APPENDIX F - SYSTEM VALIDATION

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

Client **Celltech**

CALIBRATION CERTIFICATE

Object(s) D5GHzV2 - SN:1031

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

Calibration date: January 11, 2005

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

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator R&S SMT06	100058	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Fin Bomholt	R&D Director	

Issued: January 14, 2005

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: 1031

Manufactured: July 9, 2004
Calibrated: January 11, 2005

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	**36.5**	± 5%
Conductivity	**4.64 mho/m**	± 5%
Frequency:	**5500 MHz**	
Relative Dielectricity	**35.9**	± 5%
Conductivity	**4.97 mho/m**	± 5%
Frequency:	**5800 MHz**	
Relative Dielectricity	**35.4**	± 5%
Conductivity	**5.28 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe EX3DV3 - SN:3503 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 2.0 mm. The dipole input power (forward power) was 250 mW ± 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 EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **81.2 mW/g** ± 20.3 % (k=2)[1]

averaged over 10 cm^3 (10 g) of tissue: **22.8 mW/g** ± 19.8 % (k=2)[1]

[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.

The resulting averaged SAR-values measured **at 5500 MHz (Head Tissue)** with the dosimetric probe EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **84.8 mW/g** ± 20.3 % $(k=2)^2$

averaged over 10 cm^3 (10 g) of tissue: **23.6 mW/g** ± 19.8 % $(k=2)^2$

The resulting averaged SAR-values measured **at 5800 MHz (Head Tissue)** with the dosimetric probe EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **79.2 mW/g** ± 20.3 % $(k=2)^3$

averaged over 10 cm^3 (10 g) of tissue: **22.3 mW/g** ± 19.8 % $(k=2)^3$

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:	**1.196 ns**	(one direction)
Transmission factor:	**0.955**	(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	**48.6**	± 5%
Conductivity	**5.17 mho/m**	± 5%

Frequency:	**5500 MHz**	
Relative Dielectricity	**48.0**	± 5%
Conductivity	**5.55 mho/m**	± 5%

Frequency:	**5800 MHz**	
Relative Dielectricity	**47.4**	± 5%
Conductivity	**5.95 mho/m**	± 5%

[2] Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR_1g=83.3 mW/g, SAR_10g=23.4 mW/g and SAR_peak=349.4 mW/g.

[3] 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.

The DASY4 System with a dosimetric E-field probe EX3DV3 - SN:3503 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 2.0 mm. The dipole input power (forward power) was 250 mW ± 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 EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **80.0 mW/g** ± 20.3 % (k=2)[4]

averaged over 10 cm^3 (10 g) of tissue: **22.4 mW/g** ± 19.8 % (k=2)[4]

The resulting averaged SAR-values measured **at 5500 MHz (Body Tissue)** with the dosimetric probe EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **78.8 mW/g** ± 20.3 % (k=2)[5]

averaged over 10 cm^3 (10 g) of tissue: **21.8 mW/g** ± 19.8 % (k=2)[5]

The resulting averaged SAR-values measured **at 5800 MHz (Body Tissue)** with the dosimetric probe EX3DV3 SN:3503 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue: **73.6 mW/g** ± 20.3 % (k=2)[6]

averaged over 10 cm^3 (10 g) of tissue: **20.5 mW/g** ± 19.8 % (k=2)[6]

[4] 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.
[5] Target dipole values determined by FDTD (feedpoint impedance set to 50 Ohm). The values are SAR_1g=79.1 mW/g, SAR_10g=22.0 mW/g and SAR_peak=326.3 mW/g.
[6] 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.

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.

