

SAR EVALUATION REPORT

For

CELLON FRANCE

Route d'Angers, Le Mans
France 72000

FCC ID: RXXCT6558

This Report Concerns: ☒ Original Report	Equipment Type: GSM 1900 MHz Mobile Phone
Test Engineer: Daniel Deng / 	
Report No.: R0409304S	
Test Date: 2004-11-02	
Reviewed By: Ming Jing/ 	
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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, Office of Engineering & Technology, Washington, DC, 1997.
- [3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.
- [4] Niels Kuster, Ralph Kastle, 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 dependence 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 Recipes 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 uncertainty 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
Apriel Validation Dipole D-1800-S-2	2003-03-06	BCL-049
Brain Equivalent Matter (1900MHz)	Each Use	N/A
Muscle Equivalent Matter (1900MHz)	Each Use	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 Agilent E441913	2004-04-29	MY4121511
Power Sensor Agilent E4412A	2004-05-07	US38488542
Network Analyzer HP-8752C	2004-07-30	820079
Dielectric Probe Kit HP85070A	Each Use	US99360201
SPEAG E-Field Probe ES3DV2	2004-06-10	1604
Signal, Generator 83650B	2004-01-29	3614A00276
Dual Directional Couple HP 778D	2003-08-13	14900
RF Amplifier ST181-20	N/R	E012-0101
Analyzer, Spectrum, 8564E	2003-08-25	3943A01781
Wireless Communications E5515C	2004-04-05	GB44051221

2.2 Equipment Calibration Certificate

Please see the attached file.

Probe ET3DV6

SN:1604

Manufactured:	July 30, 2001
Last calibrated:	August 26, 2002
Repaired:	June 3, 2004
Recalibrated:	June 10, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1604

June 10, 2004

DASY - Parameters of Probe: ET3DV6 SN:1604**Sensitivity in Free Space****Diode Compression^A**

NormX	1.90 $\mu\text{V}/(\text{V/m})^2$	DCP X	94
NormY	1.82 $\mu\text{V}/(\text{V/m})^2$	DCP Y	94
NormZ	1.92 $\mu\text{V}/(\text{V/m})^2$	DCP Z	94 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 _{oe} [%]	Without Correction Algorithm	8.9	4.6
SAR _{oe} [%]	With Correction Algorithm	0.1	0.2

Head 1800 MHz Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{oe} [%]	Without Correction Algorithm	13.0	8.7
SAR _{oe} [%]	With Correction Algorithm	0.2	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%.

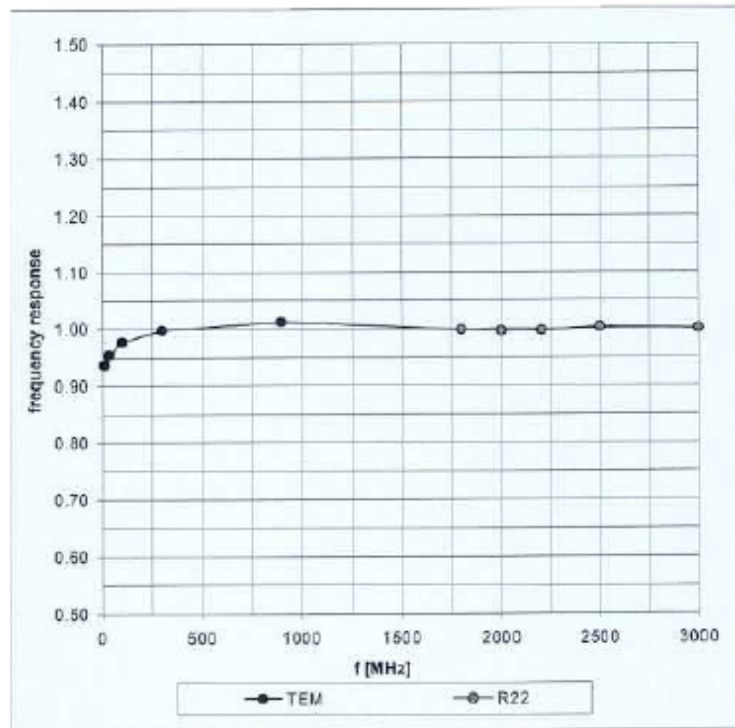
^A numerical linearization parameter: uncertainty not required

ET3DV6 SN:1604

June 10, 2004

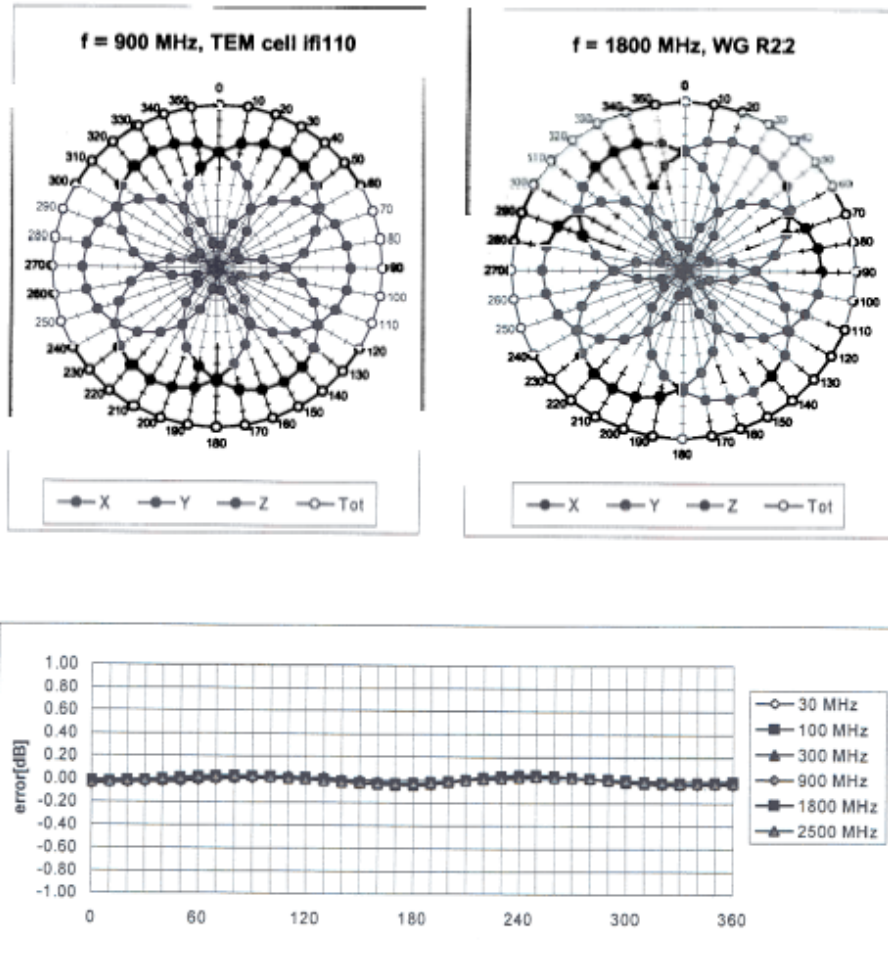
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1604

