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Appendix C

Phantom Description

Schmid & Partner Engineering AG a

Zeughausstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9779 info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

| Item | Oval Flat Phantom ELI 5.0 | |
|--------------|--|--|
| Type No | QD OVA 002 A | |
| Series No | 1108 and higher | |
| Manufacturer | Untersee Composites Knebelstrasse 8, CH-8268 Mannenbach, Switzerland | |

Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

| Test | Requirement | Details | Units tested |
|-------------------------|---|---|---------------------------------|
| Shape | Internal dimensions, depth and sagging are compatible with standards | Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz | Prototypes |
| Material thickness | Bottom: 2.0mm +/- 0.2mm | dimension compliant with [3] for f > 800 MHz | all |
| Material parameters | rel. permittivity 2 – 5, loss tangent ≤ 0.05, at f ≤ 6 GHz | rel. permittivity 3.5 +/- 0.5 loss tangent ≤ 0.05 | Material samples |
| Material resistivity | Compatibility with tissue simulating liquids . | Compatible with SPEAG liquids. ** | Phantoms, Material sample |
| Sagging | Sagging of the flat section in tolerance when filled with tissue simulating liquid. | within tolerance for filling height up to 155 mm | Prototypes, samples |

Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

Standards

- OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
 IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific
- Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement
- Techniques, December 2003

 [3] IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices Human models, instrumentation, and procedures Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)*, 2005-02-18
- [4] IEC 62209-2 ed 1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices Human models, instrumentation, and procedures Part 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)", 2010-03-30

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of body-worn SAR measurements and system performance checks as specified in [1 – 4] and further standards

Signature / Stamp

Doc No 881 - QD OVA 002 A - A

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System Validation from Original Equipment Supplier

| | | "Mahahaha | 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 | cornelitation No.: SCS 0108 |
| SGS-TW (Auden |) | Certificate No | o. D750V3-1015_Aug19 |
| CALIBRATION C | ERTIFICATE | | |
| Object | D750V3 - SN:10 | 15 | |
| Calibration procedure(s) | QA CAL 05.v11 Calibration Proce | edure for SAR Validation Sources | s between 0.7-3 GHz |
| Calibration date: | August 23, 2019 | 0 | |
| Calibration Equipment used (M&TE | critical for calibration) | ry facility: environment temperature (22 + 3) ⁶ | |
| Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 | ID # SN: 104778 SN: 103244 | Cal Date (Certificate No.) 03-Apr-16 (No. 217-02892/02892) 03-Apr-19 (No. 217-02892) | Scheduled Calibration Apr 20 Apr 20 |
| Calibration Equipment used (M&TE Primary Standards Power mater NRP Power sensor NRP-291 Power sensor NRP-291 Reference 20 dD Affectionator Type-A mismatch combination | ID # SN: 104778 SN: 103244 SN: 103245 SN: 5047.2 / 06327 | 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) 04-Apr-19 (No. 217-02896) | Scheduled Calibration Apr-20 Apr-20 Apr-20 Apr-20 |
| Calibration Equipment used (M&TE Primary Standards Power mater NRP | E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) | Cal Date (Certificate No.) Q3-Apr-19 (No. 217-02892/02893) Q3-Apr-19 (No. 217-02893) Q5-Apr-19 (No. 217-02893) Q5-Apr-19 (No. 217-02894) | Scheduled Calibration Apr-30 Apr-20 Apr-20 Apr-20 |
| Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Power sansor NRP-Z91 Type-N mismatch combination Retorence Probe EXSIDV4 DAE4 | E critical (or calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (20%) SN: 5047.2 / 06327 SN: 5381 SN: 601 | Cal Date (Certificate No.) Q3-Apr-19 (No. 217-02892/02893) Q3-Apr-19 (No. 217-02892) Q3-Apr-19 (No. 217-02893) Q4-Apr-19 (No. 217-02893) Q4-Apr-19 (No. 217-02894) Q4-Apr-19 (No. 217-02896) 29-May-19 (No. EX3-7348, May19) 30-Apr-19 (No. DAE-4-801_Apr/19) Check Date (in house) | Scheduled Calibration Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-71 Apr-20 Scheduled Check |
| Calibration Equipment used (MATE Primary Standards Power mater MRP Power sonsor NRP-291 Power sonsor NRP-291 Heterance 20 dD Altenuator Type-II mismatch combination Retiremone Probe EXSDV4 DAE4 | Ecritical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 5006 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 | Cal Date (Certificate No.) 03-Apr-10 (No. 217-02892/02893) 03-Apr-10 (No. 217-02893) 03-Apr-19 (No. 217-02893) 04-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. DAE-4-60), Apr-19 (No. DAE-4-60), Apr | Scheduled Calibration Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 |
| Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sansor NRP-Z91 Sacondary Standards Power sensor NRP-Z81A Power sensor NRP-Z81A Power sensor NRP-Z81A | Editical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: GR00519475 SN: US37282783 SN: US37282783 SN: M: 474092217 | Cal Date (Certificate No.) O3-Apr-19 (No. 217-02892/02893) O5-Apr-19 (No. 217-02892/02893) O4-Apr-19 (No. 217-02893) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02896) O4-Apr-19 (No. 217-02896) O4-Apr-19 (No. 217-02896) O5-Apr-19 (No. DAEA-601, Apr19) Check Date (in house) O5-O6-15 (in house check Feb-19) O7-O6-15 (in house check Cet-18) | Scheduled Galibration Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 May-20 Scheduled Check In house check: Cct-20 In house check: Cct-20 In house check: Cct-20 |
| Calibration Equipment used (MSTE Primary Standards Power mater MRP Power sancer NRP-Z91 Power sancer NRP-Z91 Flower sancer NRP-Z91 Refusence 20 ad Altenuator Type-N mismatch combination Refusence Probe EXSIV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A Responsable MS SMT 96 Responsable SMT 96 Responsab | Entitical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 00362 (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. 217-02892/02893) O3-Apr-19 (No. 217-02892/02893) O4-Apr-19 (No. 217-02893) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02896) S9-Apr-19 (No. 128-3-348) S9-Apr-19 (No. 128-3-348) S9-Apr-19 (No. 128-4-601, Apr119) Check Date (in house) O3-Oct-1-15 (in house check Cet-18) O7-Oct-1-15 (in house check Cet-18) Thurs 16 (house check Cet-18) | Scheduled Calibration Apr-30 Apr-90 Apr-90 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 In house check: Cct-20 |
| Calibration Equipment used (MATE Primary Standards Power mater MRIP Power sensor NRIP-291 Power sensor NRIP-291 Potenter sensor NRIP-291 Refluence 20 did Atlenuator Type-N mismatch combination Refluence Probe EX3DV4 DAE4 Secondary Standards Power mister F4419R Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A Ref generator R48 SMT 06 Network Analyzer Aglinet ER48A. | Emiscal (or calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 00324 SN: 5047.2 / 06327 SN: 5847.3 / 06327 SN: 5807 ID # SN: GRR0819476 SN: US37252783 SN: MY41092317 SN: US37252783 SN: MY41092317 SN: US37252783 | Cal Date (Certificate No.) O3-Apr-19 (No. 217-02892/02893) O3-Apr-19 (No. 217-02892) O3-Apr-19 (No. 217-02892) O4-Apr-19 (No. 217-02893) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02894) O4-Apr-19 (No. 217-02896) 29-Apr-19 (No. 217-02896) 30-O4-14 (in house) O7-O4-14 (in house) O7-O4-15 (in house check Cet-18) O7-O4-15 (in house check Cet-18) Sun-16 (in house check Cet-18) Sun-16 (in house check Cet-18) Sun-16 (in house check Cet-18) | Scheduled Galibration Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 In house check: Oct-20 |
| Caitbration Equipment used (MATE Primary Standards Power mater MRP Power sansor NRP-291 Power sansor NRP-291 Power sansor NRP-291 Power sansor NRP-291 Type-N mismatch combination Reference Probe EXSDV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A RP generator R&S SMT 06 Network Analyzer Aglient ERSSRA Celibrated by: | Editical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 5047.2 / 06327 SN: 5047.3 / 06327 SN: 5047.3 / 06327 SN: 5047.3 / 06327 SN: 5047.3 / 06327 SN: 1037/25/27/83 SN: MY41092317 SN: 105972 SN: 1054178/0477 Name Jetor; Kastrati | Cal Date (Certificate No.) Q3-Apr-19 (No. 217-02892/02893) Q3-Apr-19 (No. 217-02892) Q3-Apr-19 (No. 217-02893) Q4-Apr-19 (No. 217-02893) Q4-Apr-19 (No. 217-02894) Q4-Apr-19 (No. 217-02896) 29-May-19 (No. 217-02896) 30-Apr-19 (No. 217-02896) 30-Apr-19 (No. DAE-4-801_Apr-19) Check Date (in house) S0-Cq-1-14 (in house check Feb-19) Q7-Qc-1-5 (in house check Cd-18) Q7-Qc-1-5 (in house check Oct-18) 15 Jun-16 (in house check Oct-18) Function Laboratory Tscfinician: | Scheduled Galibration Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 Apr-20 In house check: Oct-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:

