

## Appendix C for KSCR221100235501

## 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 checked="" type="checkbox"/>	4	D835V2	4d114	2022/03/31	2025/03/30
	<input type="checkbox"/>	5	D900V2	1d079	2022/06/07	2025/06/06
	<input checked="" type="checkbox"/>	6	D1800V2	2d170	2022/03/31	2025/03/30
	<input checked="" 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 checked="" 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



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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	
<b>CALIBRATION CERTIFICATE</b>			
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 require 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 (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 10476	09-Apr-21 (No. 217-0301/0320)	Apr-22
Power sensor NRP Z91	SN: 10344	09-Apr-21 (No. 217-0301)	Apr-22
Power sensor NRP Z91	SN: 10345	09-Apr-21 (No. 217-0302)	Apr-22
Reference 20 dB Attenuator	SN: C23862 (200)	09-Apr-21 (No. 217-0334)	Apr-22
Type-N mismatch combination	SN: 310907 / 0007	09-Apr-21 (No. 217-0334)	Apr-22
Reference Probe EXENNA	SN: 3877	30-Dec-20 (No. EX3-0877_Dec20)	Dec-21
EXENNA	SN: 664	26-Jan-20 (No. EXENNA-664_Jan20)	Jan-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter S44185	SN: G8412002/4	09-Apr-16 (in house check Jun-20)	In house check: Jun-20
Power sensor E4113A	SN: MY4148007	09-Apr-16 (in house check Jun-20)	In house check: Jun-20
Power sensor E4113A	SN: 000110210	09-Apr-16 (in house check Jun-20)	In house check: Jun-20
RF generator HP 8440D	SN: US44401710	04-Aug-09 (in house check Jun-20)	In house check: Jun-20
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 ± 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: 62.3
Head TSL temperature change during test	Conductivity: 0.75 mho/m
	(22.0 ± 0.2) °C
	51.1 ± 6 %
	0.75 mho/m ± 6 %
	< 0.5 °C

SAR result with Head TSL	
SAR averaged over 1 cm³ (1 g) of Head TSL	Condition
SAR measured	1 W input power
SAR for nominal Head TSL parameters	3.90 W/kg
	normalized to 1W
	3.88 W/kg ± 19.4 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	condition
SAR measured	1 W input power
SAR for nominal Head TSL parameters	2.60 W/kg
	normalized to 1W
	2.59 W/kg ± 18.0 % (k=2)

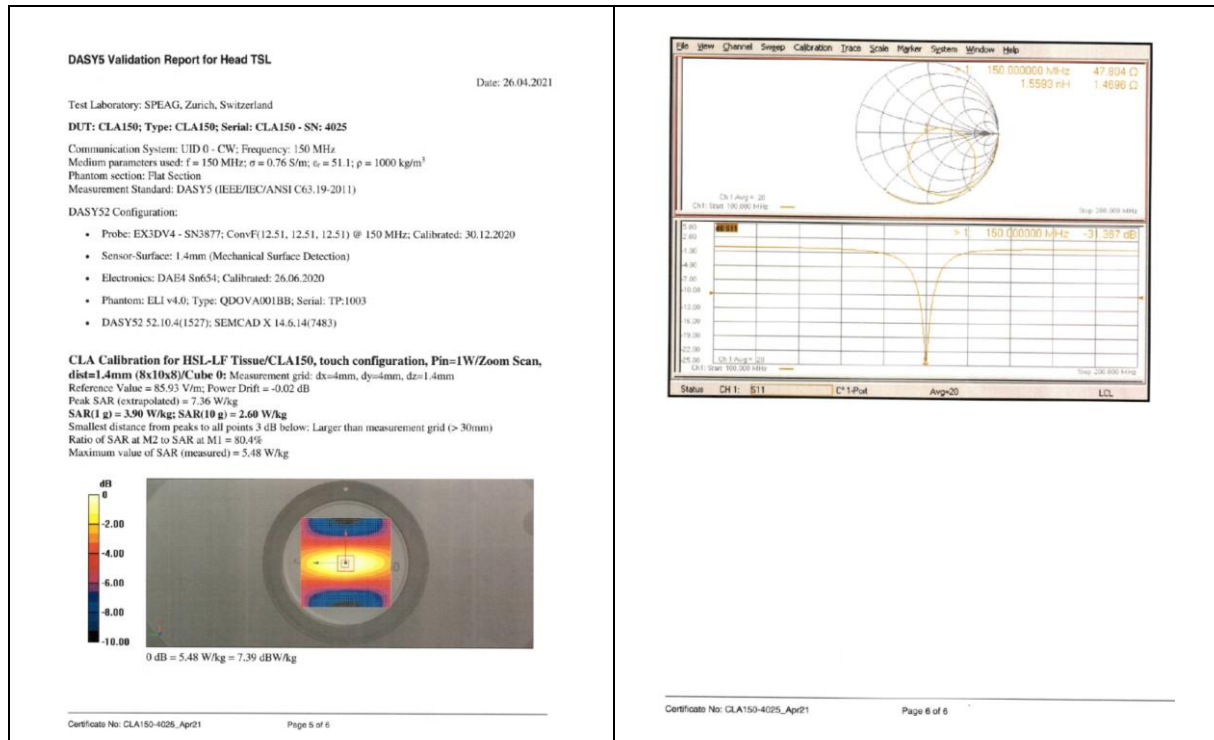
Appendix (Additional assessments outside the scope of SCS 0108)	
Antenna Parameters with Head TSL	
Impedance, transformed to feed point	47.9 Ω ± 1.5 Ω
Return Loss	-31.4 dB
Additional EUT Data	
Manufactured by	SPEAG

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Antenna Parameters with Head TSL	
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Return Loss	-31.4 dB
Additional EUT Data	
Manufactured by	SPEAG



## 1.2 D450V3 - SN 1103

**Calibration Laboratory of Schmid & Partner Engineering AG**  
Zugstrasse 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. 217-03201/03202)	Apr-22
Power sensor MHP-291	SN: 102344	09-Apr-21 (No. 217-03201)	Apr-22
Power sensor MHP-291	SN: 102345	09-Apr-21 (No. 217-03202)	Apr-22
Reference 20 dB Attenuator	SN: CG252 (200)	09-Apr-21 (No. 217-03345)	Apr-22
Type-N mismatch contribution	SN: 310827 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe E30309	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 E44198	SN: GB41200274 06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4412A	SN: MY41496047 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-19 (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

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Zugstrasse 43, 8004 Zurich, Switzerland

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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:**

- IEC 61010-1:2010, "Safety requirements for low voltage electrical equipment", July 2010
- 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%.

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# Measurement Conditions

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

DASY Version	DASY5	V62.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	$d_x, d_y, d_z = 5$ 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 %	0.57 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	4.55 W/kg ± 18.1 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (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)

# 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
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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 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
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## 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/m<sup>3</sup>

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: ELI 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:  $d_x=5$ mm,  $d_y=5$ mm,  $d_z=5$ mm

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

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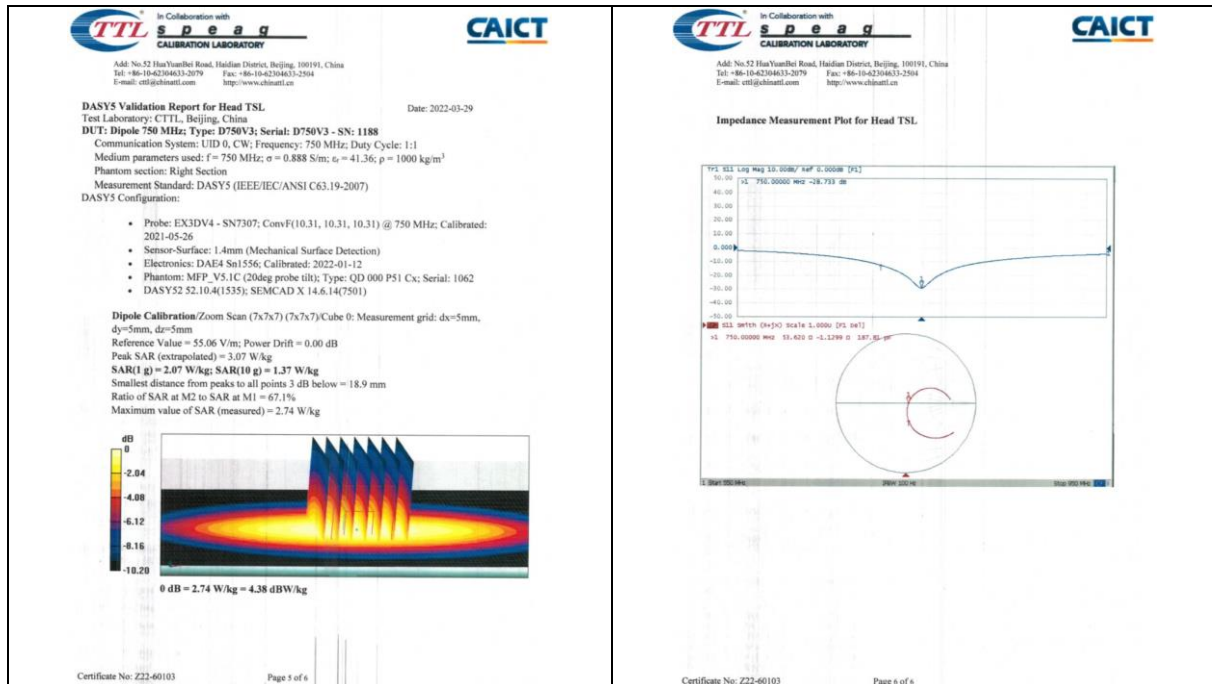
## 1.3 D750V3 - SN 1188

