



Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 11/10/2005 2:38:34 PM

**Body\_PCS Ch512\_Keypad Down With 1.5cm Gap\_20051110****DUT: 5N0802; Type: ASUS J202 Triple Band GPRS Mobile Phone; Serial: 358079000000011**

Communication System: PCS; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL\_1900 Medium parameters used :  $f = 1850.2$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 52.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6 °C; Liquid Temperature : 22.2 °C

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1788; ConvF(4.56, 4.56, 4.56); Calibrated: 9/30/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn658; Calibrated: 3/30/2005
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Ch512/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.224 mW/g

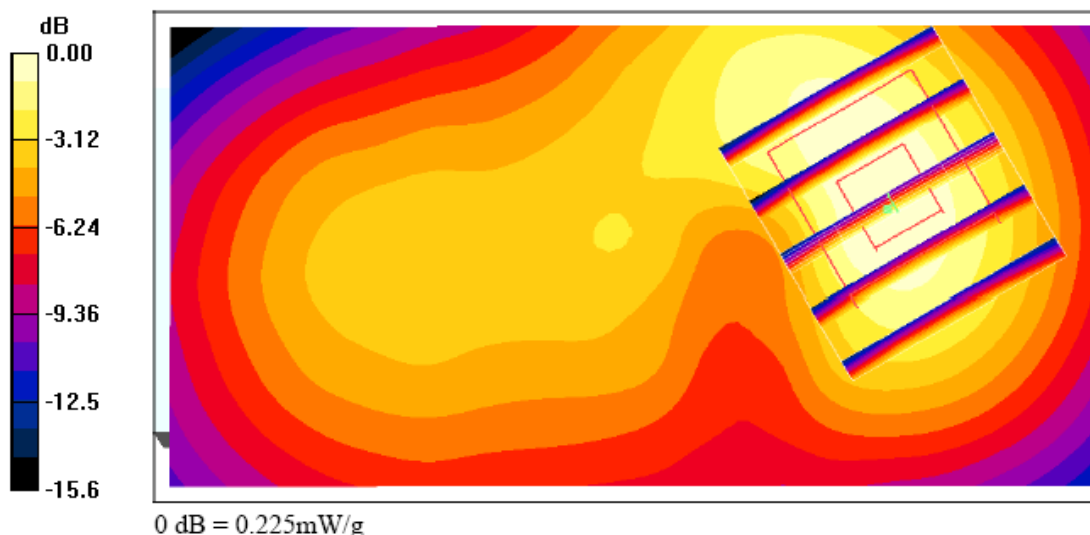
**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.2 V/m; Power Drift = -0.072 dB

Peak SAR (extrapolated) = 0.305 W/kg

**SAR(1 g) = 0.204 mW/g; SAR(10 g) = 0.124 mW/g**

Maximum value of SAR (measured) = 0.225 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 11/10/2005 10:52:10 AM

**Right Cheek\_PCS Ch512\_20051110\_2D****DUT: 5N0802; Type: ASUS J202 Triple Band GPRS Mobile Phone; Serial: 358079000000011**

Communication System: PCS; Frequency: 1850.2 MHz; Duty Cycle: 1:8.3

Medium: HSL\_1900 Medium parameters used :  $f = 1850.2$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 39.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.4 °C; Liquid Temperature : 22.0 °C

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1788; ConvF(5.16, 5.16, 5.16); Calibrated: 9/30/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn658; Calibrated: 3/30/2005
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Ch512/Area Scan (41x111x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.27 mW/g

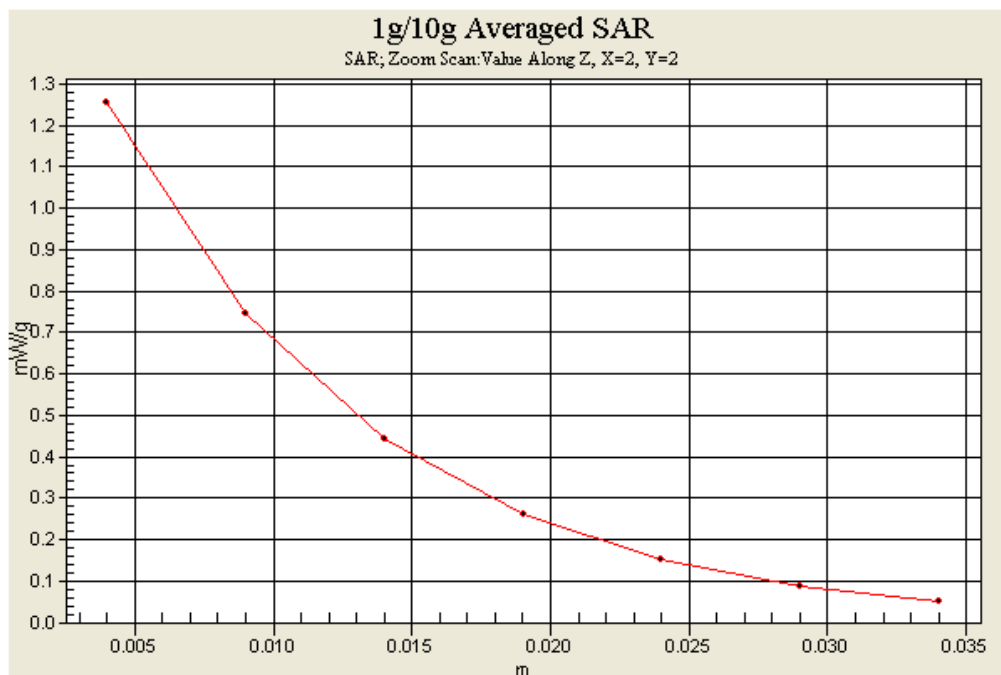
**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.6 V/m; Power Drift = 0.029 dB

