Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland

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



Certificate No. CLA13-1015_Aug24

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Schweizerischer Kalibrierdienst

Accreditation No.: SCS 0108

Service suisse d'étalonnage

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Swiss Calibration Service

Gyeonggi-do, Republic of Korea

Dbject	CLA13 - SN: 101	5	
Calibration procedure(s)	QA CAL-15.v11	dure for SAR Validation Sources	below 700 MHz
	Calibration 11000	dure for SATT validation cources	BCIOW 7 00 IVII 12
Calibration date:	August 22, 2024		
		onal standards, which realize the physical unit obability are given on the following pages and	
Il calibrations have been conduct	ed in the closed laborator	y facility: environment temperature (22 \pm 3)°C	and humidity < 70%.
Calibration Equipment used (M&T	E critical for calibration)		
rimary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
	ID # SN: 104778	Cal Date (Certificate No.) 26-Mar-24 (No. 217-04036/04037)	Scheduled Calibration Mar-25
ower meter NRP2			
ower meter NRP2 ower sensor NRP-Z91	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91	SN: 104778 SN: 103244	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036)	Mar-25 Mar-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 deference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037)	Mar-25 Mar-25 Mar-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x)	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046)	Mar-25 Mar-25 Mar-25 Mar-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Jan-25
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25
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Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 RF generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922 SN: 100418	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24
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Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 RF generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922 SN: 100418 SN: US3642U01700 SN: US41080477	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22) 04-Aug-99 (in house check Jun-24) 31-Mar-14 (in house check Oct-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24 In house check: Dec-24

Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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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/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)". October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY 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%.

Measurement Conditions

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

DASY Version	DASY5	V52.10.4		
Extrapolation	Advanced Extrapolation			
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm		
EUT Positioning	Touch Position			
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)		
Frequency	13 MHz ± 1 MHz			

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	55.0	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	53.0 ± 6 %	0.74 mho/m ± 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	0.535 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.537 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.332 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.333 W/kg ± 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.4 Ω + 2.6 jΩ
Return Loss	- 31.6 dB

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 22.08.2024

Test Laboratory: SPEAG, Zurich, Switzerland

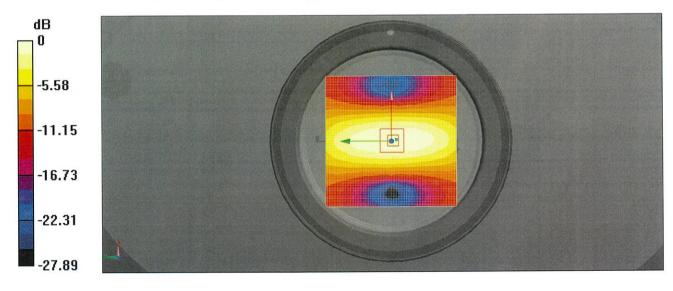
DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1015

Communication System: UID 0 - CW; Frequency: 13 MHz Medium parameters used: f = 13 MHz; $\sigma = 0.74$ S/m; $\epsilon_r = 53$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 10/01/2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 15/01/2024
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 29.97 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 1.10 W/kg SAR(1 g) = 0.535 W/kg; SAR(10 g) = 0.332 W/kg Smallest distance from peaks to all points 3 dB below = 20.9 mm Ratio of SAR at M2 to SAR at M1 = 77.9% Maximum value of SAR (measured) = 0.793 W/kg

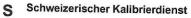


0 dB = 0.793 W/kg = -1.01 dBW/kg

Impedance Measurement Plot for Head TSL

<u>F</u> ile	⊻iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	<u>T</u> race	<u>S</u> cale	Marker	System	<u>W</u> indov	v <u>H</u> e	lp		
										13.00	0000 MHz 31.893 nH		0.416 Ω 6050 Ω
	Ch1: Sta	Ch 1 Avg = art 10.0000 I	MHz —									Stop 1	6.0000 MHz
5.0 2.0 -1.0 -7.0 -10 -13 -16 -19 -22 -25	0 - 00 - 00 - 00 - 00 - 00 - 00 - 00 -	<u>tB \$11</u> <u>Ch 1 Avg =</u> art 10.0000	20 MHz					>	1:	13.0			.613 dB
Sta	atus	CH 1:	S11		C 1-Port			Avg=20	1.111				LCL





