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

### Antenna Parameters with Head TSL at 4500 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 47.1Ω - 4.03jΩ |
| Return Loss                          | - 25.8dB       |

### Antenna Parameters with Head TSL at 4700 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 55.3Ω - 1.24jΩ |
| Return Loss                          | - 25.7dB       |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.015 ns |
|----------------------------------|----------|

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

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

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

### Additional EUT Data

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



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

Date: 2022-10-20

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 4600 MHz; Type: D4600V2; Serial: D4600V2 - SN: 1033**

Communication System: UID 0, CW; Frequency: 4500 MHz; Frequency: 4700 MHz

Medium parameters used:  $f = 4500$  MHz;  $\sigma = 3.87$  S/m;  $\epsilon_r = 36.69$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Medium parameters used:  $f = 4700$  MHz;  $\sigma = 4.113$  S/m;  $\epsilon_r = 36.186$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(6.53, 6.53, 6.53) @ 4500 MHz; ConvF(6.4, 6.4, 6.4) @ 4700 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration /Pin=100mW, d=10mm, f=4500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**

Reference Value = 61.33 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 20.4 W/kg

**SAR(1 g) = 6.78 W/kg; SAR(10 g) = 2.25 W/kg**

Smallest distance from peaks to all points 3 dB below = 7.9 mm

Ratio of SAR at M2 to SAR at M1 = 72.7%

Maximum value of SAR (measured) = 13.8 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=4700 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**

Reference Value = 59.59 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 20.8 W/kg

**SAR(1 g) = 6.61 W/kg; SAR(10 g) = 2.17 W/kg**

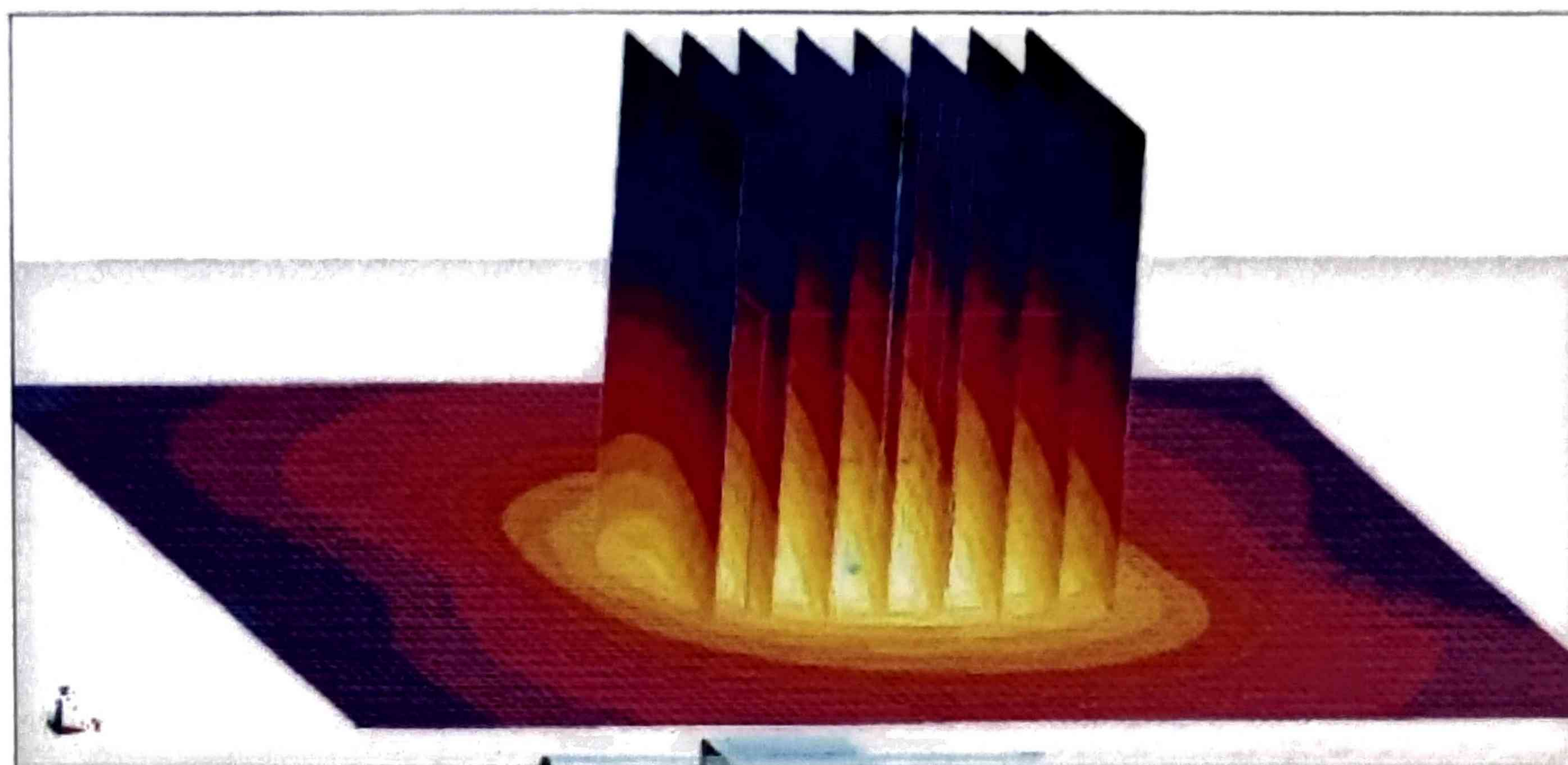
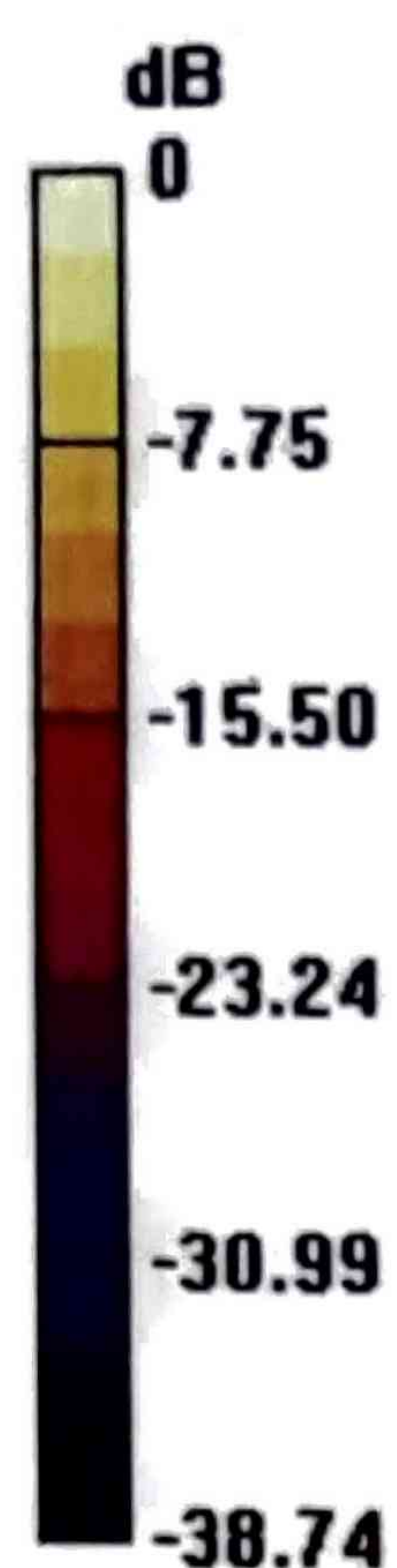
Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 70.9%

