



#### 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

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

### Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

- Measurement Conditions: Further details are available from the Validation Report at the end
  of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed
  point exactly below the center marking of the flat phantom section, with the arms oriented
  parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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## **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
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	42.2 ± 6 %	0.89 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	2.14 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.57 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	1.39 W/kg

### **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.1 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.55 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.63 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	53.1 Ω - 1.3 jΩ	
Return Loss	- 29.6 dB	

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9 Ω - 4.3 jΩ	
Return Loss	- 27.0 dB	

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

Electrical Delay (one direction)	1.041 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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## DASY5 Validation Report for Head TSL

Date: 18.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

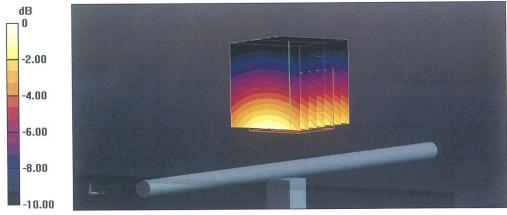
#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1017

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma$  = 0.89 S/m;  $\epsilon_r$  = 42.2;  $\rho$  = 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(10.07, 10.07, 10.07) @ 750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 59.72 V/m; Power Drift = 0.00 dB Peak SAR (extrapolated) = 3.21 W/kg SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.39 W/kg Maximum value of SAR (measured) = 2.84 W/kg



0 dB = 2.84 W/kg = 4.53 dBW/kg

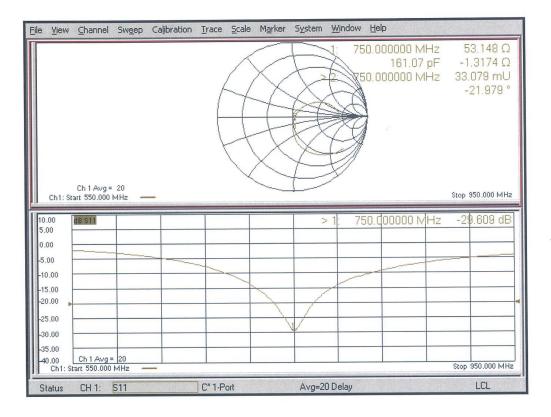
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# Impedance Measurement Plot for Head TSL



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### DASY5 Validation Report for Body TSL

Date: 18.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

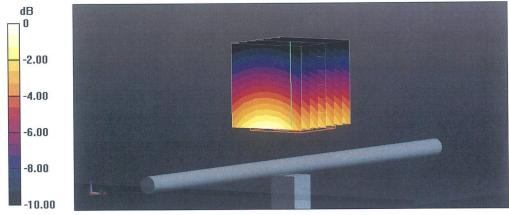
#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1017

Communication System: UID 0 - CW; Frequency: 750 MHz Medium parameters used: f = 750 MHz;  $\sigma$  = 0.96 S/m;  $\epsilon_r$  = 55.1;  $\rho$  = 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(10.4, 10.4, 10.4) @ 750 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 55.74 V/m; Power Drift = -0.02 dB Peak SAR (extrapolated) = 3.18 W/kg SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.41 W/kg Maximum value of SAR (measured) = 2.84 W/kg



0 dB = 2.84 W/kg = 4.53 dBW/kg

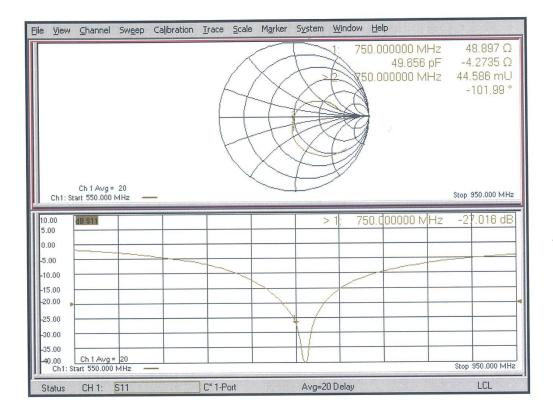
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# Impedance Measurement Plot for Body TSL



