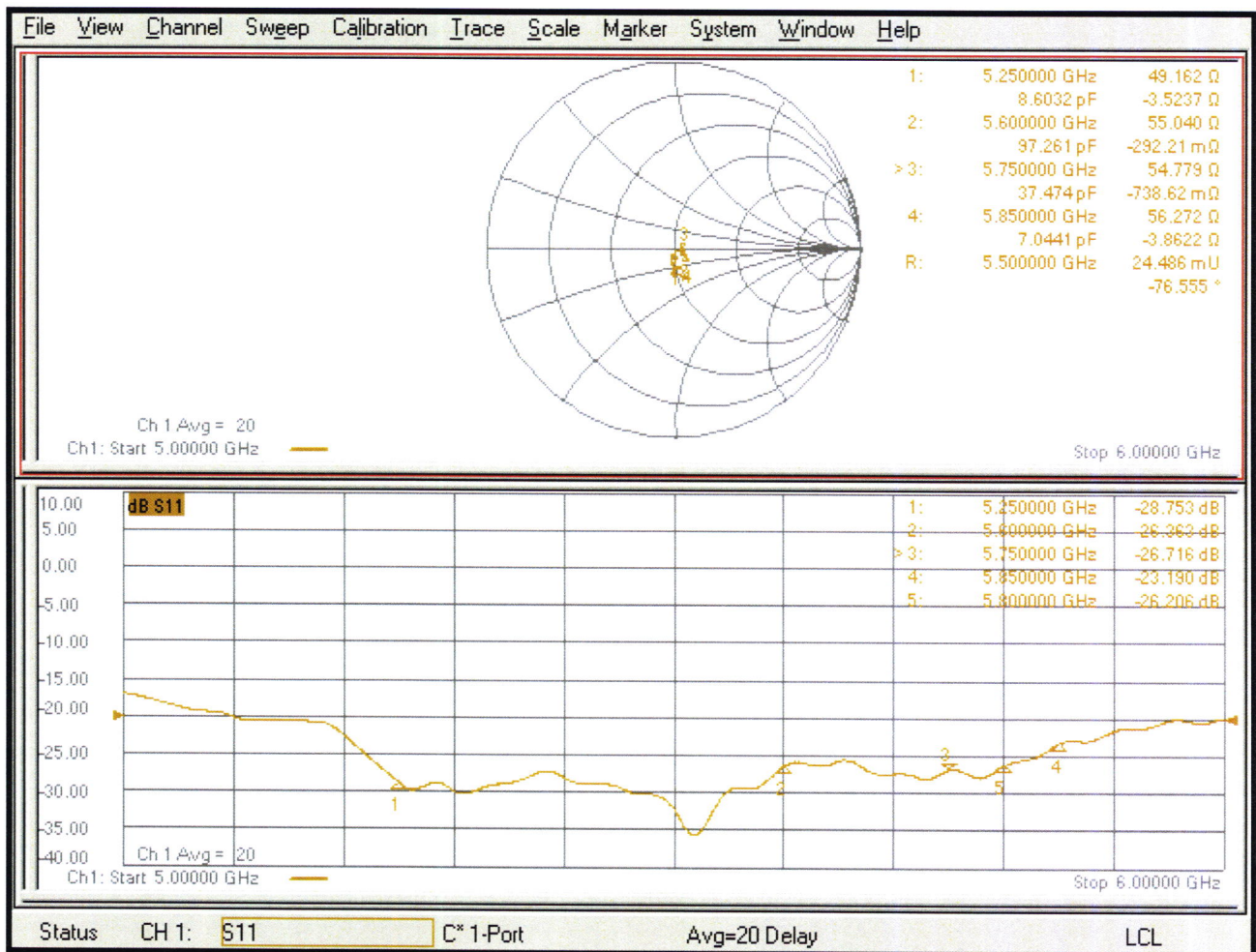


Impedance Measurement Plot for Head TSL



Validation Report for Head TSL of 5.25GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5250_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5250 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.589$ S/m; $\epsilon_r = 35.391$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(6.23, 5.73, 5.57)@5250 MHz; Calibrated:2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 16.0 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 66.73 V/m; Power Drift = -0.04 dB

