

Appendix C

Phantom Description

s p e a g

Schmid & Partner Engineering AG
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 info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

| | | | |
|--------------|--|--|--|
| Item | SAM Twin Phantom V4.0 | | |
| Type No. | QD 000 P40 C | | |
| Series No. | TP-1150 and higher | | |
| Manufacturer | SPEAG Zeughausstrasse 43 CH-8004 Zurich Switzerland | | |

Tests
 The series production process used allows the limitation to test of first articles.
 Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

| Test | Requirement | Details | Units tested |
|-----------------------------|--|--|---|
| Dimensions | Compliant with the geometry according to the CAD model. | IT15 CAD File (*) | First article, Samples |
| Material thickness of shell | Compliant with the requirements according to the standards | 2mm +/- 0.2mm in flat and specific areas of head section | First article, Samples, TP-1314 ff. |
| Material thickness at ERP | Compliant with the requirements according to the standards | 8mm +/- 0.2mm at ERP | First article, A3 items |
| Material parameters | Dielectric parameters for required frequencies | 300 MHz – 6 GHz: Relative permittivity < 5, Loss tangent < 0.05 | Material samples |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility. | DEGMBE based simulating liquids | Pre-series, First article, Material samples |
| Sagging | Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid | < 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below | Prototypes, Sample testing |

Standards
 (1) CENELEC EN 50361
 (2) IEEE Std 1528-2003
 (3) IEC 62209 Part 1
 (4) FCC OET Bulletin 65, Supplement C, Edition 01-01
 (*) The IT15 CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

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

Date: 07.07.2005

Signature / Stamp: 

Doc No: S&P - QD 000 P40 C - 0 Page: 1 (1)

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 CALIBRATION
 CNAS L0570


 Client **SGS**

 Certificate No: **23J02Z80050**

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d063

Calibration Procedure(s): FF-Z11-003-01
 Calibration Procedures for dipole validation kits

Calibration date: September 20, 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 (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Power Meter NRP2 | 106277 | 22-Sep-22 (CTTL, No.J22X09561) | Sep-23 |
| Power sensor NRP8S | 104291 | 22-Sep-22 (CTTL, No.J22X09561) | Sep-23 |
| Reference Probe EX3DV4 | SN 3617 | 31-Mar-23(CTTL-SPEAG,No.Z23-60161) | Mar-24 |
| DAE4 | SN 1556 | 11-Jan-23(CTTL-SPEAG,No.Z23-60034) | Jan-24 |
| Secondary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 05-Jan-23 (CTTL, No. J23X00107) | Jan-24 |
| NetworkAnalyzer E5071C | MY46110673 | 10-Jan-23 (CTTL, No. J23X00104) | Jan-24 |

| | Name | Function | Signature |
|----------------|-------------|--------------------|---|
| Calibrated by: | Zhao Jing | SAR Test Engineer |  |
| Reviewed by: | Lin Hao | SAR Test Engineer |  |
| Approved by: | Qi Dianyuan | SAR Project Leader |  |

Issued: September 26, 2023

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

Certificate No: 23J02Z80050

Page 1 of 6

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Glossary:

| | |
|-------|--------------------------------|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORMx,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-mounted 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) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

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Measurement Conditions

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

| | | |
|------------------------------|--------------------------|-------------|
| DASY Version | DASY52 | V52.10.4 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | Triple Flat Phantom 5.1C | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 41.5 | 0.90 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 41.2 ± 6 % | 0.89 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C | — | — |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------|
| SAR measured | 250 mW input power | 2.37 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 9.53 W/kg ± 18.8 % (k=2) |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | Condition | |
| SAR measured | 250 mW input power | 1.52 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 6.11 W/kg ± 18.7 % (k=2) |

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

| | |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 52.3Ω+ 4.2jΩ |
| Return Loss | - 26.6dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.298 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

Additional EUT Data

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

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DASY5 Validation Report for Head TSL

Date: 2023-09-20

Test Laboratory: CTTL, Beijing, China

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

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.892 \text{ S/m}$; $\epsilon_r = 41.18$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(10.1, 10.1, 10.1) @ 835 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.75 V/m; Power Drift = -0.02 dB

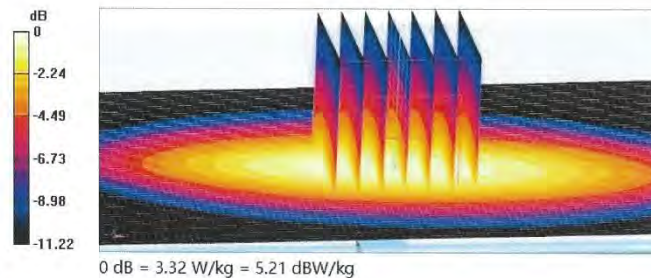
Peak SAR (extrapolated) = 3.88 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.52 W/kg

