Certificate Number: 1449-02

MOTOROLA

ACCREDITED

CGISS EME Test Laboratory

8000 West Sunrise Blvd
Fort Lauderdale, FL. 33322

S.A.R. EME Compliance Test Report

Attention:	FCC
Date of Report:	September 25, 2003
Report Revision:	Rev. B
Manufacturer:	Motorola
Product Description:	2W UHF RBR 6 channel w/ display; Fixed antenna
FCC ID:	**AZ489FT4851**
Model(s) Tested:	NUE2986A
Model(s) affected:	NUE2986A, NUE2986B, NUE2983B, NUE2984B, NUE3002B, NUE3001B, NUE2982B

Test Period:	9/5/03
EME Tech:	Ed Church
EME Engineer:	Deanna Zakharia Elect. Principle Staff 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 — 9/26/03

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

Date Approved

Note: This report shall not be reproduced without written approval from an officially designated representative of the Motorola EME Laboratory.

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REVISION HISTORY

Date	Revision	Comments
8/27/01	O	Original release.
8/29/03	A	Modified final SAR derivation in section 7.0 per supplement C Appendix D “Test Device Operating Conditions”
9/25/03	B	Disclosure of compliance results with new addendum accessory

1.0 Introduction

This report details the utilization, test setup, test equipment, and updated test results of the Specific Absorption Rate (S.A.R.) measurements performed at the CGISS EME Test Lab for tested model number NUE2986A FCC ID: AZ489FT4851.
A new earpiece w/ boom microphone audio accessory, model HCSN4001A is being offered for this product. The compliance results presented herein reflect the compliance performance of the affected models listed above.

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
- 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 Terminal communications (Electromagnetic Radiation - Human Exposure) Standard 2003
- ANATEL, Brazil Regulatory Authority, Resolution 256 (April 11, 2001) "additional requirements for SMR, cellular and PCS product certification."

3.0 Description of Test Sample

DUT model number NUE2986A FCC ID: AZ489FT4851 is a handheld transceiver, which operates as a traditional simplex 2-way radio. It will be marketed to and used by employees solely for work - related operations, such as Retail Business, Construction, and Small Business Operation. User training is the responsibility of the business group, 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. The intended use positions are "at the face" with the microphone 1 to 2 inches from the mouth or "at the waist or abdomen" secured to the user's belt. When operated at the waist or abdomen, the audio and push-to-talk functions are routed to a remote accessory, which connects to the side of the radio. The transmit duty cycle, 50% maximum for this type of device, is controlled by the user via the push – to - talk button. This device transmits in the 461.0375 – 469.5625MHz band with 6 channels. The maximum conducted power, as defined by the production line final test station upper limit, is 2.2 watts. See section 5.0 for more detailed information on the maximum conducted power.

The following are applicable options and accessories assessed along with the new audio accessory model HCSN4001A. Other offered options and accessories specific to the tested models were disclosed during the respective product compliance certification.
The battery and carry case assessed herein represents the accessories that produced the highest S.A.R. results for the tested model NUE2986A.

Antenna:

Fixed ¼ wave 60mm helical, fixed non-retractable, freq. range 460-470MHz.

Batteries

NTN8971B XTN/CP100 Series NiMH Rechargeable (53871)

Body-worn Accessories

NNTN4020A XTN Series Carry Case (53873)

Audio attachments

HCSN4001A Earpiece/ W Boom mic (56518)

3.1 Test Signal

Test Signal mode:

Test Mode	X	Base Station		Simulator	

Transmission Mode:

CW	**X**
Native Transmission	
TDM:	
Other	

3.2 Test Output Power

This device uses a fixed antenna and power output measurements are not possible prior to each test. The DASY3™ system's S.A.R. drift function was used to determine the power slump characteristic of the device. A characteristic power versus time assessment based on 50 ohms measurements was performed on a representative sample of this product and a results table and plot are provided in APPENDIX A for the batteries producing the highest S.A.R. results.

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 an ET3DV6 E-Field probe. 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/SN1383. The system performance check was conducted daily and within 24 hours prior to testing. DASY 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. Result when normalized to 1W (mW/g)	Reference S.A.R @ 1W (mW/g)	Test Date(s)
1383	FCC Body	2/26/03	SPEAG D450V2 MHz /1002	4.62 +/- 0.00	4.52 +/- 10%	9/5/03

Note: see APPENDIX C for an explanation of the reference S.A.R. targets stated above

The DASY3™ system is operated per the instructions in the DASY3™ Users Manual. The complete manual is available directly from SPEAG™. All measurement equipment used to assess EME S.A.R. 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) with a dielectric constant of 2.26 and a loss tangent of less than 0.00031. The phantom is mounted on a wooden supporting structure that has a loss tangent of < 0.05. The flat phantom used for this assessment 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 at the body was: length=80cm, Width=30cm, Height=20cm, Surface thickness=0.2cm.

4.2.2 SAM Phantom

SAM Phantom assessment was not applicable for this filing.

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).

Simulated Tissue	Body Position
FCC Body	Torso

4.3.2 Simulated Tissue Composition

Tissue Ingredient (%) @ 450 MHz		
	Head	**Body**
Sugar	56	46.5
DGBE (Glycol)	-	-
De ionized -Water	39.1	50.53
Salt	3.8	1.87
HEC	1.0	1.0
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	56.70	54.9-54.9	0.94	0.90-0.90
465	56.60	54.7-54.7	0.94	0.91-0.91

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^{o}C of the temperature at which the dielectric properties were determined. 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: 21.3-23.72˚C Avg. 22.9˚C
Relative Humidity	30 - 70 %	Range: 40.20-45.7% Avg. 42.15%
Tissue Temperature	NA	Range: 20.5-20.5˚C Avg. 20.5˚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 Description of Test Procedure

All options and accessories listed in section 3.0 were considered in order to develop the S.A.R. test plan for this product. A S.A.R. measurement was performed using a flat phantom to assess performance at the body. The assessment was done using the flat phantom containing FCC body or tissue, and with the DUT in CW mode.

The DUT was assessed with the new audio accessory model HCSN4001A attached using the battery and carry case accessory that produced the highest S.A.R. results previously submitted to the FCC.

5.1 Device Test Positions

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

5.1.1 Body

The DUT was positioned such that it was centered against the flat phantom with the applicable body-worn accessory.

5.1.2 Head

Assessments at the head was not applicable for this filing.

5.1.3 Face

Assessment at the face was not applicable for this filing.

5.2 Test Position Photographs

Figure 1: Highest S.A.R. Test Position at the body
(DUT w/ carry case model against the flat phantom)

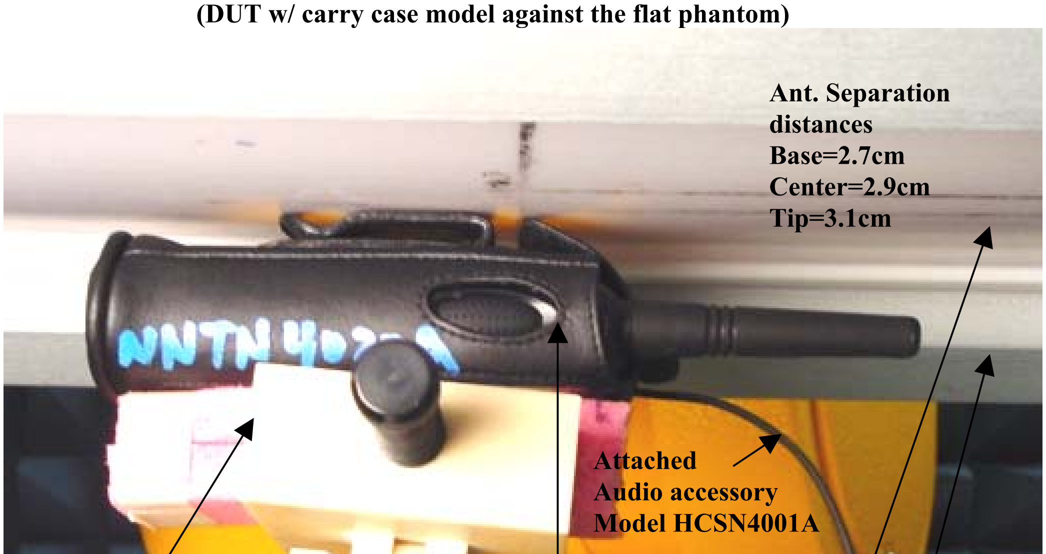


Figure 2: Robot Test setup (Abdomen)

5.3 Probe Scan Procedures

The E-field probe first scans in 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.

