# SAR EVALUATION REPORT

For

## CELLON FRANCE

Route d'Angers, Le Mans
France 72000

**FCC ID: RXXCT6558**

| This Report Concerns: | Equipment Type: |
|---|---|
| ☒ Original Report | GSM 1900 MHz Mobile Phone |

**Test Engineer:** Daniel Deng /

**Report No.:** R0409304S

**Test Date:** 2004-11-02

**Reviewed By:** Ming Jing/

**Prepared By:** Bay Area Compliance Laboratory Corporation (BACL)
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Sunnyvale, CA 94085
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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 (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

| | | | |
|---|---|---|---|
| NormX | **1.90** $\mu V/(V/m)^2$ | | |
| NormY | **1.82** $\mu V/(V/m)^2$ | | |
| NormZ | **1.92** $\mu V/(V/m)^2$ | | |

## Diode Compression[A]

| | | |
|---|---|---|
| DCP X | **94** | |
| DCP Y | **94** | |
| DCP Z | **94** | mV |

## Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Plese see Page 7**

## Boundary Effect

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

| Sensor Center to Phantom Surface Distance | | **3.7 mm** | **4.7 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 8.9 | 4.6 |
| $SAR_{be}$ [%] | 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** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 13.0 | 8.7 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.2 | 0.1 |

## Sensor Offset

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

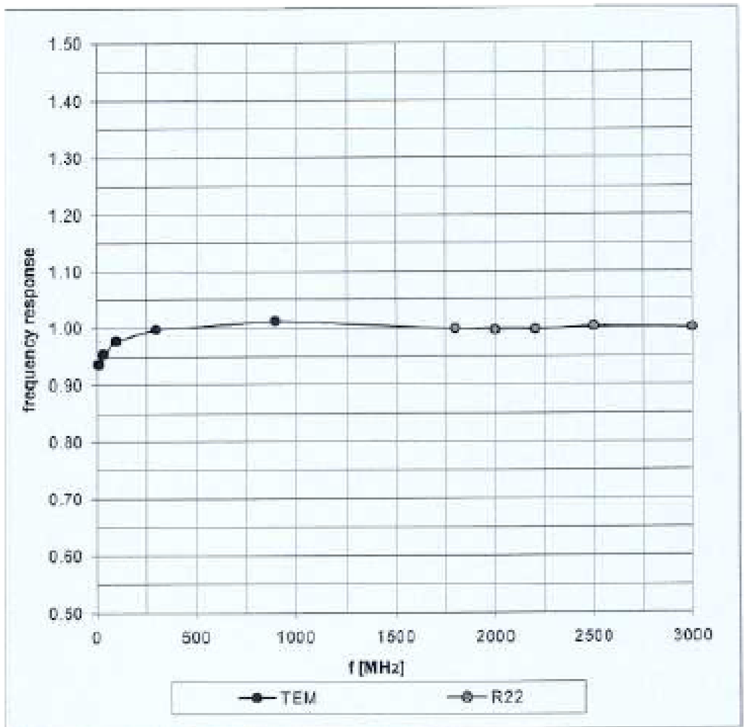
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

