

# DASY

## Dipole Validation Kit

Type: D1900V2

Serial: 511

Manufactured: October 20, 1999  
Calibrated: February 27, 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>38.6</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 holder 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: **41.2 mW/g**  $\pm 17.5\% (k=2)$ <sup>1</sup>

averaged over  $10\text{ cm}^3$  (10 g) of tissue: **20.8 mW/g**  $\pm 17.5\% (k=2)$ <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>1.187 ns</b>	(one direction)
Transmission factor:	<b>0.997</b>	(voltage transmission, one direction)

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

Feedpoint impedance at 1900 MHz:  $\text{Re}\{Z\} = 48.8 \Omega$

$\text{Im}\{Z\} = 0.9 \Omega$

Return Loss at 1900 MHz **-36.1 dB**

### **4. Measurement Conditions**

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

Relative Dielectricity	<b>51.2</b>	$\pm 5\%$
Conductivity	<b>1.59 mho/m</b>	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.8 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 holder 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.

## 5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue: **42.4 mW/g ± 17.5 % (k=2)**<sup>2</sup>

averaged over 10 cm<sup>3</sup> (10 g) of tissue: **21.6 mW/g ± 17.5 % (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 holder was in place during impedance measurements.

Feedpoint impedance at 1900 MHz: **Re{Z} = 45.1 Ω**

**Im {Z} = 1.7 Ω**

Return Loss at 1900 MHz **-25.3 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

Date/Time: 02/26/03 18:15:55

Test Laboratory: SPEAG, Zurich, Switzerland  
File Name: SN511\_SN1507\_HSL1900\_260203.da4

**DUT: Dipole 1900 MHz; Serial: D1900V2 - SN511**  
**Program: Dipole Calibration**

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

Medium: HSL 1900 MHz; ( $\sigma = 1.46 \text{ mho/m}$ ,  $\epsilon_r = 38.6$ ,  $\rho = 1000 \text{ kg/m}^3$ )

Phantom section: Flat Section

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 25; Postprocessing SW: SEMCAD, V1.6 Build 105

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

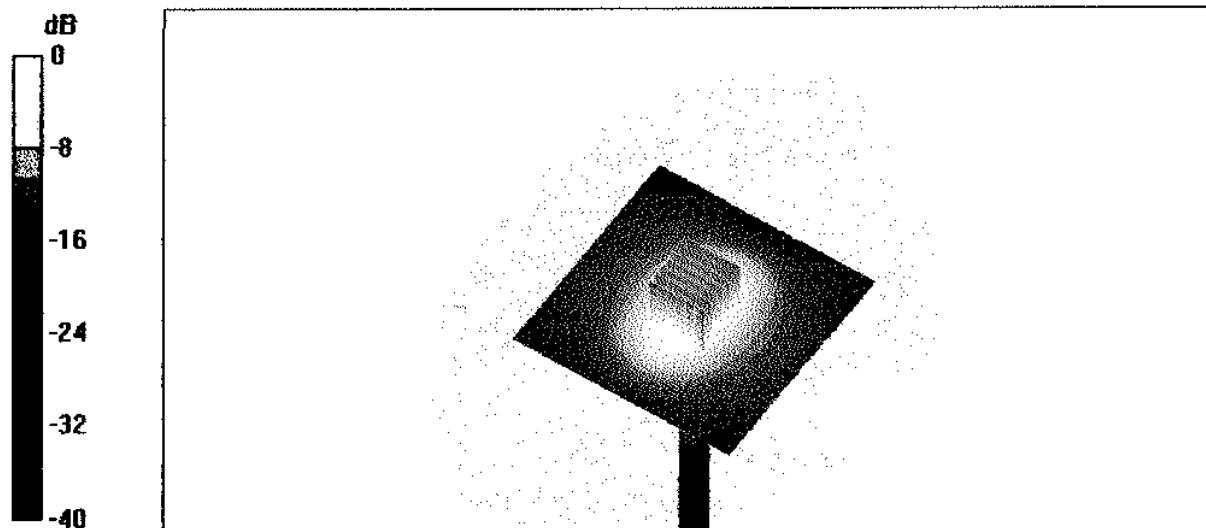
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.1 V/m

