SAR EVALUATION REPORT

For

VeriFone Inc.

3755 Atherton Road, Rocklin, CA 95765

FCC ID: B32OMNI56XXG

2004-08-12

This Report Concerns:	**Equipment Type:**
☒ Original Report	Wireless POS Terminal

Test Engineer:	Eric Hong /
Report No.:	R0407301S
Test Date:	2004-08-12
Reviewed By:	Ming Jing /
Prepared By:	Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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SUMMARY

The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1].

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 “Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under “worst-case” conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g average over 1 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

There was no SAR of any concern measured on the device for any of the investigated configurations.

1 - REFERENCE

[1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.

[2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.

[4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.

[5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.

[6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.

[7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9

[13] NIS81 NAMAS, \The treatment of uncertainity in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.

[14] Barry N. Taylor and Christ E. Kuyatt, \Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10

2 - TESTING EQUIPMENT

2.1 Equipments List & Calibration Info

Type / Model	Cal. Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	F00/5H31A1/A/01
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A
Pentium III, Windows NT	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	2003-06	456
SPEAG E-Field Probe ES3DV2	2004-04-12	3019
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
Aprel Validation Dipole D-1800-S-2	2003-03-06	BCL-049
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	N/A
Robot Table	Each Use	N/A
Phone Holder	Each Use	N/A
Phantom Cover	Each Use	N/A
HP Spectrum Analyzer HP8566A	N/A	2240A01930
Microwave Amp. 8349A	N/A	2644A02662
Power Meter HP436A	2004-04-02	2709A29209
Power Sensor HP8482A	2004-04-02	2349A08568
Network Analyzer HP-8752C	2004-07-30	820079
Dielectric Probe Kit HP85070A	Each Use	US99360201

2.2 Equipment Calibration Certificate

Please see the attached file.

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

Client Bay Area Comp. Lab (BACL)

CALIBRATION CERTIFICATE

Object(s)	ES3DV2 - SN:3019
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	October 8, 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 (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 8684C	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

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

Date issued: October 9, 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.

880-KP0301061-A Page 1 (1)

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

Probe ES3DV2

SN: 3019

Manufactured: December 5, 2002
Last calibration: July 12, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ES3DV2 SN: 3019 July 12, 2003

DASY - Parameters of Probe: ES3DV2 SN: 3019

Sensitivity in Free Space

Diode Compression

NormX	1.03 $\mu V/(V/m)^2$	DCP X	99
NormY	1.12 $\mu V/(V/m)^2$	DCP Y	99
NormZ	0.98 $\mu V/(V/m)^2$	DCP Z	99

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

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

ConvF X	6.4 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.4 ± 9.5% (k=2)	Alpha	0.68
ConvF Z	6.4 ± 9.5% (k=2)	Depth	1.11

Head **1800 MHz** ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

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

ConvF X	5.0 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.0 ± 9.5% (k=2)	Alpha	0.21
ConvF Z	5.0 ± 9.5% (k=2)	Depth	2.78

Boundary Effect

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

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	4.3	1.8
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

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

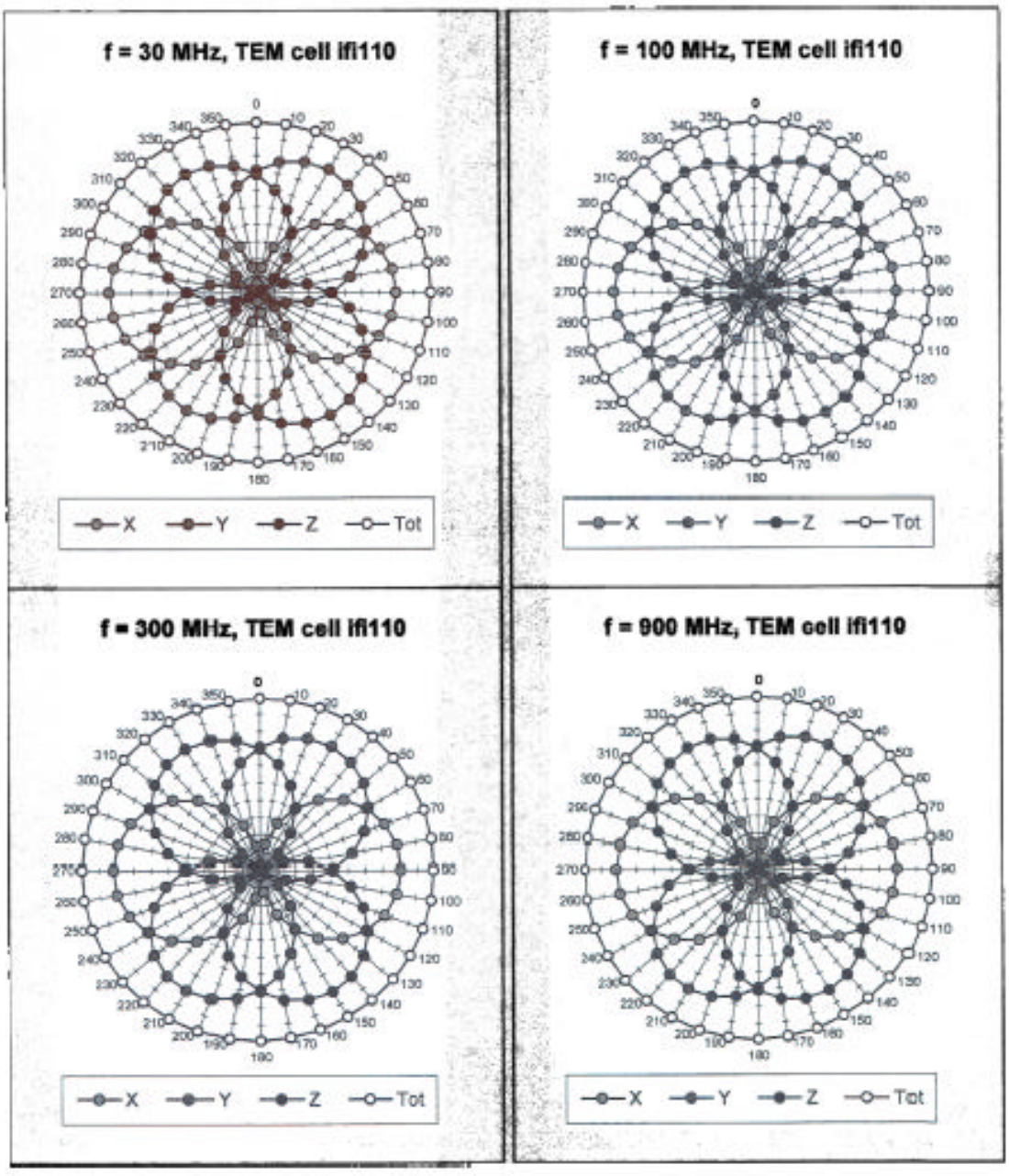
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	7.4	5.0
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Sensor Offset

