Appendix A

Calibration Certificate

Note:

ETS Dr. Genz GmbH has extended the calibration interval for SPEAG System Validation Dipoles up to two years above the two years recommended by manufacturer. The determination of individual calibrations interval is covered and defined by ETS internal quality management procedures according EN 17025. This QM procedures are acknowledged by accreditation bodies mentioned on page 3 of this test report.

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

900 MHz System Validation Dipole

Type:	**D900V2**
Serial Number:	**164**
Place of Calibration:	**Zurich**
Date of Calibration:	**September 5, 2002**
Calibration Interval:	**24 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	N.Vetter
Approved by:	[illegible]

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D900V2

Serial: 164

Manufactured: April 30, 2002
Calibrated: September 5, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating solution of the following electrical parameters at 900 MHz:

Relative Dielectricity	**40.6**	± 5%
Conductivity	**0.95 mho/m**	± 5%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.5 at 900 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 holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 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 cm^3 (1 g) of tissue:	**10.2 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**6.56 mW/g**

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:	**1.408 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 900 MHz:	Re{Z} = **50.7 Ω**
	Im {Z} = **-5.2 Ω**
Return Loss at 900 MHz	**-25.7 dB**

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

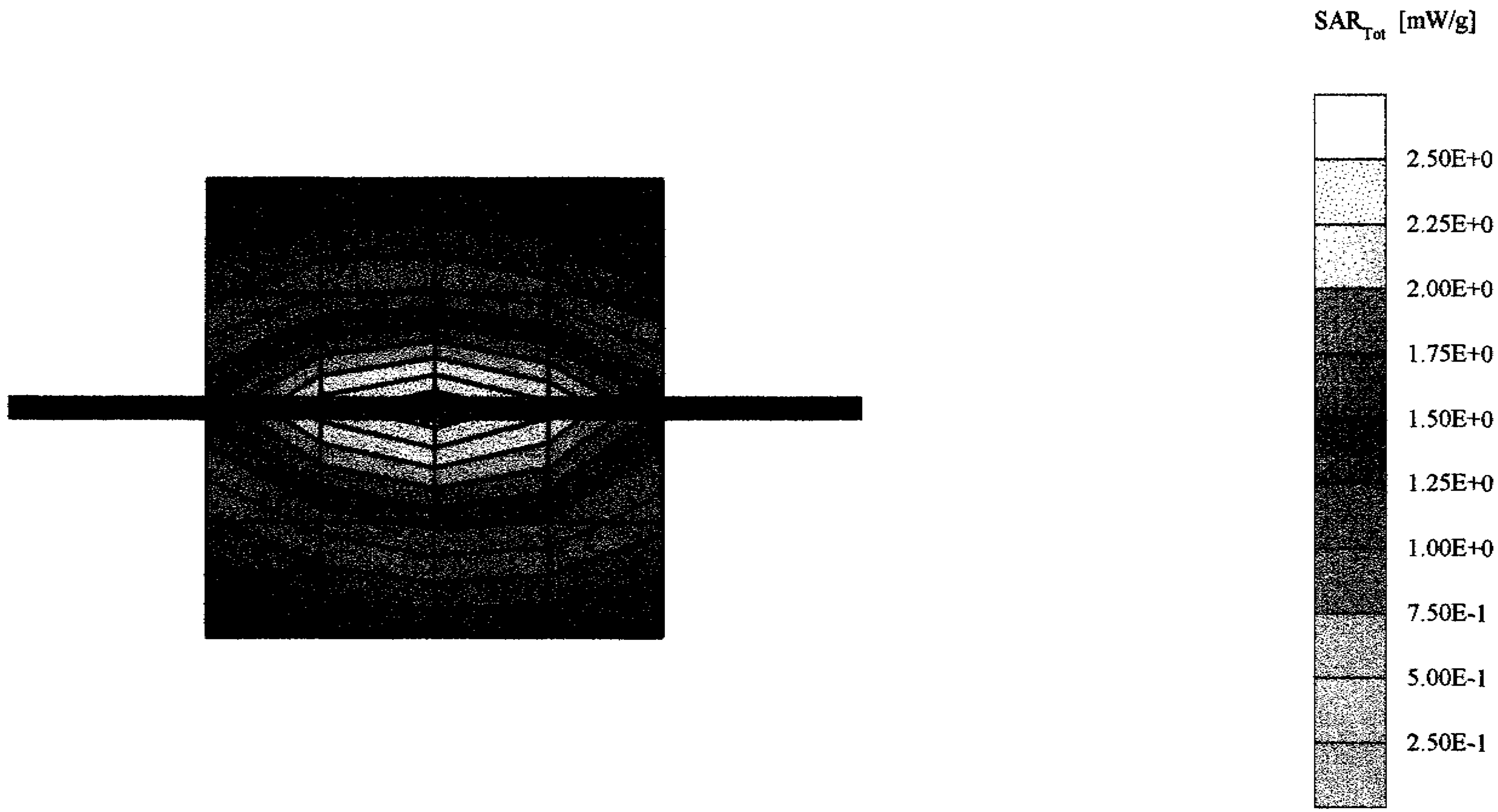
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

6. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

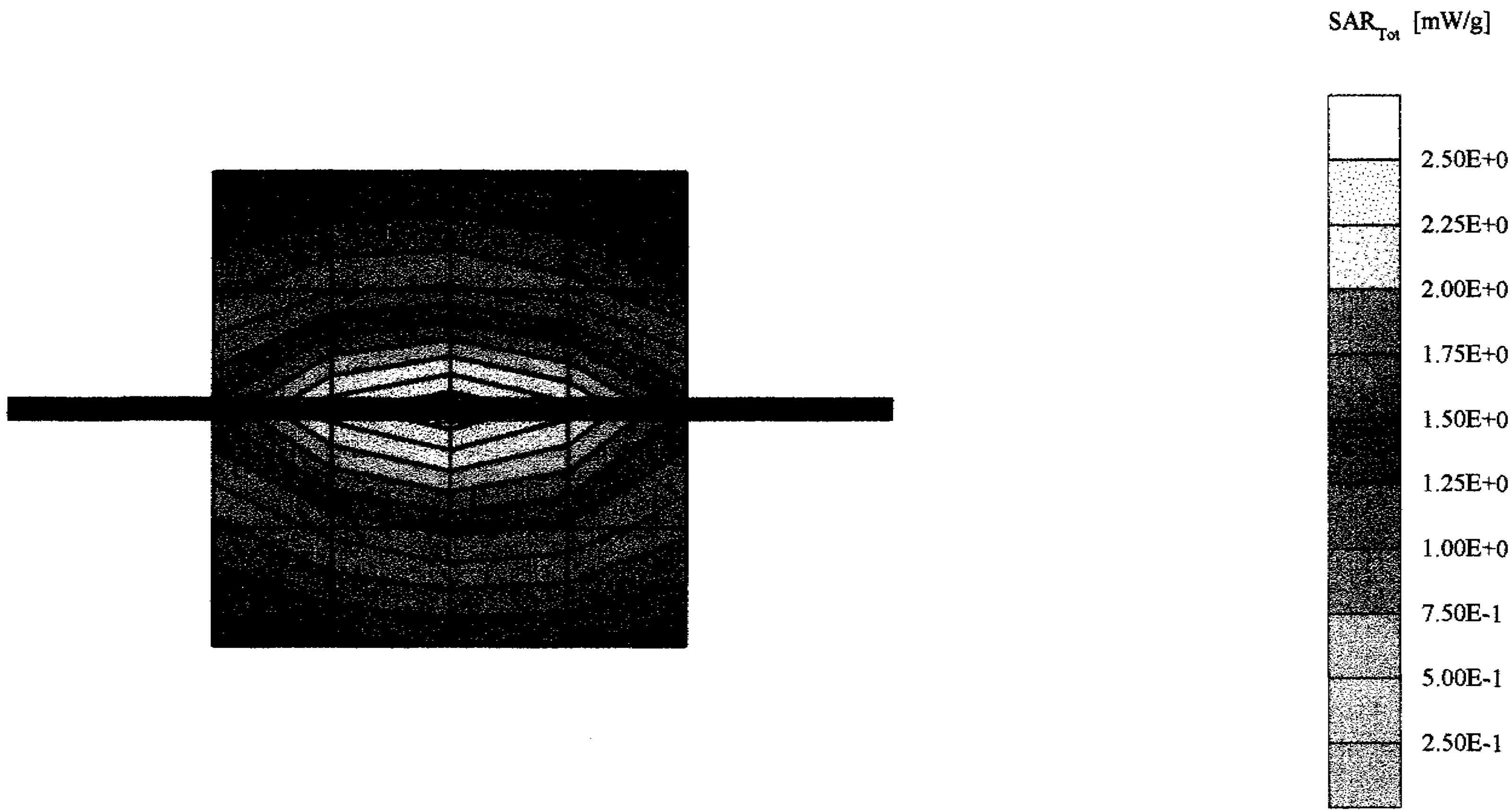
Validation Dipole D900V2 SN:164, d=15 mm

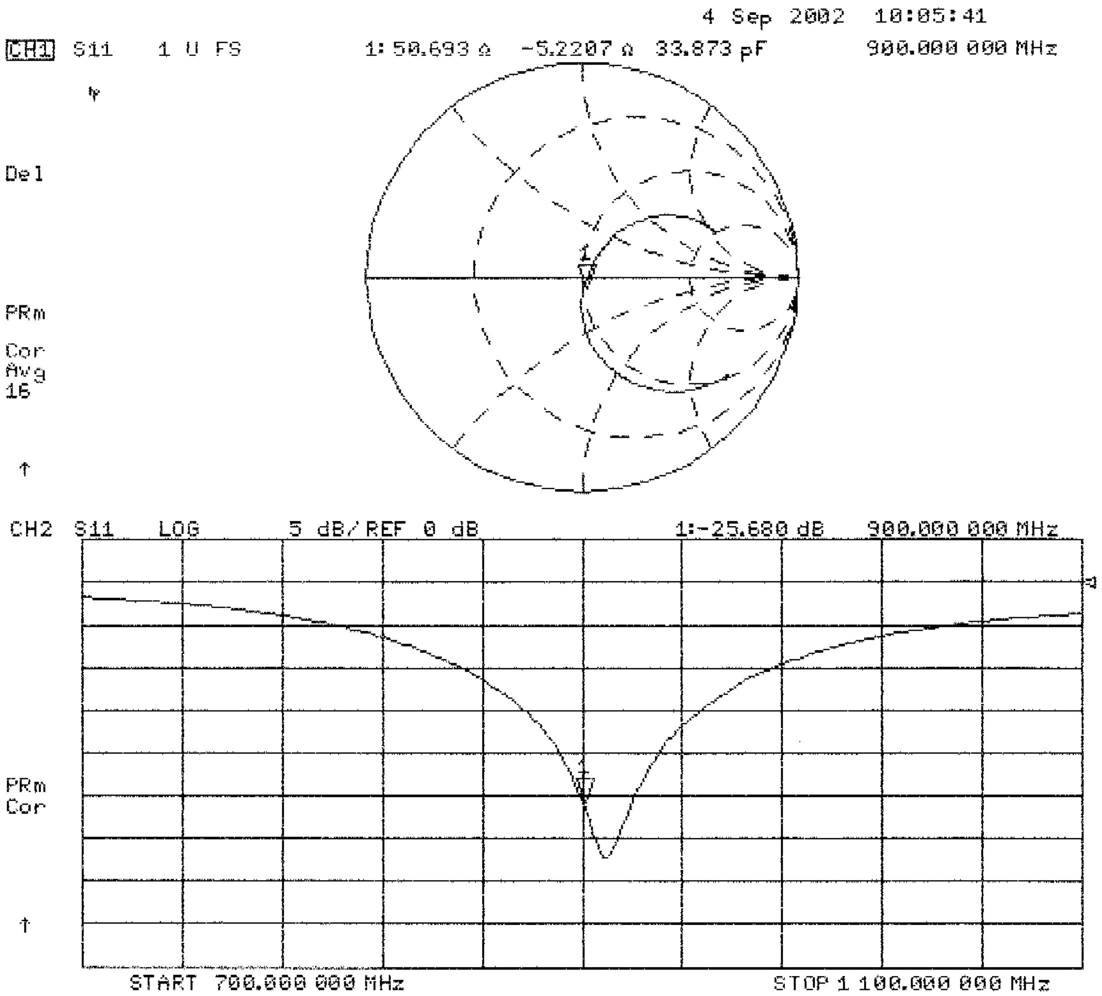
Frequency: 900 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.50,6.50,6.50) at 900 MHz; IEEE 1528 900 MHz: σ = 0.95 mho/m ε_r = 40.6 ρ = 1.00 g/cm^3
Cubes (2): Peak: 3.80 mW/g ± 0.03 dB, SAR (1g): 2.54 mW/g ± 0.03 dB, SAR (10g): 1.64 mW/g ± 0.02 dB, (Advanced extrapolation)
Penetration depth: 12.5 (12.3, 13.0) [mm]
Powerdrift: -0.01 dB



