

Appendix C for KSCR230200021401

Calibration Certificate

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



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1 Dipole

1.1 CLA150 - SN 4025

Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland		S Schweizerischer Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura S Swiss Calibration Service	
Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates		Accreditation No.: SCS 0108	
Client: SGS-CN (Auden)		Certificate No: CLA150-4025_Apr21	
CALIBRATION CERTIFICATE			
Object: CLA150 - SN: 4025			
Calibration procedure(s): QA CAL-15-v9 Calibration Procedure for SAR Validation Sources below 700 MHz			
Calibration date: April 26, 2021			
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature $22 \pm 3^\circ\text{C}$ and humidity $< 70\%$.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 10476	09-Apr-21 (No. 217-03201/03202)	Apr-22
Power sensor NRP Z91	SN: 100344	09-Apr-21 (No. 217-03201)	Apr-22
Power sensor NRP Z91	SN: 100345	09-Apr-21 (No. 217-03202)	Apr-22
Reference 20 dB Attenuator	SN: C22862 (20dB)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310952 / 00057	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX300A	SN: 3877	30-Dec-20 (No. EX3-3077_Dec20)	Dec-21
EX64	SN: 664	26-Jun-20 (No. EX64-654_Jun20)	Jun-21
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter S4413B	SN: G841203074	06-Apr-15 (in house check Jun-20)	In house check Jun-22
Power sensor E4113A	SN: MY4149067	06-Apr-15 (in house check Jun-20)	In house check Jun-22
Power sensor E4113A	SN: 00010010	06-Apr-15 (in house check Jun-20)	In house check Jun-22
RF generator HP 8440D	SN: US4840107109	04-Aug-09 (in house check Jun-20)	In house check Jun-22
Network Analyser Agilent E8360A	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	

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Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates		Accreditation No.: SCS 0108	
Glossary:			
TSL	Issue simulating liquid		
ConvF	sensitivity in TSL / NORM x,y,z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Technique", June 2013			
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016			
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010			
d) KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation:			
e) DASY4/5 System Handbook			
Methods Applied and Interpretation of Parameters:			
• Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.			
• Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.			
• Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.			
• SAR measured: SAR measured at the stated antenna input power.			
• SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.			
• SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.			
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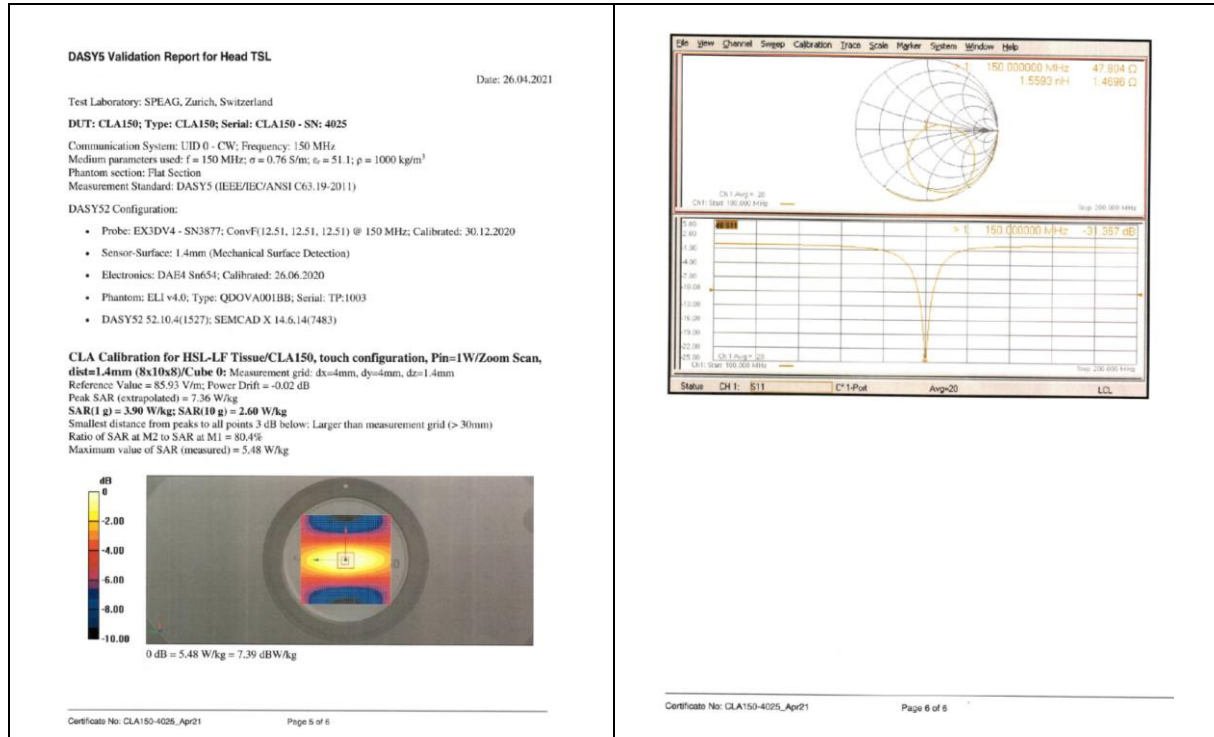
Measurement Conditions			
DASY system configuration, as far as not given on page 1.			
DASY Version	DASY5	V52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	ELIA Flat Phantom	Shell thickness: 2 ± 0.2 mm	
EUT Positioning	Touch Position		
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)	
Frequency	150 MHz ± 1 MHz		

Head TSL parameters			
The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	52.3	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	51.1 ± 6 %	0.75 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	---	---

SAR result with Head TSL			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	1 W input power	3.90 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	3.88 W/kg ± 19.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition		
SAR measured	1 W input power	2.60 W/kg	
SAR for nominal Head TSL parameters	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	SPLEAG

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

Calibration Laboratory of Schmid & Partner Engineering AG
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Client: **SGS-CN (Aude)** Certificate No: **D450V3-1103_Apr21**

CALIBRATION CERTIFICATE

Object: **D450V3 - SN: 1103**

Calibration procedure(s): **QA CAL-15-v9**
Calibration Procedure for SAR Validation Sources below 700 MHz

Calibration date: **April 21, 2021**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (20 ± 2) °C and humidity < 70%.

Calibration Equipment used (MPE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	09-Apr-21 (No. 217-03021/03020)	Apr-22
Power sensor NRP-Z91	SN: 102344	09-Apr-21 (No. 217-03021)	Apr-22
Power sensor NRP-Z91	SN: 102345	09-Apr-21 (No. 217-03020)	Apr-22
Reference 20 dB Attenuator	SN: CG2852 (200)	09-Apr-21 (No. 217-03345)	Apr-22
Type-N mismatch combination	SN: 310852 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 3877	30-Dec-20 (No. EX3-3877 Dec20)	Dec-21
DA54	SN: 654	26-Jun-20 (No. DA54-654 Jun20)	Jun-21

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4118B	SN: G841200274	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4112A	SN: MY41496027	06-Apr-16 (in house check Jun-20)	In house check Jun-22
Power sensor E4112A	SN: 00018010	06-Apr-16 (in house check Jun-20)	In house check Jun-22
RF generator HP 8548C	SN: U03460.01700	06-Aug-99 (in house check Jun-20)	In house check Jun-22
Network Analyzer Agilent E8358A	SN: U841080477	31-Mar-14 (in house check Oct-20)	In house check Oct-21

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

Approved by: **Katja Polovic** Technical Manager

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Accreditation No: **SCS 0106**

Glossary:

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

ConvF: not applicable or not measured

N/A: not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 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	V82.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELJ Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 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 %	0.07 mho/m ± 8 %
Head TSL temperature change during test	< 0.5 °C	---	---

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

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

Appendix (Additional assessments outside the scope of SCS 0106)		
Antenna Parameters with Head TSL		
Impedance, transformed to feed point	57.1 Ω - 2.8 jΩ	
Return Loss	-23.0 dB	

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

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

The dipole is made of standard coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when twisted 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.

