



MOTOROLA



CGISS EME Test Laboratory

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S.A.R. EME Compliance Test Report
Part 1 of 1

Date of Report: July 16, 2004
Report Revision: Rev. O
Manufacturer: Motorola
Product Description: Portable transceiver 403-470MHz; 4W Conventional preferred keypad
FCC ID: AZ489FT4826
Device Model: PMUE1407A

Test Period: 7/2/04
Technician: Ed Church (EME Technician Electronics II)
Responsible Eng: Stephen Whalen (Sr. EME Eng.)
Author: Michael Sailsman (Global EME Regulatory Affairs Liaison)

Note: Based on the information and the testing results provided herein, the undersigned certifies that when used as stated in the operating instructions supplied, said product complies with the national and international reference standards and guidelines listed in section 2.0 of this report.

Signature on file

7/16/04

Ken Enger
Senior Resource Manager, Laboratory Director, CGISS EME Lab

Date Approved

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REVISION HISTORY

Date	Revision	Comments
7/16/04	O	Release of new battery accessories compliance results

1.0 Introduction

This report details the utilization, test setup, test equipment, and test results of the Specific Absorption Rate (S.A.R.) measurements performed at the CGISS EME Test Lab for model number PMUE1407A, FCC ID: AZ489FT4826 using new offered battery accessories.

The applicable exposure environment is Occupational/Controlled.

2.0 Reference Standards and Guidelines

This product is designed to comply with the following national and international standards and guidelines.

- United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 2 sub-part J
- IEEE 1528, 2003 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques"
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Terminal frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2003
- ANATEL, Brazil Regulatory Authority, Resolution No. 303 of July 2, 2002 "Regulation of the limitation of exposure to electrical, magnetic, and electromagnetic fields in the radio frequency range between 9KHz and 300 GHz." and "Attachment to resolution # 303 from July 2, 2002"

3.0 Description of Test Sample



FCC ID: AZ489FT4826 is a conventional portable transceiver with a keypad that utilizes frequency modulation (FM). Normal operational use is 5% TX, 5%RX, and 90% stand by. The radio's functional use is at the face in PTT mode or at the body using optional body worn and audio accessories. This device will be marketed to and used by the general population. This device may be used while held against the head in voice mode, in front of the face in PTT mode, and against the body in voice, PTT and data modes.

This device will be marketed to and used by employees solely for work-related operations, such as public safety agencies, e.g. police, fire and emergency medical. User training is the responsibility of these agencies, who can be expected to employ the usage instructions, safety information and operational cautions set forth in the user's manual, instructional sessions or other means. Motorola also makes available to its customers training classes on the proper use of two-way radios and wireless data devices. FCC ID: AZ489FT4826 operates in the 403-470MHz band. The rated power is 4 watts with a maximum output capability of 6.0 watts as defined by the upper limit of the production line final test station.

FCC ID: AZ489FT4826 is offered with the following options and accessories:

Antenna	Description
PMAE4003A	¼ wave Helical; 438-470MHz; -4.5dBi

Batteries

HNN4001A	1800mAH NiMH FM standard battey
HNN4002A	1690mAH NiMH FM battey
HNN4003A	2000mAH Li Ion battey

Audio Accessories

HMN9052A	Remote Speaker Microphone (Standard)
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3.1 Test Signal

Test Mode	<input checked="" type="checkbox"/>	Call Simulator	<input type="checkbox"/>	Simulator	<input type="checkbox"/>
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Test Signal mode:

Transmission Mode:

CW	<input checked="" type="checkbox"/>
Native Transmission	<input type="checkbox"/>
TDMA	<input type="checkbox"/>
Other	<input type="checkbox"/>

3.2 Test Output Power

A table of the characteristic power slump versus time is provided in Appendix A for all tested batteries.

4.0 Description of Test Equipment

4.1 Descriptions of S.A.R. Measurement System

The laboratory utilizes a Dosimetric Assessment System (DASY3™) S.A.R. measurement system manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. The test system consists of a Stäubli RX90L robot with ET3DV6 and EX3DV3 E-Field probes. Please reference the SPEAG user manual and application notes for detailed probe, robot, and S.A.R. computational procedures.

The S.A.R. measurements were conducted with probe model/serial number ET3DV6/SN1384. The system performance check was conducted daily and within 24 hours prior to testing. DASYS output files of the system performance test results and the probe/dipole calibration certificates are included in appendices C and D respectively. The table below summarizes the system performance check results normalized to 1W.

Probe Serial #	Tissue Type	Probe Cal Date	Dipole Kit / Serial #	System Perf. 1-g S.A.R. Result when normalized to 1W (mW/g)	Reference 1-g S.A.R @ 1W (mW/g)	Test Date(s)
1384	FCC Body	5/27/04	D450V2/1001	4.67 +/- 0.000	4.61 +/- 10%	7/2/04

Note: System performance results reflects the median performance +/- 1/2 of the test date(s) performance ranges

The DASYSTM system is operated per the instructions in the DASYSTM Users Manual. The complete manual is available directly from SPEAGTM. All measurement equipment used to assess S.A.R. EME compliance was calibrated according to 17025 A2LA guidelines.

4.2 Description of Phantom

4.2.1 Flat Phantom

A rectangular shaped box made of high density polyethylene (HDPE) material. The phantom is mounted on a wooden supporting structure that has a loss tangent of < 0.05. The structure has a 68.58 cm x 20.32 cm opening at its center to allow positioning the DUT to the phantom's surface. The flat phantom dimensions used for S.A.R. performance assessment are L = 80cm, W = 30cm, H = 20cm, Surface Thickness = 0.2cm.

4.2.2 SAM Phantom

NA

4.3 Simulated Tissue Properties

4.3.1 Type of Simulated Tissue

The simulated tissue used is compliant to that specified in FCC Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01) and IEEE 1528, 2003 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques"

Simulated Tissue	Body Position
FCC Body	Torso
IEEE Head	Head/Face

4.3.2 Simulated Tissue Composition

% of listed ingredients	450MHz	
	Head	Body
Sugar	56	46.5
DGBE (Glycol)	NA	NA
Diacetin	NA	NA
De ionized -Water	39.1	50.3
Salt	3.8	1.87
HEC	1	1
Bact.	0.1	0.1

Characterization of simulated tissue materials and ambient conditions:

Simulated tissue prepared for S.A.R. measurements is measured daily and within 24 hours prior to actual S.A.R. testing to verify that the tissue is within 5% of target parameters at the center of the transmit band. This measurement is done using the Agilent (HP) probe kit model 85070C and a HP8753D Network Analyzer.

Target tissue parameters

FCC Body				
Frequency (MHz)	Di-electric Constant Target	Di-electric Constant Meas. (Range)	Conductivity Target S/m	Conductivity Meas. (Range) S/m
450	56.7	55.6-55.6	0.94	0.93-0.93
435	56.9	55.7-55.7	0.94	0.92-0.92

IEEE Head				
Frequency (MHz)	Di-electric Constant Target	Di-electric Constant Meas. (Range)	Conductivity Target S/m	Conductivity Meas. (Range) S/m
450	43.5	43.7-43.7	0.87	0.86-0.86
435	43.7	44.1-44.1	0.87	0.85-0.85

4.4 Test conditions

The EME Laboratory ambient environment is well controlled resulting in very stable simulated tissue temperature and therefore stable dielectric properties. Simulated tissue temperature is measured prior to each scan to insure it is within +/- 2°C of the temperature at which the dielectric properties were determined. The liquid depth in the phantom used for measurements was 15cm +/- 0.5cm. Additional precautions are routinely taken to ensure the stability of the simulated tissue such as covering the phantoms when scans are not actively in process in order to minimize evaporation. The lab environment is continuously monitored. The table below presents the range and average environmental conditions during the S.A.R. tests reported herein:

	Target	Measured
Ambient Temperature	20 - 25 °C	Range: 20.5-22.7°C Avg. 22.0°C
Relative Humidity	30 - 70 %	Range: 47.4-55.6% Avg. 50.9%
Tissue Temperature	NA	Range: 20.9-20.9°C Avg. 20.9°C

The EME Lab RF environment uses a Spectrum Analyzer to monitor for extraneous large signal RF contaminants that could possibly affect the test results. If such unwanted signals are discovered the S.A.R. scans are repeated. However, the lab environment is sufficiently protected such that no S.A.R. impacting interference has been experienced to date.

5.0 Probe Scan Procedures

The E-field probe first scans a coarse grid over a large area inside the phantom in order to locate the interpolated maximum S.A.R. distribution. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The subsequent scan can directly use this position as reference for the cube evaluations.

5.1 Shortened scan rationale

NA

5.2 Device test positions

Reference Figure 1 for the device orientation and position which exhibited the highest S.A.R. performance.

5.2.1 Body

The DUT was positioned such that its' back housing towards the phantom and separated 2.5cm.

5.2.2 Head

NA

5.2.3 Face

The DUT was placed with its' front housing separated 2.5cm from the phantom.

5.3 Description of Test Procedure

The options and accessories listed in section 3.0 were considered in order to develop the S.A.R. test plan for this product. Other applicable options and accessories offered with this product were previously tested and reported. S.A.R. measurements were performed using a flat phantom with applicable tissue simulant to assess performance at the body and in front of the face using the applicable transmission modes. Note that the worst case test configuration from each body location previously reported for FCC ID: AZ489FT4826 was used to assess the performance of the new offered battery options stated herein.

Assessments at the Body [\[Page 15 of 44; Table 1\]](#)

The DUT was assessed at the worst case test configuration from the previously reported results, using each of the new offered batteries, in the CW transmission mode.

Assessments at the Face [\[Page 15 of 44; Table 1\]](#)

The DUT was assessed at the worst case test configuration from the previously reported results at the face, using each of the new offered batteries, in the CW transmission mode.

