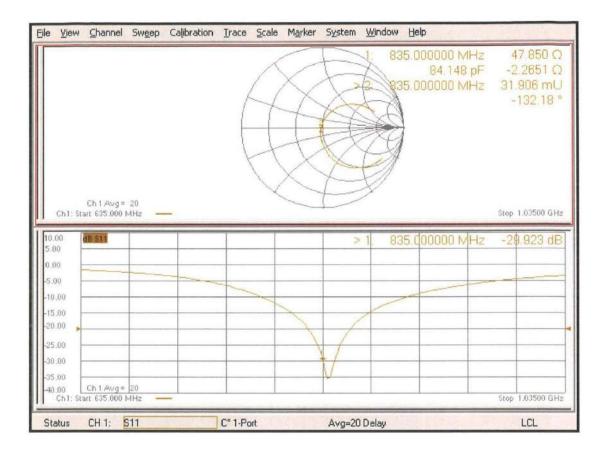


### Impedance Measurement Plot for Head TSL





### Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>1</sup>

#### **Evaluation Condition**

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

### SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.24 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

### SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.70 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

### SAR result with SAM Head (Neck ≅ H0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	9.22 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

### SAR result with SAM Head (Ear ≅ D90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	7.93 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

Certificate No: D835V2-4d277\_Sep21

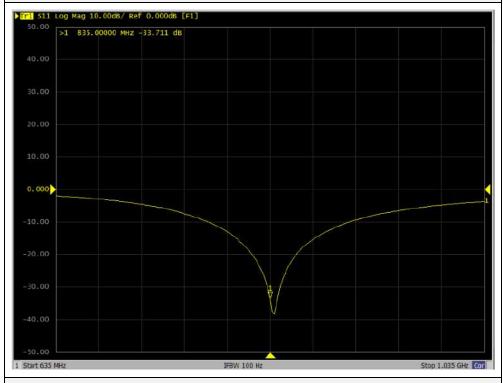
<sup>&</sup>lt;sup>1</sup> Additional assessments outside the current scope of SCS 0108



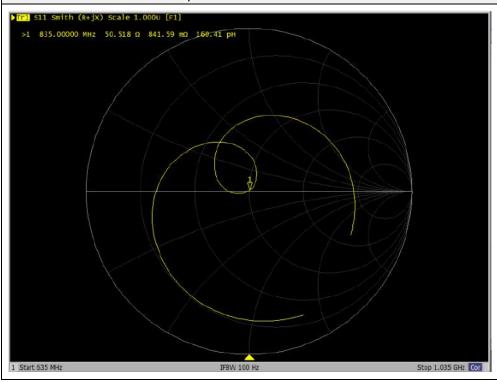
D835V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.09.08	2022.09.08	1
Return Loss(dB)	-33.711	-31.256	7.85%
Impedance	50.518 Ω + 0.842	48.958 Ω - 1.232	2.074Ω
Impedance	jΩ	jΩ	(Imaginary part)

### Return Loss for Head TSL



### Impedance for Head TSL





### F.5 1750 MHz Dipole

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





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

Balun (Auden)

Certificate No: D1750V2-1183\_Jul21

Object	D1750V2 - SN:11	183	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	July 06, 2021		
		onal standards, which realize the physical uni robability are given on the following pages an	
All calibrations have been conduct	ed in the closed laborator	ry facility: environment temperature (22 ± 3)°C	C and humidity < 70%,
Calibration Equipment used (M&TI	E critical for calibration)		
rimary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
	ID # SN: 104778	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292)	Scheduled Calibration Apr-22
ower meter NRP	13500		
ower meter NRP ower sensor NRP-Z91	SN: 104778	09-Apr-21 (No. 217-03291/03292)	Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	SN: 104778 SN: 103244	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	Apr-22 Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 104778 SN: 103244 SN: 103245	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22 Apr-22
ower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 deference 20 dB Attenuator type-N mismatch combination	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22
Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A  Calibrated by:	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 28-Dec-20 (No. EX3-7349_Dec20) 02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-22 In house check: Oct-21

Certificate No: D1750V2-1183\_Jul21

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
Servizio svizzero di taratura
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 N/A sensitivity in TSL / NORM x,y,z

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%.

Certificate No: D1750V2-1183\_Jul21

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#### **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	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	1750 MHz ± 1 MHz	

### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.7 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.09 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.5 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.78 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg ± 16.5 % (k=2)

Certificate No: D1750V2-1183\_Jul21



# Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 Ω - 1.1 jΩ	
Return Loss	- 37.7 dB	

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.210 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 by	SPEAG

Certificate No: D1750V2-1183\_Jul21

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### **DASY5 Validation Report for Head TSL**

Date: 06.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1183

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: f = 1750 MHz;  $\sigma = 1.37 \text{ S/m}$ ;  $\varepsilon_r = 40.7$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.67, 8.67, 8.67) @ 1750 MHz; Calibrated: 28.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.1 V/m; Power Drift = 0.05 dB

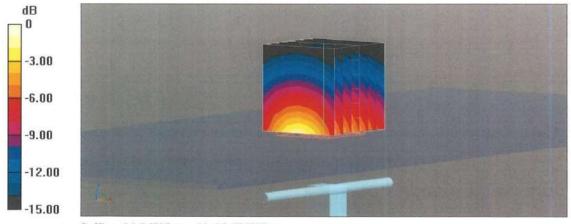
Peak SAR (extrapolated) = 16.9 W/kg

SAR(1 g) = 9.09 W/kg; SAR(10 g) = 4.78 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54.3%