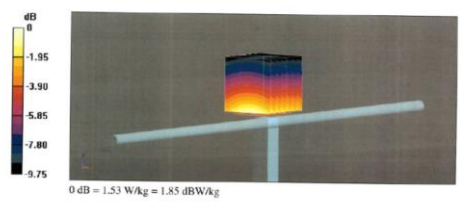
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data	
Manufactured by	SPEAG

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Certificate No: D450V3-1103_Apr21 Page 4 of 6

DASY5 Validation Report for Head TSL		
Test Laboratory: SPEAG, Zurich, Switzerland		
Date: 21.04.2021		
DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1103		
Communication System: UID 0 - CW; Frequency: 450 MHz		
Medium parameters used: f = 450 MHz; α = 0.87 S/m; ε = 43.1; ρ = 1000 kg/m ³		
Phantom section: Flat Section		
Measurement Standard: DASY5 (IEE/IEC/ANSI C63.19-2011)		
DASY52 Configuration:		
- Probe: EX3DV4 - SN3877; ConvF(10.64, 10.64) @ 450 MHz; Calibrated: 30.12.2020 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DAE4 Sn654; Calibrated: 26.06.2020 - Phantom: ELJ v4.0; Type: QDOVA001BB; Serial: TP:1003 - DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)		
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:		
Measurement grid: dx=5mm, dy=5mm, dz=5mm		
Reference Value = 39.18 V/m; Power Drift = -0.08 dB		
Peak SAR (extrapolated) = 1.76 W/kg		
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.767 W/kg		
Smallest distance from peaks to all points 3 dB below: Larger than measurement grid		
Ratio of SAR at M2 to SAR at M1 = 64.9%		
Maximum value of SAR (measured) = 1.53 W/kg		



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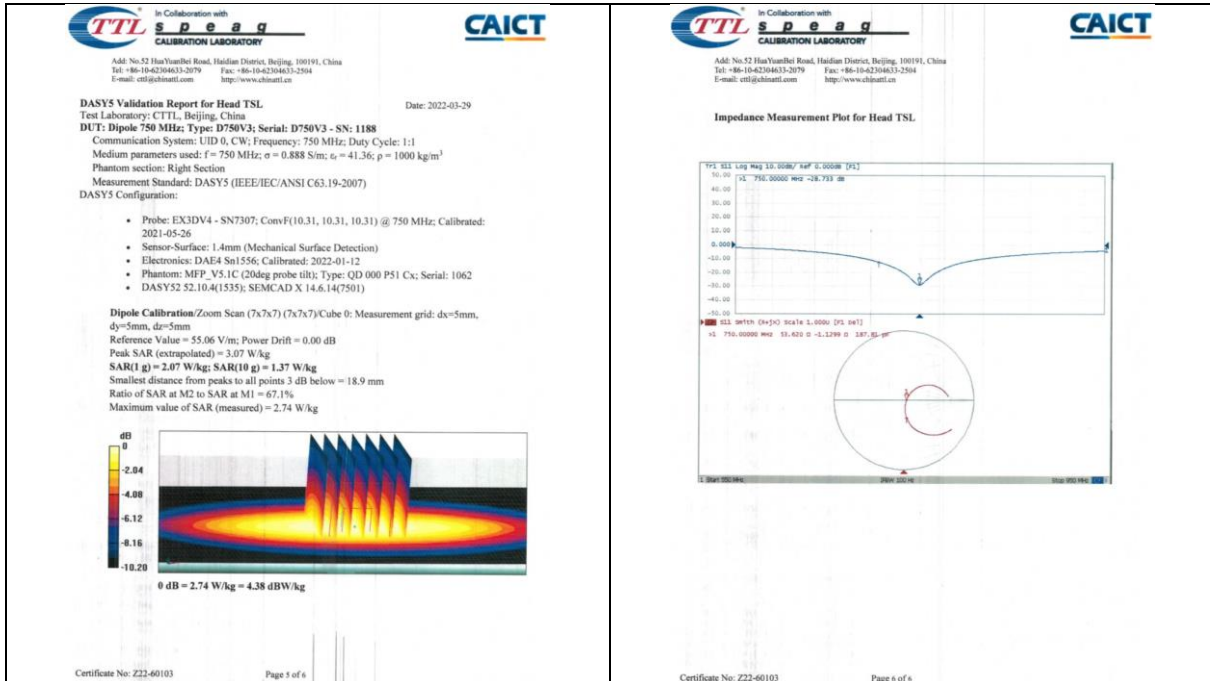
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1.3 D750V3 - SN 1188

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Client: SGS-CN		Certificate No: Z22-60103																					
CALIBRATION CERTIFICATE																							
Object: D750V3 - SN: 1188																							
Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits																							
Calibration date: March 28, 2022																							
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)																							
<table border="1"><thead><tr><th>Primary Standards</th><th>ID #</th><th>Cal Date (Calibrated by Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Power Meter NRP2</td><td>104277</td><td>24-Sep-21 (CTTL No.J21X08328)</td><td>Sep-22</td></tr><tr><td>Power sensor NRP88</td><td>104291</td><td>24-Sep-21 (CTTL No.J21X08328)</td><td>Sep-22</td></tr><tr><td>Reference Probe EX30V4</td><td>SN 7307</td><td>26-May-21(SPEAG No EX3-7307_May21)</td><td>May-22</td></tr><tr><td>DAE4</td><td>SN 1556</td><td>12-Jan-22(CTTL-SPEAG No Z22-60007)</td><td>Jan-23</td></tr></tbody></table>				Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration	Power Meter NRP2	104277	24-Sep-21 (CTTL No.J21X08328)	Sep-22	Power sensor NRP88	104291	24-Sep-21 (CTTL No.J21X08328)	Sep-22	Reference Probe EX30V4	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
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration																				
Power Meter NRP2	104277	24-Sep-21 (CTTL No.J21X08328)	Sep-22																				
Power sensor NRP88	104291	24-Sep-21 (CTTL No.J21X08328)	Sep-22																				
Reference Probe EX30V4	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																				
<table border="1"><thead><tr><th>Secondary Standards</th><th>ID #</th><th>Cal Date (Calibrated by Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Signal Generator S4438C</td><td>MY48071430</td><td>13-Jan-22 (CTTL No.J22X00409)</td><td>Jan-23</td></tr><tr><td>Network Analyzer E5071C</td><td>MY48110673</td><td>14-Jan-22 (CTTL No.J22X00409)</td><td>Jan-23</td></tr></tbody></table>				Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration	Signal Generator S4438C	MY48071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23	Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X00409)	Jan-23								
Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration																				
Signal Generator S4438C	MY48071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23																				
Network Analyzer E5071C	MY48110673	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 3, 2022																							
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Measurement Conditions DASY system configuration, as far as not given on page 1:			
DASY Version		V52.10.4	
Extrapolation		Advanced Extrapolation	
Phantom		Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL		15 mm with Spacer	
Zoom Scan Resolution		dx, dy, dz = 5 mm	
Frequency		750 MHz ± 1 MHz	
Head TSL parameters The following parameters and calculations were applied:			
Temperature		22.0 °C	
Permittivity		42.0	
Conductivity		0.90 mho/m	
Nominal Head TSL parameters		(22.0 ± 0.2) °C	
Measured Head TSL parameters		(22.0 ± 0.2) °C	
Head TSL temperature change during test		<1.0 °C	
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL		Condition	
SAR measured		250 mW input power	
SAR for nominal Head TSL parameters		normalized to 1W	
SAR averaged over 10 cm ² (10 g) of Head TSL		Condition	
SAR measured		250 mW input power	
SAR for nominal Head TSL parameters		normalized to 1W	

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



1.4 D835V2 - SN 4d114

Page 1 of 6:

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

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 Dianyan, SAR Project Leader

Issued: April 6, 2022
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Page 2 of 6:

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

Calibration is Performed According to the Following Standards:
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
b) KDB 665664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:
c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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



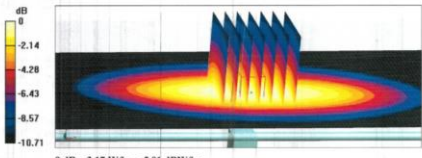
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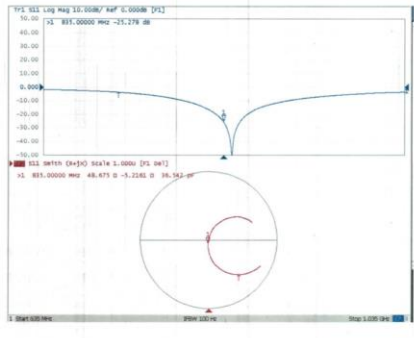
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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	VS2 10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	835 MHz $\pm$ 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
Nominal Head TSL parameters	Temperature	Permittivity	Conductivity
	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	41.0 $\pm$ 5 %	0.91 mho/m $\pm$ 5 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	2.37 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	9.40 W/kg $\pm$ 18.5 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	1.54 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	6.12 W/kg $\pm$ 18.7 % (k=2)	
Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	48.70 - j22.0Q		
Return Loss	-25.3dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.307 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60104 Page 3 of 6			

