

Appendix C for KSCR240400057201

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

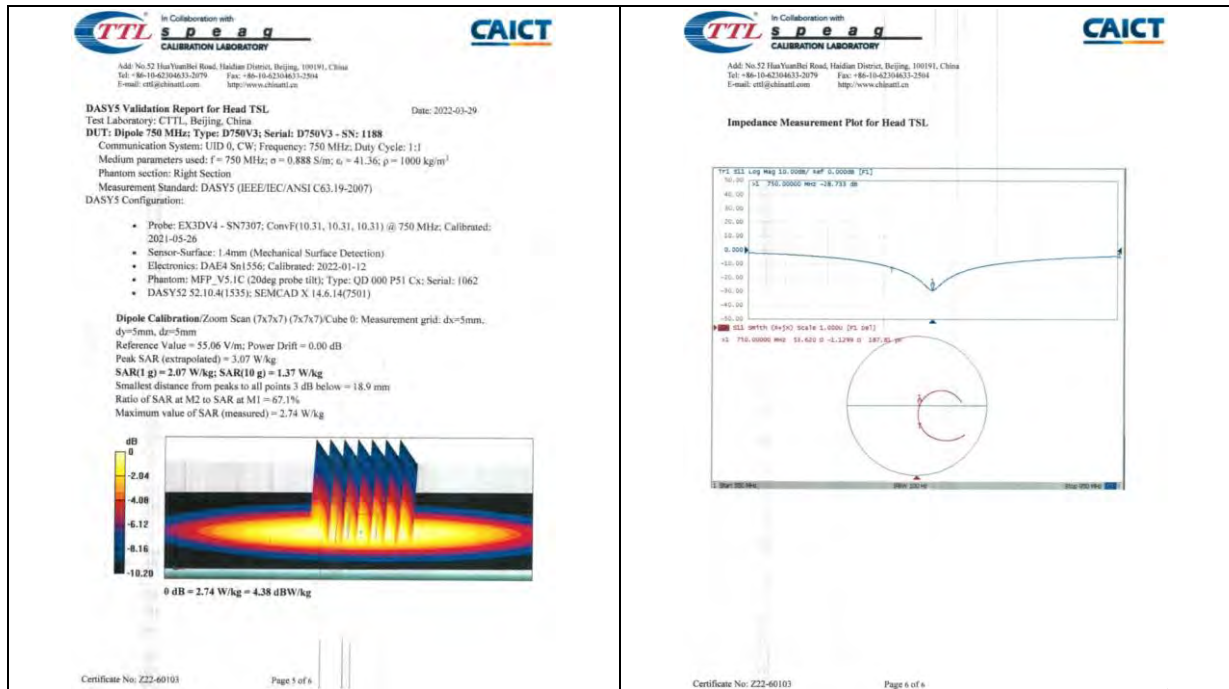
1.1 D750V3 - SN 1188

TTL Calibration Laboratory		CAICT Calibration Laboratory																																	
Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191 Tel: +86-10-42364633-2512 Fax: +86-10-42364633-2504 E-mail: csl@china-test.com http://www.china-test.com		Add: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-42364633-2579 Fax: +86-10-42364633-2504 E-mail: csl@china-test.com http://www.china-test.com																																	
Client: SGS-CN		Certificate No: Z22-60103																																	
CALIBRATION CERTIFICATE Object: D750V3 - SN: 1188 Calibration Procedure(s): FF-211-003-01 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&PE critical for calibration)																																			
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Calibrated by: Zhao Jing SAR Test Engineer Reviewed by: Lin Hao SAR Test Engineer Approved by: Qi Diqiyuan SAR Project Leader 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 / NORMs 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) DASYS4.5 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 DASYS system configuration, as far as not given on page 1																					
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Head TSL parameters The following parameters and calculations were applied:																					
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Appendix (Additional assessments outside the scope of CNAS L0570)							
Antenna Parameters with Head TSL							
<table border="1"> <tbody> <tr> <td>Impedance, transformed to feed point</td> <td>53.60 - 1.13jΩ</td> </tr> <tr> <td>Return Loss</td> <td>-26.7dB</td> </tr> </tbody> </table>				Impedance, transformed to feed point	53.60 - 1.13jΩ	Return Loss	-26.7dB
Impedance, transformed to feed point	53.60 - 1.13jΩ						
Return Loss	-26.7dB						
General Antenna Parameters and Design							
<table border="1"> <tbody> <tr> <td>Electrical Delay (one direction)</td> <td>0.947 ns</td> </tr> </tbody> </table>				Electrical Delay (one direction)	0.947 ns		
Electrical Delay (one direction)	0.947 ns						
After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can be measured. The dipole is made of standard semi-rigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small and caps are added to the dipole arms in order to improve matching when cabled 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"> <tbody> <tr> <td>Manufactured by</td> <td>SPEAG</td> </tr> </tbody> </table>				Manufactured by	SPEAG		
Manufactured by	SPEAG						
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1.2 D835V2 - SN 4d114

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CALIBRATION LABORATORY

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CAICT

In Collaboration with

Client: SGS-CN Certificate No: Z22-60104

CALIBRATION CERTIFICATE

Object: D835V2 - SN: 4d114

Calibration Procedure(s): PF-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 (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: NRPBS	104291	24-Sep-21 (CTTL No.J21X08328)	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	MY46071430	15-Jan-22 (CTTL No.J22X00409)	Jan-23
Network Analyzer E5071C	MY46110873	14-Jan-22 (CTTL No.J22X00406)	Jan-23

