

Appendix C for KSCR230200012801

Calibration Certificate

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



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1 Dipole

1.1 CLA150 - SN 4025

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland		S Schweizerischer Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura S Swiss Calibration Service	
Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates		Accreditation No.: SCS 0108	
Client: SGS-CN (Auden)		Certificate No: CLA150-4025_Apr21	
CALIBRATION CERTIFICATE			
Object: CLA150 - SN: 4025			
Calibration procedure(s): QA CAL-15-v9 Calibration Procedure for SAR Validation Sources below 700 MHz			
Calibration date: April 26, 2021			
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature $22 \pm 3^\circ\text{C}$ and humidity $< 70\%$.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 10476	09-Apr-21 (No. 217-03201/03202)	Apr-22
Power sensor NRP Z01	SN: 10364	09-Apr-21 (No. 217-03201)	Apr-22
Power sensor NRP Z01	SN: 10365	09-Apr-21 (No. 217-03202)	Apr-22
Reference 20 dB Attenuator	SN: C22862 (203)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310952 / 00357	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX30N4	SN: 3877	30-Dec-20 (No. EX3-3877_Dec20)	Dec-21
ENEA	SN: 684	26-Jan-20 (No. D458-684_Jan20)	Jun-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter S4413B	SN: G841203074	06-Apr-18 (in house check Jun-20)	In house check Jun-22
Power sensor E4113A	SN: MY4148067	06-Apr-18 (in house check Jun-20)	In house check Jun-22
Power sensor E4113A	SN: 000110210	06-Apr-18 (in house check Jun-20)	In house check Jun-22
RF generator HP 8440D	SN: US484001709	04-Aug-19 (in house check Jun-20)	In house check Jun-22
Network Analyser Agilent E8363A	SN: US41000477	31-Mar-14 (in house check Oct-20)	In house check Oct-21
Calibrated by:	Name: Jeffrey Katsman	Function: Laboratory Technician	Signature:
Approved by:	Name: Kaja Polovic	Function: Technical Manager	Signature:
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Issued: April 26, 2021			
Certificate No: CLA150-4025_Apr21		Page 1 of 6	

Measurement Conditions	
DASY system configuration, as far as not given on page 1:	
DASY Version	V52.10.4
Extrapolation	Advanced Extrapolation
Phantom	ELIA Flat Phantom
EUT Positioning	Touch Position
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm
Frequency	150 MHz $\pm$ 1 MHz
Graded Ratio	1.4 (Z direction)

Head TSL parameters	
The following parameters and calculations were applied:	
Nominal Head TSL parameters	Temperature: 22.0°C
Measured Head TSL parameters	Permittivity: 52.3
Head TSL temperature change during test	Conductivity: 0.75 mho/m
	Measured Head TSL parameters: $(22.0 \pm 0.2)^\circ\text{C}$
	Permittivity: $51.1 \pm 6\%$
	Conductivity: $0.75\text{ mho/m} \pm 6\%$
	Head TSL temperature change during test: $< 0.5^\circ\text{C}$

SAR result with Head TSL	
SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition
SAR measured	1 W input power
SAR for nominal Head TSL parameters	normalized to 1W
	3.90 W/kg
	$3.88\text{ W/kg} \pm 19.4\%$ (k=2)
SAR averaged over 10 cm^3 (10 g) of Head TSL	condition
SAR measured	1 W input power
SAR for nominal Head TSL parameters	normalized to 1W
	2.60 W/kg
	$2.59\text{ W/kg} \pm 18.0\%$ (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)	
Antenna Parameters with Head TSL	
Impedance, transformed to feed point	$47.9\Omega \pm 1.5\Omega$
Return Loss	-31.4 dB
Additional EUT Data	
Manufactured by	SPLEAG

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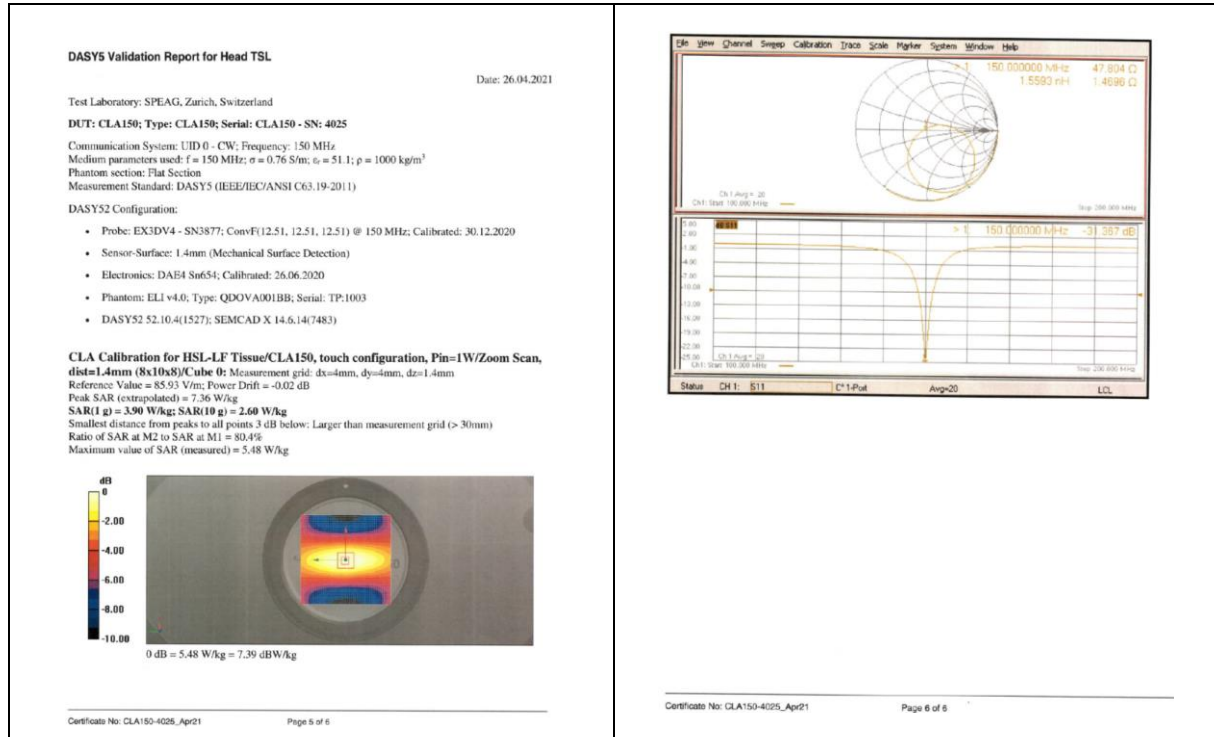
Certificate No: CLA150-4025_Apr21	
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1.2 D450V3 - SN 1103

Calibration Laboratory of Schmid & Partner Engineering AG
Zweigschulstrasse 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 (20 ± 2) °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. 217-03021/03020)	Apr-22
Power sensor NRP-291	SN: 102844	09-Apr-21 (No. 217-03021)	Apr-22
Power sensor NRP-291	SN: 102845	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 mismatch combination	SN: 310827 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe E3030A	SN: 3877	30-Dec-20 (No. E30-3877, Dec20)	Dec-21
DAEA	SN: 654	26-Jun-20 (No. D454-654, Jun20)	Jun-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41200274	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4412A	SN: MY41496027	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4412A	SN: 00010010	06-Apr-16 (in house check Jun-20)	In house check Jun-22
RF generator HP 8548C	SN: L053460101700	06-Aug-99 (in house check Jun-20)	In house check Jun-22
Network Analyzer Agilent E8358A	SN: U841080477	31-Mar-14 (in house check Oct-20)	In house check Oct-21

Calibrated by: **Christoph Leuber** Function: **Laboratory Technician**

Approved by: **Kelly Polovic** Technical Manager

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Certificate No: D450V3-1103_Apr21 Page 1 of 6

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Accreditation No: **SCS 0106**

Glossary:

TSL: Issue simulating liquid sensitivity in TSL / NORM x,y,z

ConvF: not applicable or not measured

N/A: not applicable or not measured

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions		
DASY system configuration, as far as not given on page 1.		
DASY Version	DASY5	V82.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELJ 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 $\pm$ 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 $\pm$ 0.2) °C	43.1 $\pm$ 6 %	0.07 mho/m $\pm$ 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	4.55 W/kg $\pm$ 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 $\pm$ 17.6 % (k=2)

Certificate No: D450V3-1103_Apr21

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; $\alpha = 0.87$ S/m; $\epsilon_r = 43.1$; $\rho = 1000$ 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

0 dB = 1.53 W/kg = 1.85 dBW/kg

Certificate No: D450V3-1103_Apr21

Appendix (Additional assessments outside the scope of SCS 0108)	
Antenna Parameters with Head TSL	
Impedance, transformed to feed point	57.1 Ω - j2.6 jΩ
Return Loss	-23.0 dB