Validation Dipole D900V2 SN:164, d=15 mm

Frequency: 900 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.50,6.50,6.50) at 900 MHz; IEEE 1528 900 MHz: $\sigma = 0.95$ mho/m $\varepsilon_r = 40.6$ $\rho = 1.00$ g/cm^3
Cubes (2): Peak: 4.29 mW/g ± 0.03 dB, SAR (1g): 2.71 mW/g ± 0.03 dB, SAR (10g): 1.72 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 11.6 (10.7, 12.8) [mm]
Powerdrift: -0.01 dB




4 Sep 2002 10:05:41
CH1 S11 1 U FS
1: 50.693 Ω -5.2207 Ω 33.873 pF
900.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-25.680 dB 900.000 000 MHz
PRm
Cor
START 700.000 000 MHz
STOP 1 100.000 000 MHz

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

D2: 900MHz SYSTEM VALIDATION DIPOLE

CALIBRATION CERTIFICATE

900 MHz System Validation Dipole (Muscle)

Type:	**D900V2**
Serial Number:	**164**
Place of Calibration:	**Reichenwalde**
Date of Calibration:	**September 05, 2003**
Calibration Interval:	**24 month**

ETS Dr. Genz GmbH hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of ETS Dr. Genz GmbH.

Wherever applicable, the standards used in the calibration process are traceable to International standards.

Calibrated by:	**W. Treffke**
Approved by:	**K. Damm**

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

DASY

DIPOLE VALIDATION KIT

Type: **D900V2**

Serial: **164**

Manufactured : April 30, 2002
Calibrated : September 05, 2003

Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with body simulating solution of the following electrical parameters at 900 MHz:

Relative permittivity	54.41	+/- 5 %
Conductivity	1.038 mho/m	+/- 10 %

The DASY System with a dosimetric E-field probe ET3DV6 (SN: 1711, conversion factor 6.2 at 900 MHz body) was used for the measurements.

The dipole feed-point was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm 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 5 mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250 mW +/- 3 %. The results are normalized to 1 W input power.

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 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1711 and applying the advanced extrapolation are:

Averaged over 1 cm3 (1 g) of tissue: 11.2 mW/g

Averaged over 10 cm3 (10 g) of tissue: 7.16 mW/g

Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (Measurement conditions) (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feed-point impedance at 900 MHz: Re {Z} = 54.3 Ω

Im {Z} = -3.2 Ω

Return Loss at 900 MHz: - 23.6 dB

Date/Time: 09/05/03 13:33:02

Test Laboratory: ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH
File Name: Dipol Calibr.900 (m) 250mW.da4

Dipol Calibr.900 (m) 250mW

DUT: Dipole 900 MHz; Type: D900V2; Serial: SN: 164
Program: Dipol Calibration 900 Muscle

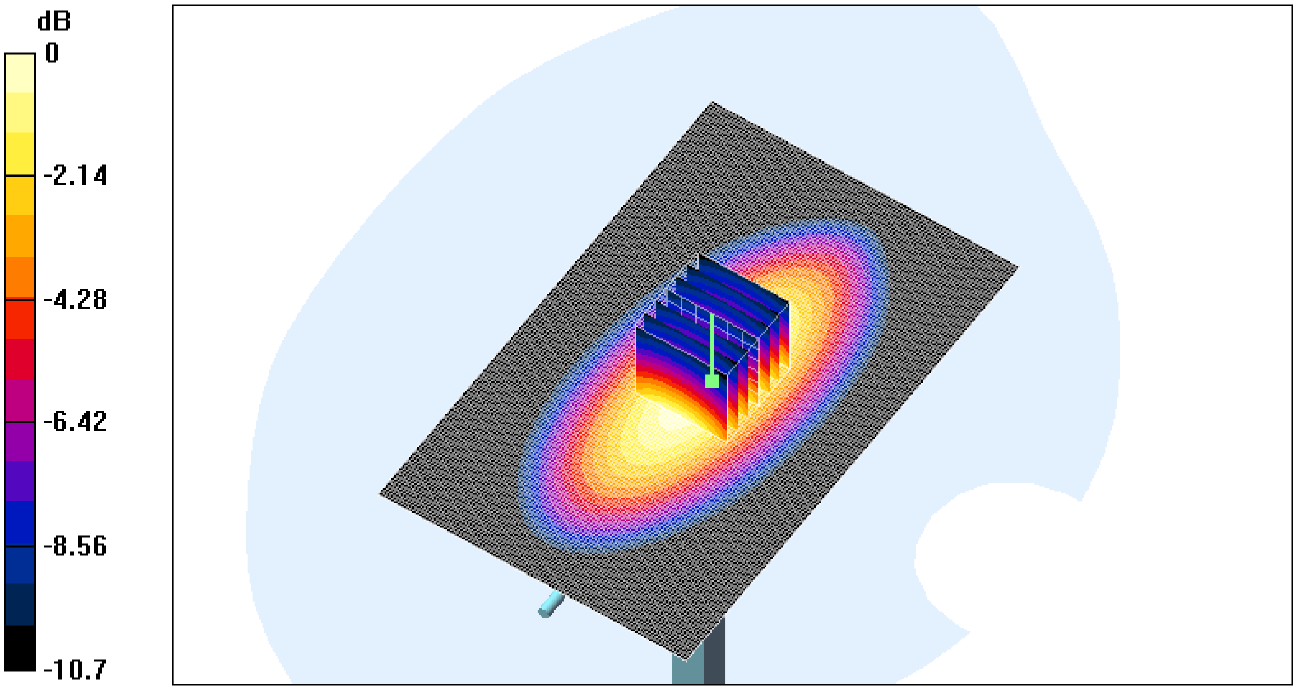
Communication System: CW; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: Muscle 900 MHz (σ = 1.03749 mho/m, ε_r = 54.4094, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1711; ConvF(6.2, 6.2, 6.2); Calibrated: 11/29/2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn522; Calibrated: 9/11/2002
- Phantom: SAM 12; Type: TP-1217; Serial: QD000P40CA
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

_ (250 mW)/Area Scan (101x161x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 55.5 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 3.03 mW/g

_ (250 mW)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 4.05 W/kg
SAR(1 g) = 2.8 mW/g; SAR(10 g) = 1.79 mW/g
Reference Value = 55.5 V/m
Power Drift = 0.009 dB
Maximum value of SAR = 3.02 mW/g



0 dB = 3.02mW/g

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

1800 MHz System Validation Dipole

Type:	**D1800V2**
Serial Number:	**2d046**
Place of Calibration:	**Zurich**
Date of Calibration:	**August 5, 2002**
Calibration Interval:	**24 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

Approved by:

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D1800V2

Serial: 2d046

Manufactured: May 16, 2002
Calibrated: August 5, 2002

1. Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with head simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**40.3**	± 5%
Conductivity	**1.36 mho/m**	± 5%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.3 at 1800 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 20mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 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 cm^3 (1 g) of tissue:	**36.6 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**19.8 mW/g**

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:	**1.209 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 1800 MHz:	Re{Z} = **49.2 Ω**
	Im {Z} = **-3.9 Ω**
Return Loss at 1800 MHz	**-27.9 dB**

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

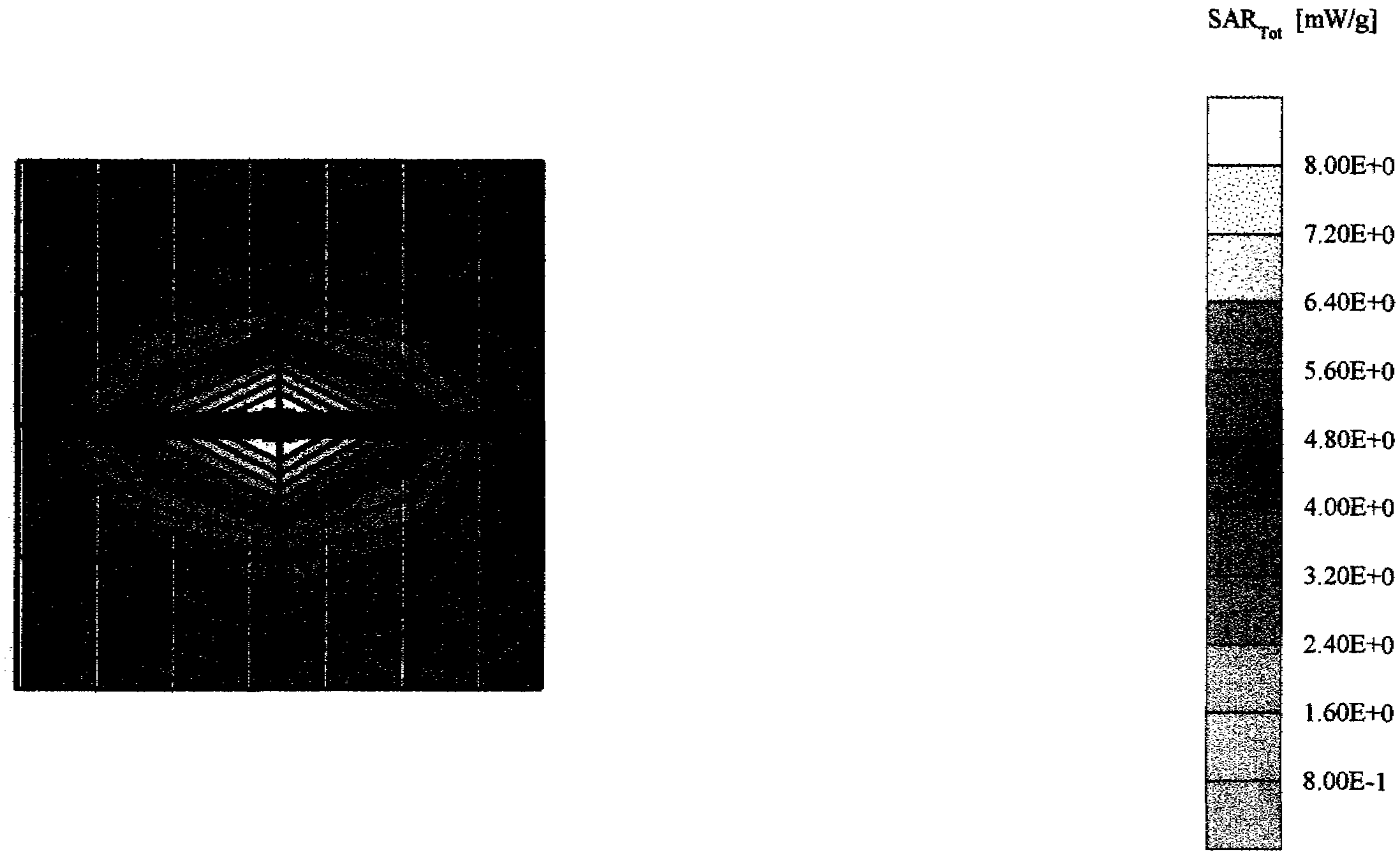
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

6. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

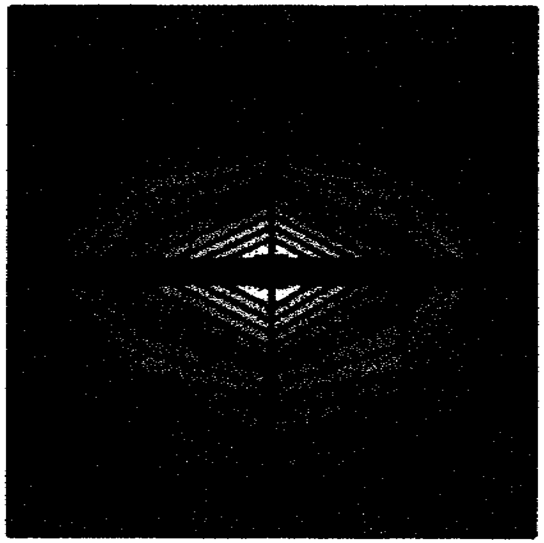
Validation Dipole D1800V2 SN:2d046, d = 10 mm

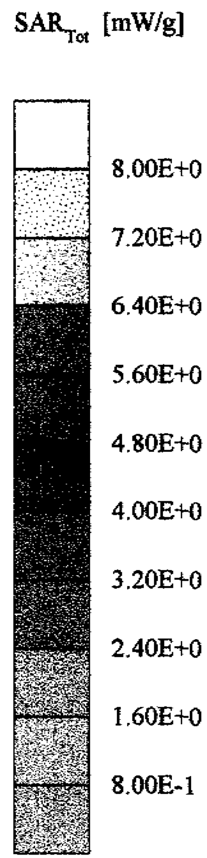
Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.30,5.30,5.30) at 1800 MHz; IEEE1528 1800 MHz: σ = 1.36 mho/m ε_r = 40.3 ρ = 1.00 g/cm^3
Cubes (2): Peak: 15.8 mW/g ± 0.01 dB, SAR (1g): 9.14 mW/g ± 0.01 dB, SAR (10g): 4.95 mW/g ± 0.01 dB, (Advanced extrapolation)
Penetration depth: 9.3 (9.1, 9.6) [mm]
Powerdrift: -0.01 dB

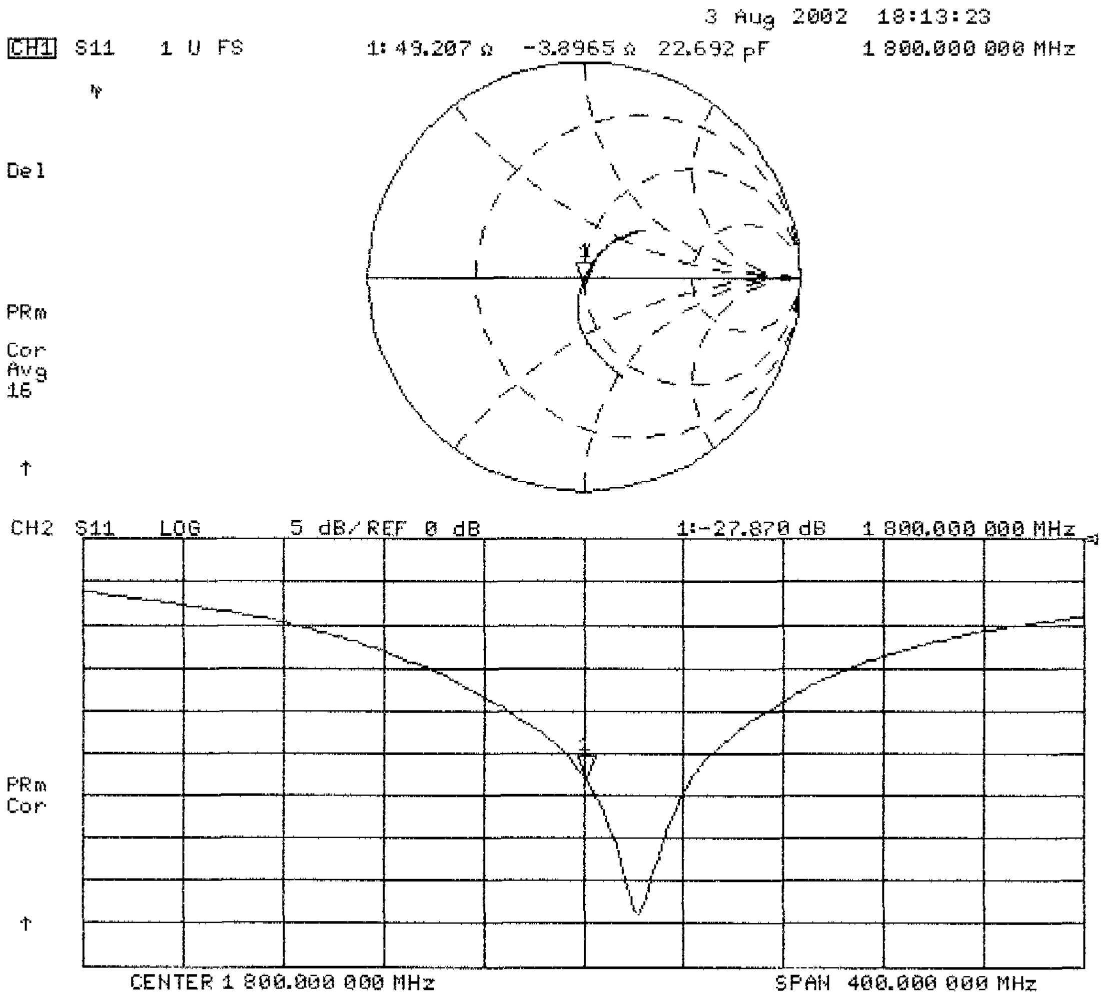


Validation Dipole D1800V2 SN:2d046, d = 10 mm

Frequency: 1800 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(5.30,5.30,5.30) at 1800 MHz; IEEE1528 1800 MHz: $\sigma = 1.36$ mho/m $\varepsilon_r = 40.3$ $\rho = 1.00$ g/cm³
Cubes (2): Peak: 18.1 mW/g ± 0.01 dB, SAR (1g): 9.94 mW/g ± 0.01 dB, SAR (10g): 5.26 mW/g ± 0.01 dB, (Worst-case extrapolation)
Penetration depth: 8.6 (8.2, 9.4) [mm]
Powerdrift: -0.01 dB






3 Aug 2002 18:13:23
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Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB
1:-27.870 dB 1 800.000 000 MHz
PRm
Cor
CENTER 1 800.000 000 MHz
SPAN 400.000 000 MHz

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

D2: 1800MHz SYSTEM VALIDATION DIPOLE

CALIBRATION CERTIFICATE

1800 MHz System Validation Dipole (Muscle)

Type:	**D1800V2**
Serial Number:	**2d046**
Place of Calibration:	**Reichenwalde**
Date of Calibration:	**September 05, 2003**
Calibration Interval:	**24 month**

ETS Dr. Genz GmbH hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of ETS Dr. Genz GmbH.

Wherever applicable, the standards used in the calibration process are traceable to International standards.

Calibrated by:	**W. Treffke**
Approved by:	**K. Damm**

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

DASY

DIPOLE VALIDATION KIT

Type: D1800V2

Serial: 2d046

Manufactured : May 16, 2002
Calibrated : September 05, 2003

Measurement Conditions

The measurements were performed in the flat section of the new SAM twin phantom filled with body simulating solution of the following electrical parameters at 1800 MHz:

Relative permittivity	52.25	+/- 5 %
Conductivity	1.469 mho/m	+/- 10 %

The DASY System with a dosimetric E-field probe ET3DV6 (SN: 1711, conversion factor 5,0 at 1800 MHz body) was used for the measurements.

The dipole feed-point was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm 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 10 mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250 mW +/- 3 %. The results are normalized to 1 W input power.

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 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1711 and applying the advanced extrapolation are:

Averaged over 1 cm3 (1 g) of tissue: 40.8 mW/g

Averaged over 10 cm3 (10 g) of tissue: 21.4 mW/g

Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (Measurement conditions) (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feed-point impedance at 1800 MHz: Re {Z} = 54.7 Ω

Im {Z} = -3.6 Ω

Return Loss at 1800 MHz: - 24.0 dB

Date/Time: 09/05/03 10:30:05

Test Laboratory: ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH
File Name: Dipol Calibr.1800 (m) 250mW.da4

Dipol Calibr.1800 (m) 250mW

DUT: Dipole 1800 MHz (D1800V2); Type: SA AAD 180 BA; Serial: 2d046
Program: Dipol Calibration 1800 Muscle

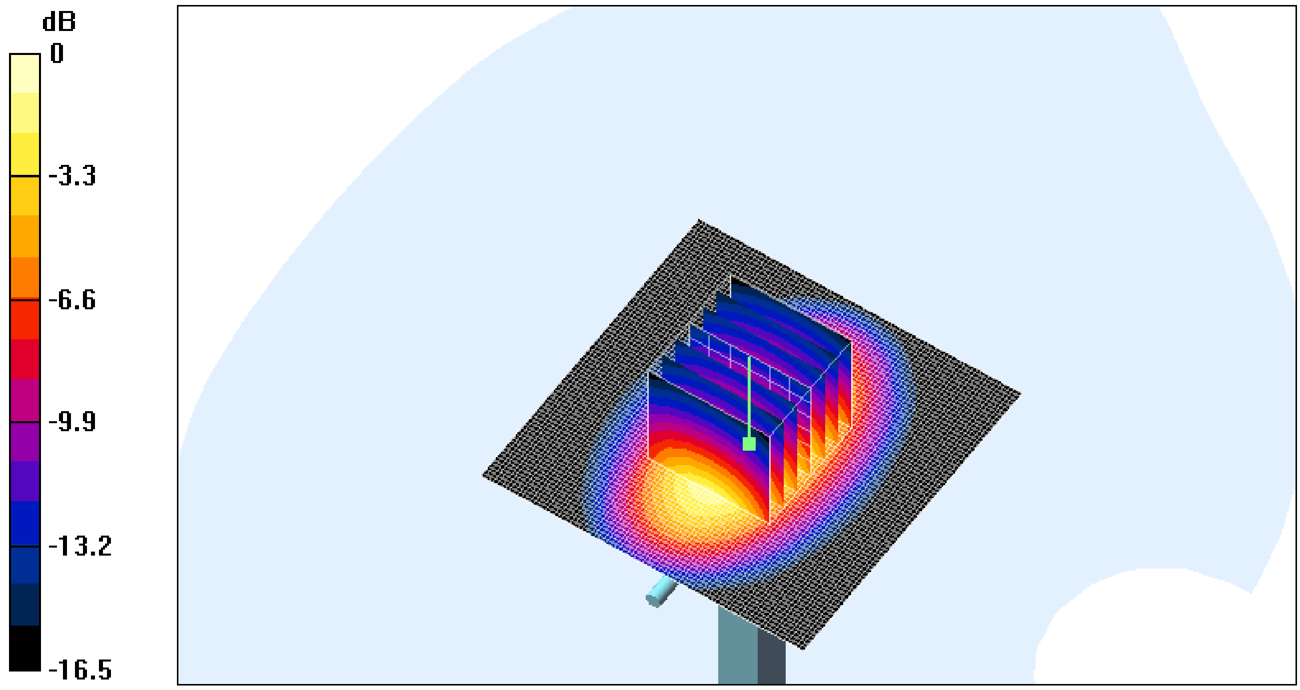
Communication System: CW; Frequency: 1800 MHz;Duty Cycle: 1:1
Medium: Muscle 1800 MHz (σ = 1.46898 mho/m, ε_r = 52.2493, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1711; ConvF(5, 5, 5); Calibrated: 11/29/2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn522; Calibrated: 9/11/2002
- Phantom: SAM 12; Type: TP-1217; Serial: QD000P40CA
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

_ (250 mW)/Area Scan (81x81x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 92.7 V/m
Power Drift = 0.01 dB
Maximum value of SAR = 11.5 mW/g

_ (250 mW)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 17.7 W/kg
SAR(1 g) = 10.2 mW/g; SAR(10 g) = 5.35 mW/g
Reference Value = 92.7 V/m
Power Drift = 0.01 dB
Maximum value of SAR = 11.5 mW/g



