPECIFIC ABSORPTION RATE

SAR TEST REPORT

FOR

MIDLAND RADIO CORPORATION

PORTABLE FM UHF PTT RADIO TRANSCEIVER

MODEL(S): PL5164

IDENTIFIER(S):	FCC ID: O7KPL5164	IC: 3690A-PL5164
Application:	Permissive Change	Modification
Test Standard(s) and Procedure(s)	FCC OET Bulletin 65, Supplement C (01-01)	
	Industry Canada RSS-102 Issue 2	

Test Report Serial No.

012607O7K-T814-S90U

Test Report Revision No.

Revision 1.0 (Initial Release)

Test Lab and Location

Celltech Compliance Testing & Engineering Lab
(Celltech Labs Inc.)
1955 Moss Court
Kelowna, BC
Canada
V1Y 9L3




Certificate No. 2470.01



Test Report Prepared By:

Cheri Frangiadakis
Test Report Writer
Celltech Labs Inc.

Test Report Reviewed By:

Jonathan Hughes
General Manager
Celltech Labs Inc.

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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DECLARATION OF COMPLIANCE SAR RF EXPOSURE EVALUATION

Test Lab and Location

CELLTECH LABS INCORPORATED

Testing and Engineering Services
1955 Moss Court
Kelowna, B.C.
Canada V1Y 9L3
Phone: 250-448-7047
Fax: 250-448-7046
e-mail: info@celltechlabs.com
web site: www.celltechlabs.com

Company Information

MIDLAND RADIO CORPORATION

5900 Parretta Drive
Kansas City, Missouri 64120
United States

FCC IDENTIFIER: O7KPL5164
IC IDENTIFIER: 3690A-PL5164
Device Model(s): PL5164

Test Requirement(s): FCC 47 CFR §2.1093; Health Canada Safety Code 6
Test Procedure(s): FCC OET Bulletin 65, Supplement C (Edition 01-01)
Industry Canada RSS-102 Issue 2

Device Description: Portable FM UHF PTT Radio Transceiver
Transmit Frequency Range(s): 450 - 490 MHz
Max. RF Output Power Tested: 5.0 Watts (37.0 dBm) Conducted
Antenna Type(s) Tested: Detachable Whip (Model: ACC-145)
Battery Type(s) Tested: Ni-MH 7.2 V, 1200 mAh (Model: ACC-207)

Body-Worn Accessories Tested: Plastic Belt-Clip with Metal Spring (Model: 550-070-2001)
Audio Accessories Tested: Speaker-Microphone (Model: ACC-727)

Permissive Change(s): Circuit Changes

Max. SAR Level(s) Evaluated: Face-held: 2.45 W/kg (1g) - 50% duty cycle
Body-worn: 3.39 W/kg (1g) - 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 2 for the Occupational / Controlled 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.

Test Report Approved By:

Sean Johnston
SAR Lab Manager
Celltech Labs Inc.



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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1.0 INTRODUCTION

This measurement report demonstrates continued compliance of the Midland Radio Corporation Model(s): PL5164 Portable FM UHF PTT Radio Transceiver FCC ID: O7KPL5164 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 Occupational / Controlled Exposure environment. The test procedures described in FCC OET Bulletin 65, Supplement C (Edition 01-01) (see reference [3]) and IC RSS-102 Issue 2 (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)

Test Requirement(s)	FCC Rule Part 47 CFR §2.1093			
	Health Canada Safety Code 6			
Test Procedure(s)	FCC OET Bulletin 65, Supplement C (01-01)			
	Industry Canada RSS-102 Issue 2			
Device Description	Portable FM UHF PTT Radio Transceiver			
RF Exposure Category	Occupational / Controlled Exposure			
FCC IDENTIFIER	O7KPL5164			
IC IDENTIFIER	3690A-PL5164			
Device Model(s)	PL5164			
Test Sample Serial No.	14		Identical Prototype	
Transmit Frequency Range(s)	450 - 490 MHz			
Max. RF Output Power Tested	5.0 Watts	37.0 dBm	470.0125 MHz	Conducted
Antenna Type(s) Tested	Detachable Whip		Model: ACC-145	
Battery Type(s) Tested	Ni-MH 7.2 V, 1200 mAh		Model: ACC-207	
Body-Worn Accessories Tested	Plastic Belt-Clip with Metal Spring		Model: 550-070-2001	
Audio Accessories Tested	Speaker-Microphone		Model: ACC-727	
Permissive Change(s)	Circuit Changes			

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
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3.0 SAR MEASUREMENT SYSTEM


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





DASY4 SAR Measurement System with Plexiglas validation phantom



DASY4 SAR Measurement System with Plexiglas side planar phantom

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4.0 MEASUREMENT SUMMARY

SAR EVALUATION RESULTS

Test Type	Freq.	Chan.	Test Mode	Antenna Position	Battery Type	Accessories		DUT Spacing to Planar Phantom	Cond. Power Before Test	Measured SAR 1g (W/kg)		SAR Drift During Test	Scaled SAR with droop 1g (W/kg)	
									Duty Cycle		Duty Cycle			
	MHz						Watts		100%	50%	dB	100%	50%	
Face	470.0125	Mid	CW	Fixed	Ni-MH	na	na	2.5 cm Front Side	5.0	4.66	2.33	-0.226	4.91	2.45
Body	470.0125	Mid	CW	Fixed	Ni-MH	Belt-Clip	Spkr-Mic	1.0 cm Back Side	5.0	6.34	3.17	-0.296	6.79	3.39
ANSI / IEEE C95.1 2005 - SAFETY LIMIT					BRAIN / BODY: 8.0 W/kg (averaged over 1 gram)					Spatial Peak Controlled Exposure / Occupational				
Test Date(s)		February 07, 2007			February 07, 2007				Measured Fluid Type		Brain	Body	Unit	
Dielectric Constant ϵ_r		450 MHz Brain				450 MHz Body				Atmospheric Pressure		103.4	103.4	kPa
		IEEE Target		Meas.	Dev.	IEEE Target		Meas.	Dev.	Relative Humidity		30	30	%
		43.5	± 5%	44.8	+3.0%	56.7	± 5%	57.2	+0.9%	Ambient Temperature		23.3	23.3	°C
Conductivity σ (mho/m)		450 MHz Brain				450 MHz Body				Fluid Temperature		22.5	22.0	°C
		IEEE Target		Meas.	Dev.	IEEE Target		Meas.	Dev.	Fluid Depth		≥ 15	≥ 15	cm
		0.87	± 5%	0.89	+2.3%	0.94	± 5%	0.93	-1.1%	ρ (Kg/m ³)		1000		
Note(s)		1.	The measurement results were obtained with the DUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the DUT are reported in Appendix A.											
		2.	If the SAR levels evaluated at the mid channel (50% duty cycle) were ≥ 3 dB below the SAR limit, SAR evaluation for the low and high channels was optional (per FCC OET Bulletin 65, Supplement C, Edition 01-01 - see reference [3]).											
		3.	The test configurations utilized for this Permissive Change evaluation were determined based on the maximum SAR results from the face-held and body-worn configurations evaluated during the original certification testing (Celltech Test Report Serial No.s: 112301-188O7K and 041902-244O7K). The measured conducted power levels listed in this test report are within +/- 0.5 dB from the previously measured power levels.											
		4.	The area scan evaluation was performed with a fully charged battery. After the area scan was completed the radio was cooled down and the battery was replaced with a fully charged battery prior to the zoom scan evaluation.											
		5.	The power drift of the DUT during the SAR evaluations was measured by the DASY4 system. The measured power droops were added to the measured SAR levels to report scaled SAR results as shown in the above test data table.											
		6.	A SAR-versus-Time power droop evaluation was performed in the maximum SAR configuration. See Appendix A (SAR Test Plots) for SAR-versus-Time power droop evaluation plot.											
		7.	The fluid temperature was measured prior to and after the SAR evaluations to ensure the temperature remained within +/-2°C of the fluid temperature reported during the dielectric parameter measurements.											
		8.	The dielectric parameters of the simulated tissue mixtures were measured prior to the SAR evaluations using an ALS-PR-DIEL Dielectric Probe Kit and an HP 8753ET Network Analyzer (see Appendix C).											
		9.	The SAR evaluations were performed within 24 hours of the system performance check.											

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5.0 DETAILS OF SAR EVALUATION



The Midland Radio Corporation Model(s): PL5164 Portable FM UHF PTT Radio Transceiver FCC ID: 07KPL5164 was compliant for localized Specific Absorption Rate (Occupational / Controlled Exposure) based on the test provisions and conditions described below. The detailed test setup photographs are shown in Appendix D.

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 spacing was maintained between the front of the DUT and the outer surface of the planar phantom.
2. The DUT was evaluated in a body-worn configuration with the back of the radio placed parallel to the outer surface of the planar phantom. The attached belt-clip accessory was touching the planar phantom and provided a 1.0 cm spacing from the back of the DUT to the outer surface of the planar phantom. The DUT was evaluated for body-worn SAR with the supplied speaker-microphone audio accessory connected to the audio port.
3. The conducted power level(s) of the DUT were measured prior to the SAR evaluations using a Gigatronics 8652A Universal Power Meter according to the procedures described in FCC 47 CFR §2.1046.
4. The power drift of the DUT during the SAR evaluations was measured by the DASY4 system.
5. The area scan evaluation was performed with a fully charged battery. After the area scan was completed the radio was cooled down and the battery was replaced with a fully charged battery prior to the zoom scan evaluation.
6. 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.
7. The SAR evaluations were performed using a Plexiglas side-planar phantom.

6.0 EVALUATION PROCEDURES

- (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.
- 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:
- 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:
- Extrapolation is used to find the points between the dipole center of the probe and the surface of the phantom. This data cannot be measured, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.4 mm (see probe calibration document in Appendix F). The extrapolation was based on trivariate quadratics computed from the previously calculated 3D interpolated points nearest the phantom surface.
- 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).
- A zoom scan volume of 32 mm x 32 mm x 30 mm (5 x 5 x 7 points) centered at the peak SAR location determined from the area scan is used for all zoom scans for devices with a transmit frequency < 800 MHz. Zoom scans for frequencies ≥ 800 MHz are determined with a scan volume of 30 mm x 30 mm x 30 mm (7 x 7 x 7) to ensure complete capture of the peak spatial-average SAR.

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7.0 SYSTEM PERFORMANCE CHECK

Prior to the SAR evaluations a system check was performed using a Plexiglas planar phantom and 450MHz dipole (see Appendix E for system validation procedures). The dielectric parameters of the simulated tissue mixture were measured prior to the system performance check using an ALS-PR-DIEL Dielectric Probe Kit and HP 8753ET Network Analyzer (see Appendix C). A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of $\pm 10\%$ (see Appendix B for system performance check test plot).

SYSTEM PERFORMANCE CHECK EVALUATION

Test Date	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)
	Freq. MHz	IEEE Target	Meas.	Dev.	IEEE Target	Meas.	Dev.	IEEE Target	Meas.	Dev.						
2/7/07	Brain 450	1.23 $\pm 10\%$	1.30	+5.7%	43.5 $\pm 5\%$	44.8	+3.0%	0.87 $\pm 5\%$	0.89	+2.3%	1000	23.3	22.5	≥ 15	30	103.4
Note(s)		1. The fluid temperature was measured prior to and after the SAR evaluation to ensure the temperature remained within $\pm 2^\circ\text{C}$ of the fluid temperature reported during the dielectric parameter measurements.														
		2. The SAR evaluations were performed within 24 hours of the system performance check.														

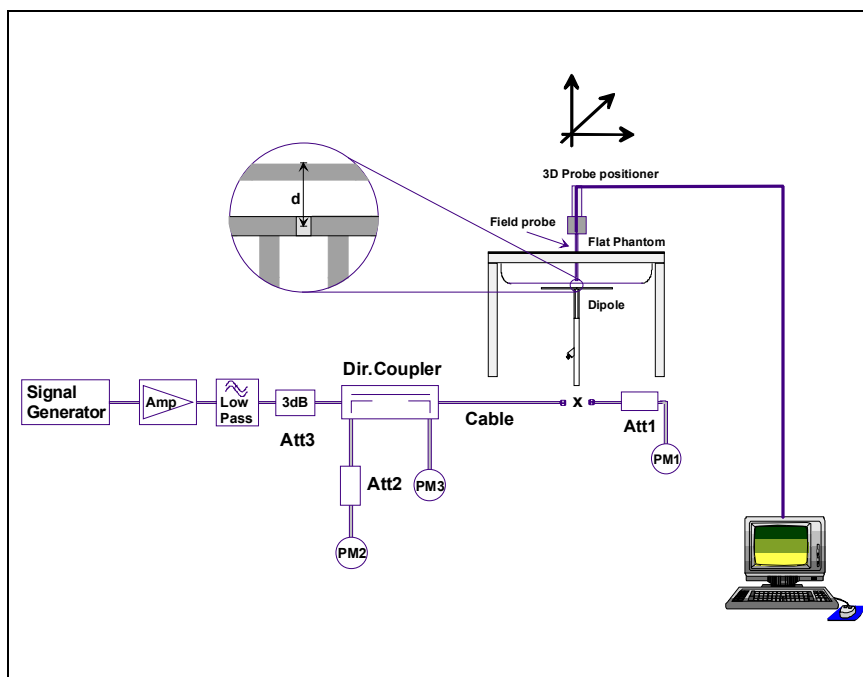





Figure 1. System Performance Check Setup Diagram



450 MHz Dipole Setup

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8.0 SIMULATED EQUIVALENT TISSUES



The 450MHz brain and body simulated tissue mixtures consisted of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution. Preservation with a bactericide was added and visual inspection made to ensure air bubbles were 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	450 MHz Brain	450 MHz Body
	System Check & DUT Evaluation	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 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0
The Spatial Average value of the SAR averaged over the whole body.		
The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.		
The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.		
Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.		
Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.		



