

**TTL Speaq** CALIBRATION LABORATORY  
 In Collaboration with **CAICT**

Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China  
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 E-mail: cti@china.ttl.com http://www.china.ttl.com

Date: 2022-03-31

**DASY5 Validation Report for Head TSL**  
 Test Laboratory: TTL, Beijing, China  
**DUT:** Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1096  
 Communication System: UID 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1  
 Phantom parameters used:  $f = 2300 \text{ MHz}$ ;  $\sigma = 1.702 \text{ S/m}$ ;  $\epsilon = 39.77$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Right Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.01, 8.01) @ 2300 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sni 1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.IC (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:  $d_x=5\text{mm}$ ,  $d_y=5\text{mm}$ ,  $d_z=5\text{mm}$   
 Reference Value = 102.7 V/m; Power Drift = 0.00 dB  
 Peak SAR (extrapolated) = 24.8 W/kg  
**SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.88 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 9 mm  
 Ratio of SAR at M2 to SAR at M1 = 50.4%  
 Maximum value of SAR (measured) = 20.3 W/kg

0 dB = 20.3 W/kg = 13.07 dBW/kg

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**Impedance Measurement Plot for Head TSL**

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### 1.10 D2450V2 - SN 817

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 E-mail: cti@china.ttl.com http://www.china.ttl.com

Client: **SGS-CN** Certificate No: **Z22-60107**

**CALIBRATION CERTIFICATE**

Object: D2450V2 - SN 817  
 Calibration Procedure(s): FF-Z11-003-01  
 Calibration date: April 1, 2022

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       | 108277  | 24-Sep-21 (CTTL No.J21X08326)            | Sep-22                |
| Power sensor NRP8S     | 104291  | 24-Sep-21 (CTTL No.J21X08326)            | Sep-22                |
| Reference Probe EX3DV4 | SN 7307 | 28-May-21 (SPEAG.No.EX3-7307_May21)      | May-22                |
| DAE4                   | SN 1556 | 12-Jan-22 (CTTL-SPEAG.No.Z22-60007)      | Jan-23                |

| Secondary Standards     | ID #       | Cal Date (Calibrated by Certificate No.) | Scheduled Calibration |
|-------------------------|------------|--|-----------------------|
| Signal Generator E4439C | MY49071430 | 13-Jan-22 (CTTL No.J22X00409)            | Jan-23                |
| Network Analyzer E5071C | MY48110673 | 14-Jan-22 (CTTL No.J22X00406)            | Jan-23                |

Calibrated by: Zhao Jing (SAR Test Engineer)  
 Reviewed by: Lin Hao (SAR Test Engineer)  
 Approved by: Qi Dianyan (SAR Project Leader)

Issued: April 6, 2022  
 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

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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 865864, "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**  
 DASYS 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                    | 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 | 39.5 ± 6 %   | 1.79 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL**

| SAR averaged over 1 cm <sup>3</sup> (1g) of Head TSL   | Condition          |                          |
|--|--------------------|--------------------------|
| SAR measured   | 250 mW input power | 13.2 W/kg                |
| SAR for nominal Head TSL parameters                    | normalized to 1W   | 53.0 W/kg ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10g) of Head TSL | Condition          |                          |
| SAR measured   | 250 mW input power | 6.15 W/kg                |
| SAR for nominal Head TSL parameters                    | normalized to 1W   | 24.7 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 | 52.10 ± 3.20Ω |
| Return Loss                          | -28.5dB       |

**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.066 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: 2022-04-01

Test Laboratory: CTTL, Beijing, China  
 DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817  
 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1  
 Medium parameters used: f = 2450 MHz; σ = 1.79 S/m; ε = 39.52; ρ = 1000 kg/m<sup>3</sup>  
 Phantom section: Right Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.75, 7.75, 7.75) @ 2450 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- 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) (Cube 0):** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
 Reference Value = 104.6 V/m; Power Drift = -0.03 dB  
 Peak SAR (extrapolated) = 27.0 W/kg  
**SAR(1g) = 13.2 W/kg; SAR(10g) = 6.15 W/kg**  
 Smallest distance from peaks to all points 3 dB below = 8.9 mm  
 Ratio of SAR at M2 to SAR at M1 = 49.2%  
 Maximum value of SAR (measured) = 22.1 W/kg

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**Impedance Measurement Plot for Head TSL**

