

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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.5 Ω + 6.1 jΩ	
Return Loss	- 22.8 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 ns
Execution Delay (one uneceous)	1,105 HS

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

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

Manufactured by SPEAG	
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# **DASY5 Validation Report for Head TSL**

Date: 14.03.2024

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:743

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

Medium parameters used: f = 2450 MHz;  $\sigma = 1.83 \text{ S/m}$ ;  $\epsilon_r = 38.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 115.1 V/m; Power Drift = 0.07 dB Peak SAR (extrapolated) = 26.4 W/kg

SAR(1 g) = 13.1 W/kg; SAR(10 g) = 6.09 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 50.1%

Maximum value of SAR (measured) = 21.4 W/kg



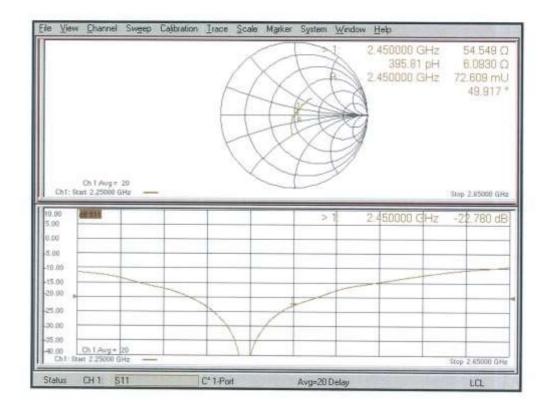
0 dB = 21.4 W/kg = 13.30 dBW/kg

Certificate No: D2450V2-743\_Mar24

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# Impedance Measurement Plot for Head TSL



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# Appendix: Transfer Calibration at Four Validation Locations on SAM Head1

## **Evaluation Condition**

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

# SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	55.2 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	56.3 W/kg ± 17.5 % (k=2)
SAD averaged over 10 am3 (10 et al Hand TO)		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	53.0 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Ear ≅ D90)

SAR for nominal Head TSL parameters

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	34.0 W/kg ± 17.5 % (k=2)
SAR for nominal Head TSL parameters	normalized to 1W	34.0 W/kg ± 17.5 % (I
AR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

normalized to 1W

17.1 W/kg ± 16.9 % (k=2)

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Additional assessments outside the current scope of SCS 0108



# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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 HCT

Gyeonggi-do, Republic of Korea

Certificate No. D2600V2-1015\_Apr24

Object	D2600V2 - SN:1	이15 제 기고(현	2 1 1 1 May
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	Calibration Proce	edure for SAR Validation Sources	
Calibration date:	April 22, 2024		
The measurements and the uncer	tainties with confidence p	onal standards, which realize the physical uni robability are given on the following pages an y facility: environment temperature (22 ± 3)*(	d are part of the certificate.
Calibration Equipment used (M&T)	E critical for calibration)		
Primary Standards	1D #	Cal Date (Certificate No.)	D-1-47-40-W
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#### Calibration Laboratory of

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





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Accreditation No.: SCS 0108

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#### 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**

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

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.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.4 ± 6 %	2.04 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		3-3

# 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	14.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	56.4 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	6.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 W/kg ± 16.5 % (k=2)



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.4 Ω - 5.1 jΩ	
Return Loss	- 25.2 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

Manufactured by	SPEAG

Certificate No: D2600V2-1015\_Apr24

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

Date: 22.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1015

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

Medium parameters used: f = 2600 MHz;  $\sigma = 2.04$  S/m;  $\epsilon_r = 37.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- 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=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

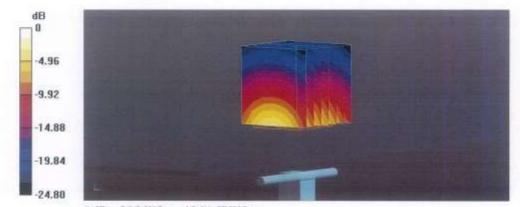
Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 119.3 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 29.4 W/kg

SAR(1 g) = 14.5 W/kg; SAR(10 g) = 6.41 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 49.4% Maximum value of SAR (measured) = 24.2 W/kg



0 dB = 24.2 W/kg = 13.84 dBW/kg

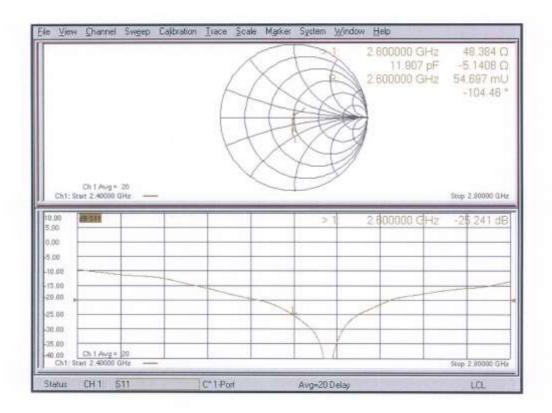
Certificate No: D2600V2-1015\_Apr24

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# Impedance Measurement Plot for Head TSL



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# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Accreditation No.: SCS 0108

