Calibration Laboratory of
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ilac-MRA

SWISS CALIBRATION

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **CCS (Auden)**

Certificate No: **D835V2-4d015_Nov06**

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d015
Calibration procedure(s)	QA CAL-05.v6 Calibration procedure for dipole validation kits
Calibration date:	November 21, 2006
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 meter EPM-442A	GB37480704	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Power sensor HP 8481A	US37292783	03-Oct-06 (METAS, No. 217-00608)	Oct-07
Reference 20 dB Attenuator	SN: 5086 (20g)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	10-Aug-06 (METAS, No 217-00591)	Aug-07
Reference Probe ET3DV6 (HF)	SN 1507	19-Oct-06 (SPEAG, No. ET3-1507_Oct06)	Oct-07
DAE4	SN 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-05)	In house check: Oct-07
RF generator Agilent E4421B	MY41000675	11-May-05 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-06)	In house check: Oct-07

	Name	Function	Signature
Calibrated by:	Mike Meili	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 23, 2006

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

Glossary:

TSL	tissue simulating liquid
ConvF	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	V4.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
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	42.1 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature during test	(22.3 ± 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	2.28 mW / g
SAR normalized	normalized to 1W	9.12 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**9.19 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.50 mW / g
SAR normalized	normalized to 1W	6.00 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**6.04 mW / g ± 16.5 % (k=2)**

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

Body TSL parameters

The following parameters and calculations were applied.

		Temperature	Permittivity	Conductivity
Nominal Body TSL parameters		22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters		(22.0 ± 0.2) °C	53.6 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature during test		(22.5 ± 0.2) °C	----	—

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL		condition	
SAR measured		250 mW input power	2.47 mW / g
SAR normalized		normalized to 1W	9.88 mW / g
SAR for nominal Body TSL parameters [2]		normalized to 1W	**9.56 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL		condition	
SAR measured		250 mW input power	1.63 mW / g
SAR normalized		normalized to 1W	6.52 mW / g
SAR for nominal Body TSL parameters [2]		normalized to 1W	**6.35 mW / g ± 16.5 % (k=2)**

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[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point		53.0 Ω - 3.9 jΩ
Return Loss		- 26.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point		49.5 Ω - 4.6 jΩ
Return Loss		- 26.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)		1.390 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		April 22, 2004

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d015

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL 900 MHz;
Medium parameters used: f = 835 MHz; $\sigma = 0.901$ mho/m; $\varepsilon_r = 42.2$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(6.09, 6.09, 6.09); Calibrated: 19.10.2006

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 15.12.2005

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA

- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.9 V/m; Power Drift = -0.003 dB
Peak SAR (extrapolated) = 3.28 W/kg
SAR(1 g) = 2.28 mW/g; SAR(10 g) = 1.5 mW/g
Maximum value of SAR (measured) = 2.47 mW/g

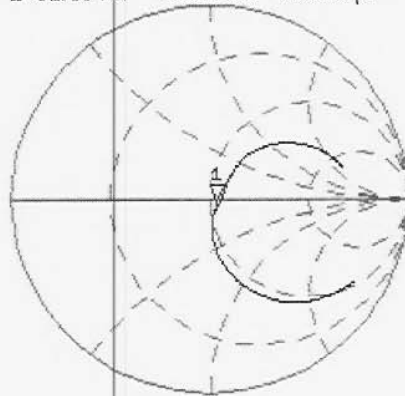0 dB = 2.47mW/g
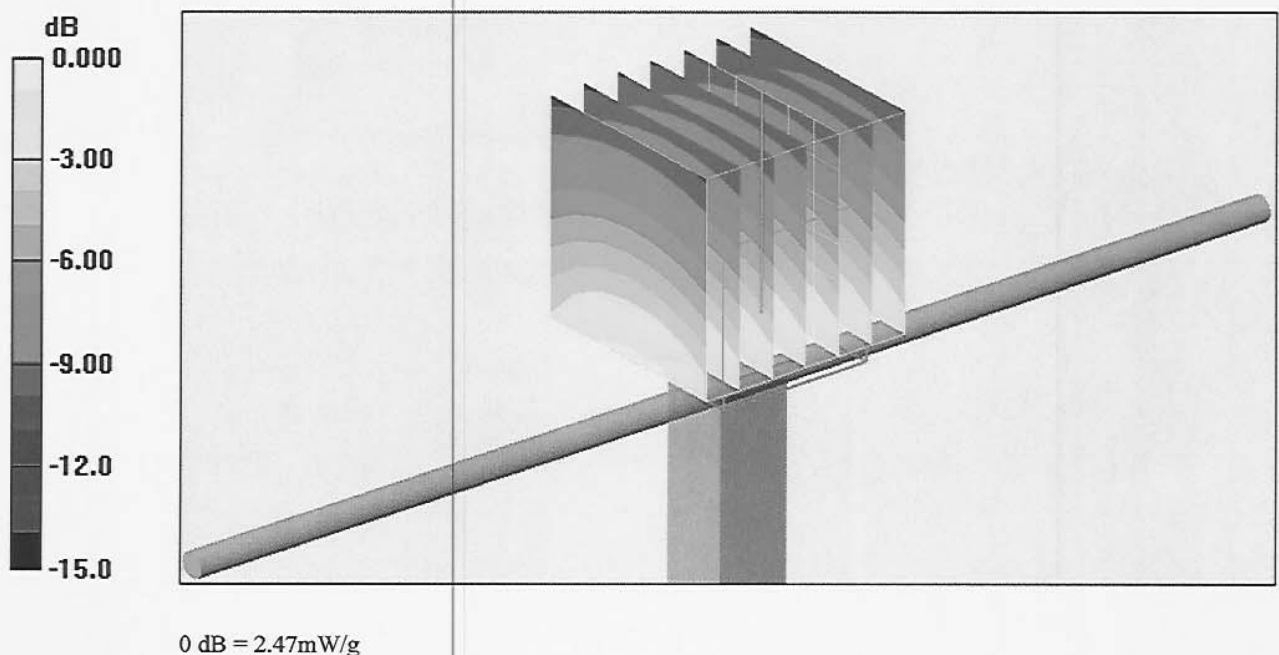
Impedance Measurement Plot for Head TSL