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DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114 Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1 Medium parameters used: f = 835 MHz; σ = 0.907 S/m; ϵ_r = 40.98; ρ = 1000 kg/m ³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:			
- Probe: EX3DV4 - SN7307; ConvF(10.13, 10.13, 10.13) @ 835 MHz; Calibrated: 2021-05-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA-E4 Sn1556; Calibrated: 2022-01-12 - Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6(147501)			
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 57.88 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 3.56 W/kg SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg Smallest distance from peaks to all points 3 dB below = 15.8 mm Ratio of SAR at M2 to SAR at M1 = 66.2% Maximum value of SAR (measured) = 3.17 W/kg			
			
Certificate No: Z22-60104 Page 5 of 6			

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Impedance Measurement Plot for Head TSL			
			
Certificate No: Z22-60104 Page 6 of 6			



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1.5 D900V2 - SN 1d079

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Client: SGS-CN		Certificate No: Z22-60184																					
CALIBRATION CERTIFICATE																							
Object: D900V2 - SN: 1d079																							
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±3)°C and humidity <70%.																							
Calibration Equipment used (M&TE critical for calibration)																							
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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: June 13, 2022																							
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Measurement Conditions DASY system configuration, as far as not given on page 1.																					
<table border="1"><thead><tr><th>DASY Version</th><th>DASY2</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 S 1C</td><td></td></tr><tr><td>Distance Dipole Center - TSL</td><td>15 mm</td><td>with Spacer</td></tr><tr><td>Zoom Scan Resolution</td><td>dk, dy, dz = 5 mm</td><td></td></tr><tr><td>Frequency</td><td>900 MHz ± 1 MHz</td><td></td></tr></tbody></table>				DASY Version	DASY2	52.10.4	Extrapolation	Advanced Extrapolation		Phantom	Triple Flat Phantom S 1C		Distance Dipole Center - TSL	15 mm	with Spacer	Zoom Scan Resolution	dk, dy, dz = 5 mm		Frequency	900 MHz ± 1 MHz	
DASY Version	DASY2	52.10.4																			
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Head TSL parameters The following parameters and calculations were applied.																					
<table border="1"><thead><tr><th></th><th>Temperature</th><th>Permittivity</th><th>Conductivity</th></tr></thead><tbody><tr><td>Nominal Head TSL parameters</td><td>22.0 °C</td><td>41.5</td><td>0.97 nS/m</td></tr><tr><td>Measured Head TSL parameters</td><td>(22.0 ± 0.2) °C</td><td>42.1 ± 6 %</td><td>0.98 nS/m ± 6 %</td></tr><tr><td>Head TSL temperature change during test</td><td><1.0 °C</td><td>---</td><td>---</td></tr></tbody></table>					Temperature	Permittivity	Conductivity	Nominal Head TSL parameters	22.0 °C	41.5	0.97 nS/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.98 nS/m ± 6 %	Head TSL temperature change during test	<1.0 °C	---	---		
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Head TSL temperature change during test	<1.0 °C	---	---																		
SAR result with Head TSL																					
<table border="1"><thead><tr><th>SAR averaged over 1 cm³ (1 g) of Head TSL</th><th>Condition</th><th></th></tr></thead><tbody><tr><td>SAR measured</td><td>250 mW input power</td><td>2.70 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>11.0 W/kg ± 18.8 % (k=2)</td></tr><tr><td>SAR averaged over 10 cm³ (10 g) of Head TSL</td><td>Condition</td><td></td></tr><tr><td>SAR measured</td><td>250 mW input power</td><td>1.73 W/kg</td></tr><tr><td>SAR for nominal Head TSL parameters</td><td>normalized to 1W</td><td>7.09 W/kg ± 18.7 % (k=2)</td></tr></tbody></table>				SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		SAR measured	250 mW input power	2.70 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	11.0 W/kg ± 18.8 % (k=2)	SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		SAR measured	250 mW input power	1.73 W/kg	SAR for nominal Head TSL parameters	normalized to 1W	7.09 W/kg ± 18.7 % (k=2)
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Certificate No: Z22-60184		Page 3 of 6																			

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Glossary: TSL: tissue simulating liquid ConvF: sensitivity in TSL / NORMx,y,z N/A: not applicable or not measured			
Calibration is Performed According to the Following Standards: a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020 b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz" c) DASY4/5 System Handbook			
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: Z22-60184		Page 2 of 6	

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Appendix (Additional assessments outside the scope of CNAS L0570)							
Antenna Parameters with Head TSL							
<table border="1"><thead><tr><th>Impedance, transformed to feed point</th><th>48.10 - 8.49jΩ</th></tr><tr><th>Return Loss</th><th>-23.3 dB</th></tr></thead></table>				Impedance, transformed to feed point	48.10 - 8.49jΩ	Return Loss	-23.3 dB
Impedance, transformed to feed point	48.10 - 8.49jΩ						
Return Loss	-23.3 dB						
General Antenna Parameters and Design							
<table border="1"><thead><tr><th>Electrical Delay (one direction)</th><th>1.312 ns</th></tr></thead></table>				Electrical Delay (one direction)	1.312 ns		
Electrical Delay (one direction)	1.312 ns						
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.							
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.							
Additional EUT Data							
<table border="1"><thead><tr><th>Manufactured by</th><th>SPEAG</th></tr></thead></table>				Manufactured by	SPEAG		
Manufactured by	SPEAG						
Certificate No: Z22-60184		Page 4 of 6					

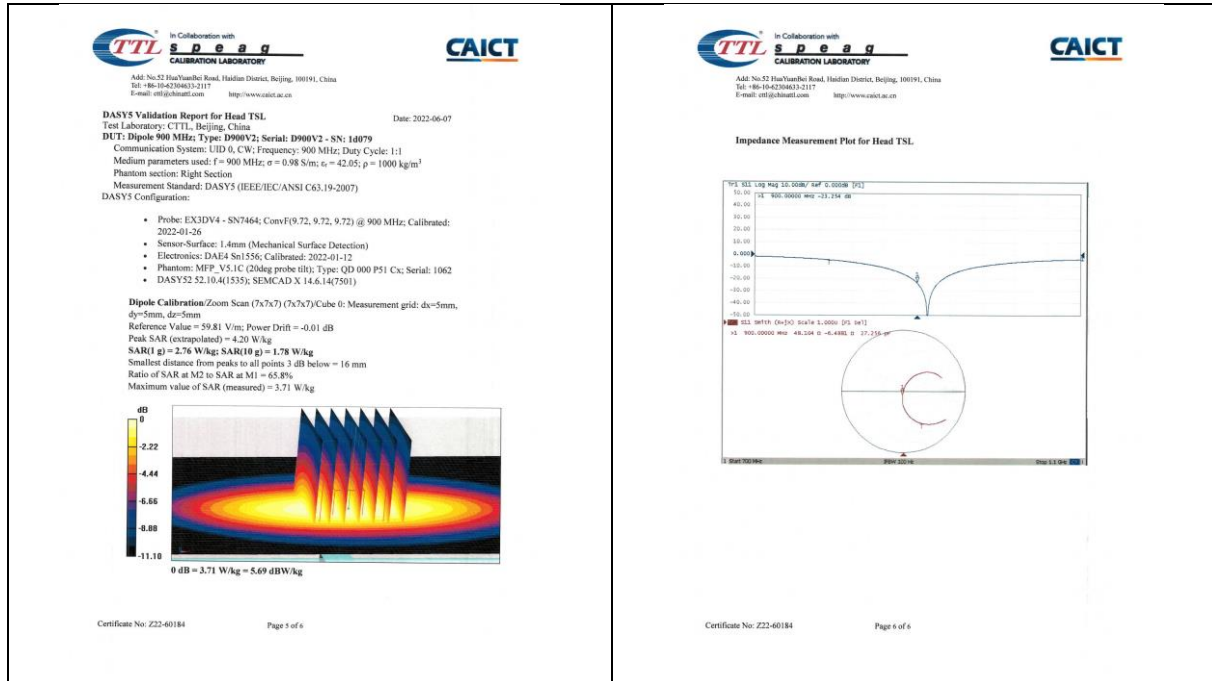


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1.6 D1800V2 - SN 2d170

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CALIBRATION LABORATORY

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

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

Issued April 6, 2022

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Certificate No: Z22-60105 Page 1 of 6

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

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

Additional Documentation:
c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60105 Page 2 of 6

