

## 835MHz Brain Dipole Validation

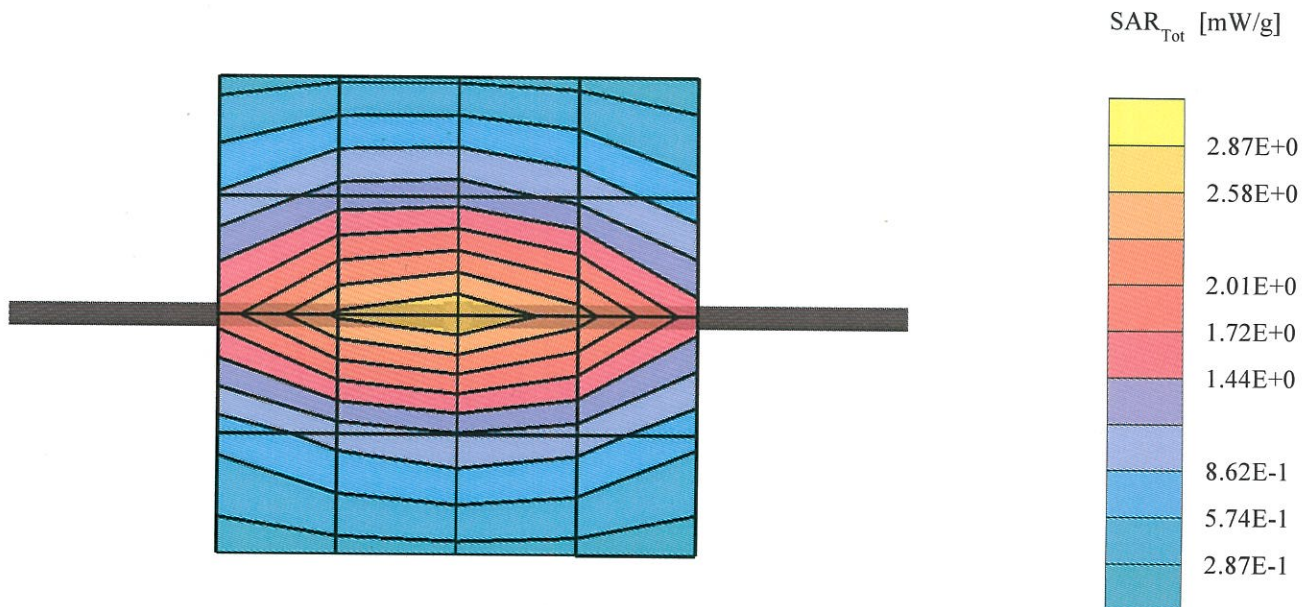
SAM(900MHz) Phantom; Flat Section; Probe: ET3DV6 - SN1735; ConvF(7.00,7.00,7.00)

Head 835 MHz:  $\sigma = 0.88$  mho/m  $\epsilon_r = 40.5$   $\rho = 1.00$  g/cm<sup>3</sup> Crest factor: 1.0;

SAR (1g): 2.53 mW/g

835MHz Brain Dipole Validation (D835V2 S/N:451)

Frequency: 835 MHz; Antenna Input Power: 250 [mW]; Ambient Temp. (°C) - 21.3; Tissue Temp. (°C) - 20.6  
Brain Tissue Simulating Liquid [05/24/2004]