Peak SAR (extrapolated) = 1.89 W/kg

**SAR(1 g) = 1.13 mW/g; SAR(10 g) = 0.612 mW/g**

Maximum value of SAR (measured) = 1.25 mW/g





Test Laboratory: Sporton International Inc. SAR Testing Lab

Date/Time: 11/10/2005 2:38:34 PM

**Body\_PCS Ch512\_Keypad Down With 1.5cm Gap\_20051110\_2D****DUT: 5N0802; Type: ASUS J202 Triple Band GPRS Mobile Phone; Serial: 358079000000011**

Communication System: PCS; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL\_1900 Medium parameters used :  $f = 1850.2$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 52.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.6 °C; Liquid Temperature : 22.2 °C

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1788; ConvF(4.56, 4.56, 4.56); Calibrated: 9/30/2004
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE4 Sn658; Calibrated: 3/30/2005
- Phantom: SAM 12; Type: QD 000 P40 C; Serial: TP-1150
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

**Ch512/Area Scan (41x81x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.224 mW/g

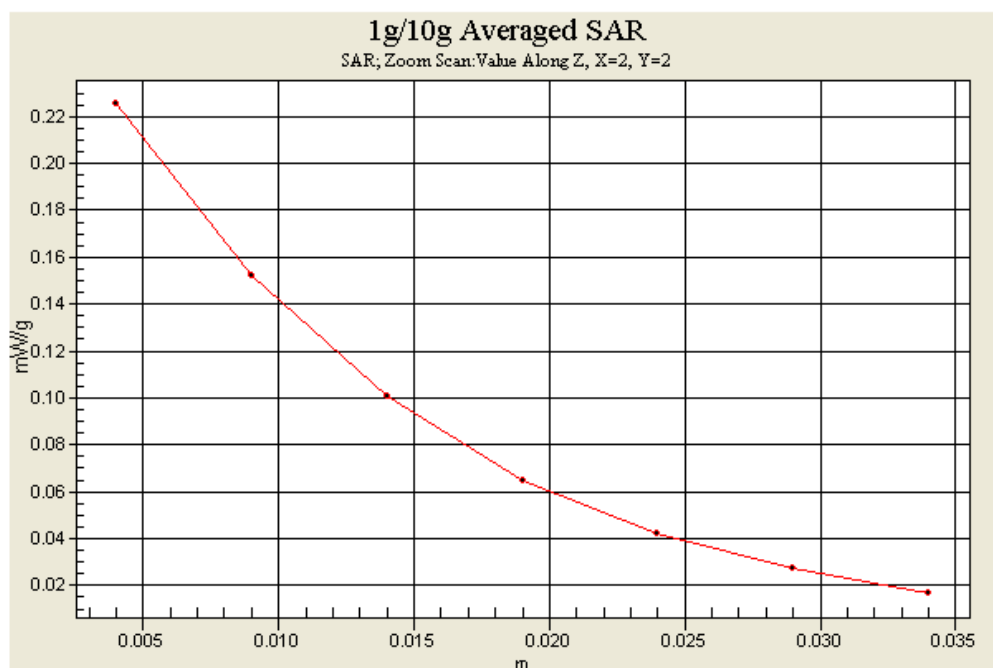
**Ch512/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.2 V/m; Power Drift = -0.072 dB

Peak SAR (extrapolated) = 0.305 W/kg

SAR(1 g) = 0.204 mW/g; SAR(10 g) = 0.124 mW/g

Maximum value of SAR (measured) = 0.225 mW/g





## Appendix C – Calibration Data

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

Client **Sproton Int. (Auden)**

| CALIBRATION CERTIFICATE                                                                                                                                                                                                        |                                                                  |                                           |                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------|------------------------|
| Object(s)                                                                                                                                                                                                                      | D1900V2 - SN:5d041                                               |                                           |                        |
| Calibration procedure(s)                                                                                                                                                                                                       | QA CAL-05 v2<br>Calibration procedure for dipole validation kits |                                           |                        |
| Calibration date:                                                                                                                                                                                                              | February 17, 2004                                                |                                           |                        |
| 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 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 |
| Calibrated by:                                                                                                                                                                                                                 | Name<br>Judith Mueser                                            | Function<br>Technician                    | Signature<br>          |
| Approved by:                                                                                                                                                                                                                   | Name<br>Kerja Pokovic                                            | Function<br>Laboratory Director           | Signature<br>          |
| Date issued: February 18, 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. |                                                                  |                                           |                        |



Schmid & Partner Engineering AG

**s p e a g**

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info@speag.com, <http://www.speag.com>

