

Appendix C for KSCR230200025001

Calibration Certificate

Object	Apply	No	Model	SN	Calibration Date	Due date of calibration
Dipole	<input type="checkbox"/>	1	CLA150	4025	2021/04/26	2024/04/25
	<input type="checkbox"/>	2	D450V3	1103	2021/04/21	2024/04/20
	<input type="checkbox"/>	3	D750V3	1188	2022/03/29	2025/03/28
	<input type="checkbox"/>	4	D835V2	4d114	2022/03/31	2025/03/30
	<input type="checkbox"/>	5	D900V2	1d079	2022/06/07	2025/06/06
	<input type="checkbox"/>	6	D1800V2	2d170	2022/03/31	2025/03/30
	<input type="checkbox"/>	7	D1900V2	5d136	2022/06/07	2025/06/06
	<input type="checkbox"/>	8	D2000V2	1041	2022/06/06	2025/06/05
	<input type="checkbox"/>	9	D2300V2	1096	2022/03/31	2025/03/30
	<input checked="" type="checkbox"/>	10	D2450V2	817	2022/04/01	2025/03/31
	<input type="checkbox"/>	11	D2600V2	1158	2022/03/31	2025/03/30
	<input checked="" type="checkbox"/>	12	D5GHzV2	1095	2022/06/01	2025/05/31
DAE	<input checked="" type="checkbox"/>	13	DAE4	1245	2022/05/30	2023/05/29
Probe	<input checked="" type="checkbox"/>	14	EX3DV4	7767	2022/10/28	2023/10/27

1 Dipole

1.1 CLA150 - SN 4025

<p>Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland</p> <p>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</p> <p>Client: SGS-CN (Auden) Certificate No: CLA150-4025_Apr21</p> <p style="text-align: right;">Accreditation No.: SCS 0108</p> <hr/> <p style="text-align: center;">CALIBRATION CERTIFICATE</p> <p>Object: CLA150 - SN: 4025</p> <p>Calibration procedure(s): QA CAL-15.v9 Calibration Procedure for SAR Validation Sources below 700 MHz</p> <p>Calibration date: April 26, 2021</p> <p>The 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.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3)°C and humidity < 70%.</p> <p>Calibration Equipment used (M&E critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Schedule/Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter NRP</td> <td>SN: 10475</td> <td>09-Apr-21 (No. 217-03201/03202)</td> <td>Apr-22</td> </tr> <tr> <td>Power sensor NRP Z01</td> <td>SN: 103344</td> <td>09-Apr-21 (No. 217-03201)</td> <td>Apr-22</td> </tr> <tr> <td>Power sensor NRP Z01</td> <td>SN: 103345</td> <td>09-Apr-21 (No. 217-03202)</td> <td>Apr-22</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: C22362 (20)</td> <td>09-Apr-21 (No. 217-03343)</td> <td>Apr-22</td> </tr> <tr> <td>Type-N mismatch combination</td> <td>SN: 310952 / 00327</td> <td>09-Apr-21 (No. 217-03344)</td> <td>Apr-22</td> </tr> <tr> <td>Reference Probe EX3004 (DIE4)</td> <td>SN: 3877</td> <td>30-Dec-20 (No. EX3-3877_Dec20)</td> <td>Dec-21</td> </tr> <tr> <td></td> <td>SN: 664</td> <td>26-Jun-20 (No. DMS4-654_Jun20)</td> <td>Jun-21</td> </tr> </tbody> </table> <table border="1" style="width: 100%; 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Measurement Techniques", June 2013 IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016 IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010 KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz" <p>Additional Documentation:</p> <ol style="list-style-type: none"> DASY4/5 System Handbook <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in this certificate are valid at the frequency indicated. Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom. Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required. SAR measured: SAR measured at the stated antenna input power. SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>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%.</p> </div> <p>Certificate No: CLA150-4025_Apr21 Page 2 of 6</p>		
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DASY5 Validation Report for Head TSL

Date: 26.04.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4025

Communication System: UID 0 - CW; Frequency: 150 MHz
 Medium parameters used: $f = 150 \text{ MHz}$; $\sigma = 0.76 \text{ S/m}$; $\epsilon_0 = 51.1$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(12.51, 12.51, 12.51) @ 150 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA54 Snt54; Calibrated: 26.06.2020
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP.1003
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
 Reference Value = 85.93 W/m; Power Drift = -0.02 dB
 Peak SAR (extrapolated) = 7.36 W/kg
SAR(1 g) = 3.90 W/kg; SAR(10 g) = 2.60 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid (> 30mm)
 Ratio of SAR at M2 to SAR at M1 = 80.4%
 Maximum value of SAR (measured) = 5.48 W/kg

Certificate No: CLA150-4025_Apr21 Page 5 of 6

Certificate No: CLA150-4025_Apr21 Page 6 of 6

1.2 D450V3 - SN 1103

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

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Client: **SGS-CN (Aude)** Certificate No: **D450V3-1103_Apr21**

CALIBRATION CERTIFICATE

Object: **D450V3 - SN:1103**

Calibration procedure(s): **QA CAL-15_v9
 Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **April 21, 2021**

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

All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 0.1) °C and humidity < 70%.

Calibration Equipment used (MPE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03021/03030)	Apr-22
Power sensor NRP-291	SN: 103244	09-Apr-21 (No. 217-03021)	Apr-22
Power sensor NRP-291	SN: 103245	09-Apr-21 (No. 217-03020)	Apr-22
Reference 20 dB Attenuator	SN: CC2852 (200)	09-Apr-21 (No. 217-03345)	Apr-22
Type-N mission combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe E3030A	SN: 3877	30-Dec-20 (No. E303-2077_Decl2)	Dec-21
DAEA	SN: 654	26-Jan-20 (No. DAE4-654_Jan20)	Jan-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4118B	SN: GB41200274	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4112A	SN: MY41496027	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4112A	SN: 000100210	06-Apr-16 (in house check Jun-20)	In house check Jun-22
RF generator HP 8448C	SN: L033400101700	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Network Analyzer Agilent E8358A	SN: U841980477	31-Mar-14 (in house check Oct-20)	In house check Oct-21

Calibrated by: **Christoph Leuber** (Function: Laboratory Technician) [Signature]

Approved by: **Katja Polovic** (Function: Technical Manager) [Signature]

This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: April 23, 2021

Certificate No: D450V3-1103_Apr21 Page 1 of 6

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Client: **SGS-CN (Aude)** Certificate No: **D450V3-1103_Apr21**

Glossary:

TSL: Issue 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:

- IEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices; Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 665664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: D450V3-1103_Apr21 Page 2 of 6

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

DASY Version	DASY5	V82.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELJ4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters
 The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	43.5	0.57 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.1 ± 6 %	0.67 mho/m ± 8 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.56 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	0.757 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.06 W/kg ± 17.6 % (k=2)

Certificate No: D450V3-1103_Apr21 Page 3 of 6

Appendix (Additional assessments outside the scope of SCS 0106)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	57.1 Ω - 2.6 jΩ
Return Loss	-23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.346 ns
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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 straight 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 set according to the Standard.
 No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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Certificate No: D450V3-1103_Apr21 Page 4 of 6

DASY5 Validation Report for Head TSL

Test Laboratory: SPEAG, Zurich, Switzerland Date: 21.04.2021

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1103

Communication System: UID 0 - CW; Frequency: 450 MHz
 Medium parameters used: f = 450 MHz, α = 0.87 S/m; ε_r = 43.1; ρ = 1000 kg/m³
 Phantom section: Flat Section
 Measurement Standard: DASY5 (IEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64, 10.64) @ 450 MHz; Calibrated: 30.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.06.2020
- Phantom: ELJ v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:
 Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 39.18 V/m; Power Drift = -0.08 dB
 Peak SAR (extrapolated) = 1.76 W/kg
 SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.767 W/kg
 Smallest distance from peaks to all points 3 dB below: Larger than measurement grid
 Ratio of SAR at M2 to SAR at M1 = 64.9%
 Maximum value of SAR (measured) = 1.53 W/kg

