

## **Annex Z. Calibration Certificate for Probe and Dipole**

The SPEAG calibration certificates are shown as follows.



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

Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **CLA13-1018\_Mar22**

## CALIBRATION CERTIFICATE

Object **CLA13 - SN: 1018**

Calibration procedure(s) **QA CAL-15.v9  
Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **March 22, 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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 09-Apr-21 (No. 217-03291/03292) | Apr-22                |
| Power sensor NRP-Z91        | SN: 103244         | 09-Apr-21 (No. 217-03291)       | Apr-22                |
| Power sensor NRP-Z91        | SN: 103245         | 09-Apr-21 (No. 217-03292)       | Apr-22                |
| Reference 20 dB Attenuator  | SN: CC2552 (20x)   | 09-Apr-21 (No. 217-03343)       | Apr-22                |
| Type-N mismatch combination | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344)       | Apr-22                |
| Reference Probe EX3DV4      | SN: 3877           | 31-Dec-21 (No. EX3-3877_Dec21)  | Dec-22                |
| DAE4                        | SN: 654            | 26-Jan-22 (No. DAE4-654_Jan22)  | Jan-23                |

| Secondary Standards             | ID #             | Check Date (in house)             | Scheduled Check        |
|---------------------------------|------------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB41293874   | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A             | SN: MY41498087   | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| Power sensor E4412A             | SN: 000110210    | 06-Apr-16 (in house check Jun-20) | In house check: Jun-22 |
| RF generator HP 8648C           | SN: US3642U01700 | 04-Aug-99 (in house check Jun-20) | In house check: Jun-22 |
| Network Analyzer Agilent E8358A | SN: US41080477   | 31-Mar-14 (in house check Oct-20) | In house check: Oct-22 |

Calibrated by: **Jeffrey Katzman**      **Jeffrey Katzman**      **Laboratory Technician**

Approved by: **Sven Kühn**      **Sven Kühn**      **Deputy Manager**

Signature

Issued: March 22, 2022

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



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:

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

### Additional Documentation:

- DASY System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

## Measurement Conditions

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

|                      |                                  |                                  |
|----------------------|----------------------------------|----------------------------------|
| DASY Version         | DASY52                           | V52.10.4                         |
| Extrapolation        | Advanced Extrapolation           |                                  |
| Phantom              | ELI4 Flat Phantom                | Shell thickness: $2 \pm 0.2$ mm  |
| EUT Positioning      | Touch Position                   |                                  |
| Zoom Scan Resolution | $dx, dy = 4.0$ mm, $dz = 1.4$ mm | Graded Ratio = 1.4 (Z direction) |
| Frequency            | $13$ MHz $\pm 1$ MHz             |                                  |

## Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity           |
|---|---------------------|----------------|------------------------|
| Nominal Head TSL parameters             | $22.0$ °C           | 55.0           | 0.75 mho/m             |
| Measured Head TSL parameters            | $(22.0 \pm 0.2)$ °C | $55.1 \pm 6$ % | $0.73$ mho/m $\pm 6$ % |
| 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  | 1 W input power  | 0.551 W/kg                                      |
| SAR for nominal Head TSL parameters                       | normalized to 1W | <b>0.563 W/kg <math>\pm 18.4</math> % (k=2)</b> |
| SAR averaged over $10$ cm <sup>3</sup> (10 g) of Head TSL | condition        |   |
| SAR measured  | 1 W input power  | 0.343 W/kg                                      |
| SAR for nominal Head TSL parameters                       | normalized to 1W | <b>0.350 W/kg <math>\pm 18.0</math> % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                             |
|--------------------------------------|-----------------------------|
| Impedance, transformed to feed point | $50.9 \Omega + 3.0 j\Omega$ |
| Return Loss                          | - 30.2 dB                   |

### Additional EUT Data

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

# DASY5 Validation Report for Head TSL

Date: 22.03.2022

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1018**

Communication System: UID 0 - CW; Frequency: 13 MHz

Medium parameters used:  $f = 13 \text{ MHz}$ ;  $\sigma = 0.73 \text{ S/m}$ ;  $\epsilon_r = 55.1$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0:** Measurement grid:  $dx=4\text{mm}$ ,  $dy=4\text{mm}$ ,  $dz=1.4\text{mm}$

Reference Value = 29.21 V/m; Power Drift = -0.06 dB

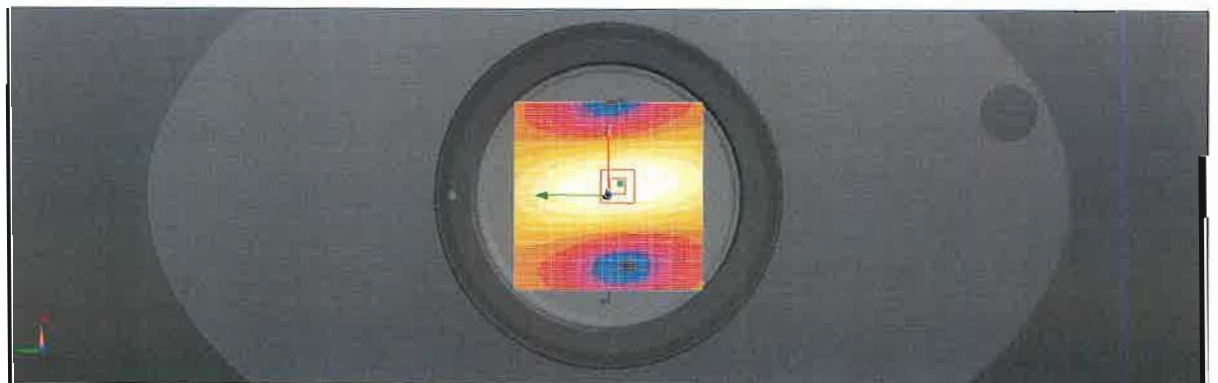
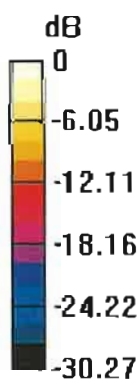
Peak SAR (extrapolated) = 1.08 W/kg

**SAR(1 g) = 0.551 W/kg; SAR(10 g) = 0.343 W/kg**

Smallest distance from peaks to all points 3 dB below = 26.6 mm

Ratio of SAR at M2 to SAR at M1 = 79.6%

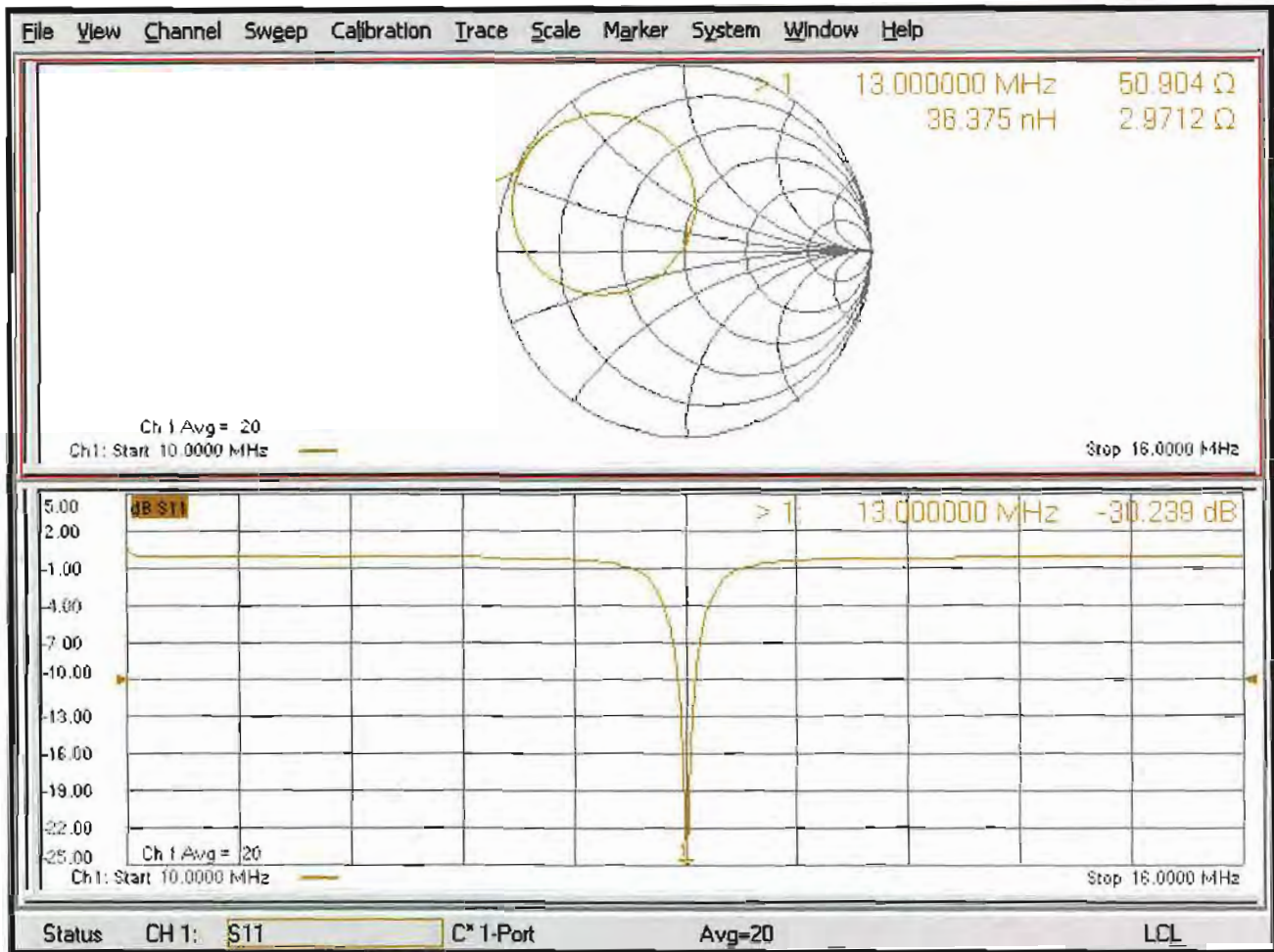
Maximum value of SAR (measured) = 0.803 W/kg



0 dB = 0.803 W/kg = -0.95 dBW/kg



# Impedance Measurement Plot for Head TSL





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中国认可  
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CNAS L0570

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Client

**B.V.ADT**

Certificate No:

**Z21-60279**

## CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1013**

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

Calibration date: **August 31, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Power Meter NRP2        | 106277     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Power sensor NRP8S      | 104291     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Reference Probe EX3DV4  | SN 7517    | 03-Feb-21(CTTL-SPEAG,No.Z21-60001)        | Feb-22                |
| DAE3                    | SN 536     | 06-Nov-20(CTTL-SPEAG,No.Z20-60452)        | Nov-21                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-21 (CTTL, No.J21X00593)            | Jan-22                |
| NetworkAnalyzer E5071C  | MY46110673 | 14-Jan-21 (CTTL, No.J21X00232)            | Jan-22                |

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

Issued: September 6, 2021

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### Glossary:

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

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

- 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
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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 stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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



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### Measurement Conditions

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | V52.10.4    |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 15 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 750 MHz $\pm$ 1 MHz      |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature         | Permittivity   | Conductivity         |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 42.0           | 0.90 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 41.8 $\pm$ 6 % | 0.90 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | ---            | ---                  |

### SAR result with Head TSL

|   |                    |  |
|---|--------------------|--|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>   | Condition          |  |
| SAR measured  | 250 mW input power | 2.15 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>8.56 W/kg <math>\pm</math> 18.8 % (k=2)</b> |
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | Condition          |  |
| SAR measured  | 250 mW input power | 1.41 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>5.62 W/kg <math>\pm</math> 18.7 % (k=2)</b> |



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

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 53.6Ω+ 0.26jΩ |
| Return Loss                          | - 29.2dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 0.941 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: 08.31.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1013**

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 750$  MHz;  $\sigma = 0.895$  S/m;  $\epsilon_r = 41.82$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(9.81, 9.81, 9.81) @ 750 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2020-11-06
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 55.83 V/m; Power Drift = -0.01 dB

