

**D3: DAE**

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **DAE3-510\_Aug05**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 510**

Calibration procedure(s) **QA CAL-06.v12**  
**Calibration procedure for the data acquisition unit (DAE)**

Calibration date: **August 17, 2005**

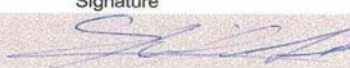
Condition of the calibrated item **In Tolerance**

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  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards                 | ID #               | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-----------------------------------|--------------------|-------------------------------------------|-----------------------|
| Fluke Process Calibrator Type 702 | SN: 6295803        | 7-Sep-04 (Sintrel, No.E-040073)           | Sep-05                |
| Secondary Standards               | ID #               | Check Date (in house)                     | Scheduled Check       |
| Calibrator Box V1.1               | SE UMS 006 AB 1002 | 29-Jun-05 (SPEAG, in house check)         | In house check Jun-06 |

|                |                       |                        |                                                                                                    |
|----------------|-----------------------|------------------------|----------------------------------------------------------------------------------------------------|
| Calibrated by: | Name<br>Eric Hainfeld | Function<br>Technician | Signature<br> |
| Approved by:   | Fin Bornholt          | R&D Director           |               |

Issued: August 17, 2005

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Accreditation No.: **SCS 108**

## Glossary

DAE digital acquisition electronics  
Connector angle information used in DASY system to align probe sensor X to the robot coordinate system.

## Methods Applied and Interpretation of Parameters

- **DC Voltage Measurement:** Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- **Connector angle:** The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters contain technical information as a result from the performance test and require no uncertainty.
- **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
- **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
- **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
- **AD Converter Values with inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
- **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
- **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
- **Input resistance:** DAE input resistance at the connector, during internal auto-zeroing and during measurement.
- **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
- **Power consumption:** Typical value for information. Supply currents in various operating modes.

### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X                        | Y                        | Z                        |
|---------------------|--------------------------|--------------------------|--------------------------|
| High Range          | 403.415 $\pm$ 0.1% (k=2) | 403.485 $\pm$ 0.1% (k=2) | 403.851 $\pm$ 0.1% (k=2) |
| Low Range           | 3.95575 $\pm$ 0.7% (k=2) | 3.93409 $\pm$ 0.7% (k=2) | 3.95875 $\pm$ 0.7% (k=2) |

### Connector Angle

|                                           |                                  |
|-------------------------------------------|----------------------------------|
| Connector Angle to be used in DASY system | 44 $^{\circ}$ $\pm$ 1 $^{\circ}$ |
|-------------------------------------------|----------------------------------|

## Appendix

### 1. DC Voltage Linearity

| High Range        | Input ( $\mu\text{V}$ ) | Reading ( $\mu\text{V}$ ) | Error (%) |
|-------------------|-------------------------|---------------------------|-----------|
| Channel X + Input | 200000                  | 200000.5                  | 0.00      |
| Channel X + Input | 20000                   | 20004.73                  | 0.02      |
| Channel X - Input | 20000                   | -19990.82                 | -0.05     |
| Channel Y + Input | 200000                  | 200000.4                  | 0.00      |
| Channel Y + Input | 20000                   | 20002.02                  | 0.01      |
| Channel Y - Input | 20000                   | -19995.68                 | -0.02     |
| Channel Z + Input | 200000                  | 200000.2                  | 0.00      |
| Channel Z + Input | 20000                   | 20006.25                  | 0.03      |
| Channel Z - Input | 20000                   | -19996.09                 | -0.02     |

| Low Range         | Input ( $\mu\text{V}$ ) | Reading ( $\mu\text{V}$ ) | Error (%) |
|-------------------|-------------------------|---------------------------|-----------|
| Channel X + Input | 2000                    | 2000.1                    | 0.00      |
| Channel X + Input | 200                     | 200.36                    | 0.18      |
| Channel X - Input | 200                     | -200.01                   | 0.00      |
| Channel Y + Input | 2000                    | 1999.9                    | 0.00      |
| Channel Y + Input | 200                     | 199.23                    | -0.38     |
| Channel Y - Input | 200                     | -200.56                   | 0.28      |
| Channel Z + Input | 2000                    | 2000                      | 0.00      |
| Channel Z + Input | 200                     | 199.08                    | -0.46     |
| Channel Z - Input | 200                     | -200.99                   | 0.50      |