General Antenna Parameters and Design	
Electrical Delay (one direction)	1.346 ns

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

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

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

Additional EUT Data	
Manufactured by	SPEAG

Certificate No: D450V3-1103_Apr21

CH 1: Arg= 20
CH 2: Sweep 250.000 MHz

Step 450.000 MHz

CH 1: Arg= 20
CH 2: Sweep 250.000 MHz

Status: CH 1: 511 C*1.Phot Arg=20 Delay LCL

Certificate No: D450V3-1103_Apr21



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1.3 D750V3 - SN 1188

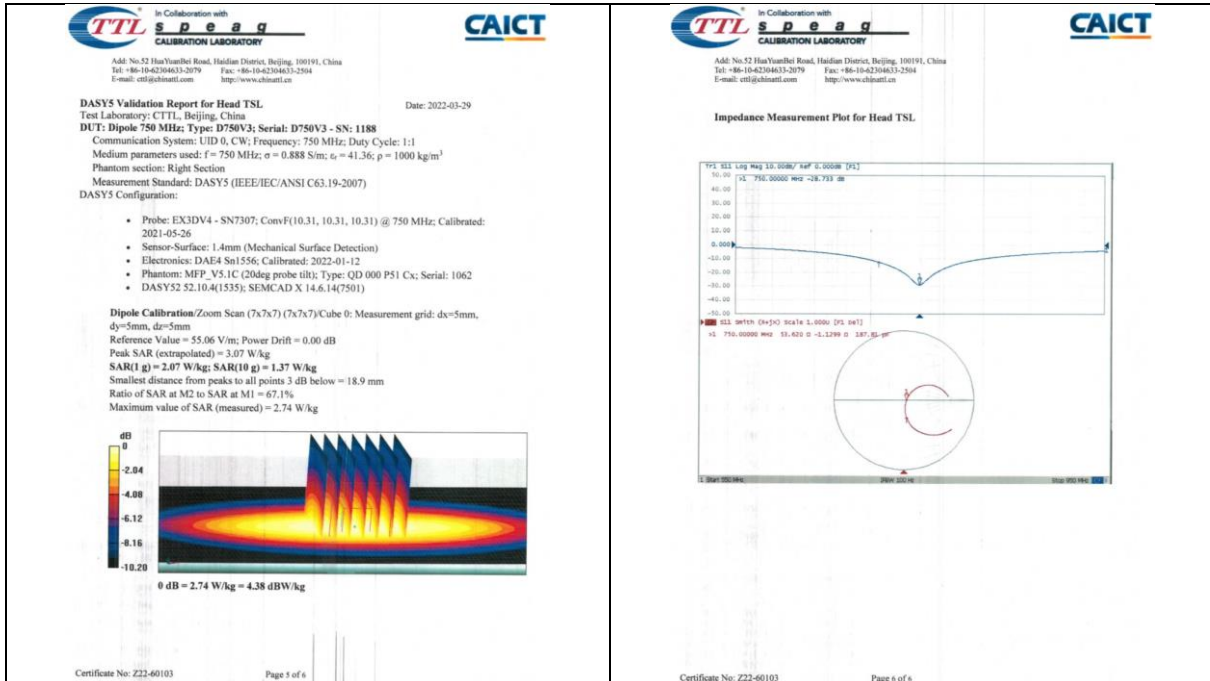
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Client: SGS-CN		Certificate No: Z22-60103																					
CALIBRATION CERTIFICATE																							
Object: D750V3 - SN: 1188																							
Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits																							
Calibration date: March 28, 2022																							
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Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL No.J22X00409)	Jan-23																				
Calibrated by: Zhao Jing SAR Test Engineer																							
Reviewed by: Lin Hao SAR Test Engineer																							
Approved by: Qi Dianyan SAR Project Leader																							
Issued: April 3, 2022																							
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Measurement Conditions DASY system configuration, as far as not given on page 1:																								
<table border="1"><thead><tr><th>DASY Version</th><th>DASY52</th><th>V52.10.4</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>15 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>750 MHz ± 1 MHz</td><td></td></tr></tbody></table>				DASY Version	DASY52	V52.10.4	Extrapolation	Advanced Extrapolation		Phantom	Triple Flat Phantom 5.1C		Distance Dipole Center - TSL	15 mm	with Spacer	Zoom Scan Resolution	dx, dy, dz = 5 mm		Frequency	750 MHz ± 1 MHz				
DASY Version	DASY52	V52.10.4																						
Extrapolation	Advanced Extrapolation																							
Phantom	Triple Flat Phantom 5.1C																							
Distance Dipole Center - TSL	15 mm	with Spacer																						
Zoom Scan Resolution	dx, dy, dz = 5 mm																							
Frequency	750 MHz ± 1 MHz																							
Head TSL parameters The following parameters and calculations were applied:																								
<table border="1"><thead><tr><th></th><th>Temperature</th><th>Permittivity</th><th>Conductivity</th></tr></thead><tbody><tr><td>Nominal Head TSL parameters</td><td>22.0 °C</td><td>42.0</td><td>0.90 mho/m</td></tr><tr><td>Measured Head TSL parameters</td><td>(22.0 ± 0.2) °C</td><td>41.4 ± 6 %</td><td>0.89 mho/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>					Temperature	Permittivity	Conductivity	Nominal Head TSL parameters	22.0 °C	42.0	0.90 mho/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %	Head TSL temperature change during test	<1.0 °C	---	---					
	Temperature	Permittivity	Conductivity																					
Nominal Head TSL parameters	22.0 °C	42.0	0.90 mho/m																					
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %																					
Head TSL temperature change during test	<1.0 °C	---	---																					
SAR result with Head TSL																								
<table border="1"><thead><tr><th></th><th>Condition</th><th></th></tr></thead><tbody><tr><td>SAR averaged over 1 cm² (1 g) of Head TSL</td><td></td><td></td></tr><tr><td>SAR measured</td><td>250 mW input power</td><td>2.07 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>8.27 W/kg ± 18.8 % (k=2)</td></tr><tr><td>SAR averaged over 10 cm² (10 g) of Head TSL</td><td></td><td></td></tr><tr><td>SAR measured</td><td>250 mW input power</td><td>1.37 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>5.48 W/kg ± 18.7 % (k=2)</td></tr></tbody></table>					Condition		SAR averaged over 1 cm ² (1 g) of Head TSL			SAR measured	250 mW input power	2.07 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	8.27 W/kg ± 18.8 % (k=2)	SAR averaged over 10 cm ² (10 g) of Head TSL			SAR measured	250 mW input power	1.37 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	5.48 W/kg ± 18.7 % (k=2)
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SAR for nominal Head TSL parameters	normalized to 1W	5.48 W/kg ± 18.7 % (k=2)																						
Certificate No: Z22-60103		Page 3 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: a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020 b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation: c) DASY4/5 System Handbook			
Methods Applied and Interpretation of Parameters: - Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. - Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis. - Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required. - Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required. - SAR measured: SAR measured at the stated antenna input power. - SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. - SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.			
Certificate No: Z22-60103		Page 2 of 6	

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Appendix (Additional assessments outside the scope of CNAS L0570)							
Antenna Parameters with Head TSL							
<table border="1"><thead><tr><th>Impedance, transformed to feed point</th><th>53.60- 1.13jΩ</th></tr><tr><th>Return Loss</th><th>-28.7dB</th></tr></thead></table>				Impedance, transformed to feed point	53.60- 1.13jΩ	Return Loss	-28.7dB
Impedance, transformed to feed point	53.60- 1.13jΩ						
Return Loss	-28.7dB						
General Antenna Parameters and Design							
<table border="1"><thead><tr><th>Electrical Delay (one direction)</th><th>0.947 ns</th></tr></thead></table>				Electrical Delay (one direction)	0.947 ns		
Electrical Delay (one direction)	0.947 ns						
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.							
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.							
Additional EUT Data							
<table border="1"><thead><tr><th>Manufactured by</th><th>SPEAG</th></tr></thead></table>				Manufactured by	SPEAG		
Manufactured by	SPEAG						
Certificate No: Z22-60103		Page 4 of 6					





1.4 D835V2 - SN 4d114

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Client: SGS-CN		Certificate No: Z22-60104	
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	104261	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.J22X00409)	Jan-23
Calibrated by:	Name: Zhao Jing	Function: SAR Test Engineer	Signature: [Signature]
Reviewed by:	Name: Lin Hao	Function: SAR Test Engineer	Signature: [Signature]
Approved by:	Name: Qi Diqian	Function: SAR Project Leader	Signature: [Signature]
Issued: April 6, 2022			
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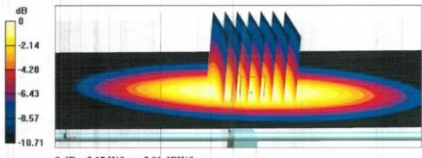
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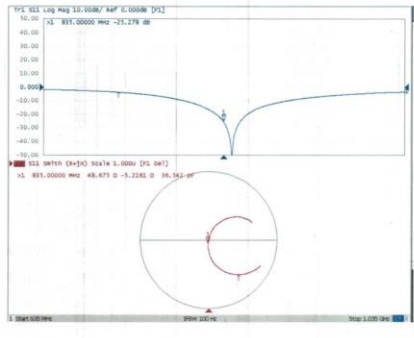
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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	VS2 10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	835 MHz $\pm$ 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
Nominal Head TSL parameters	Temperature	Permittivity	Conductivity
	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.0 $\pm$ 5 %	0.91 mho/m $\pm$ 5 %
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	9.40 W/kg $\pm$ 18.5 % (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 $\pm$ 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	48.70 - j22.0Q		
Return Loss	-25.3dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.307 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60104 Page 4 of 6			

