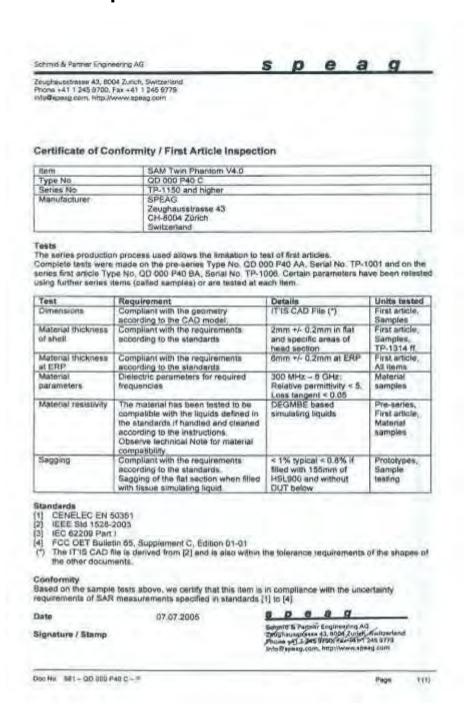


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# **Appendix C**

# **Phantom Description**



Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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# **System Validation from Original Equipment Supplier**

	Switzerland	"Mulahe"	Swiss Calibration Service
Accredited by the Swiss Accreditation The Swiss Accreditation Service is Multilateral Agreement for the rec	is one of the signatorie	s to the EA	Accreditation No.: SCS 0108
Client SGS-TW (Auden		1,000,000	lo: D750V3-1015_Aug19
CALIBRATION C	ERTIFICATE		
Object	D750V3 - SN:10	15	
Calibration procedure(s)	QA CAL 05.v11 Calibration Proce	edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	August 23, 2019		
Calibration Equipment used (M&TE	critical for calibration)	robability are given on the following pages a ry facility: environment temperature (22 ± 3)	°C and humidity < 70%
Calibration Equipment used (M&TE Primary Standards Power mater NRP Power sensor NRP-Z91 Power sensor NRP-Z91	ID # SN: 104778 SN: 103244 SN: 103245	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  C3-Apr-19 (No. 217-02892)08993)  C3-Apr-19 (No. 217-02892)  C3-Apr-19 (No. 217-02893)	*C and humidity = 70%  Scheduled Calibration  Apr.20  Apr.20  Apr.20
Calibration Equipment used (M&TE Primary Standards Power mater NRP Power sansor NRP-Z91 Power sansor NRP-Z91 Refurence 20 dD Altenuator	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5050 (20k)	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  C3-Apr-10 (No. 217-02892)(22993)  G3-Apr-19 (No. 217-02893)  O4-Apr-19 (No. 217-02893)	*C and humidity = 70%  Scheduled Calibration  Apr-30  Apr-20  Apr-20  Apr-20  Apr-20
Calibration Equipment used (M&TE Primary Standards Power mater NRP Power sensor NRP-Z91 Power sensor NRP-Z91	ID # SN: 104778 SN: 103244 SN: 103245	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  C3-Apr-19 (No. 217-02892)08993)  C3-Apr-19 (No. 217-02892)  C3-Apr-19 (No. 217-02893)	*C and humidity = 70%  Scheduled Calibration  Apr.20  Apr.20  Apr.20
Calibration Equipment used (M&TE Primary Standards Power mater NIPP Power sansor NIPP-Z91 Power sensor NIPP-Z91 Power sensor OID Altenuator Type-M mismatch combination	Entical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5050 (20k) SN: 5047.2 / 06327	ry facility: environment temperature (22 ± 3)  Gal Date (Certificate No.) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-028934)	*C and humidity = 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20
Calibration Equipment used (MSTE Primary Standards Power mater NRP Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Tenternoc 20 CD Attenuator Type-N mismatch combination Reference Probe EXSDV4 DAE4 Secondary Standards	E critical (or calibration)  ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (20%) SN: 5047.2 / 06327 SN: 7549 SN: 5607	ry facility: environment temperature (22 ± 3)  O3 Apr-19 (No. 217-02892/02893) O3 Apr-19 (No. 217-02893) O3 Apr-19 (No. 217-02893) O4 Apr-19 (No. 217-02893) O4 Apr-19 (No. 217-02893) O4 Apr-19 (No. 217-02894) O4 Apr-19 (No. 217-02894) O4 Apr-19 (No. 217-02896) 30 Apr-19 (No. 124-0491) Chock Date (in house)	*C and humidity # 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Scheduled Check
Calibration Equipment used (MATE Primary Standards Power mater NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Power sensor NRP-Z91 Power sensor NRP-Z91 Reterence 20 dD Attenuator Type N mismatch contribution Reterence Probe EXSIDV4 DAE4 Secondary Standards Prower mater E4419R	Crisical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 2036 (20k) SN: 5047: 2 / 06327 SN: 7349 SN: 601  ID #  SN: GR09519475	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 03-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 171-02894) 05-Apr-19 (No. DASH-0501_Apr19) 05-Apr-19 (No. DASH-0501_Apr19) 05-Oct-14 (in house) 05-Oct-14 (in house)	*C and humidity = 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  May-20  Apr-20  Scheduled Check  In house check: Cet-20
Calibration Equipment used (MSTE Primary Standards Power meter NRIP Power sonator NRIP-291 Power sonator NRIP-291 Power sonator NRIP-291 Reference 20 dd Attenuator Type-A misimatch combination Reference Probe EXSUV4 DAE4 Secondary Standards Prower minister E4419R Power sensor HP 5481A	Emiscal (or calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: 00285  SN: 5847.2 / 06327  SN: 5867  ID-8  SN: GROSS19475  SN: US37292783	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  Cal Date (No. 217-02892)02893)  GS-Apr-19 (No. 217-02893)  GS-Apr-19 (No. 217-02893)  OH-Apr-19 (No. 217-02893)  OH-Apr-19 (No. 217-02894)  OH-Apr-19 (No. 217-02894)  OH-Apr-19 (No. 217-02896)  30-Apr-19 (No. 217-02896)  30-Apr-19 (No. 10-E4-501_Apr19)  Chack Date (in house)  30-Oct-14 (in house chack Feb-19)  UT-Oct-15 (In house chack Cot-18)	*C and humidity # 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Scheduled Check  In house check: Cct-20  In house check: Cct-20
Calibration Equipment used (M&TE Primary Standards Dower mater NRP Power sansor NRP-Z91 Returner 20 dO Altenuator Type-A misimatch combination Reterence Probe EXSIDV4 DAE4 Socondary Standards Power mater E441R Power sensor HP 8481A Power sensor HP 8481A	Crisical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 2036 (20k) SN: 5047: 2 / 06327 SN: 7349 SN: 601  ID #  SN: GR09519475	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.) 03-Apr-19 (No. 217-02892)(02893) 03-Apr-19 (No. 217-02893) 03-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02896) 29-May-19 (No. EX3-7349, May19) 30-Apr-19 (No. DAE4-601, Apr19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Feb-19)	"C and humidity # 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Seneduled Chesk  In house check: Cet-20  In house check: Cet-20  In house check: Cet-20  In house check: Cet-20