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10.0 ROBOT SYSTEM SPECIFICATIONS

<u>Specifications</u>	
Positioner	Stäubli Unimation Corp. Robot Model: RX60L
Repeatability	0.02 mm
No. of axis	6
<u>Data Acquisition Electronic (DAE) System</u>	
<u>Cell Controller</u>	
Processor	AMD Athlon XP 2400+
Clock Speed	2.0 GHz
Operating System	Windows XP Professional
<u>Data Converter</u>	
Features	Signal Amplifier, multiplexer, A/D converter, and control logic
Software	Measurement Software: DASY4, V4.7 Build 44
	Postprocessing Software: SEMCAD, V1.8 Build 171
Connecting Lines	Optical downlink for data and status info.; Optical uplink for commands and clock
<u>DASY4 Measurement Server</u>	
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
<u>E-Field Probe</u>	
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)
<u>Phantom(s)</u>	
<u>Evaluation Phantom</u>	
Type	Side 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)
<u>Validation Phantom (≤ 450MHz)</u>	
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)


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11.0 PROBE SPECIFICATION (ET3DV6)

<p>Construction: Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, glycol)</p> <p>Calibration: In air from 10 MHz to 2.5 GHz In brain simulating tissue at frequencies of 900 MHz and 1.8 GHz (accuracy $\pm 8\%$)</p> <p>Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)</p> <p>Directivity: ± 0.2 dB in brain tissue (rotation around probe axis) ± 0.4 dB in brain tissue (rotation normal to probe axis)</p> <p>Dynamic Range: 5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB</p> <p>Surface Detect: ± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces</p> <p>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</p> <p>Application: General dosimetry up to 3 GHz Compliance tests of mobile phone</p>	
ET3DV6 E-Field Probe	


12.0 SIDE PLANAR PHANTOM


<p>The side planar phantom is constructed of Plexiglas material with a 2.0 mm shell thickness for face-held and body-worn SAR evaluations of portable radio transceivers. The side planar phantom is mounted on the side of the DASY4 compact system table.</p>	
Side Planar Phantom	



13.0 VALIDATION PLANAR PHANTOM

<p>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 to the table of the DASY4 compact system.</p>	
Validation Planar Phantom	

14.0 DEVICE HOLDER


<p>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.</p>	
Device Holder	



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	
				Certificate No. 2470.01

15.0 TEST EQUIPMENT LIST

TEST EQUIPMENT		ASSET NO.	SERIAL NO.	DATE CALIBRATED		CALIBRATION DUE DATE
USED	DESCRIPTION					
x	Schmid & Partner DASY4 System	-	-	-		-
x	-DASY4 Measurement Server	00158	1078	N/A		N/A
x	-Robot	00046	599396-01	N/A		N/A
x	-DAE4	00019	353	21Jun06		21Jun07
x	-ET3DV6 E-Field Probe	00016	1387	16Mar06		16Mar07
	-EX3DV4 E-Field Probe	00213	3600	24Jan07		24Jan08
	-300MHz Validation Dipole	00023	135	23Oct06		23Oct07
x	-450MHz Validation Dipole	00024	136	07Dec06		07Dec07
	-835MHz Validation Dipole	00022	411	Brain	28Mar06	28Mar07
				Body	18Jan07	18Jan08
	-900MHz Validation Dipole	00020	054	Brain	06Jun06	06Jun07
				Body	06Jun06	06Jun07
	-1640MHz Validation Dipole	00212	0175	Brain	14Aug06	14Aug07
	-1800MHz Validation Dipole	00021	247	Brain	08Jun06	08Jun07
				Body	09Jun06	09Jun07
	-1900MHz Validation Dipole	00032	151	Brain	09Jun06	09Jun07
				Body	02Feb07	02Feb08
	-2450MHz Validation Dipole	00025	150	Body	24Apr06	24Apr07
	-SAM Phantom V4.0C	00154	1033	N/A		N/A
	-Barski Planar Phantom	00155	03-01	N/A		N/A
x	-Plexiglas Side Planar Phantom	00156	161	N/A		N/A
x	-Plexiglas Validation Planar Phantom	00157	137	N/A		N/A
x	ALS-PR-DIEL Dielectric Probe Kit	00160	260-00953	N/A		N/A
x	Gigatronics 8652A Power Meter	00110	1835801	12Apr06		12Apr07
	Gigatronics 8652A Power Meter	00008	1835267	22Jan07		22Jan08
	Gigatronics 80701A Power Sensor	00012	1834350	22Jan07		22Jan08
x	Gigatronics 80701A Power Sensor	00014	1833699	22Jan07		22Jan08
x	HP 8753ET Network Analyzer	00134	US39170292	18Apr06		18Apr07
	HP 8648D Signal Generator	00005	3847A00611	N/A		N/A
	Rohde & Schwarz SMR40 Signal Generator	00006	100104	06Apr06		06Apr07
x	Amplifier Research 5S1G4 Power Amplifier	00106	26235	N/A		N/A
	HP E4408B Spectrum Analyzer	00015	US39240170	05Feb07		05Feb08
	Anritsu Radio Communication Analyzer	00208	6200241241	06Jun06		06Jun07


Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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				Certificate No. 2470.01

16.0 MEASUREMENT UNCERTAINTIES

UNCERTAINTY BUDGET FOR DEVICE EVALUATION						
Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	ci 1g	Uncertainty Value ±% (1g)	V _i or V _{eff}
Measurement System						
Probe calibration (450 MHz)	8.0	Normal	1	1	8.0	∞
Axial isotropy of the probe	4.7	Rectangular	1.732050808	0.7	1.9	∞
Spherical isotropy of the probe	9.6	Rectangular	1.732050808	0.7	3.9	∞
Spatial resolution	0	Rectangular	1.732050808	1	0.0	∞
Boundary effects	1	Rectangular	1.732050808	1	0.6	∞
Probe linearity	4.7	Rectangular	1.732050808	1	2.7	∞
Detection limit	1	Rectangular	1.732050808	1	0.6	∞
Readout electronics	0.3	Normal	1	1	0.3	∞
Response time	0.8	Rectangular	1.732050808	1	0.5	∞
Integration time	2.6	Rectangular	1.732050808	1	1.5	∞
RF ambient conditions	3	Rectangular	1.732050808	1	1.7	∞
Mech. constraints of robot	0.4	Rectangular	1.732050808	1	0.2	∞
Probe positioning	2.9	Rectangular	1.732050808	1	1.7	∞
Extrapolation & integration	1	Rectangular	1.732050808	1	0.6	∞
Test Sample Related						
Device positioning	2.9	Normal	1	1	2.9	12
Device holder uncertainty	3.6	Normal	1	1	3.6	8
Power drift	5	Rectangular	1.732050808	1	2.9	∞
Phantom and Setup						
Phantom uncertainty	4	Rectangular	1.732050808	1	2.3	∞
Liquid conductivity (target)	5	Rectangular	1.732050808	0.64	1.8	∞
Liquid conductivity (measured)	5	Normal	1	0.64	3.2	∞
Liquid permittivity (target)	5	Rectangular	1.732050808	0.6	1.7	∞
Liquid permittivity (measured)	5	Normal	1	0.6	3.0	∞
Combined Standard Uncertainty					12.65	
Expanded Uncertainty (k=2)					25.31	

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


Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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MEASUREMENT UNCERTAINTIES (Cont.)

UNCERTAINTY BUDGET FOR SYSTEM VALIDATION						
Error Description	Uncertainty Value ±%	Probability Distribution	Divisor	ci 1g	Uncertainty Value ±% (1g)	V _i or V _{eff}
Measurement System						
Probe calibration (450 MHz)	8.0	Normal	1	1	8.0	∞
Axial isotropy of the probe	4.7	Rectangular	1.732050808	1	2.7	∞
Spherical isotropy of the probe	0	Rectangular	1.732050808	1	0.0	∞
Spatial resolution	0	Rectangular	1.732050808	1	0.0	∞
Boundary effects	1	Rectangular	1.732050808	1	0.6	∞
Probe linearity	4.7	Rectangular	1.732050808	1	2.7	∞
Detection limit	1	Rectangular	1.732050808	1	0.6	∞
Readout electronics	0.3	Normal	1	1	0.3	∞
Response time	0	Rectangular	1.732050808	1	0.0	∞
Integration time	0	Rectangular	1.732050808	1	0.0	∞
RF ambient conditions	3	Rectangular	1.732050808	1	1.7	∞
Mech. constraints of robot	0.4	Rectangular	1.732050808	1	0.2	∞
Probe positioning	2.9	Rectangular	1.732050808	1	1.7	∞
Extrapolation & integration	1	Rectangular	1.732050808	1	0.6	∞
Test Sample Related						
Dipole Positioning	2	Normal	1.732050808	1	1.2	∞
Power & Power Drift	4.7	Normal	1.732050808	1	2.7	∞
Phantom and Setup						
Phantom uncertainty	4	Rectangular	1.732050808	1	2.3	∞
Liquid conductivity (target)	5	Rectangular	1.732050808	0.64	1.8	∞
Liquid conductivity (measured)	5	Normal	1	0.64	3.2	∞
Liquid permittivity (target)	5	Rectangular	1.732050808	0.6	1.7	∞
Liquid permittivity (measured)	5	Normal	1	0.6	3.0	∞
Combined Standard Uncertainty					11.20	
Expanded Uncertainty (k=2)					22.39	


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



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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				Certificate No. 2470.01

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: 1999.
- [3] Federal Communications Commission - "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C.: June 2001.
- [4] Industry Canada - "Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)", Radio Standards Specification RSS-102 Issue 2: November 2005.
- [5] IEEE Standard 1528-2003 - "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques": December 2003.
- [6] ANSI/IEEE C95.1-2005 - "American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz", New York: IEEE, April 2006.



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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APPENDIX A - SAR MEASUREMENT DATA

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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				Certificate No. 2470.01

Date Tested: 02/07/2007

Face-Held SAR - Mid Channel - 470.0125 MHz

DUT: Midland; Model: PL5164; Type: Portable FM UHF PTT Radio Transceiver; Serial: 14

Ambient Temp: 23.3°C; Fluid Temp: 22.5°C; Barometric Pressure: 103.4 kPa; Humidity: 30%

7.2 V 1200 mAh Ni-MH Battery

Communication System: FM UHF

RF Output Power: 5.0 Watts (Conducted)

Frequency: 470.0125 MHz; Duty Cycle: 1:1

Medium: HSL450 Medium parameters used: $f = 470.0125 \text{ MHz}$; $\sigma = 0.89 \text{ mho/m}$; $\epsilon_r = 44.8$; $\rho = 1000 \text{ kg/m}^3$

- Probe: ET3DV6 - SN1387; ConvF(7.4, 7.4, 7.4); Calibrated: 16/03/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Side Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Face-Held SAR - 2.5 cm Spacing from Front of DUT to Planar Phantom - Mid Channel

Area Scan (8x21x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Face-Held SAR - 2.5 cm Spacing from Front of DUT to Planar Phantom - Mid Channel