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

Certificate No. D3500V2-1132\_Jan24

	ERTIFICATE		-	150
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This calibration certificate documen	ts the traceability to natio	anal standards, which realize the physi	ical units of mean	screments (SI).
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Calibration Equipment used (M&TE	critical for calibration)			
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Drimany Standards	ID.W	Cal Date (Certificate No.)	6,	had and Calibration
Primary Standards	ID#	Cal Date (Certificate No.)	100.0	cheduled Calibration
Power meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	M	ar-24
Power meter NRP2 Power sensor NRP-Z91	SN: 104778 SN: 103244	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804)	M	ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805)	M: M:	ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-291 Power sensor NRP-291 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (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)	M: M: M:	ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Aftenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 8H6394 (20k) SN: 310862 / 06327	30-Mar-23 (No. 217-03804/03605) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	Mi Mi Mi Mi	ar-24 ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 3503	30-Mar-23 (No. 217-03804/03605) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503 Mar-23)	Mi Mi Mi Mi	ar-24 ar-24 ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: 8H6394 (20k) SN: 310862 / 06327	30-Mar-23 (No. 217-03804/03605) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810)	Mi Mi Mi Mi	ar-24 ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 3503	30-Mar-23 (No. 217-03804/03605) 30-Mar-23 (No. 217-03804) 30-Mar-23 (No. 217-03805) 30-Mar-23 (No. 217-03809) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503 Mar-23)	Mi Mi Mi Mi Mi	ar-24 ar-24 ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	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) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 03-Oct-23 (No. DAE4-601_Oct23) Check Date (in house)	Mi Mi Mi Mi Mi Oi	ar-24 ar-24 ar-24 ar-24 ar-24 ar-24 ar-24
Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	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) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503_Mar23) 03-Oct-23 (No. DAE4-601_Oct23) Check Date (in house)	Mi Mi Mi Mi Mi Oi	ar-24 ar-24 ar-24 ar-24 ar-24 ar-24 at-24 theduled Check house check: Oct-24
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Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: 8HB394 (20k) SN: 310882 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	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) 30-Mar-23 (No. 217-03810) 07-Mar-23 (No. EX3-3503 Mar23) 03-Oct-23 (No. DAE4-601 Oct23) Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22)	Min	ar-24 ar-24 ar-24 ar-24 ar-24 ar-24 ar-24 theduled Check house check: Oct-24 house check: Oct-24 house check: Oct-24
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#### Calibration Laboratory of

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





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S Swiss Calibration Service

Accreditation No.: SCS 0108

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

#### 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**

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

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 = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3500 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.9	2.91 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.1 ± 6 %	2.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.50 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.6 W/kg ± 19.5 % (k=2)



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.9 Ω - 3.8 jΩ	
Return Loss	- 27.6 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.130 ns

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

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

PAGE 1	0.000
Manufactured by	SPEAG

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#### DASY5 Validation Report for Head TSL

Date: 23.01.2024

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1132

Communication System: UID 0 - CW; Frequency: 3500 MHz

Medium parameters used: f = 3500 MHz;  $\sigma = 2.9 \text{ S/m}$ ;  $\varepsilon_r = 38.1$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.91, 7.91, 7.91) @ 3500 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=100 mW, d=10mm, f=3500MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 66.18 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 17.1 W/kg

# SAR(1 g) = 6.50 W/kg; SAR(10 g) = 2.46 W/kg

Smallest distance from peaks to all points 3 dB below = 8.4 mm

Ratio of SAR at M2 to SAR at M1 = 75.7%

Maximum value of SAR (measured) = 12.2 W/kg



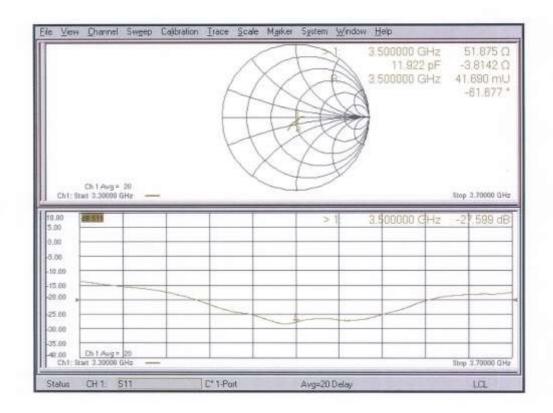
0 dB = 12.2 W/kg = 10.86 dBW/kg

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# Impedance Measurement Plot for Head TSL



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#### Calibration Laboratory of Schmid & Partner

Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland





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S Swiss Calibration Service

Accreditation No.: SCS 0108

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Accredited by the Swiss Accreditation Service (SAS)

Client

HCT

Gyeonggi-do, Republic of Korea

Certificate No.

D3700V2-1105\_Sep24

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Object	D3700V2 - SN: 1105	재 박위/함위 발과	7/2/4	1	15 1419
Calibration procedure(s)	QA CAL-22.v7 Calibration Procedure for	or SAR Va	alidation Sources	between	3 - 10 GHz
ACHLOSIC SOL	September 18, 2024				
Calibration date	Copionison 10, coc.				
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This calibration certificate do The measurements and the s	currents the traceability to national st	lity are given	on the following page	s and are par	t of the certificate.

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	25-Jan-24 (No. 4030-315007551)	Jan-25
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	Mar-25
OCP DAK-12	SN: 1016	05-Oct-23 (No. OCP-DAK12-1016_Oct23)	Oct-24
OCP DAK-3.5	SN: 1249	05-Oct-23 (No. OCP-DAK3.5-1249_Oct23)	Oct-24
Reference Probe EX3DV4	SN: 7349	03-Jun-24 (No. EX3-7349_Jun24)	Jun-25
DAE4ip	SN: 1836	10-Jan-24 (No. DAE4ip-1836 Jan24)	Jan-25

Secondary Standards	ID:	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Krešimir Franjić	Laboratory Technician	X
Approved by	Sven Kühn	Technical Manager	3/6
			Issued: September 18, 2024

Certificate No: D3700V2-1105\_Sep24

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## Calibration Laboratory of

Schmid & Partner Engineering AG

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C Service suisse d'étalonnage Servizio svizzero di taratura S Swiss Calibration Service

Accreditation No.: SCS 0108

#### 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

- 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.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz."

