

## 835MHz Brain Dipole Validation

SAM(900MHz) Phantom; Flat Section; Probe: ET3DV6 - SN1735; ConvF(7.00,7.00,7.00)

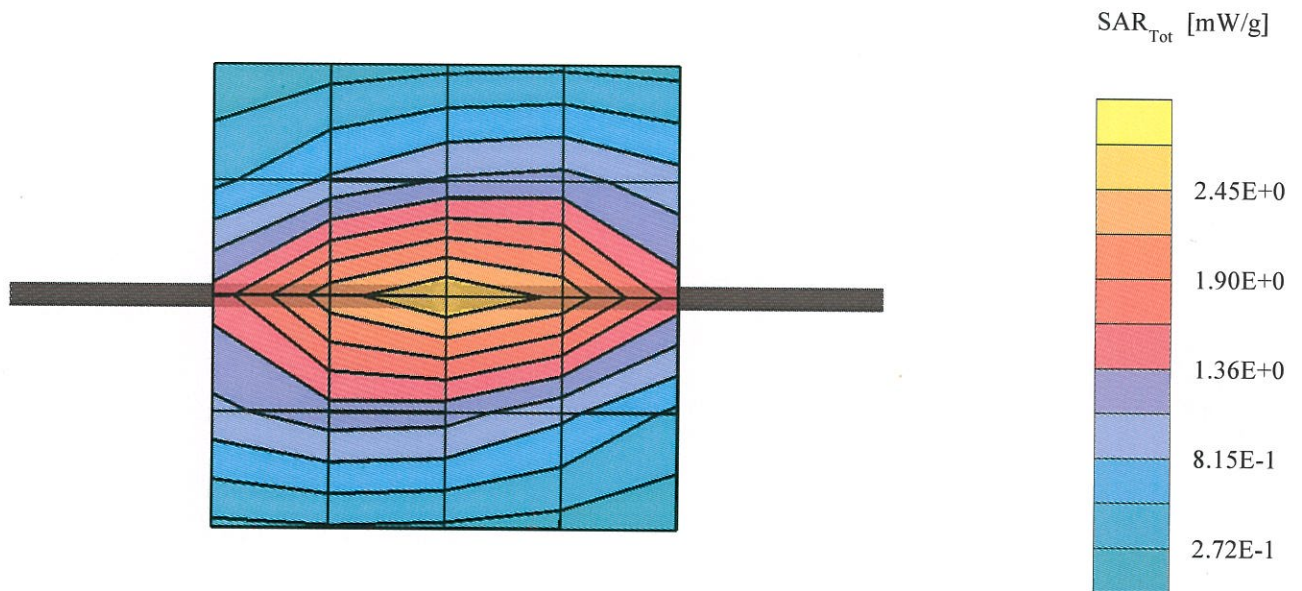
Head 835 MHz:  $\sigma = 0.87$  mho/m  $\epsilon_r = 40.1$   $\rho = 1.00$  g/cm<sup>3</sup> Crest factor: 1.0;

SAR (1g): 2.41 mW/g

835MHz Brain Dipole Validation (D835V2 S/N:494)

Frequency: 835 MHz; Antenna Input Power: 250 [mW]; Ambient Temp. (°C) - 22.8; Tissue Temp. (°C) - 21.3

Brain Tissue Simulating Liquid [05/17/2004]



# 835MHz Brain Dipole Validation

**DUT: Dipole 835 MHz; Serial: 494**

**Program Name: 835MHz Dipole Validation**

**Procedure Name: 835MHz @ 250mW**

**Procedure Notes: Meas.Tissue Temp(celsius)-21.3;Test Date-15/Jun/2004**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.86 \text{ mho/m}$ ;  $\epsilon_r = 39.9$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1734; ConvF(6.55, 6.55, 6.55); Calibrated: 2004-02-02
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn486; Calibrated: 2003-11-17
- Phantom: SAM 835/900 MHz; Type: SAM; Serial: TP-1247
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

**835MHz @ 250mW/Area Scan (61x61x1):** Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Reference Value =  $57.3 \text{ V/m}$ ; Power Drift =  $0.0 \text{ dB}$