Maximum value of SAR (measured) = 13.8 W/kg



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0 dB = 13.8 W/kg = 11.40 dBW/kg



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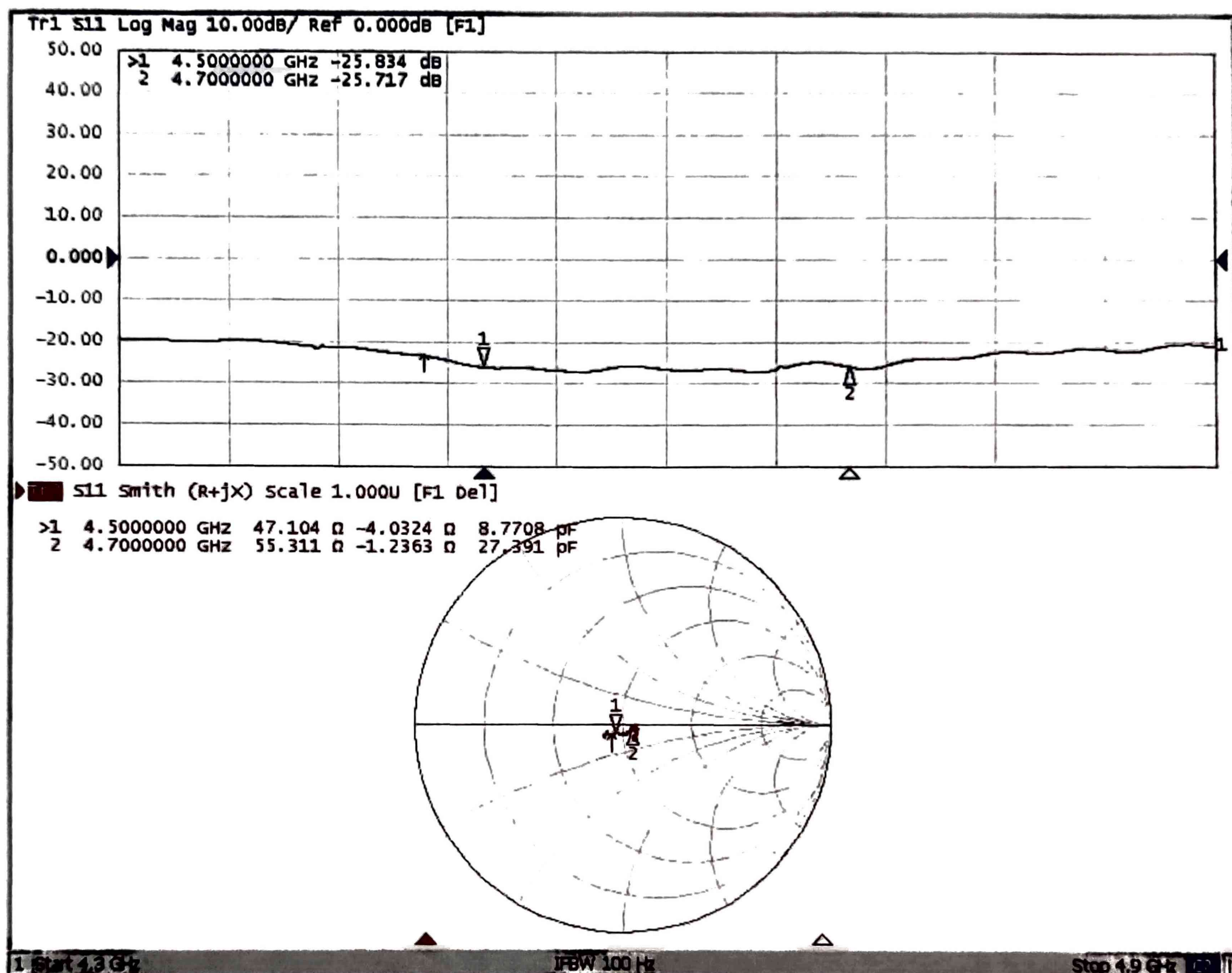
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### Impedance Measurement Plot for Head TSL