6.0 Measurement Uncertainty

Table 1: Uncertainty Budget for Device Under Test

a	*b*	*c*	*d*	*e* = *f*(*d*,*k*)	*f*	*g*	*h* = *c* x *f* / *e*	*i* = *c* x *g* / *e*	*k*
Uncertainty Component	**Section of IEEE P1528**	**Tol. (± %)**	**Prob. Dist.**	**Divisor**	c_i (1 g)	c_i (10 g)	**1 g** u_i (±%)	**10 g** u_i (±%)	v_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	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	5.8	R	1.73	1	1	3.3	3.3	∞
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	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.3	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	1.1	R	1.73	1	1	0.6	0.6	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	3.9	R	1.73	1	1	2.3	2.3	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.6	N	1.00	1	1	3.6	3.6	29
Device Holder Uncertainty	E.4.1	2.8	N	1.00	1	1	2.8	2.8	8
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	10.0	R	1.73	0.64	0.43	3.7	2.5	∞
Liquid Permittivity - deviation from target values	E.3.2	10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity - measurement uncertainty	E.3.3	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Combined Standard Uncertainty			RSS				12	11	1363
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				23	22	

Uncertainty Budget for System Performance Check (dipole & flat phantom)

a	b	c	d	e = f(d,k)	f	g	h = c x f / e	i = c x g / e	k
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	c_i (1 g)	c_i (10 g)	1 g u_i (±%)	10 g u_i (±%)	v_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	5.7	R	1.73	1	1	3.3	3.3	∞
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	0.0	R	1.73	1	1	0.0	0.0	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.3	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	1.1	R	1.73	1	1	0.6	0.6	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	3.9	R	1.73	1	1	2.3	2.3	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	1.0	R	1.73	1	1	0.6	0.6	∞
Input Power and SAR Drift Measurement	8, 6.6.2	4.7	R	1.73	1	1	2.7	2.7	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	10.0	R	1.73	0.64	0.43	3.7	2.5	∞
Liquid Permittivity - deviation from target values	E.3.2	10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity - measurement uncertainty	E.3.3	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Combined Standard Uncertainty			RSS				10	9.4	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			*k*=2				20	18	

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) *ci* - sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.
g) *ui* – SAR uncertainty
h) *vi* - degrees of freedom for standard uncertainty and effective degrees of freedom for the expanded uncertainty.

7.0 S.A.R. Test Results

The S.A.R. result obtained by the test described in Section 5.0 is listed in section 7.1 below. The result below reflects the highest observed S.A.R. performance using audio accessory model HCSN4001A. The DASY3™ S.A.R. measurement scan is provided in APPENDIX B for the result data presented.

7.1 S.A.R. results

Compliance Assessment at the body using audio accessory model HCSN4001A; CW mode												
Run Number/ SN	**Freq. (MHz)**	**Antenna/ Position**	**Battery**	**Test position**	**Body- worn Acc.**	**Additional attachments**	**Initial Power (W)**	**S.A.R. Drift (dB)**	**Measured 1g-S.A.R. (mW/g)**	**Max Calc. 1g-S.A.R. (mW/g)**	**Meas. 10g-S.A.R. (mW/g)**	**Max Calc. 10g-S.A.R. (mW/g)**
Ab-R2-030905-18/158ABS0701	464.563	Fixed	NTN8971B	Against phantom	NNTN4020A	HCSN4001A	2.505	-0.780	3.940	2.36	2.860	1.71

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. value is determined by scaling the measured S.A.R. to account for power leveling variations and power output slump below the reported maximum power during the S.A.R. measurements. For this device the Maximum Calculated 1-gram and 10-gram averaged peak S.A.R. is calculated using the following formula:

Max. Calc. 1-g Avg. SAR = ((S.A.R. meas. / (10^(Pdrift/10))*(Pmax/Pint))* 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

8.0 Conclusion

The highest Operational Maximum Calculated 1-gram and 10-gram average S.A.R. values found for FCC ID: AZ489FT4851

At the body: 1-g Avg. = 2.36 mW/g; 10-g Avg. = 1.71 mW/g

The 1-g average result above at the body replaces the previously reported 1-g average results of 1.6mW/g at the body. The previously reported 1-g average result at the face of 1.17mW/g will remain current. 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

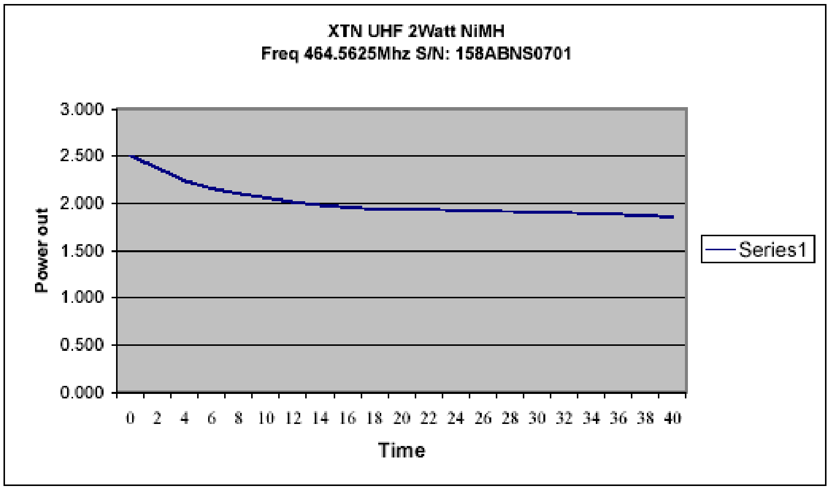
Power Slump Data

Equipment HP8920B Control # SMHPB030 calibration date Mar 17, 00 Due Mar 17, 02
9/19/2001

XTN UHF 2 Watts
Pilot pwr slump 9/19/01
NiMH

Radio S/N: 158ABS0701
Ch 2
freq 464.5625Mhz

Time	Pwr Out
0	2.505
2	2.377
4	2.239
6	2.158
8	2.104
10	2.061
12	2.014
14	1.982
16	1.959
18	1.941
20	1.941
22	1.936
24	1.928
26	1.919
28	1.914
30	1.910
32	1.901
34	1.892
36	1.884
38	1.871
40	1.858