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## 1.11 D2600V2 - SN 1158

| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China<br/>Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504<br/>E-mail: cti@china.ttl.com http://www.chinatit.com</p> </div> <div style="text-align: center;"> <p>中国合格评定委员会<br/>CALIBRATION<br/>CNAS 1079</p> </div> <div style="text-align: center;"> <p>中国信息通信研究院<br/>CALIBRATION<br/>CNAS 1079</p> </div> </div> <p style="text-align: center;">Client: <b>SGS-CN</b> Certificate No: <b>Z22-60108</b></p> <div style="border: 1px solid black; padding: 5px;"> <p><b>CALIBRATION CERTIFICATE</b></p> <p>Object: <b>D2600V2 - SN: 1158</b></p> <p>Calibration Procedure(s): <b>FF-Z11-003-01</b><br/>Calibration Procedures for dipole validation kits</p> <p>Calibration date: <b>March 31, 2022</b></p> <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>1102377</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Power sensor NRP8S</td> <td>104281</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Reference Probe EX3SDVA</td> <td>SN 7307</td> <td>26-May-21(SPEAG.No.X3-7307_May21)</td> <td>May-22</td> </tr> <tr> <td>DAE4</td> <td>SN 1556</td> <td>12-Jan-22(CTTL-SPEAG.No.Z22-60007)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1" style="width:100%; 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|---|--|--|--|-----------------------|------------------------|---------|-------------------------------|--------------------------|--------------------|------------------------------|-------------------------------|-------------|-------------------------|-------------------|-----------------------------------|-----------|------------------|---------|------------------------------------|-------------|---------------------|--------------|--|-----------------------|-------------------------|------------|-------------------------------|-----------------|-------------------------|------------------|---|---------|----------------|------|---|-----------|--|--------------|--------------------|-----------|-------------------------------------|------------------|--------------------------|---|-----------|---------|-------------------|--------------------|--------------|-------------------------------------|------------------|--------------------------|---|--------------------------------------|--------------------|-------------|--|----------------------------------|----------|-----------------|-------|
| Primary Standards   | ID #   | Cal Date (Calibrated by Certificate No.) | Scheduled Calibration                    |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Power Meter NRP2  | 1102377                                      | 24-Sep-21 (CTTL No.J21X08326)            | Sep-22                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Power sensor NRP8S  | 104281                                       | 24-Sep-21 (CTTL No.J21X08326)            | Sep-22                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Reference Probe EX3SDVA   | SN 7307                                      | 26-May-21(SPEAG.No.X3-7307_May21)        | May-22                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| DAE4  | SN 1556                                      | 12-Jan-22(CTTL-SPEAG.No.Z22-60007)       | Jan-23                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Secondary Standards   | ID #   | Cal Date (Calibrated by Certificate No.) | Scheduled Calibration                    |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Signal Generator E4438C   | MY49071430                                   | 13-Jan-22 (CTTL No.J22X00409)            | Jan-23                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Network Analyzer E5071C   | MY45110573                                   | 14-Jan-22 (CTTL No.J22X00406)            | Jan-23                                   |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Calibrated by:  | Name   | Function                                 | Signature                                |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
|   | Zhao Jing                                    | SAR Test Engineer                        |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Reviewed by:  | Name   | Function                                 | Signature                                |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
|   | Lin Hao                                      | SAR Test Engineer                        |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Approved by:  | Name   | Function                                 | Signature                                |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
|   | Qi Diaryuan                                  | SAR Project Leader                       |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| <p>Certificate No: Z22-60108 Page 1 of 6</p>  | <p>Certificate No: Z22-60108 Page 2 of 6</p> |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <p>Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China<br/>Tel: +86-10-62304633-3079 Fax: +86-10-62304633-2504<br/>E-mail: cti@china.ttl.com http://www.chinatit.com</p> </div> <div style="text-align: center;"> </div> </div> <p>Measurement Conditions</p> <p>DASY system configuration, as far as not given on page 1.</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>DASY Version</th> <th>DASY52</th> <th>52.10.4</th> </tr> </thead> <tbody> <tr> <td>Extrapolation</td> <td>Advanced Extrapolation</td> <td></td> </tr> <tr> <td>Phantom</td> <td>Triple Flat Phantom 5.1C</td> <td></td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>10 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td>dx, dy, dz = 5 mm</td> <td></td> </tr> <tr> <td>Frequency</td> <td>2600 MHz ± 1 MHz</td> <td></td> </tr> </tbody> </table> <p>Head TSL parameters</p> <p>The following parameters and calculations were applied.</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td>Nominal Head TSL parameters</td> <td>22.0 °C</td> <td>39.0</td> <td>1.96 mho/m</td> </tr> <tr> <td>Measured Head TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>38.7 ± 6 %</td> <td>1.96 mho/m ± 6 %</td> </tr> <tr> <td>Head TSL temperature change during test</td> <td>&lt;1.0 °C</td> <td>---</td> <td>---</td> </tr> </tbody> </table> <p>SAR result with Head TSL</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>SAR averaged over 1 cm<sup>2</sup> (1 g) of Head TSL</th> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>13.7 W/kg</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>64.8 W/kg ± 18.8 % (k=2)</td> </tr> </tbody> </table> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>SAR averaged over 10 cm<sup>2</sup> (10 g) of Head TSL</th> <th>Condition</th> <th></th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>6.12 W/kg</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>24.6 W/kg ± 18.7 % (k=2)</td> </tr> </tbody> </table>   | 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 | 2600 MHz ± 1 MHz |         |                                    | 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 | 38.7 ± 6 %              | 1.96 mho/m ± 6 % | Head TSL temperature change during test | <1.0 °C | ---            | ---  | SAR averaged over 1 cm <sup>2</sup> (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 | 64.8 W/kg ± 18.8 % (k=2) | SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL | Condition |         | SAR measured      | 250 mW input power | 6.12 W/kg    | SAR for nominal Head TSL parameters | normalized to 1W | 24.6 W/kg ± 18.7 % (k=2) | <p>Appendix (Additional assessments outside the scope of CNAS L0570)</p> <p>Antenna Parameters with Head TSL</p> <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>Impedance, transformed to feed point</th> <th>49.90-6.49jΩ</th> </tr> </thead> <tbody> <tr> <td>Return Loss</td> <td>-23.8dB</td> </tr> </tbody> </table> <p>General Antenna Parameters and Design</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tbody> <tr> <td>Electrical Delay (one direction)</td> <td>1.053 ns</td> </tr> </tbody> </table> <p>After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.</p> <p>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.</p> <p>Additional EUT Data</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tbody> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </tbody> </table> | Impedance, transformed to feed point | 49.90-6.49jΩ       | Return Loss | -23.8dB  | Electrical Delay (one direction) | 1.053 ns | Manufactured by | SPEAG |
| 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   | 2600 MHz ± 1 MHz                             |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
|   | 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                              | 38.7 ± 6 %                               | 1.96 mho/m ± 6 %                         |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Head TSL temperature change during test   | <1.0 °C                                      | ---                                      | ---                                      |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| SAR averaged over 1 cm <sup>2</sup> (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                             | 64.8 W/kg ± 18.8 % (k=2)                 |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL   | Condition                                    |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| SAR measured  | 250 mW input power                           | 6.12 W/kg                                |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| SAR for nominal Head TSL parameters   | normalized to 1W                             | 24.6 W/kg ± 18.7 % (k=2)                 |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Impedance, transformed to feed point  | 49.90-6.49jΩ                                 |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Return Loss   | -23.8dB                                      |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Electrical Delay (one direction)  | 1.053 ns                                     |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| Manufactured by   | SPEAG  |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |
| <p>Certificate No: Z22-60108 Page 3 of 6</p>  | <p>Certificate No: Z22-60108 Page 4 of 6</p> |  |  |                       |                        |         |                               |                          |                    |                              |                               |             |                         |                   |                                   |           |                  |         |                                    |             |                     |              |  |                       |                         |            |                               |                 |                         |                  |   |         |                |      |   |           |  |              |                    |           |                                     |                  |                          |   |           |         |                   |                    |              |                                     |                  |                          |   |                                      |                    |             |  |                                  |          |                 |       |