Maximum value of SAR (interpolated) =  $2.63 \text{ mW/g}$

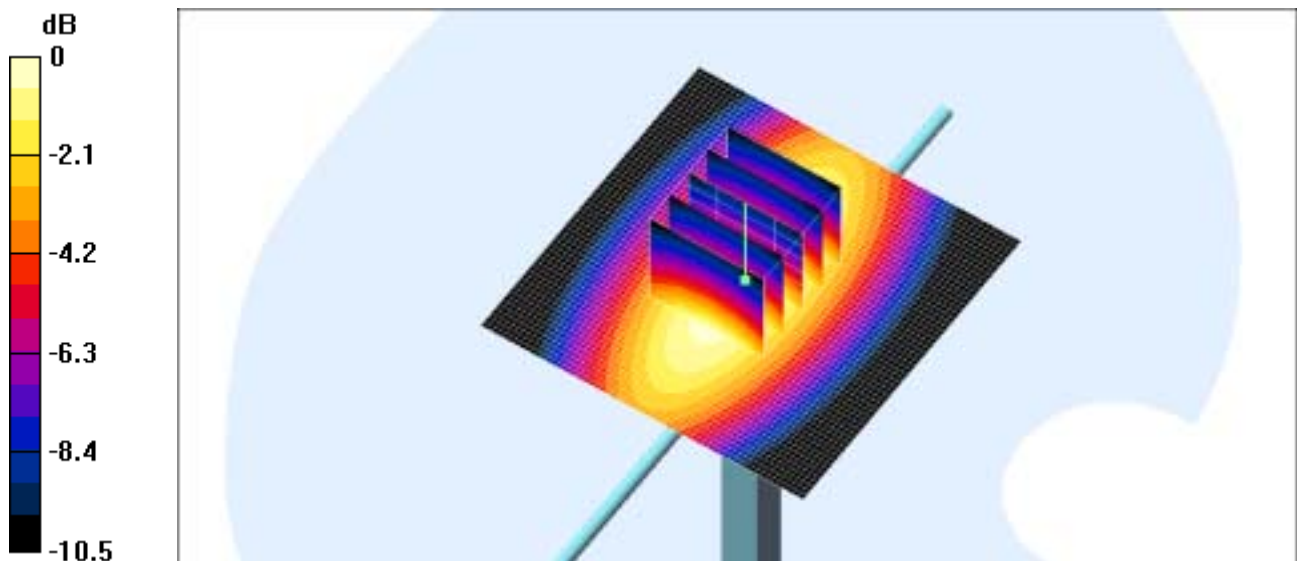
**835MHz @ 250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value =  $57.3 \text{ V/m}$ ; Power Drift =  $0.0 \text{ dB}$