Maximum value of SAR (measured) = 14.0 W/kg



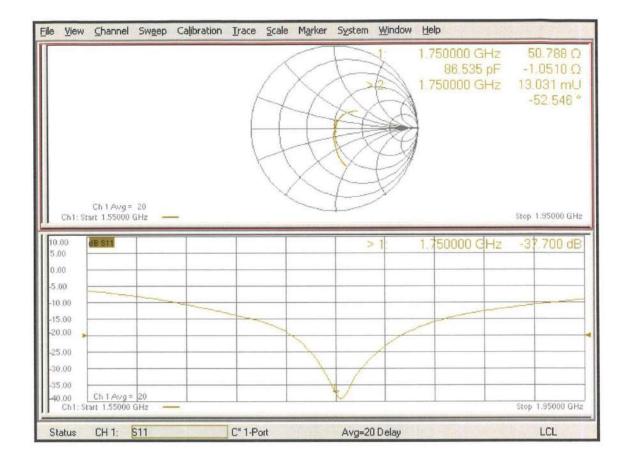
0 dB = 14.0 W/kg = 11.46 dBW/kg

Certificate No: D1750V2-1183\_Jul21

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### Impedance Measurement Plot for Head TSL

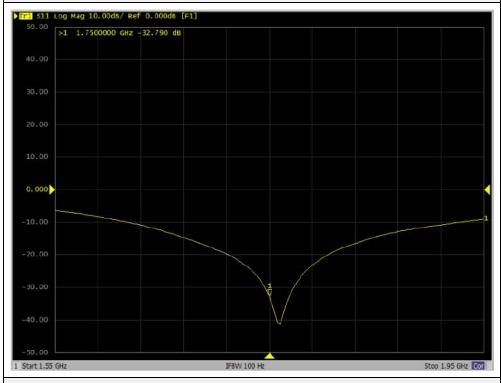




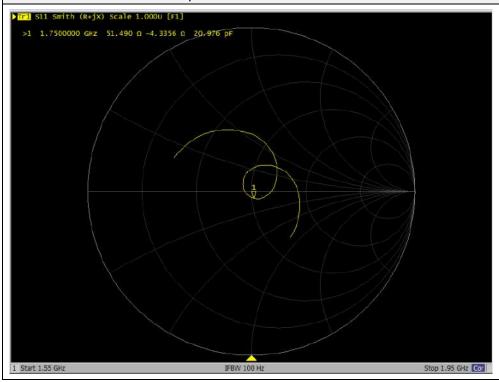
D1750V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.07.04	2022.07.04	1
Return Loss(dB)	-32.790	-34.552	-5.10%
Impedance	51.490Ω - 2.336	49.882Ω - 2.152	-2.184Ω
Impedance	jΩ	jΩ	(Imaginary part)

### Return Loss for Head TSL



Impedance for Head TSL





### F.6 1950 MHz Dipole

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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura 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

Calibration procedure(s)  Calibration date:  Calibration date:  Calibration certificate document the measurements and the uncertainty of the measurement and the uncertainty of the measurement and the uncertainty of the measurement and the uncertainty of the measurements and the uncertainty of the uncer	September 13, 20 ts the traceability to national inties with confidence put in the closed laborator	dure for SAR Validation Sources	sits of measurements (SI).  Indicate and humidity < 70%.  Scheduled Calibration  Apr-22  Apr-22  Apr-22
Calibration date:  This calibration certificate document The measurements and the uncertainal calibrations have been conducted. Calibration Equipment used (M&TE - Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	Calibration Proce  September 13, 20  Is the traceability to nation inties with confidence point in the closed laborator critical for calibration)  ID #  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	O21  onal standards, which realize the physical unrobability are given on the following pages any facility: environment temperature (22 ± 3)°(  Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)	sits of measurements (SI).  Indicate and humidity < 70%.  Scheduled Calibration  Apr-22  Apr-22  Apr-22
This calibration certificate document The measurements and the uncertai All calibrations have been conducted Calibration Equipment used (M&TE- Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ts the traceability to national inties with confidence point of in the closed laborator critical for calibration)  ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	conal standards, which realize the physical unrobability are given on the following pages and facility: environment temperature (22 ± 3)% (22 ± 3)% (23 ± 3)% (24 ± 3)% (24 ± 3)% (25 ± 3)% (25 ± 3)% (26 ± 3)% (27 ± 3)	and are part of the certificate.  C and humidity < 70%.  Scheduled Calibration  Apr-22  Apr-22  Apr-22
The measurements and the uncertain	d in the closed laborator critical for calibration)  ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)	and are part of the certificate.  C and humidity < 70%.  Scheduled Calibration  Apr-22  Apr-22  Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22 Apr-22
Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103244 SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03292)	Apr-22
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: BH9394 (20k)		
Type-N mismatch combination Reference Probe EX3DV4 DAE4		00 Apr 24 (No. 247-02242)	1
Reference Probe EX3DV4 DAE4	SN: 310982 / 06327	08-Apr-21 (140. 217-03343)	Apr-22
DAE4	ST. GIOGGE TOGGET	09-Apr-21 (No. 217-03344)	Apr-22
	SN: 7349	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
Secondary Standards	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
	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: MY41092317	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-21
	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	dell
Approved by:	Katja Pokovic	Technical Manager	ares

Certificate No: D1950V3-1240\_Sep21

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Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Service suisse d'étalonnage
Servizio svizzero di taratura
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%.

Certificate No: D1950V3-1240\_Sep21

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# Measurement Conditions DASY system configuration, as

ASY system configuration, as far as not i	given on page 1.	
DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	1950 MHz ± 1 MHz	

### Head TSL parameters

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.9 ± 6 %	1.44 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	Mark .	