## 1900MHz Brain Dipole Validation

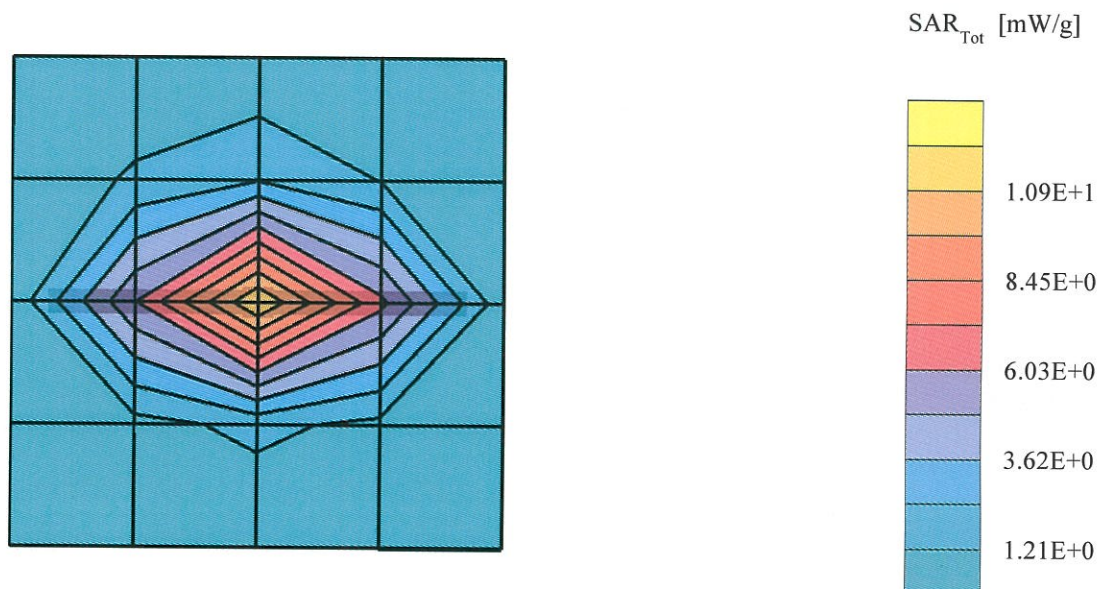
SAM(1800MHz) Phantom; Flat Section; Probe: ET3DV6 - SN1735; ConvF(5.60,5.60,5.60)

Head 1900 MHz:  $\sigma = 1.41$  mho/m  $\epsilon_r = 39.2$   $\rho = 1.00$  g/cm<sup>3</sup> Crest factor: 1.0;

SAR (1g): 9.94 mW/g

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

Frequency: 1900 MHz; Antenna Input Power: 250 [mW]; Ambient Temp. (°C) - 22.8; Tissue Temp. (°C) - 21.0  
Brain Tissue Simulating Liquid [05/25/2004]



Client

Samsung (Dymstec)

## CALIBRATION CERTIFICATE

Object(s)

D835V2 - SN.451

Calibration procedure(s)

QA CAL-05.v2

Calibration procedure for dipole validation kits

Calibration date:

November 18, 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 |

Calibrated by:

Name

Judith Mueller

Function

Technician

Signature

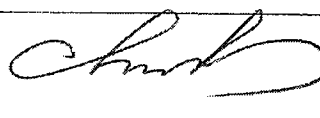
Approved by:

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.

checked by 

# DASY

## Dipole Validation Kit

Type: D835V2

Serial: 451

|               |                   |
|---------------|-------------------|
| Manufactured: | December 24, 2001 |
| Repaired:     | November 11, 2003 |
| Calibrated:   | November 18, 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>41.2</b>       | $\pm 5\%$ |
| Conductivity           | <b>0.88 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>9.32 mW/g</b> $\pm 16.8 \%$ (k=2) <sup>1</sup> |
| averaged over $10 \text{ cm}^3$ (10 g) of tissue: | <b>6.08 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>1.393 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.986</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 835 MHz: | $\text{Re}\{Z\} = $ | <b>51.6 <math>\Omega</math></b> |
|---------------------------------|---------------------|---------------------------------|

|  |                     |                                 |
|--|---------------------|---------------------------------|
|  | $\text{Im}\{Z\} = $ | <b>-0.9 <math>\Omega</math></b> |
|--|---------------------|---------------------------------|

|                        |                 |
|------------------------|-----------------|
| Return Loss at 835 MHz | <b>-35.0 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 - SN451**

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

Medium: HSL 835 MHz ( $\sigma = 0.88$  mho/m,  $\epsilon_r = 41.22$ ,  $\rho = 1000$  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 = 55.5 V/m