Certificate No: D450V3-1103_Apr21 Page 5 of 6

Certificate No: D450V3-1103_Apr21 Page 6 of 6

1.3 D750V3 - SN 1188

<div style="text-align: right;"> </div> <p style="font-size: small;"> Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4236633-2112 Fax: +86-10-4236633-2504 E-mail: cti@chinaast.com http://www.chinaast.cn </p> <p> Client: SGS-CN Certificate No: Z22-60103 </p> <h3 style="text-align: center;">CALIBRATION CERTIFICATE</h3> <p> Object: D750V3 - SN: 1188 </p> <p> Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits </p> <p> Calibration date: March 28, 2022 </p> <p> 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. </p> <p> All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%. </p> <p> Calibration Equipment used (M&TE critical for calibration) </p> <table border="1" style="width:100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>102277</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Power sensor NRP88</td> <td>104291</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN 7307</td> <td>26-May-21(SPEAG.No.EX3-7307_May21)</td> <td>May-22</td> </tr> <tr> <td>DAE4</td> <td>SN 1556</td> <td>12-Jan-22(CTTL-SPEAG.No.Z22-60007)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1" style="width:100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Signal Generator S4439C</td> <td>MY46071430</td> <td>13-Jan-22 (CTTL No.J22X00409)</td> <td>Jan-23</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>MY46110973</td> <td>14-Jan-22 (CTTL No.J22X00409)</td> <td>Jan-23</td> </tr> </tbody> </table> <p> Calibrated by: Zhao Jing SAR Test Engineer </p> <p> Reviewed by: Lin Hao SAR Test Engineer </p> <p> Approved by: Qi Dianyuan SAR Project Leader </p> <p style="text-align: right;"> Issued: April 3, 2022 </p> <p style="font-size: x-small;"> This calibration certificate shall not be reproduced except in full without written approval of the laboratory. </p> <p style="font-size: x-small;"> Certificate No: Z22-60103 Page 1 of 6 </p>	Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRP2	102277	24-Sep-21 (CTTL No.J21X08326)	Sep-22	Power sensor NRP88	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22	Reference Probe EX3DV4	SN 7307	26-May-21(SPEAG.No.EX3-7307_May21)	May-22	DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No.Z22-60007)	Jan-23	Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator S4439C	MY46071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23	Network Analyzer E5071C	MY46110973	14-Jan-22 (CTTL No.J22X00409)	Jan-23	<div style="text-align: right;"> </div> <p style="font-size: small;"> Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4236633-2079 Fax: +86-10-4236633-2504 E-mail: cti@chinaast.com http://www.chinaast.cn </p> <p> Glossary: TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx.yz N/A: not applicable or not measured </p> <p> 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 865684, "SAR Measurement Requirements for 100 MHz to 6 GHz" </p> <p> Additional Documentation: c) DASY4/5 System Handbook </p> <p> Methods Applied and Interpretation of Parameters: </p> <ul style="list-style-type: none"> • 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. <div style="border: 1px solid black; padding: 5px; font-size: x-small;"> 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%. </div> <p style="font-size: x-small;"> Certificate No: Z22-60103 Page 2 of 6 </p>																												
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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. </p> <p> Additional EUT Data </p> <table border="1" style="width:100%; border-collapse: collapse; font-size: x-small;"> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </table> <p style="font-size: x-small;"> Certificate No: Z22-60103 Page 4 of 6 </p>	Impedance, transformed to feed point	53.60- 1.13jΩ	Return Loss	-28.7dB	Electrical Delay (one direction)	0.947 ns	Manufactured by	SPEAG
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E-mail: cti@china.ttl.com http://www.chinatit.com

Date: 2022-03-29

DASY5 Validation Report for Head TSL
 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1188
 Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.888 \text{ S/m}$; $\epsilon_r = 41.36$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(10.31, 10.31, 10.31) @ 750 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 S01556; Calibrated: 2022-01-12
- Phantom: MFP_V5.1C (20kg 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 = 55.06 V/m; Power Drift = 0.00 dB
 Peak SAR (extrapolated) = 3.07 W/kg
 SAR(1 g) = 2.07 W/kg; SAR(10 g) = 1.37 W/kg
 Smallest distance from peaks to all points 3 dB below = 18.9 mm
 Ratio of SAR at M2 to SAR at M1 = 67.1%
 Maximum value of SAR (measured) = 2.74 W/kg

0 dB = 2.74 W/kg = 4.38 dBW/kg

Certificate No: Z22-60103 Page 5 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60103 Page 6 of 6

1.4 D835V2 - SN 4d114

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国家承认
CALIBRATION
CNAS 15070

Certificate No: Z22-60104

Client: SGS-CN

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d114

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

Calibration date: March 31, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL, No.J21X08326)	Sep-22
Power sensor NRPBS	104291	24-Sep-21 (CTTL, No.J21X08326)	Sep-22
Reference Probe EX3DV4	SN 7307	26-May-21(SPEAG.No.EX3-7307_May21)	May-22
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No.Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL, No.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL, No.J22X00406)	Jan-23

Calibrated by: Zhao Jing, SAR Test Engineer

Reviewed by: Lin Hao, SAR Test Engineer

Approved by: Qi Dianyuan, SAR Project Leader

Issued: April 6, 2022

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Certificate No: Z22-60104 Page 1 of 6

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E-mail: cti@china.ttl.com http://www.chinatit.com

Glossary:

TSL: tissue simulating liquid
 ConvF: sensitivity in TSL / NORMx.yz
 N/A: not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62208-1528, "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
- KDB 685864, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60104 Page 2 of 6

In Collaboration with **TTL Speag** CALIBRATION LABORATORY **CAICT**

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Measurement Conditions
 DASYS system configuration, as far as not given on page 1.

DASY Version	DASY52	VS2 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	835 MHz ± 1 MHz	

Head TSL parameters
 The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.0 ± 8 %	0.91 mho/m ± 8 %
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	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.40 W/kg ± 18.6 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.12 W/kg ± 18.7 % (k=2)

Certificate No: Z22-60104 Page 3 of 6

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.7Ω - j22Ω
Return Loss	-25.3dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.307 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.

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

Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z22-60104 Page 4 of 6

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DASY5 Validation Report for Head TSL Date: 2022-03-21
 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114
 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1
 Medium parameters used: f = 835 MHz; σ = 0.907 S/m; ε_r = 40.98; ρ = 1000 kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(10.13, 10.13, 10.13) @ 835 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA E4 Sn 1556; 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/Zoom Scan (7x7x7) (7x7x7) Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 57.88 V/m; Power Drift = 0.04 dB
 Peak SAR (extrapolated) = 3.56 W/kg
SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg
 Smallest distance from peaks to all points 3 dB below = 15.8 mm
 Ratio of SAR at M2 to SAR at M1 = 66.2%
 Maximum value of SAR (measured) = 3.17 W/kg

0 dB = 3.17 W/kg = 5.01 dBW/kg

Certificate No: Z22-60104 Page 5 of 6

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 E-mail: cti@china.ttl.com http://www.china.ttl.com

Impedance Measurement Plot for Head TSL

Certificate No: Z22-60104 Page 6 of 6

1.5 D900V2 - SN 1d079

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <small>In Collaboration with</small> TTL Calibration Laboratory <small>ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China TEL: +86-10-42394633-2117 E-mail: cti@ttest.com</small> </div> <div style="text-align: center;"> <small>中国合格评定国家认可委员会</small> CNAS <small>CALIBRATION</small> <small>CMS 1070</small> </div> <div style="text-align: center;"> <small>中国信息通信研究院</small> CAICT </div> </div> <p style="text-align: center;">Client: SGS-CN Certificate No: Z22-60184</p> <div style="border: 1px solid black; padding: 5px;"> <p>CALIBRATION CERTIFICATE</p> <p>Object: D900V2 - SN: 1d079</p> <p>Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits</p> <p>Calibration date: June 7, 2022</p> <p>The 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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity <70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>106277</td> <td>24-Sep-21 (CTTL No. J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Power sensor NRP8S</td> <td>104291</td> <td>24-Sep-21 (CTTL No. J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN 7464</td> <td>26-Jan-22 (SPEAG No. EX3-7464_Jan22)</td> <td>Jan-23</td> </tr> <tr> <td>DAE4</td> <td>SN 1566</td> <td>12-Jan-22 (CTTL-SPEAG No. Z22-60007)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Signal Generator E4438C</td> <td>M146071430</td> <td>13-Jan-22 (CTTL No. J22X00409)</td> <td>Jan-23</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>M146110673</td> <td>14-Jan-22 (CTTL No. J22X00406)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Calibrated by:</th> <th>Name</th> <th>Function</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td></td> <td>Zhao Jing</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Reviewed by:</td> <td>Lin Hao</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Approved by:</td> <td>Qi Diqiyuan</td> <td>SAR Project Leader</td> <td></td> </tr> </tbody> </table> <p style="text-align: center;">Issued: June 13, 2022</p> <p style="font-size: small;">The calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> </div>	Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRP2	106277	24-Sep-21 (CTTL No. J21X08326)	Sep-22	Power sensor NRP8S	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22	Reference Probe EX3DV4	SN 7464	26-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23	DAE4	SN 1566	12-Jan-22 (CTTL-SPEAG No. Z22-60007)	Jan-23	Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator E4438C	M146071430	13-Jan-22 (CTTL No. J22X00409)	Jan-23	Network Analyzer E5071C	M146110673	14-Jan-22 (CTTL No. J22X00406)	Jan-23	Calibrated by:	Name	Function	Signature		Zhao Jing	SAR Test Engineer		Reviewed by:	Lin Hao	SAR Test Engineer		Approved by:	Qi Diqiyuan	SAR Project Leader		<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;"> <small>In Collaboration with</small> TTL Calibration Laboratory <small>ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China TEL: +86-10-42394633-2117 E-mail: cti@ttest.com</small> </div> <div style="text-align: center;"> <small>中国信息通信研究院</small> CAICT </div> </div> <p style="text-align: center;">Certificate No: Z22-60184 Page 2 of 6</p> <p>Glossary:</p> <p>TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx,y,z N/A: not applicable or not measured</p> <p>Calibration is Performed According to the Following Standards:</p> <p>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" c) DASY4/S System Handbook</p> <p>Additional Documentation:</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in this 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. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>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%.</p> </div> <p style="text-align: center;">Certificate No: Z22-60184 Page 2 of 6</p>												
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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.</p> <p>Additional EUT Data</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tbody> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </tbody> </table>	Impedance, transformed to feed point	48.10 - 8.48jΩ	Return Loss	-23.3 dB	Electrical Delay (one direction)	1.312 ns	Manufactured by	SPEAG
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Date: 2022-06-07

