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

Element

Client

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Schweizerischer Kalibrierdienst S Service suisse d'étalonnage С

Servizio svizzero di taratura

S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Certificate No: D1900V2-5d080_Aug22

CALIBRATION CERTIFICATE

| Object | D1900V2 - SN:50 | 1080 | BN 1-08-2022 |
|---|---|--|--|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | dure for SAR Validation Sources | |
| | | | |
| Calibration date: | August 08, 2022 | | |
| This calibration certificate documer The measurements and the uncert | nts the traceability to nati ainties with confidence p | onal standards, which realize the physical unit robability are given on the following pages and | ts of measurements (SI). I are part of the certificate. |
| All calibrations have been conducte | ed in the closed laborato | y facility: environment temperature (22 \pm 3)°C | and humidity < 70%. |
| Calibration Equipment used (M&TE | eritical for calibration) | | |
| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 04-Apr-22 (No. 217-03525/03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | Apr-23 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | Apr-23 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-21 (No. EX3-7349_Dec21) | Dec-22 |
| DAE4 | SN: 601 | 02-May-22 (No. DAE4-601_May22) | May-23 |
| 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: MY41093315 | 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-22 |
| | Name | Function | Signature |
| Calibrated by: | Jeffrey Katzman | Laboratory Technician | , de kas |
| Approved by: | Niels Kuster | Quality Manager | V.KS |
| This calibration certificate shall not | be reproduced excent in | full without written approval of the laboratory. | lssued: August 9, 2022 |
| | | the factor mator approval of the labolatory. | |

Calibration Laboratory of

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





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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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 | 38.7 ± 6 % | 1.38 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | त्व न क | |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | | |
|---|---------------------------------|--------------------------|--|
| SAR measured | 250 mW input power | 9.90 W/kg | |
| SAR for nominal Head TSL parameters | normalized to 1W | 39.6 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 | 5.16 W/kg | |

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 | 52.6 ± 6 % | 1.50 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 | 10.1 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 40.7 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 5.30 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 21.3 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.7 Ω + 8.2 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 21.2 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 47.1 Ω + 9.0 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 20.3 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) 1.192 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

| 1 | | ٦. |
|-----------------|-------|----|
| Manufactured by | SPEAG | |

DASY5 Validation Report for Head TSL

Date: 08.08.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080

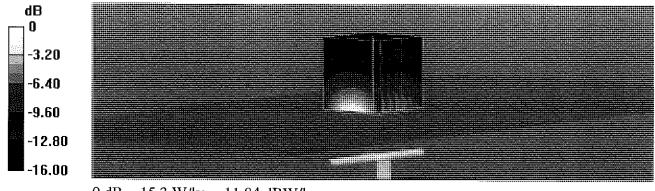
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ϵ_r = 38.7; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 108.2 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 18.2 W/kg SAR(1 g) = 9.90 W/kg; SAR(10 g) = 5.16 W/kg Smallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54.7% Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.84 dBW/kg

Impedance Measurement Plot for Head TSL

| | | 1: 1.90000 690 1.90000 |).68 pH 8.2454 Ω |
|---|--|------------------------------|---------------------------------------|
| Ch 1 Avg = 20 Ch 1: Start 1.70000 GHz .00 00 00 | | > 1: 1.90000 | stop 2.10000 GHz 10 GHz -2 .213 dB |
| 00 0.00 5.00 0.00 5.00 5.00 | | | |
| 0.00 5.00 3.00 Ch 1 Avg = 20 | | | |

DASY5 Validation Report for Body TSL

Date: 08.08.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d080

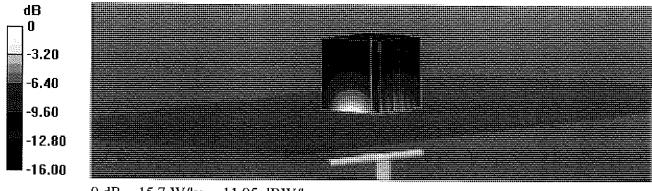
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.50 S/m; ϵ_r = 52.6; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 105.0 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 18.8 W/kg SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.30 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 54.6% Maximum value of SAR (measured) = 15.7 W/kg



0 dB = 15.7 W/kg = 11.95 dBW/kg

Impedance Measurement Plot for Body TSL

| File | ⊻iew <u>C</u> hannel | Sw <u>e</u> ep (| alibration | Trace <u>S</u> ca | e Marker | System | <u>W</u> indow <u>H</u> | <u>l</u> elp | | |
|---|---|------------------|------------|--|----------|--------|-------------------------|---------------------------------------|-------|--|
| | Ch 1 Avg = | 20 | | | | | | 900000 GHz 755.48 pH 900000 GHz | 4 (| 47.125 Ω 3.0190 Ω 1.048 mU 102.38 ° |
| | Ch1: Start 1.70000 | | | | | | | <u></u> | Stop | 2.10000 GHz |
| 10.0 | Ú desin | <u> </u> | T | r and the second se | | | | | | |
| 5.00 0.00 -5.00 -10.0 -15.0 -20.0 -25.0 -30.0 -35.0 -40.0 | 0 | 20 | | | | > 1 | . 1. | 900000 CHz | 2 -21 | 0.260 dB |
| 5.00 0.00 -5.00 -10.0 -15.0 -20.0 -25.0 -25.0 -30.0 -35.0 -40.0 | 0 0 00 00 00 00 00 00 00 00 0 | 20 511 | | | | | . 1. | 900000 GHz | | 0.260 dB |

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PC Test

Certificate No: D2450V2-981_Nov21

| Object | D2450V2 - SN:98 | 81 ⁰⁰⁰⁰⁰⁰⁰ | |
|--|--|--|---|
| Calibration procedure(s) | QA CAL-05.v11 Calibration Proce | edure for SAR Validation Sources | s between 0.7-3 GHz , |
| | | | BN12-09-2 |
| Calibration date: | November 25, 20 | 021 abbedracter and the | BN12-09-2 BN11-25-22 |
| This calibration certificate docum | ents the traceability to nati | ional standards, which realize the physical un | hits of measurements (SI). |
| | atamies with confidence p | robability are given on the following pages an | id are part of the certificate. |
| All calibrations have been condu | cted in the closed laborato | ry facility: environment temperature (22 \pm 3)°(| C and humidity < 70%. |
| Calibration Equipment used (M& | TE critical for calibration) | | |
| | | | |
| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
| | ID # SN: 104778 | Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) | Scheduled Calibration |
| Power meter NRP | | | |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 | SN: 104778 | 09-Apr-21 (No. 217-03291/03292) | Apr-22 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | SN: 104778 SN: 103244 | 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) | Apr-22 Apr-22 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator | SN: 104778 SN: 103244 SN: 103245 | 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) | Apr-22 Apr-22 Apr-22 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) | 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) | Apr-22 Apr-22 Apr-22 Apr-22 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 | 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 | 09-Apr-21 (No. 217-03291/03292) 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) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 | 09-Apr-21 (No. 217-03291/03292) 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) 01-Nov-21 (No. DAE4-601_Nov21) Check Date (in house) 30-Oct-14 (in house check Oct-20) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 |
| 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 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 | 09-Apr-21 (No. 217-03291/03292) 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) 01-Nov-21 (No. DAE4-601_Nov21) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check |
| Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 | 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) 01-Nov-21 (No. DAE4-601_Nov21) 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) | Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check In house check: Oct-22 |
| 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 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 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) 01-Nov-21 (No. DAE4-601_Nov21) 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) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 |
| 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 E8358/ | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 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) 01-Nov-21 (No. DAE4-601_Nov21) 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) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 |
| 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 | SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 | 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) 01-Nov-21 (No. DAE4-601_Nov21) 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) | Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 |
| 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 | SN: 104778 SN: 103244 SN: 103245 SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 A SN: US41080477 | 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) 01-Nov-21 (No. DAE4-601_Nov21) 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) 31-Mar-14 (in house check Oct-20) | Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 |

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Accreditation No.: SCS 0108

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

Glossarv:

| 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%.

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 | 39.1 ± 6 % | 1.87 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 | 53.9 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.42 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 25.4 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 | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 51.2 ± 6 % | 2.01 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 | 12.9 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 50.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.00 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 23.7 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.8 Ω + 5.8 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 23.6 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 50.4 Ω + 8.5 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 21.5 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) 1.163 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 |
|-----------------|-------|
| | 4 |

DASY5 Validation Report for Head TSL

Date: 25.11.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 981

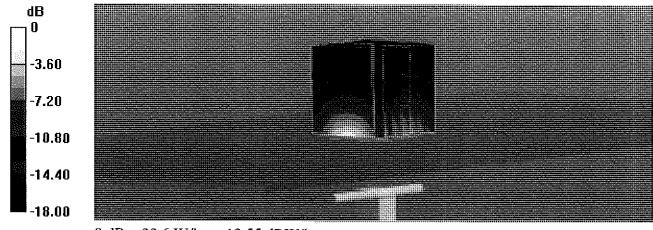
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 1.87$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 118.7 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 27.1 W/kg SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.42 W/kg Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 51.1% Maximum value of SAR (measured) = 22.6 W/kg



0 dB = 22.6 W/kg = 13.55 dBW/kg

Impedance Measurement Plot for Head TSL

| File | ⊻iew | <u>C</u> hannel | Sw <u>e</u> ep | Calibration | <u>Trace S</u> cale | M <u>a</u> rker | System | <u>W</u> indow | <u>H</u> elp | | |
|---------------------------------|--|---------------------------------|----------------|-------------|---------------------|-----------------|----------|-----------------|------------------------------------|------|---|
| | | | | | | | | 2 | 450000 G⊢ 374.71 p 450000 G⊢ | | i3.773 Ω i.7682 Ω .318 mU 53.629 ° |
| | Ch1:St | Ch 1 Avg = art 2.25000 # | GHz | NEL | | | <u></u> | lika ayarda iya | | Stop | 2,65000 GHz |
| -20 -25 -30 -35 -40 | 00 - 00 00 - 00 00 - 00, ∞ 00 - 00, 00 - 00, 00 - 00, | Ch 1 Avg = art 2.25000 i | 20 | | | | | | 450000 Cl- | | 9.587 dB |
| | atus | CH 1: § | | | C* 1-Port | | Avg=20 D | elau | | stop | 2.65000 GH2 |

DASY5 Validation Report for Body TSL

Date: 25.11.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 981

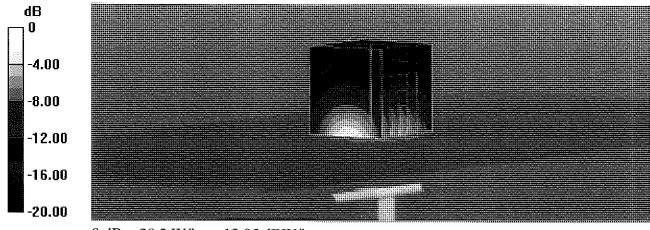
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 51.2$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.12, 8.12, 8.12) @ 2450 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 108.0 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 24.3 W/kg **SAR(1 g) = 12.9 W/kg; SAR(10 g) = 6 W/kg** Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 54.1% Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg = 13.05 dBW/kg

Impedance Measurement Plot for Body TSL

| Eile Yiew | Channel | Sweep | Calibration | <u>Trace S</u> cal | e M <u>a</u> rker | System | <u>W</u> indow | Help | | | |
|--|------------------------------|------------------|-------------|--------------------|---------------------------------------|--------|----------------|------------------------------------|----|------------|---|
| | Ch 1 Avg ≈ | | | A | | | Δ | 2.450000 (551.61 2.450000 (| рΗ | 8. 84.3 |).350 Ω 4914 Ω)88 mU 2.801 ° |
| Chi:S | tart 2,25000 i | 20 GHz | | · | · · · · · · · · · · · · · · · · · · · | | | <u></u> | | Stop 2 | .65000 GHz |
| 10.00 5.00 0.00 -5.00 -10.00 -15.00 -20.00 , -25.00 | | | | | | > | | 2.450000 (| | -21. | 474 dB |
| 30.00 35.00 40.00 Ch1: S | Ch 1 Avg = tart 2.25000 t | 20 GHz 611 | | C* 1-Port | | Avg=20 | Delay | | | | .65000 GHz |



ELEMENT MATERIALS TECHNOLOGY

(formerly PCTEST) 7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.element.com



Certification of Calibration

Object

D2450V2 - SN: 981

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 11/24/2022

Description:

SAR Validation Dipole at 2450 MHz.