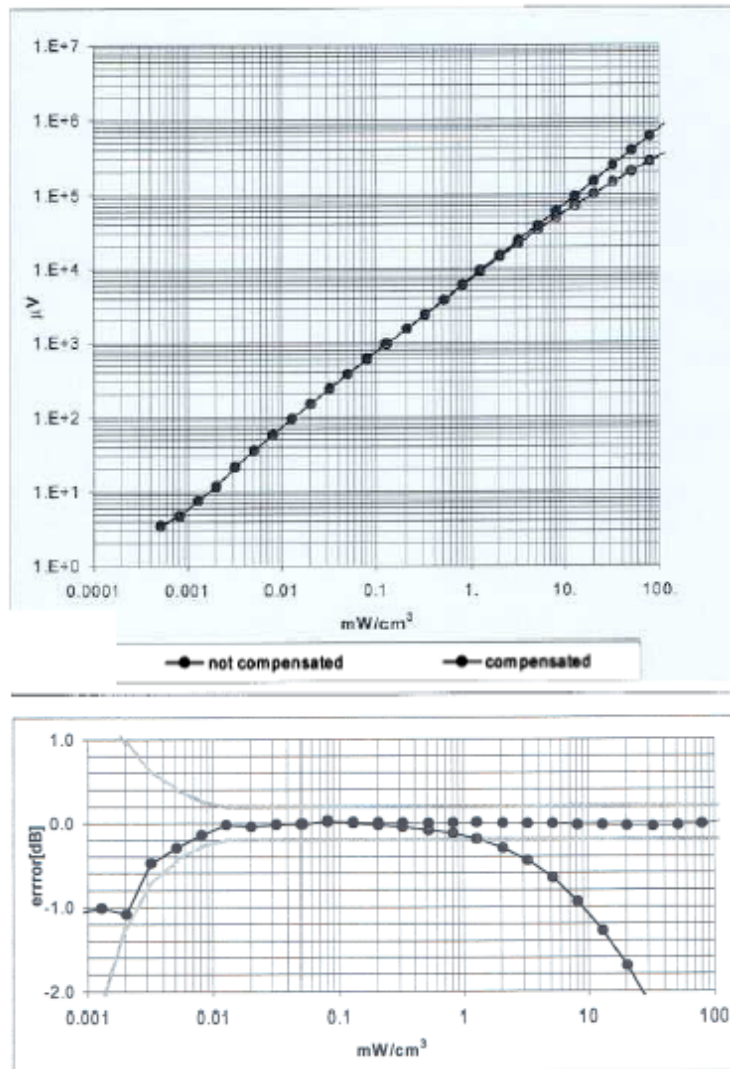
June 10, 2004

Receiving Pattern (ϕ), θ 0°Axial Isotropy Error $< \pm 0.2$ dB

ET3DV6 SN:1604

June 10, 2004

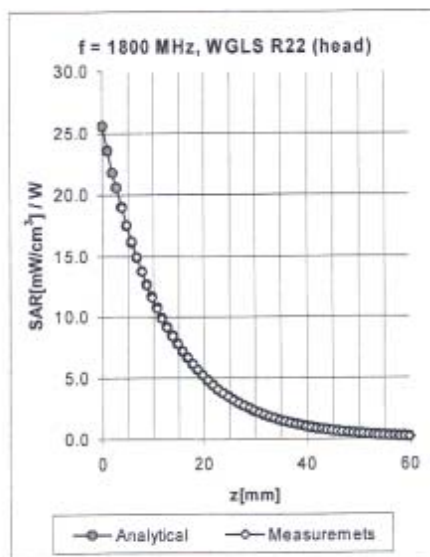
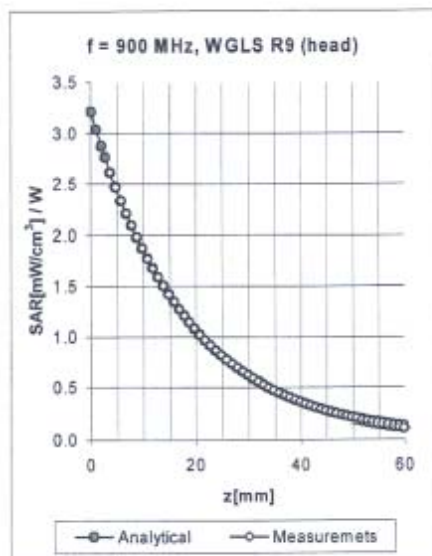
Dynamic Range f(SAR_{head}) (Waveguide R22)

**Probe Linearity Error $< \pm 0.2$ dB**

ET3DV6 SN:1604

June 10, 2004

Conversion Factor Assessment

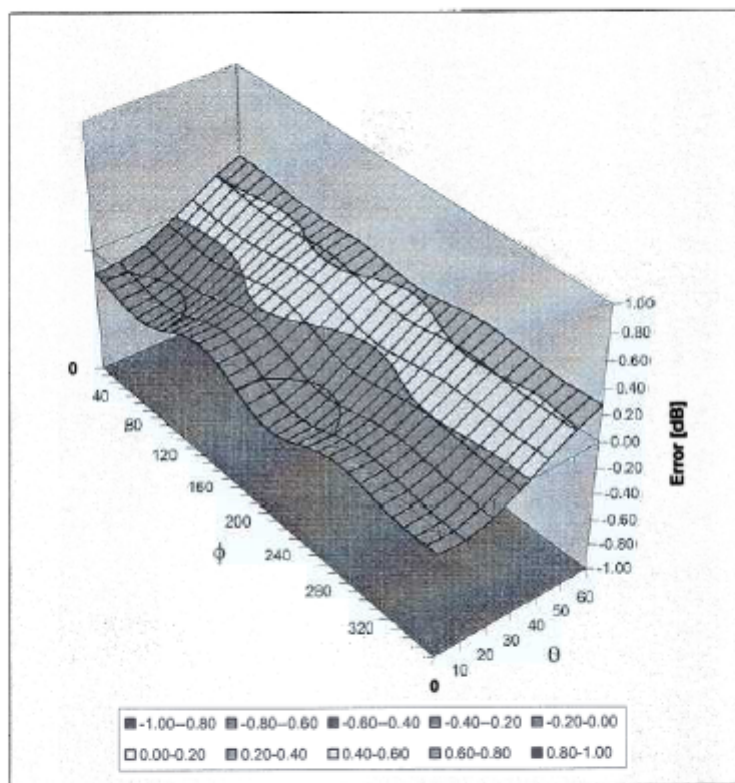


f [MHz]	Validity [MHz] [®]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.67	1.75	6.45 ± 11.3% (k=2)	
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.47	2.64	5.23 ± 11.7% (k=2)	

[®] The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Spherical Isotropy Error $< \pm 0.4$ dB

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

Client Bay Area Comp. Lab (BACL)

CALIBRATION CERTIFICATE

Object(s) E33DV2 - SN:3019

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

Calibration date: October 9, 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 Vetter	Technician	

Approved by:	Katja Rokova	Laboratory Director	
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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.

Schmid & Partner engineering AG

s p e a g

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 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	99
NormY	1.12 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	99
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	99

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	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha	0.68
ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth	1.11

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	0.21
ConvF Z	5.0 $\pm 9.5\%$ (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