Maximum value of SAR (measured) =  $2.62 \text{ mW/g}$

Peak SAR (extrapolated) =  $3.63 \text{ W/kg}$

**SAR(1 g) =  $2.43 \text{ mW/g}$**



0 dB =  $2.62\text{mW/g}$

## 1900MHz Brain Dipole Validation

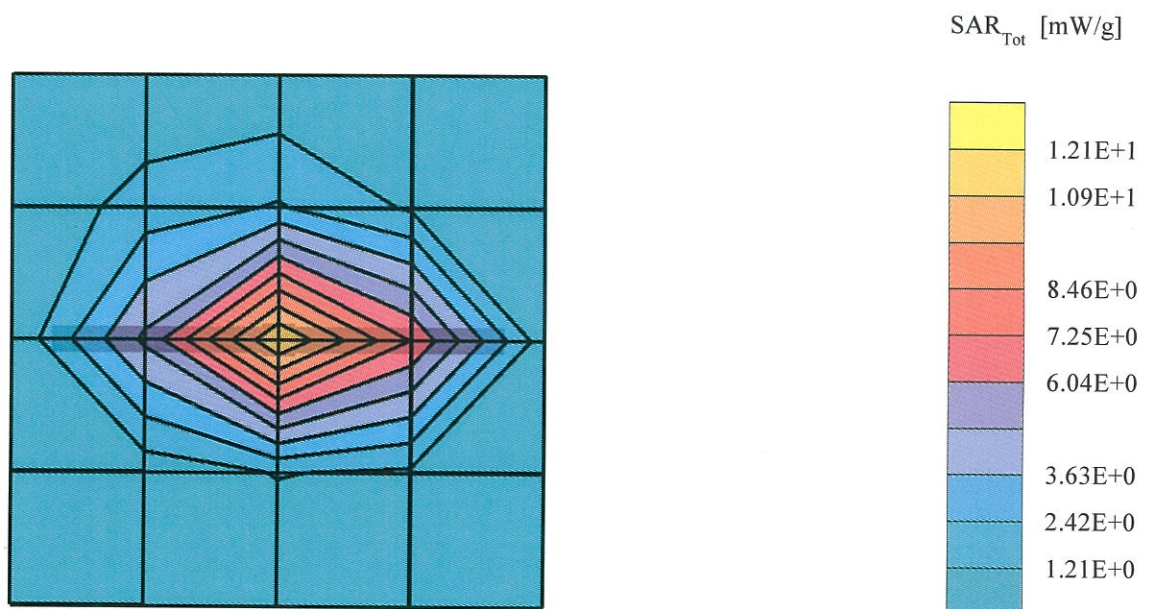
SAM(1800MHz) Phantom; Flat Section; Probe: ET3DV6 - SN1735; ConvF(5.60,5.60,5.60)

Head 1900 MHz:  $\sigma = 1.38$  mho/m  $\epsilon_r = 38.5$   $\rho = 1.00$  g/cm<sup>3</sup> Crest factor: 1.0;

SAR (1g): 10.2 mW/g

1900MHz Brain Dipole Validation (D1900V2 S/N:548)

Frequency: 1900 MHz; Antenna Input Power: 250 [mW]; Ambient Temp. (°C) - 22.3; Tissue Temp. (°C) - 21.4  
Brain Tissue Simulating Liquid [05/19/2004]



Client **Samsung (Dymstec)**

## CALIBRATION CERTIFICATE

Object(s) **D835V2 - SN.494**

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

Calibration date: **October 3, 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  |
|---------------------------|------------|-------------------------------------------|------------------------|
| Power sensor HP 8481A     | MY41092317 | 18-Oct-02 (Agilent, No. 20021018)         | Oct-04                 |
| Power sensor HP 8481A     | US37292783 | 30-Oct-02 (METAS, No. 252-0236)           | Oct-03                 |
| Power meter EPM E442      | GB37480704 | 30-Oct-02 (METAS, No. 252-0236)           | Oct-03                 |
| 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 (Agilent, No. 24BR1033101)      | In house check: Oct 03 |

Calibrated by: 

| Name           | Function   | Signature                                                                             |
|----------------|------------|---------------------------------------------------------------------------------------|
| Judith Mueller | Technician |  |

Approved by: 

|               |                     |
|---------------|---------------------|
| Katja Pokovic | Laboratory Director |
|---------------|---------------------|

Date issued: October 8, 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.

# DASY

## Dipole Validation Kit

Type: D835V2

Serial: 494

Manufactured: May 26, 2003  
Calibrated: October 3, 2003

## **1. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating solution** of the following electrical parameters at 835 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>43.0</b>       | $\pm 5\%$ |
| Conductivity           | <b>0.90 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.7 at 835 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 15mm 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>9.60 mW/g</b> $\pm 16.8\%$ (k=2) <sup>1</sup> |
| averaged over $10\text{ cm}^3$ (10 g) of tissue: | <b>6.28 mW/g</b> $\pm 16.2\%$ (k=2) <sup>1</sup> |

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<sup>1</sup> validation uncertainty

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

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

|                      |                 |                                       |
|----------------------|-----------------|---------------------------------------|
| Electrical delay:    | <b>1.371 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.985</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 835 MHz: | $\text{Re}\{Z\} = \mathbf{50.3\ \Omega}$ |
|---------------------------------|------------------------------------------|

|  |                                          |
|--|------------------------------------------|
|  | $\text{Im}\{Z\} = \mathbf{-1.9\ \Omega}$ |
|--|------------------------------------------|

|                        |                 |
|------------------------|-----------------|
| Return Loss at 835 MHz | <b>-34.6 dB</b> |
|------------------------|-----------------|

