



## 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 Mueßer                                            | Function<br>Technician                    | Signature<br>          |
| Approved by:                                                                                                                                                                                                                   | Name<br>Ketja 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. |                                                                  |                                           |                        |



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# 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 40 W 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

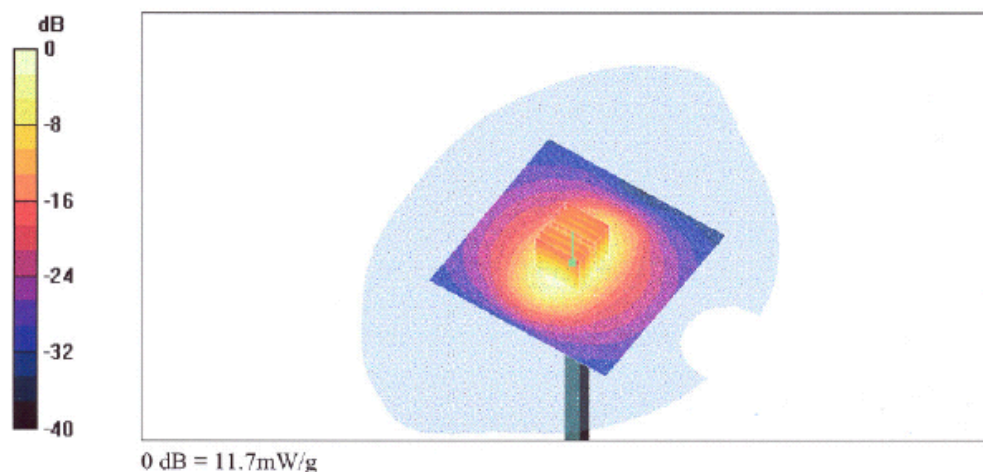
Peak SAR (extrapolated) = 18.7 W/kg

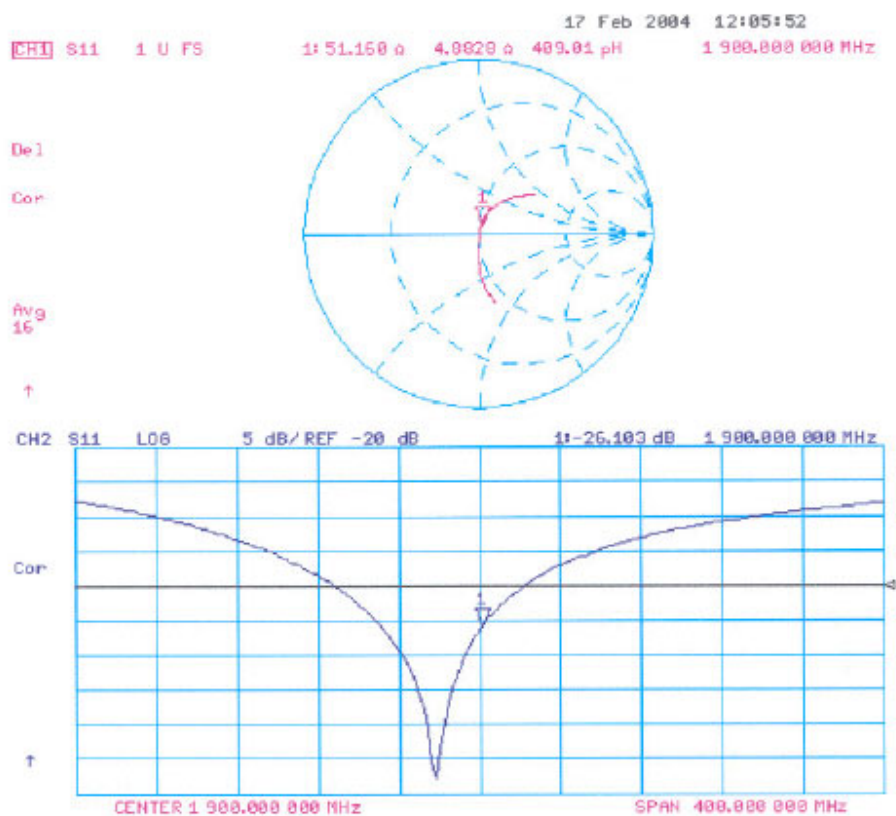
**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.39 mW/g**