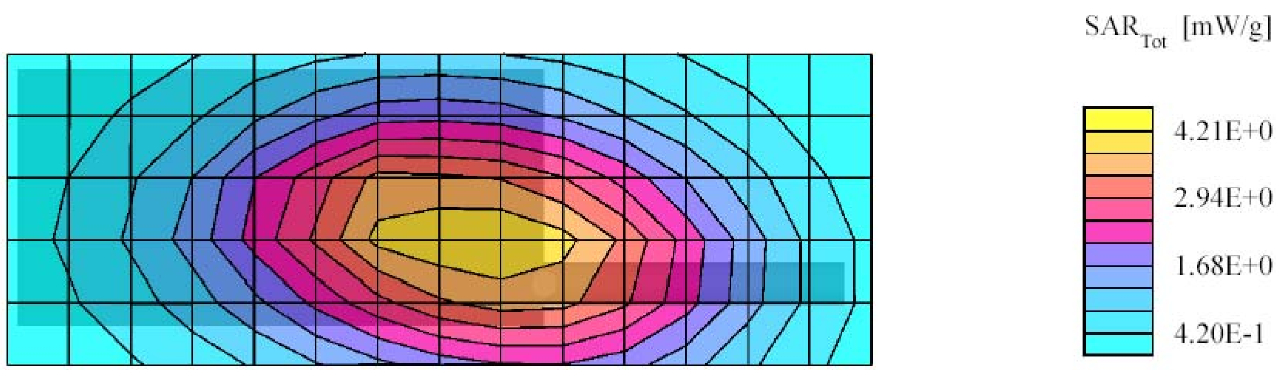
APPENDIX B
Data Results

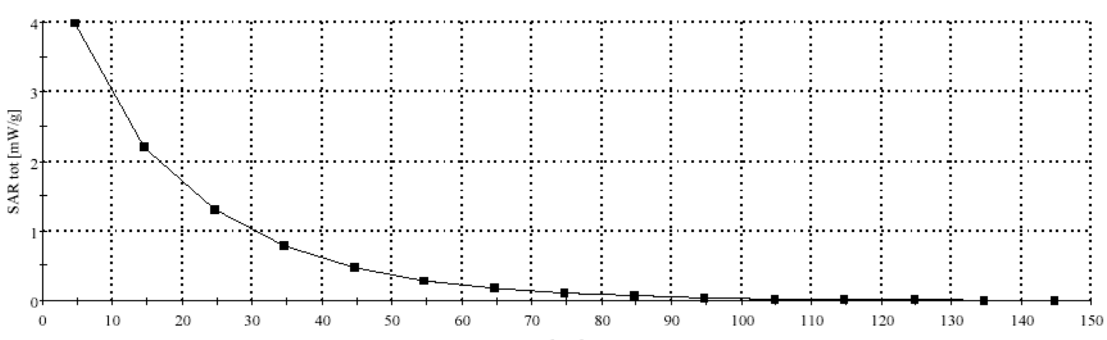
FCC ID: AZ489FT4851; Test Date: 9/5/03
Motorola CGISS EME Laboratory
RUN #: Ab-R2-030905-18
MODEL #: NUE2986A S/N: 158ABS0701
Tx freq: 464.563
Simulated tissue temp: 20.5
Start power : 2.505 W

Antenna/position: Fixed
Battery kit: NTN8971B
Carry Accessories: NNTN4020A
Audio/data accessories: HCSN4001A

DUT w/ carry case against the flat phantom

Flat Phantom; Flat Abdomen (1) Section; Position: (90°,90°);
Probe: ET3DV6 - SN1383 (Cal Date 26 February 2003); ConvF(7.50,7.50,7.50); Probe cal date: 26/02/03; Crest factor: 1.0;
FCC Body 465: σ = 0.91 mho/m ε = 54.7 ρ = 1.00 g/cm3; DAE3V1SN406 (11/11/02)
Cube 7x7x7: SAR (1g): 3.94 mW/g, SAR (10g): 2.86 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0; Max at 46.5, 118.5, 4.7
Power drift: -0.78dB





APPENDIX C
Dipole System Performance Check Results

Dipole validations at the head from SPEAG are provided herein. 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.

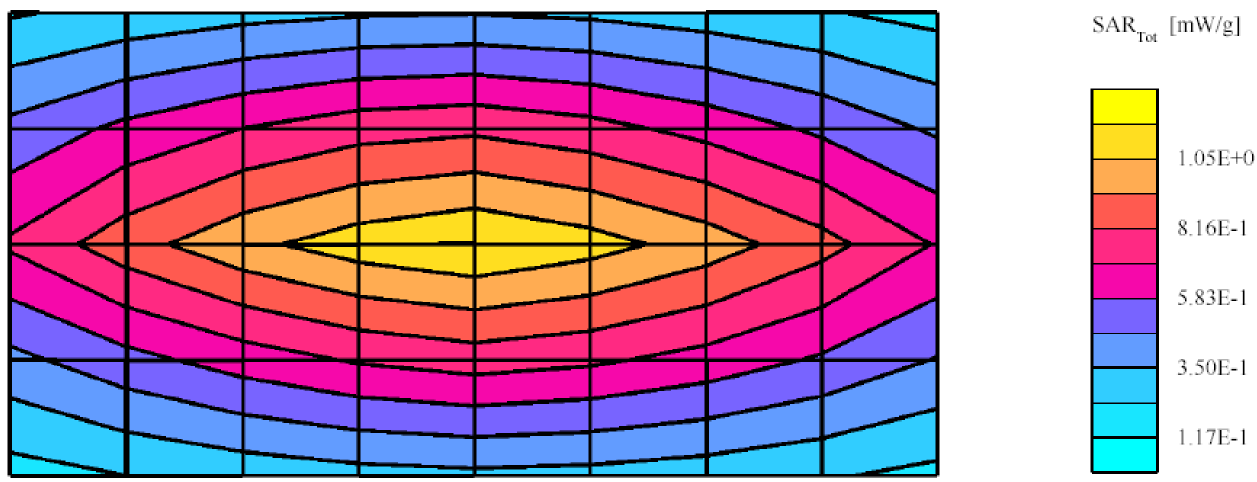
SPEAG 450 MHz Dipole D450V2; SN-1002; Test Date: 9/5/03

Motorola CGISS EME Lab

Run #: Sys Perf R2-030905-01
Tx Freq: 450MHz
Simulated tissue temp: 20.5 C
Start power: 250mW

Target:
4.52 mW/g for 1g SAR, 2.99 mW/g for 10g SAR, +/- 10% from system performance target 1/16/03.
SAR calculated 1g is 4.62 mW/g percent from target (including drift) is 2.24%
SAR Calculated 10g is 3.05 mW/g Percent from target (including drift) is 2.14%

Flat; Probe: ET3DV6 - SN1383 (Cal Date 26 February 2003);Probe Cal Date: 26/02/03ConvF(7.50,7.50,7.50); Crest factor: 1.0;
FCC Body 450: σ = 0.90 mho/m ε = 54.9 ρ = 1.00 g/cm^3; DAE3V1SN406 (11/11/02)
Cubes (2): Peak: 1.77 mW/g ± 0.02 dB, SAR (1g): 1.15 mW/g ± 0.02 dB, SAR (10g): 0.760 mW/g ± 0.02 dB, (Worst-case extrapolation) Penetration depth: 12.9 (11.5, 14.8) [mm]
Power drift: -0.02 dB



SYSTEM PERFORMANCE CHECK TARGET SAR

Date:	1/16/2003	Frequency (MHz):	450
Lab Location:	CGISS	Mixture Type:	FCC Body
Robot System:	CGISS 3	Ambient Temp.(^{o}C):	22.6, (Humid: 45%)
Probe Serial #:	ET3DV6-1393	Tissue Temp.(^{o}C):	21.5
DAE Serial #:	406		

Tissue Characteristics

Permitivity:	55.4	Phantom Type/SN:	80302002C/S7
Conductivity:	0.92	Distance (mm):	15 (tissue/dipole cnt)

Reference Source: D450V2 (Dipole)
Reference SN: 1002

Power to Dipole: 250 mW

Measured SAR Value: 1.13 mW/g, 0.748 mW/g (10g avg.)
Power Drift: 0 dB

New Target/Measured
SAR Value: 4.52 mW/g, 2.99 mW/g (10g avg.)
(normalized to 1.0 W, including drift)

Test performed by: J. Fortier Initial:

Dipole D450V2 SN1002; Test date:01/16/03

Run #: Sys Val_R3_030116-07
Model #: D450V2
Robot: CGISS-3
TX Freq: 450 MHz
Start Power; 250mW
DAE3: SN:406

Phantom #:80302002C/S7
SN: 1002
Tester: J. Fortier
Sim Tissue Temp: 21.5 (Celsius)

