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



Certificate No. CLA13-1015_Aug24

S

С

S

Schweizerischer Kalibrierdienst

Accreditation No.: SCS 0108

Service suisse d'étalonnage

Servizio svizzero di taratura

Swiss Calibration Service

Gyeonggi-do, Republic of Korea

Dbject	CLA13 - SN: 1015					
Calibration procedure(s)	QA CAL-15.v11	dure for SAR Validation Sources	below 700 MHz			
	Calibration 11000	dure for SATT validation cources	BCIOW 7 00 INI 12			
Calibration date:	August 22, 2024					
		onal standards, which realize the physical unit obability are given on the following pages and				
Il calibrations have been conduct	ed in the closed laborator	y facility: environment temperature (22 \pm 3)°C	and humidity < 70%.			
Calibration Equipment used (M&T	E critical for calibration)					
rimary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration			
	ID # SN: 104778	Cal Date (Certificate No.) 26-Mar-24 (No. 217-04036/04037)	Scheduled Calibration Mar-25			
ower meter NRP2						
ower meter NRP2 ower sensor NRP-Z91	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91	SN: 104778 SN: 103244	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036)	Mar-25 Mar-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 deference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037)	Mar-25 Mar-25 Mar-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x)	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)	Mar-25 Mar-25 Mar-25 Mar-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327	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)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 AE4	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877	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) 10-Jan-24 (No. EX3-3877_Jan24)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Jan-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654	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) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter NRP2	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID #	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22)	Mar-25 Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 eference 20 dB Attenuator ype-N mismatch combination eference Probe EX3DV4 AE4 econdary Standards ower meter NRP2 ower sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24			
ower meter NRP2 ower sensor NRP-Z91 ower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 oAE4 lecondary Standards lower meter NRP2 lower sensor NRP-Z91 lower sensor NRP-Z91	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Dec-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 Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 RF generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922 SN: 100418	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24			
Primary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Becondary Standards Power meter NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 Power sensor NRP-Z91 RF generator HP 8648C Network Analyzer Agilent E8358A	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922 SN: 100418 SN: US3642U01700	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04047) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22) 04-Aug-99 (in house check Jun-24)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Jun-26			
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 NRP2 Power sensor NRP-Z91 Power sensor NRP-Z91 RF generator HP 8648C	SN: 104778 SN: 103244 SN: 103245 SN: CC2552 (20x) SN: 310982 / 06327 SN: 3877 SN: 654 ID # SN: 107193 SN: 100922 SN: 100418 SN: US3642U01700 SN: US41080477	26-Mar-24 (No. 217-04036/04037) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04036) 26-Mar-24 (No. 217-04037) 26-Mar-24 (No. 217-04046) 26-Mar-24 (No. 217-04047) 10-Jan-24 (No. EX3-3877_Jan24) 15-Jan-24 (No. DAE4-654_Jan24) Check Date (in house) 08-Nov-21 (in house check Dec-22) 15-Dec-09 (in house check Dec-22) 01-Jan-04 (in house check Dec-22) 04-Aug-99 (in house check Jun-24) 31-Mar-14 (in house check Oct-22)	Mar-25 Mar-25 Mar-25 Mar-25 Jan-25 Jan-25 Scheduled Check In house check: Dec-24 In house check: Dec-24 In house check: Dec-24 In house check: Dec-24			

Calibration Laboratory of

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





Schweizerischer Kalibrierdienst

S Service suisse d'étalonnage С

Servizio svizzero di taratura

S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS) The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates Accreditation No.: SCS 0108

Glossary:	
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	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	53.0 ± 6 %	0.74 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	0.535 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	0.537 W/kg ± 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	0.332 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	50.4 Ω + 2.6 jΩ	
Return Loss	- 31.6 dB	

