



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



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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

### Glossary:

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

## Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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### **Measurement Conditions**

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

| DASY Version                 | DASY5                  | V52.10.2    |
|------------------------------|------------------------|-------------|
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm <sup>~</sup>     | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1750 MHz ± 1 MHz       |             |

## Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.1         | 1.37 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 40.2 ± 6 %   | 1.34 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        |              |                  |

## SAR result with Head TSL

| SAR averaged over 1 $cm^3$ (1 g) of Head TSL                            | Condition                       |                          |
|---|---------------------------------|--------------------------|
| SAR measured  | 250 mW input power              | 9.01 W/kg                |
| SAR for nominal Head TSL parameters                                     | normalized to 1W                | 36.6 W/kg ± 17.0 % (k=2) |
|   |                                 |                          |
|   | 1                               |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                 | condition                       |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured | condition<br>250 mW input power | 4.77 W/kg                |

## **Body TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 53.4         | 1.49 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 53.5 ± 6 %   | 1.46 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        |              |                  |

## SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL                   | Condition                       |                          |
|---|---------------------------------|--------------------------|
| SAR measured  | 250 mW input power              | 9.07 W/kg                |
| SAR for nominal Body TSL parameters                                     | normalized to 1W                | 36.8 W/kg ± 17.0 % (k=2) |
|   |                                 |                          |
|   |                                 |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL                 | condition                       |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL<br>SAR measured | condition<br>250 mW input power | 4.83 W/kg                |

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### Appendix (Additional assessments outside the scope of SCS 0108)

#### **Antenna Parameters with Head TSL**

| Impedance, transformed to feed point | 51.0 Ω + 0.1 jΩ |
|--------------------------------------|-----------------|
| Return Loss                          | - 39.9 dB       |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 45.6 Ω + 0.2 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | - 26.7 dB       |  |

### **General Antenna Parameters and Design**

| Electrical Delay (one direction) | 1.213 ns |  |
|----------------------------------|----------|--|
|----------------------------------|----------|--|

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

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

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

### **Additional EUT Data**

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

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## **DASY5 Validation Report for Head TSL**

Date: 16.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

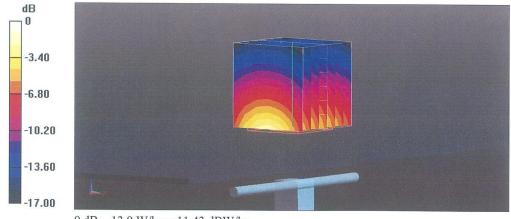
## DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1003

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.34 S/m;  $\epsilon_r$  = 40.2;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 106.1 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 16.6 W/kg SAR(1 g) = 9.01 W/kg; SAR(10 g) = 4.77 W/kg Maximum value of SAR (measured) = 13.9 W/kg



0 dB = 13.9 W/kg = 11.43 dBW/kg

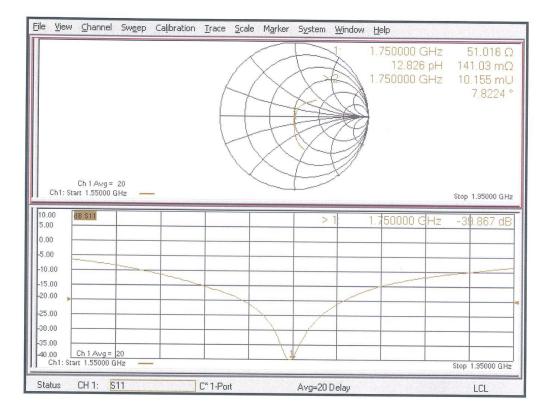
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## Impedance Measurement Plot for Head TSL



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## **DASY5 Validation Report for Body TSL**

Date: 16.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

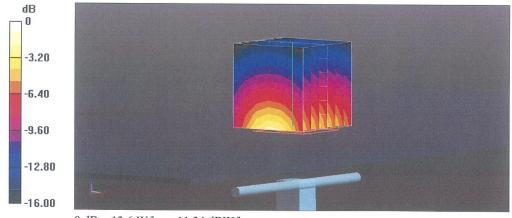
## DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1003