Smallest distance from peaks to all points 3 dB below = 16.2 mm

Ratio of SAR at M2 to SAR at M1 = 61.6%

Maximum value of SAR (measured) = 3.32 W/kg



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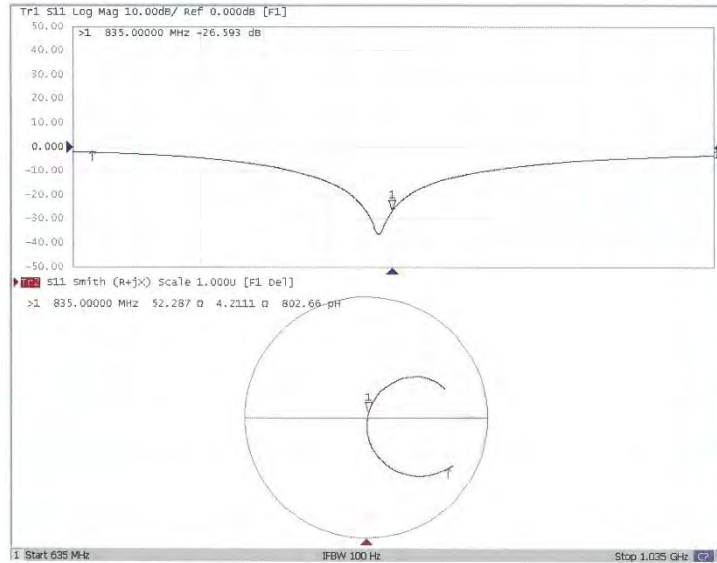
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Impedance Measurement Plot for Head TSL



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 CALIBRATION
 CNAS L0570



Client **SGS**

Certificate No: **J23Z60370**

| CALIBRATION CERTIFICATE | | | |
|--|--|---|-----------------------|
| Object | D1750V2 - SN: 1158 | | |
| Calibration Procedure(s) | FF-Z11-003-01 Calibration Procedures for dipole validation kits | | |
| Calibration date: | August 25, 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 (Calibrated by, Certificate No.) | Scheduled Calibration |
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| Network Analyzer E5071C | MY46110673 | 10-Jan-23 (CTTL, No. J23X00104) | Jan-24 |
| Calibrated by: | Name Zhao Jing | Function SAR Test Engineer | Signature |
| Reviewed by: | Name Lin Hao | Function SAR Test Engineer | Signature |
| Approved by: | Name Qi Dianyuan | Function SAR Project Leader | Signature |
| Issued: September 1, 2023 | | | |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. | | | |

Certificate No: J23Z60370

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Glossary:

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

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- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- c) DAS4/5 System Handbook

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Measurement Conditions

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

| | | |
|------------------------------|--------------------------|-------------|
| DASY Version | DASY52 | 52.10.4 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | Triple Flat Phantom 5.1C | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 1750 MHz ± 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters | 22.0 °C | 40.1 | 1.37 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 41.0 ± 6 % | 1.35 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C | — | — |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 9.07 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 36.8 W/kg ± 18.8 % (k=2) |
| SAR averaged over 10 cm ³ (10 g) of Head TSL | Condition | |
| SAR measured | 250 mW input power | 4.81 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 19.4 W/kg ± 18.7 % (k=2) |

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

| | |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 47.5Ω- 1.44jΩ |
| Return Loss | - 30.7dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.125 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point 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 feed-point may be damaged.

Additional EUT Data

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

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DASY5 Validation Report for Head TSL

Date: 2023-08-25

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1158

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 1750 \text{ MHz}$; $\sigma = 1.35 \text{ S/m}$; $\epsilon_r = 41.04$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.4, 8.4, 8.4) @ 1750 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,

dy=5mm, dz=5mm

Reference Value = 95.63 V/m; Power Drift = 0.00 dB

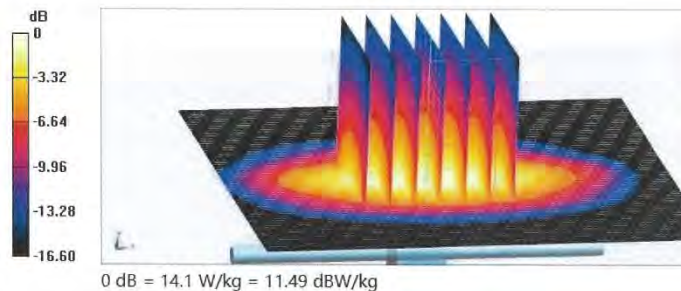
Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.07 W/kg; SAR(10 g) = 4.81 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54.2%