tissue simulating liquid sensitivity in TSL / NORM x,y,z not applicable or not measured TSL 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 p | DASY5 | | V52 10 2 |
|---|------------|---------------------------------|-------------------|----------------------------|
| Extrapolation | A | dvanced 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 | | |
| lead TSL parameters The following parameters and calculations Nominal Head TSL parameters | were app | Temperature | Permittivity 41.9 | Conductivity 0.89 mbo/m |
| Measured Head TSL parameters | | (22.0 ± 0.2) °C | 42.7+6% | 0.00 mha/m ± 6 |
| Head TSL temperature change during | lest | < 0.5 °C | 42.7 + 0.76 | D. MO DEBURN S B |
| SAR averaged over 1 cm ³ (1 g) of Head SAR measured | TSL | Condition 250 mW input power | 2 | 16 W/kg |
| 200000000000000000000000000000000000000 | | 250 mW input power | 2 | 16 W/kg |
| SAR for nominal Head TSL parameters | | normalized to 1W | 8,60 W/kg | ± 17.0 % (k=2) |
| SAR averaged over 10 cm ² (10 g) of He | ad TSL | condition | | |
| SAR measured | | 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 TSL | | | |
|---|---------------|------------------------------|---|
| Impedance, transformed to feed point Return Loss | | 53.1 Ω - 0.6 μΩ - 30.4 dB | |
| | | . 90.1 99 | |
| General Antenna Parameters and Des | sign | 1.037 ns | |
| Alter long term use with 100W radiated power, onl | Action Toller | | |
| deedpoint may be damaged. Additional EUT Data | | | |
| Manufactured by | | | |
| Treatmental Million by | | SPEAG | |
| - room met distriction sky | | SPEAG | 1 |

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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; $g_r=42.7$; $\rho=1000$ 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/ke = 4.61 dBW/ky

