



## **D4: 2450MHz SYSTEM VALIDATION DIPOLE**

**Client**      **ADT (Auden)**

## CALIBRATION CERTIFICATE

Object(s)      D2450V2 - SN:716

Calibration procedure(s)      QA CAL-05.v2  
Calibration procedure for dipole validation kits

Calibration date:      August 23, 2004

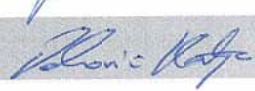
Condition of the calibrated item      In Tolerance (according to the specific calibration document)

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 E442      | GB37480704 | 6-Nov-03 (METAS, No. 252-0254)            | Nov-04                 |
| Power sensor HP 8481A     | US37292783 | 6-Nov-03 (METAS, No. 252-0254)            | Nov-04                 |
| Power sensor HP 8481A     | MY41092317 | 18-Oct-02 (Agilent, No. 20021018)         | Oct-04                 |
| RF generator R&S SML-03   | 100698     | 27-Mar-2002 (R&S, No. 20-92389)           | In house check: Mar-05 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (SPEAG, in house check Nov-03)  | In house check: Oct 05 |

|                |                |                     |                                                                                       |
|----------------|----------------|---------------------|---------------------------------------------------------------------------------------|
|                | Name           | Function            | Signature                                                                             |
| Calibrated by: | Judith Mueller | Technician          |  |
| Approved by:   | Katja Pokovic  | Laboratory Director |  |

Date issued: August 26, 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.

# DASY

## Dipole Validation Kit

Type: D2450V2

Serial: 716

Manufactured: September 10, 2002  
Calibrated: August 23, 2004

## **1. Measurement Conditions**

The measurements were performed in the quarter size flat phantom filled with **head simulating solution** of the following electrical parameters at 2450 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>38.3</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.86 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3025, Conversion factor 4.55 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the quarter size flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW  $\pm 3\%$ . The results are normalized to 1W input power.

## **2. SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3025 and applying the advanced extrapolation are:

|                                                    |                                                            |
|----------------------------------------------------|------------------------------------------------------------|
| averaged over 1 cm <sup>3</sup> (1 g) of tissue:   | <b>52.4 mW/g <math>\pm 16.8\%</math> (k=2)<sup>1</sup></b> |
| averaged over 10 cm <sup>3</sup> (10 g) of tissue: | <b>23.8 mW/g <math>\pm 16.2\%</math> (k=2)<sup>1</sup></b> |

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<sup>1</sup> validation uncertainty

### **3. Dipole Impedance and Return Loss**

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

|                      |                 |                                       |
|----------------------|-----------------|---------------------------------------|
| Electrical delay:    | <b>1.147 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.983</b>    | (voltage transmission, one direction) |

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

|                                  |                                          |
|----------------------------------|------------------------------------------|
| Feedpoint impedance at 2450 MHz: | $\text{Re}\{Z\} = \mathbf{54.7\ \Omega}$ |
|                                  | $\text{Im}\{Z\} = \mathbf{2.7\ \Omega}$  |
| Return Loss at 2450 MHz          | <b>-26.1 dB</b>                          |

### **4. Measurement Conditions**

The measurements were performed in the quarter size flat phantom filled with **body simulating solution** of the following electrical parameters at 2450 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>51.7</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.96 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3025, Conversion factor 4.22 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the quarter size flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW  $\pm 3\%$ . The results are normalized to 1W input power.

## **5. SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3025 and applying the advanced extrapolation are:

|                                                    |                                             |
|----------------------------------------------------|---------------------------------------------|
| averaged over 1 cm <sup>3</sup> (1 g) of tissue:   | <b>48.8 mW/g ± 16.8 % (k=2)<sup>2</sup></b> |
| averaged over 10 cm <sup>3</sup> (10 g) of tissue: | <b>22.6 mW/g ± 16.2 % (k=2)<sup>2</sup></b> |

## **6. Dipole Impedance and Return Loss**

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

|                                  |                       |
|----------------------------------|-----------------------|
| Feedpoint impedance at 2450 MHz: | <b>Re{Z} = 50.8 Ω</b> |
|                                  | <b>Im {Z} = 4.1 Ω</b> |
| Return Loss at 2450 MHz          | <b>-27.7 dB</b>       |

## **7. Handling**

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

## **8. Design**

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.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Sections 1 and 4. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

## **9. Power Test**

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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<sup>2</sup> validation uncertainty

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN716**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL 2450 MHz;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.86$  mho/m;  $\epsilon_r = 38.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.55, 4.55, 4.55); Calibrated: 9/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 7/22/2004
- Phantom: Flat Phantom quarter size; Type: QD000P50AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.3 Build 16; Postprocessing SW: SEMCAD, V1.8 Build 123