# DASY

## Dipole Validation Kit

Type: D1900V2

Serial: 5d041

Manufactured: July 4, 2003

Calibrated: February 17, 2004



## **1. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating liquid** of the following electrical parameters at 1900 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>38.8</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.47 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.96 at 1900 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 flat phantom section 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. The included distance 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  $250\text{mW} \pm 3\%$ . 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 ET3DV6 SN:1507 and applying the advanced extrapolation are:

|                                                  |                                                            |
|--------------------------------------------------|------------------------------------------------------------|
| averaged over $1\text{ cm}^3$ (1 g) of tissue:   | <b>41.6 mW/g <math>\pm 16.8\%</math> (k=2)<sup>1</sup></b> |
| averaged over $10\text{ cm}^3$ (10 g) of tissue: | <b>21.6 mW/g <math>\pm 16.2\%</math> (k=2)<sup>1</sup></b> |

<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>1.200 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.993</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 1900 MHz: | $\text{Re}\{Z\} = 51.2 \Omega$ |
|                                  | $\text{Im}\{Z\} = 4.9 \Omega$  |
| Return Loss at 1900 MHz          | <b>-26.1 dB</b>                |

### **4. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating tissue** of the following electrical parameters at 1900 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>52.5</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.58 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.57 at 1900 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 flat phantom section 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. The included distance 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 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue:      **42.0 mW/g ± 16.8 % (k=2)<sup>2</sup>**

averaged over 10 cm<sup>3</sup> (10 g) of tissue:      **22.0 mW/g ± 16.2 % (k=2)<sup>2</sup>**

## **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 1900 MHz:      **Re{Z} = 46.6 Ω**

**Im {Z} = 5.1 Ω**

Return Loss at 1900 MHz      **-24.0 dB**

## **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 Section 1. 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 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d041**

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL 1900 MHz;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  mho/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.96, 4.96, 4.96); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 30; Postprocessing SW: SEMCAD, V1.8 Build 98

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 93.8 V/m

Power Drift = 0.002 dB

Maximum value of SAR = 11.8 mW/g

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

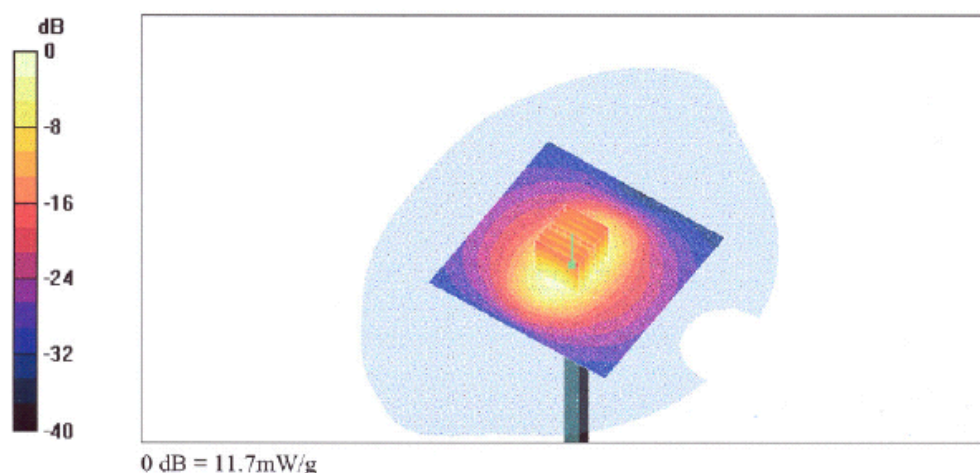
Peak SAR (extrapolated) = 18.7 W/kg

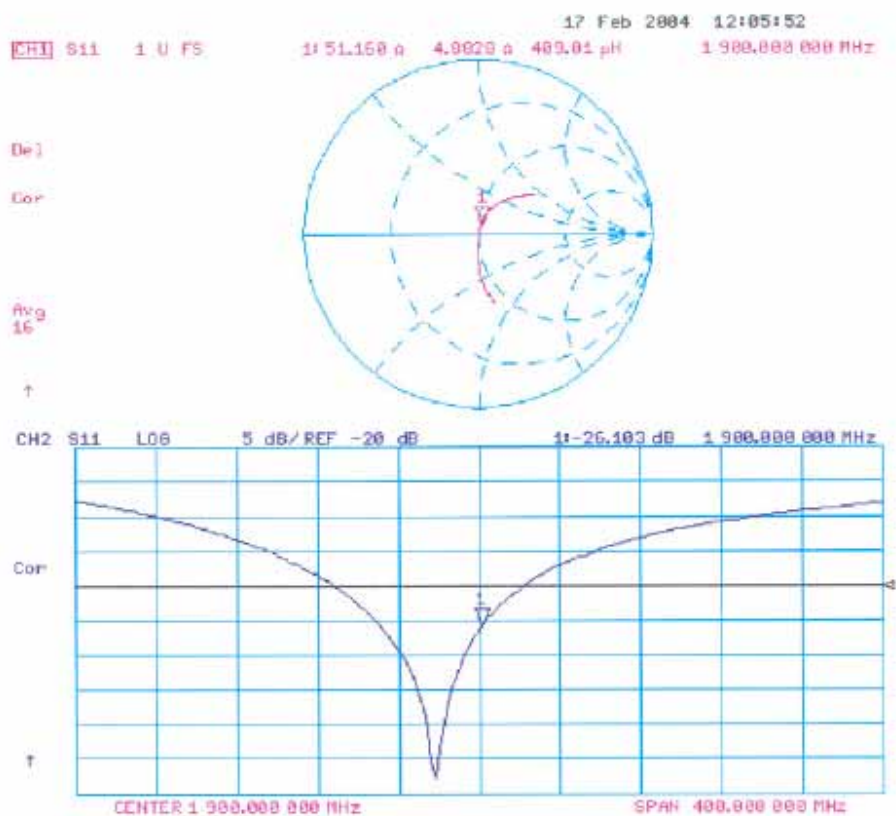
**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.39 mW/g**

