

31_LTE Band 71_20M_QPSK_1RB_49Offset_Back_15mm_Ch133322

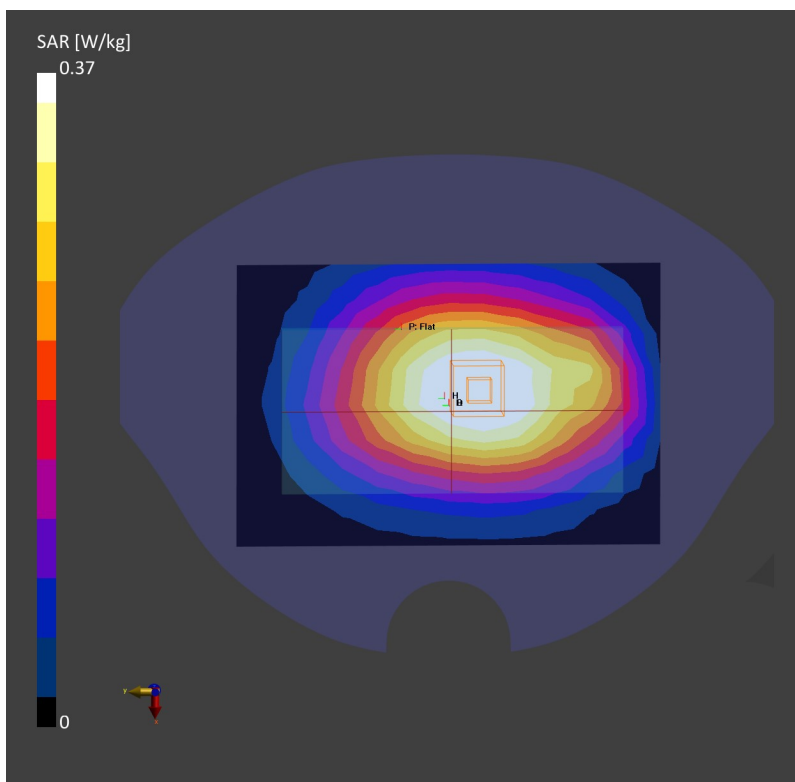
Communication System: Band 71, E-UTRA/FDD; Frequency: 683.0
Medium: HSL. Medium parameters used: $f=683.0$ MHz; $\sigma=0.892$ S/m; $\epsilon_r=42.1$
Ambient Temperature: 23.1°C; Liquid Temperature: 22.7°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(9.42, 9.42, 9.42); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 180.0 mm): Measurement Grid: 15.0 mm x 15.0 mm
SAR (1g) = 0.362 W/kg; SAR (10g) = 0.258 W/kg;

Zoom Scan (32.0 mm x 32.0 mm x 30.0 mm): Measurement Grid: 8.0 mm x 8.0 mm x 5.0 mm
Power Drift = 0.04 dB
SAR (1g) = 0.370 W/kg; SAR (10g) = 0.281 W/kg;



32_LTE Band 12_10M_QPSK_1RB_0Offset_Back_15mm_Ch23095

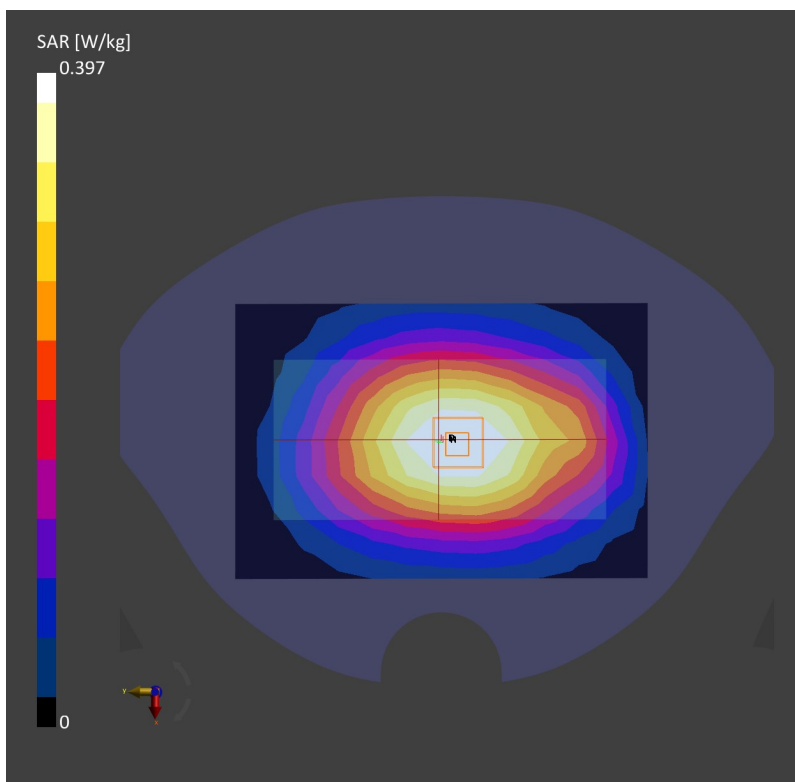
Communication System: Band 12, E-UTRA/FDD; Frequency: 707.5
Medium: HSL. Medium parameters used: $f=707.5$ MHz; $\sigma=0.901$ S/m; $\epsilon_r=42.0$
Ambient Temperature: 23.1°C; Liquid Temperature: 22.7°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(9.42, 9.42, 9.42); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 180.0 mm): Measurement Grid: 15.0 mm x 15.0 mm
SAR (1g) = 0.366 W/kg; SAR (10g) = 0.261 W/kg;

