### 1.1. D750V3 Dipole Calibration Certificate

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

CCIC-HTW (Au	den)	Certificate No	: D750V3-1180_Feb18
CALIBRATION C	ERTIFICATE		
Object	D750V3 - SN:118	80	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	edure for dipole validation kits abo	ove 700 MHz
Calibration date:	February 07, 201	8	
		ional standards, which realize the physical un probability are given on the following pages ar	
All calibrations have been condu	cted in the closed laborato	ry facility: environment temperature (22 ± 3)°	C and humidity < 70%.
All calibrations have been conductable Calibration Equipment used (M&		ry facility: environment temperature (22 $\pm$ 3) $^{\circ}$ (	C and humidity < 70%.
Calibration Equipment used (M&		ry facility: environment temperature $(22 \pm 3)^{\circ}$ 6  Cal Date (Certificate No.)	C and humidity < 70%.  Scheduled Calibration
Calibration Equipment used (M&	TE critical for calibration)		
Calibration Equipment used (M&Primary Standards Power meter NRP	TE critical for calibration)	Cal Date (Certificate No.)	Scheduled Calibration
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91	TE critical for calibration)  ID #  SN: 104778	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522)	Scheduled Calibration Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91	TE critical for calibration)  ID #  SN: 104778 SN: 103244	Cal Date (Certificate No.) 04-Apr-17 (No. 217-02521/02522) 04-Apr-17 (No. 217-02521)	Scheduled Calibration Apr-18 Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator	ID #  SN: 104778 SN: 103244 SN: 103245	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)	Scheduled Calibration  Apr-18  Apr-18  Apr-18
Calibration Equipment used (M& Primary Standards Power meter NRP Power sensor NRP-Z91 Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k)	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18
Calibration Equipment used (M& 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: 5058 (20k) SN: 5047.2 / 06327	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18
Calibration Equipment used (M& 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: 5058 (20k) SN: 5047.2 / 06327 SN: 7349	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Dec-18
Calibration Equipment used (M& 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: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Dec-18  Oct-18
Calibration Equipment used (M& 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 EPM-442A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Dec-18  Oct-18  Scheduled Check
Calibration Equipment used (M& 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 EPM-442A Power sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Oct-18  Scheduled Check  In house check: Oct-18
Calibration Equipment used (M&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 EPM-442A Power sensor HP 8481A Power sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)	Scheduled Calibration  Apr-18  Apr-18  Apr-18  Apr-18  Apr-18  Oct-18  Scheduled Check  In house check: Oct-18  In house check: Oct-18
Calibration Equipment used (M&Primary Standards Power meter NRP Power sensor NRP-Z91 Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A RF generator R&S SMT-06	ID #  SN: 104778 SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783 SN: MY41092317	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02528)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)	Scheduled Calibration  Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Dec-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02522)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  15-Jun-15 (in house check Oct-16)	Scheduled Calibration  Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18

Issued: February 7, 2018

Certificate No: D750V3-1180\_Feb18

Approved by:

Katja Pokovic

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Technical Manager

#### 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

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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	V52.10.0
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	41.4 ± 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	2.06 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.22 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	1.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.39 W/kg ± 16.5 % (k=2)

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	55.2 ± 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	1.42 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.68 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	54.1 Ω - 0.2 jΩ
Return Loss	- 28.1 dB

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.3 Ω - 4.0 jΩ
Return Loss	- 27.7 dB

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

Electrical Delay (one direction)	1.037 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	
Manufactured on	February 21, 2017	

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

Date: 07.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1180

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.89 \text{ S/m}$ ;  $\varepsilon_r = 41.4$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.22, 10.22, 10.22); Calibrated: 30.12.2017;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

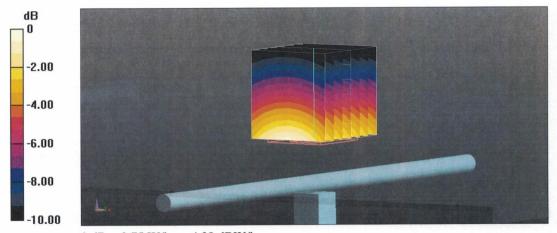
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.99 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.09 W/kg