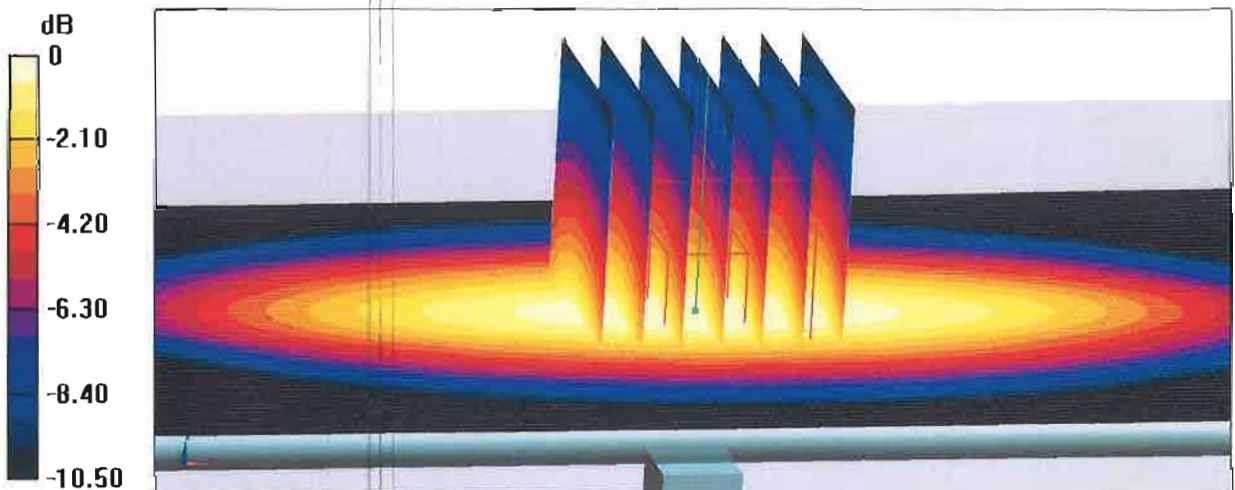
Peak SAR (extrapolated) = 3.36 W/kg

**SAR(1 g) = 2.15 W/kg; SAR(10 g) = 1.41 W/kg**

Smallest distance from peaks to all points 3 dB below = 18.6 mm

Ratio of SAR at M2 to SAR at M1 = 64.1%

Maximum value of SAR (measured) = 2.92 W/kg

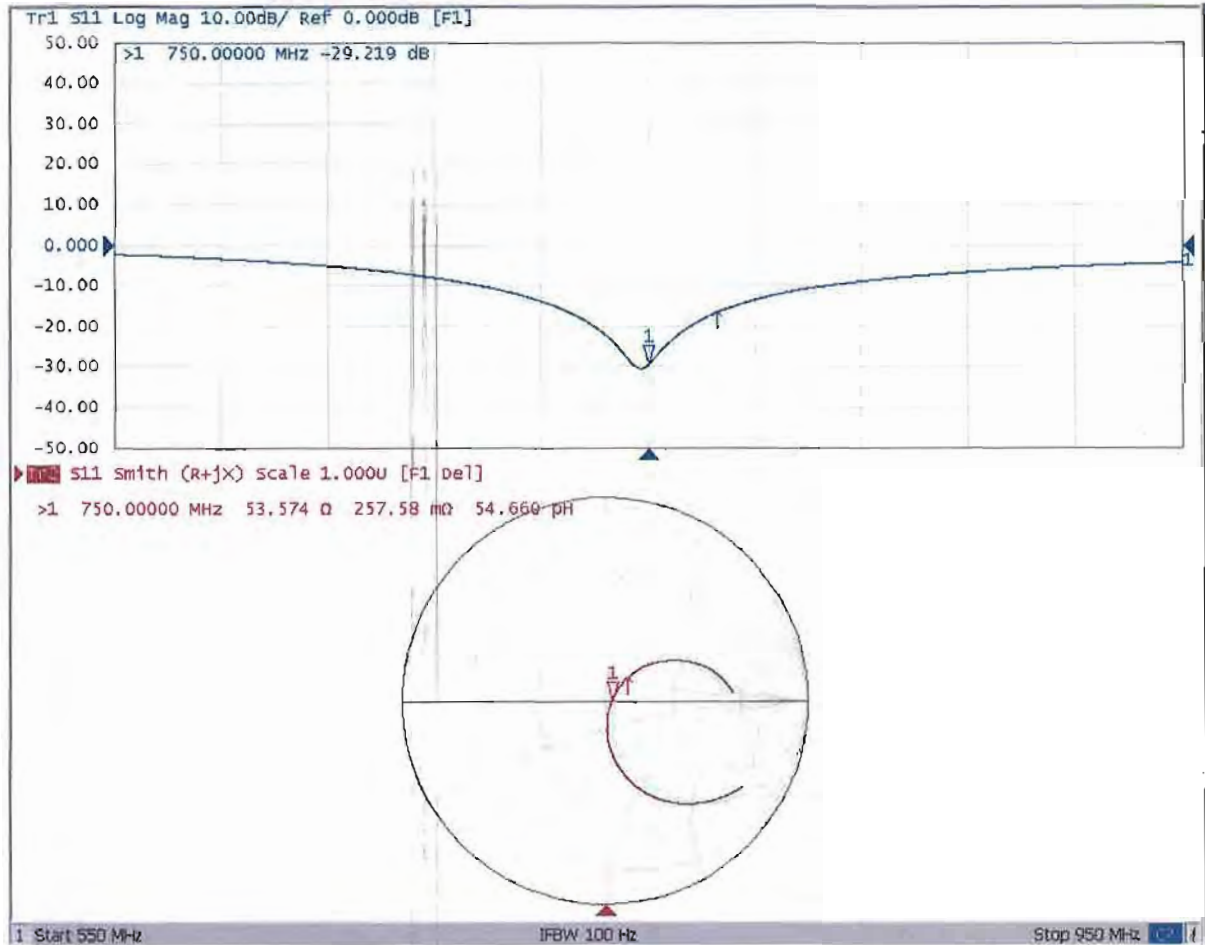


**0 dB = 2.92 W/kg = 4.65 dBW/kg**



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### Impedance Measurement Plot for Head TSL







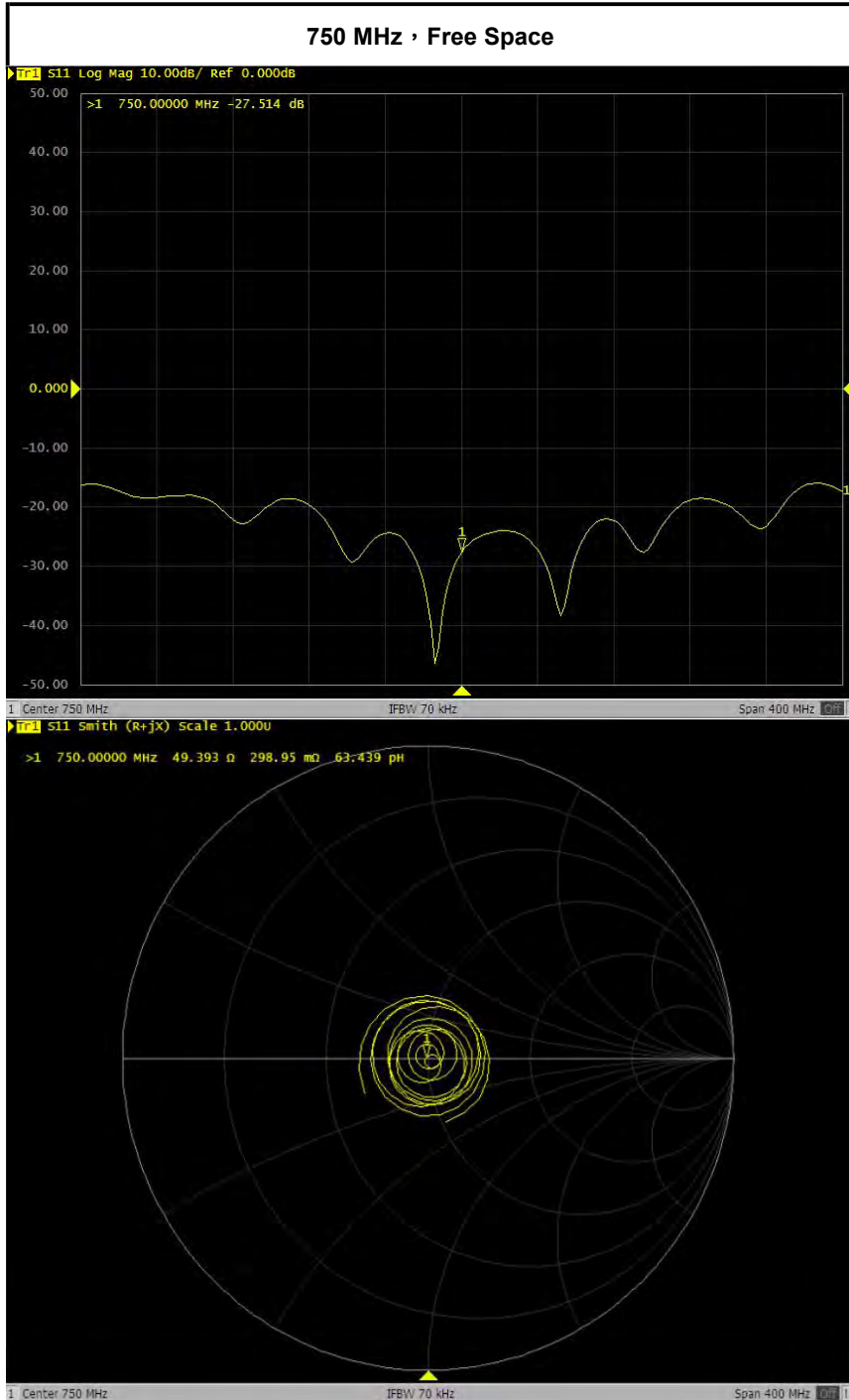
## Annual Confirmation of SAR Reference Dipole

Model : D750V3

S/N : 1013

Measurement Date : 2022/8/30

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 750             | Free Space | Real Impedance      | 53.574               | 49.393       | -4.181    | $\pm 5\Omega$      | PASS   |
|                 |            | Imaginary Impedance | 0.2576               | 0.2990       | 0.04      | $\pm 5\Omega$      | PASS   |
|                 |            | Return Loss         | -29.219              | -27.514      | -5.84%    | $\pm 20\%$         | PASS   |







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Client

**B.V.ADT**

Certificate No:

**Z21-60280**

## CALIBRATION CERTIFICATE

Object

D835V2 - SN: 4d121

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

August 31, 2021

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Power Meter NRP2        | 106277     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Power sensor NRP8S      | 104291     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Reference Probe EX3DV4  | SN 7517    | 03-Feb-21(CTTL-SPEAG,No.Z21-60001)        | Feb-22                |
| DAE3                    | SN 536     | 06-Nov-20(CTTL-SPEAG,No.Z20-60452)        | Nov-21                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-21 (CTTL, No.J21X00593)            | Jan-22                |
| NetworkAnalyzer E5071C  | MY46110673 | 14-Jan-21 (CTTL, No.J21X00232)            | Jan-22                |

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

Issued: September 6, 2021

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### Glossary:

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

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

- 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
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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 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.

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

### Head TSL parameters

The following parameters and calculations were applied.

|  | Temperature     | Permittivity | Conductivity     |
|--|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C         | 41.5         | 0.90 mho/m       |
| <b>Measured Head TSL parameters</b>            | (22.0 ± 0.2) °C | 41.7 ± 6 %   | 0.88 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>   | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 250 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>9.58 W/kg ± 18.8 % (k=2)</b> |
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | Condition          |                                 |
| SAR measured  | 250 mW input power | 1.53 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>6.19 W/kg ± 18.7 % (k=2)</b> |



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

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 51.4Ω- 3.55jΩ |
| Return Loss                          | - 28.5dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.301 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: 08.31.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d121**

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.884 \text{ S/m}$ ;  $\epsilon_r = 41.66$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(9.81, 9.81, 9.81) @ 835 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2020-11-06
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 58.83 V/m; Power Drift = 0.00 dB

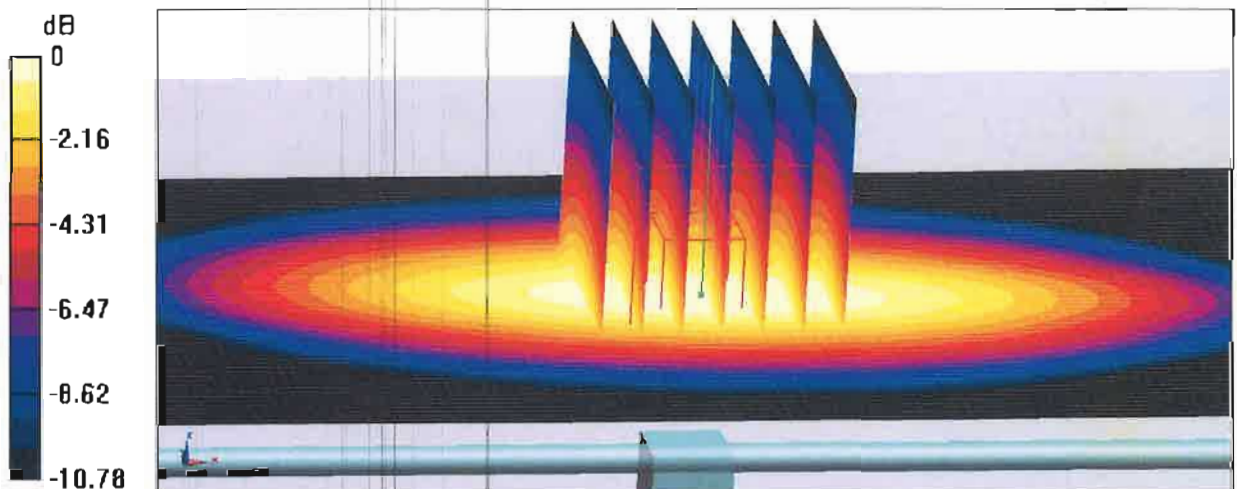
Peak SAR (extrapolated) = 3.72 W/kg

**SAR(1 g) = 2.36 W/kg; SAR(10 g) = 1.53 W/kg**

Smallest distance from peaks to all points 3 dB below = 18.6 mm

Ratio of SAR at M2 to SAR at M1 = 63.7%

Maximum value of SAR (measured) = 3.24 W/kg



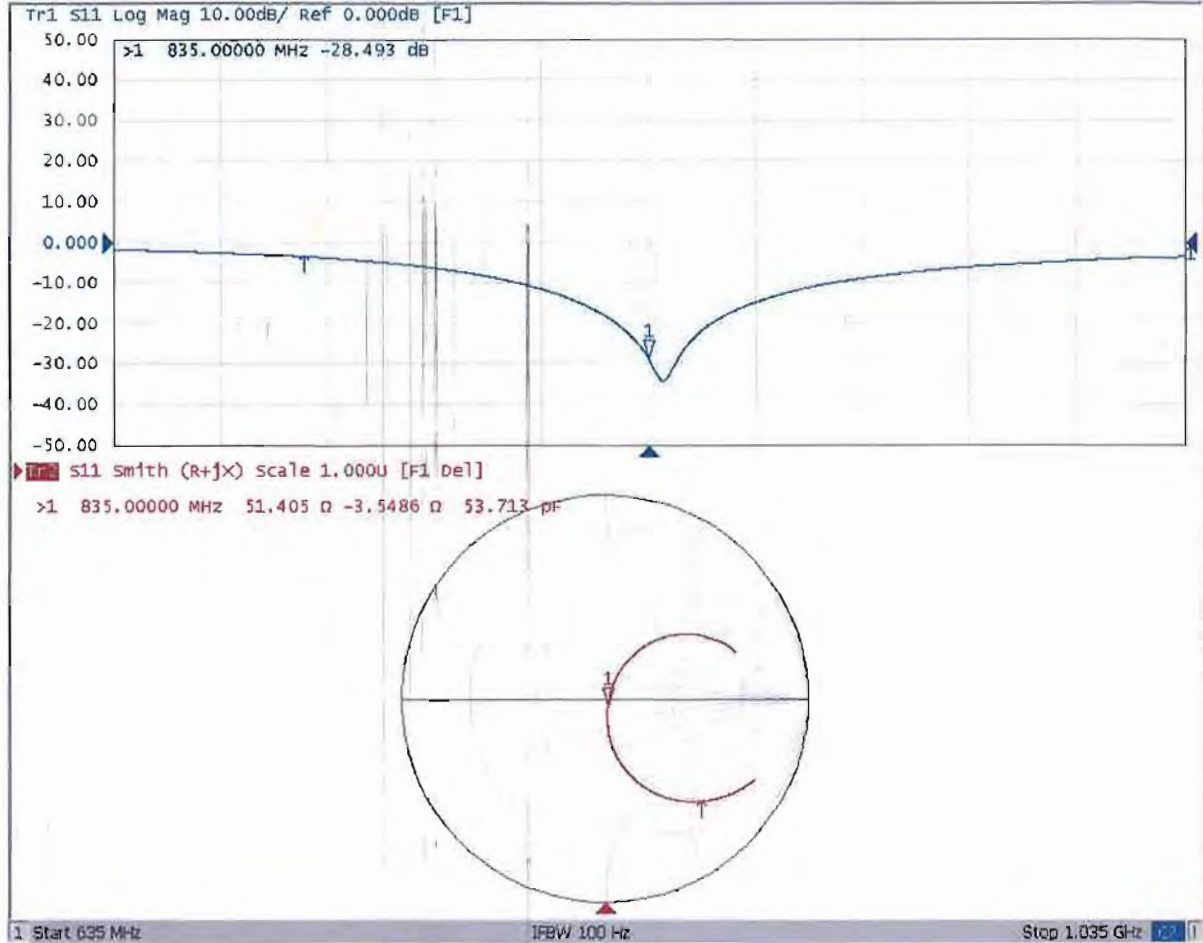
0 dB = 3.24 W/kg = 5.11 dBW/kg



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### Impedance Measurement Plot for Head TSL