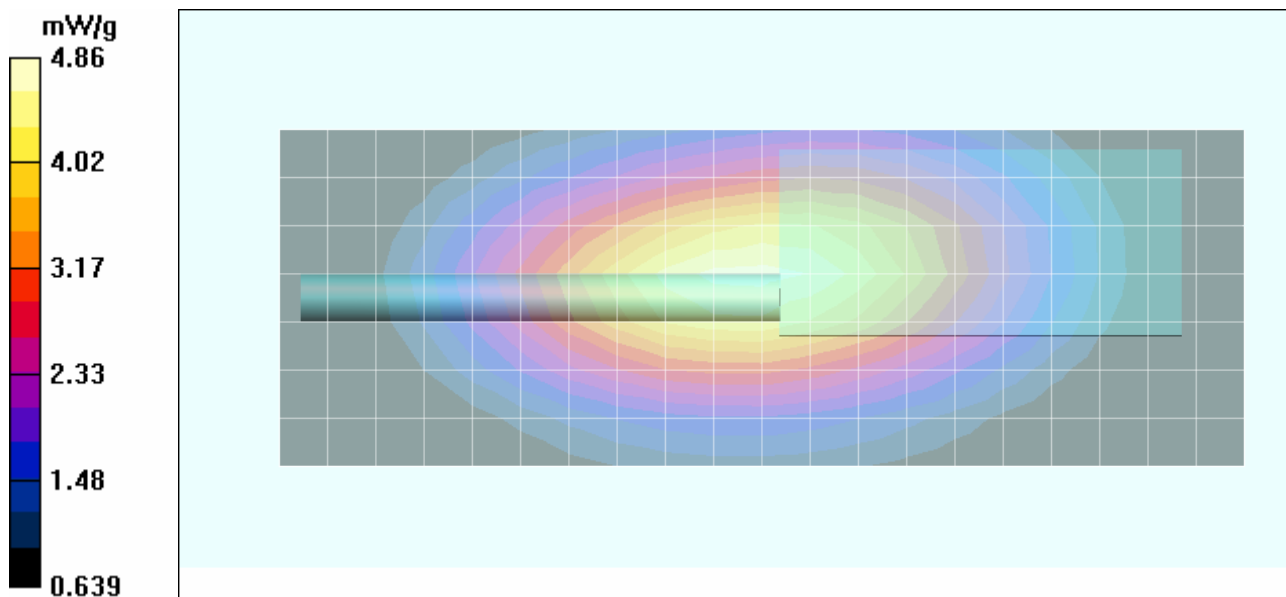
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5\text{mm}$, $dy=7.5\text{mm}$, $dz=5\text{mm}$


Reference Value = 71.4 V/m; Power Drift = -0.226 dB

Peak SAR (extrapolated) = 7.36 W/kg

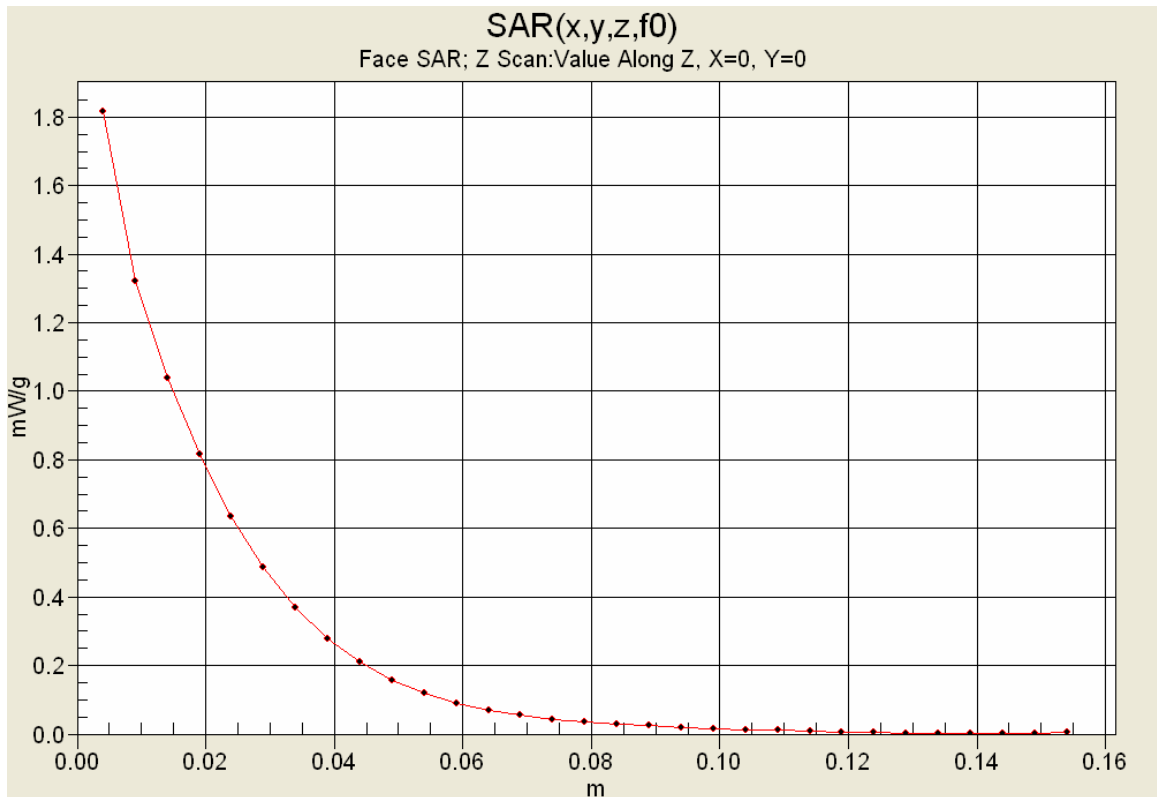
SAR(1 g) = 4.66 mW/g; SAR(10 g) = 3.29 mW/g



Maximum value of SAR (measured) = 4.86 mW/g



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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Z-Axis Scan



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Date Tested: 02/07/2007

Body-Worn SAR - Mid Channel - 470.0125 MHz

DUT: Midland; Model: PL5164; Type: Portable FM UHF PTT Radio Transceiver; Serial: 14

Body-Worn Accessory: Belt-Clip (550-070-2001); Audio Accessory: Speaker-Microphone (ACC-727)

Ambient Temp: 23.3°C; Fluid Temp: 22.0°C; Barometric Pressure: 103.4 kPa; Humidity: 30%

7.2 V 1200 mAh Ni-MH Battery

Communication System: FM UHF

RF Output Power: 5.0 Watts (Conducted)

Frequency: 470.0125 MHz; Duty Cycle: 1:1

Medium: M450 Medium parameters used: $f = 470.0125 \text{ MHz}$; $\sigma = 0.93 \text{ mho/m}$; $\epsilon_r = 57.2$; $\rho = 1000 \text{ kg/m}^3$

- Probe: ET3DV6 - SN1387; ConvF(7.3, 7.3, 7.3); Calibrated: 16/03/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Side Planar; Type: Plexiglas; Serial: 161
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Body-Worn SAR - 1.0 cm Belt-Clip Spacing from Back of DUT to Planar Phantom - Mid Channel

Area Scan (8x21x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Body-Worn SAR - 1.0 cm Belt-Clip Spacing from Back of DUT to Planar Phantom - Mid Channel

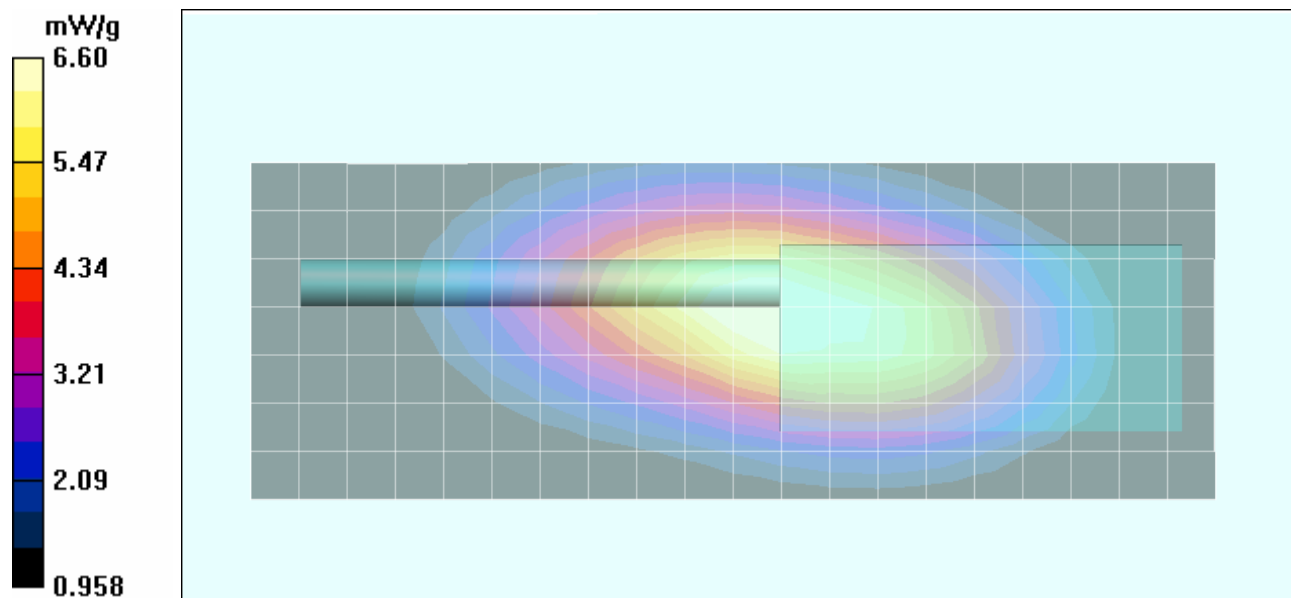
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=7.5\text{mm}$, $dy=7.5\text{mm}$, $dz=5\text{mm}$


Reference Value = 83.8 V/m; Power Drift = -0.296 dB

Peak SAR (extrapolated) = 9.96 W/kg

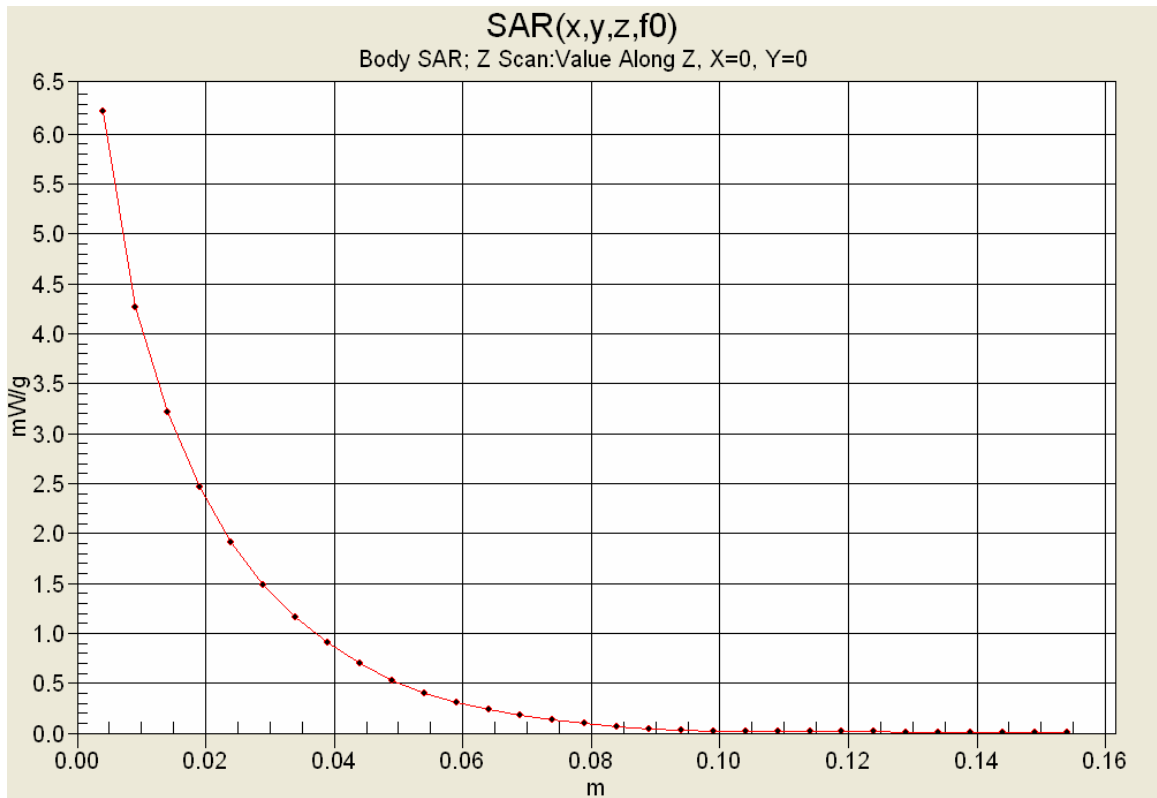
SAR(1 g) = 6.34 mW/g; SAR(10 g) = 4.5 mW/g