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# 835 MHz 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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alibration procedure(s)       QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         alibration date:       July 18, 2019         is calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). he measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.         I calibration shave been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.         alibration Equipment used (M&TE critical for calibration)         timary Standards       ID #       Cal Date (Certificate No.)       Scheduled Calibration         were meter NRP       SN: 104778       03-Apr-19 (No. 217-02892)       Apr-20         ower sensor NRP-291       SN: 103244       03-Apr-19 (No. 217-02893)       Apr-20         ower sensor NRP-291       SN: 103245       03-Apr-19 (No. 217-02893)       Apr-20         ower sensor NRP-291       SN: 103245       03-Apr-19 (No. 217-02893)       Apr-20         seference Probe EX3DV4       SN: 601       30-Apr-19 (No. 217-02894)       Apr-20         ower meter T44198       SN: 601       30-Apr-19 (No. 217-02895)       Apr-20         ower sensor NRP RestIA       SN: 603512475       30-Oct+16 (in house check Cot-18)       In house check: Cot-20         ower meter E44198       SN: 6139512475 <t< th=""><th>ent CTTL (Auden)</th><th></th><th>Certificate</th><th>No: D835V2-4d069_Jul19</th></t<>	ent CTTL (Auden)		Certificate	No: D835V2-4d069_Jul19
Itibration procedure(s)       QA CAL-05.v11 Calibration Procedure for SAR Validation Sources between 0.7-3 GHz         Itibration date:       July 18, 2019         is 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.         It calibration shave been conducted in the closed laboratory facility: environment temperature (22 ± 3)*C and humidity < 70%.         alibration Equipment used (M&TE critical for calibration)         timary Standards       ID #       Cal Date (Certificate No.)       Scheduled Calibration         were meter NRP       SN: 104778       03-Apr-19 (No. 217-02892)       Apr-20         were sensor NRP-Z91       SN: 102444       03-Apr-19 (No. 217-02893)       Apr-20         were sensor NRP-Z91       SN: 103245       03-Apr-19 (No. 217-02893)       Apr-20         selerence Probe EX3DV4       SN: 6058 (20k)       04-Apr-19 (No. 217-02893)       Apr-20         selerence Probe EX3DV4       SN: 601       30-Apr-19 (No. 217-02893)       Apr-20         econdary Standards       ID #       Check Date (in house)       Scheduled Check         ower meter E4419B       SN: 603512475       30-Oct+14 (in house check Oct-10)       In house check: Oct-20         ower sensor HP B481A       SN: US37282783 <th>ALIBRATION CE</th> <th>RTIFICATE</th> <th></th> <th></th>	ALIBRATION CE	RTIFICATE		
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rimary StandardsID #Cal Date (Certificate No.)Scheduled Calibrationower meter NRPSN: 10477803-Apr-19 (No. 217-02892/02893)Apr-20ower sensor NRP-Z91SN: 10324403-Apr-19 (No. 217-02892)Apr-20ower sensor NRP-Z91SN: 10324503-Apr-19 (No. 217-02893)Apr-20geference 20 dB AttenuatorSN: 5058 (20k)04-Apr-19 (No. 217-02894)Apr-20ype-N mismatch combinationSN: 5047.2 / 0632704-Apr-19 (No. 217-02895)Apr-20kecondary StandardsSN: 60130-Apr-19 (No. DAE4-601_Apr19)May-20kecondary StandardsID #Check Date (in house)Scheduled Checklower sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-18)In house check: Oct-20lower sensor HP 8481ASN: US3729278307-Oct-15 (in house check Oct-18)In house check: Oct-20SN: US37292783O7-Oct-15 (in house check Oct-18)In house check: Oct-20In house check: Oct-20SN: US4108047731-Mar-14 (in house check Oct-18)In house check: Oct-20In house check: Oct-20SN: US41080477SN: US4108047731-Mar-14 (in house check Oct-18)In house check: Oct-20Approved by:Katja PokovicTechnical ManagerJacuttApproved by:Katja PokovicTechnical ManagerJacuttIssued: July 19, 2019	l calibrations have been conducte	d in the closed laborator	y facility: environment temperature (22 $\pm$ 3	3)°C and humidity < 70%.
Initially Staticates       10 #       Out of the constraint of the cons	alibration Equipment used (M&TE	critical for calibration)		
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In Horizor 20 GD Hardback       Diff. 5047.2 / 06327       04-Apr-19 (No. 217-02895)       Apr-20         Age4       SN: 5047.2 / 06327       04-Apr-19 (No. EX3-7349_May19)       May-20         Age4       SN: 601       30-Apr-19 (No. DAE4-601_Apr19)       Apr-20         econdary Standards       ID #       Check Date (in house)       Scheduled Check         ower meter E4419B       SN: 5037292783       07-Oct-15 (in house check Cot-18)       In house check: Oct-20         ower sensor HP 8481A       SN: 1037292783       07-Oct-15 (in house check Oct-18)       In house check: Oct-20         SN: 100972       15-Jun-15 (in house check Oct-18)       In house check: Oct-20       In house check: Oct-20         SN: 100972       15-Jun-15 (in house check Oct-18)       In house check: Oct-20       In house check: Oct-20         alibrated by:       Name       Function       Signature         pproved by:       Katja Pokovic       Technical Manager       Mathematical         Issued: July 19, 2019       Issued: July 19, 2019       Issued: July 19, 2019	ower sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