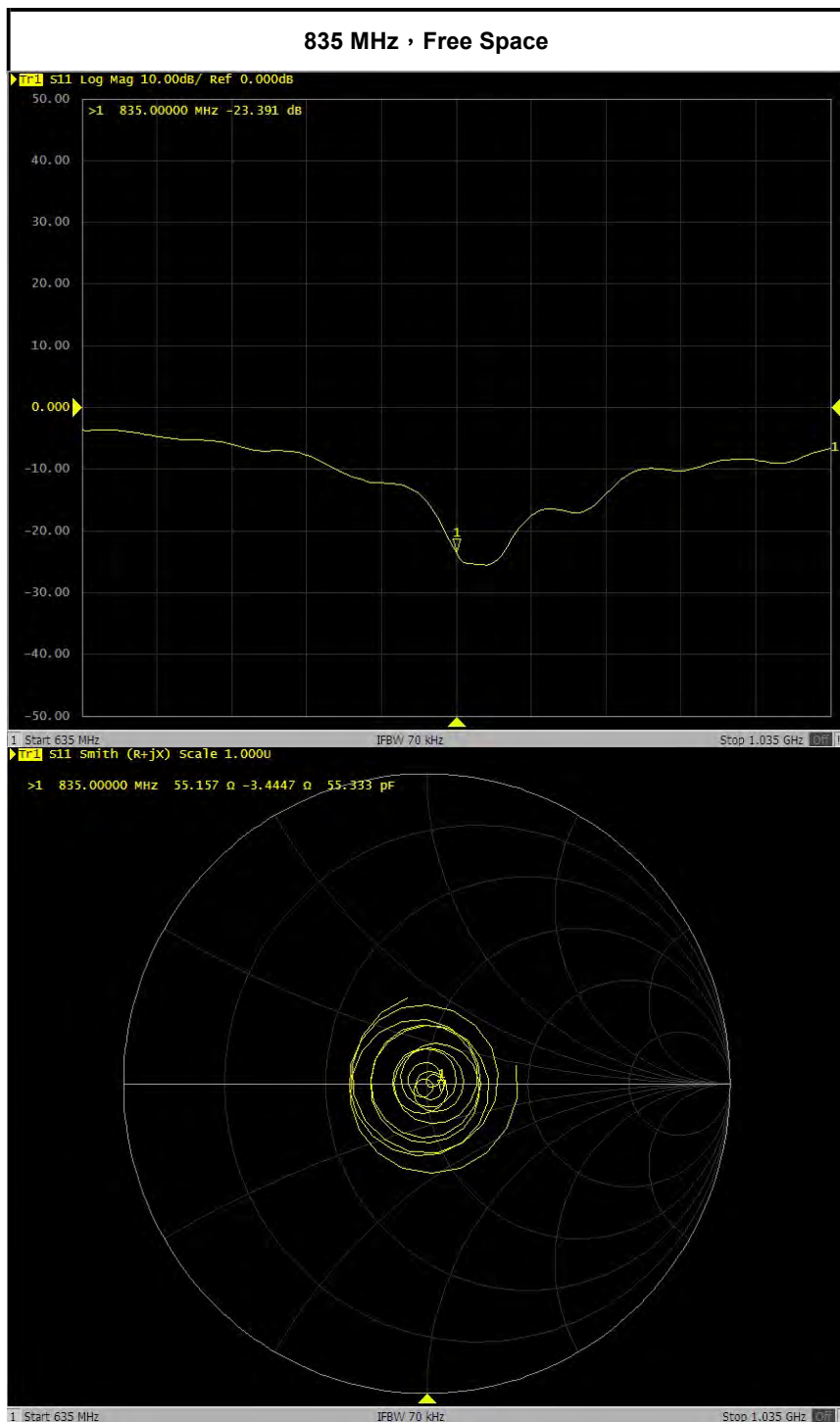
## Annual Confirmation of SAR Reference Dipole

Model : D835V2

S/N : 4d121

Measurement Date : 2022/8/30

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 835             | Free Space | Real Impedance      | 51.405               | 55.157       | 3.75      | $\pm 5\Omega$      | PASS   |
|                 |            | Imaginary Impedance | -3.5486              | -3.4447      | 0.10      | $\pm 5\Omega$      | PASS   |
|                 |            | Return Loss         | -28.493              | -23.391      | -17.91%   | $\pm 20\%$         | PASS   |





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Client **B.V.ADT**

Certificate No: **Z21-60283**

## CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1055**

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

Calibration date: **September 2, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Power Meter NRP2        | 106277     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Power sensor NRP8S      | 104291     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Reference Probe EX3DV4  | SN 7517    | 03-Feb-21(CTTL-SPEAG, No.Z21-60001)       | Feb-22                |
| DAE4                    | SN 1556    | 15-Jan-21(SPEAG, No.DAE4-1556_Jan21)      | Jan-22                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-21 (CTTL, No.J21X00593)            | Jan-22                |
| NetworkAnalyzer E5071C  | MY46110673 | 14-Jan-21 (CTTL, No.J21X00232)            | Jan-22                |

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

Issued: September 8, 2021

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



### Glossary:

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

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

- 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
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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 stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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



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### Measurement Conditions

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

|                              |                          |             |
|------------------------------|--------------------------|-------------|
| DASY Version                 | DASY52                   | V52.10.4    |
| Extrapolation                | Advanced Extrapolation   |             |
| Phantom                      | Triple Flat Phantom 5.1C |             |
| Distance Dipole Center - TSL | 10 mm                    | with Spacer |
| Zoom Scan Resolution         | dx, dy, dz = 5 mm        |             |
| Frequency                    | 1750 MHz ± 1 MHz         |             |

### Head TSL parameters

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 40.1         | 1.37 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 40.4 ± 6 %   | 1.36 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °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 | 8.90 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 35.8 W/kg ± 18.8 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured  | 250 mW input power | 4.64 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 18.6 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 | 48.7 $\Omega$ - 1.56j $\Omega$ |
| Return Loss                          | - 33.8 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.123 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: 09.02.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1055**

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

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.364$  S/m;  $\epsilon_r = 40.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(8.22, 8.22, 8.22) @ 1750 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm; (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2021-01-15
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

$dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 97.84 V/m; Power Drift = 0.00 dB

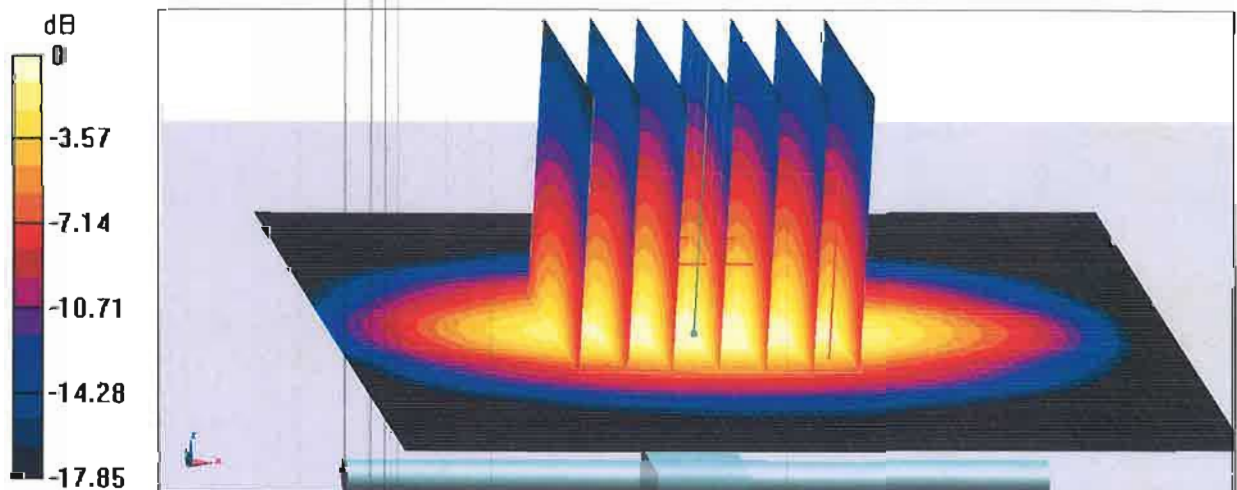
Peak SAR (extrapolated) = 17.0 W/kg

**SAR(1 g) = 8.9 W/kg; SAR(10 g) = 4.64 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 52.6%

Maximum value of SAR (measured) = 13.9 W/kg



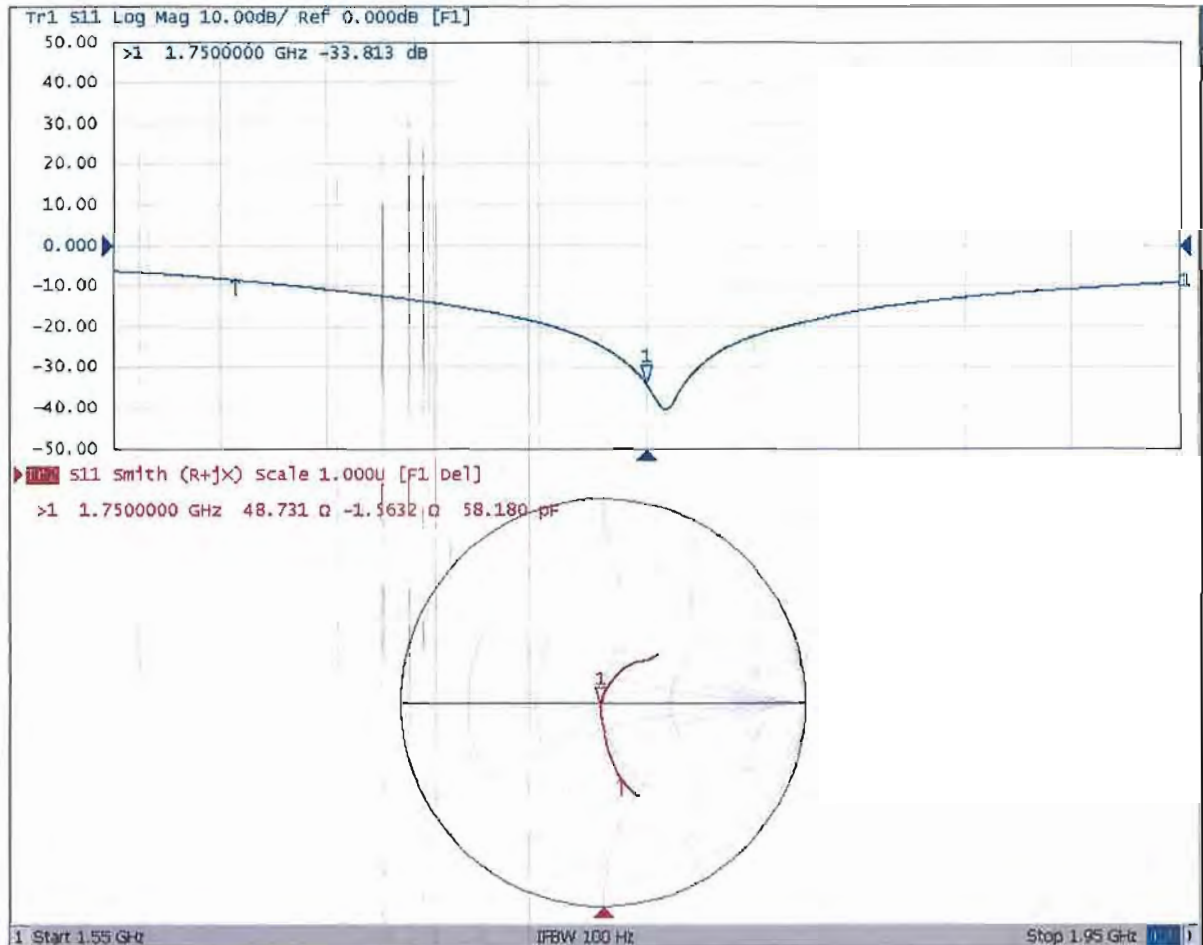
0 dB = 13.9 W/kg = 11.43 dBW/kg





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### Impedance Measurement Plot for Head TSL





Accreditation No.: **SCS 0108**

Accredited by the Swiss Accreditation Service (SAS)  
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Multilateral Agreement for the recognition of calibration certificates

Client **B.V. ADT (Auden)**

Certificate No: **D1900V2-5d036\_Jan21**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d036**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **January 22, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 01-Apr-20 (No. 217-03100/03101)   | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103244         | 01-Apr-20 (No. 217-03100)         | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103245         | 01-Apr-20 (No. 217-03101)         | Apr-21                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 31-Mar-20 (No. 217-03106)         | Apr-21                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104)         | Apr-21                 |
| Reference Probe EX3DV4          | SN: 7349           | 28-Dec-20 (No. EX3-7349_Dec20)    | Dec-21                 |
| DAE4                            | SN: 601            | 02-Nov-20 (No. DAE4-601_Nov20)    | Nov-21                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-20) | In house check: Oct-21 |

Calibrated by: **Jeffrey Katzman**      **Jeffrey Katzman**      **Laboratory Technician**

Approved by: **Katja Pokovic**      **Katja Pokovic**      **Technical Manager**

Issued: January 25, 2021

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Accreditation No.: **SCS 0108**

### Glossary:

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

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

- 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
- 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
- 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
- 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 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%.