Peak SAR = 18.2 W/kg

SAR(1 g) = 10.3 mW/g, SAR(10 g) = 5.2 mW/g

Power Drift = 0.06 dB



511

with caps

CH1 511 1 U FS

1: 49.764  $\Delta$  6.9375  $\Delta$  78.530 pH 1 900.000 000 MHz

26 Feb 2003 19:08:14

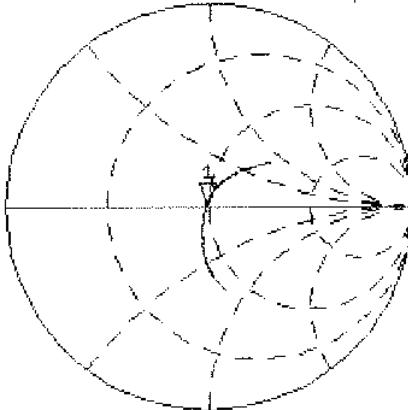
Del

PRM

Cor

AVG

16



↑

CH2

LOG

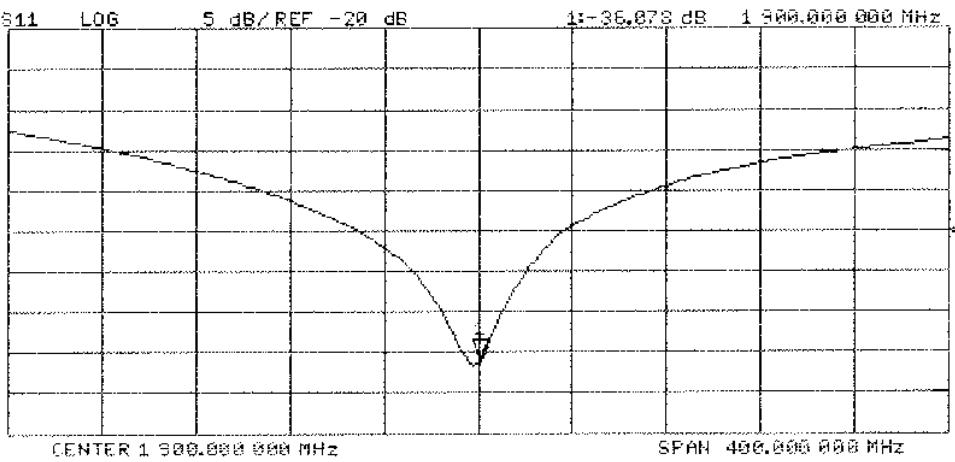
5 dB/REF -20 dB

1:-36.873 dB 1 900.000 000 MHz

PRM

Cor

↑



CENTER 1 900.000 000 MHz

SPAN 400.000 000 MHz

26 Feb 2003 11:15:49

CH1 S11 1 U FS

1: 44.387 a -9.9766 a 8.3353 pF 1 900.000 000 MHz

511  
to copy

↑

Del

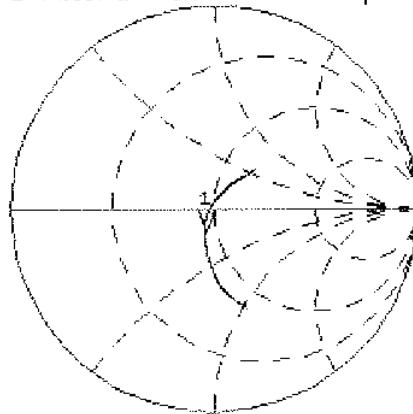
PRM

Cor

Avg

16

↑



CH2 S11 LOG

5 dB/REF -20 dB

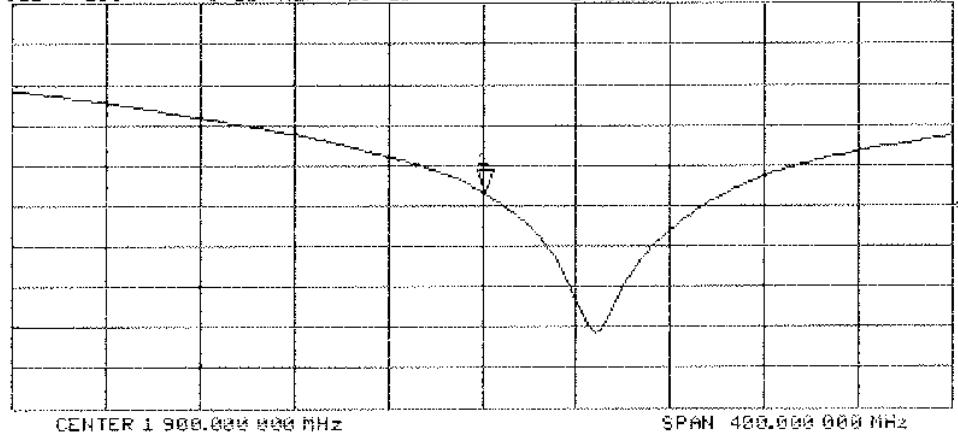
1:-18.384 dB

1 900.000 000 MHz

PRM

Cor

↑