Date/Time: 01/11/05 11:57:53

SPEAG Calibration Laboratory

DUT: Dipole 5GHz; Serial: D5GHzV2 - SN:1031

DASY4 Configuration:

- Communication System: CW-5GHz; Frequency: 5200 MHzFrequency: 5800 MHzFrequency: 5500 MHz; Duty Cycle: 1:1
- Probe: EX3DV3 - SN3503; ConvF(5.7, 5.7, 5.7)ConvF(5, 5, 5); Calibrated: 1/8/2005
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Medium: HSL5800; Medium parameters used: f = 5200 MHz; σ = 4.64 mho/m; ε_r = 36.5; ρ = 1000 kg/m^3 Medium parameters used: f = 5800 MHz; σ = 5.28 mho/m; ε_r = 35.4; ρ = 1000 kg/m^3 Medium parameters used: f = 5500 MHz; σ = 4.97 mho/m; ε_r = 35.9; ρ = 1000 kg/m^3

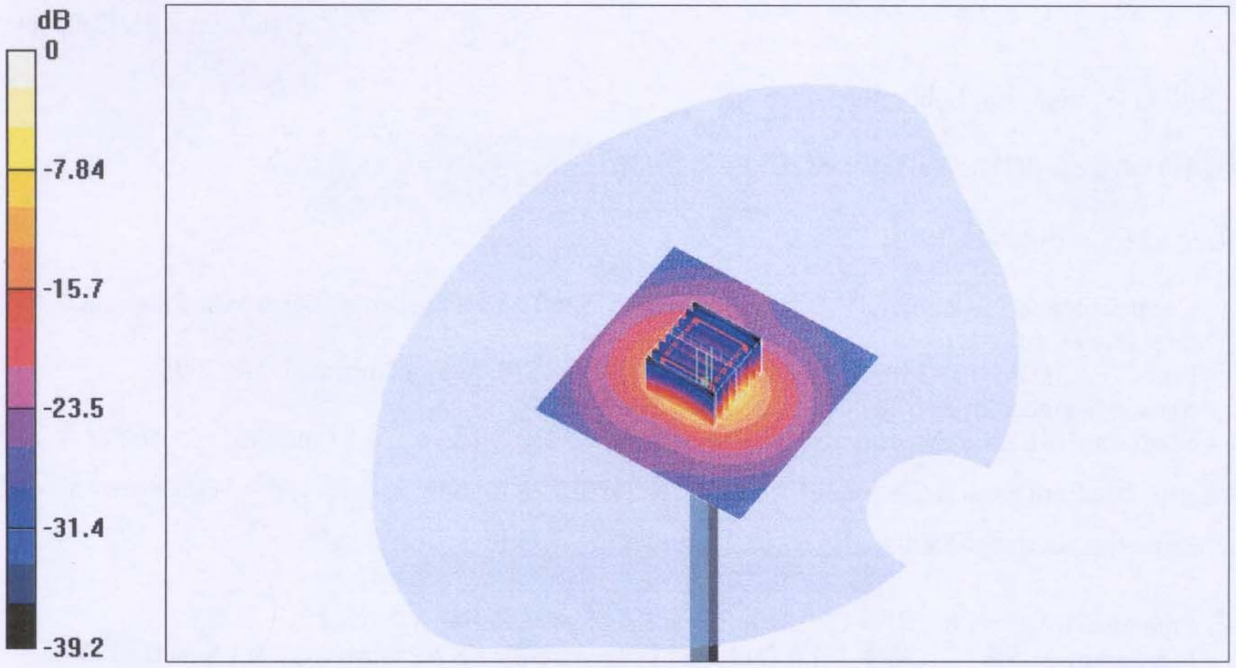
- Phantom: SAM with CRP - TP:1312; Type: SAM v4.0; Serial: TP:1312
- Measurement SW: DASY4, V4.4 Build 10; Postprocessing SW: SEMCAD, V1.8 Build 133

d=10mm, Pin=250mW, f=5200 MHz 2/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 43.3 mW/g

d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 78.3 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 85.1 W/kg
SAR(1 g) = 19.8 mW/g; SAR(10 g) = 5.57 mW/g
Maximum value of SAR (measured) = 39.8 mW/g

d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 84.1 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 86.2 W/kg
SAR(1 g) = 21.2 mW/g; SAR(10 g) = 5.91 mW/g
Maximum value of SAR (measured) = 41 mW/g

d=10mm, Pin=250mW, f=5200 MHz 2/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 85.4 V/m; Power Drift = 0.0 dB
Peak SAR (extrapolated) = 79.4 W/kg
SAR(1 g) = 20.3 mW/g; SAR(10 g) = 5.7 mW/g
Maximum value of SAR (measured) = 39.4 mW/g