Calibration Equipment used (MSTE Primary Standards Power meter NRIP Power sonator NRIP-291 Power sonator NRIP-291 Power sonator NRIP-291 Reference 20 dd Attenuator Type-A misimatch combination Reference Probe EXSUV4 DAE4 Secondary Standards Prower minister E4419R Power sensor HP 5481A	Editical for calibration)  ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5047.2 / 06327 SN: 5847.2 / 06327 SN: 587.3 / 06327 SN: GR00519475 SN: US37282783 SN: MY41092317	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  Cal Date (No. 217-02892)02893)  GS-Apr-19 (No. 217-02893)  GS-Apr-19 (No. 217-02893)  OH-Apr-19 (No. 217-02893)  OH-Apr-19 (No. 217-02894)  OH-Apr-19 (No. 217-02894)  OH-Apr-19 (No. 217-02896)  30-Apr-19 (No. 217-02896)  30-Apr-19 (No. 10-E4-501_Apr19)  Chack Date (in house)  30-Oct-14 (in house chack Feb-19)  UT-Oct-15 (In house chack Cot-18)	*C and humidity # 70%  Scheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  Scheduled Check  In house check: Cct-20  In house check: Cct-20
Calibration Equipment used (MSTE Primary Standards Power meter NRIP Power sensor NRIP-Z91 Power sensor NRIP-Z91 Power sensor NRIP-Z91 Power sensor NRIP-Z91 Reference D off Alternator Type N mismatch combination Reterence Probe EXSIDV4 DAE4  Socondary Standards Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RR generator RAS SMT 06	Entitical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: 00326 (20k)  SN: 5047.2 / 06327  SN: 5047.2 / 06327  SN: 501  ID #  ID #  ID #  SN: US37292783  SN: W141092317  SN: US37292783  SN: W141092317	Cal Date (Certificate No.)  O3-Apr-19 (No. 217-02892/02892)  O3-Apr-19 (No. 217-02892/02892)  O3-Apr-19 (No. 217-02893)  O4-Apr-19 (No. 217-02893)  O4-Apr-19 (No. 217-02893)  O4-Apr-19 (No. 217-02894)  O5-Oct-14 (in house check Feb-19)  O7-Oct-15 (in house check Cet-18)  O7-Oct-15 (in house check Uct-18)  O7-Oct-15 (in house check Uct-18)	*C and humidity = 70%  Scheduled Calibration  Apr-30  Apr-30  Apr-20  Apr-20  May-20  Apr-20  Scheduled Check  In house check: Cet-20
Calibration Equipment used (MSTE Primary Standards Power meter NRIP Power sensor NRIP-Z91 Power sensor NRIP-Z91 Power sensor NRIP-Z91 Power sensor NRIP-Z91 Reference D off Alternator Type N mismatch combination Reterence Probe EXSIDV4 DAE4  Socondary Standards Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RR generator RAS SMT 06	Errifical for calibration)  ID # SN: 104778 SN: 103244 SN: 103245 GN: 5050 (20k) SN: 50472 / 06327 SN: 50472 / 06327 SN: 7549 SN: 7547 SN: 7557 SN:	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 03-Apr-19 (No. 217-02894) 030-Apr-19 (No. 217-02894) 030-Apr-19 (No. 127-02894) 030-Apr-19 (No. 127-02894) 030-Apr-19 (No. 128-02894) 030-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Cet-18) 07-Oct-15 (in house check Cet-18) 15 Jun 15 (in house check Oct-18)	"C and humidity = 70%  Gicheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  May-20  Apr-20  Seheduled Cheek  In house cheek: Cet-20  In house cheek: Cet-20
Calibration Equipment used (MSTE Primary Standards Power meter NRIP Power sonor NRIP-291 Power sonor NRIP-291 Power sonor NRIP-291 Power sonor NRIP-291 Reference 20 dd Attenuator Type-N mismatch combination Reference Probe EXSUV4 DAE4 Secondary Standards Prower mister E4419R Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A News sensor HP 8481A New	Emiscal (or calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: 00245  SN: 5047 2 / 06327  SN: 5847 3 / 06327  SN: 589  SN: 607  ID #  SN: US37252783  SN: MY41092317  SN: US37252783  SN: MY41092317  SN: US37252783	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  O3-Apr-16 (No. 217-02892)02893)  O3-Apr-19 (No. 217-02893)  O3-Apr-19 (No. 217-02893)  O4-Apr-19 (No. 217-02894)  O4-Apr-19 (No. 217-02894)  O4-Apr-19 (No. 217-02896)  30-Apr-19 (No. 217-02896)  30-Apr-19 (No. 217-02896)  30-Oct-14 (in house)  30-Oct-14 (in house)  O7-Oct-15 (in house check Peb-19)  O7-Oct-15 (in house check Oct-18)  O7-Oct-15 (in house check Oct-18)  Sun-16 (in house check Oct-18)  Sun-16 (in house check Oct-18)	"C and humidity = 70%  Gicheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  May-20  Apr-20  Seheduled Cheek  In house cheek: Cet-20  In house cheek: Cet-20
Calibration Equipment used (MSTE Primary Standards Power mater NRIP Power sancer NRIP-Z91 Reference 20 GJ Attenuator Type-R mismatch combination Reference Probe EXSDV4 DAE4 Secondary Standards Prower mater F4419R Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT 06 Network Analyzer Aglient FRSSRA Celforated by:	Editical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103244  SN: 103245  SN: 5047.2 / 06327  SN: 1037/28/27/83  SN: MY41092317  SN: 105972  SN: 1054178/0477  Name  Jetor; Kastrati	ry facility: environment temperature (22 ± 3)  Cal Date (Certificate No.)  03-Apr-19 (No. 217-02892/02893)  03-Apr-19 (No. 217-02893)  03-Apr-19 (No. 217-02893)  04-Apr-19 (No. 217-02894)  05-Oct-16 (in house)  100-Oct-16 (in house check Feb-19)  15-Un-15 (in house check Cot-18)  15-Un-15 (in house check Cot-18)  15-Un-16 (in house check Cot-18)  Function  Function	"C and humidity = 70%  Gicheduled Calibration  Apr-20  Apr-20  Apr-20  Apr-20  Apr-20  May-20  Apr-20  Seheduled Cheek  In house cheek: Cet-20  In house cheek: Cet-20

