

Schweizerischer Kalibrierdienst S

Service suisse d'étalonnage

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Swiss Calibration Service

Accreditation No.: SCS 0108

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Client UL

Gyeonggi-do, Republic of Korea

	Certificate No.	CLA13-1015_Aug23
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Object	CLA13 - SN: 10	15	
Calibration procedure(s)	QA CAL-15.v10 Calibration Proc	edure for SAR Validation Source	s below 700 MHz
Calibration date:	August 22, 2023	3	
the measurements and the unce	nainties with confidence p	tional standards, which realize the physical un probability are given on the following pages ar pry facility: environment temperature (22 \pm 3)°(nd are part of the certificate.
Calibration Equipment used (M&T	E critical for calibration)		
	ID #	Cal Date (Certificate No.)	Scheduled Calibration
ower meter NRP2	ID # SN: 104778	Cal Date (Certificate No.) 30-Mar-23 (No. 217-03804/03805)	Scheduled Calibration
wer meter NRP2 wer sensor NRP-Z91		30-Mar-23 (No. 217-03804/03805)	Mar-24
ver meter NRP2 ver sensor NRP-Z91 ver sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245		Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 erence 20 dB Attenuator	SN: 104778 SN: 103244	30-Mar-23 (No. 217-03804/03805) 30-Mar-23 (No. 217-03804)	Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator pe-N mismatch combination	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)	Mar-24 Mar-24 Mar-24 Mar-24
wer meter NRP2 wer sensor NRP-Z91 wer sensor NRP-Z91 ference 20 dB Attenuator pe-N mismatch combination ference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877	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)	Mar-24 Mar-24 Mar-24
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ver meter NRP2 ver sensor NRP-Z91 ver sensor NRP-Z91 erence 20 dB Attenuator e-N mismatch combination erence Probe EX3DV4 E4 ondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID #	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) 06-Jan-23 (No. EX3-3877_Jan23) 27-Jan-23 (No. DAE4-654_Jan23) Check Date (in house)	Mar-24 Mar-24 Mar-24 Mar-24 Mar-24 Jan-24 Jan-24 Scheduled Check
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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:

- 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.
 SAB normalized: SAR as measured.
- 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	DASY5	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	13 MHz ± 1 MHz	

Head TSL parameters The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	55.0	0.75 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	53.6 ± 6 %	0.72 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	+	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	1 W input power	0.519 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.533 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.324 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.333 W/kg ± 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 Ω + 1.2 jΩ
Return Loss	- 30.4 dB

Additional EUT Data

Monufactured by	
Manufactured by	
	SPEAG

DASY5 Validation Report for Head TSL

Date: 22.08.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1015

Communication System: UID 0 - CW; Frequency: 13 MHz Medium parameters used: f = 13 MHz; $\sigma = 0.72$ S/m; $\epsilon_r = 53.6$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN3877; ConvF(15.33, 15.33, 15.33) @ 13 MHz; Calibrated: 06.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 27.01.2023
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

CLA Calibration for HSL-LF Tissue/CLA-13, touch configuration, Pin=1W/Zoom Scan,

dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

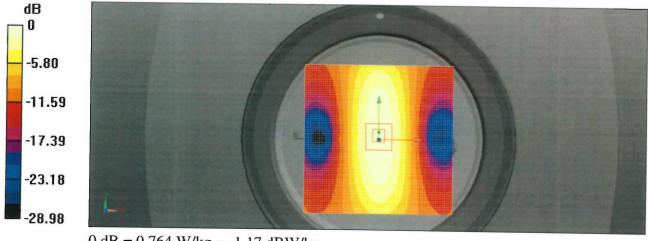
Reference Value = 30.79 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 1.06 W/kg

SAR(1 g) = 0.519 W/kg; SAR(10 g) = 0.324 W/kg

Smallest distance from peaks to all points 3 dB below = Larger than measurement grid (> 14 mm) Ratio of SAR at M2 to SAR at M1 = 78.1%Maximum value of SAR (measured) = 0.764 W/

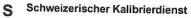
Maximum value of SAR (measured) = 0.764 W/kg