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 22.08.2024

Test Laboratory: SPEAG, Zurich, Switzerland

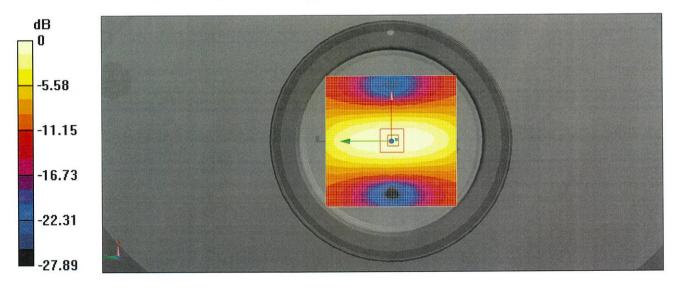
DUT: CLA13; Type: CLA13; Serial: CLA13 - SN: 1015

Communication System: UID 0 - CW; Frequency: 13 MHz Medium parameters used: f = 13 MHz; $\sigma = 0.74$ S/m; $\epsilon_r = 53$; $\rho = 1000$ 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: 10/01/2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 15/01/2024
- Phantom: ELI v6.0; Type: QDOVA003AA; Serial: TP:2034
- DASY52 52.10.4(1527); SEMCAD X 14.6.14(7483)

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 = 29.97 V/m; Power Drift = 0.09 dB Peak SAR (extrapolated) = 1.10 W/kg SAR(1 g) = 0.535 W/kg; SAR(10 g) = 0.332 W/kg Smallest distance from peaks to all points 3 dB below = 20.9 mm Ratio of SAR at M2 to SAR at M1 = 77.9% Maximum value of SAR (measured) = 0.793 W/kg



0 dB = 0.793 W/kg = -1.01 dBW/kg

Impedance Measurement Plot for Head TSL

<u>F</u> ile	⊻iew	<u>C</u> hannel	Sw <u>e</u> ep	Calibration	<u>T</u> race	<u>S</u> cale	Marker	System	<u>W</u> indov	v <u>H</u> e	lp		
										13.00	0000 MHz 31.893 nH		0.416 Ω 6050 Ω
	Ch1: Sta	Ch 1 Avg = art 10.0000 I	MHz —									Stop 1	6.0000 MHz
5.0 2.0 -1.0 -7.0 -10 -13 -16 -19 -22 -25	0 - 00 - 00 - 00 - 00 - 00 - 00 - 00 -	<u>tB \$11</u> <u>Ch 1 Avg =</u> art 10.0000	20 MHz					>	1:	13.0			.613 dB
Sta	atus	CH 1:	S11		C 1-Port			Avg=20	1000				LCL



S Schweizerischer Kalibrierdienst

Service suisse d'étalonnage С

Servizio svizzero di taratura S

Certificate No. D750V3-1205_Apr23

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 UL

Gyeonggi-do, Republic of Korea

Object	D750V3 - SN:1205				
Calibration procedure(s)	QA CAL-05.v12				
	Calibration Proce	edure for SAR Validation Source	s between 0.7-3 GHz		
Calibration date:	April 18, 2023				
		;			
This calibration certificate docume	nts the traceability to nati	onal standards, which realize the physical ur	nits of measurements (SI)		
The measurements and the uncert	ainties with confidence p	robability are given on the following pages a	nd are part of the certificate		
All calibrations have been conducted	ed in the closed laborator	ry facility: environment temperature (22 \pm 3)°	C and humidity < 70%.		
Calibration Equipment used (M&TE	E 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: 103244	30-Mar-23 (No. 217-03804)	Mar-24 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	10-Jan-23 (No. EX3-7349_Jan23)	Jan-24		
DAE4	SN: 601	19-Dec-22 (No. DAE4-601_Dec22)	Dec-23		
Secondary Standards	ID #	Check Date (in house)	Scheduled Check		
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24		
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	15-Jun-15 (in house check Oct-22)	In house check: Oct-22		
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24		
	Name	Function	Signature		
Calibrated by:	Michael Weber	Laboratory Technician	M. Hese		
Approved by:	Sven Kühn	Technical Manager			
nave			Sn		
			Issued: April 21, 2023		

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

Page 1 of 6



Schweizerischer Kalibrierdienst

- S Service suisse d'étalonnage
- C 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

Glossarv:

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	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	41.1 ± 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	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.55 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.59 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	54.3 Ω - 1.3 jΩ
Return Loss	- 27.3 dB