Certificate No: D750V3-1015_Aug19

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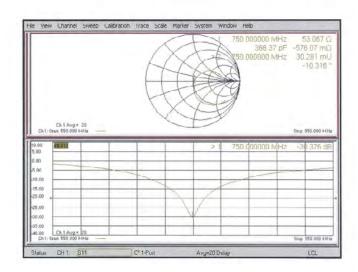
No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803/新北市五股區新北產業園區五工路 134 號 t (886-2) 2299-3279



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Impedance Measurement Plot for Head TSL



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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 Auden

| | ERTIFICATE | | |
|---|--|---|---|
| Object | D750V3 - SN:10 | 78 | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | edure for SAR Validation Sources | between 0.7-3 GHz |
| Calibration date: | June 27, 2019 | | |
| | and the second control of the second control | tional standards, which realize the physical un probability are given on the following pages an | |
| All calibrations have been conduct | ed in the closed laborato | ary facility: environment temperature (22 ± 3)*(| C and humidity < 70%. |
| Calibration Equipment used (M&T | E 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 |
| | Control & Children Street | | |
| | SN: 103245 | 03-Apr-19 (No. 217-02893) | Apr-20 |
| Power sensor NRP-Z91 | SN: 103245 SN: 5058 (20k) | 03-Apr-19 (No. 217-02893) 04-Apr-19 (No. 217-02894) | Apr-20 Apr-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator | | | |
| Power sensor NRP-Z91 Reference 20 dB. Attenuator Type-N mismatch combination | SN: 5058 (20k) | 04-Apr-19 (No. 217-02894) | Apr-20 |
| Power sensor NRP-Z91 Reference 20 dB. Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 5058 (20k) SN: 5047.2 / 06327 | 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) | Apr-20 Apr-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 | 04-Apr-19 (No. 217-02894) 04-Apr-19 (No. 217-02895) 29-May-19 (No. EX3-7349_May19) | Apr-20 Apr-20 May-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 | 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 May-20 Apr-20 Scheduled Check |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 | 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 May-20 Apr-20 Scheduled Check In house check: Oct-20 |
| 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 | SN: 5058 (20k) SN: 5047.2/06327 SN: 7349 SN: 601 ID # SN: GB39512475 | 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) | Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-20 |
| 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 | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 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) | 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 |
| 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: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 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 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 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 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) 15-Jun-15 (in house check Oct-18) | Apr-20 Apr-20 May-20 Apr-20 |
| Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 | SN: 5058 (20k) SN: 5047.2/06327 SN: 7349 SN: 601 ID# SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 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) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) | Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-18 |
| 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 PPower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name | 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) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) | Apr-20 Apr-20 May-20 Apr-20 Scheduled Check In house check: Oct-20 In house check: Oct-18 |

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





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Service suisse d'étalonnage
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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
- EC 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 | 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 ³ (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 ³ (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 ³ (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 ³ (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) |

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Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | $55.4 \Omega + 1.4 j\Omega$ |
|--------------------------------------|-----------------------------|
| Return Loss | - 25.5 dB |

Antenna Parameters with Body TSL

| In | npedance, transformed to feed point | 50.3 Ω - 2.4 jΩ |
|----|-------------------------------------|-----------------|
| R | eturn 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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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/m³

Phantom section: Flat Section

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

DASY52 Configuration:

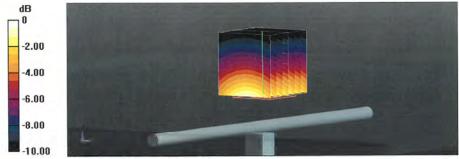
Probe: EX3DV4 - SN7349; ConvF(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 29.05.2019

- 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 = 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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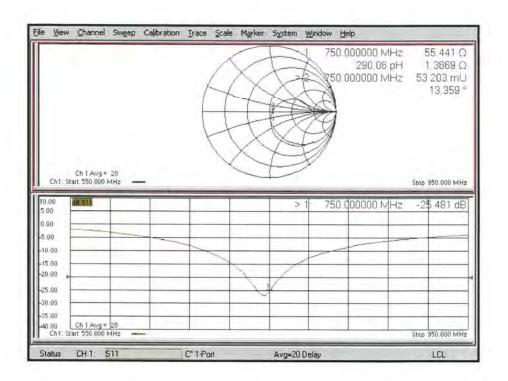
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Impedance Measurement Plot for Head TSL



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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

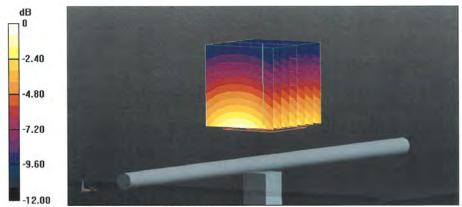
Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

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/kgMaximum 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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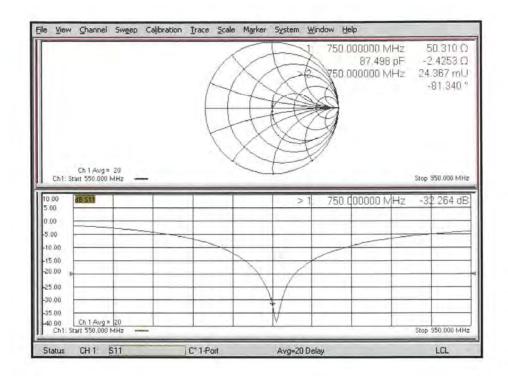
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Impedance Measurement Plot for Body TSL