TTL Speag CALIBRATION LABORATORY		CAICT																																	
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504 E-mail: csl@chinaetl.com http://www.chinaetl.cn		Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2079 Fax: +86-10-42304633-2504 E-mail: csl@chinaetl.com http://www.chinaetl.cn																																	
Client: <b>SGS-CN</b>		Certificate No: <b>Z22-60103</b>																																	
<b>CALIBRATION CERTIFICATE</b>																																			
Object: <b>D750V3 - SN: 1188</b>																																			
Calibration Procedure(s): <b>FF-Z11-003-01</b> Calibration Procedures for dipole validation kits																																			
Calibration date: <b>March 28, 2022</b>																																			
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Reviewed by: <b>Lin Hao</b> SAR Test Engineer																																			
Approved by: <b>Qi Dianyan</b> SAR Project Leader																																			
Issued: April 3, 2022																																			
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<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>&lt;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	---	---																					
<b>SAR result with Head TSL</b>																								
<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 cm² (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 cm² (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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Certificate No: Z22-60103		Page 3 of 6																						

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<b>Glossary:</b>			
TSL	tissue simulating liquid		
ConvF	sensitivity in TSL / NORMx.y.z		
N/A	not applicable or not measured		
<b>Calibration is Performed According to the Following Standards:</b>			
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"			
<b>Additional Documentation:</b>			
c) DASY4/5 System Handbook			
<b>Methods Applied and Interpretation of Parameters:</b>			
• <b>Measurement Conditions:</b> 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.			
• <b>Antenna Parameters with TSL:</b> 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.			
• <b>Feed Point Impedance and Return Loss:</b> 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.			
• <b>Electrical Delay:</b> One-way delay between the SMA connector and the antenna feed point. No uncertainty required.			
• <b>SAR measured:</b> SAR measured at the stated antenna input power.			
• <b>SAR normalized:</b> SAR as measured, normalized to an input power of 1 W at the antenna connector.			
• <b>SAR for nominal TSL parameters:</b> 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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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>							
<b>Antenna Parameters with Head TSL</b>							
<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						
<b>General Antenna Parameters and Design</b>							
<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.							
<b>Additional EUT Data</b>							
<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: **Zhao Jing** SAR Test Engineer

Reviewed by: **Lin Hao** SAR Test Engineer

Approved by: **Qi Diqian** SAR Project Leader

Issued: April 6, 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) DASY4/5 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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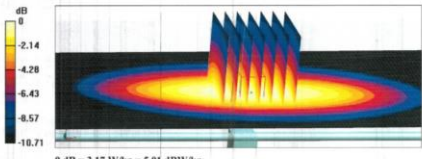
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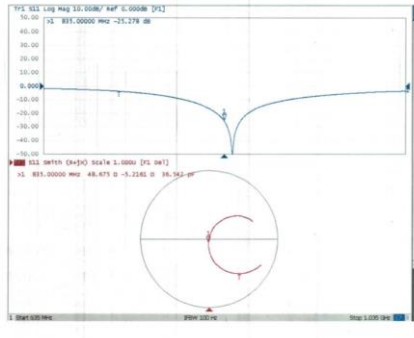
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<b>Measurement Conditions</b> DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	VS2 10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	835 MHz $\pm$ 1 MHz		
<b>Head TSL parameters</b> 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	---	---
<b>SAR result with Head TSL</b>			
SAR averaged over 1 cm <sup>3</sup> (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 $\pm$ 18.8 % (k=2)	
SAR averaged over 10 cm <sup>3</sup> (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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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>			
<b>Antenna Parameters with Head TSL</b>			
Impedance, transformed to feed point	48.70 - j22jQ		
Return Loss	-25.3dB		
<b>General Antenna Parameters and Design</b>			
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.			
<b>Additional EUT Data</b>			
Manufactured by	SPEAG		
Certificate No: Z22-60104 Page 4 of 6			

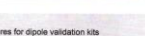
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<b>DASY5 Validation Report for Head TSL</b> Test Laboratory: CTTL, Beijing, China Date: 2022-03-31			
DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 40114 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; $\sigma$ = 0.907 S/m; $\epsilon_r$ = 40.98; $\rho$ = 1000 kg/m <sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:			
<ul style="list-style-type: none"><li>Probe: EX3DV4 - SN7307; ConvF(10.13, 10.13, 10.13) @ 835 MHz; Calibrated: 2021-05-26</li><li>Sensor Surface: 1.4mm (Mechanical Surface Detection)</li><li>Electronics: DAE4 Sn1556; Calibrated: 2022-01-12</li><li>Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062</li><li>DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)</li></ul>			
Dipole Calibration/Zoom Scan (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			
			
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<b>Impedance Measurement Plot for Head TSL</b>			
			
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### 1.5 D900V2 - SN 1d079



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E-mail: cti@china.ttl.com.cn

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 (MATE 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 NRP85	104291	24-Sep-21 (CTTL No.J21X06326)	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 Z22-60007)	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 Diqian** 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 (MATE 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
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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 Diqian** 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 (MATE 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
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Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110673		

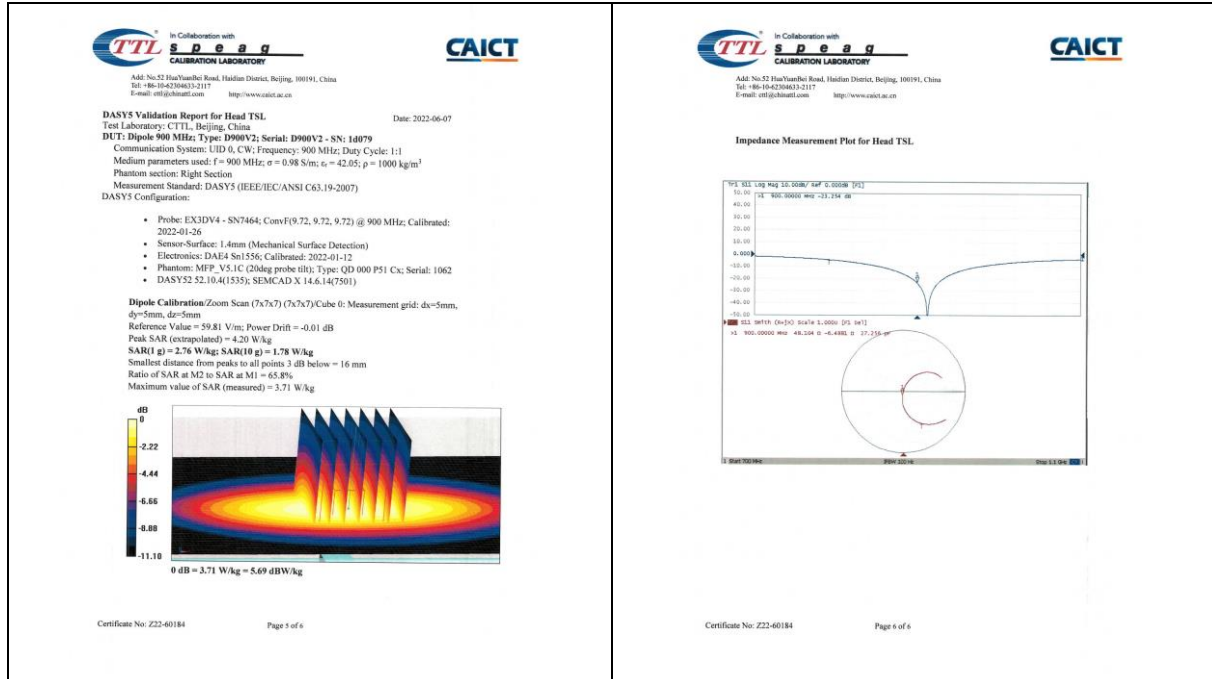


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## 1.6 D1800V2 - SN 2d170

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

Add: No.52 HuaYuanbei Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-42304633-2117  
E-mail: cti@china.ttl.com http://www.china.ttl.com

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.J22X00406)	Jan-23
Network Analyzer E5071C	MY46110573	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 Diqian** SAR Project Leader

Issued: April 6, 2022

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Certificate No: Z22-60105 Page 1 of 6

