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# 6. DAE & Probe Calibration certificate

Accredited by the Swiss Accreditation	n Service (SAS)	Accredita	ation No.: SCS 108
The Swiss Accreditation Service i Multilateral Agreement for the rec	s one of the signatories	to the EA	
Client SGS (Auden)			te No: DAE4-856_May09
CALIBRATION CI	ERTIFICATE		
Object	DAE4 - SD 000 D	04 BJ - SN: 856	
Calibration procedure(s)	QA CAL-06.v12 Calibration proceed	dure for the data acquisition e	electronics (DAE)
Calibration date:	May 26, 2009		
Condition of the calibrated item	In Tolerance		
This calibration certificate documer The measurements and the uncerta All calibrations have been conducte	nts the traceability to natic ainties with confidence pr ad in the closed laboratory	inal standards, which realize the physic obability are given on the following page / facility: environment temperature (22 ±	es and are part of the certificate.
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ccredited by the Swiss Accredit he Swiss Accreditation Service			on No.: SCS 108
fultilateral Agreement for the i			
Client SGS (Auden)		Certificate N	No: ES3-3172_May09
CALIBRATION	CERTIFICAT	E	
Object	ES3DV3 - SN:3	172	
Calibration procedure(s)		and QA CAL-23.v3 edure for dosimetric E-field probe	95
Calibration date:	May 27, 2009		
Condition of the calibrated item	In Tolerance		
The measurements and the unc All calibrations have been condu	ertainties with confidence	tional standards, which realize the physical ui probability are given on the following pages a ory facility: environment temperature (22 ± 3) <sup>5</sup>	nd are part of the certificate.
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The measurements and the uno All calibrations have been condu Calibration Equipment used (M8 Primary Standards Power sensor E4419B Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator	ertainties with confidence incted in the closed laborate ATE critical for calibration) ID # GB41293874 MY41495277 MY41495087 SN: S5054 (3c)	probability are given on the following pages a ory facility: environment temperature (22 ± 3)' Cal Date (Certificate No.) 1-Apr-09 (No. 217-01030) 1-Apr-09 (No. 217-01030) 31-Mar-09 (No. 217-01026)	nd are part of the certificate, *C and humidity < 70%. Scheduled Calibration Apr-10 Apr-10 Apr-10 Mar-10
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland

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  - Swiss Calibration Service

Accreditation No.: SCS 108

S



#### Glossary: TSL NORMX

ConvF DCP Polariza

Polariza

	tissue simulating liquid
k,y,Z	sensitivity in free space
	sensitivity in TSL / NORMx,y,z
	diode compression point
ation $\phi$	φ rotation around probe axis
ation 9	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
	measurement center), i.e., a - o is normal to probe axis

# 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held b) devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

# Methods Applied and Interpretation of Parameters:

- NORMx, y, z: Assessed for E-field polarization  $\vartheta = 0$  (f  $\leq 900$  MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx, y, z does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF)
- NORM(f)x,y,z = NORMx,y,z \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCPx, y, z: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx, v, z \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

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ES3DV3 SN:3172

May 27, 2009

# Probe ES3DV3

# SN:3172

Manufactured: Last calibrated: Recalibrated: January 23, 2008 June 23, 2008 May 27, 2009

Calibrated for DASY Systems (Note: non-compatible with DASY2 system!)

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# ES3DV3 SN:3172

# May 27, 2009

# DASY - Parameters of Probe: ES3DV3 SN:3172

Sensitivity in Free Space<sup>A</sup>

Diode Compression<sup>B</sup>

NormX	1.41 ± 10.1%	$\mu$ V/(V/m) <sup>2</sup>	DCP X	<b>94</b> mV	
NormY	1.17 ± 10.1%	$\mu V/(V/m)^2$	DCP Y	<b>93</b> mV	
NormZ	0.96 ± 10.1%	$\mu$ V/(V/m) <sup>2</sup>	DCP Z	94 mV	

