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Swiss Calibration Service

Accreditation No.: SCS 0108

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# Client UL

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Gyeonggi-do, Republic of Korea

Certificate No. D3900V2-1069\_Apr23

Object	D3900V2 - SN:	1069	
Calibration procedure(s)	QA CAL-22.v7 Calibration Proc	edure for SAR Validation Source	s between 3-10 GHz
Calibration date:	April 21, 2023		
	ted in the closed laborato	ional standards, which realize the physical un probability are given on the following pages ar ry facility: environment temperature (22 ± 3)°(	nd are part of the certificate.
Primary Standards	ID #	Cal Date (Certificate No.)	
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Scheduled Calibration
ower sensor NRP-Z91	SN: 103244		Mar-24
Loi concorrinti Loi			14
	SN: 103245	30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805)	Mar-24
ower sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103245 SN: BH9394 (20k)	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24
Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4	SN: 103245	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	Mar-24 Mar-24 Mar-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 AE4 econdary Standards ower meter E4419B	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house)	Mar-24 Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B ower sensor HP 8481A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check In house check: Oct-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Gecondary Standards Power meter E4419B Power sensor HP 8481A ower sensor HP 8481A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house)	Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 PAE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 DAE4 Power meter E4419B Power sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Becondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A F generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477	30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22) 31-Mar-14 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Dec-23 <u>Scheduled Check</u> In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24



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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%.

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# **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 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	3900 MHz ± 1 MHz	

# Head TSL parameters at 3900 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.5	3.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.4 ± 6 %	3.23 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	<b></b>	· · · · · · · · · · · · · · · · · · ·

# SAR result with Head TSL at 3900 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	69.4 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.40 W/kg

# Appendix (Additional assessments outside the scope of SCS 0108)

# Antenna Parameters with Head TSL at 3900 MHz

Impedance, transformed to feed point	45.5 Ω - 3.3 jΩ
Return Loss	- 24.7 dB

### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.103 ns
	1.100115

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

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	Manufactured by	00510
- 1		SPEAG
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# **DASY5 Validation Report for Head TSL**

Date: 21.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1069

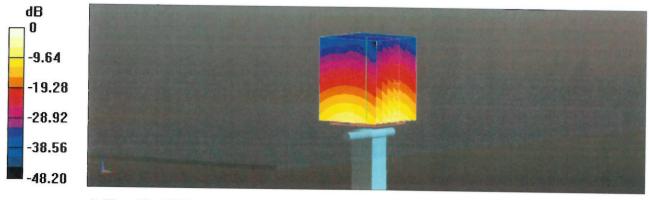
Communication System: UID 0 - CW; Frequency: 3900 MHz, Frequency: 4100 MHz Medium parameters used: f = 3900 MHz;  $\sigma$  = 3.23 S/m;  $\epsilon_r$  = 37.4;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.39, 7.39, 7.39) @ 3900 MH; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

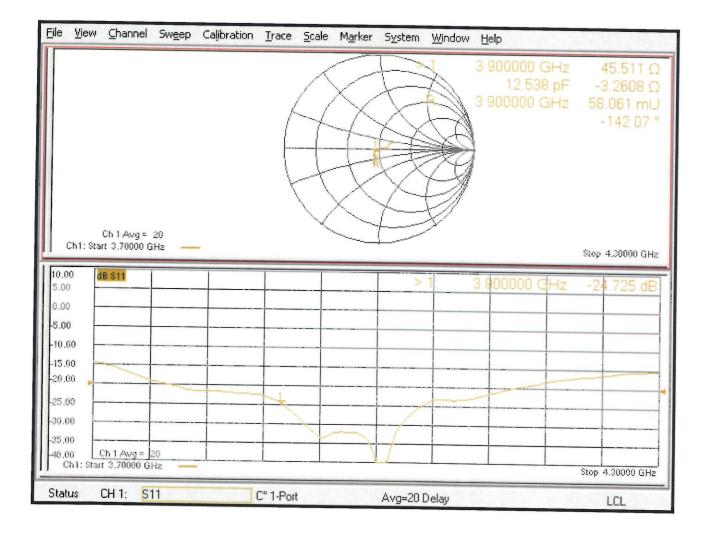
# Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3900MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.83 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 19.4 W/kg SAR(1 g) = 6.91 W/kg; SAR(10 g) = 2.40 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 74.6% Maximum value of SAR (measured) = 13.4 W/kg



