

APPENDIX D: PROBE CALIBRATION

PCTEST SAR REPORT		FCC CERTIFICATION			Reviewed by: Quality Manager
SAR Filename: SAR.240309236.AZ4	Test Dates: March 22-24, 2004	Phone Type: Dual-Mode PTT Phone (iDEN/ISM)	FCC ID: AZ489FT5831	Page D-1 of D-22	

APPENDIX D: PROBE CALIBRATION

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

Client

PC Test

CALIBRATION CERTIFICATE																																			
Object(s)	ES3DV2 - SN 3022																																		
Calibration procedure(s)	QA CAL-01 v2 Calibration procedure for dosimetric E-field probes																																		
Calibration date:	September 23, 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) <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 25%;">Model Type</th> <th style="width: 15%;">ID #</th> <th style="width: 35%;">Cal Date (Calibrated by, Certificate No.)</th> <th style="width: 25%;">Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM E4419B</td> <td>GB41293874</td> <td>2-Apr-03 (METAS, No 252-0250)</td> <td>Apr-04</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY41495277</td> <td>2-Apr-03 (METAS, No 252-0250)</td> <td>Apr-04</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5086 (20b)</td> <td>3-Apr-03 (METAS No. 251-0340)</td> <td>Apr-04</td> </tr> <tr> <td>Fluke Process Calibrator Type 702</td> <td>SN: 6295803</td> <td>8-Sep-03 (Sintrel SCS No. E-030020)</td> <td>Sep-04</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>MY41092180</td> <td>18-Sep-02 (Agilent, No. 20020918)</td> <td>In house check: Oct 03</td> </tr> <tr> <td>RF generator HP 8984C</td> <td>US3642U01700</td> <td>4-Aug-99 (SPEAG, in house check Aug-02)</td> <td>In house check: Aug-05</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (Agilent, No. 24BR1033101)</td> <td>In house check: Oct 03</td> </tr> </tbody> </table>				Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04	Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04	Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04	Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04	Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03	RF generator HP 8984C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05	Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
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Calibrated by:	Name Katja Pukovik	Function Laboratory Director	Signature 																																
Approved by:	Name Nils Kuster	Function Quality Manager	Signature 																																
Date issued: October 5, 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.																																			

PCTEST SAR REPORT		FCC CERTIFICATION		Reviewed by: Quality Manager
SAR Filename: SAR.240309236.AZ4	Test Dates: March 22-24, 2004	Phone Type: Dual-Mode PTT Phone (iDEN/ISM)	FCC ID: AZ489FT5831	Page D-2 of D-22

Schmid & Partner Engineering AG

s p e a g

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info@speag.com, <http://www.speag.com>

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Last calibration: September 23, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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DASY - Parameters of Probe: ES3DV2 SN:3022

Sensitivity in Free Space

Diode Compression

NormX	1.00 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	95	mV
NormY	1.04 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	95	mV
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	95	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m
Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha	0.32
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth	1.65

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha	0.25
ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth	2.30

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	5.5	2.5
SAR _{be} [%] With Correction Algorithm	0.1	0.4

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	7.1	4.4
SAR _{be} [%] With Correction Algorithm	0.0	0.1

Sensor Offset

Probe Tip to Sensor Center 2.0 mm

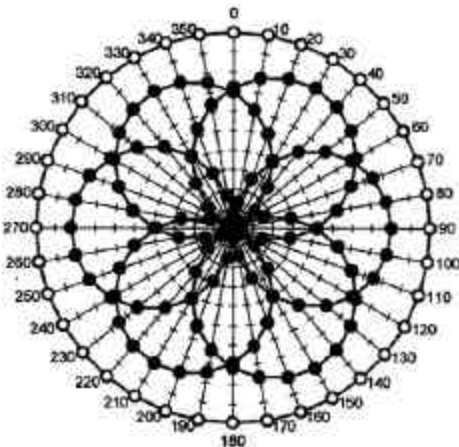
PCTEST SAR REPORT		FCC CERTIFICATION		Reviewed by: Quality Manager
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ES3DV2 SN:3022

