

1.1. 150 Dipole Calibration Certificate

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



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Accreditation No.: **SCS 0108**

Client **CCIC-HTW (Auden)**

Certificate No: **CLA150-4024_Feb18**

CALIBRATION CERTIFICATE																																																											
Object	CLA150 - SN: 4024																																																										
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for system validation sources below 700 MHz																																																										
Calibration date:	February 21, 2018																																																										
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter NRP</td> <td>SN: 104778</td> <td>04-Apr-17 (No. 217-02521/02522)</td> <td>Apr-18</td> </tr> <tr> <td>Power sensor NRP-Z91</td> <td>SN: 103244</td> <td>04-Apr-17 (No. 217-02521)</td> <td>Apr-18</td> </tr> <tr> <td>Power sensor NRP-Z91</td> <td>SN: 103245</td> <td>04-Apr-17 (No. 217-02522)</td> <td>Apr-18</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5277 (20x)</td> <td>07-Apr-17 (No. 217-02528)</td> <td>Apr-18</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 5047.2 / 06327</td> <td>07-Apr-17 (No. 217-02529)</td> <td>Apr-18</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN: 3877</td> <td>30-Dec-17 (No. EX3-3877_Dec17)</td> <td>Dec-18</td> </tr> <tr> <td>DAE4</td> <td>SN: 654</td> <td>24-Jul-17 (No. DAE4-654_Jul17)</td> <td>Jul-18</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Power meter E4419B</td> <td>SN: GB41293674</td> <td>06-Apr-16 (No. 217-02285/02284)</td> <td>In house check: Jun-18</td> </tr> <tr> <td>Power sensor E4412A</td> <td>SN: MY41498067</td> <td>06-Apr-16 (No. 217-02285)</td> <td>In house check: Jun-18</td> </tr> <tr> <td>Power sensor E4412A</td> <td>SN: 000110210</td> <td>06-Apr-16 (No. 217-02284)</td> <td>In house check: Jun-18</td> </tr> <tr> <td>RF generator HP 8648C</td> <td>SN: US3642U01700</td> <td>04-Aug-99 (in house check Jun-16)</td> <td>In house check: Jun-18</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>SN: US37390585</td> <td>18-Oct-01 (in house check Oct-17)</td> <td>In house check: Oct-18</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18	Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18	Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18	Reference 20 dB Attenuator	SN: 5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18	Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18	Reference Probe EX3DV4	SN: 3877	30-Dec-17 (No. EX3-3877_Dec17)	Dec-18	DAE4	SN: 654	24-Jul-17 (No. DAE4-654_Jul17)	Jul-18	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Power meter E4419B	SN: GB41293674	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-18	Power sensor E4412A	SN: MY41498067	06-Apr-16 (No. 217-02285)	In house check: Jun-18	Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-18	RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18	Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18
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Calibrated by:	Name Jeton Kasrati	Function Laboratory Technician	Signature 																																																								
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature 																																																								
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Accreditation No.: **SCS 0108**

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 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- e) 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 source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. 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%.

Appendix C: Dipole Calibration Certificate

Measurement Conditions

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

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	$dx, dy =$ mm, $dz =$ mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	50.3 \pm 6 %	0.76 mho/m \pm 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	1 W input power	3.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.68 W/kg \pm 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	2.45 W/kg \pm 18.0 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 \pm 0.2) °C	62.1 \pm 6 %	0.81 mho/m \pm 6 %
Body TSL temperature change during test	< 0.5 °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	1 W input power	3.78 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	3.75 W/kg \pm 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.52 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	2.50 W/kg \pm 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	44.4 Ω + 3.2 j Ω
Return Loss	- 23.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.7 Ω + 7.0 j Ω
Return Loss	- 22.9 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 10, 2017

DASY5 Validation Report for Head TSL

Date: 21.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4024

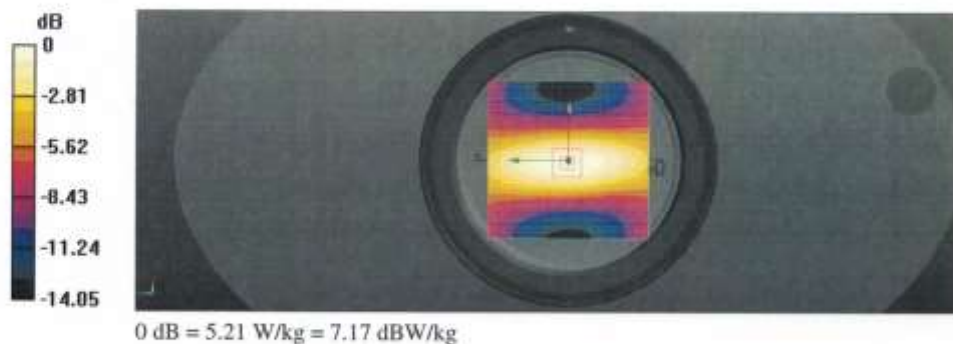
Communication System: UID 0 - CW; Frequency: 150 MHz
 Medium parameters used: $f = 150 \text{ MHz}$; $\sigma = 0.76 \text{ S/m}$; $\epsilon_r = 50.3$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

