

ES3DV2 - SN:3019

January 30, 2025

Parameters of Probe: ES3DV2 - SN:3019**Basic Calibration Parameters**

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu V/(V/m)^2$) ^A	1.06	1.16	0.96	$\pm 10.1\%$
DCP (mV) ^B	104.3	101.9	105.9	$\pm 4.7\%$

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB $\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc ^E $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	140.4	$\pm 1.1\%$	$\pm 4.7\%$
		Y	0.00	0.00	1.00		135.3		
		Z	0.00	0.00	1.00		129.4		

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%.

^A The uncertainties of Norm X,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Page 5).

^B Linearization parameter uncertainty for maximum specified field strength.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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Parameters of Probe: ES3DV2 - SN:3019**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle	-56.2°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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Parameters of Probe: ES3DV2 - SN:3019**Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) ^C	Relative Permittivity ^F	Conductivity ^F (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unc ^H (k = 2)
150	52.3	0.76	7.12	7.02	7.02	0.00	2.00	±13.3%
450	43.5	0.87	6.76	6.76	6.76	0.18	1.57	±13.3%

^C Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

^F The probes are calibrated using tissue simulating liquids (TSL) that deviate for ϵ and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.

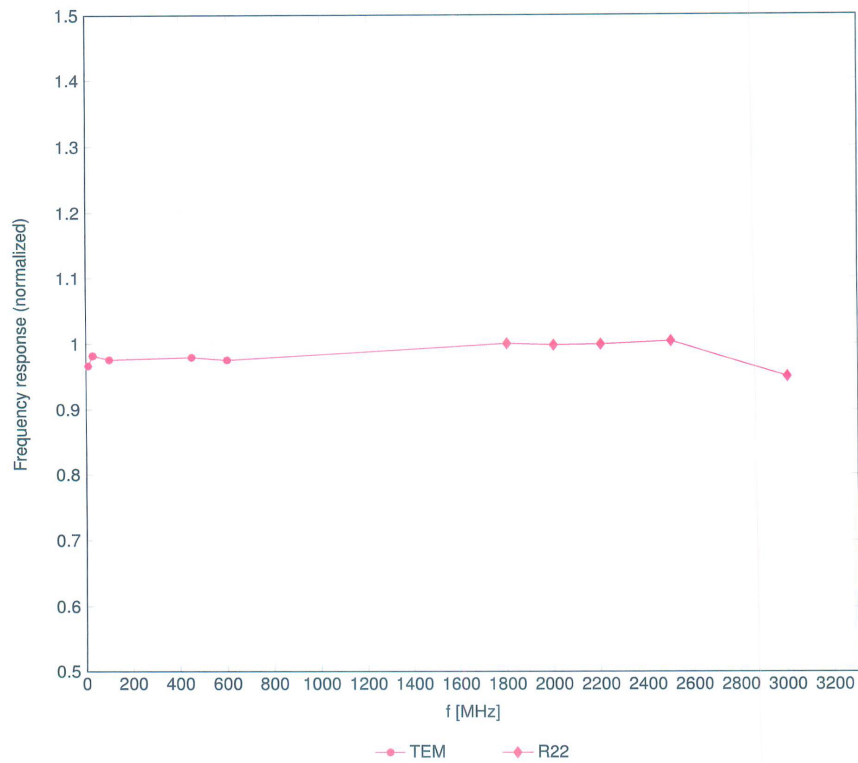
^H The stated uncertainty is the total calibration uncertainty (k = 2) of Norm-ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

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Frequency Response of E-Field

(TEM-Cell:ifl110 EXX, Waveguide:R22)