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Common mode Input Voltage (mV) | High Range Average Reading ( $\mu\text{V}$ ) | Low Range Average Reading ( $\mu\text{V}$ ) |
|-----------|--------------------------------|----------------------------------------------|---------------------------------------------|
| Channel X | 200                            | 17.56                                        | 16.61                                       |
|           | - 200                          | -15.84                                       | -17.03                                      |
| Channel Y | 200                            | 14.35                                        | 14.26                                       |
|           | - 200                          | -15.35                                       | -15.86                                      |
| Channel Z | 200                            | -8.76                                        | -8.81                                       |
|           | - 200                          | 7.41                                         | 7.46                                        |

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | Input Voltage (mV) | Channel X ( $\mu\text{V}$ ) | Channel Y ( $\mu\text{V}$ ) | Channel Z ( $\mu\text{V}$ ) |
|-----------|--------------------|-----------------------------|-----------------------------|-----------------------------|
| Channel X | 200                | -                           | 3.17                        | 0.64                        |
| Channel Y | 200                | 0.23                        | -                           | 3.72                        |
| Channel Z | 200                | -0.73                       | -0.05                       | -                           |

#### 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

|           | High Range (LSB) | Low Range (LSB) |
|-----------|------------------|-----------------|
| Channel X | 15976            | 16467           |
| Channel Y | 16203            | 16387           |
| Channel Z | 16171            | 16268           |

#### 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M $\Omega$

|           | Average ( $\mu$ V) | min. Offset ( $\mu$ V) | max. Offset ( $\mu$ V) | Std. Deviation ( $\mu$ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | 0.21               | -0.66                  | 0.72                   | 0.27                      |
| Channel Y | -1.17              | -3.01                  | 0.16                   | 0.33                      |
| Channel Z | -1.42              | -2.98                  | -0.81                  | 0.29                      |

#### 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

#### 7. Input Resistance

|           | Zeroing (MOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 0.2001         | 201.1            |
| Channel Y | 0.2001         | 199.6            |
| Channel Z | 0.2000         | 200.5            |

#### 8. Low Battery Alarm Voltage (verified during pre test)

| Typical values | Alarm Level (VDC) |
|----------------|-------------------|
| Supply (+ Vcc) | +7.9              |
| Supply (- Vcc) | -7.6              |

#### 9. Power Consumption (verified during pre test)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vcc) | +0.0              | +6            | +14               |
| Supply (- Vcc) | -0.01             | -8            | -9                |



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Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **D2450V2-737\_Mar05**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 737**

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

Calibration date: **March 16, 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  $(22 \pm 3)^\circ\text{C}$  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 |

|                |               |                       |                                                                                       |
|----------------|---------------|-----------------------|---------------------------------------------------------------------------------------|
|                | <b>Name</b>   | <b>Function</b>       | <b>Signature</b>                                                                      |
| Calibrated by: | Judith Müller | Laboratory Technician |  |
| Approved by:   | Katja Pokovic | Technical Manager     |  |

Issued: March 21, 2005

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**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:**

- 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
- 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
- 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:**

- 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.

|                                     |                           |             |
|-------------------------------------|---------------------------|-------------|
| <b>DASY Version</b>                 | DASY4                     | V4.5        |
| <b>Extrapolation</b>                | Advanced Extrapolation    |             |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0 |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                     | with Spacer |
| <b>Area Scan resolution</b>         | dx, dy = 15 mm            |             |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm         |             |
| <b>Frequency</b>                    | 2450 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>      | 22.0 °C             | 39.2           | 1.80 mho/m           |
| <b>Measured Head TSL parameters</b>     | (22.0 $\pm$ 0.2) °C | 39.9 $\pm$ 6 % | 1.78 mho/m $\pm$ 6 % |
| <b>Head TSL temperature during test</b> | (21.5 $\pm$ 0.2) °C | ---            | ---                  |

## SAR result with Head TSL

|                                                             |                    |                                                  |
|-------------------------------------------------------------|--------------------|--------------------------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | 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   | <b>55.5 mW / g <math>\pm</math> 17.0 % (k=2)</b> |

|                                                               |                    |                                                  |
|---------------------------------------------------------------|--------------------|--------------------------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                  |
| SAR measured                                                  | 250 mW input power | 6.36 mW / g                                      |
| SAR normalized                                                | normalized to 1W   | 25.4 mW / g                                      |
| SAR for nominal Head TSL parameters <sup>1</sup>              | normalized to 1W   | <b>25.8 mW / g <math>\pm</math> 16.5 % (k=2)</b> |