General Antenna Parameters and Design

Electrical De	lay (one direction)	1.040 ns
L		

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
Manalabarea by	SPEAG

DASY5 Validation Report for Head TSL

Date: 18.04.2023

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1205

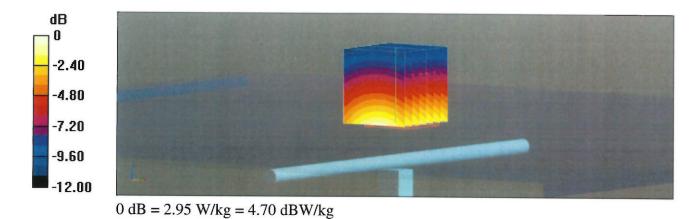
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz; $\sigma = 0.92$ S/m; $\varepsilon_r = 41.1$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 10.01.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 19.12.2022
- 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 = 59.84 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.37 W/kg **SAR(1 g) = 2.2 W/kg; SAR(10 g) = 1.43 W/kg** Smallest distance from peaks to all points 3 dB below = 17 mm Ratio of SAR at M2 to SAR at M1 = 65.4% Maximum value of SAR (measured) = 2.95 W/kg



Impedance Measurement Plot for Head TSL

		2Mēeh	Calibration	Irace	Scale	Marker	System	Window	Help				
					$\left<\right>$		\vdash	1 75	50.00	0000			4.283
					()	\times ,	+->	6 VTF	:n nn	158.9- 0000 N	4 p⊢ ⊿⊔⇒	-1	.3351
				F		\sim	X		0.00	0000 1	VIF12		017 m 16.580
				1				XA					
							1-t	7.0	t i				
				F	-+		$\langle \rangle$	H					
				1	$\left(\right)$	\sim	1						
		7 202			\sim	~	\square	Y					
Ch1: S	Ch 1 Avg = tart 550.000 (_			·							
0.00	[1		-				-	-			Stop 9	50.000 MI
	dB S11						>	1: 75	0. doi	0000 N	Hz		50.000 MI
00.	dB S11						>	1: 75	0. do(0000 N	Hz		
.00 .00	dB S11						>	1: 75	0. do(0000 N	Hz		
.00 .00 .00 0.00	dB S11						>	1: 75	0.000	0000 N	Hz		
00 00 00 00 00 5.00	dB S11						>	1 75	0.000	0000 N	Hz		
00 00 00 000 500 000	dB \$11						>	1: 75	0. dor	0000 N	Hz		
000 000 000 500 000 5.00	4B \$11						>	1: 75	0.00	0000 N	Hz		
.00 .00 0.00 5.00 0.00 5.00 5.00	dB \$11						>	1 75	0.00	0000 N	Hz		
5.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00	Ch 1 Avg =	20					>	1 75	0.000	0000 N	Hz		
0.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00		20 21 21					>	1 75	0.000	0000 N		-27	

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

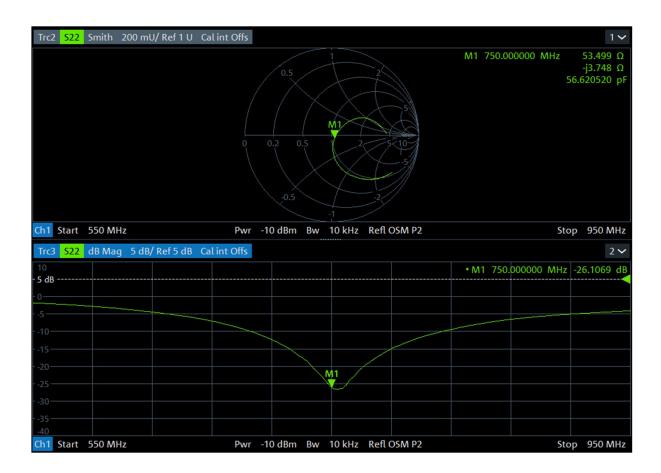
a) return loss : < - 20 dB, within 20% of previous measurement

b) impedance : within 5 Ω from previous measurement

Dipole Antenna	Head/Body	Date of Measurement	Return Loss (dB)	Δ%	Impedance (Ω)	ΔΩ
D750V3-SN : 1205	Head	2023.04.18	-27.327	4.4	54.283	0.78
D750V5-SIN . 1205	пеай	2024.04.02	-26.106	4.4	53.499	0.78

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

Dipole Antenna	Head/Body	Date of Measurement	peak SAR (1g) (W/kg)	Δ%
D750V/2 CN - 1205	Llood	2023.04.18	0.88	C 01
D750V3-SN : 1205	Head	2024.04.10	0.82	6.81





S Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage 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

Client

UL

Gyeonggi-do, Republic of Korea

Certificate No.