DASY5 Validation Report for Head TSL
 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN: 14079
 Communication System: UTD 0, CW; Frequency: 900 MHz; Duty Cycle: 1:1
 Medium parameters used: f = 900 MHz; $\sigma = 0.98$ S/m; $\epsilon_r = 42.05$; $\rho = 1000$ kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(9.72, 9.72) @ 900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronic: DA44 - SN1556; Calibrated: 2022-01-12
- Phantom: MFP_V5.1C (2ddeg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52.52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7) (7x7) Cube 0; Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 59.81 V/m; Power Drift = -0.01 dB
 Peak SAR (extrapolated) = 4.20 W/kg
 SAR(1 g) = 2.78 W/kg; SAR(10 g) = 1.78 W/kg
 Smallest distance from peaks to all points 3 dB below = 16 mm
 Ratio of SAR at M2 to SAR at M1 = 65.8%
 Maximum value of SAR (measured) = 3.71 W/kg

0 dB = 3.71 W/kg = 5.69 dBW/kg

Certificate No: Z22-60184 Page 6 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60184 Page 6 of 6

1.6 D1800V2 - SN 2d170

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E-mail: cti@china.ttl.com

Certificate No: Z22-60105

Client: SGS-CN

CALIBRATION CERTIFICATE

Object: D1800V2 - SN: 2d170

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

Calibration date: March 31, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Power sensor NRP5	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Reference Probe EX3DV4	SN 7307	26-May-21(SPEAG.No.EX3-7307_May21)	May-22
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No.Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00406)	Jan-23
Network Analyzer E5071C	MY46110973	14-Jan-22 (CTTL No.J22X00406)	Jan-23

Calibrated by: Zhao Jing, SAR Test Engineer, Signature: [Signature]

Reviewed by: Lin Hao, SAR Test Engineer, Signature: [Signature]

Approved by: Qi Diqiyuan, SAR Project Leader, Signature: [Signature]

Issued: April 6, 2022

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Certificate No: Z22-60105 Page 1 of 6

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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:

- 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
- KDB 865684, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- 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: Z22-60105 Page 2 of 6

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 E-mail: cti@chinaeui.com http://www.chinaeui.com

Measurement Conditions
 DASYS 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	1800 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 mholm
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 8 %	1.41 mholm ± 8 %
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	9.73 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	38.9 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 18.7 % (k=2)

Certificate No: Z22-60105 Page 3 of 6

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.90-2.54jΩ
Return Loss	-29.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.116 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.

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

Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z22-60105 Page 4 of 6

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 E-mail: cti@chinaeui.com http://www.chinaeui.com

DASY5 Validation Report for Head TSL Date: 2022-03-31
 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d170
 Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1
 Medium parameters used: f = 1800 MHz; σ = 1.411 S/m; ε = 40.62; ρ = 1000 kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.34, 8.34) @ 1800 MHz; Calibrated: 2021-05-26
- 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/Zoom Scan (7x7x7) (Cube 0): Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 98.14 V/m; Power Drift = 0.03 dB
 Peak SAR (extrapolated) = 18.2 W/kg
 SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.11 W/kg
 Smallest distance from peaks to all points 3 dB below = 10 mm
 Ratio of SAR at M2 to SAR at M1 = 54%
 Maximum value of SAR (measured) = 15.2 W/kg

0 dB = 15.2 W/kg = 11.82 dBW/kg

Certificate No: Z22-60105 Page 5 of 6

In Collaboration with **TTL Speaq** CALIBRATION LABORATORY **CAICT**

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60105 Page 6 of 6

1.7 D1900V2 - SN 5d136

<p>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4226633-2117 E-mail: vt@ttslab.com</p> <p>Client: SGS-CN Certificate No: Z22-60185</p> <h3>CALIBRATION CERTIFICATE</h3> <p>Object: D1900V2 - SN: 5d136</p> <p>Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits</p> <p>Calibration date: June 7, 2022</p> <p>The 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.</p> <p>All calibrations have been conducted in the closed laboratory facility; environment temperature (23±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>106277</td> <td>24-Sep-21 (CTTL No. J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Power sensor NRP65</td> <td>104291</td> <td>24-Sep-21 (CTTL No. J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Reference Probe EXSDV4</td> <td>SN 7464</td> <td>28-Jan-22 (SPEAG No. EX3-7464_Jan22)</td> <td>Jan-23</td> </tr> <tr> <td>DAE4</td> <td>SN 1656</td> <td>12-Jan-22 (CTTL-SPEAG No. Z22-90007)</td> <td>Jan-23</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> <tr> <td>Signal Generator E4438C</td> <td>MY48071430</td> <td>13-Jan-22 (CTTL No. J22X00409)</td> <td>Jan-23</td> </tr> <tr> <td>Network Analyser E5071C</td> <td>MY48110073</td> <td>14-Jan-22 (CTTL No. J22X00406)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Calibrated by:</th> <th>Name</th> <th>Function</th> <th>Signature</th> </tr> </thead> <tbody> <tr> <td></td> <td>Zhao Jing</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Reviewed by:</td> <td>Lin Hao</td> <td>SAR Test Engineer</td> <td></td> </tr> <tr> <td>Approved by:</td> <td>Qi Dianyuan</td> <td>SAR Project Leader</td> <td></td> </tr> </tbody> </table> <p>Issued: June 13, 2022</p> <p>The calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Certificate No: Z22-60185 Page 1 of 6</p>	Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power Meter NRP2	106277	24-Sep-21 (CTTL No. J21X08326)	Sep-22	Power sensor NRP65	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22	Reference Probe EXSDV4	SN 7464	28-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23	DAE4	SN 1656	12-Jan-22 (CTTL-SPEAG No. Z22-90007)	Jan-23	Secondary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Signal Generator E4438C	MY48071430	13-Jan-22 (CTTL No. J22X00409)	Jan-23	Network Analyser E5071C	MY48110073	14-Jan-22 (CTTL No. J22X00406)	Jan-23	Calibrated by:	Name	Function	Signature		Zhao Jing	SAR Test Engineer		Reviewed by:	Lin Hao	SAR Test Engineer		Approved by:	Qi Dianyuan	SAR Project Leader		<p>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4226633-2117 E-mail: vt@ttslab.com</p> <p>Glossary: TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx.y.z NA: not applicable or not measured</p> <p>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 1526: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020 b) KDB 865984, "SAR Measurement Requirements for 100 MHz to 6 GHz"</p> <p>Additional Documentation: c) DASY4/S System Handbook</p> <p>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.</p> <p>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%.</p> <p>Certificate No: Z22-60185 Page 2 of 6</p>												
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<p>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4226633-2117 E-mail: vt@ttslab.com</p> <p>Measurement Conditions DASY system configuration, as far as not given on page 1.</p> <table border="1"> <thead> <tr> <th>DASY Version</th> <th>DASY52</th> <th>52.10.4</th> </tr> </thead> <tbody> <tr> <td>Extrapolation</td> <td>Advanced Extrapolation</td> <td></td> </tr> <tr> <td>Phantom</td> <td>Triple Flat Phantom 5.1C</td> <td></td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>10 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td>dx, dy, dz = 5 mm</td> <td></td> </tr> <tr> <td>Frequency</td> <td>1900 MHz ± 1 MHz</td> <td></td> </tr> </tbody> </table> <p>Head TSL parameters The following parameters and calculations were applied:</p> <table border="1"> <thead> <tr> <th>Nominal Head TSL parameters</th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td></td> <td>22.0 °C</td> <td>40.0</td> <td>1.40 mS/m</td> </tr> <tr> <td>Measured Head TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>39.9 ± 6 %</td> <td>1.39 mS/m ± 6 %</td> </tr> <tr> <td>Head TSL temperature change during test</td> <td><1.0 °C</td> <td>—</td> <td>—</td> </tr> </tbody> </table> <p>SAR result with Head TSL</p> <table border="1"> <thead> <tr> <th>SAR averaged over 1 cm² (1 g) of Head TSL</th> <th>Condition</th> <th>9.65 W/kg</th> </tr> </thead> <tbody> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td></td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>40.0 W/kg ± 18.8 % (k=2)</td> </tr> <tr> <th>SAR averaged over 10 cm² (10 g) of Head TSL</th> <th>Condition</th> <th>5.18 W/kg</th> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td></td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>20.8 W/kg ± 18.7 % (k=2)</td> </tr> </tbody> </table> <p>Certificate No: Z22-60185 Page 3 of 6</p>	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	1900 MHz ± 1 MHz		Nominal Head TSL parameters	Temperature	Permittivity	Conductivity		22.0 °C	40.0	1.40 mS/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.39 mS/m ± 6 %	Head TSL temperature change during test	<1.0 °C	—	—	SAR averaged over 1 cm² (1 g) of Head TSL	Condition	9.65 W/kg	SAR measured	250 mW input power		SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 18.8 % (k=2)	SAR averaged over 10 cm² (10 g) of Head TSL	Condition	5.18 W/kg	SAR measured	250 mW input power		SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 18.7 % (k=2)	<p>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-4226633-2117 E-mail: vt@ttslab.com</p> <p>Appendix (Additional assessments outside the scope of CNAS L0570)</p> <p>Antenna Parameters with Head TSL</p> <table border="1"> <thead> <tr> <th>Impedance, transformed to feed point</th> <th>51.2Ω ± 7.5Ω(j)</th> </tr> </thead> <tbody> <tr> <td>Return Loss</td> <td>-22.4dB</td> </tr> </tbody> </table> <p>General Antenna Parameters and Design</p> <table border="1"> <thead> <tr> <th>Electrical Delay (one direction)</th> <th>1.109 ns</th> </tr> </thead> </table> <p>After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.</p> <p>The dipole is made of standard semi-rigid 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.</p> <p>Additional EUT Data</p> <table border="1"> <thead> <tr> <th>Manufactured by</th> <th>SPEAG</th> </tr> </thead> </table> <p>Certificate No: Z22-60185 Page 4 of 6</p>	Impedance, transformed to feed point	51.2Ω ± 7.5Ω(j)	Return Loss	-22.4dB	Electrical Delay (one direction)	1.109 ns	Manufactured by	SPEAG
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In Collaboration with
CAICT