Reference Value = 93.8 V/m

Power Drift = 0.002 dB

Maximum value of SAR = 11.7 mW/g







Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d041**

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: Muscle 1900 MHz;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.58$  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: ET3DV6 - SN1507; ConvF(4.57, 4.57, 4.57); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 25; Postprocessing SW: SEMCAD, V1.8 Build 101

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 92.6 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 11.8 mW/g

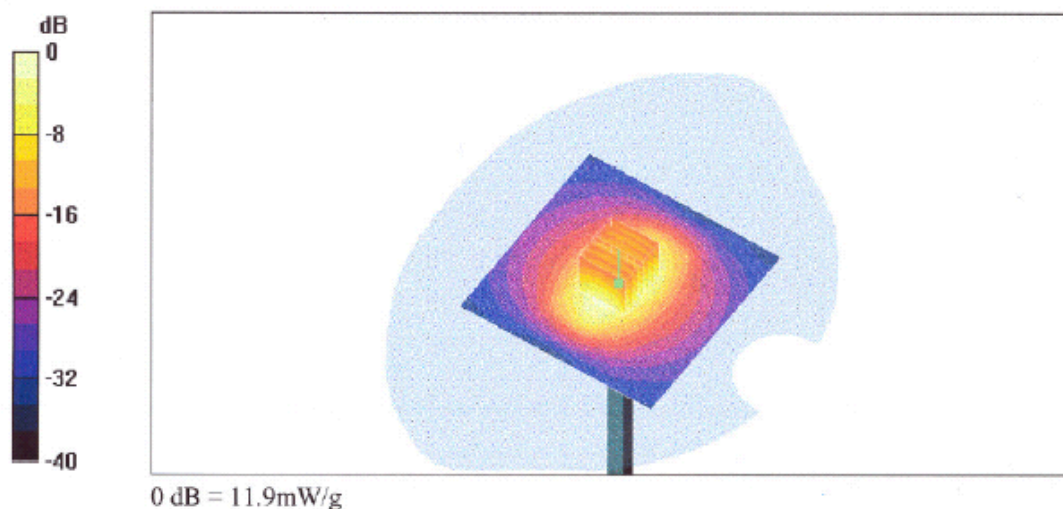
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

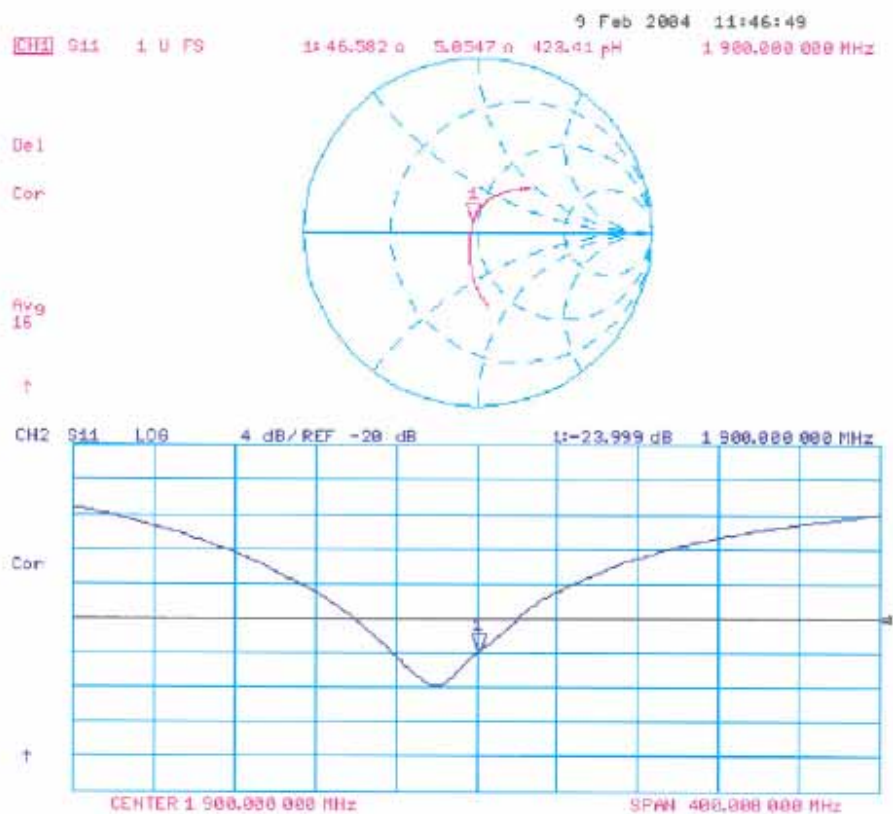
Reference Value = 92.6 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 11.9 mW/g

Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.49 mW/g







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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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 **Sporton (Auden)**

Certificate No: ET3-1788\_Sep04

**CALIBRATION CERTIFICATE**Object **ET3DV6 - SN:1788**Calibration procedure(s) **QA CAL-01.v5**  
**Calibration procedure for dosimetric E-field probes**Calibration date: **September 30, 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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&amp;T critical for calibration)

| Primary Standards          | ID #            | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration  |
|----------------------------|-----------------|-------------------------------------------|------------------------|
| Power meter 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 3 dB Attenuator  | SN: S5054 (3c)  | 3-Apr-03 (METAS, No. 251-00403)           | Aug-05                 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 3-May-04 (METAS, No. 251-00389)           | May-05                 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 3-Apr-03 (METAS, No. 251-00404)           | Aug-05                 |
| Reference Probe ES3DV2     | SN:3013         | 8-Jan-04 (SPEAG, No. ES3-3013_Jan04)      | Jan-05                 |
| DAE4                       | SN: 617         | 26-May-04 (SPEAG, No. DAE4-617_May04)     | May-05                 |
| Secondary Standards        | ID #            | Check Date (in house)                     | Scheduled Check        |
| Power sensor HP 8481A      | MY41092180      | 18-Sep-02 (SPEAG, in house check Oct-03)  | In house check: Oct-05 |
| RF generator HP 8648C      | US3642U01700    | 4-Aug-99 (SPEAG, in house check Dec-03)   | In house check: Dec-05 |
| Network Analyzer HP 8753E  | US37390585      | 18-Oct-01 (SPEAG, in house check Nov-03)  | In house check: Nov-04 |

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

Issued: October 1, 2004

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



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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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                                                                                                                             |
| NORM <sub>x,y,z</sub>    | sensitivity in free space                                                                                                                            |
| ConvF                    | sensitivity in TSL / NORM <sub>x,y,z</sub>                                                                                                           |
| DCP                      | diode compression point                                                                                                                              |
| Polarization $\varphi$   | $\varphi$ rotation around probe axis                                                                                                                 |
| Polarization $\vartheta$ | $\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis |

**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

**Methods Applied and Interpretation of Parameters:**

- NORM<sub>x,y,z</sub>:** Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* frequency\_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>:** DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters:** Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY 4.3 B17 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.



ET3DV6 SN:1788

September 30, 2004

# Probe ET3DV6

## SN:1788

|                  |                    |
|------------------|--------------------|
| Manufactured:    | May 28, 2003       |
| Last calibrated: | August 29, 2003    |
| Recalibrated:    | September 30, 2004 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ET3DV6 SN:1788

September 30, 2004

**DASY - Parameters of Probe: ET3DV6 SN:1788****Sensitivity in Free Space<sup>A</sup>****Diode Compression<sup>B</sup>**

|       |             |                 |       |       |
|-------|-------------|-----------------|-------|-------|
| NormX | 1.68 ± 9.9% | $\mu V/(V/m)^2$ | DCP X | 94 mV |
| NormY | 1.70 ± 9.9% | $\mu V/(V/m)^2$ | DCP Y | 94 mV |
| NormZ | 1.74 ± 9.9% | $\mu V/(V/m)^2$ | DCP Z | 94 mV |

**Sensitivity in Tissue Simulating Liquid (Conversion Factors)**

Please see Page 8.

**Boundary Effect****TSL 900 MHz Typical SAR gradient: 5 % per mm**

|                                           |                              |        |        |
|-------------------------------------------|------------------------------|--------|--------|
| Sensor Center to Phantom Surface Distance |                              | 3.7 mm | 4.7 mm |
| SAR <sub>ba</sub> [%]                     | Without Correction Algorithm | 8.1    | 4.4    |
| SAR <sub>ba</sub> [%]                     | With Correction Algorithm    | 0.7    | 0.1    |

**TSL 1810 MHz Typical SAR gradient: 10 % per mm**

|                                           |                              |        |        |
|-------------------------------------------|------------------------------|--------|--------|
| Sensor Center to Phantom Surface Distance |                              | 3.7 mm | 4.7 mm |
| SAR <sub>ba</sub> [%]                     | Without Correction Algorithm | 12.0   | 8.2    |
| SAR <sub>ba</sub> [%]                     | With Correction Algorithm    | 0.9    | 0.1    |

**Sensor Offset**Probe Tip to Sensor Center **2.7 mm**

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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).<sup>B</sup> Numerical linearization parameter; uncertainty not required.