0 dB = 39.4mW/g

Date/Time: 01/11/05 18:28:50

SPEAG Calibration Laboratory

DUT: Dipole 5GHz; Serial: D5GHzV2 - SN:1031

DASY4 Configuration:

- Communication System: CW-5GHz; Frequency: 5200 MHzFrequency: 5800 MHzFrequency: 5500 MHz; Duty Cycle: 1:1
- Probe: EX3DV3 - SN3503; ConvF(5, 5, 5)ConvF(4.6, 4.6, 4.6); Calibrated: 1/8/2005
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Medium: MSL5800; Medium parameters used: f = 5200 MHz; σ = 5.17 mho/m; ε_r = 48.6; ρ = 1000 kg/m^3 Medium parameters used: f = 5800 MHz; σ = 5.95 mho/m; ε_r = 47.4; ρ = 1000 kg/m^3 Medium parameters used: f = 5500 MHz; σ = 5.55 mho/m; ε_r = 48; ρ = 1000 kg/m^3

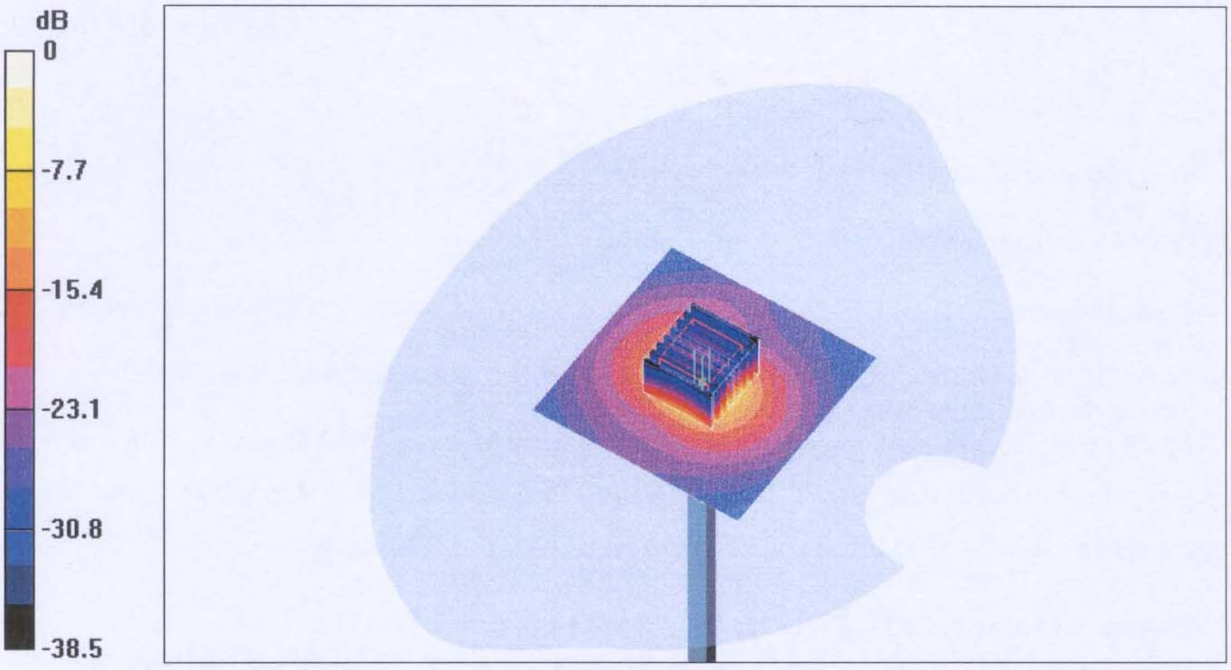
- Phantom: SAM with CRP - TP:1312; Type: SAM v4.0; Serial: TP:1312
- Measurement SW: DASY4, V4.4 Build 10; Postprocessing SW: SEMCAD, V1.8 Build 133

d=10mm, Pin=250mW, f=5200 MHz 2/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 41 mW/g

d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 71.2 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 77 W/kg
SAR(1 g) = 18.4 mW/g; SAR(10 g) = 5.13 mW/g
Maximum value of SAR (measured) = 35.6 mW/g

d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 76 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 77.9 W/kg
SAR(1 g) = 19.7 mW/g; SAR(10 g) = 5.44 mW/g
Maximum value of SAR (measured) = 37.9 mW/g

d=10mm, Pin=250mW, f=5200 MHz 2/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm
Reference Value = 79.9 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 73.5 W/kg
SAR(1 g) = 20 mW/g; SAR(10 g) = 5.6 mW/g
Maximum value of SAR (measured) = 38.4 mW/g

