



## DASY5 Validation Report for Head TSL

Date: 01.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 3500 MHz; Type: D3500V2; Serial: D3500V2 - SN:1016

Communication System: UID 0 - CW; Frequency: 3500 MHz, Frequency: 3400 MHz, Frequency: 3600 MHz

Medium parameters used: f = 3500 MHz;  $\sigma$  = 2.92 S/m;  $\epsilon_r$  = 37.2;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 3400 MHz;  $\sigma$  = 2.84 S/m;  $\epsilon_r$  = 37.3;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 3600 MHz;  $\sigma$  = 2.99 S/m;  $\epsilon_r$  = 37.1;  $\rho$  = 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(7.91, 7.91, 7.91) @ 3500 MHz, ConvF(7.97, 7.97, 7.97) @ 3400 MHz, ConvF(7.91, 7.91, 7.91) @ 3600 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- 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=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 = 69.69 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 18.5 W/kg SAR(1 g) = 6.79 W/kg; SAR(10 g) = 2.54 W/kg Smallest distance from peaks to all points 3 dB below = 8.6 mm Ratio of SAR at M2 to SAR at M1 = 74.7% Maximum value of SAR (measured) = 13.1 W/kg

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3400MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 70.52 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 18.5 W/kg SAR(1 g) = 6.85 W/kg; SAR(10 g) = 2.57 W/kg Smallest distance from peaks to all points 3 dB below = 8.4 mm Ratio of SAR at M2 to SAR at M1 = 75.4% Maximum value of SAR (measured) = 12.9 W/kg

Certificate No: D3500V2-1016\_Jul22

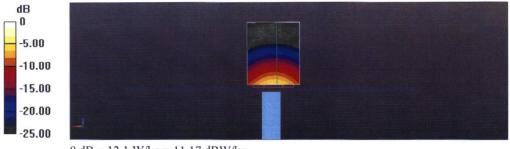
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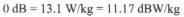




# **Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3600MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.51 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.5 W/kg SAR(1 g) = 6.66 W/kg; SAR(10 g) = 2.49 W/kg Smallest distance from peaks to all points 3 dB below = 8.4 mm Ratio of SAR at M2 to SAR at M1 = 74.3% Maximum value of SAR (measured) = 12.9 W/kg





Certificate No: D3500V2-1016\_Jul22

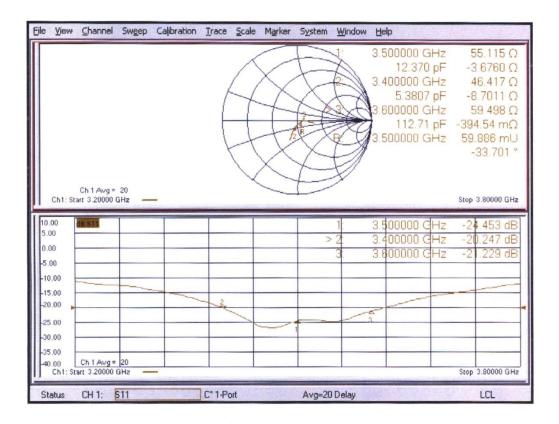
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## Impedance Measurement Plot for Head TSL



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## 3700 MHz Dipole Calibration Certificate

chmid & Partner Engineering AG rughausstrasse 43, 8004 Zurich,	of Switzerland	BC-MRA S S	Schweizerischer Kalibrierdiens Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
ccredited by the Swiss Accreditatio he Swiss Accreditation Service is			creditation No.: SCS 0108
Iultilateral Agreement for the rec	ognition of calibration		: D3700V2-1004_Jul22
CALIBRATION C	ERTIFICATE		
Object	D3700V2 - SN:10	004	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	July 01, 2022		
The measurements and the uncerta	ainties with confidence pr	onal standards, which realize the physical unit robability are given on the following pages and y facility: environment temperature (22 ± 3)°C	d are part of the certificate.
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#### Calibration Laboratory of Schmid & Partner Engineering AG

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



HARRING SSOUTH

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%.