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Accreditation No.: SCS 0108

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Multilate	ral Agreement for the	-			
	UL Gyeonggi-do, Repu	blic of Korea	c	Certificate No.	D750V3-1122_Feb24
CALI	BRATION	CERTIFICAT	E		
Object		D750V3 - SN:11	22		
Calibratio	n procedure(s)	QA CAL-05.v12 Calibration Proc	edure for SAR Validatic	on Sources	between 0.7-3 GHz
Calibration	n date:	February 22, 202	24		
This calibr The meas	ration certificate docum urements and the unce	ents the traceability to nati rtainties with confidence p	onal standards, which realize th robability are given on the follov	wing pages and	are part of the certificate.
This calibr The meas All calibrat	ration certificate docum urements and the unce tions have been conduc	ents the traceability to nati rtainties with confidence p	onal standards, which realize th	wing pages and	are part of the certificate.
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This calibr The meas All calibration Calibration Primary St Power met Power sen Power sen Reference	ration certificate docum urements and the unce tions have been conduc n Equipment used (M&1 candards ter NRP2 sor NRP-Z91 sor NRP-Z91 20 dB Attenuator	ents the traceability to nati rtainties with confidence p cted in the closed laborator FE critical for calibration) ID # SN: 104778 SN: 103244	onal standards, which realize th robability are given on the follow ry facility: environment temperat <u>Cal Date (Certificate No.)</u> 30-Mar-23 (No. 217-03804/0 30-Mar-23 (No. 217-03804)	wing pages and ture (22 ± 3)°C	are part of the certificate. and humidity < 70%. Scheduled Calibration Mar-24 Mar-24
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Fower meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	
			Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972		In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
	1 314. 0341060477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	orginatare
			tant
Approved by:	Sven Kühn	Technical Manager	Ca
			22
			Issued: February 22, 2024
This calibration certificate shall not b	e reproduced except in t	full without written approval of the laboratory	/.

Calibration Laboratory of

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





Schweizerischer Kalibrierdienst

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ConvF	sensitivity in TSL / NORM x,y,z
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- 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	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	·····
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.6 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	an a	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	<u>, , , , , , , , , , , , , , , , , , , </u>
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.58 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.62 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω - 2.5 jΩ
Return Loss	- 29.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.026 ==
	1.036 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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
	- SFLAG

DASY5 Validation Report for Head TSL

Date: 22.02.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1122

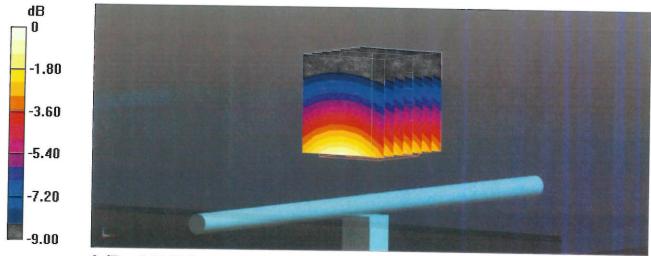
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ϵ_r = 42.6; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

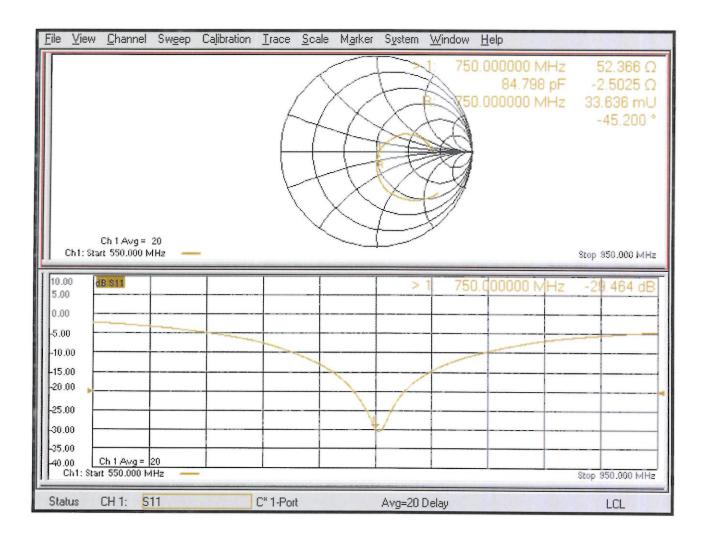
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 63.21 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 3.32 W/kg SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg Smallest distance from peaks to all points 3 dB below = 20 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 2.91 W/kg