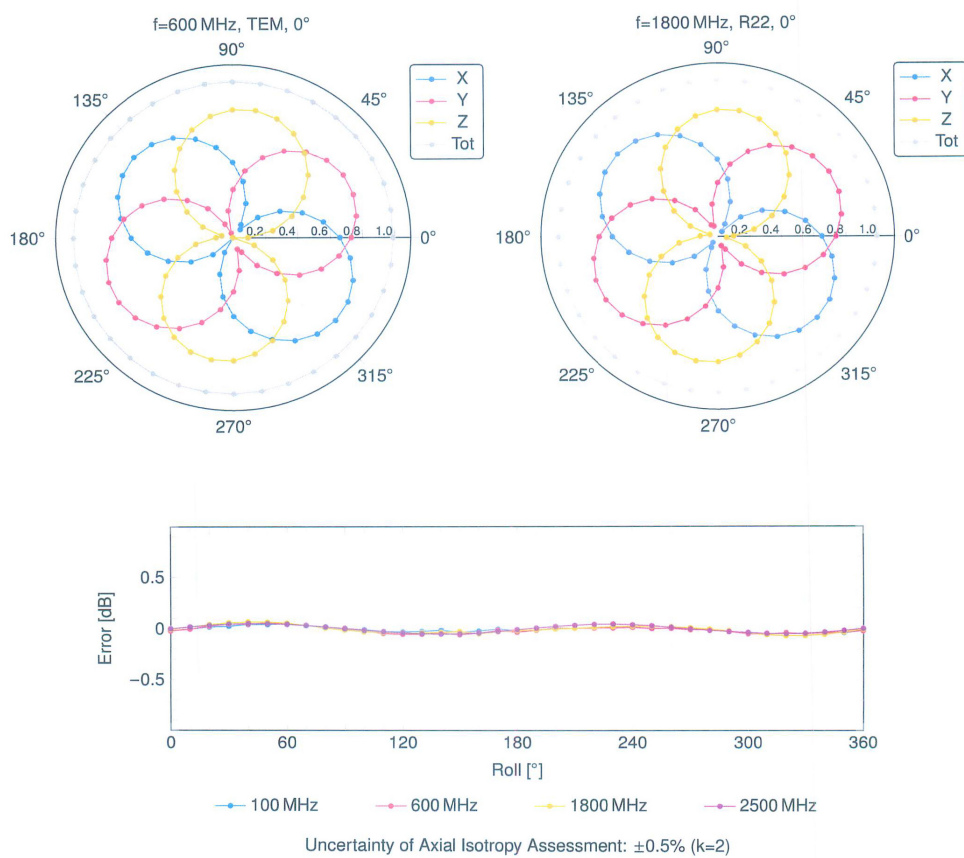


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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Receiving Pattern (ϕ), $\theta = 0^\circ$

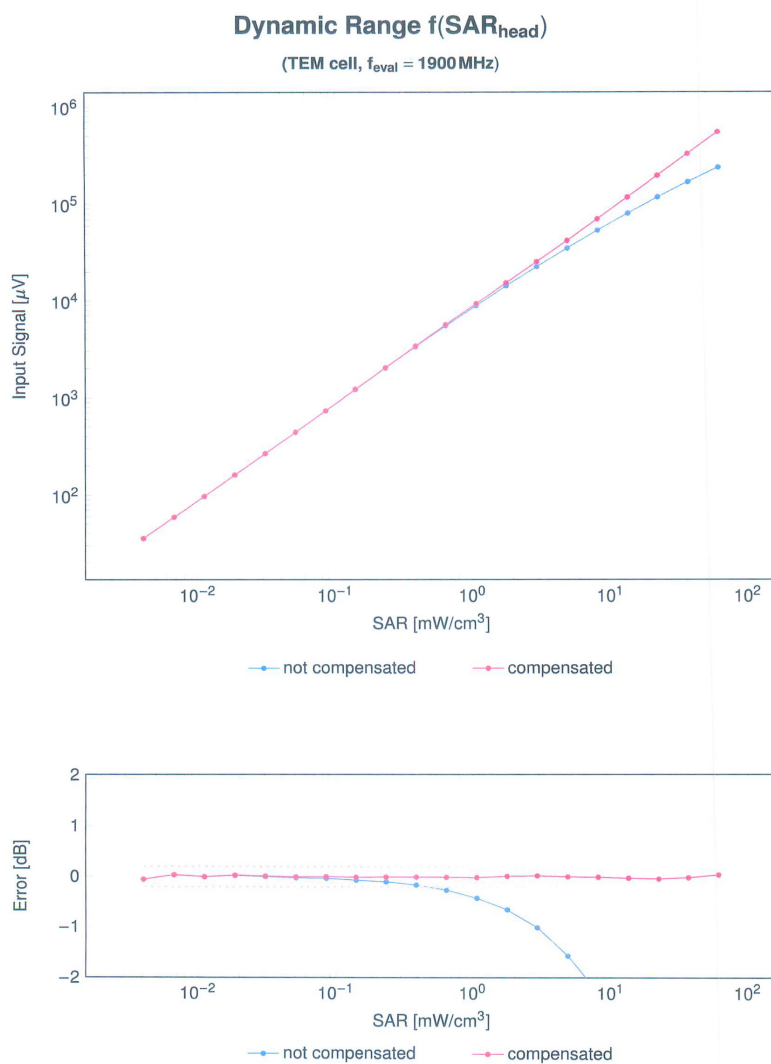


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Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