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Date: 2022-06-07

DASY5 Validation Report for Head TSL
 Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 54136
 Communication System: UTD 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 1900$ MHz; $\omega = 1.385$ S/m; $\epsilon_r = 39.85$; $\rho = 1000$ kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(R,18, 8.18, 8.18) @ 1900 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP_V5_IC (20kg probe 0H); Type: QD 000 P51 Cx; Serial: 1062
- DASY52.10.4(1555); SEMCAD X.14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube D: Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 99.99 V/m; Power Drift = 0.04 dB
 Peak SAR (extrapolated) = 18.6 W/kg
 SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.18 W/kg
 Smallest distance from peaks to all points 3 dB below = 9.2 mm
 Ratio of SAR at M2 to SAR at M1 = 54.1%

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

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

Certificate No: Z22-60185 Page 5 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60185 Page 6 of 6

1.8 D2000V2 - SN 1041

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中国合格评定
国家认可
校准
CNAS 1370

Client: **SGS-CN** Certificate No: **Z22-60188**

CALIBRATION CERTIFICATE

Object: D2000V2 - SN: 1041

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

Calibration date: June 8, 2022

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (8). 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&E critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21X06326)	Sep-22
Power sensor KRPS	104291	24-Sep-21 (CTTL No.J21X06326)	Sep-22
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG.No EX3-7464-Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X00406)	Jan-23

Calibrated by: Zhao Jing SAR Test Engineer [Signature]

Reviewed by: Lin Hao SAR Test Engineer [Signature]

Approved by: Qi Dianyuan SAR Project Leader [Signature]

Issued: June 13, 2022

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

Certificate No: Z22-60188 Page 1 of 6

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Glossary:

TSL: Issue simulating liquid

Conv: sensitivity in TSL, INORMx,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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865964, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60188 Page 2 of 6

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Measurement Conditions
 DASYS 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	40.2 ± 8 %	1.39 mho/m ± 8 %
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	10.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	41.8 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg ± 18.7 % (k=2)

Certificate No: Z22-60186 Page 3 of 6

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.4Ω ± 0.74jΩ
Return Loss	-34.9dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.088 ns
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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 semi-rigid 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 caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z22-60186 Page 4 of 6

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DASY5 Validation Report for Head TSL Date: 2022-06-06

Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1041
 Communication System: LIID 0; CW; Frequency: 2000 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 2000$ MHz; $\sigma = 1.392$ S/m; $\epsilon_r = 40.21$; $\rho = 1000$ kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(R,2, 8.2, 8.2) @ 2000 MHz; Calibrated: 2022-01-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA4E Sn1556; Calibrated: 2022-01-12
- Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY5: S2.10.4(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 = 103.4 V/m; Power Drift = 0.03 dB
 Peak SAR (extrapolated) = 19.6 W/kg
 SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.3 W/kg
 Smallest distance from peaks to all points 3 dB below = 9.1 mm
 Ratio of SAR at M2 to SAR at M1 = 53.6%
 Maximum value of SAR (measured) = 16.3 W/kg

Certificate No: Z22-60186 Page 5 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60186 Page 6 of 6

1.9 D2300V2 - SN 1096

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<p>Client: SGS-CN Certificate No: Z22-60106</p>																					
<p>CALIBRATION CERTIFICATE</p>																					
Object	D2300V2 - SN 1096																				
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits																				
Calibration date:	March 31, 2022																				
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (23±3)°C and humidity <70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p>																					
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration																		
Power Meter NRP2	108277	24-Sep-21 (CTTL No.J21X08328)	Sep-22																		
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21X08328)	Sep-22																		
Reference Probe EX3DV4 DAE4	SN 7307 SN 1556	26-May-21 (SPEAG No.EK3-7307_May21) 12-Jan-22 (CTTL-SPEAG No.Z22-60007)	May-22 Jan-23																		
Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration																		
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00406)	Jan-23																		
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X00406)	Jan-23																		
Calibrated by:	Name	Function	Signature																		
	Zhao Jing	SAR Test Engineer																			
Reviewed by:	Lin Hao	SAR Test Engineer																			
Approved by:	Qi Diaryuan	SAR Project Leader																			
<p>Issued: April 6, 2022</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>																					
Certificate No: Z22-60106		Page 1 of 6																			
<p>Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2079 Fax: +86-10-42304633-2504 E-mail: cti@chinaul.com http://www.chinaul.cn</p>		<p>Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2079 Fax: +86-10-42304633-2504 E-mail: cti@chinaul.com http://www.chinaul.cn</p>																			
<p>Measurement Conditions DASY system configuration, as far as not given on page 1</p> <table border="1"> <tr> <td>DASY Version</td> <td>DASY2</td> <td>52.10.4</td> </tr> <tr> <td>Extrapolation</td> <td>Advanced Extrapolation</td> <td></td> </tr> <tr> <td>Phantom</td> <td>Triple Flat Phantom 5.1C</td> <td></td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>10 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td>dx, dy, dz = 5 mm</td> <td></td> </tr> <tr> <td>Frequency</td> <td>2300 MHz ± 1 MHz</td> <td></td> </tr> </table>				DASY Version	DASY2	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	2300 MHz ± 1 MHz	
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<p>Head TSL parameters The following parameters and calculations were applied:</p> <table border="1"> <tr> <td></td> <td>Temperature</td> <td>Permittivity</td> <td>Conductivity</td> </tr> <tr> <td>Nominal Head TSL parameters</td> <td>22.0 °C</td> <td>39.5</td> <td>1.67 mho/m</td> </tr> <tr> <td>Measured Head TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>39.8 ± 6 %</td> <td>1.70 mho/m ± 6 %</td> </tr> <tr> <td>Head TSL temperature change during test</td> <td><1.0 °C</td> <td>---</td> <td>---</td> </tr> </table>					Temperature	Permittivity	Conductivity	Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.70 mho/m ± 6 %	Head TSL temperature change during test	<1.0 °C	---	---		
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<p>SAR result with Head TSL</p> <table border="1"> <tr> <td>SAR averaged over 1 cm³ (1g) of Head TSL</td> <td>Condition</td> <td></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>12.4 W/kg</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>49.2 W/kg ± 18.8 % (k=2)</td> </tr> <tr> <td>SAR averaged over 10 cm³ (10g) of Head TSL</td> <td>Condition</td> <td></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>5.88 W/kg</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>23.4 W/kg ± 18.7 % (k=2)</td> </tr> </table>				SAR averaged over 1 cm ³ (1g) of Head TSL	Condition		SAR measured	250 mW input power	12.4 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	49.2 W/kg ± 18.8 % (k=2)	SAR averaged over 10 cm ³ (10g) of Head TSL	Condition		SAR measured	250 mW input power	5.88 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 18.7 % (k=2)
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Certificate No: Z22-60106		Page 3 of 6																			
<p>Glossary:</p> <p>TSL: Issue simulating liquid ConvF: sensitivity in TSL / NORMx,y,z N/A: not applicable or not measured</p> <p>Calibration is Performed According to the Following Standards:</p> <p>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"</p> <p>Additional Documentation: c) DASY4/5 System Handbook</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> 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. <p>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%.</p>																					
Certificate No: Z22-60106		Page 2 of 6																			
<p>Appendix (Additional assessments outside the scope of CNAS L0570)</p> <p>Antenna Parameters with Head TSL</p> <table border="1"> <tr> <td>Impedance, transformed to feed point</td> <td>49.20 - 4.56jΩ</td> </tr> <tr> <td>Return Loss</td> <td>-26.6dB</td> </tr> </table> <p>General Antenna Parameters and Design</p> <table border="1"> <tr> <td>Electrical Delay (one direction)</td> <td>1.083 ns</td> </tr> </table> <p>After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.</p> <p>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.</p> <p>Additional EUT Data</p> <table border="1"> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </table>				Impedance, transformed to feed point	49.20 - 4.56jΩ	Return Loss	-26.6dB	Electrical Delay (one direction)	1.083 ns	Manufactured by	SPEAG										
Impedance, transformed to feed point	49.20 - 4.56jΩ																				
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Manufactured by	SPEAG																				
Certificate No: Z22-60106		Page 4 of 6																			