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DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China Date: 2022-03-31			
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 40114 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/m ³ 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: 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) (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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Impedance Measurement Plot for Head TSL			
			
Certificate No: Z22-60104 Page 6 of 6			

1.5 D900V2 - SN 1d079



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Client: **SGS-CN**

Certificate No: **Z22-60184**

CALIBRATION CERTIFICATE

Object: **D900V2 - SN: 10079**

Calibration Procedure(s): **FF-211-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **June 7, 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 (MTE 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 NRP85	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Reference Probe EX30V4	SN 7464	26-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22 (CTTL-SPEAG No. Z22-40007)	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 Diyan** SAR Project Leader

Issued: June 13, 2022

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Certificate No: **Z22-60184**

CALIBRATION CERTIFICATE

Object: **D900V2 - SN: 10079**

Calibration Procedure(s): **FF-211-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **June 7, 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 (MTE 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 NRP85	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Reference Probe EX30V4	SN 7464	26-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22 (CTTL-SPEAG No. Z22-40007)	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 Diyan** SAR Project Leader

Issued: June 13, 2022

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CALIBRATION CERTIFICATE

Object: **D900V2 - SN: 10079**

Calibration Procedure(s): **FF-211-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **June 7, 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 (MTE 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 NRP85	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22
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DAE4	SN 1556	12-Jan-22 (CTTL-SPEAG No. Z22-40007)	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 Diyan** SAR Project Leader

Issued: June 13, 2022

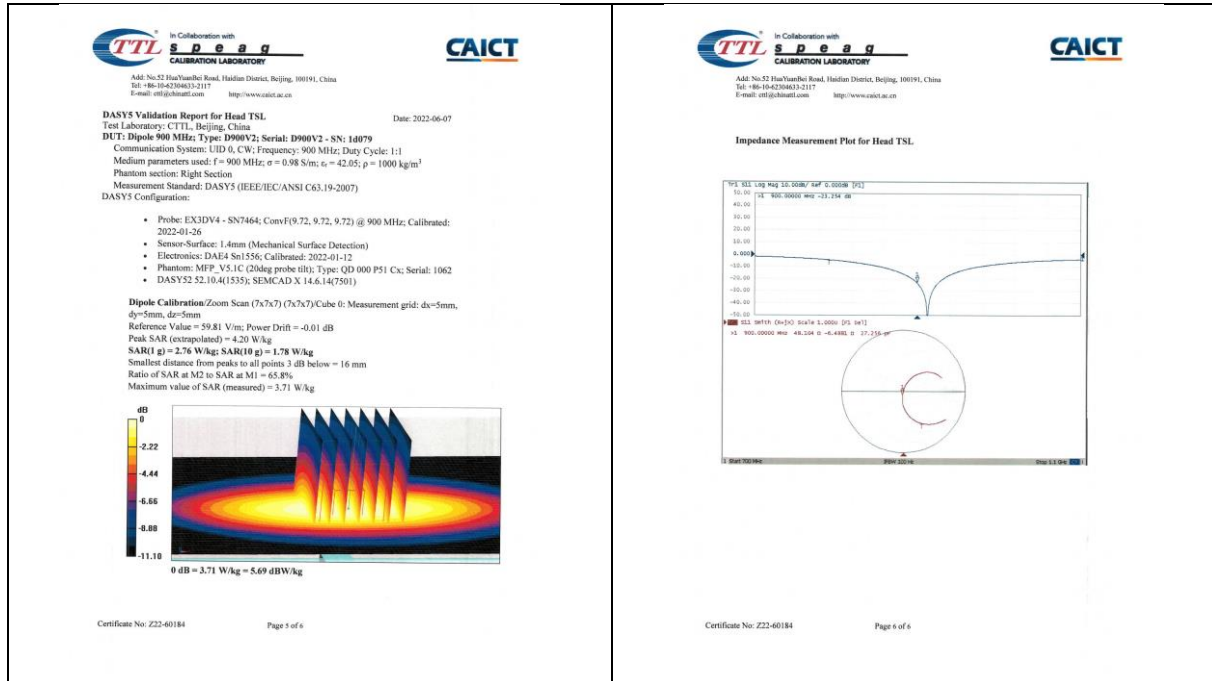
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1.6 D1800V2 - SN 2d170

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Client: **SGS-CN** Certificate No: **Z22-60105**

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 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.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110573	14-Jan-22 (CTTL No.J22X00409)	Jan-23

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

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

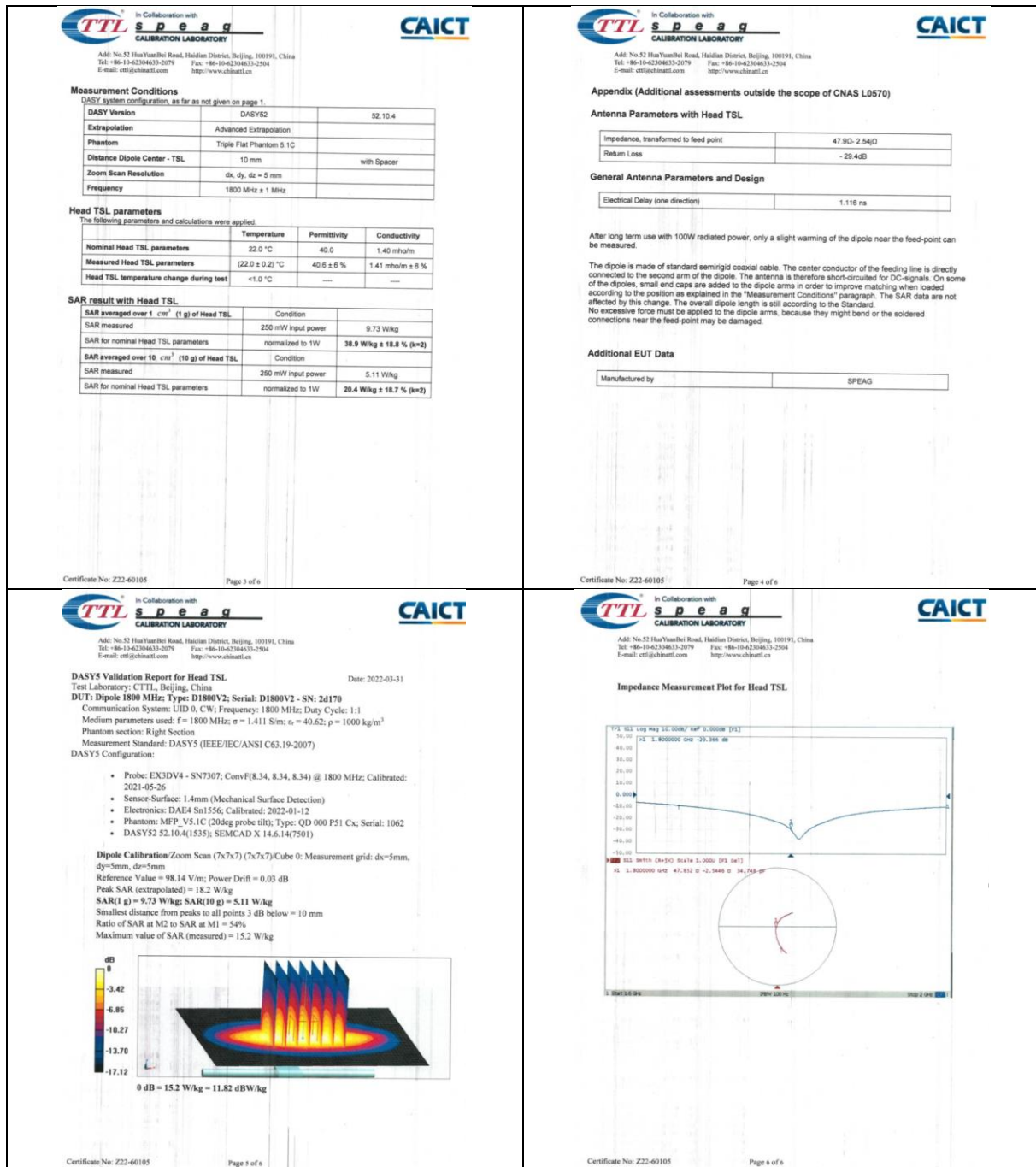
Certificate No: Z22-60105 Page 2 of 6



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1.7 D1900V2 - SN 5d136

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Client: SGS-CN		Certificate No: Z22-60185	
CALIBRATION CERTIFICATE			
Object	D1900V2 - SN: 5d136		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	June 7, 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±1)°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 NRP6S	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 Z22-60007)	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 Analyzer E5071C	MY48110073	14-Jan-22 (CTTL No.J22X00409)	Jan-23
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyan	SAR Project Leader	
Issued: June 13, 2022			
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Certificate No: Z22-60185		Page 1 of 6	