0 dB = 11.5mW/g

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

1900 MHz System Validation Dipole

Type:	**D1900V2**
Serial Number:	**5d025**
Place of Calibration:	**Zurich**
Date of Calibration:	**October 14, 2002**
Calibration Interval:	**24 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:	D. Vetter
Approved by:	[illegible]

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D1900V2

Serial: 5d025

Manufactured: July 29, 2002
Calibrated: October 14, 2002

1. Measurement Conditions

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

Relative Dielectricity	**38.7**	± 5%
Conductivity	**1.45 mho/m**	± 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 250mW ± 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 cm^3 (1 g) of tissue: **40.4 mW/g**

averaged over 10 cm^3 (10 g) of tissue: **20.6 mW/g**

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:	**1.196 ns**	(one direction)
Transmission factor:	**0.997**	(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:	Re{Z} = **51.6 Ω**
	Im {Z} = **4.7 Ω**
Return Loss at 1900 MHz	**-26.3 dB**

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 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Date/Time: 10/14/02 17:57:28

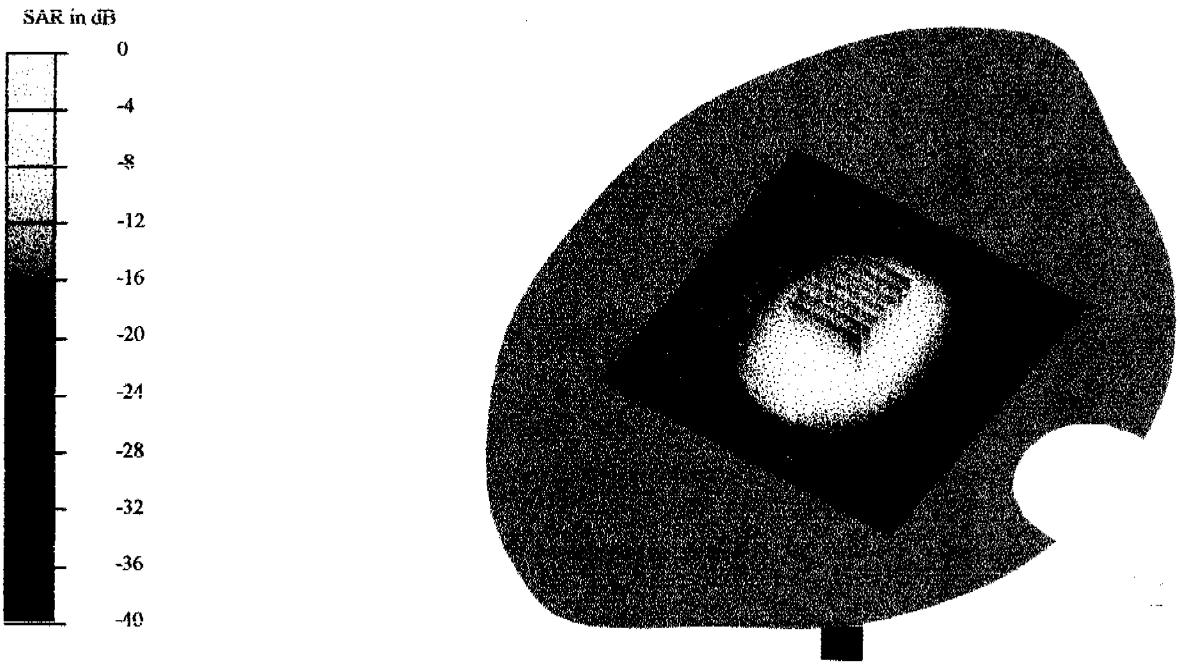
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN5d025_SN1507_HSL1900_141002.da4

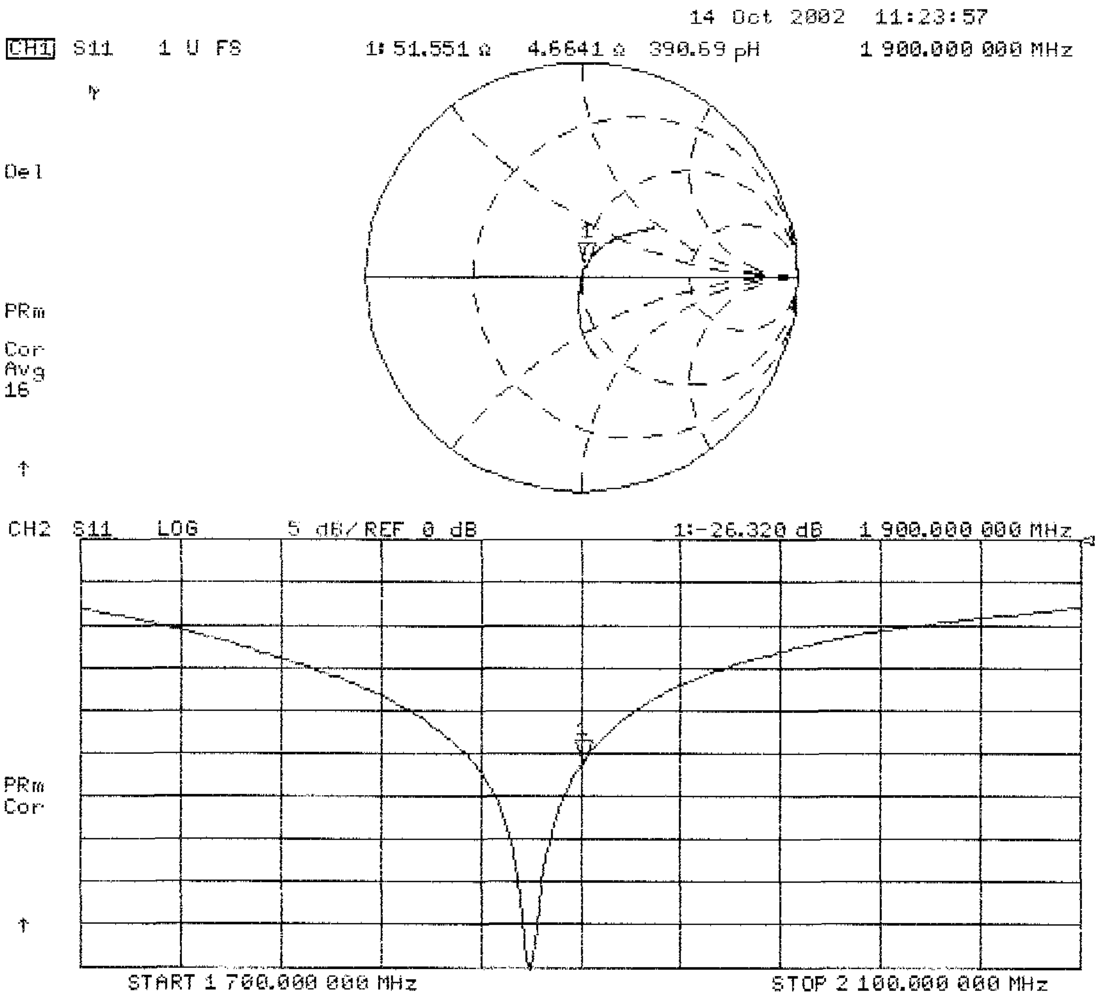
DUT: Dipole 1900 MHz Type & Serial Number: D1900V2 - SN5d025
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL 1900 MHz (σ = 1.45 mho/m, ε = 38.7, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(5.2, 5.2, 5.2); Calibrated: 1/24/2002
- *Sensor-Surface: 4mm (Mechanical Surface Detection)*
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 35

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 93 V/m
Peak SAR = 18.3 mW/g
SAR(*1* g) = *10.1* mW/g; SAR(*10* g) = 5.16 mW/g
Power Drift = -0.0005 dB





14 Oct 2002 11:23:57
CH1 S11 1 U FS
1: 51.551 Ω 4.6641 Ω 390.69 pH 1 900.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF 0 dB 1:-26.320 dB 1 900.000 000 MHz
PRm
Cor
START 1 700.000 000 MHz
STOP 2 100.000 000 MHz

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

D2: 1900MHz SYSTEM VALIDATION DIPOLE

CALIBRATION CERTIFICATE

1900 MHz System Validation Dipole (Muscle)

Type:	**D1900V2**
Serial Number:	**5d025**
Place of Calibration:	**Reichenwalde**
Date of Calibration:	**July 24, 2003**
Calibration Interval:	**24 month**

ETS Dr. Genz GmbH hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of ETS Dr. Genz GmbH.

Wherever applicable, the standards used in the calibration process are traceable to International standards.

Calibrated by:	**W. Treffke**
Approved by:	**K. Damm**

ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH - ETS -
STORKOWER STRASSE 38c, D-15526 REICHENWALDE B. BERLIN Tel: 033631 888 00 FAX: 033631 888 660

DASY

DIPOLE VALIDATION KIT

Type: **D1900V2**

Serial: **5d025**

Manufactured : Juli 29, 2002
Calibrated : Juli 24, 2003

Measurement Conditions

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

Relative permittivity	51.41	+/- 5 %
Conductivity	1.565 mho/m	+/- 10 %

The DASY System with a dosimetric E-field probe ET3DV6 (SN: 1711, conversion factor 5,0 at 1900 MHz body) was used for the measurements.

The dipole feed-point was positioned below the center marking and oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm 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 10 mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250 mW +/- 3 %. The results are normalized to 1 W input power.

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 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1711 and applying the advanced extrapolation are:

Averaged over 1 cm3 (1 g) of tissue: 45.6 mW/g

Averaged over 10 cm3 (10 g) of tissue: 23.7 mW/g

Dipole impedance and return loss

The dipole was positioned at the flat phantom sections according to section 4 (Measurement conditions) (with body tissue inside the phantom) and the distance holder was in place during impedance measurements.

Feed-point impedance at 1900 MHz: Re {Z} = 54.9 Ω

Im {Z} = -3.8 Ω

Return Loss at 1900 MHz: - 24.2 dB

Date/Time: 07/24/03 09:06:17

Test Laboratory: ELECTRONIC TECHNOLOGY SYSTEMS DR. GENZ GMBH
File Name: Dipol Calibr.1900 (m) 250mW.da4

Dipol Calibr.1900 (m) 250mW

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d025
Program: Dipol Calibration 1900 Muscle

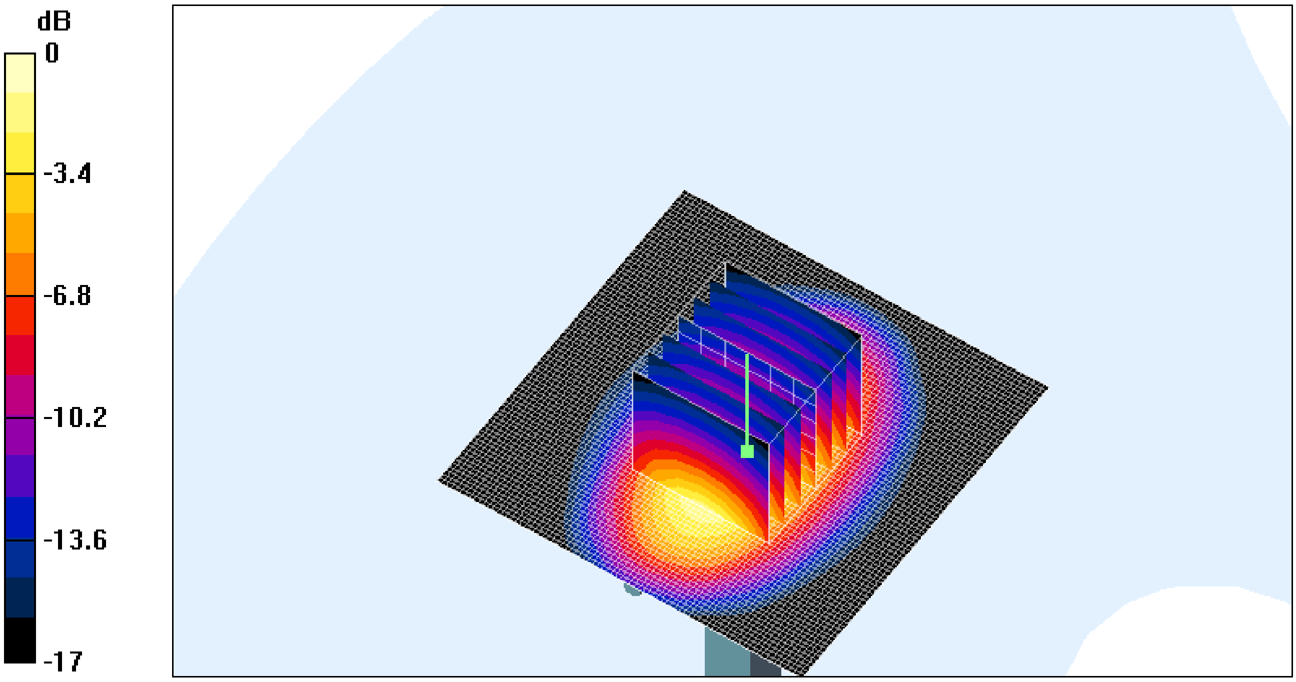
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: Muscle 1800 MHz (σ = 1.56554 mho/m, ε_r = 51.4058, ρ = 1000 kg/m^3)
Phantom section: Flat Section