## Measurement Conditions

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

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.4    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 1900 MHz $\pm$ 1 MHz   |             |

## Head TSL parameters

The following parameters and calculations were applied.

|  | Temperature         | Permittivity   | Conductivity         |
|--|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 40.0           | 1.40 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 41.2 $\pm$ 6 % | 1.39 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----           | ----                 |

## SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 10.0 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>40.4 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 5.23 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>21.1 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.4 $\Omega$ + 5.3 j $\Omega$ |
| Return Loss                          | - 25.5 dB                      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.195 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

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

# DASY5 Validation Report for Head TSL

Date: 22.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d036**

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.39$  S/m;  $\epsilon_r = 41.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(8.43, 8.43, 8.43) @ 1900 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

## 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 = 109.8 V/m; Power Drift = 0.03 dB

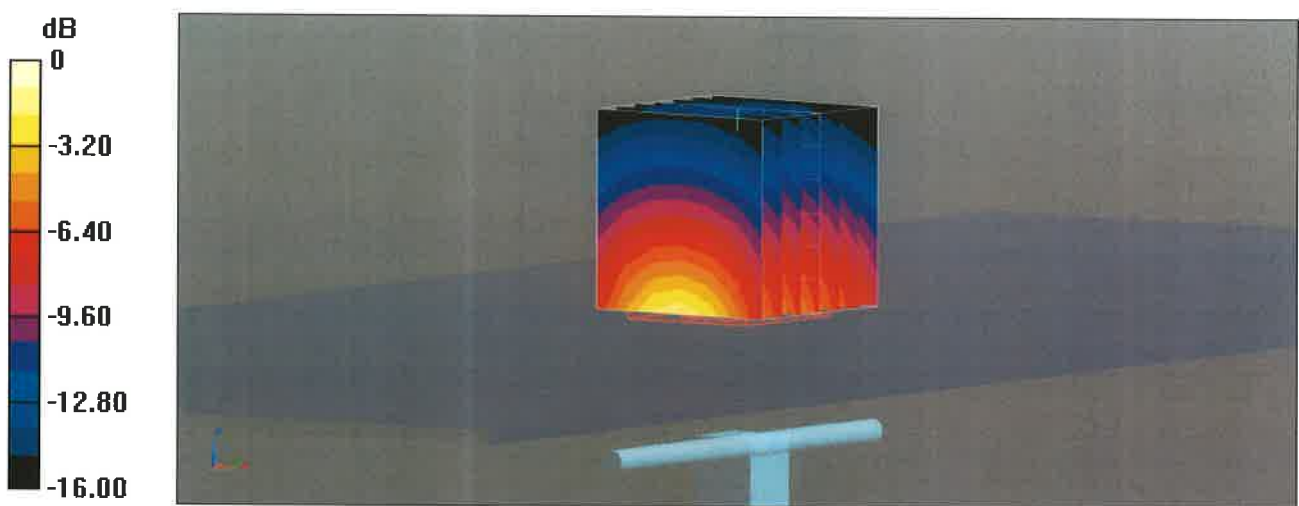
Peak SAR (extrapolated) = 18.4 W/kg

**SAR(1 g) = 10.0 W/kg; SAR(10 g) = 5.23 W/kg**

Smallest distance from peaks to all points 3 dB below = 9.8 mm

Ratio of SAR at M2 to SAR at M1 = 55.3%

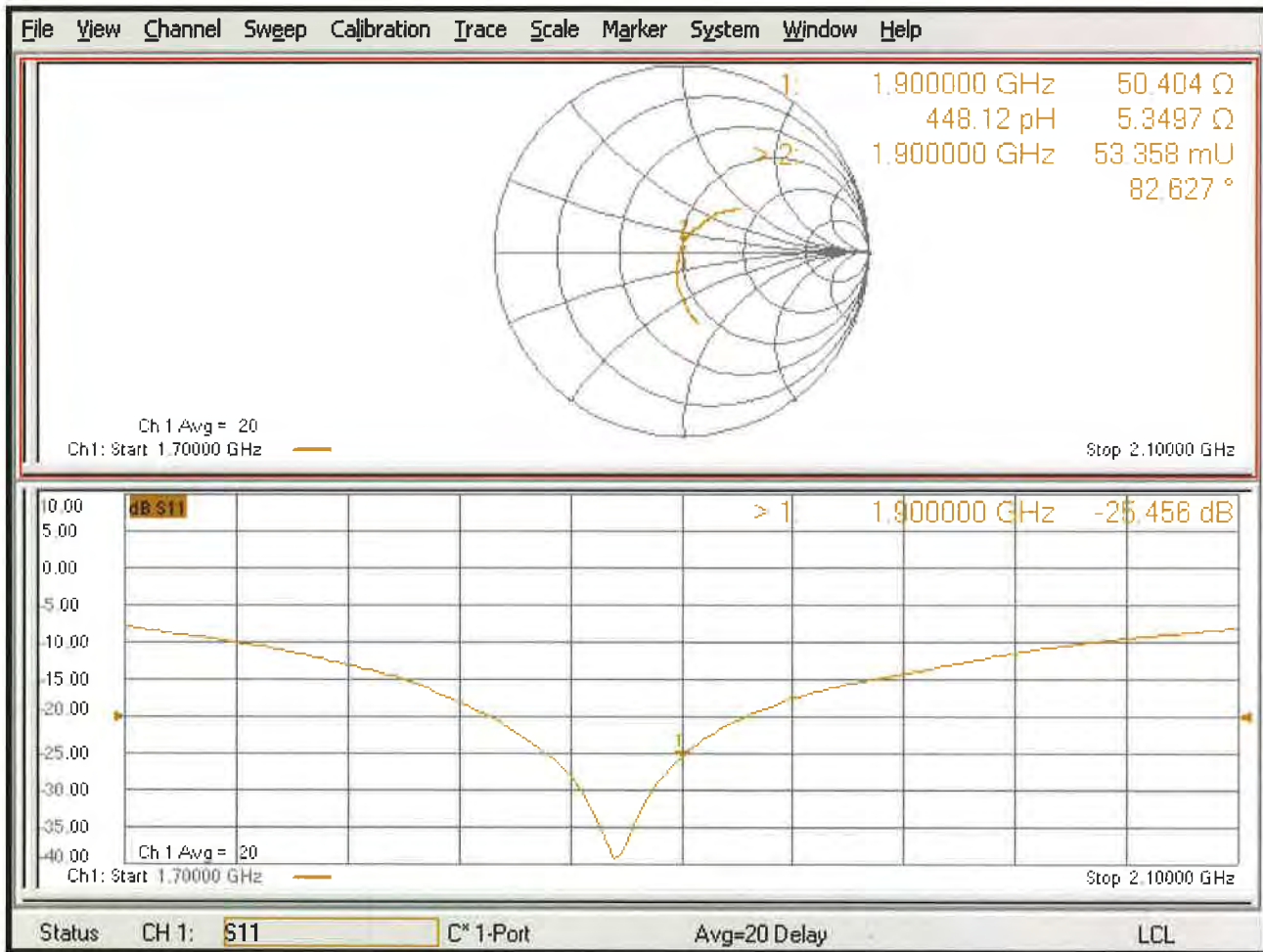
Maximum value of SAR (measured) = 15.3 W/kg



0 dB = 15.3 W/kg = 11.85 dBW/kg



# Impedance Measurement Plot for Head TSL





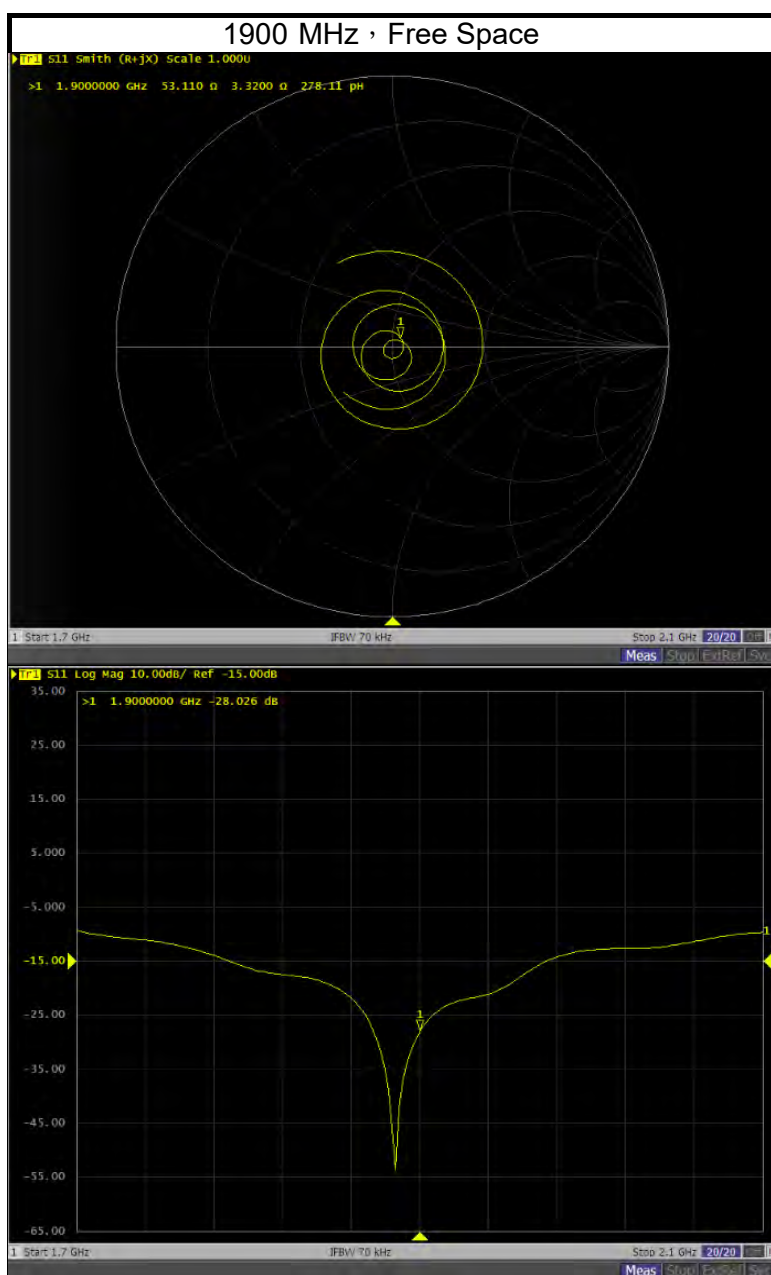
# Annual Confirmation of SAR Reference Dipole

Model : D1900V2

S/N : 5d036

Measurement Date : 2022/1/21

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 1900            | Free Space | Real Impedance      | 50.404               | 53.110       | 2.71      | $\pm 5\Omega$      | PASS   |
|                 |            | Imaginary Impedance | 0.5336               | 3.3200       | 2.79      | $\pm 5\Omega$      | PASS   |
|                 |            | Return Loss         | -25.456              | -28.026      | 10.10%    | $\pm 20\%$         | PASS   |





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Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D2300V2-1004\_Jan21**

## CALIBRATION CERTIFICATE

Object **D2300V2 - SN:1004**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **January 22, 2021**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 01-Apr-20 (No. 217-03100/03101)   | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103244         | 01-Apr-20 (No. 217-03100)         | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103245         | 01-Apr-20 (No. 217-03101)         | Apr-21                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 31-Mar-20 (No. 217-03106)         | Apr-21                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104)         | Apr-21                 |
| Reference Probe EX3DV4          | SN: 7349           | 28-Dec-20 (No. EX3-7349_Dec20)    | Dec-21                 |
| DAE4                            | SN: 601            | 02-Nov-20 (No. DAE4-601_Nov20)    | Nov-21                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-20) | In house check: Oct-21 |

Calibrated by: **Jeffrey Katzman**      **Jeffrey Katzman**      **Laboratory Technician**

Approved by: **Katja Pokovic**      **Katja Pokovic**      **Technical Manager**

Issued: January 25, 2021

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### Glossary:

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

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

- 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
- 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
- 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
- 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 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%.

