



DASY5 Validation Report for Head TSL

Date: 12.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1017

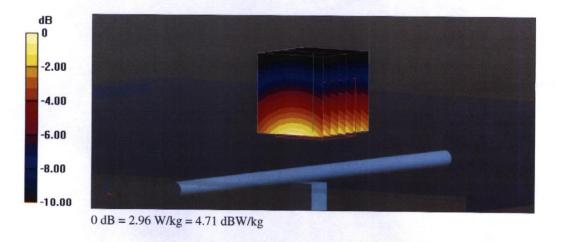
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.91$ S/m; $\varepsilon_r = 42.4$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.01 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.39 W/kg SAR(1 g) = 2.20 W/kg; SAR(10 g) = 1.43 W/kg Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 2.96 W/kg



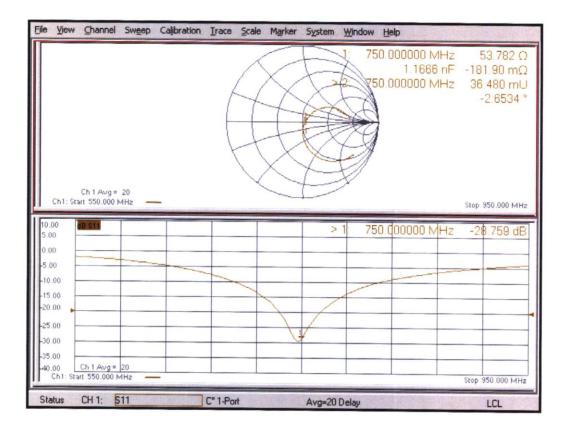
Certificate No: D750V3-1017_Jul21

Page 5 of 6





Impedance Measurement Plot for Head TSL



Certificate No: D750V3-1017_Jul21

Page 6 of 6





835 MHz Dipole Calibration Certificate

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

Accredited by the Swiss Accreditation Service (SAS)

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



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

Accreditation No.: SCS 0108

Multilateral Agreement for the recognition of calibration certificates Certificate No: D835V2-4d069_Jul21 **CTTL** (Auden) Client CALIBRATION CERTIFICATE D835V2 - SN:4d069 Object QA CAL-05.v11 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 0.7-3 GHz July 12, 2021 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) Cal Date (Certificate No.) Scheduled Calibration ID # Primary Standards 09-Apr-21 (No. 217-03291/03292) Apr-22 SN: 104778 Power meter NRP Apr-22 09-Apr-21 (No. 217-03291) Power sensor NRP-Z91 SN: 103244 Power sensor NRP-Z91 SN: 103245 09-Apr-21 (No. 217-03292) Apr-22 SN: BH9394 (20k) 09-Apr-21 (No. 217-03343) Apr-22 Reference 20 dB Attenuator Apr-22 SN: 310982 / 06327 09-Apr-21 (No. 217-03344) Type-N mismatch combination 28-Dec-20 (No. EX3-7349_Dec20) Dec-21 SN: 7349 Reference Probe EX3DV4 02-Nov-20 (No. DAE4-601_Nov20) Nov-21 DAE4 SN: 601 Scheduled Check ID # Check Date (in house) Secondary Standards In house check: Oct-22 SN: GB39512475 Power meter E4419B 30-Oct-14 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-20) Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-20) In house check: Oct-22 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-20) In house check: Oct-22 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Name Function Signature Laboratory Technician Jeffrey Katzman Calibrated by: Katja Pokovic Technical Manager Approved by: Issued: July 15, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Page 1 of 6 Certificate No: D835V2-4d069_Jul21





Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizer C Service st Service st S Swiss Cal

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: D835V2-4d069_Jul21

Page 2 of 6

ory of





Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| ine remember of the second | 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 | 42.2 ± 6 % | 0.94 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 | 2.48 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 9.63 W/kg ± 17.0 % (k=2) |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured | condition 250 mW input power | 1.60 W/kg |