Certificate No: D750V3-1078_Jun19

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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:

tissue simulating liquid sensitivity in TSL / NORM x,y,z not applicable or not measured TSL ConvE 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 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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| The following 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 42.5 ± 6 % 0.92 mho/m ± 6 ° Head TSL temperature change during test < 0.5 °C | 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 Bad TSL parameters The following 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 42.5 ± 6 % 0.92 mho/m ± 6 % Head TSL temperature change during test < 0.5 °C | DASY system configuration, as far as not DASY Version | | DASY5 | | V52.10.2 |
|---|---|--|-----------|---------------------------------|--------------|----------------|
| Distance Dipole Center - TSL | Distance Dipole Center - TSL | Extrapolation | A | dvanced Extrapolation | | |
| Zoom Scan Resolution | Zoom Scan Resolution | Phantom | | Modular Flat Phantom | | |
| ### Prequency ### B35 MHz ± 1 MHz ### B45 MHz ### | ### Prequency ### B35 MHz ± 1 MHz ### B45 MHz ### | Distance Dipole Center - TSL | | 15 mm | - 1 | with Spaner |
| Permittivity Conductivity Nominal Head TSL parameters Result with Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR measured | Permittivity Conductivity Nominal Head TSL parameters Result with Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR measured | Zoom Scan Resolution | | dx, dy, dz = 5 mm | | |
| Temperature | Temperature | Frequency | | 835 MHz ± 1 MHz | | |
| Nominal Head TSL parameters 22.0 °C 41.5 0.90 mho/m Measured Head TSL parameters (22.0 ± 0.2) °C 42.5 ± 6 % 0.92 mho/m ± 6 ° 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 SAR measured 250 mW input power 2.42 W/kg SAR for mominal Head TSL parameters normalized to 1W 9.57 W/kg ± 17.0 °s (k=2) SAR averaged over 10 cm² (10 g) of Head TSL condition SAR measured 250 mW input power 1.57 W/kg | Nominal Head TSL parameters 22.0 °C 41.5 0.90 mho/m Measured Head TSL parameters (22.0 ± 0.2) °C 42.5 ± 6 % 0.92 mho/m ± 6 ° 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 SAR measured 250 mW input power 2.42 W/kg SAR for mominal Head TSL parameters normalized to 1W 9.57 W/kg ± 17.0 °s (k=2) SAR averaged over 10 cm² (10 g) of Head TSL condition SAR measured 250 mW input power 1.57 W/kg | | were appl | 7 | Permittivity | Conductivity |
| Measured Head TSL parameters (22.0 ± 0.2) °C 42.5 ± 6 % 0.92 mho/m ± 6 ° Head TSL temperature change during test < 0.5 °C | Measured Head TSL parameters (22.0 ± 0.2) °C 42.5 ± 6 % 0.92 mho/m ± 6 ° Head TSL temperature change during test < 0.5 °C | Nominal Head TSL parameters | | TOTAL STREET | | - |
| Head TSL temperature change during test | Head TSL temperature change during test | | | | 7.115 | |
| ### Result with Head TSL ### SAR averaged over 1 cm² (1 g) of Head TSL | ### Result with Head TSL ### SAR averaged over 1 cm² (1 g) of Head TSL | | test | | | - |
| SAR for nominal Head TSL parameters normalized to 1W 6,22 W/kg ± 16.5 % (kw2) | SAR for nominal Head TSL parameters normalized to 1W 6,22 W/kg ± 16.5 % (kw2) | | J2T be | | 3.57 4769 | |
| SAR averaged over 10 cm² (10 g) of Head TSL condition SAR measured 250 mW input power 1.57 W/kg | SAR averaged over 10 cm² (10 g) of Head TSL condition SAR measured 250 mW input power 1.57 W/kg | | | The second second second second | 9 57 W/be | ± 17.0 % (k=2) |
| SAR for nominal Head TSL parameters normalized to 1W 6.22 W/kg ± 16.5 % (k=2) | SAR for nominal Hoad TSL parameters normalized to 1W 6.22 W/kg ± 16.5 % (k-2) | | ad TSL | | 3.57 17/169 | |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | nd TSL | condition 250 mW input power | 1.8 | 57 W/kg |
| | | SAR averaged over 10 cm ² (10 g) of Her SAR measured | ad TSL | condition 250 mW input power | 1.8 | 57 W/kg |

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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 Desig | gn | |
| Electrical Delay (one direction) | 1.391 ns | |
| After long term use with 100W radiated power, only a | slight warming of the dipole near the feedpoint can be | measured. |
| Additional EUT Data Manufactured by | SPEAG | |
| | SPEAG | |
| | 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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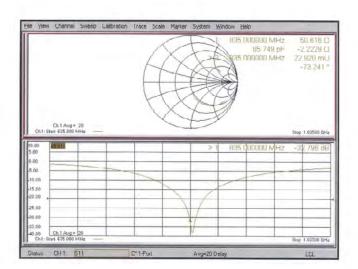
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Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d063_Aug19

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





Schweizerischer Kalibrierdienst 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