Calibration Equipment used:

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|-----------------------|---------------|---|------------|--------------|------------|---------------|
| Agilent | N5182A | MXG Vector Signal Generator | 1/12/2022 | Annual | 1/12/2023 | MY47420837 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 343971 |
| Anritsu | MA2411B | Pulse Power Sensor | 3/28/2022 | Annual | 3/28/2023 | 1339007 |
| Anritsu | MA2411B | Pulse Power Sensor | 3/2/2022 | Annual | 3/2/2023 | 1126066 |
| Anritsu | ML2496A | Power Meter | 3/31/2022 | Annual | 3/31/2023 | 1138001 |
| Anritsu | ML2496A | Power Meter | 3/17/2022 | Annual | 3/17/2023 | 941001 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 3/12/2021 | Biennial | 3/12/2023 | 210202100 |
| Control Company | 4352 | Ultra Long Stem Thermometer | 1/21/2022 | Annual | 1/21/2023 | 160508097 |
| Control Company | 4352 | Long Stem Thermometer | 9/10/2021 | Biennial | 9/10/2023 | 210774678 |
| Mini-Circuits | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Pasternack | PE5011-1 | Torque Wrench | 12/21/2021 | Biennial | 12/21/2023 | 82475 |
| Mini-Circuits | ZHDC-16-63-S+ | Coupler | CBT | N/A | CBT | N/A |
| Rohde & Schwarz | ZNLE6 | Vector Network Analyzer | 10/21/2022 | Annual | 10/21/2023 | 101307 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 5/12/2022 | Annual | 5/12/2023 | 1070 |
| Keysight Technologies | 85033E | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/21/2022 | Annual | 6/21/2023 | MY53402352 |
| SPEAG | EX3DV4 | SAR Probe | 2/21/2022 | Annual | 2/21/2023 | 7488 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 2/23/2022 | Annual | 2/23/2023 | 1415 |
| SPEAG | EX3DV4 | SAR Probe | 6/16/2022 | Annual | 6/16/2023 | 7409 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 6/14/2022 | Annual | 6/14/2023 | 1334 |

Measurement Uncertainty = $\pm 23\%$ (k=2)

| | Name | Function | Signature |
|----------------|-----------------|-----------------------------|-----------|
| Calibrated By: | Tho Tong | Test Engineer | Tho Tong |
| Approved By: | Kaitlin O'Keefe | Senior Technical Manager | ROK |

| Object: | Date Issued: | Page 1 of 4 |
|-------------------|--------------|-------------|
| D2450V2 – SN: 981 | 11/24/2022 | Fage 1014 |

DIPOLE CALIBRATION EXTENSION

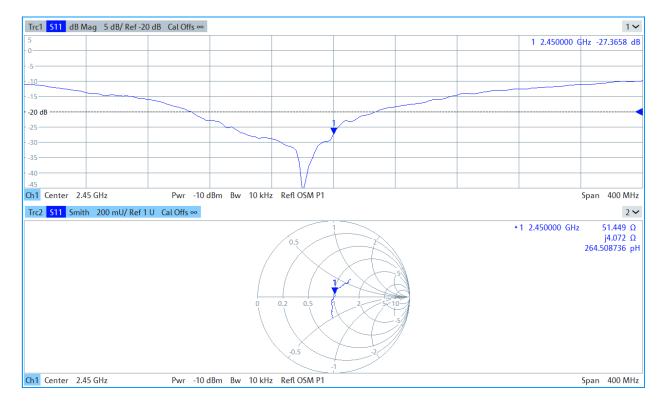
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

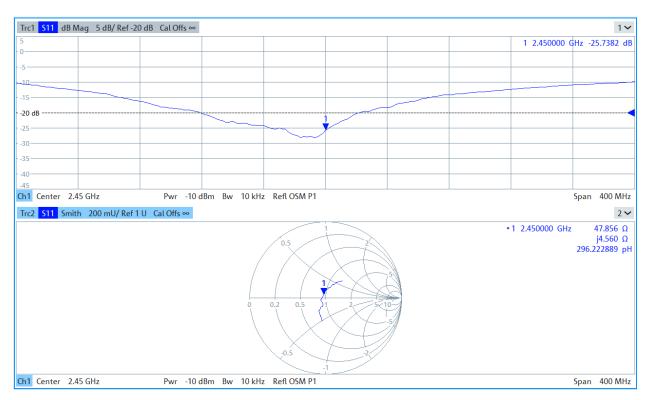
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | (10a) W/ka @ | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | PASS/FAIL |
|---------------------|----------------|---|--|---|--------|---|--------------|----------------------|--|---|--------------------------|---|--|----------------------------------|---|--------------------------------------|---------------|-----------|
| 11/25/2021 | 11/24/2022 | 1.163 | 5.39 | 5.22 | -3.15% | 2.54 | 2.43 | -4.33% | 53.8 | 51.4 | 2.4 | 5.8 | 4.1 | 1.7 | -23.6 | -27.4 | -16.00% | PASS |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | | | (10a) W/ka @ | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 11/25/2021 | 11/24/2022 | 1.163 | 5.03 | 4.88 | -2.98% | 2.37 | 2.27 | -4.22% | 50.4 | 47.9 | 2.5 | 8.5 | 4.6 | 3.9 | -21.5 | -25.7 | -19.70% | PASS |

| Object: | Date Issued: | Page 2 of 4 |
|-------------------|--------------|-------------|
| D2450V2 – SN: 981 | 11/24/2022 | Fage 2 014 |



Impedance & Return-Loss Measurement Plot for Head TSL

| Object: | Date Issued: | Daga 2 of 4 |
|-------------------|--------------|-------------|
| D2450V2 – SN: 981 | 11/24/2022 | Page 3 of 4 |



Impedance & Return-Loss Measurement Plot for Body TSL

| Object: | Date Issued: | Page 4 of 4 |
|-------------------|--------------|-------------|
| D2450V2 – SN: 981 | 11/24/2022 | Fage 4 01 4 |

Calibration Laboratory of

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



standing states

Schweizerischer Kalibrierdienst

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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

| Client Element Yongin, Republic of I | Korea | Certificate No. | D2450V2-945_May23 |
|---|------------------------------------|--|----------------------------------|
| CALIBRATION C | ERTIFICAT | | |
| Object | D2450V2 - SN:9 | 45 | |
| Calibration procedure(s) | QA CAL-05.v12 Calibration Proce | edure for SAR Validation Sources | i between 0.7-3 GHz 실무자 기술책임자 |
| Calibration date: | May 11, 2023 | | Tre 1/8 6/9/200 |
| | | onal standards, which realize the physical uni robability are given on the following pages an | |
| All calibrations have been conduct | ed in the closed laborato | ry facility: environment temperature (22 ± 3)°C | C and humidity < 70%. |
| Calibration Equipment used (M&TI | E critical for calibration) | | |
| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
| Power meter NRP2 | SN: 104778 | 30-Mar-23 (No. 217-03804/03805) | Mar-24 |
| Power sensor NRP-Z91 | SN: 103244 | 30-Mar-23 (No. 217-03804) | Mar-24 |
| Power sensor NRP-Z91 | SN: 103245 | 30-Mar-23 (No. 217-03805) | Mar-24 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 30-Mar-23 (No. 217-03809) | Mar-24 |
| Type-N mismatch combination | SN: 310982 / 06327 | 30-Mar-23 (No. 217-03810) | Mar-24 |
| Reference Probe EX3DV4 | SN: 7349 | 10-Jan-23 (No. EX3-7349_Jan23) | Jan-24 |
| DAE4 | SN: 601 | 19-Dec-22 (No. DAE4-601_Dec22) | Dec-23 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: MY41093315 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |
| | Name | Function | Signature |
| Calibrated by: | Paulo Pina | Laboratory Technician | June D |
| Approved by: | Sven Kühn | Technical Manager | 5.15 |
| | | | Issued: May 16, 2023 |
| This calibration certificate shall not | be reproduced except in | full without written approval of the laboratory. | • |

Calibration Laboratory of

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





S

Schweizerischer Kalibrierdienst

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Servizio svizzero di taratura

S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

| TSL | 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%.

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 | 37.7 ± 6 % | 1.86 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|---------------------------------|--------------------------|
| SAR measured | 250 mW input power | 13.3 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 51.9 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 | 6.23 W/kg |

Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.6 ± 6 % | 2.02 mho/m ± 6 % |
| Body ⊺SL 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 | 12.7 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 49.9 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.01 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 23.8 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 54.4 Ω + 1.8 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.8 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 50.4 Ω + 4.8 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.4 dB |

General Antenna Parameters and Design

| | Electrical Delay (one direction) | | |
|-----|----------------------------------|-----------|--|
| - 1 | | 1.157 ns | |
| | , | 1.107 115 | |
| | | | |

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

DASY5 Validation Report for Head TSL

Date: 11.05.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

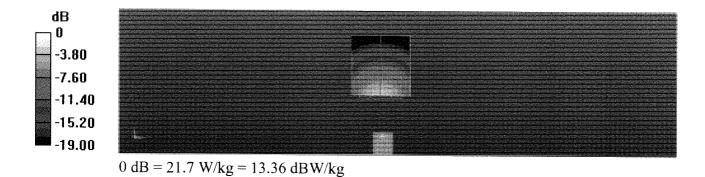
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 1.86$ S/m; $\epsilon_r = 37.7$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.9, 7.9, 7.9) @ 2450 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 115.4 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 25.8 W/kg **SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.23 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 51.7% Maximum value of SAR (measured) = 21.7 W/kg