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Date: 2022-03-31

**DASY5 Validation Report for Head TSL**  
 Test Laboratory: CTTL, Beijing, China  
 DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1158  
 Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.955$  S/m;  $\epsilon_s = 38.68$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section  
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.5, 7.5, 7.5) @ 2600 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.IC (3ddeg probe ill); 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 = 103.3 V/m; Power Drift = 0.04 dB  
 Peak SAR (extrapolated) = 29.0 W/kg  
 SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.12 W/kg  
 Smallest distance from peaks to all points 3 dB below = 8.9 mm  
 Ratio of SAR at M2 to SAR at M1 = 47.5%  
 Maximum value of SAR (measured) = 23.4 W/kg

Certificate No: Z22-60108 Page 5 of 6

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**Impedance Measurement Plot for Head TSL**

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### 1.12 D5GHZV2 - SN 1095

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Client: **SGS-CN** Certificate No: **Z22-60187**

**CALIBRATION CERTIFICATE**

Object: D5GHZV2 - SN: 1095

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

Calibration date: June 1, 2022

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 (23±3)°C; and humidity < 70%.

Calibration Equipment used (MATE critical for calibration)

| Primary Standards      | ID #    | Cal Date (Calibrated by: Certificate No.) | Scheduled Calibration |
|------------------------|---------|---|-----------------------|
| Power Meter NRP2       | 106277  | 24-Sep-21 (CTTL No.J21X08326)             | Sep-22                |
| Power sensor NRP8S     | 104291  | 24-Sep-21 (CTTL No.J21X08326)             | Sep-22                |
| Reference Probe EX3DV4 | SN 7464 | 26-Jan-22(SPEAG.No.EX3-7464_Jan22)        | Jan-23                |
| DAE4                   | SN 1556 | 12-Jan-22(CTTL-SPEAG.No.Z22-60007)        | Jan-23                |

| Secondary Standards     | ID #       | Cal Date (Calibrated by: Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Signal Generator E4438C | MY49071430 | 13-Jan-22 (CTTL No. J22X00406)            | Jan-23                |
| Network Analyzer E5071C | MY46110673 | 14-Jan-22 (CTTL No. J22X00406)            | Jan-23                |

Calibrated by: Zhao Jing, SAR Test Engineer

Reviewed by: Lin Hao, SAR Test Engineer

Approved by: Qi Dianyan, SAR Project Leader

Issued: June 6, 2022

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**Glossary:**

- TSL: Issue simulating liquid sensitivity in TSL / NORMx,y,z
- ConvF: not applicable or not measured
- N/A: not applicable or not measured