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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 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	3700 MHz ± 1 MHz 3800 MHz ± 1 MHz	

## 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	37.0 ± 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 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.44 W/kg

## Head TSL parameters at 3800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.6	3.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.8 ± 6 %	3.15 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 3800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.7 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.40 W/kg

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

## Antenna Parameters with Head TSL at 3700 MHz

Impedance, transformed to feed point	48.6 Ω - 6.6 jΩ	
Return Loss	- 23.3 dB	

## Antenna Parameters with Head TSL at 3800 MHz

Impedance, transformed to feed point	57.5 Ω - 5.9 jΩ
Return Loss	- 21.0 dB
T total T E C C	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.138 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
Manufactured by	

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## DASY5 Validation Report for Head TSL

Date: 01.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1004

Communication System: UID 0 - CW; Frequency: 3700 MHz, Frequency: 3800 MHz Medium parameters used: f = 3700 MHz;  $\sigma$  = 3.07 S/m;  $\epsilon_r$  = 37;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 3800 MHz;  $\sigma$  = 3.15 S/m;  $\epsilon_r$  = 36.8;  $\rho$  = 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(7.73, 7.73, 7.73) @ 3700 MHz, ConvF(7.73, 7.73, 7.73) @ 3800 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- 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=100 mW, d=10mm, f=3700MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.98 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 19.1 W/kg SAR(1 g) = 6.74 W/kg; SAR(10 g) = 2.44 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm

Ratio of SAR at M2 to SAR at M1 = 73.9%Maximum value of SAR (measured) = 13.1 W/kg

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3800MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.05 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 18.9 W/kg SAR(1 g) = 6.57 W/kg; SAR(10 g) = 2.40 W/kg Smallest distance from peaks to all points 3 dB below = 8.2 mm Ratio of SAR at M2 to SAR at M1 = 73.1% Maximum value of SAR (measured) = 13.0 W/kg

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0 dB = 13.1 W/kg = 11.17 dBW/kg

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## Impedance Measurement Plot for Head TSL

					/		3	3.700000 GHz		639 C
				)	$\sim$	1-4		6.4899 pF		280 Ω
				L	$\wedge$	XE	JA:	3.800000 GHz 7.0954 pF		536 Ω 029 Ω
					74	XX	A	3.700000 GHz		43 mL
				F	X	X	Ŋ		-97	2.762
Ch1:	Ch 1 Avg = Start 3.50000		_			P			Stop 4.0	10000 GH
Ch1: 5			_					3.700000 GHz	-23.2	293 dE
0.00	Start 3.50000		_					3.700000 GHz 3.800000 GHz	-23.2	
0.00 5.00	Start 3.50000		_			1>2			-23.2	293 dE
0.00 5.00 0.00	Start 3.50000								-23.2	293 dE
0.00 5.00 0.00 5.00 10.00 15.00	Start 3.50000								-23.2	293 dE
0.00 5.00 5.00 5.00 10.00 15.00 20.00	Start 3.50000					1 >2			-23.2	293 dE
0.00 5.00 5.00 5.00 10.00 15.00 20.00 25.00	Start 3.50000								-23.2	293 dE
0.00 5.00 5.00 10.00 15.00 20.00 25.00 30.00	Start 3.50000								-23.2	293 dE
0.00 5.00 5.00 5.00 10.00 15.00 20.00 25.00	Start 3.50000	GHz							-23.2	293 dE

Certificate No: D3700V2-1004\_Jul22

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## 3700 MHz Dipole Calibration Certificate