Impedance Measurement Plot for Head TSL

| File | ⊻iew | Channel | Sw <u>e</u> ep | Calibration | <u>T</u> race | <u>S</u> cale | Marker | System | <u>W</u> indow | Help | | an General Constant of State | | | somer |
|---|---|---------------------------------|----------------|-------------|---------------|---------------|---------|--------|----------------|------|----------------------------|------------------------------|-----------|---------------------------------------|--------|
| | | | | | (| | | | | | 0000 (119.6; 0000 (| 2 pH | 1 45.1 | 4.379 (8415 (505 m) 21.797 | 2 J |
| | | Ch 1 Avg = | 20 | | | \sim | ••••••• | - | J. | | | | | | |
| | Ch1: Sta | art 2.25000 (| | | T | T | | ~ | - | - 1 | | | | :.65000 GI | |
| 10.0 5.0 | Ch1: Sta DO 1 O + | art 2.25000 (18 \$11 | | | | | | | 1 | 2.45 | 0000 (| GHz | | 65000 GI 839 di | |
| 10.0 | Ch1:Sta D0 0 0 | | | | | | | | | 2.45 | 0000 (| GHz | | | |
| 10.0 5.0 0.0 -5.0 -10 | Ch1: Sta D0 0 00 00 | | | | | | | | | 2.45 | | GHz | | | |
| 10.0 5.0 0.0 -5.0 | Ch1: Sta 00 - 00 - 00 - 00 - 00 - | | | | | | | | 1 | 2.45 | 0000(| CH2 | | | |
| 10.0 5.0 0.0 -5.0 -10 -15 | Ch1: Sta 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - | | | | | | | > | | 2.45 | | GHz | | | |
| 10.0 5.0 -5.0 -10 -15 -20 | Ch1:Sta 0 - 0 - 00 - 00 - 00 - 00 - 00 - | | | | | | | | 1 | 2.45 | | GHz | | | |
| 10.0 5.0 -5.0 -10. -15. -20. -25. -30. -35. | Ch1:Sta 0 - 0 - 0 - 00 - 00 - 00 - 00 - 00 - 0 | | îHz | | | | | | | 2.45 | | GHz | | | |
| 10.0 5.0 -5.0 -10. -15. -20. -25. -30. -35. -40. | Ch1:Sta 0 - 0 - 00 - 00 - 00 - 00 - 00 - 00 - | | 20 | | | | | | | 2.45 | | GHz | 26 | | |

DASY5 Validation Report for Body TSL

Date: 09.05.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:945

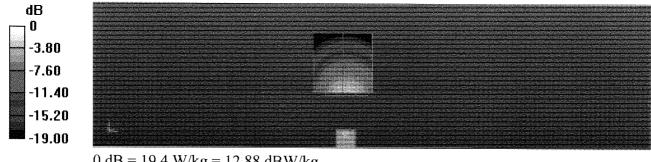
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = 2.02 \text{ S/m}$; $\varepsilon_r = 52.6$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

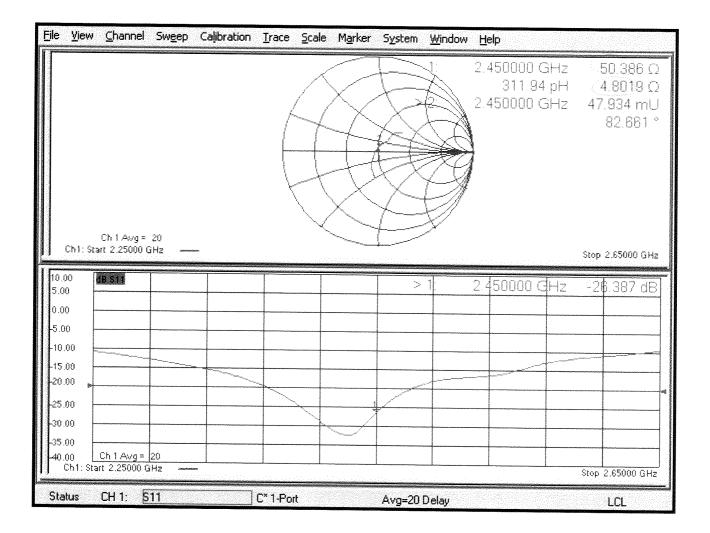
- Probe: EX3DV4 SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 10.01.2023 •
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022 •
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501) ٠

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 = 107.6 V/m; Power Drift = -0.09 dBPeak SAR (extrapolated) = 23.4 W/kgSAR(1 g) = 12.7 W/kg; SAR(10 g) = 6.01 W/kgSmallest distance from peaks to all points 3 dB below = 8.9 mmRatio of SAR at M2 to SAR at M1 = 55.9%Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg



Calibration Laboratory of Schmid & Partner **Engineering AG**

Element

Client

Zeughausstrasse 43, 8004 Zurich, Switzerland

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: D2450V2-882_Feb23

CALIBRATION CERTIFICATE

| Object | D2450V2 - SN:88 | 2 | adress provinciales Antipation and a state of the state o |
|--|------------------------------------|--|---|
| Calibration procedure(s) | QA CAL-05.v12 Calibration Proce | dure for SAR Validation Sour | rces between 0.7-3 GHz |
| | | | 실무자 기술책임자 |
| Calibration date: | February 13, 202 | 3 | Juc - 1 - 1 - 2023 - 02 - 27 |
| | | onal standards, which realize the physica obability are given on the following page | al units of measurements (SI). |
| All calibrations have been conducte | d in the closed laborator | y 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 | 04-Apr-22 (No. 217-03525/03524) | /Apr-23 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | Apr-23 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | Apr-23 |
| Reference Probe EX3DV4 | SN: 7349 | 10-Jan-23 (No. EX3-7349 Jan23) | Jan-24 |
| DAE4 | SN: 601 | 19-Dec-22 (No. DAE4-601_Dec22) | Dec-23 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: MY41093315 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |
| | Name | Function | Signature |
| Calibrated by: | Paulo Pina | Laboratory Technician | |
| | | | Jartie |
| Approved by: | Sven Kühn | Technical Manager | |
| | | | Issued: February 14, 2023 |
| This calibration certificate shall not | be reproduced except in | full without written approval of the labor | ratory. |

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datas

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Swiss Calibration Service

Accreditation No.: SCS 0108

Service suisse d'étalonnage

Calibration Laboratory of

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





Schweizerischer Kalibrierdienst

- S Service suisse d'étalonnage С
 - Servizio svizzero di taratura
- S **Swiss Calibration Service**

Accreditation No.: SCS 0108

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

Glossary:

| TSL | 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%.

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 | 39.3 ± 6 % | 1.85 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 | 13.1.W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 51.7-W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.08 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.2 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 | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.4±6% | 1.99 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | 100 AL 100 C | |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | (12.8 [°] W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 50.6 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.02 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 23.9 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.2 Ω + 1.2 μΩ |
|--------------------------------------|-----------------|
| Return Loss | -29.6 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 48.8-Ω + 3.7 jΩ |
|--------------------------------------|-----------------|
| Return Loss | (-28.1) dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.157 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 |
|-----------------|-------|

DASY5 Validation Report for Head TSL

Date: 08.02.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:882

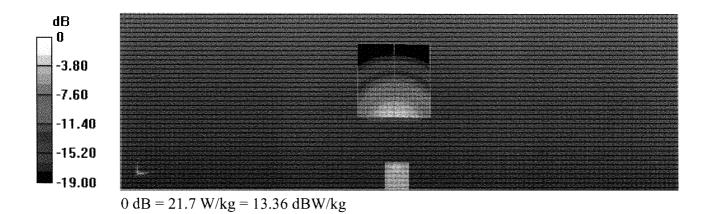
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; $\sigma = (1.85)$ S/m; $\epsilon_r = 39.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

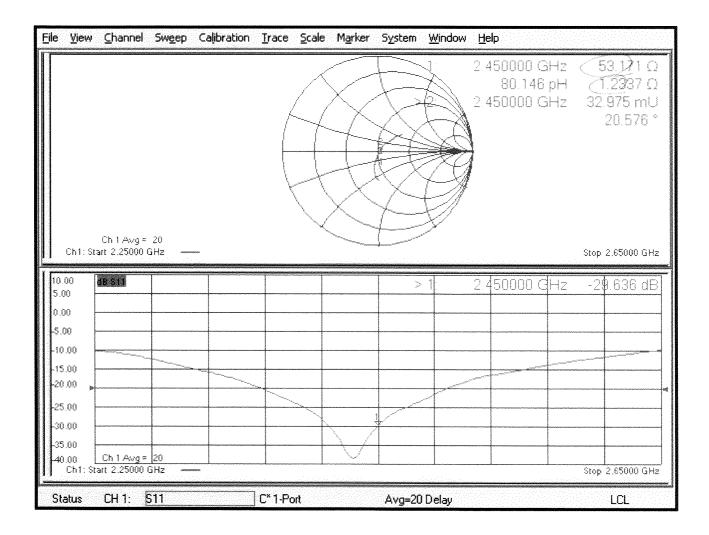
- Probe: EX3DV4 SN7349; ConvF(7.88, 7.88, 7.88) @ 2450 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 115.0 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 26.1 W/kg **SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.08 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50.3% Maximum value of SAR (measured) = 21.7 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 13.02.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:882

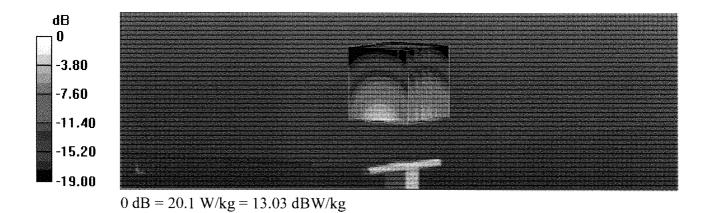
Communication System: UID 0 - CW; Frequency: 2450 MHz Medium parameters used: f = 2450 MHz; σ = 1.99 S/m; ϵ_r = 52.4; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

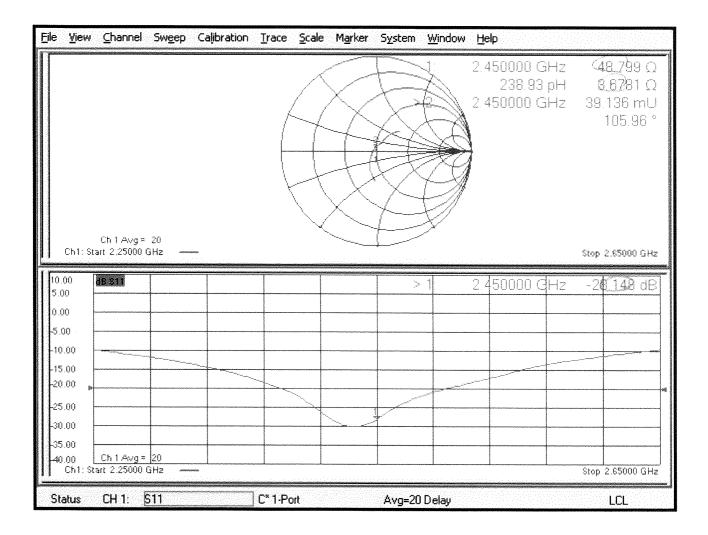
- Probe: EX3DV4 SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm 2/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 109.0 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 23.8 W/kg **SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.02 W/kg** Smallest distance from peaks to all points 3 dB below = 8.9 mm Ratio of SAR at M2 to SAR at M1 = 54.9% Maximum value of SAR (measured) = 20.1 W/kg



Impedance Measurement Plot for Body TSL



Calibration Laboratory of

Element

Client

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 Multilateral Agreement for the recognition of calibration certificates

Certificate No: D2600V2-1071_Nov22

CALIBRATION CERTIFICATE

| Object | D2600V2 - SN:10 |)71 | an a |
|---|---|--|--|
| Calibration procedure(s) | alibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz BNU-2022 12-16-2022 | | |
| Calibration date: | November 15, 20 | and the second | |
| | | onal standards, which realize the physical units of robability are given on the following pages and are | |
| All calibrations have been conducte | ed in the closed laborator | y facility: environment temperature (22 \pm 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 | 04-Apr-22 (No. 217-03525/03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | Apr-23 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | Apr-23 |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | Apr-23 |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-21 (No. EX3-7349_Dec21) | Dec-22 |
| DAE4 | SN: 601 | 31-Aug-22 (No. DAE4-601_Aug22) | Aug-23 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| Power sensor HP 8481A | SN: MY41093315 | 07-Oct-15 (in house check Oct-22) | In house check: Oct-24 |
| RF generator R&S SMT-06 | SN: 100972 | 15-Jun-15 (in house check Oct-22) | In house check: Oct-24 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-22) | In house check: Oct-24 |
| | Name | Function | Signature |
| Calibrated by: | Jeton Kastrati | Laboratory Technician | zU |
| Approved by: | Sven Kühn | Technical Manager | S.K |
| | he very address the | | Issued: November 16, 2022 |
| mis calibration certificate shall not i | ne rehroancea except iu | full without written approval of the laboratory. | |



S Schweizerischer Kalibrierdienst Service suisse d'étalonnage

- C Service suisse d'étaionnage Servizio svizzero di taratura
- S Swiss Calibration Service

Accreditation No.: SCS 0108

Calibration Laboratory of

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





S Schweizerischer Kalibrierdienst

- C Service suisse d'étalonnage
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 - 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%.