ET3DV6 SN:1604 June 10, 2004

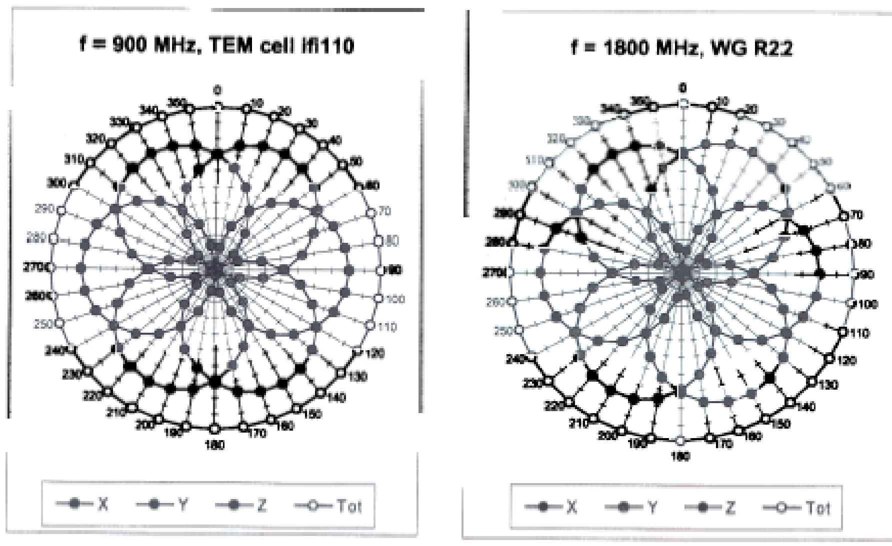
## Frequency Response of E-Field

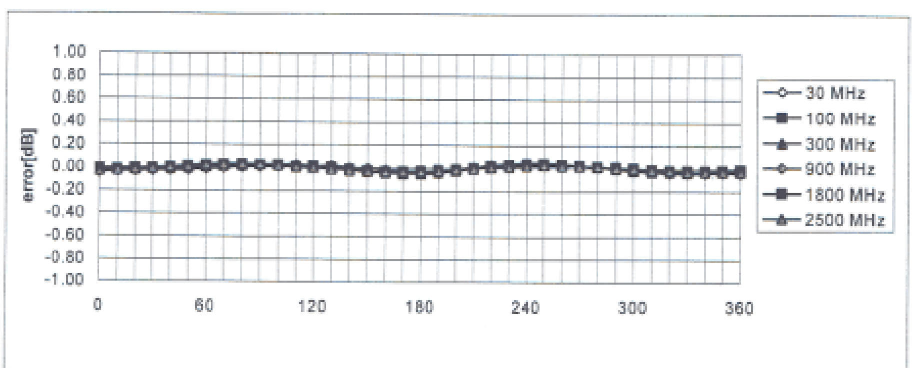
**( TEM-Cell:ifi110, Waveguide R22)**



**ET3DV6 SN:1604** **June 10, 2004**

## Receiving Pattern (φ), θ 0°



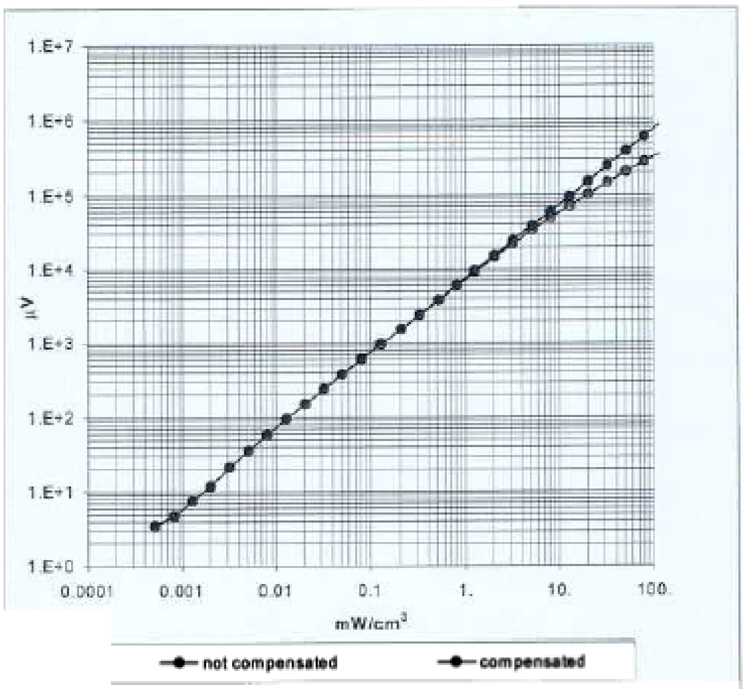



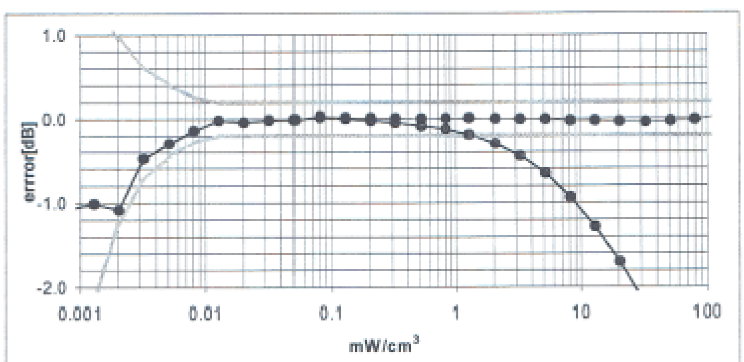

**Axial Isotropy Error < ± 0.2 dB**

ET3DV6 SN:1604 June 10, 2004

## Dynamic Range f($SAR_{head}$)

**( Waveguide R22 )**

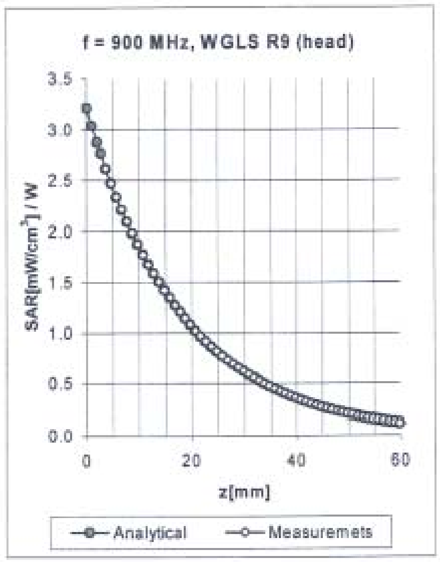


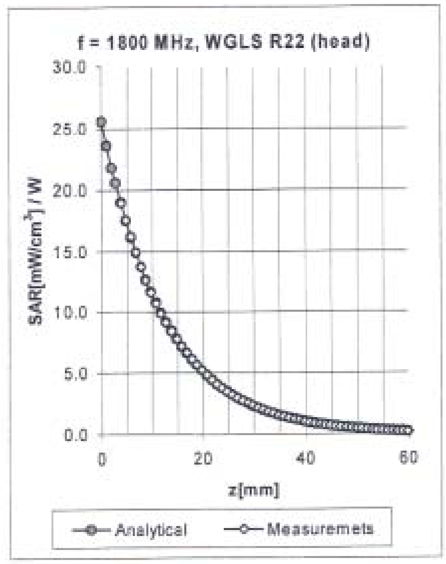




**Probe Linearity Error < ± 0.2 dB**

ET3DV6 SN:1604 June 10, 2004

## Conversion Factor Assessment



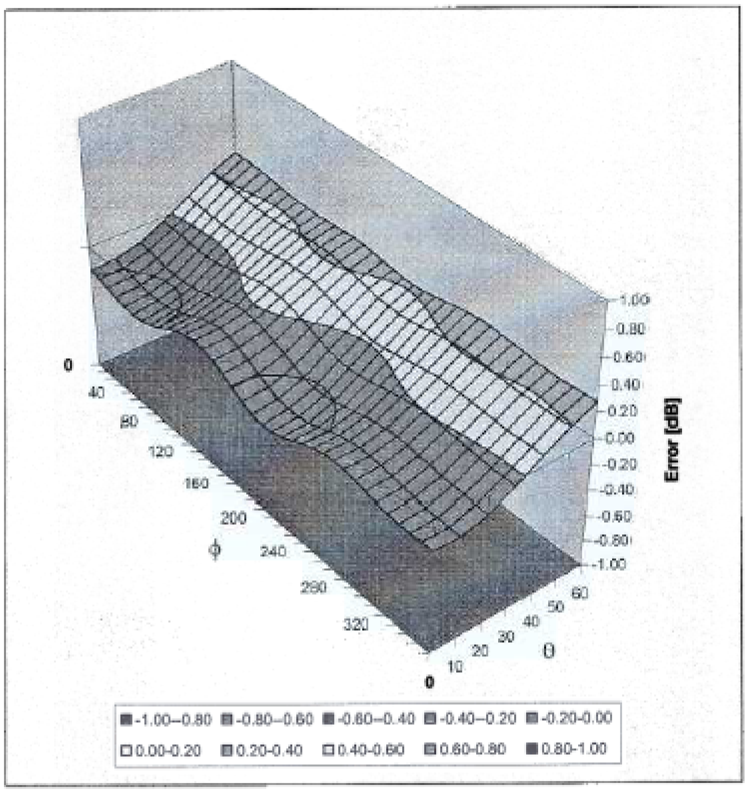




| f [MHz] | Validity [MHz][a] | Tissue | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---|---|---|---|---|---|---|---|---|
| 900 | 800-1000 | Head | 41.5 ± 5% | 0.97 ± 5% | 0.67 | 1.75 | 6.45 | ± 11.3% (k=2) |
| 1800 | 1710-1910 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.47 | 2.64 | 5.23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

[a] 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 < ± 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) | ES3DV2 - SN:3019 |
| Calibration procedure(s) | QA CAL-01.v2<br>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: | [redacted] | | |
| Approved by: | [redacted] | | |

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.

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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!)