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

**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"

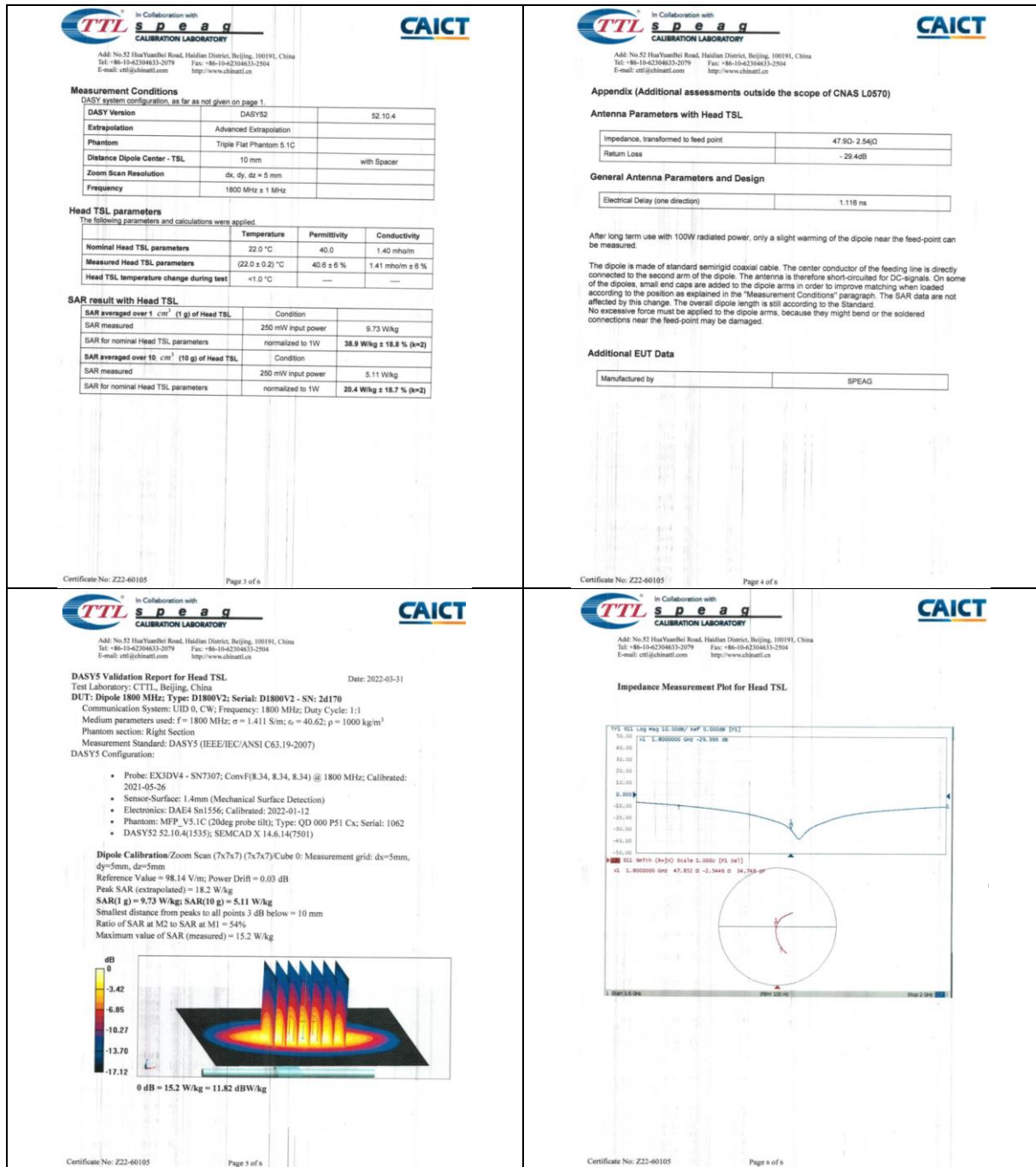
**Additional Documentation:**  
c) DASY4/5 System Handbook

**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.
- No uncertainty required.
- SAR measured: 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



## 1.7 D1900V2 - SN 5d136

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Client: SGS-CN Certificate No: Z22-60185			
<b>CALIBRATION CERTIFICATE</b>			
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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<b>Glossary:</b>			
TSL	tissue simulating liquid		
ConF	sensitivity in TSL / NORMx.y.z		
N/A	not applicable or not measured		
<b>Calibration is Performed According to the Following Standards:</b>			
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 865984, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
<b>Additional Documentation:</b>			
c) DASY4/5 System Handbook			
<b>Methods Applied and Interpretation of Parameters:</b>			
• <b>Measurement Conditions:</b> 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.			
• <b>Antenna Parameters with TSL:</b> 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.			
• <b>Feed Point Impedance and Return Loss:</b> 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.			
• <b>Electrical Delay:</b> One-way delay between the SMA connector and the antenna feed point. No uncertainty required.			
• <b>SAR measured:</b> SAR measured at the stated antenna input power.			
• <b>SAR normalized:</b> SAR as measured, normalized to an input power of 1 W at the antenna connector.			
• <b>SAR for nominal TSL parameters:</b> 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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<b>Measurement Conditions</b>			
DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	1900 MHz ± 1 MHz		
<b>Head TSL parameters</b>			
The following parameters and calculations were applied:			
Nominal Head TSL parameters	Temperature	Permittivity	Conductivity
	32.0 °C	40.0	1.40 mS/m
Measured Head TSL parameters	(22.0 ± 0.3) °C	39.9 ± 6 %	1.39 mS/m ± 6 %
Head TSL temperature change during test	<+1.0 °C	---	---
<b>SAR result with Head TSL</b>			
SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	9.66 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 16.8 % (k=2)	
SAR averaged over 10 cm <sup>2</sup> (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)	
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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>			
<b>Antenna Parameters with Head TSL</b>			
Impedance, transformed to feed point	51.02 ± 7.56 Ω		
Return Loss	-22.4 dB		
<b>General Antenna Parameters and Design</b>			
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.			
<b>Additional EUT Data</b>			
Manufactured by	SPEAG		
Certificate No: Z22-60185		Page 4 of 6	

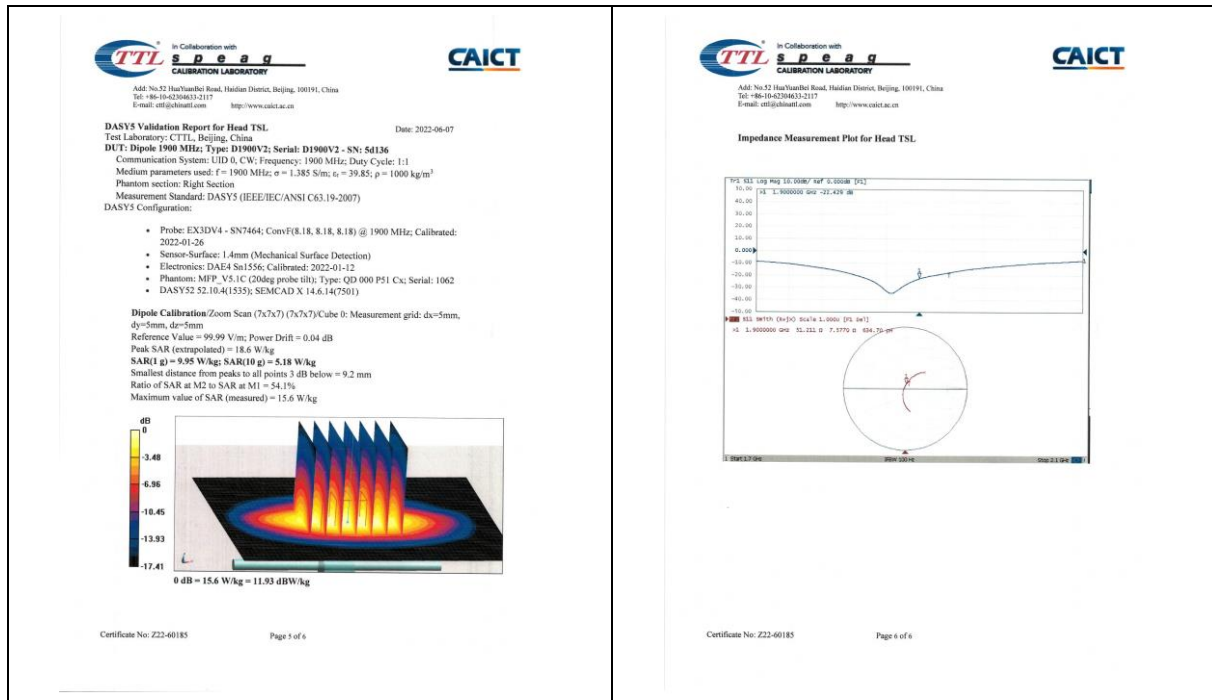


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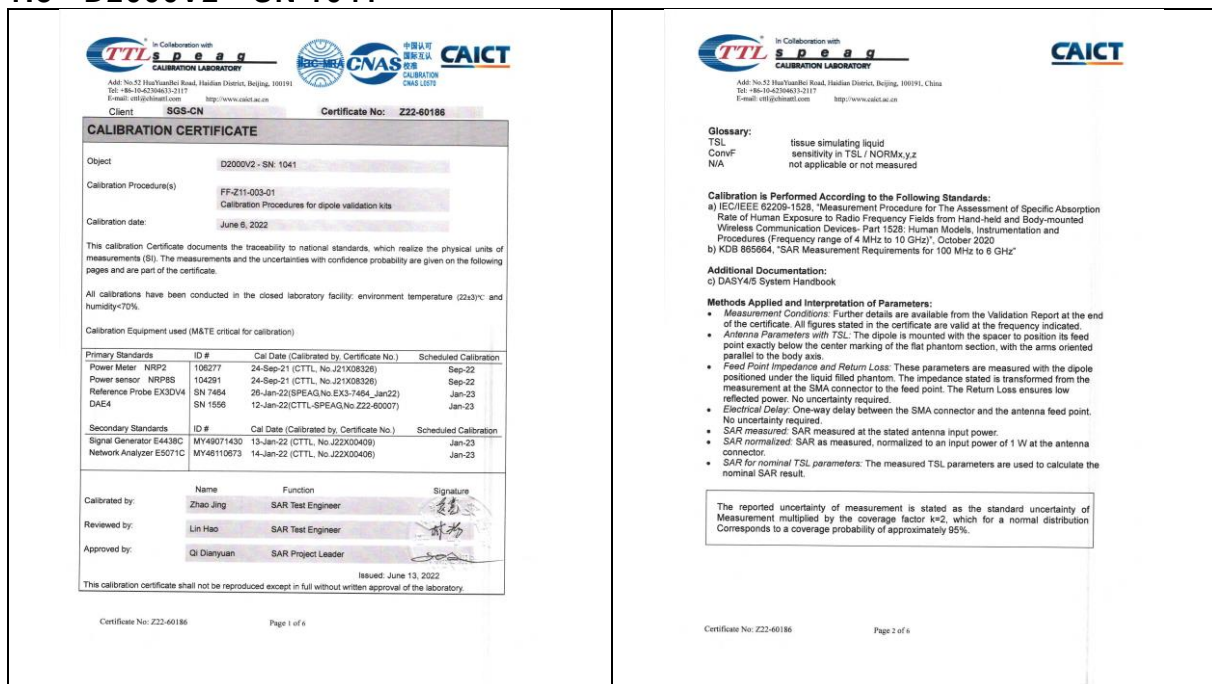
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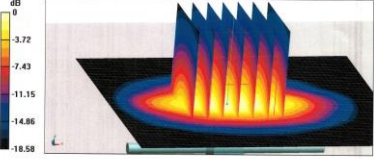