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| CALIBRATION C | CERTIFICAT | E | |
|---|---|--|---|
| Object | D835V2 - SN:40 | d092 | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Prod | cedure for SAR Validation Source | es between 0.7-3 GHz |
| Calibration date: | June 20, 2019 | | |
| All calibrations have been conduc | ted in the closed laborate | titional standards, which realize the physical uprobability are given on the following pages a pay facility: environment temperature (22 ± 3) | nd are part of the certificate. |
| Calibration Equipment used (M&T | E critical for calibration) | | |
| | E critical for calibration) | Cal Date (Certificate No.) | 01.11.70 |
| Primary Standards Power meter NRP | 17 | Cal Date (Certificate No.) 03-Apr-19 (No. 217-02892/02893) | Scheduled Calibration |
| Primary Standards Power meter NRP Power sensor NRP-Z91 | ID# | 03-Apr-19 (No. 217-02892/02893) | Apr-20 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | ID # SN: 104778 | 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 Reference 20 dB Attenuator | ID # SN: 104778 SN: 103244 | 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 Type-N mismatch combination | 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) 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 Reference Probe EX3DV4 | ID# SN: 104778 SN: 103244 SN: 103245 SN: 5056 (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) | 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: 5056 (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) | 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 DAE4 | 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. 217-02895) 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 |
| 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 | ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (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) 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) | 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 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: 5056 (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) 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 |
| Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A 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 | 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 (Irr house) 30-Oct-14 (Irr house check Feb-19) 07-Oct-15 (Irr 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 Power sensor HP 8481A RF generator R&S SMT-06 | ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (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. 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) | 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 |
| Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | 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 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 Prower sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | 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 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. 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 Apr-20 Apr-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 PF generator R&S SMT-08 | ID # SN: 104778 SN: 103244 SN: 103245 SN: 5056 (20K) SN: 5047.2 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 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. 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) 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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage

C Service suisse d etalonnage Servizio svizzero di taratura S wiss Calibration Service

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Glossary:

N/A

TSL tissue simulating liquid
ConvF 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 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

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

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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 |
|----------------------------------|-----------|
| | 1.037 113 |

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; σ = 0.91 S/m; ϵ_r = 41.8; ρ = 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

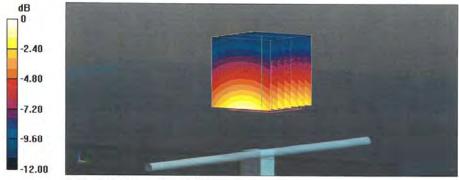
Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

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 = 63.07 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/kgMaximum value of SAR (measured) = 3.17 W/kg



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

Certificate No: D835V2-4d092 Jun19

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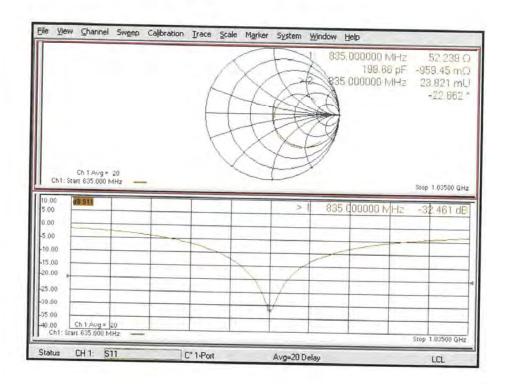
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Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL

Date: 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; σ = 0.98 S/m; ϵ_r = 55.4; ρ = 1000 kg/m³

Phantom section: Flat Section

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

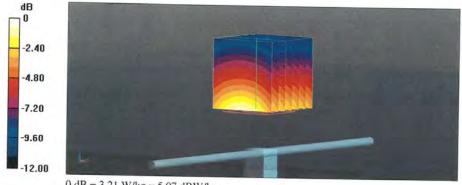
DASY52 Configuration:

- 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/kgMaximum 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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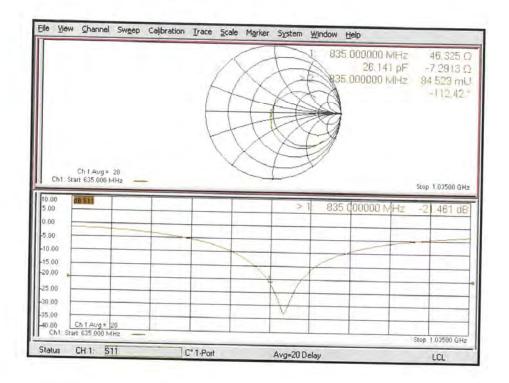
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Impedance Measurement Plot for Body TSL