Certificate No: D835V2-4d069_Jul21

Page 3 of 6





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 51.7 Ω - 2.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 31.0 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.393 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

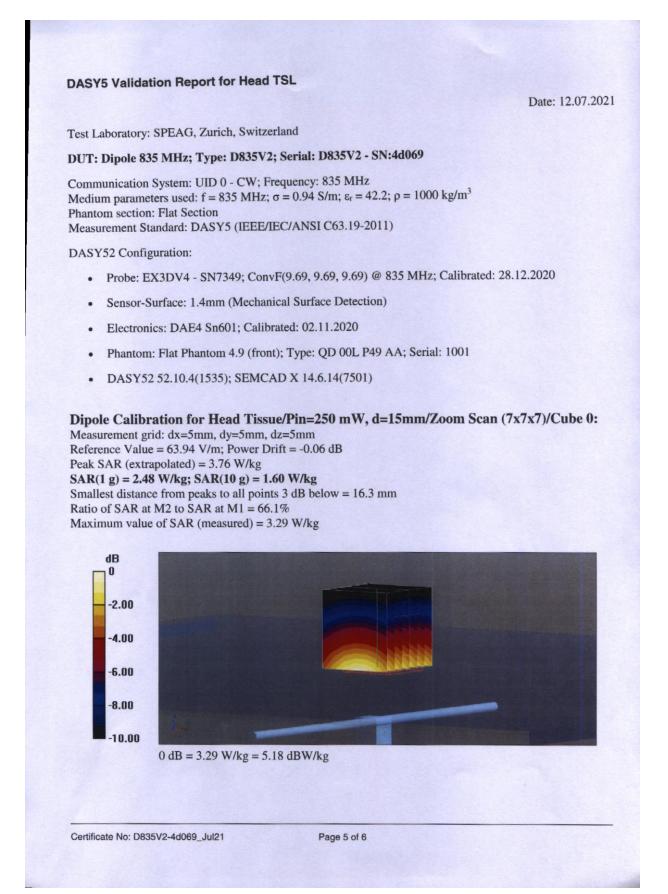
| SPEAG |
|-------|
| |

Certificate No: D835V2-4d069_Jul21

Page 4 of 6



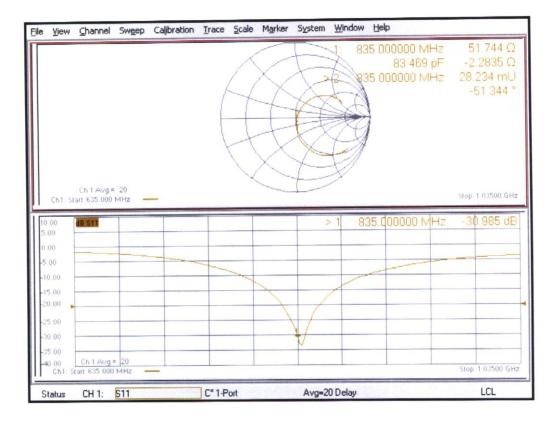








Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d069_Jul21

Page 6 of 6





1750 MHz Dipole Calibration Certificate

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



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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

