

---

---

## **DIPOLE CALIBRATION**

---

---



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 Digital EMC (Dymstec)

Certificate No: D2450V2-726\_Mar05

CALIBRATION CERTIFICATE

Object D2450V2 - SN: 726

Calibration procedure(s) QA CAL-05.v6  
Calibration procedure for dipole validation kits

Calibration date: March 14, 2005

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 ES3DV2     | SN 3025          | 29-Oct-04 (SPEAG, No. ES3-3025_Oct04)     | Oct-05                 |
| DAE4                       | SN 601           | 07-Jan-05 (SPEAG, No. DAE4-601_Jan05)     | Jan-06                 |
| 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-04)  | In house check: Nov-05 |

Calibrated by: Judith Müller      Name      Function  
Laboratory Technician

Approved by: Katja Pokovic      Technical Manager

Signature

Issued: March 22, 2005

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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                     | V4.5        |
| Extrapolation                | Advanced Extrapolation    |             |
| Phantom                      | Modular Flat Phantom V5.0 |             |
| Distance Dipole Center - TSL | 10 mm                     | with Spacer |
| Area Scan resolution         | dx, dy = 15 mm            |             |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm         |             |
| Frequency                    | 2450 MHz ± 1 MHz          |             |

Head TSL parameters

The following parameters and calculations were applied.

|                                  |                 |              |                  |
|----------------------------------|-----------------|--------------|------------------|
|                                  | Temperature     | Permittivity | Conductivity     |
| Nominal Head TSL parameters      | 22.0 °C         | 39.2         | 1.80 mho/m       |
| Measured Head TSL parameters     | (22.0 ± 0.2) °C | 39.9 ± 6 %   | 1.78 mho/m ± 6 % |
| Head TSL temperature during test | (21.7 ± 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 | 13.7 mW / g                |
| SAR normalized                                   | normalized to 1W   | 54.8 mW / g                |
| SAR for nominal Head TSL parameters <sup>1</sup> | normalized to 1W   | 55.5 mW / g ± 17.0 % (k=2) |

|                                                  |                    |                            |
|--------------------------------------------------|--------------------|----------------------------|
| SAR averaged over 10 cm³ (10 g) of Head TSL      | condition          |                            |
| SAR measured                                     | 250 mW input power | 6.40 mW / g                |
| SAR normalized                                   | normalized to 1W   | 25.6 mW / g                |
| SAR for nominal Head TSL parameters <sup>1</sup> | normalized to 1W   | 25.9 mW / g ± 16.5 % (k=2) |

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter “SAR Sensitivities”

Appendix

Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.6 $\Omega$ + 3.3 j $\Omega$ |
| Return Loss                          | - 28.9 dB                      |

General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.159 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 9, 2003 |

DASY4 Validation Report for Head TSL

Date/Time: 14.03.2005 15:44:22

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN726

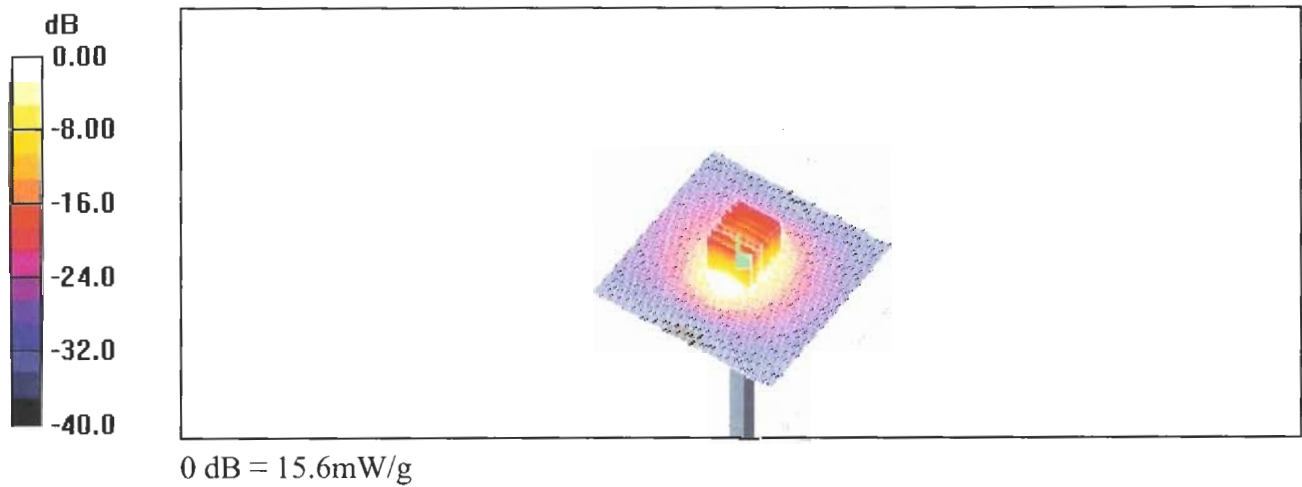
Communication System: CW-2450; Frequency: 2450 MHz;Duty Cycle: 1:1  
Medium: HSL U10 BB;  
Medium parameters used:  $f = 2450 \text{ MHz}$ ;  $\sigma = 1.78 \text{ mho/m}$ ;  $\epsilon_r = 39.9$ ;  $\rho = 1000 \text{ kg/m}^3$   
Phantom section: Flat Section  
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0; Type: QD000P50AA; Serial: 1001;
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 15.7 mW/g

Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 93.0 V/m; Power Drift = 0.063 dB  
Peak SAR (extrapolated) = 28.1 W/kg  
SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.4 mW/g  
Maximum value of SAR (measured) = 15.6 mW/g



Impedance Measurement Plot for Head TSL