Maximum value of SAR (measured) = 14.1 W/kg



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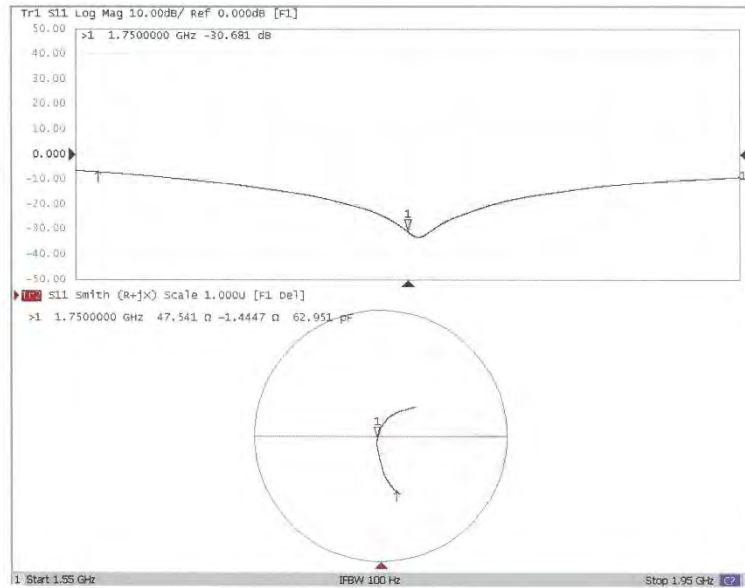
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Impedance Measurement Plot for Head TSL



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Accreditation No.: SCS 0108

Client **SGS**
 Taoyuan City, Taiwan

Certificate No. **D1900V2-5d173_Apr23**

CALIBRATION CERTIFICATE

| | | | |
|--|---|-----------------------------------|------------------------------|
| Object: | D1900V2 - SN:5d173 | | |
| Calibration procedure(s): | QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz | | |
| Calibration date: | April 26, 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: 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 |
| Calibrated by: | Name Paulo Pina | Function Laboratory Technician | Signature |
| Approved by: | Sven Kühn | Technical Manager | i.g. |
| | | | Issued: April 27, 2023 |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. | | | |

Certificate No: D1900V2-5d173_Apr23

Page 1 of 6

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Accreditation No.: SCS 0108

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%.

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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 | 38.9 ± 6 % | 1.39 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | --- | --- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 10.09 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 40.3 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 5.23 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 20.9 W/kg ± 16.5 % (k=2) |

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Appendix (Additional assessments outside the scope of SCS 0108)
Antenna Parameters with Head TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 52.6 Ω + 4.6 $j\Omega$ |
| Return Loss | - 25.7 dB |

General Antenna Parameters and Design

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

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

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

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

Additional EUT Data

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

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DASY5 Validation Report for Head TSL

Date: 26.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

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

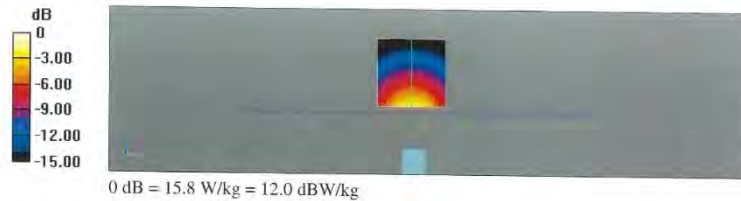
Communication System: UID 0 - CW; Frequency: 1900 MHz
 Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.39 \text{ S/m}$; $\epsilon_r = 38.9$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35) @ 1900 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$
 Reference Value = 110.0 V/m; Power Drift = -0.02 dB
 Peak SAR (extrapolated) = 18.8 W/kg
SAR(1 g) = 10.09 W/kg; SAR(10 g) = 5.23 W/kg
 Smallest distance from peaks to all points 3 dB below = 10 mm
 Ratio of SAR at M2 to SAR at M1 = 54%
 Maximum value of SAR (measured) = 15.8 W/kg

