

Validation Data (835MHz Brain)

Dipole 835 MHz

SAM II Phantom; Flat Section; Position: (90°,90°); Frequency: 835 MHz

Probe: ET3DV6 - SN1607; ConvF(6.22,6.22,6.22); Crest factor: 1.0; Head 835 MHz: $s = 0.88$ mho/m $\epsilon_r = 42.8$ $\rho = 1.00 \text{ g/cm}^3$ Cubes (2): SAR (1g): $10.2 \text{ mW/g} \pm 0.00 \text{ dB}$, SAR (10g): $6.52 \text{ mW/g} \pm 0.00 \text{ dB}$ Coarse: $D_x = 20.0$, $D_y = 20.0$, $D_z = 10.0$

Powerdrift: 0.02 dB

Comment:

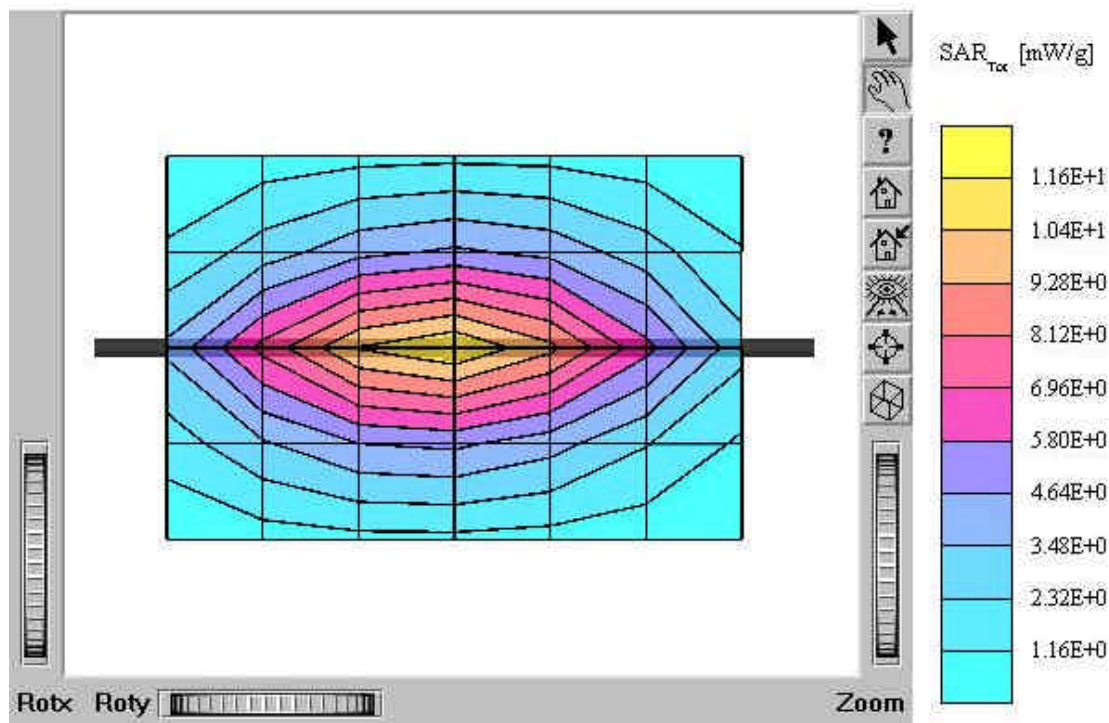
835MHz Brain Dipole Validation (D835V2/ S.N: 441)

Antenna Input Power: 30 dBm (1 W)

HCT Co., Ltd. Brain Tissue Simulating Liquid

Liquid Temperature: 21.4°C

Date Tested : October 5, 2004



Validation Data (1900MHz Brain)

Dipole 1900 MHz

SAM II Phantom: Flat Section; Position: (90°, 90°); Frequency: 1900 MHz

Probe: ET3DV6 - SN1609; ConvF(5.34, 5.34, 5.34); Crest factor: 1.0; Brain 1900 MHz: $s = 1.40$