September 23, 2003

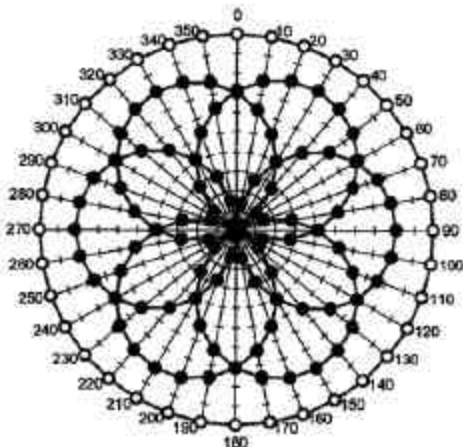
Receiving Pattern (ϕ , $\theta = 0^\circ$)

f = 30 MHz, TEM cell ifi110



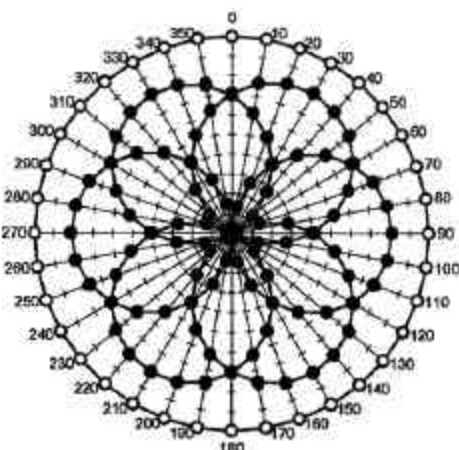
—●— X —●— Y —●— Z —○— Tot

f = 100 MHz, TEM cell ifi110



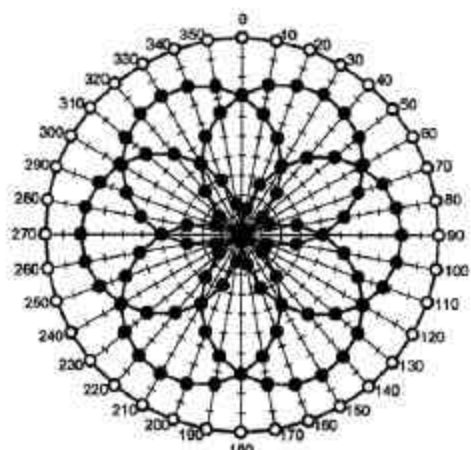
—●— X —●— Y —●— Z —○— Tot

f = 300 MHz, TEM cell ifi110



—●— X —●— Y —●— Z —○— Tot

f = 900 MHz, TEM cell ifi110

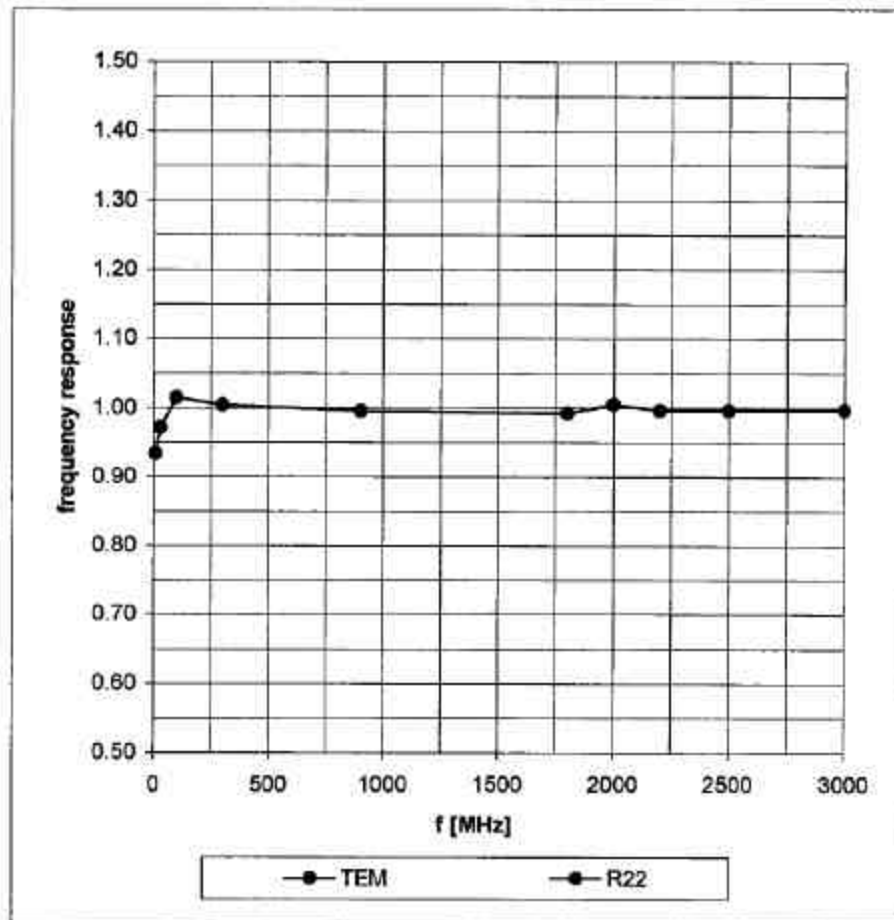


