# Appendix C

## Phantom Description

Schmid & Partner Engineering AG
s p e a g
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

### Certificate of Conformity / First Article Inspection

| | |
|---|---|
| Item | Oval Flat Phantom ELI 5.0 |
| Type No | QD OVA 002 A |
| Series No | 1108 and higher |
| Manufacturer | Untersee Composites<br>Knebelstrasse 8, CH-8268 Mannenbach, Switzerland |

**Tests**
Complete tests were made on the prototype units QD OVA 001 A, pre-series units QD OVA 001 B as well as on some series units QD OVA 001 B. Some tests are made on all series units QD OVA 002 A.

| Test | Requirement | Details | Units tested |
|---|---|---|---|
| Shape | Internal dimensions, depth and sagging are compatible with standards | Bottom elliptical 600 x 400 mm, Depth 190 mm, dimension compliant with [1] for f > 375 MHz | Prototypes |
| Material thickness | Bottom:<br>2.0mm +/- 0.2mm | dimension compliant with [3] for f > 800 MHz | all |
| Material parameters | rel. permittivity 2 – 5,<br>loss tangent ≤ 0.05, at f ≤ 6 GHz | rel. permittivity 3.5 +/- 0.5<br>loss tangent ≤ 0.05 | Material samples |
| Material resistivity | Compatibility with tissue simulating liquids . | Compatible with SPEAG liquids. ** | Phantoms, Material sample |
| Sagging | Sagging of the flat section in tolerance when filled with tissue simulating liquid. | within tolerance for filling height up to 155 mm | Prototypes, samples |

** Note: Compatibility restrictions apply certain liquid components mentioned in the standard, containing e.g. DGBE, DGMHE or Triton X-100. Observe technical note on material compatibility.

**Standards**
[1] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition 01-01
[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[3] IEC 62209–1 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", 2005-02-18
[4] IEC 62209–2 ed1.0, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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)", 2010-03-30

**Conformity**
Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of **body-worn** SAR measurements and system performance checks as specified in [1 – 4] and further standards.

**Date** 25.7.2011

**Signature / Stamp**

s p e a g
Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

# System Validation from Original Equipment Supplier

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

CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

**Client:** SGS **Certificate No: 24J02Z000789**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D750V3 - SN: 1015 |
| Calibration Procedure(s) | FF-Z11-003-01<br>Calibration Procedures for dipole validation kits |
| Calibration date: | September 27, 2024 |

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)℃ 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 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Power sensor NRP6A | 101369 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Reference Probe EX3DV4 | SN 7464 | 22-Jan-24(SPEAG, No. EX-7464_Jan24) | Jan-25 |
| DAE4 | SN 1556 | 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) | Jan-25 |
| **Secondary Standards** | **ID #** | **Cal Date (Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| Signal Generator E4438C | MY49071430 | 25-Dec-23 (CTTL, No. J23X13426) | Dec-24 |
| NetworkAnalyzer E5071C | MY46110673 | 25-Dec-23 (CTTL, No. J23X13425) | Dec-24 |
| OCP DAK-3.5(weighted) | 1040 | 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) | Jan-25 |

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

Issued: October 19, 2024

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

In Collaboration with
speag
CALIBRATION LABORATORY

CAICT

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

In Collaboration with
CALIBRATION LABORATORY

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

## Measurement Conditions

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

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

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.9 | 0.89 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 42.1 ± 6 % | 0.88 mho/m ± 6 % |
| **Head TSL temperature change during test** | <1.0 °C | --- | --- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 2.11 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **8.51 W/kg ± 18.8 % (*k*=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 1.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **5.68 W/kg ± 18.7 % (*k*=2)** |

In Collaboration with
speag
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.3Ω+ 0.01jΩ |
| Return Loss | - 32.8dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 0.944 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 |

In Collaboration with
CALIBRATION LABORATORY

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

**DASY5 Validation Report for Head TSL** Date: 2024-09-27

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1015**

Communication System: UID 0, CW; Frequency: 750 MHz

Medium parameters used: f = 750 MHz; $\sigma$ = 0.882 S/m; $\varepsilon_r$ = 42.09; $\rho$ = 1000 kg/m$^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(9.09, 9.18, 9.51) @ 750 MHz; Calibrated: 2024-01-22
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Reference Value = 56.00 V/m; Power Drift = -0.05 dB