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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 GHS)", 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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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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| Extrapolation Advance Phantom Modular Distance Dipole Center - TSL. Zoom Soan Resolution dx, dy Frequency 1750 h Head TSL parameters The following parameters and calculations were applied. Nominal Head TSL parameters Measured Head TSL parameters Hoad TSL temporature change during test SAR result with Head TSL SAR averaged over 1 cm² (1 g) of Head TSL SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR resoluted 250 r | DASYS d Extrapolation Flat Phantom 10 mm , dz = 5 mm dHz ± 1 MHz Temperature 22.0 °C 22.0 ± 0.2) °C < 0.5 °C Condition mW input power malized to 1W condition mW input power malized to 1W | 36.8 W/I | V52.10.2 With Spacer Conductivity 1.37 mho/m 1.36 mho/m ± 6 3.13 W/kg kg ± 17.0 % (k=2) 4.83 W/kg kg ± 16.5 % (k=2) |
|--|--|--------------------|---|
| Phantom Modular Distance Dipole Center - TSL Zoom Scan Resolution dx, dy Frequency 1750 M Frequency 1750 M Idead TSL parameters The following parameters and calculations were applied. Nominal Head TSL parameters Measured Head TSL parameters Hoad TSL temperature change during test SAR result with Head TSL SAR averaged over 1 cm³ (1 g) of Head TSL SAR for nominal Head TSL parameters nor SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | Flat Phantom 10 mm , dz = 5 mm MHz ± 1 MHz Temperature 22.0 °C 22.0 ± 0.2) °C < 0.5 °C Condition mW input power malized to 1W condition mW input power mw input power | 40.1 40.8 ± 6 % | Conductivity 1.37 mho/m 1.36 mho/m±6 8 13 W/kg kg ± 17.0 % (k=2) |
| Distance Dipote Center - TSL Zoom Scan Resolution dx, dy Frequency 1750 h Icad TSL parameters The following parameters and calculations were applied. Nominal Head TSL parameters Measured Head TSL parameters Hoad TSL temperature change during test SAR result with Head TSL SAR averaged over 1 cm² (1 g) of Head TSL SAR ineasured SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR ineasured | to mm dz = 5 mm MHz ± 1 MHz Temperature 22.0 °C 22.0 ± 0.2) °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.1 40.8 ± 6 % | Conductivity 1.37 mho/m 1.36 mho/m±6 8 13 W/kg kg ± 17.0 % (k=2) |
| Zoom Scan Recolution dx, dy Frequency 1750 M Fr | , dz = 5 mm MHz ± 1 MHz Temperature 22.0 °C 22.0 ± 0.2) °C < 0.5 °C Condition mW input power mailized to 1W condition mW input power | 40.1 40.8 ± 6 % | Conductivity 1.37 mho/m 1.36 mho/m±6 8 13 W/kg kg ± 17.0 % (k=2) |
| Frequency | Temperature 22.0 °C 22.0 ± 0.21 °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.1 40.8 ± 6 % | 1.35 mho/m 1.36 mho/m±6 |
| lead TSL parameters The following parameters and calculations were applied. Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change during test AR result with Head TSL SAR averaged over 1 cm³ (1 g) of Head TSL SAR ineasured SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR measured SAR averaged over 10 cm² (10 g) of Head TSL | Femperature 22.0 °C 22.0 ± 0.21 °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.1 40.8 ± 6 % | 1.35 mho/m 1.36 mho/m±6 |
| The following parameters and calculations were applied. Nominal Head TSL parameters Measured Head TSL parameters Head TSL temperature change during test AR result with Head TSL SAR averaged over 1 cm³ (1 g) of Head TSL SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL SAR averaged over 10 cm² (10 g) of Head TSL | 22.0 °C 22.0 ± 0.21 °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.1 40.8 ± 6 % | 1.35 mho/m 1.36 mho/m±6 |
| Nominal Head TSL parameters Measured Head TSL parameters Hoad TSL temperature change during test AR result with Head TSL SAR averaged over 1 cm³ (1 g) of Head TSL SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR measured SAR averaged over 10 cm² (10 g) of Head TSL SAR measured | 22.0 °C 22.0 ± 0.21 °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.1 40.8 ± 6 % | 1.37 mho/m 1.36 mho/m±6 1.36 mho/m±6 9 13 W/kg kg ± 17.0 % (k=2) |
| Measured Head TSL parameters Hoad TSL temporature change during test AR result with Head TSL SAR averaged over 1 cm² (10 g) of Head TSL SAR ineasured SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR measured SAR measured 250 r | 22.0 ± 0.2) °C < 0.5 °C Condition mW input power malized to 1W condition mW input power | 40.8±6% | 1.36 mho/m ± 6 |
| Hoad TSL temporature change during test AR result with Head TSL SAR averaged over 1 cm² (1 g) of Head TSL SAR measured SAR for nominal Head TSL parameters SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | c 0.5 °C Condition mW input power malized to 1W condition mW input power | 36.8 W/I | 9 13 W/kg kg ± 17.0 % (k=2) |
| AR result with Head TSL SAR averaged over 1 cm² (1 g) of Head TSL SAR measured 250 r SAR for nominal Head TSL parameters nor SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | Condition mW input power malized to 1W condition mW input power | 36.8 W/I | 9 13 W/kg kg ± 17.0 % (k=2) 4.83 W/kg |
| SAR averaged over 1 cm² (1 g) of Head TSL SAH measured 250 r SAR for nominal Head TSL parameters nor SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | mW input power malized to 1W condition mW input power | 36.8 W/I | kg ± 17.0 % (k=2) 4.83 W/kg |
| SAR measured 250 r SAR for nominal Head TSL parameters nor SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | mW input power malized to 1W condition mW input power | 36.8 W/I | kg ± 17.0 % (k=2) 4.83 W/kg |
| SAR for nominal Head TSL parameters nor SAR averaged over 10 cm² (10 g) of Head TSL SAR measured 250 r | condition | 36.8 W/I | kg ± 17.0 % (k=2) 4.83 W/kg |
| SAR averaged over 10 cm² (10 g) of Head TSL SAR measured. 250 r | condition mW input power | | 4.83 W/kg |
| SAR measured 250 r | mW input power | + | |
| | | + | |
| SAR for nominal Head TSL parameters nor | malized 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 power, of The dipole is made of standard semirigid coaxia second arm of the dipole. The antenna is therefore are added to the dipole arms in order to improve "Mansuranum! Conditions" paragraph The SAR according to the Standard. No excessive force must be applied to the dipole | cable. The center conductors short-circuited for DC-sig matching when loaded accordate are not affected by this | or of the feeding line is directly co prafs. On some of the dipoles, an ording to the position as explaine s change. The overall dipole leng | innected to the nall end caps id in the th is still |
| leedpoint may be damaged. Additional EUT Data | ans, vocause mey might | seria of the soldated connections | a rical tito |
| Manufactured by | | SPEAG | |
| Manulactured by | | SPEAG | |
| Manufactured by | | SPEAG | |
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| Manulactured by | | SPEAG | |
| Manufactured by | | SPEAG | |
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DASY5 Validation Report for Head TSL

Date: 23.08.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; 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 SAR (extrapolated) = 17.0 W/kg SAR(1 g) = 9.13 W/kg; SAR(10 g) = 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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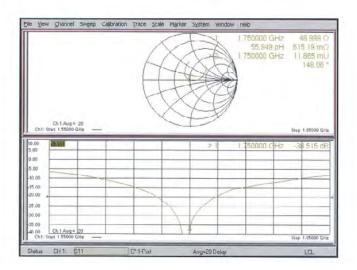
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Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1008_Aug19