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

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

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

Issued: April 6, 2022

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

Certificate No: Z22-60104 Page 1 of 6

TTL **s p e e a g**
CALIBRATION LABORATORY

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

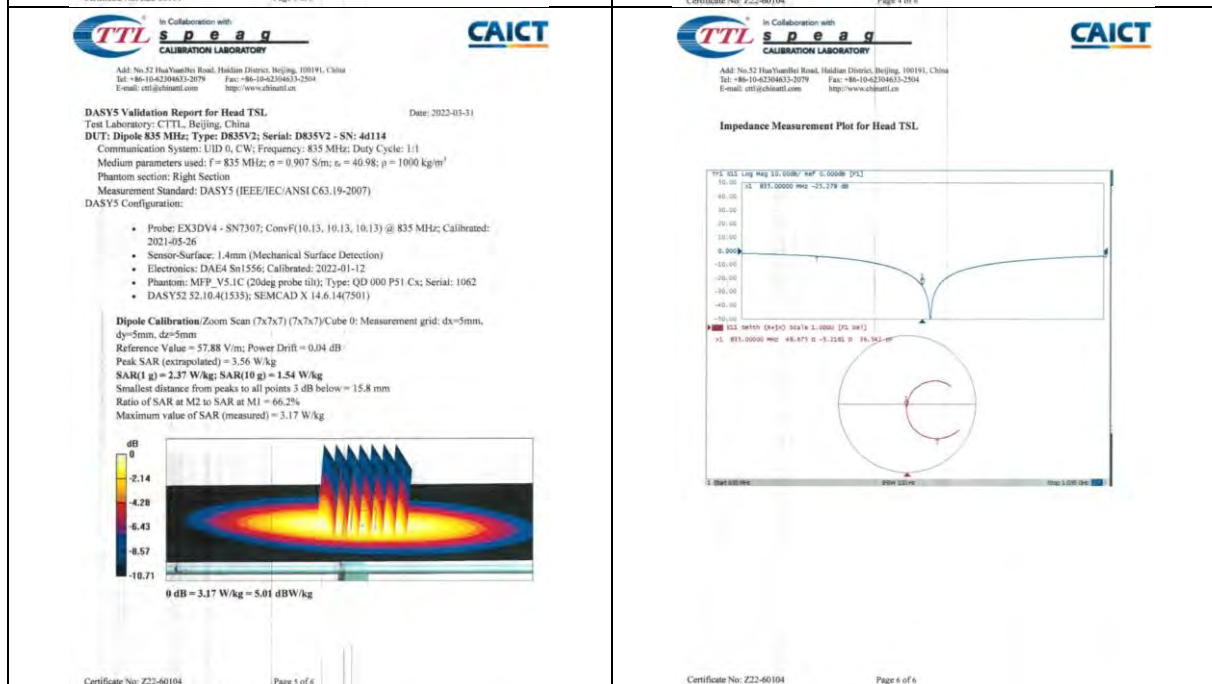
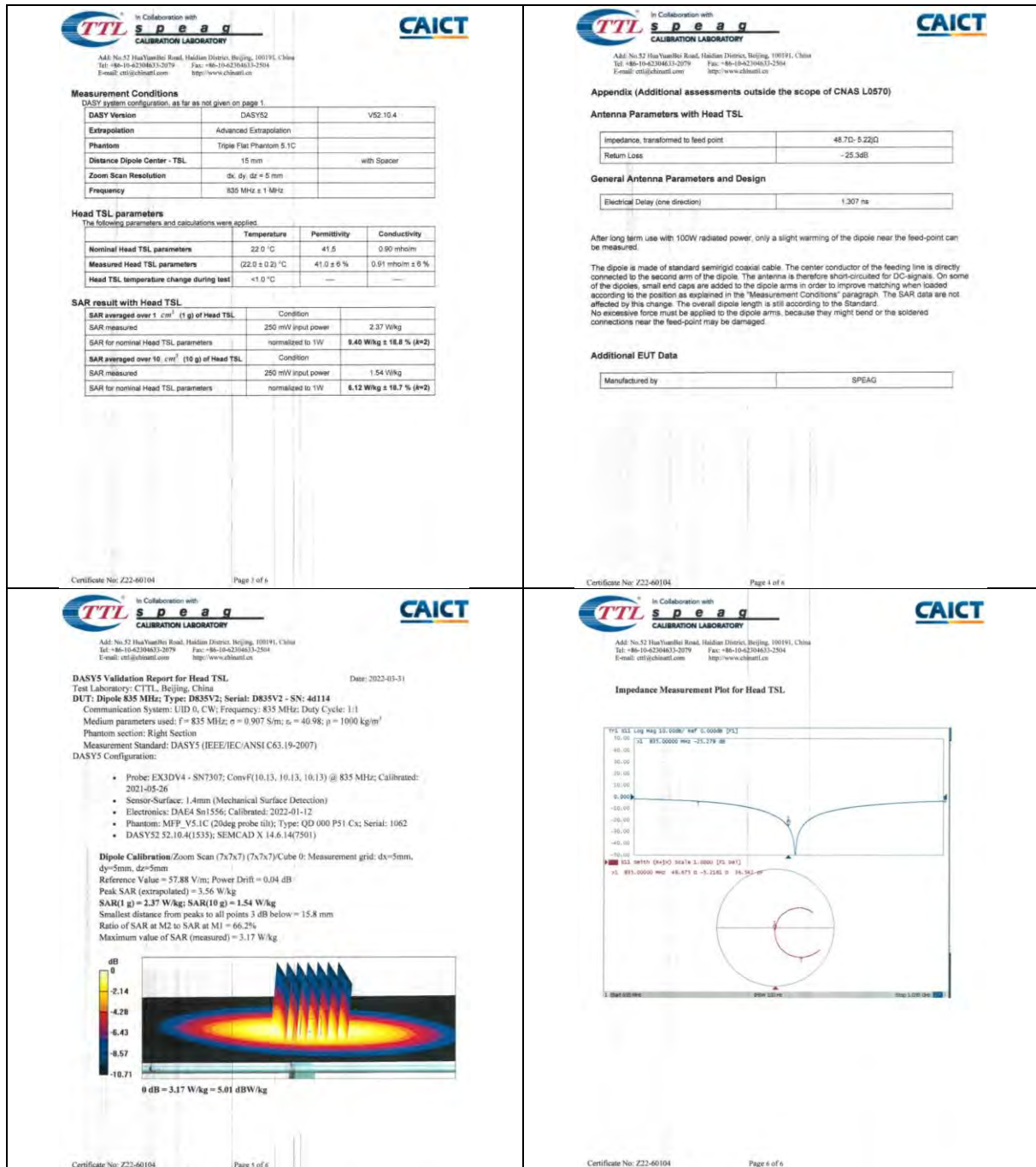
- DASY4/5 System Handbook

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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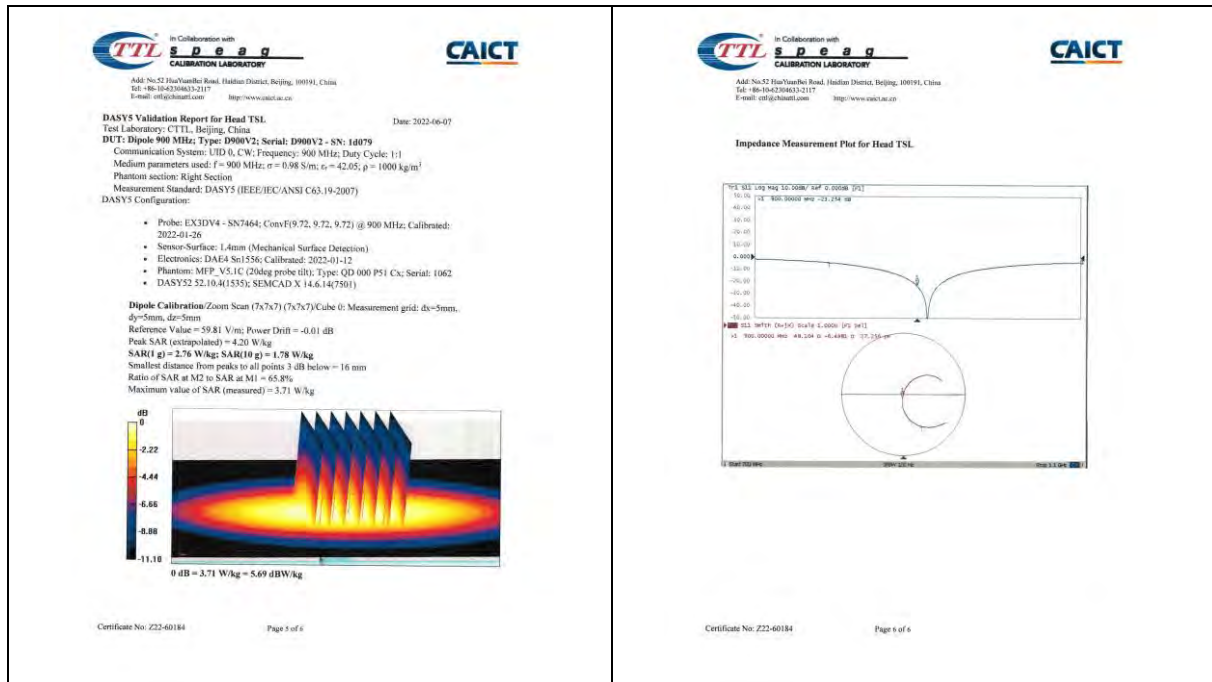
1.3 D900V2 - SN 1d079