5.4 Test Position Photographs

Figure 1: Highest S.A.R. Test Position (@ Face)
DUT with front separated 2.5 cm from the flat phantom.

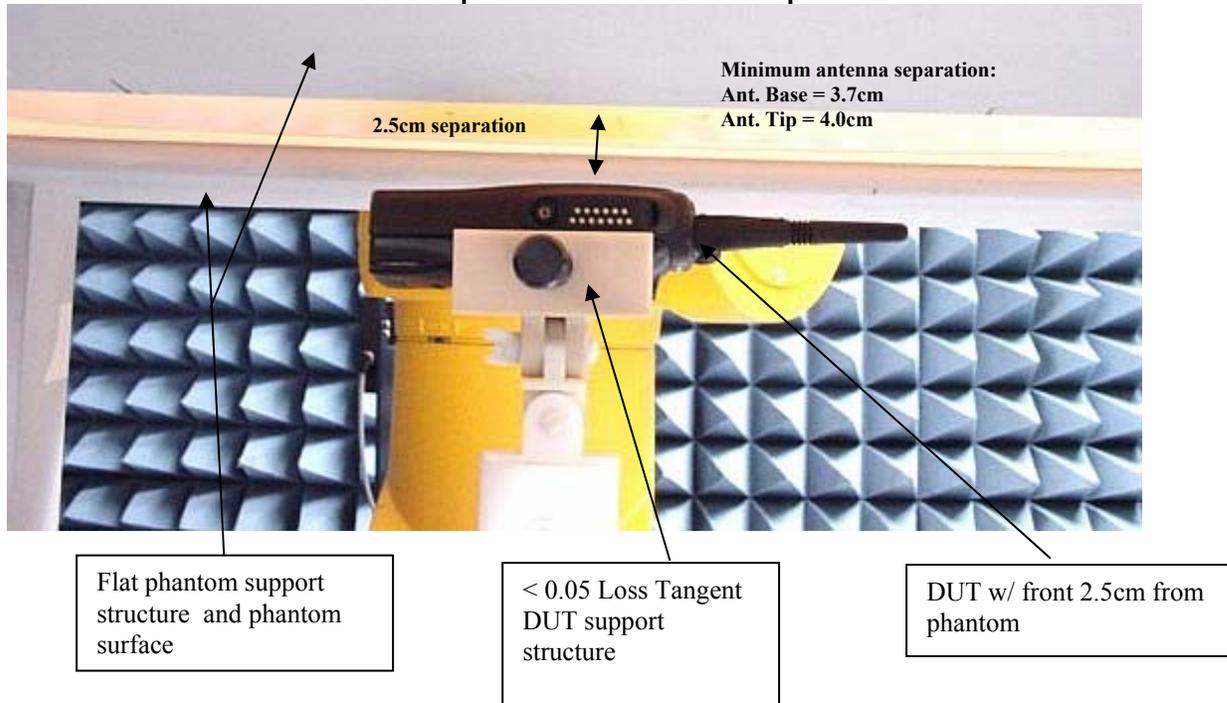


Figure 2. Assessment @ the Body
DUT with back towards phantom with 2.5cm separation

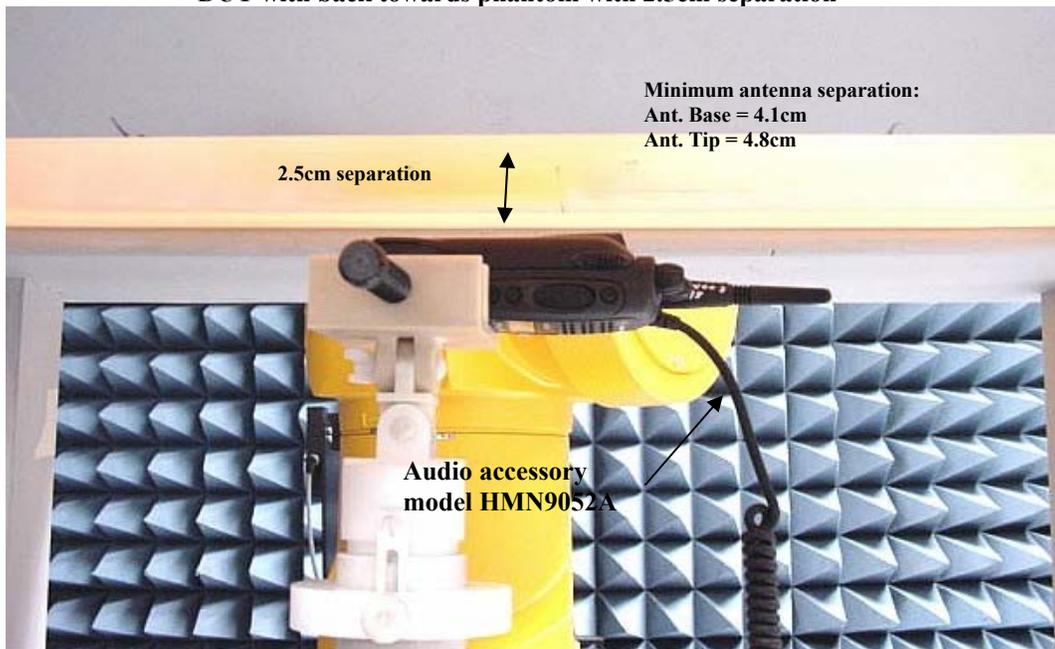
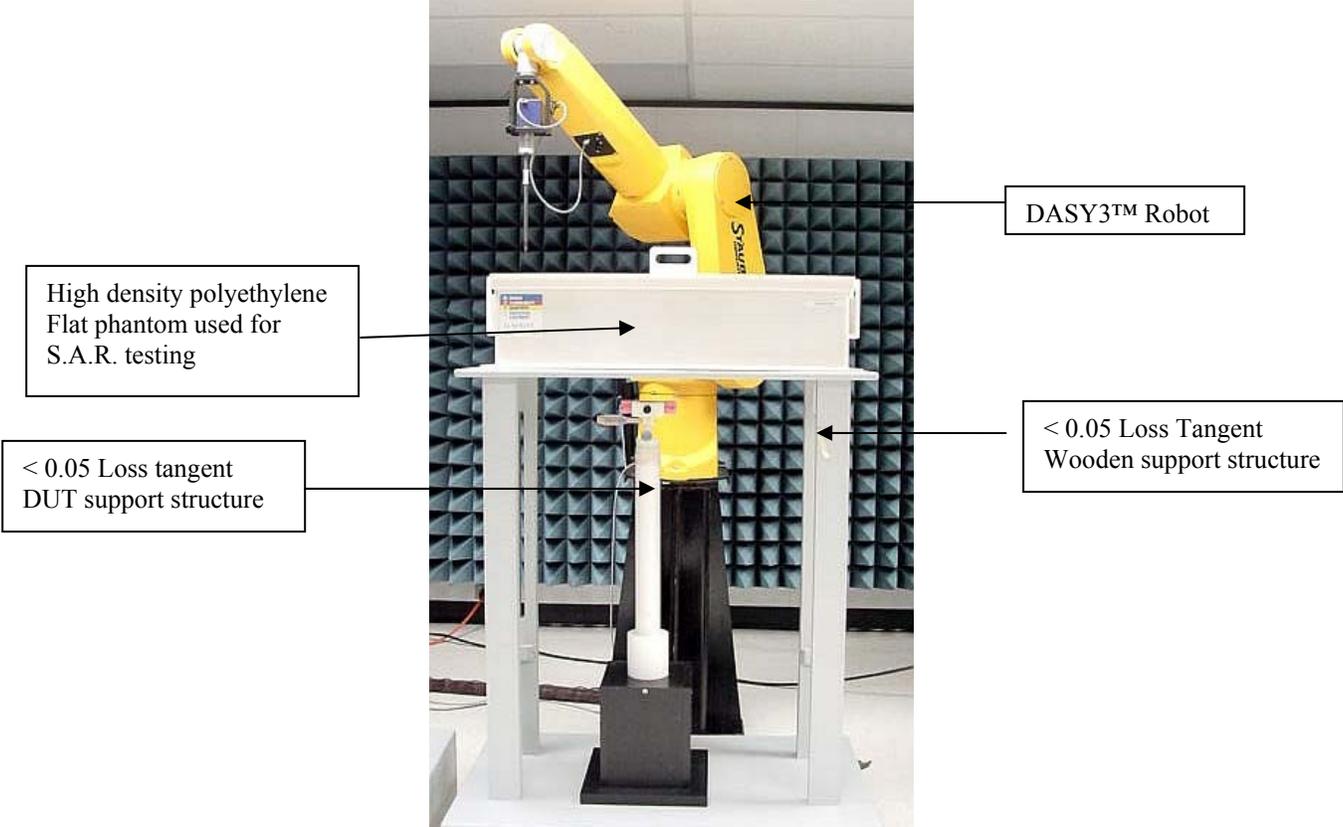


Figure 3: Robot Test System (Flat Phantom)



6.0 Measurement Uncertainty

Table 1: Uncertainty Budget for Device Under Test: 75 – 3000 MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h =</i>	<i>i =</i>	<i>k</i>
							<i>c x f / e</i>	<i>c x g / e</i>	
Uncertainty Component	IEEE 1528 section	Tol.	Prob	Div.	<i>c_i</i>	<i>c_i</i>	1 g	10 g	<i>v_i</i>
		(± %)	Dist		(1 g)	(10 g)	<i>u_i</i>	<i>u_i</i>	
Measurement System									
Probe Calibration	E.2.1	4.8	N	1.00	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1.0	N	1.00	1	1	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	1.3	R	1.73	1	1	0.8	0.8	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	E.6.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.4	N	1.00	1	1	3.4	3.4	29
Device Holder Uncertainty	E.4.1	3.8	N	1.00	1	1	3.8	3.8	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	6.5	N	1.00	0.64	0.43	4.2	2.8	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	4.0	N	1.00	0.6	0.49	2.4	2.0	∞
Combined Standard Uncertainty			RSS				12	11	601
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k=2</i>				23	22	

