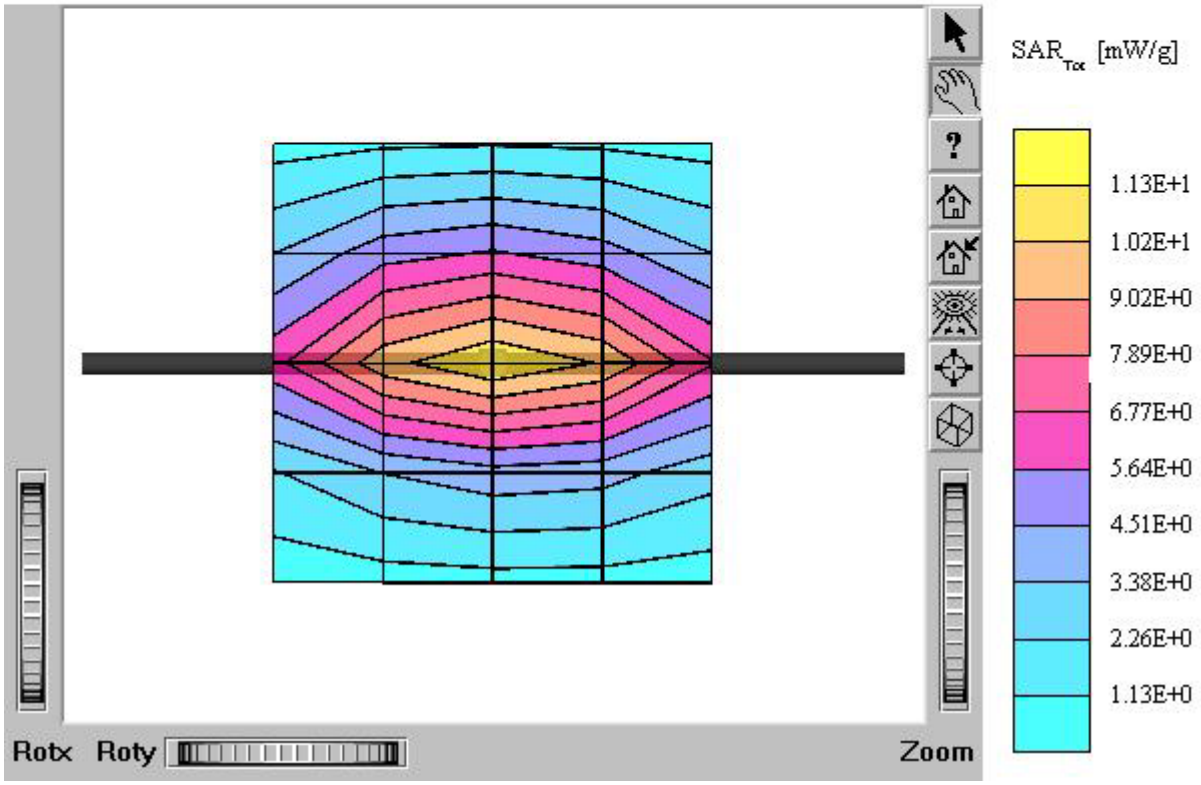
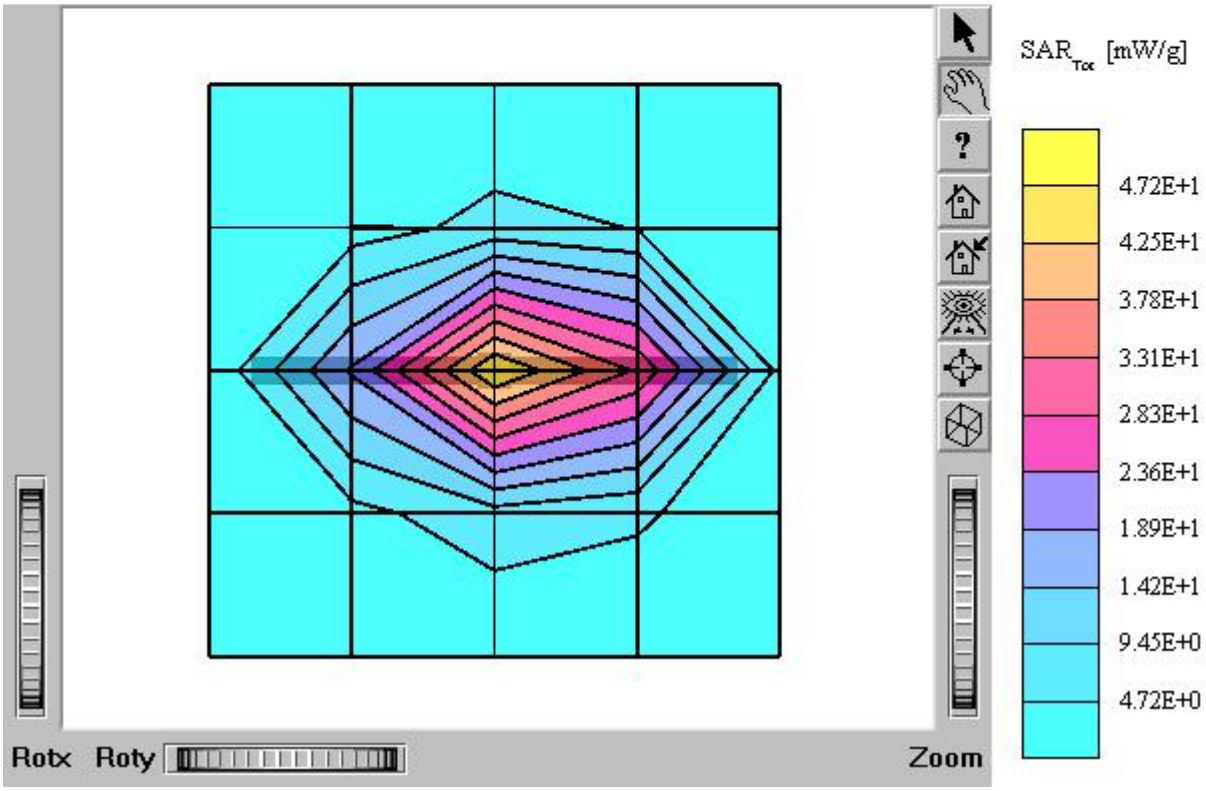
■ Validation Data (835MHz Brain)