In Collaboration with **TTL Speaq** CALIBRATION LABORATORY **CAICT**

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 E-mail: cti@china.ttl.com http://www.china.ttl.com

DASY5 Validation Report for Head TSL Date: 2022-03-31

Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 2300 MHz; Type: D2300V2; Serial: D2300V2 - SN: 1096
 Communication System: UTD 0, CW; Frequency: 2300 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 2300 \text{ MHz}$; $\sigma = 1.702 \text{ S/m}$; $\epsilon = 39.77$; $\rho = 1000 \text{ kg/m}^3$
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/EC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(8.01, 8.01) @ 2300 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sst1556; Calibrated: 2022-01-12
- Phantom: MFP V5.1C (2ldag probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 S2.10.4(1535); SEMCAD X 14.6;14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube 0: Measurement grid: $d_x=5\text{mm}$, $d_y=5\text{mm}$, $d_z=5\text{mm}$
 Reference Value = 102.7 V/m; Power Drift = 0.00 dB
 Peak SAR (extrapolated) = 21.8 W/kg
 SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.88 W/kg
 Smallest distance from peaks to all points 3 dB below = 9 mm
 Ratio of SAR at M2 to SAR at M1 = 50.4%
 Maximum value of SAR (measured) = 20.3 W/kg

0 dB = 20.3 W/kg = 13.07 dBW/kg

Certificate No: Z22-60106 Page 1 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60106 Page 4 of 6

1.10 D2450V2 - SN 817

In Collaboration with **TTL Speaq** CALIBRATION LABORATORY **CAICT** **CNAS** **中国认可 国家互认 校准 CALIBRATION CNAS 10578**

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 E-mail: cti@china.ttl.com http://www.china.ttl.com

Client: **SGS-CN** Certificate No: **Z22-60107**

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 817
 Calibration Procedure(s): FF-Z11-003-01
 Calibration Procedures for dipole validation kits
 Calibration date: April 1, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter	NRP2	24-Sep-21 (CTTL No.J21X08320)	Sep-22
Power sensor	NRP8S	104291 24-Sep-21 (CTTL No.J21X08320)	Sep-22
Reference Probe	EX3DV4	SN 7307 26-May-21(SPEAG.No.EX3-7307_May21)	May-22
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No.Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Signal Generator	E4438C	MY49071430 13-Jan-22 (CTTL No. J22X00406)	Jan-23
Network Analyzer	E5071C	MY46110873 14-Jan-22 (CTTL No. J22X00406)	Jan-23

Calibrated by: Zhao Jing SAR Test Engineer
 Reviewed by: Lin Hao SAR Test Engineer
 Approved by: Qi Dianyuan SAR Project Leader

Signature: [Signatures]
 Issued: April 6, 2022

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Glossary:

TSL tissue simulating liquid
 ConvF sensitivity in TSL / NORMx.yz
 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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 855664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60107 Page 2 of 6

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Measurement Conditions
 DASYS 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	2450 MHz ± 1 MHz	

Head TSL parameters
 The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 6 %	1.79 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.0 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.7 W/kg ± 18.7 % (k=2)

Certificate No: Z22-60107 Page 3 of 6

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.10 ± 3.20Ω
Return Loss	-28.5dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.066 ns
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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 serringid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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Certificate No: Z22-60107 Page 4 of 6

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DASY5 Validation Report for Head TSL Date: 2022-04-01

Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 2450 MHz; Type: D2450V2 - SN: 817
 Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1
 Medium parameters used: f = 2450 MHz; σ = 1.79 S/m; ε = 39.52; ρ = 1000 kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.75, 7.75, 7.75) @ 2450 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DA14 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 Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
 Reference Value = 104.6 V/m; Power Drift = -0.03 dB
 Peak SAR (extrapolated) = 27.0 W/kg
 SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.15 W/kg
 Smallest distance from peaks to all points 3 dB below = 8.9 mm
 Ratio of SAR at M2 to SAR at M1 = -49.2%
 Maximum value of SAR (measured) = 22.1 W/kg

Certificate No: Z22-60107 Page 1 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60107 Page 6 of 6

1.11 D2600V2 - SN 1158

<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <small>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504 E-mail: cti@china.ttl.com.cn http://www.chinatit.com</small> </div> <div style="text-align: center;"> <small>中国合格评定国际互认组织 CALIBRATION CNAS 1079</small> </div> <div style="text-align: center;"> <small>中国信息通信研究院 CAICT</small> </div> </div> <p style="text-align: center;">Client: SGS-CN Certificate No: Z22-60108</p> <h3 style="text-align: center;">CALIBRATION CERTIFICATE</h3> <p>Object: D2600V2 - SN: 1158</p> <p>Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits</p> <p>Calibration date: March 31, 2022</p> <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity<70%.</p> <p>Calibration Equipment used (M&TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power Meter NRP2</td> <td>102577</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Power sensor NRP8S</td> <td>104291</td> <td>24-Sep-21 (CTTL No.J21X08326)</td> <td>Sep-22</td> </tr> <tr> <td>Reference Probe EX3DV4</td> <td>SN 7307</td> <td>26-May-21(SPEAG.No.EX3-7307_May21)</td> <td>May-22</td> </tr> <tr> <td>DAE4</td> <td>SN 1556</td> <td>12-Jan-22(CTTL-SPEAG.No.Z22-60007)</td> <td>Jan-23</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Cal Date (Calibrated by Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Signal Generator E4438C</td> <td>MY49071430</td> <td>13-Jan-22 (CTTL No.J22X00406)</td> <td>Jan-23</td> </tr> <tr> <td>Network Analyzer E5071C</td> <td>MY49110673</td> <td>14-Jan-22 (CTTL No.J22X00406)</td> <td>Jan-23</td> </tr> </tbody> </table> <p>Calibrated by: Zhao Jing SAR Test Engineer</p> <p>Reviewed by: Lin Hao SAR Test Engineer</p> <p>Approved by: Qi Diaryuan SAR Project Leader</p> <p style="text-align: right;">Issued: April 6, 2022</p> <p style="text-align: center;">This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p style="text-align: center;">Certificate No: Z22-60108 Page 1 of 6</p>	Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration	Power Meter NRP2	102577	24-Sep-21 (CTTL No.J21X08326)	Sep-22	Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22	Reference Probe EX3DV4	SN 7307	26-May-21(SPEAG.No.EX3-7307_May21)	May-22	DAE4	SN 1556	12-Jan-22(CTTL-SPEAG.No.Z22-60007)	Jan-23	Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration	Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00406)	Jan-23	Network Analyzer E5071C	MY49110673	14-Jan-22 (CTTL No.J22X00406)	Jan-23	<div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <small>Address: No. 52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2079 Fax: +86-10-42304633-2504 E-mail: cti@china.ttl.com.cn http://www.chinatit.com</small> </div> <div style="text-align: center;"> <small>中国信息通信研究院 CAICT</small> </div> </div> <p>Glossary:</p> <p>TSL: tissue simulating liquid</p> <p>ConvF: sensitivity in TSL / NORMx.y.z</p> <p>N/A: not applicable or not measured</p> <p>Calibration is Performed According to the Following Standards:</p> <p>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</p> <p>b) KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"</p> <p>Additional Documentation:</p> <p>c) DASY4/S System Handbook</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> 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. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p>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%.</p> </div> <p style="text-align: center;">Certificate No: Z22-60108 Page 2 of 6</p>																												
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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.</p> <h4>Additional EUT Data</h4> <table border="1"> <tbody> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </tbody> </table> <p style="text-align: center;">Certificate No: Z22-60108 Page 4 of 6</p>	Impedance, transformed to feed point	49.90- 6.49jΩ	Return Loss	- 23.8dB	Electrical Delay (one direction)	1.053 ns	Manufactured by	SPEAG
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Date: 2022-03-31

DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China
 DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1158
 Communication System: UID 0, CW; Frequency: 2600 MHz; Duty Cycle: 1:1
 Medium parameters used: $f = 2600$ MHz; $\sigma = 1.955$ S/m; $\epsilon_r = 38.68$; $\rho = 1000$ kg/m³
 Phantom section: Right Section
 Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
 DASY5 Configuration:

- Probe: EX3DV4 - SN7307; ConvF(7.5, 7.5, 7.5) @ 2600 MHz; Calibrated: 2021-05-26
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP-V5.1C (2dkg probe fill); Type: QD 000 P51 Cx; Serial: 1062
- DASY5 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 = 103.3 V/m; Power Drift = 0.04 dB
 Peak SAR (extrapolated) = 29.0 W/kg
 SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.12 W/kg
 Smallest distance from peaks to all points 3 dB below = 8.9 mm
 Ratio of SAR at M2 to SAR at M1 = 47.5%
 Maximum value of SAR (measured) = 23.4 W/kg

0 dB = 23.4 W/kg = 13.69 dBW/kg

Certificate No: Z22-60108 Page 5 of 6

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60108 Page 6 of 6

1.12 D5GHzV2 - SN 1095

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Client: **SGS-CN** Certificate No: **Z22-60187**

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN: 1095

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

Calibration date: June 1, 2022

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (23±3)°C and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21008326)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21008326)	Sep-22
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG No EX3-7464_Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG No.Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY46071430	13-Jan-22 (CTTL No. J22X00406)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL No. J22X00406)	Jan-23

Calibrated by: Zhao Jing, SAR Test Engineer

Reviewed by: Lin Hao, SAR Test Engineer

Approved by: Qi Dianyan, SAR Project Leader

Issued: June 6, 2022

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Certificate No: Z22-60187 Page 1 of 10

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Glossary:

TSL: Issue simulating liquid
 ConvF: sensitivity in TSL / NORMx.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-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 665664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY4/G 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: Z22-60187 Page 2 of 10

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Measurement Conditions
DAZY system configuration, as far as not given on page 1.