$\rho_{ho}/m_e = 40.3$ $r = 1.00$ g/cm³

Cubes (2): SAR (1g): 42.6 mW/g ± 0.04 dB, SAR (10g): 21.6 mW/g ± 0.04 dB

Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0

Powerdrift: 0.07 dB

Comment:

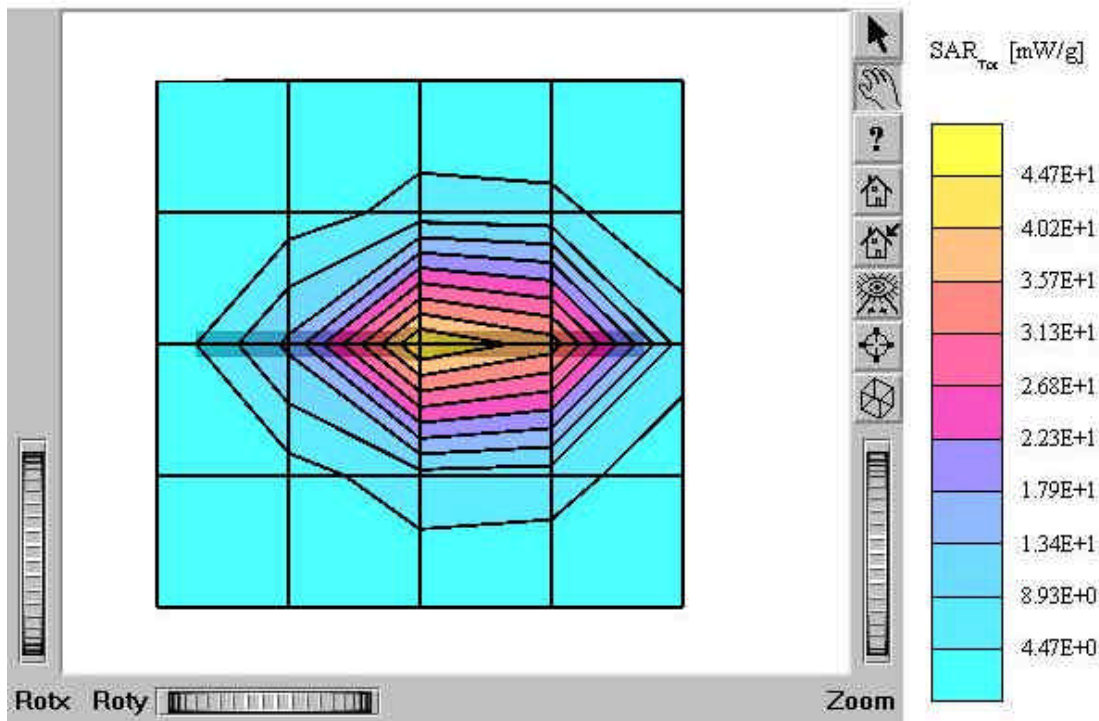
1900 MHz Brain Dipole Validation (D1900V2/ S.N: 5d032)

Antenna Input Power: 30 dBm (1 W)

HCT Co., Ltd. Brain Tissue Simulating Liquid

Liquid Temperature: 21.4°C

Date Tested : October 5, 2004



Dipole 835 MHz

SAM II Phantom: Section: Position: ; Frequency: 835 MHz
 Probe: ET3DV6 - SN1607; ConvF(6.22,6.22,6.22); Crest factor: 1.0; Head 835 MHz: $s = 0.88$
 ρ_{ho}/m $\epsilon_r = 42.8$ $r = 1.00$ g/cm³

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Comment:

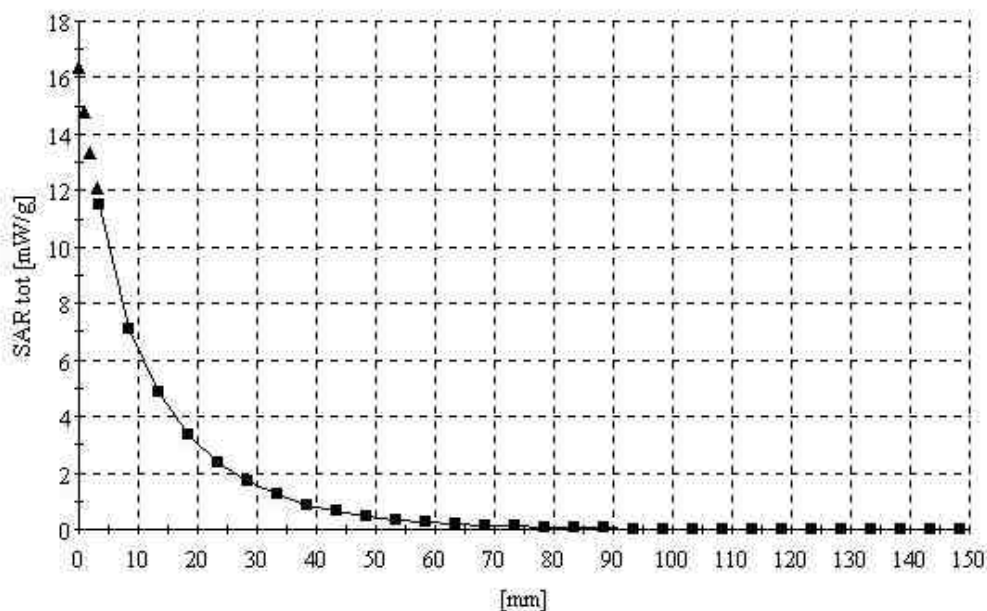
835MHz Brain Dipole Validation (D835V2/ S.N: 441)

Antenna Input Power: 30 dBm (1 W)

HCT Co., Ltd. Brain Tissue Simulating Liquid

Liquid Temperature: 21.4°C

Date Tested : October 5, 2004



Dipole 1900 MHz

SAM II Phantom: Section: Position: ; Frequency: 1900 MHz
Probe: ET3DV6 - SN1609; ConvF(5.34,5.34,5.34); Crest factor: 1.0; Brain 1900 MHz: $s = 1.40$
 $\rho = 1.00 \text{ g/cm}^3$, $\sigma = 40.3 \text{ mho/m}$

Z-Axis: $D_x = 0.0$, $D_y = 0.0$, $D_z = 5.0$

Comment:

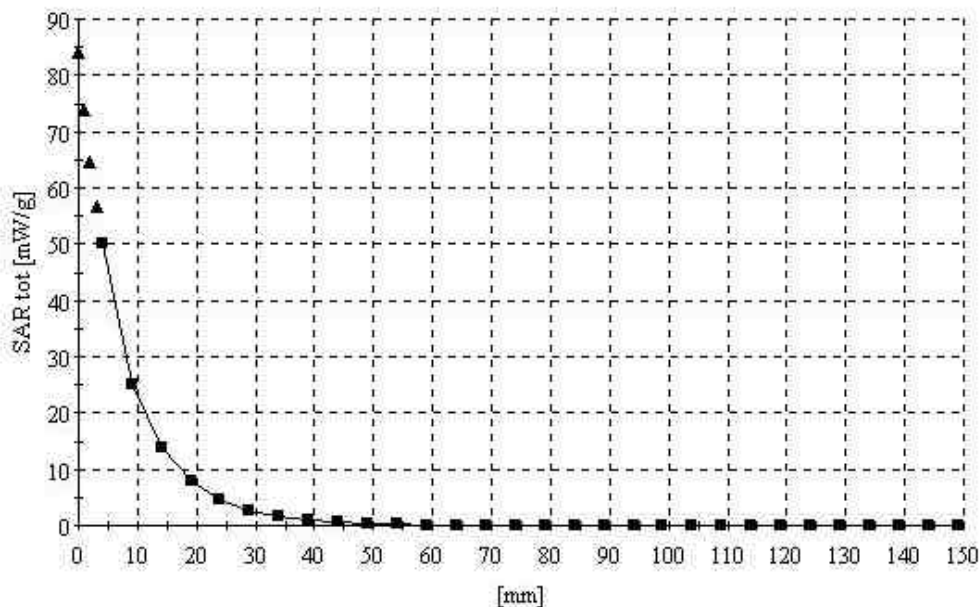
1900 MHz Brain Dipole Validation (D1900V2/ S.N: 5d032)