Probe Tip to Sensor Center	2.1	mm

ES3DV2 SN: 3019 **July 12, 2003**

Receiving Pattern (ϕ , θ = 0°



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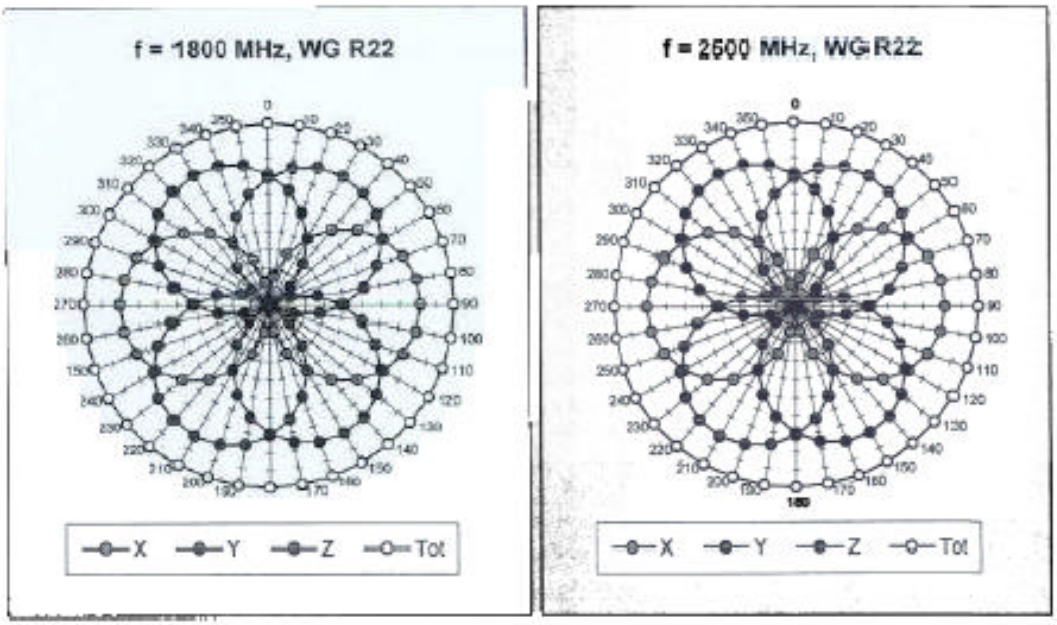
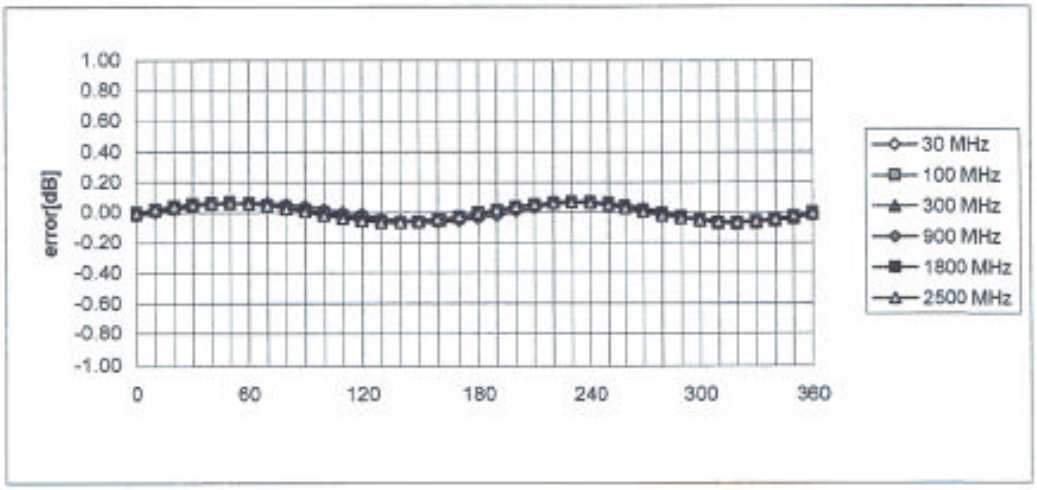