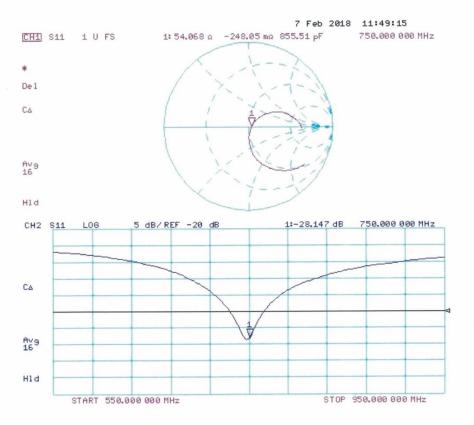
SAR(1 g) = 2.06 W/kg; SAR(10 g) = 1.35 W/kg

Maximum value of SAR (measured) = 2.75 W/kg



0 dB = 2.75 W/kg = 4.39 dBW/kg

#### Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 07.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN:1180

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

Medium parameters used: f = 750 MHz;  $\sigma = 0.96 \text{ S/m}$ ;  $\varepsilon_r = 55.2$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(10.19, 10.19, 10.19); Calibrated: 30.12.2017;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

• DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

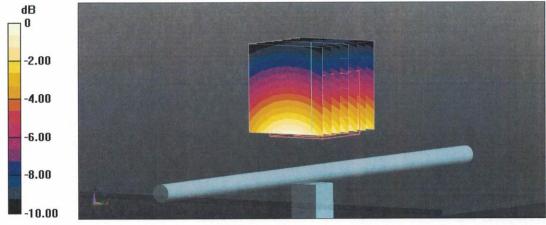
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.48 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.15 W/kg

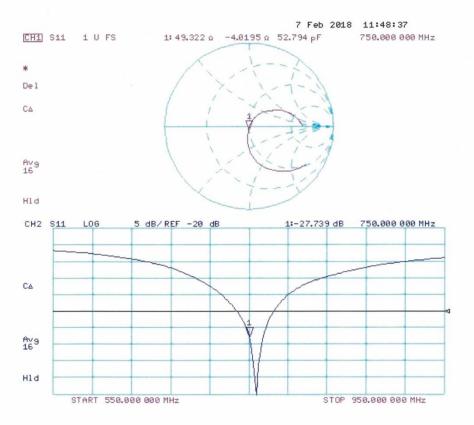
SAR(1 g) = 2.14 W/kg; SAR(10 g) = 1.42 W/kg

Maximum value of SAR (measured) = 2.80 W/kg



0 dB = 2.80 W/kg = 4.47 dBW/kg

#### Impedance Measurement Plot for Body TSL



## **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-750						
Date of	Poturo Jose (dP)	Delta (%)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB) Delta (%		(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/7	-28.1		54.1		-0.2	
2019/2/3	-27.5	2.14%	53.5	0.6	-0.5	0.3
2020/1/22	-27.7	1.42%	53.2	0.9	-0.6	0.4

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

### 1.2. D835V2 Dipole Calibration Certificate

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

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Client

CCIC-HTW (Auden)

Certificate No: D835V2-4d238\_Feb18

CALIBRATION	CERTIFICATE
Object	D835V2 - SN:4d238
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 19, 2018
This calibration certificate do	ocuments the traceability to national standards, which realize the physical units of measurements (SI). uncertainties with confidence probability are given on the following pages and are part of the certificate.
	onducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}$ C and humidity $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

	V	(O - differente No.)	Scheduled Calibration
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 EPM-442A  Power sensor HP 8481A	ID #  SN: 104778 SN: 103244 SN: 103245 SN: 5058 (20k) SN: 5047.2 / 06327 SN: 7349 SN: 601  ID #  SN: GB37480704 SN: US37292783	Cal Date (Certificate No.)  04-Apr-17 (No. 217-02521/02522)  04-Apr-17 (No. 217-02521)  04-Apr-17 (No. 217-02521)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02528)  07-Apr-17 (No. 217-02529)  30-Dec-17 (No. EX3-7349_Dec17)  26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)	Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Apr-18 Oct-18 Oct-18 Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: MY41092317 SN: 100972 SN: US37390585	15-Jun-15 (in house check Oct-16) 18-Oct-01 (in house check Oct-17) Function	In house check: Oct-18 In house check: Oct-18 Signature
Calibrated by:	Name Michael Weber	Laboratory Technician	M.Hebet
Approved by:	Katja Pokovic	Technical Manager	legued: February 19, 2018

Issued: February 19, 2018

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Certificate No: D835V2-4d238\_Feb18

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#### Calibration Laboratory of

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





Schweizerischer Kalibrierdienst Service suisse d'étalonnage

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Accreditation No.: SCS 0108

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#### 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) 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%.