Zoom Scan (32.0 mm x 32.0 mm x 30.0 mm): Measurement Grid: 8.0 mm x 8.0 mm x 5 mm
Power Drift = 0.03 dB
SAR (1g) = 0.397 W/kg; SAR (10g) = 0.287 W/kg;



33_LTE Band 5_10M_QPSK_1RB_0Offset_Back_15mm_Ch20525

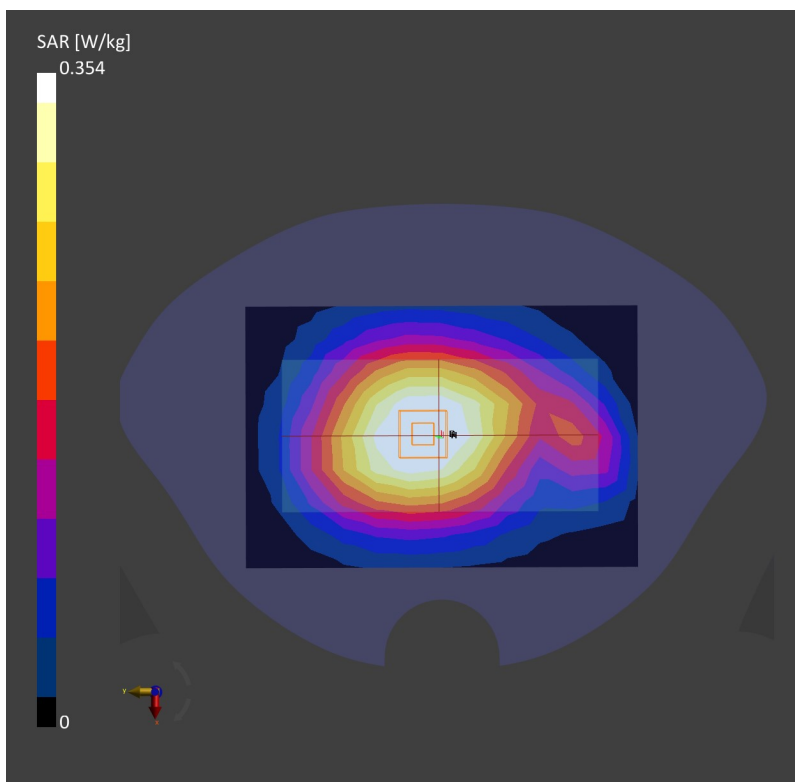
Communication System: Band 5, E-UTRA/FDD; Frequency: 836.5
Medium: HSL. Medium parameters used: $f= 836.5$ MHz; $\sigma= 0.93$ S/m; $\epsilon_r = 40.9$
Ambient Temperature: 23.2°C; Liquid Temperature: 22.7°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(9.18, 9.18, 9.18); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 180.0 mm): Measurement Grid: 15.0 mm x 15.0 mm
SAR (1g) = 0.341 W/kg; SAR (10g) = 0.240 W/kg;

Zoom Scan (32.0 mm x 32.0 mm x 30.0 mm): Measurement Grid: 8.0 mm x 8.0 mm x 5 mm
Power Drift = 0.05 dB
SAR (1g) = 0.354 W/kg; SAR (10g) = 0.269 W/kg;



