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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S Swiss Calibration Service

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Accreditation No.: SCS 108

Client **MET Laboratories**

Certificate No: IndexSAR-1S2571_Jul13

CALIBRATION CERTIFICATE

Object: IndexSAR - SN: 1S2571

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: July 24, 2013

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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
ype-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 25, 2013

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Accreditation No.: SCS 108

Client **MET Laboratories**

Certificate No: IndexSAR-1S2571_Jul13

CALIBRATION CERTIFICATE

Object	IndexSAR - SN: 1S2571
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	July 24, 2013

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Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
ype-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

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Accreditation No.: SCS 108

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) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010

b) 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:

c) 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.

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%.

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**71.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.9 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.74 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**69.5 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**67.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	1.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**19.1 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.9 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**67.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.92 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**19.2 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.79 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**65.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.89 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**18.9 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.9 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	6.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**64.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	1.79 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**17.9 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	43.8 Ω - 17.6 jΩ
Return Loss	- 14.2 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	38.2 Ω - 32.5 jΩ
Return Loss	- 8.7 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.8 Ω - 18.0 jΩ
Return Loss	- 15.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	41.7 Ω - 26.4 jΩ
Return Loss	- 10.7 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	39.0 Ω - 25.2 jΩ
Return Loss	- 10.5 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	46.8 Ω - 22.3 jΩ
Return Loss	- 12.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.671 ns

Dipole designed and manufactured by IndexSAR. Please see details on http://www.indexsar.com/balanced.htm

Additional EUT Data

Manufactured by	IndexSAR
Manufactured on	unknown

DASY5 Validation Report for Head TSL

Date: 23.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: IndexSAR; Serial: IndexSAR - SN:1S2571

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 4.46 S/m; ε_r = 35.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.74 S/m; ε_r = 34.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.05 S/m; ε_r = 34.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

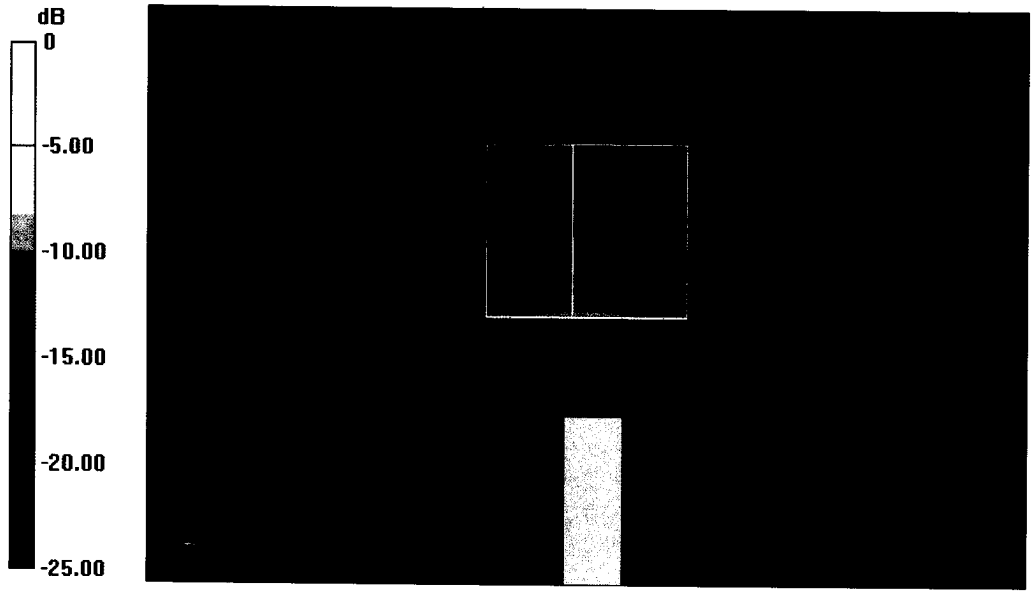
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 28.12.2012, ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.709 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 25.7 W/kg
SAR(1 g) = 7.16 W/kg; SAR(10 g) = 2.11 W/kg
Maximum value of SAR (measured) = 16.2 W/kg