2

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

## Body TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 52.3 ± 6 %   | 2.01 mho/m ± 6 % |
| Body TSL temperature during test | (22.0 ± 0.2) °C | ---          | ---              |

## SAR result with Body TSL

|                                                             |                    |                                   |
|-------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b> | condition          |                                   |
| SAR measured                                                | 250 mW input power | 13.4 mW / g                       |
| SAR normalized                                              | normalized to 1W   | 53.6 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>            | normalized to 1W   | <b>52.5 mW / g ± 17.0 % (k=2)</b> |

|                                                               |                    |                                   |
|---------------------------------------------------------------|--------------------|-----------------------------------|
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b> | condition          |                                   |
| SAR measured                                                  | 250 mW input power | 6.18 mW / g                       |
| SAR normalized                                                | normalized to 1W   | 24.7 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>              | normalized to 1W   | <b>24.2 mW / g ± 16.5 % (k=2)</b> |

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $52.4 \Omega + 5.6 j\Omega$ |
| Return Loss                          | - 24.4 dB                   |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $48.4 \Omega + 5.9 j\Omega$ |
| Return Loss                          | - 24.2 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.161 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 | August 26, 2003 |

## DASY4 Validation Report for Head TSL

Date/Time: 14.03.2005 16:57:15

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737**

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

Medium: HSL U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.78$  mho/m;  $\epsilon_r = 39.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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) = 15.9 mW/g

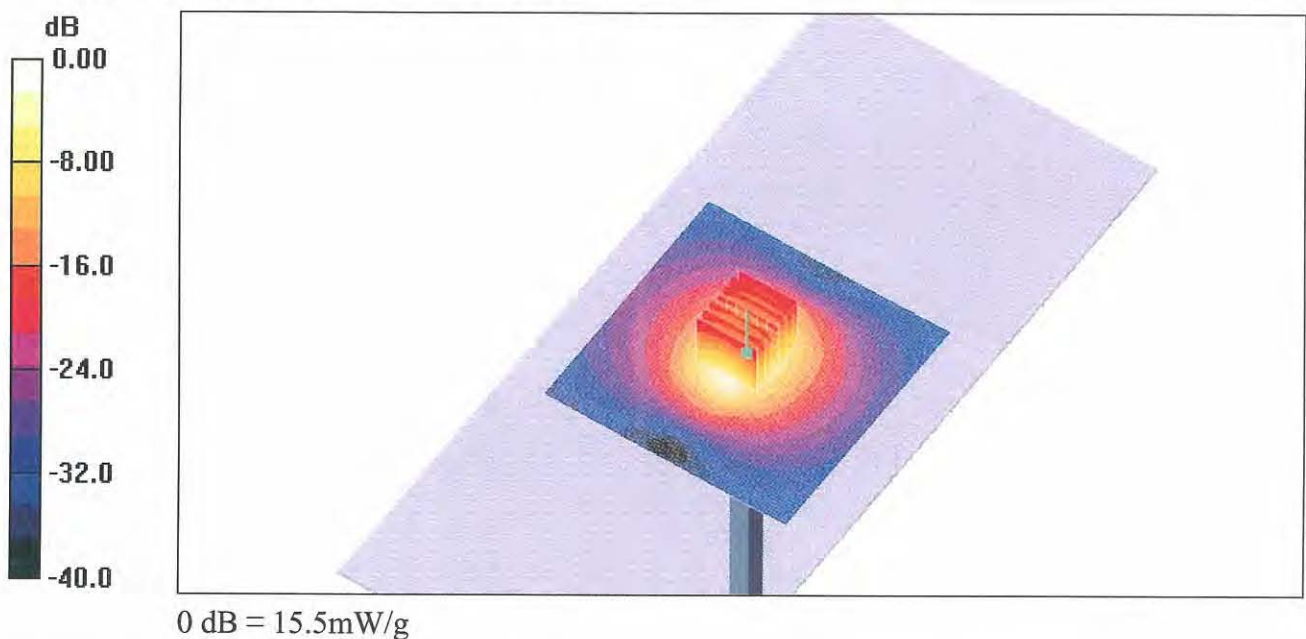
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.2 V/m; Power Drift = 0.090 dB

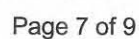
Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.36 mW/g**

