



# ANNEX H Dipole Calibration Certificate





#### 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

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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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.4 ± 6 %	0.91 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	2.20 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.68 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	1.43 W/kg

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### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω - 0.2 jΩ	
Return Loss	- 28.8 dB	

#### **General Antenna Parameters and Design**

Electrical Delay (one direction)	1.036 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

#### **Additional EUT Data**

Manufactured by	SPEAG

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

Date: 12.07.2021

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1017

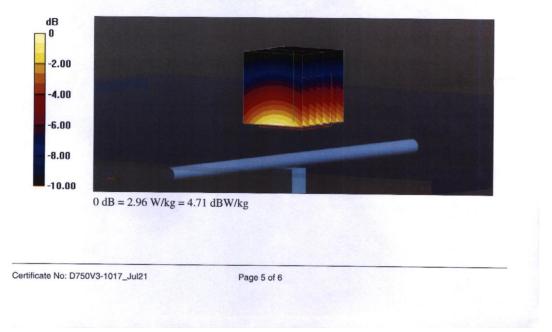
Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma = 0.91$  S/m;  $\varepsilon_r = 42.4$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.11, 10.11, 10.11) @ 750 MHz; Calibrated: 28.12.2020
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.11.2020
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 60.01 V/m; Power Drift = -0.01 dB Peak SAR (extrapolated) = 3.39 W/kg SAR(1 g) = 2.20 W/kg; SAR(10 g) = 1.43 W/kg Smallest distance from peaks to all points 3 dB below = 16 mm Ratio of SAR at M2 to SAR at M1 = 64.8% Maximum value of SAR (measured) = 2.96 W/kg







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### Impedance Measurement Plot for Head TSL

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ient CTTL (Auden)		Certificate No:	: D835V2-4d069_Jul21
CALIBRATION CE	RTIFICATE		
Dbject	D835V2 - SN:4d0	69	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	between 0.7-3 GHz
Calibration date:	July 12, 2021		
All calibrations have been conducte	ed in the closed laborator	robability are given on the following pages ar y facility: environment temperature (22 $\pm$ 3)%	
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### Calibration Laboratory of Schmid & Partner

Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



Schweizerischer Kalibrierdienst S С S

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

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- 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	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.94 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	2.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.63 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	1.60 W/kg

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### Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.7 Ω - 2.3 jΩ
Return Loss	- 31.0 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.393 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**