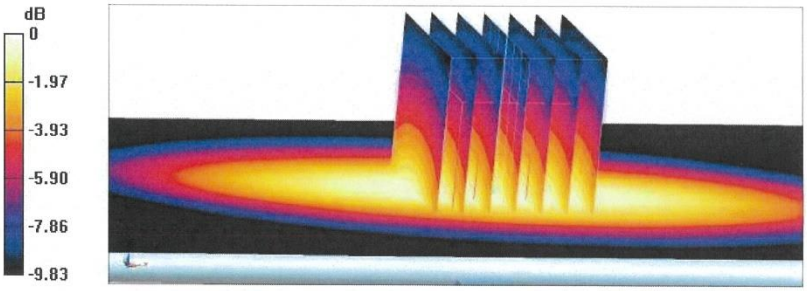
Peak SAR (extrapolated) = 3.03 W/kg

**SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.41 W/kg**

Smallest distance from peaks to all points 3 dB below = 17.5 mm

Ratio of SAR at M2 to SAR at M1 = 69.4%

Maximum value of SAR (measured) = 2.75 W/kg

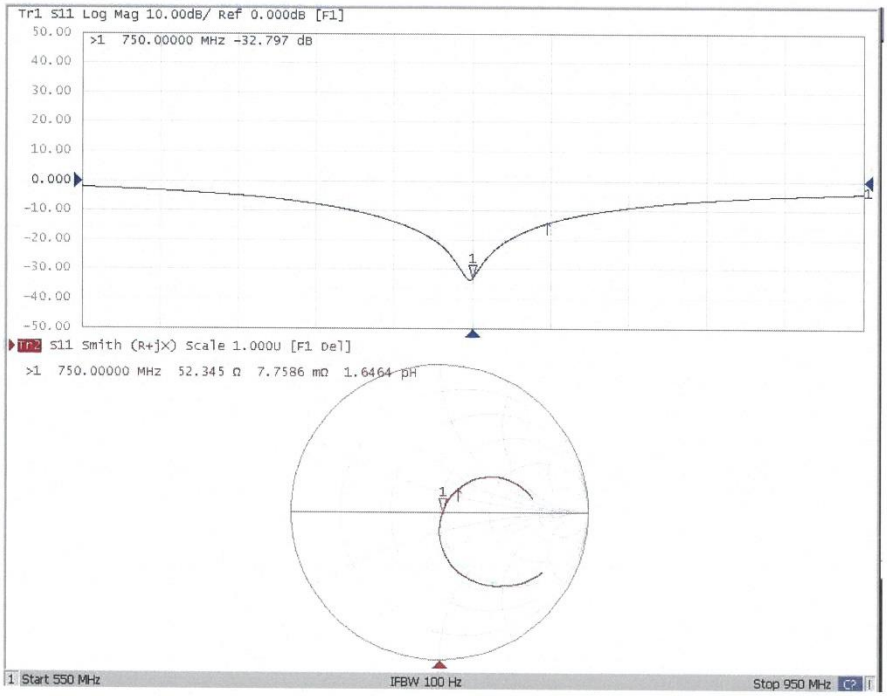



0 dB = 2.75 W/kg = 4.39 dBW/kg

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei 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




Certificate No: 24J02Z000789 Page 6 of 6

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

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

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 0108**

| Client | SGS<br>Taoyuan City | Certificate No. | D835V2-4d063_Sep24 |
|---|---|---|---|