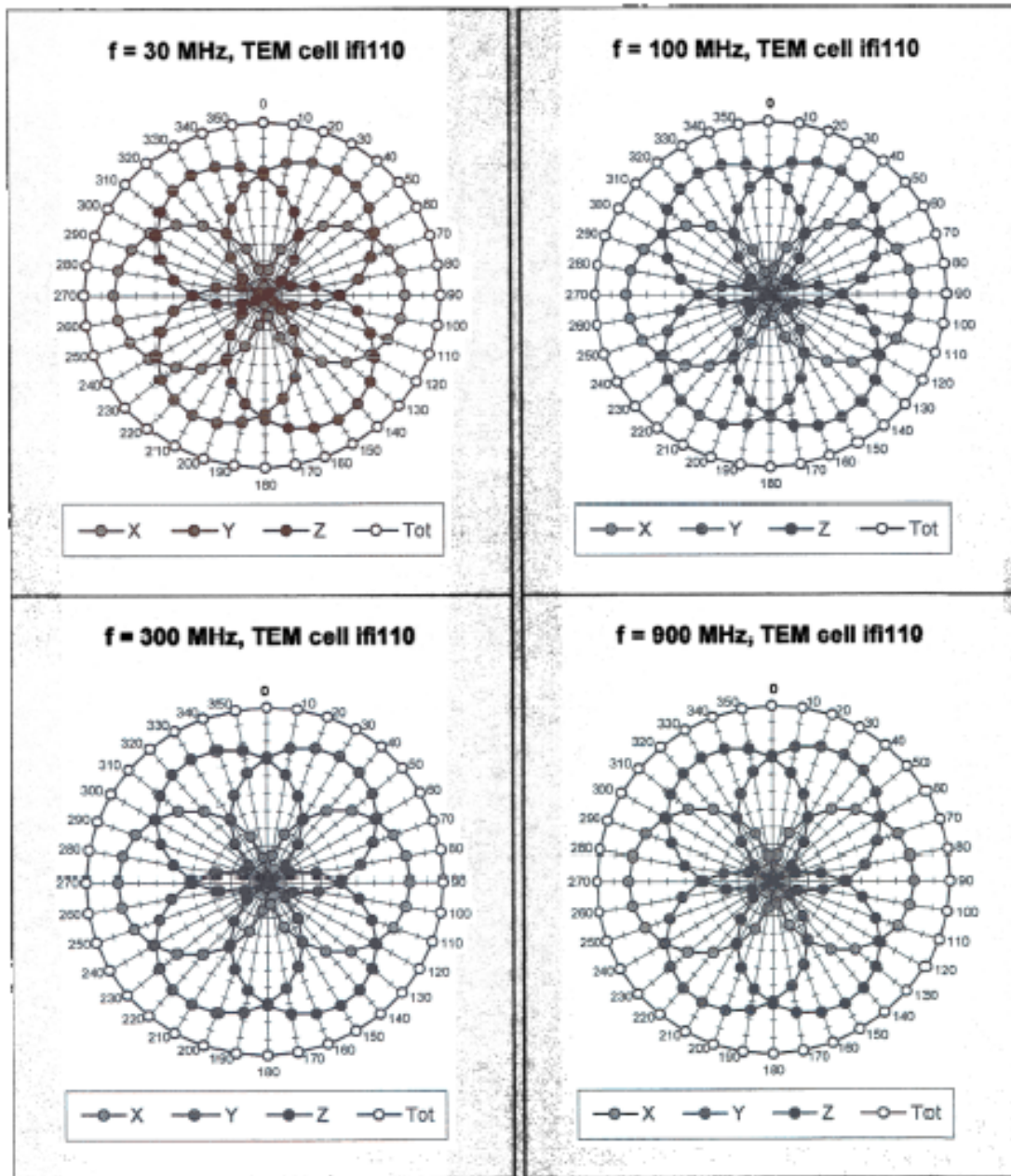
Probe Tip to Boundary		1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm		7.4	5.0
SAR _{be} [%] With Correction Algorithm		0.0	0.1

Sensor Offset

Probe Tip to Sensor Center	2.1	mm
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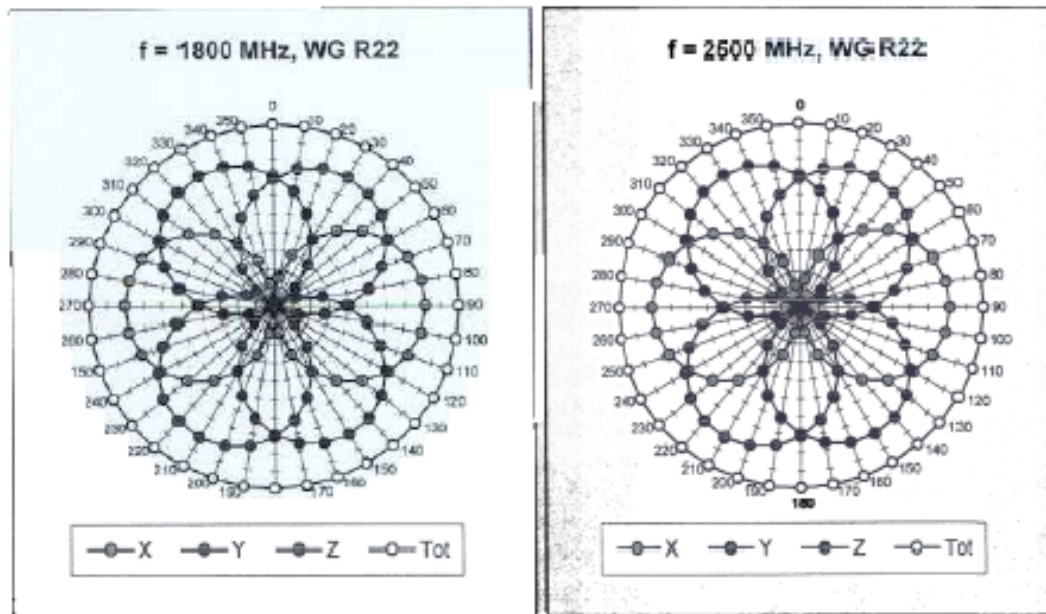
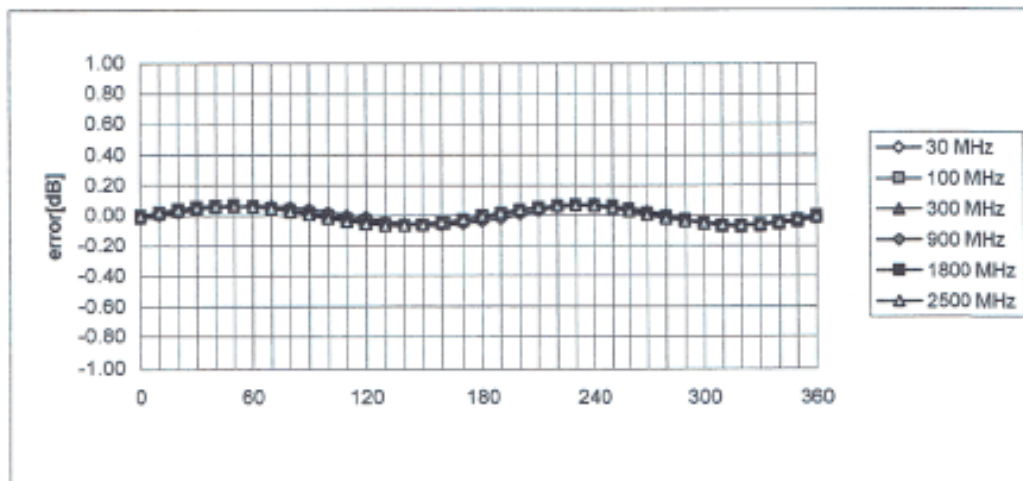
ES3DV2 SN: 3019