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

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

**Additional Documentation:**

- 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 station 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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**CAICT**

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

|                              |  |                                  |
|------------------------------|--|----------------------------------|
| DASY Version                 | DASY2  | 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 = 4 mm, dz = 1.4 mm   | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5200 MHz ± 1 MHz<br>5300 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5800 MHz ± 1 MHz |                                  |

**Head TSL parameters at 5200MHz**  
The following parameters and calculations were applied.

|   |                 |              |                  |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | Temperature     | Permittivity | Conductivity     |
|   | 22.0 °C         | 35.0         | 4.66 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.4 ± 6 %   | 4.82 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL at 5200MHz**

|   |                    |                          |
|---|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured  | 250 mW input power | 7.79 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 77.6 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured  | 250 mW input power | 2.22 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.1 W/kg ± 24.2 % (k=2) |

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**Head TSL parameters at 5300MHz**  
The following parameters and calculations were applied.

|   |                 |              |                  |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | Temperature     | Permittivity | Conductivity     |
|   | 22.0 °C         | 35.9         | 4.76 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.2 ± 6 %   | 4.73 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL at 5300MHz**

|   |                    |                          |
|---|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (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   | 79.1 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured  | 100 mW input power | 2.27 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.6 W/kg ± 24.2 % (k=2) |

**Head TSL parameters at 5500MHz**  
The following parameters and calculations were applied.

|   |                 |              |                  |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | Temperature     | Permittivity | Conductivity     |
|   | 22.0 °C         | 35.6         | 4.96 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.8 ± 6 %   | 4.94 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL at 5500MHz**

|   |                    |                          |
|---|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured  | 100 mW input power | 8.29 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 82.5 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured  | 100 mW input power | 2.34 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.3 W/kg ± 24.2 % (k=2) |

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**Head TSL parameters at 5600MHz**  
The following parameters and calculations were applied.

|   |                 |              |                  |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | Temperature     | Permittivity | Conductivity     |
|   | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.7 ± 6 %   | 5.05 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL at 5600MHz**

|   |                    |                          |
|---|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured  | 100 mW input power | 8.12 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 80.8 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (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 ± 24.2 % (k=2) |

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

|   |                 |              |                  |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | Temperature     | Permittivity | Conductivity     |
|   | 22.0 °C         | 35.3         | 5.27 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.4 ± 6 %   | 5.25 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

**SAR result with Head TSL at 5800MHz**

|   |                    |                          |
|---|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured  | 100 mW input power | 7.71 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 76.7 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured  | 100 mW input power | 2.16 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 21.5 W/kg ± 24.2 % (k=2) |

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**Appendix (Additional assessments outside the scope of CNAS L0570)**

**Antenna Parameters with Head TSL at 5200MHz**

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 46.10-5.03jΩ |
| Return Loss                          | -23.6dB      |

**Antenna Parameters with Head TSL at 5300MHz**

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 47.80-2.42jΩ |
| Return Loss                          | -29.5dB      |

**Antenna Parameters with Head TSL at 5500MHz**

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 50.30-4.26jΩ |
| Return Loss                          | -27.4dB      |

**Antenna Parameters with Head TSL at 5600MHz**

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 54.50-4.80jΩ |
| Return Loss                          | -24.0dB      |

**Antenna Parameters with Head TSL at 5800MHz**

|                                      |              |
|--------------------------------------|--------------|
| Impedance, transformed to feed point | 51.50-5.61jΩ |
| Return Loss                          | -24.9dB      |

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**General Antenna Parameters and Design**

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.101 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 | SPEAQ |
|-----------------|-------|

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**DASY5 Validation Report for Head TSL**

Test Laboratory: CTTL, Beijing, China  
Date: 2022-06-01

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095**

Communication System: CW; Frequency: 5200 MHz; Frequency: 5300 MHz; Frequency: 5500 MHz; Frequency: 5600 MHz; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.62$  S/m;  $\epsilon_r = 35.39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.73$  S/m;  $\epsilon_r = 35.19$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.939$  S/m;  $\epsilon_r = 34.83$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.051$  S/m;  $\epsilon_r = 34.68$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.247$  S/m;  $\epsilon_r = 34.42$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section  
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)  
DASY5 Configuration:

- Probe: EX3DV4 - SN7484; ConvF(5.6, 5.6, 5.6) @ 5200 MHz; ConvF(5.32, 5.32, 5.32) @ 5300 MHz; ConvF(5.11, 5.11, 5.11) @ 5500 MHz; ConvF(4.91, 4.91, 4.91) @ 5600 MHz; ConvF(5, 5, 5) @ 5800 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: GD Q00 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7601)

**Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 60.80 V/m; Power Drift = -0.06 dB  
Peak SAR (extrapolated) = 29.8 W/kg  
SAR(1 g) = 7.73 W/kg; SAR(10 g) = 2.22 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 66.8%  
Maximum value of SAR (measured) = 18.3 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 61.08 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 31.5 W/kg  
SAR(1 g) = 7.94 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 = 65.5%  
Maximum value of SAR (measured) = 19.0 W/kg

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**Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 61.92 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 34.7 W/kg  
SAR(1 g) = 8.29 W/kg; SAR(10 g) = 2.34 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 63.9%  
Maximum value of SAR (measured) = 20.2 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 65.08 V/m; Power Drift = -0.07 dB  
Peak SAR (extrapolated) = 35.2 W/kg  
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 62.5%  
Maximum value of SAR (measured) = 19.1 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 62.13 V/m; Power Drift = -0.06 dB  
Peak SAR (extrapolated) = 34.8 W/kg  
SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.16 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 61.6%  
Maximum value of SAR (measured) = 18.7 W/kg

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**Impedance Measurement Plot for Head TSL**

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## 2 DAE4 - SN 1245

| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 8px;"> <p>Schmid &amp; Partner Engineering AG<br/>Zugstrasse 43, 8004 Zurich, Switzerland<br/>Phone +41 44 245 9700, Fax +41 44 245 9770<br/>www.sgs.com, info@sgs.com</p> </div> <div style="font-weight: bold; font-size: 12px;">s p e a g</div> </div> <p style="text-align: center; color: red; font-weight: bold; margin-top: 10px;">IMPORTANT NOTICE</p> <p><b>USAGE OF THE DAE4</b></p> <p>The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:</p> <p><b>Battery Exchange:</b> The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.</p> <p><b>Shipping of the DAE:</b> Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an anti-static bag. This anti-static bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.</p> <p><b>E-Stop Failures:</b> Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.</p> <p><b>Repair:</b> Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough/unprofessional handling caused the defect.</p> <p><b>DASY Configuration Files:</b> Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.</p> <div style="border: 1px solid red; padding: 2px; margin-top: 5px;"> <p><b>Important Note:</b><br/>Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.</p> </div> <div style="border: 1px solid red; padding: 2px; margin-top: 5px;"> <p><b>Important Note:</b><br/>Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.</p> </div> <div style="border: 1px solid red; padding: 2px; margin-top: 5px;"> <p><b>Important Note:</b><br/>To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.</p> </div> <p style="font-size: 8px; margin-top: 10px;">TN_EH190306AE DAE4.docx <span style="float: right;">07.03.2019</span></p> | <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 8px;"> <p>Schmid &amp; Partner Engineering AG<br/>Zugstrasse 43, 8004 Zurich, Switzerland</p> </div> <div style="font-size: 12px;"> </div> <div style="font-size: 8px;"> <p>S Schweizerischer Kalibrierdienst<br/>C Service suisse de l'étalonnage<br/>C Servizio svizzero di taratura<br/>S Swiss Calibration Service</p> </div> </div> <p style="font-size: 8px; margin-top: 5px;">Accredited by the Swiss Accreditation Service (SAS)<br/>The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates</p> <p style="text-align: right; font-size: 8px;">Accreditation No.: SCS 0108</p> <p style="font-size: 8px;">Client: <b>SGS-CN (Auden)</b> Certificate No: <b>DAE4-1245_May22</b></p> <div style="border: 1px solid black; padding: 5px; margin-top: 5px;"> <p style="text-align: center; font-weight: bold; font-size: 10px;">CALIBRATION CERTIFICATE</p> <p>Object: <b>DAE4 - SD 000 D04 BM - SN: 1245</b></p> <p>Calibration procedure(s): <b>QA CAL-06 v30<br/>Calibration procedure for the data acquisition electronics (DAE)</b></p> <p>Calibration date: <b>May 30, 2022</b></p> <p style="font-size: 8px; margin-top: 5px;">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.<br/>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 0.1°C and humidity &lt; 70%).<br/>Calibration Equipment used (MTE critical for calibration)</p> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Kelvin Multimeter Type 2001</td> <td>SN: 0810278</td> <td>31-Aug-21 (No:31368)</td> <td>Aug-22</td> </tr> </tbody> </table> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Auto DAE Calibration Unit</td> <td>SE LWS 003 AA 1001</td> <td>24-Jan-22 (in house check)</td> <td>In house check: Jan-23</td> </tr> <tr> <td>Calibrator Box v3.1</td> <td>SE LWS 006 AA 1002</td> <td>24-Jan-22 (in house check)</td> <td>In house check: Jan-23</td> </tr> </tbody> </table> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="font-size: 8px;"> <p>Calibrated by: <b>Dominique Shelton</b><br/>Function: <b>Laboratory Technician</b></p> </div> <div style="font-size: 8px;"> <p>Approved by: <b>Seon Kwon</b><br/>Function: <b>Technical Manager</b></p> </div> <div style="font-size: 8px;"> <p>Signature: </p> <p>Signature: </p> </div> </div> <p style="font-size: 8px; margin-top: 5px;">This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: May 30, 2022</p> <p style="font-size: 8px; margin-top: 5px;">Certificate No: DAE4-1245_May22 <span style="float: right;">Page 1 of 5</span></p> </div> | Primary Standards          | ID #                   | Cal Date (Certificate No.) | Scheduled Calibration | Kelvin Multimeter Type 2001 | SN: 0810278           | 31-Aug-21 (No:31368)  | Aug-22                | Secondary Standards | ID #                  | Check Date (in house) | Scheduled Check       | Auto DAE Calibration Unit                 | SE LWS 003 AA 1001 | 24-Jan-22 (in house check) | In house check: Jan-23 | Calibrator Box v3.1 | SE LWS 006 AA 1002 | 24-Jan-22 (in house check) | In house check: Jan-23 |