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Calibration Laboratory of Schmid & Partner Engineering AG





ditation No.: SCS 0108

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Mutitateral Agreement for the recognition of calibration certificates

Glossary:

TSL

tissue simulating liquid sensitivity in TSL / NORM x,y,z not applicable or not measured ConvF

#### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. Antenna Parameters with TSL: The 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
- 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: D750V3-1015\_Aug19

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DASY Version	given on pag	DASY5		V52 10 2
Extrapolation	Adh	vanced Extrapolation		
Phantom	Me	odular 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 Nominal Head TSL parameters	s were applie	Temperature 22.0 °C	Permittivity 41.9	Conductivity 0.89 mho/m
Measured Head TSL parameters		(22.0 ± 0.2) °C	42.7 + 6 %	0.90 mha/m ± 6
Head TSL temperature change during	g lest	< 0,5 °C		_
SAR averaged over 10 cm <sup>3</sup> (10 g) of He		condition	SAN TERM	- true without
SAR for nominal Head TSL parameters		normalized to 1W		16 W/kg 1 ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of He SAR measured	ad TSL	condition 250 mW Input power	1.9	42 W/kg
SAR for naminal Head TSL parameters		normalized to 1W	5.66 W/kg	± 16.5 % (k=2)

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Antenna Parameters with Head 1	TSL	
Impedance, transformed to feed point	53.1 Ω - 0.6  Ω	
Return Loss	30.4 dB	
General Antenna Parameters and	d Design	
Electrical Delay (one direction)	1.037 ne	
second arm of the dipole. The antenna is the are added to the dipole arms in order to imp "Measurement Conditions" paragraph. The s according to the Standard.	paxial cable. The center conductor of the feeding line is directly connected or some of the dipoles, small prove matching when loaded according to the position as explained in SAR data are not affected by this change. The overall dipole length is dipole arms, because they might bend or the soldered connections in	end cap tho s still
Additional EUT Data		
Manufactured by	SPEAG	
	00 2410	

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

Date: 23.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MIIz; Type: D750V3; Serial: D750V3 - SN:1015

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f=750 MHz;  $\sigma=0.9$  S/m;  $s_r=42.7$ ;  $\rho=1000$  kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19.2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 29.05.2019
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.91 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.25 W/kg SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Certificate No: D750V3-1015\_Aug19

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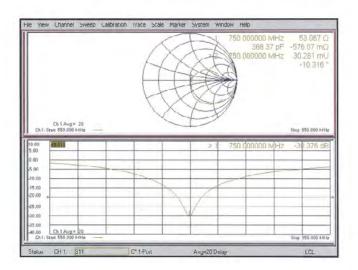
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Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1015\_Aug19

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





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

Certificate No: D750V3-1078 Jun19

Power meter NRP SN: 104778 03-Apr-19 (No. 217-02832/02893) Apr-20 Power sensor NRP-Z91 SN: 103244 03-Apr-19 (No. 217-02892) Apr-20 Apr-20 Power sensor NRP-Z91 SN: 103245 03-Apr-19 (No. 217-02893) Apr-20 Apr-20 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Apr-20 Type-N mismatch combination SN: 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20 Apr-20 Power sensor Probe EX3DV4 SN: 7349 29-May-19 (No. EX3-7349_May19) May-20 DAE4 SN: 601 30-Apr-19 (No. DAE4-601_Apr19) Apr-20 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A SN: US37292783 07-Oct-14 (in house check Peb-19) In house check: Power sensor HP 8481A SN: W371992317 07-Oct-15 (in house check Oct-18) In house check: Prower sensor HP 8481A SN: M3741092317 07-Oct-15 (in house check Oct-18) In house check: Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-18) In house check: Name Function Signature Michael Weber Laboratory Technician	ject	D750V3 - SN:10	78	
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SThe measurements and the uncertainties with confidence probability are given on the following pages and are part of the certific All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.  Calibration Equipment used (M&TE critical for calibration)  Primary Standards  ID # Cal Date (Certificate No.) Scheduled Calibration Standards  Power meter NRP  SN: 104778  03-Apr-19 (No. 217-02892/02893) Apr-20  Power sensor NRP-Z91  SN: 103244  03-Apr-19 (No. 217-02892) Apr-20  Power sensor NRP-Z91  SN: 103245  03-Apr-19 (No. 217-02893) Apr-20  Prype-N mismatch combination  SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Apr-20  Reference 20 dB Attenuator  SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Apr-20  Reference Probe EX3DV4  SN: 7349  29-May-19 (No. EX3-7349_May19) May-20  DAE4  SN: 601  30-Apr-19 (No. DAE4-601 Apr19) Apr-20  Secondary Standards  ID # Check Date (in house) Scheduled Check  Power meter E4419B  SN. GB39512475  30-Oct-14 (in house check Cet-18) In house check:  SN: 10397297783  O7-Oct-15 (in house check Cet-18) In house check:  SN: 100972  15-Jun-15 (in house check Cet-18) In house check:  Name Function Signature  Michael Weber  Laboratory Technician	libration procedure(s)		edure for SAR Validation Sources	between 0.7-3 GHz
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Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The 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
- 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: D750V3-1078 Jun19

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No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號 t (886-2) 2299-3279 f (886-2) 2298-0488

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#### **Measurement Conditions**

DASY Version	DASY5	V52.10.2
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**

	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	42.0 ± 6 %	0.88 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	2.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.60 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.60 W/kg ± 16.5 % (k=2)

#### **Body TSL parameters**

The following parameters and calculations were applied.