July 12, 2003

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

ES3DV2 SN: 3019

July 2003

Isotropy Error (ϕ), θ 0°

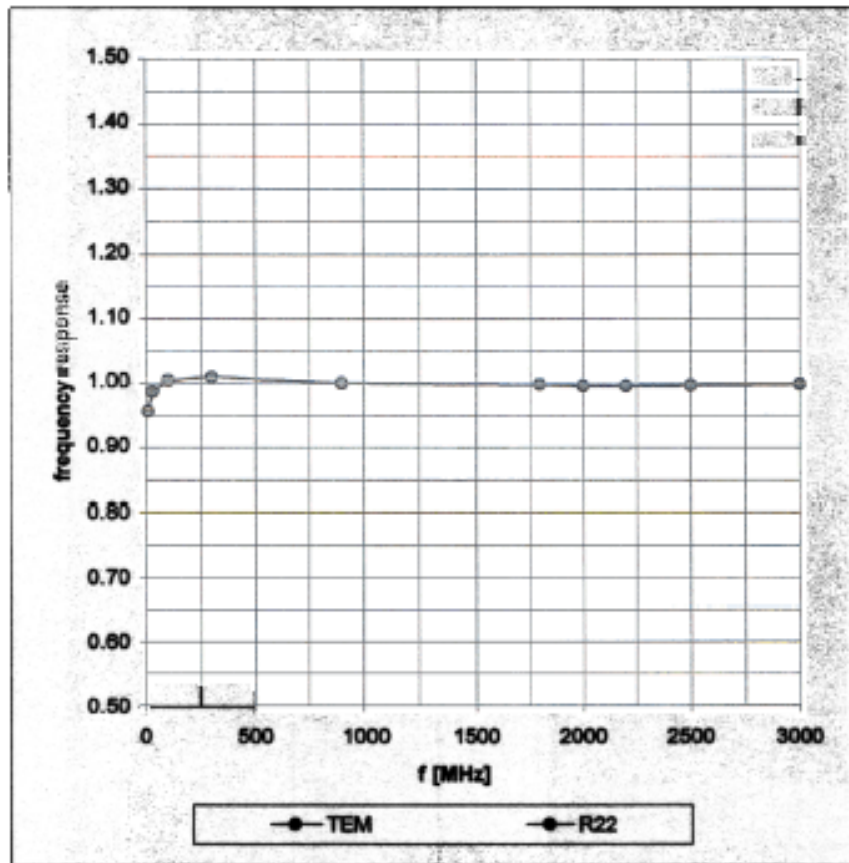
Page

ES3DV2 SN: 3019

July 12, 2003

Frequency Response of E-Field

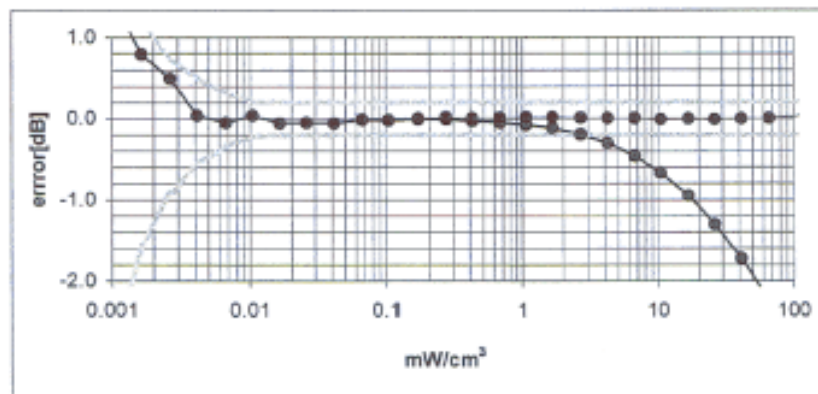
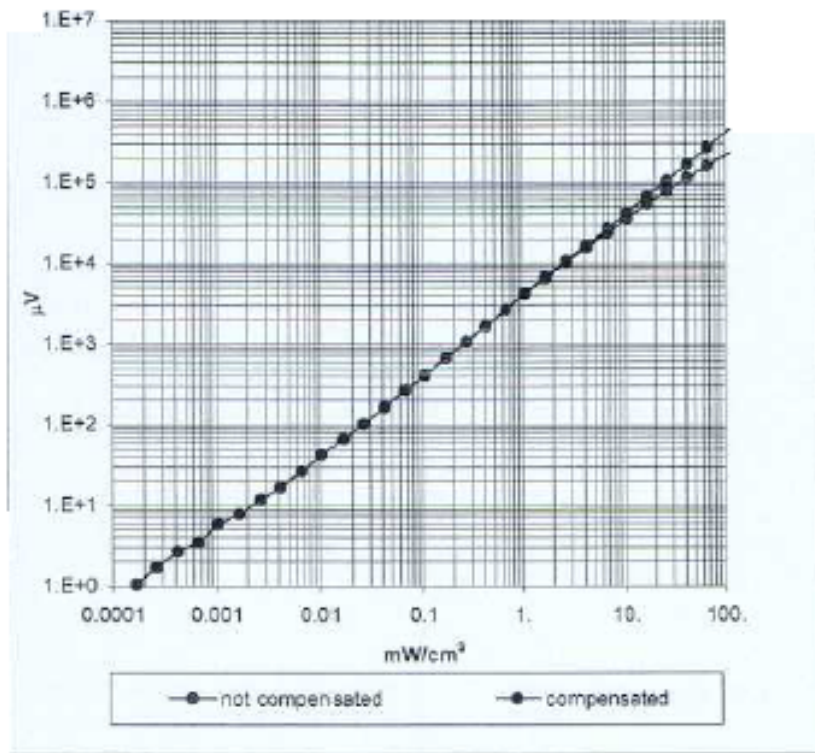
(TEM-Cell:Ifi110, Waveguide R22)



ES3DV2 SN: 3019

July 12, 2003

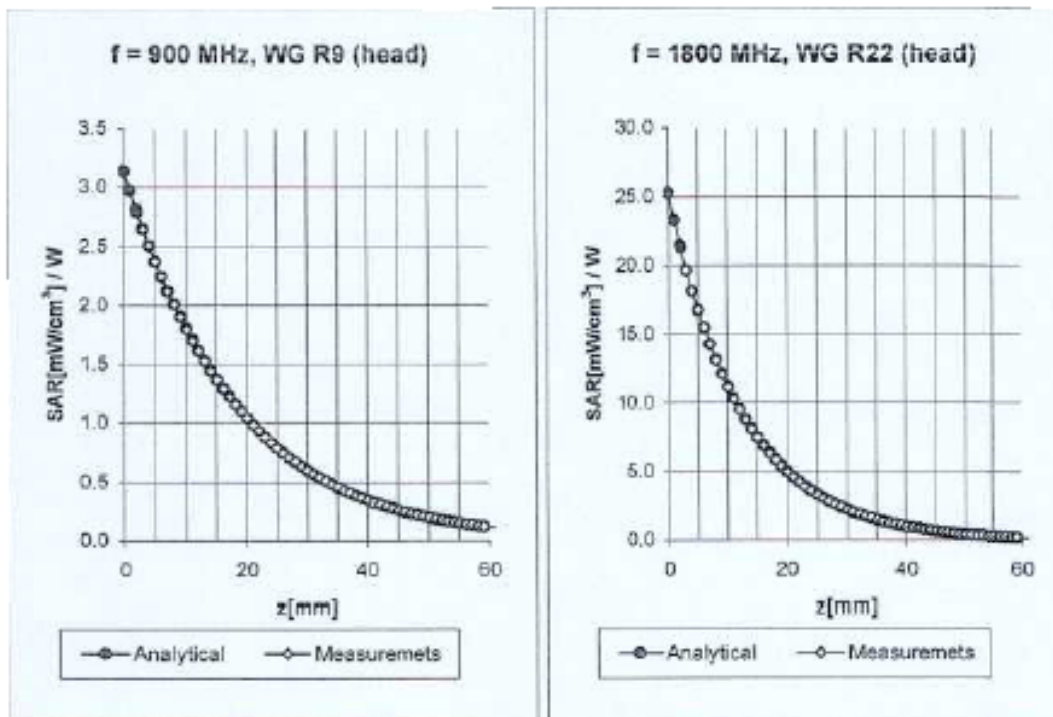
Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



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	$6.4 \pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	$6.4 \pm 9.5\%$ (k=2)	Alpha	0.68
ConvF Z	$6.4 \pm 9.5\%$ (k=2)	Depth	1.11

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

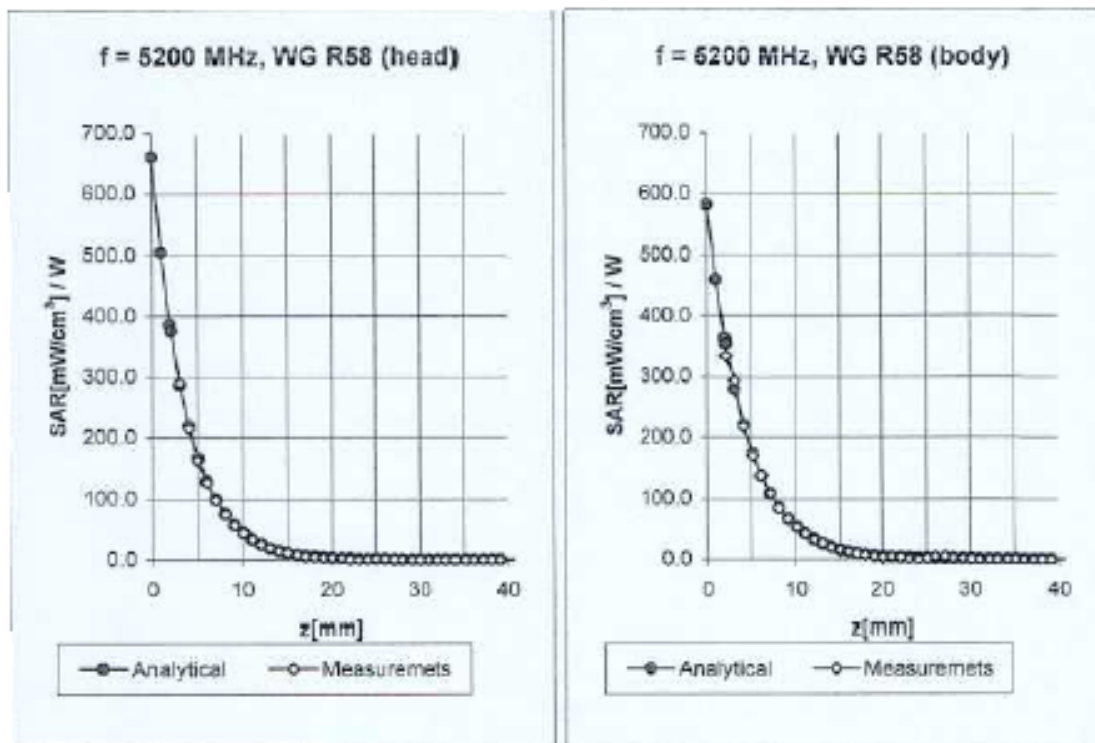
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

