

# DASY

## Dipole Validation Kit

Type: D5GHzV2

Serial: 1007

Manufactured: August 28, 2003  
Calibrated: October 5, 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:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Frequency:             | <b>5200 MHz</b>   |           |
| Relative Dielectricity | <b>36.3</b>       | $\pm 5\%$ |
| Conductivity           | <b>4.57 mho/m</b> | $\pm 5\%$ |
| Frequency:             | <b>5800 MHz</b>   |           |
| Relative Dielectricity | <b>35.4</b>       | $\pm 5\%$ |
| Conductivity           | <b>5.20 mho/m</b> | $\pm 5\%$ |

The DASY3 System with a dosimetric E-field probe ES3DV3 - SN:3025 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. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. Special 8x8x8 fine cube was chosen for cube integration ( $dx=dy=4.3\text{mm}$ ,  $dz=3\text{mm}$ ). Distance between probe sensors and phantom surface was set to 3.0 mm. The dipole input power (forward power) was  $250\text{mW} \pm 3\%$ . The results are normalized to 1W input power.

## **2. SAR Measurement with DASY System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figures supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured at **5200 MHz (Head Tissue)** with the dosimetric probe ES3DV3 SN:3025 and applying the advanced extrapolation are:

|                                                  |                                                                         |
|--------------------------------------------------|-------------------------------------------------------------------------|
| averaged over $1\text{ cm}^3$ (1 g) of tissue:   | <b>86.8 mW/g <math>\pm 32.0\%</math> (<math>k=2</math>)<sup>1</sup></b> |
| averaged over $10\text{ cm}^3$ (10 g) of tissue: | <b>24.2 mW/g <math>\pm 31.7\%</math> (<math>k=2</math>)<sup>1</sup></b> |

The resulting averaged SAR-values measured at **5800 MHz (Head Tissue)** with the dosimetric probe ES3DV3 SN:3025 and applying the advanced extrapolation are:

|                                                  |                                                                         |
|--------------------------------------------------|-------------------------------------------------------------------------|
| averaged over $1\text{ cm}^3$ (1 g) of tissue:   | <b>90.0 mW/g <math>\pm 32.0\%</math> (<math>k=2</math>)<sup>2</sup></b> |
| averaged over $10\text{ cm}^3$ (10 g) of tissue: | <b>24.7 mW/g <math>\pm 31.7\%</math> (<math>k=2</math>)<sup>2</sup></b> |

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<sup>1</sup> Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR<sub>1g</sub>=76.5 mW/g, SAR<sub>10g</sub>=21.6 mW/g and SAR<sub>peak</sub>=310.3 mW/g.

<sup>2</sup> Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR<sub>1g</sub>=78.0 mW/g, SAR<sub>10g</sub>=21.9 mW/g and SAR<sub>peak</sub>=340.9 mW/g.

### **3. Dipole Transformation Parameters**

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint (please refer to the graphics attached to this document). The transformation parameters from the SMA-connector to the dipole feedpoint are:

|                      |                 |                                       |
|----------------------|-----------------|---------------------------------------|
| Electrical delay:    | <b>1.202 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.938</b>    | (voltage transmission, one direction) |

### **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:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Frequency:             | <b>5200 MHz</b>   |           |
| Relative Dielectricity | <b>49.7</b>       | $\pm 5\%$ |
| Conductivity           | <b>5.18 mho/m</b> | $\pm 5\%$ |
| Frequency:             | <b>5800 MHz</b>   |           |
| Relative Dielectricity | <b>48.5</b>       | $\pm 5\%$ |
| Conductivity           | <b>6.01 mho/m</b> | $\pm 5\%$ |

The DASY3 System with a dosimetric E-field probe ES3DV3 - SN:3025 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. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 8x8x8 fine cube was chosen for cube integration ( $dx=dy=4.3\text{mm}$ ,  $dz=3\text{mm}$ ). Distance between probe sensors and phantom surface was set to 3.0 mm. The dipole input power (forward power) was  $250\text{mW} \pm 3\%$ . The results are normalized to 1W input power.