#### Additional Documentation

· 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 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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D3700V2 - SN: 1105

September 18, 2024

## **Measurement Conditions**

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

DASY Version	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, $dy = 5mm$ , $dz = 1.4mm$	Graded Ratio = 1.5 mm (Z direction)
Frequency	3700MHz ±1MHz	

# Head TSL parameters at 3700 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37,7	3.12 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	37.4 ±6%	3.07 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 3700 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	6.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	69.3 W/kg ±19.9% (k = 2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	20 dBm input power	2.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.4 W/kg ±19.5% (k = 2)

Certificate No: D3700V2-1105\_Sep24

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D3700V2 - SN: 1105

September 18, 2024

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

#### Antenna Parameters with Head TSL at 3700 MHz

Impedance	47.0 Ω−1.4 JΩ
Return Loss	-29.3 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction) 1.139 ns	
---	--

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

Manufactured by	ARELO
Manufactured by	SPEAG

Certificate No: D3700V2-1105\_Sep24

Page 4 of 6



D3700V2 - SN: 1105 September 18, 2024

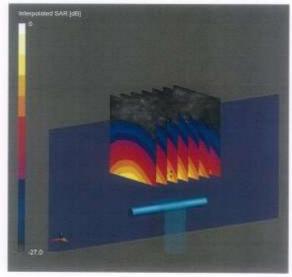
# System Performance Check Report

Summary

Dipole			Proguency (Mi	(e)	TSL	Power (dâm)		
D1700V2 - 5N1105			3700		HILL	20		
Exposure Condition	15							
Phantom Section, TSI.	Test (Sistance [mm]	Band	Group, UID	Frequency [MHz],	Channel Number	Conversion Factor	TSL Conductivity (5/m)	TSL Permittivit
Flat	10		CW, 0↔	3200,0		6.34	3.07	37.4
Hardware Setup								
Pharmom	TSL, Measured	Date		robe, Calibration D	Atie	DAE	Calibration Date	
MFP V8.0 Center	HSL, 2024-09-	18	- 1	X30V4 - 5N7349, 2	024-06-03	DAB	Hp Sm1836, 2024-01-10	
Scans Setup					Measuremen	nt Results		
				Zoom Scan				Zbam Sca

Scans Setup	
	Zoom Scan
Crid Extents (mm)	28 × 26 × 28
Grid Steps (mm)	30×50×3.4
Sensor Sorface [mm]	1.8
Craded Grid	Yes
Crading Ratio	1.5
MAIA	N/A
Surface Despenses	VMS + 5p
Scan Wethod	Measured

Measurement Results	
	Zbom Scar
ITate	2024-09-11
psSAR3g (W/Kg)	6.93
piSAR10g [W/Kg]	2.54
Power Drift (68)	-0.0
Power Scaling	Disables
Scaling Factor (sf8)	
TSL Correction	Positive / Negative



0 dB = 18.7 W/Kg

Certificate No: D3700V2-1105\_Sep24

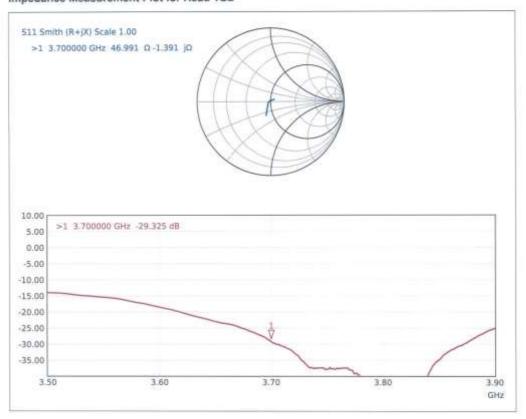
Page 5 of 6

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D3700V2 - SN: 1105 September 18, 2024

# Impedance Measurement Plot for Head TSL



Certificate No: D3700V2-1105\_Sep24 Page 6 of 6

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# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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 HCT

Gyeonogi-do, Republic of Korea

Certificate No. D3900V2-1086\_May24

CALIBRATION	ERTIFICATE		3 4 4   9 31 34
		2	W 1 /2 -
Object	D3900V2 - SN:10	086	Musty Jr.
		1447011	SW WEST CJ HET
ATRICTOR TOTAL	04 041 33.7		202406.05 2024.06.05
Calibration procedure(s)	QA CAL-22.v7	dure for SAR Validation Sou	
	Gailbrattori P1066	dure for GATY Validation 500	1003 DOLWOOL 3-10 OLIZ
Calibration date:	May 21, 2024		
	, 하면 잘 되는데 없었다. 사람은 말 하다면 보다 되었다.	onal standards, which realize the physic obability are given on the following pag	[
All calibrations have been conducte	ed in the closed laborator	y facility: environment temperature (22	± 3)°C and humidity < 70%.
Calibration Equipment used (M&TE	critical for calibration)		
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
	SN: 3503	07-Mar-24 (No. EX3-3503_Mar24)	Mar-25
Reference Probe EX3DV4			0.07.000
	SN: 781	16-Feb-24 (No. DAE4-781_Feb24)	Feb-25
DAE4	SN: 781	16-Feb-24 (No. DAE4-781_Feb24) Check Date (in house)	Feb-25 Scheduled Check
DAE4 Secondary Standards Power meter E44198	Markanan Markanan		1 ATT-ATT-1
DAE4 Secondary Standards Power meter E4419B	ID#	Check Date (in house)	Scheduled Check
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	ID# SN: G839512475	Check Date (in house) 30-Oct-14 (in house check Oct-22)	Scheduled Check In house check: Oct-24
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	Check Date (In house) 30-Oct-14 (In house check Oct-22) 07-Oct-15 (in house check Oct-22)	Scheduled Check In house check: Oct-24 In house check: Oct-24
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08	ID# SN: GB39512475 SN: US37292783 SN: MY41093315	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22)	Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08 Network Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22)	Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22) 31-Mar-14 (in house check Oct-22)	Scheduled Check In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24 In house check: Oct-24
DAE4 Secondary Standards Power meter E44198 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-08 Network Analyzer Agilent E8358A	ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22) 31-Mar-14 (in house check Oct-22) Function	Scheduled Check In house check: Oct-24