Client

**SRTC**

Certificate No: **Z22-60456**

## CALIBRATION CERTIFICATE

Object

**D4900V2 - SN: 1025**

Calibration Procedure(s)

**FF-Z11-003-01**

Calibration Procedures for dipole validation kits

Calibration date:

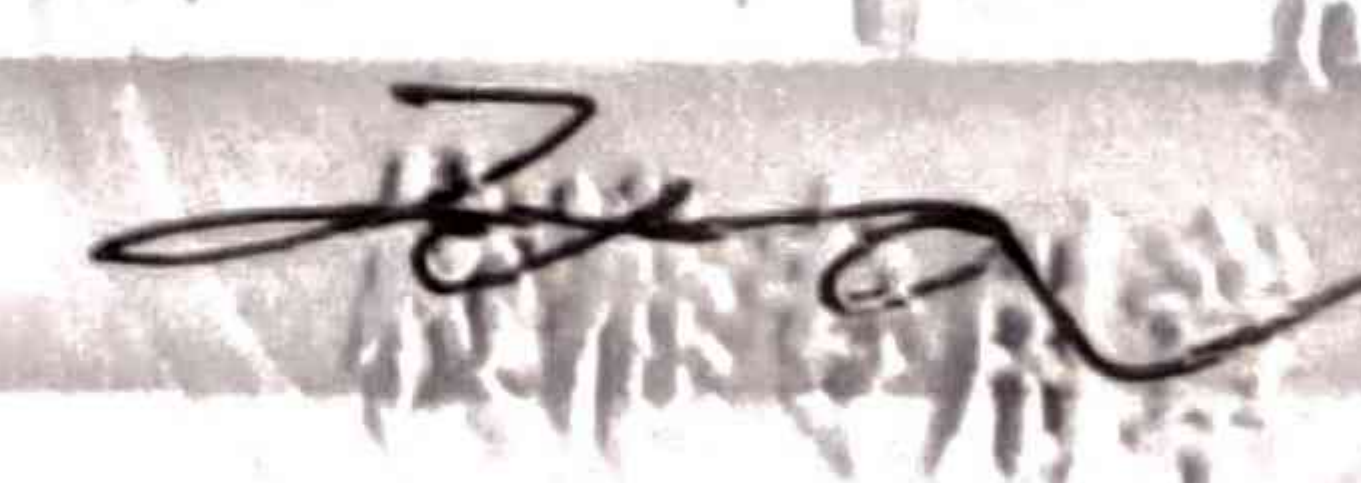
**October 21, 2022**

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  $(22\pm3)^{\circ}\text{C}$  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        | 106276     | 10-May-22 (CTTL, No.J22X03103)            | May-23                |
| Power sensor NRP6A      | 101369     | 10-May-22 (CTTL, No.J22X03103)            | May-23                |
| Reference Probe EX3DV4  | SN 7464    | 26-Jan-22(SPEAG,No.EX3-7464_Jan22)        | Jan-23                |
| DAE4                    | SN 1556    | 12-Jan-22(CTTL-SPEAG,No.Z22-60007)        | Jan-23                |
| Secondary Standards     | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 13-Jan-22 (CTTL, No.J22X00409)            | Jan-23                |
| Network Analyzer E5071C | MY46110673 | 14-Jan-22 (CTTL, No.J22X00406)            | Jan-23                |

|                | 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: October 31, 2022

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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:

- a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- c) DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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

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### Measurement Conditions

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

|                              |                            |                                  |
|------------------------------|----------------------------|----------------------------------|
| DASY Version                 | DASY52                     | 52.10.4                          |
| Extrapolation                | Advanced Extrapolation     |                                  |
| Phantom                      | Triple Flat Phantom 5.1C   |                                  |
| Distance Dipole Center - TSL | 10 mm                      | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 4900 MHz ± 1 MHz           |                                  |

### Head TSL parameters at 4900 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 36.3         | 4.35 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 36.8 ± 6 %   | 4.37 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | —            | —                |

### SAR result with Head TSL at 4900 MHz

|                                                |                    |                          |
|------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 $cm^3$ (1 g) of Head TSL   | Condition          |                          |
| SAR measured                                   | 100 mW input power | 6.95 W/kg                |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 69.7 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL | Condition          |                          |
| SAR measured                                   | 100 mW input power | 2.19 W/kg                |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 22.0 W/kg ± 24.2 % (k=2) |



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

### Antenna Parameters with Head TSL at 4900MHz

|                                      |               |
|--------------------------------------|---------------|
| Impedance, transformed to feed point | 51.2Ω- 4.95jΩ |
| Return Loss                          | - 26.0dB      |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 0.998 ns |
|----------------------------------|----------|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.  
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.