Dipole 835 MHz
SAM I Phantom; Flat Section; Position: (90°,90°); Frequency: 835 MHz
Probe: ET3DV6 - SN1609; ConvF(6.63,6.63,6.63); Crest factor: 1.0; Brain 835 MHz: s = 0.91 mho/m e_r = 40.2 r = 1.00 g/cm³
Cubes (2): SAR (1g): 10.3 mW/g ± 0.02 dB, SAR (10g): 6.61 mW/g ± 0.02 dB
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.00 dB
Comment:
835MHz Brain Dipole Validation (D835V2/ S.N: 441)
Antenna Input Power: 30 dBm (1W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature: 21.4℃
Date Tested : February 17, 2005



■ Validation Data (1900MHz Brain)

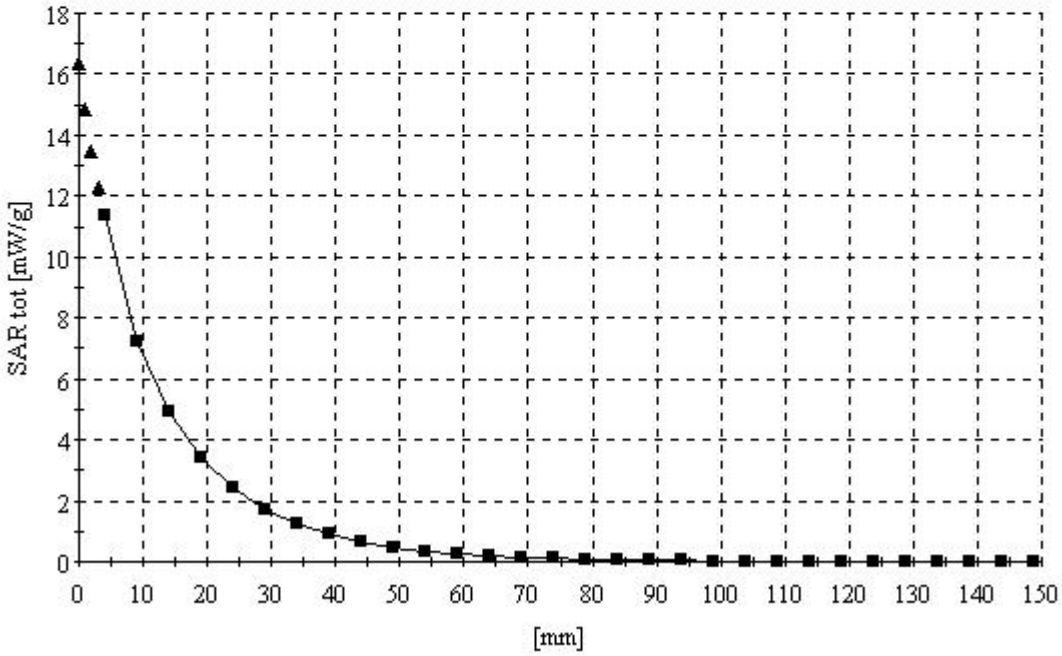
Dipole 1900 MHz
SAM II Phantom; Flat Section; Position: (90°,90°); Frequency: 1900 MHz
Probe: ET3DV6 - SN1609; ConvF(5.34,5.34,5.34); Crest factor: 1.0; Brain 1900 MHz: s = 1.42 mho/m e_r = 39.6 r = 1.00 g/cm³