	Switzerland	C S S	Schweizerischer Kalibrierdiens Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
ccredited by the Swiss Accreditation he Swiss Accreditation Service	is one of the signatories	s to the EA	creditation No.: SCS 0108
Aultilateral Agreement for the rec		Certificate No	: D3700V2-1004_Jul22
CALIBRATION C	D3700V2 - SN:10		
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	dure for SAR Validation Sources	between 3-10 GHz
Calibration date:	July 01, 2022		
The measurements and the uncert All calibrations have been conduct	ainties with confidence p	v facility: environment temperature (22 ± 3)°C	d are part of the certificate.
The measurements and the uncert All calibrations have been conduct Calibration Equipment used (M&TE	ainties with confidence p ed in the closed laborator E critical for calibration)	robability are given on the following pages an y facility: environment temperature (22 ± 3)°C	d are part of the certificate. c and humidity < 70%.
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	ainties with confidence pre- ed in the closed laborator E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 013245 SN: 013245 SN: 013245 SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41093315 SN: 100972 SN: US41080477 Name	Cal Date (Certificate No.)           04-Apr-22 (No. 217-03525/03524)           04-Apr-22 (No. 217-03525)           04-Apr-22 (No. 217-03527)           04-Apr-22 (No. 217-03528)           08-Mar-22 (No. 217-03528)           08-Mar-22 (No. 217-03528)           08-Mar-22 (No. DAE4-601_May22)           Check Date (in house)           30-Oct-14 (in house check Oct-20)           07-Oct-15 (in house check Oct-20)           07-Oct-15 (in house check Oct-20)           15-Jun-15 (in house check Oct-20)           31-Mar-14 (in house check Oct-20)           Function	d are part of the certificate. C and humidity < 70%. Scheduled Calibration Apr-23 Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 Mar-23 Scheduled Check In house check: Oct-22 In house check: Oct-22





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





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Schweizerischer Kalibrierdienst Service suisse d'étalonnage С Servizio svizzero 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	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%.

Certificate No: D3700V2-1004\_Jul22

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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 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	3700 MHz ± 1 MHz 3800 MHz ± 1 MHz	

## 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	37.0 ± 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 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.74 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	67.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.44 W/kg

## Head TSL parameters at 3800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.6	3.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.8 ± 6 %	3.15 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 3800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.57 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.7 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.40 W/kg

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

## Antenna Parameters with Head TSL at 3700 MHz

Impedance, transformed to feed point	48.6 Ω - 6.6 jΩ
Return Loss	- 23.3 dB

## Antenna Parameters with Head TSL at 3800 MHz

57.5 Ω - 5.9 jΩ	
- 21.0 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.138 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: D3700V2-1004\_Jul22

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## DASY5 Validation Report for Head TSL

Date: 01.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 3700 MHz; Type: D3700V2; Serial: D3700V2 - SN:1004

Communication System: UID 0 - CW; Frequency: 3700 MHz, Frequency: 3800 MHz Medium parameters used: f = 3700 MHz;  $\sigma$  = 3.07 S/m;  $\epsilon_r$  = 37;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 3800 MHz;  $\sigma$  = 3.15 S/m;  $\epsilon_r$  = 36.8;  $\rho$  = 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(7.73, 7.73, 7.73) @ 3700 MHz, ConvF(7.73, 7.73, 7.73) @ 3800 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- 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=100 mW, d=10mm, f=3700MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 69.98 V/m; Power Drift = -0.06 dB Peak SAR (extrapolated) = 19.1 W/kg SAR(1 g) = 6.74 W/kg; SAR(10 g) = 2.44 W/kg

Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 73.9%Maximum value of SAR (measured) = 13.1 W/kg

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=3800MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 68.05 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 18.9 W/kg SAR(1 g) = 6.57 W/kg; SAR(10 g) = 2.40 W/kg Smallest distance from peaks to all points 3 dB below = 8.2 mm Ratio of SAR at M2 to SAR at M1 = 73.1% Maximum value of SAR (measured) = 13.0 W/kg

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0 dB = 13.1 W/kg = 11.17 dBW/kg