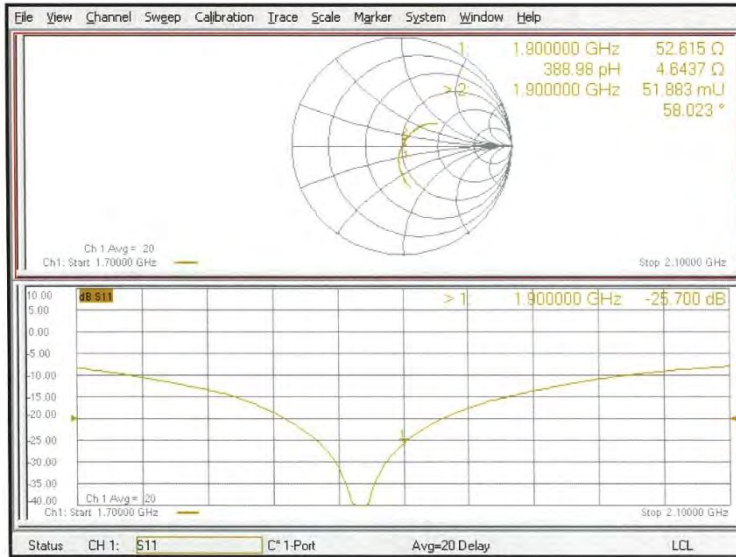


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Impedance Measurement Plot for Head TSL



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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **SGS (Auden)**

Certificate No: **D2600V2-1005_Jan23**

CALIBRATION CERTIFICATE

Object: **D2600V2 - SN:1005**

Calibration procedure(s): **QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **January 11, 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 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: | Jelon Kastrati | Laboratory Technician | |
| Approved by: | Sven Kühn | Technical Manager | |

Issued: January 12, 2023

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

Certificate No: D2600V2-1005_Jan23

Page 1 of 6

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Accreditation No.: **SCS 0108**

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%.

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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 | 38.2 ± 6 % | 2.03 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | --- | --- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 14.1 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 55.4 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|---------------------------------|
| SAR measured | 250 mW input power | 6.26 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.7 W/kg ± 16.5 % (k=2) |

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Appendix (Additional assessments outside the scope of SCS 0108)
Antenna Parameters with Head TSL

| | |
|--------------------------------------|-------------------------------|
| Impedance, transformed to feed point | 48.5 Ω - 4.2 $j\Omega$ |
| Return Loss | - 26.9 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.156 ns |
|----------------------------------|----------|

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

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

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

Additional EUT Data

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

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DASY5 Validation Report for Head TSL

Date: 11.01.2023

Test Laboratory: SPEAG, Zurich, Switzerland

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

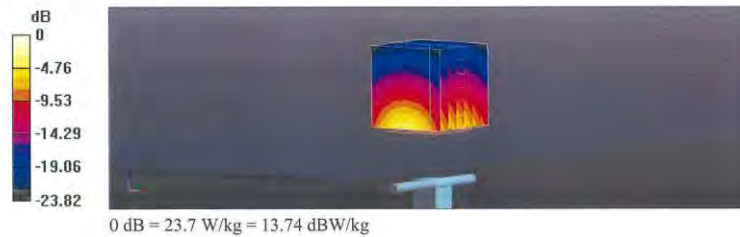
Communication System: UID 0 - CW; Frequency: 2600 MHz
 Medium parameters used: $f = 2600$ MHz; $\sigma = 2.03$ S/m; $\epsilon_r = 38.2$; $\rho = 1000$ kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 116.7 V/m; Power Drift = 0.01 dB
 Peak SAR (extrapolated) = 28.1 W/kg
SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.26 W/kg
 Smallest distance from peaks to all points 3 dB below = 8.9 mm
 Ratio of SAR at M2 to SAR at M1 = 50.1%
 Maximum value of SAR (measured) = 23.7 W/kg

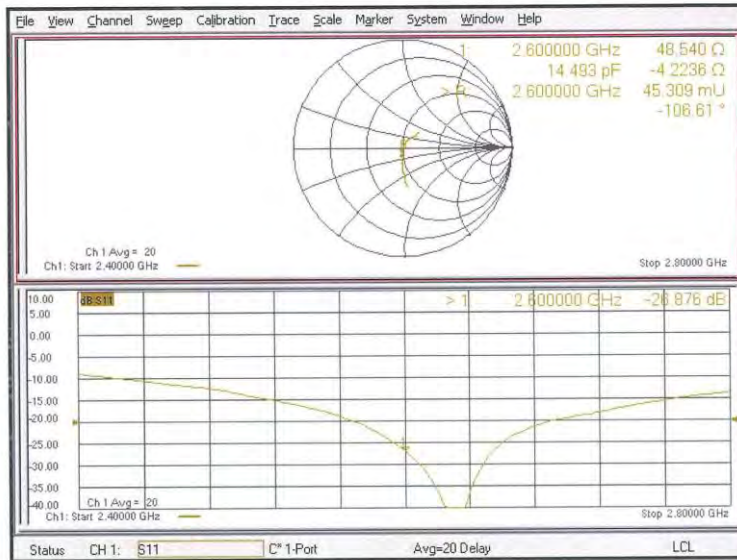


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Impedance Measurement Plot for Head TSL



- End of report -

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