Cubes (2): SAR (1g): 41.6 mW/g ± 0.03 dB, SAR (10g): 20.7 mW/g ± 0.02 dB
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.03 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℃
Date Tested : February 17, 2005



Dipole 835 MHz

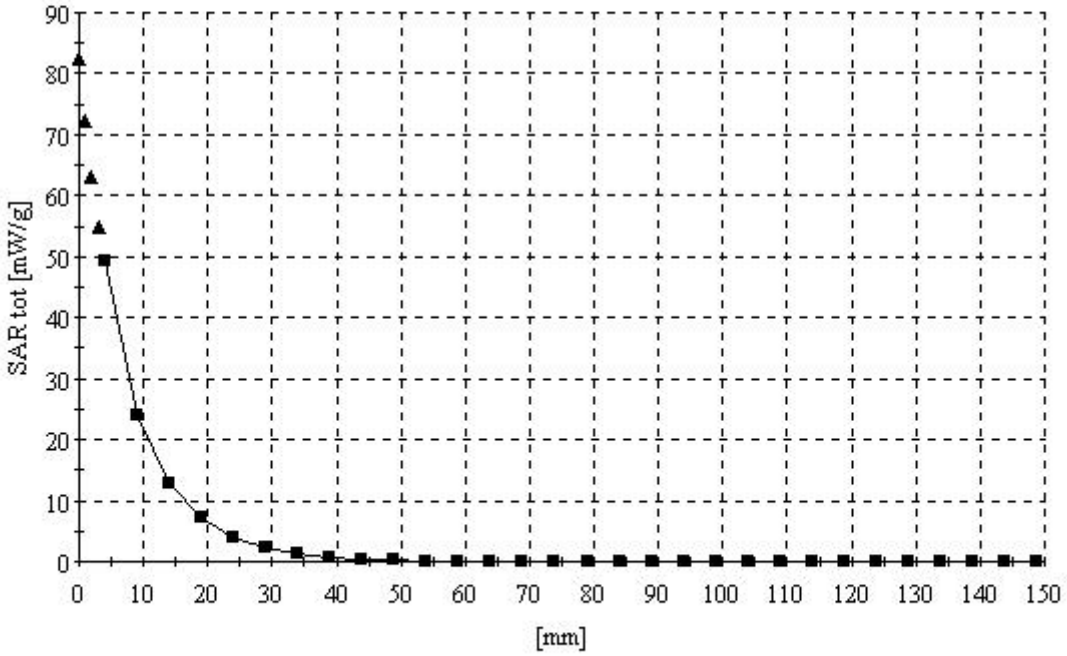
SAM I Phantom; Section; Position: ; Frequency: 835 MHz
Probe: ET3DV6 - SN1609; ConvF(6.63,6.63,6.63); Crest factor: 1.0; Brain 835 MHz: s = 0.91 mho/m e, = 40.2 r = 1.00 g/cm³
:
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Comment:
835MHz Brain Dipole Validation (D835V2/ S.N: 441)
Antenna Input Power: 30 dBm (1W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature: 21.4℃
Date Tested : February 17, 2005