| ALIBRATION C | ERTIFICATE | | |
|--------------------------------|--|---|---------------------------------|
| Dbject | D1750V2 - SN:1 | 003 | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | edure for SAR Validation Source | s between 0.7-3 GHz |
| Calibration date: | July 12, 2021 | | |
| he measurements and the uncert | ainties with confidence p ed in the closed laborato | ional standards, which realize the physical u robability are given on the following pages a ry facility: environment temperature $(22 \pm 3)^2$ | nd are part of the certificate. |
| rimary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
| ower meter NRP | SN: 104778 | 09-Apr-21 (No. 217-03291/03292) | Apr-22 |
| ower sensor NRP-Z91 | SN: 103244 | 09-Apr-21 (No. 217-03291) | Apr-22 |
| ower sensor NRP-Z91 | SN: 103245 | 09-Apr-21 (No. 217-03292) | Apr-22 |
| eference 20 dB Attenuator | SN: BH9394 (20k) | 09-Apr-21 (No. 217-03343) | Apr-22 Apr-22 |
| pe-N mismatch combination | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344) | Apr-22 |
| eference Probe EX3DV4 | SN: 7349 | 28-Dec-20 (No. EX3-7349_Dec20) | Dec-21 |
| AE4 | SN: 601 | 02-Nov-20 (No. DAE4-601_Nov20) | Nov-21 |
| econdary Standards | ID # | Check Date (in house) | Scheduled Check |
| ower meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| ower sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| ower sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| F generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| etwork Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-20) | In house check: Oct-21 |
| | Name | Function | Signature |
| alibrated by: | Jeffrey Katzman | Laboratory Technician | Alt |
| | | | d'htpo |
| | Katja Pokovic | Technical Manager | ala |
| pproved by: | Traija i Oković | | Juis |
| pproved by: | Traija F UNUVIC | | Issued: July 15, 2021 |





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



Schweizerischer Kalibrierdienst Service suisse d'étalonnage

C Servizio svizzero di taratura

Accreditation No.: SCS 0108

S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
 of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: D1750V2-1003_Jul21

Page 2 of 6





Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 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 | 40.4 ± 6 % | 1.36 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 | 9.17 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 36.9 W/kg ± 17.0 % (k=2) |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured | condition 250 mW input power | 4.82 W/kg |

Certificate No: D1750V2-1003_Jul21

Page 3 of 6





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 49.7 Ω + 0.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 47.0 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.215 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 |
|-----------------|-------|
|-----------------|-------|

Certificate No: D1750V2-1003_Jul21

Page 4 of 6

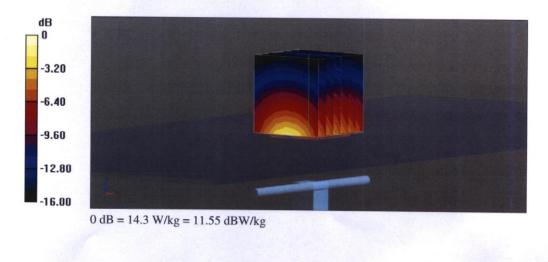




DASY5 Validation Report for Head TSL Date: 12.07.2021 Test Laboratory: SPEAG, Zurich, Switzerland DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1003 Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz; σ = 1.36 S/m; ε_r = 40.4; ρ = 1000 kg/m³ Phantom 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: 28.12.2020 Sensor-Surface: 1.4mm (Mechanical Surface Detection) Electronics: DAE4 Sn601; Calibrated: 02.11.2020 Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001 DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.5 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 17.1 W/kg **SAR(1 g) = 9.17 W/kg; SAR(10 g) = 4.82 W/kg** Smallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54% Maximum value of SAR (measured) = 14.3 W/kg