Antenna Input Power: 30 dBm (1 W)

HCT Co., Ltd. Brain Tissue Simulating Liquid

Liquid Temperature: 21.4°C

Date Tested : October 5, 2004



Dielectric Parameter (835MHz Brain)

Title : G906

SubTitle : GSM850 Brain

October 06, 2004 09:05 AM

Frequency	e'	e''
800.000000 MHz	43.7060	19.2911
805.000000 MHz	43.5675	19.2198
810.000000 MHz	43.4550	19.1965
815.000000 MHz	43.3384	19.1534
820.000000 MHz	43.2036	19.0791
825.000000 MHz	43.0439	19.0610
830.000000 MHz	42.9267	19.0368
835.000000 MHz	42.8348	19.0218
840.000000 MHz	42.6986	19.0306
845.000000 MHz	42.6797	19.0057
850.000000 MHz	42.6505	19.0151
855.000000 MHz	42.5963	19.0421
860.000000 MHz	42.5547	19.0035
865.000000 MHz	42.5879	19.0763
870.000000 MHz	42.6223	19.1172
875.000000 MHz	42.6001	19.2049
880.000000 MHz	42.6510	19.2291
885.000000 MHz	42.6201	19.2323
890.000000 MHz	42.5997	19.2020
895.000000 MHz	42.5760	19.2080
900.000000 MHz	42.5536	19.1837

Dielectric Parameter (1900MHz Brain)

Title : G906

SubTitle : GSM1900 Brain

October 06, 2004 02:12 PM

Frequency	e'	e''
1.800000000 GHz	40.8304	12.9196
1.810000000 GHz	40.7408	12.9489
1.820000000 GHz	40.7242	13.0237
1.830000000 GHz	40.6642	13.0804
1.840000000 GHz	40.6187	13.1095
1.850000000 GHz	40.5848	13.1405
1.860000000 GHz	40.5604	13.1654
1.870000000 GHz	40.5479	13.2067
1.880000000 GHz	40.4757	13.2145
1.890000000 GHz	40.4323	13.2368
1.900000000 GHz	40.3212	13.2319
1.910000000 GHz	40.2544	13.2194
1.920000000 GHz	40.1829	13.2525
1.930000000 GHz	40.0954	13.2906
1.940000000 GHz	40.0242	13.3242
1.950000000 GHz	39.9699	13.3765
1.960000000 GHz	39.9637	13.4588
1.970000000 GHz	39.9338	13.4859
1.980000000 GHz	39.9163	13.5254
1.990000000 GHz	39.9266	13.5606
2.000000000 GHz	39.9092	13.5880

Dielectric Parameter (835MHz Muscle)

Title : G906

SubTitle : GSM850 Body

October 05, 2004 01:06 PM

Frequency	e'	e''
800.000000 MHz	54.1359	21.5042
805.000000 MHz	54.0207	21.2918
810.000000 MHz	53.9266	21.4241
815.000000 MHz	53.8161	21.3143
820.000000 MHz	53.7281	21.2483
825.000000 MHz	53.7482	21.1554
830.000000 MHz	53.7874	21.1613
835.000000 MHz	53.7130	21.0206
840.000000 MHz	53.5791	21.0456
845.000000 MHz	53.5013	21.0396
850.000000 MHz	53.4163	21.0691
855.000000 MHz	53.3426	21.0079
860.000000 MHz	53.3611	20.9025
865.000000 MHz	53.3279	20.8598
870.000000 MHz	53.2380	20.8067
875.000000 MHz	53.0375	20.9503
880.000000 MHz	53.0031	20.9091
885.000000 MHz	52.8674	21.0017
890.000000 MHz	52.9800	20.7210
895.000000 MHz	52.9485	20.6695
900.000000 MHz	52.8884	20.6503

