

# 3500MHz Dipole

| Schmid & Partner<br>Engineering AG<br>eughausstrasse 43, 8004 Zurich   | , Switzerland  |   | Schweizerischer Kalibrierdienst<br>Service suisse d'étalonnage<br>Servizio svizzero di taratura<br>Swiss Calibration Service   |
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| ccredited by the Swiss Accreditati<br>he Swiss Accreditation Service<br>ultilateral Agreement for the red  | is one of the signatorie   | es to the EA  | Accreditation No.: SCS 0108  |
| ient CAICT-SZ (Aude  | -  |   | No: D3500V2-1084_Sep19   |
| CALIBRATION C  | ERTIFICATI   | E   |  |
| Dbject   | D3500V2 - SN:1   | 084   |  |
| Calibration procedure(s)   | QA CAL-22.v4<br>Calibration Proce  | edure for SAR Validation Source   | es between 3-6 GHz   |
| alibration date:   | September 20, 2  | 2019  |  |
| he measurements and the uncert   | ainties with confidence p  | tional standards, which realize the physical u<br>probability are given on the following pages a<br>bry facility: environment temperature $(22 \pm 3)$  | and are part of the certificate.   |
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# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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

Accreditation No.: SCS 0108

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Accredited by the Swiss Accreditation Service (SAS)

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

# Glossary:

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

# Calibration is Performed According to the Following Standards:

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

## Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

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

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

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# **Measurement Conditions**

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

| DASY Version                 | DASY5                      | V52.10.2                         |
|------------------------------|----------------------------|----------------------------------|
| Extrapolation                | Advanced Extrapolation     |                                  |
| Phantom                      | Modular Flat Phantom       |                                  |
| Distance Dipole Center - TSL | 10 mm                      | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 3500 MHz ± 1 MHz           |                                  |

Head TSL parameters The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 37.9         | 2.91 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 37.6 ± 6 %   | 2.91 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        |              |                  |

# SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL                   | Condition                       |                          |
|---|---------------------------------|--------------------------|
| SAR measured  | 100 mW input power              | 6.69 W/kg                |
| SAR for nominal Head TSL parameters                                     | normalized to 1W                | 66.8 W/kg ± 19.9 % (k=2) |
|   |                                 |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                 | condition                       |                          |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured | condition<br>100 mW input power | 2.52 W/kg                |

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

## Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 50.7 Ω + 2.4 jΩ |
|--------------------------------------|-----------------|
| Return Loss                          | - 32.0 dB       |

# General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.142 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 |
|-----------------|-------|
|-----------------|-------|

Certificate No: D3500V2-1084\_Sep19

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# DASY5 Validation Report for Head TSL

Date: 20.09.2019

Test Laboratory: SPEAG, Zurich, Switzerland

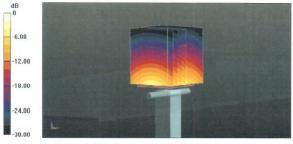
# DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1084

Communication System: UID 0 - CW; Frequency: 3500 MHz Medium parameters used: f = 3500 MHz;  $\sigma$  = 2.91 S/m;  $\epsilon_r$  = 37.6;  $\rho$  = 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(7.75, 7.75, 7.75) @ 3500 MHz; Calibrated: 25.03.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm 3500/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 72.01 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 18.5 W/kg SAR(1 g) = 6.69 W/kg; SAR(10 g) = 2.52 W/kg Maximum value of SAR (measured) = 12.9 W/kg



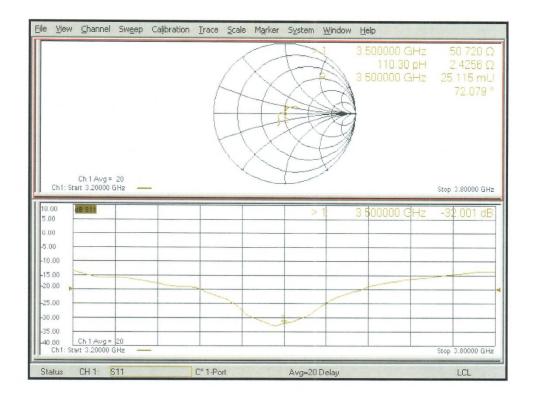
0 dB = 12.9 W/kg = 11.11 dBW/kg

Certificate No: D3500V2-1084\_Sep19

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# Impedance Measurement Plot for Head TSL