DASY4 Configuration:

- Probe: ET3DV6 - SN1711; ConvF(5, 5, 5); Calibrated: 11/29/2002
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn522; Calibrated: 9/11/2002
- Phantom: SAM 12; Type: TP-1217; Serial: QD000P40CA
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

_ (24dBm)/Area Scan (81x81x1): Measurement grid: dx=10mm, dy=10mm
Reference Value = 92.1 V/m
Power Drift = 0.001 dB
Maximum value of SAR = 12.9 mW/g

_ (24dBm)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 20.4 W/kg
SAR(1 g) = 11.4 mW/g; SAR(10 g) = 5.93 mW/g
Reference Value = 92.1 V/m
Power Drift = 0.001 dB
Maximum value of SAR = 12.8 mW/g



0 dB = 12.8mW/g

Schmid & Partner Engineering AG

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Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Probe ET3DV6

SN:1711

Manufactured:	August 7, 2002
Last calibration:	November 26, 2002
Recalibrated:	December 16, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1711

Sensitivity in Free Space

NormX	**1.41**	$\mu V/(V/m)^2$
NormY	**1.62**	$\mu V/(V/m)^2$
NormZ	**1.56**	$\mu V/(V/m)^2$

Diode Compression

DCP X	**97**	mV
DCP Y	**97**	mV
DCP Z	**97**	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.2	± 9.5% (k=2)	Alpha	**0.31**
ConvF Z	6.2	± 9.5% (k=2)	Depth	**2.87**

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2	± 9.5% (k=2)	Alpha	**0.50**
ConvF Z	5.2	± 9.5% (k=2)	Depth	**2.62**

Boundary Effect

Head **900** MHz **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	9.9	5.8
SAR_{be} [%]	With Correction Algorithm	0.4	0.6

Head **1800** MHz **Typical SAR gradient: 10 % per mm**

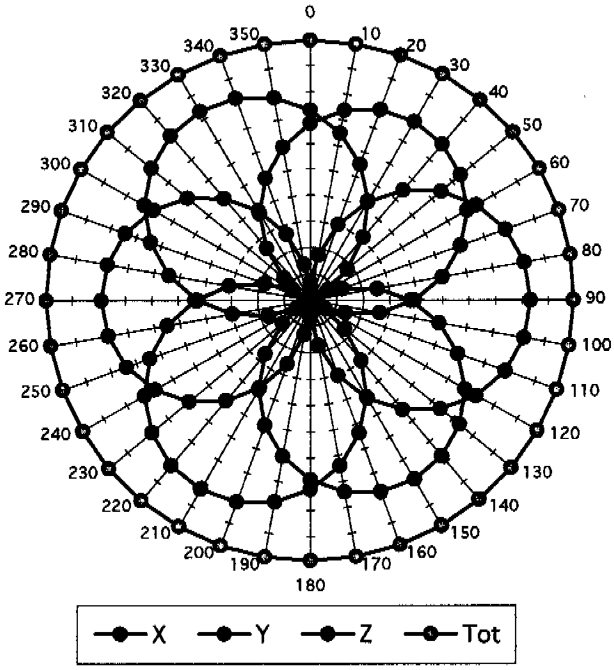
Probe Tip to Boundary		**1 mm**	**2 mm**
SAR_{be} [%]	Without Correction Algorithm	13.6	9.2
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

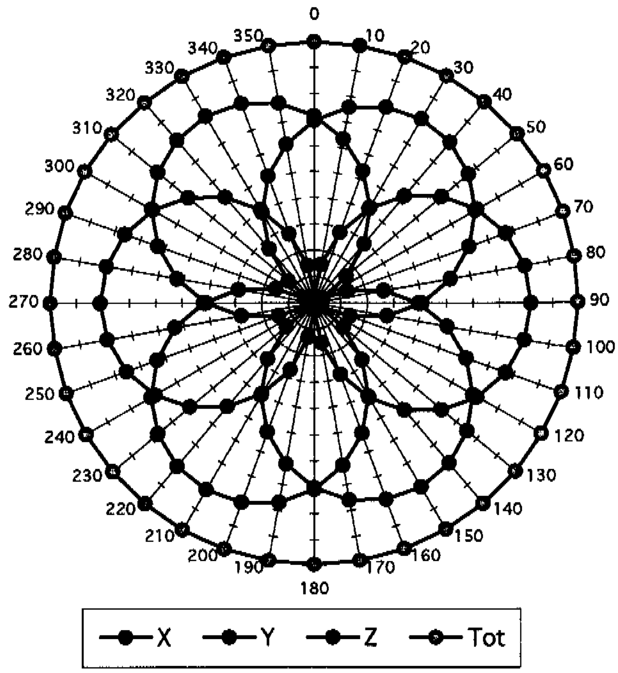
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.1 ± 0.2**	mm

