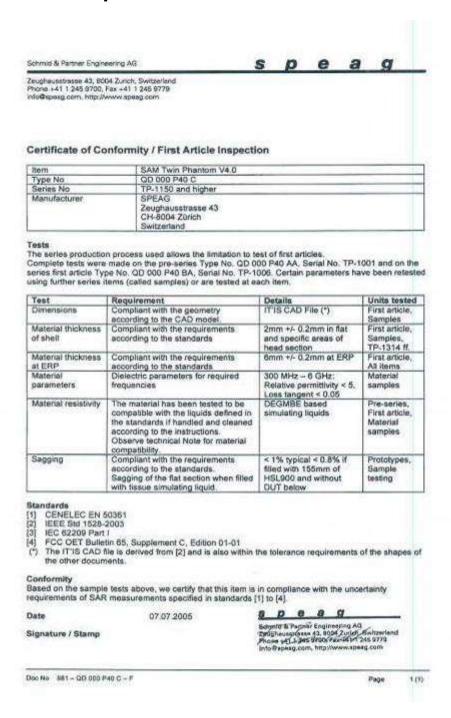


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# **Appendix C**

# **Phantom Description**



Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

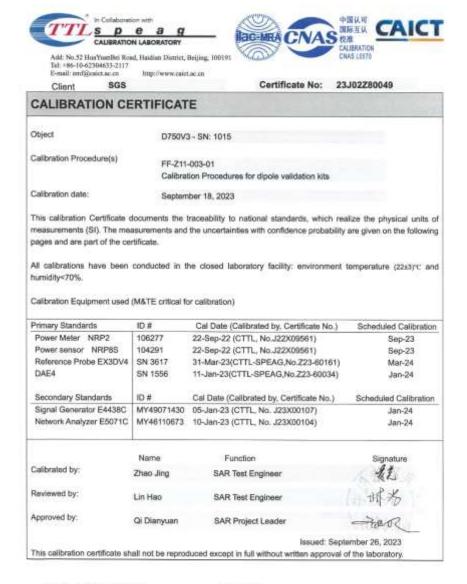
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# **System Validation from Original Equipment Supplier**



Certificate No: 23302Z80049

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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
- 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: 23J02Z80049

Page 2 of 6

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#### Measurement Conditions

ASY system configuration, as far as	not given on page 1.	
DASY Version	DA5Y52	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

volve.svx-rosseanoscarioscarios volves	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	42.0 ± 6 %	0.87 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		-

## SAR result with Head TSI

SAR averaged over 1 Cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.63 W/kg ± 18.8 % (A=2)
SAR averaged over 10 cm <sup>3</sup> (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	5.56 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.	52.30+1.13jQ	
Return Loss	- 32.1dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	0.944 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can

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 cipoles, 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: 2023-09-18

Test Laboratory: CTTL, Beijing, China DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1015

Communication System: UID 0, CW; Frequency: 750 MHz

Medium parameters used: f = 750 MHz;  $\sigma = 0.87 \text{ S/m}$ ;  $\epsilon_r = 42.01$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(10.1, 10.1, 10.1) @ 750 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- 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 = 54.31 V/m; Power Drift = -0.03 dB

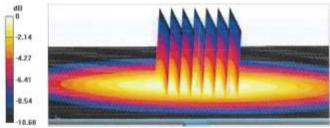
Peak SAR (extrapolated) = 3.43 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.37 W/kg

Smallest distance from peaks to all points 3 dB below = 19.2 mm

Ratio of SAR at M2 to SAR at M1 = 62%

Maximum value of SAR (measured) = 2.94 W/kg



0 dB = 2.94 W/kg = 4.68 dBW/kg

Certificate No: 23J02Z80049

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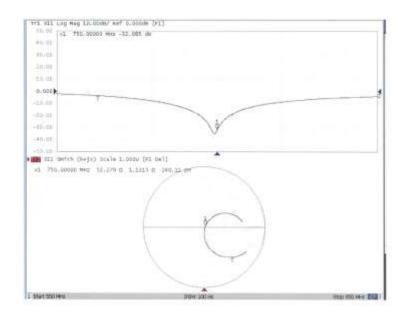
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#### Impedance Measurement Plot for Head TSL