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eichence Flobe LAGETT       SN: 601       30-Apr-19 (No. DAE4-601_Apr19)       Apr-20         econdary Standards       ID #       Check Date (in house)       Scheduled Check         ower meter E4419B       SN: GB39512475       30-Oct-14 (in house check Feb-19)       In house check: Oct-20         ower sensor HP 8481A       SN: US37292783       07-Oct-15 (in house check Oct-18)       In house check: Oct-20         Figenerator R&S SMT-06       SN: US3729277       15-Jun-15 (in house check Oct-18)       In house check: Oct-20         SN: US41080477       31-Mar-14 (in house check Oct-18)       In house check: Oct-20       In house check: Oct-20         SN: US41080477       31-Mar-14 (in house check Oct-18)       In house check: Oct-20       In house check: Oct-20         SN: US41080477       31-Mar-14 (in house check Oct-18)       In house check: Oct-20       In house check: Oct-19         Salibrated by:       Claudio Leubler       Laboratory Technician       Signature         opproved by:       Katja Pokovic       Technical Manager       Mature         Issued: July 19, 2019       Issued: July 19, 2019       Issued: July 19, 2019	ype-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	· · · · · · · · · · · · · · · · · · ·
Decondary Standards     ID #     Check Date (in house)     Scheduled Check       Power meter E4419B     SN: GB39512475     30-Oct-14 (in house check Feb-19)     In house check: Oct-20       Power sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-18)     In house check: Oct-20       Power sensor HP 8481A     SN: MY41092317     07-Oct-15 (in house check Oct-18)     In house check: Oct-20       Power sensor HP 8481A     SN: 100972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20       RF generator R&S SMT-06     SN: US41080477     31-Mar-14 (in house check Oct-18)     In house check: Oct-20       Name     Function     signature       Calibrated by:     Claudio Leubler     Laboratory Technician     Signature       Approved by:     Katja Pokovic     Technical Manager     MMM       Issued: July 19, 2019     Issued: July 19, 2019     Issued: July 19, 2019	leference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	
econdary standards     ID #     Onconcernet of the order of inconcernet of the order order of the order of the order order of the order order	AE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20
ower meter E4419B     SN: GB39512475     30-Oct-14 (in house check Feb-19)     In house check: Oct-20       ower sensor HP 8481A     SN: US37292783     07-Oct-15 (in house check Oct-18)     In house check: Oct-20       ower sensor HP 8481A     SN: WY41092317     07-Oct-15 (in house check Oct-18)     In house check: Oct-20       F generator R&S SMT-06     SN: 100972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20       etwork Analyzer Agilent E8358A     SN: US41080477     31-Mar-14 (in house check Oct-18)     In house check: Oct-20       alibrated by:     Claudio Leubler     Laboratory Technician     Signature       pproved by:     Katja Pokovic     Technical Manager     Mature       Issued: July 19, 2019     Issued: July 19, 2019	econdary Standards	ID #	Check Date (in house)	Scheduled Check
SN:     US3/222/03     SN:     OS4/13(m)     In house check Oct-13)       Sower sensor HP 8481A     SN:     MY41092317     O7-Oct-15 (in house check Oct-18)     In house check: Oct-20       F generator R&S SMT-06     SN:     US4/1092317     O7-Oct-15 (in house check Oct-18)     In house check: Oct-20       In house check     SN:     US4/1080477     31-Mar-14 (in house check Oct-18)     In house check: Oct-20       Islibrated by:     Claudio Leubler     Laboratory Technician     Signature       upproved by:     Katja Pokovic     Technical Manager     MMM4       Issued: July 19, 2019     Issued: July 19, 2019     Issued: July 19, 2019		SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
SN: 100972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20 In house check: Oct-19       SN: 100972     15-Jun-15 (in house check Oct-18)     In house check: Oct-20 In house check: Oct-19       SN: US41080477     31-Mar-14 (in house check Oct-18)     In house check: Oct-19       Name     Function     Signature       Claudio Leubler     Laboratory Technician     Jun-4       Approved by:     Katja Pokovic     Technical Manager	ower sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
In house check Oct-19         In house check Oct-18         In house check: Oct-19         In house check: Oct-19         Name         Claudio Leubler         Laboratory Technician         In house check: Oct-19         In house check: Oct-19         Sh: US41080477         Sh: US41080	ower sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Name     Function       Salibrated by:     Claudio Leubler       Laboratory Technician     Signature       Approved by:     Katja Pokovic       Technical Manager     Issued: July 19, 2019	F generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	
Ralibrated by:     Claudio Leubler     Laboratory Technician     Claudio       upproved by:     Katja Pokovic     Technical Manager     Issued: July 19, 2019	etwork Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19
Claudio Leubler Laboratory Technician Walk Approved by: Katja Pokovic Technical Manager Issued: July 19, 2019		Name	Function	Signature
Issued: July 19, 2019	Calibrated by:	Claudio Leubler	Laboratory Technician	(A)
Issued: July 19, 2019	Approved by:	Katia Pokovic	Technical Manager	anner
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This calibration certificate shall not be reproduced except in full without written approval of the laboratory.				