### **4. 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.

### **5. 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.

### **6. Power Test**

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN494**

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL 835 MHz ( $\sigma = 0.9$  mho/m,  $\epsilon_r = 43$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.7, 6.7, 6.7); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

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

Reference Value = 55.4 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 2.59 mW/g

**Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

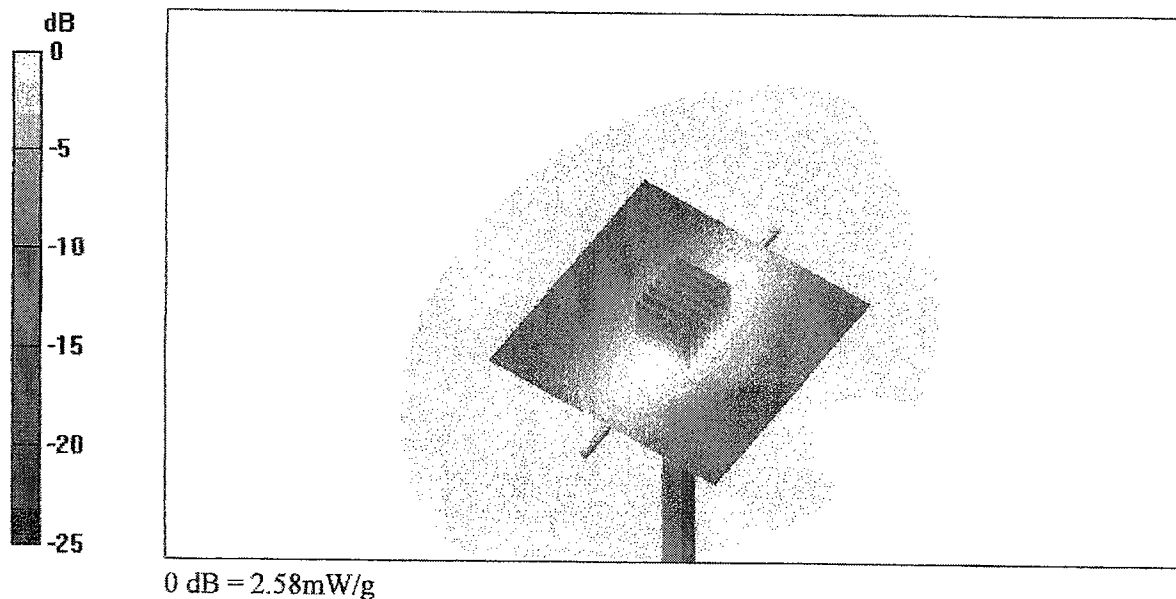
Peak SAR (extrapolated) = 3.59 W/kg

SAR(1 g) = 2.4 mW/g; SAR(10 g) = 1.57 mW/g

Reference Value = 55.4 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 2.58 mW/g