Date/Time: 02/27/03 13:38:17

Test Laboratory: SPEAG, Zurich, Switzerland  
File Name: SN511\_SN1507\_M1900\_270203.da4

**DUT: Dipole 1900 MHz; Serial: D1900V2 - SN511**

**Program: Dipole Calibration**

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

Medium: Muscle 1900 MHz; ( $\sigma = 1.59 \text{ mho/m}$ ,  $\epsilon_r = 51.2$ ,  $\rho = 1000 \text{ kg/m}^3$ )

Phantom section: Flat Section

**DASY4 Configuration:**

- Probe: ET3DV6 - SN1507; ConvF(4.8, 4.8, 4.8); 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 25; Postprocessing SW: SEMCAD, V1.6 Build 105

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

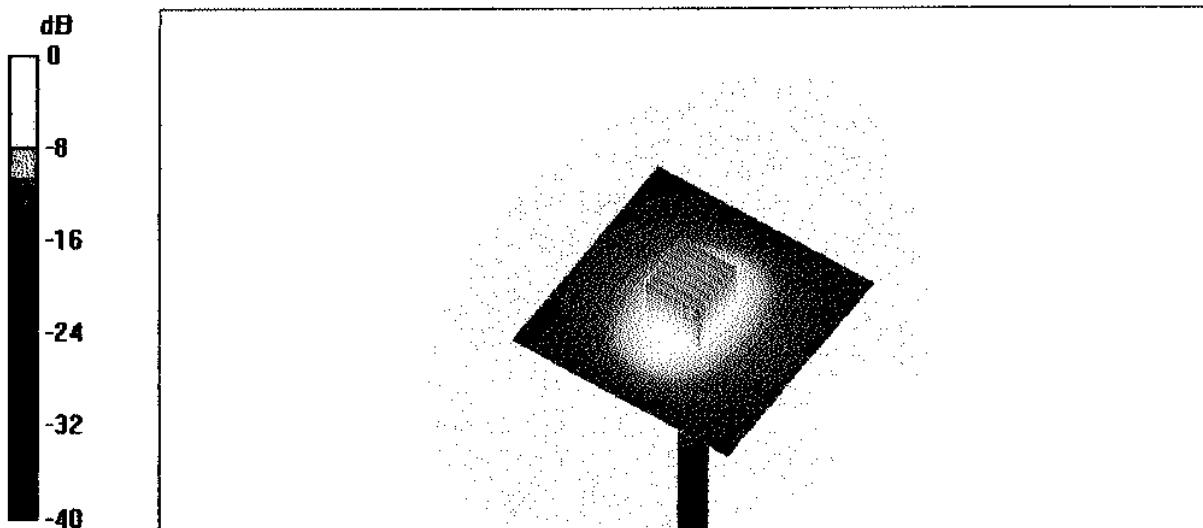
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.8 V/m