Power Drift = -0.007 dB

Maximum value of SAR = 2.51 mW/g

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

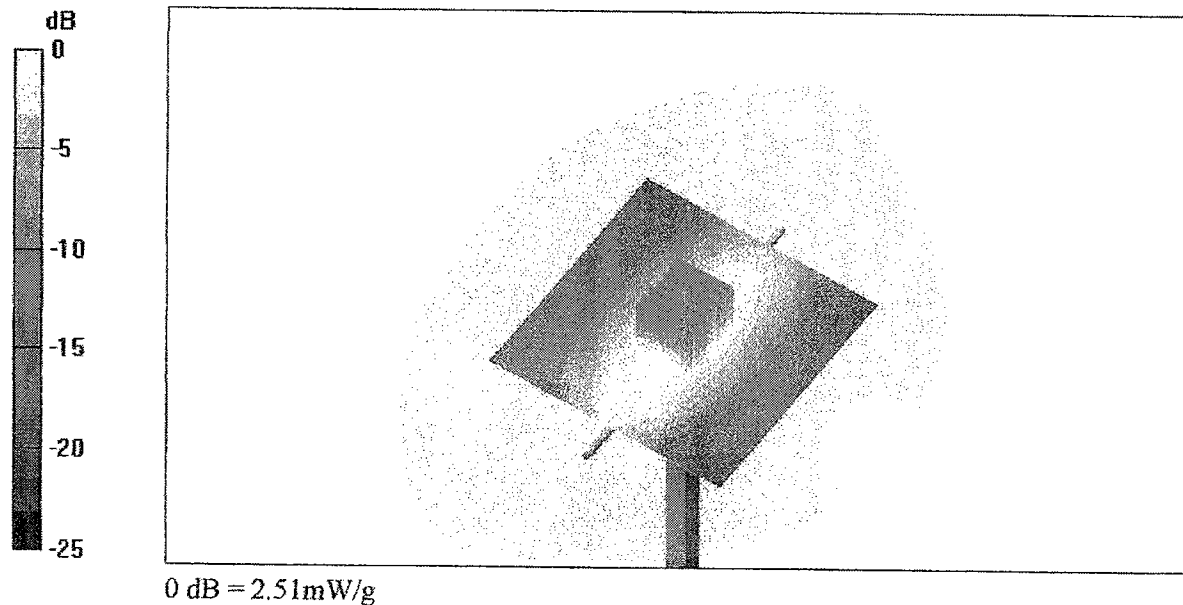
Peak SAR (extrapolated) = 3.5 W/kg

SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.52 mW/g

Reference Value = 55.5 V/m

Power Drift = -0.007 dB

Maximum value of SAR = 2.51 mW/g



18 Nov 2003 10:33:15

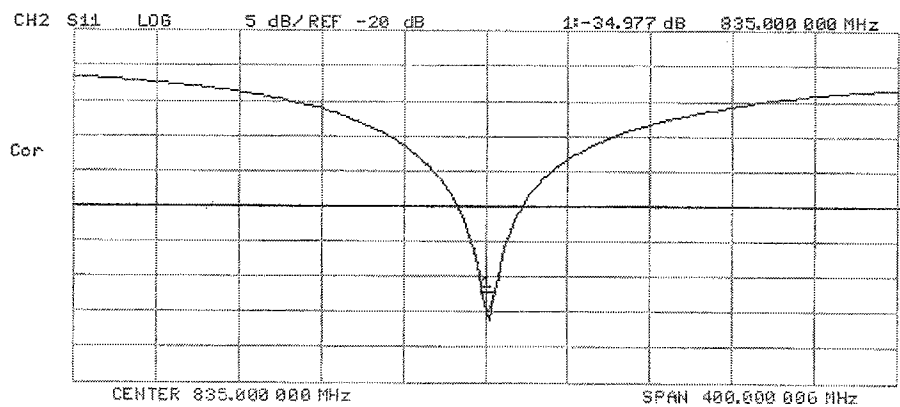
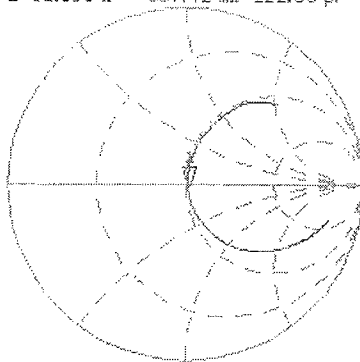
CH1 S11 1 U F3 1: 51.605  $\Omega$  -857.42  $\mu\Omega$  222.30 pF 835.000 000 MHz