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN: 4d063 |
| Calibration procedure(s) | QA CAL-05.v12<br>Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz |
| Calibration date | September 16, 2024 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Cal |
|---|---|---|---|
| Power Sensor R&S NRP-33T | SN: 100967 | 28-Mar-24 (No. 217-04038) | Mar-25 |
| Power Sensor R&S NRP18A | SN: 101859 | 22-Jul-24 (No. 4030A315008547) | Jul-25 |
| Spectrum Analyzer R&S FSV40 | SN: 101832 | 25-Jan-24 (No. 4030-315007551) | Jan-25 |
| Mismatch; Short [S4188] Attenuator [S4423] | SN: 1152 | 28-Mar-24 (No. 217-04050) | Mar-25 |
| OCP DAK-12 | SN: 1016 | 05-Oct-23 (No. OCP-DAK12-1016_Oct23) | Oct-24 |
| OCP DAK-3.5 | SN: 1249 | 05-Oct-23 (No. OCP-DAK3.5-1249_Oct23) | Oct-24 |
| Reference Probe EX3DV4 | SN: 7349 | 03-Jun-24 (No. EX3-7349_Jun24) | Jun-25 |
| DAE4ip | SN: 1836 | 10-Jan-24 (No. DAE4ip-1836_Jan24) | Jan-25 |

| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| ACAD Source Box | SN: 1000 | 28-May-24 (No. 675-ACAD_Source_Box-240528) | May-25 |
| Signal Generator R&S SMB100A | SN: 182081 | 28-May-24 (No. 675-CAL16-S4588-240528) | May-25 |
| Mismatch; SMA | SN: 1102 | 22-May-24 (No. 675-Mismatch_SMA-240522) | May-25 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by | Paulo Pina | Laboratory Technician | |
| Approved by | Sven Kühn | Technical Manager | |

Issued: September 16, 2024

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

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

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 0108**

## Glossary

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

## Calibration is Performed According to the Following Standards

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

## Additional Documentation

- DASY System Handbook

## Methods Applied and Interpretation of Parameters

- *Measurement Conditions*: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL*: The 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** | DASY8 Module SAR | 16.4.0 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with spacer |
| **Zoom Scan Resolution** | dx, dy = 6mm, dz = 1.5mm | Graded Ratio = 1.5 mm (Z direction) |
| **Frequency** | 835MHz ±1MHz | |

## Head TSL parameters at 835 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.900 mho/m |
| **Measured Head TSL parameters** | (22.0 ±0.2)°C | 43.0 ±6% | 0.900 mho/m ±6% |
| **Head TSL temperature change during test** | < 0.5 °C | | |

## SAR result with Head TSL at 835 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR for nominal Head TSL parameters | 24 dBm input power | 2.36 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 9.40 W/kg ±17.0% (k = 2) |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
|---|---|---|
| SAR for nominal Head TSL parameters | 24 dBm input power | 1.52 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 6.05 W/kg ±16.5% (k = 2) |

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

### Antenna Parameters with Head TSL at 835 MHz

| | |
|---|---|
| Impedance | 51.4 Ω – 3.6 jΩ |
| Return Loss | -28.3 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.392 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 |

System Performance Check Report

Summary

| Dipole | Frequency [MHz] | TSL | Power [dBm] |
|---|---|---|---|
| D835V2 - SN4d063 | 835 | HSL | 24 |

Exposure Conditions

| Phantom Section, TSL | Test Distance [mm] | Band | Group, UID | Frequency [MHz], Channel Number | Conversion Factor | TSL Conductivity [S/m] | TSL Permittivity |
|---|---|---|---|---|---|---|---|
| Flat | 15 | | CW, 0-- | 835, 0 | 9.61 | 0.90 | 43.0 |

Hardware Setup

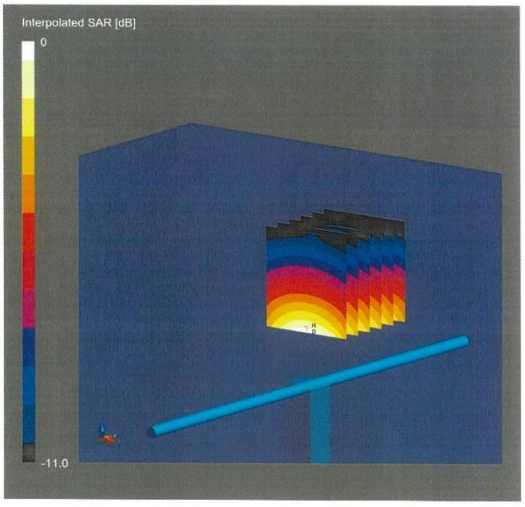
| Phantom | TSL, Measured Date | Probe, Calibration Date | DAE, Calibration Date |
|---|---|---|---|
| Flat V4.9 mod | HSL, 2024-09-16 | EX3DV4 - SN7349, 2024-06-03 | DAE4ip Sn1836, 2024-01-10 |