,,	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.64 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.68 W/kg ± 16.5 % (k=2)

Certificate No: D750V3-1078\_Jun19

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.4 Ω + 1.4 jΩ
Return Loss	- 25.5 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.3 Ω - 2.4 jΩ
Return Loss	- 32.3 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.037 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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Certificate No: D750V3-1078\_Jun19

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

Date: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1078

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: f = 750 MHz;  $\sigma = 0.88$  S/m;  $\varepsilon_r = 42$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

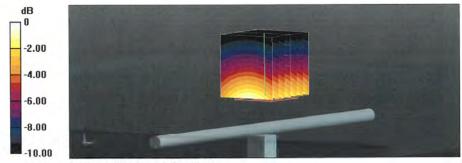
Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.18 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.21 W/kg

SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.39 W/kgMaximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Certificate No: D750V3-1078 Jun19

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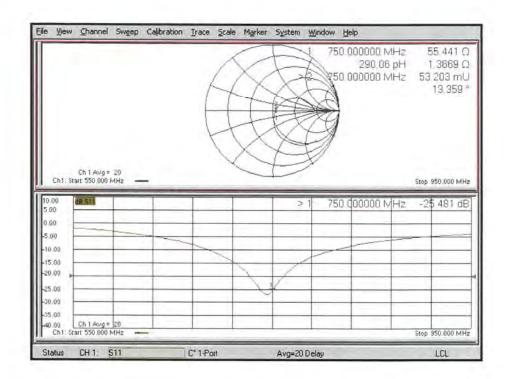
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#### Impedance Measurement Plot for Head TSL



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#### **DASY5 Validation Report for Body TSL**

Date: 27.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1078

Communication System: UID 0 - CW: Frequency: 750 MHz

Medium parameters used: f = 750 MHz;  $\sigma = 0.96 \text{ S/m}$ ;  $\varepsilon_r = 55.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.4, 10.4, 10.4) @ 750 MHz; Calibrated: 29.05,2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

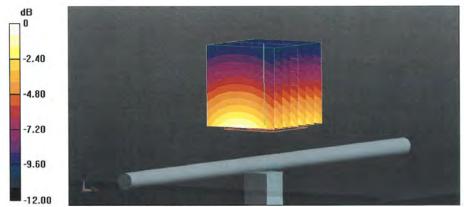
DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.85 V/m; Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.42 W/kg

Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

Certificate No: D750V3-1078 Jun19

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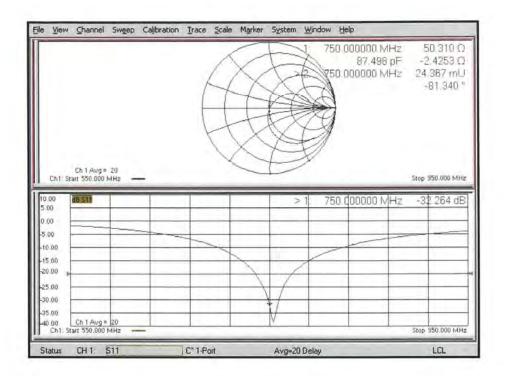
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#### Impedance Measurement Plot for Body TSL



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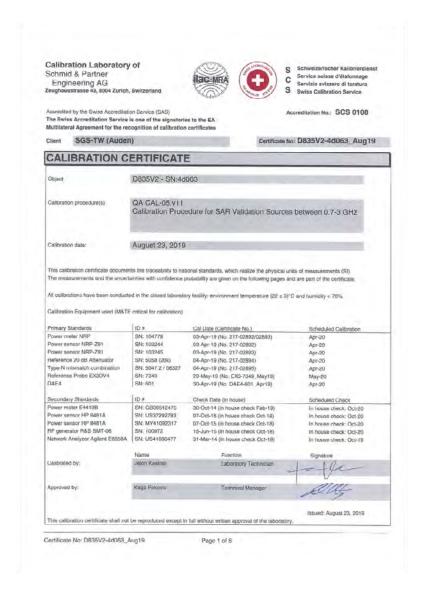
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Calibration Laboratory of Schmid & Partner Engineering AG





C S Swiss Calibration Service

ation No.: BCB 0108

Accrecited by the Swee Accrecitation Service (EAS)
The Swee Accrecitation Service is one of the signatories to t
Multilateral Agreement for the recognition of calibration certif

Glossary:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All ligures stated in the certificate are valid at the frequency indicated.

  Antenna Parameters with TSL: The dipole is mounted with the space 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 Relum 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
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the

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: D835V2-4d063\_Aug19

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Nominal Head TSL parameters 22.0 °C 41.5 0.90 mhd	Extrapolation		given on page 1.  DASY5		V52.10.2
Phantom	- manufestation	A	dvanced Extrapolation		
Zoom Scan Resolution					
### Frequency  ### 835 MHz ± 1 MHz  ### 835 MHz  ### 835 MHz ± 1 MHz  ### 835 MHz ### 835 MHz  ### 835 MHz  ### 835 MHz  ### 835 MHz  ### 835 MHz  #	Distance Dipole Center - TSL	15 mm		with Spaner	
Permittivity Conduct  Temperature Permittivity Conduct  Nominal Head TSL parameters 22.0 °C 41.5 0.90 mh  Measured Head TSL parameters (22.0 +0.2) °C 42.5 ± 6 % 0.92 mho/m  Head TSL temperature change during test < 0.5 °C	Zoom Scan Resolution		dx, dy, dz = 5 mm		
Temperature	Frequency		835 MHz = 1 MHz		
Measured Head TSL parameters         (22.0 ± 0.2) °C         42.5 ± 6 %         0.92 mho/m           Head TSL temperature change during test         < 0.5 °C             AR result with Head TSL           SAR averaged over 1 cm² (1 g) of Head TSL         Condition         2.42 W/kg           SAR measured         250 mW input power         2.42 W/kg           SAR for morninal Head TSL parameters         normalized to 1W         9.57 W/kg ± 17.0 °k (k=2           SAR averaged over 10 cm² (10 g) of Head TSL         condition           SAR measured         250 mW input power         1.57 W/kg		vere appl	7	Permittivity	Conductivity
Head TSL temperature change during test < 0.5 °C	Nominal Head TSL parameters		1,501,00,511,1140,5		0.90 mho/m
Head TSL temperature change during test				12.115	0.92 mho/m ± 6
R result with Head TSL  SAR averaged over 1 cm² (1 g) of Head TSL  SAR measured  SAR incasured  SAR incasured  SAR incasured  SAR overaged over 10 cm² (10 g) of Head TSL  SAR averaged over 10 cm² (10 g) of Head TSL  SAR incasured		est			
SAR for naminal Head TSL parameters normalized to 1W 6.22 W/kg ± 16.5 % (k=2)	SAR measured		250 mW input power	1.8	57 W/kg
SAR averaged over 10 cm² (10 g) of Head TSL condition  SAR measured 250 mW input power 1.57 W/kg					
	SAR for nominal Head TSL parameters		normalized to 1W	6.22 W/kg	± 16.5 % (k=2)