Maximum value of SAR (measured) = 6.60 mW/g



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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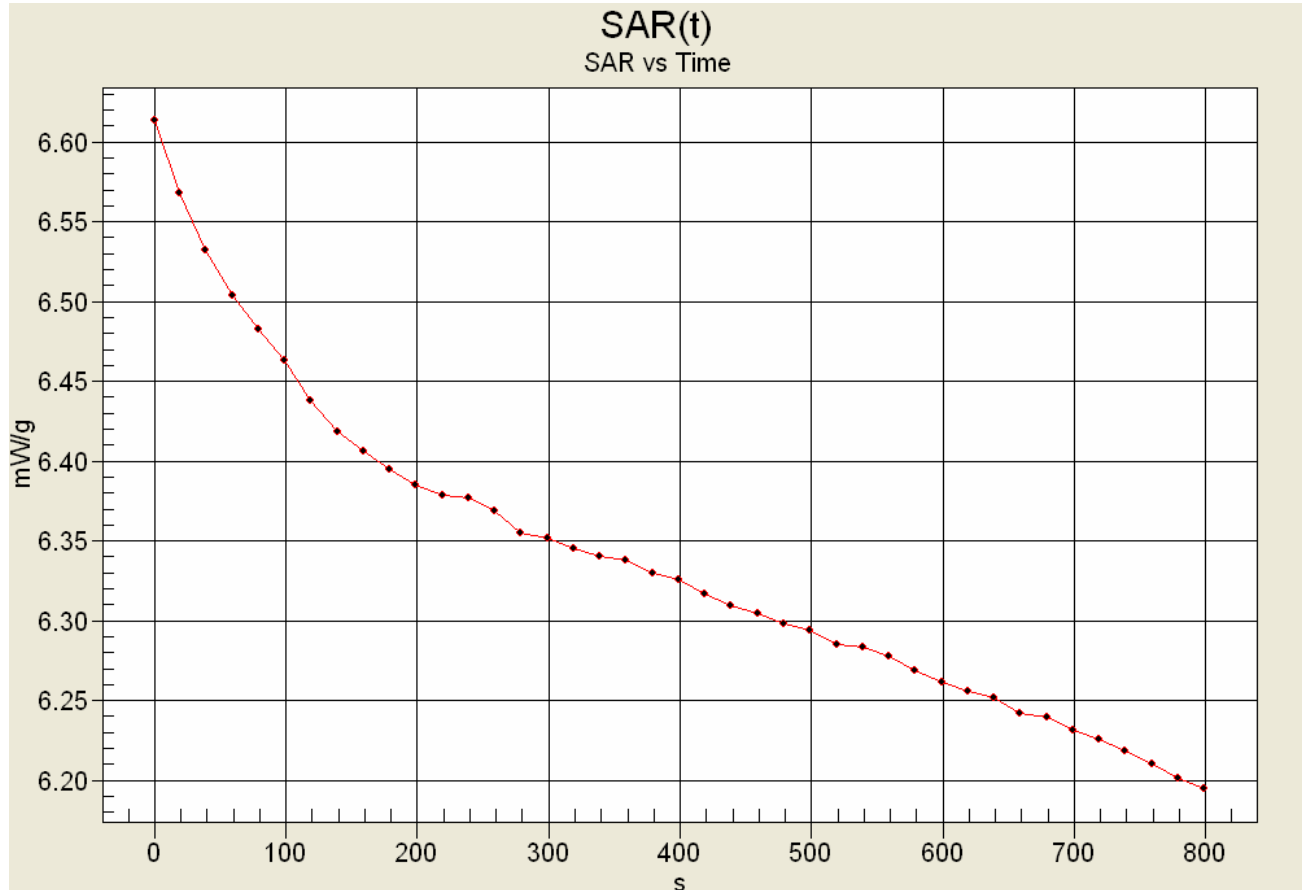


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SAR- versus-Time Power Droop Evaluation

Body-Worn Configuration
Ni-MH Battery Pack
Detachable Whip Antenna
Mid Channel - 470.0125 MHz




Max. SAR: 6.613 mW/g
Min. SAR: 6.195 mW/g (-2.84 dB)
SAR after 340s: 6.341 mW/g (-0.182 dB)
(340s = Zoom Scan Duration)
(800s = Area Scan Duration)



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
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APPENDIX B - SYSTEM PERFORMANCE CHECK DATA

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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				Certificate No. 2470.01

Date Tested: 02/07/2007

System Performance Check - 450 MHz Dipole

DUT: Dipole 450 MHz; Asset: 00024; Serial: 136; Validation: 12/07/2006

Ambient Temp: 23.3°C; Fluid Temp: 22.5°C; Barometric Pressure: 103.4 kPa; Humidity: 30%

Communication System: CW

Forward Conducted Power: 250 mW

Frequency: 450 MHz; Duty Cycle: 1:1

Medium: HSL450 Medium parameters used: $f = 450 \text{ MHz}$; $\sigma = 0.89 \text{ mho/m}$; $\epsilon_r = 44.8$; $\rho = 1000 \text{ kg/m}^3$

- Probe: ET3DV6 - SN1387; ConvF(7.4, 7.4, 7.4); Calibrated: 16/03/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Validation Planar; Type: Plexiglas; Serial: 137
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

450 MHz Dipole - System Performance Check/Area Scan (6x11x1):

Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

450 MHz Dipole - System Performance Check/Zoom Scan (5x5x7)/Cube 0:

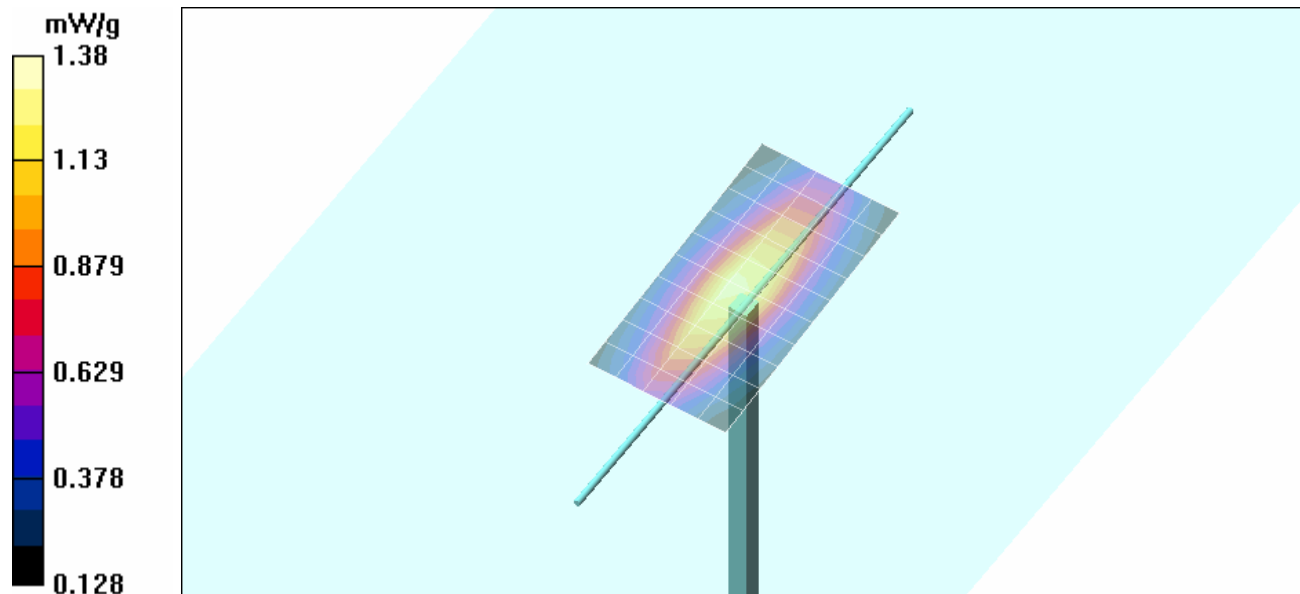
Measurement grid: $dx=7.5\text{mm}$, $dy=7.5\text{mm}$, $dz=5\text{mm}$


Reference Value = 39.3 V/m; Power Drift = -0.028 dB

Peak SAR (extrapolated) = 2.29 W/kg

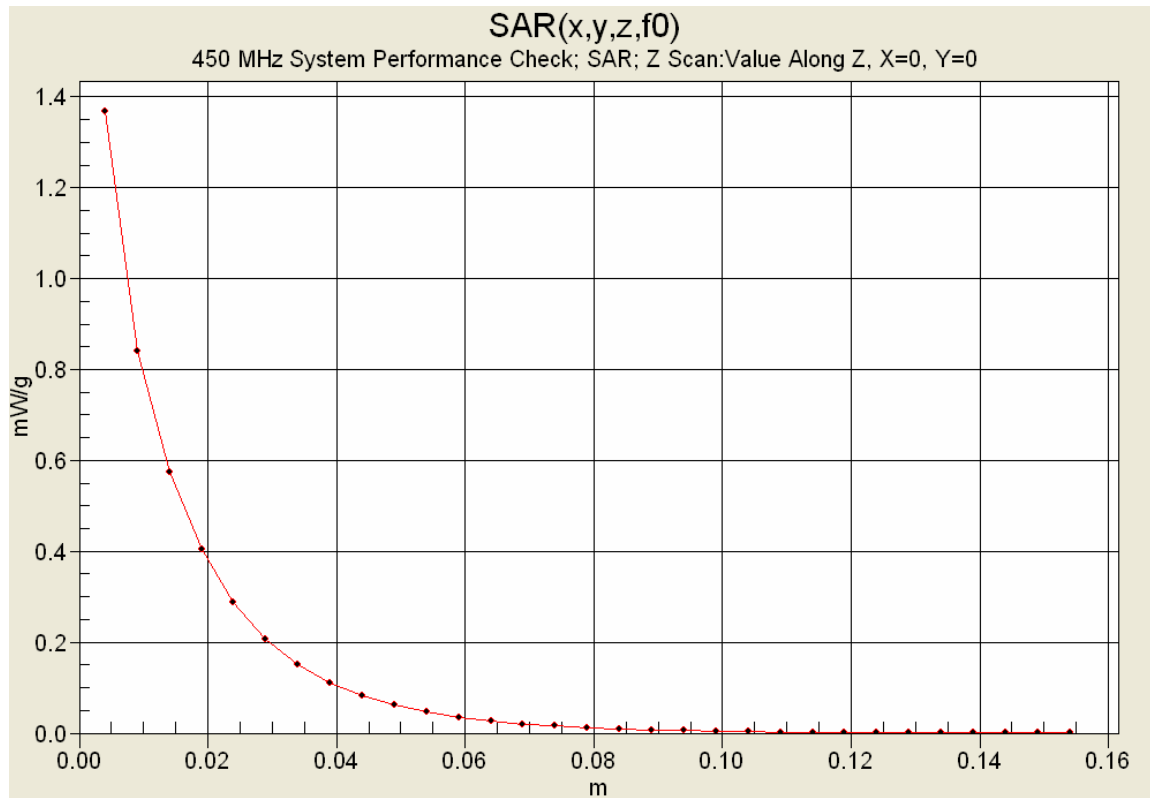
SAR(1 g) = 1.30 mW/g; SAR(10 g) = 0.830 mW/g



Maximum value of SAR (measured) = 1.38 mW/g



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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Z-Axis Scan





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Certificate No. 2470.01

APPENDIX C - MEASURED FLUID DIELECTRIC PARAMETERS

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	
				Certificate No. 2470.01

450 MHz System Performance Check & DUT Evaluation (Brain)

Celltech Labs Inc.

Test Result for UIM Dielectric Parameter

Wed 07/Feb/2007

Frequency (GHz)


FCC_eHFCC OET 65 Supplement C (June 2001) Limits for Head Epsilon



FCC_sHFCC OET 65 Supplement C (June 2001) Limits for Head Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	FCC_eHFCC	sH	Test_e	Test_s
0.3500	44.70	0.87	47.16	0.81
0.3600	44.58	0.87	47.03	0.82
0.3700	44.46	0.87	46.57	0.83
0.3800	44.34	0.87	46.50	0.84
0.3900	44.22	0.87	46.14	0.85
0.4000	44.10	0.87	45.83	0.85
0.4100	43.98	0.87	45.73	0.86
0.4200	43.86	0.87	45.40	0.87
0.4300	43.74	0.87	45.08	0.88
0.4400	43.62	0.87	44.89	0.89
0.4500	43.50	0.87	44.75	0.89
0.4600	43.45	0.87	44.59	0.92
0.4700	43.40	0.87	44.38	0.91
0.4800	43.34	0.87	44.06	0.92
0.4900	43.29	0.87	43.97	0.93
0.5000	43.24	0.87	43.57	0.94
0.5100	43.19	0.87	43.46	0.95
0.5200	43.14	0.88	43.43	0.96
0.5300	43.08	0.88	42.97	0.96
0.5400	43.03	0.88	42.94	0.97
0.5500	42.98	0.88	42.65	0.98


Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	
				Certificate No. 2470.01

450 MHz DUT Evaluation (Body)

Celltech Labs Inc.
Test Result for UIM Dielectric Parameter
Wed 07/Feb/2007
Frequency (GHz)
FCC_eHFCC Bulletin 65 Supplement C (June 2001) Limits for Head Epsilon
FCC_sHFCC Bulletin 65 Supplement C (June 2001) Limits for Head Sigma
FCC_eB FCC Limits for Body Epsilon
FCC_sB FCC Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM


Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.3500	57.70	0.93	58.83	0.85
0.3600	57.60	0.93	58.91	0.86
0.3700	57.50	0.93	58.63	0.87
0.3800	57.40	0.93	58.38	0.88
0.3900	57.30	0.93	58.34	0.89
0.4000	57.20	0.93	57.99	0.90
0.4100	57.10	0.93	57.90	0.90
0.4200	57.00	0.94	57.81	0.91
0.4300	56.90	0.94	57.47	0.92
0.4400	56.80	0.94	57.75	0.93
0.4500	56.70	0.94	57.15	0.93
0.4600	56.66	0.94	57.46	0.94
0.4700	56.62	0.94	57.20	0.95
0.4800	56.58	0.94	56.99	0.95
0.4900	56.54	0.94	57.07	0.97
0.5000	56.51	0.94	56.68	0.97
0.5100	56.47	0.94	56.88	0.98
0.5200	56.43	0.95	56.54	0.98
0.5300	56.39	0.95	56.16	1.00
0.5400	56.35	0.95	55.98	1.00
0.5500	56.31	0.95	56.04	1.01



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	

Certificate No. 2470.01

APPENDIX D - SAR TEST SETUP & DUT PHOTOGRAPHS

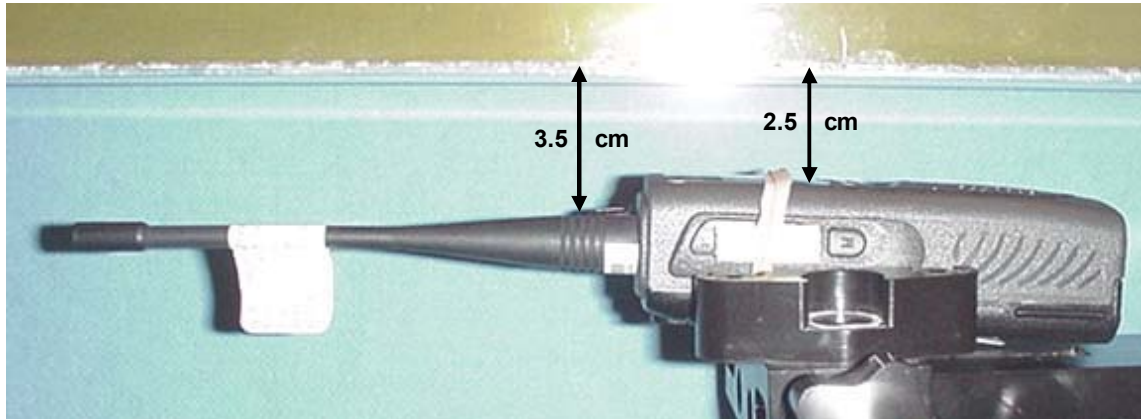
Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	



Certificate No. 2470.01

FACE-HELD SAR TEST SETUP PHOTOGRAPHS

2.5 cm Spacing from Front of DUT to Planar Phantom



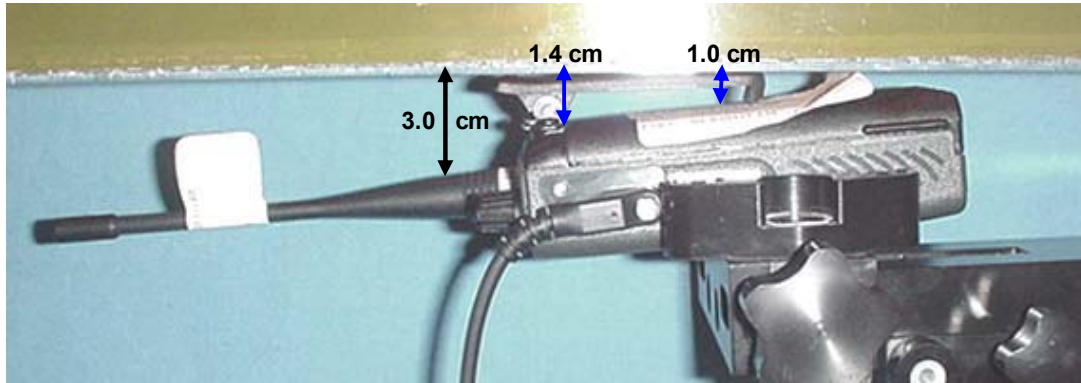
Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver	450 - 490 MHz		
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	



Certificate No. 2470.01

BODY-WORN SAR TEST SETUP PHOTOGRAPHS

1.0 cm Belt-Clip Spacing from Back of DUT to Planar Phantom
With Speaker-Microphone Audio Accessory



Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	
				Certificate No. 2470.01

DUT PHOTOGRAPHS



Front of DUT



Back of DUT




Back of DUT with Belt-Clip





Top end of DUT



Bottom end of DUT

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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 Testing and Engineering Services Ltd	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	 Certificate No. 2470.01
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	

DUT PHOTOGRAPHS



Left Side of DUT with Belt-Clip (Plastic with Metal Spring)




Right Side of DUT with Belt-Clip (Plastic with Metal Spring)





DUT Battery Compartment



Ni-MH Battery Pack


Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	
				Certificate No. 2470.01

DUT PHOTOGRAPHS




DUT with Speaker-Microphone Audio Accessory


Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	

Certificate No. 2470.01

APPENDIX E - SYSTEM VALIDATION

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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	Date of Evaluation:	December 07, 2006	Document Issue No.:	SV450B-120706-R1.0
	Evaluation Type:	System Validation	Validation Dipole:	450 MHz
			Fluid Type:	Brain

450 MHz SYSTEM VALIDATION

Type:

450 MHz Validation Dipole

Asset Number:

00024

Serial Number:

136

Place of Validation:

Celltech Labs Inc.

Date of Validation:

December 07, 2006

Celltech Labs Inc. hereby certifies that the system validation was performed on the date indicated above.

Validated by:



Approved by:

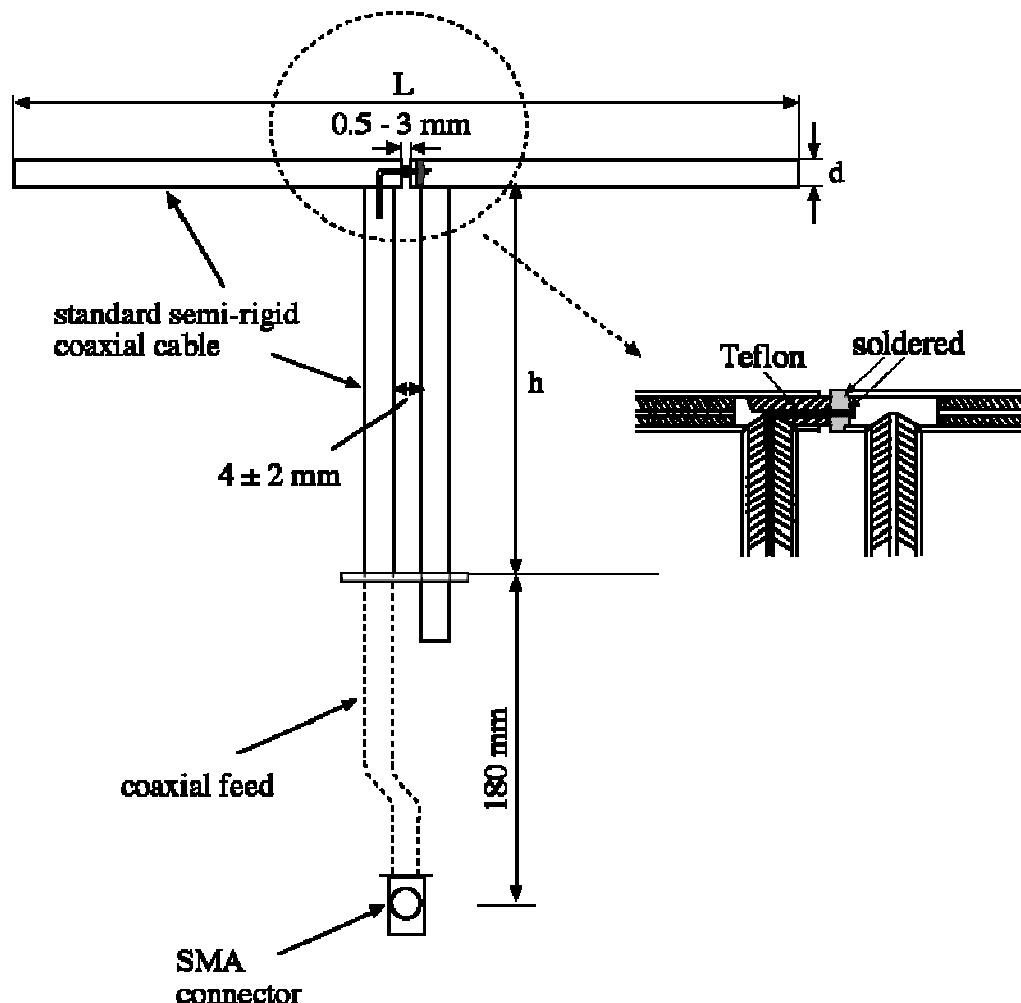


1. Dipole Construction & Electrical Characteristics

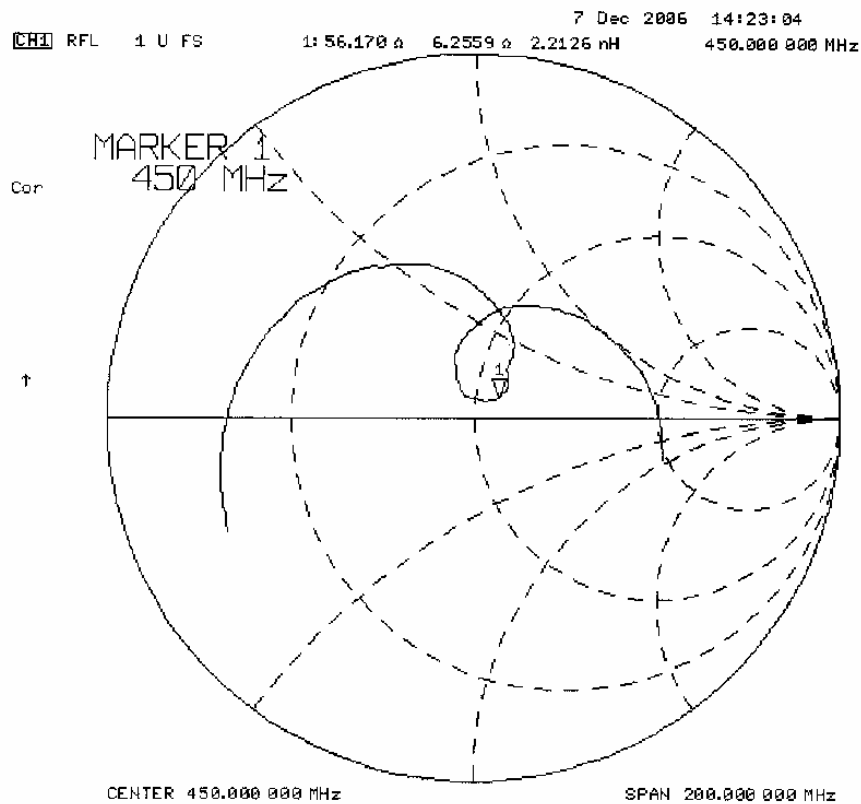
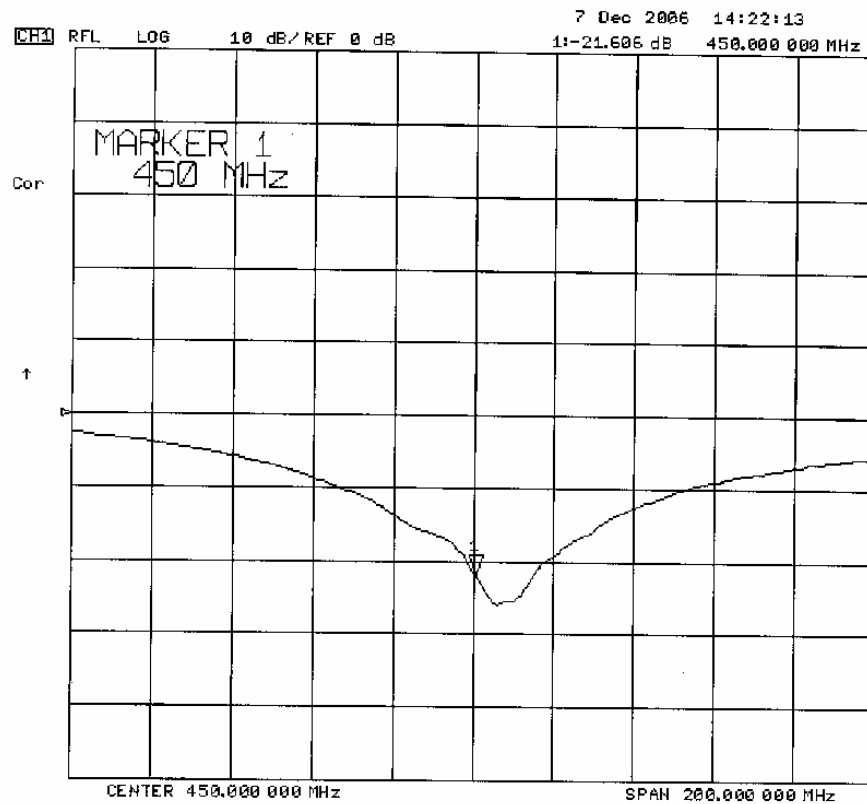
The validation dipole was constructed in accordance with the IEEE Std “Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”. The electrical properties were measured using an HP 8753ET Network 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 $\text{Re}\{Z\} = 56.170\Omega$
 $\text{Im}\{Z\} = 6.2559\Omega$