0 dB = 2.91 W/kg = 4.64 dBW/kg

Impedance Measurement Plot for Head TSL





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Certificate No. D750V3-1205_Apr23

Swiss Calibration Service

Accreditation No.: SCS 0108

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

Client UL

Gyeonggi-do, Republic of Korea

Object	D750V3 - SN:12	05	
Calibration procedure(s)	QA CAL-05.v12		
	Calibration Proce	edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	April 18, 2023		
		;	
This calibration certificate docume	nts the traceability to nati	onal standards, which realize the physical ur	nits of measurements (SI)
The measurements and the uncert	ainties with confidence p	robability are given on the following pages a	nd are part of the certificate
All calibrations have been conducted	ed in the closed laborator	ry facility: environment temperature (22 \pm 3)°	C and humidity < 70%.
Calibration Equipment used (M&TE	E critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24 Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M. Hese
Approved by:	Sven Kühn	Technical Manager	
nave			Sn
			Issued: April 21, 2023

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

Page 1 of 6



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Glossarv:

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/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY 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%.

Measurement Conditions

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

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	0.92 mho/m ± 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	250 mW input power	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.55 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.59 W/kg ± 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.3 Ω - 1.3 jΩ
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical De	lay (one direction)	1.040 ns
L		

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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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
Manalabarea by	SPEAG

DASY5 Validation Report for Head TSL

Date: 18.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1205

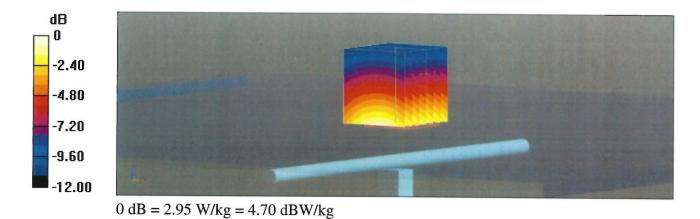
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.92$ S/m; $\varepsilon_r = 41.1$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 59.84 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.37 W/kg **SAR(1 g) = 2.2 W/kg; SAR(10 g) = 1.43 W/kg** Smallest distance from peaks to all points 3 dB below = 17 mm Ratio of SAR at M2 to SAR at M1 = 65.4% Maximum value of SAR (measured) = 2.95 W/kg



Impedance Measurement Plot for Head TSL

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Justification for Extended SAR Dipole Calibrations

Instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements

KDB 865664 D01v01r04 requirements

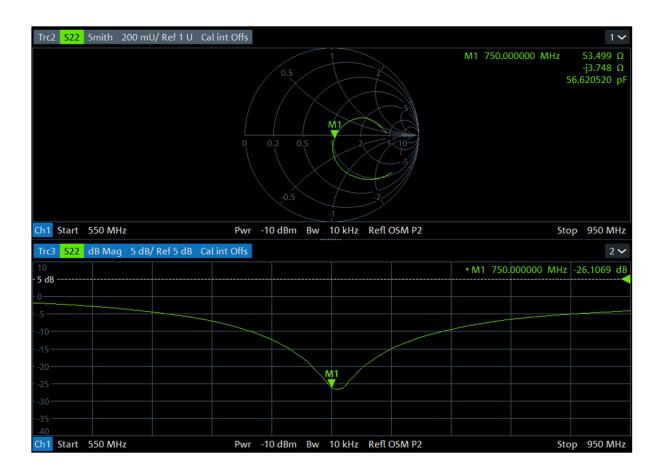
a) return loss : < - 20 dB, within 20% of previous measurement

b) impedance : within 5 Ω from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
D750V3-SN : 1205	Head	2023.04.18	-27.327	4.4	54.283	0.78
D750V5-SIN . 1205	пеай	2024.04.02	-26.106	4.4	53.499	0.78

c) peak SAR (1g) : within 10% of that reported in the calibration data

Dipole Antenna	Head/Body	Date of Measurement	peak SAR (1g) (W/kg)	Δ%
	Hoad	2023.04.18	0.88	C 01
D750V3-SN : 1205	Head	2024.04.10	0.82	6.81





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Accreditation No.: SCS 0108

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Client

UL

Gyeonggi-do, Republic of Korea

Certificate No.