Certificate No: 23J02Z80049

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#### SGS Certificate No: 23J02Z80050 **CALIBRATION CERTIFICATE** Object D835V2 - SN: 4d063 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits Calibration date: September 20, 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 (M&TE critical for calibration) Primary Standards ID# Cal Date (Calibrated by, Certificate No.) Scheduled Calibration Power Meter NRP2 106277 22-Sep-22 (CTTL, No.J22X09561) Sep-23 Power sensor NRP8S 104291 22-Sep-22 (CTTL, No.J22X09561) Sep-23 Reference Probe EX3DV4 SN 3617 31-Mar-23(CTTL-SPEAG,No.Z23-60161) Mar-24 DAE4 SN 1556 11-Jan-23(CTTL-SPEAG,No.Z23-60034) Jan-24 Secondary Standards ID# Cal Date (Calibrated by, Certificate No.) Scheduled Calibration Signal Generator E4438C MY49071430 05-Jan-23 (CTTL, No. J23X00107) Jan-24 NetworkAnalyzer E5071C MY46110673 10-Jan-23 (CTTL, No. J23X00104) Jan-24 Name Function Calibrated by: Zhao Jing SAR Test Engineer Reviewed by: Lin Hao SAR Test Engineer Approved by: Qi Dianyuan SAR Project Leader Issued: September 26, 2023

Certificate No: 23302Z80050 Page 1 of 6

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Glossary:

tissue simulating liquid TSL ConvE 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%.

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#### **Measurement Conditions**

ASY system configuration, as far as	not given on page 1.	
DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.10	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

#### Head TSL parameters

and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41,5	0.90 mha/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.2±5%	0.89 mho/m ± 6 %
Heed TSL temperature change during test	<1.0 °C		

#### SAR result with Head TSL

V Legnit Mitti Legn 1 or		
SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.53 W/kg ± 18.8 % (A=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR messured	250 mW input power	1.52 W/kg
SAR for nominal Head TSL parameters	normalized to TW	6.11 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	52.3Q+ 4.21JQ
Return Loss	- 26.6dB

#### General Antenna Parameters and Design

A STATE OF THE STA	11000
Electrical Delay (one direction)	1.298 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can

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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Date: 2023-09-20





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DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d063

Communication System: UID 0, CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma = 0.892$  S/m;  $\epsilon_r = 41.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(10.1, 10.1, 10.1) @ 835 MHz; Calibrated: 2023-03-31
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- 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 = 57.75 V/m; Power Drift = -0.02 dB

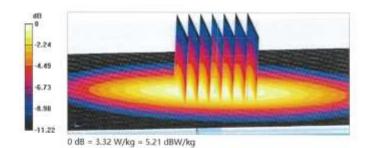
Peak SAR (extrapolated) = 3.88 W/kg

SAR(1 g) = 2.37 W/kg; SAR(10 g) = 1.52 W/kg

Smallest distance from peaks to all points 3 dB below = 16.2 mm

Ratio of SAR at M2 to SAR at M1 = 61.6%

Maximum value of SAR (measured) = 3.32 W/kg



Certificate No: 23J02Z80050

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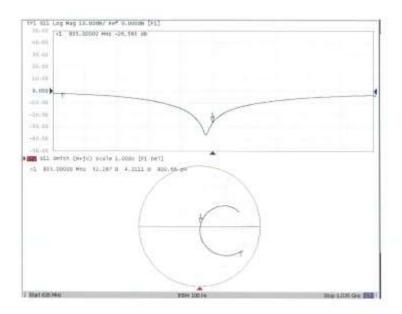
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Impedance Measurement Plot for Head TSL



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#### Certificate No: 23J02Z80052 SGS Client **CALIBRATION CERTIFICATE** Object D1750V2 - SN: 1008 Calibration Procedure(s) FF-Z11-003-01 Calibration Procedures for dipole validation kits Calibration date: September 19, 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 (M&TE critical for calibration) Primary Standards ID# Cal Date (Calibrated by, Certificate No.) Scheduled Calibration Power Meter NRP2 22-Sep-22 (CTTL, No.J22X09561) 108277 Sep-23 Power sensor NRP8S 104291 22-Sep-22 (CTTL, No.J22X09561) Sep-23 Reference Probe EX3DV4 SN 3617 31-Mar-23(CTTL-SPEAG,No.Z23-60161) Mar-24 DAE4 SN 1556 11-Jan-23(CTTL-SPEAG,No.Z23-60034) Jan-24 Secondary Standards ID# Cal Date (Calibrated by, Certificate No.) Scheduled Calibration Signal Generator E4438C MY49071430 05-Jan-23 (CTTL, No. J23X00107) Jan-24 Network Analyzer E5071C MY46110673 10-Jan-23 (CTTL, No. J23X00104) Jan-24 Name Function Calibrated by: Zhao Jing SAR Test Engineer Reviewed by: Lin Hao SAR Test Engineer Approved by: Qi Dianvuan SAR Project Leader Issued: September 26, 2023

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Certificate No: 23J02Z80052 Page 1 of 6