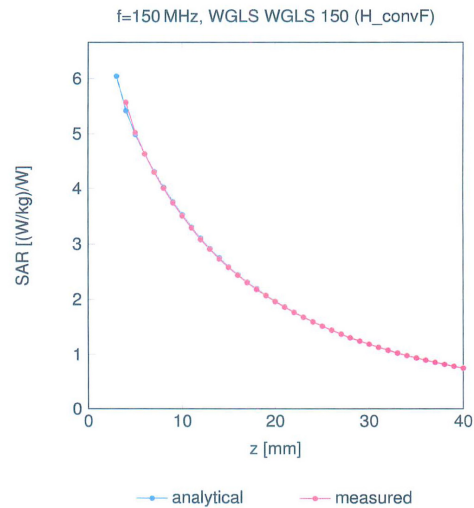
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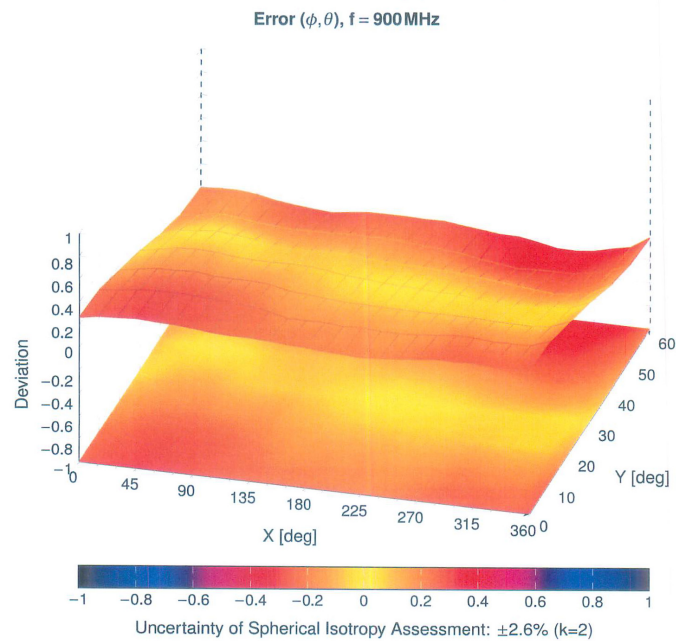
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Conversion Factor Assessment



Deviation from Isotropy in Liquid



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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **BACL USA**

Certificate No: **CLA150-4020_Nov22**

CALIBRATION CERTIFICATE

Object **CLA150 - SN: 4020**

Calibration procedure(s) **QA CAL-15.v9
Calibration Procedure for SAR Validation Sources below 700 MHz**

Calibration date: **November 16, 2022**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (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: CC2552 (20x)	04-Apr-22 (No. 217-03527)	Apr-23
Type-N mismatch combination	SN: 3109R2 / 06327	04-Apr-22 (No. 217-03528)	Apr-23
Reference Probe EX3DV4	SN: 3877	31-Dec-21 (No. EX3-3877_Dec21)	Dec-22
DAE4	SN: 654	26-Jan-22 (No. DAE4-654_Jan22)	Jan-23
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-22)	In house check: Jun-24
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-22)	In house check: Jun-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

Calibrated by: Name **Michael Weber** Function **Laboratory Technician** Signature **M. Weber**

Approved by: **Sven Kühn** Technical Manager **S. Kühn**

Issued: November 22, 2022

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

Certificate No: CLA150-4020_Nov22

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



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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:

- 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 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	150 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	$51.1 \pm 6 \%$	0.77 mho/m $\pm 6 \%$
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	3.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	3.72 W/kg $\pm$ 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	2.52 W/kg $\pm$ 18.0 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	$62.1 \pm 6 \%$	0.81 mho/m $\pm 6 \%$
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	1 W input power	3.82 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	3.79 W/kg $\pm$ 18.4 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.58 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	2.56 W/kg $\pm$ 18.0 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)**Antenna Parameters with Head TSL**

Impedance, transformed to feed point	44.5 Ω - 4.4 j Ω
Return Loss	- 22.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω - 6.1 j Ω
Return Loss	- 22.9 dB

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 08.11.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4020