Scans Setup

| | Zoom Scan |
|---|---|
| Grid Extents [mm] | 30 x 30 x 30 |
| Grid Steps [mm] | 6.0 x 6.0 x 1.5 |
| Sensor Surface [mm] | 1.4 |
| Graded Grid | Yes |
| Grading Ratio | 1.5 |
| MAIA | N/A |
| Surface Detection | VMS + 6p |
| Scan Method | Measured |

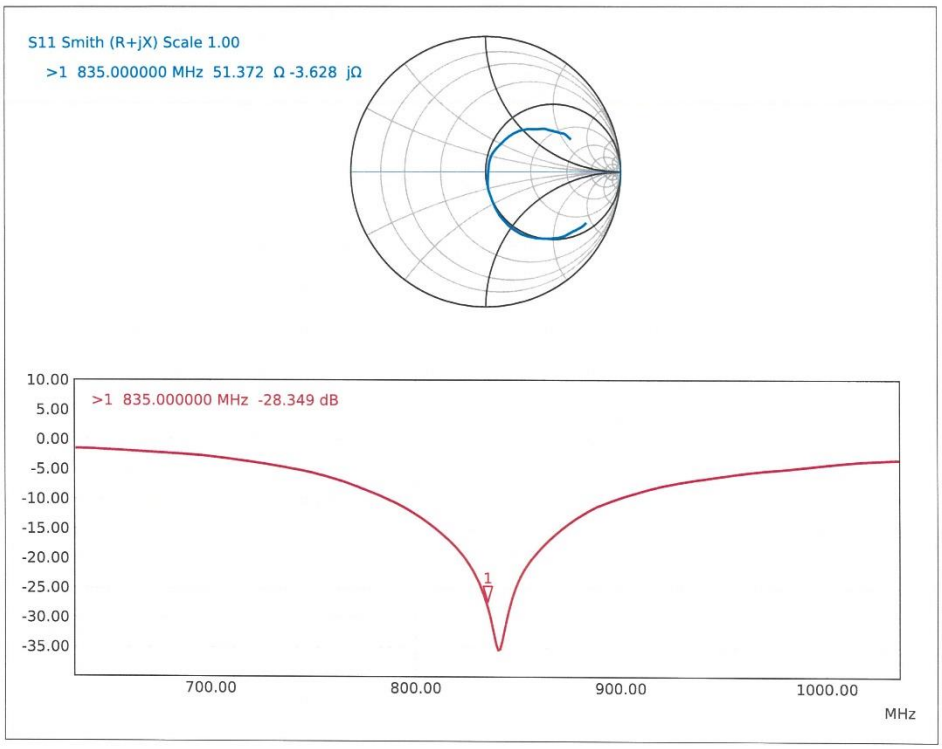
Measurement Results

| | Zoom Scan |
|---|---|
| Date | 2024-09-16 |
| psSAR1g [W/Kg] | 2.36 |
| psSAR10g [W/Kg] | 1.52 |
| Power Drift [dB] | 0.01 |
| Power Scaling | Disabled |
| Scaling Factor [dB] | |
| TSL Correction | Positive / Negative |




0 dB = 3.65 W/Kg

**Impedance Measurement Plot for Head TSL**



In Collaboration with
TTL Speag CALIBRATION LABORATORY
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

CAICT

Client SGS Certificate No: 24J02Z000790

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1750V2 - SN: 1008 |
| Calibration Procedure(s) | FF-Z11-003-01<br>Calibration Procedures for dipole validation kits |
| Calibration date: | September 27, 2024 |

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)℃ 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 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Power sensor NRP6A | 101369 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Reference Probe EX3DV4 | SN 7464 | 22-Jan-24(SPEAG, No. EX-7464_Jan24) | Jan-25 |
| DAE4 | SN 1556 | 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) | Jan-25 |
| **Secondary Standards** | **ID #** | **Cal Date (Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| Signal Generator E4438C | MY49071430 | 25-Dec-23 (CTTL, No. J23X13426) | Dec-24 |
| NetworkAnalyzer E5071C | MY46110673 | 25-Dec-23 (CTTL, No. J23X13425) | Dec-24 |
| OCP DAK-3.5(weighted) | 1040 | 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) | Jan-25 |