Maximum value of SAR (measured) = 15.5 mW/g



Certificate No: D2450V2-737\_Mar05



## DASY4 Validation Report for Body TSL

Date/Time: 16.03.2005 10:09:20

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737**

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

Medium: M2450;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 52.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.13, 4.13, 4.13); 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) = 15.6 mW/g

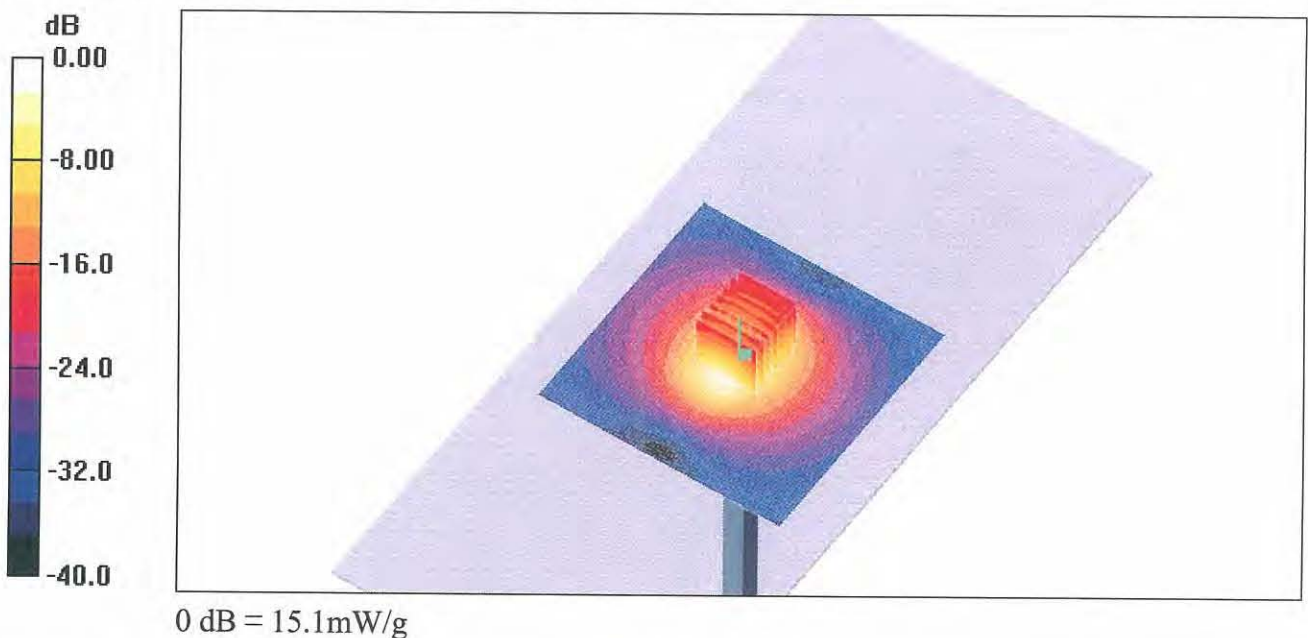
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 85.5 V/m; Power Drift = 0.079 dB