—●— X —●— Y —●— Z —○— Tot

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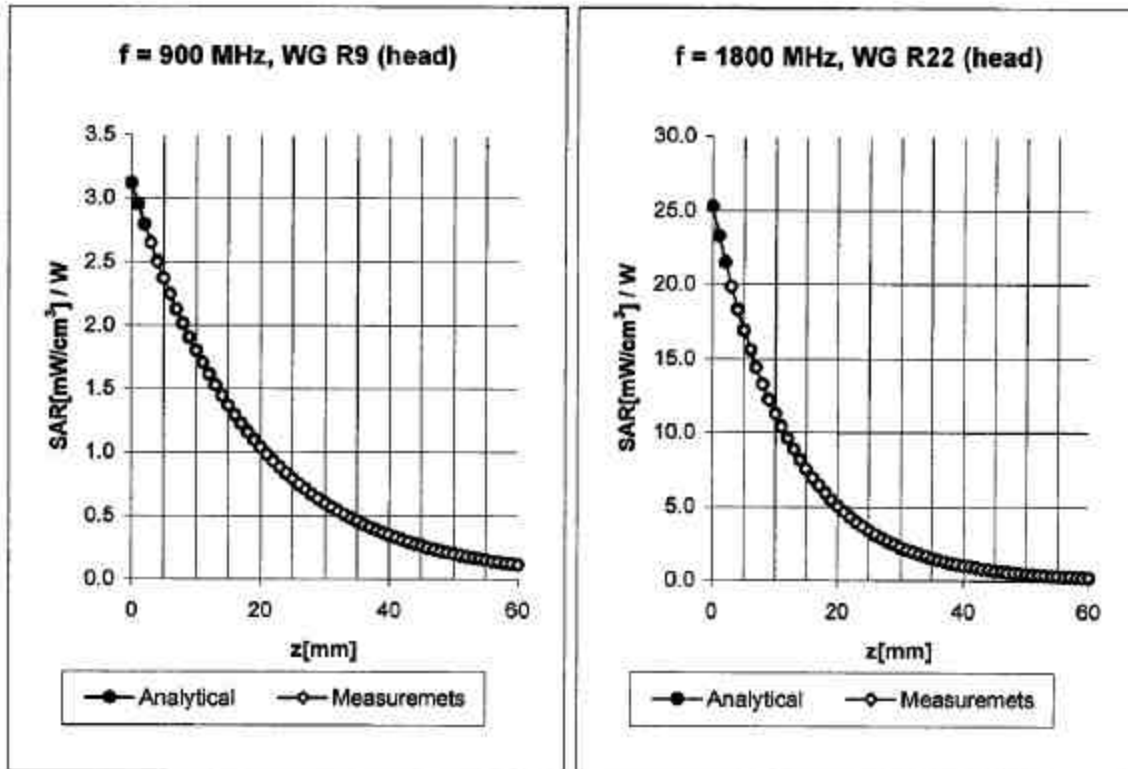
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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Conversion Factor Assessment



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

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha	0.32
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth	1.65