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 | 37.8 ± 6 % | 2.03 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 14.4 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 56.5 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.43 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 25.4 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 | 52.5 | 2.16 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 51.3 ± 6 % | 2.19 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 | 13.7 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 54.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 6.13 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 24.3 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 48.6 Ω - 5.9 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 24.2 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 45.3 Ω - 4.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 23.4 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.153 ns |
|----------------------------------|----------|
| | 1.100119 |
| | |

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

DASY5 Validation Report for Head TSL

Date: 15.11.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1071

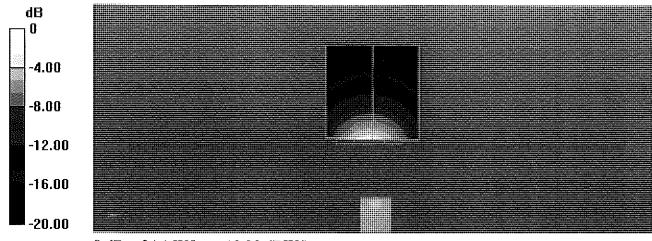
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 37.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 117.5 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 29.2 W/kg **SAR(1 g) = 14.4 W/kg; SAR(10 g) = 6.43 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 49.6% Maximum value of SAR (measured) = 24.1 W/kg



0 dB = 24.1 W/kg = 13.83 dBW/kg

Impedance Measurement Plot for Head TSL

| Elle | ⊻iew | Channel | Sw <u>e</u> ep | Ca <u>l</u> ibration | <u>Trace</u> <u>S</u> cale | e M <u>a</u> rker | System | Window | Help | | | |
|---|--|-----------------------------|----------------|----------------------|----------------------------|-------------------|--------|--------|-----------------------------------|------|--------------|--------------------------------------|
| | | | | | | XXXX | | Z. | 2.600000 (10.34 2.800000 (| l pF | -5.9 61.7 | .560 Ω 3197 Ω 02 mU 00.23 ° |
| | Ch1:Sta | Ch 1 Avg = art 2.40000 (| iHz | | | ······ | | | | | Stop 2. | 80000 GH2 |
| 10.0 5.0 -5.0 -10, -15, -20, -25, -30, -35, -40, | 0 0 00 00 00 00 00 00 | db Sil | | | | | | | 2.800000 (| | | 194 dB |
| Sta | itus | CH 1: | 511 | | C* 1-Port | | Avg=20 | | | | l | .CL |

DASY5 Validation Report for Body TSL

Date: 15.11.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1071

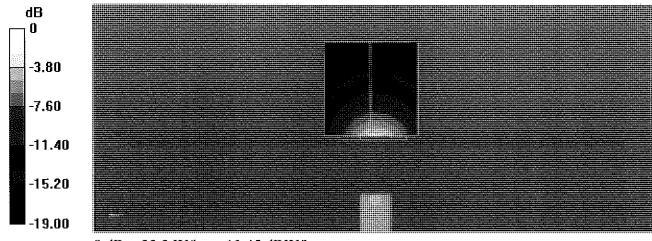
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.19$ S/m; $\epsilon_r = 51.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.91, 7.91, 7.91) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Pliantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 107.8 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 26.9 W/kg **SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.13 W/kg** Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 51.7% Maximum value of SAR (measured) = 22.2 W/kg



0 dB = 22.2 W/kg = 13.45 dBW/kg

Impedance Measurement Plot for Body TSL

| <u>-</u> ile ⊻ie | w <u>C</u> hannel | Sw <u>e</u> ep | Calibration | <u>Trace S</u> ca | e M <u>a</u> rker | S <u>v</u> stem | <u>W</u> indow | Help | | | |
|---|---|----------------|-------------|-------------------|-------------------|-----------------|----------------|-------------------------------|------|-------------|---|
| | | | | (| X | | <u>Z</u> | 2.600000 13.91 2.600000 | 5 pF | -4. 67.8 | 5.250 Ω 3991 Ω 396 mU 34.55 ° |
| Ch 1: 10.00 5.00 | Ch 1 Avg = Start 2,40000 (dB311 | 20 3Hz | | | | | | 2.600000 | GHz | | .30000 GHa 363 dB |
| 0.00 | | | | | | | | | | | |
| 0.00 -5.00 -10.00 -15.00 -20.00 -25.00 -38.00 | 6 | | | | | | | | | | |

Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland

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Schweizerischer Kalibrierdienst Service suisse d'étalonnage

- Servizio svizzero di taratura
- S Swiss Calibration Service

Accreditation No.: SCS 0108

Certificate No: D2600V2-1126_Aug22

Client Element

| CALIBRATION C | ERTIFICATE | le sur de la constant | Revenue of the second | | | |
|--|---|---|--|--|--|--|
| Object | D2600V2 - SN:11 | | 일무사 기술책임자 지수 Marker 1-14-12 | | | |
| Calibration procedure(s) | QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | | | | |
| Calibration date: | August 18, 2022 | | | | | |
| This calibration certificate documen | its the traceability to natio | onal standards, which realize the physica | l units of measurements (SI) | | | |
| i | | obability are given on the following page | | | | |
| and measurements and the differta | анасо матоонаценсе рг | opacienty are given on the following page | s and are part of the certificate. | | | |
| All calibrations have been conducte | ed in the closed laborator | y 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 | 04-Apr-22 (No. 217-03525/03524) | Apr-23 | | | |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | Apr-23 | | | |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | Apr-23 | | | |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | Apr-23 | | | |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | Apr-23 | | | |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-21 (No. EX3-7349_Dec21) | Dec-22 | | | |
| DAE4 | SN: 601 | 02-May-22 (No. DAE4-601_May22) | May-23 | | | |
| | , | | | | | |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check | | | |
| Power meter E44198 | 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: MY41093315 | 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-22 | | | |
| | | | | | | |
| | Name | Function | Signature | | | |
| Calibrated by: | Jeffrey Katzman | Laboratory Technician | dikt- | | | |
| Approved by: | Sven Kühn | Technical Manager | S.6 | | | |
| This calibration certificate shall not | he reproduced except in | full without written approval of the labora | Issued: August 22, 2022 | | | |

Calibration Laboratory of

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





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Accreditation No.: SCS 0108

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- ø 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 8 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 æ nominal SAR result.

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

Measurement Conditions

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

| DASY Version | 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 % | 2.01 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 | 14.3 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 55.9 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 | 6.38 W/kg |

Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 52.5 | 2.16 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 50.7 ± 6 % | 2.22 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 | 14.0 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 54.7 W/kg ± 17.0 % (k=2) |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured | condition 250 mW input power | 6.24 W/kg |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 49.1 Ω - 7.6 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22.2 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 45.2 Ω - 5.9 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22.0 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.154 ns |
|----------------------------------|----------|
| 4 | |

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

DASY5 Validation Report for Head TSL

Date: 11.08.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1126

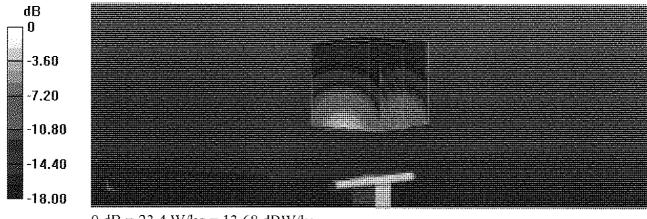
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.01$ S/m; $\epsilon_r = 37.3$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 117.4 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 28.1 W/kg **SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.38 W/kg** Smallest distance from peaks to all points 3 dB below = 9 mm Ratio of SAR at M2 to SAR at M1 = 50.8% Maximum value of SAR (measured) = 23.4 W/kg



0 dB = 23.4 W/kg = 13.68 dBW/kg

Impedance Measurement Plot for Head TSL

| File | <u>V</u> iew | <u>C</u> hannel | Sw <u>e</u> ep | Calibration | Irace | <u>S</u> cale | Marker | S <u>y</u> stem | . <u>W</u> indow | Help | ىلىدۇرىيىلىرىنىدۇرىيارىيارىيارىيارىيارىيارىيارىيارىيارىيا | | an a |
|--------------|--------------|------------------------------|----------------|--|----------|---------------|-----------|---|---|---|---|--------|--|
| | | | | | | | | | | 2.600000 8.003 2.600000 | 4 pF | -7 | <u>9</u> 116 Ω 6484 Ω 450 mU 32.183 ° |
| | | Ch 1 Awg = nt 2.40000 (| | iec , , , , , , , , , , , , , , , , , , , | | nintalatutmin | | | alanatan ing sa | | entente construction de | Stop (| 2.80000 GHz |
| 10.0 5.0 | | | | | | | | > | 1 | 2.800080 | GHz | -21 | . 220 dB |
| 0.0 0 | 1 | ta deretariante en ancienna. | | | | | | | | | | | |
| -5.0 -10 | | | | | | | | | | | | | |
| - 15. | 5 | | | | | ····· | -Internet | | | | | | |
| -20. | | | | | | | | | | | | | · |
| -25. -30. | | | 1 | | | | | | - | | | · | |
| 35. | 1 | | | | | | | | | | | | |
| 40 | 00 | Ch 1 Avg = ift 2.40000 (| 20 | | | | | 1 | | | | | |
| encentration | UII. 263 | ni 2.40000 (| LiHz | | | | | and a constant of the second secon | | nan an | | Stop 1 | 2.80000 GHz |
| Sta | itus | CH 1: { | 3 11 | | C* 1 Por | t | | Avg=20 | Delay | | | | LCL |

DASY5 Validation Report for Body TSL

Date: 18.08.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1126

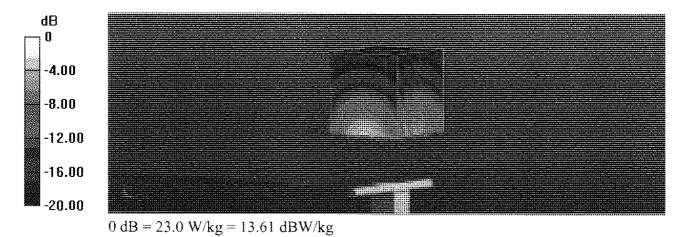
Communication System: UID 0 - CW; Frequency: 2600 MHz Medium parameters used: f = 2600 MHz; $\sigma = 2.22$ S/m; $\epsilon_r = 50.7$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.91, 7.91, 7.91) @ 2600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 109.5 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 27.3 W/kg **SAR(1 g) = 14.0 W/kg; SAR(10 g) = 6.24 W/kg** Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 51.6% Maximum value of SAR (measured) = 23.0 W/kg