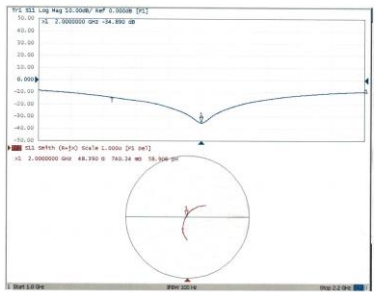
## 1.8 D2000V2 - SN 1041



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<b>Measurement Conditions</b> DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom S.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2000 MHz ± 1 MHz		
<b>Head TSL parameters</b> 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 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
<b>SAR result with Head TSL</b>			
SAR averaged over 1 cm <sup>3</sup> (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 <sup>3</sup> (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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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>			
<b>Antenna Parameters with Head TSL</b>			
Impedance, transformed to feed point	48.4Ω ± 0.74Ω		
Return Loss	-34.9dB		
<b>General Antenna Parameters and Design</b>			
Electrical Delay (one direction)	1.088 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.			
<b>Additional EUT Data</b>			
Manufactured by	SPEAG		
Certificate No: Z22-60186 Page 4 of 6			

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<b>DASY5 Validation Report for Head TSL</b> Test Laboratory: CTTL, Beijing, China DUT: Dipole 2000 MHz; Type: D2000V2; Serial: D2000V2 - SN: 1041 Communication System: UTD 0, CW; Frequency: 2000 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2000 MHz; σ = 1.392 S/m; ε <sub>r</sub> = 40.21; ρ = 1000 kg/m <sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration: <ul style="list-style-type: none"><li>Probe: EX3DV4 - SN7464; ConvF(R,2, 8.2, 8.2) @ 2000 MHz; Calibrated: 2022-01-26</li><li>Sensor-Surface: 1.4mm (Mechanical Surface Detection)</li><li>Electronics: DA64 Sn1556; Calibrated: 2022-01-12</li><li>Phantom: MPP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062</li><li>DASY52: 52.10.4(1555); SEMCAD X 14.6(147501)</li></ul>			
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			
			
0 dB = 16.3 W/kg = 12.12 dBW/kg			
Certificate No: Z22-60186 Page 5 of 6			

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<b>Impedance Measurement Plot for Head TSL</b>			
			
Certificate No: Z22-60186 Page 6 of 6			

## 1.9 D2300V2 - SN 1096

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Client	SGS-CN	Certificate No.	Z22-60106
<b>CALIBRATION CERTIFICATE</b>			
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 Dianyan	SAR Project Leader	
Issued: April 6, 2022			
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<b>Measurement Conditions</b> 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		
<b>Head TSL parameters</b> 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	---	
<b>SAR result with Head TSL</b>			
SAR averaged over 1 cm <sup>2</sup> (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 <sup>2</sup> (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)	

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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>			
<b>Antenna Parameters with Head TSL</b>			
Impedance, transformed to feed point	49.20 - 4.56jΩ		
Return Loss	- 26.6dB		
<b>General Antenna Parameters and Design</b>			
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 OC-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.			
<b>Additional EUT Data</b>			
Manufactured by	SPEAG		

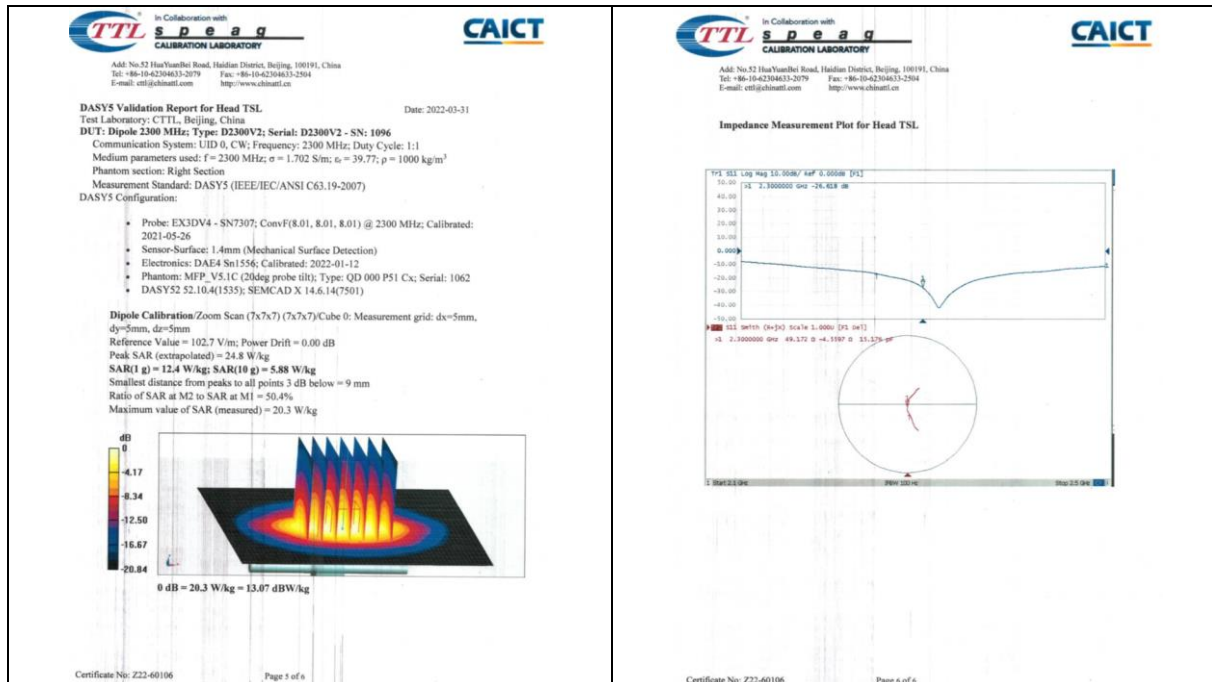


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## 1.10 D2450V2 - SN 817

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CALIBRATION LABORATORY

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Tel: +86-10-62504633-2079 Fax: +86-10-62504633-2504  
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-Q1**  
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	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	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	MY46110873	14-Jan-22 (CTTL No.J22X00409)	Jan-23

Calibrated by: **Zhao Jing** SAR Test Engineer Signature:

Reviewed by: **Lin Hao** SAR Test Engineer Signature:

Approved by: **Qi Dianyan** SAR Project Leader Signature:

Issued: April 6, 2022

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Certificate No: Z22-60107 Page 1 of 6

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

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 586564, "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%.