Certificate No: D835V2-4d069\_Jul19

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



Schweizerischer Kalibrierdienst

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Accreditation No.: SCS 0108

Accredited by the Swiss Accreditation Service (SAS)

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### Glossary:

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

# Calibration is Performed According to the Following Standards:

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

### Additional Documentation:

e) DASY4/5 System Handbook

# Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL: The dipole is mounted with the spacer to position its feed
  point exactly below the center marking of the flat phantom section, with the arms oriented
  parallel to the body axis.
- Feed Point Impedance and Return Loss: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured: SAR measured at the stated antenna input power.
- SAR normalized: SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters: The measured TSL parameters are used to calculate the nominal SAR result.

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

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### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.2
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	42.0 ± 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	2.44 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.70 W/kg ± 17.0 % (k=2)
SAR averaged over 10 cm3 (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	1.58 W/kg

### **Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.9 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C		

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.46 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.68 W/kg ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.60 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.32 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	50.8 Ω - 2.4 jΩ
Return Loss	- 32.1 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1 Ω - 3.9 jΩ	
Return Loss	- 25.9 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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### DASY5 Validation Report for Head TSL

Date: 15.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

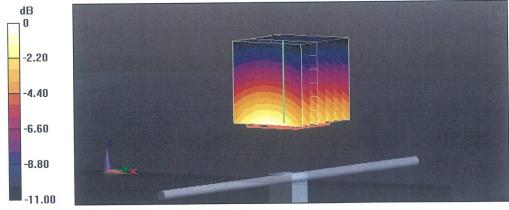
# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d069

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma$  = 0.91 S/m;  $\epsilon_r$  = 42;  $\rho$  = 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(9.89, 9.89, 9.89) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

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 = 63.48 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.58 W/kg SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.58 W/kg Maximum value of SAR (measured) = 3.22 W/kg



0 dB = 3.22 W/kg = 5.08 dBW/kg

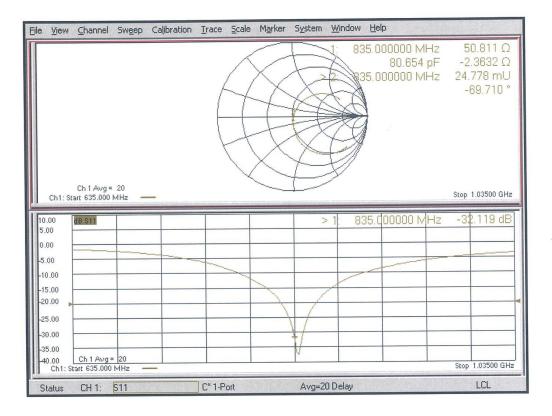
Certificate No: D835V2-4d069\_Jul19

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# Impedance Measurement Plot for Head TSL