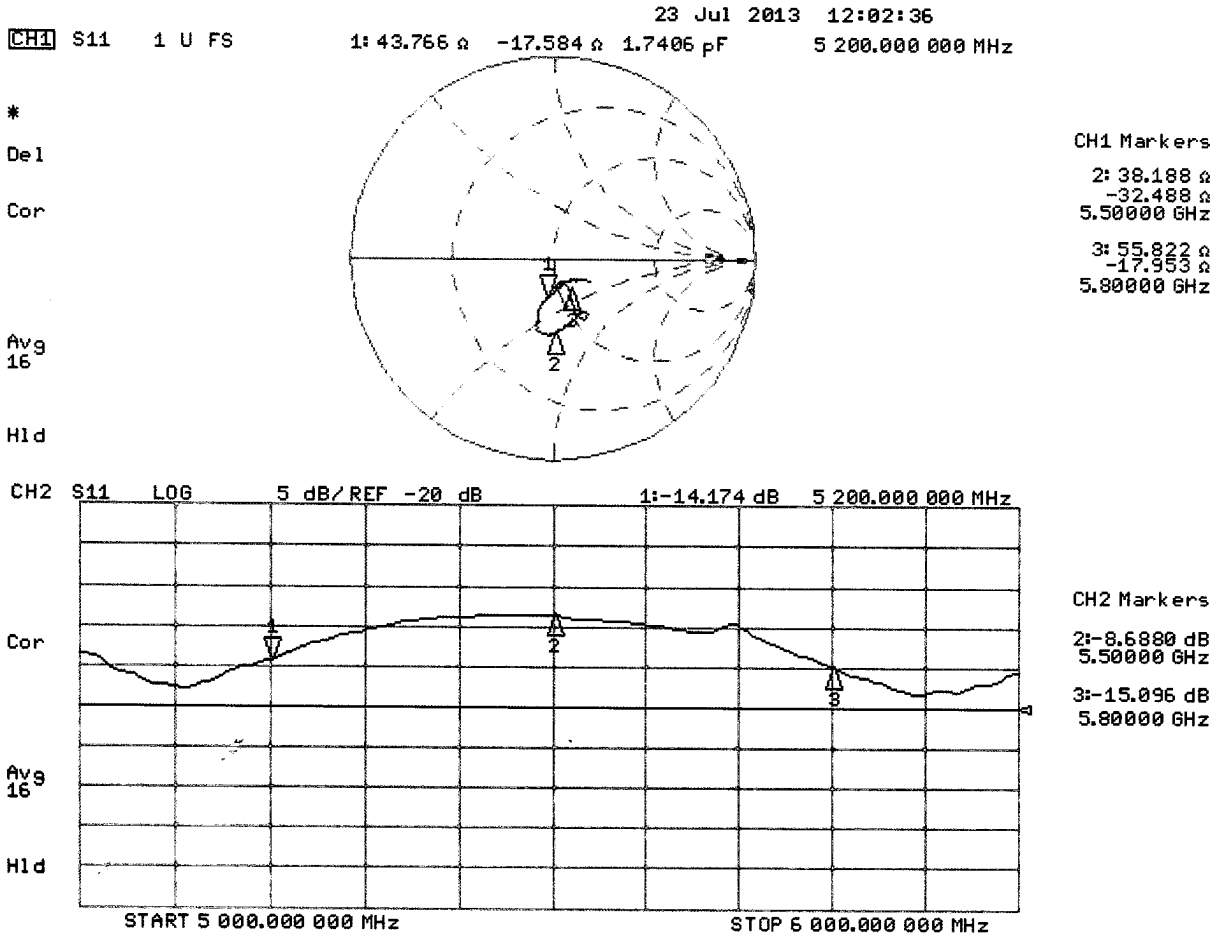
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.616 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.2 W/kg
SAR(1 g) = 7 W/kg; SAR(10 g) = 2.05 W/kg
Maximum value of SAR (measured) = 16.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 57.980 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.9 W/kg
SAR(1 g) = 6.76 W/kg; SAR(10 g) = 1.93 W/kg
Maximum value of SAR (measured) = 16.4 W/kg



0 dB = 16.4 W/kg = 12.15 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 24.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: IndexSAR; Serial: IndexSAR - SN:1S2571

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 S/m; ε_r = 48.9; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.79 S/m; ε_r = 48.4; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.21 S/m; ε_r = 47.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