21 Nov 2006 11:39:46

CH1 S11   1 U FS   1: 52.994 Ω   -3.8672 Ω 49.288 pF   835.000 000 MHz

*

Del

CΔ

Avg
16
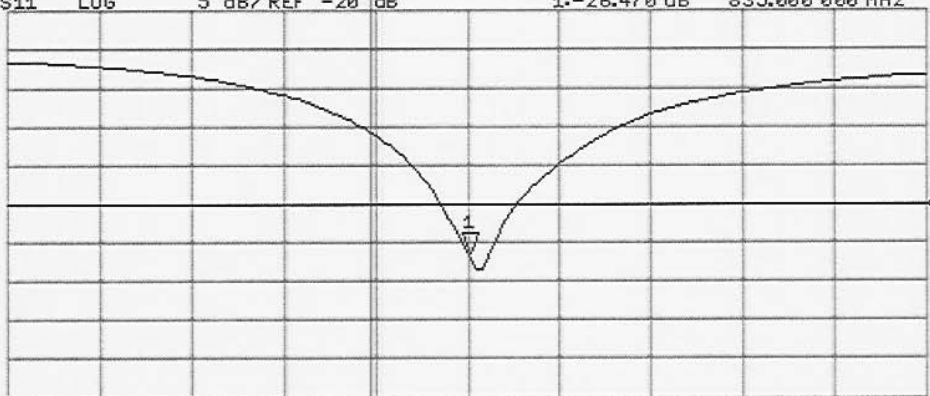
↑

CH2 S11   LOG   5 dB/ REF -20 dB   1:-26.470 dB   835.000 000 MHz

CΔ

Avg
16

↑

CENTER 835.000 000 MHz   SPAN 400.000 000 MHz

DASY4 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d015

Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: MSL900;
Medium parameters used: f = 835 MHz; σ = 0.99 mho/m; ε_r = 53.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(5.75, 5.75, 5.75); Calibrated: 19.10.2006

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 15.12.2005

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA

- Measurement SW: DASY4, V4.7 Build 44; Postprocessing SW: SEMCAD, V1.8 Build 171