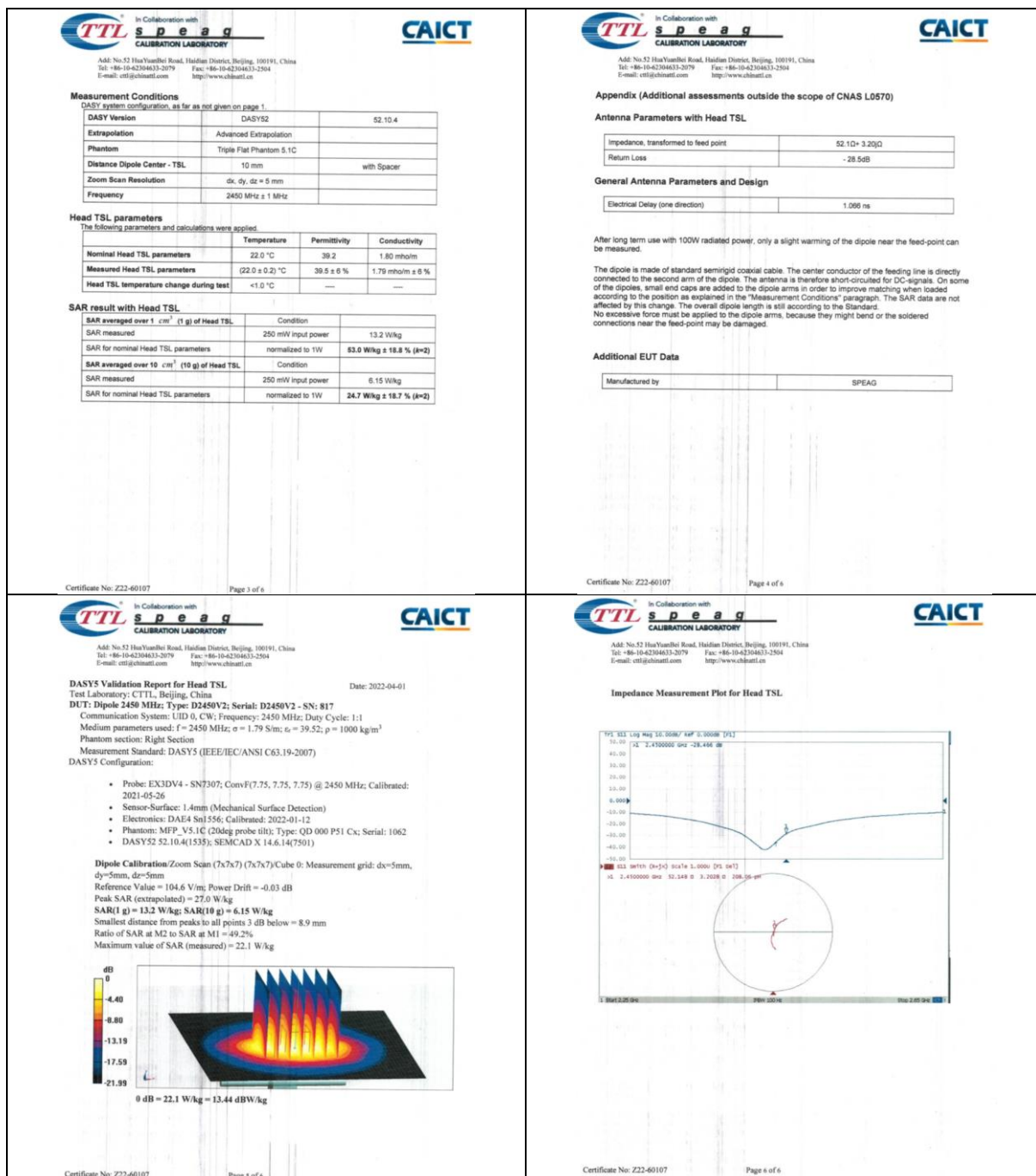
Certificate No: Z22-60107 Page 2 of 6



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## 1.11 D2600V2 - SN 1158

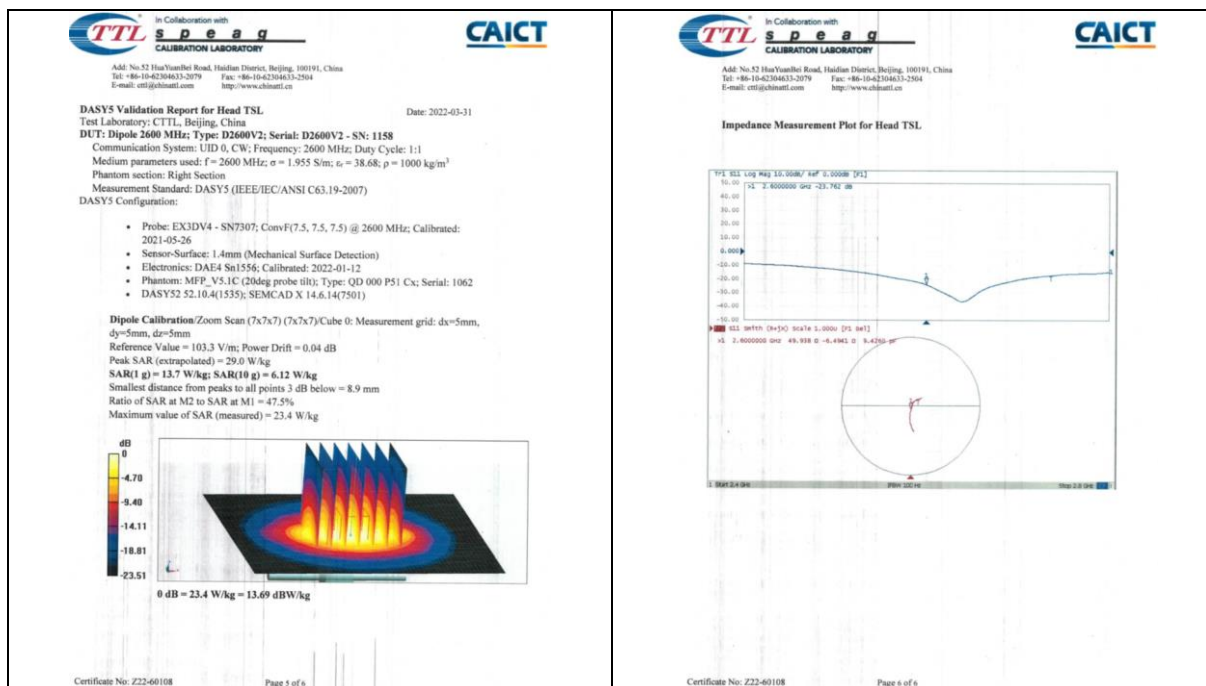
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Client: <b>SGS-CN</b>		Certificate No: <b>Z22-40108</b>																					
<b>CALIBRATION CERTIFICATE</b>																							
Object: <b>D2600V2 - SN: 1158</b>																							
Calibration Procedure(s): <b>FF-Z11-003-01</b> Calibration Procedures for dipole validation kits																							
Calibration date: <b>March 31, 2022</b>																							
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)																							
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Reviewed by: <b>Lin Hao</b> SAR Test Engineer																							
Approved by: <b>Qi Diaryuan</b> SAR Project Leader																							
Issued: April 6, 2022																							
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<b>Measurement Conditions</b> DASY system configuration, as far as not given on page 1:																								
<table border="1"><thead><tr><th>DASY Version</th><th>DASYV2</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>2600 MHz ± 1 MHz</td><td></td></tr></tbody></table>				DASY Version	DASYV2	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	2600 MHz ± 1 MHz				
DASY Version	DASYV2	52.10.4																						
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Frequency	2600 MHz ± 1 MHz																							
<b>Head TSL parameters</b> 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>39.0</td><td>1.96 mho/m</td></tr><tr><td>Measured Head TSL parameters</td><td>(22.0 ± 0.2) °C</td><td>38.7 ± 6 %</td><td>1.96 mho/m ± 6 %</td></tr><tr><td>Head TSL temperature change during test</td><td>&lt;1.0 °C</td><td>---</td><td>---</td></tr></tbody></table>					Temperature	Permittivity	Conductivity	Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 6 %	1.96 mho/m ± 6 %	Head TSL temperature change during test	<1.0 °C	---	---					
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<b>SAR result with Head TSL</b>																								
<table border="1"><thead><tr><th></th><th>Condition</th><th></th></tr></thead><tbody><tr><td>SAR averaged over 1 cm<sup>2</sup> (1 g) of Head TSL</td><td></td><td></td></tr><tr><td>SAR measured</td><td>250 mW input power</td><td>13.7 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>54.8 W/kg ± 18.8 % (k=2)</td></tr><tr><td>SAR averaged over 10 cm<sup>2</sup> (10 g) of Head TSL</td><td></td><td></td></tr><tr><td>SAR measured</td><td>250 mW input power</td><td>6.12 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>24.6 W/kg ± 18.7 % (k=2)</td></tr></tbody></table>					Condition		SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL			SAR measured	250 mW input power	13.7 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	54.8 W/kg ± 18.8 % (k=2)	SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL			SAR measured	250 mW input power	6.12 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg ± 18.7 % (k=2)
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SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg ± 18.7 % (k=2)																						
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<b>Glossary:</b> TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx.y.z N/A: not applicable or not measured			
<b>Calibration is Performed According to the Following Standards:</b> 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"			
<b>Additional Documentation:</b> c) DASY4/S System Handbook			
<b>Methods Applied and Interpretation of Parameters:</b> • 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: Z22-40108		Page 2 of 6	

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<b>Appendix (Additional assessments outside the scope of CNAS L0570)</b>							
<b>Antenna Parameters with Head TSL</b>							
<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						
<b>General Antenna Parameters and Design</b>							
<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.							
<b>Additional EUT Data</b>							
<table border="1"><thead><tr><th>Manufactured by</th><th>SPEAG</th></tr></thead></table>				Manufactured by	SPEAG		
Manufactured by	SPEAG						
Certificate No: Z22-40108		Page 4 of 6					





## 1.12 D5GHzV2 - SN 1095

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

**CAICT**

**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	MY49071430	13-Jan-22 (CTTL No.J22000409)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL No.J22000406)	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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**CAICT**

**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.
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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

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

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 = 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 <sup>2</sup> (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	77.6 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm <sup>2</sup> (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 <sup>2</sup> (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 <sup>2</sup> (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.6 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	35.8	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 <sup>2</sup> (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 <sup>2</sup> (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	35.5	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 <sup>2</sup> (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 <sup>2</sup> (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 <sup>2</sup> (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 <sup>2</sup> (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)

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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	48.1D-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

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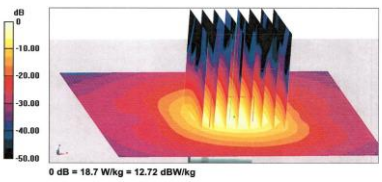
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<b>General Antenna Parameters and Design</b>			
Electrical Delay (one direction)	1.101 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid 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.			
<b>Additional EUT Data</b>			
Manufactured by	SPEAQ		
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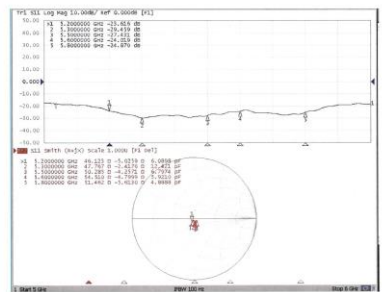
  

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<b>DASY5 Validation Report for Head TSL</b>			
Test Laboratory: CTTL, Beijing, China Date: 2022-06-01			
<b>DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095</b>			
Communication System: CW; Frequency: 5200 MHz; Frequency: 5300 MHz; Frequency: 5500 MHz; Frequency: 5600 MHz; Frequency: 5800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5200 MHz; $\sigma$ = 4.62 S/m; $\epsilon$ = 35.39; $\rho$ = 1000 kg/m <sup>3</sup> Medium parameters used: f = 5300 MHz; $\sigma$ = 4.73 S/m; $\epsilon$ = 35.19; $\rho$ = 1000 kg/m <sup>3</sup> Medium parameters used: f = 5500 MHz; $\sigma$ = 4.939 S/m; $\epsilon$ = 34.83; $\rho$ = 1000 kg/m <sup>3</sup> Medium parameters used: f = 5600 MHz; $\sigma$ = 5.051 S/m; $\epsilon$ = 34.69; $\rho$ = 1000 kg/m <sup>3</sup> Medium parameters used: f = 5800 MHz; $\sigma$ = 5.247 S/m; $\epsilon$ = 34.42; $\rho$ = 1000 kg/m <sup>3</sup> Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:			
<ul style="list-style-type: none"><li>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</li><li>Sensor-Surface: 1.4mm (Mechanical Surface Detection)</li><li>Electronics: DA64 Sn1556; Calibrated: 2022-01-12</li><li>Phantom: MPF_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062</li><li>DASY52 52.10.4(1535); SEMCAD X 14.6.1(7501)</li></ul>			
<b>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</b> 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			
<b>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</b> 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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<b>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</b> 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			
<b>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</b> 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			
<b>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</b> 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			
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<b>Impedance Measurement Plot for Head TSL</b>			
			