Table 2: Uncertainty Budget for System Check: 75 – 3000 MHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h =</i>	<i>i =</i>	<i>k</i>
							<i>c x f / e</i>	<i>c x g / e</i>	
Uncertainty Component	IEEE 1528 section	Tol.	Prob.	Div.	<i>c_i</i>	<i>c_i</i>	1 g	10 g	<i>v_i</i>
		(± %)	Dist.		(1 g)	(10 g)	<i>u_i</i>	<i>u_i</i>	
							(±%)	(±%)	
Measurement System									
Probe Calibration	E.2.1	4.8	N	1.00	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1.0	N	1.00	1	1	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	1.3	R	1.73	1	1	0.8	0.8	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t. Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Dipole									
Dipole Axis to Liquid Distance	8.E.4.2	2.0	R	1.73	1	1	1.2	1.2	∞
Input Power and SAR Drift Measurement	8.6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	6.0	R	1.73	0.64	0.43	2.2	1.5	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	6.0	R	1.73	0.6	0.49	2.1	1.7	∞
Combined Standard Uncertainty									
			RSS				9	8	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)									
			<i>k</i> =2				17	17	

Notes for Tables 1 and 2

- a) Column headings *a-k* are given for reference.
- b) Tol. - tolerance in influence quantity.
- c) Prob. Dist. – Probability distribution
- d) N, R - normal, rectangular probability distributions
- e) Div. - divisor used to translate tolerance into normally distributed standard uncertainty
- f) *c_i* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
- g) *u_i* – SAR uncertainty
- h) *v_i* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty.

7.0 S.A.R. Test Results

All S.A.R. results obtained by the tests described in Section 5.0 are listed in section 7.1 below. The bolded result indicates the highest observed S.A.R. performances for the relevant test configuration. DASy3™ S.A.R. measurement scans are provided in APPENDIX B for the highest observed S.A.R. performances.

7.1 S.A.R. results

Table 1

FCC ID: AZ489FT4826 assessment of new offered battery options at the body and face; CW mode												
Run Number/ SN	Antenna Model	Freq. (MHz)	Battery	Test position	Carry Case	Additional attachments	Initial Power (W)	S.A.R. Drift (dB)	Meas. 1g-S.A.R. (mW/g)	Meas. 10g-S.A.R. (mW/g)	Max Calc. 1g-S.A.R. (mW/g)	Max Calc. 10g-S.A.R. (mW/g)
Assessment at the body w/ battery model HNN4001A, using the previously reported worst case test configuration												
SW-Ab-R1-040702-04/749TYQ0146	PM4E4003A	433.025	HNN4001A	DUT back 2.5cm	None	HMN9052A	4.460	-0.660	3.960	2.940	3.10	2.30
Assessment at the face w/ battery model HNN4001A, using the previously reported worst case test configuration												
SW-Face-R1-040702-05/749TYQ0146	PM4E4003A	433.025	HNN4001A	DUT front 2.5cm	None	None	4.410	-0.490	5.970	4.400	4.55	3.35
Assessment at the body w/ battery model HNN4002A, using the previously reported worst case test configuration												
SW-Ab-R1-040702-02/749TYQ0146	PM4E4003A	433.025	HNN4002A	DUT back 2.5cm	None	HMN9052A	4.260	-0.490	3.650	2.710	2.88	2.14
Assessment at the face w/ battery model HNN4002A, using the previously reported worst case test configuration												
SW-Face-R1-040702-06/749TYQ0146	PM4E4003A	433.025	HNN4002A	DUT front 2.5cm	None	None	4.290	-0.460	5.580	4.110	4.34	3.20
Assessment at the body w/ battery model HNN4003A, using the previously reported worst case test configuration												
SW-Face-R1-040702-03/749TYQ0146	PM4E4003A	433.025	HNN4003A	DUT back 2.5cm	None	HMN9052A	4.520	-0.560	3.790	2.810	2.86	2.12
Assessment at the face w/ battery model HNN4003A, using the previously reported worst case test configuration												
SW-Face-R1-040702-07/749TYQ0146	PM4E4003A	433.025	HNN4003A	DUT front 2.5cm	None	None	4.540	-0.610	6.410	4.720	4.87	3.59

7.2 Peak S.A.R. location

Refer to APPENDIX B for detailed S.A.R. scan distributions.

7.3 Highest S.A.R. results calculation methodology

The calculated maximum 1-gram and 10-gram averaged S.A.R. values are determined by scaling the measured S.A.R. to account for power leveling variations and power slump. For this device the

Maximum Calculated 1-gram and 10-gram averaged peak S.A.R. is calculated using the following formula:

$$\text{Max. Calc. 1-g Avg. SAR} = ((\text{S.A.R. meas.} / (10^{(\text{Pdrift}/10)})) * (\text{Pmax}/\text{Pint})) * \text{DC}\%$$

P_{max} = Maximum Power (W)

P_{int} = Initial Power (W)

Pdrift = DASY drift results (dB)

SAR_{meas.} = Measured 1 gram averaged peak S.A.R. (mW/g)

DC % = Transmission mode duty cycle in % where applicable

Note that the use of the above formula should consider the relationship between the initial power, max power, and drift. Also, a 50% duty cycle is applied for PTT operation.

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram and 10-gram average S.A.R. values found for FCC ID: AZ489FT4826 model PMUE1407A.

At the Body: 1-g Avg. = 3.10 mW/g; 10-g Avg. = 2.30 mW/g

At the Face: 1-g Avg. = 4.87 mW/g; 10-g Avg. = 3.59 mW/g

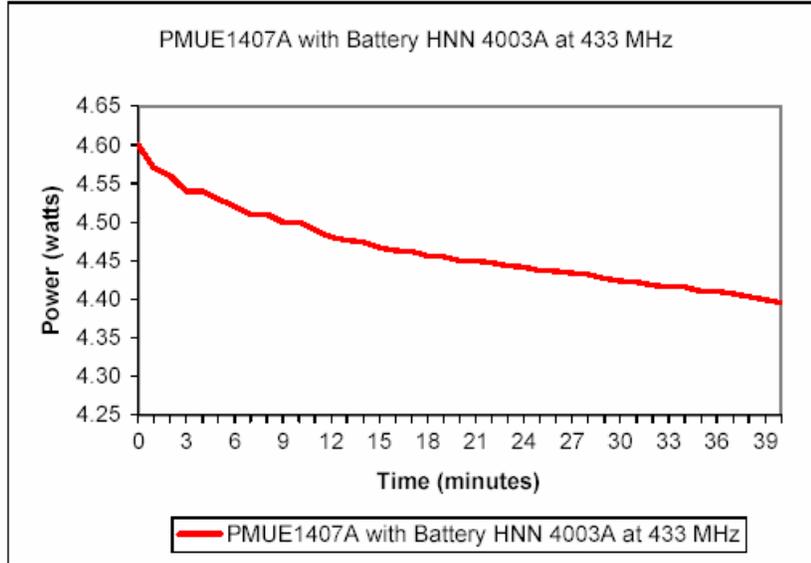
The Previously reported results at the face 3.2mW/g are hereby replaced with the results presented herein. The Previously reported results at the body 3.1mW/g are maintained.

These test results clearly demonstrate compliance with FCC Occupational/Controlled RF Exposure limits of **8.0 mW/g** per the requirements of 47 CFR 2.1093(d).

APPENDIX A
Power Slump Data

DUT Power versus time data

Time (minutes)	Power(watts)
0	4.70
1	4.67
2	4.66
3	4.64
4	4.64
5	4.63
6	4.62
7	4.61
8	4.61
9	4.60
10	4.60
11	4.59
12	4.58
13	4.58
14	4.57
15	4.57
16	4.56
17	4.56
18	4.56
19	4.56
20	4.55
21	4.55
22	4.55
23	4.54
24	4.54
25	4.54
26	4.54
27	4.53
28	4.53
29	4.53
30	4.52
31	4.52
32	4.52
33	4.52
34	4.52
35	4.51
36	4.51
37	4.51
38	4.50
39	4.50
40	4.50