Communication System: UID 0 - CW; Frequency: 150 MHz

Medium parameters used: $f = 150 \text{ MHz}$; $\sigma = 0.77 \text{ S/m}$; $\epsilon_r = 51.1$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(12.51, 12.51, 12.51) @ 150 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

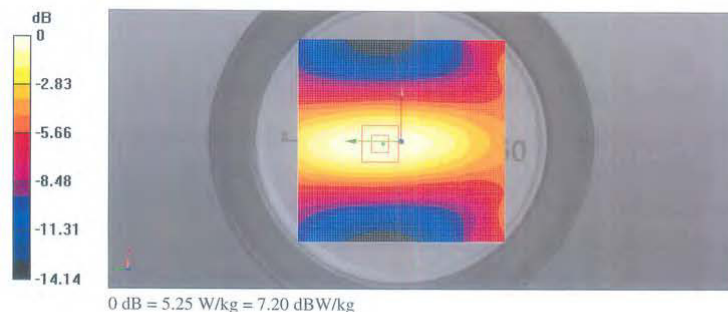
Reference Value = 78.91 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 6.94 W/kg

SAR(1 g) = 3.78 W/kg; SAR(10 g) = 2.56 W/kgSmallest distance from peaks to all points 3 dB below: Larger than measurement grid ($> 14 \text{ mm}$)

Ratio of SAR at M2 to SAR at M1 = 81.3%

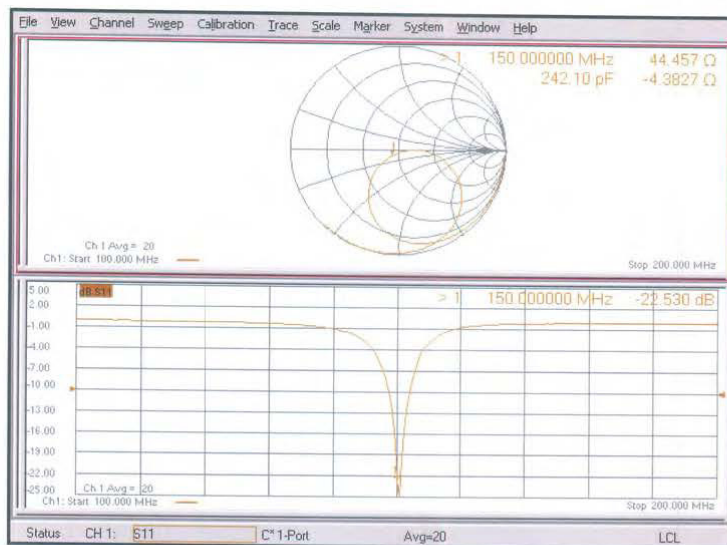
Maximum value of SAR (measured) = 5.25 W/kg



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Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 16.11.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4020

Communication System: UID 0 - CW; Frequency: 150 MHz

Medium parameters used: $f = 150$ MHz; $\sigma = 0.81$ S/m; $\epsilon_r = 62.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.56, 11.56, 11.56) @ 150 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 26.01.2022
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x8)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 80.25 V/m; Power Drift = -0.04 dB

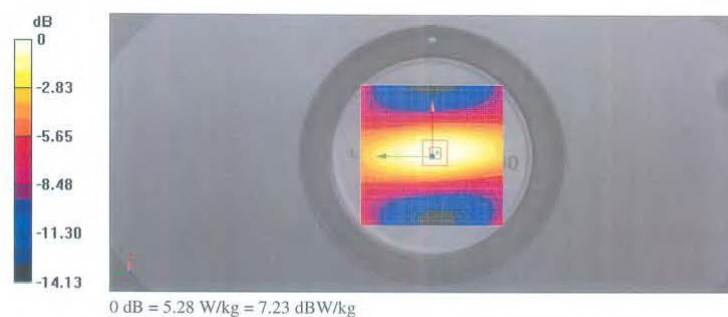
Peak SAR (extrapolated) = 7.04 W/kg

SAR(1 g) = 3.82 W/kg; SAR(10 g) = 2.58 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 = 81.2%