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Antenna Parameters with Head TSL		
Impedance, transformed to feed point	50.6 Ω 2.2  Ω	
Return Loss	- 32.8 dB	
General Antenna Parameters and Desi	a slight warming of the dipole near the feedpoint can be	
Jeedpoint may be damaged.  Additional EUT Data	ms, because they might bend of the soldered connection	s near the
Manufactured by	SPEAG	

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DASY5 Validation Report for Head TSL

Date: 23.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT; Dipole 835 MHz; Type; D835V2; Serial: D835V2 - SN: 4d063

Communication System: UID 0 - CW; Frequency: 835 MHz. Medium parameters used: f = 835 MHz;  $\sigma = 0.92$  S/m;  $\varepsilon_c = 42.5$ ;  $\rho = 1000$  kg/m³ Phantom section: Flat Section

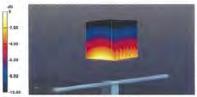
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 29.05.2019
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated; 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 63.04 V/m, Power Drift = -0.00 dB Peak SAR (extrapolated) = 3.64 W/kg SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.57 W/kg Maximum value of SAR (measured) = 3.23 W/kg



0 dB = 3.23 W/kg = 5.09 dBW/kg

Certificate No: D835V2-4d063\_Aug19

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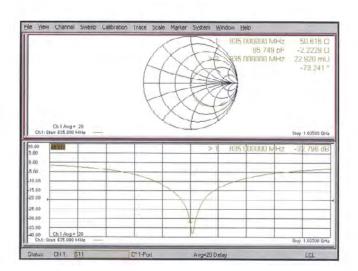
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Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d063\_Aug19

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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

- I I I I I I I I I I I I I I I I I I I	CERTIFICAT	E	
Object	D835V2 - SN:40	d092	
Calibration procedure(s)	QA CAL-05.v11		
	Calibration Proc	edure for SAR Validation Source	es between 0.7-3 GHz
Calibration date:	June 20, 2019		
This calibration certificate docume	ents the traceability to na	tional standards, which realize the physical u	4-17
The measurements and the uncer	tainties with confidence	probability are given on the following pages a	inits of measurements (SI).
All calibrations have been conduc	ted in the closed laborate	ory facility: environment temperature (22 ± 3)	°C and humidity < 70%.
Calibration Equipment used (M&T			
s and the state of	L critical for calibration)		
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
ower sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
ower sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	200.00
ype-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
	SN: 7349	29-May-19 (No. EX3-7349_May19)	Apr-20
Reference Probe EX3DV4			May-20
	SN: 601		
	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
DAE4 Secondary Standards	ID#		Apr-20
Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	4.00	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20 Scheduled Check
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	ID#	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)	Apr-20 Scheduled Check In house check: Oct-20
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	ID # SN: GB39512475	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783 SN: MY41092317	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards Power meter E4419B Ower sensor HP 8481A Power sensor HP 8481A If generator R&S SMT-06 letwork Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
DAE4 Secondary Standards Power meter E4419B Sower sensor HP 8481A Tower sensor HP 8481A IF generator R&S SMT-06 Setwork Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A If generator R&S SMT-06 Network Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)  Function  Laboratory Technician	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06 etwork Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Manu Seitz	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)	Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 setwork Analyzer Agilent E8358A Calibrated by:	ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Manu Seitz	30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house)  30-Oct-14 (in house check Feb-19)  07-Oct-15 (in house check Oct-18)  07-Oct-15 (in house check Oct-18)  15-Jun-15 (in house check Oct-18)  31-Mar-14 (in house check Oct-18)  Function  Laboratory Technician	Apr-20 Scheduled Check In house check: Oct-2I In house check: Oct-2I In house check: Oct-2I In house check: Oct-2I In house check: Oct-18

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

### Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
  of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The 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%.

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#### **Measurement Conditions**

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

### **Head TSL parameters**

The follow na parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.8 ± 6 %	0.91 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	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.50 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg ± 16.5 % (k=2)

#### **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 6 %	0.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

#### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.57 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.24 W/kg ± 16.5 % (k=2)

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.2 Ω - 1.0 jΩ
Return Loss	- 32.5 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.3 Ω - 7.3 jΩ
Return Loss	- 21.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.397 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: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d092

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma$  = 0.91 S/m;  $\epsilon_r$  = 41.8;  $\rho$  = 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(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30,04,2019

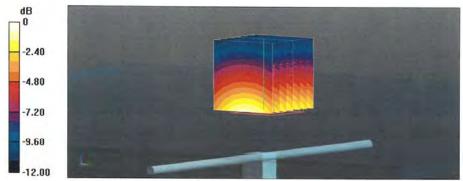
Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 63.07 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.60 W/kg SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.54 W/kg