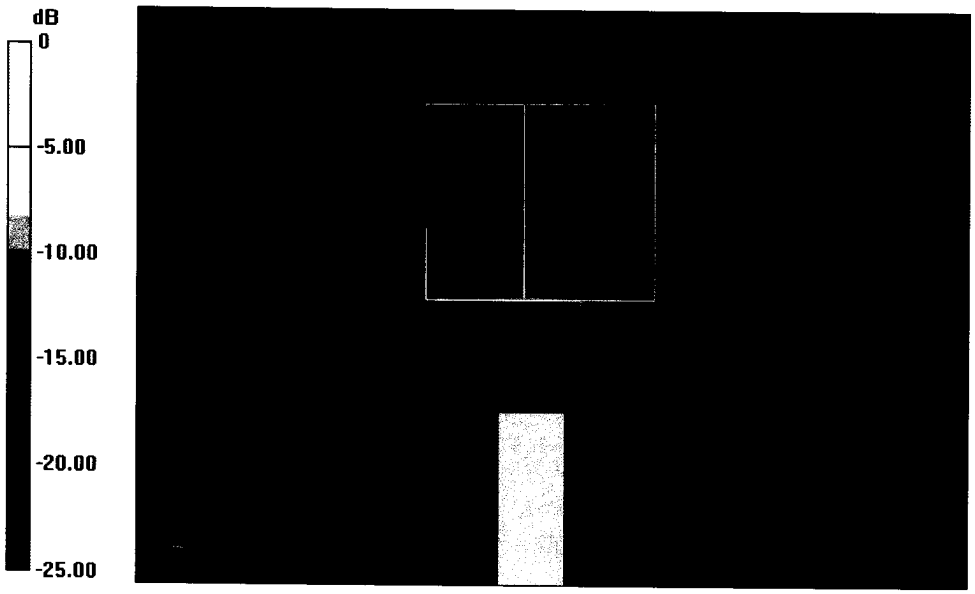
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 28.12.2012, ConvF(4.43, 4.43, 4.43); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.464 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 26.1 W/kg
SAR(1 g) = 6.74 W/kg; SAR(10 g) = 1.92 W/kg
Maximum value of SAR (measured) = 15.5 W/kg

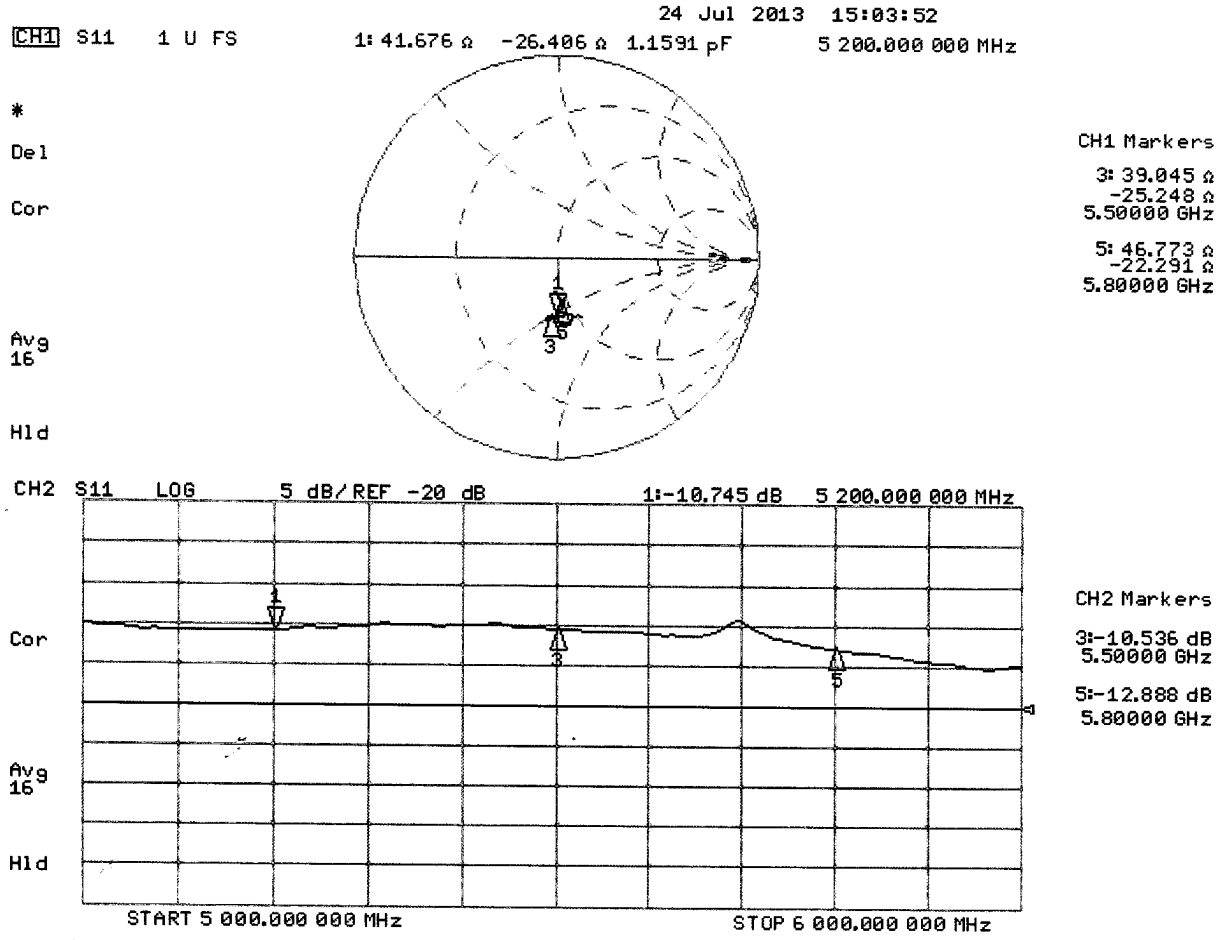
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 53.036 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 27.8 W/kg
SAR(1 g) = 6.59 W/kg; SAR(10 g) = 1.89 W/kg
Maximum value of SAR (measured) = 15.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.674 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 6.44 W/kg; SAR(10 g) = 1.79 W/kg
Maximum value of SAR (measured) = 15.9 W/kg