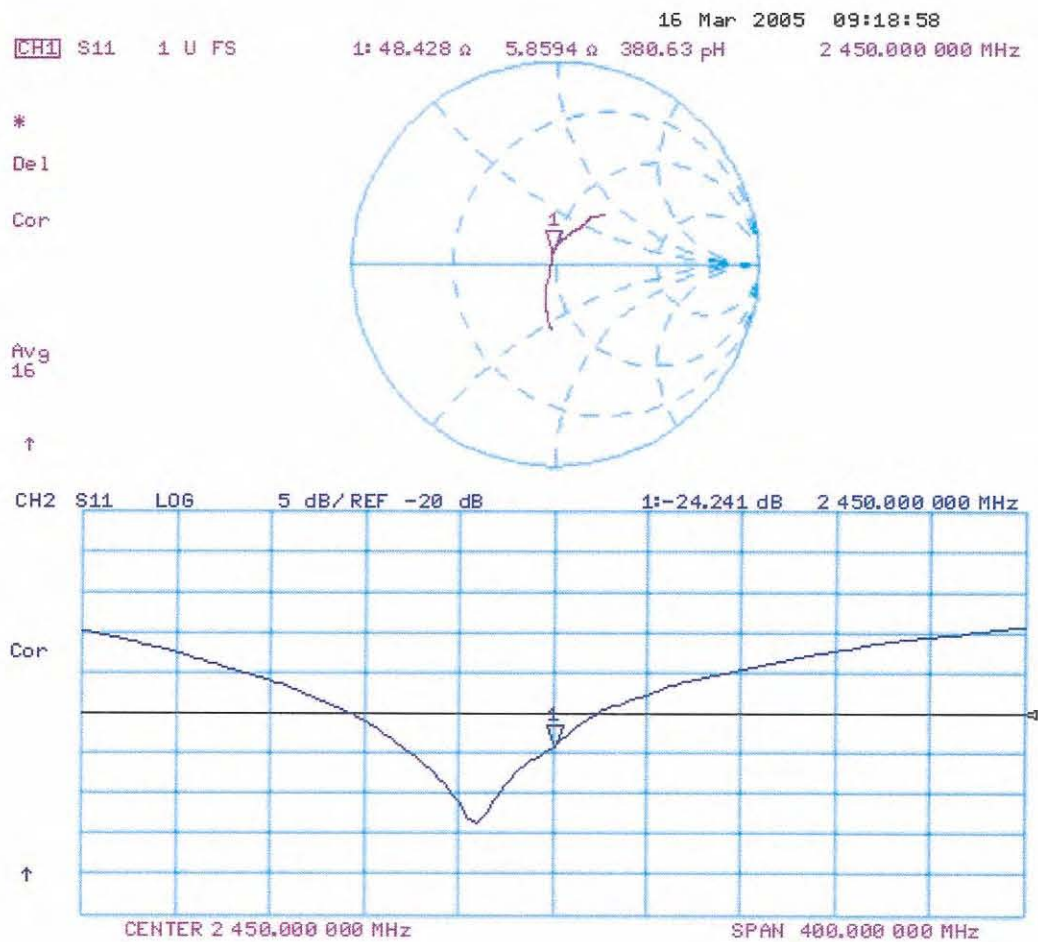
Peak SAR (extrapolated) = 27.3 W/kg

**SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.18 mW/g**

Maximum value of SAR (measured) = 15.1 mW/g



## Impedance Measurement Plot for Body TSL



## D4: SYSTEM VALIDATION DIPOLE

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



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Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **D2450V2-716\_Aug05**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 716**

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

Calibration date: **August 23, 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  $(22 \pm 3)^{\circ}\text{C}$  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)   | 11-Aug-05 (METAS, No 251-00498)           | Aug-06                 |
| Reference 10 dB Attenuator | SN: 5047.2 (10r) | 11-Aug-05 (METAS, No 251-00498)           | Aug-06                 |
| 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 |

|                | Name          | Function              | Signature            |
|----------------|---------------|-----------------------|----------------------|
| Calibrated by: | Mike Meili    | Laboratory Technician | <i>M. Meili</i>      |
| Approved by:   | Katja Pokovic | Technical Manager     | <i>Katja Pokovic</i> |

Issued: August 25, 2005

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



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**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.

|                                     |                           |             |
|-------------------------------------|---------------------------|-------------|
| <b>DASY Version</b>                 | DASY4                     | V4.6        |
| <b>Extrapolation</b>                | Advanced Extrapolation    |             |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0 |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                     | with Spacer |
| <b>Area Scan resolution</b>         | dx, dy = 15 mm            |             |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm         |             |
| <b>Frequency</b>                    | 2450 MHz $\pm$ 1 MHz      |             |

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>      | 22.0 °C             | 39.2           | 1.80 mho/m           |
| <b>Measured Head TSL parameters</b>     | (22.0 $\pm$ 0.2) °C | 38.5 $\pm$ 6 % | 1.73 mho/m $\pm$ 6 % |
| <b>Head TSL temperature during test</b> | (21.0 $\pm$ 0.2) °C | 38.4 $\pm$ 6 % | 1.77 mho/m $\pm$ 6 % |

## SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | condition          |                                                  |
|-------------------------------------------------------------|--------------------|--------------------------------------------------|
| SAR measured                                                | 250 mW input power | 13.5 mW / g                                      |
| SAR normalized                                              | normalized to 1W   | 54.0 mW / g                                      |
| SAR for nominal Head TSL parameters <sup>1</sup>            | normalized to 1W   | <b>54.4 mW / g <math>\pm</math> 17.0 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                                  |
|---------------------------------------------------------------|--------------------|--------------------------------------------------|
| SAR measured                                                  | 250 mW input power | 6.23 mW / g                                      |
| SAR normalized                                                | normalized to 1W   | 24.9 mW / g                                      |
| SAR for nominal Head TSL parameters <sup>1</sup>              | normalized to 1W   | <b>25.1 mW / g <math>\pm</math> 16.5 % (k=2)</b> |