Peak SAR = 18.8 W/kg

SAR(1 g) = 10.6 mW/g; SAR(10 g) = 5.41 mW/g

Power Drift = 0.06 dB



27 Feb 2003 14:56:52

CH1 S11 1 U FS

1: 45.078  $\Omega$  1.7123  $\Omega$  143.48 pH 1 900.000 000 MHz

SM

Muscle

↑

Del

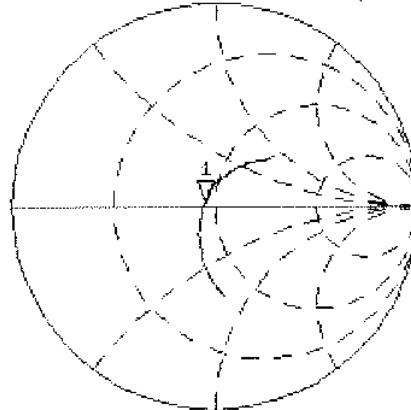
PRM

Cor

AVG

16

↑

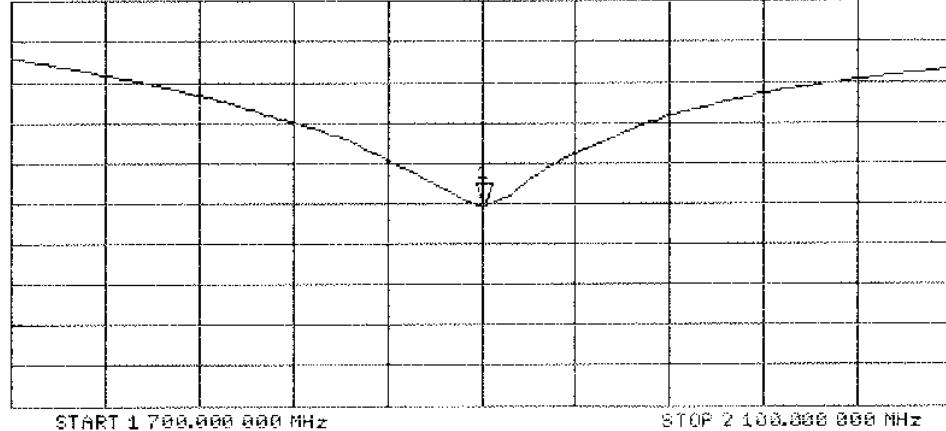


CH2 S11 LOG 5 dB/REF 0 dB 13-25.271 dB 1 900.000 000 MHz

PRM

Cor

↑



START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

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

**Client** Nokia Oyj, Oulu

## CALIBRATION CERTIFICATE

Object(s) D1900V2 - SN: 5d030

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

Calibration date: April 8, 2003

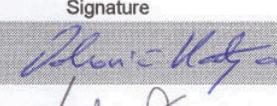
Condition of the calibrated item In Tolerance (according to the specific calibration document)

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	Scheduled Calibration
RF generator R&S SML-03	100698	27-Mar-2002	In house check: Mar-05
Power sensor HP 8481A	MY41092317	18-Oct-02	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02	Oct-03
Network Analyzer HP 8753E	US38432426	3-May-00	In house check: May 03

Calibrated by: Name Katja Pokovic Function Laboratory Director Signature 

Approved by: Name Niels Kuster Function Quality Manager Signature 

Date issued: April 11, 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: 5d030

Manufactured: December 17, 2002  
Calibrated: April 8, 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>38.8</b>	$\pm 5\%$
Conductivity	<b>1.44 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 holder 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: **42.0 mW/g**  $\pm 16.8\%$  (k=2)<sup>1</sup>

averaged over  $10\text{ cm}^3$  (10 g) of tissue: **21.7 mW/g**  $\pm 16.2\%$  (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: **1.189 ns** (one direction)  
Transmission factor: **0.990** (voltage transmission, one direction)

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

Feedpoint impedance at 1900 MHz:  $\text{Re}\{Z\} = \textbf{50.8 } \Omega$

$\text{Im } \{Z\} = \textbf{3.5 } \Omega$

Return Loss at 1900 MHz **-28.8 dB**

### 4. Measurement Conditions

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

Relative Dielectricity **51.2**  $\pm 5\%$   
Conductivity **1.59 mho/m**  $\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.8 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 holder 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.

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

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue: **42.8 mW/g ± 16.8 % (k=2)**<sup>2</sup>

averaged over 10 cm<sup>3</sup> (10 g) of tissue: **22.1 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 holder was in place during impedance measurements.