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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DAEY52	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		
Head TSL parameters The following parameters and calculations were applied:			
Nominal Head TSL parameters	Temperature	Permittivity	Conductivity
	22.0 °C	40.0	1.40 nH/m
Measured Head TSL parameters	(22.0 ± 0.3) °C	39.9 ± 6 %	1.39 nH/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	9.65 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 16.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.18 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 18.7 % (k=2)	
Certificate No: Z22-60185		Page 3 of 6	

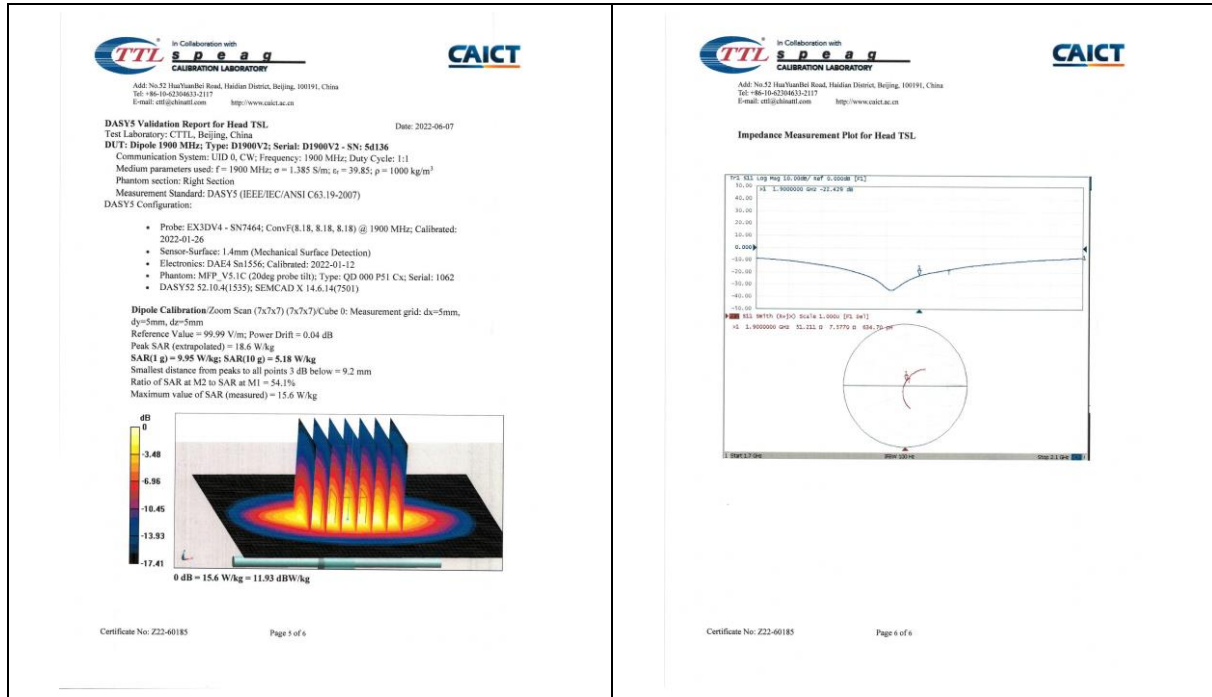
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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	51.02 ± 7.56Ω		
Return Loss	-22.4dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.109 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. On some of the dipoles, small and 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		
Certificate No: Z22-60185		Page 4 of 6	



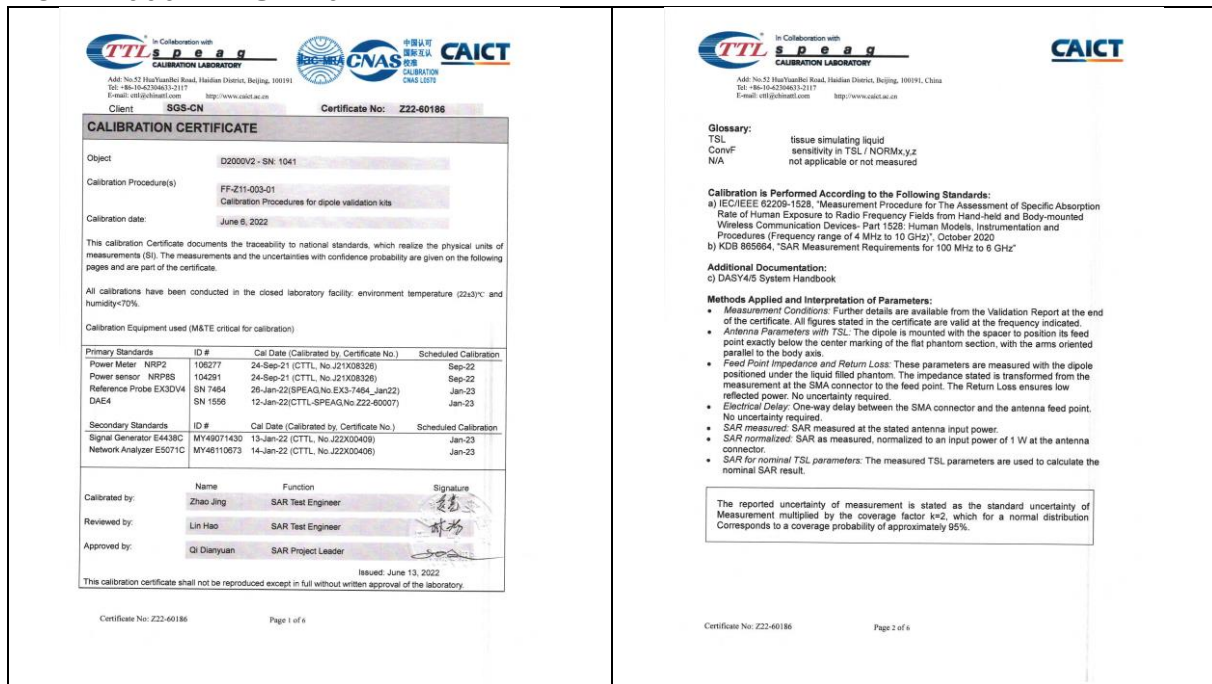
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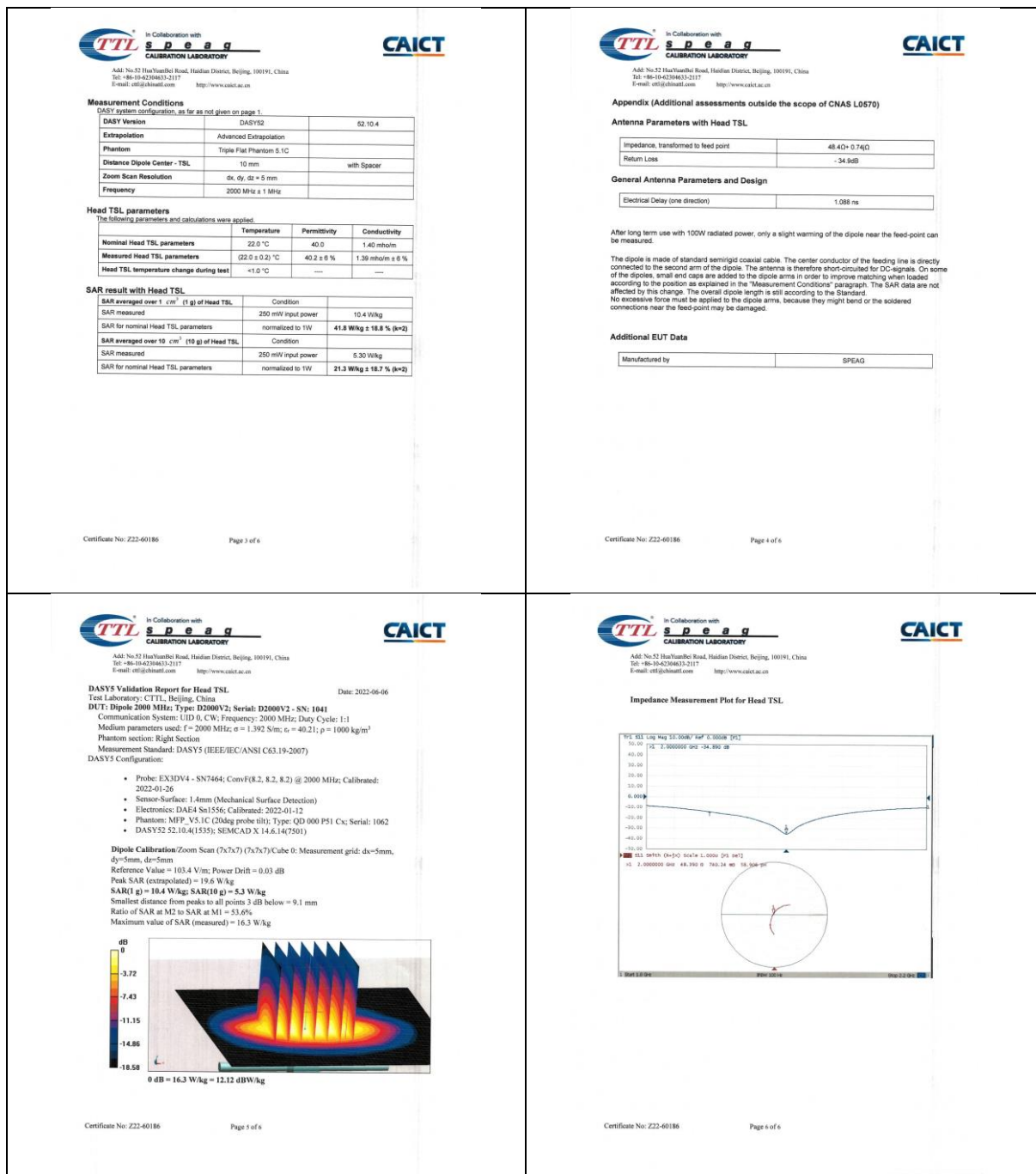
1.8 D2000V2 - SN 1041