### SAR result with Head TSL

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.5 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	41.4 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.4 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	$47.2 \Omega + 3.6 j\Omega$	
Return Loss	- 26.5 dB	

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.194 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 by	SPEAG

Certificate No: D1950V3-1240\_Sep21

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#### **DASY5 Validation Report for Head TSL**

Date: 13.09.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN:1240

Communication System: UID 0 - CW; Frequency: 1950 MHz

Medium parameters used: f = 1950 MHz;  $\sigma = 1.44 \text{ S/m}$ ;  $\varepsilon_r = 39.9$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(8.41, 8.41, 8.41) @ 1950 MHz; Calibrated: 28.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 111.5 V/m; Power Drift = 0.03 dB

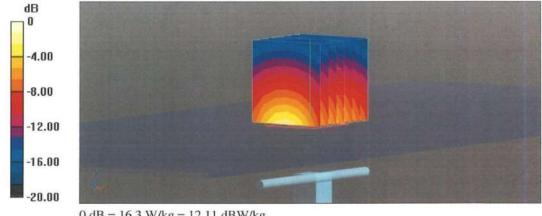
Peak SAR (extrapolated) = 19.4 W/kg

SAR(1 g) = 10.5 W/kg; SAR(10 g) = 5.40 W/kg

Smallest distance from peaks to all points 3 dB below = 10 mm

Ratio of SAR at M2 to SAR at M1 = 54.4%

Maximum value of SAR (measured) = 16.3 W/kg



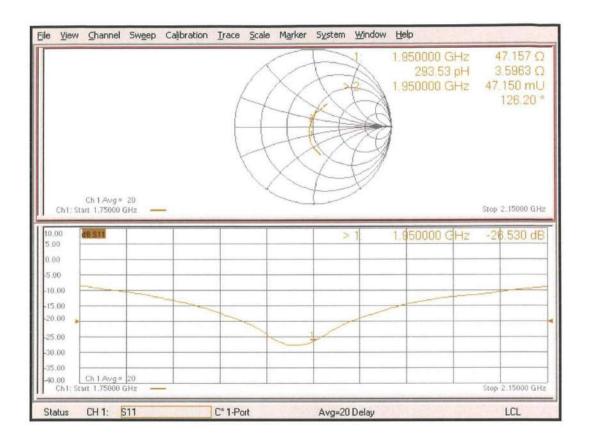
0 dB = 16.3 W/kg = 12.11 dBW/kg

Certificate No: D1950V3-1240\_Sep21

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### Impedance Measurement Plot for Head TSL





### Appendix: Transfer Calibration at Four Validation Locations on SAM Head1

#### **Evaluation Condition**

Phantam	SAM Head Phantom	For usage with cSAR3DV2-R/L
Phantom	SAM Flead Friantom	Tor dodge with cornilob value

### SAR result with SAM Head (Top ≅ C0)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	43.3 W/kg ± 17.5 % (k=2)
The second secon		
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

### SAR result with SAM Head (Mouth ≅ F90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	44.1 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

### SAR result with SAM Head (Neck $\cong$ H0)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	42.6 W/kg ± 17.5 % (k=2)
SAH for nominal Head TSL parameters	normalized to 1 vv	42.6 W/Kg ± 17.5 % (K=
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR averaged over 10 cm³ (10 g) of Head TSL condition SAR for nominal Head TSL parameters normalized to 1W 22.2 W/kg ± 16.9 % (k=2)

### SAR result with SAM Head (Ear ≅ D90)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	31.1 W/kg ± 17.5 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

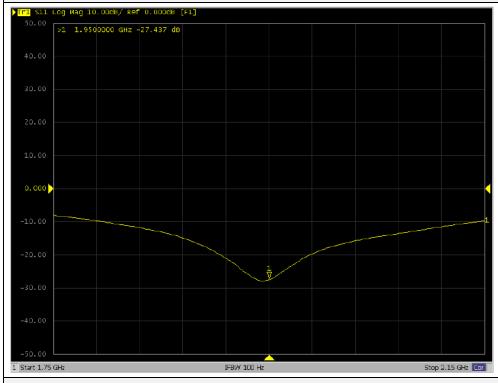
<sup>&</sup>lt;sup>1</sup> Additional assessments outside the current scope of SCS 0108



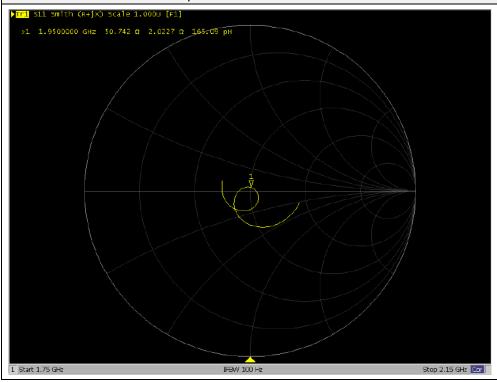
### D1950V3 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.09.11	2022.09.12	1
Return Loss(dB)	-27.437	-24.483	16.84%
Impedance	50.742 Ω + 2.023	49.381 Ω + 3.781	-1.758Ω
Impedance	jΩ	jΩ	(Imaginary part)

### Return Loss for Head TSL



Impedance for Head TSL





### F.7 2450 MHz Dipole

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





C

Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura 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

Balun (Auden)

Certificate No: D2450V2-1062\_Jul21

### **CALIBRATION CERTIFICATE**

Object

D2450V2 - SN:1062

Calibration procedure(s)

QA CAL-05.v11

Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date:

July 05, 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  $(22 \pm 3)^{\circ}$ 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	28-Dec-20 (No. EX3-7349_Dec20)	Dec-21
DAE4	SN: 601	02-Nov-20 (No. DAE4-601_Nov20)	Nov-21
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: MY41092317	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-21
	Name	Function	Signature
Calibrated by:	Jeffrey Katzman	Laboratory Technician	d. http
Approved by:	Katja Pokovic	Technical Manager	eller

Issued: July 6, 2021

Certificate No: D2450V2-1062\_Jul21

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



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





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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 not applicable or not measured

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%.