DAE Cal Date: 11/11/02

- Comments-

Target at 1W is 4.52 mW/g (1g), 2.99 mW/g (10g)
Flat; Probe: ET3DV6 - SN1393 SPEAG; ConvF(8.20,8.20,8.20); Crest factor: 1.0; FCC Body 450: $\sigma = 0.92$ mho/m $\varepsilon_r = 55.4$ $\rho = 1.00$ g/cm^3
Cubes (2): Peak: 1.74 mW/g ± 0.06 dB, SAR (1g): 1.13 mW/g ± 0.06 dB, SAR (10g): 0.748 mW/g ± 0.06 dB, (Worst-case extrapolation)
Penetration depth: 13.1 (11.6, 14.9) [mm]
Powerdrift: -0.00 dB

Motorola CGISS EME Lab

SYSTEM VALIDATION

Date:	1/16/2003	Frequency (MHz):	450
Lab Location:	CGISS	Mixture Type:	IEEE Head
Robot System:	CGISS 3	Ambient Temp.(°C):	22.6, (Humid: 46.4%)
Probe Serial #:	ET3DV6-1393	Tissue Temp.(°C):	21.2
DAE Serial #:	406		

Tissue Characteristics

Permitivity:	43.3	Phantom Type/SN:	80302002B/S6
Conductivity:	0.87	Distance (mm):	15 (tissue/dipole cnt)

Reference Source: D450V2 (Dipole)
Reference SN: 1002

Power to Dipole: 250 mW
Power Output (radio): ____ mW

Target SAR Value: 4.9 mW/g, 3.3 mW/g (10g avg.)
(normalized to 1.0 W)

Measured SAR Value: 1.17 mW/g, 0.774 mW/g (10g avg.)
Power Drift: -0.02 dB

Measured SAR Value: 4.70 mW/g, 3.11 mW/g (10g avg.)
(normalized to 1.0 W, including drift)

Percent Difference From Target (MUST be within System Uncertainty): 4.05 % (1g ave)
5.75 % (10g ave)

Test performed by: J. Fortier Initial:

SYSTEM PERFORMANCE CHECK TARGET SAR

Date:	1/16/2003	Frequency (MHz):	450
Lab Location:	CGISS	Mixture Type:	IEEE Head
Robot System:	CGISS 3	Ambient Temp.(^{o}C):	22.6, (Humid: 46.4%)
Probe Serial #:	ET3DV6-1393	Tissue Temp.(^{o}C):	21.2
DAE Serial #:	406		

Tissue Characteristics

Permitivity:	43.3	Phantom Type/SN:	80302002B/S6
Conductivity:	0.87	Distance (mm):	15 (tissue/dipole cnt)

Reference Source:	D450V2	(Dipole)
Reference SN:	1002	

Power to Dipole: 250 mW

Measured SAR Value:	1.17 mW/g,	0.774 mW/g (10g avg.)
Power Drift:	-0.02 dB	

New Target/Measured SAR Value: (normalized to 1.0 W, including drift)	4.70 mW/g,	3.11 mW/g (10g avg.)

Test performed by: J. Fortier Initial:

Dipole D450V2 SN1002; Test date:01/16/03

Run #: Sys Val_R3_030116-04
Model #: D450V2
Robot: CGISS-3
TX Freq: 450 MHz
Start Power: 250mW
DAE3: SN:406

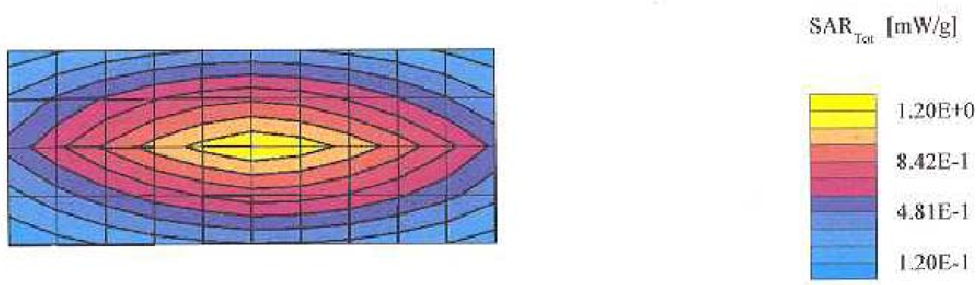
Phantom #:80302002B/S6
SN: 1002
Tester: J. Fortier
Sim Tissue Temp: 21.2 (Celsius)

DAE Cal Date: 11/11/02

- Comments-

Target at 1W is 4.9 mW/g (1g)

SAR calculated is 4.7 mW/g. Percent from IEEE-1528 target (including drift) for 1g is 4.0%
Flat; Probe: ET3DV6 - SN1393 SPEAG; ConvF(8.00,8.00,8.00); Crest factor: 1.0; IEEE Head 450 MHz: σ = 0.87 mho/m ε_r = 43.3 ρ = 1.00 g/cm^3
Cubes (2): Peak: 1.81 mW/g ± 0.05 dB, SAR (1g): 1.17 mW/g ± 0.05 dB, SAR (10g): 0.774 mW/g ± 0.06 dB, (Worst-case extrapolation)
Penetration depth: 12.8 (11.4, 14.5) [mm]
Powerdrift: -0.02 dB



Motorola CGISS EME Lab

APPENDIX D

Calibration Certificates

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

Client Motorola CGISS

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1383
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	February 26, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	8-Mar-02	Mar-03
Power sensor HP 8481A	MY41092180	18-Sep-02	Sep-03
Power meter EPM E4419B	GB41293874	13-Sep-02	Sep-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01	Sep-03

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

Date issued: February 26, 2003

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:1383

Sensitivity in Free Space

NormX	1.80	$\mu V/(V/m)^2$
NormY	1.55	$\mu V/(V/m)^2$
NormZ	1.62	$\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** $\varepsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m
Head **835 MHz** $\varepsilon_r = 41.5 \pm 5\%$ $\sigma = 0.90 \pm 5\%$ mho/m

ConvF X	6.5	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5	± 9.5% (k=2)	Alpha	0.59
ConvF Z	6.5	± 9.5% (k=2)	Depth	1.97

Head **1800 MHz** $\varepsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m
Head **1900 MHz** $\varepsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

ConvF X	5.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2	± 9.5% (k=2)	Alpha	0.57
ConvF Z	5.2	± 9.5% (k=2)	Depth	2.54

Boundary Effect

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

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	10.0	5.2
SAR_{be} [%]	With Correction Algorithm	0.1	0.5

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

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	15.1	9.9
SAR_{be} [%]	With Correction Algorithm	0.2	0.0

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	0.5 ± 0.2	mm

Schmid & Partner
Engineering AG

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ET3DV6**
Serial Number:	**1383**
Place of Assessment:	**Zurich**
Date of Assessment:	**February 28, 2003**
Probe Calibration Date:	**February 26, 2003**

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:1383

Conversion factor (± standard deviation)