Certificate No: D835V2-4d238\_Feb18

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## **Measurement Conditions**

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

DASY5  Advanced Extrapolation	V52.10.0
Advanced Extrapolation	
Modular Flat Phantom	
15 mm	with Spacer
dx, $dy$ , $dz = 5 mm$	
835 MHz ± 1 MHz	
	15 mm dx, dy, dz = 5 mm

### **Head TSL parameters**

The following parameters and calculations were applied.

ne following parameters and calculations were appli	Temperature	Permittivity	Conductivity
	22.0 °C	41.5	0.90 mho/m
Nominal Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	0.92 mho/m ± 6 %
Measured Head TSL parameters	•		
Head TSL temperature change during test	< 0.5 °C	25.00	

## SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
	250 mW input power	2.42 W/kg
SAR measured	normalized to 1W	9.51 W/kg ± 17.0 % (k=2)
SAR for nominal Head TSL parameters	normalized to 144	0.00

A ((a ) Allerd TO	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL		1.56 W/kg
SAR measured	250 mW input power	
	normalized to 1W	6.15 W/kg ± 16.5 % (k=2)
SAR for nominal Head TSL parameters	Hormanzou to 111	9,444,445

### **Body TSL parameters**

The following parameters and calculations were applied.

Temperature	Permittivity	Conductivity
22.0 °C	55.2	0.97 mho/m
(22.0 ± 0.2) °C	55.0 ± 6 %	0.99 mho/m ± 6 %
•		
	Temperature	22.0 °C 55.2 (22.0 ± 0.2) °C 55.0 ± 6 %

## SAR result with Body TSL

4 m3 (4 m) of Rody TSI	Condition	
SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	250 mW input power	2.45 W/kg
SAR measured	normalized to 1W	9.64 W/kg ± 17.0 % (k=2)
SAR for nominal Body TSL parameters	normalized to 144	

	condition	
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL		1.60 W/kg
SAR measured	250 mW input power	
	normalized to 1W	6.32 W/kg ± 16.5 % (k=2)
SAR for nominal Body TSL parameters		

Certificate No: D835V2-4d238\_Feb18

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

## Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.8 $\Omega$ - 4.0 j $\Omega$
Impedance, transformed to reed point	07.0 dB
Detum Loop	- 27.8 dB
Return Loss	

### Antenna Parameters with Body TSL

to the section of the	47.6 Ω - 6.0 jΩ
Impedance, transformed to feed point	- 23.6 dB
Return Loss	- 23.6 db

## **General Antenna Parameters and Design**

- LD Lov(and direction)	1.391 ns
Electrical Delay (one direction)	

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**

SPEAG
luna 00, 2017
June 02, 2017

Certificate No: D835V2-4d238\_Feb18

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

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma$  = 0.92 S/m;  $\epsilon_r$  = 41.2;  $\rho$  = 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(9.9, 9.9, 9.9); Calibrated: 30.12.2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn601; Calibrated: 26.10.2017

Phantom: Flat Phantom 4.9 (front); Type: QD 00L P49 AA; Serial: 1001

DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

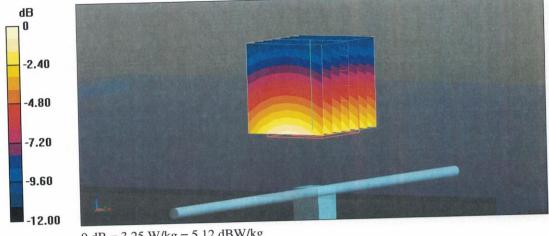
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 62.44 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 3.69 W/kg