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# DASY - Parameters of Probe: ES3DV2 SN: 3019

## Sensitivity in Free Space

| | |
|---|---|
| NormX | **1.03** $\mu V/(V/m)^2$ |
| NormY | **1.12** $\mu V/(V/m)^2$ |
| NormZ | **0.98** $\mu V/(V/m)^2$ |

## Diode Compression

| | |
|---|---|
| DCP X | 99 |
| DCP Y | 99 |
| DCP Z | 99 |

## Sensitivity in Tissue Simulating Liquid

**Head 900 MHz $\varepsilon_r$ = 41.5 ± 5% $\sigma$ = 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 $\varepsilon_r$ = 40.0 ± 5% $\sigma$ = 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**

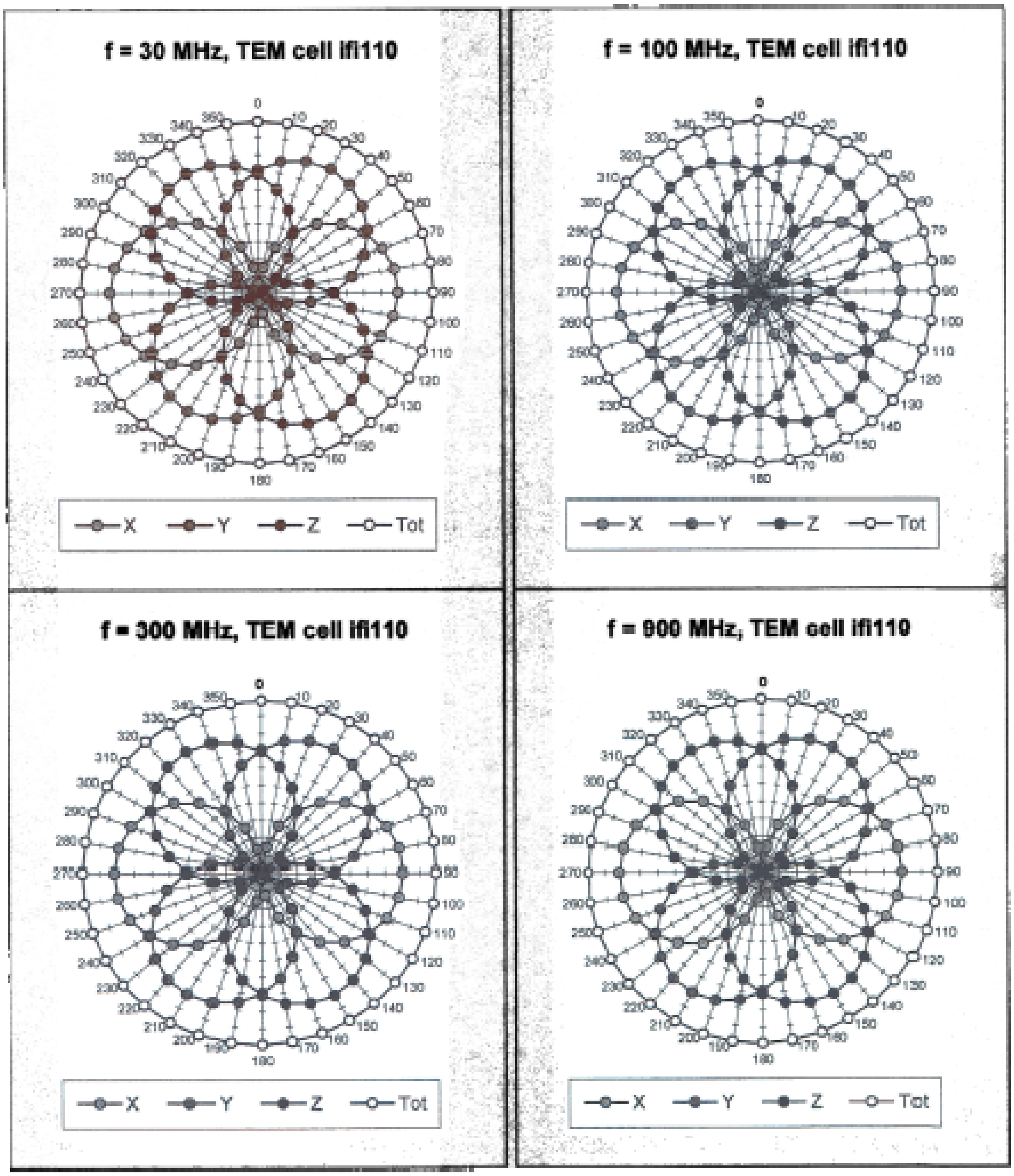
| Probe Tip to Boundary | | **1 mm** | **2 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 7.4 | 5.0 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.0 | 0.1 |

## Sensor Offset

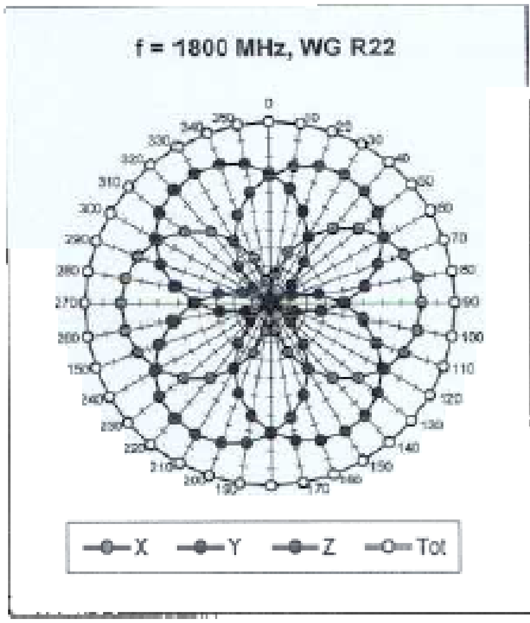
| | | |
|---|---|---|
| Probe Tip to Sensor Center | **2.1** | mm |