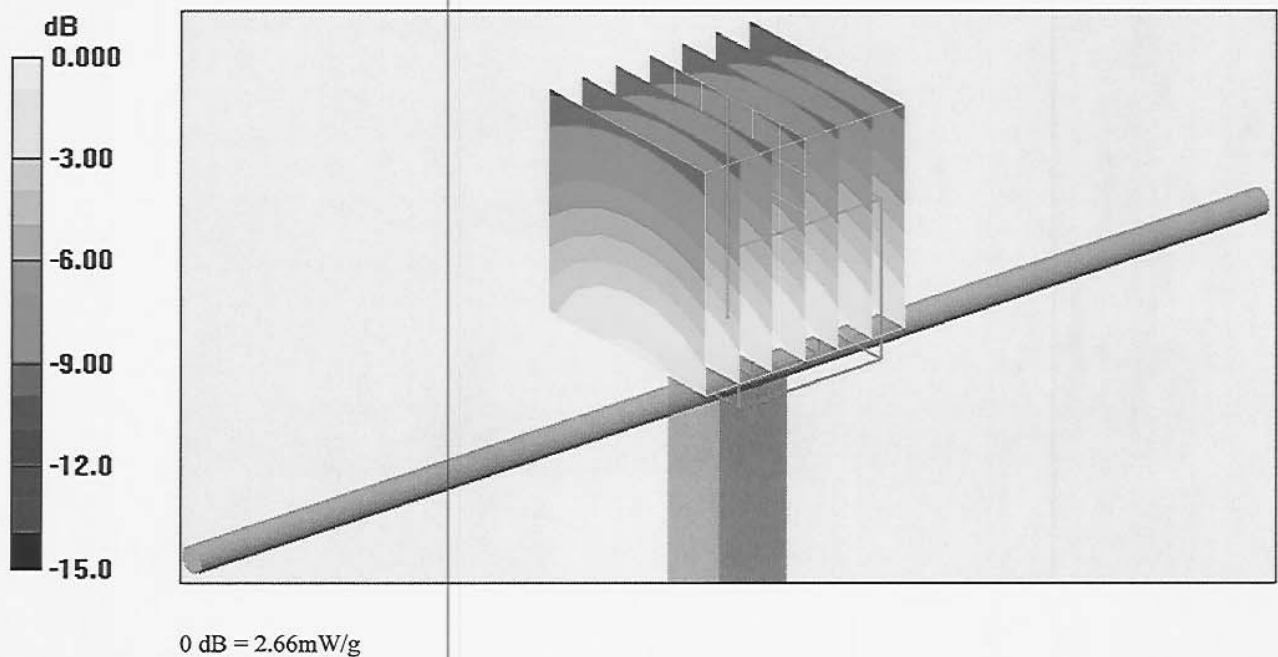## Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.1 V/m; Power Drift = -0.007 dB
Peak SAR (extrapolated) = 3.46 W/kg
SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.63 mW/g
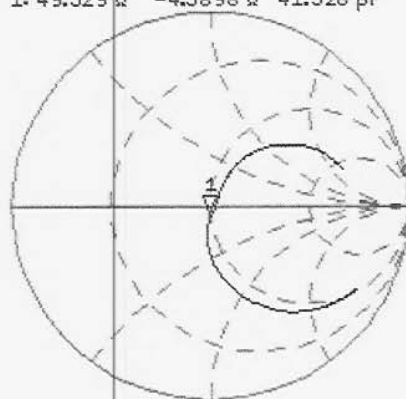Maximum value of SAR (measured) = 2.66 mW/g

0 dB = 2.66mW/g

Impedance Measurement Plot for Body TSL

14 Nov 2006 11:38:37

CH1 S11   1 U FS   1: 49.529 Ω   -4.5898 Ω 41.528 pF   835.000 000 MHz

*

Del

CΔ

Avg
16

↑

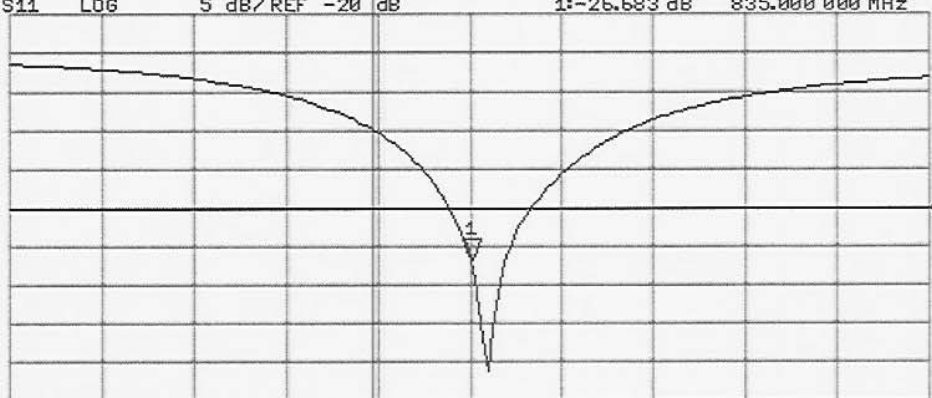CH2 S11   LOG   5 dB/ REF -20 dB   1:-26.683 dB   835.000 000 MHz

CΔ

Avg
16

↑

CENTER 835.000 000 MHz   SPAN 400.000 000 MHz