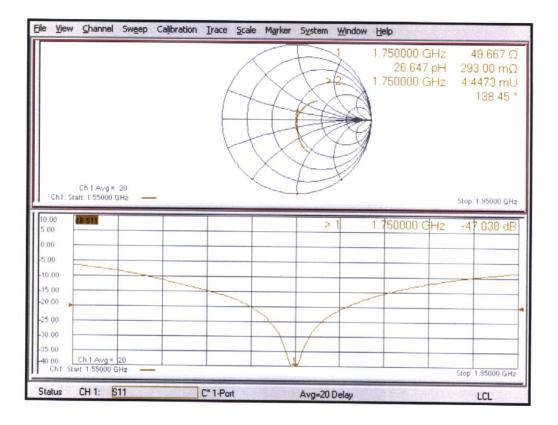
Certificate No: D1750V2-1003_Jul21

Page 5 of 6





Impedance Measurement Plot for Head TSL



Certificate No: D1750V2-1003_Jul21

Page 6 of 6





1900 MHz Dipole Calibration Certificate

| Engineering AG eughausstrasse 43, 8004 Zurich, | of Switzerland | S C S | Schweizerischer Kalibrierdien: Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service |
|--|--|---|---|
| ccredited by the Swiss Accreditation he Swiss Accreditation Service is | s one of the signatories | s to the EA | ccreditation No.: SCS 0108 |
| Iultilateral Agreement for the rec | ognition of calibration | | : D1900V2-5d101_Jul2 |
| CALIBRATION CI | | | |
| Object | D1900V2 - SN:50 | 1101 | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | s between 0.7-3 GHz |
| Calibration date: | July 15, 2021 | | |
| All calibrations have been conducte | ainties with confidence p ad in the closed laborato | robability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}$ | nd are part of the certificate. |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE | ainties with confidence p ad in the closed laborato | robability are given on the following pages an | nd are part of the certificate. |
| The measurements and the uncerta | ainties with confidence p ad in the closed laborato E critical for calibration) | robability are given on the following pages as y facility: environment temperature (22 ± 3)° | nd are part of the certificate. 'C and humidity < 70%. |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards | ainties with confidence p ad in the closed laborato E critical for calibration) | robability are given on the following pages any facility: environment temperature (22 ± 3)° Cal Date (Certificate No.) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 | robability are given on the following pages are y facility: environment temperature (22 ± 3)° Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards | ainties with confidence p ed in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. DAE4-601_Nov20) Check Date (in house) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | ainties with confidence p ed in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards 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 | ainties with confidence p ed in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 03245 SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22 |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103245 SN: 103245 SN: 03244 SN: 103245 SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-21 Signature |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 81H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WS41092317 SN: 100972 SN: US41080477 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-21 Signature |
| The measurements and the uncert All calibrations have been conducte Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A | ainties with confidence p ad in the closed laborator critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: US37292783 SN: W41092477 SN: US41080477 Name | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20) Function | nd are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-21 |





Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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

S Swiss Calibration Service

Accreditation No.: SCS 0108

S

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- · Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the . center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled . phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: D1900V2-5d101_Jul21

Page 2 of 6





Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 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 | 40.4 ± 6 % | 1.40 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 | 10.0 W/kg | |
| SAR for nominal Head TSL parameters | normalized to 1W | 40.1 W/kg ± 17.0 % (k=2) | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | | |
| or at a total goal of or to one (10 g) of field for | condition | | |
| SAR measured | 250 mW input power | 5.22 W/kg | |

Certificate No: D1900V2-5d101_Jul21

Page 3 of 6





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 50.9 Ω + 4.8 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.2 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.201 ns |
|----------------------------------|----------|
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

| Manufactured by | SPEAG |
|-----------------|-------|
|-----------------|-------|

Certificate No: D1900V2-5d101_Jul21

Page 4 of 6





DASY5 Validation Report for Head TSL

Date: 15.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

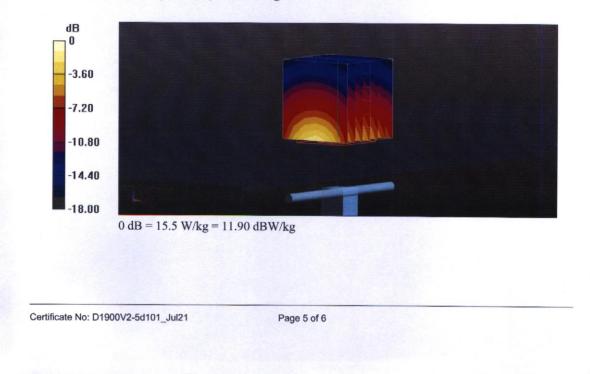
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; $\sigma = 1.4$ S/m; $\varepsilon_r = 40.4$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