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

Issued: October 19, 2024

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

In Collaboration with
speag
CALIBRATION LABORATORY

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

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

## 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, dz = 5 mm | |
| **Frequency** | 1750 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.1 | 1.37 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.9 ± 6 % | 1.37 mho/m ± 6 % |
| **Head TSL temperature change during test** | <1.0 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 9.01 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **36.3 W/kg ± 18.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 4.88 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **19.6 W/kg ± 18.7 % (k=2)** |

In Collaboration with
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 47.9Ω+ 0.24jΩ |
| Return Loss | - 33.4dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.127 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 |

In Collaboration with
s p e a g
CALIBRATION LABORATORY

CAICT

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

**DASY5 Validation Report for Head TSL** Date: 2024-09-27

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008**

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

Medium parameters used: f = 1750 MHz; $\sigma$ = 1.365 S/m; $\varepsilon_r$ = 40.87; $\rho$ = 1000 kg/m$^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(7.99, 8.13, 8.29) @ 1750 MHz; Calibrated: 2024-01-22
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Reference Value = 98.11 V/m; Power Drift = 0.01 dB

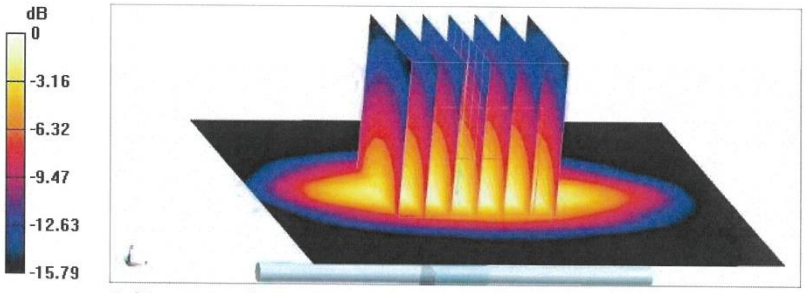
Peak SAR (extrapolated) = 15.8 W/kg

**SAR(1 g) = 9.01 W/kg; SAR(10 g) = 4.88 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 57.9%

Maximum value of SAR (measured) = 13.5 W/kg



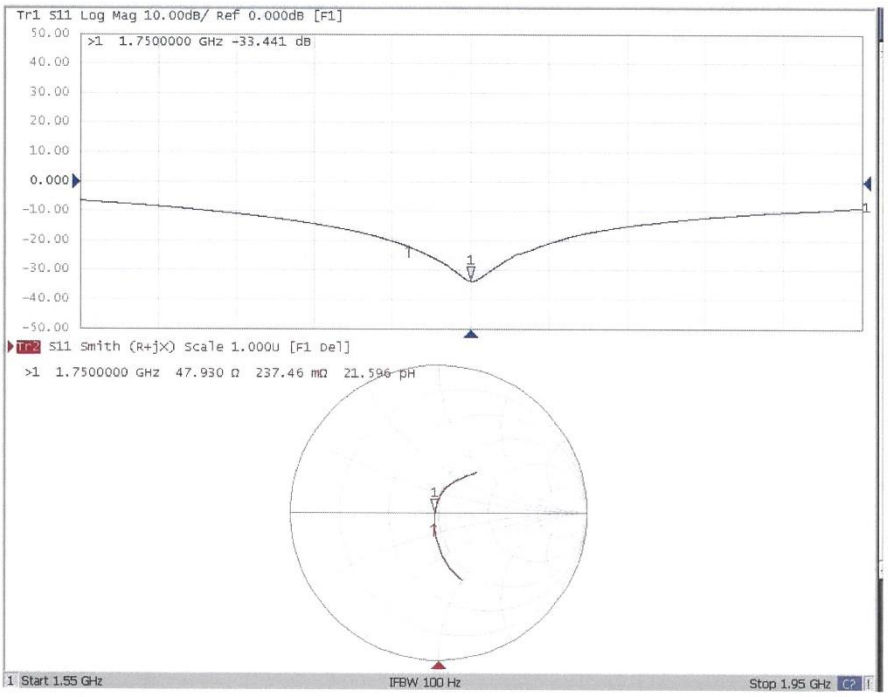

0 dB = 13.5 W/kg = 11.30 dBW/kg

In Collaboration with
s p e a g
CALIBRATION LABORATORY

CAICT

Add: No.52 HuaYuanBei 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



In Collaboration with TTL Speag CALIBRATION LABORATORY
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191
Tel: +86-10-62304633-2117
E-mail: emf@caict.ac.cn http://www.caict.ac.cn

Client SGS Certificate No: 24J02Z000791

# CALIBRATION CERTIFICATE

Object D2000V2 - SN: 1015

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

Calibration date: September 27, 2024

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)℃ 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 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Power sensor NRP6A | 101369 | 17-May-24 (CTTL, No. J24X04107) | May-25 |