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 = 1.42 mho/m e_r = 39.6 r = 1.00 g/cm³
:
Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 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℃
Date Tested : February 17, 2005



■ Dielectric Parameter (835MHz Brain)

Title : C2000

SubTitle : AMPS CDMA BRAIN

February 17, 2005 09:11 AM

Frequency	e'	e''
800.000000 MHz	39.6962	20.0307
805.000000 MHz	39.8199	19.8755
810.000000 MHz	39.9574	19.7388
815.000000 MHz	40.0511	19.6461
820.000000 MHz	40.1527	19.5674
825.000000 MHz	40.1670	19.5226
830.000000 MHz	40.2560	19.5791
835.000000 MHz	40.1579	19.6430
840.000000 MHz	40.0606	19.6647
845.000000 MHz	39.9515	19.6376
850.000000 MHz	39.8079	19.6310
855.000000 MHz	39.7210	19.5992
860.000000 MHz	39.6345	19.6396
865.000000 MHz	39.5490	19.5674
870.000000 MHz	39.4871	19.5405
875.000000 MHz	39.3724	19.5388
880.000000 MHz	39.2763	19.4720
885.000000 MHz	39.1912	19.4231
890.000000 MHz	39.1128	19.4129
895.000000 MHz	39.0743	19.3820
900.000000 MHz	38.9764	19.3484

■ Dielectric Parameter (1900MHz Brain)

Title : C2000
SubTitle : PCS BRAIN
February 17, 2005 09:34 AM

Frequency	e'	e''
1.800000000 GHz	39.9033	13.0290
1.806666667 GHz	39.8762	13.0690
1.813333333 GHz	39.8211	13.1019
1.820000000 GHz	39.8067	13.1947
1.826666667 GHz	39.8033	13.2109
1.833333333 GHz	39.7797	13.2667
1.840000000 GHz	39.8082	13.3322
1.846666667 GHz	39.8248	13.3777
1.853333333 GHz	39.7928	13.4022
1.860000000 GHz	39.8227	13.3998
1.866666667 GHz	39.8066	13.4382
1.873333333 GHz	39.7924	13.4454
1.880000000 GHz	39.7546	13.4526
1.886666667 GHz	39.7020	13.4545
1.893333333 GHz	39.6371	13.4316
1.900000000 GHz	39.5521	13.4369
1.906666667 GHz	39.4932	13.4495
1.913333333 GHz	39.3933	13.4710
1.920000000 GHz	39.3329	13.4793
1.926666667 GHz	39.2812	13.5000
1.933333333 GHz	39.2099	13.5306
1.940000000 GHz	39.2056	13.5770
1.946666667 GHz	39.1792	13.6022
1.953333333 GHz	39.1569	13.6778
1.960000000 GHz	39.1531	13.7266

■ Dielectric Parameter (835MHz Muscle)

Title : C2000

SubTitle : AMPS CDMA BODY

February 17, 2005 03:17 PM

Frequency	e'	e''
800.000000 MHz	54.0922	21.5423
805.000000 MHz	54.0402	21.4436
810.000000 MHz	54.0682	21.4416
815.000000 MHz	54.1100	21.2881
820.000000 MHz	54.0728	21.2589
825.000000 MHz	54.0576	21.1496
830.000000 MHz	53.9600	21.2095
835.000000 MHz	53.8971	21.1629
840.000000 MHz	53.8125	21.1139
845.000000 MHz	53.7736	21.0377
850.000000 MHz	53.6509	20.9391
855.000000 MHz	53.6326	20.9436
860.000000 MHz	53.5785	20.9075
865.000000 MHz	53.4961	20.9362
870.000000 MHz	53.4277	20.8848
875.000000 MHz	53.4595	20.8705
880.000000 MHz	53.3632	20.8253
885.000000 MHz	53.3241	20.8433
890.000000 MHz	53.3285	20.8077
895.000000 MHz	53.2884	20.7370
900.000000 MHz	53.2032	20.7366