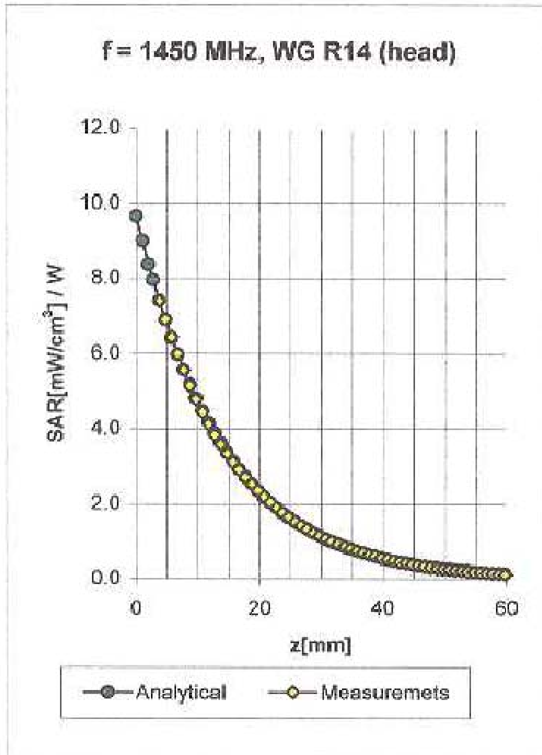
150 MHz	ConvF	8.1 ± 8%	ε_r = 61.9 σ = 0.80 mho/m (body tissue)
236 MHz	ConvF	7.9 ± 8%	ε_r = 59.8 σ = 0.87 mho/m (body tissue)
300 MHz	ConvF	7.8 ± 8%	ε_r = 58.2 σ = 0.92 mho/m (body tissue)
350 MHz	ConvF	7.8 ± 8%	ε_r = 57.7 σ = 0.93 mho/m (body tissue)
450 MHz	ConvF	7.5 ± 8%	ε_r = 56.7 σ = 0.94 mho/m (body tissue)
784 MHz	ConvF	6.5 ± 8%	ε_r = 55.4 σ = 0.97 mho/m (body tissue)
1450 MHz	ConvF	5.3 ± 8%	ε_r = 54.0 σ = 1.30 mho/m (body tissue)

Dosimetric E-Field Probe ET3DV6 SN:1383

Conversion factor (± standard deviation)

150 MHz ✓	ConvF	9.0 ± 8 %	$\varepsilon_r = 52.3$ $\sigma = 0.76$ mho/m (head tissue)
236 MHz ✓	ConvF	8.2 ± 8 %	$\varepsilon_r = 48.3$ $\sigma = 0.82$ mho/m (head tissue)
300 MHz ✓	ConvF	7.7 ± 8 %	$\varepsilon_r = 45.3$ $\sigma = 0.87$ mho/m (head tissue)
350 MHz ✓	ConvF	7.7 ± 8 %	$\varepsilon_r = 44.7$ $\sigma = 0.87$ mho/m (head tissue)
400 MHz ✓	ConvF	7.5 ± 8 %	$\varepsilon_r = 44.4$ $\sigma = 0.87$ mho/m (head tissue - CENELEC)
450 MHz ✓	ConvF	7.5 ± 8 %	$\varepsilon_r = 43.5$ $\sigma = 0.87$ mho/m (head tissue)
784 MHz ✓	ConvF	6.7 ± 8 %	$\varepsilon_r = 41.8$ $\sigma = 0.90$ mho/m (head tissue)

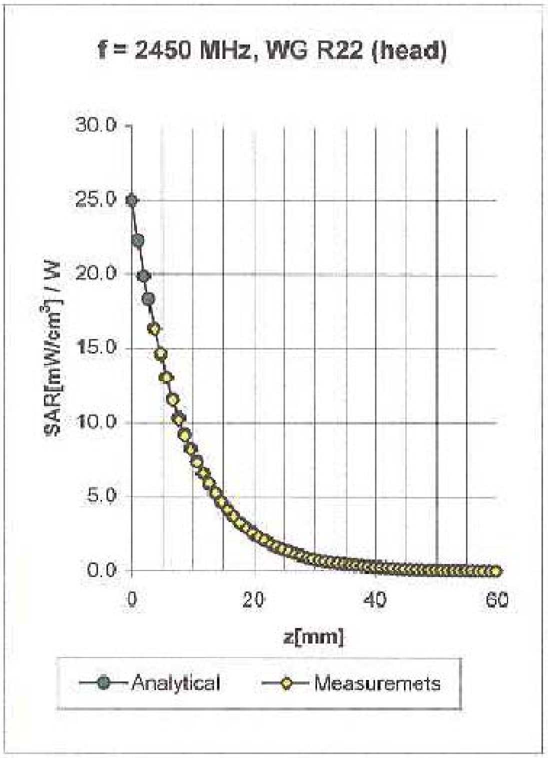
Conversion Factor Assessment

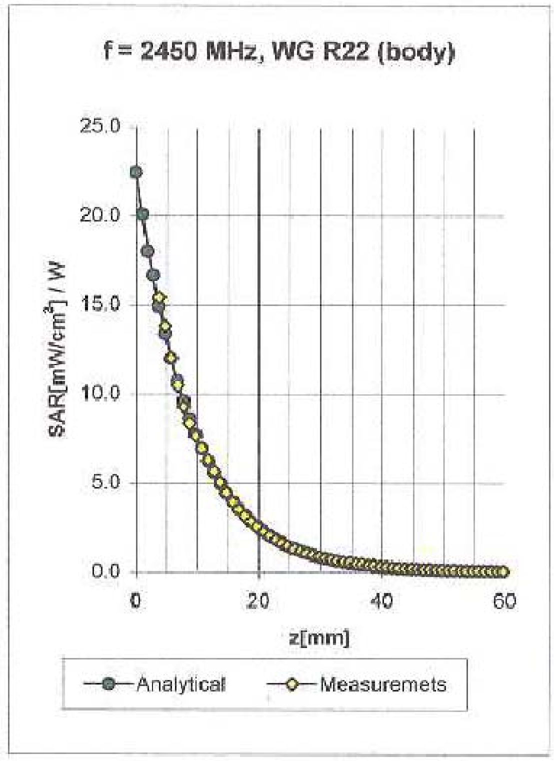


Head	1450 MHz	ε_r = 40.4 ± 5%	σ = 1.23 ± 5% mho/m

ConvF X	**5.8** ± 8.9% (k=2)		Boundary effect:	
ConvF Y	**5.8** ± 8.9% (k=2)		Alpha	**0.75**
ConvF Z	**5.8** ± 8.9% (k=2)		Depth	**1.91**

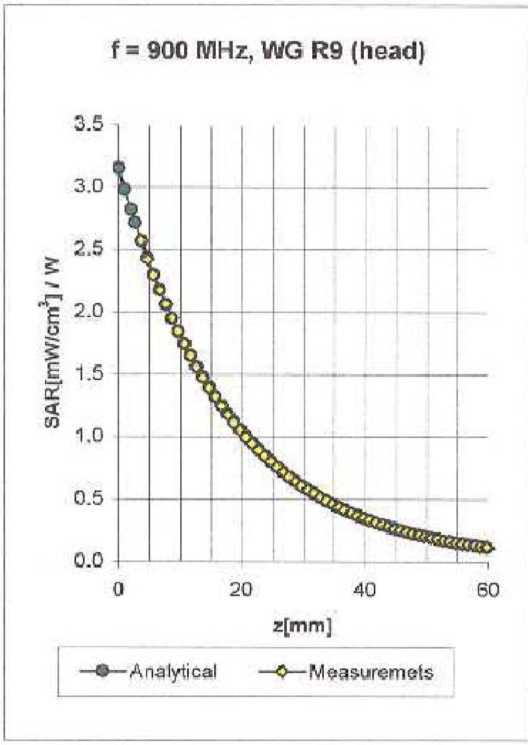
Conversion Factor Assessment

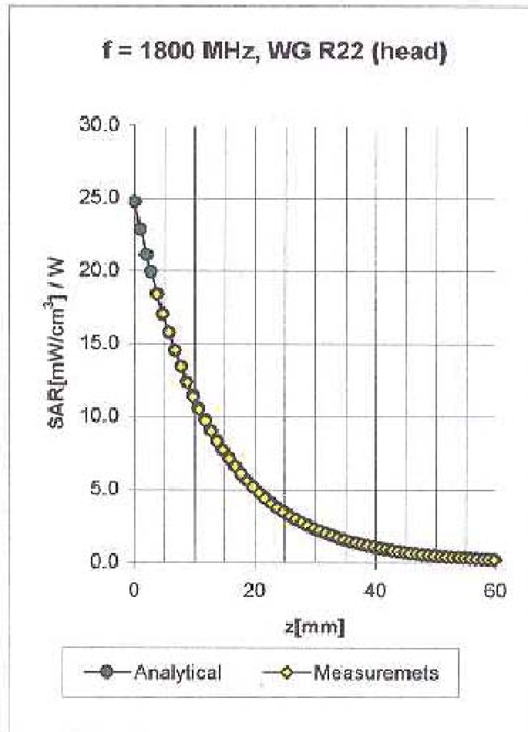




Head	**2450**	**MHz**	ε_r = 39.2 ± 5%	σ = 1.80 ± 5% mho/m
	ConvF X	**5.0** ± 8.9% (k=2)	Boundary effect:	
	ConvF Y	**5.0** ± 8.9% (k=2)	Alpha	**1.15**
	ConvF Z	**5.0** ± 8.9% (k=2)	Depth	**1.76**
Body	**2450**	**MHz**	ε_r = 52.7 ± 5%	σ = 1.95 ± 5% mho/m
	ConvF X	**4.7** ± 8.9% (k=2)	Boundary effect:	
	ConvF Y	**4.7** ± 8.9% (k=2)	Alpha	**2.00**
	ConvF Z	**4.7** ± 8.9% (k=2)	Depth	**1.24**