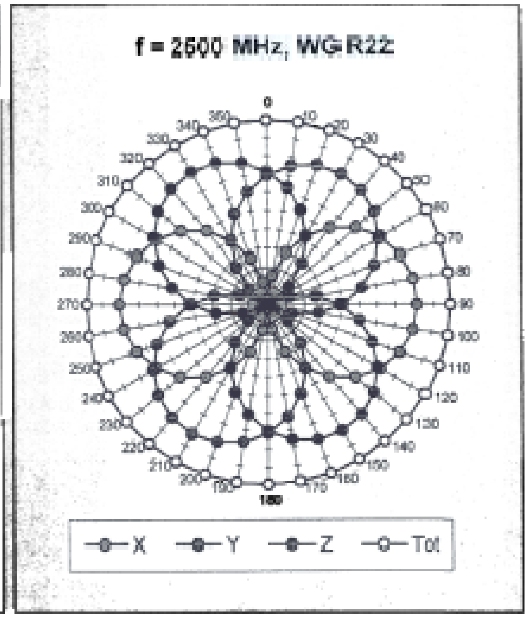
ES3DV2 SN: 3019 July 12, 2003

## Receiving Pattern ($\phi$ , $\theta = 0°$

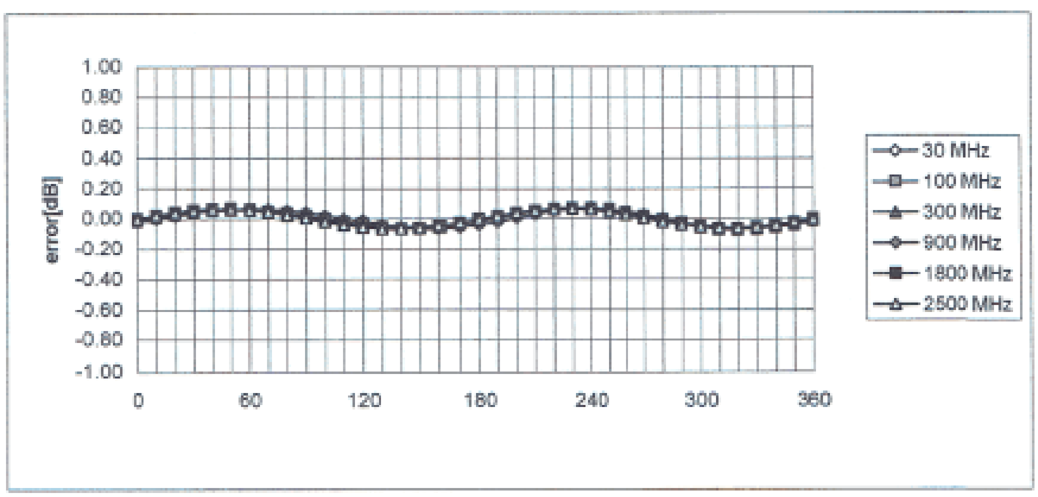


ES3DV2 SN: 3019 July 2003




## Isotropy Error (φ), θ 0°

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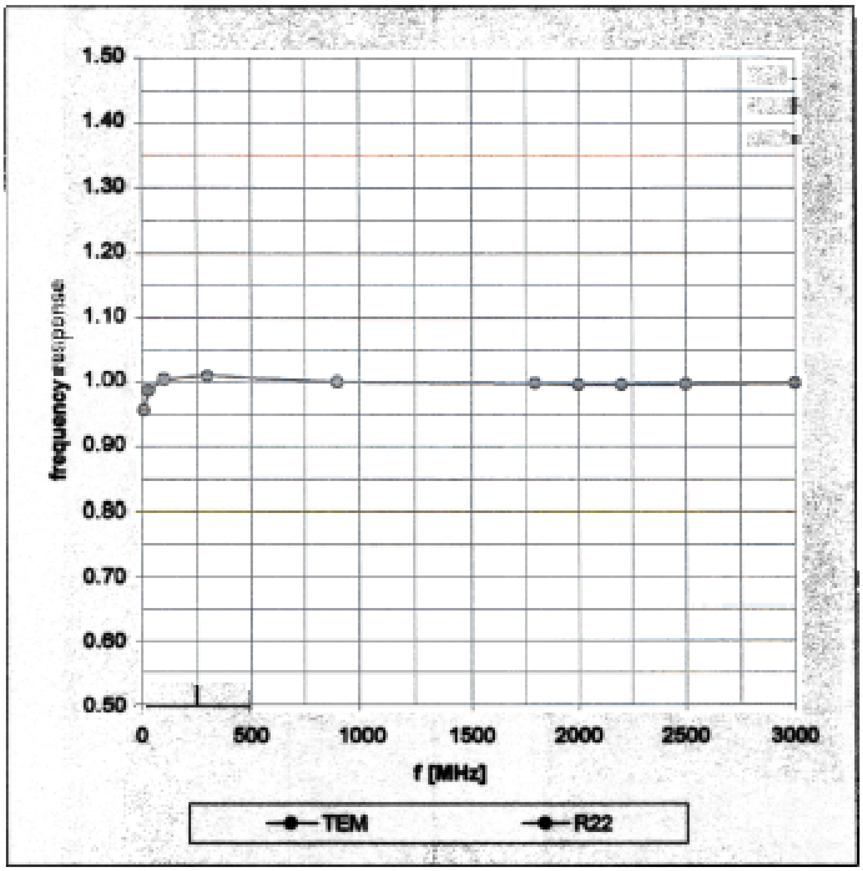
# Frequency Response of E-Field

( TEM-Cell:ifi110, Waveguide R22)

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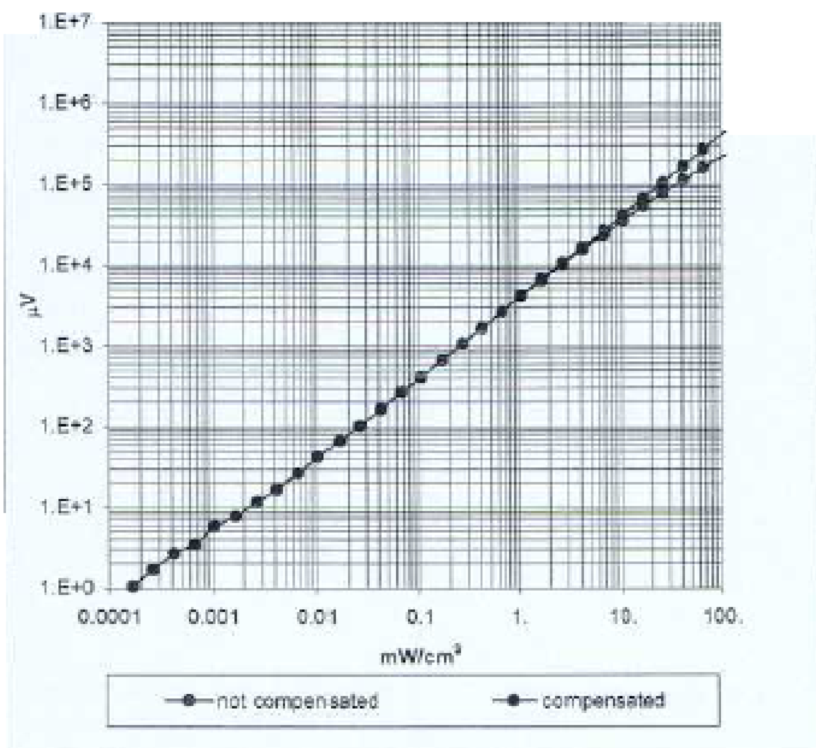
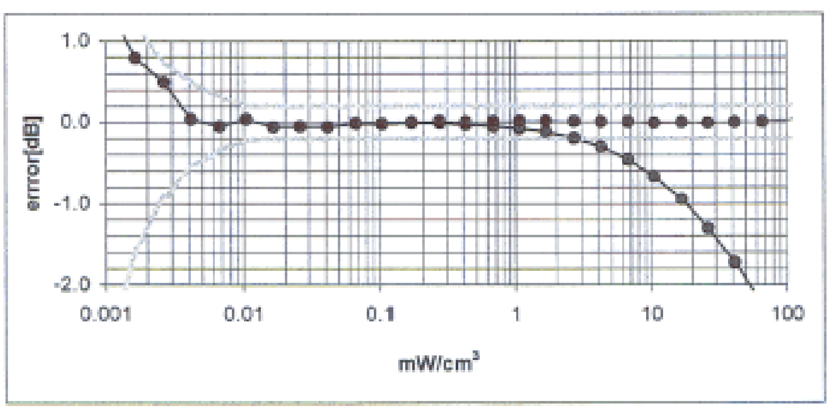
**ES3DV2 SN: 3019** **July 12, 2003**

## Dynamic Range f($SAR_{brain}$)

( Waveguide R22 )