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

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figures supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured at **5200 MHz (Body Tissue)** with the dosimetric probe ES3DV3 SN:3025 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue: **84.0 mW/g ± 32.0 % (k=2)<sup>3</sup>**

averaged over 10 cm<sup>3</sup> (10 g) of tissue: **23.6 mW/g ± 31.7 % (k=2)<sup>3</sup>**

The resulting averaged SAR-values measured at **5800 MHz (Body Tissue)** with the dosimetric probe ES3DV3 SN:3025 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue: **81.2 mW/g ± 32.0 % (k=2)<sup>4</sup>**

averaged over 10 cm<sup>3</sup> (10 g) of tissue: **22.4 mW/g ± 31.7 % (k=2)<sup>4</sup>**

## **6. 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.

## **7. 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 increase frequency bandwidth at the position as explained in Sections 1 and 4.

## **8. 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>3</sup> Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR\_1g=71.8 mW/g, SAR\_10g=20.1 mW/g and SAR\_peak=284.7 mW/g.

<sup>4</sup> Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR\_1g=74.1 mW/g, SAR\_10g=20.5 mW/g and SAR\_peak=324.7 mW/g.

SPEAG Calibration Laboratory

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1007**

Communication System: CW-5GHz; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: HSL5800 ( $\sigma = 4.57$  mho/m,  $\epsilon_r = 36.34$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3025-Y2003; ConvF(2.65, 2.65, 2.65); Calibrated: 9/19/2003
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn410; Calibrated: 4/22/2003
- Phantom: SAM 12b; Type: SAM 4.0; Serial: TP:1197
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

**d=10mm, Pin=250mW, f=5200 MHz/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Reference Value = 89.3 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 33.7 mW/g

**d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (8x8x8), dist=3mm (7x7x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