DASY Version	DAZY52	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	5200 MHz ± 1 MHz 5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	4.82 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL at 5200MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	7.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.8 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 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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Head TSL parameters at 5300MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.73 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL at 5300MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 24.2 % (k=2)

Head TSL parameters at 5500MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.94 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL at 5500MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.29 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	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ± 24.2 % (k=2)

Certificate No: Z22-60187 Page 4 of 10

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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	34.7 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL at 5600MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.8 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 24.2 % (k=2)

Head TSL parameters at 5800MHz
The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.25 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---

SAR result with Head TSL at 5800MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	76.7 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.8 W/kg ± 24.2 % (k=2)

Certificate No: Z22-60187 Page 5 of 10

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5200MHz

Impedance, transformed to feed point	46.1D-5.03jΩ
Return Loss	-23.6dB

Antenna Parameters with Head TSL at 5300MHz

Impedance, transformed to feed point	47.8D-2.42jΩ
Return Loss	-28.5dB

Antenna Parameters with Head TSL at 5500MHz

Impedance, transformed to feed point	50.3D-4.26jΩ
Return Loss	-27.4dB

Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	54.5D-4.80jΩ
Return Loss	-24.0dB

Antenna Parameters with Head TSL at 5800MHz

Impedance, transformed to feed point	51.5D-5.61jΩ
Return Loss	-24.9dB

Certificate No: Z22-60187 Page 6 of 10

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General Antenna Parameters and Design

Electrical Delay (one direction)	1.101 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL Date: 2022-06-01

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095

Communication System: CW; Frequency: 5200 MHz; Frequency: 5300 MHz; Frequency: 5500 MHz; Frequency: 5600 MHz; Frequency: 5800 MHz; Frequency: 5900 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.38$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5300$ MHz; $\sigma = 4.73$ S/m; $\epsilon_r = 35.19$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5500$ MHz; $\sigma = 4.939$ S/m; $\epsilon_r = 34.83$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.051$ S/m; $\epsilon_r = 34.68$; $\rho = 1000$ kg/m³

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.247$ S/m; $\epsilon_r = 34.42$; $\rho = 1000$ kg/m³

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7484; ConvF(5.6, 5.6, 5.6) @ 5200 MHz; ConvF(5.32, 5.32, 5.32) @ 5300 MHz; ConvF(5.11, 5.11, 5.11) @ 5500 MHz; ConvF(4.91, 4.91, 4.91) @ 5600 MHz; ConvF(5, 5, 5) @ 5800 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=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 60.80 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 29.8 W/kg

SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.22 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 66.8%

Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.08 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 31.5 W/kg

SAR(1 g) = 7.94 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 = 65.5%

Maximum value of SAR (measured) = 19.0 W/kg

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Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.92 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 34.7 W/kg

SAR(1 g) = 8.28 W/kg; SAR(10 g) = 2.34 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 63.9%

Maximum value of SAR (measured) = 20.2 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 = 65.08 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 35.2 W/kg

SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 62.5%

Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.13 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 34.8 W/kg

SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.16 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 61.6%

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

0 dB = 18.7 W/kg = 12.72 dBW/kg

Certificate No: Z22-60187 Page 9 of 10

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60187 Page 10 of 10

2 DAE4 - SN 1245

<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 8px;"> <p>Schmid & Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Phone +41 44 248 9700, Fax +41 44 248 9770 www.speag.ch, info@speag.ch</p> </div> <div style="font-weight: bold; font-size: 12px; letter-spacing: 0.5em;">s p e a g</div> </div> <p style="text-align: center; color: red; font-weight: bold; margin-top: 10px;">IMPORTANT NOTICE</p> <p>USAGE OF THE DAE4</p> <p>The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:</p> <p>Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.</p> <p>Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an anti-static bag. This anti-static bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.</p> <p>E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dirty environment if not used for measurements.</p> <p>Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.</p> <p>DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.</p> <p>Important Note: Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.</p> <p>Important Note: Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.</p> <p>Important Note: To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.</p> <p style="font-size: 8px; margin-top: 20px;">TN_EH160306AE_DAE4.docx 07.03.2019</p>	<div style="display: flex; justify-content: space-between; align-items: center;"> <div style="font-size: 8px;"> <p>Schmid & Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Phone +41 44 248 9700, Fax +41 44 248 9770 www.speag.ch, info@speag.ch</p> </div> <div style="font-size: 12px;"> </div> <div style="font-size: 8px;"> <p>S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage S Servizio svizzero di taratura S Swiss Calibration Service</p> </div> </div> <p style="font-size: 8px; margin-top: 5px;"> 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 </p> <p style="text-align: right; font-size: 8px;">Accreditation No.: SCS 0108</p> <p style="font-size: 8px;"> Client: SGS-CN (Auden) Certificate No: DAE4-1245_May22 </p> <p style="text-align: center; font-weight: bold; border: 1px solid black; padding: 2px;">CALIBRATION CERTIFICATE</p> <p style="font-size: 8px;"> Object: DAE4 - SD 000 D04 BM - SN: 1245 Calibration procedure(s): QA CAL-06 v30 Calibration procedure for the data acquisition electronics (DAE) Calibration date: May 30, 2022 </p> <p style="font-size: 8px; margin-top: 5px;"> 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&E critical for calibration) </p> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse;"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Ketby Multimeter Type 2001</td> <td>SN: 0810276</td> <td>31-Aug-21 (No:31368)</td> <td>Aug-22</td> </tr> </tbody> </table> <table border="1" style="width: 100%; font-size: 8px; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> </thead> <tbody> <tr> <td>Auto DAE Calibration Unit</td> <td>SE LMS 003 AA 1001</td> <td>24-Jan-22 (in house check)</td> <td>In house check: Jan-23</td> </tr> <tr> <td>Calibrator box v3.1</td> <td>SE LMS 106 AA 1002</td> <td>24-Jan-22 (in house check)</td> <td>In house check: Jan-23</td> </tr> </tbody> </table> <div style="margin-top: 10px; font-size: 8px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Calibrated by:</td> <td style="width: 33%;">Name: Dominique Shelten</td> <td style="width: 33%;">Function: Laboratory Technician</td> <td style="width: 15%;">Signature: </td> </tr> <tr> <td>Approved by:</td> <td>Sven Kuhn</td> <td>Technical Manager</td> <td></td> </tr> </table> <p style="font-size: 8px; margin-top: 5px;"> Issued: May 30, 2022 This calibration certificate shall not be reproduced except in full without written approval of the laboratory. </p> </div> <p style="font-size: 8px; margin-top: 10px;">Certificate No: DAE4-1245_May22 Page 1 of 5</p>	Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Ketby Multimeter Type 2001	SN: 0810276	31-Aug-21 (No:31368)	Aug-22	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Auto DAE Calibration Unit	SE LMS 003 AA 1001	24-Jan-22 (in house check)	In house check: Jan-23	Calibrator box v3.1	SE LMS 106 AA 1002	24-Jan-22 (in house check)	In house check: Jan-23	Calibrated by:	Name: Dominique Shelten	Function: Laboratory Technician	Signature:	Approved by:	Sven Kuhn	Technical Manager	
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Appendix (Additional assessments outside the scope of SCS0108)				
1. DC Voltage Linearity				
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec				
High Range	Reading (µV)	Difference (µV)	Error (%)	
Channel X + Input	19994.45	1.52	0.00	
Channel X - Input	20004.58	2.22	0.01	
Channel Y + Input	-20000.14	1.12	-0.01	
Channel Y - Input	19994.72	1.58	0.00	
Channel Z + Input	20001.22	-1.00	-0.00	
Channel Z - Input	-20003.05	-1.57	0.01	
Channel X + Input	19992.84	0.19	0.00	
Channel X - Input	20003.09	0.58	0.00	
Channel Y + Input	-20001.73	-0.27	0.00	
Low Range	Reading (µV)	Difference (µV)	Error (%)	
Channel X + Input	2001.91	0.41	0.22	
Channel X - Input	202.54	0.65	0.32	
Channel Y + Input	-197.86	0.07	-0.04	
Channel Y - Input	2002.05	0.58	0.03	
Channel Z + Input	201.27	-0.57	-0.28	
Channel Z - Input	-199.23	-0.06	0.03	
Channel X + Input	2001.98	0.08	0.00	
Channel X - Input	200.09	-1.53	-0.76	
Channel Y + Input	-199.85	-1.57	0.79	
2. Common mode sensitivity				
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec				
	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)	
Channel X	200	-3.87	-7.69	
	-200	9.12	7.79	
Channel Y	200	-8.68	-9.28	
	-200	8.52	6.36	
Channel Z	200	-5.36	-5.80	
	-200	3.58	3.08	
3. Channel separation				
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec				
	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	4.07	-3.14
Channel Y	200	9.36	-	4.57
Channel Z	200	10.11	7.14	-
Certificate No: DAE4-1245_May22 Page 4 of 5				