0 dB = 13.4 W/kg = 11.28 dBW/kg

# Impedance Measurement Plot for Head TSL





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#### Client UL

Gyeonggi-do, Republic of Korea

	Certificate No.	CLA13-1015_Aug23
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Object	CLA13 - SN: 10	15	
Calibration procedure(s)	QA CAL-15.v10 Calibration Proc	edure for SAR Validation Source	s below 700 MHz
Calibration date:	August 22, 2023	3	
the measurements and the unce	nainties with confidence p	tional standards, which realize the physical un probability are given on the following pages ar pry facility: environment temperature (22 $\pm$ 3)°(	nd are part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)		
	ID #	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP2	ID # SN: 104778	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805)	Scheduled Calibration
wer meter NRP2 wer sensor NRP-Z91		30-Mar-23 (No. 217-03804/03805)	Mar-24
ver meter NRP2 ver sensor NRP-Z91 ver sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245		Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 erence 20 dB Attenuator	SN: 104778 SN: 103244	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804)	Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator pe-N mismatch combination	SN: 104778 SN: 103244 SN: 103245	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805)	Mar-24 Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator pe-N mismatch combination ference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator pe-N mismatch combination ference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator be-N mismatch combination erence Probe EX3DV4 E4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23)	Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24
ver meter NRP2 ver sensor NRP-Z91 ver sensor NRP-Z91 erence 20 dB Attenuator e-N mismatch combination erence Probe EX3DV4 E4 ondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID #	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23) Check Date (in house)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Scheduled Check
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator be-N mismatch combination ference Probe EX3DV4 E4 condary Standards wer meter NRP2	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23) Check Date (in house) 08-Nov-21 (in house check Dec-22)	Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Scheduled Check In house check: Dec-24
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ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator /pe-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22)	Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination reference Probe EX3DV4 AE4 econdary Standards ower meter NRP2 power sensor NRP-Z91 power sensor NRP-Z91 F 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	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23) 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-22) 31-Mar-14 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24 In house check: Jun-24 In house check: Oct-24
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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.
   SAB normalized: SAR as measured.
- 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	53.6 ± 6 %	0.72 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	+	

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	1 W input power	0.519 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.533 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.324 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	52.9 Ω + 1.2 jΩ
Return Loss	- 30.4 dB

# Additional EUT Data

Monufactured by	
Manufactured by	
	SPEAG

### **DASY5 Validation Report for Head TSL**

Date: 22.08.2023

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;  $\sigma = 0.72$  S/m;  $\epsilon_r = 53.6$ ;  $\rho = 1000$  kg/m<sup>3</sup> 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: 06.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 27.01.2023
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# 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

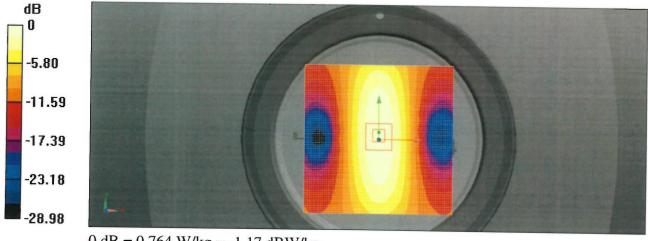
Reference Value = 30.79 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 1.06 W/kg

# SAR(1 g) = 0.519 W/kg; SAR(10 g) = 0.324 W/kg

Smallest distance from peaks to all points 3 dB below = Larger than measurement grid (> 14 mm) Ratio of SAR at M2 to SAR at M1 = 78.1%Maximum value of SAR (measured) = 0.764 W/