Certificate No: D2450V2-1062\_Jul21

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### **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	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	
Frequency	2450 MHz ± 1 MHz	

### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.87 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.9 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	54.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.2 W/kg ± 16.5 % (k=2)

Certificate No: D2450V2-1062\_Jul21



### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.5 \Omega + 4.6 j\Omega$	
Return Loss	- 26.4 dB	

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.150 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 by	SPEAG

Certificate No: D2450V2-1062\_Jul21

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### **DASY5 Validation Report for Head TSL**

Date: 05.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:1062

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used: f = 2450 MHz;  $\sigma = 1.87 \text{ S/m}$ ;  $\varepsilon_r = 37.7$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 28.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 119.4 V/m; Power Drift = 0.02 dB

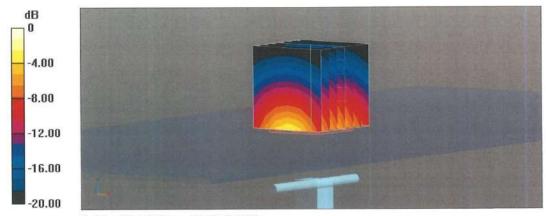
Peak SAR (extrapolated) = 27.8 W/kg

SAR(1 g) = 13.9 W/kg; SAR(10 g) = 6.41 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 50.1%

Maximum value of SAR (measured) = 23.1 W/kg



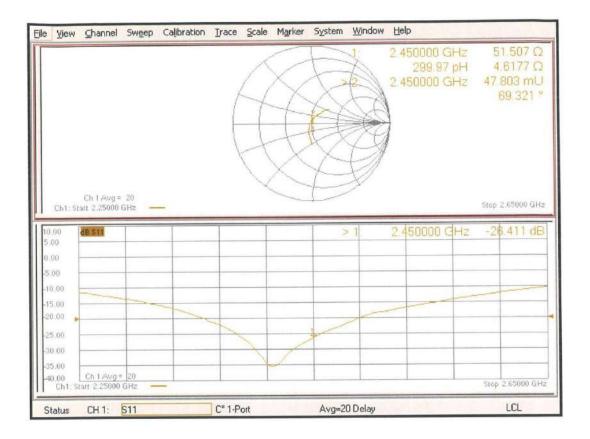
0 dB = 23.1 W/kg = 13.64 dBW/kg

Certificate No: D2450V2-1062\_Jul21

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### Impedance Measurement Plot for Head TSL

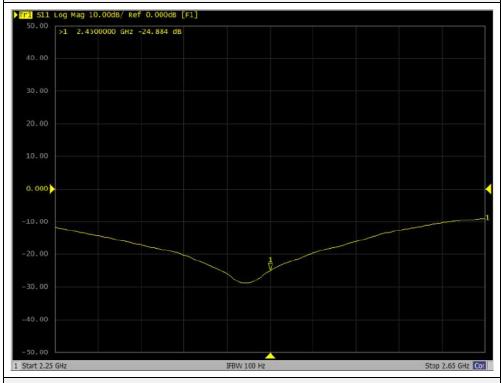




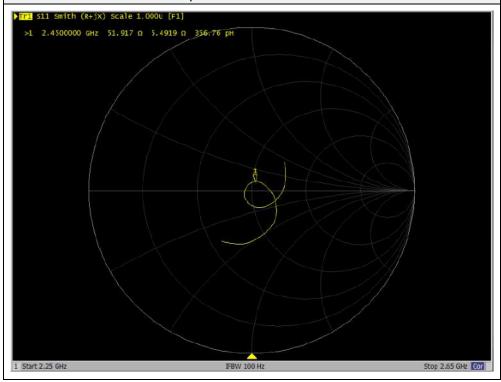
D2450V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.07.04	2022.07.04	1
Return Loss(dB)	-24.884	-25.242	-1.42%
Impedance	51.917 Ω +5.492	51.458 Ω +4.235	1.257Ω
Impedance	jΩ	jΩ	(Imaginary part)

### Return Loss for Head TSL



### Impedance for Head TSL





### F.8 2600 MHz Dipole

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





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Accreditation No.: SCS 0108

CALIBRATION C	ERTIFICATI		
Object	D2600V2 - SN:1	184	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	July 05, 2021		
The measurements and the uncert	lainties with confidence p	ional standards, which realize the physical un probability are given on the following pages are ry facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate.
		y rasiny. Environment temperature (22 ± 3) t	c and number < 70%.
Calibration Equipment used (M&TE			
Calibration Equipment used (M&TE Primary Standards Power meter NRP	E critical for calibration)	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)	Scheduled Calibration  Apr-22
rimary Standards ower meter NRP ower sensor NRP-Z91	E critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
calibration Equipment used (M&TE rimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91	ID # SN: 104778	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292)	Scheduled Calibration Apr-22
calibration Equipment used (M&TE rimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 leference 20 dB Attenuator	ID # SN: 104778 SN: 103244	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	Scheduled Calibration Apr-22 Apr-22
Calibration Equipment used (M&TE Primary Standards Cower meter NRP Cower sensor NRP-Z91 Cower sensor NRP-Z91 Deference 20 dB Attenuator Type-N mismatch combination	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)	Scheduled Calibration Apr-22 Apr-22 Apr-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Reference Probe EX3DV4	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)	Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22
Calibration Equipment used (M&TE Primary Standards Cower meter NRP Cower sensor NRP-Z91 Cower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21
calibration Equipment used (M&TE  rimary Standards  rower meter NRP  rower sensor NRP-Z91  rower sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21
Calibration Equipment used (M&TE Primary Standards Cower meter NRP Cower sensor NRP-Z91 Cower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Cower meter E4419B Cower sensor HP 8481A Cower sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Cower meter NRP Cower sensor NRP-Z91 Cower sensor NRP-Z91 Coeference 20 dB Attenuator Coppe-N mismatch combination Coeference Probe EX3DV4 COMERCIAN STANDARD COWER METERS COWER METERS COWER METERS COWER METERS COWER SENSOR HP 8481A COW	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Ref generator R&S SMT-06	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Reference R&S SMT-06 Reference R&S SMT-06 Reference Analyzer Agilent E8358A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)  15-Jun-15 (in house check Oct-20)  31-Mar-14 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Cower meter NRP Cower sensor NRP-Z91 Cower sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 PAE4 Recondary Standards Tower meter E4419B Tower sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)  15-Jun-15 (in house check Oct-20)  31-Mar-14 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Ref generator R&S SMT-06	ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601  ID #  SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477  Name	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  28-Dec-20 (No. EX3-7349_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)  15-Jun-15 (in house check Oct-20)  31-Mar-14 (in house check Oct-20)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Dec-21  Nov-21  Scheduled Check  In house check: Oct-22  In house check: Oct-22

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### Calibration Laboratory of

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





S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
Servizio svizzero di taratura
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%.