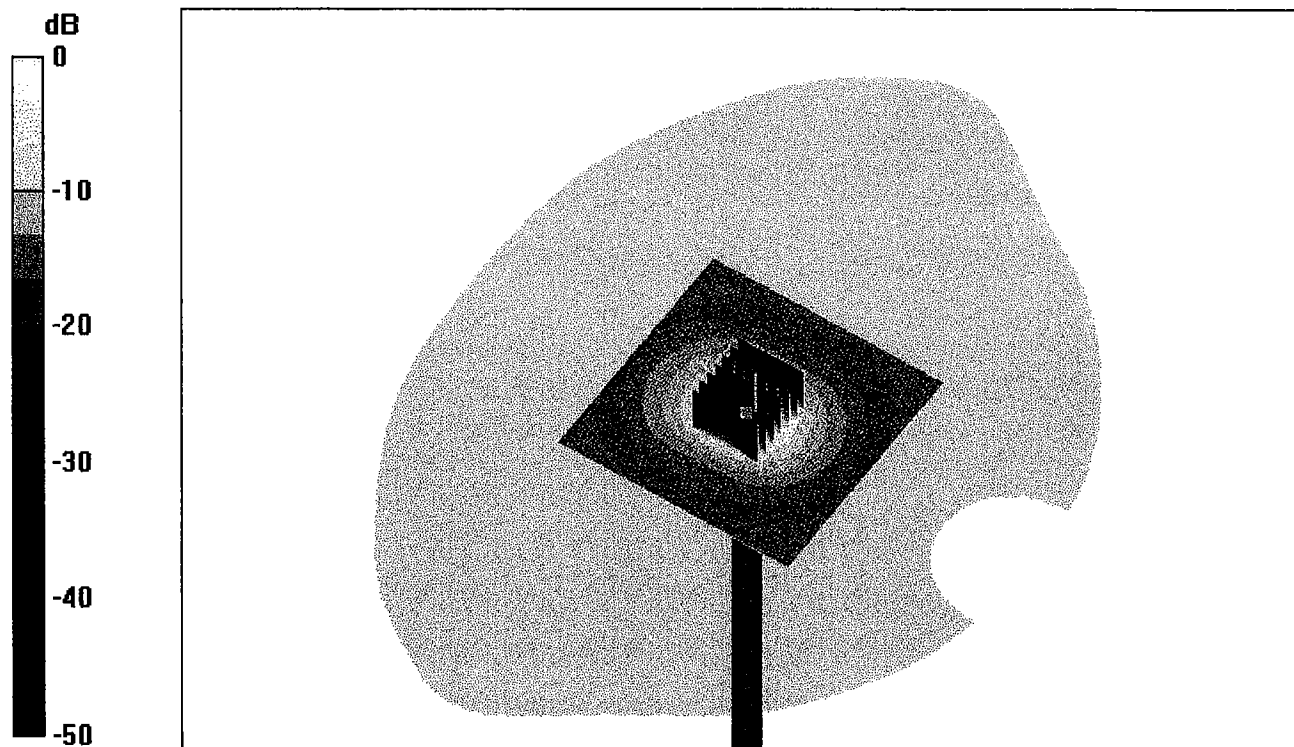
Peak SAR (extrapolated) = 97.6 W/kg

SAR(1 g) = 21.7 mW/g; SAR(10 g) = 6.06 mW/g

Reference Value = 89.3 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 29.6 mW/g



0 dB = 29.6mW/g

SPEAG Calibration Laboratory

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1007**

Communication System: CW-5GHz; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: HSL5800 ( $\sigma = 5.2$  mho/m,  $\epsilon_r = 35.39$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3025-Y2003; ConvF(2.3, 2.3, 2.3); Calibrated: 9/19/2003
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn410; Calibrated: 4/22/2003
- Phantom: SAM 12b; Type: SAM 4.0; Serial: TP:1197
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

