

## APPENDIX D CALIBRATION DOCUMENTS

1. SN: 1380 Probe Calibration Certificate
2. SN: DV900 Dipole Calibration Certificate
3. SN: DV1800V2 Dipole Calibration Certificate
4. SN: 3563 Probe Calibration Certificate
5. SN: 1008 Dipole Calibration Certificate



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



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Accreditation No.: SCS 108

Client EMC Technologies

Certificate No: ET3-1380\_Dec07

## CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1380

Calibration procedure(s) QA CAL-01.v6 and QA CAL-12.v5  
Calibration procedure for dosimetric E-field probes

Calibration date December 18, 2007

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 E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5066 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5128 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ES3DV2	SN: 3013	4-Jan-07 (SPEAG, No. ES3-3013_Jan07)	Jan-08
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-09 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

Calibrated by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	

Approved by:	Name	Function	Signature
	Niels Kuster	Quality Manager	

Issued: December 18, 2007

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Page 1 of 9



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ET3DV6 SN:1380

December 18, 2007

# Probe ET3DV6

## SN:1380

Manufactured: August 16, 1999  
Last calibrated: December 12, 2006  
Recalibrated: December 18, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ET3-1380\_Dec07

Page 3 of 9



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ET3DV6 SN:1380

December 18, 2007

**DASY - Parameters of Probe: ET3DV6 SN:1380****Sensitivity in Free Space<sup>A</sup>**

NormX	<b>1.64</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	<b>1.59</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	<b>1.69</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$

**Diode Compression<sup>B</sup>**

DCP X	<b>90</b> mV
DCP Y	<b>89</b> mV
DCP Z	<b>92</b> mV

**Sensitivity in Tissue Simulating Liquid (Conversion Factors)**

Please see Page 8.

**Boundary Effect**

TSL      900 MHz      Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance	<b>3.7</b> mm	<b>4.7</b> mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	11.0
SAR <sub>be</sub> [%]	With Correction Algorithm	0.8

TSL      1810 MHz      Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	<b>3.7</b> mm	<b>4.7</b> mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	12.4
SAR <sub>be</sub> [%]	With Correction Algorithm	0.5

**Sensor Offset**Probe Tip to Sensor Center      **2.7** mm

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

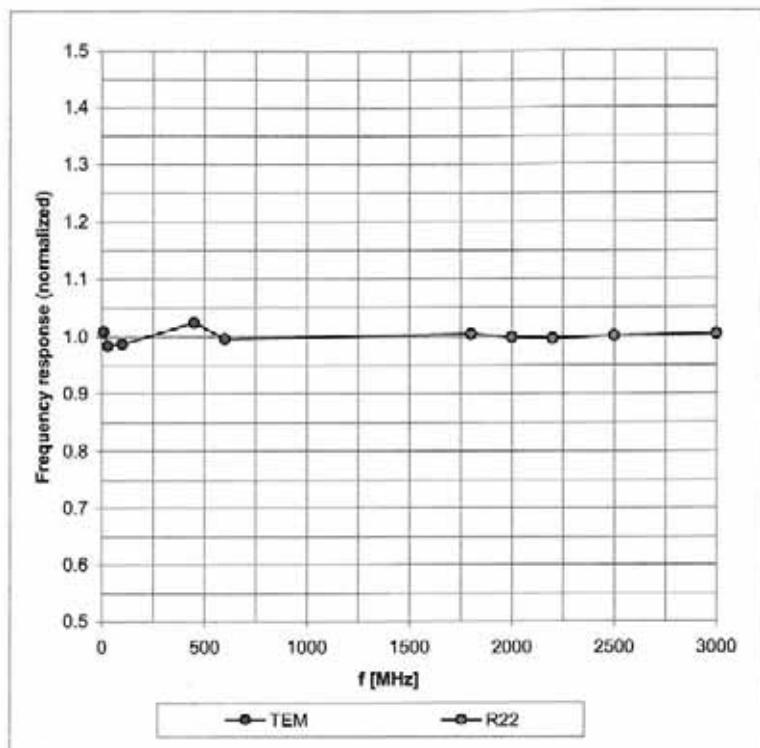
<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).<sup>B</sup> Numerical linearization parameter: uncertainty not required.