Isotropy Error (ϕ), θ = 0°



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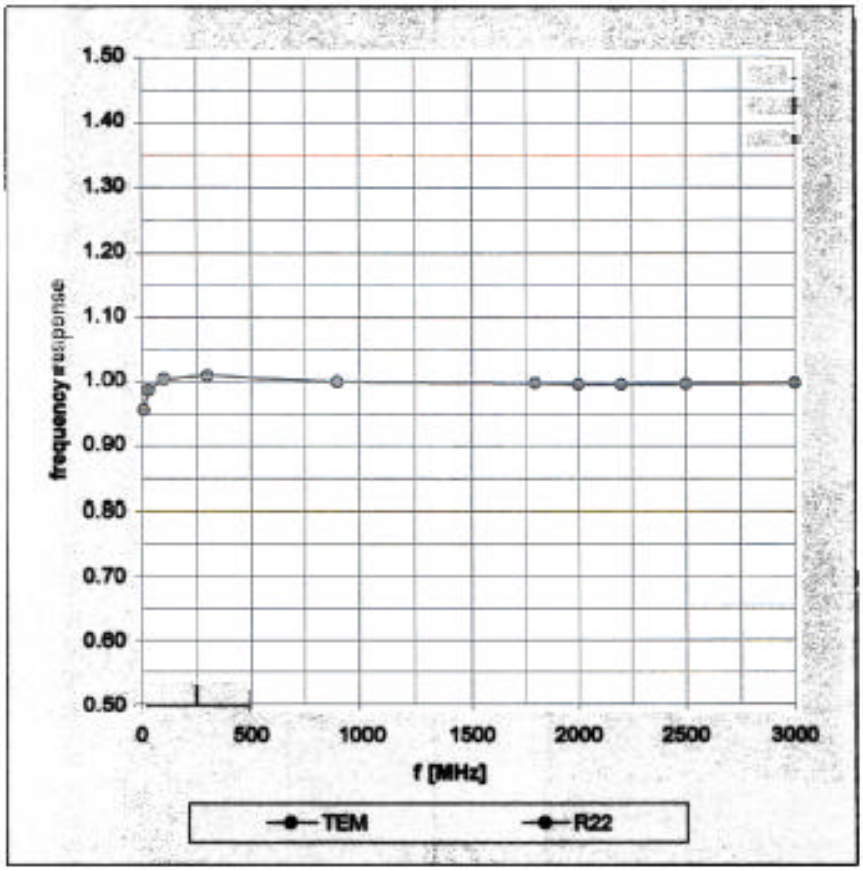
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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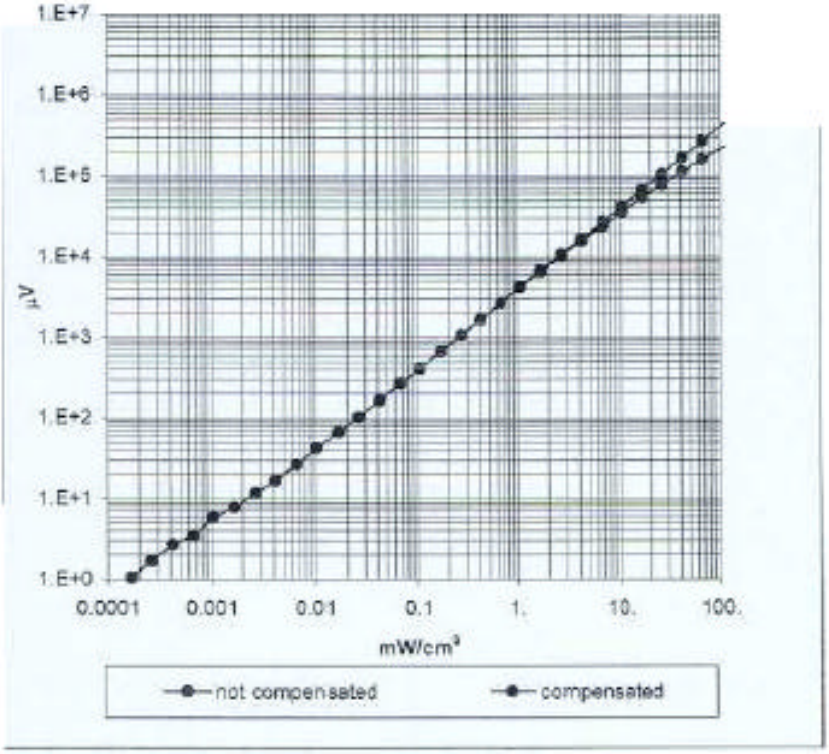
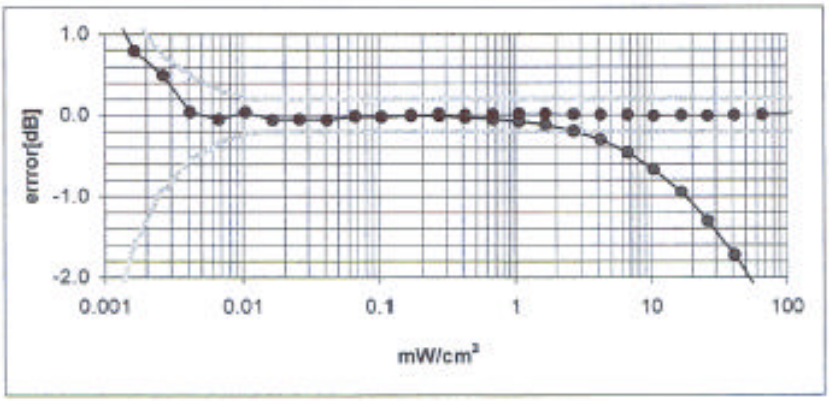
Dynamic Range f(SAR_{brain})