Maximum value of SAR (measured) = 0.764 W/kg



0 dB = 0.764 W/kg = -1.17 dBW/kg

File	⊻iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	Trace	<u>S</u> cale	Marker	System	<u>W</u> indow	Help		
		Ch 1 Avg =	~		Ę		XXX			3.000000 14.4:	I MHz 24 nH	52.894 Ω 1.1782 Ω
5.00 2.00 -1.00 -4.00	h1: Star	t 10.0000 M	1Hz					>	1 13	.00000	MHz	Stop 16.0000 MHz
-7.00 -10.00 -13.00 -16.00 -19.00	;											
F19,00												





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 Korea (Dymstec)

Certificate No: D6.5GHzV2-1010\_May22

Accreditation No.: SCS 0108

# **CALIBRATION CERTIFICATE**

Object	D6.5GHzV2 - SN	1:1010	
	0 1 0 1 0 0 0		
Calibration procedure(s)	QA CAL-22.v6		
	Calibration Proce	edure for SAR Validation Sources	between 3-10 GHz
-			
Calibration date:	May 27, 2022		
		onal standards, which realize the physical units	
The measurements and the uncerta	inties with confidence p	robability are given on the following pages and	are part of the certificate.
All calibrations have been conducted	d in the closed laborator	y facility: environment temperature (22 $\pm$ 3)°C	and humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
	1	Take antalog of Marks weaker of some not	
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor R&S NRP33T	SN: 100967	01-Apr-22 (No. 217-03526)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
Mismatch combination	SN: 84224 / 360D	26-Apr-21 (No. 217-03353)	Apr-24
Reference Probe EX3DV4	SN: 7405	31-Dec-21 (No. EX3-7405_Dec21)	Dec-22
DAE4	SN: 908	24-Jun-21 (No. DAE4-908_Jun21)	Jun-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator Anapico APSIN20G	SN: 827	18-Dec-18 (in house check Dec-21)	In house check: Dec-23
Network Analyzer Keysight E5063A	and a second	31-Oct-19 (in house check Oct-19)	In house check: Dec-23
	1		infitude check. Oct-22
	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	O nein
			Sof plan
			0.7
Approved by:	Sven Kühn	Technical Manager	$C \mid$
			2.15
			Issued: May 31, 2022
This calibration certificate shall not b	e reproduced except in	full without written approval of the laboratory.	

# **Calibration Laboratory of**

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



S Schweizerischer Kalibrierdienst

- C Service suisse d'étalonnage
  - Servizio svizzero di taratura

S 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

#### Glossary:

tissue simulating liquid
sensitivity in TSL / NORM x,y,z
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.

### Additional Documentation:

b) 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.
- 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 absorbed power density (APD): The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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	DASY6	V16.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	5 mm	with Spacer
Zoom Scan Resolution	dx, dy = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	6500 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	34.5	6.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.7 ± 6 %	6.08 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	28.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	285 W/kg ± 24.7 % (k=2)
SAR averaged over 8 cm <sup>3</sup> (8 g) of Head TSL	Condition	
SAR averaged over 8 cm <sup>3</sup> (8 g) of Head TSL SAR measured	Condition 100 mW input power	6.49 W/kg

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.32 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.9 W/kg ± 24.4 % (k=2)

### Appendix

#### **Antenna Parameters with Head TSL**

Impedance, transformed to feed point	49.9 Ω - 7.3 jΩ		
Return Loss	- 22.7 dB		

### APD (Absorbed Power Density)

APD averaged over 1 cm <sup>2</sup>	Condition			
APD measured	100 mW input power	285 W/m <sup>2</sup>		
APD measured	normalized to 1W	2850 W/m² ± 29.2 % (k=2)		

APD averaged over 4 cm <sup>2</sup>	condition	
APD measured	100 mW input power	130 W/m²
APD measured	normalized to 1W	1300 W/m <sup>2</sup> ± 28.9 % (k=2)

\*The reported APD values have been derived using psSAR8g.