Impedance Measurement Plot for Body TSL

| File | <u>V</u> iew | <u>C</u> hannel | Sw <u>e</u> ep | Calibration | Trace | <u>5</u> cale | M <u>a</u> rker | 5 <u>y</u> stem | <u>W</u> indow | Help | | | | ******* |
|-------------|-----------------|--|-----------------------|-------------|----------|---------------|--|-----------------|----------------|-------|----------------------------|------|------|--|
| | Ch1: St | Ch 1 Avig ≈ sit 2.40000 i | 20 GHz | | | | | | | | 0000 (10.379 0000 (| 5 pF | | 5.211 Ω .8999 Ω 659 mU 125.52 ° |
| | ansiasi An I | UR STI | inizio anno 1910 T | | | | | | 1. | | | | | |
| 5.0 |)0 - | | + | | | | | م . | | 2.00 | 00000 | 1712 | -2 | .975 dB |
| 0.(_5.) | | | | | | | | | | | | | | |
| | | * 1. 7 M (1997) - 1. 1 M (1997 | | | | | | | | | | | | |
| -15 | .00 | | - | | | | | | | | | | | |
| | .00 🖌 | | | | | | | | | | | | | |
| | .00 | 11 \$/#1/#1/#1/#1/#1/#1/#1/#1/#1 | *** | | | | ومادواهم است المسترات المسترا مسادو السناه | | | | ~~~~ | | | |
| -30 -35 | 00 | | | | | | ***** | | 1 | | | | | |
| 111 | 00 | Ch1Avg= | 20 | | | | | | | | | | | |
| | Ch1:St | art 2.40000 | GHz | | | | | | | ***** | | - | Stop | 2.80000 GHz |
| St | atus | CH 1: | 511 | | C* 1-Por | t | | Avg=20 | Delay | | | | | LCL |

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Accreditation No.: SCS 0108

Cli

C

| Client Element | | | Certificate No: D5G | HzV2-1120_Feb23 |
|--|-----------------------------------|-----------------------------------|------------------------|--------------------------|
| CALIBRATION C | ERTIFICATE | | | |
| Object | D5GHzV2 - SN:1 | 120 | | |
| Calibration procedure(s) | QA CAL-22.v7 Calibration Proce | dure for SAR Validatio | n Sources betwe | een 3-10 GHz |
| Calibration date: | February 15, 202 | 3 | | 무자 기술책임자 |
| This calibration certificate documer The measurements and the uncerta | ainties with confidence pr | obability are given on the follow | wing pages and are pa | rt of the certificate. |
| All calibrations have been conducte Calibration Equipment used (M&TE | | y facility: environment tempera | ture (22 ± 3)°C and hu | miany < 70%. |
| Primary Standards | ID # | Cal Date (Certificate No.) | S | Scheduled Calibration |
| Power meter NRP | SN: 104778 | 04-Apr-22 (No. 217-03525/0 | 3524) | Apr-23 |
| Power sensor NRP-Z91 | SN: 103244 | 04-Apr-22 (No. 217-03524) | ŀ | Apr-23 |
| Power sensor NRP-Z91 | SN: 103245 | 04-Apr-22 (No. 217-03525) | / | Apr-23 |
| Reference 20 dB Attenuator | SN: BH9394 (20k) | 04-Apr-22 (No. 217-03527) | / | Apr-23 |
| Type-N mismatch combination | SN: 310982 / 06327 | 04-Apr-22 (No. 217-03528) | / | Apr-23 |
| Reference Probe EX3DV4 | SN: 3503 | 08-Mar-22 (No. EX3-3503_1 | Mar22) I | Mar-23 |
| DAE4 | SN: 601 | 19-Dec-22 (No. DAE4-601_ | Dec22) I | Dec-23 |
| Secondary Standards | ID# | Check Date (in house) | | Scheduled Check |
| Power meter E4419B | SN: GB39512475 | 30-Oct-14 (in house check (| | In house check: Oct-24 |
| Power sensor HP 8481A | SN: US37292783 | 07-Oct-15 (in house check (| , | In house check: Oct-24 |
| Power sensor HP 8481A | SN: MY41093315 | 07-Oct-15 (in house check (| , | In house check: Oct-24 |
| | SN: 100972 | 15-Jun-15 (in house check | , | In house check: Oct-24 |
| RF generator R&S SMT-06 Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check | | In house check: Oct-24 |
| | · | | | |
| | Name | Function | | Signature |
| Calibrated by: | Paulo Pina | Laboratory Tec | hnician A | the second |
| Approved by: | Sven Kühn | Technical Man | ager | S. ~ |
| This calibration certificate shall no | t be reproduced except ir | n full without written approval o | | ssued: February 15, 2023 |

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Accreditation No.: SCS 0108

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

Glossarv:

| 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%.

Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|--|----------------------------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V5.0 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy = 4.0 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency | 5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz | |

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.9 | 4.71 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.5 ± 6 % | 4.70 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5250 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.13 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 81.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.33 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 23.2 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.5 | 5.07 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.4 ± 6 % | 5.07 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5600 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|---------------------------------|--------------------------|
| SAR measured | 100 mW input power | 8.34 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 83.4 W/kg ± 19.9 % (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 100 mW input power | 2.37 W/kg |

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.4 | 5.22 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.2 ± 6 % | 5.18 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5750 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.94 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 79.3 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.25 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 22.5 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.3 | 5.27 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.0 ± 6 % | 5.22 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5800 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|---------------------------------|--------------------------|
| SAR measured | 100 mW input power | 8.08 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 80.6 W/kg ± 19.9 % (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 100 mW input power | 2.27 W/kg |

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.9 | 5.36 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 49.0 ± 6 % | 5.51 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5250 MHz

SAR for nominal Body TSL parameters

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.49 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 75.0 W/kg ± 19.9 % (k=2) |
| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
| SAR measured | 100 mW input power | 2.10 W/kg |

normalized to 1W

21.1 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.5 | 5.77 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.6 ± 6 % | 6.00 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5600 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|------------------------------|--------------------------|
| SAR measured | 100 mW input power | 7.64 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 76.6 W/kg ± 19.9 % (k=2) |
| | | |
| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
| SAR averaged over 10 cm ³ (10 g) of Body TSL SAR measured | condition 100 mW input power | 2.14 W/kg |

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.3 | 5.94 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.3 ± 6 % | 6.18 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5750 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.50 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 75.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.09 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.9 W/kg ± 19.5 % (k=2) |

Body TSL parameters at 5800 MHz The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.2 | 6.00 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.2 ± 6 % | 6.24 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5800 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.41 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 74.3 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.06 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.6 W/kg ± 19.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

| Impedance, transformed to feed point | 52.4 Ω - 1.9 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 30.6 dB |

Antenna Parameters with Head TSL at 5600 MHz

| Impedance, transformed to feed point | 57.9 Ω + 0.2 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22.7 dB |

Antenna Parameters with Head TSL at 5750 MHz

| Impedance, transformed to feed point | 54.6 Ω + 5.6 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 23.2 dB |

Antenna Parameters with Head TSL at 5800 MHz

| Impedance, transformed to feed point | 51.5 Ω + 3.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 28.8 dB |

Antenna Parameters with Body TSL at 5250 MHz

| Impedance, transformed to feed point | 51.1 Ω + 0.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 39.2 dB |

Antenna Parameters with Body TSL at 5600 MHz

| Impedance, transformed to feed point | 58.4 Ω + 0.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22.2 dB |

Antenna Parameters with Body TSL at 5750 MHz

| Impedance, transformed to feed point | 55.2 Ω + 5.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 23.1 dB |

Antenna Parameters with Body TSL at 5800 MHz

| Impedance, transformed to feed point | 52.6 Ω + 3.9 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.9 dB |

General Antenna Parameters and Design

| Electrical Delay (one direction) | 1 000 | |
|----------------------------------|-----------|--|
| | 1.206 ns | |
| | 1.200 110 | |
| | | |

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

| Monufactured by | |
|-----------------|-------|
| Manufactured by | SPEAC |
| | SPEAG |
| | |

DASY5 Validation Report for Head TSL

Date: 14.02.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1120

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5250 MHz; $\sigma = 4.7$ S/m; $\epsilon_r = 35.5$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 5.07$ S/m; $\epsilon_r = 35.4$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5750 MHz; $\sigma = 5.18$ S/m; $\epsilon_r = 35.2$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.22$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.22$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.22$ S/m; $\epsilon_r = 35$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 77.01 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 27.7 W/kg SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.33 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 70.3% Maximum value of SAR (measured) = 18.3 W/kg

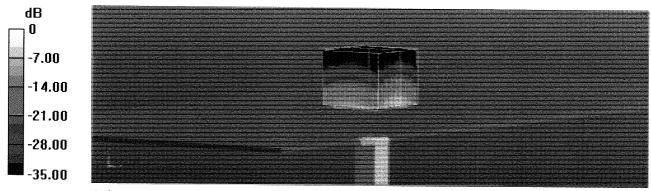
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 75.13 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 30.8 W/kg SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.37 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 67.7% Maximum value of SAR (measured) = 19.6 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 73.12 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 30.8 W/kg SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.25 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 65.9% Maximum value of SAR (measured) = 19.0 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 73.52 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 31.8 W/kg SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.27 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.8% Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.6 W/kg = 12.92 dBW/kg

| jle | ⊻iew | ⊆hannel | Sweep | Calibration | Irace | <u>S</u> cale | M <u>a</u> rker | System | <u>W</u> indow | Help | | |
|---|---|--------------------------------------|-------|-------------|-------|----------------|--|---------------|----------------|------------------|---|---------------------------------------|
| | | | | | | | and a second | | · | 1: | 5.250000 GHz | 52.356 G |
| | | | | | | \sim | Same and the second sec | | X | 2: | 16.245 pF 5.600000 GHz | -1.8661 Ω 57.931 Ω |
| | | | | | , | | ×, / | 1 | 124 | | 6.5754pH | 231.36 m Ω |
| | | | | | F | ~ | \sim | X | the for | ×3; | 5.750000 GHz 154.72 pH | 54.604 Ω 5.5897 Ω |
| | | | | | | $\int $ | ~f | | NA. | 4: | 5.800000 GHz | 51,546 0 |
| | | | | | ŀ | | | | | R: | 92.066 pH 5.500000 GHz | 3.3551 Ω 31.532 mU |
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| | | | | | K | $\sum \langle$ | X | \rightarrow | \square | | | |
| | | | | | | \mathbf{N} | XÈ | ~~~ | 1 | | | |
| | | ~ | * • | | | \sim |) | f | | | | |
| | | Ch 1 Avg = | 20 | | | | · · · · · · · · · · · · · · · · · · · | | | | | |
| C | | | | N929 | | | ······ | | | | | |
| | Ch1: Sta | irt 5,00000 i | | | | | | 4 | | | Stop | 6.00000 GHz |
| 10.0 | 0 👔 | | | | | | | | | 1 | 5. 2 50000 GHa | -30.645.d6 |
| 10.0 5.00 | 0 | irt 5,00000 i | | | | | | | | | 5.250000 GHa | -30.645.d6 22.673.dB |
| 10.0 5.00 0.00 | 0 0 | irt 5,00000 i | | | | | | | | | 5. 2 50000 GHa | -30.645.dB 22.673.dB -23.207.dB |
| 10.0 5.00 0.00 | 0 0 | irt 5,00000 i | | | | | | | | <u>2</u> ≥3: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | -30.645.dB 22.673.dB -23.207.dB |
| 10.0 5.00 0.00 5.00 | Ch1: Sta | irt 5,00000 i | | | | | | | | <u>2</u> ≥3: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | -30.645.dB 22.673.dB -23.207.dB |
| 10.0 5.00 0.00 5.00 -10.0 | Ch 1: Sta | irt 5,00000 i | | | | | | | | <u>2</u> ≥3: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | -30.645.dB 22.673.dB -23.207.dB |
| 10.0 5.00 0.00 5.00 -10.0 | Ch 1: Sta | irt 5,00000 i | | | | | | | | 2: > 3: 4: | 5.250000 GHz 5.40000 GHz 5.350000 GHz 5.400000 GHz | -30.645.dB 22.673.dB -23.207.dB |
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| 10.0 5.00 5.00 5.00 10.0 20.0 20.0 25.0 30.0 | Ch1:Sta 0 1 1 1 1 1 10 10 10 | irt 5,00000 i | | | | | | | | 2: > 3: 4: | 5.250000 GHz 5.40000 GHz 5.350000 GHz 5.400000 GHz | -30.645.dB 22.673.dB -23.207.dB |
| 10.0 5.00 5.00 5.00 10.0 15.0 25.0 30.0 35.0 40.0 | Ch1:Sta | rt 5.00000 i IB S11 Ch 1 Avg = | 20 | | | | | | | 2: > 3: 4: | 5.250000 GHz 5.40000 GHz 5.350000 GHz 5.400000 GHz | -30.645.dB 22.673.dB -23.207.dB |
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DASY5 Validation Report for Body TSL