Certificate No: D3900V2-1086\_May24

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## Calibration Laboratory of

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





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

Accreditation No.: SCS 0108

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

#### 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%.



# **Measurement Conditions**

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

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 = 4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	3900 MHz ± 1 MHz	

# Head TSL parameters

The following parameters and calculations were applied

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.5	3.32 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.1 ± 6 %	3.26 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	17112	

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.72 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2,35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 W/kg ± 19.5 % (k=2)



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	44.0 Ω - 5.7 jΩ	
Return Loss	- 21,1 dB	

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.099 ns

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

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

		_
Manufactured by	SPEAG	

Certificate No: D3900V2-1086\_May24 Page 4 of 6



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

Date: 21.05.2024

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1086

Communication System: UID 0 - CW; Frequency: 3900 MHz

Medium parameters used: f = 3900 MHz;  $\sigma = 3.26$  S/m;  $\epsilon_r = 38.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(7.32, 7.32, 7.32) @ 3900 MHz; Calibrated: 07.03.2024
- · Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn781; Calibrated: 16.02.2024
- 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=100 mW, d=10mm, f=3900MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 69.07 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 18.4 W/kg

SAR(1 g) = 6.72 W/kg; SAR(10 g) = 2.35 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 74.9%

Maximum value of SAR (measured) = 13.0 W/kg



0 db - 13.0 W/kg - 11.15 db W/kj

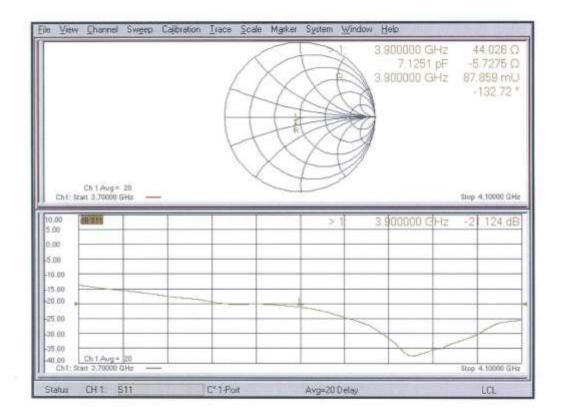
Certificate No: D3900V2-1086\_May24

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# Impedance Measurement Plot for Head TSL



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## Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland





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

Accreditation No.: SCS 0108

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 HCT

Gyeonggi-do, Republic of Korea

Certificate No. D5GHzV2-1107\_Apr24

CALIBRATION C	- CALLES AND A		
Object	D5GHzV2 - SN:1	p ( )	et Chan
Calibration procedure(s)	QA CAL-22.v7 Calibration Proce	laz t.77 of	3 2024.9703
Calibration date:	April 19, 2024		
The measurements and the uncert	ainties with confidence p	onal standards, which realize the physical un robability are given on the following pages an ry facility: environment temperature $(22 \pm 3)$ °(	d are part of the certificate.
Primary Standards	1D #	Cal Date (Certificate No.)	Scheduled Calibration
Power mater NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 07-Mar-24 (No. EX3-3503_Mar24)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Mar-25
	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	ID# SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 07-Oct-15 (in house check Oct-22) 15-Jun-15 (in house check Oct-22) 31-Mar-14 (in house check Oct-22) Function	Scheduled Check In house check: Oct-24 Signature
	Paulo Pina	Laboratory Technician	faith
Calibrated by:			
Calibrated by: Approved by:	Syen Kühn	Technical Manager	SA

Certificate No: D5GHzV2-1107\_Apr24

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#### Calibration Laboratory of

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





S Schweizerischer Kallibrierdienst
C Service suisse d'étalonnage
Servizio sylzzero di taratura
S Swiss Calibration Service

Accreditation No.: SCS 0108

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

## Glossary:

TSL

tissue simulating liquid

ConvF N/A sensitivity in TSL / NORM x,y,z 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**

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 5800 MHz ± 1 MHz	

# Head TSL parameters at 5250 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mbo/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.1 ± 6 %	4.65 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	7.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.2 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm3 (10 g) of Head TSL.	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)



# Head TSL parameters at 5600 MHz 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	36.5 ± 6 %	5.05 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.5 W/kg ± 19.5 % (k=2)

## Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.3 ± 6 %	5.22 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		-

## SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1107\_Apr24

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# Head TSL parameters at 5800 MHz

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	36.2 ± 6 %	5.27 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	222	

## SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.89 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.5 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1107\_Apr24