SAR(1 g) = 2.42 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 3.25 W/kg

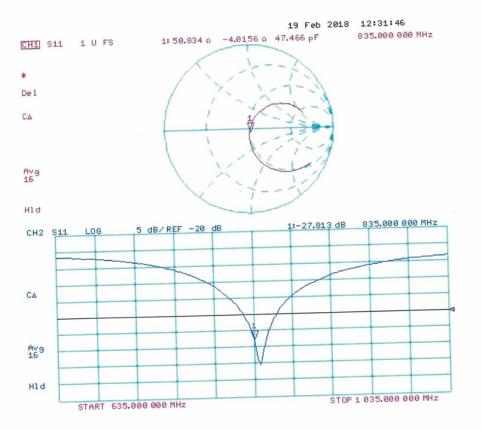


0 dB = 3.25 W/kg = 5.12 dBW/kg

Certificate No: D835V2-4d238\_Feb18

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## Impedance Measurement Plot for Head TSL



Certificate No: D835V2-4d238\_Feb18

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## **DASY5 Validation Report for Body TSL**

Date: 19.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

## DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d238

Communication System: UID 0 - CW; Frequency: 835 MHz

Medium parameters used: f = 835 MHz;  $\sigma$  = 0.99 S/m;  $\epsilon_r$  = 55;  $\rho$  = 1000 kg/m³

Phantom section: Flat Section

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

### DASY52 Configuration:

Probe: EX3DV4 - SN7349; ConvF(10.05, 10.05, 10.05); Calibrated: 30.12.2017;

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

Phantom: Flat Phantom 4.9 (Back); Type: QD 00R P49 AA; Serial: 1005

DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

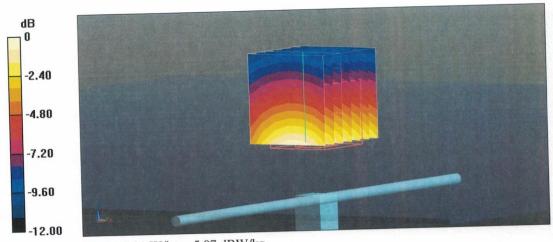
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.24 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 3.70 W/kg

SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.6 W/kg

Maximum value of SAR (measured) = 3.21 W/kg

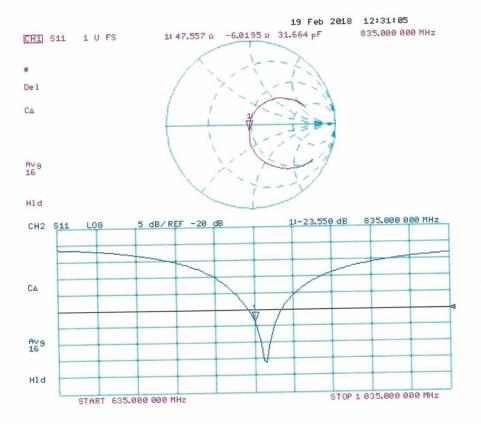


0 dB = 3.21 W/kg = 5.07 dBW/kg

Certificate No: D835V2-4d238\_Feb18

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## Impedance Measurement Plot for Body TSL



Certificate No: D835V2-4d238\_Feb18

## **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-835						
Date of	Poturo logo (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/19	-27.8		50.8		-4.0	
2019/2/3	-27.1	2.52%	49.9	0.9	-3.6	0.4
2020/1/22	-26.9	3.24%	50.2	0.6	-3.7	0.3

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

### 1.3. D1750V2 Dipole Calibration Certificate

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





Schweizerischer Kalibrierdienst
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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Accreditation No.

Accreditation No.: SCS 0108

Client

CCIC-HTW (Auden)