APPENDIX B
Data Results

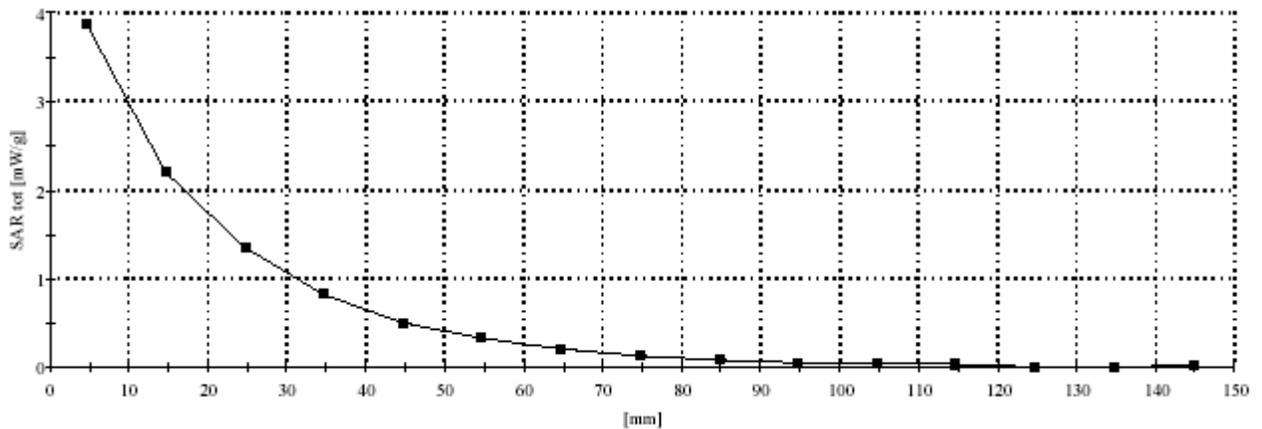
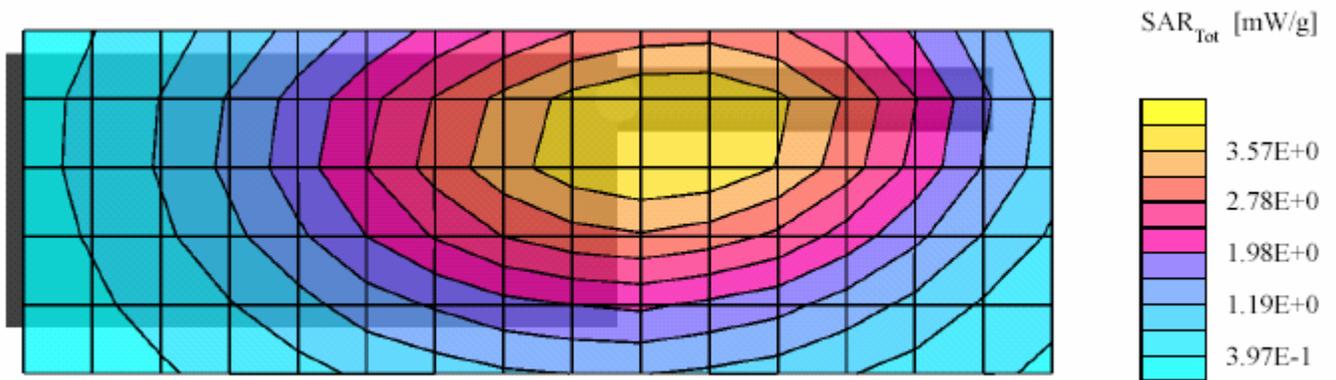
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW-Ab-R1-040702-04
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power : 4.46 W

Antenna: PMAE4003A
Battery Kit: HNN4001A
Body worn: None
Audio/Data Acc.: HMN9052A

DUT back towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; FCC
Body 435 MHz: $\sigma = 0.92$ mho/m $\epsilon = 55.7$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 3.96 mW/g, SAR (10g): 2.94 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 22.5, 141.0, 4.7
Power Drift: -0.66 dB



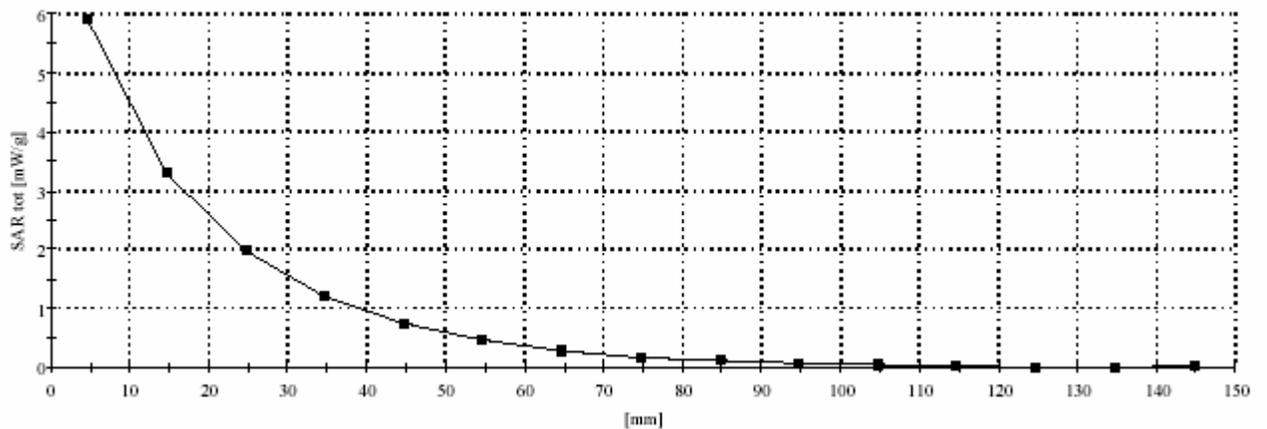
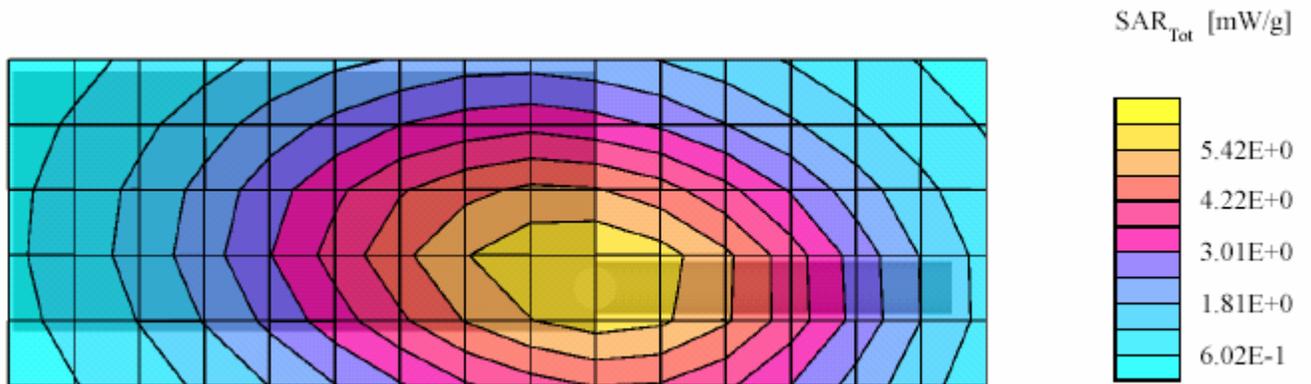
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW-Face-R1-040702-05
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power: 4.41 W

Antenna: PMAE4003A
Battery Kit: HNN4001A
Body worn: None
Audio/Data Acc.: None

DUT front towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; IEEE
Head 435 MHz: $\sigma = 0.85$ mho/m $\epsilon = 44.1$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 5.97 mW/g, SAR (10g): 4.40 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 49.5, 133.5, 4.7
Power Drift: -0.49 dB



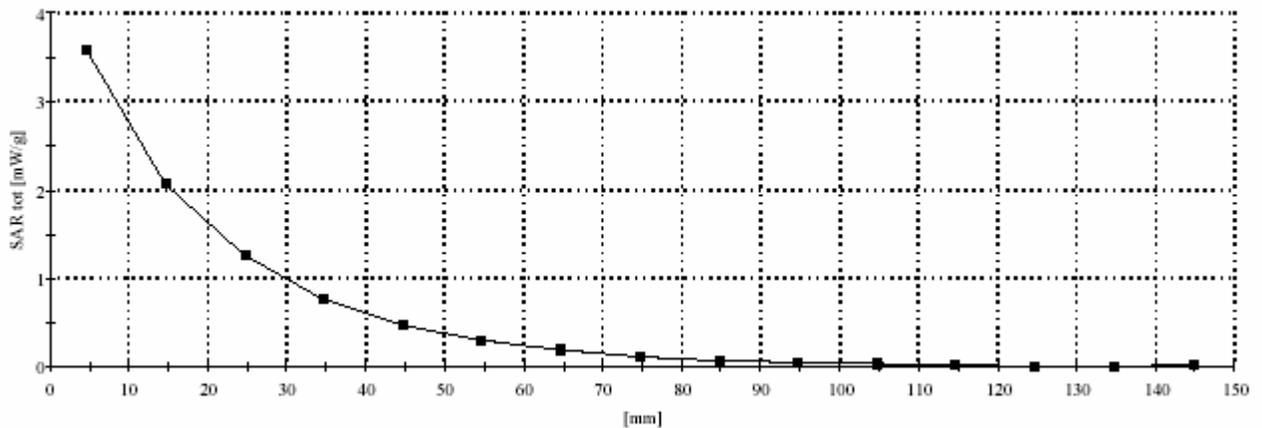
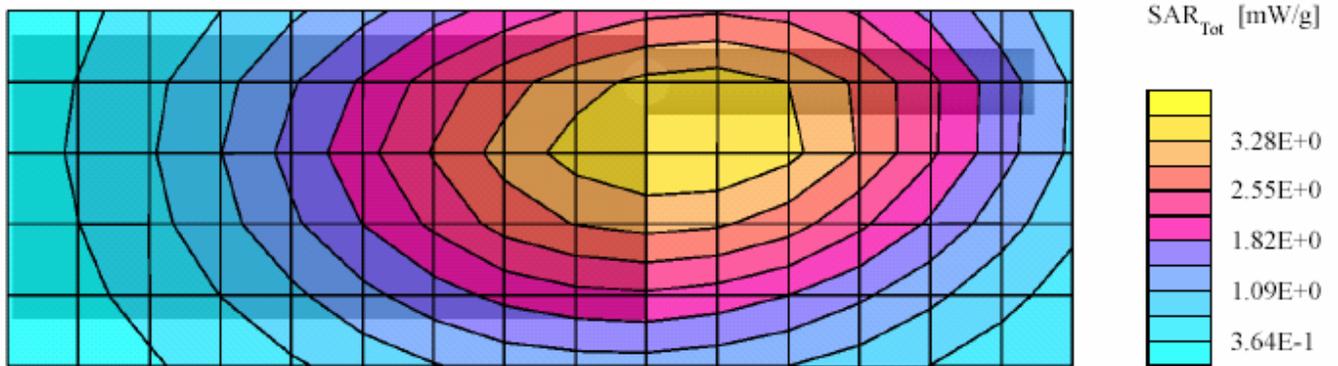
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW- Ab-R1-040702-02
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power : 4.26 W