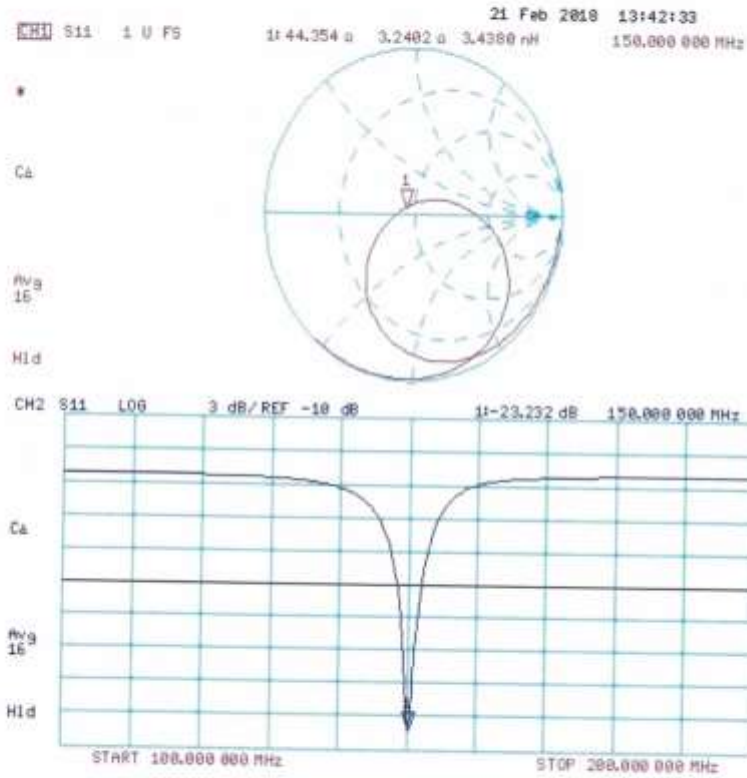
- Probe: EX3DV4 - SN3877; ConvF(12.12, 12.12, 12.12); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
 Maximum value of SAR (interpolated) = 5.21 W/kg

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
 Reference Value = 82.22 V/m; Power Drift = -0.03 dB
 Peak SAR (extrapolated) = 6.91 W/kg
SAR(1 g) = 3.71 W/kg; SAR(10 g) = 2.47 W/kg
 Maximum value of SAR (measured) = 5.18 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 21.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4024

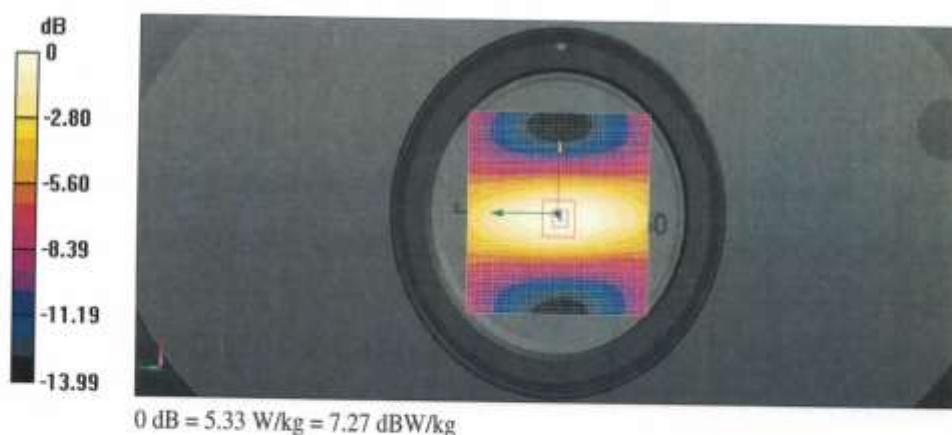
Communication System: UID 0 - CW; Frequency: 150 MHz
 Medium parameters used: $f = 150 \text{ MHz}$; $\sigma = 0.81 \text{ S/m}$; $\epsilon_r = 62.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.57, 11.57, 11.57); Calibrated: 30.12.2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 24.07.2017
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: $dx=1.500 \text{ mm}$, $dy=1.500 \text{ mm}$
 Maximum value of SAR (interpolated) = 5.33 W/kg

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$
 Reference Value = 80.56 V/m; Power Drift = -0.08 dB
 Peak SAR (extrapolated) = 7.08 W/kg
SAR(1 g) = 3.78 W/kg; SAR(10 g) = 2.52 W/kg
 Maximum value of SAR (measured) = 5.28 W/kg



Impedance Measurement Plot for Body TSL