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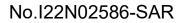


# 3700MHz Dipole

| Add: No.52 Hua YuanBei Ro   |   |  |  |
|---|---|--|--|
| Tel: +86-10-62304633-2117<br>E-mail; emf@caict.ac.cn  | http://www.caic   | t.ac.cn  |  |
| Client SAIC   | т   | Certificate No: Z2   | 2-60422  |
| CALIBRATION CE  | ERTIFICAT   | E  |  |
| Object  | D3700   | /2 - SN: 1049  |  |
| Calibration Procedure(s)  | FF-711  | -003-01  |  |
|   |   | tion Procedures for dipole validation kits   |  |
| Calibration date:   | Septem  | nber 22, 2022  |  |
| pages and are part of the ce  | ertificate.   |  |  |
|   | conducted in t  | he closed laboratory facility: environment i<br>or calibration)  | temperature (22±3)°C an  |
| All calibrations have been<br>humidity<70%.<br>Calibration Equipment used   | conducted in t  | or calibration)<br>Cal Date (Calibrated by, Certificate No.)   | temperature (22±3)°C an<br>Scheduled Calibratior   |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2  | Conducted in t<br>(M&TE critical for<br>ID #<br>106277  | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)  | Scheduled Calibration<br>Sep-22  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S  | Conducted in t<br>(M&TE critical for<br>ID #<br>106277<br>104291  | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)  | Scheduled Calibration<br>Sep-22<br>Sep-22  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4  | conducted in t<br>(M&TE critical for<br>ID #<br>106277<br>104291<br>SN 7464   | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S  | Conducted in t<br>(M&TE critical for<br>ID #<br>106277<br>104291  | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)  | Scheduled Calibration<br>Sep-22<br>Sep-22  |
| All calibrations have been<br>humidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4  | conducted in t<br>(M&TE critical for<br>ID #<br>106277<br>104291<br>SN 7464   | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23  |
| All calibrations have been<br>humidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4  | conducted in t<br>(M&TE critical fo<br>ID #<br>106277<br>104291<br>SN 7464<br>SN 1556   | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23  |
| All calibrations have been<br>humidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards   | conducted in t<br>(M&TE critical fo<br>ID #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430                       | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)   | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration                     |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C                            | conducted in t<br>(M&TE critical for<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673                          | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)             | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C<br>Network Analyzer E5071C | conducted in t<br>(M&TE critical fo<br>10 #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673<br>Name | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)<br>Function | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23           |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C<br>Network Analyzer E5071C | conducted in t<br>(M&TE critical for<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673                          | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)             | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C                            | conducted in t<br>(M&TE critical fo<br>10 #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673<br>Name | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)<br>Function | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |

Certificate No: Z22-60422

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Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2117 E-mail: emf@caict.ac.cn http://www.caiet.ac.cn

# Glossary:

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

# Calibration is Performed According to the Following Standards:

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

# Additional Documentation:

c) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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# Measurement Conditions

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

| DASY Version                 | DASY52                     | 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                    | 3700 MHz ± 1 MHz           |                                  |

# Head TSL parameters at 3700 MHz

The following parameters and calculations were applied.

|   | Temperature    | Permittivity | Conductivity    |
|---|----------------|--------------|-----------------|
| Nominal Head TSL parameters             | 22.0 °C        | 37.7         | 3.12 mho/m      |
| Measured Head TSL parameters            | (22.0 ±0.2) °C | 38.3 ±6 %    | 3.14 mho/m ±6 % |
| Head TSL temperature change during test | <1.0 °C        |              |                 |

# SAR result with Head TSL at 3700 MHz

| SAR averaged over 1 $Cm^3$ (1 g) of Head TSL   | Condition          |                         |
|--|--------------------|-------------------------|
| SAR measured                                   | 100 mW input power | 6.66 W/kg               |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 66.7 W/kg ±24.4 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL | Condition          |                         |
| SAR measured                                   | 100 mW input power | 2.49 W/kg               |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 25.0 W/kg ±24.2 % (k=2) |