Receiving Pattern (ϕ), $\theta = 0°$

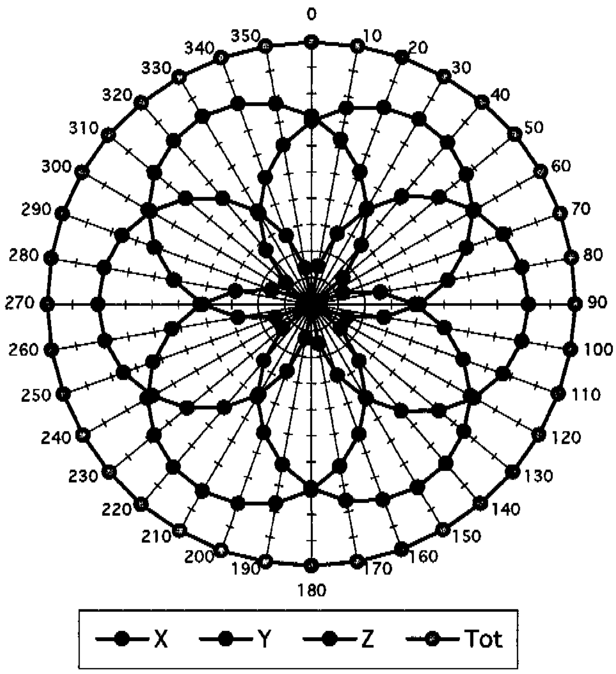
f = 30 MHz, TEM cell ifi110



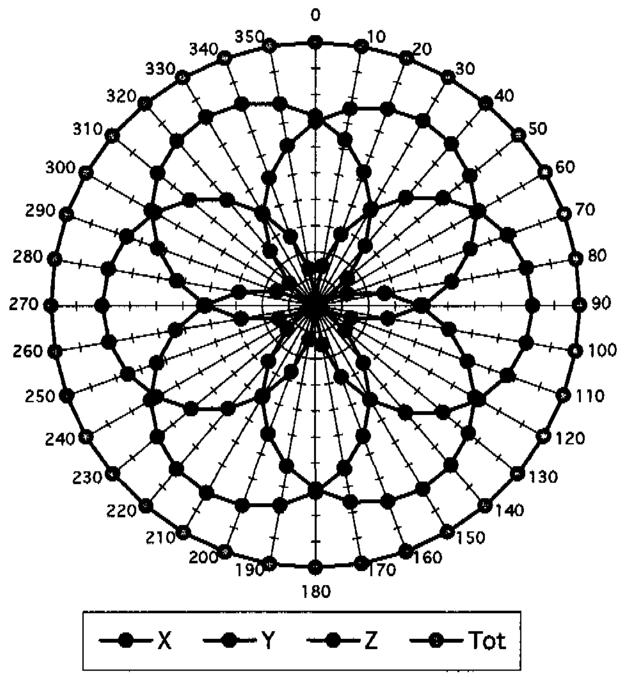
f = 100 MHz, TEM cell ifi110

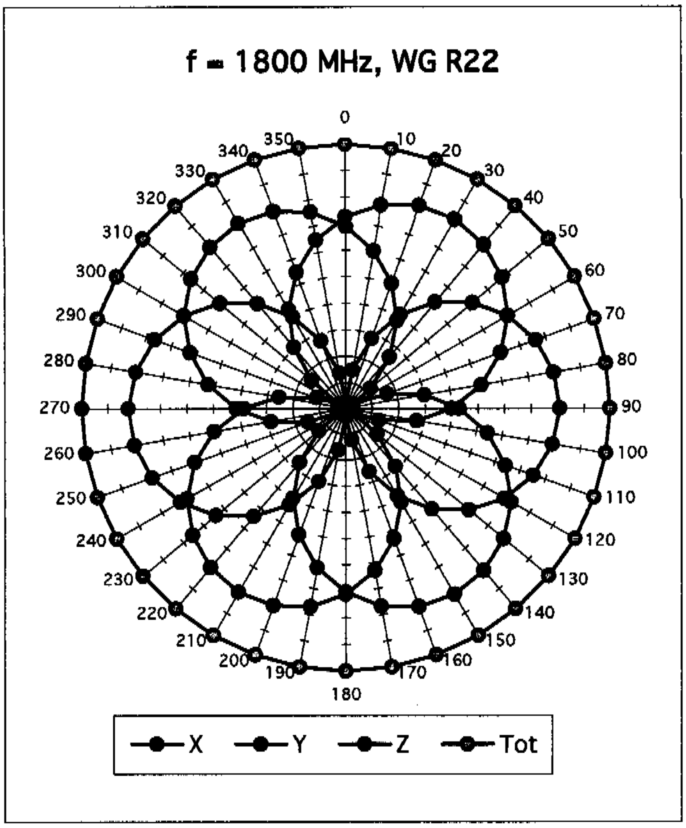


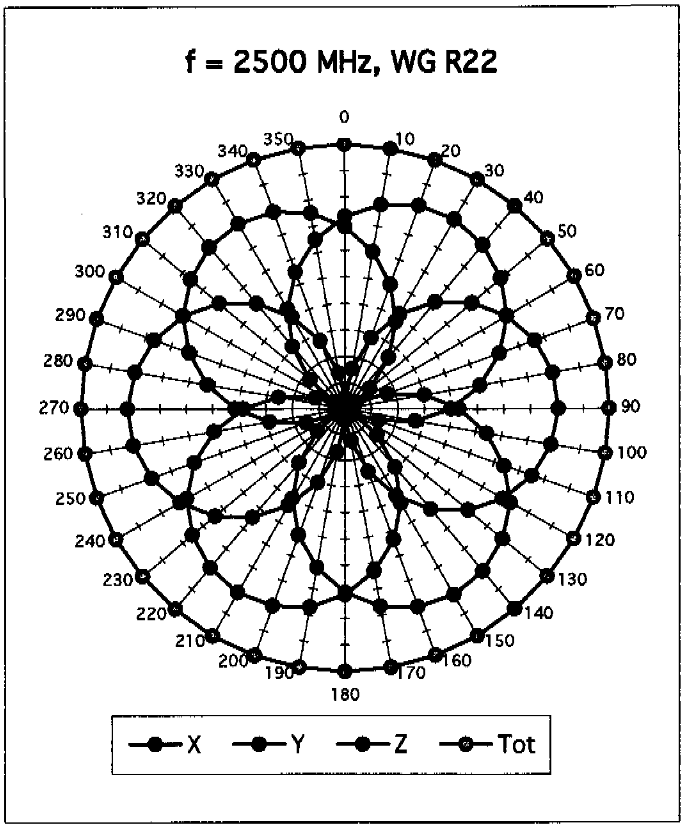
f = 300 MHz, TEM cell ifi110



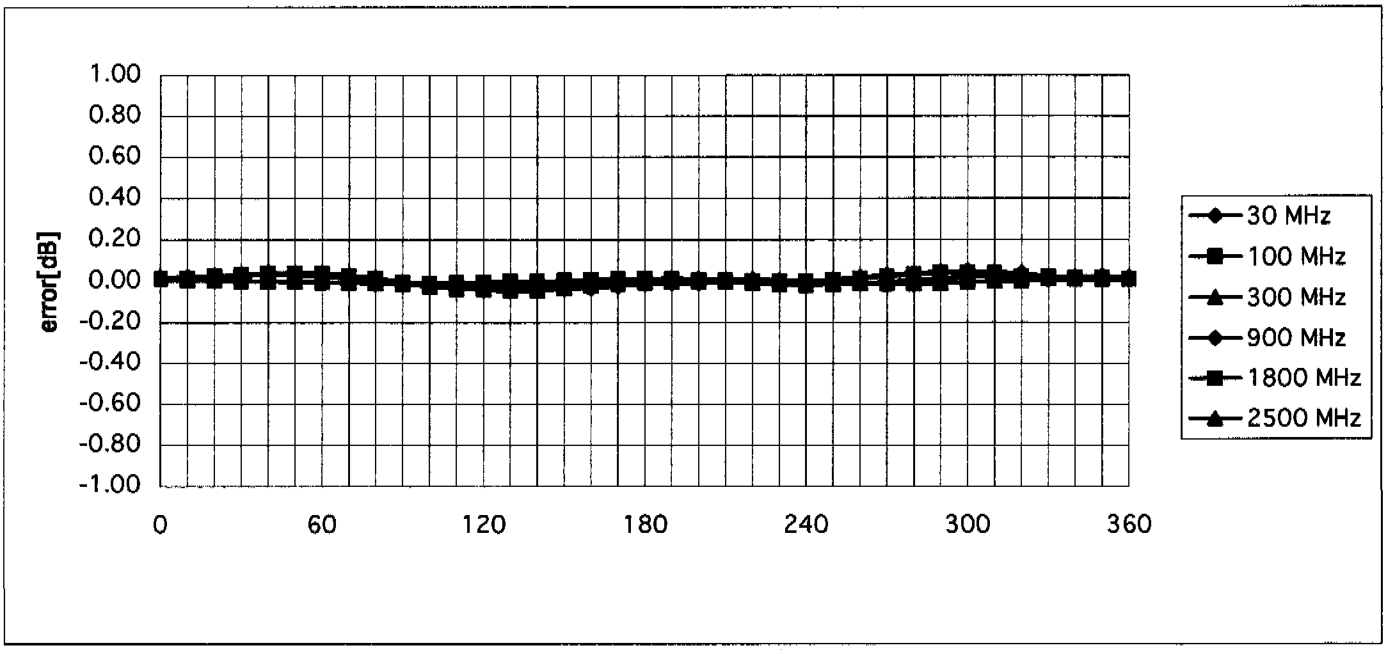
f = 900 MHz, TEM cell ifi110





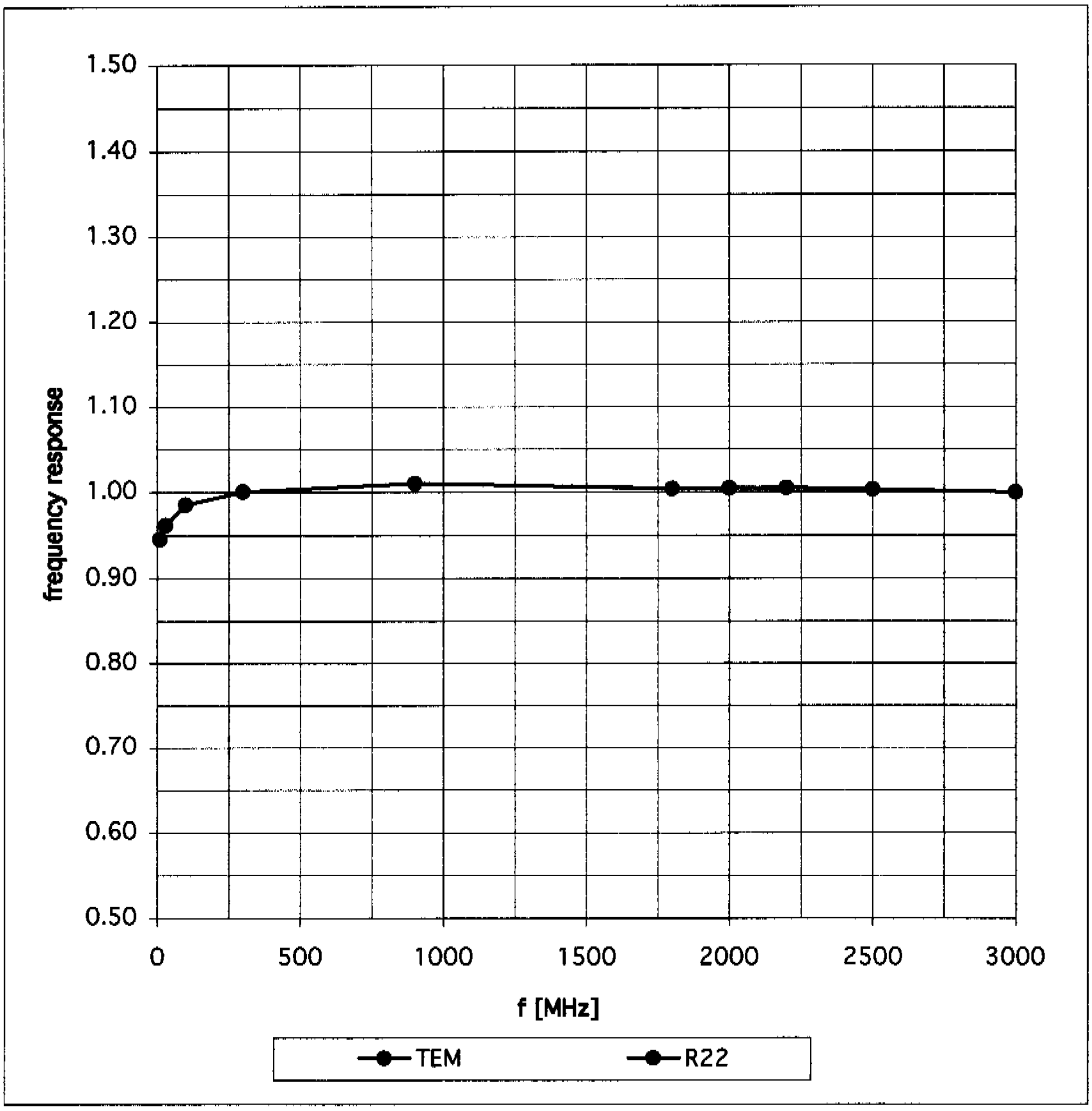


Isotropy Error (ϕ), θ = 0°



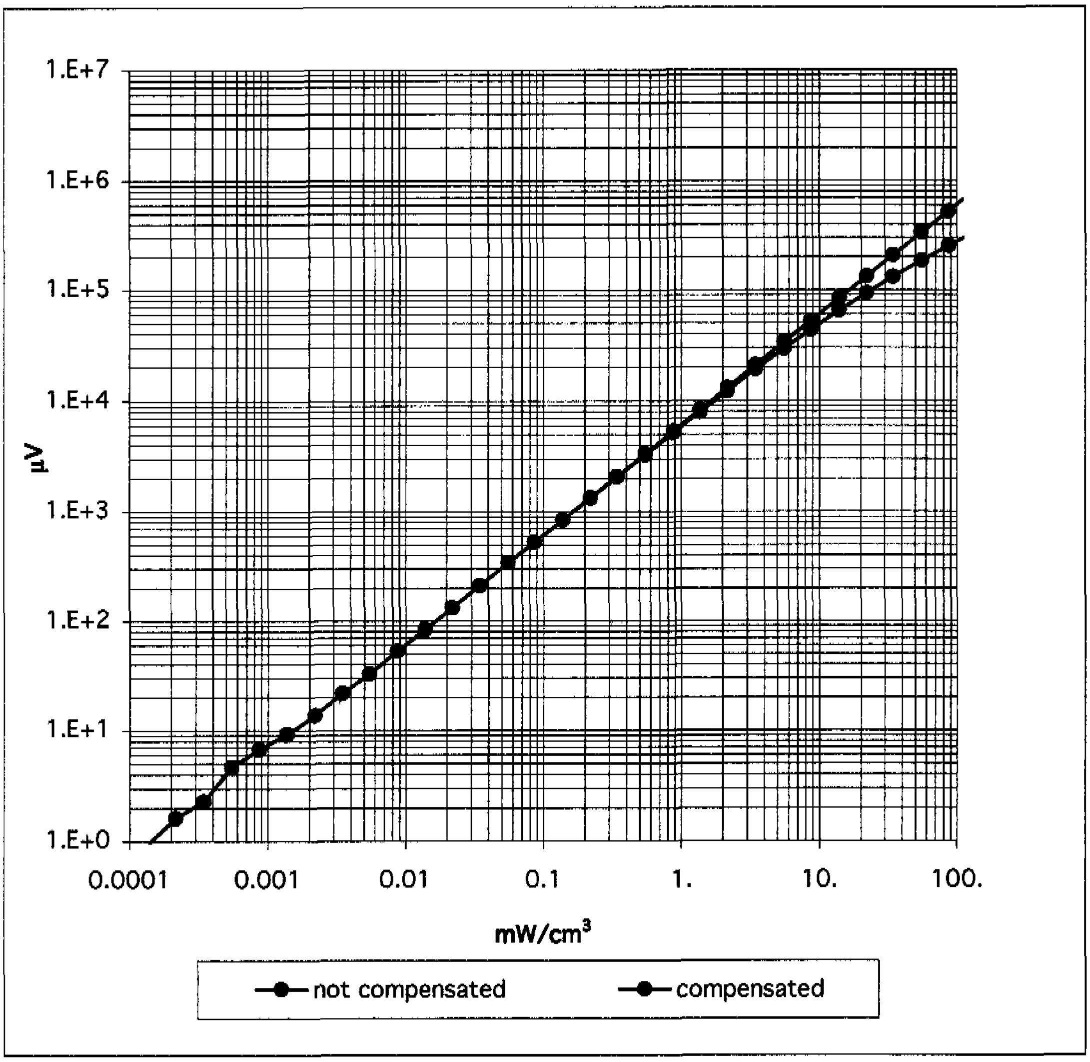
Frequency Response of E-Field

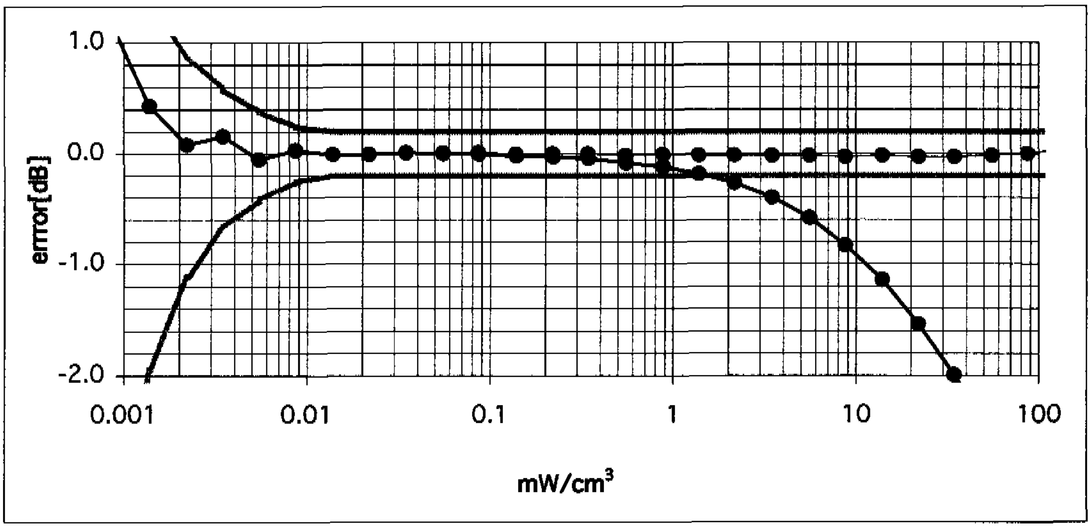
(TEM-Cell:ifi110, Waveguide R22)