Feedpoint impedance at 1900 MHz: **Re{Z} = 46.9 Ω**

**Im {Z} = 4.0 Ω**

Return Loss at 1900 MHz **-25.5 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

Date/Time: 04/01/03 15:53:35

Test Laboratory: SPEAG, Zurich, Switzerland  
File Name: [SN5d030\\_SN1507\\_HSL1900\\_010403.da4](#)

**DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d030**  
**Program: Dipole Calibration**

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

Medium: HSL 1900 MHz; ( $\sigma = 1.44 \text{ mho/m}$ ,  $\epsilon_r = 38.78$ ,  $\rho = 1000 \text{ kg/m}^3$ )

Phantom section: Flat Section

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 33; Postprocessing SW: SEMCAD, V1.6 Build 109

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

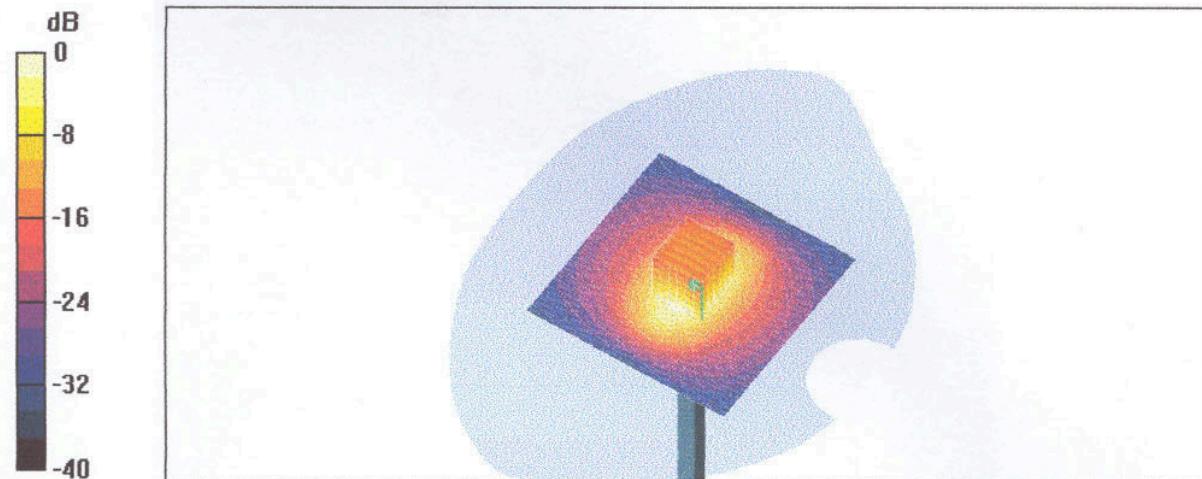
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.5 V/m

Peak SAR = 18.4 W/kg

SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.42 mW/g

Power Drift = 0.03 dB



1 Apr 2003 10:11:32

5d1030

CH1 S11 1 U FS

1: 50.848  $\Omega$  3.5273  $\Omega$  295.47 pH 1 900,000 000 MHz

Y

De1

PRM

Cor

Avg

16

↑

CH2 S11 LOG

5 dB/REF 0 dB

1: -28.845 dB 1 900,000 000 MHz

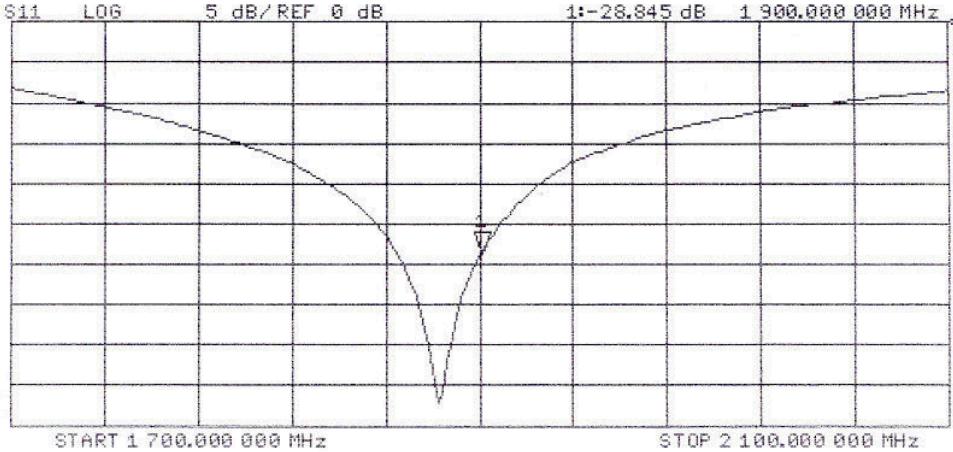
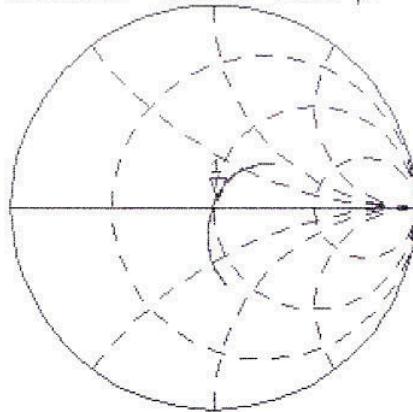
PRM