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## 2 DAE4 - SN 1245

<p>Schmid &amp; Partner Engineering AG Zugstrasse 10, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9770 www.spsg.ch, info@spg.ch</p> <p><b>s p e a g</b></p> <p><b>IMPORTANT NOTICE</b></p> <p><b>USAGE OF THE DAE4</b></p> <p>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:</p> <p><b>Battery Exchange:</b> 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.</p> <p><b>Shipping of the DAE:</b> 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><b>E-stop Failures:</b> 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.</p> <p><b>Repair:</b> 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><b>DASY Configuration Files:</b> 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.</p> <p><b>Important Note:</b> Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.</p> <p><b>Important Note:</b> 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><b>Important Note:</b> 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>TN_EH100306AE DAE4.docx 07.03.2019</p>	<p>Calibration Laboratory of Schmid &amp; Partner Engineering AG Zugstrasse 10, 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: <b>SGS-CN (Auden)</b> Certificate No.: <b>DAE4-1245_May22</b></p> <p><b>CALIBRATION CERTIFICATE</b></p> <p>Object: <b>DAE4 - SD 000 D04 BM - SN: 1245</b></p> <p>Calibration procedure(s): <b>QA CAL-06 v30</b> Calibration procedure for the data acquisition electronics (DAE)</p> <p>Calibration date: <b>May 30, 2022</b></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 &lt; 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>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> <p>Calibrated by: <b>Dominique Stettin</b> Function: <b>Laboratory Technician</b> Signature: <i>[Signature]</i></p> <p>Approved by: <b>Ben Kohn</b> Technical Manager Signature: <i>[Signature]</i></p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: May 30, 2022</p> <p>Certificate No: DAE4-1245_May22 Page 1 of 5</p>	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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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																		
<p>Calibration Laboratory of Schmid &amp; Partner Engineering AG Zugstrasse 10, 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><b>Glossary</b> DAE: data acquisition electronics Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system.</p> <p><b>Methods Applied and Interpretation of Parameters</b></p> <ul style="list-style-type: none"><li>• <b>DC Voltage Measurement:</b> 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.</li><li>• <b>Connector angle:</b> The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.</li><li>• The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.</li><li>• <b>DC Voltage Measurement Linearity:</b> Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.</li><li>• <b>Common mode sensitivity:</b> Influence of a positive or negative common mode voltage on the differential measurement.</li><li>• <b>Channel separation:</b> Influence of a voltage on the neighbor channels not subject to an input voltage.</li><li>• <b>AD Converter Values with inputs shorted:</b> Values on the internal AD converter corresponding to zero input voltage.</li><li>• <b>Input Offset Measurement:</b> Output voltage and statistical results over a large number of zero voltage measurements.</li><li>• <b>Input Offset Current:</b> Typical value for information; Maximum channel input offset current, not considering the input resistance.</li><li>• <b>Input resistance:</b> Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement.</li><li>• <b>Low Battery Alarm Voltage:</b> Typical value for information. Below this voltage, a battery alarm signal is generated.</li><li>• <b>Power consumption:</b> Typical value for information. Supply currents in various operating modes.</li></ul> <p>Certificate No: DAE4-1245_May22 Page 2 of 5</p>	<p><b>DC Voltage Measurement</b></p> <p>A/D - Converter Resolution nominal High Range: 1LSB = 6.1 μV, full range = -190...+320 mV Low Range: 1LSB = 61 μV, full range = -1...+3 mV DASY measurement parameters: Auto Zero-Time: 3 sec; Measuring time: 3 sec</p> <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> <p><b>Connector Angle</b></p> <table border="1"><thead><tr><th>Connector Angle to be used in DASY system</th><th>30.0° ± 1°</th></tr></thead></table> <p>Certificate No: DAE4-1245_May22 Page 3 of 5</p>	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°						
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°																				

## 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

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

## 3. Channel separation

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	-

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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: &lt;25nA

## 7. Input Resistance (Typical values for information)

	Zeroing (ΩOff)	Measuring (MΩIn)
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

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## 3 EX3DV4 - SN 7767

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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 &lt; 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. 217-05028-03504)	Apr-23
Power sensor NRP-291	SN: 103944	04-Apr-22 (No. 217-05024)	Apr-23
DCP DAK-3.1 (Impedance)	SN: 1545	25-Oct-22 (DCP DAK3.1-1545, Oct22)	Oct-23
DCP DAK-12	SN: 1014	25-Oct-22 (DCP DAK12-1014, Oct22)	Oct-23
Reference 30 dB Attenuator	SN: C25582 (20c)	04-Apr-22 (No. 217-05027)	Apr-23
DAE4	SN: 981	15-Oct-22 (No. DAE4-981 Oct22)	Oct-23
Reference Probe E53502	SN: 3013	27-Oct-22 (No. E535-3013, Oct22)	Nov-22

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4418B	SN: G841936874	05-Apr-16 (in house check Jun-20)	In house check Jun-24
Power sensor E4418A	SN: V141498687	05-Apr-16 (in house check Jun-20)	In house check Jun-24
Power sensor E4415A	SN: 10011210	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: G841936477	27-May-14 (in house check Oct-20)	In house check Oct-24

Calibrated by:	Name: Adonis Georgiadou	Function: Laboratory Technician	Signature: [Signature]
Approved by:	Ewen Kohn	Technical Manager	Signature: [Signature]

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

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S Servizio svizzero di taratura  
S Swiss Calibration Service

Accreditation No: SCS 0108

## Glossary

TSL: Issue simulating liquid  
NORMA<sub>xyz</sub>: sensitivity in free space  
ConfF: sensitivity in TSL; NORMA<sub>xyz</sub>  
DCP: diode compression point  
CP: crest factor (10dB, cycle) of the RF signal  
A, B, C, D: modulation dependent linearization parameters  
Polarization: if rotation around probe axis  
Polarization: if rotation around air axis that is in the plane normal to probe axis (i.e., θ = 0° is normal to probe axis  
Connector Angle: information used in DASY system to align probe sensor X1 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 15 GHz)", October 2020.
- b) IEC 60958, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Methods Applied and Interpretation of Parameters:

- NORMA<sub>xyz</sub>: Assessed for E-field polarization θ = 0° (f < 900 MHz in TEM-cell; f = 1800 MHz: R22 waveguide). NORMA<sub>xyz</sub> are only intermediate values, i.e., the uncertainties of NORMA<sub>xyz</sub> does not affect the E-field uncertainty made TSL (see below ConfF).
- NORMA<sub>xyz</sub> = NORMA<sub>xyz</sub> \* f: 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 ConfF.
- DCP<sub>xyz</sub>: 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<sub>xyz</sub>, B<sub>xyz</sub>, C<sub>xyz</sub>, D<sub>xyz</sub>, VR<sub>xyz</sub>, A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signals. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConfF and Boundary Effect Parameters: Assessed in far phantom using E-field or Temperature Transfer Standard for f < 800 MHz and inside waveguide using analytical field distribution 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<sub>xyz</sub> \* ConfF whereby the uncertainty corresponds to that given for ConfF. A frequency dependent ConfF is used in DASY version 4.4 and higher which allows extending the validity from < 50 MHz to > 100 MHz.

- Spherical geometry (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).