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





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

Swiss Calibration Service

Accreditation No.: SCS 0108

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Auden Client

Certificate No: D1750V2-1023_Jun19

CALIBRATION CERTIFICATE D1750V2 - SN:1023 Object Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz June 20, 2019 Calibration date: This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70% Calibration Equipment used (M&TE 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 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 Apr-20 Reference 20 dB Attenuator SN: 5058 (20k) 04-Apr-19 (No. 217-02894) Type-N mismatch combination SN: 5047.2 / 06327 04-Apr-19 (No. 217-02895) Apr-20 SN: 7349 29-May-19 (No. EX3-7349 May19) May-20 Reference Probe EX3DV4 DAE4 SN: 601 30-Apr-19 (No. DAE4-601_Apr19) Apr-20 Secondary Standards ID.H Check Date (in house) Scheduled Check SN: GB39512475 30-Oct-14 (in house check Feb-19) In house check; Oct-20 Power meter E4419B Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-18) In house check: Oct-20 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-18) in house check: Oct-20 RE generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-18) In house check: Oct-20 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-18) In house check: Oct-19 Name Function Calibrated by: Claudio Leubler Laboratory Technician Katja Pokovic Technical Manager Approved by: Issued: June 20, 2019 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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%.

Certificate No: D1750V2-1023 Jun19

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Measurement Conditions

| DASY system configuration, 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

The following 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 ³ (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 ³ (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 ³ (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; $\sigma = 1.34$ S/m; $\epsilon_r = 40$; $\rho = 1000$ 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)

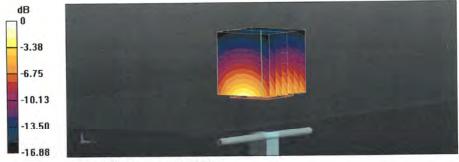
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.5 V/m; Power Drift = -0.02 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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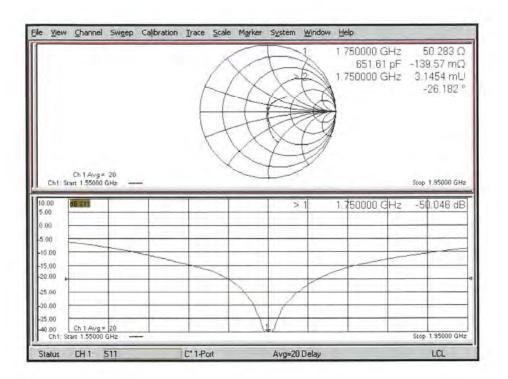
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Impedance Measurement Plot for Head TSL



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)

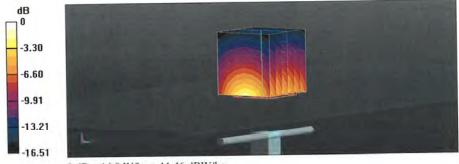
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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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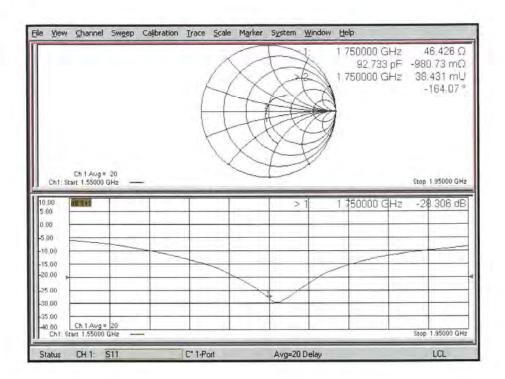
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Impedance Measurement Plot for Body TSL



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





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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

SGS-TW (Auden)

Certificate No: D1900V2-5d173_Apr19

| Object | D1900V2 - SN:5d173 | | |
|---|--|--|--|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | |
| Calibration date: | April 23, 2019 | | |
| The measurements and the uncerta | ainties with confidence p | onal standards, which realize the physical uni robability are given on the following pages an ry facility: environment temperature (22 ± 3)°C | d are part of the certificate. |
| Calibration Equipment used (M&TE | | y lacility. environment temperature (22 ± 3) C | o and fullidity < 70%. |
| Primary Standards | ID# | Cal Date (Certificate No.) | Scheduled Calibration |
| 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 |
| 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 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-18 (No. EX3-7349_Dec18) | Dec-19 |
| Telefelice Flobe EXSDV4 | SN: 601 | 04-Oct-18 (No. DAE4-601_Oct18) | Oct-19 |
| LISS STREET WATER STREET | | | Scheduled Check |
| DAE4 | ID# | Check Date (in house) | |
| DAE4 Secondary Standards | ID # SN: GB39512475 | Check Date (in house) 07-Oct-15 (in house check Feb-19) | In house check: Oct-20 |
| DAE4 Secondary Standards Power meter E4419B | 100 | | In house check: Oct-20 In house check: Oct-20 |
| DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | SN: GB39512475 | 07-Oct-15 (in house check Feb-19) | |
| DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A | SN: GB39512475 SN: US37292783 | 07-Oct-15 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) | 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 | SN: GB39512475 SN: US37292783 SN: MY41092317 | 07-Oct-15 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) | In house check: Oct-20 In house check: Oct-20 |
| Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 07-Oct-15 (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) | 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 Network Analyzer Agilent E8358A | SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 07-Oct-15 (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) | 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 | SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 07-Oct-15 (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 | 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 Network Analyzer Agilent E8358A | SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 | 07-Oct-15 (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 | In house check: Oct-2 In house check: Oct-2 In house check: Oct-2 In house check: Oct-1 |

Certificate No: D1900V2-5d173_Apr19

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





Schweizerischer Kalibrierdienst

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

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%.