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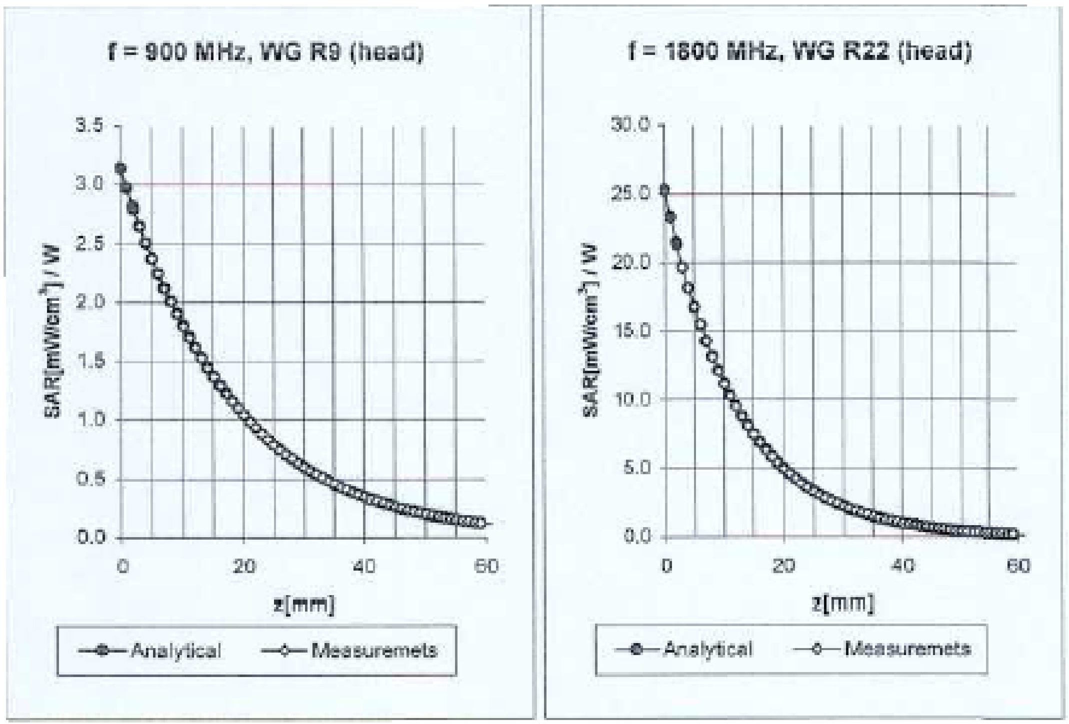
**ES3DV2 SN: 3019** **July 12, 2003**

# Conversion Factor Assessment




**900 MHz** **$\varepsilon_r$ = 41.5 ± 5%** **$\sigma$ = 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** |

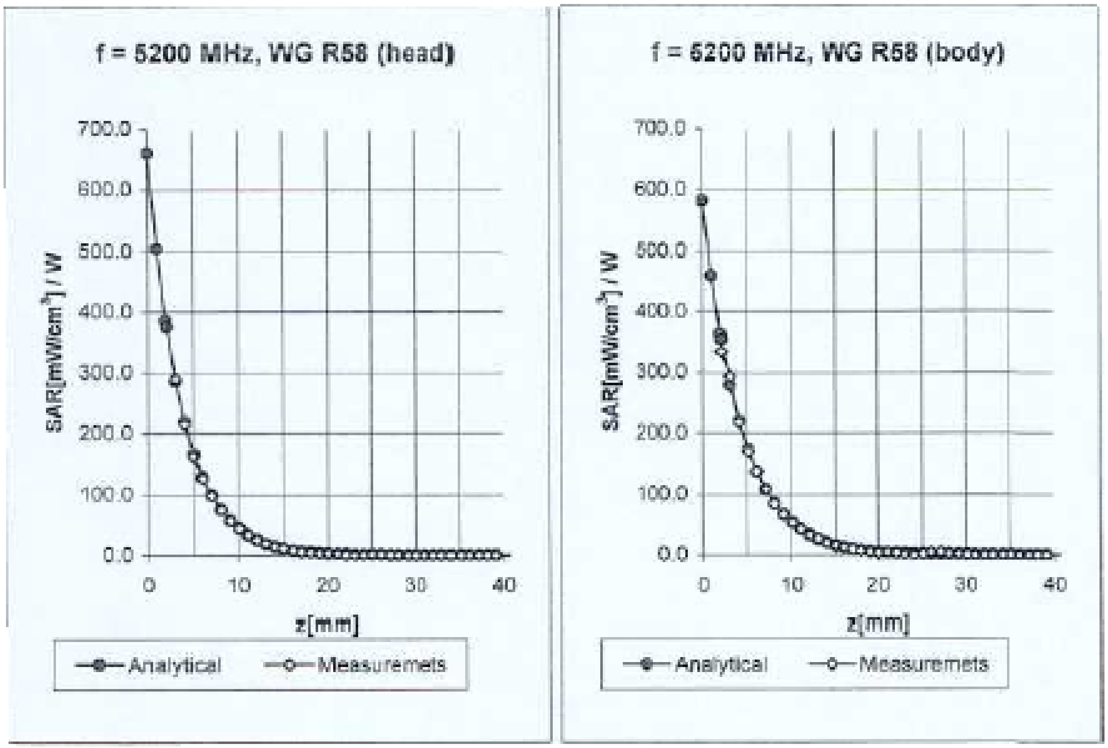
**1800 MHz** **$\varepsilon_r$ = 40.0 ± 5%** **$\sigma$ = 1.40 ± 5% mho/m**

**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** | **$\varepsilon_r$ = 36.0 ± 5%** | **$\sigma$ = 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** | **$\varepsilon_r$ = 49.0 ± 5%** | **$\sigma$ = 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** | |

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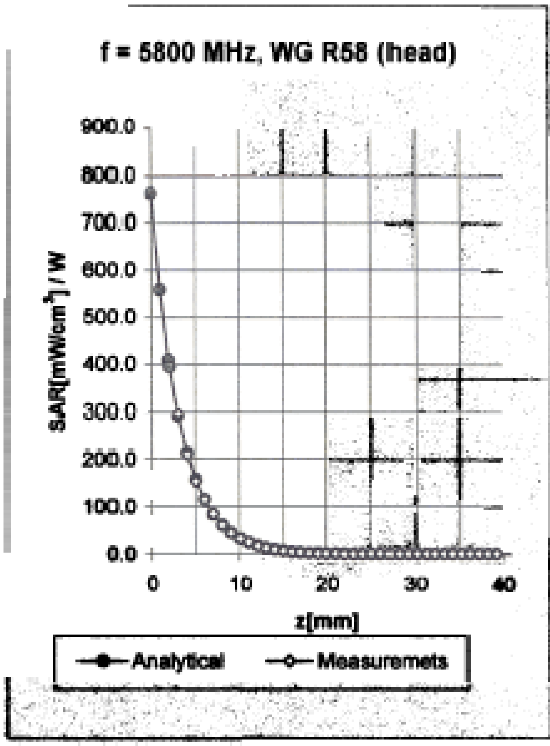
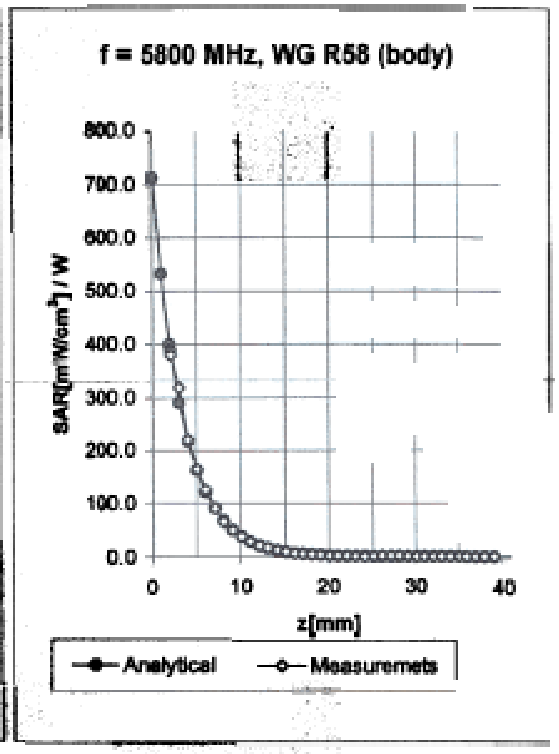
**ES3DV2 SN: 3019** **July 12, 2003**