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

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

Impedance, transformed to feed point	49.0 Ω - 2.7 μΩ
Return Loss	- 30.8 dB

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

Impedance, transformed to feed point	54.2 Ω + 1.9 jΩ	
Return Loss	- 27.1 dB	

#### Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	56.1 Ω + 1.6 jΩ
Return Loss	- 24.6 dB

#### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.3.Ω + 0.5 jΩ
Return Loss	- 25.9 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1,196 ns

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

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

and the second s	
Manufactured by	SPEAG

Certificate No: D5GHzV2-1107\_Apr24

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#### DASY5 Validation Report for Head TSL

Date: 19.04.2024

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1107

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

MHz, Frequency: 5800 MHz

Medium parameters used: f = 5250 MHz;  $\sigma = 4.65 \text{ S/m}$ ;  $\varepsilon_f = 37.1$ ;  $\rho = 1000 \text{ kg/m}^3$ ,

Medium parameters used: f = 5600 MHz;  $\sigma = 5.05 \text{ S/m}$ ;  $\varepsilon_f = 36.5$ ;  $\rho = 1000 \text{ kg/m}^3$ ,

Medium parameters used: f = 5750 MHz;  $\sigma = 5.22$  S/m;  $\epsilon_c = 36.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>,

Medium parameters used: f = 5800 MHz;  $\sigma = 5.27 \text{ S/m}$ ;  $\varepsilon_r = 36.2$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz, ConvF(4.86, 4.86, 4.86) @ 5800 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- 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 = 73.63 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 26.9 W/kg

SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.29 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 70.9%

Maximum value of SAR (measured) = 18.2 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 = 72.81 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 8.17 W/kg; SAR(10 g) = 2.33 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 68%

Maximum value of SAR (measured) = 19.4 W/kg

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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 = 71.06 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 30.9 W/kg

SAR(1 g) = 7.95 W/kg; SAR(10 g) = 2.26 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 66.2%

Maximum value of SAR (measured) = 19.1 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

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

Reference Value = 71.08 V/m; Power Drift = 0.08 dB

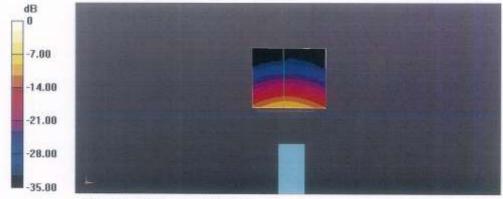
Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.89 W/kg; SAR(10 g) = 2.24 W/kg

Smallest distance from peaks to all points 3 dB below = 7.2 mm

Ratio of SAR at M2 to SAR at M1 = 65.8%

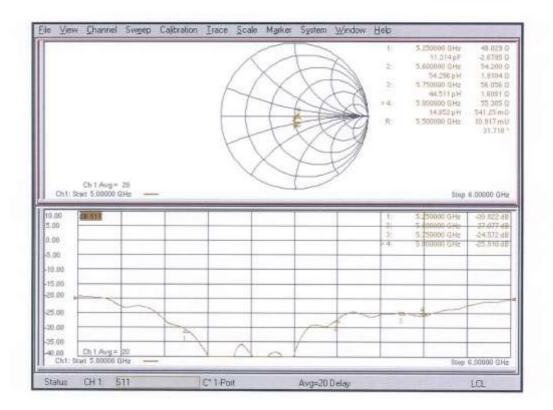
Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg



#### Impedance Measurement Plot for Head TSL



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## Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>1</sup>

## Evaluation Conditions (f=5250 MHz)

t and a second and	T	
Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

## SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	85.8 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

## SAR result with SAM Head (Mouth)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	85.0 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

#### SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	83.1 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

## SAR result with SAM Head (Ear)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	53.8 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	normalized to 1W	18.3 W/kg ± 19.9 % (k=2)

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<sup>&</sup>lt;sup>1</sup> Additional assessments outside the current scope of SCS 0108



## Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>2</sup>

#### Evaluation Conditions (f=5800 MHz)

F	1	
Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

## SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	82.4 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

## SAR result with SAM Head (Mouth)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	89.1 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

#### SAR result with SAM Head (Neck)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	79.5 W/kg ± 20.3 % (k=2)
		100000000000000000000000000000000000000
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	33333

## SAR result with SAM Head (Ear)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	56.6 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR for nominal Head TSL parameters	The state of the s	

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Additional assessments outside the current scope of SCS 0108



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Accreditation No.: SCS 0108

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Certificate No. D6.5GHzV2-1012 Sep24 HCT Gyeonggi-do, Republic of Korea CALIBRATION CERTIFICATE 재

D6.5GHzV2 - SN:1012 Object 202416.0 QA CAL-22.V7 Calibration procedure(s) Calibration Procedure for SAR Validation Sources between 3-10 GHz Calibration date: September 17, 2024 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) Cal Date (Certificate No.) Primary Standards ID# Scheduled Calibration Power sensor R&S NRP33T SN: 100987 28-Mar-24 (No. 217-04038) Mar-25 Reference 20 dB Attenuator SN: BH9394 (20k) 26-Mar-24 (No. 217-04046) Mar-25 Mismatch combination SN: 84224 / 360D 28-Mar-24 (No. 217-04050) Mar-25 Reference Probe EX3DV4 SN: 7405 01-Jul-24 (No. EX3-7405 Jul24) Jul-25 DAEd SN: 908 27-Mer-24 (No. DAE4-908\_Mer24) Mar-25 Secondary Standards ID# Check Date (in house) Scheduled Check RF generator Anapico APSIN20G 5N: 827 18-Dec-18 (in house check Jan-24) In house check: Jan-25 Power sensor NRP-Z23 SN: 100169 10-Jan-19 (in house check Jan-24) In house check: Jan-25 Power sensor NRP-18T 5N: 100950 28-Sep-22 (in house check Jan-24) In house check: Jan-25 Network Analyzer Keysight E5063A SN:MY54504221 31-Oct-19 (in house check Oct-22) In house check: Oct-24

Calibrated by: Aldonia Georgiadou Laboratory Technician Approved by: Sven Kilhn Technical Manager Issued: September 18, 2024

Function

Certificate No: D6.5GHzV2-1012\_Sep24

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

Name



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#### 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.