Conversion Factor Assessment

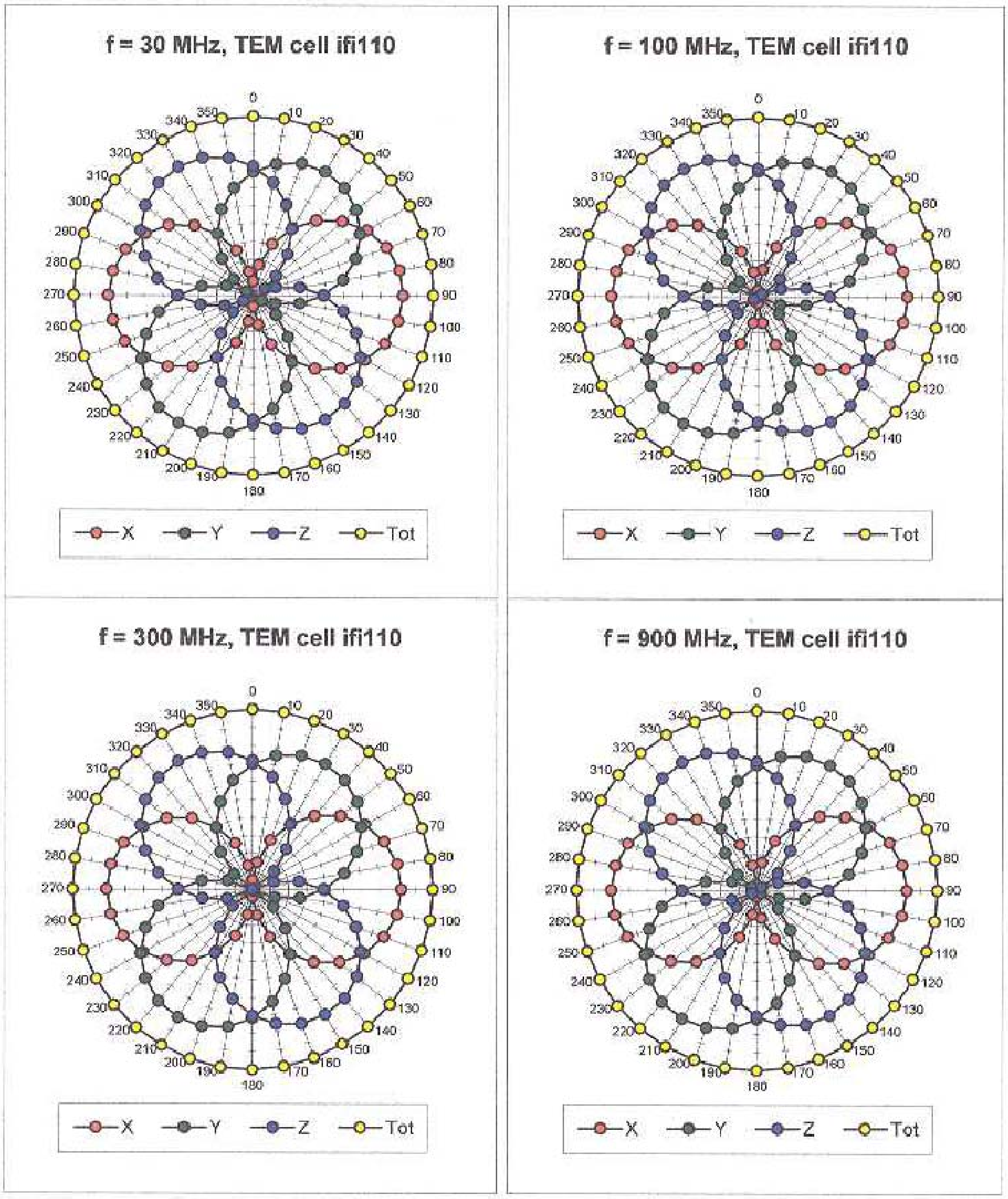


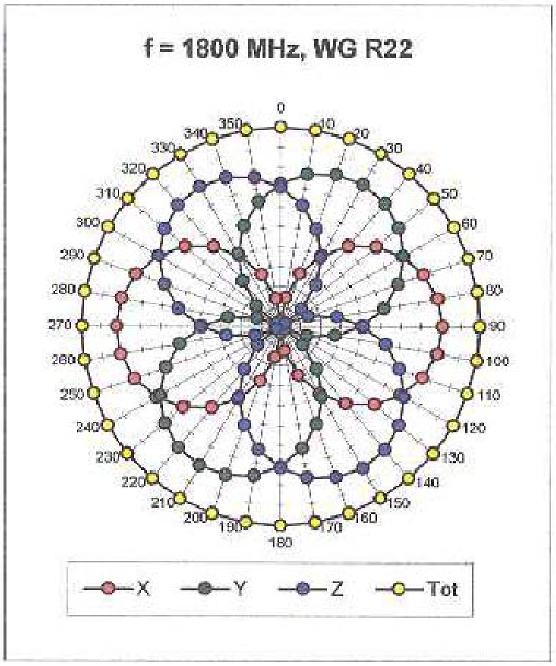


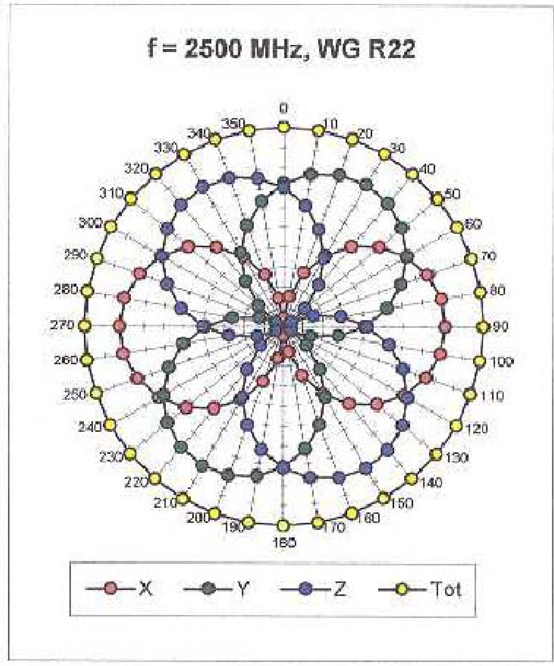
Head	**900 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.97 ± 5% mho/m**	
Head	**835 MHz**		**ε_r = 41.5 ± 5%**	**σ = 0.90 ± 5% mho/m**	
	ConvF X	**6.5**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**6.5**	± 9.5% (k=2)	Alpha	**0.59**
	ConvF Z	**6.5**	± 9.5% (k=2)	Depth	**1.97**