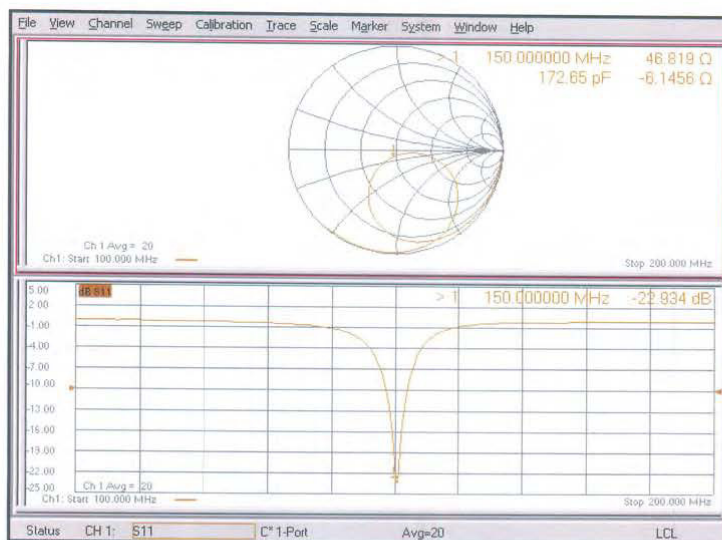
Maximum value of SAR (measured) = 5.28 W/kg



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Impedance Measurement Plot for Body TSL



APPENDIX D RETURN LOSS&IMPEDANCE MEASUREMENT**Equipment Details:**

Description: Dipole
Manufacturer: Speag
Model Number: CLA150
Serial Number: 4020
Calibration Date: 2023/11/11
Calibrated By: Bob Lu
Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18℃-25℃ and humidity < 70%

Calibrated Equipment:

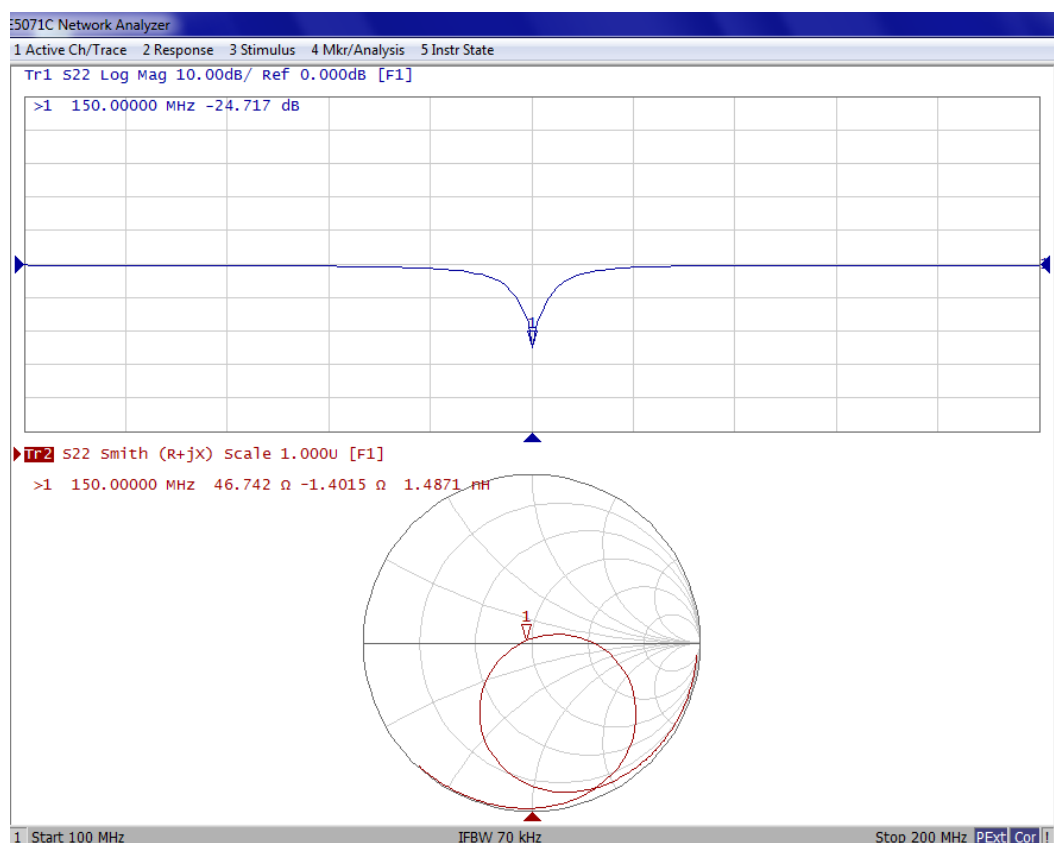
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue 150 MHz Head	TS-150H	2503015001	Each Time	
Oval Flat Phantom	ELI V8.0 P1aP2a	2092	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2023/06/08	2024/06/07
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
150	Head	Return Loss	24.717 dB	22.5 dB	9.85 %	±20%;≥20dB	Pass
		Real Impedance	46.742 Ω	44.5 Ω	2.242 Ω	≤5Ω	Pass
		Imaginary Impedance	-1.402 Ω	-4.4 Ω	2.998 Ω	≤5Ω	Pass