Return Loss at 450MHz -21.606dB



2. Validation Dipole VSWR Data



3. Validation Dipole Dimensions

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

4. Validation Phantom

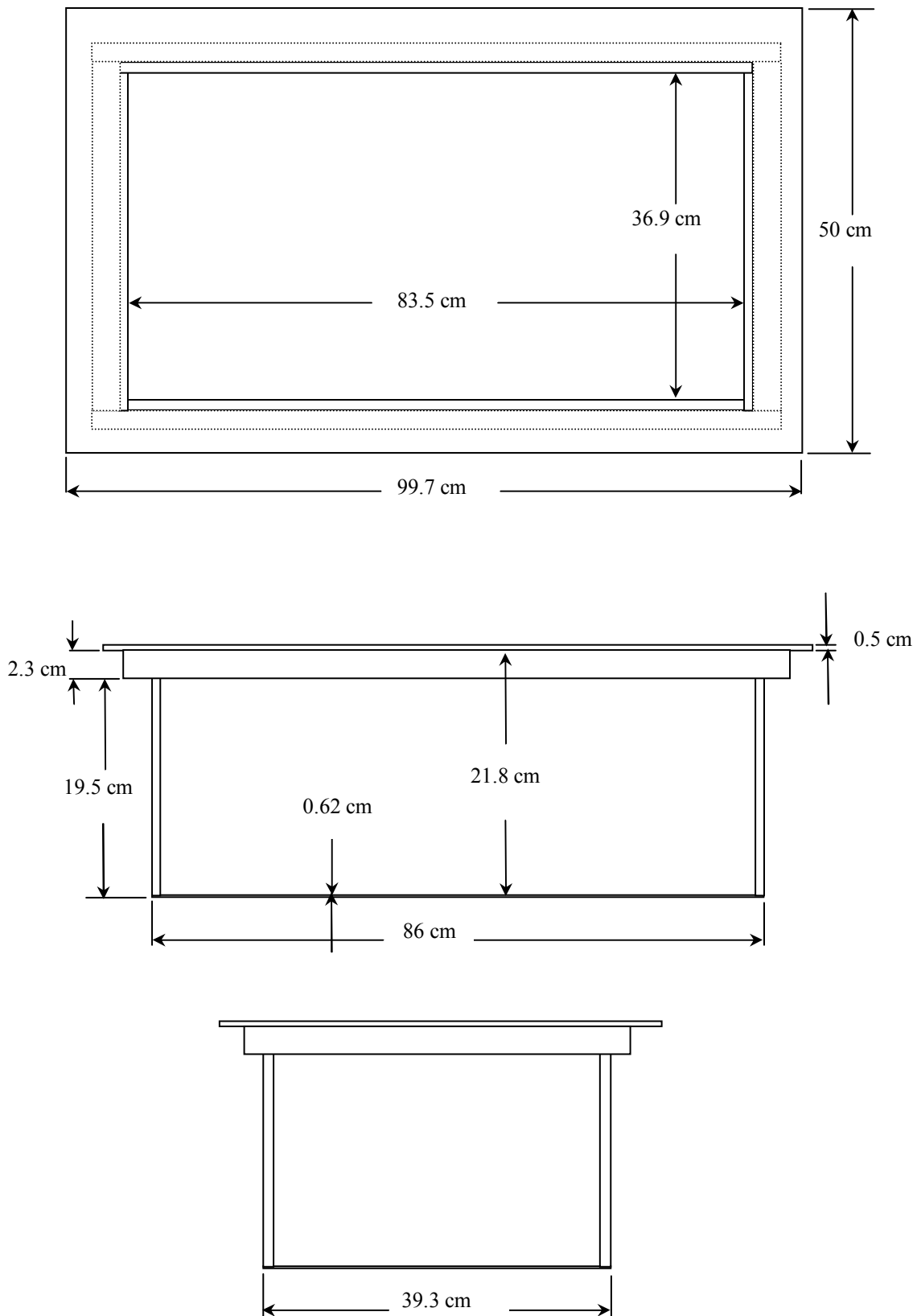
The validation phantom was constructed using relatively low-loss tangent Plexiglas material.

The inner dimensions of the validation 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 ± 0.1 mm Plexiglas.

5. Dimensions of Plexiglas Planar Phantom



6. 450 MHz System Validation Setup



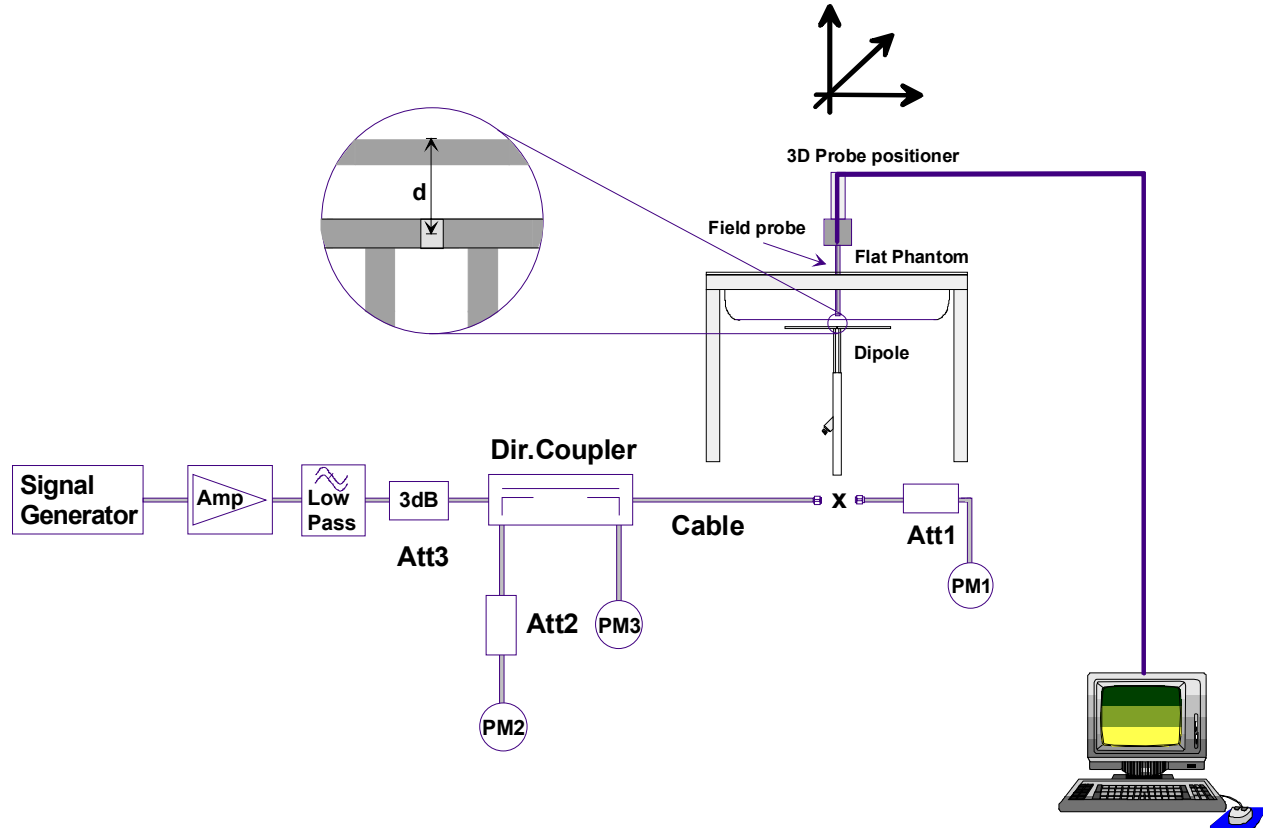
	Date of Evaluation:		December 07, 2006	Document Issue No.:		SV450B-120706-R1.0	
	Evaluation Type:	System Validation	Validation Dipole:	450 MHz	Fluid Type:	Brain	

7. 450 MHz Validation Dipole Setup



8. SAR Measurement

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



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

9. Measurement Conditions

The planar phantom was filled with 450 MHz brain tissue simulant:

Relative Permittivity: 44.7 (+2.8% deviation from target)
 Conductivity: 0.90 mho/m (+3.4% deviation from target)
 Fluid Temperature: 23.3°C
 Fluid Depth: ≥ 15.0 cm

Environmental Conditions:


Ambient Temperature: 24.0°C
 Humidity: 33 %
 Barometric Pressure: 102.1kPa

The 450 MHz brain tissue simulant consisted of the following ingredients:

Ingredient	Percentage by weight
Water	38.56%
Sugar	56.32%
Salt	3.95%
HEC	0.98%
Dowicil 75	0.19%
450 MHz Target Dielectric Parameters at 22 °C	$\epsilon_r = 43.5$ (+/- 5%) $\sigma = 0.87$ S/m (+/- 5%)

10. 450 MHz System Validation SAR Test Results

SAR @ 0.25W Input averaged over 1g				SAR @ 1W Input averaged over 1g			
IEEE Target		Measured	Deviation	IEEE Target		Measured	Deviation
1.23	+/- 10%	1.27	+3.3%	4.90	+/- 10%	5.08	+3.7%
SAR @ 0.25W Input averaged over 10g				SAR @ 1W Input averaged over 10g			
IEEE Target		Measured	Deviation	IEEE Target		Measured	Deviation
0.825	+/- 10%	0.810	-1.8%	3.30	+/- 10%	3.24	-1.8%
The results have been normalized to 1W (forward power) into the dipole.							

	Date of Evaluation:	December 07, 2006	Document Issue No.:	SV450B-120706-R1.0
	Evaluation Type:	System Validation	Validation Dipole:	450 MHz
			Fluid Type:	Brain

Date Tested: 12/07/2006

System Validation - 450 MHz Dipole - Brain Fluid

DUT: Dipole 450 MHz; Asset: 00024; Serial: 136; Validation: 12/07/2006

Ambient Temp: 24.0°C; Fluid Temp: 23.3°C; Barometric Pressure: 102.1 kPa; Humidity: 33%

Communication System: CW

Forward Conducted Power: 250 mW

Frequency: 450 MHz; Duty Cycle: 1:1

Medium: HSL450; Medium parameters used: $\sigma = 0.90$ mho/m; $\epsilon_r = 44.7$; $\rho = 1000$ kg/m³

- Probe: ET3DV6 - SN1387; ConvF(7.4, 7.4, 7.4); Calibrated: 16/03/2006
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn353; Calibrated: 21/06/2006
- Phantom: Validation Planar; Type: Plexiglas; Serial: 137
- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

450 MHz Dipole - System Validation/Area Scan (6x11x1):

Measurement grid: dx=15mm, dy=15mm

450 MHz Dipole - System Validation/Zoom Scan (5x5x7)/Cube 0:

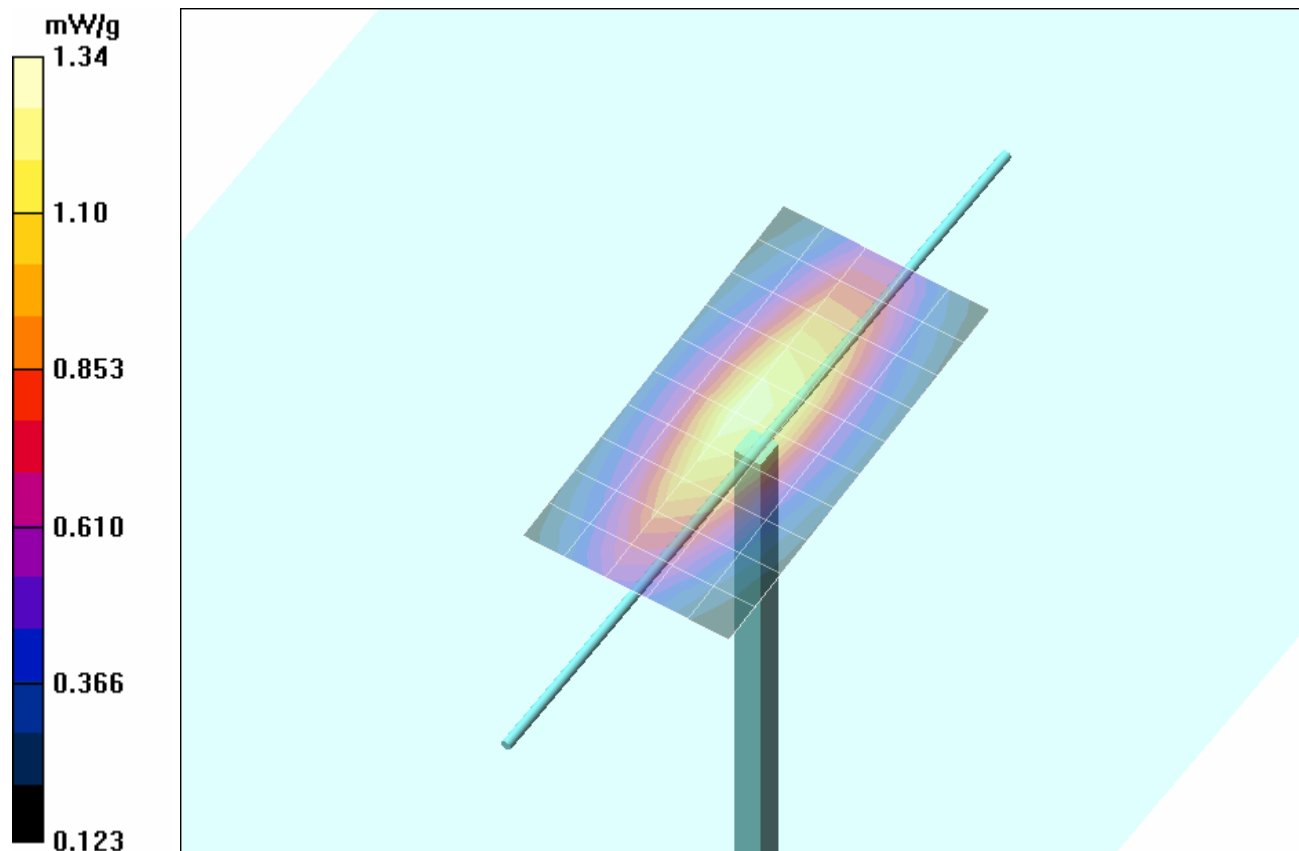
Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm

Reference Value = 38.5 V/m; Power Drift = 0.014 dB

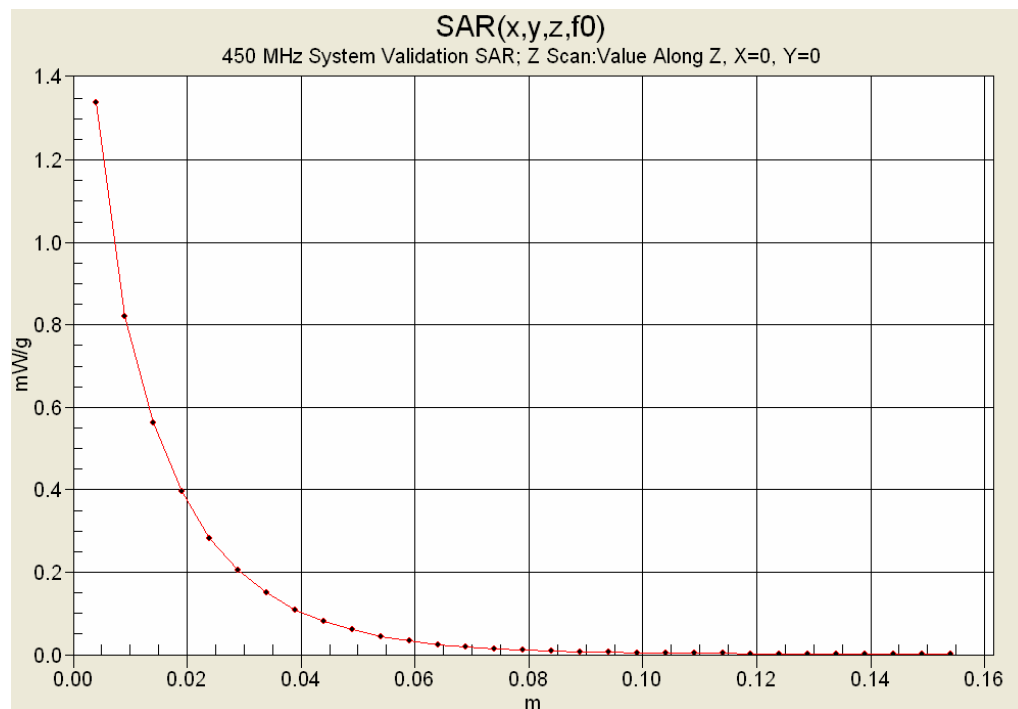
Peak SAR (extrapolated) = 2.24 W/kg

SAR(1 g) = 1.27 mW/g; SAR(10 g) = 0.810 mW/g

Maximum value of SAR (measured) = 1.34 mW/g



Z-Axis Scan



11. Measured Fluid Dielectric Parameters

System Validation (Brain) - 450 MHz Dipole

Celltech Labs Inc.

Test Result for UIM Dielectric Parameter

Thu 07/Dec/2006

Frequency (GHz)



FCC_eH FCC OET 65 Supplement C (June 2001) Limits for Head Epsilon

FCC_sH FCC OET 65 Supplement C (June 2001) Limits for Head Sigma

Test_e Epsilon of UIM


Test_s Sigma of UIM

Freq	FCC_eH	FCC_sH	Test_e	Test_s
0.3500	44.70	0.87	47.00	0.81
0.3600	44.58	0.87	47.03	0.82
0.3700	44.46	0.87	46.57	0.83
0.3800	44.34	0.87	46.74	0.84
0.3900	44.22	0.87	46.22	0.85
0.4000	44.10	0.87	45.87	0.86
0.4100	43.98	0.87	45.56	0.87
0.4200	43.86	0.87	45.20	0.88
0.4300	43.74	0.87	45.11	0.88
0.4400	43.62	0.87	44.87	0.89
0.4500	43.50	0.87	44.67	0.90
0.4600	43.45	0.87	44.53	0.91
0.4700	43.40	0.87	44.30	0.92
0.4800	43.34	0.87	43.85	0.92
0.4900	43.29	0.87	43.89	0.94
0.5000	43.24	0.87	43.69	0.94
0.5100	43.19	0.87	43.31	0.95
0.5200	43.14	0.88	43.18	0.96
0.5300	43.08	0.88	43.13	0.97
0.5400	43.03	0.88	42.70	0.98
0.5500	42.98	0.88	42.54	0.98

	<u>Date(s) of Evaluation</u> February 07, 2007	<u>Test Report Serial No.</u> 012607O7K-T814-S90U	<u>Report Revision No.</u> Revision 1.0	
	<u>Report Issue Date</u> February 09, 2007	<u>Description of Test(s)</u> Specific Absorption Rate	<u>RF Exposure Category</u> Occupational (Controlled)	

Certificate No. 2470.01

APPENDIX F - PROBE CALIBRATION

Company:	Midland Radio Corporation	FCC ID:	O7KPL5164	IC ID:	3690A-PL5164	
Model(s):	PL5164	Description:	Portable FM UHF PTT Radio Transceiver		450 - 490 MHz	
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Accredited by the Swiss Federal Office of Metrology and Accreditation
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Celltech Labs**

Certificate No: **ET3-1387_Mar06**

CALIBRATION CERTIFICATE

Object **ET3DV6 - SN:1387**

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

Calibration date: **March 16, 2006**

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	2-Jan-06 (SPEAG, No. ES3-3013_Jan06)	Jan-07
DAE4	SN: 654	2-Feb-06 (SPEAG, No. DAE4-654_Feb06)	Feb-07
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

Calibrated by: **Katja Pokovic** **Technical Manager**

Approved by: **Niels Kuster** **Quality Manager**

Signature

Issued: March 16, 2006

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



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

Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

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

Probe ET3DV6

SN:1387

Manufactured:	September 21, 1999
Last calibrated:	March 18, 2005
Recalibrated:	March 16, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1387

Sensitivity in Free Space^A

Diode Compression^B

NormX	1.62 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	92 mV
NormY	1.72 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	92 mV
NormZ	1.72 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	92 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	9.3	5.0
SAR _{be} [%]	With Correction Algorithm	0.1	0.2

Sensor Offset

Probe Tip to Sensor Center 2.7 mm

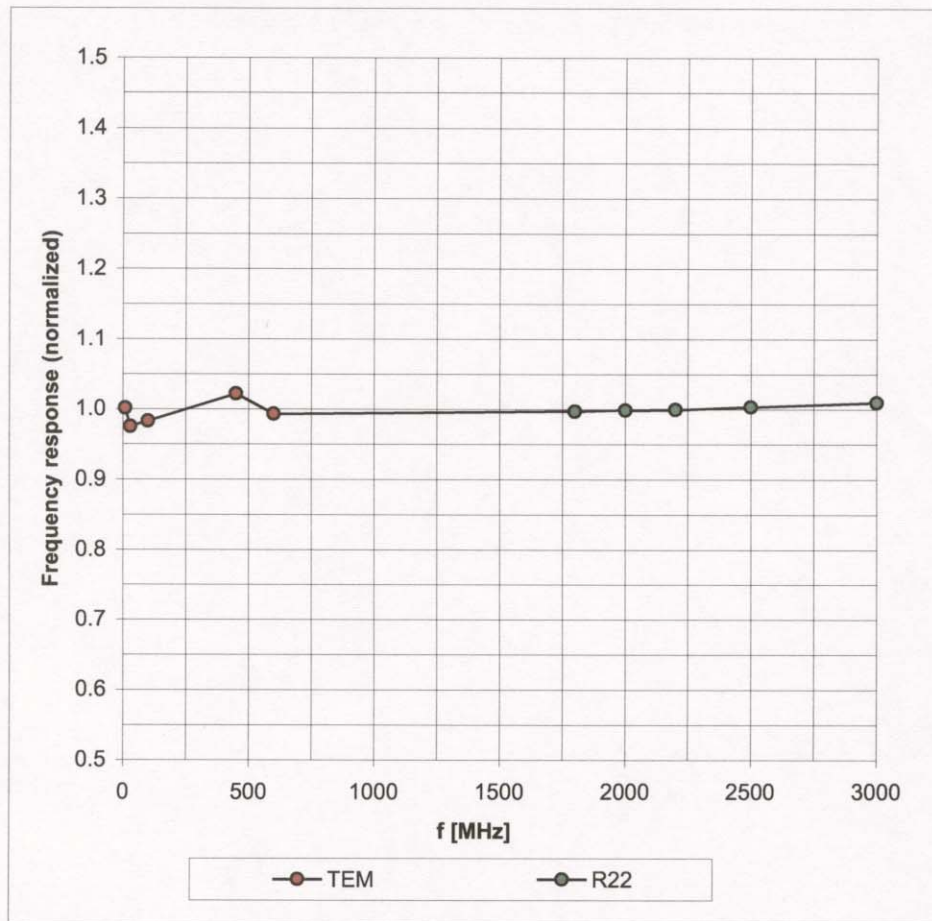
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

^B Numerical linearization parameter: uncertainty not required.

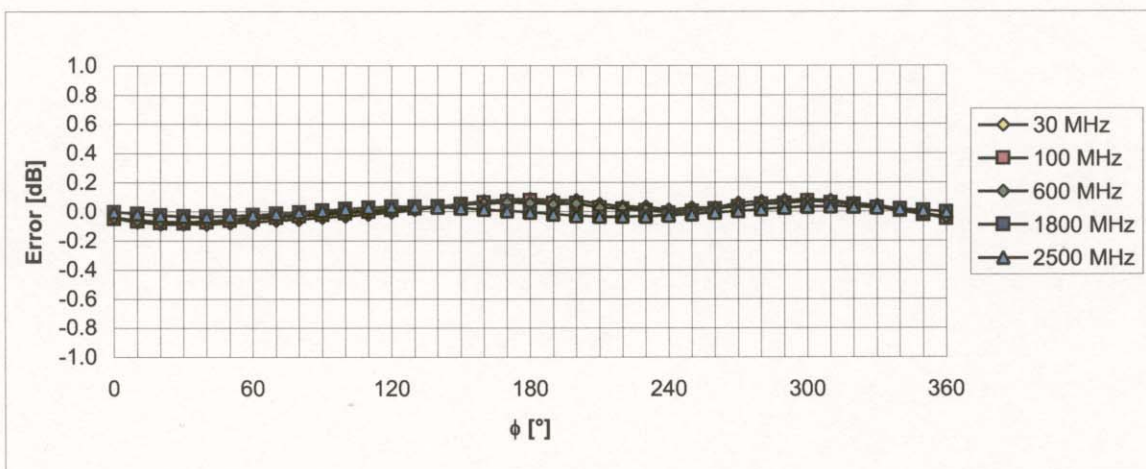
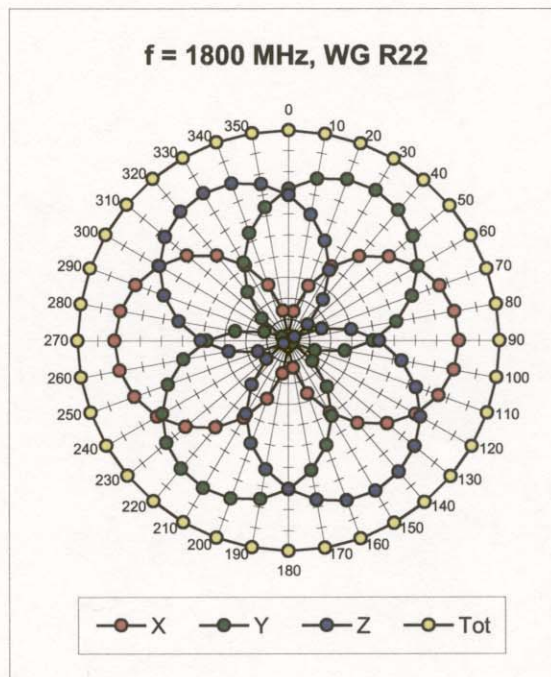
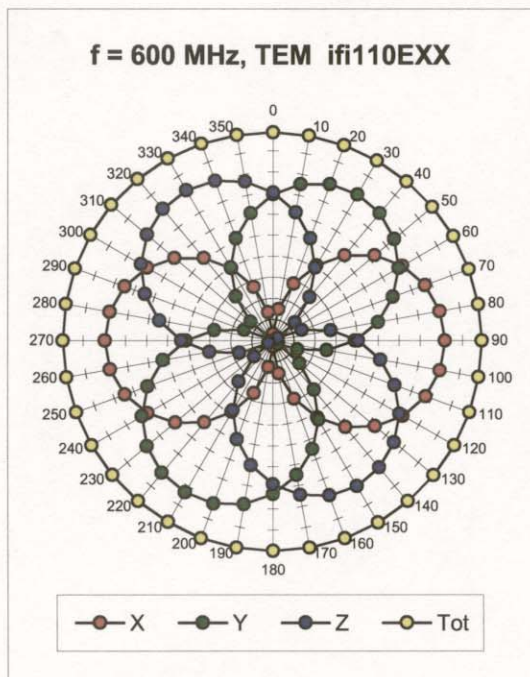
Frequency Response of E-Field