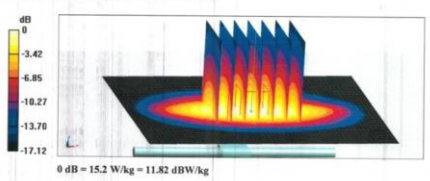


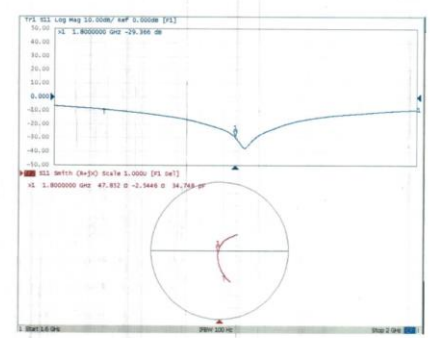
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TTL Speaq Calibration Laboratory		CAICT	
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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	1800 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	1.41 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	9.73 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	38.9 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.11 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	20.4 W/kg ± 18.7 % (k=2)	
Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	47.90-2.54jΩ		
Return Loss	-29.4dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.116 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60105 Page 3 of 6			

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DASY5 Validation Report for Head TSL Test Laboratory: TTL, Beijing, China Date: 2022-03-31 DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 2d170 Communication System: UID 0, CW; Frequency: 1800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1800 MHz; σ = 1.411 S/m; ε = 40.62; ρ = 1000 kg/m ³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/ANSI C63.19-2007) DASY5 Configuration: - Probe: EX3DV4 - SN7307; ConvF(8.34, 8.34, 8.34) @ 1800 MHz; Calibrated: 2021-05-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DAE4 Sn1556; Calibrated: 2022-01-12 - Phantom: MFP, V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501) Dipole Calibration/Zoom Scan (7x7x7) (Cube 0): Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 98.14 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 18.2 W/kg SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.11 W/kg Smallest distance from peaks to all points 3 dB below = 10 mm Ratio of SAR at M2 to SAR at M1 = 54% Maximum value of SAR (measured) = 15.2 W/kg			
			
Certificate No: Z22-60105 Page 3 of 6			

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Impedance Measurement Plot for Head TSL			
			
Certificate No: Z22-60105 Page 6 of 6			

1.7 D1900V2 - SN 5d136

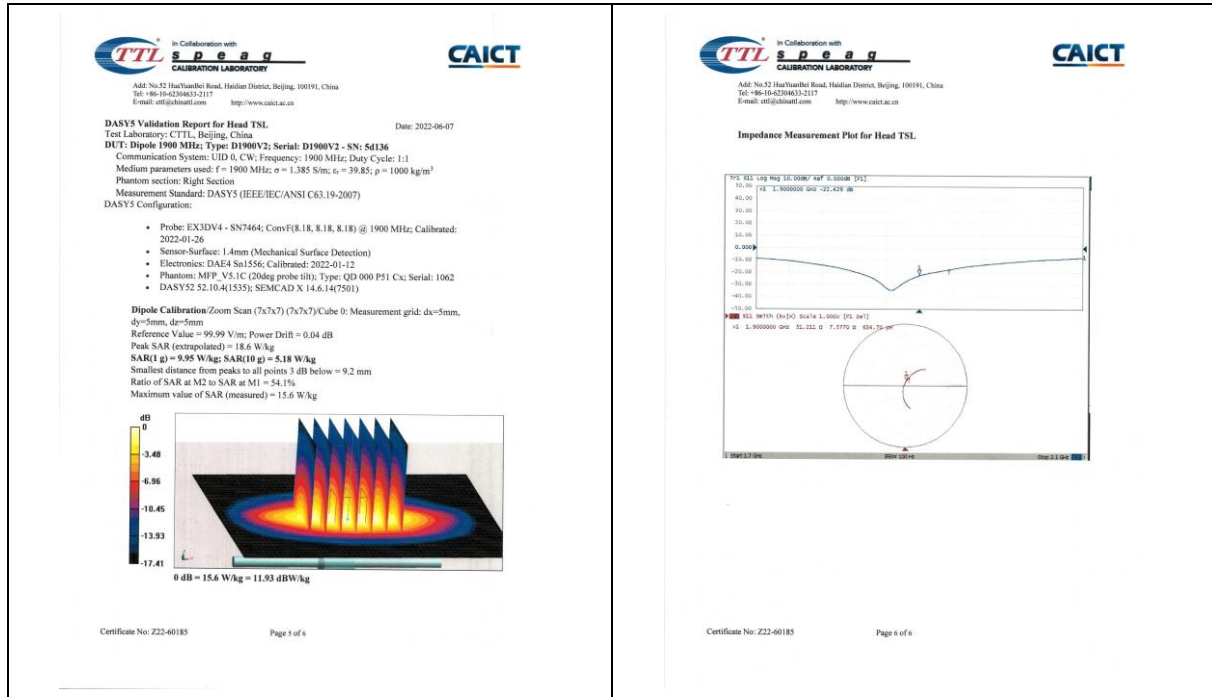
 Address: No.52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-4220633-2117 E-mail: cti@sgs.com.cn http://www.caiict.ac.cn Client: SGS-CN Certificate No: Z22-60185 CALIBRATION CERTIFICATE Object: D1900V2 - SN: 5d136 Calibration Procedure(s): FF-Z11-003-01 Calibration Procedures for dipole validation kits Calibration date: June 7, 2022 This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (23±1)°C and humidity <70%. Calibration Equipment used (M&TE critical for calibration) <table border="1"><thead><tr><th>Primary Standards</th><th>ID #</th><th>Cal Date (Calibrated by: Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Power Meter NRP2</td><td>106277</td><td>24-Sep-21 (CTTL No.J21X08326)</td><td>Sep-22</td></tr><tr><td>Power sensor NRP6S</td><td>104291</td><td>24-Sep-21 (CTTL No.J21X08326)</td><td>Sep-22</td></tr><tr><td>Reference Probe EXSDV4</td><td>SN 7464</td><td>28-Jan-22 (SPEAG No EX3-7464_Jan22)</td><td>Jan-23</td></tr><tr><td>DAE4</td><td>SN 1656</td><td>12-Jan-22 (CTTL-SPEAG No Z22-60007)</td><td>Jan-23</td></tr></tbody></table> <table border="1"><thead><tr><th>Secondary Standards</th><th>ID #</th><th>Cal Date (Calibrated by: Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Signal Generator E4438C</td><td>MY48071430</td><td>13-Jan-22 (CTTL No.J22X00409)</td><td>Jan-23</td></tr><tr><td>Network Analyzer E5071C</td><td>MY48110073</td><td>14-Jan-22 (CTTL No.J22X00409)</td><td>Jan-23</td></tr></tbody></table> Calibrated by: Zhao Jing SAR Test Engineer Reviewed by: Lin Hao SAR Test Engineer Approved by: Qi Dianyan SAR Project Leader Issued: June 13, 2022 This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Certificate No: Z22-60185 Page 1 of 6	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	 Address: No.52 Huayuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-4220633-2117 E-mail: cti@sgs.com.cn http://www.caiict.ac.cn Glossary: TSL: tissue simulating liquid CorrF: 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 865984, "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 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: Z22-60185 Page 2 of 6																												
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DASY Version	DASY52	52.10.4																																																											
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SAR measured	250 mW input power	5.18 W/kg																																																											
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 16.7 % (k=2)																																																											
Impedance, transformed to feed point	51.02 ± 7.56 Ω																																																												
Return Loss	-22.4 dB																																																												
Electrical Delay (one direction)	1.109 ns																																																												
Manufactured by	SPEAG																																																												



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1.8 D2000V2 - SN 1041

Page 1 of 6: Calibration Certificate. Client: SGS-CN. Certificate No: Z22-60186. Object: D2000V2 - SN: 1041. Calibration Procedure(s): FF-Z11-003-01. Calibration date: June 8, 2022. This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (B). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility; environment temperature (22±3)°C and humidity <70%. Calibration Equipment used (MATE critical for calibration):

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter: NRP2	106277	24-Sep-21 (CTTL No. J21X08328)	Sep-22
Power sensor: KRP8S	104291	24-Sep-21 (CTTL No. J21X08328)	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. Z22X00409)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No. Z22X00409)	Jan-23

Calibrated by: Zhao Jing, SAR Test Engineer. Reviewed by: Lin Hao, SAR Test Engineer. Approved by: Qi Danyuan, SAR Project Leader. Issued: June 13, 2022. This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Page 2 of 6: 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) K98 865964, "SAR Measurement Requirements for 100 MHz to 8 GHz". Additional Documentation: c) DASYS4/S System Handbook. Methods Applied and Interpretation of Parameters: Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis. Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required. Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required. SAR measured: SAR measured at the stated antenna input power. SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result. The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.