### Additional EUT Data

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

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## DASY5 Validation Report for Head TSL

Date: 2022-10-21

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 4900 MHz; Type: D4900V2; Serial: D4900V2 - SN: 1025**

Communication System: UID 0, CW; Frequency: 4900 MHz

Medium parameters used:  $f = 4900$  MHz;  $\sigma = 4.372$  S/m;  $\epsilon_r = 36.81$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

### DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(6, 6, 6) @ 4900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

**Dipole Calibration /Pin=100mW, d=10mm, f=4900 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**

Reference Value = 64.57 V/m; Power Drift = -0.01 dB

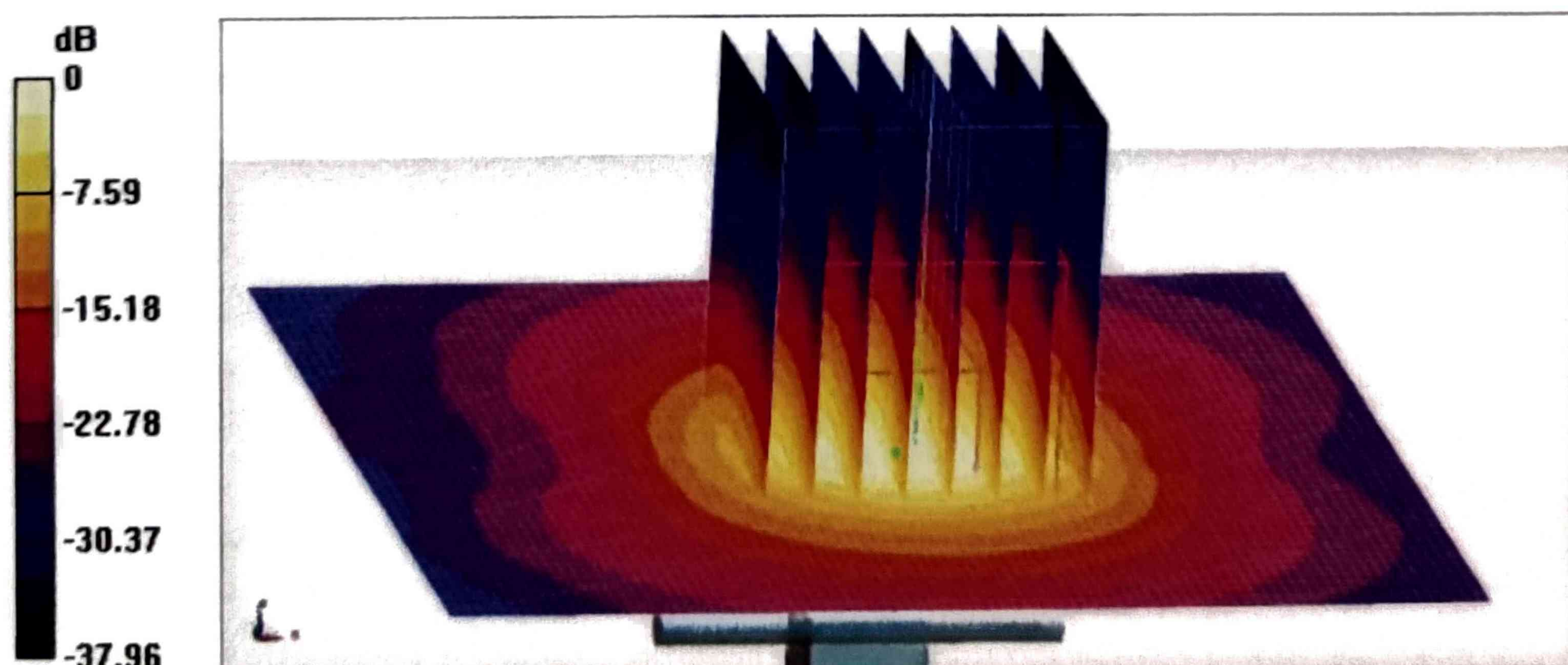
Peak SAR (extrapolated) = 23.9 W/kg

**SAR(1 g) = 6.95 W/kg; SAR(10 g) = 2.19 W/kg**

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 68.5%

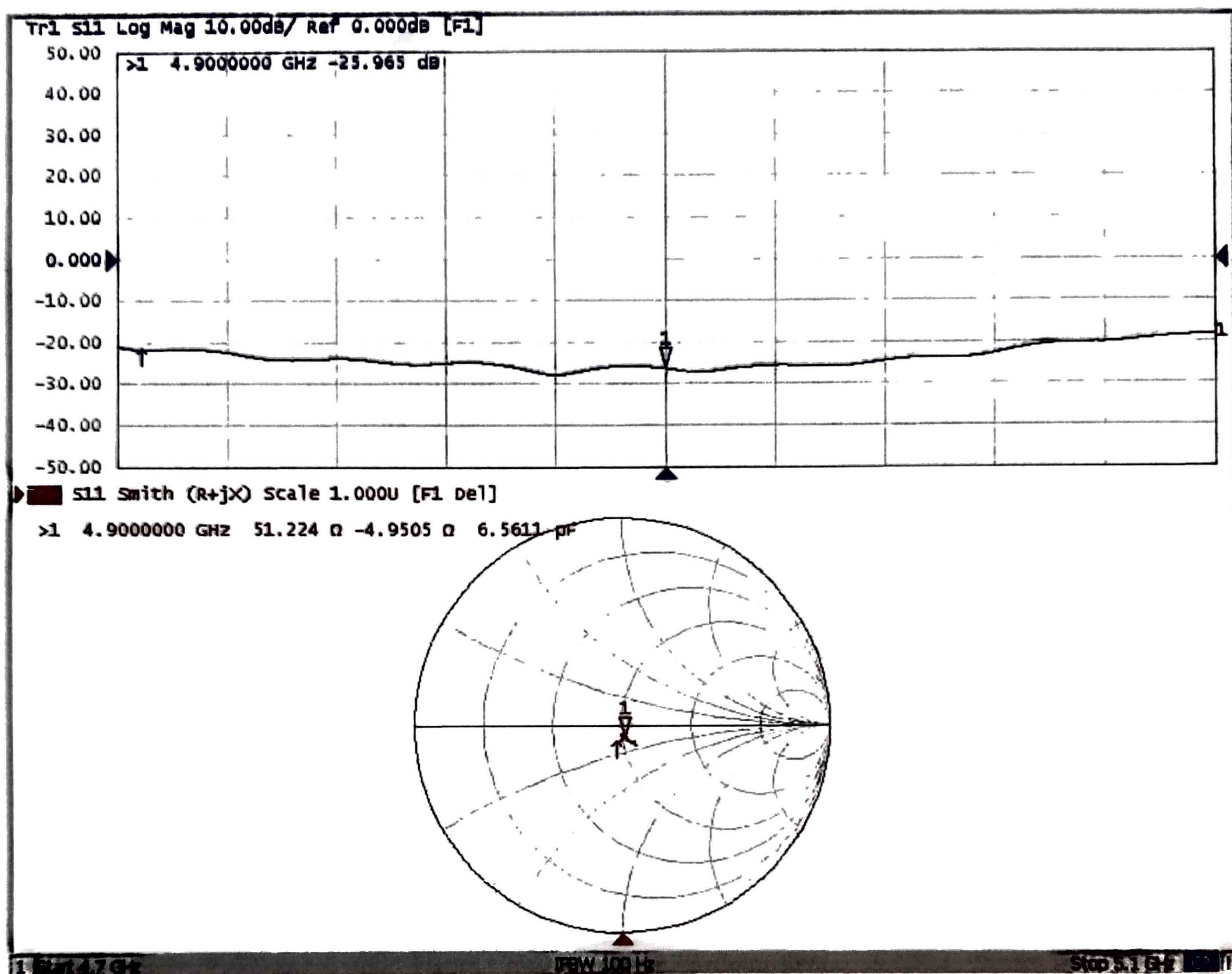
Maximum value of SAR (measured) = 15.3 W/kg



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

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### Impedance Measurement Plot for Head TSL





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Client

SRTC

Certificate No: Z20-60398

## CALIBRATION CERTIFICATE

Object

D6GHzV2 - SN: 1079

Calibration Procedure(s)

FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date:

October 10, 2020

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        | 106276     | 12-May-20 (CTTL, No.J20X02965)           | May-21                |
| Power sensor NRP6A      | 101369     | 12-May-20 (CTTL, No.J20X02965)           | May-21                |
| ReferenceProbe EX3DV4   | SN 3617    | 30-Jan-20(SPEAG,No.EX3-3617_Jan20)       | Jan-21                |
| OAE4                    | SN 771     | 10-Feb-20(CTTL-SPEAG,No.Z20-60017)       | Feb-21                |
| Secondary Standards     | ID #       | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Signal Generator E4438C | MY49071430 | 25-Feb-20 (CTTL, No.J20X00516)           | Feb-21                |
| NetworkAnalyzerE5071C   | MY46107873 | 10-Feb-20 (CTTL, No.J20X00515)           | Feb-21                |

|                | 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: October 22, 2020

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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%.



### 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         | $dx, dy = 4 \text{ mm}, dz = 1.4 \text{ mm}$                                                                                                                 | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 5200 MHz $\pm 1 \text{ MHz}$<br>5300 MHz $\pm 1 \text{ MHz}$<br>5500 MHz $\pm 1 \text{ MHz}$<br>5800 MHz $\pm 1 \text{ MHz}$<br>5900 MHz $\pm 1 \text{ MHz}$ |                                  |

### Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 36.0           | 4.66 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 36.0 $\pm$ 6 % | 4.65 mho/m $\pm$ 6 % |