Communication System: UID 0 - CW; Frequency: 1750 MHz Medium parameters used: f = 1750 MHz;  $\sigma$  = 1.46 S/m;  $\epsilon_r$  = 53.5;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.45, 8.45, 8.45) @ 1750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 101.3 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 16.0 W/kg SAR(1 g) = 9.07 W/kg; SAR(10 g) = 4.83 W/kg Maximum value of SAR (measured) = 13.6 W/kg



0 dB = 13.6 W/kg = 11.34 dBW/kg

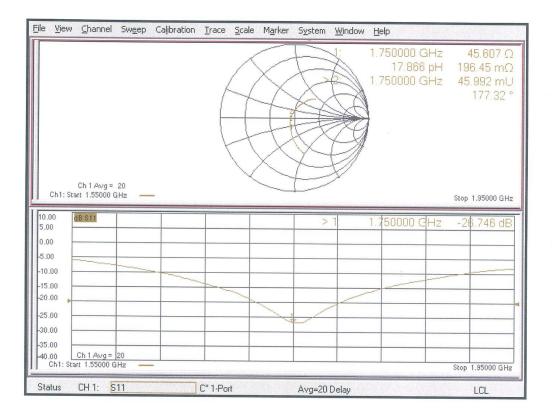
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## Impedance Measurement Plot for Body TSL



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# 1900 MHz Dipole Calibration Certificate

