

# **Appendix I**

# **Phantom Description**

Schmid & Parmer Engineering AG s e

ugheunstresse 43, 8004 Zurich, Switzeller one +41 1 245 9700; Fax +41 1 245 9779 HOGEDING COTT. HITS:/ www.apeag.com

Certificate of Conformity / First Article Inspection

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

Tests The series production process used allows line irmitation 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 sories first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness of shell	Compliant with the requirements according to the standards	2mm +/- 0.2mm in flat and specific areas of head section	First article, Samples, TP-1314 ff.
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 0.2mm at ERP	First article, All items
Material parameters	Delectric parameters for required frequencies	300 MHz - 0 GHz: Relative permittivity < 5. Loss tangent < 0.05	Material samples
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility.	DEGMBE based simulating liquids	Pre-series, First article, Material samples
Segging	Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid	< 1% typical < 0.8% H tilled with 155mm of HSL000 and without DUT below	Prototypes, Sample testing

## Standards

- CENELEC EN 50361 IEEE 8td 1528-2003 8

- 13]
- IEC 82209 Part 1 FCC OET Buildtin 65, Supplement C, Edition 01-01 The IT1S CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

Conformity

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

07.07.2005

Date

D 8 8

Signature / Stamp

a nynitt & Pacamir Englinnening AG Byllausaptersa 43, 8004 Zurich, Smither Am ytt 5 Jes Urboy, Paul Mert 245 9771 NIG-COM

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Titl Page

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# System Validation from Original Equipment Supplier

Zeughausstrasse 43, 8004 Zuric	h, Switzerland		Servizio svizzero di taratura
Accredited by the Swiss Accredita The Swiss Accreditation Service Multilateral Agreement for the re	e is one of the signatori		Accreditation No.: SCS 0108
Client SGS		Certificate No.	D2450V2-727_Apr23
Taoyuan City, Taiwar	1		02450V2-121_Api25
CALIBRATION C	ERTIFICAT	E	
Object	D2450V2 - SN:7	27	
Calibration procedure(s)	QA CAL-05.v12		
	Calibration Proce	edure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	April 25, 2023		
the measurements and the prosi	in the man berndenide p	robability are given on the following pages and	d are part of the certificate.
All calibrations have been conduct	ed in the closed laborato	ry facility: environment temperature (22 $\pm$ 3)°C	
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards	ed in the closed laborato		
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2	ed in the closed laborator E critical for calibration) ID # SN: 104778	ry facility: environment temperature (22 $\pm$ 3)°C	C and humidity < 70%.
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-291	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244	ry facility: environment temperature (22 ± 3)°C Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804)	2 and humidity < 70%. Scheduled Calibration
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Ower Sensor NRP-291 Ower sensor NRP-291	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 104244 SN: 103245	ry facility: environment temperature (22 ± 3)°C Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805)	2 and humidity < 70%. Scheduled Calibration Mar-24
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	ry facility: environment temperature (22 ± 3)°C <u>Cal Datë (Certificate No.)</u> 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809)	2 and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Seference 20 dB Attenuator Type-N mismatch combination	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: BH9394 (20k) SN: 310982 (06327	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	C and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Mar-24
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power sensor NRP-291 Yower sensor NRP-291 Vower sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.) 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) 10-Jan-23 (No. 213-7349_Jan23)	2 and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Peference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. EX3-7349_Jan23) 19-Dec-22 (No. DAE4-601_Dec22)	2 and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Dec-23
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-291 Power Senso	ed in the closed laborato: E critical for calibration) ID # SN: 104778 SN: 103244 SN: 619394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03604/03805) 30-Mar-23 (No. 217-03604/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. EX3-7349_Jan23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house)	C and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jan-24 Jan-23 Scheduled Check
All calibrations have been conduct Calibration Equipment used (M&TI Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Power meter E4419B	ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	v facility: environment temperature (22 ± 3)°C <u>Cal Date (Certificate No.)</u> 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. 217-03809) 30-Mar-23 (No. 217-03810) 10-Jar-23 (No. 217-03810) 30-Mar-23 (No. 217	2 and humidity < 70%. Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jec-23 Scheduled Check In house check: Oct-24
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accreditation No.: SCS 0108

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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:

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%.

