

Appendix C for KSCR240300047301

Calibration Certificate

Object	Apply	No	Model	SN	Calibration Date	Due date of calibration
Dipole	☐	1	D750V3	1188	2022/03/29	2025/03/28
	☒	2	D835V2	4d114	2022/03/31	2025/03/30
	☐	3	D900V2	1d079	2022/06/07	2025/06/06
	☒	4	D1800V2	2d170	2022/03/31	2025/03/30
	☒	5	D1900V2	5d136	2022/06/07	2025/06/06
	☐	6	D2000V2	1041	2022/06/06	2025/06/05
	☐	7	D2300V2	1096	2022/03/31	2025/03/30
	☒	8	D2450V2	817	2022/04/01	2025/03/31
	☒	9	D2600V2	1158	2022/03/31	2025/03/30
	☐	10	D5GHzV2	1095	2022/06/01	2025/05/31
DAE	☒	11	DAE4ip	1826	2023/12/27	2024/12/26
Probe	☒	12	EX3DV4	7833	2023/08/24	2024/08/23

1 Dipole

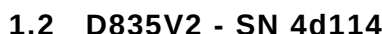
1.1 D750V3 - SN 1188

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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 29, 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.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	MY48071430	13-Jan-22 (CTTL No.J22X00409)	Jan-23
Network Analyzer E5071C	MY48110873	14-Jan-22 (CTTL No.J22X00406)	Jan-23
Calibrated by:	Name: Zhao Jing	Function: SAR Test Engineer	Signature: [Signature]
Reviewed by:	Name: Lin Hao	Function: SAR Test Engineer	Signature: [Signature]
Approved by:	Name: Qi Dianyan	Function: SAR Project Leader	Signature: [Signature]
Issued: April 3, 2022			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Certificate No: Z22-60103		Page 1 of 6	

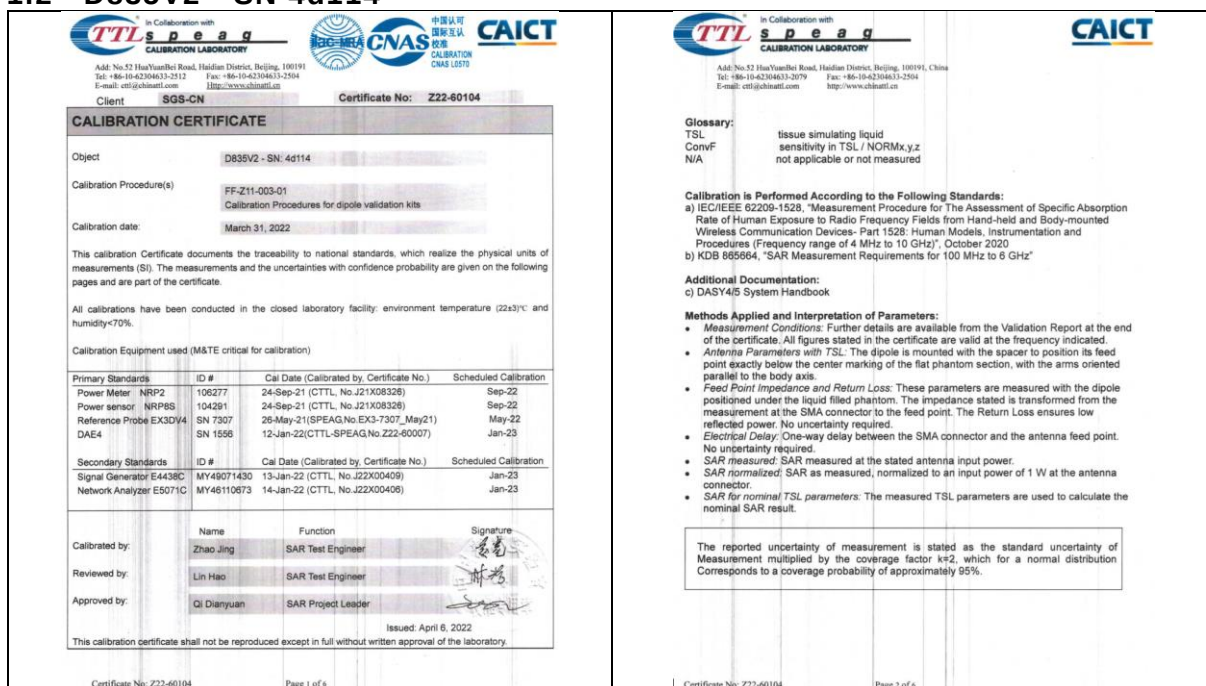
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Glossary: TSL: tissue simulating liquid Conf: sensitivity in TSL / NORM x y z N/A: not applicable or not measured			
Calibration is Performed According to the Following Standards: a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of 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) DAS74/5 System Handbook			
Methods Applied and Interpretation of Parameters: • Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. • Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis. • Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required. • Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required. • SAR measured: SAR measured at the stated antenna input power. • SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector. • SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.			
Certificate No: Z22-60103		Page 2 of 6	

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Measurement Conditions DASY system configuration, as far as not given on page 1.			
DASY Version	DASY52	V52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	750 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	42.0	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.4 ± 6 %	0.89 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	2.07 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	8.27 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	1.37 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	5.48 W/kg ± 18.7 % (k=2)	
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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	

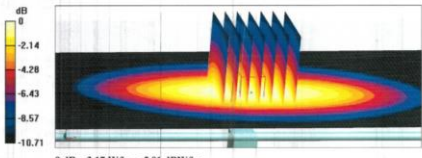


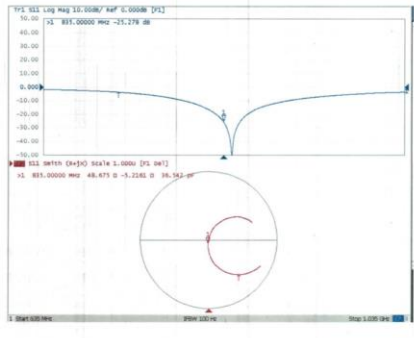
1.2 D835V2 - SN 4d114



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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.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	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 $\pm$ 18.8 % (k=2)	
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	1.54 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	6.12 W/kg $\pm$ 18.7 % (k=2)	
Certificate No: Z22-60104 Page 3 of 6			

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	48.70 - j22jQ		
Return Loss	-25.3dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.307 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60104 Page 4 of 6			

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DASY5 Validation Report for Head TSL Test Laboratory: CTTL, Beijing, China 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: DA4 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 14.6.14(7501) Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 57.88 V/m; Power Drift = 0.04 dB Peak SAR (extrapolated) = 3.56 W/kg SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.54 W/kg Smallest distance from peaks to all points 3 dB below = 15.8 mm Ratio of SAR at M2 to SAR at M1 = 66.2% Maximum value of SAR (measured) = 3.17 W/kg			
			
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Impedance Measurement Plot for Head TSL			
			