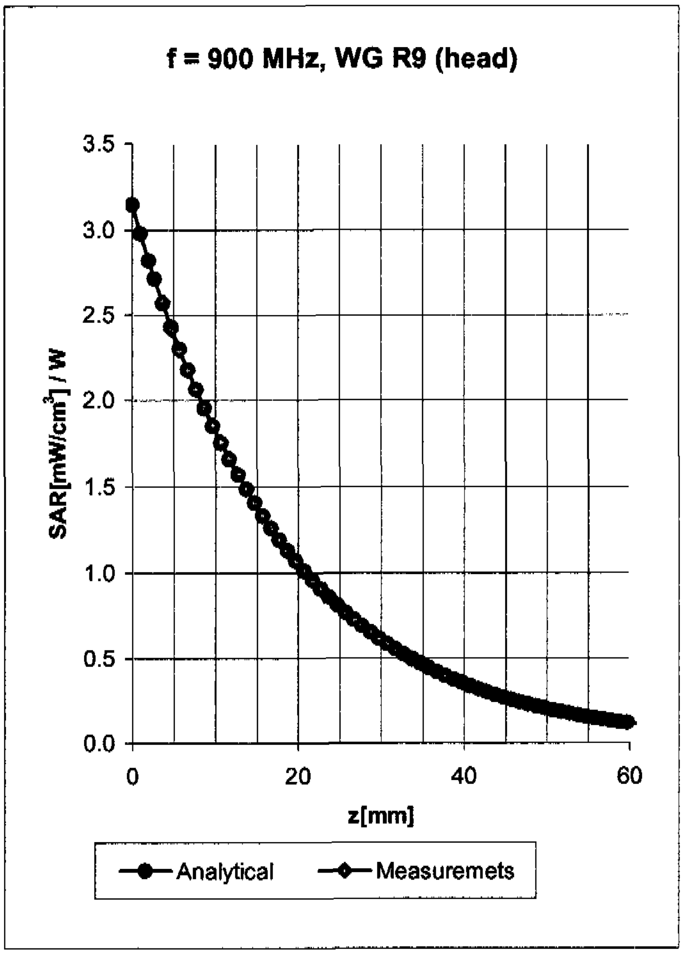
Dynamic Range f(SARhead)

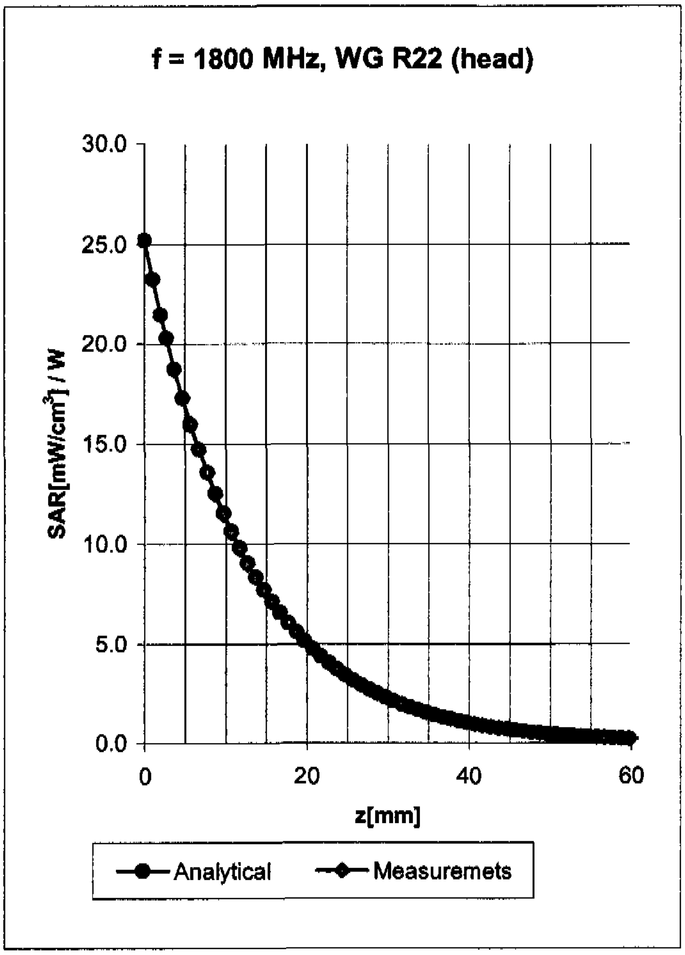
(Waveguide R22)





Conversion Factor Assessment





Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

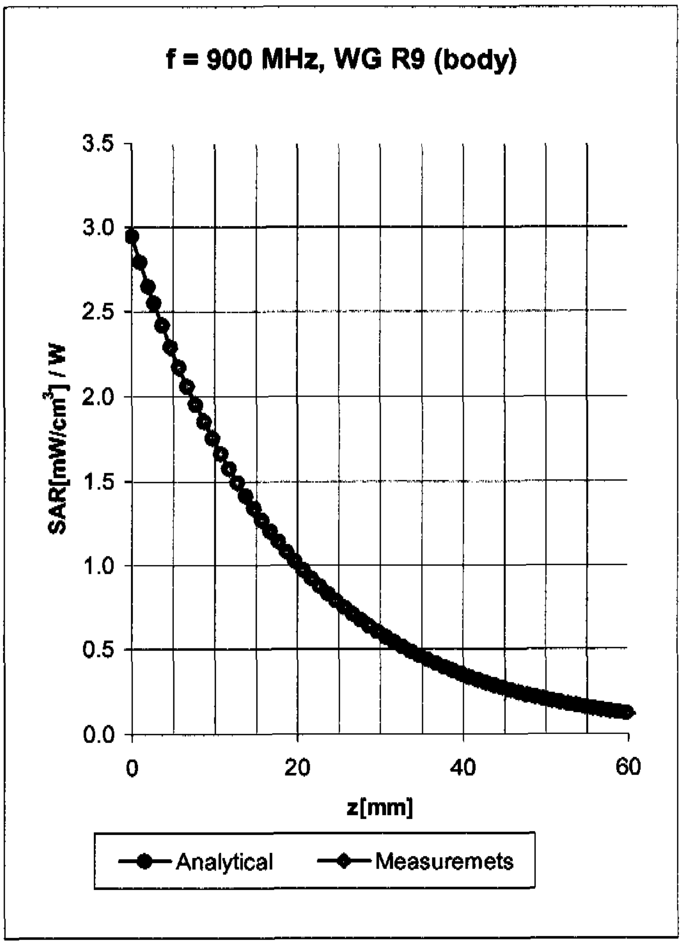
ConvF X	6.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.2	± 9.5% (k=2)	Alpha	**0.31**
ConvF Z	6.2	± 9.5% (k=2)	Depth	**2.87**

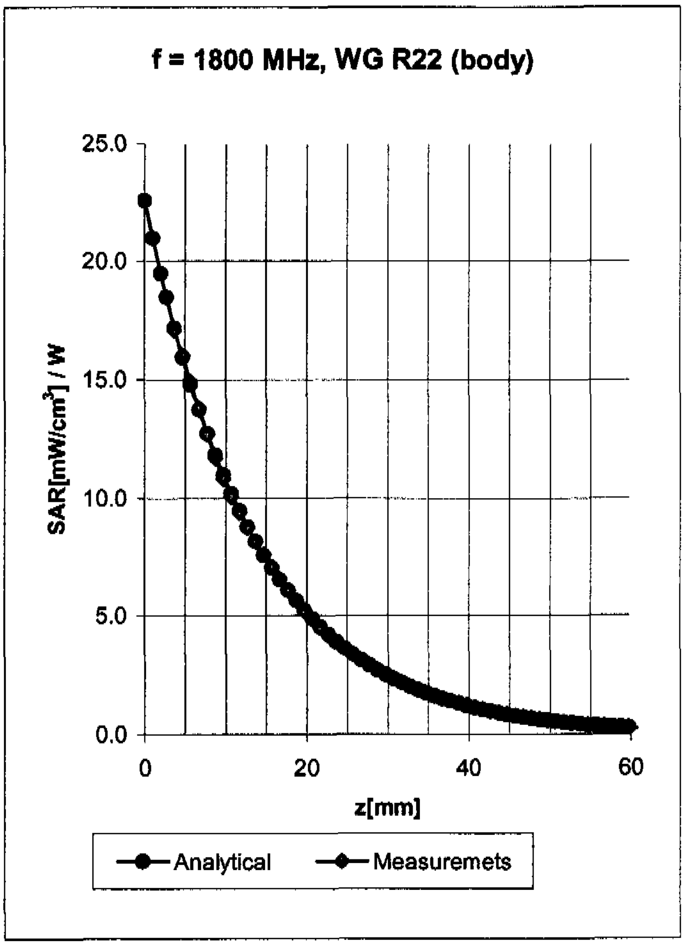
Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2	± 9.5% (k=2)	Alpha	**0.50**
ConvF Z	5.2	± 9.5% (k=2)	Depth	**2.62**

Conversion Factor Assessment





Body	900 MHz	ε_r = 55.0 ± 5%	σ = 1.05 ± 5% mho/m

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

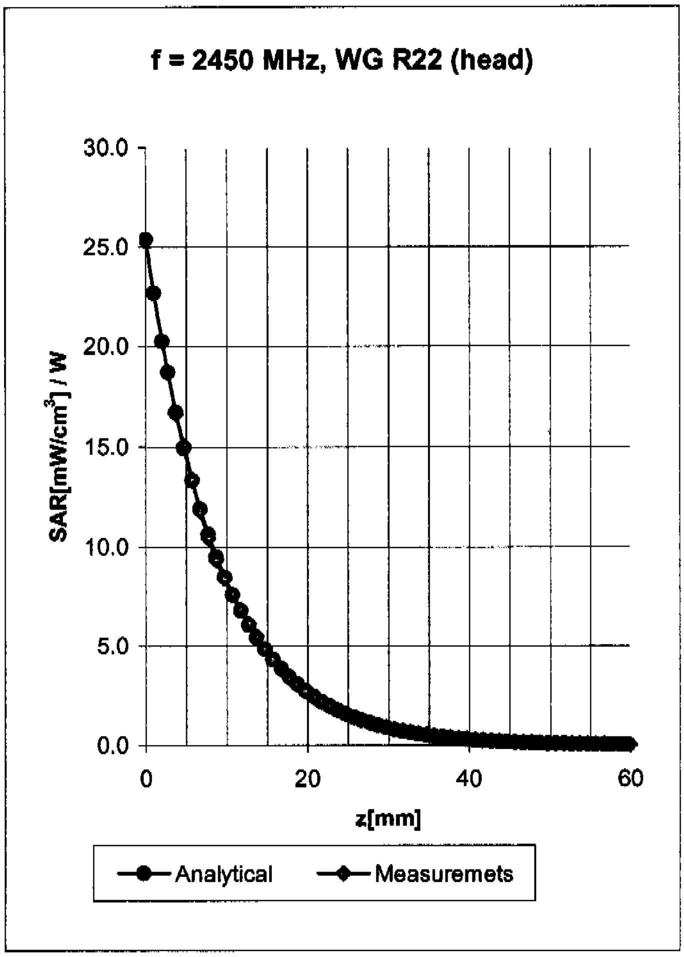
ConvF X	6.0 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.0 ± 9.5% (k=2)	Alpha	**0.38**
ConvF Z	6.0 ± 9.5% (k=2)	Depth	**2.52**