Certificate No: D2450V2-727 Apr23

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#### Measurement Conditions

DASY system configuration, as far as not given on page	1
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DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.86 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	250 mW input power	13.6 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.1 W/kg ± 17.0 % (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 250 mW input power	6.28 W/kg

Certificate No: D2450V2-727\_Apr23

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.0 Ω + 2.1 jΩ
Return Loss	- 25.8 dB

## General Antenna Parameters and Design

1.148 ns	Electrical Delay (one direction)	1.148 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 constrained to the Standard 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

Certificate No: D2450V2-727\_Apr23

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# Report No.: TESA2310000626ES Page: 6 of 25

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

Date: 25.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:727

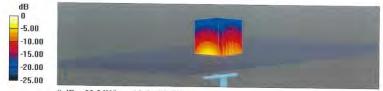
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz;  $\sigma = 1.86 \text{ S/m}$ ;  $\epsilon_r = 37.7$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 10.01.2023
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 118.5 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 27.1 W/kg SAR(1 g) = 13.6 W/kg; SAR(10 g) = 6.28 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50.2%Maximum value of SAR (measured) = 22.5 W/kg



0 dB = 22.5 W/kg = 13.52 dBW/kg

Certificate No: D2450V2-727\_Apr23

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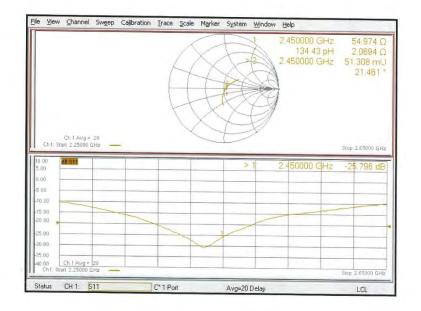
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Impedance Measurement Plot for Head TSL



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# Report No. : TESA2310000626ES Page: 8 of 25