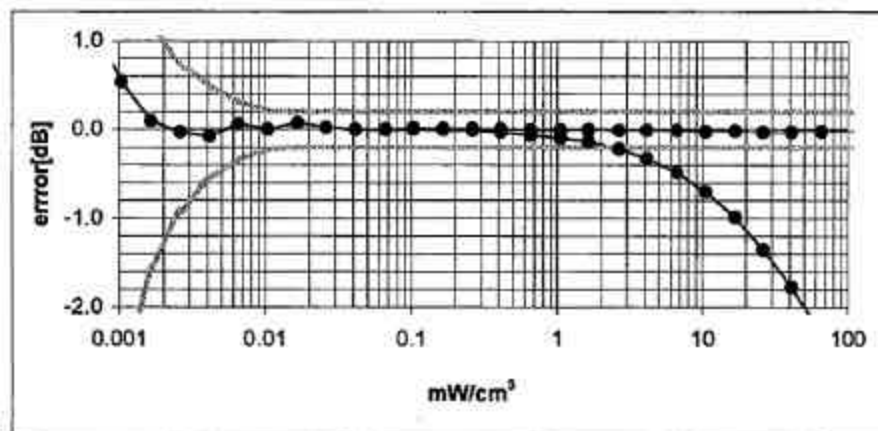
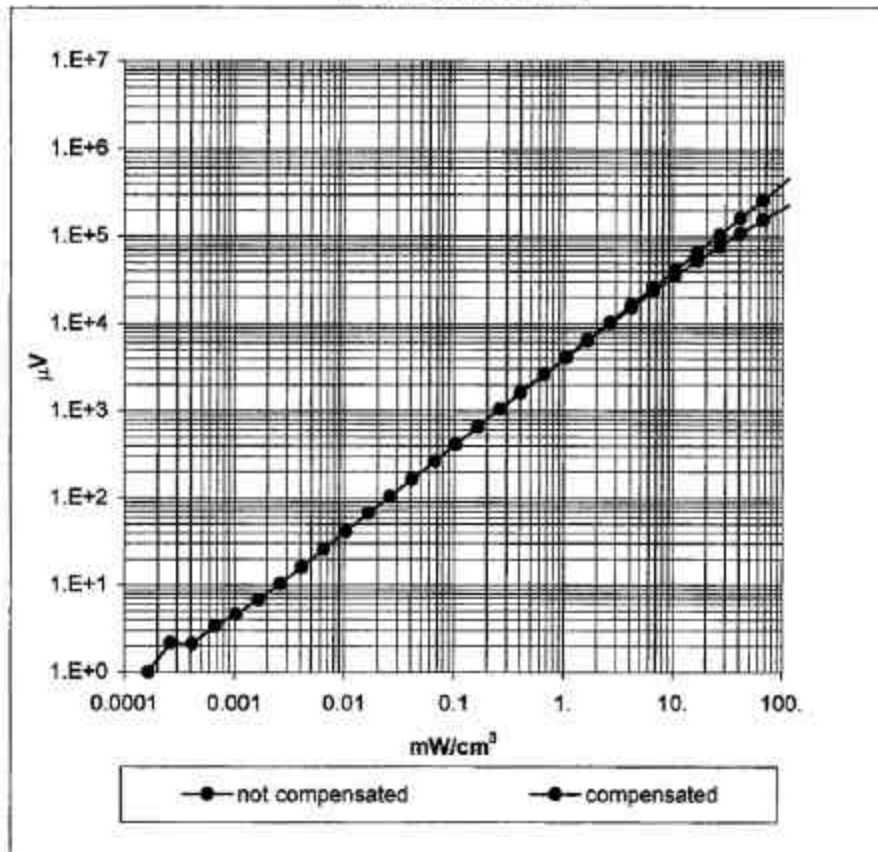
Head **1800 MHz** $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha	0.25
ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth	2.30

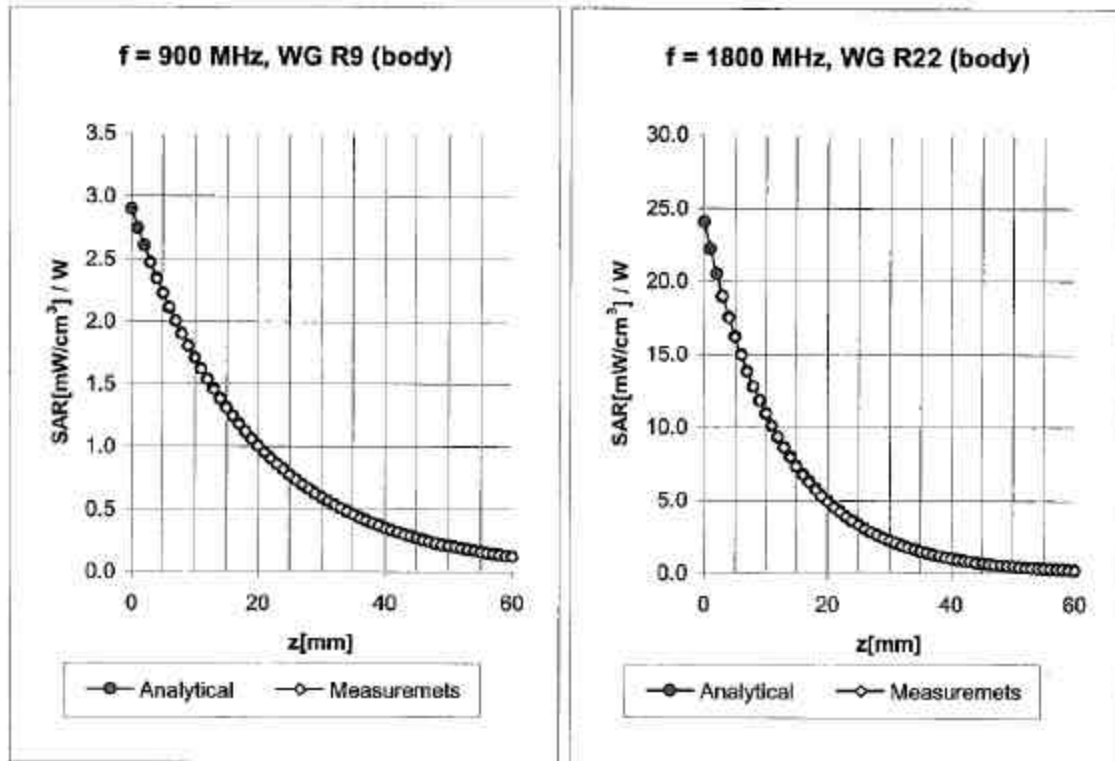
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Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



