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

Client CCS, USA

CALIBRATION CERTIFICATE

Object(s)	D5GHzV2 - SN:1003
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	October 5, 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 E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03
RF generator R&S SMT06	100058	23-May-01 (SPEAG, in house check May-03)	In house check: May-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Niels Kuster	Quality Manager	

Date issued: October 6, 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.

Schmid & Partner Engineering AG

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DASY

Dipole Validation Kit

Type: D5GHzV2

Serial: 1003

Manufactured: July 8, 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:	**5200 MHz**	
Relative Dielectricity	**36.3**	± 5%
Conductivity	**4.57 mho/m**	± 5%
Frequency:	**5800 MHz**	
Relative Dielectricity	**35.4**	± 5%
Conductivity	**5.20 mho/m**	± 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=4.3mm, dz=3mm). Distance between probe sensors and phantom surface was set to 3.0 mm. The dipole input power (forward power) was 250mW ± 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 cm^3 (1 g) of tissue: **87.2 mW/g** ± 32.0 % (k=2)[1]

averaged over 10 cm^3 (10 g) of tissue: **24.3 mW/g** ± 31.7 % (k=2)[1]

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 cm^3 (1 g) of tissue: **89.6 mW/g** ± 32.0 % (k=2)[2]

averaged over 10 cm^3 (10 g) of tissue: **25.1 mW/g** ± 31.7 % (k=2)[2]

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[1] Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR_1g=76.5 mW/g, SAR_10g=21.6 mW/g and SAR_peak=310.3 mW/g

[2] Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR_1g=78.0 mW/g, SAR_10g=21.9 mW/g and SAR_peak=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:	**1.150 ns**	(one direction)
Transmission factor:	**0.963**	(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:	**5200 MHz**	
Relative Dielectricity	**49.7**	± 5%
Conductivity	**5.18 mho/m**	± 5%
Frequency:	**5800 MHz**	
Relative Dielectricity	**48.5**	± 5%
Conductivity	**6.01 mho/m**	± 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=4.3mm, dz=3mm). Distance between probe sensors and phantom surface was set to 3.0 mm. The dipole input power (forward power) was 250mW ± 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^3 (1 g) of tissue: **84.0 mW/g** ± 32.0 % (k=2)[3]

averaged over 10 cm^3 (10 g) of tissue: **23.5 mW/g** ± 31.7 % (k=2)[3]

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^3 (1 g) of tissue: **80.8 mW/g** ± 32.0 % (k=2)[4]

averaged over 10 cm^3 (10 g) of tissue: **22.8 mW/g** ± 31.7 % (k=2)[4]

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 1and 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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[3] 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

[4] 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

Date/Time: 10/04/03 15:02:12

SPEAG Calibration Laboratory

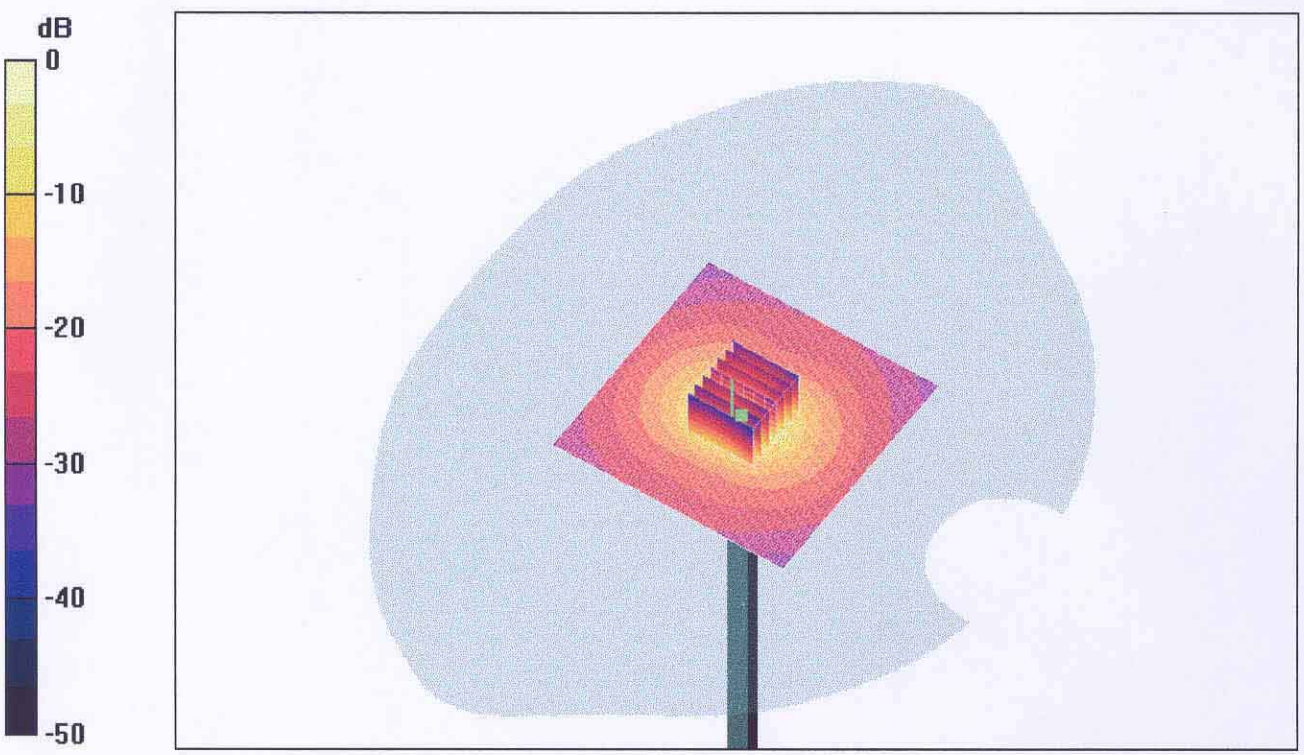
DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1003