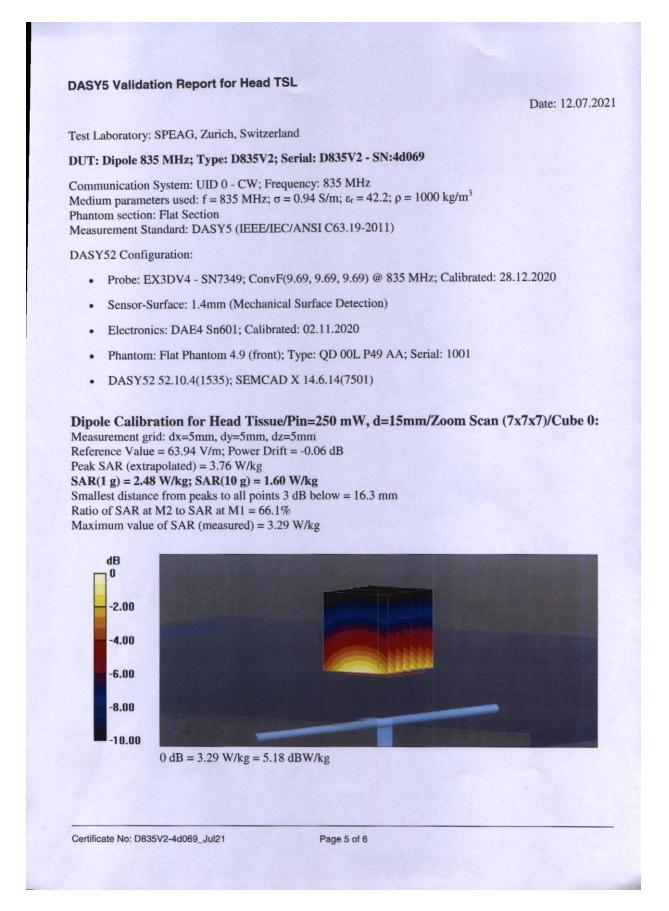
Manufactured by	SPEAG

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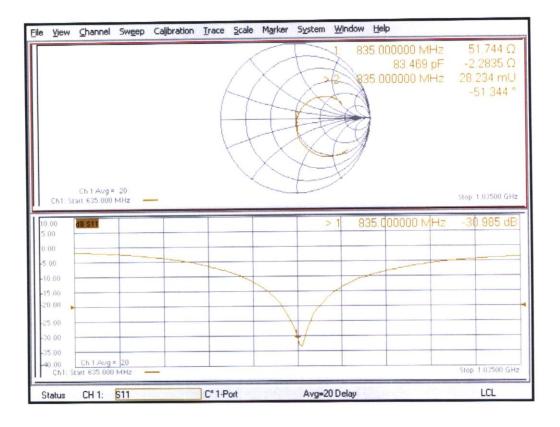