(Waveguide R22)





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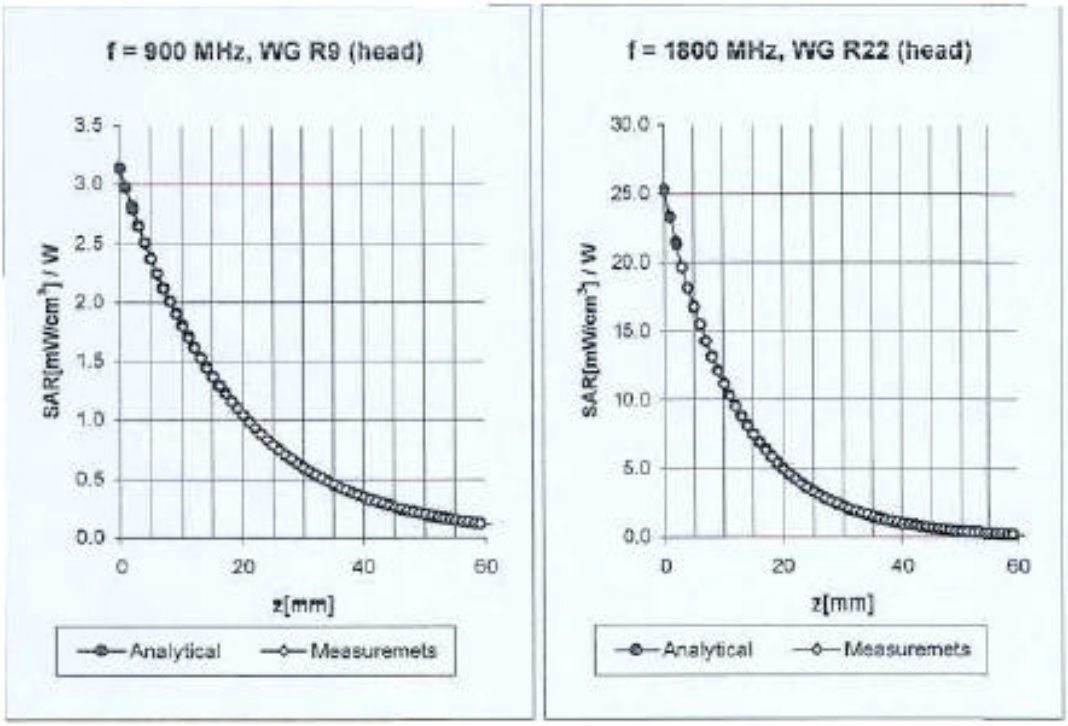
Conversion Factor Assessment



900 MHz ε_r **= 41.5 ± 5%** σ **= 0.97 ± 5% mho/m**

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

ConvF X	**6.4** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.4** ± 9.5% (k=2)	Alpha	**0.68**
ConvF Z	**6.4** ± 9.5% (k=2)	Depth	**1.11**

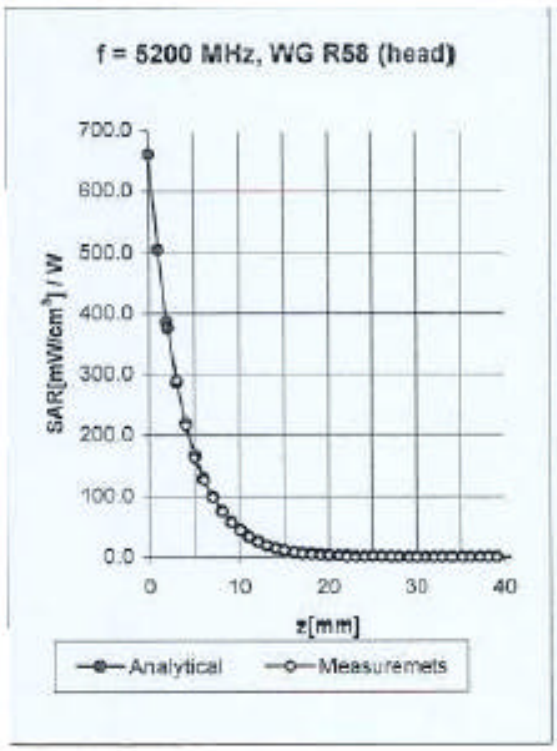
1800 MHz ε_r **= 40.0 ± 5%** σ **= 1.40 ± 5% mho/m**

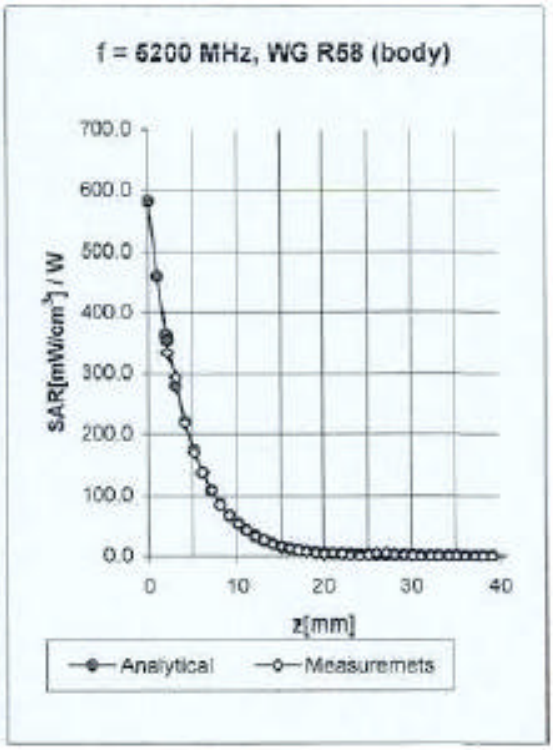
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.21**
ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.78**