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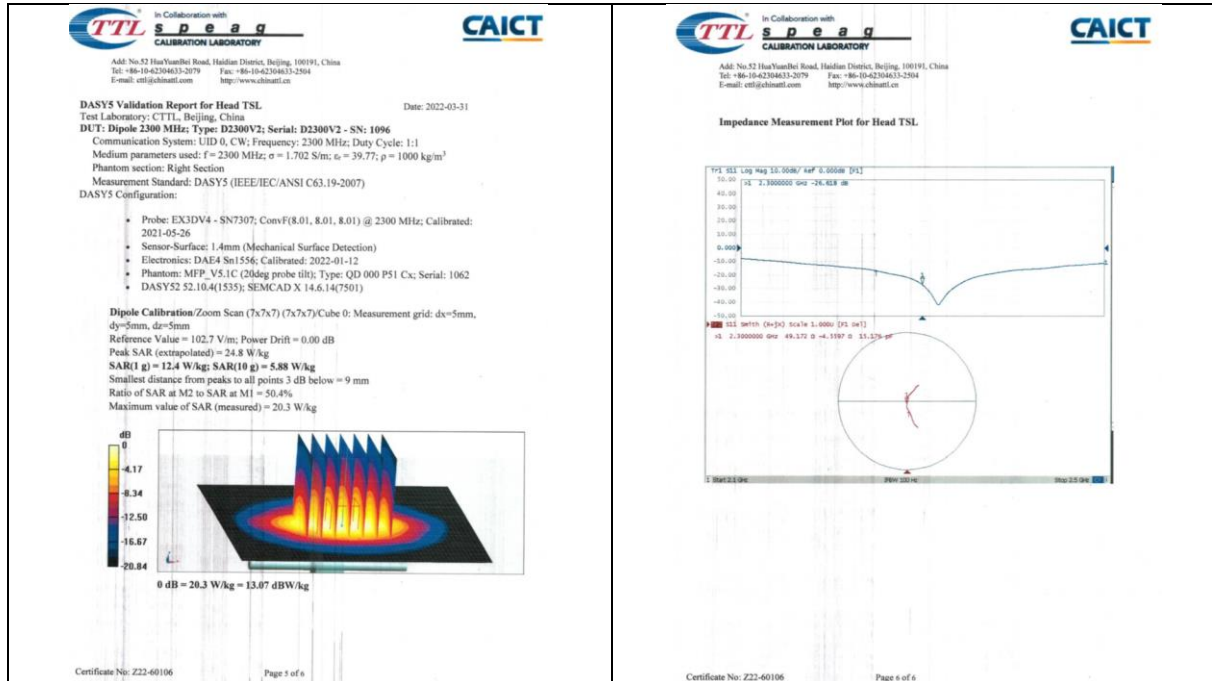
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1.9 D2300V2 - SN 1096

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Client	SGS-CN	Certificate No.	Z22-60106
CALIBRATION CERTIFICATE			
Object	D2300V2 - SN: 1096		
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	108277	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Reference Probe EX30V4	SN 7307	26-May-21 (SPEAG No.EK3-7307_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	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 Diqiyuan	SAR Project Leader	
Issued: April 6, 2022			
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Certificate No: Z22-60106		Page 1 of 6	
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Measurement Conditions			
DASY system configuration, as far as not given on page 1:			
DASY Version	DASY32	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		
Head TSL parameters			
The following parameters and calculations were applied:			
	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	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) 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 ² (10 g) 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)	
Certificate No: Z22-60106		Page 3 of 6	
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Certificate No: Z22-60106		Page 2 of 6	
Glossary:			
TSL	Issue simulating liquid		
ConvF	sensitivity in TSL / NORM y,z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1: 528 Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020			
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation:			
c) DASY4/5 System Handbook			
Methods Applied and Interpretation of Parameters:			
- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. - Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis. - Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required. - Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required. - SAR measured: SAR measured at the stated antenna input power. - SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. - SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.			
Certificate No: Z22-60106		Page 2 of 6	
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Certificate No: Z22-60106		Page 4 of 6	
Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	49.20 - 4.56jΩ		
Return Loss	-26.6dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.083 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		





1.10 D2450V2 - SN 817

TTL In Collaboration with **CAICT**
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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&E critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter: NRP2	106277	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	25-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	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

Signature: [Signatures]
Issued: April 6, 2022

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Certificate No: Z22-60107 Page 1 of 6

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

Calibration is Performed According to the Following Standards:
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
b) KDB 855664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

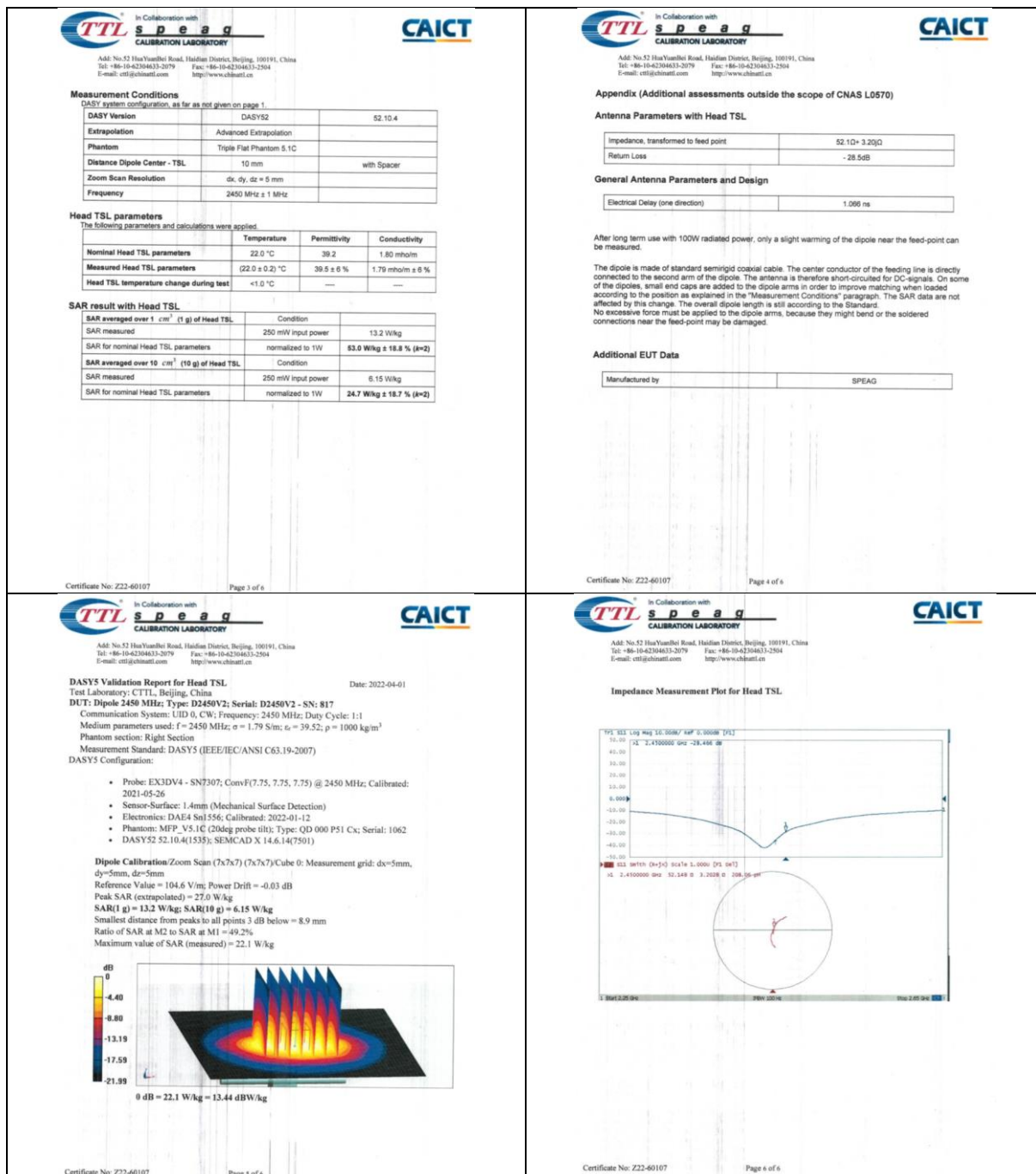
Additional Documentation:
c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60107 Page 2 of 6