D835V2-4d174_Sep24

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d174
Calibration procedure(s)	QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz
Calibration date	September 16, 2024
This calibration contificate door	uments the tracephility to national standards, which realize the physical units of measurements (SI).

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 $(22 \pm 3)^{\circ}$ C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	05-Oct-23 (No. OCP-DAK12-1016_Oct23)	Oct-24
OCP DAK-3.5	SN: 1249	05-Oct-23 (No. OCP-DAK3.5-1249_Oct23)	Oct-24
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	10-Jan-24 (No. DAE4ip-1836_Jan24)	Jan-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Paulo Pina	Laboratory Technician	Fairtes
Approved by	Sven Kühn	Technical Manager	5.65
This calibration certificate	e shall not be reproduced except	in full without written approval of the la	Issued: September 16, 2024 boratory.



Schweizerischer Kalibrierdienst

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Accreditation No.: SCS 0108

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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

- IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

DASY 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	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	835MHz ±1MHz	

Head TSL parameters at 835 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity	
Nominal Head TSL parameters	22.0 °C	41.5	0.900 mho/m	
Measured Head TSL parameters	(22.0 ±0.2)°C	43.0 ±6%	0.900 mho/m ±6%	
Head TSL temperature change during test	< 0.5 °C			

SAR result with Head TSL at 835 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition			
SAR for nominal Head TSL parameters	24 dBm input power	2.37 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg ±17.0% (k = 2)		

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition			
SAR for nominal Head TSL parameters	24 dBm input power	1.53 W/kg		
SAR for nominal Head TSL parameters	normalized to 1W	6.09 W/kg ±16.5% (k = 2)		

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 835 MHz

Impedance	50.5 Ω – 7.1 jΩ
Return Loss	-23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.396 ns

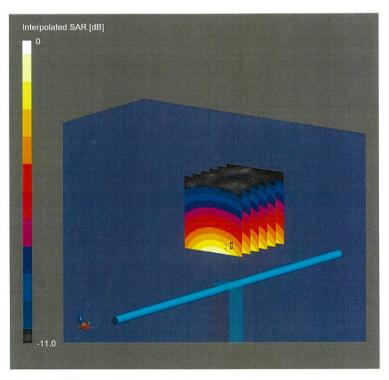
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. 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 bySPEAG	Manufactured by	JULIC
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System Performance Check Report

Dipole	Frequency [MHz]				TSL	Power [dBm]			
D835V2 - SN4d174	835				HSL	24			
Exposure Condition	S								
Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [M	Hz], Char	nnel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	15		CW, 0	835,0			9.61	0.90	43.0
Hardware Setup									
Phantom	TSL, Measured Date Probe, Calibration Date				DAE, 0	DAE, Calibration Date			
Flat V4.9 mod	HSL, 2024-09-16 EX3DV4 - SN7349, 2024-06-03			DAE4ip Sn1836, 2024-01-10					
Scans Setup					1	Measuremen	nt Results		
				Zoom Scan					Zoom Scan
Grid Extents [mm]				30 x 30 x 30	_	Date			2024-09-16
Grid Steps [mm]	6.0 × 6.0 × 1.5			.0 x 6.0 x 1.5	-	psSAR1g [W/H	; AR1g [W/Kg]		
Sensor Surface [mm]	1.4			1.4	-	psSAR10g [W/Kg]		1.53	
Graded Grid	Yes			Yes	-	Power Drift [dB]		-0.02	
Grading Ratio				1.5	-	Power Scaling			Disabled
MAIA				N/A	-	Scaling Factor	r [dB]		
Surface Detection				VMS + 6p	-	TSL Correctio	n		Positive / Negative
Scan Method				Measured	-				



0 dB = 3.71 W/Kg

Impedance Measurement Plot for Head TSL