Dielectric Parameter (1900MHz Muscle)

Title : G906

SubTitle : GSM1900 Body

October 05, 2004 07:28 PM

Frequency	e'	e''
1.800000000 GHz	51.5335	12.8721
1.806666667 GHz	51.5628	12.9107
1.813333333 GHz	51.4724	12.9482
1.820000000 GHz	51.4172	13.0052
1.826666667 GHz	51.5250	13.0787
1.833333333 GHz	51.4732	13.1332
1.840000000 GHz	51.4561	13.1896
1.846666667 GHz	51.4598	13.2282
1.853333333 GHz	51.4513	13.3125
1.860000000 GHz	51.4070	13.3785
1.866666667 GHz	51.3889	13.4288
1.873333333 GHz	51.4039	13.4996
1.880000000 GHz	51.3707	13.5704
1.886666667 GHz	51.3552	13.6080
1.893333333 GHz	51.3307	13.6502
1.900000000 GHz	51.3247	13.7042
1.906666667 GHz	51.3004	13.7640
1.913333333 GHz	51.2921	13.8131
1.920000000 GHz	51.2669	13.8422
1.926666667 GHz	51.2590	13.9052
1.933333333 GHz	51.2516	13.9324
1.940000000 GHz	51.2350	13.9681
1.946666667 GHz	51.2394	14.0411
1.953333333 GHz	51.2196	14.0904
1.960000000 GHz	51.2044	14.1320

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



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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **H-CT (Dymstec)**

Certificate No: **D835V2-441_Sep04**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 441**

Calibration procedure(s) **QA CAL-05.v6**
Calibration procedure for dipole validation kits

Calibration date: **September 16, 2004**

Condition of the calibrated item **In Tolerance**

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power sensor HP 8481A	US37292783	5-Nov-03 (METAS, No. 252-0254)	Nov-04
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-04 (METAS, No 251-00402)	Aug-05
Reference Probe ET3DV8	SN 1507	23-Jan-04 (SPEAG, No. ET3-1507_Jan04)	Jan-05
DAE4	SN 601	6-Nov-03 (SPEAG, No. DAE4-601_Jul04)	Jul-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	GB43310788	13-Aug-03 (SPEAG, in house check Jan-04)	In house check: Jan-06
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Nov-04

Calibrated by: **Judith Mueller** **Laboratory Technician** 

Approved by: **Katja Pokovic** **Technical Manager** 

Issued: September 24, 2004

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: D835V2-441_Sep04

Page 1 of 6

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY4	V4.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.8 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.2 $\pm$ 0.2) °C	---	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	condition	
SAR measured	250 mW input power	2.54 mW / g
SAR normalized	normalized to 1W	10.2 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	10.2 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.65 mW / g
SAR normalized	normalized to 1W	6.60 mW / g
SAR for nominal Head TSL parameters ¹	normalized to 1W	6.63 mW / g $\pm$ 16.5 % (k=2)

¹ Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	51.6 Ω - 6.8 j Ω
Return Loss	23.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.375 ns
----------------------------------	----------

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

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.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 9, 2001

DASY4 Validation Report for Head TSL

Date/Time: 09/16/04 14:52:29

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN441

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

Medium: HSL 835 MHz;

Medium parameters used: $f = 835$ MHz; $\sigma = 0.92$ mho/m; $\epsilon_r = 41.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.3, 6.3, 6.3); Calibrated: 23.01.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom half size; Type: QD000P49AA; Serial: SN:1001;
- Measurement SW: DASY4, V4.3 Build 20; Postprocessing SW: SEMCAD, V1.8 Build 126