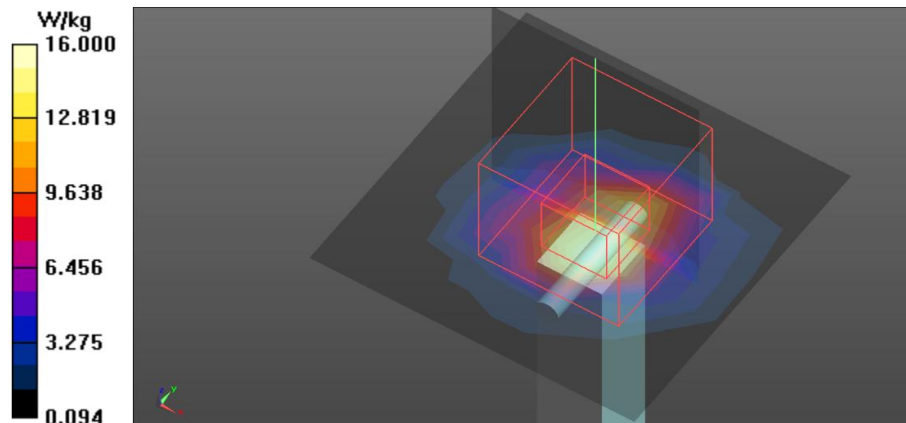
Peak SAR (extrapolated) = 37.7 W/kg

SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.25 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 19.3%

Maximum value of SAR (measured) = 20.6 W/kg



Validation Report for Head TSL of 5.6GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5600_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1
Medium parameters used: $f = 5600$ MHz; $\sigma = 5.051$ S/m; $\epsilon_r = 34.576$; $\rho = 1000$ kg/m³
Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(5.54, 5.1, 4.96) @5600 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 17.7 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 64.05 V/m; Power Drift = -0.03 dB

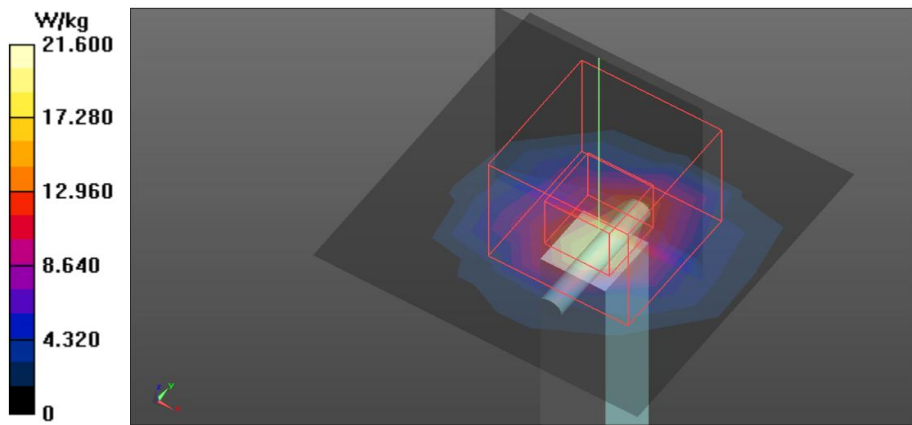
Peak SAR (extrapolated) = 44.4 W/kg

SAR(1 g) = 7.99 W/kg; SAR(10 g) = 2.27 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 15.7%

Maximum value of SAR (measured) = 21.6 W/kg



Validation Report for Head TSL of 5.75GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5750_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.168$ S/m; $\epsilon_r = 34.173$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809 ConvF(5.51, 5.06, 4.93)@5750 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 23.0$
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 15.9 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 60.96 V/m; Power Drift = -0.09 dB

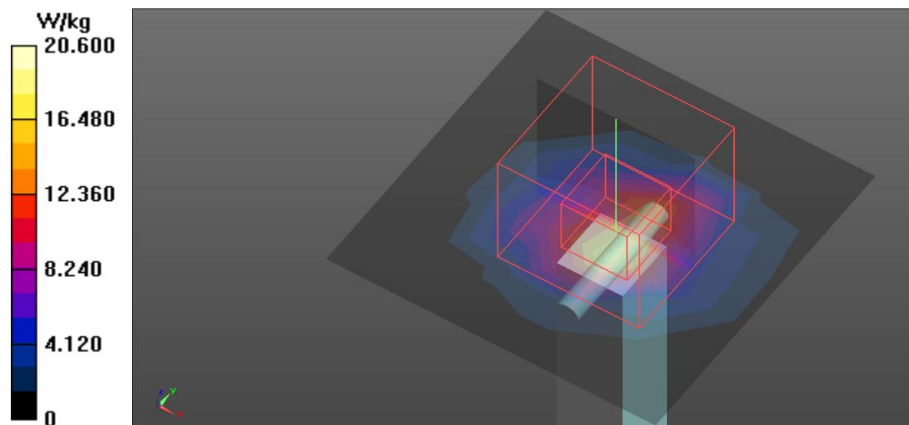
Peak SAR (extrapolated) = 39.4 W/kg

SAR(1 g) = 7.55 W/kg; SAR(10 g) = 2.15 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 45.4%

Maximum value of SAR (measured) = 20.6 W/kg



Validation Report for Head TSL of 5.85GHz

Test Laboratory: BTL Inc.