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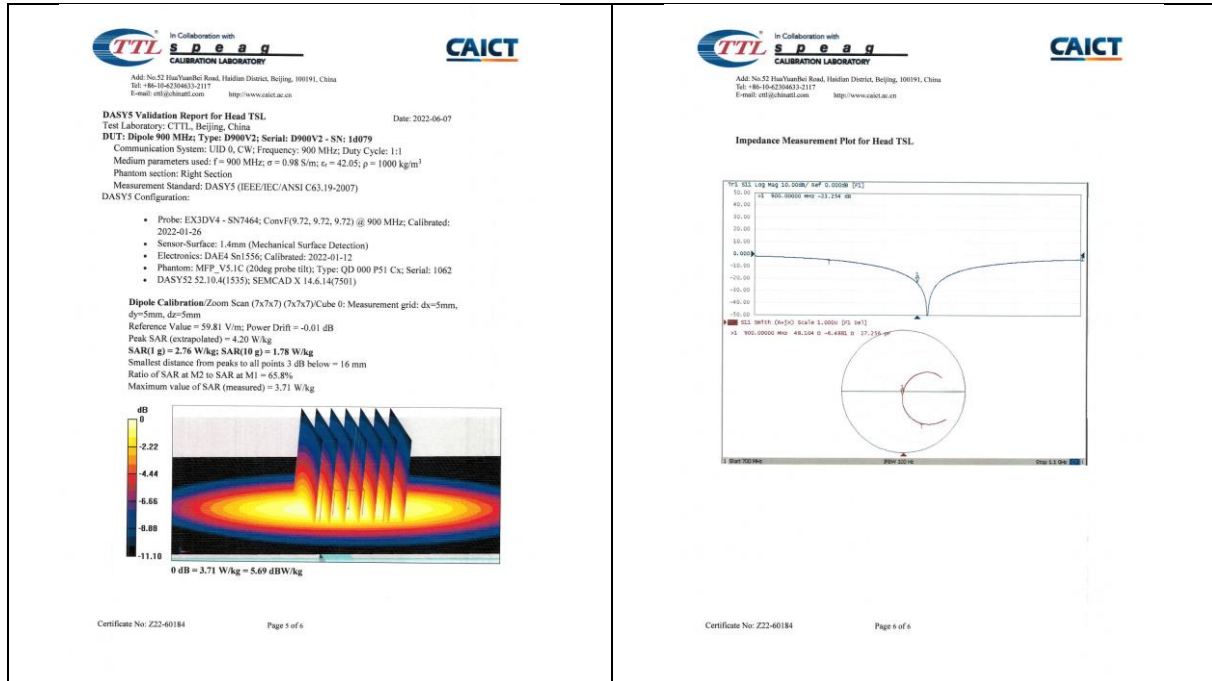
1.3 D900V2 - SN 1d079

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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 (MATE 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 7464	28-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.J22X00409)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X00409)	Jan-23
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyan	SAR Project Leader	
Issued: June 13, 2022			
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Certificate No: Z22-60184		Page 1 of 6	

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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	15 mm	with Spacer	
Zoom Scan Resolution	dk, dz: 5 mm		
Frequency	900 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied.			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.97 nholm
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.98 nholm ± 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	2.70 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	11.0 W/kg ± 18.5 % (k=2)	
SAR averaged over 10 cm ² (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)	
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: 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			
Impedance, transformed to feed point	48.10 - 8.49jΩ		
Return Loss	-23.3 dB		
General Antenna Parameters and Design			
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			
Manufactured by	SPEAG		
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1.4 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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Glossary:
TSL: tissue simulating liquid
ConvF: sensitivity in TSL / NORMx.y.z
N/A: not applicable or not measured

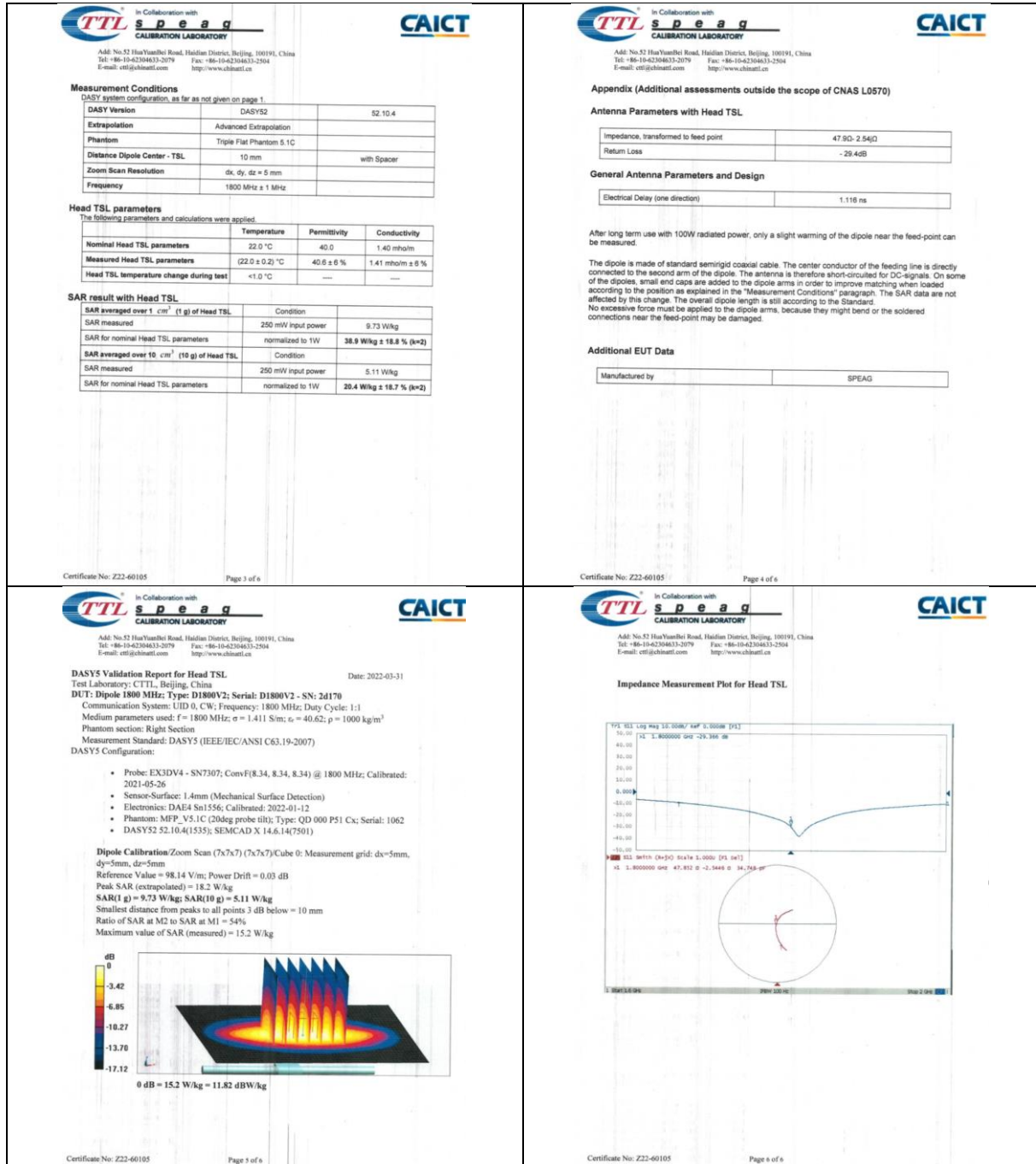
Calibration is Performed According to the Following Standards:
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation 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