### **General Antenna Parameters and Design**

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

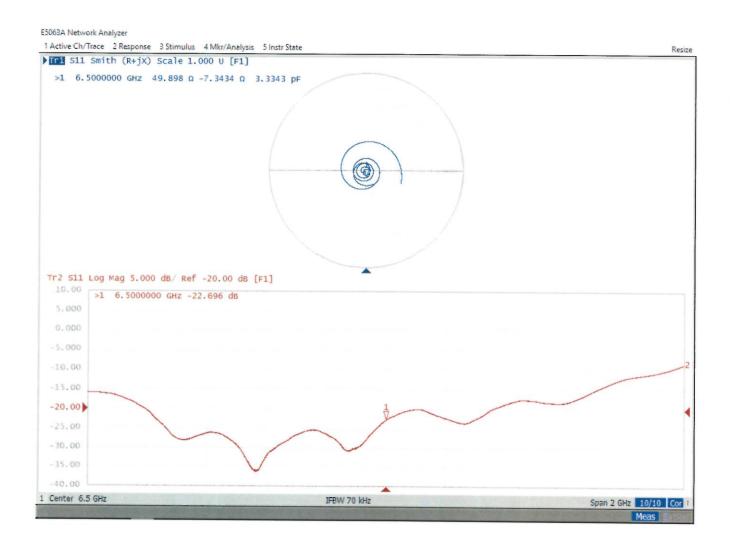
# **DASY6 Validation Report for Head TSL**

### Measurement Report for D6.5GHz-1010, UID 0 -, Channel 6500 (6500.0MHz)

Device under 1	<b>Fest Properties</b>						
Name, Manufa	acturer Di	mensions	[mm]	IMEI	DUT Ty	pe	
D6.5GHz	16	5.0 x 6.0 x	300.0	SN: 1010	-		
Exposure Conc Phantom	litions Position, Test	Band	Group,	Frequency	Conversion	TSL Cond.	TSL
Section, TSL	Distance [mm]		UID	[MHz]	Factor	[S/m]	Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.75	6.08	33.7
Hardware Setu Phantom	ıp TS			Probo Calil	pration Date		
MFP V8.0 Cent	au//doi.org/10/10/00/00/00/00/00/00/00/00/00/00/00/	BL600-10	0001/6			and participant pro-	pration Date
Will Volo cent		501000-10	00000	EX3DV4 - 31	N7405, 2021-12-31	DAE4 Sn90	08, 2021-06-24
Scan Setup				Measureme	ent Results		
			Zoom Sca				Zoom Scan
Grid Extents [			22.0 x 22.0 x 22.			20	022-05-27, 10:24
Grid Steps [mi	-		3.4 x 3.4 x 1.				28.7
Sensor Surface	e [mm]		1.	1			6.49
Graded Grid			Ye	p			5.32
Grading Ratio			1.				0.01
MAIA Surface Detec	•1		N/.		U		Disabled
	tion		VMS + 6				
Scan Method			Measure				No correction
				M2/M1 [%			50.8
				Dist 3dB Pe	eak [mm]		4.8



# Impedance Measurement Plot for Head TSL



#### 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  $\boldsymbol{\Omega}$  from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss(dB)	Δ%	Impedance(Ω)	ΔΩ
D6.5GHzV2-SN:1010	Head	2022-05-27	-22.70	3.95	49.90	-0.90
		2023-05-23	-23.59	5.95	49.00	

c ) extrapolated peak SAR : within 10% of that reported in the calibration data

Dipole Antenna	Head/Body	Date of	extrapolated	Δ%	
Dipole Antenna		Measurement	peak SAR(W/kg)	Δ %	
D6.5GHzV2-SN:1010	Head	2022-05-27	28.70	1.74	
00.3011202-310.1010		2023-05-23	29.20	1.74	