Date: 2025/4/24

System Check_H5850_0424

DUT: Dipole D5GHzV2;SN:1160;

Communication System: UID 0, CW (0); Frequency: 5850 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5850$ MHz; $\sigma = 5.252$ S/m; $\epsilon_r = 33.712$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.5°C; Liquid Temperature: 22.2°C

DASY Configuration:

- Probe: EX3DV4 - SN3809; ConvF(5.51, 5.06, 4.93)@5850 MHz; Calibrated: 2025/1/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0$, 23.0
- Electronics: DAE4 Sn1390; Calibrated: 2024/11/14
- Phantom: ELI V5.0 (20deg probe tilt); Type: QD OVA 002 Ax; Serial: 1222
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Area Scan (6x6x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 13.7 W/kg

Zoom Scan (7x7x12)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 67.76 V/m; Power Drift = -0.09 dB

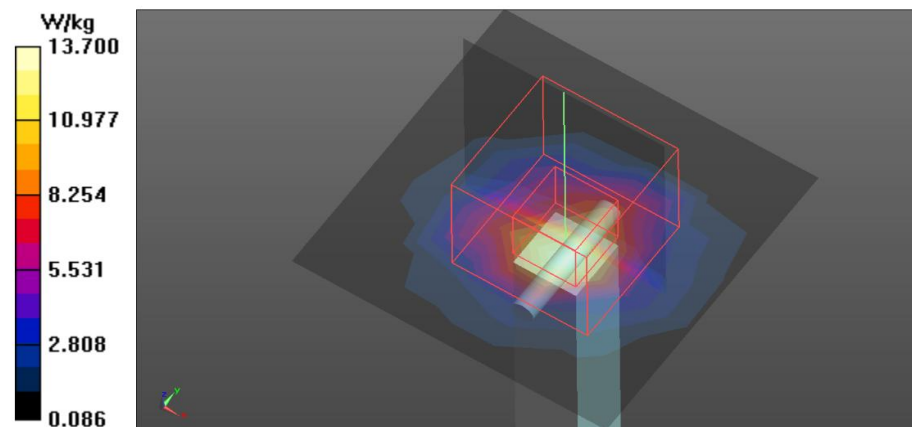
Peak SAR (extrapolated) = 43.1 W/kg

SAR(1 g) = 8 W/kg; SAR(10 g) = 2.29 W/kg

Smallest distance from peaks to all points 3 dB below = 7.9 mm

Ratio of SAR at M2 to SAR at M1 = 44.2%

Maximum value of SAR (measured) = 22.1 W/kg



Calibrator:

Justin Huang

Approver:

Herbert Lin



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **BTL Inc.**
Guangdong

Certificate No. **D6.5GHzV2-1052_Nov24**

CALIBRATION CERTIFICATE

Object **D6.5GHzV2 - SN:1052**

Calibration procedure(s) **QA CAL-22.v7**
Calibration Procedure for SAR Validation Sources between 3-10 GHz

Calibration date: **November 13, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power sensor R&S NRP33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Mismatch combination	SN: 84224 / 360D	28-Mar-24 (No. 217-04050)	Mar-25
Reference Probe EX3DV4	SN: 7405	01-Jul-24 (No. EX3-7405_Jul24)	Jul-25
DAE4	SN: 908	27-Mar-24 (No. DAE4-908_Mar24)	Mar-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator Anapico APSIN20G	SN: 827	18-Dec-18 (in house check Jan-24)	In house check: Jan-25
Power sensor NRP-Z23	SN: 100169	10-Jan-19 (in house check Jan-24)	In house check: Jan-25
Power sensor NRP-18T	SN: 100950	28-Sep-22 (in house check Jan-24)	In house check: Jan-25
Network Analyzer Keysight E5063A	SN:MY54504221	31-Oct-19 (in house check Sep-24)	In house check: Sep-26

Calibrated by: **Krešimir Franjić** **Laboratory Technician**

Signature

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

Issued: November 13, 2024

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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.