Certificate No: Z22-60422

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

# Antenna Parameters with Head TSL at 3700 MHz

| Impedance, transformed to feed point | 48.7Ω - 2.53jΩ |
|--------------------------------------|----------------|
| Return Loss                          | - 30.7dB       |
| tetum Loas                           | - 55.7 65      |

| Electrical Delay (one direction) | 1.041 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.

| lanufactured by | SPEAG |
|-----------------|-------|
|                 |       |
|                 |       |
|                 |       |
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|                 |       |
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Certificate No: Z22-60422

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**DASY5 Validation Report for Head TSL** 



Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2117 E-mail: emf@caiet.ac.en http://www.caiet.ac.en

# Date: 2022-09-22

Test Laboratory: CTTL, Beijing, China **DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN: 1049** Communication System: UID 0, CW; Frequency: 3700 MHz; Medium parameters used: f = 3700 MHz; σ = 3.144 S/m; ε<sub>r</sub> = 38.25; ρ = 1000 kg/m<sup>3</sup> Phantom section: Right Section

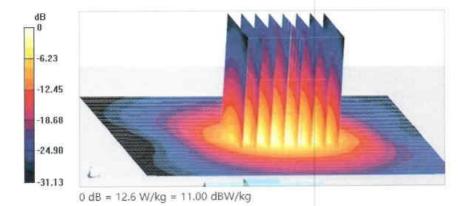
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:

- Probe: EX3DV4 SN7464; ConvF(6.78, 6.78, 6.78) @ 3700 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=3700 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 63.02 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 17.7 W/kg

SAR(1 g) = 6.66 W/kg; SAR(10 g) = 2.49 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 75.1% Maximum value of SAR (measured) = 12.6 W/kg



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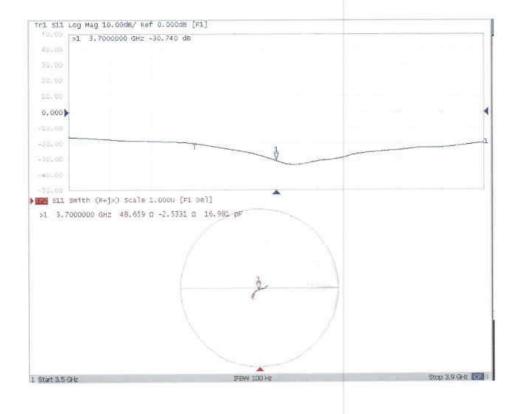






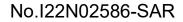
Add: No.52 HunYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2117 E-mail: emf@caict.ac.cn http://www.caict.ac.cn