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

### Body TSL parameters

The following parameters and calculations were applied.

|                                  | Temperature     | Permittivity | Conductivity     |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters      | 22.0 °C         | 52.7         | 1.95 mho/m       |
| Measured Body TSL parameters     | (22.0 ± 0.2) °C | 52.5 ± 6 %   | 2.03 mho/m ± 6 % |
| Body TSL temperature during test | (21.5 ± 0.2) °C | 52.5 ± 6 %   | 2.06 mho/m ± 6 % |

### SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL | condition          |                                   |
|-------------------------------------------------------|--------------------|-----------------------------------|
| SAR measured                                          | 250 mW input power | 13.6 mW / g                       |
| SAR normalized                                        | normalized to 1W   | 54.4 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>      | normalized to 1W   | <b>53.1 mW / g ± 17.0 % (k=2)</b> |

| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL | condition          |                                   |
|---------------------------------------------------------|--------------------|-----------------------------------|
| SAR measured                                            | 250 mW input power | 6.28 mW / g                       |
| SAR normalized                                          | normalized to 1W   | 25.1 mW / g                       |
| SAR for nominal Body TSL parameters <sup>2</sup>        | normalized to 1W   | <b>24.5 mW / g ± 16.5 % (k=2)</b> |

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $53.7 \Omega + 2.5 j\Omega$ |
| Return Loss                          | -27.3 dB                    |

### Antenna Parameters with Body TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $50.5 \Omega + 4.0 j\Omega$ |
| Return Loss                          | - 27.9 dB                   |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.147 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 | September 10 , 2002 |

## DASY4 Validation Report for Head TSL

Date/Time: 23.08.2005 17:40:59

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 U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.77$  mho/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.6 Build 9; Postprocessing SW: SEMCAD, V1.8 Build 151

**Pin = 250 mW; d = 10 mm/Area Scan (41x61x1):**

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 17.5 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**

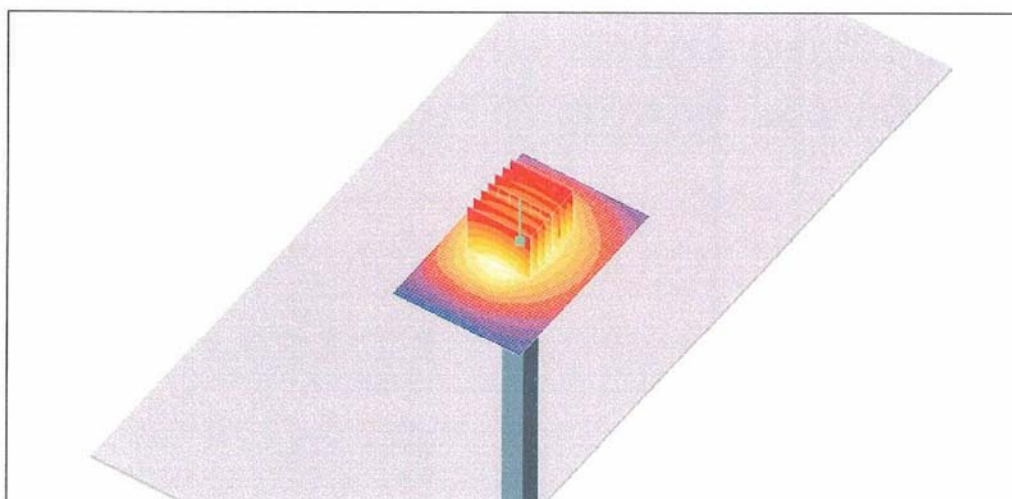
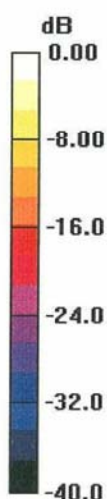
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.4 V/m; Power Drift = 0.097 dB

Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.23 mW/g**

Maximum value of SAR (measured) = 15.3 mW/g



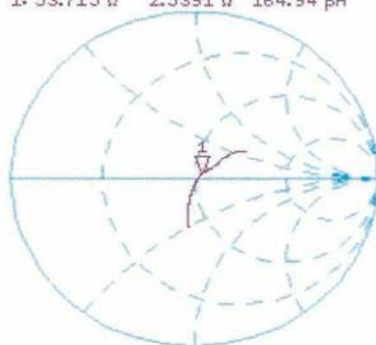
0 dB = 15.3mW/g

# Impedance Measurement Plot for Head TSL

23 Aug 2005 14:39:18  
 CH1 S11 1 U FS 1: 53.715  $\Omega$  2.5391  $\Omega$  164.94 pH 2 450.000 000 MHz

\*  
 Del  
 Cor

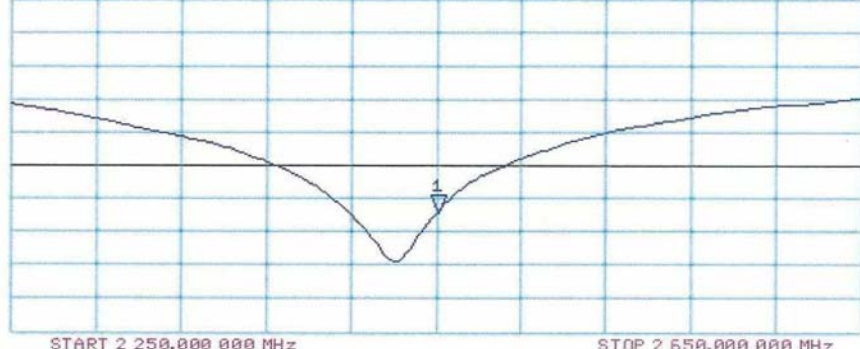
Avg  
 16



CH2 S11 L06 5 dB/ REF -20 dB 1: -27.254 dB 2 450.000 000 MHz

Cor

Avg  
 16



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz

## DASY4 Validation Report for Body TSL

Date/Time: 23.08.2005 16:16:42

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: MSL 2450;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.05$  mho/m;  $\epsilon_r = 52.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.13, 4.13, 4.13); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA
- Measurement SW: DASY4, V4.6 Build 9; Postprocessing SW: SEMCAD, V1.8 Build 151

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):**

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.4 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**

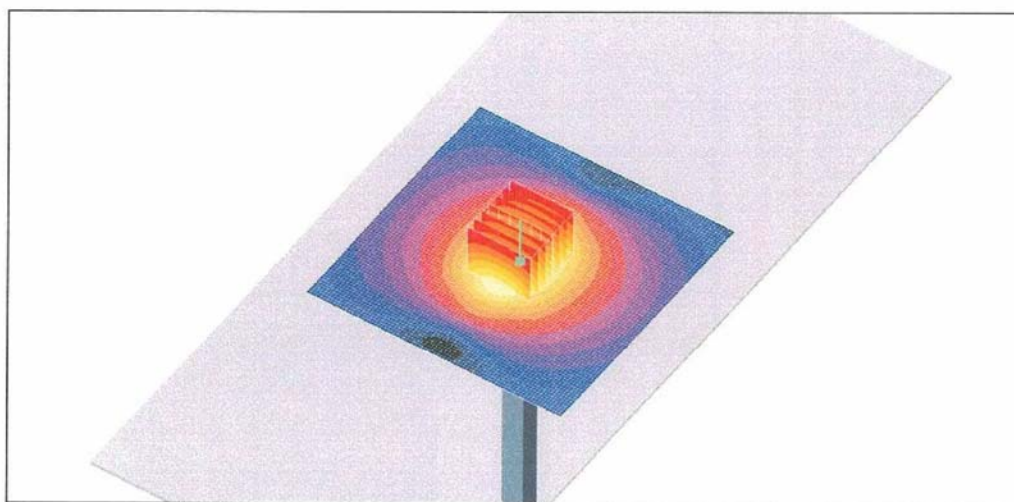
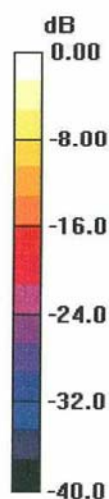
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.2 V/m; Power Drift = -0.055 dB

Peak SAR (extrapolated) = 28.3 W/kg

**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.28 mW/g**

Maximum value of SAR (measured) = 15.6 mW/g



0 dB = 15.6mW/g

# Impedance Measurement Plot for Body TSL