Engineering AG eughausstrasse 43, 8004 Zurich,	Of Switzerland		Convine quiere d'étalennage
ccredited by the Swiss Accreditatio he Swiss Accreditation Service is lultilateral Agreement for the rec	s one of the signatories		Accreditation No.: SCS 0108
lient SGS		Certificate No.	D1900V2-5d173_Apr23
Taoyuan City, Taiwan	ERTIFICATE		
Dbject	D1900V2 - SN:50	1173	
Calibration procedure(s)	QA CAL-05.v12 Calibration Proce	dure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	April 26, 2023		
All calibrations have been conducte	d in the closed laborator	y facility; environment temperature $(22 \pm 3)^{\circ}$	°C and humidity < 70%.
Calibration Equipment used (M&TE		y facility: environment temperature (22 ± 3)° Cal Date (Certificate No.)	C and humidity < 70%. Scheduled Calibration
Calibration Equipment used (M&TE Primary Standards	critical for calibration)		
alibration Equipment used (M&TE rimary Standards ower meter NRP2	critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-24 (No. 217-03805)	Scheduled Calibration Mar-24 Mar-24 Mar-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.) 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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Perference 20 (B Attenuator Fype-N mismatch combination	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cal Date (Certificate No.) 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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Mar-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Vower sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.) 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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP-2 Power sensor NRP-291 Tower sensor NRP-291 Teference 20 dB Attenuator Type-N mismatch combination Teference Probe EX3DV4 DAE4 Secondary Standards	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID #	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 213-7349_Jan23)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP-2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. EX3-7349_Jan23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house) 30-Oct-14 (in house check Oct-22)	Scheduled Calibration Mar:24 Mar:24 Mar:24 Mar:24 Jan:24 Jan:24 Jan:24 Jee:23 Scheduled Check In house check: Oct:24
Calibration Equipment used (M&TE Portmary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 819394 (20k) SN: 310982 / 06327 SN: 601 ID # SN: 6639512475 SN: US37292783	Cal Date (Certificate No.)           30-Mar-23 (No. 217-03804/03805)           30-Mar-23 (No. 217-03806)           30-Mar-23 (No. 217-03805)           30-Mar-23 (No. 217-03805)           30-Mar-23 (No. 217-03806)           30-Mar-23 (No. 217-038010)           10-Jan-23 (No. EX3-7349_Jan23)           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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5H9394 (20k) SN: 310982 / 06327 SN: 601 ID # SN: 6039512475 SN: U\$37292783 SN: W41093315	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 213-03810) 10-Jan-23 (No. 213-03810) 10-Jan-23 (No. 213-03810) 10-Jan-23 (No. 213-03810) 10-Jan-23 (No. 213-0380) 10-Jan-23 (No. 217-0380) 10-Jan-23 (No. 217-0380) 1	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jan-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
Calibration Equipment used (M&TE Primary Standards Power meter NRP-29 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination deference 20 dB Attenuator Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Regenerator R&S SMT-06	critical for calibration) ID # SN: 104778 SN: 103244 SN: 303245 SN: 310382 / 06327 SN: 310382 / 06327 SN: 310382 / 06327 SN: 5601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. EX3-7349,Jan23) 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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jan-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
Calibration Equipment used (M&TE Primary Standards Power meter NRP-29 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A Power Sensor HP 8481A Power Sensor HP 8481A RF generator R&S SMT-06	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 30982 / 06327 SN: 601 ID # SN: 0539512475 SN: US322783 SN: 103972 SN: US341080477	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03805) 30-0ct-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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jan-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
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Fype-N mismatch combination Reference 20 dB Attenuator Power Srosor NRP 2481 Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 303245 SN: 310382 / 06327 SN: 310382 / 06327 SN: 310382 / 06327 SN: 5601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03805) 30-Oct-14 (in house of the context	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Jan-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
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference 20 dB Attenuator DAE4. Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	critical for calibration) ID # SN: 104778 SN: 103244 SN: 303245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 501 ID # SN: 0839512475 SN: 0837292783 SN: 100372 SN: US41080477 Name	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03805) 30-0ct-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)	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
Calibration Equipment used (M&TE Primary Standards Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	critical for calibration) ID # SN: 104778 SN: 103244 SN: 303245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 501 ID # SN: 0839512475 SN: 0837292783 SN: 100372 SN: US41080477 Name	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03810) 10-Jan-23 (No. 217-03805) 30-Oct-14 (in house of the context	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP-29 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EXSDV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Aglient E8358A Calibrated by:	critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06827 SN: 601 ID # SN: 6B39512475 SN: 0587292783 SN: 10372 SN: US41080477 Name Paulo Pina	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03805) 10-Jar-23 (No. 217-03810) 10-Jar-23 (No. 217-03810) 10-Jar-23 (No. 217-03805) 30-0ct-14 (In house check Oct-22) 07-0ct-15 (In house check Oct-22) 07-0ct-15 (In house check Oct-22) 15-Jun-15 (In house check Oct-22) 31-Mar-14 (	Scheduled Calibration Mar-24 Mar-24 Mar-24 Mar-24 Jar-24 Jar-24 Jec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24

Certificate No: D1900V2-5d173\_Apr23

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# Report No.: TESA2310000626ES Page: 9 of 25

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



Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С 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:

TSL ConvF N/A

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.
- 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%.

Certificate No: D1900V2-5d173\_Apr23

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# Report No. : TESA2310000626ES Page: 10 of 25

## **Measurement Conditions**

DAS

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.39 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	250 mW input power	10.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.3 W/kg ± 17.0 % (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 250 mW input power	5.23 W/kg

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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6 Ω + 4.6 jΩ	
Return Loss	- 25.7 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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
-----------------	-------

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

Date: 26.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d173

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.39 S/m;  $\epsilon_r$  = 38.9;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.35, 8.35, 8.35) @ 1900 MHz; Calibrated: 10.01.2023
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 110.0 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 10.09 W/kg; SAR(10 g) = 5.23 W/kgSmallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54%Maximum value of SAR (measured) = 15.8 W/kg



0 dB = 15.8 W/kg = 12.0 dBW/kg

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# View Channel Sweep Calibration Irace Scale Marker System Window Help 52.615 Ω 4.6437 Ω 388.98 pH 1,900000 GHz 51.883 mU 58.023 Ch 1 Awg = 20 Ch1: Start 1.70000 GHz 00 5.00 0.00 Ch 1 Avg= 511 C\* 1-Port Avg=20 Delay Status CH 1: LCL