Communication System: CW-5GHz; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: HSL5800 (σ = 4.57 mho/m, ε_r = 36.34, ρ = 1000 kg/m^3)
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 = 90.1 V/m
Power Drift = -0.1 dB
Maximum value of SAR = 33.9 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) = 96.6 W/kg
SAR(1 g) = 21.8 mW/g; SAR(10 g) = 6.08 mW/g
Reference Value = 90.1 V/m
Power Drift = -0.1 dB
Maximum value of SAR = 29.7 mW/g



0 dB = 29.7mW/g

Date/Time: 10/04/03 15:02:12

SPEAG Calibration Laboratory

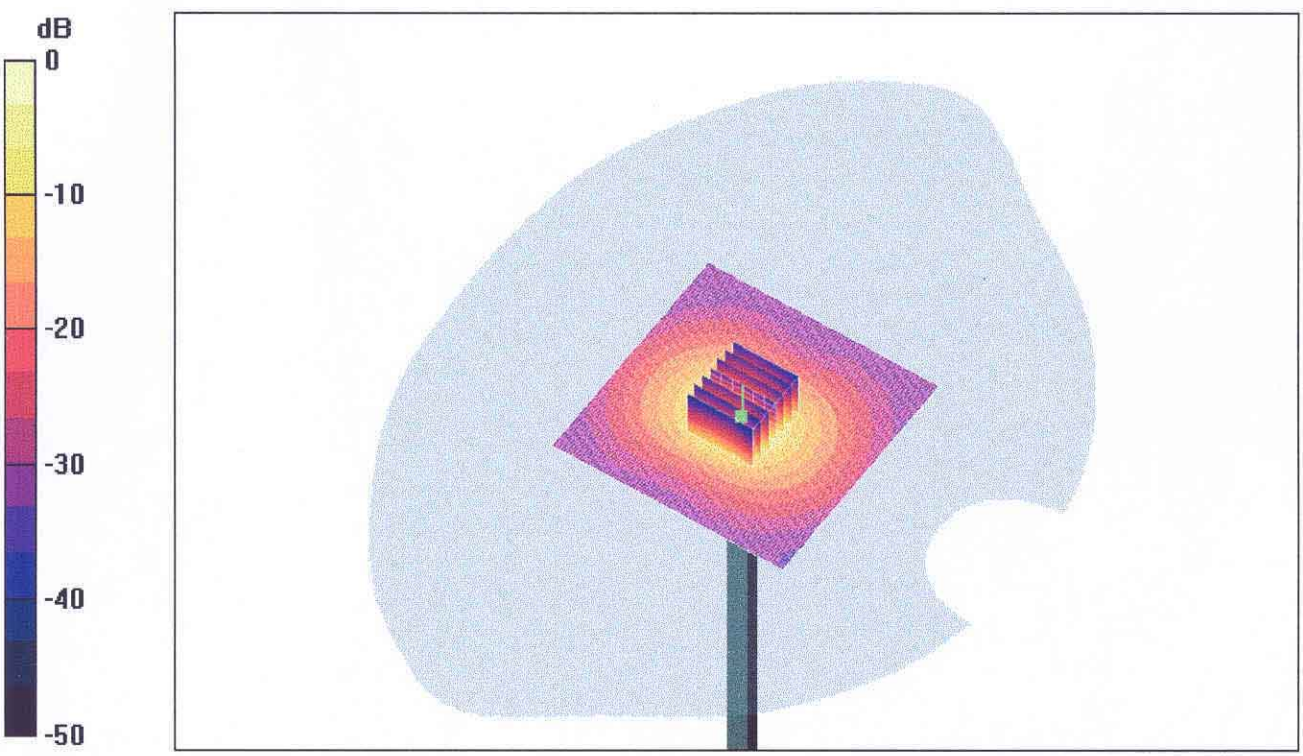
DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1003