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

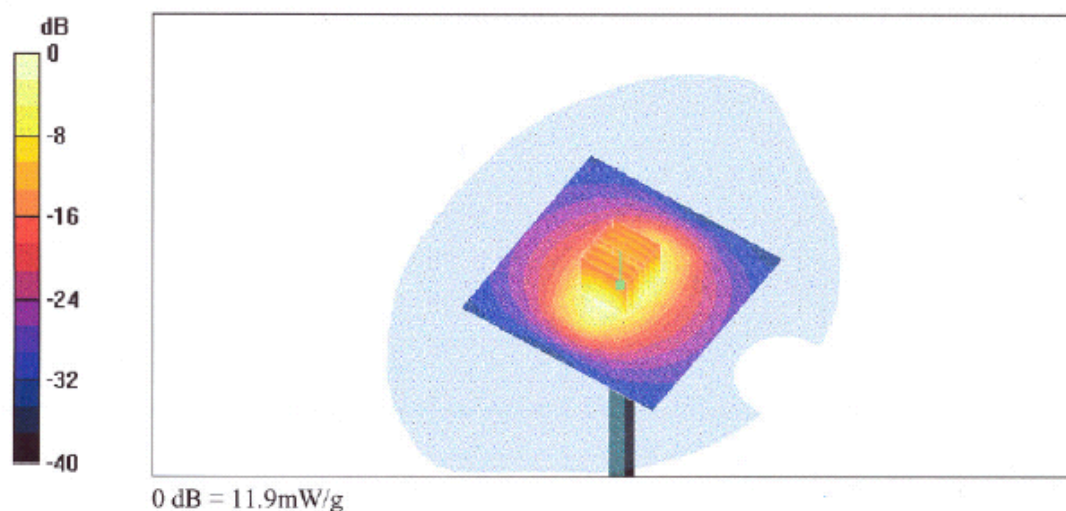
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

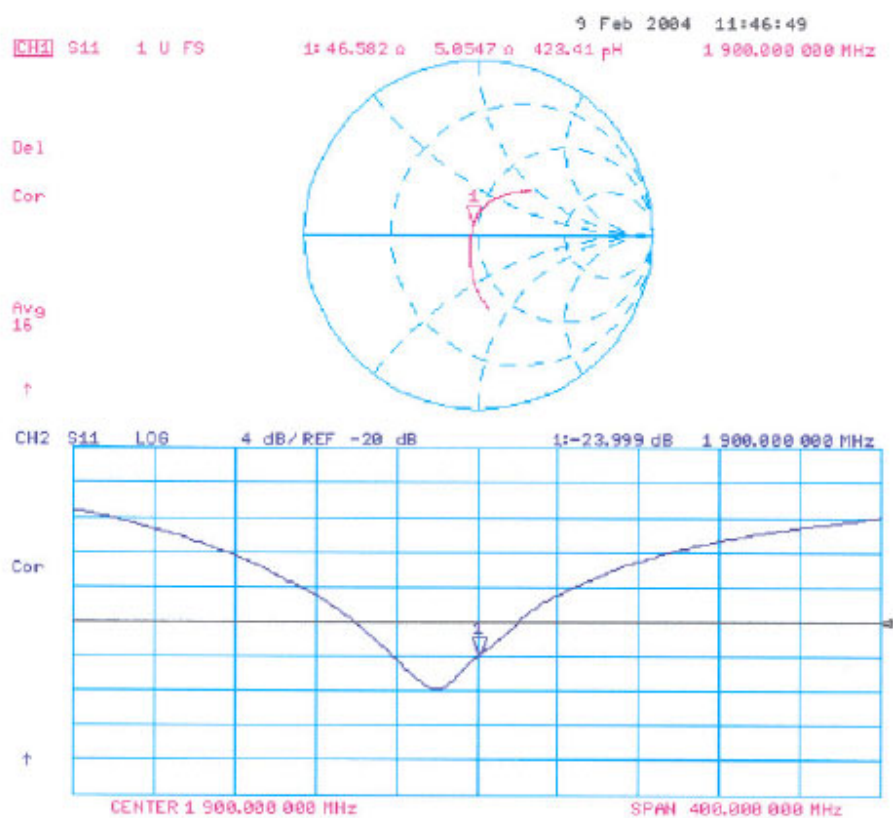
Reference Value = 92.6 V/m; Power Drift = 0.0 dB