| Calibration Laboratory<br>Schmid & Partner<br>Engineering AG<br>eughausstrasse 43, 8004 Zurich, s   |  | S<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C<br>C  | Schweizerischer Kalibrierdienst<br>Service suisse d'étalonnage<br>Servizio svizzero di taratura<br>Swiss Calibration Service   |
|---|--|---|--|
| Accredited by the Swiss Accreditatio  |  | ×14.  | creditation No.: SCS 0108  |
| Aultilateral Agreement for the reco   |  |   |  |
| -   |  |   | : D1900V2-5d101_Jul19  |
| Client CTTL (Auden)   |  | Octanicate Ac   |  |
| CALIBRATION CE  | ERTIFICATE   |   |  |
| Object  | D1900V2 - SN:50  | J101  |  |
| Calibration procedure(s)  | QA CAL-05.v11  |   |  |
| ,   | Calibration Proce  | edure for SAR Validation Sources  | between 0.7-3 GHz  |
|   |  |   |  |
| Calibration date:   | July 17, 2019  |   |  |
|   | to the traceability to nati  | ional standards, which realize the physical ur  | nits of measurements (SI).   |
| This calibration certificate documer<br>The measurements and the uncerta  | ainties with confidence p  | robability are given on the following pages ar  | nd are part of the certificate.  |
| The measurements and the uncerta  | ainties with confidence p  | robability are given on the following pages ar<br>ry facility: environment temperature $(22 \pm 3)^\circ$   | nd are part of the certificate.  |
| The measurements and the uncerta  | ainties with confidence p  | robability are given on the following pages ar  | nd are part of the certificate.  |
| The measurements and the uncerta<br>All calibrations have been conducte<br>Calibration Equipment used (M&TE   | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)  | robability are given on the following pages ar<br>ry facility: environment temperature $(22 \pm 3)^{\circ}$   | nd are part of the certificate.  |
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| The measurements and the uncerta<br>All calibrations have been conducte<br>Calibration Equipment used (M&TE<br>Primary Standards<br>Power meter NRP   | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)  | robability are given on the following pages ar<br>ry facility: environment temperature $(22 \pm 3)^{\circ}$   | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration  |
| The measurements and the uncerta<br>All calibrations have been conducte<br>Calibration Equipment used (M&TE<br>Primary Standards  | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778  | robability are given on the following pages ar<br>ry facility: environment temperature (22 ± 3)°<br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)   | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20  |
| The measurements and the uncerta<br>All calibrations have been conducte<br>Calibration Equipment used (M&TE<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-Z91<br>Power sensor NRP-Z91   | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245  | robability are given on the following pages ar<br>ry facility: environment temperature (22 ± 3)°<br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)  | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20  |
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| The measurements and the uncerta<br>All calibrations have been conducte<br>Calibration Equipment used (M&TE<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-Z91<br>Power sensor NRP-Z91<br>Reference 20 dB Attenuator   | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245<br>SN: 103245<br>SN: 5058 (20k)<br>SN: 5047.2 / 06327  | robability are given on the following pages ar<br>ry facility: environment temperature (22 ± 3)°<br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)<br>03-Apr-19 (No. 217-02893)<br>04-Apr-19 (No. 217-02894)<br>04-Apr-19 (No. 217-02895)   | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20  |
| The measurements and the uncerta<br>All calibrations have been conducted<br>Calibration Equipment used (M&TE<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-Z91<br>Power sensor NRP-Z91<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4   | ainties with confidence p<br>ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103245<br>SN: 103245<br>SN: 5058 (20k)<br>SN: 5047.2 / 06327<br>SN: 7349<br>SN: 601   | Cal Date (Certificate No.)         03-Apr-19 (No. 217-02892/02893)         03-Apr-19 (No. 217-02892)         03-Apr-19 (No. 217-02892)         03-Apr-19 (No. 217-02893)         04-Apr-19 (No. 217-02894)         04-Apr-19 (No. 217-02895)         29-May-19 (No. EX3-7349_May19)         30-Apr-19 (No. DAE4-601_Apr19)  | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>May-20  |
| The measurements and the uncertal<br>All calibrations have been conducted<br>Calibration Equipment used (M&TE<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-Z91<br>Power sensor NRP-Z91<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards   | ainties with confidence p<br>ed in the closed laborato<br>critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245<br>SN: 5058 (20k)<br>SN: 5047.2 / 06327<br>SN: 7349<br>SN: 601<br>ID #   | Cal Date (Certificate No.)         03-Apr-19 (No. 217-02892/02893)         03-Apr-19 (No. 217-02892/02893)         03-Apr-19 (No. 217-02892)         03-Apr-19 (No. 217-02892)         03-Apr-19 (No. 217-02893)         04-Apr-19 (No. 217-02894)         04-Apr-19 (No. 217-02895)         29-May-19 (No. EX3-7349_May19)         30-Apr-19 (No. DAE4-601_Apr19)         Check Date (in house)  | nd are part of the certificate.<br>C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>May-20<br>Apr-20<br>Apr-20  |
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Certificate No: D1900V2-5d101\_Jul19

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

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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

## Glossary:

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

# Calibration is Performed According to the Following Standards:

- a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

e) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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## **Measurement Conditions**

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

| DASY Version                 | DASY5                  | V52.10.2    |
|------------------------------|------------------------|-------------|
| Extrapolation                | Advanced Extrapolation |             |
| Phantom                      | Modular Flat Phantom   |             |
| Distance Dipole Center - TSL | 10 mm                  | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm      |             |
| Frequency                    | 1900 MHz ± 1 MHz       |             |

## Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.0         | 1.40 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 41.5 ± 6 %   | 1.37 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        |              |                  |

### SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL                   | Condition                       |                          |
|---|---------------------------------|--------------------------|
| SAR measured  | 250 mW input power              | 9.71 W/kg                |
| SAR for nominal Head TSL parameters                                     | normalized to 1W                | 39.7 W/kg ± 17.0 % (k=2) |
|   |                                 |                          |
|   |                                 |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                 | condition                       |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured | condition<br>250 mW input power | 5.12 W/kg                |

## **Body TSL parameters**

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Body TSL parameters             | 22.0 °C         | 53.3         | 1.52 mho/m       |
| Measured Body TSL parameters            | (22.0 ± 0.2) °C | 54.1 ± 6 %   | 1.48 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C        |              |                  |