Date: 15.02.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1205

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5250 MHz; $\sigma = 5.51$ S/m; $\epsilon_r = 49$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 6$ S/m; $\epsilon_r = 48.6$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5750 MHz; $\sigma = 6.18$ S/m; $\epsilon_r = 48.3$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.24$ S/m; $\epsilon_r = 48.2$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.24$ S/m; $\epsilon_r = 48.2$; $\rho = 1000$ kg/m³ Medium parameters Used: f = 5800 MHz; $\sigma = 6.24$ S/m; $\epsilon_r = 48.2$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.79, 4.79, 4.79) @ 5600 MHz, ConvF(4.66, 4.66, 4.66) @ 5750 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.62 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 27.3 W/kg SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.10 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 68.5% Maximum value of SAR (measured) = 17.2 W/kg

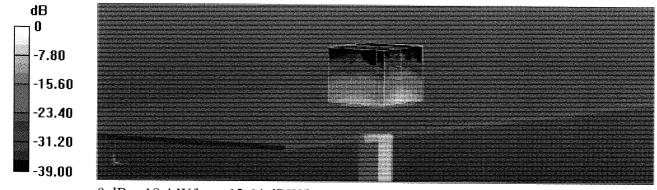
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.27 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 31.0 W/kg SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.14 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65% Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mmReference Value = 62.34 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 31.9 W/kg SAR(1 g) = 7.50 W/kg; SAR(10 g) = 2.09 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 63.5% Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mmReference Value = 62.34 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 30.6 W/kg SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.06 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 64.4% Maximum value of SAR (measured) = 18.1 W/kg



0 dB = 18.4 W/kg = 12.64 dBW/kg

Impedance Measurement Plot for Body TSL

| <u>-</u> ile | View | Channel | Sw <u>e</u> ep | Calibration | Trace | <u>S</u> cale | M <u>a</u> rker | System | <u>W</u> indow | Help | | |
|---|---|------------------------|----------------|-------------|-------|-------------------|-----------------|---------------|----------------|----------------------|---|-------------------------------------|
| | | | | | | | | | ··· | 1 | 5.250000 GHz | 51.070 Ω |
| | | | | | | $ \land$ | | | Z | 2: | 8.9434 pH 5.600000 GHz | 295.01 m Ω 58.384 Ω |
| | | | | |) | Γ, | $^{\sim}$ | 1 | 1 | × 31 | 11.072 pH 5.750000 GHz | 389.57 mΩ 55.171 Ω |
| | | | | | 1 | | $\sim \land$ | $\sqrt{\sim}$ | $-\lambda$ | | 145.48 p.H | 5.2559 Q |
| | | | | | | { | 1 | 給論 | | 4: | 5.800000 GHz 105.86 pH | 52.602 Ω 3.8577 Ω |
| | | | | | | | | R T | Z CA | R: | 5.500000 GHz | 16.224mU -79.261 * |
| | | | | | F | | | -K_^^ | <i>{−−</i> ∕¶ | | | -13.261 |
| | | | | |) | $\langle \rangle$ | \checkmark | | | | | |
| | | | | | | \sim | | \int | F/ | | | |
| | | Ch 1 Avg = | | | | | · | | | | | |
| 1 | | | | | | | | | | | | |
| | Ch1: St | art 5.00000 | | | | | | | | | Stop | 6.00000 GHz |
| 10. | 00 [| | | | | | | | | 1.122-1121-1221-1221 | 5. 1 50000 GHz | -39.184.dB |
| , 10. 5.0 | 00 [| art 5.00000 (| | | | | | | | 1: 2: 3; | | |
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| 10. 5.C 0.C | 00 10 10 10 | art 5.00000 (| | | | | | | | 3: | 5.250000 GHz 5.00000 GHz 5.250000 GHz | -39.184dB -22.22148 -23.096d8 |
| 10. 5.0 -5.0 -10 | 00 00 00 00 00 00 00 00 00 00 00 00 00 | art 5.00000 (| | | | | | | | 3: | 5.250000 GHz 5.00000 GHz 5.250000 GHz | -39.184dB -22.22148 -23.096d8 |
| 10. 5.0 0.0 -5.0 -10 -15 | 00 00 00 00 00 00 | art 5.00000 (| | | | | | | | 3: | 5.250000 GHz 5.00000 GHz 5.250000 GHz | -39.184dB -22.22148 -23.096d8 |
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| 10. 5.0 -5.0 -10 -15 -20 | 00 - 00 - 00 - 00 - 00 - 00 - 00 - 00 | art 5.00000 (| | | | | | | | 2 3; > 4: | 5.250000 GHz 5.200000 GHz 5.250000 GHz 5.200000 GHz | -39.184dB -22.22148 -23.096d8 |
| 10. 5.C -5.C -10 -15 -20 -25 -30 | 00 10 10 00 00 00 00 00 | art 5.00000 (| | | | | | | | 2 3; > 4: | 5.\$50000 GHz 5.00000 GHz 5.\$50000 GHz 5.\$00000 GHz | -39.184dB -22.22148 -23.096d8 |
| 10. 5.0 -5.0 -10 -15 -20 -25 -30 -35 | 00 - 00 - 00 - 00 - 00 - 00 - 00 - 00 | art 5.00000 (| ŝHz | | | | | | | 2 3; > 4: | 5.\$50000 GHz 5.00000 GHz 5.\$50000 GHz 5.\$00000 GHz | -39.184dB -22.22148 -23.096d8 |
| 10. 5.0 -5.0 -10 -15 -20 -25 -30 -35 -40 | 000 10 10 00 00 00 00 00 00 | art 5.00000 dB \$11 | ŝHz | | | | | | | 2 3; > 4: | 5.\$50000 GHz 5.00000 GHz 5.750000 GHz 5.\$00000 GHz 3. | -39.184dB -22.22148 -23.096d8 |

Calibration Laboratory of

BLANEN

Client

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





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- 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. D5GH2V2-1237 Apr23 Yongin, Republic of Korea CALIBRATION CERTIFICATE Object D5GHzV2 - SN:1237 0a cal-92 v7 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 3-10 GHz Calibration date: Anri 17 2023 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 NRP2 SN: 104778 30-Mar-23 (No. 217-03804/03805) Mar-24 Power sensor NRP-Z91 SN: 103244 30-Mar-23 (No. 217-03804) Mar-24 Power sensor NRP-Z91 SN: 103245 30-Mar-23 (No. 217-03805) Mar-24 Reference 20 dB Attenuator SN: BH9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 Type-N mismatch combination SN: 310982 / 06327 30-Mar-23 (No. 217-03810) Mar-24 Reference Probe EX3DV4 SN: 3503 07-Mar-23 (No. EX3-3503 Mar23) Mar-24 DAE4 SN: 601 19-Dec-22 (No. DAE4-601 Dec22) Dec-23 Secondary Standards ID # Check Date (in house) Scheduled Check Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Oct-22) In house check: Oct-24 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct-24 Power sensor HP 8481A SN: MY41093315 07-Oct-15 (in house check Oct-22) In house check: Oct-24 RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct-24 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct-24 Name Function Signature Calibrated by: Jeffrey Katzman Laboratory Technician Approved by: Sven Kühn **Technical Manager** Issued: April 18, 2023 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of

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





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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

| DASY Version | DASY52 | V52.10.4 |
|------------------------------|--|----------------------------------|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V5.0 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency | 5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz | |

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.9 | 4.71 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.5 ± 6 % | 4.63 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5250 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.03 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 80.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.30 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 22.9 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.5 | 5.07 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.3±6% | 4.99 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5600 MHz

| ····· | - Jac |
|-------------------|--------------------------|
| 00 mW input power | 8.49 W/kg |
| normalized to 1W | 84.7 W/kg ± 19.9 % (k=2) |
| 1 | |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.1 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.4 | 5.22 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.1 ± 6 % | 5.11 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5750 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 8.14 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 81.2 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.30 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 22.9 W/kg ± 19.5 % (k=2) |

Head TSL parameters at 5800 MHz The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 35.3 | 5.27 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 35.0 ± 6 % | 5.14 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | | |

SAR result with Head TSL at 5800 MHz

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|------------------------------|--------------------------|
| SAR measured | 100 mW input power | 8.08 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 80.6 W/kg ± 19.9 % (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 100 mW input power | 2.28 W/kg |

| SAR measured | 100 mW input power | 2.28 W/kg |
|-------------------------------------|--------------------|--------------------------|
| SAR for nominal Head TSL parameters | normalized to 1W | 22.8 W/kg ± 19.5 % (k=2) |
| | | |

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.9 | 5.36 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.9 ± 6 % | 5.49 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5250 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | (7.38 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 73.9 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.06 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.6 W/kg ± 19.5 % (k=2) |

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|---|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.5 | 5.77 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.5 ± 6 % | 5.96 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | na na sana ang tang tang tang tang tang tang ta | |

SAR result with Body TSL at 5600 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | (7.81/W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 78.2 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm^3 (10 g) of Body TSL | condition | |
|--|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.18 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 21.9 W/kg ± 19.5 % (k=2) |

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.3 | 5.94 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.3 ± 6 % | 6.14 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5750 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.47 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 74.8 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.07 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.7 W/kg ± 19.5 % (k=2) |

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 48.2 | 6.00 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 48.1 ± 6 % | 6.20 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | | |

SAR result with Body TSL at 5800 MHz

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 7.30 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 73.1 W/kg ± 19.9 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 100 mW input power | 2.02 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.2 W/kg ± 19.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

| Impedance, transformed to feed point | 48.4 Ω - 4.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.6 dB |

Antenna Parameters with Head TSL at 5600 MHz

| Impedance, transformed to feed point | 52.3 Ω + 0.0 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 33.0 dB |

Antenna Parameters with Head TSL at 5750 MHz

| Impedance, transformed to feed point | 55.0 Ω + 3.1 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 25.0 dB |

Antenna Parameters with Head TSL at 5800 MHz

| Impedance, transformed to feed point | 53.6 Ω + 3.6 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.2 dB |

Antenna Parameters with Body TSL at 5250 MHz

| Impedance, transformed to feed point | 46.7 Ω - 2.9 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 26.9 dB |

Antenna Parameters with Body TSL at 5600 MHz

| Impedance, transformed to feed point | 53.3 Ω + 3.2 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 27.1 dB |