D835V2-4d174_Sep24

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d174
Calibration procedure(s)	QA CAL-05.v12 Calibration Procedure for SAR Validation Sources between 0.7 - 3 GHz
Calibration date	September 16, 2024
This calibration contificate door	uments the tracephility to national standards, which realize the physical units of measurements (SI).

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 $(22 \pm 3)^{\circ}$ C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

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	Paulo Pina	Laboratory Technician	Fairtes
Approved by	Sven Kühn	Technical Manager	5.65
This calibration certificate	e shall not be reproduced except	in full without written approval of the la	Issued: September 16, 2024 boratory.



Schweizerischer Kalibrierdienst

C Service suisse d'étalonnage

C Servizio svizzero di taratura S Swiss Calibration Service

5 Swiss Calibration Service

S

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

- 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%.

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	15 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	835MHz ±1MHz	

Head TSL parameters at 835 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.900 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	43.0 ±6%	0.900 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 835 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	2.37 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg ±17.0% (k = 2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	1.53 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.09 W/kg ±16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 835 MHz

Impedance	50.5 Ω – 7.1 jΩ
Return Loss	-23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.396 ns

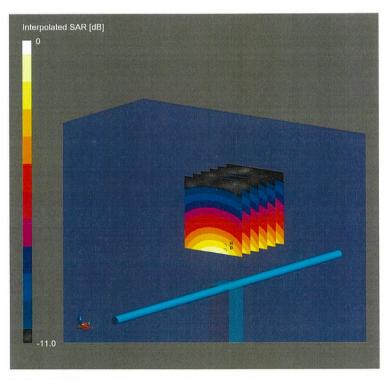
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured. The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited 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 bySPEAG	Manufactured by	JULIC
----------------------	-----------------	-------