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 14.9 mW/g

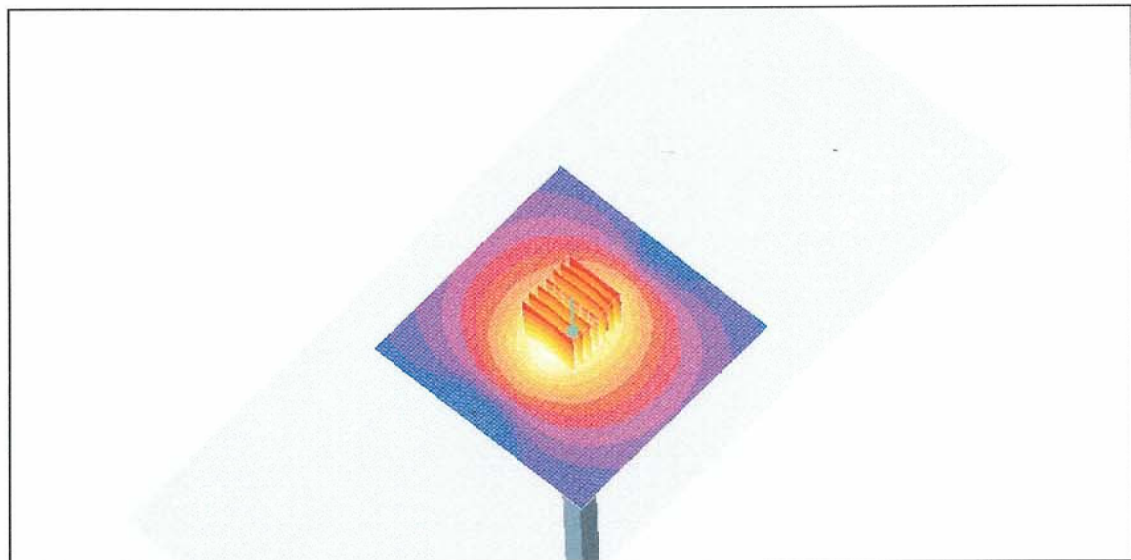
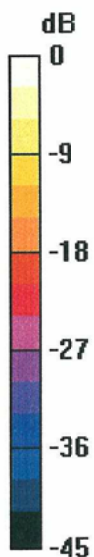
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.1 V/m; Power Drift = 0.1 dB

Peak SAR (extrapolated) = 27.6 W/kg

**SAR(1 g) = 13.1 mW/g; SAR(10 g) = 5.95 mW/g**

Maximum value of SAR (measured) = 14.8 mW/g



0 dB = 14.8mW/g

716  
Head

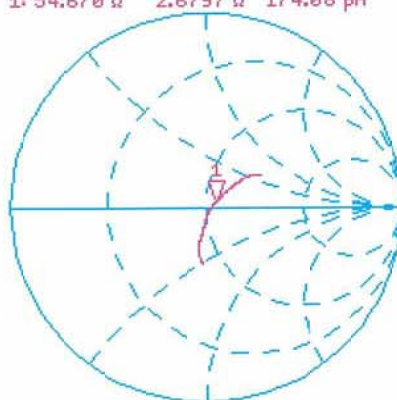
20 Aug 2004 14:02:08  
CH1 S11 1 U FS 1: 54.670  $\Omega$  2: 6797  $\Omega$  174.08 pF 2 450.000 000 MHz

De1

Cor

Avg  
16

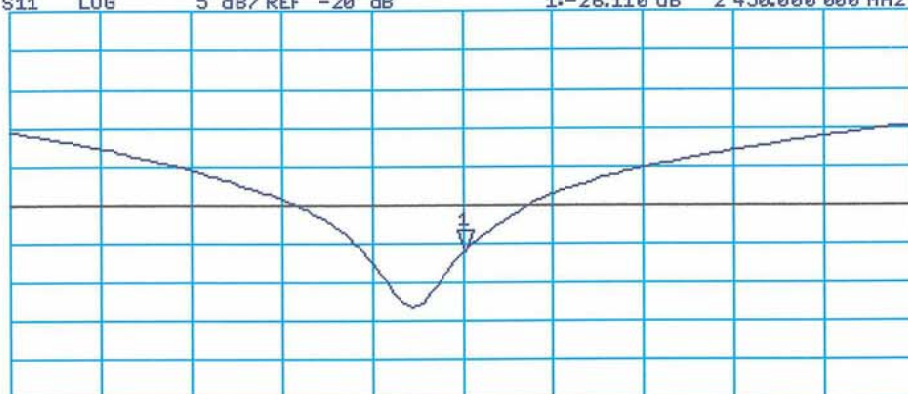
↑



CH2 S11 LOG 5 dB/REF -20 dB 1:-26.110 dB 2 450.000 000 MHz

Cor

↑



CENTER 2 450.000 000 MHz

SPAN 400.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN716**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: Muscle 2450 MHz;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 51.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.22, 4.22, 4.22); Calibrated: 9/29/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 7/22/2004
- Phantom: Flat Phantom quarter size; Type: QD000P50AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.3 Build 17; Postprocessing SW: SEMCAD, V1.8 Build 124