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 2.74 mW/g

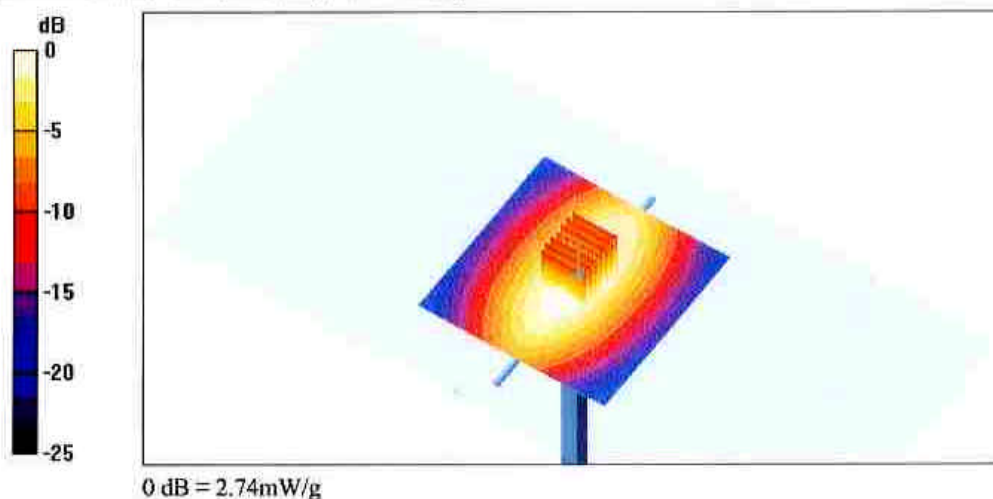
Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.4 V/m; Power Drift = 0.003 dB