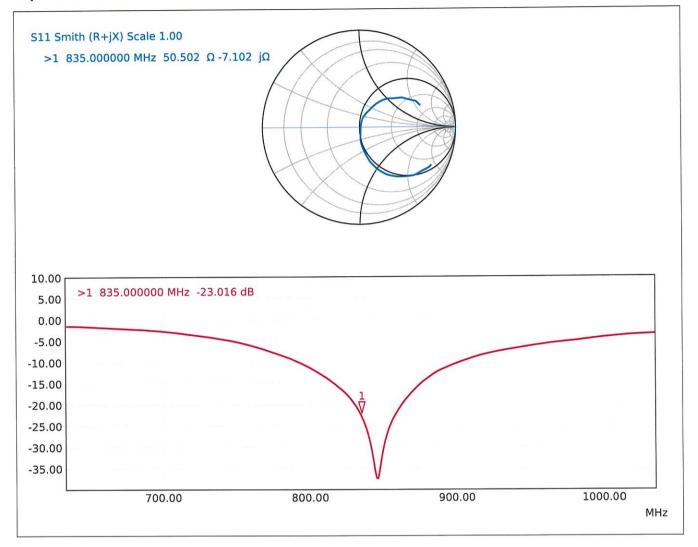
System Performance Check Report

Dipole		1	Frequency [MF	lz]		TSL	Power [dBm]		
D835V2 - SN4d174	835			HSL	24				
Exposure Condition	S								
Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [M	Hz], Char	nnel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	15		CW, 0	835,0			9.61	0.90	43.0
Hardware Setup									
Phantom	TSL, Measured Date	TSL, Measured Date Probe, Calibration Date			DAE, 0	Calibration Date			
Flat V4.9 mod	HSL, 2024-09-16 EX3DV4 - SN7349, 2024-06-03		5-03	DAE4i	p Sn1836, 2024-01-10				
Scans Setup					1	Measuremen	nt Results		
				Zoom Scan					Zoom Scan
Grid Extents [mm]	30 x 30 x 30		_	Date			2024-09-16		
Grid Steps [mm]	6.0 × 6.0 × 1.5		.0 x 6.0 x 1.5	-	psSAR1g [W/H	V/Kg]		2.37	
Sensor Surface [mm]		1.4		1.4	-	psSAR10g [W/Kg]			1.53
Graded Grid	Yes		Yes	-	Power Drift [d	B]		-0.02	
Grading Ratio	1.5		1.5	-	Power Scaling	ing		Disabled	
MAIA				N/A	-	Scaling Factor	r [dB]		
Surface Detection				VMS + 6p	-	TSL Correctio	n		Positive / Negative
Scan Method				Measured	-				