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## Impedance Measurement Plot for Head TSL

e <u>V</u> iew	<u>Channel</u>		Calibration		-	-	Window	3.700000 GHz	48.639 0
				/	$\langle /$	t	A	6.4899 pF	-6.6280 0
				/	$\sim$	T	2	3.800000 GHz	57.536 0
				1	h	XX	YX	7.0954 pF	-5.9029 0
						2-6		3.700000 GHz	68.443 ml -97.762
				{	1	T	70	1	-87.702
				F	TX	$\sim$	t A	1	
					X	X	1		
					X	1	X		
Chi	Ch 1 Avg =		_		-	-			Stop 4.00000 GI
Ch1:	Ch 1 Avg = Start 3.50000		_						Stop 4.00000 GI
0.00			_				1:	3.700000 CHz	-2 <b>8</b> .293 d
0.00 5.00	Start 3.50000		_			>	1:	3.700000 CHz 3.800000 CHz	
0.00 5.00 0.00	Start 3.50000					>	1: 2:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00	Start 3.50000					>	1:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00 10.00	Start 3.50000					>	1: 2:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00	Start 3.50000					>	1:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00 10.00 15.00	Start 3.50000					~	1:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00 10.00 15.00 20.00	Start 3.50000						1: 2:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00 10.00 10.00 20.00 25.00	Start 3.50000						1:		-2 <b>8</b> .293 d
0.00 5.00 0.00 5.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00	Start 3.50000	20					1:		-2 <b>8</b> .293 d

Certificate No: D3700V2-1004\_Jul22

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## 3900 MHz Dipole Calibration Certificate

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

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

		Certificate No:	D3900V2-1024_Jul22
ALIBRATION CI	ERTIFICATE		
ect	D3900V2 - SN:10	24	
libration procedure(s)	QA CAL-22.v6 Calibration Proces	dure for SAR Validation Sources	between 3-10 GHz
alibration date:	July 01, 2022		
ne measurements and the uncerta	ainties with confidence pr	onal standards, which realize the physical unit obability are given on the following pages and y facility: environment temperature (22 ± 3)°C	are part of the certificate.
	ID#	Cal Date (Certificate No.)	Scheduled Calibration
	10#	Cal Date (Certificate No.)	
	SNI: 104779	04-Apr-22 (No. 217-03525/03524)	Apr-23
ower meter NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524) 04-Apr-22 (No. 217-03524)	Apr-23 Apr-23
ower meter NRP ower sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91	SN: 103244 SN: 103245	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525)	
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator	SN: 103244 SN: 103245 SN: BH9394 (20k)	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527)	Apr-23 Apr-23
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528)	Apr-23 Apr-23 Apr-23
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator /pe-N mismatch combination eference Probe EX3DV4	SN: 103244 SN: 103245 SN: BH9394 (20k)	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527)	Apr-23 Apr-23 Apr-23 Apr-23
wer meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 aference 20 dB Attenuator ope-N mismatch combination oference Probe EX3DV4 AE4	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 08-Mar-22 (No. EX3-3503_Mar22) 02-May-22 (No. DAE4-601_May22)	Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 May-23
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator /pe-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 08-Mar-22 (No. EX3-3503_Mar22) 02-May-22 (No. DAE4-601_May22) Check Date (in house)	Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 May-23 Scheduled Check
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B	SN: 103244           SN: 103245           SN: BH9394 (20k)           SN: 310962 / 06327           SN: 3503           SN: 601           ID #           SN: GB39512475	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 08-Mar-22 (No. EX3-3503_Mar22) 02-May-22 (No. DAE4-601_May22) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 May-23 Scheduled Check In house check: Oct-22
ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 aference 20 dB Attenuator /pe-N mismatch combination aference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 08-Mar-22 (No. EX3-3503_Mar22) 02-May-22 (No. DAE4-601_May22) 02-May-22 (No. DAE4-601_May22) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 May-23 Scheduled Check In house check: Oct-22 In house check: Oct-22
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ower meter NRP ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter E4419B ower sensor HP 8481A ower sensor HP 8481A F generator R&S SMT-06	SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	04-Apr-22 (No. 217-03524) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03525) 04-Apr-22 (No. 217-03527) 04-Apr-22 (No. 217-03528) 08-Mar-22 (No. EX3-3503_Mar22) 02-May-22 (No. DAE4-601_May22) 02-May-22 (No. DAE4-601_May22) Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-23 Apr-23 Apr-23 Apr-23 Mar-23 May-23 Scheduled Check In house check: Oct-22 In house check: Oct-22
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Certificate No: D3900V2-1024\_Jul22