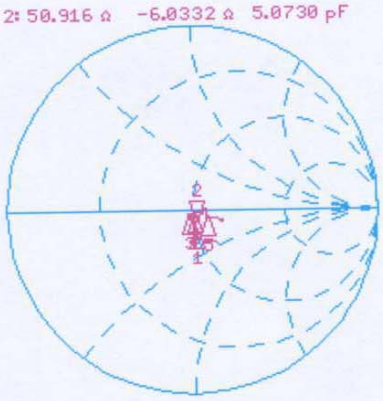


0 dB = 38.4mW/g

1031
Head

12 Jul 2004 10:53:35

CH1 S11 1 U FS 2: 50.916 Ω -6.0332 Ω 5.0730 pF 5 200.000 000 MHz

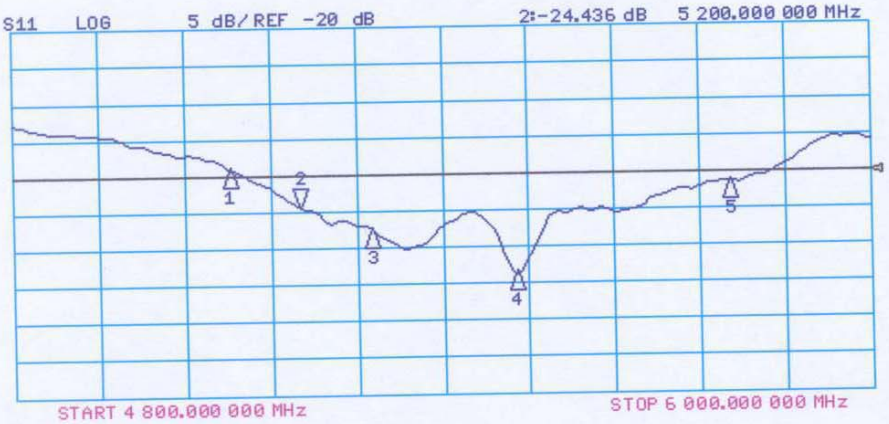


Del
Smo
Cor

Avg
16

CH1 Markers
1: 49.930 Ω
-11.264 Ω
5.10000 GHz
3: 47.152 Ω
-3.0586 Ω
5.30000 GHz
4: 50.043 Ω
-2.0957 Ω
5.50000 GHz
5: 57.963 Ω
-4.8223 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/ REF -20 dB 2:-24.436 dB 5 200.000 000 MHz