0 dB = 3.71 W/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)			
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 calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.			edure for SAR Validation Source	s hotwoon 072CH-
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%.				
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%.				
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 date:	March 11, 2024		
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (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: 8H9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 Type-N mismatch combination SN: 310982 / 06327 30-Mar-23 (No. 217-03809) Mar-24 SN: 010982 / 06327 30-Mar-23 (No. 217-03801) Mar-24 DAE4 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- Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In hous		,		
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (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 Reference 20 dB Attenuator SN: BH9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 SN: 103245 30-Mar-23 (No. 217-03809) Mar-24 Mar-24 Reference 20 dB Attenuator SN: BH9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 SN: 310982 / 06327 30-Mar-23 (No. 217-03809) Mar-24 Mar-24 SN: 601 30-Jan-24 (No. DAE4-601_Jan24) Jan-25 Mar-24 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-3N: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct-3N: 100972 SN: 10972 15-Ju	This selling it and the			
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%. Calibration Equipment used (M&TE critical for calibration) Primary Standards ID # Cal Date (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. 217-03804) Mar-24 Power sensor NRP-Z91 SN: 103245 30-Mar-23 (No. 217-03805) Mar-24 Reference 20 dB Attenuator SN: 8H9394 (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 sensor HP 8481A SN: US37292783 07-Oct-14 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: 10972 15-Jun-15 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check Oct-	This calibration certificate docume	nts the traceability to nati	ional standards, which realize the physical u	nits of measurements (SI).
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: 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: 8H9394 (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 sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: 109321 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check	the measurements and the uncert	ainties with confidence p	probability are given on the following pages a	ind are part of the certificate.
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: 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: 8H9394 (20k) 30-Mar-23 (No. 217-03809) Mar-24 Type-N mismatch combination SN: 310982 / 06327 30-Mar-23 (No. 217-03809) 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 sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: 10972 15-Jun-15 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: US41080477 31-Mar-14 (in hou	All calibrations have been conduct	ed in the closed laborate		
Primary StandardsID #Cal Date (Certificate No.)Scheduled CalibrationPower meter NRP2SN: 10477830-Mar-23 (No. 217-03804/03805)Mar-24Power sensor NRP-Z91SN: 10324430-Mar-23 (No. 217-03804)Mar-24Power sensor NRP-Z91SN: 10324530-Mar-23 (No. 217-03805)Mar-24Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03809)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 734903-Nov-23 (No. EX3-7349_Nov23)Nov-24DAE4SN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower sensor HP 8481ASN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: WY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: US4108047731-Mar-14 (in house check Oct-22)In house check: Oct-NameFunctionSignatureCalibrated by:NameFunctionSignature	an samplations have been conduct	ed in the closed laborato	ry facility: environment temperature $(22 \pm 3)^{\circ}$	°C and humidity < 70%.
Primary StandardsID #Cal Date (Certificate No.)Scheduled CalibrationPower meter NRP2SN: 10477830-Mar-23 (No. 217-03804/03805)Mar-24Power sensor NRP-Z91SN: 10324430-Mar-23 (No. 217-03804)Mar-24Power sensor NRP-Z91SN: 10324530-Mar-23 (No. 217-03805)Mar-24Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03809)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 734903-Nov-23 (No. EX3-7349_Nov23)Nov-24DAE4SN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower sensor HP 8481ASN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: WY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-SN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Network Analyzer Agilent E8358ASN: US4108047731-Mar-14 (in house check Oct-22)In house check: Oct-NameFunctionSignatureCalibrated by:Laboratory TechnicianSignature	Calibration Equipment used (M&TF	E critical for calibration)		
Power meter NRP2SN: 10477830-Mar-23 (No. 217-03804/03805)Mar-24Power sensor NRP-Z91SN: 10324430-Mar-23 (No. 217-03804)Mar-24Power sensor NRP-Z91SN: 10324530-Mar-23 (No. 217-03805)Mar-24Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03809)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 734903-Nov-23 (No. 217-03810)Mar-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower meter E4419BSN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Power sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-22)In house check: Oct-20Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-20Power sensor HP 8481ASN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-21Ref generator R&S SMT-06SN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-22NameFunctionSignatureCalibrated by:Leif KlysnerLaboratory Technician		· · · · · · · · · · · · · · · · · · ·		
Power meter NRP2 SN: 104778 30-Mar-23 (No. 217-03804/03805) Mar-24 Power sensor NRP-Z91 SN: 103244 30-Mar-23 (No. 217-03804) 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 SN: 310982 / 06327 30-Mar-23 (No. 217-03810) Mar-24 DAE4 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-22) Power sensor HP 8481A SN: MY41093315 07-Oct-15 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct-22) Power sensor HP 8481A SN: US41080477 31-Mar-14 (in house check Oct		ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor NRP-Z91SN: 10324530-Mar-23 (No. 217-03804)Mar-24Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03805)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 734903-Nov-23 (No. EX3-7349_Nov23)Nov-24DAE4SN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower meter E4419BSN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-RF generator R&S SMT-06SN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-NameFunctionSignatureCalibrated by:Leif KlysnerLaboratory Technician	Power meter NRP2	SN: 104778		
Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03809)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24DAE4SN: 734903-Nov-23 (No. EX3-7349_Nov23)Nov-24DAE4SN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower meter E4419BSN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Network Analyzer Agilent E8358ASN: US4108047731-Mar-14 (in house check Oct-22)In house check: Oct-NameFunctionSignatureCalibrated by:Leif KlysnerLaboratory TechnicianSignature	Power sensor NRP-Z91	SN: 103244	30-Mar-23 (No. 217-03804)	
Reference 20 dB AttenuatorSN: BH9394 (20k)30-Mar-23 (No. 217-03809)Mar-24Type-N mismatch combinationSN: 310982 / 0632730-Mar-23 (No. 217-03810)Mar-24Reference Probe EX3DV4SN: 734903-Nov-23 (No. EX3-7349_Nov23)Nov-24DAE4SN: 60130-Jan-24 (No. DAE4-601_Jan24)Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower meter E4419BSN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Ref generator R&S SMT-06SN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Network Analyzer Agilent E8358ASN: US4108047731-Mar-14 (in house check Oct-22)In house check: Oct-NameFunctionSignaturecalibrated by:Leif KlysnerLaboratory TechnicianSignature	ower sensor NRP-Z91	SN: 103245	30-Mar-23 (No. 217-03805)	Mar-24
Type-N mismatch combination Reference Probe EX3DV4SN: 310982 / 06327 SN: 734930-Mar-23 (No. 217-03810) SN: 7349Mar-24 Nov-23DAE4SN: 734903-Nov-23 (No. EX3-7349_Nov23) SN: 601Nov-24 Jan-25Decondary StandardsID #Check Date (in house)Scheduled Check Scheduled CheckDower meter E4419B Power sensor HP 8481A Power sensor HP 8481ASN: GB39512475 	Reference 20 dB Attenuator	SN: BH9394 (20k)		
Reference Probe EX3DV4 DAE4SN: 7349 SN: 60103-Nov-23 (No. EX3-7349_Nov23) 30-Jan-24 (No. DAE4-601_Jan24)Nov-24 Jan-25Secondary StandardsID #Check Date (in house)Scheduled CheckPower meter E4419B Power sensor HP 8481ASN: GB39512475 SN: US3729278330-Oct-14 (in house check Oct-22) Or-Oct-15 (in house check Oct-22)In house check: Oct- In house check: Oct- In house check: Oct- In house check: Oct- SN: 100972Power sensor HP 8481A Power sensor HP 8481A SN: MY41093315SN: Or-Oct-15 (in house check Oct-22) In house check: Oct- SN: 100972In house check: Oct- In house check: Oct- In house check: Oct- SN: 100972RF generator R&S SMT-06 Network Analyzer Agilent E8358ASN: US41080477 SN: US41080477S1-Mar-14 (in house check Oct-22) In house check: Oct- In house	Type-N mismatch combination	SN: 310982 / 06327		
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) In house check: Oct- Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: MY41093315 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct- RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct- 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	Reference Probe EX3DV4	SN: 7349		
Power meter E4419B SN: GB39512475 30-Oct-14 (in house check Oct-22) In house check: Oct- In house check: Oct- SN: US37292783 Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct- In house check: Oct- SN: MY41093315 In house check: Oct- SN: 100972 Power Kanalyzer Agilent E8358A SN: US41080477 31-Mar-14 (in house check Oct-22) In house check: Oct- In house check: Oct- Signature Calibrated by: Leif Klysner Laboratory Technician Signature	DAE4	SN: 601		
Power meter E4419BSN: GB3951247530-Oct-14 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-Power sensor HP 8481ASN: MY4109331507-Oct-15 (in house check Oct-22)In house check: Oct-RF generator R&S SMT-06SN: 10097215-Jun-15 (in house check Oct-22)In house check: Oct-Network Analyzer Agilent E8358ASN: US4108047731-Mar-14 (in house check Oct-22)In house check: Oct-NameFunctionSignatureCalibrated by:Leif KlysnerLaboratory Technician	Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A SN: US37292783 07-Oct-15 (in house check Oct-22) In house check: Oct- Power sensor HP 8481A SN: MY41093315 07-Oct-15 (in house check Oct-22) In house check: Oct- RF generator R&S SMT-06 SN: 100972 15-Jun-15 (in house check Oct-22) In house check: Oct- 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	^o ower meter E4419B	SN: GB39512475		
Power sensor HP 8481A SN: MY41093315 07-Oct-15 (in house check Oct-22) In house check: Oct- In house check: Oct- SN: 100972 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- In house check: Oct- Signature Calibrated by: Leif Klysner Laboratory Technician	ower sensor HP 8481A	SN: US37292783		
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