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### **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	10 mm	with Spacer
Zoom Scan Resolution	dx, $dy$ , $dz = 5 mm$	•
Frequency	2600 MHz ± 1 MHz	

### **Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.0	1.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.1 ± 6 %	2.03 mho/m ± 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	14.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	57.2 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.49 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	25.5 W/kg ± 16.5 % (k=2)

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# Appendix (Additional assessments outside the scope of SCS 0108)

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$47.5 \Omega + 1.5 j\Omega$
Return Loss	- 30.4 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.144 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 by	
iviariuractured by	SPEAG
	7,55,000

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### **DASY5 Validation Report for Head TSL**

Date: 05.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN:1184

Communication System: UID 0 - CW; Frequency: 2600 MHz

Medium parameters used: f = 2600 MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 37.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(7.84, 7.84, 7.84) @ 2600 MHz; Calibrated: 28.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 120.6 V/m; Power Drift = 0.02 dB

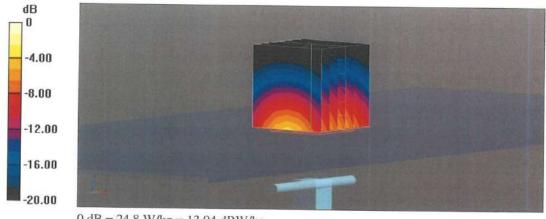
Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 14.7 W/kg; SAR(10 g) = 6.49 W/kg

Smallest distance from peaks to all points 3 dB below = 9 mm

Ratio of SAR at M2 to SAR at M1 = 49.3%

Maximum value of SAR (measured) = 24.8 W/kg

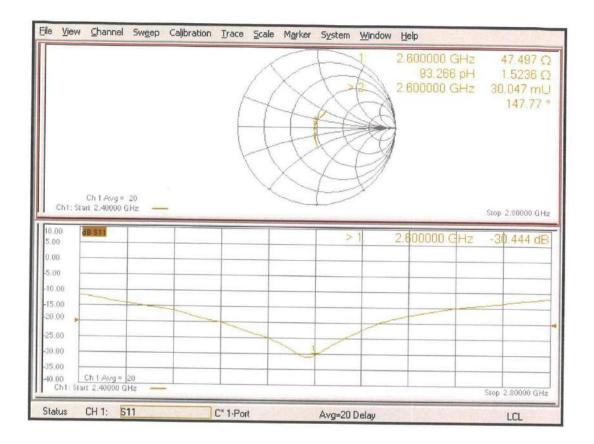


0 dB = 24.8 W/kg = 13.94 dBW/kg

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## Impedance Measurement Plot for Head TSL

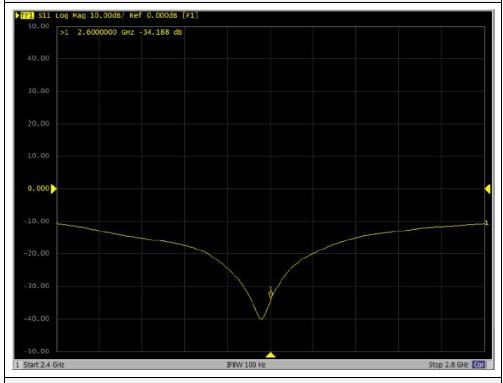




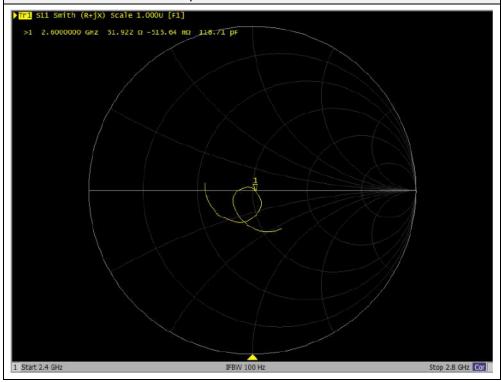
D2600V2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.07.04	2022.07.04	1
Return Loss(dB)	-34.188	-32.253	6.00%
Impodonos	51.922 Ω - 0.516	49.562 Ω + 1.023	2.360Ω
Impedance	jΩ	jΩ	(Real part)

### Return Loss for Head TSL



### Impedance for Head TSL





### F.9 5GHz Dipole

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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage C Servizio svizzero di taratura 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