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

ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



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

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

ConvF X	2.3 $\pm 14.6\%$ (k=2)	Boundary effect:
ConvF Y	2.3 $\pm 14.6\%$ (k=2)	Alpha 1.05
ConvF Z	2.3 $\pm 14.6\%$ (k=2)	Depth 1.50

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

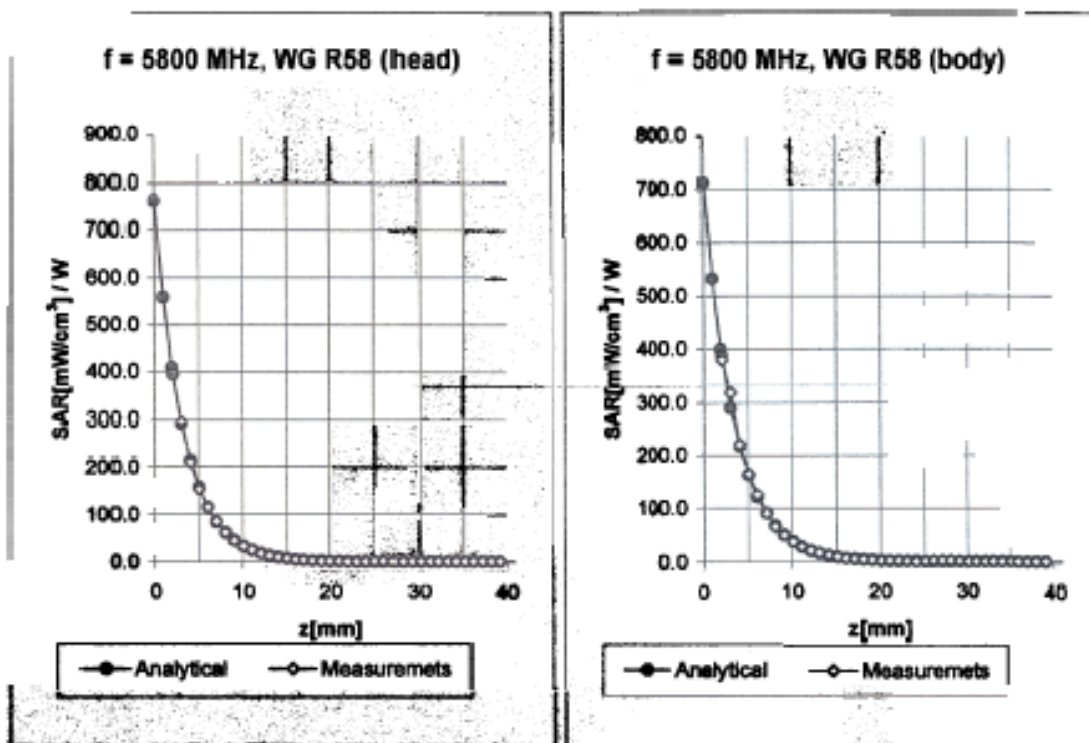
Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	1.4 $\pm 14.6\%$ (k=2)	Boundary effect:
ConvF Y	1.4 $\pm 14.6\%$ (k=2)	Alpha 1.01
ConvF Z	1.4 $\pm 14.6\%$ (k=2)	Depth 1.85

ES3DV2 SN: 3019

July 12, 2003

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 OET 65 Suppl. C

ConvF X	$1.8 \pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	$1.8 \pm 14.6\%$ (k=2)	Alpha	0.90
ConvF Z	$1.8 \pm 14.6\%$ (k=2)	Depth	1.90

Body 5800 MHz $\epsilon_r = 48.2 \pm 5\%$ $\sigma = 6.00 \pm 5\%$ mho/m

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

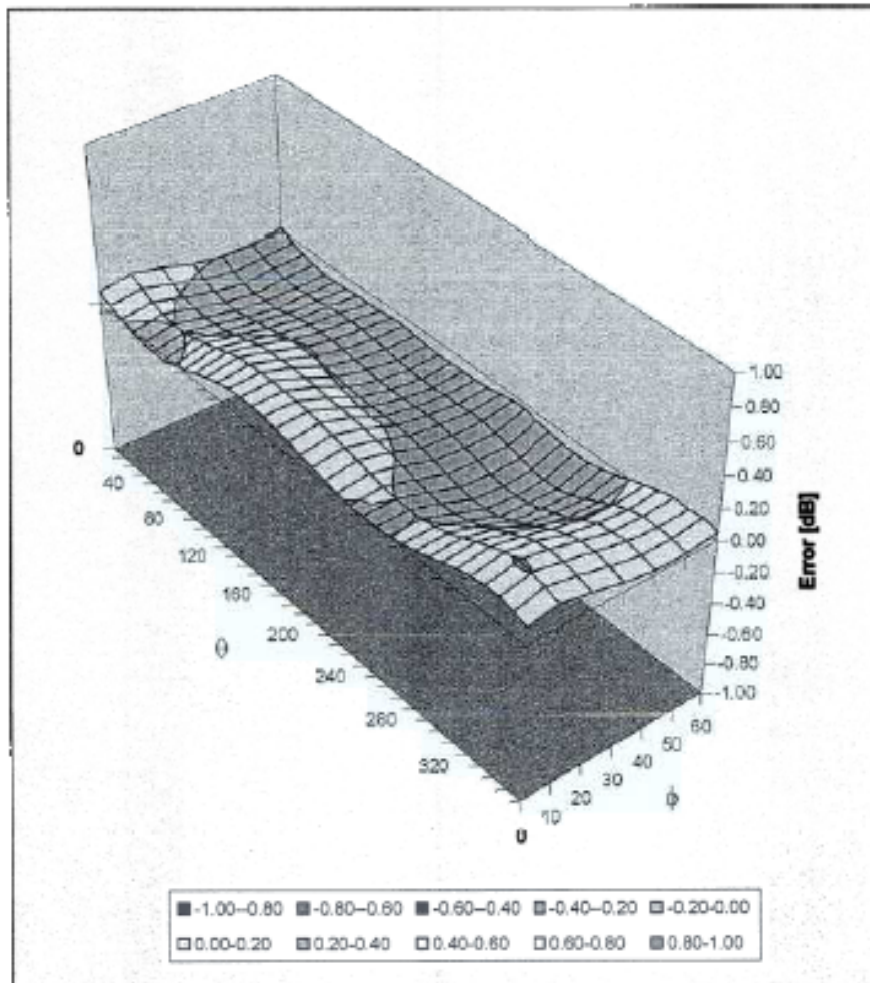
ConvF X	$1.2 \pm 14.6\%$ (k=2)	Boundary effect:	
ConvF Y	$1.2 \pm 14.6\%$ (k=2)	Alpha	1.18
ConvF Z	$1.2 \pm 14.6\%$ (k=2)	Depth	1.65