# Conversion Factor Assessment




| | | | | | | |
|---|---|---|---|---|---|---|
| **Head** | **5800** | **MHz** | $\varepsilon_r$ = 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** | $\varepsilon_r$ = 48.2 ± 5% | | σ = 6.00 ± 5% mho/m | |

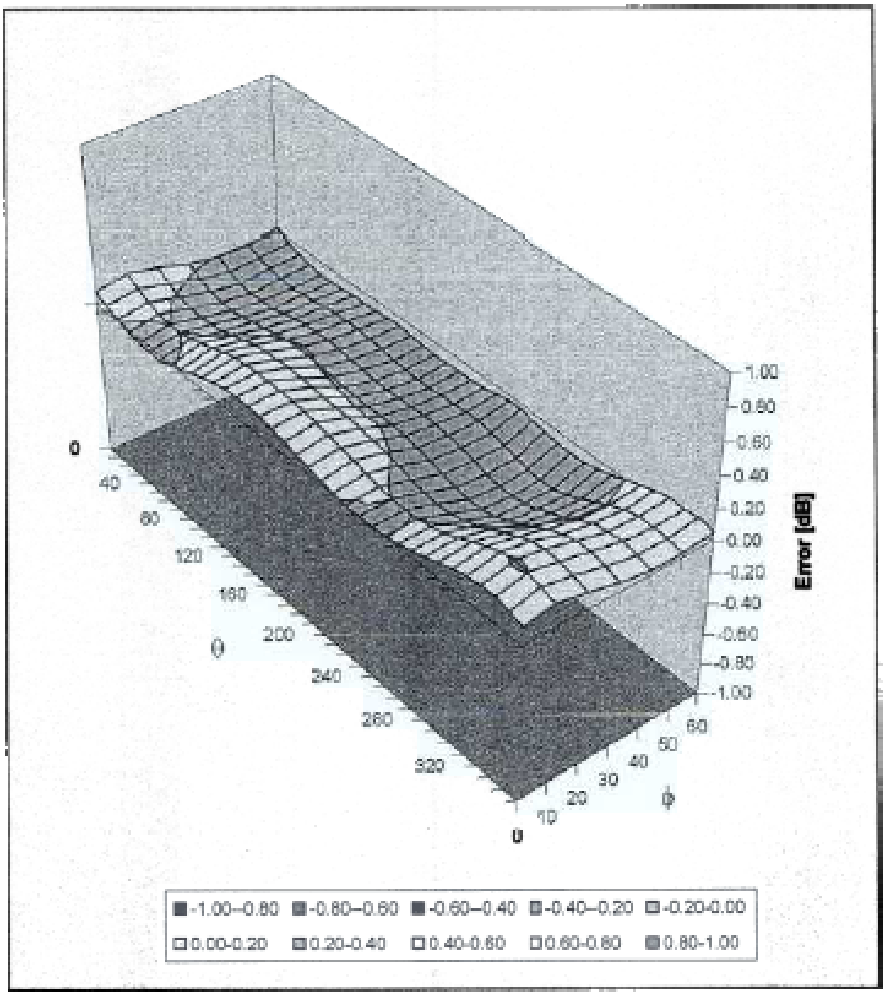
**Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C**

| | | | | |
|---|---|---|---|---|
| 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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# 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!)

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# 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 |

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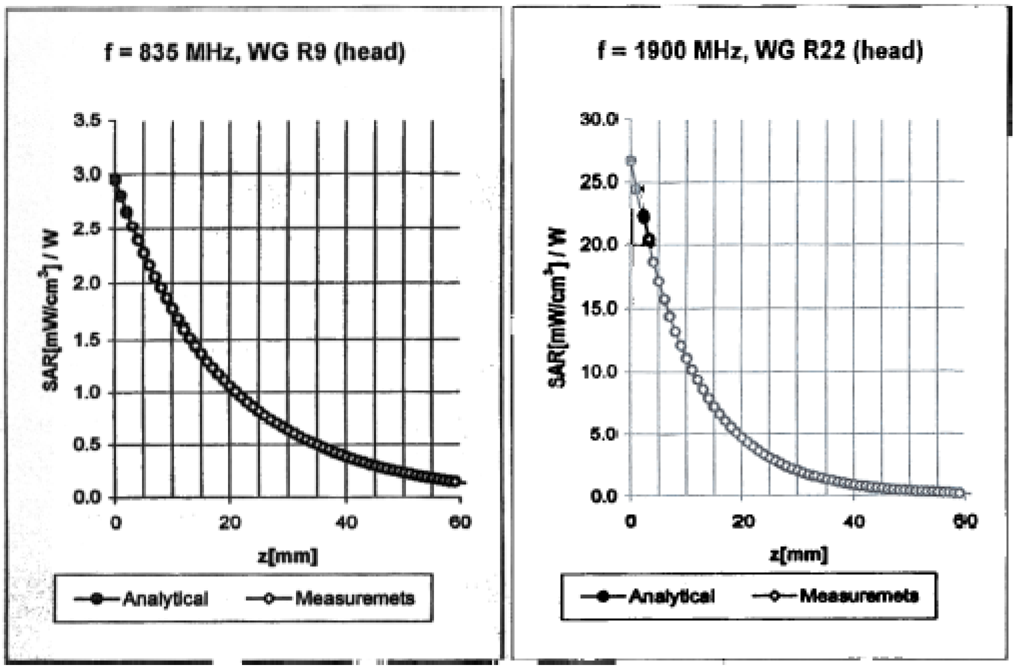
# Conversion Factor Assessment




