CETECOM ICT Services GmbH
Untertuerkheimer Str. 6-10, 66117 Saarbruecken, Germany Phone: +49 (0) 681 598-0 Fax: -8475
SAR-Laboratory Phone: +49 (0) 681 598-8454


**Accredited testing laboratory**

**DAR registration number: TTI-P-G 166/98**

**Federal Motor Transport Authority (KBA)**
**DAR registration number: KBA-P 00070-97**

# Appendix to test report 4-1567-13-02/05
# Calibration data, Phantom certificate and detail information of the DASY4 System

## Table of Content

# 1 Calibration report "Probe ET3DV6"

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

**Client** **Cetecom**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object(s) | ET3DV6 - SN:1558 |
| Calibration procedure(s) | QA CAL-01.v2<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | September6, 2004 |
| Condition of the calibrated item | In Tolerance (according to the specific calibration document) |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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 | 5-May-04 (METAS, No 251-00388) | May-05 |
| Power sensor E4412A | MY41495277 | 5-May-04 (METAS, No 251-00388) | May-05 |
| Reference 20 dB Attenuator | SN: 5086 (20b) | 3-May-04 (METAS, No 251-00389) | May-05 |
| Power sensor HP 8481A | MY41092180 | 18-Sep-02 (SPEAG, in house check Oct03) | In house check: Oct 05 |
| RF generator HP 8684C | US3642U01700 | 4-Aug-99 (SPEAG, in house check Aug02) | In house check: Aug05 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (SPEAG, in house check Oct03) | In house check: Oct 05 |

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

Date issued:September6, 2004

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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# Probe ET3DV6

## SN:1558

Manufactured: September 16, 2003
Last calibrated: September 6, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

**ET3DV6 SN:1558** **September 6, 2004**

# DASY - Parameters of Probe: ET3DV6 SN:1558

## Sensitivity in Free Space

## Diode Compression[A]

| | | | | |
|---|---|---|---|---|
| NormX | **2.03** µV/(V/m)$^2$ | DCP X | **94** | mV |
| NormY | **1.92** µV/(V/m)$^2$ | DCP Y | **94** | mV |
| NormZ | **1.63** µV/(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** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 9.6 | 5.2 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.1 | 0.2 |

**Head** **1750 MHz** **Typical SAR gradient: 10 % per mm**

| Sensor Center to Phantom Surface Distance | | **3.7 mm** | **4.7 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 13.8 | 9.0 |
| $SAR_{be}$ [%] | 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%.**

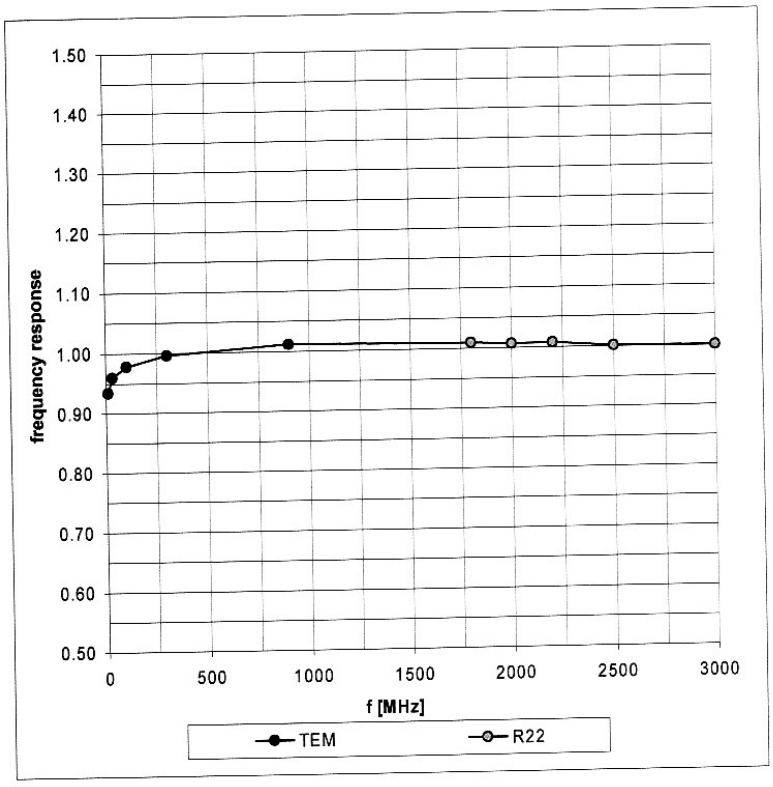
[A] numerical linearization parameter: uncertainty not required