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

# **Boundary Effect**

900 MHz Typical SAR gradient: 5 % per mm TSL

Sensor Cente	er to Phantom Surface Distance	3.0 mm	4.0 mm	
SAR <sub>be</sub> [%]	Without Correction Algorithm	9.6	5.4	
SARbe [%]	With Correction Algorithm	0.9	0.7	

#### Typical SAR gradient: 10 % per mm TSL 1810 MHz

Sensor Cente	r to Phantom Surface Distance	3.0 mm	4.0 mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	9.2	5.4
SAR <sub>be</sub> [%]	With Correction Algorithm	0.7	0.4

# Sensor Offset

Probe Tip to Sensor Center

2.0 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

Certificate No: ES3-3172 May09

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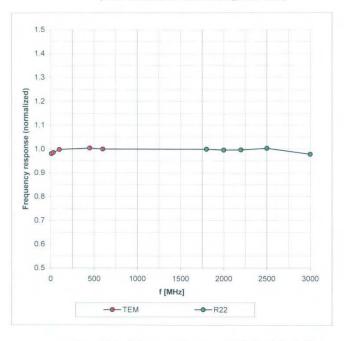


# ES3DV3 SN:3172

May 27, 2009

# Frequency Response of E-Field

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



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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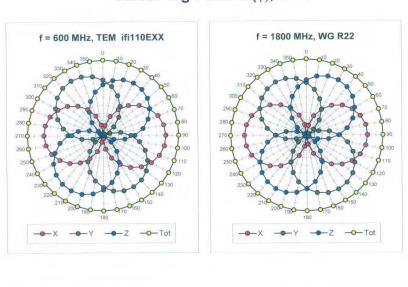
No.134, Wu Kung Road, Wuku Industrial Zone, Taipei County, Taiwan /台北縣五股工業區五工路 134 號 aiwan Ltd. f (886-2) 2298-0488 t (886-2) 2299-3279 www.tw.sgs.com



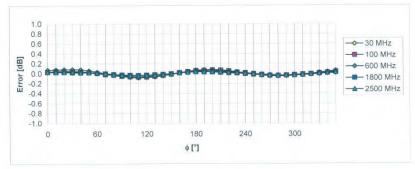
Report No. : EN/2009/90001 Page : 140 of 194

ES3DV3 SN:3172

May 27, 2009



# Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: ES3-3172\_May09

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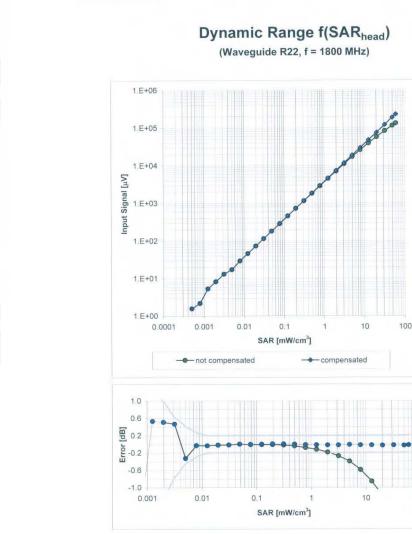


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ES3DV3 SN:3172

May 27, 2009

Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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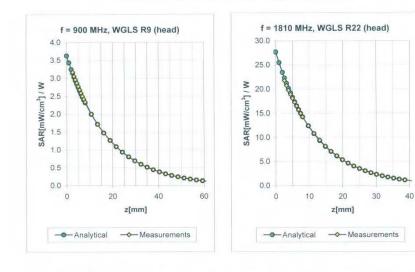
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# ES3DV3 SN:3172

# May 27, 2009



# **Conversion Factor Assessment**

f [MHz]	Validity [MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.86	1.08	5.83 ± 11.0% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.87	1.08	5.65 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.35	1.81	4.99 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.38	1.73	4.86 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.48	1.51	4.71 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.41	1.78	4.33 ± 11.0% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.78	1.15	5.81 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.78	1.15	5.67 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.4 ± 5%	1.49 ± 5%	0.45	1.75	4.69 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.33	2.23	4.54 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.27	2.99	4.53 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.40	1.40	4.02 ± 11.0% (k=2)

<sup>C</sup> The validity of ± 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.