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Glossary:

tissue simulating liquid sensitivity in TSL / NORMx,y,z TSL ConvF 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: 23J02Z80052

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#### Measurement Conditions

DASY system configuration, as far as not given on page 1. **DASY Version** 52.10.4 DASY52 Extrapolation Advanced Extrapolation Phantom Triple Flat Phantom 5.1C Distance Dipole Center - TSL with Spacer Zoom Scan Resolution dx, dy, dz = 5 mm1750 MHz ± 1 MHz Frequency

#### **Head TSL parameters**

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.0 ± 6 %	1.41 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C		

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.27 W/kg
SAR for nominal Head TSL parameters	normalized to TW	36.4 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.4 W/kg ± 18.7 % (k=2)

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# Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

48.7Ω+ 0.06jΩ	
- 37.4dB	

#### General Antenna Parameters and Design

1.126 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feed-point can

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 cape 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 demanded. connections near the feed-point may be damaged.

#### Additional FUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL

Date: 2023-09-19

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1008

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1750 MHz; σ = 1.41 S/m; ε<sub>r</sub> = 40.02; ρ = 1000 kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.4, 8.4, 8.4) @ 1750 MHz; Calibrated: 2023-03-31
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- 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 = 95.34 V/m; Power Drift = -0.02 dB

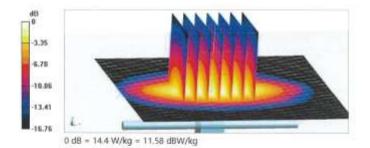
Peak SAR (extrapolated) = 17.3 W/kg

SAR(1 g) = 9.27 W/kg; SAR(10 g) = 4.9 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54%

Maximum value of SAR (measured) = 14.4 W/kg



Certificate No: 23J02Z80052

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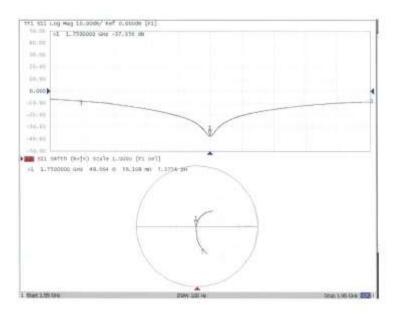
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#### Impedance Measurement Plot for Head TSL



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#### DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d142

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1 Medium parameters used: f = 1900 MHz;  $\sigma = 1.391$  S/m;  $\epsilon_r = 39.78$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3846; ConvF(7.95, 7.95, 7.95) @ 1900 MHz; Calibrated:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2022-01-12
- Phantom: MFP\_V5.1C (20deg probe tilt); Type: QD 000 P51 Cx; Serial: 1062
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm,

dy=5mm, dz=5mm

Reference Value = 97.12 V/m; Power Drift = 0.02 dB

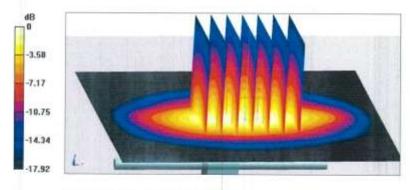
Peak SAR (extrapolated) = 19.1 W/kg

SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.13 W/kg

Smallest distance from peaks to all points 3 dB below = 9.8 mm

Ratio of SAR at M2 to SAR at M1 = 52.8%

Maximum value of SAR (measured) = 15.8 W/kg



0 dB = 15.8 W/kg = 11.99 dBW/kg

Certificate No: Z22-60267

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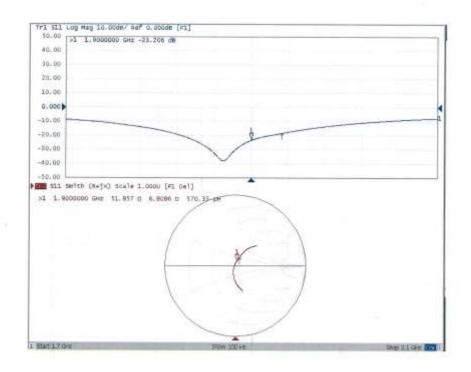
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#### Impedance Measurement Plot for Head TSL



Certificate No: Z22-60267

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J23Z60293 AUDEN Certificate No: Client

# CALIBRATION CERTIFICATE

Object D1900V2 - SN: 5d142

Calibration Procedure(s) FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date: June 14, 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 (M&TE critical for calibration)

Primary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	106277	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Power sensor NRP8S	104291	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
NetworkAnalyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24

VAUSTISAMAT ISANTI	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	龙色.
Reviewed by:	Lin Hao	SAR Test Engineer	林池
Approved by:	Qi Dianyuan	SAR Project Leader	S
		14230	40 0000