# Impedance Measurement Plot for Head TSL



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# 3900MHz Dipole

| Engineering AG<br>Reughausstrasse 43, 8004 Zurich,   | of<br>Switzerland  |  | Schweizerischer Kalibrierdiens<br>Service suisse d'étalonnage<br>Servizio svizzero di taratura<br>Swiss Calibration Service  |
|--|--|--|--|
| Accredited by the Swiss Accreditati<br>The Swiss Accreditation Service<br>Multilateral Agreement for the rec<br>Client CAICT-SZ (Aude  | is one of the signatorie<br>cognition of calibration<br>an)  | es to the EA<br>certificates<br>Certificate N  | o: D3900V2-1028_Sep19  |
|  | D3900V2 - SN:1   |  |  |
|  |  |  |  |
| Calibration procedure(s)   | QA CAL-22.v4<br>Calibration Proce  | edure for SAR Validation Sources   | s between 3-6 GHz  |
| Calibration date:  | September 20, 2  | 019  |  |
| Calibration Equipment used (M&TI<br>Primary Standards<br>Power meter NRP   | ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778   | ry facility: environment temperature (22 ± 3) <sup>er</sup><br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)   |  |
| All calibrations have been conduct<br>Calibration Equipment used (M&Ti<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-291<br>Power sensor NRP-291<br>Reference 20 dB Attenuator   | ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245<br>SN: 5058 (20k)   | ry facility: environment temperature (22 ± 3) <sup>er</sup><br><u>Cal Date (Certificate No.)</u><br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)<br>03-Apr-19 (No. 217-02893)<br>04-Apr-19 (No. 217-02894)   | C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20   |
| All calibrations have been conduct<br>Calibration Equipment used (M&TI<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-291<br>Power sensor NRP-291<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4  | ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245   | ry facility: environment temperature (22 ± 3) <sup>er</sup><br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)<br>03-Apr-19 (No. 217-02893)   | C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20   |
| All calibrations have been conduct<br>Calibration Equipment used (M&TI<br>Primary Standards  | ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245<br>SN: 5058 (20k)<br>SN: 5047.2 / 06327<br>SN: 3503   | ry facility: environment temperature (22 ± 3) <sup>er</sup><br><u>Cal Date (Certificate No.)</u><br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)<br>03-Apr-19 (No. 217-02893)<br>04-Apr-19 (No. 217-02894)<br>04-Apr-19 (No. 217-02895)<br>25-Mar-19 (No. EX3-3503_Mar19)  | C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Mar-20<br>Mar-20   |
| All calibrations have been conduct<br>Calibration Equipment used (M&TI<br>Primary Standards<br>Power meter NRP<br>Power sensor NRP-291<br>Power sensor NRP-291<br>Reference 20 dB Attenuator<br>Type-N mismatch combination<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Power meter E4419B   | ed in the closed laborato<br>E critical for calibration)<br>ID #<br>SN: 104778<br>SN: 103244<br>SN: 103245<br>SN: 5058 (20k)<br>SN: 5047.2 / 06327<br>SN: 3503<br>SN: 601<br>ID #<br>SN: GB39512475  | ry facility: environment temperature (22 ± 3) <sup>91</sup><br>Cal Date (Certificate No.)<br>03-Apr-19 (No. 217-02892/02893)<br>03-Apr-19 (No. 217-02892)<br>04-Apr-19 (No. 217-02893)<br>04-Apr-19 (No. 217-02894)<br>04-Apr-19 (No. 217-02895)<br>25-Mar-19 (No. 217-02895)<br>25-Mar-19 (No. DAE4-601_Apr19)<br>30-Apr-19 (No. DAE4-601_Apr19)<br>Check Date (in house)<br>30-Oct-14 (in house check Feb-19)  | C and humidity < 70%.<br>Scheduled Calibration<br>Apr-20<br>Apr-20<br>Apr-20<br>Apr-20<br>Mar-20<br>Mar-20<br>Mar-20<br>Scheduled Check<br>In house check: Oct-20  |
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#### Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland

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



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

Accreditation No.: SCS 0108

S

С

S

Glossary: TSL ConvF N/A

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

# Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

e) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D3900V2-1028\_Sep19

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# **Measurement Conditions**

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

| DASY Version                 | DASY5                      | V52.10.2                         |
|------------------------------|----------------------------|----------------------------------|
| Extrapolation                | Advanced Extrapolation     |                                  |
| Phantom                      | Modular Flat Phantom       |                                  |
| Distance Dipole Center - TSL | 10 mm                      | with Spacer                      |
| Zoom Scan Resolution         | dx, dy = 4 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| Frequency                    | 3900 MHz ± 1 MHz           |                                  |

Head TSL parameters The following parameters and calculations were applied.

|   | Temperature     | Permittivity | Conductivity     |
|---|-----------------|--------------|------------------|
| Nominal Head TSL parameters             | 22.0 °C         | 37.5         | 3.32 mho/m       |
| Measured Head TSL parameters            | (22.0 ± 0.2) °C | 37.1 ± 6 %   | 3.23 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C        |              |                  |

# SAR result with Head TSL

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL                   | Condition                       |                                      |
|---|---------------------------------|--------------------------------------|
| SAR measured  | 100 mW input power              | 7.11 W/kg                            |
| SAR for nominal Head TSL parameters                                     | normalized to 1W                | 71.3 W/kg ± 19.9 % (k=2)             |
|   |                                 |                                      |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL                 | condition                       |                                      |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL<br>SAR measured | condition<br>100 mW input power | 2.48 W/kg                            |
|   |                                 | 2.48 W/kg<br>24.8 W/kg ± 19.5 % (k=2 |