Certificate No: D1750V2-1164\_Feb18

bject	D1750V2 - SN:11	64	
Calibration procedure(s)	QA CAL-05.v9 Calibration proce	dure for dipole validation kits abo	ve 700 MHz
Calibration date:	February 06, 201	8	
his calibration certificate documents and the unce	ents 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 conducted that the conducted calibration Equipment used (M&T		ry facility: environment temperature (22 $\pm$ 3) $^{\circ}$ 0	C and humidity < 70%.
Primary Standards	ID#	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
	0111 00 111	30-Dec-17 (No. EX3-7349_Dec17)	Dec-18
Type-N mismatch combination	SN: 7349		
Type-N mismatch combination Reference Probe EX3DV4	SN: 7349 SN: 601	26-Oct-17 (No. DAE4-601_Oct17)	Oct-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4	SN: 601		Oct-18 Scheduled Check
Reference 20 dB Attenuator Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A		26-Oct-17 (No. DAE4-601_Oct17)	
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A	SN: 601	26-Oct-17 (No. DAE4-601_Oct17) Check Date (in house)	Scheduled Check
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards Power meter EPM-442A Power sensor HP 8481A	SN: 601 ID # SN: GB37480704	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)	Scheduled Check In house check: Oct-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A	SN: 601 ID # SN: GB37480704 SN: US37292783	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)	Scheduled Check In house check: Oct-18 In house check: Oct-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)	Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4 Secondary Standards	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  15-Jun-15 (in house check Oct-16)	Scheduled Check In house check: Oct-18 In house check: Oct-18 In house check: Oct-18 In house check: Oct-18
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06	SN: 601 ID # SN: GB37480704 SN: US37292783 SN: MY41092317 SN: 100972 SN: US37390585	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  15-Jun-15 (in house check Oct-16)  18-Oct-01 (in house check Oct-17)	Scheduled Check In house check: Oct-18 Signature
Type-N mismatch combination Reference Probe EX3DV4 DAE4  Secondary Standards Power meter EPM-442A Power sensor HP 8481A Power sensor HP 8481A RF generator R&S SMT-06 Network Analyzer HP 8753E	SN: 601  ID #  SN: GB37480704  SN: US37292783  SN: MY41092317  SN: 100972  SN: US37390585  Name	26-Oct-17 (No. DAE4-601_Oct17)  Check Date (in house)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  07-Oct-15 (in house check Oct-16)  15-Jun-15 (in house check Oct-16)  18-Oct-01 (in house check Oct-17)  Function	Scheduled Check In house check: Oct-18

Certificate No: D1750V2-1164\_Feb18

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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

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) 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%.

Certificate No: D1750V2-1164\_Feb18

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#### **Measurement Conditions**

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

DASY Version	DASY5	V52.10.0
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	39.4 ± 6 %	1.35 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	9.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.6 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	4.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.4 W/kg ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.5 ± 6 %	1.46 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	9.06 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	36.7 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	4.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.5 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	51.1 Ω - 0.1 jΩ
Return Loss	- 39.2 dB

#### **Antenna Parameters with Body TSL**

Impedance, transformed to feed point	46.2 Ω - 1.3 jΩ		
Return Loss	- 27.6 dB		

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

Electrical Delay (one direction)	1.216 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
Manufactured on	March 07, 2016

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

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

#### DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.35$  S/m;  $\varepsilon_r = 39.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(8.5, 8.5, 8.5); Calibrated: 30.12.2017;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

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

• DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

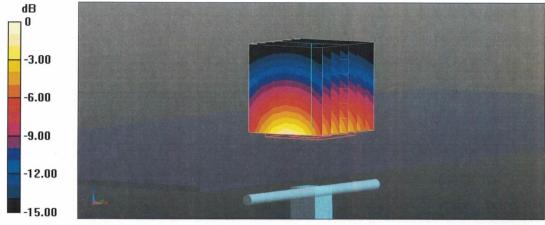
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.4 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 16.8 W/kg

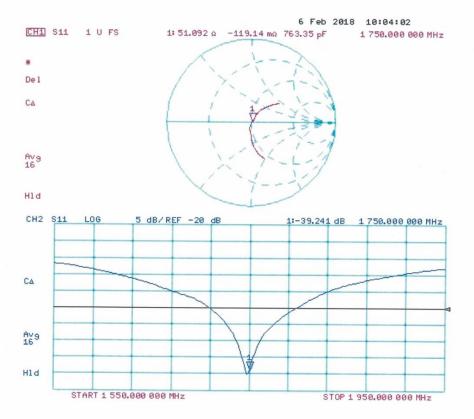
SAR(1 g) = 9.11 W/kg; SAR(10 g) = 4.83 W/kg