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15984	17040
Channel Y	16562	15768
Channel Z	16035	15656

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10MΩ

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	1.00	-0.15	1.93	0.45
Channel Y	-0.18	-1.28	0.94	0.45
Channel Z	-0.58	-2.61	0.58	0.60

6. Input Offset Current

Nominal input circuitry offset current on all channels: <25nA

7. Input Resistance (Typical values for information)

	Zeroing (ΩOhm)	Measuring (MΩhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+8	+14
Supply (- Vcc)	-0.01	-8	-9

Certificate No: DAE4-1245_May22 Page 5 of 5

3 EX3DV4 - SN 7767

<p>Calibration Laboratory of Schmid & Partner Engineering AG Zürcherstrasse 43, 8004 Zürich, Switzerland</p> <p>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</p> <p>Client: SGS-CN (Auden) Certificate No: EX-7767_Oct22</p> <p>CALIBRATION CERTIFICATE</p> <p>Object: EX3DV4 - SN:7767</p> <p>Calibration procedure(s): QA CAL-01-v9, QA CAL-12-v9, QA CAL-14-v6, QA CAL-23-v5, QA CAL-25-V7 Calibration procedure for dosimetric E-field probes</p> <p>Calibration date: October 28, 2022</p> <p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 2) °C and humidity < 70%.</p> <p>Calibration Equipment used (MATE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID</th> <th>Cal. Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter NRP</td> <td>SN: 104778</td> <td>04-Apr-22 (No. 21-F2928-03564)</td> <td>Apr-23</td> </tr> <tr> <td>Power sensor NRP-201</td> <td>SN: 103844</td> <td>04-Apr-22 (No. 21-F2928-03564)</td> <td>Apr-23</td> </tr> <tr> <td>DCP DM-3 (Imp300)</td> <td>SN: 1948</td> <td>20-Oct-22 (DCP-DMA3-1749_Oct22)</td> <td>Oct-23</td> </tr> <tr> <td>DCP DM-12</td> <td>SN: 1018</td> <td>20-Oct-22 (DCP-DMA12-1718_Oct22)</td> <td>Oct-23</td> </tr> <tr> <td>Reference 50 dB Attenuator</td> <td>SN: 102582 (50)</td> <td>04-Apr-22 (No. 21-F2928-03564)</td> <td>Apr-23</td> </tr> <tr> <td>DAE4</td> <td>SN: 986</td> <td>19-Oct-22 (No. DAE480_Oct22)</td> <td>Oct-23</td> </tr> <tr> <td>Reference Probe E53502</td> <td>SN: 3013</td> <td>27-Oct-21 (No. E5353013_Oct21)</td> <td>Oct-22</td> </tr> </tbody> </table> <p>Secondary Standards</p> <table border="1"> <thead> <tr> <th>Power meter E4118B</th> <th>SN: GB41298874</th> <th>05-Apr-18 (in house check Jun-20)</th> <th>In house check Jun-24</th> </tr> </thead> <tbody> <tr> <td>Power sensor E4118A</td> <td>SN: 1914498887</td> <td>05-Apr-18 (in house check Jun-20)</td> <td>In house check Jun-24</td> </tr> <tr> <td>Power sensor E4415A</td> <td>SN: 1005115210</td> <td>05-Apr-18 (in house check Jun-20)</td> <td>In house check Jun-24</td> </tr> <tr> <td>RF generator HP 8548C</td> <td>SN: US8840101793</td> <td>04-Aug-09 (in house check Jun-20)</td> <td>In house check Jun-24</td> </tr> <tr> <td>Network Analyzer 85959A</td> <td>SN: 164198447</td> <td>31-May-14 (in house check Oct-18)</td> <td>In house check Oct-24</td> </tr> </tbody> </table> <p>Calibrated by: Aldona Georgiadou Laboratory Technician <i>[Signature]</i></p> <p>Approved by: Gven Kilm Technical Manager <i>[Signature]</i></p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p> <p>Certificate No: EX-7767_Oct22 Page 1 of 9</p>	Primary Standards	ID	Cal. Date (Certificate No.)	Scheduled Calibration	Power meter NRP	SN: 104778	04-Apr-22 (No. 21-F2928-03564)	Apr-23	Power sensor NRP-201	SN: 103844	04-Apr-22 (No. 21-F2928-03564)	Apr-23	DCP DM-3 (Imp300)	SN: 1948	20-Oct-22 (DCP-DMA3-1749_Oct22)	Oct-23	DCP DM-12	SN: 1018	20-Oct-22 (DCP-DMA12-1718_Oct22)	Oct-23	Reference 50 dB Attenuator	SN: 102582 (50)	04-Apr-22 (No. 21-F2928-03564)	Apr-23	DAE4	SN: 986	19-Oct-22 (No. DAE480_Oct22)	Oct-23	Reference Probe E53502	SN: 3013	27-Oct-21 (No. E5353013_Oct21)	Oct-22	Power meter E4118B	SN: GB41298874	05-Apr-18 (in house check Jun-20)	In house check Jun-24	Power sensor E4118A	SN: 1914498887	05-Apr-18 (in house check Jun-20)	In house check Jun-24	Power sensor E4415A	SN: 1005115210	05-Apr-18 (in house check Jun-20)	In house check Jun-24	RF generator HP 8548C	SN: US8840101793	04-Aug-09 (in house check Jun-20)	In house check Jun-24	Network Analyzer 85959A	SN: 164198447	31-May-14 (in house check Oct-18)	In house check Oct-24	<p>Calibration Laboratory of Schmid & Partner Engineering AG Zürcherstrasse 43, 8004 Zürich, Switzerland</p> <p>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</p> <p>Accreditation No.: SCS 0108</p> <p>Glossary</p> <p>TSL: Issue simulating liquid sensitivity in free space NORM_{M,y,z}: sensitivity in TSL; NORM_{M,y,z} CompF: crest factor (1.414; cycle) of the RF signal DCP: diode compression point A, B, C, D: modulation dependent linearization parameters Polarization: angle around probe axis Polarization: angle around an axis that is in the plane normal to probe axis (at measurement center), i.e., θ = 0 is normal to probe axis Connector Angle: information used in DASY system to align probe sensor X to the robot coordinate system</p> <p>Calibration is Performed According to the Following Standards:</p> <p>a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020. b) IEC 805864, "SAR Measurement Requirements for 100 MHz to 6 GHz"</p> <p>Methods Applied and Interpretation of Parameters:</p> <ul style="list-style-type: none"> NORM_{M,y,z}: Assessed for E-field polarization θ = 0 (f = 900 MHz in TEM-cell; f = 1800 MHz; R22 waveguide). NORM_{M,y,z} are only intermediate values, i.e., the uncertainties of NORM_{M,y,z} does not affect the E-field uncertainty inside TSL (see below CompF). NORM_{M,y,z} = NORM_{M,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of CompF. DCP_{M,y,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media. PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics. A_{M,y,z}, B_{M,y,z}, C_{M,y,z}, D_{M,y,z}, VR_{M,y,z}: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode. CompF and Boundary Effect Parameters: Assessed in far phantom using E-field or Temperature Transfer Standard for f > 800 MHz and made waveguide using analytical field distributions based on power measurements for f < 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{M,y,z} * CompF whereby the uncertainty corresponds to that given for CompF. A frequency dependent CompF is used in DASY version 4.4 and higher which allows extending the validity from ±50 MHz to ±100 MHz. Spherical Isotropy (SD deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna. Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required. Connector Angle: The angle is assessed using the information gained by determining the NORM_M (no uncertainty required). <p>Certificate No: EX-7767_Oct22 Page 2 of 9</p>
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EX3DV4 - SN:7767 October 28, 2022

Parameters of Probe: EX3DV4 - SN:7767

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k = 2)
Norm. $(\mu V/m/m^2)^A$	0.67	0.69	0.56	$\pm 10.1\%$
DCP (mV) ^B	103.4	107.3	105.7	$\pm 4.7\%$

Calibration Results for Modulation Response

UBI	Communication System Name	A	B	C	D	VR	Max	Max
		dBS	dBS/μV		dBS	mV	dev.	Unc ^C
								k = 2
0	CW	X	0.00	0.00	1.00	0.00	184.7	$\pm 3.5\%$
		Y	0.00	0.00	1.00		176.3	$\pm 4.7\%$
		Z	0.00	0.00	1.00		179.3	

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%.

A The uncertainties of Norm X,Y,Z do not affect the $k=2$ uncertainty inside TRS. (see Page 5).
 B Uncertainty parameter uncertainty for maximum specified field strength.
 C Uncertainty is determined using the max. deviation from three responses applying rectangular distribution and is expressed for the square of the field value.