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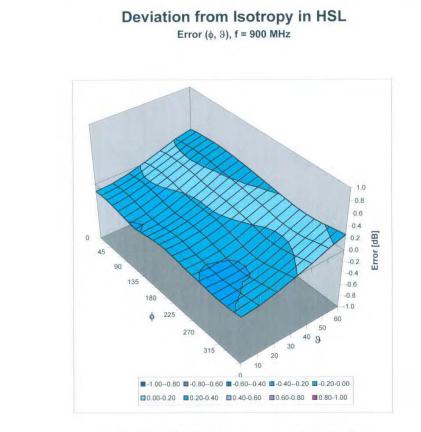
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# ES3DV3 SN:3172

May 27, 2009



# Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

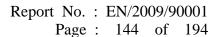
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Error Description	Uncertainty value	Prob. Dist.	Div.	$\begin{pmatrix} (c_i) \\ 1g \end{pmatrix}$	$\begin{pmatrix} c_i \\ 10g \end{pmatrix}$	Std. Unc. (1g)	Std. Unc. (10g)	$\left  \begin{array}{c} (v_t) \\ v_{eff} \end{array} \right $
Measurement System	and the second s							1000
Probe Calibration	$\pm 5.9\%$	N	1	1	1	$\pm 5.9\%$	$\pm 5.9\%$	$\infty$
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	$\pm 1.9\%$	$\pm 1.9\%$	$\infty$
Hemispherical Isotropy	$\pm 9.6\%$	R	$\sqrt{3}$	0.7	0.7	$\pm 3.9\%$	$\pm 3.9\%$	$\infty$
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6%	$\pm 0.6\%$	00
Linearity	$\pm 4.7 \%$	R	$\sqrt{3}$	1	1	$\pm 2.7\%$	$\pm 2.7\%$	00
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	$\pm 0.6\%$	±0.6%	00
Readout Electronics	$\pm 0.3 \%$	N	1	1	1	$\pm 0.3\%$	$\pm 0.3\%$	00
Response Time	$\pm 0.8\%$	R	$\sqrt{3}$	1	1	$\pm 0.5 \%$	$\pm 0.5\%$	$\infty$
Integration Time	$\pm 2.6\%$	R	$\sqrt{3}$	1	1	±1.5%	$\pm 1.5\%$	00
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	$\pm 1.7\%$	00
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7%	$\pm 1.7\%$	00
Probe Positioner	$\pm 0.4\%$	R	$\sqrt{3}$	1	1	±0.2%	$\pm 0.2\%$	00
Probe Positioning	$\pm 2.9 \%$	R	$\sqrt{3}$	1	1	±1.7%	$\pm 1.7\%$	00
Max. SAR Eval.	$\pm 1.0\%$	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	$\infty$
Test Sample Related					2			12
Device Positioning	$\pm 2.9\%$	N	1	1	1	$\pm 2.9\%$	$\pm 2.9\%$	145
Device Holder	±3.6 %	N	1	1	1	$\pm 3.6\%$	$\pm 3.6\%$	5
Power Drift	$\pm 5.0\%$	R	$\sqrt{3}$	1	1	$\pm 2.9\%$	$\pm 2.9\%$	00
Phantom and Setup					9 9 9			
Phantom Uncertainty	$\pm 4.0 \%$	R	$\sqrt{3}$	1	1	$\pm 2.3\%$	$\pm 2.3\%$	$\infty$
Liquid Conductivity (target)	$\pm 5.0\%$	R	$\sqrt{3}$	0.64	0.43	±1.8%	$\pm 1.2\%$	00
Liquid Conductivity (meas.)	$\pm 2.5 \%$	N	1	0.64	0.43	$\pm 1.6\%$	$\pm 1.1 \%$	00
Liquid Permittivity (target)	$\pm 5.0\%$	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	00
Liquid Permittivity (meas.)	$\pm 2.5 \%$	N	1	0.6	0.49	$\pm 1.5\%$	$\pm 1.2\%$	00
Combined Std. Uncertainty	· · · · · · · · · · · · · · · · · · ·					$\pm 10.9\%$	$\pm 10.7\%$	387
Expanded STD Uncertain	tv			10		$\pm 21.9 \%$	$\pm 21.4\%$	

# DASY5 Uncertainty Budget

Table 19.6: Worst-Case uncertainty budget for DASY5 assessed according to IEEE 1528 [1]. The budget is valid for the frequency range 300 MHz - 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerable smaller.