S

Swiss Calibration Service

Certificate No. D835V2-4d194_Mar24

Accreditation No.: SCS 0108

Schweizerischer Kalibrierdienst



Schweizerischer Kalibrierdienst S

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%.

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
	1.000 115

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
	01 EAG

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

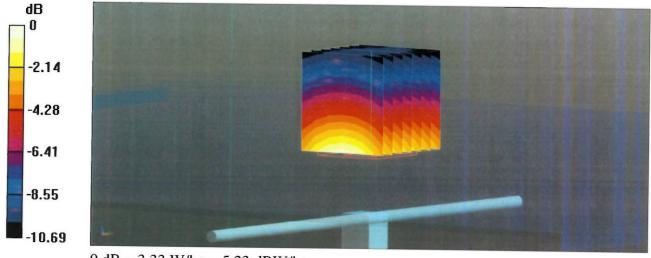
Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 42.8$; $\rho = 1000$ kg/m³ Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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	Window	Help	1.01	
		Ch 1 Avg = rt 635.000 M			Ę				A	51	00 MHz .705 pF 30 MHz	50.368 Ω -3.6864 Ω 36.886 mU -82.195 °
<u> </u>		-	1H2	_								Stop 1.03500 GHz
10.00 5.00 -5.00 -10.0 -15.0 -20.0 -25.0 -25.0 -30.0 -35.0 -40.0 C		B S11 Ch 1 Avg = 1 t 635.000 M	20 Hz					>	1: 835			-28.663 dB
Statu	us I	CH 1: 51	11		C* 1-Port			Avg=20 D)elau		1 12 1	LCL