Communication System: CW-5GHz; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: HSL5800 (σ = 5.2 mho/m, ε_r = 35.39, ρ = 1000 kg/m^3)
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

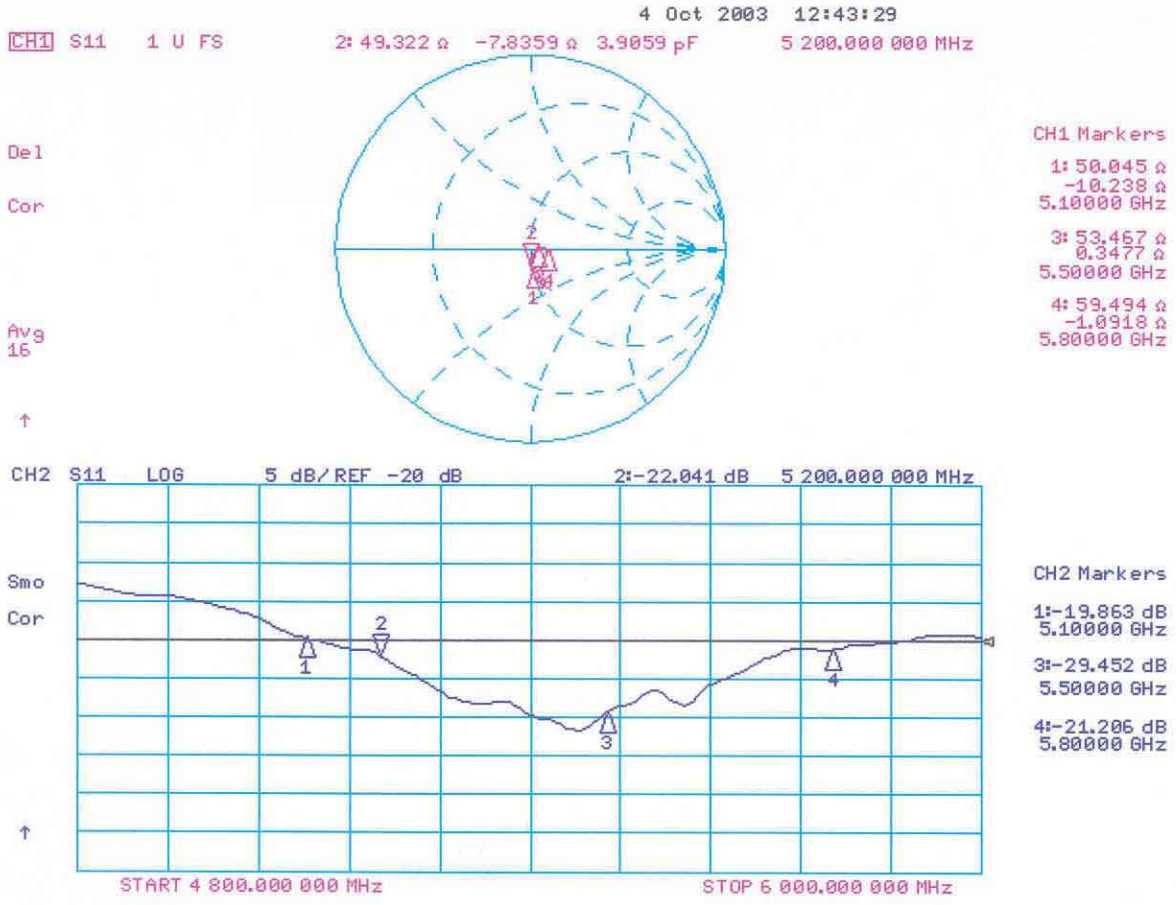
d=10mm, Pin=250mW, f=5800 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 85.1 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 33 mW/g