**d=10mm, Pin=250mW, f=5800 MHz/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Reference Value = 85.6 V/m

Power Drift = -0.008 dB

Maximum value of SAR = 33.6 mW/g

**d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=3mm (7x7x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

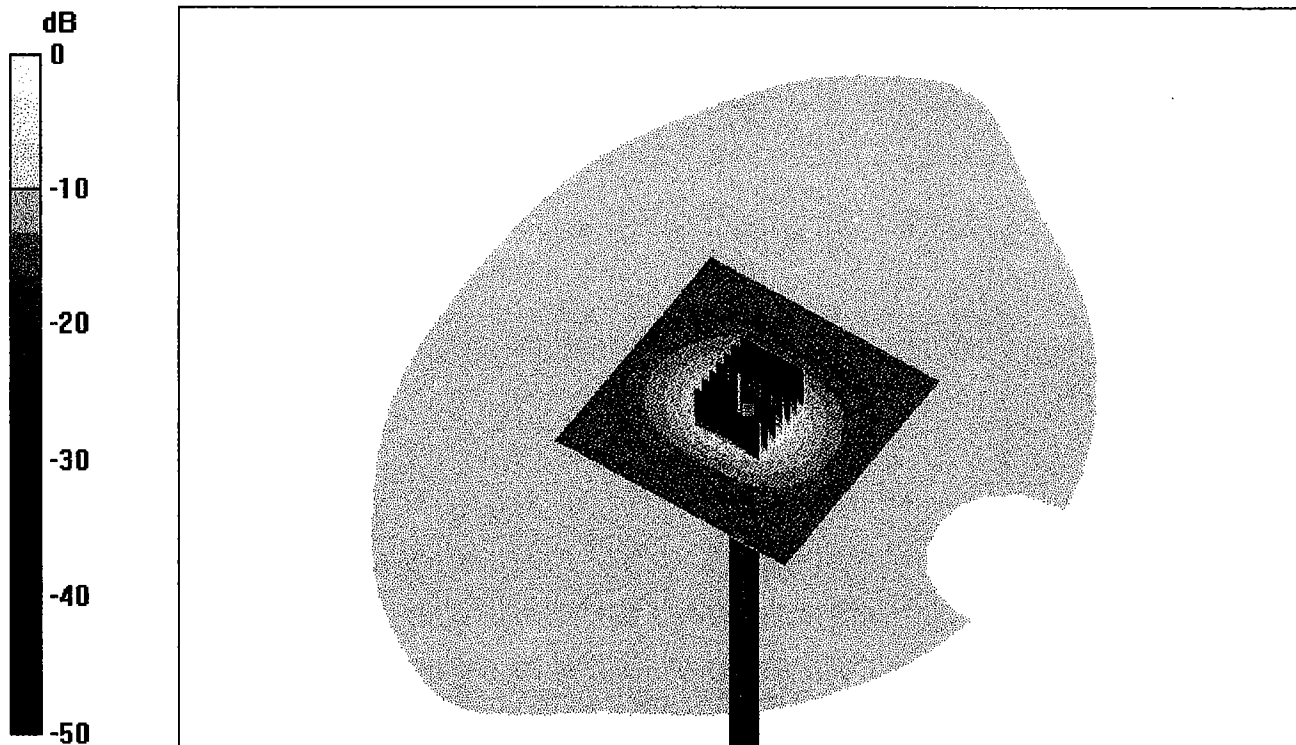
Peak SAR (extrapolated) = 116.0 W/kg

SAR(1 g) = 22.5 mW/g; SAR(10 g) = 6.17 mW/g

Reference Value = 85.6 V/m

Power Drift = -0.008 dB

Maximum value of SAR = 31.1 mW/g



0 dB = 31.1mW/g

4 Oct 2003 12:58:30

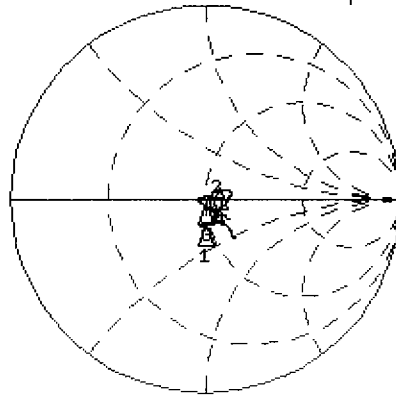
CH1 S11 1 U FS

2: 53.305  $\Omega$  -11.133  $\Omega$  2.7492 pF

5 200.120 000 MHz

De1

Cor



CH1 Markers

1: 47.193  $\Omega$   
-13.361  $\Omega$   
5.10000 GHz

3: 49.523  $\Omega$   
-3.1797  $\Omega$   
5.50000 GHz

4: 57.014  $\Omega$   
5.3711  $\Omega$   
5.80000 GHz

↑

CH2 S11 LOG 5 dB/REF -20 dB 2:-19.075 dB 5 200.120 000 MHz

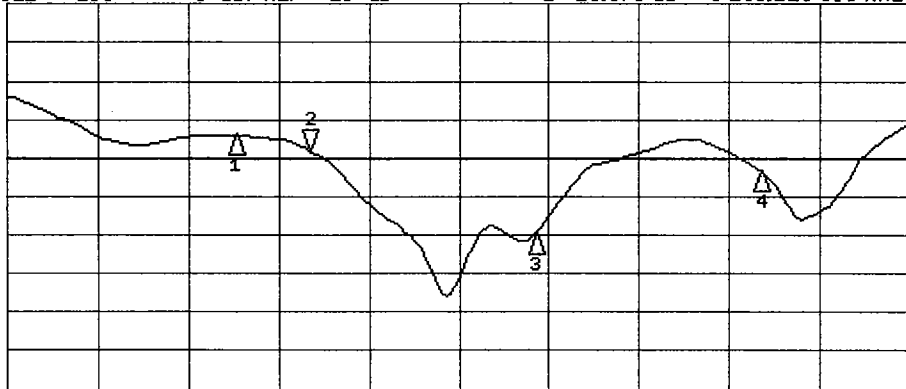
Smo

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Avg

16

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START 4 800.000 000 MHz

STOP 6 000.000 000 MHz

CH2 Markers

1:-17.109 dB  
5.10000 GHz

3:-29.884 dB  
5.50000 GHz

4:-21.670 dB  
5.80000 GHz

SPEAG Calibration Laboratory

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1007**

Communication System: CW-5GHz; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: MSL5800 ( $\sigma = 5.18$  mho/m,  $\epsilon_r = 49.73$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3025-Y2003; ConvF(1.93, 1.93, 1.93); Calibrated: 9/19/2003
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn410; Calibrated: 4/22/2003
- Phantom: SAM 12b; Type: SAM 4.0; Serial: TP:1197
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

**d=10mm, Pin=250mW, f=5200 MHz/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Reference Value = 87.7 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 33.1 mW/g

**d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (8x8x8), dist=3mm (7x7x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