|--|---|----------------------------|------------------------|----------------------------|-----------------------|-----------------------------|-----------------------|-----------------------|-----------------------|---------------------|-----------------------|-----------------------|-----------------------|---|--------------------|----------------------------|------------------------|---------------------|--------------------|----------------------------|------------------------|
| Primary Standards  | ID #  | Cal Date (Certificate No.) | Scheduled Calibration  |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Kelvin Multimeter Type 2001  | SN: 0810278   | 31-Aug-21 (No:31368)       | Aug-22                 |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Secondary Standards  | ID #  | Check Date (in house)      | Scheduled Check        |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Auto DAE Calibration Unit  | SE LWS 003 AA 1001  | 24-Jan-22 (in house check) | In house check: Jan-23 |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Calibrator Box v3.1  | SE LWS 006 AA 1002  | 24-Jan-22 (in house check) | In house check: Jan-23 |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 8px;"> <p>Schmid &amp; Partner Engineering AG<br/>Zugstrasse 43, 8004 Zurich, Switzerland</p> </div> <div style="font-size: 12px;"> </div> <div style="font-size: 8px;"> <p>S Schweizerischer Kalibrierdienst<br/>C Service suisse de l'étalonnage<br/>C Servizio svizzero di taratura<br/>S Swiss Calibration Service</p> </div> </div> <p style="font-size: 8px; margin-top: 5px;">Accredited by the Swiss Accreditation Service (SAS)<br/>The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates</p> <p style="text-align: right; font-size: 8px;">Accreditation No.: SCS 0108</p> <p><b>Glossary</b></p> <p>DAE: data acquisition electronics<br/>Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system.</p> <p><b>Methods Applied and Interpretation of Parameters</b></p> <ul style="list-style-type: none"> <li><b>DC Voltage Measurement:</b> Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.</li> <li><b>Connector angle:</b> The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.</li> <li>The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.             <ul style="list-style-type: none"> <li><b>DC Voltage Measurement Linearity:</b> Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.</li> <li><b>Common mode sensitivity:</b> Influence of a positive or negative common mode voltage on the differential measurement.</li> <li><b>Channel separation:</b> Influence of a voltage on the neighbor channels not subject to an input voltage.</li> <li><b>AD Converter Values with inputs shorted:</b> Values on the internal AD converter corresponding to zero input voltage</li> <li><b>Input Offset Measurement:</b> Output voltage and statistical results over a large number of zero voltage measurements.</li> <li><b>Input Offset Current:</b> Typical value for information; Maximum channel input offset current, not considering the input resistance.</li> <li><b>Input resistance:</b> Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.</li> <li><b>Low Battery Alarm Voltage:</b> Typical value for information. Below this voltage, a battery alarm signal is generated.</li> <li><b>Power consumption:</b> Typical value for information. Supply currents in various operating modes.</li> </ul> </li> </ul> <p style="font-size: 8px; margin-top: 10px;">Certificate No: DAE4-1245_May22 <span style="float: right;">Page 2 of 5</span></p>  | <p><b>DC Voltage Measurement</b></p> <p>AD - Converter Resolution nominal<br/>         High Range: 1LSB = 6.1µV, full range = -100...+300 mV<br/>         Low Range: 1LSB = 61µV, full range = -1...+30mV<br/>         DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec</p> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th>Calibration Factors</th> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>High Range</td> <td>405.265 ± 0.02% (k=2)</td> <td>403.974 ± 0.02% (k=2)</td> <td>405.092 ± 0.02% (k=2)</td> </tr> <tr> <td>Low Range</td> <td>3.99534 ± 1.50% (k=2)</td> <td>3.99508 ± 1.50% (k=2)</td> <td>4.01015 ± 1.50% (k=2)</td> </tr> </tbody> </table> <p><b>Connector Angle</b></p> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse; margin-top: 5px;"> <tr> <td>Connector Angle to be used in DASY system</td> <td>30.0 ± 1 °</td> </tr> </table> <p style="font-size: 8px; margin-top: 10px;">Certificate No: DAE4-1245_May22 <span style="float: right;">Page 3 of 5</span></p>  | Calibration Factors        | X                      | Y                          | Z                     | High Range                  | 405.265 ± 0.02% (k=2) | 403.974 ± 0.02% (k=2) | 405.092 ± 0.02% (k=2) | Low Range           | 3.99534 ± 1.50% (k=2) | 3.99508 ± 1.50% (k=2) | 4.01015 ± 1.50% (k=2) | Connector Angle to be used in DASY system | 30.0 ± 1 °         |                            |                        |                     |                    |                            |                        |
| Calibration Factors  | X   | Y                          | Z                      |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| High Range   | 405.265 ± 0.02% (k=2)   | 403.974 ± 0.02% (k=2)      | 405.092 ± 0.02% (k=2)  |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Low Range  | 3.99534 ± 1.50% (k=2)   | 3.99508 ± 1.50% (k=2)      | 4.01015 ± 1.50% (k=2)  |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |
| Connector Angle to be used in DASY system  | 30.0 ± 1 °  |                            |                        |                            |                       |                             |                       |                       |                       |                     |                       |                       |                       |   |                    |                            |                        |                     |                    |                            |                        |