■ Dielectric Parameter (1900MHz Muscle)

Title : C2000
SubTitle : PCS BODY
February 17, 2005 04:14 PM

Frequency	e'	e''
1.800000000 GHz	51.3462	14.6726
1.810000000 GHz	51.3109	14.7122
1.820000000 GHz	51.2843	14.7554
1.830000000 GHz	51.2432	14.8002
1.840000000 GHz	51.2420	14.8224
1.850000000 GHz	51.2137	14.8817
1.860000000 GHz	51.1565	14.9089
1.870000000 GHz	51.1042	14.9394
1.880000000 GHz	51.0707	14.9897
1.890000000 GHz	50.9769	14.9720
1.900000000 GHz	50.9201	14.9583
1.910000000 GHz	50.8845	14.9552
1.920000000 GHz	50.8300	14.9974
1.930000000 GHz	50.8006	15.0178
1.940000000 GHz	50.7559	15.0628
1.950000000 GHz	50.7037	15.0973
1.960000000 GHz	50.6825	15.1643
1.970000000 GHz	50.6893	15.1817
1.980000000 GHz	50.6484	15.2459
1.990000000 GHz	50.6276	15.2603
2.000000000 GHz	50.5790	15.2618

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

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Accredited by the Swiss Federal Office of Metrology and Accreditation
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 ± 3)°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 ET3DV6	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

	Name	Function	Signature
Calibrated by:	Judith Mueller	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 24, 2004

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

S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
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:

a) 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
b) 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
c) 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:

d) 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 ± 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 ± 0.2) °C	41.8 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature during test	(21.2 ± 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 ± 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 ± 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 jΩ
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

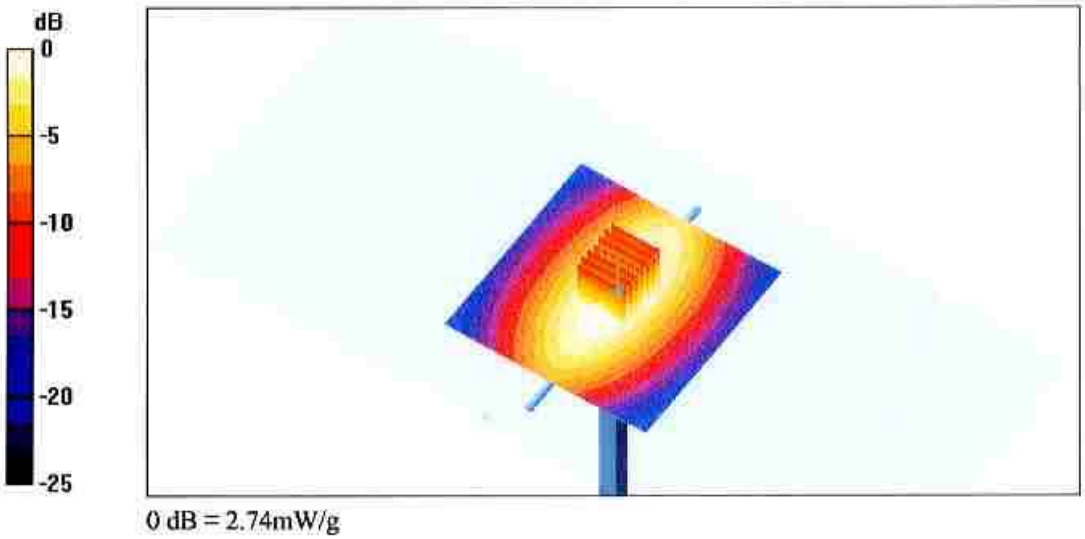
Communication System: CW-835; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: HSL 835 MHz;
Medium parameters used: f = 835 MHz; σ = 0.92 mho/m; ε_r = 41.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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