0 dB = 0.764 W/kg = -1.17 dBW/kg

File	⊻iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	Trace	<u>S</u> cale	Marker	System	<u>W</u> indow	Help		
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Multilateral Agreement for the recognition of calibration certificates								
	UL Gyeonggi-do, Repu	blic of Korea	c	Certificate No.	D750V3-1122_Feb24			
CALI	BRATION	CERTIFICAT	E					
Object		D750V3 - SN:11	22					
Calibratio	n procedure(s)	QA CAL-05.v12 Calibration Proc	edure for SAR Validatic	on Sources	between 0.7-3 GHz			
Calibration	n date:	February 22, 202	24					
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Fower meter NRP2	SN: 104778	30-Mar-23 (No. 217-03804/03805)	Mar-24
Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	Mar-24
Power sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Reference 20 dB Attenuator	SN: BH9394 (20k)	30-Mar-23 (No. 217-03809)	Mar-24
Type-N mismatch combination	SN: 310982 / 06327	30-Mar-23 (No. 217-03810)	Mar-24
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	
			Jan-25
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972		In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
	1 314. 0341060477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24
	Name	Function	Signature
Calibrated by:	Paulo Pina	Laboratory Technician	orginatare
			tant
Approved by:	Sven Kühn	Technical Manager	Ca
			22
			Issued: February 22, 2024
This calibration certificate shall not b	e reproduced except in t	full without written approval of the laboratory	/.

Calibration Laboratory of

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





Schweizerischer Kalibrierdienst

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

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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.6 ± 6 %	0.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	an a	

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	<u>, , , , , , , , , , , , , , , , , , , </u>
SAR measured	250 mW input power	2.16 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.58 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.62 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	52.4 Ω - 2.5 jΩ
Return Loss	- 29.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.026 ==
	1.036 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
	- SFLAG

DASY5 Validation Report for Head TSL

Date: 22.02.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1122

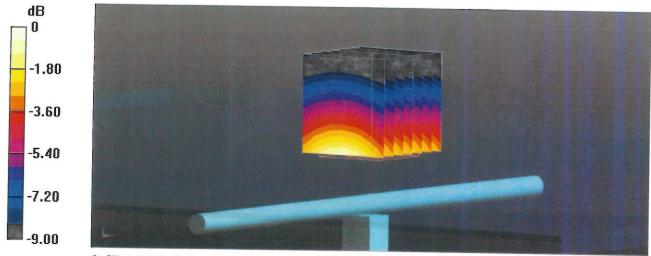
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; σ = 0.9 S/m; ϵ_r = 42.6; ρ = 1000 kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

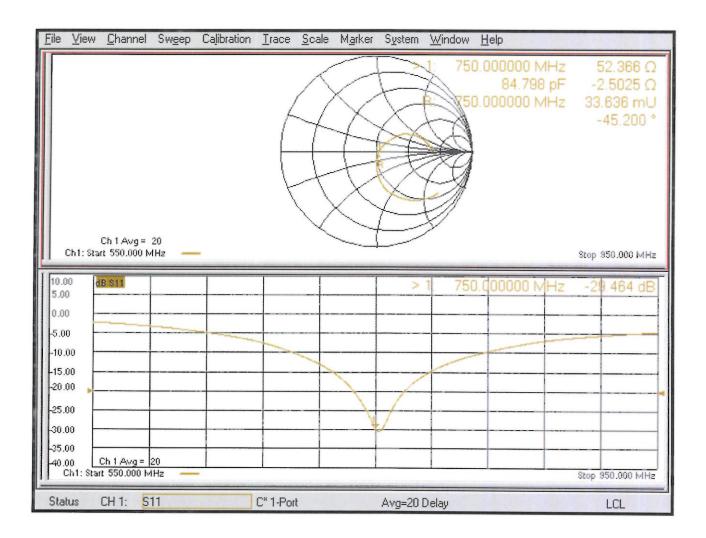
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 63.21 V/m; Power Drift = -0.09 dB Peak SAR (extrapolated) = 3.32 W/kg SAR(1 g) = 2.16 W/kg; SAR(10 g) = 1.41 W/kg Smallest distance from peaks to all points 3 dB below = 20 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 2.91 W/kg



0 dB = 2.91 W/kg = 4.64 dBW/kg

Impedance Measurement Plot for Head TSL



Calibration Laboratory of Schmid & Partner **Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland

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

Client UL

Gyeonggi-do, Republic of Korea

Calibration Equipment used (M&TE critical for calibration) ID # Cal Date (Certificate No.) Scheduled Calibration Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power meter NRP2 SN: 104778 30-Mar-23 (No. 217-03804/03805) Mar-24 Power sensor NRP-Z91 SN: 103244 30-Mar-23 (No. 217-03805) Mar-24 Power sensor NRP-Z91 SN: 103245 30-Mar-23 (No. 217-03805) Mar-24 Reference 20 dB Attenuator SN: BH9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 System SN: 310982 / 06327 30-Mar-23 (No. 217-03810) Mar-24 SN: 601 30-Jan-24 (No. DAE4-601_Jan24) Jan-25 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A SN: GB39512475 30-Oct-14 (in house check Oct-22) In house check: Oct-20 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct-20 Power sensor HP 8481A SN: W141093315 07-Oct-15 (in house check Oct-22) In house check: Oct-20 Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct-20	Object	D835V2 - SN:4d	1194	
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz Calibration date: March 11, 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 calibration shave been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (Certificate No.) Scheduled Calibration Power meter NRP2 SN: 104778 30-Mar-23 (No. 217-03804/03805) Mar-24 Power sensor NRP-Z91 SN: 103245 30-Mar-23 (No. 217-03804) Mar-24 Power sensor NRP-Z91 SN: 103245 30-Mar-23 (No. 217-03805) Mar-24 Reference 20 dB Attenuator SN: 8149394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 Reference Probe EX3DV4 SN: 3749 03-Mar-23 (No. 217-03809) Mar-24 Secondary Standards ID # Check Date (in house) Scheduled Check Power sensor HP 8481A SN: US37282783 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sens	Calibration procedure(s)			
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RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct- In house check: Oct- SN: US41080477 Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct- In house check: Oct- Signature Name Function Signature Calibrated by: Leif Klysner Laboratory Technician		SN: MY41093315		
Network Analyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct- Name Function Signature Calibrated by: Leif Klysner Laboratory Technician	Power sensor HP 8481A	SN: 100972		
Calibrated by: Leif Klysner Laboratory Technician				In house check: Oct-24
Calibrated by: Leif Klysner Laboratory Technician	RF generator R&S SMT-06	SN: US41080477	(
	RF generator R&S SMT-06			Signatura
Approved by: Sven Kühn Technical Manager	RF generator R&S SMT-06 Network Analyzer Agilent E8358A	Name	Function	Signature
	RF generator R&S SMT-06 Network Analyzer Agilent E8358A	Name	Function	0.1.100
	RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	Name Leif Klysner	Function Laboratory Technician	0:0 100
	RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	Name Leif Klysner	Function Laboratory Technician	0.1.10
Issued: March 12, 202 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.	RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	Name Leif Klysner	Function Laboratory Technician	0.1.10

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Swiss Calibration Service

Certificate No. D835V2-4d194_Mar24

Accreditation No.: SCS 0108

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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%.

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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.8 ± 6 %	0.92 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition		
SAR measured	250 mW input power	2.49 W/kg	
SAR for nominal Head TSL parameters	normalized to 1W	9.86 W/kg ± 17.0 % (k=2)	

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.63 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.45 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	50.4 Ω - 3.7 jΩ
Return Loss	- 28.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
Electrical Delay (one direction)	1.393 ns
	1.000115

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

DASY5 Validation Report for Head TSL

Date: 11.03.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d194

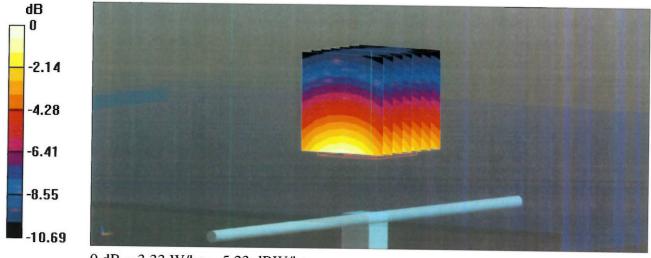
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 42.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 64.69 V/m; Power Drift = -0.03 dB Peak SAR (extrapolated) = 3.73 W/kg**SAR(1 g) = 2.49 W/kg; SAR(10 g) = 1.63 W/kg** Smallest distance from peaks to all points 3 dB below = 19.8 mm Ratio of SAR at M2 to SAR at M1 = 66.4% Maximum value of SAR (measured) = 3.33 W/kg



0 dB = 3.33 W/kg = 5.23 dBW/kg

Impedance Measurement Plot for Head TSL

File	View	<u>C</u> hannel	Sweep	Calibration	Trace	<u>S</u> cale	Marker	System	<u>W</u> indow	Help			
		Ch 1 Avg = rt 635.000 M			Ę				A	5	100 MHz 1.705 pF 100 MHz	36.886 m -82.195	ΩU
		-	1H2									Stop 1.03500 GF	Hz
10.00 5.00 -5.00 -10.0 -15.0 -20.0 -25.0 -25.0 -30.0 -35.0 -40.0 C		E S11 Ch 1 Avg = 1 t 635.000 M	20 Hz					>	1: 835	5.0000		-28.663 d	
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Certificate No: D835V2-4d174_Sep22