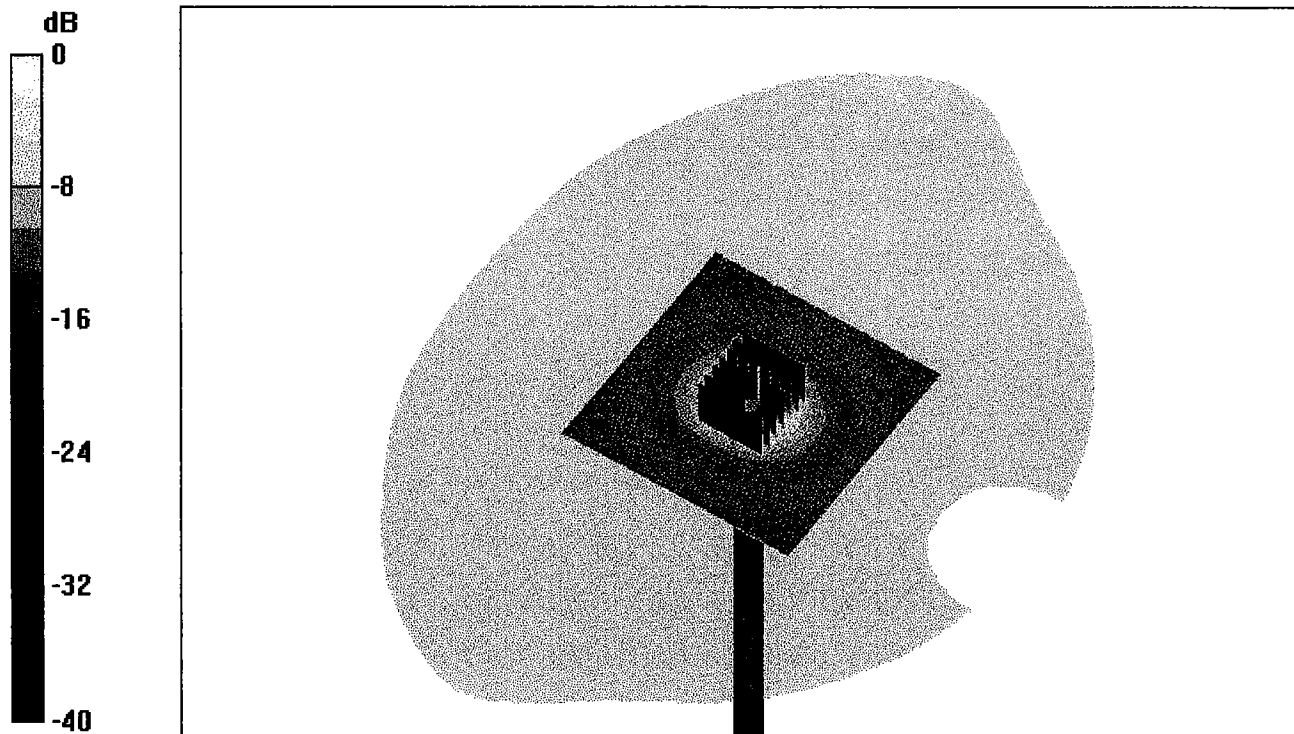
Peak SAR (extrapolated) = 80 W/kg

SAR(1 g) = 21 mW/g; SAR(10 g) = 5.9 mW/g

Reference Value = 87.7 V/m

Power Drift = -0.0 dB

Maximum value of SAR = 29.9 mW/g



0 dB = 29.9mW/g

## SPEAG Calibration Laboratory

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1007**

Communication System: CW-5GHz; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: MSL5800 ( $\sigma = 6.01$  mho/m,  $\epsilon_r = 48.51$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

## DASY4 Configuration:

- Probe: ES3DV3 - SN3025-Y2003; ConvF(1.65, 1.65, 1.65); Calibrated: 9/19/2003
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn410; Calibrated: 4/22/2003
- Phantom: SAM 12b; Type: SAM 4.0; Serial: TP:1197
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

**d=10mm, Pin=250mW, f=5800 MHz/Area Scan (91x91x1):** Measurement grid: dx=10mm, dy=10mm

Reference Value = 81.9 V/m

Power Drift = 0.0 dB

Maximum value of SAR = 30.5 mW/g

**d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=3mm (7x7x8)/Cube 0:** Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm

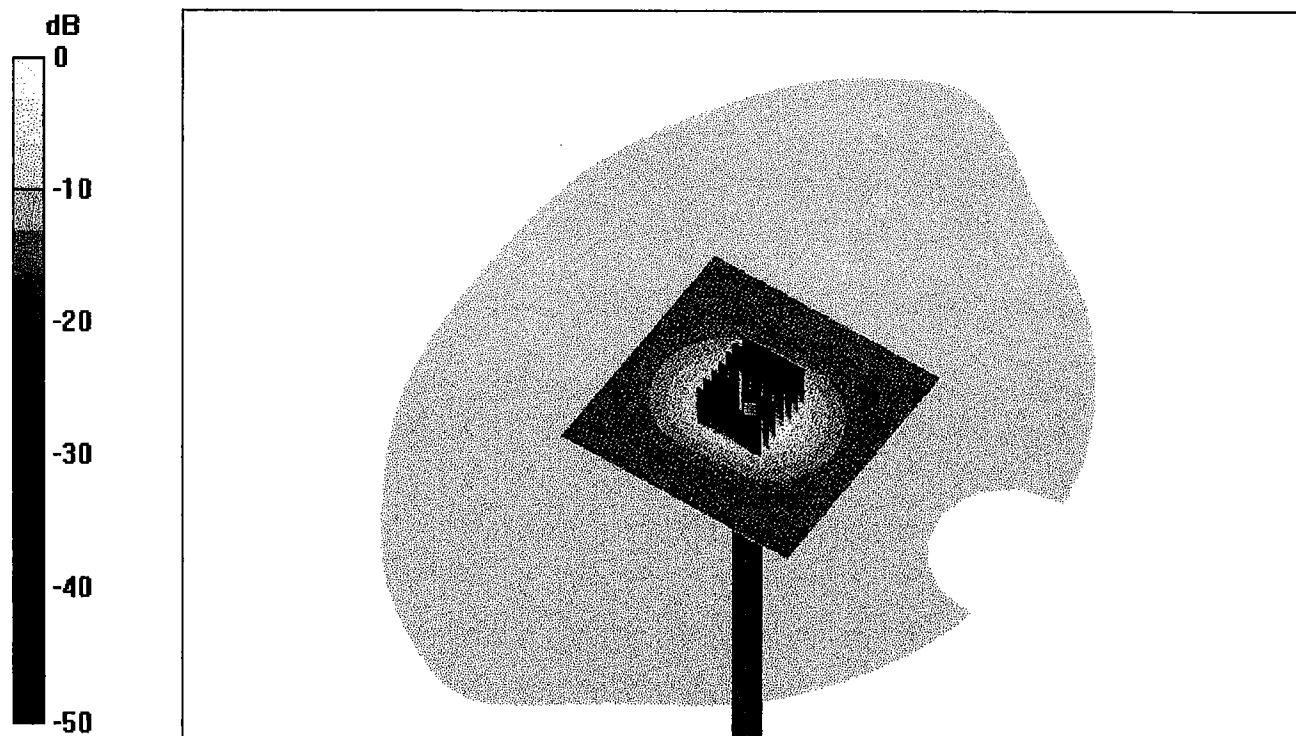
Peak SAR (extrapolated) = 84.3 W/kg

SAR(1 g) = 20.3 mW/g; SAR(10 g) = 5.61 mW/g

Reference Value = 81.9 V/m

Power Drift = 0.0 dB

Maximum value of SAR = 29.8 mW/g



0 dB = 29.8mW/g

my

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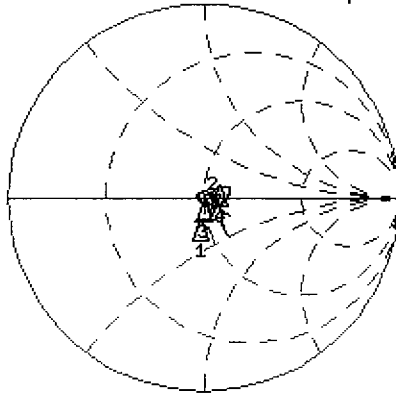
CH1 S11 1 U FS

2: 52.410  $\Omega$  -9.6367  $\Omega$  3.1761 pF

5 200.000 000 MHz

De1

Cor



CH1 Markers

1: 46.041  $\Omega$   
-11.779  $\Omega$   
5.10000 GHz

3: 49.055  $\Omega$   
-2.2852  $\Omega$   
5.50000 GHz

4: 57.572  $\Omega$   
6.1680  $\Omega$   
5.80000 GHz

↑

CH2 S11 LOG 5 dB/REF -20 dB 2:-20.295 dB 5 200.000 000 MHz

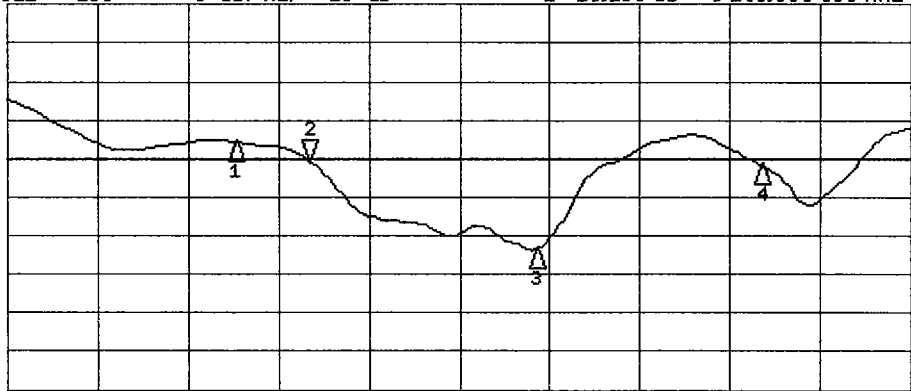
Smo

Cor

Avg

16

↑



START 4 800.000 000 MHz

STOP 6 000.000 000 MHz

CH2 Markers

1:-17.827 dB  
5.10000 GHz

3:-31.847 dB  
5.50000 GHz

4:-20.808 dB  
5.80000 GHz