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Conversion Factor Assessment



Body **900 MHz** $\epsilon_r = 55.0 \pm 5\%$ $\sigma = 1.05 \pm 5\% \text{ mho/m}$

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	6.0 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.0 $\pm 9.5\%$ (k=2)	Alpha	0.38
ConvF Z	6.0 $\pm 9.5\%$ (k=2)	Depth	1.47

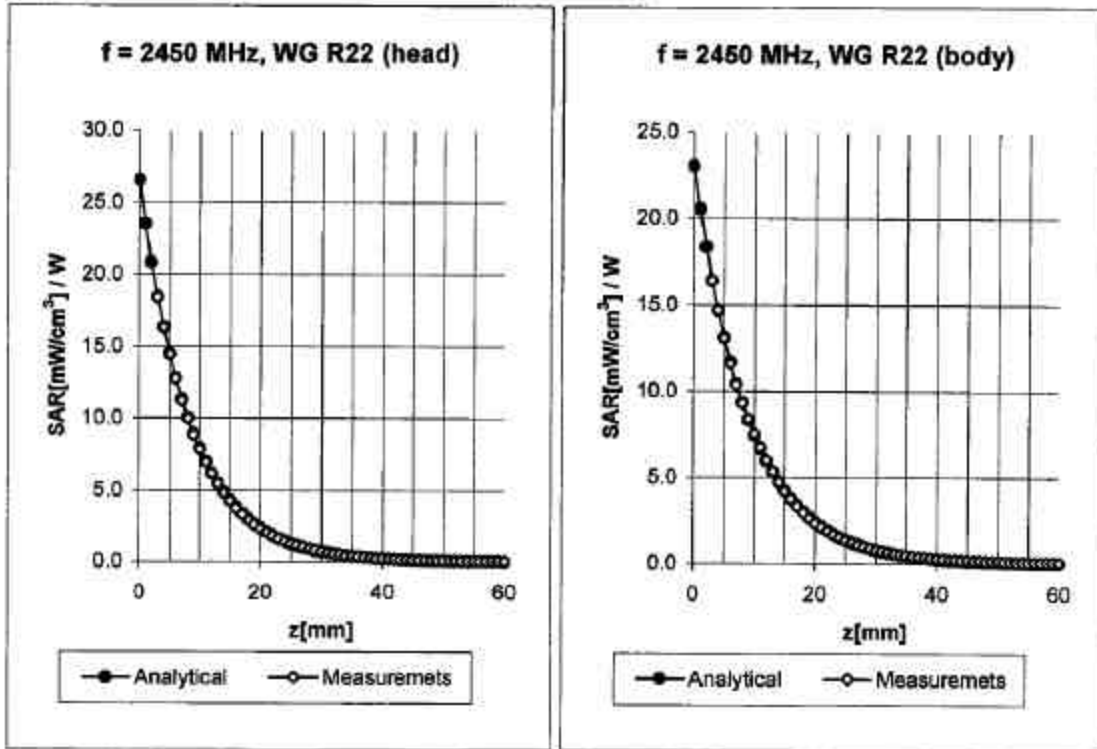
Body **1800 MHz** $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	4.5 $\pm 9.5\%$ (k=2)	Alpha	0.22
ConvF Z	4.5 $\pm 9.5\%$ (k=2)	Depth	3.42

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Conversion Factor Assessment



Head 2450 MHz $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\%$ mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.5 $\pm$ 9.5% (k=2)	Boundary effect:	
ConvF Y	4.5 $\pm$ 9.5% (k=2)	Alpha	0.42
ConvF Z	4.5 $\pm$ 9.5% (k=2)	Depth	1.56