3 Oct 2003 10:17:12  
 CH1 S11 1 U FS 1:50.297  $\Omega$  -1.8867  $\Omega$  101.02 pF 835.000 000 MHz

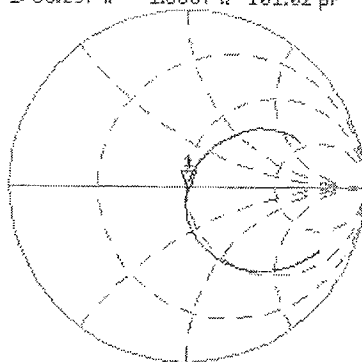
Del

Cor

Avg

16

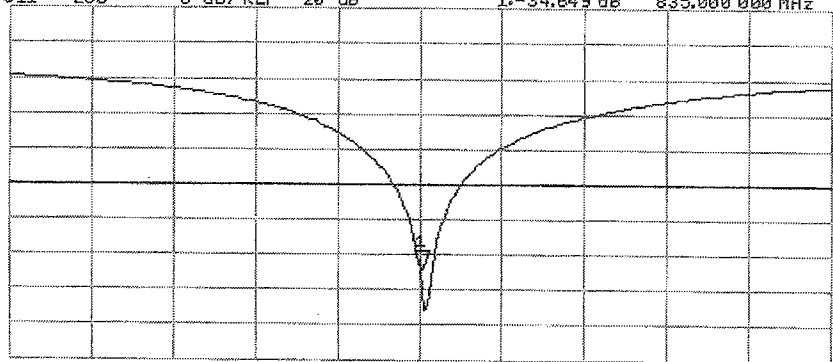
↑



CH2 S11 LOG 6 dB/REF -20 dB 1:-34.649 dB 835.000 000 MHz

Cor

↑



CENTER 835.000 000 MHz

SPAN 400.000 000 MHz

Client **Samsung (Dymstec)**

## CALIBRATION CERTIFICATE

Object(s) **D1900V2 - SN:548**

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

Calibration date: **November 13, 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  |
|---------------------------|------------|-------------------------------------------|------------------------|
| Power meter EPM E442      | GB37480704 | 6-Nov-03 (METAS, No. 252-0254)            | Nov-04                 |
| Power sensor HP 8481A     | US37292783 | 6-Nov-03 (METAS, No. 252-0254)            | Nov-04                 |
| Power sensor HP 8481A     | MY41092317 | 18-Oct-02 (Agilent, No. 20021018)         | Oct-04                 |
| RF generator R&S SML-03   | 100698     | 27-Mar-2002 (R&S, No. 20-92389)           | In house check: Mar-05 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (SPEAG, in house check Nov-03)  | In house check: Oct 05 |

|                |                |            |                                                                                       |
|----------------|----------------|------------|---------------------------------------------------------------------------------------|
|                | Name           | Function   | Signature                                                                             |
| Calibrated by: | Judith Mueller | Technician |  |

|              |               |                     |                                                                                       |
|--------------|---------------|---------------------|---------------------------------------------------------------------------------------|
| Approved by: | Katja Pokovic | Laboratory Director |  |
|--------------|---------------|---------------------|---------------------------------------------------------------------------------------|

Date issued: November 20, 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.

# DASY

## Dipole Validation Kit

Type: D1900V2

Serial: 548

|               |                   |
|---------------|-------------------|
| Manufactured: | November 15, 2001 |
| Repaired:     | November 11, 2003 |
| Calibrated:   | November 13, 2003 |

## **1. Measurement Conditions**

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

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>40.5</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.46 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.2 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>39.7 mW/g</b> $\pm 16.8 \%$ (k=2) <sup>1</sup> |
| averaged over $10 \text{ cm}^3$ (10 g) of tissue: | <b>20.8 mW/g</b> $\pm 16.2 \%$ (k=2) <sup>1</sup> |

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<sup>1</sup> validation uncertainty

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

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

|                      |                 |                                       |
|----------------------|-----------------|---------------------------------------|
| Electrical delay:    | <b>1.199 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.982</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\} = $ <b>51.1 <math>\Omega</math></b> |
|----------------------------------|-----------------------------------------------------|

|  |                                                    |
|--|----------------------------------------------------|
|  | $\text{Im}\{Z\} = $ <b>3.8 <math>\Omega</math></b> |
|--|----------------------------------------------------|

|                         |                 |
|-------------------------|-----------------|
| Return Loss at 1900 MHz | <b>-28.2 dB</b> |
|-------------------------|-----------------|

### **4. 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.

### **5. 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.

### **6. Power Test**

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

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN548**

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

Medium: HSL 1900 MHz ( $\sigma = 1.46$  mho/m,  $\epsilon_r = 40.45$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

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

Reference Value = 92.4 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 11.2 mW/g