**Head** **835 MHz** $\varepsilon_r$ **= 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**

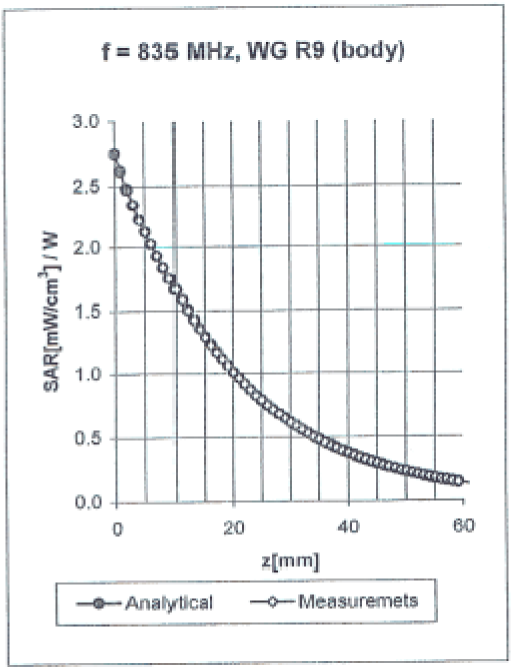
| | | | | |
|---|---|---|---|---|
| ConvF X | **6.5** ± 9.5% (k=2) | | Boundary effect: | |
| ConvF Y | **6.5** ± 9.5% (k=2) | | Alpha | **0.35** |
| ConvF Z | **6.5** ± 9.5% (k=2) | | Depth | **1.46** |

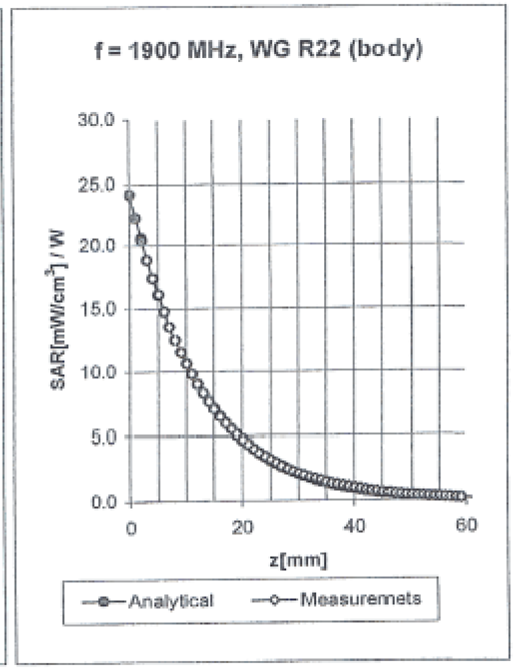
**Head** **1900 MHz** $\varepsilon_r$ **= 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

**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** |

# Convers ion Factor Assessment




**Body** **835 MHz** $\varepsilon_r$ **= 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** $\varepsilon_r$ **= 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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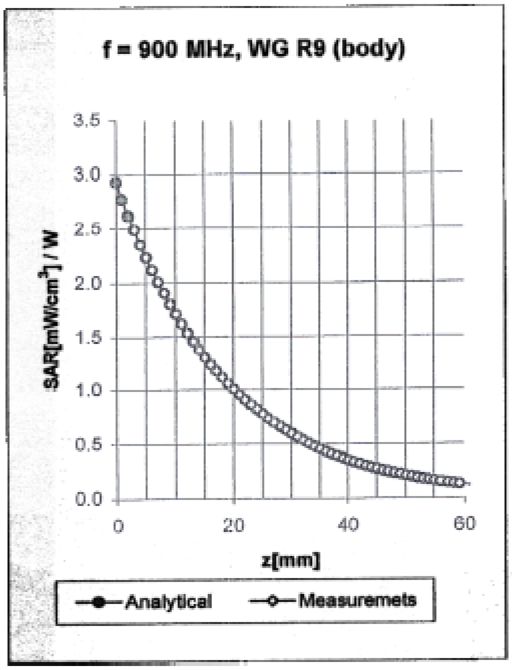
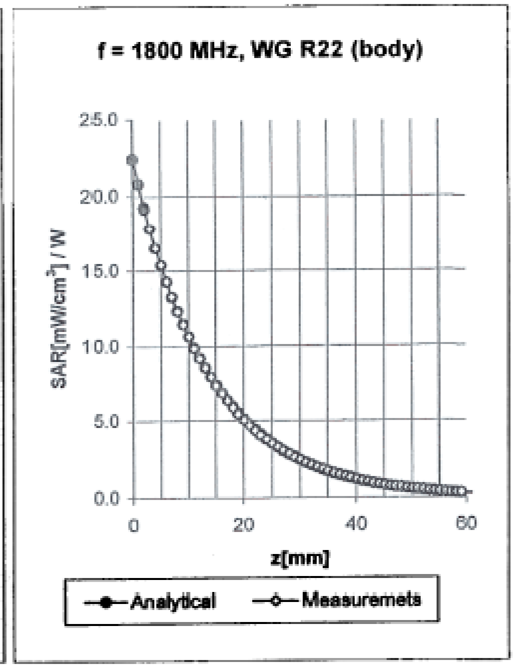
# Conversion Factor Assessment




**Body** 900 MHz $\varepsilon_r$ = 55.0 ± 5% $\sigma$ = 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 $\varepsilon_r$ = 53.3 ± 5% $\sigma$ = 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** |

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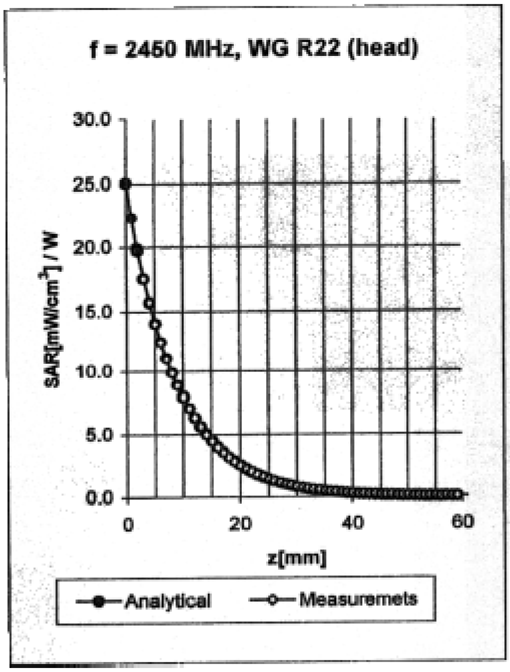
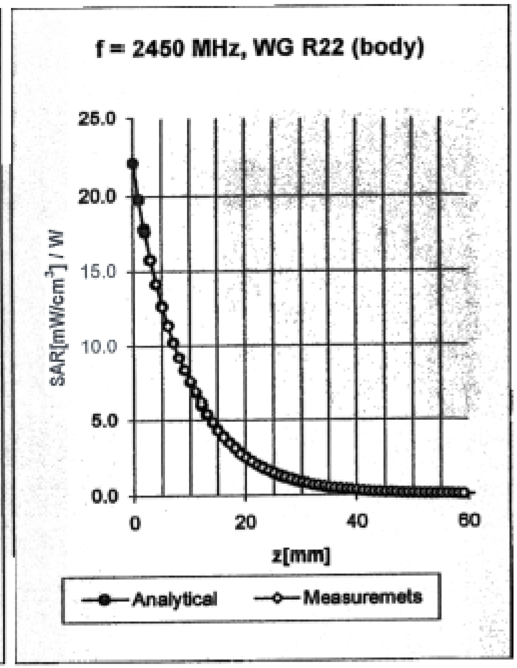
# Conversion Factor Assessment