Certificate No: EX-7767_Oct22 Page 5 of 9

EX3DV4 - SN:7767 October 28, 2022

Parameters of Probe: EX3DV4 - SN:7767

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	144.9°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	3 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3-4 mm for an Area Scan job.

Certificate No: EX-7767_Oct22 Page 4 of 9

EX3DV4 - SN:7767 October 28, 2022

Parameters of Probe: EX3DV4 - SN:7767

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^D	Conductivity ^E (S/m)	CompF X	CompF Y	CompF Z	Alpha ^F	Depth ^G (mm)	Unc (k = 2)
150	50.3	0.79	14.08	14.08	14.08	0.00	1.00	$\pm 13.2\%$
450	42.5	0.67	11.50	11.50	11.50	0.16	1.20	$\pm 13.3\%$
750	41.8	0.68	10.26	10.26	10.26	0.00	0.80	$\pm 12.0\%$
835	41.5	0.90	10.00	10.00	10.00	0.43	0.80	$\pm 12.0\%$
1750	40.1	1.37	9.32	9.32	9.32	0.36	0.86	$\pm 12.0\%$
1900	40.0	1.40	8.91	8.91	8.91	0.33	0.86	$\pm 12.0\%$
2100	39.8	1.49	8.60	8.60	8.60	0.30	0.86	$\pm 12.0\%$
2200	39.5	1.67	8.44	8.44	8.44	0.33	0.90	$\pm 12.0\%$
2450	39.2	1.80	8.24	8.24	8.24	0.32	0.90	$\pm 12.0\%$
2600	39.0	1.96	7.99	7.99	7.99	0.27	0.90	$\pm 12.0\%$
3300	38.2	2.71	7.55	7.55	7.55	0.30	1.25	$\pm 13.1\%$
3600	37.9	2.91	7.45	7.45	7.45	0.30	1.35	$\pm 13.1\%$
3700	37.7	3.12	7.20	7.20	7.20	0.30	1.05	$\pm 13.1\%$
3900	37.5	3.32	6.84	6.84	6.84	0.40	1.06	$\pm 13.1\%$
4100	37.2	3.53	6.63	6.63	6.63	0.40	1.00	$\pm 13.1\%$
4300	37.1	3.60	6.30	6.30	6.30	0.40	1.70	$\pm 13.1\%$
4400	36.9	3.84	6.17	6.17	6.17	0.40	1.70	$\pm 13.1\%$
4600	36.7	4.04	6.15	6.15	6.15	0.40	1.70	$\pm 13.1\%$
4800	36.4	4.25	6.13	6.13	6.13	0.40	1.90	$\pm 13.1\%$
4900	36.3	4.40	6.07	6.07	6.07	0.40	1.80	$\pm 13.1\%$
5000	36.0	4.66	5.65	5.65	5.65	0.40	1.80	$\pm 13.1\%$
5300	35.9	4.75	5.48	5.48	5.48	0.40	1.80	$\pm 13.1\%$
5500	35.6	4.99	5.30	5.30	5.30	0.40	1.80	$\pm 13.1\%$
5600	35.5	5.07	5.14	5.14	5.14	0.40	1.80	$\pm 13.1\%$
5800	35.3	5.27	5.10	5.10	5.10	0.40	1.80	$\pm 13.1\%$

C Frequency validly above 300 MHz and ≤ 100 MHz only applies for D03 v1.4 and higher (see Page 5), else it is reserved to $\pm 5\%$ Max. The uncertainty is the 95% of the CompF uncertainty for calibration frequency and the uncertainty for the relative permittivity. Frequency validly below 300 MHz is $\pm 1\%$, 35, 40, 45, 50 and 70 MHz for CompF measurements at 35, 40, 45, 50 and 100 MHz respectively. Validity of CompF measured at 6 MHz is $\pm 6.0\%$ and CompF measured at 15 MHz is $\pm 6.0\%$ Max. Above 6 MHz the validity of CompF can be extended to $\pm 10.0\%$.
 D At frequencies below 3 GHz, the validity of tissue parameters (relative permittivity and conductivity) can be extended to $\pm 10\%$ if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (relative permittivity and conductivity) is restricted to $\pm 10\%$. The uncertainty is the 95% of the CompF uncertainty for individual target tissue parameters.
 E Alpha depth is determined using calibration. SARAD warns that the remaining relative due to the uncertainty when after compensation is always less than $\pm 1\%$ for frequencies below 3 GHz and below $\pm 2\%$ for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the targets.
 F Alpha depth is determined using calibration. SARAD warns that the remaining relative due to the uncertainty when after compensation is always less than $\pm 1\%$ for frequencies below 3 GHz and below $\pm 2\%$ for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the targets.

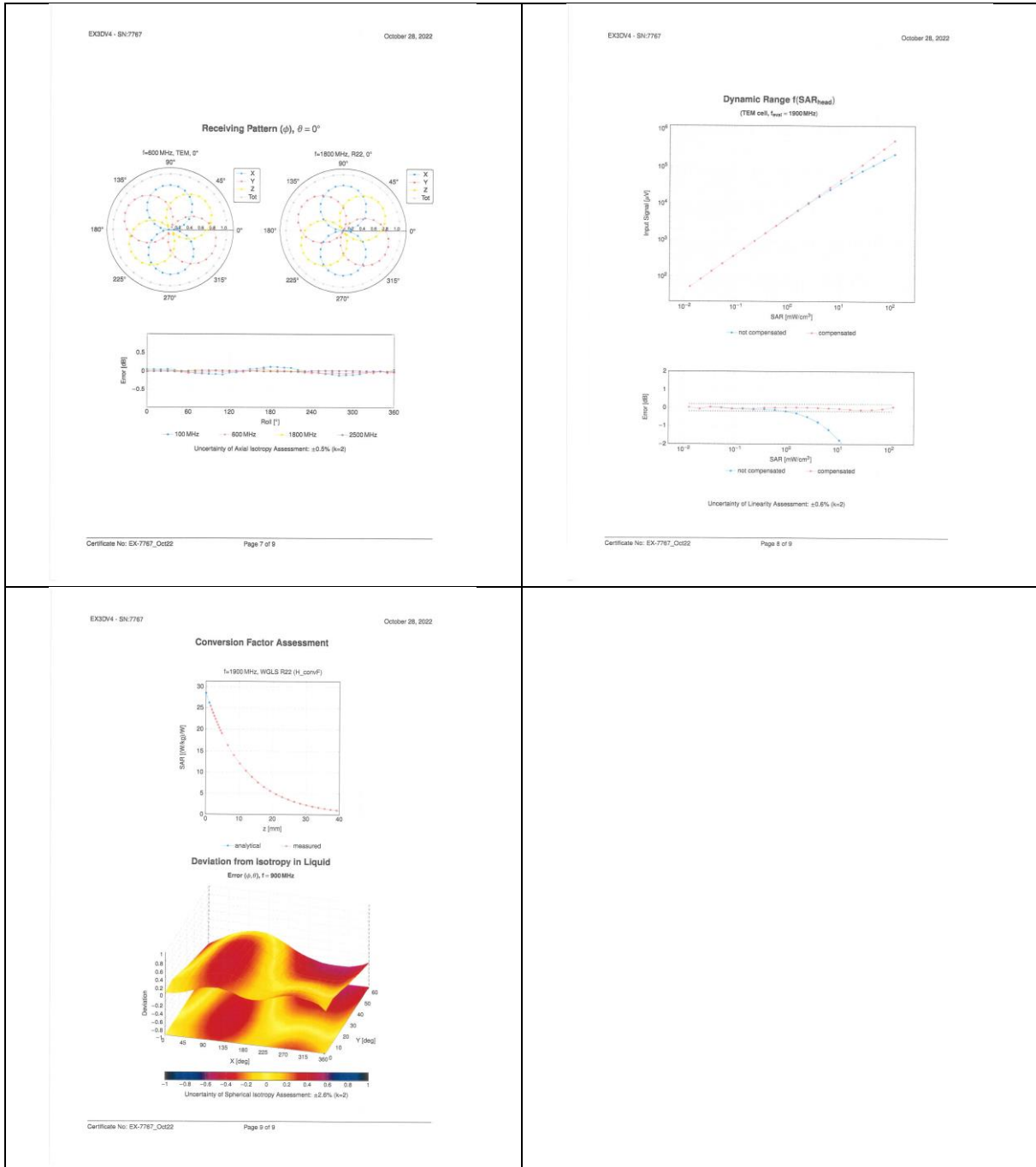
Certificate No: EX-7767_Oct22 Page 5 of 9

EX3DV4 - SN:7767 October 28, 2022

Frequency Response of E-Field
(TEM-Cell#119 EXL, Waveguide#22)

Uncertainty of Frequency Response of E-Field: $\pm 0.3\%$ (k=2)

Certificate No: EX-7767_Oct22 Page 6 of 9



4 Impedance and return loss

Dipole CLA150 SN 4025				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2021/4/26	-31.4	/	47.8	/
2022/4/26	-32.5	-3.5%	47.1	-0.7
Dipole D450V3 SN 1103				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2021/4/21	-23	/	57.1	/
2022/4/26	-23.4	-1.74%	56.6	-0.5