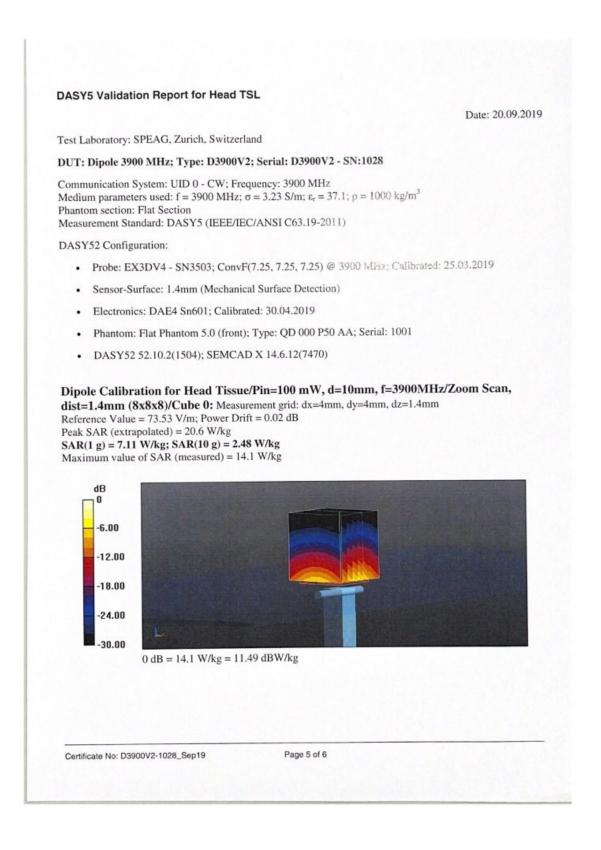
Certificate No: D3900V2-1028\_Sep19

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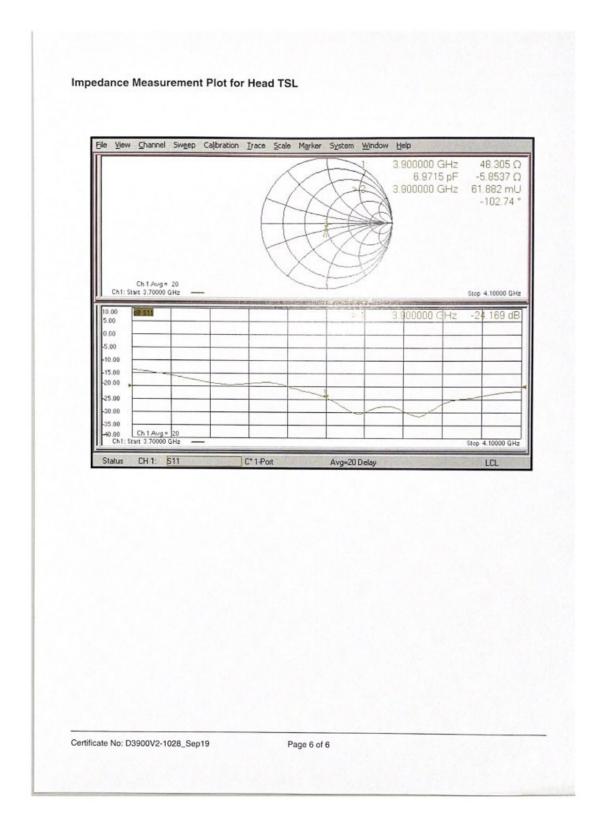


|  | arameters with Head TSL  |  |   |
|--|--|--|---|
| Impedar  | nce, transformed to feed point   | 48.  | 3 Ω - 5.9 jΩ  |
| Return I   | Loss   |  | 24.2 dB   |
| General Ar   | ntenna Parameters and De   | sign   |   |
| Electrica  | al Delay (one direction)   |  | 1.102 ns  |
| are added to t<br>"Measuremen<br>according to th<br>No excessive | he dipole arms in order to improve<br>t Conditions* paragraph. The SAR<br>he Standard. | e short-circuited for DC-signals. On so<br>natching when loaded according to the<br>data are not affected by this change. Th<br>arms, because they might bend or the | position as explained in the<br>ne overall dipole length is still |
| Additional   | EUT Data   |  |   |
| Manufa   | ctured by  |  | SPEAG   |
|  |  |  |   |
|  |  |  |   |