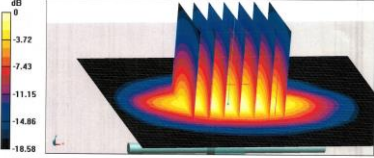
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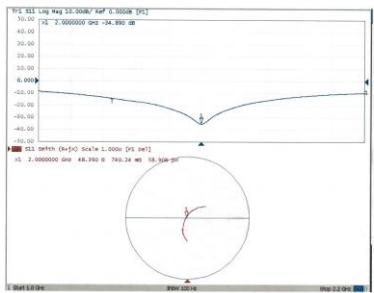
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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2000 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.2 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	10.4 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	41.8 W/kg ± 16.8 % (n=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.30 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg ± 18.7 % (n=2)	
Certificate No: Z22-60186 Page 3 of 6			

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	48.4Ω ± 0.74Ω		
Return Loss	-34.9dB		
General Antenna Parameters and Design			
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 and caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60186 Page 4 of 6			

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DASY5 Validation Report for Head TSL 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 _r = 40.21; ρ = 1000 kg/m ³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration:			
• Probe: EX3DV4 - SN7464; ConvF(8.2, 8.2, 8.2) @ 2000 MHz; Calibrated: 2022-01-26			
• Sensor-Surface: 1.4mm (Mechanical Surface Detection)			
• Electronics: DA64 Sn1556; Calibrated: 2022-01-12			
• Phantom: MPP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062			
• DASY52 52.10.4(1555); SEMCAD X 14.6.14(7501)			
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 103.4 V/m; Power Drift = 0.03 dB Peak SAR (extrapolated) = 19.6 W/kg SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.3 W/kg Smallest distance from peaks to all points 3 dB below = 9.1 mm Ratio of SAR at M2 to SAR at M1 = 53.6% Maximum value of SAR (measured) = 16.3 W/kg			
			
Certificate No: Z22-60186 Page 5 of 6			

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Impedance Measurement Plot for Head TSL			
			
Certificate No: Z22-60186 Page 6 of 6			



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1.9 D2300V2 - SN 1096

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Client: SGS-CN		Certificate No: Z22-60106	
CALIBRATION CERTIFICATE			
Object	D2300V2 - SN: 1096		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	March 31, 2022		
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity <70%.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	108277	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Power sensor NRPBS	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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Certificate No: Z22-60106		Page 1 of 6	

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Measurement Conditions DASY system configuration, as far as not given on page 1:			
DASY Version	DASY2	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2300 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.70 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	—	—
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	12.4 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	49.2 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.88 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 18.7 % (k=2)	
Certificate No: Z22-60106		Page 3 of 6	

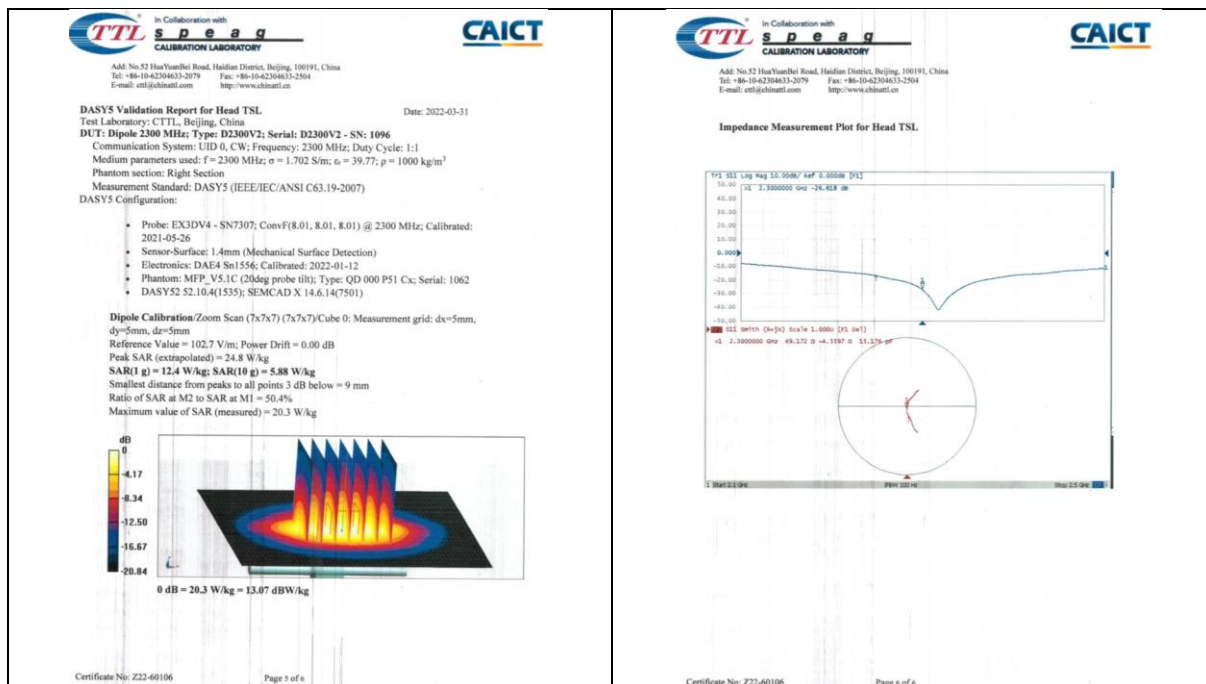
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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	49.20 - 4.56jΩ		
Return Loss	-26.6dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.083 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
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Certificate No: Z22-60106		Page 4 of 6	



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1.10 D2450V2 - SN 817

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

CALIBRATION CERTIFICATE

Object: **D2450V2 - SN: 817**

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

Calibration date: **April 1, 2022**

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

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

Calibration Equipment used (M&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.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	MY46110673	14-Jan-22 (CTTL No.J22X00406)	Jan-23

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

Signature: [Signatures]
Issued: April 6, 2022

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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 655664, "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



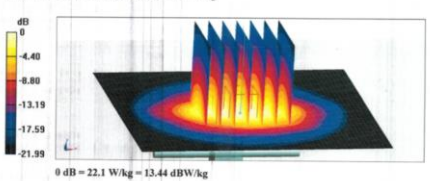
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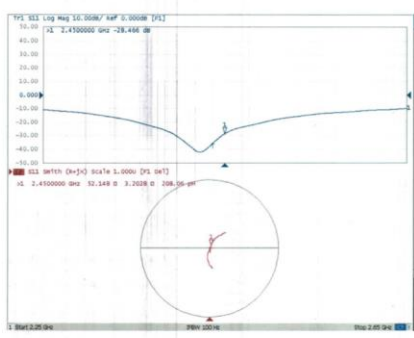
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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2450 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.5 ± 6 %	1.79 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	13.2 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	53.0 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	6.15 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	24.7 W/kg ± 18.7 % (k=2)	
Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	52.10 ± 3.20 Ω		
Return Loss	-28.5 dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.066 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
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DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China Date: 2022-04-01 DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 817 Communication System: UTD 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1 Medium parameters used: f = 2450 MHz; σ = 1.79 S/m; ε _r = 39.52; ρ = 1000 kg/m ³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration: - Probe: EX3DV4 - SN7307; ConvF(7.75, 7.75, 7.75) @ 2450 MHz; Calibrated: 2021-05-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA14 Sn1556; Calibrated: 2022-01-12 - Phantom: MFP_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501) Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 104.6 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 27.0 W/kg SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.15 W/kg Smallest distance from peaks to all points 3 dB below = 8.9 mm Ratio of SAR at M2 to SAR at M1 = -49.2% Maximum value of SAR (measured) = 22.1 W/kg			
			
Certificate No: Z22-60107 Page 5 of 6			

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Impedance Measurement Plot for Head TSL			
			