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) = 112.1 W/kg
SAR(1 g) = 22.4 mW/g; SAR(10 g) = 6.28 mW/g
Reference Value = 85.1 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 30.4 mW/g



0 dB = 30.4mW/g

1003
Head


4 Oct 2003 12:43:29
CH1 S11 1 U FS
2: 49.322 Ω -7.8359 Ω 3.9059 pF
5 200.000 000 MHz
Del
Cor
Avg
16
CH1 Markers
1: 50.045 Ω
-10.238 Ω
5.10000 GHz
3: 53.467 Ω
0.3477 Ω
5.50000 GHz
4: 59.494 Ω
-1.0918 Ω
5.80000 GHz
CH2 S11 LOG
5 dB/ REF -20 dB
2:-22.041 dB
5 200.000 000 MHz
Smo
Cor
CH2 Markers
1:-19.863 dB
5.10000 GHz
3:-29.452 dB
5.50000 GHz
4:-21.206 dB
5.80000 GHz
START 4 800.000 000 MHz
STOP 6 000.000 000 MHz

Date/Time: 10/05/03 13:40:38

SPEAG Calibration Laboratory

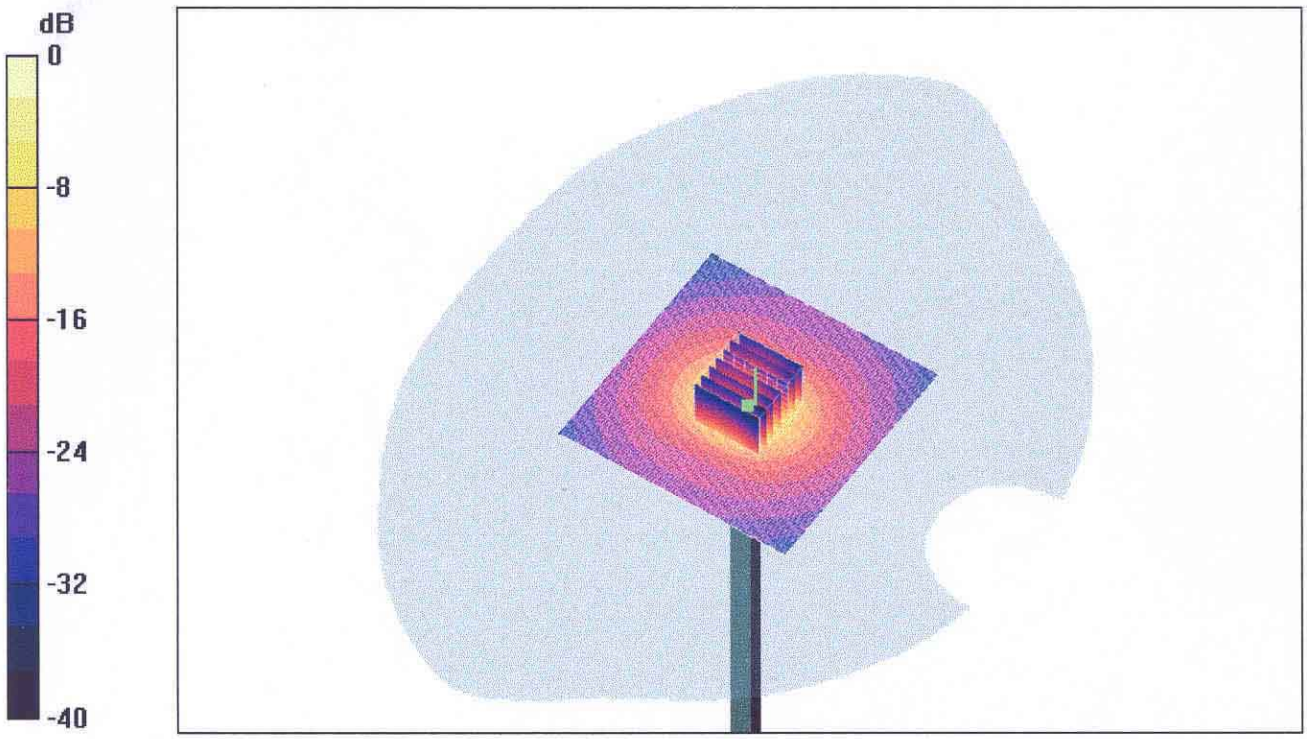
DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1003