ET3DV6 SN:1380

December 18, 2007

## Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)

Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

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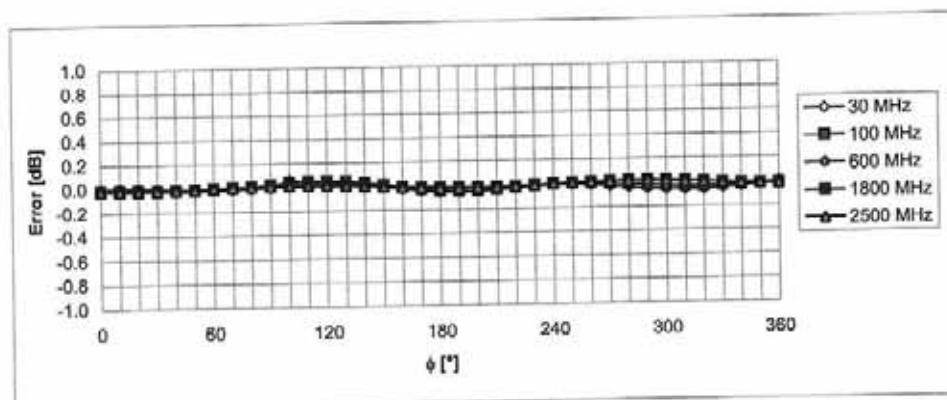
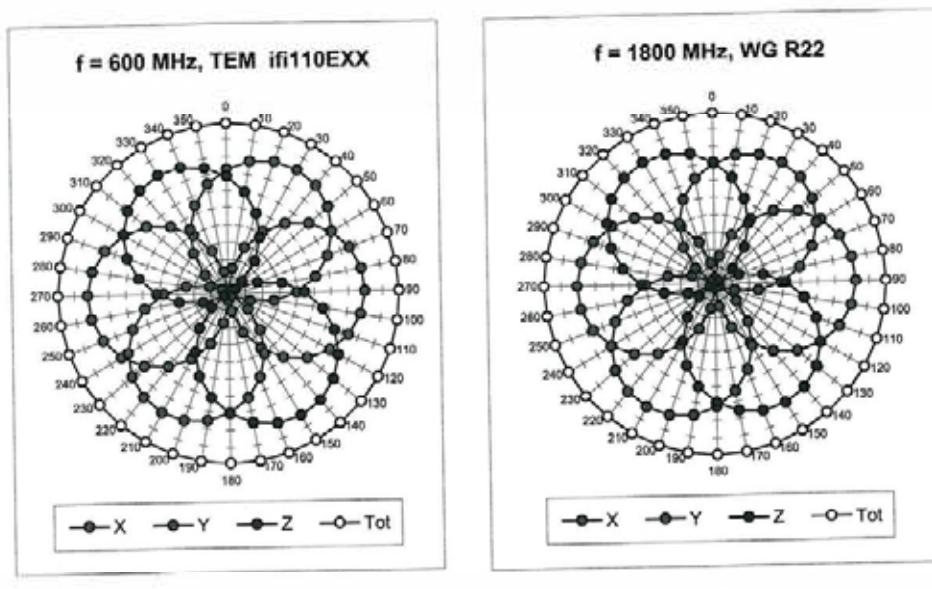
Page 5 of 9



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Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$ Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