Certificate No: Z22-60107 Page 6 of 6			



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1.11 D2600V2 - SN 1158

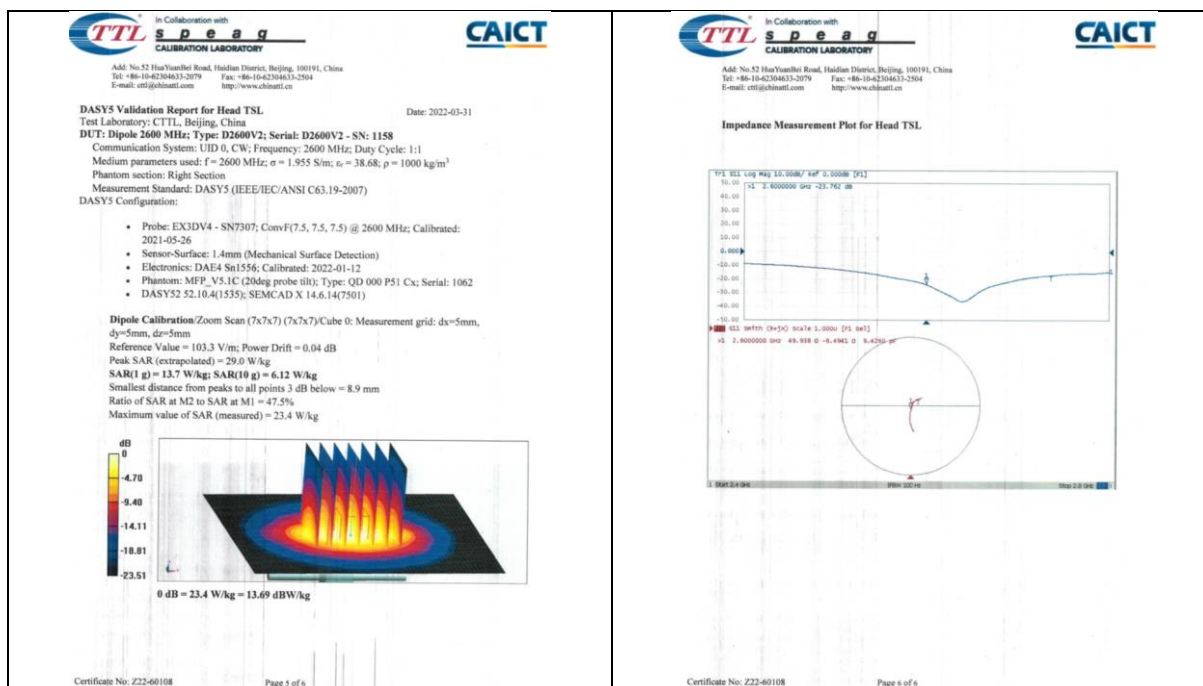
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Client: SGS-CN		Certificate No: Z22-60108	
CALIBRATION CERTIFICATE			
Object	D2600V2 - SN: 1158		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	March 31, 2022		
This calibration Certificate 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	102377	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Power sensor: NRP8S	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Reference Probe EX3DVA	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.Z22X00406)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.Z22X00406)	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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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, dz = 5 mm		
Frequency	2600 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	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	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
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 ² (10 g) of Head TSL	Condition		
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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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	49.90-6.49jΩ		
Return Loss	-23.8dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.053 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		

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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, dz = 5 mm		
Frequency	2600 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	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	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
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 ² (10 g) of Head TSL	Condition		
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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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	49.90-6.49jΩ		
Return Loss	-23.8dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.053 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.			
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		



1.12 D5GHZV2 - SN 1095

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Client: SGS-CN Certificate No: Z22-60187

CALIBRATION CERTIFICATE

Object: D5GHZV2 - SN: 1095

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

Calibration date: June 1, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21008328)	Sep-22
Power sensor NRP8S	104201	24-Sep-21 (CTTL No.J21008328)	Sep-22
Reference Probe EX3DV4	SN 7464	26-Jan-22(SPEAG No EX3-7464, Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG No.Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY48071430	13-Jan-22 (CTTL No.J22000408)	Jan-23
Network Analyzer E5071C	MY48110673	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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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) DASY5 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 station 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 GSEY 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	4.76 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 5200MHz			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	7.79 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	77.8 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	2.22 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg ± 24.2 % (k=2)	
Certificate No: Z22-60187 Page 3 of 10			

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Head TSL parameters at 5300MHz The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	4.73 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL at 5300MHz			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	100 mW input power	7.94 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	79.1 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	100 mW input power	2.27 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	22.6 W/kg ± 24.2 % (k=2)	
Head TSL parameters at 5500MHz The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.8	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 ³ (1 g) of Head TSL	Condition		
SAR measured	100 mW input power	8.29 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	100 mW input power	2.34 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ± 24.2 % (k=2)	
Certificate No: Z22-60187 Page 4 of 10			

In Collaboration with TTL s p e a g CALIBRATION LABORATORY		CAICT	
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Head TSL parameters at 5600MHz The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL at 5600MHz			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	100 mW input power	8.12 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	80.8 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	100 mW input power	2.30 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	22.9 W/kg ± 24.2 % (k=2)	
Head TSL parameters at 5800MHz The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	5.25 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL at 5800MHz			
SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	100 mW input power	7.71 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	76.7 W/kg ± 24.4 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	100 mW input power	2.16 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	21.8 W/kg ± 24.2 % (k=2)	
Certificate No: Z22-60187 Page 5 of 10			

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL at 5200MHz			
Impedance, transformed to feed point	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		
Certificate No: Z22-60187 Page 6 of 10			

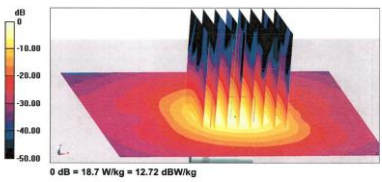
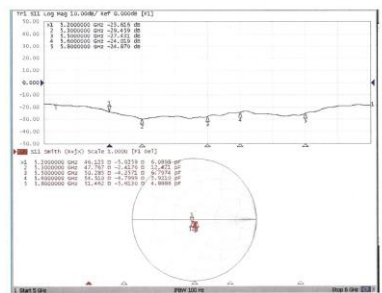


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t(86-512)57355888 f(86-512)57370818 sgs.china@sgs.com

In Collaboration with TTL s p e a q CALIBRATION LABORATORY CAICT Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn General Antenna Parameters and Design 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. Additional EUT Data Manufactured by SPEAG Certificate No: Z22-60187 Page 7 of 10	In Collaboration with TTL s p e a q CALIBRATION LABORATORY CAICT Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China Date: 2022-06-01 DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1095 Communication System: CW; Frequency: 5200 MHz; Frequency: 5300 MHz; Frequency: 5500 MHz; Frequency: 5600 MHz; Frequency: 5800 MHz; Duty Cycle: 1:1 Medium parameters used: $f = 5200 \text{ MHz}$; $\sigma = 4.62 \text{ S/m}$; $\epsilon_r = 35.19$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 4.73 \text{ S/m}$; $\epsilon_r = 35.19$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 4.939 \text{ S/m}$; $\epsilon_r = 34.83$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.051 \text{ S/m}$; $\epsilon_r = 34.89$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.247 \text{ S/m}$; $\epsilon_r = 34.42$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration: - Probe: EX3DV4 - SN7484; ConvF(5.6, 5.6) @ 5200 MHz; ConvF(5.32, 5.32) @ 5300 MHz; ConvF(5.11, 5.11) @ 5500 MHz; ConvF(4.91, 4.91) @ 5600 MHz; ConvF(5, 5) @ 5800 MHz; Calibrated: 2022-01-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA64 Sn1556; Calibrated: 2022-01-12 - Phantom: MPF_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501) Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 60.80 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 29.8 W/kg SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.22 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 66.8% Maximum value of SAR (measured) = 18.3 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 61.08 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.5% Maximum value of SAR (measured) = 19.0 W/kg Certificate No: Z22-60187 Page 8 of 10
In Collaboration with TTL s p e a q CALIBRATION LABORATORY CAICT Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 61.92 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 34.7 W/kg SAR(1 g) = 8.28 W/kg; SAR(10 g) = 2.34 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 63.9% Maximum value of SAR (measured) = 20.2 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.08 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 35.2 W/kg SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 62.5% Maximum value of SAR (measured) = 19.1 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 62.13 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 34.8 W/kg SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.16 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 61.6% Maximum value of SAR (measured) = 18.7 W/kg  Certificate No: Z22-60187 Page 9 of 10	In Collaboration with TTL s p e a q CALIBRATION LABORATORY CAICT Address: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: cn@sgs.com http://www.caict.ac.cn Impedance Measurement Plot for Head TSL  Certificate No: Z22-60187 Page 10 of 10