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Client	SGS-CN	Certificate No.	Z22-60184
CALIBRATION CERTIFICATE			
Object	D900V2 - SN 1d079		
Calibration Procedure(s)	PF-Z11-003-01 Calibration Procedures for dipole validation kits		
Calibration date:	June 7, 2022		
This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.			
All calibrations have been conducted in the closed laboratory facility: environment temperature (23±1)°C and humidity <70%.			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Power sensor RRP85	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Reference Probe EX3DVA	SN 7464	26-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23
DAE4	SN 1586	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	MY49110473	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: June 13, 2022			
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Glossary:			
TSL	tissue simulating liquid		
ConvF	sensitivity in TSL / NORM.y,z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices-Part 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) DASYS45 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 this certificate are valid at the frequency indicated.			
• Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.			
• Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.			
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The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.			
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Measurement Conditions			
DASYS system configuration, as far as is given on page 1			
DASYS Version	DASYS2		52.10.4
Extrapolation	Advanced Extrapolation		
Phantom	Triple Flat Phantom 5.1C		
Distance Dipole Center - TSL	15 mm		with Spacer
Zoom Scan Resolution	0x, dy, 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 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.1 ± 6 %	0.98 mho/m ± 6 %
Head TSL temperature change during test	<±0.5 °C	—	—
SAR result with Head TSL			
SAR averaged over 1 cm ² (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	2.75 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	11.0 W/kg ± 16.8 % (k=2)	
SAR averaged over 10 cm ² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	1.75 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	7.09 W/kg ± 16.7 % (k=2)	
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Appendix (Additional assessments outside the scope of CNAS L0670)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	48 (10-9-450)		
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 semi-rigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.			
Additional EUT Data			
Manufactured by	SPEAG		
Certificate No: Z22-60184		Page 4 of 6	



1.4 D1800V2 - SN 2d170

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

CALIBRATION CERTIFICATE

Object: **D1800V2 - SN: 2d170**

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

Calibration date: **March 31, 2022**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Power sensor NRP8S	104291	24-Sep-21 (CTTL No.J21X08326)	Sep-22
Reference Probe EX3DV4	SN 7307	26-May-21 (SPEAG No.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.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 Diqian** SAR Project Leader

Issued: April 6, 2022

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Certificate No: Z22-60105 Page 1 of 6

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CAICT

Glossary:
TSL: tissue simulating liquid
ConvF: sensitivity in TSL / NORM_{x,y,z}
N/A: not applicable or not measured

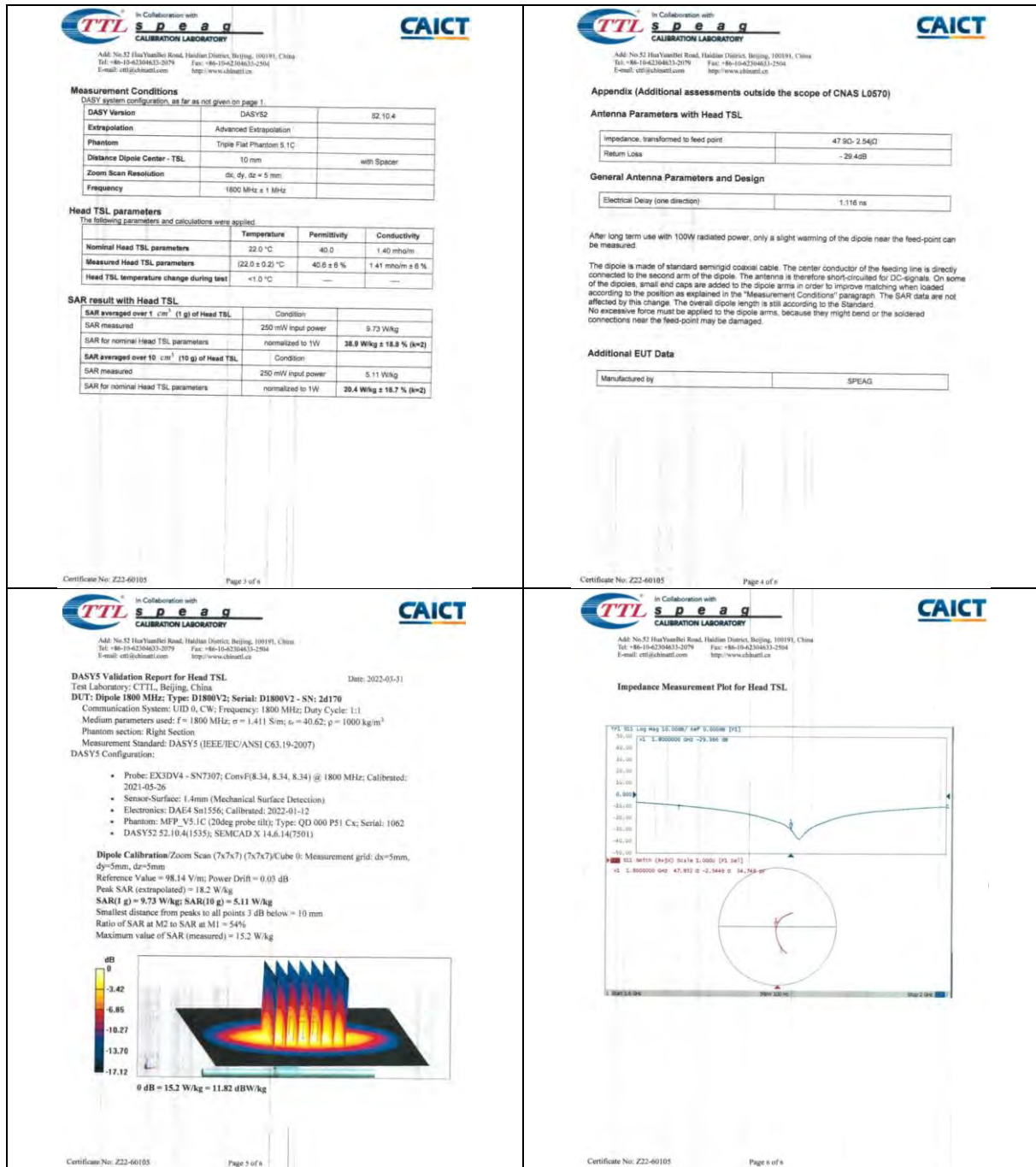
Calibration is Performed According to the Following Standards:
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1528: Human Models, Instrumentation 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: Z22-60105 Page 2 of 6