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



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

#### Impedance Measurement Plot for Head TSL



#### **DASY5 Validation Report for Body TSL**

Date: 06.02.2018

Test Laboratory: SPEAG, Zurich, Switzerland

### DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1164

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

Medium parameters used: f = 1750 MHz;  $\sigma = 1.46 \text{ S/m}$ ;  $\varepsilon_r = 53.5$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

#### DASY52 Configuration:

• Probe: EX3DV4 - SN7349; ConvF(8.35, 8.35, 8.35); Calibrated: 30.12.2017;

• Sensor-Surface: 1.4mm (Mechanical Surface Detection)

• Electronics: DAE4 Sn601; Calibrated: 26.10.2017

Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002

DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

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

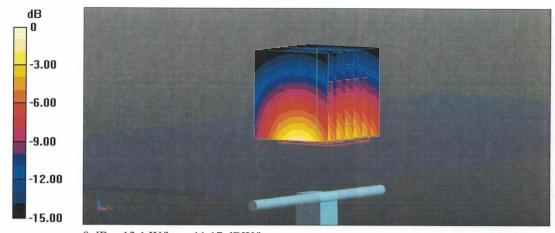
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.62 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 16.0 W/kg

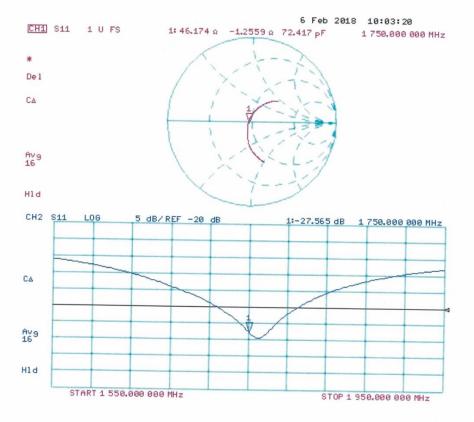
SAR(1 g) = 9.06 W/kg; SAR(10 g) = 4.84 W/kg

Maximum value of SAR (measured) = 13.1 W/kg



0 dB = 13.1 W/kg = 11.17 dBW/kg

## Impedance Measurement Plot for Body TSL



## **Extended Dipole Calibrations**

Referring to KDB865664 D01, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

Head-1750						
Date of	Poturn Iona (dP)	Dolto (9/)	Real Impedance	Delta	Imaginary	Delta
measurement	Return-loss (dB)	Delta (%)	(ohm)	(ohm)	impedance (ohm)	(ohm)
2018/2/6	-39.2		51.1		-0.1	
2019/2/3	-38.6	1.53%	50.7	0.4	-0.8	0.7
2020/1/22	-38.4	2.04%	50.5	0.6	-0.6	0.5

The return loss is <-20dB, within 20% of prior calibration; the impedance is within 50hm of prior calibration. Therefore the verification result should support extended calibration.

### 1.4. D1900V2 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

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 CCIC-HTW (Au		DEFECT.	tificate No: D1900V2-5d226_Feb18	
CALIBRATION (	CERTIFICAT	3		
Object	D1900V2 - SN:5d226			
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz			
Calibration date:	February 22, 2018			
The measurements and the unce	rtainties with confidence potential in the closed laborate	tional standards, which realize the plorobability are given on the following bry facility: environment temperature	pages and are part of the certificate.	
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522		
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18	
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18	
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18	
ype-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18	
Reference Probe EX3DV4	SN: 7349	30-Dec-17 (No. EX3-7349_Dec17	7) Dec-18	
DAE4	SN: 601	26-Oct-17 (No. DAE4-601_Oct17	) Oct-18	
Secondary Standards	ID#	Check Date (in house)	Scheduled Check	
Power meter EPM-442A	SN: GB37480704	07-Oct-15 (in house check Oct-16	in house check: Oct-18	
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-16		
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-16		
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16	In house check: Oct-18	
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17	) In house check: Oct-18	
	Name	Function	Signature	
Calibrated by:	Michael Weber	Laboratory Technician	MIKES	
Approved by:	Katja Pokovic	Technical Manager	Lelle	
		full without written approval of the la	Issued: February 22, 2018	

Certificate No: D1900V2-5d226\_Feb18

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