Cor

↑

START 1 700,000 000 MHz

STOP 2 100,000 000 MHz



Date/Time: 04/08/03 14:15:07

Test Laboratory: SPEAG, Zurich, Switzerland  
File Name: SN5d030\_SN1507\_M1900\_080403.da4

**DUT: Dipole 1900 MHz; Serial: D1900V2 - SN5d030**  
**Program: Dipole Calibration**

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

Medium: Muscle 1900 MHz; ( $\sigma = 1.59 \text{ mho/m}$ ,  $\epsilon_r = 51.2$ ,  $\rho = 1000 \text{ kg/m}^3$ )

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.8, 4.8, 4.8); 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 33; Postprocessing SW: SEMCAD, V1.6 Build 109

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

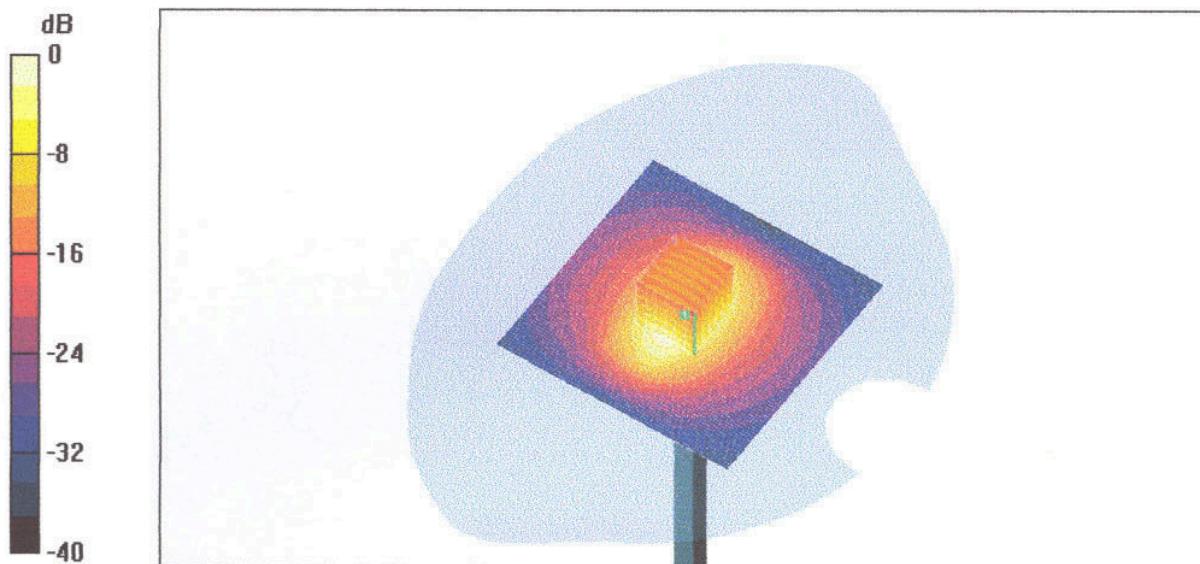
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 91.4 V/m

Peak SAR = 18.7 W/kg

SAR(1 g) = 10.7 mW/g; SAR(10 g) = 5.52 mW/g

Power Drift = 0.03 dB



5d030  
Booly

CH1 S11 1 U FS

8 Apr 2003 09:58:49  
1: 46.902  $\Delta$  3.9512  $\Delta$  330.97 pH  
1 900.000 000 MHz

PRM  
Cor  
Avg  
16