34_LTE Band 66_20M_QPSK_1RB_0Offset_Back_15mm_Ch132322

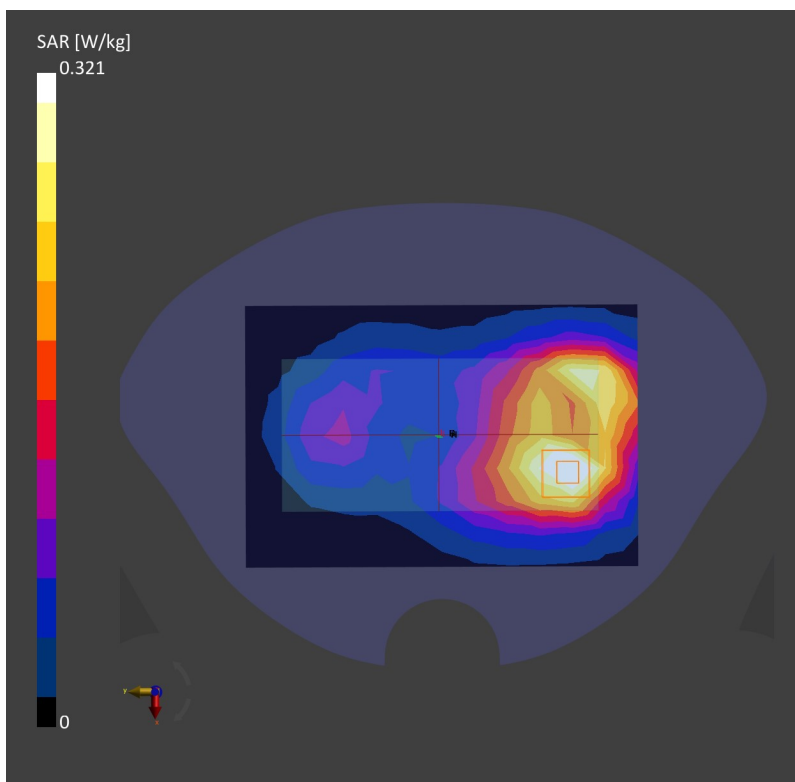
Communication System: Band 66, E-UTRA/FDD; Frequency: 1745.0
Medium: HSL. Medium parameters used: $f=1745.0$ MHz; $\sigma=1.40$ S/m; $\epsilon_r=40.7$
Ambient Temperature: 23.3°C; Liquid Temperature: 22.6°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(8.13, 8.13, 8.13); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 180.0 mm): Measurement Grid: 15.0 mm x 15.0 mm
SAR (1g) = 0.305 W/kg; SAR (10g) = 0.179 W/kg;

Zoom Scan (32.0 mm x 32.0 mm x 30.0 mm): Measurement Grid: 8.0 mm x 8.0 mm x 5.0 mm
Power Drift = 0.02 dB
SAR (1g) = 0.321 W/kg; SAR (10g) = 0.195 W/kg;



35_LTE Band 2_20M_QPSK_1RB_0Offset_Back_15mm_Ch18900

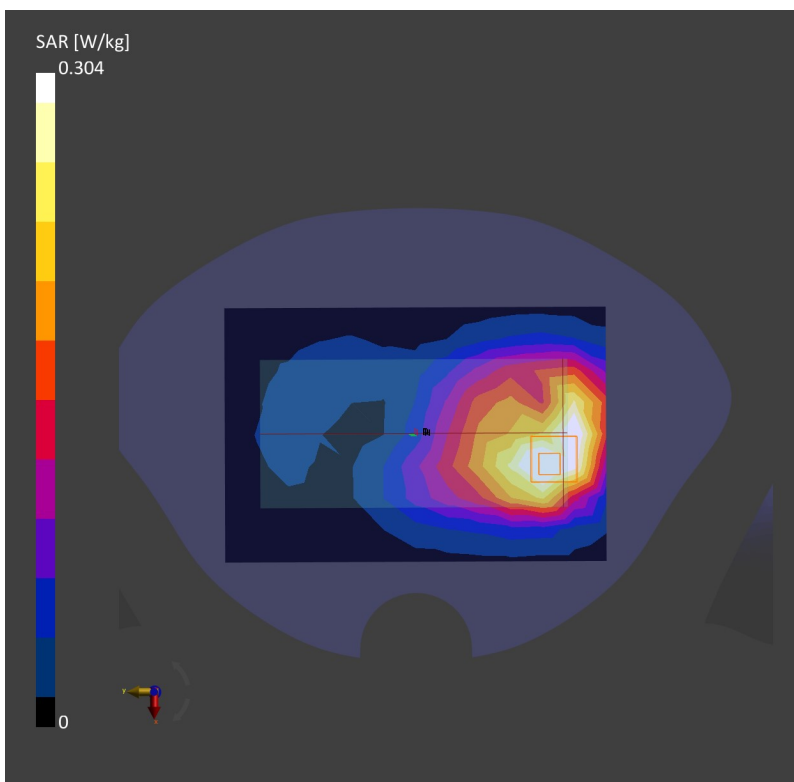
Communication System: Band 2, E-UTRA/FDD; Frequency: 1880.0
Medium: HSL. Medium parameters used: $f=1880.0$ MHz; $\sigma=1.44$ S/m; $\epsilon_r=40.7$
Ambient Temperature: 23.3°C; Liquid Temperature: 22.8°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.86, 7.86, 7.86); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 180.0 mm): Measurement Grid: 15.0 mm x 15.0 mm
SAR (1g) = 0.291 W/kg; SAR (10g) = 0.174 W/kg;