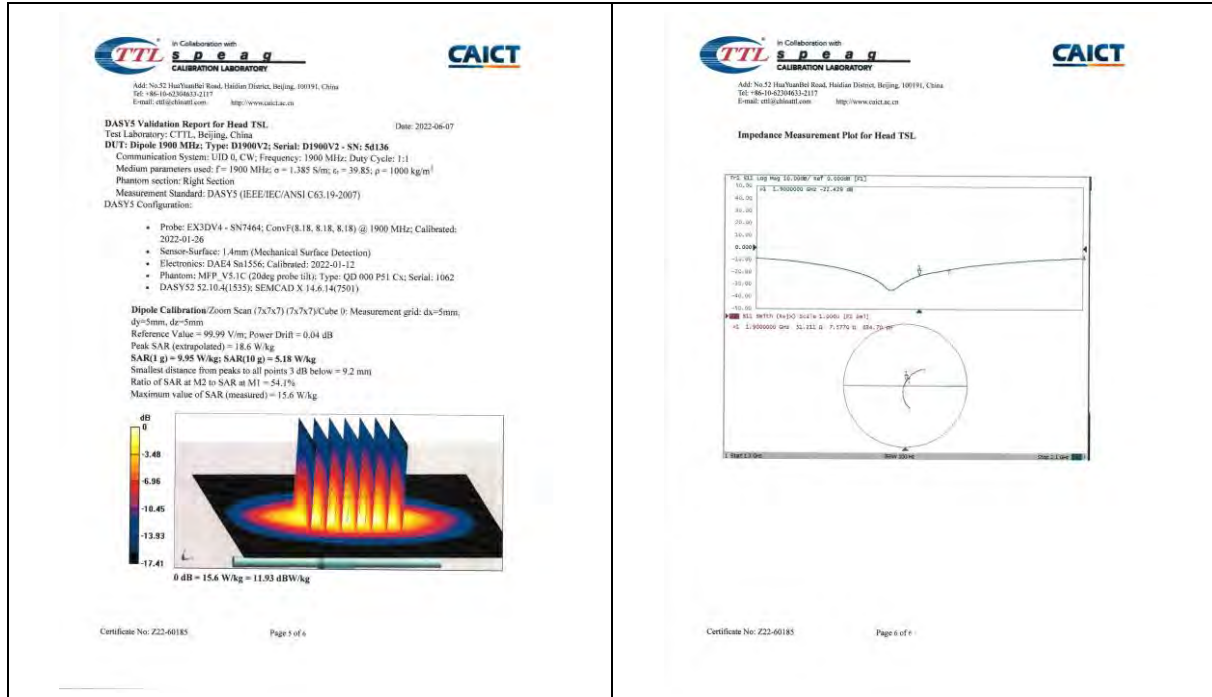
1.5 D1900V2 - SN 5d136

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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 (22±1)°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. J21X08326)	Sep-22
Power sensor NRP85	104291	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Reference Probe EXSDV4	SN 1404	28-Jan-22 (SPEAG No. EX3-7464_Jan22)	Jan-23
DAEA	SN 1558	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. 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: June 13, 2022			
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Certificate No: Z22-60185		Page 1 of 4	

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Measurement Conditions QAS 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:			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	45.0	1.40 nS/m
Measured Head TSL parameters	(22.0 ± 0.3) °C	39.9 ± 5 %	1.39 nS/m ± 5 %
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	3.65 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	40.8 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 ± 16.7 % (k=2)	
Certificate No: Z22-60185		Page 3 of 4	

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Glossary:			
TSL	Issue 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 855884, "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 4	

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Appendix (Additional assessments outside the scope of CNAS L0570)			
Antenna Parameters with Head TSL			
Impedance, transformed to feed point	51.5Ω ± 1.5Ω		
Return Loss	22.4dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.108 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 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 4	



1.6 D2000V2 - SN 1041

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CAICT

Client: SGS-CN Certificate No: Z22-60186

CALIBRATION CERTIFICATE

Object: D2000V2 - SN 1041
Calibration Procedure(s): FF-Z11-003-01
Calibration date: June 6, 2022
Calibration Procedure for dipole validation kits

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)

Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No. J21K08328)	Sep-22
Power sensor NRP5S	104291	24-Sep-21 (CTTL No. J21K08328)	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. Z22K00408)	Jan-23
Network Analyzer E5071C	MY46110673	14-Jan-22 (CTTL No. Z22K00408)	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 13, 2022

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Certificate No: Z22-60186 Page 1 of 6

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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) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-Head 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 865564, "SAR Measurement Requirements for 100 MHz to 6 GHz"
Additional Documentation:
c) DASY4/S System Handbook

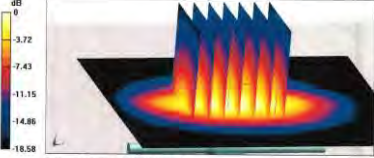
Methods Applied and Interpretation of Parameters:
• **Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
• **Antenna Parameters with TSL:** The dipole is mounted 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.

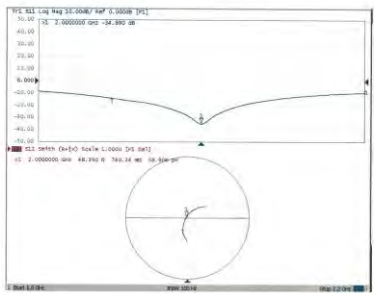
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Certificate No: Z22-60186 Page 2 of 6

In Collaboration with TTL s p e a g 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 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:			
Nominal Head TSL parameters	Temperature: 22.9 °C	Permittivity: 40.0	Conductivity: 1.40 mho/cm
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.2 ± 6 %	1.36 mho/cm ± 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 ± 15.8 % (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	-34.8dB		
General Antenna Parameters and Design			
Electrical Delay (one direction)	1.08 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 semi-rigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small gaps 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 8 of 8			

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DASY5 Validation Report for Head TSL Test Laboratory: CTIL, 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 = 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(R2, R2, R2) @ 2000 MHz; Calibrated: 2022-01-26 - Sensor Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA64 Sn1556; Calibrated: 2022-01-12 - Phantom: MPP_V5.1C (204kg probe tilt); Type: QD 000 P51 Cx; Serial: 1062 - DASY52: S2.10.4(1535); SEMCAD X 14.6.14(7501) Dipole Calibration/Zoom Scan (7x7x7) (7x7x7) Cube (t: 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 = 53.0%			
Maximum value of SAR (measured) = 16.3 W/kg			
			