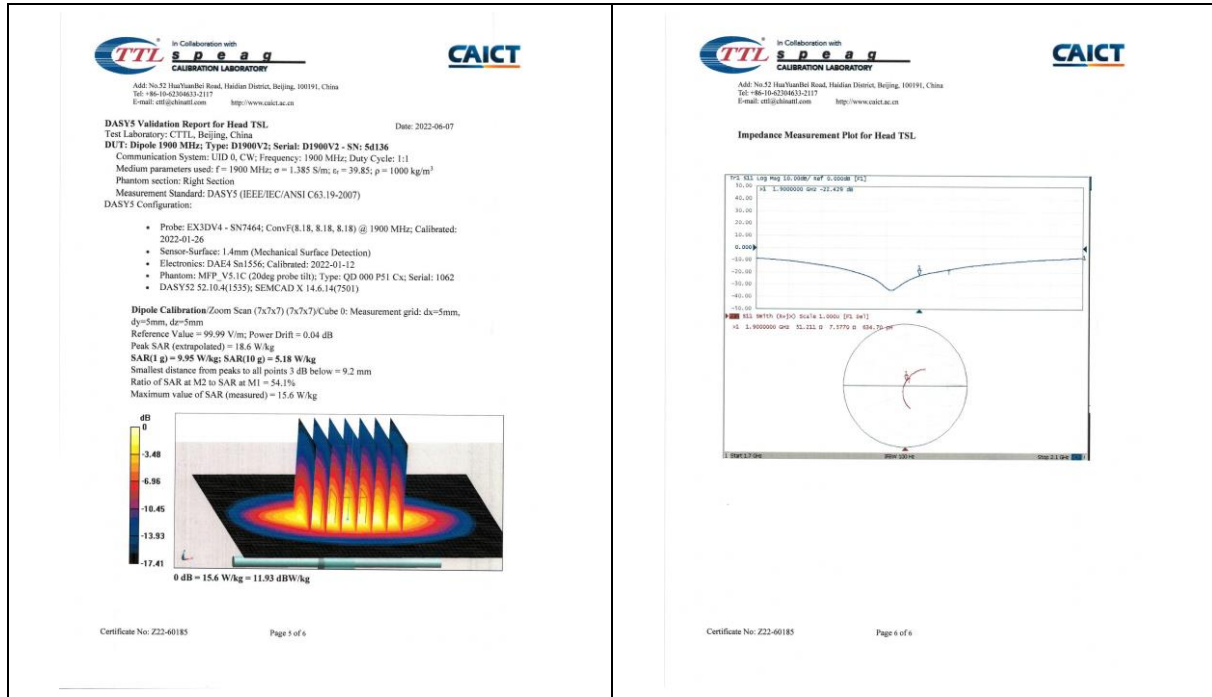
1.5 D1900V2 - SN 5d136

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Client	SGS-CN	Certificate No.	Z22-60185
CALIBRATION CERTIFICATE			
Object	D1900V2 - SN: 5d136		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	June 7, 2022		
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature (23±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 NRP65	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Reference Probe EXSDV4	SN 7464	28-Jan-22(SPEAG No EX3-7464_Jan22)	Jan-23
DAE4	SN 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.J22X00409)	Jan-23
Network Analyzer E5071C	MY48110073	14-Jan-22 (CTTL No.J22X00409)	Jan-23
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyan	SAR Project Leader	
Issued: June 13, 2022			
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Certificate No: Z22-60185		Page 1 of 6	

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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 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: Z22-60185		Page 2 of 6	

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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	1900 MHz ± 1 MHz		
Head TSL parameters			
The following parameters and calculations were applied:			
Nominal Head TSL parameters	Temperature	Permittivity	Conductivity
	32.0 °C	40.0	1.40 nS/m
Measured Head TSL parameters	(22.0 ± 0.3) °C	39.9 ± 6 %	1.39 nS/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	9.65 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	40.0 W/kg ± 16.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.18 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg ± 18.7 % (k=2)	
Certificate No: Z22-60185		Page 3 of 6	

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	51.02 ± 7.58Ω		
Return Loss	-22.4dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.109 ns		
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured.			
The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. On some of the dipoles, small and caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60185		Page 4 of 6	



1.6 D2000V2 - SN 1041

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E-mail: cti@tstl.com.cn http://www.caict.ac.cn

Client: **SGS-CN** Certificate No: **Z22-60186**

CALIBRATION CERTIFICATE

Object: **D2000V2 - SN: 1041**

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

Calibration date: **June 8, 2022**

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (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 (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. J21X08328)	Sep-22
Power sensor NRP8S	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. J22X00409)	Jan-23
Network Analyzer E5071C	MY48110673	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 Danyuan** SAR Project Leader

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Certificate No: Z22-60186 Page 1 of 6

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E-mail: cti@tstl.com.cn http://www.caict.ac.cn

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

Calibration is Performed According to the Following Standards:
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) KDS 865964, "SAR Measurement Requirements for 100 MHz to 8 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: Z22-60186 Page 2 of 6

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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 S.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 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg ± 16.7 % (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	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 end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 2022-06-06

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/m³

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7464; ConvF(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: S2.10.4(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

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Impedance Measurement Plot for Head TSL

Certificate No: Z22-60186

Page 6 of 6

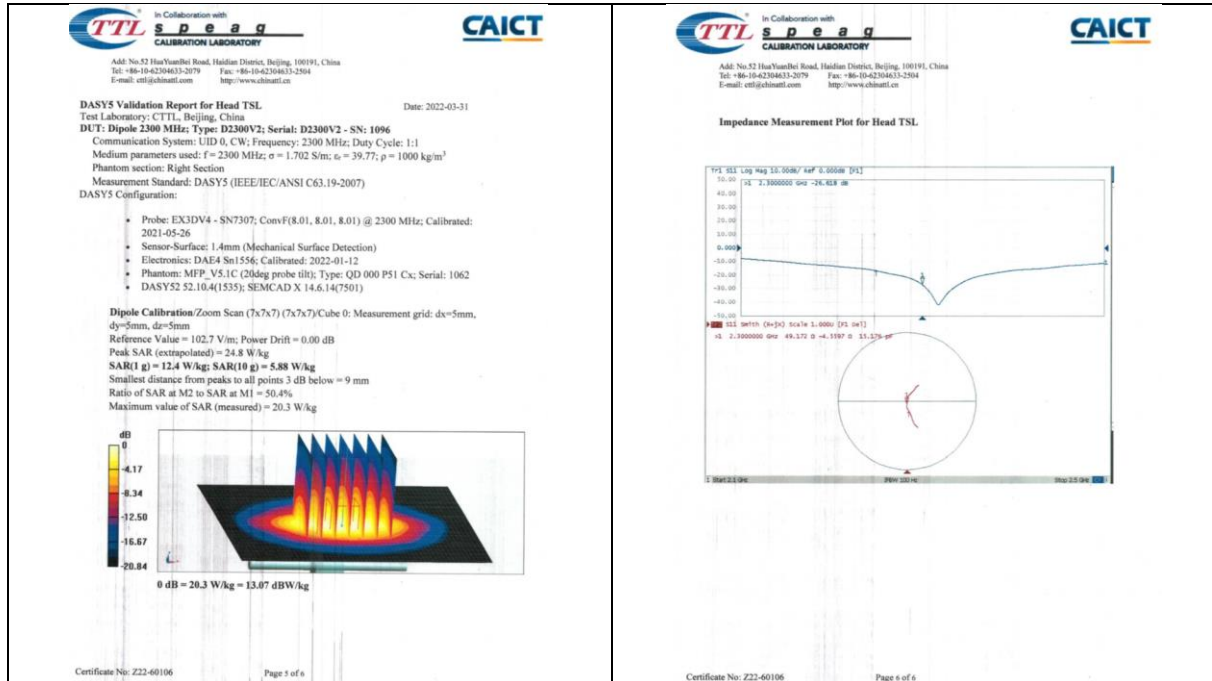
1.7 D2300V2 - SN 1096

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Client	SGS-CN	Certificate No.	Z22-60106
CALIBRATION CERTIFICATE			
Object	D2300V2 - SN: 1096		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	March 31, 2022		
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature (22±3)°C and humidity <70%.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	108277	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Reference Probe 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.J22X04046)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X04046)	Jan-23
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Diqiyuan	SAR Project Leader	
Issued: April 6, 2022			
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Measurement Conditions DASY system configuration, as far as not given on page 1:			
DASY Version	DASY32	52.10.4	
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	10 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	2300 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.5	1.67 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.70 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	---	---
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	12.4 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	49.2 W/kg ± 18.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	5.88 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 18.7 % (k=2)	
Certificate No: Z22-60106		Page 3 of 6	