Zoom Scan (32.0 mm x 32.0 mm x 30.0 mm): Measurement Grid: 8.0 mm x 8.0 mm x 5.0 mm
Power Drift = 0.06 dB
SAR (1g) = 0.304 W/kg; SAR (10g) = 0.185 W/kg;



36_LTE Band 41_20M_QPSK_1RB_49Offset_Back_15mm_Ch39750

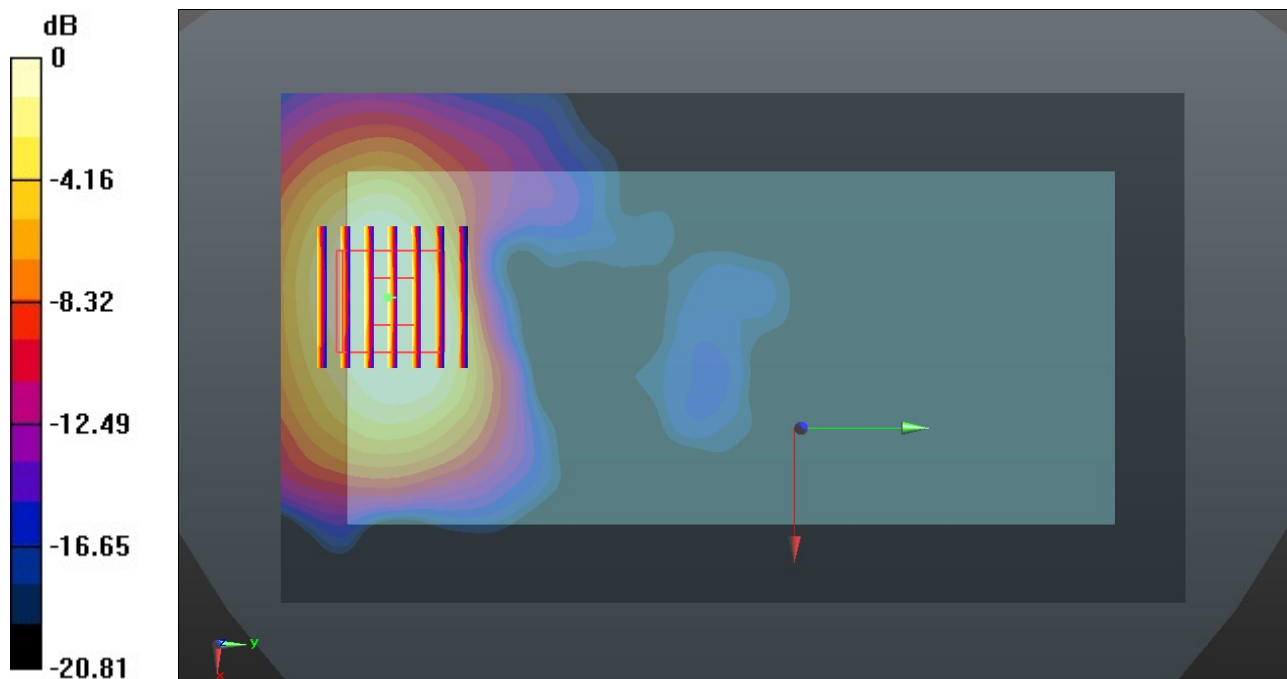
Communication System: UID 0, LTE-TDD (0); Frequency: 2506 MHz; Duty Cycle: 1:1.59
Medium: HSL_2600 Medium parameters used: $f = 2506$ MHz; $\sigma = 1.859$ S/m; $\epsilon_r = 39.163$; $\rho = 1000$ kg/m³
Ambient Temperature : 23.2 °C; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN7592; ConvF(7.26, 7.26, 7.26); Calibrated: 2021/6/24
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1303; Calibrated: 2021/6/18
- Phantom: SAM Twin Phantom; Type: SAM Twin; Serial: TP-1697
- Measurement SW: DASY52, Version 52.10 (4); SEMCAD X Version 14.6.14 (7483)