ES3DV2 SN: 3019

July 12, 2003

Deviation from Isotropy in HSL

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



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

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 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.14 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$

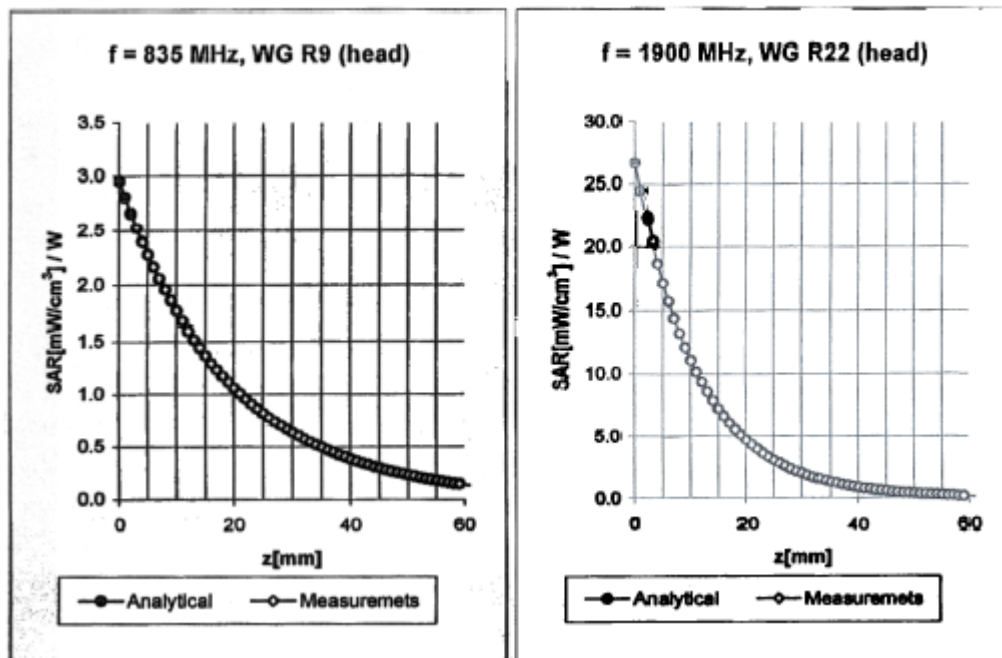
Diode Compression

DCP X	99
DCP Y	99
DCP Z	99

Sensor Offset

Probe Tip to Sensor Center	2.1	mm
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Conversion Factor Assessment



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

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

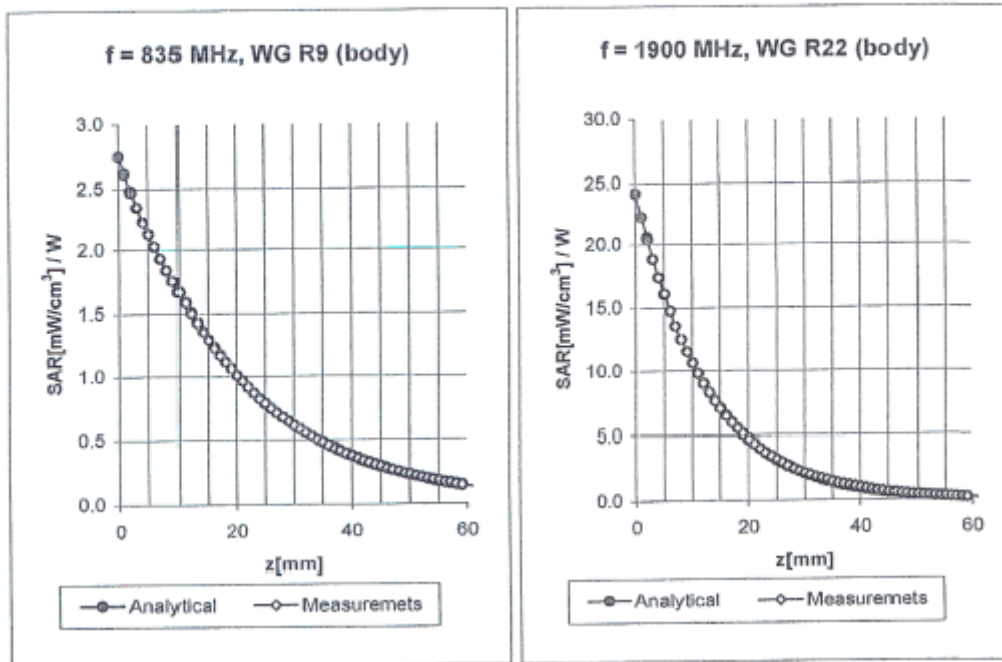
ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha	0.35
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth	1.46

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

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

ConvF X	4.7 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	4.7 $\pm 9.5\%$ (k=2)	Alpha	0.22
ConvF Z	4.7 $\pm 9.5\%$ (k=2)	Depth	3.48

Conversion Factor Assessment



Body **835 MHz** $\epsilon_r = 55.2 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

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

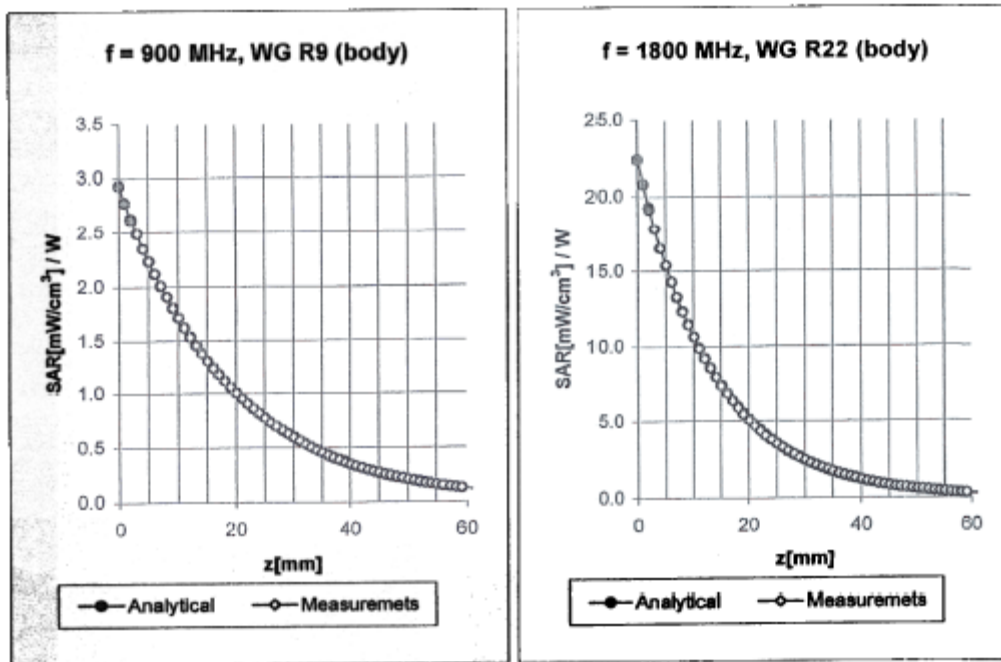
ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha 0.24
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth 2.00