Accreditation No.: SCS 0108

Client UL Korea (Dymstec)

Calibration procedure(s)	September 21, 2 the traceability to nationate the swith confidence providence	edure for SAR Validation Source	nits of measurements (SI).
Calibration date: S This calibration certificate documents The measurements and the uncertaint All calibrations have been conducted i	Calibration Proce September 21, 2 the traceability to nativities with confidence pr	022 onal standards, which realize the physical ur	nits of measurements (SI).
This calibration certificate documents The measurements and the uncertaint	the traceability to nationation the traceability to nationation the second second second second second second s	onal standards, which realize the physical ur	hits of measurements (SI).
The measurements and the uncertaint	ities with confidence p	onal standards, which realize the physical ur robability are given on the following pages a	nits of measurements (SI).
		y facility: environment temperature (22 \pm 3)°	
Primary Standards II	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP S	SN: 104778	04-Apr-22 (No. 217-03525/03524)	Apr-23
Power sensor NRP-Z91 S	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23
Power sensor NRP-Z91 S	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23
	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4 S	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4 S	SN: 601	31-Aug-22 (No. DAE4-601_Aug22)	Aug-23
Secondary Standards	D#	Check Date (in house)	Scheduled Check
Power meter E4419B S	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A S	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
ower sensor HP 8481A S	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
F generator R&S SMT-06 S	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
N	Name	Function	Signature
Calibrated by: Je	eton Kastrati	Laboratory Technician	Signature
	in here the		telle
Approved by: St	ven Kühn	Technical Manager	
	and a second		St



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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%.

Accreditation No.: SCS 0108

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	15 mm	with Spacer	
Zoom Scan Resolution	dx, dy, dz = 5 mm		
Frequency	835 MHz ± 1 MHz		

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.5 ± 6 %	0.93 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	······································	

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.63 W/kg ± 17.0 % (k=2)
040		· · · · · · · · · · · · · · · · · · ·
SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR averaged over 10 cm ³ (10 g) of Head TSL SAR measured	condition 250 mW input power	1.61 W/kg

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.4 Ω - 1.9 jΩ
Return Loss	- 30.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	
	1.394 ns
	1.034115

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	
Manufactured by	
	SPEAG
	Si EAG

DASY5 Validation Report for Head TSL

Date: 21.09.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d174

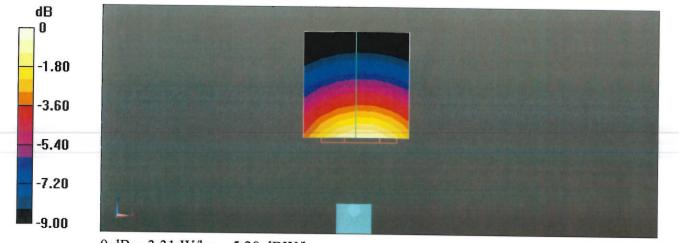
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.93$ S/m; $\epsilon_r = 40.5$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(9.69, 9.69, 9.69) @ 835 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 31.08.2022
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

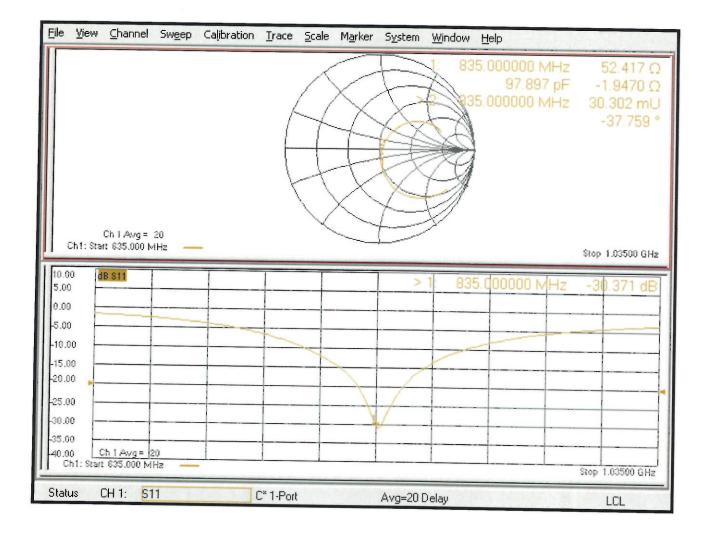
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mmReference Value = 64.03 V/m; Power Drift = -0.07 dB Peak SAR (extrapolated) = 3.73 W/kg **SAR(1 g) = 2.48 W/kg; SAR(10 g) = 1.61 W/kg** Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 66.4% Maximum value of SAR (measured) = 3.31 W/kg