Antenna Parameters with Body TSL at 5750 MHz

| Impedance, transformed to feed point | 55.1 Ω + 4.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 23.9 dB |

Antenna Parameters with Body TSL at 5800 MHz

| Impedance, transformed to feed point | 54.0 Ω + 4.3 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 24.9 dB |

General Antenna Parameters and Design

| - 1 | | | |
|-----|----------------------------------|----------|--|
| | Electrical Delay (one direction) | 1.192 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 |
|-----------------|-------|
| | |

DASY5 Validation Report for Head TSL

Date: 17.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5250 MHz; $\sigma = 4.63$ S/m; $\varepsilon_r = 35.5$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 4.99$ S/m; $\varepsilon_r = 35.3$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5750 MHz; $\sigma = 5.11$ S/m; $\varepsilon_r = 35.1$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 35.7$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 35.7$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.14$ S/m; $\varepsilon_r = 35.7$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.54 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 27.0 W/kg SAR(1 g) = 8.03 W/kg; SAR(10 g) = 2.30 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 71.3% Maximum value of SAR (measured) = 18.3 W/kg

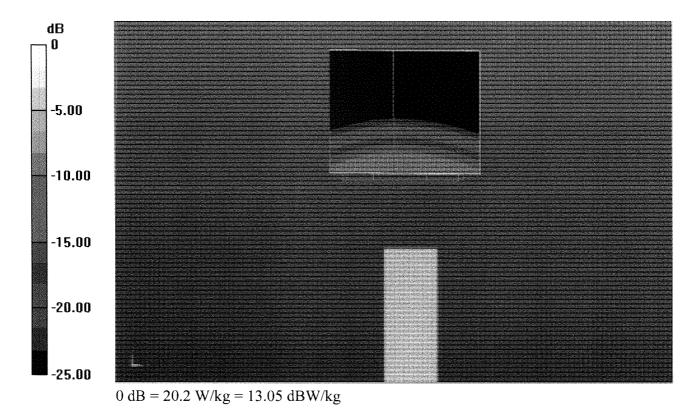
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 74.39 V/m; Power Drift = 0.08 dB Peak SAR (extrapolated) = 31.0 W/kg SAR(1 g) = 8.49 W/kg; SAR(10 g) = 2.41 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 68.4% Maximum value of SAR (measured) = 20.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.59 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 31.3 W/kg SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.30 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 66.8% Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.10 V/m; Power Drift = 0.05 dB Peak SAR (extrapolated) = 31.2 W/kg SAR(1 g) = 8.08/W/kg; SAR(10 g) = 2.28 W/kg Smallest distance from peaks to all points 3 dB below = 7.5 mm Ratio of SAR at M2 to SAR at M1 = 66.4% Maximum value of SAR (measured) = 19.5 W/kg



Impedance Measurement Plot for Head TSL

| <u>V</u> iew <u>C</u> hannel Sw <u>e</u> ep | Calibration | <u>Trace S</u> cale | e Marker | System | <u>W</u> indow | Help | | |
|--|-------------|---------------------|-----------------------|---------------------|----------------|------|--|------------------------------------|
| | | A | | | 7 | 1: | 5.250000 GHa 7.0330 pF | 48.371 |
| | | | $\mathbf{\mathbf{x}}$ | $\langle i \rangle$ | | 2: | 5.600000 GHz 1.3092 pH | <u>52,284</u> A £.066 m |
| | | - | \sim | χ t | -W | 31 | 5.750000 GHz | 55.013 |
| | | 17 | | \sim | 1A | > 4 | 84.775 pH 5.800000 GHz | 0.0628 53.580 |
| | | | | |) | F: | 99.710 pH 5.500000 GHz | 3.6337 21.139 n |
| | | | | KK | A | | | 175.6 |
| | | the l | \bigvee | /~-{ | | | | |
| | | | \land | × | Ę/ | | | |
| Ch1Avg= 20 | | * | | | , " | | | |
| | | | | | | | Cham | 6.00000 G |
| Ch1: Start 5.00000 GHz | | | | | | | stop | |
| 00 38 511 | | | | | | 1: | 5. ‡ 50000 GHz | |
| 00 dB S11 00 | | | | | | 2: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | 26,596 ((33,019 (-25,049 (|
| 00 38 511 | | | | | | | 5.250000 GH2 5.400000 GH2 | 25.596 (|
| 00 dB \$11 00 | | | | | | 2: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | 26,596 ((33,019 (-25,049 (|
| 00 dB \$11 00 | | | | | | 2: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | 26,596 ((33,019 (-25,049 (|
| 00 dB \$11 00 | | | | | | 2: | 5.250000 GHz 5.00000 GHz 5.750000 GHz | 26,596 ((33,019 (-25,049 (|
| 00 dB \$11 00 | | | | | | 2: | 5.250000 GH2 5.400000 GH2 5.50000 GH2 5.400000 GH2 | 26,596 ((33,019 (-25,049 (|
| | | | | | | 2: | 5.250000 GH2 5.400000 GH2 5.50000 GH2 5.400000 GH2 | 26,596 ((33,019 (-25,049 (|
| 00 dB \$11 00 00 00 00 00 00 00 00 00 0 00 0 0 | | | | | | 2: | 5.250000 GH2 5.400000 GH2 5.50000 GH2 5.400000 GH2 | 26.596 ((23.019) -25.049 (|
| 00 db \$11 00 00 00 00 00 00 00 00 | | | | | | 2: | 5.\$50000 GHz 5.00000 GHz 5.50000 GHz 5.\$00000 GHz | 26,596 ((33,019 (-25,049 (|

DASY5 Validation Report for Body TSL

Date: 12.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1237

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz, Frequency: 5800 MHz Medium parameters used: f = 5250 MHz; $\sigma = 5.49$ S/m; $\epsilon_r = 48.9$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 5.96$ S/m; $\epsilon_r = 48.5$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5750 MHz; $\sigma = 6.14$ S/m; $\epsilon_r = 48.3$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.2$ S/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 6.2$ S/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³

DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.26, 5.26, 5.26) @ 5250 MHz, ConvF(4.79, 4.79, 4.79) @ 5600 MHz, ConvF(4.66, 4.66, 4.66) @ 5750 MHz, ConvF(4.62, 4.62, 4.62) @ 5800 MHz; Calibrated: 07.03.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

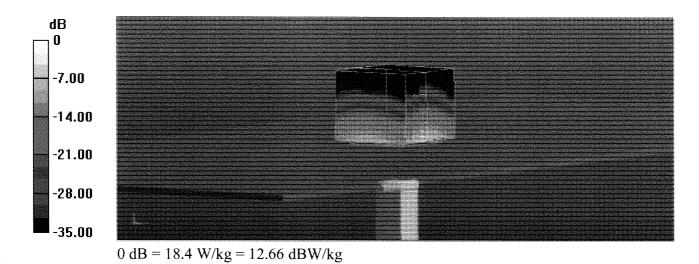
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 66.84 V/m; Power Drift = -0.05 dBPeak SAR (extrapolated) = 27.3 W/kg SAR(1 g) = 7.38 W/kg; SAR(10 g) = 2.06 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 68.7% Maximum value of SAR (measured) = 16.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

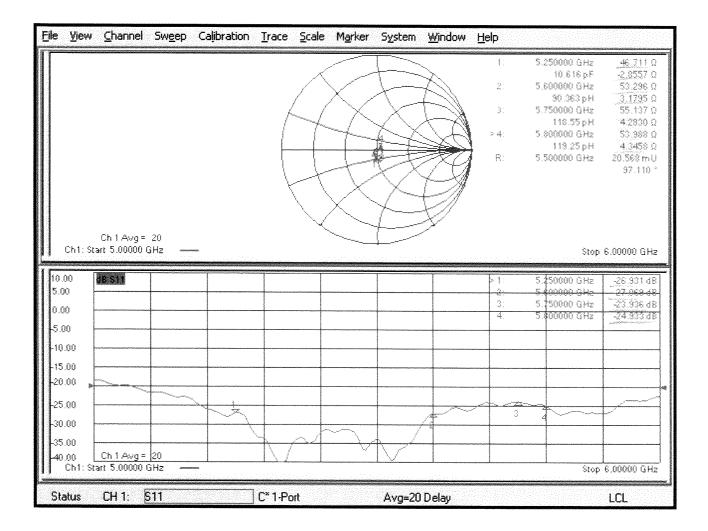
dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.99 V/m; Power Drift = -0.04 dBPeak SAR (extrapolated) = 31.6 W/kg SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.18 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.5% Maximum value of SAR (measured) = 18.4 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 64.85 V/m; Power Drift = -0.05 dB Peak SAR (extrapolated) = 31.7 W/kg SAR(1 g) = (7.47 W/kg; SAR(10 g) = 2.07 W/kgSmallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 64.1% Maximum value of SAR (measured) = 18.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.97 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 30.3 W/kg SAR(1 g) = (7.30 W/kg; SAR(10 g) = 2.02 W/kgSmallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 17.5 W/kg



Impedance Measurement Plot for Body TSL



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 Multilateral Agreement for the recognition of calibration certificates **Swiss Calibration Service**

Schweizerischer Kalibrierdienst

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Accreditation No.: SCS 0108

Certificate No: D1900V2-5d148_Feb22

Element Client

| CALIBRATION CERTIFICATE | | | | | | |
|---|--|--|---------------------------------|--|--|--|
| Object | D1900V2 - SN:50 | 1148 | | | | |
| | | | an | | | |
| Calibration procedure(s) | QA CAL-05.v11 O2-2.8-22 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | | | | |
| | | | BN 02-10-2023 | | | |
| Calibration date: | February 21, 202 | 2 | | | | |
| The measurements and the uncerta | ainties with confidence pr ad in the closed laborator | conal standards, which realize the physical un robability are given on the following pages ar y facility: environment temperature (22 \pm 3)°C | nd are part of the certificate. | | | |
| 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 Apr-22 | | | |
| Type-N mismatch combination | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344) | Apr-22 | | | |
| Reference Probe EX3DV4 | SN: 7349 | 31-Dec-21 (No. EX3-7349_Dec21) | Dec-22 | | | |
| DAE4 | SN: 601 | 01-Nov-21 (No. DAE4-601_Nov21) | Nov-22 | | | |
| 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: MY41093315 | 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-22 | | | |
| | Name | Function | Signature | | | |
| Calibrated by: | Aldonia Georgiadou | Laboratory Technician | them | | | |
| | | | XXX | | | |
| Approved by: | Niels Kuster | Quality Manager | VASS | | | |
| This calibration contificate about and | he reproduced every the | | Issued: February 24, 2022 | | | |
| anis calibration certificate stidii 110[1 | ne rehindrined except lu | full without written approval of the laboratory | • | | | |

Calibration Laboratory of

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





Schweizerischer Kalibrierdienst

- S Service suisse d'étalonnage С
 - Servizio svizzero di taratura
- S Swiss Calibration Service

Accreditation No.: SCS 0108

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

Glossary:

| TSL | 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 6 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 8 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. 0
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

| DASY Version | 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 | 39.6 ± 6 % | 1.41 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 | 10.1 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 | | | |
| CAD measured | 250 mW input power | 5.26 W/kg | | |
| SAR measured | | 5.20 W/Ky | | |

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 | 53.0 ± 6 % | 1.50 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 | 9.90 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 39.9 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 5.19 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 20.9 W/kg ± 16.5 % (k=2) |

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.9 Ω + 6.5 jΩ |
|--------------------------------------|-----------------|
| Return Loss | - 22.8 dB |

Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 49.0 Ω + 8.0 jΩ | | | |
|--------------------------------------|-----------------|--|--|--|
| Return Loss | - 21.8 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 |
|-----------------|-------|

DASY5 Validation Report for Head TSL

Date: 21.02.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

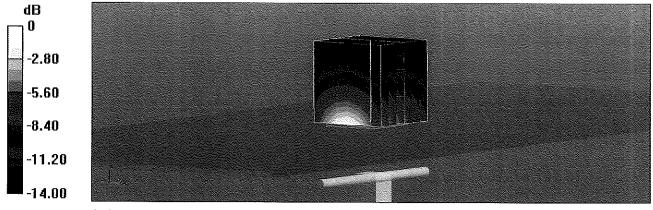
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.41 S/m; ϵ_r = 39.6; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 110.0 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 18.6 W/kg SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.26 W/kg Smallest distance from peaks to all points 3 dB below = 9.8 mm Ratio of SAR at M2 to SAR at M1 = 54.6% Maximum value of SAR (measured) = 15.5 W/kg



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

Impedance Measurement Plot for Head TSL

| Eile | ⊻iew | ⊆hannel | Sw <u>e</u> ep | Calibration | <u>Trace</u> <u>S</u> cale | M <u>a</u> rker | System | Window | Help | |
|--------------------------|--|-----------------------------|----------------|-------------|----------------------------|-----------------|----------|---|---|---|
| | | | | | A | | | X. | 1.900000 GHz 544.00 pH 1.900000 GHz | 53.874 Ω 6.4943 Ω 72.658 mU 55.605 ° |
| | Ch1: St | Ch 1 Avg = art 1.70060 # | | *** | | | | der einer der der der der der der der der der d | | Stop 2.10000 GHz |
| -25 -30 -35 -40 | 10 10 .00 .00 .00 .00 .00 .00 Ch1: Sta | de sm | GHz | | | | | | 1.800000 GHz | -22.774 dB |
| Sta | atus | CH 1: [| S11 | | C* 1-Port | | Avg=20 D | lelay | | LCL |

DASY5 Validation Report for Body TSL

Date: 21.02.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d148

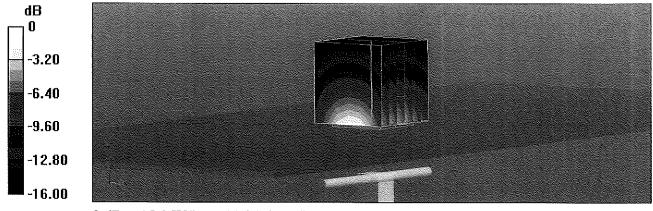
Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz; σ = 1.50 S/m; ϵ_r = 53.0; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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 = 105.3 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 18.4 W/kg SAR(1 g) = 9.90 W/kg; SAR(10 g) = 5.19 W/kg Smallest distance from peaks to all points 3 dB below = 9.5 mm Ratio of SAR at M2 to SAR at M1 = 55% Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.84 dBW/kg

Impedance Measurement Plot for Body TSL

| <u>Fi</u> le | View | Channel | Sw <u>e</u> ep | Calibration | <u>Trace</u> <u>S</u> cal | e M <u>a</u> rker | System <u>W</u> | /indow | Help | | |
|---|--|---------------------------|----------------|-------------|---------------------------|-------------------|-----------------|---------|---------------------------------------|------|---|
| | | | | | | XXXX | | No. A. | .900000 GH 670.08 pl .900000 GH | - . | 49.016 Ω 7.9994 Ω .134 mU 92.395 ° |
| | Ch1: Sta | Ch 1 Avg = art 1,70000 | | | <u></u> | | | <u></u> | <u></u> | Stop | 2.10000 GHz |
| 10.0 5.00 -5.00 -10.0 -15.0 -15.0 -20.0 -25.0 -30.0 -35.0 -40.0 | 0 - 0 9 - 0 00 - 0 | Ch 1 Avg = art 1.70000 | GHz | | | | > 1 | 1 | 900000 GH | | 2.10000 GHz |
| Stat | tus | CH 1: } | S11 | | C* 1-Port | | Avg=20 De | lay | | | LCL |



ELEMENT MATERIALS TECHNOLOGY

(formerly PCTEST) 7185 Oakland Mills Road, Columbia, MD 21046 USA Tel. +1.410.290.6652 / Fax +1.410.290.6654 http://www.element.com



Certification of Calibration

Object

D1900V2 – SN: 5d148

Calibration procedure(s) Procedure for Calibration Extension for SAR Dipoles.

Extension Calibration date: 02/02/2023

Description:

SAR Validation Dipole at 1900 MHz.

Calibration Equipment used:

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|-----------------------|------------------------------------|---|------------|--------------|------------|---------------|
| Agilent | N5182A MXG Vector Signal Generator | | | Annual | 11/30/2023 | MY47420603 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 343971 |
| Anritsu | MA2411B | Pulse Power Sensor | 3/28/2022 | Annual | 3/28/2023 | 1339007 |
| Anritsu | MA2411B | Pulse Power Sensor | 3/2/2022 | Annual | 3/2/2023 | 1126066 |
| Anritsu | ML2496A | Power Meter | 3/31/2022 | Annual | 3/31/2023 | 1138001 |
| Anritsu | ML2496A | Power Meter | 3/17/2022 | Annual | 3/17/2023 | 941001 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 3/12/2021 | Biennial | 3/12/2023 | 210202100 |
| Control Company | 4352 | Long Stem Thermometer | 9/10/2021 | Biennial | 9/10/2023 | 210774678 |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Pasternack | PE5011-1 | Torque Wrench | 12/21/2021 | Biennial | 12/21/2023 | 82475 |
| Mini-Circuits | ZHDC-16-63-S+ | Coupler | CBT | N/A | CBT | N/A |
| Rohde & Schwarz | ZNLE6 | Vector Network Analyzer | 10/21/2022 | Annual | 10/21/2023 | 101307 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 5/12/2022 | Annual | 5/12/2023 | 1070 |
| Keysight Technologies | 85033E | Standard Mechanical Calibration Kit (DC to 9GHz, 3.5mm) | 6/21/2022 | Annual | 6/21/2023 | MY53402352 |
| SPEAG | EX3DV4 | SAR Probe | 11/11/2022 | Annual | 11/11/2023 | 7551 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 11/10/2022 | Annual | 11/10/2023 | 1323 |

Measurement Uncertainty = $\pm 23\%$ (k=2)

| | Name | Function | Signature |
|----------------|-----------------|-----------------------------|-----------|
| Calibrated By: | Tho Tong | Test Engineer | The Tong |
| Approved By: | Kaitlin O'Keefe | Senior Technical Manager | ROK |

DIPOLE CALIBRATION EXTENSION

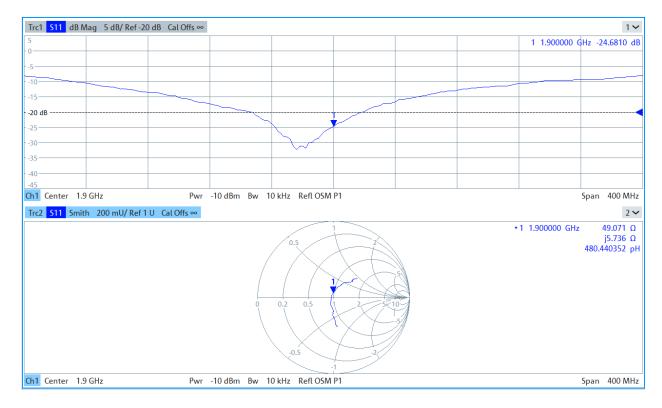
Per KDB 865664 D01, calibration intervals of up to three years may be considered for reference dipoles when it is demonstrated that the SAR target, impedance and return loss of a dipole have remained stable according to the following requirements:

- 1. The measured SAR does not deviate more than 10% from the target on the calibration certificate.
- 2. The return-loss does not deviate more than 20% from the previous measurement and meets the required 20dB minimum return-loss requirement.
- 3. The measurement of real or imaginary parts of impedance does not deviate more than 5Ω from the previous measurement.

The following dipole was checked to pass the above 3 requirements to have 2-year calibration period from the calibration date:

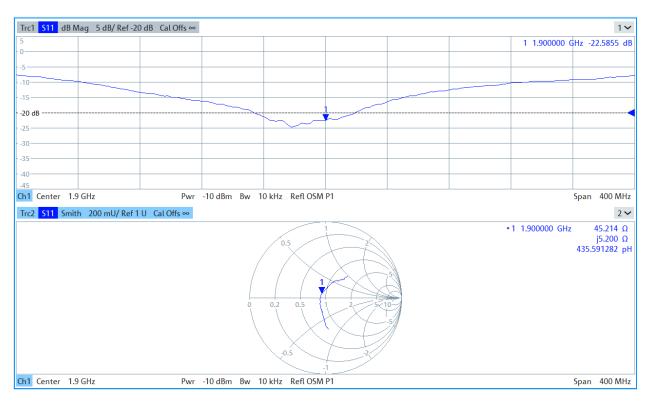
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Head (1g) W/kg @ 20.0 dBm | Measured Head SAR (1g) W/kg @ 20.0 dBm | | Certificate SAR Target Head (10g) W/kg @ 20.0 dBm | (10a) W/ka @ | Deviation 10g (%) | Certificate Impedance Head (Ohm) Real | Measured Impedance Head (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Head (Ohm) Imaginary | Measured Impedance Head (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Head (dB) | Measured Return Loss Head (dB) | Deviation (%) | |
|---------------------|----------------|---|--|---|--------|---|--------------|----------------------|--|---|--------------------------|---|--|----------------------------------|---|--------------------------------------|---------------|-----------|
| 2/21/2022 | 2/2/2023 | 1.198 | 4.01 | 3.95 | -1.50% | 2.1 | 2.06 | -1.90% | 53.9 | 49.1 | 4.8 | 6.5 | 5.7 | 0.8 | -22.8 | -24.7 | -8.30% | PASS |
| Calibration Date | Extension Date | Certificate Electrical Delay (ns) | Certificate SAR Target Body (1g) W/kg @ 20.0 dBm | Measured Body SAR (1g) W/kg @ 20.0 dBm | | | (10a) W/ka @ | Deviation 10g (%) | Certificate Impedance Body (Ohm) Real | Measured Impedance Body (Ohm) Real | Difference (Ohm) Real | Certificate Impedance Body (Ohm) Imaginary | Measured Impedance Body (Ohm) Imaginary | Difference (Ohm) Imaginary | Certificate Return Loss Body (dB) | Measured Return Loss Body (dB) | Deviation (%) | PASS/FAIL |
| 2/21/2022 | 2/2/2023 | 1.198 | 3.99 | 3.96 | -0.75% | 2.09 | 2.07 | -0.96% | 49 | 45.2 | 3.8 | 8 | 5.2 | 2.8 | -21.8 | -22.6 | -3.60% | PASS |

| Object: | Date Issued: | Page 2 of 4 |
|---------------------|--------------|--------------|
| D1900V2 – SN: 5d148 | 02/02/2023 | r age 2 01 4 |



Impedance & Return-Loss Measurement Plot for Head TSL

| Object: | Date Issued: | Page 3 of 4 | |
|---------------------|--------------|-------------|--|
| D1900V2 – SN: 5d148 | 02/02/2023 | Fage 3 01 4 | |



Impedance & Return-Loss Measurement Plot for Body TSL

| Object: | Date Issued: | Page 4 of 4 | |
|---------------------|--------------|-------------|--|
| D1900V2 – SN: 5d148 | 02/02/2023 | Faye 4 01 4 | |