ET3DV6 SN:1558

September 6, 2004

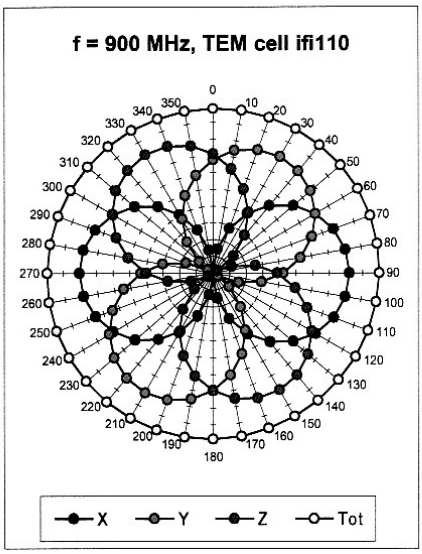
## Frequency Response of E-Field

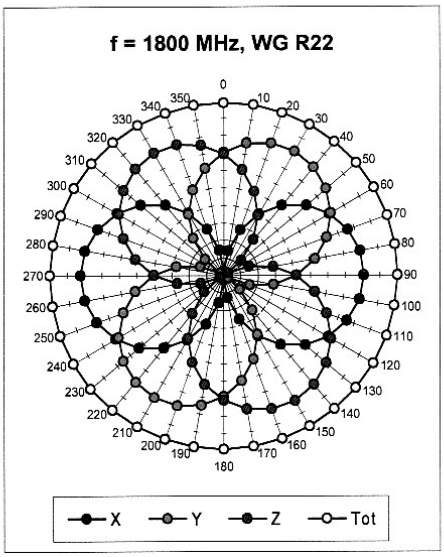
( TEM-Cell:ifi110, Waveguide R22)