Maximum value of SAR (measured) = 3.17 W/kg



0 dB = 3.17 W/kg = 5.01 dBW/kg

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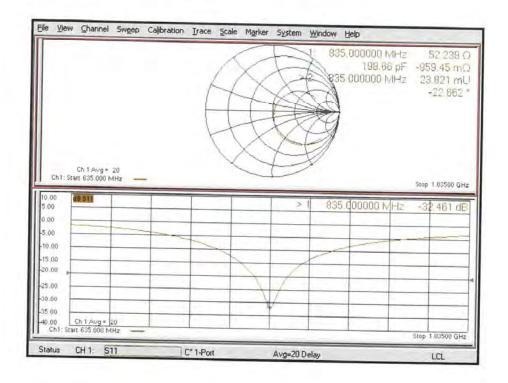
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# Impedance Measurement Plot for Head TSL



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# **DASY5 Validation Report for Body TSL**

Date: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d092

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma$  = 0.98 S/m;  $\epsilon_r$  = 55.4;  $\rho$  = 1000 kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

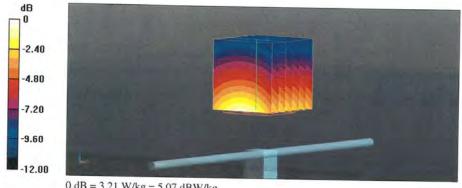
- Probe: EX3DV4 SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 58.23 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.61 W/kg

SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 3.21 W/kg



0 dB = 3.21 W/kg = 5.07 dBW/kg

Certificate No: D835V2-4d092\_Jun19

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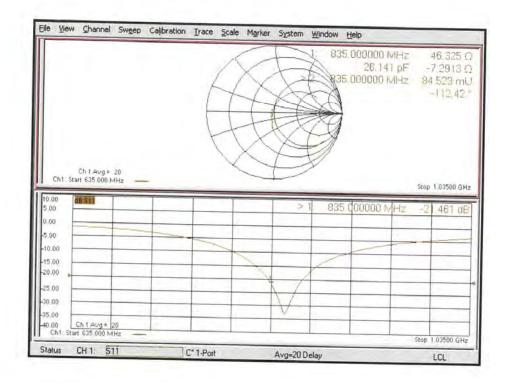
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# Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d092\_Jun19

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Calibration Laboratory of Schmid & Partner Engineering AG





tion No.: SCS 0108

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Glossary:

tissue simulating liquid sensitivity in TSL / NORM x,y,z not applicable or not measured ConvF N/A

- Calibration is Performed According to the Following Standards:

  a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

  b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 (BAP)", July 2016

  - 300 MHz to 6 GHz)\*, July 2016
    c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)\*, March 2010 d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with ISL: 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
- 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: D1/50V2-1008 Aug19

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DASY Version	given on p	DASY5		V52 10.2
Extrapolation	-	Advanced Extrapolation	_	yue 10.e
Phantom	_	Modular Flat Phantom	7	
Distance Dipole Center - TSL		10 mm		with Spacer
Zoom Scan Resolution		dx, dy, dz = 5 mm		min cyacan
Frequency		1750 MHz ± 1 MHz		
ead TSL parameters The following parameters and calculations	were app	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters		22.0 °C	40.1	1.37 mha/m
Measured Head TSL parameters		(22.0 ± 0.2) °C	40.8 ± 6 %	1.36 mha/m ± 6
Head TSL temperature change during	test	< 0.5 °C	****	***
SAR for nominal Head TSL parameters	-4701	normalized to 1W	36.8 W/kg	± 17.0 % (k=2)
SAR averaged over 10 cm <sup>2</sup> (10 g) of Her	ad TSL	condition		
SAR measured		250 mW input power	4.8	13 W/kg
SAR for nominal Head TSL parameters		normalized to 1W	19.4 W/kg	± 16.5 % (k=2)

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Impedance, transformed to feed point		49.0 Ω + 0.6  Ω	
Return Loss		-38.5 dB	
Electrical Delay (one direction)  After long term use with 100W radiated pow  The dipole is made of standard semirigid co. second arm of the dipole. The antenne is the are added to the dipole arms in order to imp  "Measurement Conditions" paragraph The 3 according to the Standard.  No excessive force must be applied to the d	axial cable. The center conducto prefere short-circuited for DC-sig rove matching when loaded acco SAR data are not affected by this	of the feeding line is directly or hals. On some of the dipoles, and rrding to the position as explains change. The overall dipole leng	onnected to nall end cap ed in the oth is still
Additional EUT Data  Manulactured by		SPEAG	

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

Date: 23.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MIIz; Type: D1750V2; Serial: D1750V2 - SN:1008

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f=1750 MHz;  $\sigma=1.36$  S/m;  $\epsilon_r=40.8$ ;  $\rho=1000$  kg/m³ Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 29.05.2019
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- · Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

#### 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 = 106.5 V/m; Power Drift = -0.01 dB Peak 5AR (extrapolated) = 17.0 W/kg SAR(1g) = 9.13 W/kg; SAR(10g) = 4.83 W/kg Maximum value of SAR (measured) = 14.3 W/kg



0 dB = 14.3 W/kg = 11.55 dBW/kg

Certificate No: D1750V2-1008\_Aug19

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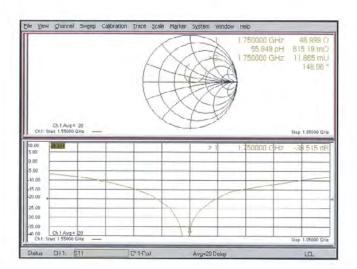
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Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1008\_Aug19

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Swiss Calibration Service

Accreditation No.: SCS 0108

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Certificate No: D1750V2-1023 Jun19

Object	D1750V2 - SN:10	023	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	June 20, 2019		
This calibration certificate documen	nts the traceability to nati	ional standards, which realize the physical un	its of measurements (SI).
he measurements and the uncertainty	ainties with confidence p	robability are given on the following pages an	d are part of the certificate.
All calibrations have been conducted	nd in the aloned laborate	ry facility; environment temperature (22 ± 3)*(	Cand humidity < 70%
ili calibrations have been conducte	ed in the closed laborato	ry lacility, environment temperature (22 ± 3)	and minimity ~ . roam
Calibration Equipment used (M&TE	critical for calibration)		
	172	and a strong and a strong at the strong at t	And an Venue and
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Primary Standards Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91	SN: 104778 SN: 103244	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892)	Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893)	Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894)	Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894)	Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20
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: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check
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	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Peterence 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check; Oct-20 In house check; Oct-20 In house check: Oct-20
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 RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check; Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check; Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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 RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check; Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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 RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100979 SN: US41080477	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (in house check Peb-19) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20
Primary Standards Power meter NRP Power sensor NRP-Z91 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 RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY4109217 SN: US41080477 Name	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19)  Check Date (in house) 30-Oct-14 (in house check Cet-18) 07-Oct-15 (in house check Oct-18) 15-liun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check; Oct-20 In house check: Oct-20