ient Balun (Auden)		Certificate No	o: D5GHzV2-1333_Sep21
CALIBRATION C	ERTIFICATE		
Dbject	D5GHzV2 - SN:1	333	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	edure for SAR Validation Sources	s between 3-10 GHz
Calibration date:	September 14, 20	021	
The measurements and the unce		ry facility: environment temperature (22 $\pm$ 3)°	
All calibrations have been conductable calibration Equipment used (M&T	ted in the closed laborator	ry facility: environment temperature (22 $\pm$ 3)°	
All calibrations have been conducted to the conducted to the calibration Equipment used (M&T) rimary Standards	ted in the closed laborator		C and humidity < 70%.
All calibrations have been conducted. Calibration Equipment used (M&Terimary Standards Power meter NRP	ted in the closed laborator E critical for calibration)	ry facility: environment temperature ( $22 \pm 3$ )° Cal Date (Certificate No.)	C and humidity < 70%.  Scheduled Calibration
All calibrations have been conducted.  Calibration Equipment used (M&Terimary Standards  Power meter NRP  Power sensor NRP-Z91	ted in the closed laborator E critical for calibration)  ID # SN: 104778	ry facility: environment temperature (22 ± 3)°(  Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)	C and humidity < 70%.  Scheduled Calibration  Apr-22
All calibrations have been conducted.  Calibration Equipment used (M&T Primary Standards  Power meter NRP  Power sensor NRP-Z91  Power sensor NRP-Z91	ted in the closed laborator E critical for calibration)  ID #  SN: 104778 SN: 103244	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291)	C and humidity < 70%.  Scheduled Calibration  Apr-22  Apr-22
All calibrations have been conducted.  Calibration Equipment used (M&T Primary Standards  Power meter NRP  Power sensor NRP-Z91  Power sensor NRP-Z91  Reference 20 dB Attenuator	ted in the closed laborator E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)	Scheduled Calibration Apr-22 Apr-22 Apr-22
All calibrations have been conducted. Calibration Equipment used (M&Termany Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	ted in the closed laborator E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k)	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22
All calibrations have been conducted.  Calibration Equipment used (M&Text of the conducted	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)	Scheduled Calibration  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22  Apr-22
All calibrations have been conducted.  Calibration Equipment used (M&Text of the conducted	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  30-Dec-20 (No. EX3-3503_Dec20)	Scheduled Calibration  Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21
All calibrations have been conducted.  Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  30-Dec-20 (No. EX3-3503_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)	Scheduled Calibration  Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21
All calibrations have been conducted. Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601  ID #	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  30-Dec-20 (No. EX3-3503_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)	Scheduled Calibration  Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check
	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601  ID #  SN: GB39512475	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  30-Dec-20 (No. EX3-3503_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)	Scheduled Calibration  Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22
All calibrations have been conductor Calibration Equipment used (M&T Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A	ted in the closed laborator  E critical for calibration)  ID #  SN: 104778  SN: 103244  SN: 103245  SN: BH9394 (20k)  SN: 310982 / 06327  SN: 3503  SN: 601  ID #  SN: GB39512475  SN: US37292783	Cal Date (Certificate No.)  09-Apr-21 (No. 217-03291/03292)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03291)  09-Apr-21 (No. 217-03292)  09-Apr-21 (No. 217-03343)  09-Apr-21 (No. 217-03344)  30-Dec-20 (No. EX3-3503_Dec20)  02-Nov-20 (No. DAE4-601_Nov20)  Check Date (in house)  30-Oct-14 (in house check Oct-20)  07-Oct-15 (in house check Oct-20)	Scheduled Calibration  Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21  Scheduled Check In house check: Oct-22 In house check: Oct-22

Approved by: Katja Pokovic Technical Manager

Issued: September 14, 2021

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

Name

Jeffrey Katzman

Certificate No: D5GHzV2-1333\_Sep21

Calibrated by:

Function

Laboratory Technician



Calibration Laboratory of Schmid & Partner

**Engineering AG** Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst 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

#### Glossary:

TSL

tissue simulating liquid

ConvF N/A

sensitivity in TSL / NORM x,y,z 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
- 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%.

Certificate No: D5GHzV2-1333\_Sep21

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#### **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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0  mm, dz = 1.4  mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5800 MHz ± 1 MHz	

### Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.8 ± 6 %	4.47 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	(****	

### SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.08 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	80.1 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.7 W/kg ± 19.5 % (k=2)

### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	5.06 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	and the second	

#### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.3 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1333\_Sep21



#### Appendix (Additional assessments outside the scope of SCS 0108)

#### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$50.0~\Omega$ - $6.3~j\Omega$	
Return Loss	- 24.1 dB	

#### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.8 Ω + 1.4 jΩ
Return Loss	- 30.4 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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 by	SPEAG

Certificate No: D5GHzV2-1333\_Sep21 Page 4 of 9

Report No.: BL-SZ2460066-AC



### **DASY5 Validation Report for Head TSL**

Date: 14.09.2021

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1333

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5800 MHz Medium parameters used: f = 5200 MHz;  $\sigma$  = 4.47 S/m;  $\epsilon_r$  = 34.8;  $\rho$  = 1000 kg/m³ , Medium parameters used: f = 5800 MHz;  $\sigma$  = 5.06 S/m;  $\epsilon_r$  = 34.0;  $\rho$  = 1000 kg/m³

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN3503; ConvF(5.8, 5.8, 5.8) @ 5200 MHz, ConvF(5.01, 5.01, 5.01) @ 5800 MHz; Calibrated: 30.12.2020

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 02.11.2020

Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001

DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

#### Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 77.82 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 28.9 W/kg

SAR(1 g) = 8.08 W/kg; SAR(10 g) = 2.29 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 69.2%

Maximum value of SAR (measured) = 18.8 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 77.05 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 33.3 W/kg

SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.34 W/kg

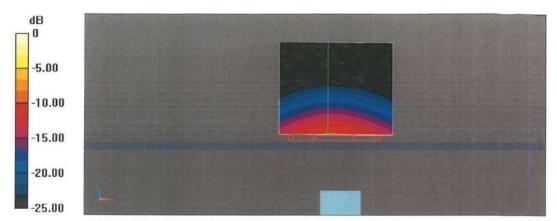
Smallest distance from peaks to all points 3 dB below = 7.4 mm