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Glossary:			
TSL	Issue simulating liquid		
ConvF	sensitivity in TSL / NORMx,y,z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
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: Z22-60106		Page 2 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			
Manufactured by	SPEAG		
Certificate No: Z22-60106		Page 4 of 6	



1.8 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-Q1**
Calibration Procedures for dipole validation kits

Calibration date: **April 1, 2022**

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

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

Calibration Equipment used (M&E critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter: NRP2	106277	24-Sep-21 (CTTL No.J21X08320)	Sep-22
Power sensor: NRP8S	104291	24-Sep-21 (CTTL No.J21X08320)	Sep-22
Reference Probe EX3DV4	SN 7307	26-May-21(SPEAG No EX3-7307_May21)	May-22
DAE4	SN 1556	12-Jan-22(CTTL-SPEAG No Z22-60007)	Jan-23

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

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

Issued: April 6, 2022

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

Certificate No: Z22-60107 Page 1 of 6

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

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

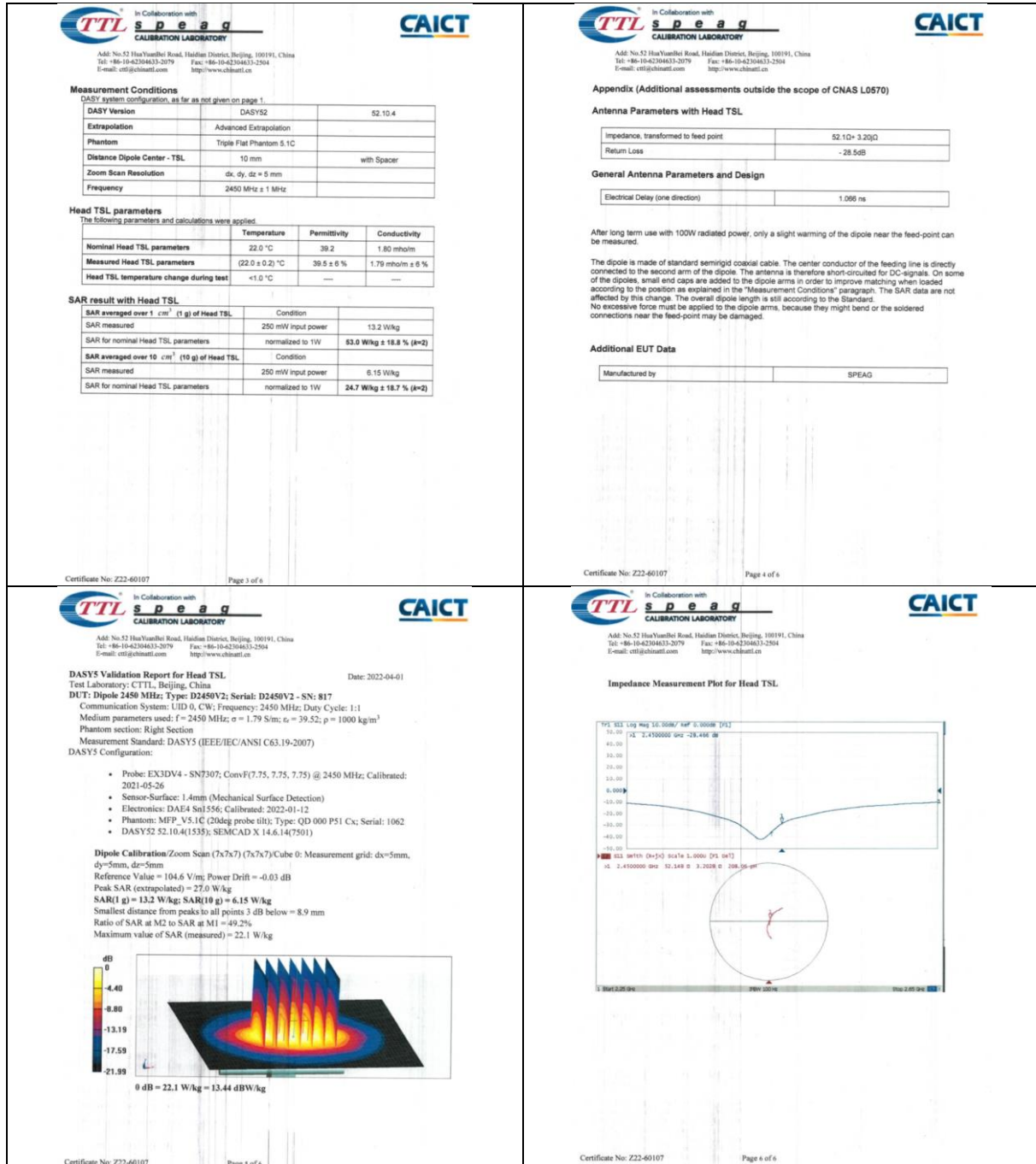
Additional Documentation:
c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60107 Page 2 of 6