## Measurement Conditions

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

|                                     |                        |             |
|-------------------------------------|------------------------|-------------|
| <b>DASY Version</b>                 | DASY5                  | V52.10.4    |
| <b>Extrapolation</b>                | Advanced Extrapolation |             |
| <b>Phantom</b>                      | Modular Flat Phantom   |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                  | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm      |             |
| <b>Frequency</b>                    | 2300 MHz ± 1 MHz       |             |

## Head TSL parameters

The following parameters and calculations were applied.

|  | Temperature     | Permittivity | Conductivity     |
|--|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C         | 39.5         | 1.67 mho/m       |
| <b>Measured Head TSL parameters</b>            | (22.0 ± 0.2) °C | 38.7 ± 6 %   | 1.71 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C        | ----         | ----             |

## SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 250 mW input power | 12.5 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>49.2 W/kg ± 17.0 % (k=2)</b> |

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



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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 48.5 $\Omega$ - 3.1 j $\Omega$ |
| Return Loss                          | - 29.2 dB                      |

### General Antenna Parameters and Design

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

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

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

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

### Additional EUT Data

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

## DASY5 Validation Report for Head TSL

Date: 22.01.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN:1004**

Communication System: UID 0 - CW; Frequency: 2300 MHz

Medium parameters used:  $f = 2300$  MHz;  $\sigma = 1.71$  S/m;  $\epsilon_r = 38.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.98, 7.98, 7.98) @ 2300 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 116.5 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 23.0 W/kg

**SAR(1 g) = 12.5 W/kg; SAR(10 g) = 6.01 W/kg**

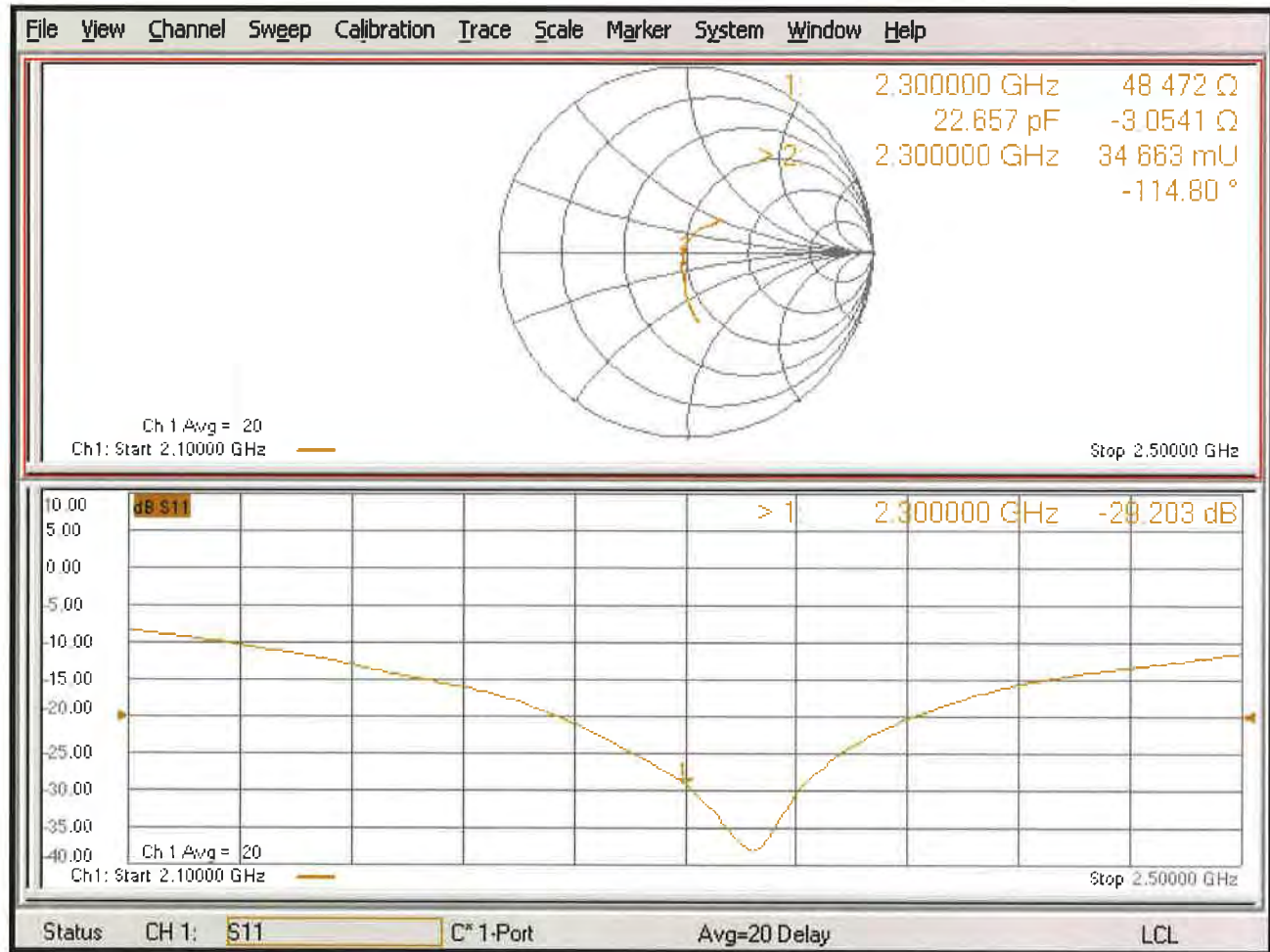
Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 54.8%

Maximum value of SAR (measured) = 19.5 W/kg



# Impedance Measurement Plot for Head TSL





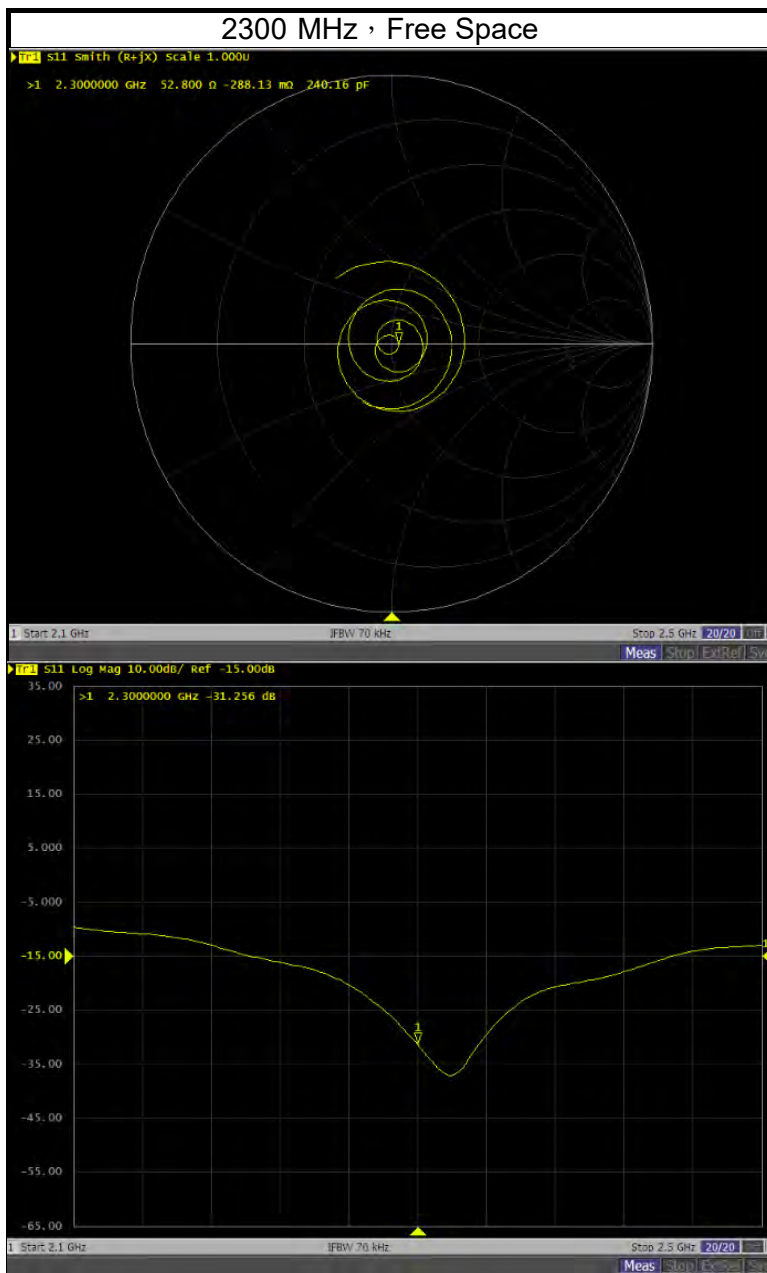
# Annual Confirmation of SAR Reference Dipole

Model : D2300V2

S/N : 1004

Measurement Date : 2022/1/21

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 2300            | Free Space | Real Impedance      | 48.472               | 52.800       | 4.33      | $\pm 5\Omega$      | PASS   |
|                 |            | Imaginary Impedance | 0.3466               | -0.2881      | -0.63     | $\pm 5\Omega$      | PASS   |
|                 |            | Return Loss         | -29.203              | -31.256      | 7.03%     | $\pm 20\%$         | PASS   |





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Client

**B.V.ADT**

Certificate No: **Z21-60284**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 737**

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

Calibration date: **August 26, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards       | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|-------------------------|------------|---|-----------------------|
| Power Meter NRP2        | 106277     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Power sensor NRP8S      | 104291     | 23-Sep-20 (CTTL, No.J20X08336)            | Sep-21                |
| Reference Probe EX3DV4  | SN 7517    | 03-Feb-21(CTTL-SPEAG,No.Z21-60001)        | Feb-22                |
| DAE3                    | SN 536     | 06-Nov-20(CTTL-SPEAG,No.Z20-60452)        | Nov-21                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 01-Feb-21 (CTTL, No.J21X00593)            | Jan-22                |
| NetworkAnalyzer E5071C  | MY46110673 | 14-Jan-21 (CTTL, No.J21X00232)            | Jan-22                |

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

Issued: August 31, 2021

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### Glossary:

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

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

- 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
- IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
- IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
- KDB865664, 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 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.

|                                     |                          |             |
|-------------------------------------|--------------------------|-------------|
| <b>DASY Version</b>                 | DASY52                   | V52.10.4    |
| <b>Extrapolation</b>                | Advanced Extrapolation   |             |
| <b>Phantom</b>                      | Triple Flat Phantom 5.1C |             |
| <b>Distance Dipole Center - TSL</b> | 10 mm                    | with Spacer |
| <b>Zoom Scan Resolution</b>         | dx, dy, dz = 5 mm        |             |
| <b>Frequency</b>                    | 2450 MHz ± 1 MHz         |             |

### Head TSL parameters

The following parameters and calculations were applied.

|  | Temperature     | Permittivity | Conductivity     |
|--|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C         | 39.2         | 1.80 mho/m       |
| <b>Measured Head TSL parameters</b>            | (22.0 ± 0.2) °C | 40.0 ± 6 %   | 1.77 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | <1.0 °C         | ----         | ----             |

### SAR result with Head TSL

|   |                    |                                 |
|---|--------------------|---------------------------------|
| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>   | Condition          |                                 |
| SAR measured  | 250 mW input power | 13.0 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>52.6 W/kg ± 18.8 % (k=2)</b> |
| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | Condition          |                                 |
| SAR measured  | 250 mW input power | 5.92 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.9 W/kg ± 18.7 % (k=2)</b> |



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

### Antenna Parameters with Head TSL

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 54.0Ω+ 4.29jΩ |
| Return Loss                          | - 25.0dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.067 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: 08.26.2021

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.772$  S/m;  $\epsilon_r = 40.04$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7517; ConvF(7.34, 7.34, 7.34) @ 2450 MHz; Calibrated: 2021-02-03
- Sensor-Surface: 1.4mm|(Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2020-11-06
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

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

Reference Value = 108.5 V/m; Power Drift = -0.01 dB

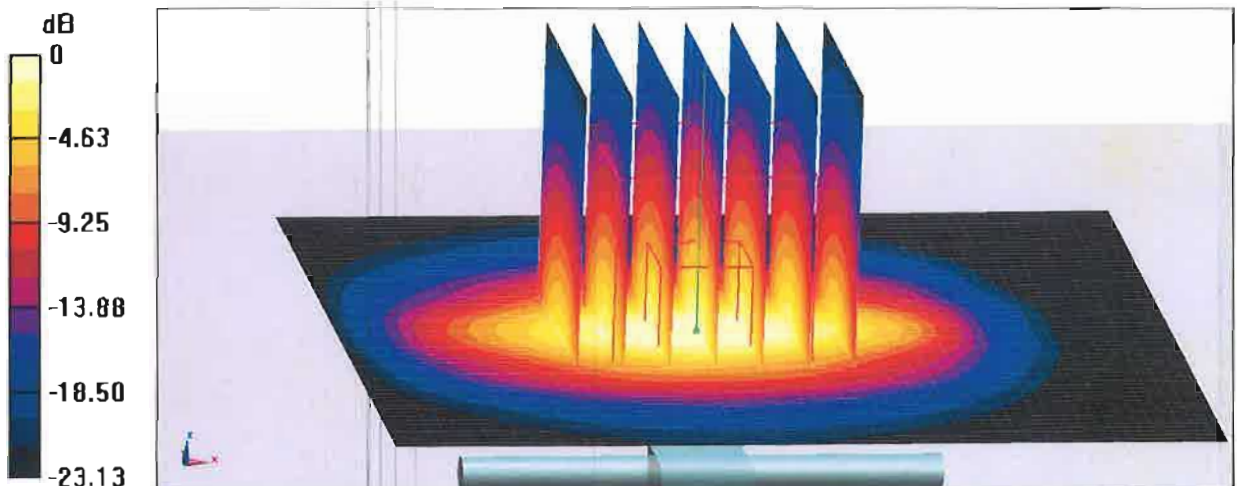
Peak SAR (extrapolated) = 27.8 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 5.92 W/kg**