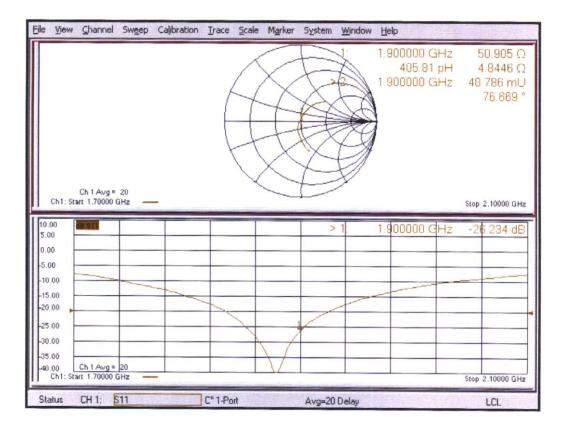
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 110.1 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 10 W/kg; SAR(10 g) = 5.22 W/kg Smallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 54.9% Maximum value of SAR (measured) = 15.5 W/kg







Impedance Measurement Plot for Head TSL



Certificate No: D1900V2-5d101_Jul21

Page 6 of 6





2450 MHz Dipole Calibration Certificate

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



S Schweizerischer Kalibrierdienst Service suisse d'étalonnage 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

| Multilateral Agreement for the reco | ognition of calibration | certificates | | |
|---|------------------------------------|-------------------------------------|--|-------------------|
| Client CTTL (Auden) | | Cer | tificate No: D2450 | /2-853_Jul21 |
| CALIBRATION CE | RTIFICATE | | | |
| Object | D2450V2 - SN:85 | 53 | | |
| | | | | |
| | QA CAL-05.v11 Calibration Proce | dure for SAR Validation S | Sources between | 0.7-3 GHz |
| | | | | |
| Calibration date: | July 26, 2021 | | | |
| This calibration certificate document The measurements and the uncerta | | | | |
| All calibrations have been conducte | d in the closed laborator | y facility: environment temperature | $(22 \pm 3)^{\circ}$ C and humidi | ty < 70%. |
| Calibration Equipment used (M&TE | critical for calibration) | | | |
| Primary Standards | ID # | Cal Date (Certificate No.) | Sche | duled Calibration |
| Power meter NRP | SN: 104778 | 09-Apr-21 (No. 217-03291/0329 | 2) Apr-2 | 2 |
| Power sensor NRP-Z91 | SN: 103244 | 09-Apr-21 (No. 217-03291) | Apr-2 | 2 |
| Power sensor NRP-Z91 | SN: 103245 | 09-Apr-21 (No. 217-03292) | Apr-2 | 2 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 09-Apr-21 (No. 217-03343) | Apr-2 | 2 |
| Type-N mismatch combination | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344) | Apr-2 | 2 |
| Reference Probe EX3DV4 | SN: 7349 | 28-Dec-20 (No. EX3-7349_Dec | 20) Dec-2 | 21 |
| DAE4 | SN: 601 | 02-Nov-20 (No. DAE4-601_Nov | 20) Nov-2 | 21 |
| Secondary Standards | ID # | Check Date (in house) | Sche | duled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct- | | use check: Oct-22 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct- | | use check: Oct-22 |
| Power sensor HP 8481A | SN: MY41092317 | 07-Oct-15 (in house check Oct- | | use check: Oct-22 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct- | and the second | use check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct- | | use check: Oct-21 |
| | Name | Function | Sign | aturo |
| Calibrated by: | Michael Weber | Laboratory Technici | | |
| Approved by: | Katja Pokovic | Technical Manager | | ally - |

Certificate No: D2450V2-853_Jul21

Page 1 of 6

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

Issued: July 26, 2021





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



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

Swiss Calibration Service

Accreditation No.: SCS 0108

S

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
 of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: D2450V2-853_Jul21

Page 2 of 6





Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|------------------------|-------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 37.9 ± 6 % | 1.88 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 | 13.7 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 53.3 W/kg ± 17.0 % (k=2) |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
| | | |
| SAR measured | 250 mW input power | 6.33 W/kg |

Certificate No: D2450V2-853_Jul21

Page 3 of 6





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.6 Ω + 3.8 jΩ | |
|--------------------------------------|-----------------|--|
| Return Loss | - 25.9 dB | |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.164 ns |
|----------------------------------|----------|
| Electrical Delay (one direction) | |