2 DAE4 - SN 1245

Schmid & Partner Engineering AG Zughausstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9770 www.spgs.ch, info@spgs.ch s p e a g IMPORTANT NOTICE USAGE OF THE DAE4 The DAE4 unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE4. Special attention shall be given to the following points: Battery Exchange: The battery cover of the DAE4 unit is fixed using a screw, over tightening the screw may cause the threads inside the DAE4 to wear out. Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an anti-static bag. This anti-static bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside. E-stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE4 carefully and keep the DAE4 unit in a non-dusty environment if not used for measurements. Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect. DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE4 unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file. Important Note: Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer. Important Note: Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure. Important Note: To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE. TN_EH190306AE DAE4.docx 07.03.2019	Calibration Laboratory of Schmid & Partner Engineering AG Zughausstrasse 43, 8004 Zurich, Switzerland Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Accreditation No.: SCS 0108 Client: SGS-CN (Auden) Certificate No.: DAE4-1245_May22 CALIBRATION CERTIFICATE Object: DAE4 - SD 000 D04 BM - SN: 1245 Calibration procedure(s): QA CAL-06 v30 Calibration procedure for the data acquisition electronics (DAE) Calibration date: May 30, 2022 This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility; environment temperature (22 ± 3) °C and humidity < 70%. Calibration Equipment used (MATE critical for calibration) <table border="1"><thead><tr><th>Primary Standards</th><th>ID #</th><th>Cal Date (Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Kelvin Multimeter Type 2001</td><td>SN: 0810276</td><td>31-Aug-21 (No.31368)</td><td>Aug-22</td></tr></tbody></table> <table border="1"><thead><tr><th>Secondary Standards</th><th>ID #</th><th>Check Date (in house)</th><th>Scheduled Check</th></tr></thead><tbody><tr><td>Auto DAE Calibration Unit</td><td>SE LWS 003 AA 1001</td><td>24-Jan-22 (in house check)</td><td>In house check: Jan-23</td></tr><tr><td>Calibrator Blue V2.1</td><td>SE LWS 006 AA 1002</td><td>24-Jan-22 (in house check)</td><td>In house check: Jan-23</td></tr></tbody></table> Calibrated by: Dominique Stettin Function: Laboratory Technician Signature: <i>[Signature]</i> Approved by: Ben Kohn Technical Manager Signature: <i>[Signature]</i> This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: May 30, 2022 Certificate No: DAE4-1245_May22 Page 1 of 5	Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Kelvin Multimeter Type 2001	SN: 0810276	31-Aug-21 (No.31368)	Aug-22	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Auto DAE Calibration Unit	SE LWS 003 AA 1001	24-Jan-22 (in house check)	In house check: Jan-23	Calibrator Blue V2.1	SE LWS 006 AA 1002	24-Jan-22 (in house check)	In house check: Jan-23
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Calibration Laboratory of Schmid & Partner Engineering AG Zughausstrasse 43, 8004 Zurich, Switzerland Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Accreditation No.: SCS 0108 Glossary DAE: data acquisition electronics Connector angle: information used in DASY system to align probe sensor X to the robot coordinate system. Methods Applied and Interpretation of Parameters • DC Voltage Measurement: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range. • Connector angle: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required. • The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty. • DC Voltage Measurement Linearity: Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement. • Common mode sensitivity: Influence of a positive or negative common mode voltage on the differential measurement. • Channel separation: Influence of a voltage on the neighbor channels not subject to an input voltage. • AD Converter Values with inputs shorted: Values on the internal AD converter corresponding to zero input voltage. • Input Offset Measurement: Output voltage and statistical results over a large number of zero voltage measurements. • Input Offset Current: Typical value for information; Maximum channel input offset current, not considering the input resistance. • Input resistance: Typical value for information; DAE input resistance at the connector, during internal auto-zeroing and during measurement. • Low Battery Alarm Voltage: Typical value for information. Below this voltage, a battery alarm signal is generated. • Power consumption: Typical value for information. Supply currents in various operating modes. Certificate No: DAE4-1245_May22 Page 2 of 5	DC Voltage Measurement AD - Converter Resolution nominal High Range: 1LSB = 6.1 μV, full range = -190...+320 mV Low Range: 1LSB = 61 μV, full range = -1...+3 mV DASY measurement parameters: Auto Zero-Time: 3 sec; Measuring time: 3 sec <table border="1"><thead><tr><th>Calibration Factors</th><th>X</th><th>Y</th><th>Z</th></tr></thead><tbody><tr><td>High Range</td><td>405.265 ± 0.02% (k=2)</td><td>403.974 ± 0.02% (k=2)</td><td>406.092 ± 0.02% (k=2)</td></tr><tr><td>Low Range</td><td>3.99534 ± 1.50% (k=2)</td><td>3.99508 ± 1.50% (k=2)</td><td>4.01015 ± 1.50% (k=2)</td></tr></tbody></table> Connector Angle <table border="1"><thead><tr><th>Connector Angle to be used in DASY system</th><th>30.0° ± 1°</th></tr></thead></table> Certificate No: DAE4-1245_May22 Page 3 of 5	Calibration Factors	X	Y	Z	High Range	405.265 ± 0.02% (k=2)	403.974 ± 0.02% (k=2)	406.092 ± 0.02% (k=2)	Low Range	3.99534 ± 1.50% (k=2)	3.99508 ± 1.50% (k=2)	4.01015 ± 1.50% (k=2)	Connector Angle to be used in DASY system	30.0° ± 1°						
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	19994.45	1.52	0.00
Channel X + Input	20004.58	2.22	0.01
Channel X - Input	-20000.14	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	200.54	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	-7.79
Channel X -200	9.12	7.79
Channel Y 200	-8.68	-9.28
Channel Y -200	8.52	6.36
Channel Z 200	-5.36	-5.60
Channel Z -200	3.58	3.08

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	-	4.07
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	16562	16768
Channel Z	16035	15668

5. Input Offset Measurement

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

Input 10MΩ	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	1.00	-0.15	1.93	0.45
Channel Y	-0.18	-1.28	0.94	0.45
Channel Z	-0.58	-2.61	0.58	0.60

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

	Zeroing (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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Client: SGS-CN (Auden)	Certificate No: EX-7767_Oct22
CALIBRATION CERTIFICATE	
Object: EX3DV4 - SN:7767	
Calibration procedure(s): QA CAL-01-v9, QA CAL-12-v9, QA CAL-14-v6, QA CAL-23-v5, QA CAL-25-v7 Calibration procedure for dosimetric E-field probes	
Calibration date: October 28, 2022	
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3) °C and humidity < 70%.	
Calibration Equipment used (DATE critical for calibration)	
Primary Standards	ID
Power meter NRP	SN: 104778
Power sensor NRP-201	SN: 103944
DCP DAK-12	SN: 1548
Reference 20 dB Attenuator	SN: 1018
DAE4	SN: 981
Reference Probe E53202	SN: 3013
Secondary Standards	ID
Power meter E4418B	SN: G841268474
Power sensor E4418A	SN: 1041449687
Power sensor E4415A	SN: 1005112510
RF generator HP 8540C	SN: US840201705
Network Analyzer F855A	SN: G84149417
Calibrated by: Name: Adonis Georgiadou Function: Laboratory Technician Signature: [Signature]	
Approved by: Sven Kuhn Technical Manager Signature: [Signature]	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.	
Issued: October 31, 2022	
Certificate No: EX-7767_Oct22	Page 1 of 8

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Glossary	
TSL	Issue simulating liquid
NORMA _{xyz}	sensitivity in free space
ConF	sensitivity in TSL, NORMA _{xyz}
DCP	diode compression point
CF	crest factor (100µs cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization	φ rotation around probe axis
Connector Angle	φ rotation around air axis that is in the plane normal to probe axis (at measurement center), i.e., φ = 0 is normal to probe axis
Information used in DASY system to align probe sensor X to the robot coordinate system	
Calibration is Performed According to the Following Standards:	
a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.	
b) IEC 609584, "SAR Measurement Requirements for 100 MHz to 6 GHz"	
Methods Applied and Interpretation of Parameters:	
• NORMA _{xyz} : Assessed for E-field polarization φ = 0 (f = 900 MHz in TEM-cell; f = 1800 MHz: R22 waveguide). NORMA _{xyz} are only intermediate values, i.e., the uncertainties of NORMA _{xyz} does not affect the E-field uncertainty made TSL (see below ConF).	
• NORMA _{xyz} = NORMA _{xyz} * Frequency response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConF.	
• DCP _{xyz} : DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media.	
• PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.	
• A _{xyz} , B _{xyz} , C _{xyz} , D _{xyz} , V _{RF,xyz} : A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media, V _{RF} is the maximum calibration range expressed in RMS voltage across the diode.	
• ConF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f > 800 MHz) and made 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. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMA _{xyz} * ConF whereby the uncertainty corresponds to that given for ConF. A frequency dependent ConF is used in DASY4 version 4.4 and higher which allows extending the validity from < 50 MHz to > 100 MHz.	
• Spherical anisotropy (3D deviation from isotropy): In a field of low gradients realized using a flat phantom exposed by a patch antenna.	
• Sensor Offset: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.	
• Connector Angle: The angle is assessed using the information gained by determining the NORMA (no uncertainty required).	
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Parameters of Probe: EX3DV4 - SN:7767	
Basic Calibration Parameters	
Norm (μA/(Vmm ²)) ^A	Sensor X
DCP (mV) ^B	Sensor Y
	Sensor Z
	Unc (k = 2)
	0.87
	0.89
	0.56
	±10.1%
	103.4
	107.3
	105.7
	±4.7%