Issued: June 19, 2023

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

Certificate No: J23Z60293 Page 1 of 6

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Glossary:

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

## Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

c) DASY4/5 System Handbook

#### Methods Applied and Interpretation of Parameters:

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

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

Certificate No: J23Z60293 Page 2 of 6

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# Measurement Conditions

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	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.1 ± 6 %	1.41 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	( <del></del>	

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	39.9 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.15 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.6 W/kg ± 18.7 % (k=2)

Certificate No: J23Z60293 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	51.5Ω+ 5.13jΩ	
Return Loss	- 25.6dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.103 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: J23Z60293 Page 4 of 6

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Date: 2023-06-14

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#### DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d142

Communication System: UID 0, CW; Frequency: 1900 MHz

Medium parameters used: f = 1900 MHz;  $\sigma = 1.408$  S/m;  $\varepsilon_r = 41.07$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(8.14, 8.14, 8.14) @ 1900 MHz; Calibrated:
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- 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 = 97.44 V/m; Power Drift = -0.05 dB

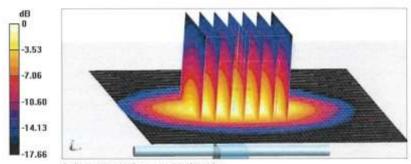
Peak SAR (extrapolated) = 18.7 W/kg

SAR(1 g) = 9.95 W/kg; SAR(10 g) = 5.15 W/kg

Smallest distance from peaks to all points 3 dB below = 9.1 mm

Ratio of SAR at M2 to SAR at M1 = 53.7%

Maximum value of SAR (measured) = 15.6 W/kg



0 dB = 15.6 W/kg = 11.93 dBW/kg

Certificate No: J23Z60293 Page 5 of 6

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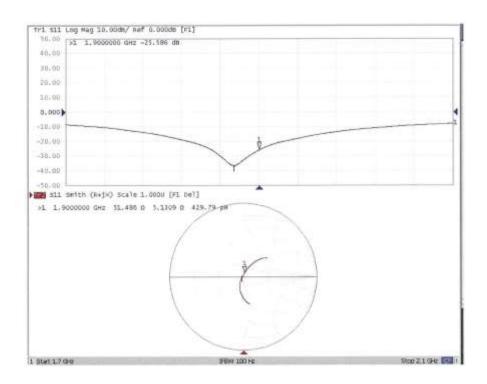
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#### Impedance Measurement Plot for Head TSL



Certificate No: J23Z60293 Page 6 of 6

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SGS Certificate No: J23Z60374 Client

**CALIBRATION CERTIFICATE** 

Object D2450V2 - SN: 728

Calibration Procedure(s) FF-Z11-003-01

Calibration Procedures for dipole validation kits

Calibration date: August 28, 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 (22x3)\*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	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Power sensor NRP8S	104291	22-Sep-22 (CTTL, No.J22X09561)	Sep-23
Reference Probe EX3DV4	SN 3617	31-Mar-23(CTTL-SPEAG,No.Z23-60161)	Mar-24
DAE4	SN 1556	11-Jan-23(CTTL-SPEAG,No.Z23-60034)	Jan-24
Secondary Standards	ID#	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	05-Jan-23 (CTTL, No. J23X00107)	Jan-24
NetworkAnalyzer E5071C	MY46110673	10-Jan-23 (CTTL, No. J23X00104)	Jan-24

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	\$6
Reviewed by:	Lin Hao	SAR Test Engineer	时光
Approved by:	Qi Dianyuan	SAR Project Leader	3332

Issued: September 1, 2023

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Certificate No: 123Z60374

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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%.

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#### Measurement Conditions

ASY system configuration, as far as	not given on page 1.	
DASY Version	DASY52	52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

#### Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mha/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.0 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	122	_

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	53.4 W/kg ± 18.8 % (k=2)
SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.9 W/kg ± 18.7 % (A=2)

Certificate No: 323Z60374

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#### Appendix (Additional assessments outside the scope of CNAS L0570)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2Ω+ 7.39jΩ
Return Loss	- 22.2dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.059 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard. No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feed-point may be damaged.