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 46.7%

Maximum value of SAR (measured) = 22.3 W/kg



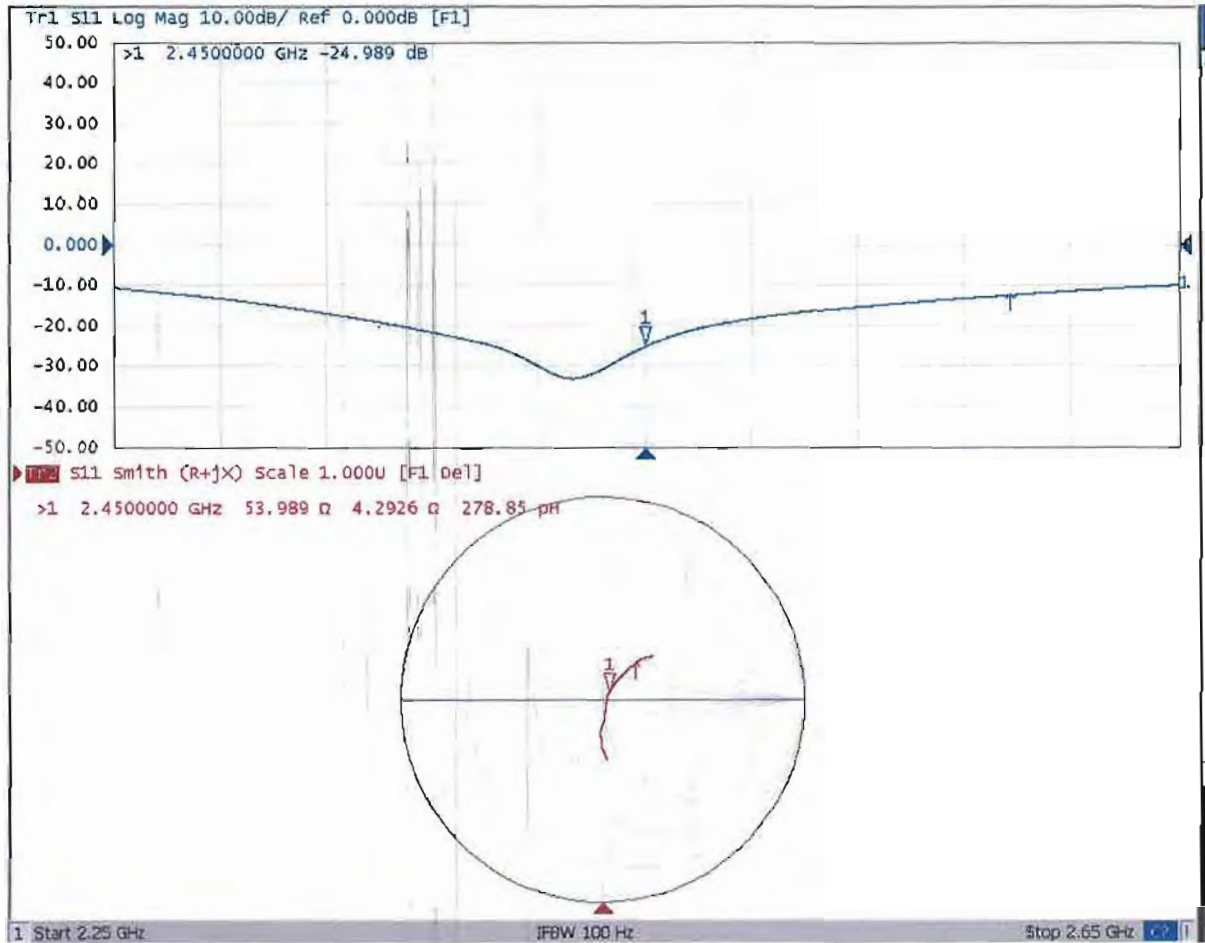
**0 dB = 22.3 W/kg = 13.48 dBW/kg**



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### Impedance Measurement Plot for Head TSL







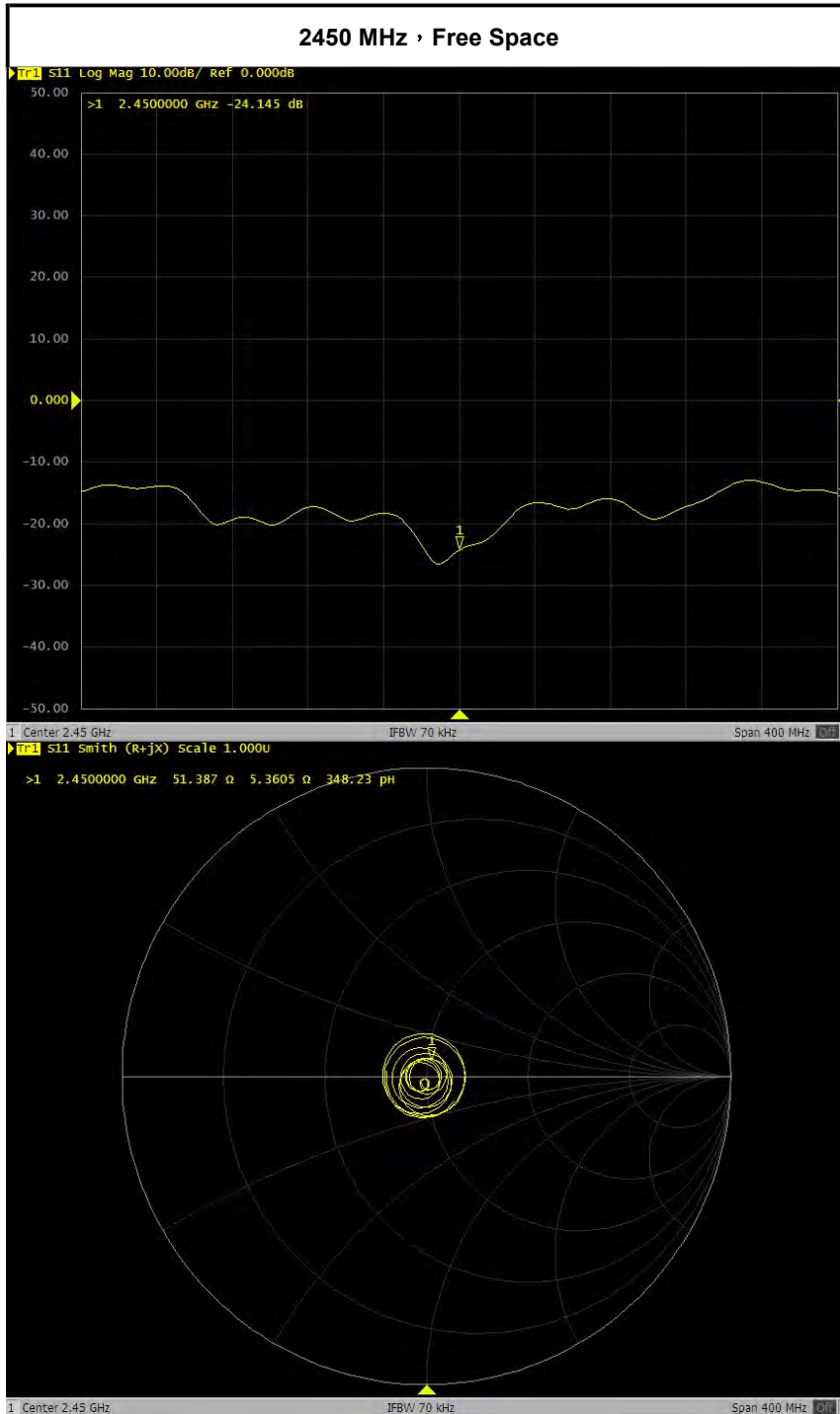
## Annual Confirmation of SAR Reference Dipole

Model : D2450V2

S/N : 737

Measurement Date : 2022/8/25

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 2450            | Free Space | Real Impedance      | 53.989               | 51.387       | -2.602    | $\pm 5\Omega$      | PASS   |
|                 |            | Imaginary Impedance | 4.2926               | 5.3605       | 1.07      | $\pm 5\Omega$      | PASS   |
|                 |            | Return Loss         | -24.989              | -24.145      | -3.38%    | $\pm 20\%$         | PASS   |





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Accreditation No.: **SCS 0108**

Client **B.V.ADT (Auden)**

Certificate No: **D2600V2-1020\_Aug21**

## CALIBRATION CERTIFICATE

Object **D2600V2 - SN:1020**

Calibration procedure(s) **QA CAL-05.v11  
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **August 17, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)      | Scheduled Calibration |
|-----------------------------|--------------------|---------------------------------|-----------------------|
| Power meter NRP             | SN: 104778         | 09-Apr-21 (No. 217-03291/03292) | Apr-22                |
| Power sensor NRP-Z91        | SN: 103244         | 09-Apr-21 (No. 217-03291)       | Apr-22                |
| Power sensor NRP-Z91        | SN: 103245         | 09-Apr-21 (No. 217-03292)       | Apr-22                |
| Reference 20 dB Attenuator  | SN: BH9394 (20k)   | 09-Apr-21 (No. 217-03343)       | Apr-22                |
| Type-N mismatch combination | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344)       | Apr-22                |
| Reference Probe EX3DV4      | SN: 7349           | 28-Dec-20 (No. EX3-7349_Dec20)  | Dec-21                |
| DAE4                        | SN: 601            | 02-Nov-20 (No. DAE4-601_Nov20)  | Nov-21                |

| Secondary Standards             | ID #           | Check Date (in house)             | Scheduled Check        |
|---------------------------------|----------------|-----------------------------------|------------------------|
| Power meter E4419B              | SN: GB39512475 | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: US37292783 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: MY41092317 | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| RF generator R&S SMT-06         | SN: 100972     | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-20) | In house check: Oct-21 |

Calibrated by: **Leif Klysner** Laboratory Technician

Approved by: **Katja Pokovic** Technical Manager

Issued: August 27, 2021

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Accreditation No.: **SCS 0108**

**Glossary:**

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

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

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

**Additional Documentation:**

- c) DASY System Handbook

**Methods Applied and Interpretation of Parameters:**

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

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

## Measurement Conditions

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

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

## Head TSL parameters

The following parameters and calculations were applied.

|  | Temperature         | Permittivity   | Conductivity         |
|--|---------------------|----------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 39.0           | 1.96 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 37.4 $\pm$ 6 % | 2.04 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ---            | ---                  |

## SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 14.8 W/kg                                      |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>57.6 W/kg <math>\pm</math> 17.0 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |  |
|---|--------------------|--|
| SAR measured  | 250 mW input power | 6.52 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>25.7 W/kg <math>\pm</math> 16.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 47.8 $\Omega$ - 4.9 j $\Omega$ |
| Return Loss                          | - 25.2 dB                      |

### General Antenna Parameters and Design

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

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

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

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

### Additional EUT Data

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



## DASY5 Validation Report for Head TSL

Date: 17.08.2021

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1020**

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.04$  S/m;  $\epsilon_r = 37.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 119.9 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 29.7 W/kg

**SAR(1 g) = 14.8 W/kg; SAR(10 g) = 6.52 W/kg**

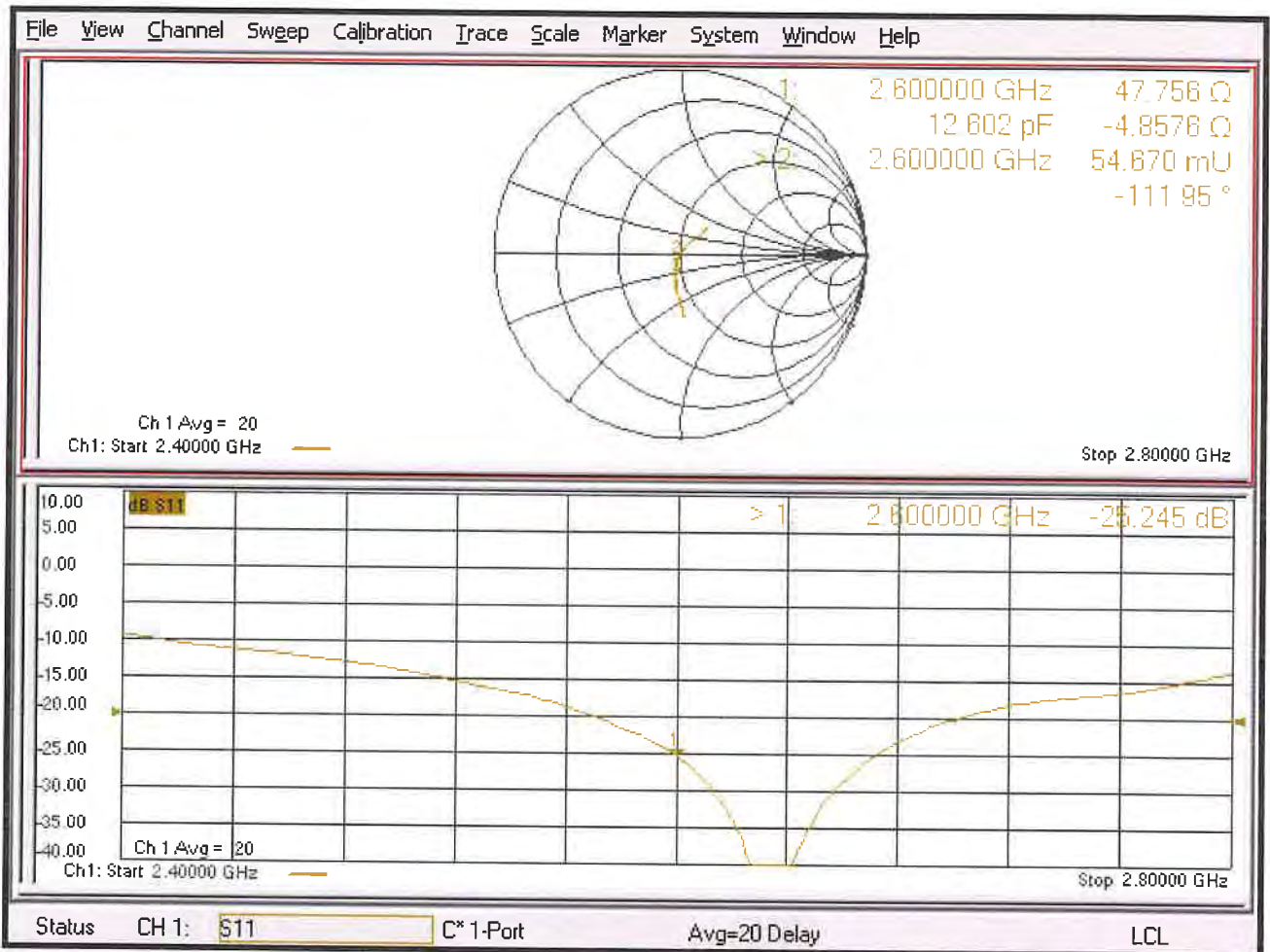
Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 49.8%