## Impedance Measurement Plot for Head TSL



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chmid & Partner Engineering AG ughausstrasse 43, 8004 Zurich,	7 Of Switzerland	S S S S S S S S S S S S S S S S S S S	Service suisse d'étalonnage Servizio svizzero di taratura
ccredited by the Swiss Accreditation Service	is one of the signatorie	es to the EA	ccreditation No.: SCS 0108
luitilateral Agreement for the red	cognition of calibration		o: D1750V2-1003_Jul21
CALIBRATION C	ERTIFICATE		
Object	D1750V2 - SN:10	003	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	July 12, 2021		
All calibrations have been conduct		ry facility: environment temperature (22 $\pm$ 3)°	nd are part of the certificate. C and humidity < 70%.
Calibration Equipment used (M&TE Primary Standards	E critical for calibration)	Cal Date (Certificate No.)	C and humidity < 70%. Scheduled Calibration
alibration Equipment used (M&TE rimary Standards ower meter NRP	E critical for calibration)	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292)	C and humidity < 70%. Scheduled Calibration Apr-22
alibration Equipment used (M&TE rimary Standards ower meter NRP ower sensor NRP-Z91	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
Calibration Equipment used (M&TE trimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91	E critical for calibration)	Cal Date (Certificate No.) 09-Apr-21 (No. 217-03291/03292) 09-Apr-21 (No. 217-03291) 09-Apr-21 (No. 217-03292)	C and humidity < 70%. 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	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)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Vower sensor NRP-Z91 leference 20 dB Attenuator Vpe-N mismatch combination Reference Probe EX3DV4	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. 217-03343)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22
alibration Equipment used (M&TE frimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 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)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Apr-22
Calibration Equipment used (M&TE trimary Standards lower meter NRP lower sensor NRP-Z91 lower sensor NRP-Z91 leference 20 dB Attenuator ype-N mismatch combination leference Probe EX3DV4 IAE4	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH3394 (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)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21
Calibration Equipment used (M&TE Primary Standards Vower meter NRP Vower sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Vype-N mismatch combination Reference Probe EX3DV4 VAE4 Recondary Standards	Critical for calibration)	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)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check
Calibration Equipment used (M&TE Primary Standards Nower meter NRP Nower sensor NRP-Z91 Nower sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4 VAE4 Recondary Standards Nower meter E4419B	E critical for calibration) 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)	C and humidity < 70%. 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 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	E critical for calibration) 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)           30-Oct-14 (in house check Oct-20)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check
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 AAE4 Recondary Standards Power meter E4419B Power sensor HP 8481A Regenerator R&S SMT-06	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 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. 217-03292)           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)	C and humidity < 70%. 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 Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: 8H9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: 6B39512475 SN: US37292783 SN: WY41092317	Cal Date (Certificate No.)           09-Apr-21 (No. 217-03291/03292)           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)	C and humidity < 70%. 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 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 Power sensor Probe EX3DV4 Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A Power sensor HP 8481A Ref generator R&S SMT-06 letwork Analyzer Agilent E8358A	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: US31080477 Name	Cal Date (Certificate No.)           09-Apr-21 (No. 217-03291/03292)           09-Apr-21 (No. 217-03291)           09-Apr-21 (No. 217-03343)           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)	C and humidity < 70%. Scheduled Calibration 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 Nower meter NRP Nower sensor NRP-Z91 Rower sensor NRP-Z91 Reference 20 dB Attenuator ype-N mismatch combination Reference Probe EX3DV4 VAE4 Recondary Standards Nower meter E4419B Nower meter E4419B Nower sensor HP 8481A Rower sensor HP 8481A F generator R&S SMT-06 letwork Analyzer Agilent E8358A	Critical for calibration) 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)	C and humidity < 70%. Scheduled Calibration 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 Signature
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 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 Regenerator R&S SMT-06 Retwork Analyzer Agilent E8358A Calibrated by:	Critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH3394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeffrey Katzman	Cal Date (Certificate No.)           09-Apr-21 (No. 217-03291/03292)           09-Apr-21 (No. 217-03291)           09-Apr-21 (No. 217-03343)           09-Apr-21 (No. 217-03344)           28-Dec-20 (No. EX3-7349_Dec20)           02-Nov-20 (No. DEX3-7349_Dec20)           02-Nov-20 (No. DEX4-601_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)           Summaria           Check Date (in house check Oct-20)           31-Mar-14 (in house check Oct-20)	C and humidity < 70%. Scheduled Calibration 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 Signature
Calibration Equipment used (M&TE Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Fype-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by:	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: US31080477 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)           07-Oct-15 (in house check Oct-20)           15-Jun-15 (in house check Oct-20)           31-Mar-14 (in house check Oct-20)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-21
	Critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH3394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name Jeffrey Katzman	Cal Date (Certificate No.)           09-Apr-21 (No. 217-03291/03292)           09-Apr-21 (No. 217-03291)           09-Apr-21 (No. 217-03343)           09-Apr-21 (No. 217-03344)           28-Dec-20 (No. EX3-7349_Dec20)           02-Nov-20 (No. DEX3-7349_Dec20)           02-Nov-20 (No. DEX4-601_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)           Summaria           Check Date (in house check Oct-20)           31-Mar-14 (in house check Oct-20)	C and humidity < 70%. 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 In house check: Oct-22 In house check: Oct-21 Signature MMMM
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 RF generator R&S SMT-06 Network Analyzer Agilent E8358A Calibrated by: Approved by:	E critical for calibration) ID # SN: 104778 SN: 103244 SN: 103245 SN: BH9394 (20k) SN: 310982 / 06327 SN: 7349 SN: 601 ID # SN: GB39512475 SN: US37292783 SN: WY41092317 SN: US37292783 SN: WY41092317 SN: US37092783 SN: US41080477 Name Jeffrey Katzman Katja Pokovic	Cal Date (Certificate No.)           09-Apr-21 (No. 217-03291/03292)           09-Apr-21 (No. 217-03291)           09-Apr-21 (No. 217-03343)           09-Apr-21 (No. 217-03344)           28-Dec-20 (No. EX3-7349_Dec20)           02-Nov-20 (No. DEX3-7349_Dec20)           02-Nov-20 (No. DEX4-601_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)           Summaria           Check Date (in house check Oct-20)           31-Mar-14 (in house check Oct-20)	C and humidity < 70%. Scheduled Calibration Apr-22 Apr-22 Apr-22 Apr-22 Dec-21 Nov-21 Scheduled Check In house check: Oct-22 In house check: Oct-21 Signature MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM





### 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

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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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19.4 W/kg ± 16.5 % (k=2)

### **Measurement Conditions**

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

	D.101/20	1150 10 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	40.4 ± 6 %	1.36 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR for nominal Head TSL parameters