# Impedance Measurement Plot for Head TSL

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CALIBRATION C	ERTIFICATE	E	
Object	D2600V2 - SN:10	005	
Calibration procedure(s)	QA CAL-05.v12 Calibration Proce	edure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	January 11, 2023	3	
	E critical for calibration)	ry facility: environment temperature $(22 \pm 3)^{\circ}$ C	
	los a		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Primary Standards Power meter NRP Power sensor NRP-Z91	SN: 104778 SN: 103244	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524)	Apr-23 Apr-23
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525)	Apr-23 Apr-23 Apr-23
Primary Standards Power meter NRP Power sensor NRP-Z91	SN: 104778 SN: 103244	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524)	Apr-23 Apr-23
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527)	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528)	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: BH9334 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03528) 10-Jan-23 (No. EX3-7349_Jan23) 19-Dec-22 (No. DAE4-601_Dec22) Check Date (in house)	Apr-23 Apr-23 Apr-23 Apr-23 Jan-24 Dec-23 Scheduled Check
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	04-Apr-22 (No: 217-03525/03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03528) 10-Jan-23 (No: EX3-7349_Jan23) 19-Dec-22 (No: EX	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Jan-24 Dec-23 Scheduled Check In house check: Oct-24
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: 6639512475 SN: US37292783	04-Apr-22 (No: 217-03525/03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03526) 04-Apr-22 (No: 217-03526) 10-Jan-23 (No: EX3-7349_Jan23) 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)	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Jan-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41093315	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03528) 10-Jan-23 (No. EX3-7349_Jan23) 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)	Apr-23 Apr-23 Apr-23 Apr-23 Jan-24 Dec-23 Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: US37292783 SN: MY41093315 SN: 100972	04-Apr-22 (No: 217-03525/03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03528) 10-Jan-23 (No: EX3-7349_Jan23) 19-Dec-22 (No: EX	Apr-23 Apr-23 Apr-23 Apr-23 Jar-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
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: US37292783 SN: MY41093315 SN: 100972	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03528) 10-Jan-23 (No. EX3-7349_Jan23) 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)	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Jan-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
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7049 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: W141093315 SN: 100972 SN: US41080477 Name	04-Apr-22 (No: 217-03525/03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03528) 10-Jan-23 (No: EX3-7349_Jan23) 19-Dec-22 (No: EX	Apr-23 Apr-23 Apr-23 Apr-23 Jar-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
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 819394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41093315 SN: 100972 SN: US41080477	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 10-Jan-23 (No. EX3-7349_Jan23) 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)	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Jan-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
Primary Standards Power meter NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7049 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: W141093315 SN: 100972 SN: US41080477 Name	04-Apr-22 (No: 217-03525/03524) 04-Apr-22 (No: 217-03524) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03525) 04-Apr-22 (No: 217-03528) 10-Jan-23 (No: EX3-7349_Jan23) 19-Dec-22 (No: EX3-7349_Jan23) 19-Dec-23 (No: EX3-7349_Jan23) 19-Dec-24 (No: EX3-7349_Jan23) 19-Dec-25 (No: EX3-7349_Jan23) 19-Dec-22 (No: EX	Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Jan-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

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Accreditation No.: SCS 0108

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Glossary: TSL ConvF N/A

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.
  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 Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2600 MHz ± 1 MHz	

## Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.2 ± 6 %	2.03 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	250 mW input power	14,1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	55.4 W/kg ± 17.0 % (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	condition 250 mW input power	6.26 W/kg

Certificate No: D2600V2-1005\_Jan23

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.5 Ω - 4.2 jΩ	
Return Loss	- 26.9 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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

Manuf	actured by	SPEAG	

Certificate No: D2600V2-1005\_Jan23

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# Report No. : TESA2310000626ES Page: 18 of 25

# DASY5 Validation Report for Head TSL

Date: 11.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

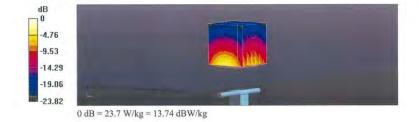
DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1005

Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 38.2$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 10.01.2023
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 116.7 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 28.1 W/kgSAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.26 W/kgSmallest distance from peaks to all points 3 dB below = 8.9 mm Ratio of SAR at M2 to SAR at M1 = 50.1% Maximum value of SAR (measured) = 23.7 W/kg