#### Additional EUT Data

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Manufactured by	SPEAG

Certificate No. 123Z60374 Page 4 of 6

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Date: 2023-08-28





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DASY5 Validation Report for Head TSL

Test Laboratory: CTTL, Beijing, China DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 728

Communication System: UID 0, CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz;  $\sigma = 1.835$  S/m;  $\epsilon_t = 39.03$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 SN3617; ConvF(7.68, 7.68, 7.68) @ 2450 MHz; Calibrated: 2023-03-31
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 2023-01-11
- 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 = 98.25 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.0 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.26 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 49.1% Maximum value of SAR (measured) = 22.4 W/kg



0 dB = 22.4 W/kg = 13.50 d8W/kg

Certificate No: J23Z60374

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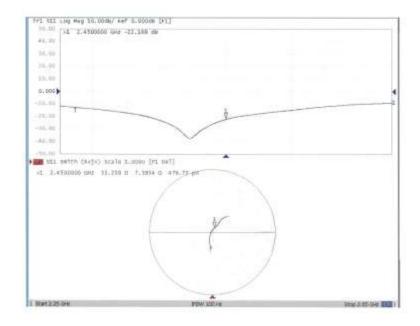
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#### Impedance Measurement Plot for Head TSL



Certificate No: J23Z60374 Page 6 of 6

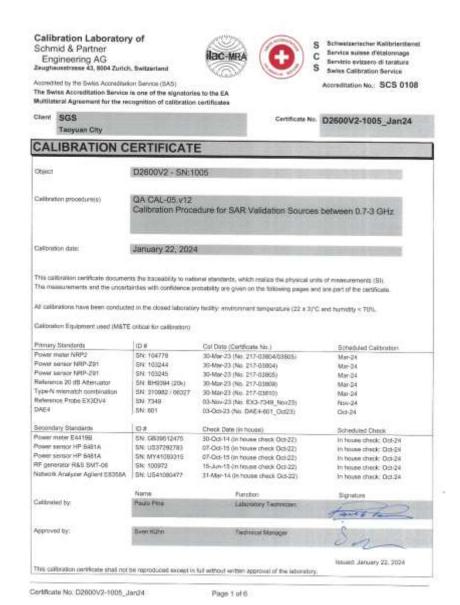
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 0108

coredited by the Swiss Accreditation Service (SAS) The Swiss Accorditation Service is one of the signatories to the EA Multilizateral Agreement for the recognition of calibration certificates

Glossary:

TSI 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-Worn 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) DASY System Handbook

#### Methods Applied and Interpretation of Parameters:

- · Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna
- 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: D2600V2-1005\_Jan24

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#### Measurement Conditions

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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.

And Annual Control of the Control of	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mhoim
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9±6%	2.02 mho/m ± 6 %
Head TSL temperature change during test	< 0.5°C	-	_

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSI.	Condition	
SAR measured	250 mW input power	14.3 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.0 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 Wkg ± 16.5 % (k=2)

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#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.8 (2 - 3.4 )(2		
Return Loss	- 28.8 dB		

## General Antenna Parameters and Design

	The state of the s
Electrical Delay (one direction)	1.153 ns

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

The dipole is made of standard semiricid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenns is therefore short-directled for DC-aignals. 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" peragraph. The SAR data are not affected by this change. The overall dipole length is still eccording to the Standard.

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

## Additional EUT Data

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## DASY5 Validation Report for Head TSL

Date: 22.01.2024

Test Laboratory: SPEAG, Zurich, Switzerland

# DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1005

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium purameters used: f = 2600 MHz;  $\sigma = 2.02 \text{ S/m}$ ;  $\epsilon_r = 37.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 03.11.2023
- Sensor-Surface: L4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 116.7 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 28.4 W/kg SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.36 W/kg Smallest distance from peaks to all points 3 dB below = 8.9 mm Ratio of SAR at M2 to SAR at M1 = 50.1%

Maximum value of SAR (measured) = 23.4 W/kg



0 dB - 23.4 W/kg = 13.68 dBW/kg

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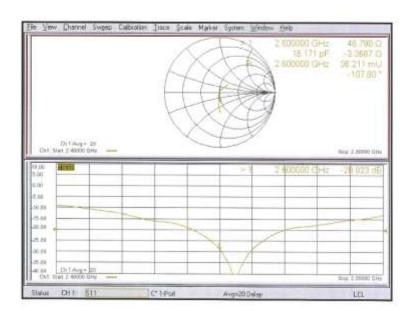
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#### Impedance Measurement Plot for Head TSL



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Calibration Laboratory of Schmid & Partner Engineering AG aughausstrasse 43, 8004 Zurich, Switzerland