| Head TSL temperature change during test | <1.0 °C             | —              | ---                  |

### SAR result with Head TSL at 5200 MHz

|                                                       |                    |                                  |
|-------------------------------------------------------|--------------------|----------------------------------|
| SAR averaged over 1 $\text{cm}^3$ (1 g) of Head TSL   | Condition          |                                  |
| SAR measured                                          | 100 mW Input power | 7.59 W/kg                        |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 75.9 W/kg $\pm$ 24.4 % ( $k=2$ ) |
| SAR averaged over 10 $\text{cm}^3$ (10 g) of Head TSL | Condition          |                                  |
| SAR measured                                          | 100 mW input power | 2.14 W/kg                        |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 21.4 W/kg $\pm$ 24.2 % ( $k=2$ ) |



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### Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.9         | 4.76 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.8 ± 8 %   | 4.76 mho/m ± 8 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL at 5300 MHz

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured                                            | 100 mW input power | 7.81 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 78.0 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured                                            | 100 mW input power | 2.20 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.0 W/kg ± 24.2 % (k=2) |

### Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.6         | 4.96 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.4 ± 8 %   | 4.97 mho/m ± 8 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL at 5500 MHz

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured                                            | 100 mW input power | 8.24 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 82.3 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured                                            | 100 mW input power | 2.31 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 23.1 W/kg ± 24.2 % (k=2) |



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### Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.5         | 5.07 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.2 ± 6 %   | 5.08 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL at 5600 MHz

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured                                            | 100 mW input power | 8.01 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 80.0 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured                                            | 100 mW input power | 2.26 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.6 W/kg ± 24.2 % (k=2) |

### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

|                                         | Temperature     | Permittivity | Conductivity     |
|-----------------------------------------|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 35.3         | 5.27 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 35.0 ± 6 %   | 5.28 mho/m ± 6 % |
| Head TSL temperature change during test | <1.0 °C         | ---          | ---              |

### SAR result with Head TSL at 5800 MHz

|                                                         |                    |                          |
|---------------------------------------------------------|--------------------|--------------------------|
| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                          |
| SAR measured                                            | 100 mW input power | 7.86 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 78.5 W/kg ± 24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                          |
| SAR measured                                            | 100 mW input power | 2.20 W/kg                |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 21.9 W/kg ± 24.2 % (k=2) |



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## Appendix (Additional assessments outside the scope of CNAS L0670)

### Antenna Parameters with Head TSL at 5200 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 50.2Ω - 10.0jΩ |
| Return Loss                          | - 20.0dB       |

### Antenna Parameters with Head TSL at 5300 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 47.2Ω - 7.33jΩ |
| Return Loss                          | - 21.9dB       |

### Antenna Parameters with Head TSL at 5500 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 52.0Ω - 7.96jΩ |
| Return Loss                          | - 21.9dB       |

### Antenna Parameters with Head TSL at 5600 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 55.7Ω - 3.78jΩ |
| Return Loss                          | - 23.8dB       |

### Antenna Parameters with Head TSL at 5800 MHz

|                                      |                |
|--------------------------------------|----------------|
| Impedance, transformed to feed point | 53.7Ω - 5.87jΩ |
| Return Loss                          | - 23.5dB       |

### General Antenna Parameters and Design

|                                  |          |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.069 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.



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#### Additional EUT Data

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



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## **DASY8 Validation Report for Head TSL**

Date: 10.10.2020

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1079**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz,  
Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz,

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.65$  S/m;  $\epsilon_r = 35.95$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.759$  S/m;  $\epsilon_r = 35.75$ ;  $\rho = 1000$

kg/m<sup>3</sup>, Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.969$  S/m;  $\epsilon_r = 35.39$ ;  $\rho =$

1000 kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.081$  S/m;  $\epsilon_r = 35.24$ ;  $\rho =$

1000 kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.279$  S/m;  $\epsilon_r = 34.97$ ;

$\rho = 1000$  kg/m<sup>3</sup>,

Phantom section: Center Section

### **DASY5 Configuration:**

- Probe: EX3DV4 - SN3617; ConvF(5.49, 5.49, 5.49) @ 5200 MHz;  
ConvF(5.29, 5.29, 5.29) @ 5300 MHz; ConvF(5.14, 5.14, 5.14) @ 5500  
MHz; ConvF(4.99, 4.99, 4.99) @ 5600 MHz; ConvF(5, 5, 5) @ 5800 MHz;  
Calibrated: 2020-01-30
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2020-02-10
- 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 /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 69.85 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 30.9 W/kg

**SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.14 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 64.9%

Maximum value of SAR (measured) = 18.7 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 68.07 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 32.5 W/kg

**SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.2 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 64.2%

Maximum value of SAR (measured) = 18.8 W/kg

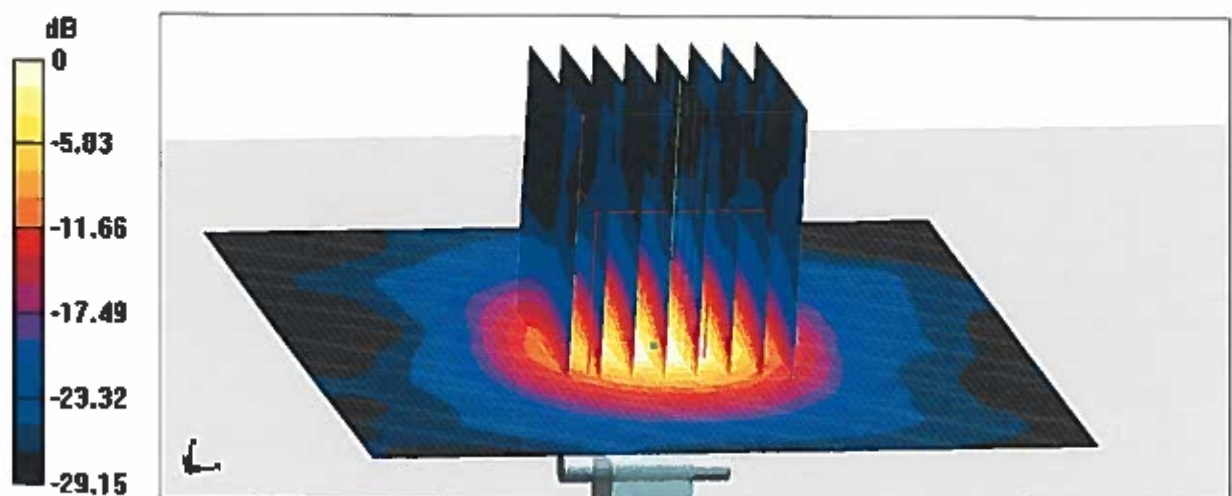


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**Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 69.06 V/m; Power Drift = -0.04 dB  
Peak SAR (extrapolated) = 36.1 W/kg  
SAR(1 g) = 8.24 W/kg; SAR(10 g) = 2.31 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 62.5%  
Maximum value of SAR (measured) = 19.9 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 67.87 V/m; Power Drift = -0.05 dB  
Peak SAR (extrapolated) = 36.0 W/kg  
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.26 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 61.7%  
Maximum value of SAR (measured) = 19.9 W/kg

**Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan,**  
**dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm**  
Reference Value = 68.36 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 37.0 W/kg  
SAR(1 g) = 7.86 W/kg; SAR(10 g) = 2.2 W/kg  
Smallest distance from peaks to all points 3 dB below = 7.2 mm  
Ratio of SAR at M2 to SAR at M1 = 60.2%  
Maximum value of SAR (measured) = 19.3 W/kg

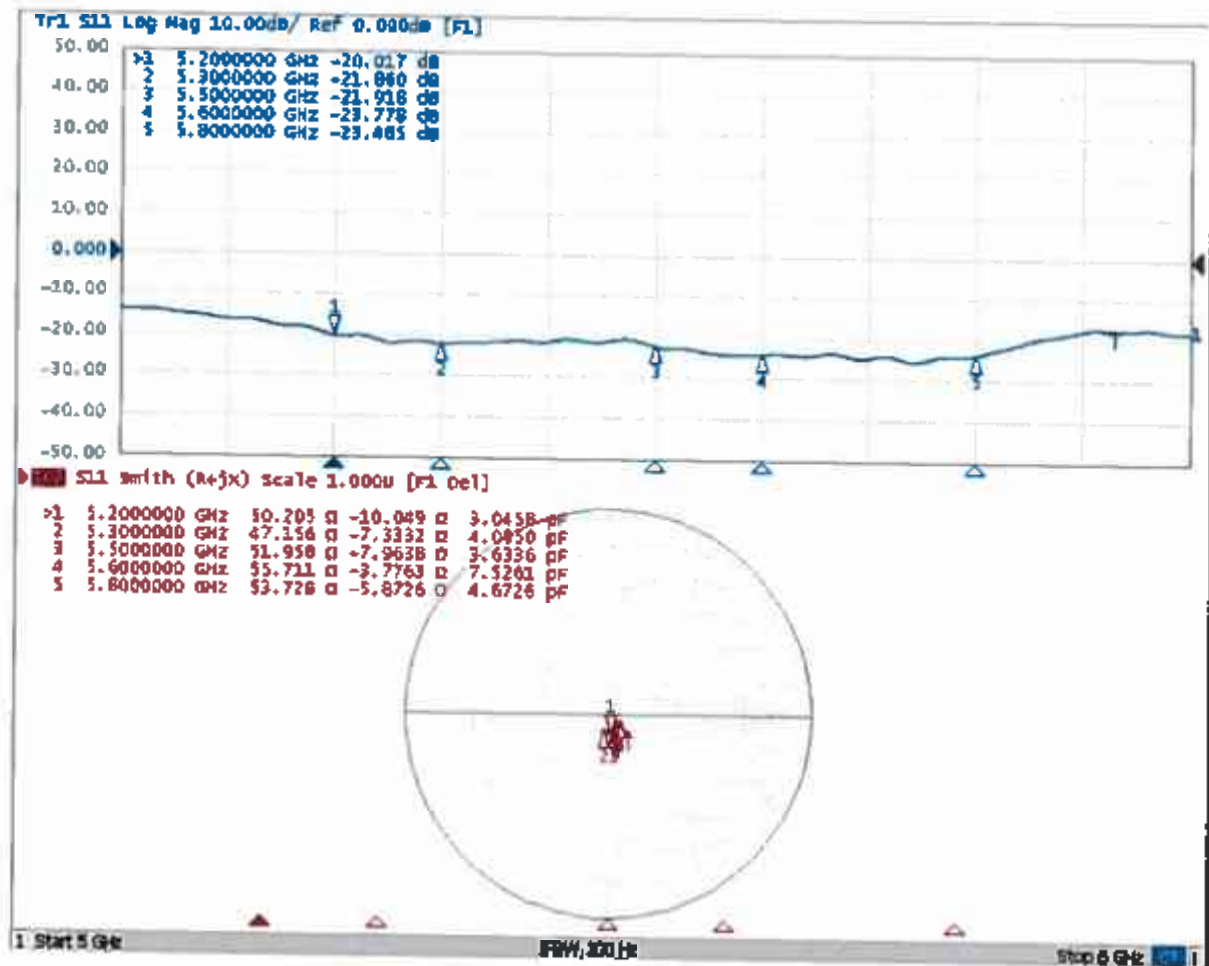




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## Impedance Measurement Plot for Head TSL





Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client: **SRTC (Auden)**

Certificate No: **D6.5GHzV2-1055\_Nov21**

## CALIBRATION CERTIFICATE

Object: **D6.5GHzV2 - SN:1055**

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

Calibration date: **November 29, 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         | 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. 217-03044)           | Apr-22                 |
| Reference Probe EX3DV4        | SN: 7405           | 30-Dec-20 (No. EX3-7405-0020)       | Jan-21                 |
| DAE4                          | SN: 908            | 24-Jun-21 (No. DAE4-908-Jun21)      | Jun-22                 |
| Secondary Standards           | ID #               | Check Date (in house)               | Scheduled Calibration  |
| RF generator Anapico APSIN20G | SN: 609            | 28-Mar-17 (in house check: 2021-18) | in house check: Dec-17 |
| Network Analyzer R&S ZVL13    | SN: 101093         | 10-May-12 (in house check: 2021-18) | in house check: Dec-17 |

Calibrated by: **Leif Klyner**      Name: **Leif Klyner**      Function: **Laboratory Technician**

Approved by: **Niels Kuster**      Name: **Niels Kuster**      Function: **Quality Manager**

Signature:

Issued: November 29, 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.

**Additional Documentation:**

- b) 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.