## SAR result with Body TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL                   | Condition                       |                          |
|---|---------------------------------|--------------------------|
| SAR measured  | 250 mW input power              | 9.74 W/kg                |
| SAR for nominal Body TSL parameters                                     | normalized to 1W                | 39.7 W/kg ± 17.0 % (k=2) |
|   |                                 |                          |
|   |                                 |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL                 | condition                       |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL<br>SAR measured | condition<br>250 mW input power | 5.17 W/kg                |

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## Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 50.7 Ω + 4.6 jΩ |  |
|--------------------------------------|-----------------|--|
| Return Loss                          | - 26.6 dB       |  |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 46.5 Ω + 6.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss                          | - 22.4 dB       |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.203 ns |
|----------------------------------|----------|
|----------------------------------|----------|

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

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

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

### **Additional EUT Data**

Manufactured by SPEAG

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## DASY5 Validation Report for Head TSL

Date: 15.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

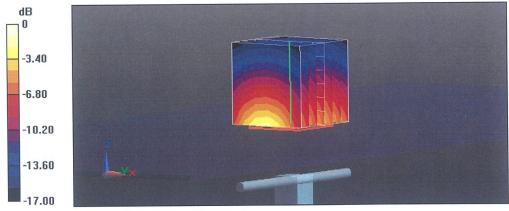
# DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.37 S/m;  $\epsilon_r$  = 41.5;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.44, 8.44, 8.44) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 108.4 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 17.6 W/kg SAR(1 g) = 9.71 W/kg; SAR(10 g) = 5.12 W/kg Maximum value of SAR (measured) = 14.9 W/kg



0 dB = 14.9 W/kg = 11.73 dBW/kg

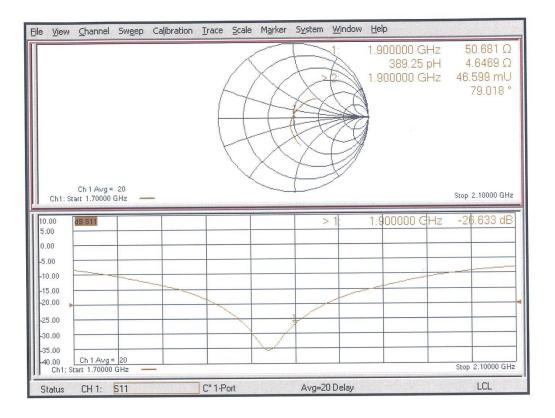
Certificate No: D1900V2-5d101\_Jul19

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## Impedance Measurement Plot for Head TSL



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## DASY5 Validation Report for Body TSL

Date: 17.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

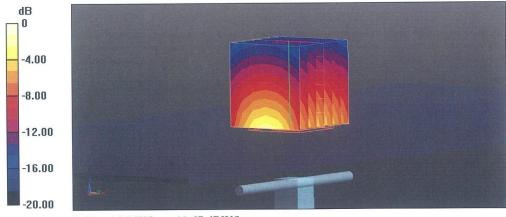
## DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d101

Communication System: UID 0 - CW; Frequency: 1900 MHz Medium parameters used: f = 1900 MHz;  $\sigma$  = 1.48 S/m;  $\epsilon_r$  = 54.1;  $\rho$  = 1000 kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(8.42, 8.42, 8.42) @ 1900 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.3 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 17.3 W/kg SAR(1 g) = 9.74 W/kg; SAR(10 g) = 5.17 W/kg Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg

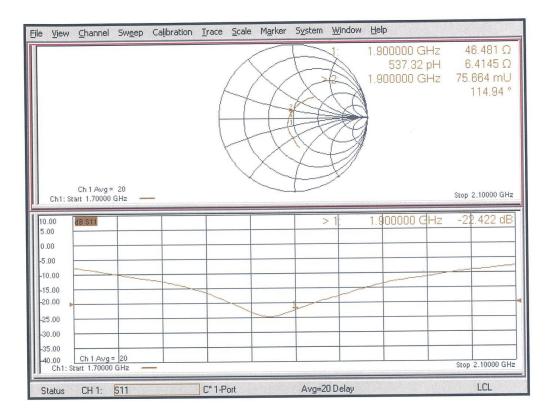
Certificate No: D1900V2-5d101\_Jul19

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## Impedance Measurement Plot for Body TSL