Certificate No: Z22-60186 Page 5 of 6			

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

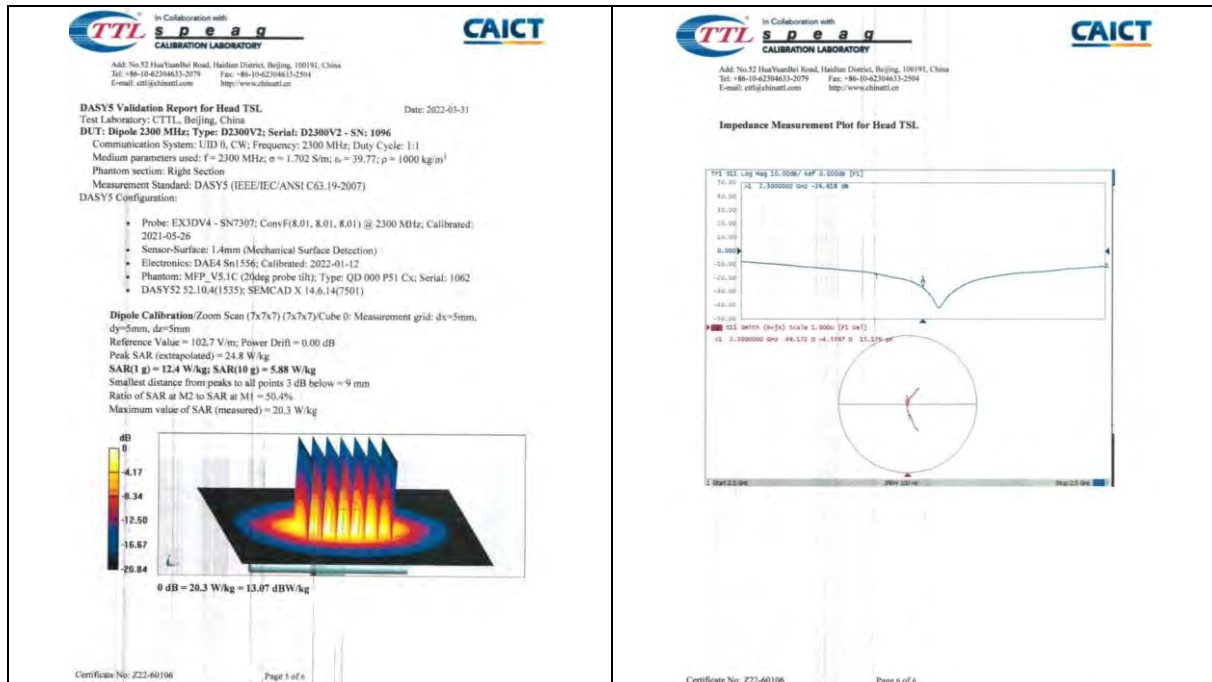
1.7 D2300V2 - SN 1096

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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	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 7307	26-May-21 (SPEAG No.EK3-7307_May21)	May-22
DAE4	SN 1556	12-Jan-22 (CTTL-SPEAG No.Z22-60007)	Jan-23
Secondary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	13-Jan-22 (CTTL No.J22X00406)	Jan-23
Network Analyzer E5071C	MY48110673	14-Jan-22 (CTTL No.J22X00406)	Jan-23
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Diqiyuan	SAR Project Leader	
Issued: April 6, 2022			
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Certificate No: Z22-60106		Page 1 of 6	

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Measurement Conditions DASY system configuration, as far as not given on page 1:			
DASY Version	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 ± 9 %	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 / NCRMx,y,z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices- Part 1: 528 Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020.			
b) KDB 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 normal 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	-25.6dB		
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-Z1(1-003-3)**
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 [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&E critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter: NRP2	108277	24-Sep-21 (CTTL No.J21X08320)	Sep-22
Power sensor: NRP8S	104291	24-Sep-21 (CTTL No.J21X08320)	Sep-22
Reference Probe EX3DV4	SN 7307	25-May-21(SPEAG.No EX3-7307_May21)	May-22
DAE4	SN 1555	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	MY48110873	14-Jan-22 (CTTL No. J22X00406)	Jan-23

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

Issued: April 6, 2022

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Glossary:

Term	Definition
TSL	Issue simulating liquid
ConvF	sensitivity in TSL / NORMx.y.z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices-Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020
- KDB 865684, "SAR Measurement Requirements for 100 MHz to 5 GHz"

Additional Documentation:

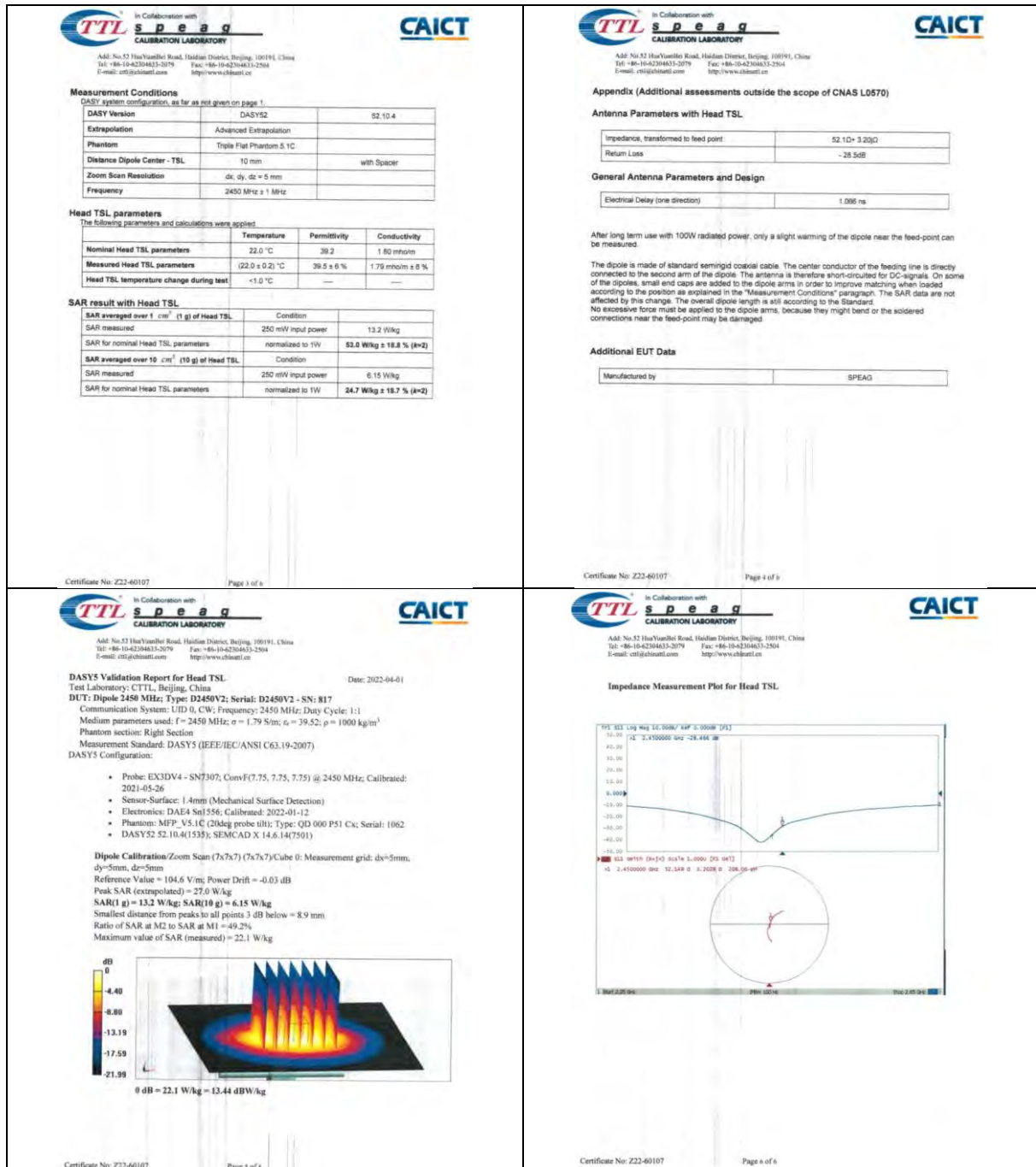
- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z22-60107 Page 2 of 5