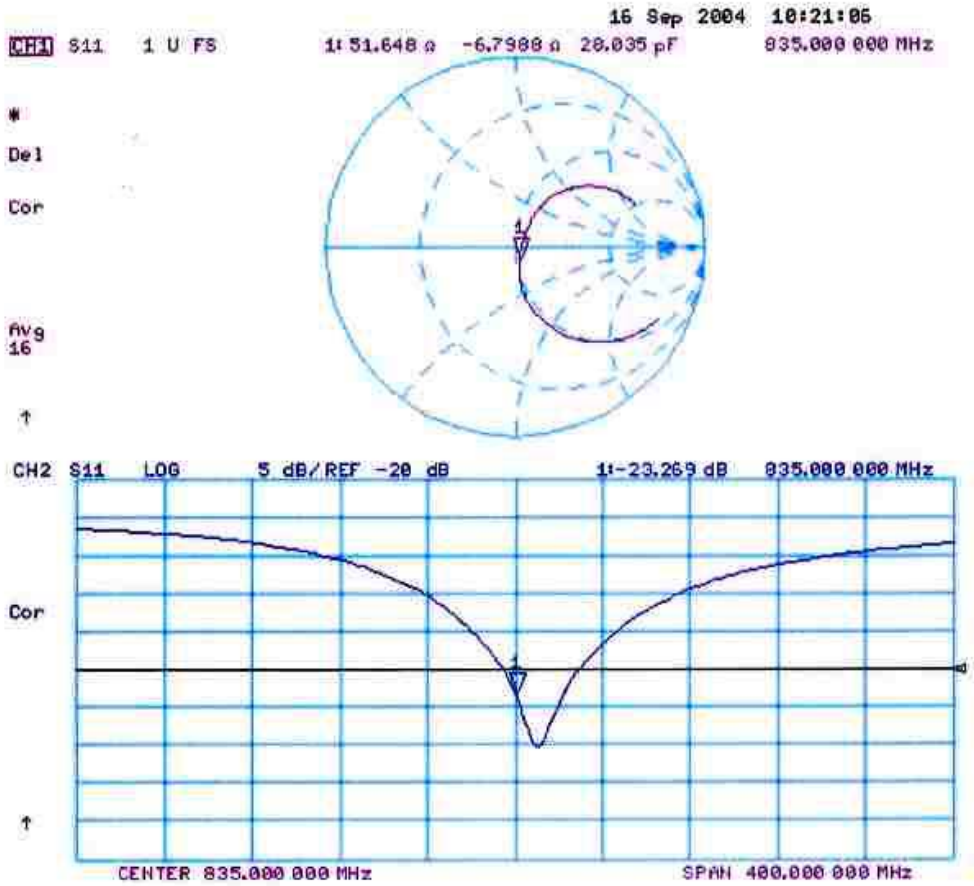
Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.74 mW/g

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



0 dB = 2.74mW/g

Impedance Measurement Plot for Head TSL



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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&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E442	GB37480704	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	US37292783	6-Nov-03 (METAS, No. 252-0254)	Nov-04
Power sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

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.

880-KP0301061-A

Schmid & Partner Engineering AG

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

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**	± 5%
Conductivity	**1.45 mho/m**	± 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 ± 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:	**40.0 mW/g** ± 16.8 % (k=2)[1]
averaged over 10 cm^3 (10 g) of tissue:	**21.0 mW/g** ± 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:	Re{Z} = **49.8 Ω**
	Im {Z} = **3.4 Ω**
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.