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### DASY5 Validation Report for Body TSL

Date: 18.07.2019

Test Laboratory: SPEAG, Zurich, Switzerland

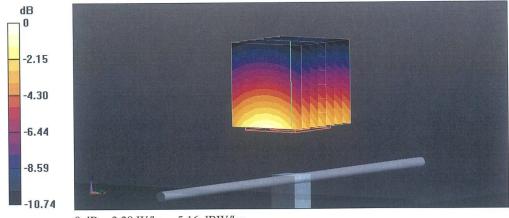
# DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d069

Communication System: UID 0 - CW; Frequency: 835 MHz Medium parameters used: f = 835 MHz;  $\sigma = 0.99$  S/m;  $\varepsilon_r = 54.9$ ;  $\rho = 1000$  kg/m<sup>3</sup> Phantom section: Flat Section Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 SN7349; ConvF(10.16, 10.16, 10.16) @ 835 MHz; Calibrated: 29.05.2019
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.04.2019
- Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm Reference Value = 57.81 V/m; Power Drift = 0.01 dB Peak SAR (extrapolated) = 3.65 W/kg SAR(1 g) = 2.46 W/kg; SAR(10 g) = 1.6 W/kg Maximum value of SAR (measured) = 3.28 W/kg



0 dB = 3.28 W/kg = 5.16 dBW/kg

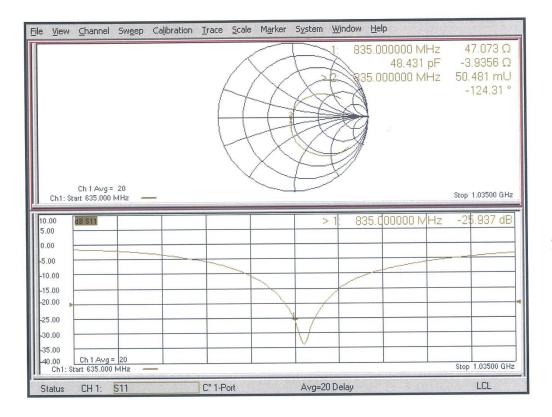
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# Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d069\_Jul19

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# 1750 MHz Dipole Calibration Certificate

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

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Swiss Calibration Service

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Accreditation No.: SCS 0108

		Certificate N	o: D1750V2-1003_Jul19
CALIBRATION C	ERTIFICATE		
Dbject	D1750V2 - SN:1	003	
Calibration procedure(s)	QA CAL-05.v11 Calibration Proce	edure for SAR Validation Source	s between 0.7-3 GHz
Calibration date:	July 16, 2019		
The measurements and the uncert	tainties with confidence p	ional standards, which realize the physical uprobability are given on the following pages a ry facility: environment temperature $(22 \pm 3)^6$	nd are part of the certificate.
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
ower sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
ype-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	
DAE4			Apr-20
	ID #	Check Date (in house)	Apr-20 Scheduled Check
Secondary Standards	ID # SN: GB39512475		
Secondary Standards Power meter E4419B		Check Date (in house)	Scheduled Check
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A	SN: GB39512475 SN: US37292783 SN: MY41092317	Check Date (in house) 30-Oct-14 (in house check Feb-19)	Scheduled Check In house check: Oct-20
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18)	Scheduled Check In house check: Oct-20 In house check: Oct-20
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB39512475 SN: US37292783 SN: MY41092317	Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18)	Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
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: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972	Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18)	Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477	Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18)	Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19
Secondary Standards Power meter E4419B Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer Agilent E8358A	SN: GB39512475 SN: US37292783 SN: MY41092317 SN: 100972 SN: US41080477 Name	Check Date (in house) 30-Oct-14 (in house check Feb-19) 07-Oct-15 (in house check Oct-18) 07-Oct-15 (in house check Oct-18) 15-Jun-15 (in house check Oct-18) 31-Mar-14 (in house check Oct-18) Function	Scheduled Check In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-20 In house check: Oct-19

Certificate No: D1750V2-1003\_Jul19

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