Maximum value of SAR (measured) = 24.5 W/kg



# Impedance Measurement Plot for Head TSL





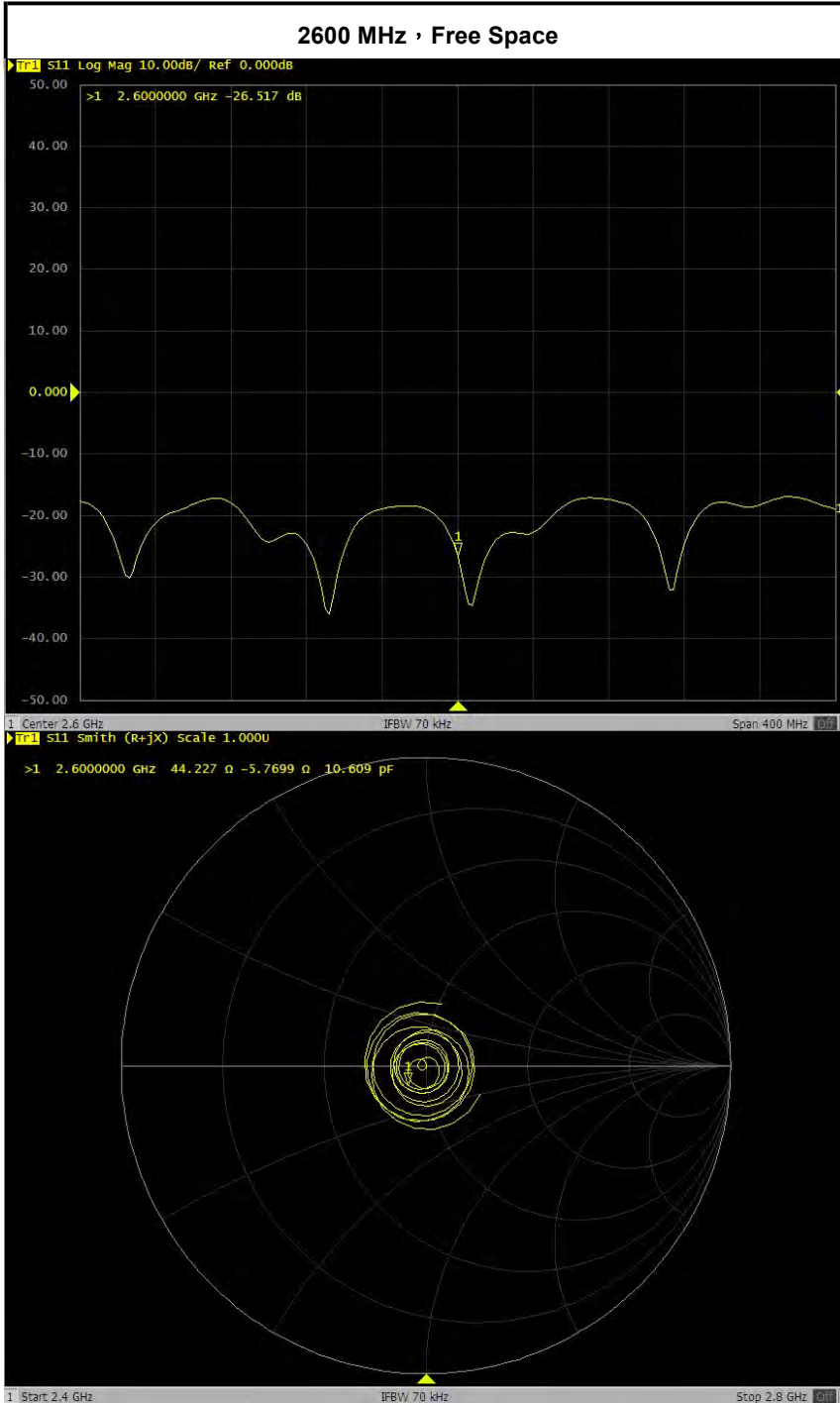
## Annual Confirmation of SAR Reference Dipole

Model : D2600V2

S/N : 1020

Measurement Date : 2022/8/16

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 2600            | Free Space | Real Impedance      | 47.756               | 44.227       | -3.529    | ±5Ω                | PASS   |
|                 |            | Imaginary Impedance | -4.8576              | -5.7699      | -0.91     | ±5Ω                | PASS   |
|                 |            | Return Loss         | -25.245              | -26.517      | 5.04%     | ±20%               | PASS   |





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D5GHzV2-1019\_Mar21**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1019**

Calibration procedure(s) **QA CAL-22.v6  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **March 19, 2021**

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  $(22 \pm 3)^\circ\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards               | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|---------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                 | SN: 104778         | 01-Apr-20 (No. 217-03100/03101)   | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103244         | 01-Apr-20 (No. 217-03100)         | Apr-21                 |
| Power sensor NRP-Z91            | SN: 103245         | 01-Apr-20 (No. 217-03101)         | Apr-21                 |
| Reference 20 dB Attenuator      | SN: BH9394 (20k)   | 31-Mar-20 (No. 217-03106)         | Apr-21                 |
| Type-N mismatch combination     | SN: 310982 / 06327 | 31-Mar-20 (No. 217-03104)         | Apr-21                 |
| Reference Probe EX3DV4          | SN: 3503           | 30-Dec-20 (No. EX3-3503_Dec20)    | Dec-21                 |
| DAE4                            | SN: 601            | 02-Nov-20 (No. DAE4-601_Nov20)    | Nov-21                 |
| Secondary Standards             | ID #               | Check Date (in house)             | Scheduled Check        |
| Power meter E4419B              | SN: GB39512475     | 30-Oct-14 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: US37292783     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| Power sensor HP 8481A           | SN: MY41092317     | 07-Oct-15 (in house check Oct-20) | In house check: Oct-22 |
| RF generator R&S SMT-06         | SN: 100972         | 15-Jun-15 (in house check Oct-20) | In house check: Oct-22 |
| Network Analyzer Agilent E8358A | SN: US41080477     | 31-Mar-14 (in house check Oct-20) | In house check: Oct-21 |

Calibrated by: **Claudio Leubler**      **Laboratory Technician**

Signature

Approved by: **Katja Pokovic**      **Technical Manager**

Issued: March 19, 2021

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### Glossary:

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

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

- 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
- 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
- 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
- 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 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%.



## Measurement Conditions

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

|                                     |  |                                  |
|-------------------------------------|--|----------------------------------|
| <b>DASY Version</b>                 | DASY5  | V52.10.4                         |
| <b>Extrapolation</b>                | Advanced Extrapolation                                   |                                  |
| <b>Phantom</b>                      | Modular Flat Phantom V5.0                                |                                  |
| <b>Distance Dipole Center - TSL</b> | 10 mm  | with Spacer                      |
| <b>Zoom Scan Resolution</b>         | dx, dy = 4.0 mm, dz = 1.4 mm                             | Graded Ratio = 1.4 (Z direction) |
| <b>Frequency</b>                    | 5250 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5750 MHz ± 1 MHz |                                  |

## Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

|  | Temperature     | Permittivity | Conductivity     |
|--|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C         | 35.9         | 4.71 mho/m       |
| <b>Measured Head TSL parameters</b>            | (22.0 ± 0.2) °C | 34.7 ± 6 %   | 4.51 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C        | ----         | ----             |

## SAR result with Head TSL at 5250 MHz

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 8.13 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>80.6 W/kg ± 19.9 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.32 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.0 W/kg ± 19.5 % (k=2)</b> |

## Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|  | Temperature     | Permittivity | Conductivity     |
|--|-----------------|--------------|------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| <b>Measured Head TSL parameters</b>            | (22.0 ± 0.2) °C | 34.2 ± 6 %   | 4.86 mho/m ± 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C        | ----         | ----             |

## SAR result with Head TSL at 5600 MHz

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 8.32 W/kg                       |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>82.4 W/kg ± 19.9 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 2.36 W/kg                       |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>23.3 W/kg ± 19.5 % (k=2)</b> |

## Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.4         | 5.22 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 34.0 ± 6 %   | 5.01 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        | ----         | ----             |

## SAR result with Head TSL at 5750 MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                                 |
|---|--------------------|---------------------------------|
| SAR measured  | 100 mW input power | 8.02 W/kg                       |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | <b>79.4 W/kg ± 19.9 % (k=2)</b> |

| 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   | <b>22.4 W/kg ± 19.5 % (k=2)</b> |

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

### Antenna Parameters with Head TSL at 5250 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 54.1 $\Omega$ - 6.4 j $\Omega$ |
| Return Loss                          | - 22.7 dB                      |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 57.6 $\Omega$ - 2.5 j $\Omega$ |
| Return Loss                          | - 22.6 dB                      |

### Antenna Parameters with Head TSL at 5750 MHz

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 57.9 $\Omega$ + 3.1 j $\Omega$ |
| Return Loss                          | - 22.1 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 |
|-----------------|-------|

## DASY5 Validation Report for Head TSL

Date: 19.03.2021

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1019

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used:  $f = 5250$  MHz;  $\sigma = 4.51$  S/m;  $\epsilon_r = 34.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.86$  S/m;  $\epsilon_r = 34.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 5750$  MHz;  $\sigma = 5.01$  S/m;  $\epsilon_r = 34$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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

**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 79.20 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 27.6 W/kg

**SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.32 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.7%

Maximum value of SAR (measured) = 18.1 W/kg

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

**dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 77.00 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 31.0 W/kg

**SAR(1 g) = 8.32 W/kg; SAR(10 g) = 2.36 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.9%

Maximum value of SAR (measured) = 19.6 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**

Reference Value = 74.22 V/m; Power Drift = -0.08 dB

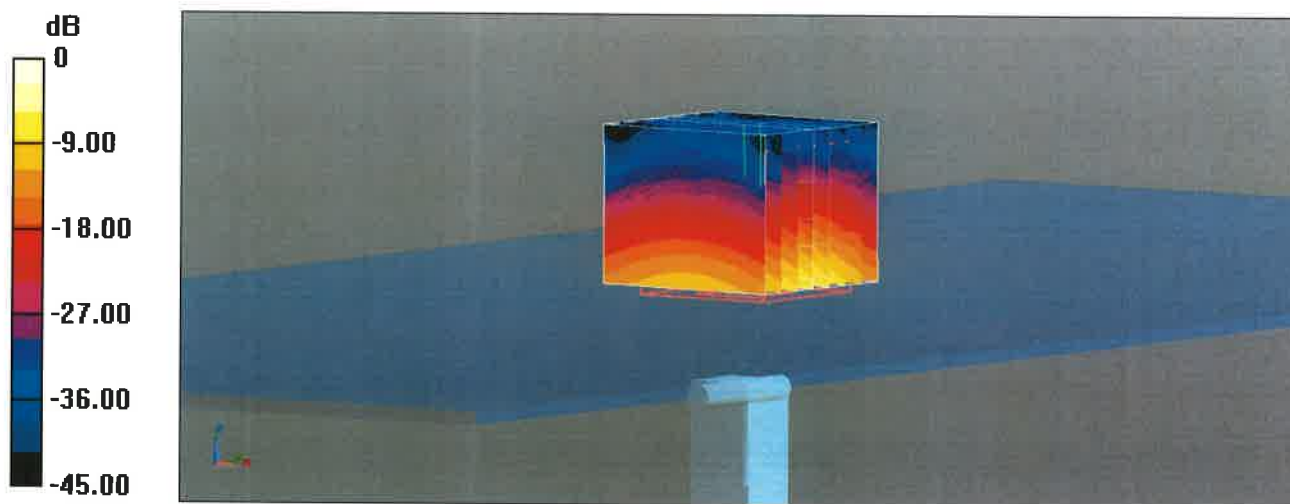
Peak SAR (extrapolated) = 31.6 W/kg

**SAR(1 g) = 8.02 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%

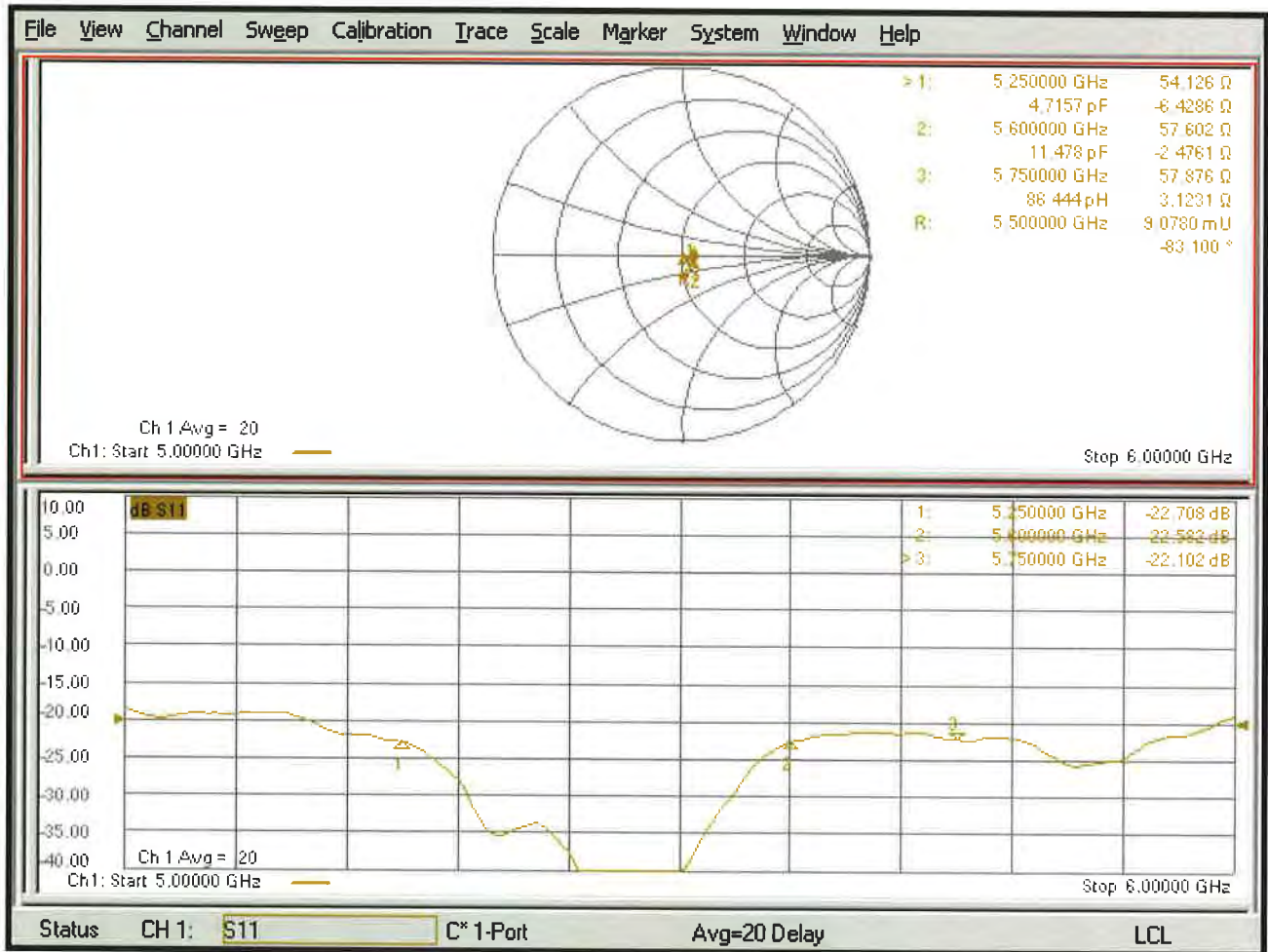
Maximum value of SAR (measured) = 19.2 W/kg