0 dB = 3.31 W/kg = 5.20 dBW/kg

Impedance Measurement Plot for Head TSL



Justification for Extended SAR Dipole Calibrations

Instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the SAR target, impedance and return loss of a dipole have remain stable according to the following requirements

KDB 865664 D01v01r04 requirements

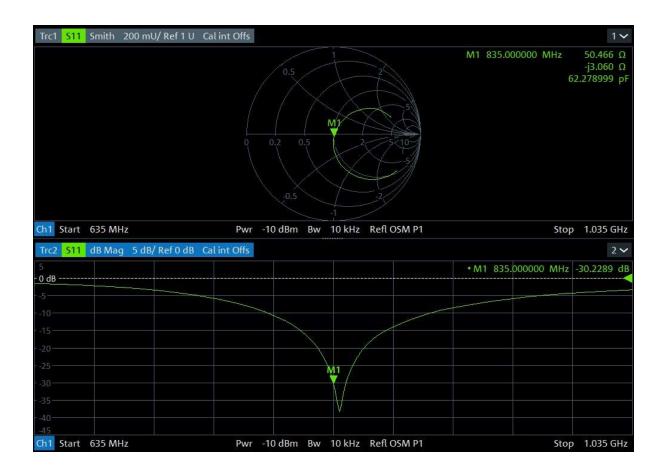
a) return loss : < - 20 dB, within 20% of previous measurement

b) impedance : within 5 Ω from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
D835V2-SN : 4d174	Head	2022.09.21	-30.371	0.47	52.417	1.951
D655V2-5N . 40174		2023.09.14	-30.229		50.466	

c) 1g SAR : within 10% of that reported in the calibration data

Dipole Antenna	Head/Body	Date of Measurement	1g SAR (W/kg)	Δ%	
D835V2-SN : 4d174	174 Head	2022.09.21	0.992	2.02	
D055VZ-5IN:401/4		2023.09.15	0.966	2.62	





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Client UL Korea (Dymstec)

Certificate No: D1750V2-1125_Nov22	2
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CALIBRATION CERTIFICATE

Object D1750V2 - SN:1125						
On l'hand in	04.041.47					
Calibration procedure(s)		QA CAL-05.v11				
	Calibration Procedure for SAR Validation Sources between 0.7-3 GHz					
-						
Calibration date:	November 30, 20)22				
This calibration certificate documer	nts the traceability to nati	onal standards, which realize the physical	units of measurements (SI).			
The measurements and the uncert	ainties with confidence p	robability are given on the following pages	and are part of the certificate.			
			· · · ·			
All calibrations have been conducted	ed in the closed laborator	y facility: environment temperature (22 \pm 3	8)°C and humidity < 70%.			
Calibration Equipment used (M&TE	E 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			
Power sensor NRP-Z91	SN: 103244	04-Apr-22 (No. 217-03524)	Apr-23			
Power sensor NRP-Z91	SN: 103245	04-Apr-22 (No. 217-03525)	Apr-23			
Reference 20 dB Attenuator	SN: BH9394 (20k)	04-Apr-22 (No. 217-03527)	Apr-23			
Type-N mismatch combination	SN: 310982 / 06327	04-Apr-22 (No. 217-03528)	Apr-23			
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22			
DAE4	SN: 601	31-Aug-22 (No. DAE4-601_Aug22)	Aug-23			
Secondary Standards	ID #					
Power meter E4419B		Check Date (in house)	Scheduled Check			
Power sensor HP 8481A	SN: GB39512475 SN: US37292783	30-Oct-14 (in house check Oct-22)	In house check: Oct-24			
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24			
RF generator R&S SMT-06	SN: 100972	07-Oct-15 (in house check Oct-22)	In house check: Oct-24			
Network Analyzer Agilent E8358A	SN: US41080477	15-Jun-15 (in house check Oct-22)	In house check: Oct-24			
Notwont Analyzer Agrent LossoA	314. 0341060477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24			
	Name	Function	Signature			
Calibrated by:	Jeton Kastrati	Laboratory Technician	Signature			
,	Solon Rastrall		102			
			Fla.			
Approved by:	Sven Kühn	Technical Manager				
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Issued: December 2, 2022 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.						