Antenna: PMAE4003A
Battery Kit: HNN4002A
Body worn: None
Audio/Data Acc.: HMN9052A

DUT back towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; FCC
Body 435 MHz: $\sigma = 0.92$ mho/m $\epsilon = 55.7$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 3.65 mW/g, SAR (10g): 2.71 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 25.5, 145.5, 4.7
Power Drift: -0.49 dB



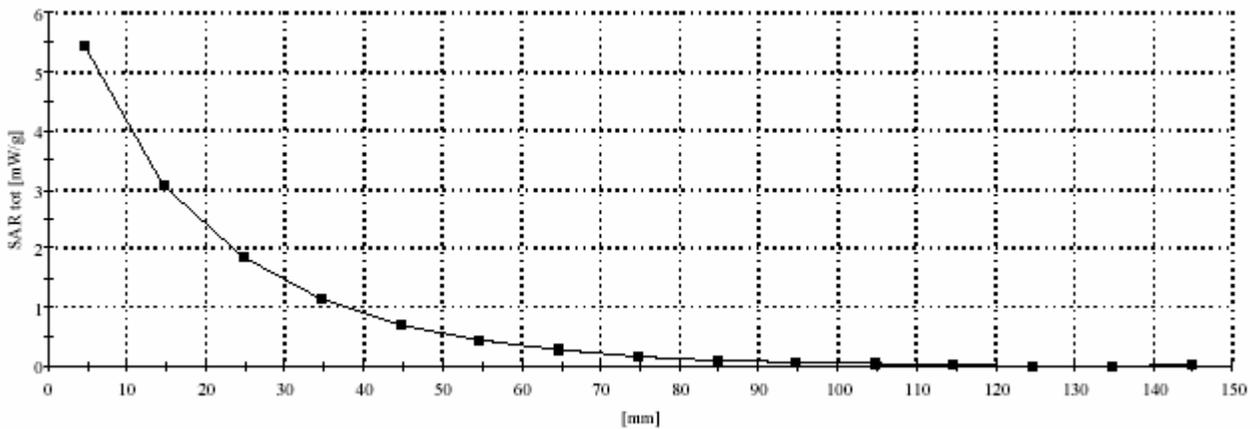
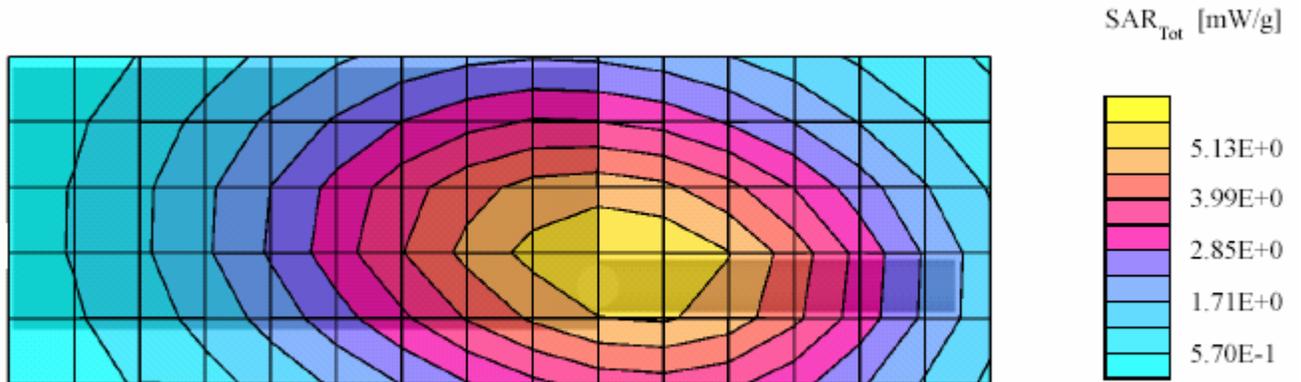
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW- Face-R1-040702-06
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power: 4.29W

Antenna: PMAE4003A
Battery Kit: HNN4002A
Body worn: None
Audio/Data Acc.: None

DUT front towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; IEEE
Head 435 MHz: $\sigma = 0.85$ mho/m $\epsilon = 44.1$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 5.58 mW/g, SAR (10g): 4.11 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 46.5, 141.0, 4.7
Power Drift: -0.46 dB



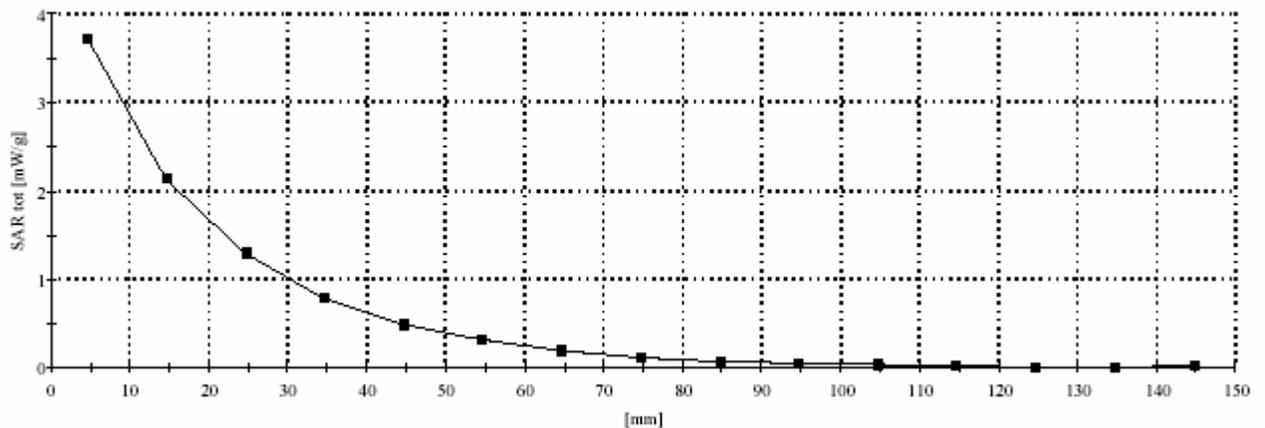
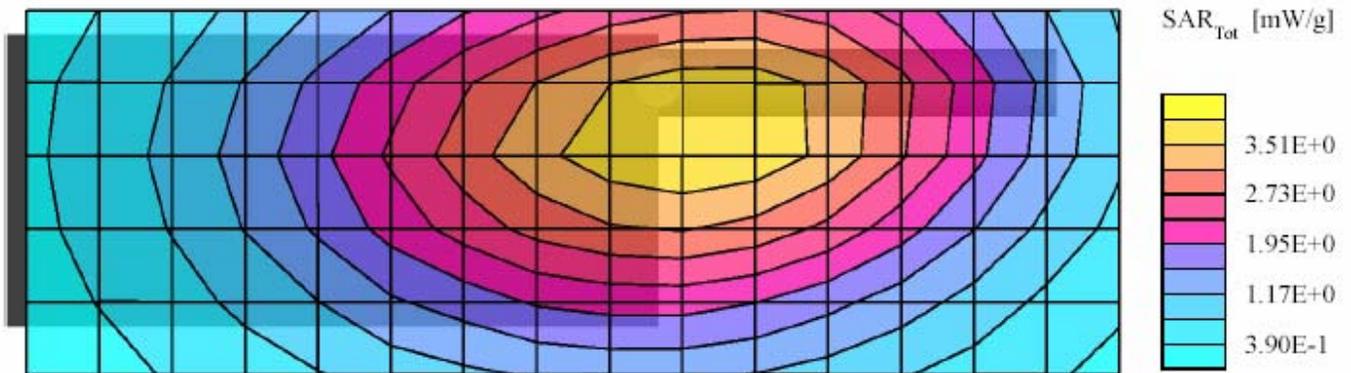
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW- Ab-R1-040702-03
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power: 4.52W

Antenna: PMAE4003A
Battery Kit: HNN4003A
Body worn: None
Audio/Data Acc.: HMN9052A

DUT back towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; FCC
Body 435 MHz: $\sigma = 0.92$ mho/m $\epsilon = 55.7$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 3.79 mW/g, SAR (10g): 2.81 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 25.5, 138.0, 4.7
Power Drift: -0.56 dB