| Reference Probe EX3DV4 | SN 7464 | 22-Jan-24(SPEAG, No. EX-7464_Jan24) | Jan-25 |
| DAE4 | SN 1556 | 03-Jan-24(CTTL-SPEAG, No.24J02Z80002) | Jan-25 |
| **Secondary Standards** | **ID #** | **Cal Date (Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| Signal Generator E4438C | MY49071430 | 25-Dec-23 (CTTL, No. J23X13426) | Dec-24 |
| NetworkAnalyzer E5071C | MY46110673 | 25-Dec-23 (CTTL, No. J23X13425) | Dec-24 |
| OCP DAK-3.5(weighted) | 1040 | 22-Jan-24(SPEAG, No.OCP-DAK3.5-1040_Jan24) | Jan-25 |

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

Issued: October 19, 2024

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

In Collaboration with
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2117
E-mail: cttl@chinattl.com http://www.caict.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%.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

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

## 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, dz = 5 mm | |
| **Frequency** | 2000 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 40.0 | 1.40 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 40.7 ± 6 % | 1.39 mho/m ± 6 % |
| **Head TSL temperature change during test** | <1.0 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.2 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **41.2 W/kg ± 18.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 5.29 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.3 W/kg ± 18.7 % (k=2)** |

In Collaboration with
s p e a g
CALIBRATION LABORATORY

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

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

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.8Ω- 2.80jΩ |
| Return Loss | - 30.2dB |

### 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

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

In Collaboration with
CALIBRATION LABORATORY

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

**DASY5 Validation Report for Head TSL** Date: 2024-09-27

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1015**

Communication System: UID 0, CW; Frequency: 2000 MHz

Medium parameters used: f = 2000 MHz; $\sigma$ = 1.388 S/m; $\varepsilon_r$ = 40.74; $\rho$ = 1000 kg/m$^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(7.57, 7.71, 7.88) @ 2000 MHz; Calibrated: 2024-01-22
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2024-01-03
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

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

Reference Value = 92.35 V/m; Power Drift = -0.03 dB

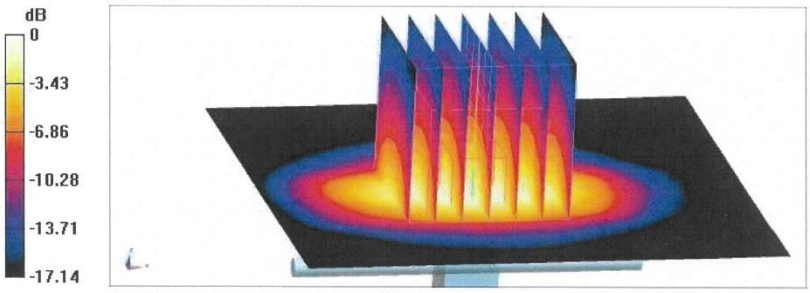
Peak SAR (extrapolated) = 18.3 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.29 W/kg**