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



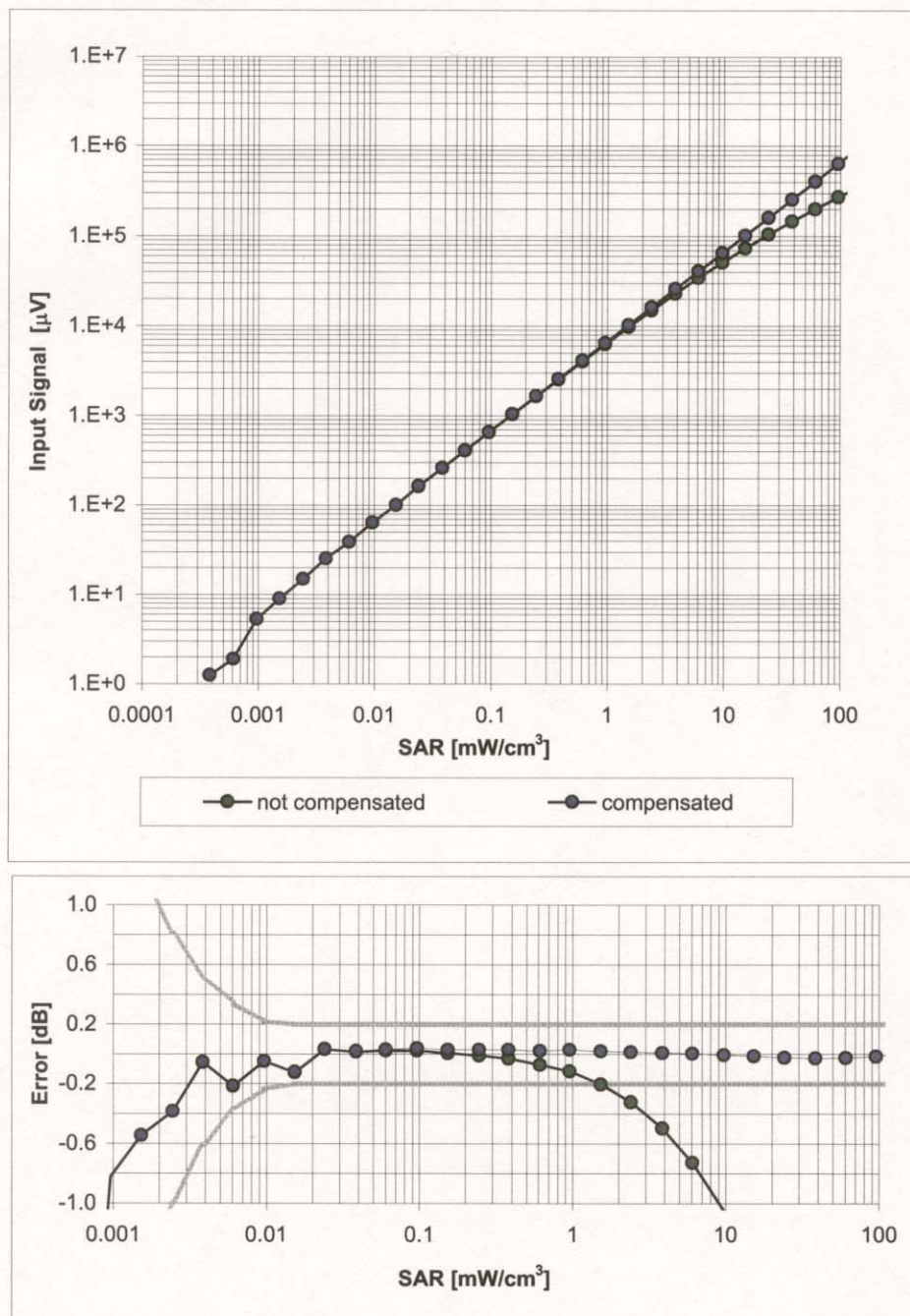
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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



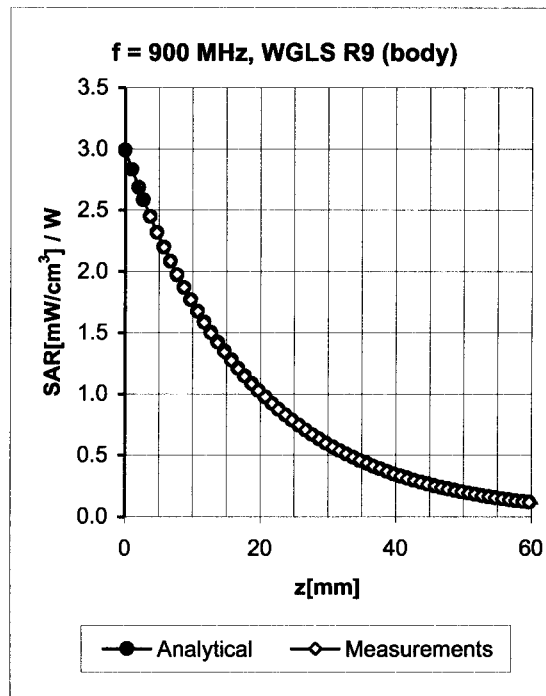
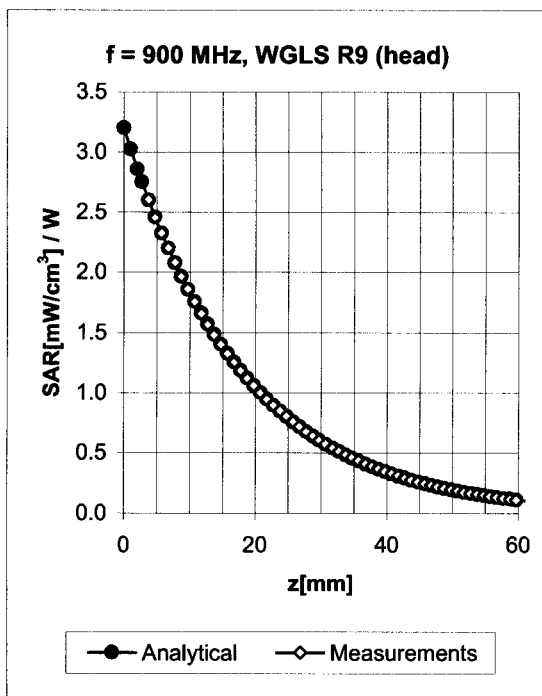
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



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

Conversion Factor Assessment

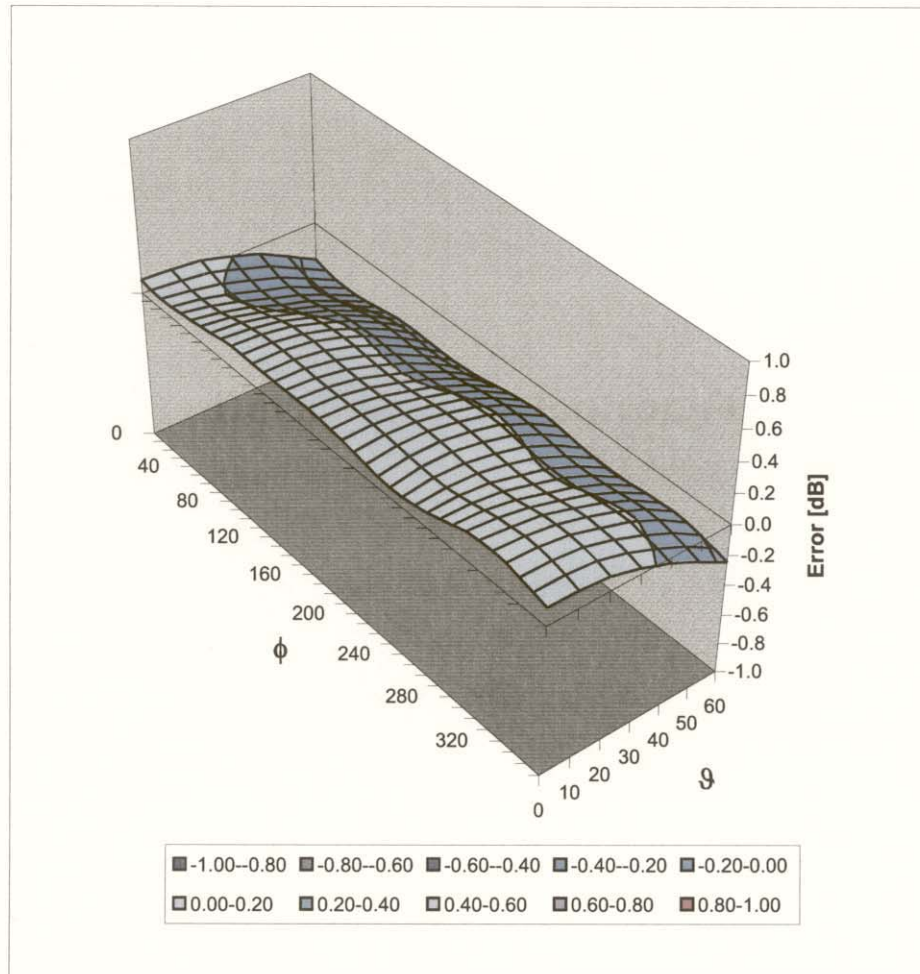


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.62	1.86	6.35 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.59	1.97	6.04 ± 11.0% (k=2)

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1387

Place of Assessment:

Zurich

Date of Assessment:

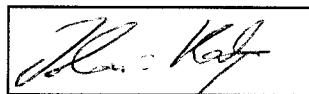
March 18, 2006

Probe Calibration Date:

March 16, 2006

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

Assessed by:



Dosimetric E-Field Probe ET3DV6 SN:1387

Conversion factor (\pm standard deviation)

150 \pm 50 MHz	ConvF	8.6 \pm 10%	$\epsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m (head tissue)
150 \pm 50 MHz	ConvF	8.2 \pm 10%	$\epsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m (body tissue)
300 \pm 50 MHz	ConvF	7.8 \pm 9%	$\epsilon_r = 45.3 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 \pm 50 MHz	ConvF	7.4 \pm 8%	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 \pm 50 MHz	ConvF	7.3 \pm 8%	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (body tissue)
750 \pm 50 MHz	ConvF	6.6 \pm 7%	$\epsilon_r = 41.8 \pm 5\%$ $\sigma = 0.89 \pm 5\%$ mho/m (head tissue)
750 \pm 50 MHz	ConvF	6.4 \pm 7%	$\epsilon_r = 55.4 \pm 5\%$ $\sigma = 0.96 \pm 5\%$ mho/m (body tissue)
1925 \pm 50 MHz	ConvF	5.0 \pm 7%	$\epsilon_r = 39.8 \pm 5\%$ $\sigma = 1.48 \pm 5\%$ mho/m (head tissue)
1925 \pm 50 MHz	ConvF	4.7 \pm 7%	$\epsilon_r = 53.2 \pm 5\%$ $\sigma = 1.60 \pm 5\%$ 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.