ES3DV2 SN: 3019 **July 12, 2003**

Conversion Factor Assessment





Head **5200** **MHz** ε_r = 36.0 ± 5% σ = 4.66 ± 5% mho/m

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**2.3** ± 14.6% (k=2)	Boundary effect:	
ConvF Y	**2.3** ± 14.6% (k=2)	Alpha	**1.05**
ConvF Z	**2.3** ± 14.6% (k=2)	Depth	**1.50**

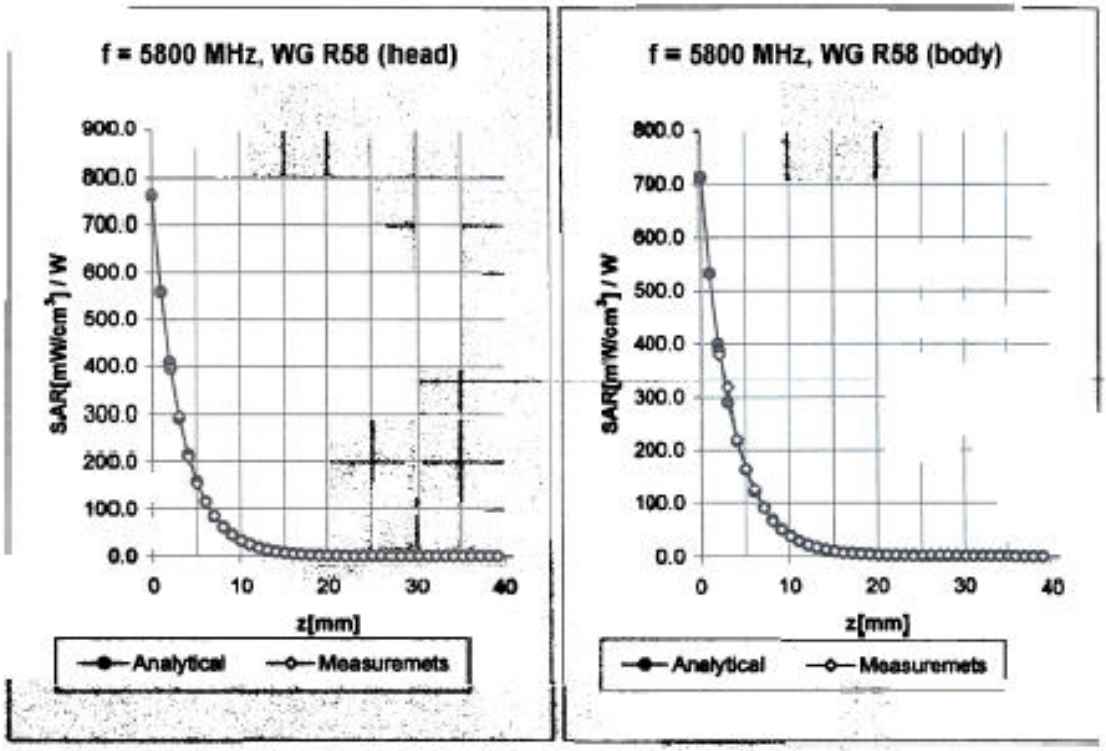
Body **5200** **MHz** ε_r = 49.0 ± 5% σ = 5.30 ± 5% mho/m

Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.4** ± 14.6% (k=2)	Boundary effect:	
ConvF Y	**1.4** ± 14.6% (k=2)	Alpha	**1.01**
ConvF Z	**1.4** ± 14.6% (k=2)	Depth	**1.85**

ES3DV2 SN: 3019 **July 12, 2003**

Conversion Factor Assessment



Head **5800** **MHz** ε_r = **35.3 ± 5%** σ = **5.27 ± 5% mho/m**

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.8** ± 14.6% (k=2)	Boundary effect:	
ConvF Y	**1.8** ± 14.6% (k=2)	Alpha	**0.90**
ConvF Z	**1.8** ± 14.6% (k=2)	Depth	**1.90**