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## Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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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%.

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## **Measurement Conditions**

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

ed Extrapolation Flat Phantom V5.0	
10 mm	with Spacer
0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
MHz ± 1 MHz	
	0 mm, dz = 1.4 mm 0 MHz ± 1 MHz 0 MHz ± 1 MHz 0 MHz ± 1 MHz

## Head TSL parameters at 3900 MHz

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	36.7 ± 6 %	3.24 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 3900 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.96 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	69.6 W/kg ± 19.9 % (k=2)
	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.42 W/kg

## Head TSL parameters at 4000 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.4	3.43 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.6 ± 6 %	3.33 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 4000 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.82 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	68.2 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.38 W/kg

Certificate No: D3900V2-1024\_Jul22

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## Head TSL parameters at 4100 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	37.2	3.53 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.5 ± 6 %	3.41 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 4100 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.82 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	68.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.37 W/kg

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

#### Antenna Parameters with Head TSL at 3900 MHz

Impedance, transformed to feed point	46.3 Ω - 6.6 jΩ	
Return Loss	- 22.1 dB	

## Antenna Parameters with Head TSL at 4000 MHz

Impedance, transformed to feed point	52.1 Ω - 2.7 jΩ
Return Loss	- 29.5 dB

## Antenna Parameters with Head TSL at 4100 MHz

Impedance, transformed to feed point	59.8 Ω - 1.9 jΩ	
Return Loss	- 20.8 dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.107 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
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## **DASY5 Validation Report for Head TSL**

Date: 01.07.2022

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 3900 MHz; Type: D3900V2; Serial: D3900V2 - SN:1024

Communication System: UID 0 - CW; Frequency: 3900 MHz, Frequency: 4000 MHz, Frequency: 4100 MHz

Medium parameters used: f = 3900 MHz;  $\sigma$  = 3.24 S/m;  $\epsilon_r$  = 36.7;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 4000 MHz;  $\sigma$  = 3.33 S/m;  $\epsilon_r$  = 36.6;  $\rho$  = 1000 kg/m<sup>3</sup>, Medium parameters used: f = 4100 MHz;  $\sigma$  = 3.41 S/m;  $\epsilon_r$  = 36.5;  $\rho$  = 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(7.39, 7.39, 7.39) @ 3900 MHz, ConvF(7.39, 7.39, 7.39) @ 4000 MHz, ConvF(7.26, 7.26, 7.26) @ 4100 MHz; Calibrated: 08.03.2022
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.05.2022
- 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=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 = 71.06 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 20.0 W/kg SAR(1 g) = 6.96 W/kg; SAR(10 g) = 2.42 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 74.2% Maximum value of SAR (measured) = 13.9 W/kg

Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=4000MHz/Zoom Scan, dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm Reference Value = 71.32 V/m; Power Drift = 0.02 dB Peak SAR (extrapolated) = 20.0 W/kg SAR(1 g) = 6.82 W/kg; SAR(10 g) = 2.38 W/kg Smallest distance from peaks to all points 3 dB below = 8 mm Ratio of SAR at M2 to SAR at M1 = 73.6% Maximum value of SAR (measured) = 13.8 W/kg