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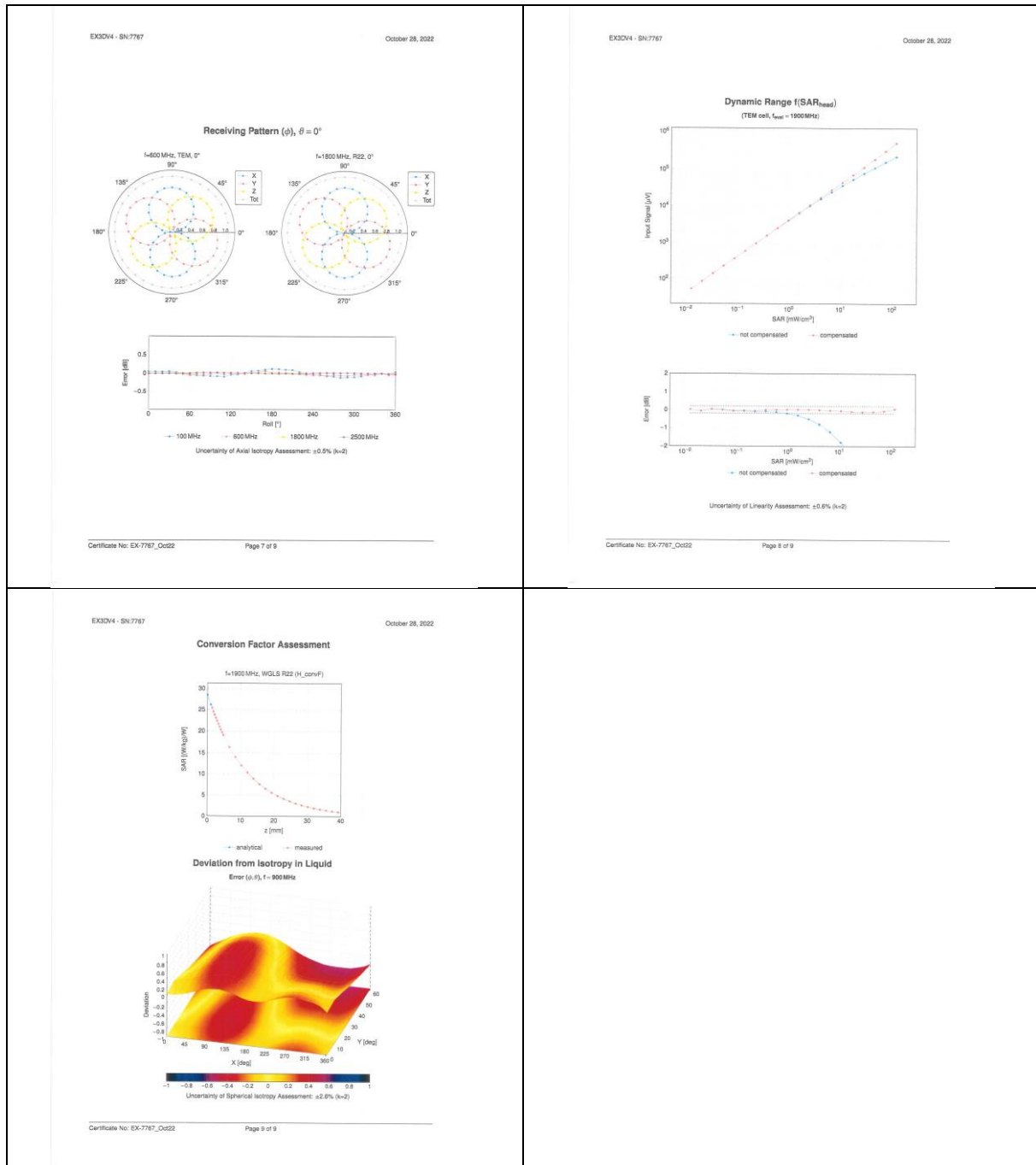
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<div>EX3DV4 - SN:7767 October 28, 2022 Parameters of Probe: EX3DV4 - SN:7767 Basic Calibration Parameters <table><tr><th></th><th>Sensor X</th><th>Sensor Y</th><th>Sensor Z</th><th>Unc (k = 2)</th></tr><tr><td>Norm (µV/m/m²) A</td><td>0.87</td><td>0.89</td><td>0.56</td><td>±10.1%</td></tr><tr><td>DCP (mV) B</td><td>103.4</td><td>107.3</td><td>105.7</td><td>±4.7%</td></tr></table> Calibration Results for Modulation Response <table><tr><th>URS</th><th>Communication System Name</th><th>A dB</th><th>B dB/µV</th><th>C</th><th>D dB</th><th>VR mV</th><th>Max dec.</th><th>Max Unc<sup>2</sup> k = 2</th></tr><tr><td>0</td><td>CW</td><td>X 0.00 Y 0.00 Z 0.00</td><td>0.00 0.00 0.00</td><td>1.00 1.00 1.00</td><td>0.00</td><td>184.7 186.7 179.3</td><td>±3.5%</td><td>±4.7%</td></tr></table> <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><sup>1</sup> The uncertainties of Norm X,Y,Z do not affect the 95% total uncertainty inside T50. (see Page 5).</p><p><sup>2</sup> Uncertainty parameter uncertainty for maximum specified field strength.</p><p><sup>3</sup> Uncertainty is determined using the max. deviation from three responses applying rectangular distribution and is expressed for the square of the field value.</p> Certificate No: EX-7767_Oct22 Page 3 of 9</div>		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%	URS	Communication System Name	A dB	B dB/µV	C	D dB	VR mV	Max dec.	Max Unc <sup>2</sup> 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	184.7 186.7 179.3	±3.5%	±4.7%	<div>EX3DV4 - SN:7767 October 28, 2022 Parameters of Probe: EX3DV4 - SN:7767 Other Probe Parameters <table><tr><td>Sensor Arrangement</td><td>Triangular</td></tr><tr><td>Connector Angle</td><td>144.8°</td></tr><tr><td>Mechanical Surface Detection Mode</td><td>angled</td></tr><tr><td>Optical Surface Detection Mode</td><td>displaced</td></tr><tr><td>Probe Overall Length</td><td>337 mm</td></tr><tr><td>Probe Body Diameter</td><td>16 mm</td></tr><tr><td>Tip Length</td><td>3 mm</td></tr><tr><td>Tip Diameter</td><td>2.5 mm</td></tr><tr><td>Probe Tip to Sensor X Calibration Point</td><td>1 mm</td></tr><tr><td>Probe Tip to Sensor Y Calibration Point</td><td>1 mm</td></tr><tr><td>Probe Tip to Sensor Z Calibration Point</td><td>1 mm</td></tr><tr><td>Recommended Measurement Distance from Surface</td><td>1.4 mm</td></tr></table> <p>Note: Measurement distance from surface can be increased to 3-4 mm for all Area Scan jobs.</p> Certificate No: EX-7767_Oct22 Page 4 of 9</div>	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																																																																																																																																																																																
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Recommended Measurement Distance from Surface	1.4 mm																																																																																																																																																																																																																																									
<div>EX3DV4 - SN:7767 October 28, 2022 Parameters of Probe: EX3DV4 - SN:7767 Calibration Parameter Determined in Head Tissue Simulating Media <table><tr><th>f (MHz)<sup>1</sup></th><th>Relative Permittivity<sup>2</sup></th><th>Conductivity<sup>3</sup> (S/m)</th><th>CompF X</th><th>CompF Y</th><th>CompF Z</th><th>Alpha<sup>4</sup></th><th>Depth<sup>5</sup> (mm)</th><th>Unc (k = 2)</th></tr><tr><td>150</td><td>82.3</td><td>0.79</td><td>14.08</td><td>14.08</td><td>14.08</td><td>0.00</td><td>1.00</td><td>±13.2%</td></tr><tr><td>450</td><td>42.5</td><td>0.97</td><td>11.90</td><td>11.90</td><td>11.90</td><td>0.16</td><td>1.20</td><td>±13.3%</td></tr><tr><td>750</td><td>41.9</td><td>0.89</td><td>10.26</td><td>10.26</td><td>10.26</td><td>0.00</td><td>0.80</td><td>±12.0%</td></tr><tr><td>835</td><td>41.5</td><td>0.90</td><td>10.00</td><td>10.00</td><td>10.00</td><td>0.43</td><td>0.80</td><td>±12.0%</td></tr><tr><td>1750</td><td>40.1</td><td>1.37</td><td>9.32</td><td>9.32</td><td>9.32</td><td>0.36</td><td>0.86</td><td>±12.0%</td></tr><tr><td>1900</td><td>40.0</td><td>1.40</td><td>8.91</td><td>8.91</td><td>8.91</td><td>0.33</td><td>0.86</td><td>±12.0%</td></tr><tr><td>2100</td><td>39.8</td><td>1.49</td><td>8.60</td><td>8.60</td><td>8.60</td><td>0.30</td><td>0.86</td><td>±12.0%</td></tr><tr><td>2200</td><td>39.5</td><td>1.67</td><td>8.44</td><td>8.44</td><td>8.44</td><td>0.33</td><td>0.90</td><td>±12.0%</td></tr><tr><td>2450</td><td>39.2</td><td>1.80</td><td>8.24</td><td>8.24</td><td>8.24</td><td>0.32</td><td>0.90</td><td>±12.0%</td></tr><tr><td>2600</td><td>39.0</td><td>1.96</td><td>7.99</td><td>7.99</td><td>7.99</td><td>0.27</td><td>0.90</td><td>±12.0%</td></tr><tr><td>3000</td><td>38.2</td><td>2.71</td><td>7.55</td><td>7.55</td><td>7.55</td><td>0.30</td><td>1.25</td><td>±13.1%</td></tr><tr><td>3600</td><td>37.9</td><td>2.91</td><td>7.45</td><td>7.45</td><td>7.45</td><td>0.30</td><td>1.35</td><td>±13.1%</td></tr><tr><td>3700</td><td>37.7</td><td>3.12</td><td>7.20</td><td>7.20</td><td>7.20</td><td>0.30</td><td>1.35</td><td>±13.1%</td></tr><tr><td>3900</td><td>37.5</td><td>3.32</td><td>6.84</td><td>6.84</td><td>6.84</td><td>0.40</td><td>1.69</td><td>±13.1%</td></tr><tr><td>4100</td><td>37.2</td><td>3.53</td><td>6.63</td><td>6.63</td><td>6.63</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>4200</td><td>37.1</td><td>3.65</td><td>6.39</td><td>6.39</td><td>6.39</td><td>0.40</td><td>1.70</td><td>±13.1%</td></tr><tr><td>4400</td><td>36.9</td><td>3.84</td><td>6.17</td><td>6.17</td><td>6.17</td><td>0.40</td><td>1.70</td><td>±13.1%</td></tr><tr><td>4600</td><td>36.7</td><td>4.04</td><td>6.15</td><td>6.15</td><td>6.15</td><td>0.40</td><td>1.70</td><td>±13.1%</td></tr><tr><td>4800</td><td>36.4</td><td>4.26</td><td>6.13</td><td>6.13</td><td>6.13</td><td>0.45</td><td>1.90</td><td>±13.1%</td></tr><tr><td>4900</td><td>36.3</td><td>4.40</td><td>6.07</td><td>6.07</td><td>6.07</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>5200</td><td>36.0</td><td>4.66</td><td>5.65</td><td>5.65</td><td>5.65</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>5300</td><td>35.9</td><td>4.76</td><td>5.48</td><td>5.48</td><td>5.48</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>5600</td><td>35.6</td><td>4.96</td><td>5.30</td><td>5.30</td><td>5.30</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>5900</td><td>35.5</td><td>5.07</td><td>5.14</td><td>5.14</td><td>5.14</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr><tr><td>5900</td><td>35.3</td><td>5.27</td><td>5.10</td><td>5.10</td><td>5.10</td><td>0.40</td><td>1.80</td><td>±13.1%</td></tr></table> <p><sup>1</sup> 