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

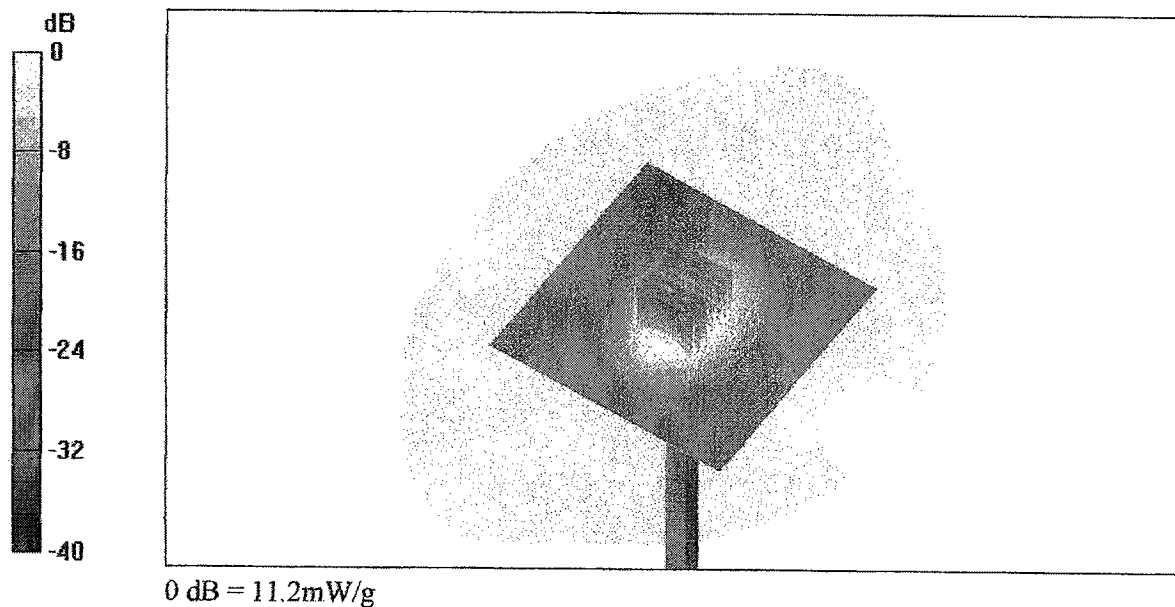
Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.92 mW/g; SAR(10 g) = 5.19 mW/g

Reference Value = 92.4 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 11.2 mW/g

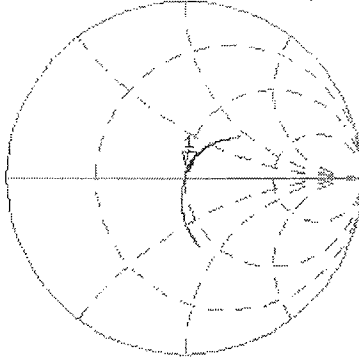


13 Nov 2003 10:34:34  
 CH1 S11 1 U F8 1: 51.074  $\alpha$  3.7715  $\alpha$  315.92 pH 1 900.000 000 MHz

De1

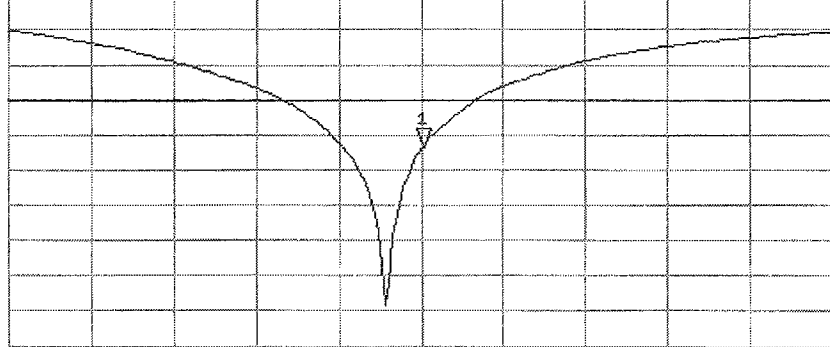
Cor

Avg  
16



CH2 S11 LOG 6 dB/REF -20 dB 1: -28.226 dB 1 900.000 000 MHz

Cor



CENTER 1 900.000 000 MHz

SPAN 400.000 000 MHz