#### Additional Documentation:

b) 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 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 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 absorbed power density (APD): The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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**

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

ASY system configuration, as far as no	t given on page 1,	117417
DASY Version	DASY6	V16.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	5 mm	with Spacer
Zoom Scan Resolution	dx, dy = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	6500 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	34.5	6.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	6.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	-	

#### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	29.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	297 W/kg ± 24.7 % (k=2)

SAR averaged over 8 cm3 (8 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.64 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	66.5 W/kg ± 24.4 % (k=2)

SAR averaged over 10 cm <sup>1</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.6 W/kg ± 24.4 % (k=2)



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

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1 Ω - 5.5 jΩ
Return Loss	- 25.1 dB

#### APD (Absorbed Power Density)

APD averaged over 1 cm <sup>2</sup>	Condition	
APD measured	100 mW input power	296 W/m²
APD measured	normalized to 1W	2960 W/m <sup>2</sup> ± 29.2 % (k=2)

APD averaged over 4 cm <sup>3</sup>	condition	
APD measured	100 mW input power	133 W/m <sup>2</sup>
APD measured	normalized to 1W	1330 W/m <sup>2</sup> ± 28.9 % (k=2)

<sup>&</sup>quot;The reported APO values have been derived using the psSAR1g and psSAR8g.

#### General Antenna Parameters and Design

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

The dipole is made of standard 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 feedpoint may be damaged.

#### Additional EUT Data

Manufactured by	SPEAG

Certificate No: D6.5GHzV2-1012\_Sep24

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## DASY6 Validation Report for Head TSL

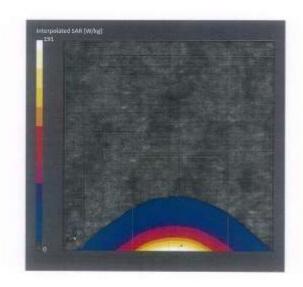
Measurement Report for D6.5GHz-1012, UID 0 -, Channel 6500 (6500.0MHz)

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type	
D6.5GHz	16.0 x 6.0 x 300.0	SN: 1012	*	

Exposure Cond	ditions						
Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.14	6.24	34.6

Hardware Setup			
Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2024-07-01	DAE4 Sn908, 2024-03-27

Scan Setup		Measurement Results	
	Zoom Scan		Zoom Scan
Grid Extents [mm]	22.0 x 22.0 x 22.0	Date	2024-09-17, 13:56
Grid Steps [mm]	3.4 x 3.4 x 1.4	psSAR1g [W/Kg]	29.7
Sensor Surface [mm]	1.4	psSARBg [W/Kg]	6.64
Graded Grid	Yes	psSAR10g [W/Kg]	5.45
Grading Ratio	1.4	Power Drift [dB]	-0.02
MAIA	N/A	Power Scaling	Disabled
Surface Detection	VMS + 6p	Scaling Factor [dB]	
Scan Method	Measured	TSL Correction	No correction
		M2/M1 [%]	50.5
		Dist 3dB Peak [mm]	4.8

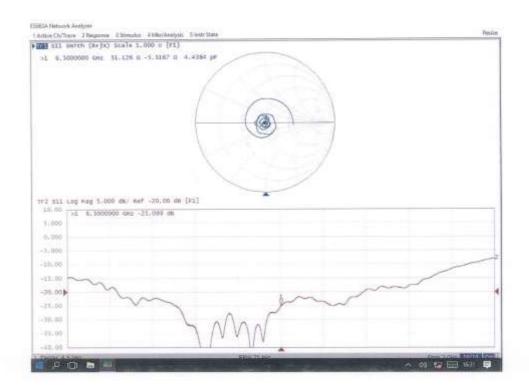


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## Impedance Measurement Plot for Head TSL



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Certificate No. 5G-Veri10-1018 Apr24

CALIBRATION C	ERTIFICAT	E	
Object	5G Verification S	Source 10 GHz - SN: 1018	
본교 회문 가지 아무리 이번의 하는 경기를 가지 않아 가장 그렇게 되었다.	QA CAL-45.v5 Calibration proce	edure for sources in air above 6 GH;	
Calibration date:	April 17, 2024		
The measurements and the uncertain	inties with confidence p	ional standards, which realize the physical units of probability are given on the following pages and an ry facility: environment temperature $\{22 \pm 3\}^2$ C an	re part of the certificate.
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Reference Probe EUmmWV3 DAE4ip	SN: 9374 SN: 1602	04-Dec-23 (No. EUmm-9374, Dec23) 08-Nov-23 (No. DAE4ip-1602_Nov23)	Dec-24 Nov-24
Secondary Standards	ID#	Check Date (in house)	Scheduled Check
RF generator R&S SMF100A Power sensor R&S NRP18S-10 Network Analyzer Keysight E5063A	SN: 100184 SN: 101258 SN: MY54504221	29-Nov-23 (in house check Nov-23) 29-Nov-23 (in house check Nov-23) 31-Oct-19 (in house check Oct-22)	In house check: Nov-24 In house check: Nov-24 In house check: Oct-25
		결 말 당 자	확인자
		相	25 MM2 2524.87.03
	Name	ANIMA 20 \AZZ	2-24-67.03 Signature
Calibrated by:	Name Laif Klysner	利用用 50 / 121 日 本 80 1 - W.03	Signature
Calibrated by: Approved by:		제제시에 5  / 기조년 및 과 86가 - Wr.03	