Communication System: CW-5GHz; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL5800 (σ = 5.18 mho/m, ε_r = 49.73, ρ = 1000 kg/m^3)
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 = 89 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) = 81.2 W/kg
SAR(1 g) = 21 mW/g; SAR(10 g) = 5.87 mW/g
Reference Value = 89 V/m
Power Drift = -0.0 dB
Maximum value of SAR = 30.1 mW/g



0 dB = 30.1mW/g

Date/Time: 10/05/03 14:05:23

SPEAG Calibration Laboratory

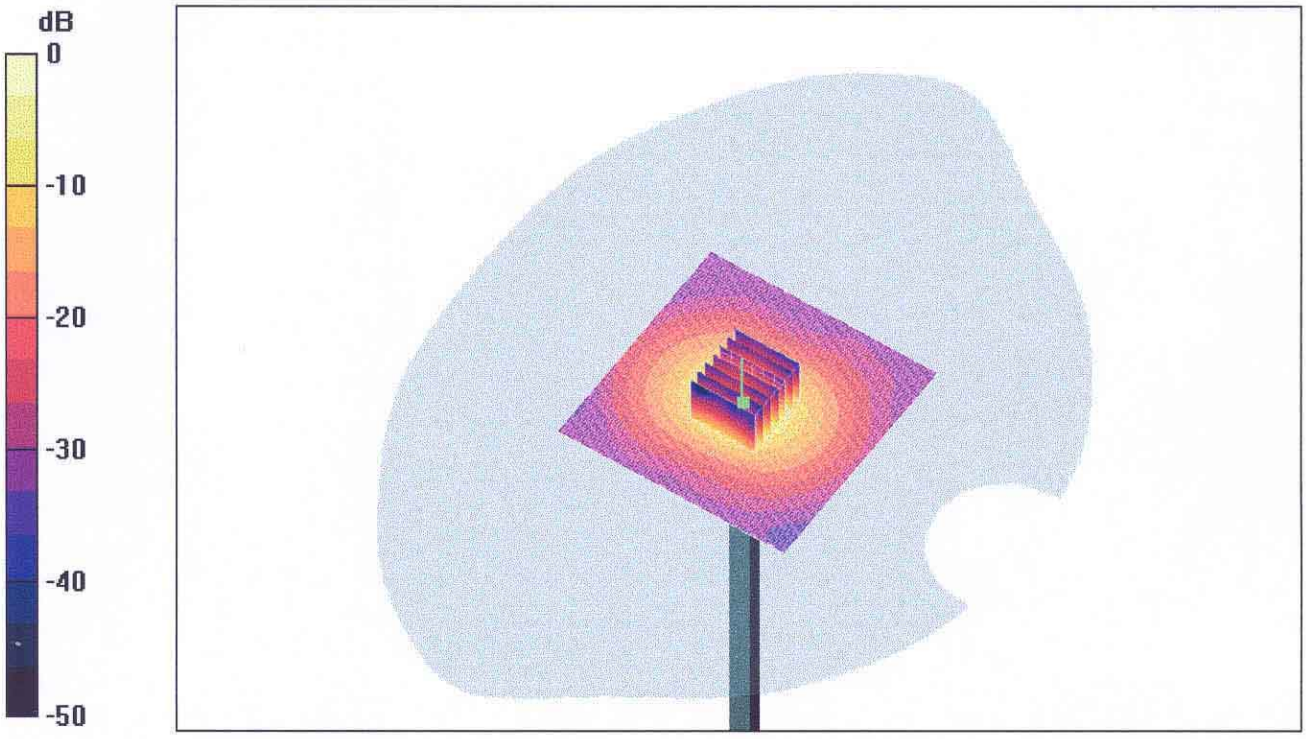
DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1003

Communication System: CW-5GHz; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL5800 (σ = 6.01 mho/m, ε_r = 48.51, ρ = 1000 kg/m^3)
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