Area Scan (91x161x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.716 W/kg

Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.616 W/kg
SAR(1 g) = 0.342 W/kg; SAR(10 g) = 0.184 W/kg
Maximum value of SAR (measured) = 0.425 W/kg



0 dB = 0.425 W/kg = -3.72 dBW/kg

37_WLAN2.4G_802.11b 1Mbps_Back_15mm_Ch6

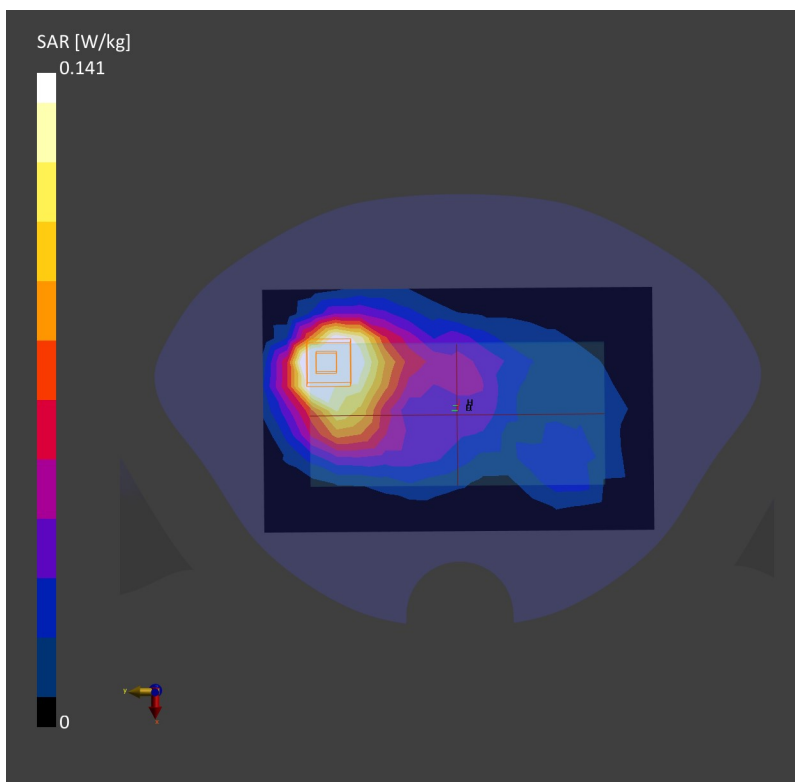
Communication System: WLAN 2.4GHz; Frequency: 2437.0
Medium: HSL. Medium parameters used: $f= 2437.0$ MHz; $\sigma= 1.81$ S/m; $\epsilon_r = 39.2$
Ambient Temperature: 23.2°C; Liquid Temperature: 22.6°C

DASY6 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(7.53, 7.53, 7.53); Calibrated: 2021-11-24
- Sensor-Surface: 1.4 mm
- Electronics: DAE4 Sn1338; Calibrated: 2021-12-1
- Phantom: Twin-SAM V8.0 (30deg probe tilt); Serial: 2074; Section: Flat
- Measurement Software: cDASY6 V6.6.0.13926

Area Scan (120.0 mm x 192.0 mm): Measurement Grid: 12.0 mm x 12.0 mm
SAR (1g) = 0.163 W/kg; SAR (10g) = 0.087 W/kg;

Zoom Scan (30.0 mm x 30.0 mm x 30.0 mm): Measurement Grid: 5.0 mm x 5.0 mm x 5.0 mm
Power Drift = -0.02 dB
SAR (1g) = 0.141 W/kg; SAR (10g) = 0.077 W/kg;





Appendix C. DASYS Calibration Certificate

The DASYS calibration certificates are shown as follows.