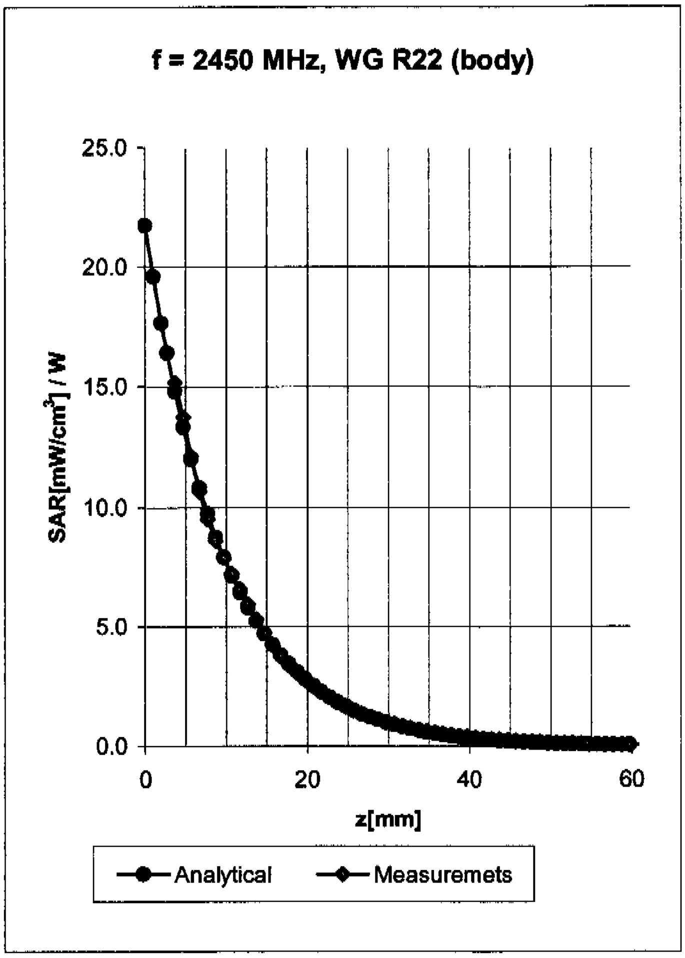
Body	1800 MHz	ε_r = 53.3 ± 5%	σ = 1.52 ± 5% mho/m

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	4.6 ± 9.5% (k=2)	Alpha	**0.56**
ConvF Z	4.6 ± 9.5% (k=2)	Depth	**2.67**

Conversion Factor Assessment





Head	2450 MHz	ε_r = 39.2 ± 5%	σ = 1.80 ± 5% mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.6	± 9.5% (k=2)	Boundary effect:	
ConvF Y	4.6	± 9.5% (k=2)	Alpha	**1.07**
ConvF Z	4.6	± 9.5% (k=2)	Depth	**1.79**

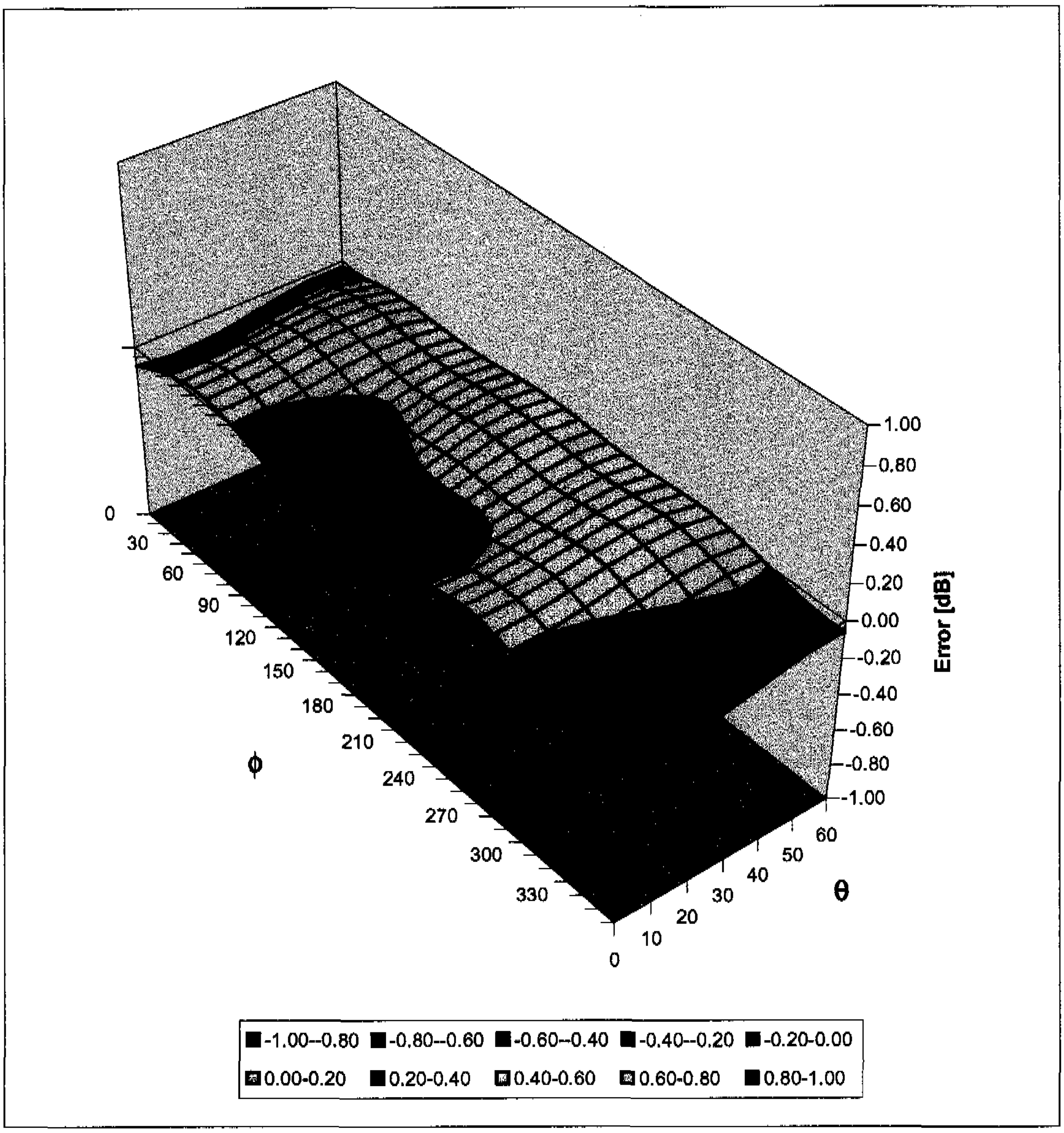
Body	2450 MHz	ε_r = 52.7 ± 5%	σ = 1.95 ± 5% mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.1	± 9.5% (k=2)	Boundary effect:	
ConvF Y	4.1	± 9.5% (k=2)	Alpha	**1.11**
ConvF Z	4.1	± 9.5% (k=2)	Depth	**1.56**

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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

Client **ETS Dr. Genz**

CALIBRATION CERTIFICATE

Object(s)	DAE3 – SD 000 D03 AA – SN:522
Calibration procedure(s)	QA CAL-06.v5a Calibration procedure for the data acquisition unit (DAE)
Calibration date:	16.12.2003
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
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03	Sep-04

	Name	Function	Signature
Calibrated by:	Philipp Storchenegger	Technician	P. A.
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Date issued: 16.12.2003

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.

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply outmost caution not to bend or damage the connector when changing batteries.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration Customer shall remove the batteries and pack the DAE in an antistatic bag. The packaging shall protect the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, Customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

s p e a g

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info@speag.com, http://www.speag.com

Schmid & Partner Engineering AG

1. Cal Lab. Incoming Inspection & Pre Test

Modification Status	Note Status here → → → →	BC
Visual Inspection	Note anomalies....................	None
	....	....
Pre Test	**Indication**	**Yes/No**
Probe Touch	Function	Yes
Probe Collision	Function	Yes
Probe Touch&Collision	Function	Yes

2. DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = 400 mV
Low Range: 1LSB = 61nV , full range = 4 mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	**X**	**Y**	**Z**
High Range	403.721	403.496	403.817
Low Range	3.90669	3.92578	3.92595
Connector Angle to be used	in DASY System	44 °	

High Range	**Input**	**Reading in μV**	**% Error**
Channel X + Input	200mV	199999.4	0.00
	20mV	19996.3	-0.02
Channel X - Input	20mV	-19993.6	-0.03
Channel Y + Input	200mV	199999.5	0.00
	20mV	19995.9	-0.02
Channel Y - Input	20mV	-19994.4	-0.03
Channel Z + Input	200mV	200000.7	0.00
	20mV	19994.2	-0.03
Channel Z - Input	20mV	-19995.6	-0.02

Low Range	**Input**	**Reading in μV**	**% Error**
Channel X + Input	2mV	1999.97	0.00
	0.2mV	200.58	0.29
Channel X - Input	0.2mV	-200.30	0.15
Channel Y + Input	2mV	1999.98	0.00
	0.2mV	199.72	-0.14
Channel Y - Input	0.2mV	-200.64	0.32
Channel Z + Input	2mV	2000.02	0.00
	0.2mV	199.41	-0.30
Channel Z - Input	0.2mV	-201.21	0.61

3. Common mode sensitivity

DASY measurement parameters:

Auto Zero Time: 3 sec, Measuring time: 3 sec

High/Low Range

in µV	Common mode Input Voltage	High Range Reading	Low Range Reading
Channel X	200mV	-0.71	-1.13
	- 200mV	2.36	-0.91
Channel Y	200mV	-0.87	-0.14
	- 200mV	-0.34	-1.27
Channel Z	200mV	-7.73	-6.96
	- 200mV	5.49	6.16

4. Channel separation

DASY measurement parameters:

Auto Zero Time: 3 sec, Measuring time: 3 sec

High Range

in µV	Input Voltage	Channel X	Channel Y	Channel Z
Channel X	200mV	-	1.45	0.18
Channel Y	200mV	-0.88	-	4.83
Channel Z	200mV	-1.60	0.24	-

5.1 AD-Converter Values with Input Voltage set to 2.0 mVDC

in Zero Low	Low Range Max - Min	Max.	Min
Channel X	10	16531	16521
Channel Y	5	16003	15998
Channel Z	13	16439	16426

5.2 AD-Converter Values with inputs shorted

in LSB	Low Range	High Range
Channel X	16555	15364
Channel Y	16020	15473
Channel Z	16437	15486

6. Input Offset Measurement

DASY measurement parameters:
Auto Zero Time: 3 sec, Measuring time: 3 sec
Number of measurements: 100, Low Range

Input 10MΩ

in µV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	1.48	0.57	2.44	0.40
Channel Y	-1.16	-1.66	-0.62	0.23
Channel Z	0.05	-0.52	1.00	0.23

Input shorted

in µV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	0.15	-0.68	0.94	0.31
Channel Y	-0.50	-1.87	-0.10	0.25
Channel Z	-0.86	-1.70	-0.19	0.23

7. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

8. Input Resistance

In MOhm	Calibrating	Measuring
Channel X	0.2000	199.5
Channel Y	0.2000	199.0
Channel Z	0.1999	199.5

9. Low Battery Alarm Voltage

in V	Alarm Level
Supply (+ Vcc)	7.88
Supply (- Vcc)	-7.65

10. Power Consumption

in mA	Switched off	Stand by	Transmitting
Supply (+ Vcc)	0.00	5.70	13.9
Supply (- Vcc)	-0.01	-8.03	-9.22