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 |
|-----------------|-------|
|-----------------|-------|

Certificate No: D2450V2-853_Jul21

Page 4 of 6





DASY5 Validation Report for Head TSL

Date: 26.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 853

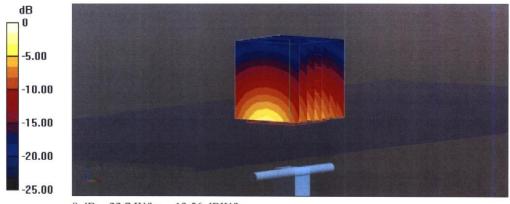
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.88 S/m; ϵ_r = 37.9; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 116.2 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 27.4 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.33 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50% Maximum value of SAR (measured) = 22.7 W/kg



0 dB = 22.7 W/kg = 13.56 dBW/kg

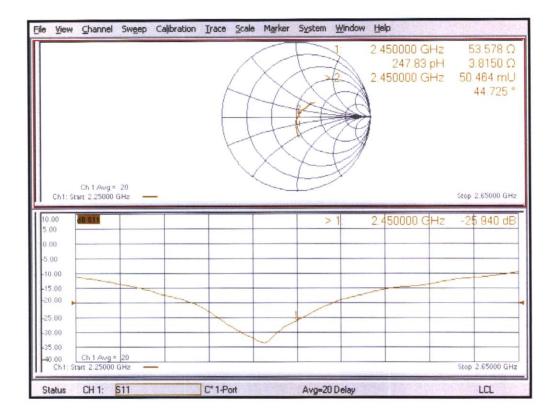
Certificate No: D2450V2-853_Jul21

Page 5 of 6





Impedance Measurement Plot for Head TSL



Certificate No: D2450V2-853_Jul21

Page 6 of 6





2600 MHz Dipole Calibration Certificate

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

S

С

S

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

CTTL (Auden) Certificate No: D2600V2-1012 Jul21 Client **CALIBRATION CERTIFICATE** Object D2600V2 - SN:1012 QA CAL-05.v11 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 0.7-3 GHz July 26, 2021 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 09-Apr-21 (No. 217-03291/03292) Apr-22 Power sensor NRP-Z91 SN: 103244 09-Apr-21 (No. 217-03291) Apr-22 Power sensor NRP-Z91 SN: 103245 09-Apr-21 (No. 217-03292) Apr-22 Reference 20 dB Attenuator SN: BH9394 (20k) 09-Apr-21 (No. 217-03343) Apr-22 SN: 310982 / 06327 Type-N mismatch combination 09-Apr-21 (No. 217-03344) Apr-22 Reference Probe EX3DV4 SN: 7349 28-Dec-20 (No. EX3-7349_Dec20) Dec-21 DAE4 SN: 601 02-Nov-20 (No. DAE4-601_Nov20) Nov-21 Secondary Standards ID # Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-20) In house check: Oct-22 Power sensor HP 8481A SN: MY41092317 07-Oct-15 (in house check Oct-20) In house check: Oct-22 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-20) In house check: Oct-22 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-20) In house check: Oct-21 Name Function Signature Calibrated by: Michael Weber Laboratory Technician Approved by: Katja Pokovic Technical Manager Issued: July 26, 2021 This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Certificate No: D2600V2-1012_Jul21 Page 1 of 6





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



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

Accreditation No.: SCS 0108

S

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
 of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: D2600V2-1012_Jul21

Page 2 of 6





Measurement Conditions

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

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

Head TSL parameters The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.0 | 1.96 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 37.3 ± 6 % | 2.05 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 | 14.7 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 57.1 W/kg ± 17.0 % (k=2) |
| | | |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured | condition 250 mW input power | 6.48 W/kg |

Certificate No: D2600V2-1012_Jul21

Page 3 of 6





Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 47.8 Ω - 5.7 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 24.1 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.153 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 |
|-----------------|-------|
|-----------------|-------|

Certificate No: D2600V2-1012_Jul21

Page 4 of 6