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# 8. Phantom description

Schmid & Partner Engineering AG

e a

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

# Certificate of Conformity / First Article Inspection

Item	SAM Twin Phantom V4.0	
Type No	QD 000 P40 C	
Series No	TP-1150 and higher	
Manufacturer	SPEAG Zeughausstrasse 43 CH-8004 Zbrich Switzerland	

S

#### Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness of shell	Compliant with the requirements according to the standards	2mm +/- 0.2mm in flat and specific areas of head section	First article, Samples, TP-1314 ff.
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 0.2mm at ERP	First article, All items
Material parameters	Dielectric parameters for required frequencies	300 MHz – 6 GHz: Relative permittivity < 5, Loss tangent < 0.05	Material samples
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility.	DEGMBÉ based simulating liquids	Pre-series, First article, Material samples
Sagging	Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid.	< 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below	Prototypes. Sample testing

#### Standards

CENELEC EN 50361 IEEE Std 1528-2003

[1] [2] [3] [4]

IEC 62209 Part I FCC OET Bulletin 65, Supplement C, Edition 01-01

The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

### Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standards [1] to [4].

07.07.2005

Date

Signature / Stamp

to & Permer Engineering AG nussplasse 43, 8004 Zurlet, Switzeri 944, 1, 945 97000 Fax 44 1 245 9779 w.speeg.com n. http://www

Doc No 881 - QD 000 P40 C - F

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Page

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9. System Validation from Original equipment supplier

Accredited by the Swiss Accred	ditation Service (SAS)	Accreditatio	n No.: SCS 108
The Swiss Accreditation Servic	e is one of the signatorie	es to the EA	
Multilateral Agreement for the r	ecognition of calibration	certificates	
Client SGS (Auden)		Certificate N	o: D835V2-4d063_May0
CALIBRATION C	CERTIFICATI		
Object	D835V2 - SN: 40	1063	
Calibration procedure(s)	QA CAL-05.v7 Calibration proce	dure for dipole validation kits	
			방법 이 가지 않는 것 같아요.
		221 오늘에 오늘에 가지 않는 것이다.	
Calibration date:	May 25, 2009	n an	an an an tha an
Condition of the calibrated item	In Tolerance		
This calibration certificate docum The measurements and the unce	ents the traceability to nat artainties with confidence p	ional standards, which realize the physical un robability are given on the following pages a ry facility: environment temperature (22 ± 3)°	nd are part of the certificate.
This calibration certificate docum The measurements and the unce	ents the traceability to nat artainties with confidence p cted in the closed laborato	ional standards, which realize the physical u robability are given on the following pages a	nd are part of the certificate.
This calibration certificate docum The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards	ents the traceability to nat entainties with confidence p cted in the closed laborato TE critical for calibration)	ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature (22 ± 3) <sup>e</sup> Cal Date (Certificate No.)	nd are part of the certificate.
This calibration certificate docum The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter EPM-442A	ents the traceability to nat entainties with confidence p cted in the closed laborato TE critical for calibration) ID # GB37480704	ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature (22 ± 3) <sup>o</sup> <u>Cal Date (Certificate No.)</u> 08-Oct-08 (No. 217-00898)	nd are part of the certificate. 'C and humidity < 70%. Scheduled Calibration Oct-09
This calibration certificate docum The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter EPM-442A Power sensor HP 8481A	ents the traceability to nat entainties with confidence p cted in the closed laborato TE critical for calibration) ID # GB37480704 US37292783	ional standards, which realize the physical un robability are given on the following pages a ry facility: environment temperature (22 ± 3)° Cal Date (Certificate No.) 08-Oct-08 (No. 217-00898) 08-Oct-08 (No. 217-00898)	nd are part of the certificate. 'C and humidity < 70%. Scheduled Calibration Oct-09 Oct-09 Oct-09
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This calibration certificate docum The measurements and the unce All calibrations have been conduc Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	ents the traceability to nat ertainties with confidence p cted in the closed laborato TE critical for calibration) ID # GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327	ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature (22 ± 3)* <u>Cal Date (Certificate No.)</u> 08-Oct-08 (No. 217-00898) 08-Oct-08 (No. 217-00898) 31-Mar-09 (No. 217-01025) 31-Mar-09 (No. 217-01029)	nd are part of the certificate. 'C and humidity < 70%. Scheduled Calibration Oct-09 Oct-09 Mar-10 Mar-10
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С Servizio svizzero di taratura S Swiss Calibration Service