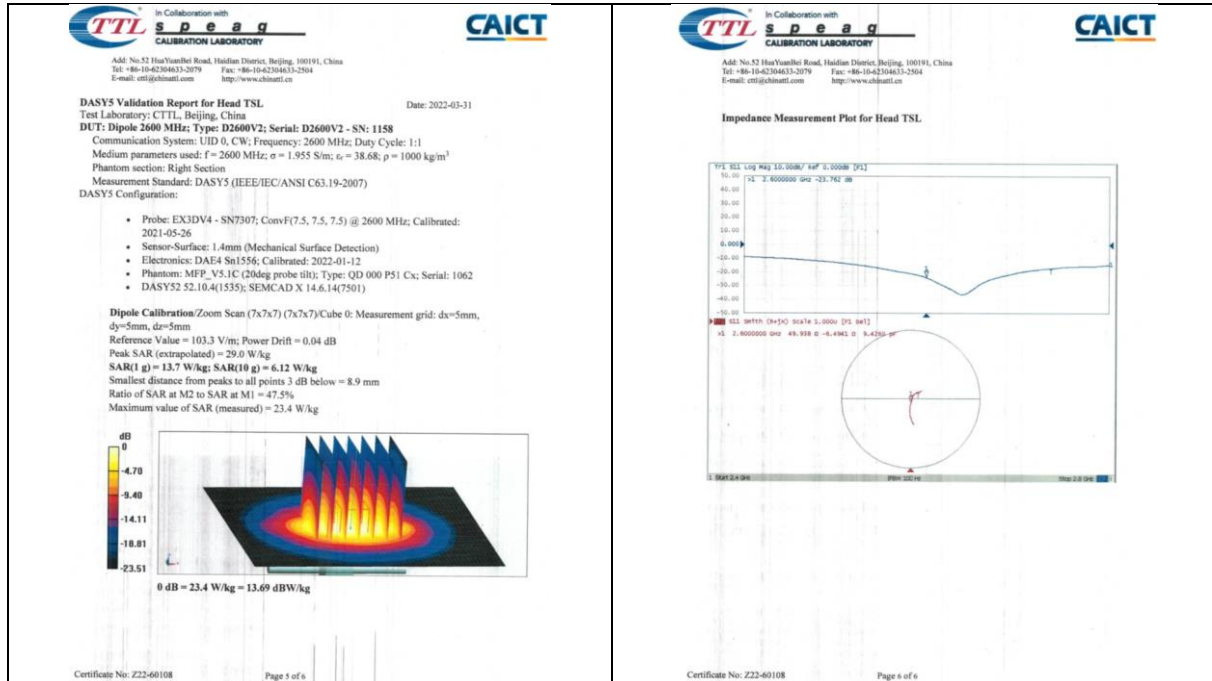
1.9 D2600V2 - SN 1158

TTL Speaq CALIBRATION LABORATORY		CAICT	
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191 Tel: +86-10-42304633-2512 Fax: +86-10-42304633-2504 E-mail: cti@chinafl.com.cn http://www.chinafl.cn		Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42304633-2579 Fax: +86-10-42304633-2504 E-mail: cti@chinafl.com.cn http://www.chinafl.cn	
Client: SGS-CN		Certificate No: Z22-40108	
CALIBRATION CERTIFICATE			
Object	D2600V2 - SN: 1158		
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	March 31, 2022		
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 1158	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: Zhao Jing	Function: SAR Test Engineer	Signature: [Signature]
Reviewed by:	Name: Lin Hao	Function: SAR Test Engineer	Signature: [Signature]
Approved by:	Name: Qi Dianyan	Function: SAR Project Leader	Signature: [Signature]
Issued: April 6, 2022			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Certificate No: Z22-40108		Page 1 of 6	

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	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)	

TTL Speaq CALIBRATION LABORATORY		CAICT	
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Glossary:			
TSL	tissue simulating liquid		
ConvF	sensitivity in TSL / NORMx.y.z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices - Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020			
b) KDB 865864, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation:			
c) DASY4/S System Handbook			
Methods Applied and Interpretation of Parameters:			
• Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.			
• Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.			
• Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.			
• Electrical Delay: One-way delay between the SMA connector and the antenna feed point. No uncertainty required.			
• SAR measured: SAR measured at the stated antenna input power.			
• SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.			
• SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.			
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.			

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
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		



1.10 D5GHZV2 - SN 1095

TTL Speaq
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62104633-2079 Fax: +86-10-62104633-2504
E-mail: cti@china.ttl.com http://www.china.ttl.com

CAICT

Client: SGS-CN Certificate No: Z22-60187

CALIBRATION CERTIFICATE

Object: D5GHZV2 - SN: 1095

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

Calibration date: June 1, 2022

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21X08328)	Sep-22
Power sensor NRP8S	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	MY48071430	13-Jan-22 (CTTL No. J22X00409)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No. J22X00406)	Jan-23

Calibrated by: Zhao Jing SAR Test Engineer

Reviewed by: Lin Hao SAR Test Engineer

Approved by: Qi Dianyan SAR Project Leader

Issued: June 6, 2022

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

Certificate No: Z22-60187 Page 1 of 10

TTL Speaq
CALIBRATION LABORATORY

Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62104633-2079 Fax: +86-10-62104633-2504
E-mail: cti@china.ttl.com http://www.china.ttl.com

CAICT

Glossary:

TSL: Issue simulating liquid

CompF: 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:

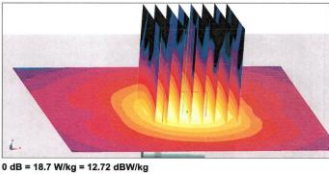
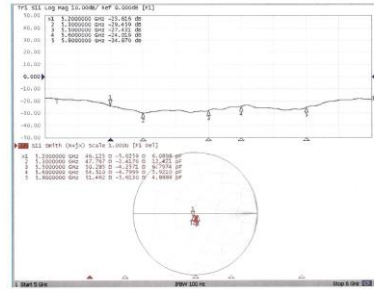
c) DASY4/5 System Handbook

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%.

Certificate No: Z22-60187 Page 2 of 10

In Collaboration with TTL CALIBRATION LABORATORY Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@china.ttl.com http://www.caict.ac.cn CAICT General Antenna Parameters and Design <table border="1"><tr><td>Electrical Delay (one direction)</td><td>1.101 ns</td></tr></table> After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged. Additional EUT Data <table border="1"><tr><td>Manufactured by</td><td>SPEAG</td></tr></table> Certificate No: Z22-60187 Page 7 of 10	Electrical Delay (one direction)	1.101 ns	Manufactured by	SPEAG	In Collaboration with TTL CALIBRATION LABORATORY Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@china.ttl.com http://www.caict.ac.cn CAICT DASY5 Validation Report for Head TSL Date: 2022-06-01 Test Laboratory: CTTL, Beijing, China DUT: Dipole 5Ghz; Type: D5GhzV2; Serial: D5GhzV2 - SN: 1095 Communication System: CW; Frequency: 5200 MHz; Frequency: 5300 MHz; Frequency: 5500 MHz; Frequency: 5600 MHz; Frequency: 5800 MHz; Duty Cycle: 1:1 Medium parameters used: f = 5200 MHz; $\sigma = 4.62$ S/m; $\epsilon_r = 35.39$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5300 MHz; $\sigma = 4.73$ S/m; $\epsilon_r = 35.19$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5500 MHz; $\sigma = 4.939$ S/m; $\epsilon_r = 34.83$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5600 MHz; $\sigma = 5.051$ S/m; $\epsilon_r = 34.69$; $\rho = 1000$ kg/m³ Medium parameters used: f = 5800 MHz; $\sigma = 5.247$ S/m; $\epsilon_r = 34.42$; $\rho = 1000$ kg/m³ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007) DASY5 Configuration: - Probe: EX3DV4 - SN7484; ConvF(5.6, 5.6, 5.6) @ 5200 MHz; ConvF(5.32, 5.32, 5.32) @ 5300 MHz; ConvF(5.11, 5.11, 5.11) @ 5500 MHz; ConvF(4.91, 4.91, 4.91) @ 5600 MHz; ConvF(5, 5, 5) @ 5800 MHz; Calibrated: 2022-01-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA64 Sn1556; Calibrated: 2022-01-12 - Phantom: MPF_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501) Dipole Calibration /Pin=100mW, d=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 60.80 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 29.8 W/kg SAR(1 g) = 7.79 W/kg; SAR(10 g) = 2.22 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 66.8% Maximum value of SAR (measured) = 18.3 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 61.08 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 31.5 W/kg SAR(1 g) = 7.94 W/kg; SAR(10 g) = 2.27 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 65.5% Maximum value of SAR (measured) = 19.0 W/kg Certificate No: Z22-60187 Page 8 of 10
Electrical Delay (one direction)	1.101 ns				
Manufactured by	SPEAG				
In Collaboration with TTL CALIBRATION LABORATORY Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@china.ttl.com http://www.caict.ac.cn CAICT Dipole Calibration /Pin=100mW, d=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 61.92 V/m; Power Drift = -0.08 dB Peak SAR (extrapolated) = 34.7 W/kg SAR(1 g) = 8.20 W/kg; SAR(10 g) = 2.34 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 63.9% Maximum value of SAR (measured) = 20.2 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 65.08 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 35.2 W/kg SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 62.5% Maximum value of SAR (measured) = 19.1 W/kg Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 62.13 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 34.8 W/kg SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.16 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 61.6% Maximum value of SAR (measured) = 18.7 W/kg  Certificate No: Z22-60187 Page 9 of 10	In Collaboration with TTL CALIBRATION LABORATORY Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@china.ttl.com http://www.caict.ac.cn CAICT Impedance Measurement Plot for Head TSL  Certificate No: Z22-60187 Page 10 of 10				