Body **1900 MHz** $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

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

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

Conversion Factor Assessment



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

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

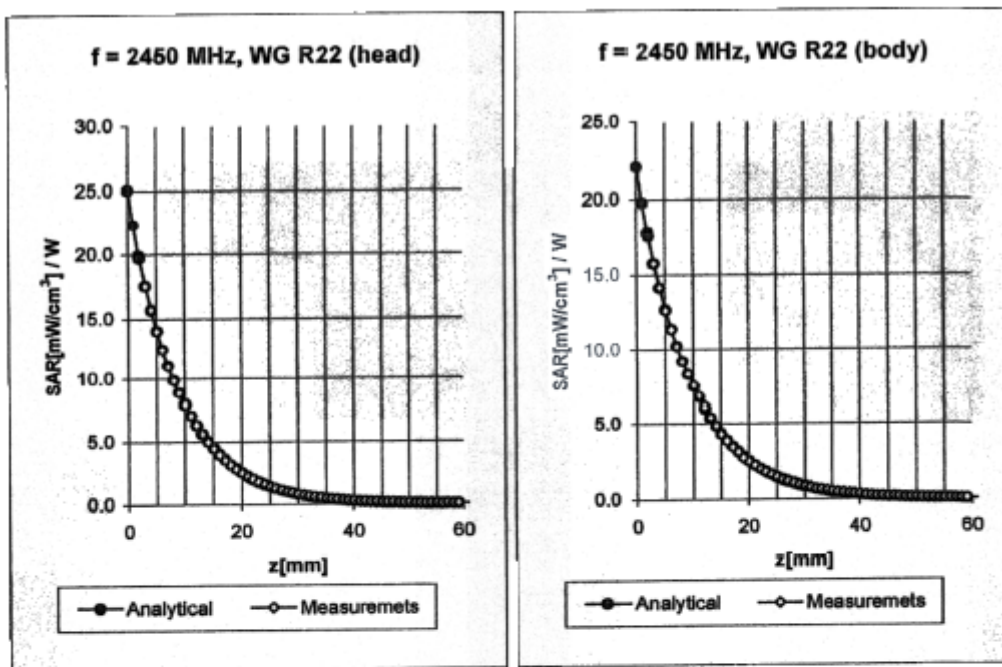
ConvF X	6.1 $\pm$ 9.5% (k=2)	Boundary effect:
ConvF Y	6.1 $\pm$ 9.5% (k=2)	Alpha 0.27
ConvF Z	6.1 $\pm$ 9.5% (k=2)	Depth 1.82

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

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

ConvF X	4.7 $\pm$ 9.5% (k=2)	Boundary effect:
ConvF Y	4.7 $\pm$ 9.5% (k=2)	Alpha 0.23
ConvF Z	4.7 $\pm$ 9.5% (k=2)	Depth 2.99

Conversion Factor Assessment



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

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 60381, P1528-200X

ConvF X	4.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.5 $\pm 9.5\%$ (k=2)	Alpha 0.40
ConvF Z	4.5 $\pm 9.5\%$ (k=2)	Depth 1.62

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

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 0.32
ConvF Z	4.2 $\pm 9.5\%$ (k=2)	Depth 1.98

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Phone +41 1 245 9700, Fax +41 1 245 9779
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 ($\pm$ standard deviation)

150 MHz	ConvF	8.7 $\pm$ 8 %	$\epsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\%$ mho/m (head tissue)
150 MHz	ConvF	8.3 $\pm$ 8 %	$\epsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\%$ mho/m (body tissue)
450 MHz	ConvF	7.4 $\pm$ 8 %	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\%$ mho/m (head tissue)
450 MHz	ConvF	7.3 $\pm$ 8 %	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\%$ 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:($\leq 2^{\circ}\text{C}$)	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

Liquid Validation

Instrument	Manufacturer Model		Calibrated
Network Analyzer	HP	4396B	1 Nov 2002
Dielectric Probe Kit,	Agilent	85070C	Each Use
H ₂ O, 18 M-Ohm	BACL		Each Use
Probe, SAR 10 kHz - 6 GHz	SPEAG	ES3DV2	9 Oct 2003

Attestation:

I hereby attest that the equipment are suitable for the performance requirements of IEEE P1528/D1.2:2003 and the personnel operating the test equipment and measurements are properly trained to perform the verification of this calibration procedure set forth in IEEE P1528/D1.2:2003.

The validation antenna herein meets the minimum requirements of 20 dB insertion loss



2004-04-12

Hans T. Mellberg
Engineering Manager

Date

1800 MHz Head Liquid validation

Date : 12APR2004

Ambient Temp = 23 °C

Liquid Temp = 22 °C

Frequency

e'

e''

 $\sigma (\sigma = 2\pi f \epsilon_0 \epsilon''')$

1850000000.0000	38.8246	13.2534	
1852000000.0000	38.7736	13.2429	
1854000000.0000	38.8400	13.2576	
1856000000.0000	38.8463	13.2425	
1858000000.0000	38.8167	13.2672	
1860000000.0000	38.8129	13.2552	
1862000000.0000	38.8118	13.2476	
1864000000.0000	38.7654	13.2345	
1866000000.0000	38.7686	13.2633	
1868000000.0000	38.7997	13.2690	
1870000000.0000	38.7262	13.2308	
1872000000.0000	38.7413	13.2642	
1874000000.0000	38.7458	13.2802	
1876000000.0000	38.7127	13.2833	
1878000000.0000	38.7145	13.2799	
1880000000.0000	38.7380	13.2633	
1882000000.0000	38.7086	13.2820	
1884000000.0000	38.7111	13.2991	
1886000000.0000	38.7184	13.2656	
1888000000.0000	38.7086	13.2724	
1890000000.0000	38.6697	13.2703	
1892000000.0000	38.6773	13.3051	
1894000000.0000	38.6729	13.2817	
1896000000.0000	38.6377	13.2805	
1898000000.0000	38.6113	13.2648	
1900000000.0000	38.6019	13.2714	1.40
1902000000.0000	38.5554	13.2951	
1904000000.0000	38.5535	13.2851	
1906000000.0000	38.5103	13.3424	
1908000000.0000	38.5402	13.3692	
1910000000.0000	38.5162	13.3760	
1912000000.0000	38.4971	13.3857	
1914000000.0000	38.5126	13.3651	
1916000000.0000	38.4920	13.3817	
1918000000.0000	38.5463	13.3665	
1920000000.0000	38.5063	13.3804	
1922000000.0000	38.4973	13.3868	
1924000000.0000	38.5244	13.3470	
1926000000.0000	38.5362	13.3583	
1928000000.0000	38.5352	13.3774	
1930000000.0000	38.5427	13.3676	
1932000000.0000	38.5433	13.3562	
1934000000.0000	38.5374	13.3814	
1936000000.0000	38.5717	13.4048	
1938000000.0000	38.5057	13.4235	
1940000000.0000	38.5314	13.4375	
1942000000.0000	38.5104	13.4338	
1944000000.0000	38.4827	13.4285	
1946000000.0000	38.4545	13.4411	
1948000000.0000	38.4227	13.4385	
1950000000.0000	38.3682	13.4325	

System Validation for 1900 MHz Head Liquid (Ambient Temp = 23 C, Liquid Temp = 22 C,
Forward Power = 20.42 dBm, 4/12/2004)

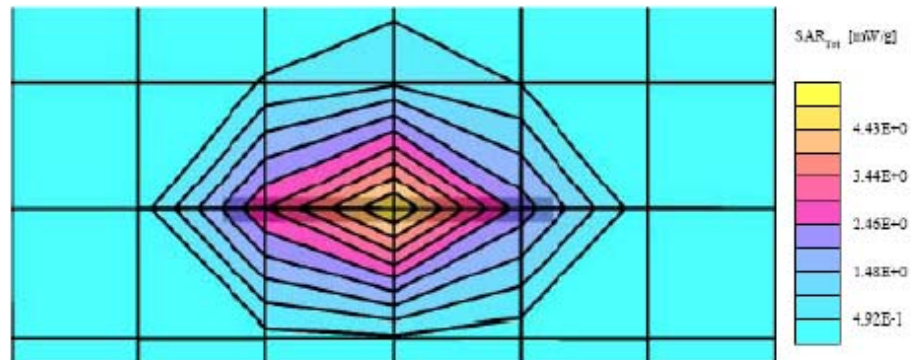
SAM Phantom: Flat Section; Position: (90°,90°); Frequency: 1900 MHz