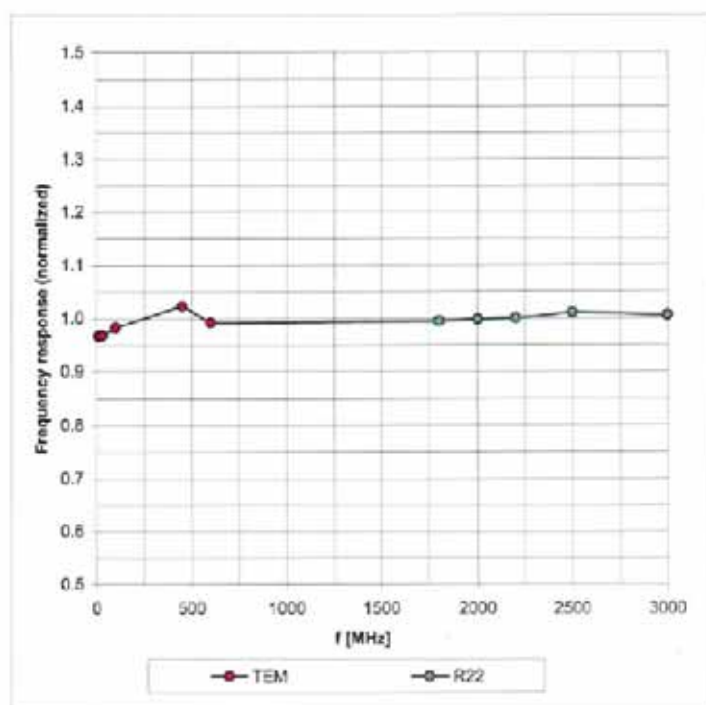


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## Frequency Response of E-Field

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



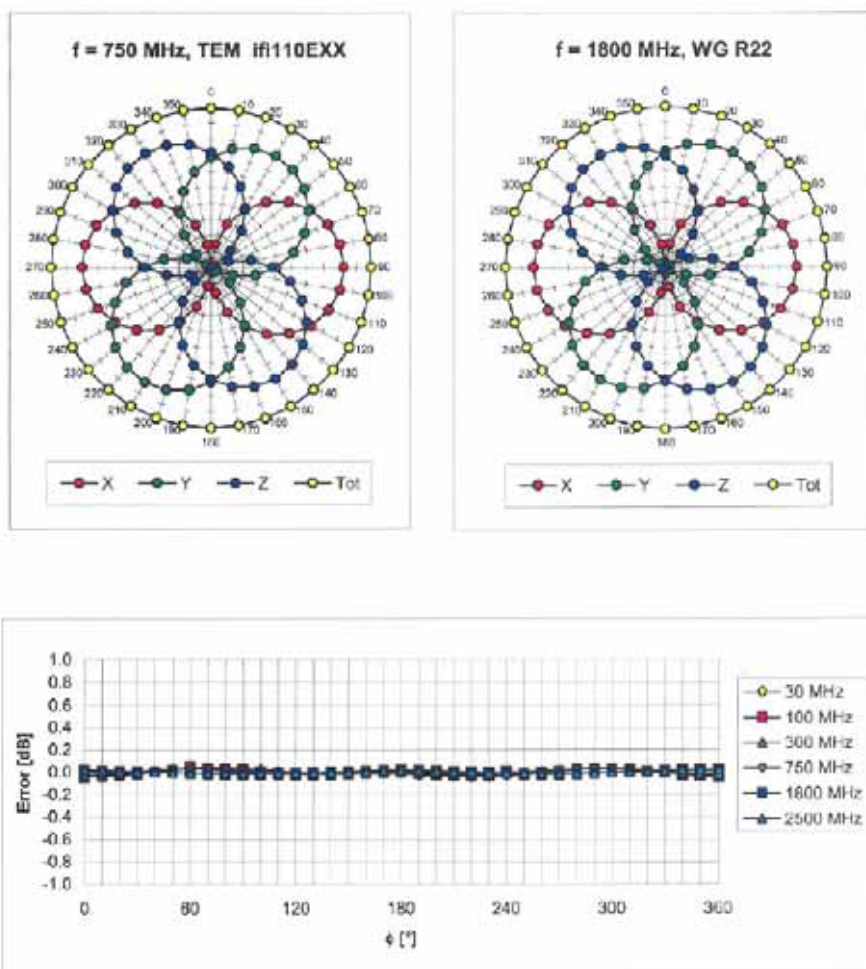
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )



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



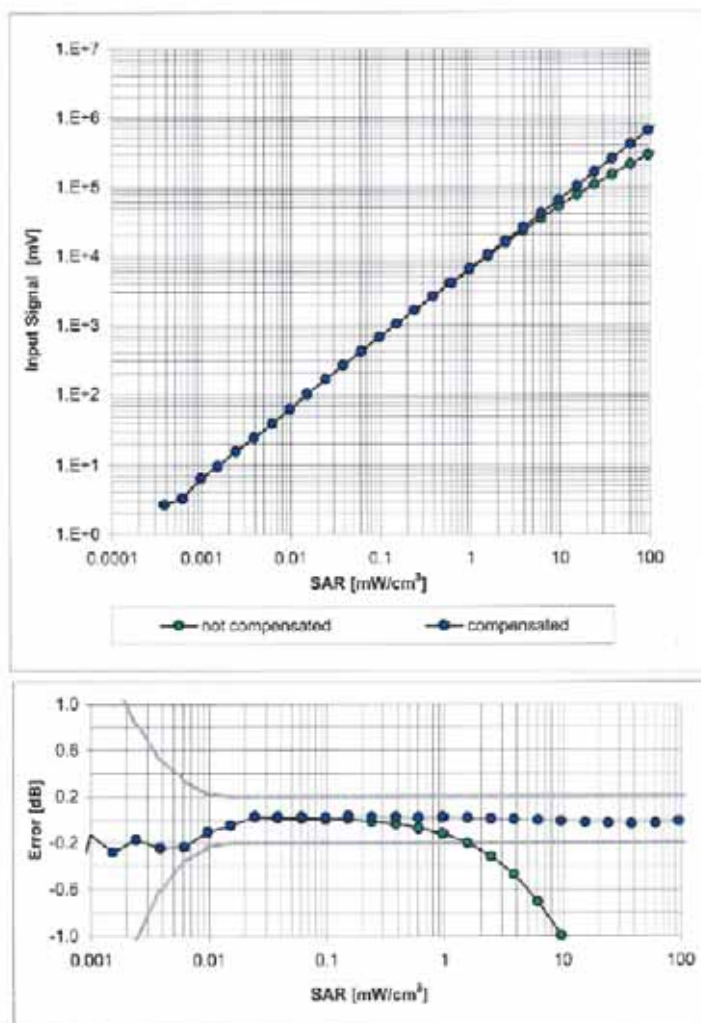
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )



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**Dynamic Range  $f(\text{SAR}_{\text{head}})$**   
(Waveguide R22,  $f = 1800$  MHz)

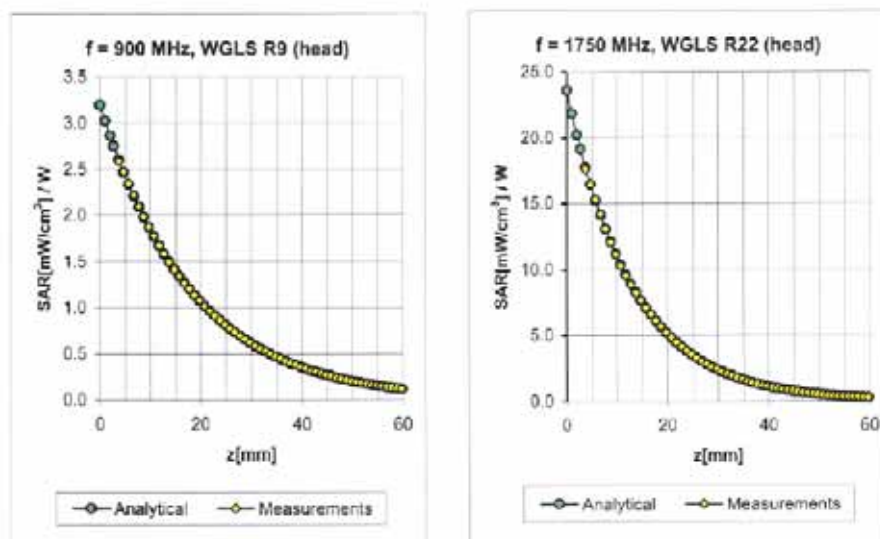


Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

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## Conversion Factor Assessment



| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|------|--------------|--------------|-------|-------|--------------------|
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%    | 1.12  | 1.42  | 6.74 ± 11.0% (k=2) |
| 800     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.97 ± 5%    | 1.07  | 1.44  | 6.63 ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.56  | 2.31  | 5.37 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.55  | 2.42  | 5.16 ± 11.0% (k=2) |
| 2000    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.54  | 2.59  | 4.88 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Head | 39.2 ± 5%    | 1.80 ± 5%    | 0.65  | 2.22  | 4.56 ± 11.8% (k=2) |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 1.04  | 1.52  | 6.53 ± 11.0% (k=2) |
| 900     | ± 50 / ± 100                | Body | 55.0 ± 5%    | 1.05 ± 5%    | 0.99  | 1.55  | 6.17 ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.53  | 2.74  | 4.73 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.55  | 2.82  | 4.56 ± 11.0% (k=2) |
| 2000    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.54  | 2.98  | 4.43 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Body | 52.7 ± 5%    | 1.95 ± 5%    | 0.72  | 2.00  | 4.26 ± 11.8% (k=2) |

<sup>c</sup> The validity of ± 100 MHz only applies for DASY 4.3 B17 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

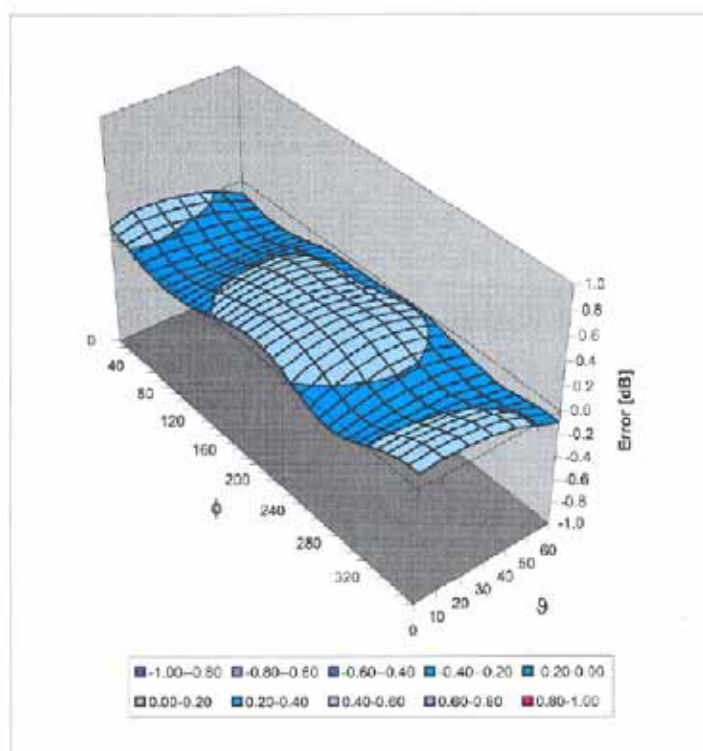


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### Deviation from Isotropy in HSL