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**

Client **Sporton**

Certificate No: **D750V3-1087_Feb22**

CALIBRATION CERTIFICATE

Object **D750V3 - SN:1087**

Calibration procedure(s) **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **February 24, 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	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power sensor NRP-Z91	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
Power sensor NRP-Z91	SN: 103245	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	09-Apr-21 (No. 217-03343)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	09-Apr-21 (No. 217-03344)	Apr-22
Reference Probe EX3DV4	SN: 7349	31-Dec-21 (No. EX3-7349_Dec21)	Dec-22
DAE4	SN: 601	01-Nov-21 (No. DAE4-601_Nov21)	Nov-22
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-20)	In house check: Oct-22
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-20)	In house check: Oct-22
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-20)	In house check: Oct-22

Calibrated by:	Name Joanna Lleshaj	Function Laboratory Technician	Signature
Approved by:	Niels Kuster	Quality Manager	

Issued: March 2, 2022

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:

- 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	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 \pm 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 \pm 0.2) °C	42.4 \pm 6 %	0.89 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	250 mW input power	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.58 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (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	5.65 W/kg \pm 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6 Ω - 2.5 j Ω
Return Loss	- 29.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

Additional EUT Data

Manufactured by	SPEAG
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DASY5 Validation Report for Head TSL

Date: 24.02.2022

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1087

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.89 \text{ S/m}$; $\epsilon_r = 42.4$; $\rho = 1000 \text{ kg/m}^3$

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: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- 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 = 59.64 V/m; Power Drift = -0.03 dB