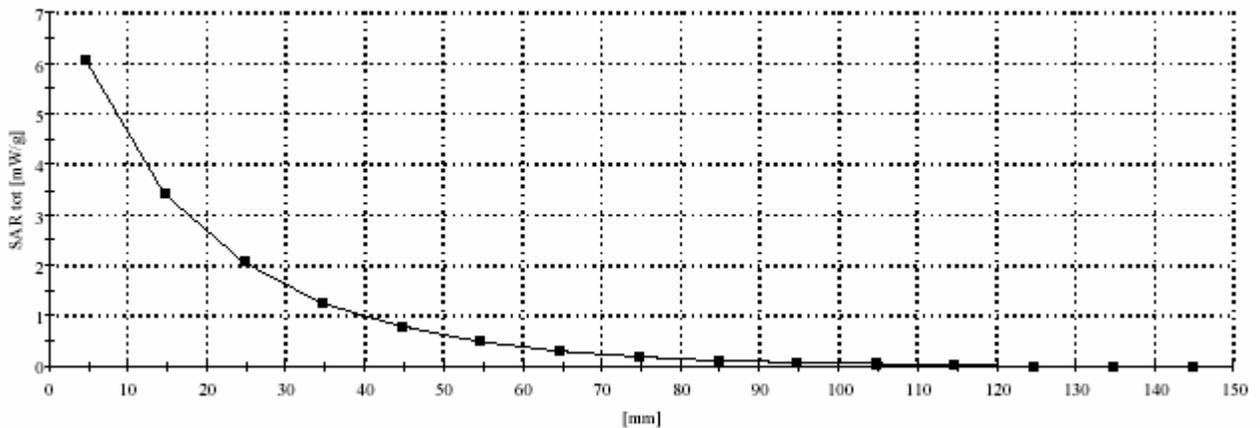
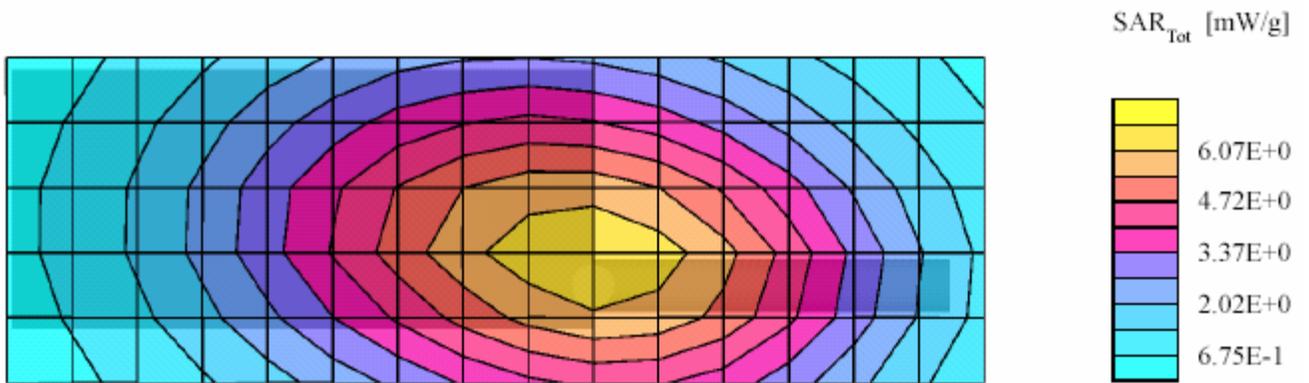
FCC ID: AZ489FT4826; Test Date: 7/02/04

Motorola CGISS EME Laboratory
Run #: SW-Face-R1-040702-07
Model #: PMUE1407A SN: 749TYQ0146
TX Freq: 433.025 MHz
Sim Tissue Temp: 20.9 (Celsius)
Start Power: 4.54W

Antenna: PMAE4003A
Battery Kit: HNN4003A
Body worn: None
Audio/Data Acc.: None

DUT back towards phantom with 2.5cm separation

Flat Phantom; Device Section; Position: (90°,90°);
Probe: ET3DV6 - SN1384(Cal Date 5-27-2004); ConvF(7.40,7.40,7.40); Probe cal date: 27/5/04; Crest factor: 1.0; IEEE
Head 435 MHz: $\sigma = 0.85$ mho/m $\epsilon = 44.1$ $\rho = 1.00$ g/cm³; DAE SN: 363 DAE Cal Date: 05/26/04
Cube 7x7x7: SAR (1g): 6.41 mW/g, SAR (10g): 4.72 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 46.5, 135.0, 4.7
Power Drift: -0.61 dB



APPENDIX C

Dipole System Performance Check Results

Dipole validation scans at the head from SPEAG are provided in APPENDIX D. The CGISS EME lab validated the dipole to the applicable IEEE system performance targets. Within the same day system validation was performed using FCC body tissue parameters to generate the system performance target values for body at the applicable frequency. The results of the CGISS EME system performance validation are provided in this appendix.

SPEAG 450 MHz Dipole; Model D450V2, SN 1001; Test Date: 7/2/04

Motorola CGISS EME Lab

Run #: Sys Perf-R1-040702-01

TX Freq: 450 MHz

Sim Tissue Temp: 20.9 (Celsius)

Start Power; 250mW

SAR target at 1W is 4.61 mW/g (1g avg, including drift)

SAR target at 1W is 3.06 mW/g (10g avg, including drift)

SAR calculated at 1W is 4.67 mW/g (1g avg). Percent from target (including drift) is 1.28 %

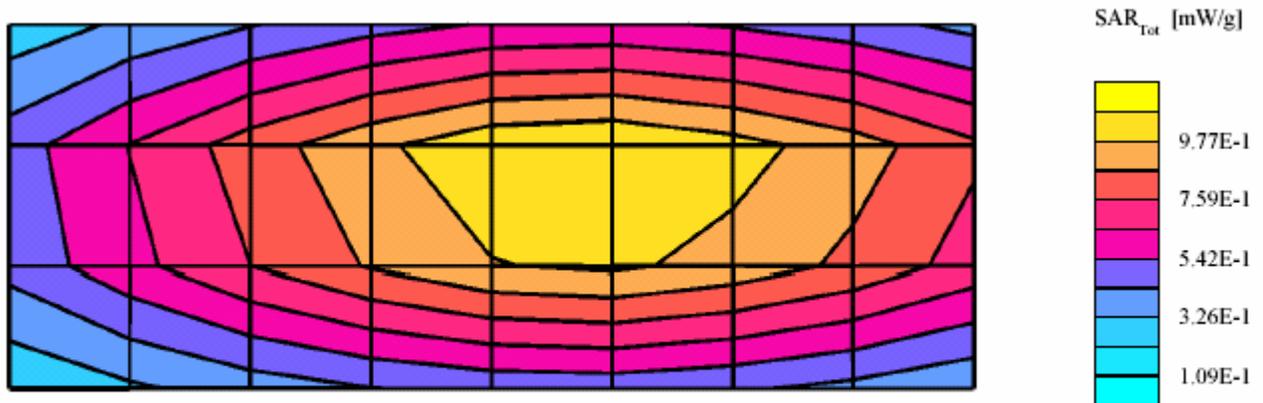
SAR calculated at 1W is 3.08 mW/g (10g avg). Percent from target (including drift) is 0.55 %

Flat Phantom; Probe: ET3DV6 - SN1384(Cal Date 5-27-2004);Probe Cal Date: 27/5/04ConvF(7.40,7.40,7.40); Crest factor:

1.0; FCC Body 450 MHz: $\sigma = 0.93$ mho/m $\epsilon = 55.6$ $\rho = 1.00$ g/cm³; DAE3: SN363 DAE Cal Date: 05/26/2004

Cubes (2): Peak: 1.81 mW/g \pm 0.02 dB, SAR (1g): 1.17 mW/g \pm 0.02 dB, SAR (10g): 0.771 mW/g \pm 0.02 dB, (Worst-case extrapolation)Penetration depth: 12.9 (11.5, 14.7) [mm]

Power drift: 0.01 dB



SYSTEM PERFORMANCE CHECK TARGET SAR

Date: 01/15/2004 Frequency (MHz): 450
Lab Location: CGISS Mixture Type: 450-FCC Body
Robot System: CGISS-2 Ambient Temp.(°C): 22.5
Probe Serial #: 1383 Tissue Temp.(°C): 20.8
DAE Serial #: DAE3V1 SN406

Tissue Characteristics Phantom Type/SN: 80602002C/S7
Permittivity: 55.8 Distance (mm): 15
Conductivity: 0.92

Reference Source: Dipole (Dipole)
Reference SN: 1001
Power to Dipole: 250 mW

Measured SAR Value: 1.14 mW/g (1g avg.), 0.756 mW/g (10g avg.)
Power Drift: -0.05 dB

New Target/Measured
SAR Value: 4.61 mW/g (1g avg.), 3.06 mW/g (10g avg.)
(Normalized to 1.0 W,
with drift compensation)

Test performed by: Kim Uong

Initial: 

Dipole D450V2 SN1001; Test date:01/15/04

Run #: Sys Perf-R2-040115-01

Phantom #: 80302002C-S7

Model #: D450V2 SN: 1001

Robot: CGISS-2

DAE3: SN: 406 (11/20/03) Tester: K. Uong

TX Freq: 450 MHz

Sim Tissue Temp: 20.8 C

Start Power: 250mW

Target:

System performance target: 4.61 mW/g for 1g SAR, 3.06 mW/g for 10g SAR.

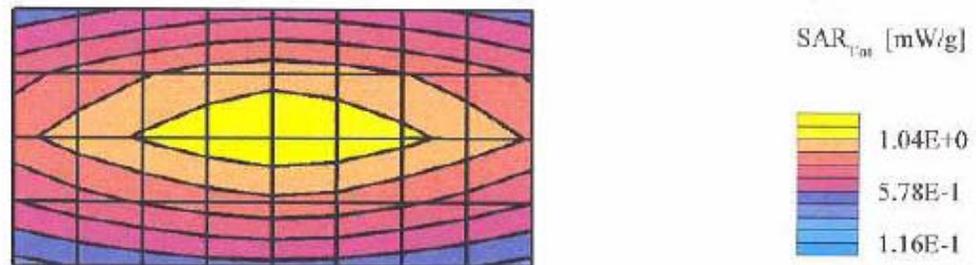
Flat (2); Probe: ET3DV6 - SN1383 (Cal Date 26 February 2003); ConvF(7.50,7.50,7.50); Crest factor: 1.0;

FCC Body 450: $\sigma = 0.92$ mho/m $\epsilon_r = 55.8$ $\rho = 1.00$ g/cm³

Cubes (2): Peak: 1.77 mW/g ± 0.00 dB, SAR (1g): 1.14 mW/g ± 0.01 dB, SAR (10g): 0.756 mW/g ± 0.01 dB, (Worst-case extrapolation)

Penetration depth: 12.8 (11.5, 14.6) [mm]

Powerdrift: -0.05 dB



Motorola CGISS EME Lab

APPENDIX D
Probe/Dipole Calibration Certificates

Client **Motorola CGISS**

CALIBRATION CERTIFICATE

Object(s) **ET3DV6 - SN:1384**

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

Calibration date: **May 27, 2004**

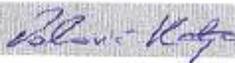
Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

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	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
Fluke Process Calibrator Type 702	SN: 6295603	8-Sep-03 (Simirel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41062180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator HP 8684C	US3642U01700	4-Aug-00 (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 Vetterl	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: May 27, 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.