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



# Impedance Measurement Plot for Head TSL





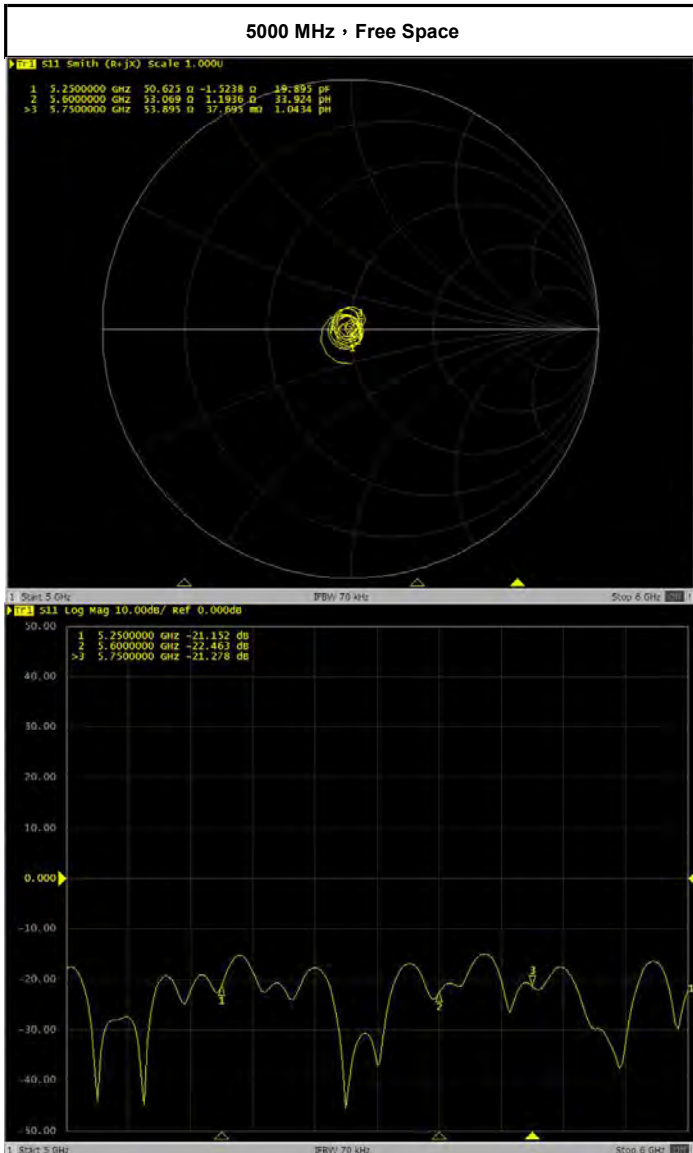
## Annual Confirmation of SAR Reference Dipole

Model : D5000V2

S/N : 1019

Measurement Date : 2022/3/18

| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
|-----------------|------------|---------------------|----------------------|--------------|-----------|--------------------|--------|
| 5250            | Free Space | Real Impedance      | 54.126               | 50.625       | -3.501    | ±5Ω                | PASS   |
|                 |            | Imaginary Impedance | -6.4286              | -1.5238      | 4.905     | ±5Ω                | PASS   |
|                 |            | Return Loss         | -22.708              | -21.152      | -6.85%    | ±20%               | PASS   |
| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
| 5600            | Free Space | Real Impedance      | 57.602               | 53.069       | -4.533    | ±5Ω                | PASS   |
|                 |            | Imaginary Impedance | -2.4761              | 1.1936       | 3.670     | ±5Ω                | PASS   |
|                 |            | Return Loss         | -22.582              | -22.463      | -0.53%    | ±20%               | PASS   |
| Frequency (MHz) | Type       | Item                | Previous Measurement | Annual Check | Deviation | Accepted Tolerance | Result |
| 5750            | Free Space | Real Impedance      | 57.876               | 53.895       | -3.981    | ±5Ω                | PASS   |
|                 |            | Imaginary Impedance | 3.1231               | 0.0377       | -3.085    | ±5Ω                | PASS   |
|                 |            | Return Loss         | -22.102              | -21.278      | -3.73%    | ±20%               | PASS   |





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Accreditation No.: **SCS 0108**

Client **B.V. ADT (Auden)**

Certificate No: **D6.5GHzV2-1008\_Sep21**

## CALIBRATION CERTIFICATE

Object **D6.5GHzV2 - SN:1008**

Calibration procedure(s) **QA CAL-22.v6  
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **September 24, 2021**


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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards                | ID #               | Cal Date (Certificate No.)        | Scheduled Calibration  |
|----------------------------------|--------------------|-----------------------------------|------------------------|
| Power meter NRP                  | SN: 104778         | 09-Apr-21 (No. 217-03291/03292)   | Apr-22                 |
| Power sensor NRP-Z91             | SN: 103244         | 09-Apr-21 (No. 217-03291)         | Apr-22                 |
| Power sensor NRP-Z91             | SN: 103245         | 09-Apr-21 (No. 217-03292)         | Apr-22                 |
| Power sensor R&S NRP33T          | SN: 100967         | 08-Apr-21 (No. 217-03293)         | Apr-22                 |
| Reference 20 dB Attenuator       | SN: BH9394 (20k)   | 09-Apr-21 (No. 217-03343)         | Apr-22                 |
| Type-N mismatch combination      | SN: 310982 / 06327 | 09-Apr-21 (No. 217-03344)         | Apr-22                 |
| Reference Probe EX3DV4           | SN: 7405           | 30-Dec-20 (No. EX3-7405_Dec20)    | Dec-21                 |
| DAE4                             | SN: 908            | 24-Jun-21 (No. DAE4-908_Jun21)    | Jun-22                 |
| Secondary Standards              | ID #               | Check Date (in house)             | Scheduled Check        |
| RF generator Anapico APSIN20G    | SN: 669            | 28-Mar-17 (in house check Dec-18) | In house check: Dec-21 |
| Network Analyzer Keysight E5063A | SN:MY54504221      | 31-Oct-19 (in house check Oct-19) | In house check: Oct-22 |

Calibrated by: **Jeton Kastrati** (Name) **Laboratory Technician** (Function)  (Signature)

Approved by: **Katja Pokovic** (Name) **Technical Manager** (Function)  (Signature)

Issued: September 27, 2021

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Accreditation No.: **SCS 0108**

### Glossary:

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

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

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

### Additional Documentation:

- DASY System Handbook

### Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The 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.
- 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 absorbed power density (APD):** The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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

## Measurement Conditions

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

|                                     |                              |                                  |
|-------------------------------------|------------------------------|----------------------------------|
| <b>DASY Version</b>                 | DASY6                        | V16.0                            |
| <b>Extrapolation</b>                | Advanced Extrapolation       |                                  |
| <b>Phantom</b>                      | Modular Flat Phantom         |                                  |
| <b>Distance Dipole Center - TSL</b> | 5 mm                         | with Spacer                      |
| <b>Zoom Scan Resolution</b>         | dx, dy = 3.4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| <b>Frequency</b>                    | 6500 MHz $\pm$ 1 MHz         |                                  |

## Head TSL parameters

The following parameters and calculations were applied.

|  | <b>Temperature</b>  | <b>Permittivity</b> | <b>Conductivity</b>  |
|--|---------------------|---------------------|----------------------|
| <b>Nominal Head TSL parameters</b>             | 22.0 °C             | 34.5                | 6.07 mho/m           |
| <b>Measured Head TSL parameters</b>            | (22.0 $\pm$ 0.2) °C | 33.6 $\pm$ 6 %      | 6.11 mho/m $\pm$ 6 % |
| <b>Head TSL temperature change during test</b> | < 0.5 °C            | ----                | ----                 |

## SAR result with Head TSL

| <b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b> | <b>Condition</b>   |   |
|---|--------------------|---|
| SAR measured  | 100 mW input power | 29.1 W/kg                                     |
| SAR for nominal Head TSL parameters                         | normalized to 1W   | <b>289 W/kg <math>\pm</math> 24.7 % (k=2)</b> |

| <b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b> | <b>condition</b>   |  |
|---|--------------------|--|
| SAR measured  | 100 mW input power | 5.39 W/kg                                      |
| SAR for nominal Head TSL parameters                           | normalized to 1W   | <b>53.5 W/kg <math>\pm</math> 24.4 % (k=2)</b> |



## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.9 $\Omega$ - 7.6 j $\Omega$ |
| Return Loss                          | - 22.3 dB                      |

### APD (Absorbed Power Density)

| APD averaged over 1 cm <sup>2</sup> | Condition          |   |
|-------------------------------------|--------------------|---|
| APD measured                        | 100 mW input power | 289 W/m <sup>2</sup>                                      |
| APD measured                        | normalized to 1W   | <b>2890 W/m<sup>2</sup> <math>\pm</math> 29.2 % (k=2)</b> |

| APD averaged over 4 cm <sup>2</sup> | condition          |   |
|-------------------------------------|--------------------|---|
| APD measured                        | 100 mW input power | 132 W/m <sup>2</sup>                                      |
| APD measured                        | normalized to 1W   | <b>1320 W/m<sup>2</sup> <math>\pm</math> 28.9 % (k=2)</b> |

### General Antenna Parameters and Design

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

# DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1008, UID 0 -, Channel 6500 (6500.0MHz)

## Device under Test Properties

| Name, Manufacturer | Dimensions [mm]    | IMEI     | DUT Type |
|--------------------|--------------------|----------|----------|
| D6.5GHz            | 16.0 x 6.0 x 300.0 | SN: 1008 | -        |

## Exposure Conditions

| Phantom Section, TSL | Position, Test Distance [mm] | Band | Group, UID | Frequency [MHz] | Conversion Factor | TSL Cond. [S/m] | TSL Permittivity |
|----------------------|------------------------------|------|------------|-----------------|-------------------|-----------------|------------------|
| Flat, HSL            | 5.00                         | Band | CW,        | 6500            | 5.75              | 6.11            | 33.6             |

## Hardware Setup

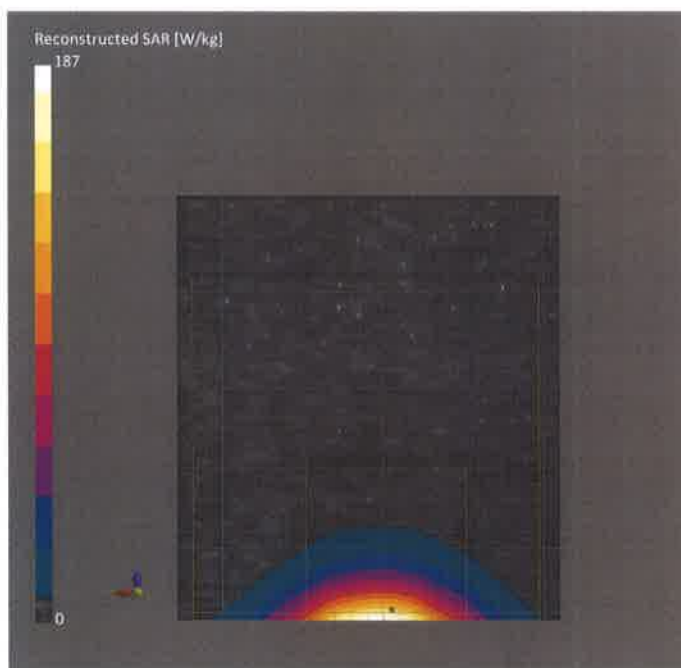
| Phantom                | TSL             | Probe, Calibration Date     | DAE, Calibration Date  |
|------------------------|-----------------|-----------------------------|------------------------|
| MFP V8.0 Center - 1182 | HBBL600-10000V6 | EX3DV4 - SN7405, 2020-12-30 | DAE4 Sn908, 2021-06-24 |

## Scan Setup

|                     | Zoom Scan          |
|---------------------|--------------------|
| Grid Extents [mm]   | 22.0 x 22.0 x 22.0 |
| Grid Steps [mm]     | 3.4 x 3.4 x 1.4    |
| Sensor Surface [mm] | 1.4                |
| Graded Grid         | Yes                |
| Grading Ratio       | 1.4                |
| MAIA                | N/A                |
| Surface Detection   | VMS + 6p           |
| Scan Method         | Measured           |

## Measurement Results

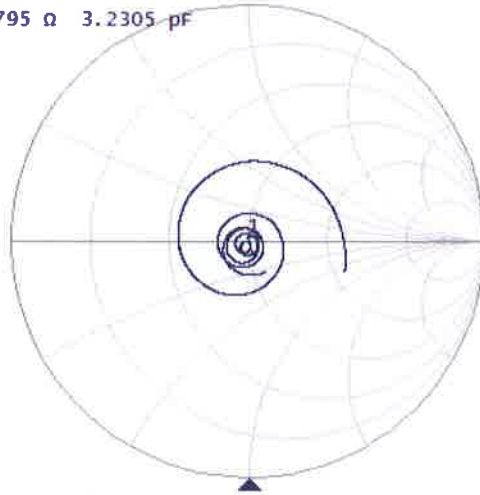
|                     | Zoom Scan         |
|---------------------|-------------------|
| Date                | 2021-09-24, 11:35 |
| psSAR1g [W/Kg]      | 29.1              |
| psSAR10g [W/Kg]     | 5.39              |
| Power Drift [dB]    | 0.02              |
| Power Scaling       | Disabled          |
| Scaling Factor [dB] |                   |
| TSL Correction      | No correction     |
| M2/M1 [%]           | 50.1              |
| Dist 3dB Peak [mm]  | 4.8               |



# Impedance Measurement Plot for Head TSL

▶ Tr1 S11 Smith (R+jX) Scale 1.000 u [F1]

>1 6.5000000 GHz 51.894  $\Omega$  -7.5795  $\Omega$  3.2305 pF



Tr2 S11 Log Mag 5.000 dB/ Ref -20.00 dB [F1]

>1 6.5000000 GHz -22.331 dB