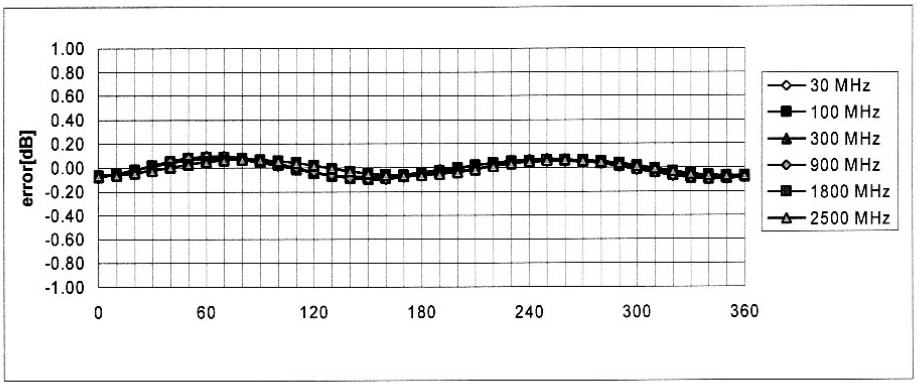


**ET3DV6 SN:1558** **September 6, 2004**

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



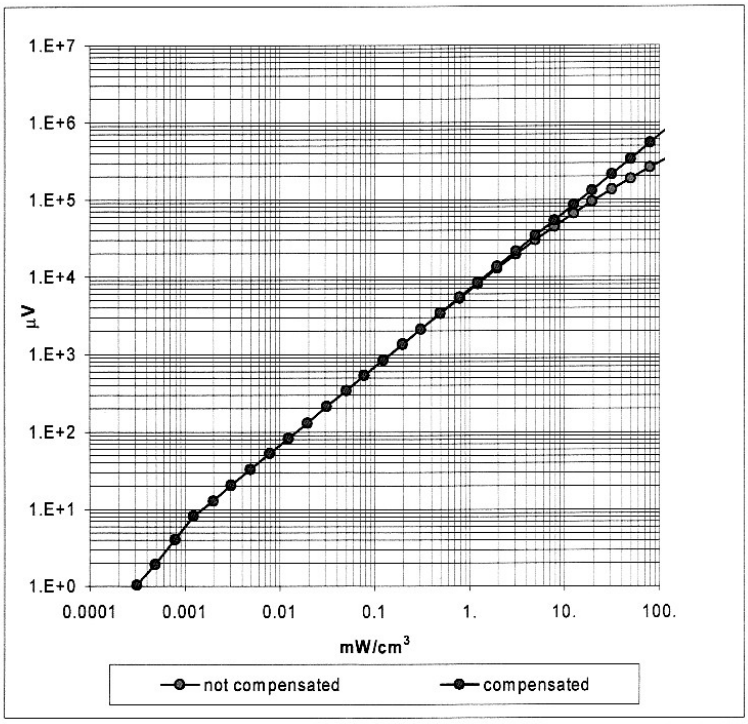



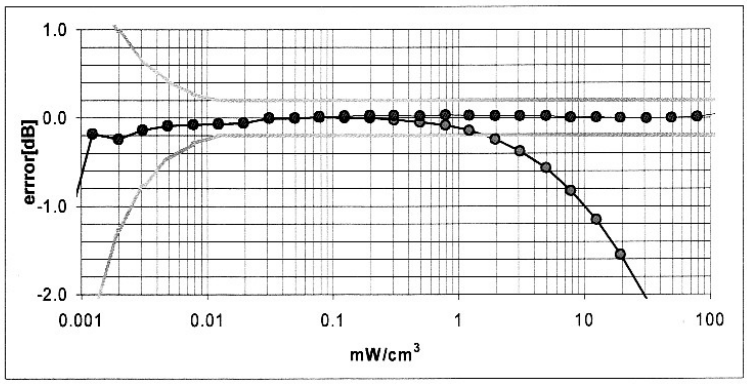

**Axial Isotropy Error < ± 0.2 dB**

**ET3DV6 SN:1558** **September 6, 2004**

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

**( Waveguide R22 )**

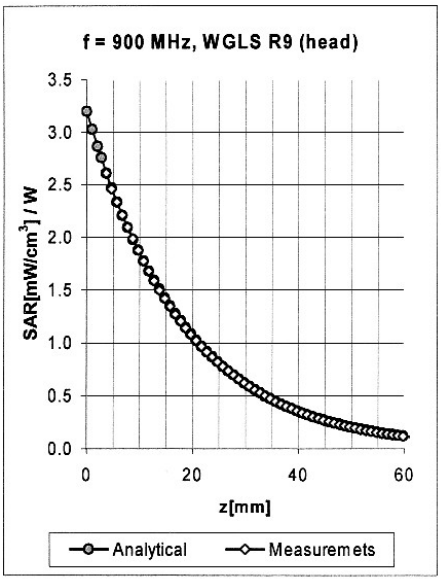


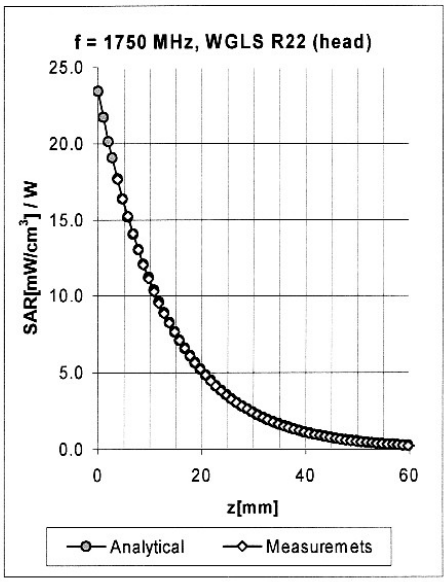




**Probe Linearity Error < ± 0.2 dB**

**ET3DV6 SN:1558** **September 6, 2004**

## Conversion Factor Assessment



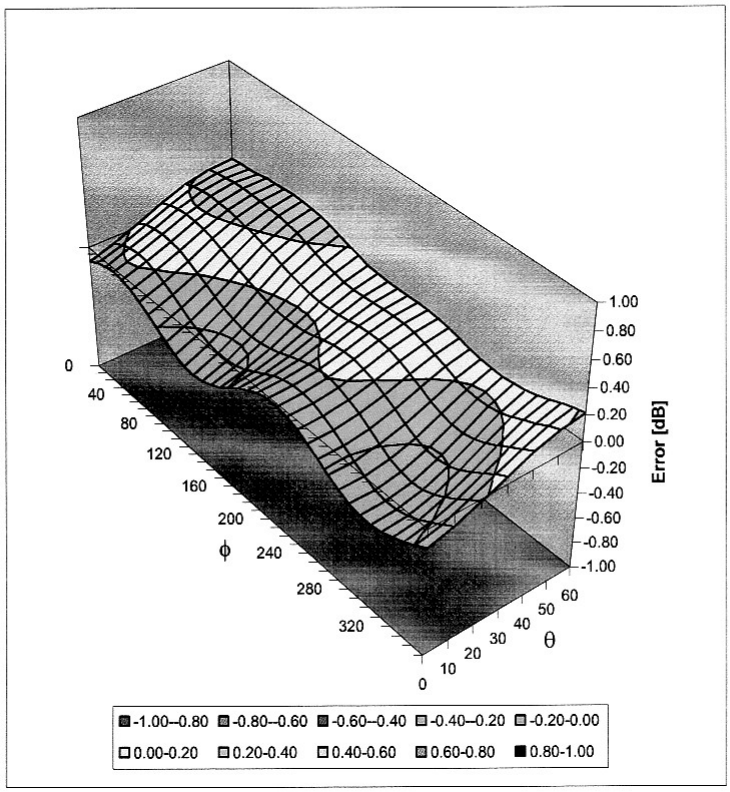

| f [MHz] | Validity [MHz][B] | Tissue | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty |
|---|---|---|---|---|---|---|---|
| 835 | 785-885 | Head | 41.5 ± 5% | 0.90 ± 5% | 0.60 | 1.89 | 6.31 ± 9.7% (k=2) |
| 900 | 850-950 | Head | 41.5 ± 5% | 0.97 ± 5% | 0.62 | 1.89 | 6.03 ± 9.7% (k=2) |
| 1750 | 1700-1800 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.52 | 2.56 | 4.96 ± 9.7% (k=2) |
| 1900 | 1850-1950 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.52 | 2.64 | 4.82 ± 9.7% (k=2) |
| 2450 | 2400-2500 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.95 | 1.92 | 4.27 ± 9.7% (k=2) |
| | | | | | | | |
| 835 | 785-885 | Body | 55.2 ± 5% | 0.97 ± 5% | 0.51 | 2.15 | 6.01 ± 9.7% (k=2) |
| 900 | 850-950 | Body | 55.0 ± 5% | 1.05 ± 5% | 0.47 | 2.24 | 5.78 ± 9.7% (k=2) |
| 1750 | 1700-1800 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.52 | 2.85 | 4.45 ± 9.7% (k=2) |
| 1900 | 1850-1950 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.57 | 2.83 | 4.32 ± 9.7% (k=2) |
| 2450 | 2400-2500 | Body | 52.7 ± 5% | 1.95 ± 5% | 1.01 | 1.69 | 4.06 ± 9.7% (k=2) |

[B] 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.