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Client SGS

Certificate No. D5GHzV2-1023\_Jan24

Rject	D5GHzV2 - SN:1	023	
Calibration procedure(s)	QA CAL-22.V7 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	January 24, 2024		
The measurements and the uncert	einties with confidence pr	onel standands, which realize the physical un- rotability are given on the following pages an sy facility: arwinoment temperature (22 x 3)*C	d are part of the certificate.
Calibration Equipment used (M&TE	critical for calibration)		
	T-200	NEW 2011-12-101-17010	
The state of the s	O+	Cal Date (Certificate No.)	Scheduled Galibration
Power motor NRP2	SN: 104776	30 Mar-23 (No. 217-03804/03805)	Mar-24
Power motor NRP2 Power sensor NRP 291	SN: 104778 SN: 103944	30 Mar-23 (No. 217-03804/03805) 30 Mar-23 (No. 217-03804)	Mor 24 Mor 24
Power motor NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104776 SN: 103944 SN: 103945	30 Mai+23 (No. 217-03804/03805) 30 Mai+23 (No. 217-03804) 30 Mai+23 (No. 217-03805)	Mor 24 Mor 24 Mor 34
Power motor NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	SN: 104776 SN: 103944 SN: 103245 SN: 8H#284 (20k)	30 Mar-23 (No. 217-03804/03805) 30 Mar-23 (No. 217-03804) 30 Mar-23 (No. 217-03805) 30 Mar-23 (No. 217-03809)	Mor-24 Mor-24 Mor-24 Mor-24
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Power motor NAPP2 Fower sensor MEP-291 Fower sensor MEP-291 Reference 30 dB Attenuator Type-N mismatch continuator Reference Probe EXXIDVE DACE	5N: 104776 5N: 103944 5N: 103945 5N: 814934 (200) 5N: 310862 (30007 5N: 3003 5N: 601	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-03804) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03801) 30 Mair-23 (No. 217-03810) 37 Mair-23 (No. 217-03810) 37 Mair-23 (No. 217-03810) 38 Oct-33 (No. DAE-4-601_Oct23)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-28 Get-88
Power motor NAPP 251 Power sensor NAPP 251 Power sensor NAPP-251 Pederence 30 dB Attenuator Type-N mamwitch contrinator Reference Probe EXXXVIII Socondary Stantande	SN: 104776 SN: 103944 SN: 103945 SN: BH9394 (20k) SN: 310982 / 00097 SN: 3503	30 Mai+33 (No. 217-09804/03805) 30-Mai+23 (No. 217-09804) 30-Mai+23 (No. 217-09805) 30-Mai+23 (No. 217-09801) 30-Mai+24 (No. 217-09801) 07-Mai+24 (No. EX3-3503, Mai+25)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-26 Oct-26 Schedulod Check
Power motor NRP2 Power association NRP-291 Power servor NRP-291 Perference 20 dB Attenuator Types-N mismatch contrinston Reference Prote EXXXVIII DAE4 Secondary Standarde Prover mister 544188	SN: 104776 SN: 105944 SN: 105945 SN: 814394 (20k) SN: 210982 (00087 SN: 2008 SN: 601	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-03804) 30 Mair-23 (No. 217-03806) 30 Mair-23 (No. 217-03806) 30 Mair-23 (No. 217-03810) 67 Mair-23 (No. 527-03810) 67 Mair-23 (No. 523-3503, Mair-23) 33 Oct-33 (No. 523-3503, Mair-23) Chisck Date (In Triuse)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-28 Get-88
Power motor NAPP2 Fower annote NAPP-291 Fower sensor NAPP-291 Reference 20 off Attenuator Type-N mismatch contrination Reference Probe EXIDIVA DAE4 Secondary Standarde Proper meter E44108 Proper annote NAPP	SN: 104776 SN: 103944 SN: 103945 SN: BH9284 (20k) SN: B10982 ( 00007 SN: 8000 SN: 601	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-09804) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09810) 30 Mair-23 (No. 217-09801) 30 Mair-23 (No. 217-0980	Mar-24 Mar-24 Mar-24 Mar-24 Mar-28 Oct-28 Schedulod Check In house sheck: Oct-24