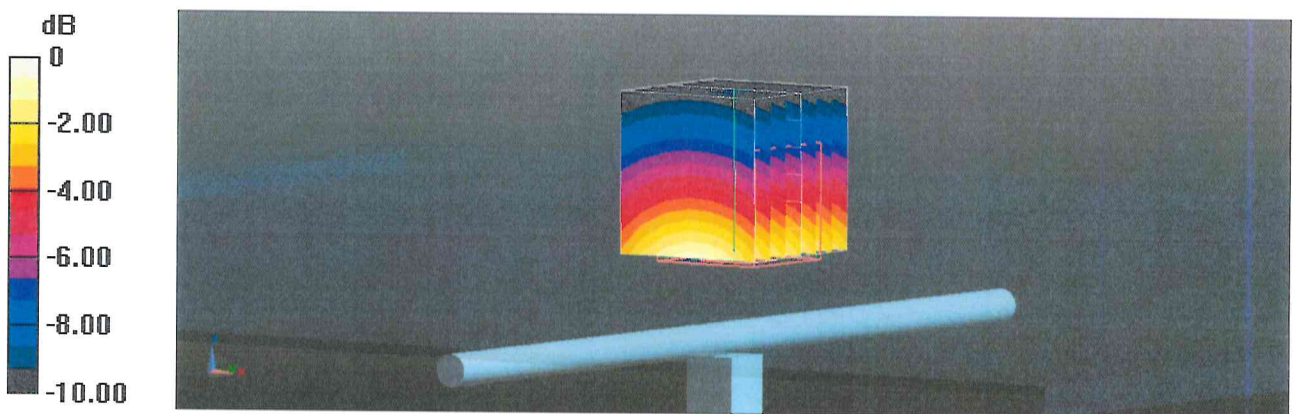
Peak SAR (extrapolated) = 3.22 W/kg

SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.41 W/kg

Smallest distance from peaks to all points 3 dB below = 17 mm

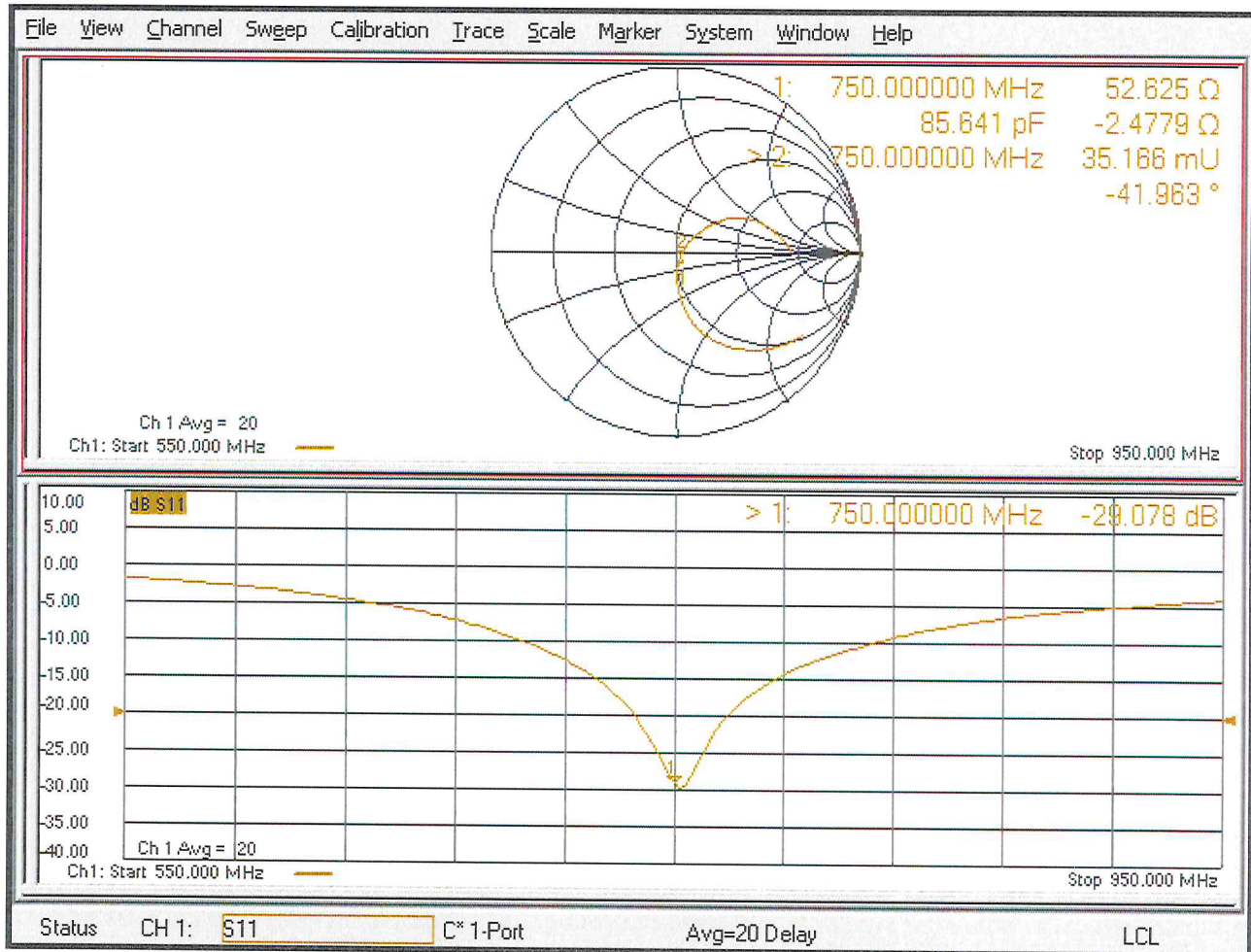
Ratio of SAR at M2 to SAR at M1 = 66.5%

Maximum value of SAR (measured) = 2.83 W/kg



0 dB = 2.83 W/kg = 4.52 dBW/kg

Impedance Measurement Plot for Head TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Sporton**

Certificate No: **D835V2-4d258_May20**

CALIBRATION CERTIFICATE

Object **D835V2 - SN:4d258**

Calibration procedure(s) **QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz**

Calibration date: **May 07, 2020**

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	01-Apr-20 (No. 217-03100/03101)	Apr-21
Power sensor NRP-Z91	SN: 103244	01-Apr-20 (No. 217-03100)	Apr-21
Power sensor NRP-Z91	SN: 103245	01-Apr-20 (No. 217-03101)	Apr-21
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-20 (No. 217-03106)	Apr-21
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 7349	31-Dec-19 (No. EX3-7349_Dec19)	Dec-20
DAE4	SN: 601	27-Dec-19 (No. DAE4-601_Dec19)	Dec-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

Calibrated by:	Name Jeffrey Katzman	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: May 7, 2020

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Accredited by the Swiss Accreditation Service (SAS)

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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:

- IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
- IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
- IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- DASY4/5 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	DASY5	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 \pm 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 \pm 0.2) °C	42.2 \pm 6 %	0.92 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	250 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.44 W/kg \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.55 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.13 W/kg \pm 16.5 % (k=2)