Error ( $\phi$ ,  $\theta$ ),  $f = 900$  MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  ( $k=2$ )



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Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 108

Client

Certificate No: DAE4-658\_Mar05

**CALIBRATION CERTIFICATE**

Object: DAE4 - SD 000 D04 BA - SN: 658

Calibration procedure(s): QA CAL-06.v10  
Calibration procedure for the data acquisition unit (DAE)

Calibration date: March 30, 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&amp;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 | 16-Jul-04 (SPEAG, in house check)         | In house check Jul-05 |

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

Issued: March 30, 2005

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

Certificate No: DAE4-658\_Mar05

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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          | 404.903 $\pm$ 0.1% (k=2) | 405.558 $\pm$ 0.1% (k=2) | 404.679 $\pm$ 0.1% (k=2) |
| Low Range           | 3.95385 $\pm$ 0.7% (k=2) | 3.97596 $\pm$ 0.7% (k=2) | 3.92396 $\pm$ 0.7% (k=2) |

**Connector Angle**

|                                           |              |
|-------------------------------------------|--------------|
| Connector Angle to be used in DASY system | 11° $\pm$ 1° |
|-------------------------------------------|--------------|

**Appendix**
**1. DC Voltage Linearity**

| High Range        | Input ( $\mu\text{V}$ ) | Reading ( $\mu\text{V}$ ) | Error (%) |
|-------------------|-------------------------|---------------------------|-----------|
| Channel X + Input | 200000                  | 200000.1                  | 0.00      |
| Channel X + Input | 20000                   | 20002.73                  | 0.01      |
| Channel X - Input | 20000                   | -19994.94                 | -0.03     |
| Channel Y + Input | 200000                  | 200000.4                  | 0.00      |
| Channel Y + Input | 20000                   | 19999.59                  | 0.00      |
| Channel Y - Input | 20000                   | -19995.52                 | -0.02     |
| Channel Z + Input | 200000                  | 200000.2                  | 0.00      |
| Channel Z + Input | 20000                   | 20000.11                  | 0.00      |
| Channel Z - Input | 20000                   | -19998.59                 | -0.01     |

| Low Range         | Input ( $\mu\text{V}$ ) | Reading ( $\mu\text{V}$ ) | Error (%) |
|-------------------|-------------------------|---------------------------|-----------|
| Channel X + Input | 2000                    | 2000                      | 0.00      |
| Channel X + Input | 200                     | 200.34                    | 0.17      |
| Channel X - Input | 200                     | -200.17                   | 0.08      |
| Channel Y + Input | 2000                    | 2000.1                    | 0.00      |
| Channel Y + Input | 200                     | 199.33                    | -0.33     |
| Channel Y - Input | 200                     | -200.68                   | 0.34      |
| Channel Z + Input | 2000                    | 1999.9                    | 0.00      |
| Channel Z + Input | 200                     | 199.24                    | -0.38     |
| Channel Z - Input | 200                     | -201.01                   | 0.50      |

**2. Common mode sensitivity**

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

|           | Common mode<br>Input Voltage (mV) | High Range<br>Average Reading ( $\mu\text{V}$ ) | Low Range<br>Average Reading ( $\mu\text{V}$ ) |
|-----------|-----------------------------------|-------------------------------------------------|------------------------------------------------|
| Channel X | 200                               | -13.88                                          | -15.94                                         |
|           | - 200                             | 16.64                                           | 16.19                                          |
| Channel Y | 200                               | -15.73                                          | -16.74                                         |
|           | - 200                             | 14.95                                           | 15.21                                          |
| Channel Z | 200                               | -8.70                                           | -10.46                                         |
|           | - 200                             | 8.55                                            | 8.69                                           |

**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                | -                           | 2.67                        | 0.07                        |
| Channel Y | 200                | 0.58                        | -                           | 3.05                        |
| Channel Z | 200                | -1.84                       | 0.66                        | -                           |

**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 | 16059            | 16215           |
| Channel Y | 15676            | 15942           |
| Channel Z | 15471            | 15731           |

**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 | 0.63               | -1.23                  | 2.00                   | 0.38                      |
| Channel Y | -0.97              | -2.83                  | 0.94                   | 0.46                      |
| Channel Z | -0.41              | -2.34                  | 0.55                   | 0.40                      |

**6. Input Offset Current**

Nominal input circuitry offset current on all channels: &lt;25fA

**7. Input Resistance**

|           | Zeroing (MOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 0.1999         | 198.3            |
| Channel Y | 0.2000         | 199.9            |
| Channel Z | 0.2000         | 199.7            |

**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                |

**10. Common Mode Bit Generation** (verified during pre test)

| Typical values  | Bit set to High at Common Mode Error (V <sub>DC</sub> ) |
|-----------------|---------------------------------------------------------|
| Channel X, Y, Z | +1.25                                                   |