Certificate No: ET3-1380\_Dec07

Page 6 of 9

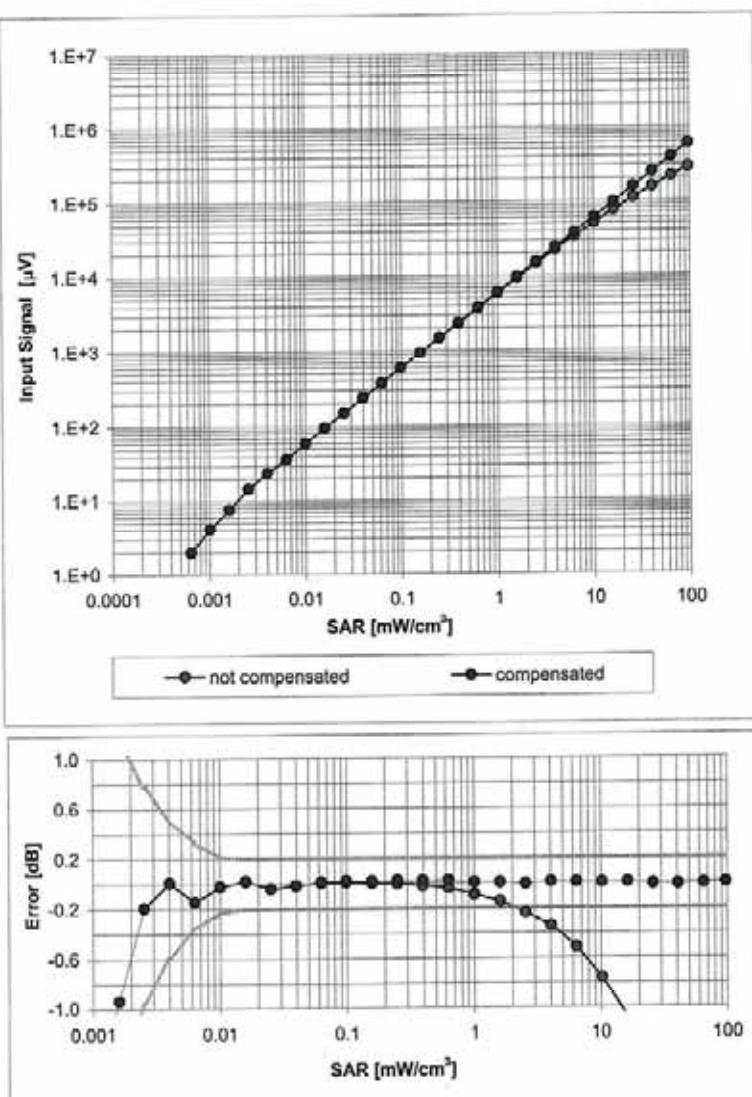


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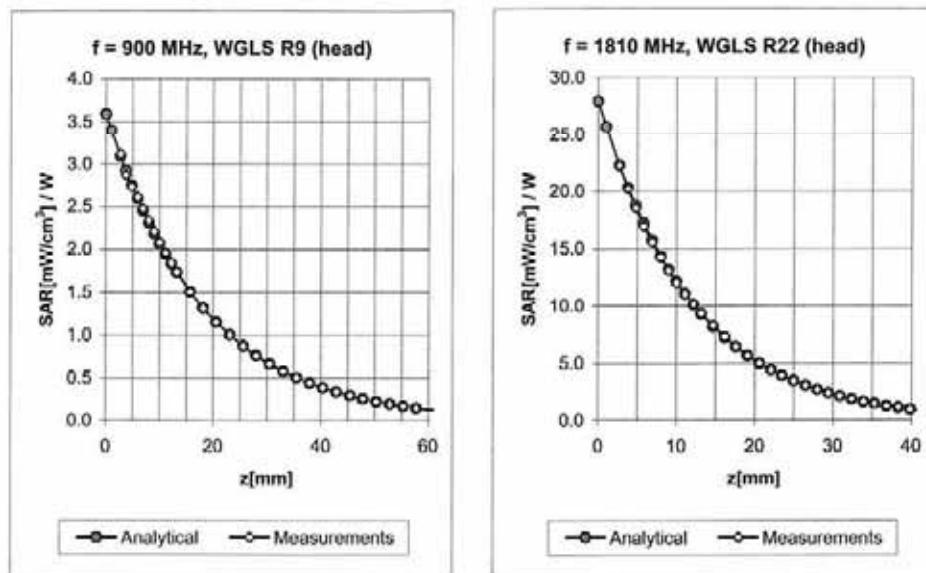
### Dynamic Range f(SAR<sub>head</sub>) (Waveguide R22, f = 1800 MHz)

Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )

ET3DV6 SN:1380

December 18, 2007

## Conversion Factor Assessment



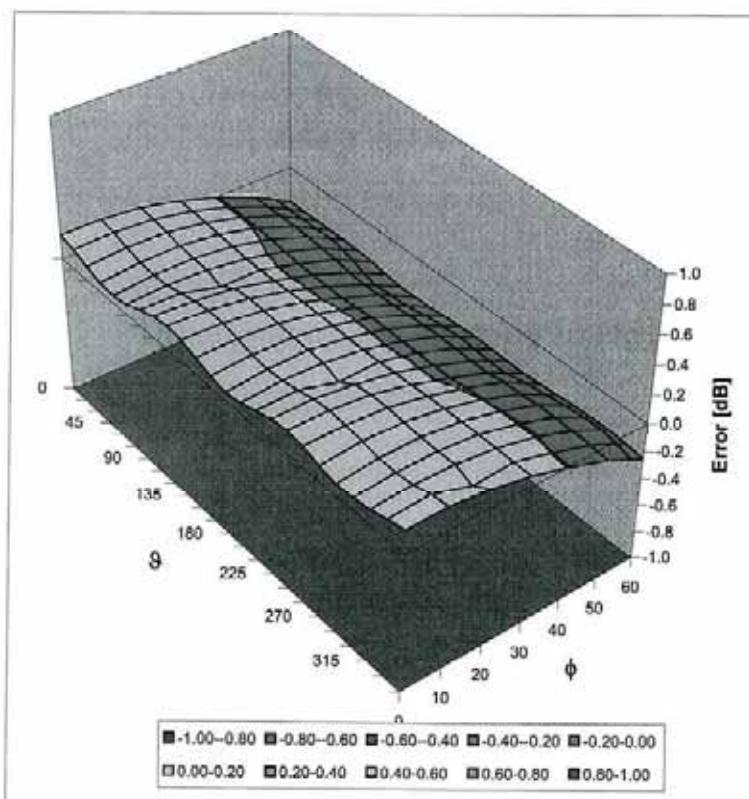
f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	$\pm 50 / \pm 100$	Head	$43.5 \pm 5\%$	$0.87 \pm 5\%$	0.38	1.95	$6.93 \pm 13.3\% \text{ (k=2)}$
900	$\pm 50 / \pm 100$	Head	$41.5 \pm 5\%$	$0.97 \pm 5\%$	0.77	1.96	$6.30 \pm 11.0\% \text{ (k=2)}$
1640	$\pm 50 / \pm 100$	Head	$40.3 \pm 5\%$	$1.29 \pm 5\%$	0.62	2.51	$5.60 \pm 11.0\% \text{ (k=2)}$
1810	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.73	2.11	$5.11 \pm 11.0\% \text{ (k=2)}$
1950	$\pm 50 / \pm 100$	Head	$40.0 \pm 5\%$	$1.40 \pm 5\%$	0.64	2.38	$4.92 \pm 11.0\% \text{ (k=2)}$
2450	$\pm 50 / \pm 100$	Head	$39.2 \pm 5\%$	$1.80 \pm 5\%$	0.95	1.68	$4.55 \pm 11.8\% \text{ (k=2)}$
450	$\pm 50 / \pm 100$	Body	$56.7 \pm 5\%$	$0.94 \pm 5\%$	0.32	1.99	$7.44 \pm 13.3\% \text{ (k=2)}$
900	$\pm 50 / \pm 100$	Body	$55.0 \pm 5\%$	$1.05 \pm 5\%$	0.82	1.93	$6.03 \pm 11.0\% \text{ (k=2)}$
1810	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.89	1.79	$4.79 \pm 11.0\% \text{ (k=2)}$
1950	$\pm 50 / \pm 100$	Body	$53.3 \pm 5\%$	$1.52 \pm 5\%$	0.71	2.12	$4.55 \pm 11.0\% \text{ (k=2)}$
2450	$\pm 50 / \pm 100$	Body	$52.7 \pm 5\%$	$1.95 \pm 5\%$	0.99	1.58	$4.18 \pm 11.8\% \text{ (k=2)}$

<sup>c</sup> The validity of  $\pm 100$  MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.



ET3DV6 SN:1380

December 18, 2007

**Deviation from Isotropy in HSL**Error ( $\phi, \theta$ ),  $f = 900$  MHz

Certificate No: ET3-1380\_Doc07

Page 9 of 9



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Accreditation No.: **SCS 108**

Client

Certificate No.: **D900V2-047\_Jul08**

## CALIBRATION CERTIFICATE

Object	D900V2-SN:047
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	July 07, 2008
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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-07 (No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (No. 217-00736)	Oct-08
Reference 20 dB Attenuator	SN: 5086 (20g)	01-Jul-08 (No. 217-00864)	Jul-09
Type-N mismatch combination	SN: 5047.2 / 06327	01-Jul-08 (No. 217-00867)	Jul-09
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
DAE4	SN 601	14-Mar-08 (No. DAE4-601_Mar08)	Mar-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-07)	In house check: Oct-08

Calibrated by:	Name	Function	Signature
	Jelonj Kastrati	Laboratory technician	

Approved by:	Name	Function	Signature
	Kajaal Pokovic	Technical Manager	

Issued: July 8, 2008

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Certificate No: D900V2-047\_Jul08

Page 1 of 6



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Accreditation No.: **SCS 108**

#### **Glossary:**

<b>TSL</b>	tissue simulating liquid
<b>ConvF</b>	sensitivity in TSL / NORM x,y,z
<b>N/A</b>	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) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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) DASY4/5 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.