Power motor NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 30 dB Attenuator Type-N mismatch contrination Reference Probe EXXDV4 DAC4 Secondary Standards Power refer S44108 Power sensor NR 544108 Power sensor NR 5441A	SN: 104776 SN: 103245 SN: 103245 SN: 203245 SN: 20324 (206) SN: 20325 SN: 20325 SN: 001 (D.# SN: 0833512475 SN: 0833528270)	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-03804) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03810) 30 Mair-24 (No. 217-03810) 31 Mair-24 (No. 217-03810) 32 Dot-33 (No. DAG-4-01_Cxt23) Chiesh, Date (in hisses check Cxt-22) 37-02-14 (in hisses check Cxt-22) 37-02-14 (in hisses check Cxt-22)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-26 Oct-26 Schedulod Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
Power restor NRP2 Power as service NRP 291 Power service NRP 291 Perference 20 dB Attenuator Type-N internation contrinsion Resterence Probe EXXXVIII DAE4 Secondary Standards Prover restor EX 49108 Prover centor INP 8461A Prover centor INP 8461A RF generator R&S 5161-06	SN: 104776 SN: 103944 SN: 103945 SN: 210345 SN: 210382 / D0027 SN: 2002 SN: 2002 SN: 001 ID:8 SN: 0053512475 SN: 00435512475 SN: 00441093215	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-03804) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03805) Chick Date (in feutie) 30 Oct-14 (in feutie) their Oct-23 10 Oct-14 (in feutie) their Oct-23 10 Oct-15 (in feutie) their Oct-23 10 Oct-15 (in feutie) their Oct-23	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-26 Oct-36 Schedulod Check In house offscic Oct-24
Prenary Standards Power rector NRP2 Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator Type-N mismwich contrination Reference Probe EX30X4 DAE4 Secondary Standards Power mister E44188 Power sensor NRP-8481A Power sensor NRP-8481A Power sensor NRP-8481A Reservator	SN: 104776 SN: 103944 SN: 103945 SN: 103945 SN: 104927 (2007 SN: 20092 (2007 SN: 20092 (2007 SN: 001 ID:# SN: 00593513475 SN: 0441096215 SN: 4041096215	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-09804) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09810) 30 Mair-23 (No. 217-0981	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-28 Get-28 Schedulod Check In house check: Get-24
Power motor NRP2 Power association NRP-291 Power servor NRP-291 Perference 20 IBI Athenuator Types N-Internaction Contrinsion Reference Probe EXDDV8 DAE4 Secondary Blandande Power meter E44108 Power servor NRP-8617A Power servor NRP-8617A RF generator R&S SMT-06 Notwork Analyzer Agilant E83SBA	SN: 104776 SN: 103944 SN: 103945 SN: 210982 / D0027 SN: 210982 / D0027 SN: 3038 SN: 001 ID:8 SN: 04392582703 SN: MV41098215 SN: 100872 SN: US41090477	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-03804) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03805) 30 Mair-23 (No. 217-03801) 37-Mair-23 (No. 217-03810) 33-Oct-33 (No. DARS-601_Oct23) Check Date (in house check Oct-22) 37-Oct-14 (in house check Oct-22) 37-Oct-15 (in house check Oct-22) 47-Oct-16 (in house check Oct-22) 45-Jun-19 (in house check Oct-22) 31 Mair-14 (in house check Oct-22)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-26 Oct-26 Oct-26 In house check: Oct-26
Power motor NRP2 Power associated NRP-291 Power servor NRP-291 Perference 20 till Athenuatur Types-N miamach contrinston Reference Probe EXXXVIII DA24 Socondary Standarde Prover meter E44108 Prover meter E44108 Regenerater NRP-8461A REgenerater R85-556T-06	SN: 104776 SN: 103944 SN: 103945 SN: 103945 SN: 104927 (90007 SN: 304982 (90007 SN: 304982 (90007 SN: 304982 (90007 SN: 404982 (90007 SN: 404982 (90007 SN: 404982 (90007 SN: 404982 (90007 SN: 404982 (90007 SN: 40498 (90007 SN:	30 Mair-23 (No. 217-09804/03805) 30 Mair-23 (No. 217-09804) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 30 Mair-23 (No. 217-09805) 31 Mair-23 (No. 217-09805) 32 Mair-23 (No. 217-09805) 33 Mair-23 (No. 217-09805) 34 Mair-23 (No. 217-09805) 35 Mair-23 (No. 217-09805) 36 Mair-23 (No. 217-09805) 37 Mair-24 (In house check Oct-22) 31 Mair-14 (In house check Oct-22) 31 Mair-14 (In house check Oct-22)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Mar-26 Oct-26 Oct-26 In house check: Oct-26