**ET3DV6 SN:1558** **September 6, 2004**

## Deviation from Isotropy in HSL

**Error (θ, ϕ), f = 900 MHz**




**Spherical Isotropy Error < ± 0.4 dB**

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# 2 Calibration report "900 MHz System validation dipole"

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

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Accredited by the Swiss Federal Office of Metrology and Accreditation
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 108**

**Client** Cetecom

**Certificate No: D900V2-102_Oct04/2**

## CALIBRATION CERTIFICATE (Replacement of D900V2-102_Oct04)

| | |
|---|---|
| Object | D900V2 - SN: 102 |
| Calibration procedure(s) | QA CAL-05.v6<br>Calibration procedure for dipole validation kits |
| Calibration date: | October 26, 2004 |
| Condition of the calibrated item | In Tolerance |

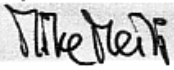
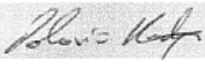
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM E442 | GB37480704 | 12-Oct-04 (METAS, No. 251-00412) | Oct-05 |
| Power sensor HP 8481A | US37292783 | 12-Oct-04 (METAS, No. 251-00412) | Oct-05 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 10-Aug-04 (METAS, No 251-00402) | Aug-05 |
| Reference 10 dB Attenuator | SN: 5047.2 (10r) | 10-Aug-04 (METAS, No 251-00402) | Aug-05 |
| Reference Probe ET3DV6 | SN 1680 | 23-Feb-04 (SPEAG, No. ET3-1680_Feb04) | Feb-05 |
| DAE4 | SN 601 | 22-Jul-04 (SPEAG, No. DAE4-601_Jul04) | Jul-05 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (SPEAG, in house check Oct-03) | In house check: Oct-05 |
| RF generator R&S SML-03 | 100698 | 27-Mar-02 (SPEAG, in house check Dec-03) | In house check: Dec-05 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (SPEAG, in house check Nov-03) | In house check: Nov 04 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Mike Meili | Laboratory Technician |  |
| Approved by: | Katja Pokovic | Technical Manager |  |

Issued: November 10, 2004

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

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Accredited by the Swiss Federal Office of Metrology and Accreditation
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

d) DASY4 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

## Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|---|---|---|
| **DASY Version** | DASY4 | V4.4 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom V4.9 | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Area Scan resolution** | dx, dy = 15 mm | |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 900 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.97 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 41.01 ± 6 % | 0.95 mho/m ± 6 % |
| **Head TSL temperature during test** | (22.0 ± 0.2) °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 cm³ (1 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.62 mW / g |
| SAR normalized | normalized to 1W | 10.5 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **10.5 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 cm³ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.68 mW / g |
| SAR normalized | normalized to 1W | 6.72 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **6.80 mW / g ± 16.5 % (k=2)** |

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.5 Ω - 6.0 jΩ |
| Return Loss | - 24.0 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.409 ns |

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | January 24, 2001 |

**DASY4 Validation Report for Head TSL**

Date/Time: 11/10/04 19:32:28

Test Laboratory: SPEAG, Zürich, Switzerland

**DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN102**

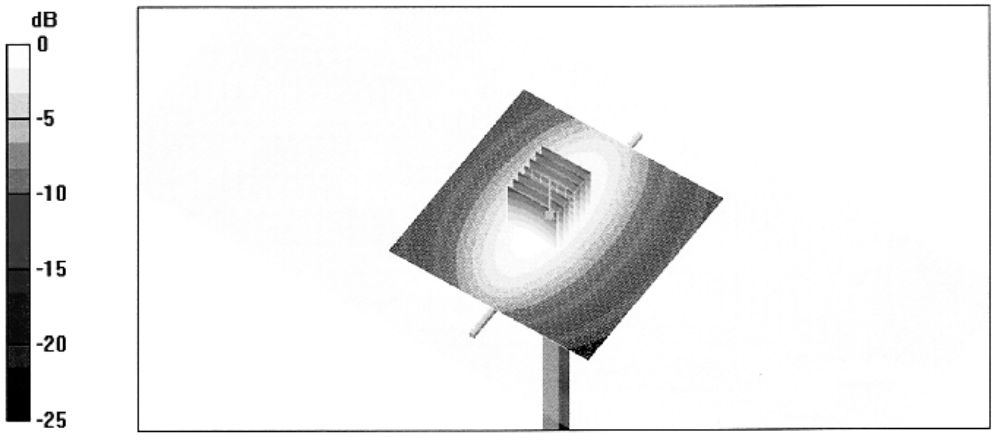
Communication System: CW-900; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: HSL 900 MHz;
Medium parameters used: f = 900 MHz; $\sigma$ = 0.95 mho/m; $\varepsilon_r$ = 41; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1680; ConvF(6.32, 6.32, 6.32); Calibrated: 23.02.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom half size; Type: QD000P49AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.4 Build 3; Postprocessing SW: SEMCAD, V1.8 Build 130