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

## Head TSL parameters

The following parameters and calculations were applied.

|                                         | Temperature         | Permittivity   | Conductivity         |
|-----------------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters             | 22.0 °C             | 34.5           | 6.07 mho/m           |
| Measured Head TSL parameters            | (22.0 $\pm$ 0.2) °C | 34.3 $\pm$ 6 % | 6.13 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                                          | 100 mW input power | 28.8 W/kg                   |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 287 W/kg $\pm$ 24.7 % (k=2) |

|                                                         |                    |                              |
|---------------------------------------------------------|--------------------|------------------------------|
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | condition          |                              |
| SAR measured                                            | 100 mW input power | 5.32 W/kg                    |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 53.2 W/kg $\pm$ 24.4 % (k=2) |

## Appendix

### Antenna Parameters with Head TSL

|                                      |                                |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 51.1 $\Omega$ - 2.2 j $\Omega$ |
| Return Loss                          | - 32.3 dB                      |

### APD (Absorbed Power Density)

| APD averaged over 1 cm <sup>2</sup> | Condition          |                                          |
|-------------------------------------|--------------------|------------------------------------------|
| APD measured                        | 100 mW input power | 287 W/m <sup>2</sup>                     |
| APD measured                        | normalized to 1W   | 2870 W/m <sup>2</sup> $\pm$ 29.2 % (k=2) |

| APD averaged over 4 cm <sup>2</sup> | condition          |                                          |
|-------------------------------------|--------------------|------------------------------------------|
| APD measured                        | 100 mW input power | 130 W/m <sup>2</sup>                     |
| APD measured                        | normalized to 1W   | 1300 W/m <sup>2</sup> $\pm$ 28.9 % (k=2) |

\*The reported APD values have been derived using psSAR8g.

### 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-1055, 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: 1055 | -        |

### 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              | 6.13            | 34.3             |

### Hardware Setup

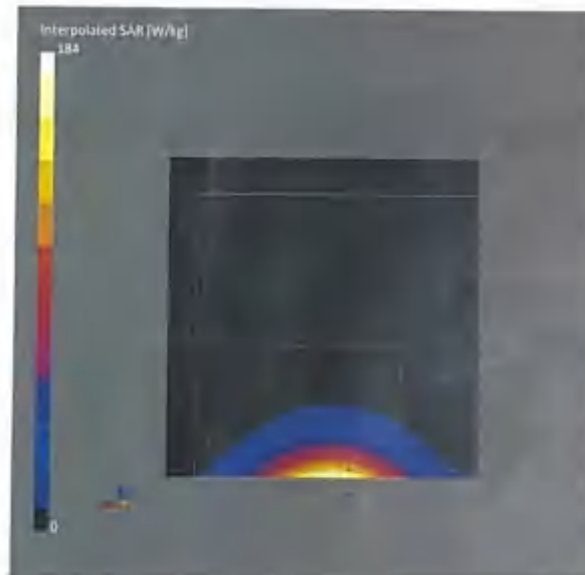
| Phantom                | TSL             | Probe, Calibration Date     | DAE, Calibration Date  |
|------------------------|-----------------|-----------------------------|------------------------|
| MFP V8.0 Center - 1182 | HBBL600-10000V6 | EX3DV4 - SN7405, 2020-12-30 | DAE4 Sn908, 2021-06-24 |

### 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                | 2021-11-29, 10:54 |
| psSAR1g [W/Kg]      | 28.8              |
| psSAR10g [W/Kg]     | 5.32              |
| Power Drift [dB]    | -0.01             |
| Power Scaling       | Disabled          |
| Scaling Factor [dB] |                   |
| TSL Correction      | No correction     |
| M2/M1 [%]           | 50.3              |
| Dist 3dB Peak [mm]  | 4.8               |



## Impedance Measurement Plot for Head TSL

ES063A Network Analyzer

1 Active Ch/Trace 2 Response 3 Stimulus 4 Mns/Analysis 5 Input State

Reset

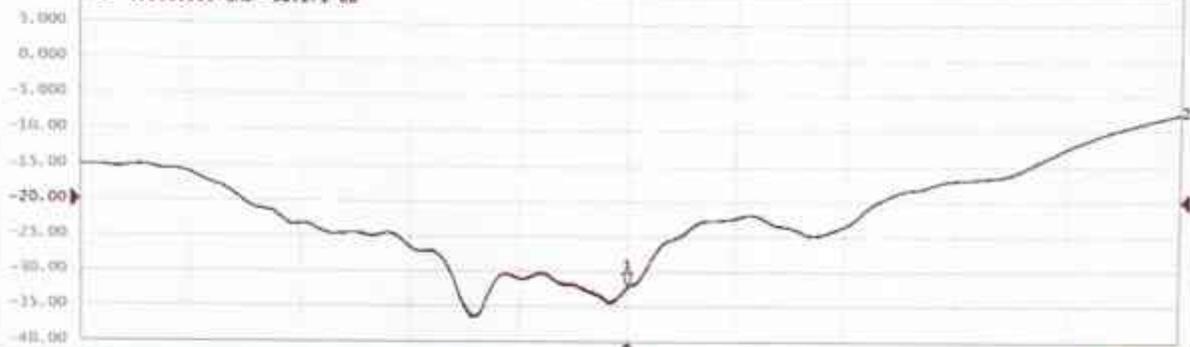
▶ **S11** Smith (R+jX) Scale 1.000 u (F1)

>1 6.500000 GHz 11.091 n -2.2072 n 11.094 pF



Tr2 S11 Log Mag 5.000 dB/ Ref -20.00 dB (F1)

>1 6.500000 GHz -32.271 dB



1 Center 6.5 GHz

Span 70 MHz

Span 2 GHz 10.00 GHz

Mag