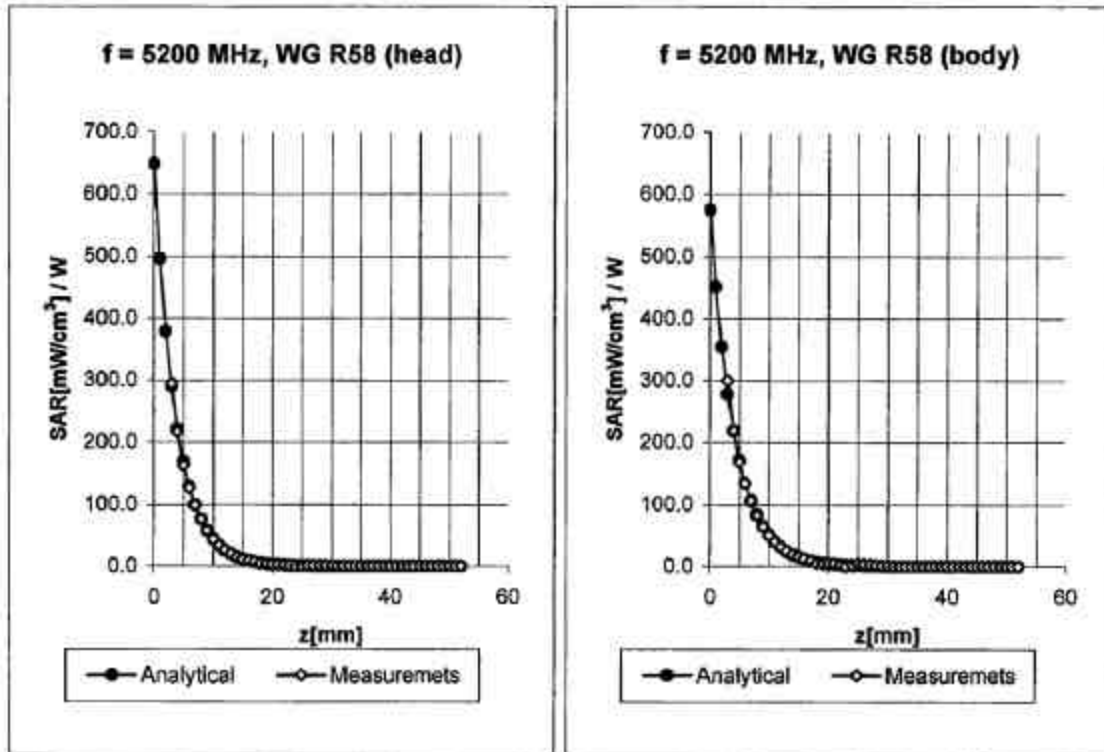
Body 2450 MHz $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.2 $\pm$ 9.5% (k=2)	Boundary effect:	
ConvF Y	4.2 $\pm$ 9.5% (k=2)	Alpha	0.42
ConvF Z	4.2 $\pm$ 9.5% (k=2)	Depth	1.65

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Conversion Factor Assessment



Head **5200 MHz** $\epsilon_r = 36.0 \pm 5\%$ $\sigma = 4.66 \pm 5\% \text{ mho/m}$

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET65-SuppC

ConvF X	2.60 $\pm 16.6\%$ (k=2)	Boundary effect:	
ConvF Y	2.60 $\pm 16.6\%$ (k=2)	Alpha	0.93
ConvF Z	2.60 $\pm 16.6\%$ (k=2)	Depth	1.50