Body **5800** **MHz** ε_r = **48.2 ± 5%** σ = **6.00 ± 5% mho/m**

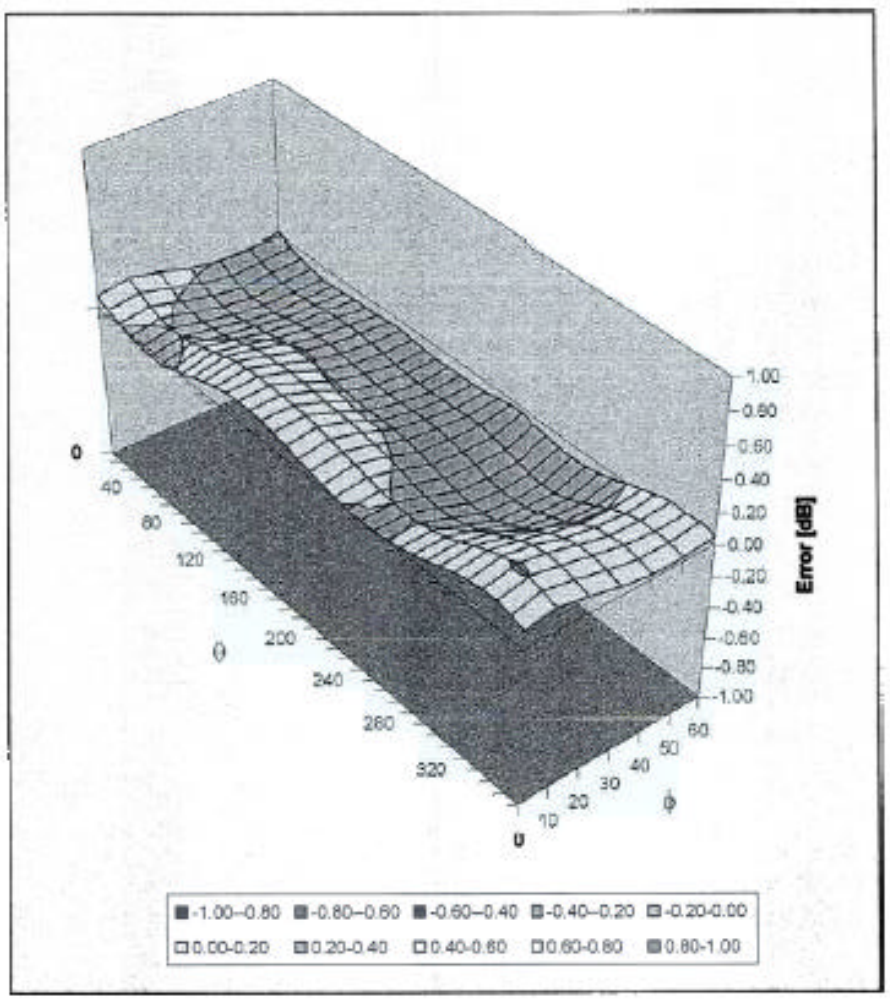
Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.2** ± 14.6% (k=2)	Boundary effect:	
ConvF Y	**1.2** ± 14.6% (k=2)	Alpha	**1.18**
ConvF Z	**1.2** ± 14.6% (k=2)	Depth	**1.65**

ES3DV2 SN: 3019 **July 12, 2003**

Deviation from Isotropy in HSL

Error (θϕ), f = 900 MHz



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

Probe ES3DV2

SN:3019

Additional Conversion Factors

Manufactured:	December 5, 2002
Last calibration:	July 12, 2003
Add. calibration:	October 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV2 SN:3019

Sensitivity in Free Space

NormX	**1.05** $\mu V/(V/m)^2$
NormY	**1.14** $\mu V/(V/m)^2$
NormZ	**0.98** $\mu V/(V/m)^2$