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**Appendix (Additional assessments outside the scope of SCS0108)**

**1. DC Voltage Linearity**

| High Range        | Reading (µV) | Difference (µV) | Error (%) |
|-------------------|--------------|-----------------|-----------|
| Channel X + Input | 19994.45     | 1.52            | 0.00      |
| Channel X + Input | 20004.58     | 2.22            | 0.01      |
| Channel X - Input | -20000.14    | 1.12            | -0.01     |
| Channel Y + Input | 199994.72    | 1.98            | 0.00      |
| Channel Y + Input | 20001.22     | -1.00           | -0.00     |
| Channel Y - Input | -20003.05    | -1.57           | 0.01      |
| Channel Z + Input | 199992.84    | 0.19            | 0.00      |
| Channel Z + Input | 20003.09     | 0.58            | 0.00      |
| Channel Z - Input | -20001.73    | -0.27           | 0.00      |

  

| Low Range         | Reading (µV) | Difference (µV) | Error (%) |
|-------------------|--------------|-----------------|-----------|
| Channel X + Input | 2001.91      | 0.41            | 0.02      |
| Channel X + Input | 202.54       | 0.65            | 0.32      |
| Channel X - Input | -197.88      | 0.07            | -0.04     |
| Channel Y + Input | 2002.05      | 0.58            | 0.03      |
| Channel Y + Input | 201.27       | -0.57           | -0.28     |
| Channel Y - Input | -196.23      | -0.06           | 0.03      |
| Channel Z + Input | 2001.36      | 0.08            | 0.00      |
| Channel Z + Input | 200.09       | -1.53           | -0.76     |
| Channel Z - Input | -199.85      | -1.57           | 0.79      |

**2. Common mode sensitivity**

| Common mode Input Voltage (mV) | High Range Average Reading (µV) | Low Range Average Reading (µV) |       |
|--------------------------------|---------------------------------|--------------------------------|-------|
| Channel X                      | 200                             | -5.87                          |       |
| -200                           | 9.12                            | 7.79                           |       |
| Channel Y                      | 200                             | -8.68                          | -9.28 |
| -200                           | 8.52                            | 8.38                           |       |
| Channel Z                      | 200                             | -5.36                          | -5.80 |
| -200                           | 3.58                            | 3.06                           |       |

**3. Channel separation**

| Input Voltage (mV) | Channel X (µV) | Channel Y (µV) | Channel Z (µV) |       |
|--------------------|----------------|----------------|----------------|-------|
| Channel X          | 200            | -              | 4.07           | -3.14 |
| Channel Y          | 200            | 9.36           | -              | 4.27  |
| Channel Z          | 200            | 10.11          | 7.14           | -     |

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**4. AD-Converter Values with inputs shorted**

| DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec | High Range (LSB) | Low Range (LSB) |
|---|------------------|-----------------|
| Channel X   | 15964            | 17040           |
| Channel Y   | 16052            | 15768           |
| Channel Z   | 16035            | 15968           |

**5. Input Offset Measurement**

| DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec | Average (µV) | min. Offset (µV) | max. Offset (µV) | Std. Deviation (µV) |
|---|--------------|------------------|------------------|---------------------|
| Channel X   | 1.00         | -0.15            | 1.83             | 0.45                |
| Channel Y   | -0.18        | -1.28            | 0.94             | 0.45                |
| Channel Z   | -0.58        | -2.61            | 0.58             | 0.60                |

**6. Input Offset Current**

Nominal input offset current on all channels: <math>-25\mu A</math>

**7. Input Resistance** (Typical values for information)

| Zeroing (kOhm) | Measuring (MOhm) |     |
|----------------|------------------|-----|
| Channel X      | 200              | 200 |
| Channel Y      | 200              | 200 |
| Channel Z      | 200              | 200 |

**8. Low Battery Alarm Voltage** (Typical values for information)

| Typical values | Alarm Level (VDC) |
|----------------|-------------------|
| Supply (+ Vec) | +7.9              |
| Supply (- Vec) | -7.6              |