DASY - Parameters of Probe: ET3DV6 SN:1384

Sensitivity in Free Space		Diode Compression ^A		
NormX	1.78 $\mu V/(V/m)^2$	DCP X	92	mV
NormY	1.76 $\mu V/(V/m)^2$	DCP Y	92	mV
NormZ	1.91 $\mu V/(V/m)^2$	DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

Boundary Effect

Head	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	9.9	4.9	
	SAR _{be} [%] With Correction Algorithm	0.1	0.4	
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
	Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm	
	SAR _{be} [%] Without Correction Algorithm	14.1	9.0	
	SAR _{be} [%] With Correction Algorithm	0.3	0.1	

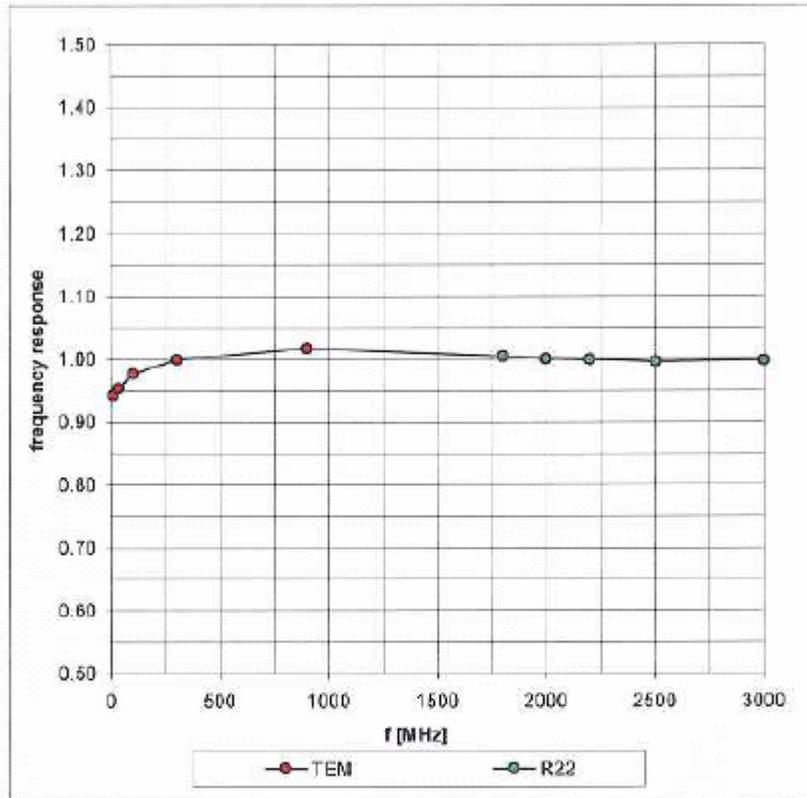
Sensor Offset

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

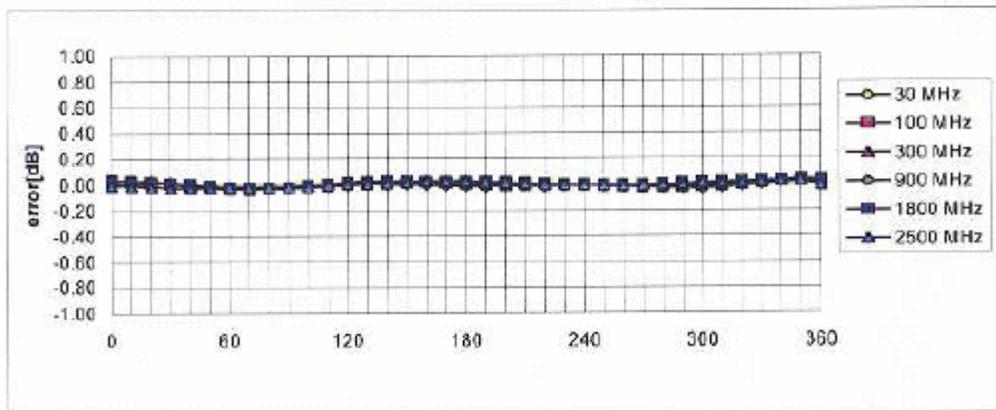
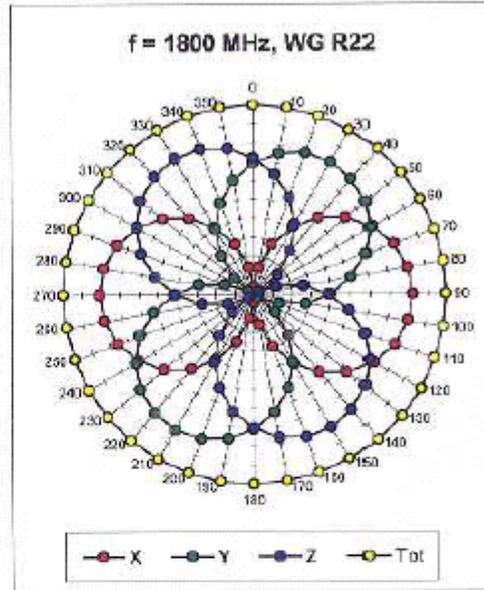
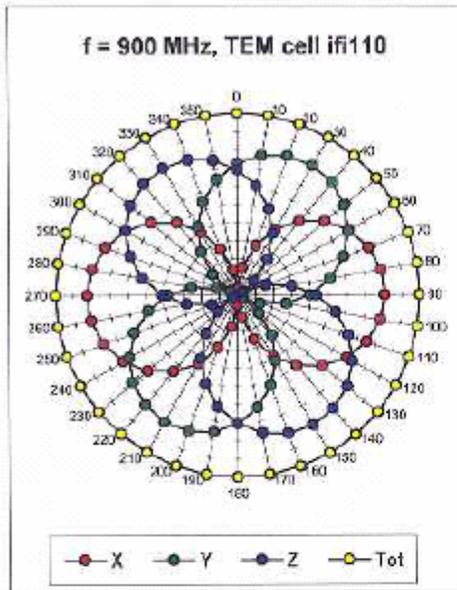
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A numerical linearization parameter: uncertainty not required

Frequency Response of E-Field (TEM-Cell:ifi110, Waveguide R22)