2 DAE4IP - SN 1826

Schmid & Partner Engineering AG Zugzwangstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 9700, Fax +41 44 245 9779 www.speag.ch, info@speag.ch s p e a g IMPORTANT NOTICE USAGE OF THE DAE4ip The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points: Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, pack the DAE in an antistatic bag. This antistatic 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 Failure: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements. Repair: Minor repairs are performed at no extra cost during the calibration. However, SPEAG reserves the right to charge for any repair especially if rough/unprofessional handling caused the defect. DASY Configuration File: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MΩ 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 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. TM_EH231006AA DAE4ip.docx 06.10.2023	Calibration Laboratory of Schmid & Partner Engineering AG Zugzwangstrasse 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 Kunshan Certificate No: DAE4ip-1826_Dec23 CALIBRATION CERTIFICATE Object: DAE4ip - SD 000 D14 AG - SN: 1826 Calibration procedure(s): QA CAL-06.v30 Calibration procedure for the data acquisition electronics (DAE) Calibration date: December 27, 2023 This calibration certificate documents the traceability to national standards, which realizes 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) °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>Kettler Maltmeter Type 3001</td><td>SN: 0810278</td><td>29-Aug-23 (No:27421)</td><td>Aug-24</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 Definition Unit</td><td>SE LWS 003 AA 1001</td><td>27-Jan-23 (in house check)</td><td>In house check: Jan-24</td></tr><tr><td>Calibrator line Vx 1</td><td>SE LWS 006 AA 1002</td><td>27-Jan-23 (in house check)</td><td>In house check: Jan-24</td></tr></tbody></table> Calibrated by: Dominik Staffen Function: Laboratory Technician Signature: [Signature] Approved by: Sven Kohn Function: Technical Manager Signature: [Signature] This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Certificate No: DAE4ip-1826_Dec23 Page 1 of 5	Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Kettler Maltmeter Type 3001	SN: 0810278	29-Aug-23 (No:27421)	Aug-24	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Auto DAE Definition Unit	SE LWS 003 AA 1001	27-Jan-23 (in house check)	In house check: Jan-24	Calibrator line Vx 1	SE LWS 006 AA 1002	27-Jan-23 (in house check)	In house check: Jan-24
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																		
Kettler Maltmeter Type 3001	SN: 0810278	29-Aug-23 (No:27421)	Aug-24																		
Secondary Standards	ID #	Check Date (in house)	Scheduled Check																		
Auto DAE Definition Unit	SE LWS 003 AA 1001	27-Jan-23 (in house check)	In house check: Jan-24																		
Calibrator line Vx 1	SE LWS 006 AA 1002	27-Jan-23 (in house check)	In house check: Jan-24																		
Calibration Laboratory of Schmid & Partner Engineering AG Zugzwangstrasse 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: DAE4ip-1826_Dec23 Page 2 of 5	DC Voltage Measurement A/D - Converter Resolution nominal: 6 fV/V High Range: 1LSB = 6 fV/V, full range = -100...+300 mV Low Range: 1LSB = 6 fV/V, 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>404.998 $\pm$ 0.02% (k=2)</td><td>404.997 $\pm$ 0.02% (k=2)</td><td>404.991 $\pm$ 0.02% (k=2)</td></tr><tr><td>Low Range</td><td>3.96544 $\pm$ 1.50% (k=2)</td><td>3.96262 $\pm$ 1.50% (k=2)</td><td>3.96874 $\pm$ 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>44.5° $\pm$ 1°</th></tr></thead></table> Certificate No: DAE4ip-1826_Dec23 Page 3 of 5	Calibration Factors	X	Y	Z	High Range	404.998 $\pm$ 0.02% (k=2)	404.997 $\pm$ 0.02% (k=2)	404.991 $\pm$ 0.02% (k=2)	Low Range	3.96544 $\pm$ 1.50% (k=2)	3.96262 $\pm$ 1.50% (k=2)	3.96874 $\pm$ 1.50% (k=2)	Connector Angle to be used in DASY system	44.5° $\pm$ 1°						
Calibration Factors	X	Y	Z																		
High Range	404.998 $\pm$ 0.02% (k=2)	404.997 $\pm$ 0.02% (k=2)	404.991 $\pm$ 0.02% (k=2)																		
Low Range	3.96544 $\pm$ 1.50% (k=2)	3.96262 $\pm$ 1.50% (k=2)	3.96874 $\pm$ 1.50% (k=2)																		
Connector Angle to be used in DASY system	44.5° $\pm$ 1°																				

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

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

High Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	200026.55	5.13	0.01
Channel X - Input	19991.55	0.01	0.00
Channel Y + Input	-20021.43	-0.49	0.00
Channel Y - Input	200021.86	0.45	0.00
Channel Z + Input	19999.29	-2.35	-0.01
Channel Z - Input	-20022.88	-0.07	0.01
Channel X + Input	200022.09	0.67	0.00
Channel Z + Input	19991.17	-0.50	-0.00
Channel Z - Input	-20021.15	-0.49	0.00

Low Range	Reading (µV)	Difference (µV)	Error (%)
Channel X + Input	1885.36	-0.23	-0.01
Channel X - Input	185.86	-0.54	-0.29
Channel Y + Input	-214.55	-1.12	0.53
Channel Y - Input	1989.41	-0.36	-0.02
Channel Z + Input	185.56	-1.10	-0.59
Channel Z - Input	-213.67	-0.60	0.28
Channel X + Input	1986.27	-0.58	-0.03
Channel Z + Input	185.83	-0.85	-0.45
Channel Z - Input	-213.36	-0.20	0.10

2. Common mode sensitivity

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

Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	-12.32
Channel Y	-200	14.81
Channel Z	200	8.62
Channel X	-200	-9.97
Channel Y	200	-9.23
Channel Z	-200	7.29

3. Channel separation

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

Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	0.64	-2.58
Channel Y	200	5.74	3.70
Channel Z	200	9.03	4.09

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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	15882
Channel Y	15588
Channel Z	15205

5. Input Offset Measurement

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

Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	0.58	-0.12	1.52
Channel Y	-2.57	-2.89	0.59
Channel Z	-0.31	-0.55	0.60

6. Input Offset Current

Nominal input circuitry offset current on all channels: <255A

7. Input Resistance (Typical values for information)

Zeroing (kOhm)	Measuring (MOhm)
Channel X	200
Channel Y	200
Channel Z	200

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

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.5
Supply (- Vcc)	-7.5

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-6	-9

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3 EX3DV4 - SN 7833

Calibration Laboratory of Schmid & Partner Engineering AG
Schiessstrasse 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

Client: SCS Kunshan
Certificate No.: EX-7833_Aug23

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN 7833

Calibration procedure(s): QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: August 24, 2023

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 initial for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN 124778	30-Mar-23 (No. 217-03824-03805)	Mar-24
Power sensor MNP-251	SN 133344	30-Mar-23 (No. 217-03824-03805)	Mar-24
DCP GAX-3.5 (reassigned)	SN 13489	25-Oct-22 (DCP-DAX3.5-1949, Oct22)	Oct-23
DCP GAX-12	SN 17016	25-Oct-22 (DCP-DAX3.5-1949, Oct22)	Oct-23
Reference 50 dB Attenuator	SN C22562 (20x)	30-Mar-23 (No. 217-03809)	Mar-24
GAX4	SN 186	18-Mar-23 (No. DAE4-488, Mar23)	Mar-24
Reference Probe ES3DV2	SN 3013	06-Jun-23 (No. ES3-3013, Jun23)	Jun-24

Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter EA41B5	SN G841292874	06-Apr-18 (in house check Jun-22)	In house check Jun-24
Power sensor EA411A	SN 1011438087	06-Apr-18 (in house check Jun-22)	In house check Jun-24
Power sensor EA411A	SN 100110216	06-Apr-18 (in house check Jun-22)	In house check Jun-24
RF generator HP 8440C	SN U8566057190	04-Aug-20 (in house check Jun-22)	In house check Jun-24
Network Analyzer E8363A	SN U84108477	31-Mar-14 (in house check Oct-22)	In house check Oct-24

Calibrated by: Jean Kasriel
Approved by: Sven Kohn
Technician Manager

This calibration certificate shall not be reproduced except in full without written approval of the laboratory. Issued: August 28, 2023

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Calibration Laboratory of Schmid & Partner Engineering AG
Schiessstrasse 43, 8004 Zurich, Switzerland
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Accreditation No.: SCS 0108

Glossary

TSL: Issue stimulating liquid
NORM_{M,x,z}: sensitivity in free space
CompF: diode compression point
DCP: crest factor (1.414), cycle of the RF signal
A, B, C, D: modulation dependent linearization parameters
Polarization θ: y rotation around probe axis
Polarization φ: θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., θ = 0 is normal to probe axis
Connector Angle: information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1538: "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 1538: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) IEC 60564: "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{M,x,z}: Assessed for E-field polarization (θ = 0) (f < 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORM_{M,x,z} are only intermediate values, i.e., the uncertainties of NORM_{M,x,z} does not affect the E-field uncertainty inside TSL (see below CompF).
- NORM_{M,x,z} = NORM_{M,x,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of CompF.
- DCP_{M,x,z}: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media.
- RMF-RM is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- A_{K,x,z}, B_{K,x,z}, C_{K,x,z}, D_{K,x,z}, V_{R,x,z}: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- CompF and Boundary Effect Parameter: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f < 300 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 300 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{M,x,z} * CompF whereby the uncertainty corresponds to that given for CompF. A frequency dependent CompF is used in DASY version 4.4 and higher which allows extending the validity from 150 MHz to > 100 MHz.
- Spherical Isotropy (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 NORM_M (no uncertainty required).

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EX3DV4 - SN:7833

August 24, 2023

Parameters of Probe: EX3DV4 - SN:7833

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k = 2)
Norm $(\mu V/V/m)^2$ A	0.40	0.65	0.59	$\pm 10.1\%$
DOF (mv) B	111.0	108.3	108.3	$\pm 4.7\%$

Calibration Results for Modulation Response

UID	Communication System Name	A	B	C	D	VR	Max	Max
		$\mu V/\mu V$	$\mu V/\mu V$		dB	mV	dev.	Unc ²
0	CW	X 0.00	0.00	1.00	0.00	136.2	$\pm 0.2\%$	$\pm 4.7\%$
		Y 0.00	0.00	1.00	0.00	136.2		
		Z 0.00	0.00	1.00	0.00	136.2		
10352	Pulse Waveform (200Hz, 10%)	X 1.45	40.30	6.14	10.00	60.0	$\pm 3.2\%$	$\pm 9.8\%$
		Y 1.37	51.59	6.81	10.00	60.0		
		Z 1.41	40.30	6.14	10.00	60.0		
10353	Pulse Waveform (200Hz, 20%)	X 10.00	72.00	9.00	5.99	90.0	$\pm 2.9\%$	$\pm 9.8\%$
		Y 9.84	69.00	4.79	60.0	90.0		
		Z 10.00	72.00	9.00	5.99	90.0		
10354	Pulse Waveform (200Hz, 40%)	X 0.37	66.00	3.64	3.96	96.0	$\pm 0.8\%$	$\pm 9.8\%$
		Y 0.36	67.00	0.00	0.00	96.0		
		Z 0.36	66.00	0.00	0.00	96.0		
10355	Pulse Waveform (200Hz, 60%)	X 7.50	77.00	2.05	2.22	100.0	$\pm 1.7\%$	$\pm 9.8\%$
		Y 7.50	77.00	12.49	1.00	100.0		
		Z 7.50	77.00	0.00	0.00	100.0		
10357	QPSK Waveform, 1 MHz	X 0.37	66.00	14.25	1.00	100.0	$\pm 3.9\%$	$\pm 9.8\%$
		Y 0.49	83.39	12.04	1.00	100.0		
		Z 0.48	84.04	12.04	1.00	100.0		
10358	QPSK Waveform, 10 MHz	X 1.43	67.67	14.98	0.00	100.0	$\pm 0.9\%$	$\pm 9.8\%$
		Y 1.39	65.56	13.88	0.00	100.0		
		Z 1.39	66.73	13.78	0.00	100.0		
10396	64-QAM Waveform, 100 kHz	X 1.77	65.62	18.47	3.01	100.0	$\pm 1.0\%$	$\pm 9.8\%$
		Y 1.79	65.50	18.35	1.00	100.0		
		Z 1.76	65.45	18.14	1.00	100.0		
10399	64-QAM Waveform, 40 MHz	X 0.37	66.00	14.25	0.00	100.0	$\pm 2.1\%$	$\pm 9.8\%$
		Y 0.36	66.00	14.25	0.00	100.0		
		Z 0.36	66.00	14.25	0.00	100.0		
10414	WLAN CDD, 64-QAM, 40 MHz	X 0.37	66.00	14.25	0.00	100.0	$\pm 3.5\%$	$\pm 9.8\%$
		Y 0.36	66.00	14.25	0.00	100.0		
		Z 0.36	66.00	14.25	0.00	100.0		

Note: For details on UID parameters see Appendix

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

¹ The uncertainties of Norm X, Y, Z do not affect the $k=2$ test uncertainty value. See Page 5 and 6.

² Precision parameter uncertainty for maximum specified field strength.

³ Uncertainty is determined using the root deviation from linear response applying rectangular distribution and is expressed for the square of the test value.

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August 24, 2023

Parameters of Probe: EX3DV4 - SN:7833

Sensor Model Parameters

	C1	C2	A	V1	V2	T3	T4	T5	T6
	dB	dB	V ²	ms/V ²	ms/V ²	ms	V ²	V ²	V ²
x	8.5	69.54	31.91	4.38	0.30	4.30	0.61	0.00	1.00
y	8.5	69.77	32.80	4.10	0.30	4.30	0.61	0.00	1.00
z	7.3	51.94	32.49	3.75	0.30	4.30	0.61	0.00	1.00

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	30°
Mechanical Surface Detection Mode	disabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	16 mm
Tip Diameter	9 mm
Tip Length	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3.4 mm for an Apple iPhone.