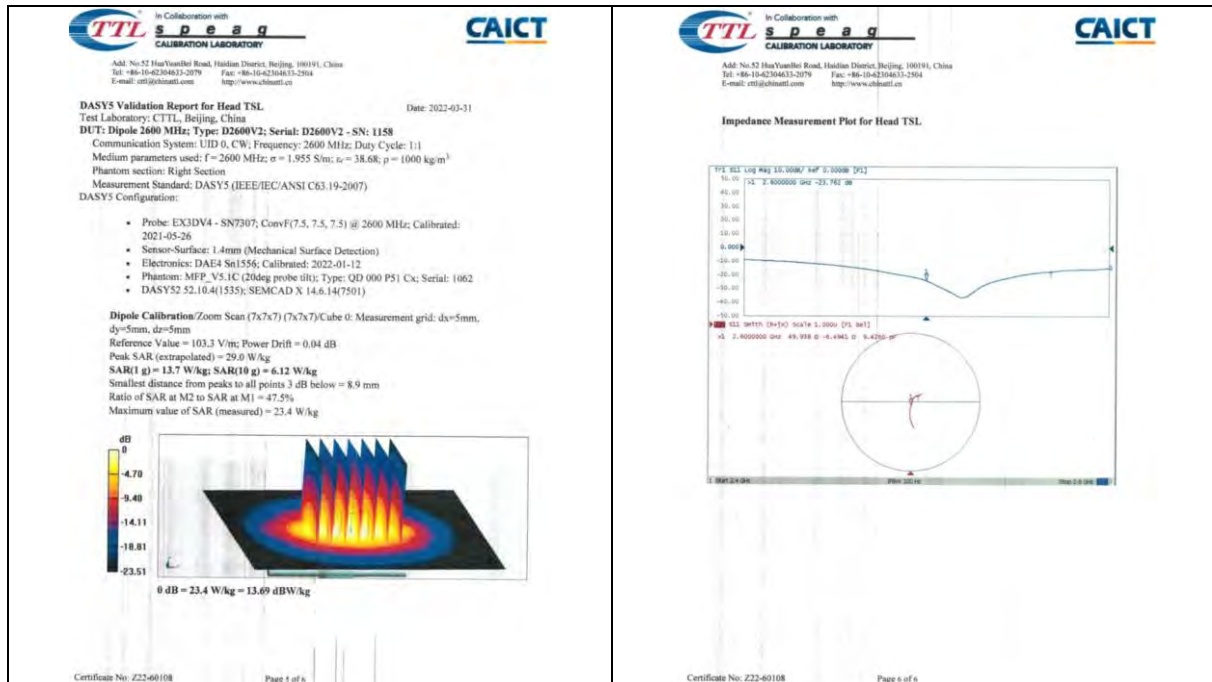
1.9 D2600V2 - SN 1158

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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 (23±3)°C and humidity <70%.			
Calibration Equipment used (MSTE critical for calibration)			
Primary Standards	ID #	Cal Date (Calibrated by Certificate No.)	Scheduled Calibration
Power Meter NRP2	106377	24-Sep-21 (CTTL No. J21X08326)	Sep-22
Power sensor NRP8	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 E5438C	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: April 6, 2022			
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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	2600 MHz ± 1 MHz		
Head TSL parameters The following parameters and calculations were applied:			
	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	38.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.7 ± 8 %	1.96 mho/m ± 8 %
Head TSL temperature change during test	±1.0 °C	—	
SAR result with Head TSL			
SAR averaged over 1 cm² (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 cm² (10 g) of Head TSL	Condition		
SAR measured	250 mW input power	8.12 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	24.5 W/kg ± 18.7 % (k=2)	
Certificate No: Z22-60108		Page 3 of 6	

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Glossary:			
TSL	tissue simulating liquid		
ConvF	sensitivity in TSL / NORMx.y.z		
N/A	not applicable or not measured		
Calibration is Performed According to the Following Standards:			
a) IEC/IEEE 62209-1528, "Measurement Procedure for The Assessment of Specific Absorption Rate of Human Exposure to Radio Frequency Fields from Hand-held and Body-mounted Wireless Communication Devices - Part 1528: Human Models, Instrumentation and Procedures (Frequency range of 4 MHz to 10 GHz)", October 2020			
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"			
Additional Documentation:			
c) DASY4/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		
Certificate No: Z22-60108		Page 4 of 6	



1.10 D5GHZV2 - SN 1095

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

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 kit

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±1)°C and humidity <70%.

Calibration Equipment used (MSTE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	24-Sep-21 (CTTL No. J2100328)	Sep-22
Power sensor NRP85	104291	24-Sep-21 (CTTL No. J2100328)	Sep-22
Reference Probe EX3DV4	SN 7464	26-Jan-22 (SPEAG No. EX3-7464, Jan22)	Jan-23
DAE4	SN 1556	12-Jan-22 (CTTL-SPEAG No. Z22-60007)	Jan-23

Secondary Standards	ID #	Cal Date (Calibrated by: Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY48071430	13-Jan-22 (CTTL No. J22000409)	Jan-23
Network Analyzer E5071C	MY46110873	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 8, 2022

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Glossary:

TSL: Issue simulating liquid

CompE: 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 665664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY45 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 7 of 10

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Measurement Conditions

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

DASY Version	DASY2	52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom S.1C	
Distance Dipole Center - TSL	10 mm	with 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 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	4.68 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 5 %	4.62 mho/m ± 5 %
Head TSL temperature change during test	<+1.0 °C	—	—

SAR result with Head TSL at 5200MHz

	Condition	
SAR averaged over 1 cm ² (1 g) of Head TSL	250 mW input power	7.75 W/kg
SAR measured	100 mW input power	77.8 W/kg ± 24.4 % (k=2)
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	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg ± 24.2 % (k=2)