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm  
Maximum value of SAR (interpolated) = 14.2 mW/g

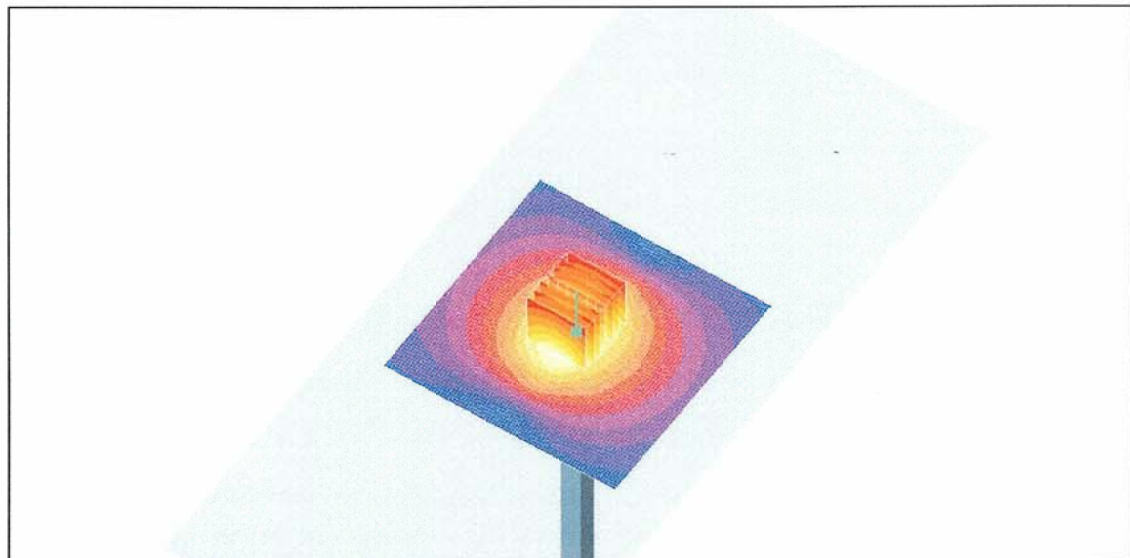
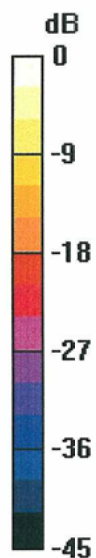
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 85.8 V/m; Power Drift = 0.0 dB

Peak SAR (extrapolated) = 24.9 W/kg

**SAR(1 g) = 12.2 mW/g; SAR(10 g) = 5.64 mW/g**

Maximum value of SAR (measured) = 14.1 mW/g



0 dB = 14.1mW/g

23 Aug 2004 08:51:35

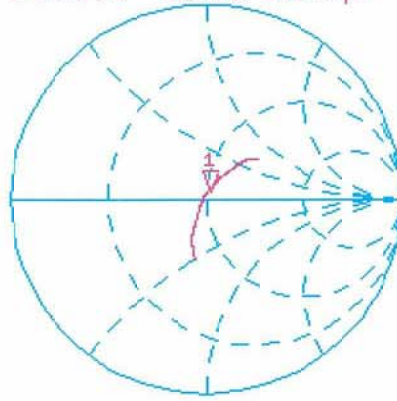
CH1 S11 1 U FS

1: 50.824  $\Omega$  4.0840  $\Omega$  265.30 pH 2 450.000 000 MHz

Del

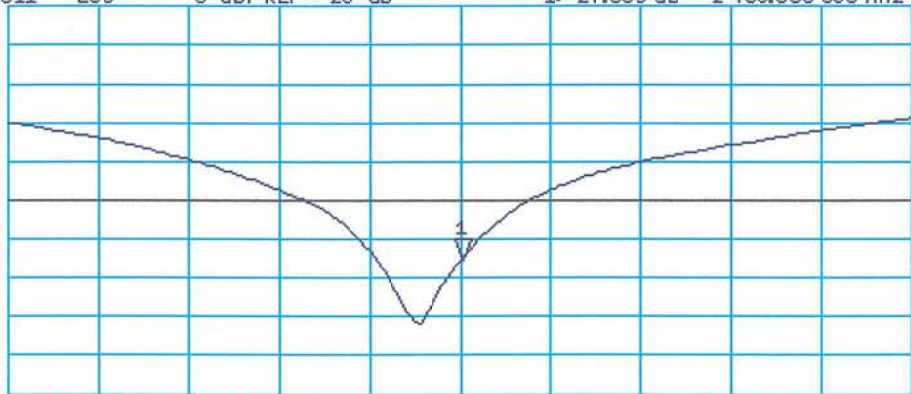
Cor

Avg  
16



CH2 S11 LOG 5 dB/REF -20 dB 1:-27.655 dB 2 450.000 000 MHz

Cor



CENTER 2 450.000 000 MHz

SPAN 400.000 000 MHz