**9. Power Consumption** (Typical values for information)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|----------------|-------------------|---------------|-------------------|
| Supply (+ Vec) | +0.01             | -8            | +14               |
| Supply (- Vec) | -0.01             | -8            | -9                |

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### 3 EX3DV4 - SN 7346

Calibration Laboratory of Schmid & Partner Engineering AG  
Zugstrasse 6, 8044 Zurich, Switzerland

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Client: **Auden** Certificate No: **EX3-7346\_Mar22**

**CALIBRATION CERTIFICATE**

Object: **EX3DV4 - SN 7346**

Calibration procedure(s): **QA CAL-01 v9, QA CAL-14 v6, QA CAL-23 v5, QA CAL-25 v7**  
Calibration procedure for dosimetric E-field probes

Calibration date: **March 30, 2022**

This calibration certificate documents the traceability to national standards, which make the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following page and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility, environment temperature (22 ± 3)°C and humidity <math>\leq 70\%</math>

Calibration Equipment used (MATE critical for calibration)

| Primary Standards          | ID                | Cal Date (Certificate No.)      | Scheduled Calibration |
|----------------------------|-------------------|---------------------------------|-----------------------|
| Power meter NMP            | SN: 100718        | 09-Apr-21 (No. 217-02591-02592) | Apr-22                |
| Power sensor NMP-291       | SN: 103244        | 09-Apr-21 (No. 217-02591)       | Apr-22                |
| Power sensor NMP-291       | SN: 103245        | 09-Apr-21 (No. 217-02592)       | Apr-22                |
| Reference 20 dB attenuator | SN: C220502 (20s) | 09-Apr-21 (No. 217-02543)       | Apr-22                |
| DAE4                       | SN: 660           | 13-Oct-21 (No. DAE4-660_04521)  | Oct-22                |
| Reference Probe ES3DV2     | SN: 3013          | 07-Dec-21 (No. ES3-3013_06c21)  | Dec-22                |

Secondary Standards

| ID                      | Check Date (in house) | Scheduled Calibration             |                       |
|-------------------------|-----------------------|-----------------------------------|-----------------------|
| Power meter E4419B      | SN: G841292874        | 06-Apr-18 (in house check Jun-20) | In house check Jun-22 |
| Power sensor E4413A     | SN: MY41498987        | 06-Apr-18 (in house check Jun-20) | In house check Jun-22 |
| Power sensor E4413A     | SN: W0110216          | 06-Apr-18 (in house check Jun-20) | In house check Jun-22 |
| RF generator HP 8642C   | SN: US3482401700      | 04-Apr-20 (in house check Jun-20) | In house check Jun-22 |
| Network Analyzer E8362A | SN: USA1080477        | 31-Mar-14 (in house check Oct-20) | In house check Oct-22 |

Calibrated by: **Malin Krampe** Function: **Laboratory Technician** Signature: *[Signature]*

Approved by: **Oliver Kuhn** Function: **Quality Manager** Signature: *[Signature]*

This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued March 31, 2022

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Client: **Auden** Certificate No: **EX3-7346\_Mar22**

**Glossary:**

TSL: issue simulating liquid  
NORMM<sub>x,y,z</sub>: sensitivity in free space  
ConF: crest factor (10μsly cycle) of the RF signal  
DCP: modulation dependent linearization parameters  
A, B, C, D: orientation around probe axis  
Polarization: rotation around probe axis  
Connector Angle: rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., 0 is normal to probe axis

Connector Angle: information used in DASY system to align probe sensor X to the robot coordinate system

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

a) IEC61010-1:2018 "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 1538: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)"; October 2020

b) KDS 845664 "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Methods Applied and Interpretation of Parameters:**

- NORMM<sub>x,y,z</sub>: Assessed for E-field polarization  $\beta = 0$  if  $\beta < 900$  MHz in TEM-cell;  $\beta > 1800$  MHz: R22 waveguide. NORMM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORMM<sub>x,y,z</sub> does not affect the E-field uncertainty inside TSL (see below ConF).
- NORMM<sub>x,y,z</sub> = NORMM<sub>x,y,z</sub> \* frequency response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConF.
- DCP<sub>x,y,z</sub>: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A<sub>1,y,z</sub>; B<sub>1,y,z</sub>; C<sub>1,y,z</sub>; D<sub>1,y,z</sub>; V<sub>1,y,z</sub>; A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. V<sub>1,y,z</sub> is the maximum calibration range expressed in RMS voltage across the diode.
- ConF and Boundary Effect Parameters: Assessed in flat phantom using E-Field (or Temperature Transfer Standard for  $f < 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same settings are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are assessed in flat phantom using DASY4 software to the boundary. The sensitivity in TSL corresponds to NORMM<sub>x,y,z</sub> \* ConF where the uncertainty corresponds to that given for ConF. A frequency dependent ConF is used in DASY7 version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical Isotropy (SD deviation from isotropy): in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle: The angle is assessed using the information gained by determining the NORMM (no uncertainty required).

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