Certificate No: D2600V2-1005\_Jan23

Page 5 of 6

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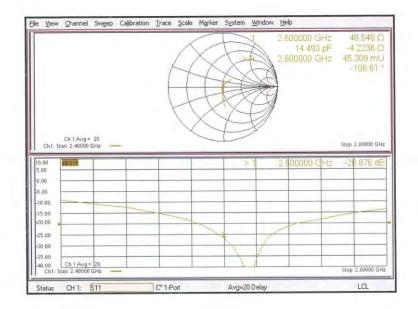
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# Impedance Measurement Plot for Head TSL



Certificate No: D2600V2-1005\_Jan23

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# Report No. : TESA2310000626ES Page: 20 of 25

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Swiss Calibration Service

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alibration procedure(s) alibration date: his calibration certificate docum he measurements and the unce Il calibrations have been condu	QA CAL-22.v6 Calibration Proce November 22, 20 ents the traceability to nationation rtainties with confidence proceed in the closed laborator	edure for SAR Validation Sources 122 onal standards, which realize the physical un robability are given on the following pages an	its of measurements (SI), ad are part of the certificate.	
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he measurements and the unce Il calibrations have been condu	rtainties with confidence p	robability are given on the following pages an	nd are part of the certificate.	
		ry facility: environment temperature (22 $\pm$ 3)°(	C and humidity < 70%.	
alibration Equipment used (M&	TE critical for calibration)			
rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration	
ower meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23	
ower sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23	
ower sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23	
eference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23	
pe-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23	
eference Probe EX3DV4	SN: 3503	08-Mar-22 (No. EX3-3503_Mar22)	Mar-23	
AE4	SN: 601	31-Aug-22 (No. DAE4-601_Aug22)	Aug-23	
econdary Standards	ID#	Check Date (in house)	Scheduled Check	
ower meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24	
ower sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24	
ower 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-24	
letwork Analyzer Agilent E8358	A SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24	
	Name	Function	Signature	
Calibrated by:	Jeton Kastrati	Laboratory Technician	1-1le	
Approved by:	Sven Kühn	Technical Manager	56	

ac-MR

Certificate No: D3700V2-1057\_Nov22

Calibration Laboratory of

Engineering AG eughausstrasse 43, 8004 Zurich, Switzerland

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Page 1 of 6

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# Report No.: TESA2310000626ES Page: 21 of 25

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



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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:

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%

Certificate No: D3700V2-1057 Nov22

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## **Measurement Conditions**

DASY system	n configuration, as	far as not giv	en on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3700 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.7	3.12 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.1 ± 6 %	3.08 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	6.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.6 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	2.43 W/kg

Certificate No: D3700V2-1057\_Nov22

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Appendix (Additional assessments outside the scope of SCS 0108)

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7 Ω + 0.5 jΩ
Return Loss	- 36.8 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.137 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
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SPEAG

Certificate No: D3700V2-1057\_Nov22

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

Date: 22.11.2022

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1057

Communication System: UID 0 - CW; Frequency: 3700 MHz Medium parameters used: f = 3700 MHz;  $\sigma = 3.08 \text{ S/m}$ ;  $\varepsilon_r = 38.1$ ;  $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.73, 7.73, 7.73) @ 3700 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- 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=3700MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.62 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 6.63 W/kg; SAR(10 g) = 2.43 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 73.8%Maximum value of SAR (measured) = 12.6 W/kg



Certificate No: D3700V2-1057 Nov22

Page 5 of 6

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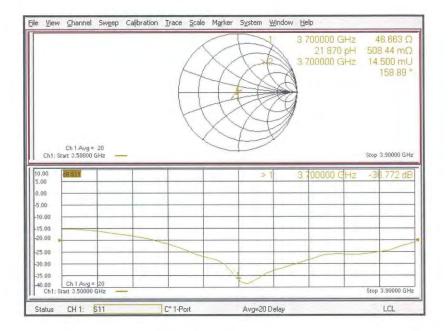
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## Impedance Measurement Plot for Head TSL



Certificate No: D3700V2-1057\_Nov22

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# - End of report -

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t (886-2) 2299-3279 台灣檢驗科技股份有限公司

f (886-2) 2298-0488

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