Certificate No: D1750V2-1023\_Jun19

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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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### Glossary:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z not applicable or not measured

#### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The 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
- 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**

as far as not given on page 1

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	1750 MHz ± 1 MHz	

#### **Head TSL parameters**

and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0 ± 6 %	1.34 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	8.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.1 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.9 W/kg ± 16.5 % (k=2)

## **Body TSL parameters**

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	1.46 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	4.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 16.5 % (k=2)

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.3 Ω - 0.1 jΩ
Return Loss	- 50.0 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4 Ω - 1.0 jΩ
Return Loss	- 28.3 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.218 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: 19.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz;  $\sigma = 1.34 \text{ S/m}$ ;  $\varepsilon_r = 40$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

## DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

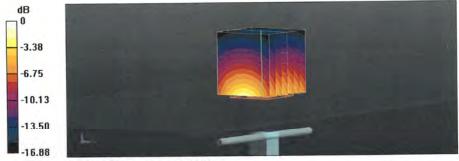
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.5 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.6 W/kg

SAR(1 g) = 8.9 W/kg; SAR(10 g) = 4.69 W/kg

Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

Certificate No: D1750V2-1023\_Jun19

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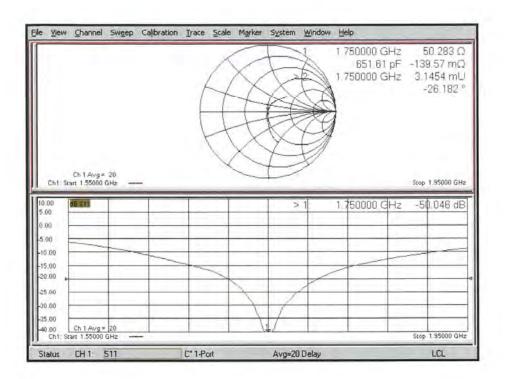
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#### Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1023 Jun19

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## **DASY5 Validation Report for Body TSL**

Date: 20.06.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1023

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz;  $\sigma = 1.46 \text{ S/m}$ ;  $\varepsilon_r = 53.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

## DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.45, 8.45, 8.45) @ 1750 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

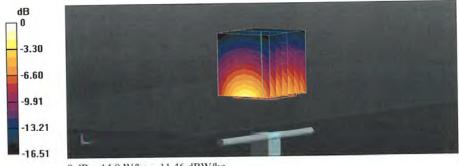
# Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 102.7 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 9.23 W/kg; SAR(10 g) = 4.91 W/kg

Maximum value of SAR (measured) = 14.0 W/kg



0 dB = 14.0 W/kg = 11.46 dBW/kg

Certificate No: D1750V2-1023\_Jun19

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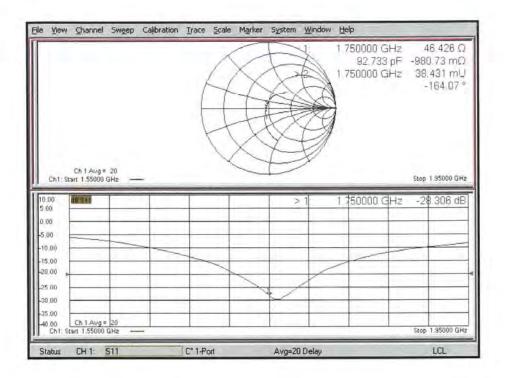
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### Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 0108

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SGS-TW (Auden)

Certificate No: D1900V2-5d173\_Apr19

QA CAL-05.v11		
Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
April 23, 2019		
tainties with confidence p	robability are given on the following pages an	d are part of the certificate.
	y taliny.	7
ID#	Cal Date (Certificate No.)	Scheduled Calibration
SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
SN: 5047.2 / 06327		Apr-20
SN: 7349	31-Dec-18 (No. EX3-7349_Dec18)	Dec-19
SN: 601	04-Oct-18 (No. DAE4-601_Oct18)	Oct-19
ID#	Check Date (in house)	Scheduled Check
SN: GB39512475	07-Oct-15 (in house check Feb-19)	In house check: Oct-20
SN: US37292783		In house check: Oct-20
SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
Name	Function	Signature
Michael Weber	Laboratory Technician	1/1/// _
		Mileses
	ents the traceability to natitainties with confidence placed in the closed laborato  E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	Ints the traceability to national standards, which realize the physical unitainties with confidence probability are given on the following pages and ted in the closed laboratory facility: environment temperature (22 ± 3)°0 (22 ± 3)°0 (23 ± 3)°0 (24 ± 3)°0 (25 ± 3)

Certificate No: D1900V2-5d173\_Apr19

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Schweizerischer Kalibrierdienst

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Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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Glossary:

tissue simulating liquid TSL sensitivity in TSL / NORM x,y,z ConvF not applicable or not measured N/A

Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The 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
- 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	DASY5	V52.10.2
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.

to following paramoters and careamans.	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	40.6 ± 6 %	1.38 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	<del></del>	

#### 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	9.92 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.0 W/kg ± 16.5 % (k=2)

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.3 \Omega + 5.1 j\Omega$
Return Loss	- 25.3 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 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: 23.04.2019

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;  $\sigma = 1.38$  S/m;  $\epsilon_r = 40.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.26, 8.26, 8.26) @ 1900 MHz; Calibrated: 31.12.2018

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 04.10.2018

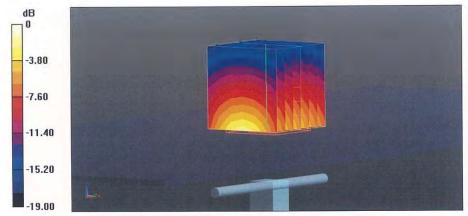
Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