Ratio of SAR at M2 to SAR at M1 = 65.4%

Maximum value of SAR (measured) = 20.3 W/kg

Certificate No: D5GHzV2-1333\_Sep21 Page 5 of 9

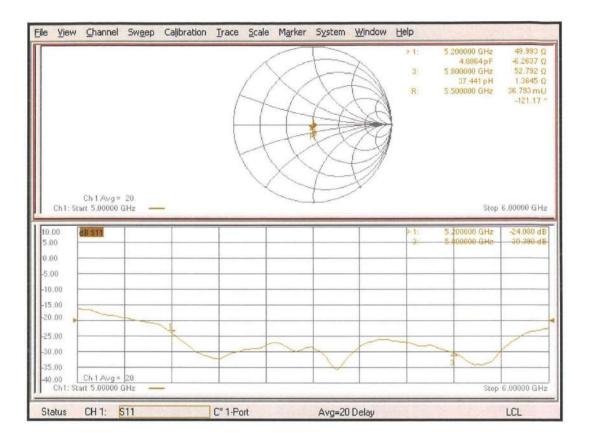




0 dB = 20.3 W/kg = 13.07 dBW/kg



# Impedance Measurement Plot for Head TSL



Certificate No: D5GHzV2-1333\_Sep21 Page 7 of 9



# Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>1</sup>

# Evaluation Conditions (f=5200 MHz)

Phantom SAM Head Phantom For usage with cSAR3DV2-R/L
--

# SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	84.8 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	88.7 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	84.7 W/kg ± 20.3 % (k=2)
	SEASON SOUNDAY CONNECTION BOOM TONE OF PROPERTY.	
SAR averaged over 10 cm3 (10 g) of Head TSL	condition	

normalized to 1W

23.9 W/kg ± 19.9 % (k=2)

# SAR result with SAM Head (Ear)

SAR for nominal Head TSL parameters

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	54.0 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

Certificate No: D5GHzV2-1333\_Sep21

<sup>&</sup>lt;sup>1</sup> Additional assessments outside the current scope of SCS 0108



Appendix: Transfer Calibration at Four Validation Locations on SAM Head<sup>2</sup>

# Evaluation Conditions (f=5800 MHz)

Phantom	SAM Head Phantom	For usage with cSAR3DV2-R/L

## SAR result with SAM Head (Top)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	85.6 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Mouth)

SAR averaged over 1 cm3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	92.5 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

# SAR result with SAM Head (Neck)

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W/kg ± 20.3 % (k=2)

normalized to 1W

23.0 W/kg  $\pm$  19.9 % (k=2)

## SAR result with SAM Head (Ear)

SAR for nominal Head TSL parameters

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	normalized to 1W	58.8 W/kg ± 20.3 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

Certificate No: D5GHzV2-1333\_Sep21

 $<sup>^{2}</sup>$  Additional assessments outside the current scope of SCS 0108  $\,$ 

Report No.: BL-SZ2460066-AC



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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura **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

	ERTIFICAT		
Object	D5GHzV2 - SN:	1333	
Calibration procedure(s)	QA CAL-22.v6 Calibration Proce	edure for SAR Validation Sources	s between 3-10 GHz
Calibration date:	March 07, 2022		
This calibration certificate docume	nts the traceability to nati	onal standards, which realize the physical un robability are given on the following pages an	its of measurements (SI).
All calibrations have been conduct	ed in the closed laborator	ry facility: environment temperature (22 ± 3)°0	C and humidity < 70%.
Calibration Equipment used (M&TI	E 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
	SN: 103244	09-Apr-21 (No. 217-03291)	Apr-22
ower sensor NRP-Z91	1 SIV. 103244		
	SN: 103244 SN: 103245		
Power sensor NRP-Z91	0.000	09-Apr-21 (No. 217-03292)	Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator	SN: 103245	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343)	Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	SN: 103245 SN: BH9394 (20k)	09-Apr-21 (No. 217-03292)	Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344)	Apr-22 Apr-22 Apr-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21)	Apr-22 Apr-22 Apr-22 Dec-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21) Check Date (in house)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21) Check Date (in house) 30-Oct-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A RF generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 In house check: Oct-22 In house check: Oct-22
Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 Signature
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22
Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 3503 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41093315 SN: 100972 SN: US41080477 Name	09-Apr-21 (No. 217-03292) 09-Apr-21 (No. 217-03343) 09-Apr-21 (No. 217-03344) 31-Dec-21 (No. EX3-3503_Dec21) 01-Nov-21 (No. DAE4-601_Nov21)  Check Date (in house) 30-Oct-14 (in house check Oct-20) 07-Oct-15 (in house check Oct-20) 15-Jun-15 (in house check Oct-20) 31-Mar-14 (in house check Oct-20)	Apr-22 Apr-22 Apr-22 Dec-22 Nov-22 Scheduled Check In house check: Oct-22 Signature

Certificate No: D5GHzV2-1333\_Mar22

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# Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





Schweizerischer Kalibrierdienst Service suisse d'étalonnage Servizio svizzero di taratura 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 N/A

sensitivity in TSL / NORM x,y,z 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%.

Certificate No: D5GHzV2-1333\_Mar22

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#### **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 V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction
Frequency	5300 MHz ± 1 MHz 5500 MHz ± 1 MHz 5600 MHz ± 1 MHz	

## Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.0 ± 6 %	4.60 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

## SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.4 W/kg ± 19.5 % (k=2)

# Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.7 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	86.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	24.4 W/kg ± 19.5 % (k=2)

Certificate No: D5GHzV2-1333\_Mar22



# Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.5 ± 6 %	4.90 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

# SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.43 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)



# Appendix (Additional assessments outside the scope of SCS 0108)

# Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$47.3 \Omega - 2.0 j\Omega$	
Return Loss	- 29.1 dB	

# Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	48.0 Ω - 2.7 jΩ	
Return Loss	- 29.3 dB	

#### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.4 Ω - 1.1 jΩ	
Return Loss	- 29.1 dB	

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.195 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	

Certificate No: D5GHzV2-1333\_Mar22

Report No.: BL-SZ2460066-AC



## **DASY5 Validation Report for Head TSL**

Date: 07.03.2022

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1333

Communication System: UID 0 - CW; Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600

MHz

Medium parameters used: f=5300 MHz;  $\sigma=4.6$  S/m;  $\epsilon r=35;$   $\rho=1000$  kg/m³ , Medium parameters used: f=5500 MHz;  $\sigma=4.8$  S/m;  $\epsilon r=34.7;$   $\rho=1000$  kg/m³ , Medium parameters used: f=5600 MHz;  $\sigma=4.9$  S/m;  $\epsilon r=34.5;$   $\rho=1000$  kg/m³ .