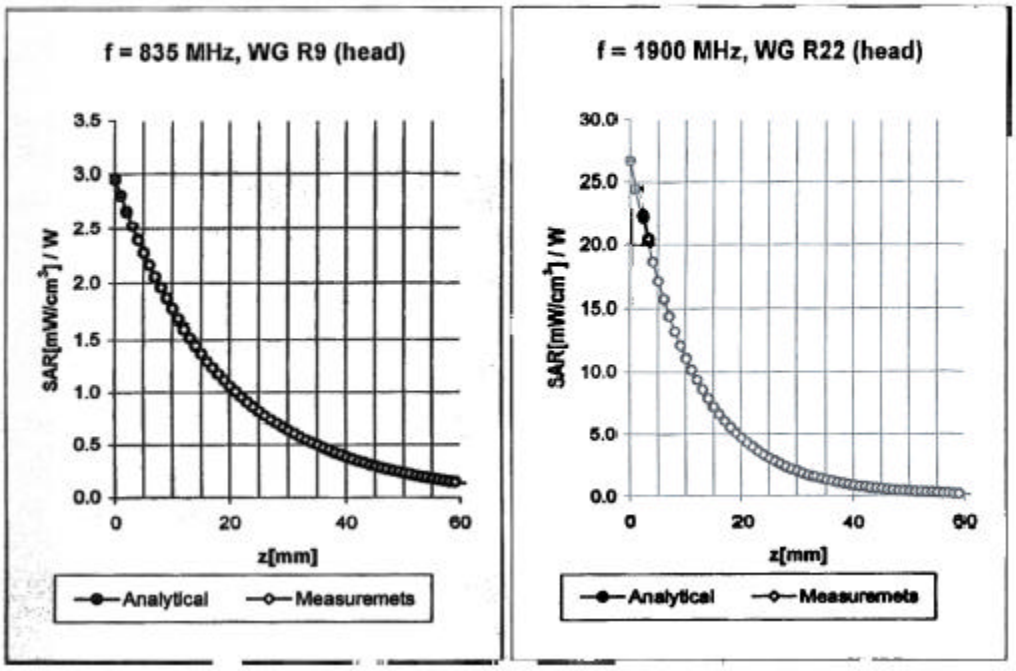
Diode Compression

DCP X	**99**
DCP Y	**99**
DCP Z	**99**

Sensor Offset

Probe Tip to Sensor Center	**2.1**	mm

Conversion Factor Assessment



Head **835 MHz** ε_r = 41.5 ± 5% σ = 0.90 ± 5% mho/m

Valid for f=793-877 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

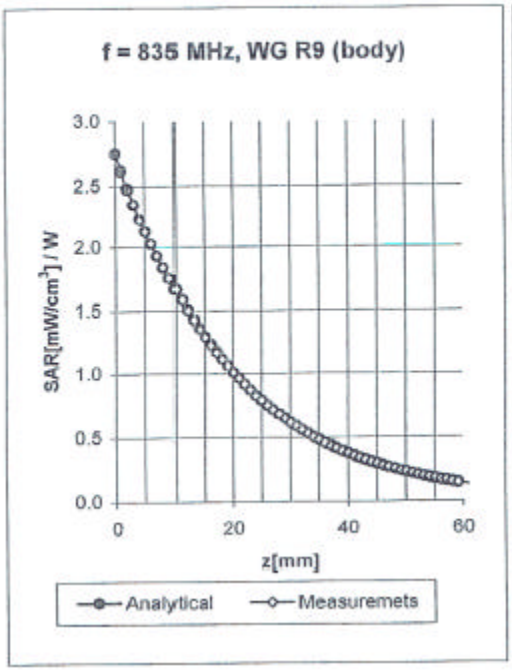
ConvF X	**6.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.5** ± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.5** ± 9.5% (k=2)	Depth	**1.46**

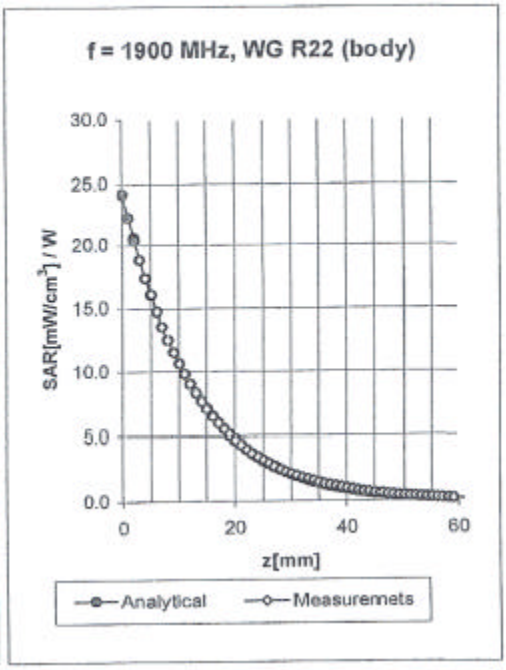
Head **1900 MHz** ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1805-1995 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**4.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)	Alpha	**0.22**
ConvF Z	**4.7** ± 9.5% (k=2)	Depth	**3.48**

Conversion Factor Assessment





Body **835 MHz** ε_r = 55.2 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=793-877 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	6.1 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.1 ± 9.5% (k=2)	Alpha	0.24
ConvF Z	6.1 ± 9.5% (k=2)	Depth	2.00

Body **1900 MHz** ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1805-1995 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	4.6 ± 9.5% (k=2)	Alpha	0.24
ConvF Z	4.6 ± 9.5% (k=2)	Depth	2.64

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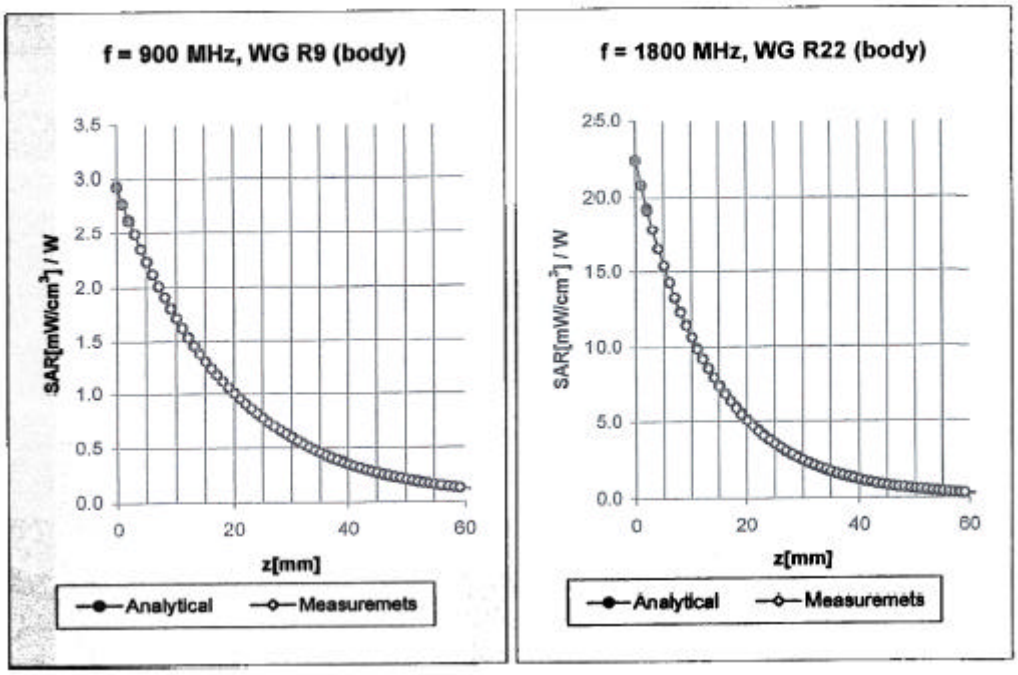
Conversion Factor Assessment