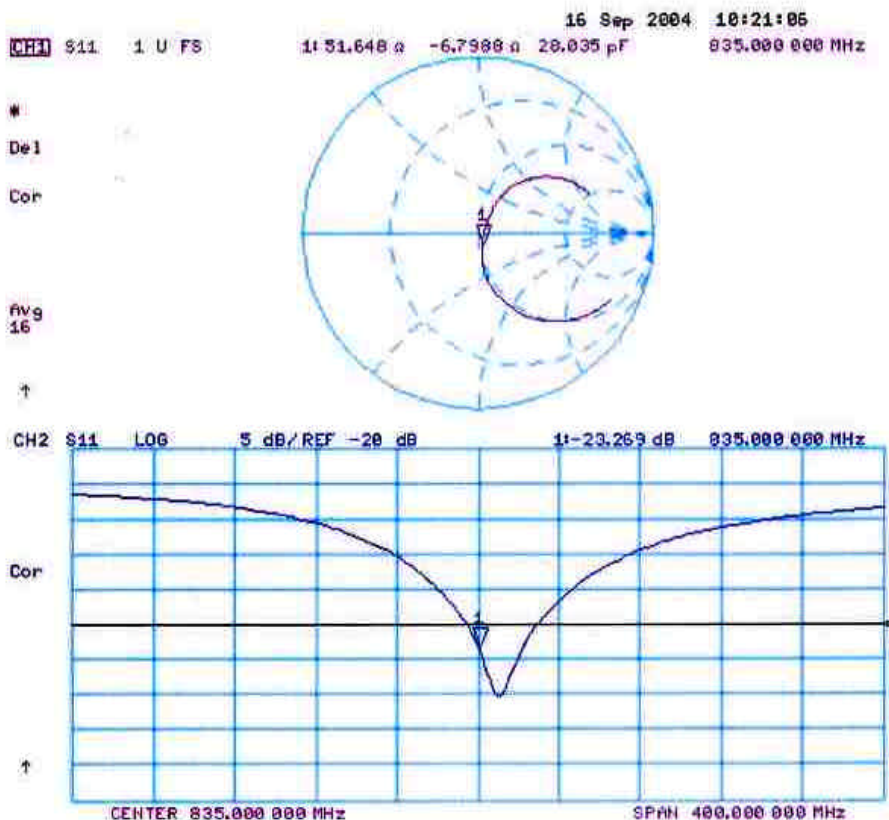
Peak SAR (extrapolated) = 3.78 W/kg

SAR(1 g) = 2.54 mW/g; SAR(10 g) = 1.65 mW/g

Maximum value of SAR (measured) = 2.74 mW/g



Impedance Measurement Plot for Head TSL



Calibration Laboratory of
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 Zeughausstrasse 43, 8004 Zurich, Switzerland

Client **H-CT (Dymstec)**

CALIBRATION CERTIFICATE

Object(s) D1900V2 - SN:5d032

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

Calibration date: April 26, 2004

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

This calibration statement documents traceability of M&E 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&E critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37460704	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	100898	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390665	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Oct-05

Calibrated by: Name: Judith Mueller Function: Technician Signature: 

Approved by: Name: Kaja Pokovic Function: Laboratory Director Signature: 

Date issued: April 27, 2004

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: D1900V2

Serial: 5d032

Manufactured: March 17, 2003
Calibrated: April 26, 2004

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	40.1	$\pm 5\%$
Conductivity	1.45 mho/m	$\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.96 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 mW $\pm 3\%$. The results are normalized to 1 W 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 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm³ (1 g) of tissue: **40.0 mW/g $\pm 16.8\%$ (k=2)¹**

averaged over 10 cm³ (10 g) of tissue: **21.0 mW/g $\pm 16.2\%$ (k=2)¹**

¹ 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: **1.192 ns** (one direction)
Transmission factor: **0.999** (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: $\text{Re}\{Z\} = 49.8 \Omega$

$\text{Im}\{Z\} = 3.4 \Omega$

Return Loss at 1900 MHz: **-29.5 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.

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 - SN5d032

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL 1900 MHz;

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 40.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.96, 4.96, 4.96); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASY4, V4.2 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 112

Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm

Reference Value = 92 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 11.4 mW/g

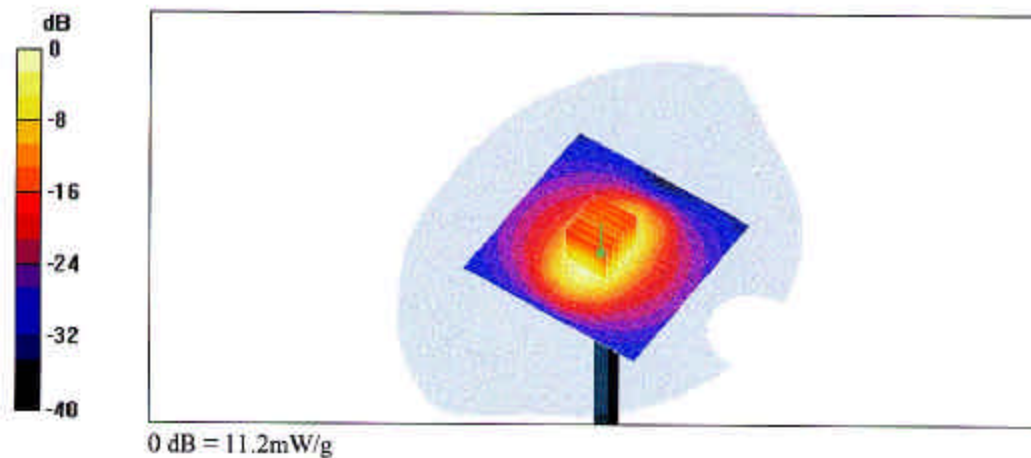
Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 11.2 mW/g

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 10 mW/g; SAR(10 g) = 5.25 mW/g



5d052