Certificate No: 5G-Veri10-1018\_Apr24

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#### Glossary

CW

Continuous wave

## Calibration is Performed According to the Following Standards

- Internal procedure QA CAL-45, Calibration procedure for sources in air above 6 GHz.
- IEC/IEEE 63195-1, "Assessment of power density of human exposure to radio frequency fields from wireless devices in close proximity to the head and body (frequency range of 6 GHz to 300 GHz)", May 2022

## Methods Applied and Interpretation of Parameters

- Coordinate System: z-axis in the waveguide horn boresight, x-axis is in the direction of the E-field, y-axis normal to the others in the field scanning plane parallel to the horn flare and horn flange.
- Measurement Conditions: (1) 10 GHz: The radiated power is the forward power to the horn
  antenna minus ohmic and mismatch loss. The forward power is measured prior and after
  the measurement with a power sensor. During the measurements, the horn is directly
  connected to the cable and the antenna ohmic and mismatch losses are determined by farfield measurements. (2) 30, 45, 60 and 90 GHz: The verification sources are switched on for
  at least 30 minutes. Absorbers are used around the probe cub and at the ceiling to minimize
  reflections.
- Horn Positioning: The waveguide horn is mounted vertically on the flange of the waveguide source to allow vertical positioning of the EUmmW probe during the scan. The plane is parallel to the phantom surface. Probe distance is verified using mechanical gauges positioned on the flare of the horn.
- E- field distribution: E field is measured in two x-y-plane (10mm, 10mm + λ/4) with a vectorial E-field probe. The E-field value stated as calibration value represents the E-fieldmaxima and the averaged (1cm² and 4cm²) power density values at 10mm in front of the horn.
- Field polarization: Above the open horn, linear polarization of the field is expected. This is verified graphically in the field representation.

#### Calibrated Quantity

 Local peak E-field (V/m) and average of peak spatial components of the poynting vector (W/m²) averaged over the surface area of 1 cm² and 4cm² at the nominal operational frequency of the verification source. Both square and circular averaging results are listed.

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: 5G-Veri10-1018\_Apr24

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## **Measurement Conditions**

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

DASY Version	DASY8 Module mmWave	V3.2
Phantom	5G Phantom	
Distance Horn Aperture - plane	10 mm	
Number of measured planes	2 (10mm, 10mm + λ/4)	
Frequency	10 GHz ± 10 MHz	

## Calibration Parameters, 10 GHz

#### Circular Averaging

Distance Hom Aperture to Measured Plane	Prad <sup>r</sup> Max E-field (mW) (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDtor+, psPDmod+) (W/m²)		Uncertainty (k = 2)	
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	93.3	154	1.27 dB	61.4	57.0	1.28 dB

Distance Hom Aperture to Measured Plane	Prad <sup>†</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Power Density psPDn+, psPDtot+, psPDmod+ (W/m²)		Uncertainty (k = 2)
			1 cm²	4 cm <sup>2</sup>		
10 mm	93.3	154	1.27 dB	61.0, 61.5, 61.7	56.5, 57.1, 57.3	1.28 dB

## **Square Averaging**

Distance Horn Aperture to Measured Plane	Prad¹ (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Avg Power Density Avg (psPDn+, psPDnod+) (W/m²)		Uncertainty (k = 2)
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	93.3	154	1.27 dB	61.4	56.9	1.28 dB

Distance Horn Aperture to Measured Plane	Prad' (mW)	Max E-field (V/m)	Uncertainty (k = 2)	psPDn+, psPDt	Power Density psPDn+, psPDtot+, psPDmod+ (W/m²)	
				1 cm <sup>2</sup>	4 cm <sup>2</sup>	
10 mm	93.3	154	1.27 dB	61.0, 61.5, 61.7	56.4, 57.0, 57.2	1.28 dB

## Max Power Density

Distance Horn Aperture to Measured Plane	Prad <sup>t</sup> (mW)	Max E-field (V/m)	Uncertainty (k = 2)	Max Power Density Sn, Stot, [Stot] (W/m²)	Uncertainty (k = 2)
10 mm	93.3	154	1.27 dB	62.6, 63.1, 63.3	1.28 dB

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Assessed ohmic and mismatch loss plus numerical offset: 0.30 dB

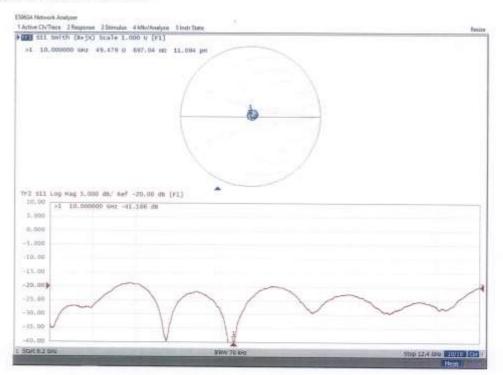


## Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters

Impedance, transformed to feed point	49.5 Ω + 0.70 jΩ	
Return Loss	- 41.2 dB	

#### Impedance Measurement Plot



Certificate No: 5G-Veri10-1018\_Apr24

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mmWave Phantom - 1002

## Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Pr Name, Manufacturer	operties Dimensions (mm	d.	IMEI	DUT Type	
SG Verification Source 10	GHz 100.0 x 100.0 x 1	172.0	SN: 1018	/*	
Exposure Conditions					
Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0
Hardware Setup					
Phantom	Medium		Probe, Callb	ration Date D	AE. Calibration Date