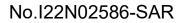


| 5GHz Dipole | 5GH | z | Di | p | ol | е |
|-------------|-----|---|----|---|----|---|
|-------------|-----|---|----|---|----|---|

| Tel: +86-10-62304633-2117<br>E-mail: emf@caict.ac.cn  | Lange Character and the   | and the second se |  |
|---|---|---|--|
| Client SAIC   | http://www.caic   |   | 22-60336   |
| CALIBRATION C   | ERTIFICAT   | E   |  |
| Object  | D5GHz   | 2V2 - SN: 1238  |  |
| Calibration Procedure(s)  | <b>FF 74</b>  | 000.04  |  |
|   |   | -003-01<br>tion Procedures for dipole validation kits   |  |
| Calibration date:   |   |   |  |
| salbration date.  | August  | 17, 2022  |  |
| bages and are part of the ce  | ertificate.   |   |  |
| numidity<70%.   | conducted in t  | he closed laboratory facility: environment  | temperature (22±3)℃ an   |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used   | conducted in t  | or calibration)   |  |
| All calibrations have been numidity<70%.  | conducted in t  |   | temperature (22±3)°C an<br>Scheduled Calibration<br>Sep-22   |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards  | CONDUCTED IN T  | Cal Date (Calibrated by, Certificate No.)   | Scheduled Calibration  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4  | conducted in t<br>(M&TE critical fe<br>ID #<br>106277<br>104291<br>SN 7464  | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)   | Scheduled Calibration<br>Sep-22  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S  | Conducted in t<br>(M&TE critical fe<br>ID #<br>106277<br>104291   | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)   | Scheduled Calibration<br>Sep-22<br>Sep-22  |
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| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4  | conducted in t<br>(M&TE critical fe<br>ID #<br>106277<br>104291<br>SN 7464<br>SN 1556   | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)   | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23  |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C                            | Conducted in t<br>(M&TE critical for<br>1D #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>ID #<br>MY49071430              | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration                     |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C                            | conducted in t<br>(M&TE critical fe<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673                 | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No. J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)   | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C<br>Network Analyzer E5071C | conducted in t<br>(M&TE critical fe<br>1D #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673<br>Name | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)<br>Function  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23           |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards<br>Signal Generator E4438C<br>Network Analyzer E5071C | conducted in t<br>(M&TE critical fe<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673                 | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No. J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)   | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |
| All calibrations have been<br>numidity<70%.<br>Calibration Equipment used<br>Primary Standards<br>Power Meter NRP2<br>Power sensor NRP8S<br>Reference Probe EX3DV4<br>DAE4<br>Secondary Standards   | conducted in t<br>(M&TE critical fe<br>1D #<br>106277<br>104291<br>SN 7464<br>SN 1556<br>ID #<br>MY49071430<br>MY46110673<br>Name | Cal Date (Calibrated by, Certificate No.)<br>24-Sep-21 (CTTL, No.J21X08326)<br>24-Sep-21 (CTTL, No.J21X08326)<br>26-Jan-22(SPEAG,No.EX3-7464_Jan22)<br>12-Jan-22(CTTL-SPEAG,No.Z22-60007)<br>Cal Date (Calibrated by, Certificate No.)<br>13-Jan-22 (CTTL, No.J22X00409)<br>14-Jan-22 (CTTL, No.J22X00406)<br>Function  | Scheduled Calibration<br>Sep-22<br>Sep-22<br>Jan-23<br>Jan-23<br>Scheduled Calibration<br>Jan-23<br>Jan-23 |

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# Glossary:

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

# Calibration is Performed According to the Following Standards:

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

# Additional Documentation:

c) DASY4/5 System Handbook

## Methods Applied and Interpretation of Parameters:

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

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

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# Measurement Conditions

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

| DASY Version                 | DASY52   | 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                    | 5250 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5750 MHz ± 1 MHz |                                  |  |

## Head TSL parameters at 5250MHz

The following parameters and calculations were applied.

|   | Temperature    | Permittivity | Conductivity    |
|---|----------------|--------------|-----------------|
| Nominal Head TSL parameters             | 22.0 °C        | 35.9         | 4.71 mho/m      |
| Measured Head TSL parameters            | (22.0 ±0.2) °C | 36.3 ±6 %    | 4.64 mho/m ±6 % |
| Head TSL temperature change during test | <1.0 °C        |              |                 |