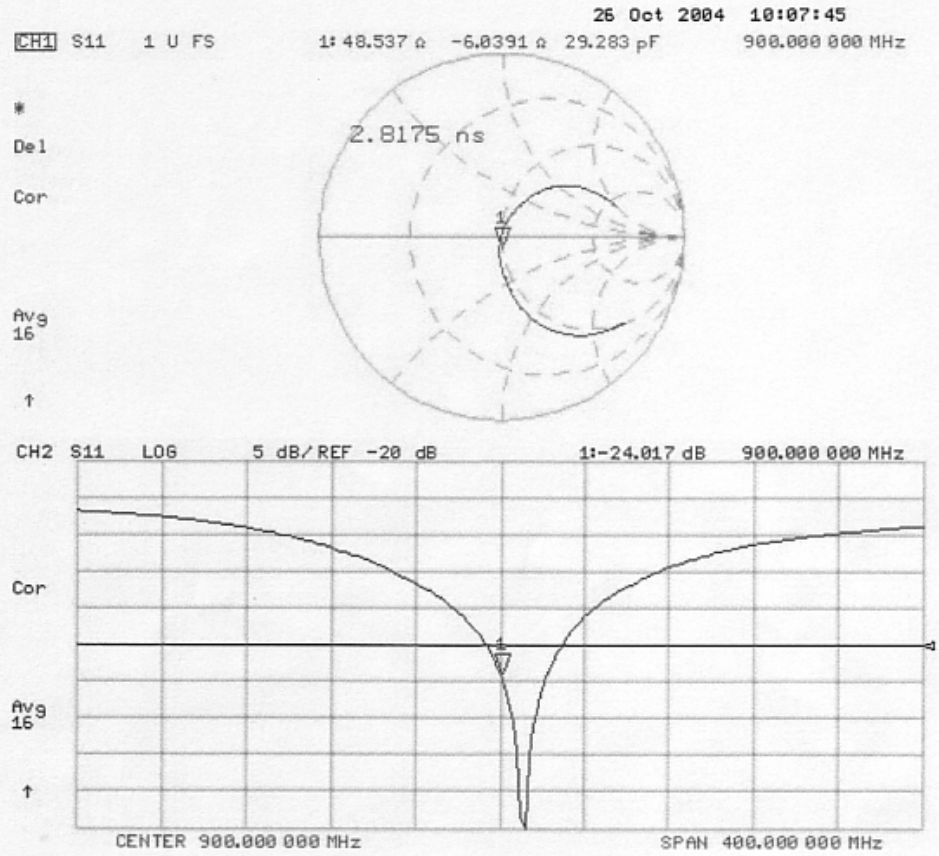
**Pin = 250 mW; d = 15 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.79 mW/g

**Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.5 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 3.93 W/kg
**SAR(1 g) = 2.62 mW/g; SAR(10 g) = 1.68 mW/g**
Maximum value of SAR (measured) = 2.85 mW/g




0 dB = 2.85 mW/g

## Impedance Measurement Plot for Head TSL




Certificate No: D900V2-102_Oct04/2 Page 6 of 6