Note: Return Loss Deviation = (Measured-Target)/Target×100%

Dipole, 150MHz, 4020



Equipment Details:

Description: Dipole
 Manufacturer: Speag
 Model Number: CLA150
 Serial Number: 4020
 Calibration Date: 2024/11/11
 Calibrated By: Bob Lu
 Signature: Bob Lu

All Calibration have been conducted in the closed laboratory facility: Lab Temperature 18℃-25℃ and humidity < 70%

Calibrated Equipment:

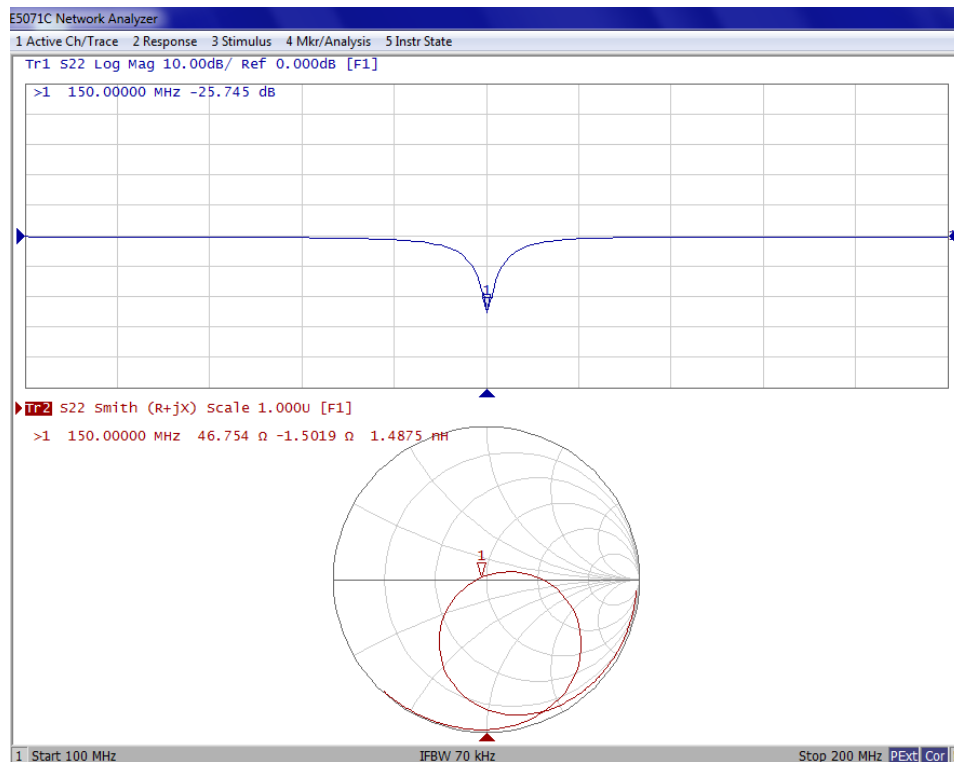
Equipment	Model	S/N	Calibration Date	Calibration Due Date
Simulated Tissue 150 MHz Head	TS-150H	2503015001	Each Time	
Oval Flat Phantom	ELI V8.0 P1aP2a	2092	NCR	NCR
Network Analyzer	E5071C	SER MY46519680	2024/05/21	2025/05/20
Network Analyzer Calibration Kit	50Ω	51026	NCR	NCR

Test Data:

Frequency (MHz)	Simulated Liquid	Parameter	Measured Value	Target Value	Deviation	Reference Range	Results
150	Head	Return Loss	25.745 dB	22.5 dB	14.42 %	±20%;≥20dB	Pass
		Real Impedance	46.754 Ω	44.5 Ω	2.254 Ω	≤5Ω	Pass
		Imaginary Impedance	-1.502 Ω	-4.4 Ω	2.898 Ω	≤5Ω	Pass

Note: Return Loss Deviation = (Measured-Target)/Target×100%

Dipole, 150MHz, 4020



**** END OF REPORT ****