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Accreditation No.: **SCS 0108**

Client **Morlab (Auden)**

Certificate No: **D6500V2-1039_Jun20**

CALIBRATION CERTIFICATE

Object **D6500V2 - SN:1039**

Calibration procedure(s) **QA CAL-22.v4
Calibration Procedure for SAR Validation Sources between 3-10 GHz**

Calibration date: **June 02, 2021**

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-21 (No. 217-03100/03101)	Apr-22
Power sensor NRP-Z91	SN: 103244	01-Apr-21 (No. 217-03100)	Apr-22
Power sensor NRP-Z91	SN: 103245	01-Apr-21 (No. 217-03101)	Apr-22
Reference 20 dB Attenuator	SN: BH9394 (20k)	31-Mar-21 (No. 217-03106)	Apr-22
Type-N mismatch combination	SN: 310982 / 06327	31-Mar-20 (No. 217-03104)	Apr-21
Reference Probe EX3DV4	SN: 3503	31-Dec-20 (No. EX3-3503_Dec19)	Dec-21
DAE4	SN: 601	27-Dec-20 (No. DAE4-601_Dec19)	Dec-21
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 Michael Weber	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 2, 2021

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



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Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC IEEE Std 62209-1528 ED1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) of Human to radio frequency fields from hand-held and body-worn wireless communications devices-Part 1528: Human models, instrumentation and procedures (Frequency range of 4 MHz to 10 GHz)".

Additional Documentation:

- b) DASY6 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	DASY6	V6.14
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	34.7	6.04 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	33.3 \pm 6 %	6.39 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	100 mW input power	24.8 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	248 W/kg \pm 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	5.21 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	52.1 W/kg \pm 19.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 6500 MHz

Impedance, transformed to feed point	50.4 Ω - 8.1 $j\Omega$
Return Loss	- 21.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.094 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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DASY6 Validation Report for Head TSL

Measurement Report for D6.5GHz-1008, 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: 1008	-

Exposure Conditions

Phantom Section Section, TSL	Position, Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor
Flat, HSL	5.00	Band n260	CW,	6500, 6500	5.75

Hardware Setup

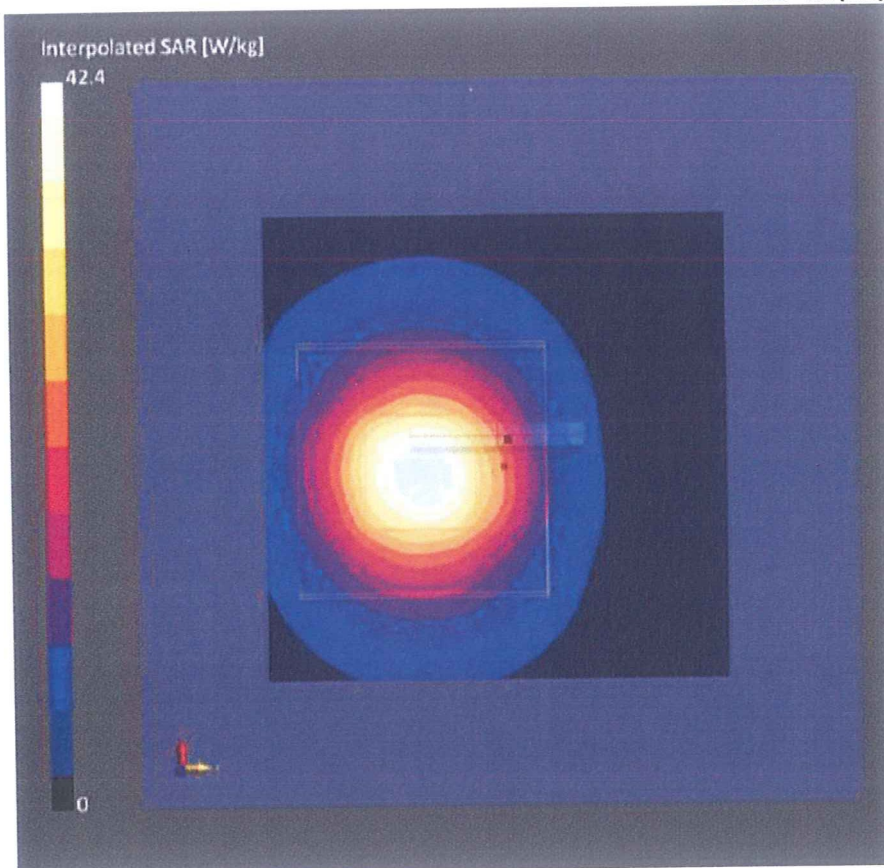
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Centre - 1182	HBBL600-10000V6	EX3D4 – SN7405, 2020-05-18	DAE4 Sn908,2020-05-27