Certificate No: D3900V2-1024\_Jul22

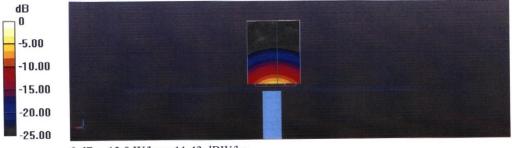
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## Dipole Calibration for Head Tissue/Pin=100 mW, d=10mm, f=4100MHz/Zoom Scan,

dist=1.4mm (8x8x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.19 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 19.7 W/kg
SAR(1 g) = 6.82 W/kg; SAR(10 g) = 2.37 W/kg
Smallest distance from peaks to all points 3 dB below = 8 mm
Ratio of SAR at M2 to SAR at M1 = 74.2%
Maximum value of SAR (measured) = 13.7 W/kg



<sup>0</sup> dB = 13.9 W/kg = 11.43 dBW/kg

Certificate No: D3900V2-1024\_Jul22

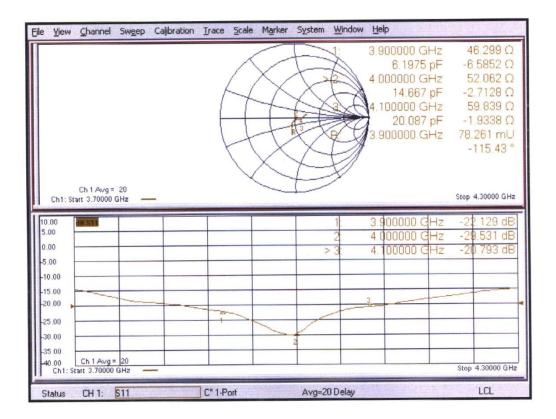
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#### Impedance Measurement Plot for Head TSL



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## **5 GHz Dipole Calibration Certificate**

**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

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

CALIBRATION C	ERTIFICATE		
Dbject	D5GHzV2 - SN:1	060	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	edure for SAR Validation Sources	s between 3-10 GHz
Calibration date:	July 05, 2022		
his calibration certificate documer	nts the traceability to natio	onal standards, which realize the physical un	its of measurements (SI).
he measurements and the uncert	ainties with confidence pr	robability are given on the following pages ar	nd are part of the certificate.
Il calibrations have been conducte	ed in the closed laborator	ry 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 NRP	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
ower sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
ower sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
eference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
ype-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 3503	08-Mar-22 (No. EX3-3503_Mar22)	Mar-23
AE4	SN: 601	02-May-22 (No. DAE4-601_May22)	May-23
econdary Standards	ID #	Check Date (in house)	Scheduled Check
ower meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
ower sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
ower sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
letwork Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22
	Name	Function	Signature
Calibrated by:	Aldonia Georgiadou	Laboratory Technician	AZ
sanbrated by.			×
	Suga Kübe	Technician	
	Sven Kühn	Technical Manager	5.4
Approved by:		Technical Manager	S Issued: July 8, 2022





#### **Calibration Laboratory of**

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





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- C Servizio svizzero di taratura
- S Swiss Calibration Service

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 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	5200 MHz ± 1 MHz 5250 MHz ± 1 MHz 5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.9 ± 6 %	4.50 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.84 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.8 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	22.3 W/kg ± 19.5 % (k=2)

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## 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 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.55 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	7.87 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.1 W/kg ± 19.9 % (k=2)
SAB averaged over 10 cm <sup>3</sup> (10 g) of Hoad TSI	appdition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.25 W/kg

#### Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (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	81.1 W/kg ± 19.9 % (k=2)
·		0111 1/1kg 1 15.5 /0 (k-
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	23.1 W/kg ± 19.5 % (k=2)

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#### Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

#### SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.60 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	85.3 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.44 W/kg

#### 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	34.3 ± 6 %	4.90 mho/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>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.2 W/kg ± 19.9 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 100 mW input power	2.40 W/kg
		2.40 W/kg 23.7 W/kg ± 19.5 % (k=2

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