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Head TSL parameters at 5300MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 5 %	4.73 mho/m ± 5 %
Head TSL temperature change during test	<+1.0 °C	—	—

SAR result with Head TSL at 5300MHz

	Condition	
SAR averaged over 1 cm ² (1 g) of Head TSL	100 mW input power	7.94 W/kg
SAR measured	100 mW input power	7.94 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.4 W/kg ± 24.4 % (k=2)
SAR averaged over 10 cm ² (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	4.88 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 5 %	4.84 mho/m ± 5 %
Head TSL temperature change during test	<+1.0 °C	—	—

SAR result with Head TSL at 5500MHz

	Condition	
SAR averaged over 1 cm ² (1 g) of Head TSL	100 mW input power	8.26 W/kg
SAR measured	100 mW input power	82.6 W/kg ± 24.4 % (k=2)
SAR for nominal Head TSL parameters	normalized to 1W	
SAR averaged over 10 cm ² (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

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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 ± 5 %	5.05 mho/m ± 5 %
Head TSL temperature change during test	<+1.0 °C	—	—

SAR result with Head TSL at 5600MHz

	Condition	
SAR averaged over 1 cm ² (1 g) of Head TSL	100 mW input power	8.12 W/kg
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 ² (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 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 ± 5 %	5.25 mho/m ± 5 %
Head TSL temperature change during test	<+1.0 °C	—	—

SAR result with Head TSL at 5800MHz

	Condition	
SAR averaged over 1 cm ² (1 g) of Head TSL	100 mW input power	7.71 W/kg
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 ² (10 g) of Head TSL	Condition	
SAR measured	100 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.6 W/kg ± 24.2 % (k=2)

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL at 5200MHz

Impedance, transformed to feed point	46.10-5.03jΩ
Return Loss	-23.8dB

Antenna Parameters with Head TSL at 5300MHz

Impedance, transformed to feed point	47.80-2.42jΩ
Return Loss	-23.5dB

Antenna Parameters with Head TSL at 5500MHz

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

Antenna Parameters with Head TSL at 5600MHz

Impedance, transformed to feed point	54.80-4.86jΩ
Return Loss	-24.6dB

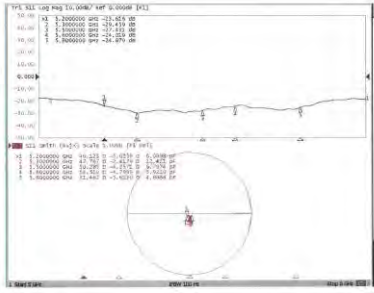
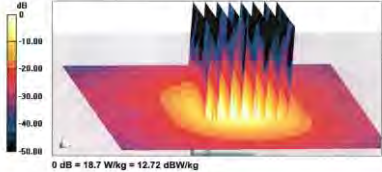
Antenna Parameters with Head TSL at 5800MHz

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

Certificate No: Z22-60187

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 In Collaboration with speaq CALIBRATION LABORATORY ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@speaq.com http://www.speaq.com.cn 		 In Collaboration with speaq CALIBRATION LABORATORY ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@speaq.com http://www.speaq.com.cn 	
General Antenna Parameters and Design		DASY5 Validation Report for Head TSL (Date: 2022-09-01)	
Electrical Delay (one direction): 1.101 ns		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: $f = 5200 \text{ MHz}$; $\sigma = 4.82 \text{ S/m}$; $\epsilon = 35.39$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5300 \text{ MHz}$; $\sigma = 4.73 \text{ S/m}$; $\epsilon = 35.19$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5500 \text{ MHz}$; $\sigma = 4.939 \text{ S/m}$; $\epsilon = 34.83$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.051 \text{ S/m}$; $\epsilon = 34.89$; $\rho = 1000 \text{ kg/m}^3$ Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 5.247 \text{ S/m}$; $\epsilon = 34.42$; $\rho = 1000 \text{ kg/m}^3$ Phantom section: Right Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C38.19-2007) DASY5 Configuration:	
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 carrier conductor of the feeding line is directly connected to the second arm of the dipole. This 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.		- 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, 5.5) @ 5800 MHz; Calibrated: 2022-01-26 - Sensor-Surface: 1.4mm (Mechanical Surface Detection) - Electronics: DA84 Sn1556; Calibrated: 2022-01-12 - Phantom: MPF_V5.1C (20deg probe tilt); Type: QD Q00 P51 Cx; Serial: 1062 - DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)	
Additional EUT Data		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) = 7.73 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) = 19.3 W/kg	
Manufactured by: SPEAQ		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 1 of 6		Certificate No: Z22-60187 Page 4 of 6	

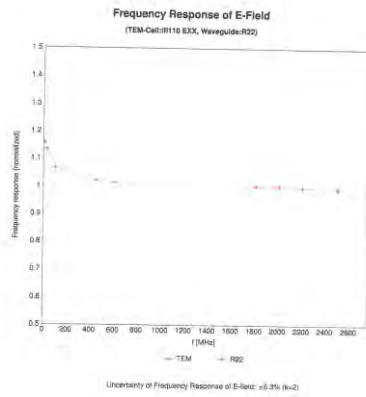
 In Collaboration with speaq CALIBRATION LABORATORY ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@speaq.com http://www.speaq.com.cn 		 In Collaboration with speaq CALIBRATION LABORATORY ADD: No.52 HuaYuanBei Road, Haidian District, Beijing, 100191, China Tel: +86-10-62302117 E-mail: csl@speaq.com http://www.speaq.com.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		Impedance Measurement Plot for Head TSL	
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) = 36.3 W/kg SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 62.5% Maximum value of SAR (measured) = 19.1 W/kg			
Dipole Calibration /Pin=100mW, d=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Reference Value = 62.13 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 34.8 W/kg SAR(1 g) = 7.71 W/kg; SAR(10 g) = 2.16 W/kg Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 61.6% Maximum value of SAR (measured) = 18.7 W/kg			
			
0 dB = 18.7 W/kg = 12.72 dBW/kg			
Certificate No: Z22-60187 Page 9 of 10		Certificate No: Z22-60187 Page 10 of 10	