Scan Setup

 Probe, Calibration Date
 DAE, Calibration Date

 EUmm/WV3 - SN9374\_F1-55GHz,
 DAE4ip Sn1602,

 2023-12-04
 2023-11-08

# | 56 Scan | | 10.0 | MAIA | MAIA not used |

measurement nesure	
	5G Scar
Date	2024-04-17, 09:50
Avg. Area [cm²]	1.00
Avg. Type	Circular Averaging
psPDm+ (W/m <sup>1</sup> )	61.0
psPDtat+ (W/m²)	61.3
psPDmod+ [W/m <sup>2</sup> ]	61.7
Max(Sn) [W/m <sup>2</sup> ]	62.6
Max(Stot) [W/m <sup>2</sup> ]	63.1
Max([Stot() [W/m <sup>1</sup> ]	63.3
E <sub>max</sub> [V/m]	150
Power Drift [dB]	-0.00



Certificate No: 5G-Veri10-1018\_Apr24

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#### Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test Pro	perties					
Name, Manufacturer	Dimensions (mm	1	IMEL	DUT Typ	ie	
5G Verification Source 10 G	Hz 100.0 x 100.0 x	172.0	5N: 1018			
<b>Exposure Conditions</b>						
Phantom Section	Position, Test Distance [mm]	Band	Group	p, Frequency ( Channel Nur	mber	Factor
5G -	1(0.0 mm)	Validation band	CW	10000.0, 10000	1.0	
Hardware Setup						
Phantom	Medium		1	Probe, Calibration Date	DAE, Calibration Date	OF .
mmWave Phantom - 1002	Air			EUmmWV3 - 5N9374_F1-55GHz, 2023-12-04	DAE4lip Sn1602, 2023-11-08	
Scan Setup				Measurement Results		
		56.5				5G Scan
Sensor Surface [mm]			10.0	Date	2024-0	14-17, 09:50
MAIA		MAIA not u	ned	Avg. Area [cm <sup>2</sup> ]		4.00
				Avg. Type	Circula	ir Averaging
				psPDn+ [W/m²]		56.5
				psPDtot+ [W/m²]		57.1
				psPDmod+ [W/m²] Max(Snì [W/m²]		57.3
				Max(Stot) [W/m <sup>2</sup> ]		62.6 63.1
				Max((Stot)) (W/m <sup>2</sup> )		63.3
				Emas [V/m]		154
				Power Drift [dB]		-0.00



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## Measurement Report for 5G Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test	Properties
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Name, Manufacturer	Dimensions [mm]	IMEL	DUT Type
5G Verification Source 10 GHz	100.0 x 100.0 x 172.0	SN-1018	33334466

## **Exposure Conditions**

Phantom Section	Position, Test Distance [mm]	Band	Group,	Frequency [MHz], Channel Number	Conversion Factor
5G -	10.0 mm	Validation band	CW	10000.0, 10000	1.0

#### Hardware Setup

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Air	EUmmWV3 - 5N9374_F1-55GHz,	DAE4ip Sn1602,
		2023-12-04	2023-11-08

#### Scan Setup

	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

#### Measurement Results

	5G Scan
Date	2024-04-17, 09:50
Avg. Area [cm²]	1.00
Avg. Type	Square Averaging
psPDrs+ (W/m²)	61.0
psPDtot+ (W/m <sup>2</sup> )	61.5
psPDmod+ (W/m <sup>2</sup> )	61.7
Max(5n) [W/m <sup>2</sup> ]	62.6
Max(Stot) [W/m <sup>2</sup> ]	63.1
Max[[Stot]) [W/m <sup>2</sup> ]	63.3
Emer [V/m]	154
Power Drift [d8]	-0.00



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## Measurement Report for SG Verification Source 10 GHz, UID 0 -, Channel 10000 (10000.0MHz)

Device under Test	Properties				
Name, Manufacturer	Dimer	rsions [mm]	IMEI	DUT Type	
5G Verification Source		x 100.0 x 172.0	5N: 1018	A STATE OF THE STA	
Exposure Conditio	ns				
Phantom Section	Position, Test [mm]		Group,	Frequency [MHz], Channel Number	Conversion Factor
56 -	10.0 mm	Validation band	i CW	10000:0, 10000	1.0

Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave Phantom - 1002	Ale	EUmmWV3 - SN9374_F2-55GHz, 2023-12-04	DAE4ip 5n1602, 2023-11-08

Scan Setup	
	5G Scan
Sensor Surface [mm]	10.0
MAIA	MAIA not used

Weasurement Results	
	5G Scan
Date	2024-04-17, 09:50
Avg. Area [cm²]	4.00
Avg. Type	Square Averaging
psPDn+ [W/m <sup>2</sup> ]	56.4
psPDtot= (W/m²)	57.0
psPDmod+ [W/m²]	57.2
Max(Sn) (W/m <sup>2</sup> )	62.6
Max(Stot) (W/m <sup>2</sup> )	63.1
Max( Stot ) [W/m <sup>2</sup> ]	63.3
E <sub>max</sub> [V/m]	154
Power Drift (dB)	-0.00



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