## 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 = 110.1 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 18.1 W/kg SAR(1 g) = 9.92 W/kg; SAR(10 g) = 5.22 W/kg

Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg

Certificate No: D1900V2-5d173\_Apr19

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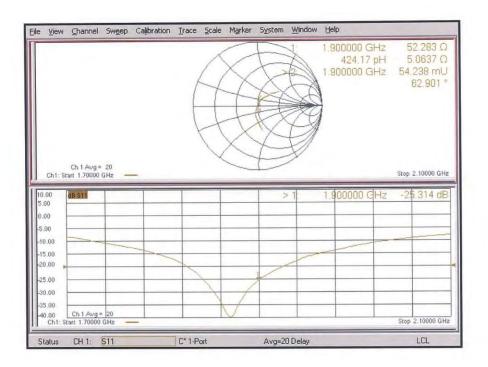
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#### Impedance Measurement Plot for Head TSL



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Certificate No: D1900V2-5d142 Jul19

Object	D1900V2 - SN:56	d142	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	July 26, 2019		
		ional standards, which realize the physical un probability are given on the following pages an	
All calibrations have been conducted	ed in the closed laborato	ry facility: environment temperature (22 ± 3)°C	C and humidity < 70%.
a Arrivation and the state of t	and the of the and the office of		
Calibration Equipment used (M&TE	critical for calibration)		
	ID #	Cal Date (Certificate No.)	Scheduled Calibration
rimary Standards		03-Apr-19 (No. 217-02892/02893)	Scheduled Calibration Apr-20
Primary Standards	ID#	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892)	Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	ID # SN: 104778 SN: 103244 SN: 103245	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893)	Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894)	Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Reference 20 dB Attenuator Reference Probe EX3DV4 DAE4 Secondary Standards	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (in house)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check
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	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (In house check Feb-19)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20
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	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 Im house check: Oct-20
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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 RF generator R&S SMT-06	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047. 2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (In house check Feb-19) 07-Oct-15 (In house check Oct-18) 07-Oct-15 (In house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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 RF generator R&S SMT-06	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (In house check Feb-19) 07-Oct-15 (In house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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 RF generator R&S SMT-06	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5038 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (In house check Feb-19) 07-Oct-15 (In house check Oct-18) 07-Oct-15 (In house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Calibration Equipment used (M&TE 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 meller E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilient E8358A Calibrated by:	ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY410927317 SN: 100972 SN: US41080477	03-Apr-19 (No. 217-02892/02893) 03-Apr-19 (No. 217-02892) 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. EX3-7349_May19) 30-Apr-19 (No. DAE4-601_Apr19) Check Date (In house) 30-Oct-14 (In house check Oct-18) 07-Oct-15 (In house check Oct-18) 15-Jun-15 (In house check Oct-18) 31-Mar-14 (In house check Oct-18)	Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20

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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)

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The 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
- 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	DASY5	V52.10.2
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	41.5 ± 6 %	1.37 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	9.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.6 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 W/kg ± 16.5 % (k=2)

## **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.1 ± 6 %	1.48 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.77 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.8 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.9 W/kg ± 16.5 % (k=2)

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.7 \Omega + 5.3 j\Omega$
Return Loss	- 25.3 dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.7 \Omega + 6.5 j\Omega$
Return Loss	- 23.5 dB

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

Electrical Delay (one direction) 1.198 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: 26,07,2019

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d142

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz;  $\sigma = 1.37 \text{ S/m}$ ;  $\varepsilon_r = 41.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.44, 8.44, 8.44) @ 1900 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 30.04.2019

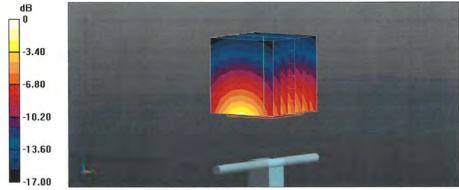
Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

#### 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 = 110.3 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 9.94 W/kg; SAR(10 g) = 5.22 W/kgMaximum value of SAR (measured) = 15.5 W/kg



0 dB = 15.5 W/kg = 11.90 dBW/kg

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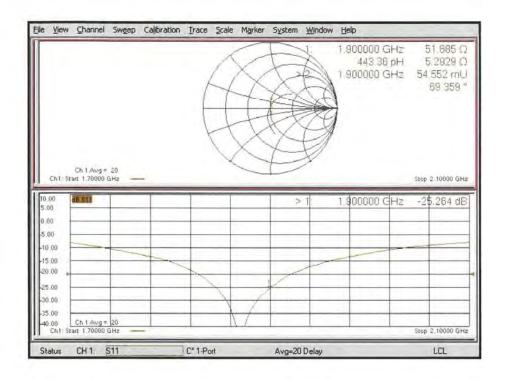
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#### Impedance Measurement Plot for Head TSL



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## **DASY5 Validation Report for Body TSL**

Date: 26.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d142

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz;  $\sigma = 1.48 \text{ S/m}$ ;  $\varepsilon_r = 54.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 29.05.2019

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

· Electronics: DAE4 Sn601; Calibrated: 30.04.2019

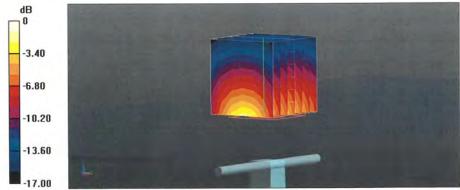
Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.1 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 17.5 W/kg

SAR(1 g) = 9.77 W/kg; SAR(10 g) = 5.17 W/kgMaximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg

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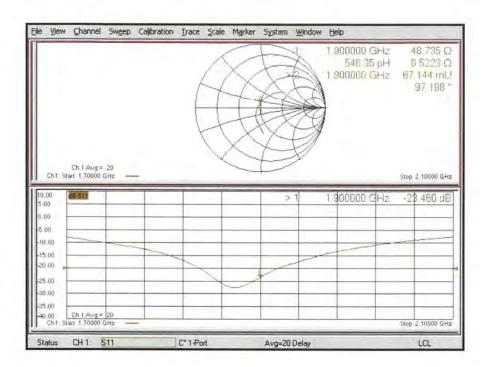
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#### Impedance Measurement Plot for Body TSL



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# - End of report -

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