Accreditation No.: SCS 108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

# Glossary:

oloodaly.	
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) 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), c) "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.

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# **Measurement Conditions**

<ul> <li>DASY system configuration, a</li> </ul>	is far as not g	iven on page	1.

DASY Version	DASY5	V5.0
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

	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	40.8 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature during test	(21.6 ± 0.2) °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 mW / g
SAR normalized	normalized to 1W	9.52 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	9.56 mW /g ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 mW / g
SAR normalized	normalized to 1W	6.24 mW / g

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

Certificate No: D835V2-4d063\_May09

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# **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	53.8 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.55 mW / g
SAR normalized	normalized to 1W	10.2 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	9.84 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.68 mW / g
SAR normalized	normalized to 1W	6.72 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	6.55 mW / g ± 16.5 % (k=2)



<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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### Appendix

# Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω - 3.0 jΩ
Return Loss	- 29.2 dB

## Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 Ω - 4.3 jΩ
Return Loss	- 26.0 dB

## **General Antenna Parameters and Design**

10 · · · · · · · · · · · · · · · · · · ·	
Electrical Delay (one direction)	1.392 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	November 27, 2006

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# **DASY5 Validation Report for Head TSL**

Date/Time: 25.05.2009 10:53:04

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

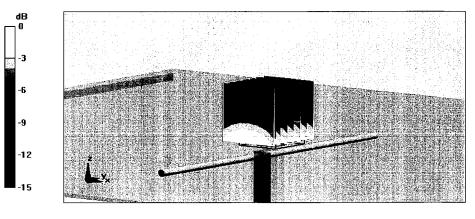
Communication System: CW-835; Frequency: 835 MHz; Duty Cycle: 1:1 Medium: HSL 900 MHz Medium parameters used: f = 835 MHz;  $\sigma = 0.89$  mho/m;  $\varepsilon_r = 40.7$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC)

**DASY5** Configuration:

- Probe: ES3DV2 SN3025; ConvF(5.86, 5.86, 5.86); Calibrated: 30.04.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

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

Reference Value = 57 V/m; Power Drift = 0.028 dB Peak SAR (extrapolated) = 3.54 W/kg SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.56 mW/g Maximum value of SAR (measured) = 2.77 mW/g



 $0 \, dB = 2.77 \, mW/g$ 

Certificate No: D835V2-4d063 May09

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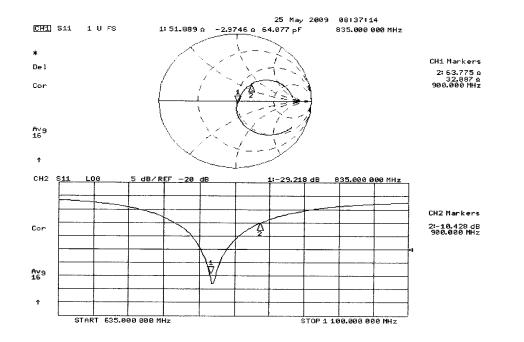
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# Impedance Measurement Plot for Head TSL