Certificate No: D1900V2-5d173 Apr19

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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

| | 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 | | |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (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 ³ (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) |

Certificate No: D1900V2-5d173_Apr19

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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

| 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/m³

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)

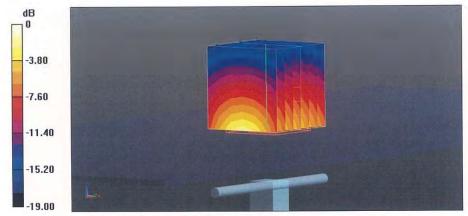
Electronics: DAE4 Sn601; Calibrated: 04.10.2018

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/kgMaximum 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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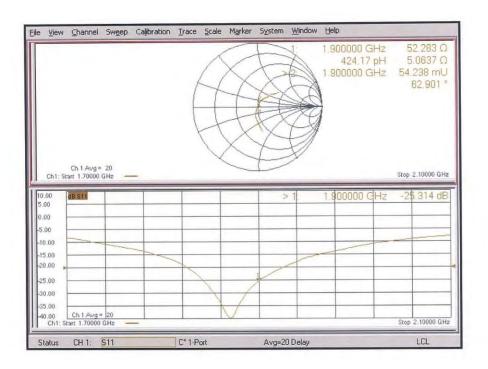
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Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d173_Apr19

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





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

Accreditation No.: SCS 0108

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: 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 | |
| he measurements and the uncer | tainties with confidence p | probability are given on the following pages an | id are part of the certificate. |
| All calibrations have been conduct | ted in the closed laborato | ry facility: environment temperature (22 ± 3)°C | C and humidity < 70%. |
| 5-16-16-1 F-16-14-14-14-14-14-14-14-14-14-14-14-14-14- | E critical for calibration) | | |
| Salibration Equipment used (M&T | c cinical for canonation, | | |
| | 1 | Cal Date (Certificate No.) | Scheduled Calibration |
| rimary Standards | ID# | Cal Date (Certificate No.) 03-Apr-19 (No. 217-02892/02893) | Scheduled Calibration |
| rimary Standards ower meter NRP | ID # SN: 104778 | 03-Apr-19 (No. 217-02892/02893) | Apr-20 |
| rimary Standards lower meter NRP lower sensor NRP-Z91 | ID# | | |
| rimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 | ID # 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 Reference 20 dB Attenuator | 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 Type-N mismatch combination | 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 misrratch 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 |
| Calibration Equipment used (M&T 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 | 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 Seletrence 20 dB Attenuator Type-N mismatch combination 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. 217-02895) 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 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. 217-02894) 04-Apr-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 In tiouse check: Oct-20 In house check: Oct-20 |
| 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 | 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. 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 May-20 Apr-20 Scheduled Check 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 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 May-20 Apr-20 Scheduled Check In tiouse 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 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. 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 May-20 Apr-20 Scheduled Check In tiouse 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 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 May-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 DAE4 | 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 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) 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 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 Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | 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 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 Feb-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 flouse check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 |

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C Service suisse d'étalonnage
Servizio svizzero di tarátura
S 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
- EC 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%.

Certificate No: D1900V2-5d142_Jul19

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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 ³ (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 ³ (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 cm3 (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 ³ (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 Ω + 6.5 jΩ |
|--------------------------------------|-----------------|
| 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

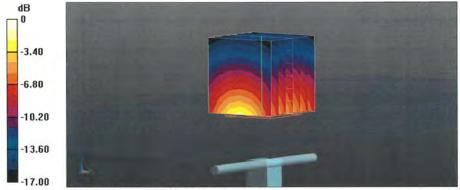
Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

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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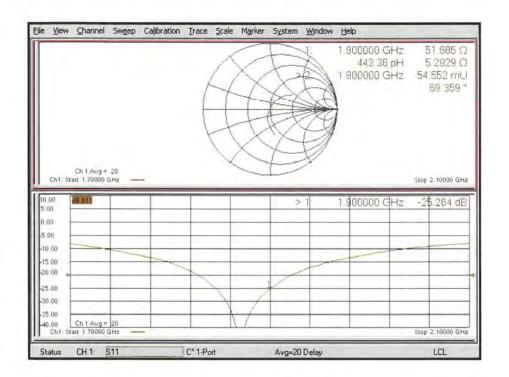
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Impedance Measurement Plot for Head TSL



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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

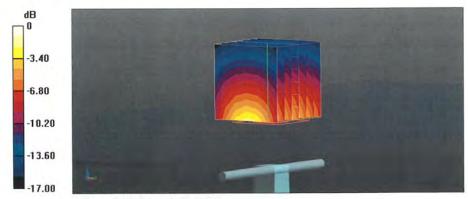
Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

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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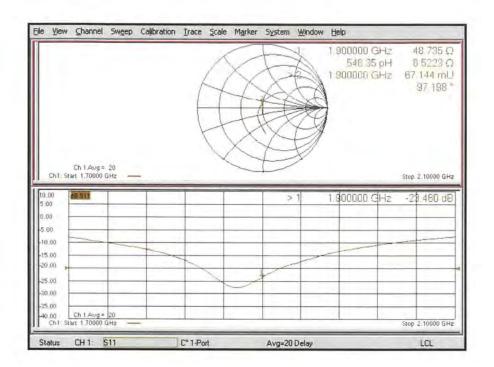
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Impedance Measurement Plot for Body TSL



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- End of report -

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