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

Ratio of SAR at M2 to SAR at M1 = 56.7%

Maximum value of SAR (measured) = 15.6 W/kg



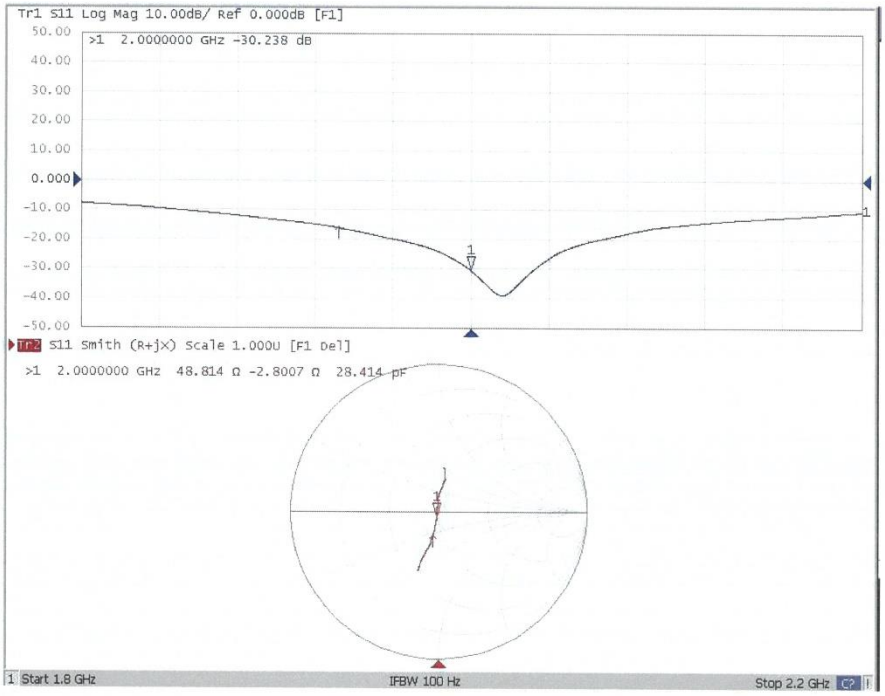

0 dB = 15.6 W/kg = 11.93 dBW/kg

In Collaboration with
s p e a g
CALIBRATION LABORATORY

CAICT

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

## Impedance Measurement Plot for Head TSL




Certificate No: 24J02Z000791 Page 6 of 6

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

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

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

Accreditation No.: **SCS 0108**

| Client | SGS<br>Taoyuan City | Certificate No. | D2450V2-727_Apr25 |
|---|---|---|---|

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 727 |
| Calibration procedure(s) | QA CAL-05.v12<br>Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz |
| Calibration date | April 15, 2025 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Cal |
|---|---|---|---|
| Power Sensor R&S NRP-33T | SN: 100967 | 26-Mar-25 (No. 217-04290) | Mar-26 |
| Power Sensor R&S NRP18A | SN: 101859 | 06-Feb-25 (No. 4030A315009541) | Feb-26 |
| Spectrum Analyzer R&S FSV40 | SN: 101832 | 29-Jan-25 (No. 4030A315009658) | Jan-26 |
| 3.5mm mismatch combination | SN: 1152 | 24-Mar-25 (No. 217-04293) | Mar-26 |
| OCP DAK-12 | SN: 1016 | 24-Sept-24 (No. OCP-DAK12-1016_Sep24) | Sep-25 |
| OCP DAK-3.5 | SN: 1249 | 23-Sept-24 (No. OCP-DAK3.5-1249_Sep24) | Sep-25 |
| Reference Probe EX3DV4 | SN: 7349 | 10-Jan-25 (No. EX3-7349_Jan25) | Jan-26 |
| DAE4ip | SN: 1836 | 28-Oct-24 (No. DAE4ip-1836_Oct24) | Oct-25 |

| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| ACAD Source Box | SN: 1000 | 28-May-24 (No. 675-ACAD_Source_Box-240528) | May-25 |
| Signal Generator R&S SMB100A | SN: 182081 | 28-May-24 (No. 675-CAL16-S4588-240528) | May-25 |
| Mismatch; SMA | SN: 1102 | 22-May-24 (No. 675-Mismatch_SMA-240522) | May-25 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by | Leif Klysner | Laboratory Technician | |
| Approved by | Sven Kühn | Technical Manager | |

Issued: April 15, 2025