Calibration Results for Modulation Response	
URS	Communication System Name
	A
	B
	C
	D
	VR
	Max
	Max
	Unc ^C
	k = 2
0	CW
	X
	Y
	Z
	0.00
	0.00
	0.00
	0.00
	184.7
	±3.5%
	±4.7%
	179.3

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

^A The uncertainties of Norm X,Y,Z do not affect the 95% field uncertainty inside TSS (see Page 5).

^B Uncertainty parameter uncertainty for maximum specified field strength.

^C Uncertainty is determined using the max. deviation from three responses applying rectangular distribution and is expressed for the square of the field value.

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Parameters of Probe: EX3DV4 - SN:7767	
Other Probe Parameters	
Sensor Arrangement	Triangular
Connector Angle	144.8°
Mechanical Surface Detection Mode	angled
Optical Surface Detection Mode	displaced
Probe Overall Length	337mm
Probe Body Diameter	3mm
Tip Length	15mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

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

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AK3DV4 - SN:7767

October 28, 2021

Parameters of Probe: EX3DV4 - SN:7767

Calibration Parameter Determined in Head Tissue Simulating Media

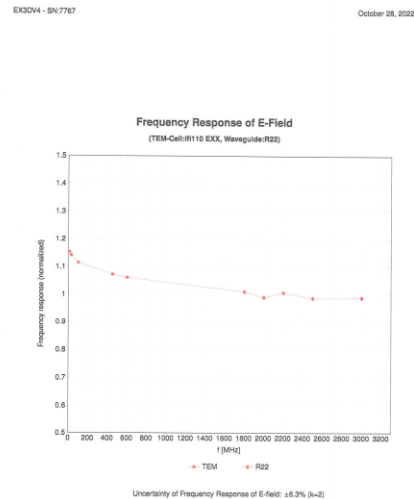
f (MHz) ^D	Relative Permittivity ^E	Conductivity ^F (S/m)	CompF X	CompF Y	CompF Z	Alpha ^G	Depth ^H (mm)	Unc (k = 2)
150	82.3	0.79	14.08	14.08	14.08	0.00	1.00	±13.2%
450	43.5	0.97	11.90	11.90	11.90	0.16	1.20	±13.3%
750	41.9	0.99	10.26	10.26	10.26	0.00	0.80	±12.0%
835	41.5	0.90	10.00	10.00	10.00	0.43	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	0.80	±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	0.86	±12.0%
3800	38.2	2.71	7.55	7.55	7.55	0.30	1.25	±13.1%
3800	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	1.25	±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	0.40	1.80	±13.1%
4900	36.3	4.40	6.07	6.07	6.07	0.40	1.80	±13.1%
5200	36.0	4.66	5.65	5.65	5.65	0.40	1.80	±13.1%
5300	35.9	4.76	5.48	5.48	5.48	0.40	1.80	±13.1%
5500	35.6	4.96	5.30	5.30	5.30	0.40	1.80	±13.1%
5800	35.5	5.07	5.14	5.14	5.14	0.40	1.80	±13.1%
5800	35.3	5.27	5.10	5.10	5.10	0.40	1.80	±13.1%

^D Frequency validity above 300 MHz at ±100 MHz only applies for CDP v4.4 and higher (see Page 5), while it is extended to ±50 MHz. The uncertainty is the 95% of the CompF parameter at calibration frequency and the uncertainty for the relative permittivity term. Frequency validity below 300 MHz is ±1%, 25, 40, 50 and 70 MHz for CDP v4.4, v4.5, v4.6, v4.7, v4.8, v4.9 and 100 MHz for CDP v5.0 respectively. Validity of CompF assessed at 60 MHz is ±1.40%, and CompF assessed at 150 MHz is 0.16%, below 300 MHz the validity of CompF is 0.16%.

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

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

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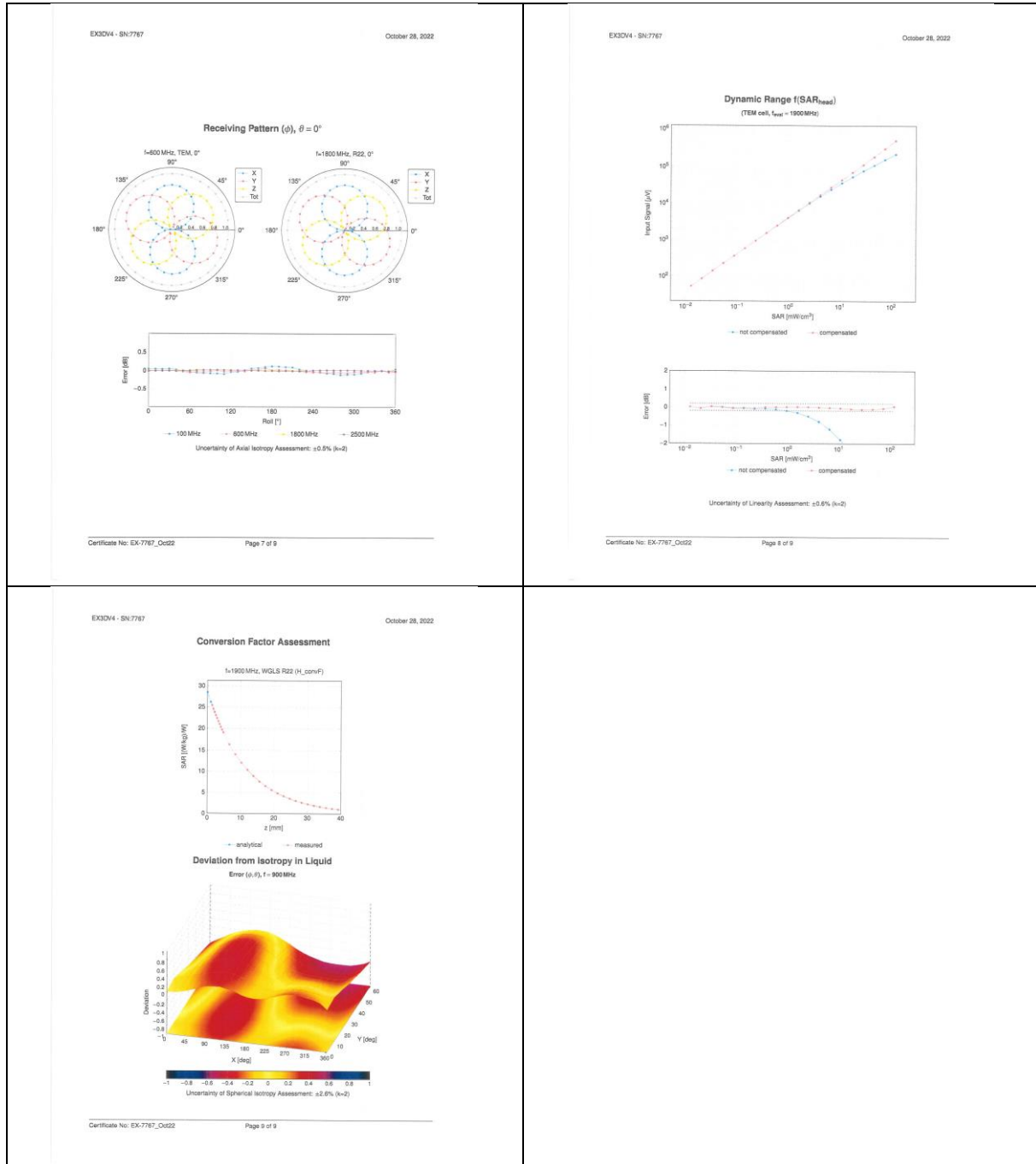


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4 Impedance and return loss

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



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