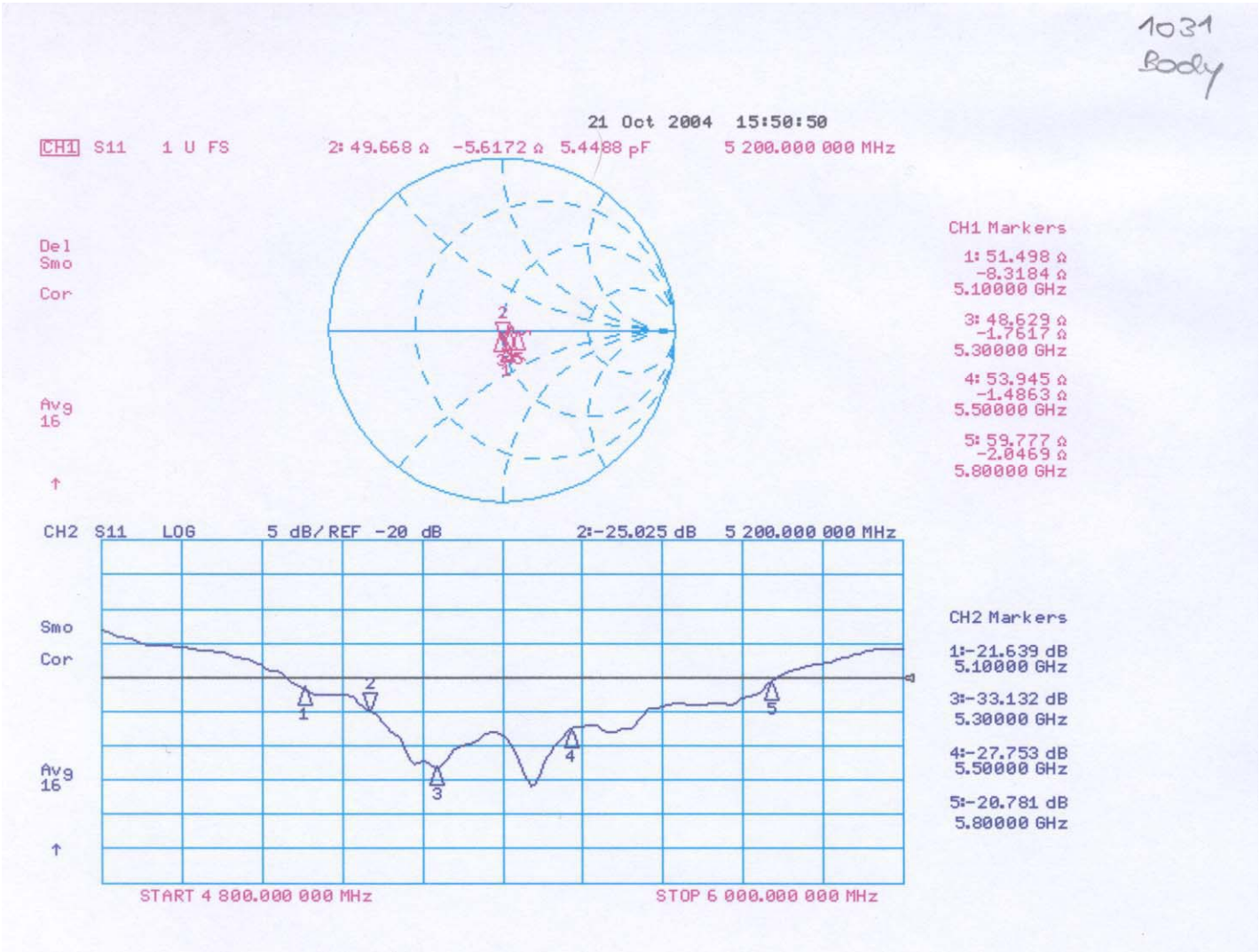
Smo
Cor

Avg
16

CH2 Markers
1:-19.046 dB
5.10000 GHz
3:-27.480 dB
5.30000 GHz
4:-33.587 dB
5.50000 GHz
5:-21.271 dB
5.80000 GHz

START 4 800.000 000 MHz STOP 6 000.000 000 MHz

1031
Body


21 Oct 2004 15:50:50
CH1 S11 1 U FS
2: 49.668 Ω -5.6172 Ω 5.4488 pF
5 200.000 000 MHz
Del
Smo
Cor
Avg
16
CH1 Markers
1: 51.498 Ω
-8.3184 Ω
5.10000 GHz
3: 48.629 Ω
-1.7617 Ω
5.30000 GHz
4: 53.945 Ω
-1.4863 Ω
5.50000 GHz
5: 59.777 Ω
-2.0469 Ω
5.80000 GHz
CH2 S11 LOG 5 dB/ REF -20 dB
2:-25.025 dB 5 200.000 000 MHz
Smo
Cor
Avg
16
CH2 Markers
1:-21.639 dB
5.10000 GHz
3:-33.132 dB
5.30000 GHz
4:-27.753 dB
5.50000 GHz
5:-20.781 dB
5.80000 GHz
START 4 800.000 000 MHz
STOP 6 000.000 000 MHz