# SAR result with Head TSL at 5250MHz

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL   | Condition          |                         |
|---|--------------------|-------------------------|
| SAR measured  | 100 mW input power | 7.95 W/kg               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 79.7 W/kg ±24.4 % (k=2) |
| SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL | Condition          |                         |
| SAR measured  | 100 mW input power | 2.27 W/kg               |
| SAR for nominal Head TSL parameters                     | normalized to 1W   | 22.8 W/kg ±24.2 % (k=2) |

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# Head TSL parameters at 5600MHz 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 %    | 5.01 mho/m ±6 % |
| Head TSL temperature change during test | <1.0 °C        |              |                 |

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

| SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL | Condition          |                         |
|---|--------------------|-------------------------|
| SAR measured  | 100 mW input power | 8.28 W/kg               |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 82.6 W/kg ±24.4 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL        | Condition          |                         |
| SAR measured  | 100 mW input power | 2.37 W/kg               |
| SAR for nominal Head TSL parameters                   | normalized to 1W   | 23.6 W/kg ±24.2 % (k=2) |

# Head TSL parameters at 5750MHz

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 | 35.0 ±6 %    | 5.18 mho/m ±6 % |
| Head TSL temperature change during test | <1.0 °C        |              |                 |

# SAR result with Head TSL at 5750MHz

| SAR averaged over 1 $cm^3$ (1 g) of Head TSL   | Condition          |                         |
|--|--------------------|-------------------------|
| SAR measured                                   | 100 mW input power | 7.87 W/kg               |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 78.5 W/kg ±24.4 % (k=2) |
| SAR averaged over 10 $cm^3$ (10 g) of Head TSL | Condition          |                         |
| SAR measured                                   | 100 mW input power | 2.22 W/kg               |
| SAR for nominal Head TSL parameters            | normalized to 1W   | 22.1 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 5250MHz

| Impedance, transformed to feed point | 48.4Ω- 3.36jΩ |  |
|--------------------------------------|---------------|--|
| Return Loss                          | - 28.5dB      |  |

# Antenna Parameters with Head TSL at 5600MHz

| Impedance, transformed to feed point | 50.8Ω+ 2.69jΩ |  |
|--------------------------------------|---------------|--|
| Return Loss                          | - 31.1dB      |  |

#### Antenna Parameters with Head TSL at 5750MHz

| Impedance, transformed to feed point | 53.5Ω+ 2.34jΩ |  |  |
|--------------------------------------|---------------|--|--|
| Return Loss                          | - 27.9dB      |  |  |

#### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.098 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 SPEAG Manufactured by SPEAG Certificate No: Z22-60336 Page 5 of 8







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# DASY5 Validation Report for Head TSL

Date: 2022-08-17

# Test Laboratory: CTTL, Beijing, China **DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1238** Communication System: CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz Duty Cycle: 1:1 Medium parameters used: f = 5250 MHz; $\sigma$ = 4.643 S/m; $\epsilon_r$ = 36.34; $\rho$ = 1000 kg/m<sup>3</sup> Medium parameters used: f = 5600 MHz; $\sigma$ = 5.006 S/m; $\epsilon_r$ = 35.17; $\rho$ = 1000 kg/m<sup>3</sup> Medium parameters used: f = 5750 MHz; $\sigma$ = 5.18 S/m; $\epsilon_r$ = 34.96; $\rho$ = 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(5.43, 5.43, 5.43) @ 5250 MHz; ConvF(4.91, 4.91, 4.91) @ 5600 MHz; ConvF(4.85, 4.85, 4.85) @ 5750 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=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 67.66 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 31.9 W/kg SAR(1 g) = 7.95 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 = 65.1%

Maximum value of SAR (measured) = 18.8 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 = 68.44 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 35.2 W/kg SAR(1 g) = 8.28 W/kg; SAR(10 g) = 2.37 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 63.5% Maximum value of SAR (measured) = 20.1 W/kg

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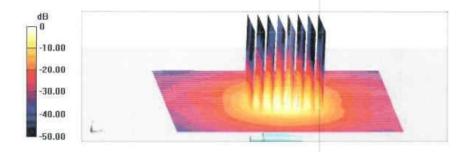






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Dipole Calibration /Pin=100mW, d=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.17 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 35.8 W/kg SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.22 W/kg Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 61.3% Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