De1

Cor

Avg

1E



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 |

Calibrated by:

Name  
Judith Mueller

Function  
Technician

Signature

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

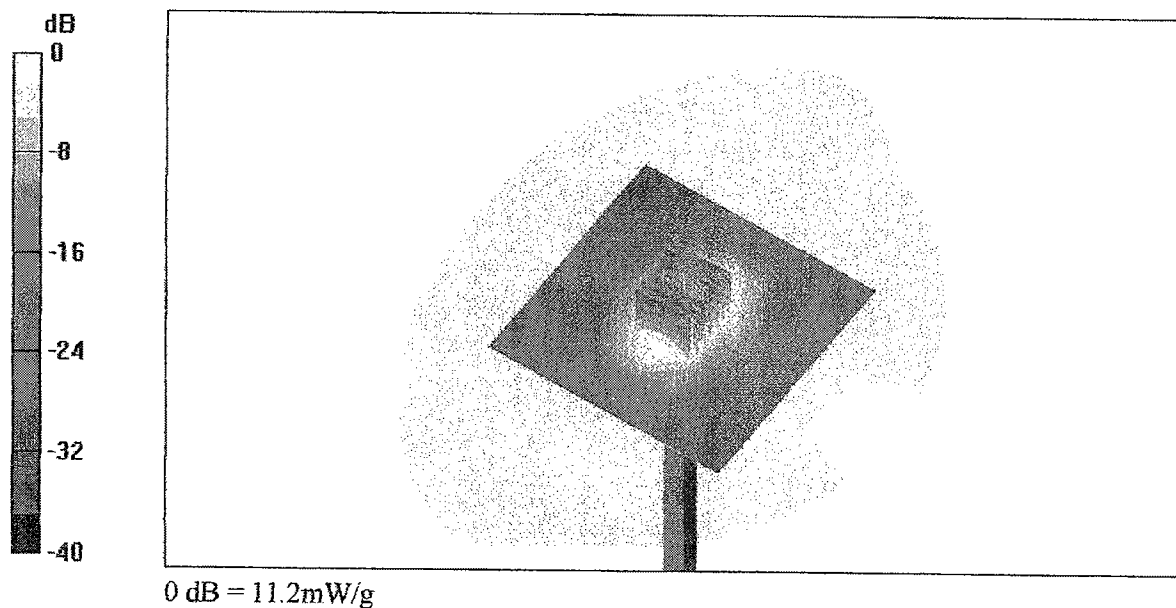
Peak SAR (extrapolated) = 17.6 W/kg

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



CH1 S11 1 U F9 1: 51.074  $\alpha$  3.7715  $\alpha$  315.92 pH 1 900.000 000 MHz

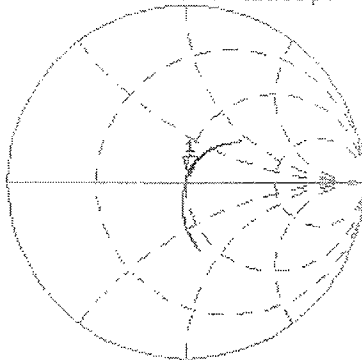
13 Nov 2003 10:34:34

Del

Cor

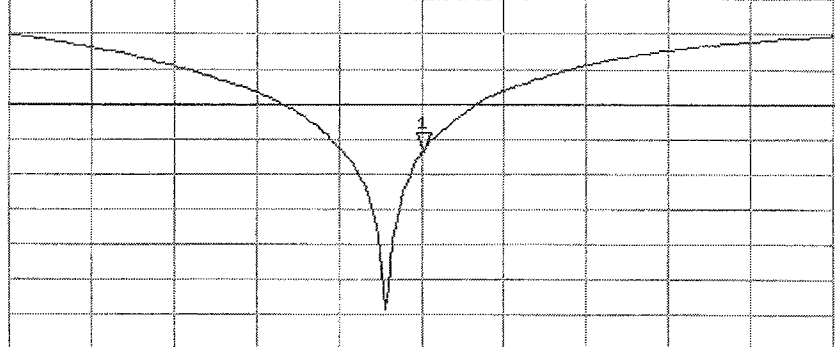
Avg

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