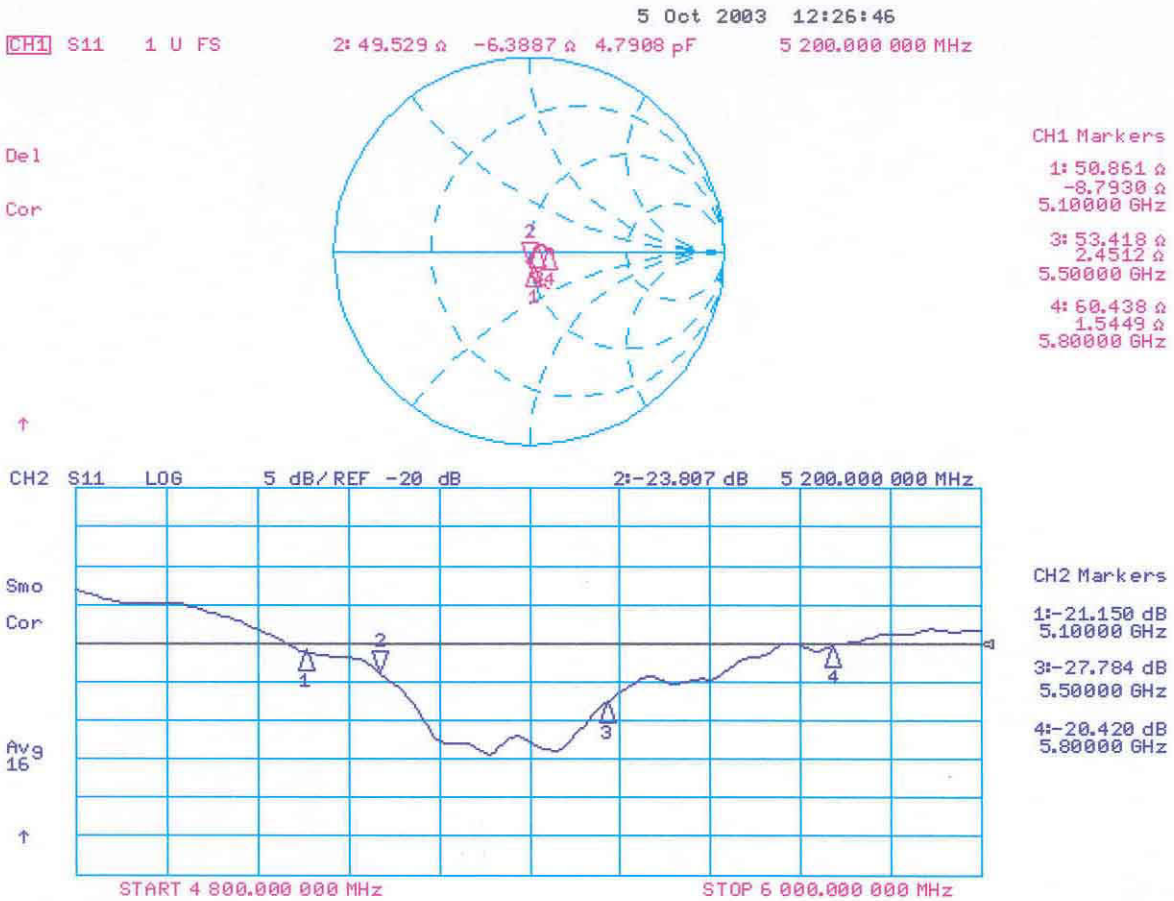
d=10mm, Pin=250mW, f=5800 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 80.2 V/m
Power Drift = -0.0 dB
Maximum value of SAR = 32.3 mW/g

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) = 81.5 W/kg
SAR(1 g) = 20.2 mW/g; SAR(10 g) = 5.69 mW/g
Reference Value = 80.2 V/m
Power Drift = -0.0 dB
Maximum value of SAR = 29.4 mW/g



0 dB = 29.4mW/g

1003
Body


5 Oct 2003 12:26:46
CH1 S11 1 U FS
2: 49.529 Ω -6.3887 Ω 4.7908 pF
5 200.000 000 MHz
Del
Cor
CH1 Markers
1: 50.861 Ω
-8.7930 Ω
5.10000 GHz
3: 53.418 Ω
2.4512 Ω
5.50000 GHz
4: 60.438 Ω
1.5449 Ω
5.80000 GHz
CH2 S11 LOG
5 dB/ REF -20 dB
2:-23.807 dB
5 200.000 000 MHz
Smo
Cor
Avg
16
CH2 Markers
1:-21.150 dB
5.10000 GHz
3:-27.784 dB
5.50000 GHz
4:-20.420 dB
5.80000 GHz
START 4 800.000 000 MHz
STOP 6 000.000 000 MHz