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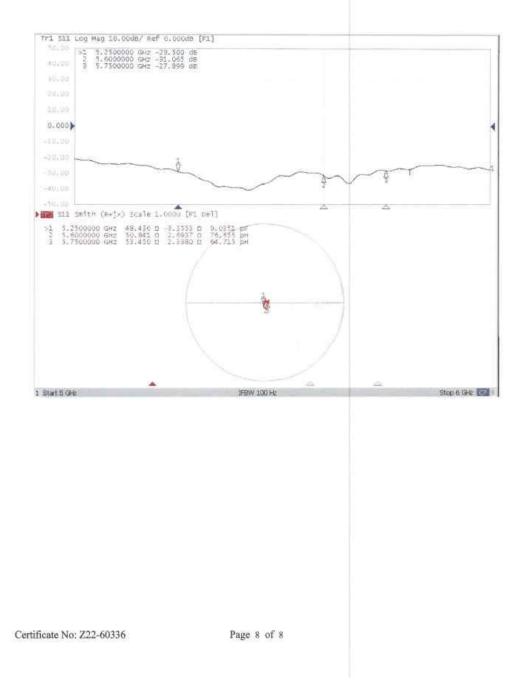






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Impedance Measurement Plot for Head TSL





# **ANNEX J: Extended Calibration SAR Dipole**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dBm, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended..

Justification of Extended Calibration SAR Dipole D835V2 - serial no. 4d057

|                        |                     |           | Head                       |                |                                  |                 |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |
| 2021-10-18             | -27.5               | /         | 49.8                       | /              | -4.19                            | /               |
| 2022-10-18             | -26.8               | 2.5       | 51.4                       | 1.6            | -3.97                            | 0.22            |

Justification of Extended Calibration SAR Dipole D1900V2 - serial no. 5d088

| Head                   |                     |           |                            |                |                                  |                 |  |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|--|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |  |
| 2021-10-18             | -22.6               | /         | 53.7                       | /              | 6.80                             | /               |  |
| 2022-10-18             | -22.2               | 1.8       | 54.6                       | 0.9            | 6.93                             | 0.13            |  |

Justification of Extended Calibration SAR Dipole D2300V2 - serial no. 1059

| Head                   |                     |           |                            |                |                                  |                 |  |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|--|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |  |
| 2021-09-22             | -26.5               | /         | 48.6                       | /              | -4.46                            | /               |  |
| 2022-09-22             | -25.8               | 2.6       | 49.8                       | 1.2            | -4.32                            | 0.14            |  |

Justification of Extended Calibration SAR Dipole D2450V2 - serial no. 873

| Head                   |                     |           |                            |                |                                  |                 |  |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|--|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |  |
| 2021-10-21             | -28.8               | /         | 53.6                       | /              | 1.26                             | /               |  |
| 2022-10-20             | -28.1               | 2.4       | 54.9                       | 1.3            | 1.43                             | 0.17            |  |

Justification of Extended Calibration SAR Dipole D3500V2– serial no.1084

| Head                   |                     |           |                            |                |                                  |                 |  |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|--|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |  |
| 2019-09-20             | -32.0               | /         | 50.7                       | /              | 2.40                             | /               |  |
| 2020-09-19             | -30.3               | 5.3       | 51.5                       | 0.8            | 2.53                             | 0.13            |  |
| 2021-09-18             | -29.2               | 8.8       | 52.1                       | 1.4            | 2.66                             | 0.26            |  |

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| Head                   |                     |           |                            |                |                                  |                 |  |
|------------------------|---------------------|-----------|----------------------------|----------------|----------------------------------|-----------------|--|
| Date of<br>Measurement | Return-Loss<br>(dB) | Delta (%) | Real<br>Impedance<br>(ohm) | Delta<br>(ohm) | Imaginary<br>Impedance<br>(johm) | Delta<br>(johm) |  |
| 2019-09-20             | -24.2               | /         | 48.3                       | /              | -5.90                            | /               |  |
| 2020-09-19             | -23.5               | 2.9       | 49.1                       | 0.8            | -5.66                            | 0.24            |  |
| 2021-09-18             | -22.6               | 6.6       | 50.2                       | 1.9            | -5.43                            | 0.47            |  |

Justification of Extended Calibration SAR Dipole D3900V2- serial no.1028

The Return-Loss is <-20dB, and within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the value result should support extended cabration.

\*\*\*END OF REPORT\*\*\*