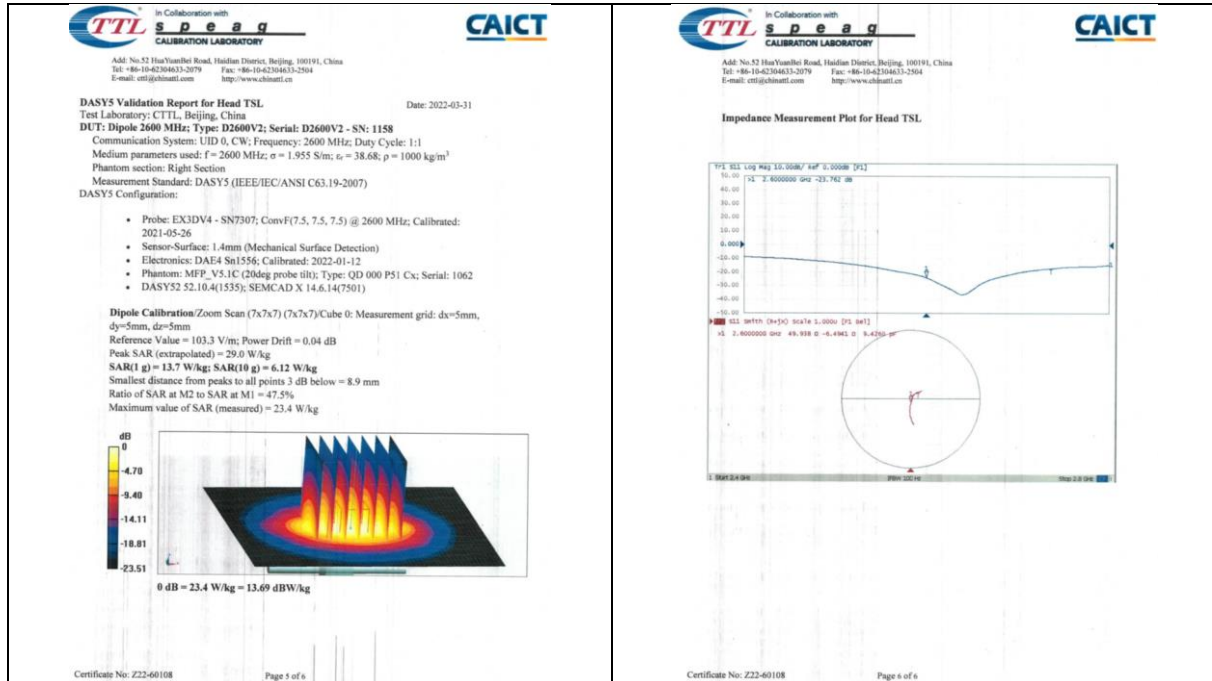
1.11 D2600V2 - SN 1158

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Client: SGS-CN		Certificate No: Z22-40108																																	
CALIBRATION CERTIFICATE																																			
Object: D2600V2 - SN: 1158																																			
Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits																																			
Calibration date: March 31, 2022																																			
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Glossary: TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx.y.z N/A: not applicable or not measured			
Calibration is Performed According to the Following Standards: a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices - Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020 b) KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation: c) DASY4/S System Handbook			
Methods Applied and Interpretation of Parameters: • Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. • Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis. • Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required. • Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required. • SAR measured: SAR measured at the stated antenna input power. • SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. • SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.			
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Appendix (Additional assessments outside the scope of CNAS L0570)							
Antenna Parameters with Head TSL							
<table border="1"><thead><tr><th>Impedance, transformed to feed point</th><th>49.90-6.49jΩ</th></tr></thead><tbody><tr><td>Return Loss</td><td>-23.8dB</td></tr></tbody></table>				Impedance, transformed to feed point	49.90-6.49jΩ	Return Loss	-23.8dB
Impedance, transformed to feed point	49.90-6.49jΩ						
Return Loss	-23.8dB						
General Antenna Parameters and Design							
<table border="1"><thead><tr><th>Electrical Delay (one direction)</th><th>1.053 ns</th></tr></thead></table>				Electrical Delay (one direction)	1.053 ns		
Electrical Delay (one direction)	1.053 ns						
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.							
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.							
Additional EUT Data							
<table border="1"><thead><tr><th>Manufactured by</th><th>SPEAG</th></tr></thead></table>				Manufactured by	SPEAG		
Manufactured by	SPEAG						
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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.J21008328)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21008328)	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	MY48071430	13-Jan-22 (CTTL No.J22000409)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22000406)	Jan-23
Name: Zhao Jing		Function: SAR Test Engineer	Signature: [Signature]
Reviewed by: Lin Hao		SAR Test Engineer	[Signature]
Approved by: Qi Dianyan		SAR Project Leader	[Signature]
Issued: June 6, 2022			
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Right Page:
Glossary:
TSL: Issue simulating liquid
sensitivity in TSL: NORMx,y,z
N/A: not applicable or not measured
Calibration is Performed According to the Following Standards:
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices-Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
b) KDB 665664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
Additional Documentation:
c) DASY4/5 System Handbook
Methods Applied and Interpretation of Parameters:
• Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
• Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
• Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
• Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
• SAR measured: SAR measured at the stated antenna input power.
• SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
• SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

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Measurement Conditions

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

DASY Version	DASY2	52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom S.1C	
Distance Dipole Center - TSL	10 mm	with Opacor
Zoom Scan Resolution	dx, dy = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 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	35.9	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	4.62 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	7.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.6 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	82.5 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ± 24.2 % (k=2)

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Head TSL parameters at 5600MHz

The following parameters and calculations were applied:

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	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	21.6 W/kg ± 24.2 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5200MHz

Impedance, transformed to feed point	46.10-5.03jΩ
Return Loss	-29.6dB

Antenna Parameters with Head TSL at 5300MHz

Impedance, transformed to feed point	47.80-5.42jΩ
Return Loss	-29.5dB

Antenna Parameters with Head TSL at 5500MHz

Impedance, transformed to feed point	50.30-4.26jΩ
Return Loss	-27.4dB

Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	54.50-4.80jΩ
Return Loss	-24.0dB

Antenna Parameters with Head TSL at 5800MHz

Impedance, transformed to feed point	51.50-5.61jΩ
Return Loss	-24.9dB

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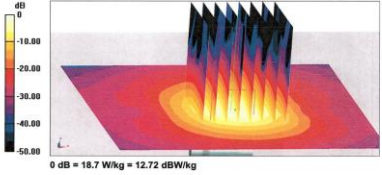
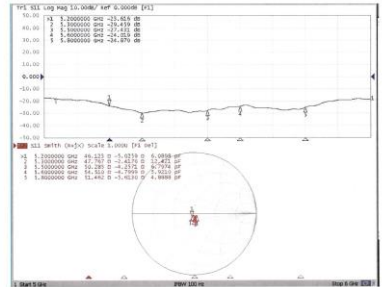
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中国·江苏·昆山开发区伟业路10号 邮编: 215300 (86-512) 57355888 (86-512) 57370818 sgs.china@sgs.com

In Collaboration with TTL speaq CALIBRATION LABORATORY CAICT Address: No. 52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn General Antenna Parameters and Design <table border="1"><tr><td>Electrical Delay (one direction)</td><td>1.101 ns</td></tr></table> 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 <table border="1"><tr><td>Manufactured by</td><td>SPEAG</td></tr></table> Certificate No: Z22-60187 Page 7 of 10	Electrical Delay (one direction)	1.101 ns	Manufactured by	SPEAG	In Collaboration with TTL speaq CALIBRATION LABORATORY CAICT Address: No. 52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China Date: 2022-06-01 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; Duty Cycle: 1:1 Medium parameters used: $f = 5200$ MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.19$; $\rho = 1000$ 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; $\epsilon_r = 34.89$; $\rho = 1000$ 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: DA64 Sn1556; Calibrated: 2022-01-12 - Phantom: MPF_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 Certificate No: Z22-60187 Page 8 of 10
Electrical Delay (one direction)	1.101 ns				
Manufactured by	SPEAG				
In Collaboration with TTL speaq CALIBRATION LABORATORY CAICT Address: No. 52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn 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) = 8.20 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 = 16.7 W/kg = 12.72 dBW/kg  Certificate No: Z22-60187 Page 9 of 10	In Collaboration with TTL speaq CALIBRATION LABORATORY CAICT Address: No. 52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn Impedance Measurement Plot for Head TSL  Certificate No: Z22-60187 Page 10 of 10				