Body 900 MHz ε_r = 55.0 ± 5% σ = 1.05 ± 5% mho/m

Valid for f=855-945 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

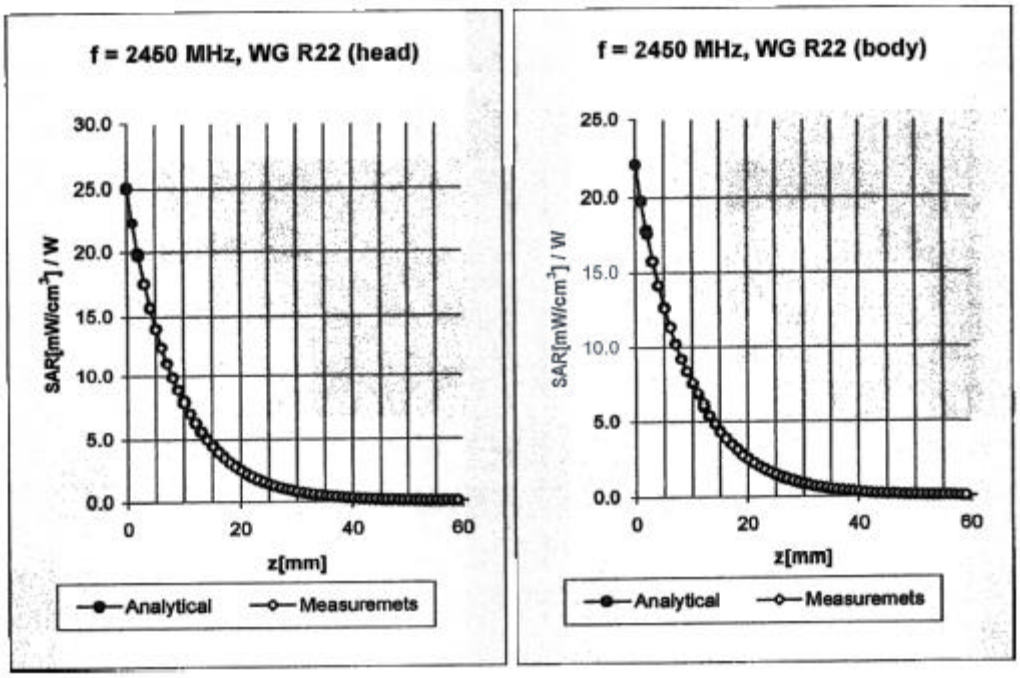
ConvF X	6.1 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.1 ± 9.5% (k=2)	Alpha	0.27
ConvF Z	6.1 ± 9.5% (k=2)	Depth	1.82

Body 1800 MHz ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

Valid for f=1710-1890 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)	Alpha	**0.23**
ConvF Z	**4.7** ± 9.5% (k=2)	Depth	**2.99**

Conversion Factor Assessment



Head **2450 MHz** ε_r = 39.2 ± 5% σ = 1.80 ± 5% mho/m

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

ConvF X	**4.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)	Alpha	**0.40**
ConvF Z	**4.5** ± 9.5% (k=2)	Depth	**1.62**

Body **2450 MHz** ε_r = 52.7 ± 5% σ = 1.95 ± 5% mho/m

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

ConvF X	**4.2** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.2** ± 9.5% (k=2)	Alpha	**0.32**
ConvF Z	**4.2** ± 9.5% (k=2)	Depth	**1.98**

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

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	ES3DV2
Serial Number:	3019
Place of Assessment:	Zurich
Date of Assessment:	October 13, 2003
Probe Calibration Date:	October 9, 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:

ES3DV2-SN:3019 October 13, 2003

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

Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor (± standard deviation)

150 MHz	ConvF	**8.7 ± 8%**	$\varepsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m (head tissue)
150 MHz	ConvF	**8.3 ± 8%**	$\varepsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m (body tissue)
450 MHz	ConvF	**7.4 ± 8%**	$\varepsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 MHz	ConvF	**7.3 ± 8%**	$\varepsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ mho/m (body tissue)

ES3DV2-SN:3019 **October 13, 2003**

Certificate of Calibration Verification

Description of EUT	Tuned Dipole Antenna
EUT Model Number	D-1800-S-1
EUT Serial Number	BCL-049
Center Frequency	1800 MHz

Calibration Date: 12 April 2004

Testing conditions:

per P1528/D1.2:2003:	
Ambient Temperature (18-25 °C)	23 °C
Ambient Humidity	43%
Liquid Temperature at start of measurements:(≤2°C)	21 °C
Liquid temperature at end of measurements:	21 °C
Date and time at beginning of test:	2004-04-09-16:20 PST
Date and time at beginning of test:	2004-04-09-19:40 PST

Equipment used for measurements

Network Analyzer	HP	8752C	1 Nov 2002
Impedance adapter	AGILENT	43961A	31 Oct 2003
Short Reference	HP	04191-85300	31 Oct 2003
Open Reference	HP	04191-85302	31 Oct 2003
Load Reference	HP	04191-85301	31 Oct 2003
Signal Generator	HP	83650B	29 Feb 2004
Calibration Cable:	SMA Utiflex, 3.05 meter cable S/N 99E1206 (Number 8)		
Phantom Model:	SAM		
Liquid:	1800 MHz, Head Liquid		
Liquid Validation Date:	12 April 2004		
Quantity of Liquid in Phantom:	19.8 Liters		

Measurement Procedure

In accordance with IEEE P1528/D1.2:2003, 8.3.4, 8.2.3 through 8.2.4