0 dB = 15.9 W/kg = 12.01 dBW/kg

Impedance Measurement Plot for Body TSL



APPENDIX E - MEASURED FLUID DIELECTRIC PARAMETERS

Title

SubTitle

June 17, 2014 04:12 PM

Frequency	e'	e''
2.400000000 GI	50.946	14.8684
2.402000000 GI	50.939	14.8920
2.404000000 GI	50.928	14.8994
2.406000000 GI	50.928	14.9158
2.408000000 GI	50.924	14.9291
2.410000000 GI	50.909	14.9400
2.412000000 GI	50.889	14.9581
2.414000000 GI	50.878	14.9587
2.416000000 GI	50.876	14.9617
2.418000000 GI	50.865	14.9807
2.420000000 GI	50.836	14.9912
2.422000000 GI	50.822	15.0086
2.424000000 GI	50.816	15.0070
2.426000000 GI	50.799	15.0064
2.428000000 GI	50.805	15.0153
2.430000000 GI	50.790	15.0246
2.432000000 GI	50.778	15.0367
2.434000000 GI	50.775	15.0531
2.436000000 GI	50.750	15.0516
2.438000000 GI	50.735	15.0607
2.440000000 GI	50.728	15.0524
2.442000000 GI	50.726	15.0786
2.444000000 GI	50.711	15.0761
2.446000000 GI	50.708	15.0708
2.448000000 GI	50.707	15.0885
2.450000000 GI	50.702	15.0849
2.452000000 GI	50.696	15.0981
2.454000000 GI	50.698	15.1154
2.456000000 GI	50.693	15.1385
2.458000000 GI	50.682	15.1537
2.460000000 GI	50.674	15.1654
2.462000000 GI	50.667	15.1901
2.464000000 GI	50.664	15.2028
2.466000000 GI	50.651	15.2133
2.468000000 GI	50.647	15.2245

2.470000000 GI	50.637	15.2312
2.472000000 GI	50.619	15.2405
2.474000000 GI	50.621	15.2626
2.476000000 GI	50.599	15.2689
2.478000000 GI	50.583	15.2795
2.480000000 GI	50.568	15.3083
2.482000000 GI	50.557	15.3233
2.484000000 GI	50.543	15.3354
2.486000000 GI	50.532	15.3406
2.488000000 GI	50.526	15.3650
2.490000000 GI	50.515	15.3651
2.492000000 GI	50.491	15.3832
2.494000000 GI	50.472	15.3941
2.496000000 GI	50.460	15.3810
2.498000000 GI	50.449	15.4042
2.500000000 GI	50.442	15.3941

Title

SubTitle

August 15, 2014 09:17 AM

Frequency	e'	e''
5.000000000 GI	47.408	17.3486
5.020000000 GI	47.375	17.3428
5.040000000 GI	47.324	17.3940
5.060000000 GI	47.245	17.4331
5.080000000 GI	47.230	17.4594
5.100000000 GI	47.208	17.5254
5.120000000 GI	47.189	17.5271
5.140000000 GI	47.192	17.5459
5.160000000 GI	47.116	17.5702
5.180000000 GI	47.068	17.5878
5.200000000 GI	47.010	17.6387
5.220000000 GI	46.989	17.6385
5.240000000 GI	47.003	17.6733
5.260000000 GI	46.940	17.6813
5.280000000 GI	46.908	17.6871
5.300000000 GI	46.827	17.7458
5.320000000 GI	46.764	17.7820
5.340000000 GI	46.776	17.8383
5.360000000 GI	46.805	17.8585
5.380000000 GI	46.779	17.8437
5.400000000 GI	46.718	17.8718
5.420000000 GI	46.662	17.8641
5.440000000 GI	46.617	17.9383
5.460000000 GI	46.567	17.9775
5.480000000 GI	46.570	17.9816
5.500000000 GI	46.565	17.9916
5.520000000 GI	46.488	17.9800
5.540000000 GI	46.438	18.0157
5.560000000 GI	46.375	18.0766
5.580000000 GI	46.351	18.0911
5.600000000 GI	46.343	18.1045
5.620000000 GI	46.307	18.0970
5.640000000 GI	46.274	18.1469
5.660000000 GI	46.186	18.1928
5.680000000 GI	46.153	18.2091