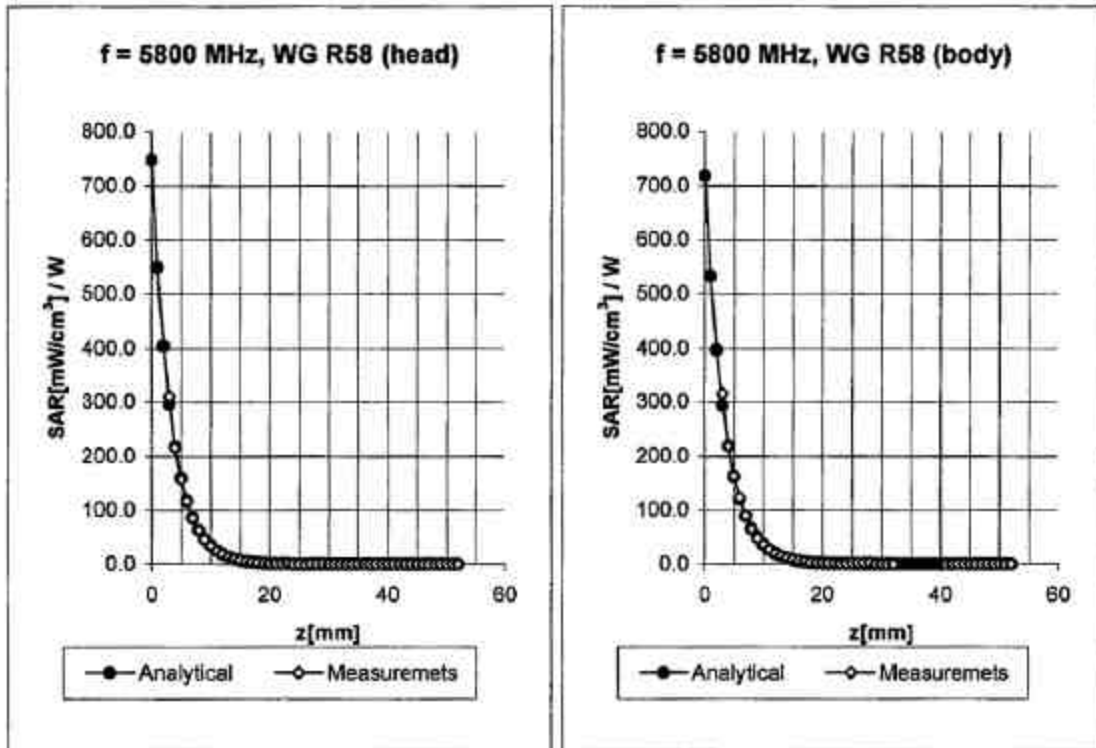
Body **5200 MHz** $\epsilon_r = 49.0 \pm 5\%$ $\sigma = 5.30 \pm 5\% \text{ mho/m}$

Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET65-SuppC

ConvF X	1.80 $\pm 16.6\%$ (k=2)	Boundary effect:	
ConvF Y	1.80 $\pm 16.6\%$ (k=2)	Alpha	1.05
ConvF Z	1.80 $\pm 16.6\%$ (k=2)	Depth	1.60

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Conversion Factor Assessment



Head **5800 MHz** $\epsilon_r = 35.3 \pm 5\%$ $\sigma = 5.27 \pm 5\%$ mho/m

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET65-SuppC

ConvF X	2.15 $\pm 16.6\%$ (k=2)	Boundary effect:
ConvF Y	2.15 $\pm 16.6\%$ (k=2)	Alpha 1.04
ConvF Z	2.15 $\pm 16.6\%$ (k=2)	Depth 1.50

Body **5800 MHz** $\epsilon_r = 48.2 \pm 5\%$ $\sigma = 6.0 \pm 5\%$ mho/m

Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET65-SuppC

ConvF X	1.57 $\pm 16.6\%$ (k=2)	Boundary effect:
ConvF Y	1.57 $\pm 16.6\%$ (k=2)	Alpha 1.15
ConvF Z	1.57 $\pm 16.6\%$ (k=2)	Depth 1.70