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EX3DV4 - SN:7833

August 24, 2023

Parameters of Probe: EX3DV4 - SN:7833

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity ³ (S/m)	Comp# X	Comp# Y	Comp# Z	Alpha ⁴	Depth ⁵ (mm)	Unc (k = 2)
750	41.9	0.09	7.85	8.96	8.55	0.43	1.27	$\pm 12.0\%$
855	41.5	0.90	7.57	8.62	8.54	0.42	1.27	$\pm 12.0\%$
1750	40.1	1.37	7.08	8.09	7.65	0.28	1.27	$\pm 12.0\%$
1900	40.0	1.40	6.39	7.26	5.93	0.31	1.27	$\pm 12.0\%$
2100	39.8	1.49	6.25	7.10	6.75	0.32	1.27	$\pm 12.0\%$
2300	39.5	1.57	6.07	6.82	6.58	0.33	1.27	$\pm 12.0\%$
2450	39.2	1.60	5.98	6.77	6.44	0.31	1.27	$\pm 12.0\%$
2600	39.0	1.56	5.11	6.91	6.68	0.30	1.27	$\pm 12.0\%$
3300	38.2	2.71	6.16	7.02	6.07	0.36	1.27	$\pm 14.0\%$
3500	37.9	2.91	5.61	6.40	6.07	0.36	1.27	$\pm 14.0\%$
3700	37.7	3.12	5.65	6.46	6.15	0.32	1.30	$\pm 14.0\%$
3900	37.5	3.32	6.07	6.91	6.66	0.38	1.27	$\pm 14.0\%$
4100	37.2	3.53	5.78	6.58	6.21	0.37	1.27	$\pm 14.0\%$
4200	37.1	3.63	5.41	6.17	5.88	0.36	1.27	$\pm 14.0\%$
4400	36.9	3.84	5.25	5.95	5.69	0.37	1.27	$\pm 14.0\%$
4600	36.7	4.04	5.88	6.44	6.12	0.36	1.30	$\pm 14.0\%$
4800	36.4	4.25	5.77	6.55	6.25	0.38	1.27	$\pm 14.0\%$
4950	36.3	4.40	5.26	5.93	5.69	0.41	1.30	$\pm 14.0\%$
5200	36.0	4.68	5.16	5.87	5.61	0.34	1.51	$\pm 14.0\%$
5300	35.9	4.76	5.02	5.70	5.39	0.32	1.63	$\pm 14.0\%$
5500	35.6	4.96	4.50	5.15	4.85	0.36	1.61	$\pm 14.0\%$
5600	35.5	5.07	4.33	4.92	4.65	0.41	1.54	$\pm 14.0\%$
5800	35.3	5.27	4.50	5.13	4.87	0.31	1.66	$\pm 14.0\%$

¹ Frequency validity above 802.1044 of $\pm 10\%$ only applies for QM4 v4.4 and higher (see Page 2), when it is specified to $\pm 10\%$. The uncertainty is the RMS of the Comp# uncertainty in calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 802.1044 is $\pm 10\%$, $\pm 15\%$, $\pm 20\%$, $\pm 25\%$, $\pm 30\%$, $\pm 35\%$, $\pm 40\%$, $\pm 45\%$, $\pm 50\%$, $\pm 55\%$, $\pm 60\%$, $\pm 65\%$, $\pm 70\%$, $\pm 75\%$, $\pm 80\%$, $\pm 85\%$, $\pm 90\%$, $\pm 95\%$, $\pm 100\%$.

² The permittivity is determined using 1000 ppm using formula (7) for values for ϵ and σ less than 1000, both the target values typically below 1000, and are used for ϵ with deviation of $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 13\%$, $\pm 14\%$, $\pm 15\%$, $\pm 16\%$, $\pm 17\%$, $\pm 18\%$, $\pm 19\%$, $\pm 20\%$.

³ The permittivity is determined using 1000 ppm using formula (7) for values for ϵ and σ less than 1000, both the target values typically below 1000, and are used for ϵ with deviation of $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 13\%$, $\pm 14\%$, $\pm 15\%$, $\pm 16\%$, $\pm 17\%$, $\pm 18\%$, $\pm 19\%$, $\pm 20\%$.

⁴ AlphaDepth is determined during calibration. SPAD3 warrants that the magnitude reduction due to the frequency effect after compensation is always less than $\pm 1\%$ for frequencies below 5 GHz and below $\pm 2\%$ for frequencies between 5-10 GHz at any distance larger than half the probe diameter from the boundary.

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August 24, 2023

Parameters of Probe: EX3DV4 - SN:7833

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ¹	Relative Permittivity ²	Conductivity ³ (S/m)	Comp# X	Comp# Y	Comp# Z	Alpha ⁴	Depth ⁵ (mm)	Unc (k = 2)
6500	34.5	6.07	4.74	5.36	4.91	0.20	2.00	$\pm 18.6\%$

¹ Frequency validity at 6.5 GHz is $\pm 10\%$ only applies for QM4 v4.4 and higher (see Page 2), when it is specified to $\pm 10\%$. The uncertainty is the RMS of the Comp# uncertainty in calibration frequency and the uncertainty for the indicated frequency band.

² The permittivity is determined using 1000 ppm using formula (7) for values for ϵ and σ less than 1000, both the target values typically below 1000, and are used for ϵ with deviation of $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 13\%$, $\pm 14\%$, $\pm 15\%$, $\pm 16\%$, $\pm 17\%$, $\pm 18\%$, $\pm 19\%$, $\pm 20\%$.

³ The permittivity is determined using 1000 ppm using formula (7) for values for ϵ and σ less than 1000, both the target values typically below 1000, and are used for ϵ with deviation of $\pm 1\%$, $\pm 2\%$, $\pm 3\%$, $\pm 4\%$, $\pm 5\%$, $\pm 6\%$, $\pm 7\%$, $\pm 8\%$, $\pm 9\%$, $\pm 10\%$, $\pm 11\%$, $\pm 12\%$, $\pm 13\%$, $\pm 14\%$, $\pm 15\%$, $\pm 16\%$, $\pm 17\%$, $\pm 18\%$, $\pm 19\%$, $\pm 20\%$.

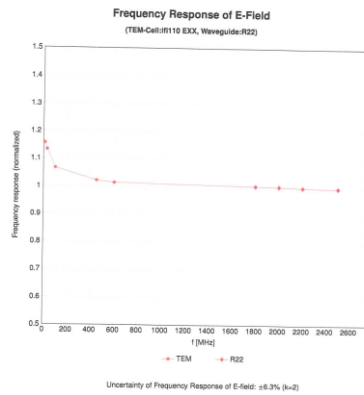
⁴ AlphaDepth is determined during calibration. SPAD3 warrants that the magnitude reduction due to the frequency effect after compensation is always less than $\pm 1\%$ for frequencies below 5 GHz and below $\pm 2\%$ for frequencies between 5-10 GHz at any distance larger than half the probe diameter from the boundary.

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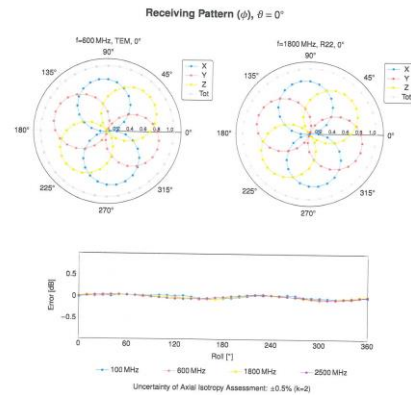


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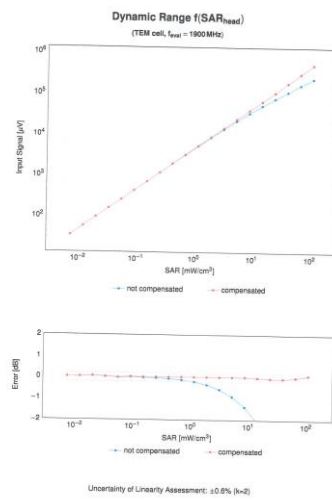


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August 24, 2023

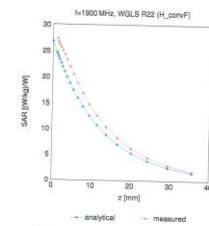
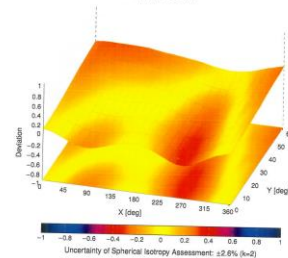


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Conversion Factor Assessment**Deviation from Isotropy in Liquid**
Error (ϕ, θ), $f = 900 \text{ MHz}$ 

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[illegible]