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# **DASY5 Validation Report for Body TSL**

Date/Time: 25.05.2009 14:01:33

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063

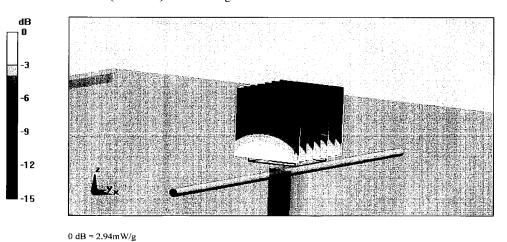
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium: MSL900 Medium parameters used: f = 835 MHz;  $\sigma = 1.01$  mho/m;  $\varepsilon_r = 53.8$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC)

**DASY5** Configuration:

- Probe: ES3DV2 SN3025; ConvF(5.79, 5.79, 5.79); Calibrated: 30.04.2009 ٠
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

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

```
Reference Value = 55.6 V/m; Power Drift = 0.024 dB
Peak SAR (extrapolated) = 3.74 \text{ W/kg}
SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.68 mW/g
Maximum value of SAR (measured) = 2.94 \text{ mW/g}
```



Certificate No: D835V2-4d063, May09

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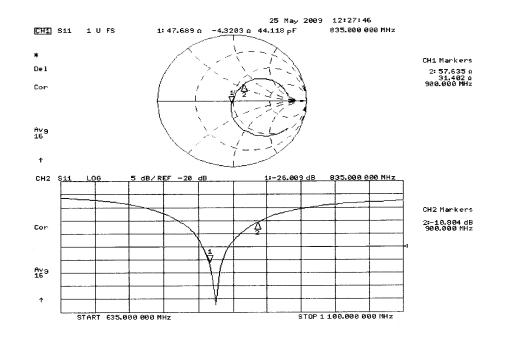
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# Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d063\_May09 Page 9 of 9