Head	**1800 MHz**		**ε_r = 40.0 ± 5%**	**σ = 1.40 ± 5% mho/m**	
Head	**1900 MHz**		**ε_r = 40.0 ± 5%**	**σ = 1.40 ± 5% mho/m**	
	ConvF X	**5.2**	± 9.5% (k=2)	Boundary effect:	
	ConvF Y	**5.2**	± 9.5% (k=2)	Alpha	**0.57**
	ConvF Z	**5.2**	± 9.5% (k=2)	Depth	**2.54**

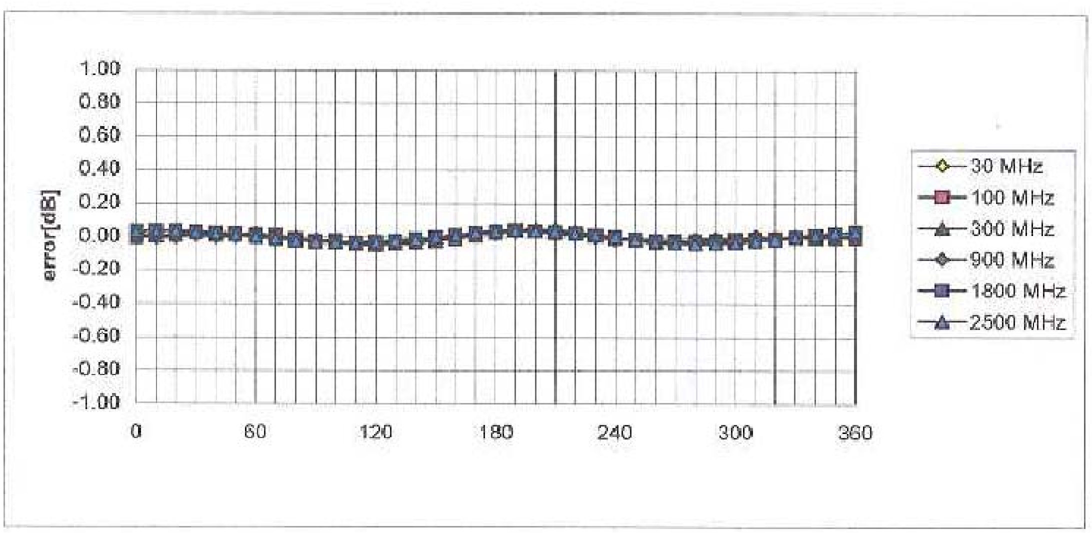
Receiving Pattern (ϕ), $\theta = 0°$





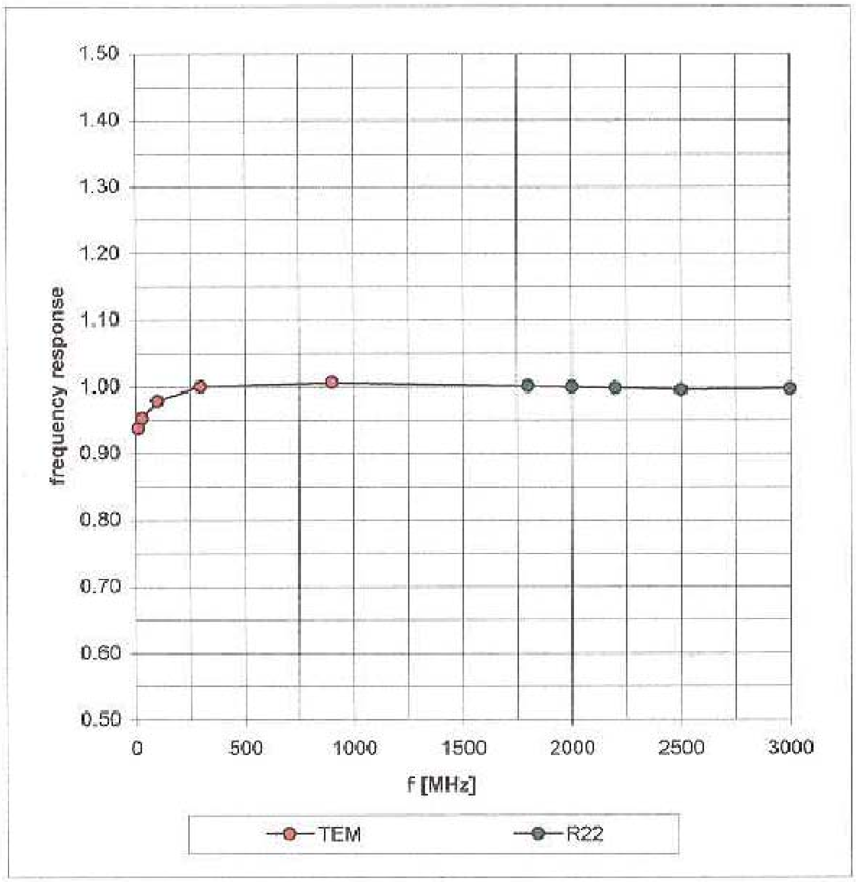


Isotropy Error (ϕ), θ = 0°



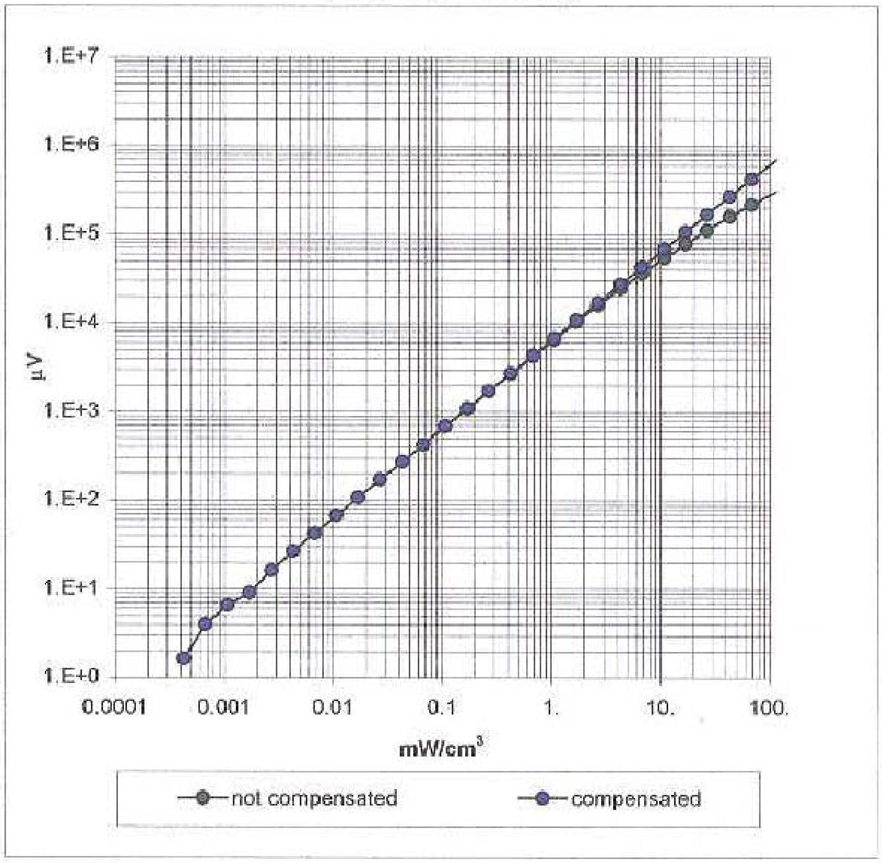
Frequency Response of E-Field

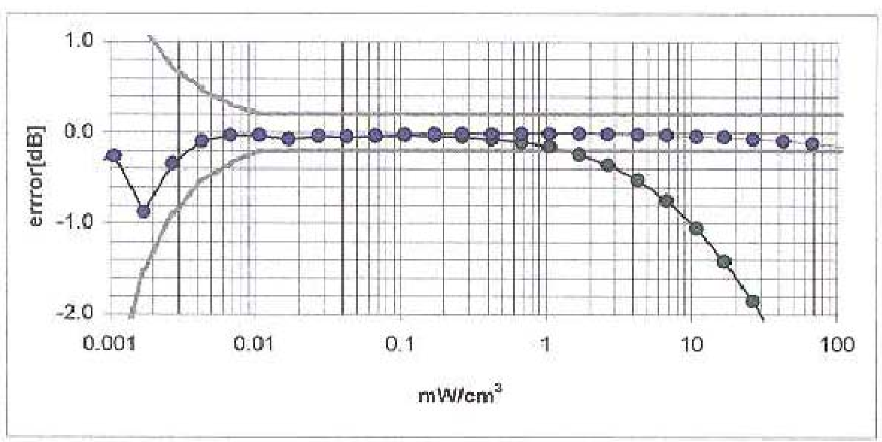
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain})