Additional Documentation:

- b) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.
- *The absorbed power density (APD):* The absorbed power density is evaluated according to Samaras T, Christ A, Kuster N, "Compliance assessment of the epithelial or absorbed power density above 6 GHz using SAR measurement systems", Bioelectromagnetics, 2021 (submitted). The additional evaluation uncertainty of 0.55 dB (rectangular distribution) is considered.

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

Measurement Conditions

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

DASY Version	DASY6	V16.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	5 mm	with Spacer
Zoom Scan Resolution	dx, dy = 3.4 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	6500 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	34.5	6.07 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	34.6 $\pm$ 6 %	6.21 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	29.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	291 W/kg $\pm$ 24.7 % (k=2)

SAR averaged over 8 cm³ (8 g) of Head TSL	Condition	
SAR measured	100 mW input power	6.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	65.8 W/kg $\pm$ 24.4 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg $\pm$ 24.4 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω - 3.7 j Ω
Return Loss	- 28.6 dB

APD (Absorbed Power Density)

APD averaged over 1 cm²	Condition	
APD measured	100 mW input power	291 W/m ²
APD measured	normalized to 1W	2910 W/m² $\pm$ 29.2 % (k=2)

APD averaged over 4 cm²	condition	
APD measured	100 mW input power	132 W/m ²
APD measured	normalized to 1W	1320 W/m² $\pm$ 28.9 % (k=2)

*The reported APD values have been derived using the psSAR1g and psSAR8g.

General Antenna Parameters and Design

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
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DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1052, UID 0 -, Channel 6500 (6500.0MHz)

Device under Test Properties

Name, Manufacturer	Dimensions [mm]	IMEI	DUT Type
D6.5GHz	16.0 x 6.0 x 300.0	SN: 1052	-

Exposure Conditions

Phantom Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz]	Conversion Factor	TSL Cond. [S/m]	TSL Permittivity
Flat, HSL	5.00	Band	CW,	6500	5.14	6.21	34.6

Hardware Setup

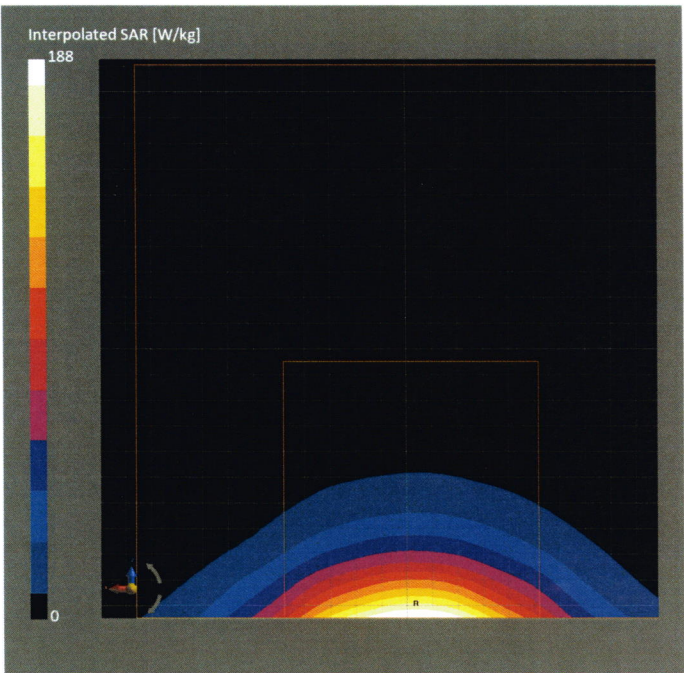
Phantom	TSL	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center - 1182	HBBL600-10000V6	EX3DV4 - SN7405, 2024-07-01	DAE4 Sn908, 2024-03-27

Scan Setup

	Zoom Scan
Grid Extents [mm]	22.0 x 22.0 x 22.0
Grid Steps [mm]	3.4 x 3.4 x 1.4
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.4
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2024-11-13, 11:13
psSAR1g [W/Kg]	29.1
psSAR8g [W/Kg]	6.58
psSAR10g [W/Kg]	5.40
Power Drift [dB]	-0.01
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	No correction
M2/M1 [%]	49.2
Dist 3dB Peak [mm]	4.8



Impedance Measurement Plot for Head TSL