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 measurement in calibration frequency and the uncertainty for the relative permittivity and conductivity is ±10%, ±15%, ±20%, ±25%, and ±30% for CDP v4.4, v4.5, v4.6, v4.7, v4.8, v4.9, v5.0, v5.1, v5.2, v5.3, v5.4, v5.5, v5.6, v5.7, v5.8, v5.9, v6.0, v6.1, v6.2, v6.3, v6.4, v6.5, v6.6, v6.7, v6.8, v6.9, v7.0, v7.1, v7.2, v7.3, v7.4, v7.5, v7.6, v7.7, v7.8, v7.9, v8.0, v8.1, v8.2, v8.3, v8.4, v8.5, v8.6, v8.7, v8.8, v8.9, v9.0, v9.1, v9.2, v9.3, v9.4, v9.5, v9.6, v9.7, v9.8, v9.9, v10.0, v10.1, v10.2, v10.3, v10.4, v10.5, v10.6, v10.7, v10.8, v10.9, v11.0, v11.1, v11.2, v11.3, v11.4, v11.5, v11.6, v11.7, v11.8, v11.9, v12.0, v12.1, v12.2, v12.3, v12.4, v12.5, v12.6, v12.7, v12.8, v12.9, v13.0, v13.1, v13.2, v13.3, v13.4, v13.5, v13.6, v13.7, v13.8, v13.9, v14.0, v14.1, v14.2, v14.3, v14.4, v14.5, v14.6, v14.7, v14.8, v14.9, v15.0, v15.1, v15.2, v15.3, v15.4, v15.5, v15.6, v15.7, v15.8, v15.9, v16.0, v16.1, v16.2, v16.3, v16.4, v16.5, v16.6, v16.7, v16.8, v16.9, v17.0, v17.1, v17.2, v17.3, v17.4, v17.5, v17.6, v17.7, v17.8, v17.9, v18.0, v18.1, v18.2, v18.3, v18.4, v18.5, v18.6, v18.7, v18.8, v18.9, v19.0, v19.1, v19.2, v19.3, v19.4, v19.5, v19.6, v19.7, v19.8, v19.9, v20.0, v20.1, v20.2, v20.3, v20.4, v20.5, v20.6, v20.7, v20.8, v20.9, v21.0, v21.1, v21.2, v21.3, v21.4, v21.5, v21.6, v21.7, v21.8, v21.9, v22.0, v22.1, v22.2, v22.3, v22.4, v22.5, v22.6, v22.7, v22.8, v22.9, v23.0, v23.1, v23.2, v23.3, v23.4, v23.5, v23.6, v23.7, v23.8, v23.9, v24.0, v24.1, v24.2, v24.3, v24.4, v24.5, v24.6, v24.7, v24.8, v24.9, v25.0, v25.1, v25.2, v25.3, v25.4, v25.5, v25.6, v25.7, v25.8, v25.9, v26.0, v26.1, v26.2, v26.3, v26.4, v26.5, v26.6, v26.7, v26.8, v26.9, v27.0, v27.1, v27.2, v27.3, v27.4, v27.5, v27.6, v27.7, v27.8, v27.9, v28.0, v28.1, v28.2, v28.3, v28.4, v28.5, v28.6, v28.7, v28.8, v28.9, v29.0, v29.1, v29.2, v29.3, v29.4, v29.5, v29.6, v29.7, v29.8, v29.9, v30.0, v30.1, v30.2, v30.3, v30.4, v30.5, v30.6, v30.7, v30.8, v30.9, v31.0, 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v45.4, v45.5, v45.6, v45.7, v45.8, v45.9, v46.0, v46.1, v46.2, v46.3, v46.4, v46.5, v46.6, v46.7, v46.8, v46.9, v47.0, v47.1, v47.2, v47.3, v47.4, v47.5, v47.6, v47.7, v47.8, v47.9, v48.0, v48.1, v48.2, v48.3, v48.4, v48.5, v48.6, v48.7, v48.8, v48.9, v49.0, v49.1, v49.2, v49.3, v49.4, v49.5, v49.6, v49.7, v49.8, v49.9, v50.0, v50.1, v50.2, v50.3, v50.4, v50.5, v50.6, v50.7, v50.8, v50.9, v51.0, v51.1, v51.2, v51.3, v51.4, v51.5, v51.6, v51.7, v51.8, v51.9, v52.0, v52.1, v52.2, v52.3, v52.4, v52.5, v52.6, v52.7, v52.8, v52.9, v53.0, v53.1, v53.2, v53.3, v53.4, v53.5, v53.6, v53.7, v53.8, v53.9, v54.0, v54.1, v54.2, v54.3, v54.4, v54.5, v54.6, v54.7, v54.8, v54.9, v55.0, v55.1, v55.2, v55.3, v55.4, v55.5, v55.6, v55.7, v55.8, v55.9, v56.0, v56.1, v56.2, v56.3, v56.4, v56.5, v56.6, v56.7, v56.8, v56.9, v57.0, v57.1, v57.2, v57.3, v57.4, v57.5, v57.6, v57.7, v57.8, v57.9, v58.0, v58.1, v58.2, v58.3, v58.4, v58.5, v58.6, v58.7, v58.8, v58.9, v59.0, v59.1, v59.2, v59.3, v59.4, v59.5, v59.6, 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v74.0, v74.1, v74.2, v74.3, v74.4, v74.5, v74.6, v74.7, v74.8, v74.9, v75.0, v75.1, v75.2, v75.3, v75.4, v75.5, v75.6, v75.7, v75.8, v75.9, v76.0, v76.1, v76.2, v76.3, v76.4, v76.5, v76.6, v76.7, v76.8, v76.9, v77.0, v77.1, v77.2, v77.3, v77.4, v77.5, v77.6, v77.7, v77.8, v77.9, v78.0, v78.1, v78.2, v78.3, v78.4, v78.5, v78.6, v78.7, v78.8, v78.9, v79.0, v79.1, v79.2, v79.3, v79.4, v79.5, v79.6, v79.7, v79.8, v79.9, v80.0, v80.1, v80.2, v80.3, v80.4, v80.5, v80.6, v80.7, v80.8, v80.9, v81.0, v81.1, v81.2, v81.3, v81.4, v81.5, v81.6, v81.7, v81.8, v81.9, v82.0, v82.1, v82.2, v82.3, v82.4, v82.5, v82.6, v82.7, v82.8, v82.9, v83.0, v83.1, v83.2, v83.3, v83.4, v83.5, v83.6, v83.7, v83.8, v83.9, v84.0, v84.1, v84.2, v84.3, v84.4, v84.5, v84.6, v84.7, v84.8, v84.9, v85.0, v85.1, v85.2, v85.3, v85.4, v85.5, v85.6, v85.7, v85.8, v85.9, v86.0, v86.1, v86.2, v86.3, v86.4, v86.5, v86.6, v86.7, v86.8, v86.9, v87.0, v87.1, v87.2, v87.3, v87.4, v87.5, v87.6, v87.7, v87.8, v87.9, v88.0, v88.1, v88.2, 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v139.7, v139.8, v139.9, v140.0, v140.1, v140.2, v140.3, v140.4, v140.5, v140.6, v140.7, v140.8, v140.9, v141.0, v141.1, v141.2, v141.3, v141.4, v141.5, v141.6, v141.7, v141.8, v141.9, v142.0, v142.1, v142.2, v142.3, v142.4, v142.5, v142.6, v142.7, v142.8, v142.9, v143.0, v143.1, v143.2, v143.3, v143.4, v143.5, v143.6, v143.7, v143.8, v143.9, v144.0, v144.1, v144.2, v144.3, v144.4, v144.5, v144.6, v144.7, v144.8, v144.9, v145.0, v145.1, v1</p></div>	f (MHz) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity <sup>3</sup> (S/m)	CompF X	CompF Y	CompF Z	Alpha <sup>4</sup>	Depth <sup>5</sup> (mm)	Unc (k = 2)	150	82.3	0.79	14.08	14.08	14.08	0.00	1.00	±13.2%	450	42.5	0.97	11.90	11.90	11.90	0.16	1.20	±13.3%	750	41.9	0.89	10.26	10.26	10.26	0.00	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%	5600	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%
f (MHz) <sup>1</sup>	Relative Permittivity <sup>2</sup>	Conductivity <sup>3</sup> (S/m)	CompF X	CompF Y	CompF Z	Alpha <sup>4</sup>	Depth <sup>5</sup> (mm)	Unc (k = 2)																																																																																																																																																																																																																																		
150	82.3	0.79	14.08	14.08	14.08	0.00	1.00	±13.2%																																																																																																																																																																																																																																		
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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%																																																																																																																																																																																																																																		
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#### 4 Impedance and return loss

Dipole CLA150 SN 4025				
Head Liquid				
Date of Measurement	Return Loss(dB)	$\Delta$ %	Impedance ( $\Omega$ )	$\Delta\Omega$
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)	$\Delta$ %	Impedance ( $\Omega$ )	$\Delta\Omega$
2021/4/21	-23	/	57.1	/
2022/4/26	-23.4	-1.74%	56.6	-0.5



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