2 DAE4IP - SN 1826

Schmid & Partner Engineering AG Zugwegstrasse 43, 8004 Zurich, Switzerland Phone +41 44 245 3700, Fax +41 44 245 3719 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 250 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_EH21500AA DAE4ip.docx 06.10.2023	Calibration Laboratory of Schmid & Partner Engineering AG Zugwegstrasse 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: SGS Kommen Accreditation No.: SCS 0108 Certificate No.: DAE4ip-1826_Dec23 CALIBRATION CERTIFICATE Object: DAE4ip - SD 800 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 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 clean laboratory facility: environment temperature (22 ± 3) °C and humidity < 70%. Calibration Equipment used (MATE) (color for calibration) <table border="1"><thead><tr><th>Primary Standards</th><th>Q1 #</th><th>Cal Class (Certificate No.)</th><th>Scheduled Calibration</th></tr></thead><tbody><tr><td>Kathay Mattress Type 301</td><td>SN: 0810378</td><td>26-Aug-23 (Rev. 3742)</td><td>Aug-24</td></tr></tbody></table> <table border="1"><thead><tr><th>Secondary Standards</th><th>Q1 #</th><th>Check Date (in house)</th><th>Scheduled Check</th></tr></thead><tbody><tr><td>Auto DAE Calibration Unit</td><td>SE LWS 053 AA 1001</td><td>27-Jan-24 (in house check)</td><td>10 house check Jan-24</td></tr><tr><td>Calibration Box V1</td><td>SE LWS 008 AA 1002</td><td>27-Jan-23 (in house check)</td><td>in house check Jan-24</td></tr></tbody></table> Calibrated by: Domènec Ràfols Function: Laboratory Technician Signature: <i>[Signature]</i> Approved by: Stefan Kälin Function: Technical Manager Signature: <i>[Signature]</i> This calibration certificate shall not be reproduced without the full written approval of the laboratory. Issued: December 27, 2023 Certificate No.: DAE4ip-1826_Dec23 Page 1 of 5	Primary Standards	Q1 #	Cal Class (Certificate No.)	Scheduled Calibration	Kathay Mattress Type 301	SN: 0810378	26-Aug-23 (Rev. 3742)	Aug-24	Secondary Standards	Q1 #	Check Date (in house)	Scheduled Check	Auto DAE Calibration Unit	SE LWS 053 AA 1001	27-Jan-24 (in house check)	10 house check Jan-24	Calibration Box V1	SE LWS 008 AA 1002	27-Jan-23 (in house check)	in house check Jan-24
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Calibration Laboratory of Schmid & Partner Engineering AG Zugwegstrasse 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 resistances 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 3 of 5	DC Voltage Measurement A/D - Converter Resolution nominal: 6 fV High Range: 1LSB = 6 fV, full range = -100...+300 mV Low Range: 1LSB = 6 fV, full range = -1...+1 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 ± 0.02% (k=2)</td><td>404.997 ± 0.02% (k=2)</td><td>404.991 ± 0.02% (k=2)</td></tr><tr><td>Low Range</td><td>3.96544 ± 1.50% (k=2)</td><td>3.96282 ± 1.50% (k=2)</td><td>3.96874 ± 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° ± 1°</th></tr></thead></table> Certificate No.: DAE4ip-1826_Dec23 Page 3 of 6	Calibration Factors	X	Y	Z	High Range	404.998 ± 0.02% (k=2)	404.997 ± 0.02% (k=2)	404.991 ± 0.02% (k=2)	Low Range	3.96544 ± 1.50% (k=2)	3.96282 ± 1.50% (k=2)	3.96874 ± 1.50% (k=2)	Connector Angle to be used in DASY system	44.5° ± 1°						
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Connector Angle to be used in DASY system	44.5° ± 1°																				

EX3DV4 - SN:7833

August 24, 2023

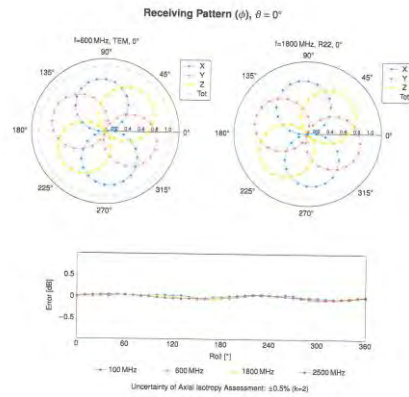


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August 24, 2023

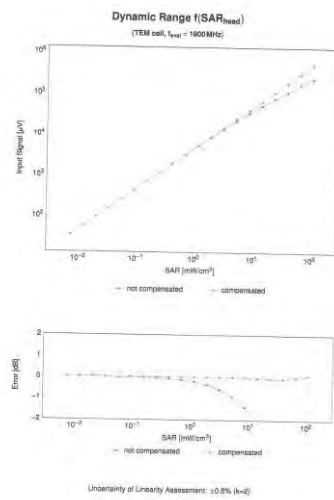


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August 24, 2023

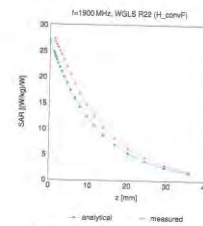
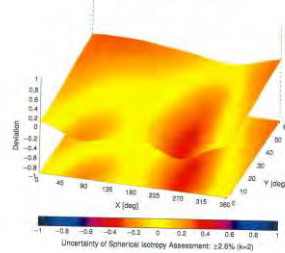


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August 24, 2023

Conversion Factor Assessment**Deviation from Isotropy in Liquid**
Error (ϕ, θ), $f = 800$ MHz

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[illegible]

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[illegible]

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1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	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4 Impedance and return loss

Dipole D750V3 SN 1188				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/3/29	-28.7	/	53.6	/
2023/3/29	-28.3	1.39%	53.2	0.4
Dipole D835V2 SN 4d114				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/3/31	-25.3	/	48.7	/
2023/3/31	-24.6	2.77%	49.1	0.4
Dipole D900V2 SN 1d079				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/7	-23.3	/	48.1	/
2023/6/7	-23.6	-1.29%	48.3	0.2
Dipole D1800V2 SN 2d170				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/3/31	-29.4	/	47.9	/
2023/3/31	-28.9	1.70%	47.2	0.7
Dipole D1900V2 SN 5d136				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/7	-22.4	/	51.2	/
2023/6/7	-22.9	-2.23%	51.6	-0.4
Dipole D2000V2 SN 1041				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/6	-34.9	/	48.4	/
2023/6/6	-33.5	4.01%	49.1	-0.7
Dipole D2300V2 SN 1096				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/3/31	-26.6	/	49.2	/
2023/3/31	-27.1	-1.88%	49.4	0.2
Dipole D2450V2 SN 817				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/4/1	-28.5	/	52.1	/
2023/4/1	-28.0	1.75%	51.6	0.5
Dipole D2600V2 SN 1158				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/3/31	-23.8	/	49.9	/
2023/3/31	-23.3	2.10%	50.3	0.4

Dipole D5GHzV2 SN 1095 for 5200				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/1	-23.6	/	46.1	/
2023/6/1	-23.1	2.12%	45.6	0.5
Dipole D5GHzV2 SN 1095 for 5300				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/1	-29.5	/	47.8	/
2023/6/1	-28.8	2.37%	46.9	0.9
Dipole D5GHzV2 SN 1095 for 5500				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/1	-27.4	/	50.3	/
2023/6/1	-27.6	-0.73%	50.8	-0.5
Dipole D5GHzV2 SN 1095 for 5600				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/1	-24.0	/	54.5	/
2023/6/1	-23.6	1.67%	54.9	-0.4
Dipole D5GHzV2 SN 1095 for 5800				
Head Liquid				
Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	$\Delta\Omega$
2022/6/1	-24.9	/	51.5	/
2023/6/1	-24.3	2.41%	51.0	0.5