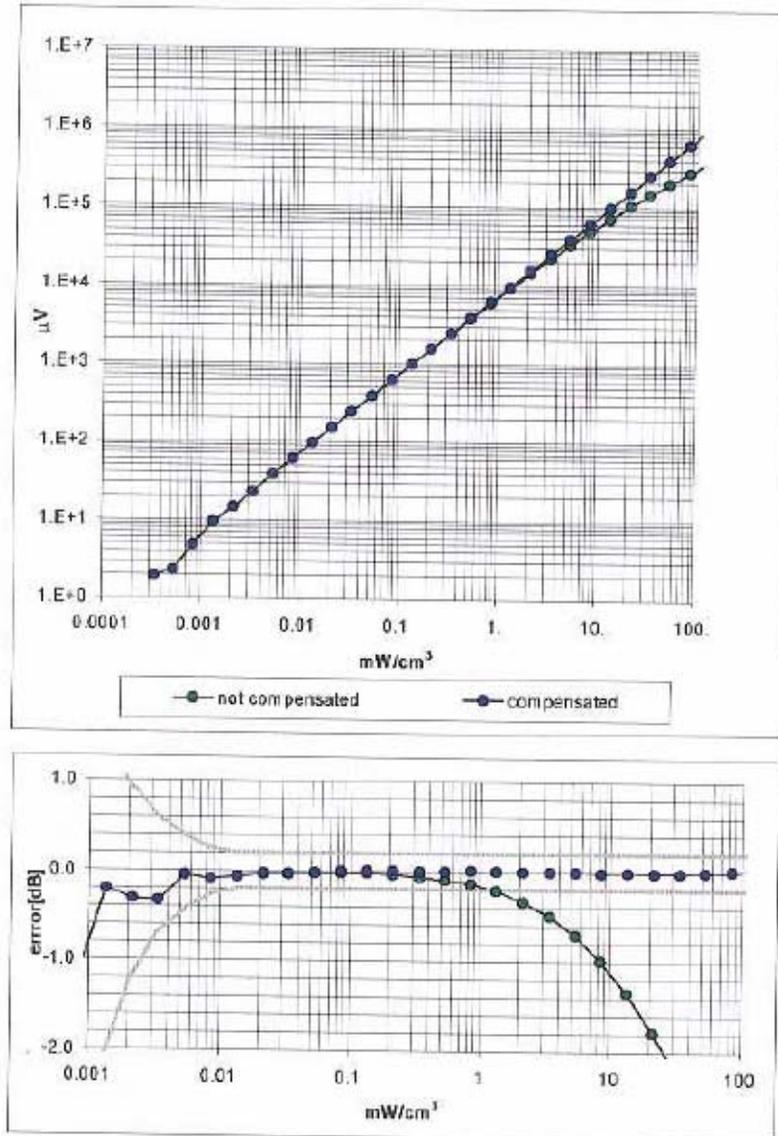


Receiving Pattern (ϕ), $\theta = 0^\circ$



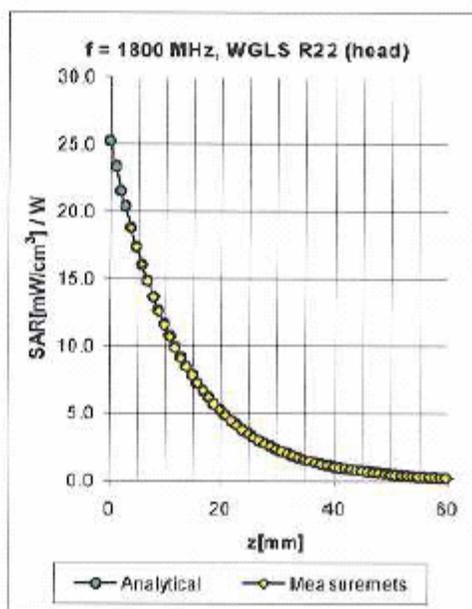
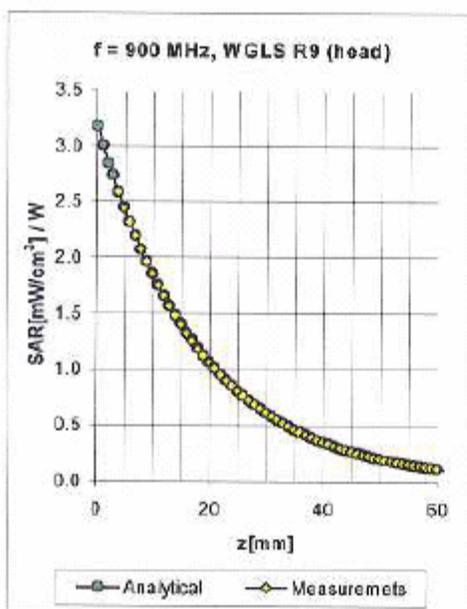
Axial Isotropy Error $< \pm 0.2$ dB

Dynamic Range f(SAR_{head}) (Waveguide R22)



Probe Linearity Error < ± 0.2 dB

Conversion Factor Assessment

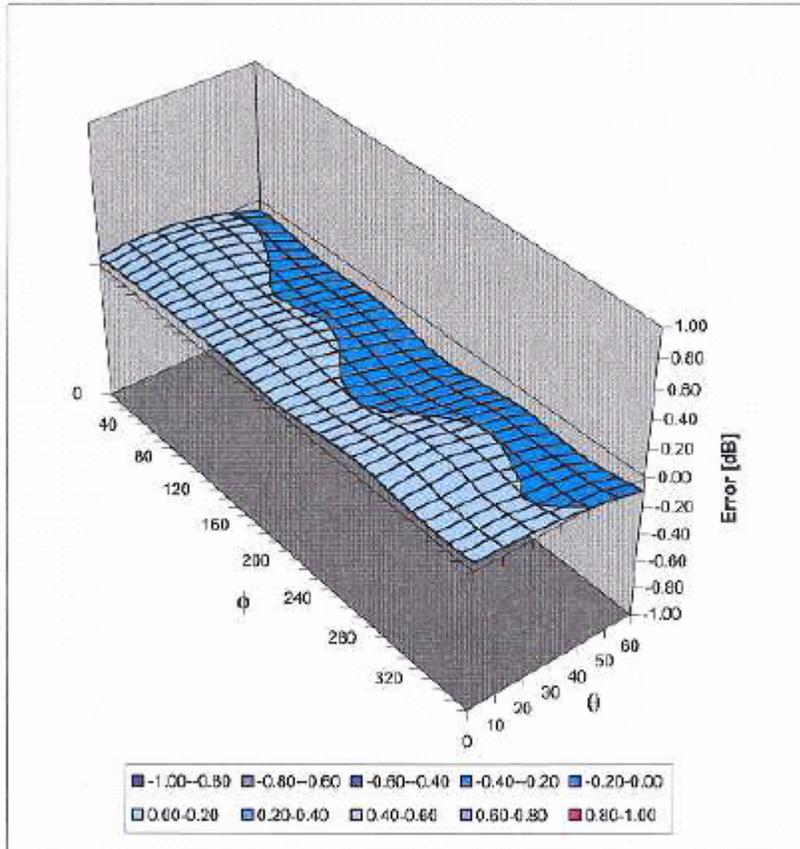


f [MHz]	Validity [MHz] [ⓐ]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.79	1.71	6.53 ± 9.5% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.59	2.42	5.32 ± 9.5% (k=2)
2450	2400-2500	Head	39.2 ± 5%	1.80 ± 5%	1.05	1.94	4.70 ± 9.5% (k=2)
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.61	2.06	6.09 ± 9.5% (k=2)
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.63	2.64	4.81 ± 9.5% (k=2)
2450	2400-2500	Body	52.7 ± 5%	1.95 ± 5%	1.81	1.29	4.64 ± 9.5% (k=2)

[ⓐ] The stated uncertainty of calibration is according to P152B.

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



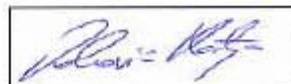
Spherical Isotropy Error $< \pm 0.4$ dB

Additional Conversion Factors for Dosimetric E-Field Probe

Type:	ET3DV6
Serial Number:	1384
Place of Assessment:	Zurich
Date of Assessment:	May 27, 2004
Probe Calibration Date:	June 1, 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 FDID 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:1384Conversion factor (\pm standard deviation)

150 MHz	ConvF	$8.2 \pm 8\%$	$\epsilon_r = 61.9$ $\sigma = 0.80 \text{ mho/m}$ (body tissue)
250 MHz	ConvF	$8.0 \pm 8\%$	$\epsilon_r = 59.4$ $\sigma = 0.88 \text{ mho/m}$ (body tissue)
300 MHz	ConvF	$7.8 \pm 8\%$	$\epsilon_r = 58.2$ $\sigma = 0.92 \text{ mho/m}$ (body tissue)
380 MHz	ConvF	$7.6 \pm 8\%$	$\epsilon_r = 58.2$ $\sigma = 0.92 \text{ mho/m}$ (body tissue)
480 MHz	ConvF	$7.4 \pm 8\%$	$\epsilon_r = 56.6$ $\sigma = 0.94 \text{ mho/m}$ (body tissue)
800 MHz	ConvF	$6.5 \pm 8\%$	$\epsilon_r = 55.3$ $\sigma = 0.97 \text{ mho/m}$ (body tissue)
1750 MHz	ConvF	$5.0 \pm 8\%$	$\epsilon_r = 53.3$ $\sigma = 1.52 \text{ mho/m}$ (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.

Dosimetric E-Field Probe ET3DV6 SN:1384Conversion factor (\pm standard deviation)

150 MHz	ConvF	9.0 \pm 8%	$\epsilon_r = 52.3$ $\sigma = 0.76 \text{ mho/m}$ (head tissue)
250 MHz	ConvF	7.9 \pm 8%	$\epsilon_r = 47.6$ $\sigma = 0.83 \text{ mho/m}$ (head tissue)
300 MHz	ConvF	7.8 \pm 8%	$\epsilon_r = 45.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
380 MHz	ConvF	7.6 \pm 8%	$\epsilon_r = 44.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
480 MHz	ConvF	7.4 \pm 8%	$\epsilon_r = 43.3$ $\sigma = 0.87 \text{ mho/m}$ (head tissue)
800 MHz	ConvF	6.7 \pm 8%	$\epsilon_r = 41.7$ $\sigma = 0.90 \text{ mho/m}$ (head tissue)
1750 MHz	ConvF	5.4 \pm 8%	$\epsilon_r = 40.0$ $\sigma = 1.40 \text{ mho/m}$ (head 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.

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

450 MHz System Validation Dipole

Type:

D450V2

Serial Number:

1001

Place of Calibration:

Zurich

Date of Calibration:

April 5, 2002

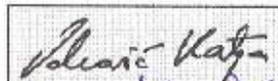
Calibration Interval:

24 months

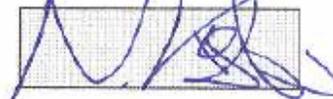
Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:



Approved by:



1. Measurement Conditions

The measurements were performed in the flat phantom filled with head simulating liquid of the following electrical parameters at 450 MHz:

Relative Dielectricity	44.5	$\pm 5\%$
Conductivity	0.86 mho/m	$\pm 5\%$

The DASY3 System (Software version 3.1d) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 7.2 at 450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the longer side of the phantom. The standard measuring distance was 15mm from dipole center to the liquid surface including the 6mm thick phantom shell. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.

The dipole input power (forward power) was 389 mW $\pm 3\%$. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm³ (1 g) of tissue: **4.77 mW/g** (Advanced Extrapolation)

averaged over 10 cm³ (10 g) of tissue: **3.17 mW/g** (Advanced Extrapolation)

Advanced extrapolation has been applied to the measured SAR values to compensate for the probe boundary effect (see DASY User Manual for details).

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well.

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	1,342 ns	(one direction)
Transmission factor:	0,997	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

Feedpoint impedance at 450 MHz:	$\text{Re}\{Z\} = 57,9 \Omega$
	$\text{Im}\{Z\} = -6,0 \Omega$
Return Loss at 450 MHz	-20,8 dB

4. Handling

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

5. Design

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

6. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Validation Dipole D450V2 SN:1001, d = 15 mm

Frequency: 450 MHz; Antenna Input Power: 388 [mW]
Phantom Name: Calibration; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ETSDV6 - SN1507; ConvF(7.20, 7.20, 7.20); Crest Factor: 1.0; Head 450 MHz: $\sigma = 0.86$ mho/m, $\epsilon = 44.5$, $\rho = 1.00$ g/cm³
Cubes (2): Peak: 2.81 mW/g \pm 0.03 dB, SAR (1g): 1.85 mW/g \pm 0.03 dB, SAR (10g): 1.23 mW/g \pm 0.03 dB, (Advanced extrapolation)
Penetration depth: 13.1 (12.0, 14.4) [mm]