**Head** **2450 MHz** $\varepsilon_r$ = **39.2 ± 5%** $\sigma$ = **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** $\varepsilon_r$ = **52.7 ± 5%** $\sigma$ = **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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# Additional Conversion Factors

**for Dosimetric E-Field Probe**

| | |
|---|---|
| 'ype: | 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

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## Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor (± standard deviation)

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

# 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

# Liquid Validation

| Instrument | Manufacturer | Model | Calibrated |
|---|---|---|---|
| Network Analyzer | HP | 4396B | 1 Nov 2002 |
| Dielectric Probe Kit, | Agilent | 85070C | Each Use |
| $H_2O$, 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

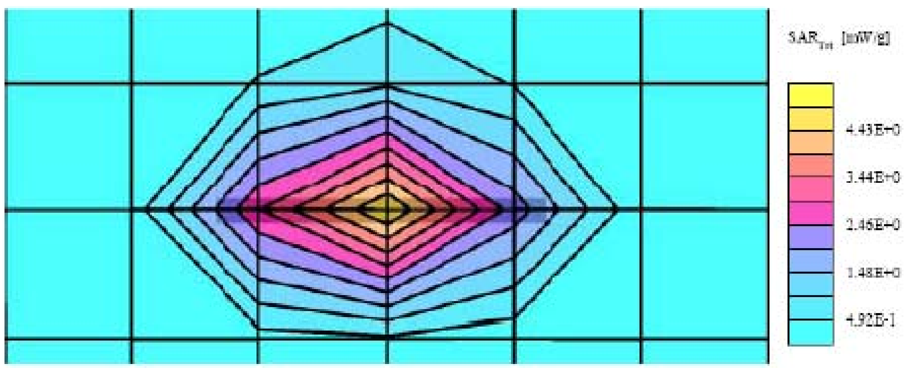
1800 MHz Head Liquid validation Date :12APR2004

Ambient Temp = 23 °C Liquid Temp = 22 °C

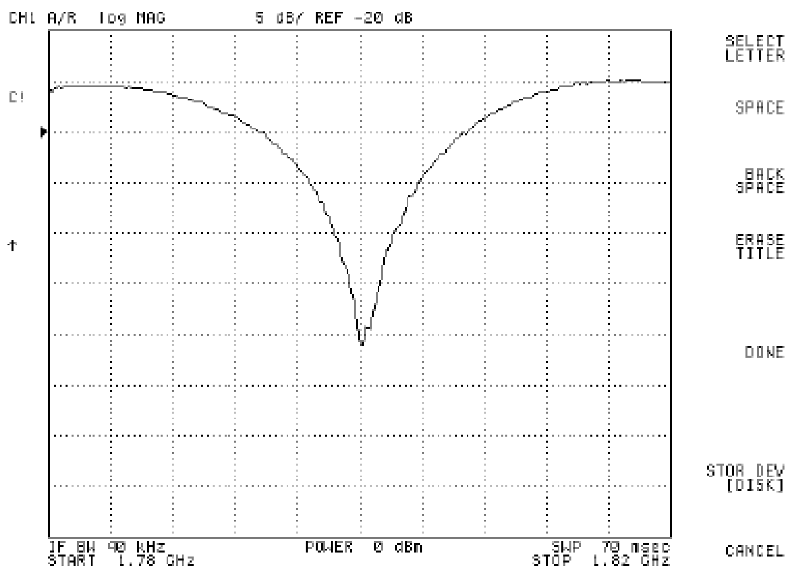
| Frequency | e' | e" | σ (σ = 2πfε$_0$ε") |
|---|---|---|---|
| 1850000000.0000 | 38.8246 | 13.2534 | |
| 1852000000.0000 | 38.7736 | 13.2429 | |
| 1854000000.0000 | 38.8400 | 13.2576 | |
| 1856000000.0000 | 38.8463 | 13.2425 | |
| 1858000000.0000 | 38.8167 | 13.2672 | |
| 1860000000.0000 | 38.8129 | 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)

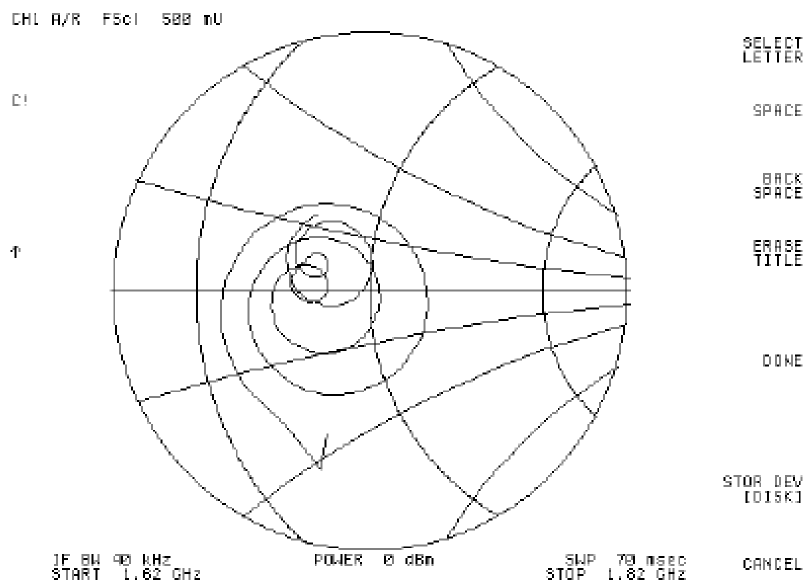
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 1900 MHz
Probe: ES3DV2 - SN3019; ConvF(4.70,4.70,4.70); Crest factor: 1.0; Head Liquid 1900 MHz: $\sigma$ = 1.40 mho/m $\varepsilon_r$ = 40.0 $\rho$ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 4.38 mW/g, SAR (10g): 2.21 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.01 dB



Insertion Loss Plot
S11



Smith Chart


CH1 A/R FScl 500 mU
SELECT LETTER
SPACE
BACK SPACE
ERASE TITLE
DONE
STOR DEV [DISK]
CANCEL
IF BW 90 kHz
START 1.62 GHz
POWER 0 dBm
SWP 70 msec
STOP 1.82 GHz

1900 MHZ Body Liquid Validation
Ambient Temp = 25 Deg C , Liquid Temp = 22 Deg C , 10/13/2004

| frequency | e' | e'' |
|---|---|---|
| 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 |

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 1.5349$

*where* $f = 1900 x\, 10^6$

$\varepsilon_o = 8.854\ x\ 10^{-12}$

$\varepsilon'' = 14.5212$

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 |

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon''=1.4160$
*where* $f = 1900 \times 10^6$
$\varepsilon_o = 8.854 \times 10^{-12}$
$\varepsilon'' = 13.3963$