Certificate No: D1900V2-5d101\_Jul19

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# 2450 MHz Dipole Calibration Certificate

| The Swies Accreditation Service is one of the signatories to the EA<br>Multilateral Agreement for the recognition of calibration certificates Client CTTL (Auden) CALIBRATION CERTIFICATE Object D2450V2 - SN:853 Calibration procedure(s) QA CAL-05.v11 Calibration procedure(s) QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Calibration date: July 17, 2019 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibratio Power sensor NRP-291 SN: 103244 03-Apr19 (No. 217-02892/02893) Apr-20 Power sensor NRP-291 SN: 103244 03-Apr19 (No. 217-02892) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02892) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02892) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Reference 20 dB Attenuator SN: 5058 (20), 04-Apr-19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02892) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Reference 20 dB Attenuator SN: 5058 (20), 04-Apr-19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Power sensor NRP-291 SN: 103245 03-Apr19 (No. 217-02893) Apr-20 Reference 20 dB Attenuator SN: 5058 (20), 04-Apr-19 (No. 217-02893) Apr-20 Reference 20 BA Attenuator SN: 5058 (20), 04-Apr-19 (No. 217-02893) Apr-20 Reference 20 DE X3DV4 SN: 5047 20 (Aspr-19 (No. 217-02893) Apr-2 | bration Laboratory of<br>mid & Partner<br>ngineering AG<br>nausstrasse 43, 8004 Zurich, Sw                      |                       | HICKEDING   | <ul> <li>S Schweizerischer Kalibrierdienst</li> <li>Service suisse d'étalonnage</li> <li>Servizio svizzero di taratura</li> <li>S Swiss Calibration Service</li> </ul> |
|---|---|-----------------------|---|--|
| Client       CTTL (Auden)       Certificate No: D2450V2-853_Ju         CALIBRATION CERTIFICATE         Object       D2450V2 - SN:853         Calibration procedure(s)       QA CAL-05.v11<br>Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       July 17, 2019         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 calibration Equipment used (M&TE critical for calibration)         Primary Standards       ID #         Power meter NRP       SN: 103244         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02892)         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02893)         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02893)         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02893)         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02893)         Power sensor NRP-291       SN: 103245         SN: 103245       03-Apr-19 (No. 217-02893)   | wiss Accreditation Service is o   | one of the signatorie |   | Accreditation No.: SCS 0108  |
| Object         D2450V2 - SN:853           Calibration procedure(s)         QA CAL-05.v11<br>Calibration Procedure for SAR Validation Sources between 0.7-3 GHz           Calibration date:         July 17, 2019           This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).<br>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 ± 3)°C and humidity < 70%.<br>Calibration Equipment used (M&TE critical for calibration)           Primary Standards         ID #         Cal Date (Certificate No.)         Scheduled Calibration<br>Apr-20           Power sensor NRP-Z91         SN: 104778         03-Apr-19 (No. 217-02892/02893)         Apr-20           Power sensor NRP-Z91         SN: 104244         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 103244         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02892)         Apr-20           Type-N mismatch combination         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02895)         <   |   |                       |   | e No: D2450V2-853_Jul19  |
| Calibration procedure(s)       QA CAL-05.v11<br>Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       July 17, 2019         This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).<br>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%.   | LIBRATION CEP   | RTIFICATE             |   |  |
| Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Calibration date:       July 17, 2019         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%.  | D2  | 2450V2 - SN:85        | 53  |  |
| 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%.   |   |                       | dure for SAR Validation Sour  | ces between 0.7-3 GHz  |