<b>DASY Version</b>	DASY4	V4.7
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V4.9	
<b>Distance Dipole Center - TSL</b>	15 mm	with Spacer
<b>Zoom Scan Resolution</b>	$dx, dy, dz = 5 \text{ mm}$	
<b>Frequency</b>	$900 \text{ MHz} \pm 1 \text{ MHz}$	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	41.5	0.97 mho/m
<b>Measured Head TSL parameters</b>	$(22.0 \pm 0.2) \text{ °C}$	$40.2 \pm 6 \text{ %}$	$0.95 \text{ mho/m} \pm 6 \text{ %}$
<b>Head TSL temperature during test</b>	$(22.0 \pm 0.2) \text{ °C}$	---	---

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	2.75 mW / g
SAR normalized	normalized to 1W	11.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>10.9 mW / g <math>\pm 17.0 \text{ % (k=2)}</math></b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	1.78 mW / g
SAR normalized	normalized to 1W	7.12 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>7.07 mW / g <math>\pm 16.5 \text{ % (k=2)}</math></b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.4 $\Omega$ - 6.8 $j\Omega$
Return Loss	- 23.4 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.409 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	October 07, 1998

**DASY4 Validation Report for Head TSL**

Date/Time: 07.07.2008 12:17:03

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN:047**

Communication System: CW-900; Frequency: 900 MHz; Duty Cycle: 1:1

Medium: HSL 900 MHz;

Medium parameters used:  $f = 900$  MHz;  $\sigma = 0.95$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

## DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.78, 5.78, 5.78); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

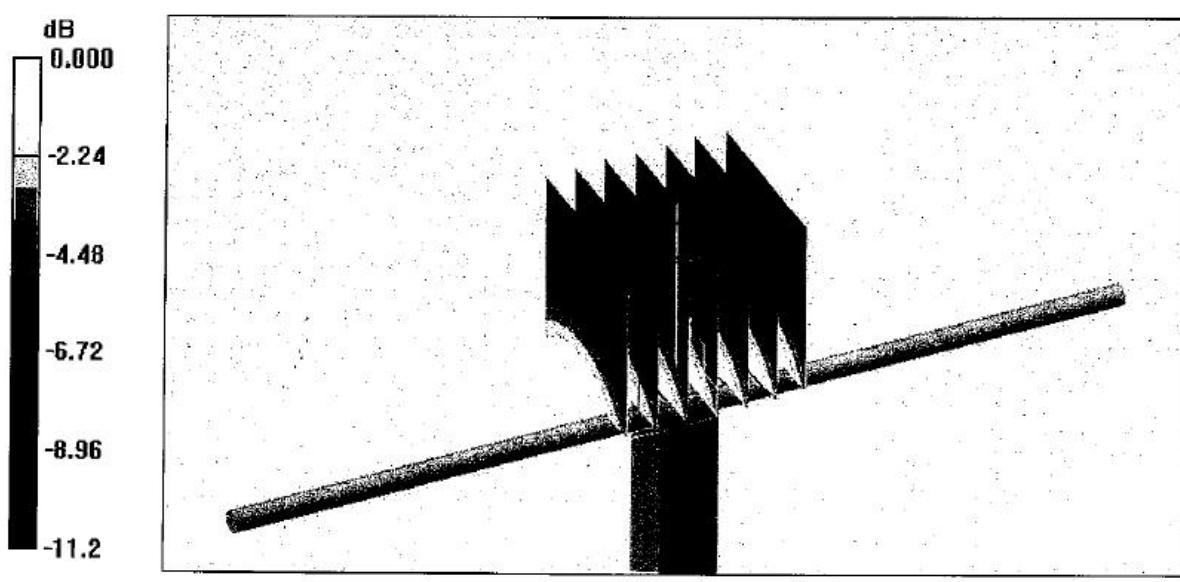
**Pin=250mW; dip=15mm; dist=3.4mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.0 V/m; Power Drift = 0.009 dB

Peak SAR (extrapolated) = 4.11 W/kg

**SAR(1 g) = 2.75 mW/g; SAR(10 g) = 1.78 mW/g**

Maximum value of SAR (measured) = 3.09 mW/g



0 dB = 3.09mW/g

**Impedance Measurement Plot for Head TSL**