2 DAE4 - SN 1245

Schmid & Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9770 www.spgs.ch, info@spgs.ch s p e a g IMPORTANT NOTICE USAGE OF THE DAE4 The DAE4 unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE4. Special attention shall be given to the following points: Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE4 to wear out. Shipping of the DAE4: Before shipping the DAE4 to SPEAG for calibration, remove the batteries and pack the DAE4 in an anti-static bag. This anti-static bag shall then be packed into a larger box or container which protects the DAE4 from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside. 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 DAE4 carefully and keep the DAE4 unit in a non-dusty environment if not used for measurements. 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. DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE4 unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file. Important Note: Warranty and calibration is void if the DAE4 unit is disassembled partly or fully by the Customer. 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. 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. TN_EH190306AE DAE4.docx 07.03.2019	Calibration Laboratory of Schmid & Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Client: SGS-CN (Auden) Certificate No.: DAE4-1245_May22 CALIBRATION CERTIFICATE 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 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 (MATE critical for calibration) <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>Kettway 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"><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 LWS 003 AA 1001</td><td>24-Jan-22 (in house check)</td><td>In house check: Jan-23</td></tr><tr><td>Calibrator Blue V2.1</td><td>SE LWS 006 AA 1002</td><td>24-Jan-22 (in house check)</td><td>In house check: Jan-23</td></tr></tbody></table> Calibrated by: Dominique Stettin Function: Laboratory Technician Signature: <i>[Signature]</i> Approved by: Ben Kohn Technical Manager <i>[Signature]</i> This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Certificate No: DAE4-1245_May22 Page 1 of 5	Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Kettway 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 LWS 003 AA 1001	24-Jan-22 (in house check)	In house check: Jan-23	Calibrator Blue V2.1	SE LWS 006 AA 1002	24-Jan-22 (in house check)	In house check: Jan-23
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Calibration Laboratory of Schmid & Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Glossary DAE: data acquisition electronics Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system. Methods Applied and Interpretation of Parameters • DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range. • Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required. • The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty. • DC Voltage Measurement Linearity: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement. • Common mode sensitivity: Influence of a positive or negative common mode voltage on the differential measurement. • Channel separation: Influence of a voltage on the neighbor channels not subject to an input voltage. • AD Converter Values with inputs shorted: Values on the internal AD converter corresponding to zero input voltage. • Input Offset Measurement: Output voltage and statistical results over a large number of zero voltage measurements. • Input Offset Current: Typical value for information; Maximum channel input offset current, not considering the input resistance. • Input resistance: Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement. • Low Battery Alarm Voltage: Typical value for information. Below this voltage, a battery alarm signal is generated. • Power consumption: Typical value for information. Supply currents in various operating modes. Certificate No: DAE4-1245_May22 Page 2 of 5	DC Voltage Measurement AD - Converter Resolution nominal High Range: 1LSB = 6.1 μV, full range = -190...+920 mV Low Range: 1LSB = 61 μV, full range = -1...+3mV DASY measurement parameters: Auto Zero-Time: 3 sec; Measuring time: 3 sec <table border="1"><thead><tr><th>Calibration Factors</th><th>X</th><th>Y</th><th>Z</th></tr></thead><tbody><tr><td>High Range</td><td>405.265 ± 0.02% (k=2)</td><td>403.974 ± 0.02% (k=2)</td><td>406.092 ± 0.02% (k=2)</td></tr><tr><td>Low Range</td><td>3.99534 ± 1.50% (k=2)</td><td>3.99508 ± 1.50% (k=2)</td><td>4.01015 ± 1.50% (k=2)</td></tr></tbody></table> Connector Angle <table border="1"><thead><tr><th>Connector Angle to be used in DASY system</th><th>30.0° ± 1°</th></tr></thead></table> Certificate No: DAE4-1245_May22 Page 3 of 5	Calibration Factors	X	Y	Z	High Range	405.265 ± 0.02% (k=2)	403.974 ± 0.02% (k=2)	406.092 ± 0.02% (k=2)	Low Range	3.99534 ± 1.50% (k=2)	3.99508 ± 1.50% (k=2)	4.01015 ± 1.50% (k=2)	Connector Angle to be used in DASY system	30.0° ± 1°						
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

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 X - Input	-20001.14	1.12	-0.01
Channel Y + Input	19994.72	1.58	0.00
Channel Y + Input	20001.22	-1.00	-0.00
Channel Y - Input	-20003.05	-1.57	0.01
Channel Z + Input	19992.44	0.19	0.00
Channel Z + Input	20003.09	0.58	0.00
Channel Z - Input	-20001.73	-0.27	0.00
Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	2001.91	0.41	0.02
Channel X + Input	202.54	0.65	0.32
Channel X - Input	-197.86	0.07	-0.04
Channel Y + Input	2002.05	0.58	0.03
Channel Y + Input	201.27	-0.57	-0.28
Channel Y - Input	-196.23	-0.06	0.03
Channel Z + Input	2001.96	0.08	0.00
Channel Z + Input	200.09	-1.53	-0.76
Channel Z - Input	-199.85	-1.57	0.79

2. Common mode sensitivity

Channel	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	-200	-5.87	-7.69
Channel X	-200	9.12	7.79
Channel Y	-200	-8.68	-9.28
Channel Y	-200	8.52	6.36
Channel Z	-200	-5.36	-5.60
Channel Z	-200	3.58	3.06

3. Channel separation

Channel	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	4.07	-3.14
Channel Y	200	9.36	-	4.27
Channel Z	200	10.11	7.14	-

Certificate No: DAE4-1245_May22

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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	16062	16768
Channel Z	16035	15968

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	-2.81	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 (ΩOff)	Measuring (ΩChn)
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

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3 EX3DV4 - SN 7767

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S Servizio svizzero di taratura
S Swiss Calibration Service

Accreditation No: SCS 0108

Client: SGS-CN (Auden)

Certificate No: EX-7767_Oct22

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:7767

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

Calibration date: October 28, 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 (DATE critical for calibration)

Primary Standards	ID	Cal. Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-22 (No. 217-03528-03524)	Apr-23
Power sensor NRP-251	SN: 103944	04-Apr-22 (No. 217-03524)	Apr-23
DCP DAK-3.1 (Impedance)	SN: 1545	25-Oct-22 (DCP DAK3-1016, Oct22)	Oct-23
DCP DAK-12	SN: 1014	25-Oct-22 (DCP DAK3-1016, Oct22)	Oct-23
Reference 30 dB Attenuator	SN: C25582 (20c)	04-Apr-22 (No. 217-03527)	Apr-23
DAE4	SN: 961	15-Oct-22 (No. DAE4-880 Oct22)	Oct-23
Reference Probe E3302	SN: 3013	27-Oct-22 (No. E33-3013, Oct22)	Oct-23

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4118B	SN: GB41268474	05-Apr-16 (in house check Jun-20)	In house check Jun-24
Power sensor E4118A	SN: SN-141498687	05-Apr-16 (in house check Jun-20)	In house check Jun-24
Power sensor E4415A	SN: 100511210	05-Apr-16 (in house check Jun-20)	In house check Jun-24
RF generator HP 8540C	SN: US840101705	04-Apr-09 (in house check Jun-20)	In house check Jun-24
Network Analyzer F855A	SN: E411849477	27-May-14 (in house check Oct-20)	In house check Oct-24

Calibrated by	Name	Function	Signature
	Aldona Georgiadou	Laboratory Technician	
Approved by	Ewen Kohn	Technical Manager	

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

Certificate No: EX-7767_Oct22

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C Service suisse d'étalonnage
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S Swiss Calibration Service

Accreditation No: SCS 0108

Glossary

TSL	Issue simulating liquid
NORMA _{xyz}	sensitivity in free space
Conf _F	sensitivity in TSL, NORMA _{xyz}
DCP	diode compression point
CP	crest factor (1/3 duty cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization θ	θ rotation around probe axis
Polarization φ	φ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., φ = 0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
- b) IEC 60958, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORMA_{xyz}: Assessed for E-field polarization θ = 0 (f < 800 MHz in TEM-cell; f = 1800 MHz: R22 waveguide). NORMA_{xyz} are only intermediate values, i.e., the uncertainties of NORMA_{xyz} does not affect the E-field uncertainty made TSL (see below Conf_F).
- NORMA_{xyz} = NORMA_{xyz} * 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 Conf_F.
- DCP_{xyz}: 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_{xyz}, B_{xyz}, C_{xyz}, D_{xyz}, V_{RF,xyz}: 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, V_{RF} is the maximum calibration range expressed in RMS voltage across the diode.
- Conf_F 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 in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMA_{xyz} * Conf_F whereby the uncertainty corresponds to that given for Conf_F. A frequency dependent Conf_F is used in DASY version 4.4 and higher which allows extending the validity from < 50 MHz to > 100 MHz.
- Spherical anisotropy (3D 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 NORMA (no uncertainty required).