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| Power meter NRP         SN: 104778         03-Apr-19 (No. 217-02892/02893)         Apr-20           Power sensor NRP-Z91         SN: 103244         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02893)         Apr-20           Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02893)         Apr-20           Reference 20 dB Attenuator         SN: 5058 (20k)         04-Apr-19 (No. 217-02893)         Apr-20           Type-N mismatch combination         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02895)         Apr-20           Reference Probe EX3DV4         SN: 7349         29-May-19 (No. EX3-7349_May19)         May-20           DAE4         SN: 601         30-Apr-19 (No. DAE4-601_Apr19)         Apr-20           Secondary Standards         ID #         Check Date (in house)         Scheduled Check           Power meter E4419B         SN: GB39512475         30-Oct-14 (in house check Feb-19)         In house check: Oct-18)           Power sensor HP 8481A         SN: US37292783         07-Oct-15 (in house check Oct-18)         In house check: Oct-18)  |   | ,                     |   |  |
| Power sensor NRP-Z91         SN: 103244         03-Apr-19 (No. 217-02892)         Apr-20           Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02892)         Apr-20           Reference 20 dB Attenuator         SN: 5058 (20k)         04-Apr-19 (No. 217-02894)         Apr-20           Type-N mismatch combination         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02894)         Apr-20           Reference Probe EX3DV4         SN: 7349         29-May-19 (No. EX3-7349_May19)         May-20           DAE4         SN: 601         30-Apr-19 (No. DAE4-601_Apr19)         Apr-20           Secondary Standards         ID #         Check Date (in house)         Scheduled Check           Power meter E4419B         SN: GB39512475         30-Oct-14 (in house check Feb-19)         In house check: Oct-18)           Power sensor HP 8481A         SN: WY41092317         07-Oct-15 (in house check Oct-18)         In house check: Oct-18)   |   |                       |   | Scheduled Calibration  |
| Power sensor NRP-Z91         SN: 103245         03-Apr-19 (No. 217-02893)         Apr-20           Reference 20 dB Attenuator         SN: 5058 (20k)         04-Apr-19 (No. 217-02893)         Apr-20           Type-N mismatch combination         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02895)         Apr-20           Reference Probe EX3DV4         SN: 7349         29-May-19 (No. 2X7-02895)         Apr-20           DAE4         SN: 601         30-Apr-19 (No. DAE4-601_Apr19)         May-20           Secondary Standards         ID #         Check Date (in house)         Scheduled Check           Power meter E4419B         SN: GB39512475         30-Oct-14 (in house check Feb-19)         In house check: Oct-18           Power sensor HP 8481A         SN: WY41092317         07-Oct-15 (in house check Oct-18)         In house check: Oct-18   |   |                       |   | DATE OF ENGLISHING   |
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| Type-N mismatch combination         SN: 5047.2 / 06327         04-Apr-19 (No. 217-02895)         Apr-20           Reference Probe EX3DV4         SN: 7349         29-May-19 (No. 247-02895)         Apr-20           DAE4         SN: 601         30-Apr-19 (No. DAE4-601_Apr19)         May-20           Secondary Standards         ID #         Check Date (in house)         Scheduled Check           Power meter E4419B         SN: GB39512475         30-Oct-14 (in house check Feb-19)         In house check: Oct-18)           Power sensor HP 8481A         SN: US37292783         07-Oct-15 (in house check Oct-18)         In house check: Oct-18)   |   |                       |   |  |
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| Jetwork Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-18) In house check: Oct-   | IN Analyzer Aglient E8358A SN   | N: US41080477         | з1-маг-14 (In house check Oct-18)   | In house check: Oct-19   |
| Name Function Signature   |   |                       | Function  | Signature  |
| Calibrated by: Michael Weber Laboratory Technician  | ated by: Mid  | chael Weber           | Laboratory Technician   | Meres  |
| Approved by: Katja Pokovic Technical Manager  | ved by: Ka  | tja Pokovic           | Technical Manager   | Alls   |

Certificate No: D2450V2-853\_Jul19

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