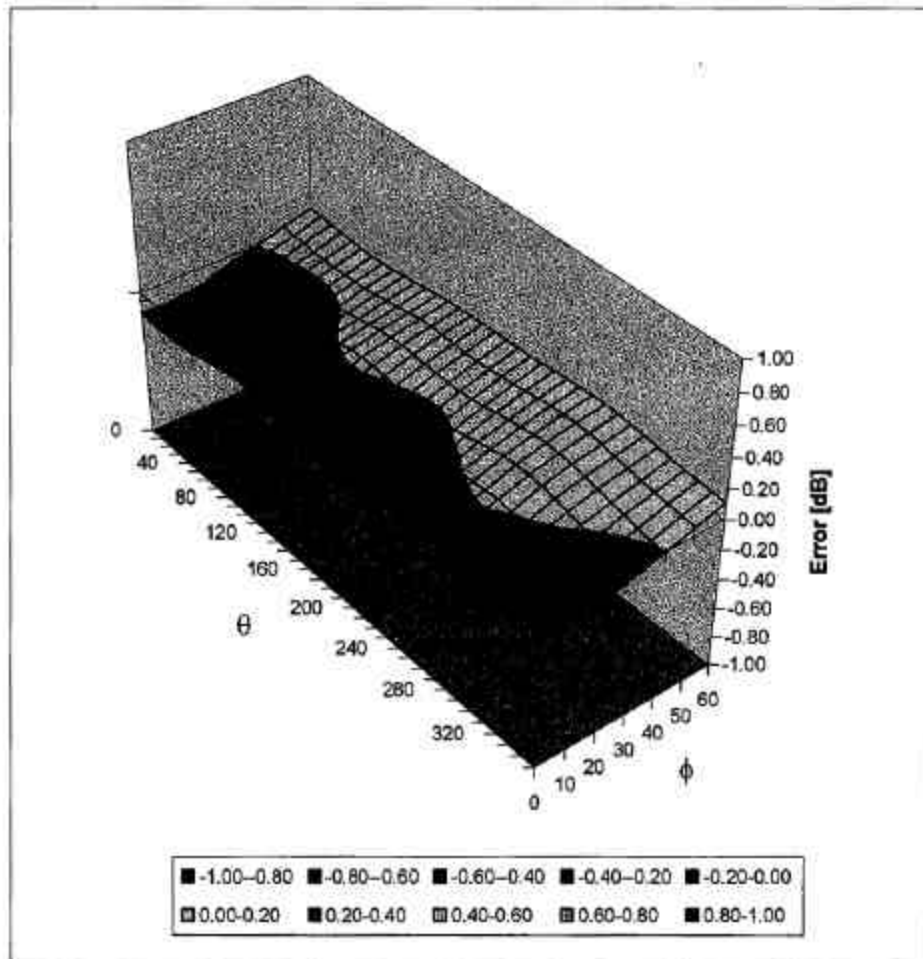
PCTEST SAR REPORT		FCC CERTIFICATION		Reviewed by: Quality Manager
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ES3DV2 SN:3022

September 23, 2003

Deviation from Isotropy in HSL

Error ($\theta\phi$), $f = 900$ MHz



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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3022

Place of Assessment:

Zurich

Date of Assessment:

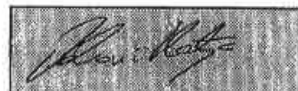
December 3, 2003

Probe Calibration Date:

September 23, 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:



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Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor ($\pm$ standard deviation)

1950 MHz	ConvF	4.7 $\pm$ 9.5%	$E = 40.0 \pm 5\%$ $\rho = 1.40 \pm 5\%$ mho/m (head tissue)
1950 MHz	ConvF	4.3 $\pm$ 9.5%	$E = 53.3 \pm 5\%$ $\rho = 1.52 \pm 5\%$ mho/m (body tissue)

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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3022

Place of Assessment:

Zurich

Date of Assessment:

October 3, 2003

Probe Calibration Date:

September 23, 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:



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 info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor ($\pm$ standard deviation)

150 MHz	ConvF	8.5 $\pm$ 8%	$\epsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m (head tissue)
150 MHz	ConvF	8.0 $\pm$ 8%	$\epsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m (body tissue)
450 MHz	ConvF	7.1 $\pm$ 8%	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 MHz	ConvF	7.2 $\pm$ 8%	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (body tissue)

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Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3022

Place of Assessment:

Zurich

Date of Assessment:

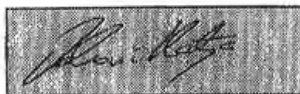
November 28, 2003

Probe Calibration Date:

September 23, 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:



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Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor ($\pm$ standard deviation)

1600 MHz ConvF $5.2 \pm 8\%$

$\epsilon = 40.3 \pm 5\%$
 $\sigma = 1.29 \pm 5\%$ mho/m
 (head tissue)

1600 MHz ConvF $4.9 \pm 8\%$

$\epsilon = 53.8 \pm 5\%$
 $\sigma = 1.40 \pm 5\%$ mho/m
 (body tissue)

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Schmid & Partner Engineering AG

s p e a g

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info@speag.com, <http://www.speag.com>

Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3022

Place of Assessment:

Zurich

Date of Assessment:

December 9, 2003

Probe Calibration Date:

September 23, 2003

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Dosimetric E-Field Probe ES3DV2 SN:3022

Conversion factor ($\pm$ standard deviation)

2140 MHz

ConvF

$4.5 \pm 8\%$

$\epsilon = 39.8 \pm 5\%$
 $\sigma = 1.49 \pm 5\%$ mho/m
 (brain tissue)

PCTEST SAR REPORT		FCC CERTIFICATION			Reviewed by: Quality Manager
SAR Filename: SAR.240309236.AZ4	Test Dates: March 22-24, 2004	Phone Type: Dual-Mode PTT Phone (iDEN/ISM)	FCC ID: AZ489FT5831		Page D-22 of D-22