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he Swiss Accreditation Service Aultilateral Agreement for the re			
CALIBRATION C	EDTIFICATE		D1900V2-5d027-Apr09
Object	D1900V2 - SN: 50		
Calibration procedure(s)	QA CAL-05.v7		
		dure for dipole validation kits	
Calibration date:	April 27, 2009		
Condition of the calibrated item	In Tolerance		
The measurements and the unce	rtainties with confidence protection of the closed laborator	onal standards, which realize the physical units robability are given on the following pages and y facility: environment temperature (22 ± 3)°C	are part of the certificate.
The measurements and the unce All calibrations have been conduc Calibration Equipment used (M&1 Primary Standards	rtainties with confidence protected in the closed laborator TE critical for calibration)	robability are given on the following pages and y facility: environment temperature (22 ± 3)°C Cal Date (Calibrated by, Certificate No.)	are part of the certificate. and humidity < 70%. Scheduled Calibration
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The measurements and the unce All calibrations have been conduc Calibration Equipment used (M&1 Primary Standards Power meter EPM-442A Power sensor HP 8481A	rtainties with confidence protected in the closed laborator TE critical for calibration) ID # GB37480704 US37292783	Cal Date (Calibrated by, Certificate No.) 08-Oct-08 (No. 217-00898) 08-Oct-08 (No. 217-00898)	and humidity < 70%. Scheduled Calibration Oct-09 Oct-09
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The measurements and the unce All calibrations have been conduc Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination	rtainties with confidence protected in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5086 (20g) SN: 5047.2 / 06327	Cal Date (Calibrated by, Certificate No.) 08-Oct-08 (No. 217-00898) 08-Oct-08 (No. 217-00898) 08-Oct-08 (No. 217-00898) 31-Mar-09 (No. 217-01025) 31-Mar-09 (No. 217-01029)	and humidity < 70%. Scheduled Calibration Oct-09 Oct-09 Mar-10 Mar-10
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The measurements and the unce All calibrations have been conduc Calibration Equipment used (M&1 Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV2 DAE4 Secondary Standards Power sensor HP 8481A	rtainties with confidence pr ted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5086 (20g) SN: 5086 (20g) SN: 5047.2 / 06327 SN: 3025 SN: 601 ID # MY41092317	cobability are given on the following pages and           y facility: environment temperature (22 ± 3)°C           Cal Date (Calibrated by, Certificate No.)           08-Oct-08 (No. 217-00898)           08-Oct-08 (No. 217-00898)           31-Mar-09 (No. 217-01025)           31-Mar-09 (No. 217-01029)           28-Apr-08 (No. ES3-3025_Apr08)           07-Mar-09 (No. DAE4-601_Mar09)           Check Date (in house)           18-Oct-02 (in house check Oct-07)	and humidity < 70%. Scheduled Calibration Oct-09 Oct-09 Mar-10 Mar-10 Apr-09 Mar-10 Scheduled Check In house check: Oct-09
The measurements and the unce All calibrations have been conduct Calibration Equipment used (M&T Primary Standards Power meter EPM-442A Power sensor HP 8481A Reference 20 dB Attenuator Type-N mismatch combination Reference Probe ES3DV2 DAE4 Secondary Standards Power sensor HP 8481A RF generator R&S SMT-06	rtainties with confidence pr cted in the closed laborator TE critical for calibration) ID # GB37480704 US37292783 SN: 5046 (20g) SN: 5047.2 / 06327 SN: 3025 SN: 601 ID # MY41092317 100005	cobability are given on the following pages and           y facility: environment temperature (22 ± 3)°C           Cal Date (Calibrated by, Certificate No.)           08-Oct-08 (No. 217-00898)           08-Oct-08 (No. 217-00898)           31-Mar-09 (No. 217-01025)           31-Mar-09 (No. 217-01029)           28-Apr-08 (No. ES3-3025_Apr08)           07-Mar-09 (No. DAE4-601_Mar09)           Check Date (in house)           18-Oct-02 (in house check Oct-07)           4-Aug-99 (in house check Oct-07)	and humidity < 70%. Scheduled Calibration Oct-09 Oct-09 Mar-10 Mar-10 Apr-09 Mar-10 Scheduled Check In house check: Oct-09 In house check: Oct-09
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Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 108

Glossary:

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

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# 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) DASY4/5 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.

Certificate No: D1900V2-5d027\_Apr09

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## **Measurement Conditions**

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.6 ± 6 %	1.47 mho/m ± 6 %
Head TSL temperature during test	(21.6 ± 0.2) °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	250 mW input power	10.5 mW / g
SAR normalized	normalized to 1W	42.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	40.5 mW / g ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
	Condition 250 mW input power	5.38 mW / g
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured SAR normalized		5.38 mW / g 21.5 mW / g

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

Certificate No: D1900V2-5d027\_Apr09

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# Body TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.9 ± 6 %	1.56 mho/m ± 6 %
Body TSL temperature during test	(21.3 ± 0.2) °C		

# SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.6 mW / g
SAR normalized	normalized to 1W	42.4 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	42.1 mW / g ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.58 mW / g
SAR normalized	normalized to 1W	22.3 mW / g



<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Certificate No: D1900V2-5d027\_Apr09

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# Appendix

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω + 5.6 jΩ
Return Loss	- 24.5 dB

# Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 Ω + 6.4 jΩ	
Return Loss	- 22.7 dB	

# **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.197 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	December 17, 2002	

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# DASY5 Validation Report for Head TSL

Date/Time: 27.04.2009 11:54:57

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d027

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium: HSL U10 BB Medium parameters used: f = 1900 MHz;  $\sigma = 1.47 \text{ mho/m}$ ;  $\varepsilon_r = 38.7$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 SN3025; ConvF(4,9, 4,9, 4,9); Calibrated: 28.04.2008 .
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45 .

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

Reference Value = 97.1 V/m; Power Drift = 0.044 dB Peak SAR (extrapolated) = 19.7 W/kg SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.38 mW/g Maximum value of SAR (measured) = 13 mW/g



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