5.700000000 GI	46.139	18.2459
5.720000000 GI	46.117	18.2016
5.740000000 GI	46.065	18.1610
5.760000000 GI	45.922	18.1858
5.780000000 GI	45.901	18.2575
5.800000000 GI	45.878	18.3276
5.820000000 GI	45.882	18.3880
5.840000000 GI	45.866	18.3926
5.860000000 GI	45.826	18.3588
5.880000000 GI	45.765	18.3544
5.900000000 GI	45.695	18.4146
5.920000000 GI	45.605	18.4601
5.940000000 GI	45.617	18.5262
5.960000000 GI	45.617	18.5303
5.980000000 GI	45.617	18.5273
6.000000000 GI	45.549	18.5624

APPENDIX F – PHANTOM CERTIFICATE OF CONFORMITY

Schmid & Partner Engineering AG

s p e a g

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info@speag.com, http://www.speag.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 / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

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 units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas; 6mm +/- 0.2mm at ERP	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
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	DEGMBE based simulating liquids	Pre-series, First article, Samples

Standards

[1] CENELEC EN 50361
[2] IEEE Std 1528-200x Draft CD 1.1 (Dec 02)
[3] IEC 62209/CD (Nov 02)
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 7.8.2003

Signature / Stamp

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APPENDIX G - DAE CALIBRATION CERTIFICATE

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

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

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

Accreditation No.: SCS 108

Client **MET Laboratories**

Certificate No: **DAE3-584_Jul13**

CALIBRATION CERTIFICATE

Object DAE3 - SD 000 D03 AA - SN: 584

Calibration procedure(s) QA CAL-06.v26
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: July 18, 2013

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 (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: July 18, 2013

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

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

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

Accreditation No.: SCS 108

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:	1LSB =	6.1μV ,	full range =	-100...+300 mV
Low Range:	1LSB =	61nV ,	full range =	-1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.662 ± 0.02% (k=2)	404.844 ± 0.02% (k=2)	404.267 ± 0.02% (k=2)
Low Range	3.93273 ± 1.50% (k=2)	3.98110 ± 1.50% (k=2)	3.97938 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	141.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199996.51	-1.40	-0.00
Channel X	+ Input	20001.72	1.16	0.01
Channel X	- Input	-19998.74	2.23	-0.01
Channel Y	+ Input	199995.49	-2.08	-0.00
Channel Y	+ Input	20001.55	1.15	0.01
Channel Y	- Input	-19997.38	3.75	-0.02
Channel Z	+ Input	199996.10	-1.20	-0.00
Channel Z	+ Input	19999.08	-1.38	-0.01
Channel Z	- Input	-19999.72	1.40	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.82	1.92	0.10
Channel X	+ Input	202.17	0.93	0.46
Channel X	- Input	-198.65	-0.18	0.09
Channel Y	+ Input	2002.22	1.54	0.08
Channel Y	+ Input	200.42	-0.71	-0.35
Channel Y	- Input	-199.73	-1.09	0.55
Channel Z	+ Input	2000.94	0.28	0.01
Channel Z	+ Input	200.01	-1.13	-0.56
Channel Z	- Input	-200.29	-1.60	0.80

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	3.04	1.31
	- 200	-0.45	-1.35
Channel Y	200	3.69	2.42
	- 200	-3.59	-3.54
Channel Z	200	-7.37	-7.51
	- 200	5.30	5.09

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-0.18	-3.67
Channel Y	200	6.93	-	-0.17
Channel Z	200	7.39	5.46	-

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IMPORTANT NOTICE

USAGE OF THE DAE 3

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply outmost caution not to bend or damage the connector when changing batteries.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration the customer shall remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, Customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16109	15852
Channel Y	16158	16754
Channel Z	16279	16611

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.30	-0.50	3.30	0.53
Channel Y	-0.18	-1.65	1.35	0.50
Channel Z	-0.26	-1.48	1.14	0.47

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9