Scan Setup

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

Measurement Results

	Zoom Scan
Date	2021-06-20, 14:51
psSAR1g[W/kg]	24.8
psSAR10g[W/kg]	5.21
Power Drift [dB]	0.07
Power Scaling	Disabled
Scaling Factor[dB]	
TSL Correction	Enabled
M2/M1 [%]	50.2
Dist 3dB Peak [mm]	4.68



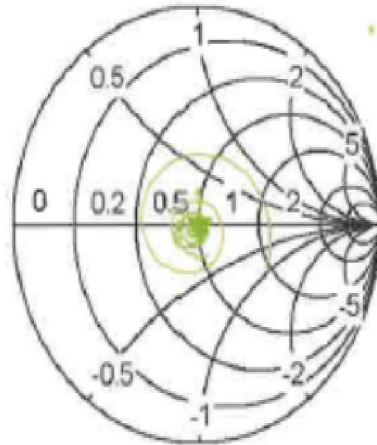
Impedance Measurement Plot for Head TSL



Trc1 S11 Smith Ref1 U Cal

1

S11



6.500000 GHz 50.441 Ω
 $-j8.092 \Omega$
3.026 pF

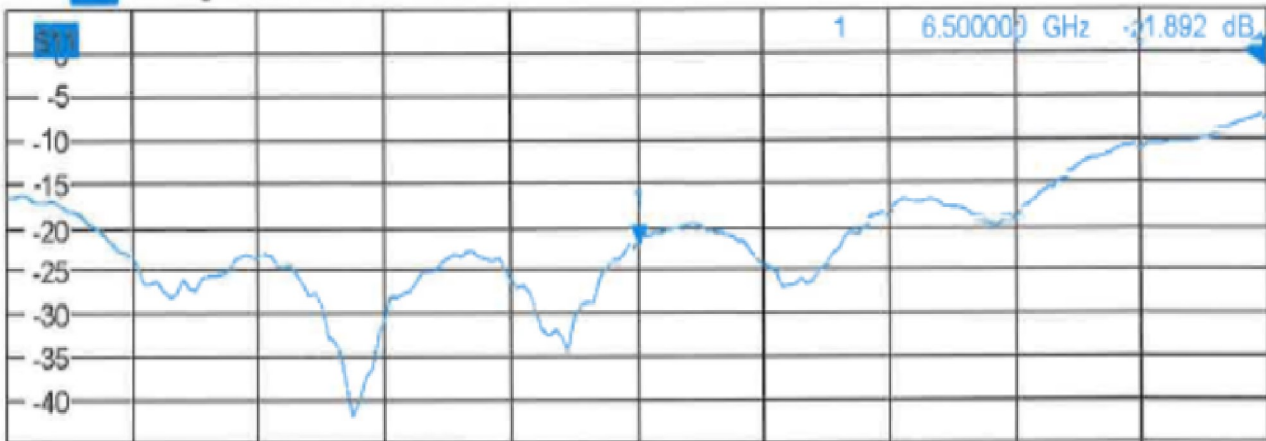
Ch1 Center 6.5 GHz

Pwr 0 dBm

Span 2 GHz

Trc2 S11 dB Mag 5 dB/ Ref0 dB Cal

2



1 6.500000 GHz -1.892 dB

Ch1 Center 6.5 GHz

Pwr 0 dBm

Span 2 GHz