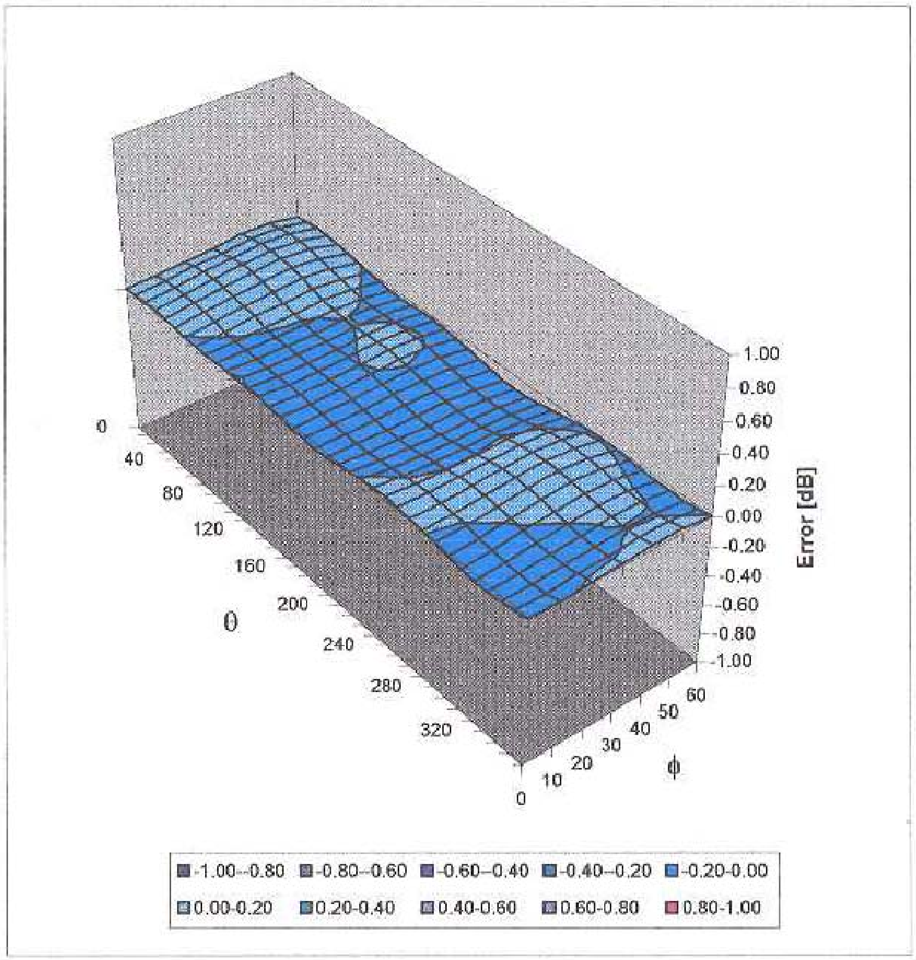
(Waveguide R22)





Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



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:	**1002**
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: Volkoni Katja

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**	± 5%
Conductivity	**0.86 mho/m**	± 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 ± 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 cm^3 (**1 g**) of tissue:	**4.81 mW/g** (Advanced Extrapolation)
averaged over 10 cm^3 (10 g) of tissue:	**3.19 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:	**1.347 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:	Re{Z} = **57.2 Ω**
	Im {Z} = **-5.2 Ω**
Return Loss at 450 MHz	**-21.7 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.

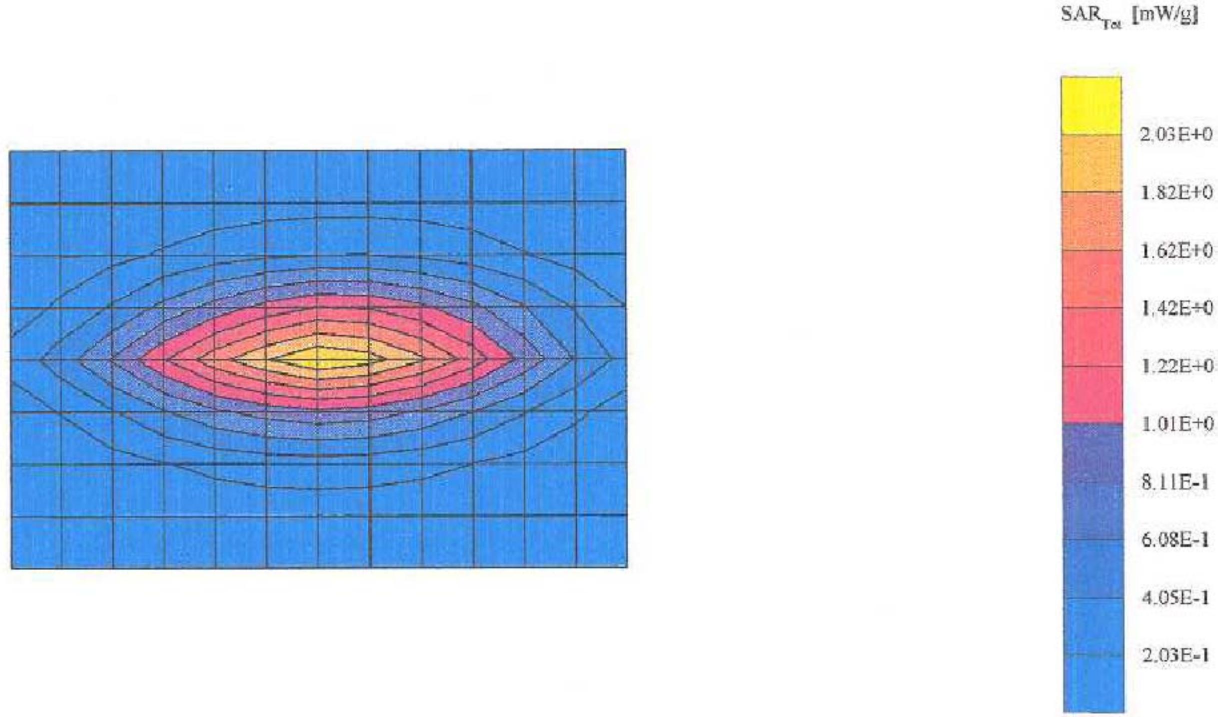
6. Power Test

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

03/27/02

Validation Dipole D450V2 SN:1002, d = 15 mm

Frequency: 450 MHz; Antenna Input Power: 389 [mW]
Phantom Name: Calibration, Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(7.20,7.20,7.20); Crest factor: 1.0; Head 450 MHz: σ = 0.86 mho/m ε_r = 44.5 ρ = 1.00 g/cm^3
Cubes (2): Peak: 2.84 mW/g ± 0.03 dB, SAR (1g): 1.87 mW/g ± 0.03 dB, SAR (10g): 1.24 mW/g ± 0.03 dB , (Advanced extrapolation)
Penetration depth: 13.0 (11.9, 14.4) [mm]



Schmid & Partner Engineering AG, Zurich, Switzerland