Certificate No: EX-7767_Oct22

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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 (µV/m/m²) A	0.87	0.89	0.56	±10.1%
DCP (mV) B	103.4	107.3	105.7	±4.7%

Calibration Results for Modulation Response

URS	Communication System Name	A dB	B dB/µV	C	D dB	VR mV	Max dec.	Max Unc ² k=2
0	CW	X 0.00 Y 0.00 Z 0.00	0.00 0.00 0.00	1.00 1.00 1.00	0.00 184.7 179.3	±3.5% ±4.7%		

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%.

¹ The uncertainties of Norm X,Y,Z do not affect the E₁-field uncertainty inside T85 (see Page 5).
² Uncertainty parameter uncertainty for maximum specified field strength.
³ Uncertainty is determined using the min. deviation from three responses applying rectangular distribution and is expressed for the square of the field value.

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EX3DV4 - SN:7767
October 28, 2022
Parameters of Probe: EX3DV4 - SN:7767
Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	144.8°
Mechanical Surface Detection Mode	angled
Optical Surface Detection Mode	displaced
Probe Overall Length	337 mm
Probe Body Diameter	16 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

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EX3DV4 - SN:7767
October 28, 2022
Parameters of Probe: EX3DV4 - SN:7767
Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity ³ (S/m)	CompF X	CompF Y	CompF Z	Alpha ⁴	Depth ⁵ (mm)	Unc (k = 2)
150	52.3	0.79	14.08	14.08	14.08	0.00	1.00	±13.2%
450	43.5	0.87	11.50	11.50	11.50	0.16	1.20	±13.3%
750	41.9	0.89	10.26	10.26	10.26	0.55	0.80	±12.0%
835	41.5	0.90	10.00	10.00	10.00	0.43	0.80	±12.0%
1750	40.1	1.37	9.32	9.32	9.32	0.36	0.86	±12.0%
1900	40.0	1.40	8.91	8.91	8.91	0.33	0.86	±12.0%
2100	39.8	1.49	8.60	8.60	8.60	0.30	0.86	±12.0%
2200	39.5	1.67	8.44	8.44	8.44	0.33	0.90	±12.0%
2450	39.2	1.80	8.24	8.24	8.24	0.32	0.90	±12.0%
2600	39.0	1.96	7.99	7.99	7.99	0.27	0.90	±12.0%
3000	38.2	2.71	7.55	7.55	7.55	0.30	1.25	±13.1%
3600	37.9	2.91	7.45	7.45	7.45	0.30	1.35	±13.1%
3700	37.7	3.12	7.20	7.20	7.20	0.30	1.35	±13.1%
3900	37.5	3.32	6.84	6.84	6.84	0.40	1.69	±13.1%
4100	37.2	3.53	6.63	6.63	6.63	0.40	1.80	±13.1%
4200	37.1	3.65	6.39	6.39	6.39	0.40	1.70	±13.1%
4400	36.9	3.84	6.17	6.17	6.17	0.40	1.70	±13.1%
4600	36.7	4.04	6.15	6.15	6.15	0.40	1.70	±13.1%
4800	36.4	4.26	6.13	6.13	6.13	0.45	1.90	±13.1%
4900	36.3	4.40	6.07	6.07	6.07	0.40	1.80	±13.1%
5200	36.0	4.66	5.65	5.65	5.65	0.40	1.80	±13.1%
5300	35.9	4.76	5.48	5.48	5.48	0.40	1.80	±13.1%
5500	35.6	4.96	5.30	5.30	5.30	0.40	1.80	±13.1%
5900	35.5	5.07	5.14	5.14	5.14	0.40	1.80	±13.1%
5900	35.3	5.27	5.10	5.10	5.10	0.40	1.80	±13.1%

¹ Frequency validity above 300 MHz at ±100 MHz only applies for CDP v4.4 and higher (see Page 5), while it is relevant to ±50 MHz. The uncertainty is the 95% of the CompF parameter at calibration frequency and the uncertainty for the relative permittivity and conductivity validity below 300 MHz is ±15, 25, 40, 50 and 70% for CompF measurements at 30, 40, 100, 150 and 200 MHz respectively. Validity of CompF assessed at 6 MHz to 4.0 GHz, and CompF assessed at 15 MHz to 0.1 MHz. Above 0.5 MHz the validity of CompF can be determined by the formula.

² As frequencies below 3 GHz, the validity of tissue parameters (α and/or σ) can be related to a 10% liquid composition formula is applied to measure S10 values. At frequencies above 3 GHz, the validity of tissue parameters (α and/or σ) is related to a 10% uncertainty in the 95% of the CompF uncertainty for incident target tissue parameters.

³ Alpha/Gamma are determined during calibration. SRFAD warns that the remaining deviation due to the uncertainty when after composition is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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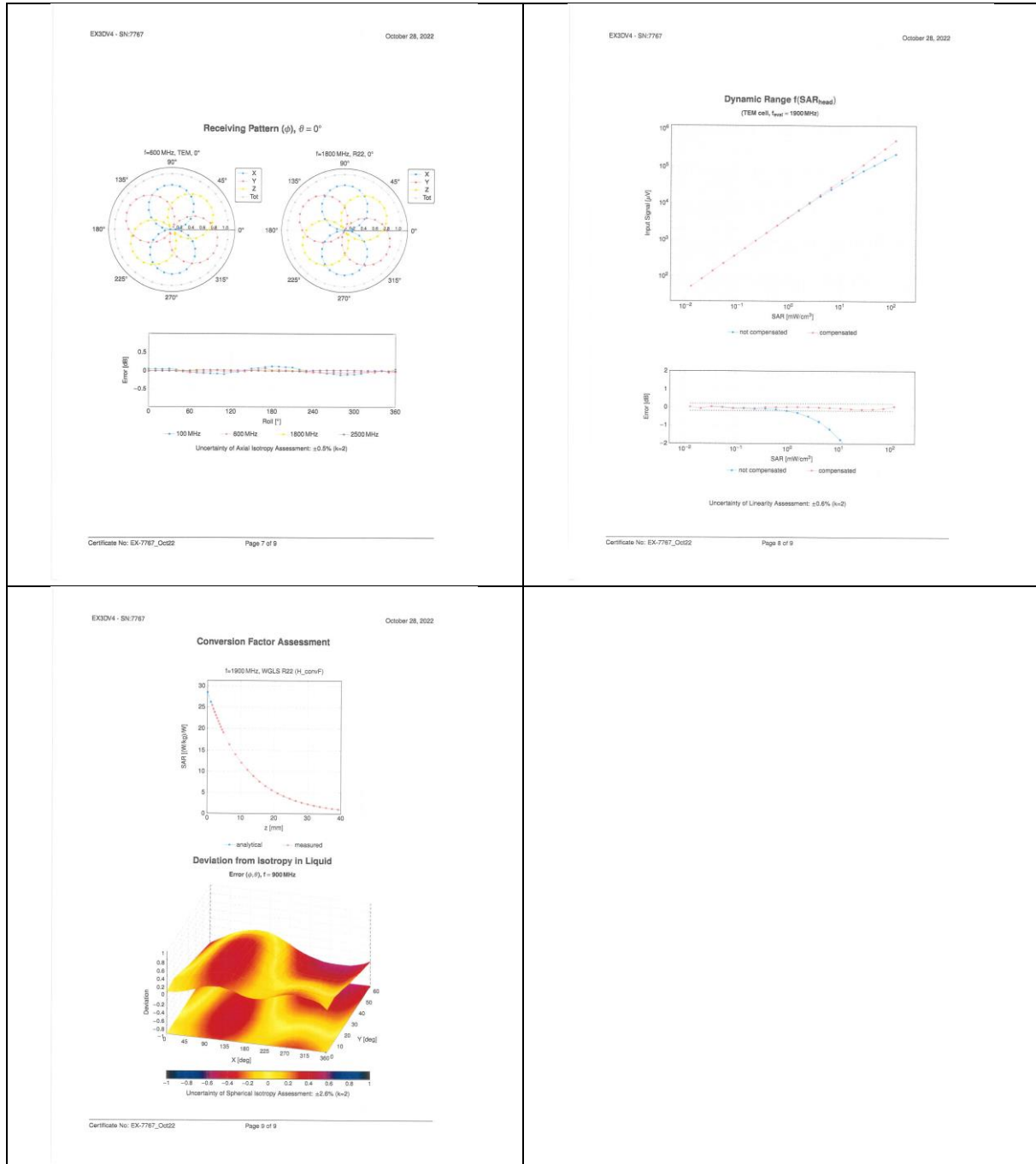
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EX3DV4 - SN:7767
October 28, 2022
Frequency Response of E-Field
(TEM-Cell:01110 EXX, Waveguide:R22)

Uncertainty of Frequency Response of E-Field: ±5.3% (k=2)

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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	/
Dipole D450V3 SN 1103				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2021/4/21	-23	/	57.1	/



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