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  
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Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **Auden > Sporton Int. Inc.**

**CALIBRATION CERTIFICATE**

Object(s) **ET3DV6 - SN:1788**

Calibration procedure(s) **QA CAL-01 v2  
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 29, 2003**

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  |
|-----------------------------------|--------------|-------------------------------------------|------------------------|
| RF generator HP 8684C             | US3642U01700 | 4-Aug-99 (SPEAG, in house check Aug-02)   | In house check: Aug-05 |
| Power sensor E4412A               | MY41495277   | 2-Apr-03 (METAS, No 252-0250)             | Apr-04                 |
| Power sensor HP 8481A             | MY41092180   | 18-Sep-02 (Agilent, No. 20020918)         | Sep-03                 |
| Power meter EPM E4419B            | GB41293874   | 2-Apr-03 (METAS, No 252-0250)             | Apr-04                 |
| Network Analyzer HP 8753E         | US37390585   | 18-Oct-01 (Agilent, No. 24BR1033101)      | In house check: Oct 03 |
| Fluke Process Calibrator Type 702 | SN: 6295803  | 3-Sep-01 (ELCAL, No.2360)                 | Sep-03                 |

Calibrated by: **Name: Nino Vetterli, Function: Technician, Signature: [Signature]**

Approved by: **Katja Polovic, Laboratory Director, Signature: [Signature]**

Date issued: August 28, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.



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# Probe ET3DV6

## SN:1788

Manufactured: May 28, 2003  
Last calibration: August 29, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ET3DV6 SN:1788

August 29, 2003

**DASY - Parameters of Probe: ET3DV6 SN:1788****Sensitivity in Free Space****Diode Compression**

|       |                                          |       |    |    |
|-------|------------------------------------------|-------|----|----|
| NormX | 1.68 $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP X | 95 | mV |
| NormY | 1.62 $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Y | 95 | mV |
| NormZ | 1.71 $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Z | 95 | mV |

**Sensitivity in Tissue Simulating Liquid**

Head 900 MHz  $\epsilon_r = 41.5 \pm 5\%$   $\sigma = 0.97 \pm 5\%$  mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

|         |                       |                  |      |
|---------|-----------------------|------------------|------|
| ConvF X | 6.6 $\pm 9.5\%$ (k=2) | Boundary effect: |      |
| ConvF Y | 6.6 $\pm 9.5\%$ (k=2) | Alpha            | 0.34 |
| ConvF Z | 6.6 $\pm 9.5\%$ (k=2) | Depth            | 2.48 |

Head 1800 MHz  $\epsilon_r = 40.0 \pm 5\%$   $\sigma = 1.40 \pm 5\%$  mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

|         |                       |                  |      |
|---------|-----------------------|------------------|------|
| ConvF X | 5.3 $\pm 9.5\%$ (k=2) | Boundary effect: |      |
| ConvF Y | 5.3 $\pm 9.5\%$ (k=2) | Alpha            | 0.43 |
| ConvF Z | 5.3 $\pm 9.5\%$ (k=2) | Depth            | 2.80 |

**Boundary Effect**

Head 900 MHz Typical SAR gradient: 5 % per mm

|                       |                              |      |      |
|-----------------------|------------------------------|------|------|
| Probe Tip to Boundary |                              | 1 mm | 2 mm |
| SAR <sub>te</sub> [%] | Without Correction Algorithm | 8.7  | 5.0  |
| SAR <sub>te</sub> [%] | With Correction Algorithm    | 0.3  | 0.5  |

Head 1800 MHz Typical SAR gradient: 10 % per mm

|                       |                              |      |      |
|-----------------------|------------------------------|------|------|
| Probe Tip to Boundary |                              | 1 mm | 2 mm |
| SAR <sub>te</sub> [%] | Without Correction Algorithm | 12.8 | 8.9  |
| SAR <sub>te</sub> [%] | With Correction Algorithm    | 0.3  | 0.1  |

**Sensor Offset**

|                            |               |    |
|----------------------------|---------------|----|
| Probe Tip to Sensor Center | 2.7           | mm |
| Optical Surface Detection  | 1.6 $\pm 0.2$ | mm |