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.9 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm3 (10 c) of Hood TSI	appdition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	

normalized to 1W

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#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.7 Ω + 0.3 jΩ
Return Loss	- 47.0 dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.215 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
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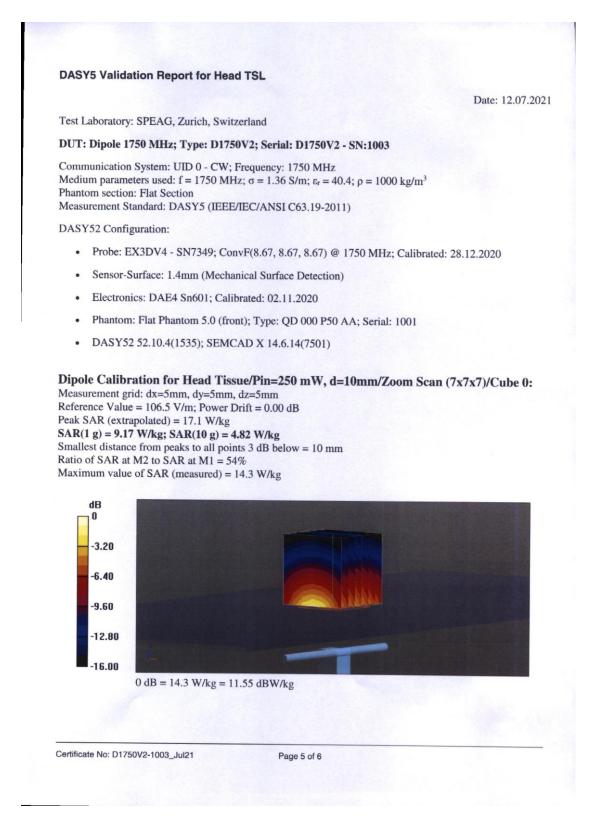
Certificate No: D1750V2-1003\_Jul21

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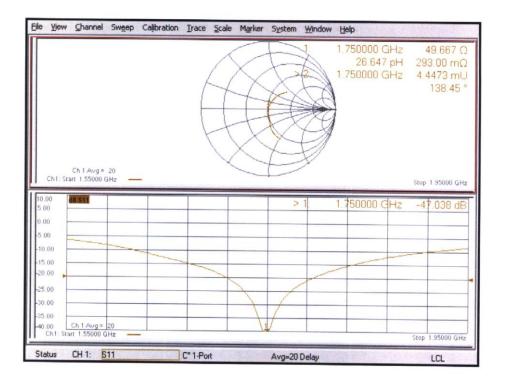








### Impedance Measurement Plot for Head TSL



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Schmid & Partner Engineering AG eughausstrasse 43, 8004 Zurich,	Of Switzerland	S S S S S S S S S S S S S S S S S S S	Schweizerischer Kalibrierdien Service suisse d'étalonnage Servizio svizzero di taratura Swiss Calibration Service
Accredited by the Swiss Accreditation The Swiss Accreditation Service in Multilateral Agreement for the rec	s one of the signatories	s to the EA	ccreditation No.: SCS 0108
Client CTTL (Auden)	ognition of canoration		: D1900V2-5d101_Jul2
CALIBRATION CI	ERTIFICATE		
Object	D1900V2 - SN:50	1101	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	dure for SAR Validation Sources	s between 0.7-3 GHz
Calibration date:	July 15, 2021		
The measurements and the uncert All calibrations have been conducted	ainties with confidence p ed in the closed laborato	onal standards, which realize the physical ur robability are given on the following pages are ry facility: environment temperature $(22 \pm 3)^{\circ}$	nd are part of the certificate.
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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

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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 Glocean

orooodiyi	
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.

BLOWN I	DAGWEG	1/50 40 4
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	1900 MHz ± 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	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	40.4 ± 6 %	1.40 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C		

### SAR result with Head TSL

SAR for nominal Head TSL parameters

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSI	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL SAR measured	condition 250 mW input power	5.22 W/kg

normalized to 1W

20.9 W/kg ± 16.5 % (k=2)

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#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 4.8 jΩ
Return Loss	- 26.2 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

#### Additional EUT Data

Manufactured by	SPEAG
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