Phantom section: Flat Section

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

#### DASY52 Configuration:

- Probe: EX3DV4 SN3503; ConvF(5.49, 5.49, 5.49) @ 5300 MHz, ConvF(5.25, 5.25, 5.25) @ 5500 MHz, ConvF(5.1, 5.1, 5.1) @ 5600 MHz; Calibrated: 31.12.2021
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 01.11.2021
- Phantom: Flat Phantom 5.0 (front); Type: QD 000 P50 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 78.45 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 28.3 W/kg

SAR(1 g) = 8.23 W/kg; SAR(10 g) = 2.36 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 70.1%

Maximum value of SAR (measured) = 18.3 W/kg

# Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 79.41 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 32.7 W/kg

SAR(1 g) = 8.71 W/kg; SAR(10 g) = 2.46 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 67.4%

Maximum value of SAR (measured) = 20.0 W/kg

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Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan,

dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 79.18 V/m; Power Drift = -0.03 dB

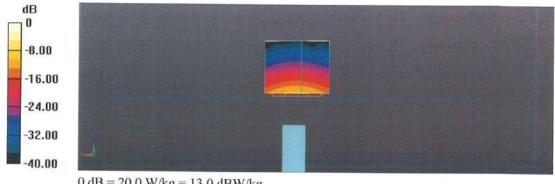
Peak SAR (extrapolated) = 30.5 W/kg

SAR(1 g) = 8.43 W/kg; SAR(10 g) = 2.40 W/kg

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

Ratio of SAR at M2 to SAR at M1 = 68.5%

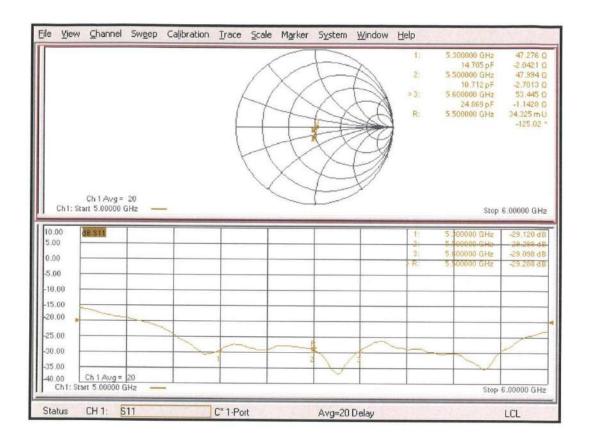
Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 20.0 W/kg = 13.0 dBW/kg



## Impedance Measurement Plot for Head TSL

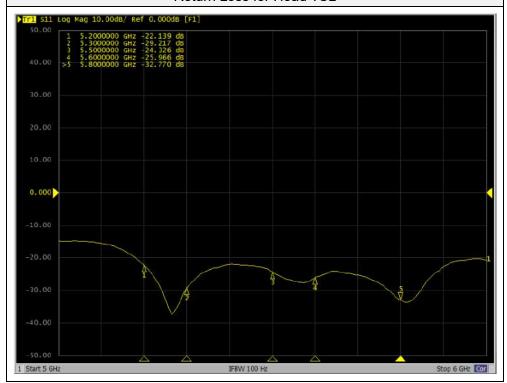




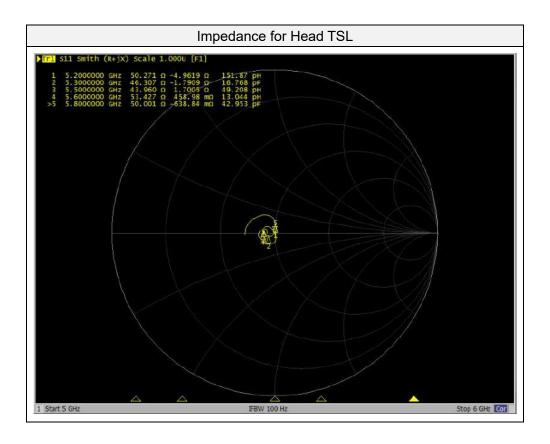
D5GHzV2 Dipole impedance and return loss Validation

Meas. Results	Current Meas.	Previous Meas.	Max. Deviation
Meas. Data	2023.09.13	2029.09.13	1
5.2GHz Return Loss(dB)	-22.139	-22.856	-3.14%
5.2GHz	50.271 Ω -4.962	50.025 Ω -5.023	0.245Ω
Impedance	jΩ	jΩ	(Real part)
5.3GHz Return Loss(dB)	-29.217	-29.235	-0.06%
5.3GHz	$46.307\Omega$ -1.791	45.658Ω -0.596	-1.195Ω
Impedance	jΩ	jΩ	(Imaginary part)
5.5GHz Return Loss(dB)	-24.326	-25.888	-6.03%
5.5GHz	43.960Ω	45.325Ω	-1.365Ω
Impedance	+1.701jΩ	+0.358jΩ	(Real part)
5.6GHz Return Loss(dB)	-25.966	-26.856	-3.31%
5.6GHz	53.427Ω	53.253Ω	0.335Ω
Impedance	+0.459jΩ	+0.124jΩ	(Imaginary part)
5.8GHz Return Loss(dB)	-32.770	-31.256	4.84%
5.8GHz	50.001Ω -0.639	51.085Ω -0.553	-1.084Ω
Impedance	jΩ	jΩ	(Real part)

# Return Loss for Head TSL







--END OF REPORT--