Certificate No: D5GHzV2-1023 Jan24

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# Calibration Laboratory of

Schmid & Partner Engineering AG sughsusetrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kallbrierdienst Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service

Accreditation No.: SCS 0108 The Swiss Accreditation Service is one of the signatories to the EA Multilatoral Agreement for the recognition of calibration certificates

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-Worn 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) DASY System Handbook

# Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The source is mounted in a touch configuration below the center marking of the flat phantom.
- Return Loss: This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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#### Measurement Conditions

is far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5:0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5850 MHz ± 1 MHz	

# Head TSL parameters at 5250 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	26.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	4.57 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		_

# SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.90 Wkg
SAR for nominal Head TSL parameters	normalized to 1W	78.8 Wkg ± 19.9 % (k=2)
0.8.D	and the same	
	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL. SAR measured	oondition 100 mW input power	2.28 WAg
		2.28 W/kg 22.7 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1023\_Jan24

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## Head TSL parameters at 5600 MHz

	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	35.5 ± 6 %	4.97 mbo/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.13 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.3 W/kg ± 19.9 % (ks:2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.3 W/kg ± 19.5 % (k=2)

# Head TSL parameters at 5750 MHz

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0°C	35.4	5.22 mhaint
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.4 ± 6 %	5.11 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	22111	

#### SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>2</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7,81 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.0 W/kg a 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.1 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1023\_Jan24

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# Head TSL parameters at 5850 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.2	5.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.2 ± 6 %	5.19 mha/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	

## SAR result with Head TSL at 5850 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW Input power	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>2</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input pawer	2.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 Wikg ± 19.5 % (k=2)

Certificate No: D6GHzV2-1023\_Jan24

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### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	50.9 (1 - 4.9 (0)
Return Loss	- 26.2 dB

#### Antenna Parameters with Head TSL at 5600 MHz

impedance, transformed to feed point	54.5 (1) - 0.4 (0)	
Return Loss	-27.3 dB	

# Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.6 \( \O + 4.7 \) (1)	
Return Loss	+22.4 dB	

## Antenna Parameters with Head TSL at 5850 MHz

Impedance, transformed to feed point	54.6 Ω - 3.3 <u>j</u> Ω	
Return Loss	√25.3 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	5.200 mg
Electrical Datify (one direction)	1:200 No

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

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

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

# Additional EUT Data

Manufactured by		SPEAG	
icate No: D5GHzV2-1023_Jan24	Page 6 of 9		

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#### **DASY5 Validation Report for Head TSL**

Date: 24.01.2024

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1023

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750

MHz, Frequency; 5850 MHz.

Medium parameters used: f = 5250 MHz;  $\alpha = 4.57$  S/m;  $c_c = 35.8$ ;  $\rho = 1000$  kg/m; Medium parameters used: f = 5600 MHz;  $\sigma = 4.97 \text{ S/m}$ ;  $\varepsilon_r = 35.5$ ;  $\rho = 1000 \text{ kg/m}$ 

Medium parameters used: f = 5750 MHz;  $\sigma = 5.11 \text{ S/m}$ ;  $\epsilon_r = 35.4$ ;  $\rho = 1000 \text{ kg/m}$ Modium parameters used:  $f \approx 5850$  MHz;  $\sigma = 5.19$  S/m;  $\epsilon_f = 35.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

## DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.5, 5.5, 5.5) @ 5250 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz, ConvF(5.08, 5.08, 5.08) @ 5750 MHz, ConvF(4.99, 4.99, 4.99) @ 5850 MHz; Calibrated: 07.03.2023
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 03.10.2023
- Phantom: Flat Phantom: 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.22 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 7.90 W/kg; SAR(10 g) = 2.28 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm Ratio of SAR at M2 to SAR at M1 = 71%

Maximum value of SAR (measured) = 18.1 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 72.82 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 8.13 W/kg; SAR(10 g) = 2.33 W/kg

Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 68.5%

Maximum value of SAR (measured) = 18.7 W/kg

Certificate No. D6GHzV2-1023 Jan24

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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 70.20 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 7.81 W/kg; SAR(10 g) = 2.22 W/kg

Smallest distance from peaks to all points 3 dB below = 7.4 mm Ratio of SAR at M2 to SAR at M1 = 66.9%

Maximum value of SAR (measured) = 18.3 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5850 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0; Measurement grid: dx-4mm, dy-4mm, dz-1.4mm

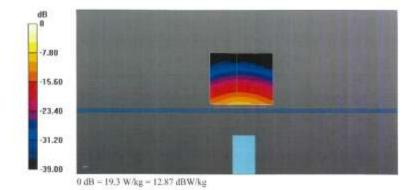
Reference Value = 69.49 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) - 30.9 W/kg

SAR(1 g) = 7.87 W/kg; SAR(10 g) = 2.23 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%

Maximum value of SAR (measured) = 19.3 W/kg



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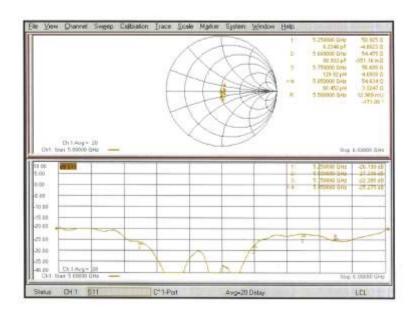
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## Impedance Measurement Plot for Head TSL



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