Date/Time: 04/26/04 13:04:32

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d032

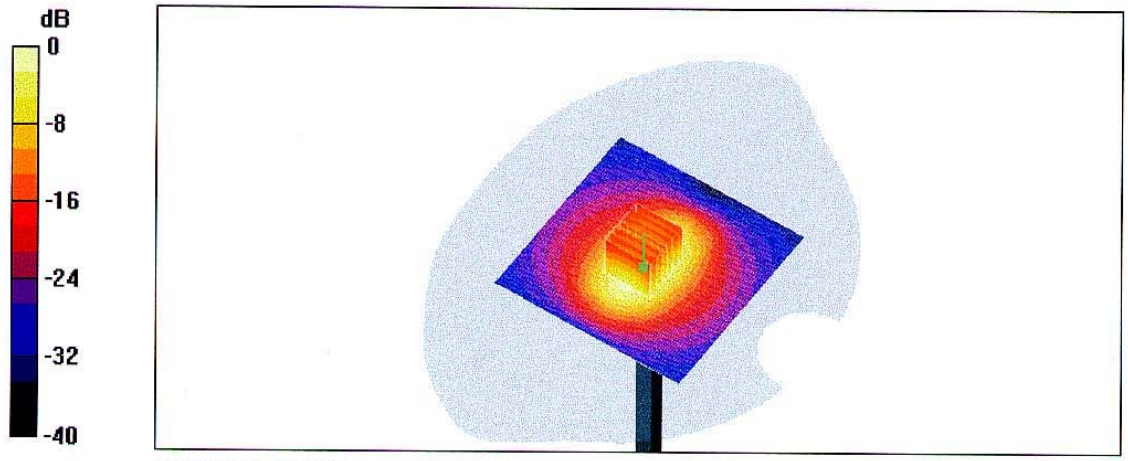
Communication System: CW-1900; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: HSL 1900 MHz;
Medium parameters used: f = 1900 MHz; σ = 1.45 mho/m; ε_r = 40.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

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

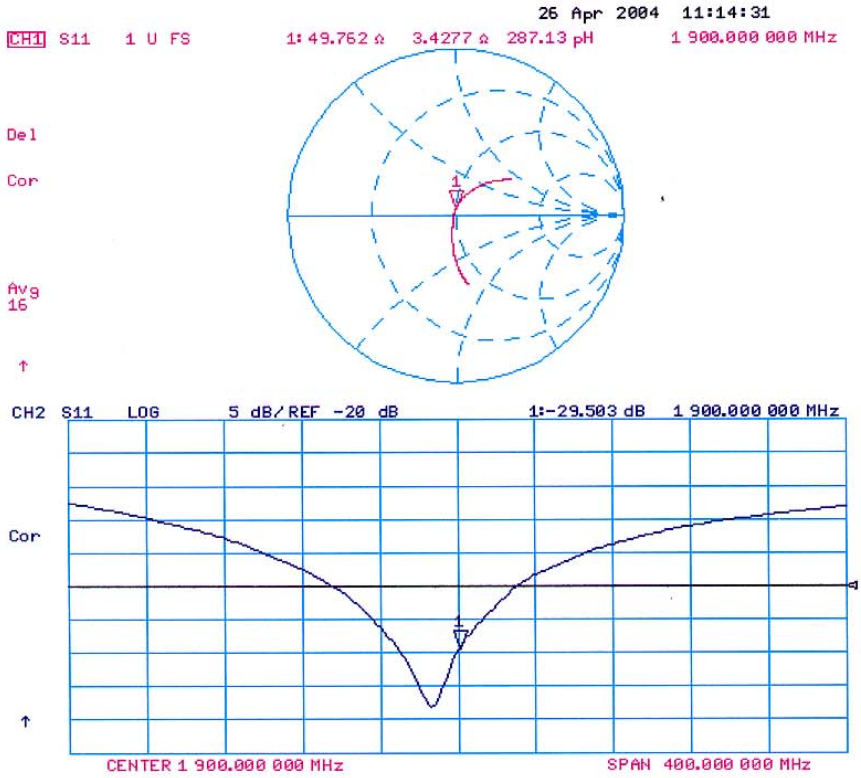
Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 92 V/m; Power Drift = 0.0 dB
Maximum value of SAR (interpolated) = 11.4 mW/g

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



0 dB = 11.2mW/g

5d032


26 Apr 2004 11:14:31
CH1 S11 1 U FS
1: 49.762 Ω 3.4277 Ω 287.13 pH
1 900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG
5 dB/ REF -20 dB
1:-29.503 dB 1 900.000 000 MHz
Cor
CENTER 1 900.000 000 MHz
SPAN 400.000 000 MHz