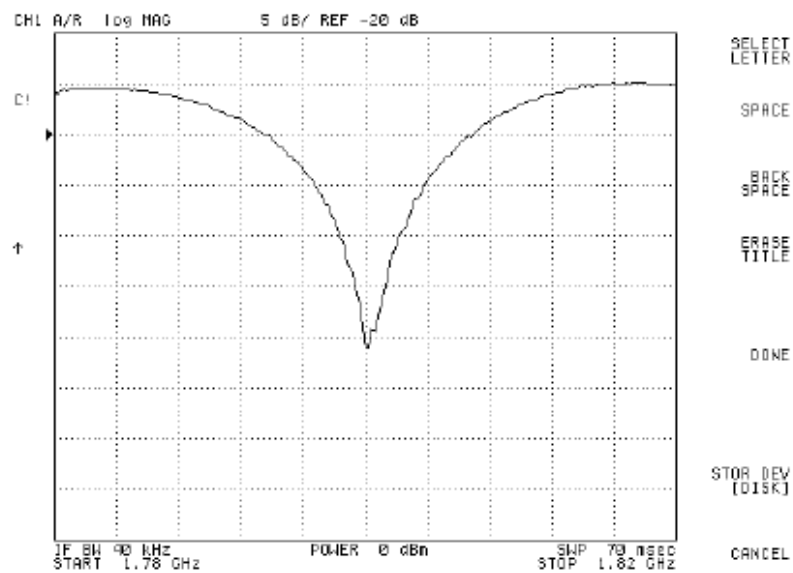
Probe: E53DV2 - SN3019, Conn(F(4.70,4.70,4.70), Crest factor: 1.0, Head Liquid 1900 MHz: $\sigma = 1.40 \text{ mho/m}$, $\epsilon = 40.0$ $\rho = 1.00 \text{ g/cm}^3$

Obs SAR(1g): 4.18 mW/g, SAR (10g): 2.21 mW/g, (Worst-case extrapolation)

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

PowerShift: 0.01 dB



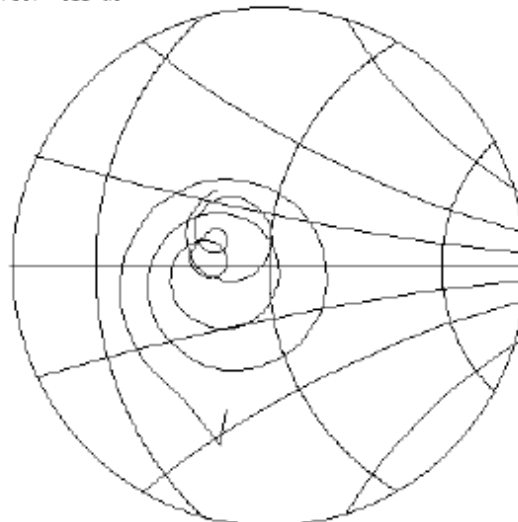
Insertion Loss Plot
S11

Smith Chart

CH1 A/R F5c1 500 mU

C1

↑

IF BW 90 kHz
START 1.62 GHz

POWER 0 dBm

SWP 70 MHz
STOP 1.82 GHzSELECT
LETTER

SPACE

BACK
SPACEERASE
TITLE

DONE

STOR DEV
[015K]

CANCEL

1900 MHZ Body Liquid Validation

Ambient Temp = 25 Deg C , Liquid Temp = 22 Deg C , 10/13/2004

frequency	ϵ'	ϵ''
1850000000.0000	52.4669	14.2841
1852000000.0000	52.4667	14.2865
1854000000.0000	52.4830	14.3008
1856000000.0000	52.4531	14.2788
1858000000.0000	52.3714	14.2941
1860000000.0000	52.3399	14.3012
1862000000.0000	52.3435	14.3255
1864000000.0000	52.3553	14.3500
1866000000.0000	52.3761	14.3699
1868000000.0000	52.3942	14.3821
1870000000.0000	52.4011	14.3944
1872000000.0000	52.4071	14.4310
1874000000.0000	52.3835	14.4241
1876000000.0000	52.4214	14.4666
1878000000.0000	52.4010	14.5172
1880000000.0000	52.4147	14.5007
1882000000.0000	52.3687	14.5216
1884000000.0000	52.3235	14.4988
1886000000.0000	52.2487	14.4520
1888000000.0000	52.2012	14.4714
1890000000.0000	52.2155	14.4854
1892000000.0000	52.2296	14.5075
1894000000.0000	52.2054	14.5408
1896000000.0000	52.2192	14.5130
1898000000.0000	52.0922	14.5060
1900000000.0000	52.0974	14.5212
1902000000.0000	52.1095	14.5387
1904000000.0000	52.0707	14.5119
1906000000.0000	51.9987	14.5517
1908000000.0000	51.9964	14.5314
1910000000.0000	52.0487	14.5851
1912000000.0000	52.0267	14.5619
1914000000.0000	52.0626	14.5847
1916000000.0000	52.1139	14.5855
1918000000.0000	52.1429	14.5869
1920000000.0000	52.0625	14.5852
1922000000.0000	52.0918	14.6055
1924000000.0000	52.1017	14.6070
1926000000.0000	52.1466	14.6597
1928000000.0000	52.2170	14.6758
1930000000.0000	52.2336	14.6599
1932000000.0000	52.2292	14.6428
1934000000.0000	52.2165	14.6497
1936000000.0000	52.2413	14.6688
1938000000.0000	52.2174	14.6842
1940000000.0000	52.2210	14.6752
1942000000.0000	52.2018	14.6800
1944000000.0000	52.2113	14.7018
1946000000.0000	52.2074	14.7198
1948000000.0000	52.1788	14.6831
1950000000.0000	52.1801	14.7016

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.5349$$

where $f = 1900 \times 10^6$
 $\epsilon_0 = 8.854 \times 10^{-12}$
 $\epsilon'' = 14.5212$

1900 MHZ Head Liquid Validation

Ambient Temp = 25 Deg C , Liquid Temp = 22 Deg C , 10/13/2004

frequency	e'	e''
1850000000.0000	39.2294	13.4561
1852000000.0000	39.2315	13.4747
1854000000.0000	39.2519	13.4864
1856000000.0000	39.2034	13.4883
1858000000.0000	39.1150	13.4833
1860000000.0000	39.1260	13.5026
1862000000.0000	39.1551	13.5151
1864000000.0000	39.1665	13.5316
1866000000.0000	39.2543	13.5830
1868000000.0000	39.2971	13.6213
1870000000.0000	39.3287	13.6395
1872000000.0000	39.3344	13.6711
1874000000.0000	39.3769	13.6828
1876000000.0000	39.4330	13.7204
1878000000.0000	39.4394	13.7461
1880000000.0000	39.4298	13.7079
1882000000.0000	39.3899	13.6845
1884000000.0000	39.3293	13.6519
1886000000.0000	39.1839	13.5684
1888000000.0000	39.1673	13.5312
1890000000.0000	39.1506	13.5288
1892000000.0000	39.1925	13.5460
1894000000.0000	39.1834	13.5213
1896000000.0000	39.1732	13.4448
1898000000.0000	39.0123	13.4211
1900000000.0000	39.0192	13.3963
1902000000.0000	39.0487	13.4081
1904000000.0000	38.8851	13.3086
1906000000.0000	38.7524	13.2545
1908000000.0000	38.7587	13.2385
1910000000.0000	38.7839	13.2330
1912000000.0000	38.7726	13.2399
1914000000.0000	38.8007	13.2501
1916000000.0000	38.8440	13.2163
1918000000.0000	38.8425	13.2409
1920000000.0000	38.7510	13.1927
1922000000.0000	38.7677	13.2046
1924000000.0000	38.7755	13.2554
1926000000.0000	38.8336	13.2792
1928000000.0000	38.9151	13.3304
1930000000.0000	38.9376	13.3058
1932000000.0000	38.8870	13.2782
1934000000.0000	38.8460	13.2894
1936000000.0000	38.8580	13.3260
1938000000.0000	38.8198	13.3036
1940000000.0000	38.8104	13.3272
1942000000.0000	38.7844	13.3833
1944000000.0000	38.7595	13.3548
1946000000.0000	38.7759	13.3564
1948000000.0000	38.7606	13.3696
1950000000.0000	38.7030	13.4006

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.4160$$

$$\text{where } f = 1900 \times 10^6$$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$\epsilon'' = 13.3963$$